NCAR | RESEARCH APPLICATIONS LABORATORY

WEATHER GUIDANCE FOR

ADVANCED AIR MOBILITY

Specialized Guidance

NCAR's Aviation Applications Program is committed to enabling the safe integration of Advanced Air Mobility (AAM) into the National Airspace. In support of developing the UAS (Uncrewed Aircraft System) Traffic Management (UTM) systems and Urban Air Mobility across the country, NCAR is coupling the latest weather technologies with new algorithms that translate detailed micro-weather information into specific autonomous aircraft performance impacts. This capability can be tailored for specific UAS applications and AAM operations to aid in both flight planning and in-flight decision making.

WEATHER IMPACTS ON ADVANCED AIR MOBILITY

AAM includes a suite of uncrewed aircraft ranging from small UAS (package delivery systems weighing less than 55 lbs) to electric Vertical Takeoff and Landing (eVTOL) cargo and passenger transport vehicles. Commercial operation of both types of autonomous aerial systems are expected to continue to grow over the next decade. Both operations are more susceptible to low visibility, icing conditions, winds, and turbulence than larger commercial aircraft. Sudden changes in wind speed and direction can render small UAS unrecoverable if the resulting head winds exceed performance characteristics. At the same time, unexpected turbulence and complex wind flow patterns through an urban landscape can render these systems unflyable. For the next generation of air taxis, passenger comfort is an important consideration; thus, knowledge of the location of smooth air corridors can provide a competitive advantage to air service providers.

Benefits & Impacts

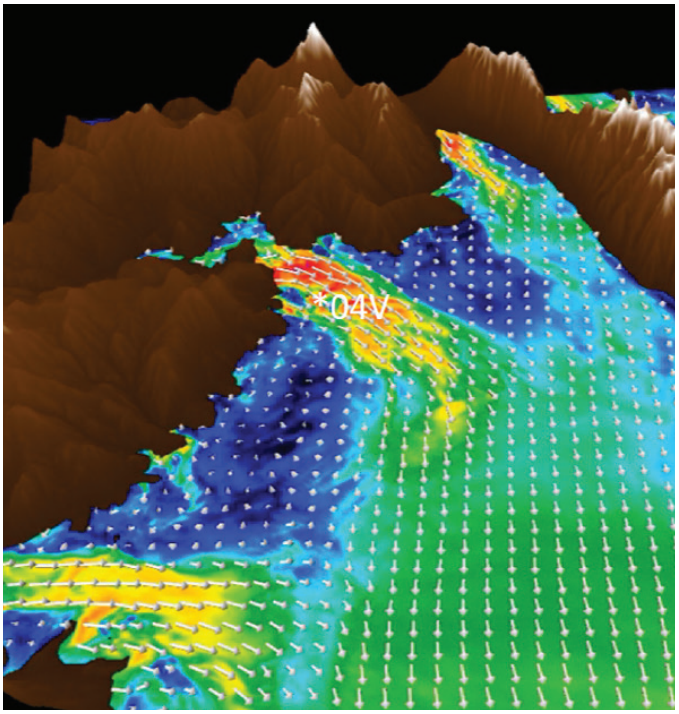
- Real-time, high-resolution weather guidance
- Wind & turbulence within urban landscapes
- Advanced air mobility weather hazard detection
- Web-based displays & standard data formats

ral.ucar.edu
@NCAR_RAL
info@ral.ucar.edu

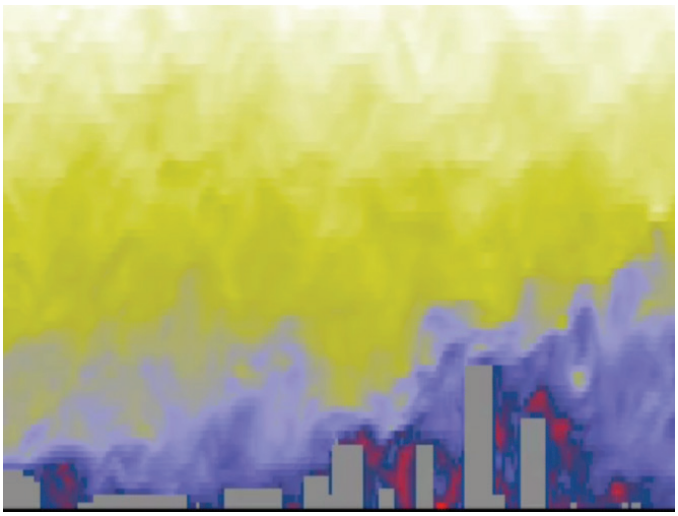
MEETING WEATHER NEEDS

NCAR is uniquely positioned to support AAM with actionable weather guidance based on its four decades of experience with aviation weather and advanced weather prediction capabilities. NCAR's scientists and engineers have been developing and demonstrating high-resolution weather analysis and forecasting capabilities to capture the fine-scale weather phenomena prevalent in complex terrain as well as urban landscapes, and near major water bodies that pose unique weather challenges. Moreover, through close collaboration with the aviation industry, the detailed weather guidance can be translated into weather impacts for specific types of AAM operations. This detailed location and time-specific guidance can be utilized to inform operational decisions towards minimizing avoidable impacts.

NCAR recently demonstrated a real-time UAS weather hazard guidance system to support small UAS flight operations in the San Luis Valley in Colorado. Using a modified version of the Weather Research and Forecasting Large-Eddy Simulation (WRF-LES) model, NCAR produced forecasts of UAS flight hazards (e.g., ceiling, visibility, turbulence and thermal intensity and vertical wind shear)



Prediction of low-level winds in complex terrain using a large eddy resolving model



Wind speed variations between buildings using GPU-based FastEddy® model

to support UAS flight planning. Validation studies showed that the fine-scale flow structures that can impact UAS performance and geo-fencing requirements (e.g., thermals, horizontal rolls) were accurately predicted during that demonstration.

In addition, NCAR has developed a building-resolving GPU-based LES system (FastEddy®) that can provide guidance on low clouds, fog, winds and turbulence within an urban landscape. These advanced weather hazard guidance systems continue to be evaluated and expanded. Current research activities include efforts with the Choctaw Nation in Oklahoma, CVG Airport near Cincinnati, and NOAA near Crested Butte, Colorado, as well as the Dallas/Fort Worth metropolitan area. Concurrently, studies are ongoing to evaluate the benefits of utilizing UAS weather observations to enhance forecast skill. Results clearly demonstrate the value of assimilating UAS weather observations for more accurate predictions of winds and other UAS hazards, thus revealing the possibility of UAS being able to help improve their own weather guidance!

NCAR's Aviation Applications Program has been a leader in developing aviation weather solutions for four decades and demonstrated how it can leverage this expertise to develop new weather guidance that is tailored for the safe and efficient integration of AAM into the National Airspace System.

UAS MICROWEATHER
ral.ucar.edu/uas

This material is based upon work supported by the National Center for Atmospheric Research, a major facility sponsored by the National Science Foundation and managed by the University Corporation for Atmospheric Research. Any opinions, findings and conclusions or recommendations expressed in this material do not necessarily reflect the views of the National Science Foundation.