NTSB Conference Center, 429 L'Enfant Plaza, SW, Washington, D.C. 20594

Geographic Information Systems in Transportation Safety
December 4-5, 2012

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National Transportation Safety Board

Geographic Information Systems

in Transportation Safety

Conference Agenda

December 4–5, 2012

GIS in Transportation Safety Public Conference

TUESDAY, DECEMBER 4

9:00 a.m. Welcome and Opening Remarks, Deborah A.P. Hersman, *NTSB Chairman*

9:30 a.m. Panel 1: Opening Panel
Reginald Souleyrette, Ph.D., P.E., *University of Kentucky*
Stephen Lewis, *U.S. DOT, Research and Innovative Technology Administration*

10:10 a.m. Break/Exhibit Viewing

10:30 a.m. Panel 2: Multi-Modal Data and Technology
Nadine Alameh, Ph.D., *Open Geospatial Consortium*
Michael Ratcliffe, *U.S. Census Bureau*
George Gonzalez, *U.S. DOT, Federal Aviation Administration*
Jeffrey Danielson, *U.S. Geological Survey, Earth Resources Observation and Science Center*
Mark Skoog, *NASA*

12:00 p.m. Lunch/Exhibit Viewing

1:20 p.m. Panel 3: Aviation Safety
Mike McNerney, Ph.D., P.E., *U.S. DOT, Federal Aviation Administration*
Dejan Damjanovic, *GeoEye*
Christopher Knouss, *MITRE*
Rich Fosnot, *Jeppesen*

3:00 p.m. Break/Exhibit Viewing

3:20 p.m. Panel 4: Highway Safety
Craig Thor, Ph.D., *U.S. DOT, Federal Highway Administration*
Matthew Barth, Ph.D., *University of California, Riverside*
John Bigham, *University of California, Berkeley*
Captain Woodland "Butch" Wilson, *Baltimore County Police Department*

5:00 p.m. Day 1 Concludes/Exhibits Close

WEDNESDAY, DECEMBER 5

9:00 a.m. Panel 5: Multi-Modal Application and Analysis
Lisa Park, *American Transportation Research Institute*
Michelle Barnes, BSCE, MPS, MSGIS, *University of Michigan Transportation Research Institute*
Marco Merens, *International Civil Aviation Organization*
Marc Berryman, *National Emergency Number Association*

10:15 a.m. Break/Exhibit Viewing

10:35 a.m. Panel 6: Marine Safety
Julia Powell, *NOAA, Coast Survey*
Peter Noy and Rodney Martinez, *U.S. Coast Guard*

James Dobbins, Ph.D., *Vanderbilt University*
Richard Ford, *Marine Accident Investigation Branch, UK*

12:10 p.m. Lunch/Exhibit Viewing

1:30 p.m. Panel 7: Rail, Pipeline, and Hazmat Safety
Raquel Hunt, *U.S. DOT, Federal Rail Administration*
Ed Wells, *Washington Metropolitan Area Transit Authority*
Eric Williams, *Access Midstream Partners*
Amy Nelson, *U.S. DOT, Pipeline and Hazardous Materials Safety Administration*

3:10 p.m. Break/Exhibit Viewing

3:30 p.m. Panel 8: Closing Panel
David Cowen, Ph.D., *National Geospatial Advisory Committee*
Allen Carroll, *ESRI*

4:25 p.m. Closing Remarks, Deborah A.P. Hersman, *NTSB Chairman*

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ABOUT THE CONFERENCE

Geographic Information Systems (GIS) is a rapidly expanding group of technologies and analytical techniques that uses geographically referenced data to support complex data integration, advanced statistical analysis, precise investigation, and effective visualization of data. This conference, Geographic Information Systems in Transportation Safety, will bring researchers and practitioners in transportation safety and GIS together to discuss how GIS data, technologies, and techniques are applied to improve safety in all modes of transportation. They will identify emerging themes, current challenges, and potential solutions in using GIS in transportation safety.

FOR ADDITIONAL INFORMATION

For more information, including the detailed agenda, presenter biographies, archived webcast, presentations, and other materials associated with this conference, please visit www.ntsb.gov/news/events/2012/GIS.

ABOUT THE NTSB

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating every civil aviation accident the United States and significant accidents in other modes of transportation—railroad, highway, marine, and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. In addition, the NTSB carries out special studies concerning transportation safety and coordinates the resources of the Federal Government and other organizations to provide assistance to victims and their family members impacted by major transportation disasters.

490 L'Enfant Plaza, SW
Washington, D.C. 20594
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GEOGRAPHIC INFORMATION SYSTEMS
IN TRANSPORTATION SAFETY

Participating Exhibitors

District of Columbia Department of Transportation

ESRI

GeoEye

Open Geospatial Consortium

South Dakota State University, Civil and Environmental Engineering Department

University of California Berkeley, Transportation Injury Mapping System

U.S Census Bureau

U.S. DOT, National Pipeline Mapping System

U.S. DOT, Volpe National Transportation Systems Center

U.S. Geological Survey, Earth Resources Observation and Science (EROS) Center

University of Michigan, Transportation Research Institute

Westat

GEOGRAPHIC INFORMATION SYSTEMS
IN TRANSPORTATION SAFETY

Invited Panelist Biographies

Panel 1: Opening Panel

Reginald R. Souleyrette, Ph.D., P.E.

Commonwealth Chair Professor of Transportation Engineering
University of Kentucky

Dr. Souleyrette is the Commonwealth Professor of Civil Engineering at the University of Kentucky, where he also serves as a program manager for the Kentucky Transportation Center. He joined UK following 18 years at Iowa State University. He currently serves as chair of the Transportation Research Board's Data and Information Technology Section and has served as co-chair of the GIS Applications and Science Committee. Following his term as chair of the Data Section, Reg will pursue cross-committee safety data initiatives for TRB. He holds a BS and MS in civil engineering from the University of Texas and a PhD in Transportation Engineering from UC Berkeley.

Stephen M. Lewis

Director of Geospatial Information Systems
Research and Innovative Technology Administration
Bureau of Transportation Statistics
U.S. Department of Transportation

Stephen M. (Steve) Lewis is the Geospatial Information Officer (GIO) at the United States Department of Transportation (USDOT). As GIO, he coordinates geospatial activities across USDOT and ensures that USDOT meets its obligations to the National Spatial Data Infrastructure. In addition to these duties, he is also the Director of the Office of Geospatial Information Systems within USDOT's Research and Innovative Technology Administration/Bureau of Transportation Statistics. Over his 25 year career, he has also worked at the Federal Highway Administration and the National Imagery and Mapping Agency. Mr. Lewis has a Bachelor of Science degree in Industrial Engineering and Operations Research and a Master of Engineering degree in Civil Engineering, both from Virginia Tech.

Panel 2: Multi-modal Data and Technology Panel

Nadine Alameh, Ph.D.

Director - Interoperability Programs
Open Geospatial Consortium

Dr. Alameh is Director of Interoperability Programs at the Open Geospatial Consortium (OGC), a non-profit, international, voluntary consensus standards organization. Dr. Alameh focuses on planning and managing multi-vendor software prototyping and pilot initiatives to advance geoinformatics. Dr. Alameh is a leader in the field of geospatial interoperability with a proven track record in architecting and implementing geospatial technologies, standards and web services. Her current engagements include leading the (OWS-9), a global web prototyping activity in the areas of security, aeronautical information management, mobile application development, and compliance testing.

Michael Ratcliffe

Assistant Division Chief – Geocartographic Products and Criteria
U.S. Census Bureau

Michael Ratcliffe is Assistant Division Chief for Geocartographic Products and Criteria, Geography Division, U.S. Census Bureau. He is responsible for programs related to the development of geographic area concepts and criteria, cartographic products, TIGER/Line shapefiles, and other geographic information products. In his tenure at the Census Bureau he has worked in both the Geography and Population Divisions, with a primary focus on geographic area concepts and criteria. Mr. Ratcliffe holds degrees in geography from the University of Maryland and the University of Oxford.

George Gonzalez

Technology & ATC Products Group
FAA

George Gonzalez is the Production Systems Team Manager at Mike Monroney Aeronautical Center (MMAC). He has managed the Eastern Flight Procedures Branch and the Army/International Flight Procedures Branch. He has been with the FAA for 14 years. Prior to joining the FAA, Mr. Gonzalez served twenty years in the United States Air Force as an Air Traffic Controller. He received an associate degree in Airway Science from the Community College of the Air Force (CCAF).

Jeffrey J. Danielson

Physical Geographer
U.S. Geological Survey (USGS)
USGS Earth Resources Observation & Science (EROS) Center
Topographic Sciences

Jeff Danielson is employed by the U.S. Geological Survey (USGS) at the Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota as a physical geographer. Jeff has been engaged in topographic science research for over 17 years and has an extensive background in working with geographic information systems technologies, image processing, and digital terrain models. His current research is focused on developing high-resolution topobathymetric elevation models derived from both LIDAR (topography) and bathymetric (water depth) data sources that will provide a seamless elevation product useful for applications such as, modeling sea level rise, storm surge, and sediment transport.

Mark A. Skoog

Integrated Test Team for the Automatic Collision Avoidance Technology (ACAT)
Dryden Flight Research Center
NASA

Mark Skoog works for NASA's Dryden Flight Research Center at Edwards AFB in California. He is currently leading the Collision Avoidance Technical Stewardship Group for the Office of the Secretary of Defense and the Integrated Test Team for the Automatic Collision Avoidance Technology (ACAT) projects. He has managed numerous UAV efforts for NASA and the Air Force. His technical background stems from early days of research and development on the AFTI/F-16 and B-2 aircraft, including the integration of flight controls and avionics for high authority autopilots to automatically accomplish all phases of fighter combat missions. More recently, He conducted the Automatic Ground Collision Avoidance System, and Automatic Air Collision Avoidance System testing on the F-16, and led the ACAT Fighter Risk Reduction Project. Mark has a BS in aerospace engineering from Cal Poly San Luis Obispo.

Panel 3: Aviation Safety Panel

Michael T. McNerney, Ph.D., P.E.

Assistant Manager, Airport Engineering Division, AAS-100
Federal Aviation Administration
Office of Airport Safety and Standards

Dr. McNerney is the assistant manager of the Airport Engineering Division, of the FAA Office of Airport Safety and Standards. Prior to that, he was an airport consultant with AECOM for 9 years. He served 17 years in the US Air Force as pilot, instructor, commander, and civil engineer where he lead the pavement portion of the US Air Force rapid runway repair research effort for 3 years. He is experienced in the areas of Airport Planning, Airport Noise, Airport Geographical Information Systems (GIS), D-GPS Satellite Navigation Systems, Aerial Photography, and Environmental Planning and is an industry leader in Geospatial Airport Pavement Management Systems and Airport Aircraft Compatibility. He has authored over 60 publications related to air and ground transportation research and pavement evaluation. He has served as supervisor of flight operations at three Air Force Bases. He received his Ph.D. in Civil Engineering at the University of Texas at Austin.

Dejan Damjanovic

Director
Air and Marine Solutions
GeoEye

Dejan Damjanovic is a graduate of Concordia University's school of Engineering and Computer Science. For most of the last decade, he has led the Airport/eTOD team at GeoEye in mapping over 3,500 airports for the US DOD, and is spending the coming decade doing the same for the world's commercial airports. He is a principal co-author of three industry standards on Airport Mapping (RTCA DO-272), Electronic Terrain and Obstacle (RTCA DO-276), and Aeronautical Information Exchange (RTCA DO-291). Mr. Damjanovic has spoken at many industry events such as MAPPS, ION, ESRI, and most recently at the ICAO PBN Summit in Montreal. He is a licensed Commercial, Multi-Engine pilot in the USA and Canada.

Christopher Knouss

Geospatial Computing Specialists
MITRE

Mr. Chris Knouss is a Principal Geospatial Computing Specialist at MITRE since 2004 and has over 12 years' experience in GIS and geographic sciences. His work and research interests are primarily focused on the application, training, and development of interdisciplinary geospatial technologies that include geospatial application development, cartography, visualization, modeling, analysis, data services, cloud computing, and remotely sensed technologies. Mr. Knouss has supported geospatial initiatives across the aviation, health, environmental, security, housing, local government, and criminal justice domains. Mr. Knouss has a MA in Geography from the University of Maryland and was an ESRI certified instructor for 4 years.

Rich Fosnot

Senior Manager
Aviation and Marine Safety
Jeppesen

Mr. Fosnot is the Senior Manager for Aviation and Marine Safety at Jeppesen. He supports a variety of aviation industry safety initiatives through his participation in training, accident investigation, and safety management committees working groups. Mr. Fosnot is also an experienced commercial pilot and flight instructor.

Panel 4: Highway Safety Panel

Craig P. Thor, Ph.D.

Research Civil Engineer – Office of Safety R&D
Federal Highway Administration

Dr. Craig Thor is Research Civil Engineer at the Federal Highway Administration (FHWA) in the Office of Safety Research and Development. He received his Ph.D. in biomedical engineering with a focus on crash injury biomechanics and the associated epidemiology from Virginia Tech. He has extensive experience in the areas of crash causation, data analysis, and data collection. At FHWA, Dr. Thor serves as the lead in the area of GIS research. His efforts in this area largely focus on the identification and development of effective research tools that will assist State and local governments to improve their GIS-based data systems to make informed safety improvement decisions. In addition to his work related to GIS, he also manages the FHWA Motorcycle Crash Causation Study, the Strategic Initiative for the Evaluation of Reduced Lighting on Roadways, and is serving as an advisor to an NRC Fellow who is exploring the development of surrogate crash measures using the SHRP2 naturalistic driving data.

Matthew Barth, Ph.D.

Professor of Electrical Engineering
University of California, Riverside

Matthew Barth is a Professor of Electrical Engineering at UC Riverside, holds the Yeager Family Chair, and is also the Director of the College of Engineering Center for Environmental Research and Technology (CE-CERT). Dr. Barth's research focuses is in Transportation Systems, particularly how it relates to energy and air quality issues. Current research interests include Intelligent Transportation System Technology, Transportation/Emissions Modeling, Vehicle Activity Analysis, and Vehicle Navigation.

John Bigham

GIS Program Manager
University of California - Berkeley

John Bigham is the GIS Program Manager at the UC Berkeley Safe Transportation Research and Education Center (SafeTREC). His background is in Geographic Information Systems (GIS) design and analysis and he manages GIS-related activities at SafeTREC, including spatial analysis, web mapping and database development. He is currently the project director for the Transportation Injury Mapping System (TIMS), a web site that provides tools to view, query and spatially explore collision data. He previously worked at the Environmental Systems Research Institute (ESRI) as a Product Engineer.

Woodland Wilson

Baltimore County Police Department

Woodland "Butch" Wilson joined the Baltimore County Police Department in April 1990 after serving four years in the USMC. He has served at various ranks in criminal investigations, narcotics, traffic, patrol, internal affairs, and strategic planning. In September 2007 he was promoted to the rank of Captain and spent the next several years as a precinct commander, overseeing his command's DDACTS program and utilizing GIS products to target criminal activity and repeat offenders. In July 2012, Captain Wilson was assigned as the commander of the Operational Support Section and oversees units such as traffic management, crash investigations, SWAT, and K9. Captain Wilson is a graduate of the Johns Hopkins University Police Executive Leadership Program and holds BS and MS degrees in Management.

Co-authors:

Joseph Donahue

Sergeant Joseph Donohue is an 18-year veteran of the Baltimore County Police Department and has served in various assignments including patrol, traffic, and criminal investigations. He is a Level III Crash Reconstructionist with experience responding to traffic crashes both as a police officer and volunteer Firefighter / Rescue Specialist / Emergency Medical Technician. Sergeant Donohue has been involved in various aspects of the department's DDACTS program since its beginnings as the Crash/Crime Initiative in 2007. He currently is assigned to the Traffic Management Unit and oversees the department's implementation of the program. Sergeant Donohue also works as an adjunct instructor for the National Highway Traffic Safety Administration, delivering DDACTS Implementation Workshops to other law enforcement agencies throughout the United States. Sergeant Donohue was recognized by the Maryland Police and Correctional Training Commission as a Traffic Safety Specialist in 2012. He is currently attending American Military University, working to complete his BA degree in Criminal Justice.

Emily N. Varga

Mrs. Emily N. Varga received a BS in Geography from the University of Maryland, Baltimore County in 2007. She began working as a Statistical Analyst with the Planning and Crime Analysis Unit of the Baltimore County Police Department in 2007. In 2009, she transferred within the Crime and Traffic Analysis Team from Scanning and Forecasting to the Traffic Accident Analysis to research and analyze statistical patterns and trends of traffic accidents and driving violations. The reports she produces are used internally by the Police Department to determine the most effective deployment of its traffic resources and to evaluate traffic initiatives. Currently, Mrs. Varga is working closely with Traffic Resources Management of Baltimore County Police on the Data Driven Approaches to Crime and Traffic Safety (DDACTS) initiative. Mrs. Varga, along with other department members involved in the DDACTS initiative, received the Department's Traffic Safety Award in 2010.

Stephen Troutman

Lieutenant Stephen Troutman is a 25-year veteran of the Baltimore County Police Department and has served in multiple assignments, including patrol, internal affairs, training, and records management. As a sergeant, he was selected to lead one of the department's newly formed Community Action Teams, which are strike teams designed to be deployable in high-crime and/or crash areas. Lieutenant Troutman was assigned to the Operational Support Section as the K9 commander in 2010 and in October 2012 became the Traffic Management Unit commander. During his time in OSS, Lieutenant Troutman has, at various times and in addition to K9, supervised several teams with responsibilities such as marine, underwater recovery, fatal crash investigations, and the department's DDACTS program. Lieutenant Troutman is currently completing his BS degree in Political Science at Towson University.

Panel 5: Multi-modal Application and Analysis Panel

Lisa Park

Research Analyst
American Transportation Research Institute

As a Research Analyst with the American Transportation Research Institute, Lisa Park has studied a variety of freight transportation topics. In particular, Ms. Park uses spatial data to research truck safety and conduct accident data analysis. Using state-level crash records and GIS software, Ms. Park has developed a methodology to locate and analyze locations where large truck rollover crashes are most prevalent. As part of this three phase project, the rollover locations identified through the Phase 1 research are disseminated to trucking industry stakeholders in state-specific summary reports and through an online interactive map. Ms. Park holds a BA from the University of Kentucky.

Michelle A. Barnes, BSCE, MPS, MSGIS

Senior Research Engineer
UMTRI

Ms. Barnes is a Senior Research Engineer in the Engineering Systems Group and works closely with the Transportation Data Center at UMTRI. She has 24 years experience in transportation engineering encompassing both transportation agency experience and applied research, and is a recognized expert in the area of roadway data fusion and analysis of spatial data using geographic information system tools. She is also the lead expert within UMTRI for map databases that characterize roadway attributes.

Marco Merens

Safety Data Analysis Officer
ICAO

Marco Merens is safety data analysis officer in ICAO's Integrated Safety Management section. He started his career as an aeronautical engineer at Airbus in Toulouse working on the design of avionic and flight control systems for the A340 and A380. He then went back to his home country of Luxembourg to join the CAA where he held various positions from head of the airworthiness department to the manager of the CAA's occurrence reporting and analysis system, before joining ICAO in 2009 at his current position.

Marc Berryman, ENP

Product Development Manager

NENA

Marc Berryman has a Masters Degree in Geographic Information Systems (GIS) and over 16 years of experience working with both public and private organizations. He has worked as a GIS consultant for several Fortune 100 companies, and is the former GIS Engineer for the Greater Harris County 9-1-1 Emergency Network. Marc has provided instruction on GIS and Next Generation 9-1-1 at numerous national and regional conferences. He is the author of the 2008 publication "Addressing Systems; A Training Guide For 9-1-1". With over 11 years of 9-1-1 operational experience, Marc is able to bring complex subjects down to an understandable level with his dynamic and interactive teaching methods. Marc is currently employed with Digital Data Technologies Incorporated, where he is the 9-1-1 GIS Product Development Manager.

Panel 6: Marine Safety Panel

Julia Powell

Electronic Navigational Chart Technical Director
NOAA

Julia Powell is the Electronic Navigational Chart Technical Director, and represents the United States on various standards committee's in the development of the ENC product specification. The ENC product specification is the international standard for countries to build electronic charts in a specific format to be used on board ship's navigation systems. She also ensures that the US products comply with the relevant international standards, and leads the development of the next generation electronic charting standards. Ms. Powell has been with NOAA since 1997 and has a Bachelor's degree in Geological Sciences from Cornell University and a Master's Degree in Computer Systems Management from the University of Maryland.

Peter Noy

IT Specialist (Geospatial Management/Information Assurance)
US Coast Guard

Mr. Noy works for the Coast Guard Geospatial Management Office (GMO – CG-63) on a number of Coast Guard geospatial initiatives, including Coast Guard Geospatial Data Sharing, Coast Guard Geospatial Convergence, Coast Guard Geospatial software support, and DHS Geospatial Working Group Efforts. He also serves as Asset Manager for several existing Coast Guard Enterprise applications, including Coast Guard Enterprise Geographic Information System (EGIS), Search and Rescue Optimal Planning System (SAROPS), and Long Range Identification and Tracking (LRIT). Before joining the Coast Guard, he was a geographer at the Baltimore District U.S. Army Corps of Engineers managing the Planning Division Geographic Information System. He received his MA in Geography and Environmental Planning at Towson University.

Co-presenter/co-author
Rodney Martinez

Rodney Martinez serves as sponsor's representative and subject matter expert for Coast Guard's GIS program. He holds a B.S. in Information Systems, Kennesaw State University, M.S. in Quality Systems Management National Graduate School, and a M.S in Information Technology Management, Naval Postgraduate School.

James Dobbins, Ph.D.

Research Associate Professor of Civil and Environmental Engineering
Vanderbilt University

Dr. Dobbins is a Research Associate Professor of Civil and Environmental Engineering at Vanderbilt University in Nashville, TN. He is the Director of the Vanderbilt Center for Transportation Research (VECTOR). Dr. Dobbins manages research projects related to transportation risk assessment, intermodal freight transportation, inland marine transportation, geographic information systems (GIS) and the development of transportation decision support systems. Dr. Dobbins earned a BS in Marine Transportation and Marine Engineering from the United States Merchant Marine Academy at Kings Point, NY. He completed his MS and Ph.D degrees in Civil Engineering at Vanderbilt University. He holds a dual U.S. Coast Guard license of 3rd Mate (unlimited gross tonnage, oceans) and 3rd Assistant Engineer (unlimited horsepower, steam, motor or gas turbine) and a commission as Commander in the U.S. Naval Reserve.

Richard Ford

Technical Officer
(MAIB) United Kingdom's Marine Accident Investigation Branch

Richard Ford is the Technical Officer for the UK's Marine Accident Investigation Branch. He is responsible for the recovery of all electronic evidence from accident scenes. Widely accepted as the world leaders in VDR data recovery; the branch has successfully recovered 21 VDRs this year. Richard has previously worked for the UK's national mapping agency Ordinance Survey as a GIS specialist, responsible for designing and developing workflow and work management systems.

Panel 7: Rail, Pipeline, and Hazmat Safety Panel

Raquel Hunt

GIS Program Manager
Federal Railroad Administration

Ms. Hunt has been with the Federal Railroad Administration (FRA) since 2006, where her main responsibilities have been the development, implementation, and management of the FRA's geographic information systems (GIS). Before joining FRA, Ms. Hunt was an onsite contractor with the Bureau of Transportation Statistics, where she was the technical lead on the National Transportation Atlas Database. She also participated on a taskforce to restructure the Commodity Flow Survey. Ms. Hunt has a BS in Geography from Old Dominion University and a Masters in Geography from George Mason University with a Graduate Certificate in Geographic Information Sciences.

Ed Wells

Geographic Information System (GIS) Manager
Office of Enterprise Web Portal and GIS (EWPG)
Department of Information Technology (IT)
Washington Metropolitan Area Transit Authority (WMATA)

Ed Wells is the GIS Manager for the Washington (DC) Metropolitan Area Transit Authority. He has over twenty-five years' experience as a GIS manager and consultant in the public and private sectors. He holds a BA in Human Biology from Stanford University and a Master of Public Management degree from Carnegie Mellon University. He is past president of the Urban and Regional Information Systems Association (URISA).

Eric Williams

Coordinator – Damage Prevention and Public Awareness
Pipeline Safety and Integrity Department
Access Midstream Partners, LP

Mr. Williams is currently the Coordinator of Damage Prevention and Public Awareness at Access Midstream Partners (formerly known as Chesapeake Midstream Partners) in Oklahoma City, OK. His role in the Pipeline Safety department is to coordinate and lead education, outreach and training efforts for external audiences in regards to pipeline safety and awareness. Audiences include emergency responders, public officials, professional contractors and schools, among others. He is also responsible for internal management and oversight of programs to protect company assets from unintended line strikes or other safety related conditions. He has held this position since January 2011. Before his current role, he spent five years as the GIS Coordinator at Chesapeake/Access Midstream.

Amy Nelson

GIS Manager

Pipeline and Hazardous Materials Safety Administration, U.S. DOT

Ms. Nelson is the GIS Manager for the US Department of Transportation, Pipeline and Hazardous Materials Safety Administration. She has worked on the National Pipeline Mapping System project since 2002. She holds a BA in Geography from the University of Mary Washington and an MA in Geographic Information Systems from Clark University.

Panel 8: Closing Panel

David Cowen, Ph.D.

Distinguished Professor Emeritus
University of South Carolina

Dr. Cowen is Distinguished Professor Emeritus and is a former chair of the Department of Geography at the University of South Carolina. While an active faculty member, he started one of the earliest academic GIS programs, and advised 14 Ph.D. and 47 masters students to completion of their degrees. In addition to his university activities, Dr. Cowen is the current Chair of the National Geospatial Advisory Committee. He also chaired the Mapping Science Committee of the National Research Council for six years, and is a member of the NRC Board on Earth Sciences and Resources and he recently chaired the NRC Study Committee "Land Parcel Databases: A National Vision." Professor Cowen served as the first elected president of the AAG GISS specialty group, and ran the group's central office for more than 20 years. He was one of the cofounders of UCGIS. He has also served as the President of the Cartography and Geographic Information Society (CaGIS). Dr. David Cowen received his BA (1966) and MA (1971) in Geography from the State University of New York at Buffalo, and his PhD. in Geography from The Ohio State University in 1971.

Allen Carroll

Program Manager
ArcGIS Online content
Esri

Allen Carroll is Program Manager, ArcGIS Online Content at Esri. He leads a team that regularly publishes map-based stories and narratives, and that develops innovative ways to utilize maps and geographic information systems as storytelling platforms. In addition, he helps guide strategy for organizing Esri's online content and for serving its global user communities. Allen came to Esri after 27 years at the National Geographic Society. As chief cartographer at NGS, he was deeply involved in the creation of the Society's renowned reference and wall maps, globes, and atlases. He led the creation of the Seventh and Eighth editions of the World Atlas, incorporating satellite imagery and innovative thematic maps into the editions and integrating them for the first time with interactive Web resources. He has spearheaded the publication of many new maps and Web resources, ranging from decorative wall maps and supplement maps for National Geographic magazine to special projects featuring biodiversity, conservation, and indigenous cultures. He has served as a member of the National Geospatial Advisory Committee.

GEOGRAPHIC INFORMATION SYSTEMS
IN TRANSPORTATION SAFETY

NTSB Staff Technical Panelist Biographies

Christopher Babcock
Aerospace Engineer, Vehicle Recorder Division
National Transportation Safety Board

Mr. Babcock has been employed at the NTSB since 2007 in the Office of Research and Engineering as an aerospace engineer in the Vehicle Recorder Division. He has served as group chairman in several foreign and domestic major aviation and marine accident investigations and is also responsible for performing sound spectrum analysis in support of accident investigations. Before joining the NTSB, Mr. Babcock was an acoustics/vibration engineer at Gulfstream Aerospace in the areas of interior cabin noise control, component vibration, sonic boom acceptability, signal processing, community noise, airport access, and FAR part 36 certification.

Ivan Cheung, Ph.D.
Transportation Safety Analyst, Safety Research Division
National Transportation Safety Board

Dr. Cheung is a transportation research analyst in the NTSB's Office of Research and Engineering, Safety Research Division. Dr. Cheung completed his PhD at the University of California, Los Angeles. Before joining the NTSB, he worked for the Insurance Institute for Highway Safety. His research focuses on using statistical and spatial analytics to study transportation safety issue across all modes of transportation. He also uses geographic information systems (GIS) and other geospatial technologies and techniques in his research.

Robert Dodd, Sc.D.
Chief, Safety Research Division
National Transportation Safety Board

Dr. Dodd has worked at the NTSB since 2007 as Chief of the Safety Research Division, providing oversight to the NTSB's research and data analysis activities. Dr. Dodd was employed at the Safety Board previously, from 1986 to 1988, as a Transportation Safety Program Specialist, and completed a safety study on air medical helicopters and participated in a special investigation on operational errors at Chicago O'Hare's ATC tower. Before joining the NTSB, Dr. Dodd managed a research firm that addressed transportation safety, occupational safety, and public health issues. Dr. Dodd also served as a consultant to the Flight Safety Foundation, serving as its Manager of Data Systems and Analysis. He is also an associate faculty member in the Department of Health Policy and Management at the Johns Hopkins University Bloomberg School of Public Health in Baltimore.

Eric Emery, Ph.D., D-ABFA

Transportation Disaster Assistance Specialist, Transportation Disaster Assistance Division
National Transportation Safety Board

Dr. Emery currently serves as a Coordinator for Medicolegal Operations with the Transportation Disaster Assistance Division of the National Transportation Safety Board (NTSB). He received his PhD in Anthropology from Texas A&M University and has been actively involved in victim search and recovery work since 1993. Dr. Emery joined the NTSB from the Department of Defense's Joint POW/MIA Accounting Command-Central Identification Laboratory (JPAC-CIL), where he worked in medicolegal operations as a human remains recovery leader and lab manager for the CIL Annex Pearl Harbor. He has conducted mass fatality investigation, scene mapping, and recovery operations in Iraq, North Korea, Vietnam, Laos, Cambodia, South Korea, Papua New Guinea, Suriname, Palau, and throughout Europe.

Dr. Emery has helped develop interagency and international training programs in forensics and mass fatality recovery work, to include a five-year collaboration with the Department of Justice's International Criminal Investigative Training Assistance Program (ICITAP) in Bogota, Colombia. He holds a professional certificate in project management from George Mason University and is currently working on a certificate in Geographic Information Systems (GIS). Dr. Emery is a Diplomate of the American Board of Forensic Anthropology and an active member of the American Academy of Forensic Sciences. He has consulted for the U.S. Department of Defense's Forensic Sciences Working Group and is a qualified technical assessor of forensic laboratories with the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB).

Bill English

Senior Air Safety Investigator, Major Investigations Division, Office of Aviation Safety
National Transportation Safety Board

Mr. English is a Senior Air Safety Investigator in the Major Investigations division. He has been in that position since 2005, and has been with the Board since 1999. His main responsibilities are to conduct investigations of major air carrier accidents in the U.S. and assist foreign government air safety agencies on similar cases in the host country. He has led the investigation team in many major accidents including the Continental Airlines 737 in Denver, the Brazilian B737 and Legacy jet midair collision, and the UPS B747 cargo fire. Mr. English also holds the collateral duty as agency point of contact for the development of technical capability in unmanned aircraft systems, and is trained on the MQ-9 Predator-B. Before joining the NTSB, he was an FAA Air Traffic Controller, Quality Assurance and instrument procedures specialist, working GPS Implementation. He is a commercial pilot and flight instructor and worked as a corporate and charter pilot, flew navigation test and evaluation, and began his flying as an airborne radio traffic reporter. Mr. English is a graduate of Embry-Riddle University, the USAF Mishap Investigation school, and is currently completing graduate work at Penn State in Geospatial Intelligence.

Loren Groff, Ph.D.

National Resource Specialist, Safety Research Division
National Transportation Safety Board

Dr. Groff is a National Resource Specialist for Safety Data Systems and Analysis in NTSB's Office of Research and Engineering, Safety Research Division. He assists accident investigations and conducts safety data analyses, and regularly represents the NTSB and United States in international aviation industry and government initiatives and working groups involving safety data sharing and analysis. He has managed or co-managed several NTSB safety studies since joining the NTSB in 2002, including weather-related general aviation accidents, the introduction of glass cockpit avionics into light aircraft, and most recently, the safety of experimental amateur-built aircraft. Before joining the NTSB, he held aviation positions as a flight instructor and as a regional airline pilot. Dr. Groff received his M.A. and Ph.D. from Wichita State University in Human Factors Psychology.

Joseph Kolly, Ph.D.

Director, Office of Research and Engineering
National Transportation Safety Board

Dr. Kolly became the Director of the Office of Research and Engineering in 2009 and is responsible for oversight of the NTSB's three laboratory divisions; Materials, Vehicle Recorders, and Vehicle Performance, as well as the Safety Research Division. Dr. Kolly began his career with the NTSB in 1998 as a mechanical engineer where he served as an investigator on numerous major investigations, most significantly the fire explosion investigation of the 1996 TWA Flight 800 accident, where he led applied research and testing programs to investigate jet fuel chemistry, airplane fuel tank thermochemisty, jet fuel flammability and ignition energy, and computational and experimental fuel tank combustion modeling

Rafael Marshall, Ph.D.

Project Manager, Report Development Division, Office of Highway Safety
National Transportation Safety Board

Dr. Marshall has been with the NTSB since 1999. He has served as project manager for reports exploring issues on medical impairment, illicit drug use, fatigue, distraction, and driver training. He has managed a hearing on noncommercial driver medical oversight and a forum on truck and bus safety. He has served as a technical panel member on forums and symposia ranging from driver's education to transportation safety and the use of sedating or impairing medications. His Ph.D. is in cognitive psychology from George Mason University, and his M.P.H. in epidemiology from The George Washington University.

Kristin Poland, Ph.D

Senior Biomechanical Engineer, Vehicle Performance Division
National Transportation Safety Board

Dr. Poland has been employed at the NTSB since 1998 as a senior biomechanical engineer in the Vehicle Performance Division. She developed NTSB methodology for occupant kinematics investigations; performed occupant kinematics simulations and injury causation analysis for the special investigation report on bus crashworthiness (1999) and the safety study for airbag-equipped general aviation aircraft; developed vehicle dynamics and occupant kinematics simulations for investigations of the 1999 motorcoach accident in New Orleans, Louisiana; the 2000 school bus/train collision in Conasauga, Tennessee; the Hampshire, Illinois, specialty bus collision; and the Osseo, Wisconsin, motorcoach/tractor trailer collision. She analyzed occupant motion during highway, rail, and aviation crashes; participated in the human performance investigations of USAir 427, TWA 800, EgyptAir 990, American Airlines 587, and the *Crown Princess* marine accident. Dr. Poland has published multiple papers for the Society of Automotive Engineers (SAE) and the American Society of Mechanical Engineers (ASME).

Eric Stolzenberg

Senior Investigator, Office of Marine Safety
National Transportation Safety Board

Eric Stolzenberg has been with the Office of Marine Safety at NTSB since January 2008. He has served as chairman for both naval architecture and marine engineering groups on several accidents. He was also the Investigator in Charge of the 2010 allision of the passenger ferry Andrew J. Barberi with its slip on Staten Island. Mr. Stolzenberg received a Bachelor of Engineering degree in Naval Architecture from State University of New York Maritime College in 1991 and subsequently sailed worldwide as engineering officer aboard very large crude oil tankers, chemical products tankers and advanced fiber-optic cable-laying vessels. Before joining the NTSB, Mr. Stolzenberg worked as naval architect at John J. McMullen Associates and later with Rolls-Royce Seaworthy Systems, both full service naval architecture and marine engineering firms. Mr. Stolzenberg also served in the Navy Reserve to the rank of Lieutenant. At this time, he maintains his Coast Guard license and is certified as International Safety Management (ISM) auditor by the International Register of Certificated Auditors.

John B. Vorderbrueggen, PE

Chief, Pipeline and Hazardous Materials Investigations Division
National Transportation Safety Board

Mr. Vorderbrueggen joined the NTSB in 2012 as the Division Chief, Pipeline and Hazardous Materials Investigations. Prior to joining the NTSB, he worked in the DOE Office of Health, Safety, and Security interfacing with the Defense Nuclear Facilities Safety Board. Prior to joining DOE, Mr. Vorderbrueggen spent more than eight years as an Investigations Supervisor at the U.S. Chemical Safety Board. He was the lead investigator on more than 13 major accidents at industrial facilities in the U.S. He has more than 37 years of experience in design, process safety, regulatory programs, maintenance management, human factors, and workforce training. He has extensive experience in incident investigations, Process Safety Management, and fitness-for-service engineering analyses. Industries include chemical, hazardous materials transportation, refining, pharmaceutical, and nuclear and fossil power. He served on the Mary Kay O'Connor Process Safety Center Technical Advisory Committee. He holds a BSME from California Polytechnic State University and is a registered professional engineer.

Panel #1: Opening Panel

Chairman Deborah Hersman, National Transportation Safety Board
Opening Remarks

Reginald R. Souleyrette, Ph.D., P.E., University of Kentucky
GIS in Transportation Safety

Stephen M. Lewis, U.S. Department of Transportation
Geospatial Coordination at USDOT and Transportation for the Nation (TFTN)

Chairman Deborah A.P. Hersman
National Transportation Safety Board
Opening Remarks
Geographic Information Systems in Transportation Safety
Washington, DC - December 4, 2012
(As Prepared for Delivery)

Good morning. Welcome to the Boardroom of the National Transportation Safety Board. I am Debbie Hersman, and it is my privilege to serve as Chairman of the NTSB. Joining me are my fellow Board members: Member Robert Sumwalt, Member Mark Rosekind and Member Earl Weener. Vice Chairman Christopher Hart is unable to join us today.

We are here to learn about the use of geographic information systems, or GIS, in transportation safety. Here at the NTSB, we see GIS helping us conduct better investigations across all modes of transportation.

In addition, there are benefits from using GIS to help identify trends and areas of growing risk. For example, if we start to see a series of accidents and incidents, with GIS we can identify patterns, understand relationships and use its capabilities to help develop countermeasures.

GIS is an exciting use of technology, both for what it can do and for how it can work with other data sources, which we will hear more about today and tomorrow.

I look forward to an extremely informative conference about how GIS can help in accident investigation, prevention, emergency response and so much more.

We are joined by a number of distinguished panelists from across academia, industry, government and the research community. Thank you - all - for your participation.

Now, for some logistics. To begin with, we have a pretty tightly scripted agenda to follow with eight panels designed to cover a range of topics about geographic information systems in transportation safety. The agenda is available in the lobby outside the boardroom and on the NTSB website. The website also includes biographical information about the panelists, who have graciously made themselves available to participate this week.

R. Souleyrette

TRB Data and Information Systems

University of Kentucky

NATIONAL TRANSPORTATION SAFETY BOARD

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

UK

What is GIS?

A computer system designed for Geographically Referenced Data:

- Capture
- Storing/Managing
- Integration
- Analyzing
- Interpreting
- Visualizing

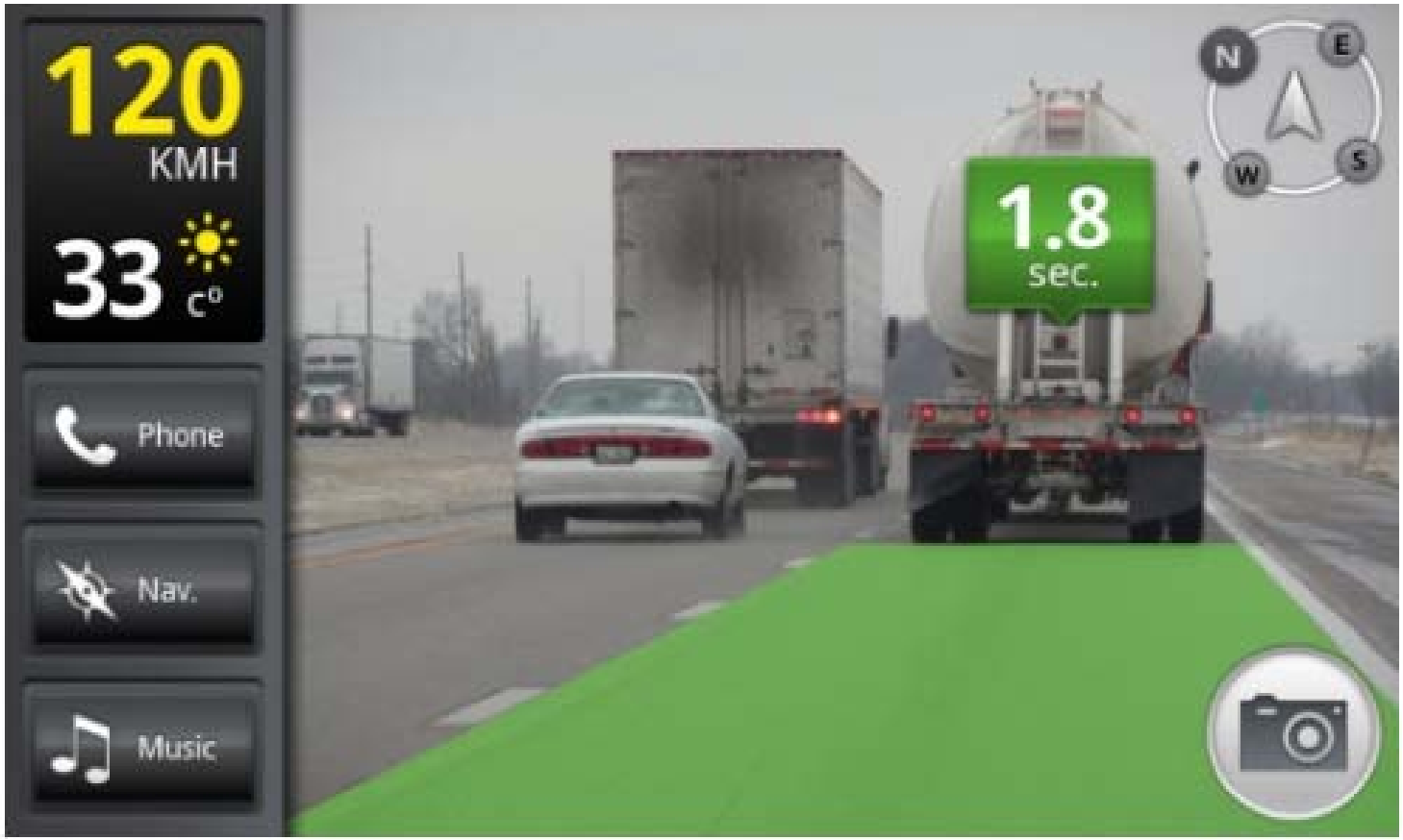
- Relationships
- Patterns
- Trends

- Increase Productivity
- More Informed Decision Making
- Improved Communication
- Improved Record Keeping
- Managing Data Geographically

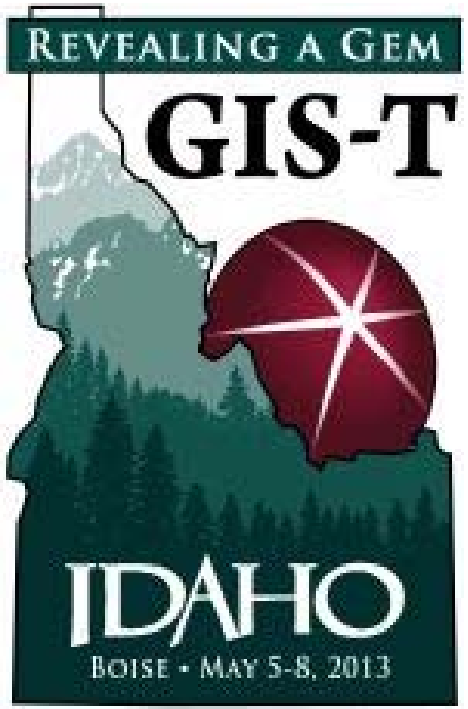
Source:
http://egsc.usgs.gov/isb/pubs/gis_poster/; http://www.esri.com/what-is-gis/overview

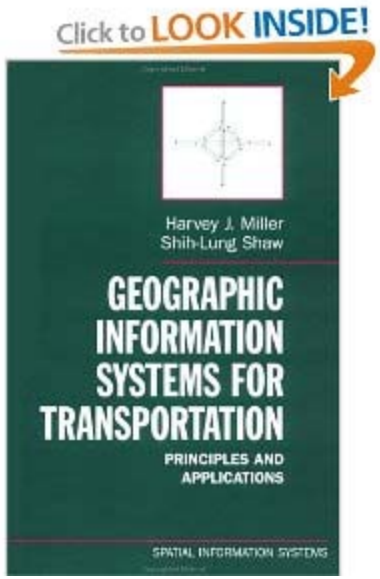
Free Android App Adds Collision Avoidance

by MATT BALL *on* NOVEMBER 1, 2011



GIS-T applications …





Aviation

Use GIS for managing airport facilities, regulating use of airspace, and noise modeling.

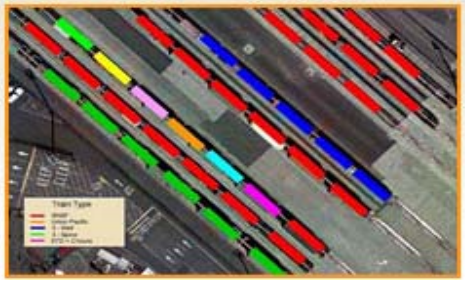
Michigan's Lane Mile Inventory

GIS helps the Michigan Department of Transportation efficiently and accurately deliver annual maintenance and capital funds to various regions.

GIS in Transportation, Winter 2012

Ports and Maritime

GIS helps engineers build and manage port facilities and helps planners accommodate community and environmental constraints more easily.



Railways

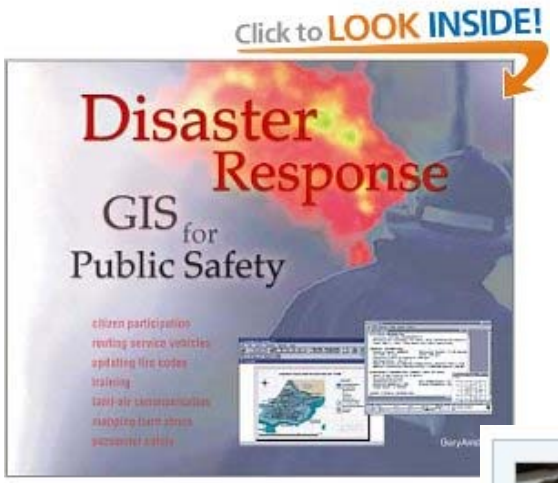
Rail system operators use GIS to keep accurate inventories of facilities and report safety and performance statistics.

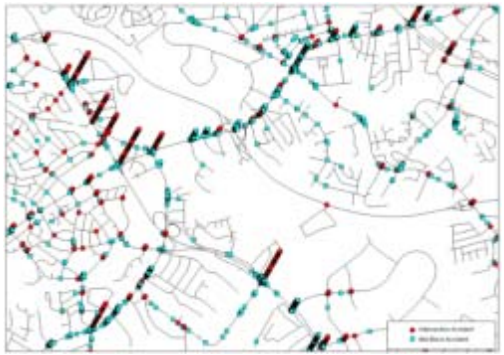
Public Transit

GIS is an excellent tool for analyzing ridership and service, as well as revenue, patterns, and usage, by select populations.

www.esri.com

GIS-TS applications …

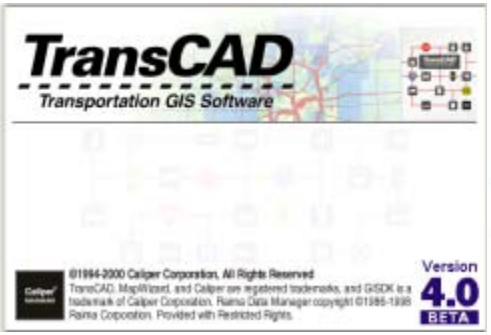


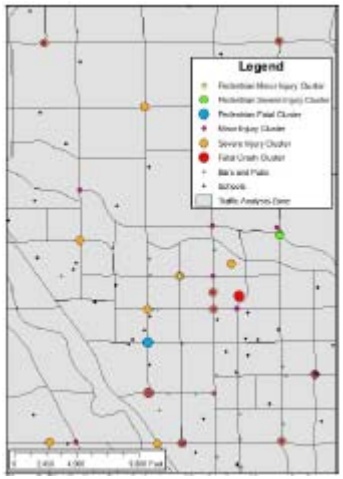


AIMS

Airport and Transit Security

www.intergraph.com





Computer-Aided Dispatch/E911
Putting spatial intelligence at the fingertips of dispatchers and field personnel ensures proper response time. Learn More

Emergency/Disaster Management
GIS is essential for all phases: preparation, mitigation, response, and recovery. Learn More

Fire/Rescue and EMS
GIS helps fire/rescue and EMS protect life and property using information and analysis as a powerful tool. Learn More

Homeland/National Security
Federal, state, local, and tribal agencies use GIS to support the homeland/national security mission. Learn More

Law Enforcement
Discover how to leverage data collected each day to create intelligence you can use and share. Learn More

Wildland Fire Management
Access to information, increased safety and efficiency, and resource management are realized with GIS. Learn More

www.esri.com

NATIONAL TRANSPORTATION SAFETY BOARD

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Home > Transportation Safety > Most Wanted List

SHARE

MOST WANTED LIST

The Most Wanted List represents the NTSB's advocacy priorities. It is designed to increase awareness of, and support for, the most critical changes needed to reduce transportation accidents and save lives. Link for Most Wanted List Press Conference Video

PRESERVE THE INTEGRITY OF TRANSPORTATION INFRASTRUCTURE

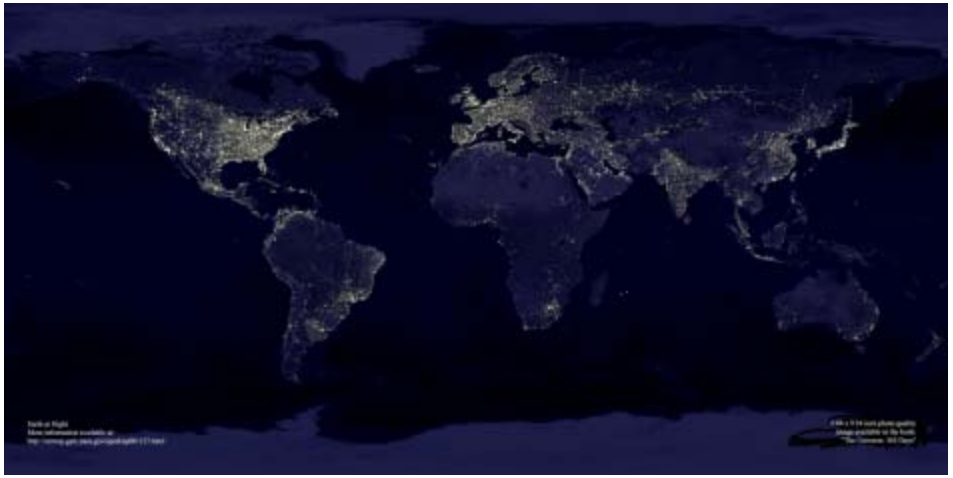
The nation's transportation infrastructure includes 600,000 bridges, nearly 4 million miles of public roads, 2.6 million miles of oil and gas pipelines, 120,000 miles of major railroads, and more than 25,000 miles of commercially navigable waterways. Infrastructure requires regular maintenance and when necessary, repair or replacement. READ MORE

- AIRPORT SURFACE OPERATION ★
- BUS SAFETY
- ELIMINATE DISTRACTION
- FIRE SAFETY
- GENERAL AVIATION SAFETY
- INFRASTRUCTURE ★
- PIPELINE SAFETY ★
- POSITIVE TRAIN CONTROL ★
- SUBSTANCE-IMPAIRED DRIVING
- COLLISION AVOIDANCE ★

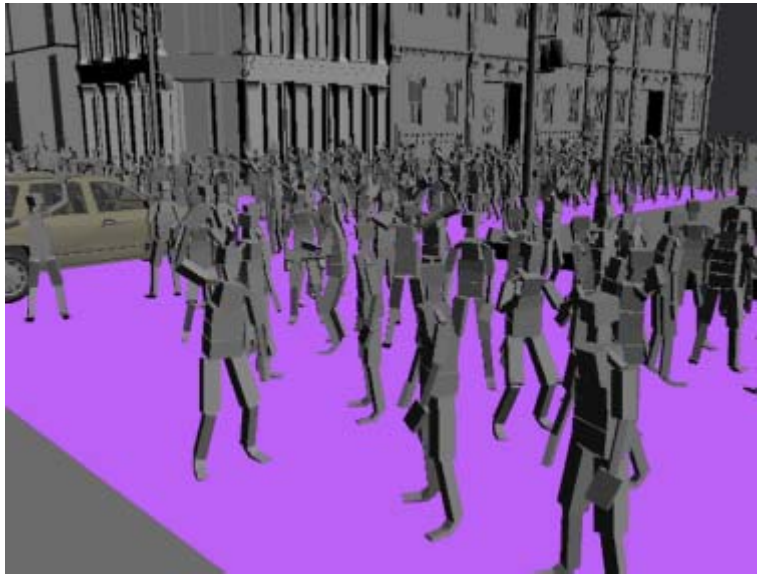
Most Wanted List Archive Pages

GIS can help

Evolution of GIS-TS



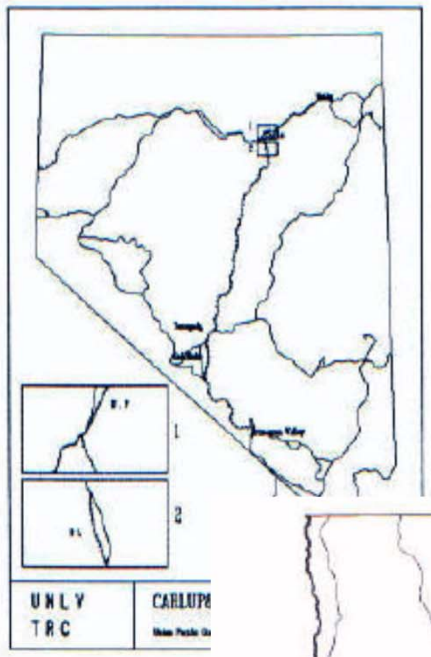
NASA

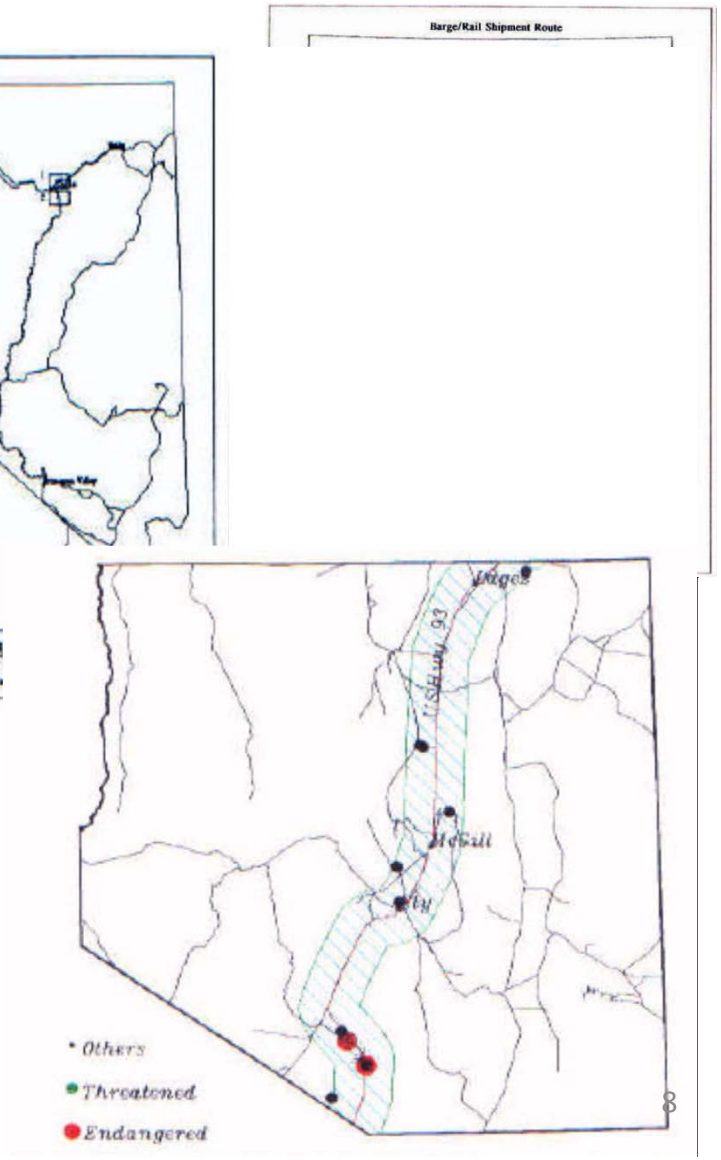


Torrens, P.M.

TOMTOM

Yucca Mountain - 1989





1998 GIS-ALAS

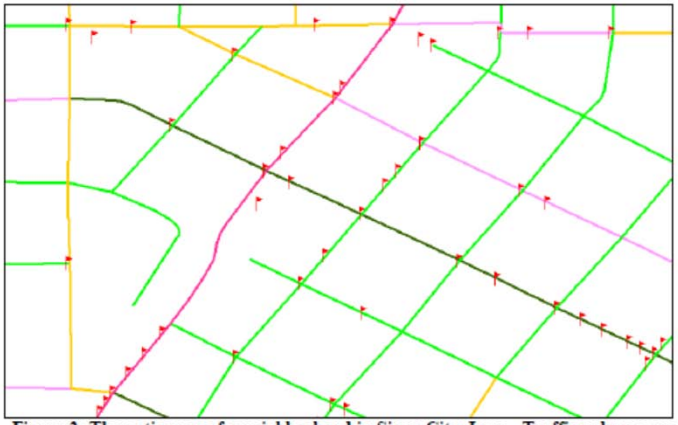


Figure 3: Thematic map of a neighborhood in Sioux City, Iowa. Traffic volumes are reflected in the shading of the roads. Accidents are displayed as flag symbols on the road network. This kind of graphical representation of data was not readily available before GIS-ALAS.

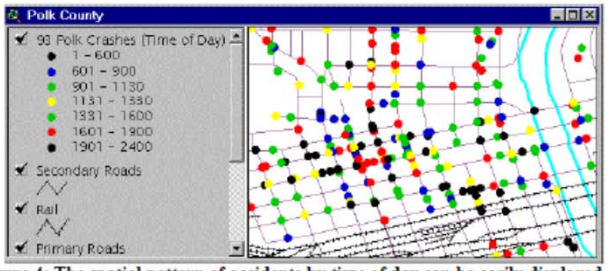


Figure 4: The spatial pattern of accidents by time of day can be easily displayed using the power of a GIS.

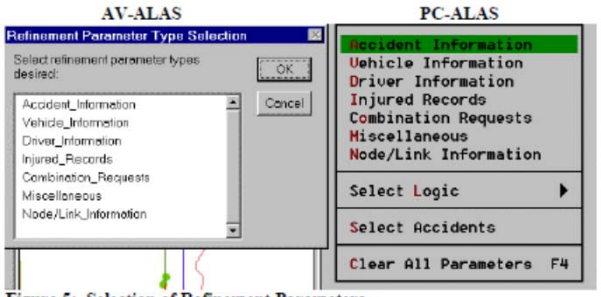
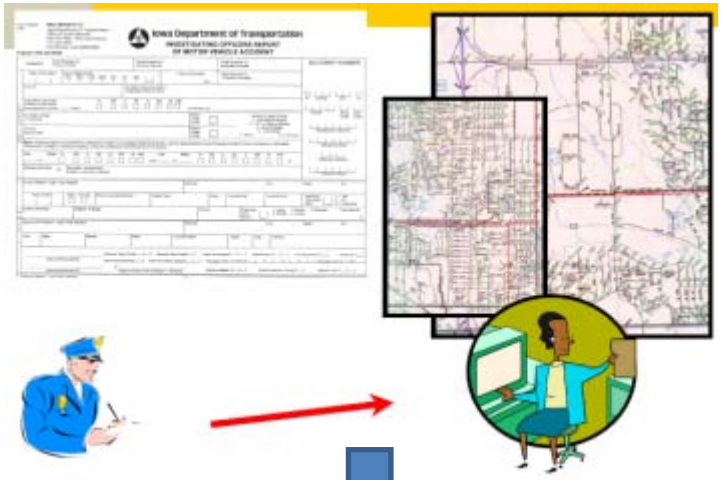
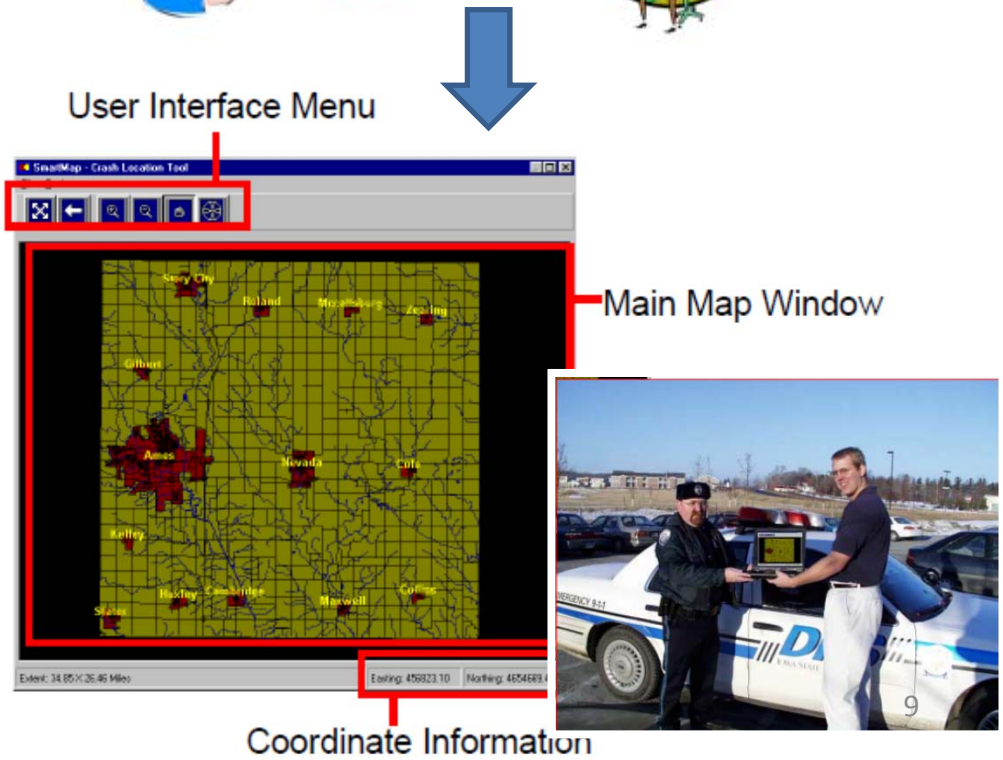


Figure 5: Selection of Refinement Parameters.

1999 TraCS

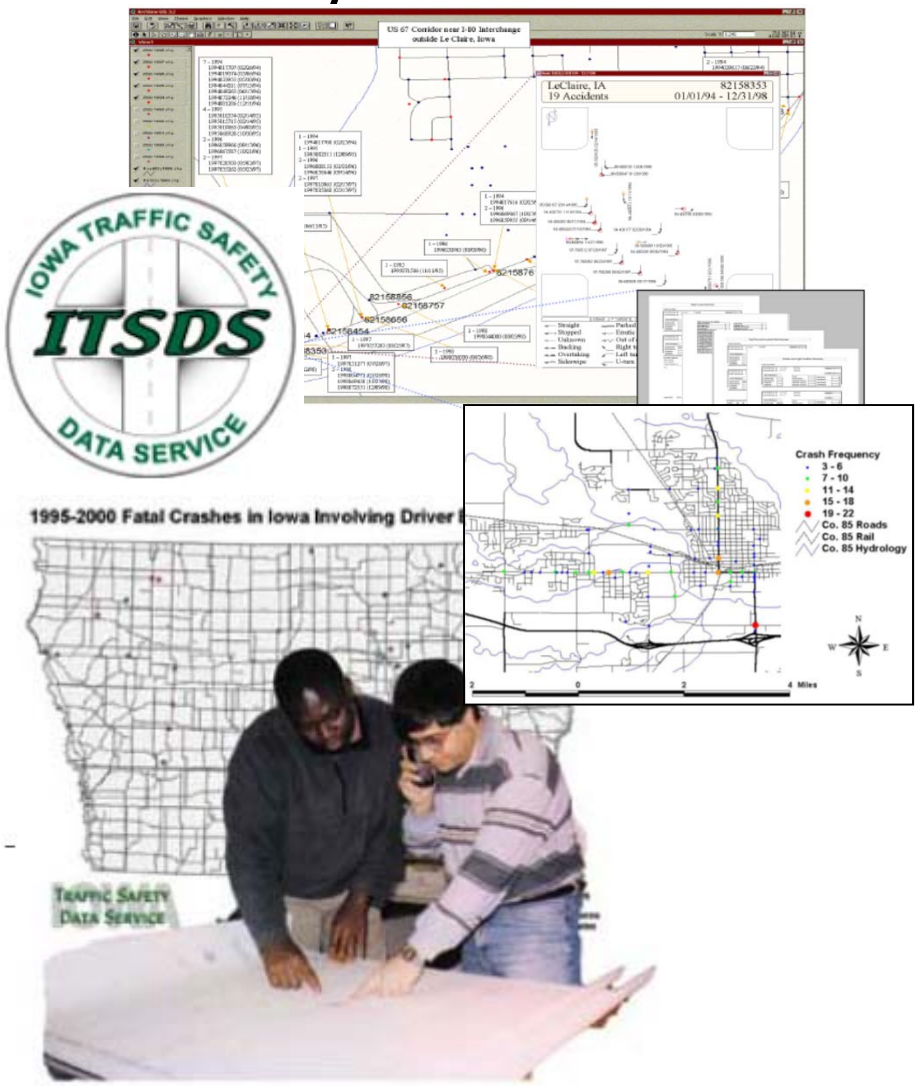




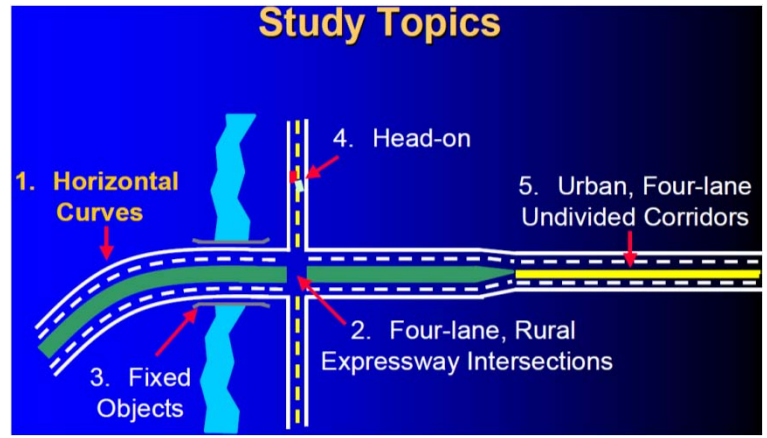
Evolution of GIS-TS applications …

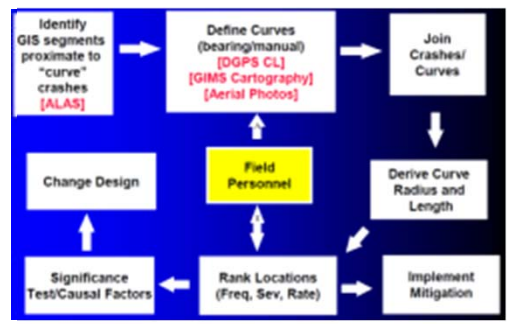
Services, more sophisticated analysis

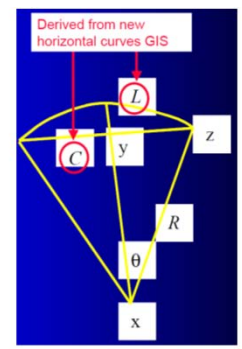
1999 Iowa Traffic Safety Data Service

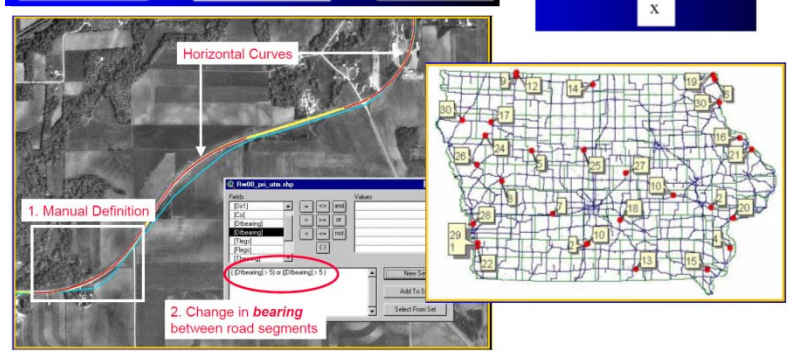


2001 High Crash Locations

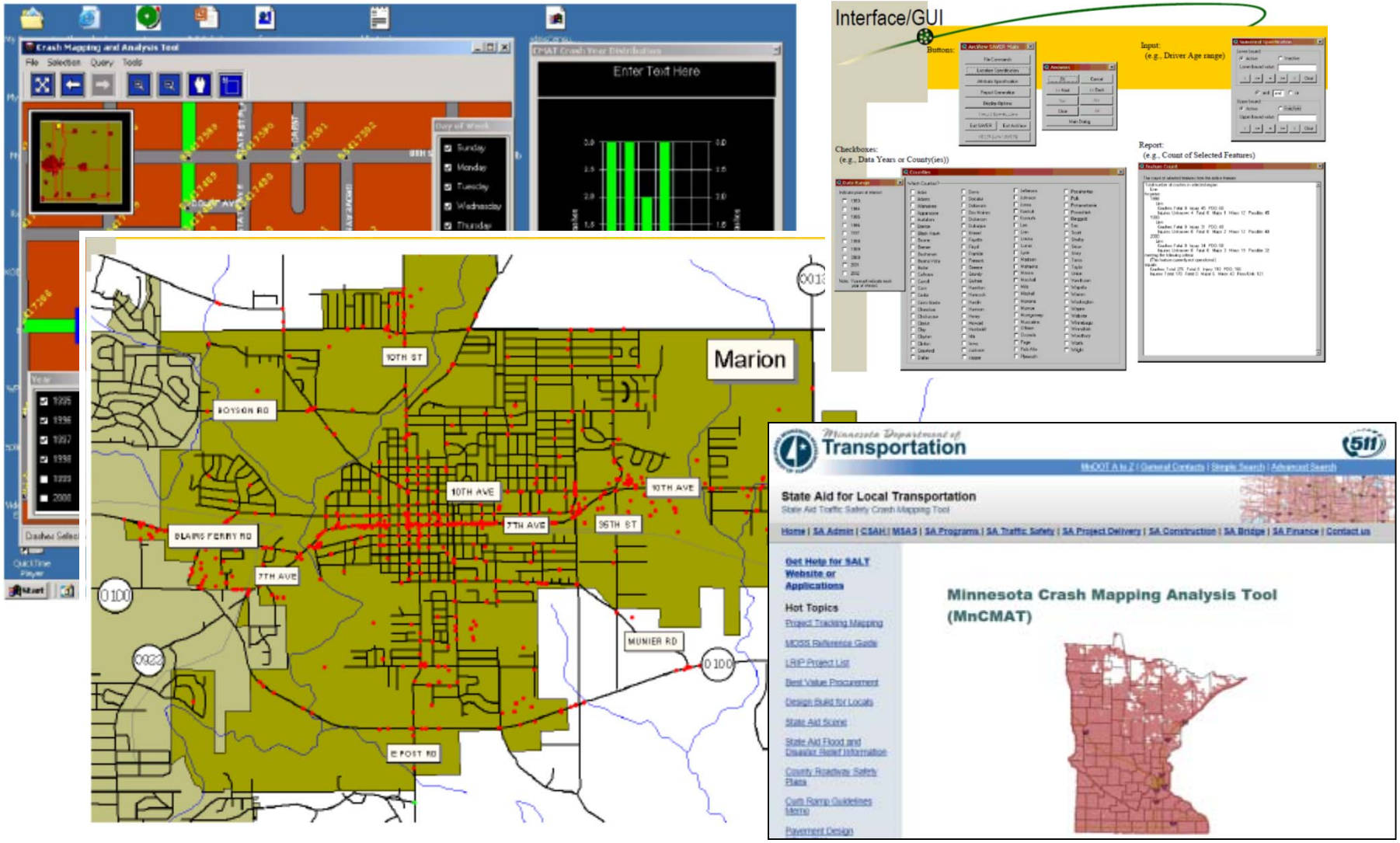




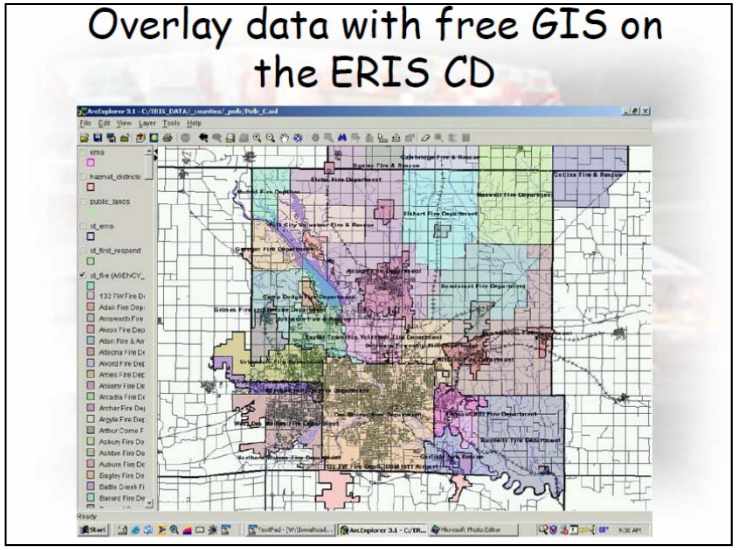


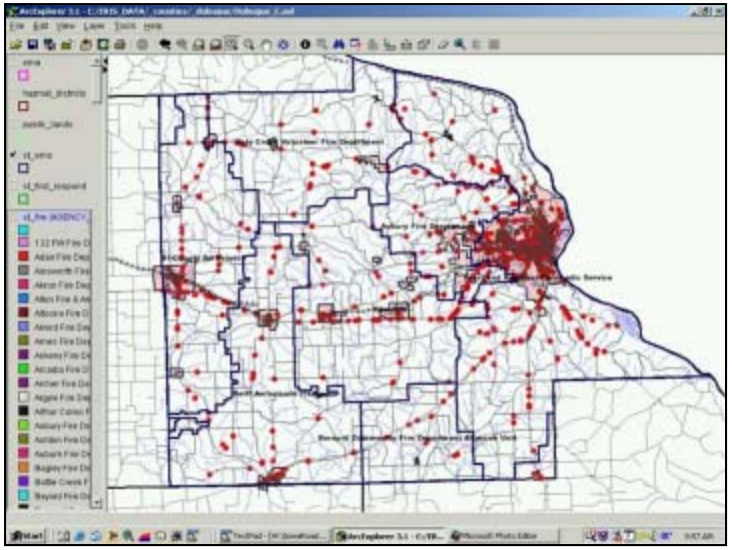


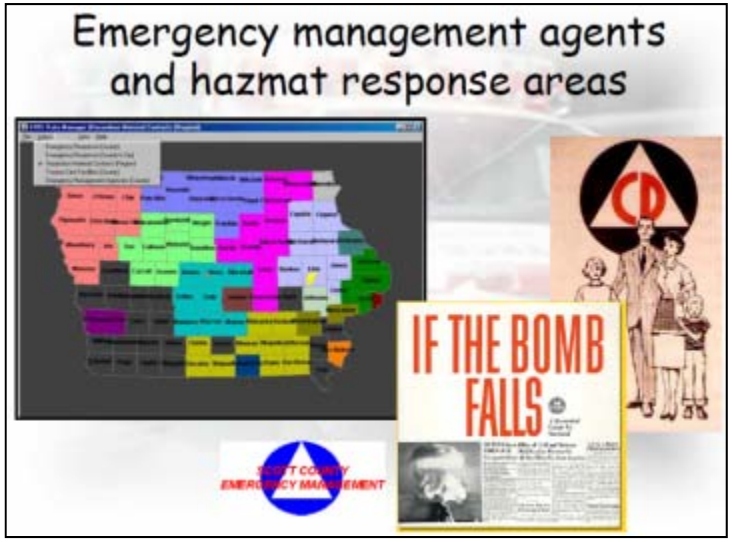
2002 – Crash Mapping Analysis Tool/SAVER

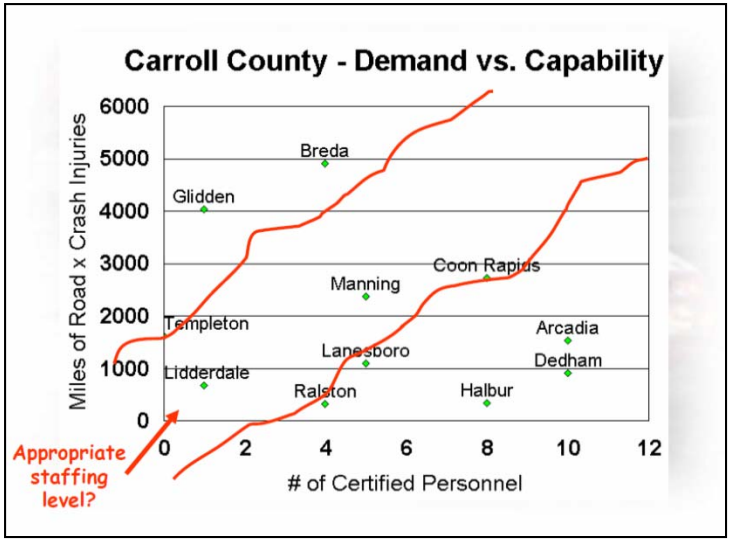


2003 ERIS – Emergency Response Information System



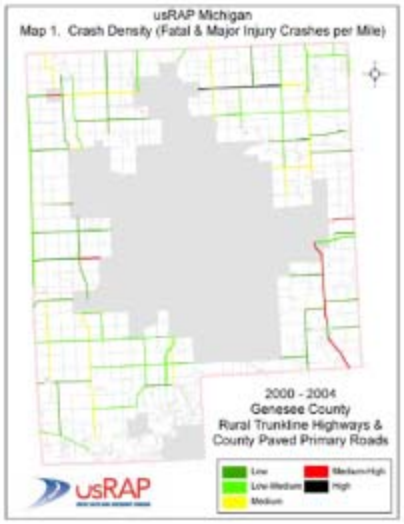






Today – usRAP – US Road Assessment Program

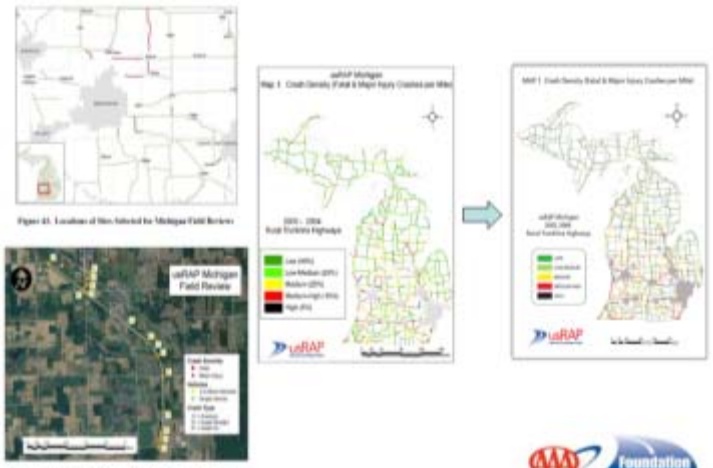
★ ★ ★ ★ usRAP Protocol 1. Risk Maps



Map 1 – Crash Density

- Dark green (40% of roadway length) – lowest risk
- Green (25% of roadway length)
- Yellow (20% of roadway length)
- Red (10% of roadway length)
- Black (5% of roadway length) – highest risk

★ ★ ★ ★ usRAP Protocol 2. Performance Tracking



★ ★ ★ ★ usRAP Protocol 3. Star Ratings based on Road Protection Score

★ ★ ★ ★ usRAP Protocol 4. Safer Roads Investment Plans

RPS x traffic volume x calibration factor

- Deaths and serious injuries (before)

Apply countermeasures → new RPS

Deaths and serious injuries (after)

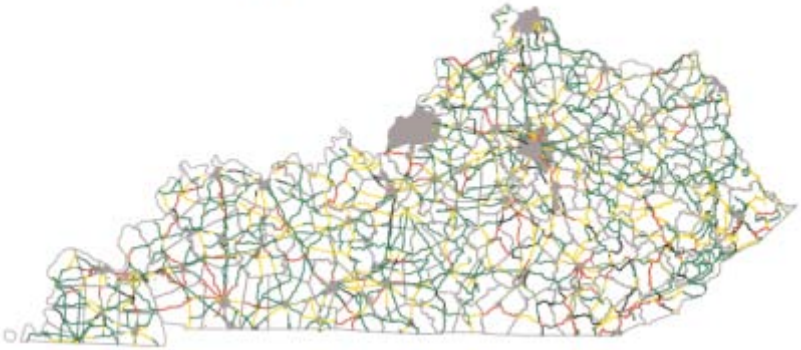
Reduction in deaths and serious injuries and economic benefit

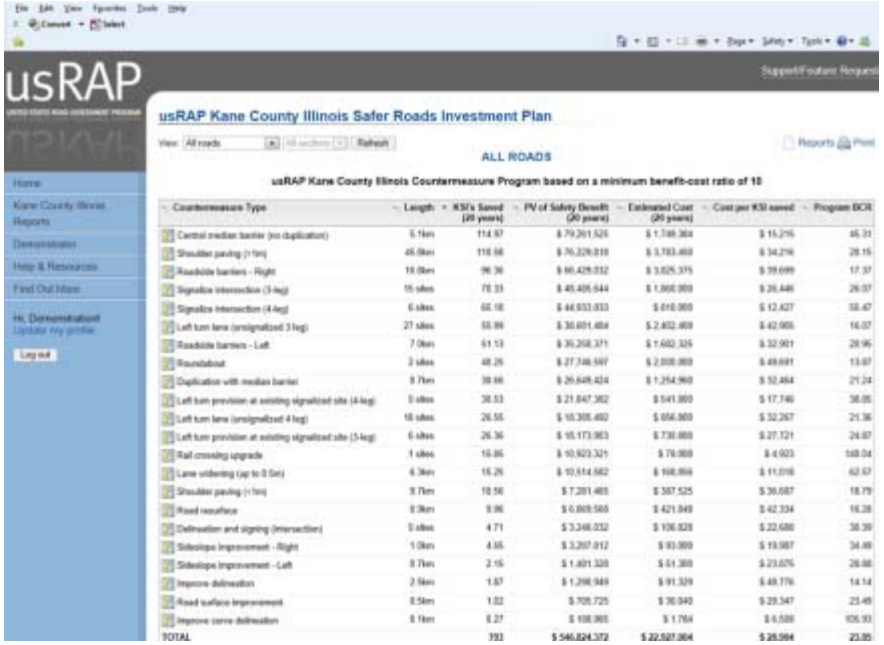
usRAP

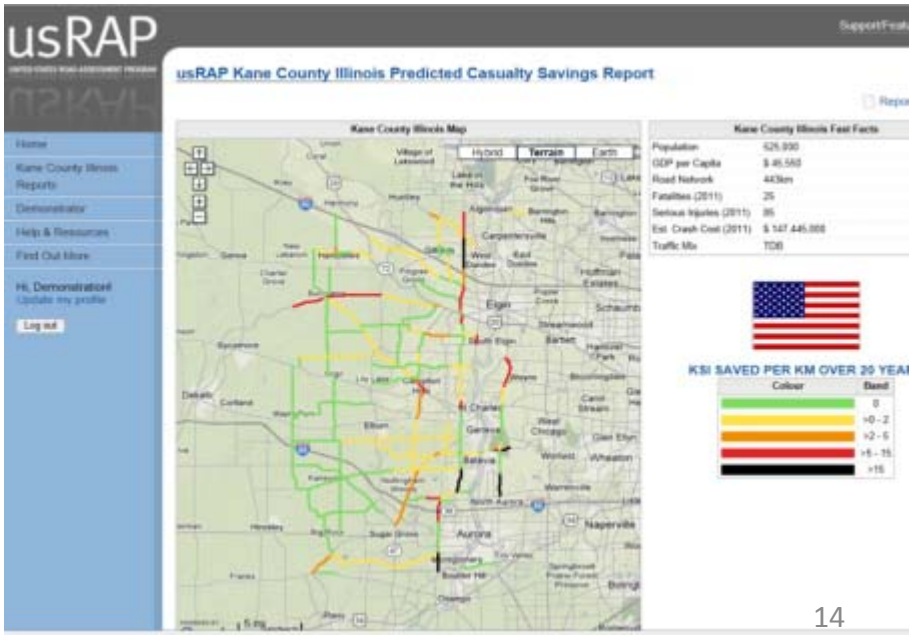
RPS Validation – Washington, Iowa, Illinois

Public Awareness Campaigns – Utah, Michigan

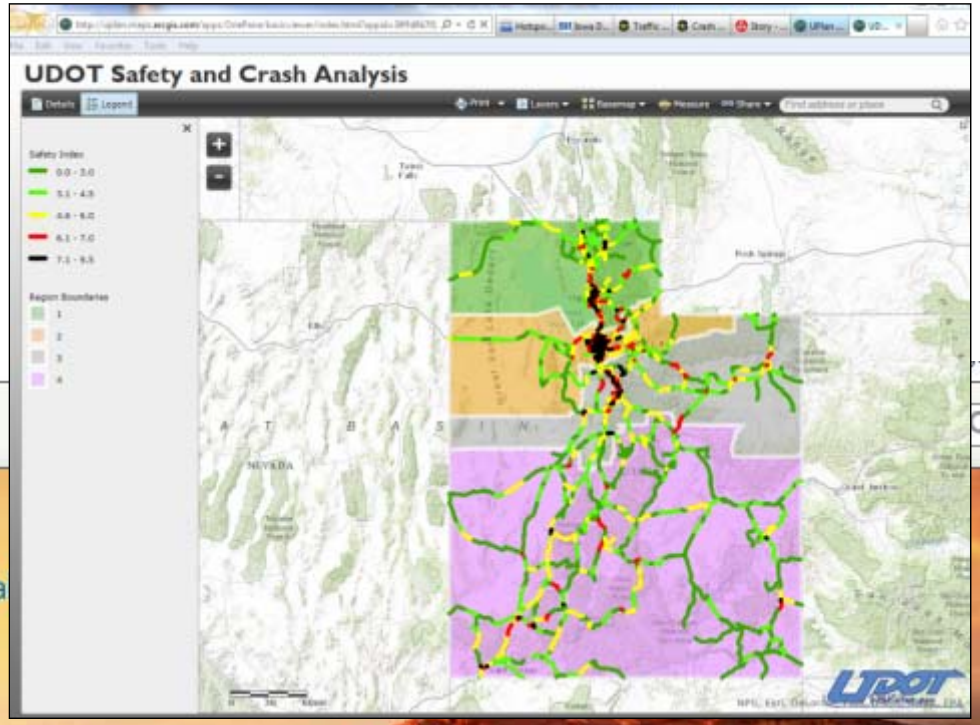
MAP 2. Crash Rate (Fatal and Major Injury Crashes per 100M VMT)
Aggressive Driving Crashes





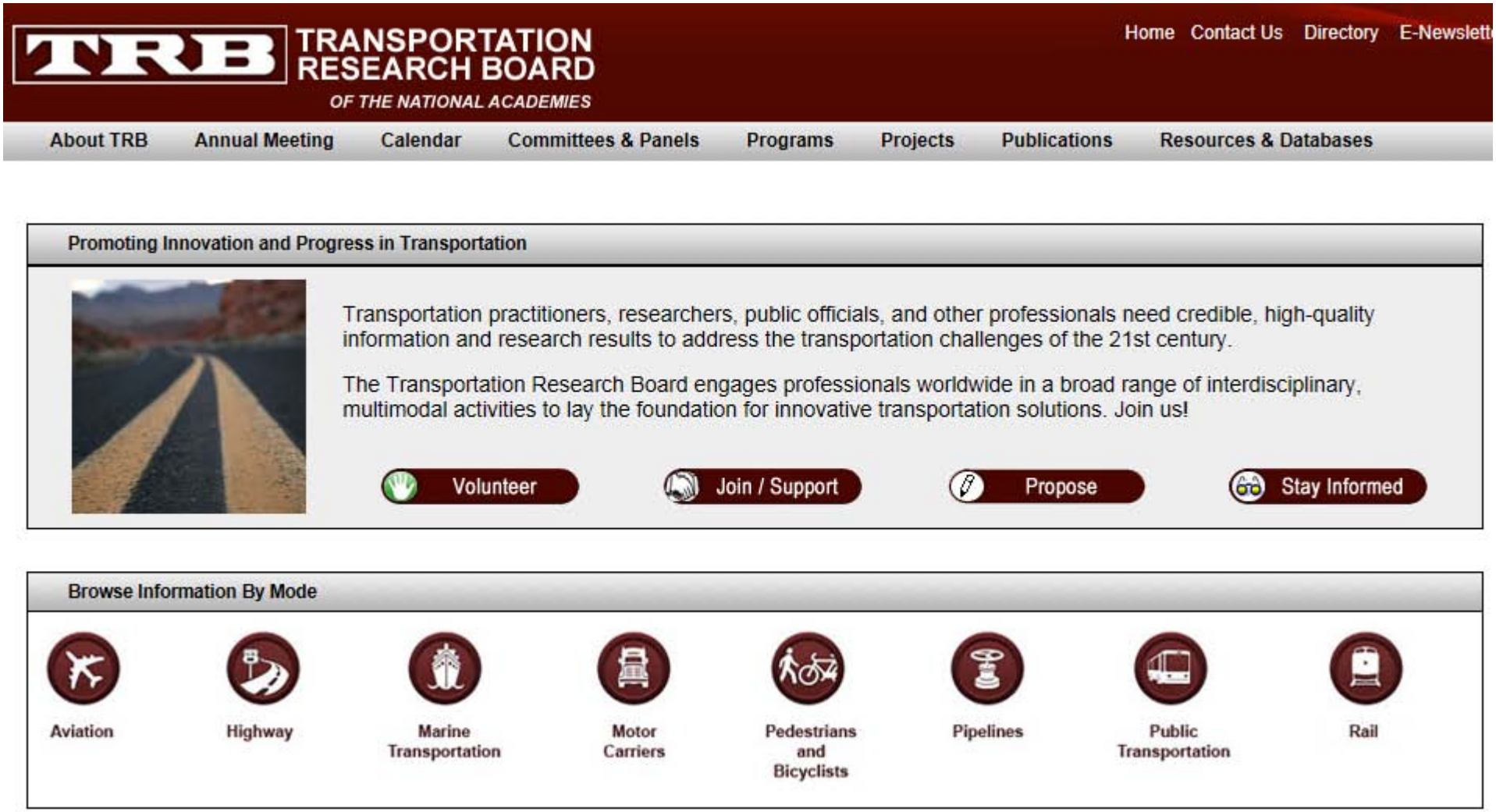


CANADA
AASHTO TSG Pilot States
None scheduled
First Circuit
Second Circuit
Third Circuit
Fourth Circuit
esri


UDOT Safety and Crash Analysis
Safety Index
Region Boundaries
NEVADA
UDOT

HOME
GALLERY
MAP
UPLAN
UDOT PLANNING NETWORK
A colla
Maintenance Station Information
2011 Daily Traffic Map - AADT
UDOT Projects Map
UDOT Pavement Management Map

TRB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TRB Committees Related to Safety and Human Factors

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

Standing Committees

Code	Committee Name
ABE60	Accessible Transportation and Mobility
AFB20	Roadside Safety Design
AHB60	Highway/Rail Grade Crossings
AL070	Tort Liability and Risk Management
AN000	Safety and Systems Users Group
ANB00	Section - Safety
ANB10	Transportation Safety Management
ANB20	Safety Data, Analysis and Evaluation
ANB23T	Task Force on Highway Safety Workforce Development
ANB25	Highway Safety Performance
ANB30	Operator Education and Regulation
ANB40	Traffic Law Enforcement
ANB45	Occupant Protection
ANB50	Alcohol, Other Drugs, and Transportation
ANB60	Safe Mobility of Older Persons
ANB70	Truck and Bus Safety
ANB75	Roundabouts
ANB99C	Research on the Health and Wellness of Commercial Truck and Bus Drivers: A Conference
AND00	Section - Users Performance
AND10	Vehicle User Characteristics
AND20	User Information Systems
AND30	Simulation and Measurement of Vehicle and Operator Performance

Policy Study Committees

Code	Committee Name
B0102	Committee for the Study of Traffic Safety Lessons from Benchmark Nations
B0105	Committee for Review of the Federal Railroad Administration Research and Development Program
B0110	Commercial Truck and Bus Safety Synthesis Program
B0113	Committee for a Review of the En Route Air Traffic Control Complexity and Workload Model
B0115	Committee on Offshore Oil and Gas Platform Inspection Program of the Minerals Management Service: A
E1008	Transportation Safety IDEA Program Committee

(Continued from left)

AND40	Visibility
ANF10	Pedestrians
ANF20	Bicycle Transportation
ANF30	Motorcycles and Mopeds
AP099A	Committee for Research on Fatigue in Transit Operations: A Conference
AR070	Railroad Operational Safety
AT040	Transportation of Hazardous Materials
AV090	Aviation Security and Emergency Management
AW040	Marine Safety and Human Factors

TRB Committees Related to Data and Information Technology

Standing Committees

Code	Committee Name
A0030T	Special Task Force on Data for Decisions and Performance Measures
ABC30	Performance Measurement
ABC40	Transportation Asset Management
ABJ00	Section - Data and Information Systems
ABJ10	National Transportation Data Requirements and Programs
ABJ15T	Task Force for the Using Census Data for Transportation Applications Conference
ABJ20	Statewide Transportation Data and Information Systems
ABJ25T	Task Force on the Traffic Monitoring Conferences
ABJ30	Urban Transportation Data and Information Systems
ABJ35	Highway Traffic Monitoring
ABJ40	Travel Survey Methods
ABJ45T	Task Force on Understanding New Directions for the National Household Travel Survey
ABJ50	Information Systems and Technology
ABJ60	Geographic Information Science and Applications
ABJ70	Artificial Intelligence and Advanced Computing Applications
ABJ80	Statistical Methods
ABJ90	Freight Transportation Data
ABJ95	Visualization in Transportation
ABJ99F	Using Census Data for Transportation Applications: A Conference
ABJ99G	Committee for Access to International Transportation Research Information: A Conference
AFB80	Geospatial Data Acquisition Technologies in Design and Construction
ANB20	Safety Data, Analysis and Evaluation

Policy Study Committees

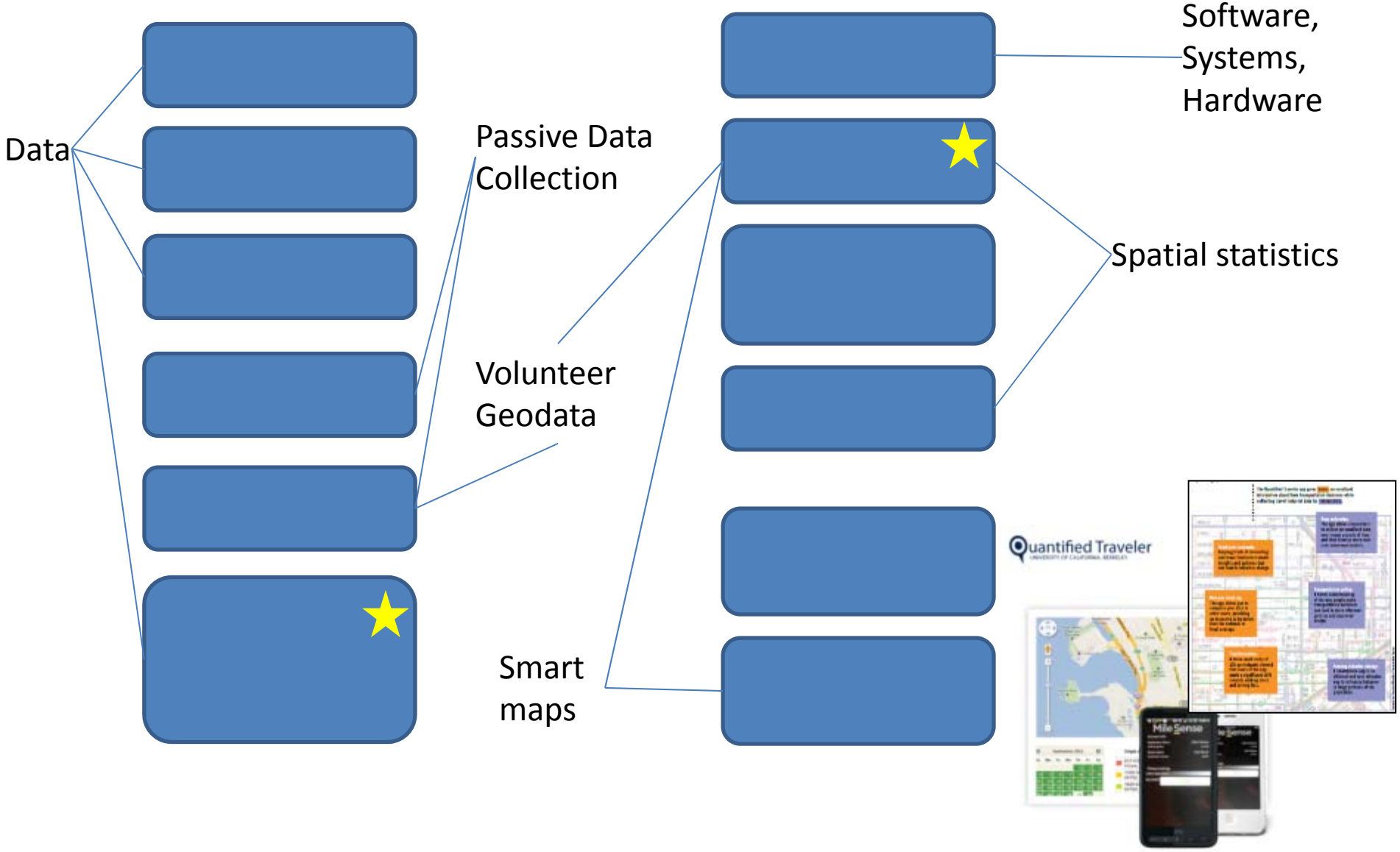
Code	Committee Name
B0002	TRB Information Services Committee
B0114	Committee on Strategies for Improved Passenger and Freight Travel Data
E1002	TRB Long-Term Pavement Performance (LTPP) Committee
E1002-B	Expert Task Group on LTPP Special Activities
E1002-C	Expert Task Group on LTPP Traffic Data Collection and Analysis
E1003	Data Analysis Working Group (DAWG)

Search results for "GIS"

13 matches were found.

ABJ60	Geographic Information Science and Applications
ADB30	Transportation Network Modeling
AFB80	Geospatial Data Acquisition Technologies in Design and Construction
AL050	Environmental Issues in Transportation Law
AT015	Freight Transportation Planning and Logistics
AT035	Military Transportation
AT060	Trucking Industry Research
AT065T	Task Force on the Logistics of Disaster Response and Business Continuity
AT099C	Committee for EU-U.S. Transportation Research Symposium No. 1: Urban Freight Transport-The Last Mile
B0125	Committee for Operating in the Ocean Environment: A Workshop on Offshore Renewable Energy Development
D0887	NCHRP Project Panel on Best Practices in GIS-Based Asset Management
DA0411	ACRP Project Panel on Integrating GIS into Emergency Management at Airports
DF040	NCFRP Project Panel on Improving Export Freight Logistics

TRB GIS/Safety Key Committees (DRAFT)



Example of Volunteer Geodata

Challenges

GRT Corp

MANAGEMENT ISSUES:

1. Education - How to get top management to understand the magnitude of GIS without getting them turned off before the system is completed:

   a. Training for executives and managers
   b. Training for Legislators
   c. Good definition of GIS
   d. Define benefits of GIS
   e. Define needs
   f. How will quality be maintained

2. Organization - What changes should be made to organizational structure related to GIS:

   a. GIS / DBA ?
   b. Where/Who should control

3. External Coordination:

   a. FHWA role
   b. Standards
   c. Reporting
   d. Goals - FHWA/State/Local

DATA NEEDS and DATA ACQUISITION ISSUES:

40 issues received were reviewed and analysis reduced issues to the following 5 major categories:

1. Data Standardization

2. Data Accuracy

3. Data Sharing - Federal, State, Local governments

4. Create interface among separate data bases (created at different scales, resolutions, etc.)

5. Optimize data collection and maintenance techniques

TECHNOLOGY ISSUES:

1. Technology Transfer:

   a. General information of what's going on in GIS
   b. Dialogue between DOT's and Vendor Community

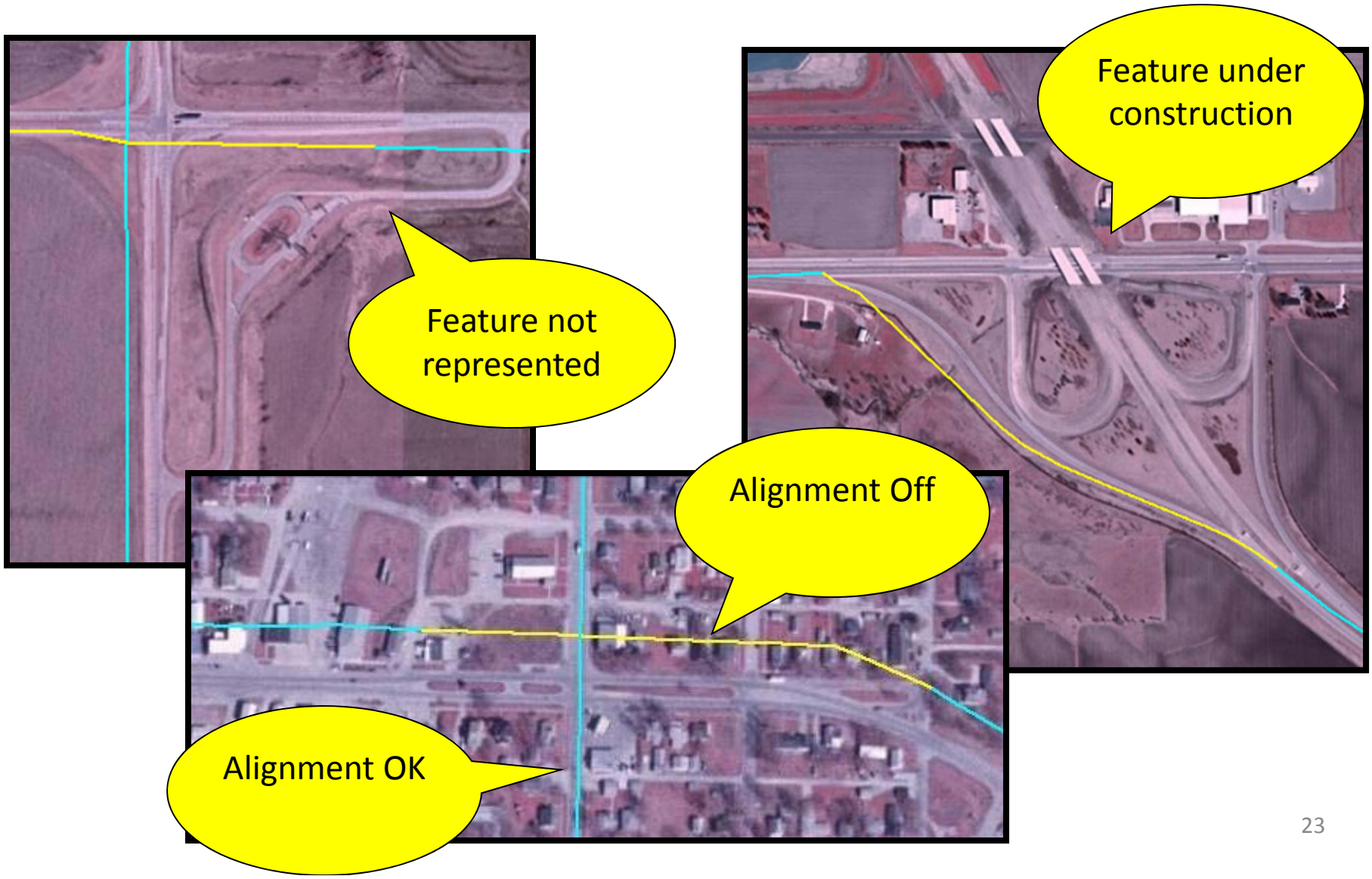
2. Integration Issues:

   a. Multiple hardware platforms
   b. Integrating - CADD, Image, Spatial Data, Workstations, Mainframe, Non-Spatial Data

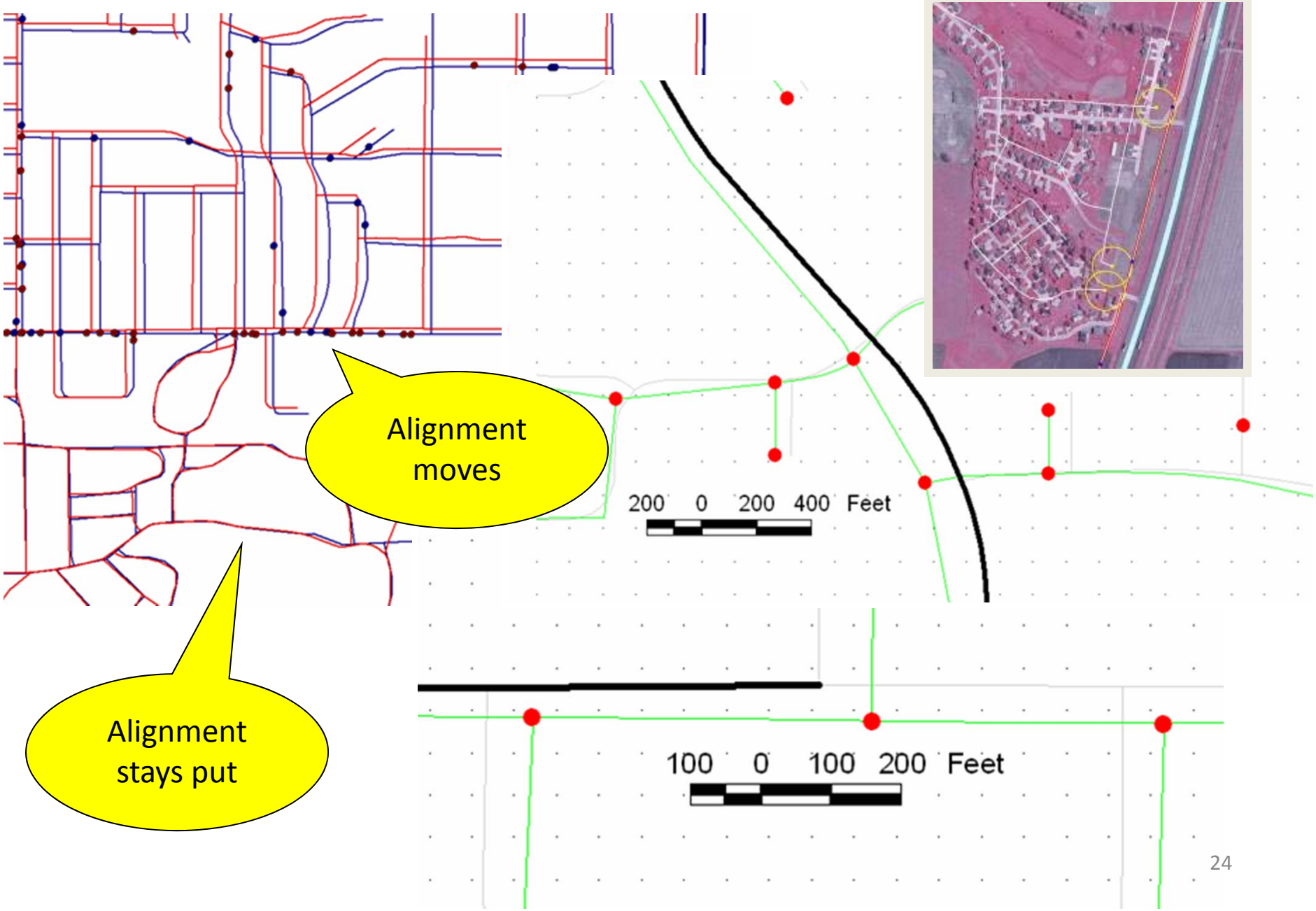
1989 A.D.

Some not-so "simple" questions

Where are the roads? (Incorrect or incomplete cartography)



Where are the roads? (Improving cartography)

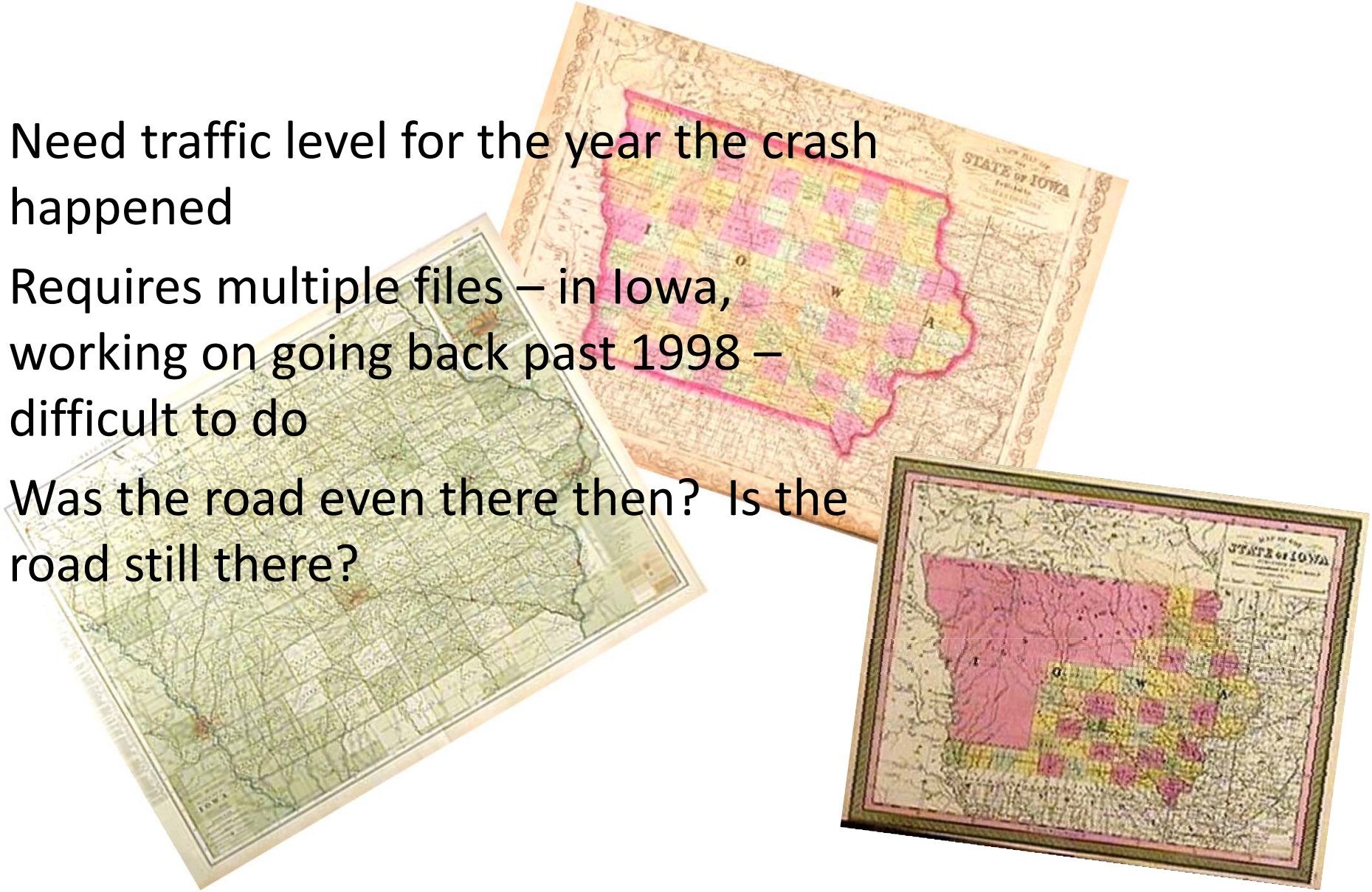


Where are the crashes?

- Crashes are not necessarily point events
- Some crashes may be located using different methods and degree of accuracy
  - Temporal (e.g. link node to lat long)
  - Spatial (e.g., state police v. local)
  - Techno (GPS v. smart map)

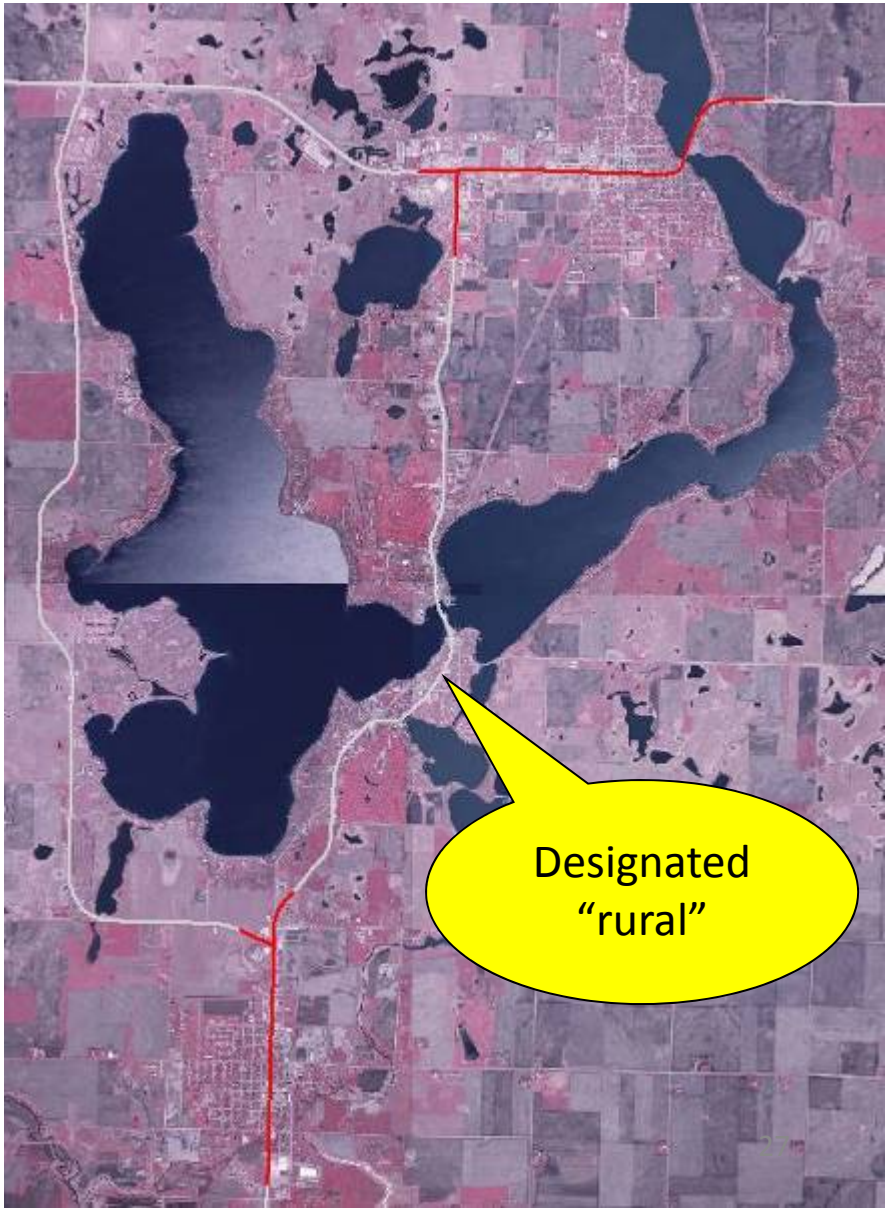
What's "the" traffic volume on "the" road?

- Need traffic level for the year the crash happened
- Requires multiple files – in Iowa, working on going back past 1998 – difficult to do
- Was the road even there then? Is the road still there?

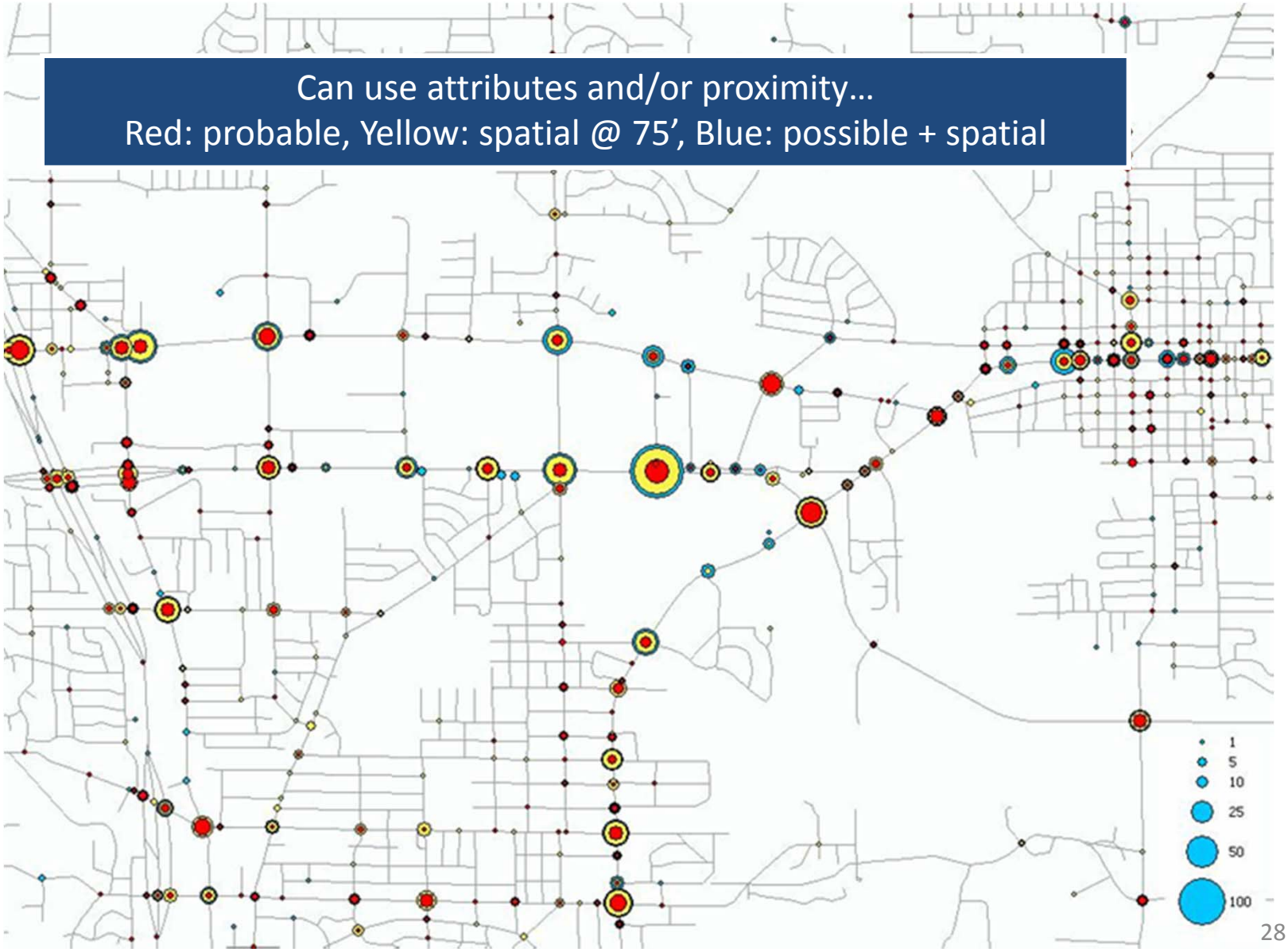


How to segment the road system?

- Requirements
  - Logical breaks (engineering and public)
  - Relationship to inventory data
  - Long enough for manageability and presentation
  - Short enough to reflect important changes
  - Clear and understandable to use
- Facility location and type
  - What is rural/urban? Character is important …



What is an intersection crash?



ArcNews Fall 2012

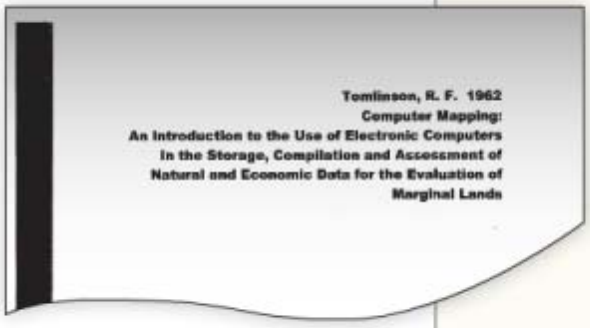
The 50th Anniversary of GIS

Roger Tomlinson

Some events, like birthdays, weddings, and graduations, are easy to mark on the calendar. Others, like the beginning of a social movement or a language—or the invention of GIS—are harder to pinpoint. However, the confluence of three pivotal events in 1962 and 1963 makes this as good a time as any to celebrate a half-century of GIS.

The first event was the establishment of the Canada Land Inventory (CLI) in 1962. CLI set out to produce about 1,500 maps of land use and land capabilities at 1:50,000 scales. Though the maps were tional manual methods, Roger T employed by Spartan Air Servi convinced the head of CLI that co be used to automate map analysis. CLI invited Tomlinson to define the functional requirements of what would later be called the Canada Geographic Information System. His carefully considered use of the qualifier "geographic" caught on and has created opportunities and challenges for the discipline of geography ever since.

In August 1963, just as Tomlinson delivered his feasibility report to CLI, Edward Horwood of the University of Washington organized the First Annual Conference on Urban Planning Information Systems and Programs. Within a few years, that event became the annual conference of a new organization called the Urban and Regional Information Systems Association (URISA). Urban and Regional Information

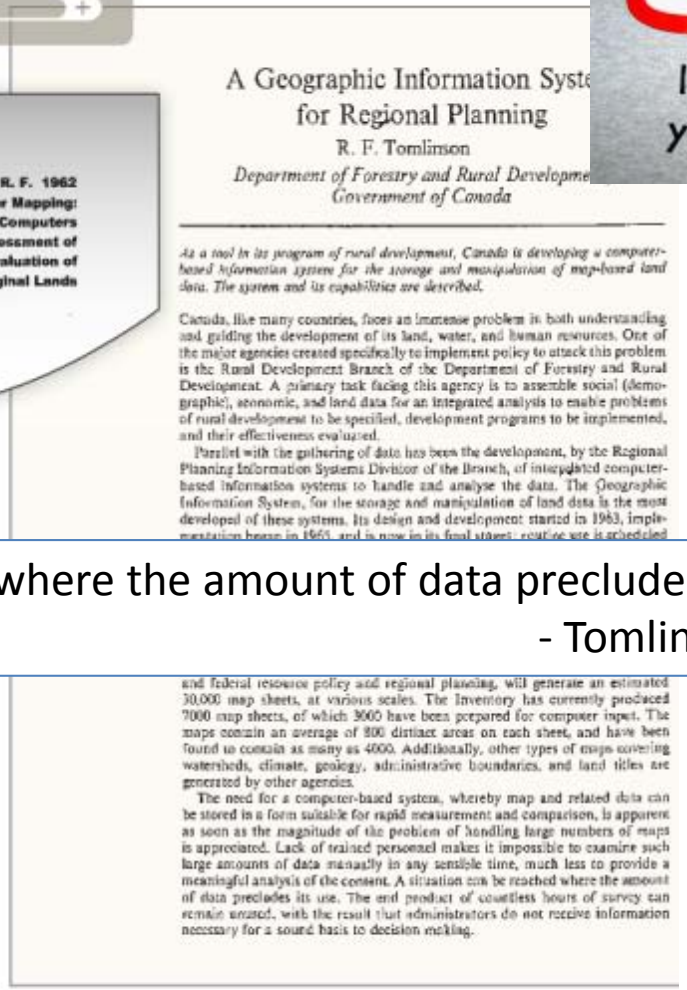


Tomlinson, R. F. 1962
Computer Mapping:
An Introduction to the Use of Electronic Computers
in the Storage, Compilation and Assessment of
Natural and Economic Data for the Evaluation of
Marginal Lands

The title page of Roger Tomlinson's 1962 paper that started the work on GIS in the Government of Canada.

grant from the Ford Foundation, Fisher later founded the Laboratory for Computer Graphics at Harvard, where he oversaw an important strand of the evolution of computer mapping into GIS.

Whether we choose these milestones or others as the origins of GIS, the fact remains that GIS has come a long way, baby, in a relatively short period of time. Its impact extends far beyond the hundreds of thousands of GIS professionals at work around the world. The recent Penn State-Public Broadcasting video series *Geospatial Revolution* (geospatialrevolution.psu.edu) dramatizes the far-reaching impacts of GIS and related technologies on how we think, act, and interact. At its 50th anniversary, GIS has itself become a kind of movement and



A Geographic Information Syste
for Regional Planning
R. F. Tomlinson
Department of Forestry and Rural Developme
Government of Canada

As a tool in its program of rural development, Canada is developing a computer-based information system for the storage and manipulation of map-based land data. The system and its capabilities are described.

Canada, like many countries, faces an immense problem in both understanding and guiding the development of its land, water, and human resources. One of the major agencies created specifically to implement policy to attack this problem is the Rural Development Branch of the Department of Forestry and Rural Development. A primary task facing this agency is to assemble social (demographic), economic, and land data for an integrated analysis to enable problems of rural development to be specified, development programs to be implemented, and their effectiveness evaluated.

Parallel with the gathering of data has been the development, by the Regional Planning Information Systems Division of the Branch, of interpolated computer-based information systems to handle and analyse the data. The Geographic Information System, for the storage and manipulation of land data is the most developed of these systems. Its design and development started in 1963, implementation began in 1965, and is now in its final stages; routine use is scheduled

and federal resource policy and regional planning, will generate an estimated 30,000 map sheets, at various scales. The Inventory has currently produced 7000 map sheets, of which 3000 have been prepared for computer input. The maps contain an average of 800 distinct areas on each sheet, and have been found to contain as many as 4000. Additionally, other types of maps covering watersheds, climate, geology, administrative boundaries, and land titles are generated by other agencies.

The need for a computer-based system, whereby map and related data can be stored in a form suitable for rapid measurement and comparison, is apparent as soon as the magnitude of the problem of handling large numbers of maps is appreciated. Lack of trained personnel makes it impossible to examine such large amounts of data manually in any sensible time, much less to provide a meaningful analysis of the content. A situation can be reached where the amount of data precludes its use. The end product of countless hours of survey can remain unused, with the result that administrators do not receive information necessary for a sound basis to decision making.

The first known published use of the term Geographic Inform August 1968.

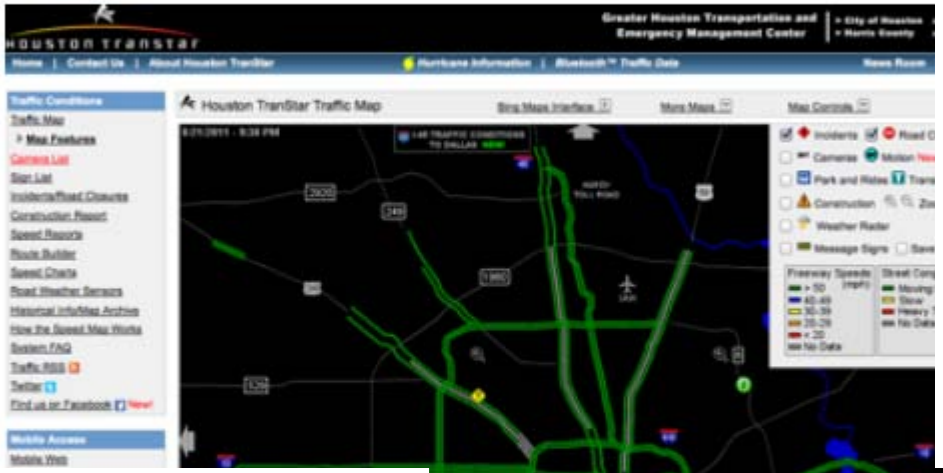
For more information, contact David DiBiase. Tomlinson, Roger. 1998

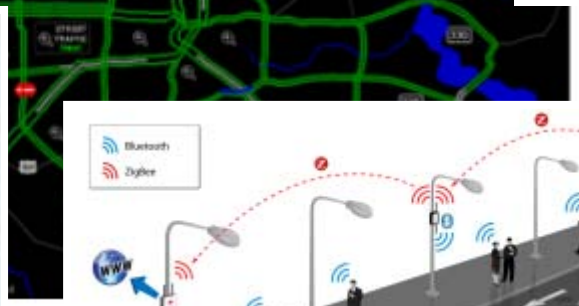
"A situation can be reached where the amount of data precludes its use."
- Tomlinson, 1962

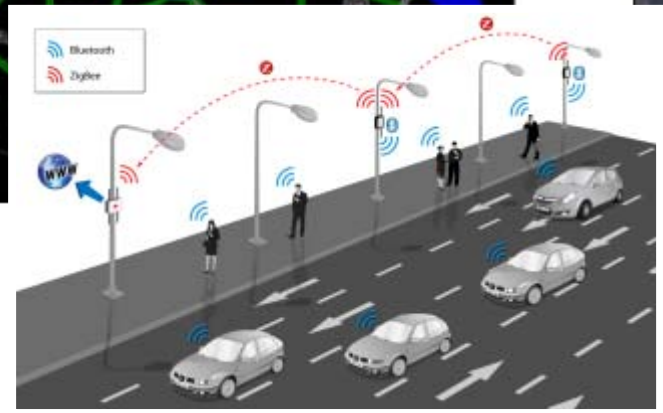
Big data: Sensors

TranStar Traffic Uses Bluetooth for Real-Time Monitoring

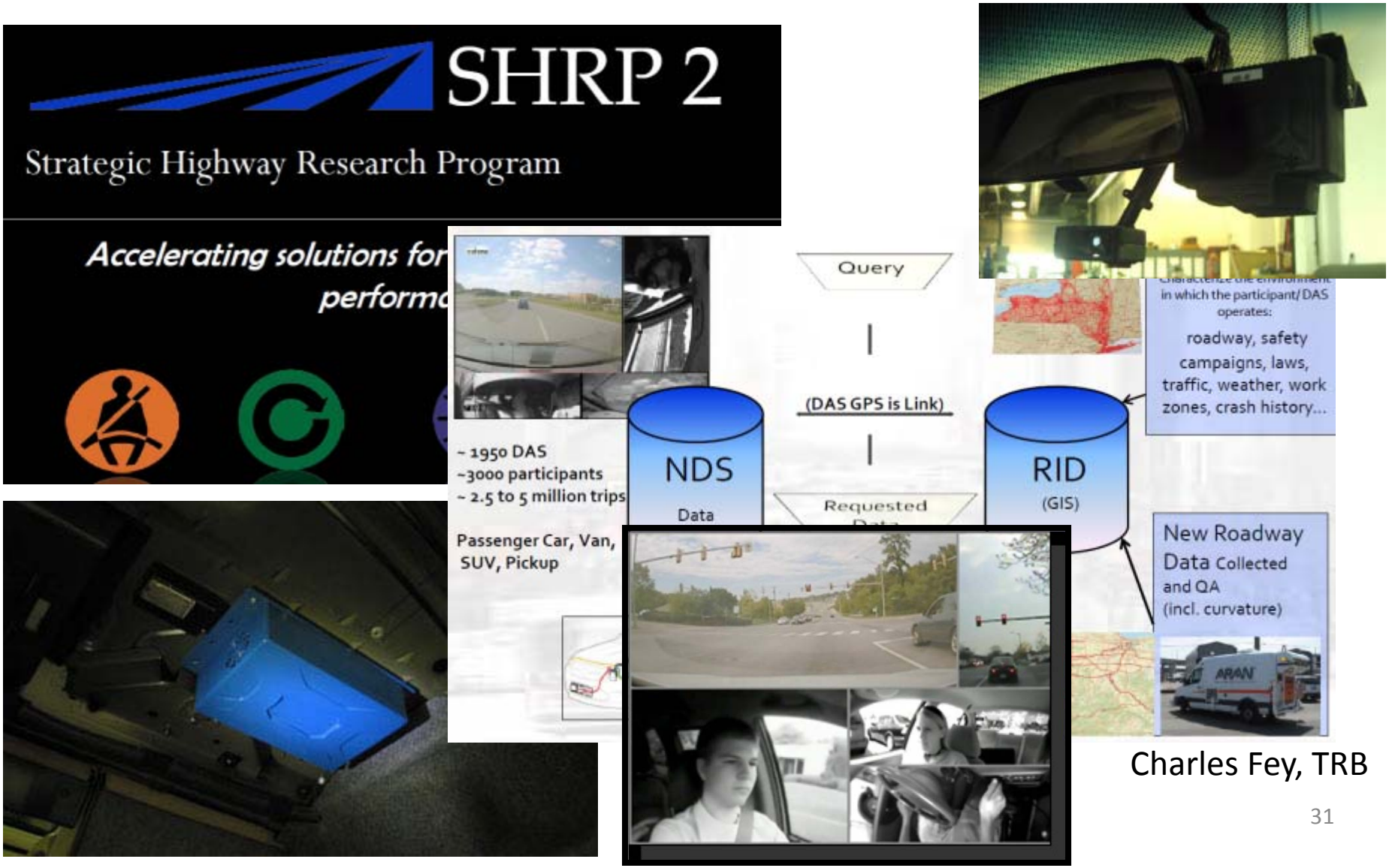
by MATT BALL *on* AUGUST 22, 2011



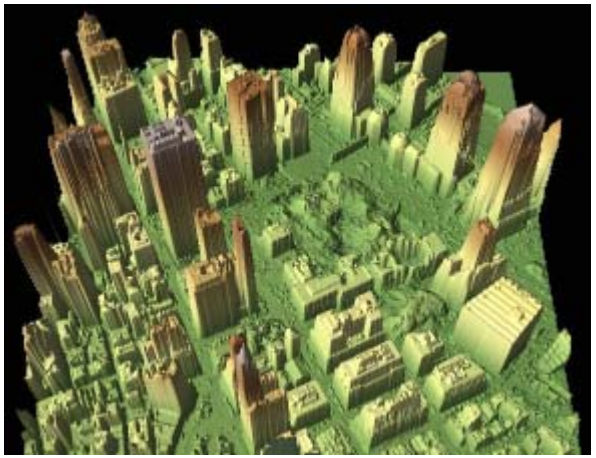




Big Data: SHRP2



Charles Fey, TRB



Big Data: Scanners

28 December 2011 Last updated at 23:56 ET

Share

Motorway crash closures to be cut by 3D laser scanners

New technology is to be employed to cut down the time that motorways are closed after crashes, the government says.

A £2.7m deal will allow 27 police forces across England to get 3D laser scanning technology.

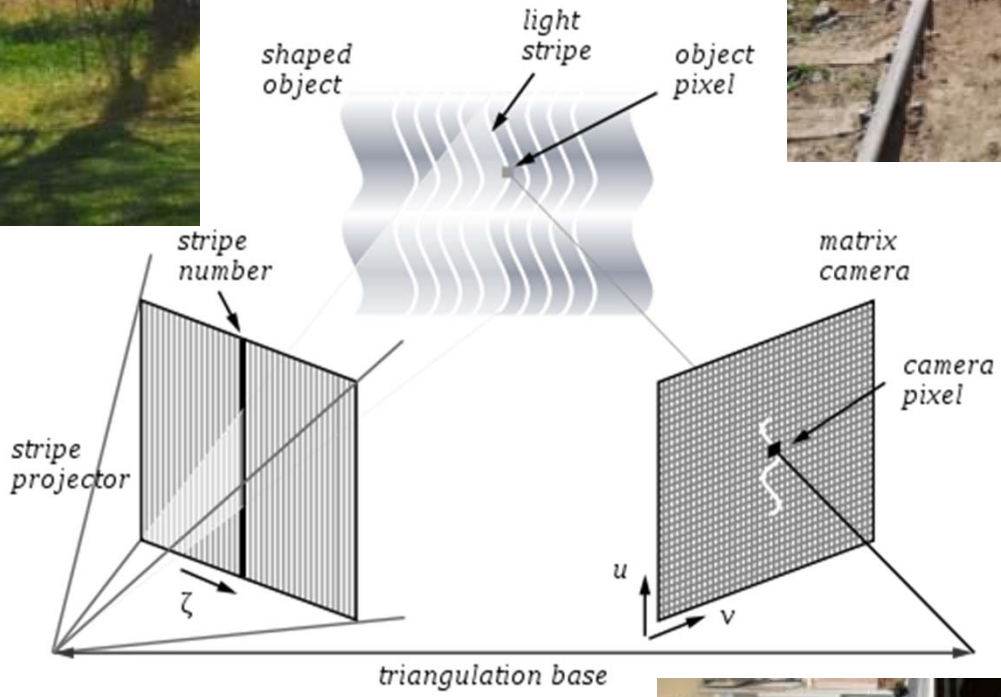
This quickly makes a 3D image of the crash site, instead of investigators surveying multiple sections of a scene.

Roads Minister Mike Penning said the technology will benefit drivers "by reducing incident clear up times by 39 minutes on average".

There were more than 18,000 full or partial motorway closures in 2010

Related Stories

ROUGH
CROSSING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matrix camera
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wikipedia

L&N Magazine

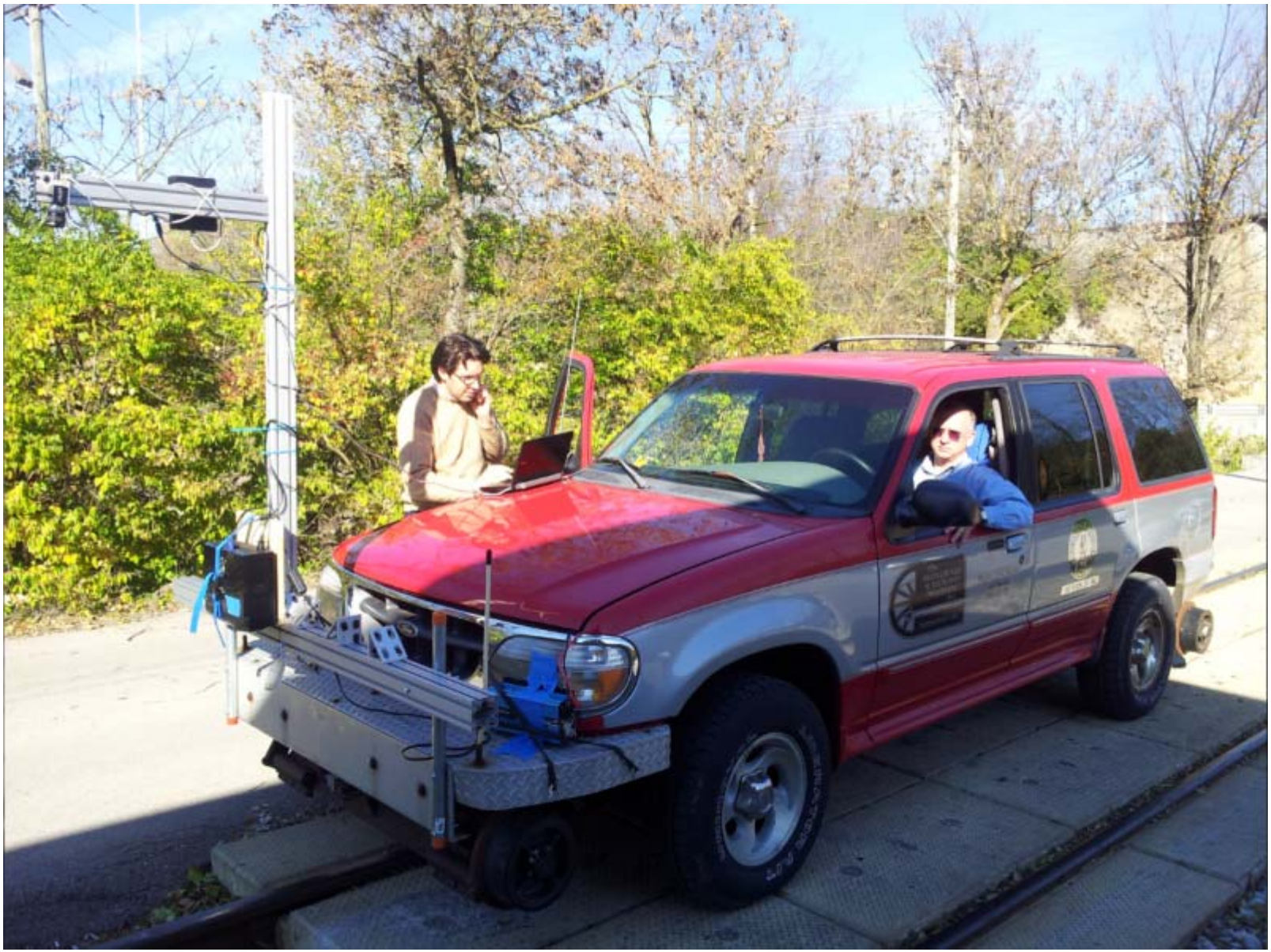
Portion of First Railway in West Is Kept on University Grounds

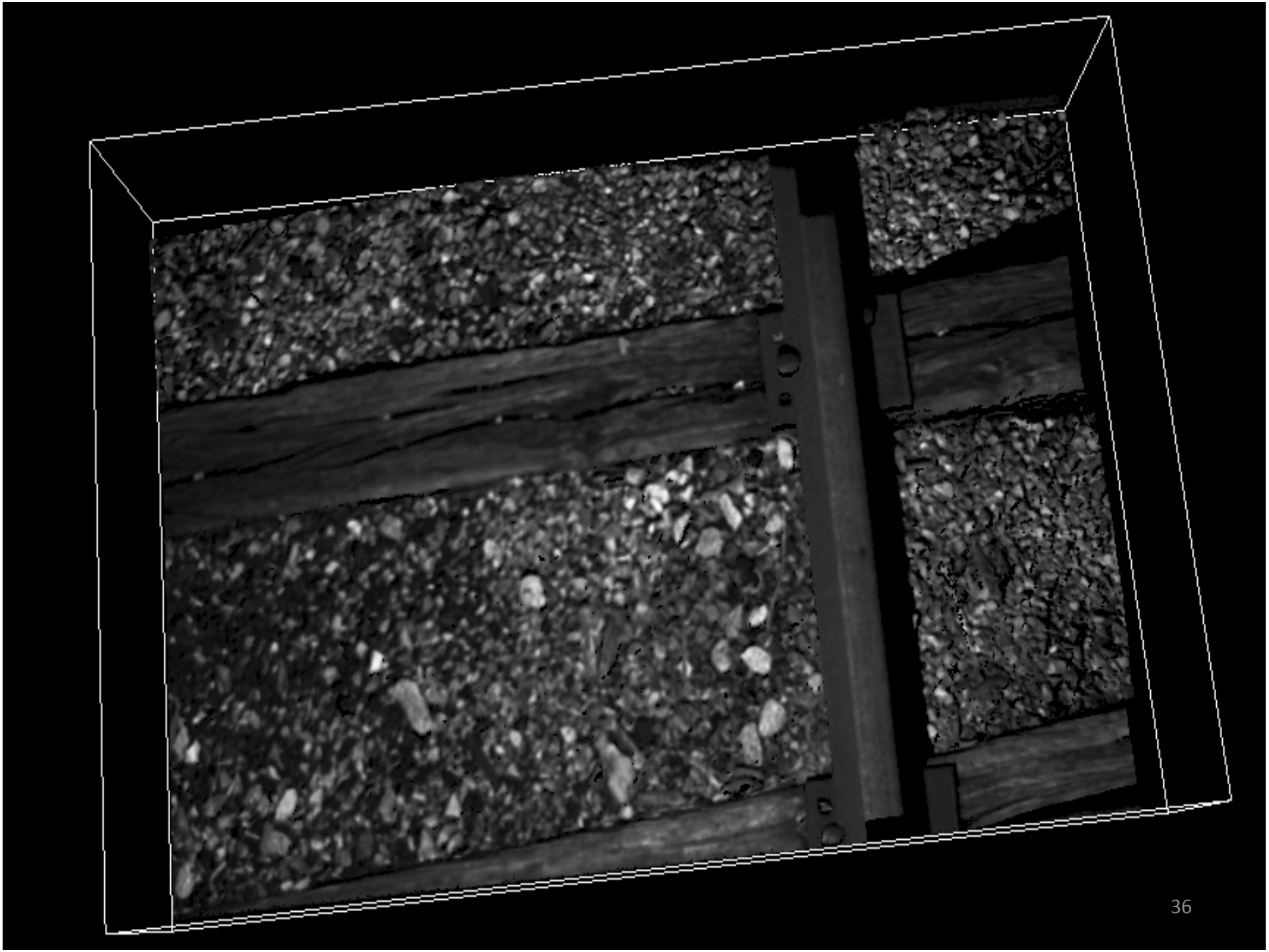
Tracks of Old Lexington and Ohio Railroad Are Embedded in Concrete on Lawn in Front of Mechanical Hall; Dedication of Historical Monument Was Held on May 30, 1916

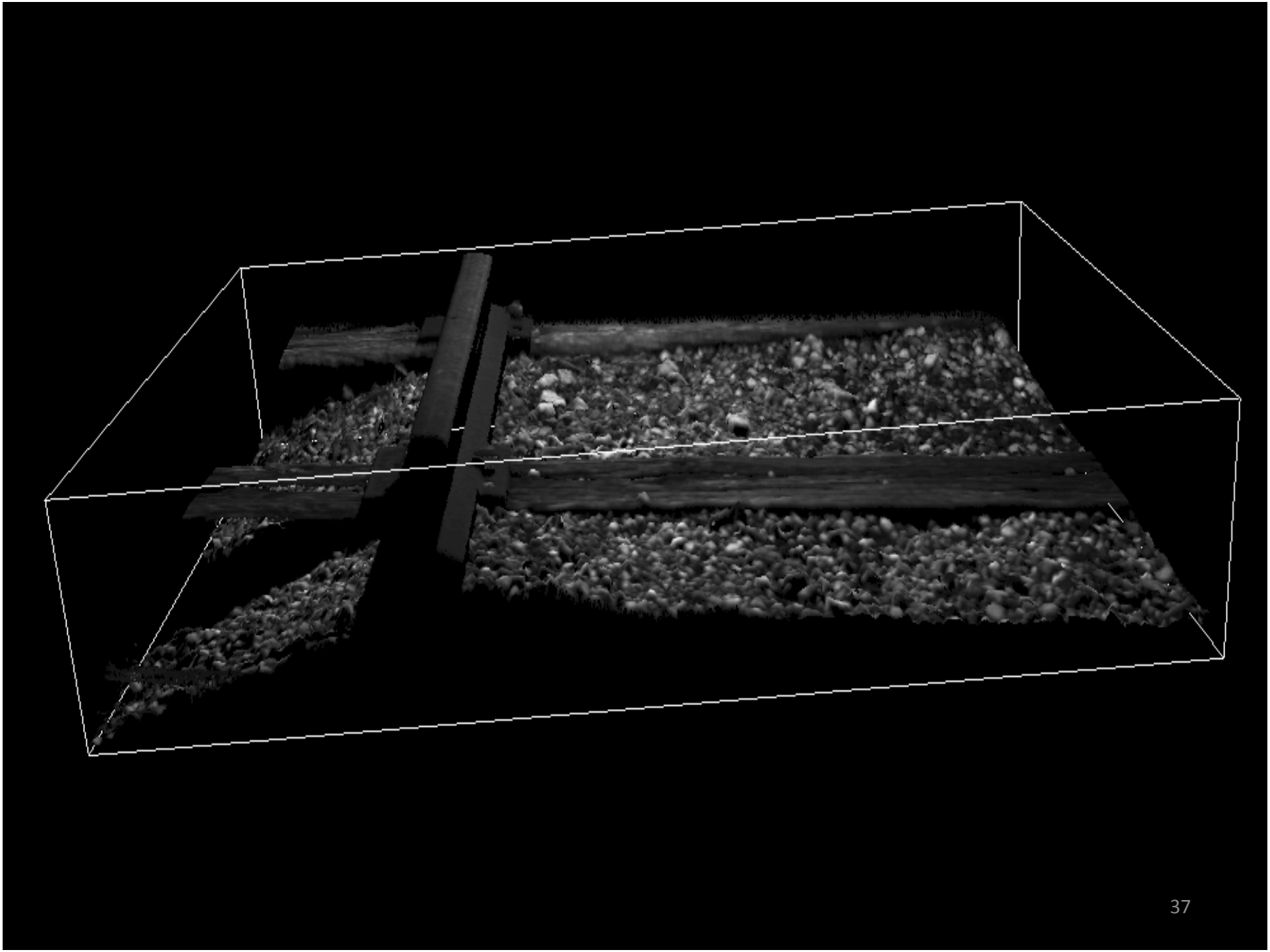
Unknown to a large number of students of the summer session there is on the university campus a portion of

year a group of citizens set to work to obtain a charter from the legislature for a railroad from Lexington

ling the restoration of a part of the original track of the Lexington & Ohio Railroad, at the University of Ke
left to right: J. G. Metcalfe (now Superintendent, Ky. Division); W. H. Anderson (superintendent of Ky.
ased); F. B. Carr, general agent, Lexington; J. H. Kastle, Lexington; F. L. Salisbury, Lexington; Judg
rtis Dougherty, Lexington; Dean Paul Anderson, Lexington; H. S. Barker, Lexington; J. P. Nelson, Le
gton; G. H. Campbell, Baltimore, Md., (B. & O. R. R.); Wm. Gibson, Pittsburg, Pa., (Penna. R. R.); I
trainmaster on E. K. Division); D. F. Crawford, Pittsburg, Pa., (Penna. R. R.); Col. W. H. Polk, Lexin
ngton.

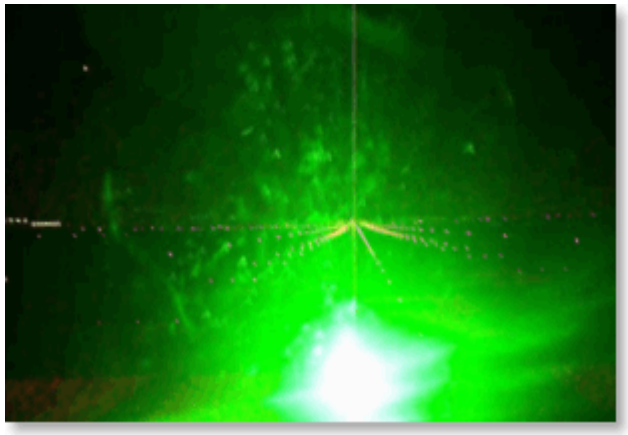






1831 to 2012

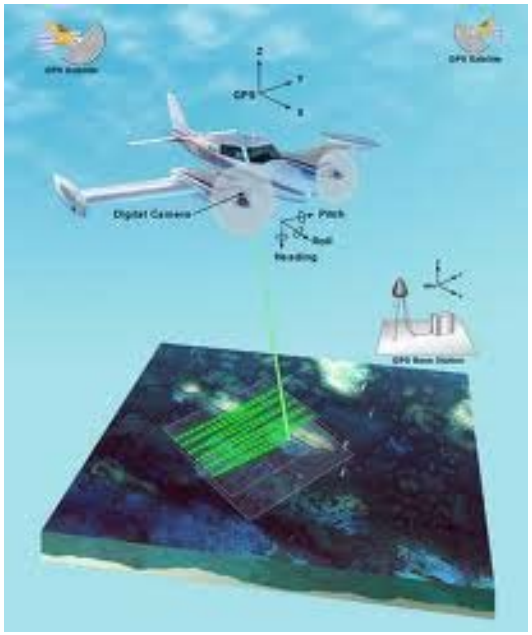
Sometimes, the cure is worse that the disease …



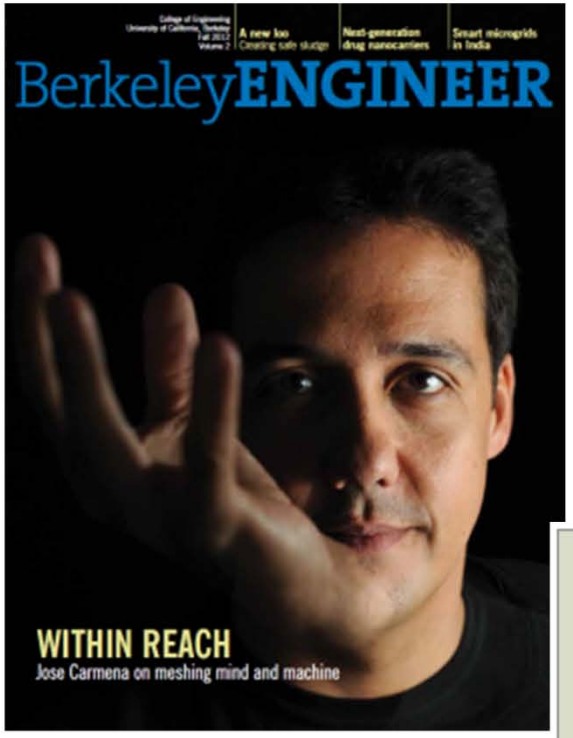
NGAC Meeting Addresses Transportation and Laser Regulation

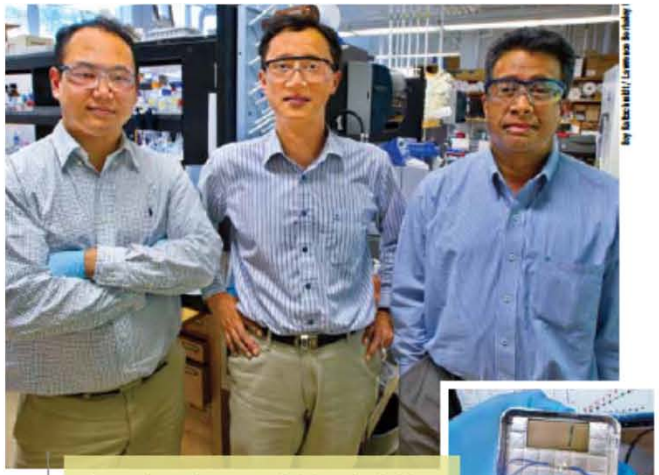
by MATT BALL *on* JUNE 20, 2011

The National Geospatial Advisory Committee (NGAC) met June 8-9, in Washington, D.C. On the agenda were discussions on transportation for the nation, Census address and road features and parcels, and parcel data on tribal lands. There was also concern about the impact on lidar mapping technologies from new Federal Aviation Administration regulations that ban the pointing of lasers at aircraft.



Challenges, or Opportunities?





A generator that uses viruses to turn mechanical energy into electricity, right, was developed by Berkeley researchers **Byung Yang Lee**, **Seung-Wuk Lee** and **Ramamoorthy Ramesh**, above.

ENERGY

Electricity goes viral

What if you could create electrical energy with the tap of a finger? Scientists at Lawrence Berkeley National Laboratory have discovered a novel way to do just that.

Bioengineering professor **Seung-Wuk Lee**, materials science professor **Ramamoorthy Ramesh** and researcher **Byung Yang Lee** have developed a generator that uses genetically engineered viruses to convert mechanical energy into electricity. When a finger taps a small electrode coated with the viruses—which are harmless to people—the viruses transform that pressure into current.

Their generator makes enough power to run a small liquid-crystal display and is the first to utilize the piezoelectric properties of a biological material to produce electricity. The researchers hope this development will eventually lead to microelectronic devices that capture electrical energy from the movements of everyday activities, such as walking, climbing stairs or shutting a door.

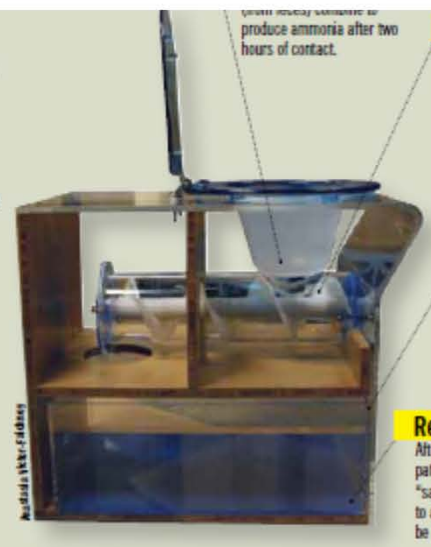
PUBLIC HEALTH

A new loo

Aiming to improve sanitation services in developing countries, the Bill and Melinda Gates Foundation challenged engineers to make toilets clean, affordable and sustainable for the 2.5 billion people—40 percent of the world's population—who lack access to modern latrines. In response, environmental postdoctoral ed a toilet

s a two- creta to ting waste, without endangering humans or the environment. Their goal is for each toilet to cost less than $50.

Over the next year, the researchers plan to refine their design, test it under actual use conditions and investigate ways to incorporate their solution into existing waste management systems. The display model, shown here, was designed to be transparent to show the toilet's inner components.



produce ammonia after two hours of contact.

Mixture
The hand-cranked auger mixes the urine and feces, then moves the excreta down the cylinder, which provides the necessary two-hour storage period to create ammonia. When the waste reaches the end of the cylinder, it moves into the collection bin.

Collection bin
The 10-gallon collection bin contains a lime solution that will raise the pH of the waste mixture to 12, converting the ammonia to a disinfectant.

Removal
After a week of storage in the bin, pathogens are disinfected. The "safe sludge" is ready to be taken to a processing facility, possibly to be converted to fertilizer or fuel.

Thank you

Accomplishments

- Technology
- Applications
- Innovation

Challenges

- Making sense of big data
- Supporting decisions
- Privacy
- Finance data programs
- Coordination

NATIONAL TRANSPORTATION SAFETY BOARD

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

UK

RITA Research and Innovative Technology Administration

Geospatial Coordination at USDOT and Transportation for the Nation (TFTN)

Steve Lewis
Geospatial Information Officer, USDOT
Director, Office of Geospatial Information Systems, USDOT/RITA/BTS
December 4, 2012

Topics

- USDOT Organizational Structure
- USDOT Geospatial Programs
- Geospatial Coordination
- Transportation for the Nation (TFTN)
- Moving Ahead for Progress in the 21st Century (MAP-21)

USDOT Organizational Structure

- 13 “Operating Administrations”
  - Office of the Secretary Transportation
  - Office of the Inspector General
  - Federal Aviation Administration
  - Federal Highway Administration
  - Federal Railroad Administration
  - Federal Transit Administration
  - Federal Motor Carrier Safety Administration
  - Maritime Administration
  - National Highway Traffic Safety Administration
  - Pipeline and Hazardous Material Safety Administration
  - Saint Lawrence Seaway Development Corporation
  - Surface Transportation Board
  - Research and Innovative Technology Administration

USDOT Geospatial Programs

- Almost all of the Operating Administrations have geospatial programs
- Some have dedicated programs, some are “other duties as assigned”
- With the exception of the Research and Innovative Technology Administration (RITA), all are “modally biased”

Geospatial Coordination

- RITA leads the geospatial coordination efforts at USDOT
  - Geospatial Information Officer
  - Senior Agency Official for Geospatial Information
  - Designated lead for Transportation Theme of the National Spatial Data Infrastructure
    - National Transportation Atlas Databases (NTAD) product represents the Transportation Theme
  - Represents the USDOT on the Federal Geographic Data Committee and in the Office of Management and Budget's e-gov initiatives
  - Participates in meetings of the National States Geographic Information Council and the National Geospatial Advisory Committee

TFTN - Background

Influenced by several different efforts:

- In 2008, an “issues brief” by NSGIC called for the creation of TFTN
- OMB Circular A-16 identifies the USDOT as the “lead agency” for the “transportation theme” of the National Spatial Data Infrastructure (NSDI).
- Emerging USDOT data requirements for geospatial data for all roads, such as accident reporting for enhanced safety and bridge inventory.
- Aligned with several initiatives such the emerging federal Geospatial Platform concept. - one element of the “geospatial portfolio”

TFTN Concept

"Creation and maintenance of high-quality, nationwide transportation data that is in the public domain"

- An initial focus on street centerlines, but eventually multi-modal
- Nationwide data spanning all states and territories
- All roads, not just Federally funded roads
- Provides a common geometric baseline
  - Road naming
  - Persistent segment ID numbering
  - Advanced functionality is built on top of baseline

TFTN Strategic Planning Effort – What We Did

- Identified and engaged stakeholders
- Defined requirements, challenges and opportunities
- Documented progress already made
  - Existing Datasets
  - Best Practices
  - New Ideas
- Explored implementation issues
- Evaluated funding sources

Stakeholder Outreach
Interviews

- Safety
- FHWA Highway Performance Management System
- Intelligent Transportation Systems
- Asset Management

Stakeholder Outreach
Presentations & Workshops

Transportation Research Board
89th Annual Meeting
January 10-14, 2010
Washington, D.C.

2010 GIS-T
Mountains of Opportunity

NSGIC 2010 Midyear Conference

"A Collaborative Heading"

March 7-10, 2010
Loews Annapolis Hotel
Annapolis, MD

ESRI International
User Conference
Join us July 12–16, 2010 at the
San Diego Convention Center

2010
ESRI FedUC

Transportation Research Board
90th Annual Meeting
January 23–27, 2011 • Washington, D.C.

GIS-Pro 2010
URISA's 48th Annual Conference for GIS Professionals

NSGIC

Baseline Geometry with "Special Sauce"

- The specifics of what's included in "baseline geometry" requires further definition
- Initial, minimal components might be:
  - Road naming
  - Basic attributes (e.g. functional classification)
  - Persistent segment ID numbering
- Seeking additional ideas and input from stakeholders on what's feasible
- "Special sauce" can be content and/or capabilities

Variety of stakeholders adds their own "special sauce" on top

- **Private Sector:** full routability and immersive imagery
- **US Census:** Polygon topology for census geographic units
- **USGS:** Enhanced cartographic display and labeling
- **State DOTs:** advanced attributes
- **State DOTs:** Linear Referencing System (LRS)
- **State E911:** Addresses
- **TFTN: Common baseline foundation of geometry, basic attributes**

The Model for TFTN - HPMS

- Federal Highway Administration (FHWA) reporting requirements for the Highway Performance Monitoring System (HPMS) included the submission of a geospatial network of all **Federal-aid roads** by each State DOT
- Reporting requirements for the HPMS could be expanded to require all roads
  - Detailed HPMS attributes would continue to be provided for only Federal-aid roads
  - Annual nature of HPMS reporting provides a data update mechanism
  - USDOT will work with states to develop basic standards
  - Reporting requirement would enable states to utilize FHWA funding for creation and maintenance of inventory

Obstacles Associated With This Model

- FHWA needed to change the HPMS Reporting Requirements to include all roads in the geospatial submission
- States are not required to work with neighbors for connectivity
- No USDOT resources currently available for aggregation, assembly and publication of a nationwide data set
- The level of quality/accuracy varies from State to State
- Although there is general agreement that the state DOTs are the authoritative source for street centerlines for their respective jurisdictions, there is very little independent verification of their accuracy

Case Studies – “Mini TFTNs”

1. **OH**: Example of state activating counties
2. **NY**: Example of state-private sector partnership for centerlines
3. **MI**: Example of a state GIS office assisting a state DOT
4. **KY**: Statewide, multi-purpose centerline used for HPMS, E-911, etc.
5. **VA Counties**: Example of multiple counties collaborating for centerlines
6. **WA Pooled Funds Study**: Example of a multi-state, regional data collection and integration effort
7. **I-95 Corridor Study**: Example of multi-state data integration and update challenges

NGAC Endorsement

- TFTN Strategic Plan was presented to NGAC on June 8, 2011
- On June 9, 2011, NGAC passed the following recommendation: ***The NGAC commends the U.S. Department of Transportation (USDOT) for developing the new Transportation for the Nation (TFTN) Strategic Plan through the engagement of the stakeholder community. The NGAC encourages USDOT to develop a business plan as the next step in the development of TFTN.***

Will the Business Plan Happen?

- RITA lacks the funding for a Business Plan
- FHWA has the funding
  - They fully support TFTN and the recommendations from the Strategic Plan
  - They believe that a Business Plan is NOT necessary
- Do TFTN stakeholders believe a Business Plan is necessary?
- If so, what can the stakeholders to express their concerns and communicate their support of the Business Plan?

TFTN Without A Business Plan: The Good

- FHWA believes they are already making progress
  - For the 2010 HPMS submittal, networks received from all but one State DOT
  - 20 State DOTs provided networks for ALL roads
  - Several State DOTs provided dual-carriageway networks
- A search through regulations reveals several avenues to require State DOTs to provide complete networks to support the Safety and Certified Public Mileage programs.
- FHWA is working on submittal guidance that will require State DOTs to submit all roads and dual carriageways starting with the 2013 submittal.
- FHWA has promised to keep the stakeholders involved.

Moving Ahead for Progress in the 21st Century (MAP-21)

- Signed into law by President Obama on July 6, 2012
- Funds surface transportation programs at over $105 billion for fiscal years 2013 and 2014
- Includes funding of $4.8 billion for a Highway Safety Improvement Program (HSIP)
  - Requires the development of a “basemap” of all roads onto which safety attributes can be attached
  - HSIP funds can be used by State DOTs to develop the basemap

MAP-21 and TFTN

- FHWA has embraced the recommendations of the TFTN Strategic Plan and will develop the “basemap” using HPMS networks
  - A memo was issued to each State DOT requiring that they provide a complete road network as part of the annual HPMS submittal
  - Will include both paved and unpaved roads and dual carriageway representation where appropriate
  - In addition to HSIP funds, FHWA waived the match requirement for using State Planning and Research Funds
  - A plan of action is required from each State DOT by June 2013
  - Complete networks required by June 2014

What’s Next

- FGDC Transportation Subcommittee will be looking at best ways to expand TFTN to other modes of transportation.

Questions/Comments?

Steve Lewis

(202) 366-9223

steve.lewis@dot.gov

Panel #2: Multi-modal GIS Data and Technology Panel

Objective: This panel will examine the diverse needs of data for different aspects of transportation safety across all modes. It will provide an understanding of the limitations associated with these data and the importance of data standards.

Nadine Alameh, Ph.D., Open Geospatial Consortium
Geospatial Standards and Interoperability in Transportation

Michael R. Ratcliffe, U.S. Census Bureau
The Census Bureau, TIGER, and Geospatial Information: Over Two Decades of Accurate and Reliable Data for the GIS Community

George Gonzalez, Federal Aviation Administration
Air Traffic Organization

Jeffrey J. Danielson, U.S. Geological Survey
National Elevation Data for Transportation-Based Applications

Mark A. Skoog, National Aeronautics and Space Administration
Improving Collision Avoidance Systems

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Making location count.

Geospatial Standards and Interoperability in Transportation

Nadine Alameh, Ph.D.
nalameh@opengeospatial.org
Open Geospatial Consortium (OGC)
Director of Interoperability Programs

National Transportation Safety Board
Geographic Information Systems (GIS) in Transportation Safety
4-5 December 2012

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Everything we do happens somewhere, and sometime!

- Geography – the master framework for data integration
- Location is critical to the vast majority of decision support, situational awareness, modeling, and simulation systems

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http://www.webviewservice.org/

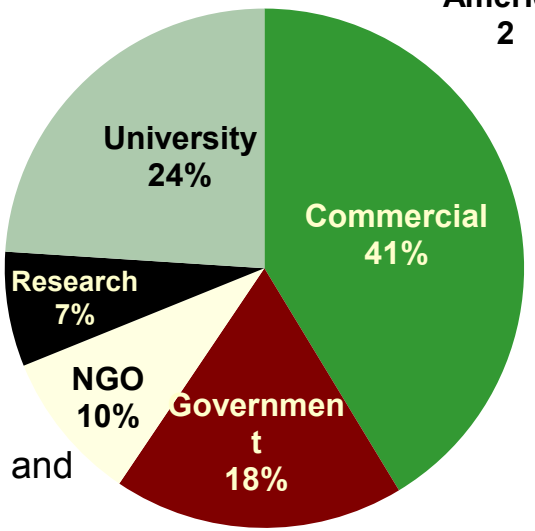
Source: http://en.wikipedia.org/wiki/File:Wikitude.jpg

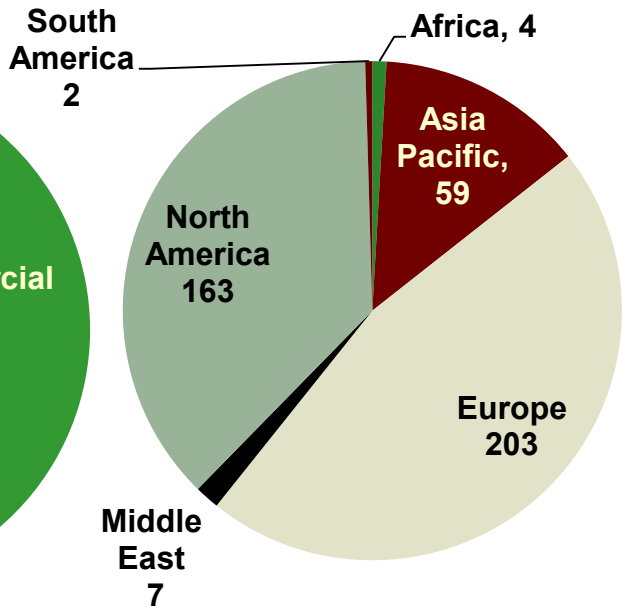
The Open Geospatial Consortium

Achieve the full societal, economic and scientific benefits of integrating location resources into commercial and institutional processes worldwide

Not-for-profit, international voluntary consensus standards organization; leading development of geospatial standards

- Founded in 1994.
- 475+ members and growing
- 38 standards
- Hundreds of product implementations
- Broad user community implementation worldwide
- Alliances and collaborative activities with ISO and many other SDO's





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DIGITALGLOBE
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Example Government Organizations

- Abu Dhabi Police
- DOD Australia
- Geoscience Australia
- NSW Dept of Environment and Climate Change (Australia)
- Eurocontrol
- European Environment Agency
- European Satellite Centre
- European Space Agency
- UK MOD
- UK MET
- METEO France
- Korea Land & Housing
- BRGM (France)
- Ordnance Survey (UK)
- State Land Agencies (Germany)
- US DHS
- US EPA
- US FAA
- US NASA
- USGS
- US NGA
- US Census
- US NOAA
- US Joint Program Executive Office
- Oakridge National Lab
- Natural Resources Canada
- NC Dept of Environment & Natural Resources
- Dept. Science & Technology (India)
- EU Joint Research Centre
- Korea Land & Housing…

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OGC Alliance Partners

A Critical Resource for Advancing Useful Standards

… and others

www.opengeospatial.org/ogc/alliancepartners

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Approved OGC® Standards

- Web Services
  - Web Map Service (WMS) **{ISO}**
  - Web Feature Service (WFS) **{ISO}**
  - Web Coverage Service (WCS)
  - Catalog Services for the Web (CS/W)
  - Coordinate Transformation
- XML Encodings
  - Geography Markup Language (GML) **{ISO}**
  - KML
  - Web Map Context
- Sensor Web Enablement
  - SensorML
  - PUCK
  - Sensor Observation Service (SOS)
  - Sensor Planning Service (SPS)
  - Sensor Web Enablement Service Model
- Open Location Services (OpenLS)
- Tightly coupled
  - Simple Feature Access – OLE, SQL, CORBA **{ISO}**
  - Grid Coverages

Available free of charge at
http://opengeospatial.org/standards

Interoperability: information integration

"We don't have a common language to speak about our geospatial data or our services."

"We need to share maps on the Web, across devices or platforms."

"We need to find and pull together data from our automated sensors."

Value of open standards

"We need to deliver data to different systems."

"We have security issues relating to geospatial data exchange."

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OGC Activities Driven by Community Needs

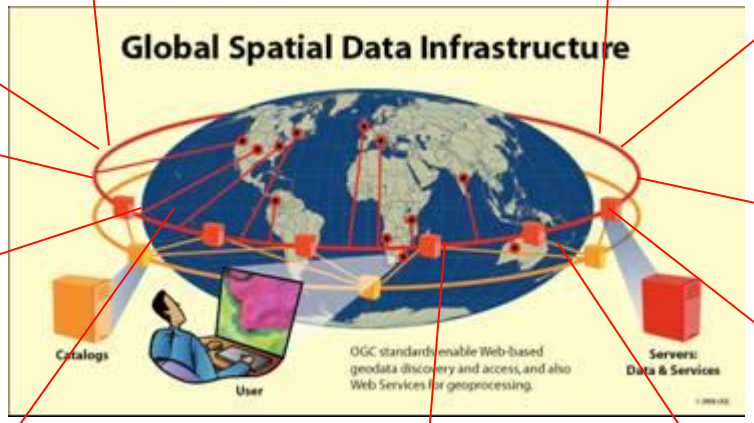
Other Standards Organizations

Education & Research

Sustainable Development

Infrastructure - Transportation

Health



E -Government

Emergency Services, Disaster Management

Aviation

Energy

Geosciences

Consumer Services, Real Time Information

OGC

Aviation Safety

- To improve air travel safety and operational efficiency, the global aviation community is moving forward on the adoption of an international framework of standards that enable communication in a net-centric, globally interoperable Air Transport System (ATS).

- Because location information is critical in virtually all aviation activities, location interface and encoding standards from the OGC play an important role.

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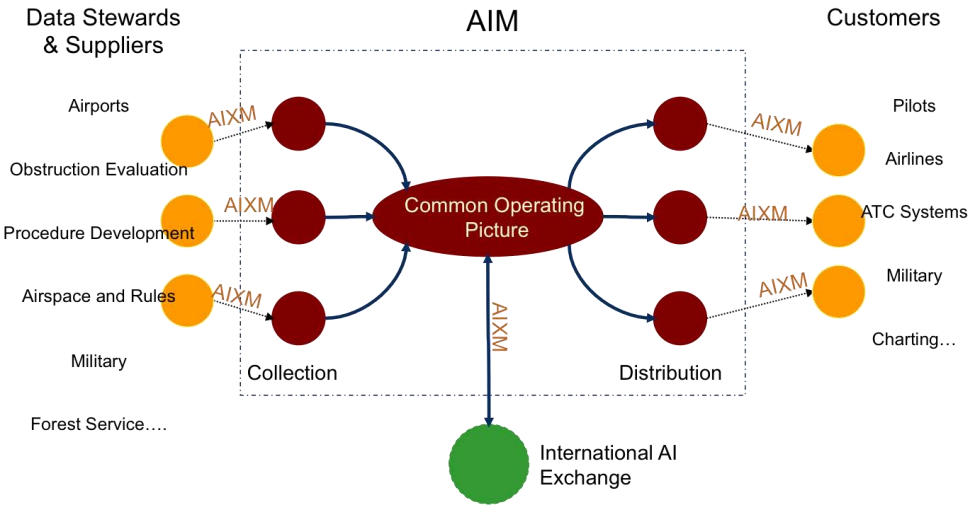
Aeronautical Information Management (AIM)

- Develop and test standards-based service-oriented architecture to support the provision of aeronautical information directly to flight decks and Electronic Flight Bags (EFB)

- Support vision for Aeronautical Information Management
  - Interconnected systems with many actors and many users
  - Need for real-time information used in flight planning, navigation, rerouting, etc
  - Right information at the right time at the right place to the right user
  - End-to-end management of information



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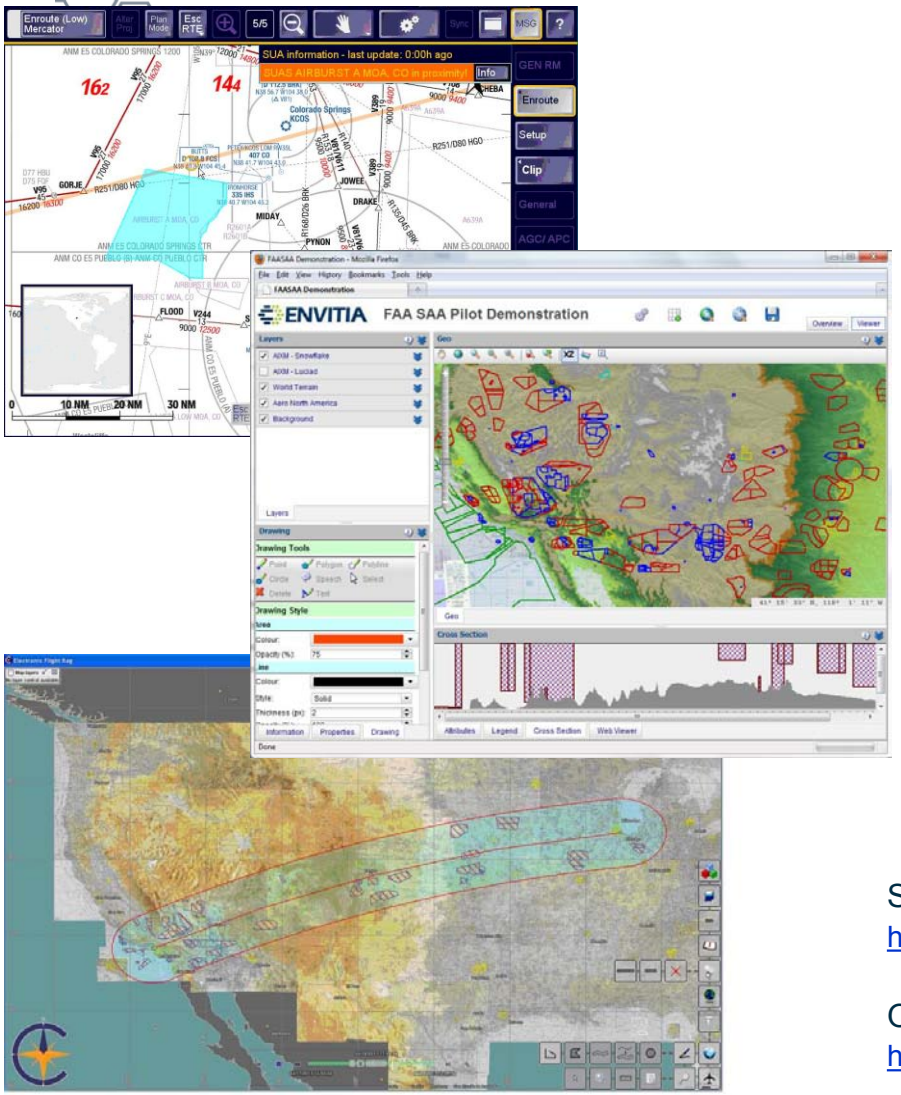
FAA Special Access Airspace (SAA) Pilot



- Provide access to SAA information to National Airspace System (NAS) Stakeholders
- Support airlines in automated flight dispatch and planning
- Increased situational awareness and flight decision support
- Geospatial and temporal data fusion for the display and use of airspace activation data

SAA Pilot Demo page
http://www.opengeospatial.org/pub/www/saa/index.html

OGC Aviation Domain Working Group
http://www.opengeospatial.org/projects/groups/aviationdwg

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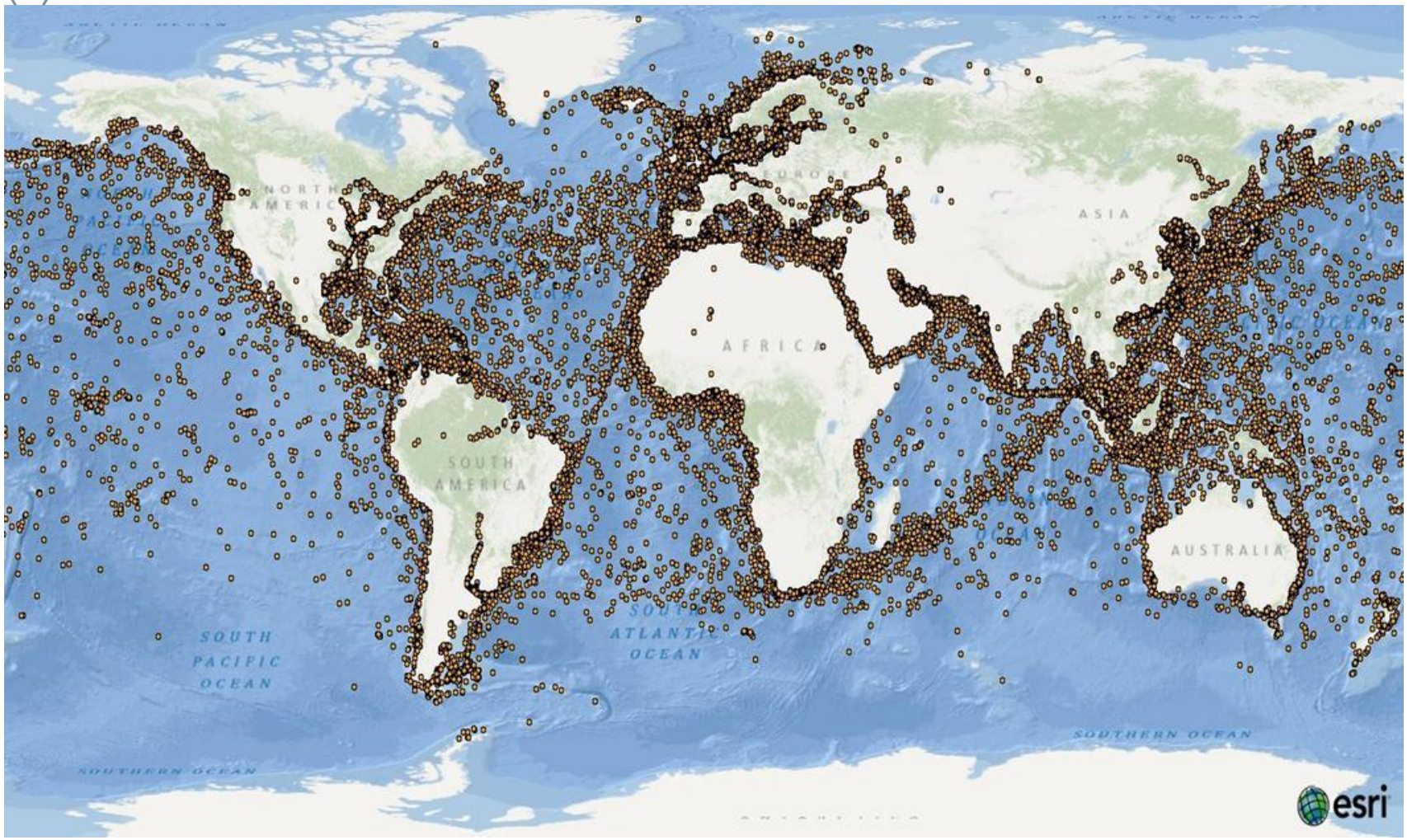
80,000 Vessels Daily – Global Capability



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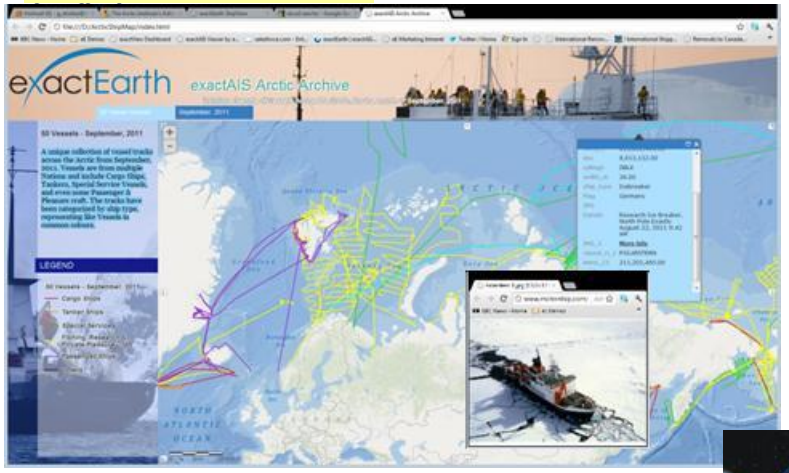
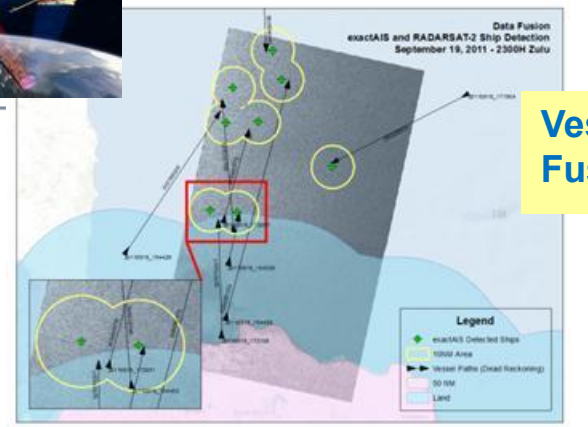
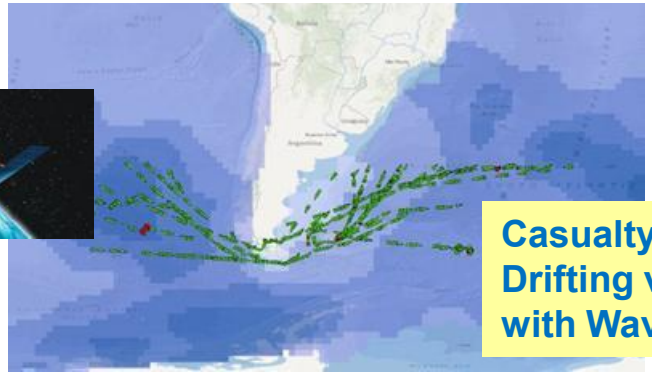
S-AIS: Sample Uses

Arctic Monitoring





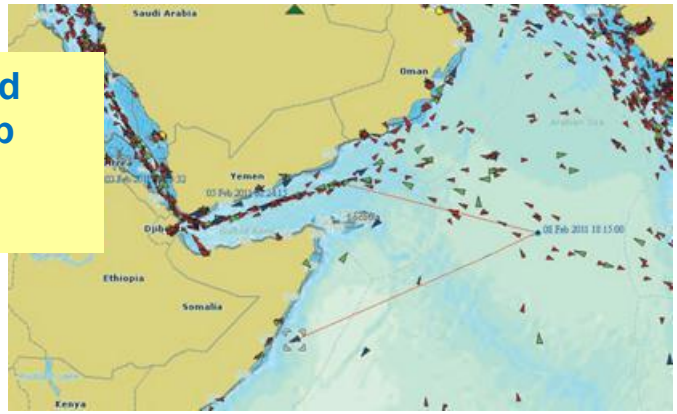
Vessel Detections: Fusion with Radar



Casualty Alerting: Drifting vessels fused with Wave Heights

Flotilla Identification: Fusion with Optical Imagery, Tripoli, Summer 2011

Piracy prevention and tracking: Mother Ship and Pirated Vessel Tracking



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Tomorrow: The Internet of things

Location apps

Sensor webs

Location marketing

Indoor/outdoor location

Building information models

Environmental monitoring

Predictive maintenance

Machine-to-machine communication

Augmented reality

Smart buildings

Smart pipes

Smart grid

Today's Internet

Conclusion

- Location is an integral part of transportation data
- Technological innovation continues to better support navigation and safety in transportation
- Standards are critical for information exchange and sharing
- OGC membership (commercial, government, academia and research) continues to push the boundaries to find effective solutions for today's and tomorrow's interoperability problems
- Standards innovation needs you! Voice your requirements and get involved http://www.opengeospatial.org

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Making location count.

Geospatial Standards and Interoperability in Transportation

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Executive Director of Interoperability Programs

National Transportation Safety Board
Geographic Information Systems (GIS) in Transportation Safety
4-5 December 2012

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The Census Bureau, TIGER, and Geospatial Information: Over Two Decades of Accurate and Reliable Data for the GIS Community

Michael Ratcliffe
Geography Division
US Census Bureau

GIS in Transportation Safety
National Transportation Safety Board
December 4, 2012

United States Census Bureau
U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU

Today's Presentation:

- Brief introduction to TIGER
- Census Bureau spatial data
  - TIGER/Line shapefiles
  - TIGERweb
- Accessing statistical data and visualizing data
- Geographic areas
  - Urban Areas
  - Places
  - Census Tracts

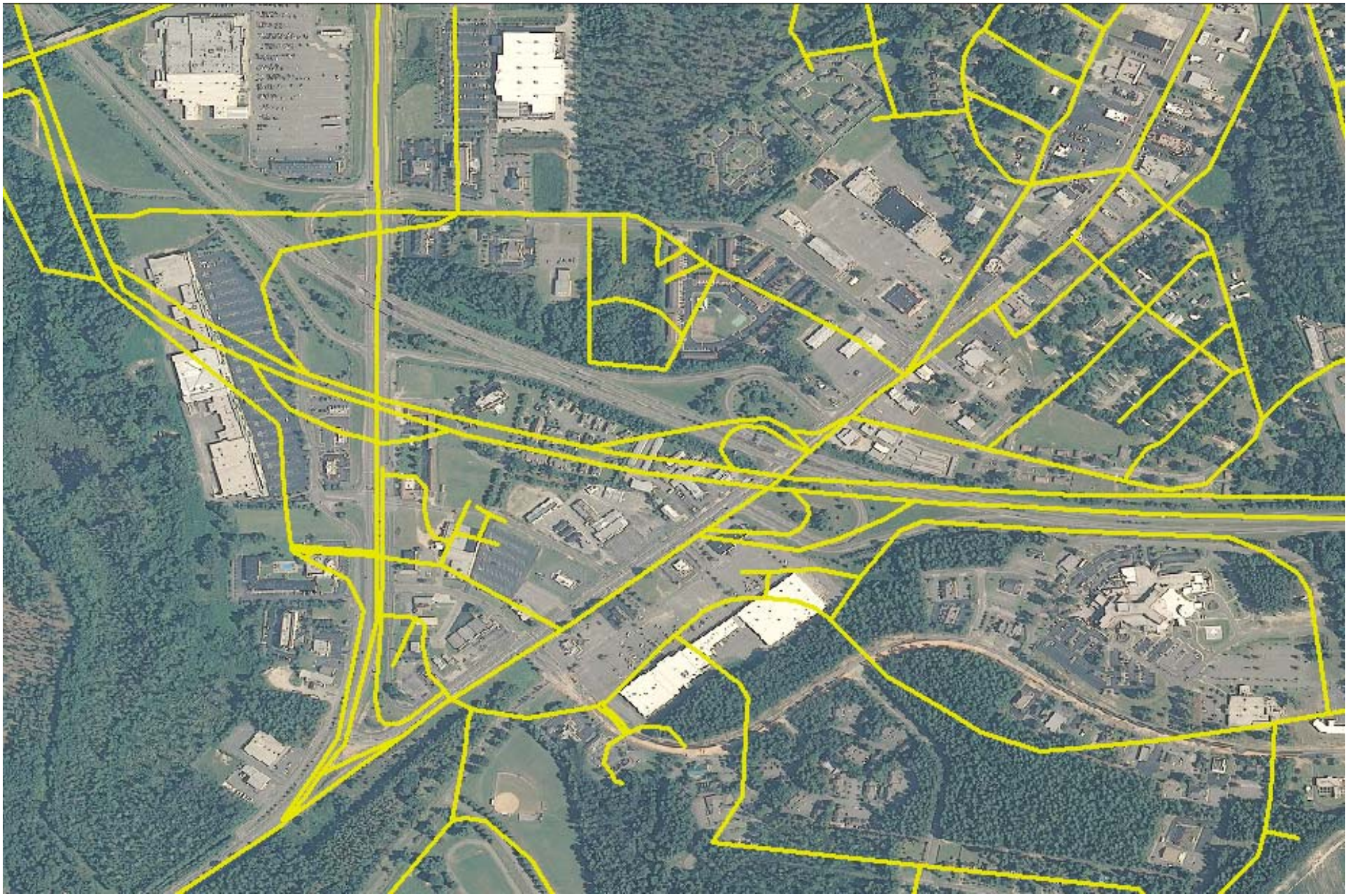
TIGER

- **T**opologically **I**ntegrated **G**eographic **E**ncoding and **R**eferencing System
  - A digital map of US, Puerto Rico, & Island Areas
  - Contains
    - Roads (Streets), Rail, Hydro
    - Geographic Entity Boundaries
    - Housing Unit Locations
    - Address Ranges and Zip codes
    - Key Geographic Locations

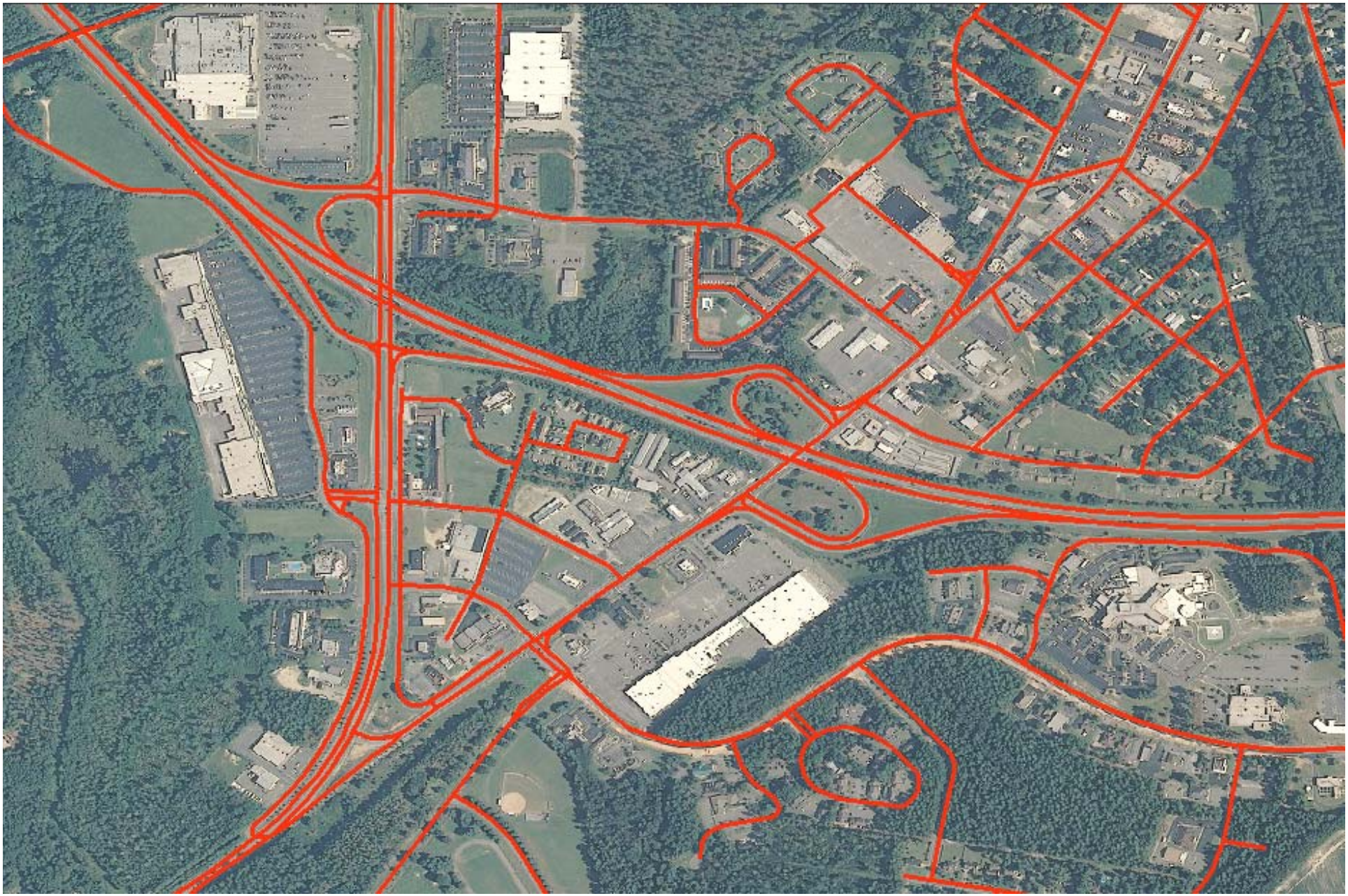
MAF/TIGER Accuracy Improvement (MTAIP)

- 2002 – 2008
- Emphasis on **positional** accuracy
- Processed at county level
- Total of 3,233 files processed

Scotland County, NC – Before MTAIP



Scotland County, NC – After MTAIP



Geography

Maps & Data

- Maps & Data Main Page

Maps

- Reference
- Thematic
- Maps Available for Purchase

Data

- TIGER Products
- Partnership Shapefiles
- Relationship Files
- Comparability Files
  - Places
  - County Subdivisions
- Gazetteer Files
- Block Assignment Files
- Name Lookup Tables
- Tallies
- LandView

TIGER Products

TIGER = Topologically Integrated Geographic Encoding and Referencing

The Census Bureau offers several file types and an application for mapping census geographic data based on data found in our MAF/TIGER database. Our products are:

- TIGER/Line Shapefiles
- TIGER/Line Shapefiles pre-joined with Demographic Data - 2010 Census selected geography
- Cartographic Boundary Files
- KML Prototype Files
- TIGERweb

Which product should I use?

Product	Best For...	File Format	Type of Data	Level of Detail	Descriptive Attributes	Vintages Available
TIGER/Line Shapefiles	Most mapping projects--this is our ***most comprehensive dataset***. Designed for use with GIS (geographic information systems).	Shapefiles (.shp) and database files (.dbf)	Boundaries, roads, address information, water features, and more	Full detail (not generalized)	Extensive	2006 - 2011
TIGER/Line Shapefiles & Geodatabases with Demographic Data	Demographic analysis from selected attributes from the 2010 Census. Designed for use with GIS.	Shapefiles (.shp) and Geodatabases	Boundaries, Population Counts, Housing Unit Counts, 2010 Census Demographic Profile 1 attributes and geography	Full detail (not generalized)	Limited	2010
Cartographic Boundary Files	Small scale (limited detail) mapping projects clipped to shoreline. Designed for thematic mapping using GIS.	Shapefiles (.shp)	Selected boundaries	Less detail (generalized)	Limited	2010, 2000, 1990
KML Prototype Files	Viewing data or creating maps using Google Earth, Google Maps, or other platforms that use KML.	KML (.kml)	Selected boundaries	Less detail (generalized)	Limited	2010
TIGERweb	Viewing maps online or streaming to your mapping application.	interactive viewer and WMS	Boundaries, roads, address information, water features, and more	Detailed and generalized	Extensive	2010

TIGER/Line Shapefiles - What

- http://www.census.gov/geo/maps-data/data/tiger-line.html
- Spatial Extracts from the Census Bureau's MAF/TIGER database
- Geographic Boundaries and Features
- 2007 version first in Shapefile format
  - Previously in TIGER/Line format
  - Change due to migration to Oracle

2010 Census TIGER/Line Shapefiles Pre-Joined with 2010 Census Demographic Profile

TIGER/Line® Shapefiles Pre-joined with Demographic Data

A limited set of TIGER/Line Shapefiles are available pre-joined with demographic data. These files were created as a proof of concept for another project and we are making them available to everyone.

We are working on an on-line tool that will allow you to access selected data from the 2010 Census and American Community Survey (ACS) for custom geographic areas (conforming to blocks for the 2010 Census and block groups or census tract boundaries for the ACS). We do not have plans to continue to create shapefiles and/or geodatabases pre-joined with demographic data as a regular product because of the large volume of data available and the many varying needs of customers. We will continue to work with our data providers to ensure there are easy links between the geographic products and the data products.

+ 2010 Census Demographic Profile 1 - Shapefile Format
+ 2010 Census Demographic Profile 1 - Geodatabase Format
+ 2010 Census Population & Housing Unit Counts - Blocks

TIGERweb http://tigerweb.geo.census.gov/tigerwebmain/tigerweb_main.html

TIGERweb Applications | WMS | REST Services | Data Files | TIGERweb Geography | Contact Us

TIGERweb Applications

Note: These links will open new browser windows.

TIGERweb

TIGERweb2010

The applications need:
- JavaScript enabled
- Allow Popups
- Microsoft Silverlight Plug-In

Click to sign up for updates on TIGERweb and other Census Bureau Topics

TIGERweb Application

The TIGERweb web-based application allows the users to visualize our TIGER(Topologically Integrated Geographic Encoding and Referencing database) data. The application allows users to select features and view their attributes, to search for features by name or geocode, and to identify features by selecting them from a map. The TIGERweb application is a simple way to view our TIGER data without having to download the data.

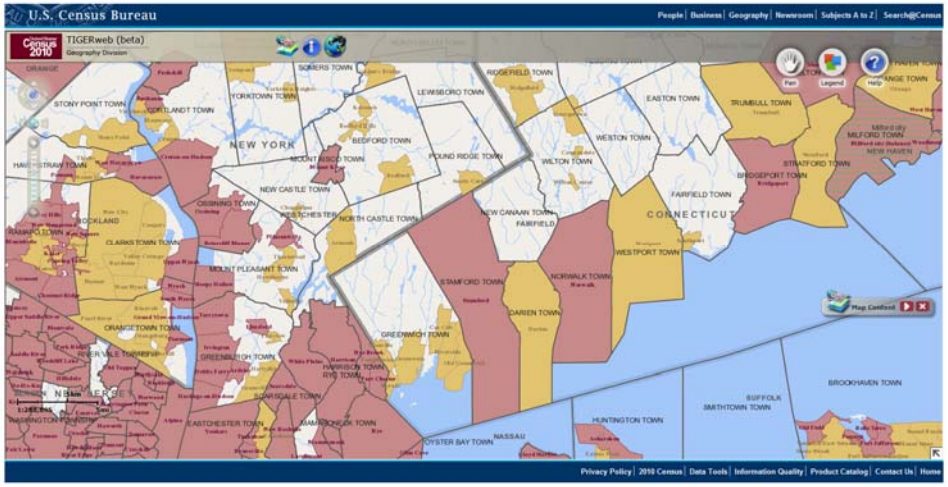
The TIGERweb application offers the ability to view:

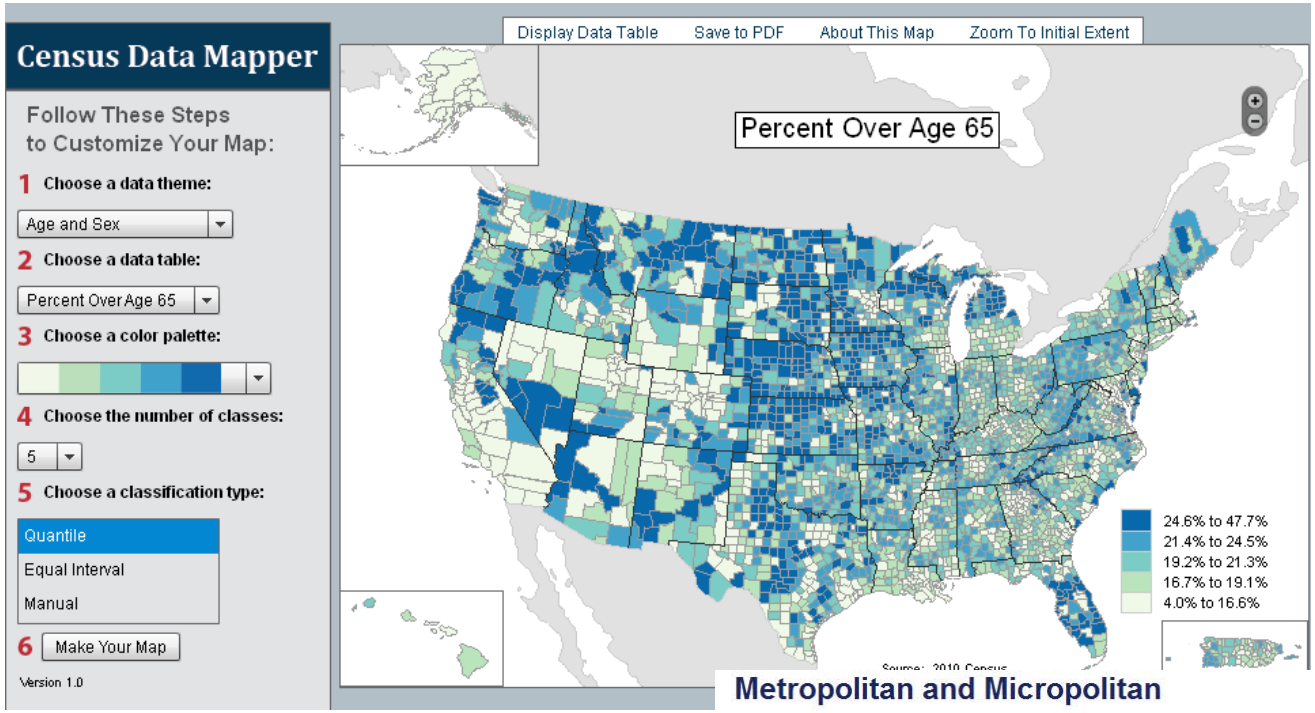
- Linear features
  - Roads, highways, streets
  - Railroads
  - Rivers, streams, and other "single-line" drainage
- Area water
  - Rivers, lakes, and glaciers
- Boundaries for legal and statistical geographic entities

Because geographic and locational context and relationships are important, the TIGERweb application determines which geographic entities and features may be visible based on map scale.

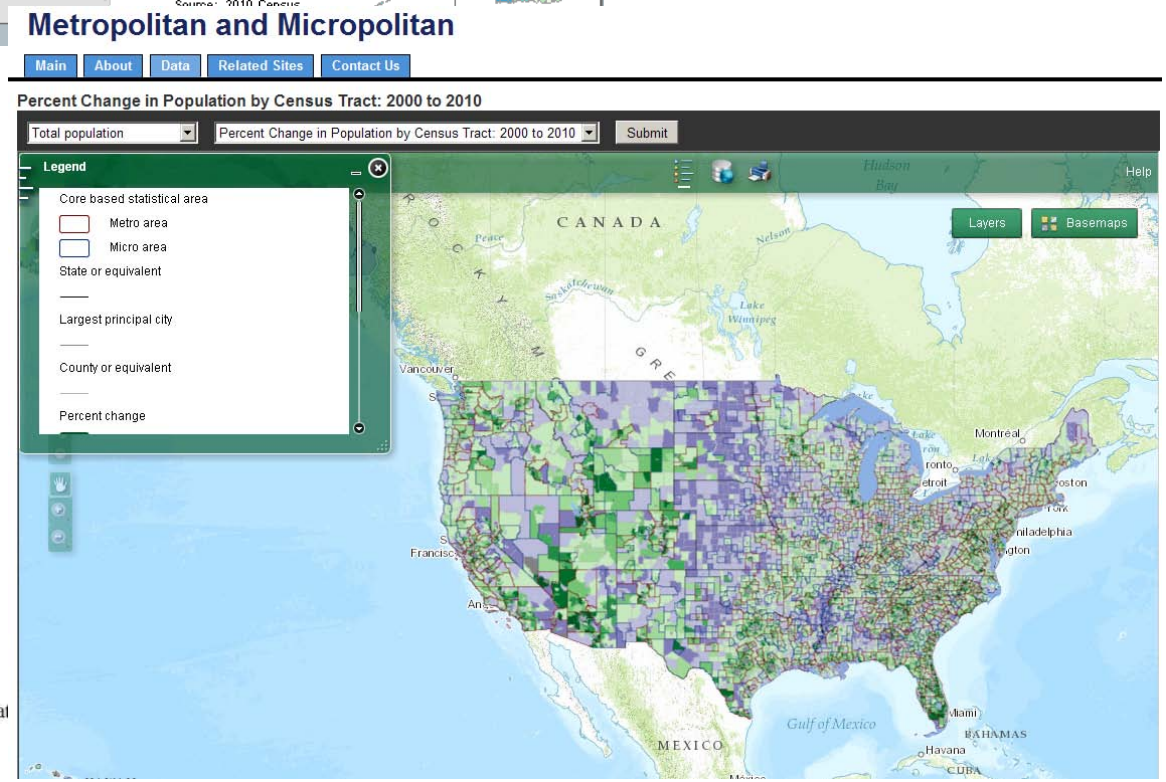
Users have the capability to turn on and off linear features and geographic entities by type. This allows users to limit the amount of data on the map by selecting only the features and entity types they would like to see.

View the following video for an introduction to the TIGERweb application:





On-Line Mapping Tools



Census Data Mapper and Metro/Micro Area Data Viewer

United States Census Bureau

U.S. Department of Commerce
Economics and Statistics Administrat
U.S. CENSUS BUREAU

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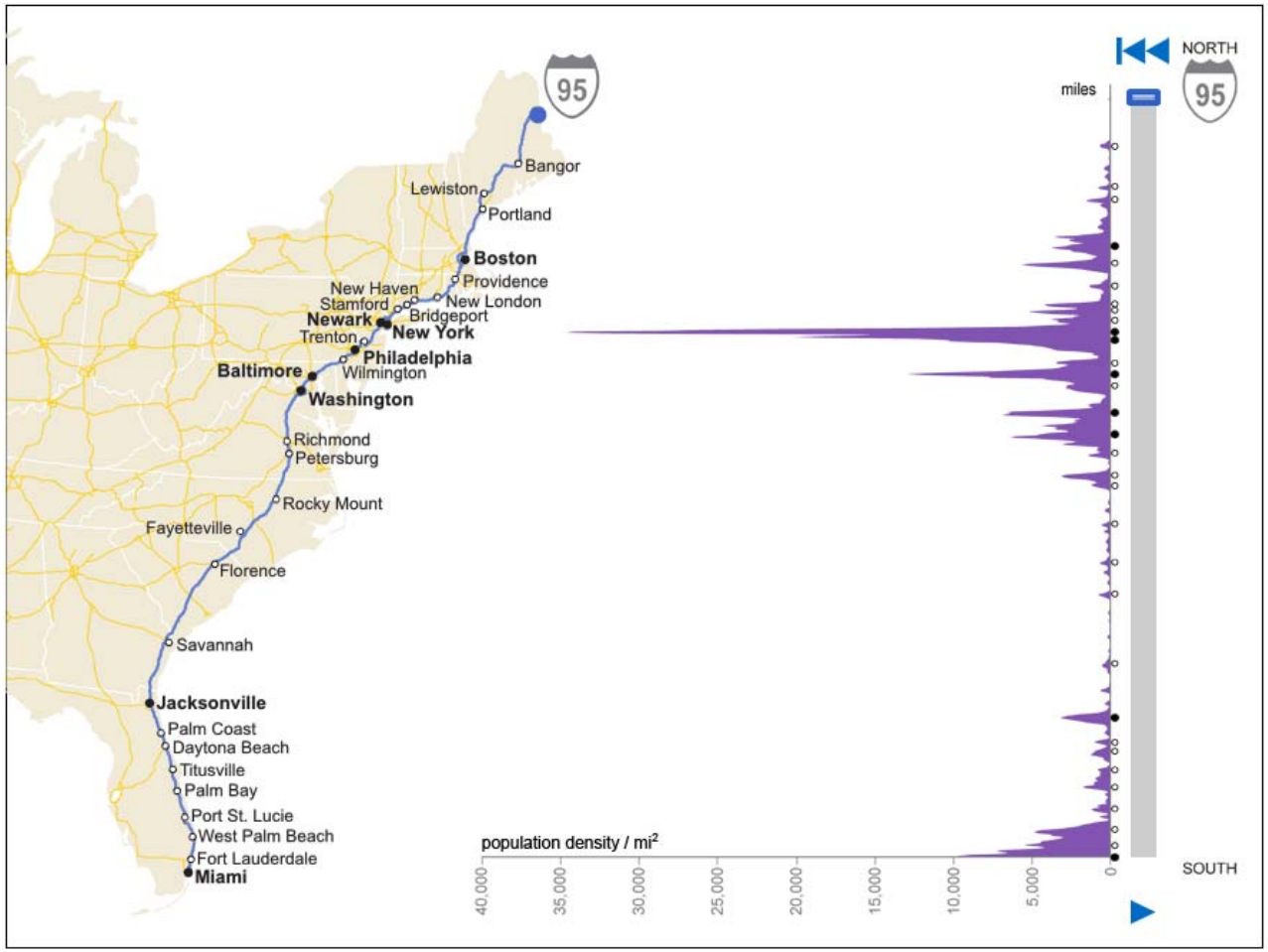
I-95 Population Density Profile, 2010

July 26, 2012



View Data Table

Running from Florida to Maine, I-95 passes through 15 states and seven major cities. I-95 serves the most densely populated region of the U.S. The Boston to Washington corridor. Peaks and valleys in population density within 5 miles of the interstate show several stretches of continuously built up

Data visualization gallery:
http://www.census.gov/dataviz/

U.S. Census Bureau

AMERICAN FactFinder

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'Your Selections' is empty

Search using the options below:

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- Geographies (states, counties, places, ...)
- Race and Ethnic Groups (race, ancestry, tribe)
- Industry Codes (NAICS industry, ...)
- EEO Occupation Codes (executives, analysts, ...)

Quick Facts

Quick, easy access to facts about people, business, and geography.

Select the U.S. or a state to begin: United States GO

Popular Searches

- Decennial Census
- Population
- Poverty
- Housing
- Income

Your source for population, housing, economic, and geographic information

Quick Start

Enter search term(s) and click 'GO'

topic or table name for state, county or place (optional) GO

topics race/ancestry industries occupations

Or use the options on the left to begin your search

News and Notes

GET EMAIL UPDATES

Nov 08, 2012

2011 Annual Survey of Manufactures (ASM) data are now available! The ASM provides sample estimates of statistics for all manufacturing establishments with one or more paid employees. Some key statistics include employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, value of shipments, value added by manufacturing, detailed capital expenditures, fuels and electric energy used, and inventories. more »

Oct 25, 2012

The 2009-2011 American Community Survey 3-year estimates are now available for cities, counties, and other geographic areas with populations of 20,000 or more. The 2009-2011 ACS 3-year data products are the first multiyear release to include the topic of Bachelor's Field of Degree. more »

Census Newsroom »

Getting Detailed Data

The following data are available on American FactFinder:

- Decennial Census
  Taken every 10 years to collect information about the people and housing of the United States
- American Community Survey
  An ongoing survey that provides data about your community every year
- Puerto Rico Community Survey
  The equivalent of the American Community Survey for Puerto Rico
- Economic Census
  Profiles the U.S. economy every 5 years

Address Search

Find Census data by entering a street address.

View the American FactFinder Data Release Schedule

Download large volume data from the Census Bureau's FTP Site

A how-to guide for Building Deep Links into American Factfinder (PDF) is available

Reference Maps

Reference Maps show selected geographic boundaries for an area along with orienting features, such as roads.

United States GO

Load Query

Use Load Query to restore a previously saved query

LOAD QUERY

Access Data with Census APIs

Main | Data Sets | Geography | App Gallery

Developer Forum

Join our Developer Forum to submit questions, provide feedback, and share ideas to help the Census Bureau as it makes data available through APIs.

Using the API

- Examples and Supported Geography [PDF]
- SF1 Examples and Supported Geography
- ACS Examples and Supported Geography
- Request a Key

Download Data

To download full data sets, visit our FTP Server

Print | Share this page | Connect with us

Census Bureau APIs

To improve access to data and encourage innovation, the Census Bureau has begun to provide API access to some data sets, beginning with the 2010 Census Summary File 1 and the 2010 American Community Survey (five year data). We invite developers to use these APIs, join our Developer Forum, and provide feedback to help us move forward with continued API development.

Please read the Terms of Service for using the API.

Note on URL base: Please note the the URL of the API has changed to api.census.gov. The former URL will remain active until August 6th. Please update your calls to reflect the new URL.

Accessing Data

Data are accessible to software developers through a stateless HTTP GET request. In order to access data, you will need to insert a key into the request URL in order for query results to be returned. If you do not have a key assigned to you, you will be directed to the Request a Key page where you can register for one.

1) Example of the request URL for 2010 Census SF1 data that has an assigned key inserted:

http://api.census.gov/data/2010/sf1?key=b48301d897146e8f8efd9bef3c6eb1fcb864cf&get=P0010001,NAME&for=state:*

2) Example of the request URL for ACS 2010 5 Year data for Total Population for California and New York:

http://api.census.gov/data/2010/acs5?key=b48301d897146e8f8efd9bef3c6eb1fcb864cf&get=B02001_001E,NAME&for=state:06,36

3) Example of the request URL for ACS 2010 5 Year data for Gross Rent as a Percentage of Household Income, 10.0 to 14.9 percent for all counties in CA:

http://api.census.gov/data/2010/acs5?key=b48301d897146e8f8efd9bef3c6eb1fcb864cf&get=B25070_003E,NAME&for=county:*&in=state:06

4) Example of the request URL for 2010 Census SF1 white population of 12 year olds in Alabama

http://api.census.gov/data/2010/sf1?key=[user key]&get=PCT012A015,PCT012A119&for=state:01

Query Response

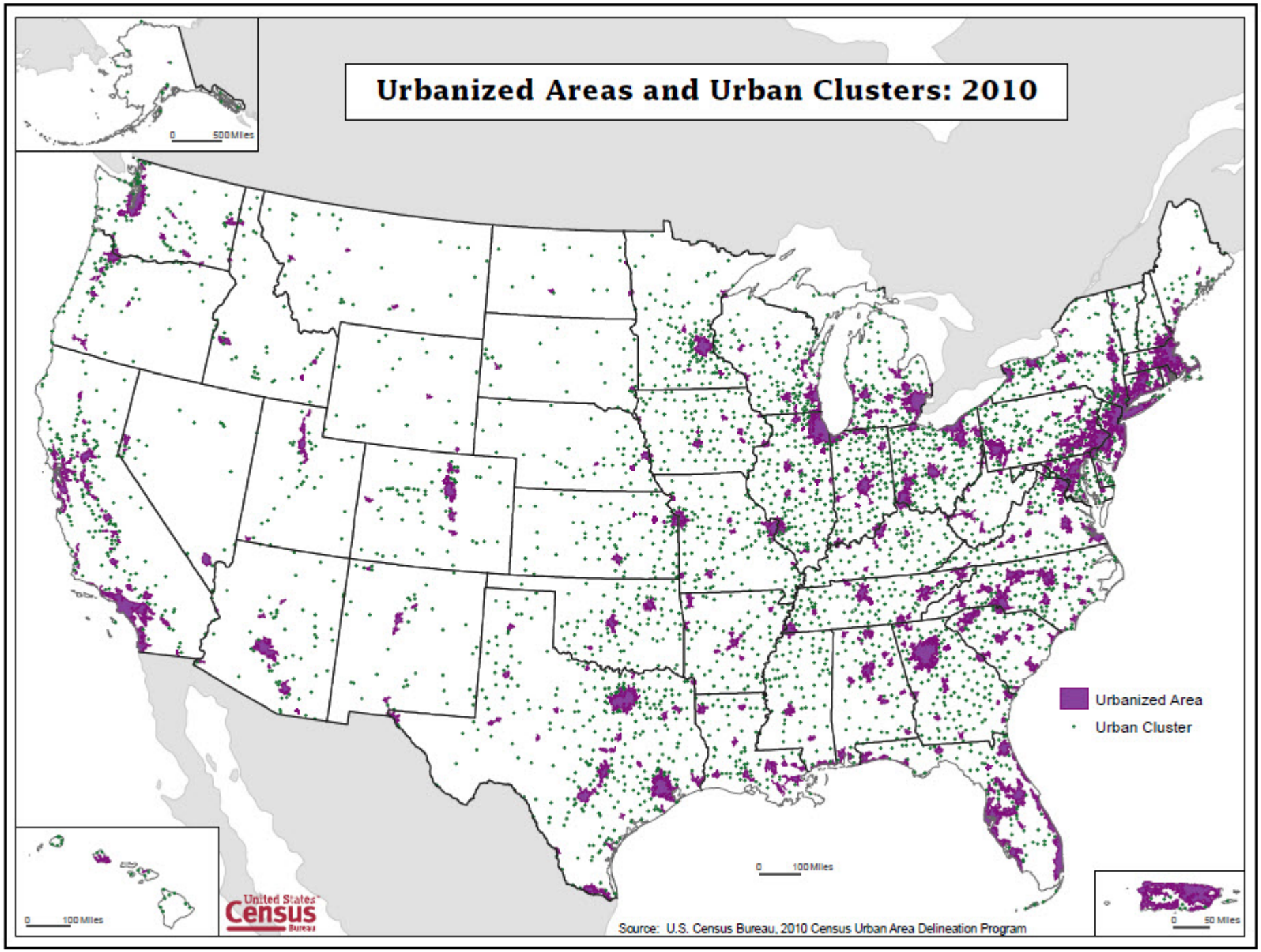
The response for all queries is formatted as a two dimensional JSON array where the first row provides column names and subsequent rows provide data values.

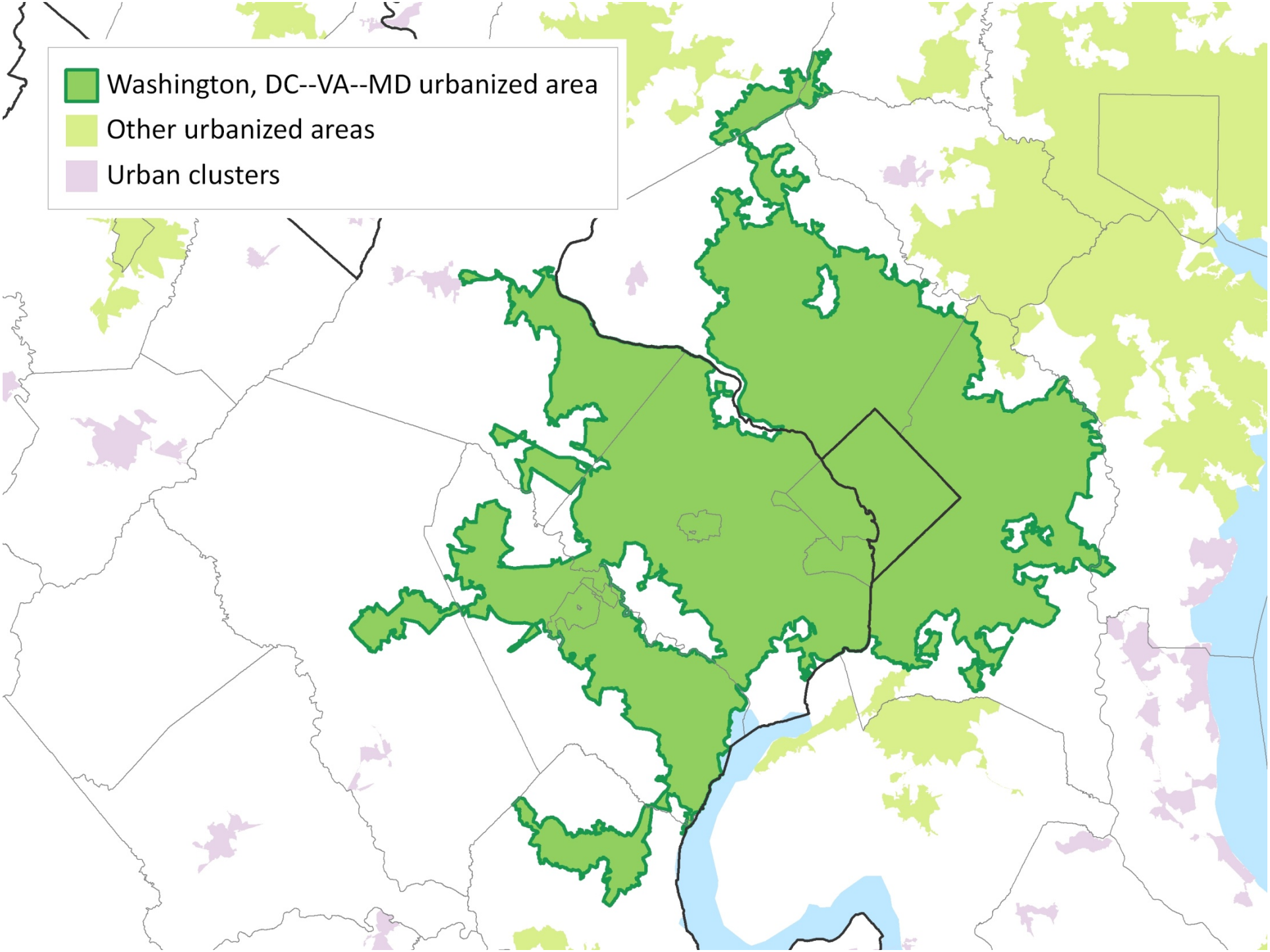
An example query response looks like this:

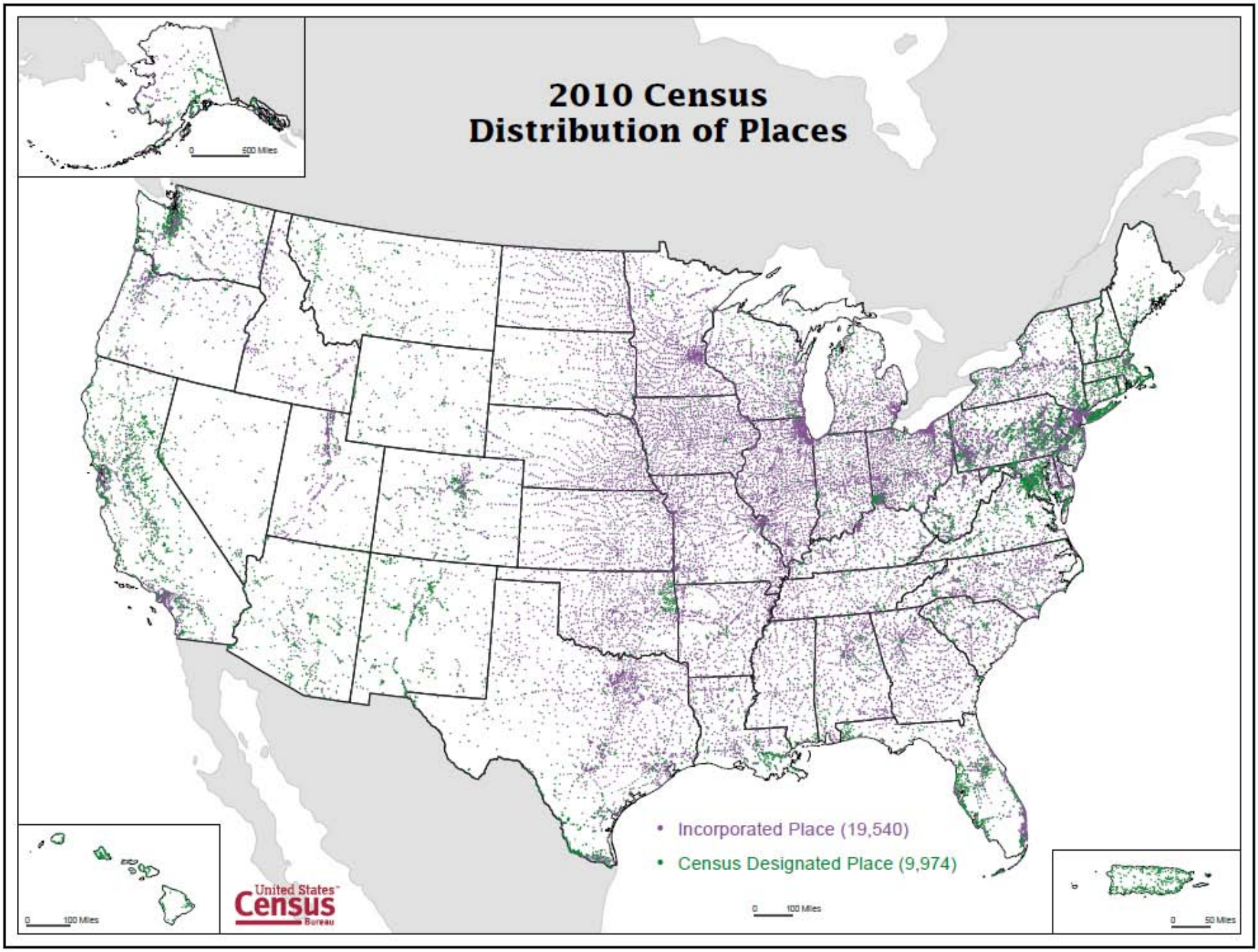

```
[["P0010001","NAME","state"],
["710231","Alaska","02"],
["4779736","Alabama","01"],
["2915918","Arkansas","05"],
["6392017","Arizona","04"],
["37253956","California","06"],
```


Each query response will include an HTTP status code. The table below lists the status codes and what they mean.

HTTP Status Code Descriptions


Urbanized Areas and Urban Clusters: 2010
0 500 Miles
Urbanized Area
Urban Cluster
0 100 Miles
0 100 Miles
0 50 Miles
United States Census Bureau
Source: U.S. Census Bureau, 2010 Census Urban Area Delineation Program

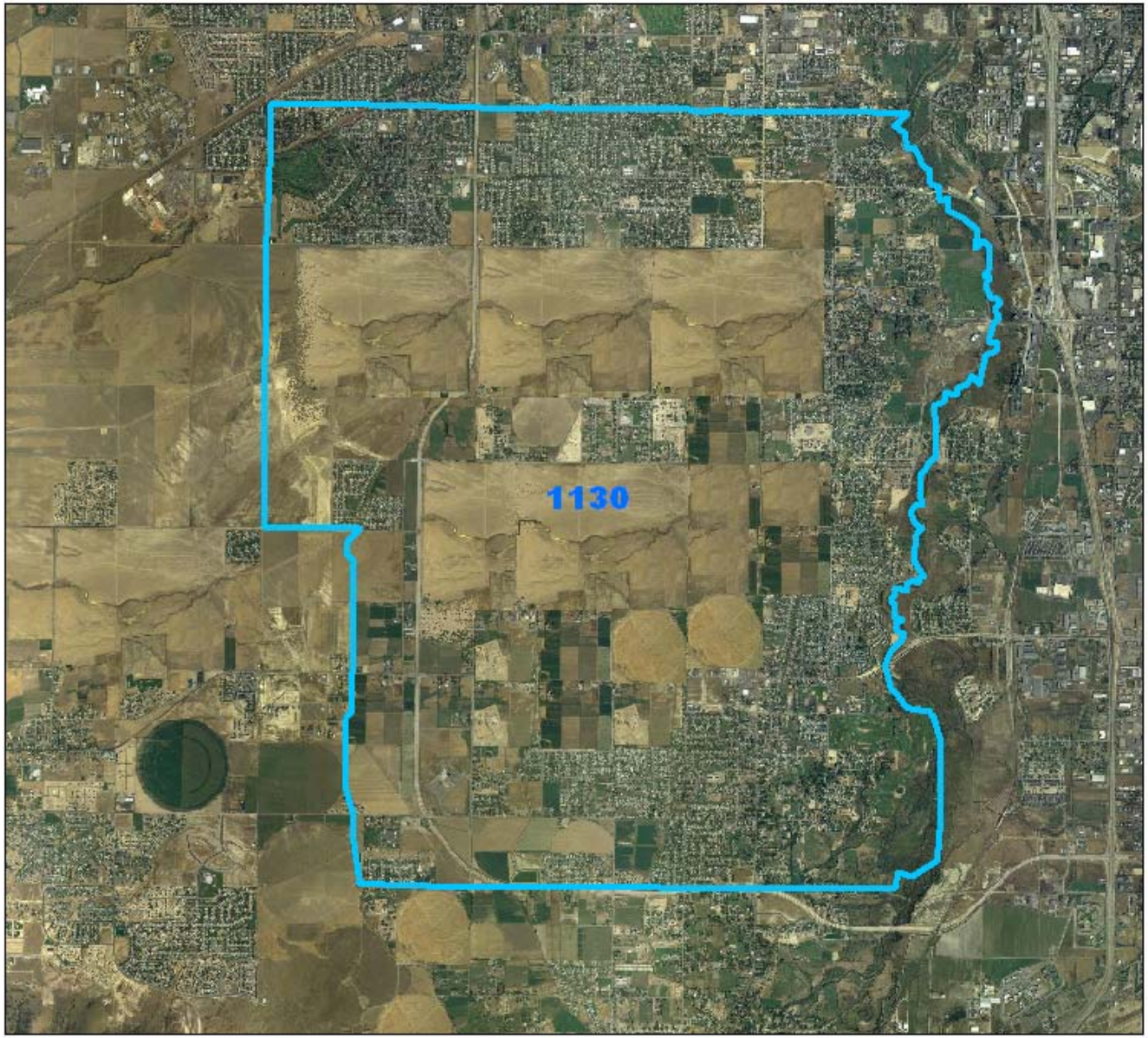

Washington, DC--VA--MD urbanized area
Other urbanized areas
Urban clusters


2010 Census
Distribution of Places
0 500 Miles
Incorporated Place (19,540)
Census Designated Place (9,974)
0 100 Miles
United States Census Bureau
0 100 Miles
0 50 Miles

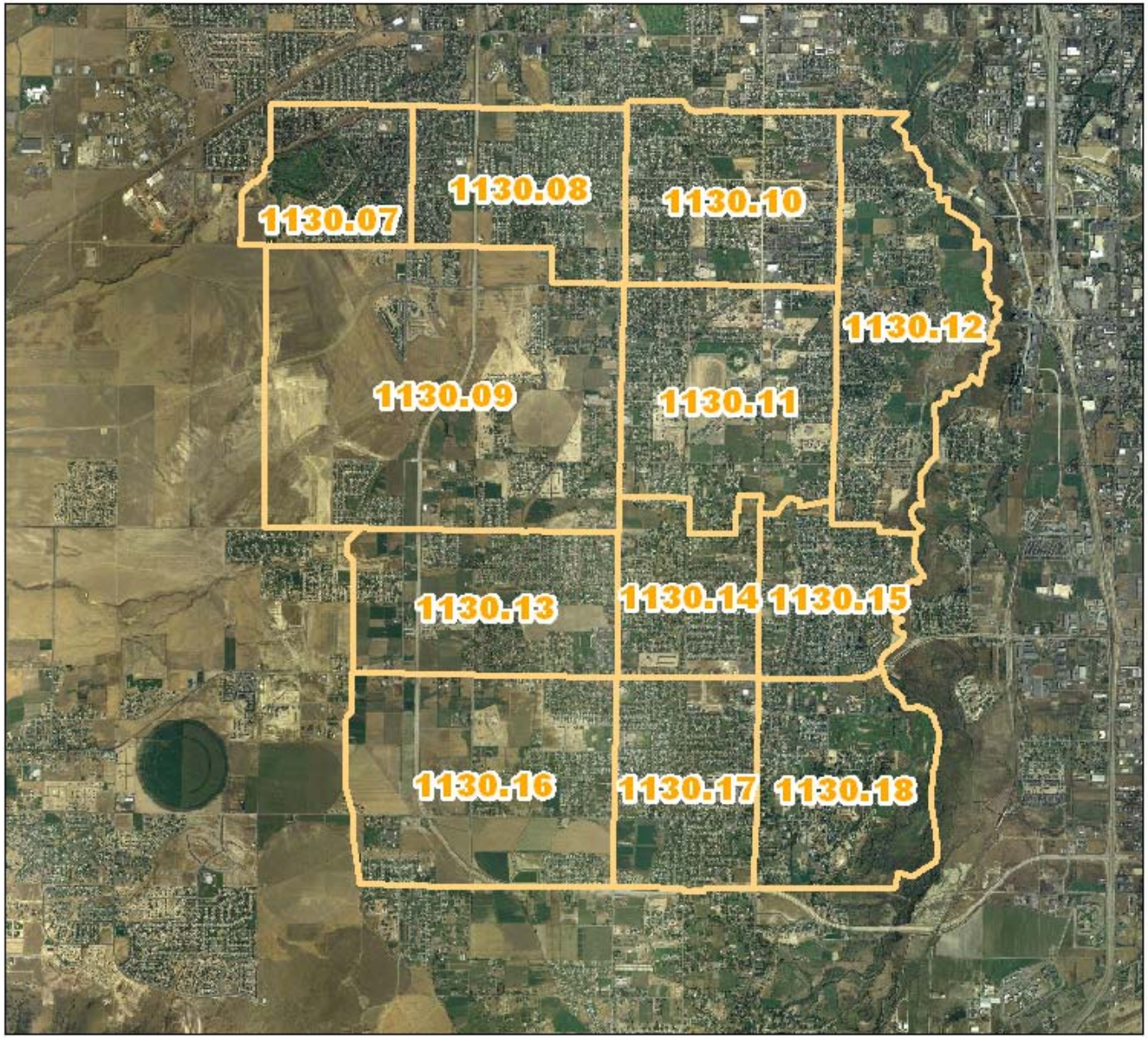
Census Tracts

- Census tracts are small, relatively permanent statistical subdivisions of a county.
  - Uniquely numbered in each county with a numeric code
- Census tracts average about 4,000 inhabitants
  - Minimum Population – 1,200
  - Maximum Population – 8,000

1970 Census Tracts



2000 Census Tracts



Questions? Need more information?

Michael Ratcliffe

Michael.r.ratcliffe@census.gov

301-763-8977

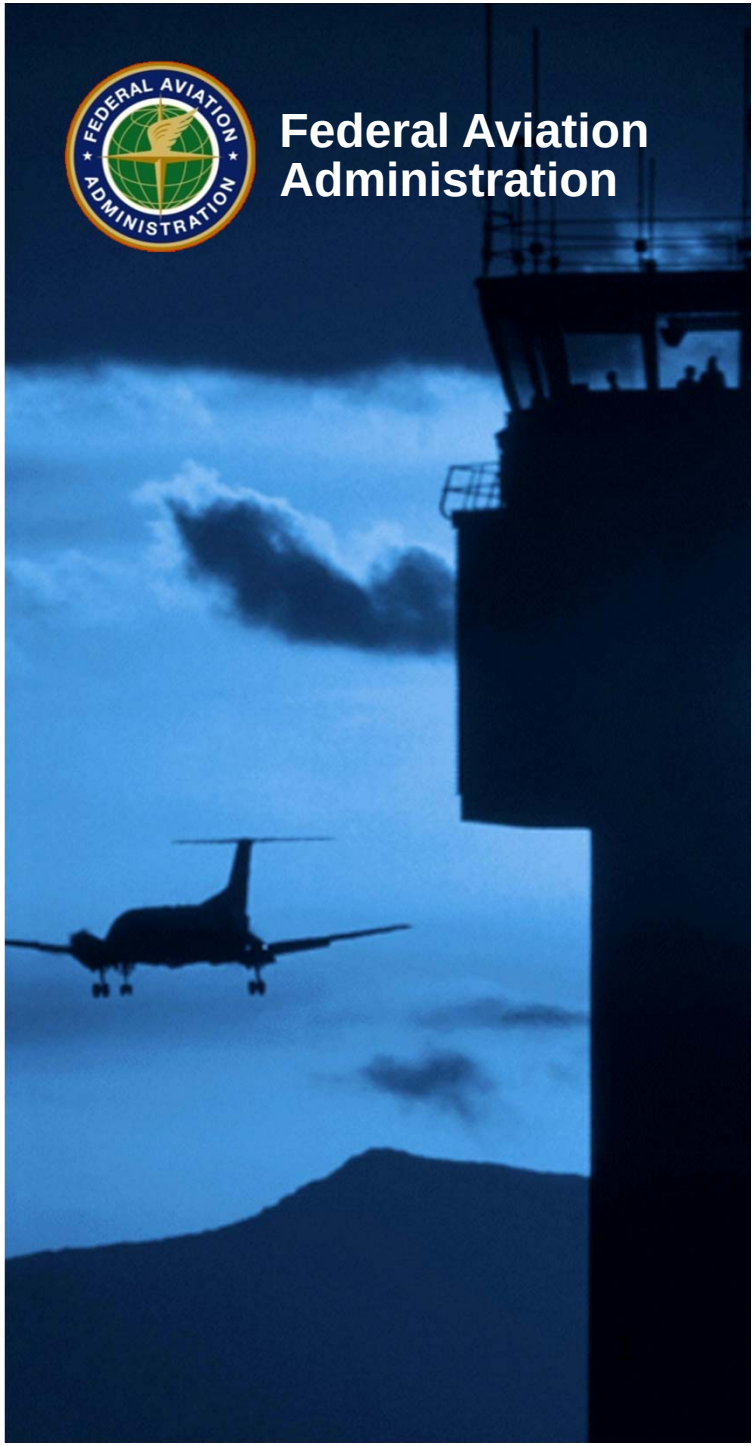
Geographic Products Branch

301-763-1128

Geo.geography@census.gov

Geo.tiger@census.gov

Air Traffic Organization



Mission Support Services

Aeronautical Products

Technology & Air Traffic Products

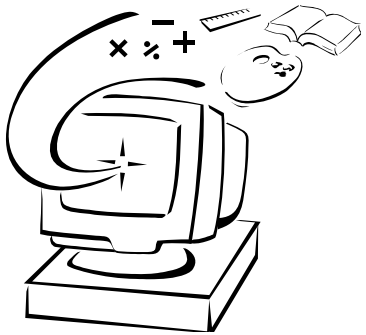
Instrument Procedures Development System (IPDS)

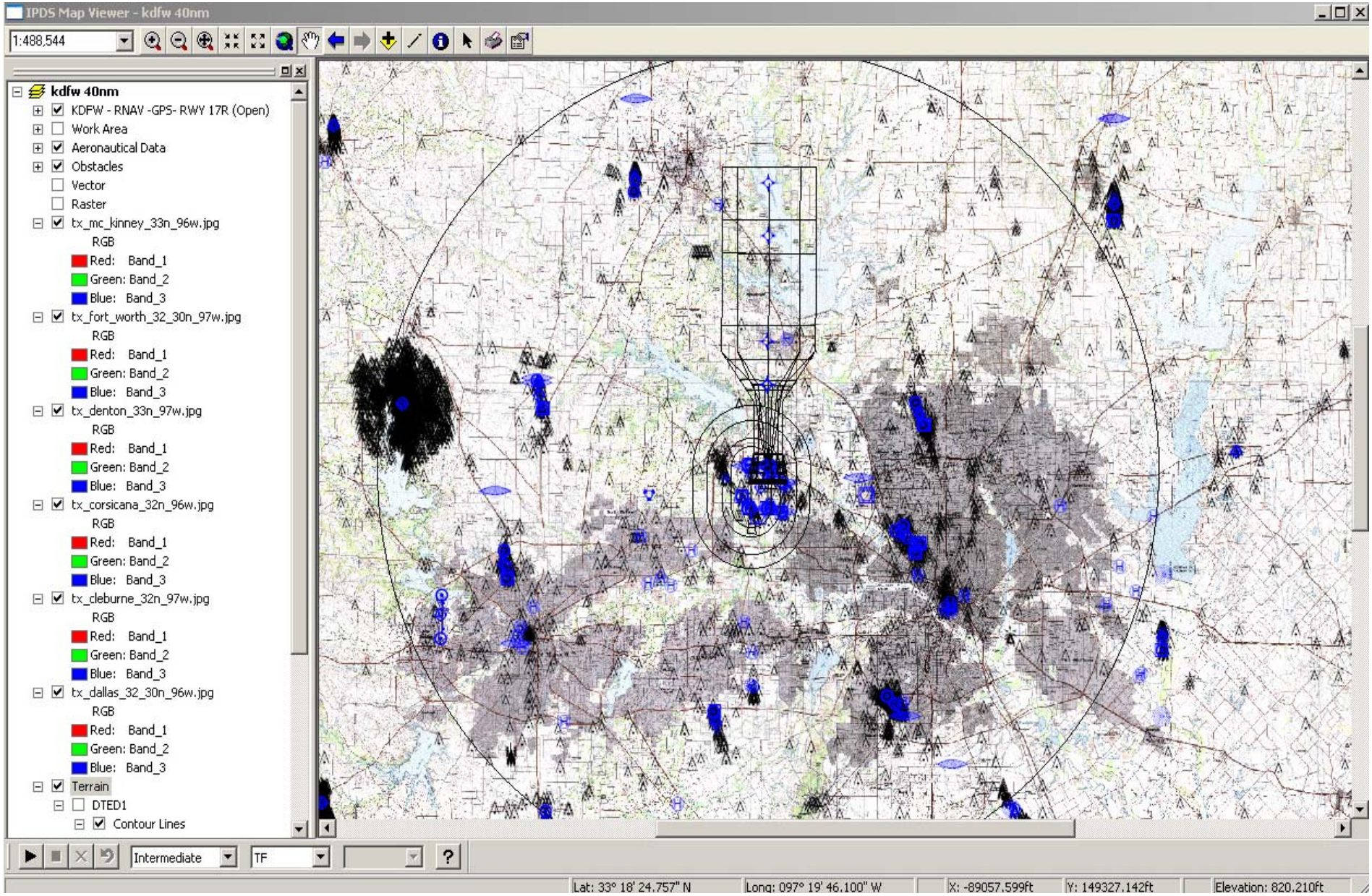
By: George Gonzalez

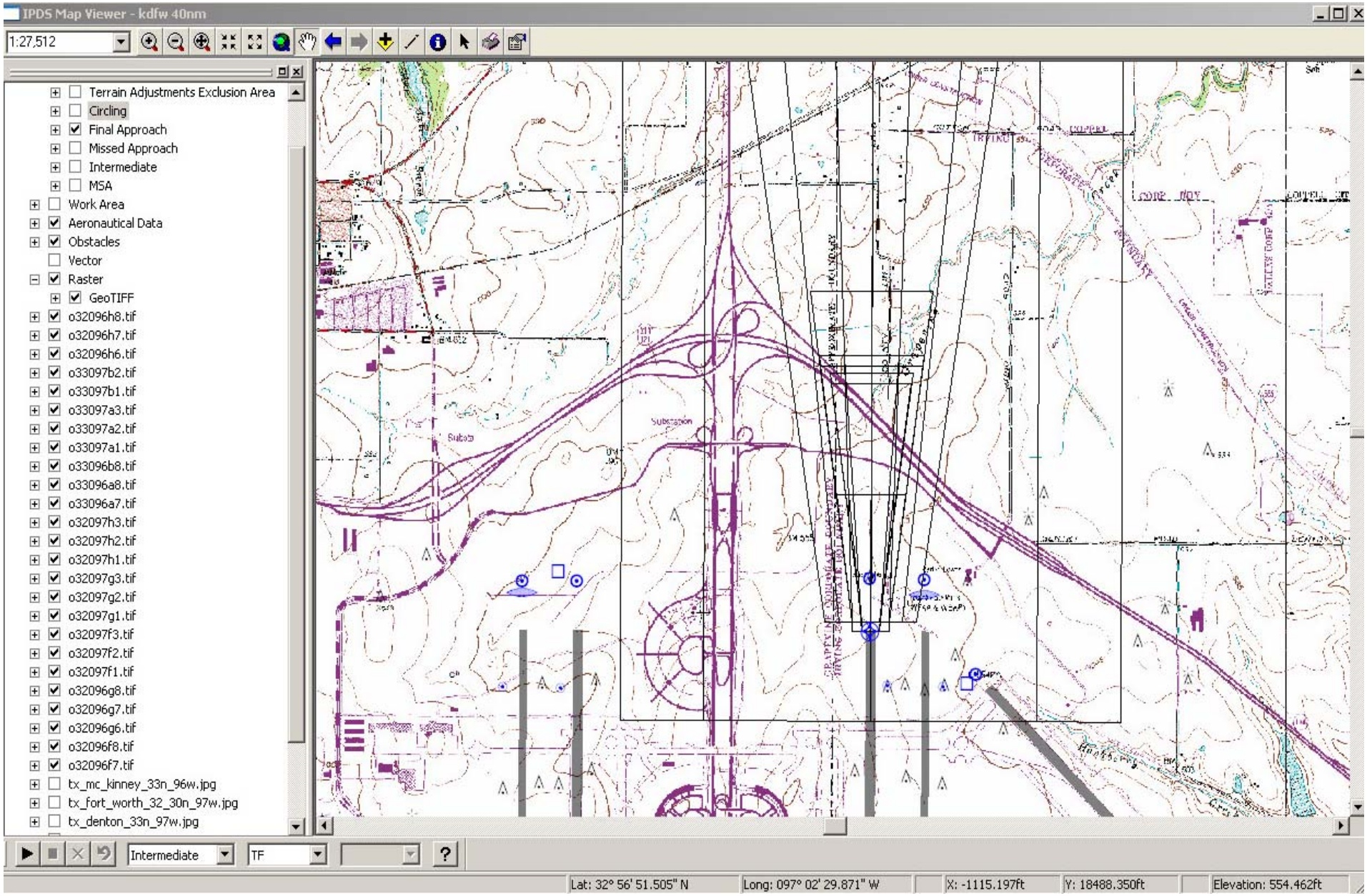
Date: 12/4/12

IPDS History

- The FAA has a requirement for the development of an Instrument Procedures Development System (IPDS) to fully replace its current Instrument Approach Procedure Automation (IAPA) System. It utilizes the latest Geographic Information System (GIS) from the leading supplier worldwide Economic & Social Research Institute (Esri) to display map data and images.
- IPDS Module 1 maximizes the leverage of the existing DoD capability and extends it with procedure types that support the performance based NAS. Module 1 has been fielded to FAA users and a select subset of DoD operators. Both sets of operators are able to design fixed wing RNP SAAAR, LPV and RNAV instrument approach procedures.
- The DoD operators will continue to develop Instrument Flight Procedures (IFP's) using data from the National Geospatial-Intelligence Agency (NGA).
- FAA operators will develop IFP's using data from systems within the FAA data enterprise which consist of Airports & NavAids (AIRNAV), Instrument Flight Procedure Automation (IFPA), Obstacle Repository System (ORS), National Airspace System Resource (NASR), etc.




IPDS Map Viewer - kdfw 40nm
1:488,544
kdfw 40nm
KDFW - RNAV -GPS- RWY 17R (Open)
Work Area
Aeronautical Data
Obstacles
Vector
Raster
tx_mc_kinney_33n_96w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
tx_fort_worth_32_30n_97w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
tx_denton_33n_97w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
tx_corsicana_32n_96w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
tx_cleburne_32n_97w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
tx_dallas_32_30n_96w.jpg
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
Terrain
DTED1
Contour Lines
Intermediate
TF
Lat: 33° 18' 24.757" N
Long: 097° 19' 46.100" W
X: -89057.599ft
Y: 149327.142ft
Elevation: 820.210ft


IPDS Map Viewer - kdfw 40nm
1:27,512
Terrain Adjustments Exclusion Area
Circling
Final Approach
Missed Approach
Intermediate
MSA
Work Area
Aeronautical Data
Obstacles
Vector
Raster
GeoTIFF
o32096h8.tif
o32096h7.tif
o32096h6.tif
o33097b2.tif
o33097b1.tif
o33097a3.tif
o33097a2.tif
o33097a1.tif
o33096b8.tif
o33096a8.tif
o33096a7.tif
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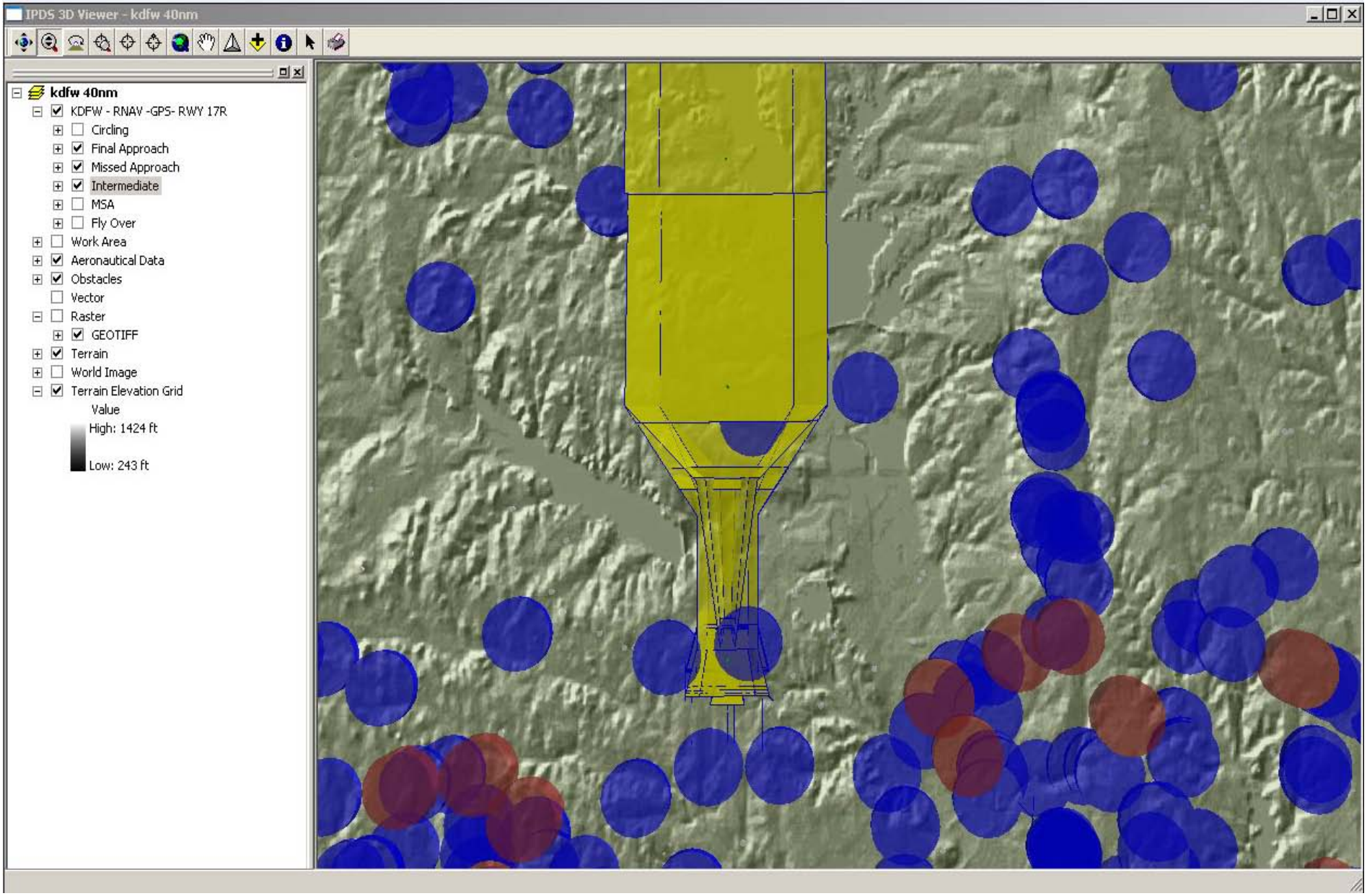
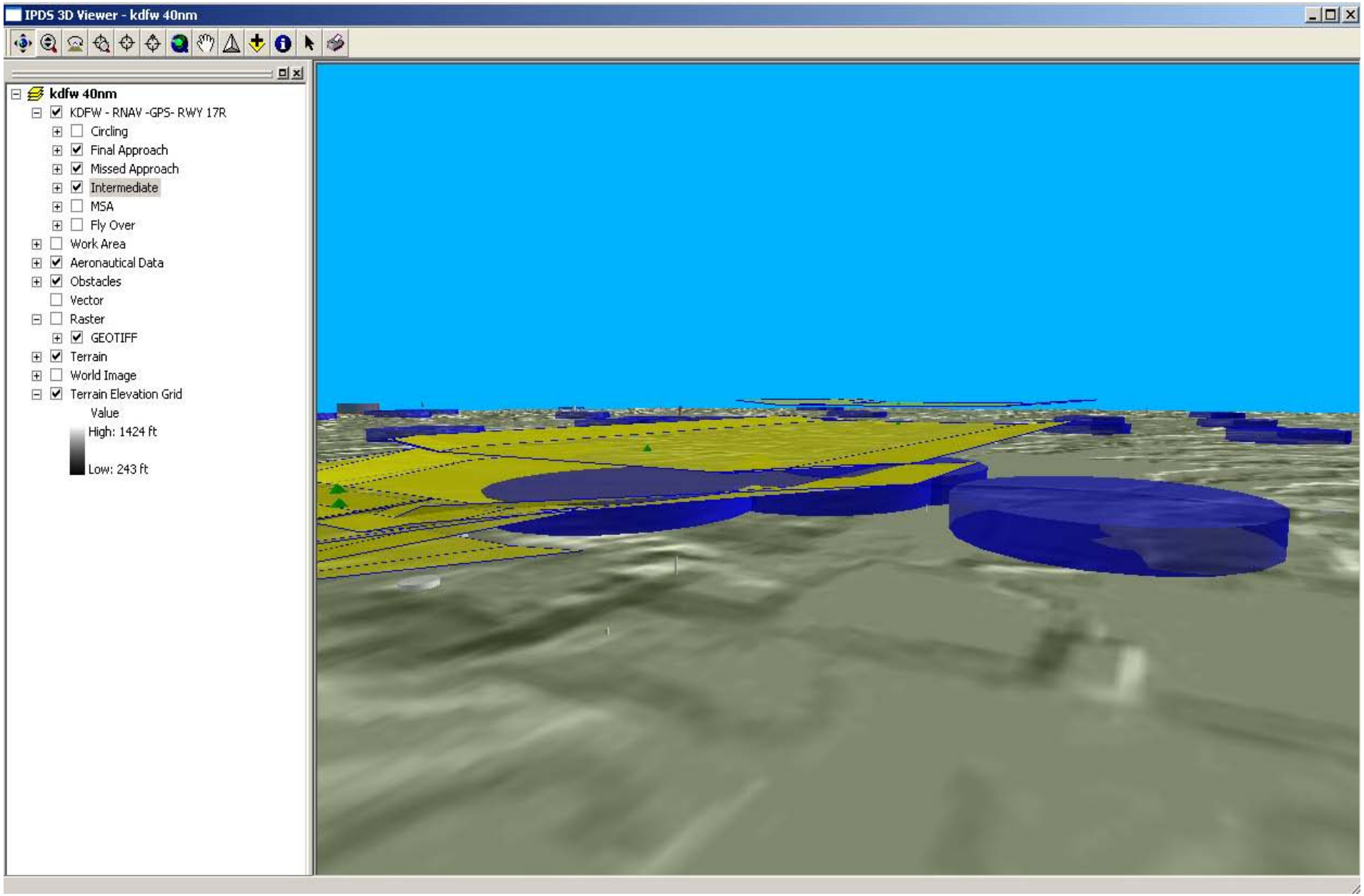
o32097h2.tif
o32097h1.tif
o32097g3.tif
o32097g2.tif
o32097g1.tif
o32097f3.tif
o32097f2.tif
o32097f1.tif
o32096g8.tif
o32096g7.tif
o32096g6.tif
o32096f8.tif
o32096f7.tif
tx_mc_kinney_33n_96w.jpg
tx_fort_worth_32_30n_97w.jpg
tx_denton_33n_97w.jpg
Intermediate
TF
Lat: 32° 56' 51.505" N
Long: 097° 02' 29.871" W
X: -1115.197ft
Y: 18488.350ft
Elevation: 554.462ft


IPDS 3D Viewer - kdfw 40nm
kdfw 40nm
KDFW - RNAV -GPS- RWY 17R
Circling
Final Approach
Missed Approach
Intermediate
MSA
Fly Over
Work Area
Aeronautical Data
Obstacles
Vector
Raster
GEOTIFF
Terrain
World Image
Terrain Elevation Grid
Value
High: 1424 ft
Low: 243 ft


IPDS 3D Viewer - kdfw 40nm
kdfw 40nm
KDFW - RNAV -GPS- RWY 17R
Circling
Final Approach
Missed Approach
Intermediate
MSA
Fly Over
Work Area
Aeronautical Data
Obstacles
Vector
Raster
GEOTIFF
Terrain
World Image
Terrain Elevation Grid
Value
High: 1424 ft
Low: 243 ft

Future IPDS Releases

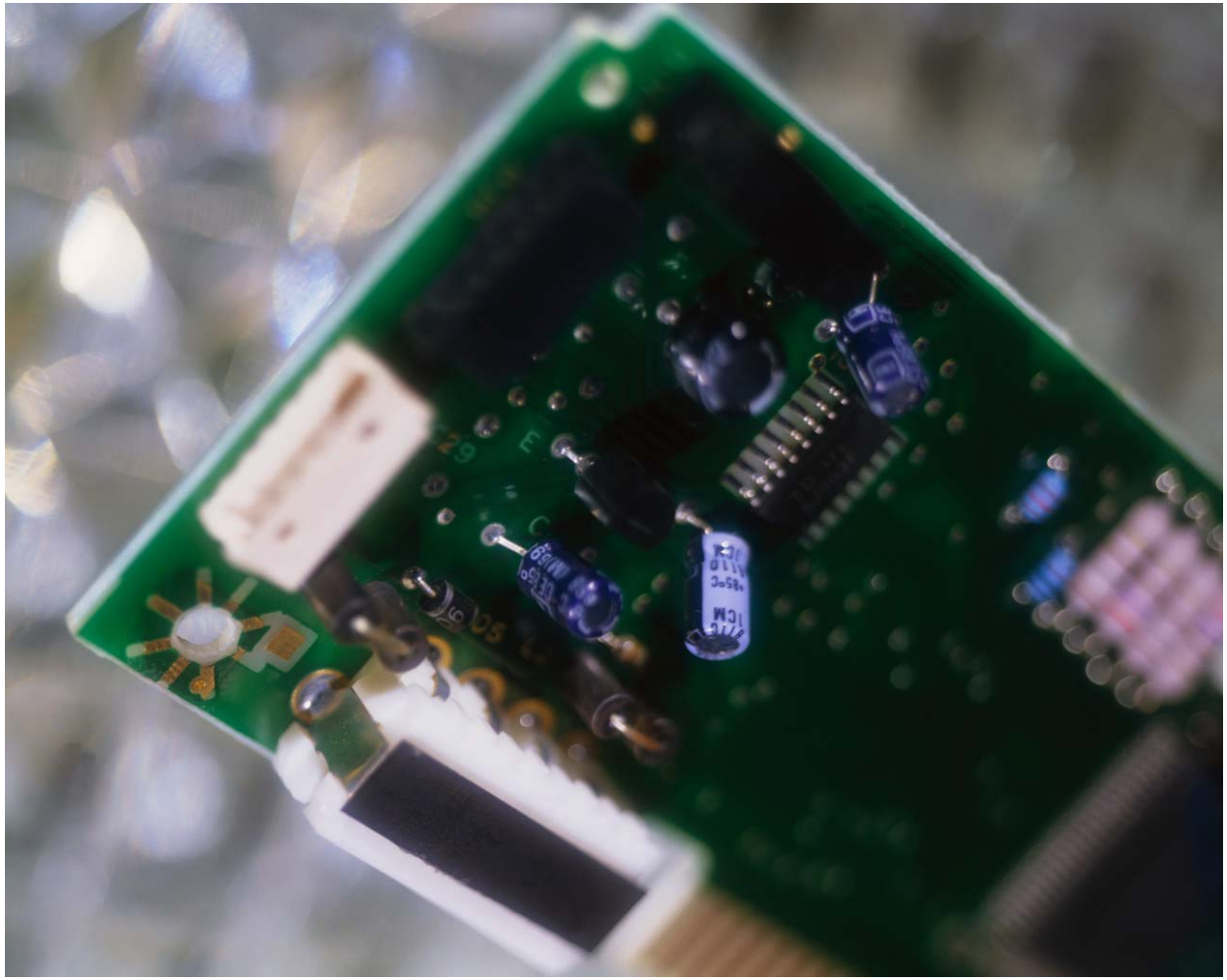
- **IPDS (Module 2.1)**
  - Ground-Based Criteria
  - Diverse Departures
  - OE Assessment for Ground Based Procedures
  - Projected for Production in 2014
- **IPDS (Module 2.2)**
  - Window 7 / 64 Bit Technology

Future Modules Will Contain:
- Full Enroute & Departure
- Automated OE Evaluation
- STARs
- Copter RNAV
- Data Push Back to SIAP

IFPA Change Control Board (CCB)

- The IFPA CCB is envisioned to be a joint FAA/DoD committee to ensure that a structured process is used to consider proposed changes and incorporate them into systems development schedules and production software releases. The software systems that are included in IFPA are as follows: IPDS, IFP (SIAP, FIX, Departures, STARs, Enroute), AIRNAV, & APTS (PTS, NTS, OETS). Changes that will be discuss include:
  - Enhancements
  - Maintenance
  - Defects/Bugs

Questions



National Elevation Data For Transportation-Based Applications

Jeffrey J. Danielson
Physical Geographer
USGS EROS

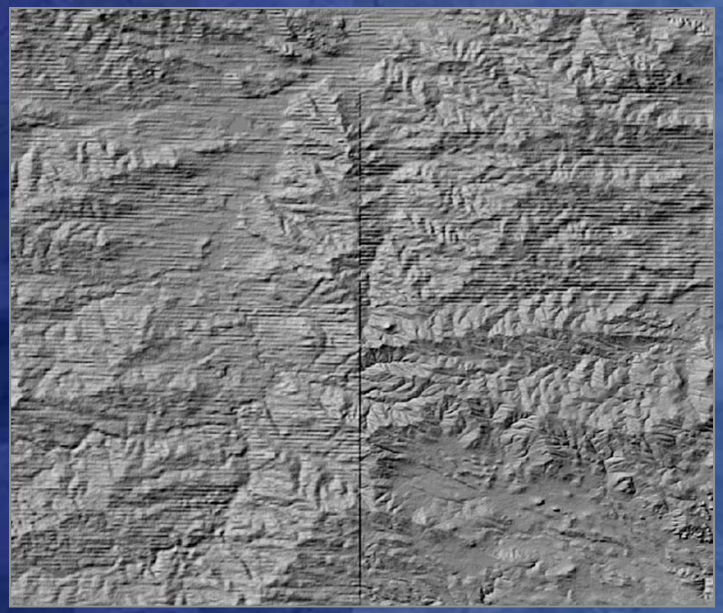
U.S. Department of the Interior
U.S. Geological Survey

The National Elevation Dataset (NED)

- Seamless national coverage of "best available" raster elevation data
  - Geographic "projection"
  - 1-arc-second (30-meter), 1/3-arc-second (10-meter), and 1/9-arc-second (3-meter) grid spacing
    - Alaska: 2-arc-second grid spacing
  - Datum: NAD 83 horizontal; NAVD 88 vertical
  - Elevation units: decimal meters
  - Updated bi-monthly to incorporate all new USGS DEM production and other newly available source data
- NED is the elevation layer of *The National Map*

USGS

Large-Area Elevation Data Coverage



7.5-minute quadrangle tiled database

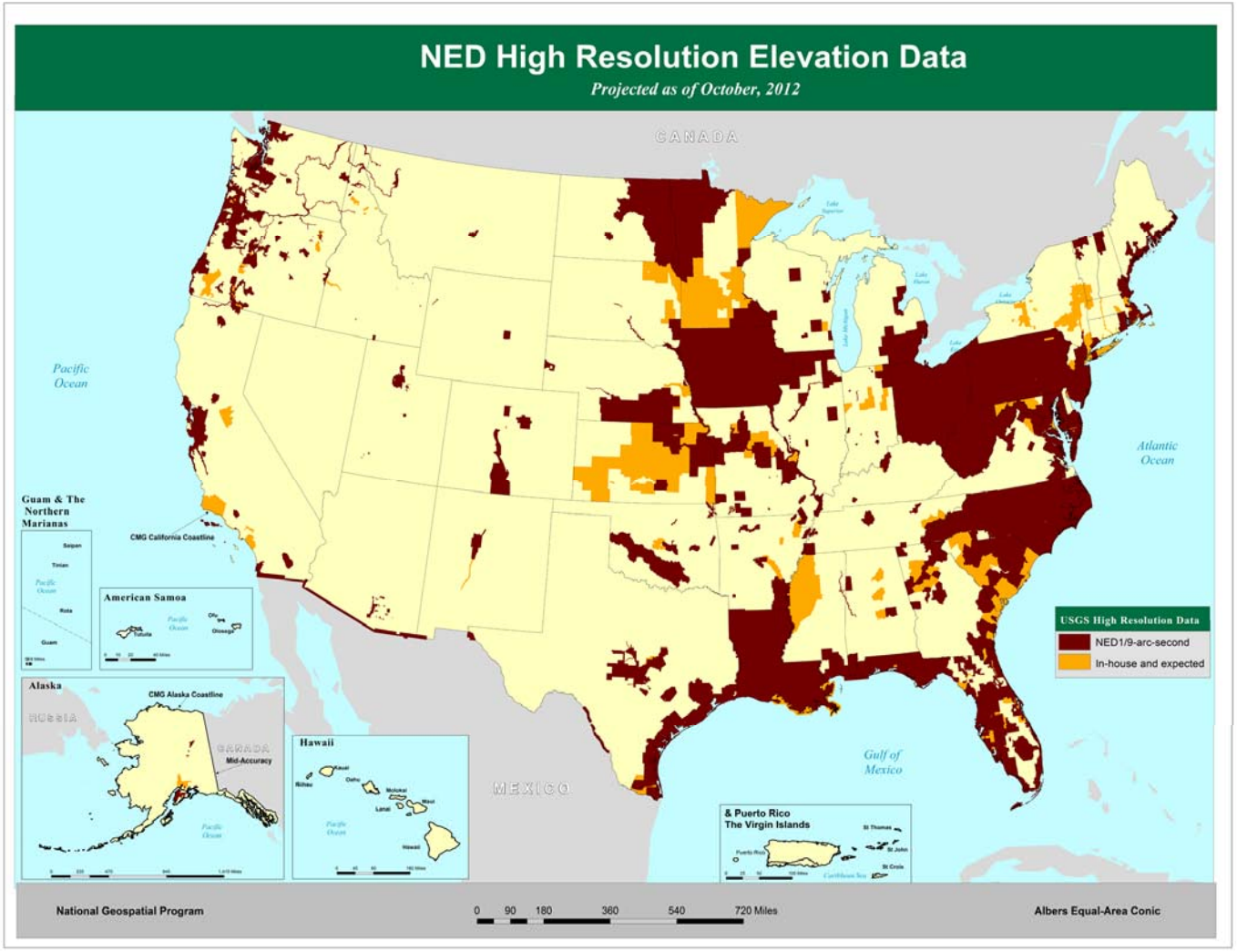
- Nearly 54,000 quad-based DEMs
- Projected in 10 different UTM zones
- Production artifacts (stripes), slivers of missing data, elevation value mismatches along quad boundaries
- Metadata in individual files

The National Elevation Dataset (NED)

- Seamless raster mosaic
- Consistent national coordinate system
- Standardized datums and units
- Filtered and edge-matched, where necessary
- Spatially referenced metadata

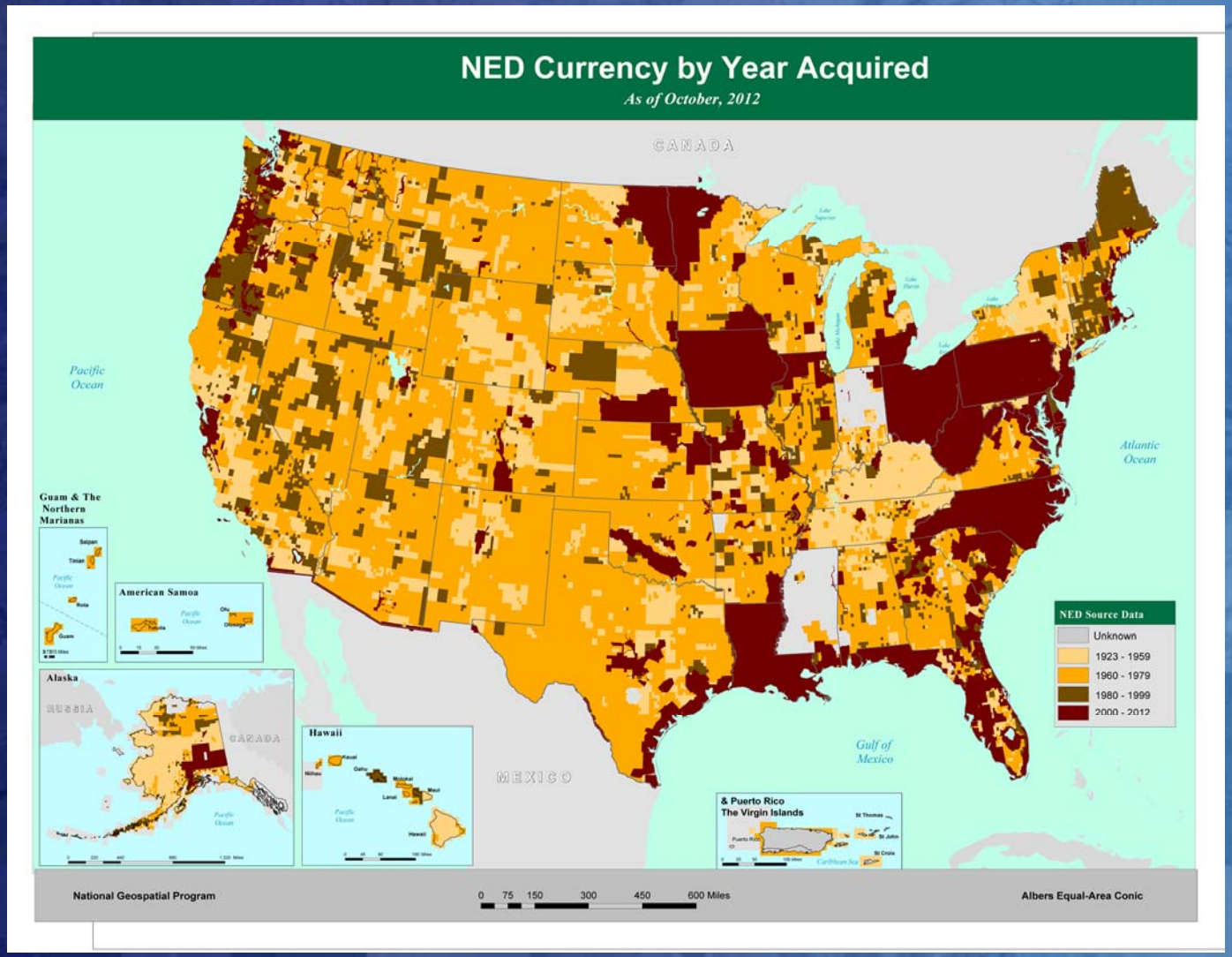
USGS

NED – High Resolution Elevation Data



USGS

NED – Currency



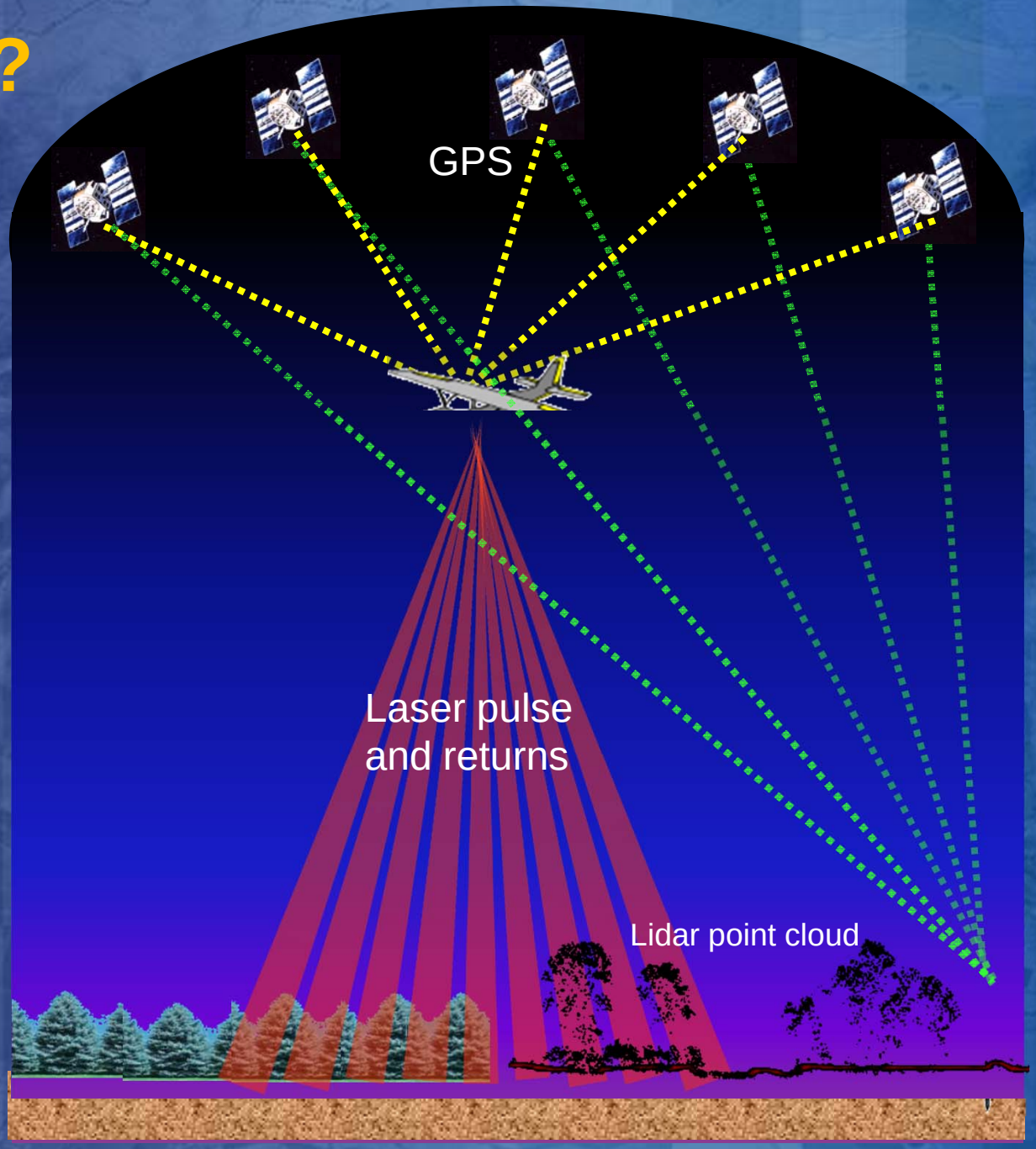
NED Vertical Accuracy Statistics (CONUS)

n = 18,313
min = -9.92
max = 9.77
mean = -0.27
sigma = 1.41
RMSE = 1.44

USGS

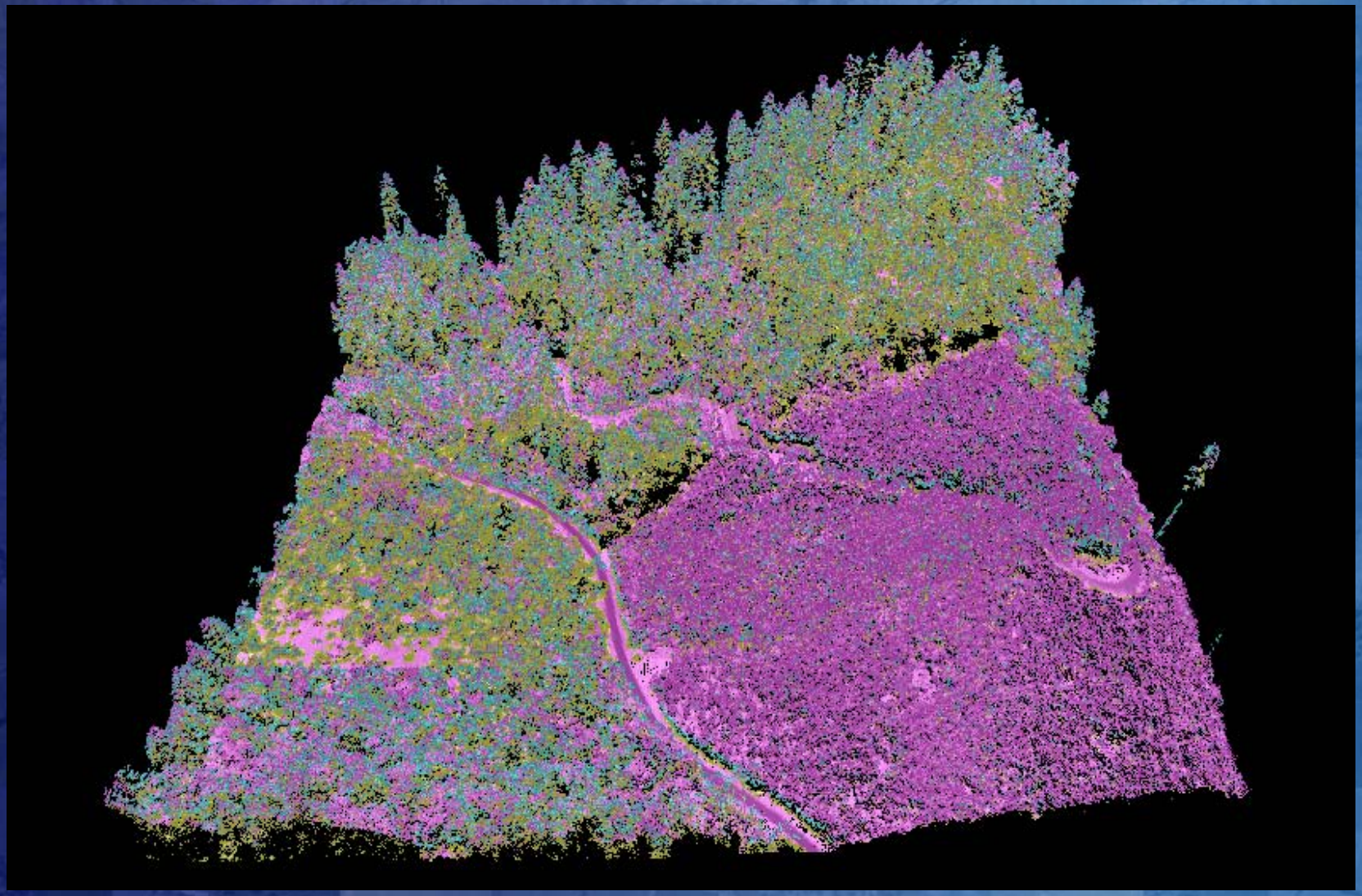
What is Lidar?

- Light Detection and Ranging
- System with a laser and detector (range), scanning mirror (laser direction), GPS (location), and IMU (orientation)
- Can output 300,000+ laser pulses per second & record laser reflection information
- End result is billions of 3-dimensional points representing bare earth, vegetation & structures at cm-level accuracy

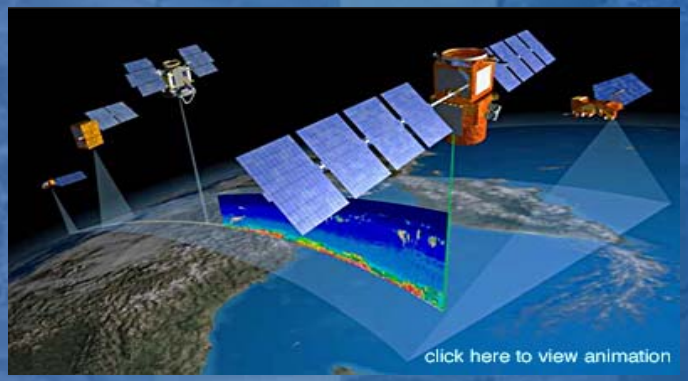


USGS

“Raw” Lidar – Point Cloud

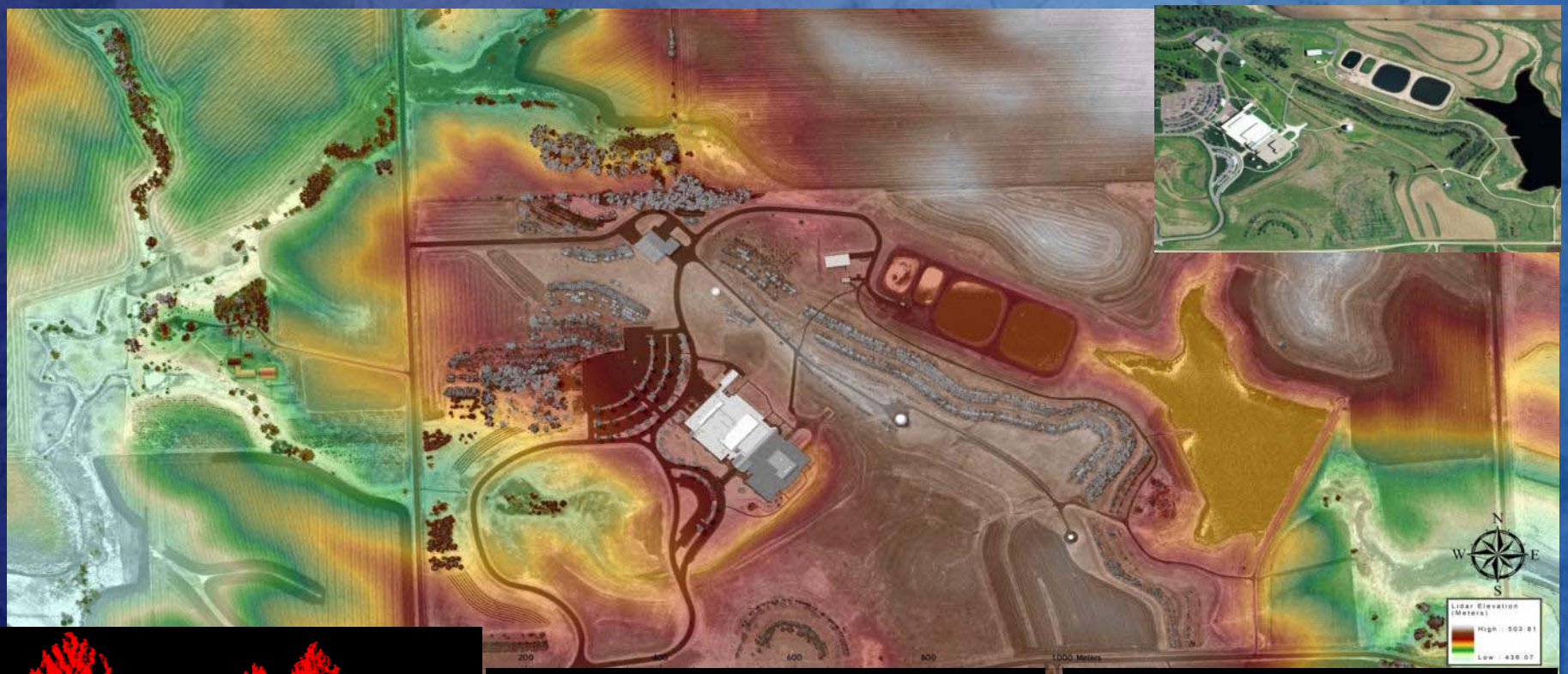


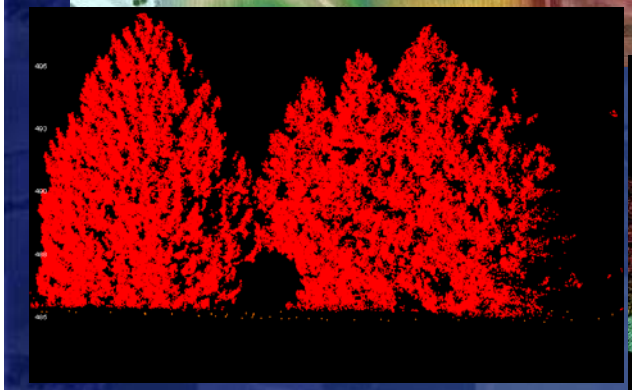
A Suite of Lidar Platforms

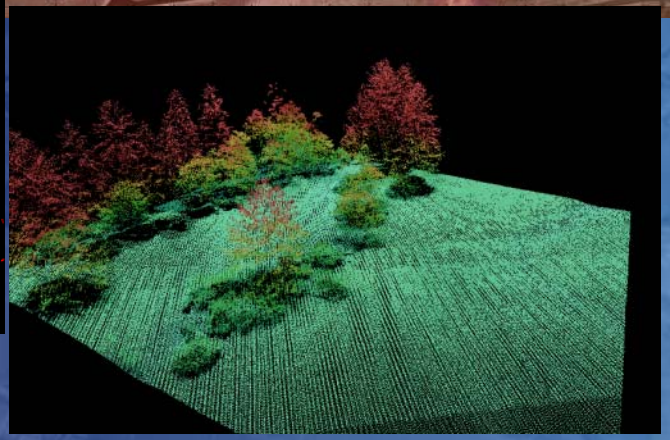


USGS

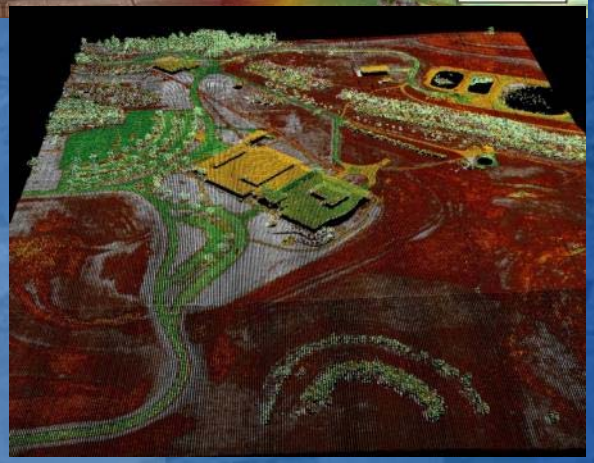
What can lidar information look like?





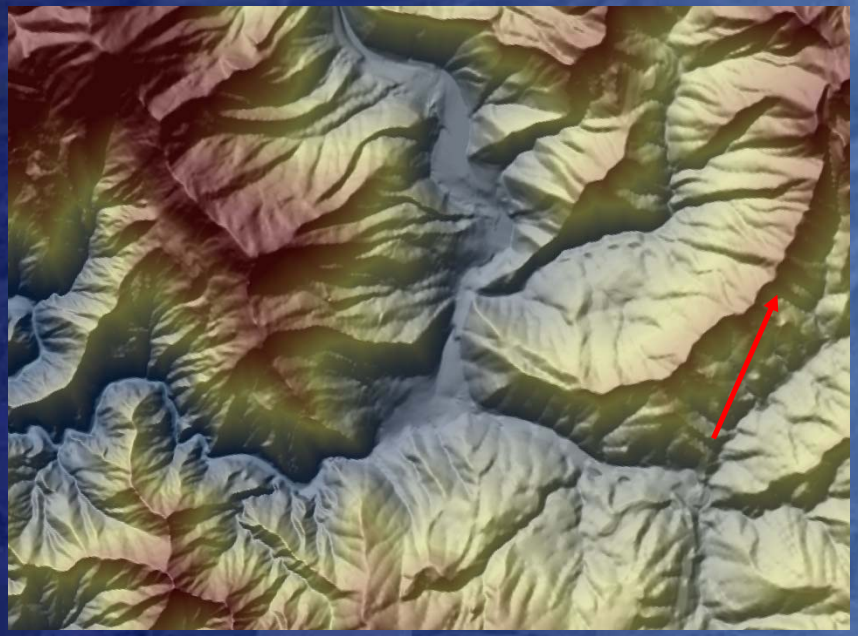


Trees in Mt. Rainier National Park

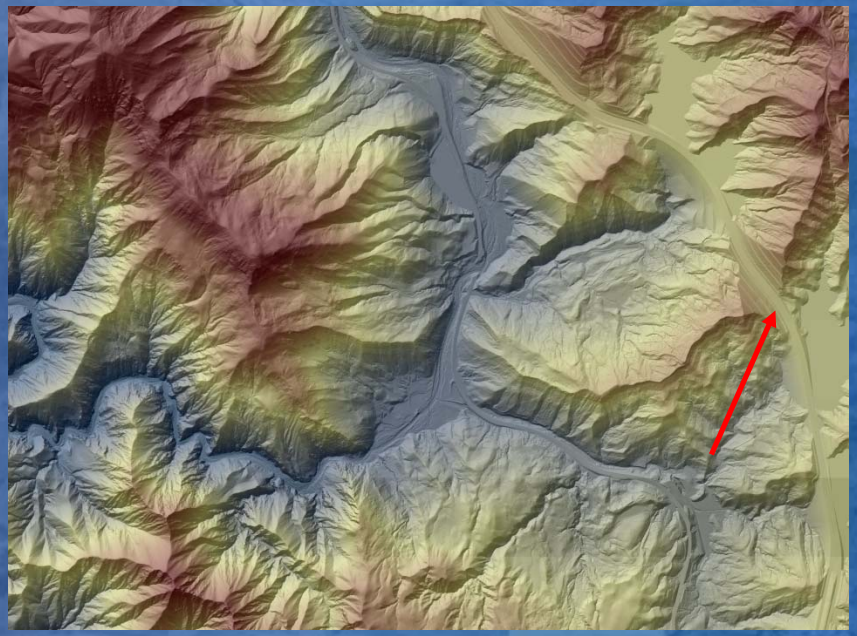


USGS EROS, Sioux Falls, SD

Importance of improved elevation 10-meter vs 1-meter lidar



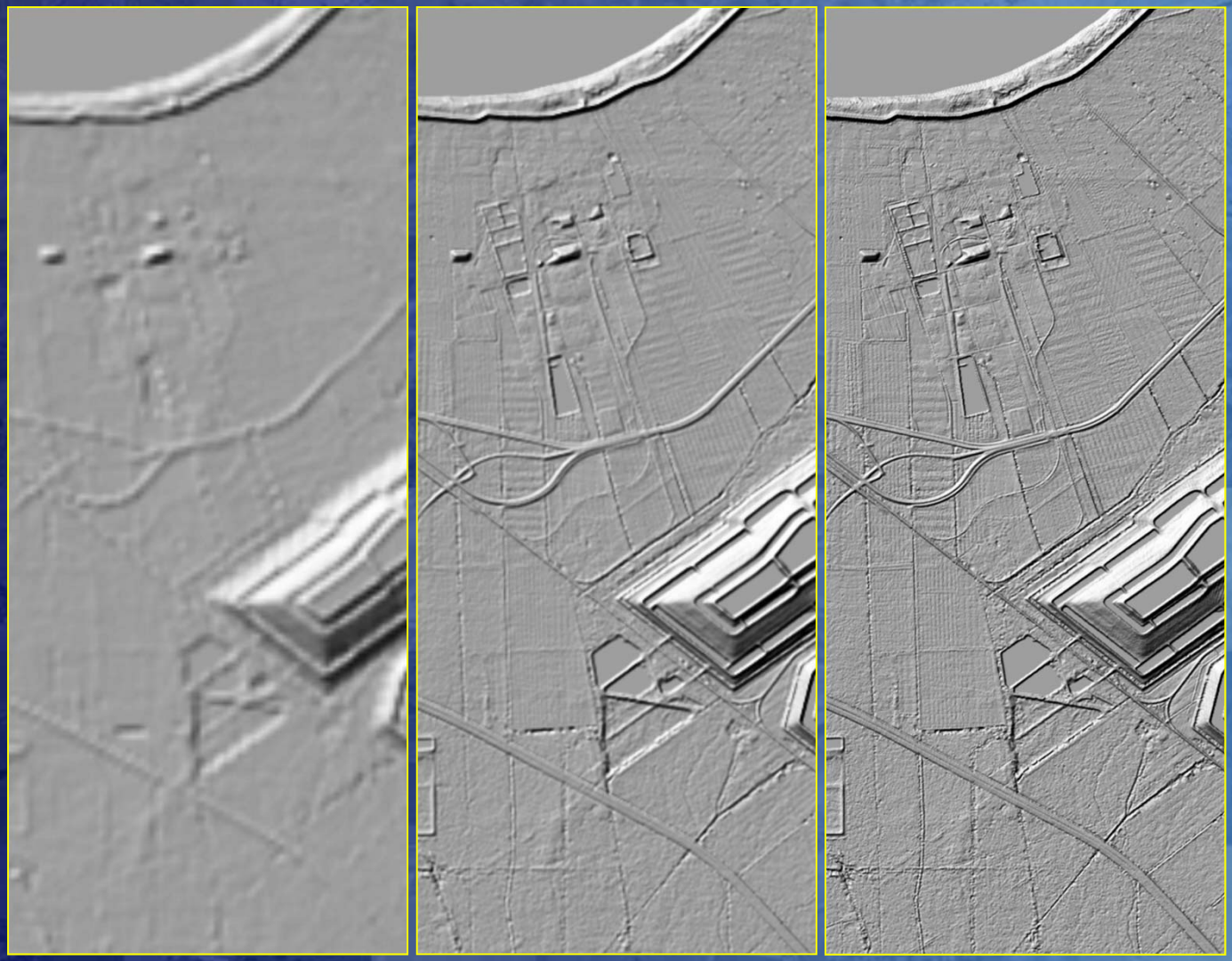
10 meter elevation data



1 meter elevation data derived from lidar

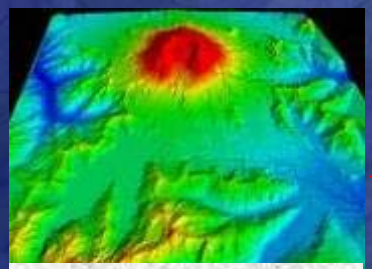
USGS

NED - Higher Resolution Source Migration

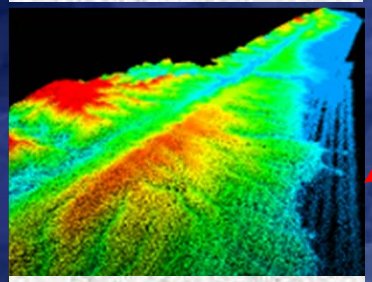


USGS

Potential National Applications for Lidar Data

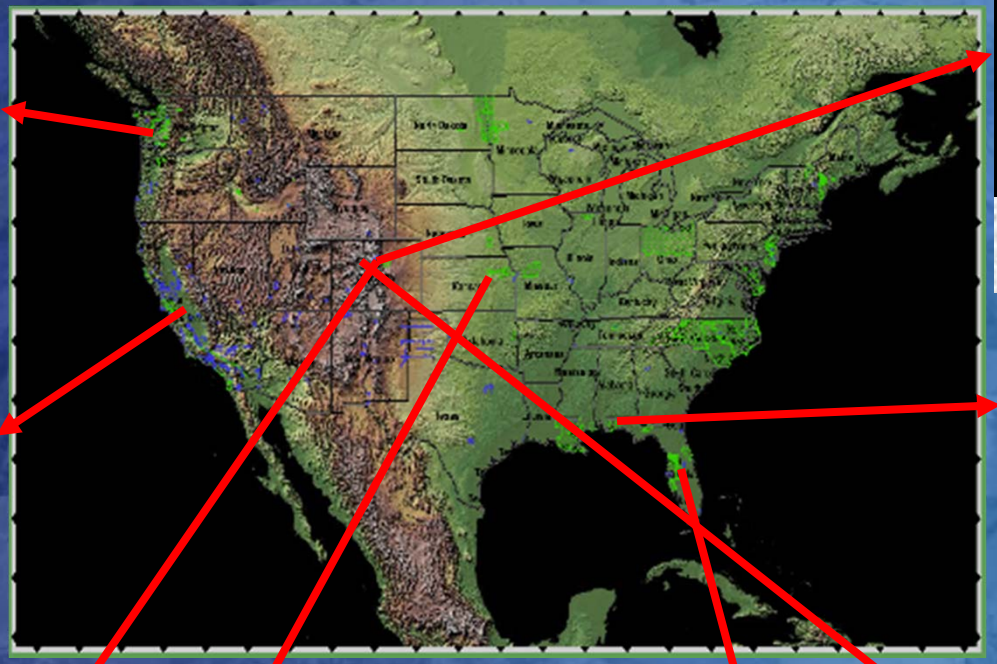


Volcano monitoring

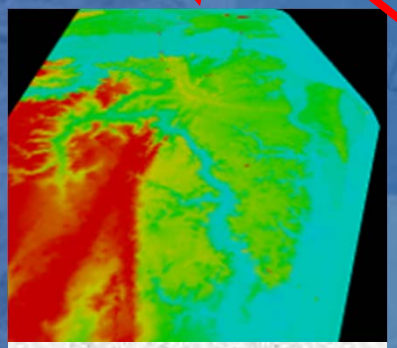


Earthquake faults

Hydrologic Studies

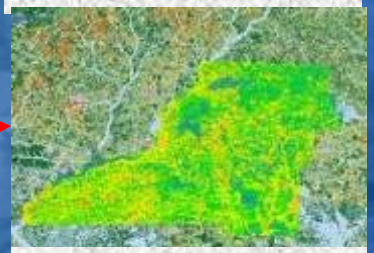


Urban / Suburban Response

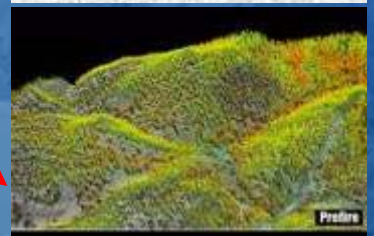


Coastal Studies

Vegetation / Biomass



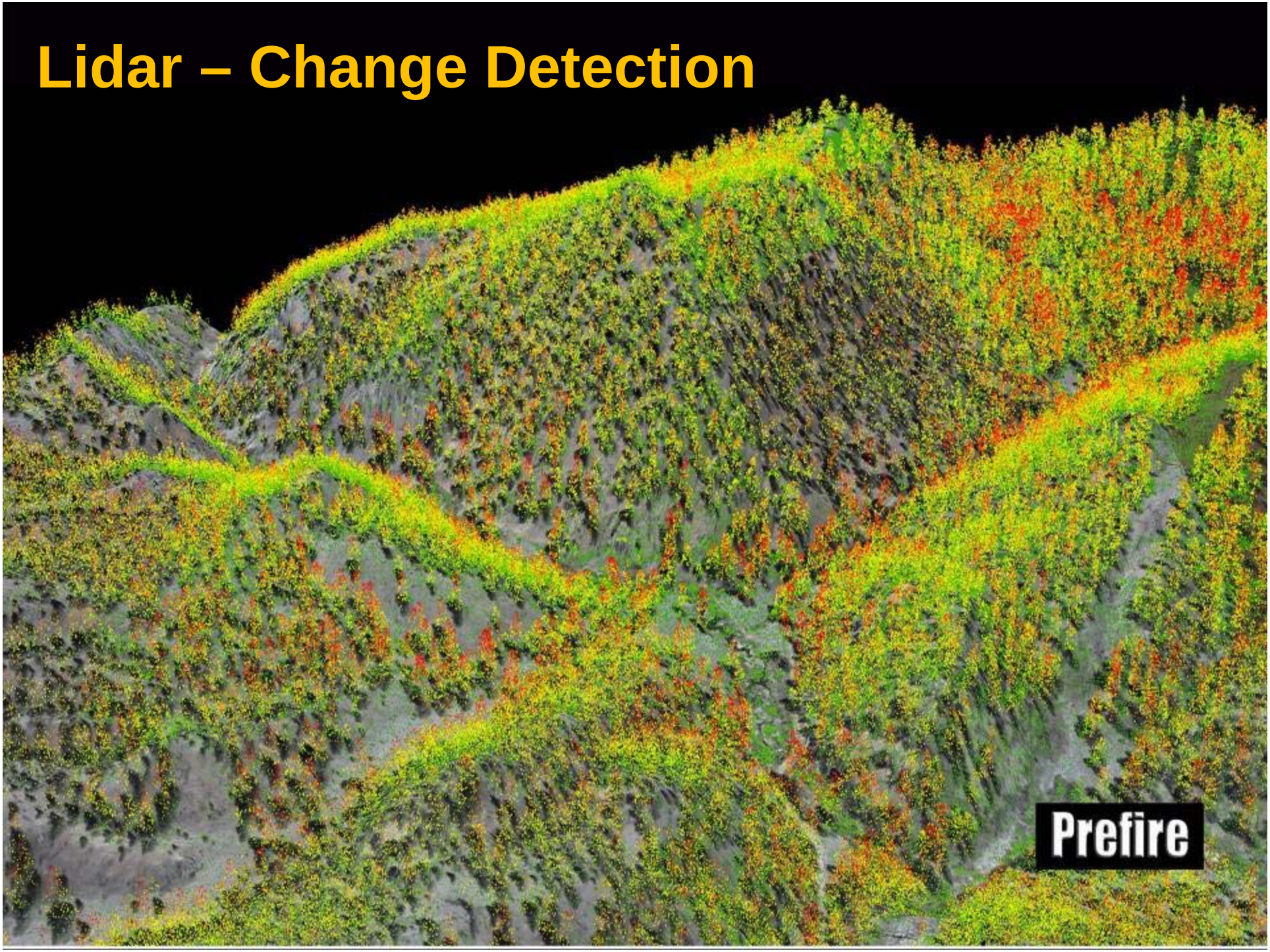
Land Cover



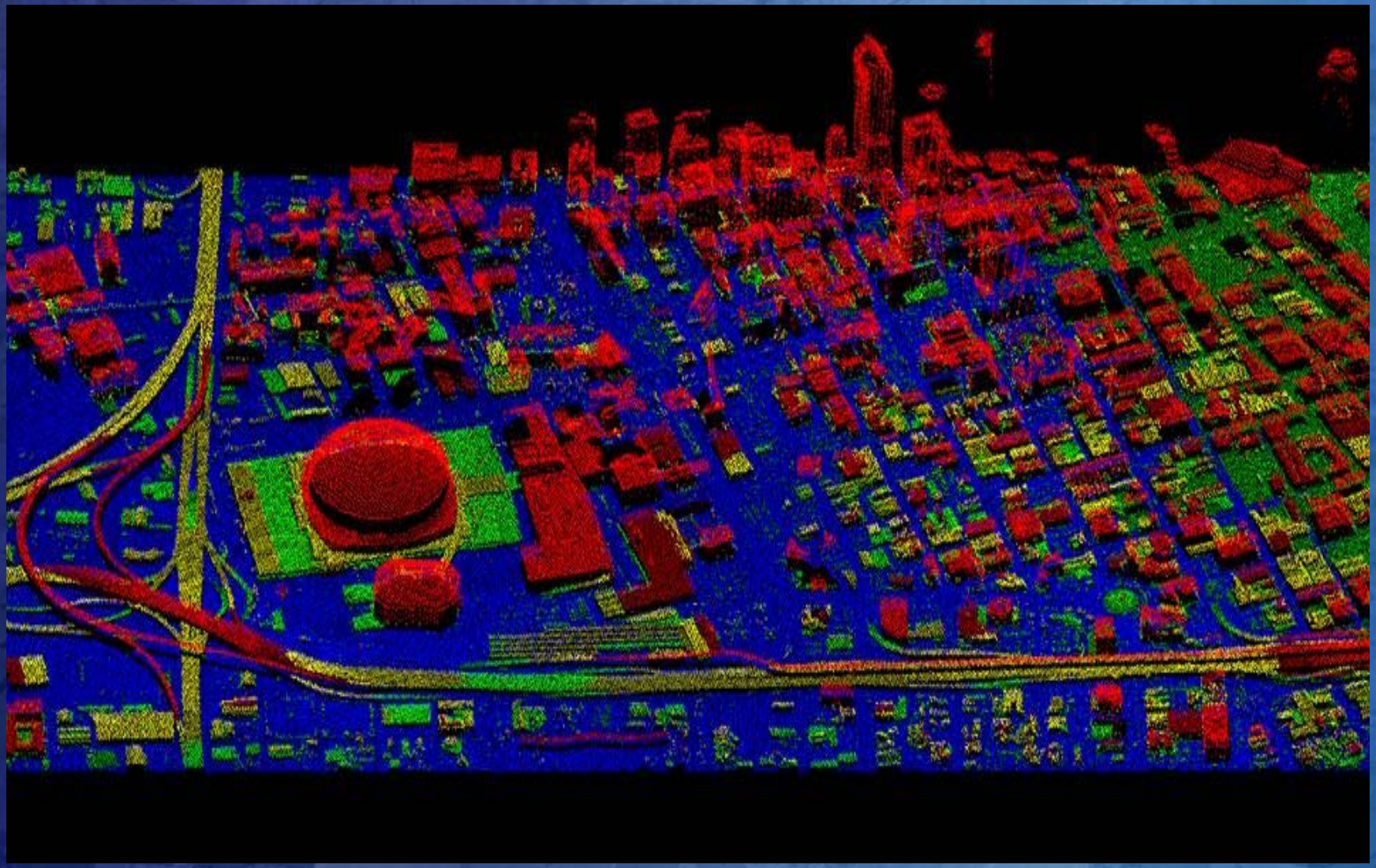
Carbon / Disturbance studies

USGS

Lidar – Change Detection

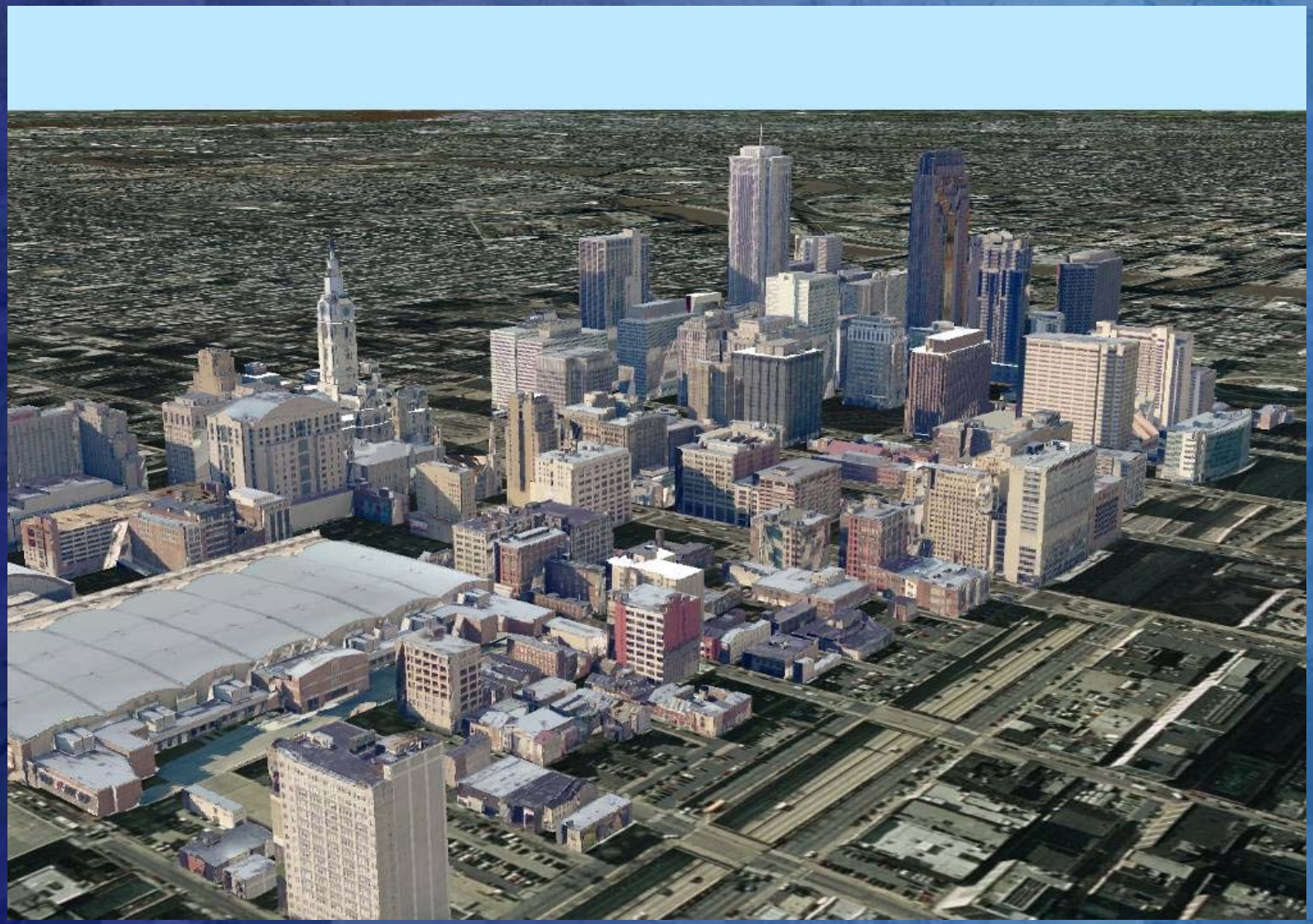


Other Lidar Uses: Urban Modeling



USGS

Lidar Capabilities – Infrastructure



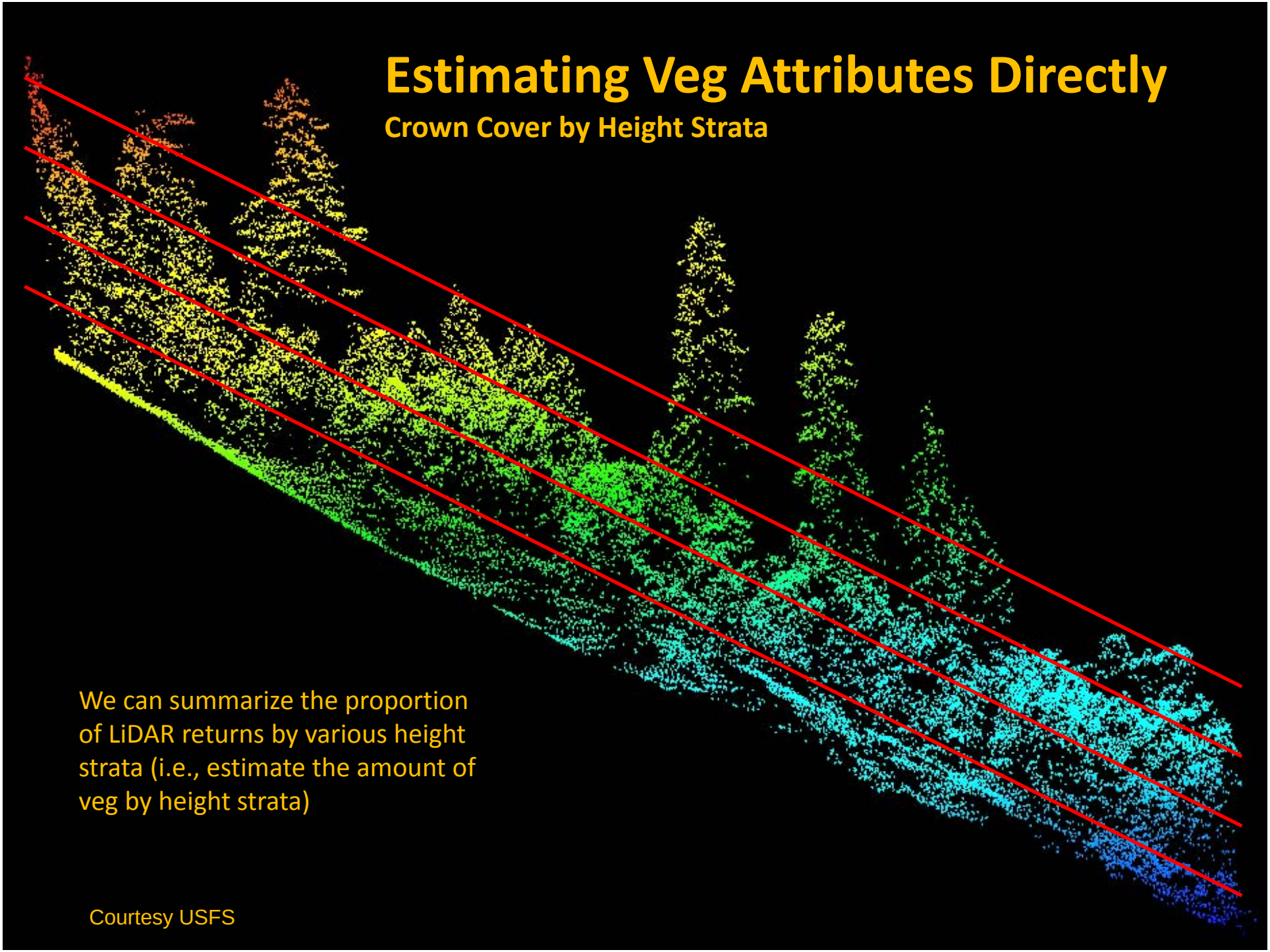
Other Lidar Uses: Feature Extraction

USGS

Lidar Capabilities - Intensity

Estimating Veg Attributes Directly

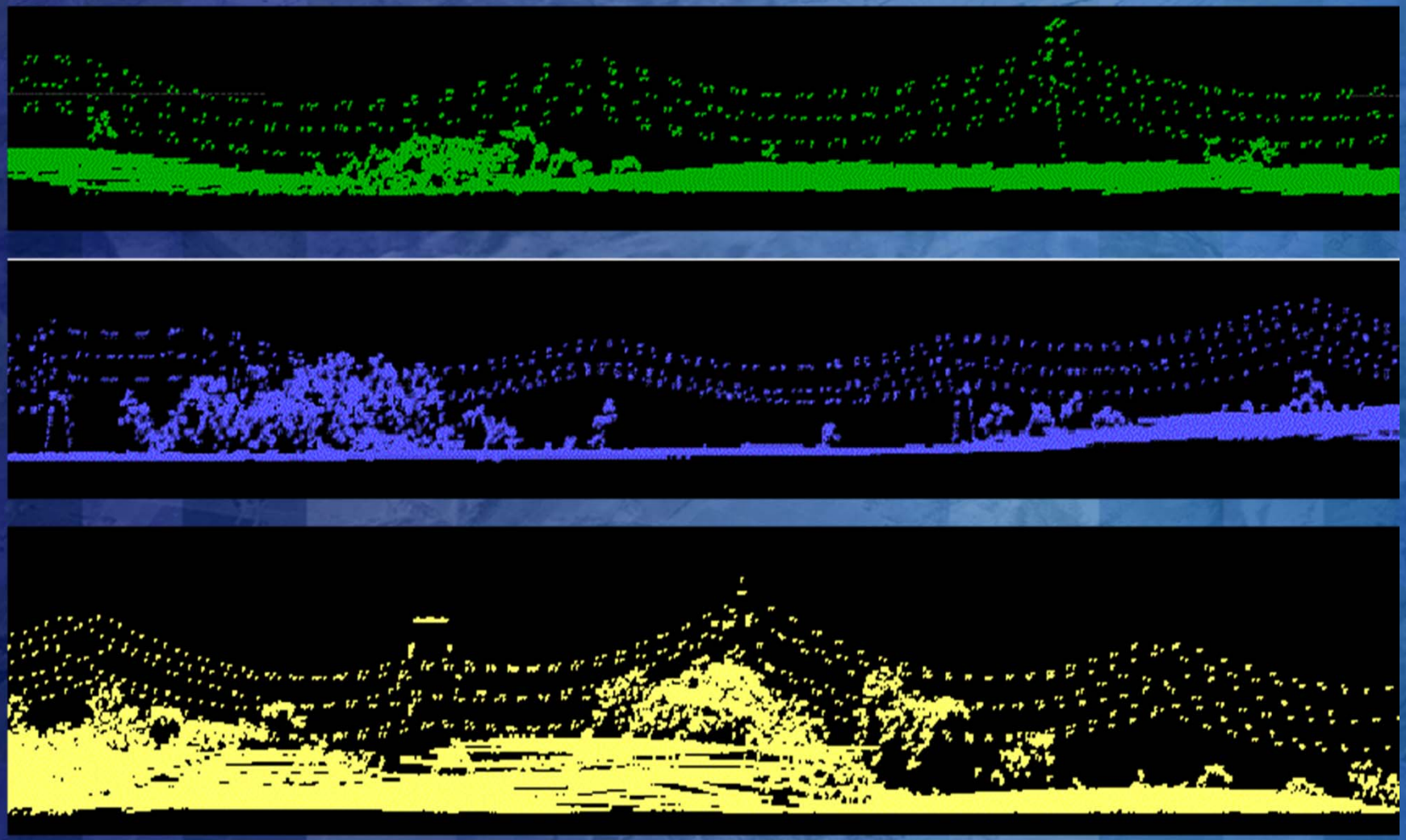
Crown Cover by Height Strata



We can summarize the proportion of LiDAR returns by various height strata (i.e., estimate the amount of veg by height strata)

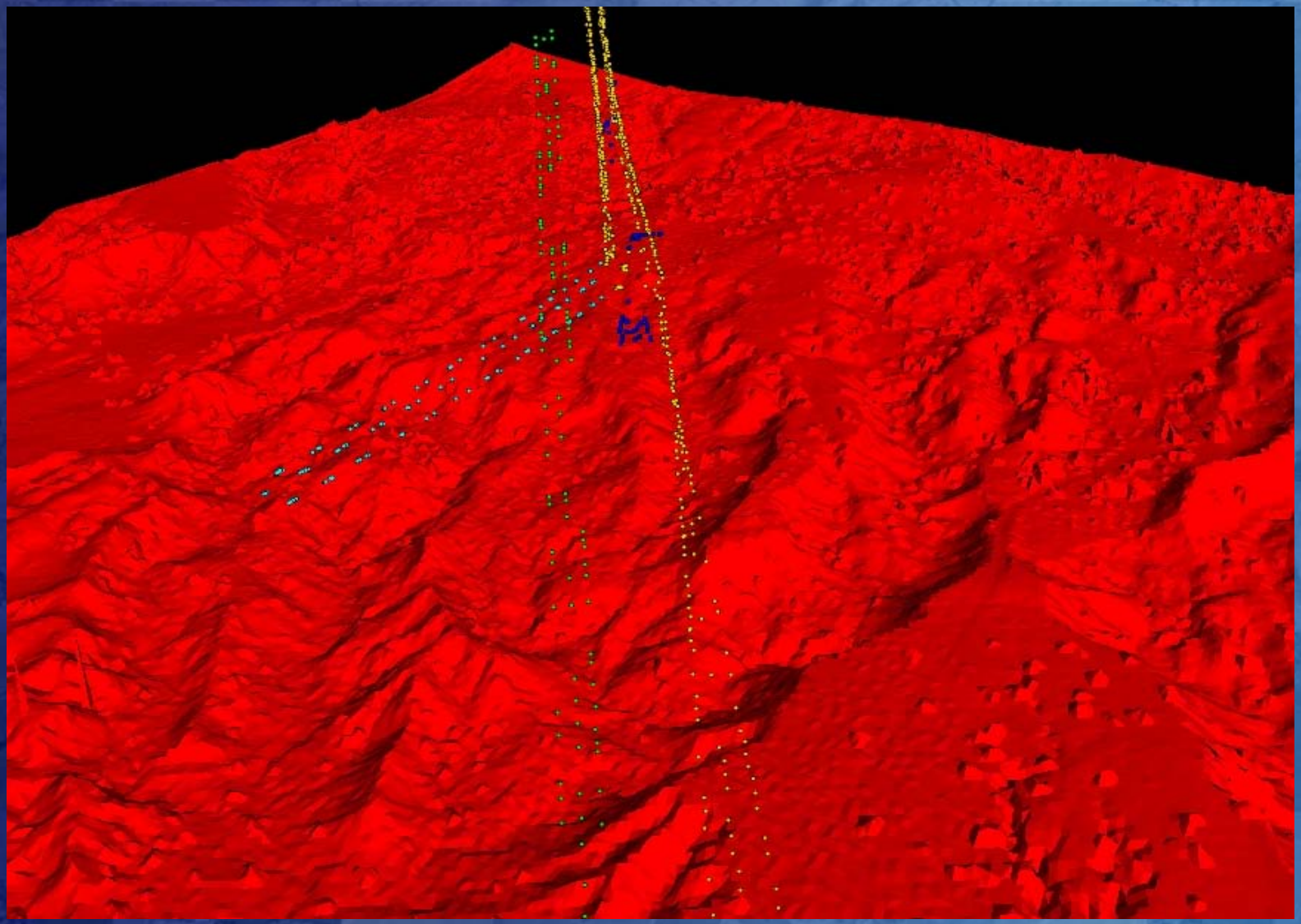
Courtesy USFS

Other Lidar Uses: Utility Mapping



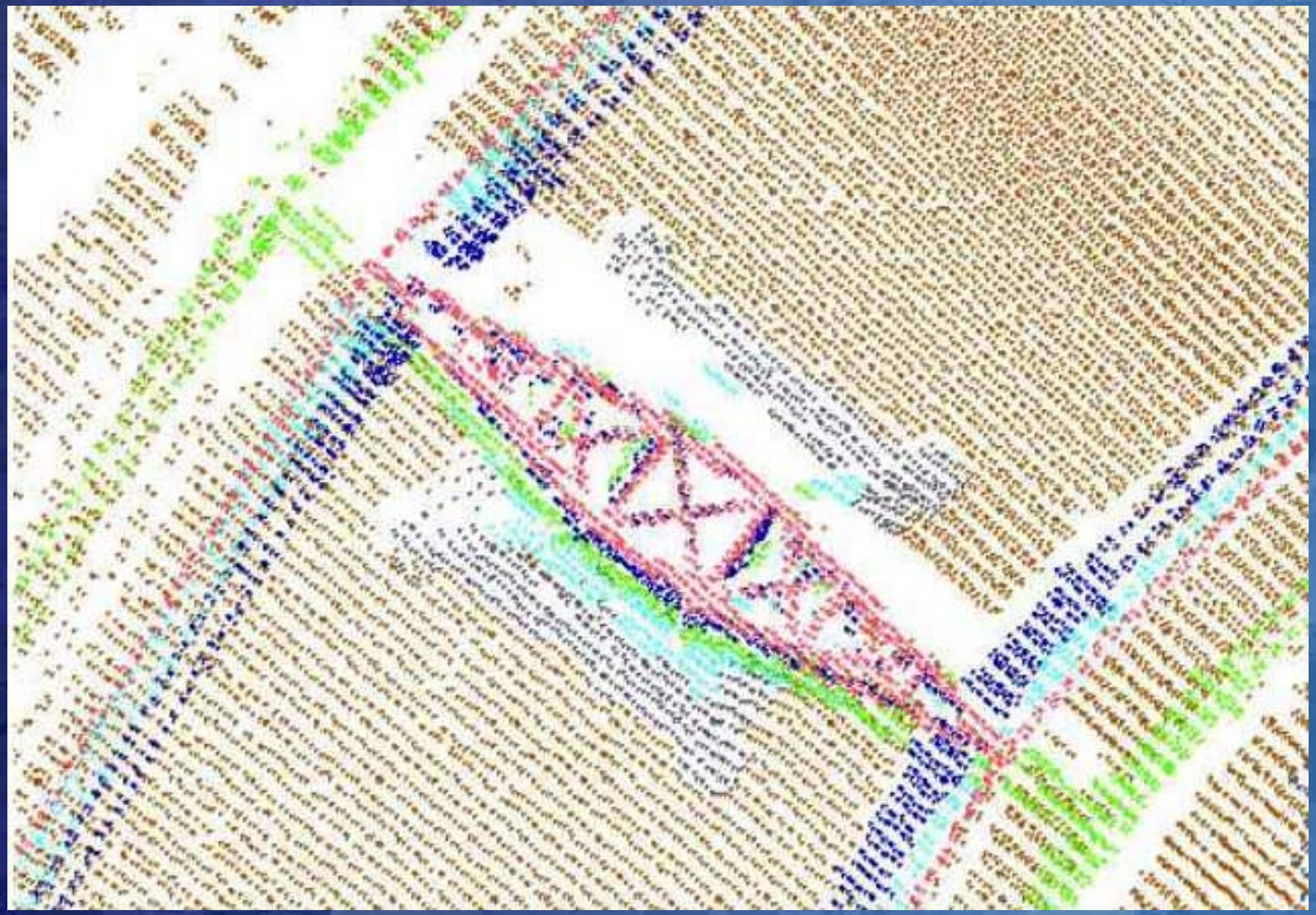
USGS

Multiple Powerlines



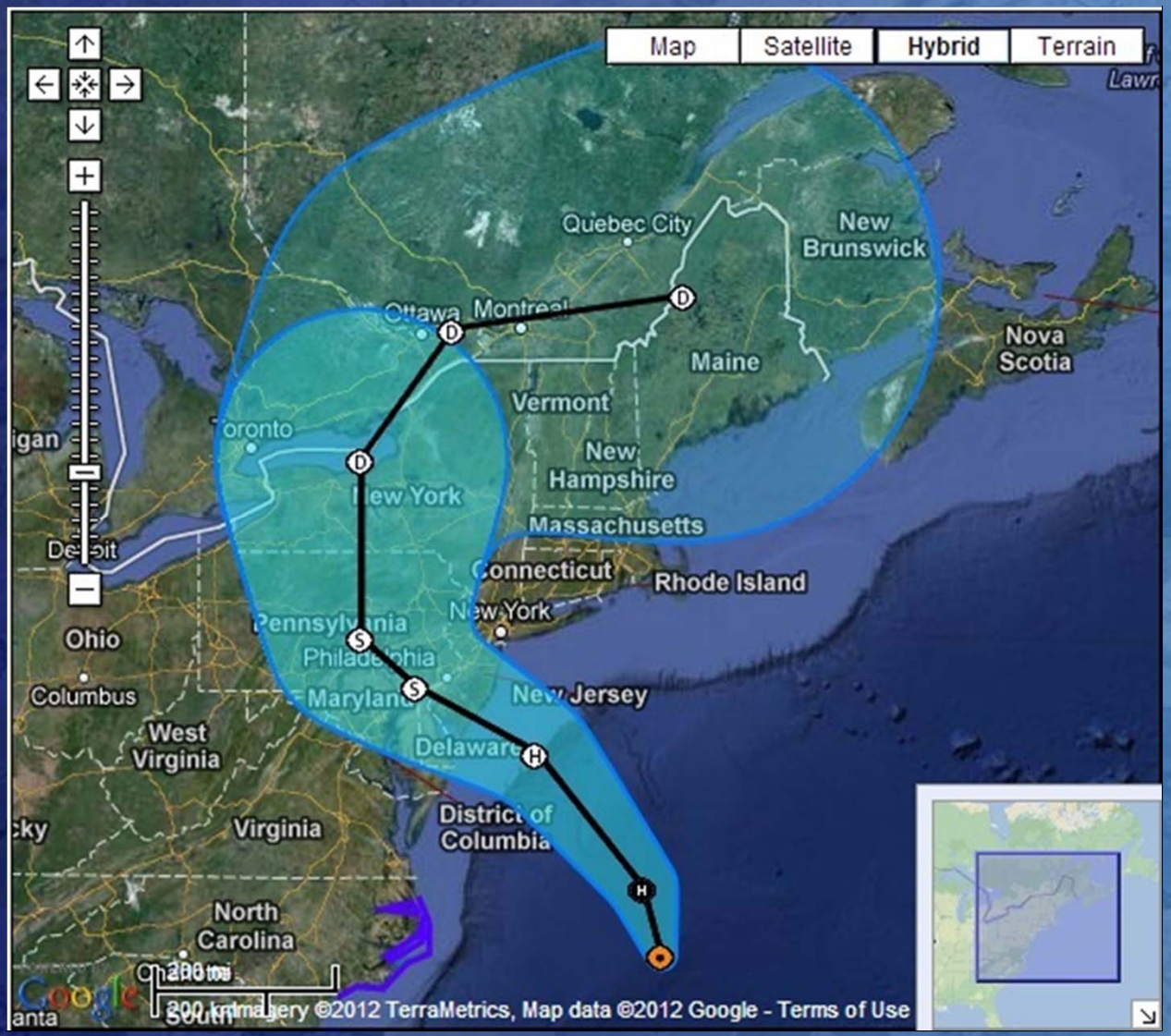
USGS

Power Line Mapping/Inspection



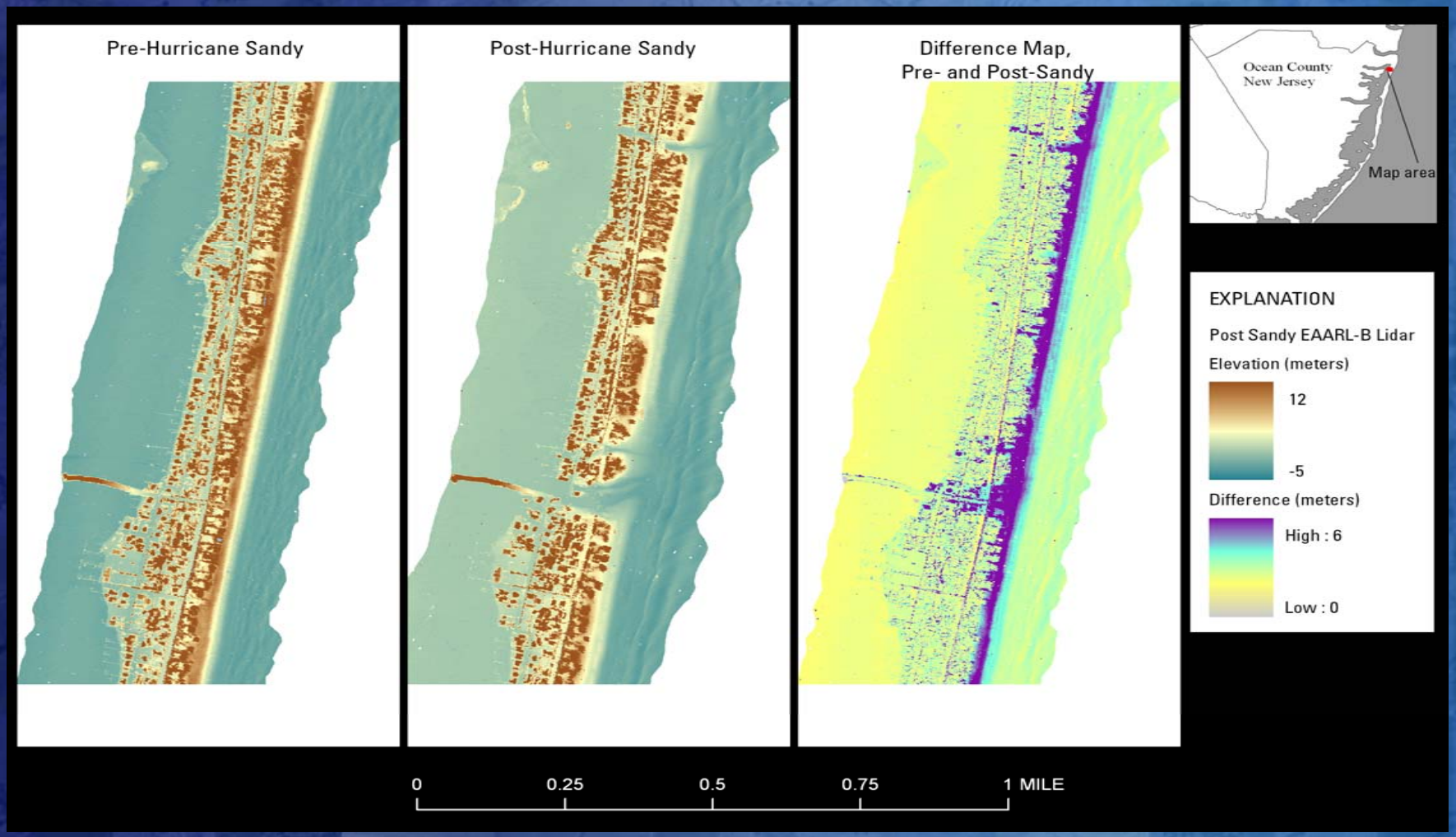
USGS

Hurricane Sandy – Storm Track



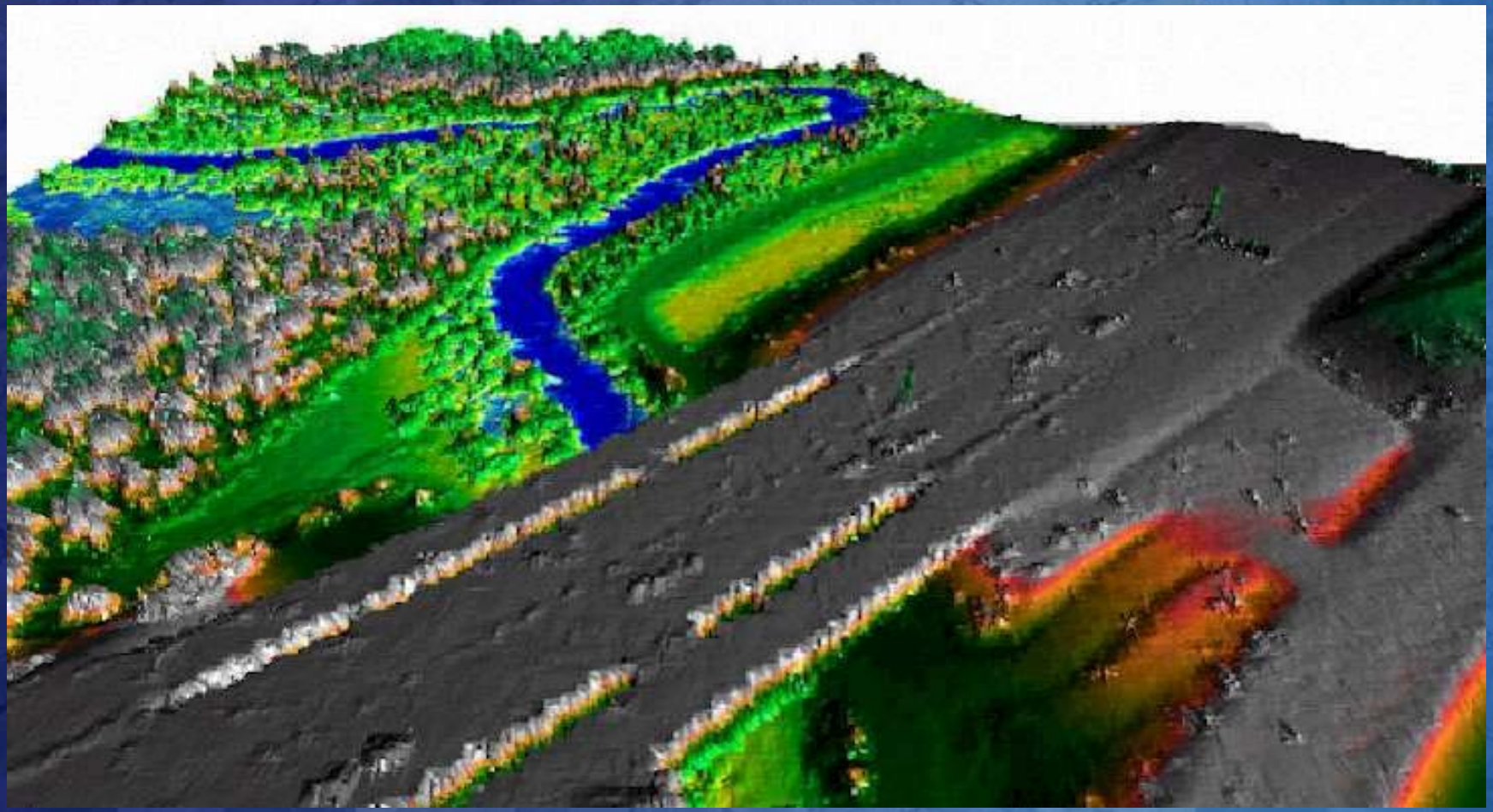
USGS

Hurricane Sandy – Pre and Post Change Mantoloking, New Jersey (Barnegat Peninsula) (USGS EAARL-B)



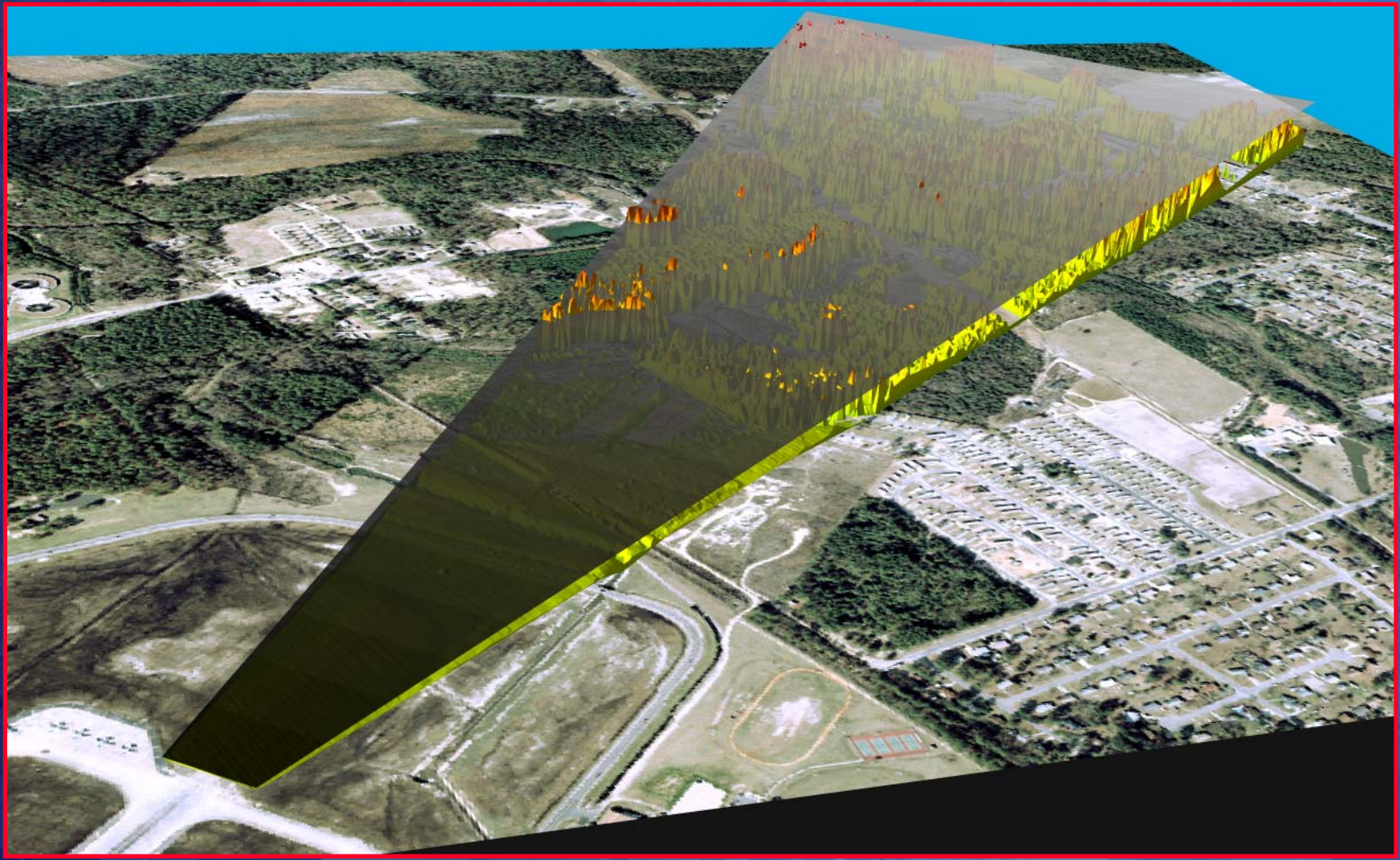
USGS

Other Lidar Uses: Transportation Mapping



USGS

Aviation Safety – Landing Approach

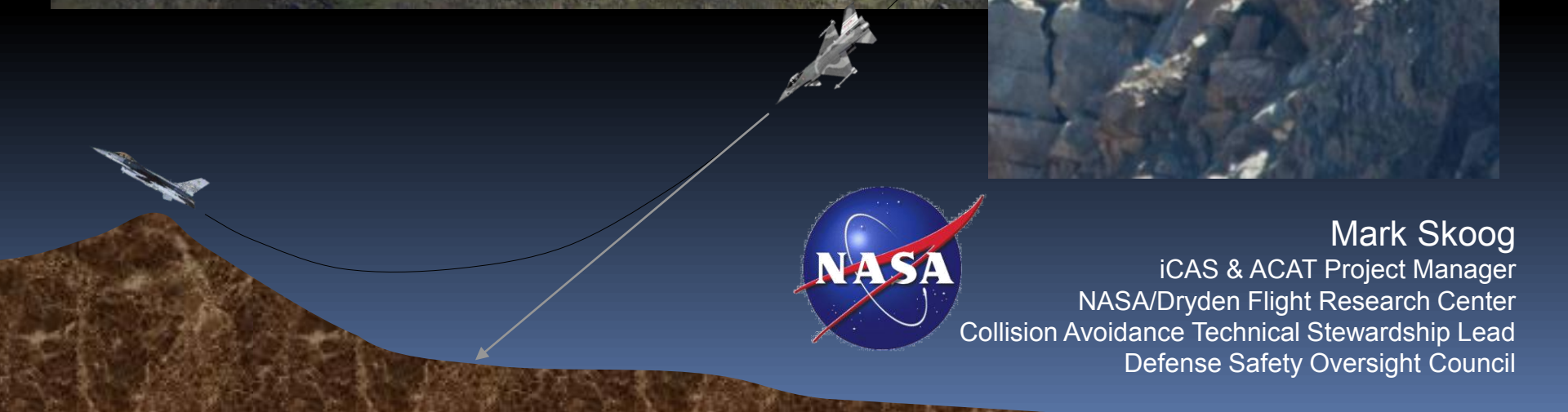


USGS

Questions?

Jeffrey J. Danielson
Physical Geographer
USGS EROS
daniels@usgs.gov

Improving Collision Avoidance Systems

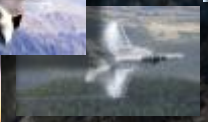


Mark Skoog
iCAS & ACAT Project Manager
NASA/Dryden Flight Research Center
Collision Avoidance Technical Stewardship Lead
Defense Safety Oversight Council

Topics

- **Ground Collision Avoidance Development**
  - Platform Agnostic Architecture
  - Enhanced Precision Elements
- **Digital Terrain**
  - Requirements for Aviation
  - Influences of Product Features
  - Enhanced Terrain Handling

Auto CA Timeline



- 1985 – 97 *AFTI/F-16* Development
- 1998 *AFTI* GCAS Program
- 2000 – 01 GCAS Demos
- 2003 SecDef Mishap Reduction Memo & ACAS Testing
- 2009 ACAT/FRRP
- 2008 – 11 F-22 NASA ACAT Development
- 2011 ACAT/SUAV
- 2011 – 14 F-16 Integration & Fielding
- 20?? F-22 & 35 Integration

F-16
2010 Risk Reduction Project
2014 Production Fielding

Small UAV
2012 Migration to Smart-Phone

RECENT WORK

What is Different about this Work?

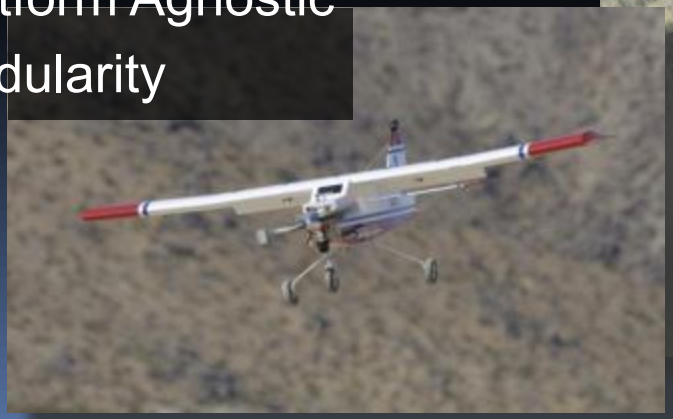
Understanding

- **Requirements**
  What is most Important
  1. **Do No Harm**
  2. **Do Not Interfere**
  3. **Prevent Collisions**
- **Functionality**
  - Sensor Agnostic
  - Platform Agnostic
  - Modularity

Precision

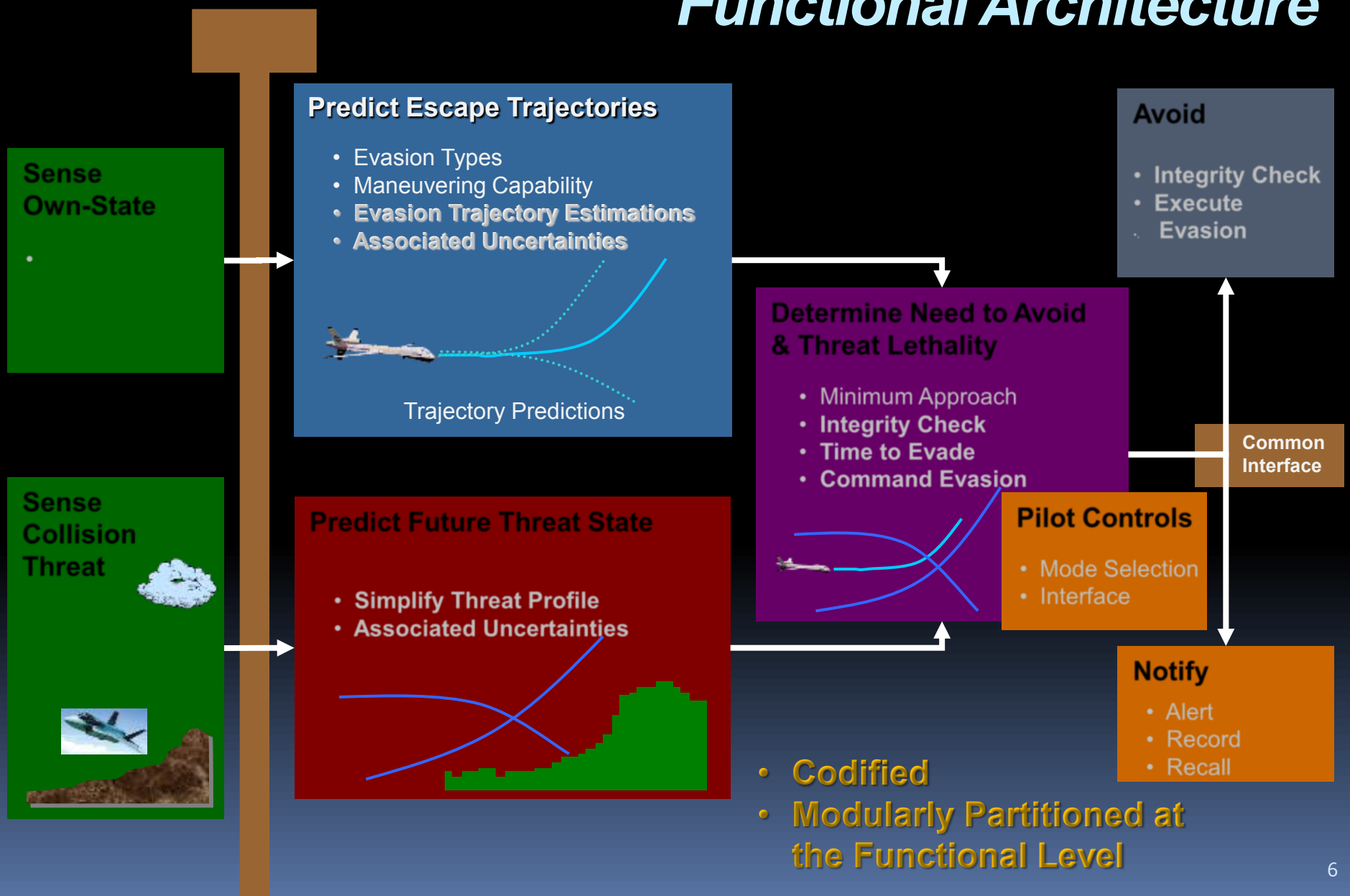
- Digital Terrain
- Terrain Handling
- Aircraft Performance Modeling
- Pilot Interface

Mountainous SDO
0 Buffer
87' Min
0.2 sec.



Mountainous SDO
100' Buffer
125' Min
0.2 sec.

ACAT Common Functional Architecture



- Codified
- Modularly Partitioned at the Functional Level

Flight Test Results

Overall

- **F-16 Flight Test Evaluation**
  - 103 Flights Conducted
  - 141 Total Flight Hours
  - 1670 Recoveries
  - **Conclusions**
    - Excellent Mishap Prevention
    - Nuisance Free Operation
- **Small-UAV Test Evaluation**
  - Added Many Features for Low Performance Aircraft
  - Implemented Algorithm on Smart Phone
  - 21 Flights
  - 208 Recoveries
  - **Conclusion**

Mountainous SDO
0 Buffer
87' Min
0.2 sec.

Smooth Terrain
0 Buffer
100' AGL
LOW Protection

Extreme Terrain
0 Buffer
170' Min
LOW Protection

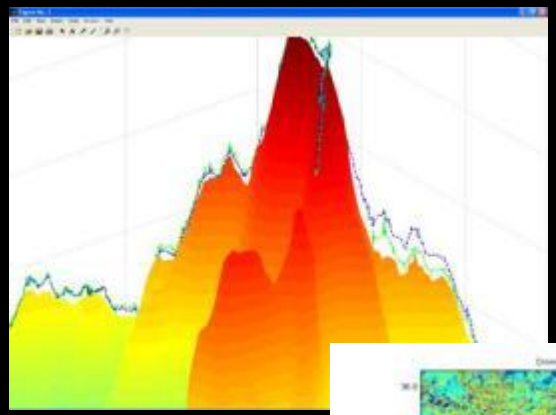
Mountainous SDO
100' Buffer
125' Min
0.2 sec.

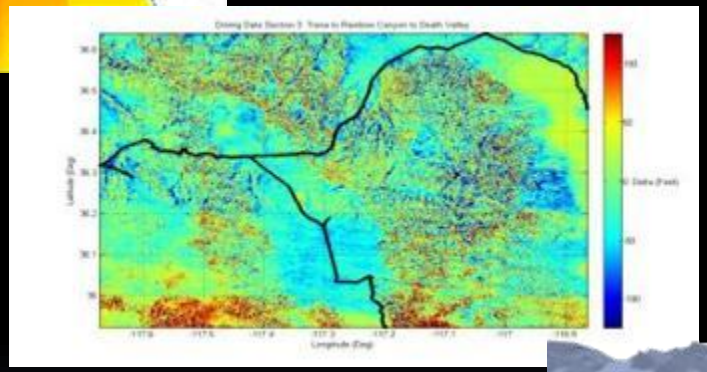
A Level of Precision has been Achieved that May Allow a Walk-On Smart Device to Provide a Capability Better than Today's EGPWS & TAWS

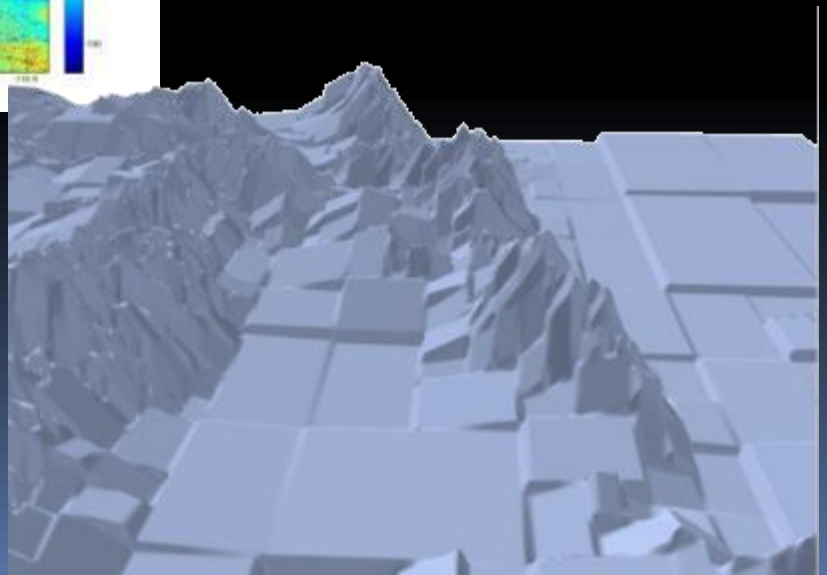
083:22:32:52.82
23:35:01
1.0
50
445
40
LOWLEVEL
035.0
2650
32.0
SIM
0.70
28
294
30
31
R
310
7.0
NAV
175
052
FIL
90
B073.0
00923
073X06
BINGO
6
NO GPW
SET
TOTAL
1988LBS
H012 V16

Digital Terrain

Requirements, Products & Techniques

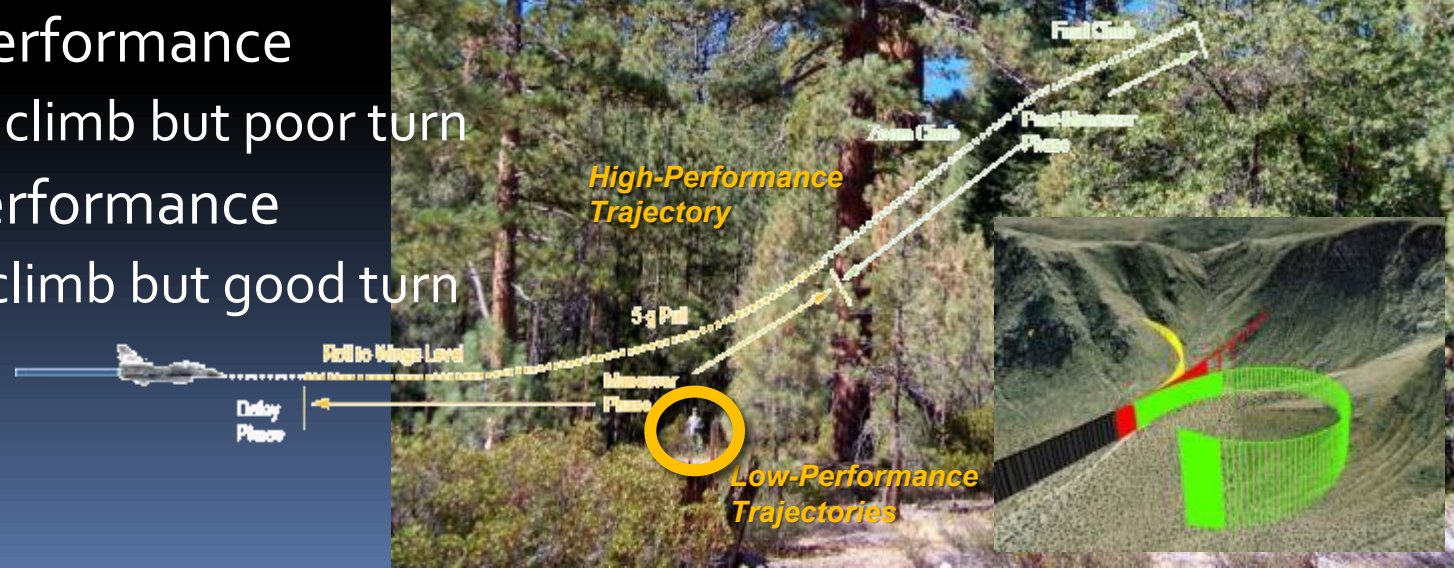






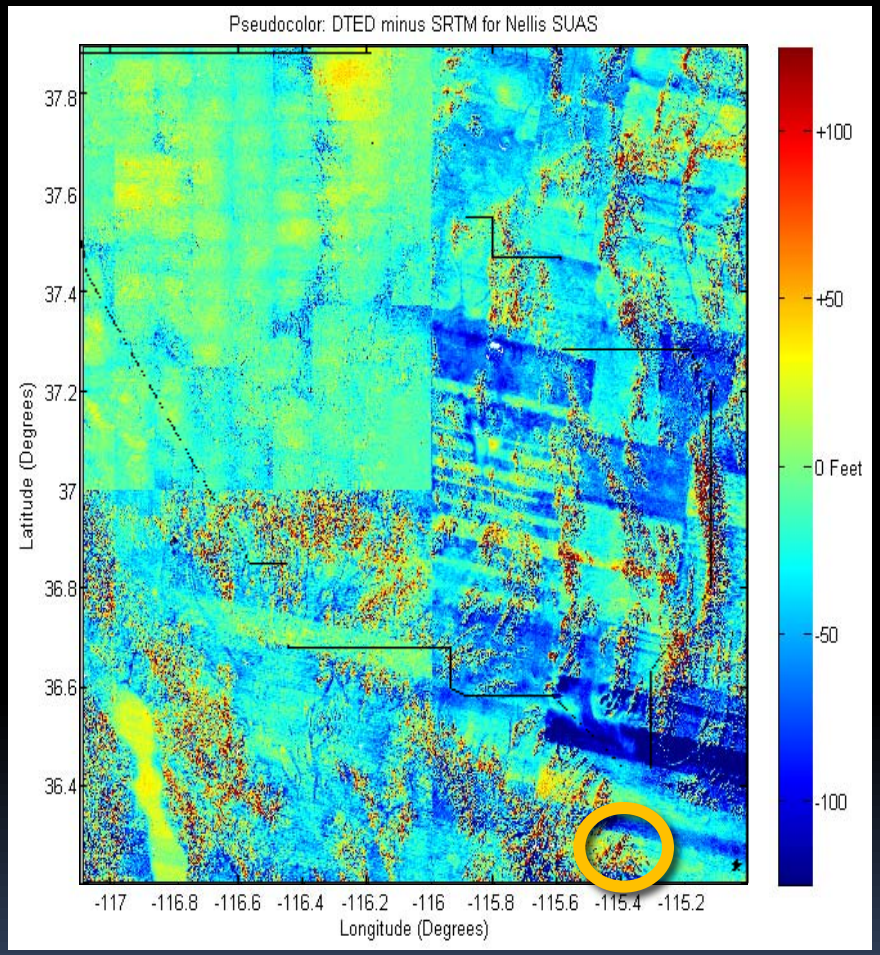
Requirements for Aviation

- **Bare-Earth vs First Return**
  - Most Products are Bare-Earth
  - Aviation needs First Return
- **Required Level of Fidelity Varies**
  - Horizontal vs Vertical = Mountainous flying vs Smooth
  - Commercial
    - Only close to terrain near runway
  - High-Performance
    - Good climb but poor turn
  - Low-Performance
    - Poor climb but good turn



Digital Terrain Artifacts & Evaluation Techniques

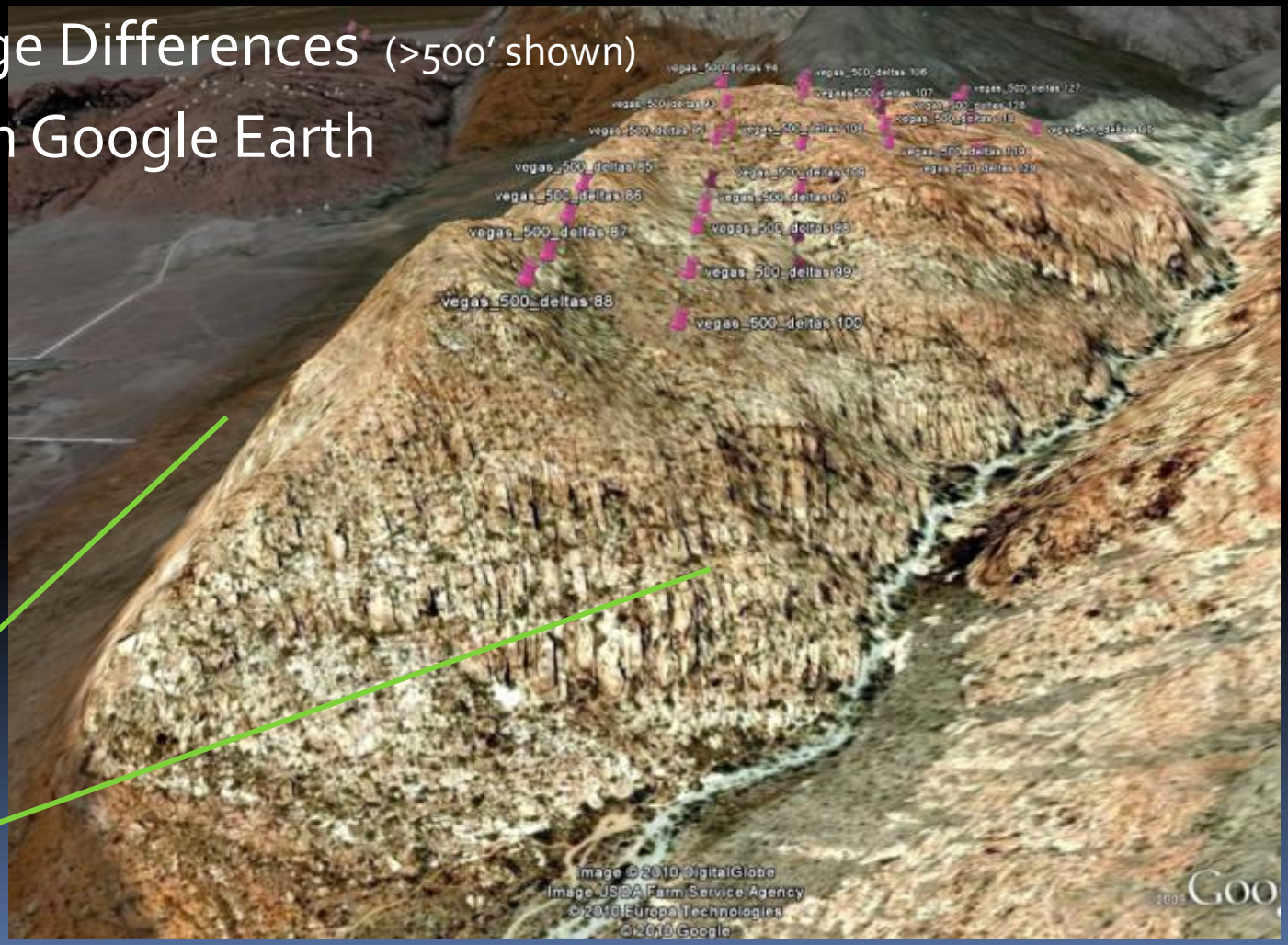
- **New Products Available**
  - Shuttle Radar Topography Mission (**SRTM**)
  - Others
  - Different Products Give Different Elevations for Same Location



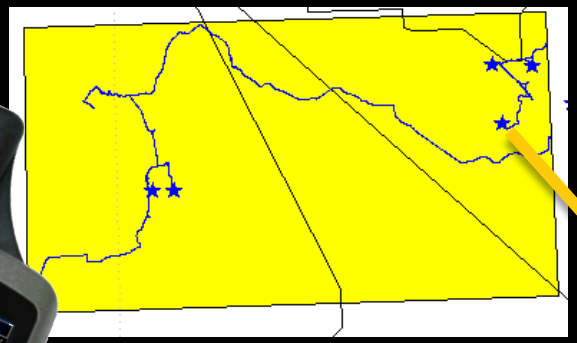
Both Products Can't be Right if they have Different Elevations

DTED Survey

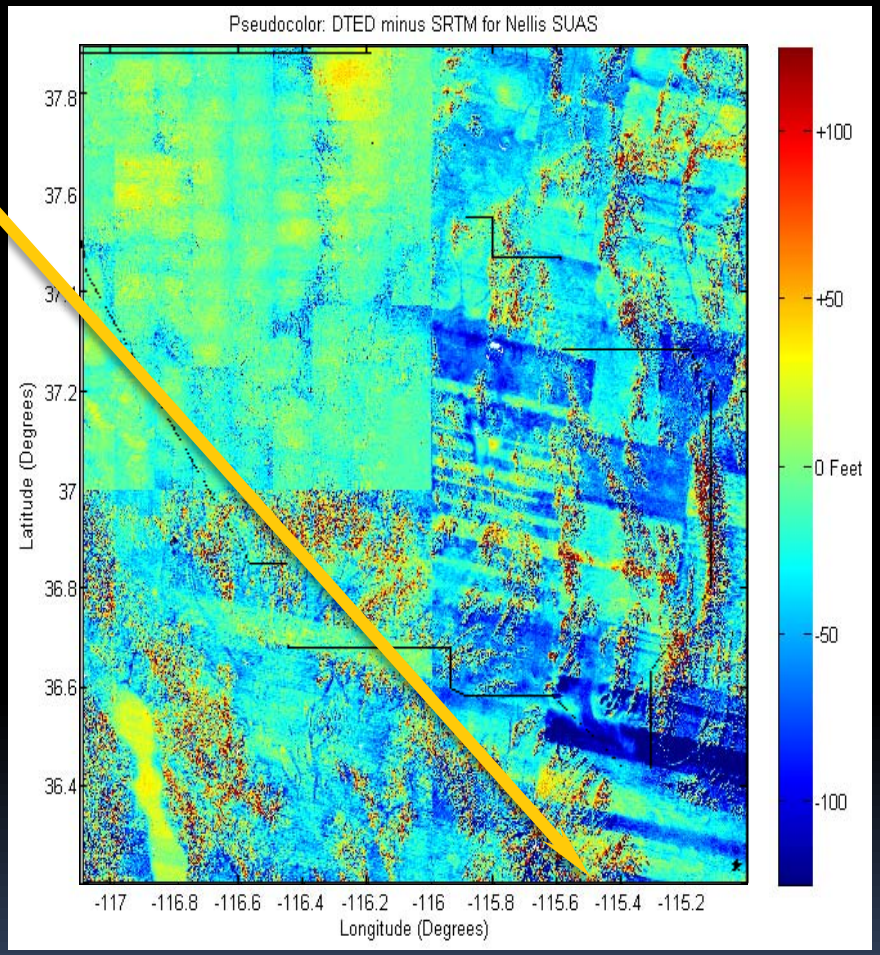
- **Identify Points of Interest**
  - Flag Large Differences (>500' shown)
  - Review in Google Earth



DTED Survey

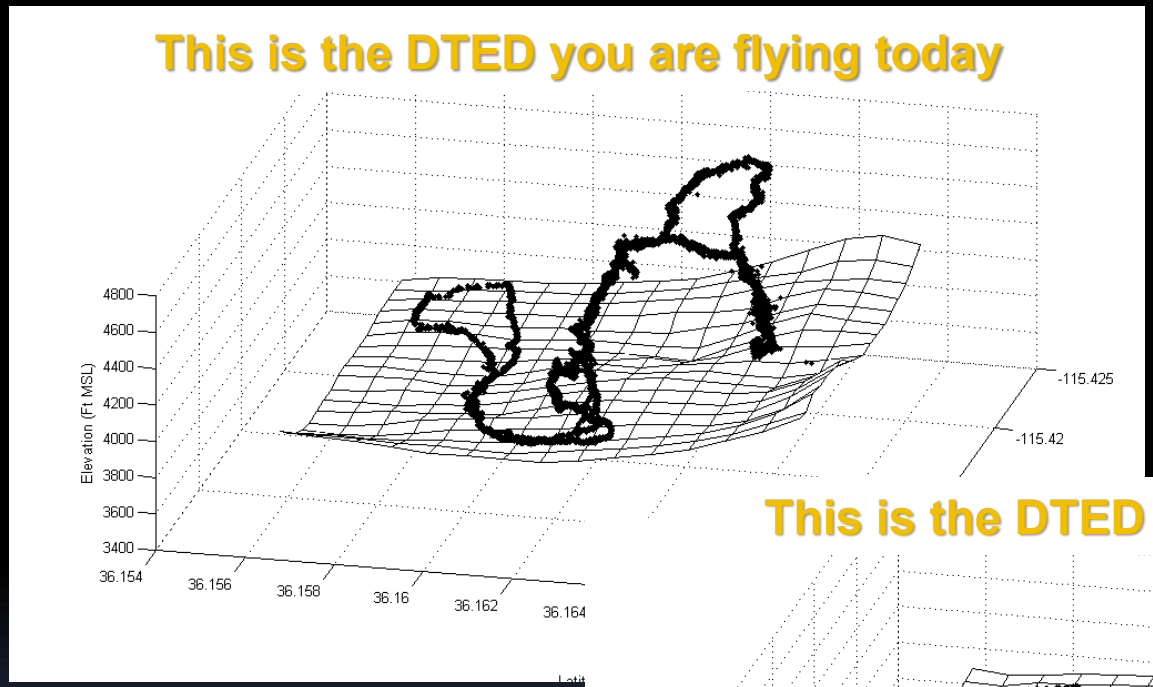


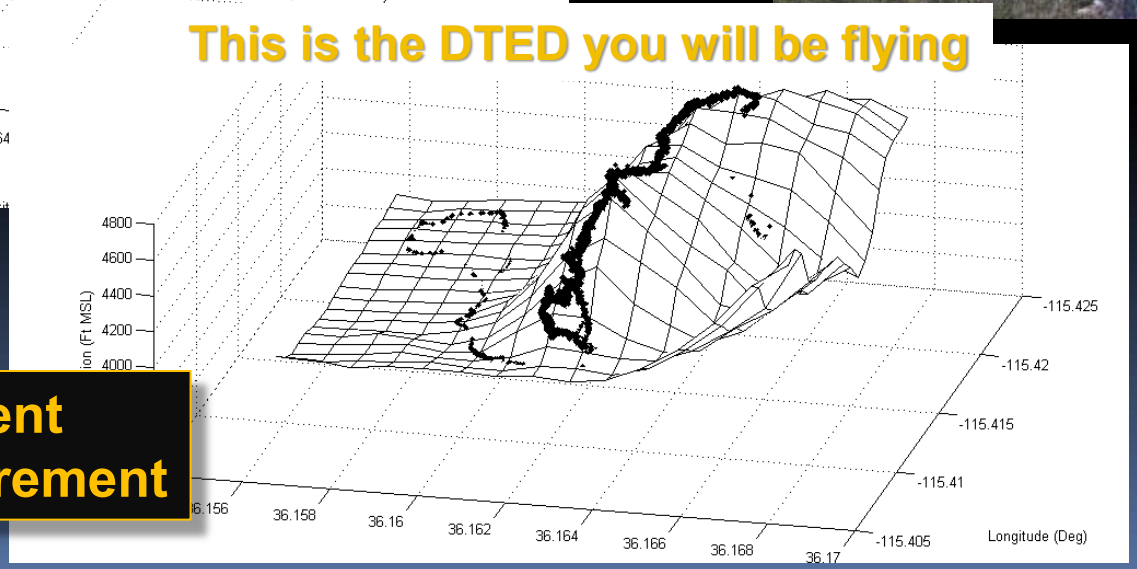
GPSmap 60CSx
GARMIN


Pseudocolor: DTED minus SRTM for Nellis SUAS
Latitude (Degrees)
37.8
37.6
37.2
37
36.8
36.6
36.4
Longitude (Degrees)
-117
-116.8
-116.6
-116.4
-116.2
-116
-115.8
-115.6
-115.4
-115.2
+100
+50
0 Feet
-50
-100

DTED Requirements

CANNOT be overcome with creative design

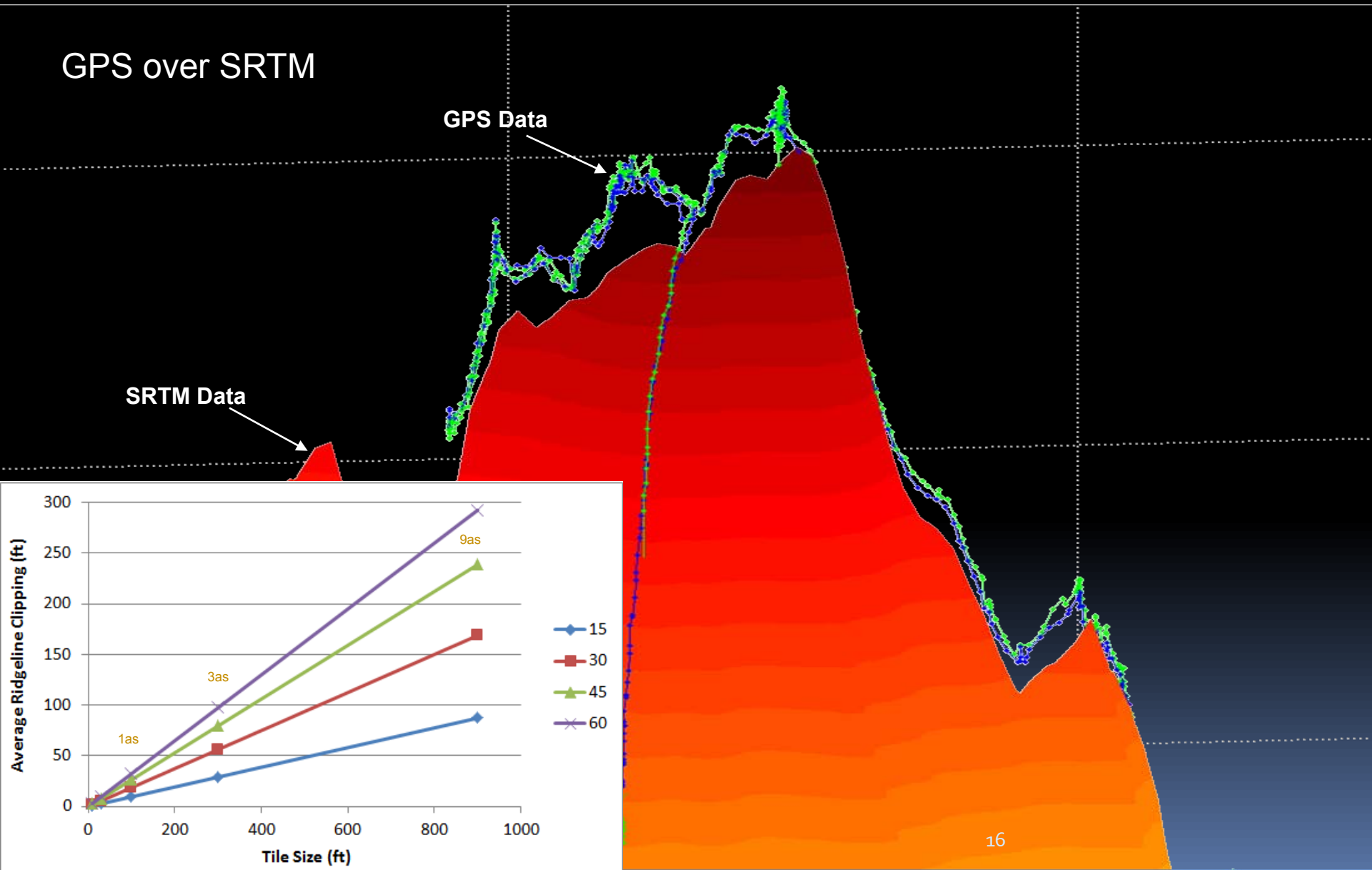




DTED Management
Is an Ongoing Requirement

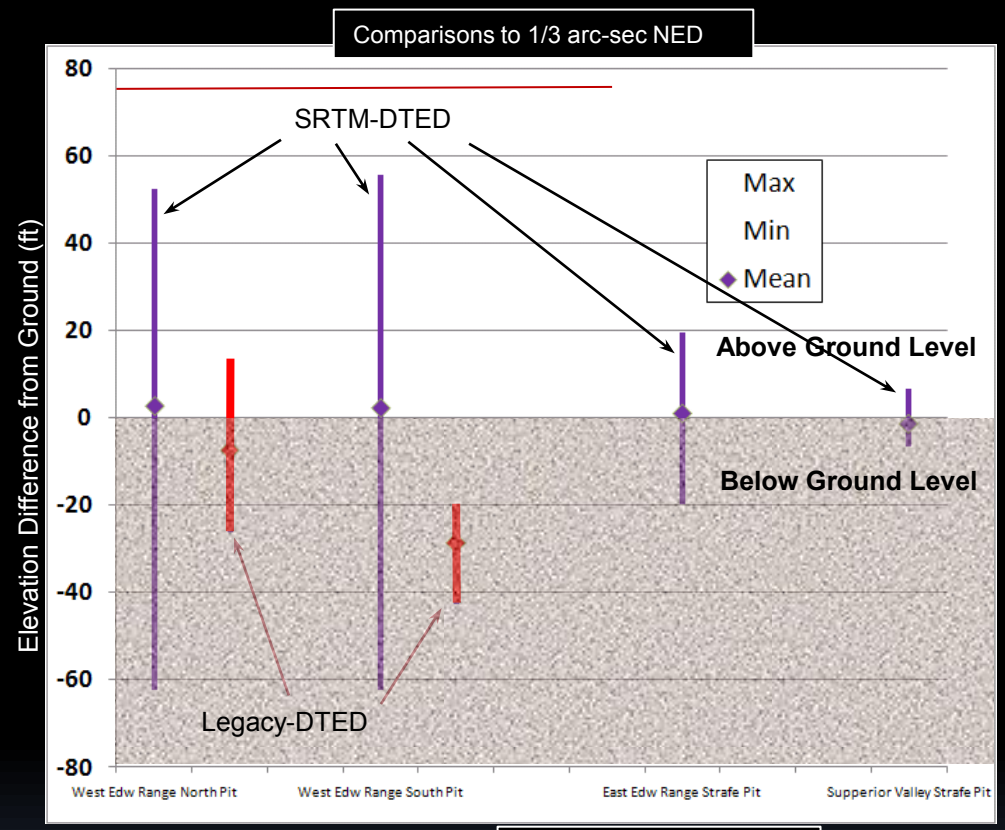
Graphic of Ridgeline Effect

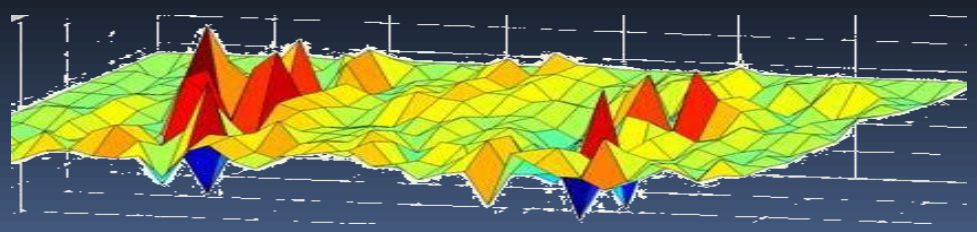
GPS over SRTM



SRTM Background Scatter

- **SRTM DTED Error**
  - Edwards west range has particularly noisy SRTM data
  - 30' DTED uncertainty used in strafing mode





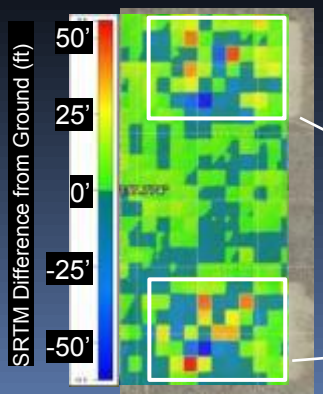
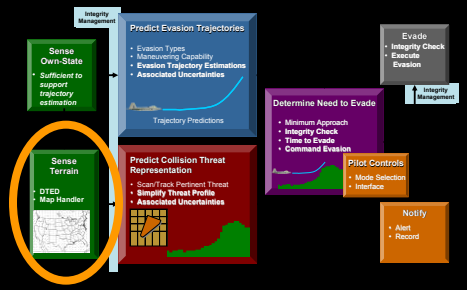


Illustration of high freq. noise in SRTM data over Edwards west range strafing pits

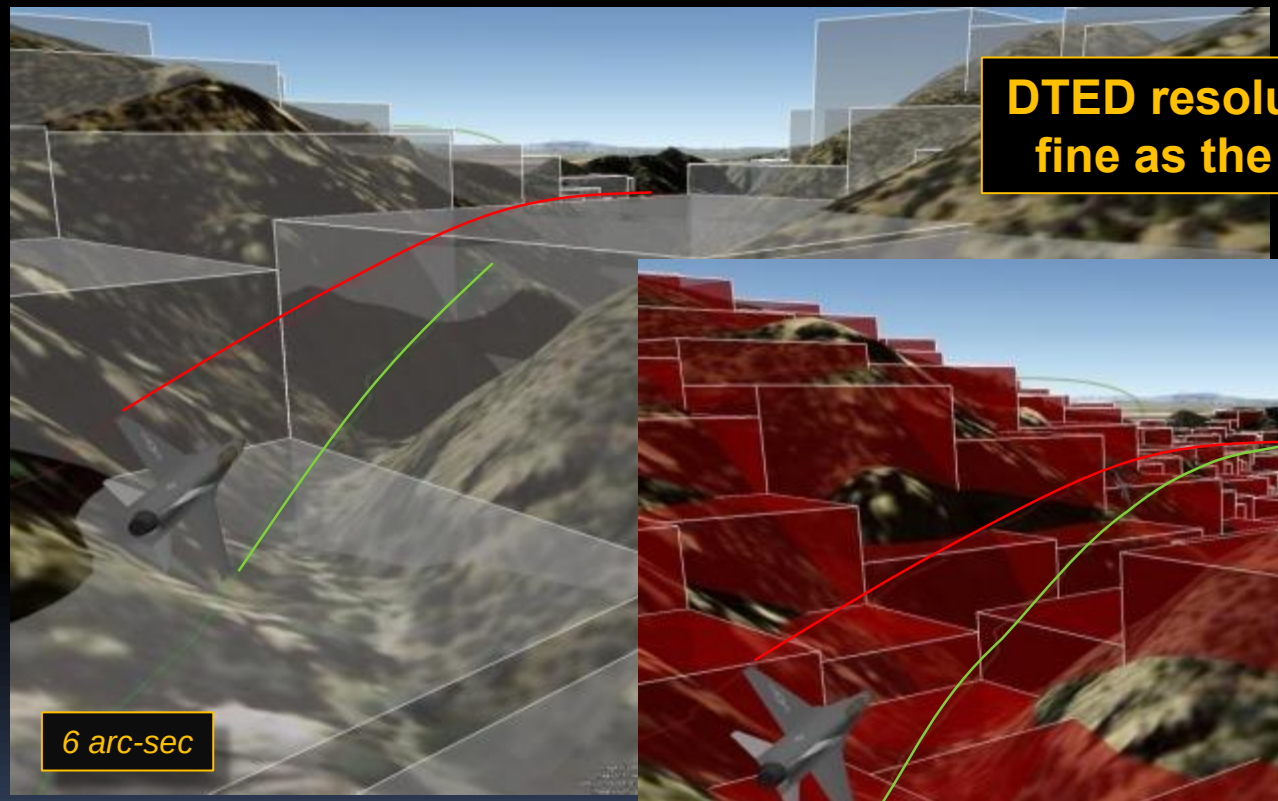
	North Pit		South Pit	
Mean	2.86459	ft	2.402481	ft
StdDev	19.3191	ft	20.64314	ft
Min	-62.3352	ft	-62.3352	ft
Max	52.4928	ft	55.7736	ft

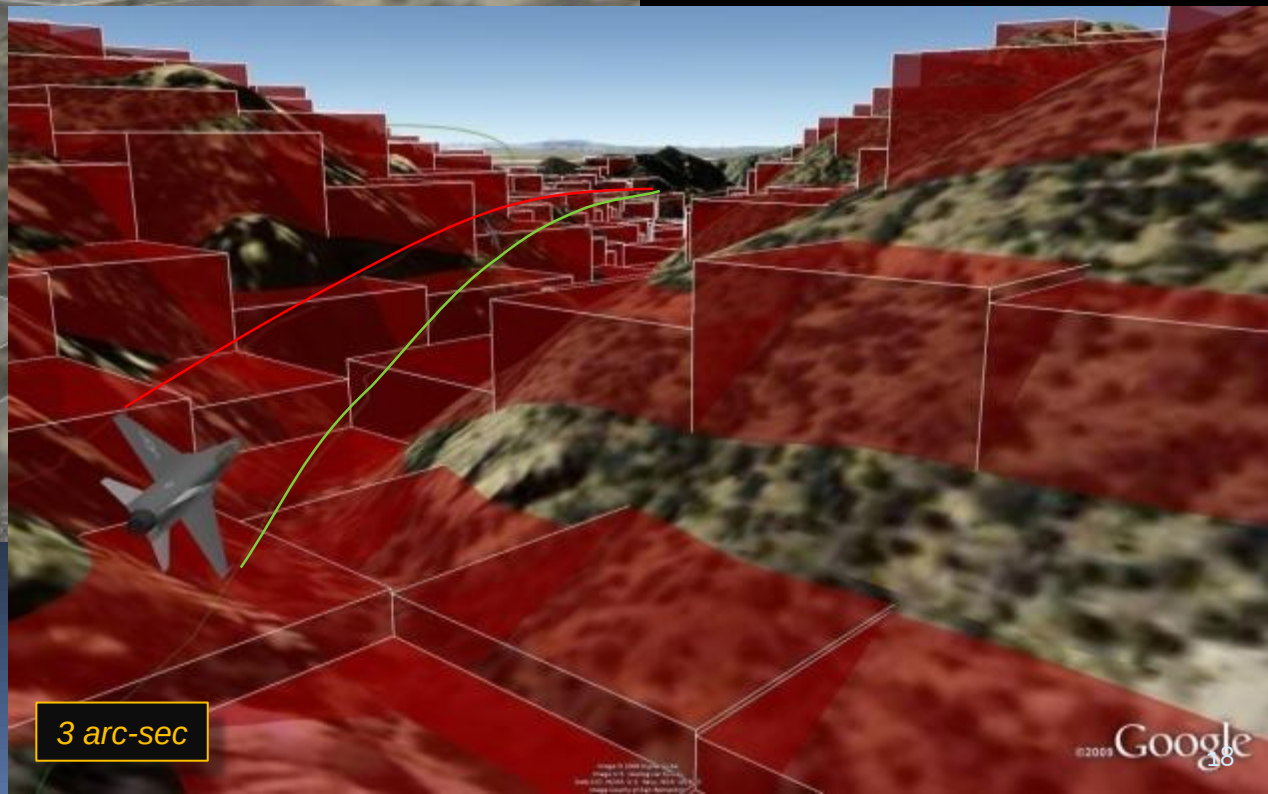


FRRP F-16

DTED Resolution Findings

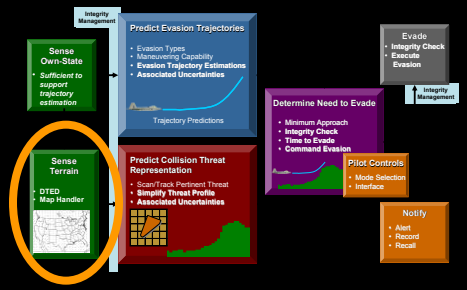
DTED resolution must be at least as fine as the altitude of the mission





Binary-Tree Tip-Tilt

(Patent Pending)



Original DTED

- **Map Size**
  - Original DTED = 2.76 Gbytes
  - Binary-Tree Tip-Tilt = 328 Kbytes

  8415 : 1 Compression Ratio
- **Current F-22 Plan**
  - 1000' Flight Globally
  - Landing at 1500 Bases
  - Upgrade Computers to allow Global Storage

  <200M for Entire Globe

- **Tight control of errors induced by compression**
  - Easily Adjusts to Mission Requirements
  - Geographic Control of Errors
  - Re-Rasters at any Resolution
- **Rapid Decompression**

Compressed Terrain

iCAS-GA

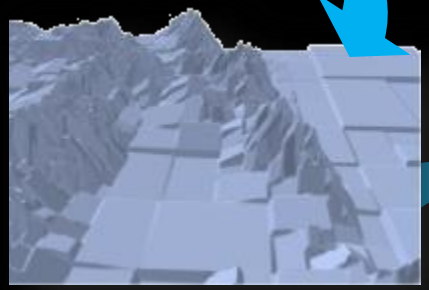
WHAT IS NEXT?

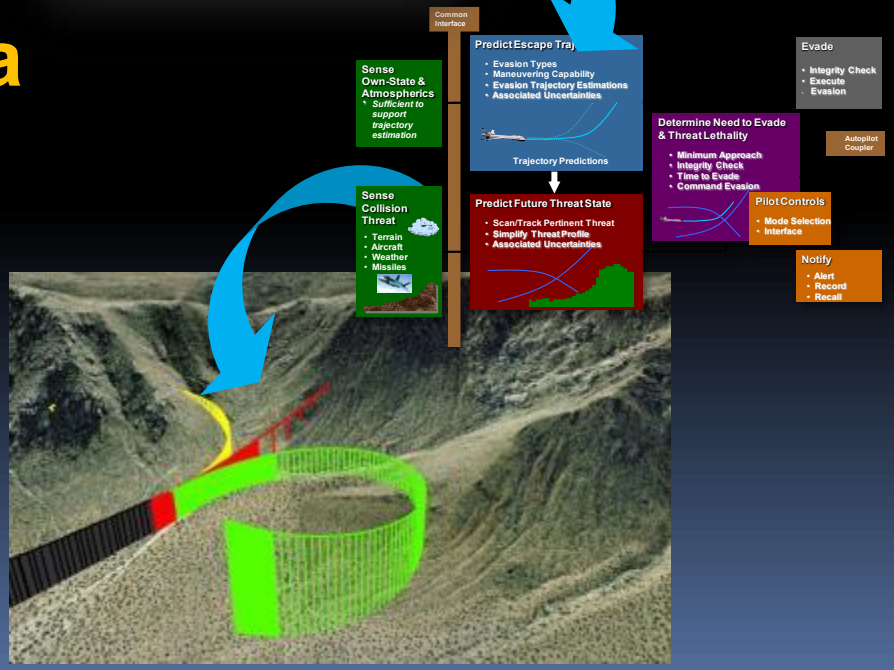
IMPROVED COLLISION AVOIDANCE SYSTEM

iCAS

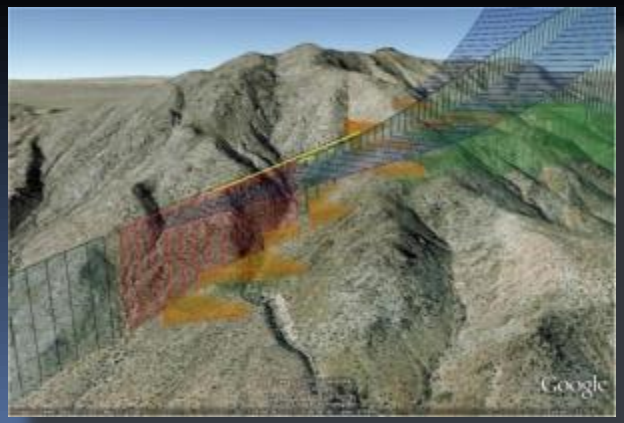
iCAS is:

- >300 Gb of Global Terrain Data
- To 180 Mb File
- Processed through a 108k algorithm
- Issuing 2 bits to direct a pilot when and where to avoid





DISCUSSION



Panel #3: Aviation Safety Panel

Objective: This panel will provide an understanding of how GIS data and technologies facilitate the improvement of aviation safety from gate to gate.

Mike McNerney, Ph.D., Federal Aviation Administration
Airport GIS Program Safety Benefits: A Change in Direction

Dejan Damjanovic, GeoEye
Challenges in Terrain and Obstacle Identification

Christopher Knouss, MITRE Corporation
Enabling Aviation Analysis

Rich Fosnot, Jeppesen Aviation & Marine Safety
Airport Moving Map (AMM) and Terrain & Obstacle Databases

Airport GIS Program Safety Benefits

A Change in Direction

Dr. Michael T. McNerney, P.E. - FAA

Presented to | NTSB GIS for Aviation Safety Symposium

Date | December 4, 2012

US Airports 2011

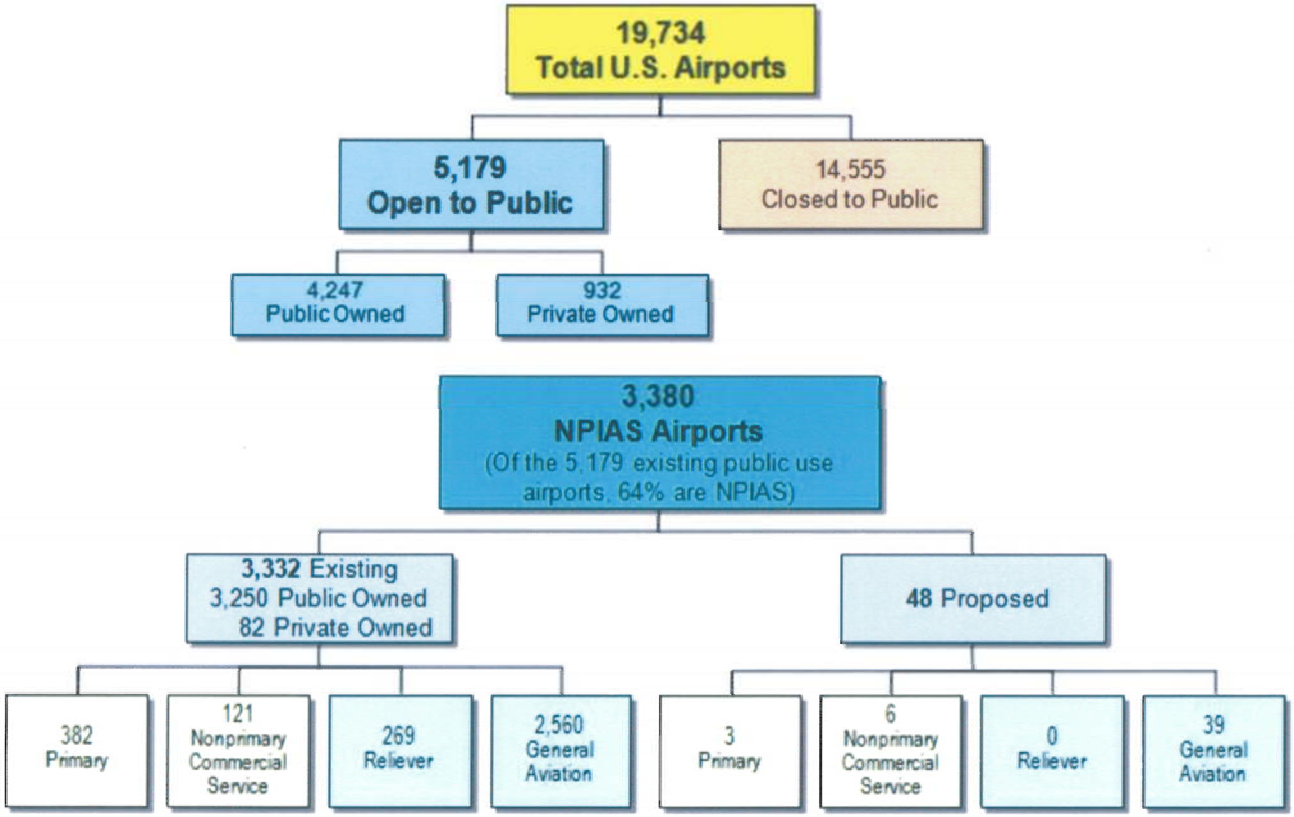


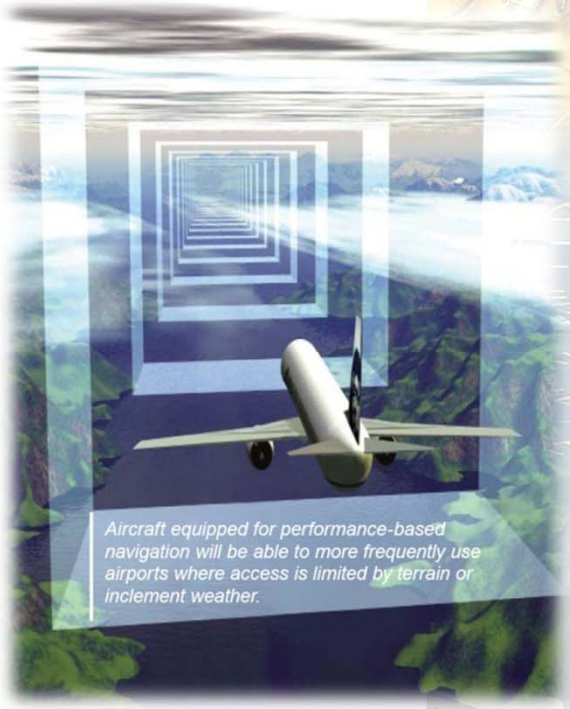
Figure 6 NPIAS Report to Congress – Sept 27, 2010

https://airports-gis.faa.gov/

Federal Aviation Administration

Justification for Airports GIS

Improve Efficiencies	• Single, authoritative, accessible data source
Reduce Costs	• Airports, FAA, consultants
Improve Safety	• Increased need for real-time data accuracy
NextGen	• A repository of airport information (not just survey data)



What is the FAA Airports GIS Program

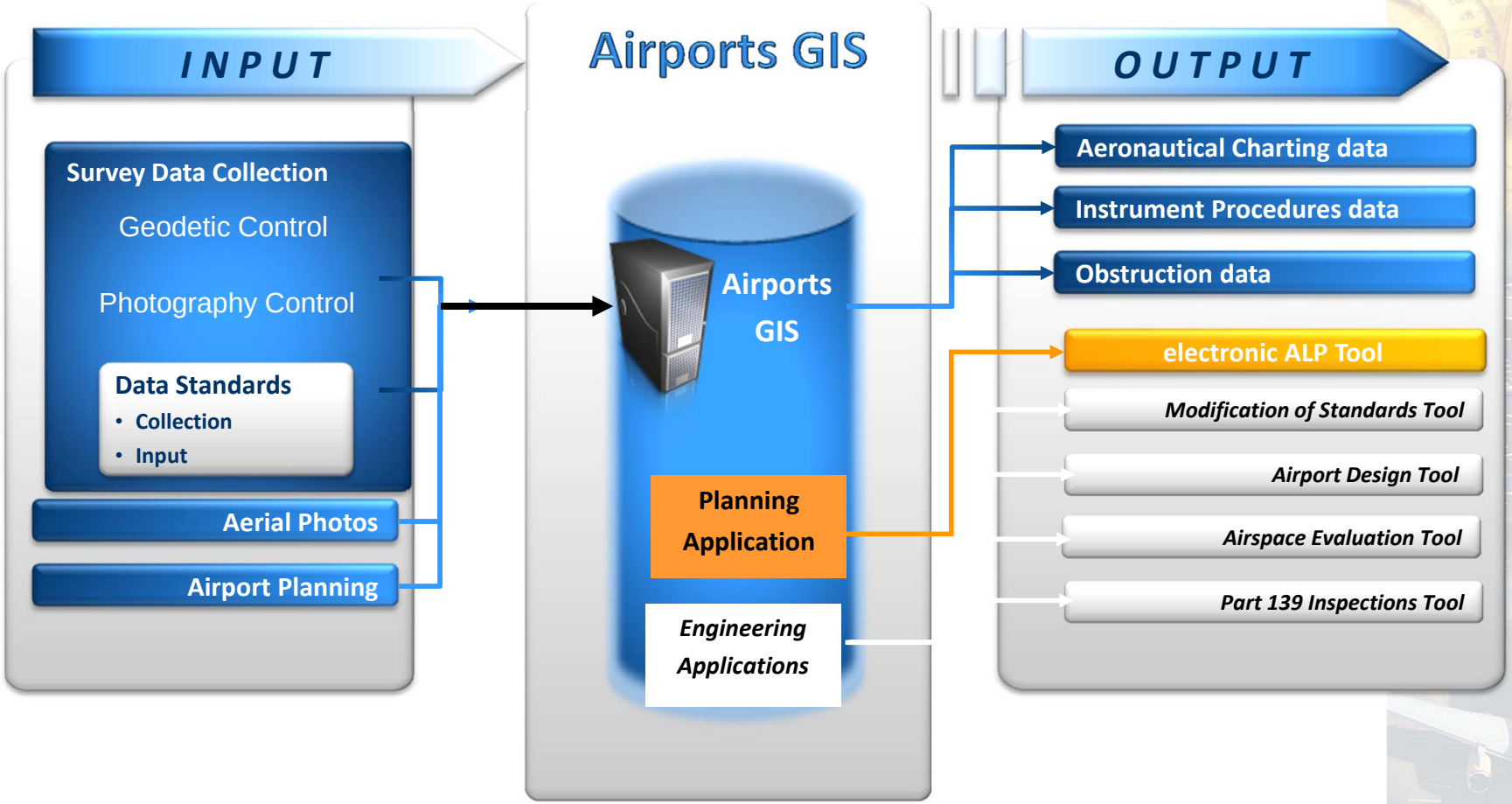
- About 547 airports have commercial service in US
- About 3,331 receive federal funding and are included in the National Plan of Integrated Airport System (NPIAS)

Full Feature Geospatial Data Collection

- There are about 13,450 Airports and 5,856 Heliports
- Of those about 8,377 Airports and 5,508 Heliports are private use landing facilities.
- About 19, 782 landing facilities in the FAA database including seaplane bases, gliderports, ballonports and ultralight Flightparks

Airport point location and attributes only -2013

Airports GIS



https://airports-gis.faa.gov/

Federal Aviation Administration

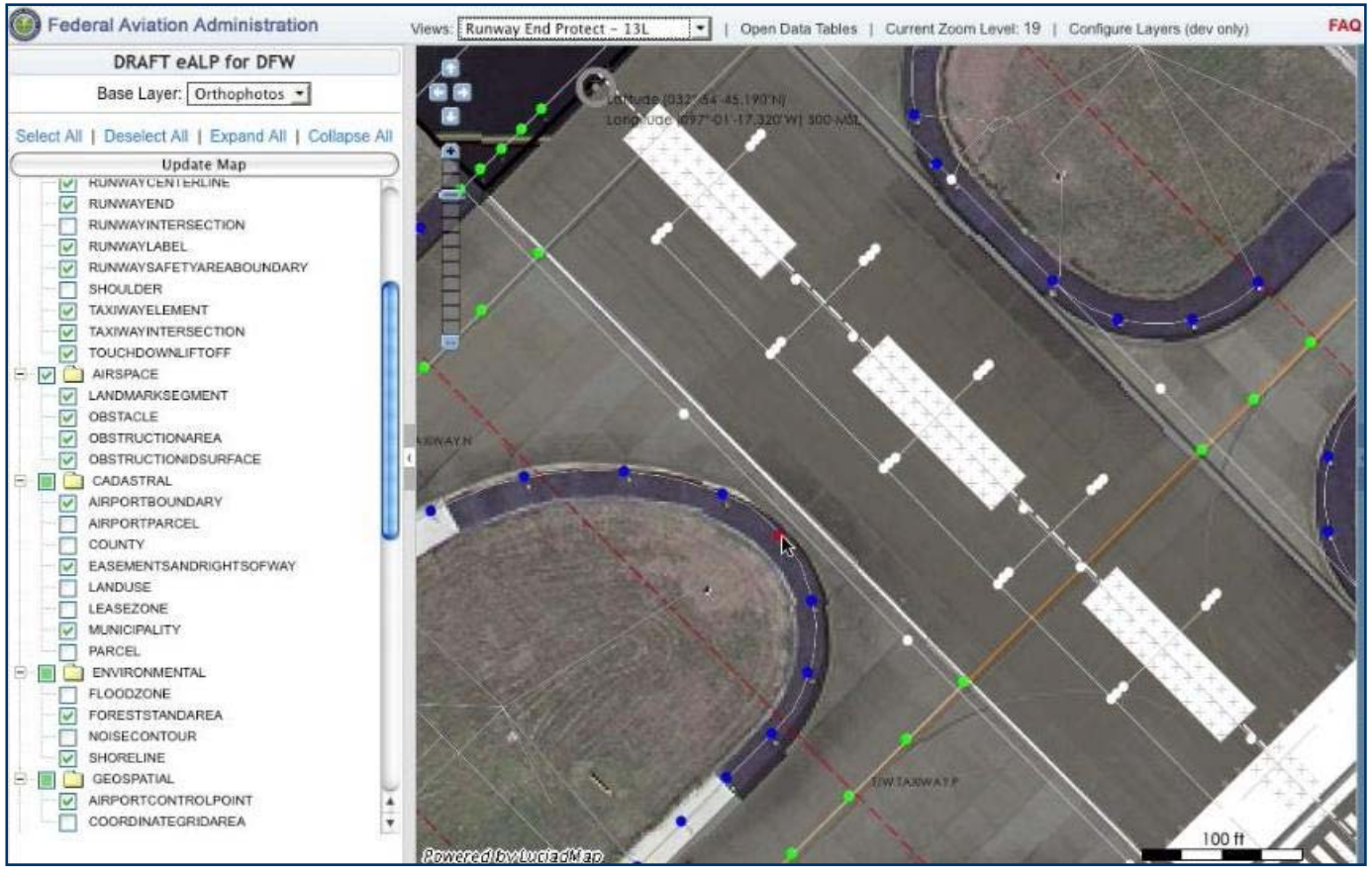
Anticipate the Transition to eALP

Today	Near Term	End State
2012	2013-2016	2016 +
• Airports GIS data collection and submittal • Sponsor/FAA access to data through Airports GIS • Legacy ALP (paper or PDF) • Legacy ALP coordination and approval process	• Airports GIS data collection and submittal • Sponsor/FAA access to data through Airports GIS • Electronic Signatures (submittal and approval) • eALP (geo-referenced PDF) with legacy ALP review and approval process	• Airports GIS data collection and submittal • Sponsor/FAA access to data through Airports GIS • Electronic eALP submittal • Electronic eALP review and approval through Airports GIS • Geo-referenced PDF (for use outside Airports GIS)
Limited e-Capability	Increasing Efficiency	Optimized Efficiency

https://airports-gis.faa.gov/

FY 2013 Limited Number of eALP to be signed

eALP



https://airports-gis.faa.gov/

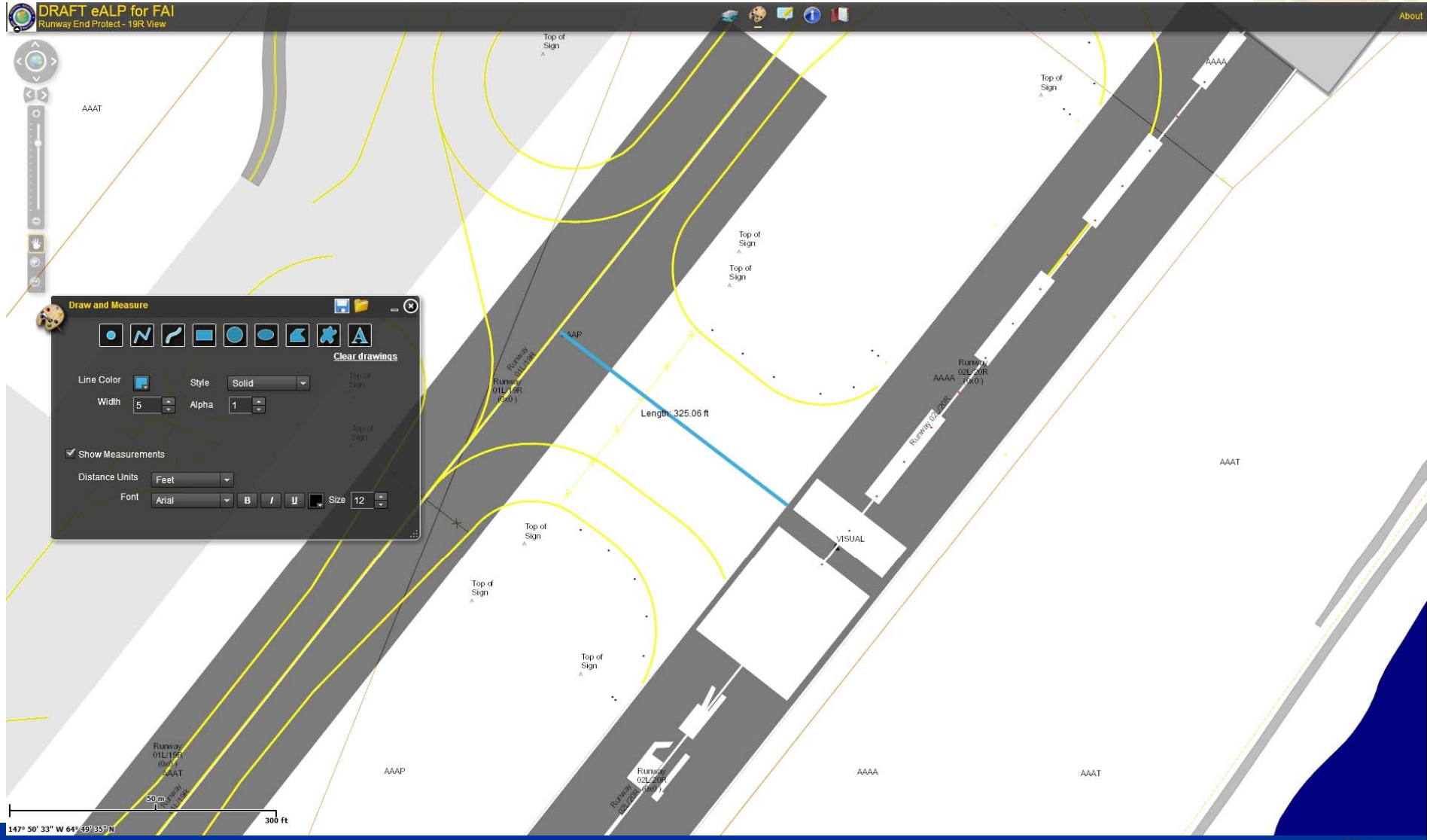
Federal Aviation Administration

Layerlist

https://airports-gis.faa.gov/

Federal Aviation Administration

Draw and Measure

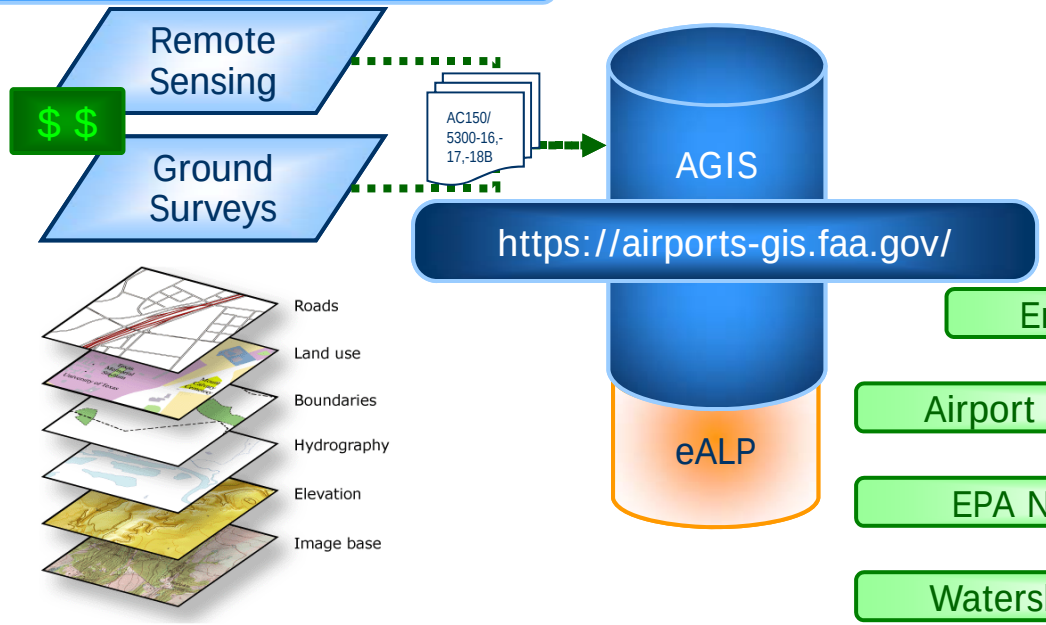


https://airports-gis.faa.gov/

Federal Aviation Administration

Significant Potential for Integrated Capability

Widely-accepted GIS format means there is significant potential for integrated capability/connectivity for airports data sharing



NFDC | NASR/5010 data

iOEAAA data

National Map (USGS)

EnviroMapper (EPA)

Environmental Design Tool

Airport Land Project Cert.System

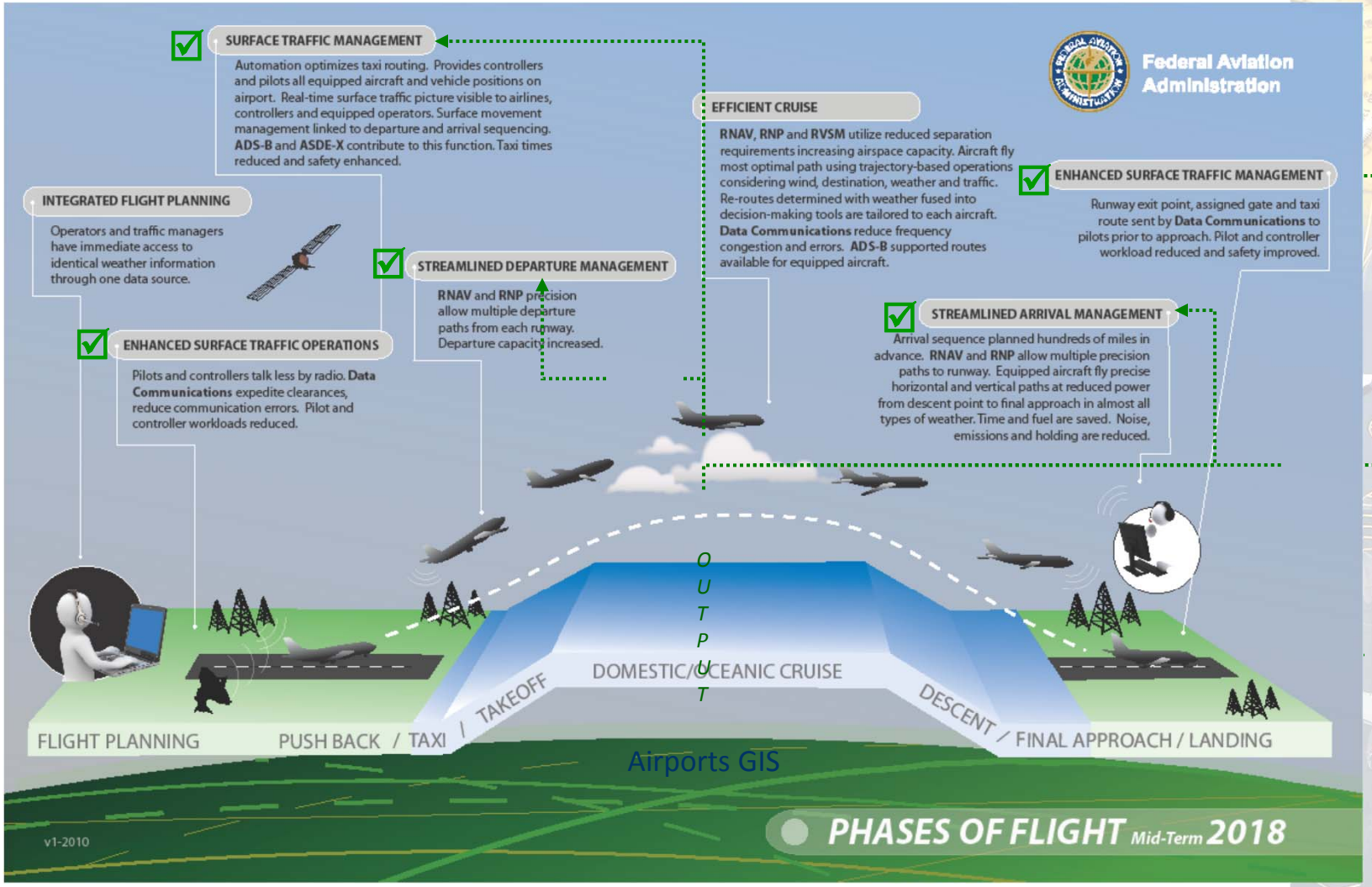
EPA Natl. Geospatial Data CH

Watershed Assessment Tracking

FWS Natl. Wetland Inventory

NRCS Natl. Geospatial Data CH

NextGen | Connection to Airports GIS data



https://airports-gis.faa.gov/

Federal Aviation Administration

What are the Incremental Quantifiable Benefits of FAA Airports GIS?

The primary benefits we expect Airports GIS to provide include:

1. Increased labor productivity due to improved coordination
2. Earlier completion of projects due to improved coordination
3. Better information for more efficient planning and preliminary design
4. Broader use of GIS at airports due to FAA standards and funds for data collection
5. Elimination of redundant airport mapping and survey costs

These benefits closely correspond to other major IT investments in other venues. They were identified by interviewing a broad range of stakeholders—including both supporters and opponents of the program—from the FAA, airports, consultants, and GIS vendors.

What are the Identifiable Safety Benefits of Airports GIS

- As the Authoritative Source this will preclude other lines of business from creating airport data from a less verified source.
- Requiring the single entry point assures that all users have the most current data.
- Airports GIS safety critical data (runways and taxiways) has a very rigorous verification and validation program and QA/QC program
- Airports GIS has a requirement to update data for design and construction.

Airport Data and Information Management Program

(Formerly 5010 Airport Safety Data Program)

- **About Jan 1, 2015 Transition to the new program**
- **AC 150/5300-19**
  - All Landing Areas (19,000)
  - Non Survey Data
  - Airport must submit data to web portal
  - Data fields similar to 5010 program
  - Add a sketching tool for airports
  - Data will be available in geospatial format for analysis

Safety Benefits of New Geospatial Airport Data Management Program

- Direct Web input and transfer avoids transcription errors especially in coordinates
- Geospatial Plotting is an error checking mechanism for data review that catches errors
- Digital signature from source
- Review from appropriate Airports District Office
- Receiving about 500 new landing facilities each year and 500 abandonments each year

Airports GIS BCA Non-Quantifiable Benefits

- Improved Safety
- Improved Funding Allocation
- Operational Efficiency
- Longer asset life due to improved maintenance
- Better Use of Land Surrounding an Airport
- Reduced Chance of Change Orders
- Better Design and Compliance Decisions

Aeronautical Data Management Initiative

- **AIM Office has embraced concept and agreed to work closely with Airports**
  - All airport diagrams changes will be submitted Airports GIS
  - All digital NOTAM maps will be submitted in Airports GIS
  - All SMGCS charts will be prepared from Airports GIS
  - Web service from Airports GIS to OE/AAA
  - 5010 Program data will be submitted in Airports GIS
  - 5010 Program data will be made available as a web service in Esri Shp files.

Conclusions

- **Airports GIS will have better than 2 to 1 Benefits to Costs ratio**
- **Safety Benefits were not measured but are significant**
- **Better Geospatial Data of Airports GIS will support the FAA NextGen Implementation**

Geographic Information Systems (GIS) in Traffic Safety - NTSB

Panel #3 – AVIATION SAFETY PANEL

Tuesday December 4th, 13:15 TO 15:00

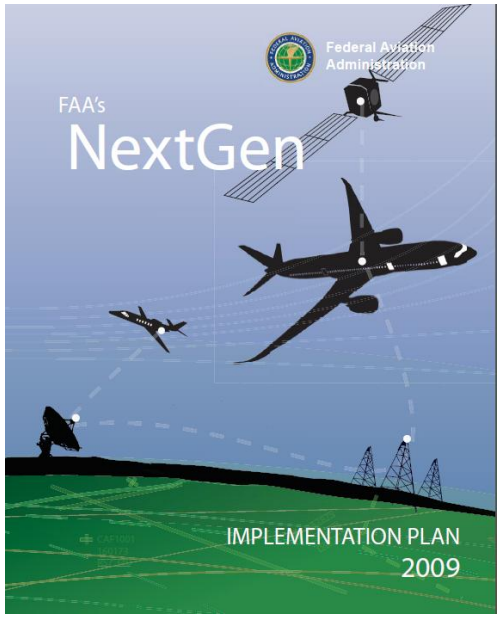
Dejan Damjanovic

CHALLENGES IN TERRAIN & OBSTACLE IDENTIFICATION

GeoEye®

Elevating Insight

We are all moving to FANS/PBN



Industry Declaration in support of Performance-based Navigation (PBN)

We, as representatives of the air transportation community,

Affirming our joint responsibility to seek continual improvements to the safety, access, capacity, efficiency and environmental sustainability of the air transportation system,

Recognizing that Performance-based Navigation (PBN) provides a catalyst for these improvements to air traffic operations, while enabling a seamless and cost effective solution throughout the entire flight,

Recognizing the work of ICAO in formulating and publishing globally harmonized Area Navigation (RNAV) and Required Navigation Performance (RNP) provisions, now known as Performance-based Navigation (PBN),

Recalling that Resolution A36-23 of the 36th ICAO General Assembly whereby States are urged to implement PBN procedures in accordance with the established timetable,

We resolve:

To support the timetable set out by ICAO for the global implementation of PBN,

To collectively work to facilitate the implementation of PBN, and

To assist States, regions and other stakeholders in their development and execution of a complete PBN implementation plan.

We call upon:

All leaders of the civil aviation community, to fully support implementation of PBN into the air navigation system according to the ICAO provisions and established timetable.

Roberto Kobeh González, Council President

Giovanni Bisignani, Director General and CEO

Alexander ter Kulle, Secretary General

Marc Baumgartner, President & CEO

Capt. Carlos Limon, President

Donald D. Spruston, Director General

François Gayet, Chairman

Angela Gittens, Director General

Matthew S. Zuccaro, President

William R. Voss, President & CEO

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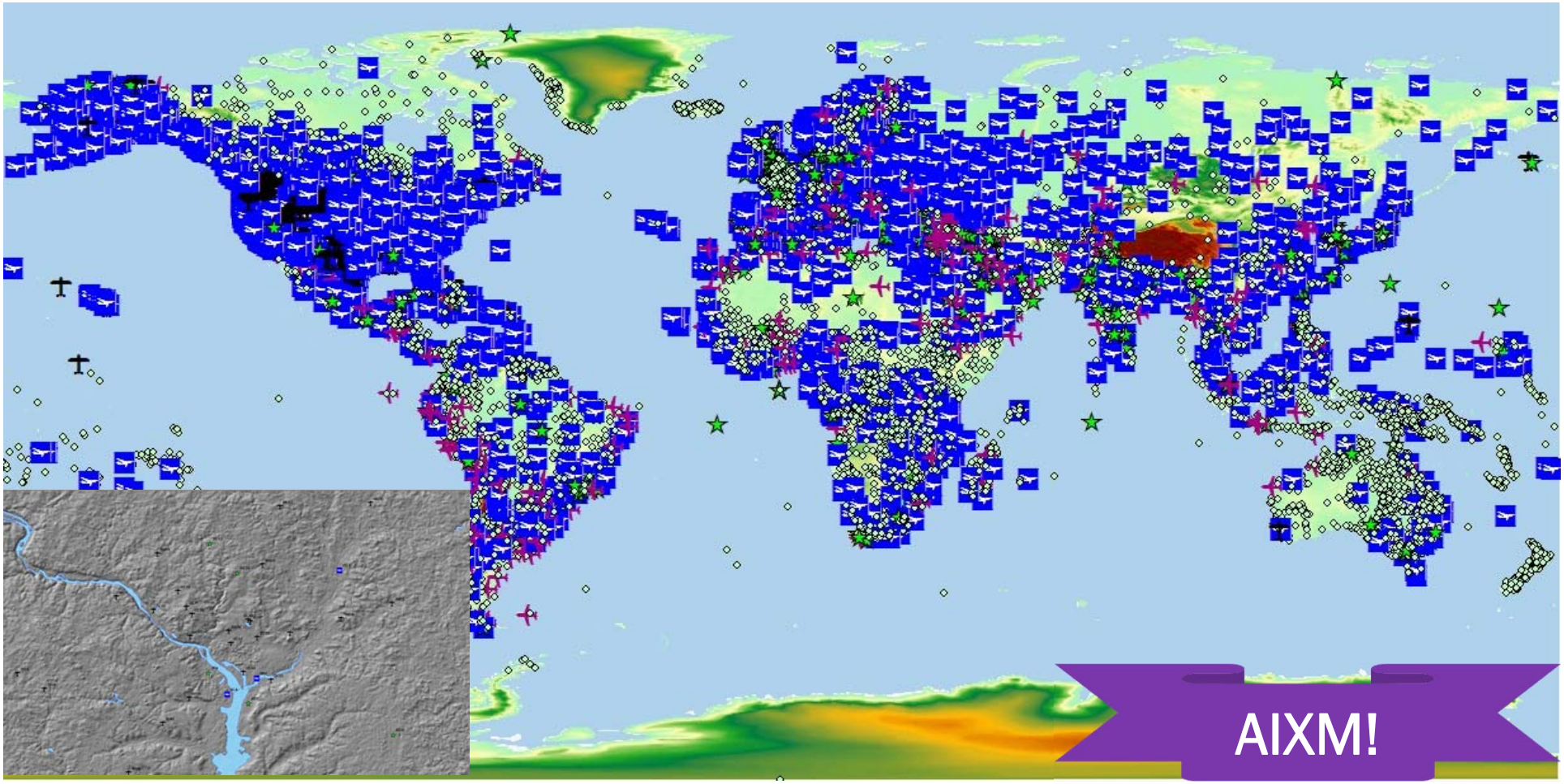
This is a Global challenge – eTOD for all!



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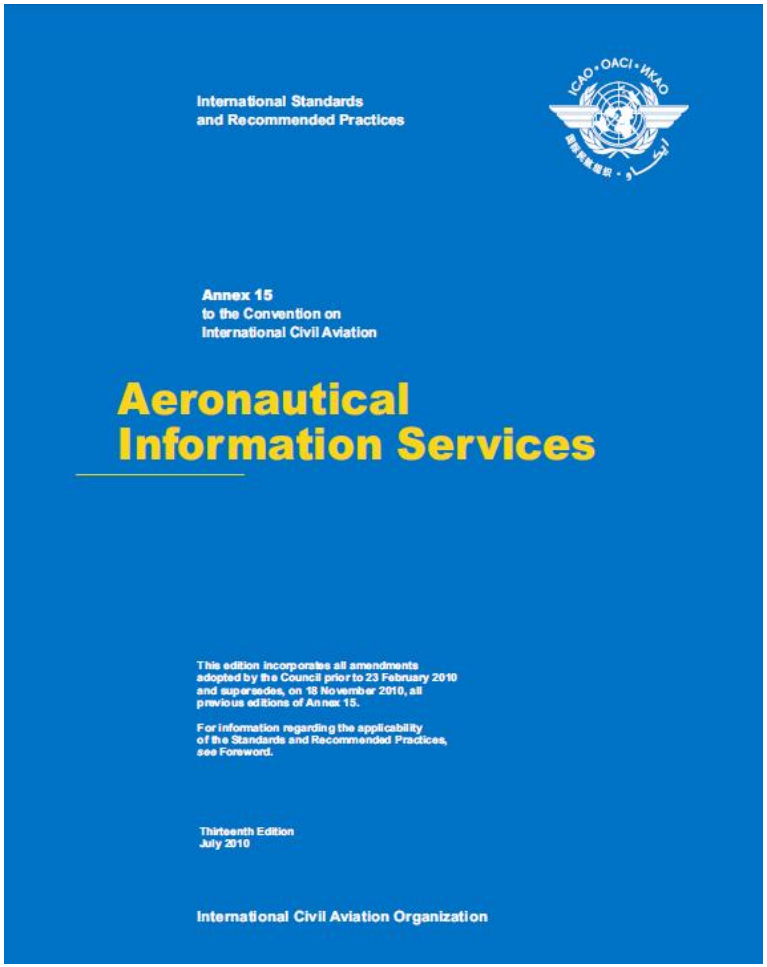
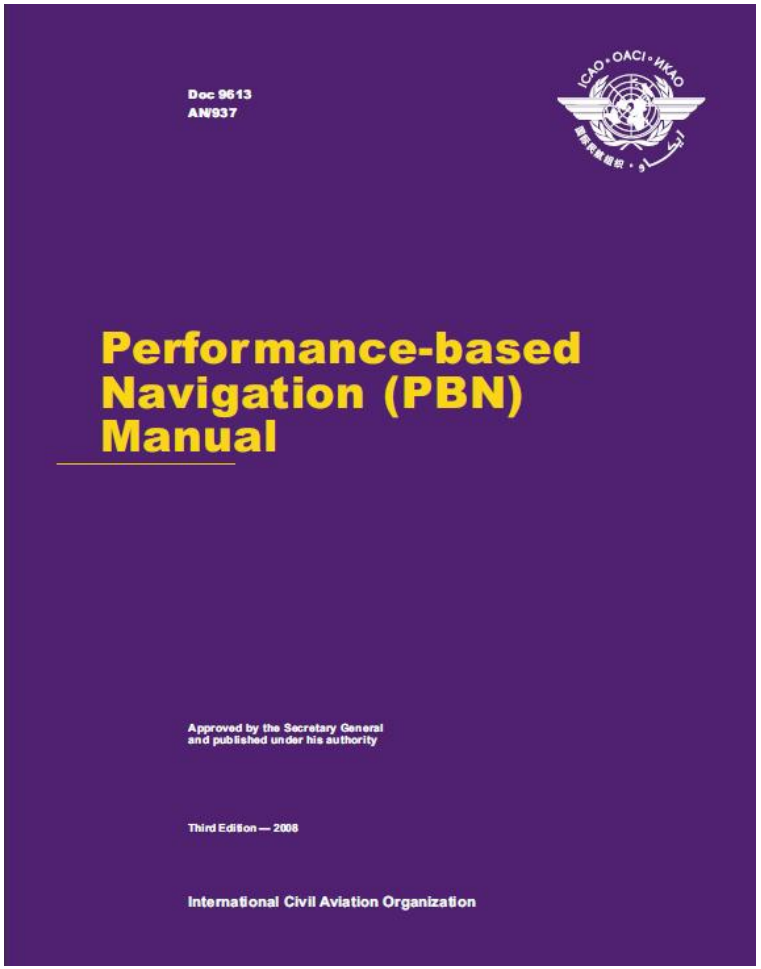
New International Mandates for FANS:





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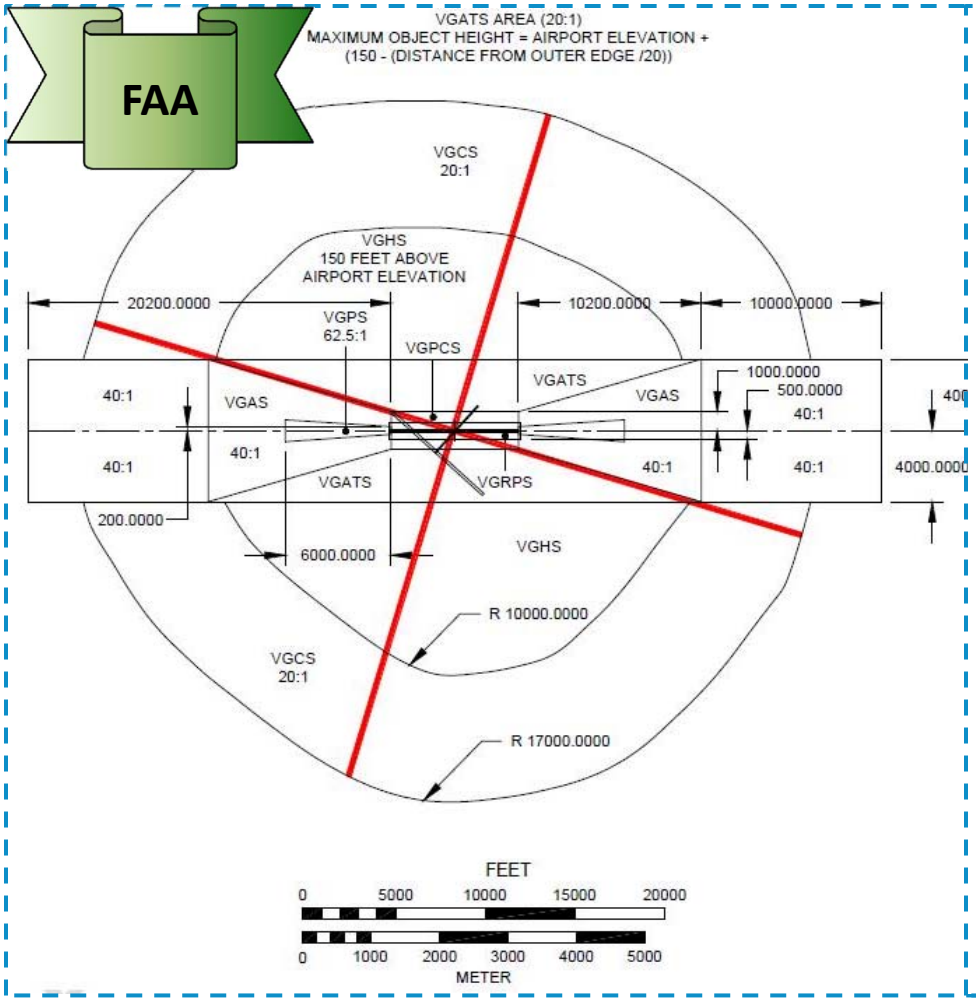
FAA & ICAO differ in eTOD criteria



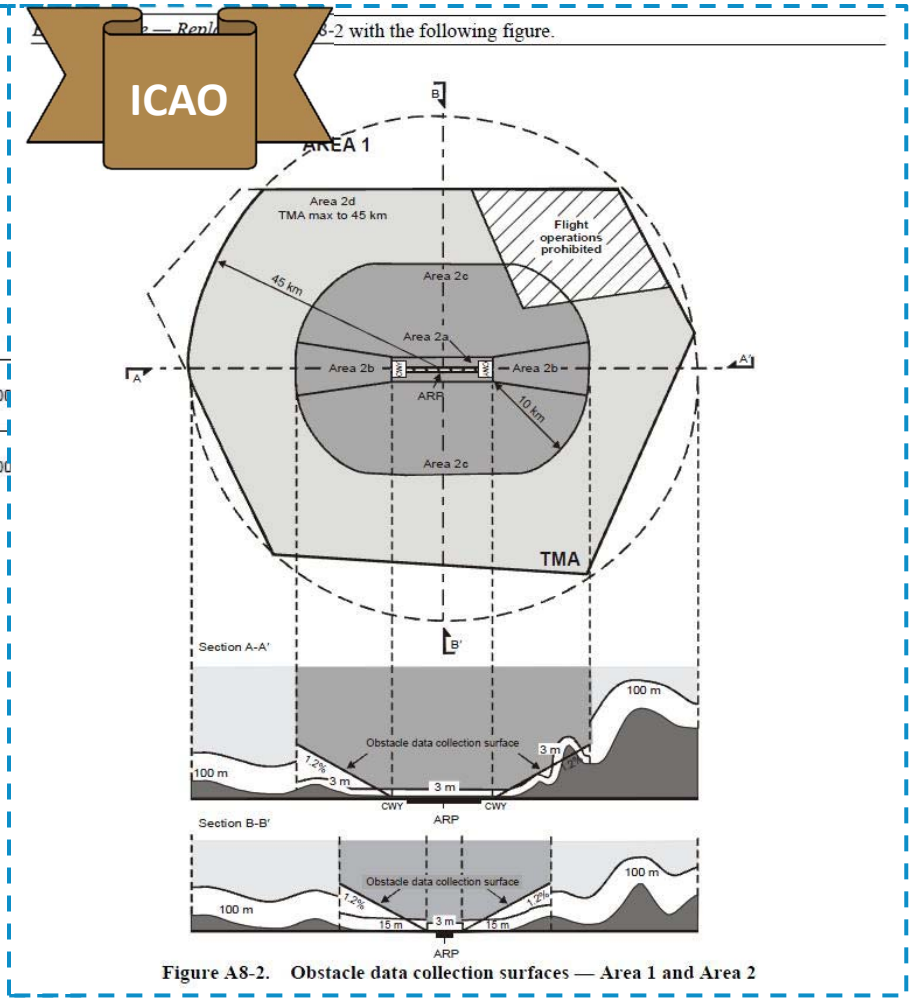


Figure A8-2. Obstacle data collection surfaces — Area 1 and Area 2

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Area-2 VO Criteria: Complete by 2015

Table A8-1. Terrain data numerical requirements

	Area 1	Area 2	Area 3	Area 4
Post spacing	3 arc seconds (approx. 90 m)	1 arc second (approx. 30 m)	0.6 arc seconds (approx. 20 m)	0.3 arc seconds (approx. 9 m)
Vertical accuracy	30 m	3 m	0.5 m	1 m
Vertical resolution	1 m	0.1 m	0.01 m	0.1 m
Horizontal accuracy	50 m	5 m	0.5 m	2.5 m
Confidence level ~~(1σ)~~	90%	90%	90%	90%
Data classification Integrity level	routine 1×10^{-3}	essential 1×10^{-5}	essential 1×10^{-5}	essential 1×10^{-5}
Maintenance period	as required	as required	as required	as required

Table A8-2. Obstacle data numerical requirements

	Area 1	Area 2	Area 3	Area 4
Vertical accuracy	30 m	3 m	0.5 m	1 m
Vertical resolution	1 m	0.1 m	0.01m	0.1 m
Horizontal accuracy	50 m	5 m	0.5 m	2.5 m
Confidence level ~~(1σ)~~	90%	90%	90%	90%
Data classification Integrity level	routine 1×10^{-3}	essential 1×10^{-5}	essential 1×10^{-5}	Essential 1×10^{-5}
Maintenance period	as required	as required	as required	as required

Editorial Note.— Replace Figure A8-2 with the following figure.

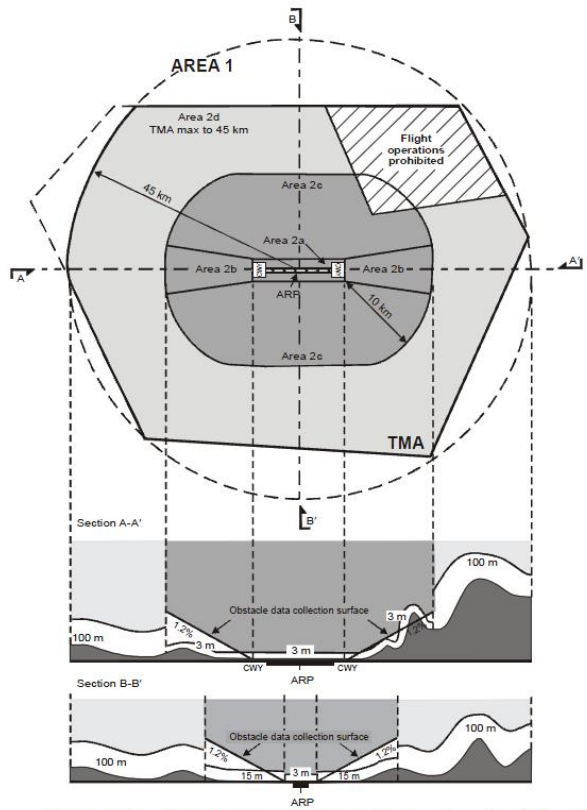

Figure A8-2. Obstacle data collection surfaces — Area 1 and Area 2

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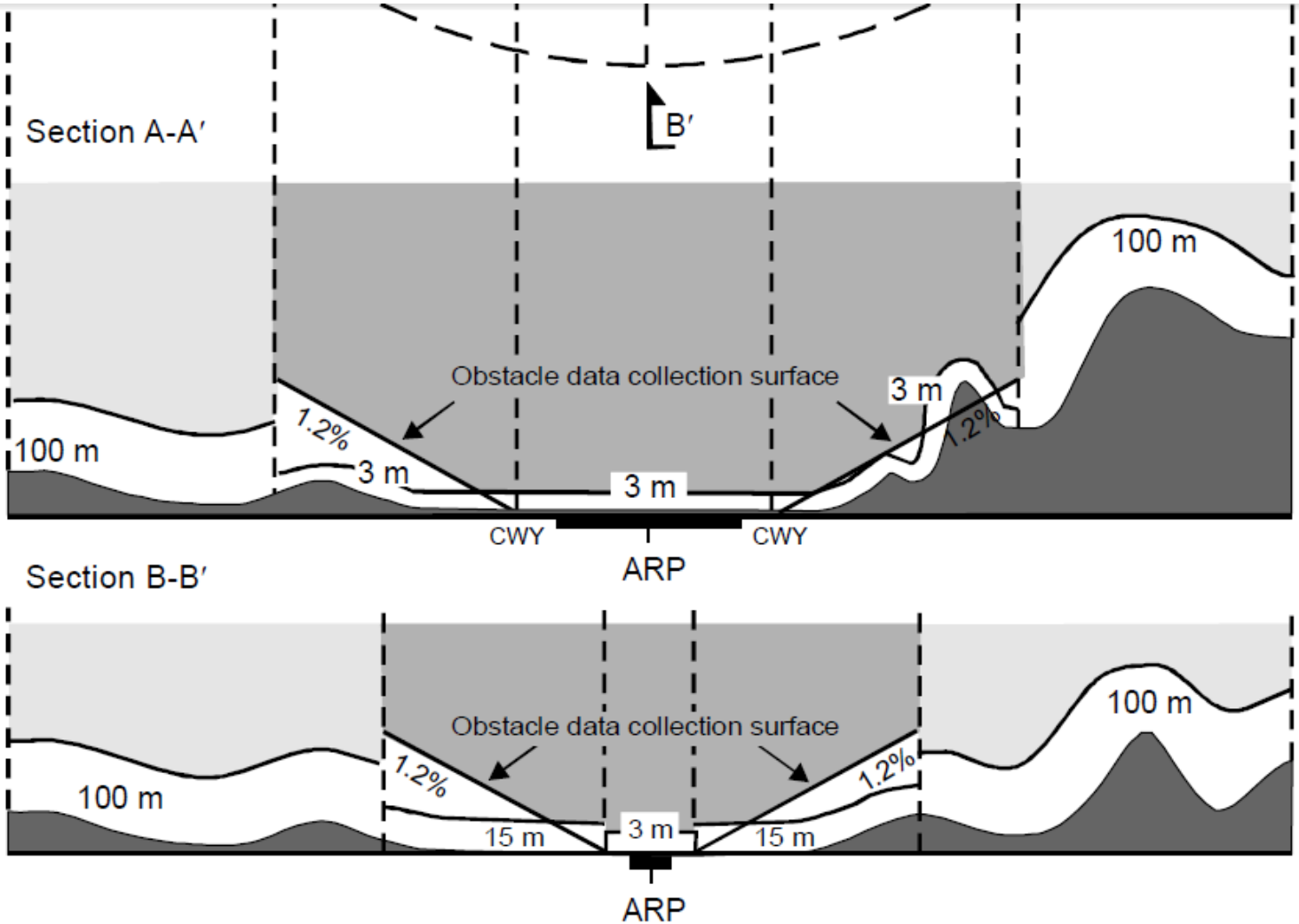
Area-2 VO Criteria: Collect what VO size?



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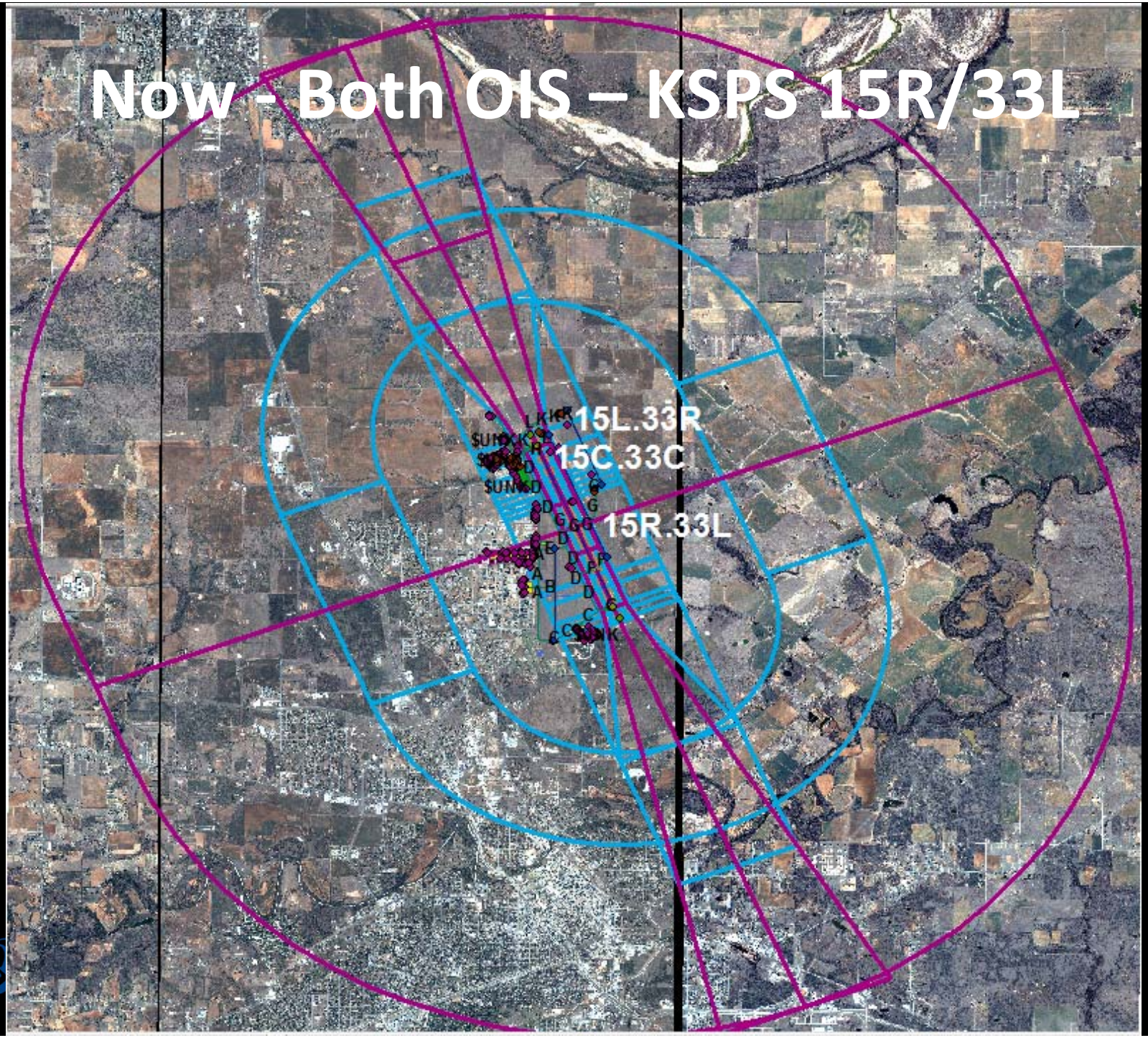
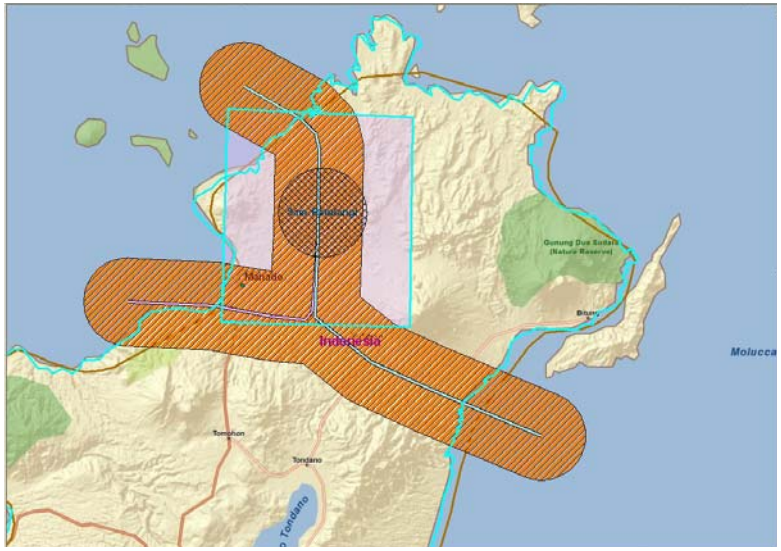
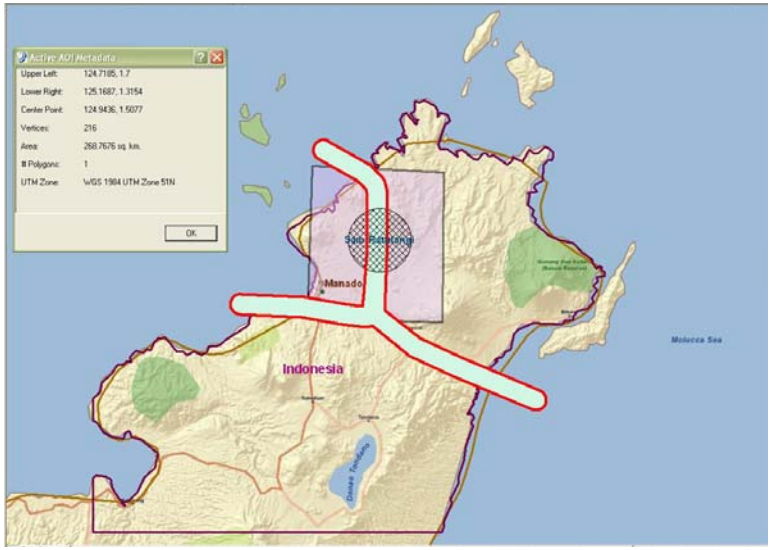
Now - Both OIS – KSPS 15R/33L



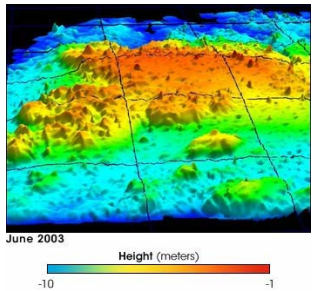
How to acquire Obstacles and Terrain?

1. Understand your collection AOI requirements. ☑
2. Understand your eTOD Criteria & formats. ☑
3. Choose your collection method(s).
4. Choose Validation Sources
5. Begin with Bare Earth DEM
6. Ensure that Airport Features (Area-3) and eTOD Features (Area-2) have a single position solution.
7. Define & Implement your Obstacle Maintenance Plan.

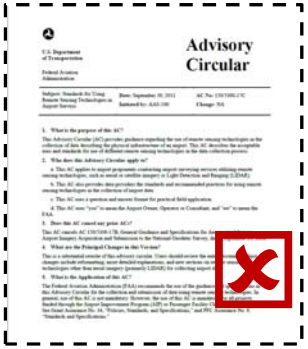


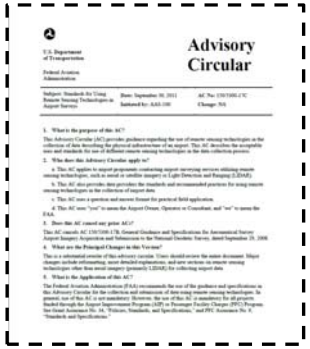


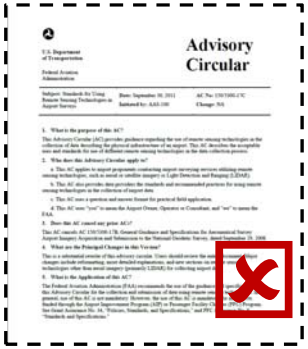
What are the collection methods?

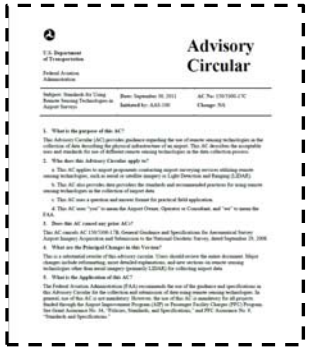


Satellite | **LIDAR** | **SAR/IF-SAR** | **Aerial**









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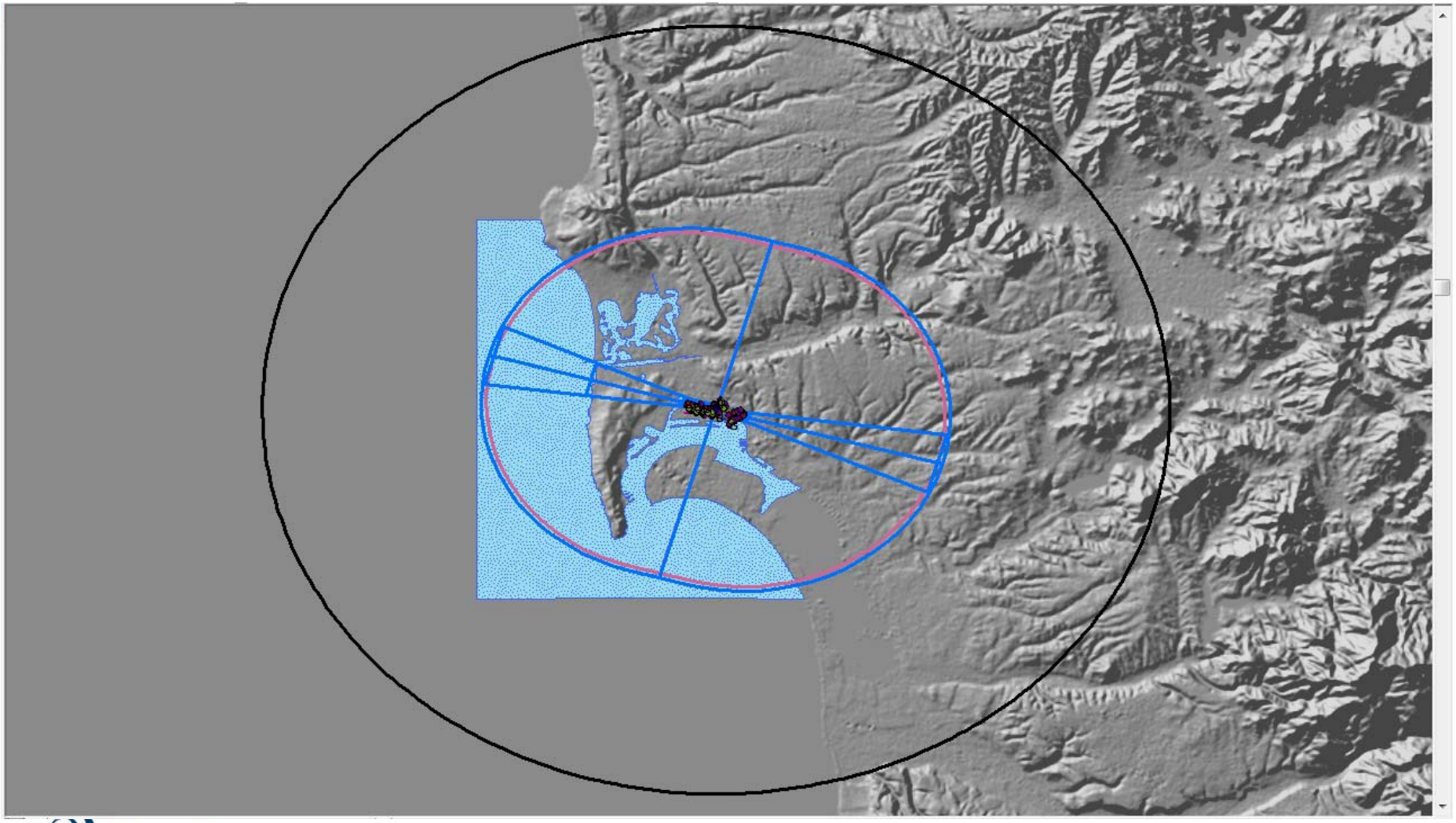
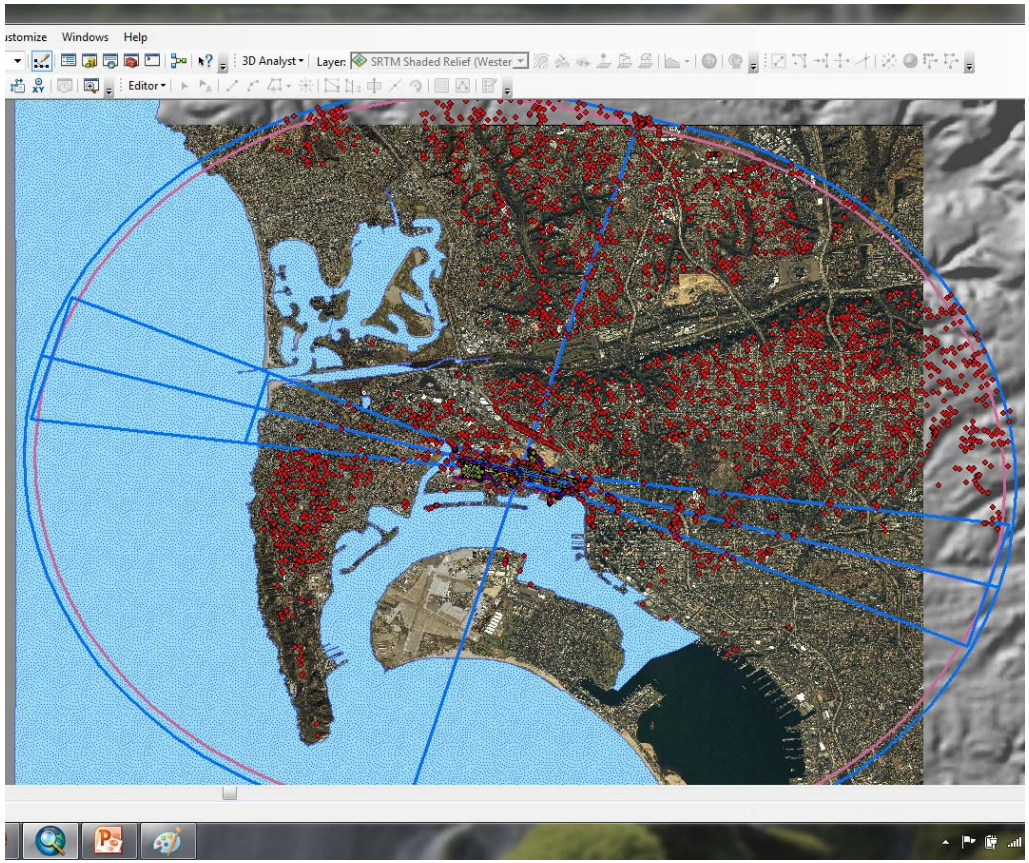
An real-world example – KSAN:



Point Obstacle Challenges

- Must understand difference between man-made and natural
- Ensuring placement of Point(s) onto DEM to identify Base & Height.
- Correct identification of top of trees.
- Choice of highest elevation within groupings of points.
- For KSAN – **2,763 Points**



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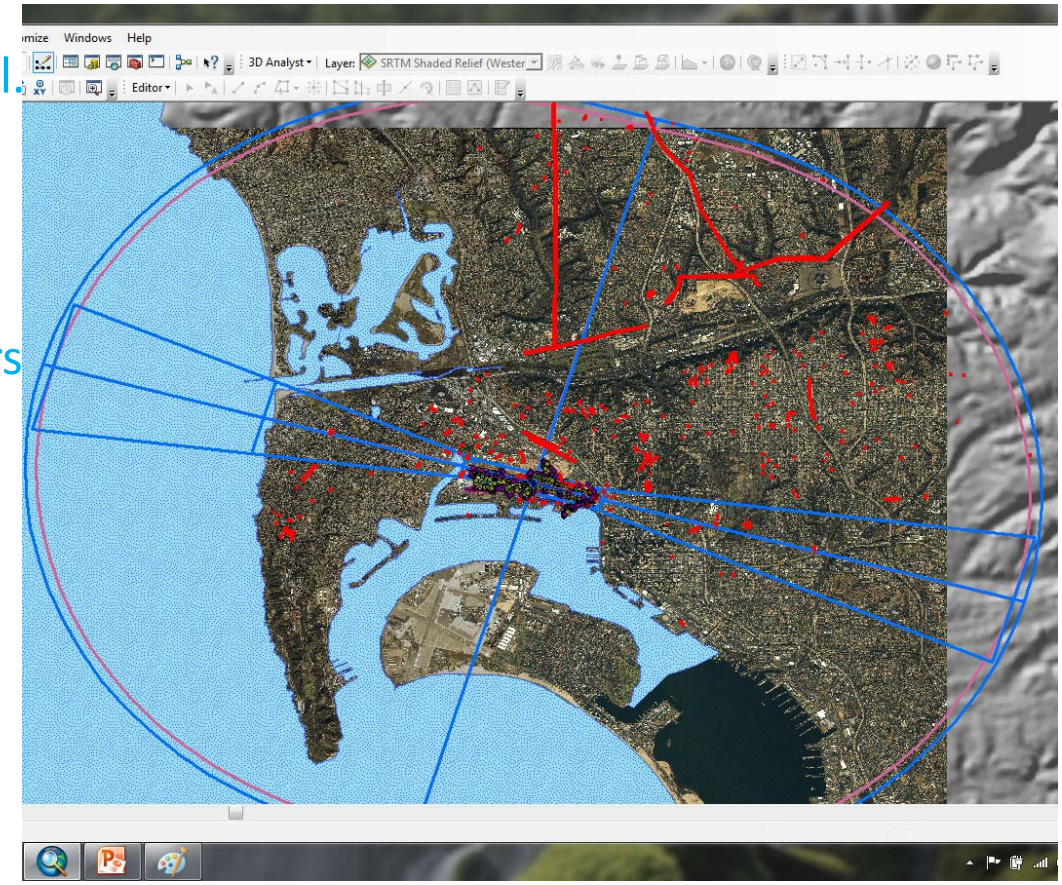
Line Obstacle Challenges

- Must understand difference between man-made and natural.
- Ensuring placement of Line(s) onto DEM to identify Base & Height.
- Must integrate powerline towers (Points) with powerlines (Line)
- Must choose clumps of trees between line features and polygonal features.
- For KSAN – **483 Lines**



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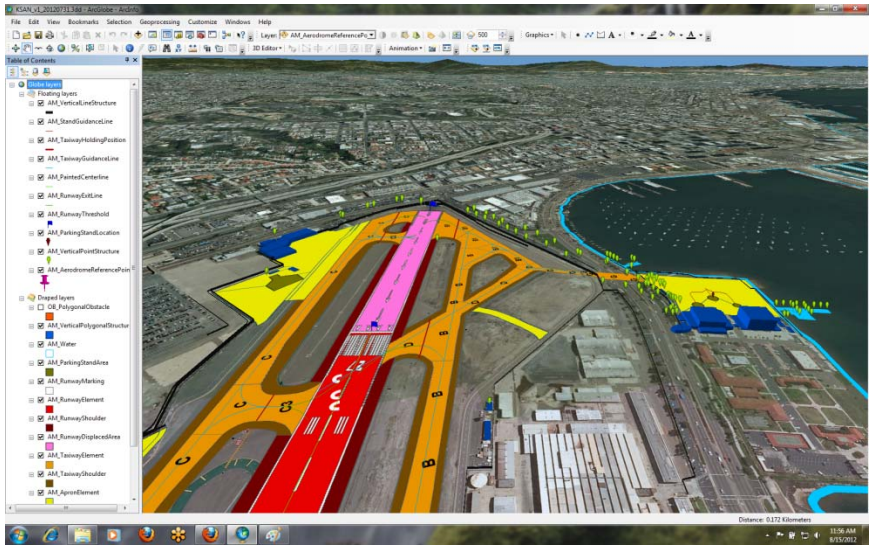
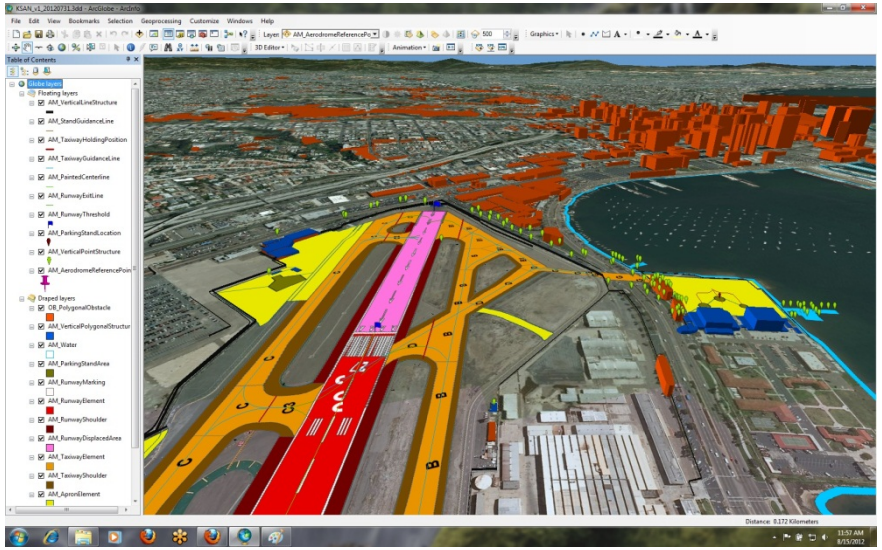
Polygonal Obstacle Challenges

- Must understand difference between man-made structures and natural terrain.
- Ensuring placement of Polygon(s) onto DEM to identify Base & Height.
- Must choose clumps of trees between line features and polygonal features.
- Must understand highest point within a polygon – clumps of buildings, clumps of trees, terrain that protrudes.
- For KSAN – **3,177 Polygons.**





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Some Conclusions from people who do this!

Things to keep in mind when acquiring this type of data:

- **Understand all the collection technology available, and don't make assumptions about technologies that you are less familiar with.**
- **Understand what AIXM means to provide a single, global "lingua franca" for Aeronautical Information Exchange**
- **Understand how to validate or cross-reference your collected data with published sources, and how you intend to resolve differences.**
- **Understand how you intend to maintain this data once you have collected it the first time – FOREVER.**

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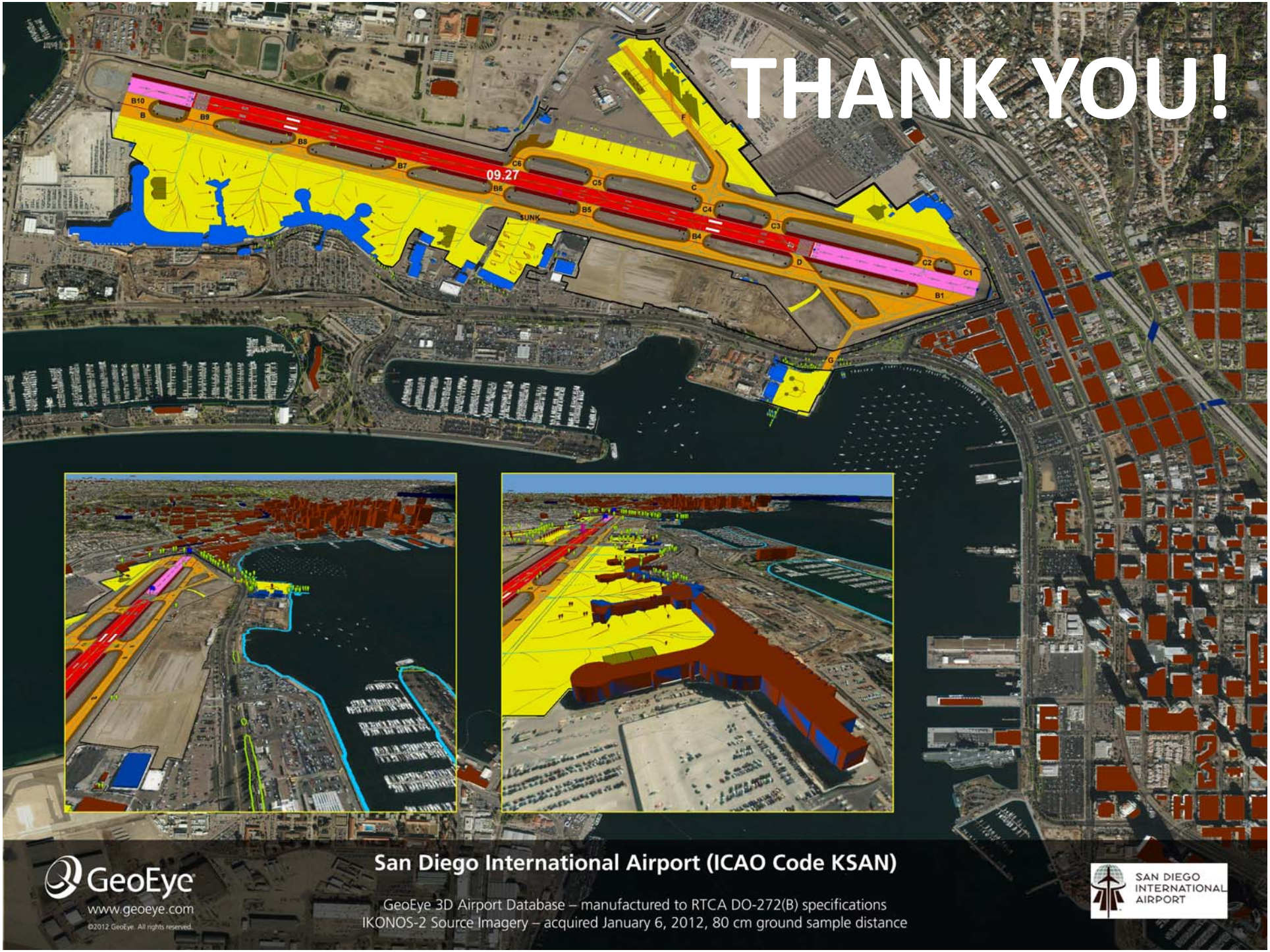
THANK YOU!
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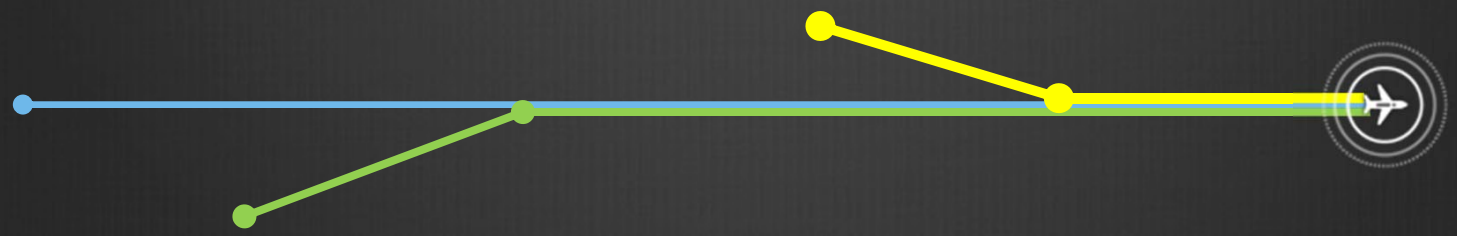
San Diego International Airport (ICAO Code KSAN)
GeoEye 3D Airport Database – manufactured to RTCA DO-272(B) specifications
IKONOS-2 Source Imagery – acquired January 6, 2012, 80 cm ground sample distance
SAN DIEGO INTERNATIONAL AIRPORT

Enabling Aviation Analysis

Christopher Knouss

MITRE Corporation



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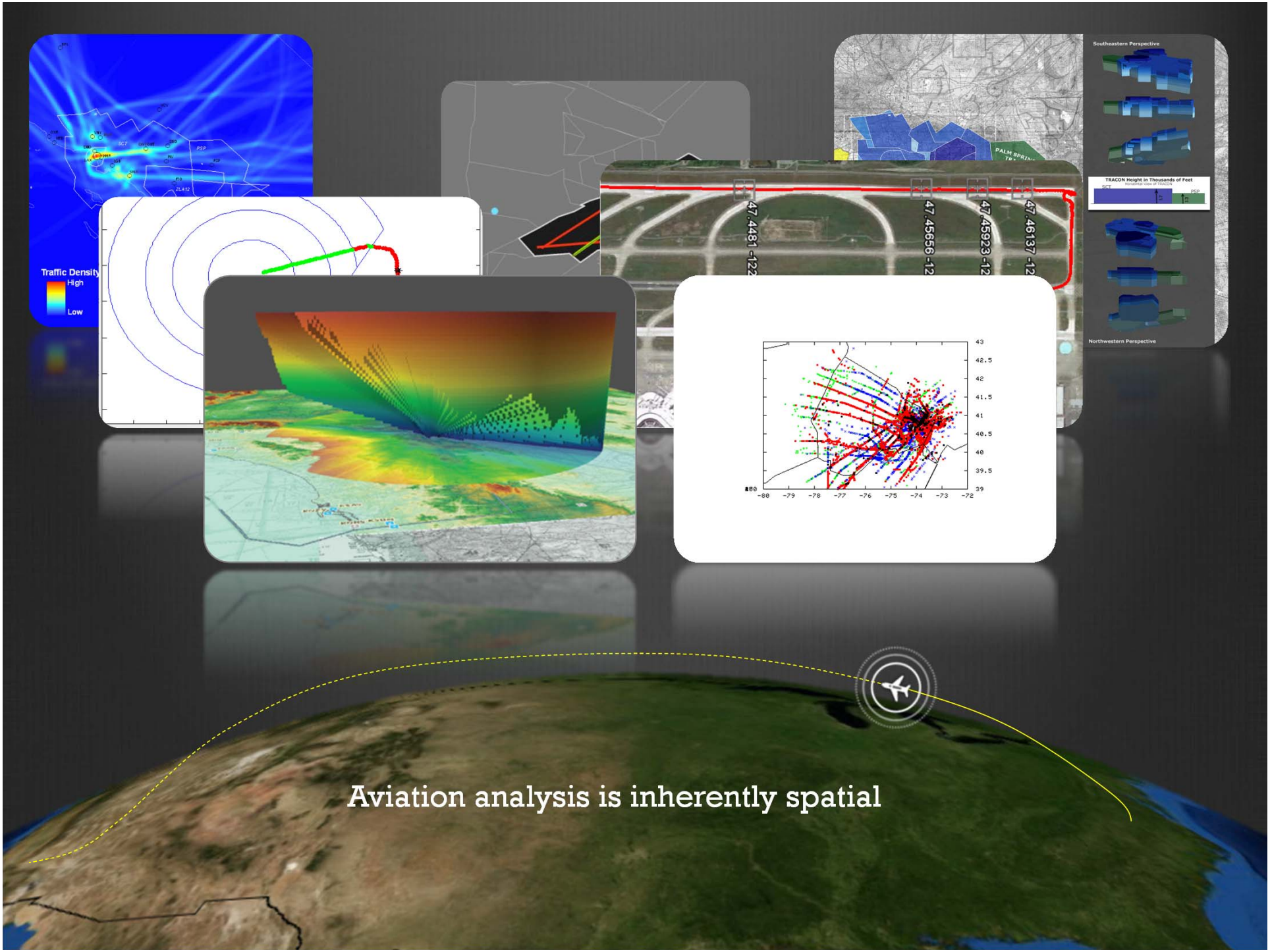

Traffic Density
High
Low
Southeastern Perspective
Northwestern Perspective
TRACON Height in Thousands of Feet
Aviation analysis is inherently spatial

ORACLE

hadoop

PostgreSQL

mongoDB

data management

discovery and services

esri

python™

GDAL

iOS

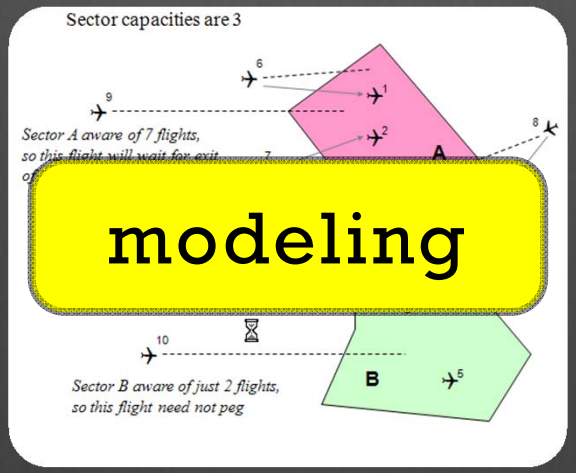
utilities

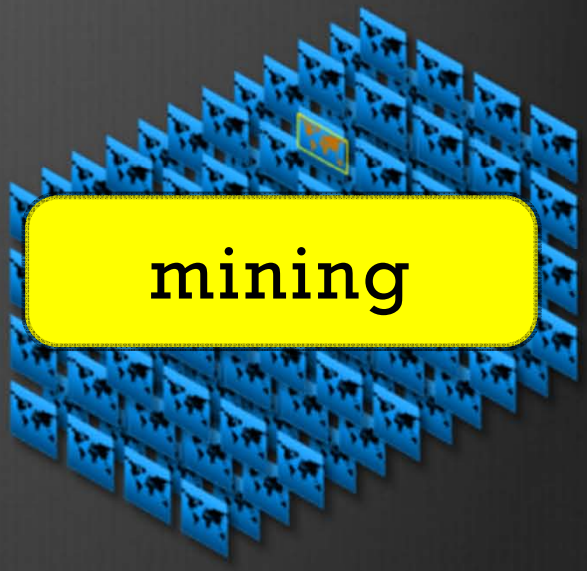
commercial

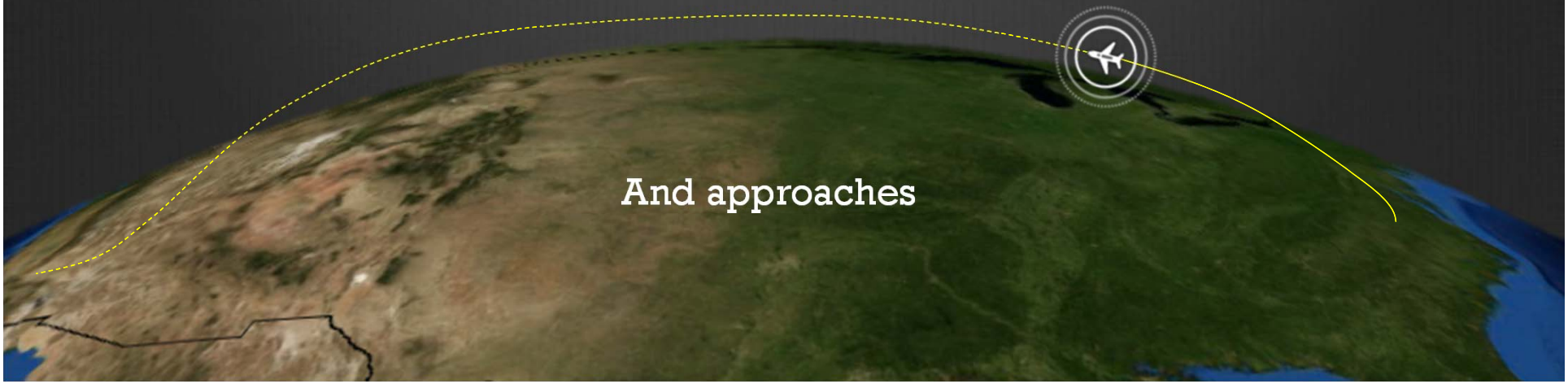
open source

proprietary

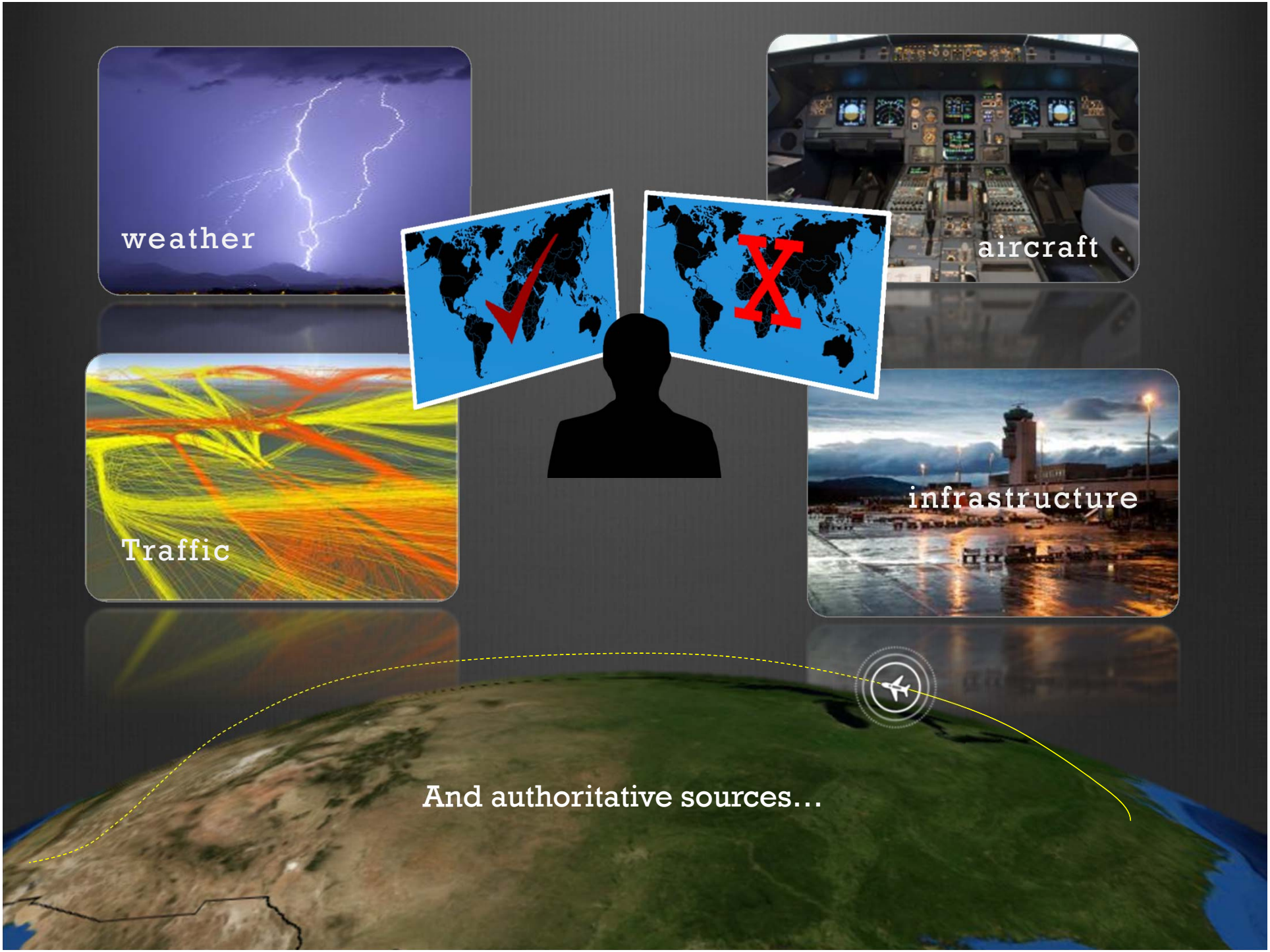
And relies on many different tools



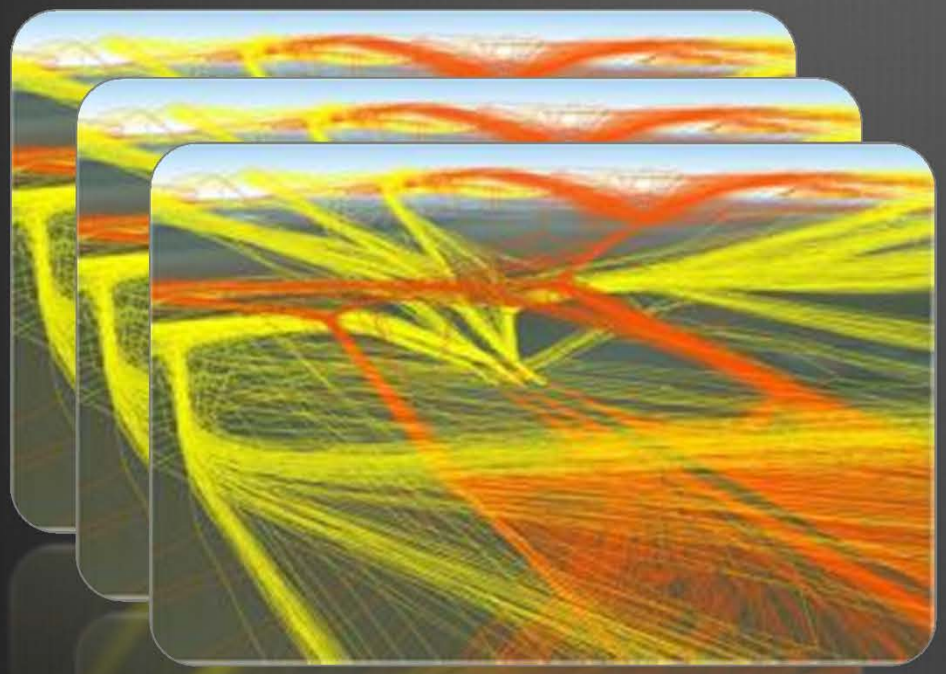




And approaches


weather
aircraft
Traffic
infrastructure
And authoritative sources…

weather
aircraft
Traffic
infrastructure
But what if these are not enough?

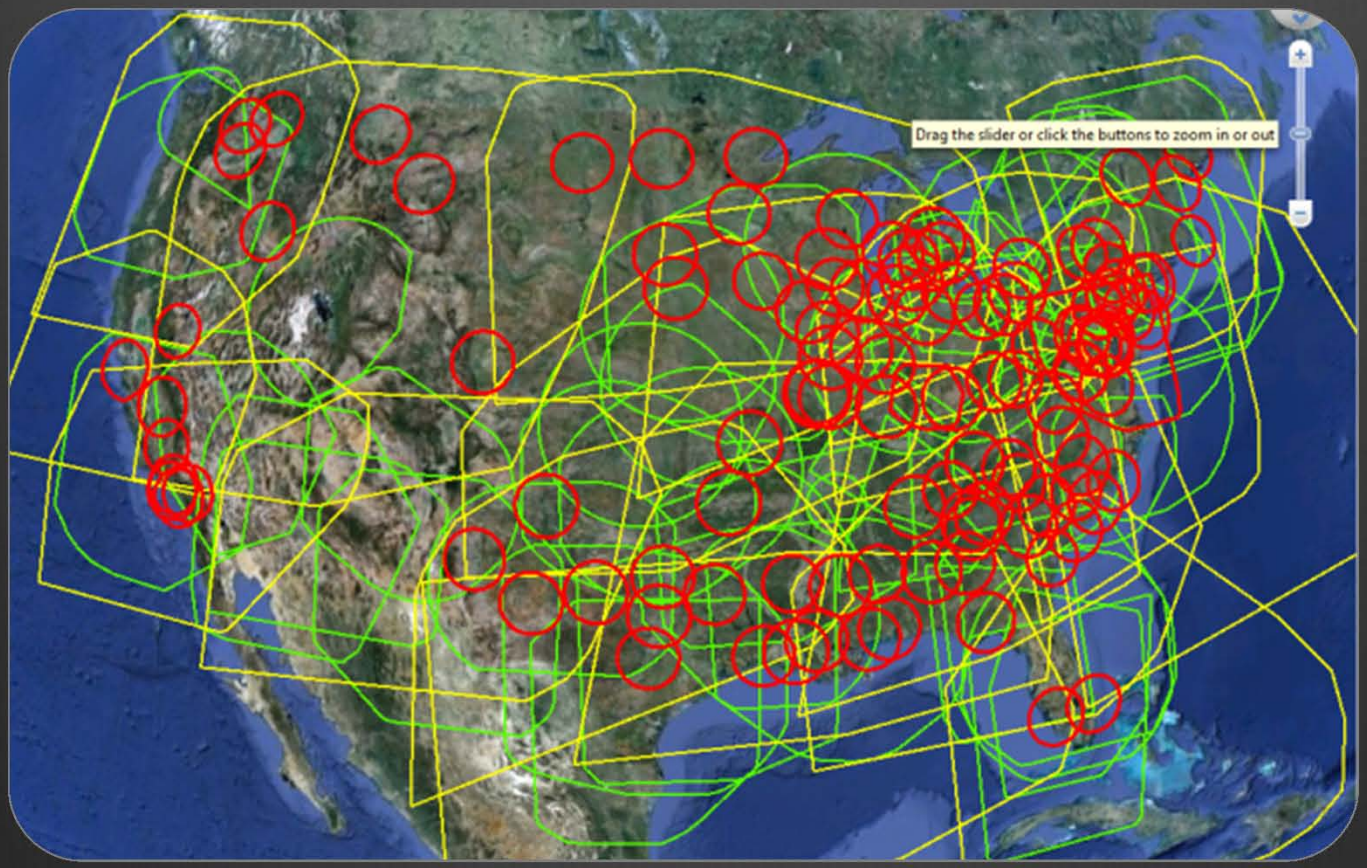


?

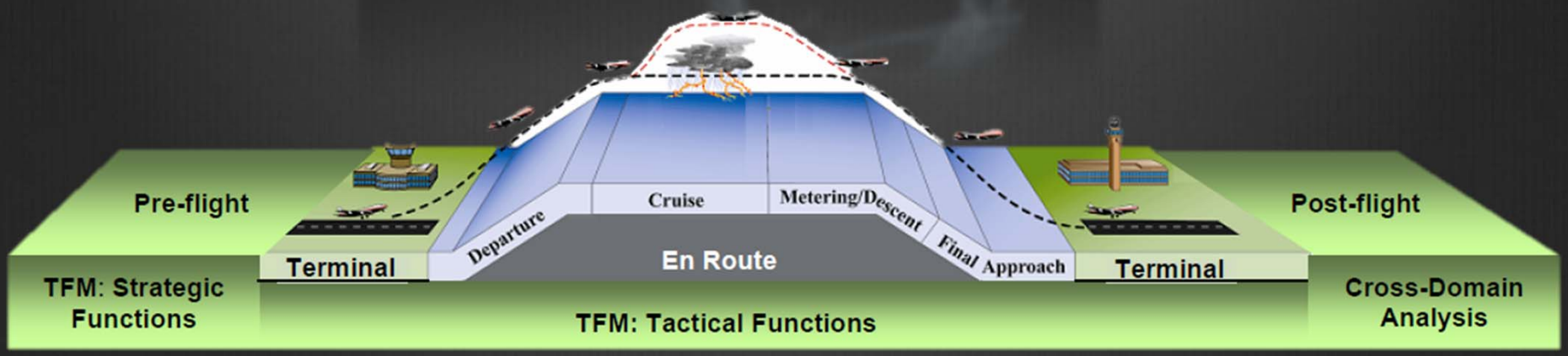
Problem!? What do I use?

There are often several sources for similar datasets.
Each have distinct characteristics, benefits, utility, and information

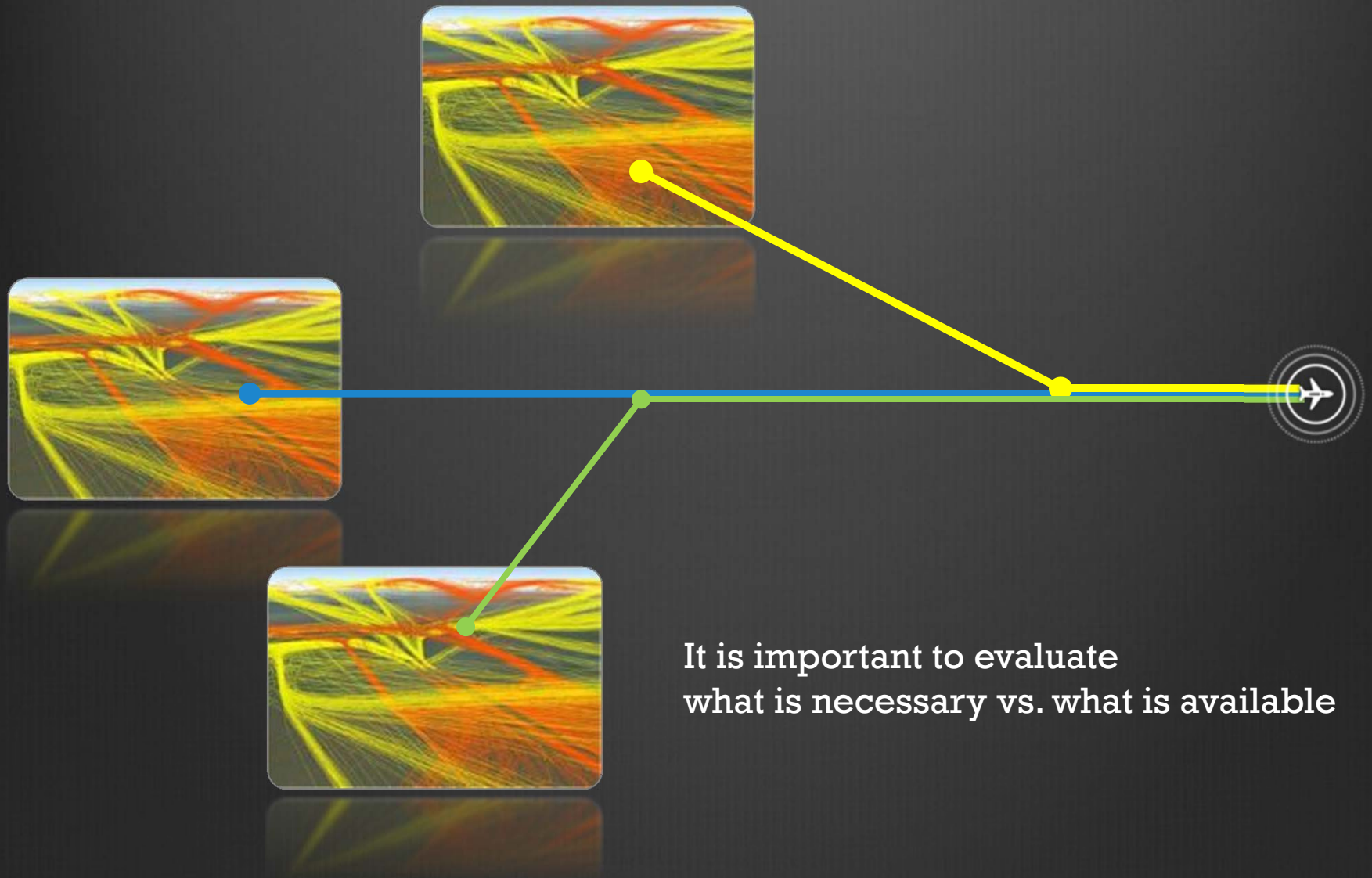
20 ARTCC 50 STARS 104 ARTS 35 ASDE-X



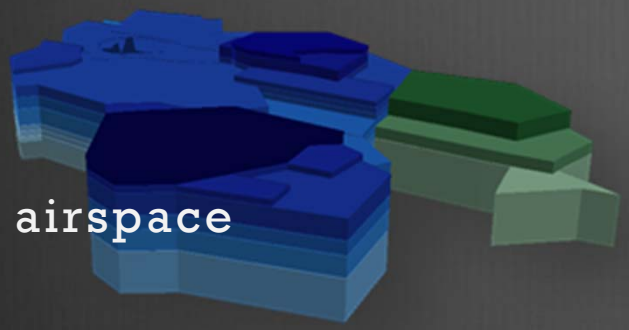
Authoritative sources abound but are often non-standardized, and have different origins, sensitivities, and "owners"

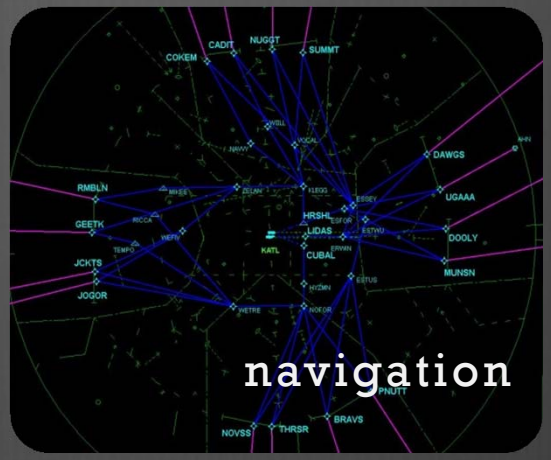


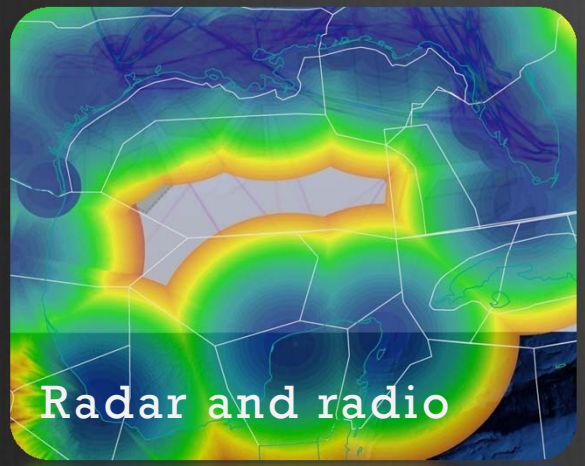
They also cover different operational needs and geographic and temporal scales



It is important to evaluate
what is necessary vs. what is available

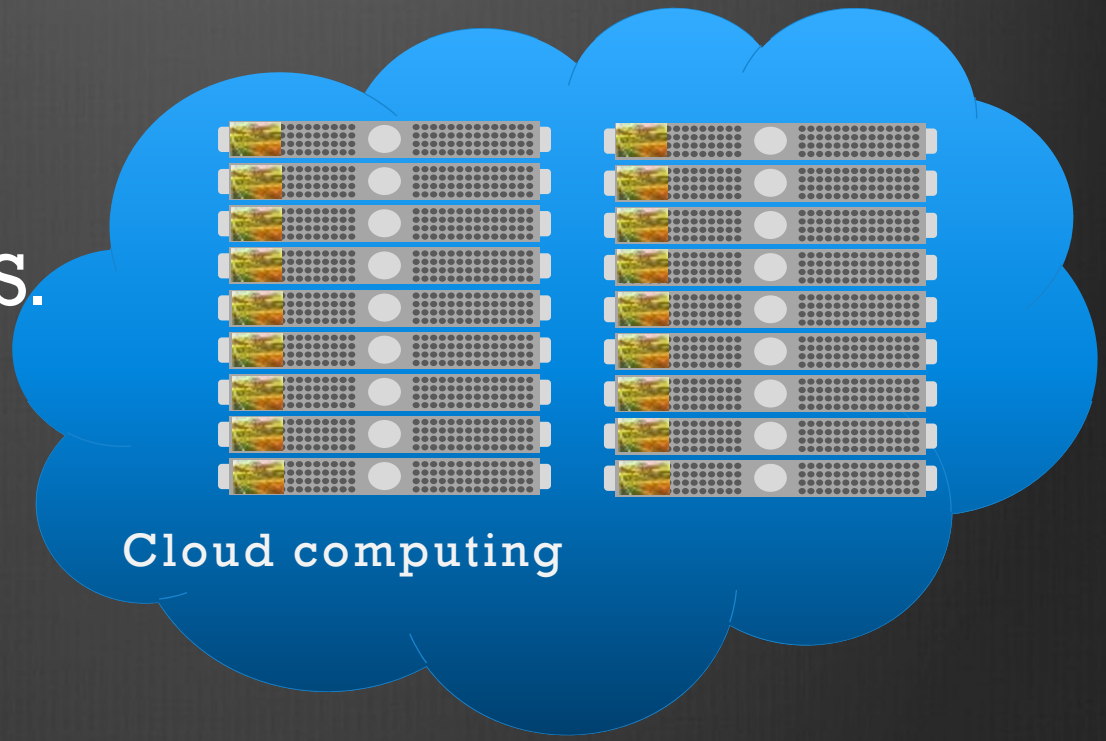






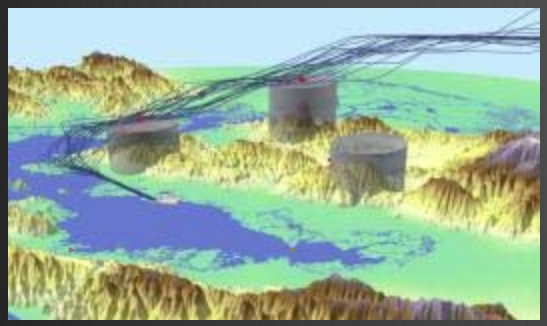
It is important to evaluate
what is necessary vs. what is available

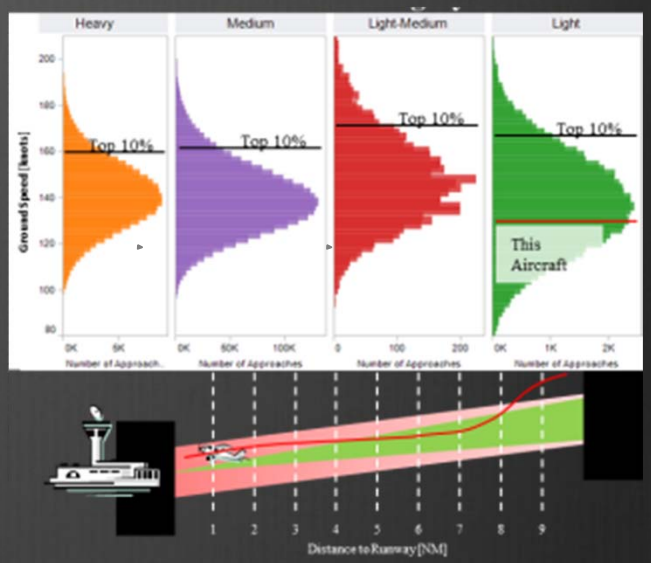
VS.

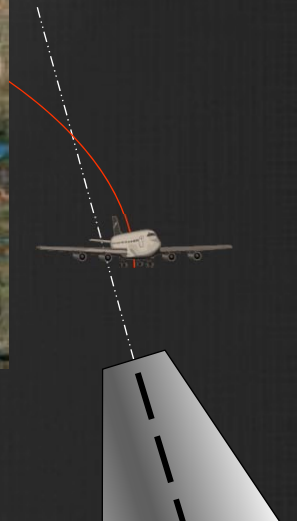


And to break the traditional GIS model when necessary…

To best support safety analysis and safety metrics!







Questions?

Airport Moving Map (AMM)

Terrain & Obstacle Databases

Rich Fosnot

Sr. Manager, Jeppesen Aviation & Marine Safety

NTSB Public Conference on Geographic Information Systems in Transportation Safety

4 Dec 2012

Distribution limited to Jeppesen Personnel

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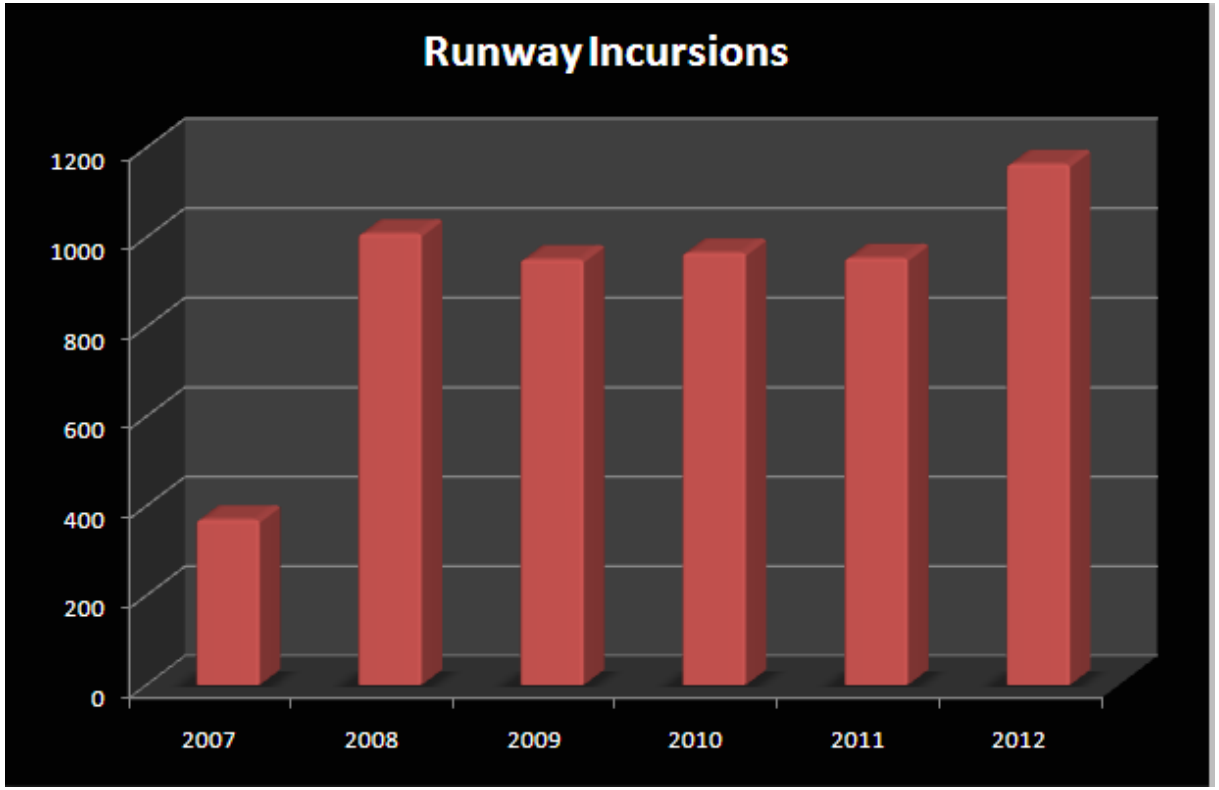
Why Airport Moving Map



Data valid through 3-Jun-2012
2012: Data through JUN 3 2012. 1164 projected EOY
Source: Federal Aviation Administration

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Runway Incursion and Excursion Events
IATA Safety Report

- 2011 - 17 Runway excursion accidents – 0 fatalities
- 2010 - 20 Runway excursion accidents 10% fatal

- 2011 - 0 Runway incursion accidents
- 2010 - 0 Runway incursion accidents

- Does not include Air Taxi, General, Business and Military Aviation

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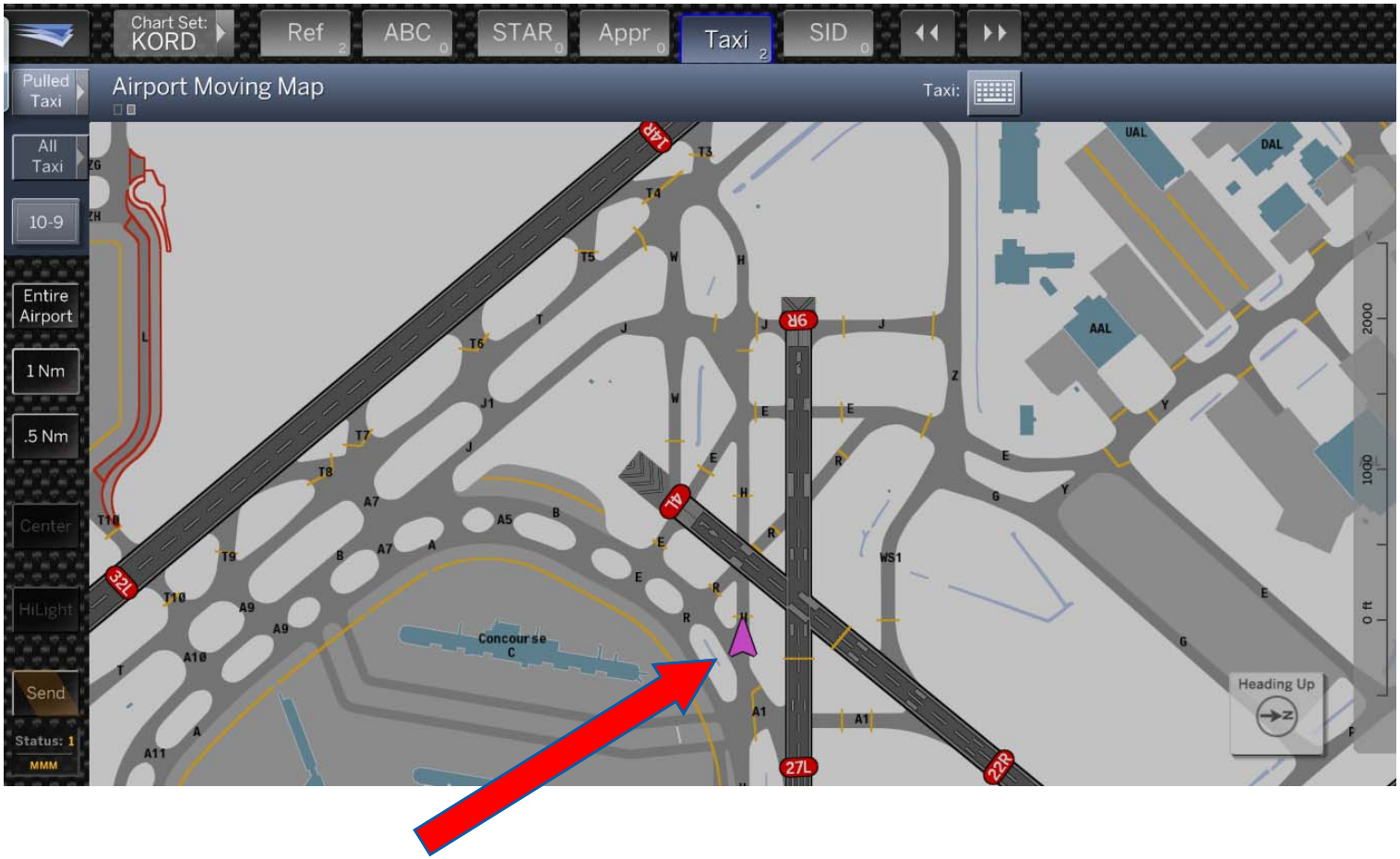
Jeppesen Airport Moving Map - Overview

Own-Ship Position
Magenta spotter



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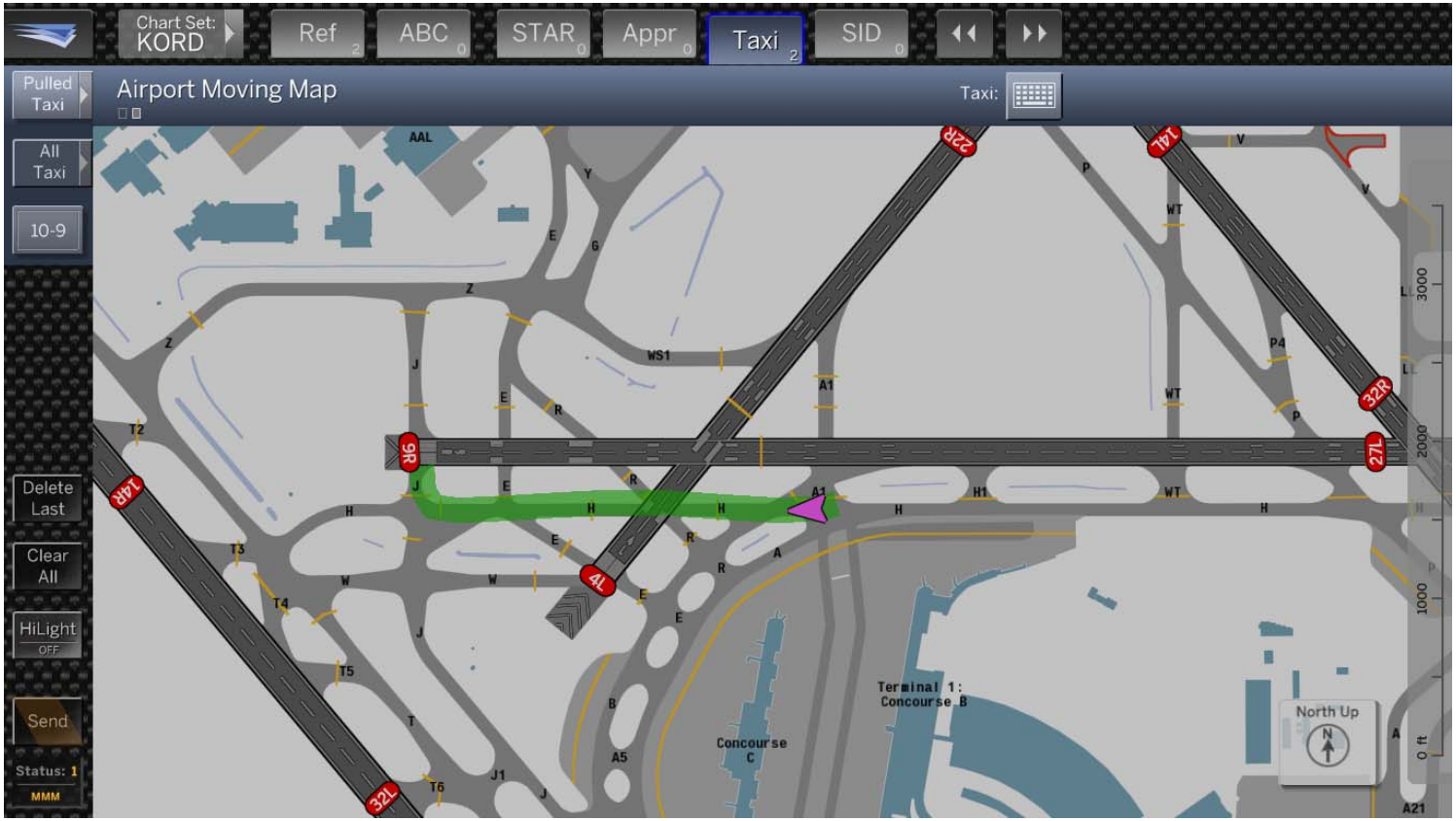
Jeppesen Airport Moving Map - Overview

Own-Ship Position
Magenta spotter

Highlighting
Highlight your route of taxi



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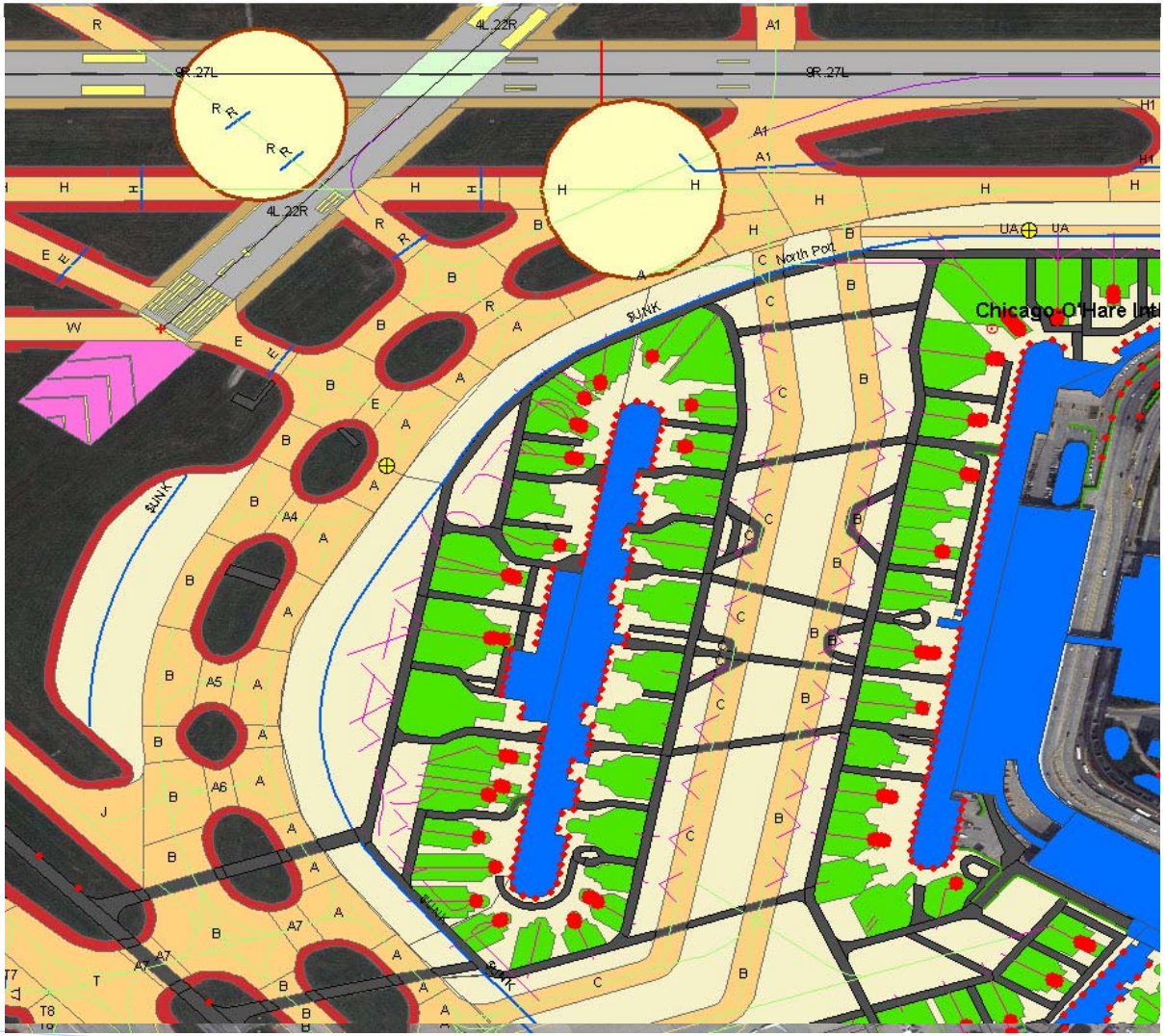
AMDB - KORD Sample – Incursion Hot Spots



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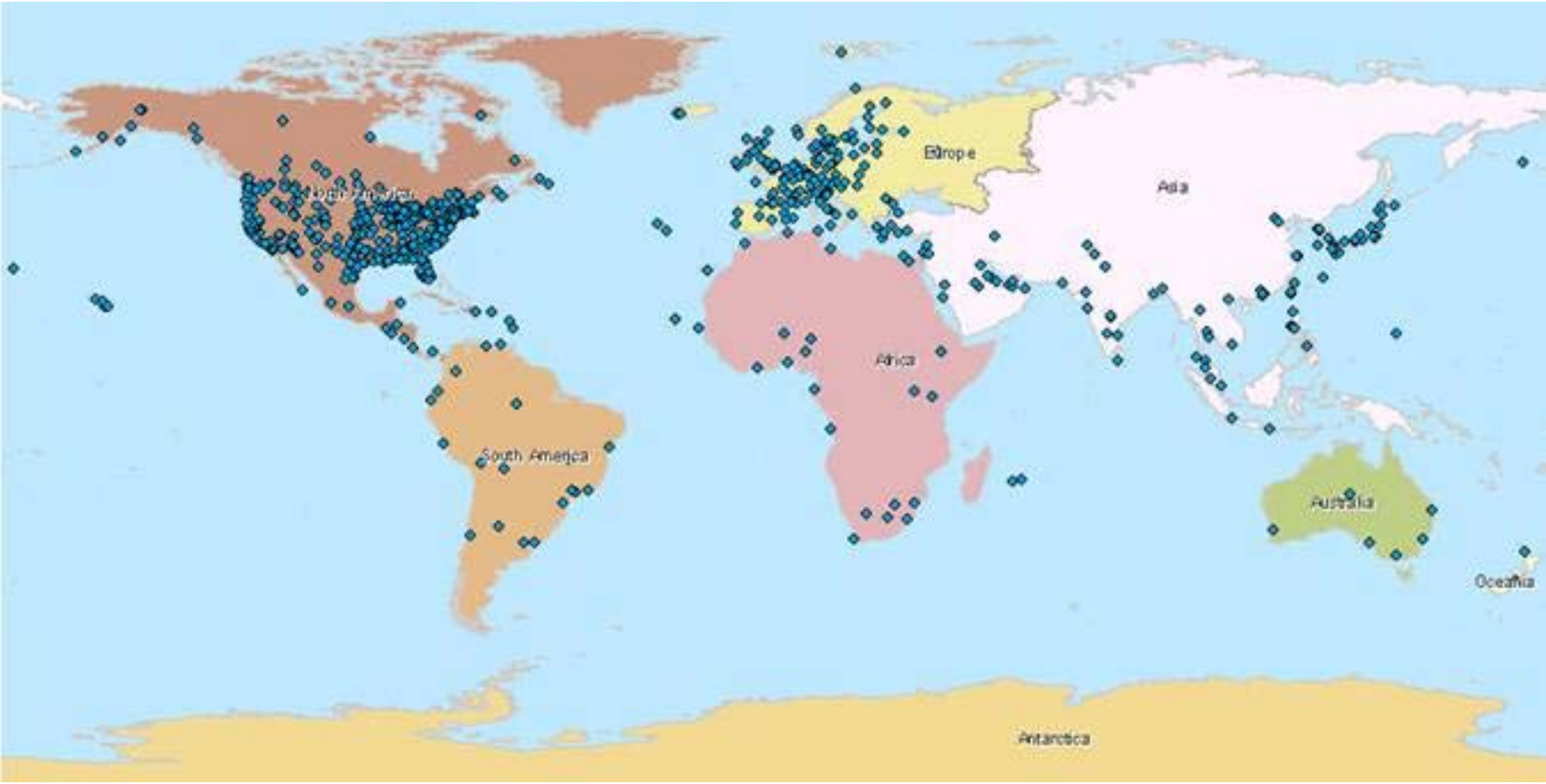
COVERAGE – >730 AIRPORTS & COUNTING



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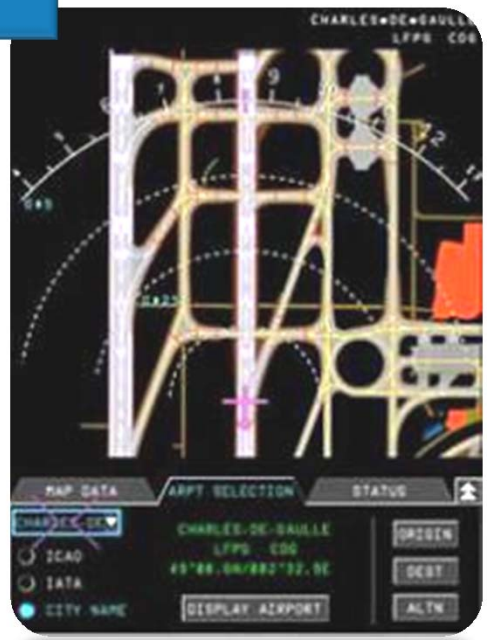
AMM Front Panel Deployments



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JEPPESEN AMDB FOR AIRBUS "BRAKE TO VACATE" (BTV)

- Improves management of approach & landing
- Runway Overrun Warning (ROW)
- Runway Overrun Protection (ROP)
- Value Proposition
  - Guarantee to vacate at the assigned exit
  - Reduce brake temperature & wear
  - Reduce max thrust reversers on dry runways
  - Reduce noise level on ground, fuel use, emissions
  - Minimize runway occupancy time
  - Reduce Taxi-Out time to the gate - Fuel Burn

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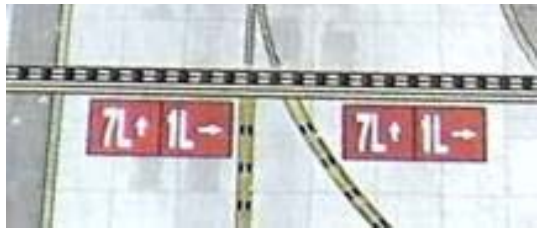
AMDB Roadmap – What's next ?

- Compliance with DO-272C
  - Routing Network - Accommodates Digital Taxi
  - Temporality attributes afford sub-cycle changes

- Early adoption of elements that will be eventually addressed if DO-272D gets approval to proceed from RTCA
  - Hold position "Doormats" – Accommodates SVS
  - Published Taxi Routes
  - Low Vis Routes



- Tailored airline AMM data (Highlight Gates, Operators specific Runway /Taxiway restrictions, Preferred routes, Ramp frequencies, company specific deicing areas)

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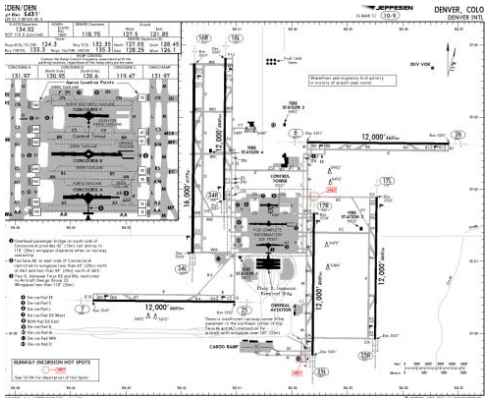
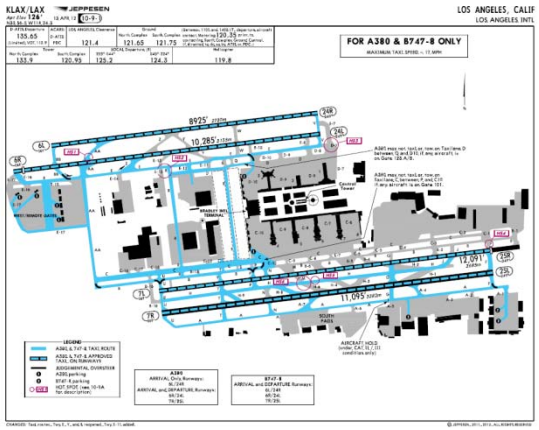
AMDB Roadmap – What's next ?

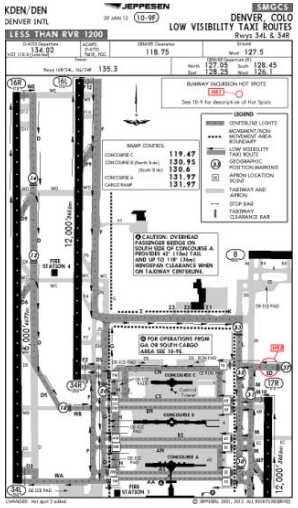
Single application for all Airport info and Ground operation requirements

Airport Chart

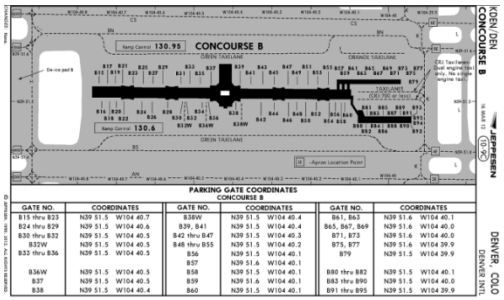


Airframe specific Restrictions

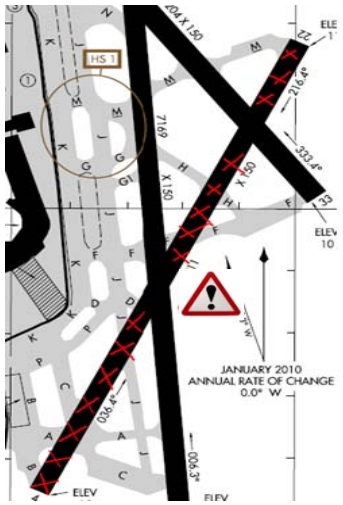




Low Vis Procedures



Gate Chart



Digital NOTAMs

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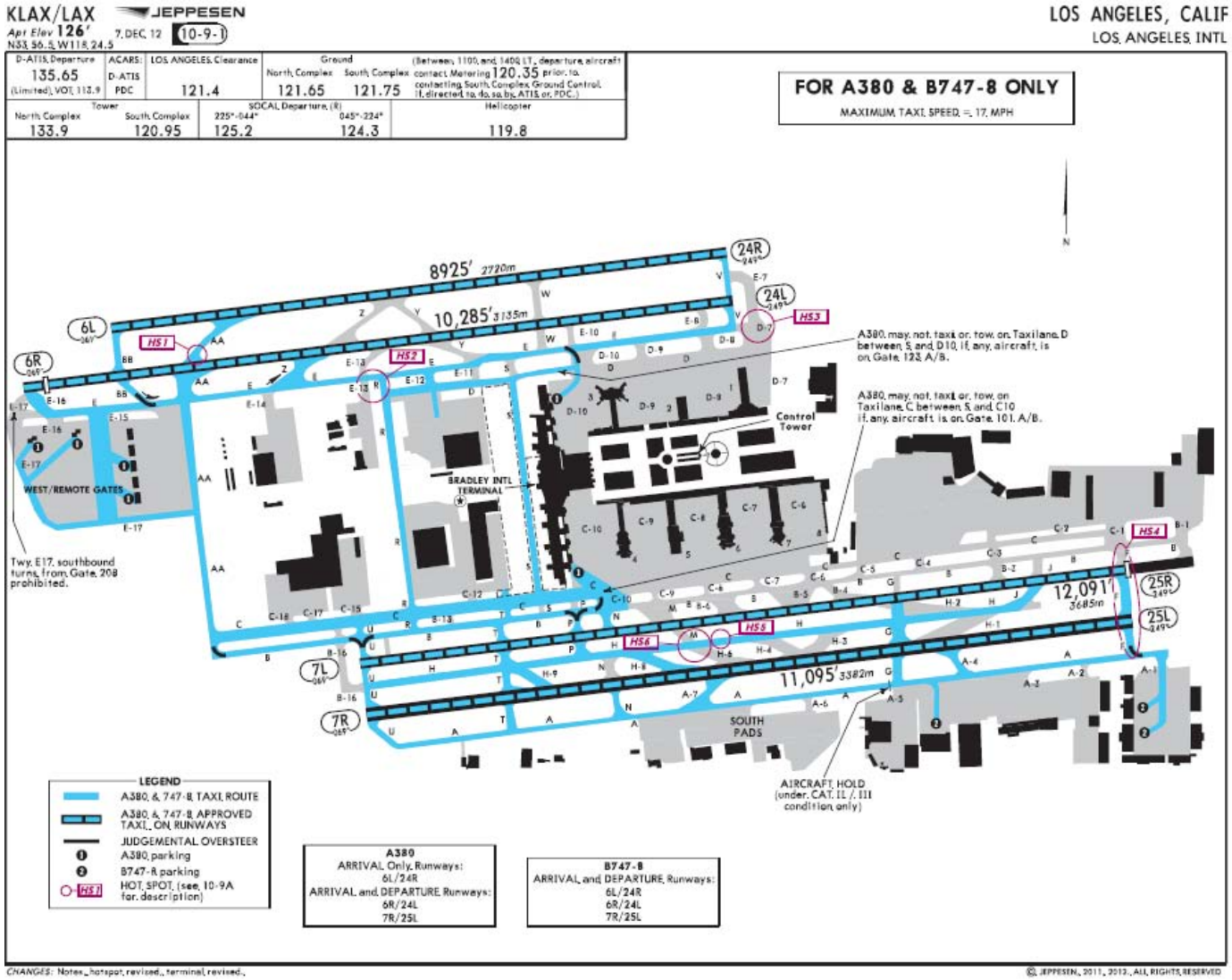
Airframe Specific Airport Diagram



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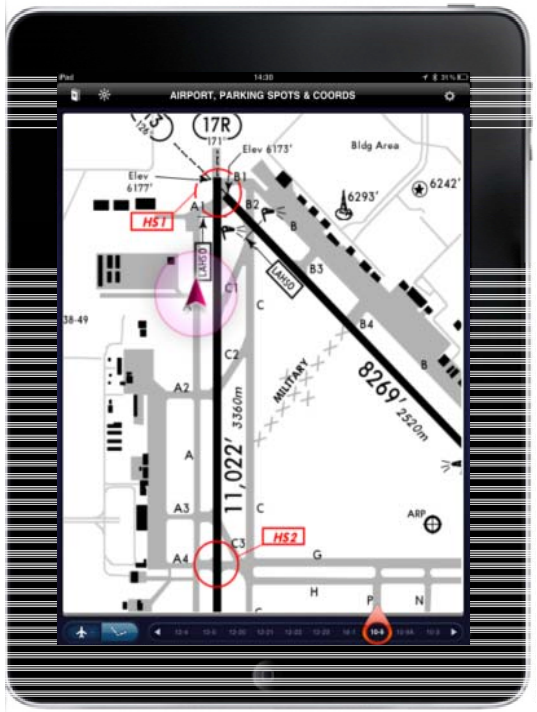
Accurate Airport Diagrams

- Jeppesen worked with Executive Jet Management to complete field trials analyzing the usability, accuracy, reliability and quality of a simple situation awareness tool during taxi operations

- Pilots were provided with portable GPS receiver to enable own-ship display on Jeppesen accurate airport diagrams of 23m or better using Mobile FliteDeck on iPad

- As a result of this study, effective JAN 31 2013 the FAA is implementing a new policy to support this ground-based capability as a “Type B” application, thus allowing acft spotters on Airport Diagrams of sufficient accuracy.



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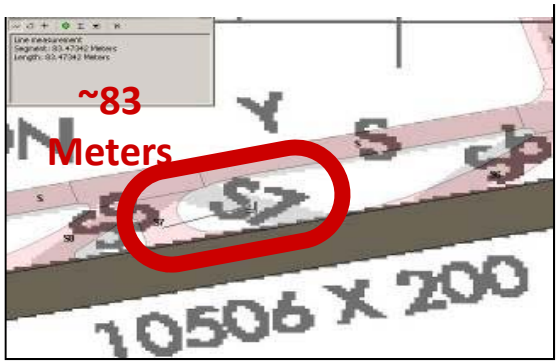
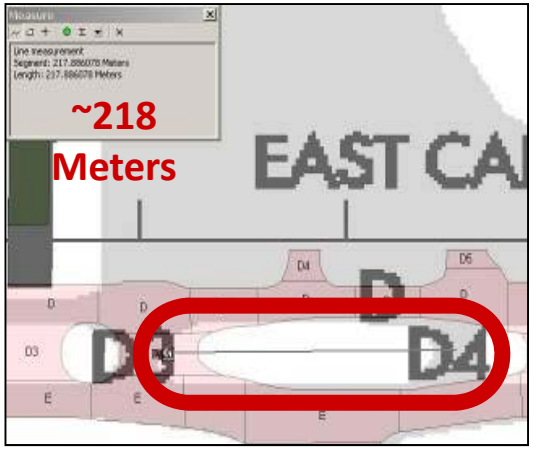
Accurate Airport Diagrams

- ANSP supplied airport diagrams often contain gross errors
- Errors exceeding 100m are common
- Database Accuracy required from DO-257A for display of acft spotters
  - Total runway error budget 79m
  - Total taxiway error budget 101m
- **Low accuracy airport diagrams cannot display own-ship**
- It is not practical to create an AMDB for every airport in the World





- **The Solution: Accurate Airport Diagrams @ 23m or better acc**
- Total error budget 40m (GPS location acc. 17m + Database acc. 23m)

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Mobile Roadmap

Terminal

Standard

Tailored

Enroute

Standard

Weather

Tailored

Text

Standard

Tailored

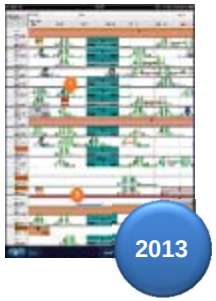
Further Enhancement

Document Mgmt.

Flight Planning

AMM

Crew Briefing



Windows

Already hosting Jeppesen FliteDeck Pro on Win 7.1
Win8 will be supported

Android

Galaxy development is moving along – 1st release in Q3 2012

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Controlled Flight into Terrain Events – IATA Safety Report

- 2011 - 10 accidents 90% Fatal
- 2010 - 7 accidents 86% Fatal

- Does not include Air Taxi, General, Business and Military Aviation

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Terrain and Obstacle Database

Overview

The Jeppesen Terrain Database provides the latest generation of terrain data for prevention of controlled flight into terrain and terrain avoidance warning systems (TAWS). Developed as a worldwide database based on the Shuttle Radar Topography Mission (SRTM) data from the National Geospatial Intelligence Agency (NGA).

The Jeppesen Obstacle Database is the world's most complete database of obstacles relevant to aviation. The database contains man-made and certain natural obstacles extracted from digital and paper sources provided by governmental civil aviation authorities and military agencies worldwide.

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Obstacle database

The Obstacle Database Can be Viewed in Google Earth

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TAWS
Terrain Awareness and Warning System

FAA TSO-C151c - Class A TAWS equipment must provide indications of imminent contact with the ground for the following conditions :

Mode 1: Excessive rates of descent

Mode 2: Excessive closure rate to terrain

Mode 3: Negative climb rate or altitude loss after takeoff

Mode 4: Flight into terrain when not in landing configuration

Mode 5: Excessive downward deviation from an Instrument Landing System (ILS) glideslope, Localizer Performance and Vertical Guidance (LPV), or Global Navigation Satellite System (GNSS) Landing System (GLS) glidepath.

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Other Uses of Digital Terrain and Obstacle Databases

- Aeronautical charts (examples follow)
- Airport Obstacle Analysis (AC 120-91)
- Moving Map displays
- SVS
- Flight Planning systems
- Flight Procedure Design
- TAAM (Airspace and Airport Modeling software)

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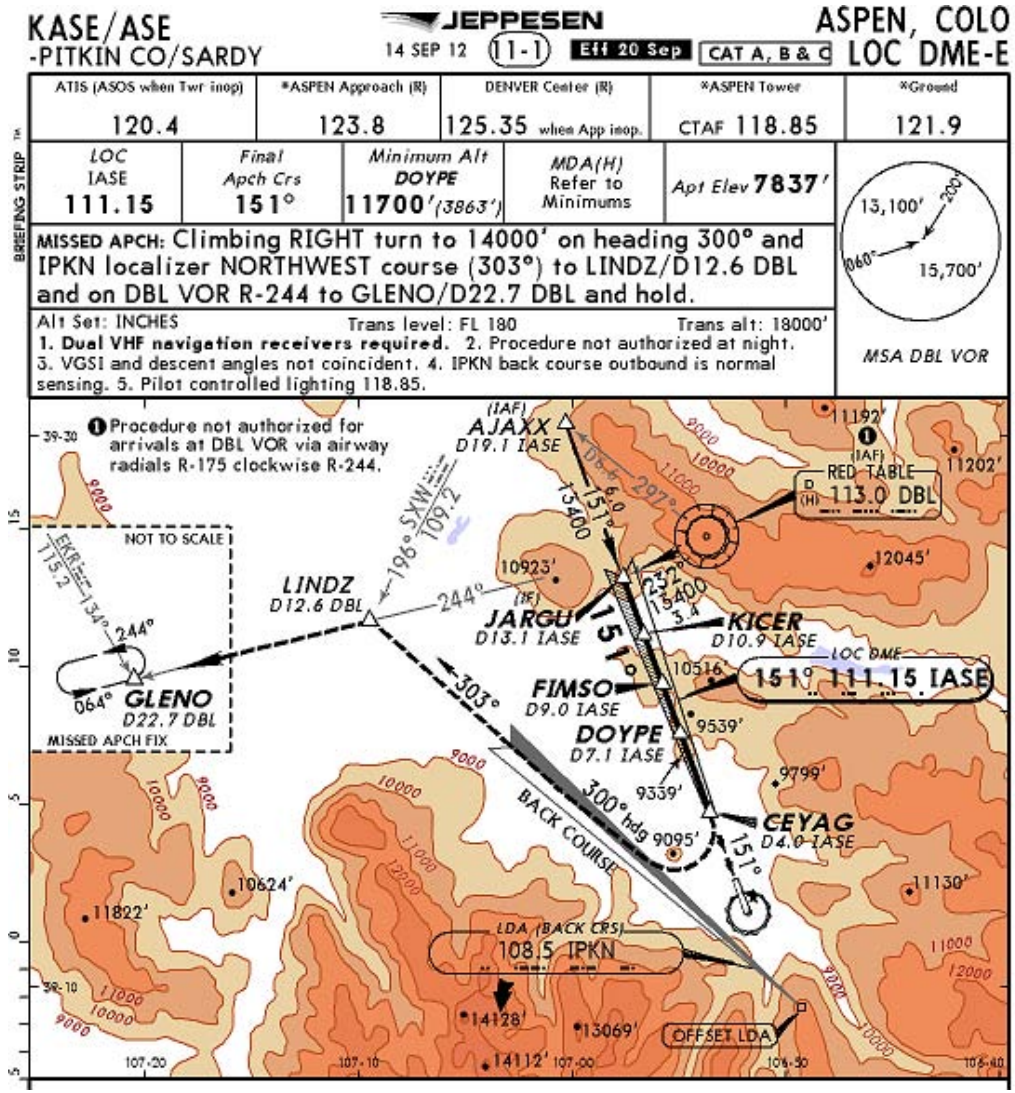
Terminal Aeronautical Charts

Terrain Contours

High Point elevations



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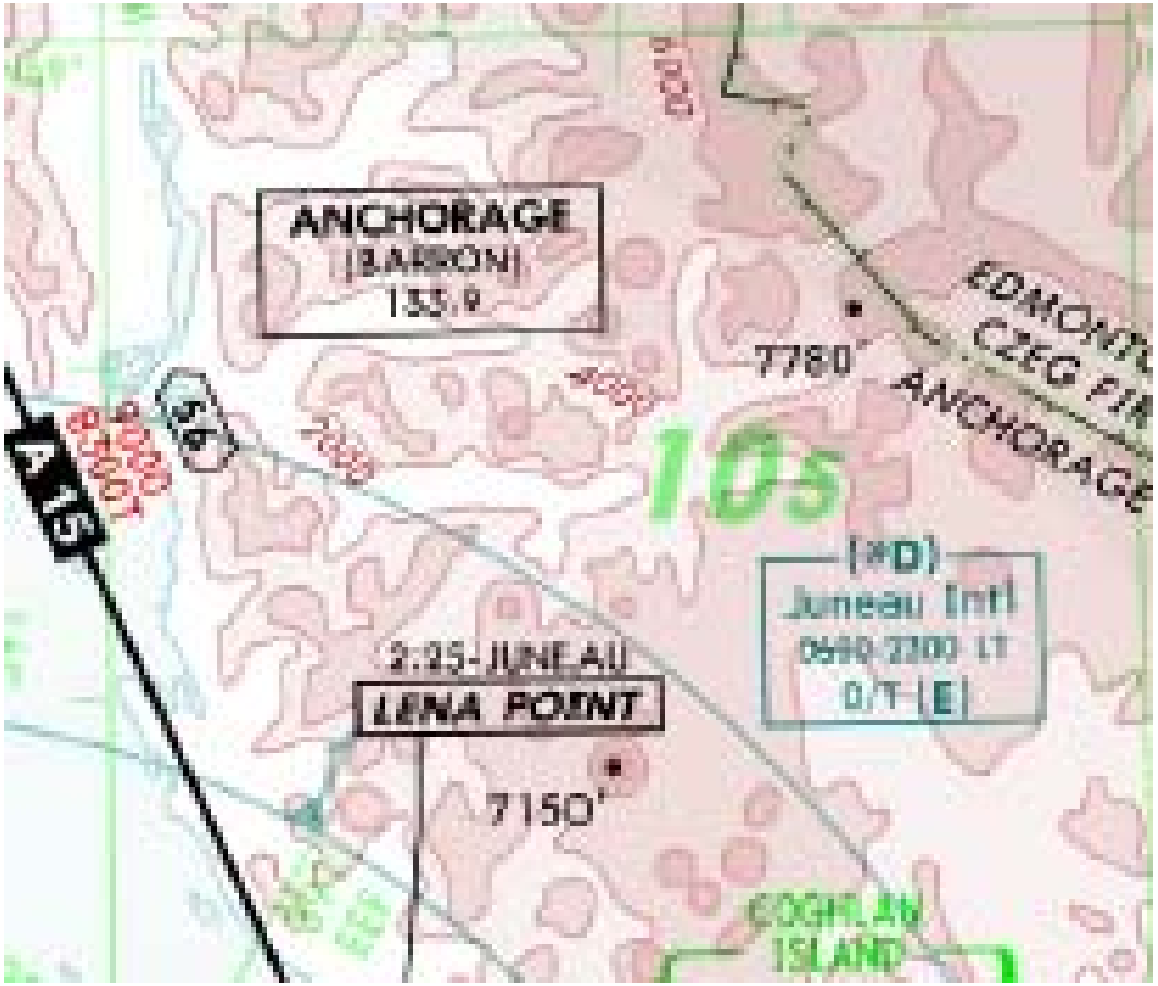
Enroute Paper charts

Terrain Contours

High Point elevations

Grid MORAs



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Enroute Electronic Charts

FliteDeck Pro

Boeing Enroute

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Why chart Terrain if it is not used in the Procedure?

Situational Awareness:

"The perception of the elements in an environment of time and space, the understanding of their meaning, and the projection of their status in the near future"

END

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Panel #4: Highway Safety Panel

Objective: This panel will examine the development of GIS technologies in crash avoidance, crash data reporting, safety analysis, and enforcement activities on U.S. public roads.

Craig Thor, Ph.D., Federal Highway Administration
Utilizing GIS to Improve Safety on the Nation's Highways

Matthew Barth, Ph.D., Jay Farrell, and Michael Todd, University of California-Riverside
Innovative Approaches for Next Generation Roadway Mapping and Vehicle Positioning

John Bigham, University of California Berkeley
Error Consideration in Georeferencing Police Reported Crash Data

Captain Woodland Wilson, Lieutenant Stephen Troutman, Sergeant Joseph Donohue, and Emily Varga, Baltimore County Police Department
Data Driven Approaches to Crime and Traffic Safety (DDACTS)

Office of Safety Research and Development

UTILIZING GIS TO IMPROVE SAFETY ON THE NATION'S HIGHWAYS

Craig Thor, Ph.D.

Geographic Information Systems (GIS) in Transportation Safety

December 4-5, 2012

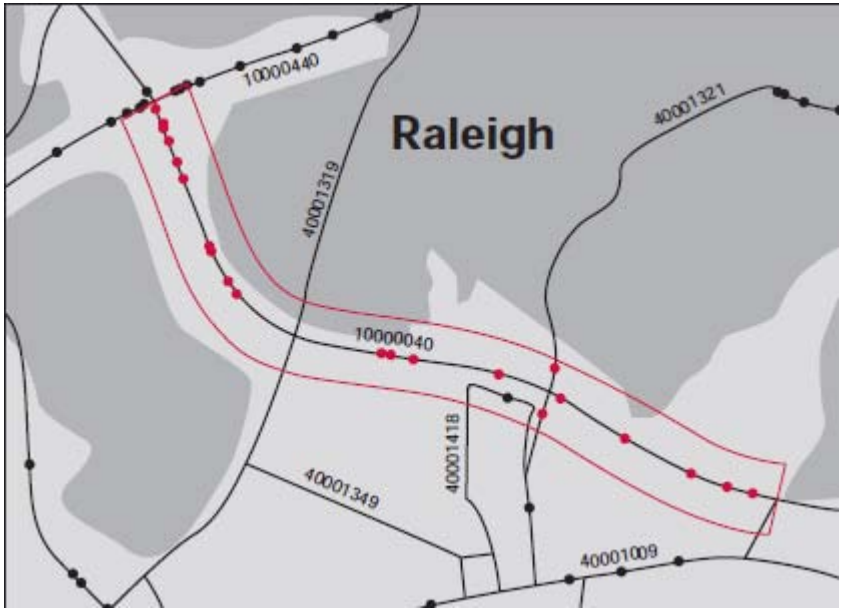
GIS at FHWA

U.S. Department of Transportation
Federal Highway Administration

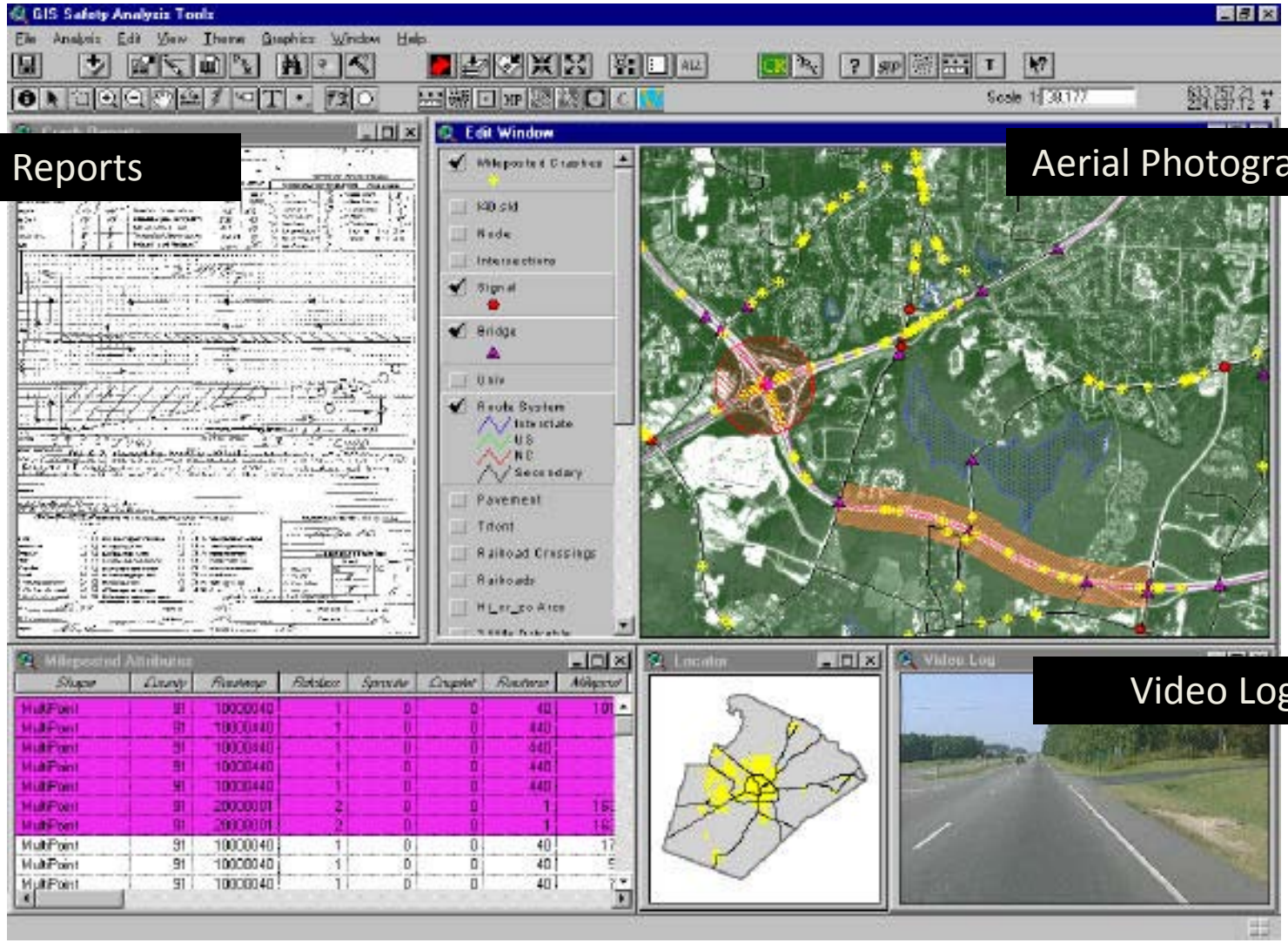
- Asset Management
- Planning
- Bridge Inventory
- Highway Performance Monitoring
- Operations
- **SAFETY**

GIS in the FHWA Safety Program

- Analysis Tools
  - GIS Safety Analysis Tools
  - PBCAT – Pedestrian and Bicycle Crash Analysis Tools

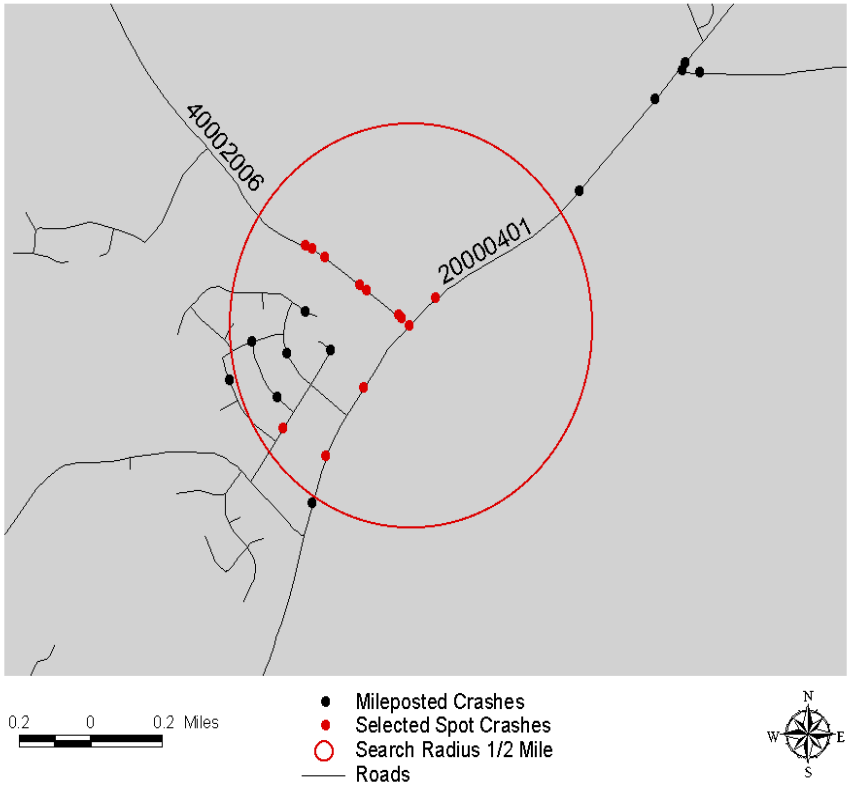


GIS Safety Analysis Tools



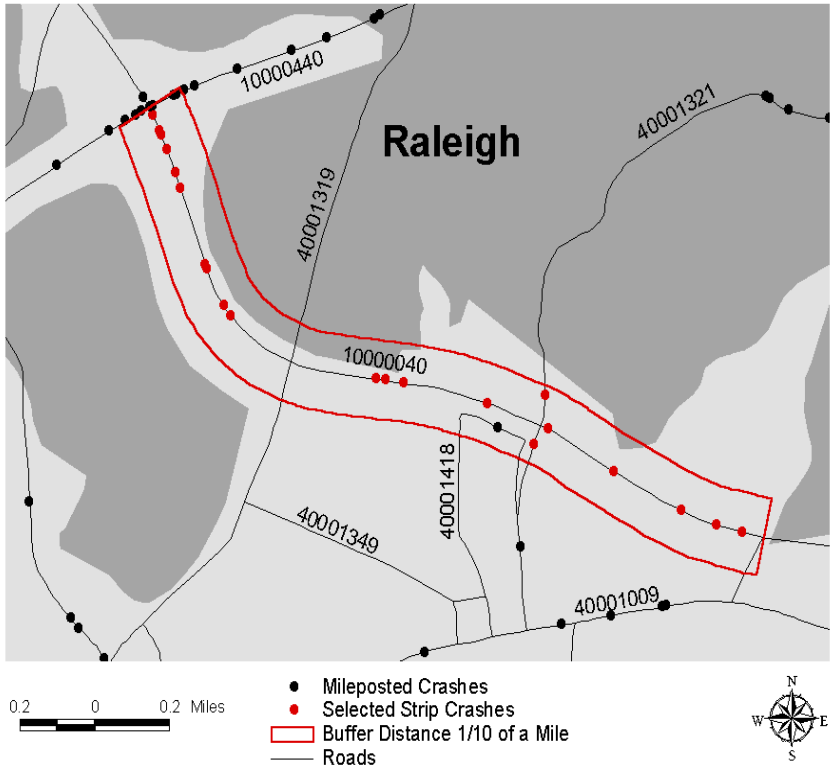
Intersection Analysis

- Evaluation of crashes at a specific location (intersection)



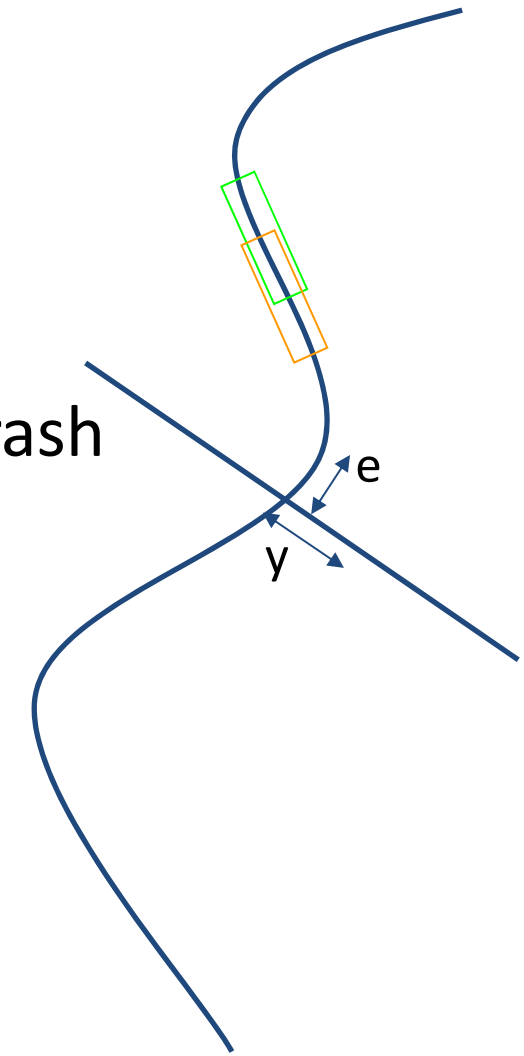
Strip Analysis

- Evaluation of crashes along a designated length of roadway



Sliding Scale Analysis

- Input Parameters
  - Starting length
  - Extension length
  - Maximum extensions without a crash
  - Exclusion distance (e)
  - Y-line distance (y)
  - Crash rate
  - Average crash rate



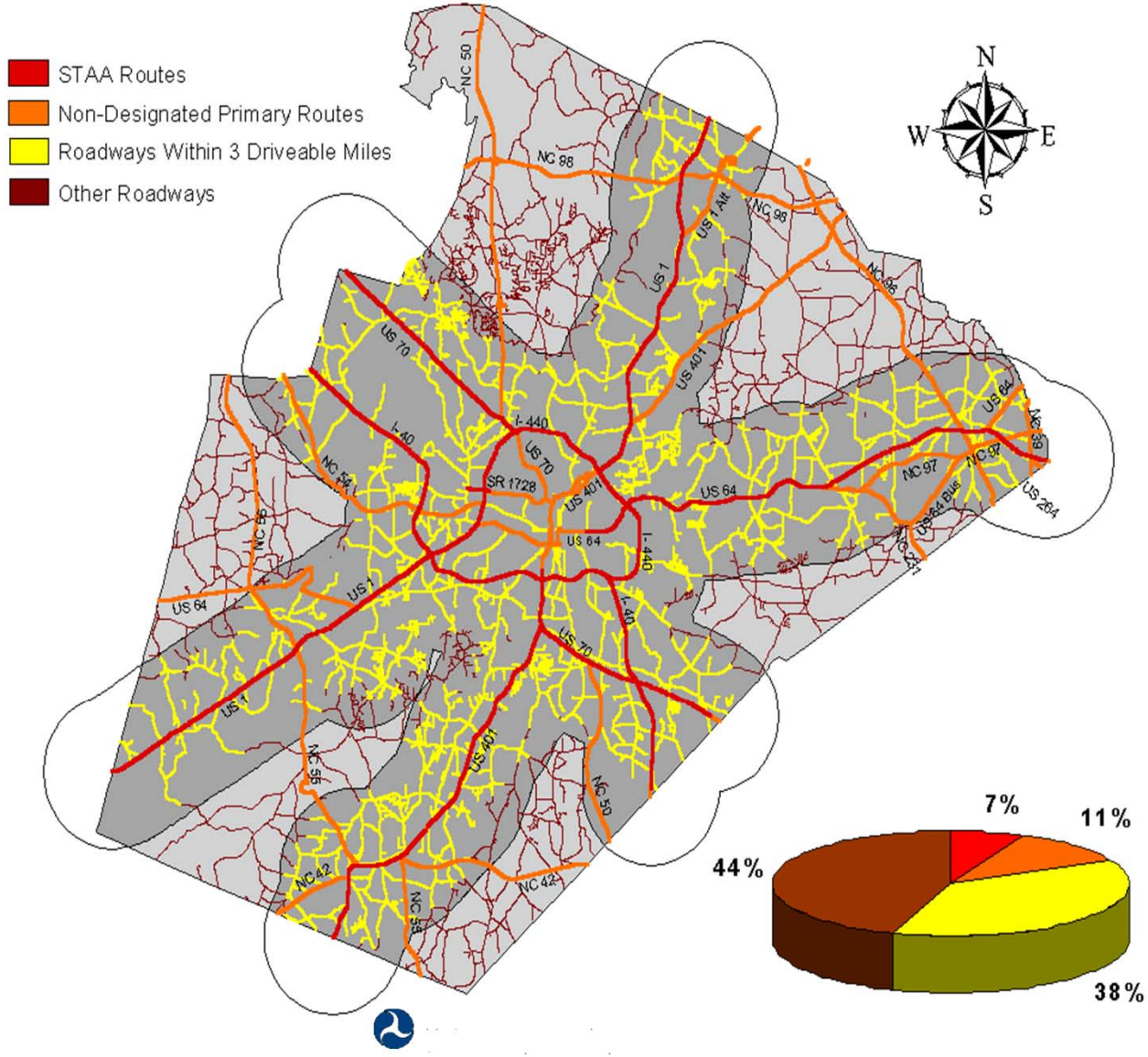
Corridor Analysis

- Evaluation of crashes within a corridor, which may include several connected roadways

<u>EXAMPLE:</u>

Truck crashes within Wake County, NC

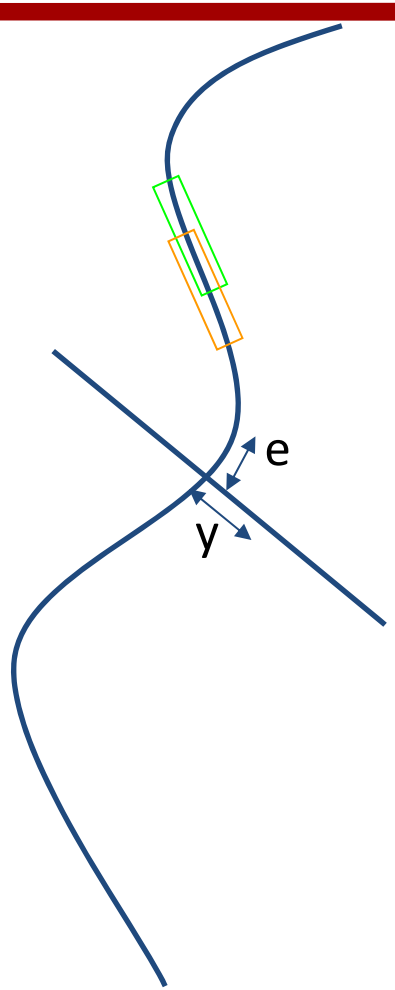
Truck Route Network



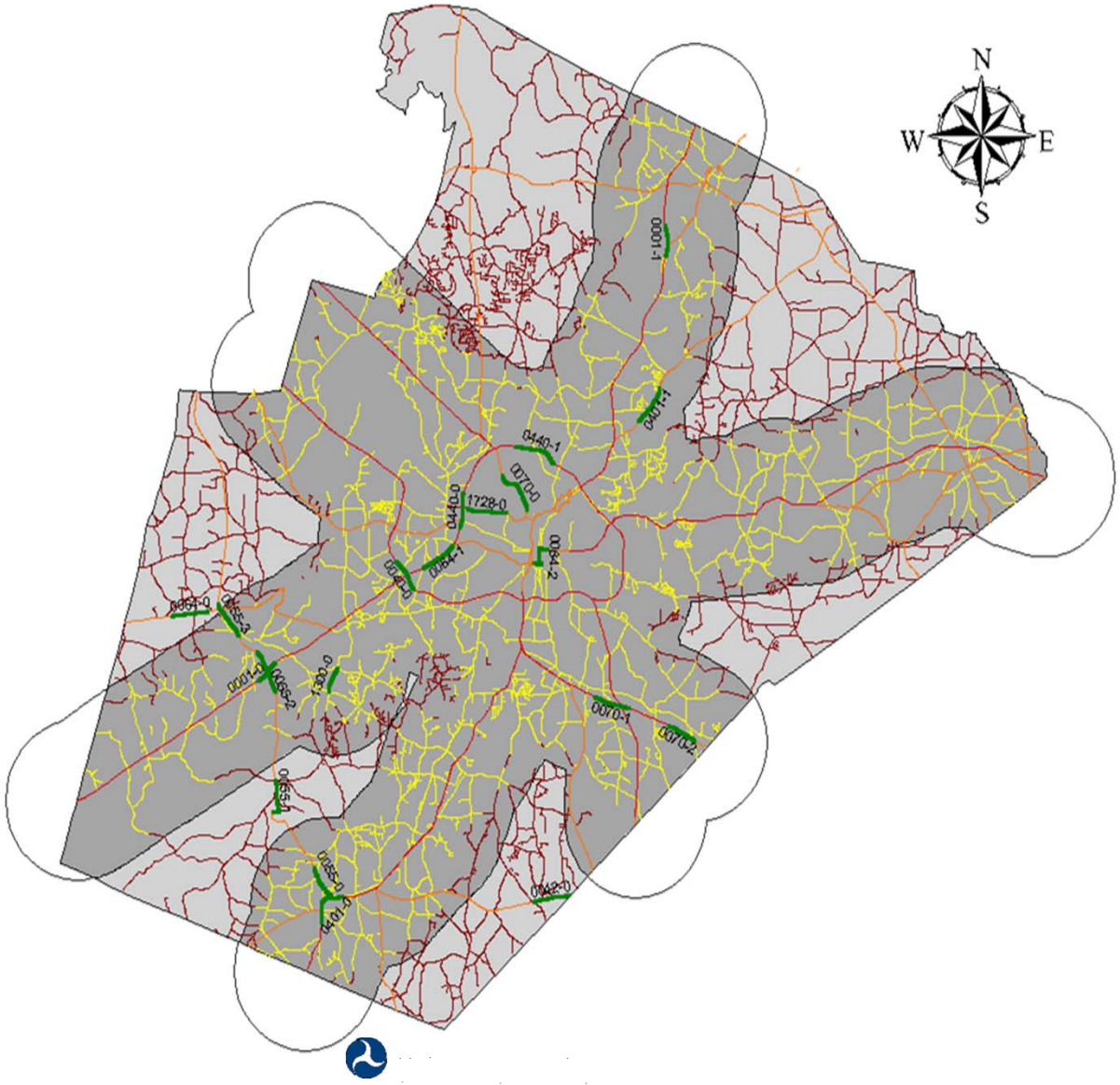
Sliding Scale Analysis

➔ **Input Parameters**

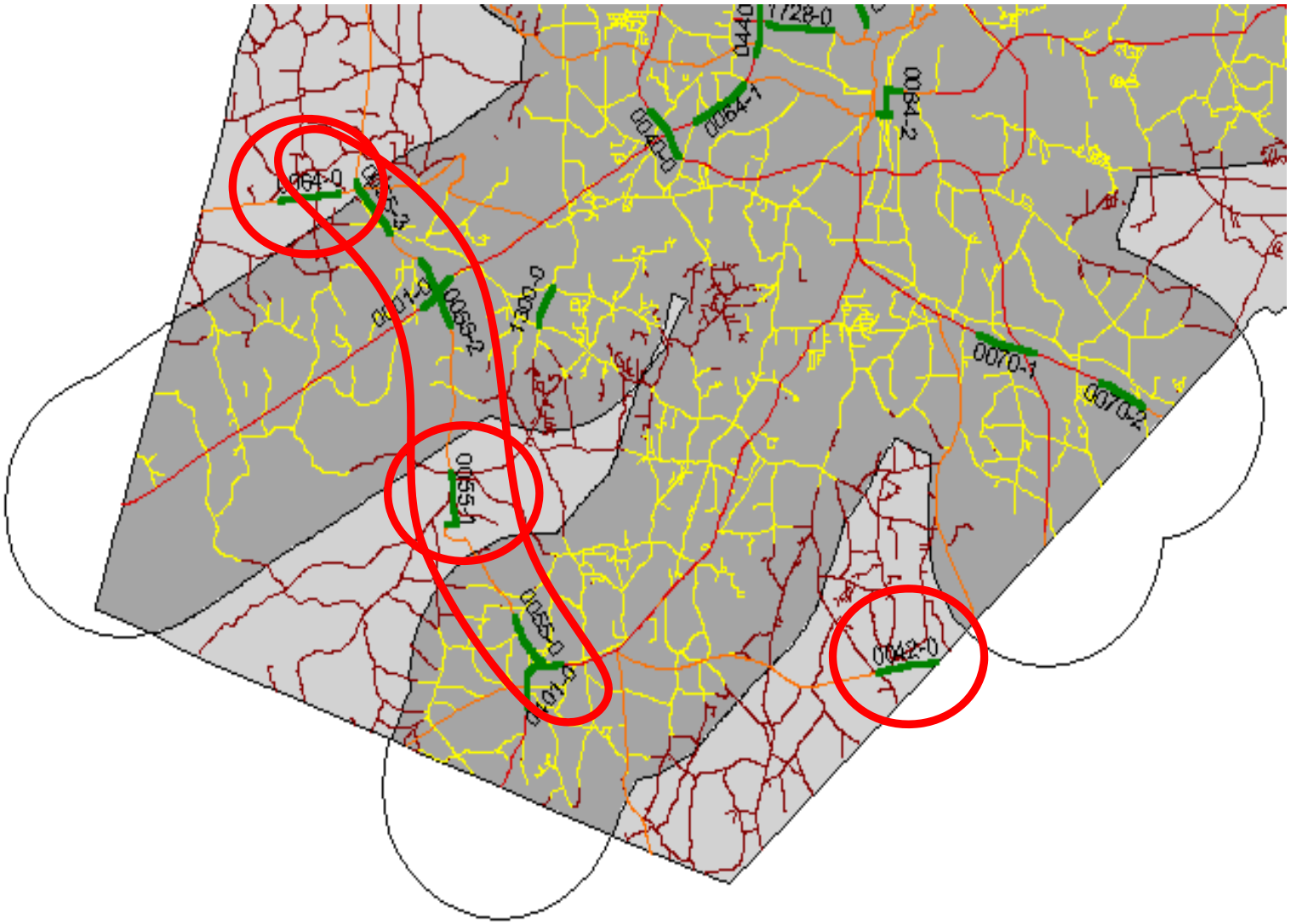
- Starting length: **(1.6 km)**
- Extension length: **(0.16 km)**
- Maximum extensions without a crash: **(5)**
- Exclusion distance (e): **(0)**
- Y-line distance (y): **(0)**
- Average crash rate (crashes / MVM):
  - **Interstate: 0.104**
  - **US Routes: 0.088**
  - **NC Primary: 0.086**
  - **NC Secondary: 0.063**



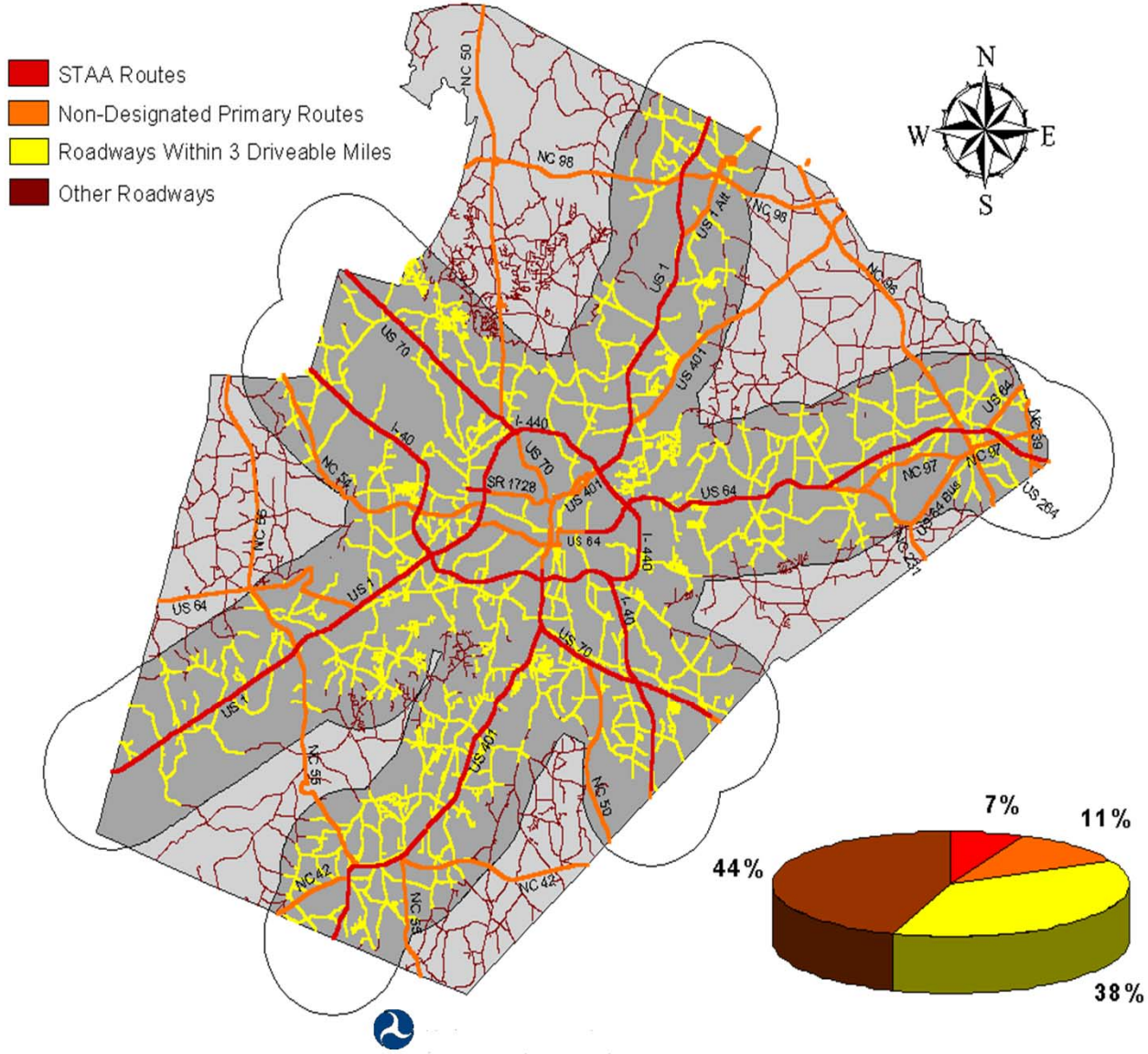
Sliding Scale Analysis Results



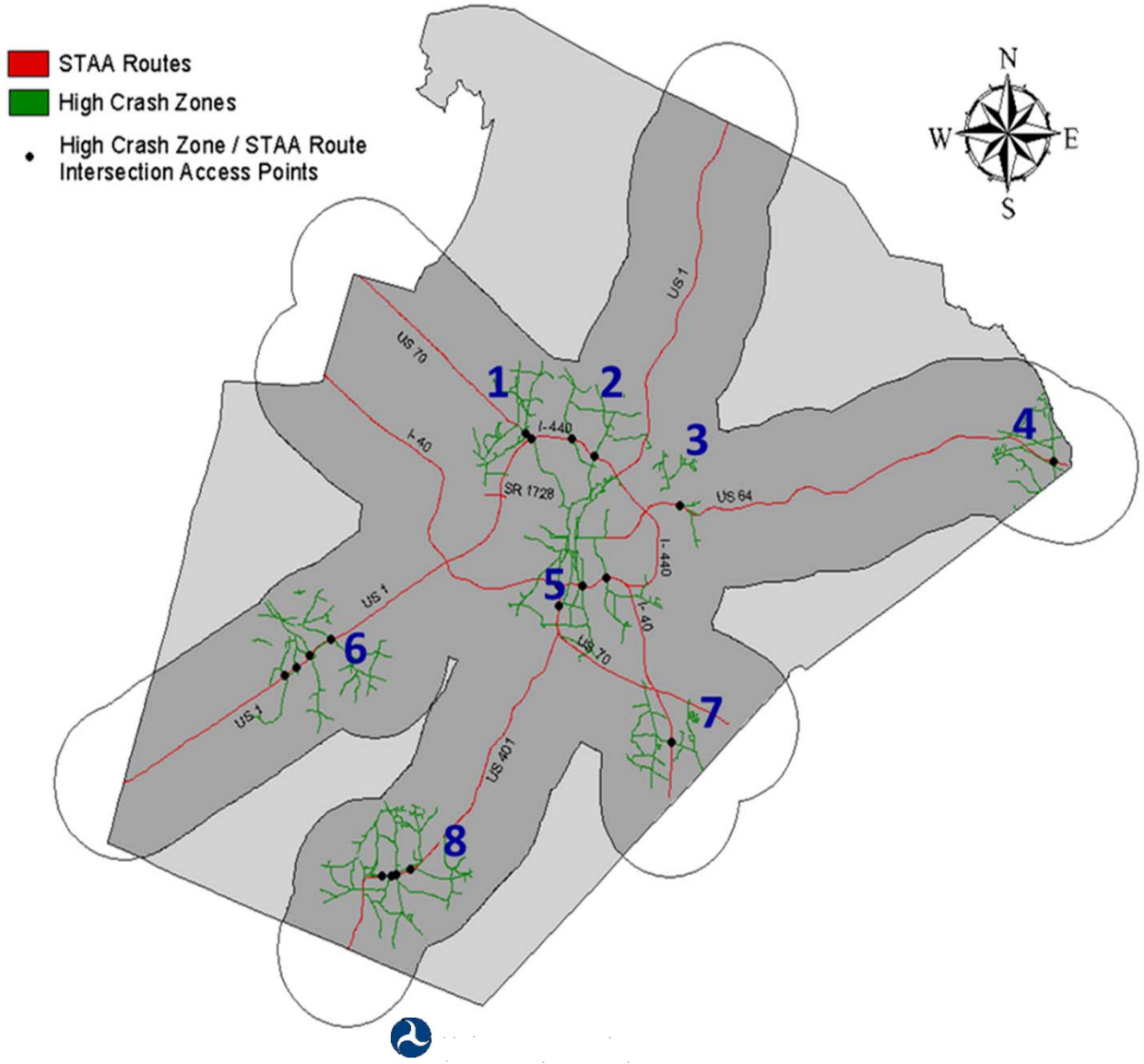
Critical Locations



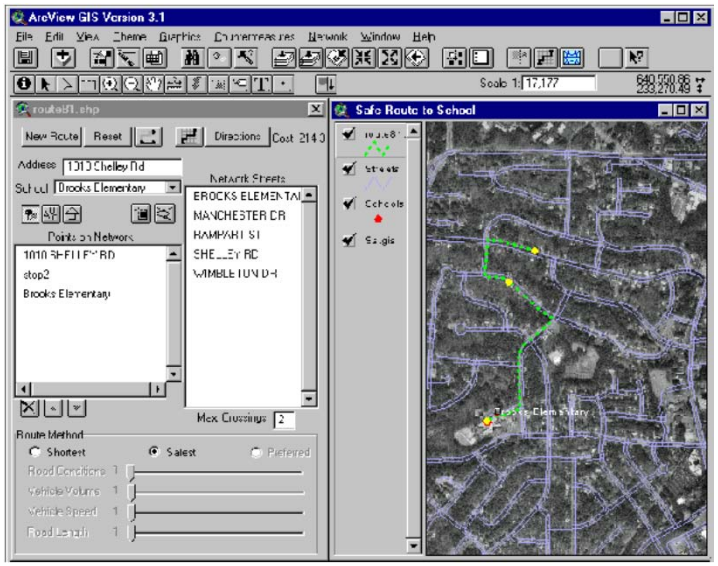
Truck Route Network

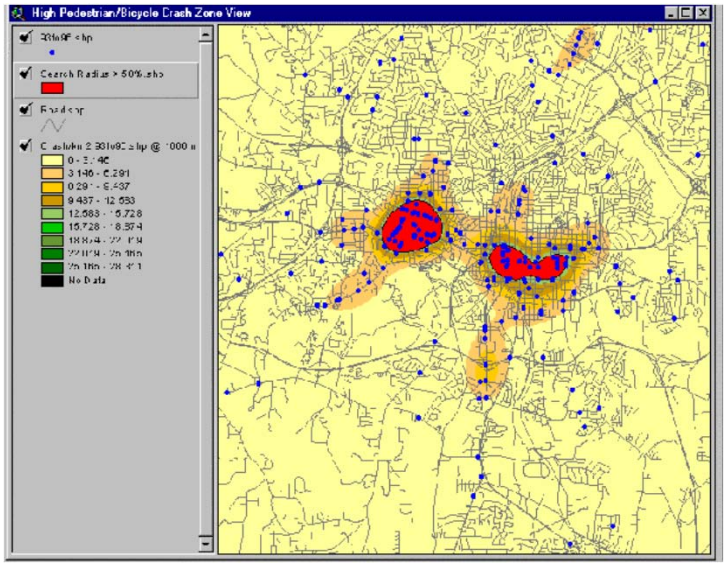


Critical Locations Off Primary Routes



Pedestrian and Bicycle Safety





Roadway Safety Analysis

- FHWA supported projects for advanced data analysis
  - **Highway Safety Manual (HSM)**
    - Provides transportation professionals with knowledge, techniques, and methodologies to quantify the safety-related effects of transportation decisions
  - **SafetyAnalyst**
    - Incorporates state-of-the-art safety management approaches into analytical tools to identify safety improvement needs and to develop a systemwide program of site-specific improvement projects.
  - **Interactive Highway Safety Design Model (IHSDM)**
    - A suite of software analysis tools for evaluating safety and operational effects of geometric design decisions on highways
  - **CMF Clearing House**

HSM Highway Safety Manual AASHTO

http://www.highwaysafetymanual.org

SafetyAnalyst

http://www.safetyanalyst.org/

IHSDM

http://www.ihsdm.org/

CMF CRASH MODIFICATION FACTORS CLEARINGHOUSE

http://www.cmfclearinghouse.org/

GIS in the FHWA Safety Program

- Roadway Safety Data Partnership (RSDP)
  - A collaborative effort between FHWA and States to ensure that they are able to develop robust data-driven safety decisions.
  - Capability Assessment
  - Peer Exchanges

ROADWAY SAFETY DATA PARTNERSHIP
COLLECTING • ANALYZING • MANAGING • EXPANDING

- Model Minimum Uniform Crash Criteria (MMUCC)

MMUCC Model Minimum Uniform Crash Criteria

http://www.mmucc.us/

- Model Inventory of Roadway Elements (MIRE)

MIRE
MODEL INVENTORY OF ROADWAY ELEMENTS

http://www.mireinfo.org/

GIS at State DOTs

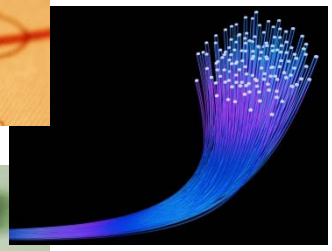
- States are moving towards or have created GIS-based data and analysis systems
- Everyday users of the data
  - What are the States doing?
  - What are the priorities?
  - What are the challenges and capability gaps?
  - ***HOW CAN FHWA HELP?***

Assessing GIS Needs for State and Local Safety Programs

- October, 2012 – September, 2013
- Objectives
  - *Assess the GIS practices, needs and challenges, and opportunities in safety programs.*
  - *Help guide future efforts to best support the needs of agencies as they develop and improve their GIS programs for safety.*

Current Challenges

- **Existing Analytical Tools**
  - Available GIS software applications
  - Analytical/statistical techniques
- **Technical obstacles**
  - Warehousing the data
  - Data precision/accuracy
  - Availability of basemaps
  - Different geo-referencing systems
  - Incompatible data definitions/formats
- **Administrative obstacles**
  - Establishing a GIS Champion
  - Funding challenges
  - Identifying GIS as a priority
  - Determining the cost/benefit of GIS implementation
  - Data ownership



What is Needed?

- **Research Topics**
  - Identification of current state of practice
  - Emerging practices/tools, i.e. what will be available in the future?
  - Identification of research gaps that FHWA can help support filling.
  - What program support can FHWA provide?
  - What guidance can be developed to address known administrative challenges?

Office of Safety Research and Development

UTILIZING GIS TO IMPROVE SAFETY ON THE NATION'S HIGHWAYS

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Innovative Approaches for Next Generation Roadway Mapping and Vehicle Positioning

Matthew Barth, Jay Farrell, and Michael Todd
University of California-Riverside

NTSB Conference in
Geographic Information Systems (GIS) in Transportation Safety
December 4-5, 2012
Washington, DC

Outline:

- Big picture: Positioning and Mapping
- FHWA Project: Precision Mapping: Objectives & Approach
- FHWA Exploratory Advanced Research Project in Precise Vehicle Positioning: Objectives & Approach
- Latest Results and Applications
- Interesting Directions

Mapping and Positioning Research to Support Lane-Level ITS Applications

Objectives:

- **To analyze mapping and positioning technologies:**
  - **Automated and sensor-based for low-cost map production**
  - **High precision for next-generation (lane-level) applications (Lane Departure Warning, Curve Overspeed Warning, Signal Phase and Timing, by lane, Intersection management and collision avoidance, etc.)**
  - **Most precise mapping and positioning for ITS research is based on relative coordinates rather than absolute coordinates**

Such applications are transformative improvements for safety, mobility, and environmental performance

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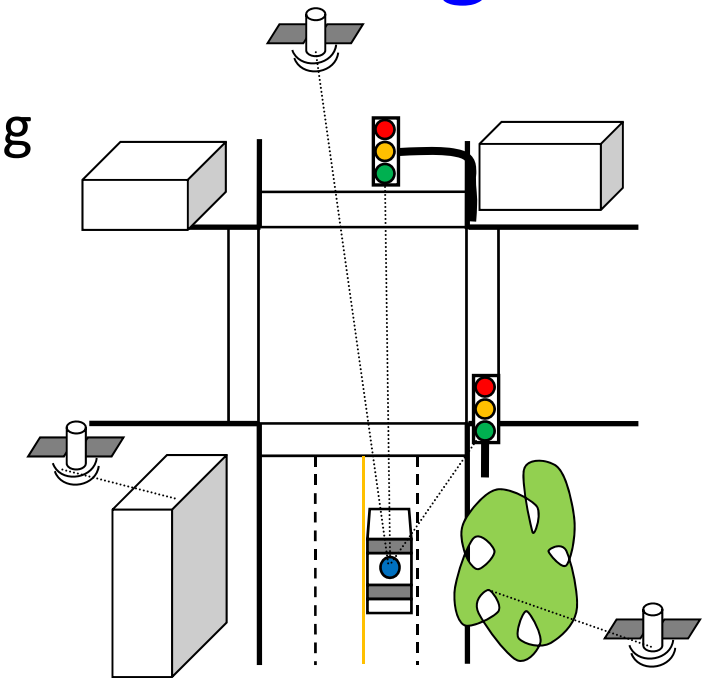
Precision Real-time Positioning



- Many ITS Applications need Positioning with high degrees of:
  - ***Accuracy*** – Less than one meter
  - ***Continuity*** – High sample rate
  - ***Availability*** – Works in diverse environments
  - Accomplished at a ***Low Cost***
- Solution: Sensor Fusion using
  - Inertial Measurement Unit
  - Differential GPS
  - Feature sensors: RADAR, LIDAR, Camera
  - Existing Infrastructure

ITS *Safety* Example Applications:
lane-departure warning, freeway merge assistance, intersection collision avoidance, curve over-speed warning

ITS *Mobility* Example Applications:
vehicle navigation assistance, congestion warning systems, adaptive cruise control, and parking assistance

Aiding Sensor Categories

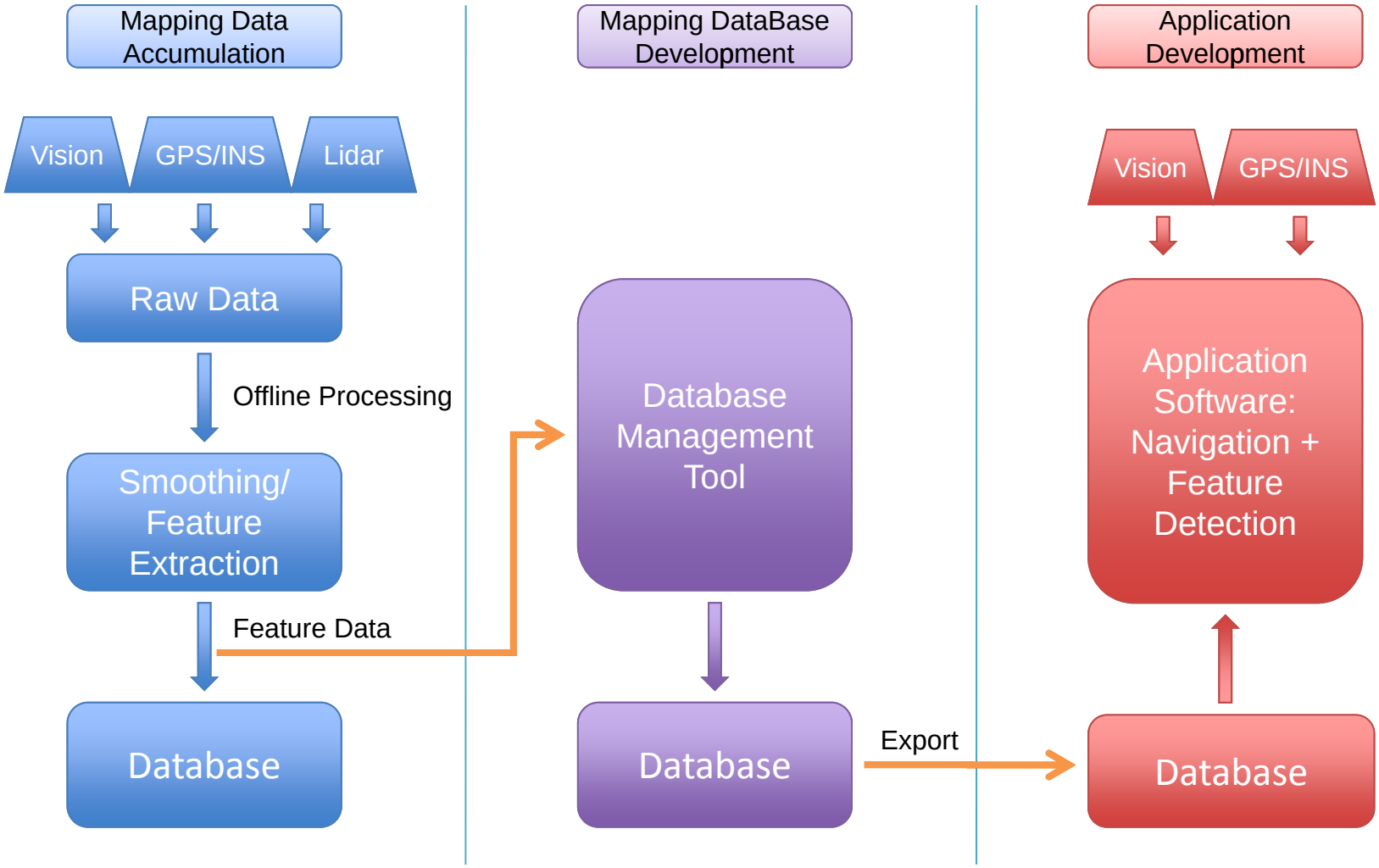
	Technology	Principle	Range Accuracy	Veh. Cost	Rdwy. Cost	Req'd Advances
	GPS	TOA	10 m	Low	Bases, comms	Modernization
	DGPS		1 m	Low	Bases, comms	Modernization
	CPDGPS		0.01 m	High	Bases, comms	Modernization
	Pseudolites	TOA, TDOA	0.01 m	Med	High	> First generation
Terrestrial Radio Navigation	-- Cell Phone	RSSI	km's	Low	Existing	
	-- Cell Phone	TOA, TDOA	100's m	Low	Existing	Physical layer timing
	-- TV - digital	TOA	10's m	??	Bases, comms	??
	-- Radio AM Analog	TOA	10's m	Low	Existing	??
	-- Radio FM Analog	TOA	??	Low	Existing	??
	-- Radio Digital	TOA	??	Low	Existing	??
	-- Packet Radios	TOA, TDOA	km's	Low	High	Physical layer timing
Feature Based	Vision	AOA		Low-Med	Feature Mapping	Feature Robustness
	Radar	AOA, RTOA	0.1 m	Low-Med	Feature Mapping	Feature Robustness
	Lidar	AOA, RTOA	0.01 m	High	Feature Mapping	Feature Robustness

GNSS: Proven with open skies. Challenging in urban environments.

TRN: Shows great promise as physical layer timing advances

FB: Assessed as viable *if precision roadway feature maps are available*. Research leading FB positioning demonstrations was the project focus after year one.

Precision Mapping & Real-time Positioning



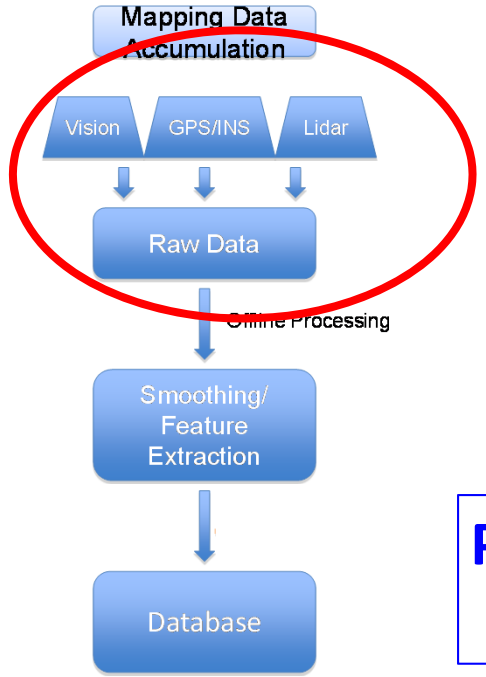
Feature based positioning and ITS application performance are enabled and enhanced by precise roadway feature maps.

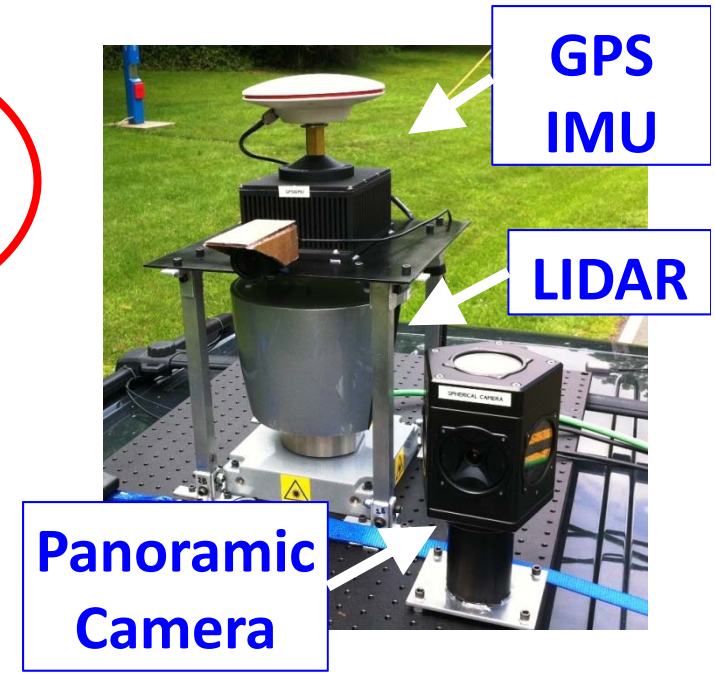
Precise Roadway Feature Maps

- **Analyze, develop, & demonstrate roadway feature mapping technologies:**
  - **Automated and sensor-based for low-cost map production**
  - **High precision (decimeter) for next-generation applications**
    - **Lane departure warning**
    - **Curve overspeed warning**
    - **Headlight steering into curves**
    - **Signal Phase and Timing by lane**
    - **Intersection management and collision avoidance**

  Such applications are transformative improvements for safety, mobility, and environmental performance
- **Roadway features: Road & lane edges, Sign type & location, Street and stop lights, stop bars, …**

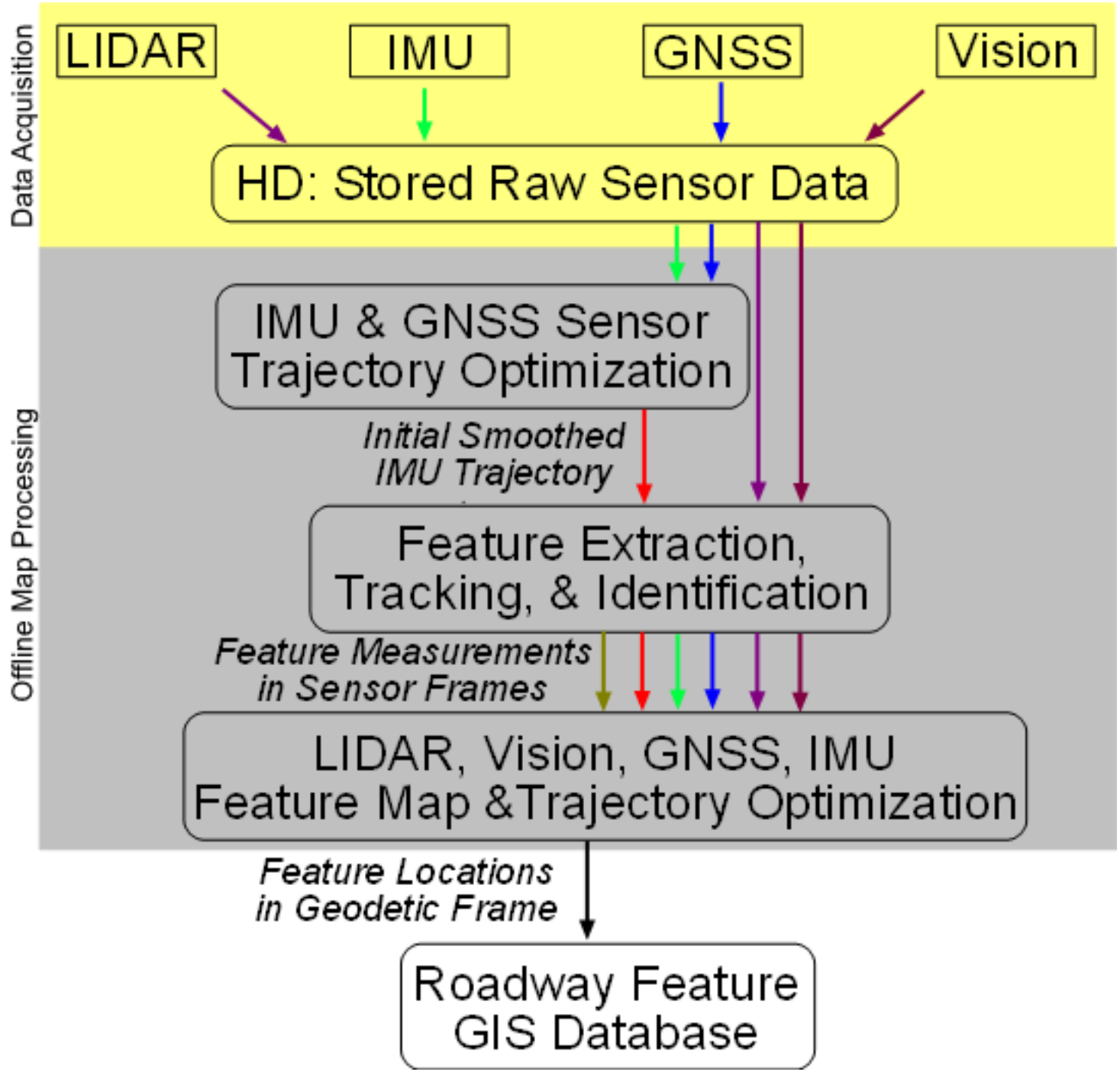
Precision Roadway Map: Data Acquisition





Sensor	Bytes/Msg.	Msgs./sec	Bytes/Sec	GB/Hr	GB/Hr (with timestamp overhead)
IMU	19	200	3800	0.013	0.232
LIDAR	1206	3473	4,188,438	15.08	15.278
Camera	35,836,416	7.5	268,773,120	967.583232	967.583
GPS measurement data	612	1	612	0.002	0.0374
GPS Ephemeris data	256	.002	.512	1.8432e-6	3.13344e-5
DGPS data	1071	1	1071	0.0038	0.0039
		Total:	273 MB /sec	982 GB/Hr	983 GB/Hr
		Hrs. of collection per TB:			≈1 Hr.
		Miles of coverage per TB (assuming a speed of 30 mph):			≈30 miles

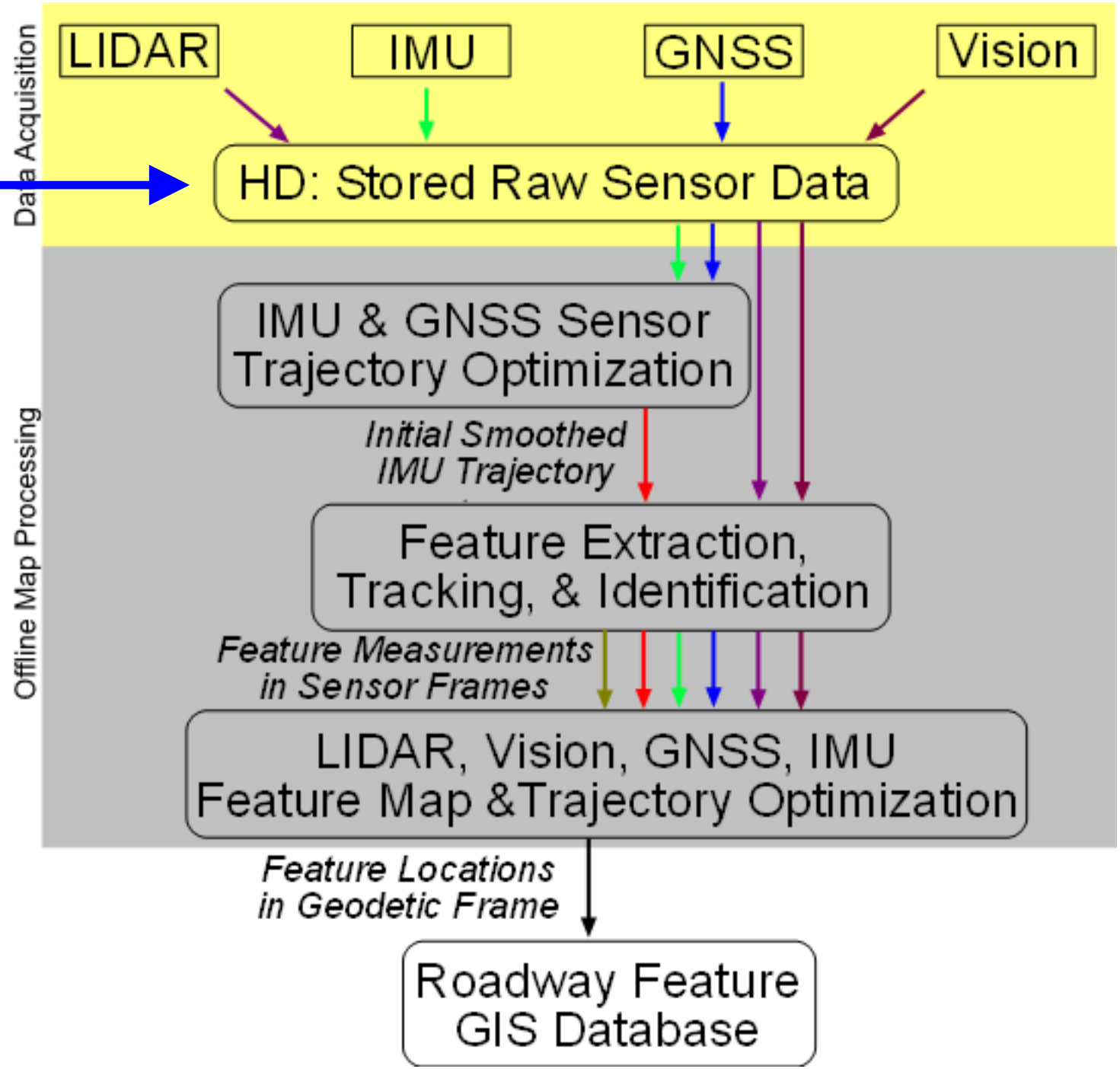
Mapping Process



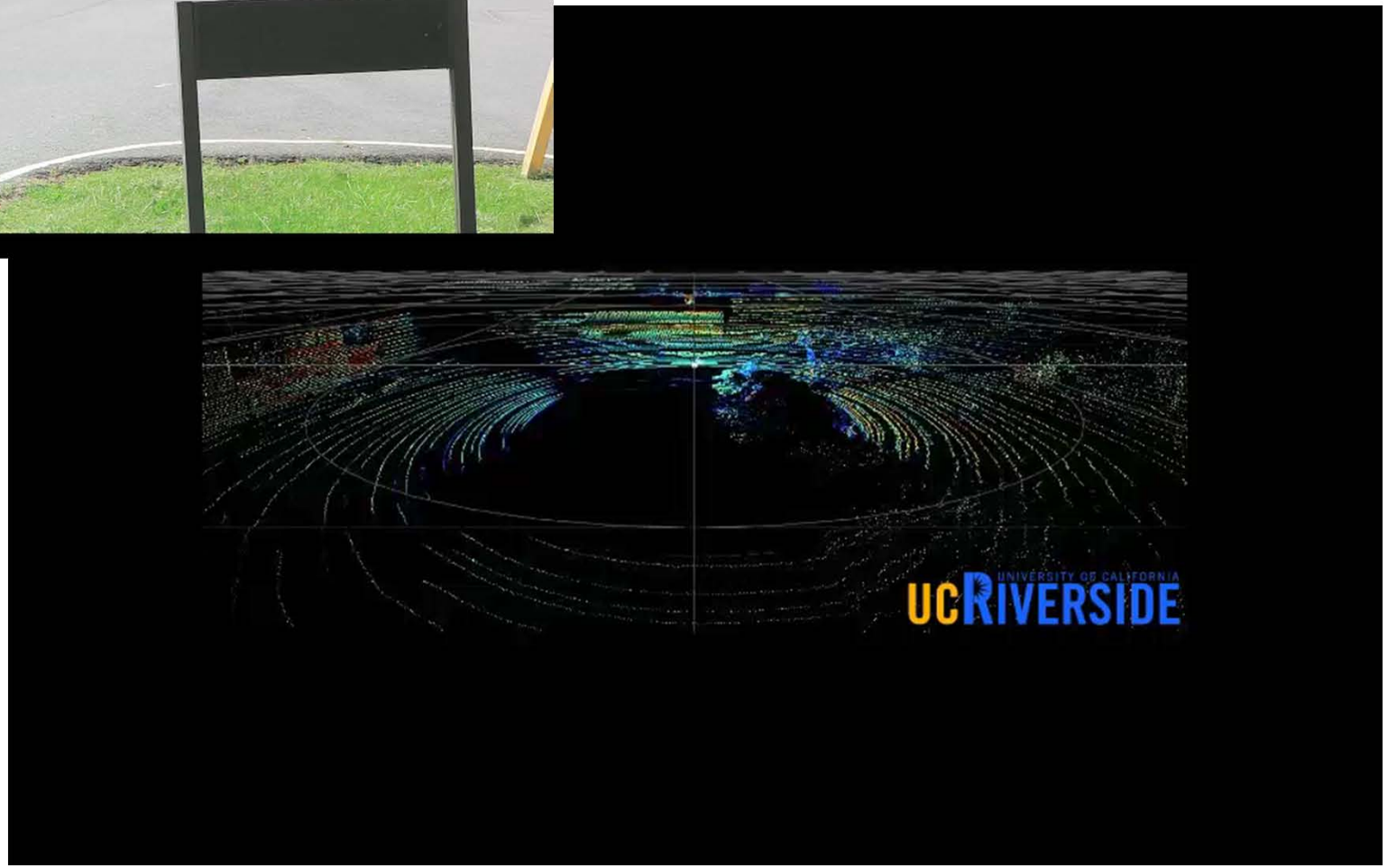
Equipment:

- LIDAR
- Camera set
- IMU
- GNSS Receiver
- High capacity HD
- Roof Platform
- Power supply
- Matlab
- DGPS station
- Data Communication
- GIS
- High Performance CPU

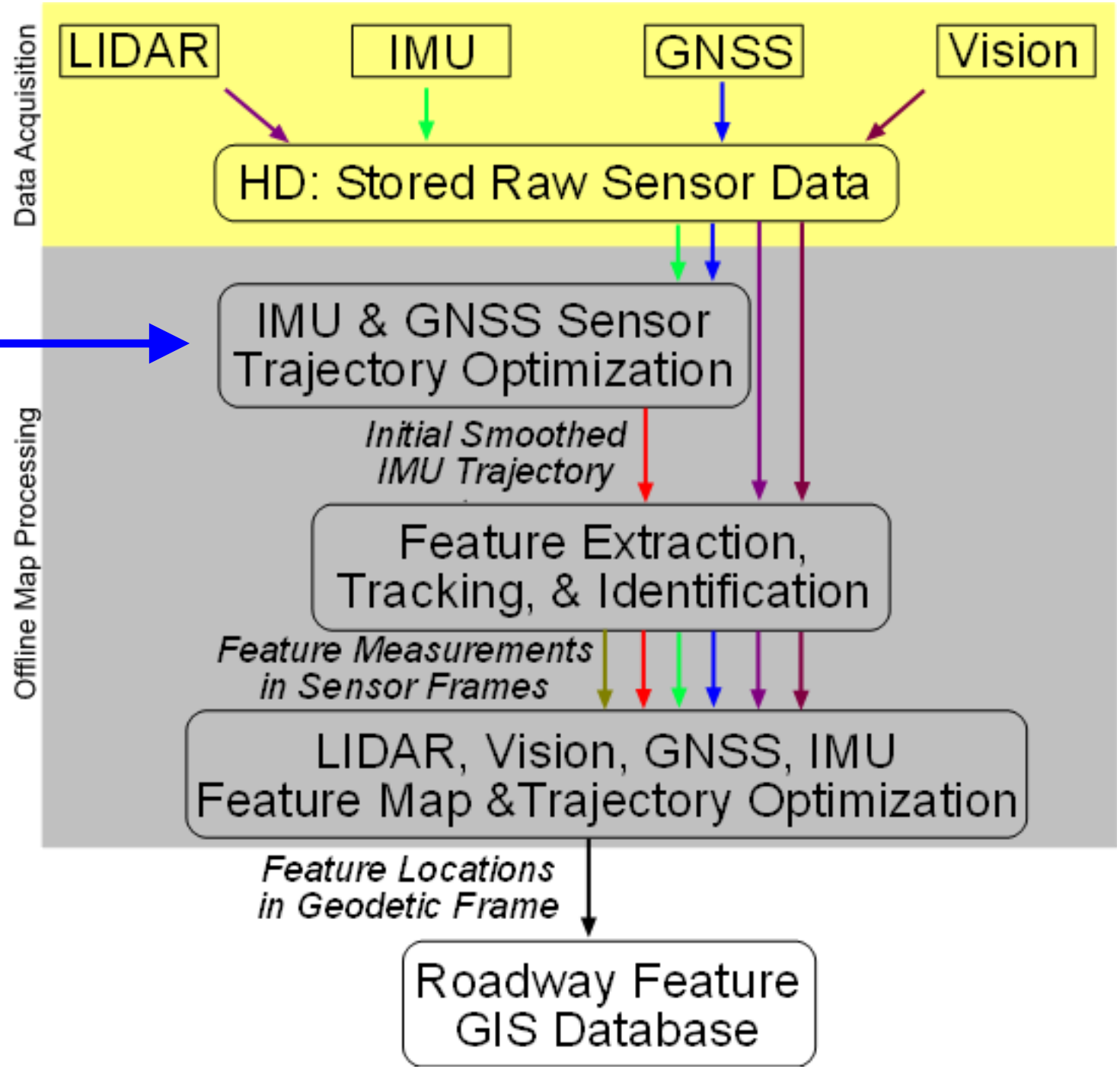
Vehicle is driven and data are collected



Driving and data collection …

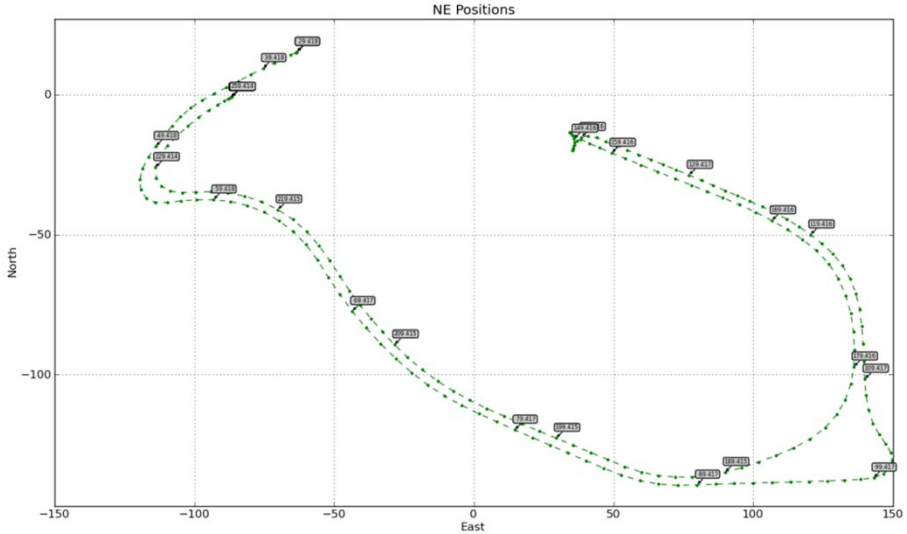


IMU and GPS data are smoothed providing a continuous smooth trajectory

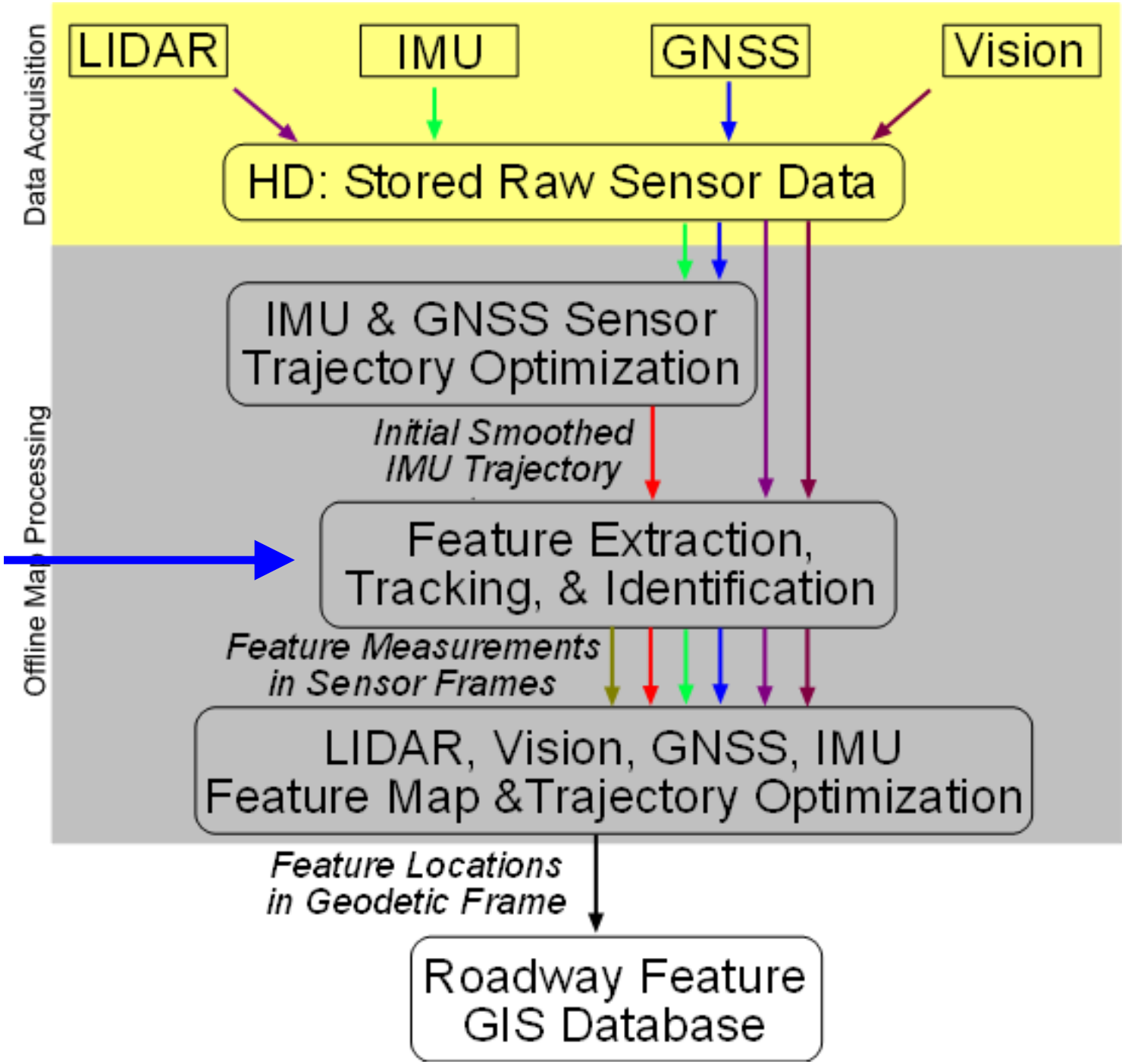


Trajectory Estimation

- **Solve for Integer Ambiguity**
  - **Smooth trajectory using inertial measurements, pseudo-range, and Doppler measurements**
  - **Use smooth trajectory to find integer intervals**
  - **Extend integers from known intervals to adjacent intervals**
- **Final Trajectory Smoothing**
  - **Use integers when available, otherwise, use pseudo-range and Doppler**
- **Can be Utilized Extensively in Mapping**
- **See:** **A. Vu et al., (2012) "Improved Vehicle Trajectory and State Estimation using Raw GPS and IMU Data Smoothing", in press, *IEEE Intelligent Vehicle Symposium*, Madrid Spain, June 2012.**



Features (e.g., road signs, lane markings, road curves, etc.) are extracted and identified from the raw data



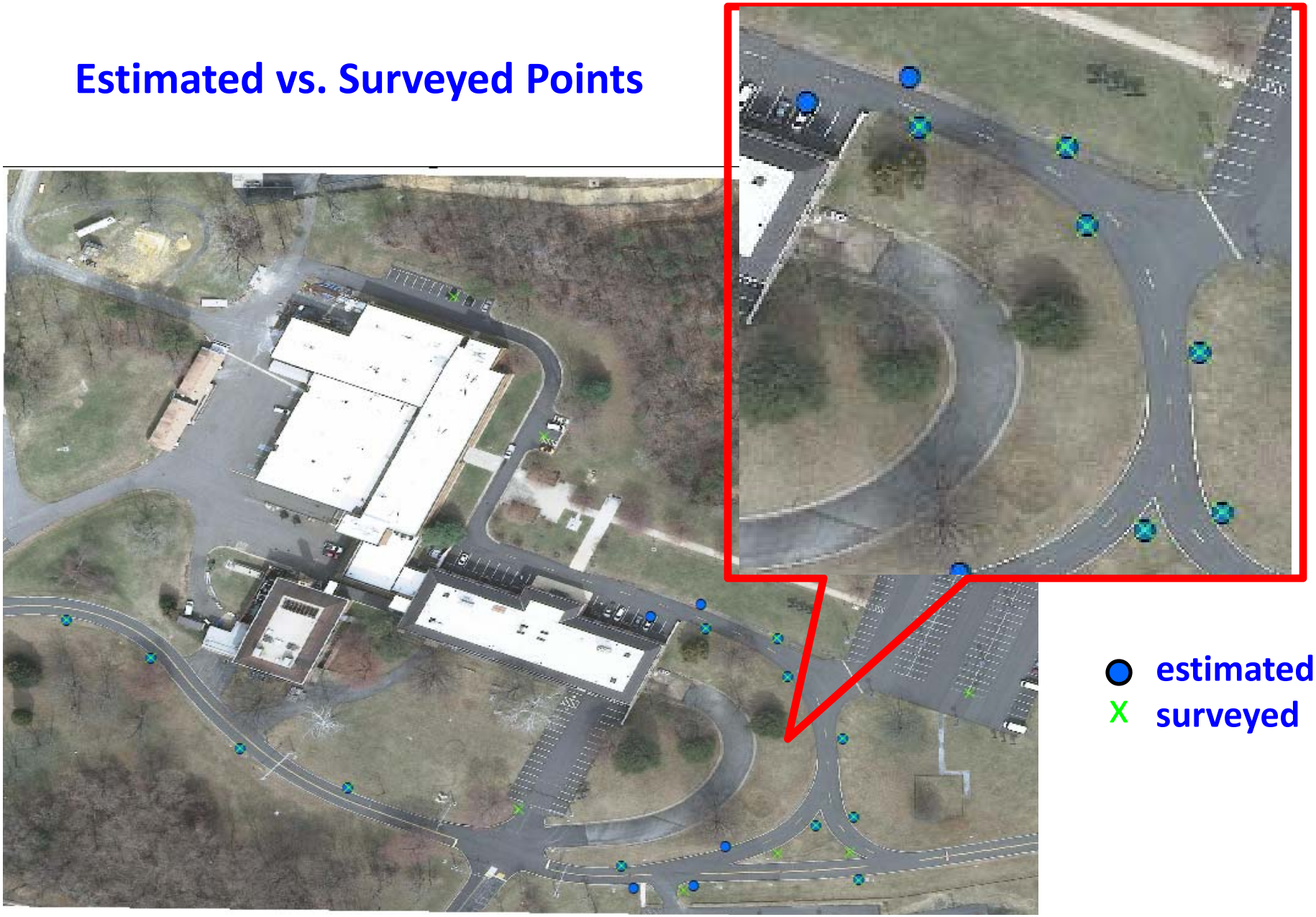
Feature Extraction and Identification (1)

- ***Traffic Sign Extraction***
  - **Primary sensor: LIDAR 64-laser, 20 Hz laser range finder**
  - **Processing step 1: *Feature Detection***
    - **From projected measurement images of intensity and range**
    - **Output: Candidates in LIDAR frame (each has a position & normal)**
  - **Processing step 2: *Feature Association***
    - **Output: Candidate features grouped to objects**
  - **Processing step 3: *Optimization***
    - **Transformation of features from LIDAR to ECEF**
    - **Optimal combination of grouped features to estimate sign position and normal**

- ***Traffic Sign Verification***
  - **Primary sensor: LIDAR candidates and camera**
  - **Processing: Template matching based on extracted signs**
  - **Output: Tags are given to traffic signs extracted from the previous step**

Road Signs Locations

Estimated vs. Surveyed Points



Estimated Plane Position vs. Surveyed Plane Position

Sign Post #	Survey North (m)	Survey East (m)	Max Survey ECEF Std (m)	Computed North (m)	Computed East (m)	Abs. Horiz. Error (m)
1	-41.192	-87.313	0.042	-41.133	-87.345	0.067
2	-55.321	-62.332	0.126	-55.271	-62.328	0.050
3	-89.666	-36.001	0.159	-89.656	-36.112	0.111
4	-142.194	80.051	0.057	-142.244	80.054	0.050
5	-139.078	146.342	0.047	-139.101	146.358	0.028
6	-115.571	144.863	0.009	-115.658	144.923	0.106
7	-85.860	141.540	0.031	-85.882	141.543	0.022
8	-47.903	122.360	0.025	-47.952	122.415	0.073
9	-35.369	99.666	0.045	-35.381	99.686	0.023
10	-44.498	101.259	0.024	-44.433	101.281	0.068
11	-62.597	125.258	0.04	-62.555	125.306	0.063
12	-134.138	76.493	0.025	-134.073	76.519	0.069
13	-104.598	-4.185	0.061	-104.569	-4.152	0.044
16	-118.704	133.631	0.015	-118.618	133.724	0.126

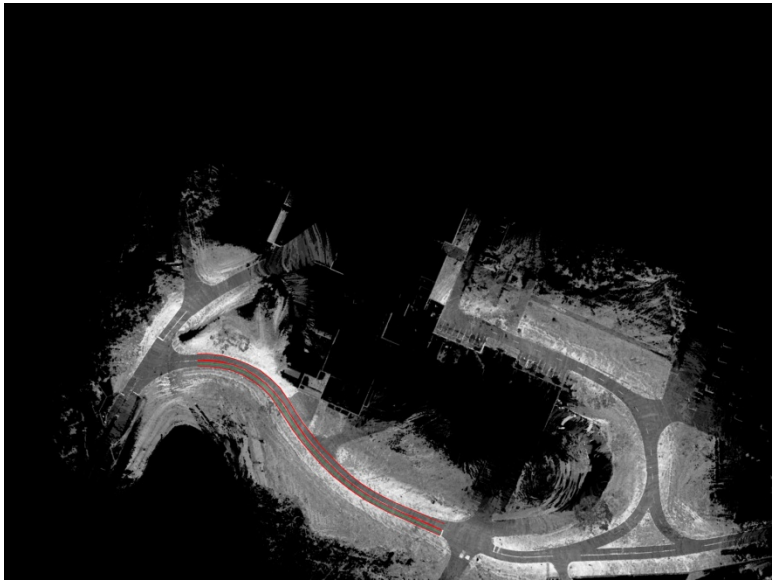
Sign Identification Process…

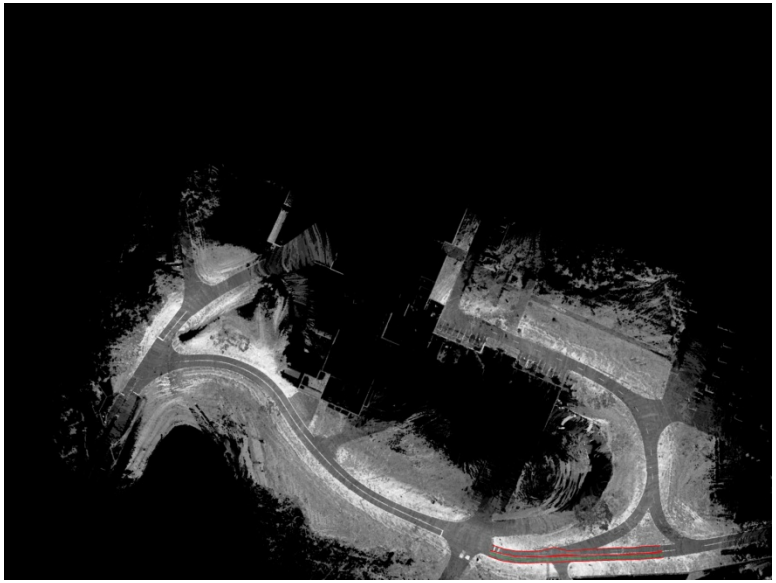
Feature Extraction and Identification (2)

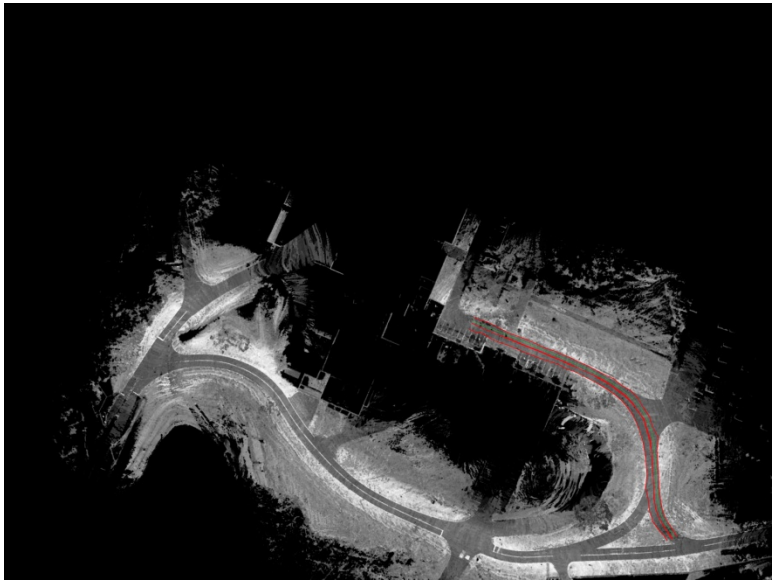
- *Curve Extraction*
  - Primary sensor: LIDAR 64-laser, 20 Hz laser range finder
  - Processing step 1:
    - Ground plane image projection from measurements
    - Output: intensity as a function of position
  - Processing step 2:
    - Curve detection using projected vehicle trajectory on ground plane images
    - Output: Curves composed of a set of sequential 3D positions in world frame
- *Curve Parameterization*
  - Primary input: curves from previous step
  - Processing step: Curve Fitting
  - Output: roadway curve format suitable for GIS

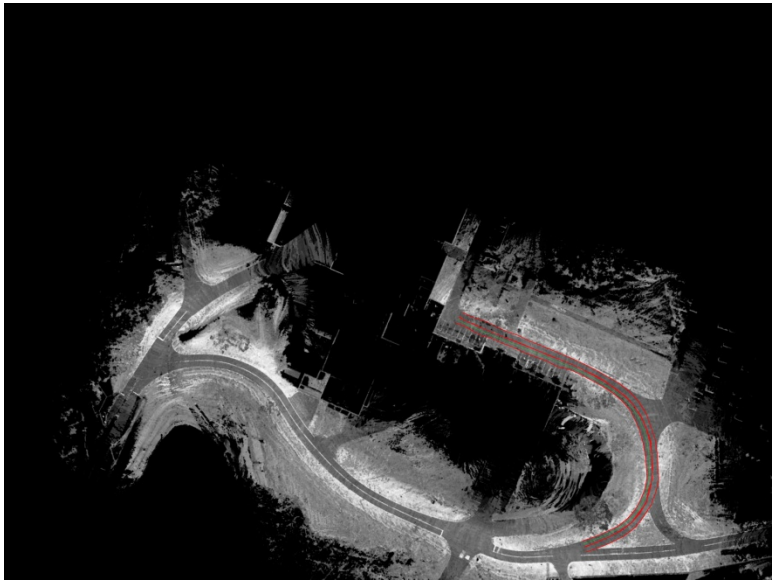
LIDAR Intensity Point Cloud…

Finding Lanes and Curves

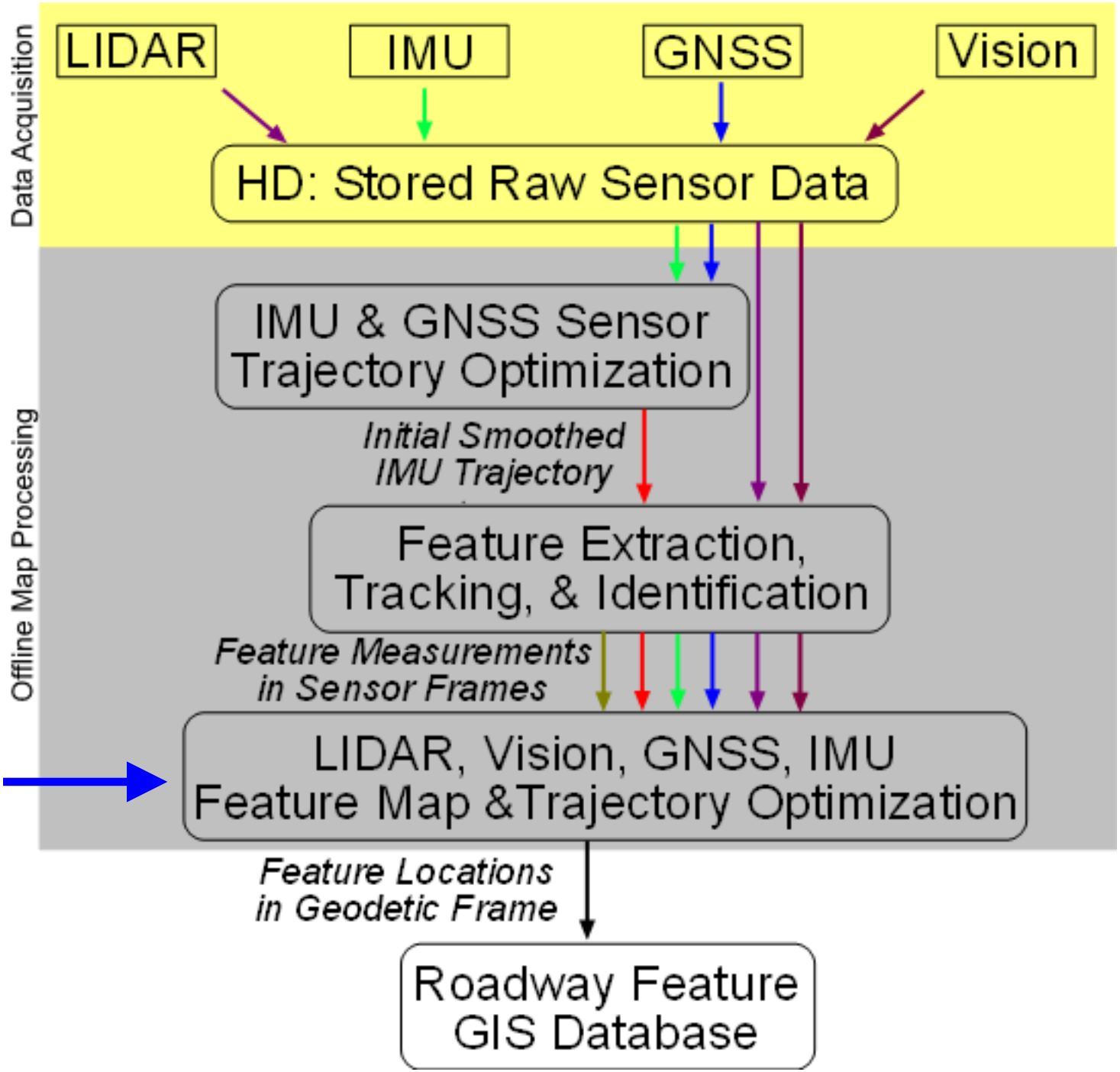




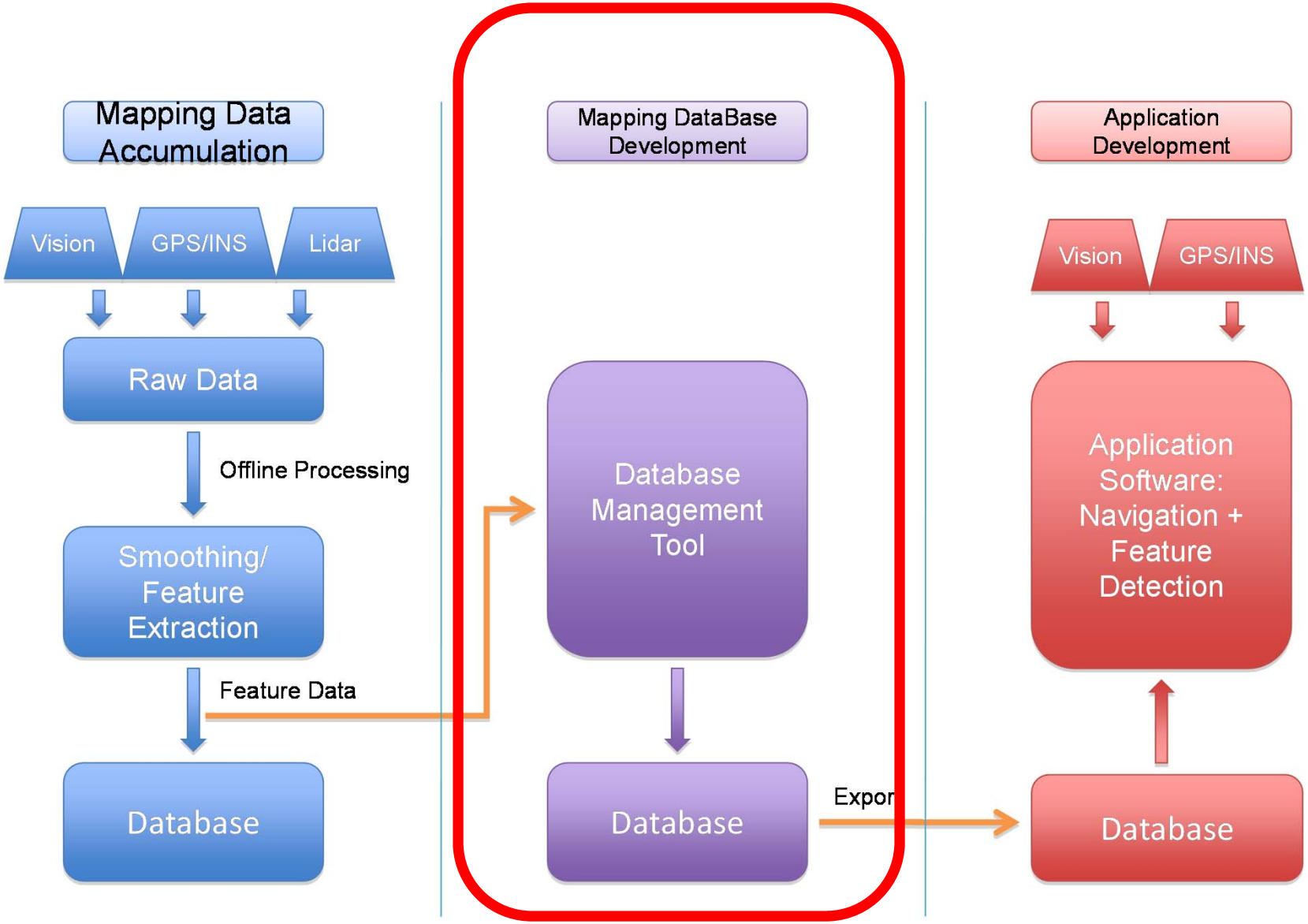




Relative map features are combined with absolute trajectory and placed in GIS database in world coordinates

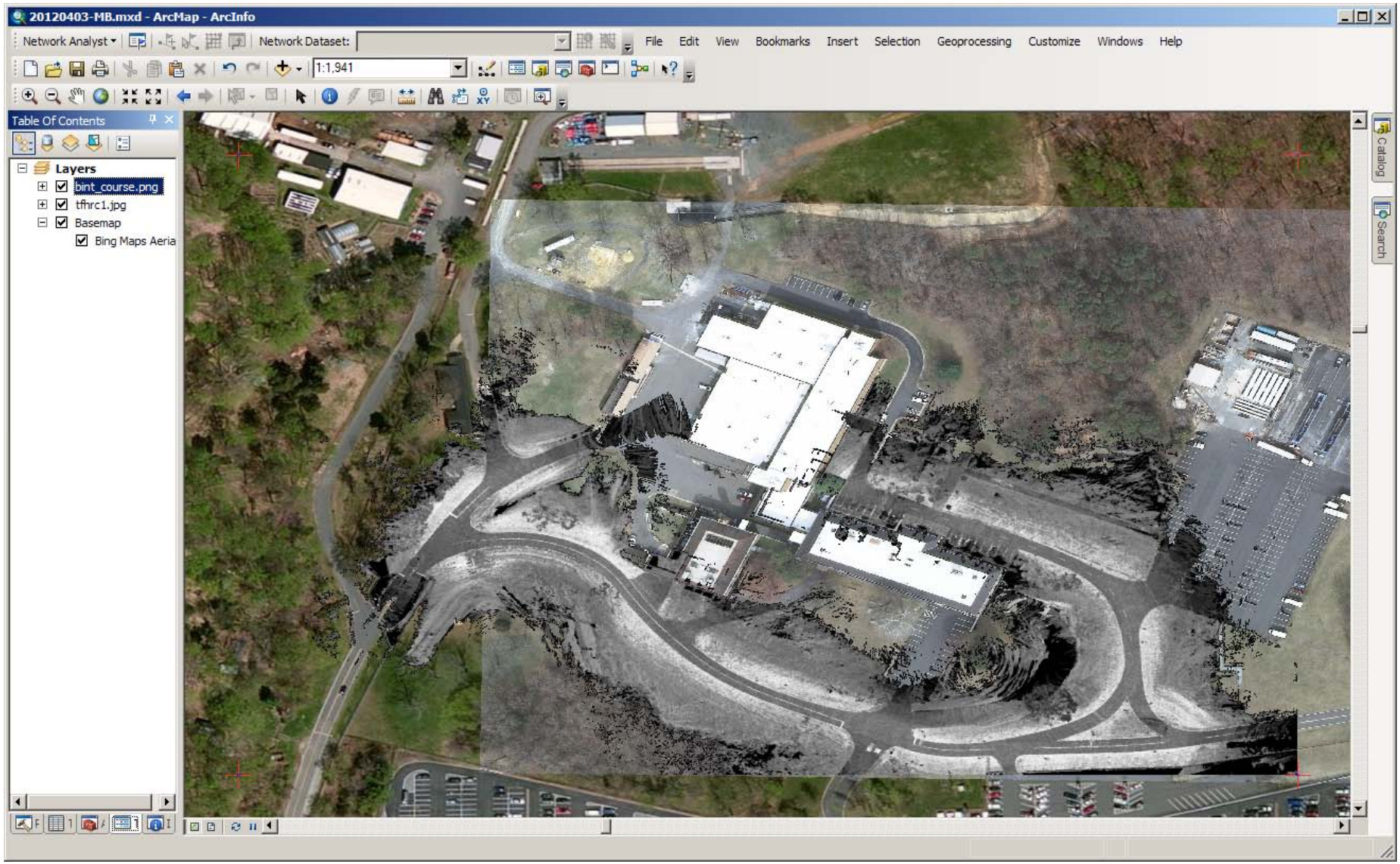


Map Database

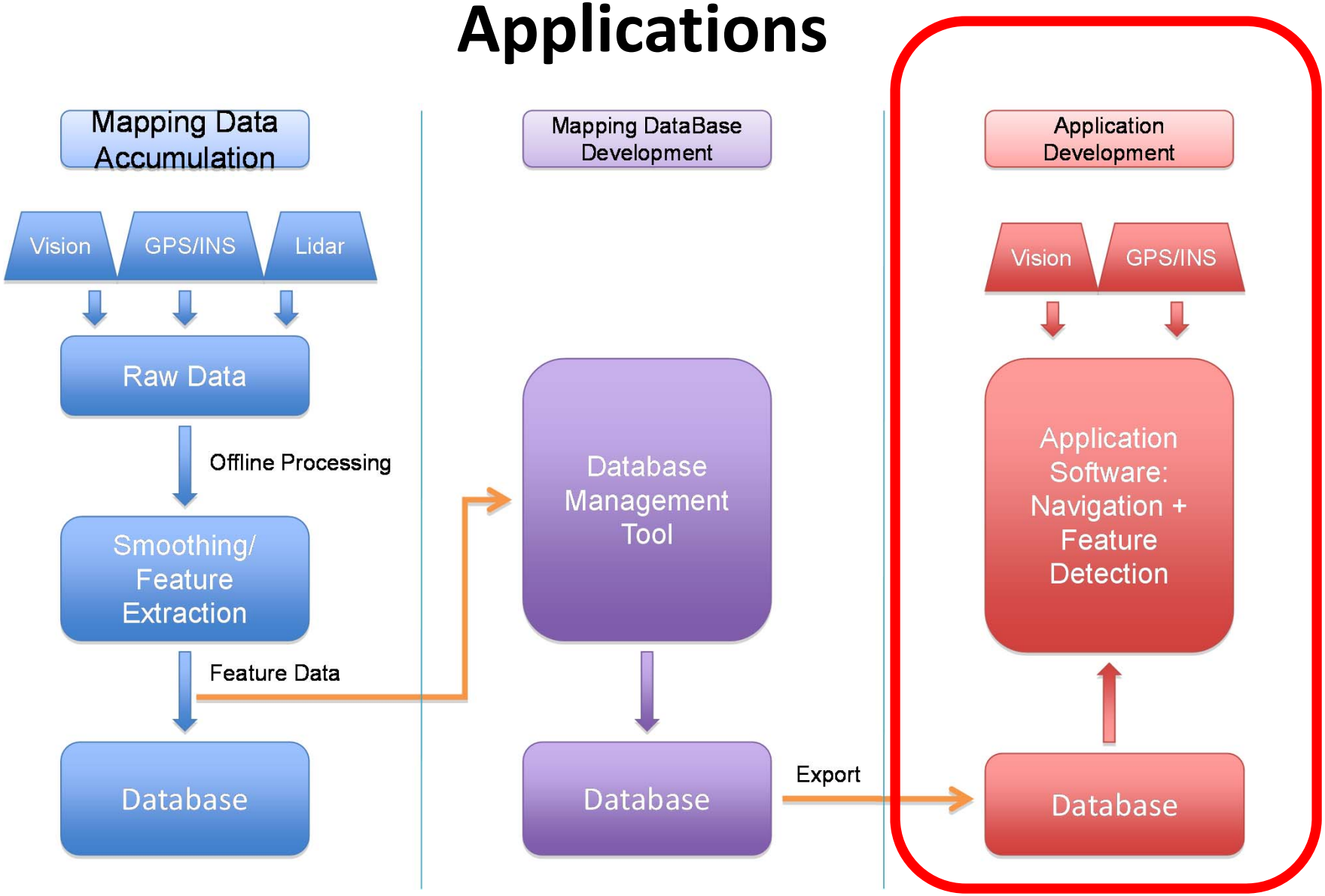


Map Representation in ArcGIS

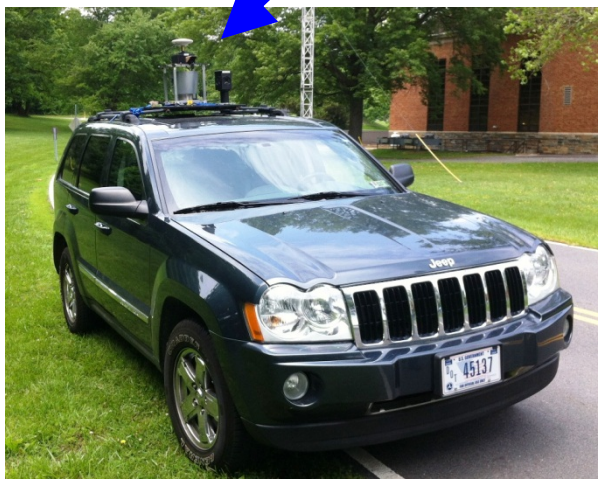
Bing Map, TFHRC Aerial Image, LIDAR-based intensity image overlay



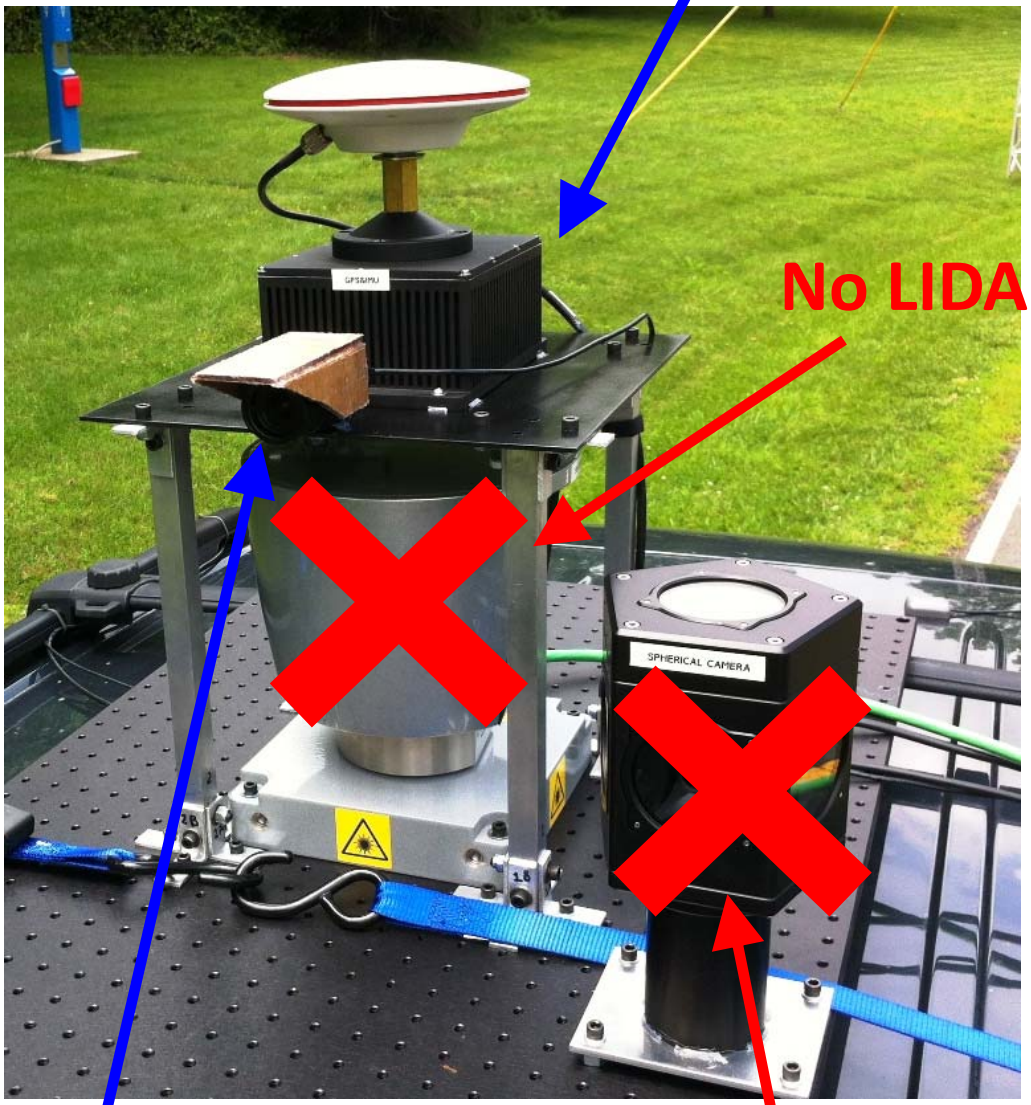
Applications



Sensor platform for *positioning*



sensor platform



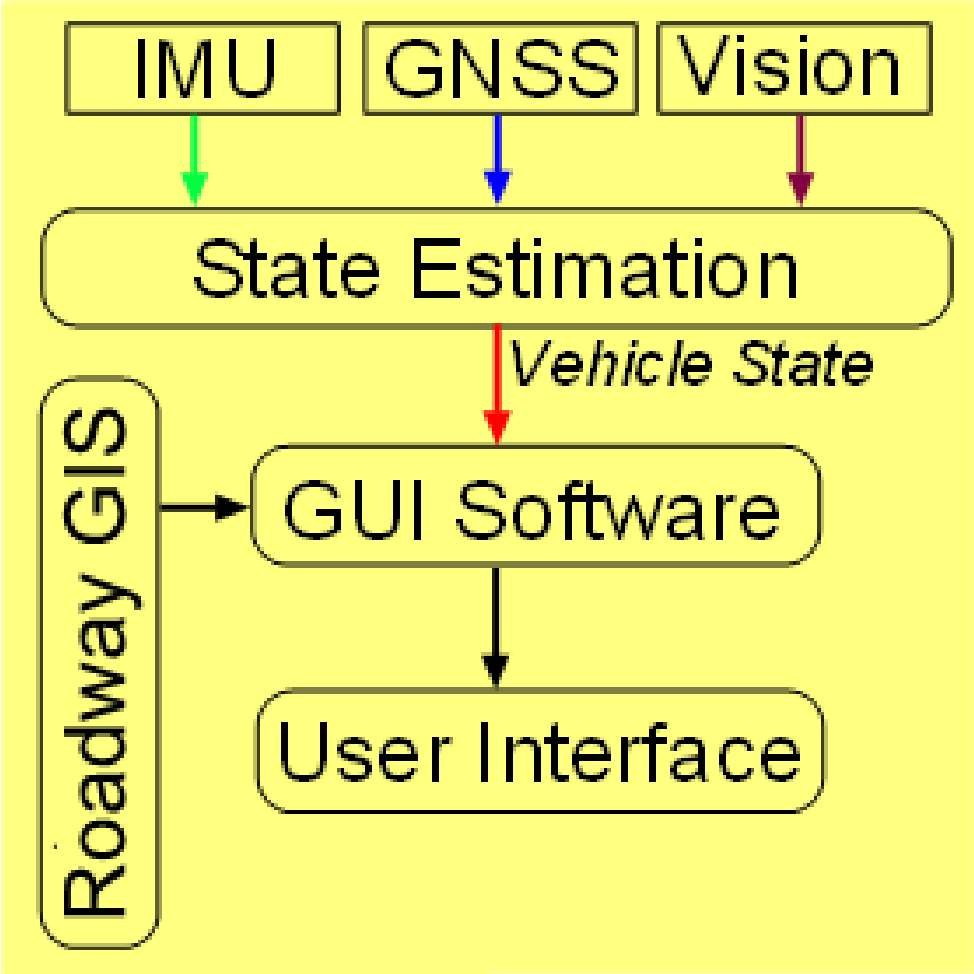
inexpensive GPS/IMU

No LIDAR

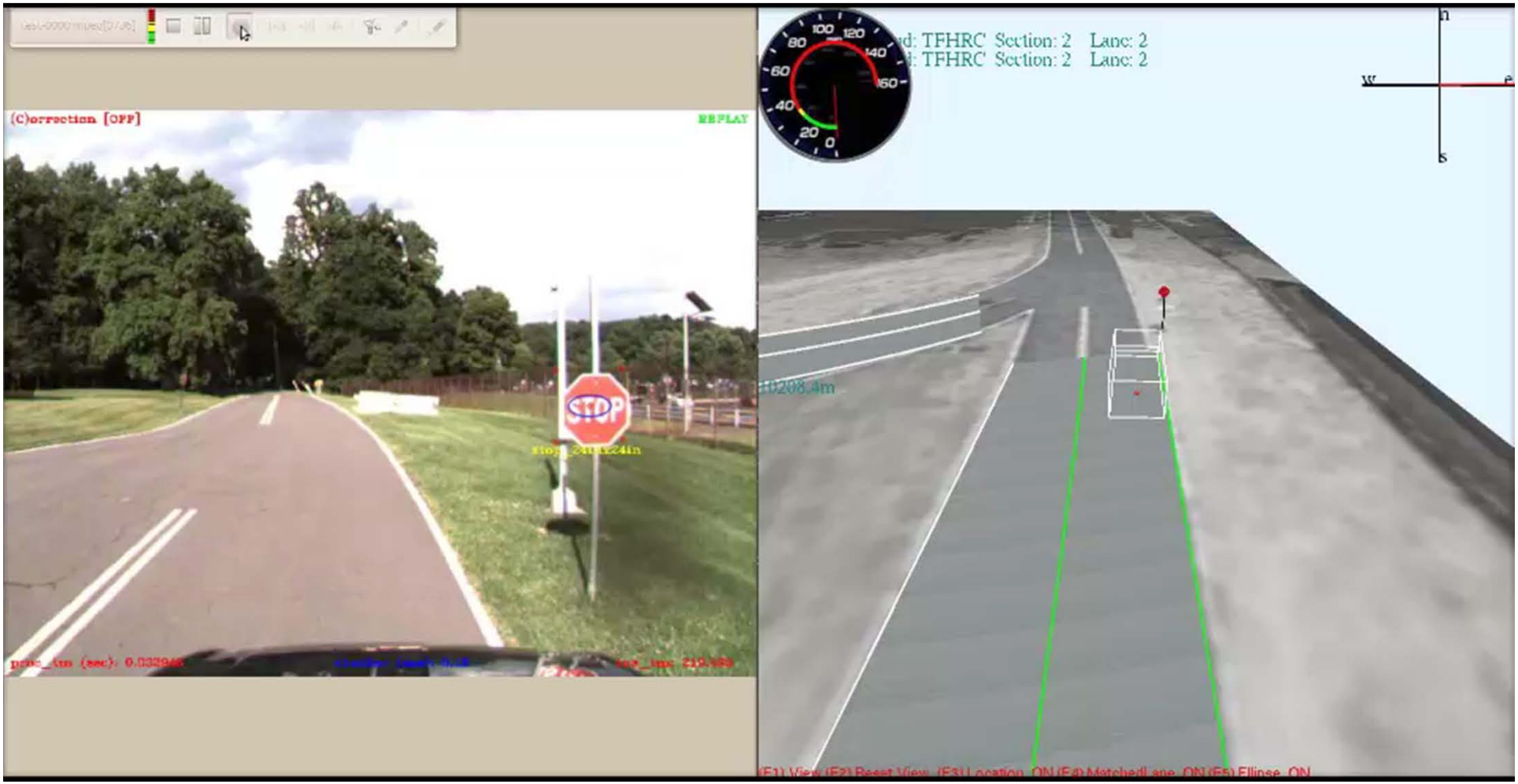
inexpensive rectilinear camera

No panoramic camera

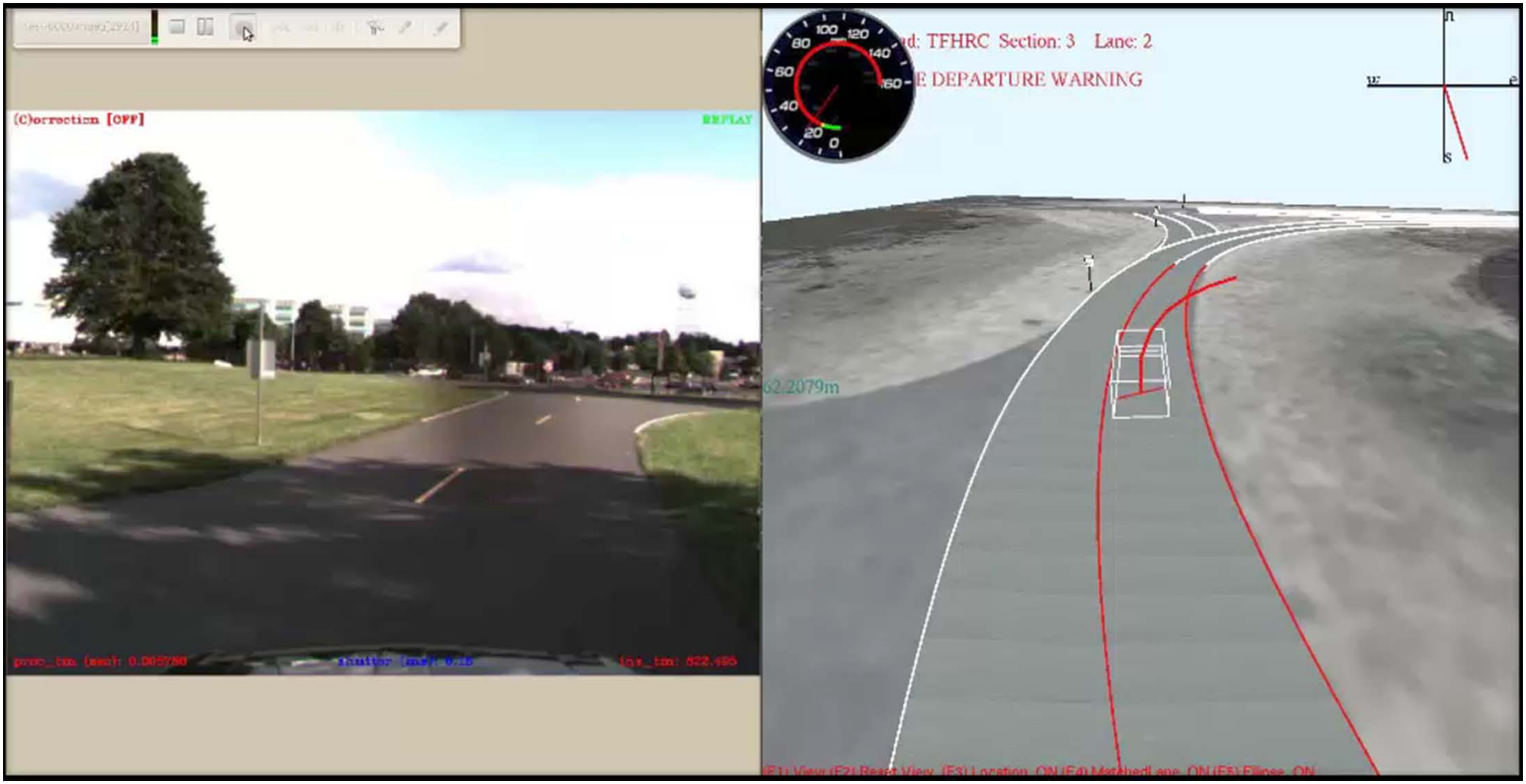
Application Data Flow



Application Graphical User Interface…

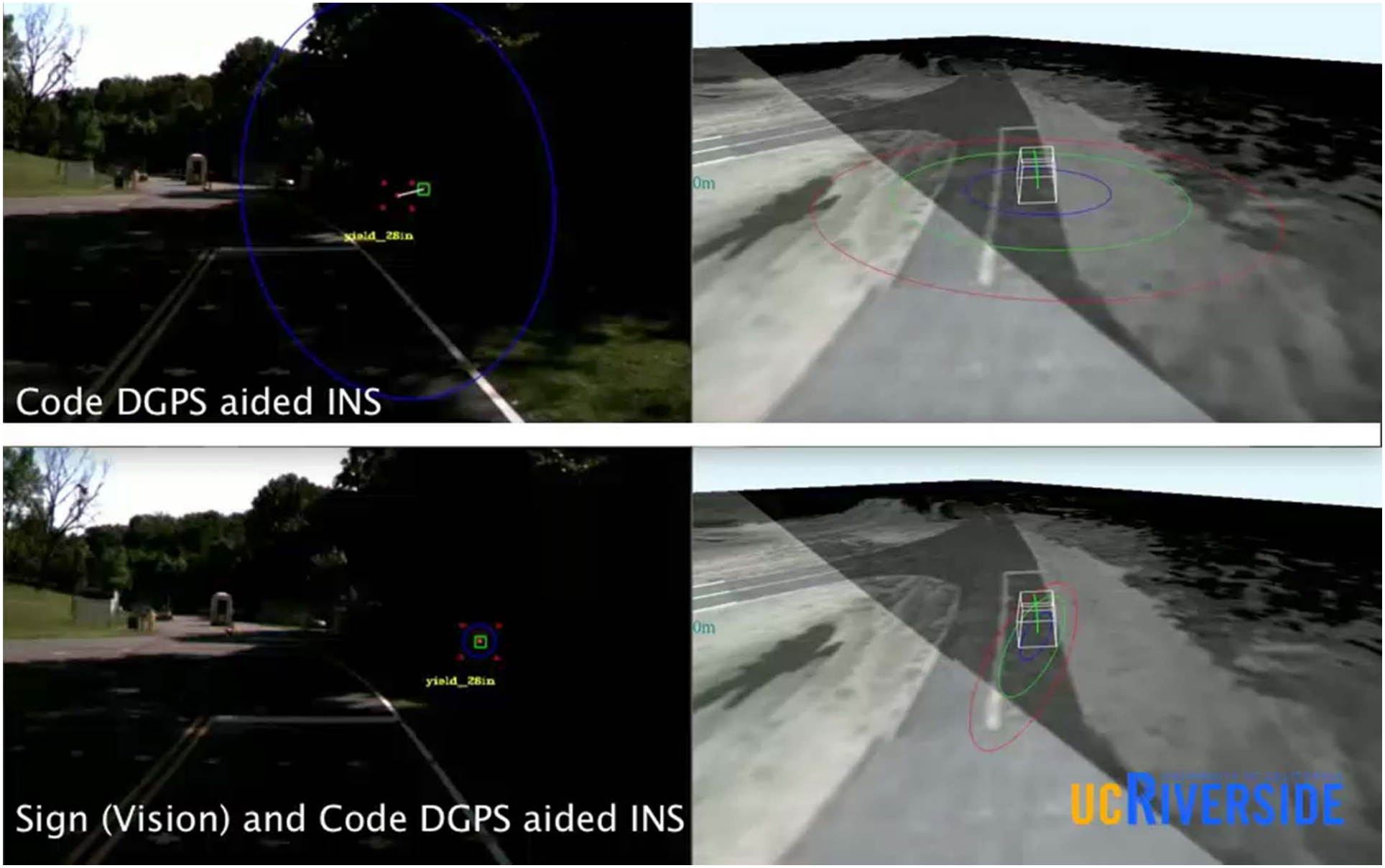


Lane Departure Warning…



Curve Overspeed Warning…

Sign Aiding …


yield_28in
0m
Code DGPS aided INS
yield_28in
0m
Sign (Vision) and Code DGPS aided INS
UCRIVERSIDE

Conclusions (1 of 2)

- **No single independent sensor technology is capable of simultaneously attaining the accuracy, integrity, and availability specifications for lane-level positioning in the expected diverse environments**

- **Integrated positioning that fuses asynchronous data from diverse sensors is the best approach to reliably and accurately estimate vehicle position**

- **Inertial Navigation Systems and Encoder Navigation Systems provide positioning solutions in all environments continuously at high rates; however their accuracy drifts over time *without aiding*;**

Conclusions (2 of 2)

- **GNSS provide high accuracy at low bandwidth in open areas where satellite signals can be received; however performance degrades in dense urban areas**

- **Feature-based navigation aiding using camera, LIDAR, or RADAR can be successful when mapped features can be reliably detected and tracked**

- **Several forms of ground based radio communication systems offer potentially useful position information, have been designed to penetrated the urban infrastructure, and have the added advantage that their performance characteristics can still be influenced by the engineering community interested in roadway applications.**

SafeTREC Safe Transportation Research & Education Center

ITSBerkeley Institute of Transportation Studies

School of Public Health

Error consideration in georeferencing police reported crash data

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University of California, Berkeley
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SafeTREC Safe Transportation Research & Education Center

About UC Berkeley SafeTREC

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Founded in 2000 by with a grant from California Office of Traffic Safety (OTS) to reduce traffic fatalities and injuries through multi-disciplinary collaboration in:

- Education
- Technical assistance
- Information Dissemination/outreach.

Affiliated with the Institute of Transportation Studies and the School of Public Health.

Overview

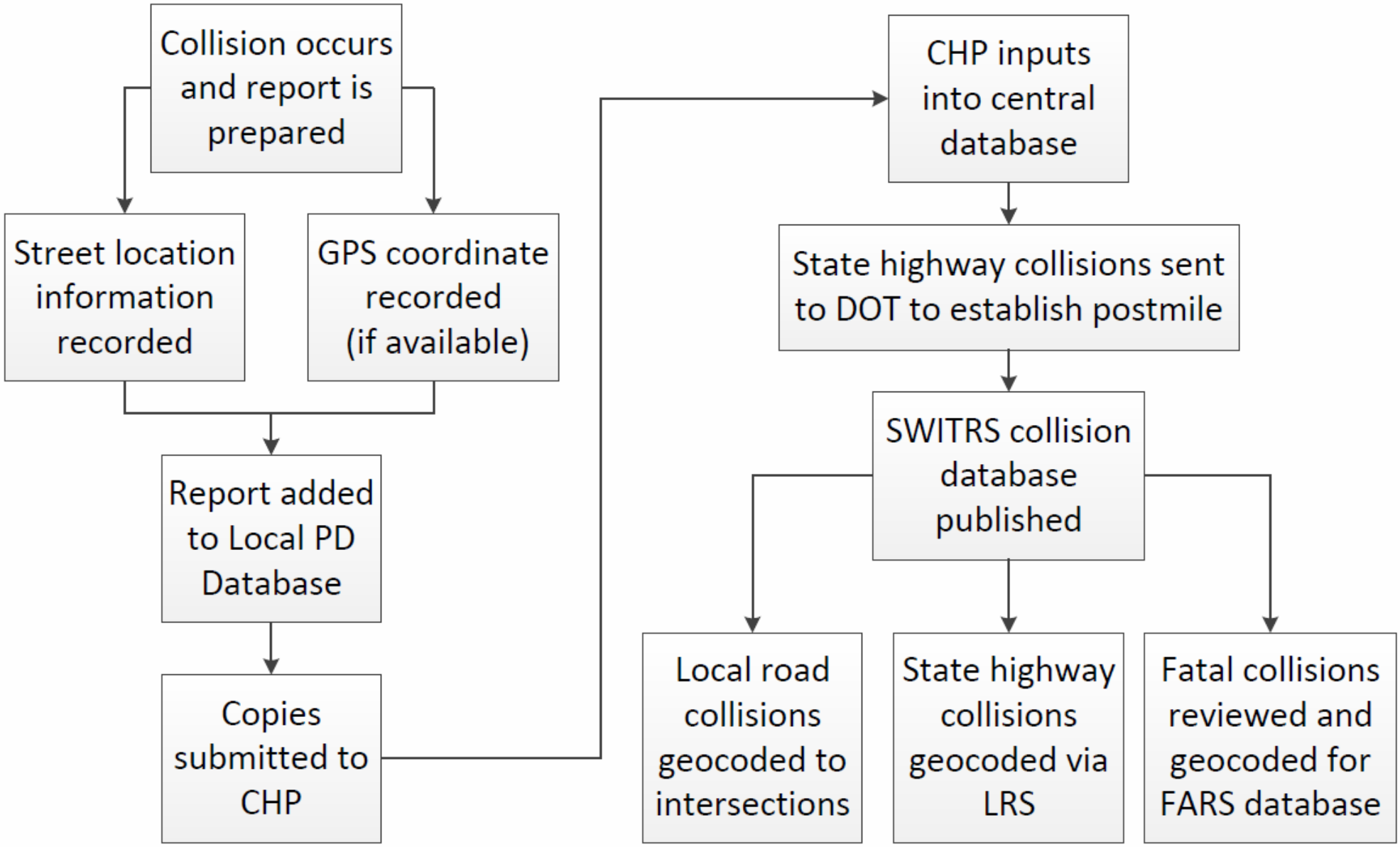
- Police reports are completed for injury involved crashes
- Reports are compiled into a database
- Georeferencing each collision provides a latitude/longitude coordinate for geospatial analysis

However, from the initial police report to the final database there are many obstacles to accurate georeferencing!

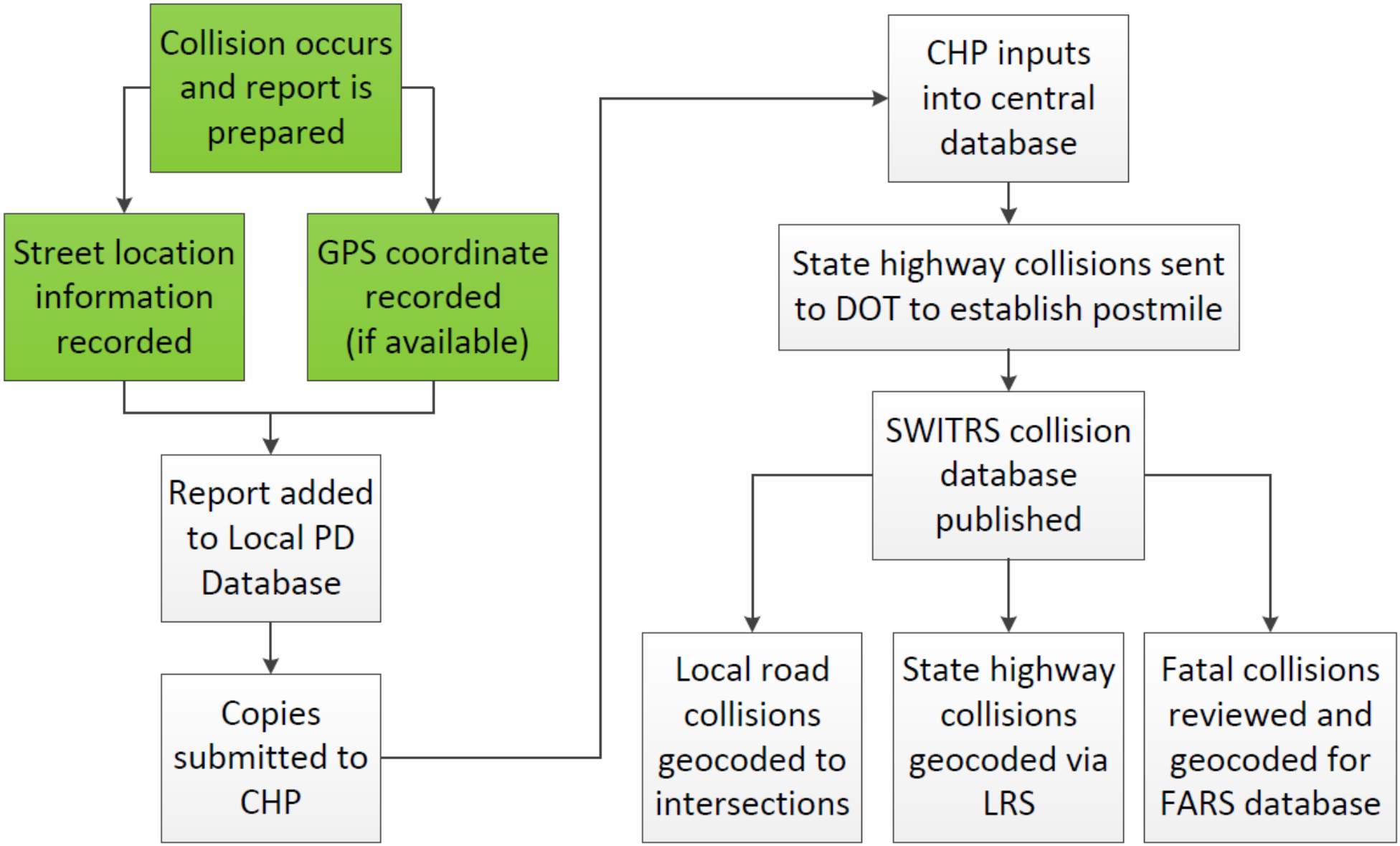
Collision Georeferencing Phases

- Police report entry at collision site
- Submission to central authority and database entry (California – CHP)
- State highway reference location (postmile) input
- Georeferencing state highway collisions on a LRS
- Geocoding local road collisions to intersections
- Geocoding fatal collisions for inclusion in FARS database

Collision Georeferencing Flowchart



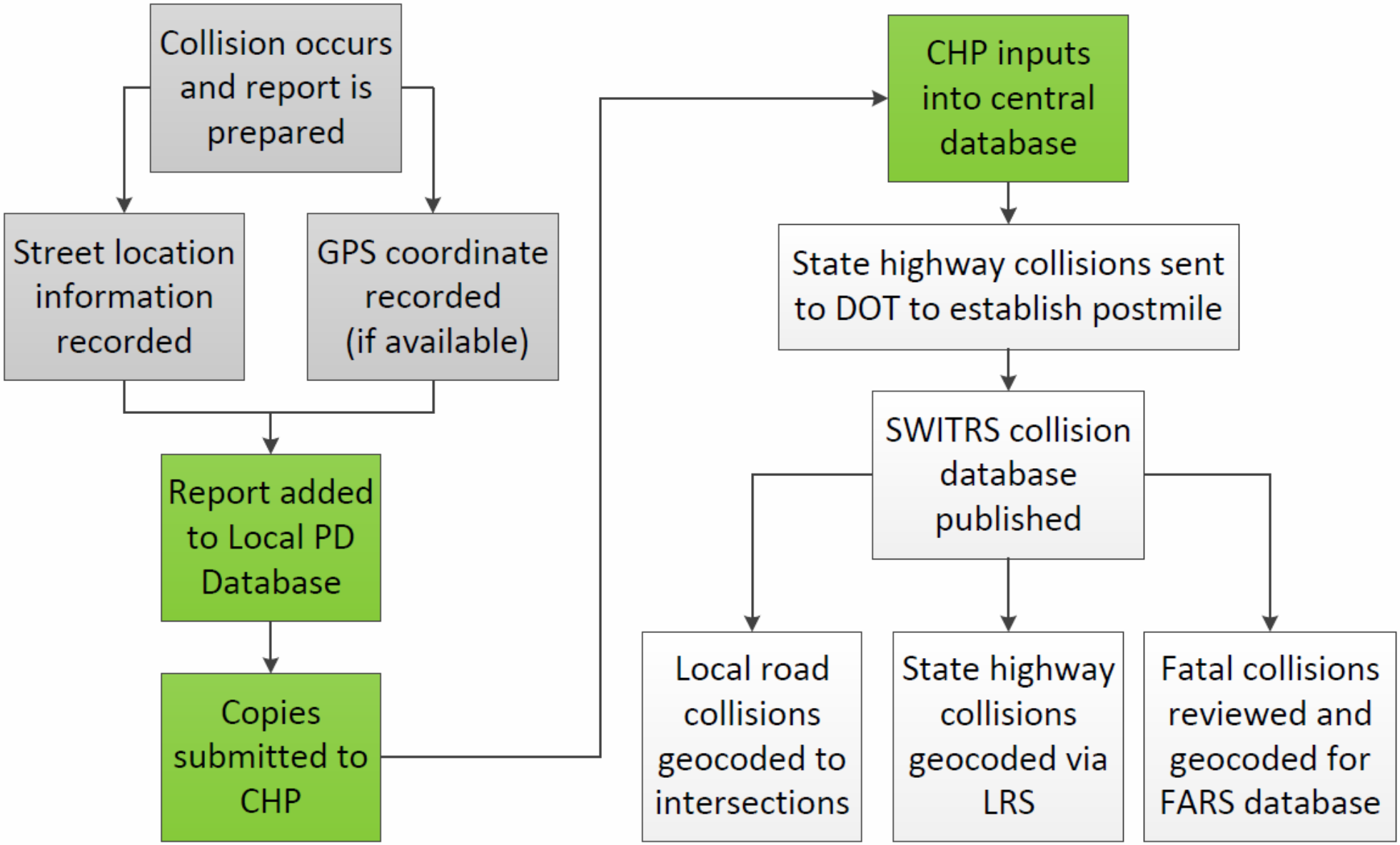
Police report entry at collision site



Police report entry at collision site

- Invalid initial data entry will affect all subsequent phases
  - Spelling errors
  - Non-existent streets
  - Landmarks instead of streets
  - GPS coordinate incorrectly obtained
- Accurate on-site data entry is the most crucial requirement for valid georeferencing

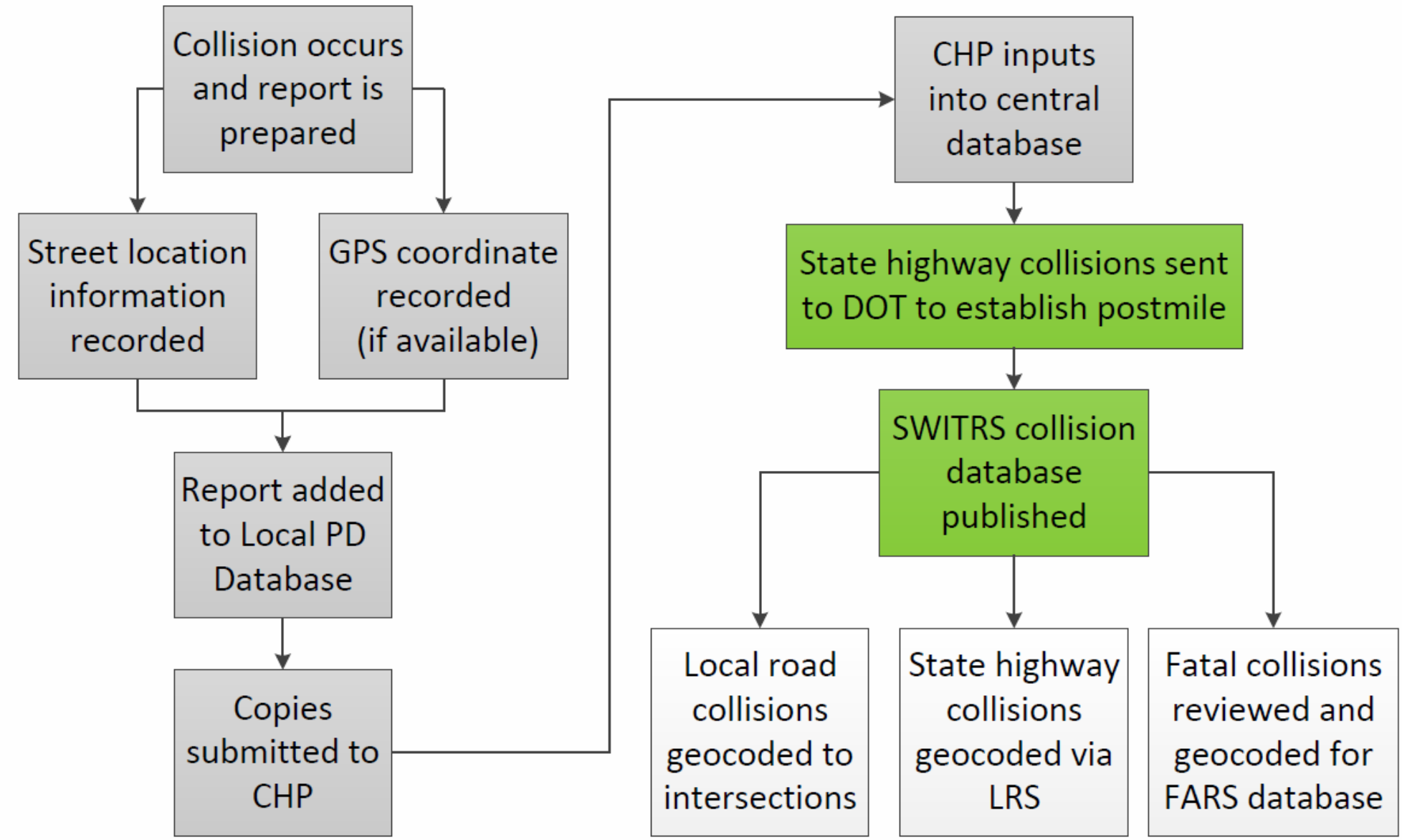
Submission to central authority and database entry (California – CHP)



Submission to central authority and database entry (California – CHP)

- Local jurisdictions submit paper reports to California Highway Patrol
- CHP manually review and enter collision reports into database
  - Potential for incorrect transcription
  - The second opportunity to invalidate a collision location before georeferencing

State highway reference location (postmile) input



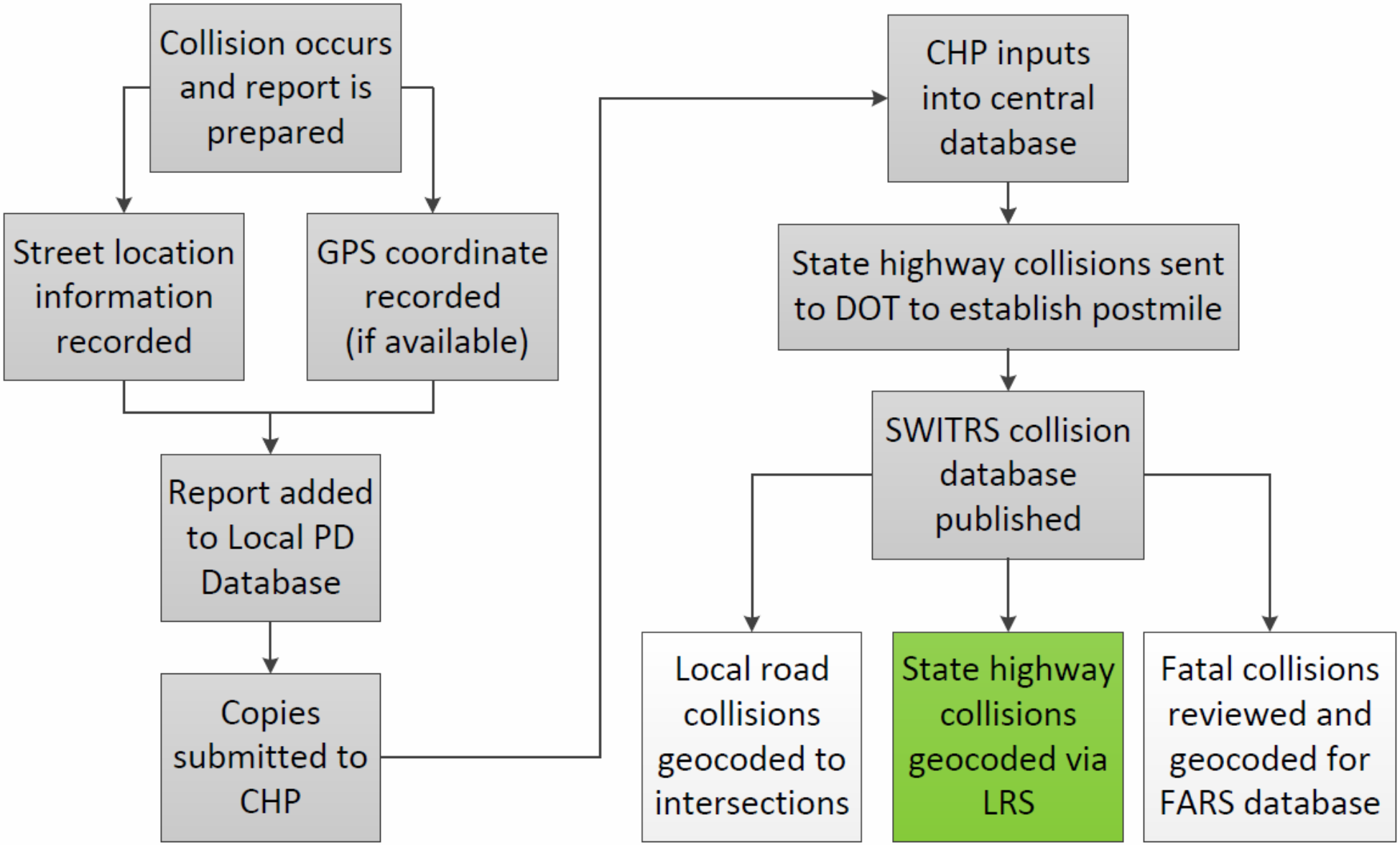
State highway reference location (postmile) input

- State highway events are identified by a postmile value
- CHP sends to Caltrans to review collision report and input postmile
  - Incorrect translation can create invalid postmiles

Types of postmile entry errors

- Incorrect postmile within allowed range (not easily detectable)
- Invalid postmile value outside of established ranges for a highway
- Non-existent highway number or direction
- Incorrect county

Georeferencing state highway collisions on a LRS

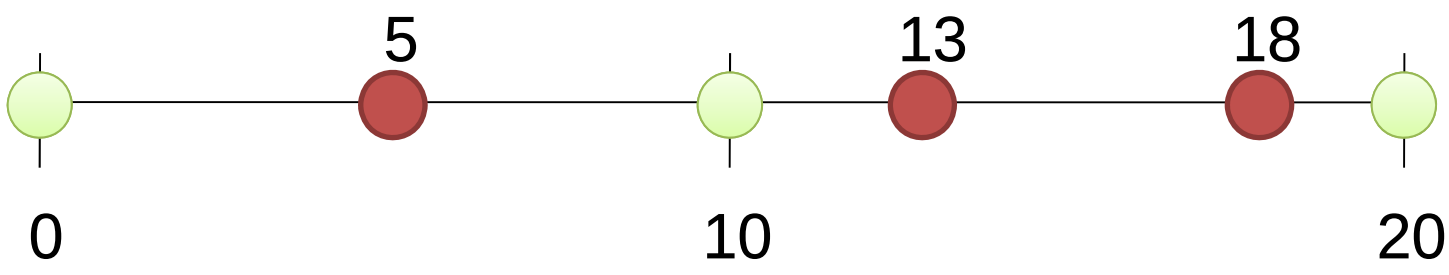


Linear Referencing

- Method of storing geographic locations by using relative positions along a linear feature

Known locations (Postmile Ramp Markers)

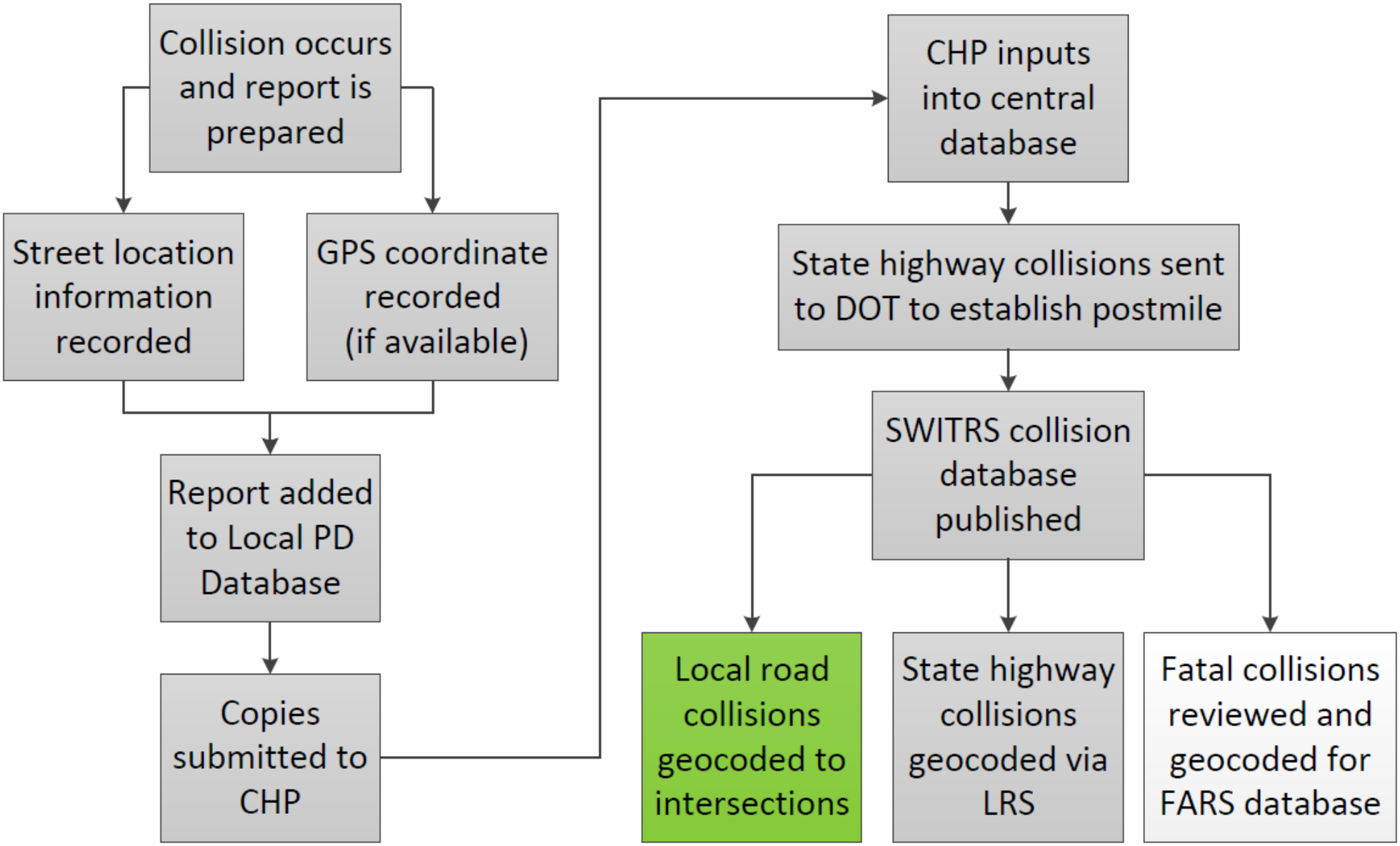
Event Locations (Collisions)



Georeferencing state highway collisions on a LRS

- Causes of LRS calibration errors:
  - Incorrect postmile marker placement (non-sequential order)
  - Incorrect postmile marker placement (not on route)
  - Only one known postmile marker on route
  - Incorrect measures of accumulation
  - No postmile markers near the end of a route

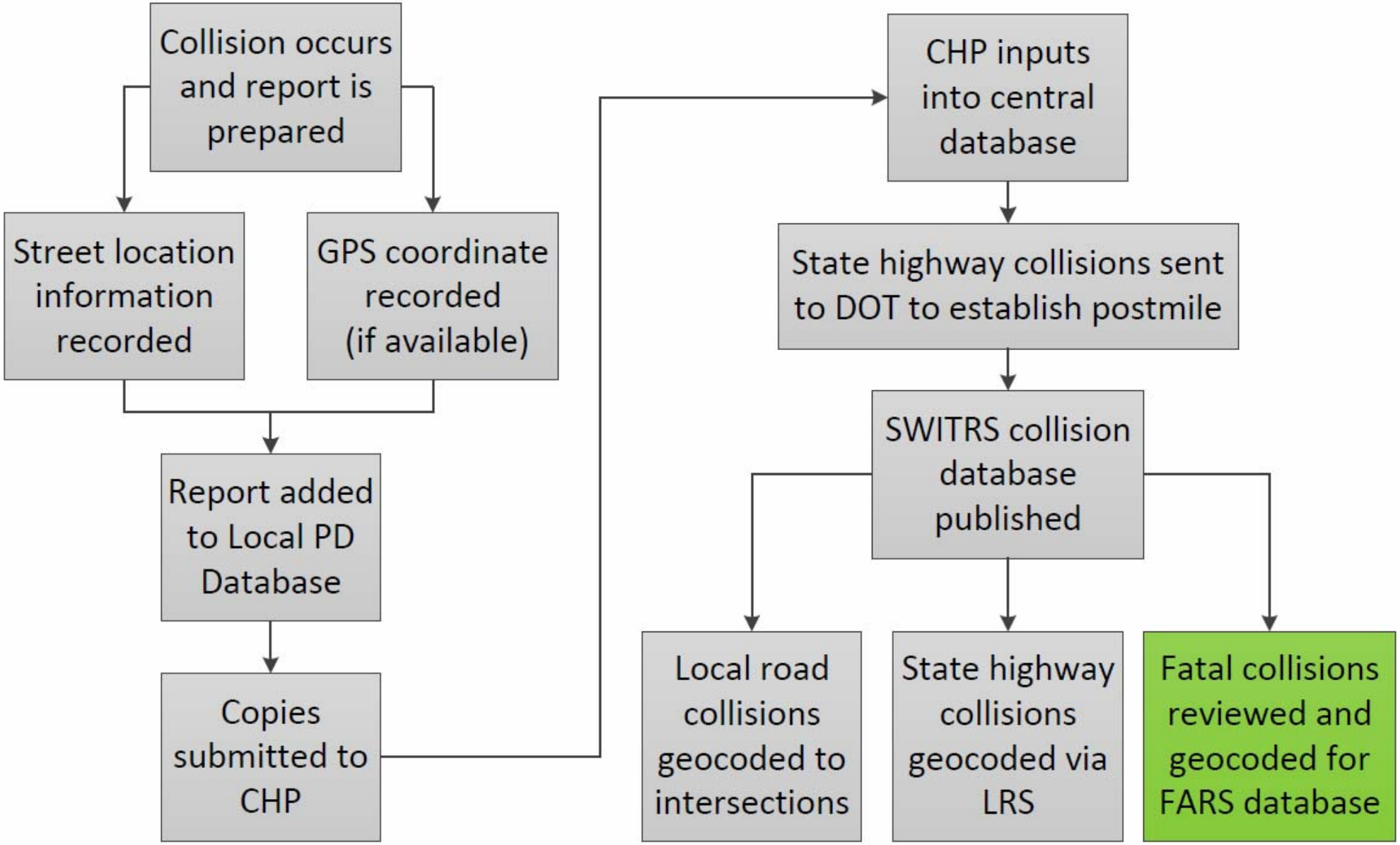
Geocoding local road collisions to intersections



Geocoding local road collisions to intersections

- Established software and methods
- However, even with perfect data entry, errors can occur from:
  - Street network out of date or name mis-match
  - Custom offset code for collisions occurring a distance from intersections fails

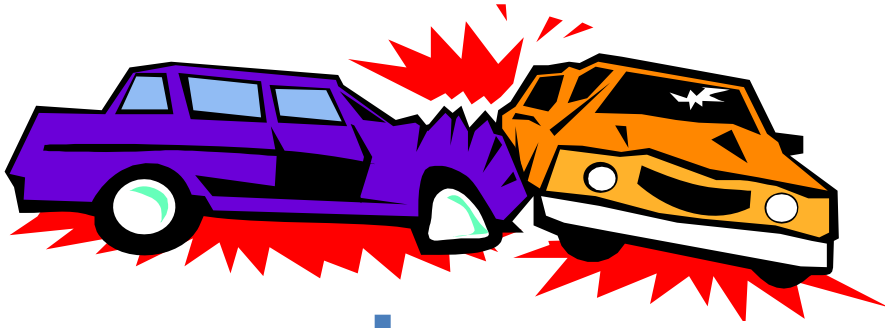
Geocoding fatal collisions for inclusion in FARS database

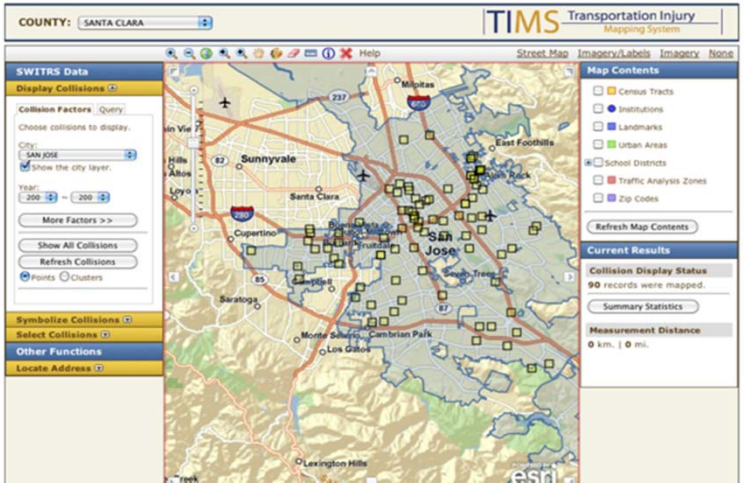


Geocoding fatal collisions for inclusion in FARS database

- Collision manually geocoded using custom software – always room for human error
- All collisions must be geocoded for FARS
- Potential errors difficult to identify

An extensive process to georeference collision data





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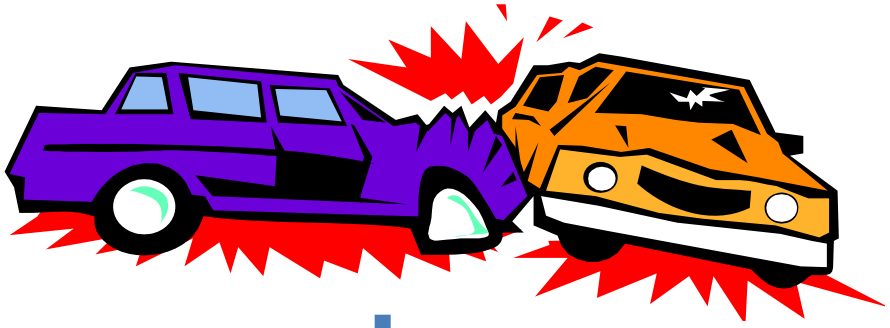
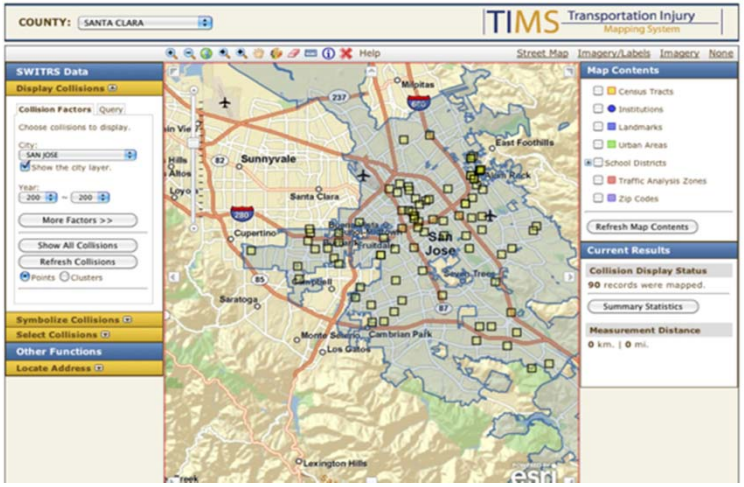
Many different causes of georeferencing errors!





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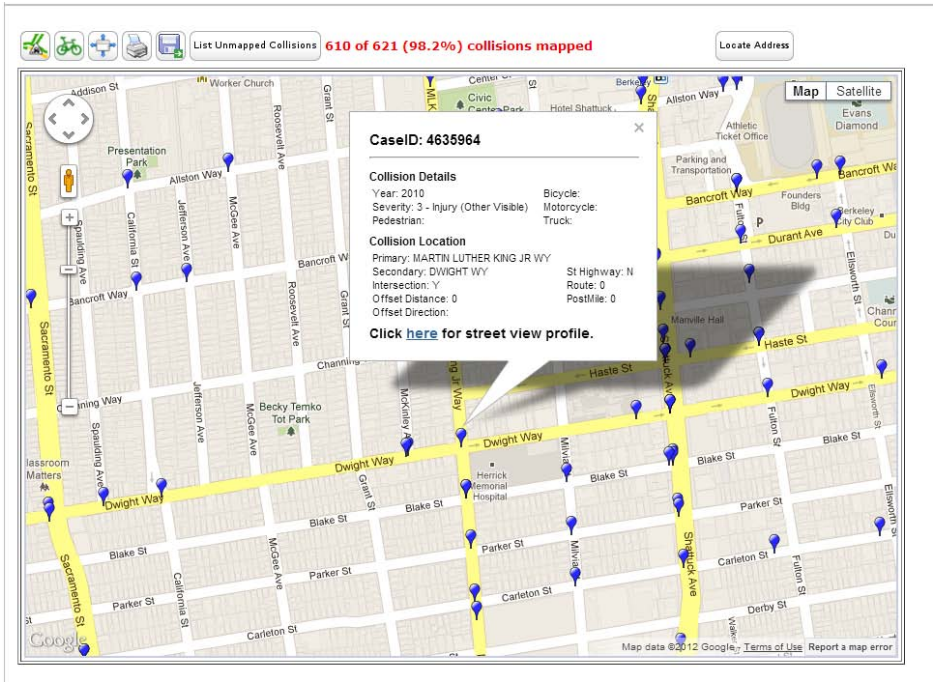
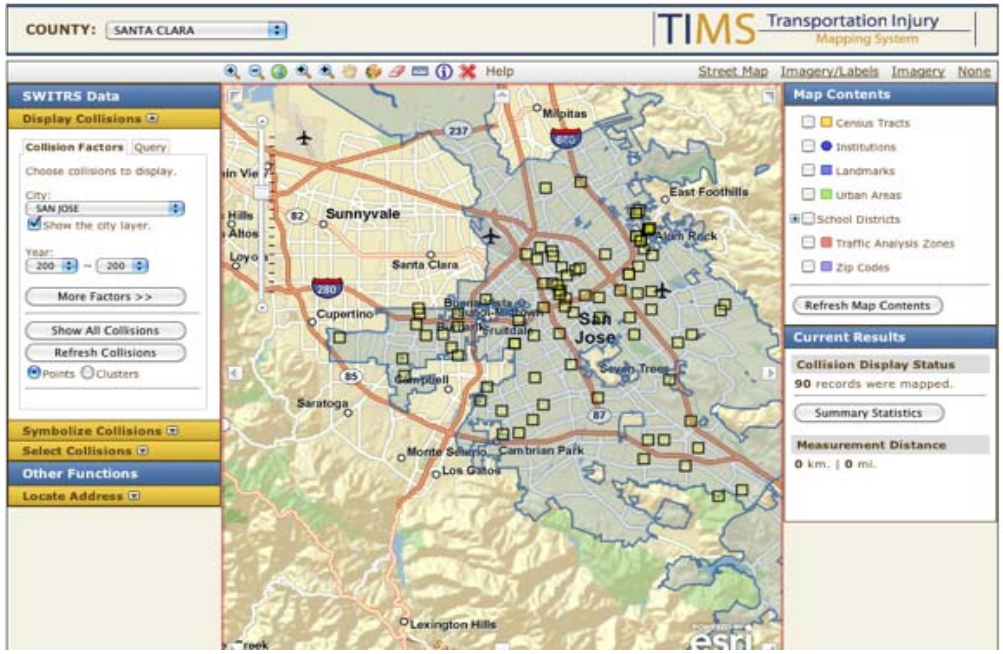
Why is accurate georeferencing important?

- Accurate georeferencing is necessary for accurate geospatial analysis:
  - Collision mapping web tools
  - High concentration collision location identification
  - Safety countermeasure selection

Collision mapping web tools

- Transportation Injury Mapping System (TIMS)
- http://tims.berkeley.edu





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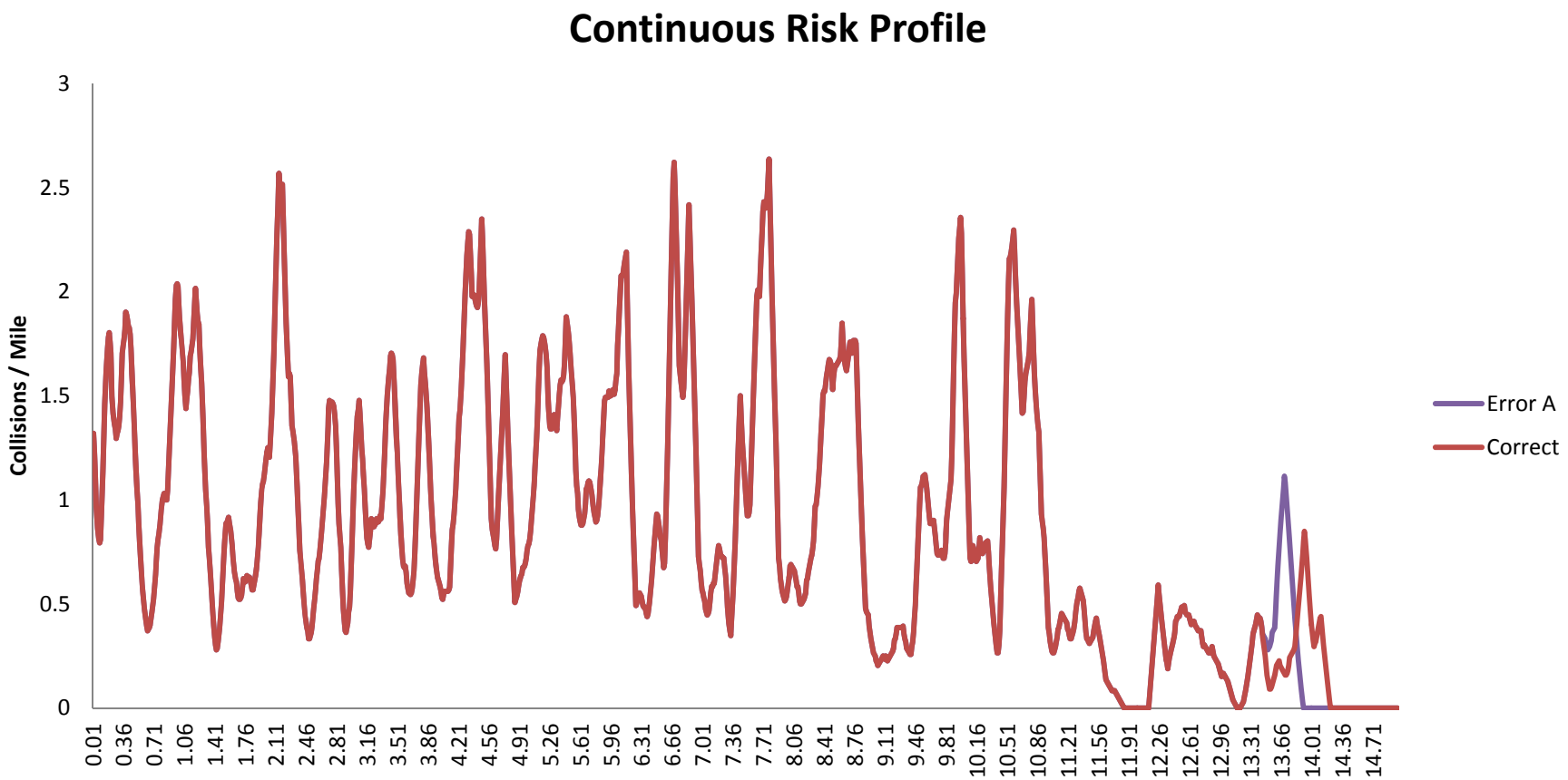
High concentration collision location identification

- Highway collision rates
  - Correct georeferencing vs. LRS error



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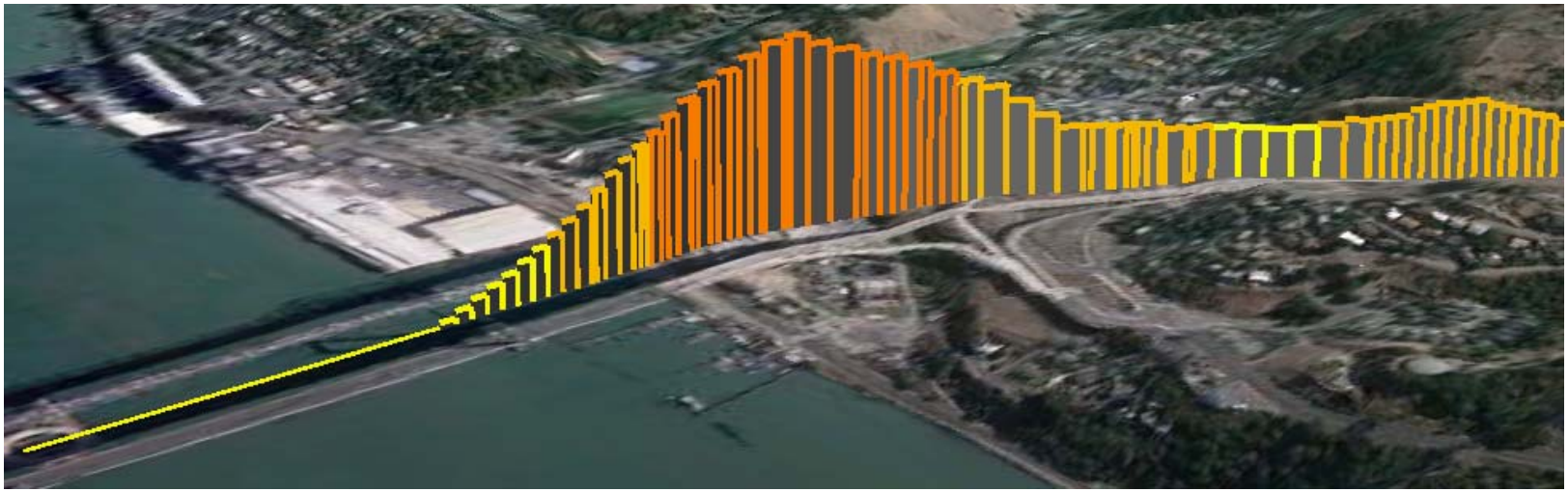
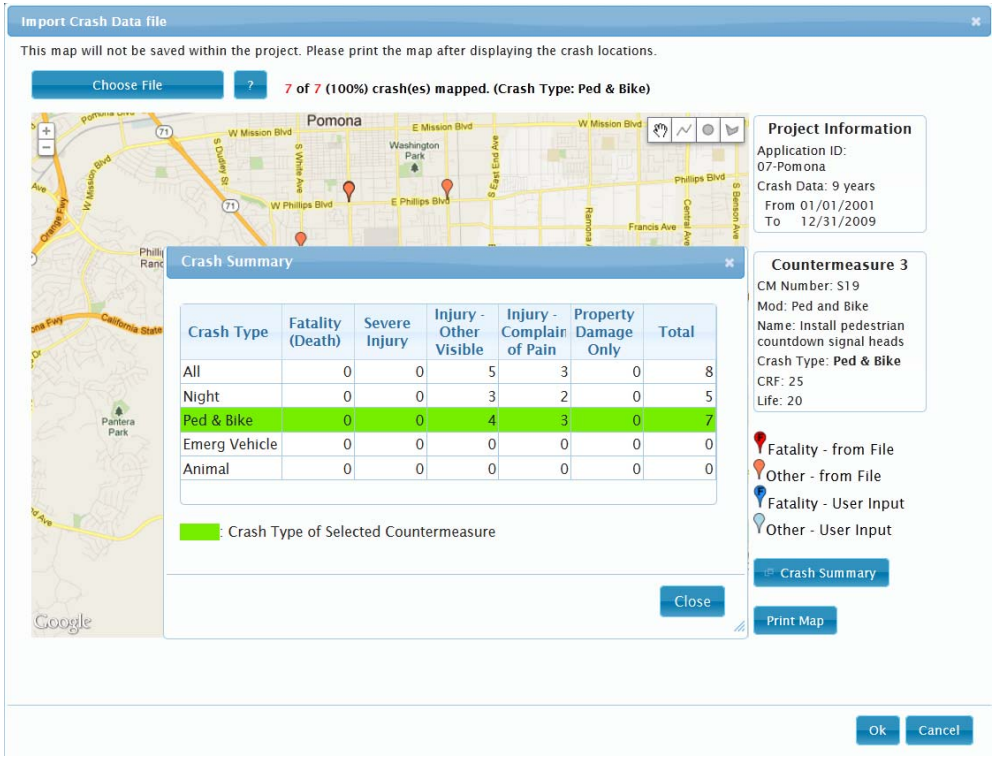
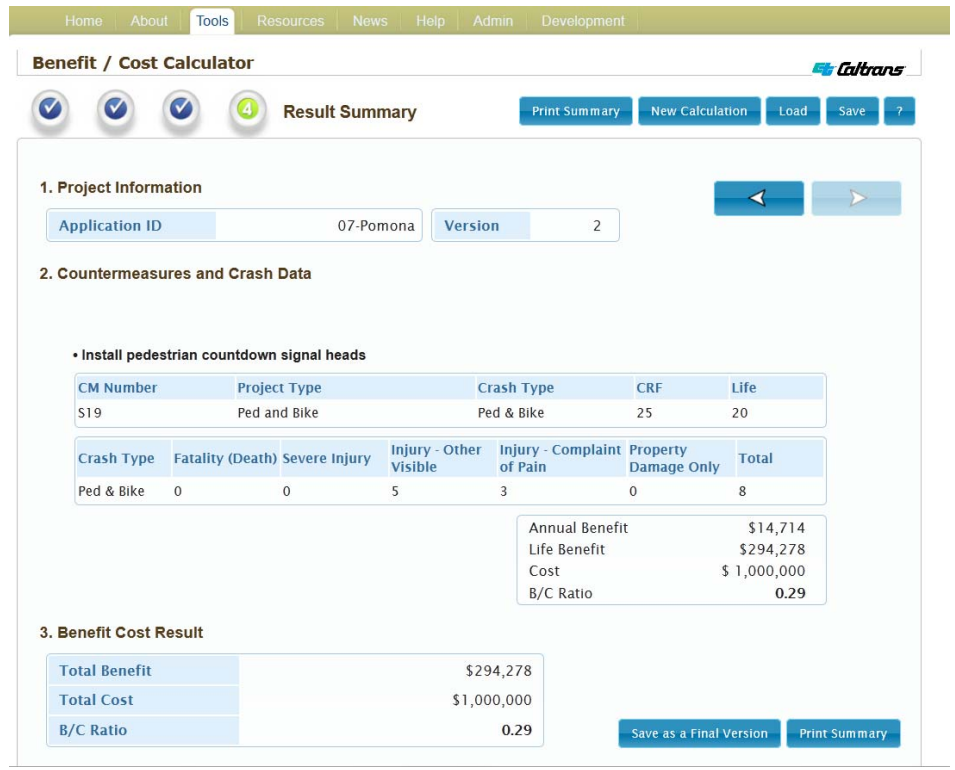
High concentration collision location identification



Safety countermeasure selection

- Benefit/cost analysis of countermeasures
- Apply for Highway Safety Improvement Program (HSIP) funds





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Future Directions

- Traffic Records Coordinating Committees (TRCCs)
- Initiatives
  - Standardize statewide data entry forms
  - Automated processes
    - No paper submissions
  - Interactive data entry mapping tools

Funding Support

- Funding for TIMS was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration.

Questions?

- Thank you!

Data Driven Approaches to Crime *and* Traffic Safety (DDACTS)

Geographic Information Systems (GIS) in Transportation Safety

National Transportation Safety Board

December 4, 2012

Presented by the Baltimore County (MD) Police Department

Captain Woodland Wilson

Lieutenant Stephen Troutman

Sergeant Joseph Donohue

Traffic Analyst Emily Varga

"INTEGRITY FAIRNESS SERVICE"

What is DDACTS?

DDACTS is an operational model that uses the integration of location-based crime and traffic data to establish effective and efficient methods for deploying law enforcement and other resources.

"INTEGRITY...FAIRNESS...SERVICE"

Why DDACTS?

- **Crime and Crashes Often Occur in Close Proximity**

POLICE
BALTIMORE COUNTY
MARYLAND
"INTEGRITY...FAIRNESS...SERVICE"

2007-2008 Crash-Crime Initiative

- In 2006 department analysts discovered an overlap between crime hotspots and crash hotspots
- The initial focus was along several primary thoroughfares originating in Baltimore City and expanding outward in a spoke-like fashion
- The idea was to direct resources into these overlap areas to have a “two birds with one stone” effect on both crashes and crime

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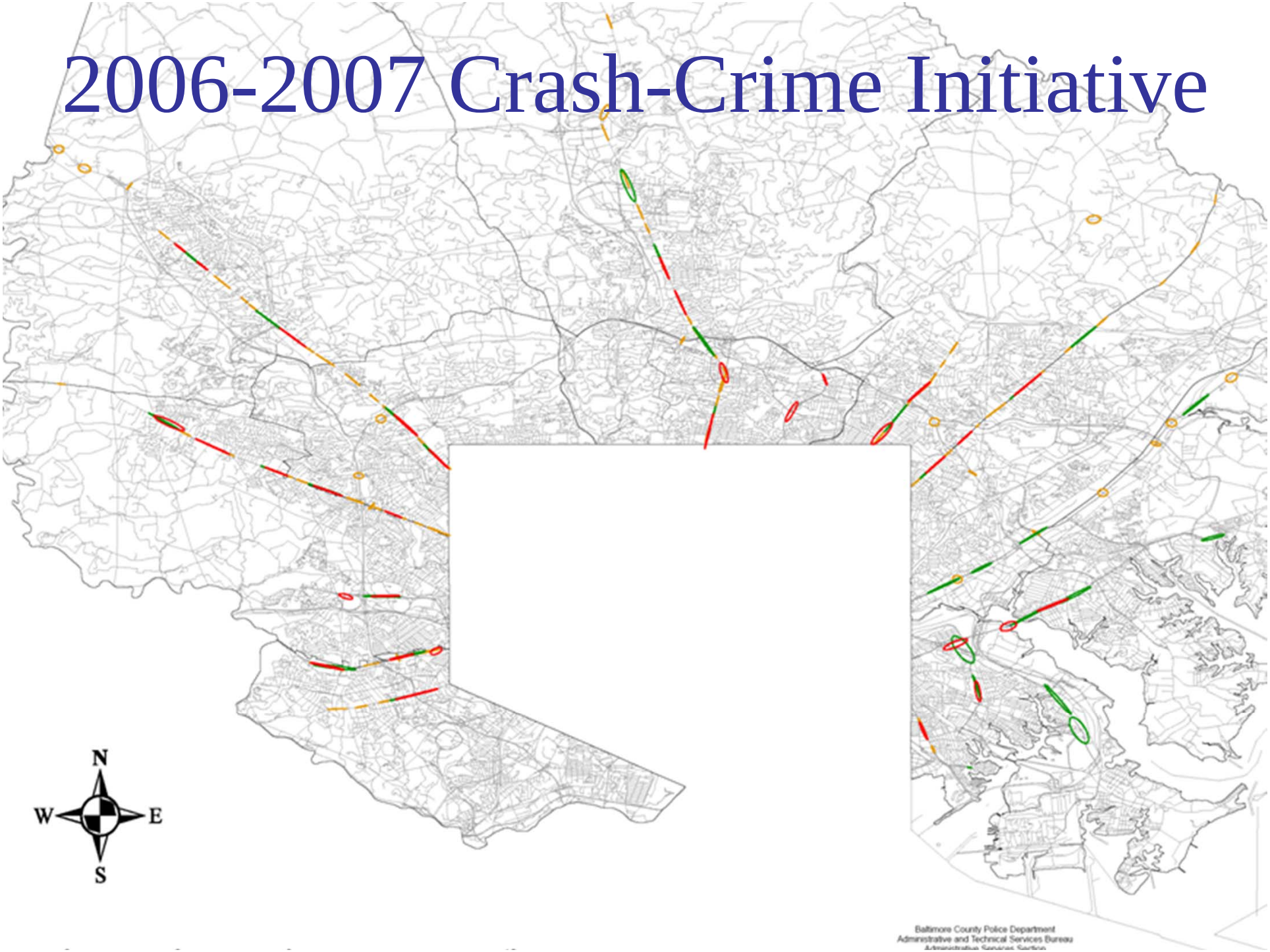
2006-2007 Crash-Crime Initiative



Why DDACTS?

- **Crime and Crashes Often Occur in Close Proximity**
- **Increasing Demands and Limited Resources**
- **Conflicting / Competing Demands for Service**
- **Crimes Often Involve a Motor Vehicle**
- **Renewed Emphasis on Traffic Safety**

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DDACTS Guiding Principles

Partners / Stakeholder Participation

Data Collection

Data Analysis

Strategic Operations

Information Sharing and Outreach

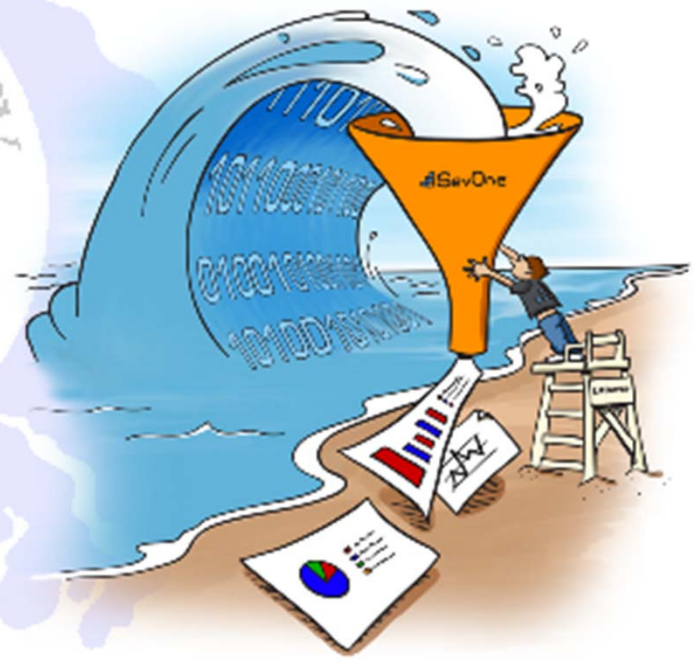
Monitor, Evaluate and Adjust

Outcomes

"INTEGRITY...FAIRNESS...SERVICE"

Data Collection

- Crash Data
- Crime Data
- Calls for Service
- Community Complaints



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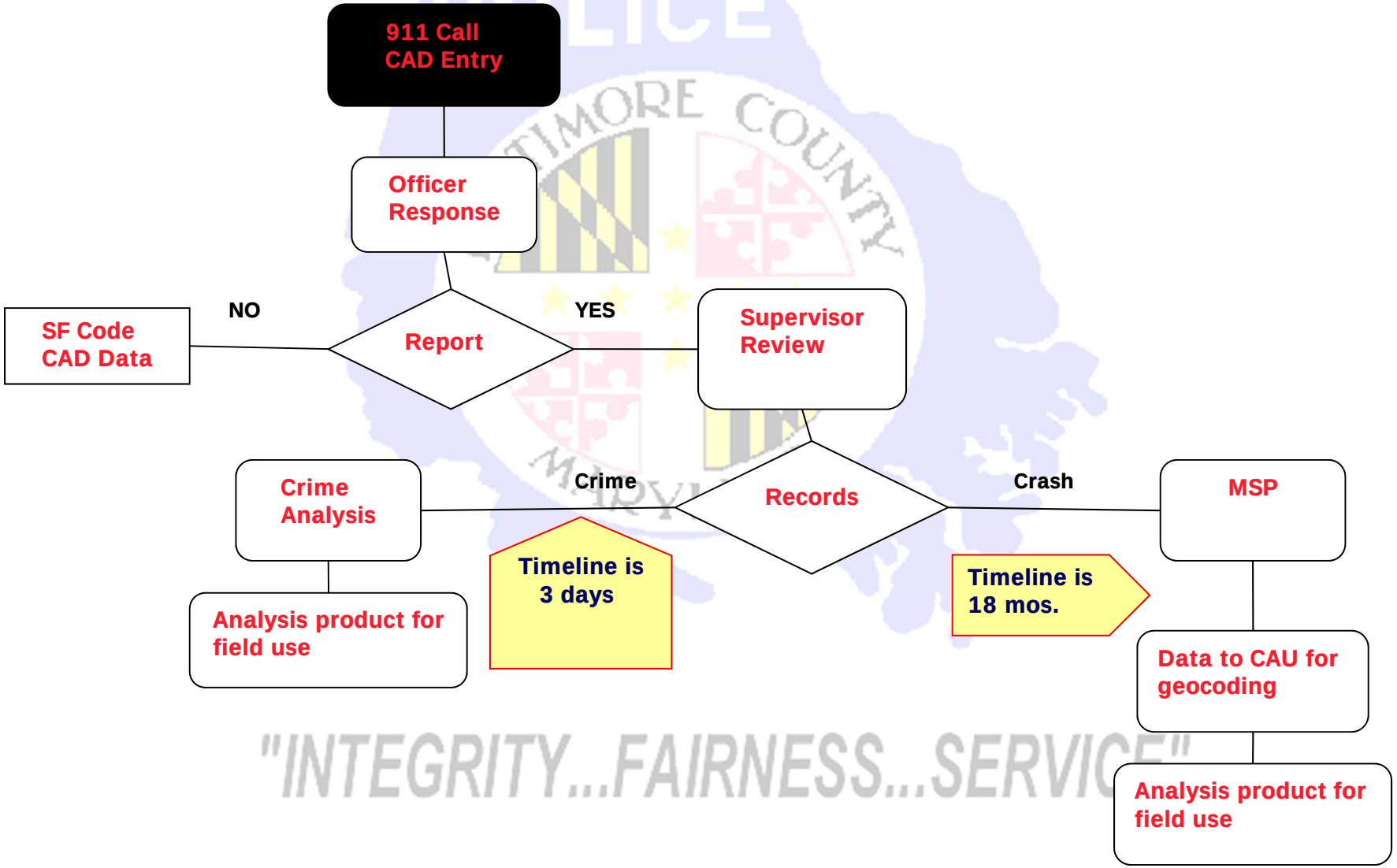
Data Collection Flow



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Difficulty Geocoding Crash Locations

- Road name misspelled
- Road name missing
- Multiple designations of interstate highways
- Hit rate about 83% for MAARS (Maryland Accident Analysis Reporting System) data

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Crime Hot Spot Areas

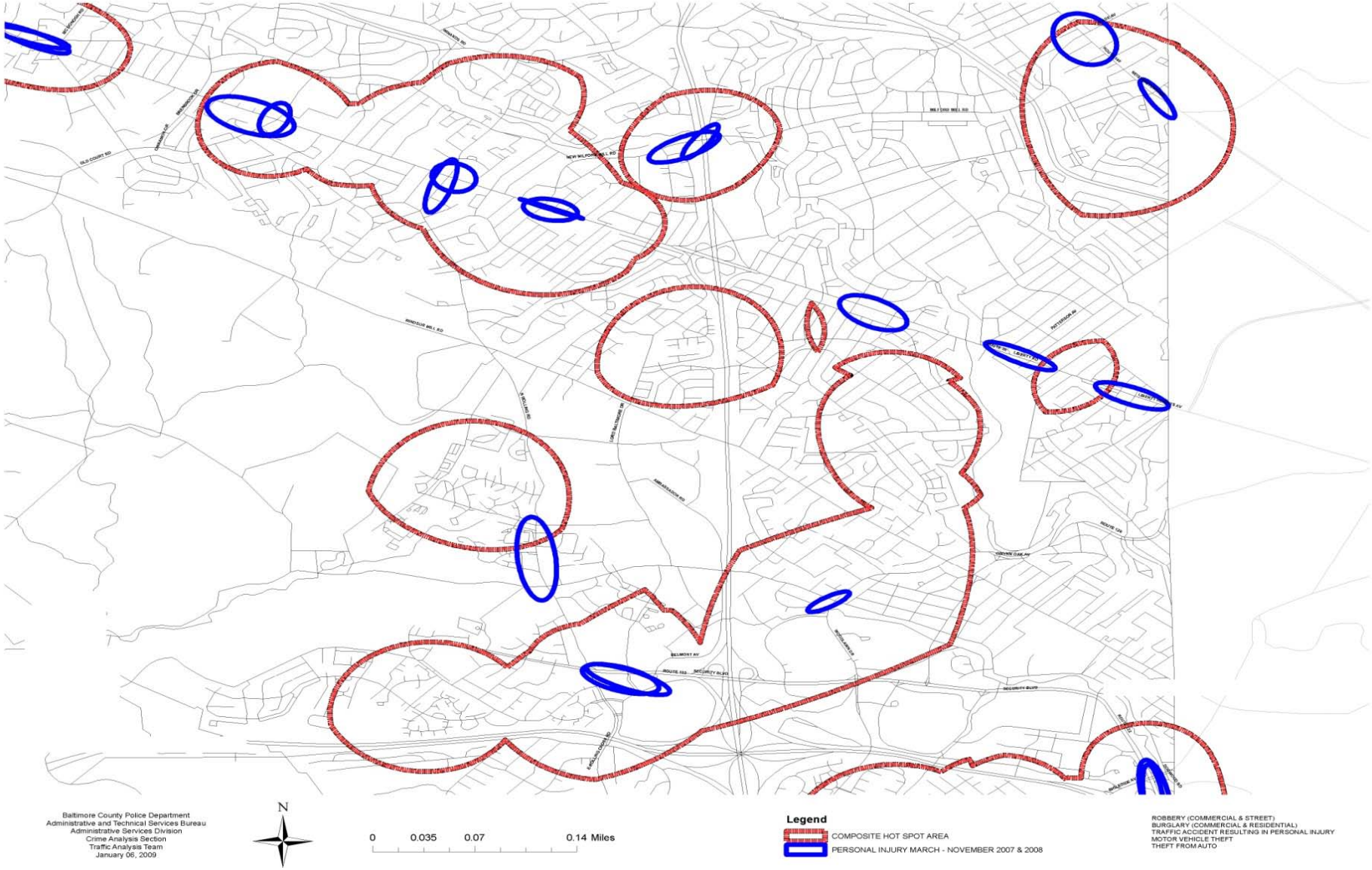
"INTEGRITY...FAIRNESS...SERVICE"

MINIMUM NUMBER OF POINTS PER ELLIPSE = 10

Traffic Analysis Team
December 9 , 2008

Composite Hot Spot Areas

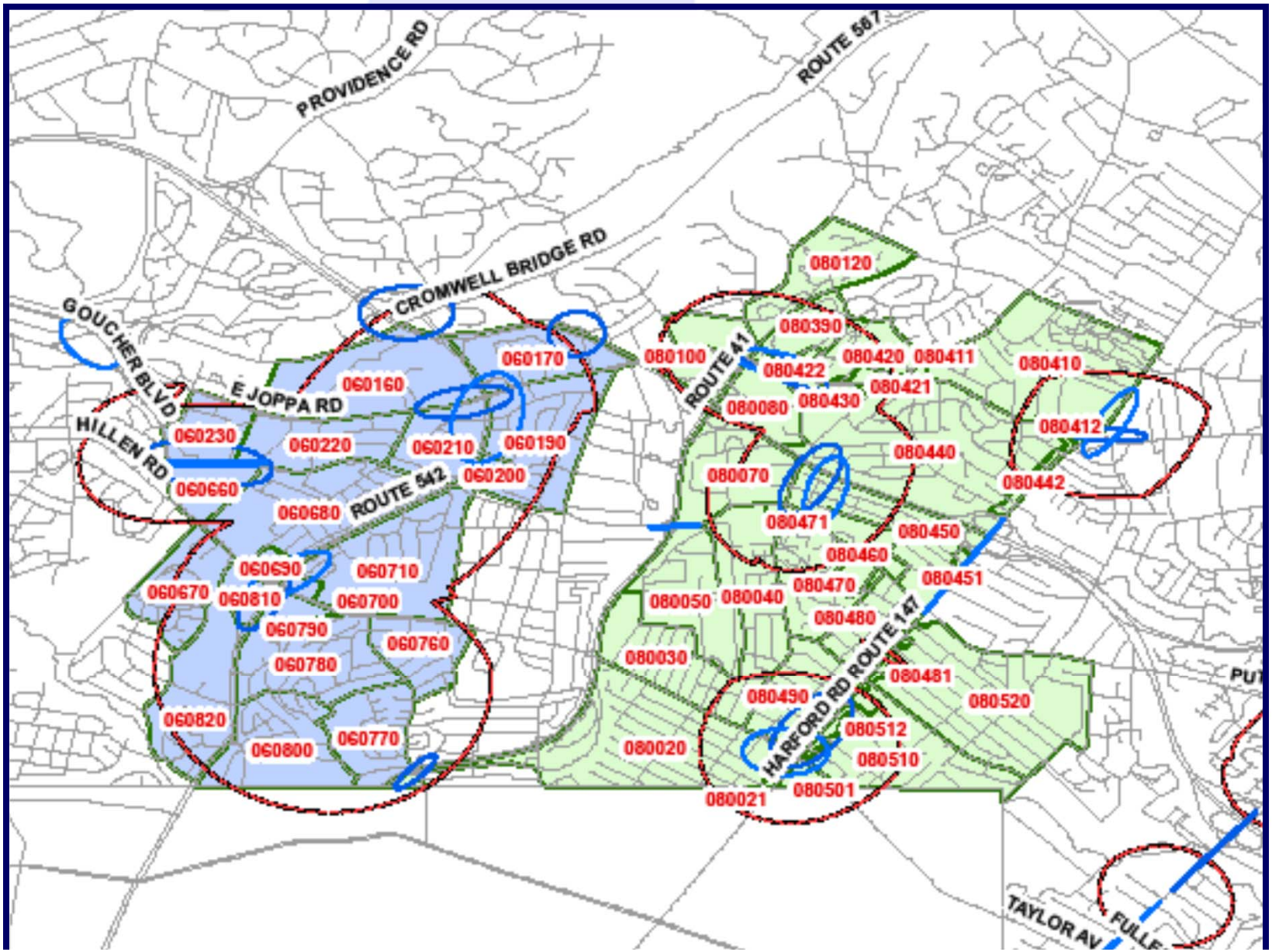
COMPOSITE HOT SPOTS OF SELECTED CRIMES AND PERSONAL INJURY CRASHES
MARCH - NOVEMBER 2007 AND MARCH - NOVEMBER 2008

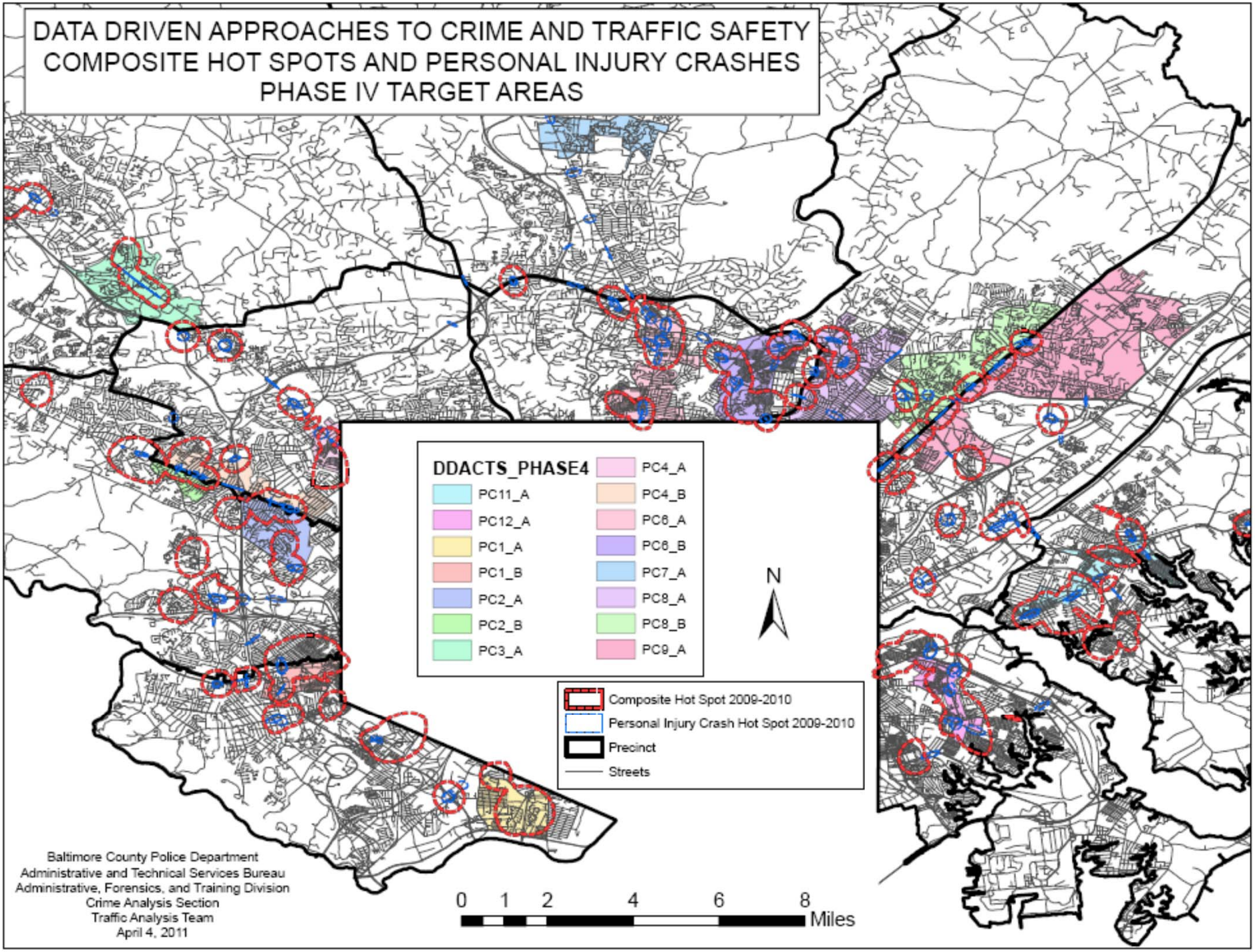


Composite Hot Spot Areas

"INTEGRITY...FAIRNESS...SERVICE"

Developing Target Areas




DATA DRIVEN APPROACHES TO CRIME AND TRAFFIC SAFETY
COMPOSITE HOT SPOTS AND PERSONAL INJURY CRASHES
PHASE IV TARGET AREAS
DDACTS_PHASE4
PC11_A
PC12_A
PC1_A
PC1_B
PC2_A
PC2_B
PC3_A
PC4_A
PC4_B
PC6_A
PC6_B
PC7_A
PC8_A
PC8_B
PC9_A
N
Composite Hot Spot 2009-2010
Personal Injury Crash Hot Spot 2009-2010
Precinct
Streets
0 1 2 4 6 8
Miles
Baltimore County Police Department
Administrative and Technical Services Bureau
Administrative, Forensics, and Training Division
Crime Analysis Section
Traffic Analysis Team
April 4, 2011

Evaluation Considerations

- Establish criteria ahead of time
- Identifying pre- and post-periods
- Averages instead of individual data points
- Methods of measuring change
- Control areas
- Statistical tests and significance
- Displacement and diffusion

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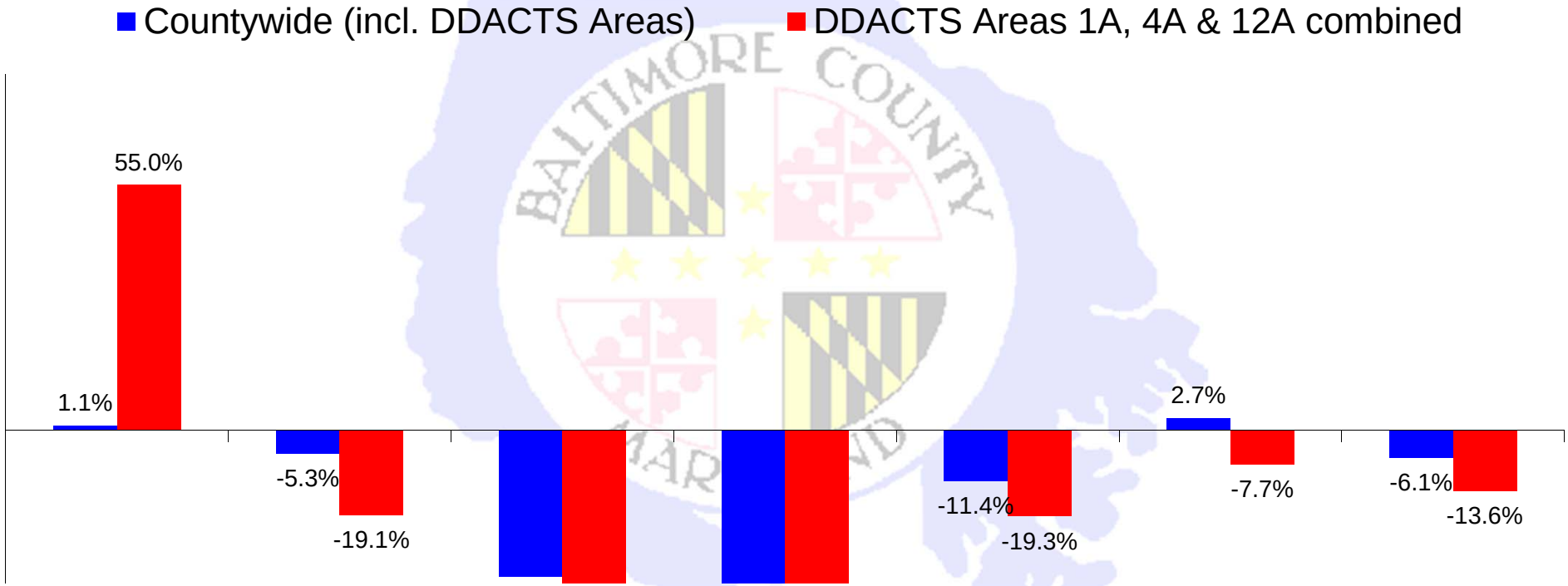
The Long-Term Effects

3 Target Areas have remained the same since DDACTS was started in 2009



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Change between April to November 2006-2008 yearly average (pre-DDACTS) and 2011

COLLEGE STATION
STATE OF TEXAS
PHILADELPHIA
POLICE
KANSAS CITY
MISSOURI
CITY OF ATLANTA
RESURGENS
1847
1865
ATLANTA, GA.
POLICE
SHERIFF
RHODE ISLAND STATE POLICE
75th ANNIVERSARY
IN THE SERVICE OF THE STATE
HOPE
1925 - 2000
GOLDEN HEART
PITTSBURGH
POLICE
IDAHO
GEM
STATE POLICE
MEMPHIS POLICE
ALLENTOWN
PA
POLICE
TEXAS
NORTH DAKOTA
GATEWAY
THIBODAUX
LOUISIANA
WASHINGTON
D.C.
POLICE
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Panel #5: Multi-modal Application and Analysis Panel

Objective: This panel will illustrate the uses of GIS data and technologies in selected transportation safety topics.

Lisa Park, American Transportation Research Institute
Mapping Large Truck Rollovers: Identification and Mitigation through Spatial Data Analysis

Michelle Barnes, University of Michigan Transportation Research Institute
Employing Spatial Data and GIS Tools to Support Transportation Safety Research

Marco Merens, International Civil Aviation Organization
Aviation Safety Analysis and GIS

Marc Berryman, National Emergency Number Association
GIS in Public Safety: NENA & USDOT

Mapping Large Truck Rollovers: Identification and Mitigation Through Spatial Data Analysis

Lisa Park

Research Analyst

American Transportation Research Institute

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Trucking industry's NFP research organization

- Commercial Drivers
- Congestion and Mobility
- Economic Analysis
- Environment
- Safety
- Security
- Technology
- Transportation Infrastructure
- Trucking Industry Operations

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COMMERCIAL VEHICLE SAFETY ALLIANCE CVSA
DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION
MDOT Department of Transportation
New York State Motor Truck Association Safety, Service & Solutions
CFIRE National Center for Freight & Infrastructure Research & Education
CMCA Colorado Motor Carriers Association
PRIME inc.
GT
ATRI American Transportation Research Institute

Research Overview

- Top RAC priority from 2010
- Explore innovative methods for identifying sites where roadway design and signage have a significant negative impact on truck safety
- Distribute database rollover locations to motor carriers and commercial drivers
- Work with DOTs to identify infrastructure solutions

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Research Agenda

- <u>Phase 1-Completed</u>
  - Determine truck rollover clusters/patterns that may indicate areas where high instances of large truck rollovers occur
- Phase 2- Underway
  - Dissemination of real-time, geofence-based information to drivers via onboard computers
  - As truck drivers approach a high risk rollover location an in cab warning will be generated
  - Goal to modify driver behavior
- Phase 3- Future
  - An analysis of the features of each cluster location
  - Identify and categorize possible roadway design issues
  - Work with DOTs to propose solutions

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Phase 1- Methodology

- Defining Data Elements and Review of Data Sources
  - Determine crash record criteria
  - Collaboration with AASHTO to identify state POC
  - Collect and organize large truck rollover crash records
  - Collect FARS database records
- Data Assimilation and Mapping
  - Refine and standardize crash records

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Phase 1- Methodology

- Cluster Identification
  - Utilize GIS tools to determine clustering of rollover events within a defined proximity
  - Analyze historical crash data based on the number of rollovers at a site using the Accident Frequency method
  - Identify locations within each state with the highest frequency of rollovers

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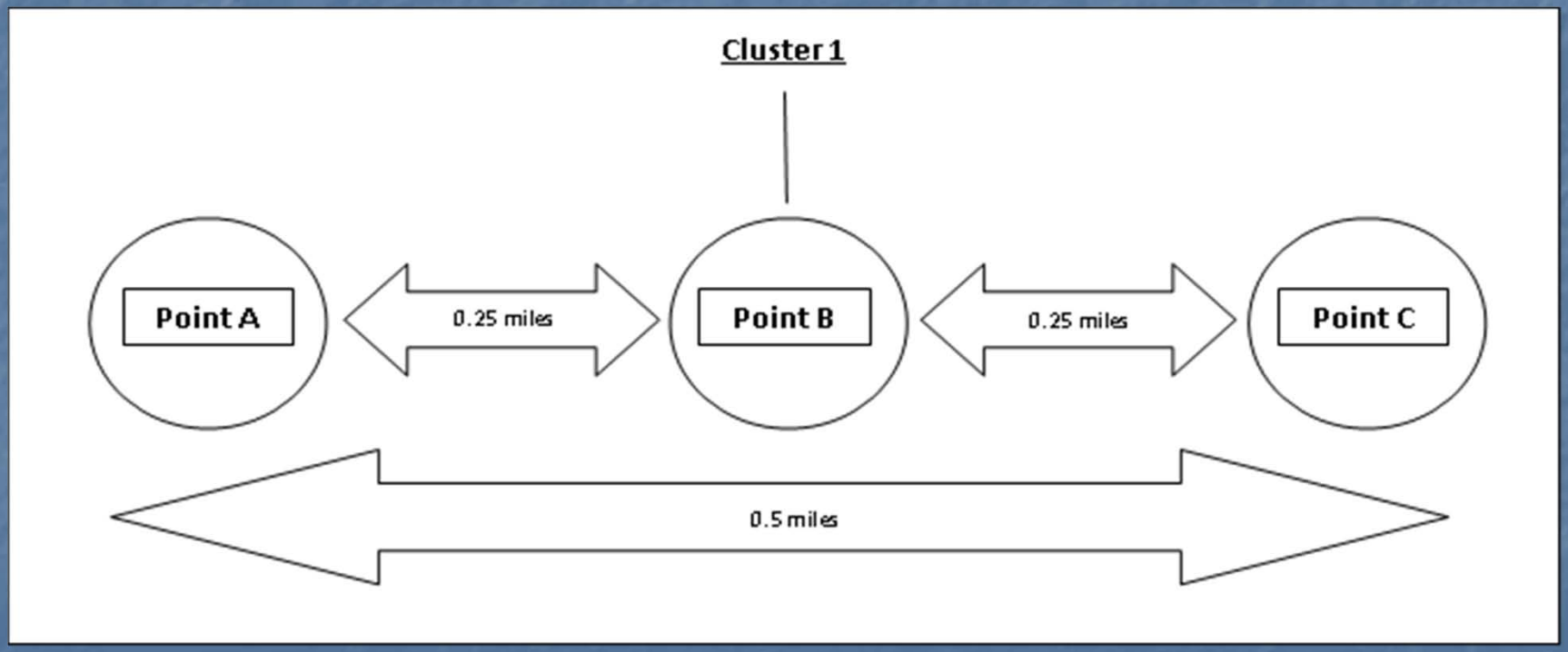
Phase 1- Methodology

- Cluster Tolerance
  - Integrate events into coincident points
  - Count events at identified clusters



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Phase 1- Results

- Large Truck Rollover Database
  - Data from 9 Years
    - 2001-2009
  - 51,229 Rollover Crash Records
    - > 48,000 non-fatal
    - 2,691 fatal
- State Participation
  - 39 states participated
    - 31 integrated
    - 8 states not integrated
    - 10 states not participating

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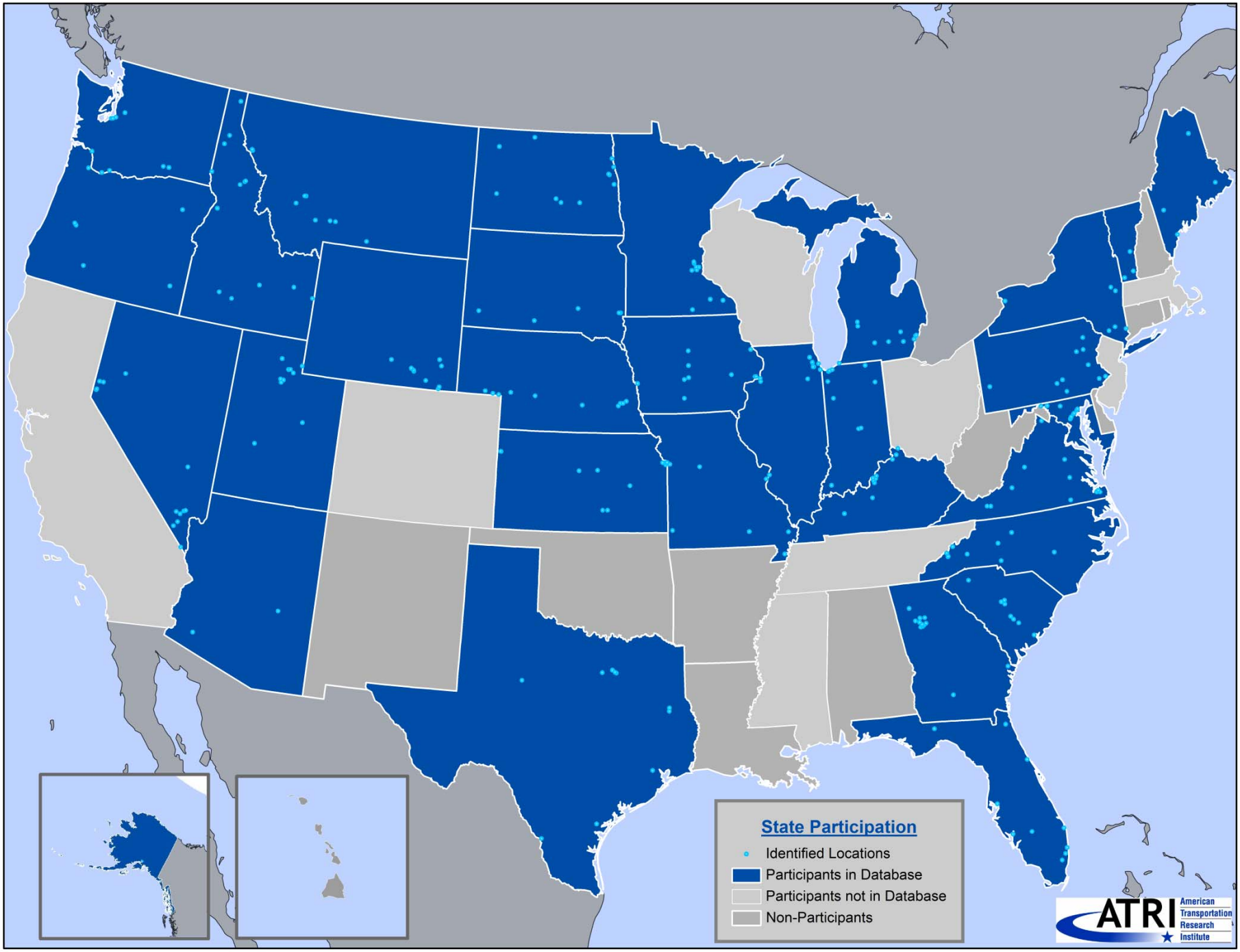
State Participation
Identified Locations
Participants in Database
Participants not in Database
Non-Participants
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Phase 1- Results

- **State Summary Reports**
  - Created for each state in database (31)
  - Includes the number of fatal and nonfatal rollover crashes for each year as well as the top rollover locations based on highest frequency of rollover events
  - Collaboration with FMCSA to increase state participation
- **Online Interactive Map**
  - Aids in distributing information
  - Promotes use of spatial technologies in large truck crash research
- **Digital and Hard Copy Publication**
  - May be updated as current hot spots are addressed, causing risks to diminish, as well as when new hot spots are identified

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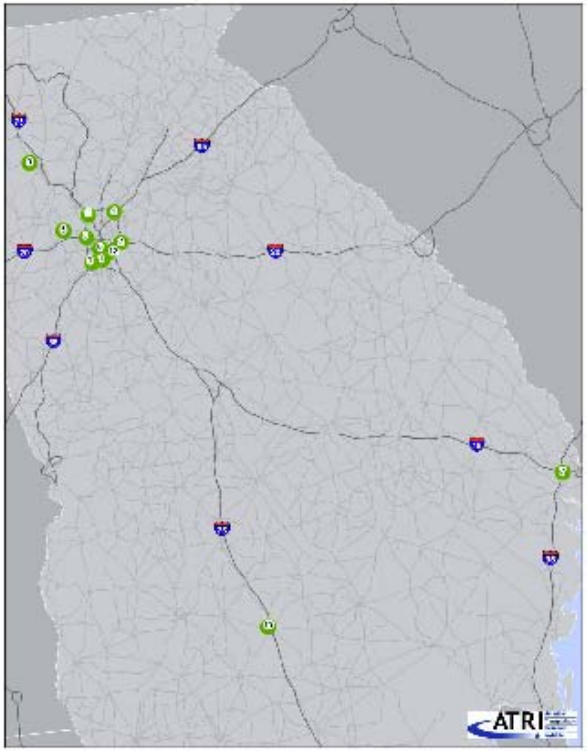
Georgia



Rollovers by Year and Severity			
Year	Fatal	Non-Fatal	Total Rollovers
2001	16	451	467
2002	18	421	439
2003	21	524	545
2004	15	563	578
2005	18	630	648
2006	26	600	626
2007	28	488	516
2008	23	471	494
2009	19	249	268
All Years	184	4397	4581

Top Rollover Locations		
ID	*Location*	*Number of Rollovers*
1	I-285 and I-75 (South Side)	35
2	I-285 and I-20 (East Side)	32
3	I-285 and I-85 (South Side)	31
4	I-285 and I-85 (North Side)	17
5	US 278 and Spur 6	16
6	I-75 between SR 166 and I-85	16
7	I-95 and I-16	15
8	I-285 and I-20 (West Side)	14
9	US 411 and US 41/Joe Frank Harris Pkwy SE	11
10	I-75 between US 319 and Old Omega Rd	11
11	I-285 and I-75 (North Side)	11
12	I-285 and US 23/Moreland Ave	11

Please refer to the full report, *Mapping Large Truck Rollovers: Identification and Mitigation Through Spatial Data Analysis*, available from ATRI at www.atri-online.org for methodology and data sources.

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Search

Mapping Large Truck Rollovers: Interactive Map

Click in the interactive map below to zoom in to rollover locations. Click on a rollover location to link to the state report.

Share this: Print Facebook Email

Phase 1- Conclusions

- Demonstrates the feasibility and utility of creating a spatial national large truck rollover database
  - Reveals a need for more uniform crash reporting procedures among states
  - Encourages enhanced national standard for reporting all crash types
- Methodology was effective for identifying rollover concentrations, especially those concentrations that were not limited to a single stretch of road but rather multiple intersecting roads
- Provides ATRI Research Team with a foundation to proceed with Phase 2 and 3 research

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The FPM Program

- Sponsored by Federal Highway Administration (2002-Present)
- Billions of unique truck GPS positions received / processed per year
- Several hundred thousand individual trucks (mostly Class 8) in the population
- The dataset used is multi-year / multi-source
- Customized Processing System / Methods for Producing Freight Performance Measures

Utilizing Empirical Data to Analyze Road Closures and Freight Diversion

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Background

- May 2011 – Flooding closes Interstate 40 in Arkansas at White River Bridge
- I-40 is a critical trucking corridor
  - 2010 average daily volume ~18,000 trucks
- Both directions closed for several days, resulting in significant detours
- Question: How can Freight Performance Measures (FPM) dataset be used to analyze closure impacts?

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Methodology

- Isolated FPM data on first full day of closure (May 6) and one week prior (April 29)
- Each data point contains:
  - Unique Truck ID
  - Latitude/Longitude (precise)
  - Date/time stamp
  - Speed
  - Heading
- Using ArcGIS, data was spatially joined to the Freight Analysis Framework road network shapefile
  - Network divided into smaller segments for more detailed analysis
  - Each segment assigned a unique ID
- Number of unique truck IDs aggregated and difference between May 6 and April 29 calculated
- National control analysis performed to reduce impact of external trends

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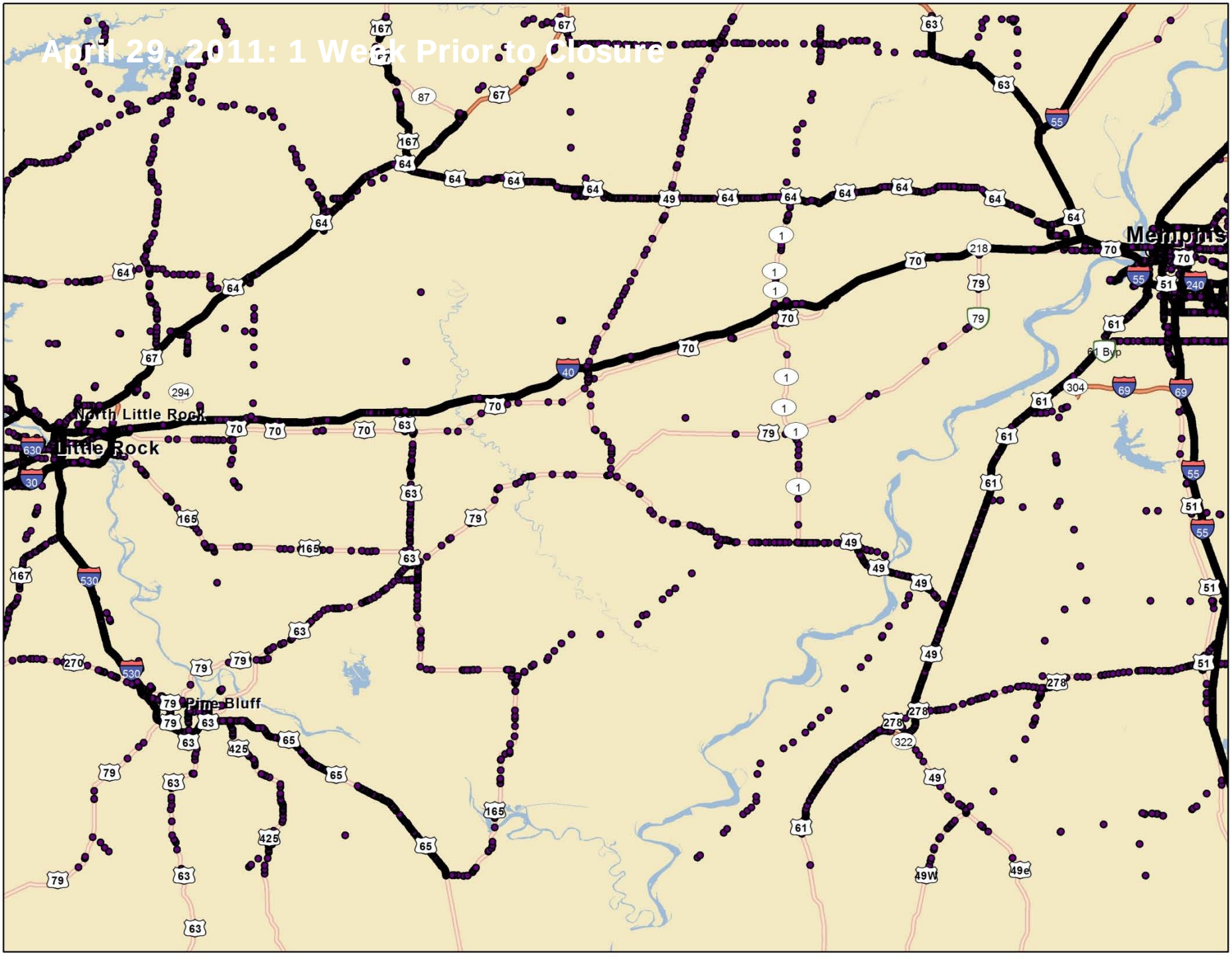
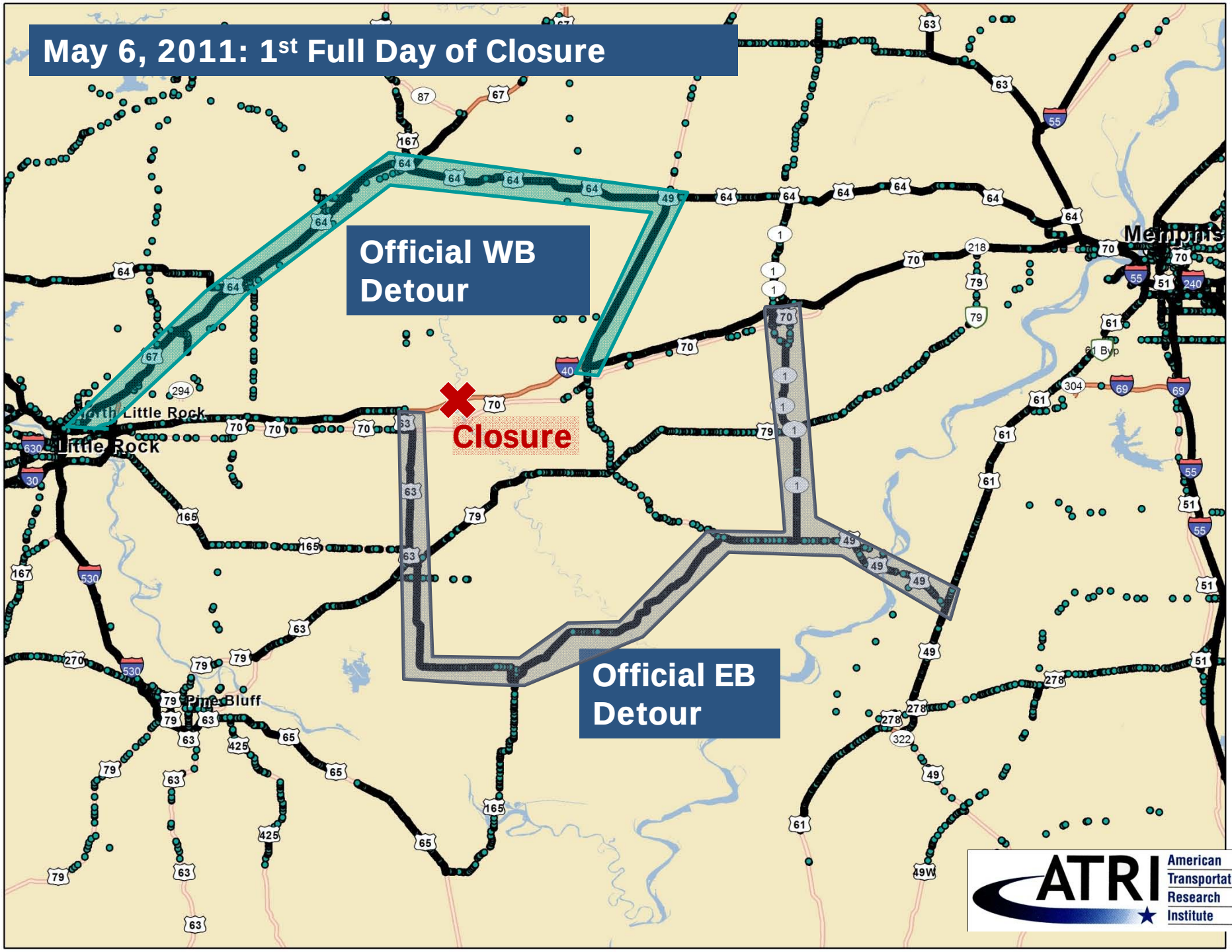
April 29, 2011: 1 Week Prior to Closure



May 6, 2011: 1st Full Day of Closure



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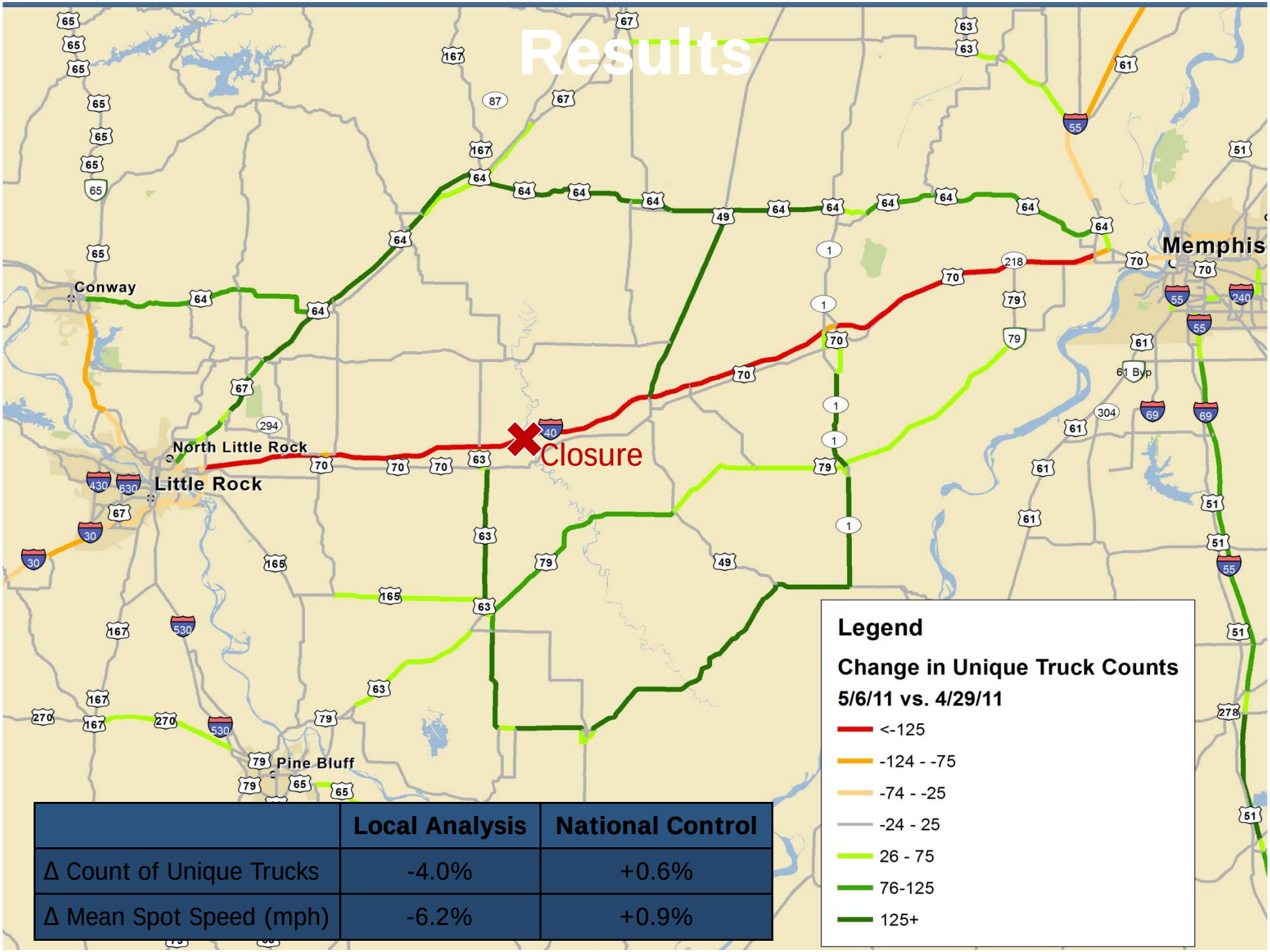
Results



	Local Analysis	National Control
Δ Count of Unique Trucks	-4.0%	+0.6%
Δ Mean Spot Speed (mph)	-6.2%	+0.9%

Methodology

- Evidence of regional diversion in local analysis, corroborated by media reports
- Replicated local diversion analysis for southeastern US
- Utilized ATRI National Corridors road network instead of FAF
  - Customized for use with FPM data
  - 93,000+ segments and growing
  - Suitable for multi-directional analysis
- Longer corridors (~150 miles long) analyzed to better yield regional trends

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Indianapolis
Cincinnati
Kansas City
St. Louis
Wichita
Lexington-Fayette
Tulsa
Nashville
Oklahoma City
Memphis
Closure
Atlanta
Fort Worth
Dallas
Austin
Houston
San Antonio
New Orleans
9.3%
6.7%
-1.3 %
0.5%
-2.0%
-13.8%
-9.3%
-3.3%
-5.5%
-7.9%
9.9%
28.6%
-5.4%
-0.2%
-0.9%
-10.2%
6.7%
-1.8%
-0.4%
1.1%
-4.0%
-2.9%
-6.1%
-2.4%
-13.3%
-11.6%
-0.8%
-5.3%
2.6%
-2.9%
-14.3%
-9.6%
-7.3%
-6.6%
-11.0%
-9.3%
-7.6%
-43.4%
9.7%
-6.4%
2.0%
23.4%
7.7%
-36.9%
-1.8%
0.1%
-25.0%
25.2%
34.8%
-25.2%
14.8%
18.4%
7.9%
9.7%
-9.9%
-8.8%
19.5%
15.3%
0.4%
0.2%
9.5%
19.2%
34.5%
6.3%
4.7%
19.5%
20.5%
3.1%
1.1%
0.8%
8.0%
0.8%
-1.4%
-1.0%
27.9%
6.4%
7.9%
16.7%
15.9%
13.4%
-2.1%
1.8%
5.1%
1.2%
Legend
Percent Change in Truck Counts
5/6/11 vs. 4/29/11
< -10%
-10% - -5%
-5% - 5%
5% - 10%
>10%
May 6 Position Reads

Results

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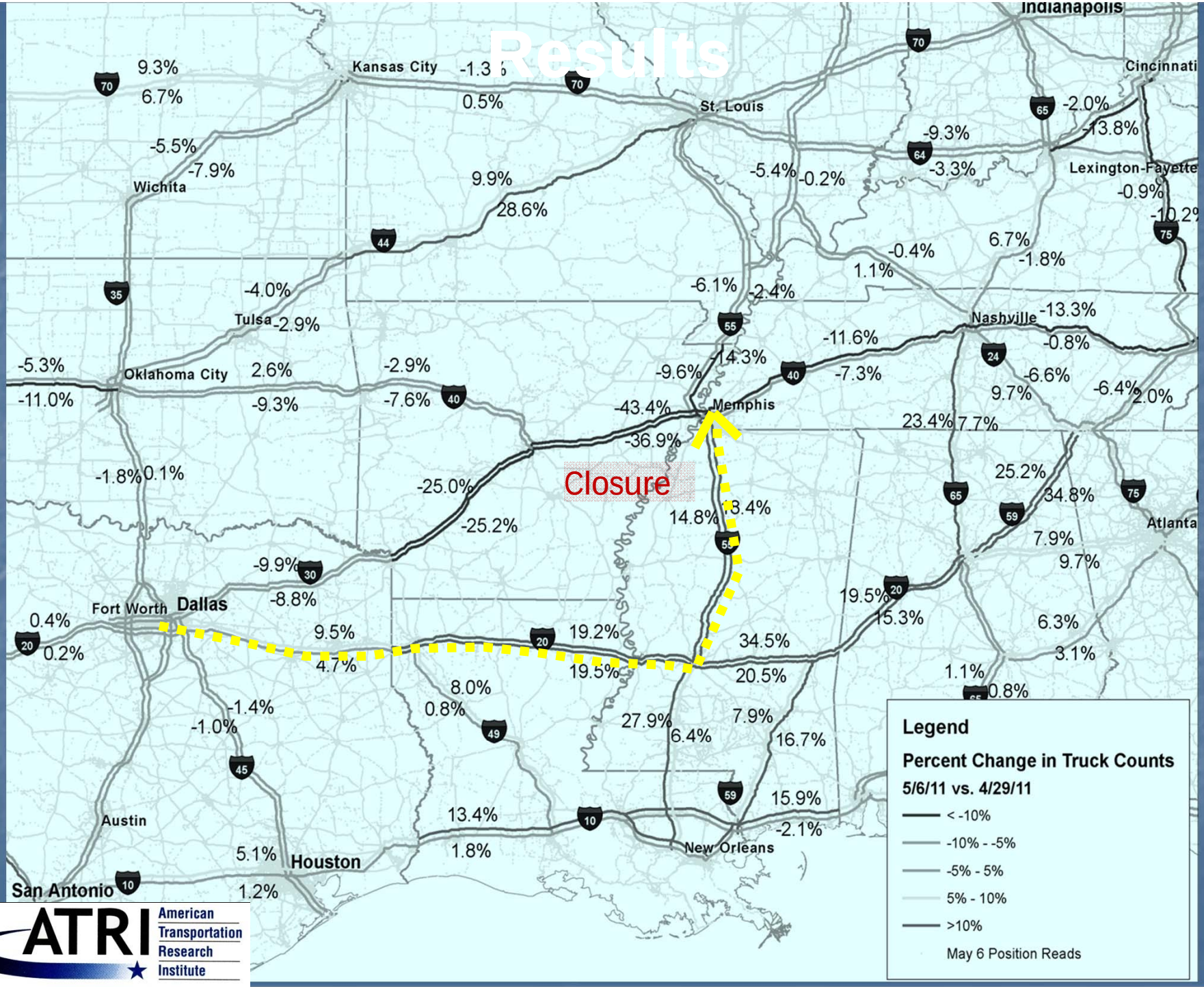
Results



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Utilizing Empirical Data to Analyze Truck Parking Needs

Commercial Drivers are not permitted to drive for more than 11 consecutive hours. Congestion, weather, and other unplanned events can cause variation in the distance travelled over the course of 11 hours.

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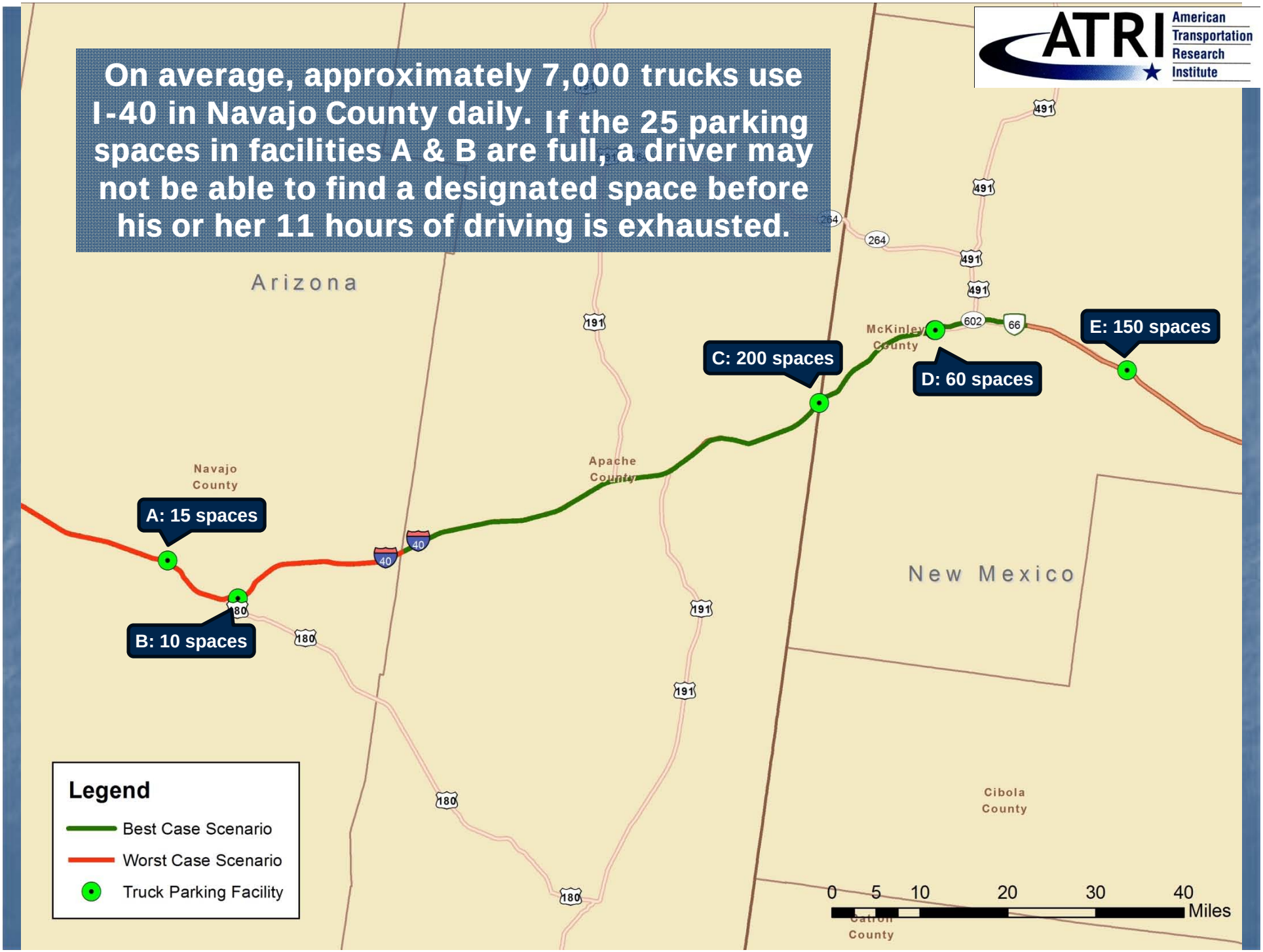
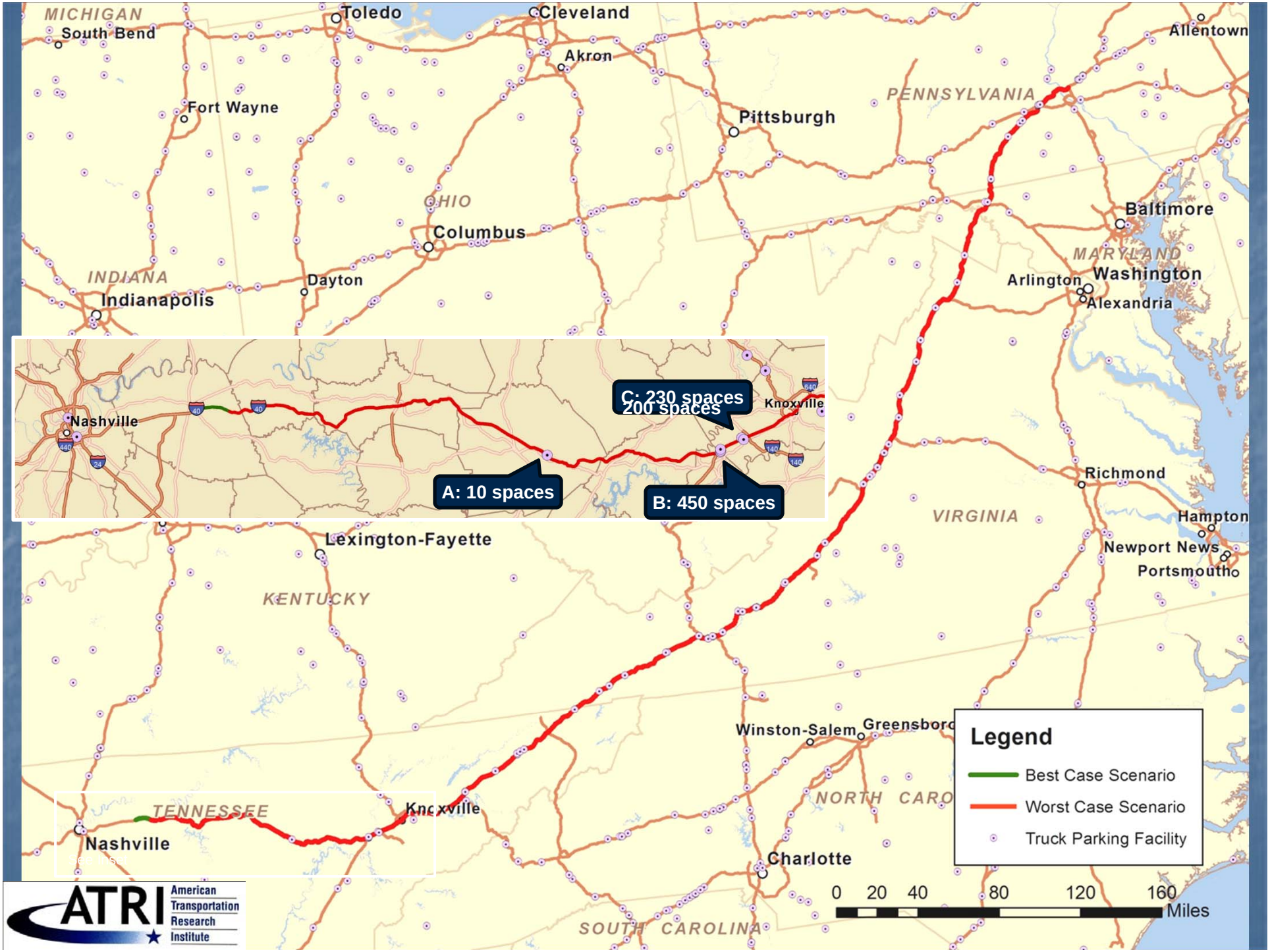
NEVADA
UTAH
CALIFORNIA
ARIZONA
NEW MEXICO
Los Angeles
San Diego
Phoenix
80 miles
Legend
Best Case Scenario
Worst Case Scenario


On average, approximately 7,000 trucks use I-40 in Navajo County daily. If the 25 parking spaces in facilities A & B are full, a driver may not be able to find a designated space before his or her 11 hours of driving is exhausted.
ATRI
American Transportation Research Institute
Arizona
New Mexico
Navajo County
Apache County
McKinley County
Cibola County
Catron County
A: 15 spaces
B: 10 spaces
C: 200 spaces
D: 60 spaces
E: 150 spaces
Legend
Best Case Scenario
Worst Case Scenario
Truck Parking Facility
0 5 10 20 30 40 Miles


MICHIGAN
South Bend
Toledo
Cleveland
Akron
Allentown
Fort Wayne
PENNSYLVANIA
Pittsburgh
OHIO
Columbus
Baltimore
MARYLAND
INDIANA
Dayton
Arlington
Washington
Indianapolis
Alexandria
Nashville
C: 230 spaces
200 spaces
Knoxville
A: 10 spaces
B: 450 spaces
Richmond
VIRGINIA
Hampton
Lexington-Fayette
Newport News
Portsmouth
KENTUCKY
Winston-Salem
Greensboro
Legend
Best Case Scenario
Worst Case Scenario
Truck Parking Facility
TENNESSEE
Knoxville
NORTH CARO
Nashville
Charlotte
0 20 40 80 120 160
Miles
SOUTH CAROLINA
ATRI
American Transportation Research Institute

NEW MEXICO
El Paso
See Inset
Abilene
Fort Worth
Irving
Plano
Garland
Mesquite
Arlington
Waco
TEXAS
Austin
Houston
Pasadena
San Antonio
A: 350 spaces
B: 12 spaces
Corpus Christi
Laredo
D: 32 spaces
McAllen
C: 332 spaces
Brownsville
Legend
Worst Case Scenario
Best Case Scenario
Truck Parking Facility
0 25 50 100 150 200
Miles

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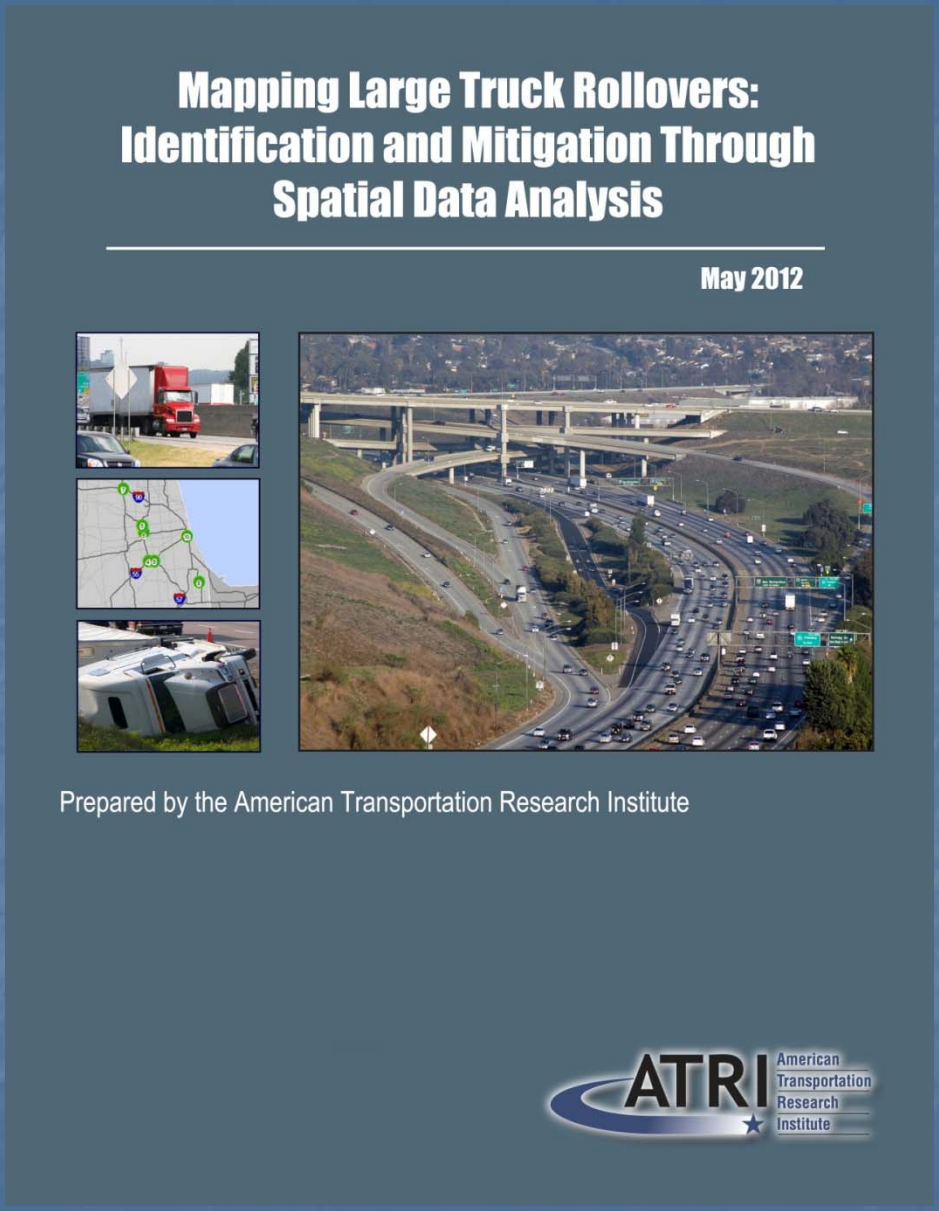


Employing Spatial Data and GIS Tools to Support Transportation Safety Research

Michelle A. Barnes, BSCE, MPA, MSGIS
Engineering System Group
Senior Research Engineer

UMTRI
University of Michigan
Transportation Research Institute

UMTRI UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE

Our Vision
Safe and Sustainable Transportation for a Global Society

Our Mission
Research Advancing Safe and Sustainable Transportation

- Interdisciplinary Transportation Safety Research
- Some $23M in annual funding from the government, foundations and industry
- 120 Full-time staff and students

Thanks to the NTSB for holding this meeting to discuss how GIS supports Transportation Safety

Presentation

Overview of UMTRI research supported by GIS
Short list of UMTRI generated and acquired spatial data
Experience and suggestions for employing a diverse set of spatial data to support transportation research
Q and A

UMTRI spatial data-naturalistic driving

- Safety Pilot Model Deployment
- Road Departure Crash Warning (RDCW)
- Integrated Vehicle Based Safety Systems (IVBSS)
- Teen Driving
- Alzheimer's Study

among other

Spatial Data provided to support UMTRI research

- HPMS national and state files that include: Michigan, New York, Ohio, Pennsylvania, Texas, and Washington State
- All Michigan public road intersections
- Several local agency, sign and signal locations, building footprints, and parcel data
- MDOT system sufficiency data
- High resolution aerial photography and Lidar data for several Michigan counties
- Michigan statewide crash data

UMTRI Transportation Research Projects Supported by GIS

TRB SO1 Development of Analysis Methods Using Recent Data: A Multivariate Analysis of Crash and Naturalistic Event Data in Relation to Highway Factors Using the GIS Framework, Nat'l Academy of Sciences. Investigator Gordon, T., UMTRI

- Driver Behavior
- Analytical application of naturalistic driving, crash & road data
- Map matching & data fusion (Michigan Data)
- Statistical analysis using data measures as surrogates

Ticketing Aggressive Cars and Trucks (TACT) project to support the Michigan Office of Highway Safety Planning submission to USDOT Federal Motor Carrier Safety Administration. Investigator Kostyniuk, L., UMTRI

- Law Enforcement/Driver Behavior
- Crash locations subset of aggressive driver behavior
- Map matching & data fusion (Michigan Data)
- Determination of concentrated enforcement & control sites (Michigan Data)

Center for the Management for Safe and Sustainable Transportation (CMISST)

Teen Driving Events, University of Michigan Injury Prevention Center, Nat'l Center for Injury Prevention and Control. Investigator, Bingham, R., UMTRI

- Teen Drivers/Public Health
- Map matching & data fusion (Michigan Data)
- Spatial Hierarchical modeling & statistics

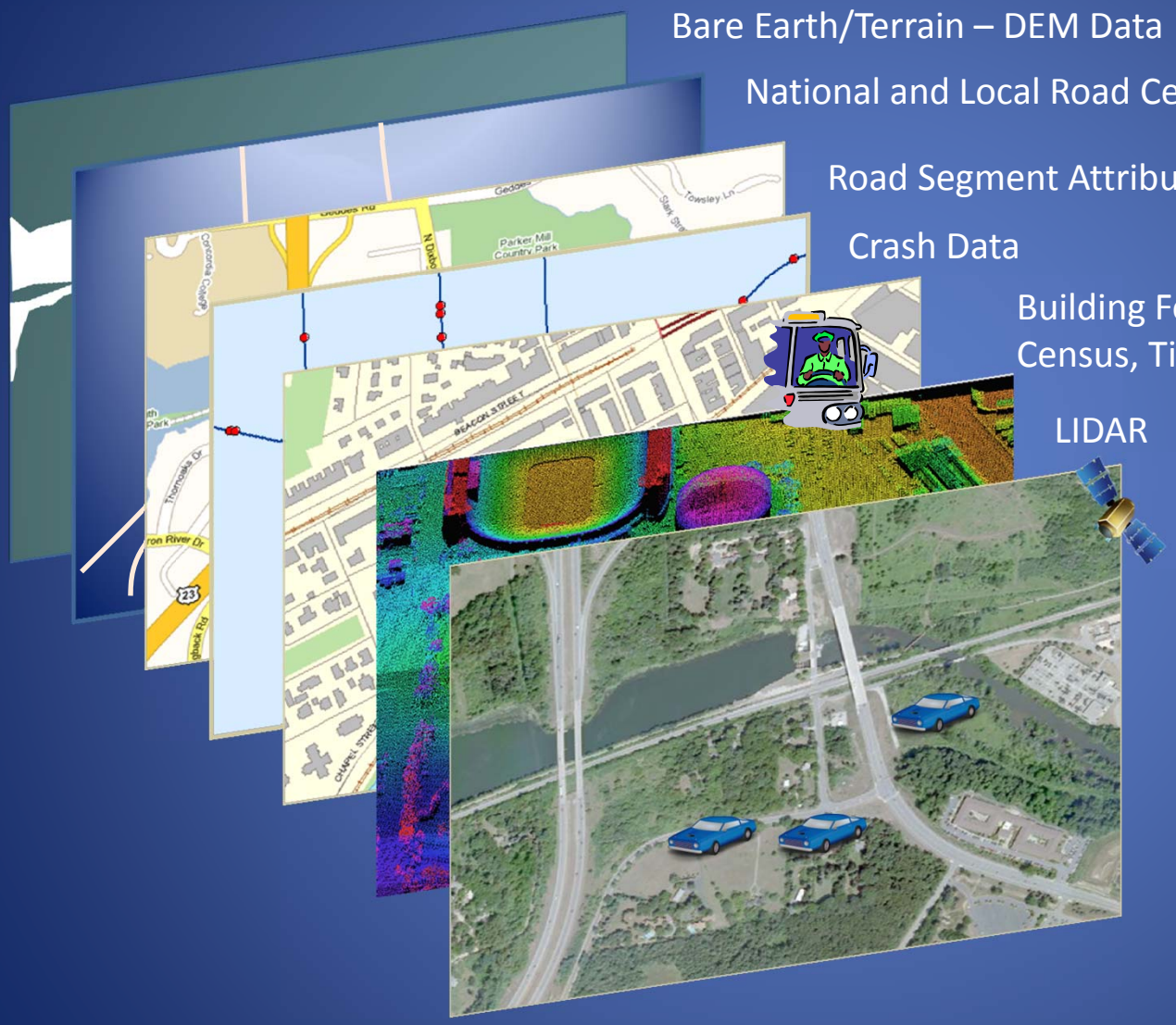
Safety Pilot Model Deployment, U.S. Department of Transportation, automobile, and industry partners. Investigator Sayer, J., UMTRI

- Vehicle Safety Device Evaluation-Vehicle to Vehicle and Vehicle to Roadside Communication
- Potential analysis includes: map matching between vehicles & roadside Dedicated Short Range Communication (DSRC) units (deployment route Ann Arbor, MI)
- Analysis of DSRC transmissions relative to path obstructions

Look Ahead Driver Feedback & Powertrain Management Systems, Eaton Corporation. Investigator LeBlanc, D., UMTRI

- Fleet/Driver Training & Performance
- Map matching, data fusion and digital elevation modeling (DEM) – multi-state road data
- Integrated Vehicle Based Safety System (IVBSS) FOT data mining – multi-state naturalistic driving data

Snapshot of spatial data sources used by UMTRI to support transportation research



Bare Earth/Terrain – DEM Data

National and Local Road Centerline – Polyline Data

Road Segment Attribute Data

Crash Data

Building Footprint, Transit Routes, Census, Time Zone, etc.

LIDAR

UMTRI Generated Spatial Data (GPS) via Data Acquisition Systems (DAS)
RDCW and IVBSS FOT
Naturalistic Driving Data (GPS)
Model Deployment
Teen Driving to name a few.

Ortho-Corrected Aerial Photo

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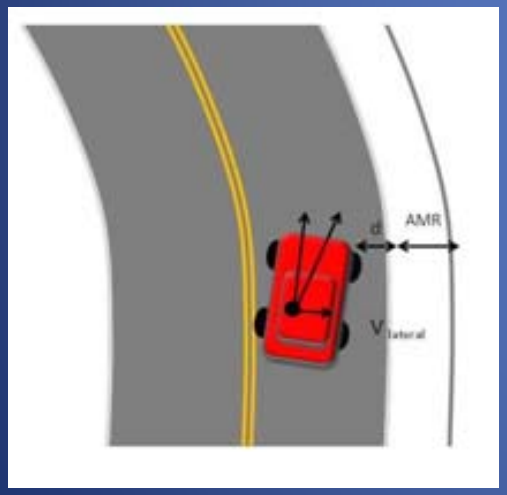
TRB SHRP II, SO1: Development of Analysis Methods Using Recent Data: A Multivariate Analysis of Crash and Naturalistic Event Data in Relation to Highway Factors Using the GIS Framework

Objective: To provide a validated quantitative link between detailed measurements from naturalistic driving behavior, road departure crashes, and road segment attributes. Then, if possible, identify common roadway elements that are associated with crash data and driver behavior as captured in the RDCW naturalistic driving data.



Time of edge crossing (TTEC)

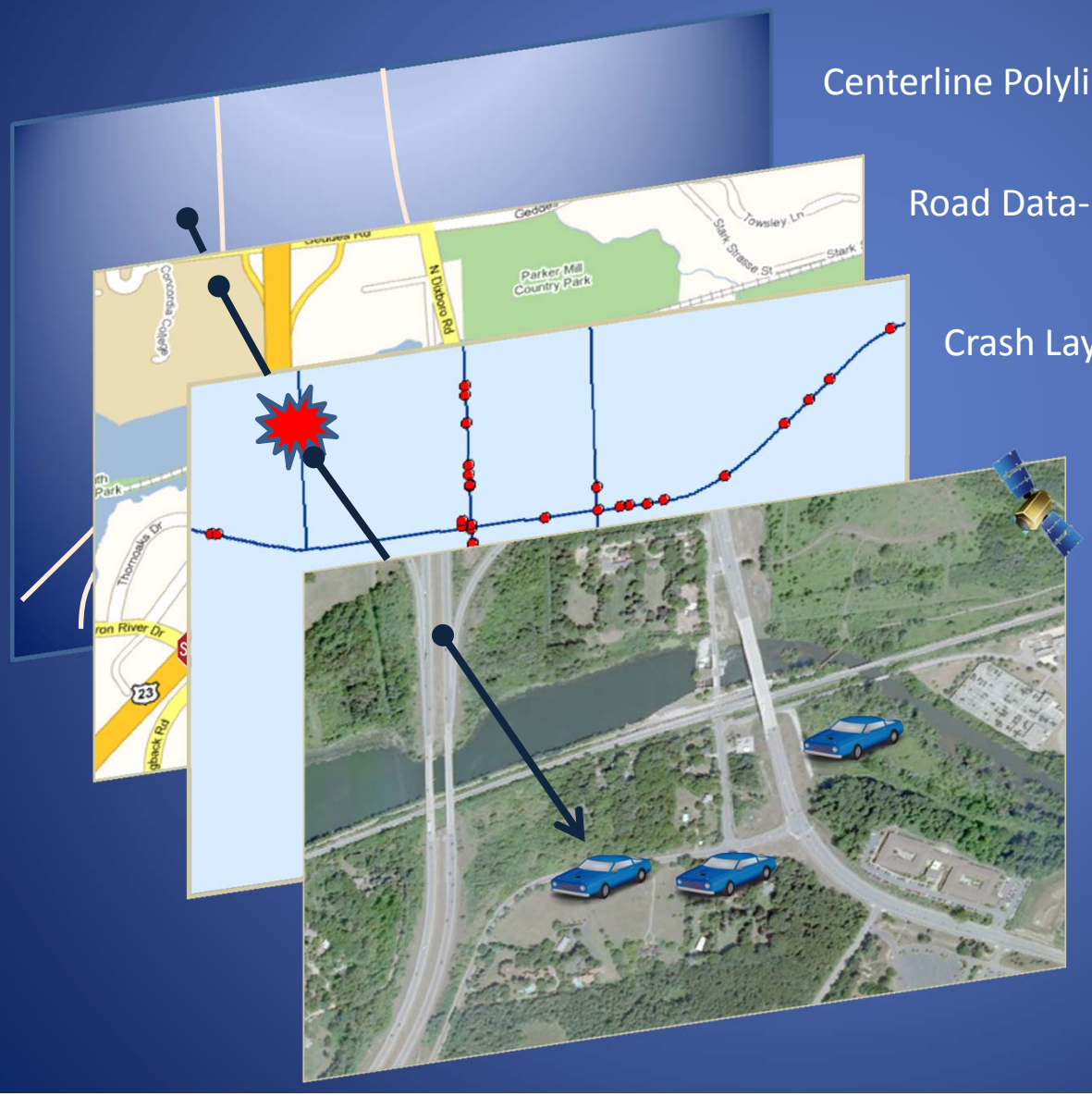
Research Questions:

Do naturalistic driving data contain measurable episodes of disturbed control?

Do objective measures of disturbed control from naturalistic driving data, integrated with on and off roadway geometrics and environmental factors satisfy criteria to act as crash surrogates for actual crashes?

TRB SHRP II, SO1

Spatial RDCW driving, road and crash data were fused to each HPMS road segment traversed.



Centerline Polyline File –HPMS Data

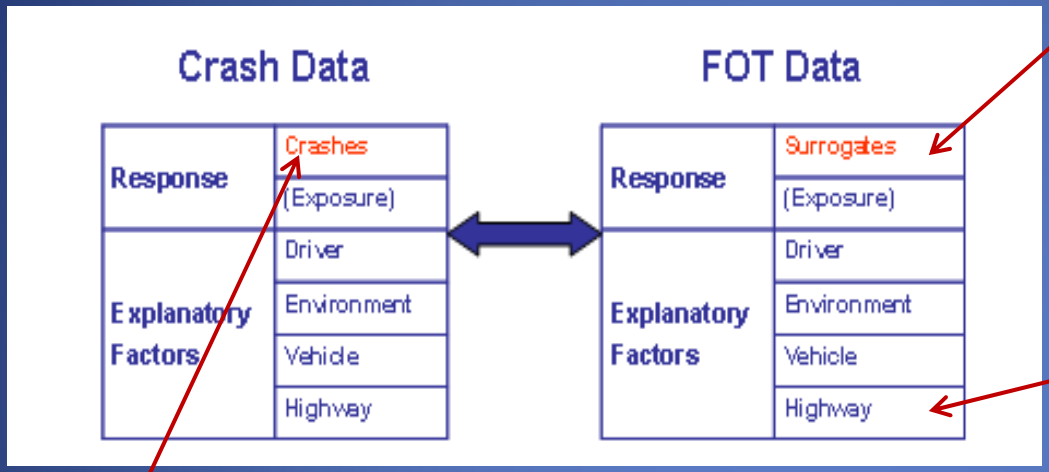
Road Data- Polyline Attribute Data

Crash Layer – Point/Event Data

Road Departure Crash Warning FOT Naturalistic Driving Data Alerts (GPS) /Aerial Photo

TRB SHRP SO1 - For each HPMS road segment that was traversed by an RDCW vehicle a variety of data were spatially joined to that segment. These records formed the multivariate data tables to support statistical analysis methods such as Extreme Value Theory and Seemingly Unrelated Regression

Analysis Model



Measures of Distributed Control Surrogates
Time to Edge Crossing
Lateral Drift Warning
Lane Deviation
Yaw Rate Error*

Highway Measures
Curves (via HPMS sample data)
Functional Class
Shoulder Type
Shoulder R/L Width
Through Lanes
Urban/Rural
Number of Traversals/Segment

Crash Measures
Crash ID
Road Departure Crash Count
(37K crashes, 2001-05)
Weather
Lighting
Road Condition
XY Coordinates
Direction
Time

Conclusion: The analyzes provided ample indication that episodes of disturbed control exist in the naturalistic driving data, and can be related to crashes via highway variables. The fusion/integration of spatial data sets make it possible to develop valid surrogates measures for behavioral outcomes.

SAFETYPILOT
GET CONNECTED

Research Vision

The vision of the Safety Pilot is to test connected vehicle safety applications in real-world driving scenarios to determine their effectiveness at reducing crashes and to ensure that the devices are safe and do not unnecessarily distract motorists or cause unintended consequences.

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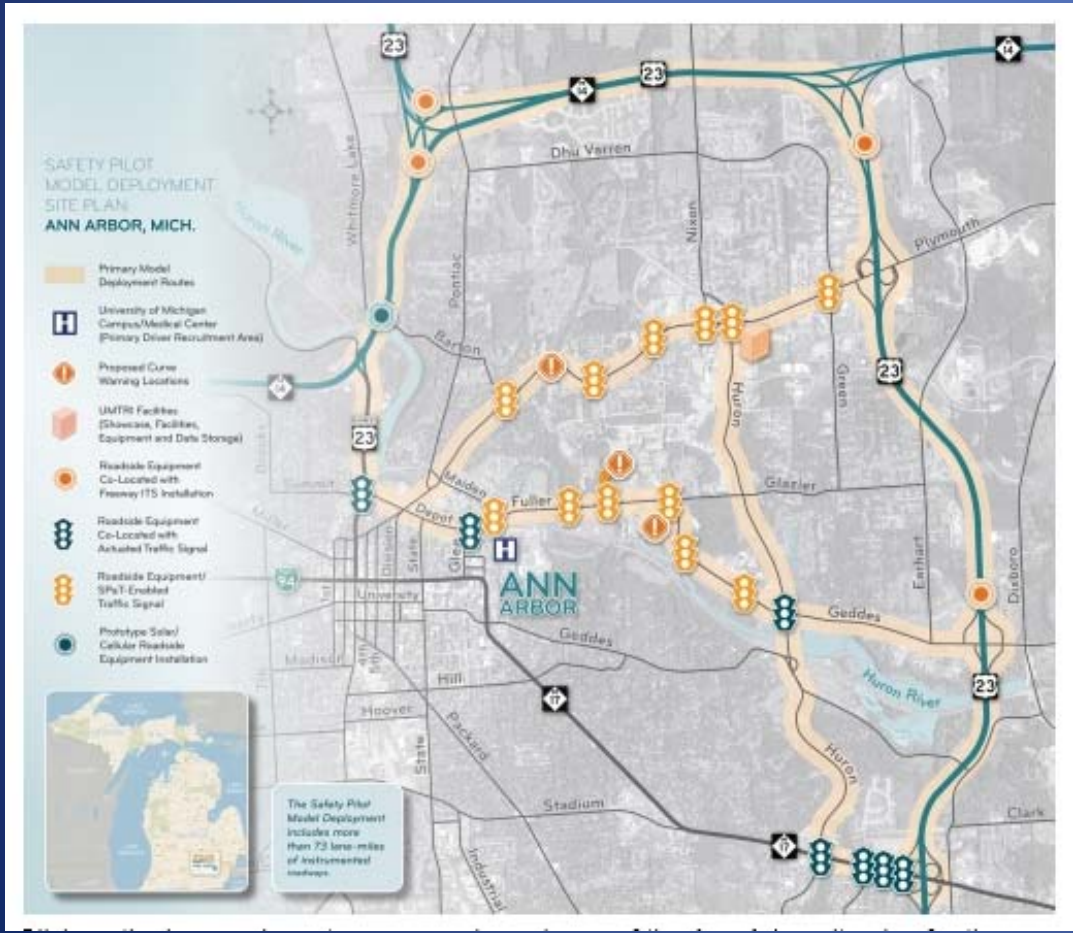
TRANSPORTATION RESEARCH INSTITUTE



Safety Pilot Model Deployment: Approximately 2,836 vehicles will be equipped with wireless connected vehicle devices to test safety applications using DSRC between vehicles, while operating on public streets in an area highly concentrated with equipped vehicles.

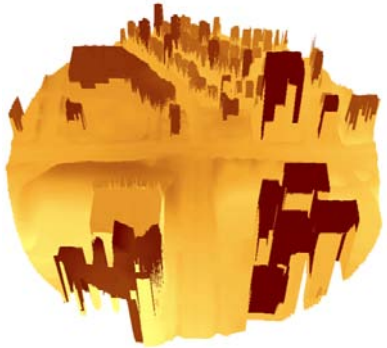
UMTRI envisions the Model Deployment project and its spatial data as a critical step to improving transportation safety.

Model Deployment Potential
Spatial Data Analysis

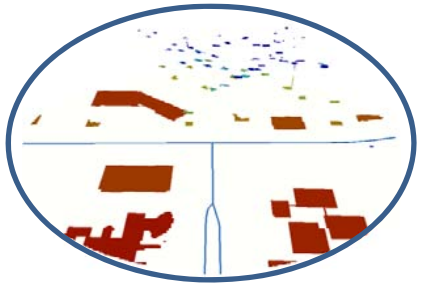
Aerial Photo draped and road draped over DEM

Ortho-Corrected Aerial Photo Clip

Digital Elevation Model (DEM) derived from LIDAR* data with extruded building footprints



Building Footprints



Omni-Directional Antenna Signal
Plymouth Rd @ Huron Parkway

The pink areas shown in the illustration above represent the extent of the omnidirectional antenna signal ** placed within the intersection. The surface of the earth and building footprints were used to model those features which may block or degrade the antenna signal.

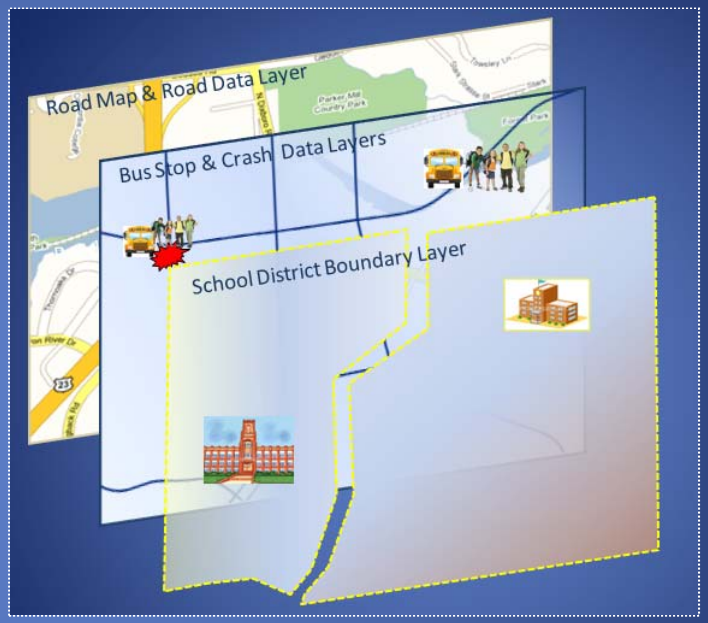
**Antenna
High Frequency Range (2.4 – 2.5 ghz)
Azimuth 3dB omnidirectional
Elevation Plan 50 degrees
Range modeled 300 meters

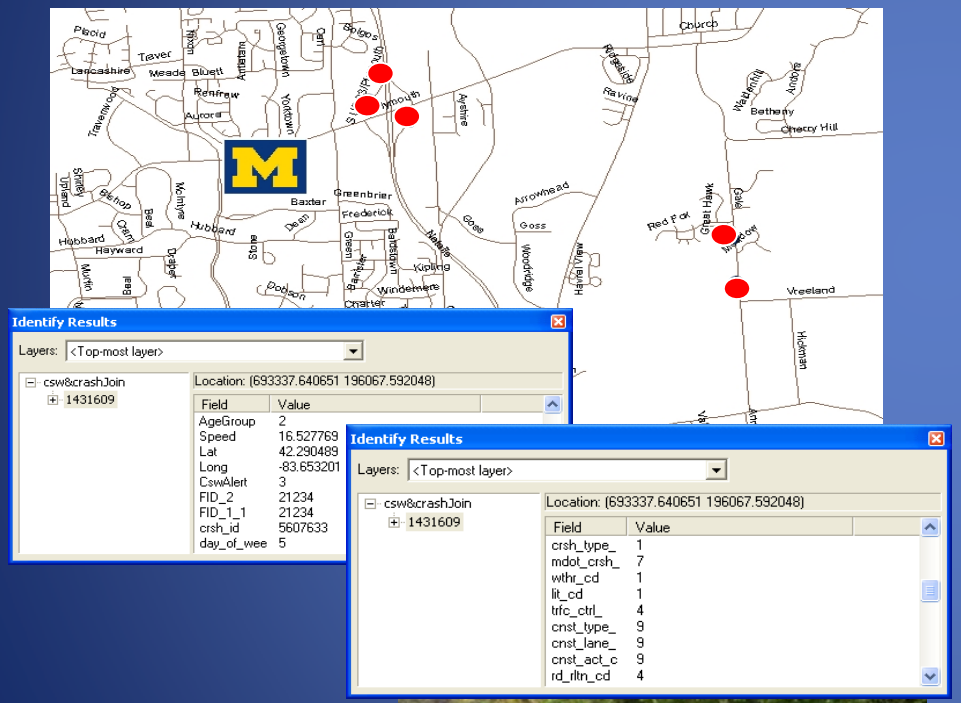
*LIDAR resolution – elevation 18 cm

Look Ahead Driver Feedback & Powertrain Management Systems

- Use of IVBSS naturalistic driving data
- Isolate scenarios of interest
- Eco-Driving Technology, automatic technology to reduce fuel use
- Driver Feedback/Behavior
- Fuel performance analysis by driver, trip, speed and mass. Fleet manager gets reports per driver
- Integrate roadway characteristics with driving data
- Explored grade/terrain impacts fuel usage

Transportation Data Center and Biosciences
STAR Database Proposal, Mapping of school bus crashes, bus stops, and districts.





Vehicle Safety Analysis
Plotting and Analysis of Large Truck and Car Crashes
Geo-Location of Large Truck Crashes: Sandia Nat'l Lab

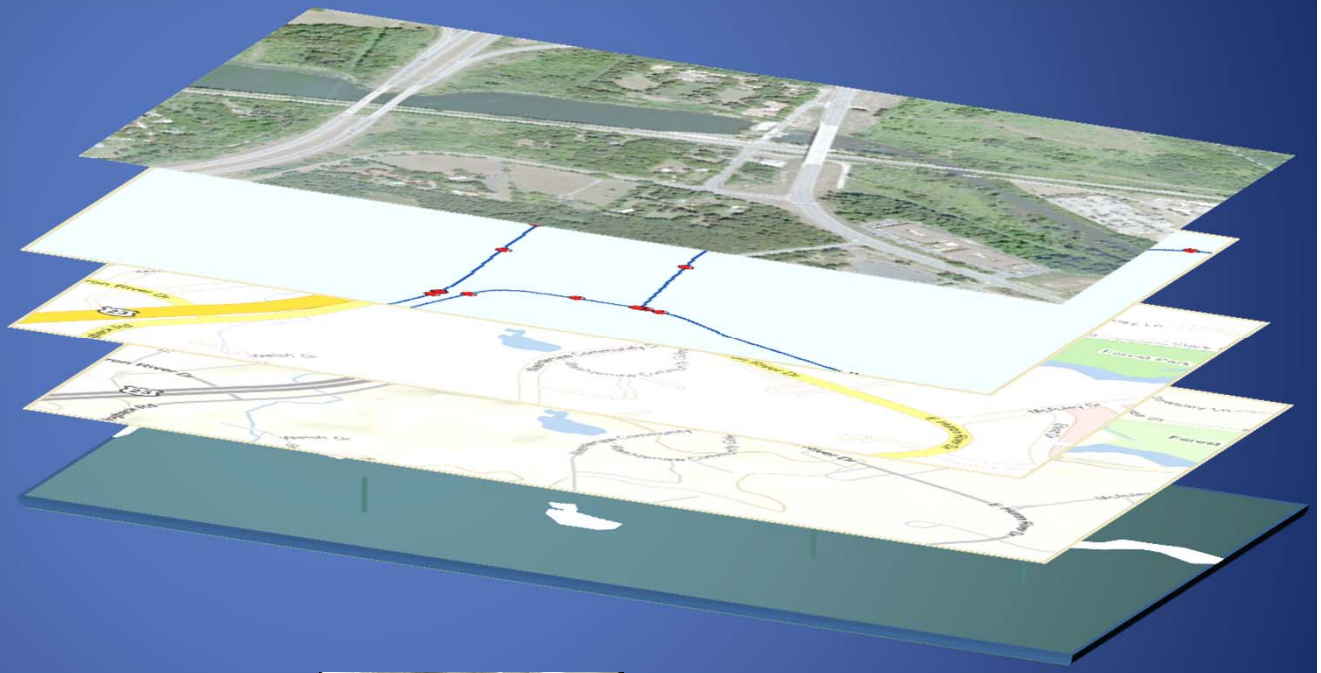
Road Departure Crash Warning (RCDW) Field Operational Test
UMTRI Vehicle Systems and Control
UMTRI Human Factors

Two areas were addressed: Safety-related changes in driver performance and driver acceptance of the RDCW system.

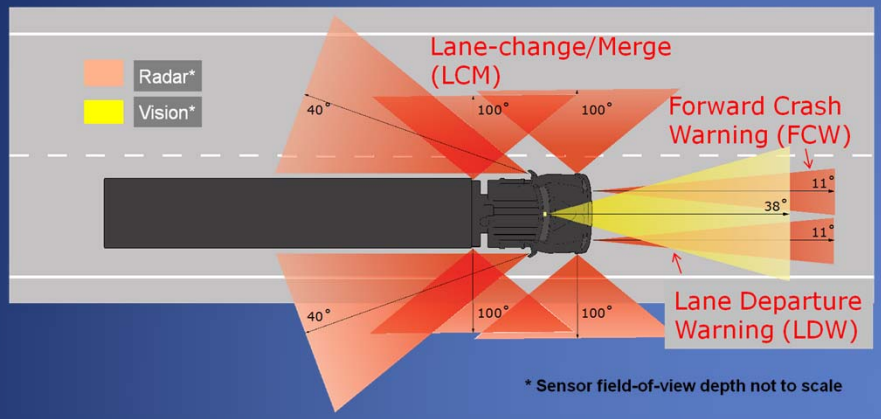
11 passenger sedans were equipped with RDCW and a data acquisition system that compiled numerical, video, and audio data.

78 unsupervised drivers used the vehicle for 4 weeks.

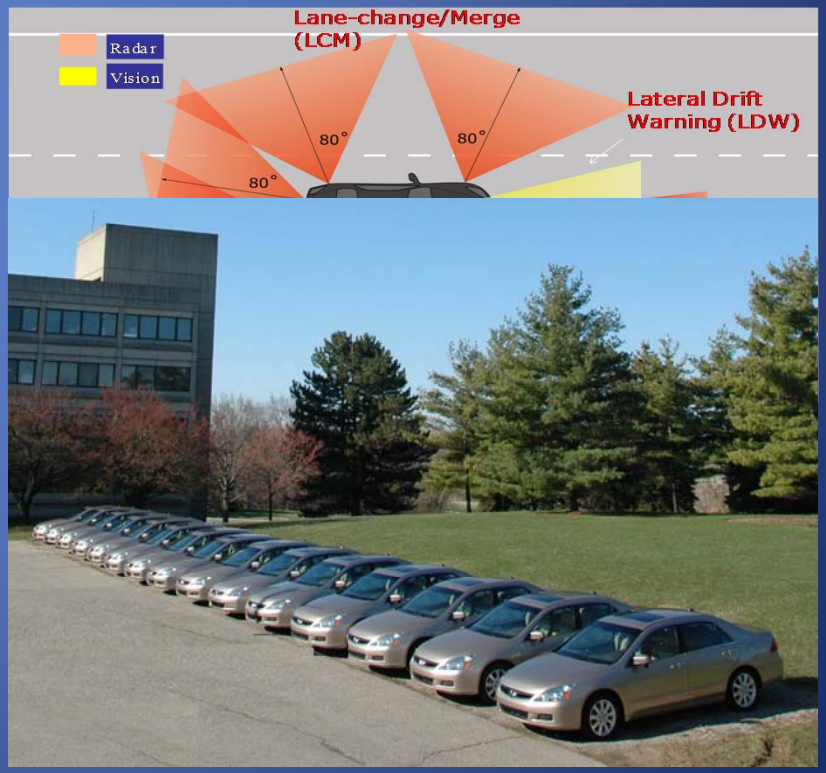
83,000 miles of driving were captured and 400+ signals captured at 10 Hz or faster.



Integrated Vehicle Based Safety System (IVBSS) FOT



Commercial Fleet Con-way Freight
10 International tractors equipped
3 Warning Systems:
- Forward Crash
-Lane Drift
-Lane Change
1 year – 20 drivers – 600,000 miles
5 video, GPS, 500+ data signals @10-50Hz capture



Passenger Fleet, 16 vehicles
4 Warning Systems:
-Lateral Drift
-Forward Crash Warning
-Curve Speed Warning
-Lane Change Merge
108 drivers - 6 weeks -200,000 miles
7 radars, 5 video steams, GPS,
500+ data signals, @ 10-50Hz capture.

Practical experience, comments, suggestions in using GIS to support transportation safety research

Understand the differences between UMTRI generated spatial data and provided sources.

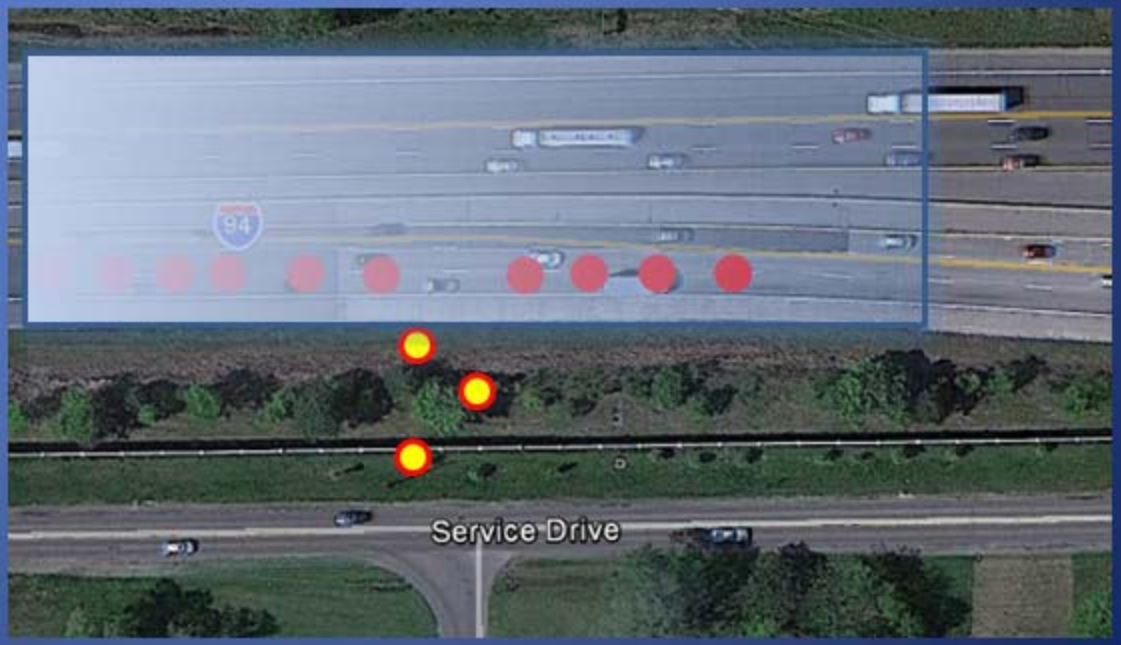
High density GPS trace data for a set of vehicles and experimental systems vs. multi-jurisdiction roadway asset data for maintenance and condition monitoring.

Understand the variance in resolution of data before integration and application to research.

Field Test GPS data 3 – 10m vs. High Resolution Lidar - sub meter

Validation of map matching for driver trips with a variety of spatial data sets. Integrating millions of points does not allow eye balling validation point by point.

Model the centerline data (polylines) as a polygon using the number of lanes and lane width.



UMTRI is highly regarded for field based geospatial data collection , analysis and integration of spatial data sources. UMTRI projects have involved a variety of platforms such as:

Commercial Truck Fleets,
Transit Bus and
Passenger Car Fleets.

GIS plays a key role to improving the safety of the nation's transportation system through the collection, mining and analysis of spatial data emerging from the Model Deployment project among others.

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Advancing Safe and Sustainable Transportation

Thank you for your interest in GIS to support UMTRI based transportation research

- www.umtri.umich.edu
- mbarnes@umich.edu
- www.CMISST.org

cmisst
Center for the Management of Information for Safe and Sustainable Transportation
Safe Sustainable Transportation

References

Safety Pilot Model Deployment, US Department of Transportation

Understanding Driving Behavior and the Built Environment by Integrating GIS and GPS datasets, Special Issue Spatial Intelligence for Urban and Regional Analysis, International Journal of Applied Geospatial Research

A Comprehensive Speed Control Model for Human Drivers with Application to Intersection Left Turns, American Control Conference 2011.

Analysis of Crash Rates and Surrogate Events: Unified Approach, Transportation Research Board, Journal of the Transportation Research Board, forthcoming 2011.

Ticketing Aggressive Cars and Trucks (TACT) project to support the Michigan Office of Highway Safety Planning proposal to the USDOT Federal Motor Carrier Safety Administration

Teen Driving Events, The University of Michigan Injury Prevention Center Project, National Center for Injury Prevention and Control

Development of a Comprehensive Approach for Serious Traffic Crash Injury Measurement and Reporting Systems (FHWA)

Road Departure Crash Warning (RDCW) Field Operational Test

Integrated Vehicle Based Safety Systems (IVBSS) Field Operational Test

SO1 Development of Analysis Methods Using Recent Data: A Multivariate Analysis of Crash and Naturalistic Event Data in Relation to Highway Factors Using the GIS Framework (TRB)

SO9 Site-Based Video System Design and Development -Transportation Research Board (TRB)

INTERNATIONAL CIVIL AVIATION ORGANIZATION
A United Nations Specialized Agency

AVIATION SAFETY ANALYSIS AND GIS

Marco Merens

Technical Officer, Air Navigation Bureau, ICAO

Safety Intelligence Objectives

- Create **actionable information** for use by decision makers in defining **aviation safety strategies**
- Identify targeted **areas of current and emerging risk** and develop specific alternatives to be considered for effective mitigation

Safety Intelligence Frameworks

http://www.icao.int/safety

http://gis.icao.int

- Accident, traffic, fleet and USOAP Audit Data
- Integrated safety analysis results

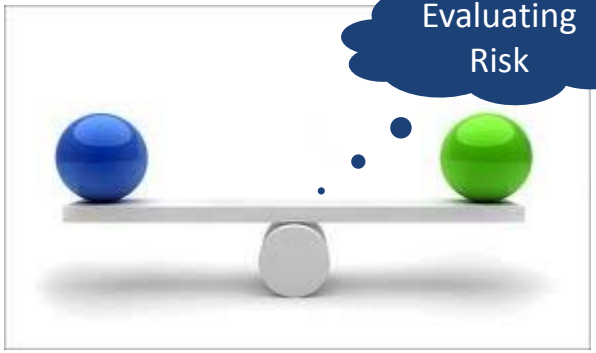
- Georeferenced Data visualization maps
- Routes, traffic and airspace maps

Accident Risk Model

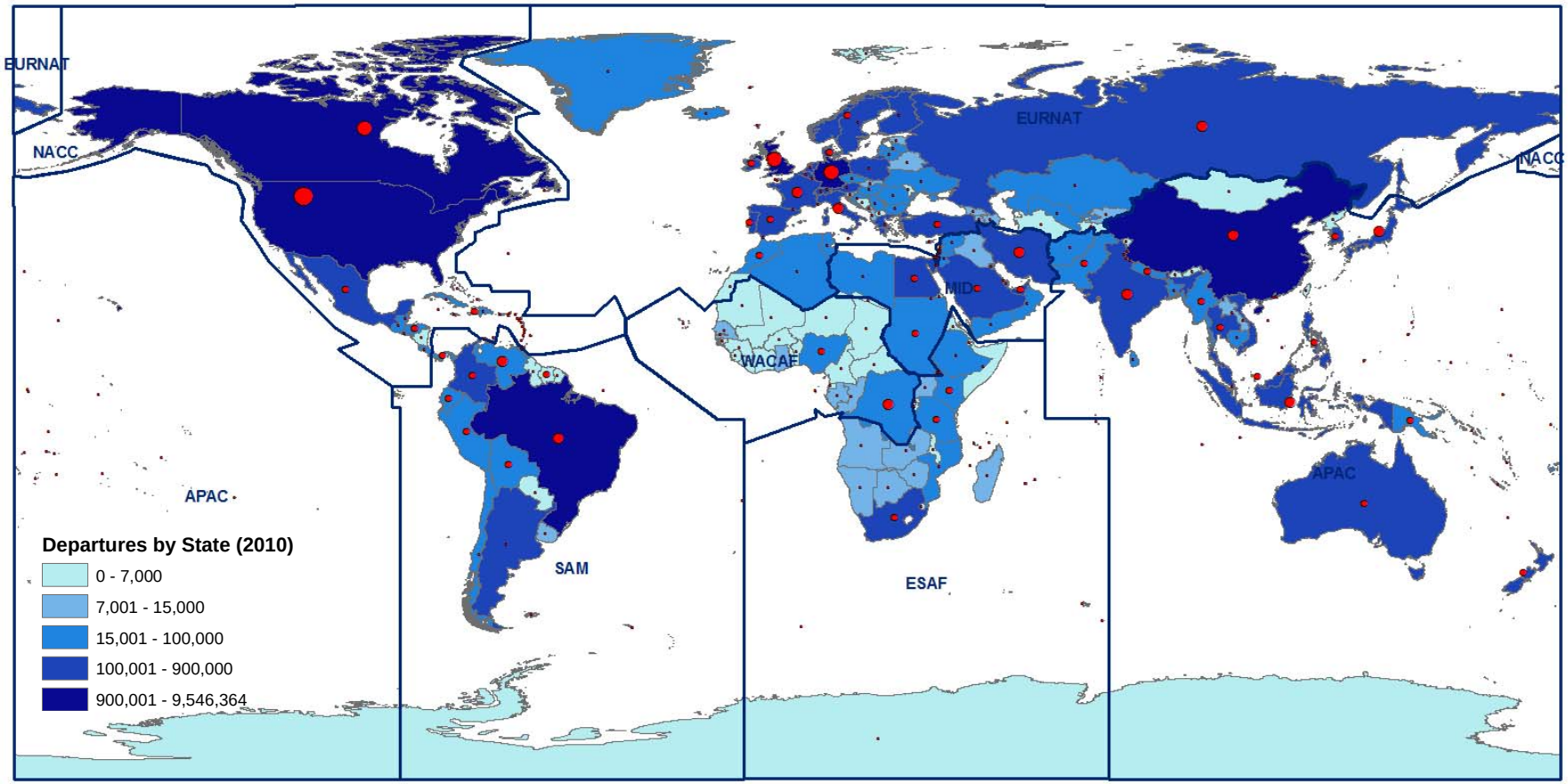
Modifiable Areal Unit Problem (MAUP)

( )

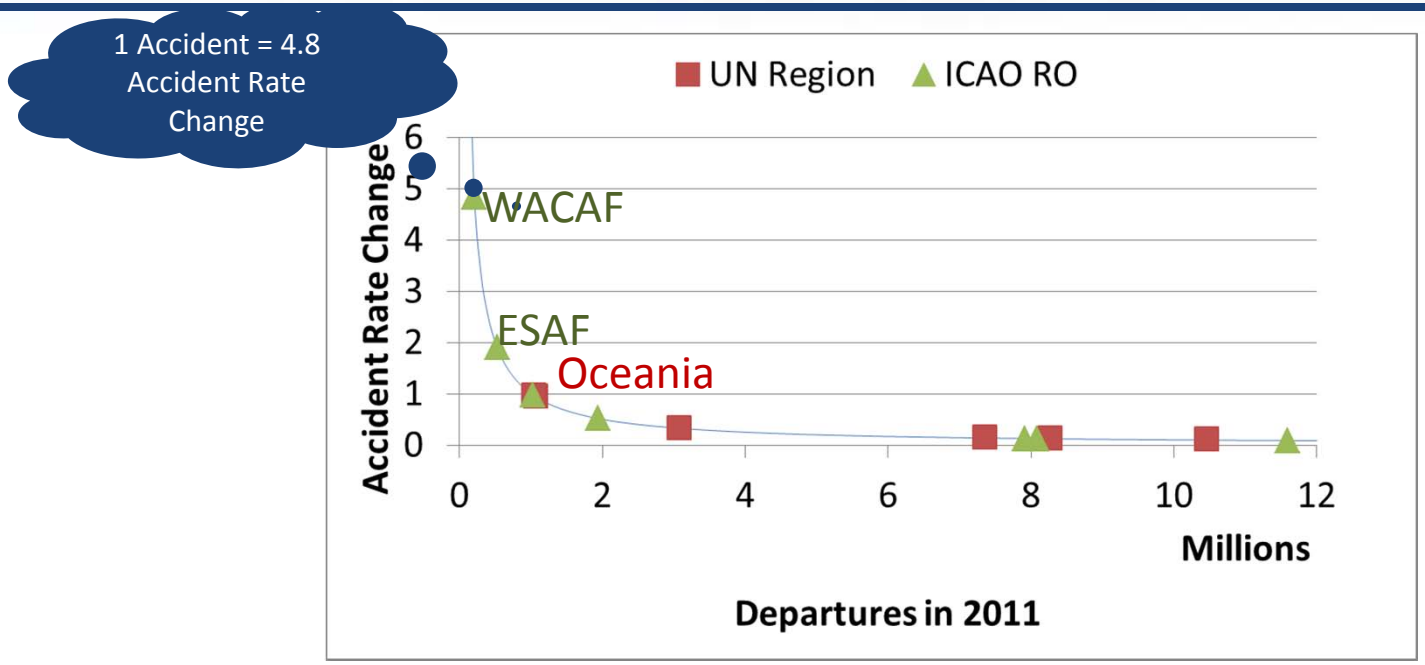
( ) ( ) ( )



Accidents and Departures



Modifiable Areal Unit Problem



Standard Deviation of Unitary Change in Accident rate can used to measure MAUP for a given grouping

Evaluating Risk

1. Visualize the hazard (volume) by areal unit

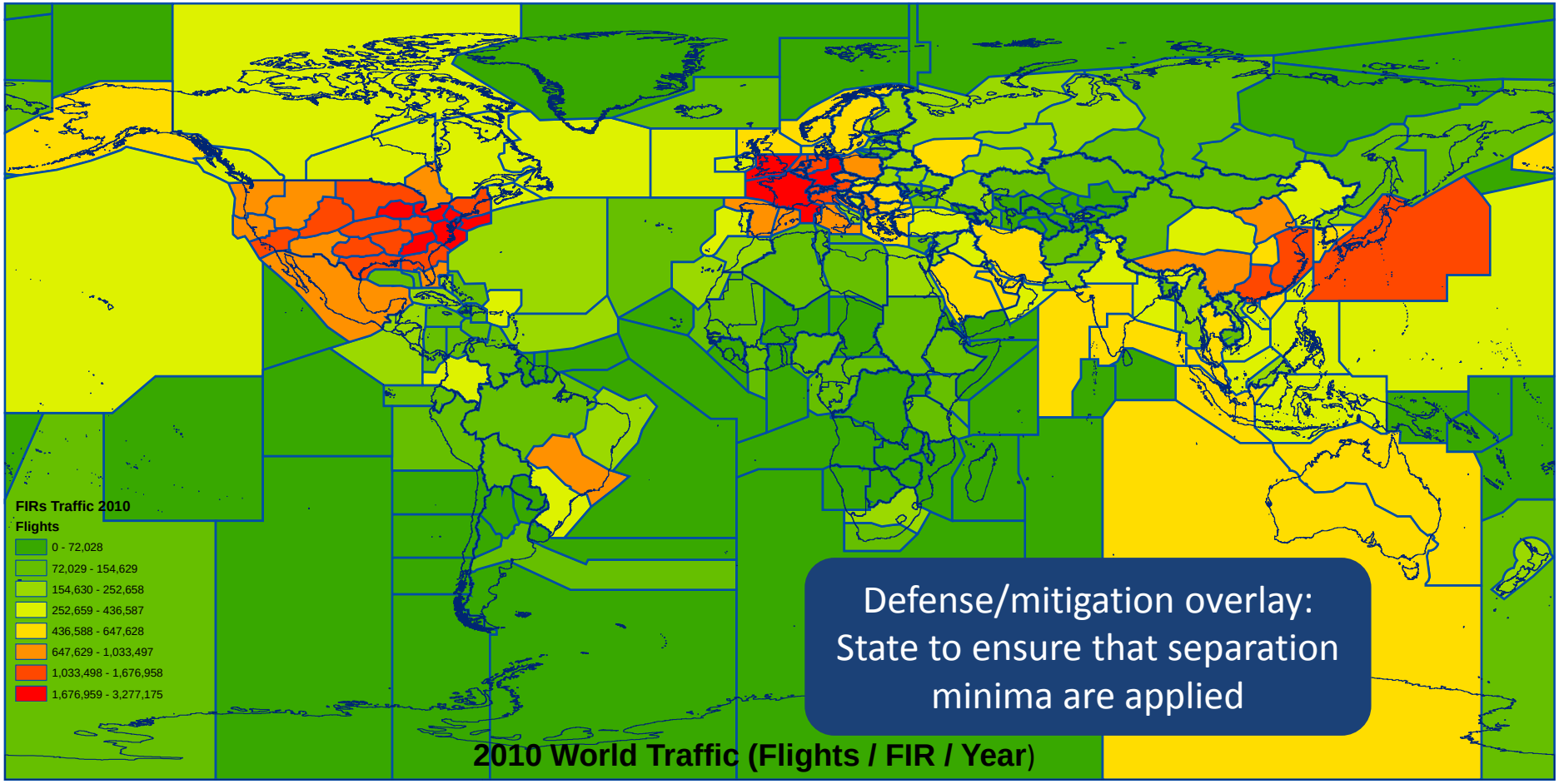
2. Overlay the corresponding defense/mitigation (level of implementation of ICAO standard, USOAP)

3. Identify areas of strong hazards with week defenses

Evaluating Risk

Loss of separation

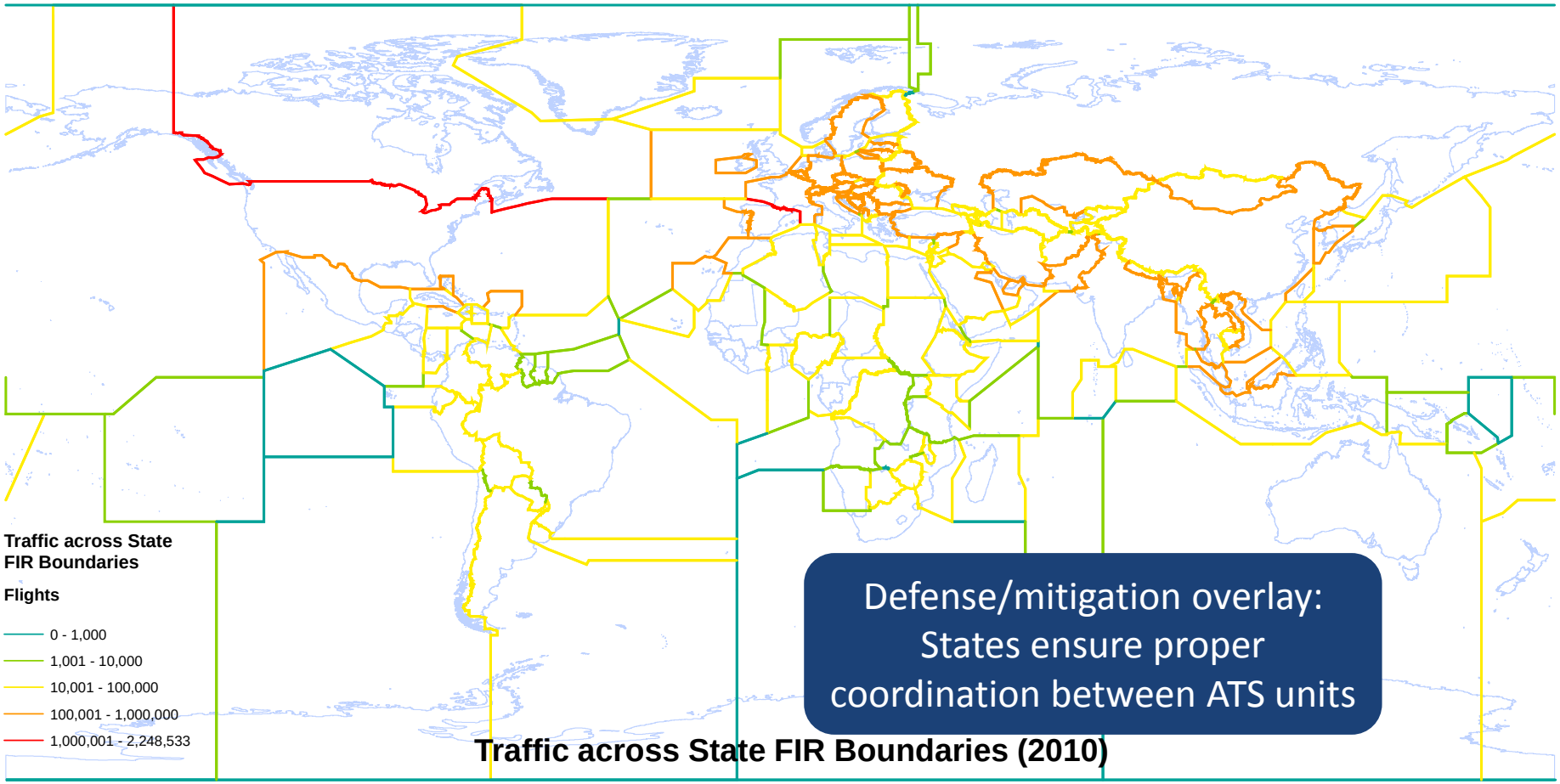
Hazard=Flights Areal Unit = Flight Information Region (FIR)



Evaluating Risk

Handover and coordination between States

Hazard=Flights Areal Unit =State Airspace Boundaries



Defense/mitigation overlay: States ensure proper coordination between ATS units

Traffic across State FIR Boundaries (2010)

What next

- Expand iSTARS to include spatial analysis tools
- Integrate analytical terrain and weather related hazard data
- Simulate terrain

ICAO

Uniting Aviation on

Safety | Security | Environment

NENA
THE
9·1·1
ASSOCIATION

GIS in Public Safety
NENA & USDOT

Marc Berryman, ENP

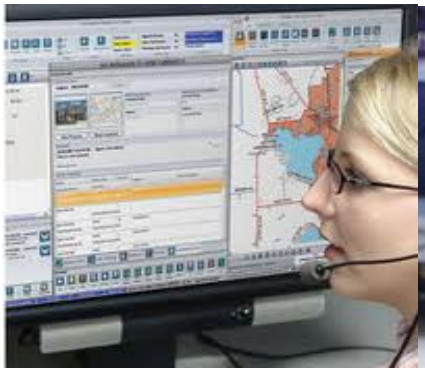
What is NENA?

- NENA is a membership-based, volunteer-driven professional organization focused on:
  - 9-1-1 and emergency communications issues
  - 9-1-1 policy, technology, operations, and education
- 7,000+ Members
  - 48 chapters across the US and around the globe

NENA THE 9·1·1 ASSOCIATION

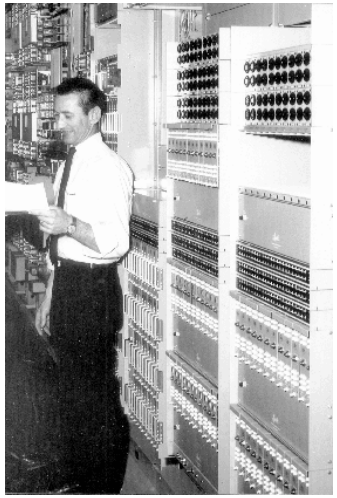
NENA's Goals

- Leadership and guidance on 9-1-1 and related issues
- Facilitate the creation of an IP-based Next Generation 9-1-1 system
- Establish technical & operations Standards
- Promotes 9-1-1 implementation and awareness



Evolution of 9-1-1

At 2 p.m. on Friday, Feb. 16, 1968 the first 911 call was placed from the mayor's office in Haleyville (Ala.)



January, 1980, Work began on two fully “Enhanced” 911 systems in **Orange County** (Fla.), and another in **St. Louis** (Mo.).

These systems had features we now know as E9-1-1 ("Enhanced" 911)

Approximately 6000 Primary PSAP's in the U.S.

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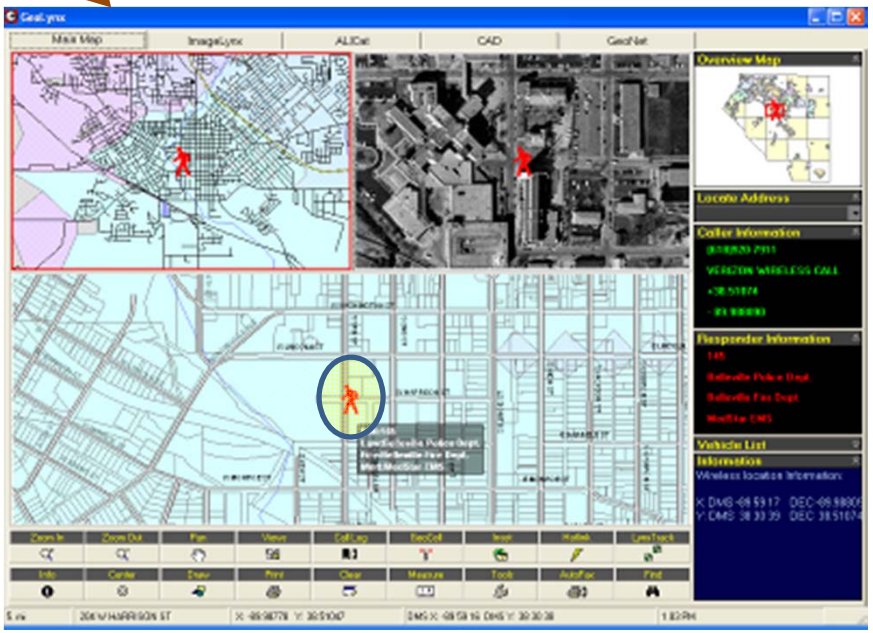
GIS in 9-1-1

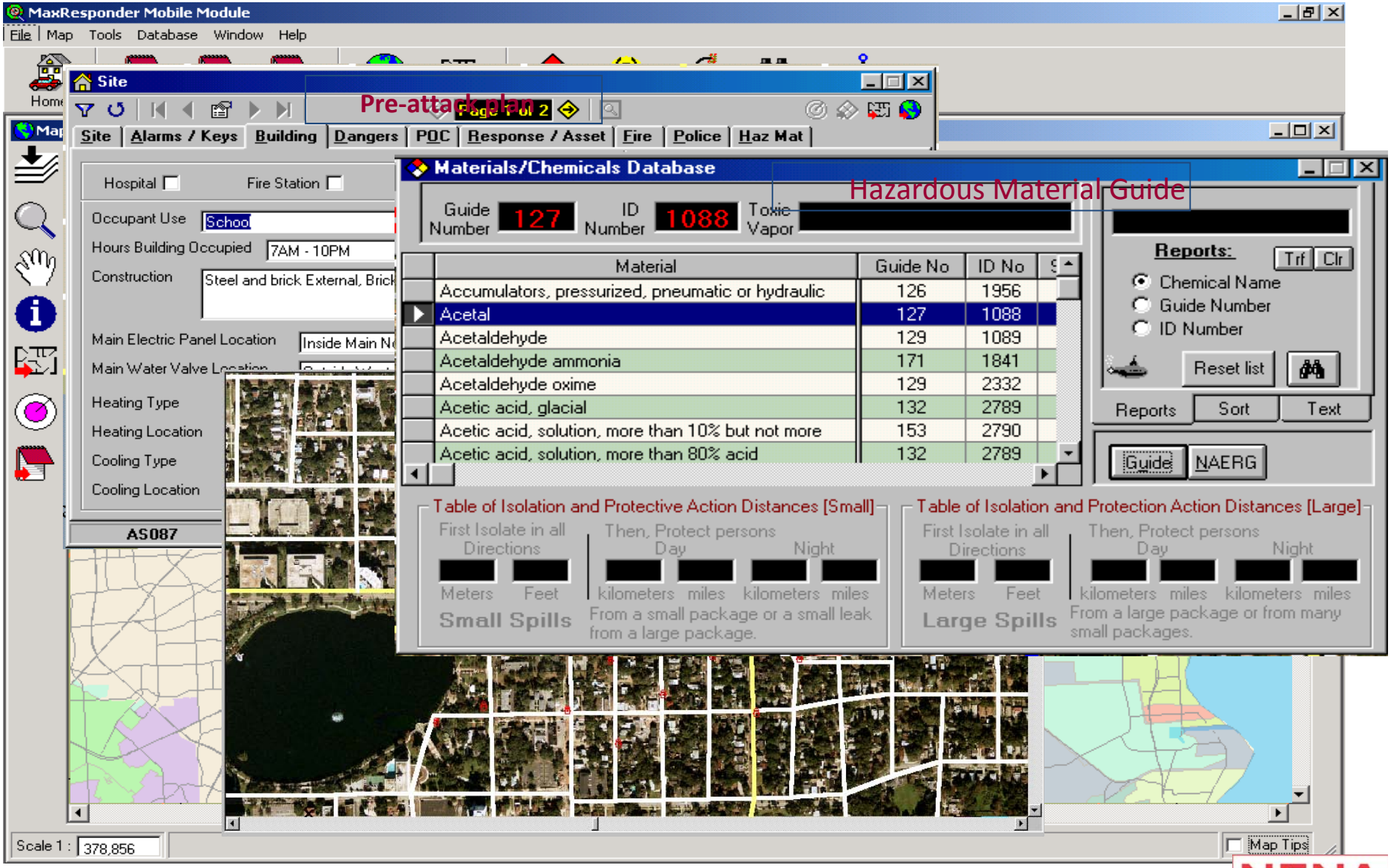
Being able to plot the location of a wireless caller



With 80% of 9-1-1 calls being wireless, you need a GIS technology to help locate the caller

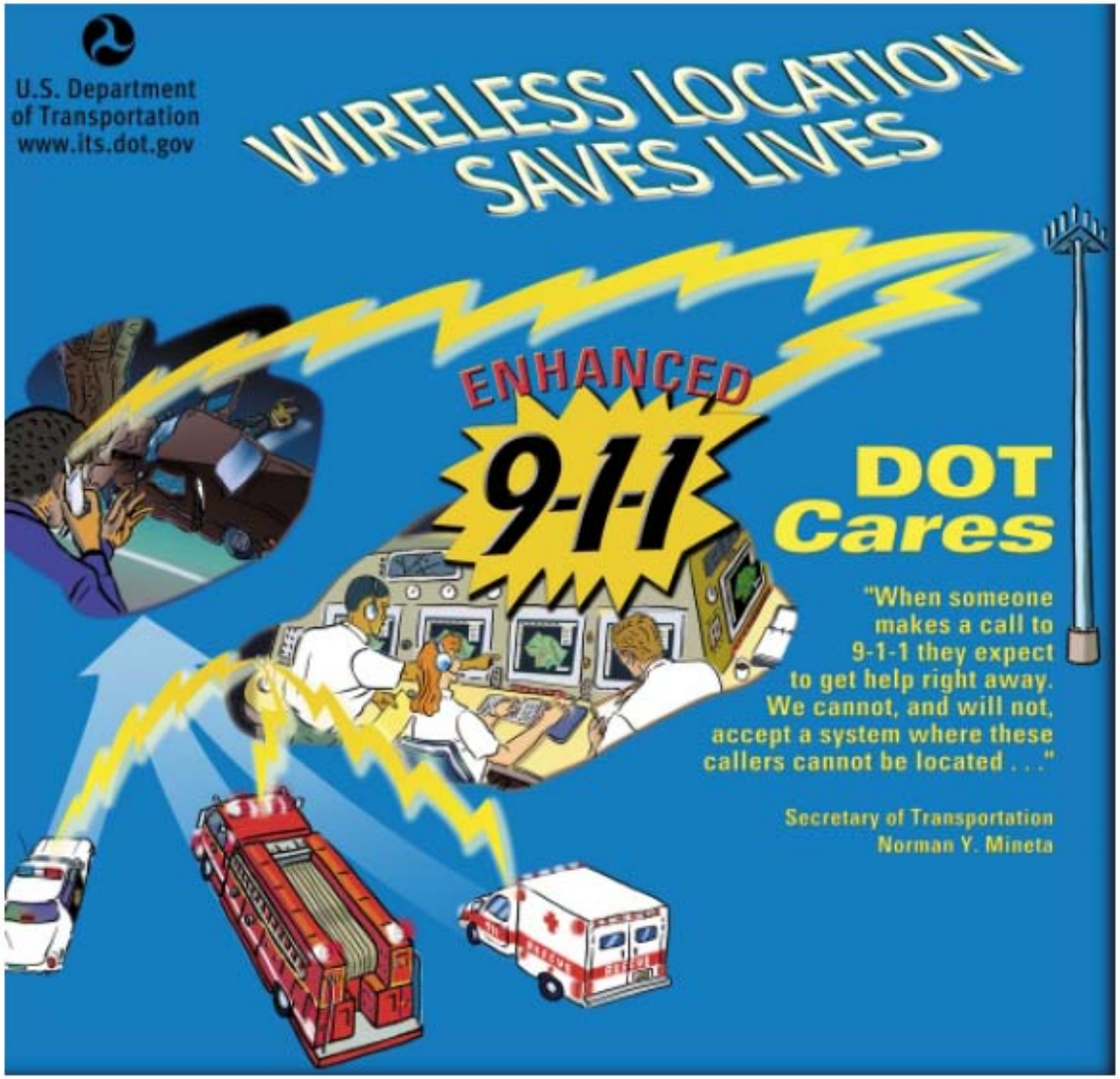
NENA THE 9·1·1 ASSOCIATION

GIS in 9-1-1



NENA THE 9·1·1 ASSOCIATION

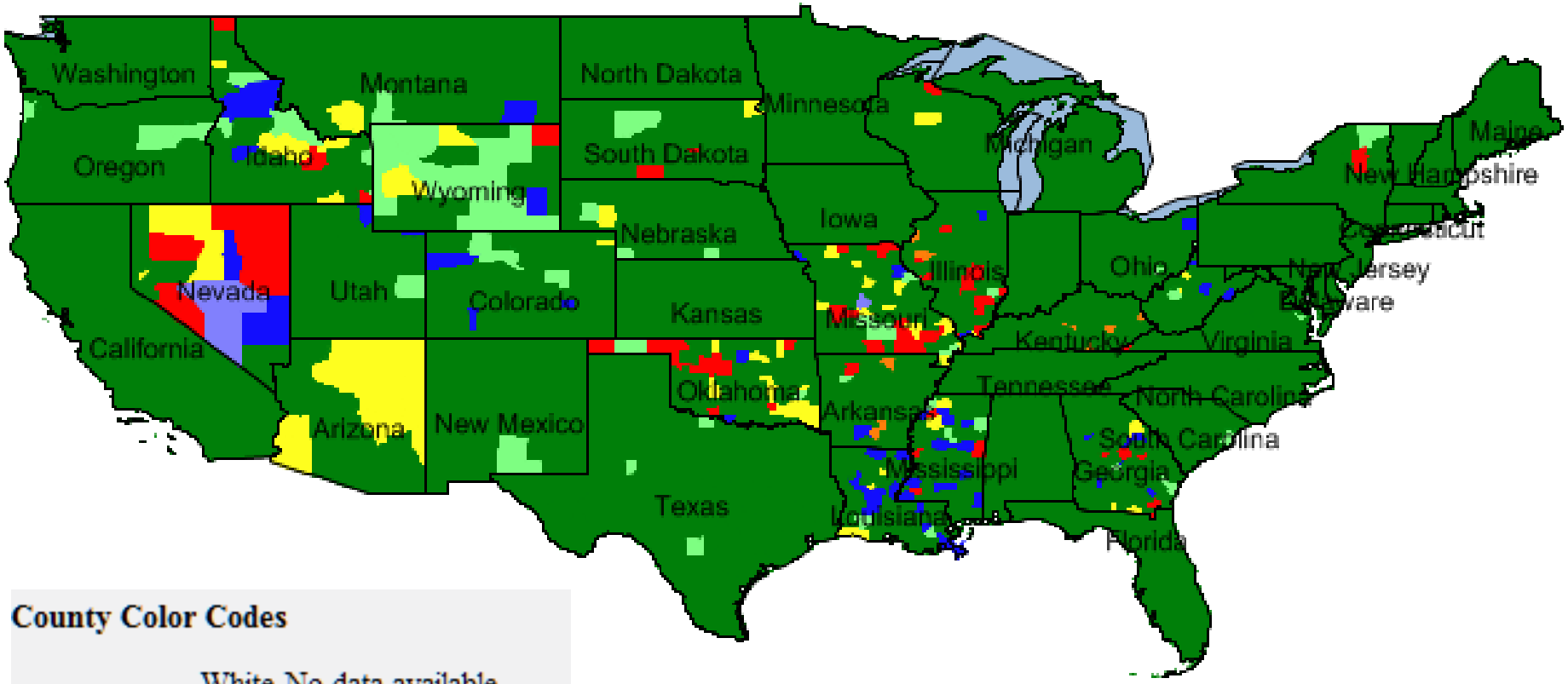
"When someone calls 9-1-1 they expect to get help right away. We cannot, and will not, accept a system where these callers cannot be located as quickly as possible. We have the technology to solve this problem. All we need is the resolve and the commitment to make it happen."



The Honorable Norman Y. Mineta

Secretary of Transportation at the Wireless E9-1-1 Summit Meeting Washington, DC April 8, 2002

Wireless Phase I and II implementation 3Q, 2012



County Color Codes

White	No data available
Red	No 9-1-1/Basic
Yellow	Enhanced 9-1-1
Light Blue	Started Phase I
Dark Blue	Completed Phase I
Light Green	Started Phase II
Dark Green	Completed Phase II

NENA THE 9·1·1 ASSOCIATION

NENA Milepost Operational Information Document (OID)

NENA Milepost Operational Information Document
Document 56-502
December 16, 2004

Recommendation for developing a national database to include milepost information and other data for highways and railways within the United States

NENA Standard
For
NORAD/FAA Notification:
Airborne Events

NENA Standard for NORAD/FAA Notification: Airborne Events
Document 56-002 Version 2, May 6, 2008

Standard for Public Safety answering Points (PSAPs) to notify North American Aerospace Defense Command (NORAD) of air events that may require a national response

NENA Railroad & PSAP Interaction Operations Information Document (OID)

NENA Railroad & PSAP Interaction Operations Information Document
NENA 56 – 507
April 28, 2009, Version 1

Recommendation for PSAPs to development and implementation emergency communications protocols for railroad emergencies

NENA
Pipeline Emergency Operations Standard/Model Recommendation

NENA Pipeline Emergency Operations Standard/Model Recommendation

Document 56-007, November 11, 2010

Standards Advisory Committee Approval date, October 25, 2010

NENA Executive Board approval date, November 11, 2010

Standard for PSAPs to development and implementation emergency communications protocols for pipeline emergencies

Moving to NG9-1-1

"Today's 911 system is built on an infrastructure that does not support most of the features that Americans expect are part of an emergency response"

Congressional Research Service Report for Congress, Emergency Communications: The Future of 911, November 21, 2008

"In the past 15 years, advancements in modern communications technology have created the need for a more advanced system to access emergency care. While the existing 9-1-1 system has been a success story for more than 30 years, it has been stretched to its limit as technology advances."

-National Emergency Number Association (NENA)

NENA THE 9·1·1 ASSOCIATION

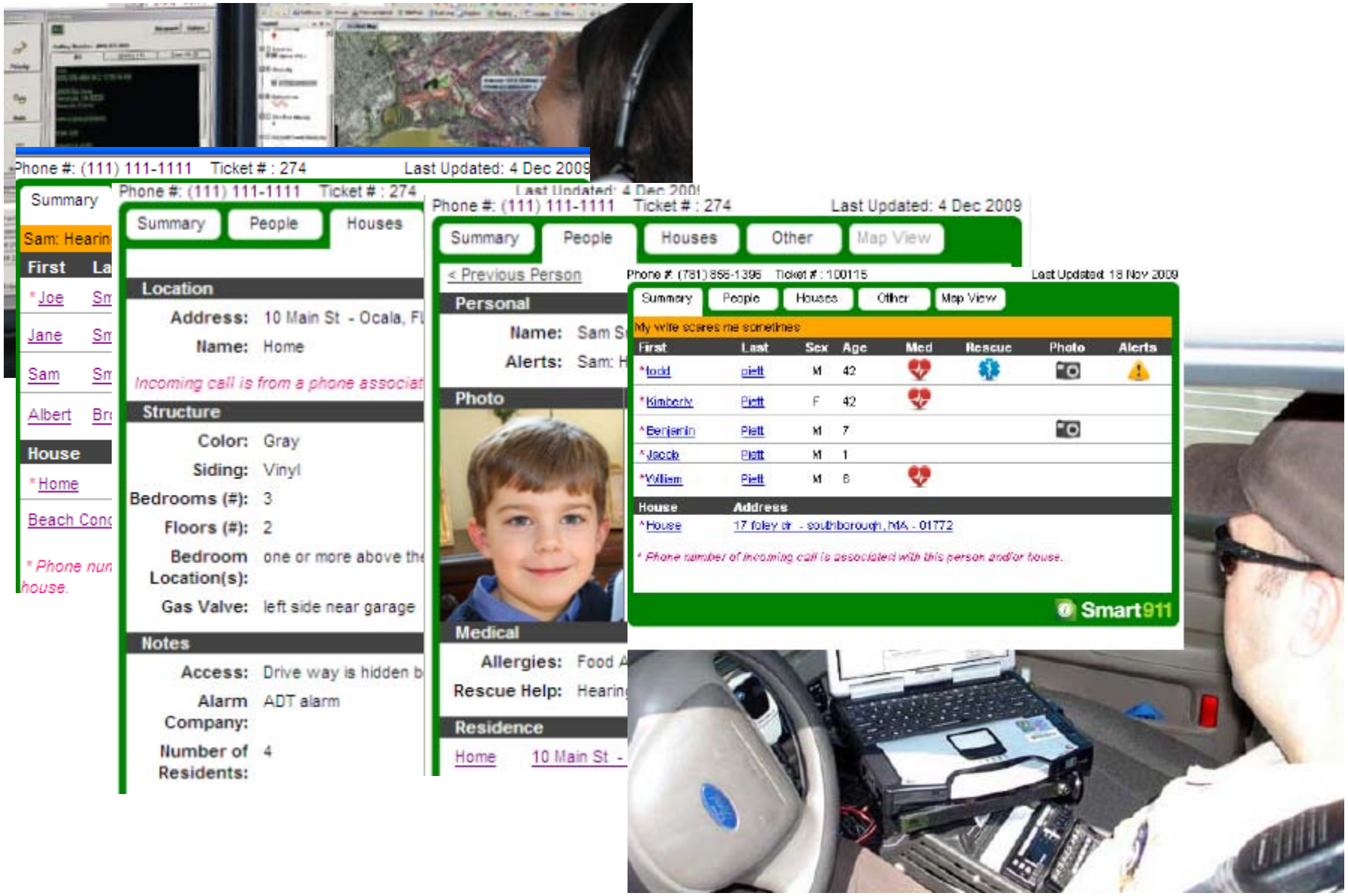
Public Expectations

- 9-1-1 knows my exact location
- Text, Multi-Media (Images, Video)
  - 95% of all mobiles phones have camera
  - Over 150 million text messages daily
- **85% of calls today are downgraded to analog voice to work with E9-1-1**

New sources of information

- Smartphones
- Vehicle Telematics
- Environmental Sensors
- Video Surveillances
- Intelligent Transportation Systems

More information to Responders



USDOT Next Generation 9-1-1 Initiative

December 2005

A DOT research and development project to define the system architecture and develop a transition plan that considers responsibilities, costs, schedule and benefits for deploying IP-based emergency services across the Nation

Major Goals and Objectives

The primary goal of the NG9-1-1 System is to save lives, health and property by improving emergency services access and response in the United States

RITA U.S. Department of Transportation
Research and Innovative Technology Administration

Intelligent Transportation Systems
U.S. Department of Transportation

NG9-1-1

Next Generation 9-1-1 (NG9-1-1) System Initiative

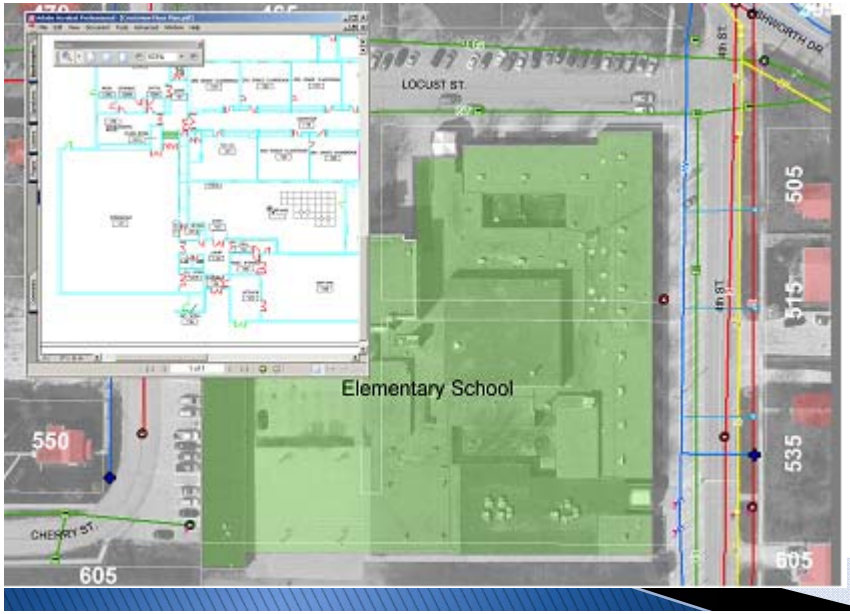
Proof of Concept Deployment Plan

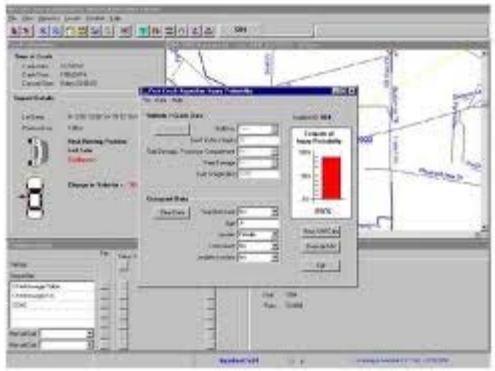
Washington, D.C.
February 2008

What is NG 9-1-1

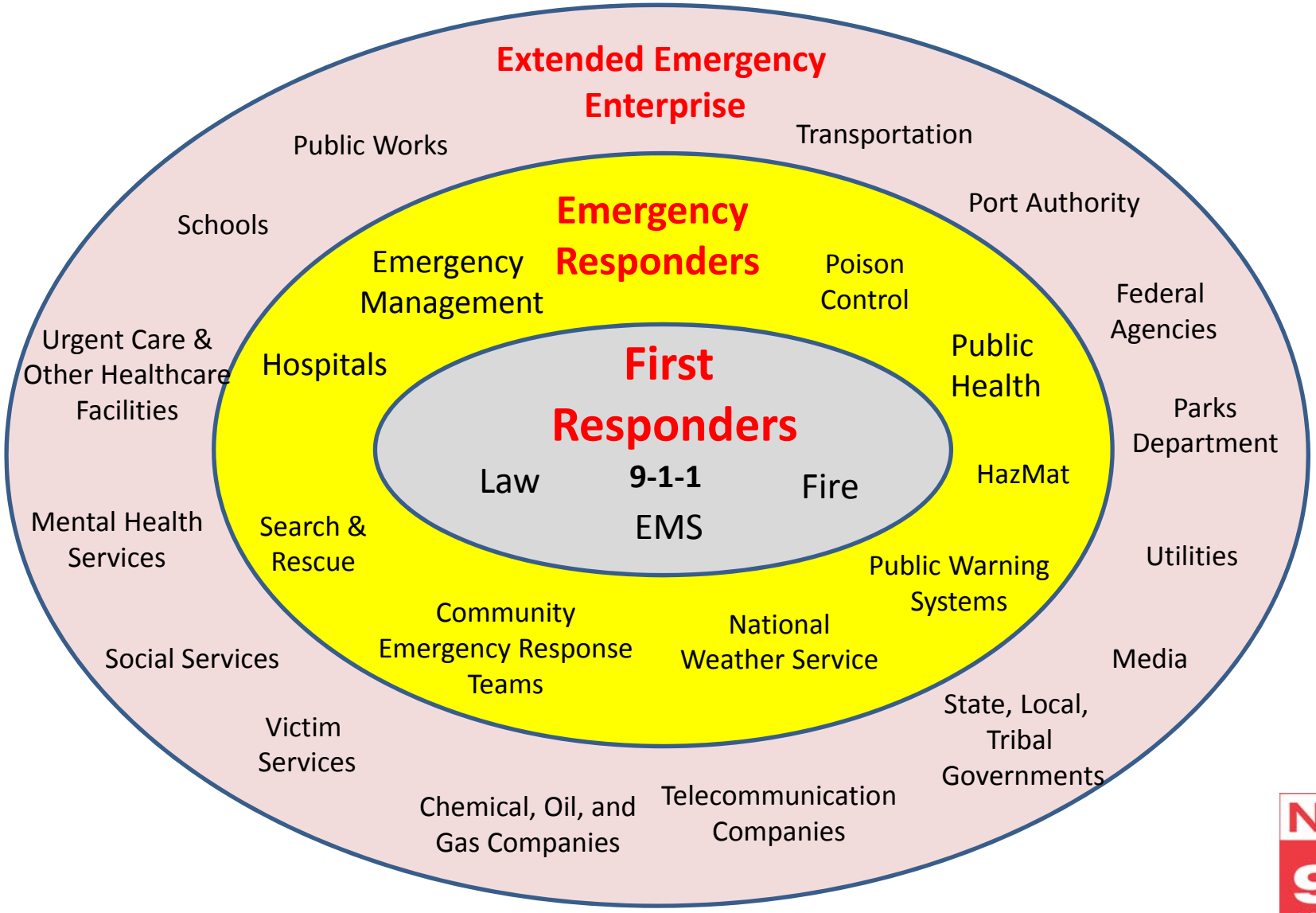
Non-proprietary system of ***Standardized*** data and formats operating on ***Open System*** specifications

Providing advanced capabilities for PSAPs and **E**mergency **S**ervice **P**roviders (ESPs*)





*Emergency Service Providers (ESP)



NENA THE 9·1·1 ASSOCIATION

What is NG 9-1-1

Collaborative data sharing creating a ***Common Operating Picture*** **(COP)** among incident commanders

A ***Common Operating Picture*** enables more accurate and timely decision making thereby improving ***Quality of Command*** **(QoC)**

Improved ***Operational Effectiveness*** and thus the safety of field personnel and the public

Bottom Line…Improved Public Safety!

NENA THE 9·1·1 ASSOCIATION

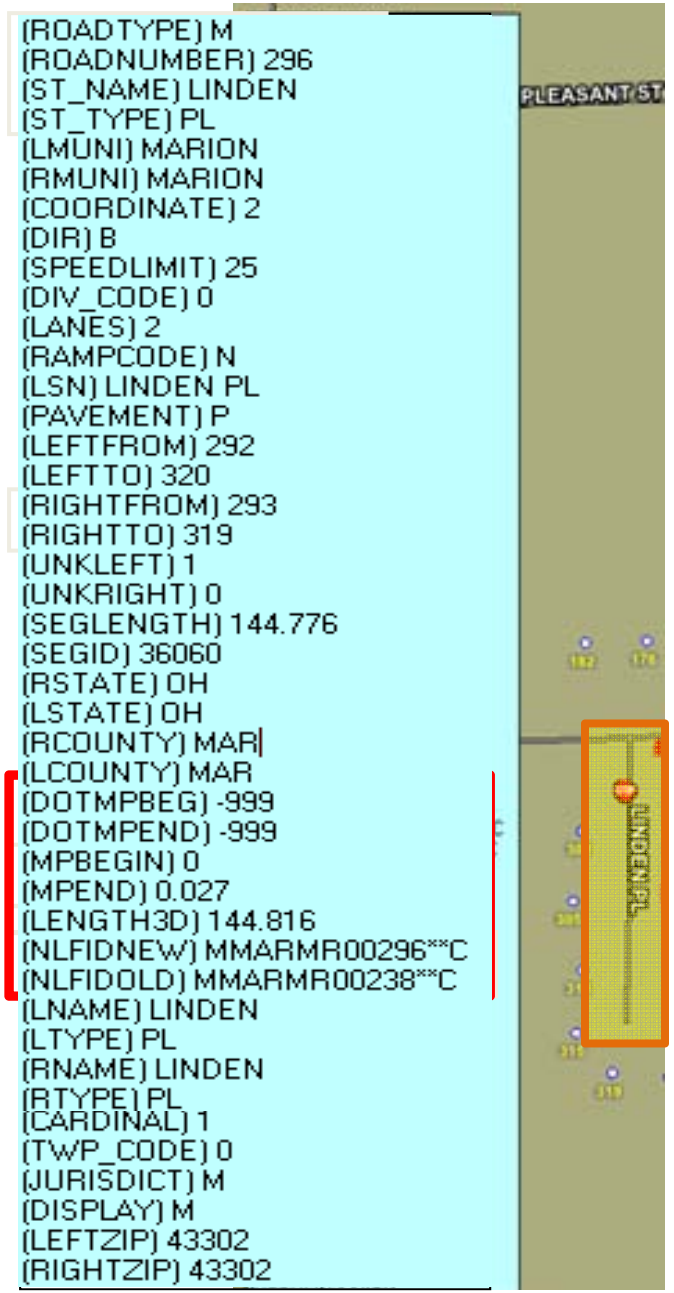
GIS in NG9-1-1

- NG9-1-1 Requires GIS data to Operate
- GIS data is used to validate all addresses
- GIS data needs to be down to a site specific point
  - Site Specific = Field Verified
- GIS will be used to route call to 9-1-1 and other entities
- **GIS Data will be Locally Maintained**

Ohio Location Based Response System (LBRS)

- Coordinated intelligent transportation and location information that meets the needs of 9-1-1, DOT, and local, state, and federal agencies

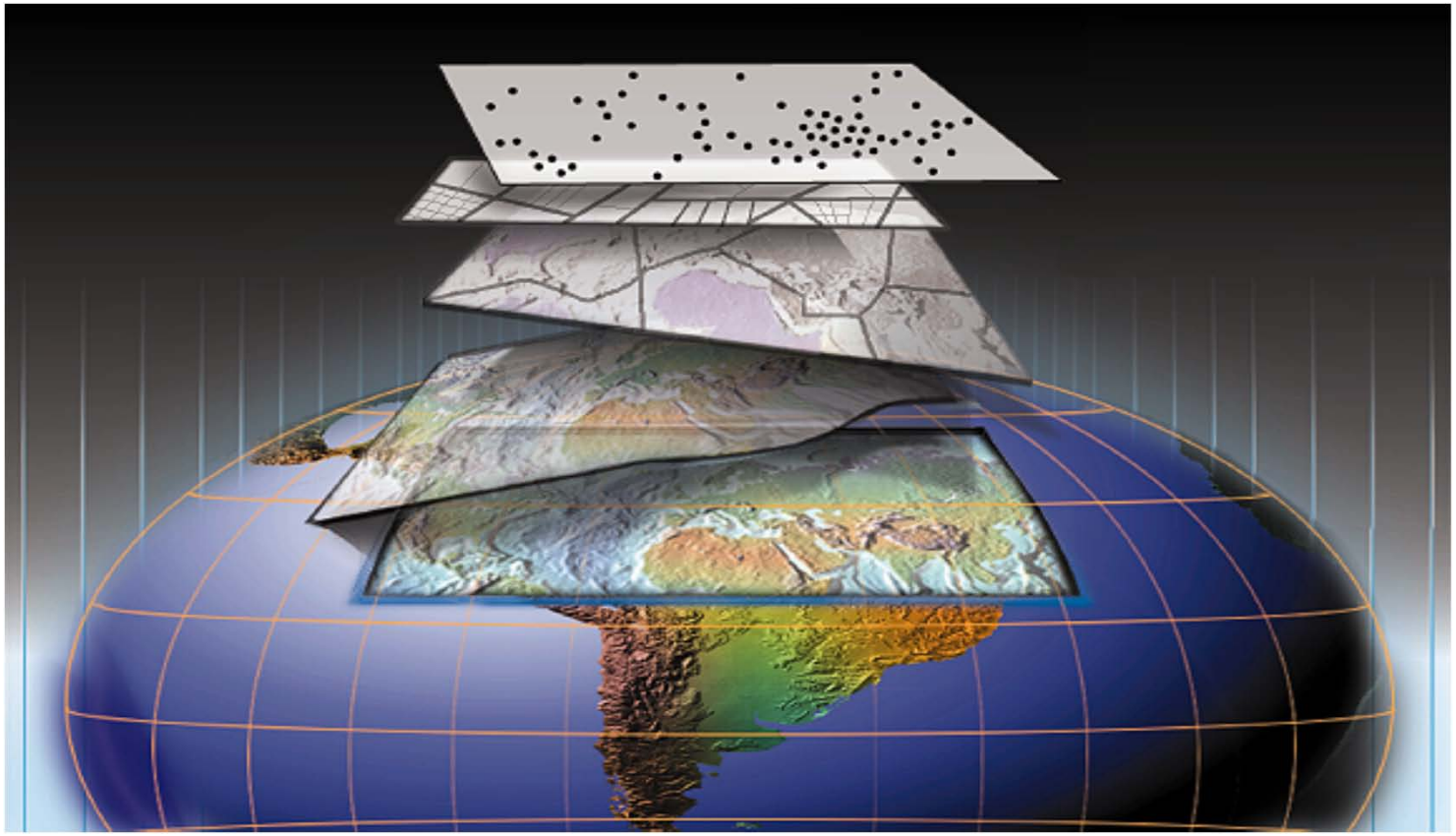
- Current, accurate, and accessible data that is collaboratively maintained by local and state resources



Thanks!!

Marc Berryman, ENP

marcberryman@GIS-NG9-1-1.net



Panel #6: Marine Safety Panel

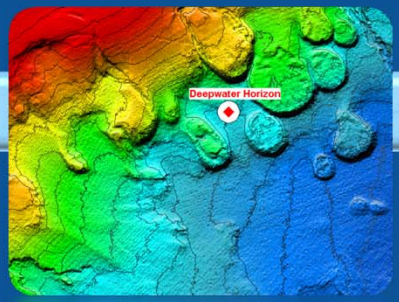
Objective: This panel will explore the status of the use of GIS technologies in marine safety from navigation, accident investigation, search and rescue, to safety analysis.

Julia Powell, National Oceanic and Atmospheric Administration
Utilizing GIS to Improve Navigation Safety

Peter Noy and Lt. Rodney Martinez, U.S. Coast Guard
Geographic Information System (GIS) Use with U.S. Coast Guard

James Dobbins, Ph.D., Vanderbilt University Center for Transportation Research
Inland Marine Transportation Casualty Data Analysis

Richard Ford, Marine Accident Investigation Branch, United Kingdom
The Use of GIS in Marine Accident Investigation



Office of Coast Survey

Utilizing GIS to improve navigation safety

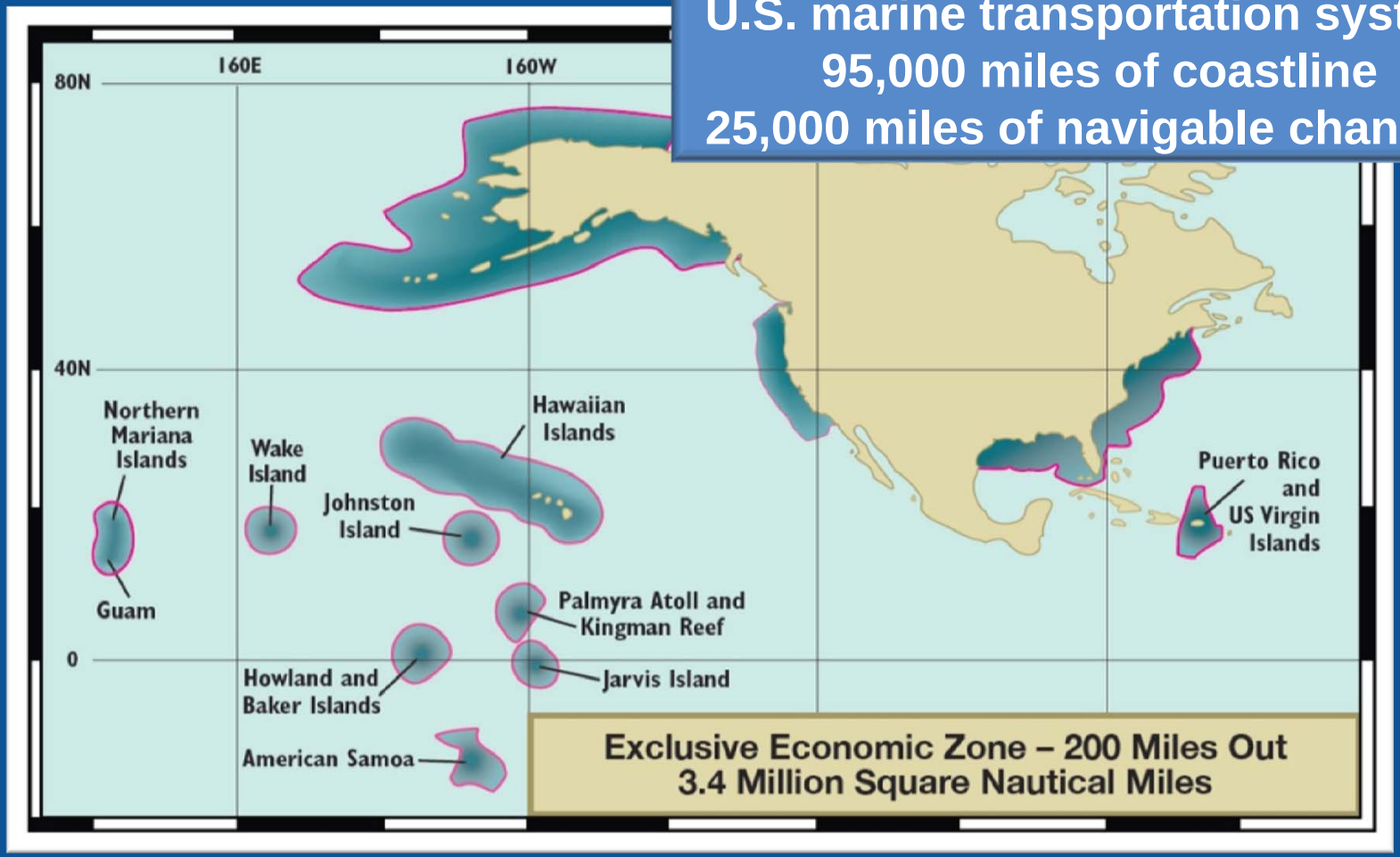
Julia Powell

Who is Coast Survey?

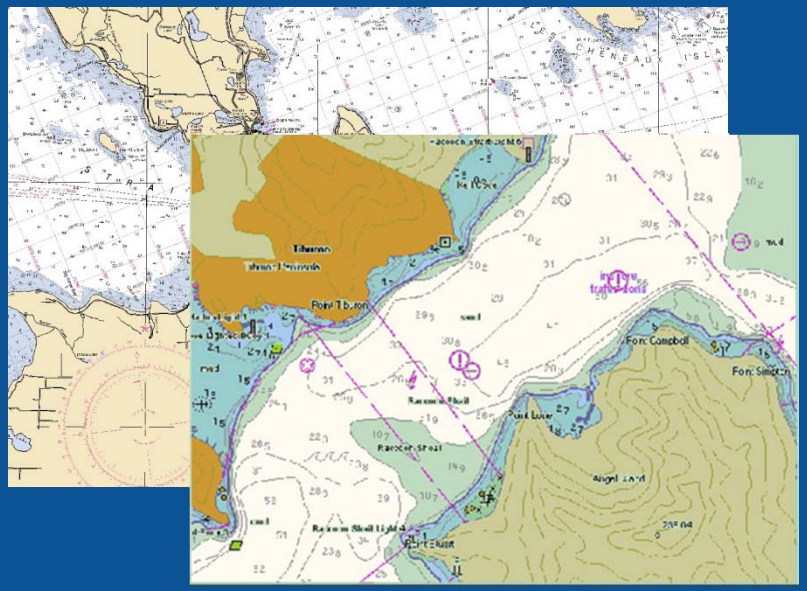
- First science agency of the U.S.
- Responsible for surveying 3.4 million square nautical miles
- Creates and Updates Nautical Products
- Speeds re-opening of ports after hurricanes and other disasters
- Develops hydrodynamic models for coastal management
- Provides global hydrographic leadership

Scope of coverage

U.S. marine transportation system:
95,000 miles of coastline
25,000 miles of navigable channels



Producing navigational information for diverse groups of users



- 1022 traditional paper charts
- 1022 raster navigational charts (NOAA RNC®)
- 958 electronic navigational charts (NOAA ENC®)
- 1007 Print-on-Demand charts, sold by OceanGrafix
- Updated on a weekly basis for critical corrections

Meeting legislative & regulatory mandates

- Coast and Geodetic Survey Act of 1947
  - Authorized Coast Survey to support maritime commerce with nautical charts & products
  - Authorizes Director of Coast Survey as the National Hydrographer
  - Represents the United States at the International Hydrographic Organization
- Title 33 of Code of Federal Regulations
  - Mandated that NOAA nautical charts, *U.S. Coast Pilot*, and tidal and current information be carried on all self-propelled vessels bigger than 1600 gross tons, including passenger vessels
- IMO Safety of Life at Sea – Chapter V
  - Nautical chart or nautical publication is a special purpose map or book, or a specially compiled database… that is issued officially or on the authority of a Government, authorized Hydrographic Office … and is designed to meet the requirements of marine navigation

IHO and IMO

- International Hydrographic Organization
  - 80 Member States
  - Support safety of navigation through standardization
    - S-57 – Electronic Navigational Chart
    - S-100 – Universal Hydrographic Model
    - S-101 – New Electronic Navigational Chart Specification
- International Maritime Organization
  - 160 Coastal States
  - Responsibility for the safety and security of shipping
    - Electronic Chart Display and Information System (ECDIS) Performance Standard

ECDIS

- Computer based Navigation System
- Integrated AIS and RADAR
- Must use an official ENC for primary navigation
- Improves the safety and efficiency of marine operations
  - Depending on the navigation scenario alarms and warnings are triggered based on the ships draft and surrounding chart elements
- SOLAS (V) was amended in 2012 that ships of certain size must carry and ECDIS

ECDIS Components

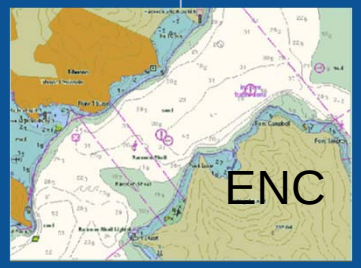
Satellite Navigation

Gyrocompass

RADAR

SENC

Computer



AIS

Log

Depth sounder

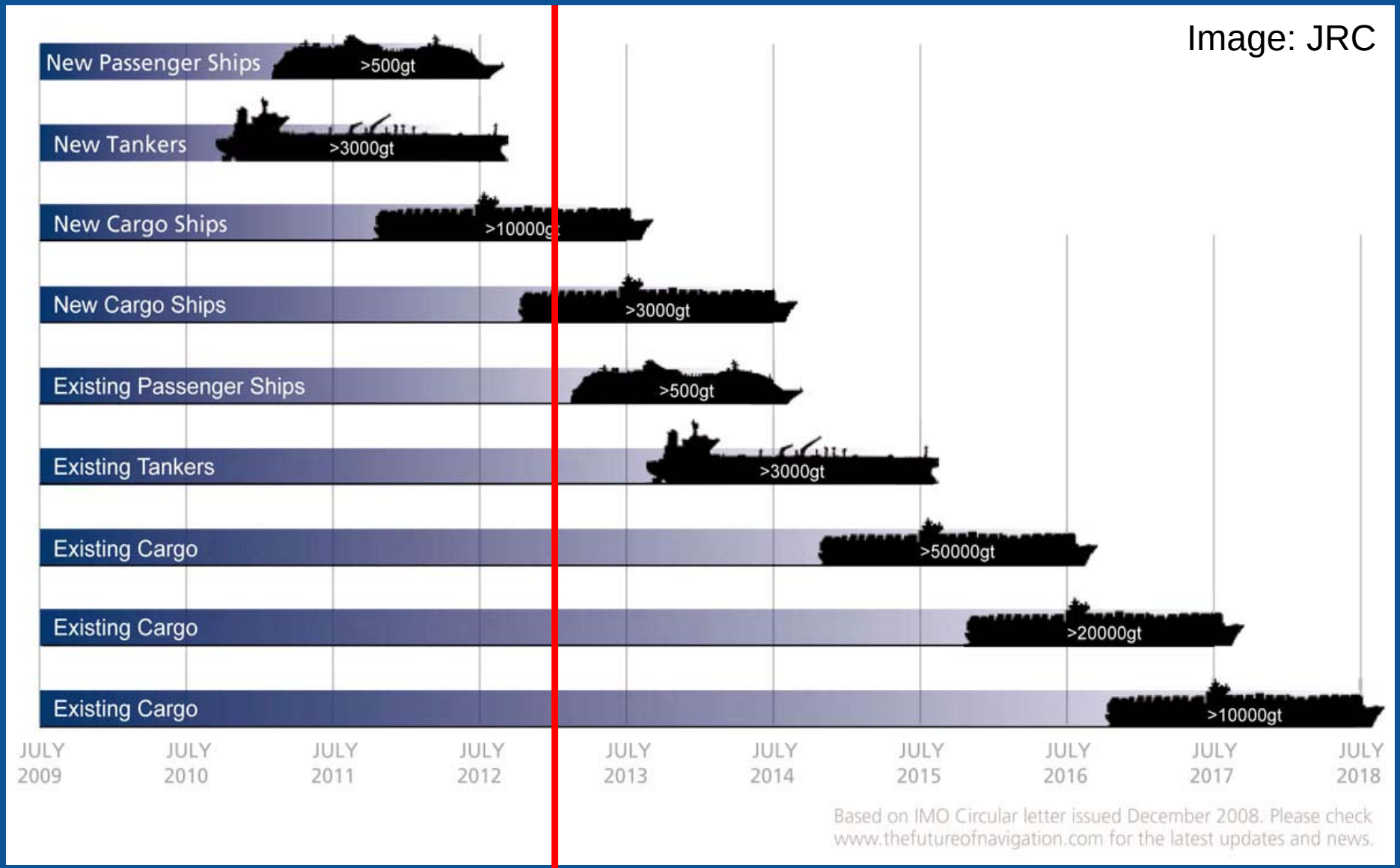
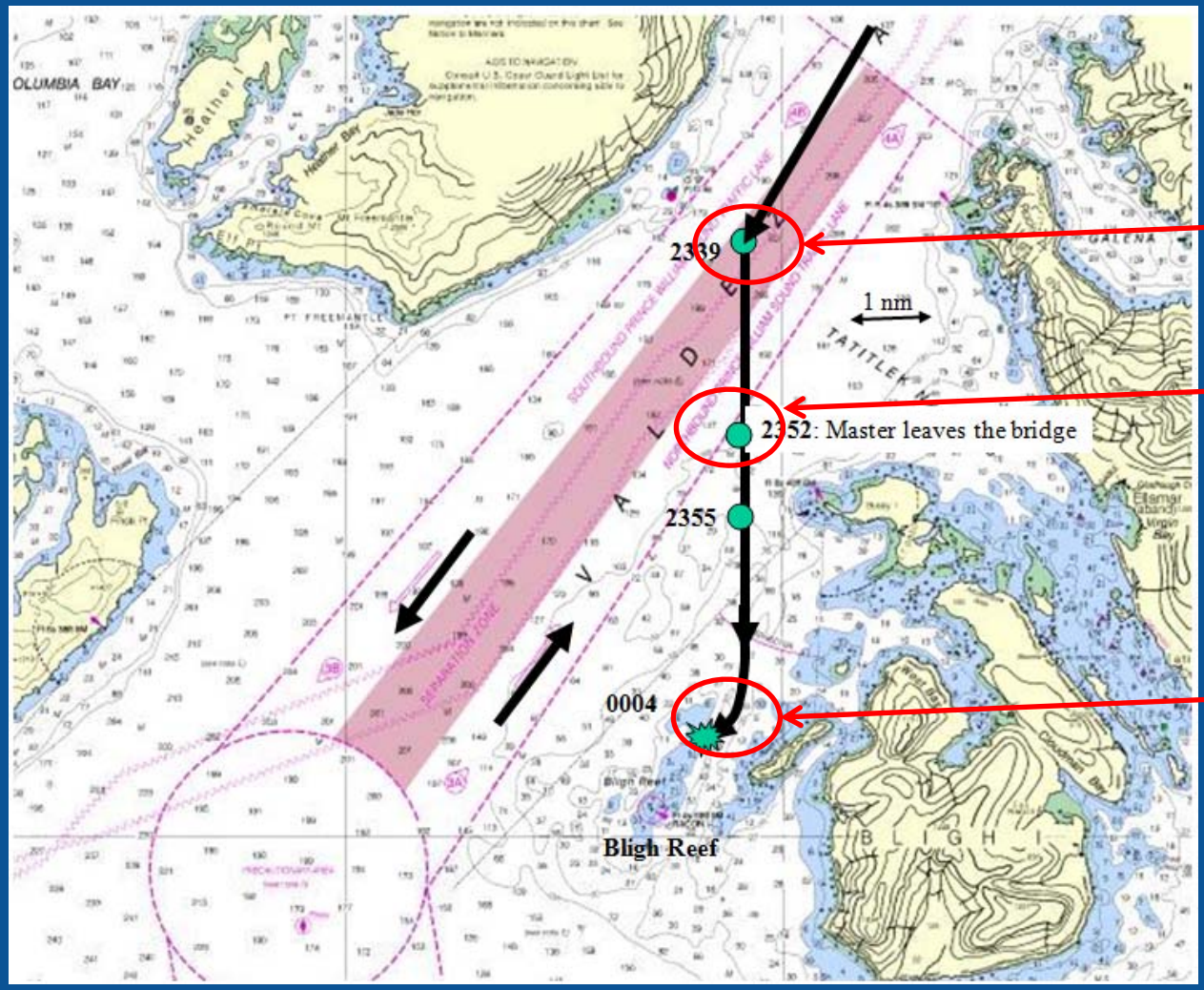


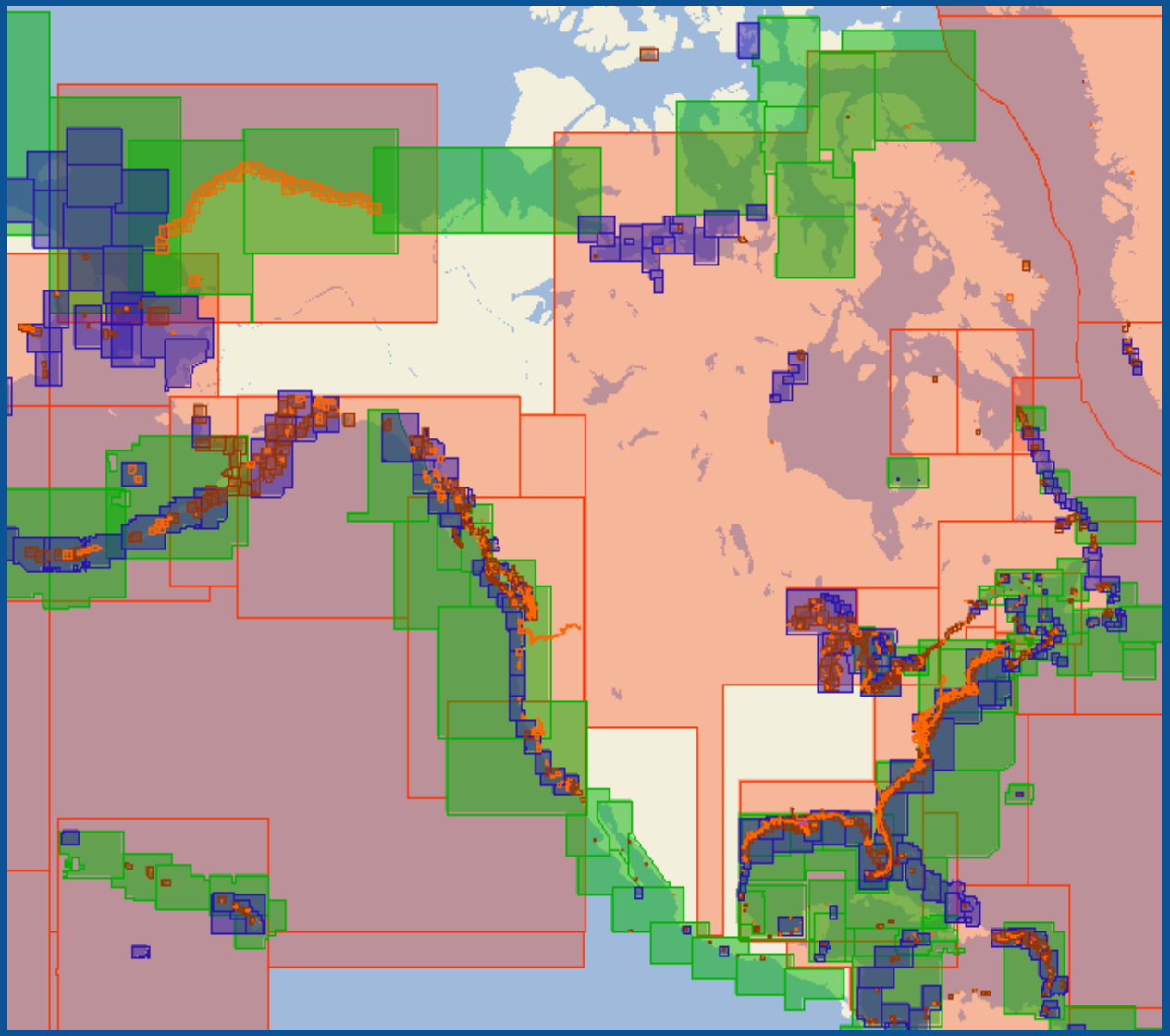
Image: JRC
New Passenger Ships
>500gt
New Tankers
>3000gt
New Cargo Ships
>10000gt
New Cargo Ships
>3000gt
Existing Passenger Ships
>500gt
Existing Tankers
>3000gt
Existing Cargo
>50000gt
Existing Cargo
>20000gt
Existing Cargo
>10000gt
JULY 2009
JULY 2010
JULY 2011
JULY 2012
JULY 2013
JULY 2014
JULY 2015
JULY 2016
JULY 2017
JULY 2018
Based on IMO Circular letter issued December 2008. Please check www.thefutureofnavigation.com for the latest updates and news.

Today

Exxon Valdez – what if it had an ECDIS?



NOAA ENC Coverage

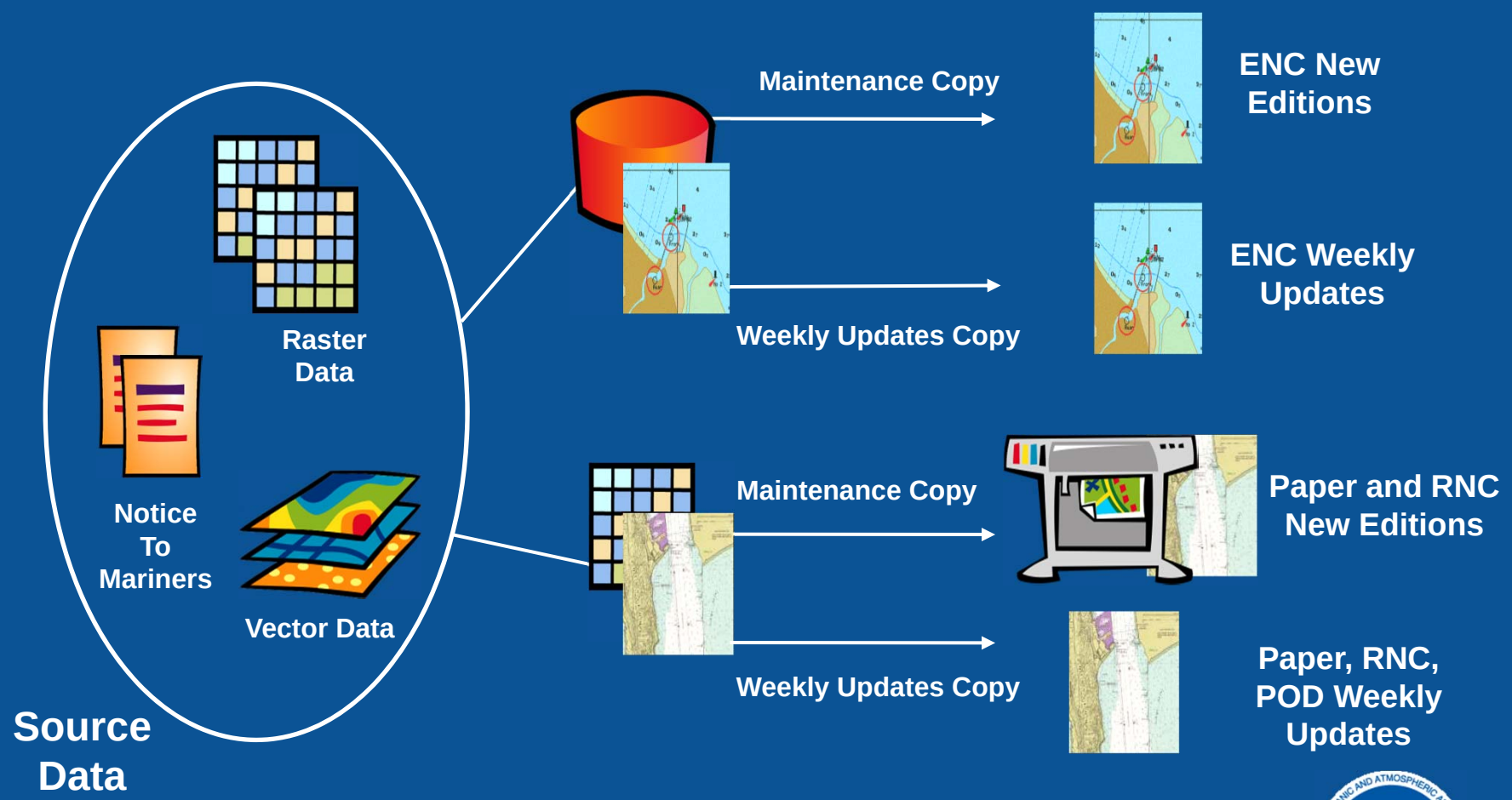


- 1997 – First ENC
- 2012 – Complete Coverage

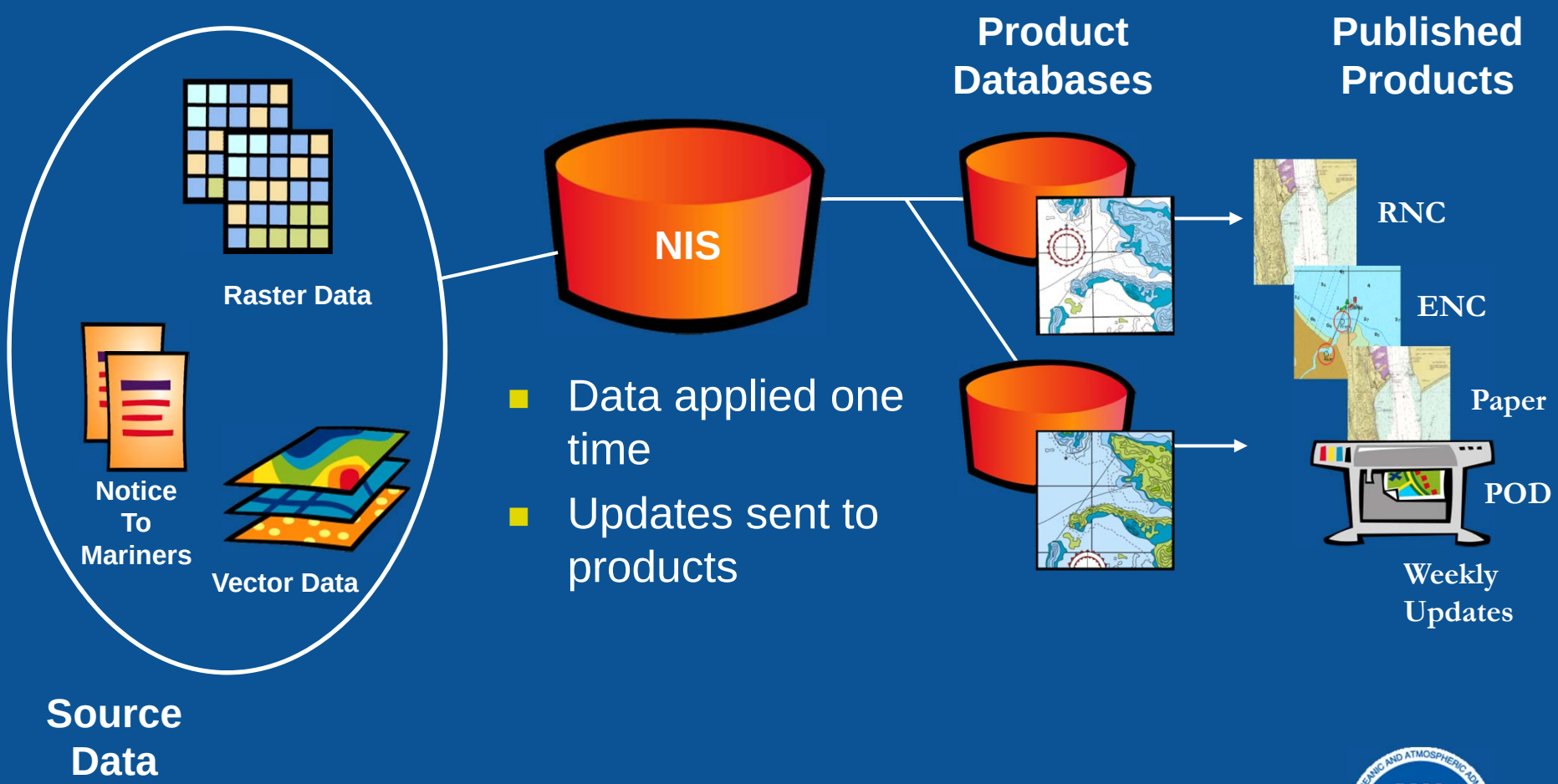
NOAA ENC Distribution

- Two Methods
  - Available for free download on the internet
    - www.nauticalcharts.gov
  - Or through a Certified ENC Distributor
    - PRIMAR
    - UKHO
    - Jepessen
    - Chart World
    - Maris
- Updated to the latest Notice to Mariners

NOAA Chart Production – pre 2012



NOAA Chart Production – moving to a GIS

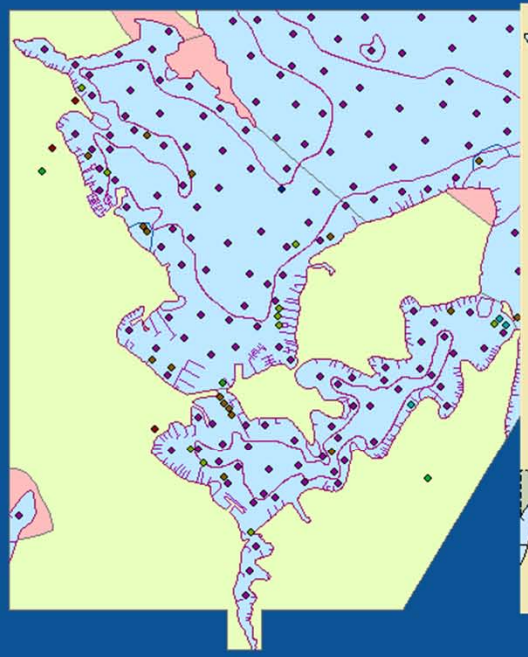


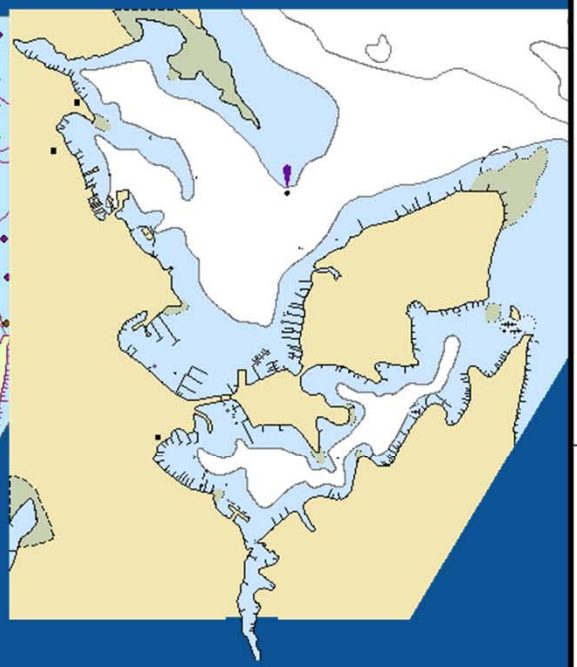
- Data applied one time
- Updates sent to products

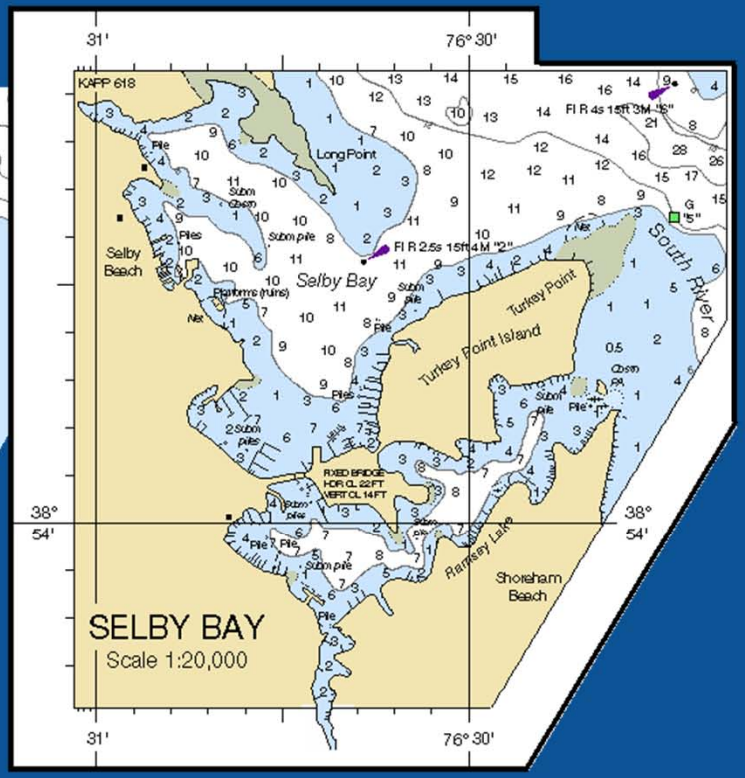
Why a GIS based approach?

- Increase the efficacy of the production system
  - One time source load, evaluation, and application
  - Variety of formats supported
  - Workforce trained on multiple products, versus product specialization
- Improved product for the mariner
  - Multiple products from single database provides consistency
  - Product synchronization
  - More up-to-date product
- Integrated end-to-end COTS solution

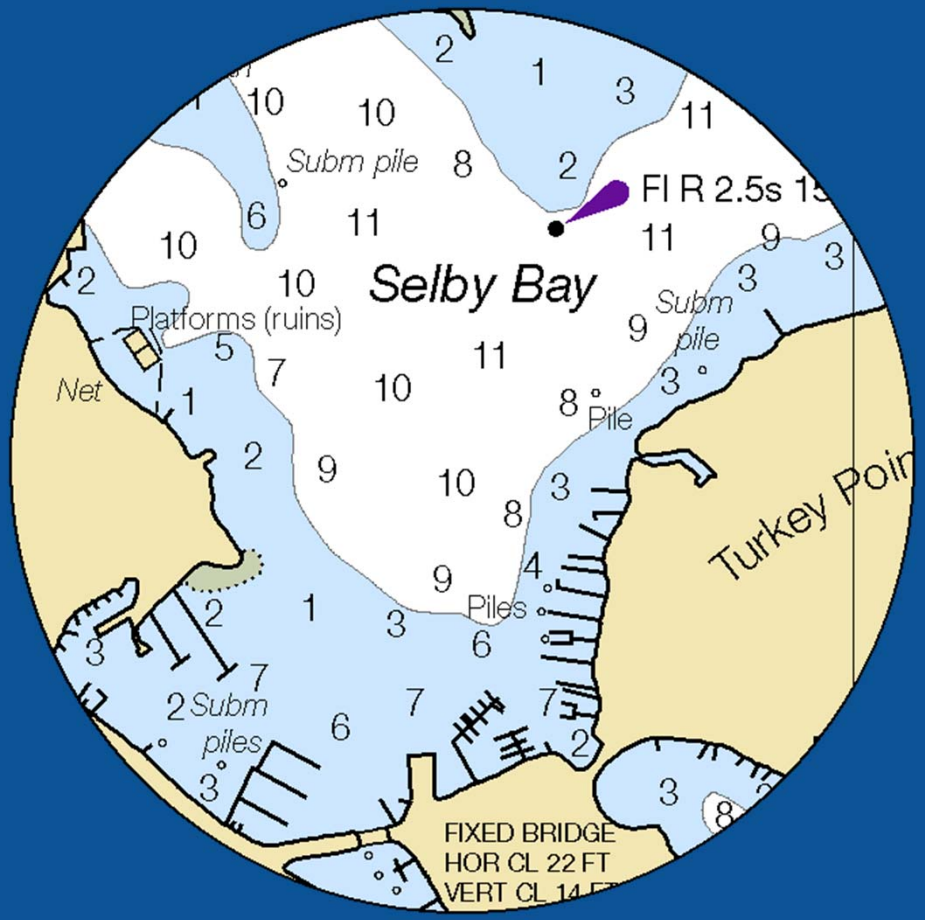
Product Finishing







Product Finishing



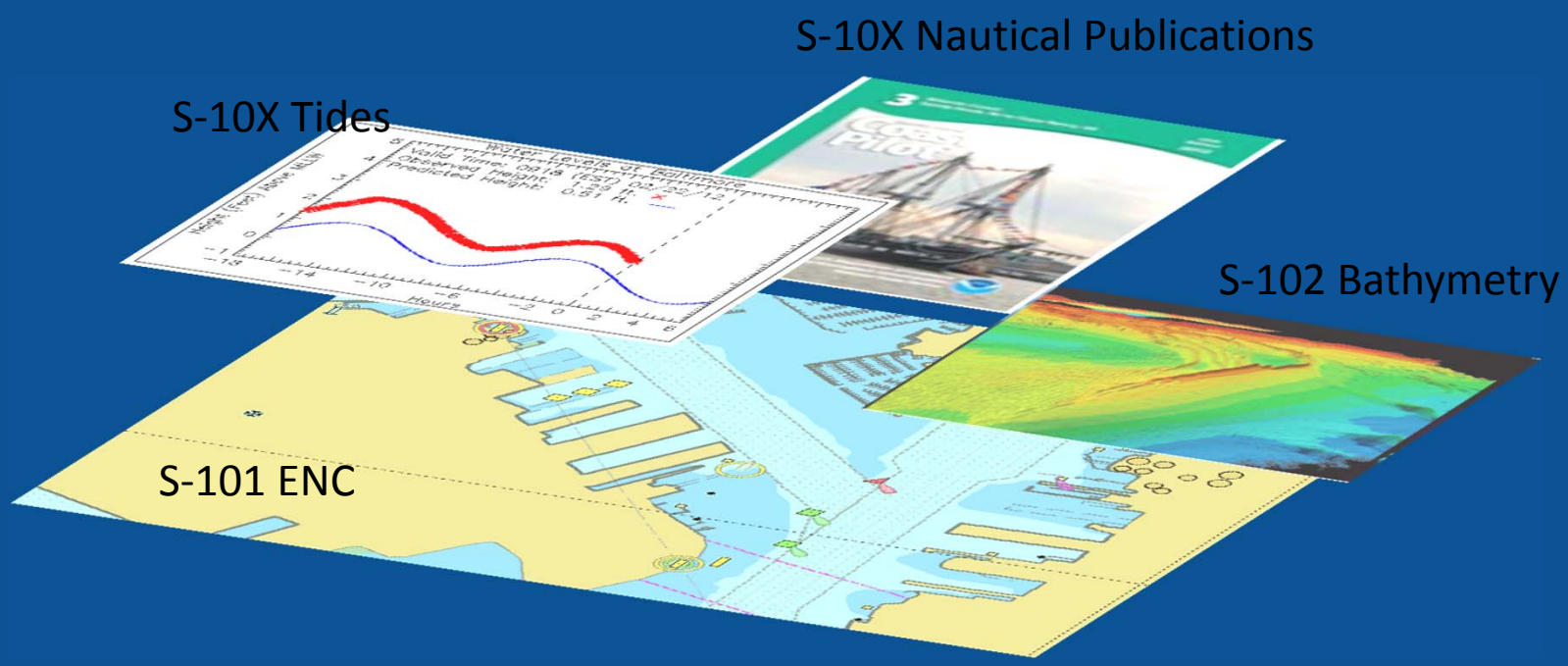
Improving ENC Standards

- Currently based on IHO S-57
  - While good it can be better
    - Not flexible
    - Takes Years to make a change
- IHO introduced S-100 – Universal Hydrographic Model
  - Leverages the ISO Geographic Information System Standards
  - Flexible Catalogue Structure

S-101

- S-101 represents a major step forward in product specifications for ENCs
- Dynamic content
  - Exchangeable and Machine Readable Catalogues
    - New content will NOT take years to implement
    - Or require new type approval for ECDIS
  - Will allow for real-time tidal information
  - Interoperability with other S-100 product specifications
    - Sailing Directions
    - High Resolution Bathymetry

S-100 Enabled ECDIS



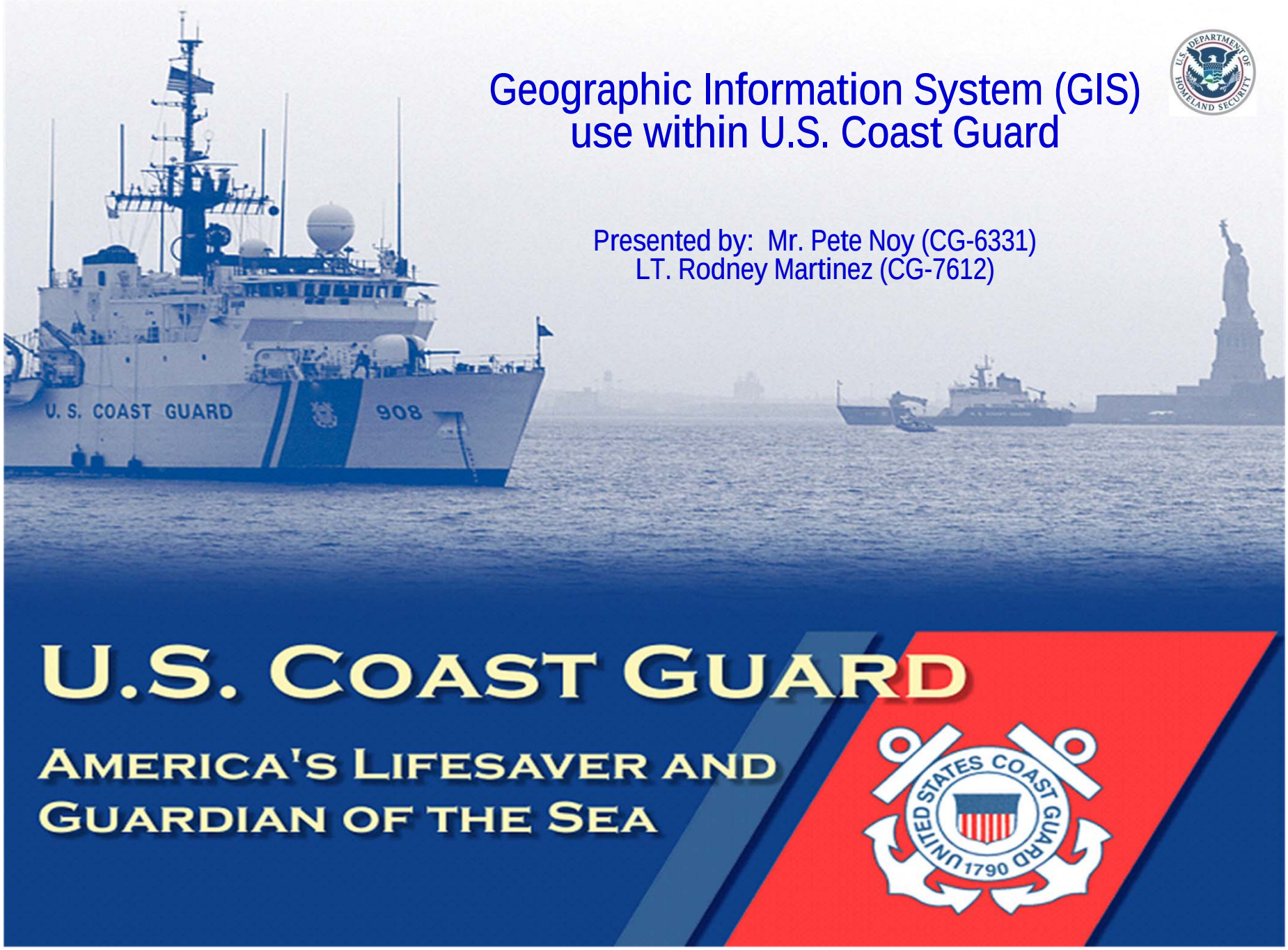
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NOAA

U.S. DEPARTMENT OF COMMERCE

Geographic Information System (GIS) use within U.S. Coast Guard

Presented by: Mr. Pete Noy (CG-6331)
LT. Rodney Martinez (CG-7612)



Coast Guard GIS

Purpose: Provide GIS data and services to the Coast Guard for its fundamental missions:

- Maritime Safety
- Maritime Security
- Maritime Mobility
- National Defense
- Incident Management
- Port Intelligence (unclassified)
- Protection of Natural Resources
- Search and Rescue

Geographic Information System (GIS) use within U.S. Coast Guard

Current challenges

- Ease of use
- Adaptability of technology
- Data Accuracy
- Identification of Trusted Data Sources
- DOD/DHS IT requirements

What is Coast Guard Enterprise GIS (EGIS)

- A Data Warehouse for static GIS data
  - Contains an extensive library of vector and raster data
  - Alleviates need for local storage and maintenance of large or common data sets
- Accessible to all Coast Guard users
  - Through both a desktop client and a web-enabled viewer
  - GIS clients include ArcGIS Explorer for Desktop and ArcGIS Desktop
- Sensitive but Unclassified (SBU)

EGIS Data Warehouse Services

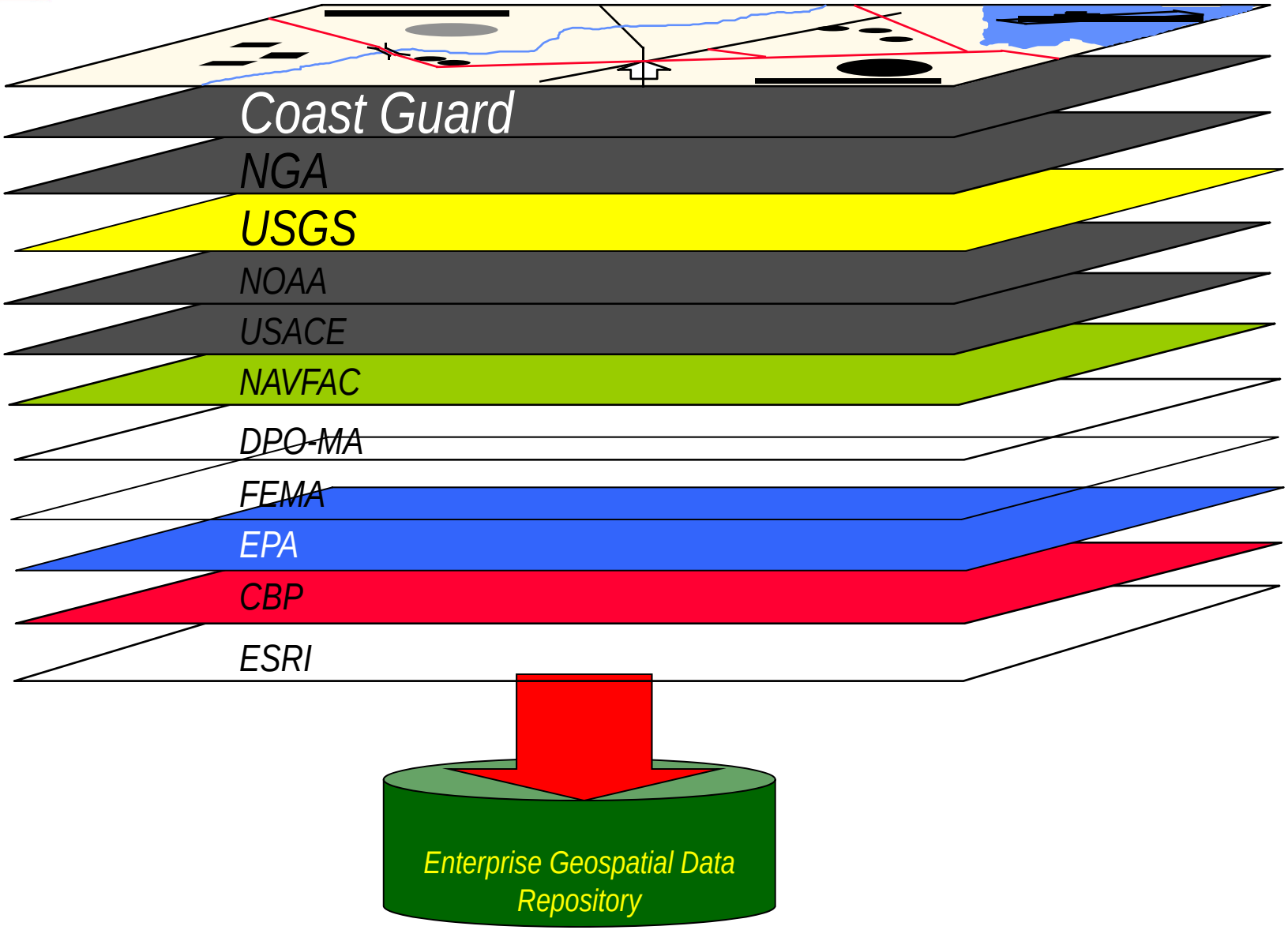
National Data Coverage

- Relevant vector data sets from federal government and industry providers
  - Focus: Homeland Security Infrastructure Program (HSIP) vector data sets
- Coast Guard data
  - Jurisdictional/CFR data
  - Program-specific data
- Nautical Charts (NOAA RNC/ENC, USACE IENC, CYC)
- Access to Microsoft Bing via DHS ELA

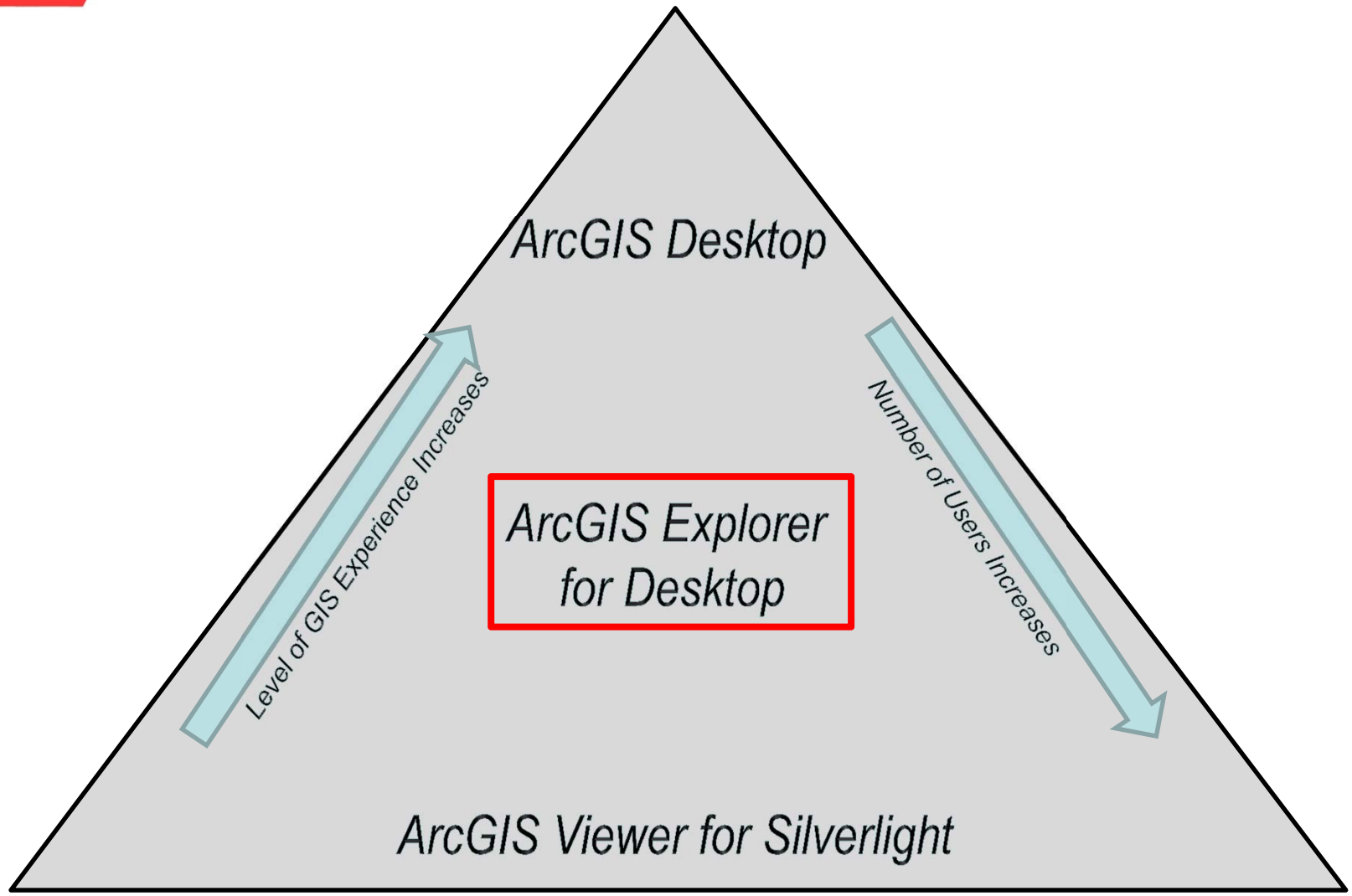
HSIP Vector Data Sets

- Other Vector & Raster Data from Federal Providers
- External and Internal Data Services
- Real-time Vessel Track Data Fee Data Warehouse for National-level GIS Data

GIS Data Providers

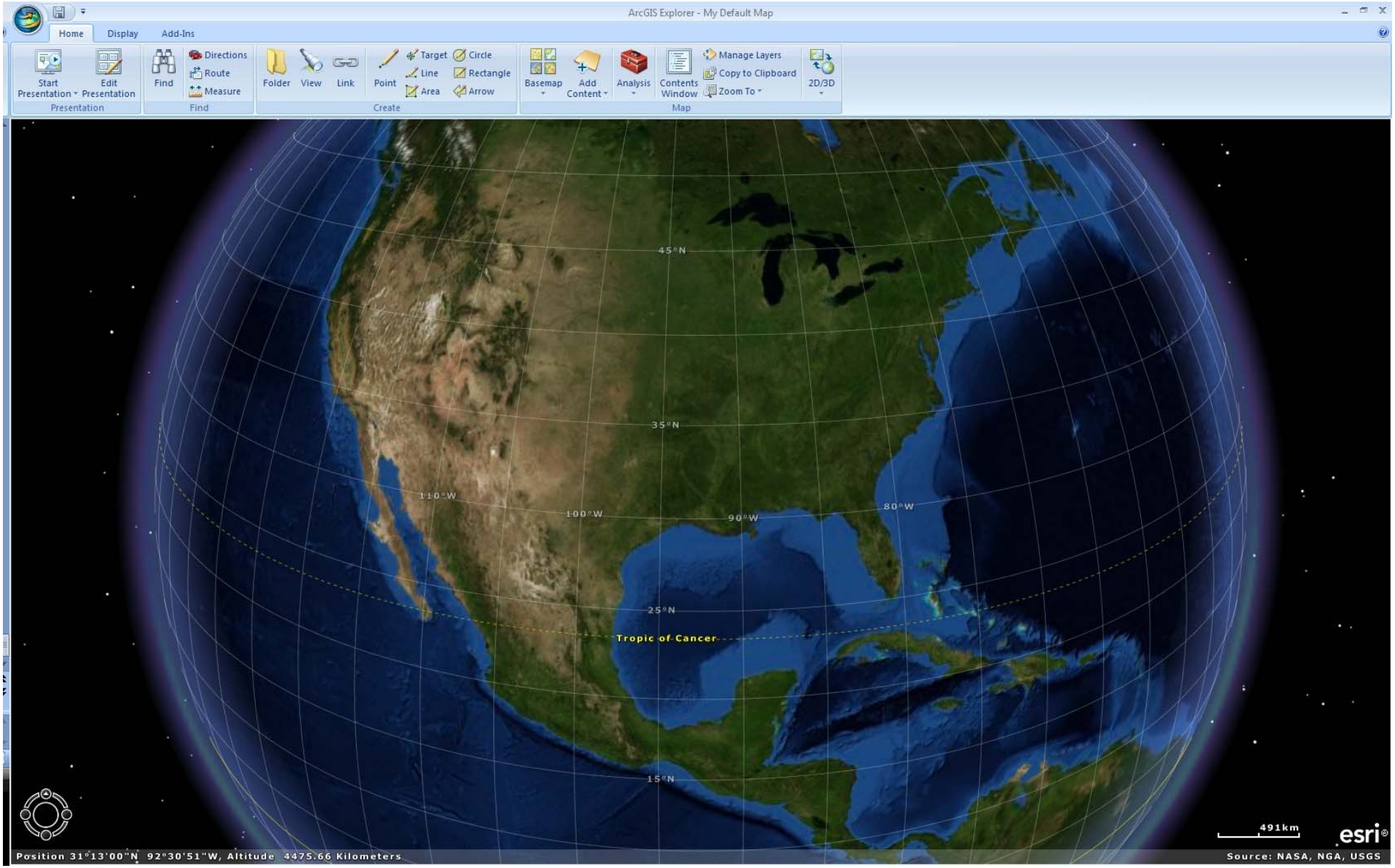


GIS Software Capability

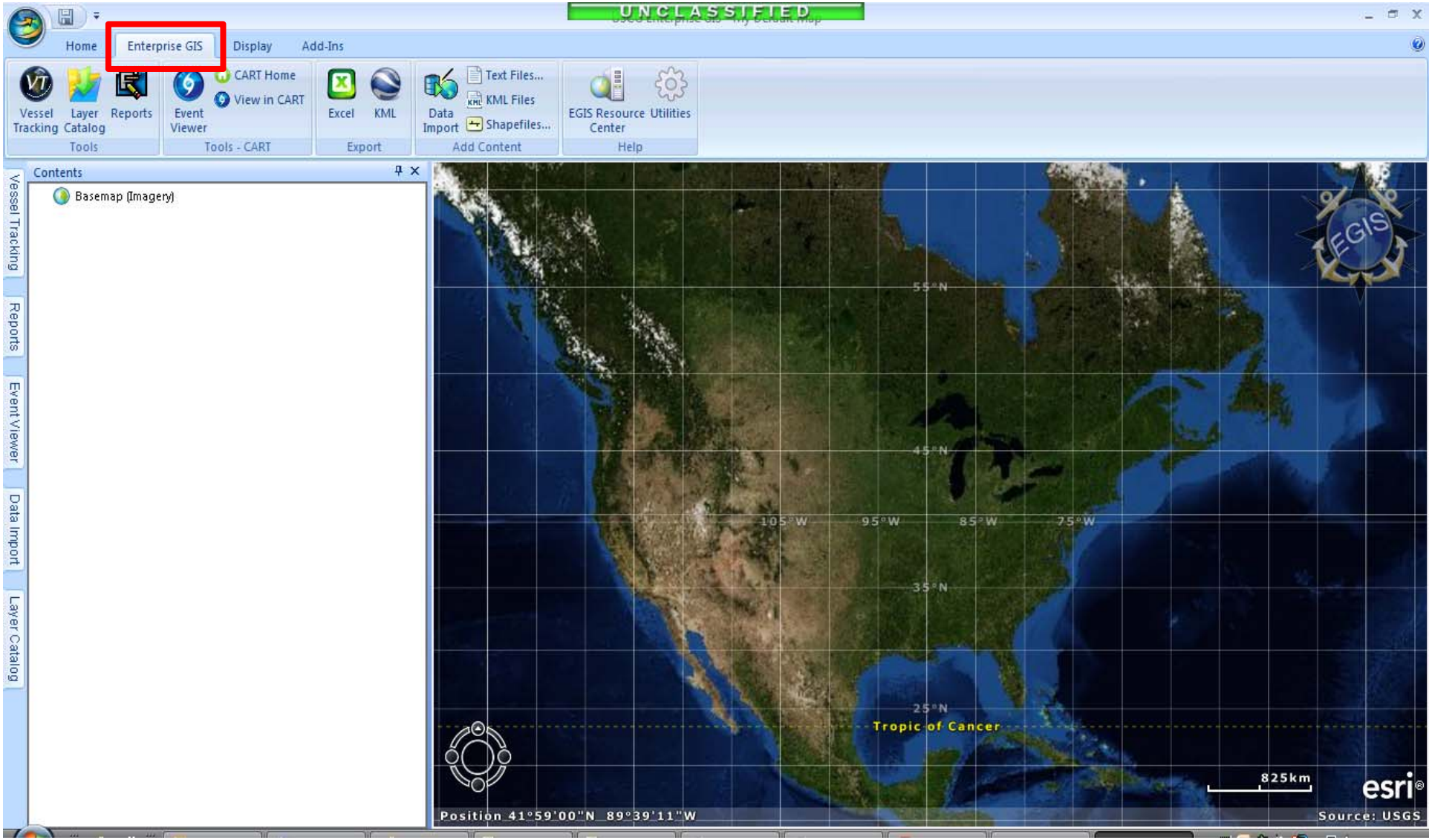


Conceptual model of GIS user community within United States Coast Guard.

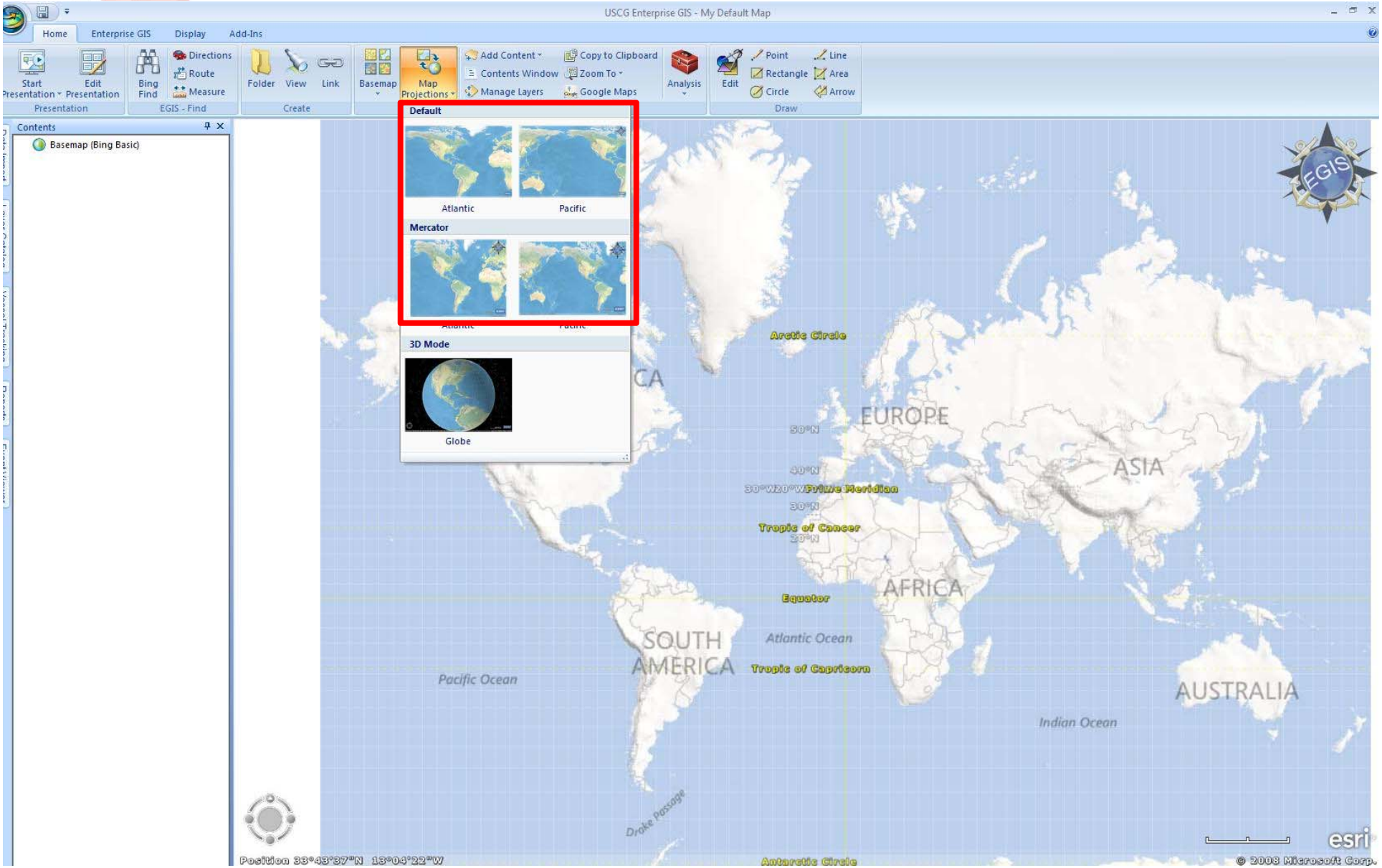
ArcGIS Explorer for Desktop (Build 1700)



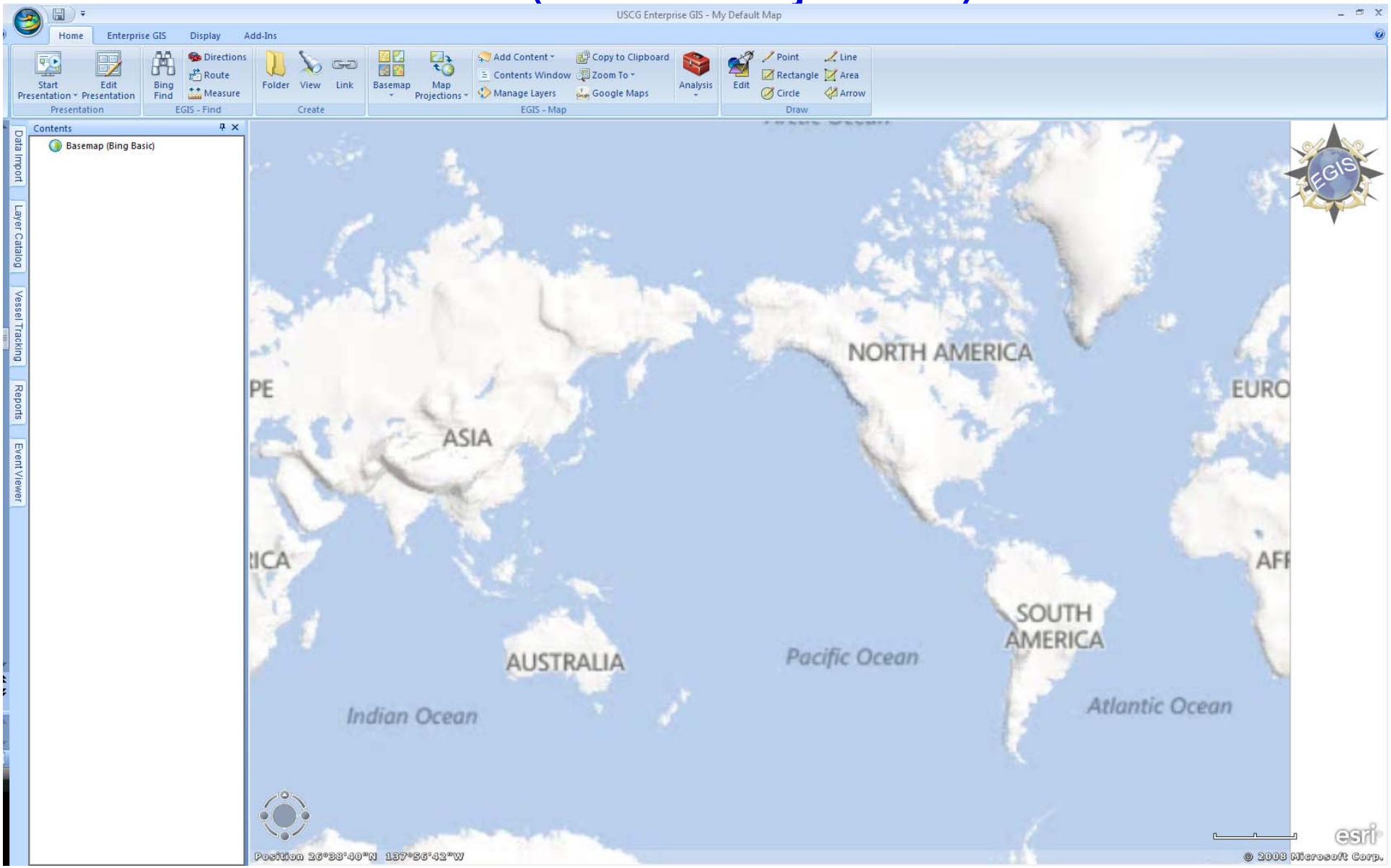
USCG Modified ArcGIS Explorer for Desktop



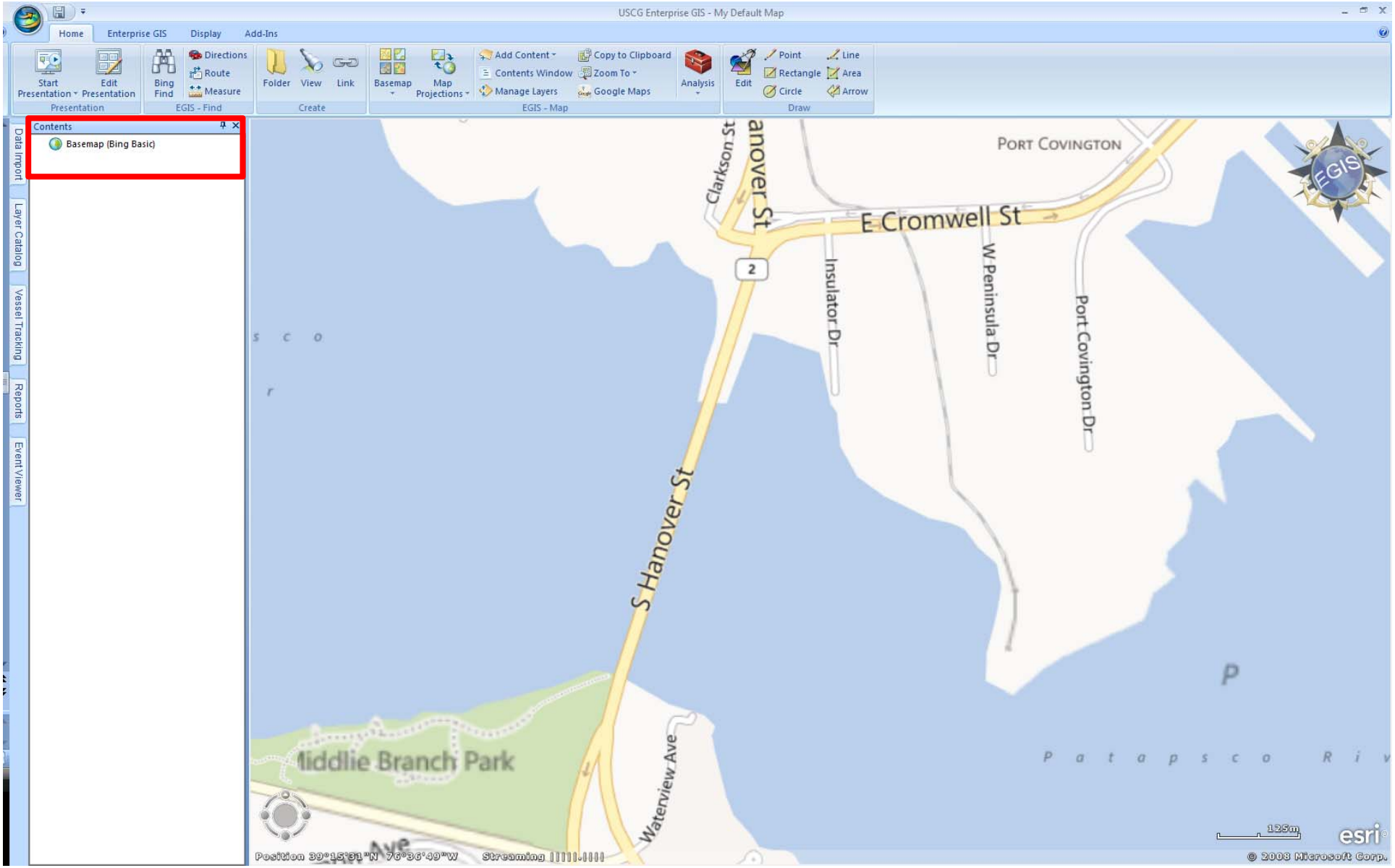
USCG Modified ArcGIS Explorer for Desktop



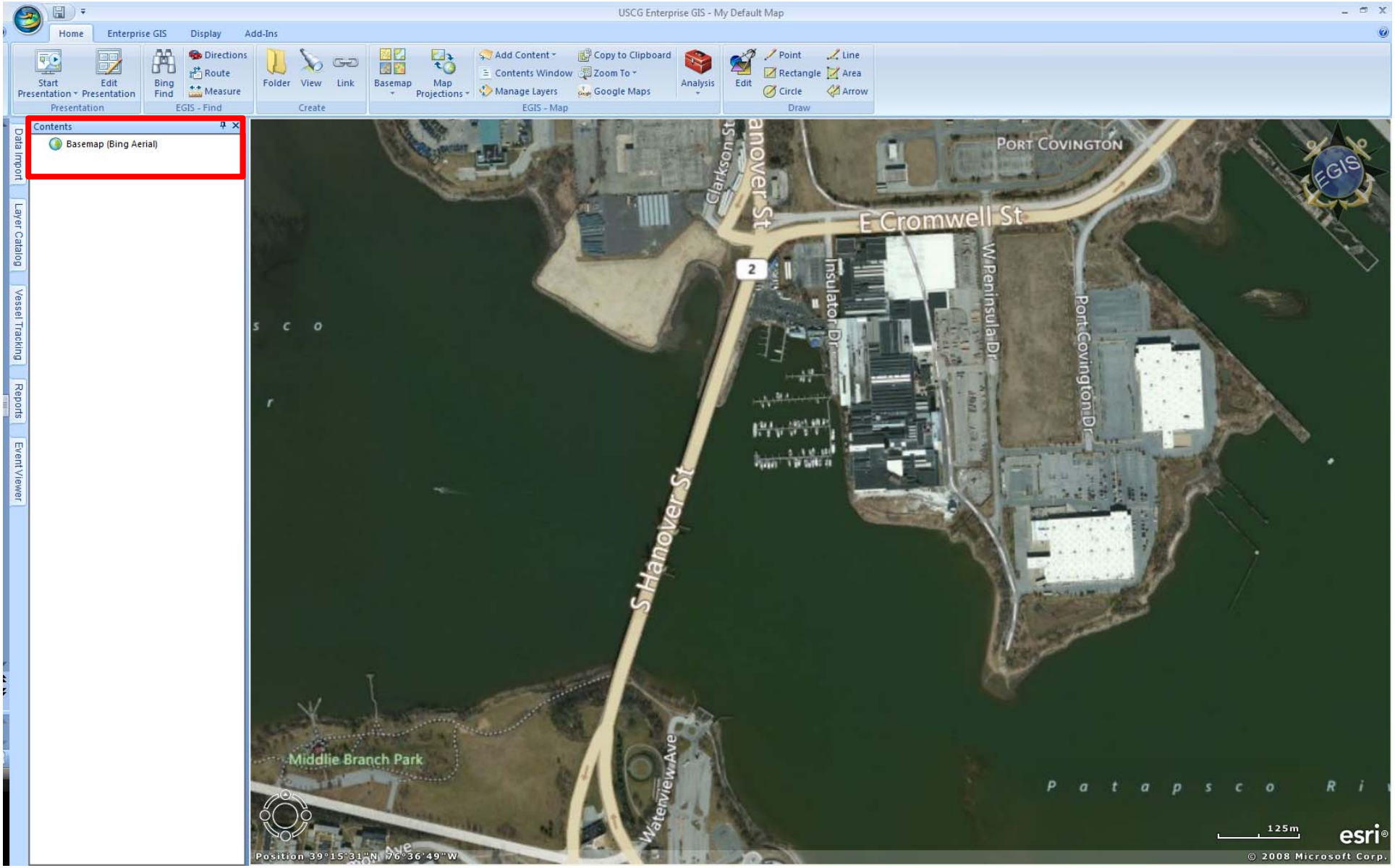
USCG Modified ArcGIS Explorer for Desktop (Custom Projections)



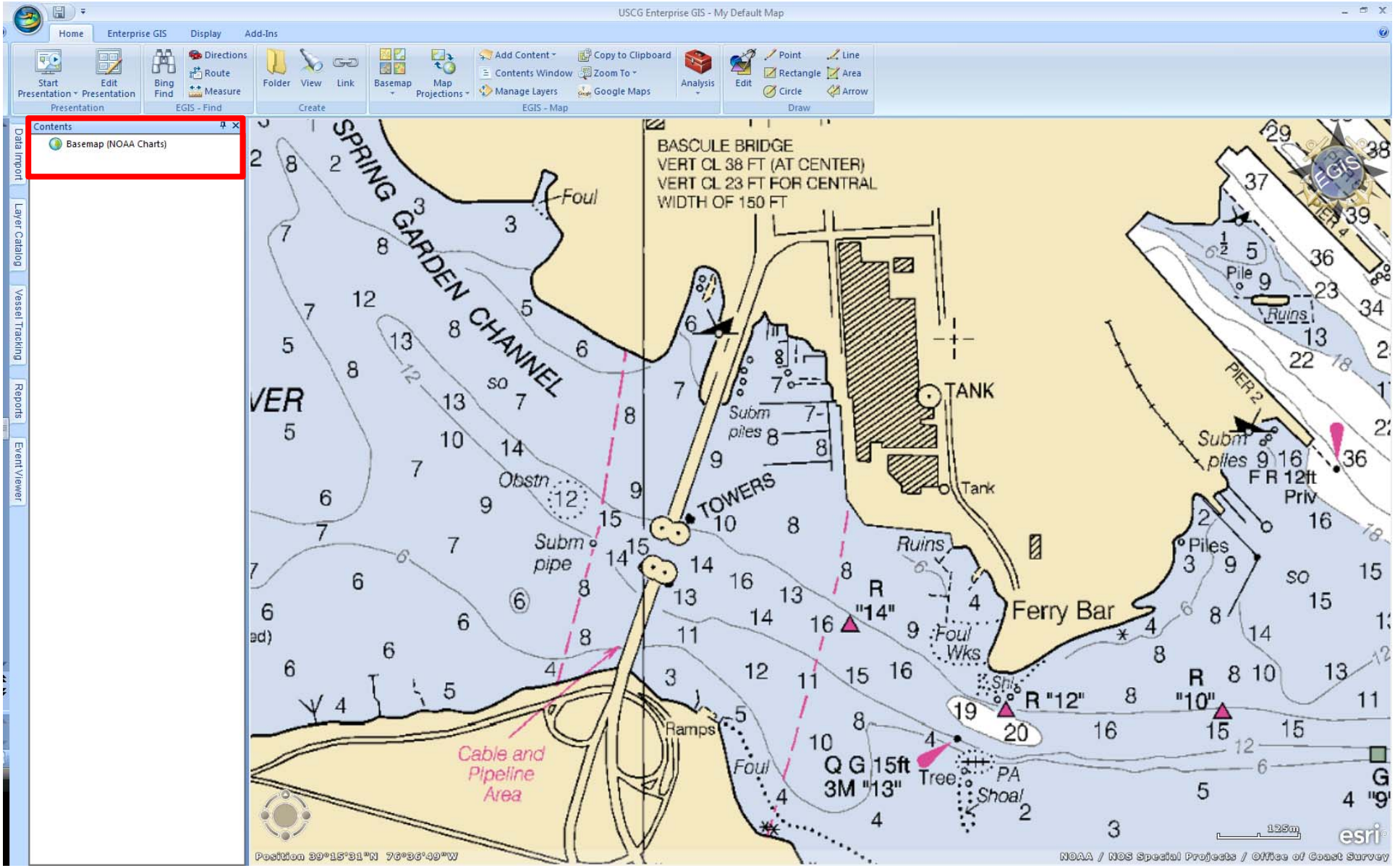
Leverages DHS ELA with Microsoft Bing



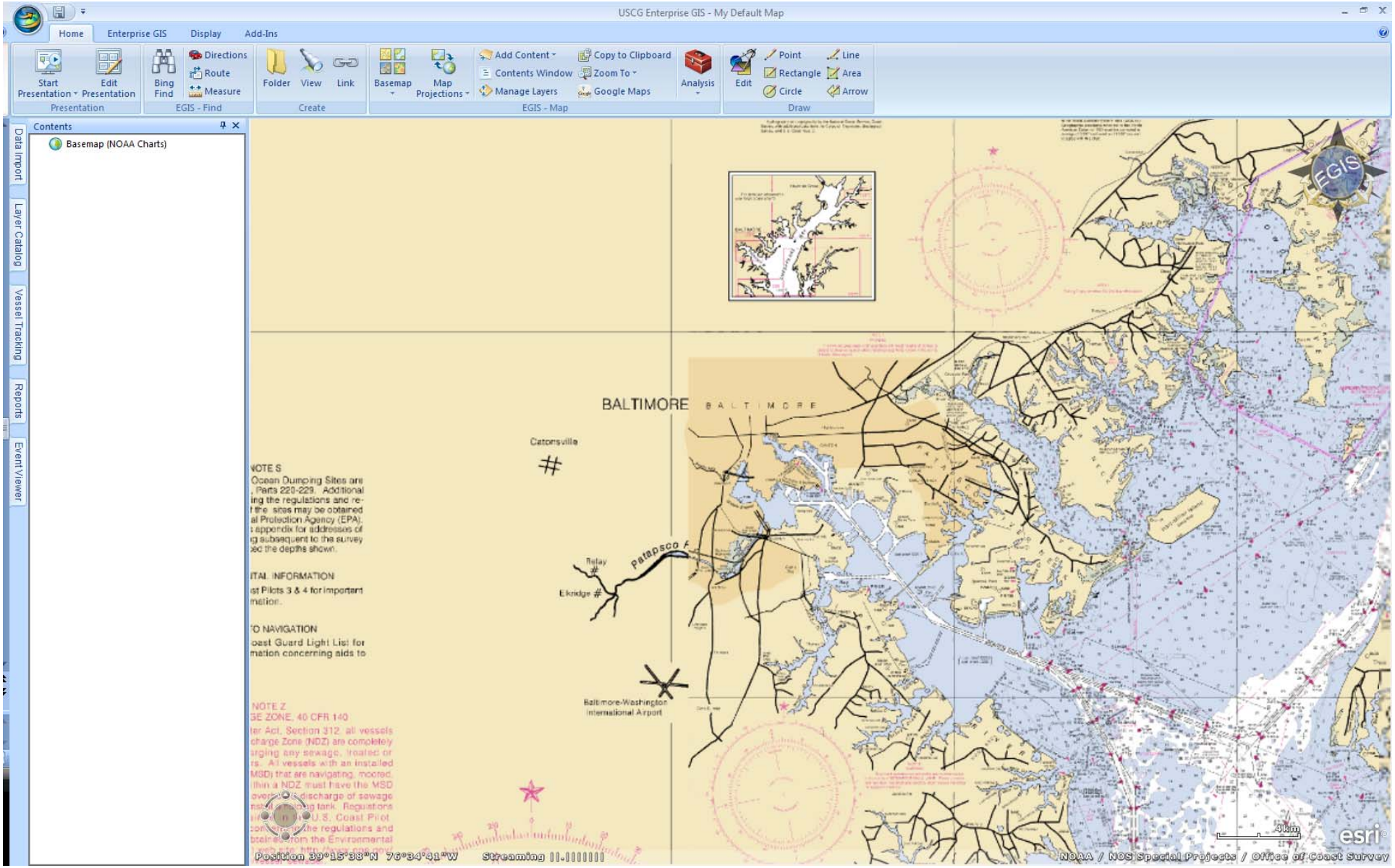
Leverages DHS ELA with Microsoft Bing



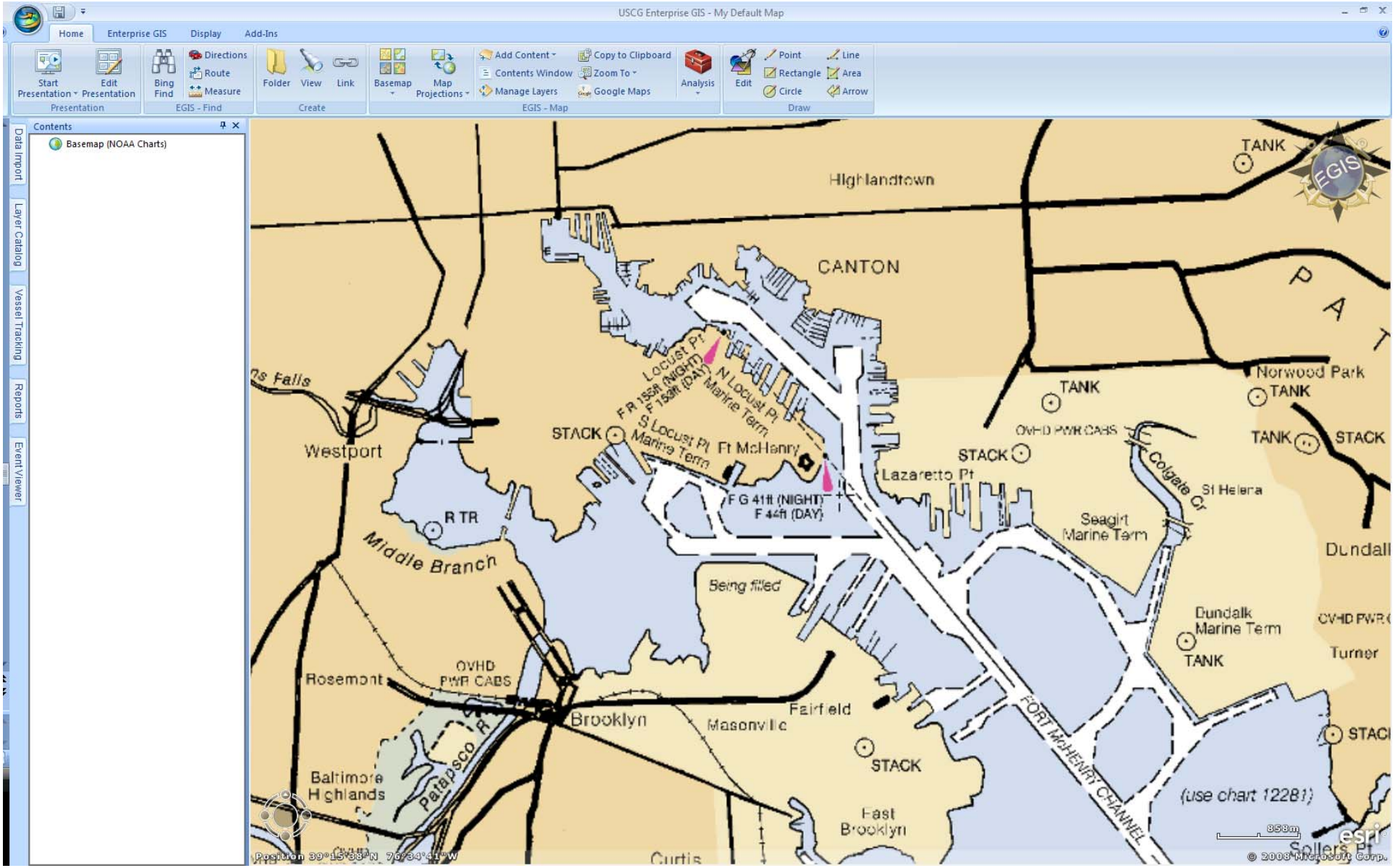
NOAA Seamless RNC Services



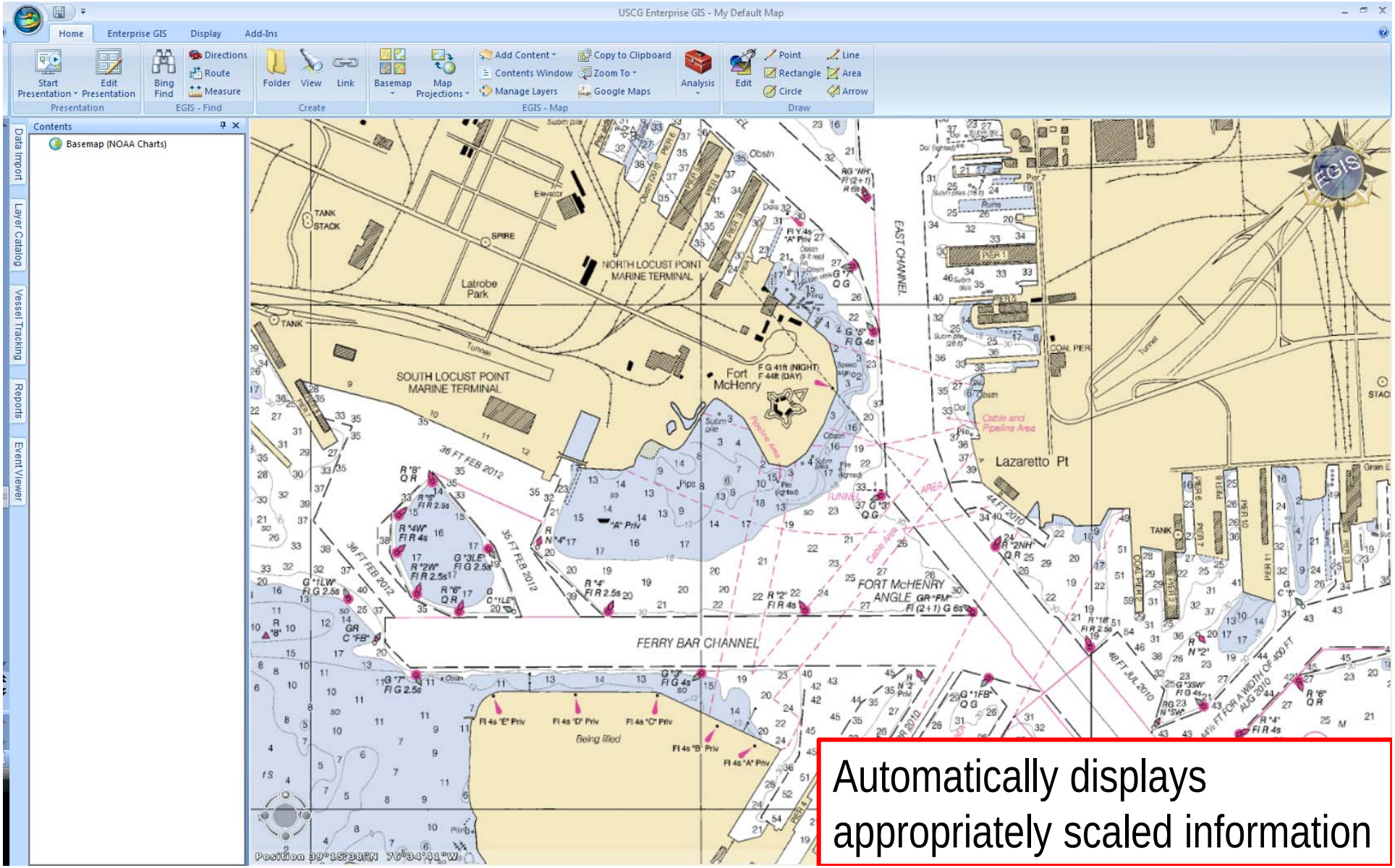
NOAA Seamless RNC Services



NOAA Seamless RNC Services

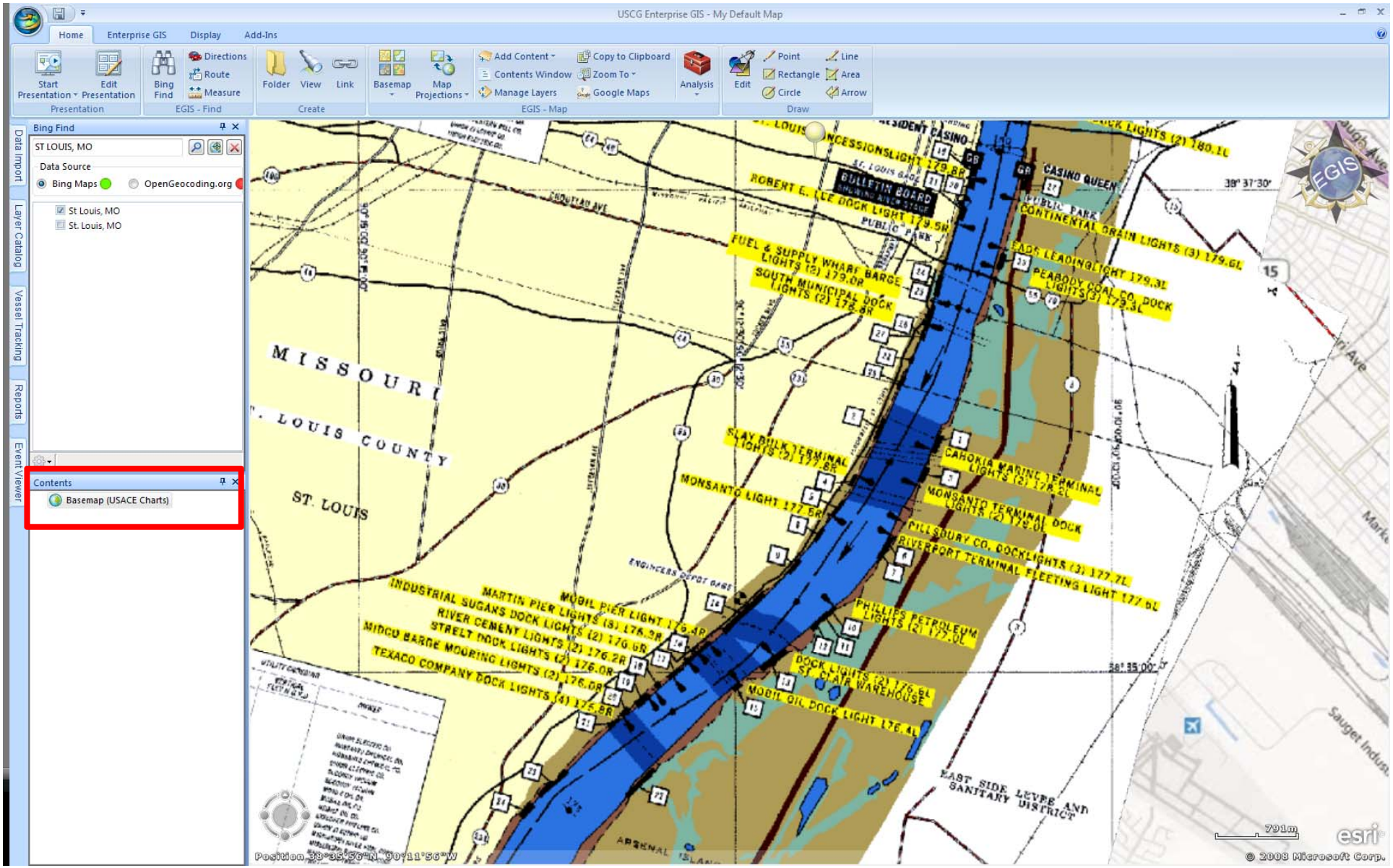


NOAA Seamless RNC Services

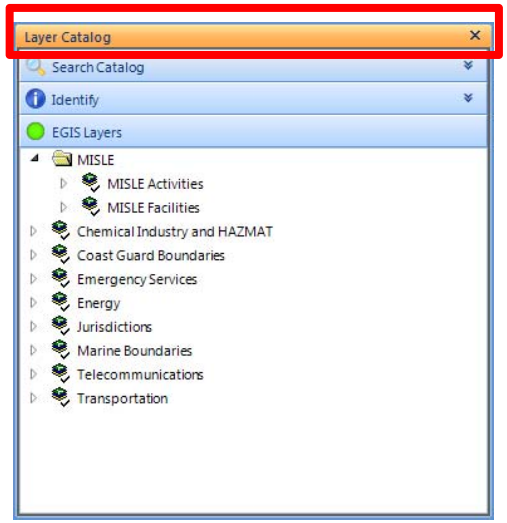


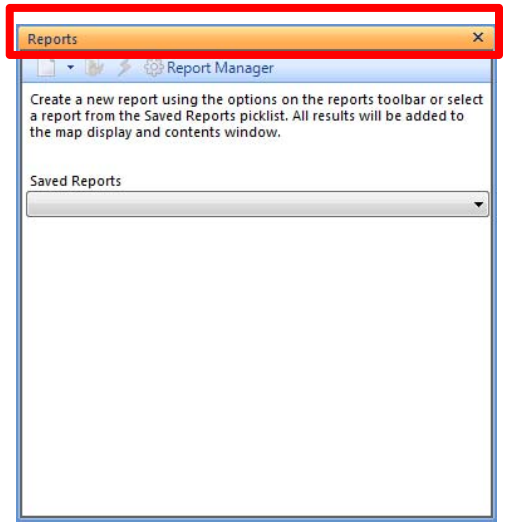
Automatically displays appropriately scaled information

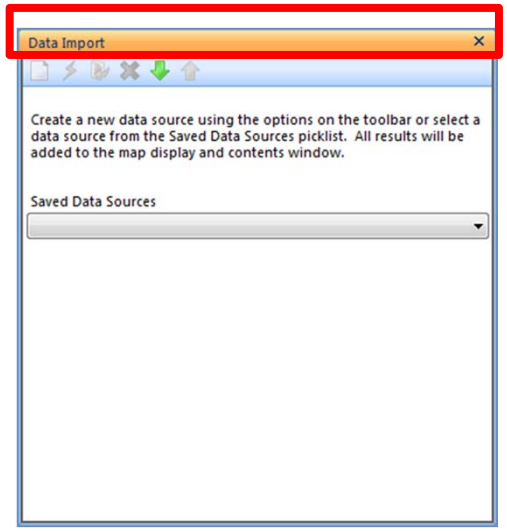
USACE Seamless IENC Services

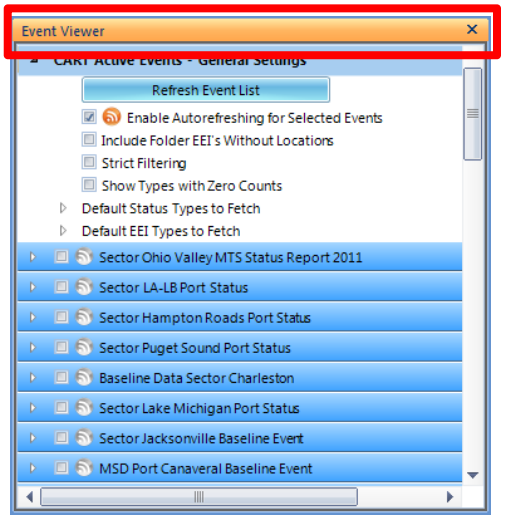


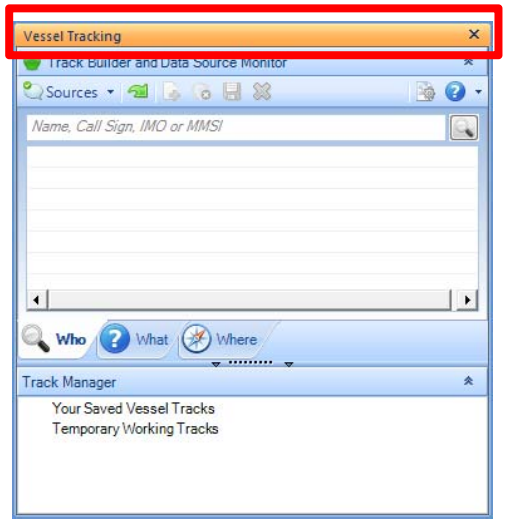
USCG Customized Capabilities



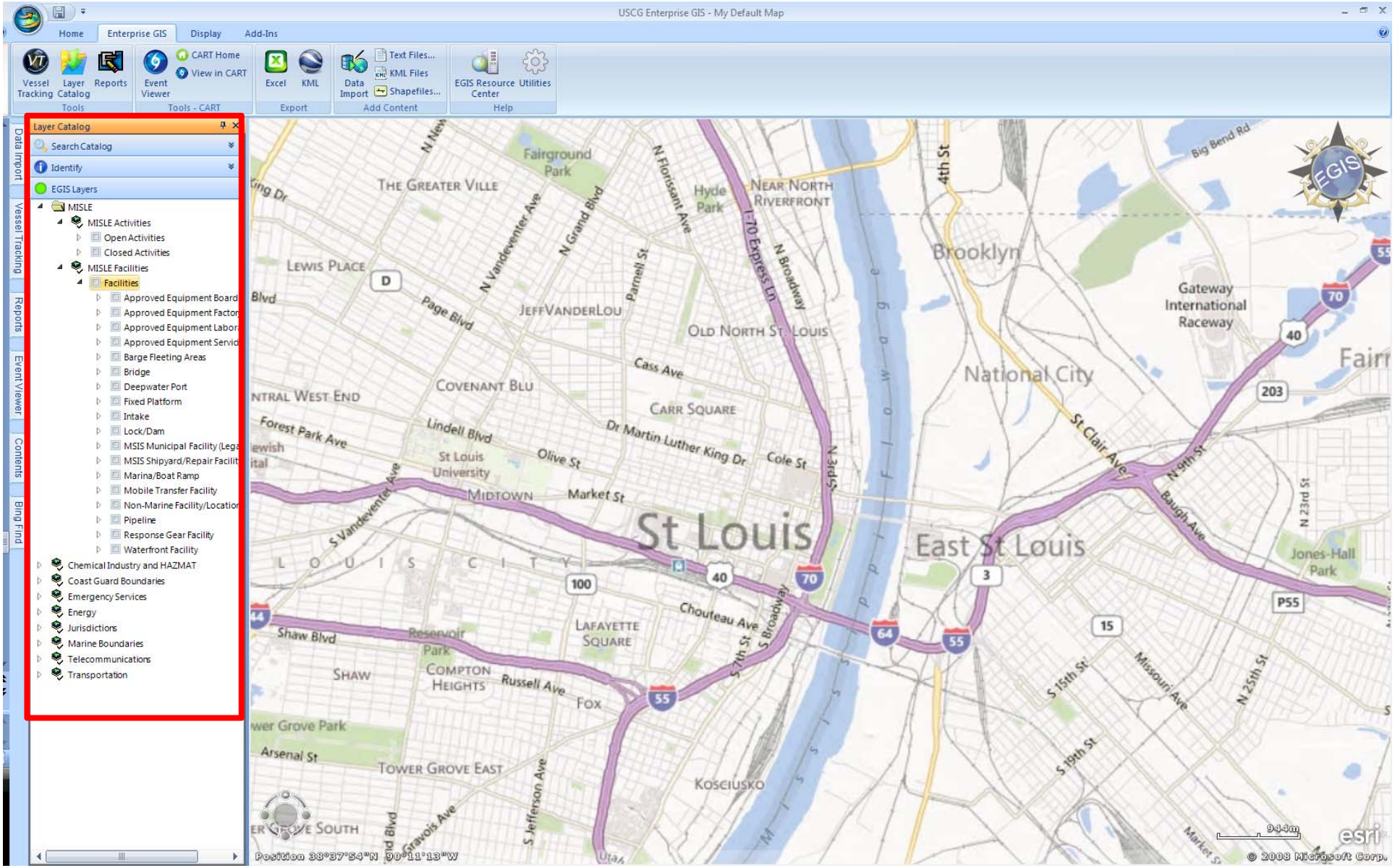




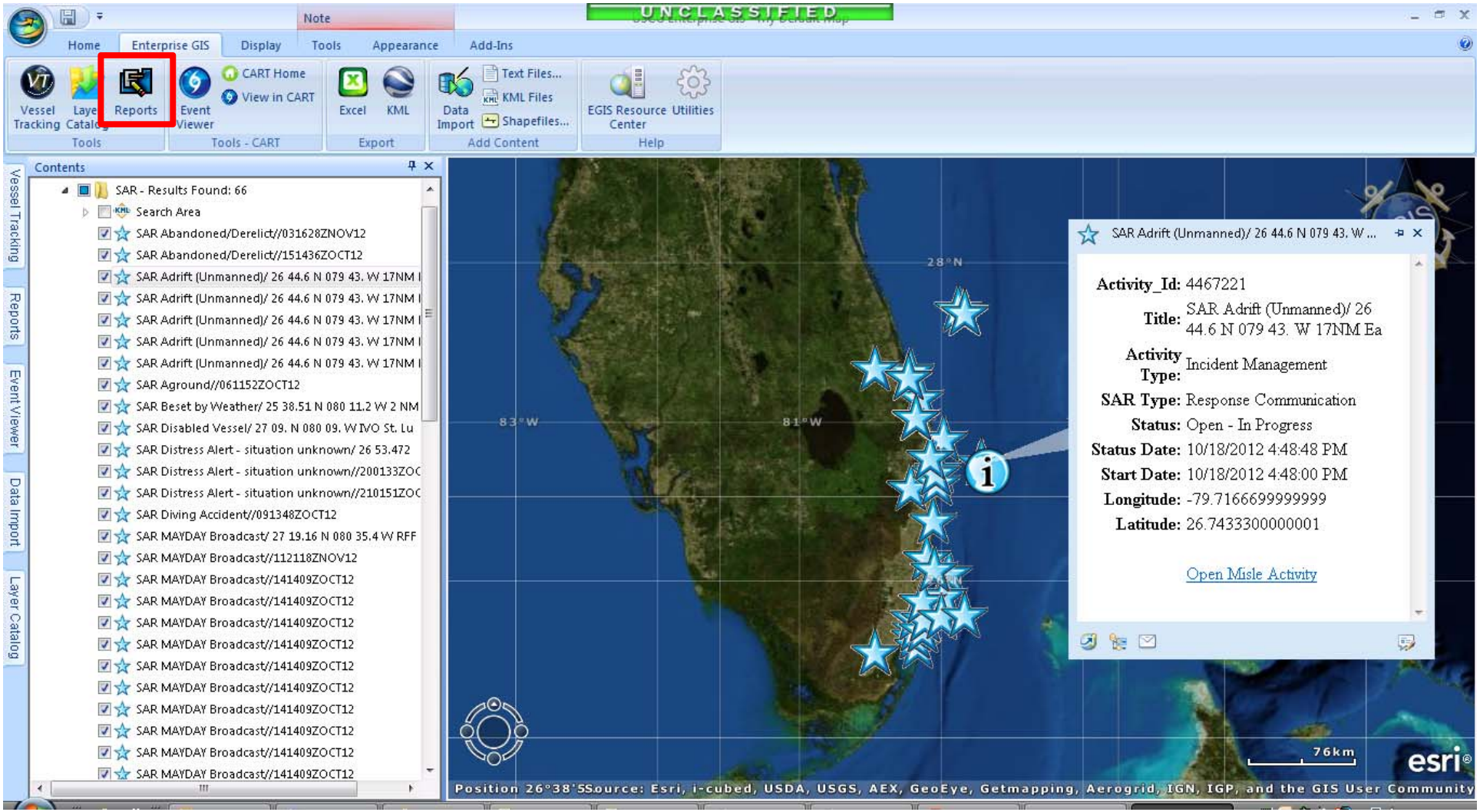




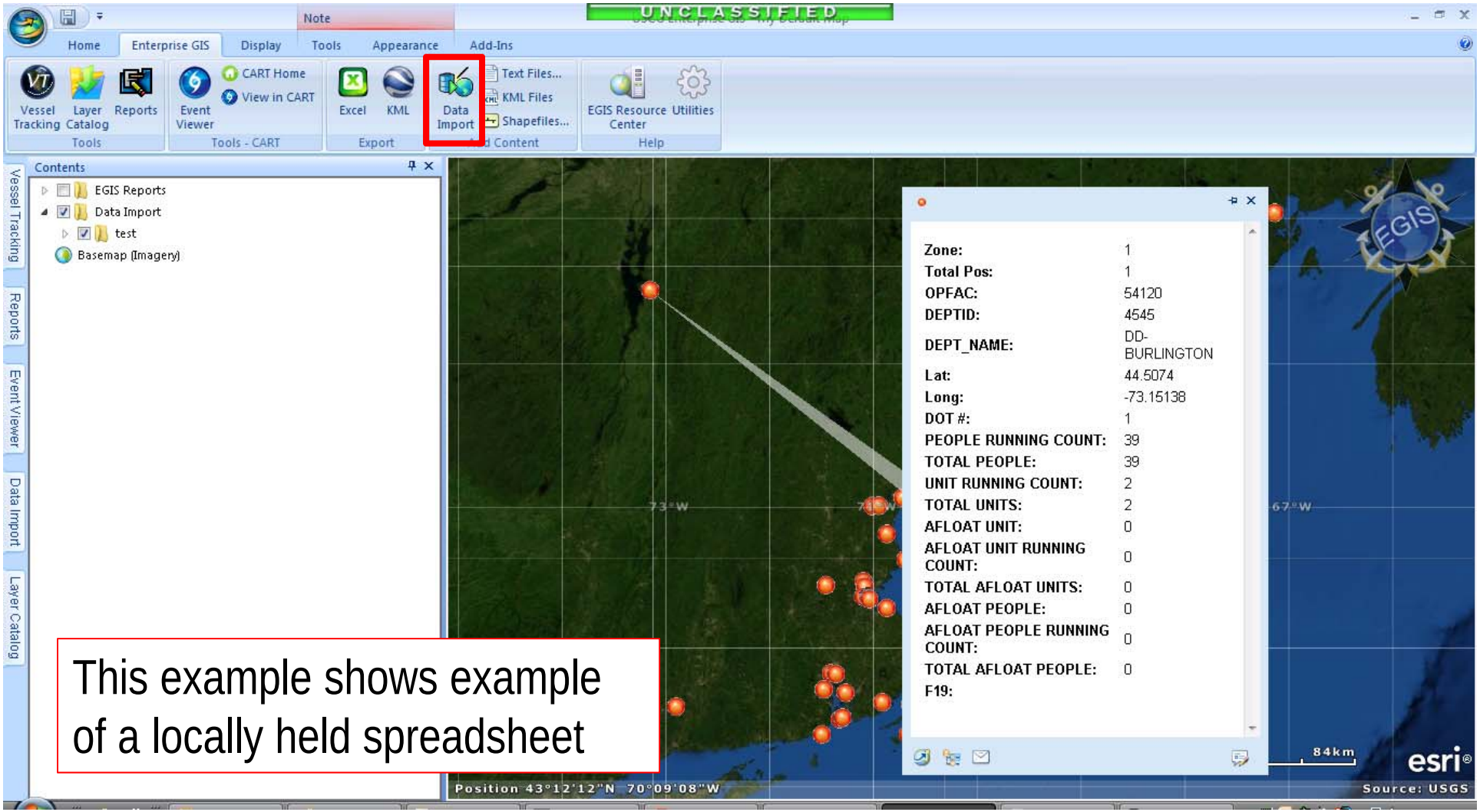
USCG Customized Capabilities
Layer Catalog



USCG Customized Capabilities
Reports

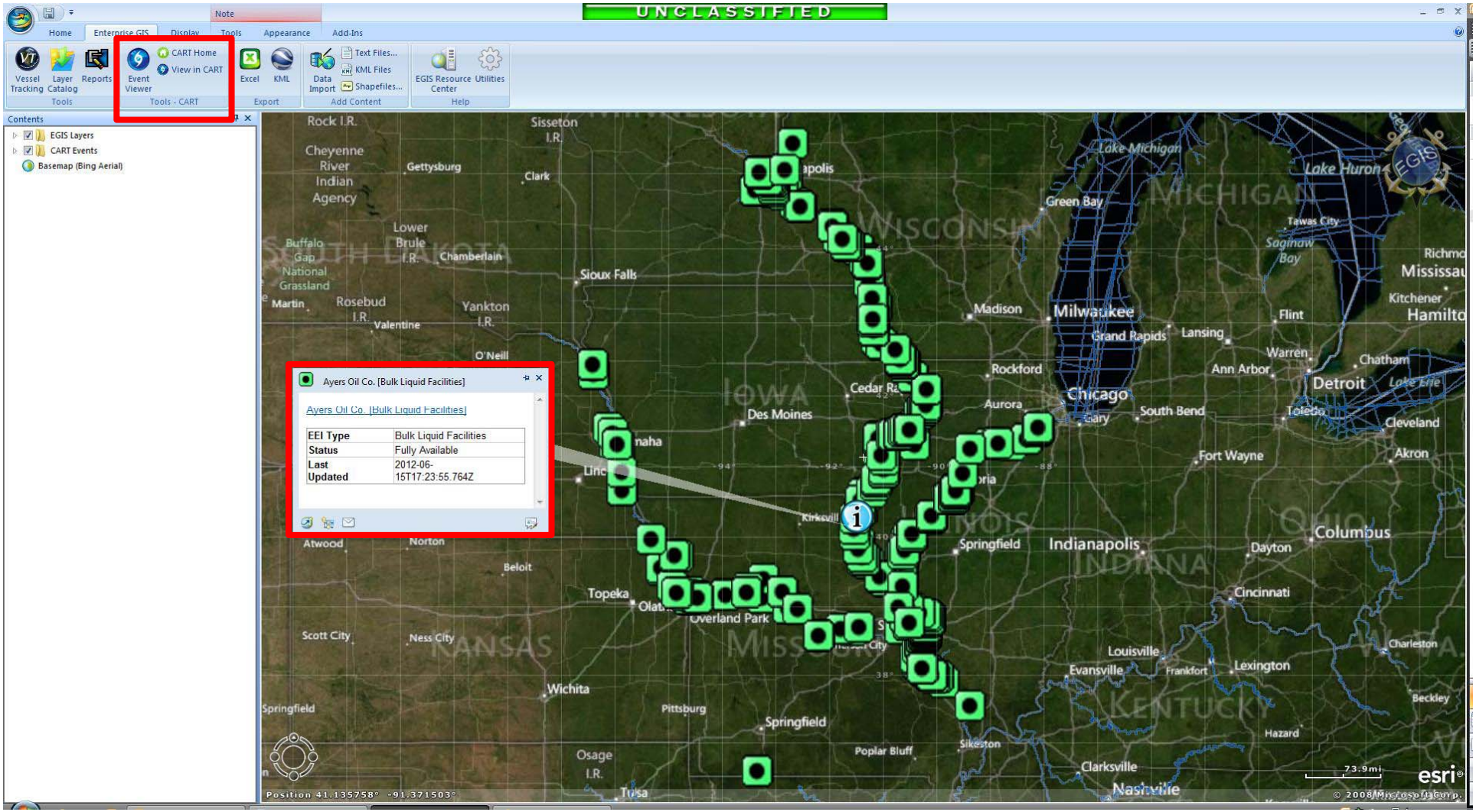


USCG Customized Capabilities
External Data Import

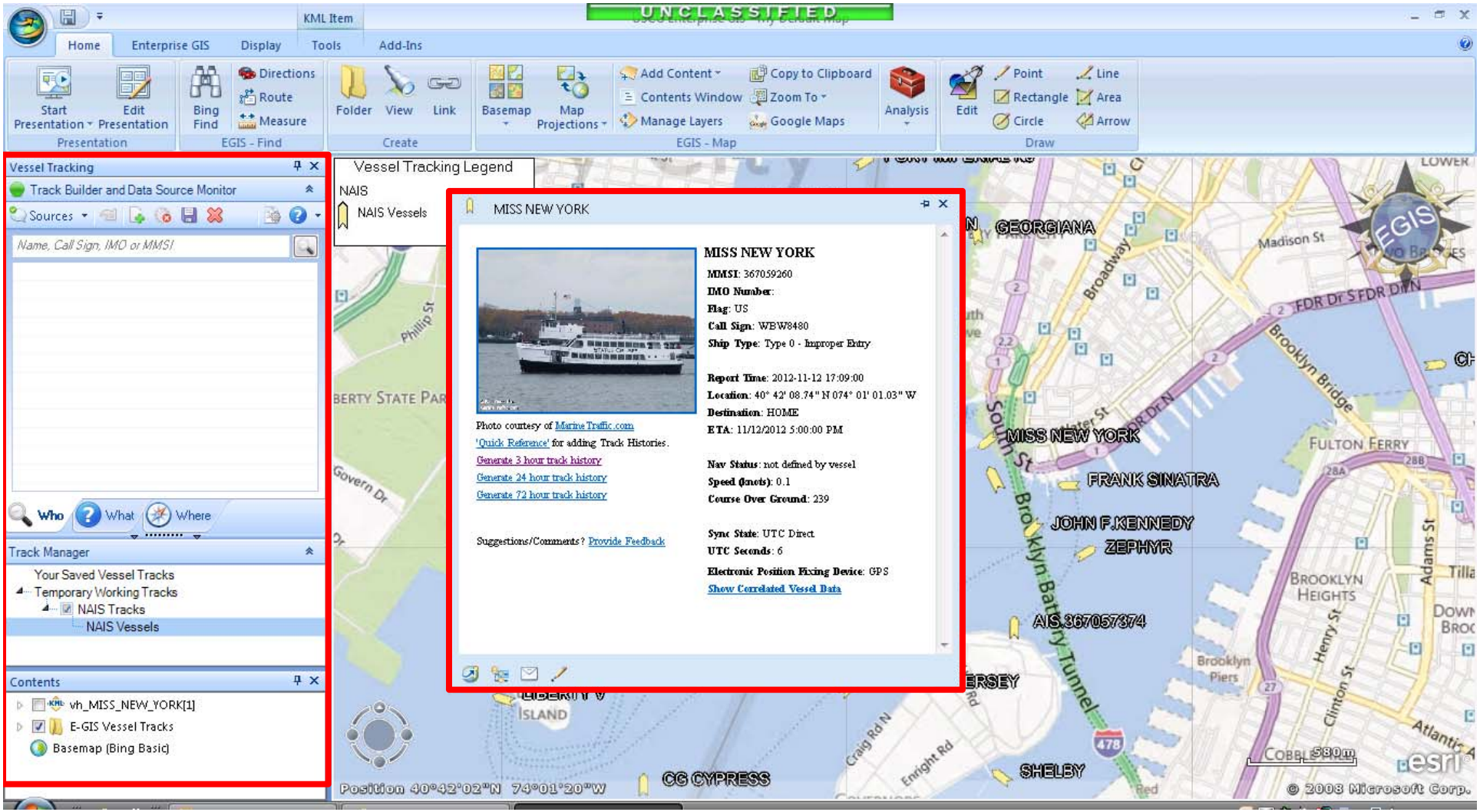


This example shows example of a locally held spreadsheet

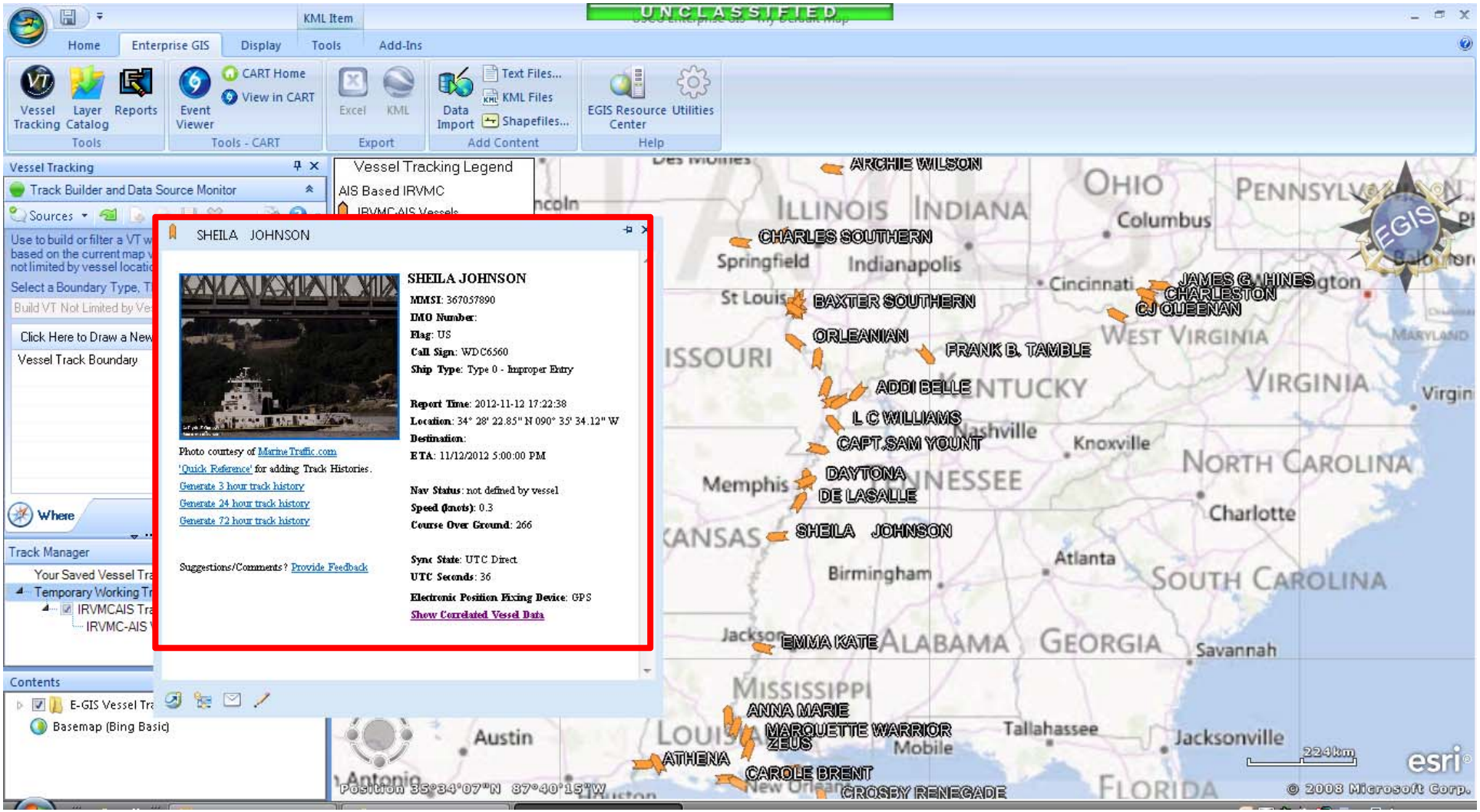
USCG Customized Capabilities
MTSR-CART Function



USCG Customized Capabilities
Vessel Tracks



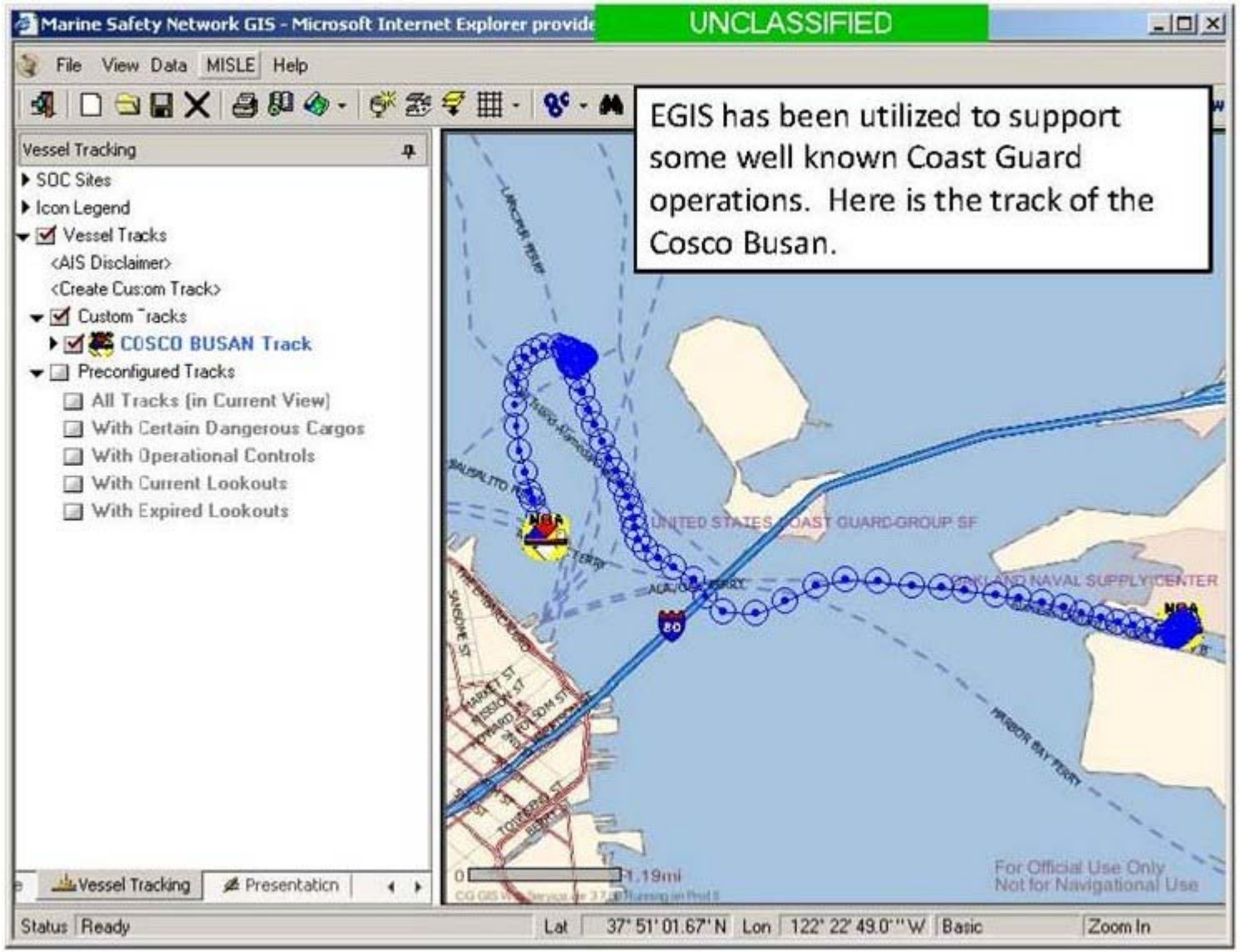
USCG Customized Capabilities
Vessel Tracks - NAIS



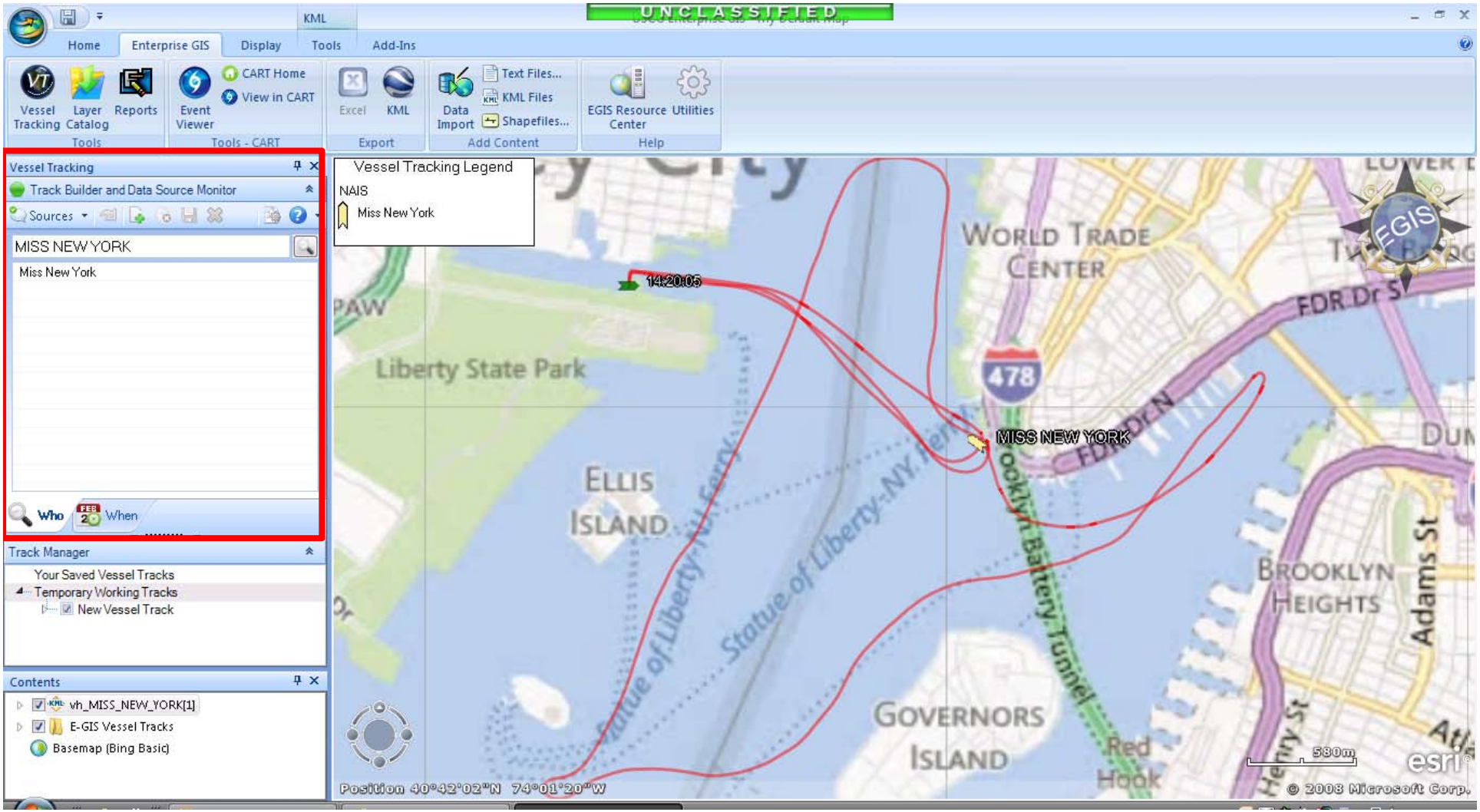
USCG Customized Capabilities
Vessel Track – Drill Through

USCG Customized Capabilities
Satellite-based AIS

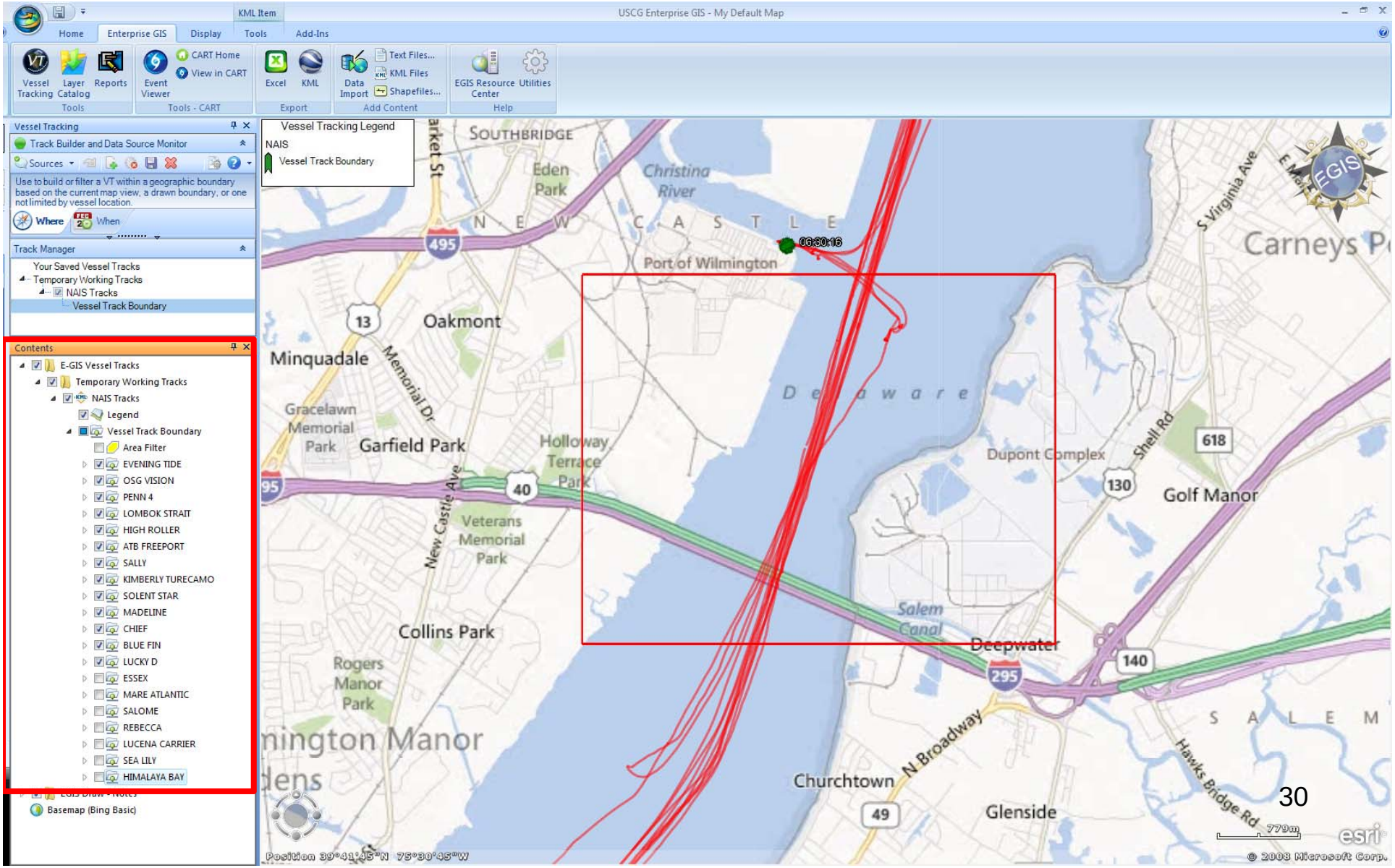
USCG Legacy Capabilities
Vessel Track Playback



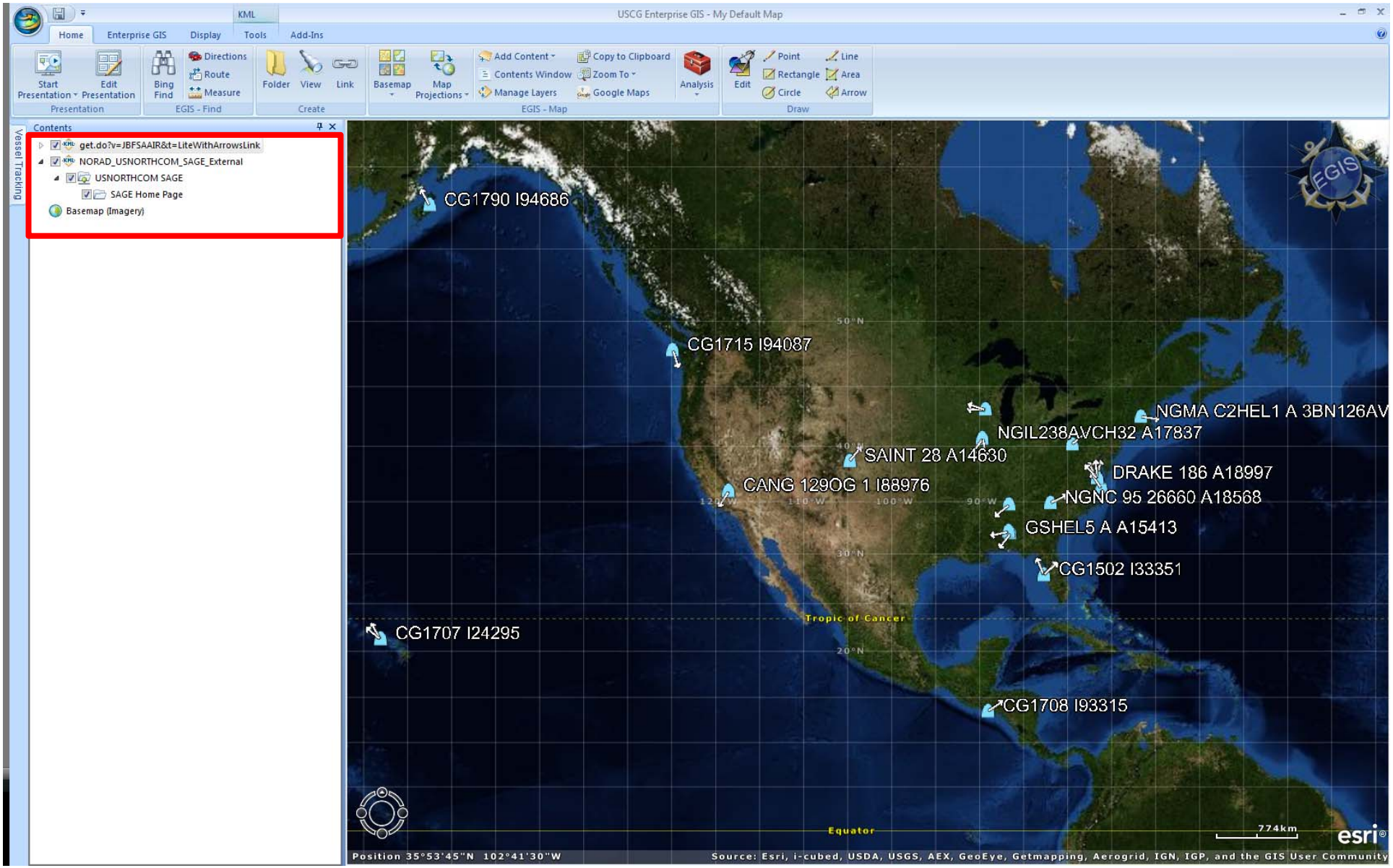
USCG New Customized Capabilities
Vessel Track Playback



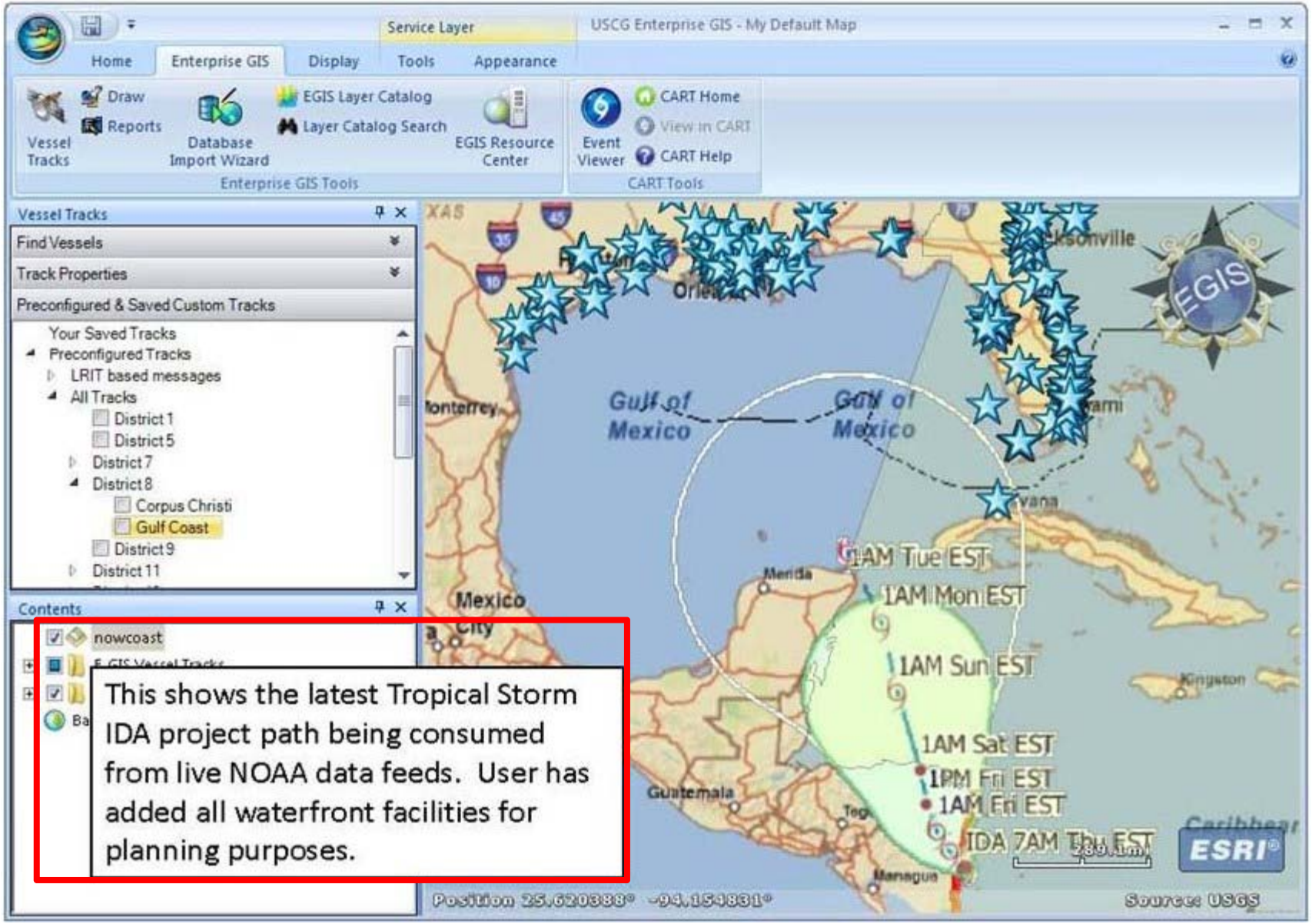
USCG Customized Capabilities
Area Transit



USCG Customized Capabilities
NORTHCOM Sage Consumption

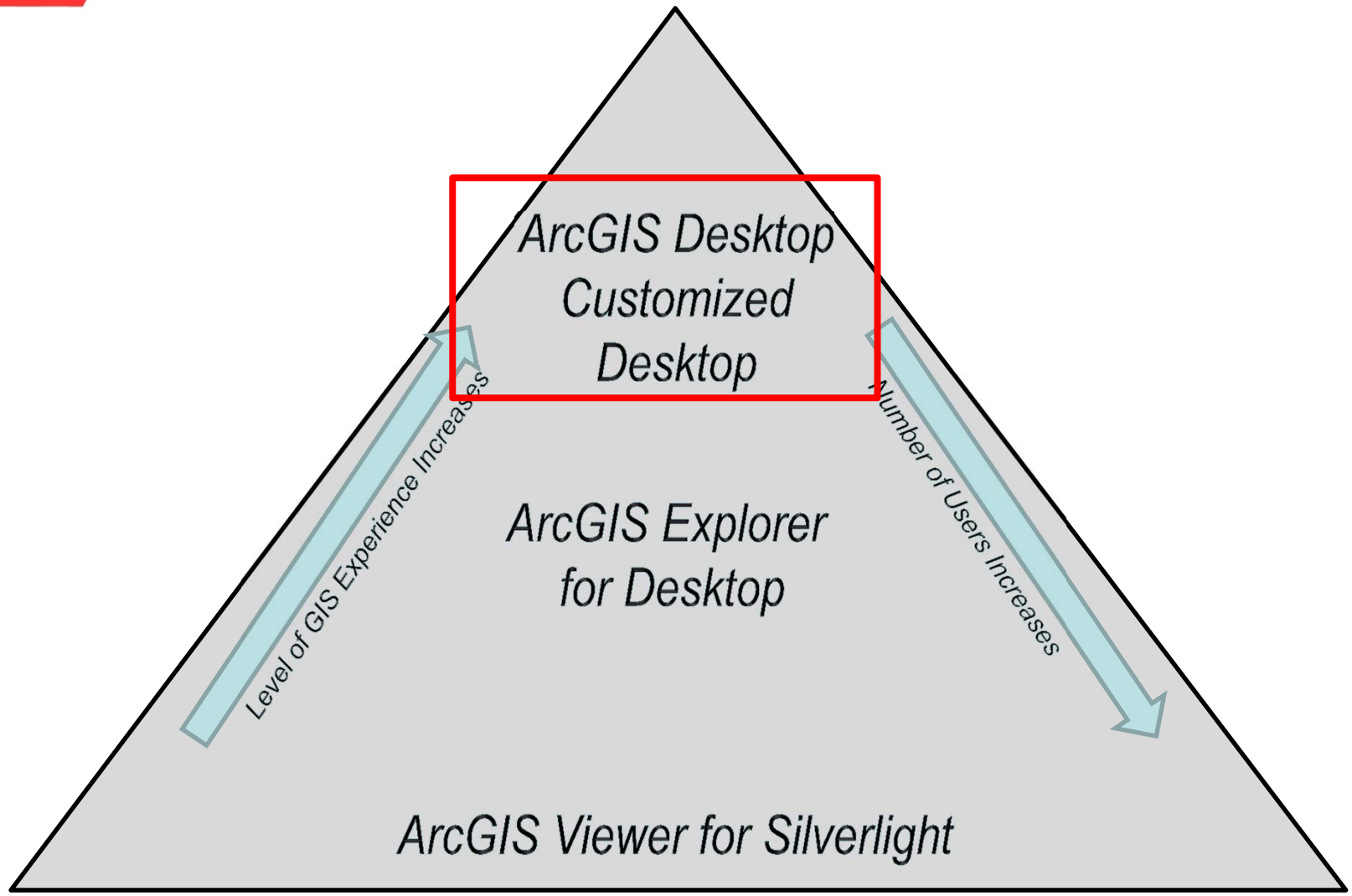


USCG Customized Capabilities
NORTHCOM Sage Consumption



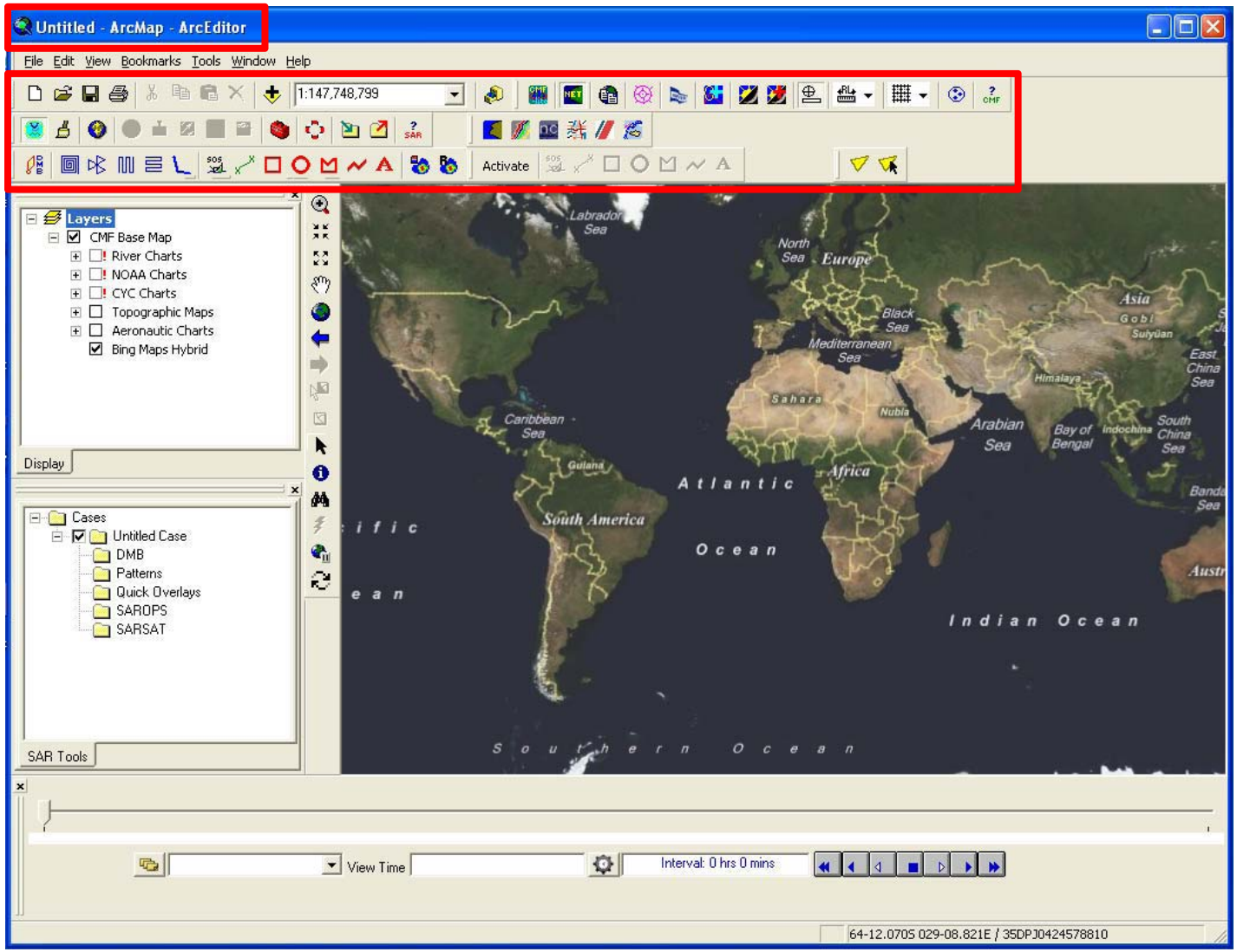
This shows the latest Tropical Storm IDA project path being consumed from live NOAA data feeds. User has added all waterfront facilities for planning purposes.

GIS Software Capability

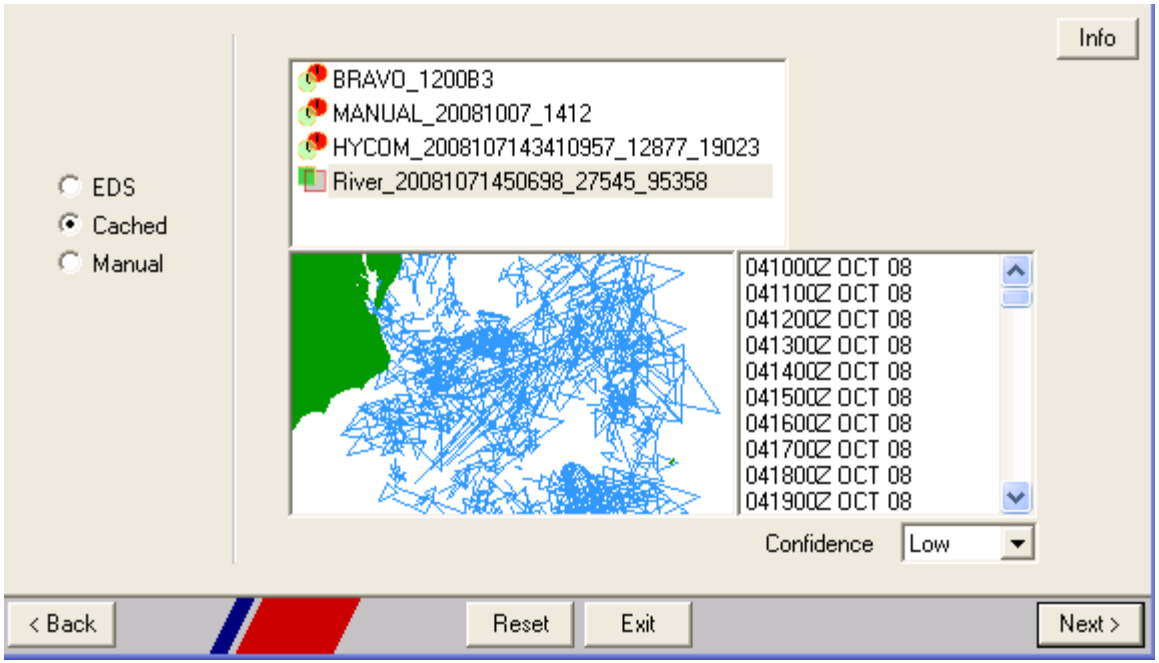


Conceptual model of GIS user community within United States Coast Guard.

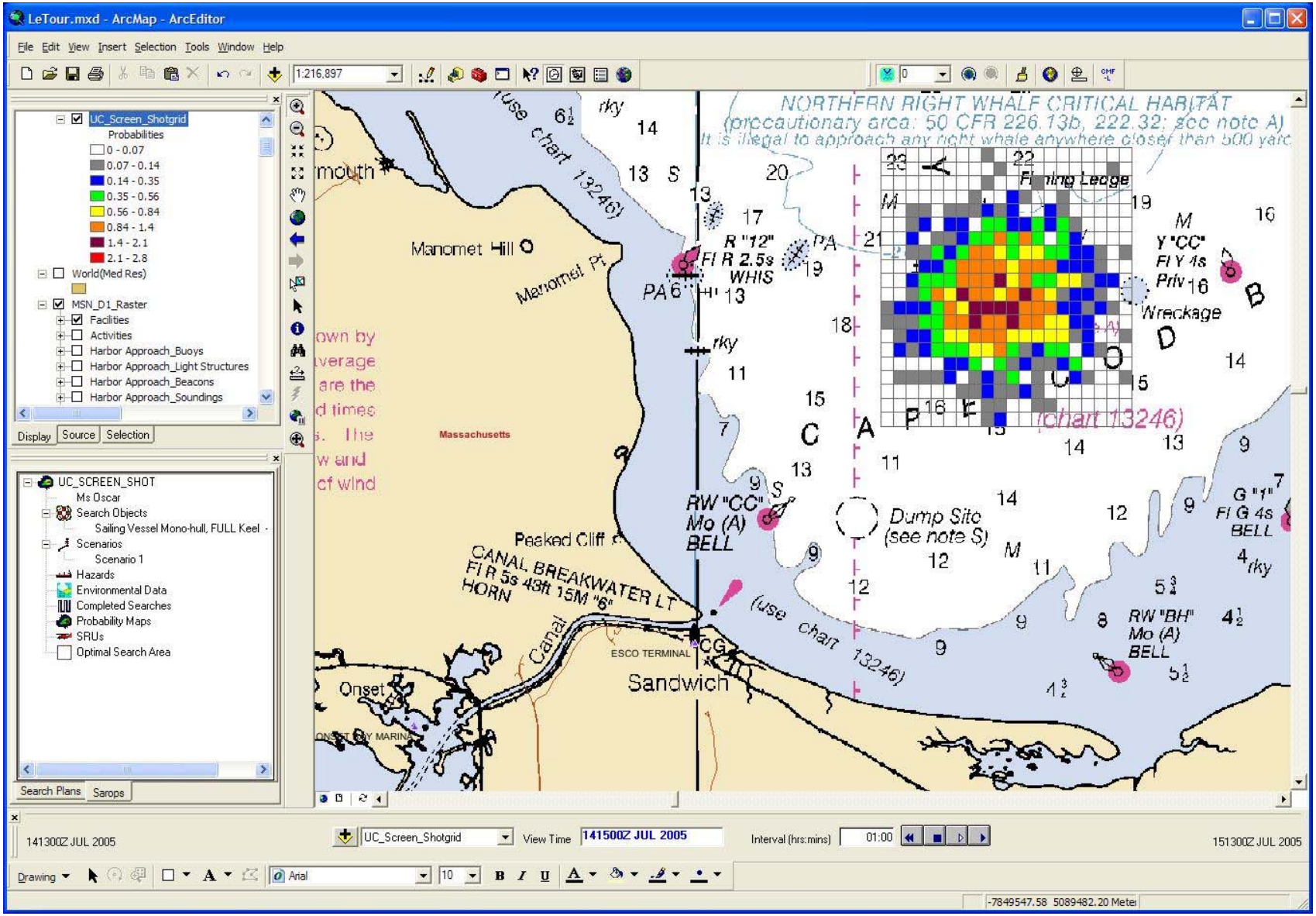
Search and Rescue Optimal Planning System (SAROPS)



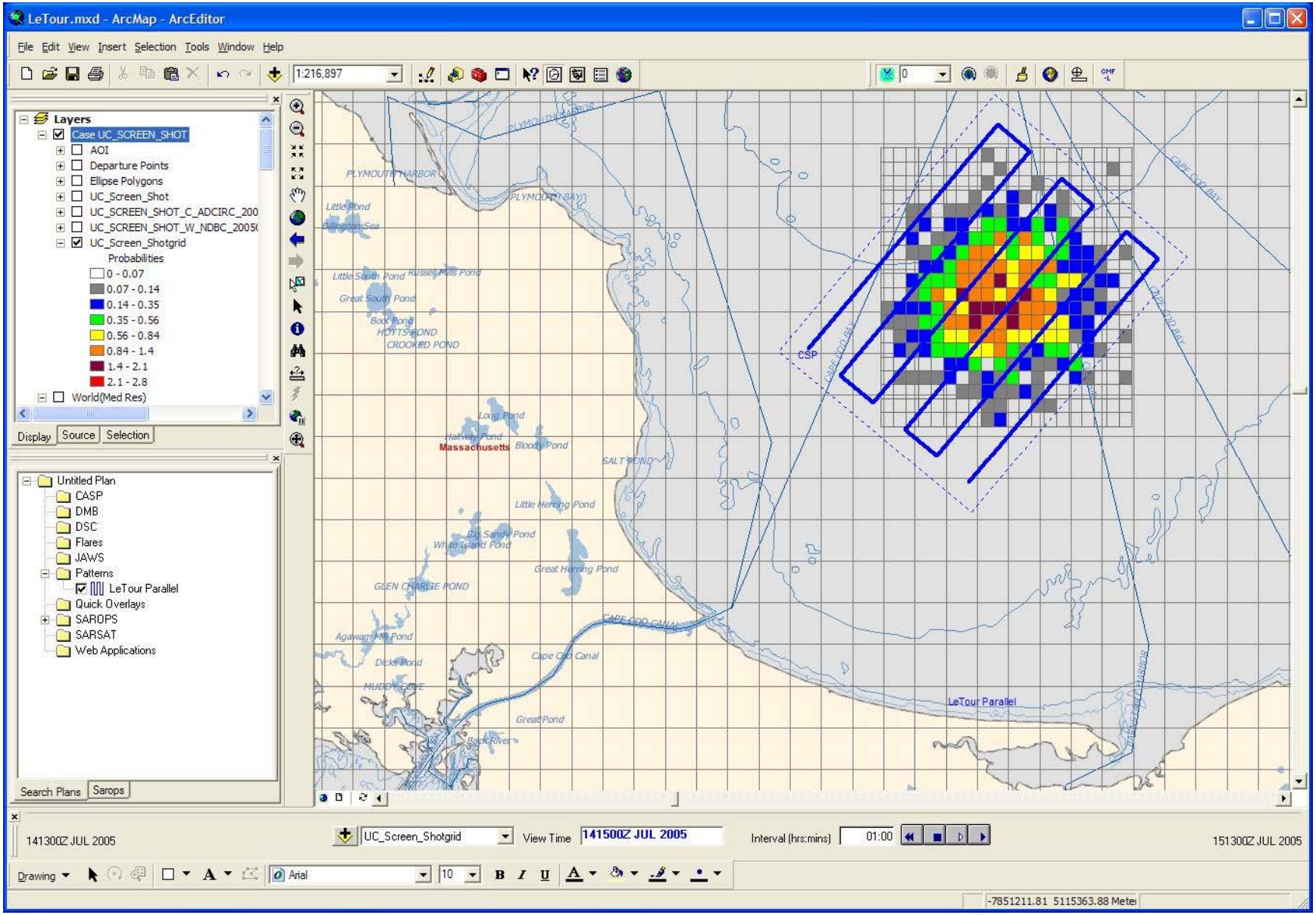
Search and Rescue Optimal Planning System (SAROPS) – Environmental Data Services



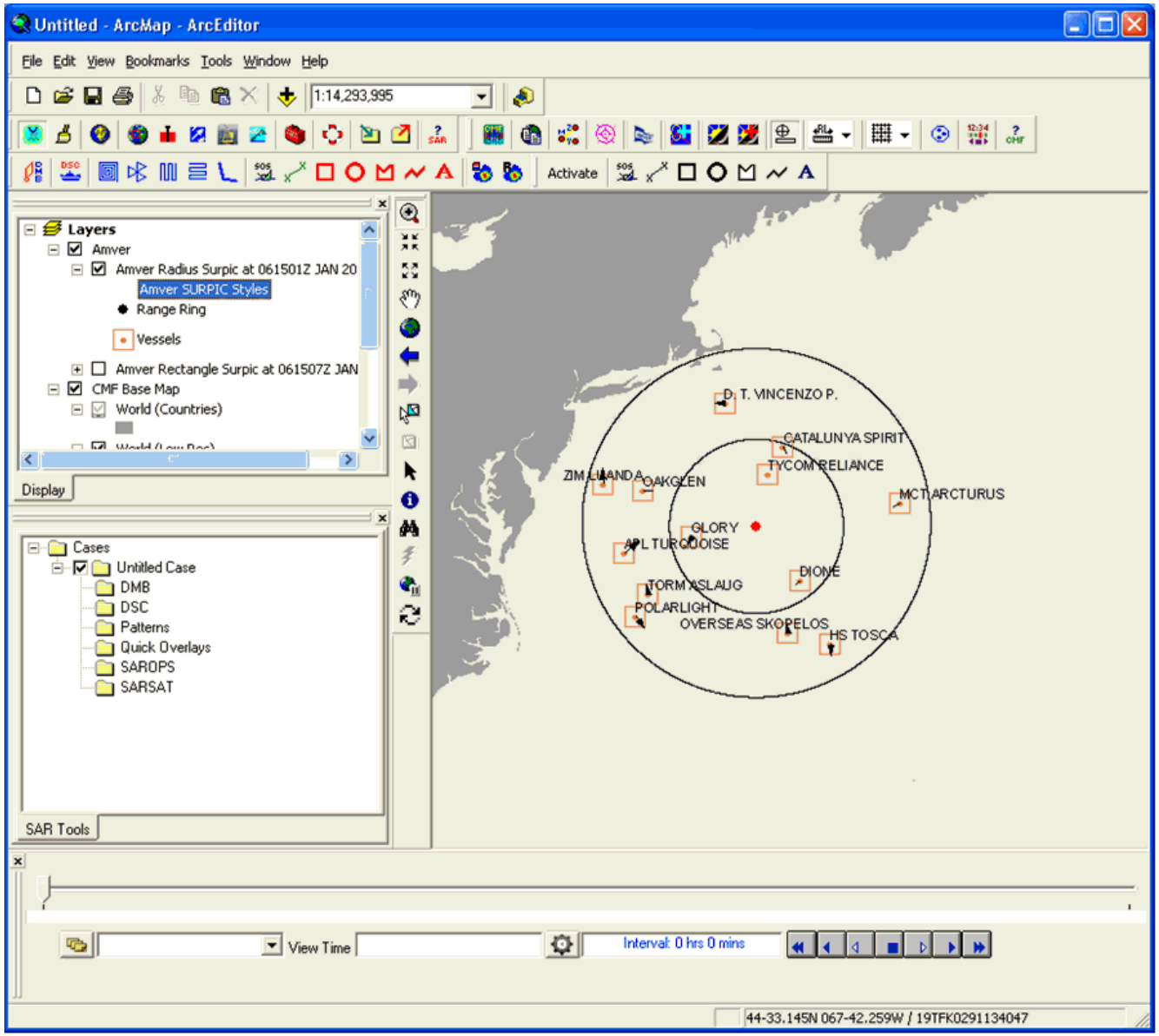
Search and Rescue Optimal Planning System (SAROPS) – Probability Grid



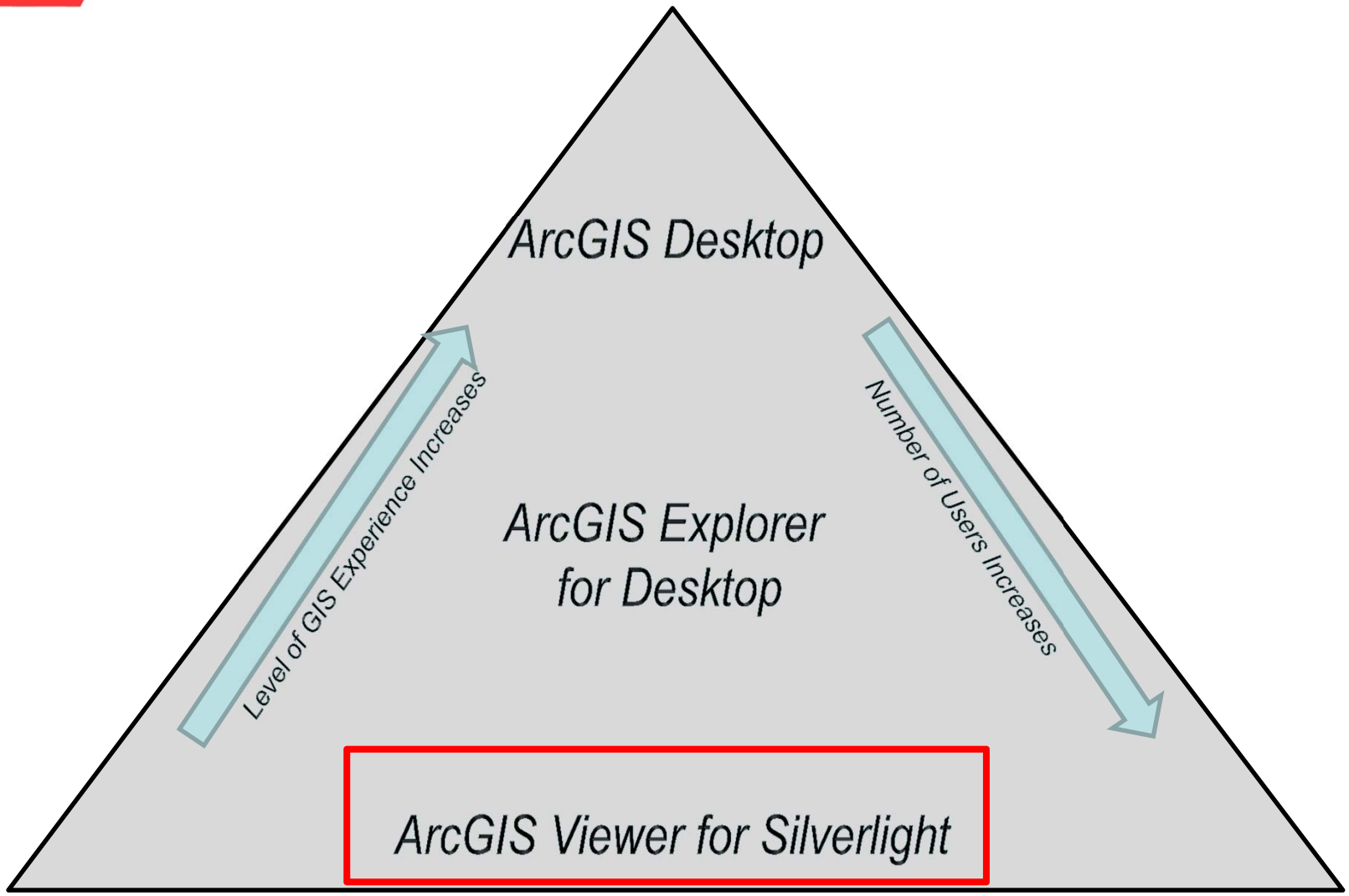
Search and Rescue Optimal Planning System (SAROPS) – Search Pattern



Search and Rescue Optimal Planning System (SAROPS) – AMVER Linkage

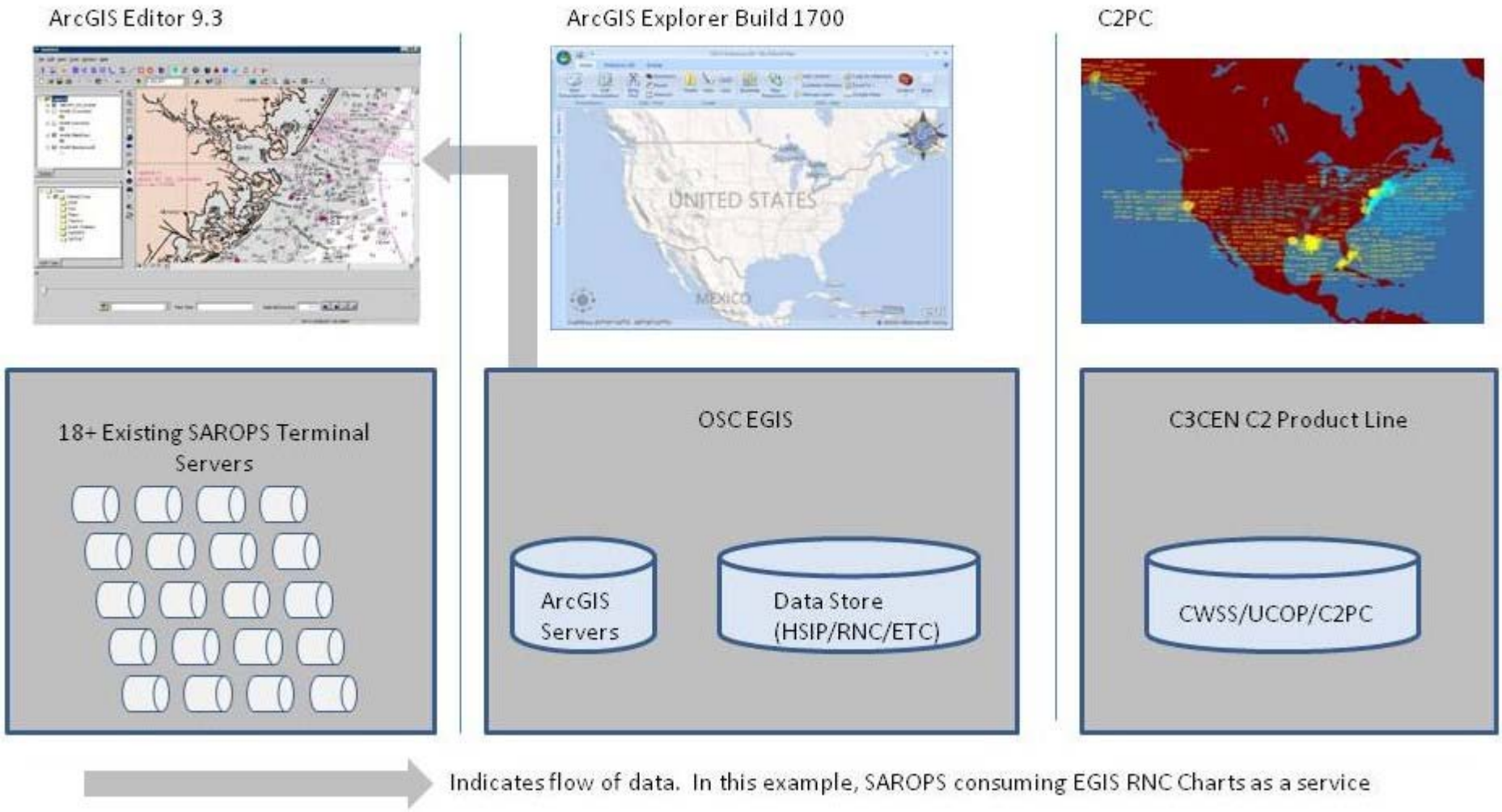


GIS Software Capability

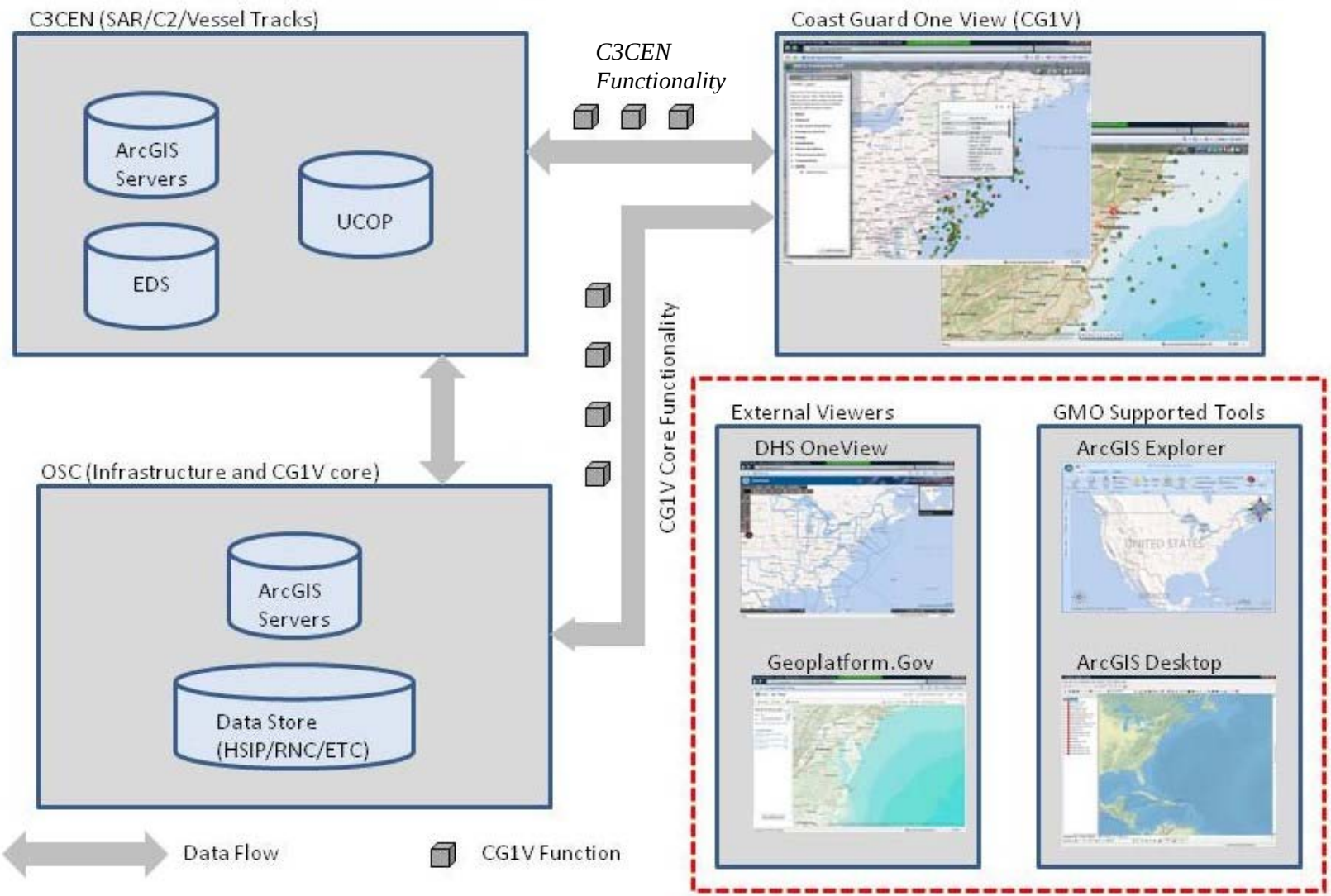


Conceptual model of GIS user community within United States Coast Guard.

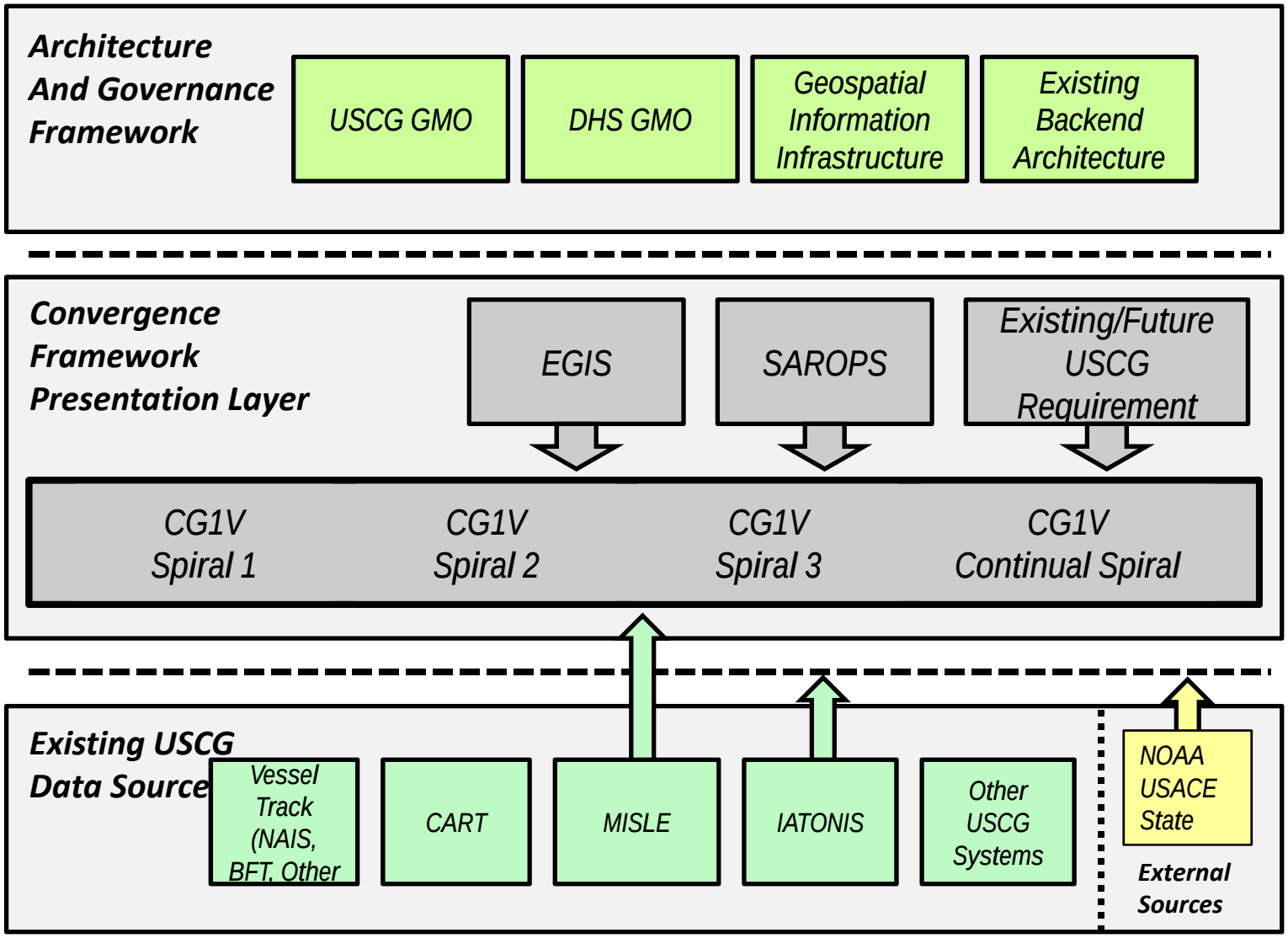
Coast Guard GIS - Current



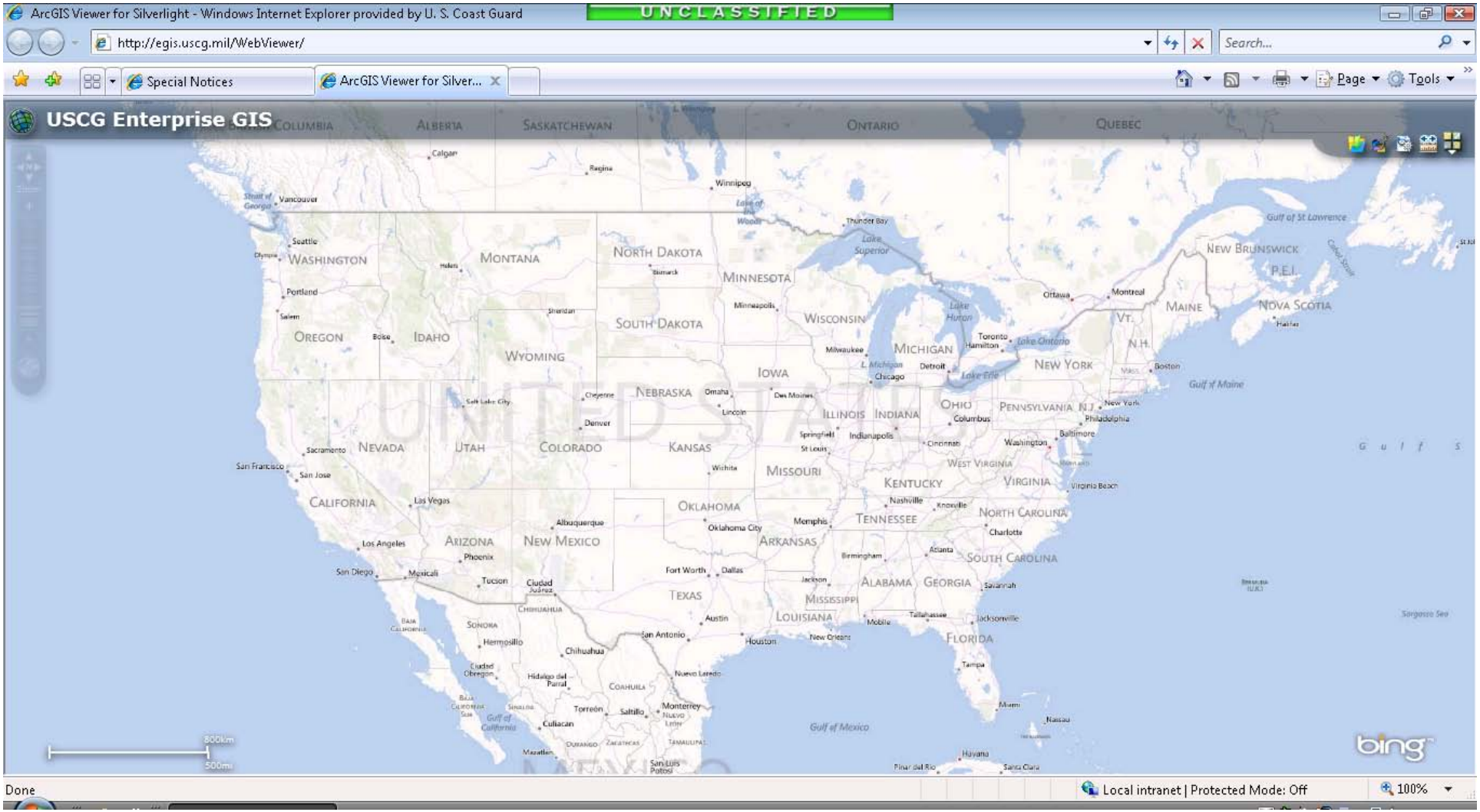
Coast Guard GIS - Future



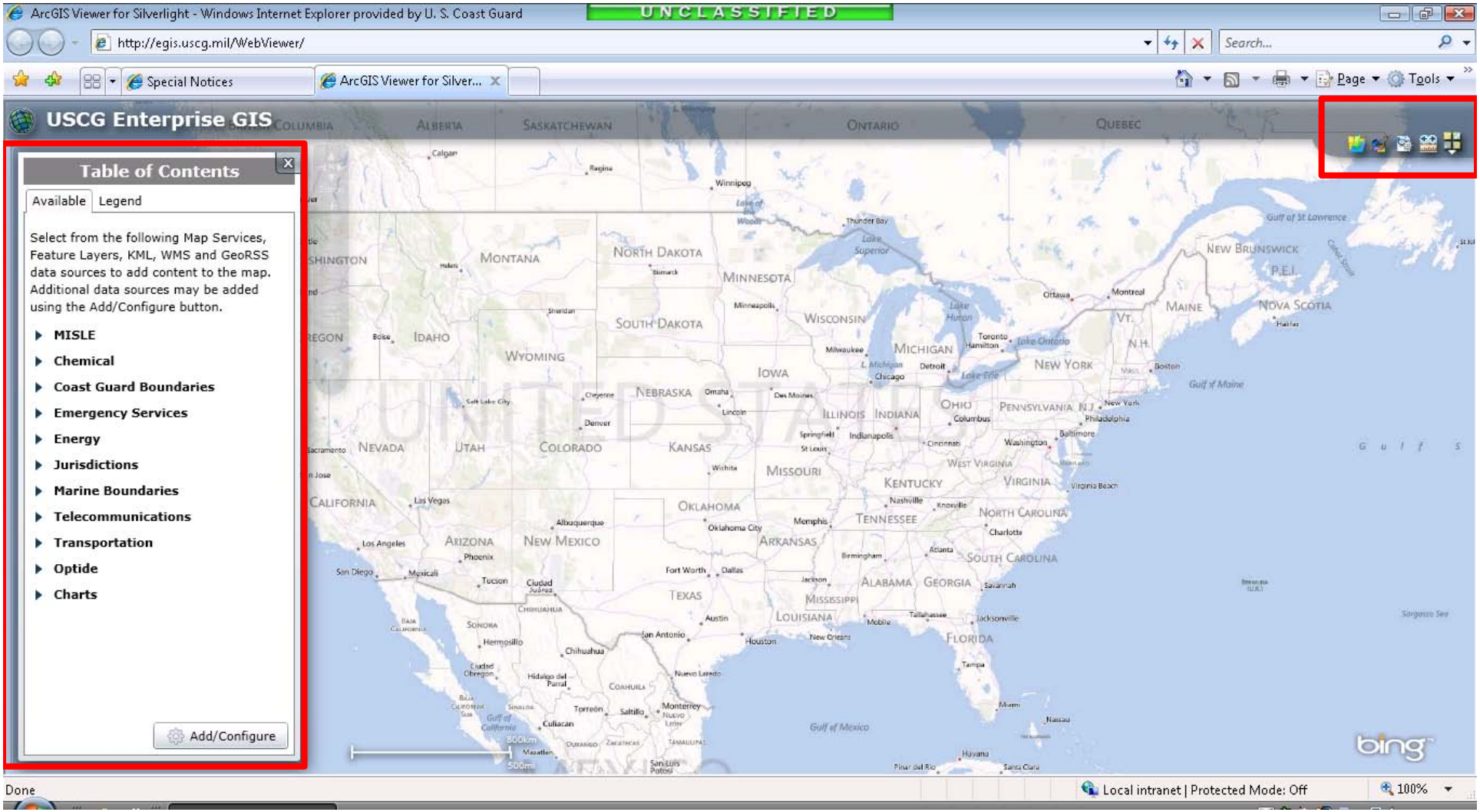
Coast Guard GIS – CG1V



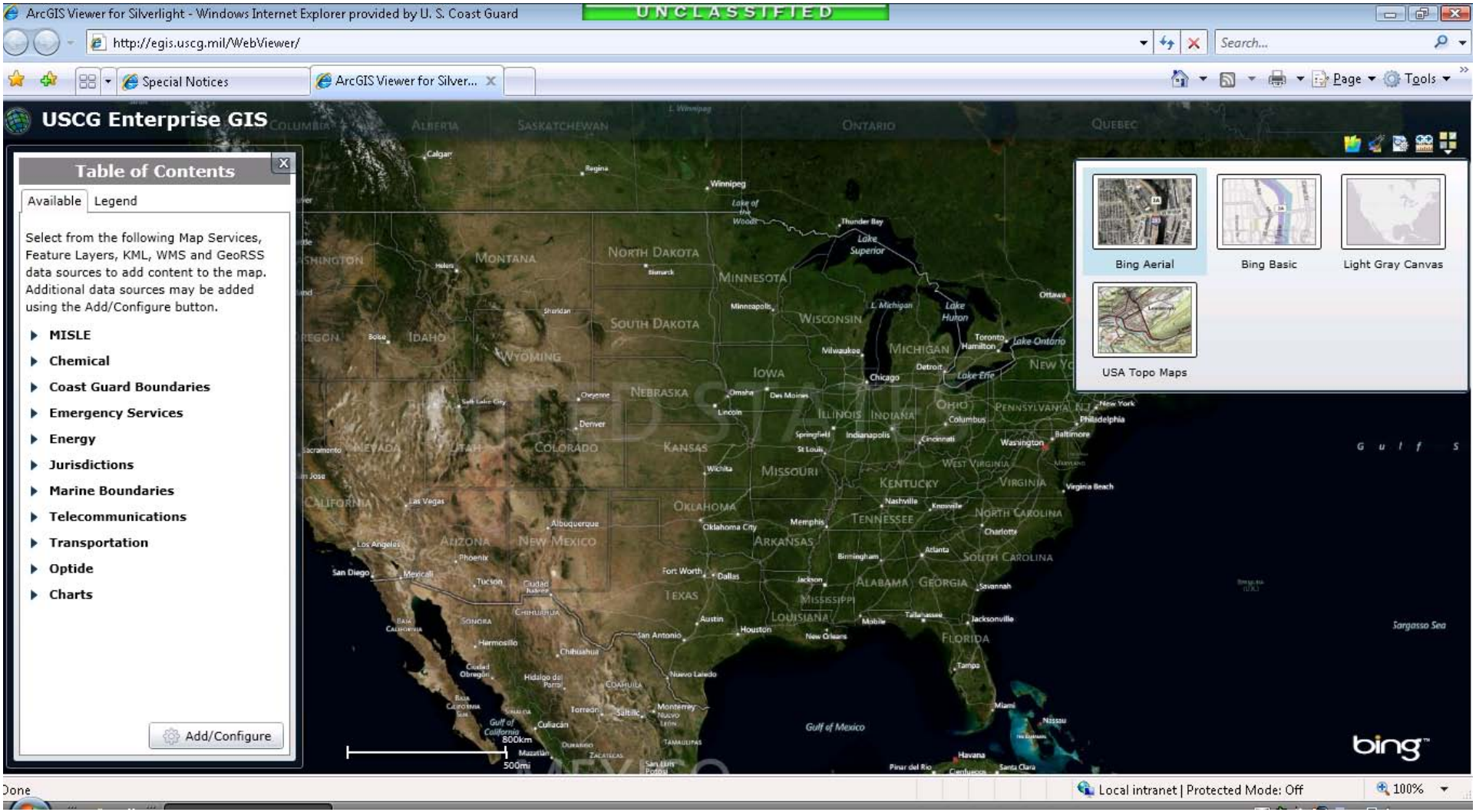
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



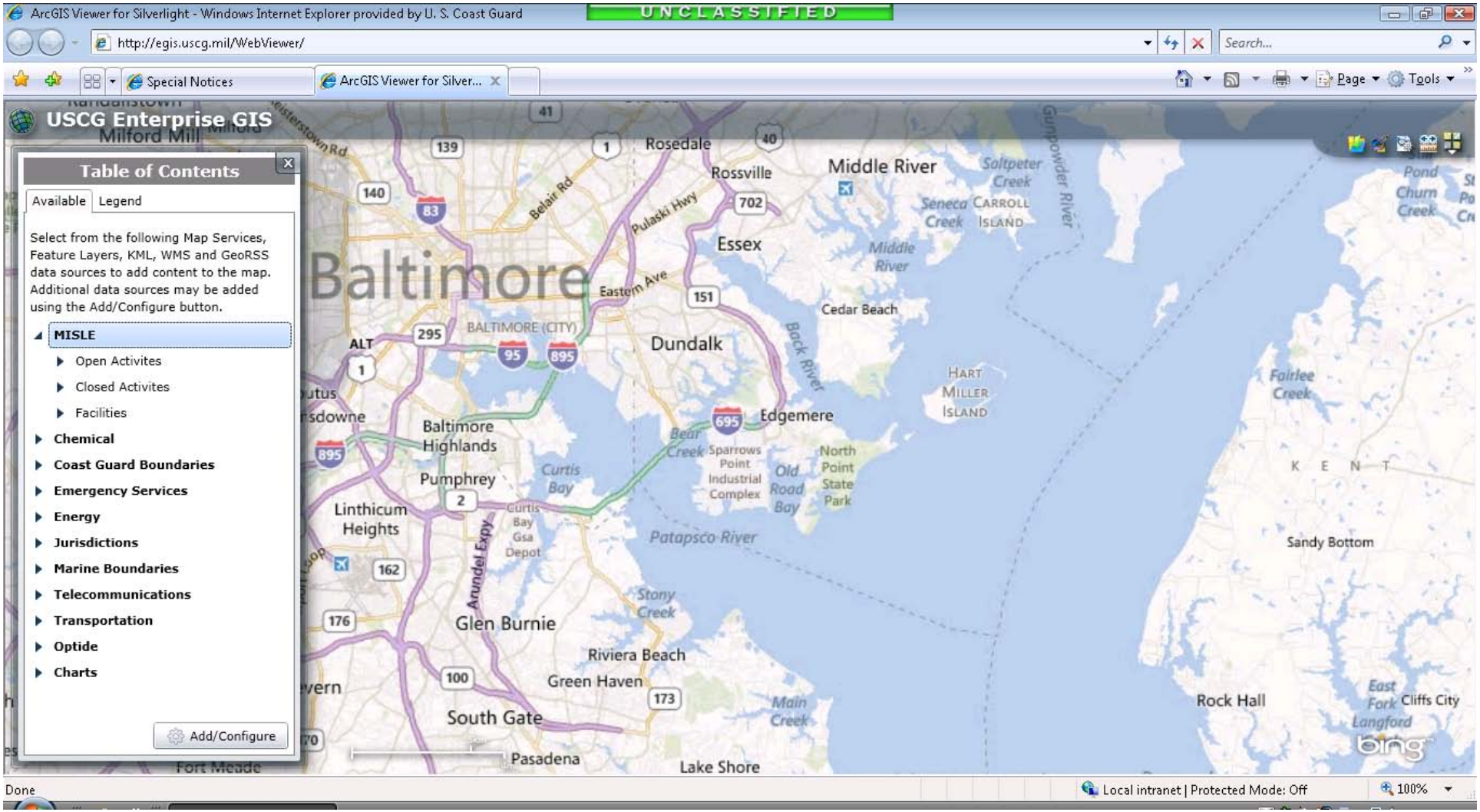
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



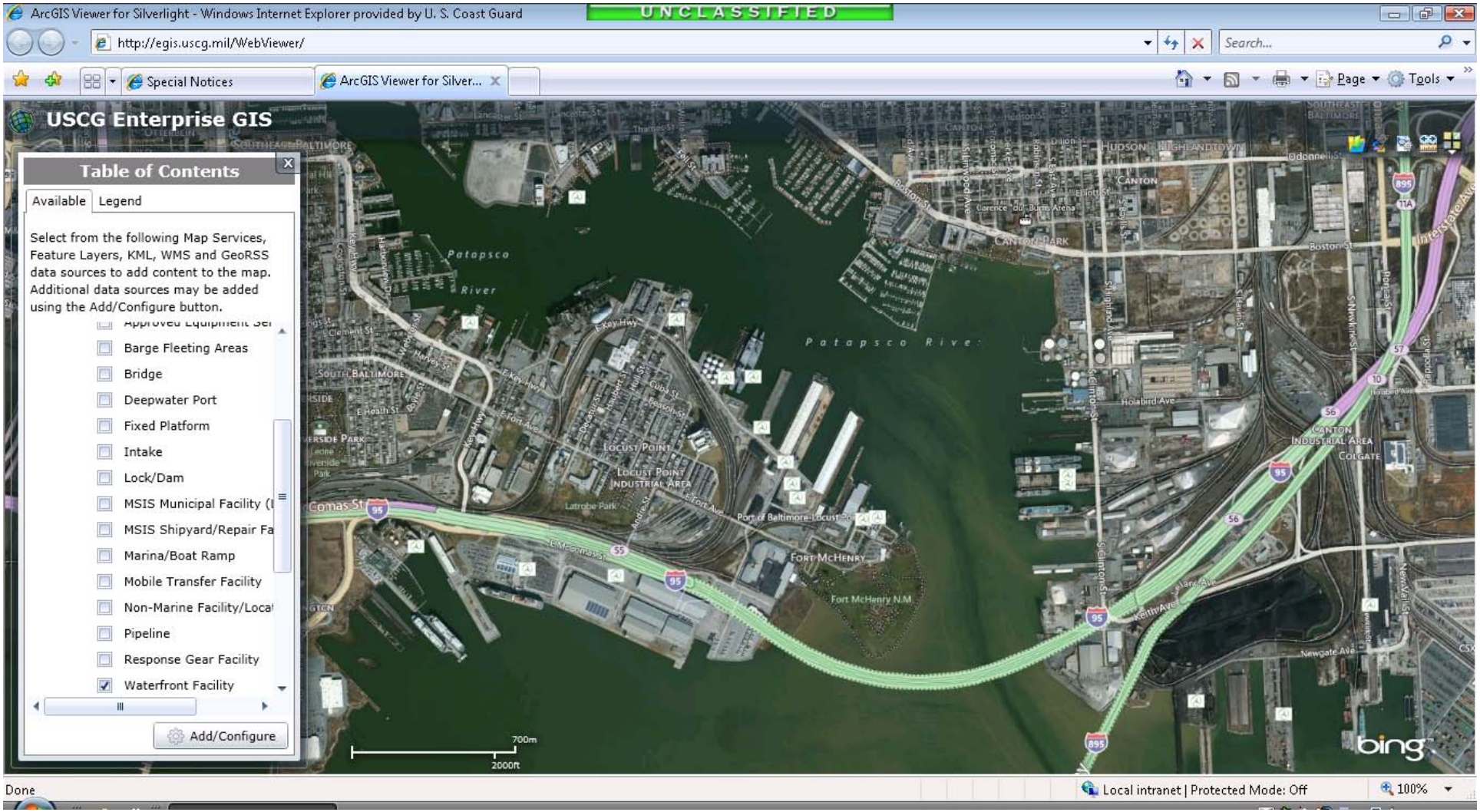
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



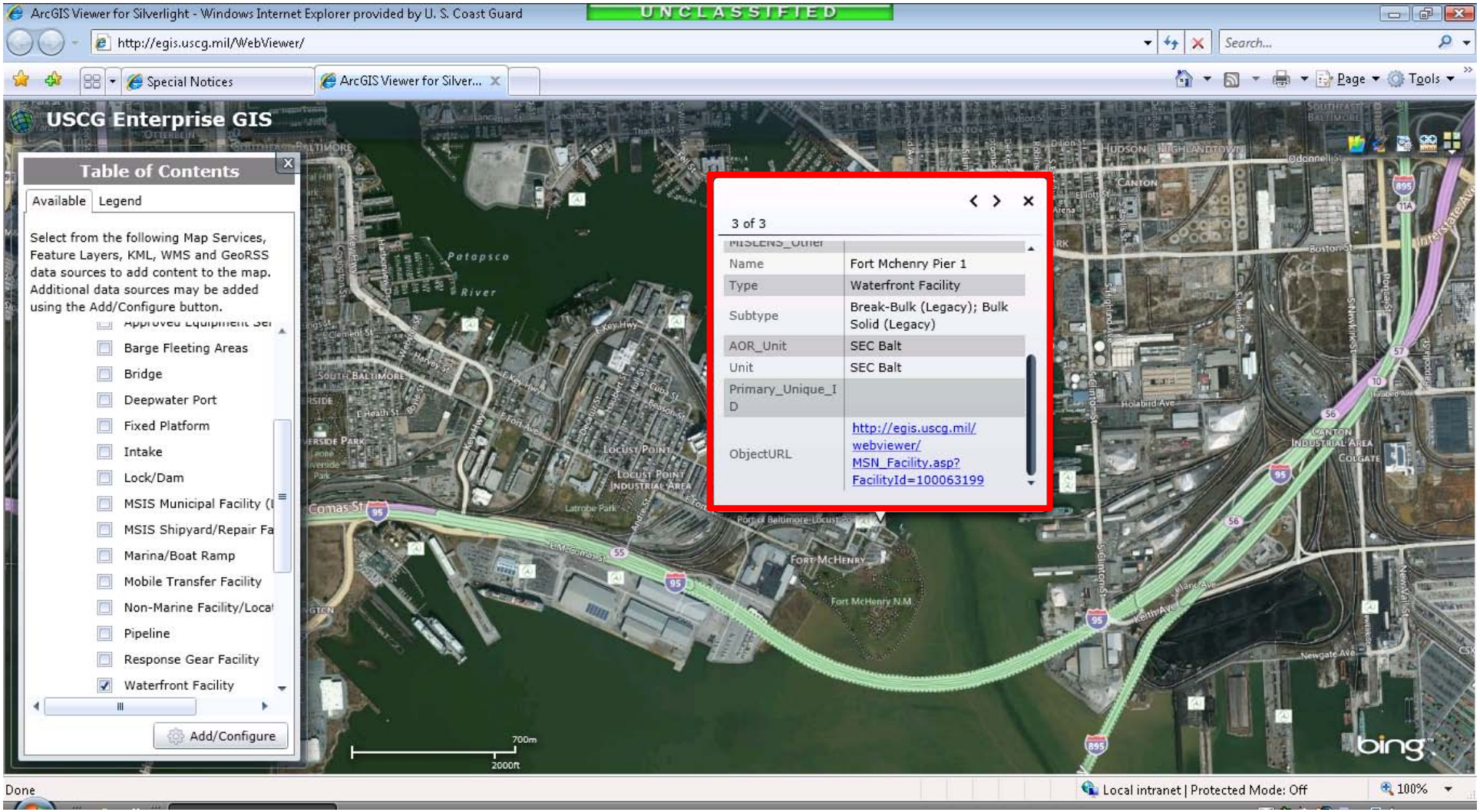
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



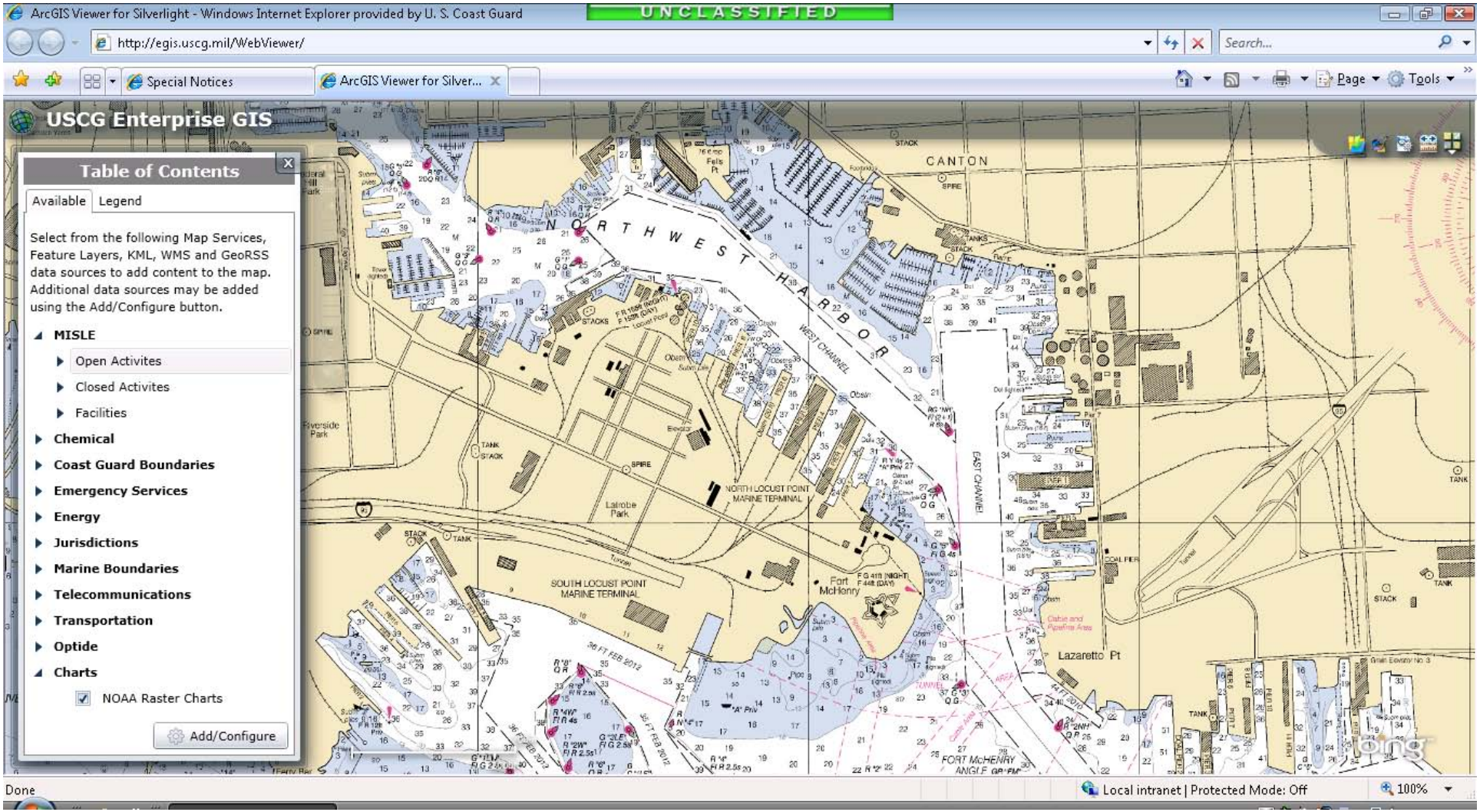
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



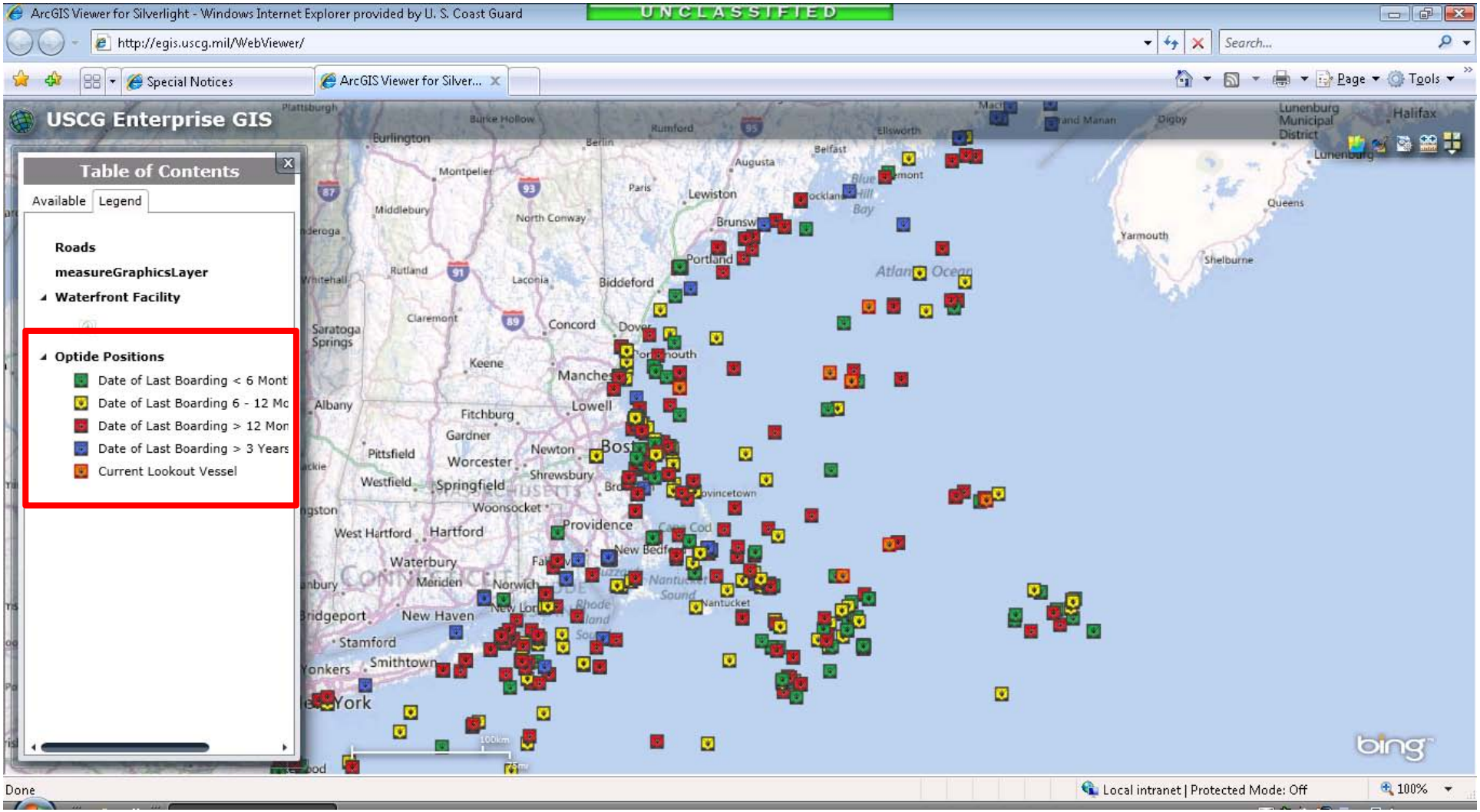
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



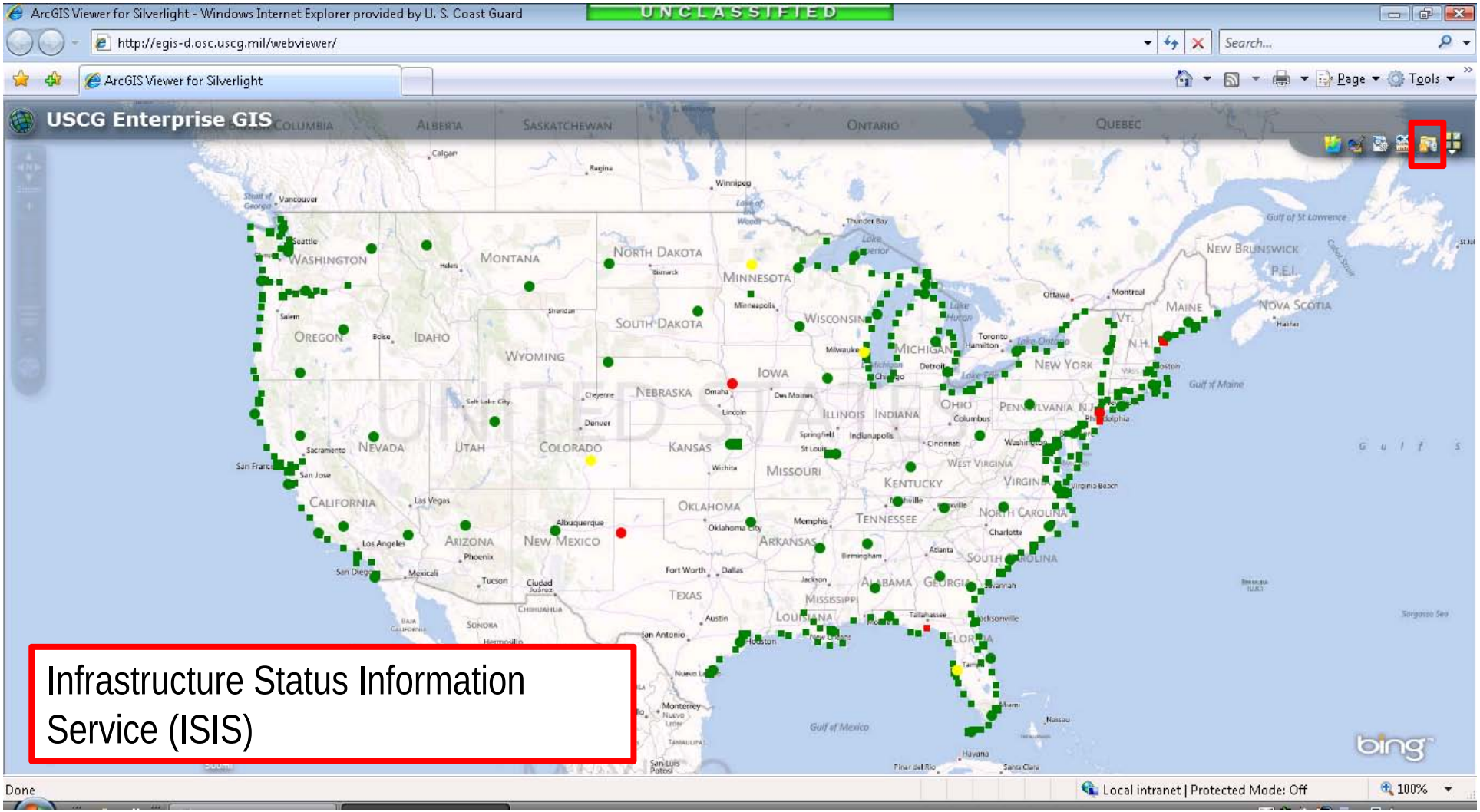
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



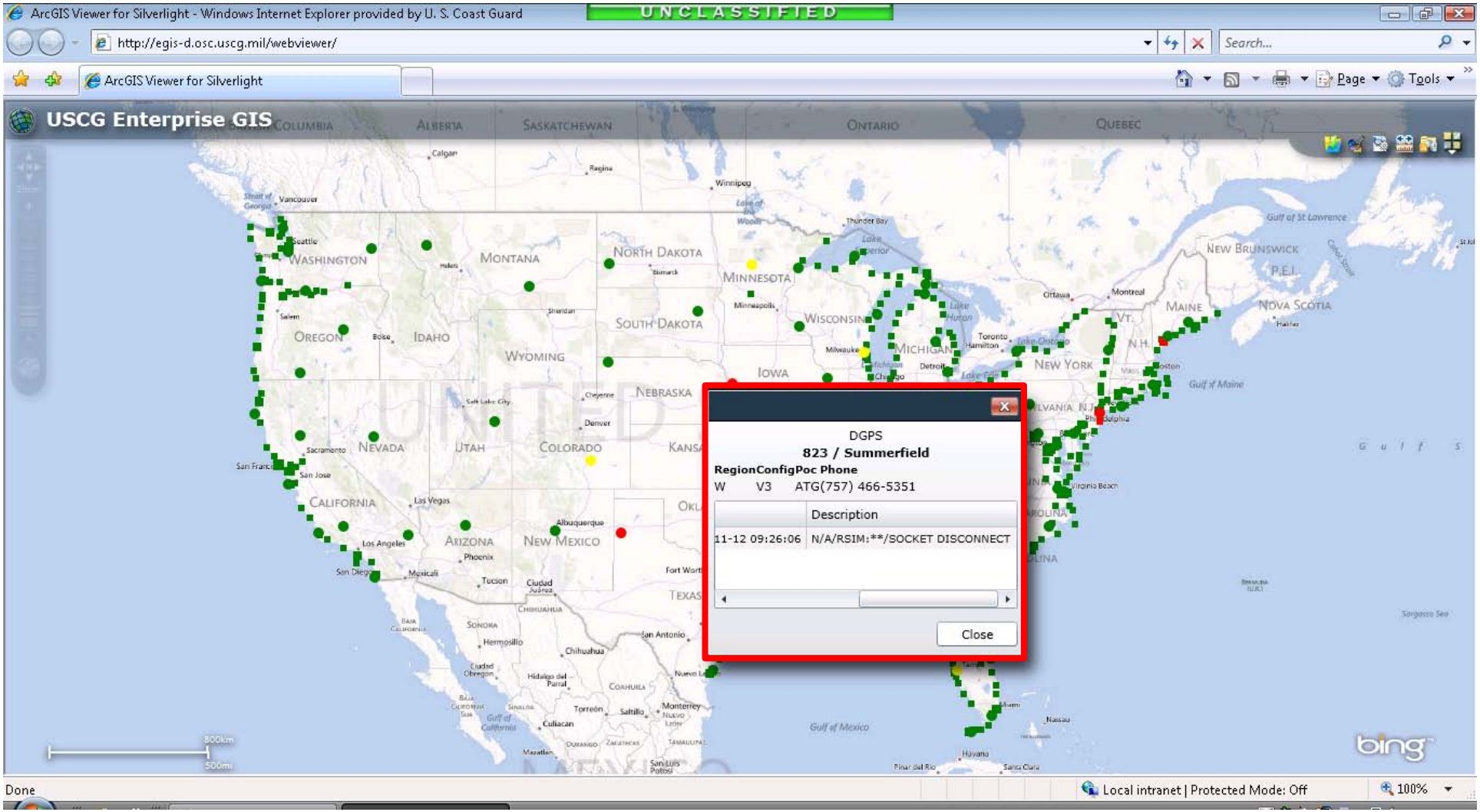
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



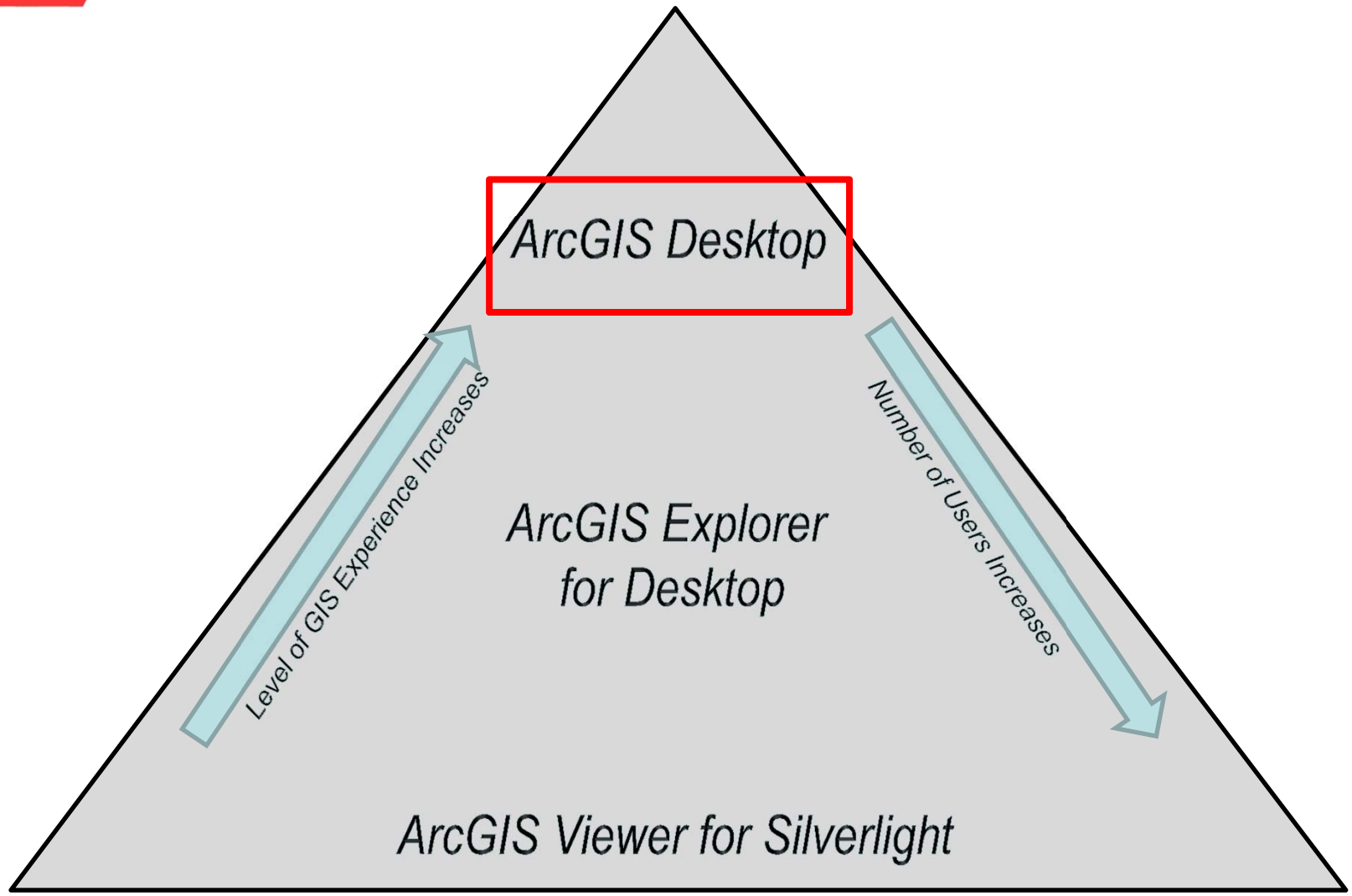
Coast Guard One View (CG1V)
Silverlight-based Common Viewer



Coast Guard One View (CG1V)
Silverlight-based Common Viewer



GIS Software Capability



Conceptual model of GIS user community within United States Coast Guard.

Coast Guard GIS – Advanced Use

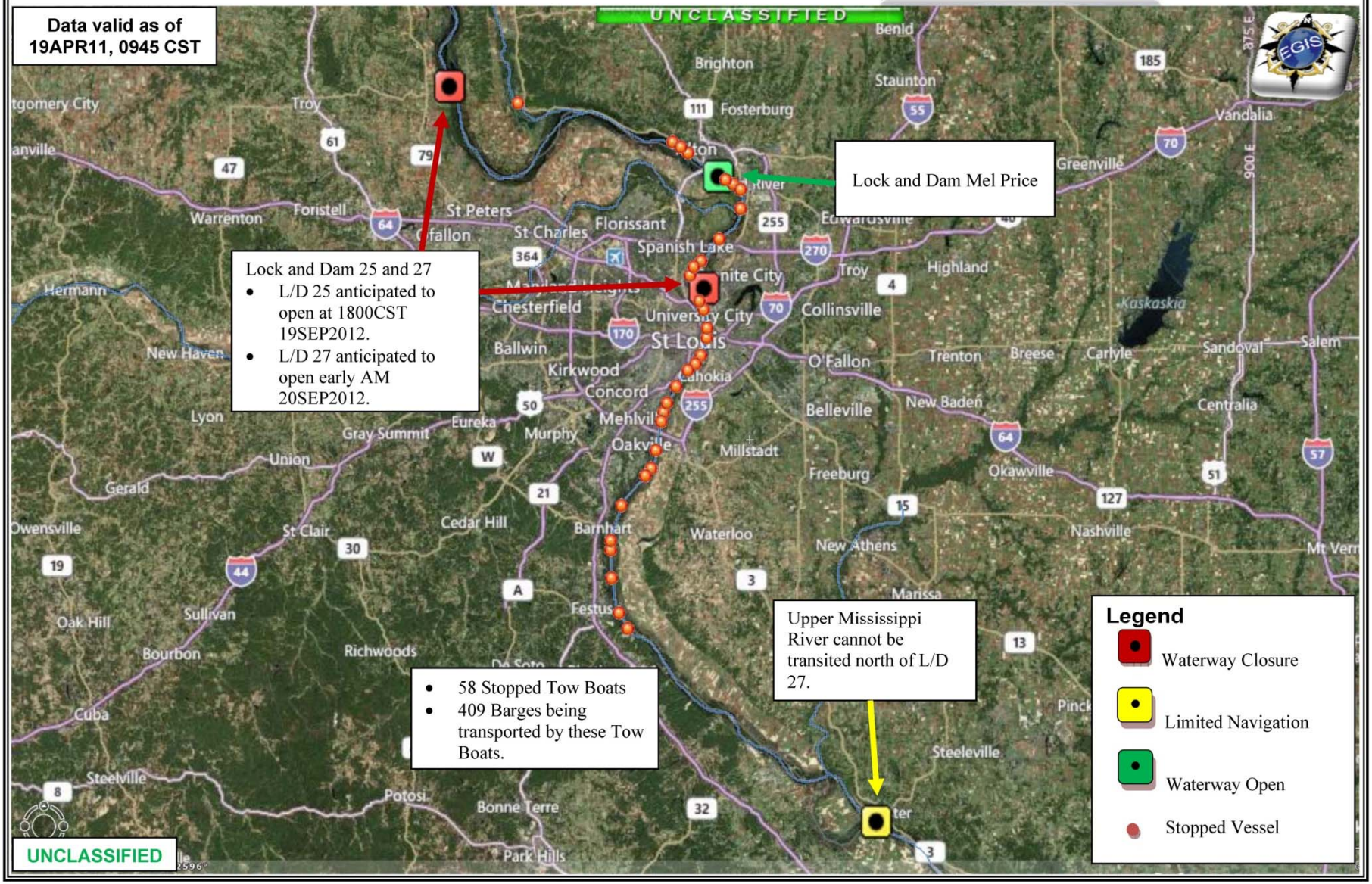
- Currently leverage DHS ELA with Esri
  - Unclassified
  - Classified
- Software available to all Coast Guard users
  - Moving to ArcGIS 10/10.1
  - Access includes extensions
  - Will use concurrent use model – users can checkout license on a quarterly basis
- Training
  - Available via Esri Virtual Campus
  - NGA Training

SECTOR UPPER MISSISSIPPI MTS STATUS

Upper Mississippi River from Mile Marker 185.5 (L/D 27)

CART data provided by SUMR

UNCLASSIFIED



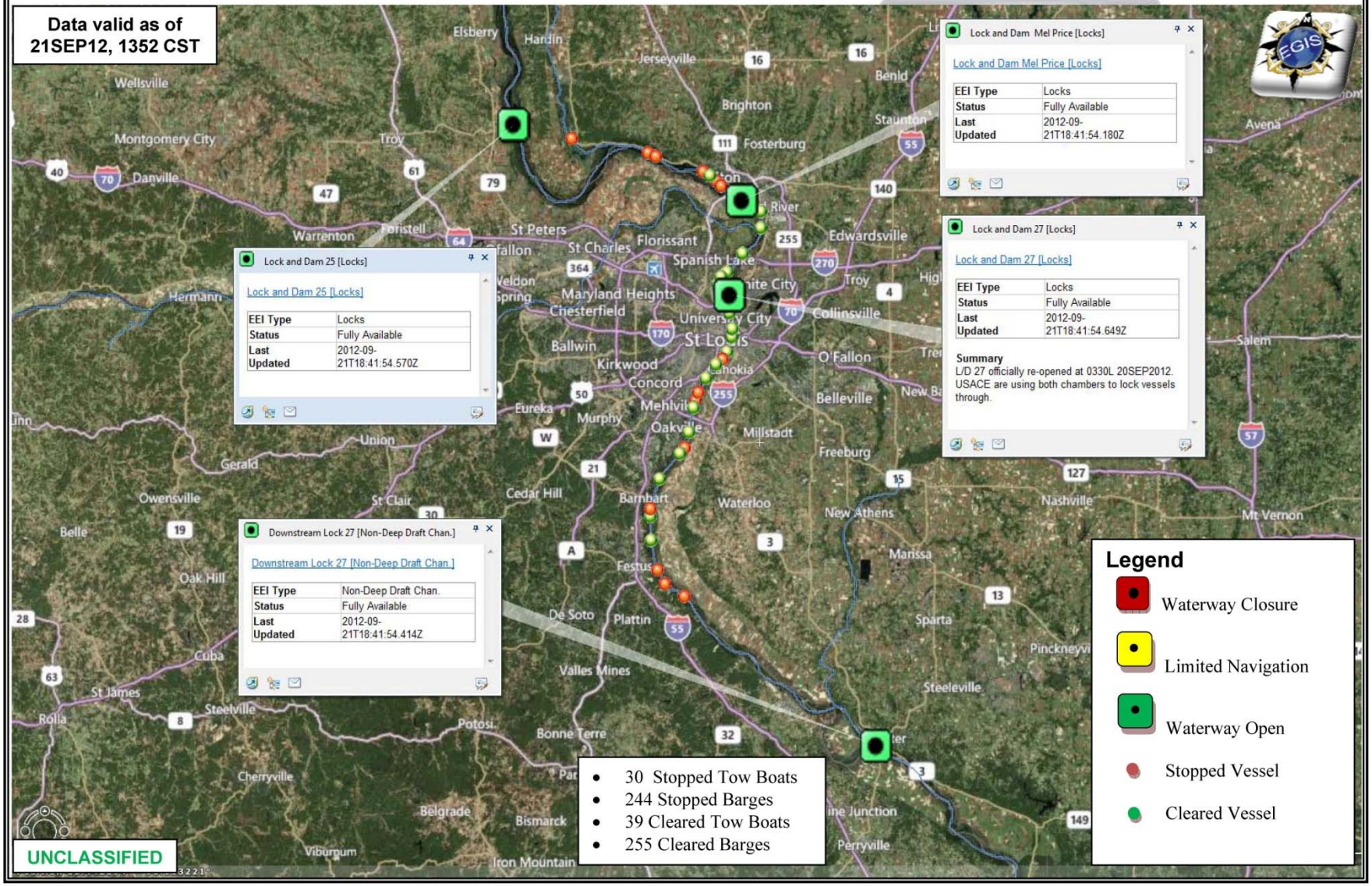
SECTOR UPPER MISSISSIPPI MTS STATUS

Upper Mississippi River Mile Marker 185.5 (L/D 27)

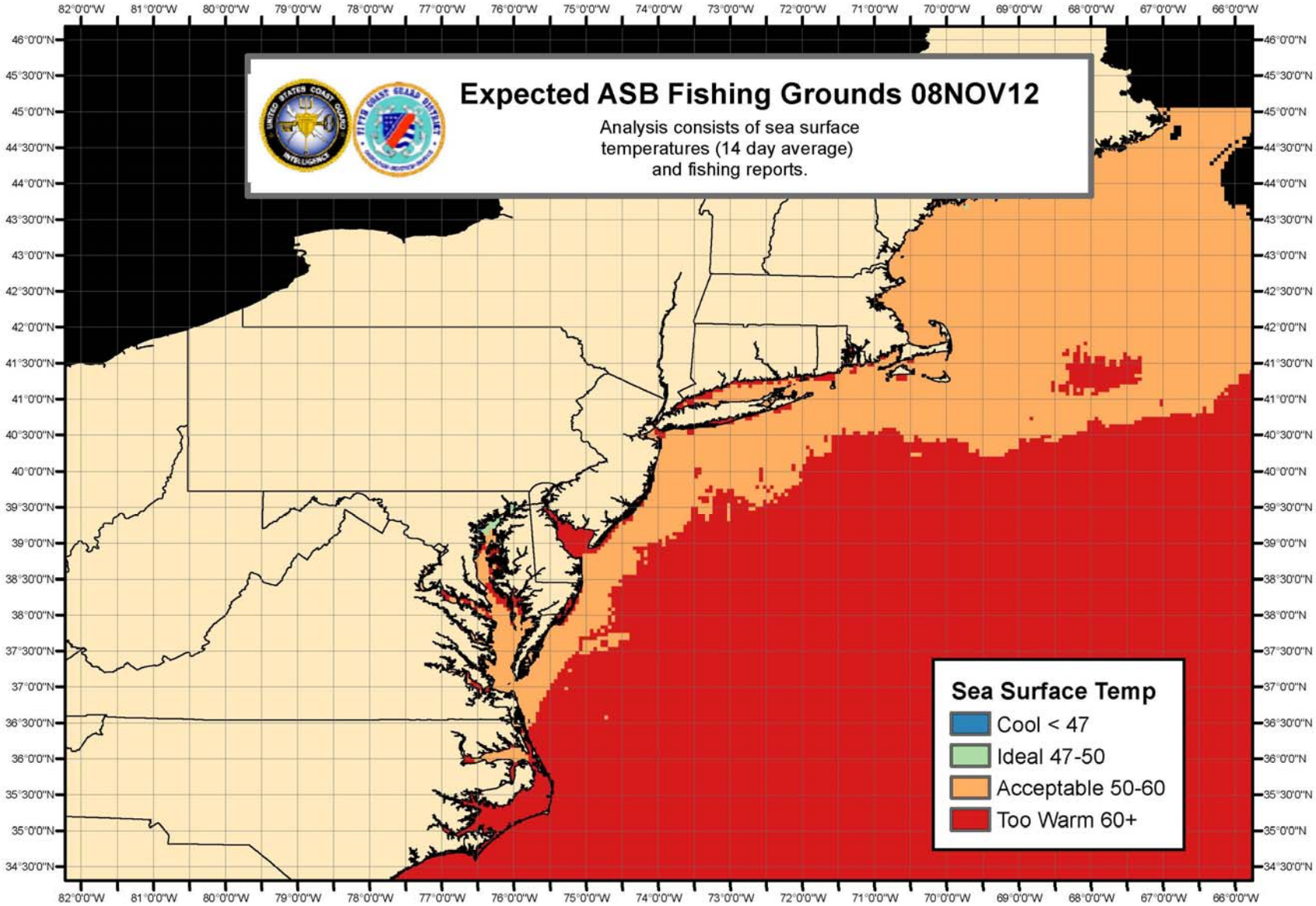
CART & VqPASS data provided by SUMR

UNCLASSIFIED

Data valid as of 21SEP12, 1352 CST

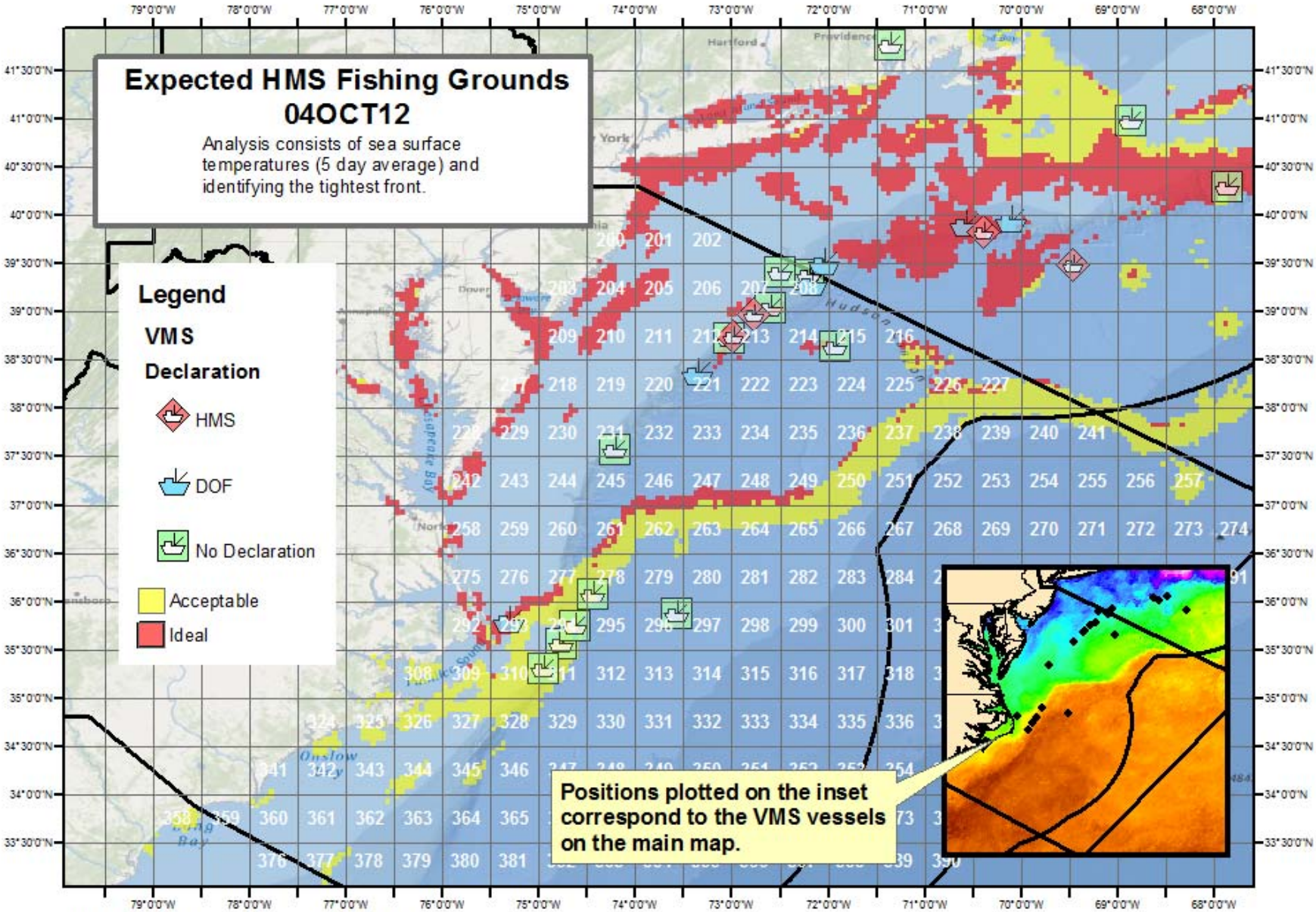


UNCLASSIFIED

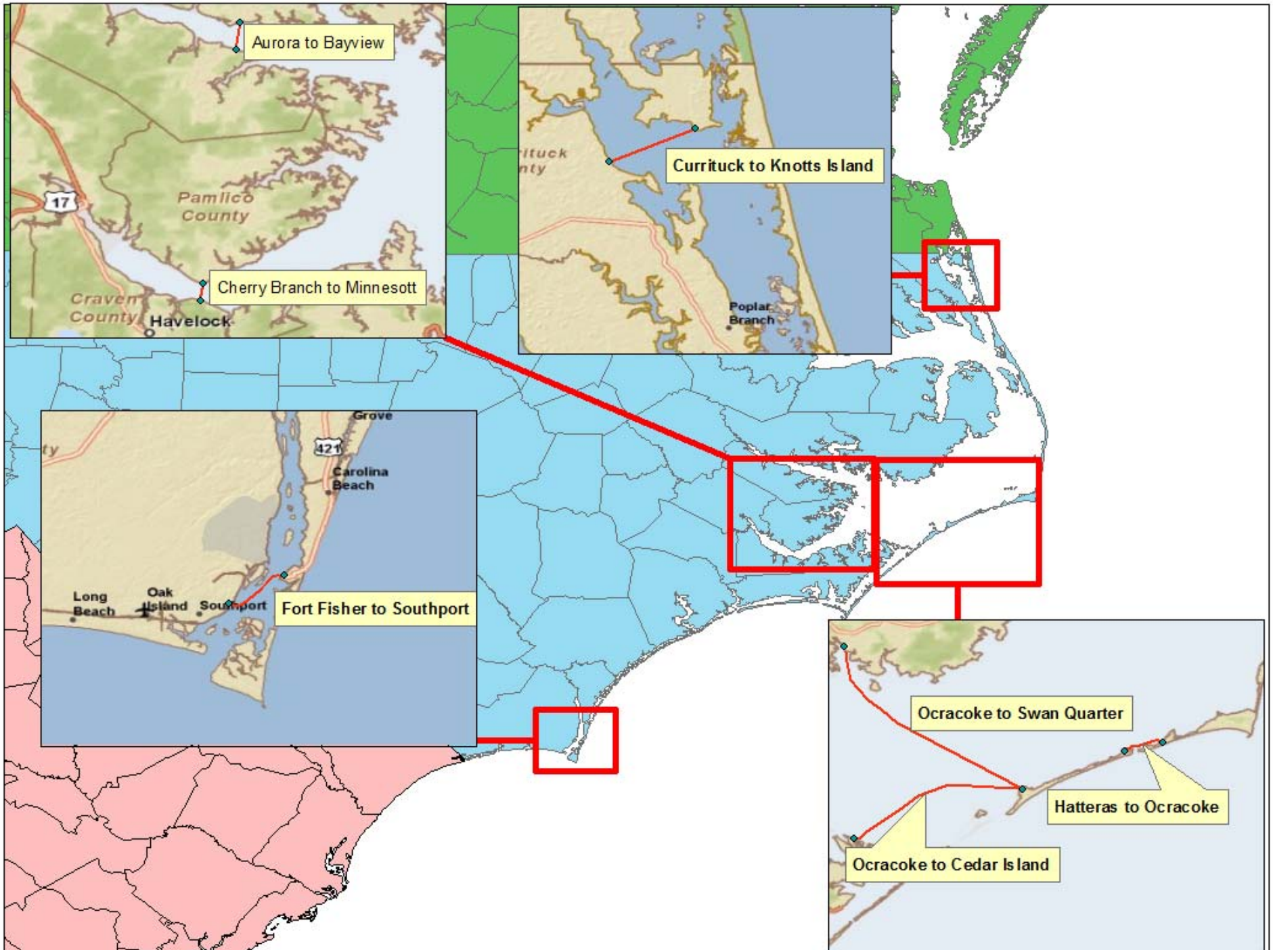


Source: SST, NOAA GOES Imager, Day and Night, 0.05 degrees
14 Day average centered on 01NOV12
Black areas denote no data due to persistant cloud cover.

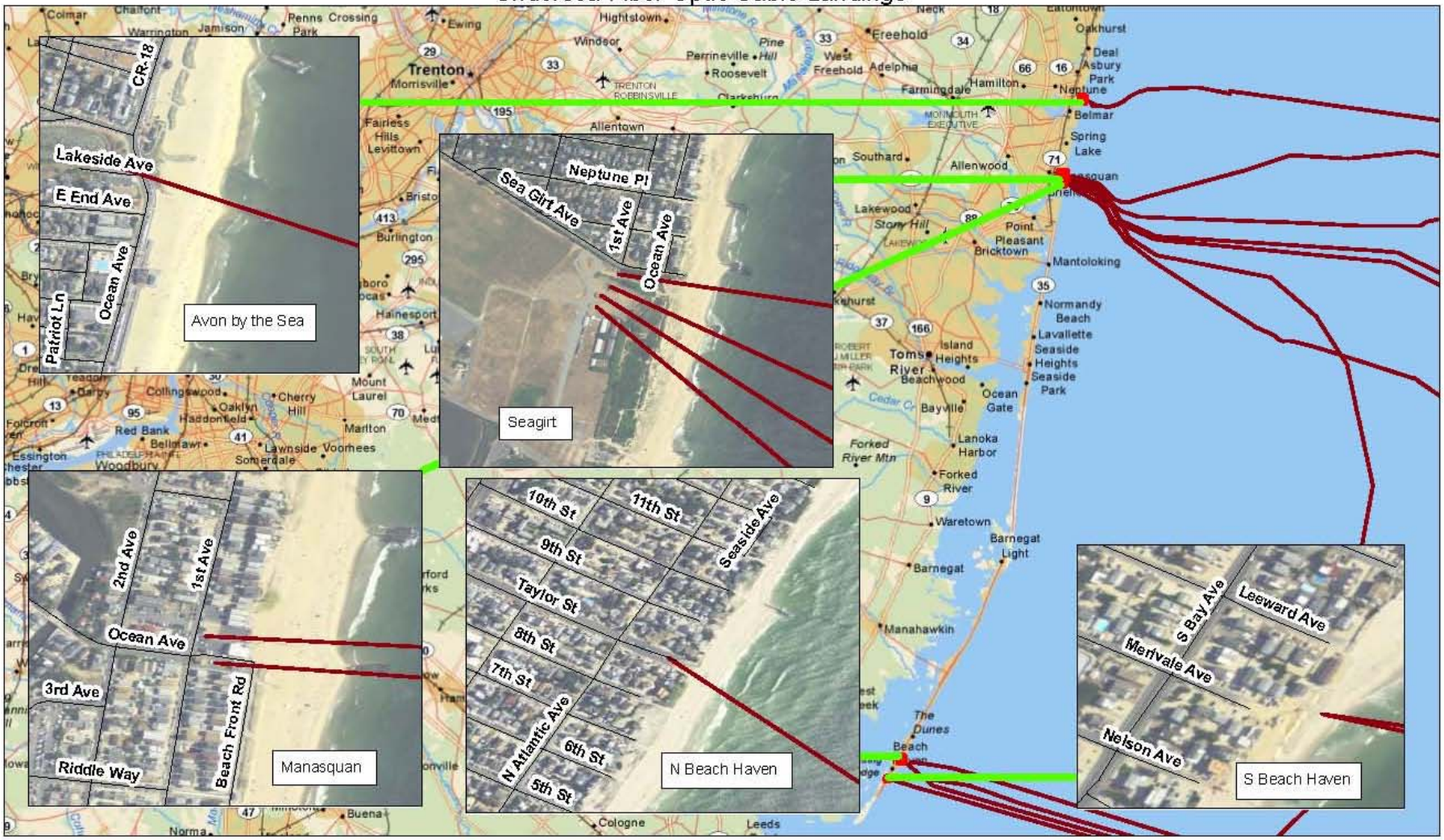
UNCLASSIFIED



Source: SST, NOAA GOES Imager, Day and Night, 0.05 degrees
8 day average centered on 30SEP12.


Aurora to Bayview
Pamlico County
17
Cherry Branch to Minnesott
Craven County
Havelock
Currituck to Knotts Island
Poplar Branch
Grove
421
Carolina Beach
Long Beach
Oak Island
Southport
Fort Fisher to Southport
Ocracoke to Swan Quarter
Hatteras to Ocracoke
Ocracoke to Cedar Island

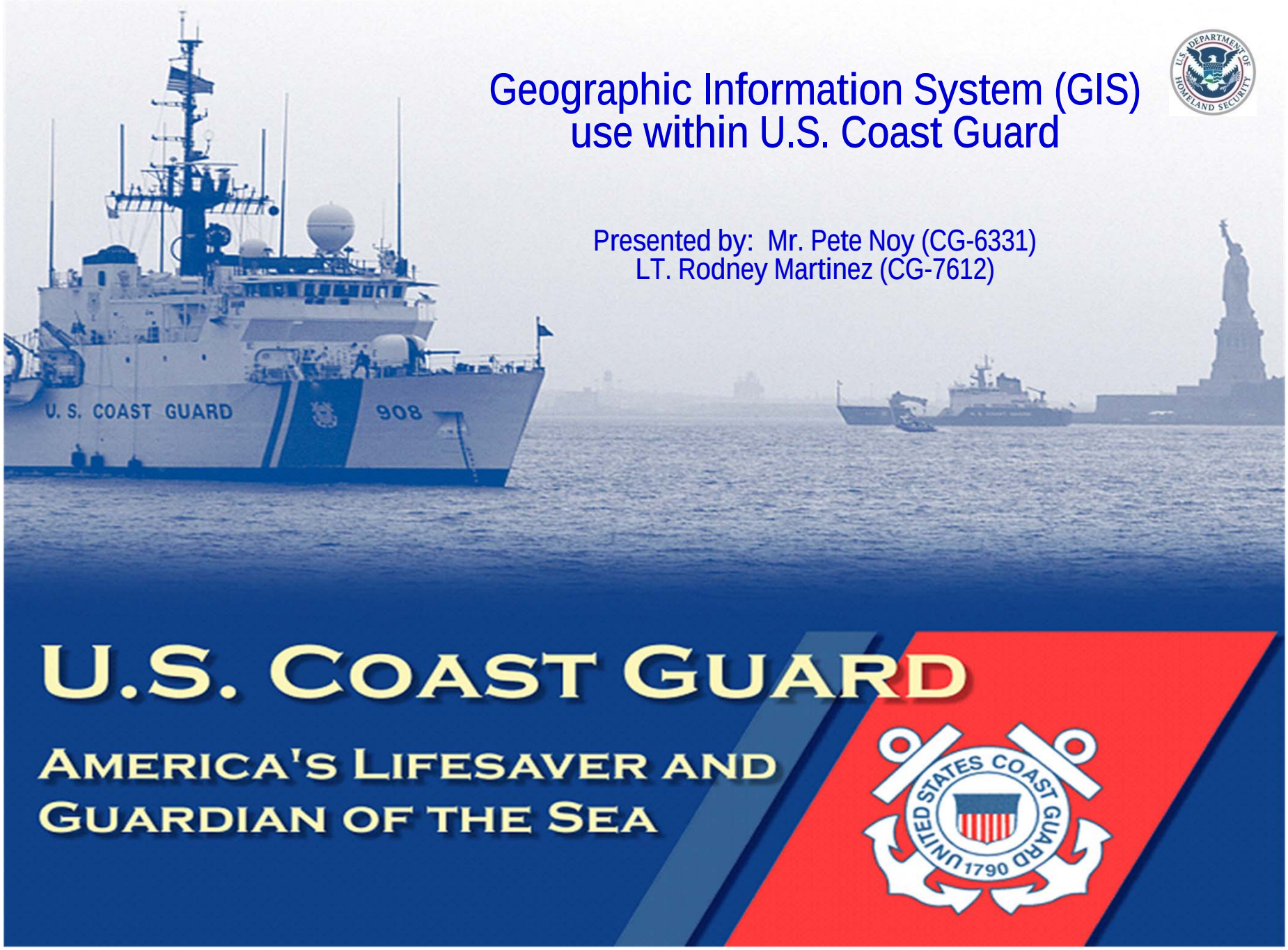
Undersea Fiber Optic Cable Landings



Questions?

Geographic Information System (GIS) use within U.S. Coast Guard

Presented by: Mr. Pete Noy (CG-6331)
LT. Rodney Martinez (CG-7612)



Inland Marine Transportation Casualty Data Analysis

James P. Dobbins, Ph.D.

December 5, 2012

VANDERBILT UNIVERSITY School of Engineering
Vanderbilt Center for Transportation Research (VECTOR)

Introduction

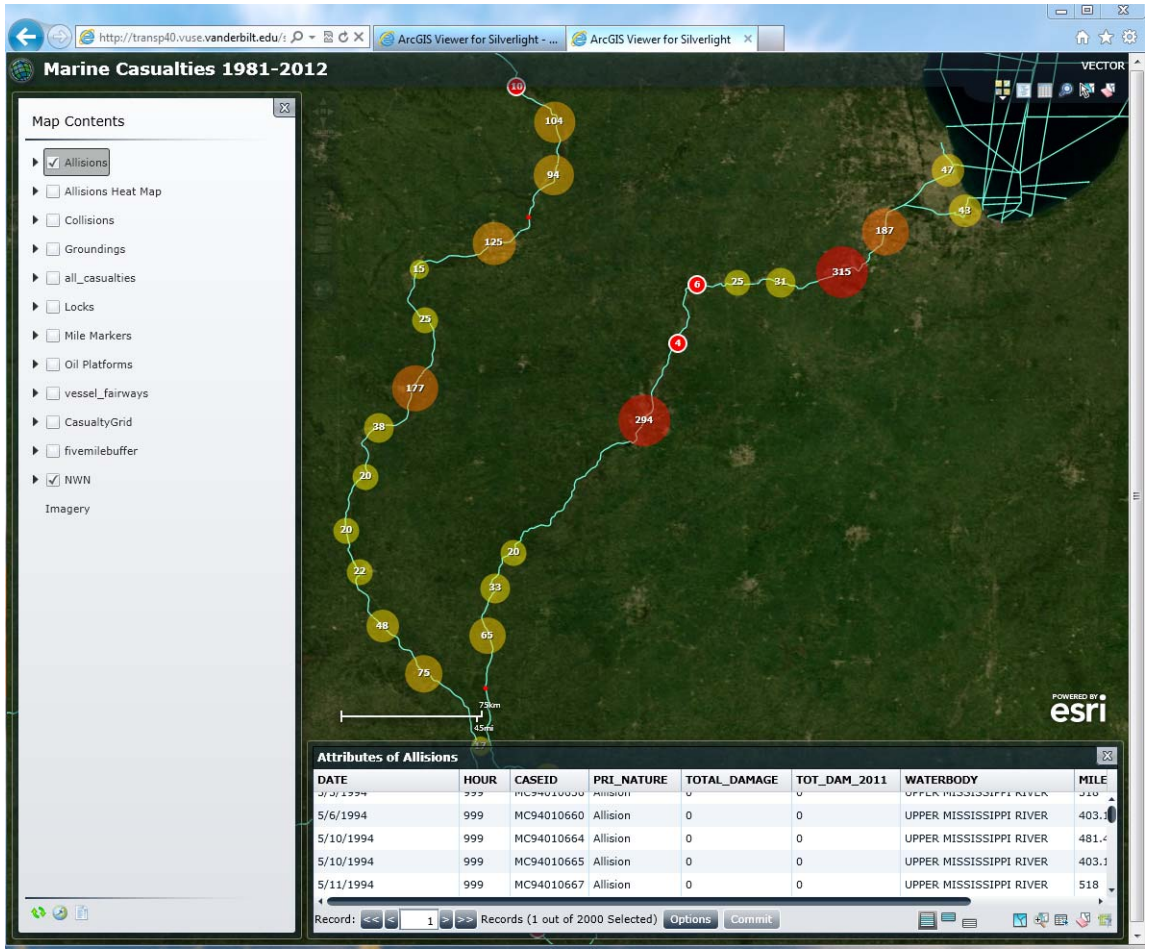
- Marine casualties – allisions, collisions, groundings
- Objectives:
  - Identify most hazardous sections of U.S. inland waterway network (2010)
    - Assess quality and limitations of relevant datasets
  - Determine weather effect (river gage, wind speed, visibility) on inland casualties (2012)

Technologies

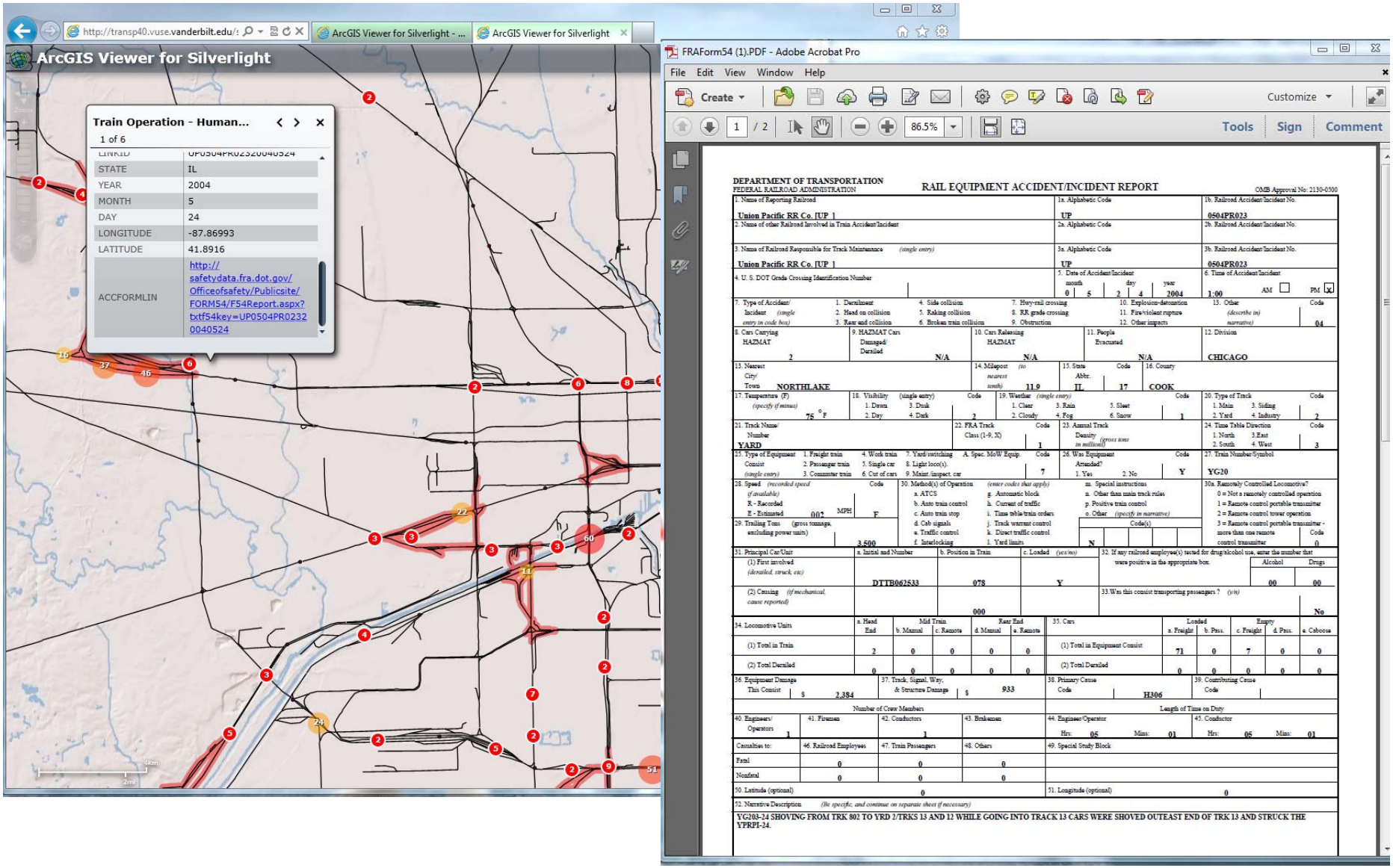
- Geographic information systems (GIS)
  - Cluster analysis and spatial joins
- Database management systems (DBMS)
  - Manage and relate historical data
- Data visualization/analytics
  - Discover trends in data, ad-hoc drill-down into details, animate events

Internet GIS

- GIS functionality through browser
- Advantages
  - Centralized
  - Easy to use
  - Report management



Internet GIS – Report Management

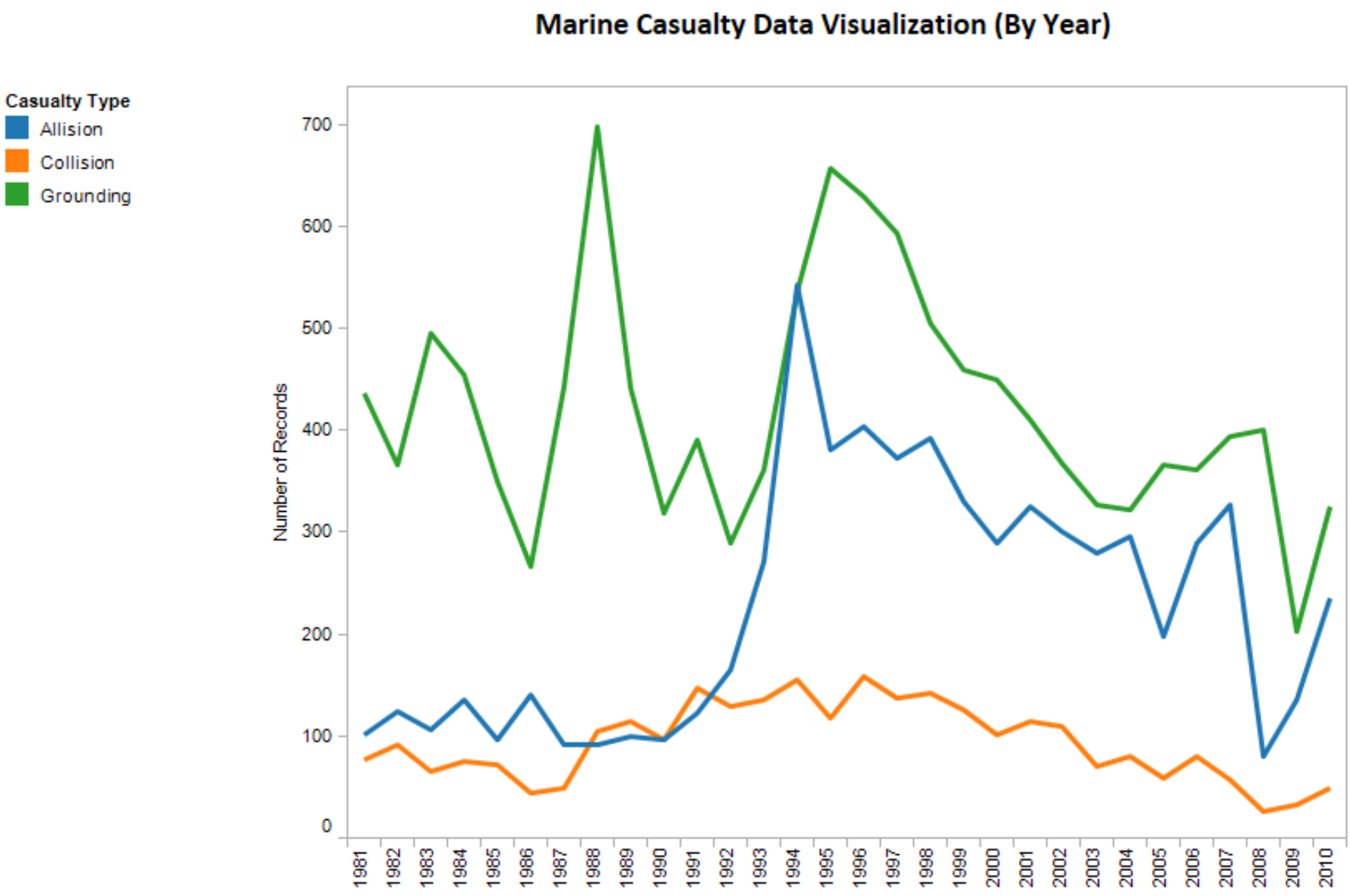


Data

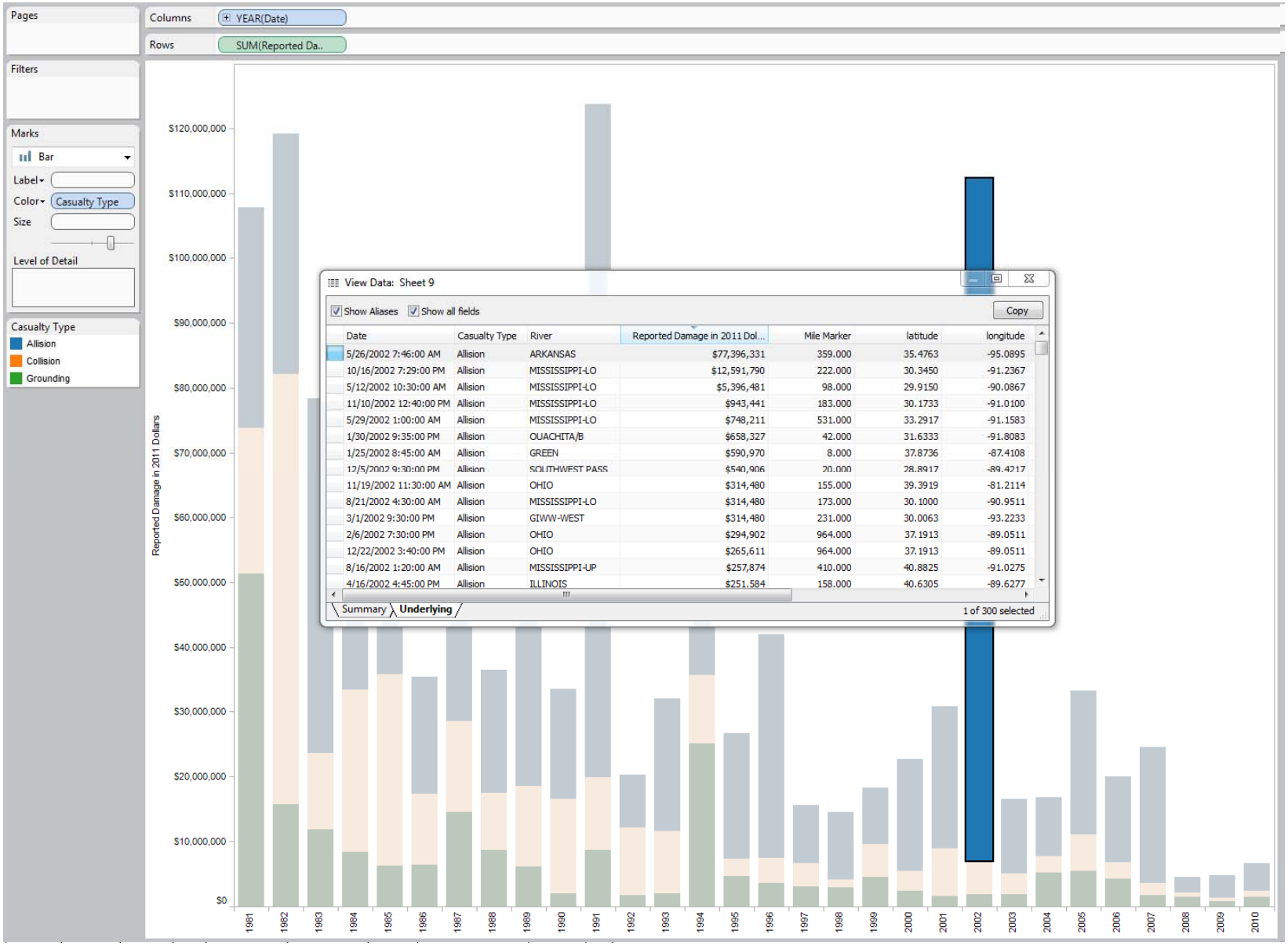
- 1981-2012: 3 USCG reporting systems
  - CASMAIN/MSIS (1981 - 1991)
  - MINMOD (1992 - 2001)
  - MISLE (2002 - present)
- Merged into common data structure
  - Attributes: Date, casualty type, damage, lat/long
  - Other attributes retained, but not used
    - Vessel(s) involved, vessel type, fatalities, injuries, contributing factors

Welcome to the US Army Corps of Engineers
Navigation Data Center

United States Coast Guard
U.S. Department of Homeland Security


Marine Casualty Data Visualization (By Year)
Casualty Type
Allision
Collision
Grounding
Number of Records
0
100
200
300
400
500
600
700
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

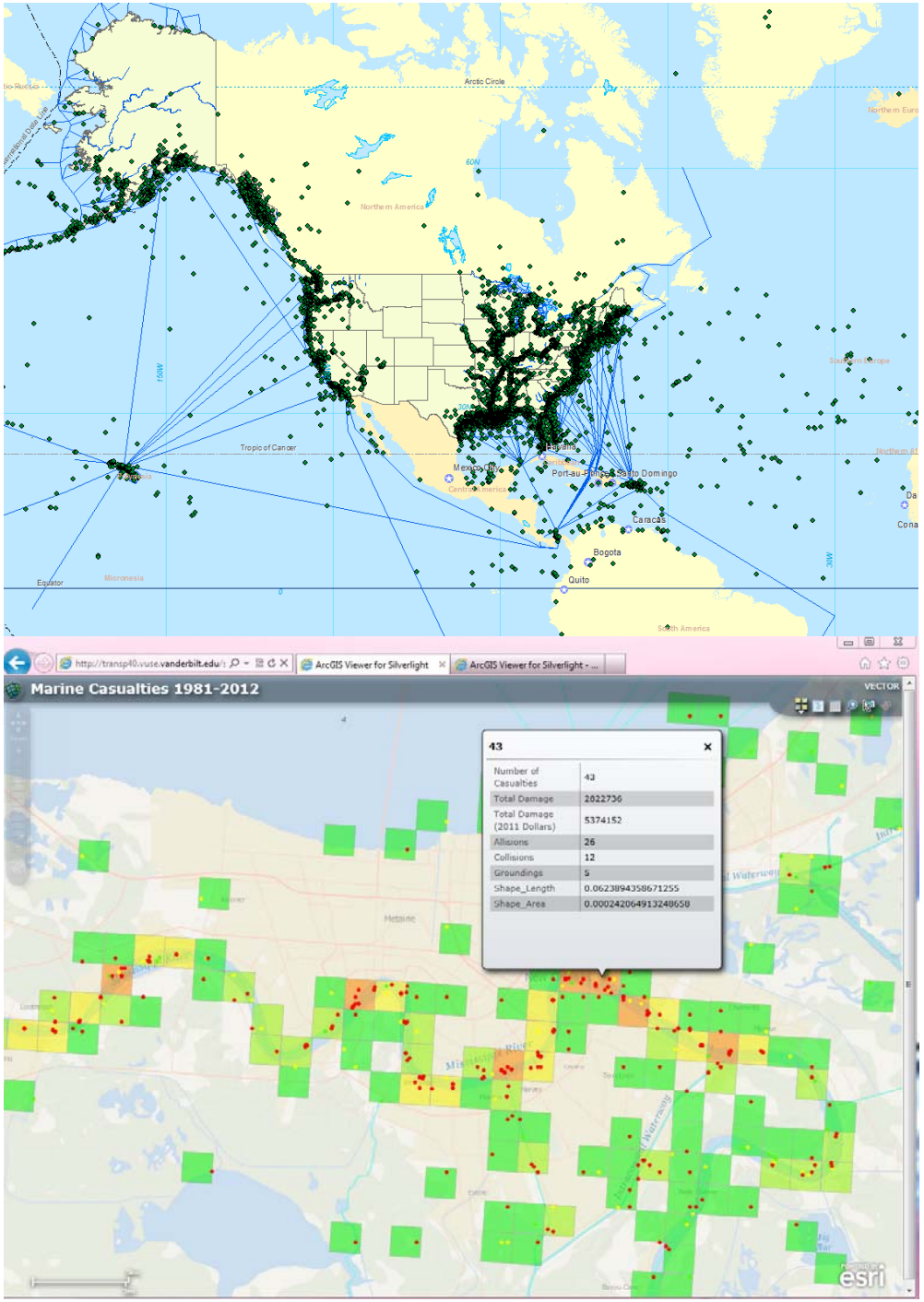
Damage by Year (drill-down)



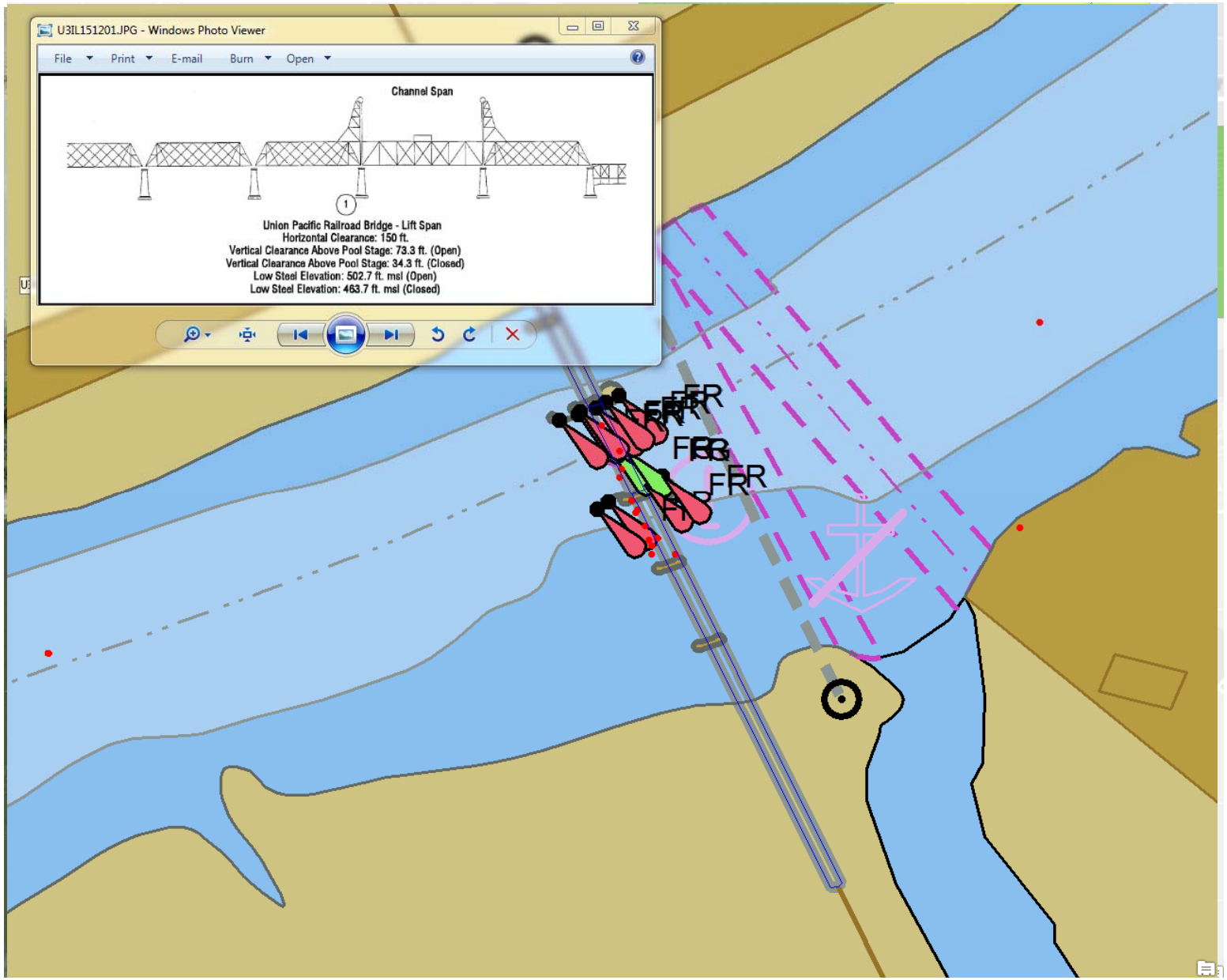
Date	Casualty Type	River	Reported Damage in 2011 Dol...	Mile Marker	latitude	longitude
5/26/2002 7:46:00 AM	Allision	ARKANSAS	$77,396,331	359.000	35.4763	-95.0895
10/16/2002 7:29:00 PM	Allision	MISSISSIPPI-LO	$12,591,790	222.000	30.3450	-91.2367
5/12/2002 10:30:00 AM	Allision	MISSISSIPPI-LO	$5,396,481	98.000	29.9150	-90.0867
11/10/2002 12:40:00 PM	Allision	MISSISSIPPI-LO	$943,441	183.000	30.1733	-91.0100
5/29/2002 1:00:00 AM	Allision	MISSISSIPPI-LO	$748,211	531.000	33.2917	-91.1583
1/30/2002 9:35:00 PM	Allision	OUACHITA/B	$658,327	42.000	31.6333	-91.8083
1/25/2002 8:45:00 AM	Allision	GREEN	$590,970	8.000	37.8736	-87.4108
12/5/2002 9:30:00 PM	Allision	SOUTHWEST PASS	$540,906	20.000	28.8917	-89.4217
11/19/2002 11:30:00 AM	Allision	OHIO	$314,480	155.000	39.3919	-81.2114
8/21/2002 4:30:00 AM	Allision	MISSISSIPPI-LO	$314,480	173.000	30.1000	-90.9511
3/1/2002 9:30:00 PM	Allision	GIWW-WEST	$314,480	231.000	30.0063	-93.2233
2/6/2002 7:30:00 PM	Allision	OHIO	$294,902	964.000	37.1913	-89.0511
12/22/2002 3:40:00 PM	Allision	OHIO	$265,611	964.000	37.1913	-89.0511
8/16/2002 1:20:00 AM	Allision	MISSISSIPPI-UP	$257,874	410.000	40.8825	-91.0275
4/16/2002 4:45:00 PM	Allision	ILLINOIS	$251,584	158.000	40.6305	-89.6277

Methodology

- Entire dataset contains 51,458 ACGs (1981-2012)
  - Inland approx. 54%
- Compute casualties by mile marker
- One-mile square grid to detect clusters



Illinois River – MM151



Issues and Limitations

- Casualty data quality
  - Coordinate typos prevent identification of specific bridge piers and lock walls that present hazard
- Lack of detailed trip data (USACE)
  - Necessary for rate calculation
  - Aggregation performed due to confidentiality concerns

Results: Hotspots

- Validated with river industry personnel
- Allisions
  - Illinois River bridges
- Collisions
  - Lower Miss. near Southwest Pass
- Groundings
  - Memphis, St. Louis
- Overall:
  - Galveston Bay and Gulf Intracoastal Waterway West

Intersection of Gulf Intracoastal Waterway West and Houston Ship Channel

Weather Data

- Weather attributes inconsistently populated in casualty datasets
- Weather data (NOAA)
  - 29,266 stations worldwide
  - Wind speed, visibility
  - Hourly observations

North American Weather Stations (NOAA)

River Gage Data

- USGS (175 stations)
- USACE (84 stations)
- Daily gage readings (7am)
- Flood level categories not available for all gages
  - Gage readings normally distributed
  - Used percentiles instead of flood categories

Green = USACE gages
Purple = USGS gages

Weather Results

- Wind speed data unreliable
- Restricted visibility does not appear to be a factor in inland casualties
- Groundings occur primarily between 11pm-5am
- Allisions occur primarily between 8am-4pm
- Allisions and groundings correlated with seasons
- Allisions and river gage levels correlated

	River Gage Distribution Function									
	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Allision	6%	5%	6%	6%	6%	9%	10%	10%	19%	23%
Collision	11%	11%	11%	11%	6%	6%	13%	9%	17%	6%
Grounding	24%	15%	13%	9%	7%	8%	7%	7%	6%	4%

Future Research

- Closely examine corridor and specific hotspots
- Automatic Identification System (AIS):
  - Combine with lockage data to generate precise trip data
  - Detect near-miss events
  - Correlate with “black box” data (engine rpm, rudder angle) to detect difficult maneuvering areas

Conclusions

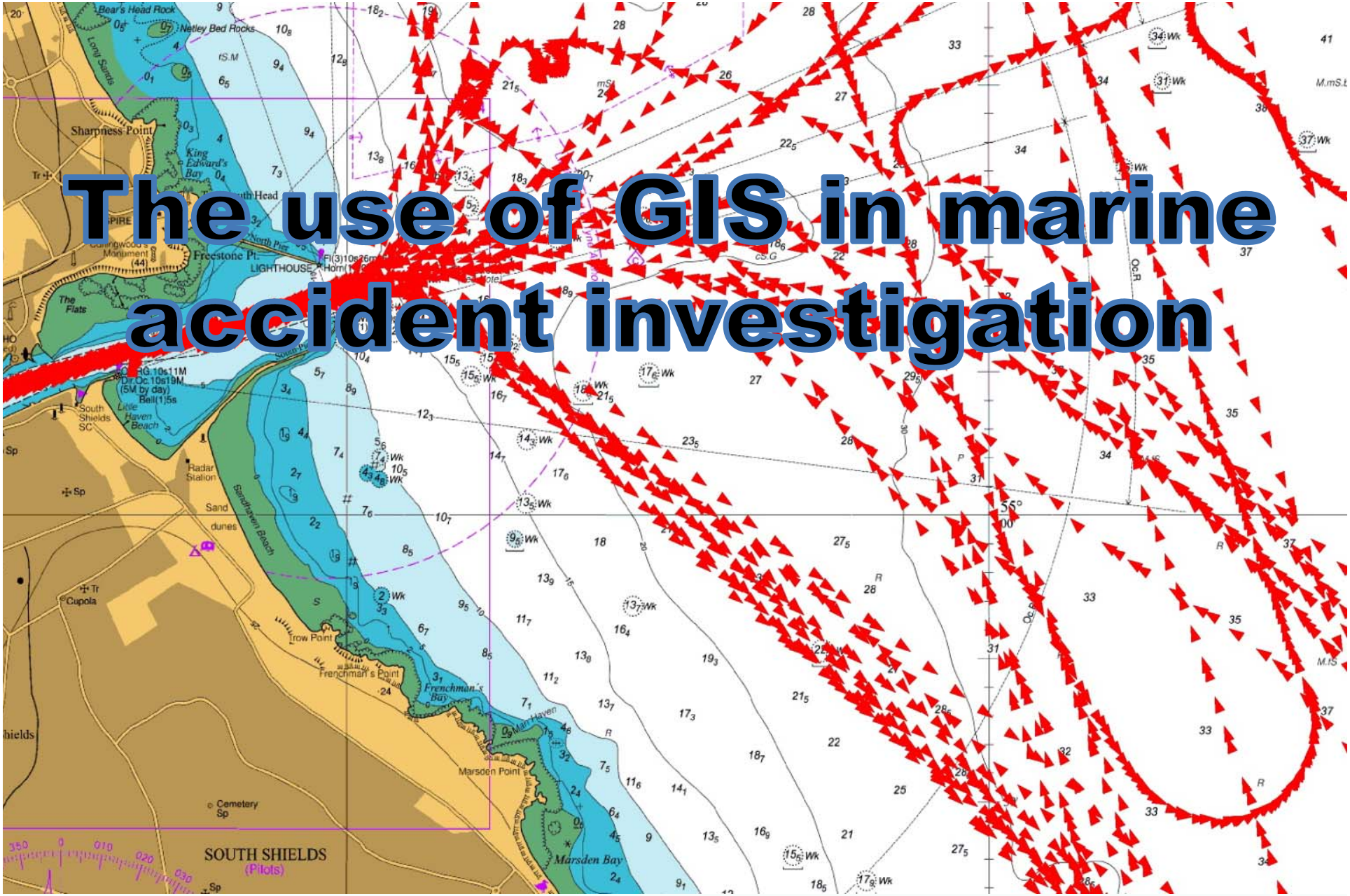
- Combination of GIS, DBMS, data visualization tools is powerful
- GIS can make spatial linkage between seemingly unrelated datasets
  - Possible to reconstruct events using external data sources
- Internet GIS can be effective as a casualty data maintenance platform

Questions?

j.dobbins@vanderbilt.edu

www.vanderbilt.edu/vector

The use of GIS in marine accident investigation



MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

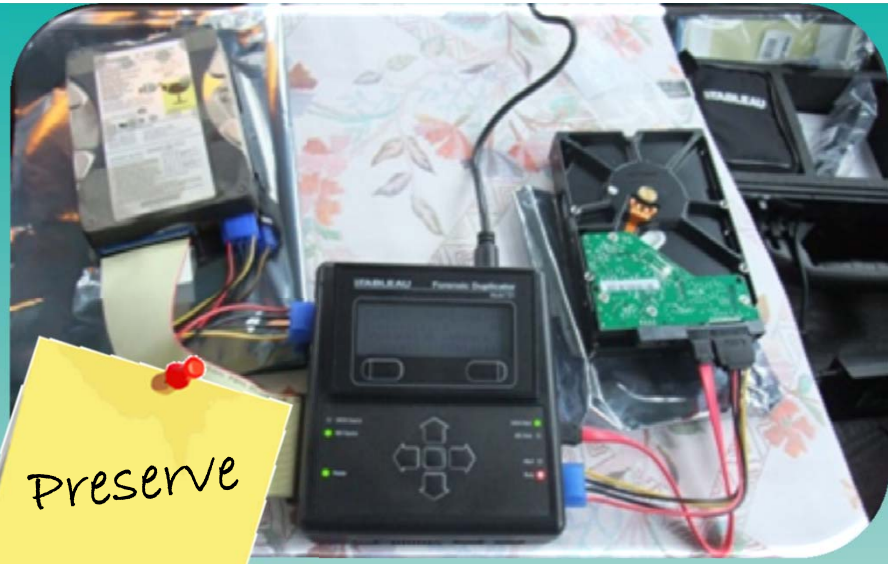
Who are the MAIB?

We are a UK government organisation which is responsible for examining and investigating all types of marine accidents to or on board UK ships worldwide, and other ships in UK territorial waters.

We do not apportion blame.

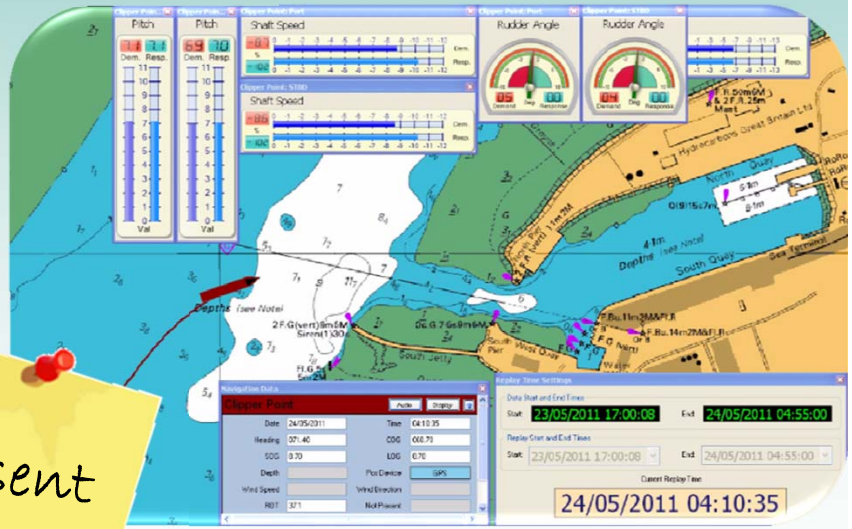
MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

Recover



Preserve

Analyse

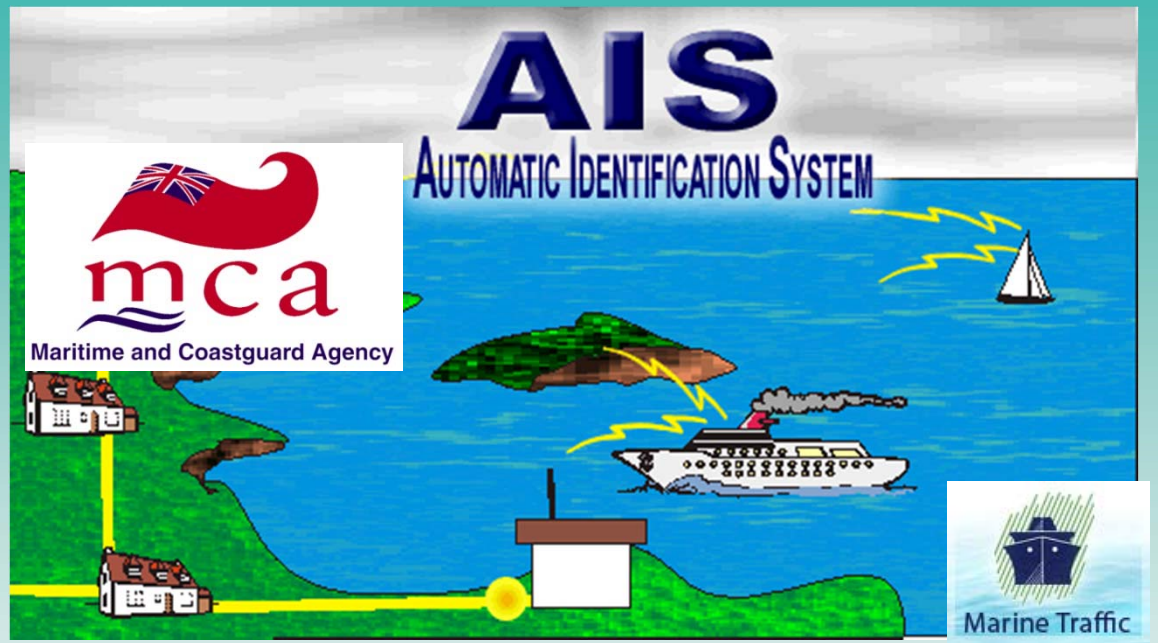


Present

MAIB

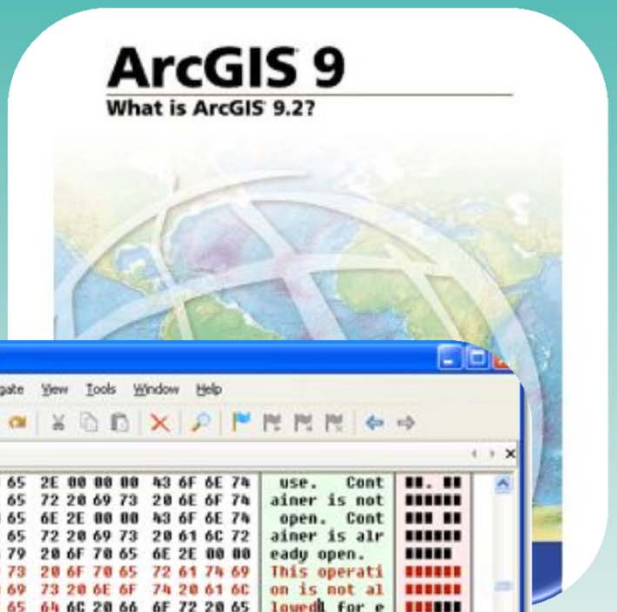
MARINE ACCIDENT INVESTIGATION BRANCH

Sources of Positional Data



MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

The Tools we Use



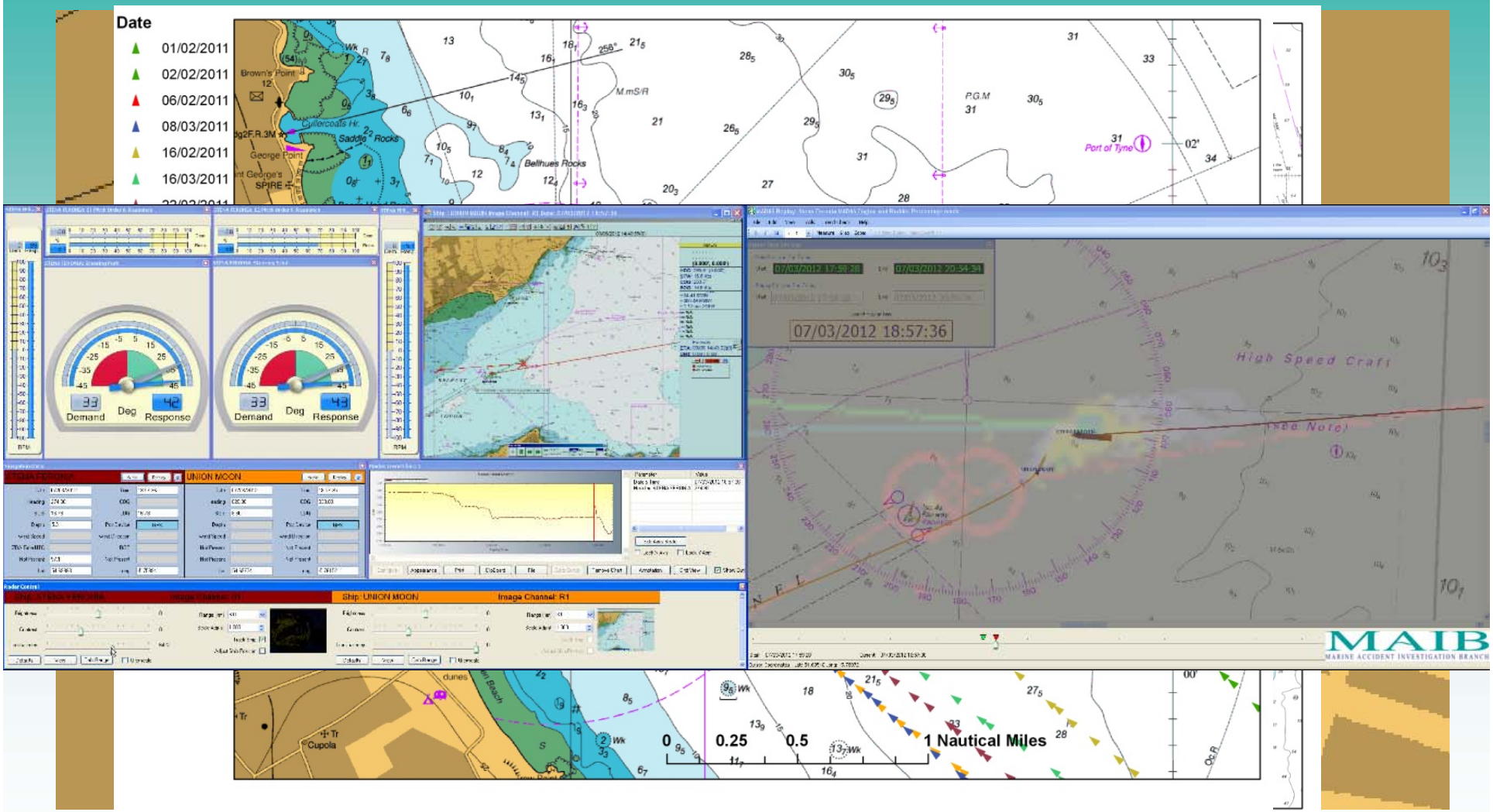
MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

Issues we face

- VDR not functioning as expected
- AIS out of range
- Data missing

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

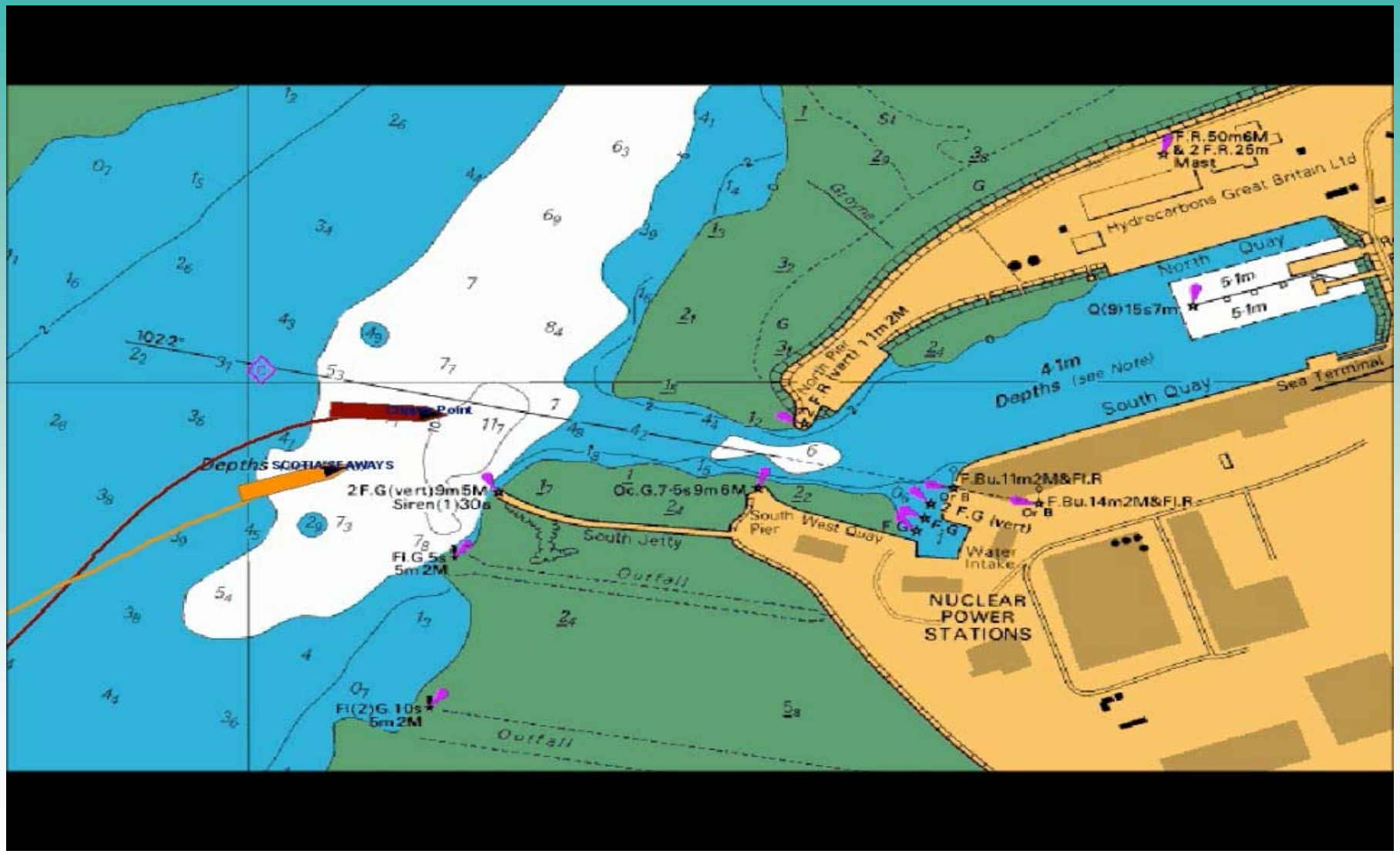
Our use of MADAS and ArcGIS



MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

Clipper Point Case Study



MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

Panel #7: Rail, Pipeline, and HazMat Safety Panel

Objective: This panel will explore the trend in using GIS technologies for safety in rails, transits, and pipelines.

Raquel Hunt, Federal Railroad Administration
Putting Rail Safety on the Map

Ed Wells, Washington Metropolitan Area Transit Authority
GIS for Public Transit Safety

Eric Williams, Access Midstream Partners
Pipeline Safety and GIS: How We Leverage GIS to Make Pipeline Safer

Amy Nelson, Pipeline and Hazardous Materials Safety Administration
The National Pipeline Mapping System (NPMS)

Putting Rail Safety on the Map December 5th 2012

Raquel Hunt
Federal Railroad Administration
USDOT

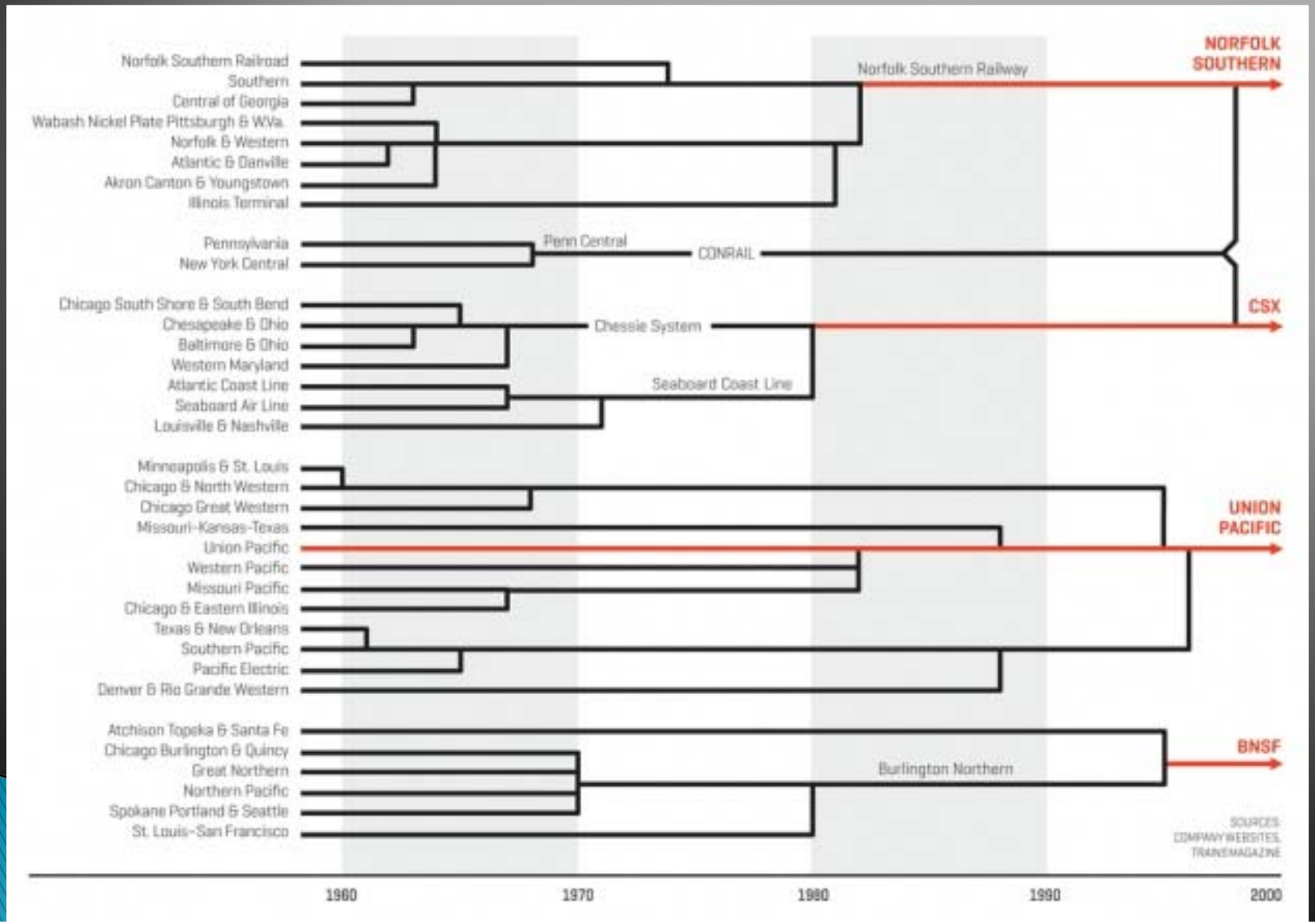
Overview

- Background
  - Rail Industry
  - FRA
- FRA GIS Program
- FRA's GIS Data
- FRA's GIS Applications

Seattle
Portland
San Francisco
San Jose
Los Angeles
San Diego
Phoenix
Denver
El Paso
Fort Worth
Dallas
Austin
San Antonio
Houston
Oklahoma City
Memphis
Milwaukee
Chicago
Detroit
Columbus
Charlotte
Jacksonville
Boston
New York
Philadelphia
Baltimore
Washington
Legend
Major Cities
Main Rail Lines

Seattle
Portland
San Francisco
San Jose
Los Angeles
San Diego
Phoenix
Denver
El Paso
Oklahoma City
Fort Worth
Dallas
Austin
San Antonio
Houston
Memphis
Milwaukee
Chicago
Detroit
Columbus
Charlotte
Jacksonville
Boston
New York
Philadelphia
Baltimore
Washington
Legend
Major Cities
Amtrak
Main Rail Lines

Rail Industry: Staggers Rail Act of 1980



Classes of Railroads

Class I Railroads	Class II Railroads	Class III Railroads
7 Companies	~ 10 Companies	> 500 Companies
Revenue ≥ $433.2 million per year	Revenue $34.7 to <$433.2 million per year	Revenue < $34.7 million per year
Large railways with interstate links	Service to selected regions	Service to small geographic areas
Mainly East-West Orientation	Mainly neighboring states/economic centers	Mostly branch lines with only one track

BNSF: Burlington
Northern Santa Fe

CN: Canadian National

CPRS: Canadian Pacific

CSXT: CSX Transportation

KCS: Kansas City Southern

NS: Norfolk Southern

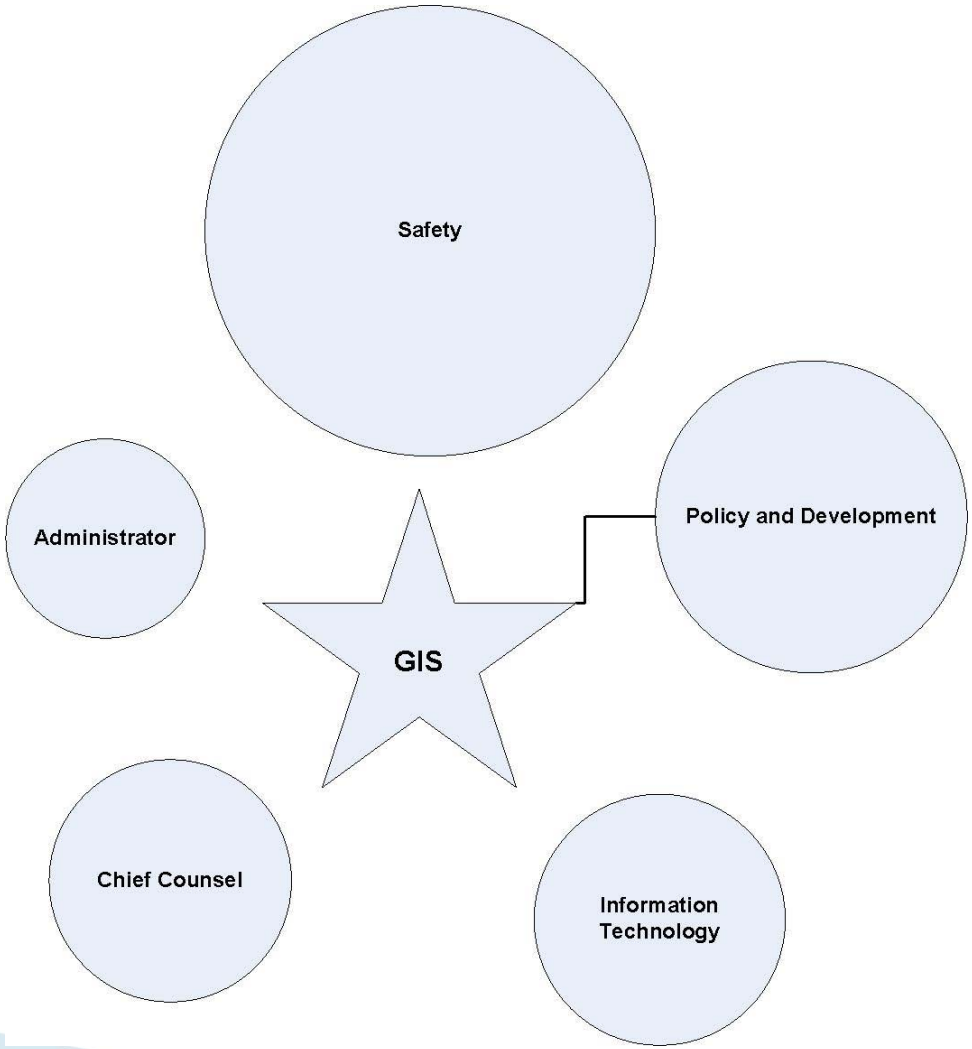
Federal Railroad Administration (FRA)

- Created by the Department of Transportation Act of 1966 (49 U.S.C. 103, Section 3(e)(1))

- The purpose of FRA is to:
  - Promulgate and enforce rail safety regulations
  - Administer railroad assistance programs
  - Conduct research and development in support of improved railroad safety and national rail transportation policy
  - Provide for the rehabilitation of Northeast Corridor rail passenger service
  - Consolidate government support of rail transportation activities.

- Today, FRA is one of ten agencies within the U.S. Department of Transportation concerned with intermodal transportation. It operates through seven divisions under the offices of the Administrator and Deputy Administrator.

FRA's GIS Program



FRA's GIS Data Overview

- Primary
  - 1:100k network
  - Milepost
  - Freight Stations
  - Highway-rail grade crossings
  - Amtrak passenger stations
- Secondary
  - Yards
  - Subdivisions
  - Accidents
  - FRA Inspections
  - Designated Quiet Zones
  - Bridges
  - Etc.

Previous Networks

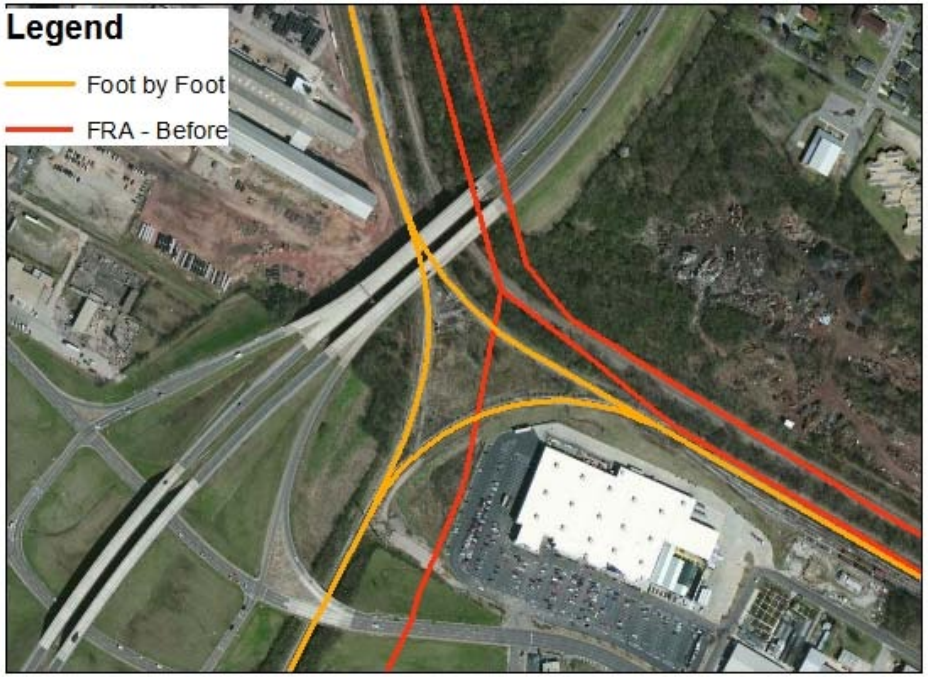
- 1:2 million (USGS): Used for cartographic representation, attributes, and routing
- 1:100,000 (Census): Had a better spatial representation but lack routability and attributes
- By 2005, the 1:2 million attributes were conflated to the 1:100,000 network & the 1:100,000 was completely routable

2008 Total Waybill Flow

Spatial Improvements

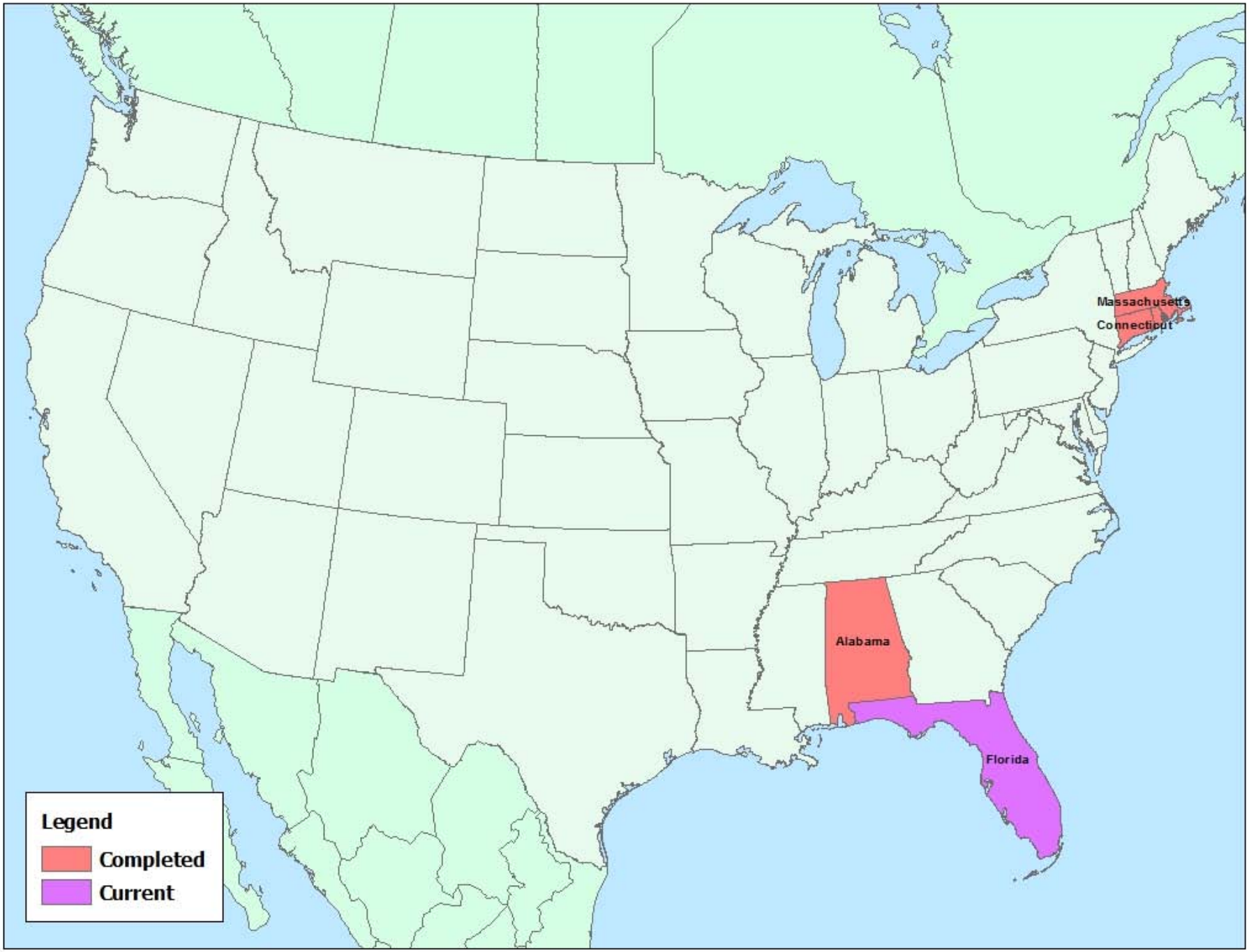
- Integrating the FRA's Automated Track Inspection Program (ATIP) Data

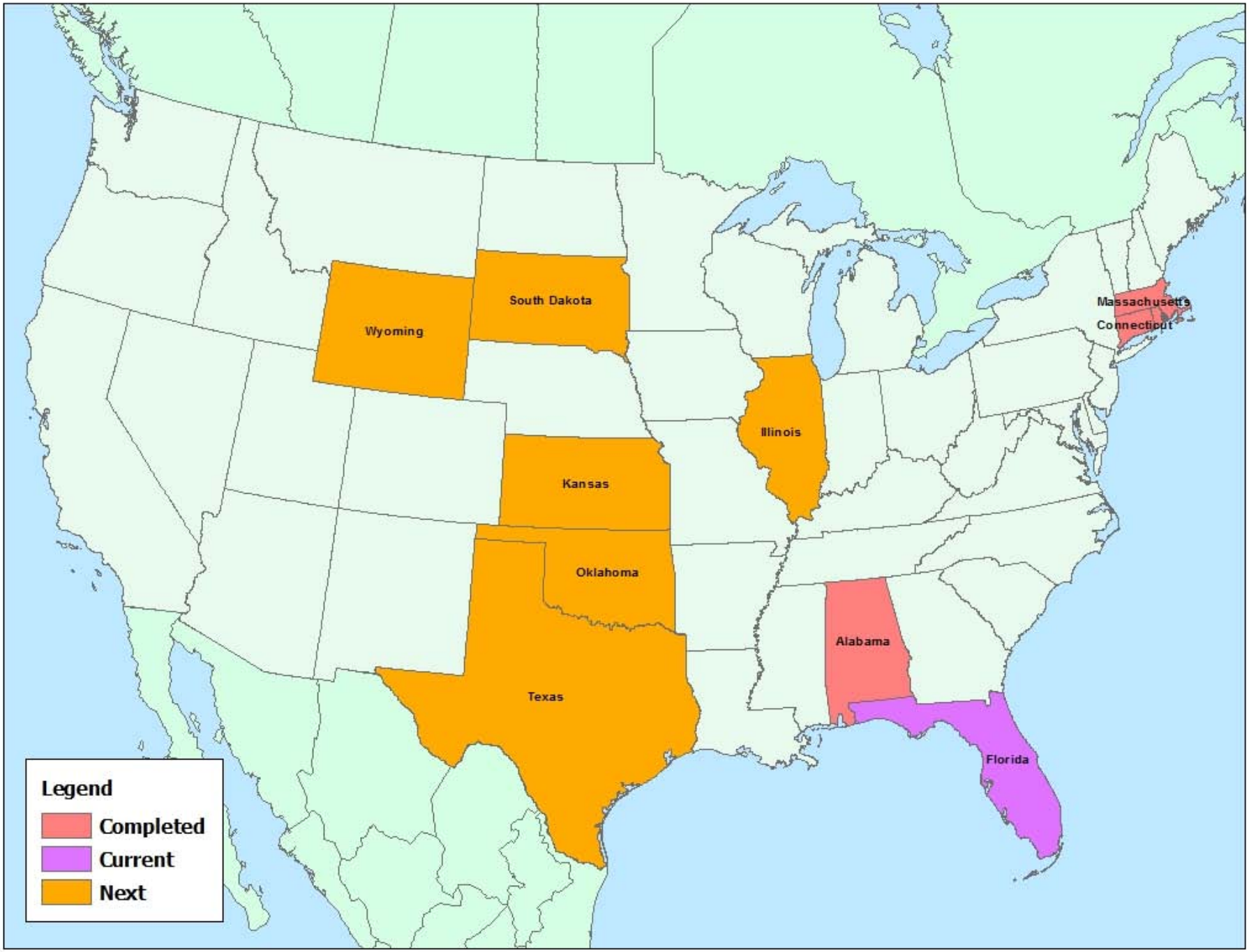
- The ATIP cars takes a latitude and longitude reading every foot.

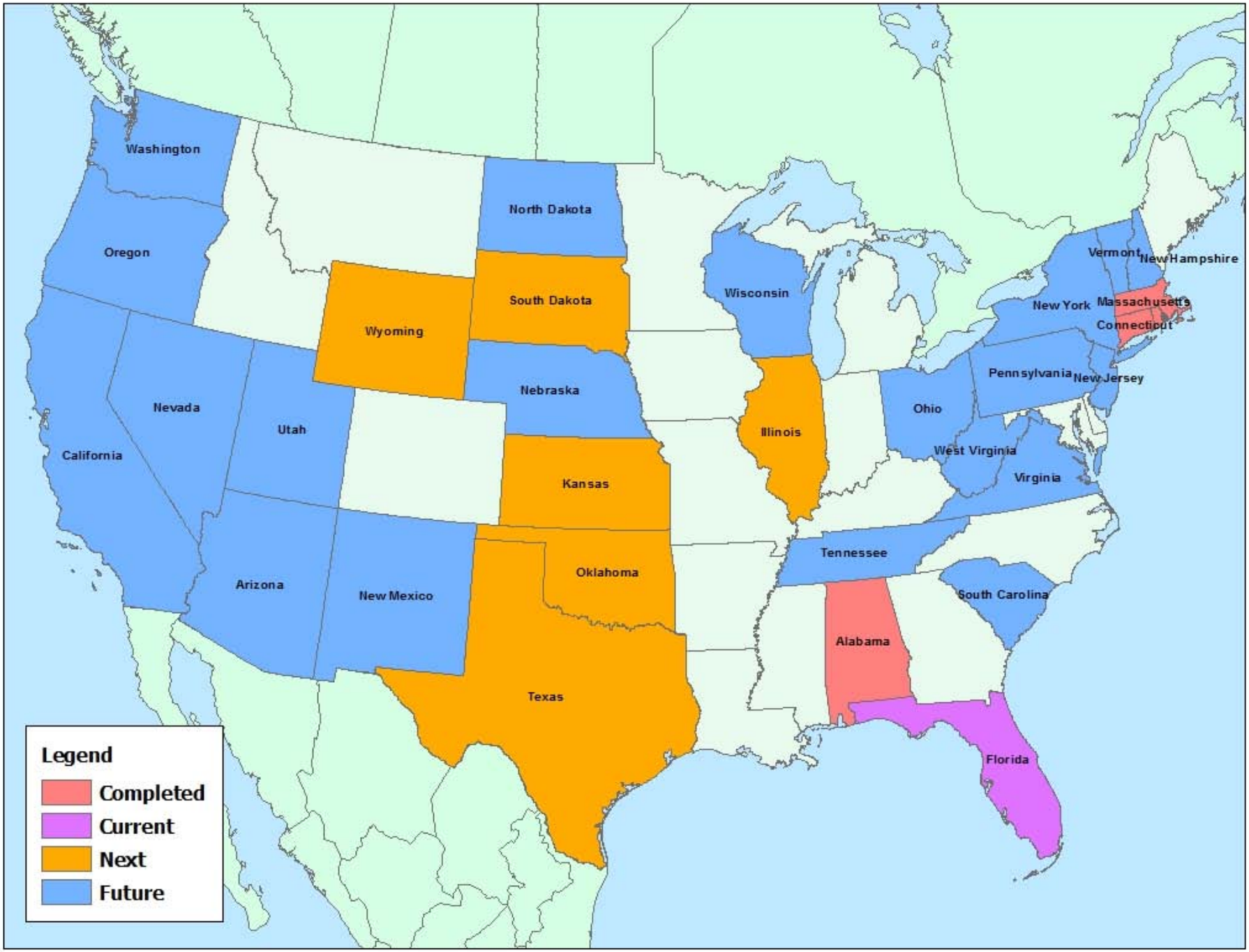

Legend
Foot by Foot
FRA - Before

Legend
Foot by Foot
FRA - After

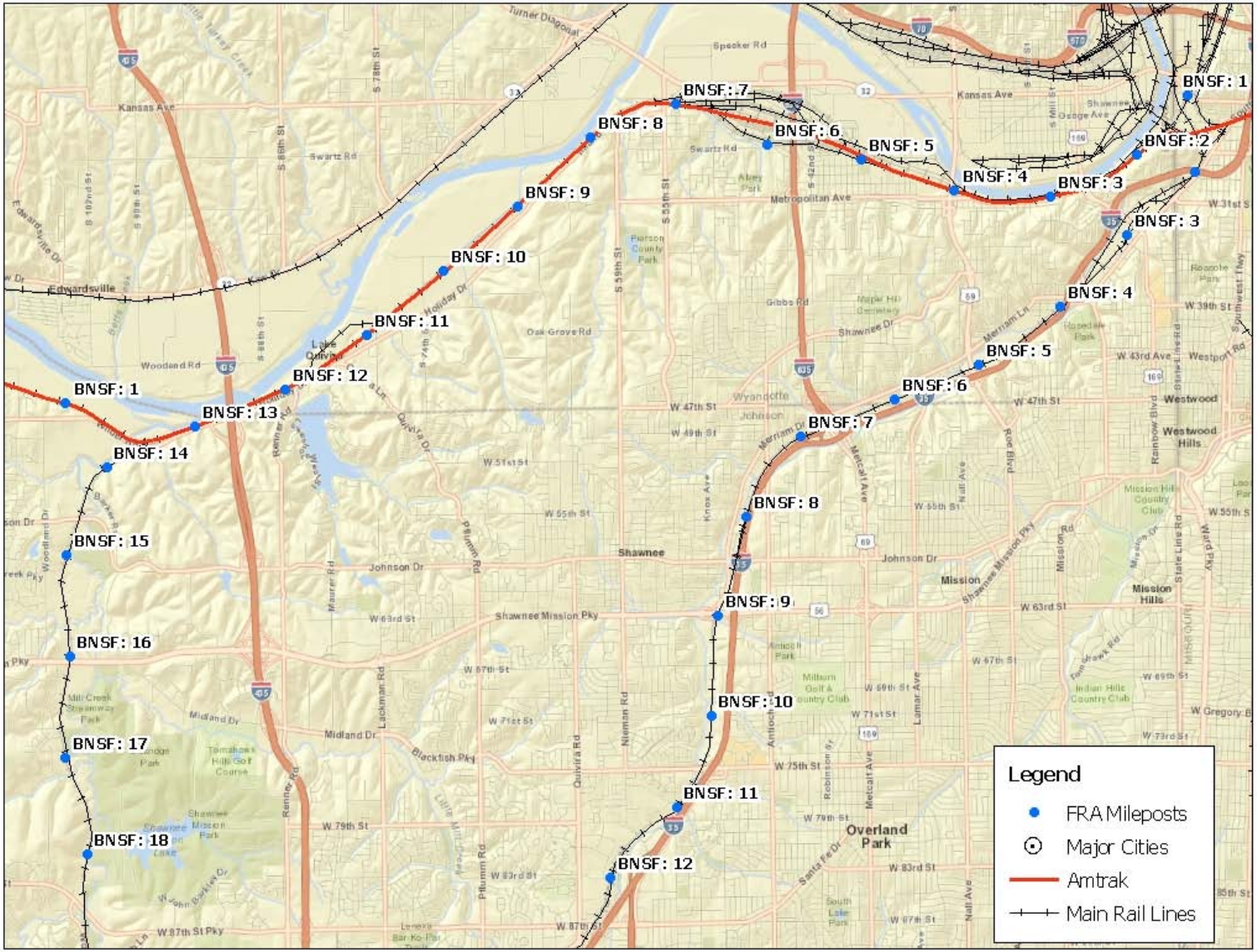
Massachusetts
Connecticut
Alabama
Legend
Completed


Massachusetts
Connecticut
Alabama
Florida
Legend
Completed
Current


Wyoming
South Dakota
Massachusetts
Connecticut
Illinois
Kansas
Oklahoma
Alabama
Texas
Florida
Legend
Completed
Current
Next


Washington
Oregon
California
Nevada
Utah
Arizona
New Mexico
Wyoming
North Dakota
South Dakota
Nebraska
Kansas
Oklahoma
Texas
Wisconsin
Illinois
Ohio
Pennsylvania
New York
Vermont
New Hampshire
Massachusetts
Connecticut
New Jersey
West Virginia
Virginia
Tennessee
South Carolina
Alabama
Florida
Legend
Completed
Current
Next
Future

Mileposts


BNSF: 1
BNSF: 2
BNSF: 3
BNSF: 4
BNSF: 5
BNSF: 6
BNSF: 7
BNSF: 8
BNSF: 9
BNSF: 10
BNSF: 11
BNSF: 12
BNSF: 13
BNSF: 14
BNSF: 15
BNSF: 16
BNSF: 17
BNSF: 18
Legend
FRA Mileposts
Major Cities
Amtrak
Main Rail Lines

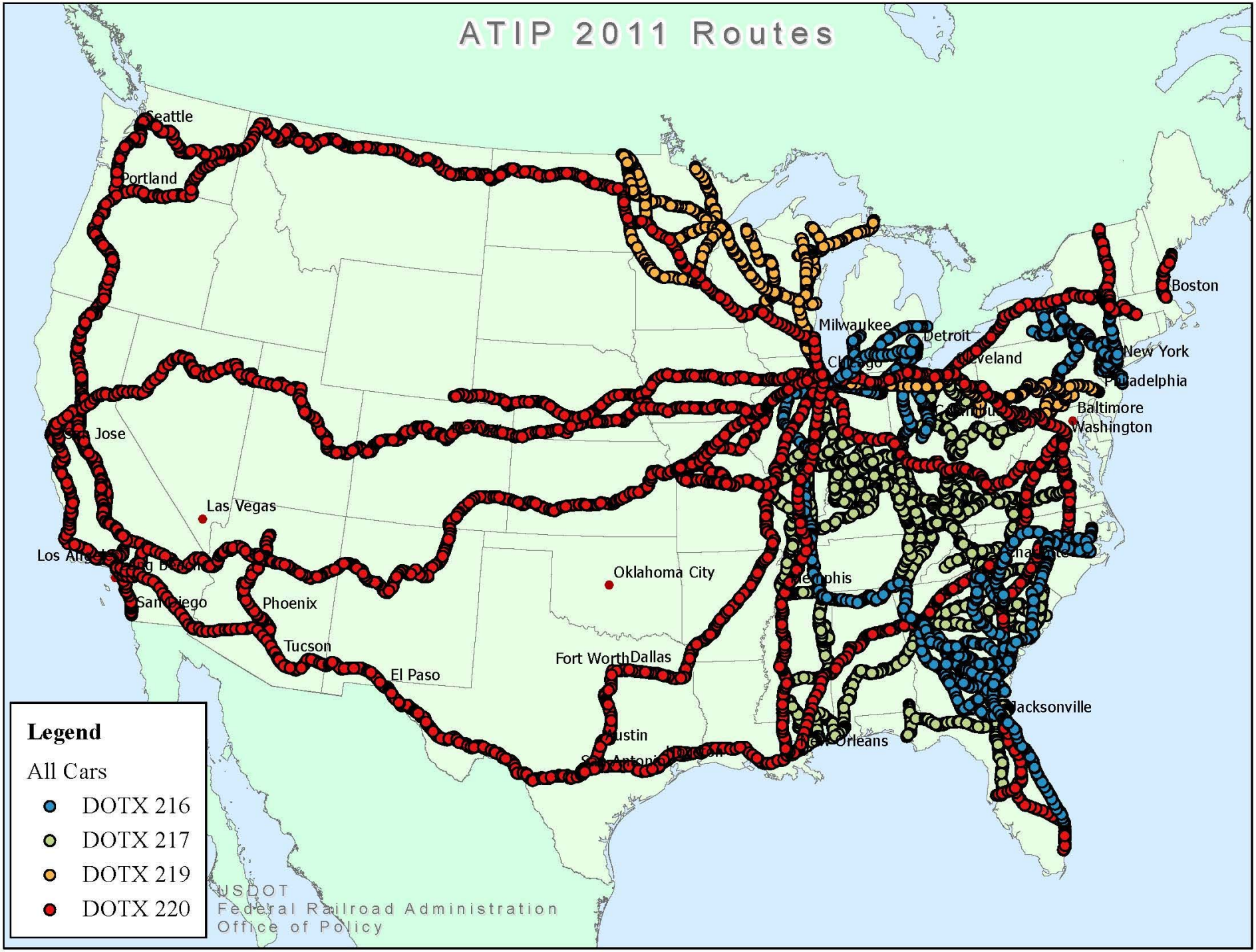
Grade Crossings

- FRA has a Highway-Rail Crossing and Trespasser Program Division that plans, develops, and directs programs that address highway-rail safety and trespasser issues. Committed to reducing the number of collisions at highway-rail crossings and along railroad right-of-way.

- Prior to the Rail Safety Improvement Act of 2008, this information was not required and the spatial information provided could be very inaccurate. Beginning in the fall of 2010, grade crossing data collected and recorded by the state DOT or railroad had to contain spatial coordinates.

- Since 2008, FRA has provided guidance and input for the development of the policy for 911 operators and responders regarding rail accidents/incidents. This policy can be found in the NENA Railroad & PSAP Interaction Operations Information Document (OID).

- The use of GIS data and technology has been essential to the program


ATIP 2011 Routes
Seattle
Portland
Jose
Las Vegas
Los Angeles
Long Beach
San Diego
Phoenix
Tucson
El Paso
Oklahoma City
Fort Worth
Dallas
Austin
San Antonio
Houston
Milwaukee
Detroit
Chicago
Cleveland
Columbus
Memphis
New Orleans
Jacksonville
Charlotte
Boston
New York
Philadelphia
Baltimore
Washington
Legend
All Cars
DOTX 216
DOTX 217
DOTX 219
DOTX 220
USDOT
Federal Railroad Administration
Office of Policy

FRA GIS Applications

- Data Driven
  - National Transportation Atlas Database (NTAD)

http://www.bts.gov/publications/national_transportation_atlas_database/2012/

- Web Services
  - FRA's Main web Application

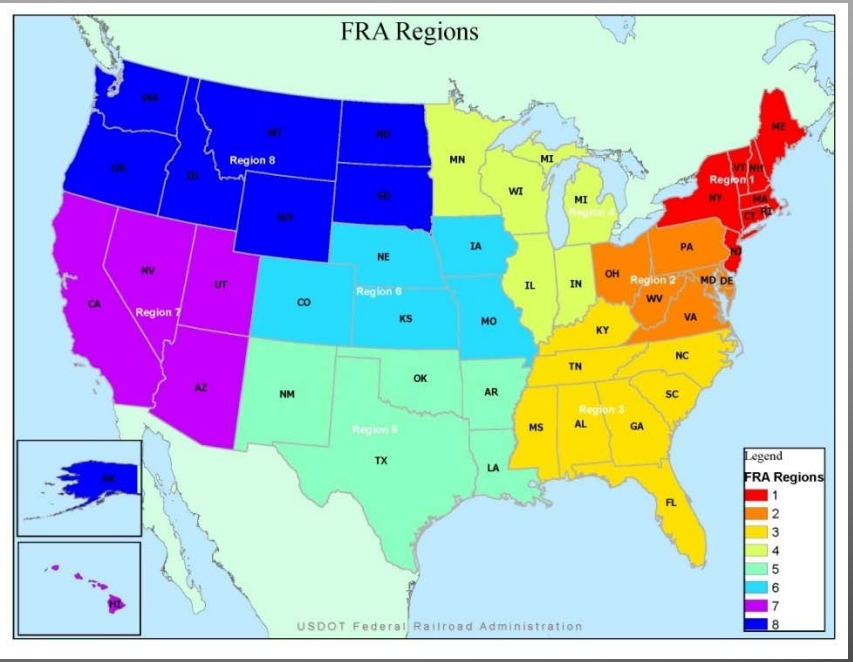
http://fragis.frasafety.net/GISFRASafety/default.aspx

  - Popup Viewer

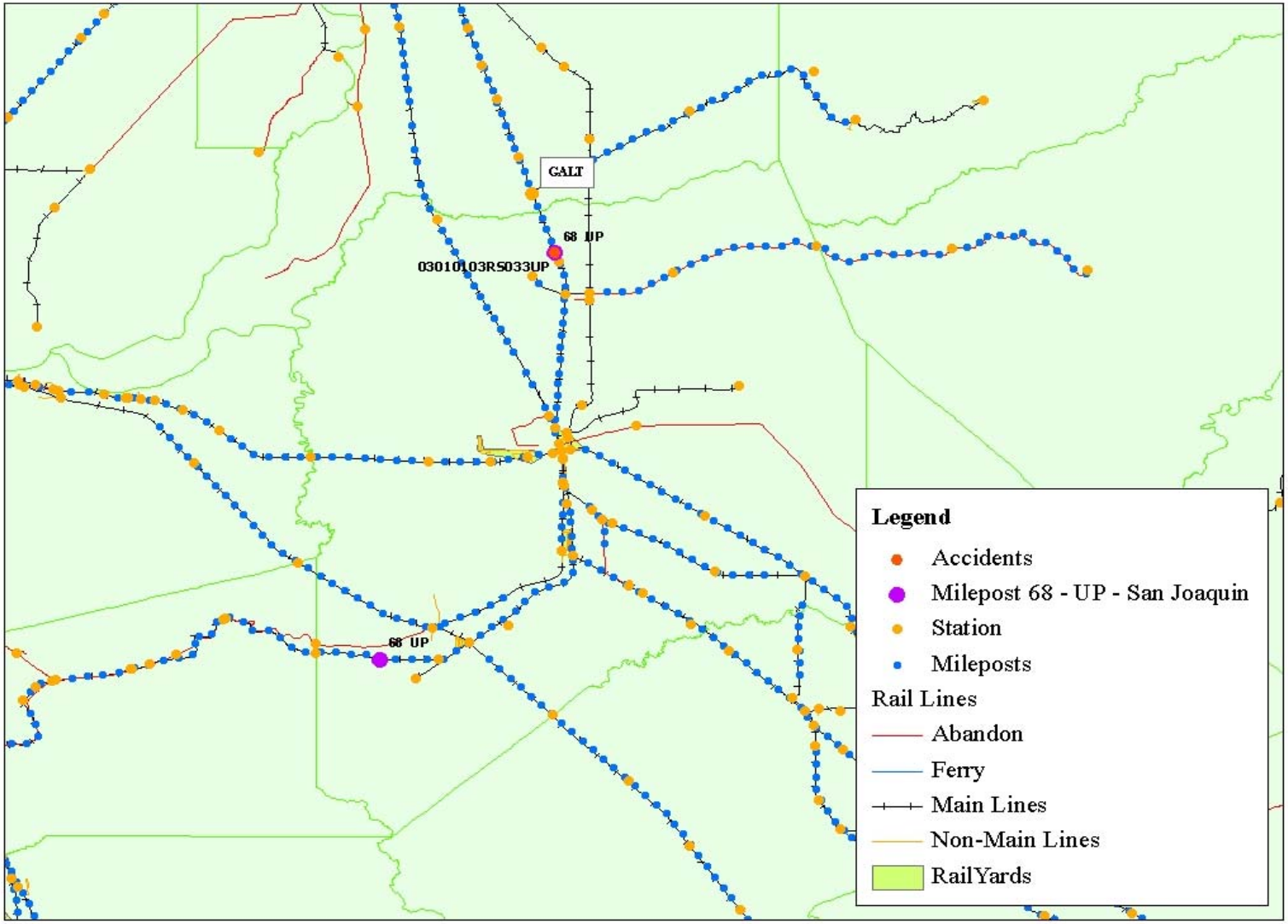
http://safetydata.fra.dot.gov/OfficeofSafety/PublicSite/Crossing/Crossing.aspx

FRA Regions

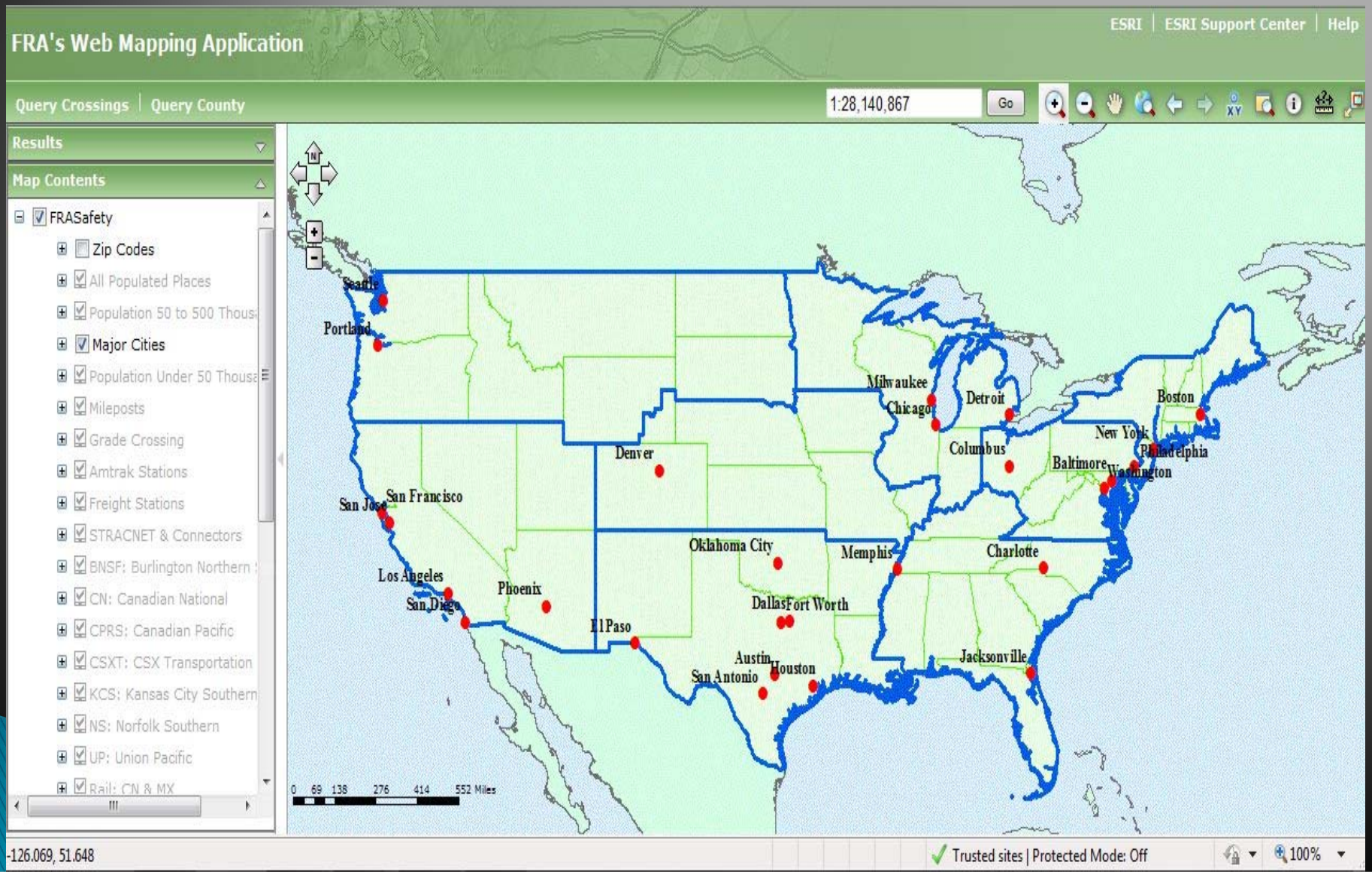
- Regulatory of Safety
- Safety Disciplines
  - Hazardous Materials
  - Motive Power and Equipment
  - Operating Practices
  - Signal and Train Control
  - Track Structures



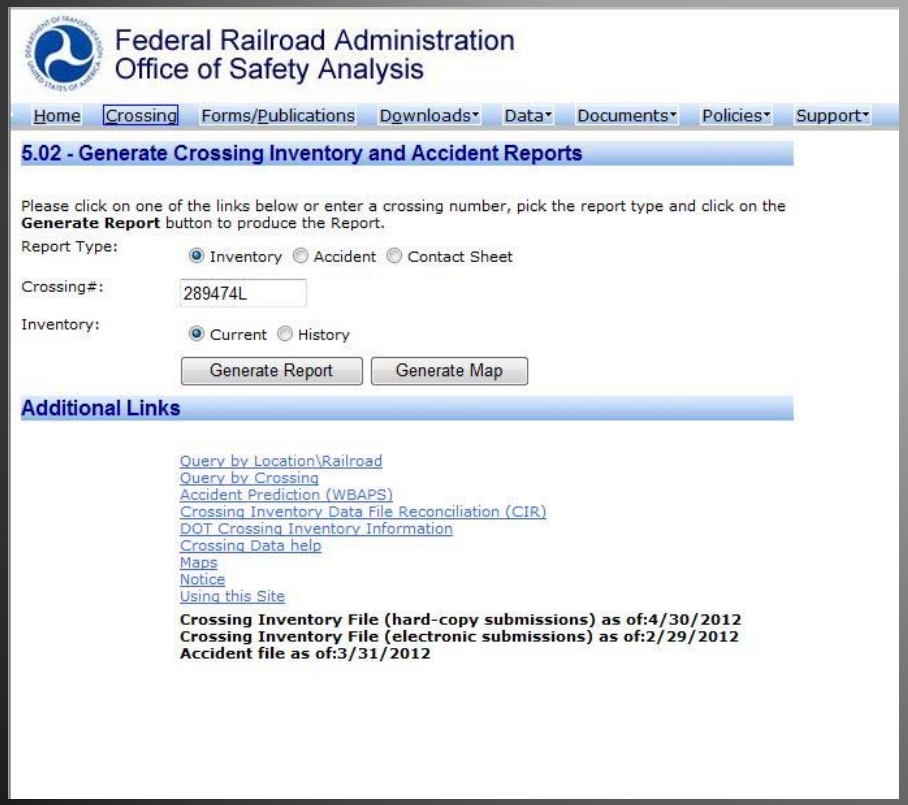
Accidents

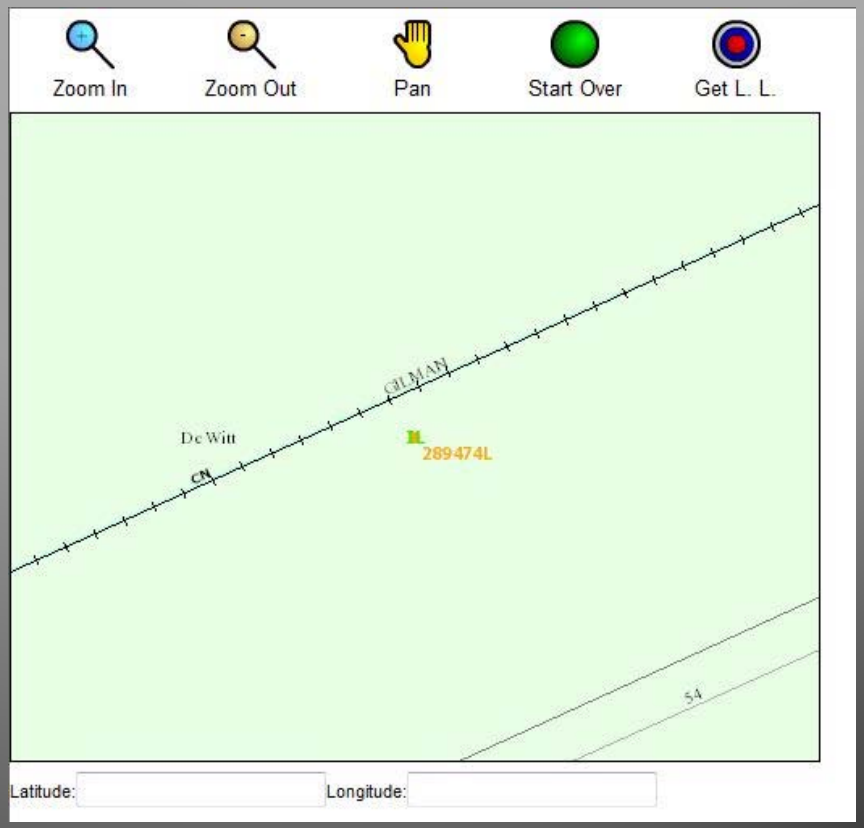

GALT
68 UP
03010103RS033UP
68 UP
Legend
Accidents
Milepost 68 - UP - San Joaquin
Station
Mileposts
Rail Lines
Abandon
Ferry
Main Lines
Non-Main Lines
RailYards

Main GIS Web Application

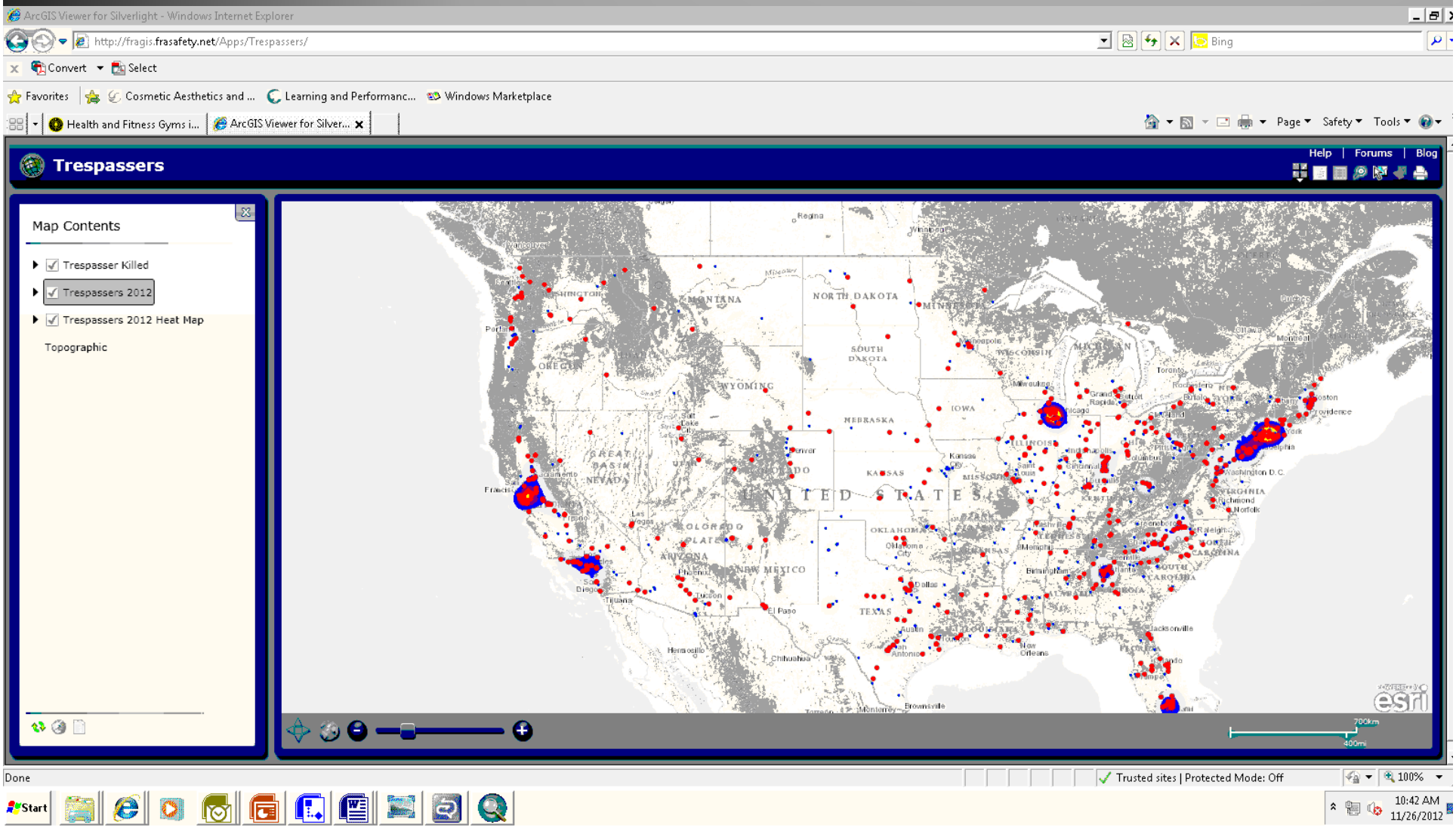


Popup Viewer



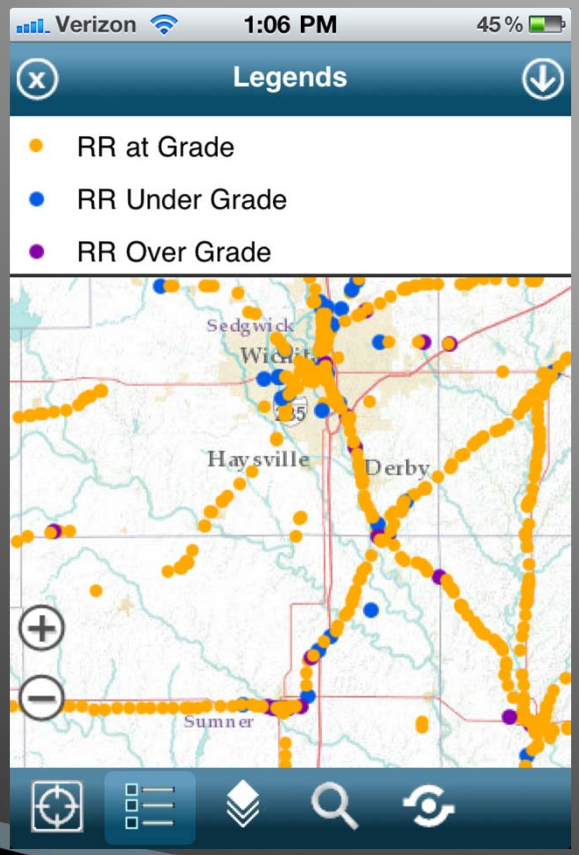


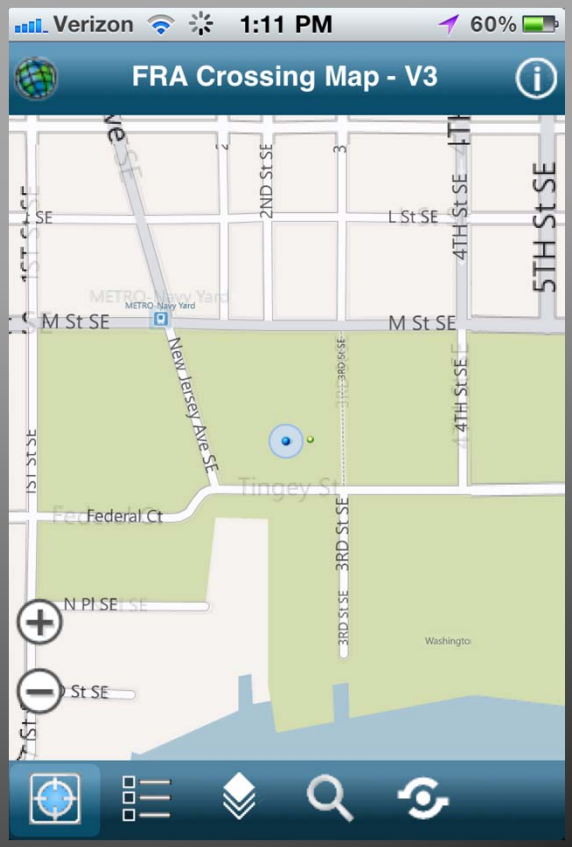
Trespassers



Mobile Applicaiton

- Mobile GIS application utilizing GPS from mobile device (iOS) and FRA's spatial data (GX'ings)



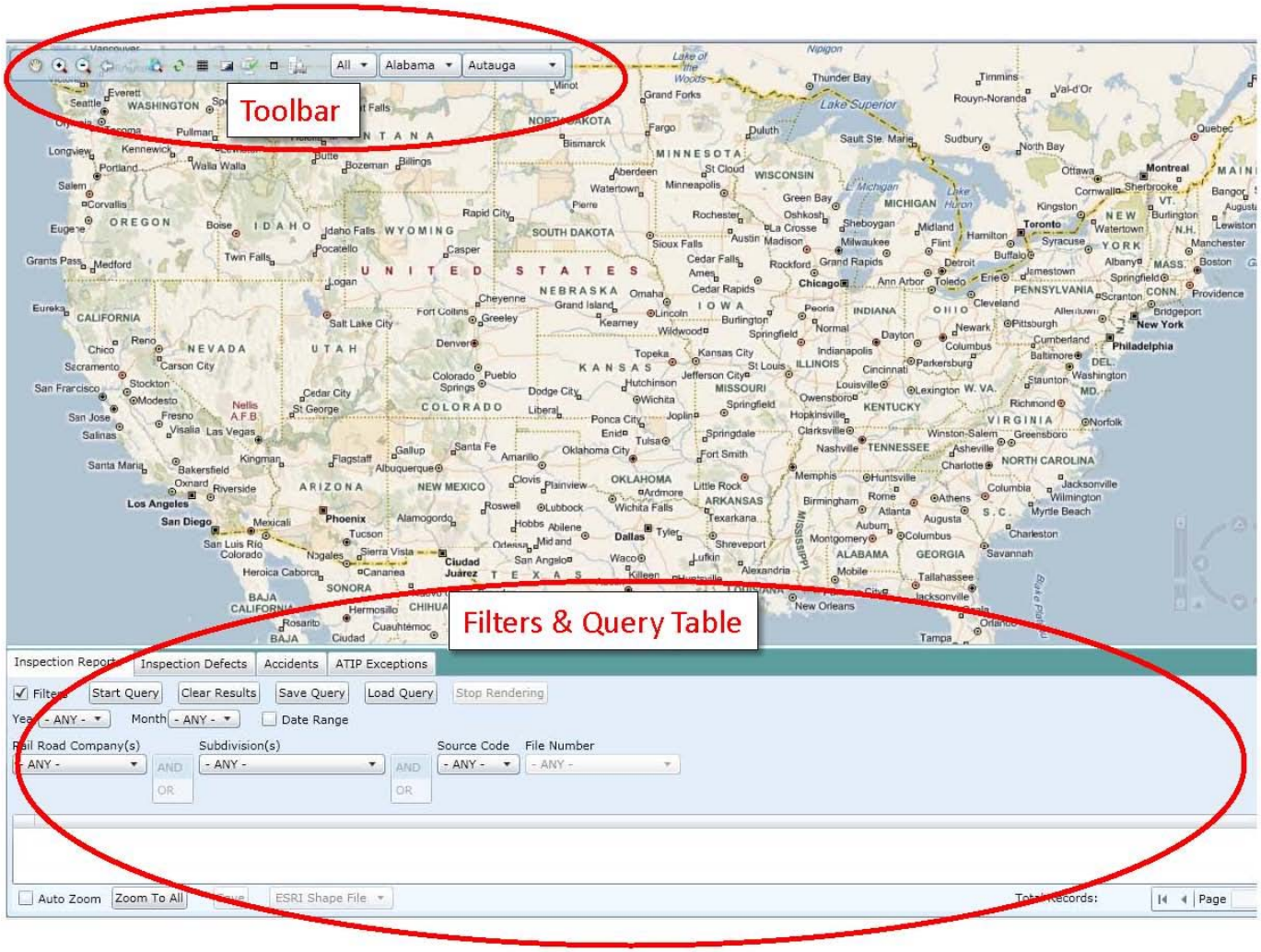


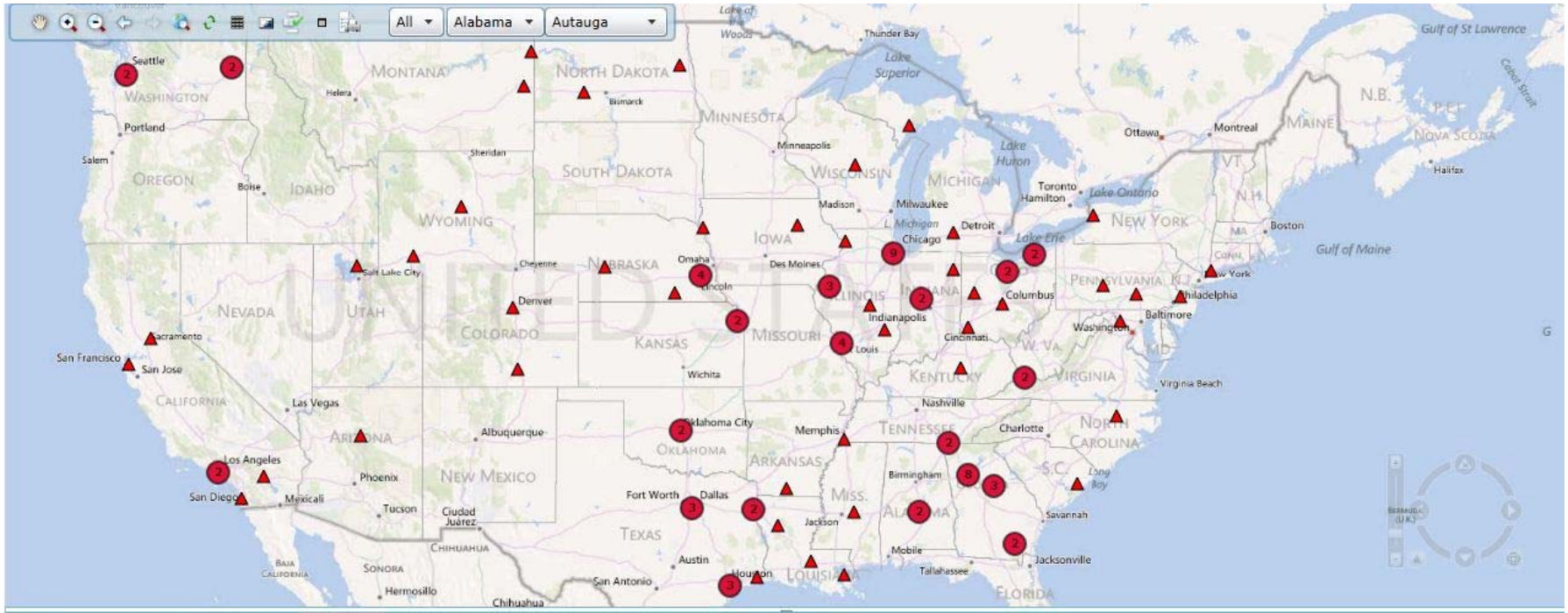
GIS Track Inspection Dashboard

- Internal Application to view
  - Inspection Reports
  - Inspection Defects
  - Accidents
  - Automated Track Inspection Program (ATIP) Exceptions

- All filters can be queried by time and type

Basic Overview





Inspection Reports | Inspection Defects | Accidents | ATIP Exceptions

☑ Filters | Start Query | Clear Results | Save Query | Load Query | Stop Rendering | Rendering completed. Elapsed:0

Year 2010 | Month - ANY - | ☐ Date Range

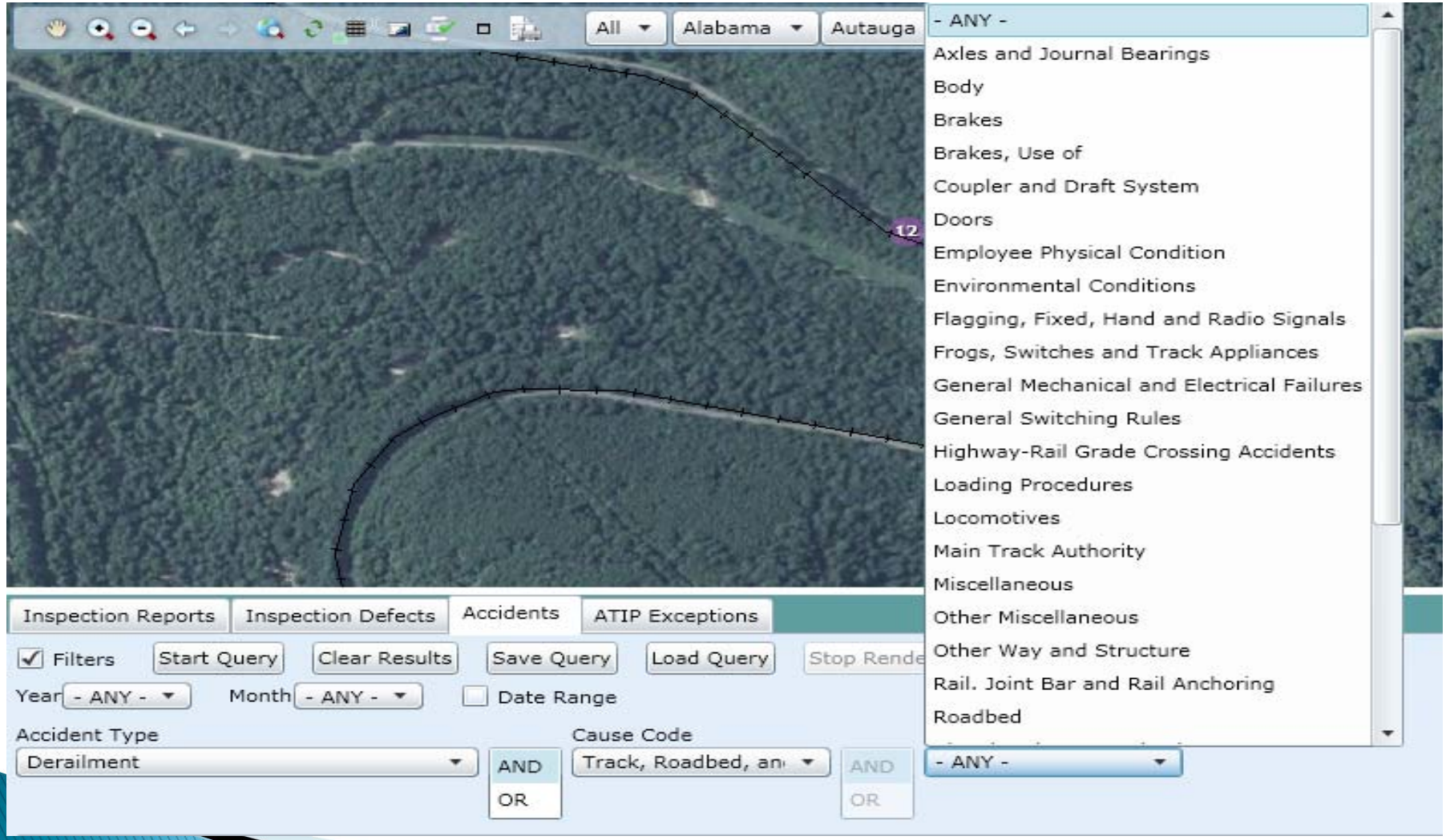
Accident Type: Derailment | AND / OR | Cause Code: ration - Human Factors | AND / OR | Sub Cause Code: - ANY -

UNIQUEID	INCDTNO3	RR3	TYPE_ACC	CARSHAZNO	CARHAZDAM	CARSHZREL	STATION	TYPE_CONSI	ANN_DEN	TRKCLASS	TYPETRK	CAUSE	CAUSE_ACC
1004000074900CSX	000074900	CSX	Derailment	8	1	0	ROCKY MOUNT	Freight Train	0	1	Yard	H525	Independent (engine) brake,
1004000075160CSX	000075160	CSX	Derailment	0	0	0	CLEVELAND	Freight Train	0	1	Yard	H702	Switch improperly lined
1004000075231CSX	000075231	CSX	Derailment	0	0	0	ATLANTA	Yards/Switching	0	1	Yard	H702	Switch improperly lined
1004000075277CSX	000075277	CSX	Derailment	0	0	0	GAINESVILLE	Freight Train	0	1	Industry	H514	Failure to allow air brakes to
1004038933NS	038933	NS	Derailment	0	0	0	NEW ORLEANS	Freight Train	18	1	Main	H601	Coupling speed excessive

☐ Auto Zoom | Zoom To All | Save | ESRI Shape File

Total Records: 109 | Page 1 of 4

Unique Queries



Inspection Reports | Inspection Defects | Accidents | ATIP Exceptions

Filters | Start Query | Clear Results | Save Query | Load Query | Stop Rendering | Rendering completed. Elapsed:0

Year - ANY - | Month - ANY - | Date Range

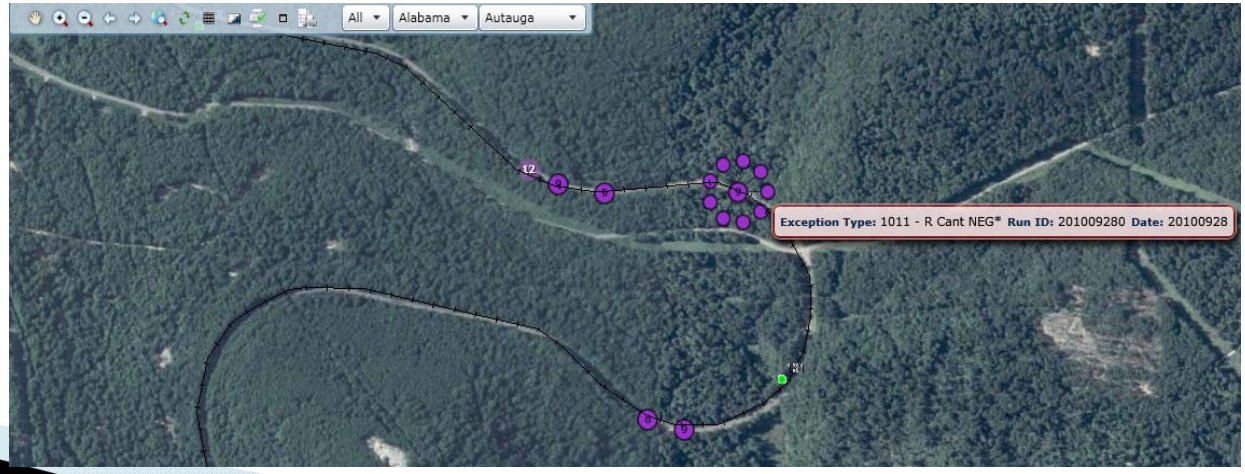
Rail Road Company(s): CSXT | AND | OR

Subdivision(s): C&N | AND | OR

Source Code: - ANY - | File Number: - ANY -

RrCode	RrCoName	ReportDate	PayrollID	ReportNo	Violation	Division	SubDivision	RrCoRep	RrCoTitl
CSXT	CSX TRANSPORTATION INTERMODAL	3/29/2004 12:00:00 AM	****	048	N	APPALA	KINGSPORT	PETERSON JR	
CSX	CSX TRANSPORTATION	7/22/2004 12:00:00 AM	****	071	N	LOUISV	C&N	I P DUSHARME	ROADM
CUOH	COLUMBUS & OHIO RIVER RR	1/31/2006 12:00:00 AM	****	012	N	SYSTEM	C&N	Cary Gregory	Assistar
CSXT	CSX TRANSPORTATION INTERMODAL	9/23/2010 12:00:00 AM	****	007	N	ALBANY	SYSTEM	ALLEN WENGERT	TRACK I
CSXT	CSX TRANSPORTATION INTERMODAL	9/23/2010 12:00:00 AM	****	008	N	ALBANY	SYSTEM	ALLEN WENGERT	TRACK I
CSXT	CSX TRANSPORTATION INTERMODAL	9/24/2010 12:00:00 AM	****	009	N	ALBANY	SYSTEM	ALLEN WENGERT	TRACK I
OHCR	OHIO CENTRAL RR CO.	1/11/2011 12:00:00 AM	****	009	N	SYSTEM	C&N	S. E. Bible	Track Ir

Auto Zoom | Zoom To All | Save | ESRI Shape File | Total Records:7 | Page 1



Conclusion

- The FRA GIS staff has made significant advancements by providing GIS expertise, spatial data, and applications in bringing additional meaning to safety data.
- The partnership with the Office of Safety, as well as others, is essential to continue the programs that utilize the current and future GIS technology.
- It is clear that there is still a lot of spatial work to do and having one centralized GIS shop for the agency is critical to continue to grow these programs in a comprehensive manner.

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Washington Metropolitan Area Transit Authority

GIS for Public Transit Safety

Ed Wells, GIS Manager
Washington Metropolitan Area Transit Authority (WMATA)

Geographic Information Systems in Transportation Safety Conference
National Transportation Safety Board
December 5, 2012

Outline

Purpose: Show how GIS can be used to support public transit safety

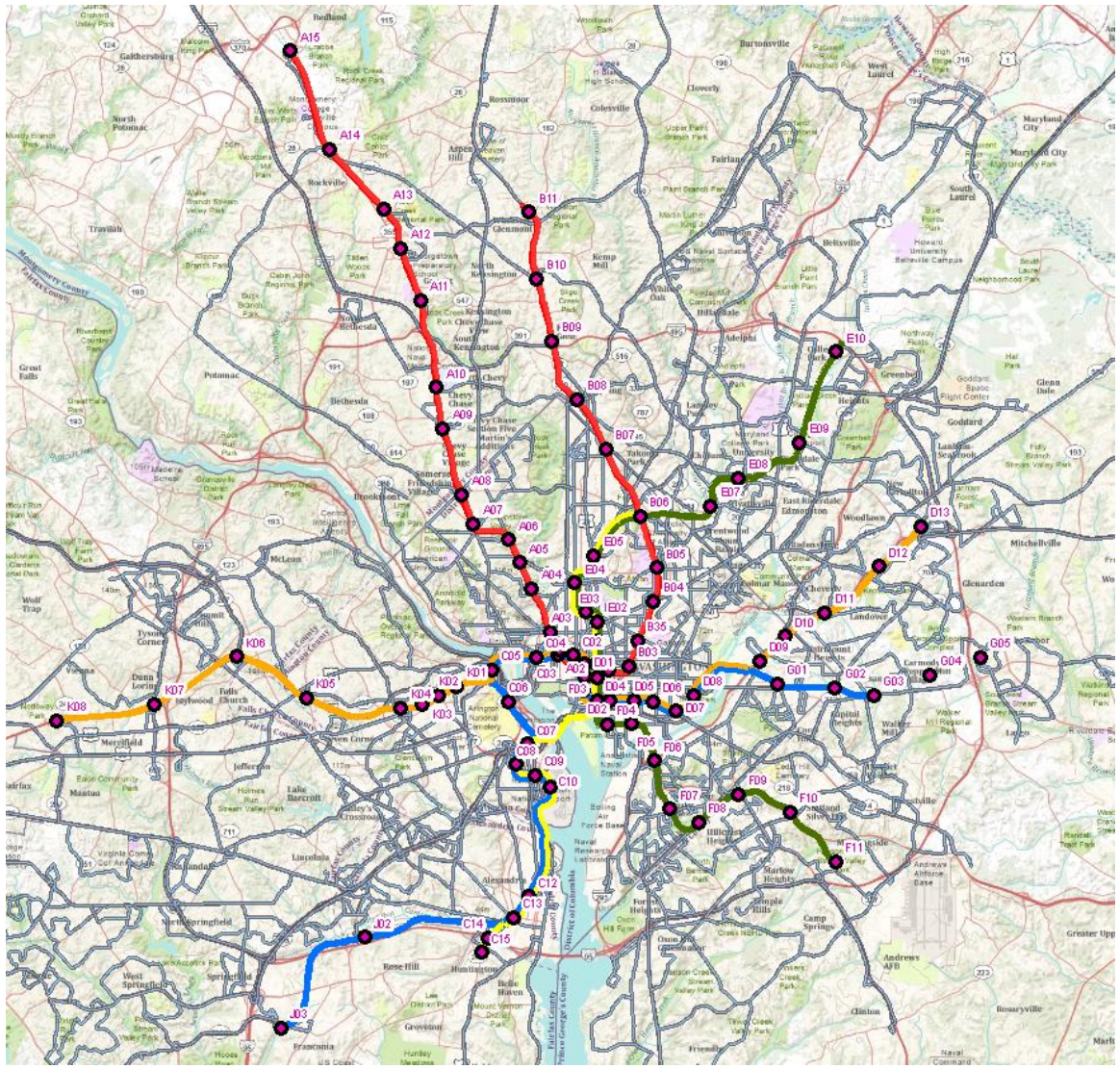
- Challenges
- Foundations
- Possibilities (general capabilities, not specific WMATA capacities or plans)
- Principles for implementation

GIS Purpose and Role

GIS integrates geography and relational databases

- Geographic data capture and display
- Geographic analysis
- Geographic data base management
- Data integrity
- Data integration

Challenge: Scope and Scale of Services



- ***WMATA*** *provides passenger transit rail, bus and paratransit services for DC and surrounding areas of MD and VA (1,500 sq mi).*
- ***Rail:*** *103 mi track; 86 stations; 850 railcars; 217M annual ridership*
- ***Bus:*** *11,500 stops; 350 routes; 1,480 buses; 124M annual ridership*
- ***Paratransit:*** *600 vehicles; 2.4M annual ridership*
- ***Infrastructure:*** *Structures, track, power, signals, HVAC, drainage, IT networks, etc.*
- ***Support:*** *Safety; Police; Planning; Real Estate; Environmental Management*

Transit GIS Challenges

- Location
- Precision
- Time
- Transit network
- IT span
- Data Integration

Business and Data Foundations

Strategic Portfolio of Enterprise Transit GIS

Fixed Asset Management

Parcel — Facility — Amenity

Transit Operations

Rail, Bus, Van, Road Network

- **Stops, time points, chain markers, waypoints**
- **Patterns, routes, lines, transfers**
- **Performance (vehicles, trips, blocks)**

Support Operations

Safety, Police, Planning, Real Estate; Environmental

IT Infrastructure Foundation

- Enterprise GIS software
- Data, data models, and data maintenance procedures
- Servers, storage, network
- Production, staging, development environments
- Desktop, web, application access
- Internal and public information
- Scale-up capacity
- Security and disaster recovery

Worker Safety

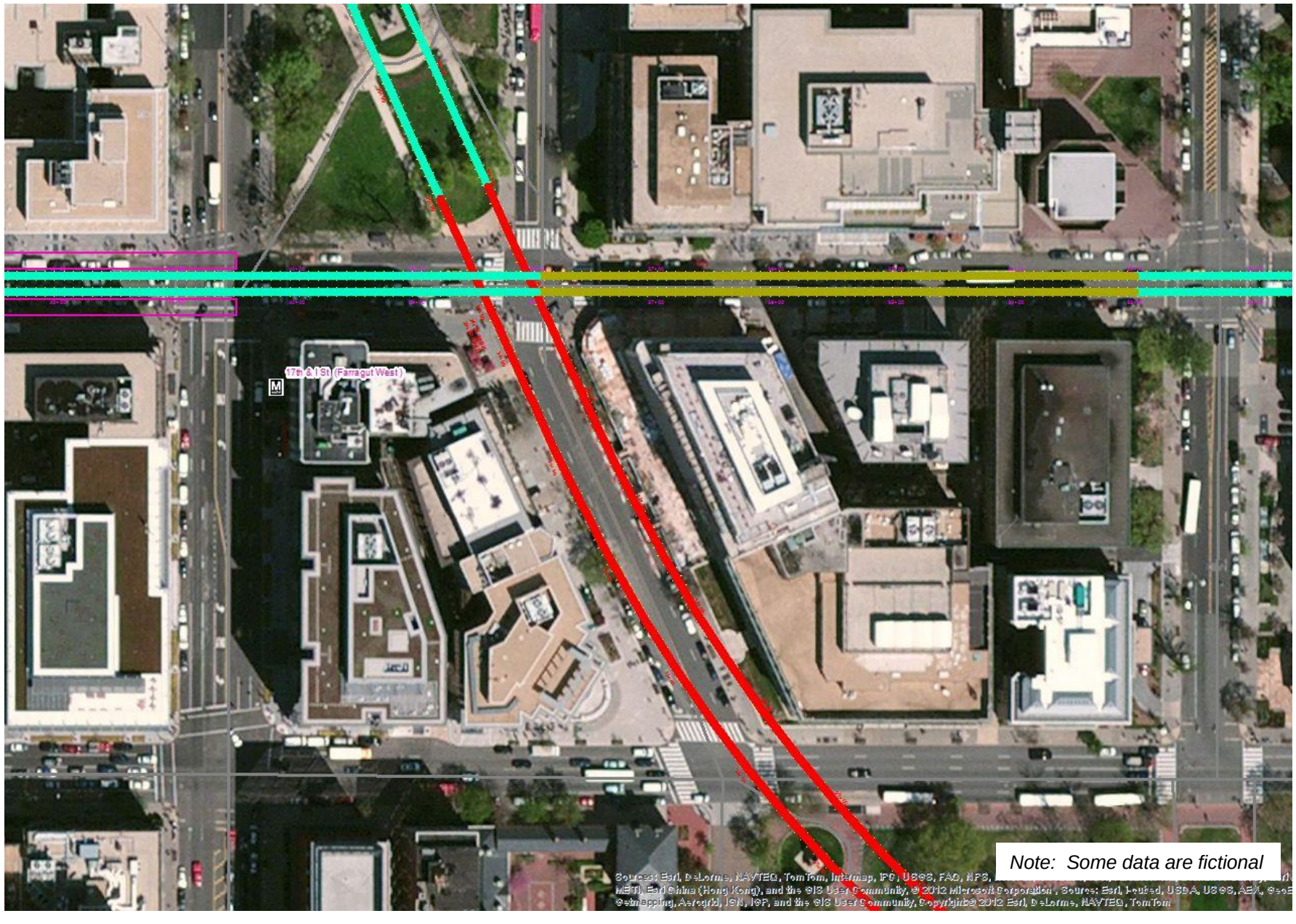
Roadway Access Guide

				M LINE					
	TRACK 1					TRACK 2			
RWP	NOTES	STATION END	STATION START	Ch, Mkr # start	ch, Mkr# end	STATION START	STATION END	NOTES	RWP
	CLEAR VIEW	M01	M02	34+00	59+00	M01	M02	CLEAR VIEW	
	CURVE: RESTRICTED VIEW	M01	M02	59+00	69+00	M01	M02	CURVE: RESTRICTED VIEW	
	CLEAR VIEW	M01	M02	69+00	79+00	M01	M02	CLEAR VIEW	
	CLEAR VIEW	M02	M03	79+00	104+00	M02	M03	CLEAR VIEW	
	CLEAR VIEW	M03	M04	104+00	124+00	M03	M04	CLEAR VIEW	
	HILL: RESTRICTED VIEW	M03	M04	124+00	144+00	M03	M04	HILL: RESTRICTED VIEW	
	CLEAR VIEW	M03	M04	144+00	164+00	M03	M04	CLEAR VIEW	
	CLEAR VIEW	M04	M05	164+00	184+00	M04	M05	CLEAR VIEW	
	CLEAR VIEW	M04	M05	184+00	194+00	M04	M05	HILL: RESTRICTED VIEW	
	HILL: RESTRICTED VIEW	M04	M05	194+00	204+00	M04	M05	CLEAR VIEW	
	CLEAR VIEW	M05	M06	204+00	219+00	M05	M06	CLEAR VIEW	
	HILL: RESTRICTED VIEW	M05	M06	219+00	234+00	M05	M06	HILL: RESTRICTED VIEW	

Note: Data are fictional

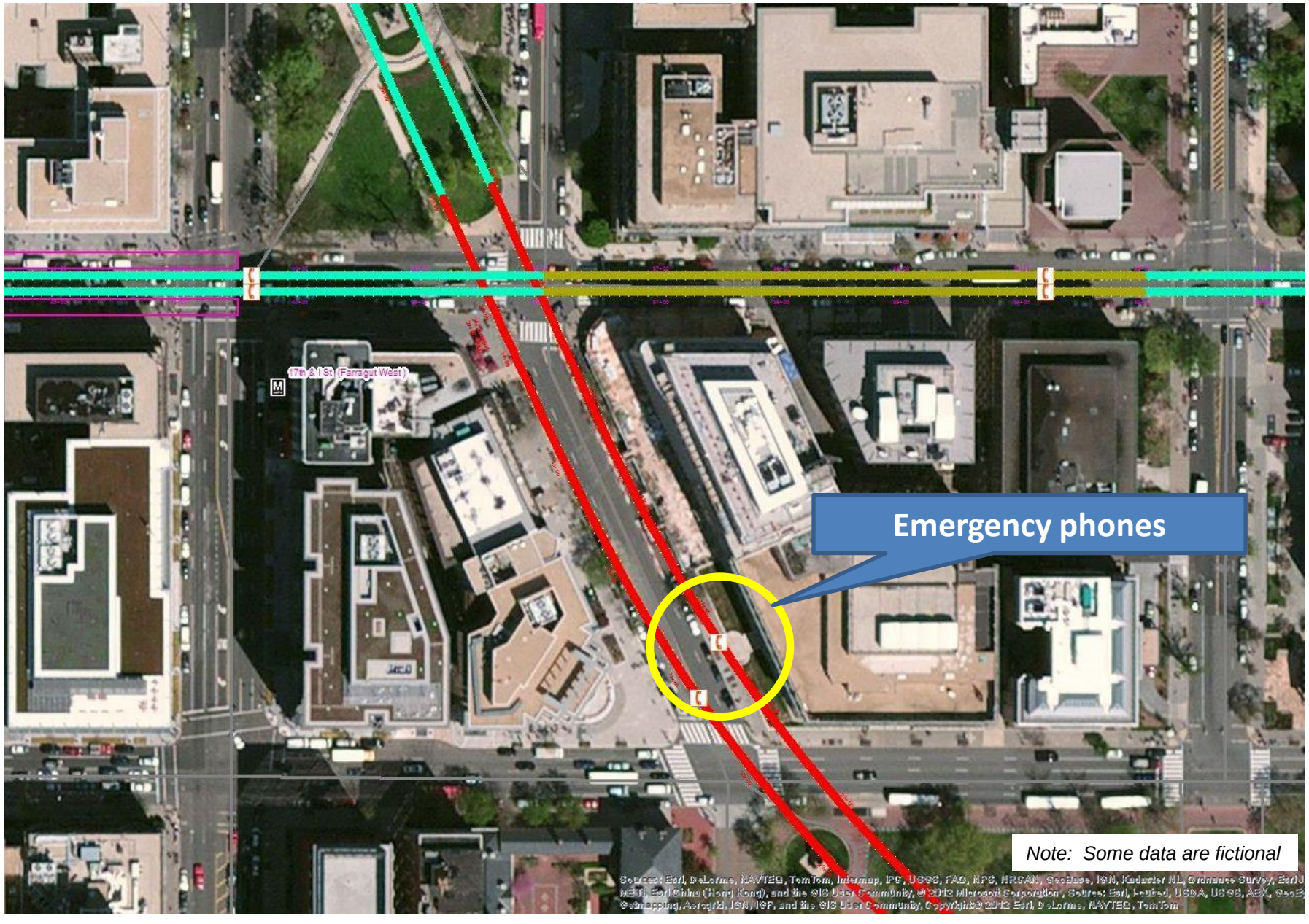
Worker Safety

- Roadway Access Guide, mapped



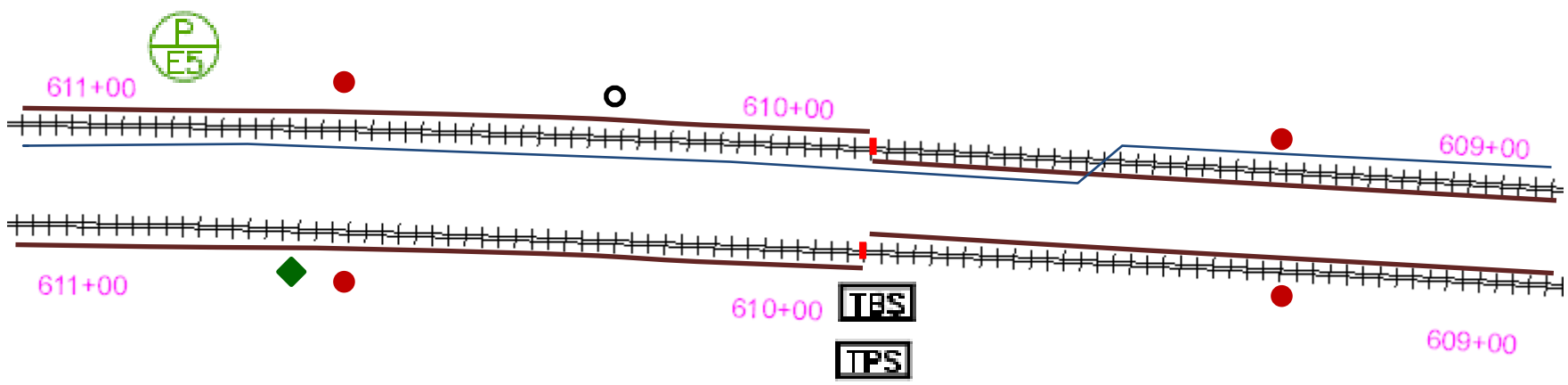
Worker Safety

- Map, with emergency phones added



Asset Safety: Inventory and Location

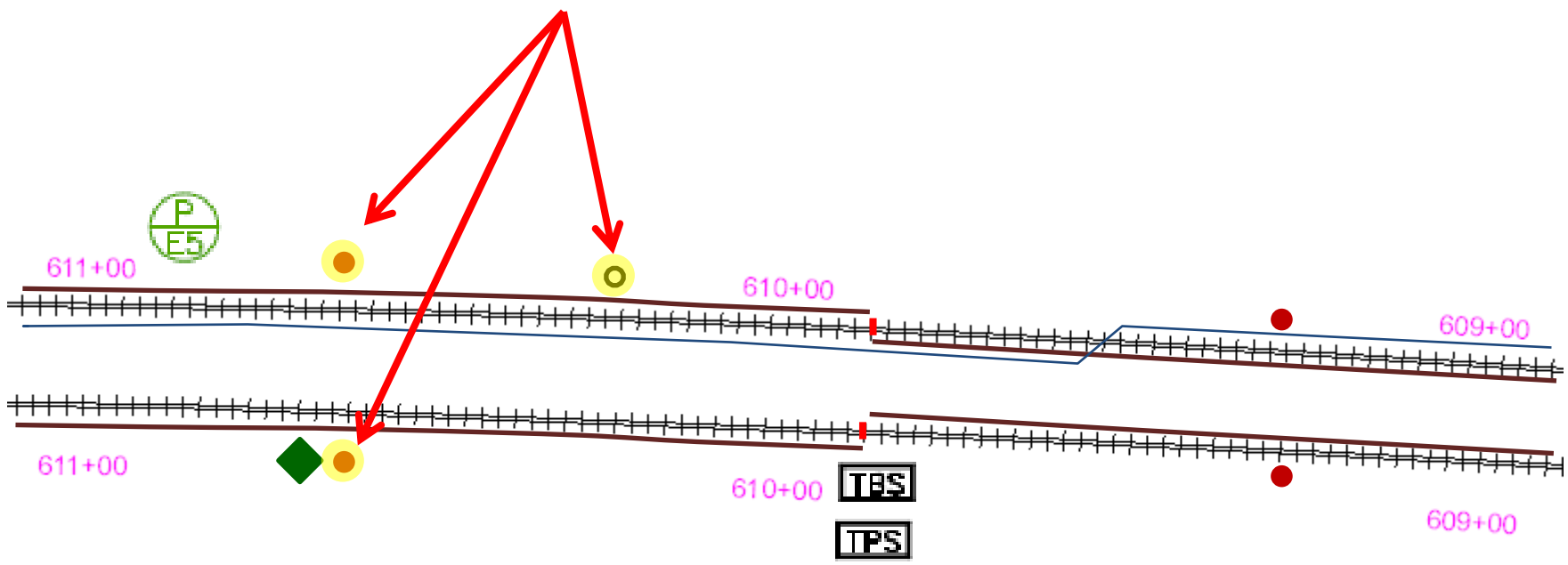
- Asset inventory and maps



Note: Data are fictional

Asset Safety: Status

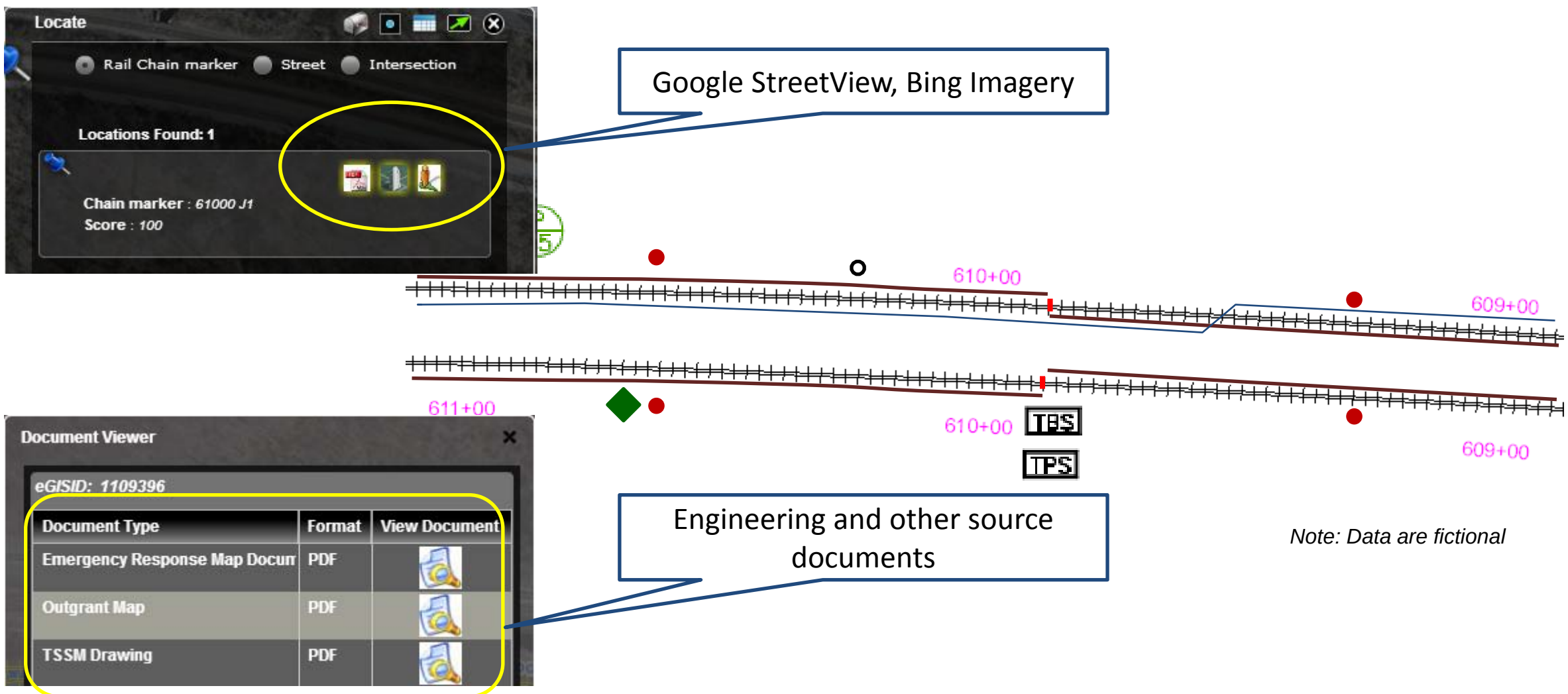
- Assets requiring inspection, maintenance, etc. (from work order management system)



Note: Data are fictional

Asset Safety: Views and Documentation

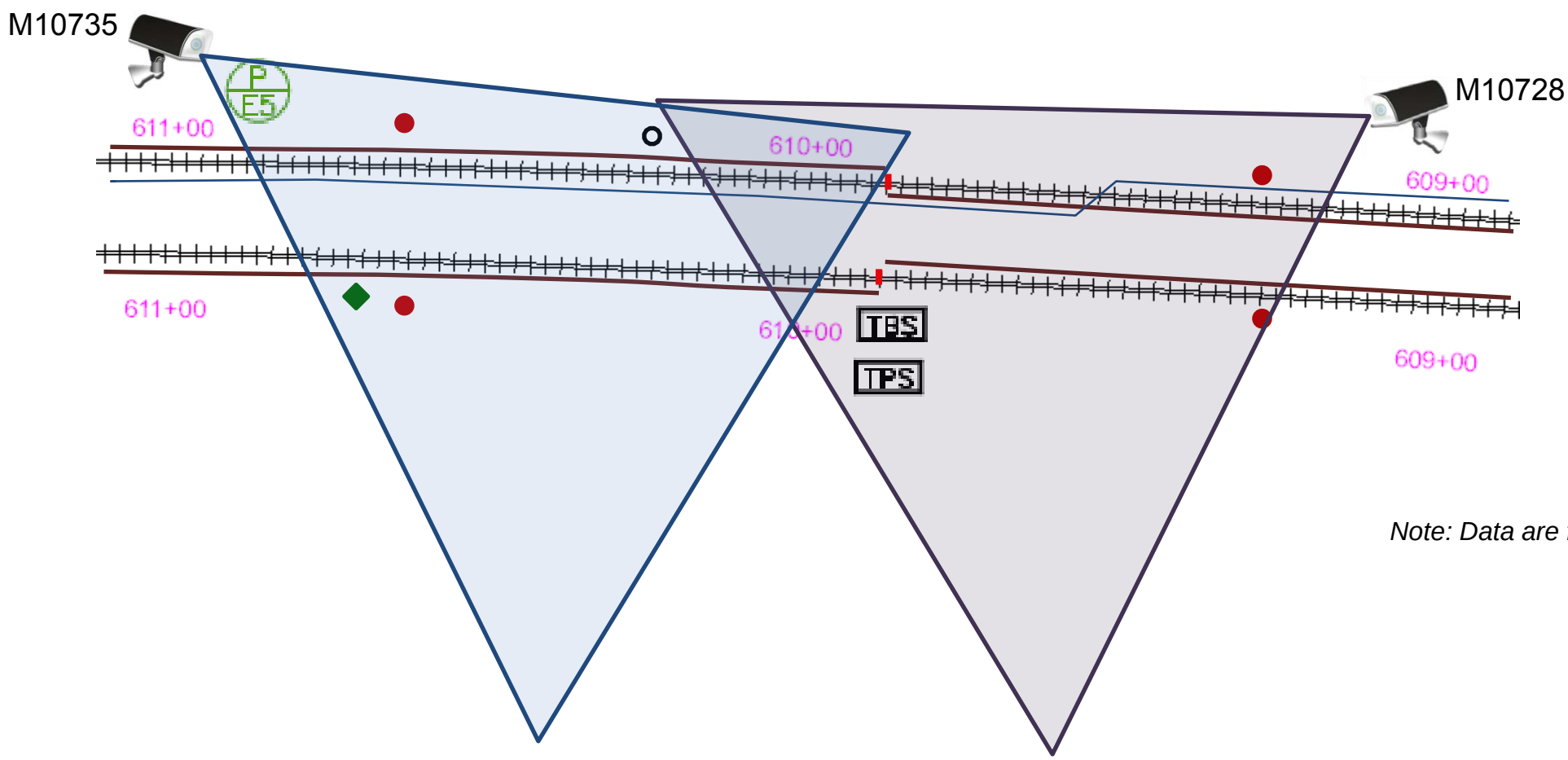
- Detailed documentation and context views.



Note: Data are fictional

Asset Safety: Monitoring

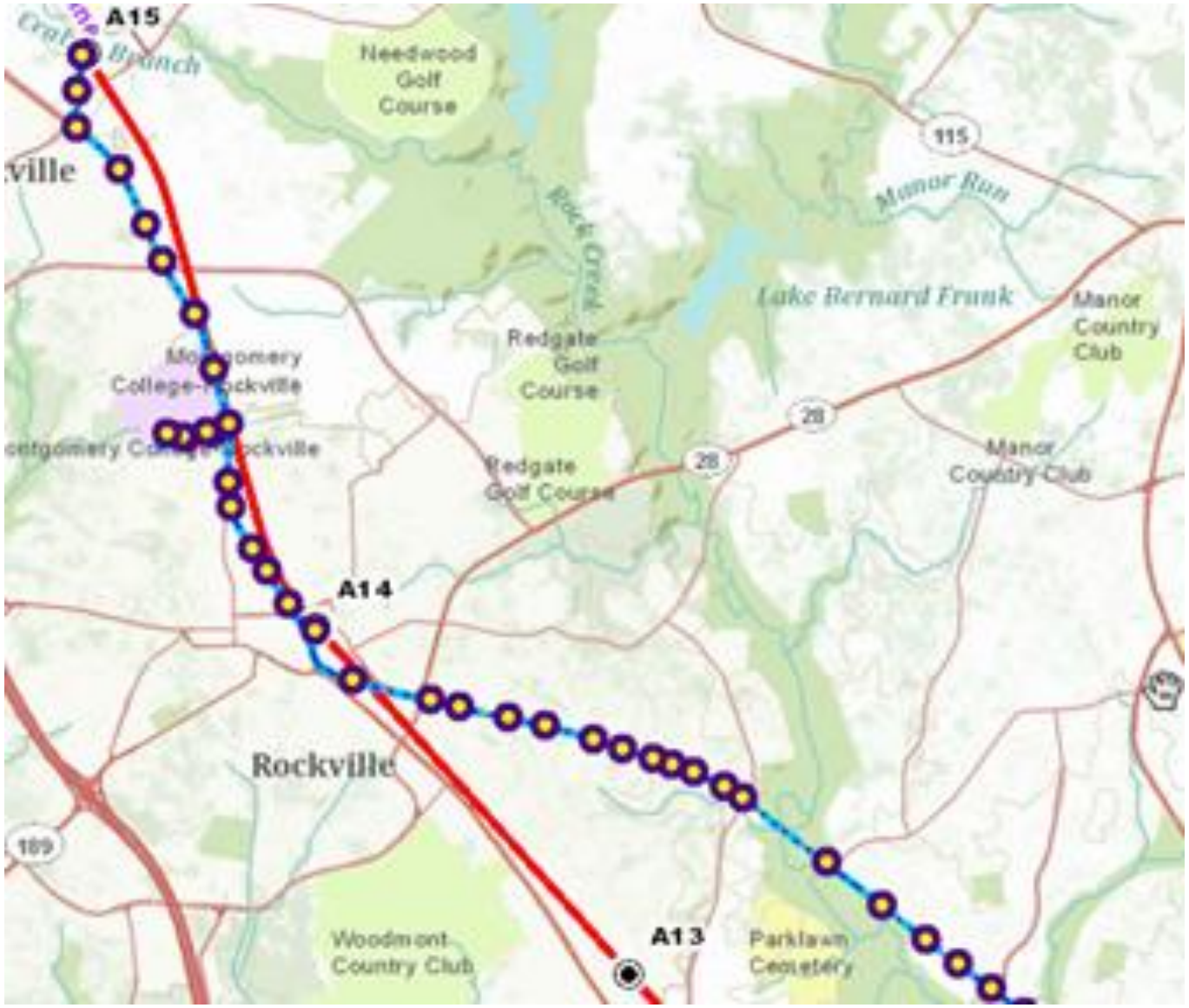
- Assets within camera viewsheds



Note: Data are fictional

Situational Awareness

- Routes and Stops



Situational Awareness

- Bus and train locations (updated every 90 sec.)

Situational Awareness

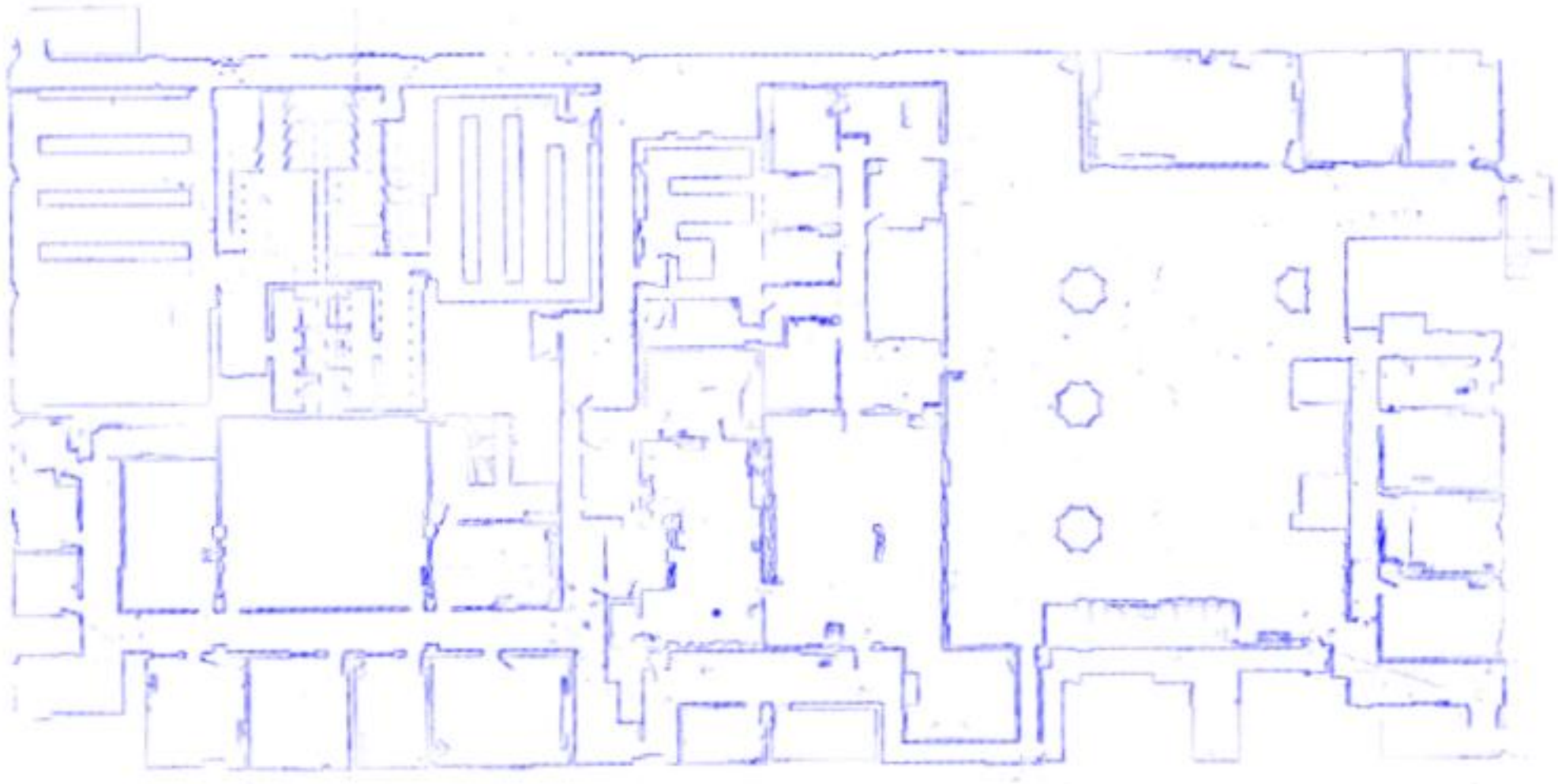
- Alerts, incidents, delays

Situational Awareness

- Crime mapping

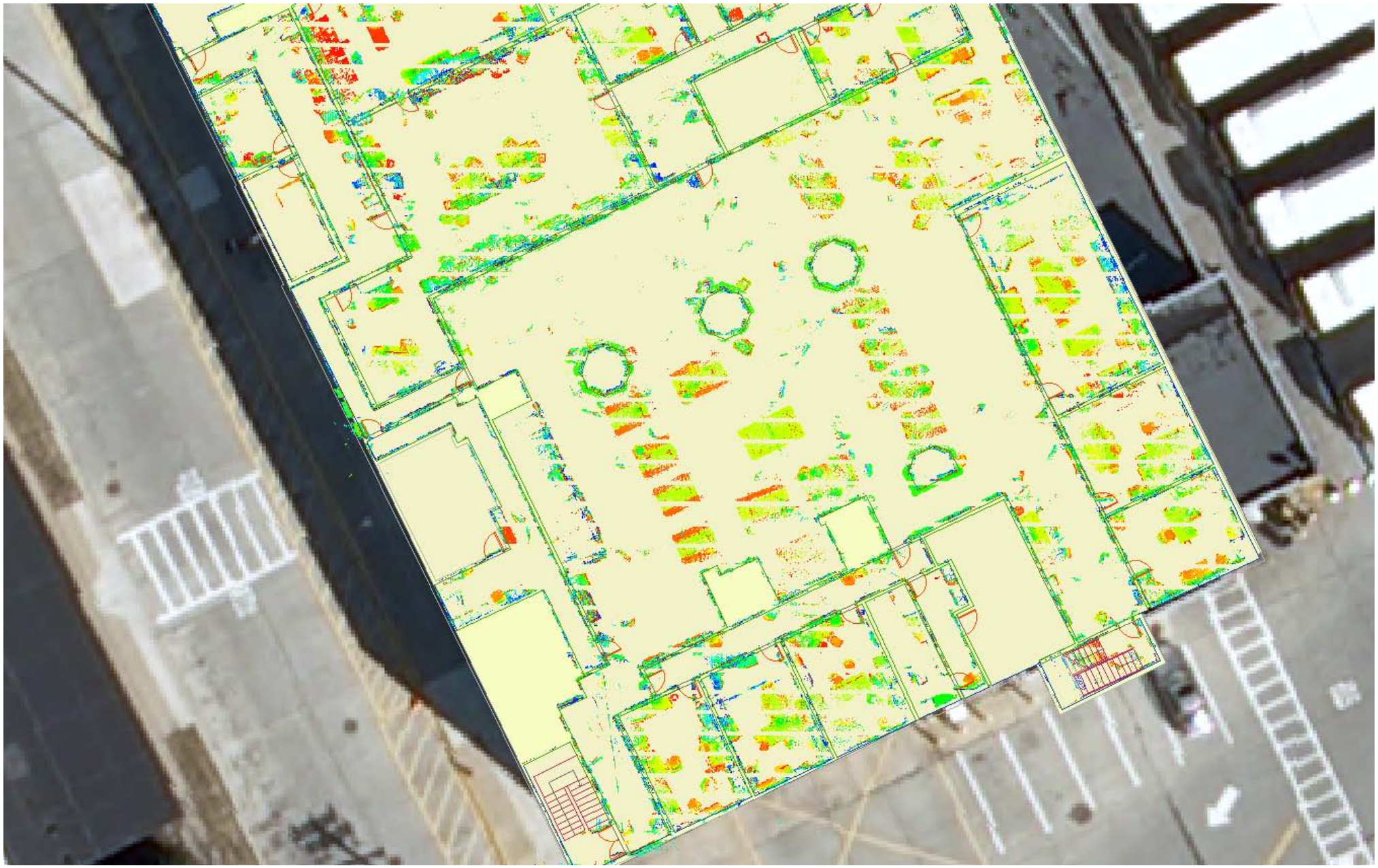
Building Mapping

- Floor plan



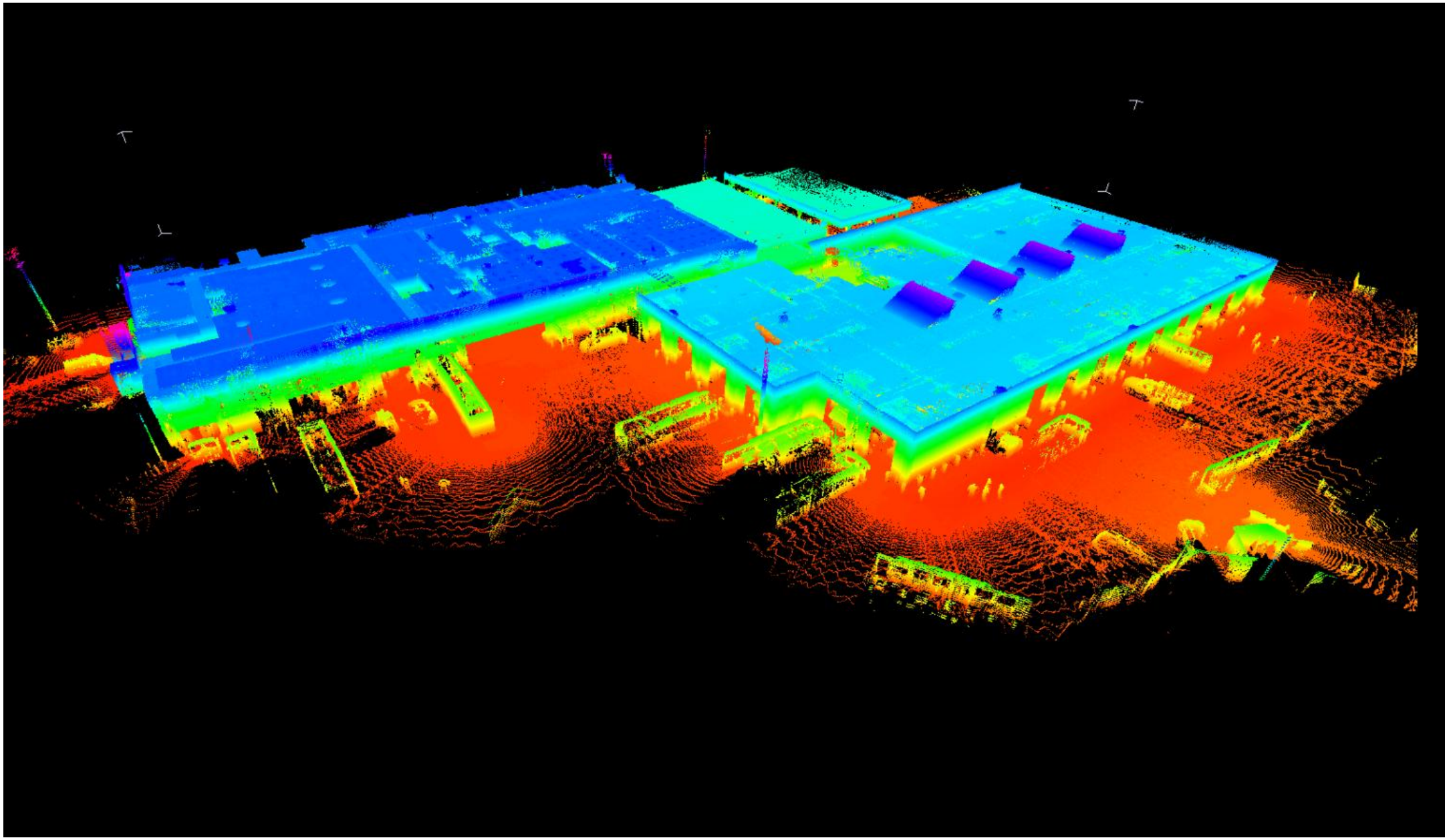
Building Mapping

- Georeferenced, and superimposed on imagery



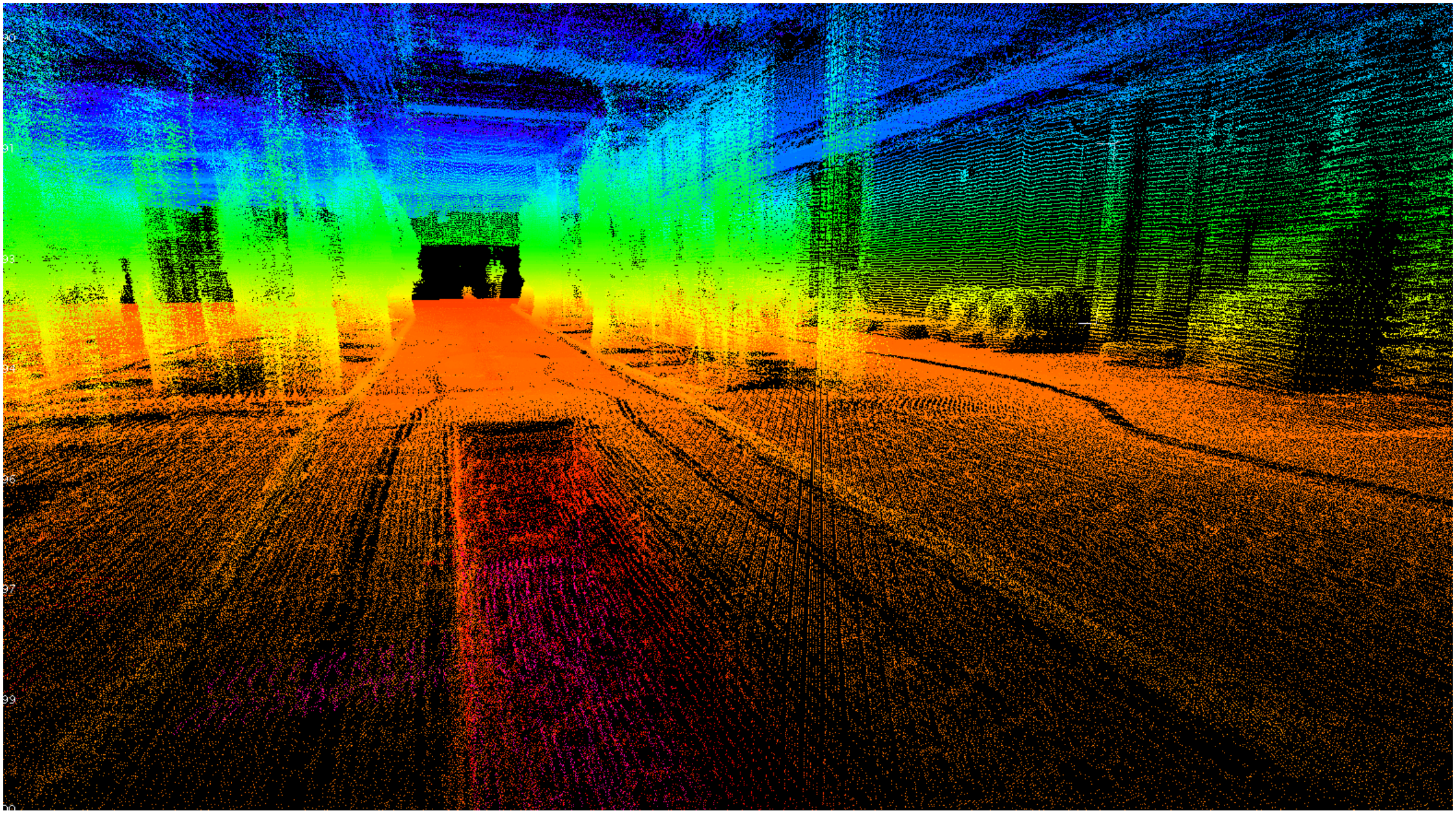
Building Mapping

- 3-D exterior view



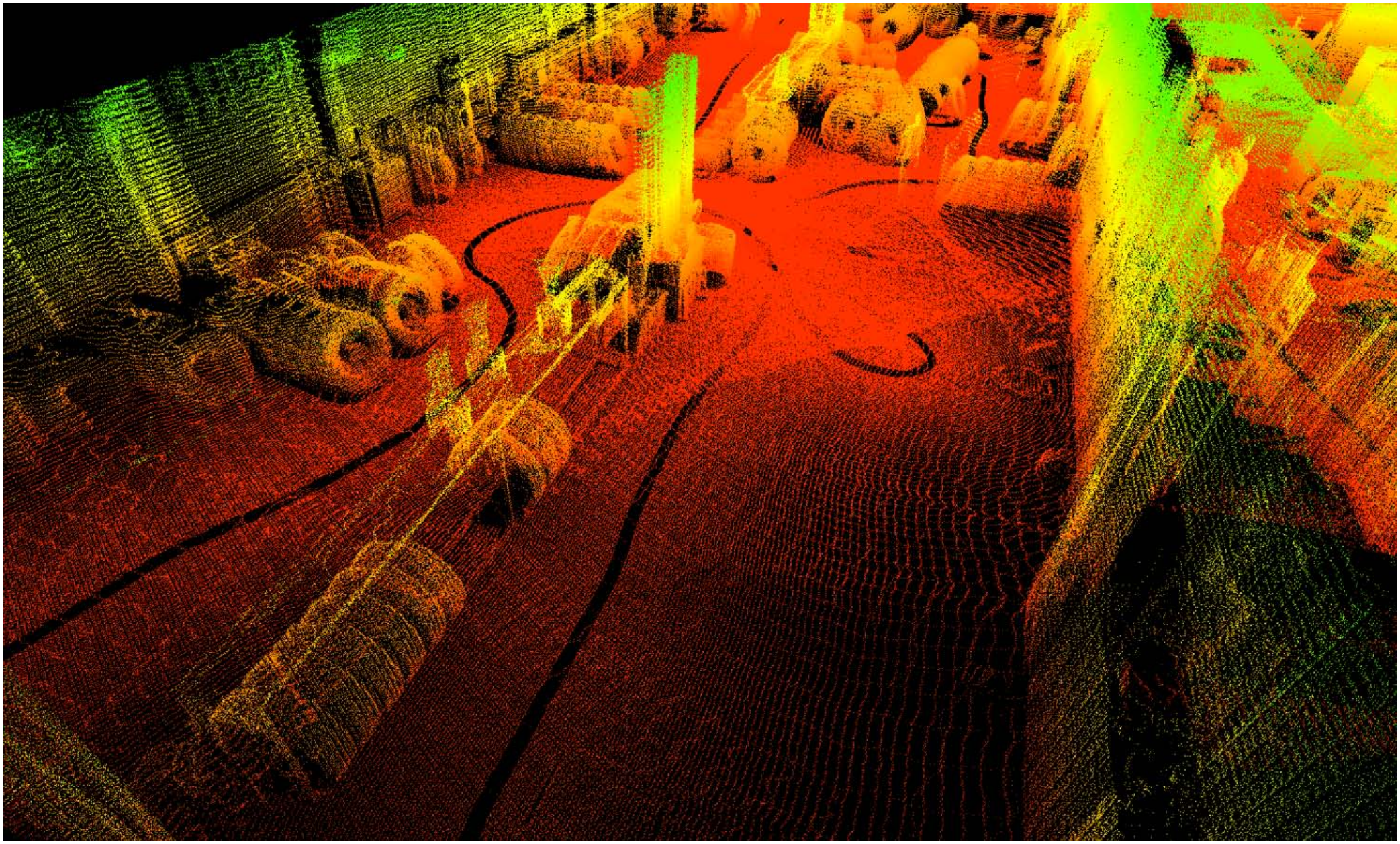
Building Mapping

- Interior view



Building Mapping

- Recomputed view



Building Mapping

- 360˚ Imagery

More Complex Applications

- Incident analytics
- Safety dashboards
- Impact zone and plume dispersion overlays
- Geo-data feeds to external fusion centers
- Station or rail evacuation planning
- Preset map configurations for emergency planning scenarios

Pathways to Success

- Build from simple to complex.
- Write once, use many. (Integrate, don’t replicate.)
- Build a close partnership between IT and business departments.
- Use and improve on legacy data.
- Set strategy first, then obtain system infrastructure; then data and maintenance processes. Build applications only after they have a solid foundation.

Questions and Discussion

Ed Wells, ewells@wmata.com

Washington (DC) Metropolitan Area Transit Authority

ACCESS MIDSTREAM

PIPELINE SAFETY AND GIS

HOW WE LEVERAGE GIS TO MAKE PIPELINES SAFER

ACCESS MIDSTREAM

OVERVIEW:

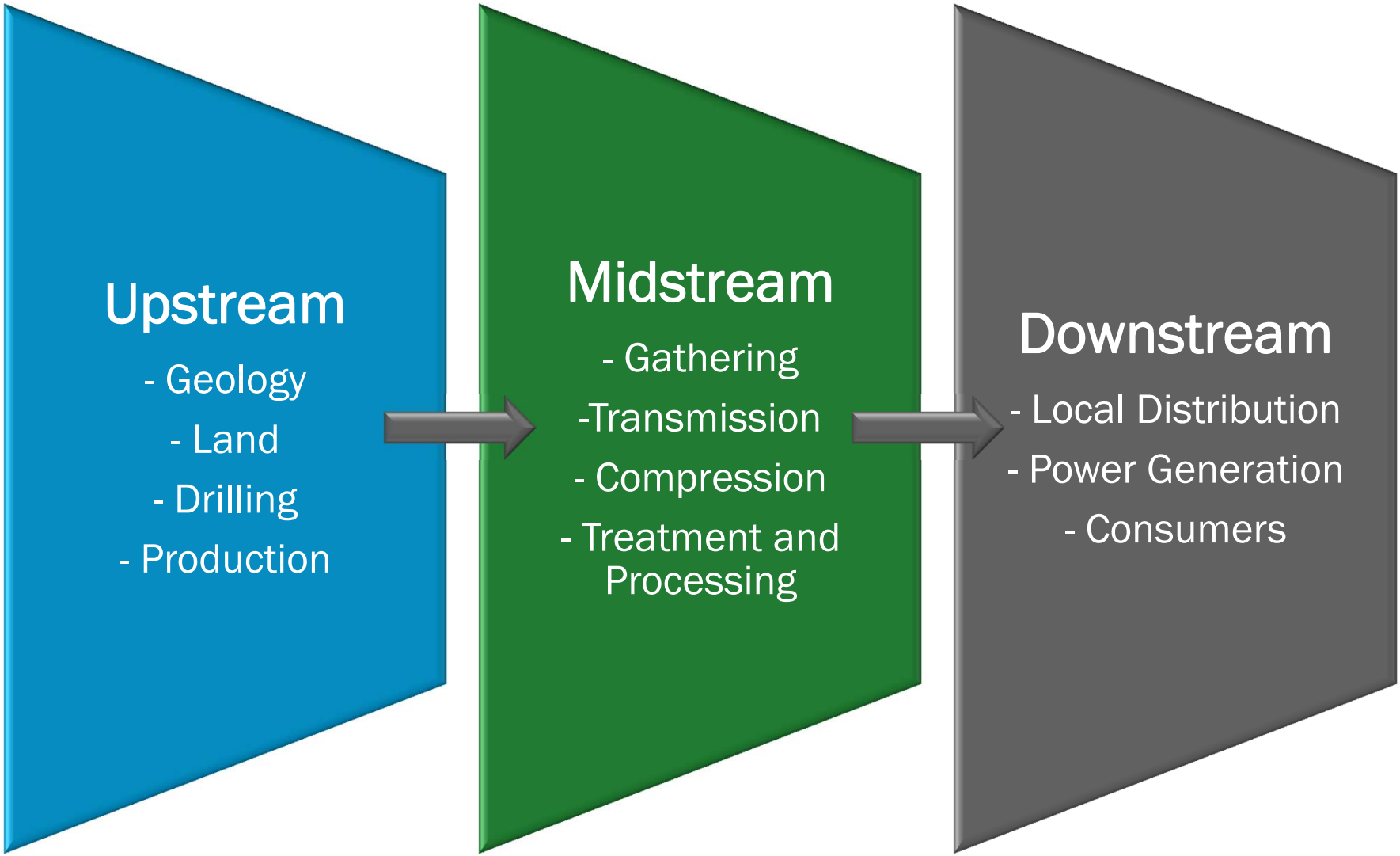
ACCESS MIDSTREAM AND OUR INDUSTRY

WHO IS ACCESS MIDSTREAM?

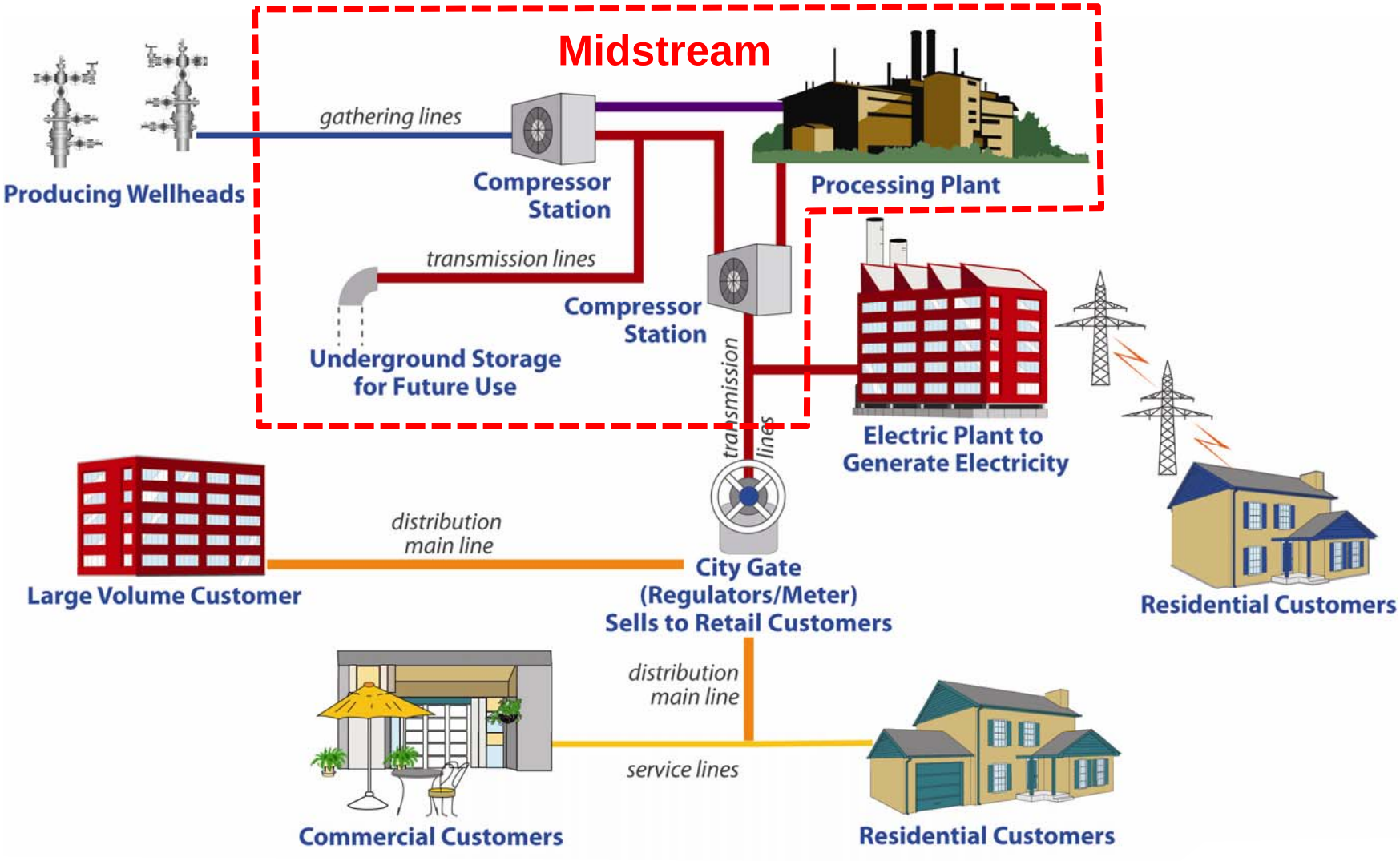
- Headquartered in **Oklahoma City** with operations across the United States.
- Industry's largest independent gathering and processing master limited partnership as measured by throughput volume. Operations in **13 states** with over **6500 miles** of pipeline.
- Access owns, operates, develops and acquires natural gas and liquids gathering systems and other **midstream energy assets** across the United States for the largest energy companies in the country.
- Access is committed to safe and environmentally sound operations across all of its operating areas and in 2011 celebrated a **third consecutive year with no lost-time injuries, zero agency reportable spills and no air permit violations.**
- Founded as Chesapeake Midstream, a wholly owned subsidiary of Chesapeake Energy. Now an **independent midstream company.**

WHERE DOES MIDSTREAM FIT?

ACCESS MIDSTREAM



WHAT DOES MIDSTREAM MEAN?



ACCESS MIDSTREAM

PIPELINE SAFETY:

REGULATORY COMPLIANCE AND PIPELINE INTEGRITY WITH GIS

WHAT DOES IT MEAN TO BE REGULATED?

ACCESS MIDSTREAM

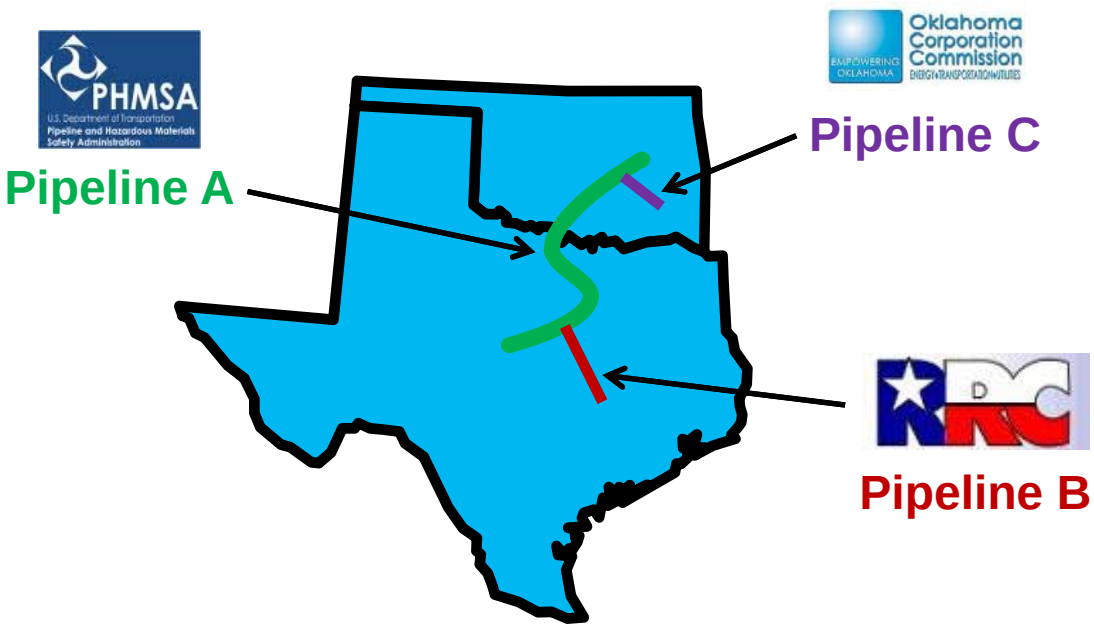
- **Government inspections and audits**
  - Agencies inspect and monitor operator activity for regulated lines
- **"Unregulated" does not mean "Unsafe"**
- **Examples of Required Tasks:**
  - General compliance requirements:
    - Pipeline patrols
    - Stringent construction requirements
    - Operator qualification training and certification
    - Operations and maintenance inspections
    - Data retention requirements
    - Corrosion control documentation
    - Class location and HCA studies
    - Integrity management
    - Annual Reporting
    - Quality control and inspections
    - Inspections by state and/or federal auditors
  - Public Awareness:
    - Safety communication and outreach efforts
    - Required messaging
    - Defined stakeholders
    - Effective measurement
  - Damage Prevention:
    - One call ticket audits
    - Positive response audits
    - Bottom Line Results

GOVERNMENT REGULATIONS

- **Not all pipelines are regulated…**
  - **Natural gas pipelines** are subject to Class Location Determinations based upon population density and operating characteristics (operating pressure, line size, material grade, usage type, etc)
  - **Liquid product pipelines** are regulated based primarily upon potential environmental impacts, or High Consequence Areas

REGULATORY JURISDICTION

- Interstate vs Intrastate
  - Determines the government entity with oversight/jurisdiction
    - Pipeline A is *interstate* and regulated by PHMSA
    - Pipeline B is *intrastate* and regulated by Texas Railroad Commission
    - Pipeline C is *intrastate* and regulated by Oklahoma Corporation Commission



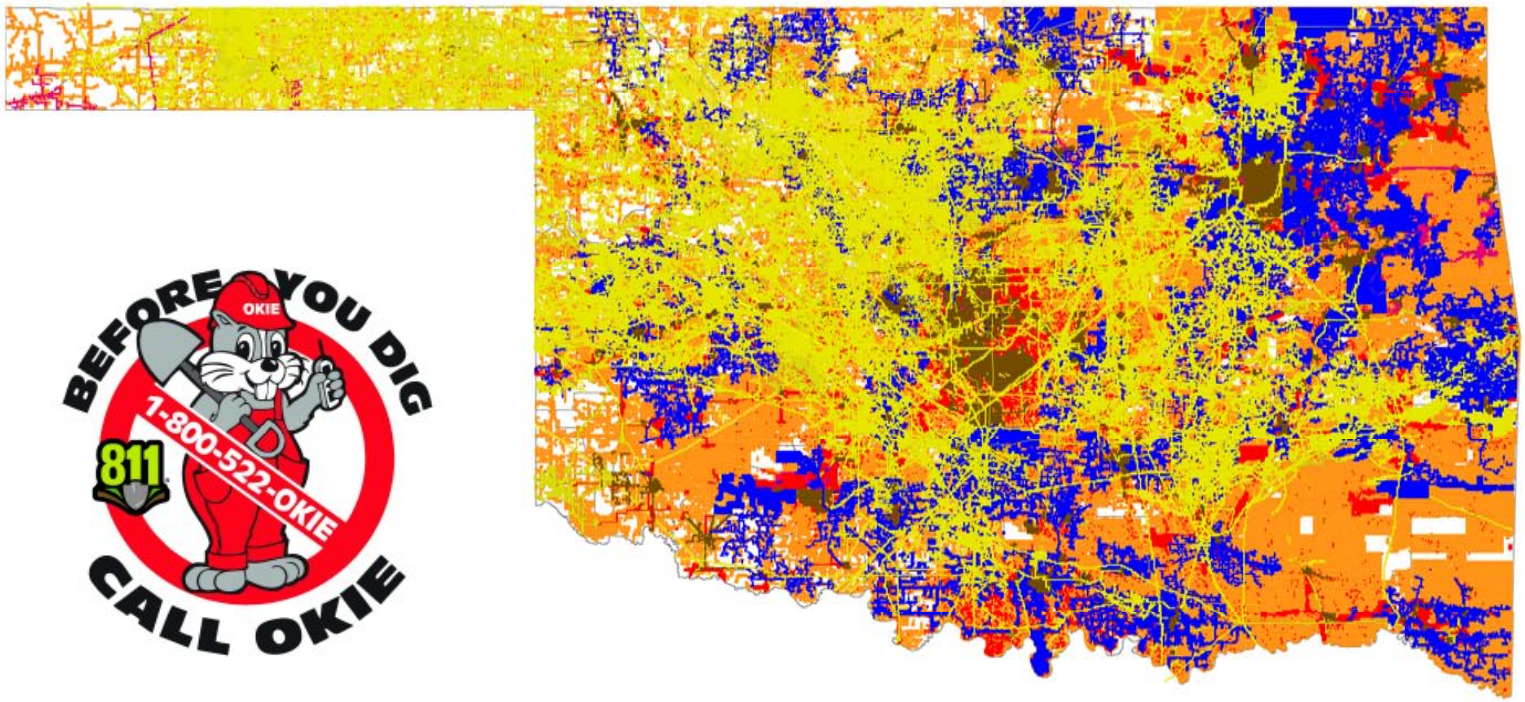
ACCESS MIDSTREAM

PIPELINE SAFETY AND GIS:

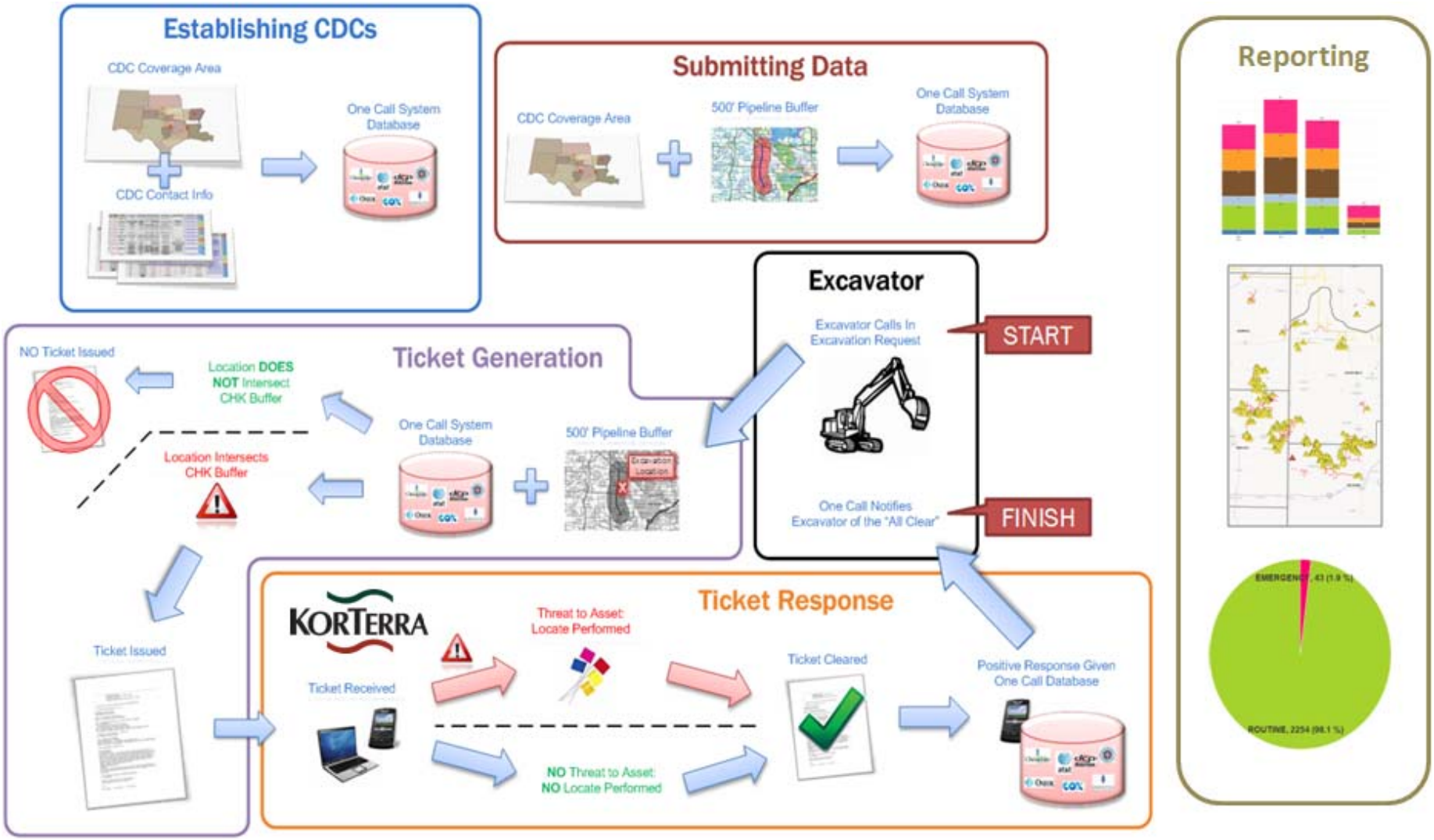
1. DAMAGE PREVENTION & ONE CALL MANAGEMENT
2. INCIDENT TRACKING
3. INTERNAL INSPECTIONS
4. RISK ANALYSIS
5. PUBLIC AWARENESS AND EMERGENCY RESPONSE

WHY DAMAGE PREVENTION?

- Over 2.5 million miles of oil/gas pipeline in the United States
- That doesn't include electric lines, water pipe, sewage, fiber-optic, telephone lines or other types of facilities.



THE ONE CALL PROCESS USING GIS

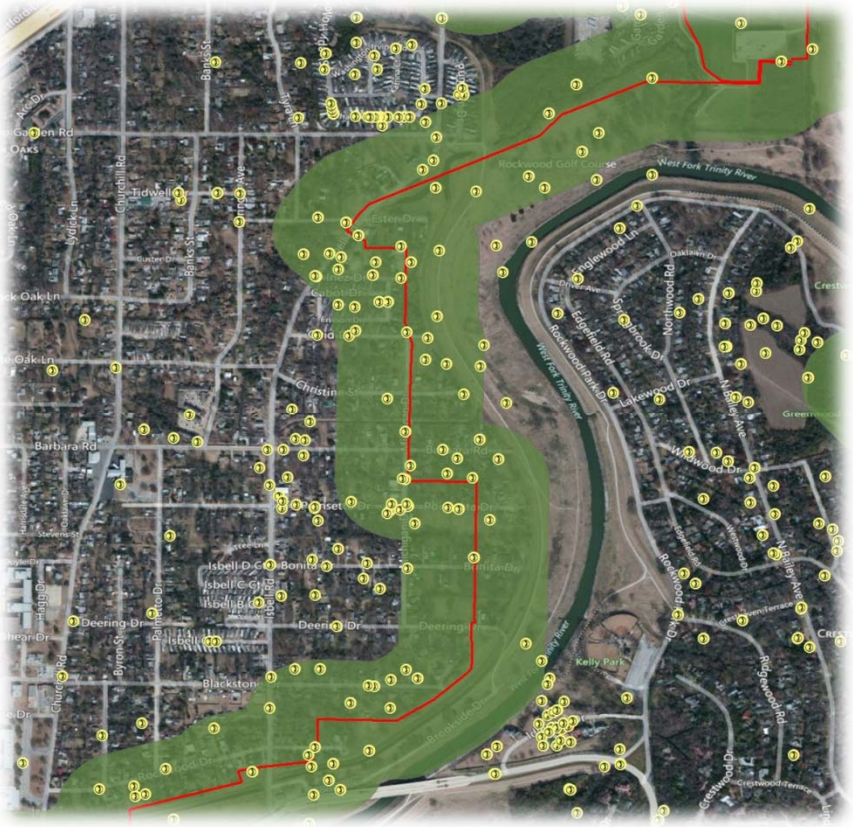


BENEFITS AND GAPS OF GIS FOR ONE CALL MANAGEMENT

ACCESS MIDSTREAM

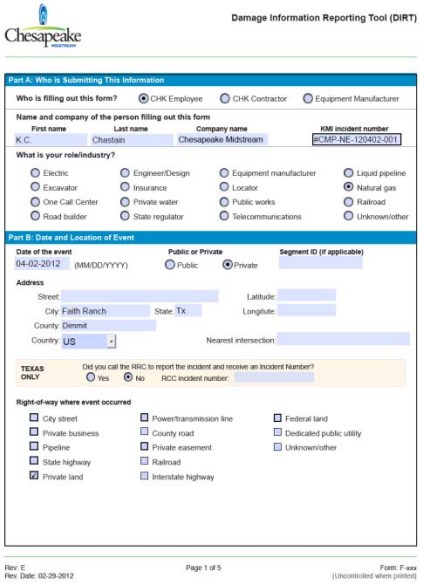
- **Benefits**
  - Efficient – Ticket requests to OCC processed quickly
  - Precise – Less “white noise”
  - Cheaper – Less tickets means lower costs
  - Online request systems

- **Gaps**
  - Poor geocoding results on tickets
  - Incorrect GPS coordinates
  - Requires highly accurate asset datasets



PIPELINE INCIDENT MANAGEMENT WITH GIS

- "DIRT" – Damage Information Reporting Tool
- National program sponsored by the Common Ground Alliance, used internally at Access Midstream
- Used to analyze and trend excavation related damages



Chesapeake MIDSTREAM

Damage Information Reporting Tool (DIRT)

Part A: Who is Submitting This Information

Who is filling out this form? ○ CHK Employee ○ CHK Contractor ○ Equipment Manufacturer

Name and company of the person filling out this form

First name	Last name	Company name	KMI incident number
K.C.	Chastain	Chesapeake Midstream	#CMP-NE-120402-001

What is your role/industry?

○ Electric ○ Engineer/Design ○ Equipment manufacturer ○ Liquid pipeline
○ Excavator ○ Insurance ○ Locator ● Natural gas
○ One Call Center ○ Private water ○ Public works ○ Railroad
○ Road builder ○ State regulator ○ Telecommunications ○ Unknown/other

Part B: Date and Location of Event

Date of the event: 04-02-2012 (MM/DD/YYYY)
Public or Private: ○ Public ● Private
Segment ID (if applicable):

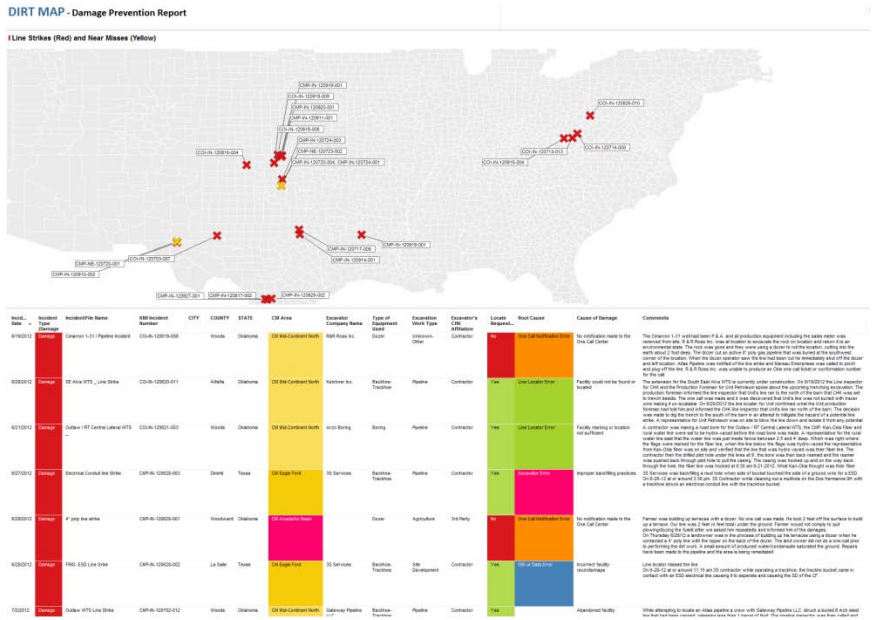
Address
Street:
City: Faith Ranch State: Tx
Latitude:
Longitude:
County: Dimmit
Country: US
Nearest intersection:

TEXAS ONLY: Did you call the RRC to report the incident and receive an Incident Number? ○ Yes ● No RCC incident number:

Right-of-way where event occurred

☐ City street ☐ Power/transmission line ☐ Federal land
☐ Private business ☐ County road ☐ Dedicated public utility
☐ Pipeline ☐ Private easement ☐ Unknown/other
☐ State highway ☐ Railroad
☑ Private land ☐ Interstate highway

Rev: E
Rev. Date: 02-29-2012
Page 1 of 5
Form: F-xxx
(Uncontrolled when printed)



DIRT MAP - Damage Prevention Report

Line Strikes (Red) and Near Misses (Yellow)

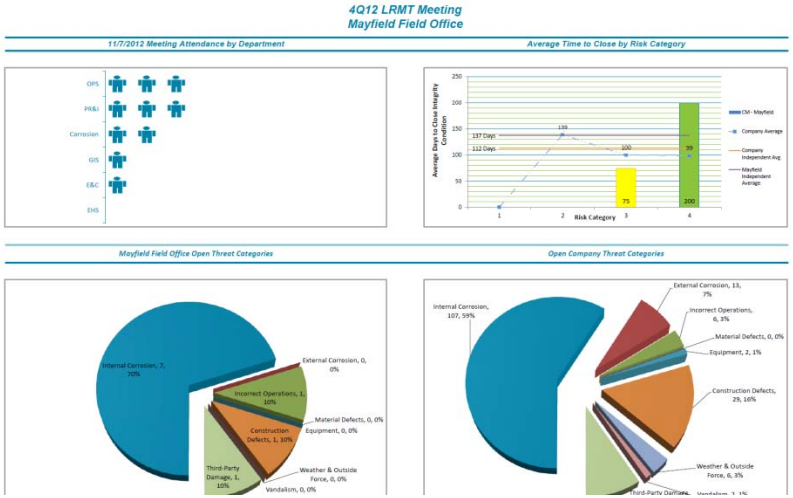
Incid... Date	Incident Type Damage	Incident/File Name	KMI Incident Number	CITY	COUNTY	STATE	CM Area	Excavator Company Name	Type of Equipment Used	Excavation Work Type	Excavator's CHK Affiliation	Locator Request...	Root Cause	Cause of Damage	Comments
8/19/2012	Damage	Cimarron 1-31 / Pipeline Incident	CO-IN-120819-006		Woods	Oklahoma	CM Mid-Continent North	R&R Ross Inc.	Dozer	Unknown-Other	Contractor	No	One Call Notification Error	No notification made to the One Call Center	The Cimarron 1-31 well had been P.&A. and all production equipment including the sales meter was removed from site. R & R Ross Inc. was at location to excavate the rock on location and return it to an environmental state. The rock was gone and they were using a dozer to refill the location, cutting into the earth about 2 feet deep. The dozer cut an active 8" poly gas pipeline that was buried at the southwest corner of the location. When the dozer operator saw the line had been cut he immediately shut off the dozer and called his supervisor. The supervisor came to the site and called the pipeline company to come out and plug off the line. R & R Ross Inc. was unable to produce an One one call ticket or confirmation number for the call.
6/28/2012	Damage	SE Alva WTS _ Line Strike	CO-IN-120630-011	Alfalfa	Oklahoma	CM Mid-Continent North	Ketchner Inc.	Backhoe-Trackhoe	Pipeline	Contractor	Yes	Line Locator Error	Facility could not be found or located	The extension for the South East Alva WTS is currently under construction. On 6/19/2012 the Line inspector for CHK and the Production Foreman for Unit Petroleum spoke about the upcoming trenching excavation. The Line inspector contacted the Locator for the area to mark the line and the Locator said the line was not located to trench beside. The one call was made and it was discovered that Unit's line was not buried with trackers, wire making it un-locatable. On 6/20/2012 the line locater for Unit confirmed what the Unit production foreman had told him and informed the CHK line inspector that Unit's line ran north of the barn. The decision was made to dig the trench to the south of the barn in an attempt to mitigate the hazard of a potential line strike. A representative for Unit Petroleum was on site to blow the line down and isolate it from any potential
6/21/2012	Damage	Outlaw / RT Central Lateral WTS _	CO-IN-120621-003	Woods	Oklahoma	CM Mid-Continent North	Arco Boring	Boring	Pipeline	Contractor	Yes	Line Locator Error	Facility marking or location not surfaced	A contractor was making a road bore for the Outlaw / RT Central Lateral WTS, the CMP, Kan-Ola Fiber and Unit Petroleum lines were located and marked prior to the road bore. The contractor was using a vacuum water line said that the water line was just inside fence between 2.5 and 4' deep. Which was right where the flags were marked for the fiber line, when the line below the flags was hydro-vaced the representative from Kan-Ola fiber was on site and verified that the line that was hydro vacced was their fiber line. The contractor then dug a hole to the fiber line and the fiber was broken and the water line had been marked and was not located which caused the water line to be cut. The claim was filed with the contractor and the water through the hole, the fiber line was located at 5:35 am 6-21-2012. What Kan-Ola thought was their fiber
6/27/2012	Damage	Electrical Conduit line Strike	CMP-IN-120628-003	Dimmit	Texas	CM Eagle Ford	SS Services	Backhoe-Trackhoe	Pipeline	Contractor	Yes	Excavator Error	Improper backfilling practices	SS Services was backfilling a mud hole when side of bucket touched the side of a ground wire for a ESD. On 6-28-12 at or around 3:30 pm SS Contractor while clearing out a mudhole on the Dos Hermanos 8H with a trackhoe struck an electrical conduit line with the trackhoe bucket.
6/28/2012	Damage	4" poly line strike	CMP-IN-120628-001	Woodward	Oklahoma	CM Anadarko Basin		Dozer	Agriculture	3rd Party	No	One Call Notification Error	No notification made to the One Call Center	Farmer was building up terraces with a dozer. No one call was made. He took 2 feet off the surface to build up a terrace. Our line was 2 feet or feet total under the ground. Farmer would not compay to quit plowing/ripping the field after we asked him repeatedly and informed him of the damages. On Thursday 6/28/12 a landowner was in the process of building up his terraces using a dozer when he contacted a 4" poly line with the ripper on the back of the dozer. The skid mover did not do a one-call prior to performing the work. A small amount of produced water/condensate saturated the ground. Repairs have been made to the pipeline and the area is being remediated.
6/28/2012	Damage	FRIO...ESD Line Strike	CMP-IN-120628-002	La Salle	Texas	CM Eagle Ford	SS Services	Backhoe-Trackhoe	Site Development	Contractor	Yes	811 or Data Error	Incorrect facility records/maps	Line locator missed the line On 6-28-12 at or around 11:15 am SS contractor while operating a trackhoe, the trackhe bucket came in contact with an ESD electrical line causing it to separate and causing the 52 of the CT
7/2/2012	Damage	Outlaw WTS Line Strike	CMP-IN-120702-012	Woods	Oklahoma	CM Mid-Continent North	Gateway Pipeline LLC	Backhoe-Trackhoe	Pipeline	Contractor	Yes		Abandoned facility	While attempting to locate an Atlas pipeline a crew with Gateway Pipeline LLC struck a buried 8 inch steel line that had been removed, abandoned less than 3 years of that. The crewhoe operator was then called and

PIPELINE INTEGRITY – INTERNAL INSPECTIONS WITH GIS

- Inline inspection (ILI) data is gathered using smart pigs to locate defects along a pipeline.
- The data is collected and reported in GIS format to locate weld locations, as well as defects, dents, gouges, corrosion or other abnormal operating conditions.

PIPELINE INTEGRITY – RISK RANKINGS AND ANALYSIS

- GIS is used to identify probability and consequence rankings for each pipe segment in regards to internal or external corrosion, excavation damage and other operating concerns.
- Risk scores impact business decisions.

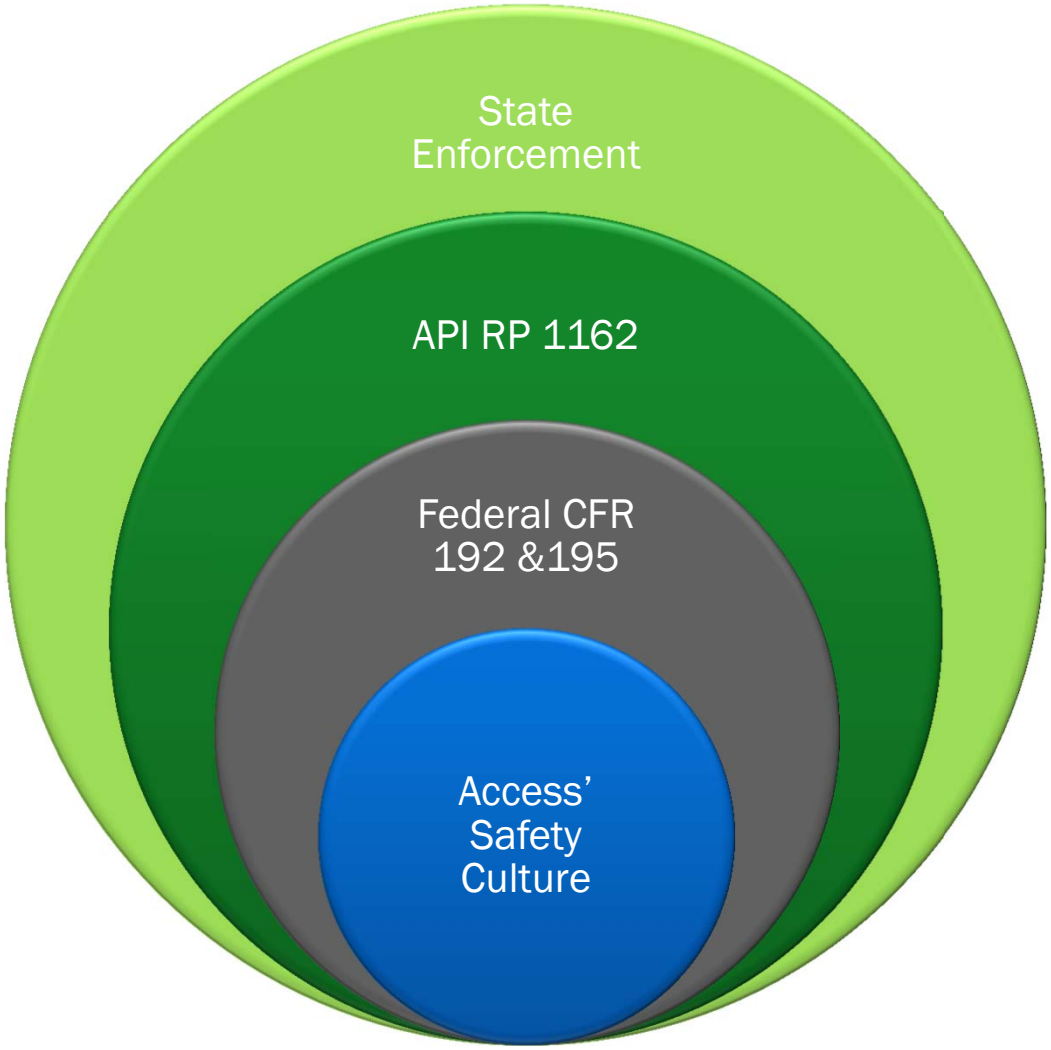


WHAT IS PUBLIC AWARENESS?

- Required safety education and outreach for external audiences regarding pipeline and related facilities

REGULATORY OVERVIEW FOR PUBLIC AWARENESS

- **State Enforcement:**
  - We are audited and inspected by state enforcement agencies.
- **API RP 1162:**
  - Provides guidance for pipeline operators to develop and manage public awareness programs. Requires regular (annual/bi-annual) contact with affected stakeholders.
- **CFR 49 Part 192 & 195:**
  - Incorporates by reference the API RP1162 as required guidelines by PHMSA
- **Access' Safety Culture:**
  - Provides the support and empowerment for our pipeline safety and integrity efforts.



PUBLIC AWARENESS GOALS

ACCESS MIDSTREAM

8 Core Safety Messages

- Pipeline Purpose and Reliability
- Damage Prevention
- Right of Way
- Potential Hazards
- Pipeline Location
- Prevention Measures
- Encroachments
- Leak Recognition and Response

4 Stakeholder Groups

- Emergency Officials
- Excavators & Farmers
- Local Public Officials
- Affected Public & Schools

GIS IN PIPELINE EMERGENCY RESPONSE

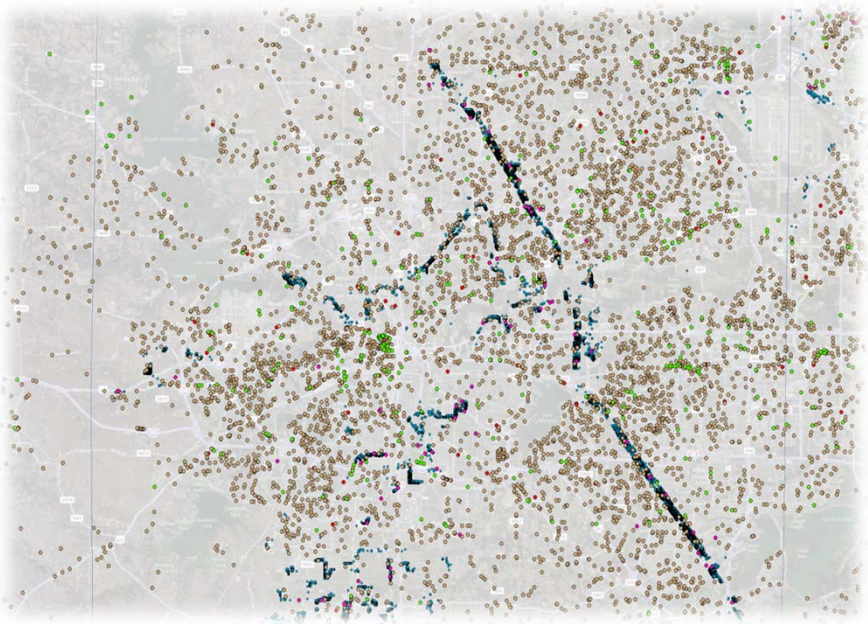
ACCESS MIDSTREAM

Current Uses:

- Audience identification
- NPMS
- Shows pipeline location
- Simulations/training

Current Gaps:

- NPMS only contains transmission pipelines
- Emergency responders are without a centralized GIS
- Lack of national effort to advance the technology for pipeline safety



GIS FOR PUBLIC SAFETY IN THE PIPELINE INDUSTRY

- **Our goals as an organization:**
  - A national public safety GIS initiative that will put important pipeline and other public safety data from all industries in the hands of emergency response personnel and community planners to make our communities safer.
  - A pipeline specific GIS can be deployed easily, but if it's not a useful tool for multiple tasks for the target audience it will not be leveraged to full potential.

THANK YOU!

QUESTIONS?

Eric Williams

Coordinator, Damage Prevention and Public Awareness

- Before January 1: eric.williams@chk.com
- After January 1: eric.williams@accessmidstream.com

- Learn more and take our survey: www.AccessMidstream.com/Safety

The National Pipeline Mapping System (NPMS)

Amy Nelson, GIS Manager

US DOT PHMSA

Objectives

- Explain the purpose of the NPMS and the applications that use NPMS data
- Major challenges facing the NPMS program
- Overview of PHMSA's data management systems
- Integrity Management-related issues

Overview

- Gas transmission and hazardous liquid operators are required to make annual data submissions to the NPMS showing their pipeline location and basic attributes
- The NPMS contains 500,000+ miles of pipeline data submitted by 1,000+ operators
- There are two primary web-based GIS applications at www.npms.phmsa.dot.gov:
  - The Public Viewer allows citizens to view pipelines in one county per session, with certain restrictions
  - PIMMA is available only to government officials, who can view pipelines in their area of jurisdiction

The role of NPMS at PHMSA

- NPMS was created to help PHMSA manage its regulatory assets, to provide inspectors with information about pipelines they inspect, and to assist operators in defining Unusually Sensitive Areas along their pipelines
- When a pipeline release occurs, identifying other operators, sensitive areas, and public facilities in the area is critical. This helps PHMSA meet its mission goals of Environmental Stewardship and Preparedness and Response.
- Having accurate information about pipeline locations helps PHMSA meet its mission goal of Safety.
- The NPMS is now used for many other purposes, including decision support, pipeline risk ranking, and community planning

NPMS Data Challenges

- Data quality: positional accuracy requirement is 500 feet
- Synchronizing NPMS submissions with Annual Reports
- Mapping tabular datasets, such as inspection reports
- Change detection/ creating history for a pipeline segment

NPMS Data Challenges

PHMSA is meeting these challenges with

- Draft rulemaking to collect additional data and improve data accuracy
- Conversion of the NPMS data model to linear referencing
- Custom tools to facilitate tabular data mapping and perform change detection, allowing PHMSA to build pipeline history

Collecting additional GIS data

- Data accuracy will be changed to reflect current GPS standards
- Additional data such as pump/compressor stations and operating pressure will allow PHMSA to better ensure the safety of its regulatory assets
- New data collection will likely be phased in to accommodate smaller pipeline operators

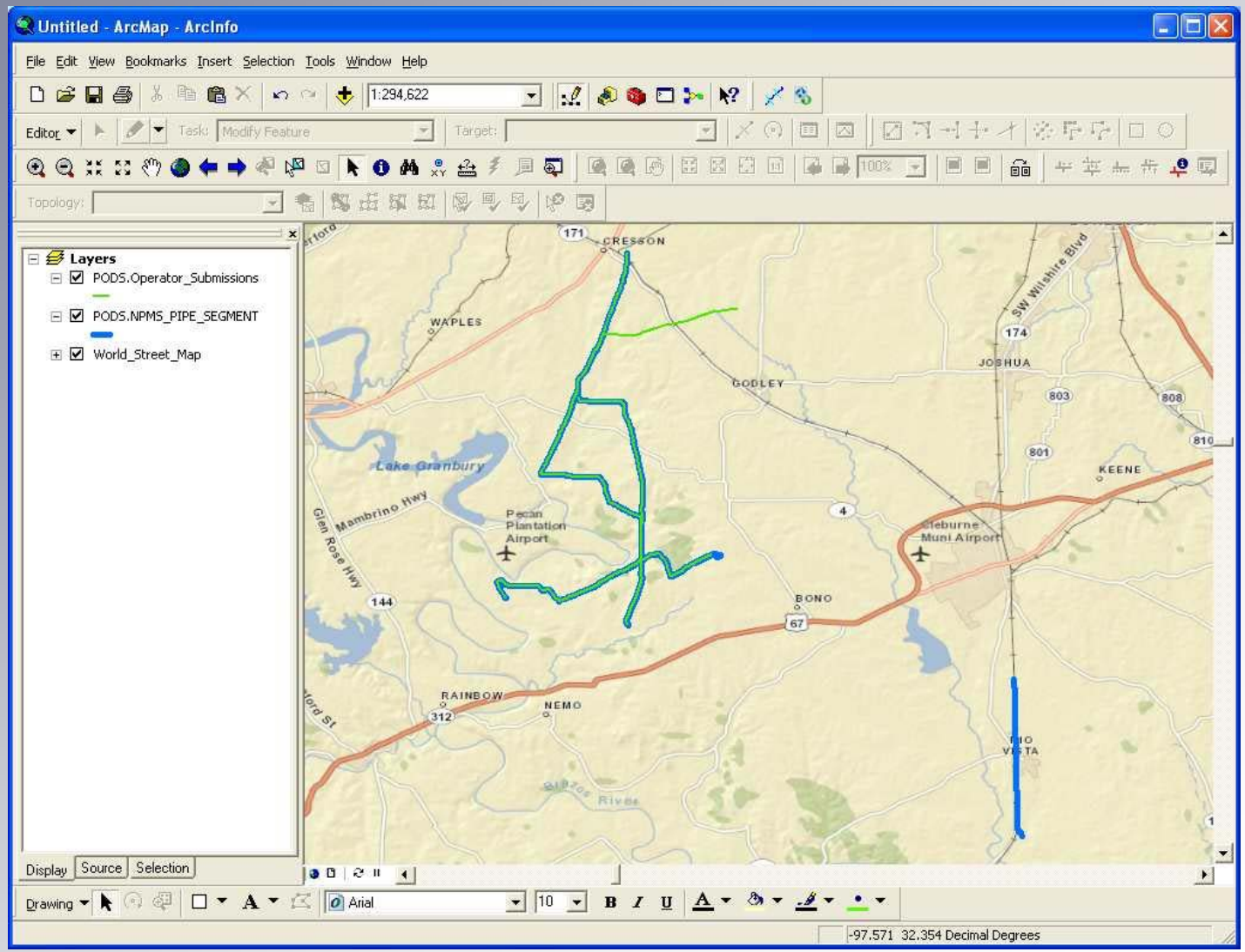
Mapping tabular data

- Inspection units (boundaries) were mapped manually; updates to boundaries will employ a web tool
- Special permits will be mapped manually
- Accidents/incidents will become events on pipeline segments

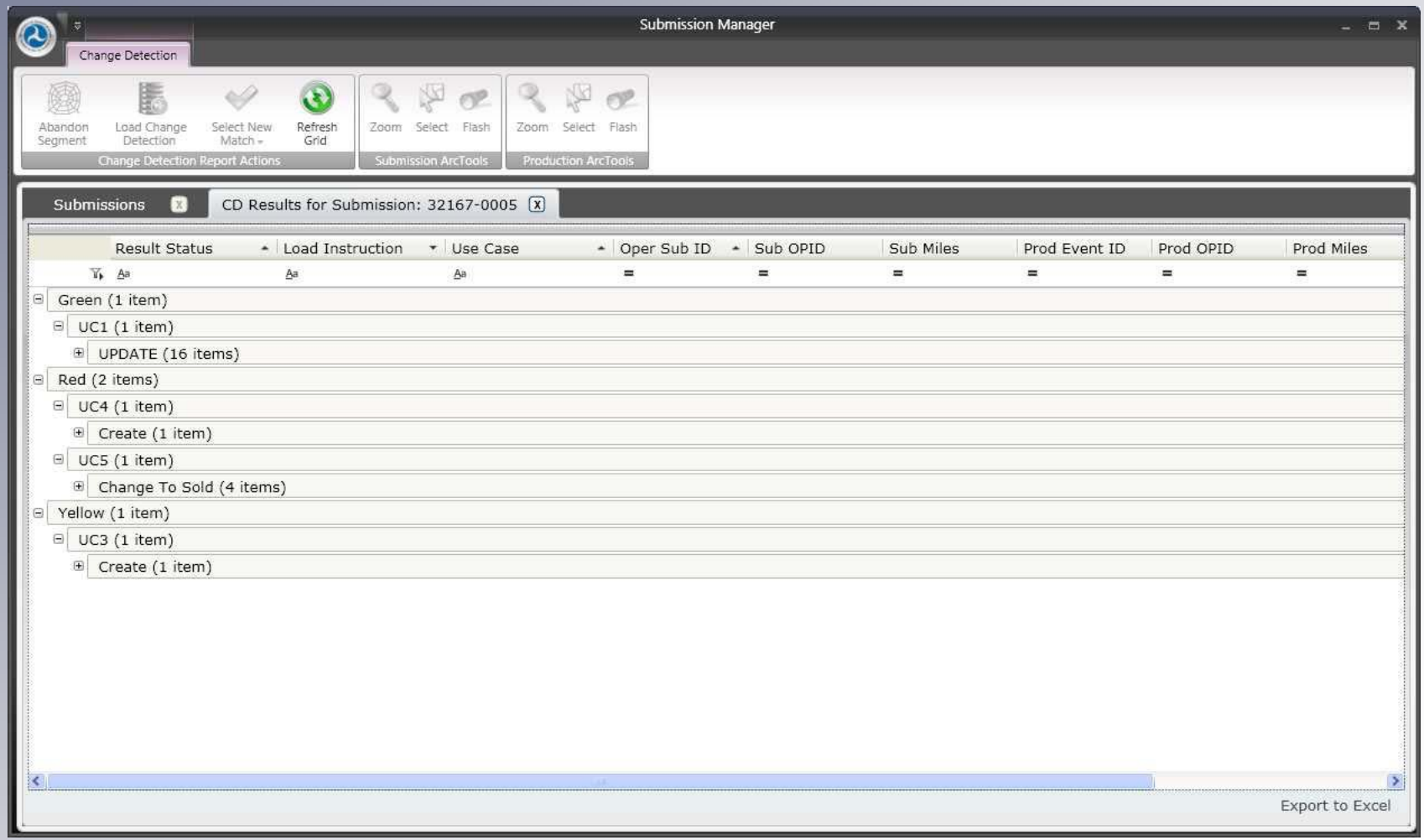
Building pipeline history

- PHMSA desires the ability to track assets as they change operators
- All tabular data is currently tied to the operator
- The NPMS custom change detection tools allow us to track a pipeline as it changes operators, commodities, etc.
  - Accidents/incidents are now related to the pipeline, not to the operator, allowing us to differentiate pipe performance from operator performance

Change detection



Change detection



Questions?

Amy.Nelson@dot.gov

202-493-0591

Panel #8: Closing Panel

Objective: This panel will synthesize and summarize the two-day event and explain how maps and GIS technologies can effectively communicate safety messages.

David Cowen, Ph.D., National Geospatial Advisory Committee
GIS @ NTSB: The Next Steps

Allen Carroll, Esri
Emancipating Data: Using GIS to Serve the Public

Chairman Deborah A.P. Hersman, National Transportation Safety Board
Closing Remarks

GIS @ NTSB : The Next Steps

Dr. David J. Cowen

Chair, National Geospatial Advisory Committee

Outline

- Role of GIS data and technologies in transportation safety.
- Institutional Issues - FGDC and NGAC
  - FGDC Mission
  - The Transportation Theme
    - Role of DOT (GAO Report)
  - NGAC initiatives
  - Potential linkage to NTSB
- Data accessibility, standard, and interoperability
  - Streets and Addresses
- Long Term impacts of driverless vehicles

1. Role of GIS data and technologies in transportation safety.

Typical NTSB Highway Accident Report
Non – GIS

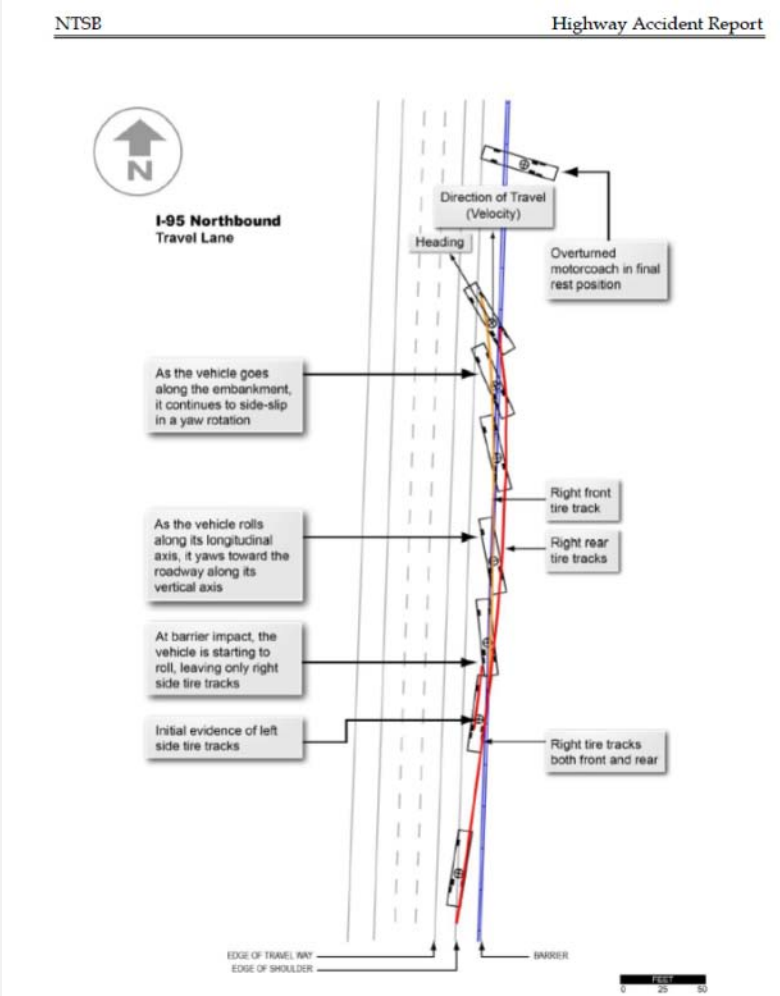


Figure 2. Accident scene diagram.

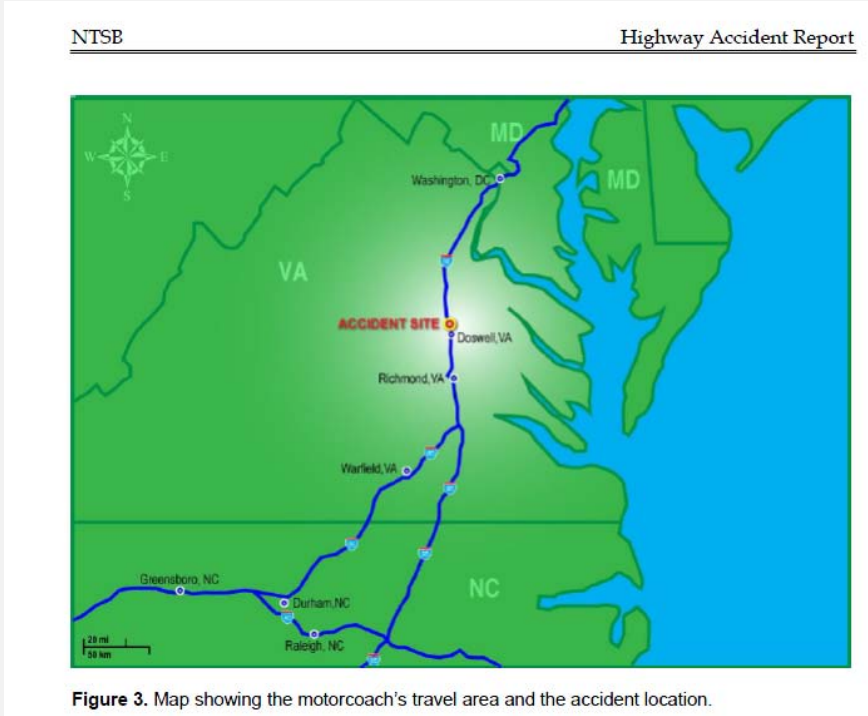


Figure 3. Map showing the motorcoach's travel area and the accident location.

NTSB 2012

Safety Oriented GIS Events

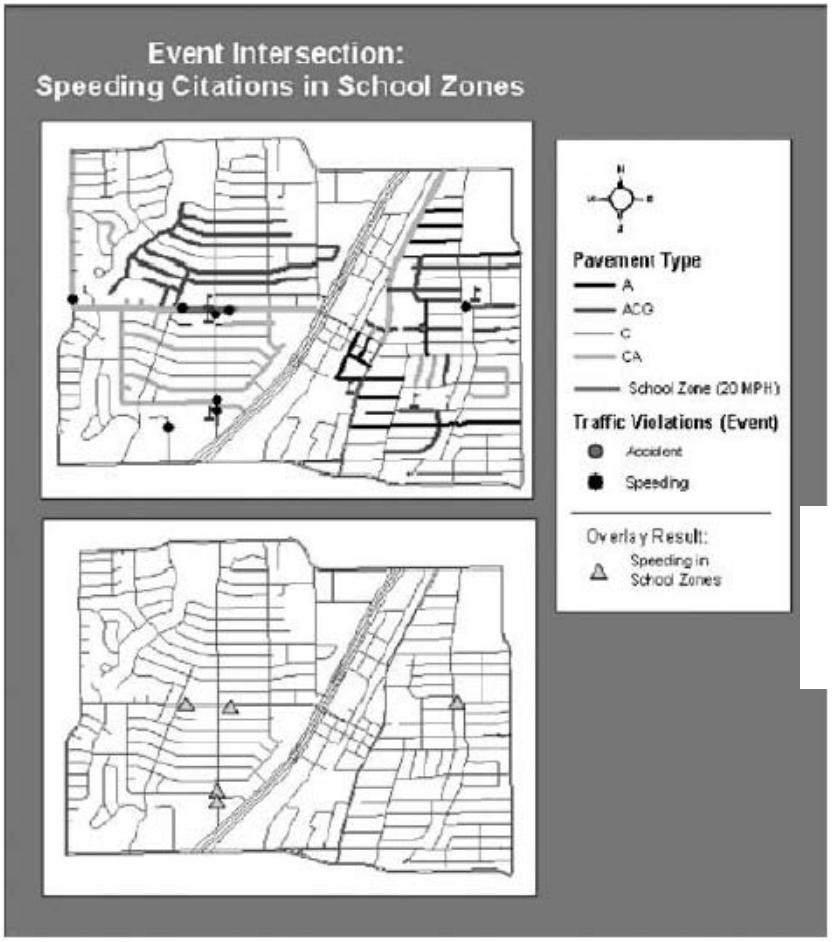


Figure 9. Intersection of linear and point events

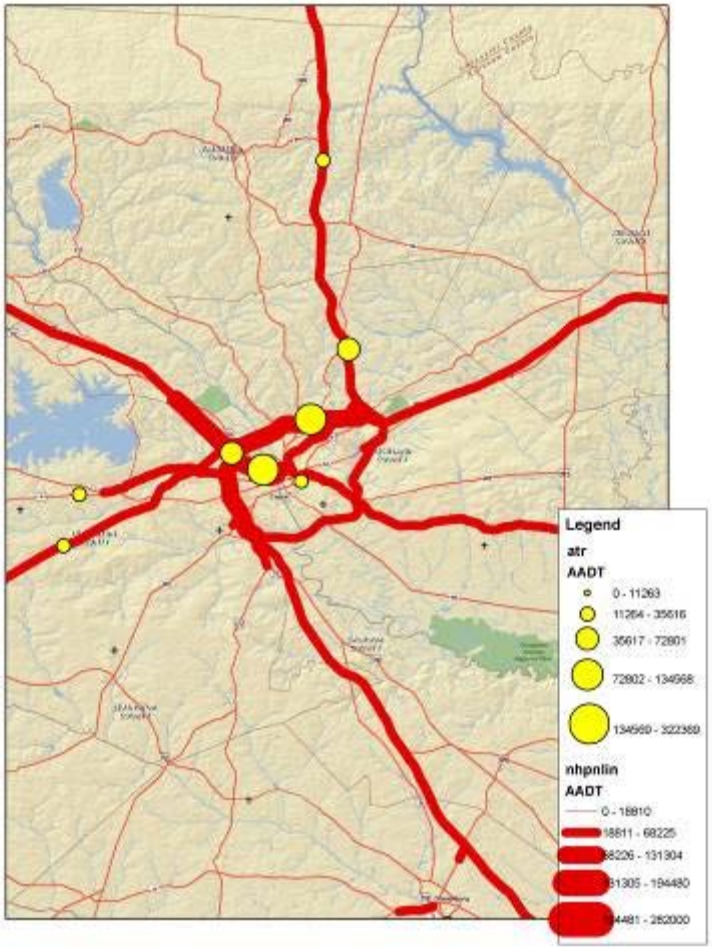
A Comprehensive Process for Linear Referencing

Kevin M. Curtin, Greta Nicoara, and Rumana Reaz Arifin

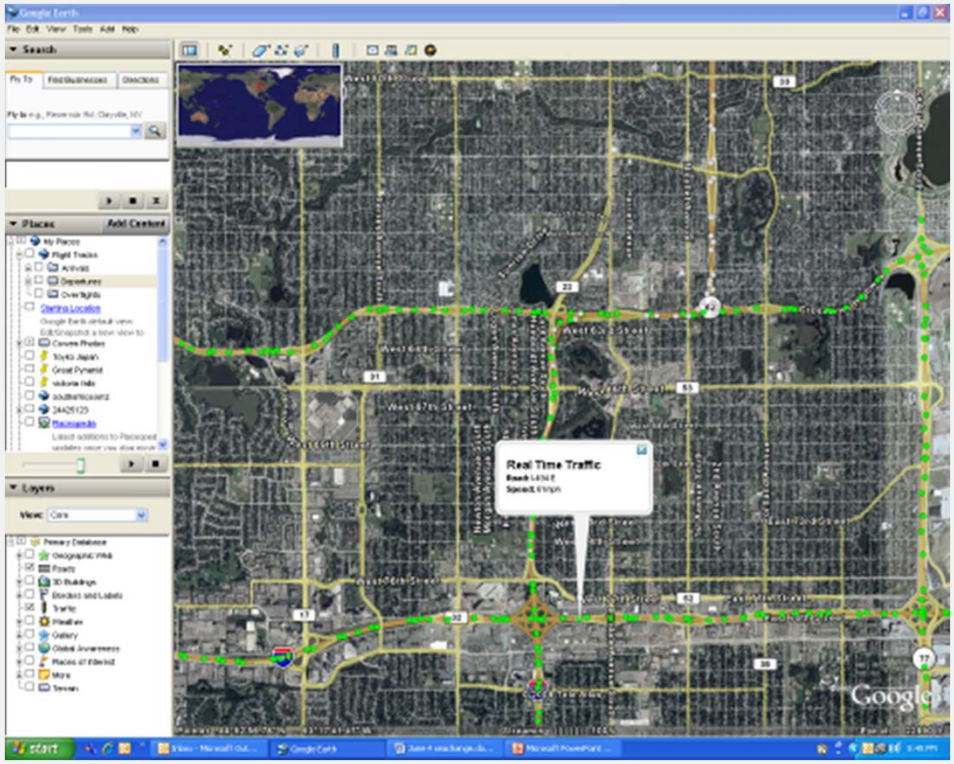
GIS Context

Static

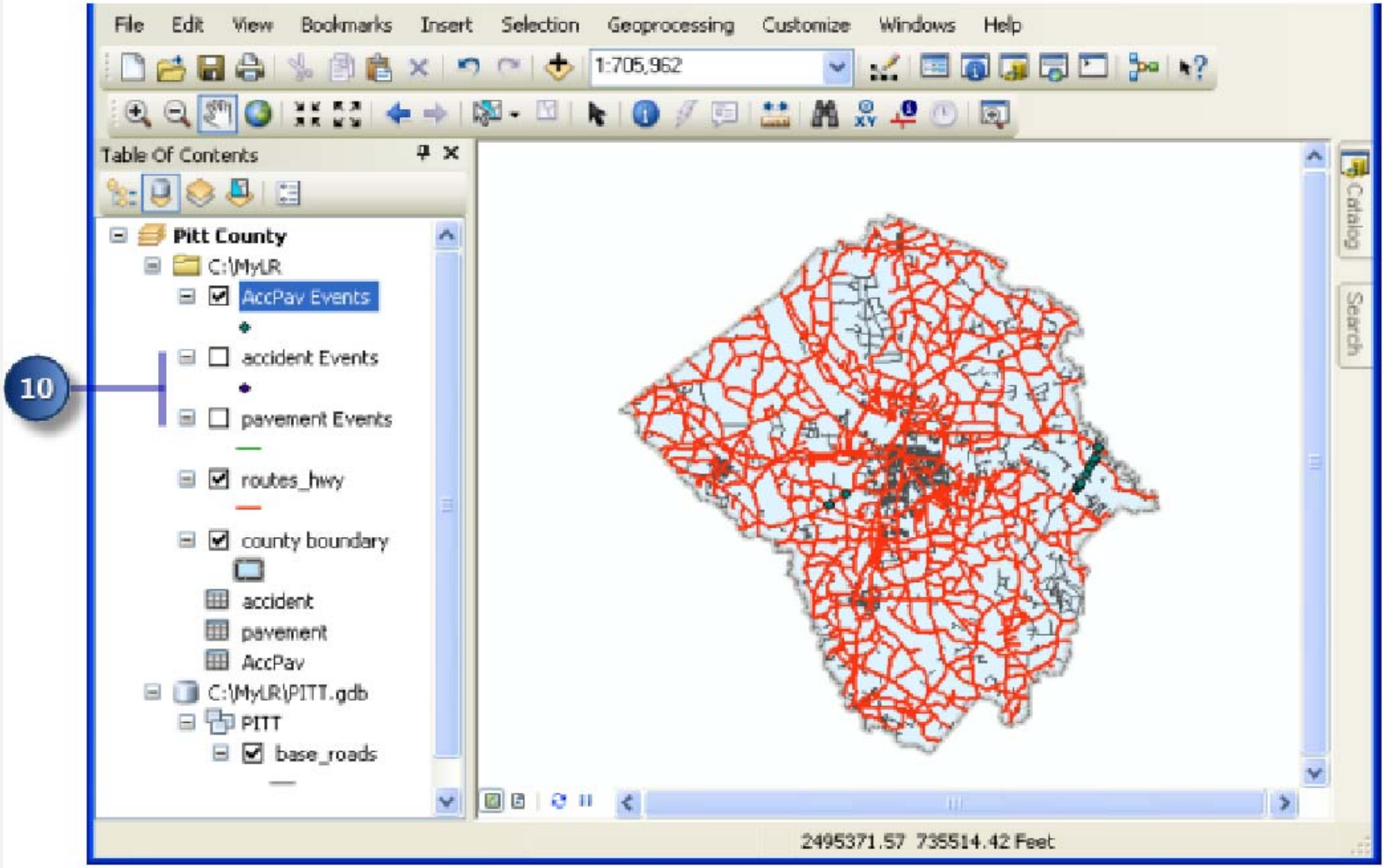
BTS GIS Data



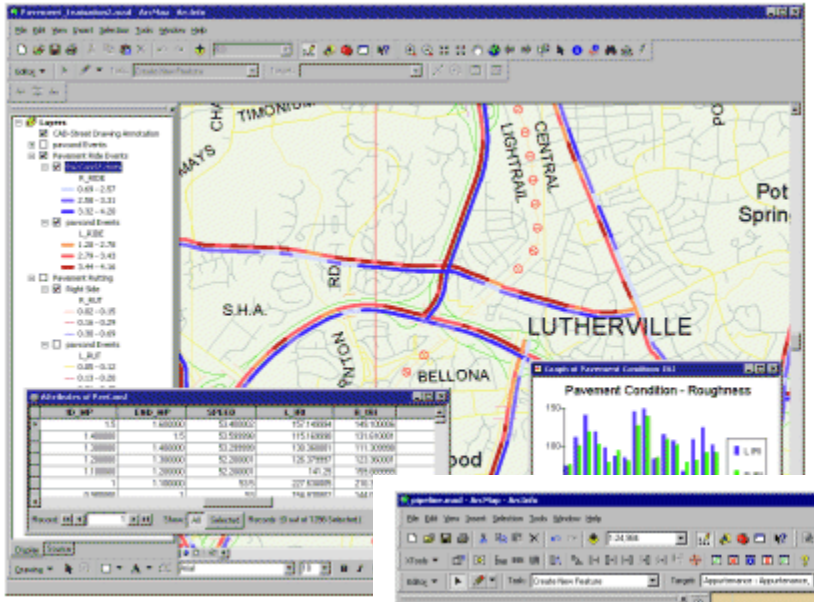
Real Time

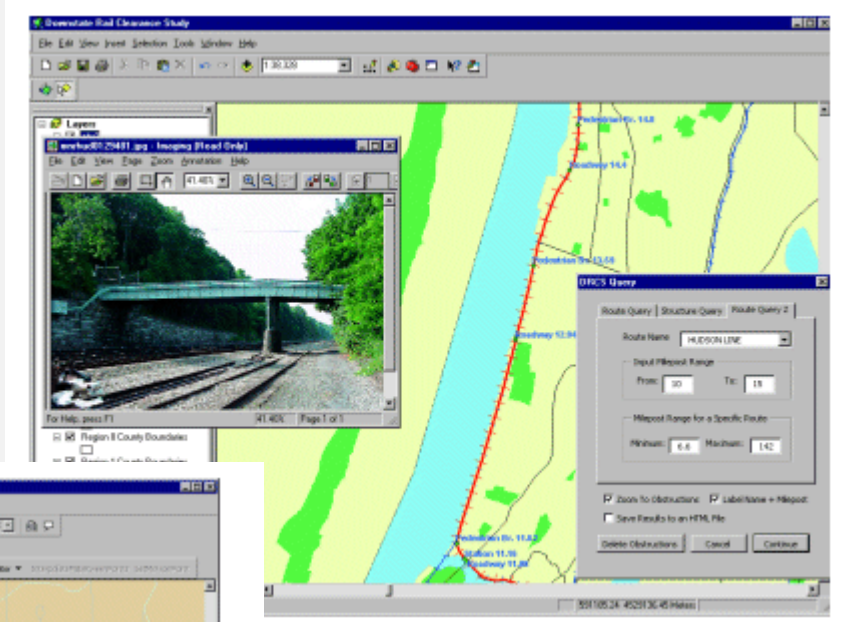


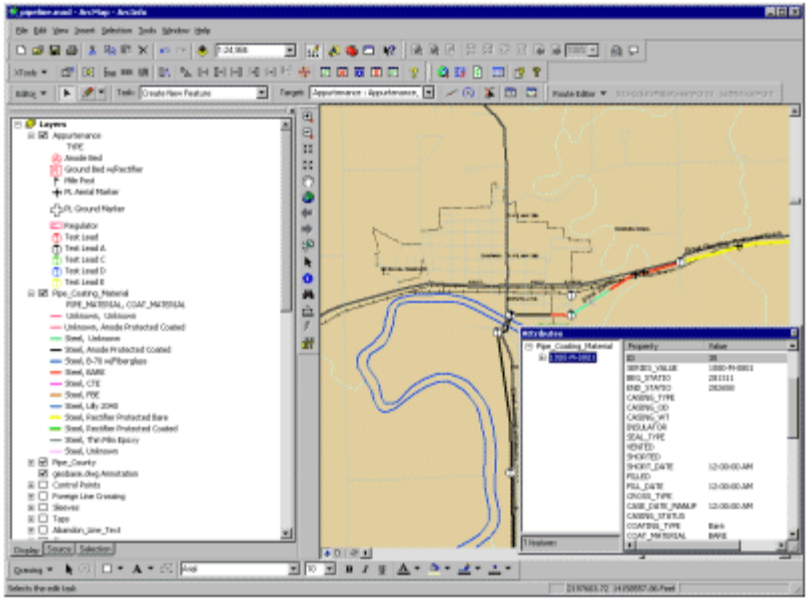
GIS - Point and Linear Events



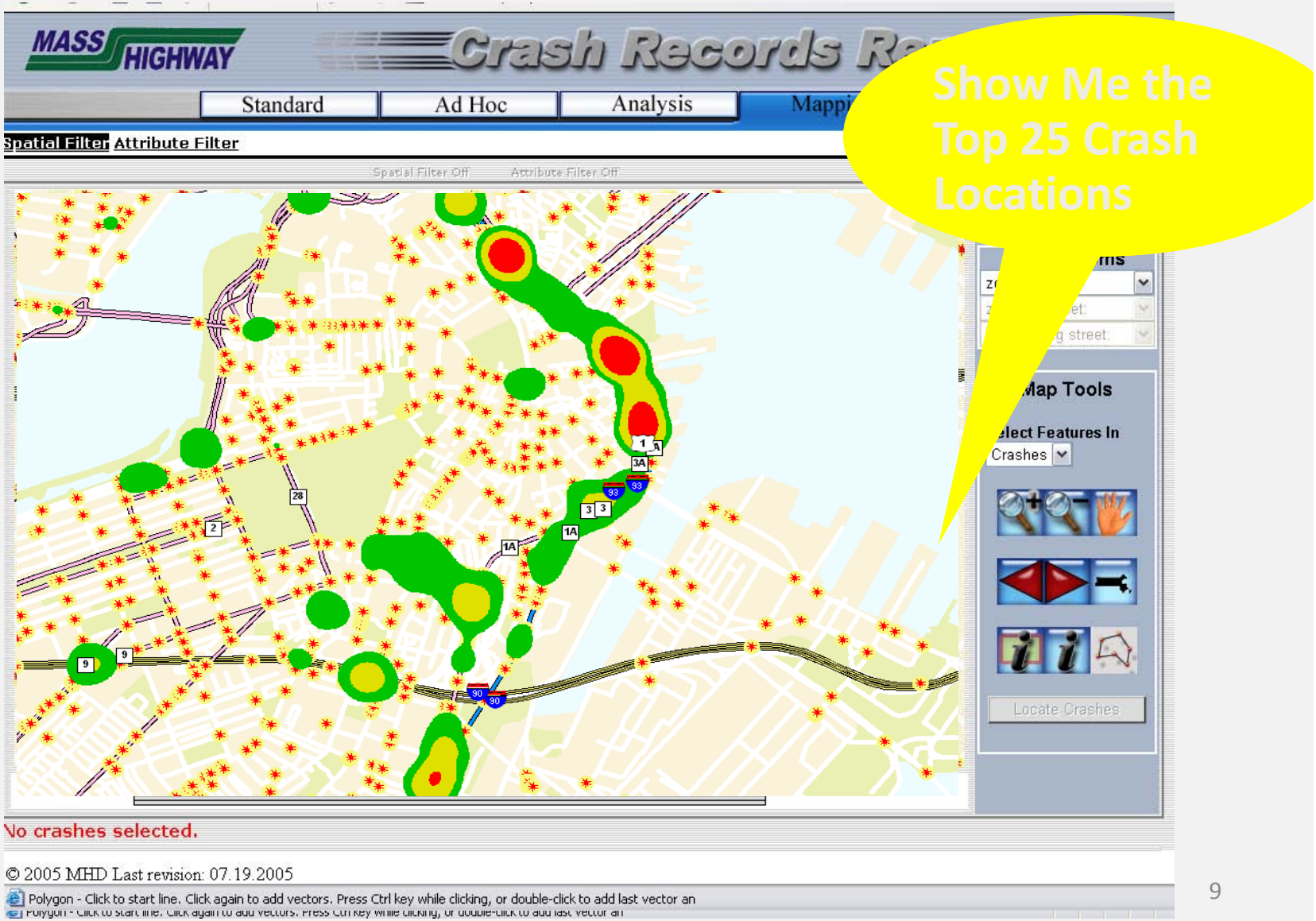
Patterns and Context







Custom GIS Server Analysis



Infrastructure: GIS is needed! - $1.6 Trillion

36 United States

Economist

Infrastructure

The cracks are showing

CHICAGO AND NEW YORK

America's tradition of bold national projects has dwindled. With the country's infrastructure crumbling, it is time to revive it

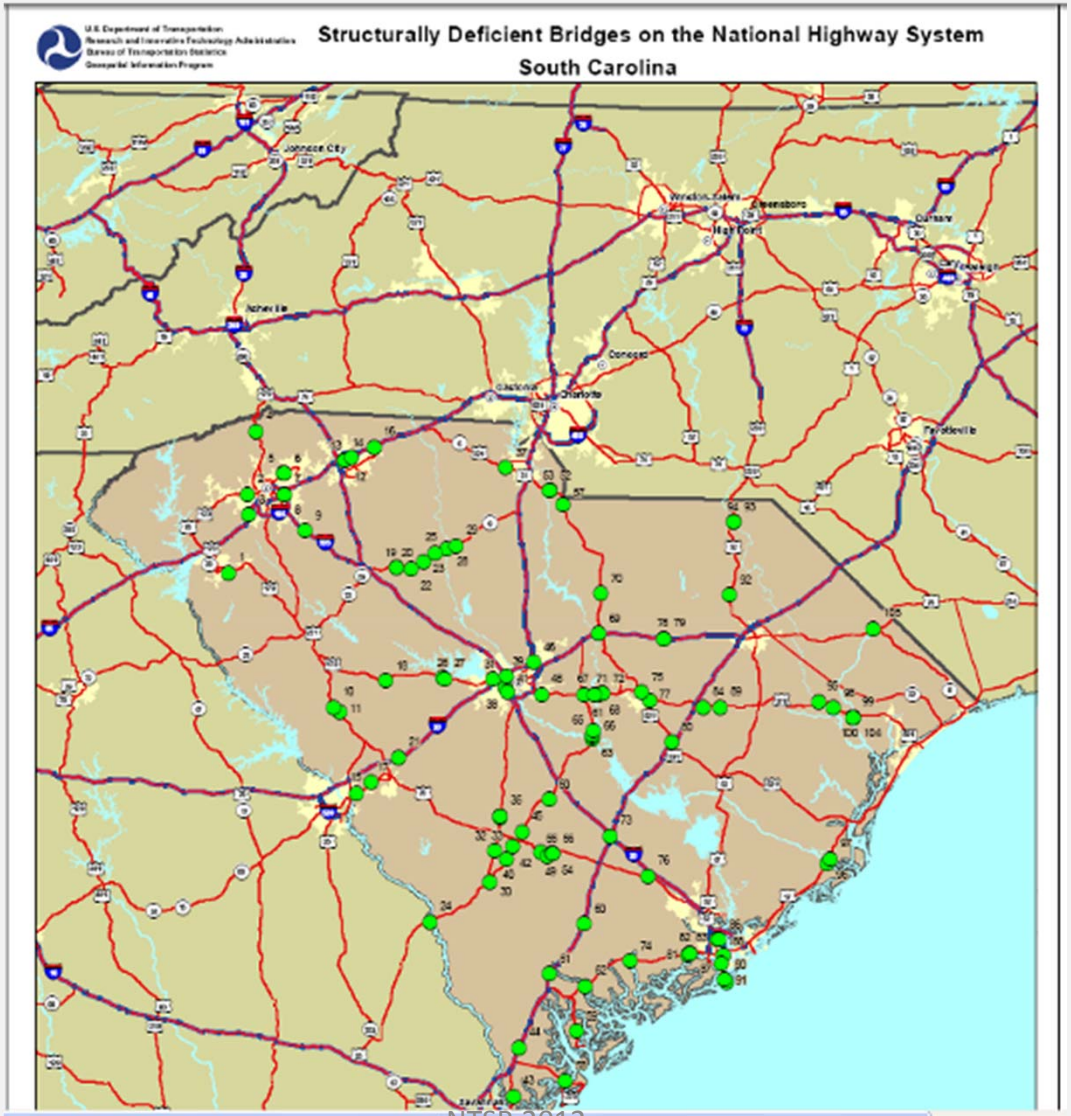
America has a grand tradition of national planning, from Thomas Jefferson's vision for roads and canals in 1808, which influenced policy for the next century (and led to America's first transcontinental railway) to Dwight Eisenhower's Federal Highway-Aid Act of 1956, which created the interstate system. Such plans stand in stark contrast to the federal government's strategy today. America invests a mere 2.4% of GDP in infrastructure, compared with 5% in Europe and 9% in China. America's ageing water infrastructure is sorely underfunded: the Environmental Protection Agency forecasts an $11 billion annual gap in meeting costs over the next 20 years.

The country's transport network is similarly dysfunctional, says a recent Urban Land Institute report. Important gateways, such as the ports in Los Angeles and New York, are choked. Flight delays cost at least $15 billion each year in lost productivity. Commutes are more dismal than ever. Congestion on roads costs $78 billion annually in the form of 4.2 billion lost hours and 2.9 billion gallons of wasted petrol, ac-

last summer. In 2005 the American Society of Civil Engineers estimated that $1.6 trillion was needed over five years to bring just the existing infrastructure into good repair. This does not account for future needs. By 2020 freight volumes are projected to be 70% greater than in 1998. By 2050 America's population is expected to reach 420m, 50% more than in 2000. Much of this growth will take place in metropolitan areas, where the infrastructure is already run down.

No little plan needed

Measure, Map, Monitor & Manage Structurally Deficient Bridges



2. Institutional Issues - FGDC and NGAC

- FGDC Mission
- The Transportation Theme
  - Role of DOT (GAO Report)
- NGAC initiatives
- Potential linkage to NTSB

FGDC - Mission / Authority

The Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the ***coordinated development, use, sharing, and dissemination*** of geospatial data on a national basis.

"…advance the goals of the National Information Infrastructure; and to avoid wasteful duplication of effort and promote effective and economical management of resources by Federal, State, local, and tribal governments…" (Clinton Executive Order 12906)

Authority: The Office of Management & Budget (OMB) established the FGDC in 1990, and re-chartered the committee in its August 2002 revision of Circular A-16, "Coordination of Geographic Information and Related Spatial Data Activities." Executive Order 12906 assigns NSDI implementation responsibility to the FGDC.

FGDC Structure

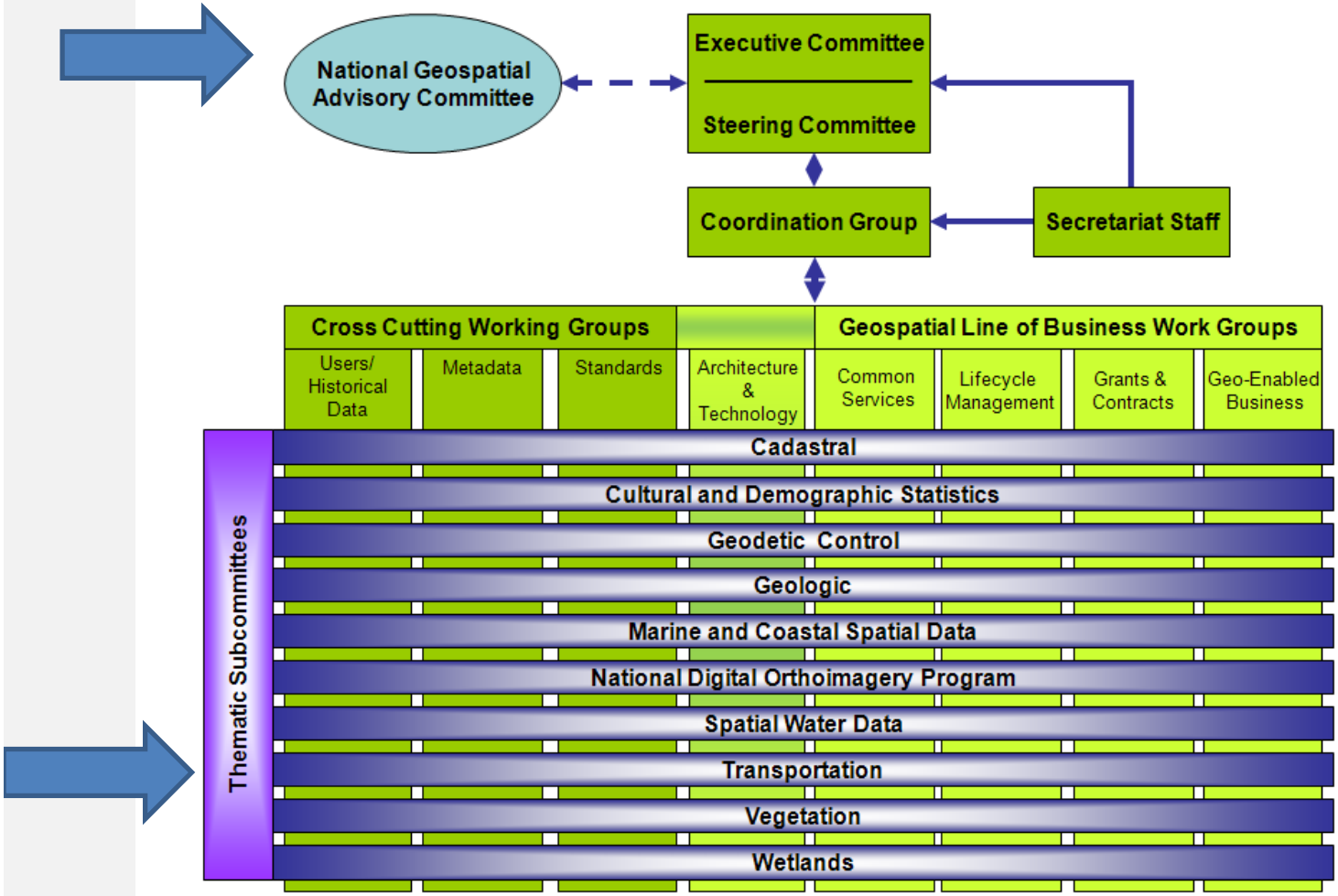
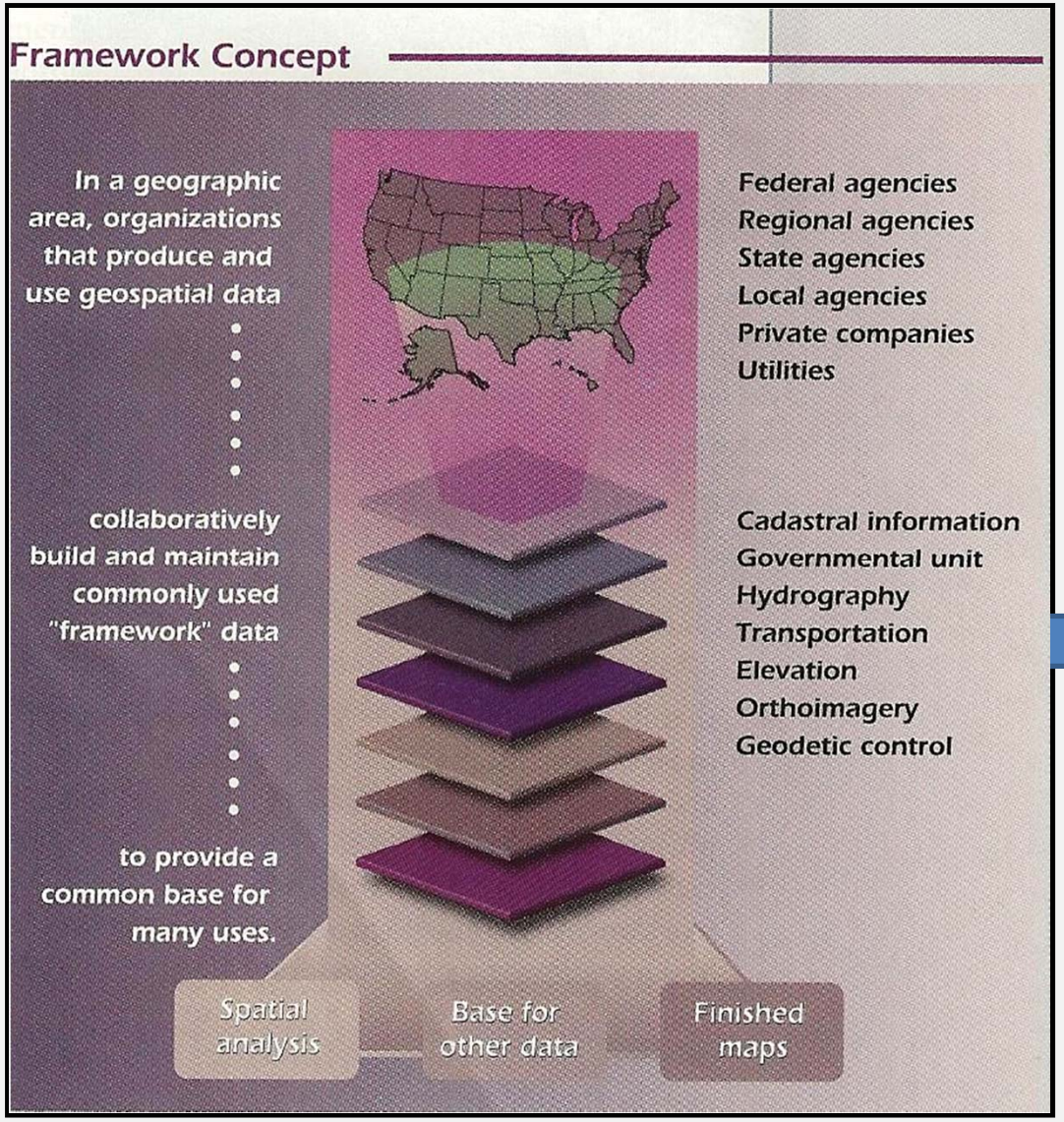


Figure: Overview of the structure of the various components of the FGDC

Transportation is a Framework Dataset



Framework Data: Seven themes of geospatial data that are used by most GIS applications. These data include an encoding of the geographic extent of the features and a minimal number of attributes needed to identify and describe the features.

Source:
Framework Data Survey: Preliminary Report , NSGIC & FGDC , 1999

OMB – A-16

- **Transportation:** Department of Transportation, Bureau of Transportation Statistics

  Transportation data are used to model the geographic locations, interconnectedness, and characteristics of the transportation system within the United States. The transportation system includes ***both physical and non-physical components representing all modes of travel*** *that allow the movement of goods and people between locations.*

- **Transportation (Marine):** USACE

Proposed New Data Themes -

Status of Theme Lead Agencies and Theme Leads

Theme	Lead Agency	Theme Lead	Contact Name
Biota	DOI/USGS	Theme Lead Candidate**	Marcia McNiff
Cadastre	DOI/BLM	Point of Contact***	Don Buhler
Climate and Weather	Commerce/NOAA	Theme Lead Candidate	Anne Ball
Cultural Resources	DOI/NPS	Theme Lead Candidate	Deidre McCarthy
Elevation	DOI/USGS Commerce/NOAA	Theme Lead Candidate Theme Lead Candidate	Tracy Fuller Jeff Ferguson
Geodetic Control	Commerce/NOAA	Theme Lead Candidate	Juliana Blackwell
Geology	DOI/USGS DOI/BOEM	Theme Lead Candidate Theme Lead Candidate	Dave Soller George.Dellagiarino
Governmental Units, and Administrative and Statistical Boundaries	Commerce/NOAA	Theme Lead Candidate	Lynda Liptrap
Imagery	DOI/USGS USDA/FSA	Theme Lead Candidate Theme Lead Candidate	Dick Vraga Shirley Hall
Land-Use Land Cover	DOI/USGS USDA/FS	Theme Lead Candidate Theme Lead Candidate	Jonathan Smith Ken Brewer
Real Property	GSA	Theme Lead Candidate	John Sullivan
Soils	USDA/NRCS	Theme Lead Candidate	David Hoover
Transportation	DOT	Theme Lead Candidate	Raquel Hunt
Utilities	BSEE DOE (TBD)*	Theme Lead Candidate	Warren Williamson
Water-Inland	DOI/USGS DOI/FWS	Theme Lead Candidate Theme Lead Candidate	Steve Aichele Bill Wiilen
Water Oceans Coasts	Commerce/NOAA	Theme Lead Candidate	Tony LaVoi

* Conversations about a specific Agency Theme Lead resource are underway

** The nominated Theme Lead will be listed as a "Theme Lead Candidate" until the nominee is approved by the Theme Lead Agency SAOGI and Executive Theme Champion

*** An agency contact is listed as "point of contact" if they indicated they are not yet ready to appoint a Theme Lead

**** An Agency contact is listed as FDGC Coordination Group Member when there has been no nomination of a Theme Lead or a point of contact other than the FGDC CG member

Proposed Transportation Datasets

Dataset Name	Theme	Agency
Census Address Range-Feature Name Relationship File	Transportation	DOC-Census
Census Address Ranges Relationship File	Transportation	DOC-Census
Census All Roads Dataset	Transportation	DOC-Census
Inland Electronic Navigation Charts (IENC)	Transportation	DOD-USACE
National Transportation Dataset - National Map	Transportation	DOI-USGS
National Transportation Atlas DataBase-Airports Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-Rails Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-TransitlLines Dataset	Transportation	DOT-BTS
National Transportation Atlas DataBase-TransitlStation Dataset	Transportation	DOT-BTS
Census Rails Dataset	Transportation	DOC-Census
Traffic Analysis Zone (Census 2000)	Transportation	DOC-Census

GAO Report - November 26 , 2012
Need to reduce duplication

United States Government Accountability Office

GAO

Report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate

November 2012

GEOSPATIAL INFORMATION

OMB and Agencies Need to Make Coordination a Priority to Reduce Duplication

GAO Recommendations to DOT

Secretary designate a ***senior agency official*** who has department wide responsibility, accountability, and authority for geospatial information issues.

Specific recommendations

- Prepare, maintain, publish, and implement a ***strategy*** for advancing geographic information and related geospatial data activities appropriate to its mission.
- Develop a ***policy*** that requires the department to make its geospatial metadata available on the clearinghouse.
- Develop and implement internal ***procedures*** to ensure that it accesses the NSDI clearinghouse before it expends funds to collect or produce new geospatial data to determine
  - (1)whether the information has already been collected by others and
  - (2) whether cooperative efforts to obtain the data are possible.

Source: GAO 13-94, Nov 2012

GAO Recommendations Continued

- We further recommend that the Secretary of Transportation direct the transportation ***theme point of contact*** to take the following three actions.
  - • Prepare goals relating to all datasets within the transportation theme that support the NSDI, and as needed, collect and analyze information from ***user needs*** and include those needs in the theme-related goals.
  - • Develop and implement a plan for the nationwide population of the transportation theme that addresses all datasets within the theme; and that includes
    - (1) the development of ***partnership programs*** with states, tribes, academia, the private sector, other federal agencies, and localities that meet the needs of users;
    - (2) human and financial resource needs;
    - (3) standards, metadata, and the clearinghouse needs; and
    - (4) a timetable for the development for the theme.
  - • Create and implement a plan to develop and implement transportation theme standards.

Standards

- The FGDC has adopted the United States ***Thoroughfare, Landmark, and Postal Address*** Data Standard (FGDC-STD-016-2011).

Overview of Draft Street Address Standard

Address Standards Working Group

Co-Chairs:

Martha Lombard
Spatial Focus, Inc.

Ed Wells
DC OCTO

Hilary Perkins
Jacobs Civil, Inc.

Sara Yurman
Spatial Focus, Inc.

Carl Anderson
Fulton County, GA

October 2006

Thoroughfare Classes

A thoroughfare address specifies a location by reference to a thoroughfare.

A thoroughfare in this context is a road or other access route (for example, a walkway, railroad or river) by which the addressed feature can be reached.

- **Site: 1230A North Main Street Extended**
- **Landmark-Site: City Hall, 410 Main Street**
- **Intersection: Seventh Street and D Street**
- **Two-number Range: 110-126 Main Street**
- **Four-number Range** (TIGER format):
  - **100-130, 101-135 Main Street**
- **Unnumbered Thoroughfare: Fagaima Road**

Part 3: Street Address Data Quality

- Goal: Define quality control for addresses (not redefine principles of spatial quality)
- Existing standards and documents describing spatial data quality
  - Content Standard for Digital Geospatial Metadata (CSDGM)
  - Topic 11: OpenGIS Metadata (ISO/TC 211 DIS 19115)
  - Supporting ISO Geographic Information standards
    - 19113: Quality principles
    - 19114: Quality evaluation procedures
  - Spatial Data Transfer Standard (SDTS)
- All the standards describe spatial data quality in similar terms

NGAC Initiatives

NGAC – Geospatial Information Services for the Nation

- Overarching recommendation: The FGDC responsibilities for leadership, management and coordination of geospatial information and services across government, including continuing management of the Geospatial Platform and its supporting data, ***must assume a central role in the policy, budgetary, and procurement process related to geospatial programs.***
- Outcome: FGDC has ***greater authority, a more comprehensive funding strategy, and permanent staffing*** to implement a more robust, efficient, reliable, cost effective level of Geospatial Information Services for the Nation to support decision making.

National Geospatial Strategy

- **Stimulating Economic Growth Through Geospatial Technology**
- **Using Geospatial Information To Control Costs and Save Taxpayer Dollars**
- **Applying Geospatial Tools To Ensure Public Safety and Decision-Support**

Recommendations - Continued

- Fully Implement the Geospatial Platform and Geospatial Portfolio Management
- Implement Coordinated Multi-Agency, Intergovernmental Geospatial Data Initiatives
  - 3-D Elevation Program
  - ***Transportation for the Nation***
  - National Land Imaging
  - ***National Land Parcel Data***
  - ***National Address Data***
  - Imagery for the Nation
  - National Height Modernization System

The Need for a National Address Database

- The NGAC proposes the following *Vision Statement* for a National Address Database.

  "The National Address Database is an authoritative and ***publicly available resource*** *that provides accurate address location information to save lives, reduce costs, and improve service provision for public and private interests."*

National Address Database

USERS	PURPOSE
FEMA	Pinpoint disaster areas, provide relief
Emergency Response, E9-1-1	Emergency response by first responders (police, fire, ambulance, rescue)
Department of Homeland Security	Locate and protect critical infrastructure
Public Safety	Crime analysis and response, incident/citation tracking
Voter Registration	Precinct assignment
State Dept. of Revenue	Sales tax collection and distribution
USPS, UPS, FedEx	Mail and package delivery
Census Bureau	Mail census and survey forms, geocode responses; Census gathering and tracking; locate non-respondents
Health and Human Services Agency	Track medical benefits, disease, births/deaths, and vulnerable populations.
Call Before You Dig (8-1-1)	Infrastructure protections, development coordination
Department of Transportation	Locate traffic accidents, access to FHWA funds to improve dangerous non-state roads.
Utilities (public & private)	Hookup, service calls, billing
Map and address companies (e.g. MapQuest, Navteq and TomTom)	Repackage/reformat accurate data for insurance companies, location based service companies and utilities
Retail/Services (e.g., Sears, local plumber)	Delivery of goods and services, new site locations
Assessor/Taxation	Property and owner location
Planning & Zoning Office	Building permit, planning studies

Data - Linkage to NTSB

- Place accidents and safety into geographic context
  - Quantitative and qualitative attributes to transportation features
- Measure, Map, Monitor and Manage transportation infrastructure to support safer movement of people and freight
- Identify patterns and associated causes for accidents
- Recommend preventative measures
  - Speed limits
  - Crossing hazards
  - Guard rails
  - Signage
  - Bridge maintenance

3. Data accessibility, standard, and interoperability

- Geospatial Platform
- Streets and Addresses

Executive Support for a Common Platform

Platform Provides Opportunity for NTSB

GEOSPATIAL PLATFORM
RESOURCE CENTER

HOME | ABOUT | DOCUMENTS | NEWS

WELCOME TO THE GEOSPATIAL PLATFORM WEBSITE

The partner agencies of the Federal Geographic Data Committee (FGDC) are developing a Geospatial Platform to more effectively provide place-based products and services to the American public. The Geospatial Platform will be a managed portfolio of common geospatial data, services, and applications contributed and administered by authoritative sources and hosted on a shared infrastructure, for use by government agencies and partners to meet their mission needs and the broader needs of the Nation.

Read the President's Call to Action that Launched the Geospatial Platform

New! Read the new Geospatial Platform Value Proposition and let us know what you think.

Learn More: View the Geospatial Platform Conceptual Model, Technical Model, or Timeline.

COMMON DATA

Core geospatial data will be a key building bock of the platform offering. Data sets are selected by the Managing Partner because they meet inclusion criteria outlined in the A-16 Supplemental Guidance and are used by two or more agencies/partners to meet their business needs.

COMMON SERVICES

Common geospatial services will provide users with consistent capabilities for performing necessary geospatial functions. Examples of common services include geocoding, basemap services, requirements development and tracking tools, system computing cycles and file transfer protocol (FTP) services, acquisition services, data production services and training.

COMMON APPLICATIONS

Key tools or capabilities that enable users to perform geospatial visualization or analysis, including software, online applications and geo-processing required by two or more agencies/partners/customers. This category of applications includes a broad spectrum of analytical support generated to facilitate the government's delivery of services to citizens.

fgdc
FederalGeographicDataCommittee

The FGDC is an interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data on a national basis.
See More

DATA.GOV
EMPOWERING PEOPLE

Data.gov increases the ability of the public to easily find, download, and use datasets generated and held by the Federal Government.
See More

GAO Highlighted the Need to Coordinate National Highway Data Base

Duplication of Effort:

Acquisition of nationwide road centerline data across federal agencies and other levels of government, resulting in millions of wasted taxpayer dollars.

- Census Bureau's (TIGER) system, which uses data procured from local sources for census enumeration and demographic applications.

The report identified several initiatives that are currently independently acquiring road centerline data:

- USGS's National Map website, which uses licensed data from a commercial provider to create viewable maps on the National Map. These data are managed by USGS.
- The Department of Defense's Homeland Security Infrastructure Program, which uses licensed commercial data procured by the National Geospatial-Intelligence Agency for emergency management.

DOT – MAP 21
A Unique Opportunity

- MAP-21 passed legislating the creation of a "Basemap" with the capability to ***attach Safety attributes***.
- Office of Management and Budget cleared HPMS to collect an All-Public dual carriageway Road Network ***from States DOT***
- Office of Planning authorized the use of State Planning and Research (SPR) funds for producing this Network with a ***waiver to the state Match requirement***
- HPMS issued a Memo that requests states to provide a network to include ***all paved and unpaved public roads in 2014.***

Centerlines Versus Ramps and Carriageways

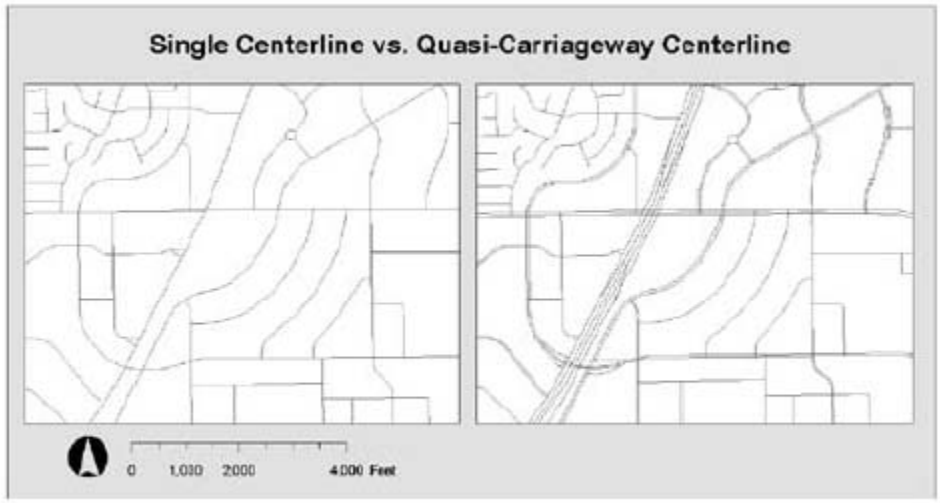


Figure 3. Simple centerline over quasi-carriageway

A Comprehensive Process for Linear Referencing

Kevin M. Curtin, Greta Nicoara, and Rumana Reaz Arifin

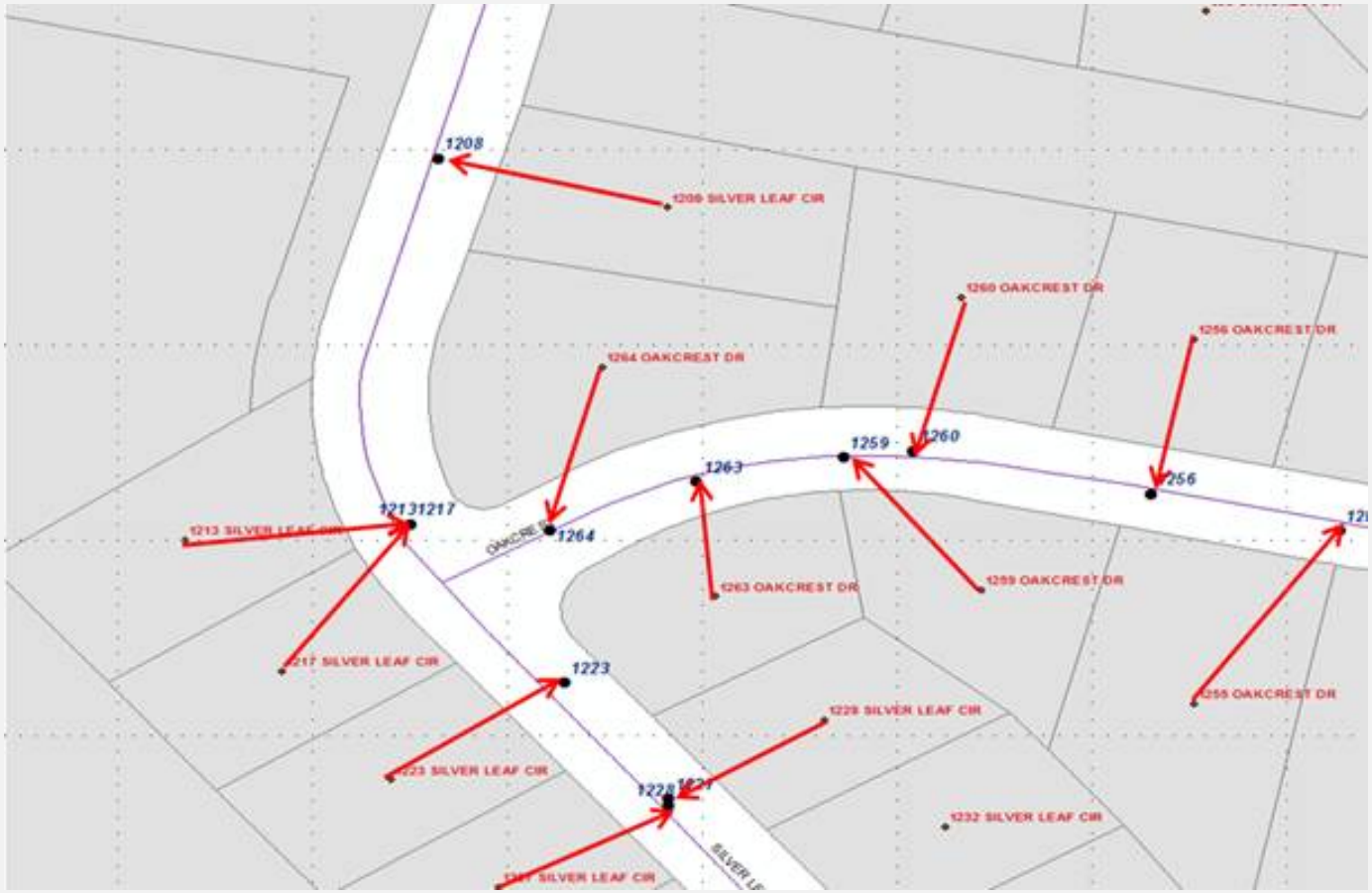
Comparison of TIGER and Local Roads
Not Good for Navigation

TIGER Roads Compared to Loudoun Centerlines

Legend

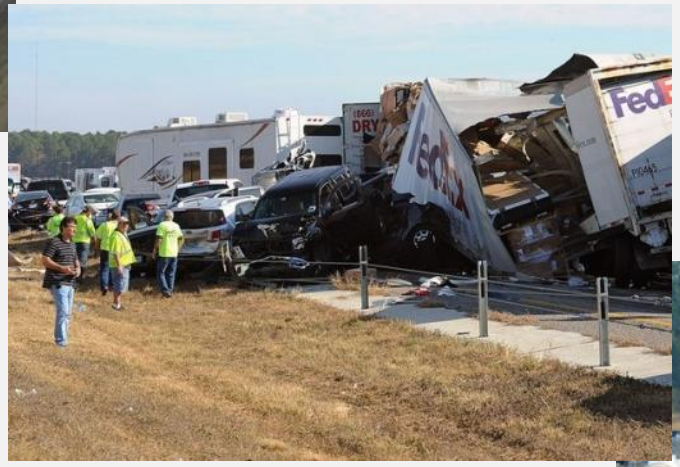
- study area
- Tiger_Roads
- Loudoun Centerlines

Linkage Between Parcel Addresses and Navigation Points – Adding Attributes through Geoprocessing



4. Long Term Societal impacts of driverless Vehicles

This Doesn’t Have to happen



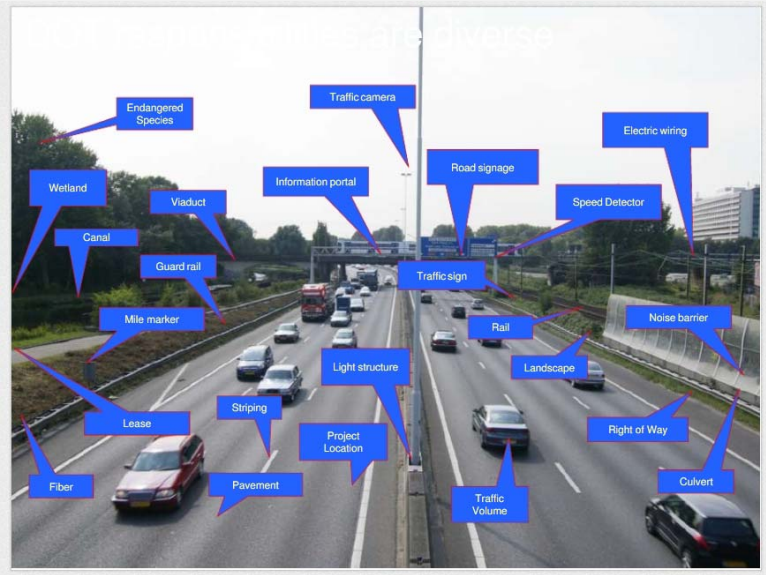
Already

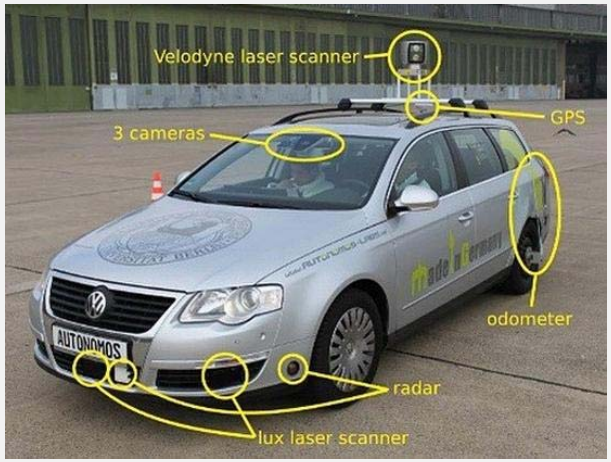
- Cruise on auto pilot
- Slot themselves into awkward parkign spaces
- Brake automatically
- Google experimental vehicle

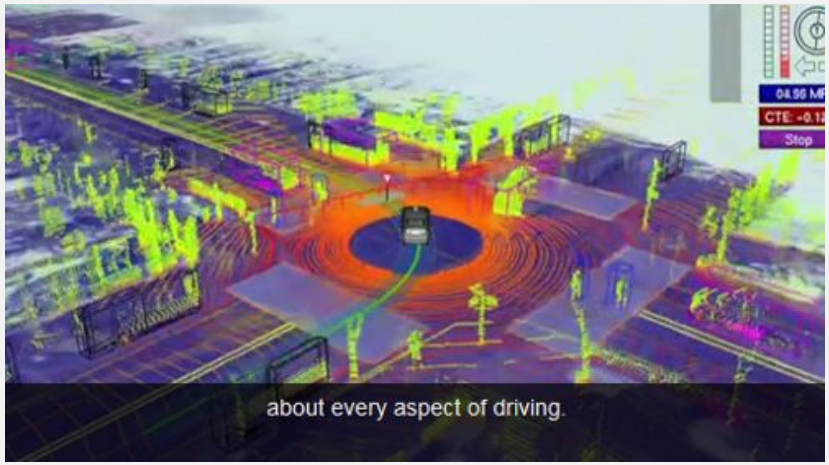
Examples

http://slideshow.techworld.com/3405617/20-cars-that-drive-themselves/

Intelligent







Potential Societal Changes Of Driverless Vehicles: The Economist (10/20/2012)

- Boost new car sales – feature rich
- Increased capacity of existing roads (nose to tail)
- New designs
  - No steering wheels, pedals
  - Lighter materials (don't have to resist crashes)
- Electronics Boost
  - Driver Oriented Entertainment –(don't have to watch road)
- Buses in convoys
- Travel at night and sleep > Fewer hotels
- Loss of jobs
  - Taxis, car rental could merge into one pick up a d drop off service
  - On demand vehicle rental Supermarkets, department stores , shopping centers – will send a vehicle

Potential Societal Changes Of Driverless Vehicles: The Economist (10/20/2012)

- Obey all laws > Eliminate traffic tickets, traffic cops, meter maids
- Lower revenues – Fewer parking fees
- Eliminate the need for auto insurance
- 2 Million hospital visits / year
  - Less need for emergency rooms etc.
- Longer commutes possible (productive in transit, lower cost / mile) > Exurbs
- Free mothers from car pooling – join the work force

Conclusions

- A robust GIS program will enable the NTSB to improve the way is monitors and manages its safety programs – it deals with fundamental geographic events
- NTSB should work closely with FGDC, DOT, and Census to ensure that the transportation features meet its needs
- NTSB should take advantage of the geospatial platform data and services to initiate its programs
- NTSB must help guide all the stakeholders associated with driverless vehicles and provide recommendations and regulations that ensure these developments are safe, economical and efficient.

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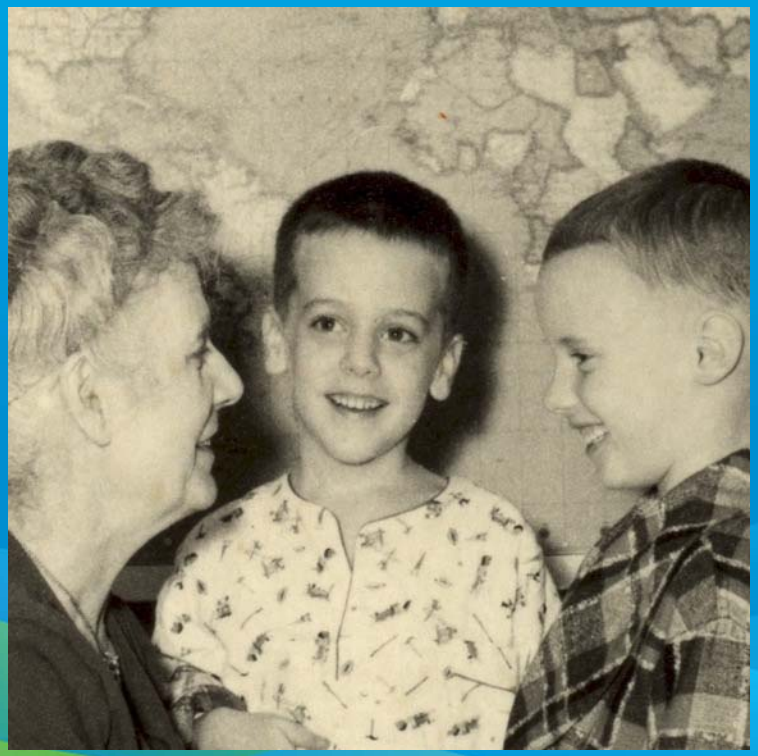
Emancipating Data:
Using GIS to Serve the Public

Allen Carroll

My background

- 27 years at National Geographic
- Most of them telling stories with maps
- Two years ago, joined Esri to head a story maps team



What is a story map?

- Story maps combine maps with other content (text, photos, videos) to tell stories
- They combine the traditional allure of maps with web and mobile apps
- They inform, educate, entertain, and inspire people about the world.

storymaps.esri.com

Why are we Making Story Maps?

- To showcase interesting geographic information
- To develop new ways to tell stories with maps
- To show how GIS has emerged from the back office
- To liberate enslaved data

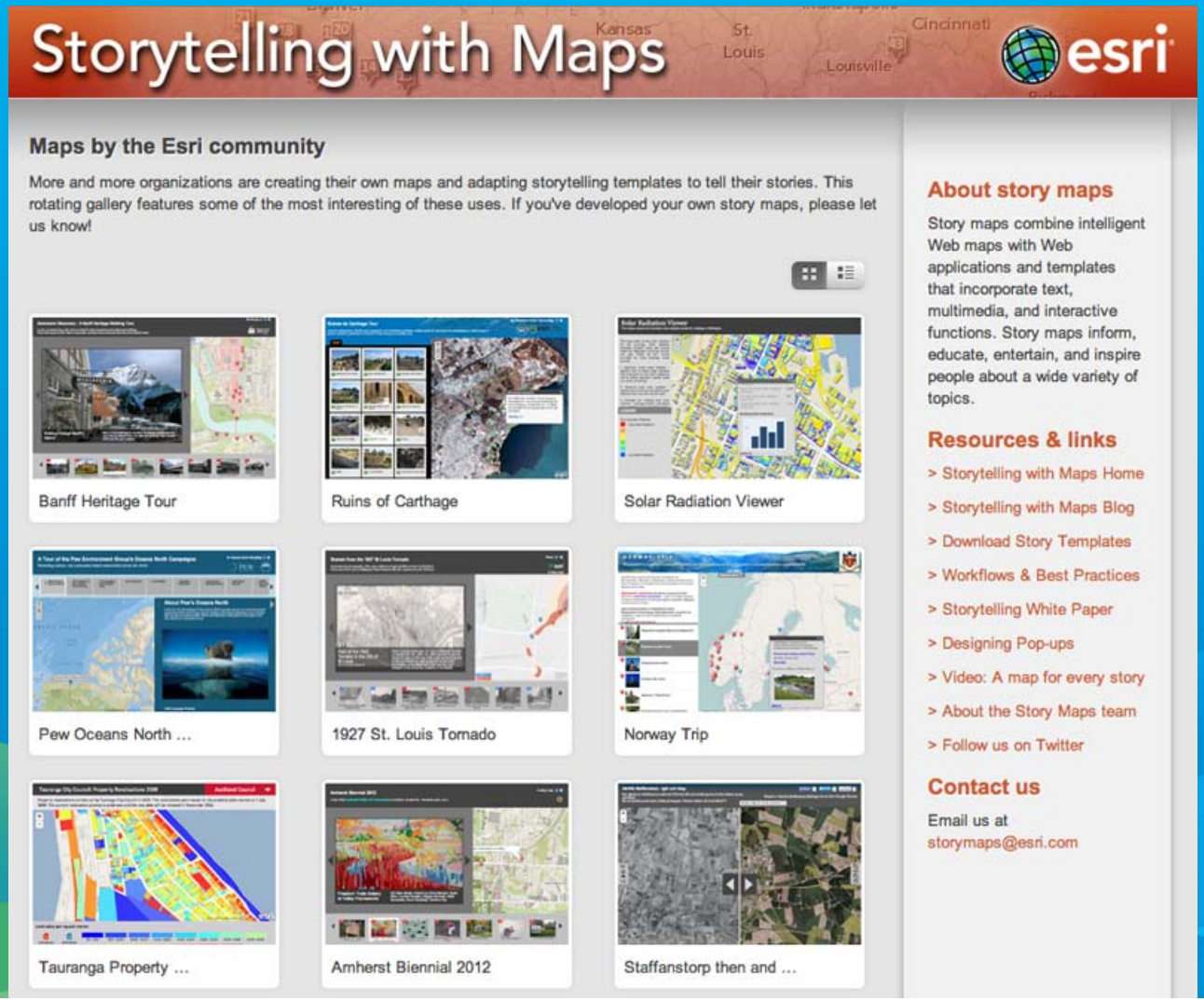
Why are we Making Story Maps?

Liberating data

Why are we Making Story Maps?

- To showcase interesting geographic information
- To develop new ways to tell stories with maps
- To show how GIS has emerged from the back office
- To liberate enslaved data
- To enable thousands of people to create and publish their own story maps

A growing community of storytellers



Why do people use GIS?

Asset Management

Collect, Organize, & Exchange Data

Planning & Analysis

Transform Data Into Actionable Information

Field Mobility

Get Information Into and Out of the Field

Operational Awareness

Disseminate Information Where and When it is Needed

Constituent Engagement

Get Feedback and Make Informed Decisions

- **Your managers**
- **Congress**
- **Other agencies**
- **Citizens**

What is the mission of the NTSB?

NTSB is an independent federal agency, charged by Congress to

- Investigate transportation accidents,
- Determine probable cause, and
- Issue safety recommendations

Issue safety recommendations

Emancipate data

Engage constituents

Telling stories!

How are story maps made?

- **Well-defined story concept**

+

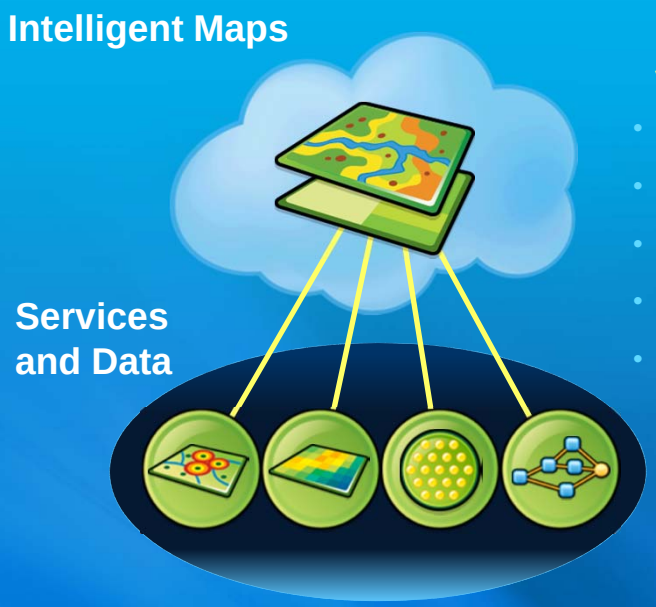
- **Intelligent web map**

+

- **Storytelling app**

Intelligent Web Maps…

- Integrating Services (Data, Maps, Models . . .)



Supporting

- Visualization
- Editing
- Pop-ups
- Analysis
- Time

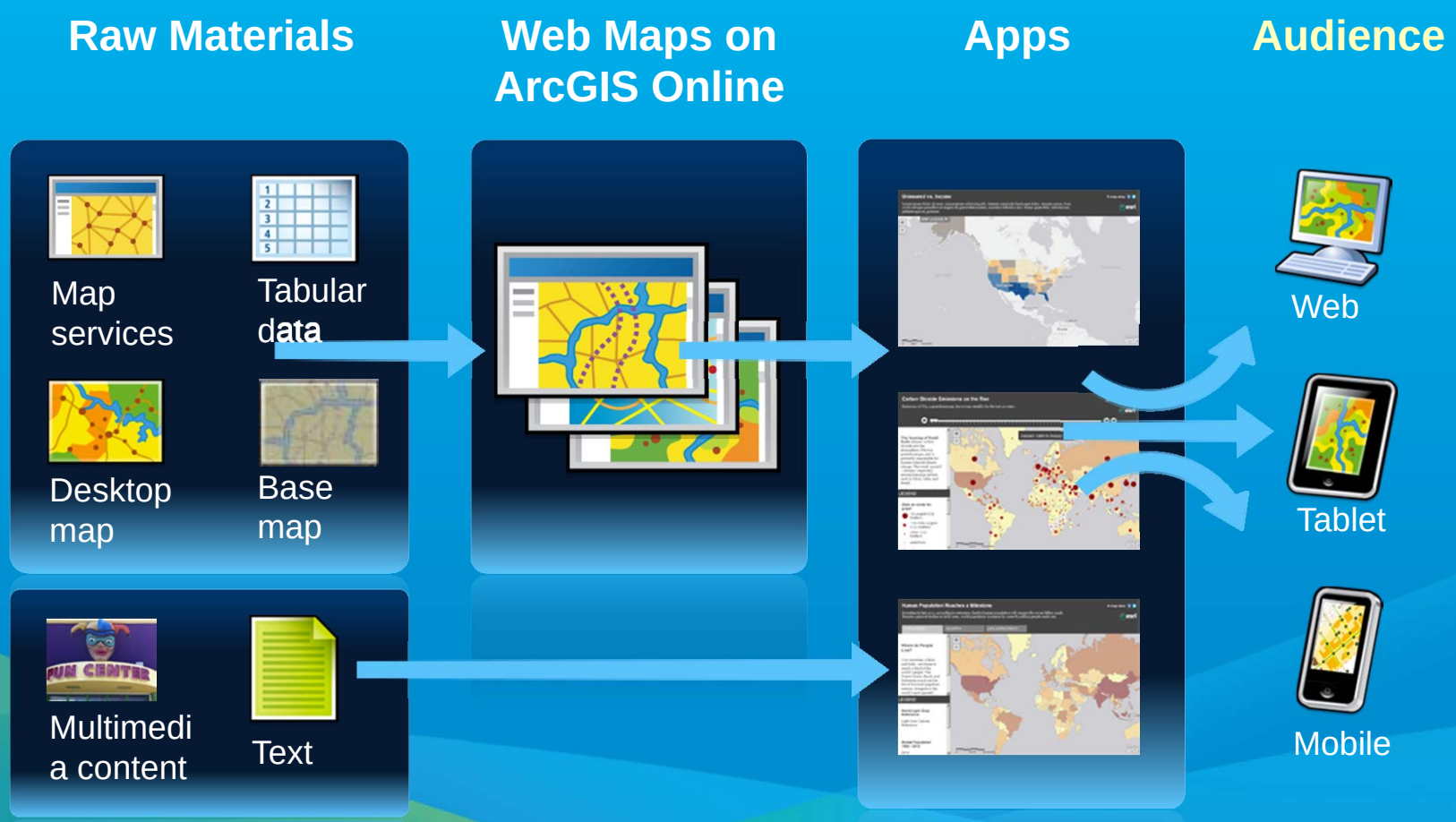
Easily Created
and Shared

- Simplifying GIS . . .
- . . . Connecting and Providing Open Access

…enabled in apps that can be used everywhere

- . . . Enhancing Access and Collaboration

How we make story maps



A growing collection of apps

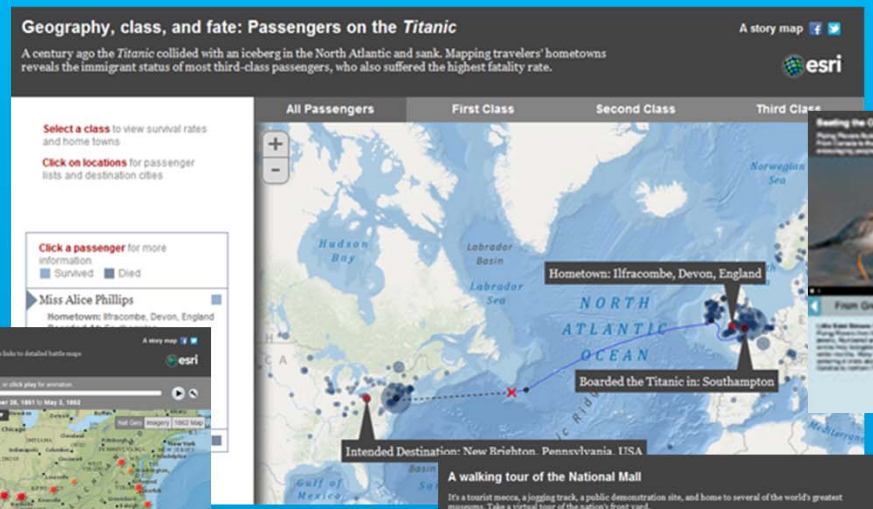
How are we enabling people to make their own story maps?

- ArcGIS Online: Create, mash up, and refine, maps to publish into templates
- Storytelling templates: Download source code; includes config sections and read-me files
- All source code for all our stories is freely available
- We'll be making this process even easier

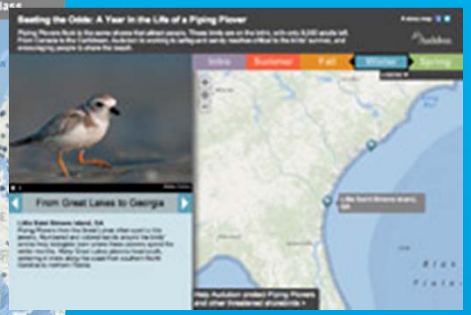
storymaps.esri.com

Some recent story maps

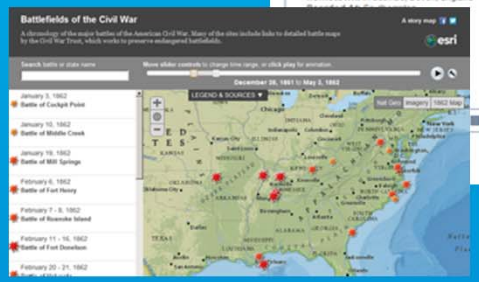
Titanic

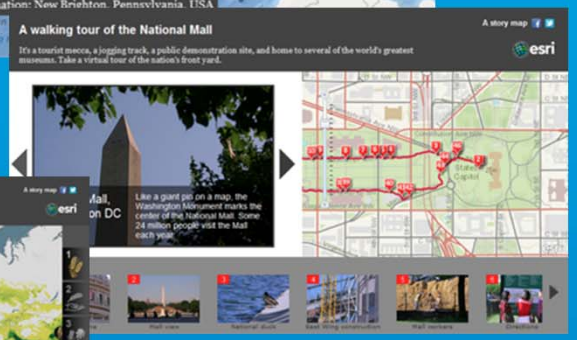


Piping plover



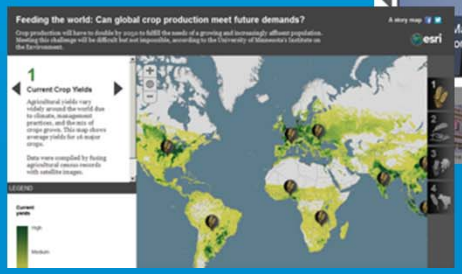
Civil War





National Mall Walking Tour

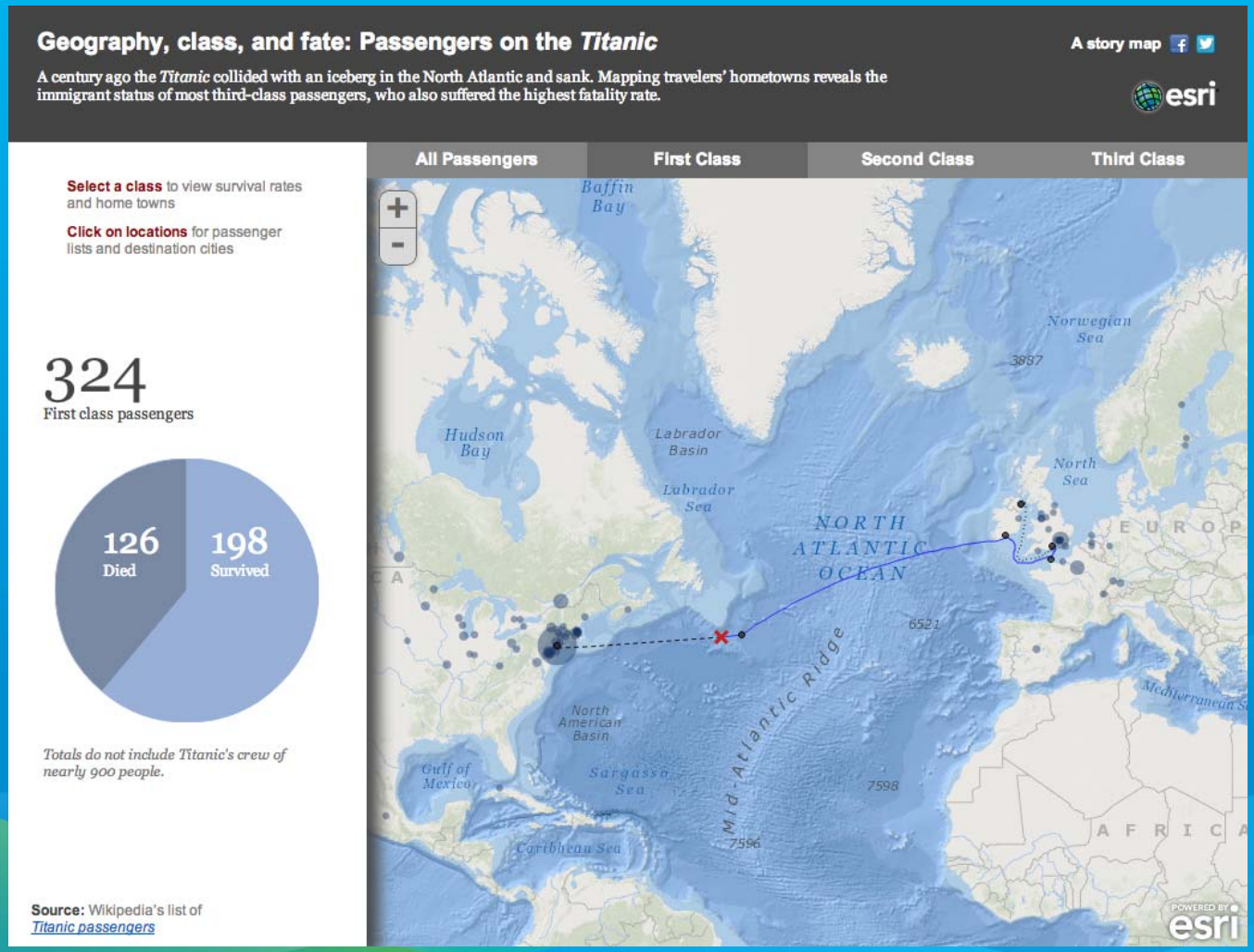
Feeding the World



storymaps.esri.com

Titanic passengers

First class
vs. steerage



Titanic passengers

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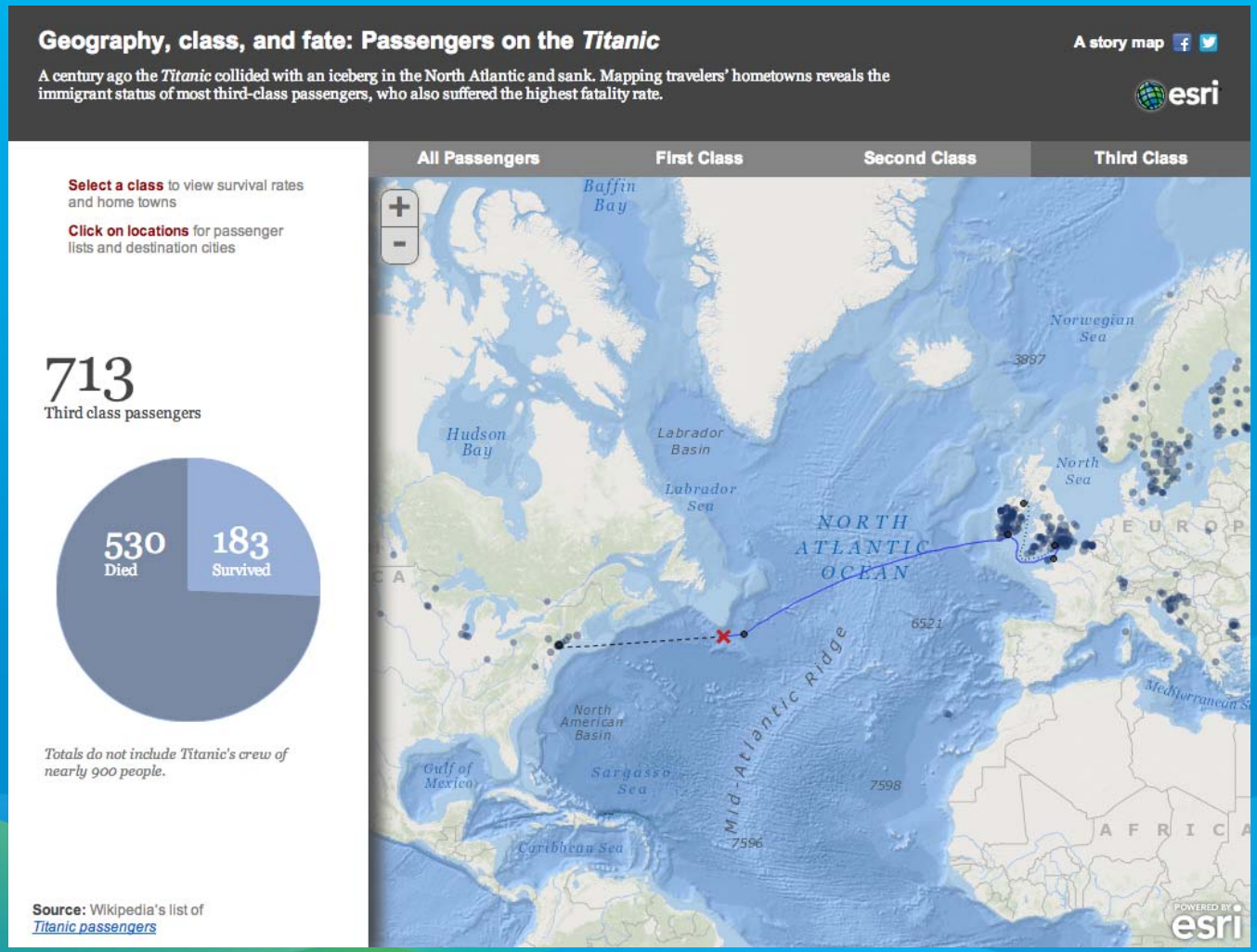
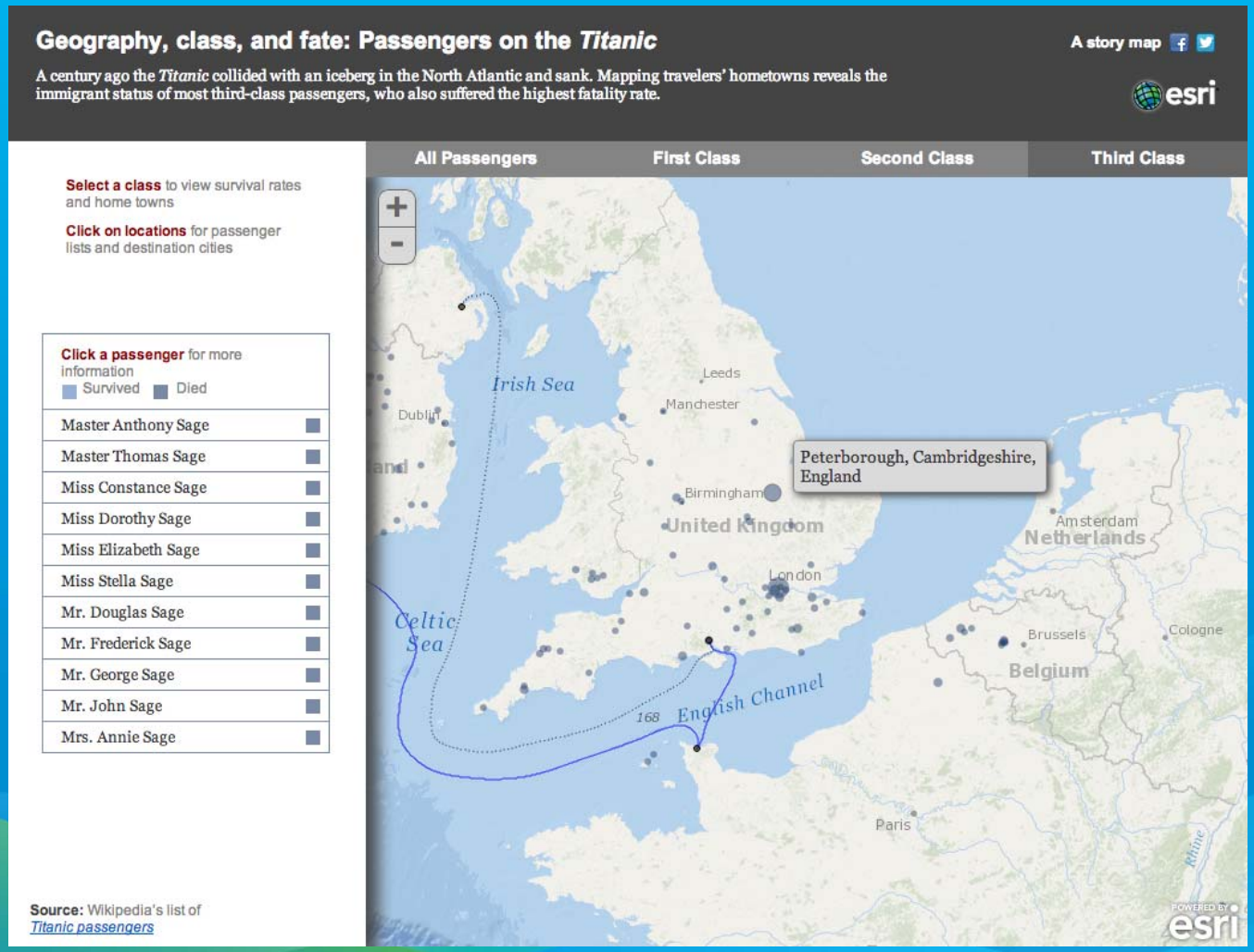


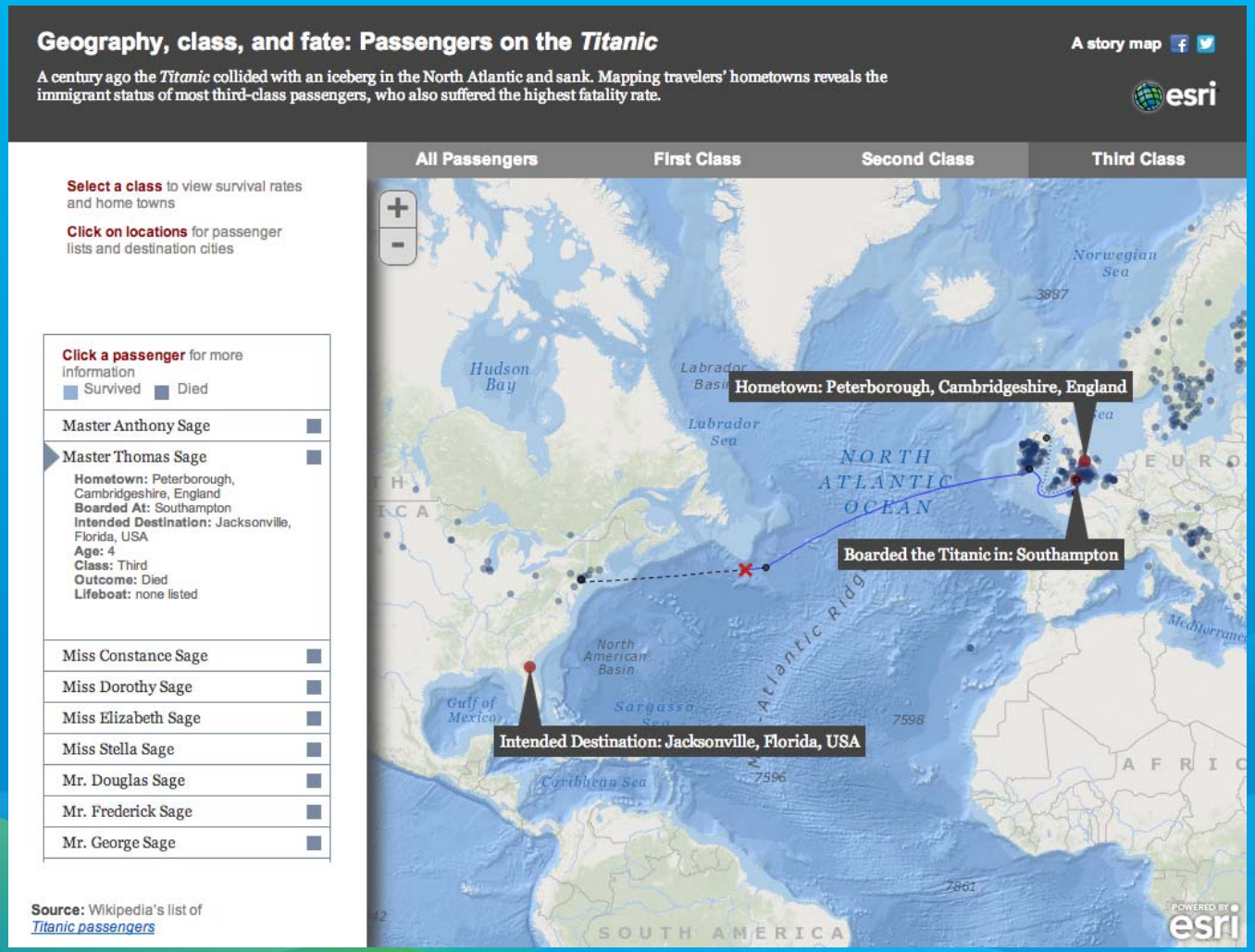
Titanic passengers

Fate of a family



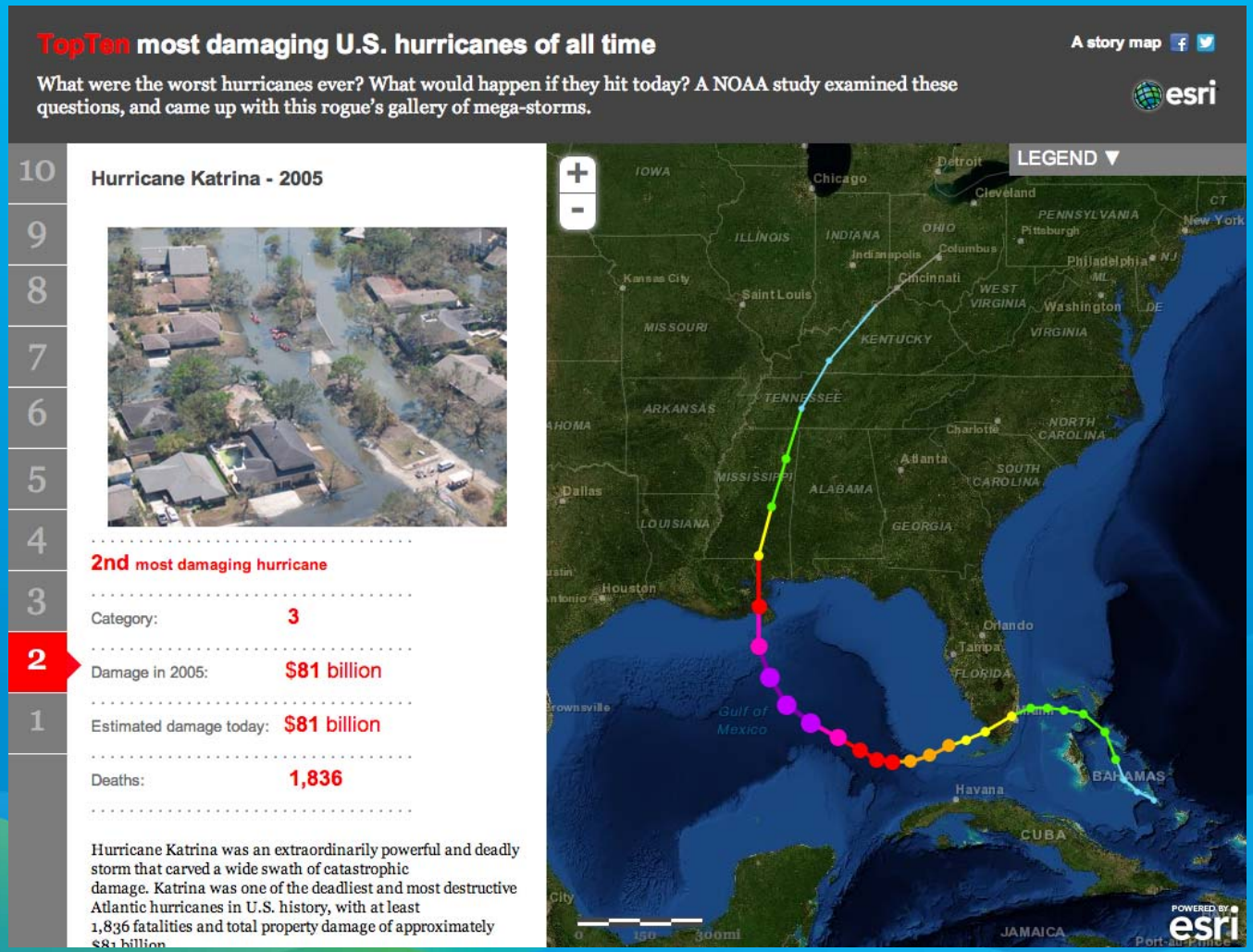
Titanic passengers

Fate of a family



Ten worst hurricanes

…assuming they were to strike today



Ten worst hurricanes

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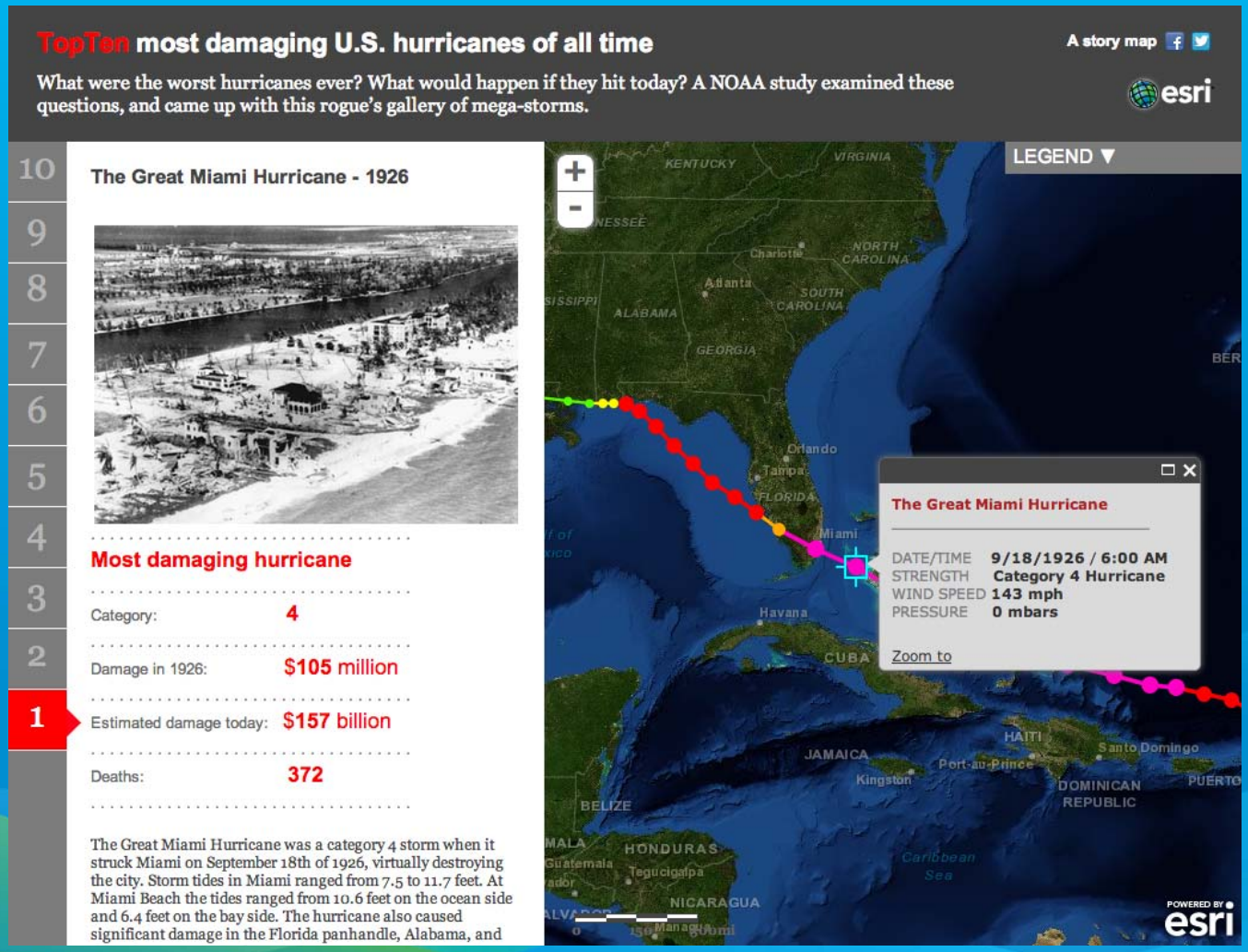
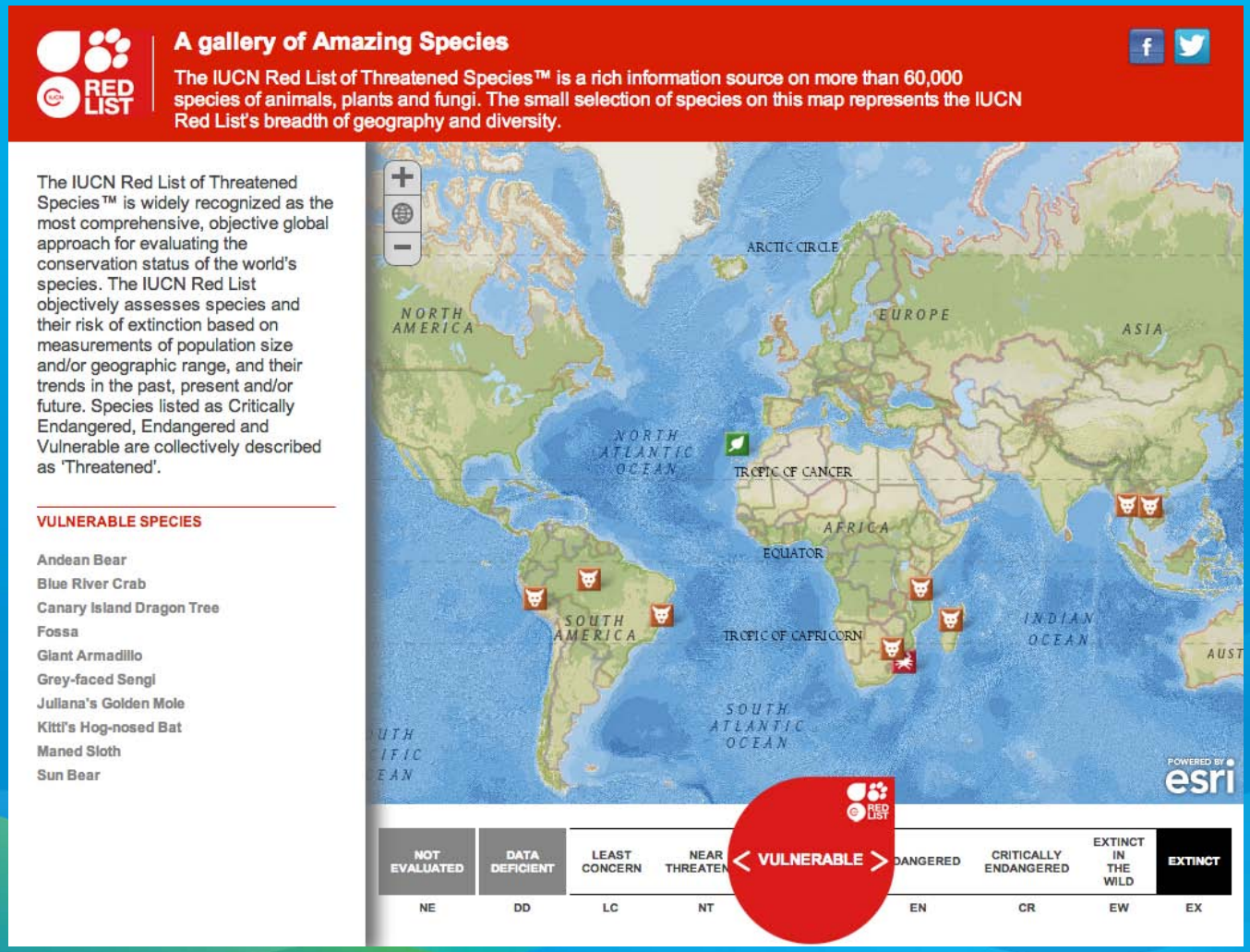


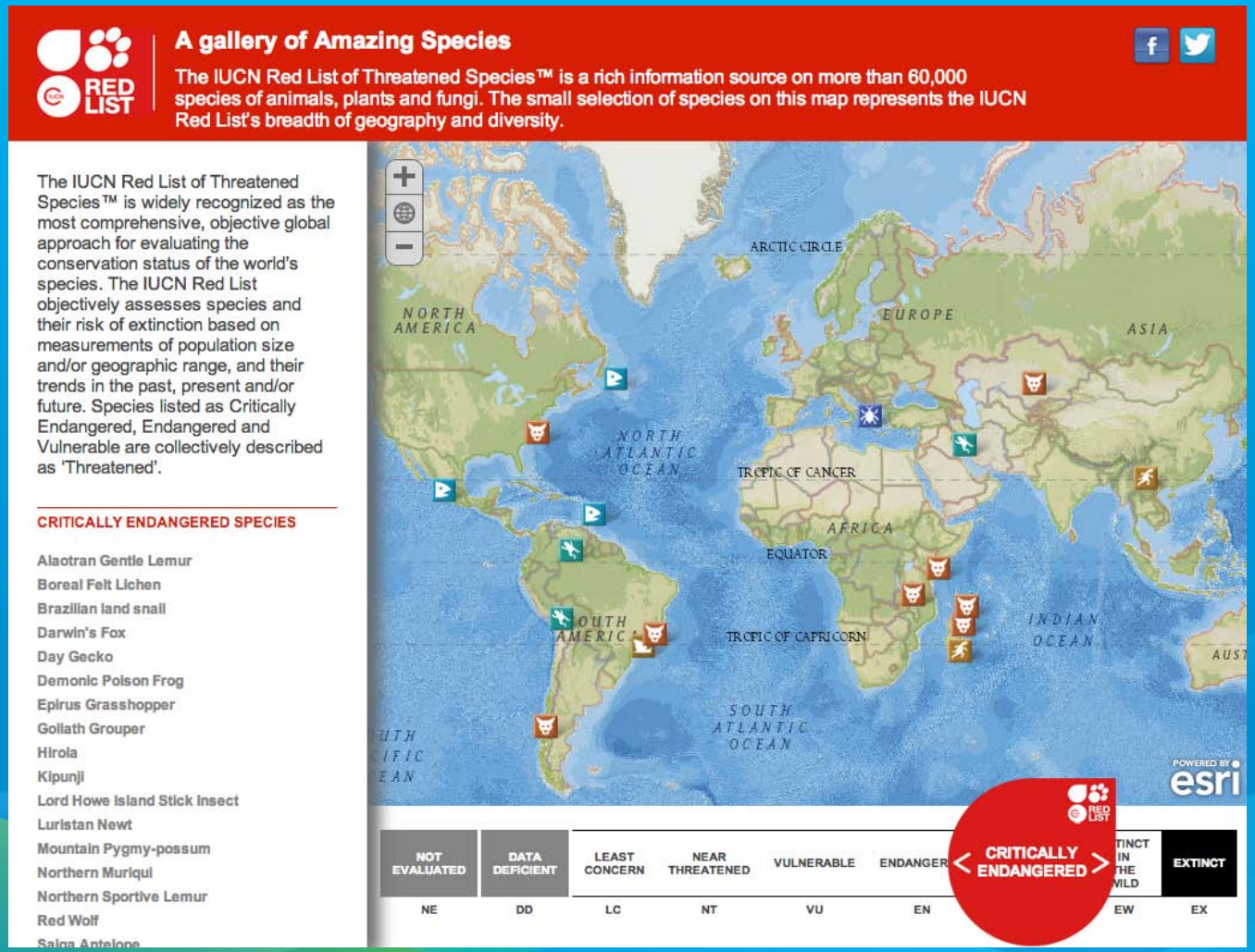
IUCN Red List of endangered species

Move the slider icon



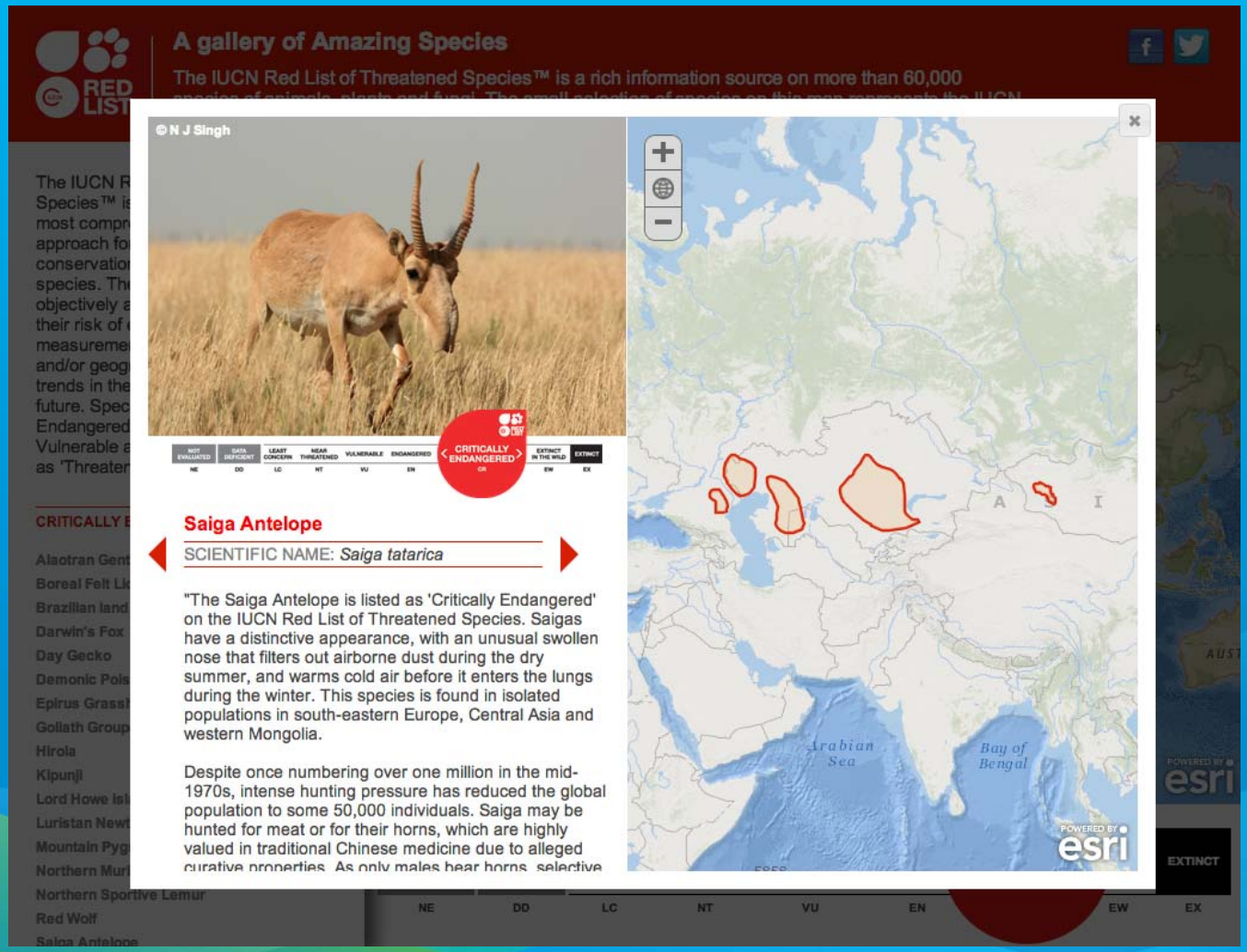
IUCN Red List of endangered species

Move the slider icon…



IUCN Red List of endangered species

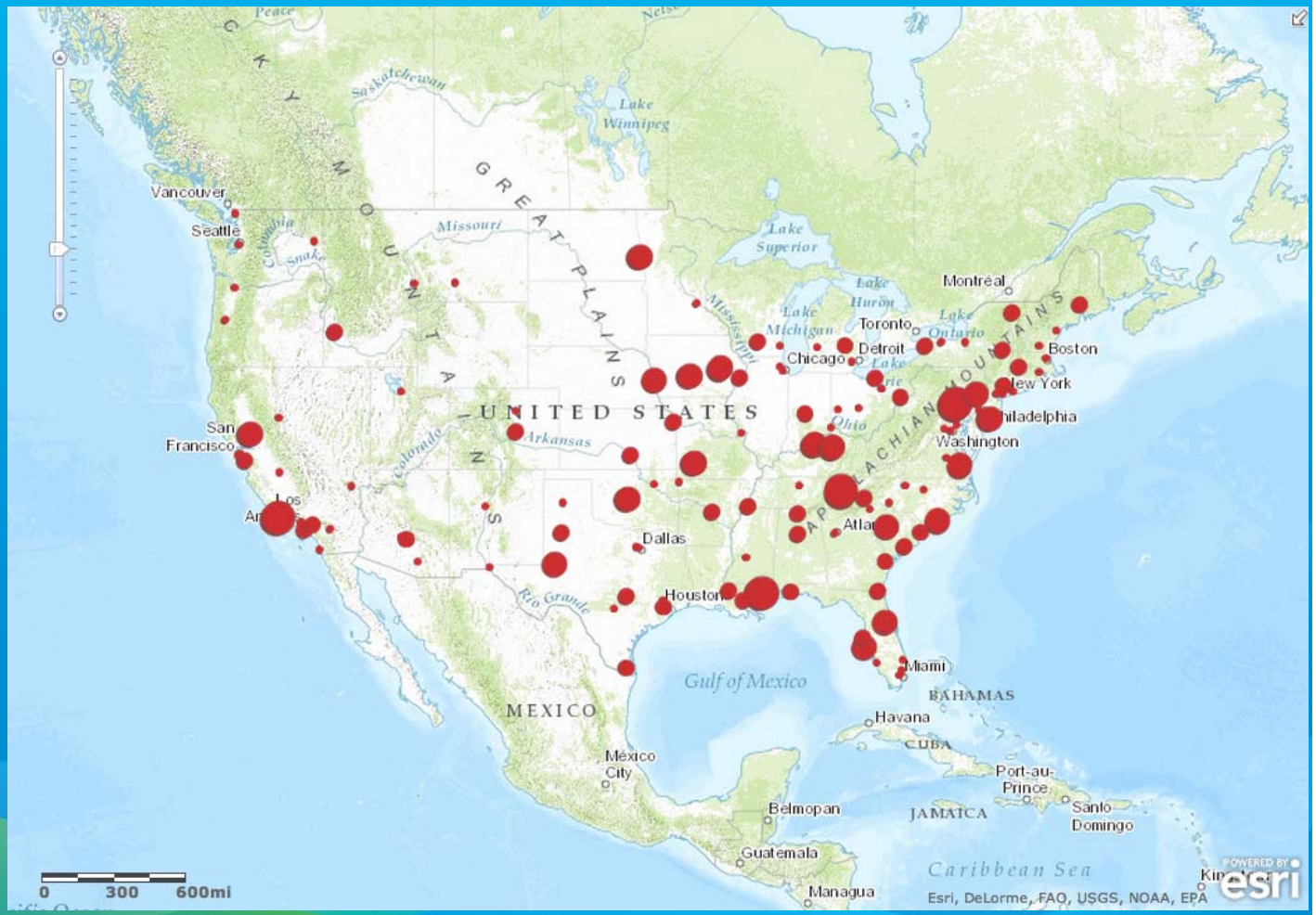
…and view individual species



How could story maps work for NTSB?

- **Example: Bird strikes**

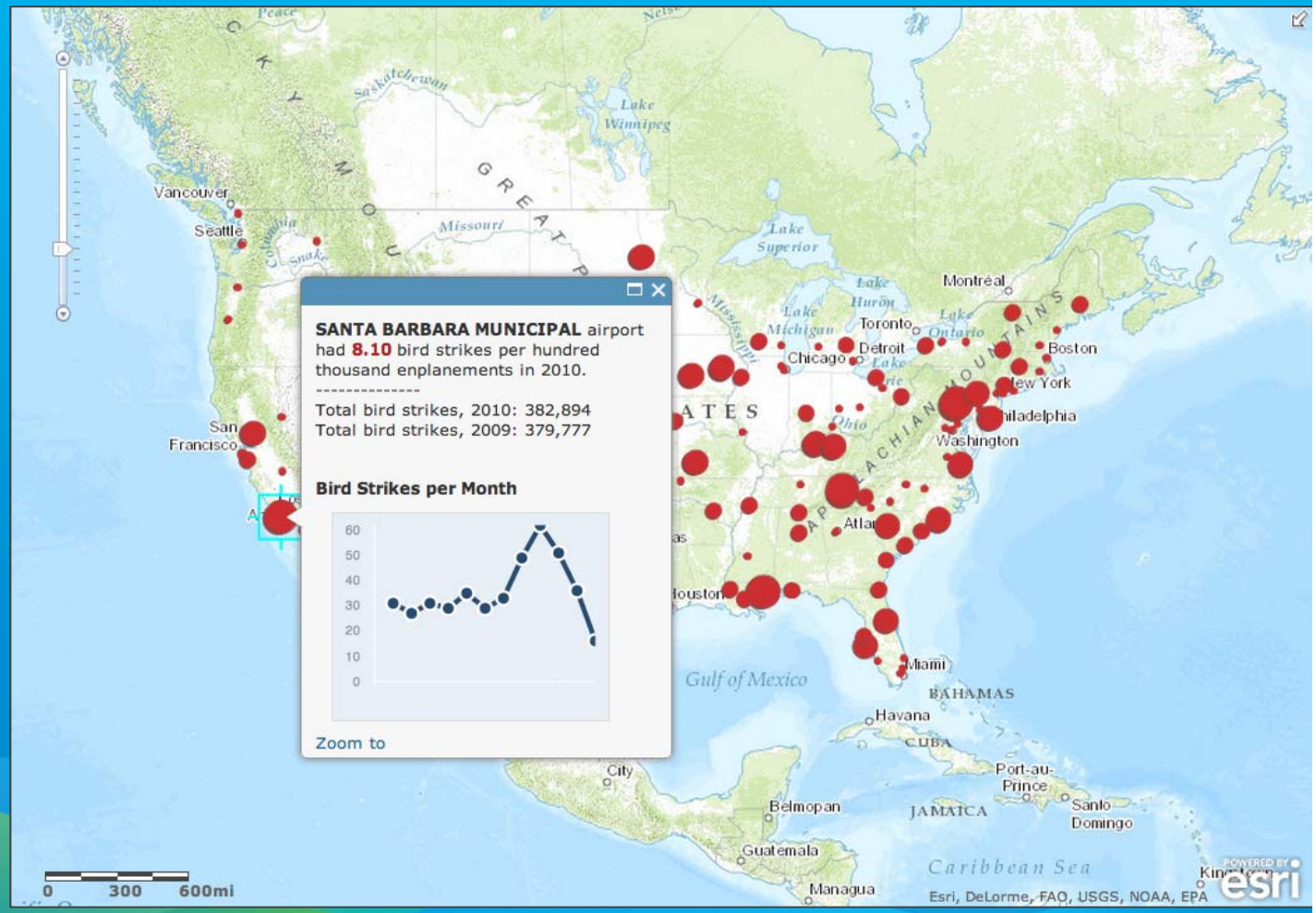
Bird strikes per 1000 emplanements



How could story maps work for NTSB?

- **Example: Bird strikes**

Show bird strikes by month

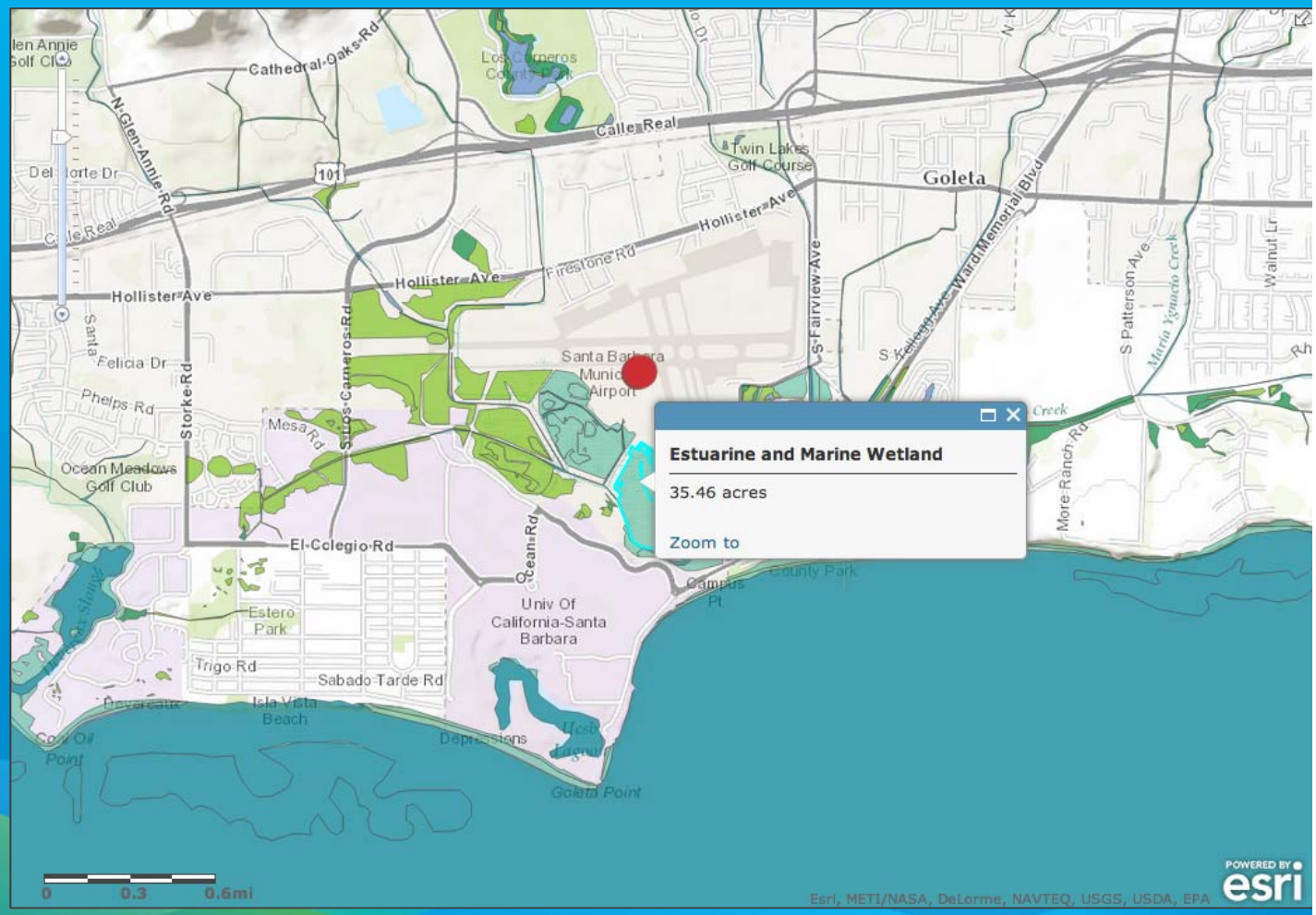


How could story maps work for NTSB?

- **Example: Bird strikes**

Show proximity of some airports to wetlands…

Santa Barbara, California



How could story maps work for NTSB?

- **Example: Bird strikes**

…or rivers

Harrisburg, Pennsylvania

Liberate your data!

Allen Carroll
acarroll@esri.com

Chairman Deborah A.P. Hersman
National Transportation Safety Board
Closing Remarks
Geographic Information Systems in Transportation Safety
Washington, DC - December 5, 2012
(As Prepared for Delivery)

On behalf of my fellow Board members, I want to thank everyone who has participated in this forum — especially our panelists, who took the time to provide us with highly informative presentations and to answer our many questions.

This week's conference has shown us loudly, clearly and graphically that there are many tools in the safety toolkit and we are now far better informed about GIS and its many applications across transportation safety.

Many thanks to Ivan Cheung and the NTSB team for the great work putting this forum together.

We stand adjourned.