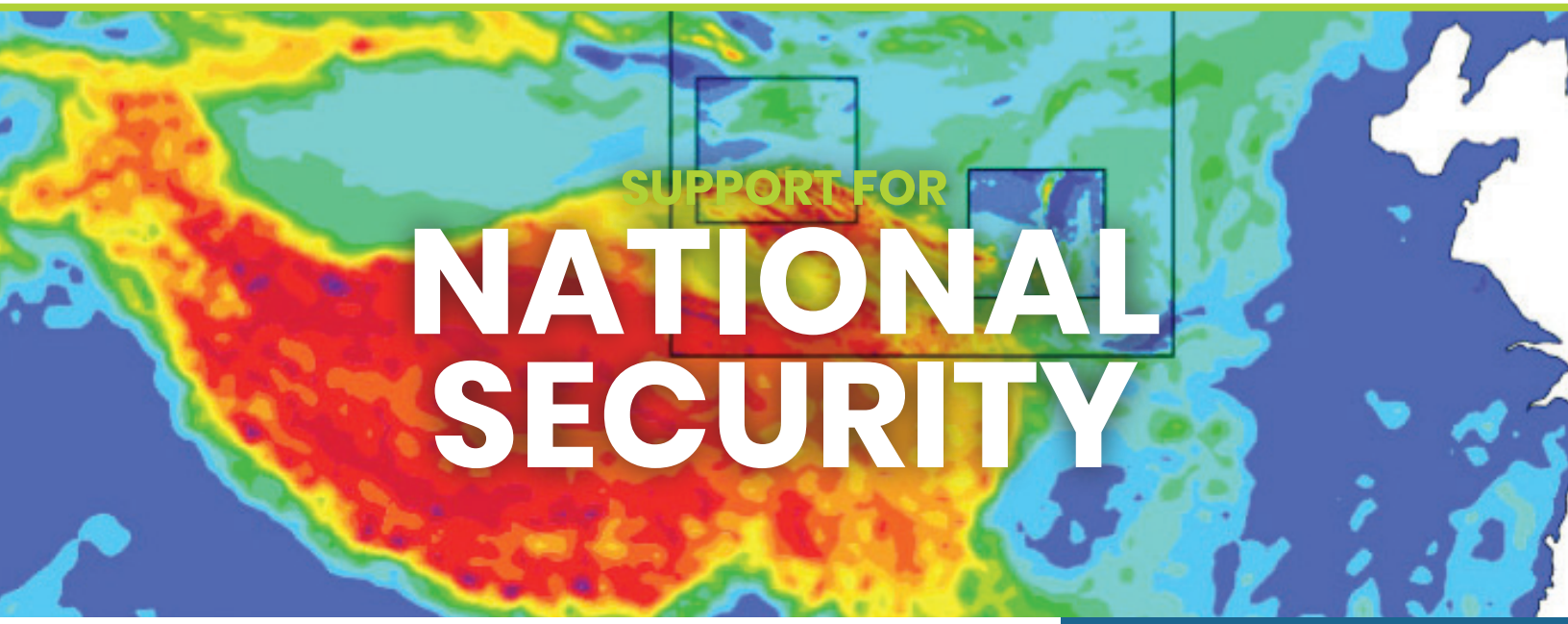
NCAR | RESEARCH APPLICATIONS LABORATORY



SUPPORT FOR

NATIONAL SECURITY

Life-Saving Capabilities

RAL's work significantly advances our understanding of mesoscale and urban-scale weather and climate processes, especially in the boundary layer, and our ability to forecast these atmospheric conditions operationally for the purpose of providing forecasters, decision makers, and emergency managers with accurate information to save lives and property.

NATIONAL SECURITY

Protecting society from a biological or chemical attack is a problem that is difficult to grasp, much less solve. The National Center for Atmospheric Research (NCAR) has joined with other agencies to develop new technologies that make our communities less vulnerable to such attacks and reduce the harm if one occurs.

Numerical weather prediction (NWP) models that predict local weather and models that simulate toxic plumes are generally not tailored to provide the right information quickly enough for first responders and other people who must make critical decisions in emergencies. Operational NWP models lack the resolution and input data to accurately predict the movement and location of a toxic plume during the next 30 minutes to an hour. Research shows that employing less standard observations, such radar- and lidar-derived winds, can make models more accurate at fine scales, increasing the chances that first responders can evacuate citizens out of harm's way. Additionally, first responders need to receive this critical information within a few minutes on scene, rather than to have it interpreted by another party at intervals of several hours who then relay interpretations to decision makers, as is done today.

Benefits & Impacts

- Providing regional climate information
- Predicting fine-scale weather & climate processes
- Predicting direction of toxic releases
- FastEddy® is a GPU-Accelerated microscale model

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

4DWX

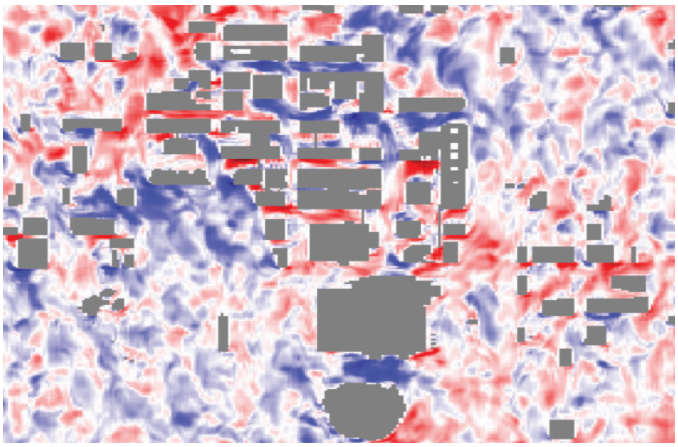
The Four-Dimensional Weather System (4DWX) is the culmination of nearly two decades of research and development sponsored mostly by the U.S. Army Test and Evaluation Command (ATEC). The system is used for operational forecasting and analysis at eight Army test ranges spanning nearly as many climate zones. With 4DWX, forecasters at the ranges can provide customers with more accurate guidance, making their work safer, more efficient, and more cost-effective.

Aside from operationally supporting the test ranges, the 4DWX system has been applied for other purposes:

- Analysis of potential exposure of U.S. troops to nerve agents during the Gulf War
- Consequence assessment for counter-proliferation mission-planning in Afghanistan and Iraq
- Anti-terrorism support for the 2002 Salt Lake City Olympics and 2004 Summer Olympics in Athens
- Urban-scale modeling in Washington, D.C. and Oklahoma City
- Protection of the Pentagon and surrounding regions
- Supporting firefighters in Colorado and Arizona during wildfire season

SOURCE TERM ESTIMATION (STE)

When analyzing the effects of hazardous airborne materials, we often do not know the composition of a material, where it originated, and how it was released. STE applies a variety of algorithms to the latest numerical weather prediction and transport-and-diffusion models to help emergency managers reconstruct a release, and to develop a better situational awareness of how a population was exposed. Following the devastating earthquake and tsunami that severely damaged the nuclear power plant in Fukushima, Japan, an unknown quantity of radioactive material was released into the air and the water. To help reconstruct and study the disaster, NCAR led an international workshop under National Science Foundation sponsorship



Wind speed variations between buildings using GPU-enhanced FastEddy® LES

to explore current STE approaches, the available data, and how the current state of the science can be extended to unravel the complex disaster at the Fukushima Daiichi plant. Information is available online at www. ral.ucar.edu/nsap/events/fukushima. Results from the workshop are being compiled and documented so the scientific community can develop and enhance technologies that could be used in the wake of similar disasters in the future.

FINE-SCALE CLIMATOGRAPHIES

Mesoscale analyses of current climates can be used for many purposes, such as optimal siting of wind-energy farms and airports, calculating the most probable direction of the transport of hazardous material at some future time, and scheduling events that require certain weather. To construct such climatographies for the many areas of the world where there are few routine four-dimensional (4D) observations of the atmosphere, RAL developed a Climate Four-Dimensional Data Assimilation (Climate-FDDA) system that uses the WRF model to downscale present-day climates from archived global analyses.

The Climate-FDDA system generates a 4D description of the diurnal and seasonal patterns of regional and local atmospheric processes, with a focus on the boundary layer. Unlike point measurements, the gridded fields define coherent multidimensional realizations of complete physical systems. Not only does the Climate-FDDA system define mean values of variables as a function of season and time of day, it estimates extremes and characterizes typical weather.

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