Convective Weather Guidance for Aviation

Safety and Efficiency
Thunderstorms produce strong winds, turbulence, heavy precipitation, icing, hail and lightning, and significantly reduce the visibility. Every year these convective weather phenomena cause substantial delays, reroutes, diversion, cancellations, and accidents, costing the aviation industry billions of dollars and the traveling public much grief. Yet, the initiation, evolution and motion of thunderstorms are notoriously difficult to predict.

The manner by which weather is observed, forecast, disseminated, and used in aviation decision-making is of critical importance.

Research and Development
NCAR has been conducting research and developing systems aimed at improving prediction of thunderstorms and associated hazards on regional, national, and global scales. This work is supported by various agencies, including the Federal Aviation Administration’s (FAA) Aviation Weather Research Program (AWRP), the National Aeronautics and Space Administration (NASA), the National Weather Service (NWS), the Department of Defense (DoD) Army Test and Evaluation Command (ATEC), the National Science Foundation (NSF), and international governments.

Terminal Focus
THUNDERSTORMS AND WIND
Monitoring and prediction of the three-dimensional wind and temperature fields near airports has been difficult, especially for locations with marked land surface features like mountains or land/sea contrasts. NCAR has developed a sophisticated system (FINECAST) to obtain high-resolution, frequently updating, regional-scale analyses and short-term forecasts of thunderstorms and associated environmental conditions based on synthesizing Doppler radar/lidar data and surface network observations.

LOW-LEVEL WIND SHEAR
Low-level wind shear is a serious safety hazard for arriving and departing aircraft. NCAR has developed integrated solutions that detect hazardous wind shear and microburst events on airport grounds, and determine the strength in terms of head/tailwind gains or losses in relation to runways. Alerts are specific to each runway operation with a probability of detection of 90 percent or greater and a false alarm rate of 10 percent or less. A siting evaluation has to be done for each airport to determine the wind sensor network geometry for a low-level wind shear alert system (LLWAS), since it depends on terrain, number of runways, obstructions, etc. Terminal Doppler Weather Radar (TDWR) and other sensors may also be utilized for integrated wind shear detection systems.

LIGHTNING
Ramp closures are a necessity during thunderstorm and lightning impacts to ensure the safety of outdoor personnel servicing gate-side aircraft. Today’s ramp closure decision-
making process is burdened with uncertainty related to the procedures and their implementation, and the lightning data used to trigger ramp closures. NCAR has been developing algorithms to better diagnose lightning threats and prediction of such threats into the near future enabling more consistent and proactive ramp closure decisions. The BoltAlert™ system processes radar, temperature, and lightning data to derive statistically calibrated lightning probability and lightning safety guidance for specifiable locations.

**En Route Focus**

**THUNDERSTORMS**

NCAR has developed capabilities to identify thunderstorms and predict them into the future. TITAN is a simple and easy-to-use real-time algorithm for automated identification, tracking, and extrapolation of thunderstorms utilizing weather radar and satellite data, yielding short-term forecast of both storm position and size. TITAN builds the basis for several more advanced systems, like the AutoNowcaster/Trident system for predicting the location and intensity of heavy precipitation.

More advanced thunderstorm prediction further out into the future requires blending of heuristically derived short-term forecasts with longer-term numerical model predictions. NCAR has developed the state-of-the-art blending technique that provides a cornerstone for the FAA-supported CoSPA forecasts. The 3 km resolution CoSPA information is updated every 15 min and includes storm motion, growth and decay trends, and precipitation phase (rain, snow, mixed). Overlay of airspace information is available as well. Implementation of CoSPA-like thunderstorm prediction systems will help to reduce the impact of adverse weather on aviation.

**For More Information, Contact:**

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Satellite cloud image with deep convection identified (yellow/red) and lightning (cyan) overlaid.

Probabilistic prediction of expected capacity reduction hours in advance (left) and observed traffic impacts (right).

Web display of CoSPA analysis and forecast products, including select routes.

Past (yellow), current (cyan), and future (green) TITAN storm cell locations.