NCAR | RESEARCH APPLICATIONS LABORATORY

Science Serving Society

No matter the meteorological challenge, our goal is to advance understanding of the atmosphere and deliver science-based information and tools to end users and the broader public in the name of improving safety, health, and well-being of society. From airline pilots, to truck drivers, to energy managers, to healthcare workers, to emergency managers to troops protecting the nation, experts at NCAR's Research Applications Laboratory are committed to supporting all community sectors to meet meteorological challenges with creative, practical solutions. At RAL, scientists and engineers innovate solutions that directly serve society. We conduct directed research and engineering to address challenges to human and environmental well-being, and facilitate the transfer of our information, expertise, and technology to decision makers.

AVIATION SAFETY

Aviation safety has improved dramatically since the discovery of low-level wind shear, once responsible for hundreds of airplane fatalities. Our research engineered ways to detect and warn pilots of this hazardous phenomenon so they can steer clear of danger. But our aviation safety work wasn't finished. Further research found ways to discern and address other hazards that threaten aviation safety. Diagnosing and predicting turbulence, icing, visibility, and thunderstorms give air traffic controllers and airlines valuable planning windows, as well as the decision-making tools to avoid these hazards.

Benefits & Impacts

- Collaborative research, development, and technology transfer
- Innovating solutions to society's critical challenges
- Science that protects and improves lives, property, and well-being

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HIGH-IMPACT WEATHER

Hurricanes, wildfires, and extreme weather events devastate lives and property. Dramatic storm surge, sea-level rise, flash flooding, and extreme heat/droughts sustain the assault long after the weather moves out. Even the best forecasting fails if the public doesn't understand the consequences. Our scientists are teaming with our partners and local communities to improve risk messaging through animated graphics and mapping tools, clearer wording used by the media for alerts, and public education.

TAILORED MODELS

Uniquely designed models form the foundation of our forecasting tools. We refine these models with machine-learning methods, meso- to microscale numerical weather prediction, large-eddy simulation (LES) acceleration using graphical processing units (GPUs), and tuned physics schemes. Our specialized models include Hurricane WRF (HWRF), WRF-Fire, WRF-Urban, WRF-Crop, WRF-Solar®, and WRF-Hydro®, and FastEddy®.

HUMAN HEALTH

It is no surprise that heavy air pollution causes lasting health damage. Highly toxic air levels can be as dangerous to humans as the effects of heavy smoking. Our scientists have developed an air-quality forecasting system that local authorities can use to alert residents of New Delhi about poor air quality days. Although we can't improve the air quality yet, we can advise residents to stay indoors, reschedule activities, and take precautions to protect their health. We also study the connection between weather and climate and spread of vector-borne diseases, such as zika, dengue, and meningitis. For example, we have designed a system to issue 14-day predictions of atmospheric conditions related to disease spread using computer models, local observations, and satellite data. Mapping discrete locations of populations most vulnerable to extreme heat or storm-surge events informs decision makers how to best alert people to hazards, and communicate helpful resources.

NATIONAL SECURITY

Atmospheric releases of hazardous materials, either accidental or intentional, pose a viable threat to both United States citizens, as well as to citizens and troops abroad. To counter this threat, we are actively researching and developing novel techniques and systems that can more accurately simulate the atmospheric state and evolution of the released material in both time and space. The capability to model and visualize biological or chemical threat is critical for emergency planning, real-time response, and forensic purposes.

RENEWABLE ENERGY

Broadening the options for alternative energy sources is essential for the global community to maintain robust, cost-effective, and reliable power grids. Public and private electric utility managers use our forecasting tools to efficiently and economically incorporate solar and wind power into their energy portfolios. The research strides we've made help predict solar and wind events. The power generated from these sources is now more reliable, which moves the world's communities closer to achieving their renewable energy goals.

WATER RESOURCES

We develop the technologies used for delivering relevant and timely information about the world's complex water system, assisting water-resource planners and managers to address issues such as water supply, flooding, droughts, reservoir operations, emergency response, to name just a few. Our directed research and development, including several robust decision-support tools in hydrometeorology, aerosol-precipitation interactions, short-term precipitation nowcasting, cloud microphysical modeling, winter weather, and observational networks, are being implemented and deployed in countless arenas by researchers, water resource utility managers, and decision makers worldwide.

OUTSMARTING THE WEATHER

Our exciting research, development, and applications contribute value to the atmospheric science research community, and the capabilities we continue to innovate support the global weather, water, and climate enterprise. There is more work ahead, but with rapidly emerging tools and faster, more powerful computers and models, we will meet these societal challenges persevering in our mission to solve problems and improve lives. This is the essence of actionable science.

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