PROVIDING GO/NO GO WEATHER INFO TO AIR AMBULANCE PILOTS

CHALLENGE In 2006, the FAA required a review of rescue helicopter crashes. The review revealed that a lack of detailed weather information was often a factor.

SOLUTION Helicopter Emergency Medical Services (HEMS) - The HEMS tool is an extension of NCAR’s Aviation Digital Data Service (ADDS) which provides pilots easy-to-use web access to a variety of critical aviation weather information, such as ceiling, visibility, flight category, winds, icing severity, relative humidity, temperature, radar, satellite, etc.

BENEFITS The HEMS tool became operational at the Aviation Weather Center in 2015. User reports showed ambulance pilots rely on the HEMS tool to make quick, life-saving decisions.

IDENTIFYING + TRACKING THUNDERSTORMS

CHALLENGE When multiple thunderstorms are occurring, it’s hard for forecasters to keep track of the characteristics of each one (severity, hail potential, etc.) and where the storms are moving.

SOLUTION Thunderstorm Identification, Tracking, Analysis and Nowcasting (TITAN) System. NCAR developed TITAN to support research on thunderstorm morphology and rain production, but it was expanded to support aviation hazard prediction, rain augmentation studies, and hydrology. TITAN is installed at a number of sites around the world.

BENEFITS TITAN is used for meteorological and hydrological research, severe weather forecasting, precipitation analysis and conducting and evaluating weather modification projects. This technology is provided freely through a UCAR license.

SYNTHESIZING WEATHER INFO FOR PREFLIGHT PLANNING

CHALLENGE Pilots have an overwhelming amount of weather information to wade through and a lot of it is not tailored to a specific flight plan. A system that tailors the weather information and presents it in an intuitive manner and can deliver data to airline dispatch operations was required.

SOLUTION Aviation Digital Data Service (ADDS) - ADDS is well known within the aviation community for its innovative, user-friendly methods of presentation. NCAR combined its advanced gridded aviation products (e.g., icing, turbulence, convective hazards) along with the traditionally used aviation weather products, such as AIRMETs, SIGMETs and METARs into a single application.

BENEFITS Since 1996, pilots, dispatchers, the military, airlines, and airports have benefited from increased weather awareness because of the comprehensive weather information available on ADDS. Today, Operational ADDS is hosted at the National Weather Service Aviation Weather Center. This site gets an average of 10 million hits per day with major users being commercial airline and general aviation pilots.

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THE LEADER IN WEATHER RESEARCH + TECHNOLOGIES FOR THE GLOBAL AVIATION SYSTEM

One winter storm can cost airlines and stranded passengers nearly $200 million. Airlines pay, passengers pay and blood pressures sky rocket. Airlines pay in lost revenue due to refunds to fliers choosing not to rebook, paying the flight crews already in place, repeated aircraft deicing, etc. Passengers pay in rebooking fees, meals and lodging, and lost productivity.

Weather hazards such as windshear, turbulence, in-flight and ground icing and other phenomena are the number one cause of flight delays in the nation’s airspace system. While bad weather is inevitable and unavoidable, NCAR scientists and engineers have been dedicated to understanding and providing solutions to reduce those disruptions and costly hazards. Since the 1980s and its maiden field program studying microbursts, NCAR today has a proven track record of not only understanding the mysteries and challenges of the atmosphere, but providing advanced technologies and solutions to mitigate them. The flying public is safer and airlines run much more efficiently today, thanks to NCAR’s unique position of applying basic research to real challenges to the aviation system.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
Research Applications Laboratory
IDENTIFYING + ALERTING PILOTS OF TURBULENCE AT JUNEAU

**CHALLENGE** Pilots landing and departing from Juneau, Alaska face some of the nation’s most challenging conditions; the airport has a history of turbulence-related incidents involving passenger jets.

**SOLUTION** Juneau Airport Wind System (JAWS) - This project involved the development and implementation of sensing systems and turbulence alerting software. This role meant that the team would have to identify best placement of weather profiling stations in order to pinpoint areas of greatest turbulence, then design, build and maintain the sensor sites that provided information about wind speed, wind direction, air temperature, etc. JAWS was fully tested and put into operational use by the FAA in 2012.

**BENEFITS** JAWS allows aircraft to operate into and out of Juneau Airport in a safe and efficient manner. JAWS-like systems could be used at airports around the United States experiencing similar terrain-influenced turbulence. Plots flying into and out of airports located in Maui, Reno, and Las Vegas, and other sites in Alaska, for example, could benefit from JAWS technology.

**CALCULATING SNOW + ICING BEFORE TAKEOFF

**CHALLENGE** Snow and ice on a plane’s wings can prohibit it from gaining lift and taking off safely. Airlines and airport operations personnel need detailed information on the amount of ice and snow that can accumulate and dilute deicing fluid and how much time a plane can wait between deicing operations and takeoff.

**SOLUTION** Weather Support to Deicing Decision Making (WSDDM) - NCAR research found that the icing hazard for aircraft directly corresponds to the amount of water in the snow, rather than visibility. It is the latter that had traditionally been used to determine de-icing and take-off decisions. Refocusing on the amount of water in the snow, this finding led to the development of WSDDM.

**BENEFITS** WSDDM provides airline and airport operations personnel critical information on the timing and effectiveness of aircraft deicing fluids. Use of the system during de-icing operations has been shown to reduce end of runway deicing; a significant cost saving. United Airlines saved $1M in one snow event at Chicago’s O’Hare Airport.

REDUCING TURBULENCE-RELATED INCIDENTS

**CHALLENGE** According to a review of National Transportation Safety Board (NTSB) data from 1992 to 2001, turbulence was a factor in at least 509 accidents in the United States that resulted in 251 deaths in general aviation. Between 2002 and 2013, there were 430 passenger and crew injuries due to turbulence.

**SOLUTION** NCAR Turbulence Detection Algorithm (NTDA) and Graphical Turbulence Guidance Product (GTG) - NTDA was designed for use on the nation’s network of NEXRAD radars. It utilizes NEXRAD reflectivity, radial velocity, and spectrum width to produce atmospheric turbulence intensity measurements of “in-cloud” turbulence.

**GTG** predicts clear-air and terrain-induced turbulence. It uses numerical weather prediction model forecasts to compute turbulence diagnostics which are then weighted and combined and are dynamically optimized for best agreement with the most recent turbulence observations.

**BENEFITS** NTDA is operational on all NEXRAD systems. It reduces turbulence-related incidents by diagnosing the location of turbulence near storms. GTG is most useful for route planning, i.e., strategic avoidance of turbulence. It currently contributes to the nation’s airspace safety, capacity and efficiency.

RELIABLE DETECTION OF HAZARDOUS WEATHER

**CHALLENGE** The FAA NextGen program anticipates a significant growth in air traffic services in coming decades. The manner by which weather is observed, forecast, disseminated, and used in decision-making is of critical importance.

**SOLUTION** Consolidated Storm Prediction for Aviation (CoSPa) - Researchers and engineers integrated a set of different forecast models into a single comprehensive forecast prediction model to provide seamless 0-8-hour forecasts of convective hazards.

**BENEFITS** This CoSPa-funded project is a collaborative effort between NCAR, MIT-LL and NOAA-ESRL. Annual benefits to the national aviation system are estimated to be $27M.

FORECASTING HAZARDS FOR TRANSCOCEANIC FLIGHTS

**CHALLENGE** Remote, oceanic regions have severely limited data availability and therefore, have few, if any, high resolution weather products that indicate locations of convection. Convective hazards impact the safety, efficiency and economic viability of oceanic aircraft operations.

**SOLUTION** The NASA-sponsored Oceanic Convective Diagnosis and Nowcasting product, is an intelligent system that generates 0-2-hour nowcasts of oceanic convective hazard regions. Geostationary satellite imagery are used to define the locations of deep convective clouds in oceanic regions, through the weighted combination of three independent algorithms.

**BENEFITS** This product is uplinked to airline cockpits via electronic flight bag systems to support safe and efficient flight operations and rerouting decisions.

IN-FLIGHT ICING

**CHALLENGE** The NTSB and NASA’s Aviation Safety Reporting System quantified the number of in-flight icing related incidents from 2006-2010 and revealed 228 icing related incidents and accidents related to icing incidents occurring on the wings, fuselage or control surfaces. Reports showed that cruising aircraft were more likely to have ice buildup than in any other phase of the flight.

**SOLUTION** Our goal is a gridded depiction of icing conditions including probability, expected severity and supercooled large drop areas. The Current Icing Product (CIP) combines model output with real-time sensor data to provide a diagnosis of icing conditions across the CONUS. The Forecast Icing Product (FIP) uses model surrogates to provide a forecast one to 12 h. Components of the integrated algorithms are developed and evaluated prior to their inclusion. Verification is an important part of the development process, and is accomplished using pilot reports and data from research aircraft.

**BENEFITS** CIP and FIP are used for both flight planning and icing avoidance through uplink to cockpit display devices.