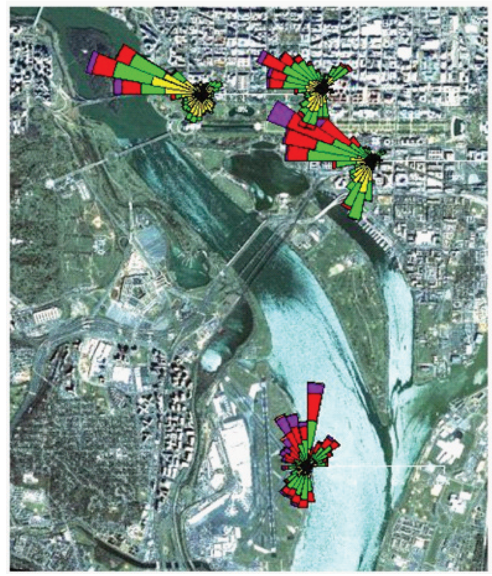
Air Resources Laboratory
Boundary Layer and Surface Exchange Research and Development

What We Do

The Air Resources Laboratory (ARL) uses state-of-the-art methods and techniques, and develop new ones as necessary, to better understand and model the atmospheric boundary layer (the portion of the atmosphere closest to and most influenced by the Earth's surface). ARL's work improves the prediction of surface and near-surface weather and climate conditions. The primary boundary layer research areas ARL is focused on are DCNet, Extreme Turbulence Probe, and the Surface Energy Budget Network.

<u>DCNet</u>

ARL has been operating an intensive urban research meteorological network within the National Capital Region, called DCNet, since 2003. The network consist of 15 stations, most of them on building rooftops, which collect not only the standard meteorological parameters but also measure characteristics of atmospheric turbulence. DCNet provides critical data and insights that improve the predictions of where hazardous materials will go; thus improving an emergency manager's ability to protect first responders and the public.



High quality wind data from the DCNet meteorological towers are used to drive computer models to better predict movement of hazardous substances and to track severe weather. (image: NOAA)

With a strong focus on data quality, DCNet is designed to support development of urban monitoring methodologies and observation standards, evaluation of the utility of using private meteorological observing networks within urban environments, and to provide an intensive dataset for model evaluation and initialization, process studies, and decision support. While a research network, DCNet observations are used by numerous government security and emergency management activities within the National Capital Region.

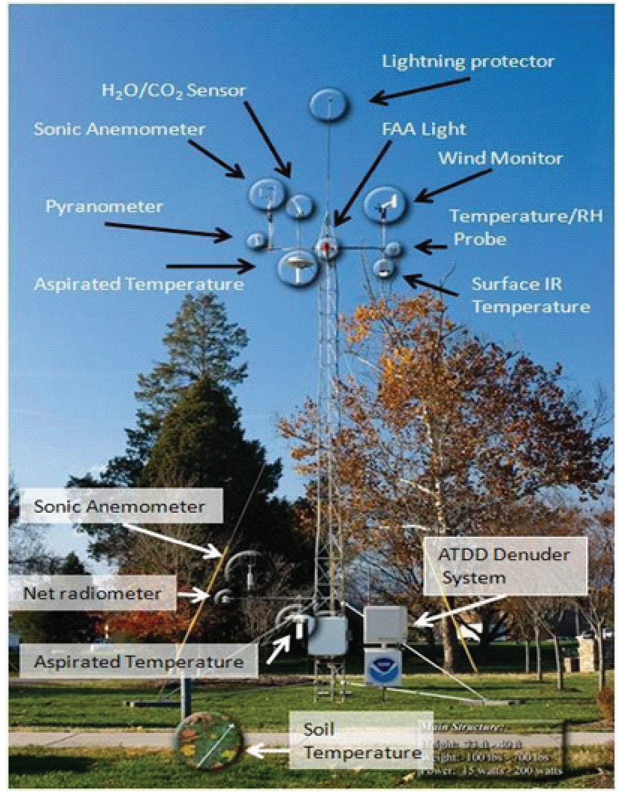
ARL scientist deploying an ET Probe on a tower at the end of a 560 meter long pier in Duck, NC during August 2009. (image: NOAA)

<u>Extreme Turbulence (ET) Probe</u>

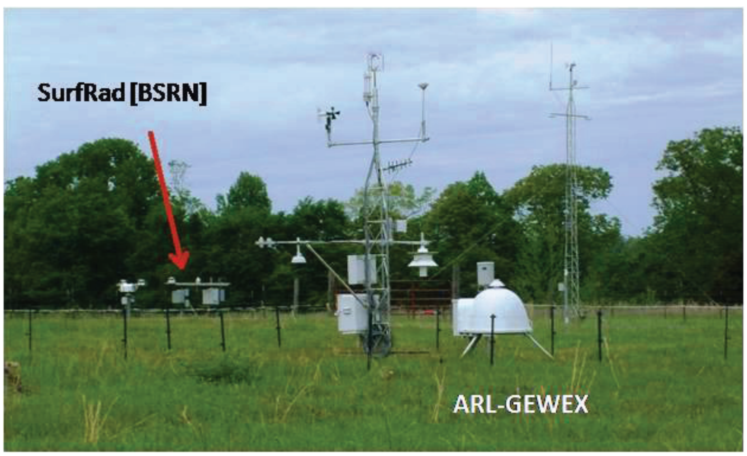
ARL designed and developed the ET Probe to measure winds, turbulence, and air-sea fluxes in conditions with rain and high-winds, such as those encountered in hurricanes. The ET Probe is basically an aircraft gust probe that has been adapted for use at a fixed surface location in high winds. It has special modifications to mitigate the effects of rain and spray on the wind data. The ET Probe has been successfully deployed on land in advance of hurricanes to measure details of wind gusts and turbulence. ARL is currently developing a version that could be placed on buoys for several months. The intent is to eventually allow the probes to be placed in open water in areas likely to be hit by a hurricane. This would enable the collection of information on the exchange of energy between the ocean and the atmosphere in a hurricane, which is a poorly understood but an important factor in hurricane intensification.

<u>Surface Energy Budget Network (SEBN)</u>

ARL cooperates with NOAA's Earth System Research Laboratory to measure all types of significant energy fluxes at the air-land interface to improve understanding of the Earth's surface energy balance. It is this balance that drives weather, climate, and ocean circulation, and therefore must be accurately reproduced in climate models in order for decision-makers to make sound choices regarding environmental and economic policy. Accurate understanding and simulation of this balance is also important for weather prediction, including short-term and seasonal predictions of water resources. The SEBN is a consolidation of several independent but closely related observing systems into a single, cost-effective and efficient network and seeks to explain *why* climate variables (e.g., air temperature, precipitation) have changed. Data, which includes the input of moisture and heat to the atmosphere, are used by NOAA scientists to provide detailed examination of the land-surface feedbacks and related radiative processes that can drive regional climate. Currently, NOAA has seven SEBN stations in operation with a plan that calls for an additional thirteen stations to cover representative eco-regions (forests, grasslands, crops, etc) in the U.S.



ARL's Surface Exchange System at the Atmospheric Turbulence and Diffusion Division in Oak Ridge, TN. (Image: NOAA)



A Surface Energy Budget Network Station at Goodwin Creek, MS showing the Surface Radiation (Baseline Surface Radiation Network) equipment (left) and the ARL-Global Energy and Water Cycle Experiment (GEWEX) equipment (right). (Image: NOAA)

Why It Is Important

The boundary layer is the mixed layer of the atmosphere closest to the ground, basically where people live, work, and play. As such, it has a significant influence on a number of important atmospheric and environmental issues. These include dispersion of airborne hazardous materials, low-level winds and turbulence which affect wind energy production and transportation, initiation of convection which affects aviation, evolution of hurricanes, air quality, regional climate changes, the transfer of compounds between land/water and the atmosphere, and the behavior of wildland and agricultural fires and the smoke they produce. ARL's boundary layer and surface exchange research and development provides essential information and tools for improving the characterization and prediction of those issues. These benefits are driven by improved understanding of key boundary layer processes and model algorithms and analysis of long-term trends.

For More Information:

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ET Probe: www.noaa.inel.gov/capabilities/etprobe.htm
SEBN: www.atdd.noaa.gov

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