Predicting In-flight Icing

Preflight de-icing is critical to safe winter air travel. But once an airplane is in flight, cold, wet air can cause fresh sheets of ice to form on a plane’s wings, air intakes, and control surfaces, creating dangerous conditions that have been blamed for the deaths of close to 100 air passengers since 1994.

A team at NCAR’s Research Applications Laboratory is working with the NASA Glenn Research Center in Cleveland to make better icing forecasts so that pilots can be warned away from treacherous areas. They are putting their predictions to the test in a NASA Twin Otter turboprop airplane, flying through clouds with high icing potential and comparing the accuracy of their forecasts with their own observations of ice build-up on the wings.

Icing occurs when supercooled water drops adhere to an aircraft wing and freeze (supercooled drops are liquid even though the temperature is below 32°F, or 0°C). When ice builds up on the wings of an aircraft, it can simultaneously slow velocity and decrease lift, potentially sending a plane into a catastrophic dive. The challenge for the forecasters is to locate the “Goldilocks” region, where conditions are just right for icing to take hold. A few degrees too warm, and the water drops won’t freeze on the wings of an aircraft; a few degrees too cold, and the water drops will turn into ice crystals or snow instead. The research will help pilots plan their flights safely and guide the manufacture of new devices to protect wings from large-droplet icing.

Researchers found that the fraction of global land experiencing very dry conditions rose from about 10-15 percent in the early 1970s to about 30 percent by 2002. Even as drought has expanded across Earth's land areas, the amount of water vapor in the air has increased. The average global precipitation has also risen slightly. But the faster evaporation that comes with hotter temperatures more than makes up for the extra moisture.

In the long term, drought can lead to famine and disease epidemics. More immediately, shortages of food and drinking water can lead to poor nutrition and faster spread of infection. Europe and Asia, Canada, western and southern Africa, and eastern Australia are already experiencing very dry conditions. Thanks to increased precipitation, the United States has actually bucked global trend, with soil moisture increasing, especially between the Rocky Mountains and Mississippi River.


Drought Linked to Global Warming

The percentage of Earth's land area stricken by serious drought more than doubled between the 1970s and the early 2000s, and global warming may be to blame. A team of NCAR and university scientists found that almost half of the increase in global drought is due to rising temperatures, which force faster evaporation, rather than decreases in rainfall or snowfall. Their research was funded by the National Science Foundation.

http://www.ucar.edu/communications/staffnotes/0412/ice.html

HIAPER Aircraft Cleared for Take-Off

A new research aircraft will take to the skies this spring. After six years of planning and engineering, the High-performance Instrumented Airborne Platform for Environmental Research, or HIAPER, is ready to be delivered to Colorado’s Jefferson County Airport. The most ambitious community project in NCAR history, the modified Gulfstream V jet is designed to meet the environmental research needs of the nation over the next several decades.

Once the aircraft is delivered, NCAR engineers will work with subcontractors to install the communications systems that will complete HIAPER’s transformation from corporate jet into premier research instrument. Able to climb to an altitude of 51,000 feet, the NSF/NCAR craft will allow scientists to study the upper edges of hurricanes and thunderstorms using state-of-the-art sensors, probing the dynamics that drive these powerful storms. A 7,000 mile range will give HIAPER access to the South Pole from bases in South America or New Zealand and will enable it to track atmospheric particles across the oceans. Once preliminary science experiments are completed, HIAPER flight time will be open to competitive proposals from researchers across the geosciences.

http://www.hiaper.ucar.edu/
Translating Climate Change to Alaskan Native Cultures

Over the past 30 years, Alaska has observed more drastic temperature changes than any other part of the world, warming at a rate twice the global average. The effects of this warming, including coastal erosion, more frequent storms, melting permafrost and higher sea levels, are impacting natural habitats and human settlements. Major ecological impacts, including species disturbances, migration of plant species, and widespread retreat of glaciers, have also become facts of life for Alaskans. Researchers from NCAR’s Institute for the Study of Society and Environment (ISSE) are teaming up to help Alaskan communities understand and cope with the effects of climate change in the state.

Determining the effect of climate change on the local level has become one of the priorities of the Intergovernmental Panel for Climate Change (IPCC) and other national and international assessment efforts. ISSE researchers have partnered with Native communities to integrate western science with indigenous knowledge and Native observations of climate change. They have also worked to support local decision-making processes on the Alaskan North Slope, where ice is vanishing and sea levels are rising, by modeling storm surges, sea ice variability, and coastal erosion.

The ISSE team is currently developing an interdisciplinary research project which will consider how communities adapt to sea level rise, and how those strategies are limited by physical, economic, social, ecological and political factors. They will take as case studies not only Alaska, but California, Hawaii, the East Coast states, and states bordering the Gulf of Mexico.

http://www.isse.ucar.edu/alaska/index.html

Shutting Down Hackers: NCAR Organizes Cybersecurity Summit

In response to a major cybersecurity incident that involved multiple high-performance computing centers, universities, and national laboratories across the U.S. and Europe last year, NCAR organized a two-day workshop that involved computer experts from some of the nation's top research institutions to share information and develop strategies to better protect the nation’s scientific computing enterprise.

Sponsored by the National Science Foundation, managers, software engineers, and administrators of high-performance systems and networks gathered at the workshop as a first step creating a trust network that could be used in the event of future large-scale security breaches, reducing the disruptive impact of such incidents on the nation’s research agenda. Increased cooperation among research institutions on security policies, procedures, and incident response will better protect the integrity of the nation's scientific computing and data assets without sacrificing an open, collaborative research environment.


The Airplane Engine That Could: Avoiding Drizzle Damage

Heavy freezing drizzle can cause as much as $2 million in aircraft engine damage in a single night. Unlike light drizzle or freezing rain, freezing drizzle gets sucked into the engine, where it turns to ice and accumulates on the engine’s hub, or spinner. When the engine is revved up to takeoff speed, ice shards are thrown off the spinner into the rest of the engine, where they can bend delicate fan blade tips. Though the problem has a simple fix—revving the engine frequently while idling to break up the ice—the trick for airport meteorologists is discerning heavy freezing drizzle from its relatively harmless cousins. With only their eyes to rely on, meteorologists routinely mistake heavy drizzle for light drizzle, at a cost of millions of dollars to the aviation industry.

Using an existing National Weather Service ice-detection instrument, an NCAR researcher has developed a new system to identify the drizzle accurately. Airlines have already revised pilot training and on-ground procedures thanks to this research, and this winter, this detection method will become part of the Weather Support for Decision Making (WSDM), a system now in use at Denver International Airport that offers minute-by-minute weather reports tailored to aviation users. WSDM data are displayed in a color-coded, user-friendly format that can be easily read by pilots and other non-meteorologists.

This system was developed with support from the Federal Aviation Administration's Aviation Weather Research Program.


UCAR is a consortium of 68 research universities in the United States and Canada with doctoral programs in the atmospheric and related sciences. Through the contributions of each member, and primary sponsorship from the National Science Foundation, UCAR oversees a wide range of basic and applied research programs and facilities that help to build and strengthen partnerships among the universities, national laboratories, federal agencies, industry and policy makers. UCAR manages and operates the National Center for Atmospheric Research and the UCAR Office of Programs. For more information on these stories, contact Laura Curtis: lecurtis@ucar.edu.