

J. Collaborations

Evidence of collaboration with other national and international research groups both inside and outside of NOAA as well as reimbursable support from non-NOAA sponsors

Primary Collaborations

National Weather Service

Since 1990, the National Weather Service has been GSD's primary collaborator and customer. In the early days, the National Weather Service relied on GSD to develop the first AWIPS system for its forecasting offices nationwide. GSD continues to develop forecaster tools for the AWIPS enterprise, requiring close interaction with NWS forecasters at all levels, including the NCEP centers, for input and feedback during development, testing and implementation. For many years, GSD supported the NWS Incident Meteorologists in the field with a mobile AWIPS system primarily with on-the-scene fire weather forecasts. In the past 10 years, GSD has collaborated with NCEP's Environmental Modeling Center to implement three GSD regional, short-range weather models with new versions to be implemented early next year. Through the High Impact Weather Prediction Project and other programs, GSD will continue to collaborate with NWS in the pursuit of the best next generation global model prediction system and both regional and global ensembles. For many years GSD has specialized in developing and improving aviation weather tools used by NWS aviation forecasters and air traffic managers and conducting assessments of new aviation tools to verify they work as designed as part of the Aviation Weather Research Program (AWRP). GSD highly values this collaboration with NWS and looks forward to a continuing productive synergy with NWS in the future.

Federal Aviation Administration

Twenty-five years ago, GSD's predecessor, the Forecast Systems Laboratory, and the Federal Aviation Administration (FAA) began a partnership that is still going strong. The Aviation Weather Research Program began with the goal of producing an aviation gridded forecast system. This system was envisioned to consist of a high resolution and frequently updated numerical prediction model, and algorithms to translate the model output into aviation impact variables (AIVs), such as icing, turbulence, ceiling and visibility, and winds (which are a direct model output). AWRP also funded the development of experimental tools to enable better coordination of volcanic ash advisories and to help traffic managers better visualize the effect of convection on aircraft arrivals and departures. AWRP supported the development of the High Resolution Rapid Refresh (HRRR) model, which became operational at NCEP in September of 2014. AWRP continues to support a robust quality assessment project which provides independent assessments of AIV algorithms. These assessments depend on the development and application of new verification methodologies

which take verification science beyond the norm of point forecast and observation comparisons. AIV algorithms developed and assessed have become operational via the Aviation Digital Data Service, which is produced at NWS' Aviation Weather Center. GSD looks forward to a continuing collaboration with the FAA, improving products for accurate aviation weather information that is so critical to aviation safety and efficiency.

NOAA and Cooperative Institute Partnerships

Cooperative Institute for Research in the Atmosphere (CIRA)

Cooperative Institute for Research in Environmental Sciences (CIRES)

Global Systems Division is fortunate to have productive and enduring research partnerships with the venerable University of Colorado's *Cooperative Institute for Research in Environmental Sciences (CIRES)* and the versatile Colorado State University's *Cooperative Institute for Research in the Atmosphere (CIRA)*. Both cooperative institutes actively support GSD's mission, providing expert scientists and technologists to pursue GSD's grand challenges. A majority of GSD staff are employees of the cooperative institutes and provide new perspectives, energy and innovation to GSD's research areas.

NOAA

- National Weather Service (All Offices, Centers, and Forecasting Offices)
- NOAA Environmental Satellite, Data, and Information Service
- National Ocean Service
- Office of the Chief Information Officer
- Office of the Chief Scientist

Office of Oceanic and Atmospheric Research (OAR) Laboratories

- Air Resources Laboratory
- Atlantic Oceanographic and Meteorological Laboratory
- Earth System Research Laboratory (Global Monitoring Division, Physical Sciences Division, and Chemical Sciences Division)
- Geophysical Fluid Dynamics Laboratory
- Great Lakes Environmental Research Laboratory
- National Severe Storms Laboratory
- Pacific Marine Environmental Laboratory

OAR Programs

- Office of Weather and Air Quality
- NOAA Climate Program Office
- NOAA Unmanned Aircraft Systems

International Government Agencies

Australia Bureau of Meteorology (BOM)
Central Weather Bureau, Taiwan (CWB)
German Aerospace Center (DLR)
Korea Meteorological Administration, Republic of Korea
Meteorological Service of Canada
Network of European National Meteorological Services (EUMETNET)
Shanghai Meteorological Bureau, Shanghai, People's Republic of China
Soil and Water Conservation Bureau, Taipei, Taiwan, Republic of China
Spain's State Meteorological Agency (AEMET), Madrid, Spain
State Oceanic Administration, National Marine Data and Information Service, Tianjin, People's Republic of China
United Kingdom Meteorological Office
University of Chile, Santiago de Chile
Water Resources Agency, Taipei, Taiwan Republic of China

International Private Companies

China National Huayun Technology Development Corporation, People's Republic of China
Højbygaard Paper Factory, Denmark
Korea Water Resources Corporation, Republic of Korea
Korean Broadcasting System, Republic of Korea
NAV Canada
Trimble, Ltd.
Vaisala Corporation, Helsinki, Finland

International Non-Profit Organizations

American Institute in Taiwan (AIT)
Max Planck Institut, Mainz Germany

U.S. Government Organizations

National Center for Atmospheric Research (NCAR)
NASA Langley Research Center
National Interagency Fire Center (NIFC)
National Institute of Standards and Technology (NIST)
National Science Foundation (NSF)
U.S. Air Force Base Vandenberg
U.S. Air Force Research Laboratory
U.S. Air Force Space and Missile Command
U.S. Air Force Weather Agency
U.S. Army Research Laboratory

U.S. Department of Agriculture – Office of the Chief Information Officer
U.S. Department of Agriculture – Forest Service
U.S. Department of Energy – National Renewable Energy Laboratory
U.S. Department of Energy - Virtual Worlds Strategic Outreach
U.S. Department of Homeland Security – Science and Technology Directorate
U.S. Department of the Interior – Bureau of Land Management
U.S. Department of Transportation/Federal Aviation Administration
U.S. Department of Transportation/Federal Highways Administration
U.S. National Geodetic Survey
U.S. Geological Survey
U.S. Weather Research Program

State Government Organizations

California Department of Water Resources
Colorado Department of Transportation
Colorado State University/Cooperative Institute for Research in the Atmosphere (CIRA)
Iowa State University
Florida State University
Louisiana Spatial Reference Center, Louisiana State University
State of Colorado
New Mexico Institute of Mining and Technology
North Carolina State University
North Carolina A&T University
The Pennsylvania State University
University of Alaska Southeast
University of California, Berkeley
University of Colorado, Boulder/Cooperative Institute for Research in the Environmental Sciences
University of Hawaii
University of Oklahoma
University of Wisconsin/Cooperative Institute for Meteorological Satellite Studies
University of Wyoming

U.S. Private Companies

Ace Info Solutions, Inc.
Atmospheric and Environmental Research, Inc.
AvMet Corp
nCentral Valley Holdings LLC
Cherokee Services Group
Cherokee Nation Technologies
Cirrascale
Cray
Devon Energy Production Company, LP

ENSCO, Inc.
Iberdrola Renewables, Inc.
IBM
ImagiCorps
ITT, Corp.
Intel Corp.
Lockheed Martin Corporation
NVIDIA
Pathscale
PGI
Planning Systems, Inc.
Tim Gard and Comic Visions
Toyota Racing Development USA, Inc.
Trimble Navigation
Weather Decision Technologies, Inc. (WDT)
Xcel Energy

U.S Non-Profit Organizations

University Corporation for Atmospheric Research (UCAR)

Science On a Sphere® Installations

Listed chronologically in order of installation

NOAA Earth System Research Lab, Boulder, CO
Nauticus - The National Maritime Center, Norfolk, VA
The Science Museum of Minnesota, St. Paul, MN
Bishop Museum, Honolulu, HI
The Tech Museum of Innovation, San Jose, CA
The Maryland Science Center, Baltimore, MD
NASA Goddard Space Flight Center, Visitors Center, Greenbelt, MD
Great Lakes Maritime Heritage Center, Alpena, MI
Imiloa, Astronomy Center of Hawaii, Hilo, HI
James Madison University, Harrisonburg, VA
McWane Science Center, Birmingham, AL
Fiske Planetarium and Science Center of Colorado University, Boulder, CO
Orlando Science Center, Orlando, Florida
The Museum of Science and Industry, Chicago, IL
NOAA's National Severe Storms Laboratory, Norman, OK
Clark Planetarium, Salt Lake City, UT
Lawrence Hall of Science, Berkeley, CA
National Museum Of Natural Science, Taichung, Taiwan, R.O.C
Gwacheon National Science Museum, Gwacheon, Republic of Korea

Smithsonian National Museum of Natural History, Washington, D.C.
International Museum of Art & Science, McAllen, TX
Microsoft Visitor Center, Redmond, WA
Ted Stevens Marine Research Institute (NMFS), Juneau, AK
NASA Visitor Center, Wallops Island, VA
Boonshoft Museum of Discovery, Dayton, OH
Harsco Science Center, Harrisburg, PA
North Carolina Aquarium, Manteo, NC
Smithsonian's National Zoo, Washington, D.C.
Alaska State Museum, Juneau, AK
Infinity Science Center, Stennis Space Center, MS
The Wildlife Experience, Parker, CO
Cite des Sciences et de l'Industrie, Paris, France
Oregon Museum of Science and Industry, Portland, OR
Heureka, The Finnish Science Center, Vantaa, Finland
Houston Museum of Natural Science, Sugarland, TX
Discovery Cube Orange County, Santa Ana, CA
NASA Ames Exploration Center, Moffett Field, CA
Climate Institute, Mexico City, Mexico
US Astronaut Hall of Fame, Titusville, FL
Beijiko Meteorological Museum, Nanjing, PRC
Cite de l'espace, Toulouse, France
Denver Museum of Nature and Science, Denver, CO
Point Reyes National Seashore, CA
Central Weather Bureau, Taipei, Taiwan
Bay Education Center, Rockport, TX
Climate Institute, Cuernavaca, Mexico
Pacific Science Center, Seattle, WA
Danville Science Center, Danville, VA
Science Museum, London, UK
Climate Institute, Chilpancingo, Mexico
Climate Institute, Atlacomulco, Mexico
Climate Institute, Metepec, Mexico
Climate Institute, Casa de la Tierra, Veracruz, Mexico
Climate Institute, Planetario de Morelia, Morelia, Mexico
Science Museum of Virginia, Richmond, VA
Climate Institute, Acapulco, Mexico
Aquarium of the Pacific, Long Beach, CA
Detroit Zoological Society, Royal Oak, MI
Beijing Huaxinchuanzi Technology Co.,Ltd., Beijing, PRC
KIGAM Geological Museum, Daejeon, Republic of Korea
Nurture Nature Center, Easton, PA
Visual Climate Center, Holeby, Denmark

Climate Institute, Texcoco, Mexico
Climate Institute, Valle de Bravo, Mexico
Climate Institute, Villahermosa, Mexico
Museum of Natural History, Halifax, Canada
Aldo Leopold Nature Center, Monona, WI
China Weather Channel, Huafeng Building, Beijing, PRC
Grand Canyon Visitors Center, AZ
China Maritime Museum, Shanghai, PRC
St. Paul's School, Concord, NH
Science Centre Singapore, Singapore
Science City at Union Station, Kansas City, MO
Daegu National Science Museum, Daegu, Republic of Korea
Climate Institute, Oaxaca, MX
Instituto Oceanografico da Universidade de Sao Paulo, Sao Paulo, Brazil
The Wild Center, Tupper Lake, NY
Tauese P.F. Sunia Ocean Center, Pago Pago, American Samoa
Space Foundation Visitors Center, Colorado Spring, CO
The Climate Corporation, San Francisco, CA
Telus World of Science, Edmonton, Canada
Universidad Autónoma de Coahuila, Saltillo, MX
Gwangju National Science Museum, Gwangju, Republic of Korea
National Youth Space Center, Goheung, Republic of Korea
Great Valley Museum - Modesto Junior College, Modesto, CA
China Science and Technology Museum, Beijing, PRC
South Florida Science Museum, West Palm Beach, FL
Fuzhou Science and Technology Museum
E. O. Wilson Biophilia Center, Freeport, Florida
Indiana University, Bloomington, IN
Museo delle Scienze, Trento, Italy
Techmania, Pilsen, Czech Republic
NOAA Headquarters, Silver Spring, MD
Science Central, Fort Wayne, IN
National Museum of Marine Science & Technology, Keelung City, Taiwan
Galaxy Elementary School, Delray Beach, FL
NOAA Inouye Regional Center, Honolulu, HI
Climate Institute, Ciudad Victoria, MX
Dongguan Meteorology and Astronomy Museum, Dongguan, PRC
Discovery Center, Higashimatsushima, Japan
Imagination Station Science Museum, Wilson, NC
St. Charles High School, Waldorf, MD
Climate Institute, Monterrey, MX
Visvesvaraya Industrial & Technological Museum, Bangalore, India
Exploreum, Pasay City, Philippines

Precision Planting, Tremont, IL
Discovery Cube Los Angeles, Sylmar, CA
MTA Natural History Museum, Ankara, Turkey
Children's City, Dubai, U.A.E.
Climate Institute, Reynosa, Mexico
Hong Kong Maritime Museum, Hong Kong, Hong Kong SAR
GulfQuest Maritime Museum of the Gulf of Mexico, Mobile, AL
Earth Day Texas, Dallas, TX
EcoParque Los Yarumos, Manizales, Colombia
Alternator Science Center, Trebic, Czech Republic
Wings of Eagles Discovery Center, Horseheads, NY
Chongqing Museum of Natural History, Chongqing, PRC
Museum of Arts and Sciences, Macon, GA
Rochester Museum and Science Center, Rochester, NY