Winter Weather

Snowfall and Freezing Precipitation
The National Center for Atmospheric Research (NCAR) has a successful history of involvement with airport and aircraft operations dealing with the impact of snow and freezing precipitation. The operation of aircraft during these weather conditions can be a significant safety issue due to the rapid loss of lift and increase in drag produced by ice accreted on the aircraft. Snow and freezing rain accumulation on taxiways and runways also impact the safety and efficiency of ground operations. NCAR scientists and engineers developed a user-friendly, automated nowcasting system called WSDDM (Weather Support to Deicing Decision Making) to provide airport, airline, and air traffic users current and short-term forecasts of weather conditions, including the liquid-equivalent snowfall rate during winter storms. The system was demonstrated to users at Chicago and New York airports and is currently operational at Denver International Airport (DIA) and Minneapolis/St. Paul (MSP). It is available for purchase through Vaisala Inc. This work is sponsored by the Federal Aviation Administration’s Aviation Weather Research Program.

Recent winter weather achievements by NCAR scientists and engineers include:

- Implementation of the WSDDM at DIA in 2003. This system provides real-time winter weather information for operations at the airport.
- Development of a new algorithm to issue advisories for freezing drizzle, a potential hazard to jet engines awaiting departure, using the National Weather Service’s Automated Surface Observing System (ASOS) icing sensor.
- Development of a new algorithm called Check Time to calculate real-time holdover times based on one-minute snow and temperature data.

Weather Support to Deicing Decision Making (WSDDM)
The WSDDM system was developed through cooperative research and development programs with United Airlines, Delta Airlines, US Airways, DIA, Chicago O’Hare International Airport and the Port Authority of New York and New Jersey. WSDDM prototypes were demonstrated at each of these facilities in successive years, and system improvements were made based on the feedback gathered from users during each season. During the 1997-1998 winter season, the WSDDM system was also tested for usability, functionality, and reliability by the FAA’s Human Factors Laboratory. Since 1999, NCAR has been working to commercialize the proven WSDDM system products, while continuing to research and test new forecasting algorithms and weather products.

As little as 0.08 mm of ice on a wing surface can increase drag and reduce airplane lift by 25%.

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RAL has developed a new concept for ground deicing called Check Time. Check Time provides a deicing fluid specific wall clock fluid failure time for all aircraft on the field based on the actual one minute snowfall (or other precipitation) rate and temperature occurring at the airfield. If the time of the last step of deicing of an aircraft is before the wall clock Check Time, then the aircraft is within the estimated endurance time of the applied fluid. If, on the other hand, the time of the last step of deicing is beyond the wall clock Check Time, then the aircraft fluid may have failed, and needs to be “Checked”. This system was demonstrated to United Airlines (UA) staff at Denver International Airport and shown to be effective in optimizing aircraft deicing. United Airlines staff found the system to be useful in the following ways:

- Allowed UA deicing staff to quickly determine when to transition from a one-step deicing procedure (Type I only) to a two-step procedure (Type I followed by Type IV) based on increasing snowfall rates and consequently decreasing hold times.

- Allowed UA deicing staff to monitor the hold time status of all deiced aircraft prior to takeoff.

- Provided the ability to determine accurate real-time precipitation rates at night.

- Provided the ability to determine the weather conditions close to the location of deicing (Automated Surface Observing System (ASOS) sites are often miles away from the deicing location).

A WSDDM system was installed at DIA in April 2003 and provides real-time weather information for the City of Denver Operations at DIA. Products include NEXRAD radar data, storm tracks, current precipitation rates from a network of precipitation gauges, 60-min forecasts of precipitation rate, and alert information when icing conditions (freezing drizzle, freezing rain, freezing fog and frost) are being observed. Computers located at DIA ingest data from DIA-owned weather stations located within 100 km of the airport and provide displays of current and forecast weather to various operational facilities at the airport. The weather station data is updated every minute giving airport operations personnel the ability to observe and monitor changing weather conditions in real time.

This information is used to improve decision-making regarding aircraft deicing, runway plowing, and airport operations in winter weather. The system is also used to track thunderstorms during summer operations.

**Freezing Drizzle Detection System**

Using 1-min ASOS data from freezing drizzle events, an algorithm was developed that indicates not only when freezing drizzle occurs, but also the icing accretion rate during the event. Results from previous studies of the relationship between the rate of frequency decrease on the ASOS icing sensor and the accumulation of ice on horizontal surfaces are used in this algorithm as indicators of the instantaneous icing intensity and the total ice accumulation since the start of the event. This information is displayed as a part of the WSDDM system display at DIA. This experimental product is intended to augment the official NWS weather observation. During initial testing of the algorithm at DIA for the 2004-2005 winter season, United Airlines reported no engine damage to aircraft from freezing drizzle.

For More Information, Contact:
Scott Landolt
National Center for Atmospheric Research
Research Applications Laboratory
PO Box 3000 Boulder CO 80307-3000
303-497-2804
303-497-8401 fax
landolt@ucar.edu
www.ral.ucar.edu