NCAR

Advanced Aviation Weather Decision Support System

Advancements in Aviation Weather

NCAR has more than twenty-eight years of experience developing advanced aviation weather products yielding fundamental improvements in the scientific understanding of aviation weather hazards as well as a broad array of practical tools and systems that reduce the vulnerability of aviation to such hazards.

It is designed as a weather briefing system, allowing end users to view multiple aviation weather products in plan view and along user selected flight routes and forecast times.

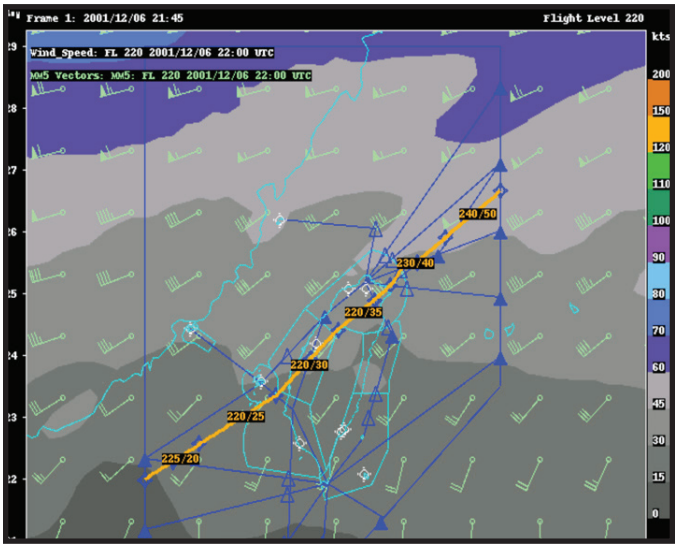
Since weather seriously impacts air traffic operations and the levels of service available to system users, the manner by which weather is observed, predicted, disseminated and used within air traffic decision processes and systems is of critical global importance. NCAR's work includes developing and implementing wind shear and turbulence alerting systems, four dimensional gridded aviation weather forecasting systems that include guidance products covering in–flight icing, turbulence, winds, temperatures, ceiling and visibility, and convective hazards. NCAR's international aviation weather research and development leverages aviation weather research conducted with Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) funding.

The AOAWS operational concept has been developed by coupling user requirements with current scientific and engineering capabilities.

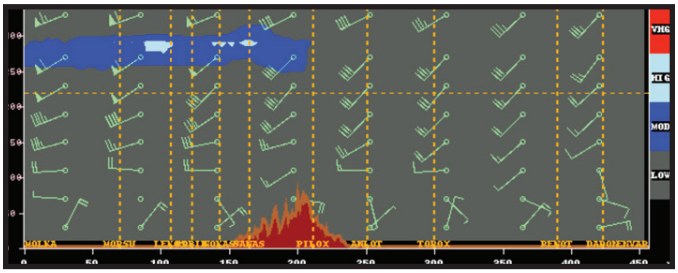
Comprehensive Decision Support

Beginning in 1998, NCAR teamed with the Civil Aeronautics Administration (CAA) of Taiwan to develop the Advanced Operational Aviation Weather System (AOAWS) to enhance operational safety, capacity and efficiency in the terminal and Taipei Flight Information Region (FIR). The AOAWS product suite is designed to aid both tactical and strategic decision making for the direct users of the system, specifically pilots, airline dispatchers, air traffic controllers, traffic managers, flight service specialists, and aviation weather forecasters. The system utilizes data from high-resolution weather models to generate analysis and prediction products such as in-flight icing, turbulence, ceiling and visibility, and thunderstorm identification and tracking.

The AOAWS aids both tactical and strategic decision making for direct users.



Plan view graphic of the winds at flight level 220 and along a user defined route of flight. Wind speed is color coded and the user selected flight route is highlighted.



Vertical cross-section of wind speed and turbulence intensity along a user selected flight route.

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Interactive display systems allow users to create customized graphics such as flight route specific products. The Java based Multi-dimensional Display System (JMDS) is designed as a weather briefing system as it allows end users to view multiple aviation weather products in plan view and along user selected flight routes. Features include product selection, time selection, animation, zoom, and pan. The AOAWS allows end users to instantly access aeronautical weather information quickly, efficiently, and for many products at high temporal and spatial resolution. The shared situational awareness across multiple user categories provided by this integrated system improves flight safety and enhances the efficiency of obtaining weather information.

Products available on the JMDS include:

- Turbulence
- Winds
- Temperatures
- Freezing Level
- In-flight Icing
- Ceiling and Visibility
- Flight Category
- Soundings (Model and Balloon)
- Lightning
- Surface Observations (METARS)
- Aircraft Reports
- Satellite Imagery
- Radar Echo Intensity
- Terminal Forecasts
- Upper Air Charts
- Significant Weather Charts

Aviation Weather Product Algorithms

The system utilizes advanced icing and turbulence diagnosis and prediction algorithms developed by NCAR for the FAA.

The Graphical Turbulence Guidance (GTG) product uses numerical weather prediction model forecasts to compute a number of turbulence diagnostics which are then weighted and combined. The relative weights for the combination are dynamically optimized for best agreement with the most recent available turbulence observations (in situ EDR data and pilot reports). This procedure allows the algorithm to minimize forecast errors due to uncertainties in individual diagnostic performance and thresholds.

The advanced aviation weather decision support system is designed to ingest standard and non-standard aviation weather datasets common to international aviation operations.

The NCAR Turbulence Detection Algorithm (NTDA) utilizes Doppler radar data – reflectivity, radial velocity, and spectrum width – to perform data quality control and produce atmospheric turbulence intensity (eddy dissipation rate, EDR) measurements of "in–cloud" turbulence. The expert system combines multiple modules for quality control and turbulence estimation to produce a final EDR and associated quality control index. By providing direct detection of turbulence, NTDA provides an important addition to radar reflectivity as an indication of in–cloud aviation hazards.

The Current Icing Product (CIP) combines sensor and numerical weather prediction model output to provide a three-dimensional diagnosis of the icing environment. The Forecast Icing Product (FIP) is similar to CIP except that it does not include the sensor inputs. CIP/FIP outputs include calibrated icing probability, icing severity, and potential for SLD (supercooled large drop - includes freezing drizzle and freezing rain).

Implementation

The advanced aviation weather decision support system is designed to ingest standard and non-standard aviation weather datasets common to international aviation operations. Tuning and refinement of the aviation impact products is often necessary to ensure they are performing optimally with the given input datasets, regional weather, geography, and environmental factors.

For More Information, Contact:

Bill Mahoney 303-497-8426 mahoney@ucar.edu
Matthias Steiner 303-497-2720 msteiner@ucar.edu
NCAR, Research Applications Laboratory
PO Box 3000 Boulder CO 80307-3000
www.ral.ucar.edu 303-497-8401 fax