Outstanding Accomplishments in Research

Weather Observing Technologies

Research is at the center of all NOAA services. NOAA's Office of Oceanic & Atmospheric Research (OAR) helps improve weather forecasts, and enhances navigation and aviation safety, as well as a variety of coastal services.

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NOAA's life-saving weather services begin with NOAA research. NOAA researchers and partners are developing observing and forecasting technologies to improve forecast accuracy and hazardous weather warning lead times, which can save lives, protect property, and enhance the economy.

Polarimetric Radar Improves Precipitation Estimates

The National Severe Storm Laboratory (NSSL) in Norman, OK, developed a prototype radar with better capabilities for rainfall estimation and precipitation classification. NOAA Research expects Polarimetric Radar to provide two to four times the improvement in precipitation estimation accuracies. Single polarization radars, such as the existing WSR-88D NEXRAD radars, transmit and receive only horizontal polarizations. Polarimetric radars transmit and receive both horizontal *and* vertical polarization radio wave pulses, enabling measurement of both the horizontal *and* vertical dimensions of cloud and precipitation particles. This upgrade to NEXRAD Doppler radar provides information about precipitation in clouds to better distinguish between rain, ice, hail, and mixtures. This will help forecasters provide better warnings for flash floods, the number-one severe weather threat to human life. Polarimetric radar is currently scheduled for deployment on the national WSR-88D network at the end of the decade.

Phased Array Radar Speeds Scanning

Early tests of the Phased Array Radar (PAR) system by NSSL, working with private sector partners, including Lockheed Martin, show that this innovative technology, developed by the Department of Defense, has the potential to vastly improve upon the capabilities of the national NEXRAD radar network for all weather radar applications. Tests demonstrated a complete volume scan around the Multi-functional Phased-Array Radar can be obtained in less than one minute, while the current NEXRAD radar takes five to six minutes for such a scan. This technology has the potential to increase the average lead time for tornado warnings well beyond the current average of 13 minutes.

Phased Array Radar, National Severe Storms Laboratory, Norman, OK

GPS Used to Measure Water Vapor, Improve Weather Forecasts

Scientists at the Earth System Research Laboratory (ESRL) in Boulder, CO, developed a new technology that uses Global Positioning System (GPS) signals to continuously measure the total amount of water vapor in the atmosphere. Real-time GPS-based data can be used to improve forecasts of relative humidity and other weather variables, track climate change, calibrate satellite instruments, and provide new opportunities for atmospheric research. NOAA's National Weather Service has incorporated the data into two of its primary operational forecast models and similar systems have followed NOAA's lead in Canada, Europe, and Japan.

Radio signals emitted by GPS satellites for positioning purposes are bent and slowed by water vapor as they travel through Earth's atmosphere. The ESRL team measures that delay by comparing the signals' ideal speed in a vacuum to their actual speed as they travel from the satellites to a network of more than 300 ground-based receivers. They convert the difference into estimates of total water vapor along the signal paths. Early results show that the data improve forecasts of relative humidity, rainfall, and severe thunderstorms.

For their achievement, ESRL scientists Seth Gutman, Kirk Holub, Stan Benjamin, and Susan Sahm earned the Commerce Department's Gold Medal for Scientific or Engineering Achievement — the highest honorary award granted by the Secretary of Commerce.

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Unmanned Aircraft Systems Offer Unique Observing Capabilities

NOAA Research is looking at Unmanned Aircraft Systems (UAS) to perform missions that cannot easily or as readily be performed by manned aircraft, such as low level flights into hurricanes, or long-duration flights over data-sparse regions of the Pacific and poles. UAS do not carry a pilot, but are independently or remotely piloted. UAS-acquired data will supplement data gathered by current "suborbital" airborne platforms — aircraft, sounding rockets, airships and balloons — and complement existing surface-based and space-based observing systems. In the summer of 2006 NOAA partnered with NASA to use a UAS for wildfire monitoring — identifying hotspots and tracking wildfires.

NOAA scientists integrated ozone and water vapor sensors into the Altair UAS platform. Two record-breaking mission flights, a 23-hour flight at 43,000 feet and a 21-hour flight at 48,000 feet, successfully demonstrated the high-altitude loitering capability of a UAS. One vision for using UAS as an observing platform would be to position about 240 units equally spaced at fixed locations over oceans and polar regions in the lower stratosphere to regularly drop sondes. Some UAS units could descend routinely at a few locations to near the Earth's surface to measure detailed profiles of clouds, aerosols, and chemistry. This combination of fixed and adaptive soundings over oceans and polar regions would significantly reduce initial analysis error, thus, leading to better weather prediction.

PREEMINENT RESEARCH

Two NOAA laboratories conduct a wide range of weather research; the National Severe Storms Laboratory in Norman, OK, and the Earth System Research Laboratory in Boulder, CO. Research focuses on improving observing technologies such as weather radar, studying emerging technologies such as unmanned aircraft systems, and improving forecast techniques and warning processes. NOAA's research labs study many aspects of storms from damaging winds to hail, lightning, and tornadoes. Researchers use modeling, direct observation through field studies and past weather data in order to better understand when and where severe weather will occur, with the aim of improving the accuracy and amount of lead time of forecasts and warnings issued by NOAA's National Weather Service.

Members of a forecast team evaluate deterministic model output during a Hazardous Weather Testbed Spring Experiment in Norman, Oklahoma.

NOAA is teaming operational and research scientists to operate testbeds that will accelerate the transition of promising new meteorological technologies into advances in forecasting and warning. Testbeds give NOAA forecasters direct access to the latest research developments while imparting scientists with the knowledge to formulate research strategies with practical benefits. Testbeds emphasize concentrated, regional demonstrations followed by nationwide implementations of the most successful methods. The end result is not only better forecasts, but important contributions to the scientific literature as well. A Hazardous Weather Testbed is conducted in Norman, OK, each spring during the height of severe weather season. NOAA conducts similar testbeds for climate, hydrological, hurricane and modeling.

VALUE TO SOCIETY

NOAA Research has contributed many life-saving improvements to the Nation's severe weather warning system. Through ingenuity and creativity spanning more than 40 years, NOAA scientists and engineers have taken technology to the edge in studying severe storms. As a result, in the past three decades, NOAA's National Weather Service has gone from relying on vintage, World War II-era radar technology to operating a modern system that includes a network of NEXRAD Doppler weather radars, more sophisticated modeling, and enhanced computer processing and communications technology to monitor weather systems and warn the public of impending severe weather. The technology now in place has saved countless lives by preparing and alerting communities of impending disasters. In the past decade, the average tornado warning lead time has climbed from a few minutes to 12-13 minutes on average; and socio-economic research indicates the NEXRAD system has reduced tornado-related deaths by 45 percent. This research leads to services that save lives and property.

To Learn More, Visit These Sites:

National Severe Storms Laboratory http://www.nssl.noaa.gov/research/projects/
Earth System Research Laboratory http://www.esrl.noaa.gov/
NOAA GPS-Met Network: http://gpsmet.noaa.gov

To Work or Study at OAR, Visit:

NOAA Careers: http://www.careers.noaa.gov
Hollings Scholarships: http://www.orau.gov/noaa/HollingsScholarship/
Knauss Fellowships: http://www.seagrant.noaa.gov/knauss/

OAR's mission is to conduct research, develop products, provide scientific understanding and leadership and to conduct outreach towards fostering NOAA's evolving environmental and economic mission.