



NTSB

SAFETY ALERT

National Transportation Safety Board

★ Visual Illusions: The Ground May Be Closer Than It Appears ★

Prevent controlled flight into terrain in flat light and whiteout conditions

The problem

Flight operations in geographic areas that are susceptible to flat light and whiteout conditions can lead to accidents, as visual references are greatly reduced for pilots.

- Flat light occurs when the sky is overcast, especially over snow-covered terrain and large bodies of water. In flat light conditions, no shadows are cast and terrain features and other visual cues are masked, making it difficult for pilots operating under visual flight rules (VFR) to perceive depth, distance, or altitude. The photograph in this figure shows how these conditions combine to create an environment where it is difficult, if not impossible, to distinguish the sky from the ground.



Figure. Photograph of an accident site showing the visual effects of flat light and snow-covered terrain

- Similarly, whiteout conditions can occur in areas with snow cover. Pilots can experience a loss of depth perception and become spatially disoriented, unable to maintain visual reference with the ground and unaware of their actual altitude.

Related accidents

The NTSB has investigated many general aviation (GA) accidents involving flat light or whiteout conditions. These accidents serve as important reminders about the critical need to ensure that pilots are aware of the challenges associated with these operating conditions and are adequately prepared for safe operations. The following accident summaries help to highlight the issues involved.

- An Airbus AS350B2 helicopter sustained substantial damage when it impacted terrain following a loss of control while landing. The commercial pilot, who was the sole occupant, reported that the weather was deteriorating and he encountered an area with flat light conditions over snow-covered ground. As the visibility decreased, he

slowed the helicopter and stayed low to the ground; he reported that blowing snow from the main rotor downwash reduced the visibility to whiteout conditions with no ground reference. ([GAA16LA031](#))

- A Bell 206L-1 helicopter sustained substantial damage following the commercial pilot's attempted precautionary landing due to poor visibility conditions. The pilot reported that while flying over an area of flat and featureless, snow-covered terrain, deteriorating weather conditions with low ceilings, light snow, and flat light conditions reduced his visibility. He said that, while attempting to land, blowing snow from the main rotor downwash reduced his ability to discern topographical features on the snow-covered terrain. During touchdown, the helicopter drifted to the left, the left skid struck the snow-covered terrain, and the helicopter rolled onto its left side. ([ANC13CA041](#))
- A Cessna 182B airplane, being operated on a cross-country flight that included flying through a narrow mountain pass, sustained substantial damage when it collided with mountainous, snow-covered terrain. The commercial pilot and two passengers were fatally injured. The typical route through the pass required making multiple turns, and the pass intersected with a box canyon. The airplane's wreckage was located at the bottom of the box canyon a day after the airplane was reported overdue. A friend of the pilot, who attempted to cross the mountain pass the day of the accident, reported flat light conditions and difficulty discerning terrain features. Another pilot who flew through the mountain pass on the morning of the accident reported 4,400-foot ceilings, severe turbulence, and flat light conditions. ([ANC13FA027](#))
- An Aviat A1-A airplane, being operated on a cross-country flight under VFR, sustained substantial damage after colliding with snow-covered ice (a frozen drainage reservoir). The commercial pilot, the sole occupant of the airplane, was not injured. The pilot reported that he intended to overfly an airstrip without landing and that flat light conditions hampered his ability to judge his relative distance to the ground. He further stated that he did not realize he was descending over the snow-covered terrain until he impacted the snow. ([SEA06CA043](#))

What can pilots do?

- If possible, look for, use, and don't lose sight of multiple visual reference points.
- Obtain an instrument rating and become proficient and comfortable with operating in instrument meteorological conditions (IMC). Trust the cockpit instruments and develop good cross-check practices.
- Understand that the ability to judge the height and determine the contour of terrain is difficult in conditions where the sky and ground (or water) are similar in color. When landing on snow-covered terrain, conduct an overflight and consider using weighted flags or other markers that can be dropped from an aircraft and provide contrast. Shorelines may also provide needed contrast.
- If you regularly fly in snowy conditions, become proficient and comfortable with taxiing, taking off, landing, and conducting en route maneuvers and go-arounds in areas with snow. If visibility drops, use your instruments and land at the nearest suitable airport.

- Install instruments that can enhance situational awareness (for example, radar altimeters, ground proximity warning systems, onboard weather systems, and GPS displays).
- Check all available weather sources before and during a flight. Study the flight routes and avoid potentially hazardous areas (such as rapidly rising terrain, towers/wires, and large open water areas), particularly if the weather is conducive to flat light or whiteout conditions.
- Set and use personal minimums, taking into account your skill level and the demands of a situation. Sticking to your personal minimums helps manage risk.
- Use other sources of information during a flight to determine the weather conditions (for example: company dispatch, other pilots operating in the area, or weather cameras that may be in place, particularly in Alaska).

Interested in more information?

- Federal Aviation Administration (FAA) Pamphlet AM-400-00/1, "[Spatial Disorientation Visual Illusions](#)," explains both phenomena and how to avoid them during flight operations.
- The FAA pamphlet "[Flying in Flat Light and White Out Conditions](#)" provides information about how to safely operate in these conditions.
- FAA Pamphlet P-8740-24, "[Winter Flying Tips](#)," provides information to remind pilots about winter weather operating procedures.
- The FAA Safety Team provides access to online training courses, seminars, and webinars. The course "Weather Wise: VFR into IMC" and many others can be accessed from www.faasafety.gov.
- FAA Advisory Circular 60-22, "[Aeronautical Decision Making](#)" provides information about how to implement the various aspects of aeronautical decision-making into flight operations.
- FAA Advisory Circular 61-134, "[General Aviation Controlled Flight into Terrain Awareness](#)," provides information about controlled flight into terrain and mitigation strategies.
- The NTSB issued Safety Recommendations A-02-33 through -35 and A-79-75 to improve, respectively, the safety of helicopter operations in flat light and whiteout conditions and GA safety in Alaska and other regions with similar environmental conditions.
- NTSB Safety Alert SA-020, "Reduced Visual References Require Vigilance," provides information about operating in reduced visibility conditions and historical accident information.

The NTSB's Aviation Information Resources web page, www.nts.gov/air, provides convenient access to NTSB aviation safety products. The reports for the accidents referenced in this safety alert are accessible by NTSB accident number from the [Aviation Accident Database](#) link, and each accident's public docket is accessible from the [Accident Dockets](#) link for the Docket Management System. The safety recommendation letters referenced in this alert can be accessed from the [Safety Recommendations](#) link. This safety alert and others can be accessed from the [Aviation Safety Alerts](#) link.