Improving Safety for General Aviation
Adverse ceiling and visibility (C&V) conditions seriously test the general aviation pilot’s judgment. When deteriorating conditions go unrecognized, and the threat of a sudden drop in ceiling or visibility becomes alarmingly real, the pilot is all too often unprepared and unable to quickly identify an escape route. The threat and its consequences are further amplified when complex, rising terrain plays a role in the flight environment. Spatial disorientation, loss of control, controlled flight into terrain, and forced landings are some of the recurring consequences of C&V hazards. These hazards illustrate C&V’s overall role as a contributing factor in over 35% of all weather-related accidents in the U.S. civil aviation sector.

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Improved national-scale analyses and forecasts of C&V and new tools to present this to pilots, weather briefing staff and others are key to improving the C&V safety record.

Automated Ceiling and Visibility Products for the Continental U.S. and Alaska
Automated 24 h/day analysis and forecast products, content updates on the timescale of minutes rather than hours, and flexible web-based displays offer possibilities for advantageous guidance to the professional meteorologist and tailored products for the aviation end user. The NCV team conceives and supports a product family with these attributes and uses it to deliver current analyses and (in the near future) improved 1-10 hour forecasts of ceiling, visibility and flight category.

NCAR’s continental U.S. (CONUS) C&V analysis product displays current ceiling, surface visibility and flight category information based on real-time METAR and satellite data, registering any available sub-hour analysis updates every 5 minutes. The color-contoured display presents current conditions in terms of aviation-critical thresholds with options for user-selectable overlays of individual METAR values and cloud coverage.

NCAR is also developing a C&V analysis product for Alaska utilizing an approach that combines use of data from surface observations, weather cameras, satellites and models to help overcome data scarcity challenges in this region.

NCAR’s prototype 1-10 hour C&V forecast product (CVF) is being developed for CONUS airport locations. CVF is updated hourly as an optimized blend of independent forecast components including the RAP model, NWS LAMP operational forecasts, and NCAR regression-based statistical forecasts.

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While development of automated C&V systems has concentrated historically on areas over the U.S., these systems could also be adapted to operate over other geographical locations which are impacted by adverse C&V conditions, assuming there is adequate input data available from observations and model data.

**Field Research in Ceiling and Visibility**

Improved forecasting of ceiling and visibility conditions is critically dependent upon our understanding of the underlying physical processes at work. In past years NCAR has maintained a fully instrumented field site supporting ongoing studies of the formation and evolution of fog and low ceiling events. The site is located on the grounds of Brookhaven National Laboratory on east-central Long Island, New York. Research focused on the formation of fog of several types – including radiation, precipitation-related, and advection fog.

Instrumentation at the site included a vertical array of temperature, humidity and wind sensors from the base to the top of an existing 88 m meteorological tower. Visibility, temperature and moisture flux, radiation flux divergence, fog droplet size spectrum and other measurements were made at other levels. Surface instrumentation included a ceilometer and a profiling microwave radiometer. The site is co-located with NWS rawinsonde and NEXRAD operations which provided excellent supplementary information.

**Airport Terminal Area Ceiling and Visibility**

Adverse C&V conditions also impose critical restrictions upon the rates of traffic flow into and out of major airports across the country, and these restrictions, in turn, strongly affect the capacity and efficiency of U.S. air traffic as a whole.

NCAR staff worked with colleagues from MIT/Lincoln Laboratory to develop and display more accurate forecasts of operationally significant changes in ceiling height and visibility near major airports in the Northeastern U.S. This recent effort follows the 2004 completion of the San Francisco Marine Stratus Forecaster Display system, which provides forecasts of the time that low clouds and fog will clear the approach to the San Francisco Airport. The system was transferred to the NWS and is currently running operationally.

The San Francisco Marine Stratus Forecaster Display (above) is used operationally by the Center Weather Service Unit (CWSU) forecaster, WFO aviation forecaster, FAA traffic managers, and airline meteorologists. The left side provides displays of sensor data, used in the forecast models. There are four primitive forecast models and a consensus forecast. The right side provides the forecast information. The historical probability of success is provided as a measure of confidence in the consensus forecast.

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