Aircraft Based Observations

National Weather Service Aircraft Based Observation (ABO) Program

Aircraft Weather Data – Outline

- US ABO Program
- Benefits of ABO Program
- Humidity reports
- MADIS AMDAR displays
- Summary

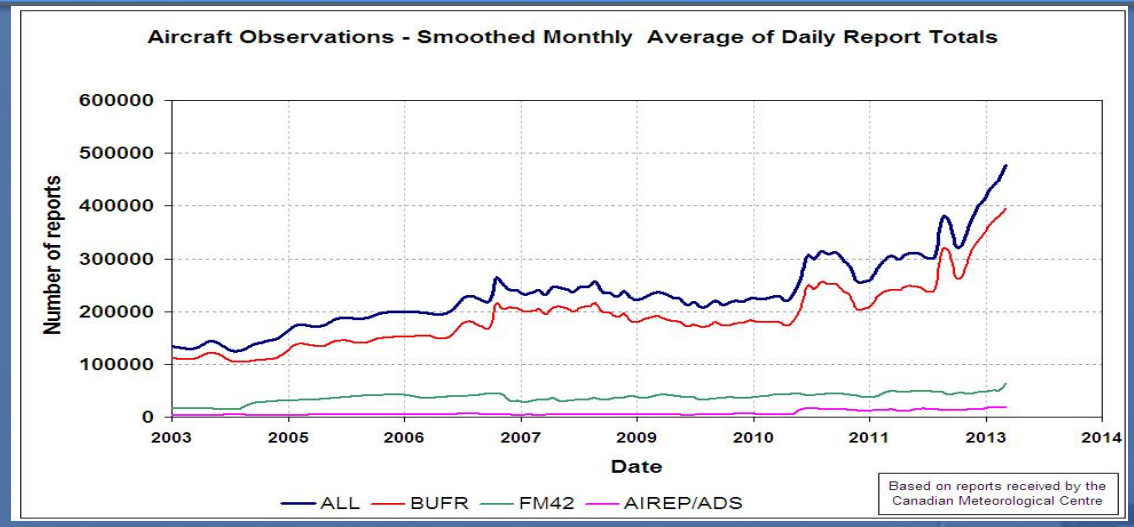
US Aircraft Based Observation Program

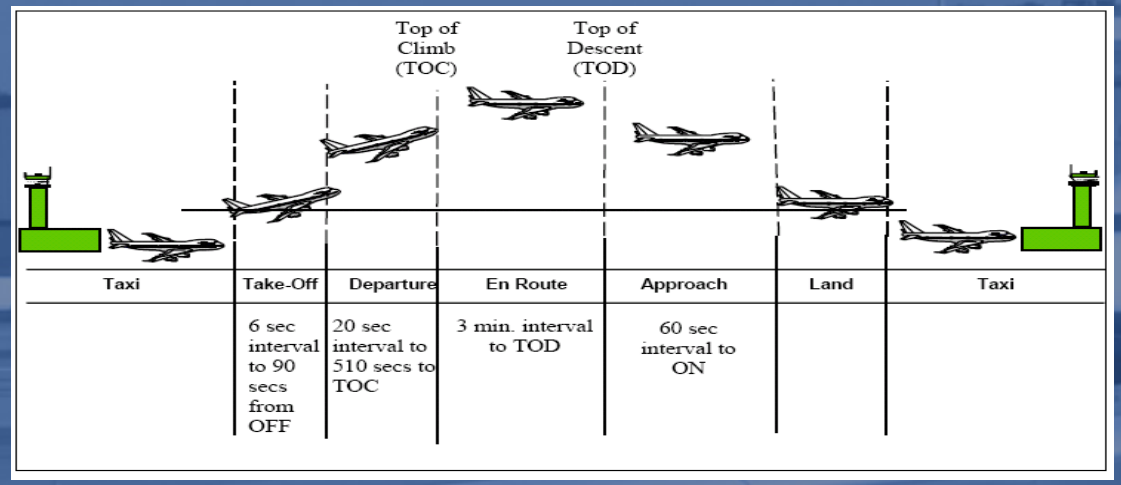
- 1980's, NOAA Research ins using Aircraft Obs in experimental numerical weather products
- 1993 NOAA Research stands up AMDAR website for QC and distribution.
  http:// amdar.noaa.gov
- 1996 US airlines allow direct access to data by NOAA's NWS meteorologists for use in NWS operations
- 1996-2015 and beyond NOAA committed to sustainment and expansion of US ABO program

Weather Forecast Office Green Bay Wi
NWS operational forecasters use aircraft based observations daily for forecasts and warnings to protect property and save lives

AMDAR – Aircraft Meteorological DAta Relay

- AMDAR is the core component of the Aircraft-based Observing System:
  - ~ 95% of all Aircraft Based Observations (supplemented by ICAO AIREPs, PIREPs and ADS)
  - Data derived from vertical profiles and enroute reports of meteorological parameters according to meteorological specification.
  - Over 650,000 observations per day
  - 38 participating airlines globally
  - Over 3000 participating aircraft
  - Data quality is equivalent to radiosonde





US NWS Aircraft Based Observation Program Strategies and Activities

- Aircraft Based Observations are a proven mechanism for adding valuable weather data into national airspace operations. The US ABO program is:
  - Strategic: Demonstrated improvements to Numerical Weather products
  - Tactical: Operation forecasting uses and emerging capabilities for cockpit utilization of real time hazard information (temperature, winds ,humidity, turbulence, pireps and airreps.icing)
  - Potential in the future for real time crosslink of aircraft-derived turbulence and other ABO data
  - Ongoing NOAA/FAA/A4A US ABO management team
- Expand ABO turbulence (EDR) and Icing reports
- Joint FAA NOAA MDCRS and NWS WVSS programs sustain and expand
- NWS Aircraft Observation and Mesonet contracts in place to expand regional and global coverage of aircraft based observations
  - More aircraft observations in data sparse areas of globe
  - Expand number of participating regional airlines
  - Utilizing new downlink methods such as ADS-C
- Reduce redundant soundings at hubs (optimization)
- Some data becoming available in real time through MADIS
- More interaction with WMO RA-IV and RA3-III (Americas) partners - share experiences and knowledge workshop in Panama in August 2016
- Expand MADIS and AMDAR web sites in support of data stewardship real time QC, archiving and distribution of Aircraft based observations madis.noaa.gov

Aircraft based observations – benefits real applications for improving forecasts and warnings

- Aircraft based observations have proven extremely useful in a wide variety of forecast and warning situations, including:
  - Improved information for aviation interests
    - Low level wind shear
    - Ceilings and visibilities
    - Icing and turbulence
    - fog
  - Winter Storms
    - Precipitation type
    - Lake effect snow
  - Thunderstorms
    - Convective initiation
    - Calculation of stability indices
  - Fire Weather
    - Mixing heights
    - Haines indices
    - Relative humidity forecasts
  - Marine Forecasts
    - Small craft and Gale Warnings
  - Hazardous Materials Support
    - AMDAR can be used to support HAZMAT teams
    - Can be input into local dispersion models

ABO benefits for Numerical Weather Predicition (NWP) – weather models

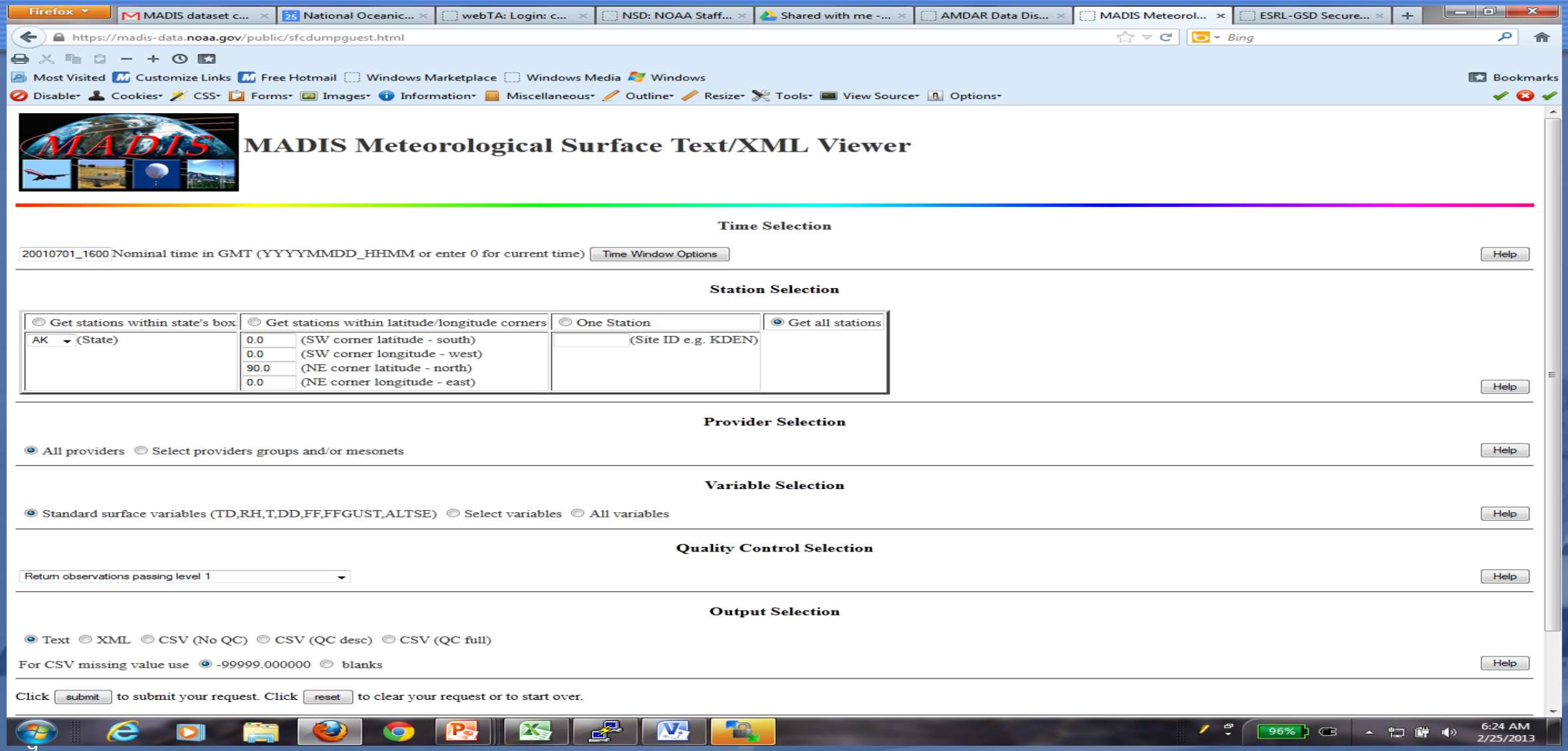
- Better forecasts – less weather delays due to NWP improved by Aircraft based observations
- NOAA HRRR/RAP weather model grids are the **backbone for most aviation hazard guidance products** for 1-18h duration, including
  - Turbulence and icing
  - Upper-level and terminal approach lower-troposphere winds
  - Ceiling/visibility, Terminal forecasts
- Skill of NOAA's regional HRRR models is dependent on high-quality hourly observations over the US and North America.
  - Aircraft observations are the most single important observation source for 1-18h forecasts over the US; other obs type also add value
  - Forecast accuracy further improves with additional aircraft data and methodology (e.g., addition of expanded Alaska Airlines, WVSS-II, TAMDAR, ADS-C)
  - Ongoing effort within NOAA to improve assimilation of ABO into global scale NWP such as NOAA's Global Forecast System (GFS) model
- New 2013 HRRR data denial study
  - Aircraft observations more dominant than in for 2011 RAP obs denial experiments
  - Now ABO is most important obs type also for moisture/RH in HRRR

Humidity Reports from Commercial aircraft

WVSS-II laser diode shown next to a penny, for size comparison purposes.

- A 2005 sensor (WVSS-II) employs a diode laser to measure water vapor mixing ratio.
- WVSS-II is installed on 25 UPS aircraft, 110 Southwest Airlines. Lufthansa has some aircraft equipped with WVSS-II.
- About 10,000 profiles per week being made available in real time through MADIS

Data Dump - used for all data types



Sample ABO Dump Using MADIS API

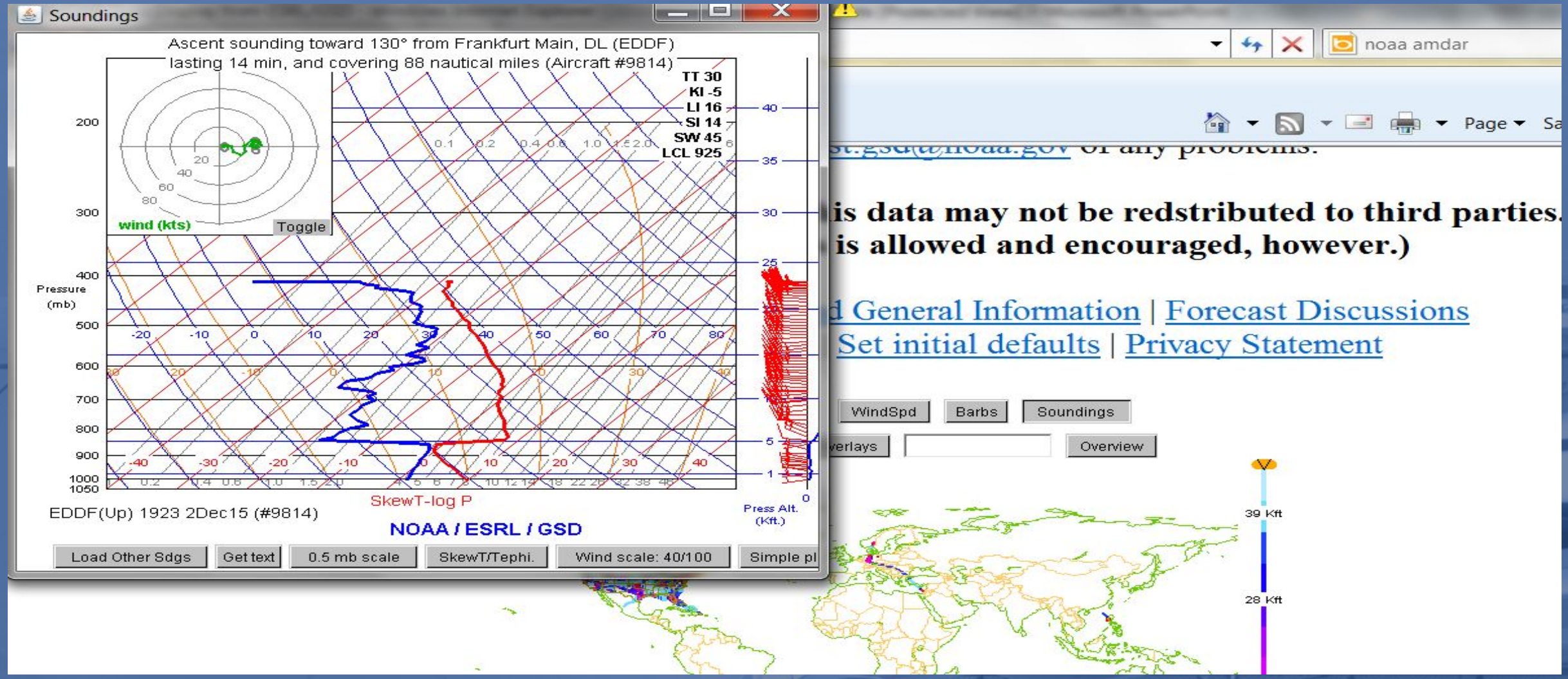
Terminal — ssh — 196×53

var DD total stns 24675 # non-missing obs 24635

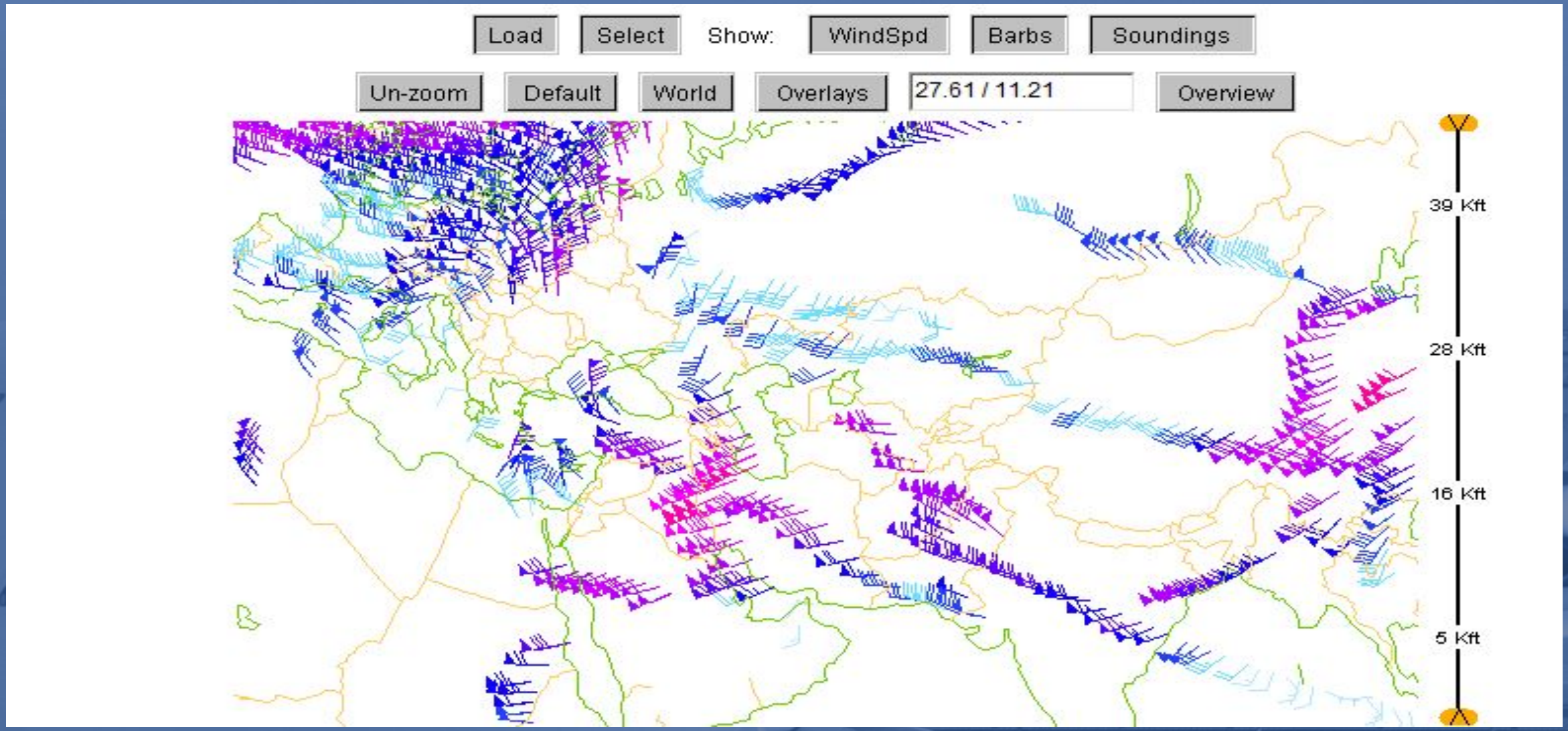
	Station	ObTime	Ht(m)	QCD	QCA	QCR	Lat(N)	QCD	QCA	QCR	Lon(E)	QCD	QCA	QCR	Grid I	Grid J	DD	QCD	QCA	QCR
V-DD	00005619	20150301_2303	-80.00	C	3	0	46.29	C	3	0	-63.13	C	3	0	0.000	0.000	163.000000	C	3	0
V-DD	00005619	20150301_2303	-30.00	S	19	0	46.28	C	7	0	-63.13	C	7	0	0.000	0.000	178.000000	C	3	0
V-DD	00005619	20150301_2303	60.00	S	19	0	46.28	C	7	0	-63.13	C	7	0	0.000	0.000	194.000000	C	3	0
V-DD	00005619	20150301_2303	190.00	S	19	0	46.28	C	7	0	-63.13	C	7	0	0.000	0.000	196.000000	C	3	0
V-DD	00005619	20150301_2303	330.00	S	19	0	46.27	C	7	0	-63.13	C	7	0	0.000	0.000	198.000000	C	3	0
V-DD	00005619	20150301_2303	440.00	S	19	0	46.27	C	7	0	-63.13	C	7	0	0.000	0.000	200.000000	C	3	0
V-DD	00005619	20150301_2303	540.00	S	19	0	46.26	C	7	0	-63.13	C	7	0	0.000	0.000	201.000000	C	3	0
V-DD	00005619	20150301_2303	620.00	S	19	0	46.26	C	7	0	-63.13	C	7	0	0.000	0.000	214.000000	C	3	0
V-DD	00005619	20150301_2303	690.00	S	19	0	46.26	C	7	0	-63.13	C	7	0	0.000	0.000	224.000000	C	3	0
V-DD	00005619	20150301_2304	770.00	S	19	0	46.25	C	7	0	-63.13	C	7	0	0.000	0.000	229.000000	C	3	0
V-DD	00005619	20150301_2304	870.00	S	19	0	46.25	C	7	0	-63.13	C	7	0	0.000	0.000	231.000000	C	3	0
V-DD	00005619	20150301_2304	980.00	S	19	0	46.24	C	7	0	-63.14	C	7	0	0.000	0.000	233.000000	C	3	0
V-DD	00005619	20150301_2304	1050.00	S	19	0	46.24	C	7	0	-63.14	C	7	0	0.000	0.000	233.000000	C	3	0
V-DD	00005619	20150301_2304	1110.00	S	19	0	46.23	C	7	0	-63.14	C	7	0	0.000	0.000	233.000000	C	3	0
V-DD	00005619	20150301_2304	1160.00	S	19	0	46.23	C	7	0	-63.14	C	7	0	0.000	0.000	234.000000	C	3	0
V-DD	00005619	20150301_2304	1220.00	S	19	0	46.22	C	7	0	-63.14	C	7	0	0.000	0.000	235.000000	C	3	0
V-DD	00005619	20150301_2305	1560.00	S	19	0	46.21	C	7	0	-63.17	C	7	0	0.000	0.000	236.000000	C	3	0
V-DD	00005619	20150301_2305	1920.00	S	19	0	46.21	C	7	0	-63.20	C	7	0	0.000	0.000	238.000000	C	3	0
V-DD	00005619	20150301_2305	2280.00	S	19	0	46.21	C	7	0	-63.23	C	7	0	0.000	0.000	246.000000	C	3	0
V-DD	00005619	20150301_2306	2690.00	S	19	0	46.21	C	7	0	-63.26	C	7	0	0.000	0.000	244.000000	C	3	0
V-DD	00005619	20150301_2306	3010.00	S	19	0	46.21	C	7	0	-63.30	C	7	0	0.000	0.000	239.000000	C	3	0
V-DD	00005619	20150301_2306	3350.00	S	19	0	46.21	C	7	0	-63.33	C	7	0	0.000	0.000	253.000000	C	3	0
V-DD	00005619	20150301_2307	3670.00	S	19	0	46.21	C	7	0	-63.36	C	7	0	0.000	0.000	262.000000	C	3	0
V-DD	00005619	20150301_2307	4040.00	S	19	0	46.21	C	7	0	-63.40	C	7	0	0.000	0.000	271.000000	C	3	0
V-DD	00005619	20150301_2307	4300.00	S	19	0	46.20	C	7	0	-63.43	C	7	0	0.000	0.000	269.000000	C	3	0
V-DD	00005619	20150301_2308	4570.00	S	19	0	46.20	C	7	0	-63.47	C	7	0	0.000	0.000	266.000000	C	3	0
V-DD	00005619	20150301_2308	4860.00	S	19	0	46.20	C	7	0	-63.50	C	7	0	0.000	0.000	270.000000	C	3	0
V-DD	00005619	20150301_2308	5150.00	S	19	0	46.19	C	7	0	-63.54	C	7	0	0.000	0.000	276.000000	C	3	0
V-DD	00005619	20150301_2309	5390.00	S	19	0	46.19	C	7	0	-63.57	C	7	0	0.000	0.000	271.000000	C	3	0
V-DD	00005619	20150301_2309	5630.00	S	19	0	46.19	C	7	0	-63.61	C	7	0	0.000	0.000	276.000000	C	3	0
V-DD	00005619	20150301_2309	5860.00	S	19	0	46.19	C	7	0	-63.65	C	7	0	0.000	0.000	274.000000	C	3	0
V-DD	00005619	20150301_2310	6100.00	S	19	0	46.19	C	7	0	-63.68	C	7	0	0.000	0.000	272.000000	C	3	0
V-DD	00005619	20150301_2310	6320.00	S	19	0	46.18	C	7	0	-63.72	C	7	0	0.000	0.000	272.000000	C	3	0
V-DD	00005619	20150301_2310	6510.00	S	19	0	46.18	C	7	0	-63.76	C	7	0	0.000	0.000	273.000000	C	3	0
V-DD	00005619	20150301_2311	6710.00	S	19	0	46.18	C	7	0	-63.80	C	7	0	0.000	0.000	276.000000	C	3	0
V-DD	00005619	20150301_2311	6920.00	S	19	0	46.18	C	7	0	-63.82	C	7	0	0.000	0.000	278.000000	C	3	0
V-DD	00005619	20150301_2312	7060.00	S	19	0	46.18	C	7	0	-63.87	C	7	0	0.000	0.000	278.000000	C	3	0
V-DD	00005619	20150301_2315	8450.00	S	19	0	46.18	C	7	0	-64.23	C	7	0	0.000	0.000	274.000000	C	3	0
V-DD	00005619	20150301_2318	9360.00	S	19	0	46.17	C	7	0	-64.60	C	7	0	0.000	0.000	284.000000	C	3	0
V-DD	00005619	20150301_2321	9750.00	S	19	0	46.17	C	7	0	-65.00	C	7	0	0.000	0.000	265.000000	C	3	0
V-DD	00005619	20150301_2324	9760.00	S	19	0	46.16	C	7	0	-65.44	C	7	0	0.000	0.000	266.000000	C	3	0
V-DD	00005619	20150301_2327	9750.00	S	19	0	46.15	C	7	0	-65.89	C	7	0	0.000	0.000	266.000000	C	3	0
V-DD	00005619	20150301_2330	9750.00	S	19	0	46.14	C	7	0	-66.33	C	7	0	0.000	0.000	269.000000	C	3	0
V-DD	00005619	20150301_2333	9760.00	S	19	0	46.13	C	7	0	-66.76	C	7	0	0.000	0.000	269.000000	C	3	0
V-DD	00005619	20150301_2336	9750.00	S	19	0	46.11	C	7	0	-67.18	C	7	0	0.000	0.000	266.000000	C	3	0
V-DD	00005619	20150301_2339	9750.00	S	19	0	46.10	C	7	0	-67.60	C	7	0	0.000	0.000	266.000000	C	3	0
V-DD	00005619	20150301_2342	9750.00	S	19	0	46.08	C	7	0	-68.02	C	7	0	0.000	0.000	264.000000	C	3	0

"acarsdump.txt" 146418L, 20494774C 1,0-1 Top

MADIS AMDAR Display Sounding with moisture



MADIS AMDAR Display Winds



Summary

- **Avoidable** delays **caused by weather** cost the airline industry **billion per annum**.
- The US ABO AMDAR program contributes to upto 30 percent skill increase for NOAA's High Resolution Rapid Refresh numerical weather model – most important data set for impact to regional model skill.
- The US ABO data coverage is currently at much less than 50% of what is potentially achievable.
- Desired expansion of aircraft reporting humidity. Currently TAMDAR (Panasonic) and WVSS-II on only a few hundred aircraft.
- Further expansion of FAA led EDR reporting for Global coverage – leading to improved and enhanced turbulence forecast products.
- Utilization of ADS-B and ADS-C meteorological data to supplement current methods of down linking ABO data from airlines.

Questions

- Steven.Pritchett@noaa.gov

  office (301) 427-9121

- Curtis.Marshall@noaa.gov

  office (301) 427-9244