

O. Collaboration with other national and international research groups and reimbursable support from non-NOAA sponsors

The following is a list of organizations that NSSL has collaborated with primarily since 2009. Details are available upon request.

International Collaborations

Central Weather Bureau, Taiwan
China Meteorology Agency
Deutscher Wetterdienst
Environment Canada
European Severe Storms Laboratory (ESSL)
Finnish Meteorological Institute
The Hebrew University of Jerusalem (Israel)
India Meteorological Department – Indian Universities of Sri Venkateswara and Science
Institute of Atmospheric Physics of Chinese Academy of Sciences
INVAP (Argentina)
Japan Meteorological Agency and Kyoto, Hokkaido Universities
Ku Leuven
Kyoungpook National University (Korea)
Lanzhou University in China
McGill University
MeteoFrance
MeteoSwiss
National Taiwan University
NERC
Royal Observatory of Hong Kong
UK Met Office
United States-Israel Binational Science Foundation
Universitat de les Illes Balears
Universitat Bonn
University Buenos Aires
Universite De Grenoble
Universitat Hohenheim
University of Manchester
University of Melbourne
University of Hamburg
Universidad Politecnica, Madrid
University of Reading, England
Universidad D' Salamanca
University of Uppsala, Sweden
Universidad de Valparaiso - Chile
World Meteorological Organization, South Africa

NOAA Collaborations

NSSL, the Earth Systems Research Laboratory (ESRL) Physical Sciences Division (PSD) and Global Systems Division (GSD), have conducted a series of inter-laboratory workshops over the past three years. The workshops were alternately hosted by each laboratory to not only discuss the science issues, but to also allow scientists to visit the other laboratories. The focus on the workshops was to educate all participants on the current research occurring within each lab, align science directions to insure no duplication of effort, and refresh relationships between scientists to encourage collaboration in new areas. The three laboratories are currently collaborating on several projects, including NOAA's Hydrometeorological Testbed, NOAA's Hazardous Weather Testbed, and development on the NWS AWIPS workstation, and with the National Centers for Atmospheric Research (NCAR) on the Developmental Testbed Center (DTC) for numerical modeling.

NSSL is currently collaborating with the Great Lakes Environmental Laboratory (GLERL) on using real-time precipitation estimates from NSSL's Q2 product to calculate runoff into the Great Lakes (primarily Lake Michigan). The precipitation information drives several GLERL models that calculate transportation of pollutants and lake levels (needed for transportation). NSSL and the Atlantic Oceanographic Meteorological Laboratory (AOML) in Miami are collaborating with the Florida Area Coastal Environment (FACE) program in efforts to develop high resolution precipitation estimates from underwater acoustical sensors in waterways and ocean areas. The measurements from FACE and from the new precipitation sensors will be useful in developing and evaluating the water quality models.

NSSL collaborated with NWS Radar Operations Center in the fielding of dual-polarization on their fleet of 160+ radars. This new technology was first implemented on NSSL's KOUN radar for testing and installation on the fleet was completed in 2013. Dual-polarization is another quantum leap in the use of weather radars.

NSSL is currently collaborating with the FAA to complete several risk-reduction activities in the building of a multi-function phased array radar system capable of providing both weather and aircraft surveillance at the same time.

NSSL continues to collaborate with NWS Office of Systems Development in providing NEXRAD product improvements for the NWS fleet of weather radars. This collaboration has existed since the NEXRAD radars were installed and has resulted in continuous upgrades for the NEXRAD radars.

NSSL collaborated with the U.S. Navy, Federal Aviation Administration, National Weather Service, University of Oklahoma, Oklahoma State Board of Regents, Lockheed Martin, and Basic Commerce Industries to build the \$27M National Weather Radar Testbed (Phased Array Radar). NSSL continues to collaborate with these groups on the testing of phased array technology for use as a multi-function radar for both weather and aircraft surveillance. NSSL has a long collaboration with the National Environmental Satellite Data and Information Services (NESDIS) National Climatic Data Center (NCDC). NCDC is responsible for acquiring,

archiving, and disseminating NOAA weather radar data. NSSL is responsible for creating and enhancing NOAA's weather radars and uses the NEXRAD data for development and refinement of severe weather algorithms in support of NWS forecasts and warnings.

NSSL began working with the National Sea Grant office and the North and South Carolina and Texas Sea Grant institutions in 1999 at the request of the then-OAR Assistant Administrator. His challenge was to find ways to take technologies "hidden" within the NOAA Research Laboratories and put them to use in areas that would benefit the Sea Grant constituents, utilizing the Sea Grant Extension Agents to help educate the public on their benefits. The Coastal, Inland Flood Observation and Warning (CI-FLOW) project was created to accomplish this task that has evolved in an effort to "track the raindrop from the sky, to the summit, to the sea." NSSL has built partnerships that include the NWS Office of Hydrologic Development, the NWS forecast offices in the SE Atlantic coastal area, several NWS River Forecast Centers, NOAA's National Ocean Service, North Carolina State University, the University of North Carolina, State Climate Office of North Carolina, NOAA in the Carolinas, the SE Caribbean Atlantic Regional Team, and several other NOAA and non-NOAA organizations.

The NOAA Hazardous Weather Testbed (HWT) is collaboratively managed by NSSL scientists and forecasters from the NWS Storm Prediction Center and the local NWS forecast office. Each spring, the HWT brings together a diverse group of meteorological researchers, practitioners, and academicians during its annual Spring Experiment, with total participation typically numbering 60-70 people in all. Participants come from across the U.S. and from other countries. The specific focus of the experiment varies each year, but there is a common theme involving evaluation of emerging scientific tools and concepts and their application in a simulated operational forecasting environment.

NSSL collaborates and interacts with field forecasters from across the National Weather Service. The annual Spring Experiments in the Hazardous Weather Testbed's Experimental Warning Program include visits from approximately 20 forecasters from 5 of the 6 NWS regions for one week each, as well as the Warning Decision Training Branch (WDTB) and Office of Climate, Weather and Water Services (OCWWS). NSSL is presently collaborating with WDTB, OCWWS, and numerous local NWSFO personnel on future changes to the way severe weather warning information is created and disseminated.

NSSL scientists collaborate routinely with the National Centers for Environmental Prediction (NCEP) Storm Prediction Center through the Hazardous Weather Testbed Spring Forecasting Experiments, direct interaction with forecasters during shifts, collaborative research projects, and forecaster training. Collaboration with the NCEP Environmental Modeling Center also is routine on radar data quality control issues, while collaboration on model development, ensemble forecasting, and data assimilation projects is more episodic.

NSSL collaborates with several National Weather Service Headquarters offices to improve the transition of NSSL research to NWS warning and forecast operations. These offices have several employees stationed at the National Weather Center. Collaboration with the Office of

Climate, Weather, and Water Services (OCCWS) allows for the infusion of research into the NWS severe weather program and policies. John Ferree is the Severe Storms Services Leader and Kevin Scharfenberg is the Severe Storms Services Coordinator for OCCWS, both located in the National Weather Center building. In addition, collaboration with the Office of Science and Technology (OST) allows for technology transition activities within the Hazardous Weather Testbed (HWT). Gregory Stumpf, a CIMMS scientist funded by the NWS Meteorological Development Laboratory (MDL), leads this effort and is also instrumental in the Experimental Warning Program spring experiments within the HWT.

NSSL is collaborating with four River Forecast Centers (RFCs) by providing real-time products from NSSL's National Mosaic and Multi-sensor Quantitative Precipitation Estimation (NMQ) system. The system produces 1x1 km resolution Cartesian-based multi-sensor Quantitative Precipitation Estimation (QPE) for the continental U.S. and southern Canada. The QPE fields are created in real time utilizing a centralized production of base-level radar reflectivity combine with other observations and model fields. During the last year modifications were made to Office of Hydrology's Advance Hydrology Processing System software to support the ingest of NMQ QPE products for use in real-time assessment and operational prototyping by RFC personnel. Feedback and ideas received from RFCs are used to focus research and development activities in improving the accuracy of the NMQ products. During the coming year NSSL will provide all 13 River Forecast Centers with NMQ products with plans in progress for a national operational implementation of NSSL's precipitation algorithms.

Working at the interface between research and operations, NSSL scientists have been major contributors to Weather Research Forecast (WRF) model development efforts and they continue to provide leadership in the operational implementation and testing of WRF. For example, NSSL scientists have strongly influenced decisions regarding the operational implementation and development of various physics options through extensive testing and evaluation of the WRF model during annual NOAA Hazardous Weather Testbed Spring Experiments, including close collaboration with developers from NCAR, National Centers for Environmental Predictions Environmental Modeling Center, and the University of Oklahoma Center for Analysis and Prediction of Storms.

NSSL is represented on both the NOAA Central and Gulf of Mexico Regional Teams. Work with the Central Region is focused on bringing social science concepts into NWS products and services. NSSL leads a joint project between the Central and Gulf of Mexico Teams linking Mississippi River runoff with the "dead zone" in the Gulf.

National (non-NOAA) Collaborations

Collaborations with the University of Oklahoma

School of Meteorology (SOM), Electrical Engineering and Computer Science (EECS), Physics and Astronomy, Civil Engineering and Environmental Science, Computer Science, Mathematics, Center for Analysis and Prediction of Storms (CAPS – a former National Science Foundation

Science and Technology Center), Cooperative Institute for Mesoscale Meteorological Studies (CIMMS), Oklahoma Climate Survey (OCS), Atmospheric Radar Research Center (ARRC), HyDROS

Collaborations with other universities

Pennsylvania State University, Texas Tech University, Texas A&M University, Colorado State University, University of Alabama Huntsville, University of Washington, University of Massachusetts, North Carolina State University, University of Nebraska, Oklahoma State University, University of Nevada / Desert Research Institute, University of California / Scripps Institute of Oceanography, University Corporation for Atmospheric Research National Center for Atmospheric Research, University of Illinois, Penn State University, University of Colorado, University of North Dakota, Purdue University, Columbia University, Washington State University, Cleveland State University, Vanderbilt University, Ball State University, University of North Carolina, Creighton University, University of Georgia, Iowa State, University of Connecticut, Florida State University, University of Wisconsin, Western Michigan University, Georgia Tech Research Institute, Utah State University, University at Albany, COLlege of DuPage

Collaboration with other government agencies

National Science Foundation (grants through OU and as collaborators on VORTEX2, MPEX, DC3, PECAN), Department of Transportation Federal Aviation Administration, Department of Homeland Security Office of Science and Technology, Department of Defense (Navy, Army, USAF), Department of Energy Pacific Northwest National Laboratory, Department of the Interior U.S. Geological Survey, National Aeronautics and Space Administration, Massachusetts Institute of Technology Lincoln Lab, and the Naval Research Laboratory, Federal Aviation Administration, National Science Foundation, Office of Naval Research, U. S. Army (Strategic Environmental Research), NASA, High Performance Computing and Communications Program, U.S. Weather Research Program

Other collaborations

State of Oklahoma, Oklahoma Water Resources Board, Chickasaw Nation
Reimbursable Support from Non-NOAA Sponsors