NCAR | RESEARCH APPLICATIONS LABORATORY

WEATHER TECHNOLOGIES FOR THE

GLOBAL AVIATION SYSTEM

Safety & Efficiency

Understanding the aviation industry's sensitivities to weather and providing solutions to mitigate avoidable weather impacts on flight operations is our mission. We have been serving the commercial and general aviation communities for about four decades, including applying our aviation weather expertise to support emerging modes of aerial transportation like urban air mobility and unmanned aerial system operations.

AVIATION WEATHER RESEARCH & GUIDANCE

The current aviation weather research areas include scientific understanding and development of methods for diagnosis and prediction of weather-related safety and efficiency concerns resulting from ceiling and visibility; ground and inflight icing; snowfall and freezing precipitation; convective storms and oceanic weather; wind, wind shear, and atmospheric turbulence. In addition, research and development is focused on in situ and remote sensing algorithms; heuristic and numerical weather prediction; data assimilation; verification methods; and advanced dissemination technology to aviation stakeholders on the ground and in the air.

The assessment of the FAA's 18-month Remote Oceanic Meteorology Information Operational (ROMIO) demonstration revealed clear benefits of having real-time weather information in the cockpit of trans-oceanic flights. The shared situational weather awareness between the cockpit, airline dispatch, and air traffic control, created by the NCAR guidance products, leads to more effective collaborative decision making regarding proactive avoidance of convective storm hazards en route through strategic

Benefits & Impacts

- Applying basic research to real aviation challenges
- Public is safer & airlines run more efficiently
- Life-saving wind shear, lightning & convection alerts
- Icing & turbulence predictions
- Strategic weather avoidance

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rather than tactical aircraft rerouting maneuvers. It facilitates earlier detection of convective storms, smarter rerouting decisions, and better management of the cabin service that yield increased safety for crew and passengers (less injuries), minimized fuel burn (less pollution of the atmosphere), and ultimately substantial cost savings to airlines and society at large (estimated to be tens of millions of Dollars per year).

ICING PREDICTION

The In-Cloud Icing and Large-Drop Experiment (ICICLE) campaign conducted by the FAA early 2019 included 25 research flights with the Canadian NRC Convair 580 to deepen the scientific understanding of the thermodynamic and microphysical processes associated with hazardous inflight icing conditions, with a particular focus on super-cooled large drop (SLD) environments and operationally-critical transitions between SLD, small-drop and non-icing environments. Scientific analyses of the extensive dataset are underway. The knowledge gained from this wealth of data will help improve current and forecast inflight icing guidance products (CIP and FIP) developed by NCAR.

AVOIDING TURBULENCE

Research is underway to explore using Automatic Dependent Surveillance-Broadcast (ADS-B) reports to capture additional in situ turbulence sensing. This potential data source could provide two orders of magnitude more in situ turbulence reports compared to the current pilot reports (PIREPs) and in situ EDR reports and be highly beneficial to calibration and enhancement of the Graphical Turbulence Guidance (GTG) products. The research is focused on algorithm development for ADS-B data quality control, aircraft maneuver detection and mitigation, turbulence detection and scaling into an aircraft-independent metric (EDR). Initial results look very promising.

FUTURE AIR TRAVEL

NCAR is examining the weather challenges for and opportunities created by the emerging modes of air transportation, like unmanned aerial systems (UAS) and urban air mobility (UAM). This research includes assessing needed enhancements to the existing observing infrastructure for effectively guiding low-level flight operations in complex environments (like cities) and potentially equipping aerial vehicles with meteorological sensors to provide lacking observations in the atmospheric boundary layer. The meteorological data collected by the UAS or UAM are essential for situational weather awareness and operational safety, but also to initiate and validate micro-scale weather predictions. Developments are underway to create very fast, building (or complex terrain) resolving weather prediction capabilities. Moreover, we can demonstrate clear benefits from assimilation of the meteorological data collected by UAS during the 2018 International Society for Atmospheric Research using Remotely Piloted Aircraft (ISARRA) flight week into fine-scale weather predictions.

TECHNOLOGICAL CAPABILITIES

NCAR has developed multiple decision support capabilities for the aviation industry, including the Low-Level Wind-shear Alert System (LLWAS) to warn landing and departing aircraft of impacting microbursts; the Helicopter Emergency Medical Service (HEMS) tool to provide essential weather information in relation to terrain and key infrastructure (streets, hospitals, heliports, etc.) to meet the needs of low-altitude VFR emergency first responders and increasingly other operators; the Maintenance Decision Support System (MDSS) to provide guidance related to winter operations and treatment of roads and airport tarmac areas, and the Weather Support to Deicing Decision Making (WSDDM) and CheckTime to support aircraft deicing operations.

The Thunderstorm Identification, Tracking, Analysis, and Nowcasting (TITAN) and the Consolidated Storm Prediction for Aviation (CoSPA) to offer convective storm guidance for tactical and strategic air traffic management and planning; BoltAlert to provide alerts of imminent lightning hazards; and more. In addition, NCAR developed the Aviation Digital Data Service (ADDS) infrastructure, now hosted by the NWS Aviation Weather Center (AWC), that is operationally serving essential weather products like the Graphical Turbulence Guidance (GTG) and many others to the aviation industry. NCAR is a key player supporting the FAA in its development of next generation capabilities to effectively serve weather information via the Common Support Services – Weather (CSS-Wx) infrastructure. Moreover, NCAR has developed turnkey systems like the Juneau Airport Wind System (JAWS) in Alaska, the Wind-shear and Turbulence Warning System (WTWS) for Hong Kong, and the Advanced Operational Aviation Weather System (AOAWS) for Taiwan.

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