

I. Contributions of Data

ESRL/GSD routinely collects, builds and archives Global Earth Observing System of Systems (GEOSS) and national data sets through its development and support of the Meteorological Assimilation Data Ingest System (MADIS). Additionally, GSD collects, quality controls, and archives specialized data sets for research purposes. Contributions to national and international-related databases and programs, and involvement in international quality-control activities to ensure accuracy, precision, inter-comparability, and accessibility of global data sets are described below.

MADIS

The U.S. contribution to GEOSS is the Integrated Earth Observation System (IEOS). The Architecture and Data Management Working Group for the IEOS has listed GSD's Meteorological Assimilation Data Ingest System (MADIS), which was transitioned to operations at the National Weather Service's (NWS) National Centers for Environmental Prediction (NCEP) Central Operations (NCO) on January 21, 2015. Research and development of MADIS continues at GSD, and the MADIS archive is now hosted by NOAA's National Centers for Environmental Information (NCEI). MADIS is designed to collect, integrate, quality control (QC), and distribute observations from NOAA and non-NOAA organizations, leverage partnerships with international, federal, state, and local agencies; universities; volunteer networks; and the private sector (e.g. airlines, railroads). Observations from these NOAA and non-NOAA stations are integrated to a finer-density, higher-frequency global observational database for use by the greater meteorological community. MADIS is now a national asset for improving meteorological observations, improving the delivery of those observations, as well as improving the on-going archive of the data and metadata at NCEI.

MADIS improves observations by Quality Controlling the observations on receipt of the data. MADIS QC is being improved in three ways:

1. Improving the understanding of the data through the collection of more complete metadata by working with programs such as:
 - a. The National MESONET (NM) program on metadata standards such as Open Geospatial Consortium's (OGC) SensorML and Starfish Fungus Language.
 - b. Sensing Hazards with Operational Unmanned Technology (SHOUT) program on ISO metadata standards.
2. Using the improved metadata to improve the QC algorithms based on a better understanding of the data.
3. Providing an open source framework and a process for the meteorological community to help improve the QC algorithms used by MADIS.

MADIS improves the delivery of the observational data to the meteorological community by acquiring and decoding data from a wide array of platform types and providers, encoding all of the observational data into a common format with standard units and time stamps, and delivering the data via a set of standard services. MADIS is working with several programs to improve the delivery and discovery of MADIS data:

1. The Next Generation IT Web Services (NGITWS) program on OGC delivery and discovery services such as Web Feature and Web Coverage.
2. The NWS Data Delivery (DD) program on OGC WFS discovery and delivery services.
3. The SHOUT program on ISO discovery and delivery services.

Distribution of MADIS to the greater meteorological community encompasses delivery to 19 national meteorological centers, including NCEP, the European Center for Medium-Range Weather Forecasts (ECMWF), the United Kingdom's National Weather Service (UK Met Office), the Korean Meteorological Administration (KMA), Taiwan's Central Weather Bureau (CWB), EUROCONTROL (European Organization for the Safety of Air Navigation), and the Chinese and Finnish Meteorological Centers. For more information about MADIS, go to <https://madis.ncep.noaa.gov/>.

GPS-Met

ESRL/GSD's GPS-Met project has developed a system to collect, quality control, archive, and distributed total precipitable water (TPW) estimates in near-real-time to support NOAA's research and operational activities. TPW estimates have been used in studies of atmospheric rivers, deep convection events, and the characteristics of satellite microwave water vapor observations over the ocean. TPW estimates are assimilated by NWS' operational North American Mesoscale (NAM) and Rapid Refresh (RAP) numerical weather models and are incorporated into the the NOAA's Environmental Satellite Data and Information Services (NESDIS) Blended TPW product to help fill gaps in precipitable water (PW) estimates where satellites cannot make these estimates.

ESRL/GSD collaborated with the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin affiliate and with NESDIS to test and select an improved algorithm for GOES TPW retrieval. ESRL/GSD scientists believe the requirement for this improved algorithm resulted from previous work that demonstrated calibration/validation problems with GOES TPW retrievals.

ESRL/GSD has participated in the free and open exchange of global atmospheric observations by providing its observations in a standard WMO BUFR format.

ESRL/GSD is currently involved in an on-going experiment to assess the long-term characteristics of offshore satellite observations and their impact on weather forecast accuracy (primarily precipitation).

ESRL/GSD initiated a Cooperative Research and Development Agreement (CRADA) process with a number of private companies to access the interest and capacity to provide total precipitable water (TPW) estimates to NOAA. The CRADA achieved its goal and ESRL/GSD is working with NWS personnel to create the statement of work needed to initiate a data purchase agreement.

For more information about GPS-Met, go to <http://gpsmet.noaa.gov/>

Science On a Sphere®

Science On a Sphere® (SOS) has established a substantial catalog of data sets that is distributed to each site that installs the system. The catalog was reorganized in 2014 into the categories of Air, Water, Land, Snow and Ice, Space, People, and Extras. The catalog now comprises over 500 datasets, including 41 real-time datasets and 74 narrated movies. The collection continues to grow as new contributions come in from a wide variety of sources including NOAA, NASA, universities, and sites that have SOS. The catalog can be found here: <http://sos.noaa.gov/Datasets/>.

HIWPP Open Data Initiative

ESRL/GSD has led the Sandy Supplemental project entitled "High Impact Weather Prediction Project" (HIWPP). GSD scientists and engineers have developed and implemented the HIWPP Open Data Initiative, a task within HIWPP designed to share research data with the broader weather community. Within HIWPP, high-resolution global models in late stages of testing and development have been contributed from the NCEP/Environmental Modeling Center (EMC), the Naval Research Laboratory (NRL), and from ESRL/GSD and have been running in a quasi-operational, real-time research mode. Output from these models has been collected in real-time within a central space in GSD. As part of NOAA's efforts to make environmental data more openly accessible to the public and to interact with the broader weather community, HIWPP has implemented a process that allows members of the public to access these global model output data, and to provide feedback to model developers. This is an innovative effort to make research data publicly available before they have moved into an operational setting. Infrastructure and issues related to the transfer, storage, and access of very large data sets generated by high-resolution global models have been a focus of the HIWPP project, and will inform NWS efforts to move to the next-generation of high-resolution models operationally. For further information, go to <http://hiwpp.noaa.gov/open-data/>.

NextGen IT Web Services (NGITWS)

ESRL/GSD scientists contributed weather data subject matter expertise to the NGITWS Project. The NOAA Integrated Dissemination Program (IDP) is fielding NGITWS, a web-based data dissemination service that will revolutionize the accessibility, discoverability, and machine-to-machine communication and processing of National Weather Service (NWS) data sets. Focused on OGC standard services and data formats for maximum interoperability, initial operational capabilities will be available from two geographically-diverse state-of-the-art data centers in College Park, Maryland and Boulder, Colorado. While the initial deployment will focus on aviation-centric data sets to support the FAA Next Generation Air Transportation (NextGen) system, the NWS Advanced Weather Interactive Processing System (AWIPS) and Aviation Weather Center (AWC) Web Services are preparing to take advantage of this new service.

FAA Common Support Services - Weather (CSS-Wx)

ESRL/GSD scientists contributed weather data subject matter expertise to the CSS-Wx Program. CSS-Wx is the single provider of weather data, products, and imagery within the National Airspace

System (NAS) using standards-based weather dissemination via System Wide Information Management (SWIM). CSS-Wx makes available both NOAA and FAA observations and forecast model products for integration into air traffic decision support tools improving the quality of traffic management decisions and reducing controller workload during severe weather. Products are provided via a set of common Web Services for weather using internationally recognized data access and data format standards.

EarthCube

The National Science Foundation's EarthCube is a community-led cyberinfrastructure program that will allow for unprecedented data sharing across the geosciences. EarthCube began in 2011 as a joint initiative between the NSF Directorate for Geosciences (GEO) and the Division of Advanced Cyberinfrastructure (ACI). EarthCube is broadly interdisciplinary, serving the Earth and Environmental Sciences, developing technologies that serve the scientific community EarthCube envisions a dynamic, community-driven cyberinfrastructure that supports standards for interoperability, infuses advanced technologies to facilitate interdisciplinary research, and helps educate scientists in the emerging practices of digital scholarship, data and software stewardship, and open science. ESRL/GSD researcher, Chris MacDermaid, was a member of the Governance Steering Committee which produced the initial EarthCube Governance Roadmap (<https://www.nsf.gov/geo/earthcube/docs/EarthCubeGovernanceRoadmap.pdf>). Chris MacDermaid is currently an executive committee member of the EarthCube Council of Data Facilities, a member of the EarthCube Technology and Architecture Committee, and a member of the EarthCube Liaison Team.

Pre/Potential Tropical Cyclones (pTC)

All tropical cyclones (TCs) originate from an organized convective disturbance. Studies of TC genesis therefore require a data set of pre-TC disturbance or 'pTCs.' ESRL/GSD has developed a global pTC data set derived from the operations of the Joint Typhoon Warning Center (JTWC) and the National Hurricane Center (NHC) for the period 2007-2015. These operational data are not managed in the same way as the post-season 'best track' so special processing and quality controlled are needed to make the data useful for research.

Initial results demonstrate, however, that every observed TC was preceded by an operational pTC – a property unique compared to satellite-based pTCs data sets. The pTCs were validated by running a TC diagnostics routine that measures the large-scale meteorological properties of the pTCs based on the analyses of the European Centre for Medium-range Weather Forecast (ECMWF) – the global leader in Numerical Weather Prediction (NWP). Clear differences in the evolution of developing vs. non-developing pTCs were found. This implies the ECMWF data correctly analyze the meteorology of TC genesis.

Forecast Impact and Quality Assessment

Through cutting edge and innovative research, the Forecast Impact and Quality Assessment Section of ESRL/GSD provides operational agencies with technology and tools for improving the accuracy and quality of weather information at critical decision points, thus improving services to the public.

An interdisciplinary team of meteorologists, physicists, mathematicians, and engineers provide quality assessment measures with meaning, network-enabled verification services for automated decision support and verification system unification, and independent comprehensive analyses to interpret and communicate the accuracy of weather.

WMO-Aircraft Based Observations

In the last several years, ESRL/GSD scientist, Bill Moninger, has served as an invited participant as a “U.S. Technical Expert” for the World Meteorological Organization’s (WMO) Automated Meteorological Data and Reporting (AMDAR) panel. AMDAR is the set of automated upper-air weather reports from commercial aircraft. AMDAR provides about 750,000 measurements of wind, temperature, and some turbulence and vapor information, per day. These data are critical inputs to numerical weather prediction (NWP) models. Dr. Moninger was one of a select group of scientists invited to the AMDAR data management workshop in Geneva. Subsequent to that, ESRL/GSD hosted a session with the AMDAR panel when they met in Boulder for an annual meeting.

NOAA Geographic Information System (GIS) Committee

ESRL/GSD researcher, Chris MacDermaid, is the OAR representative to the NOAA GIS Committee. The NOAA GIS Committee provides guidance and oversight for the NOAA GIS community. The Committee establishes policies, priorities, and provides direction for the establishment of a comprehensive NOAA-wide GIS architecture. The Committee additionally provides ongoing examination and monitoring of enterprise-wide standards.

NOAA Web Committee

ESRL/GSD researcher, Jennifer Valdez, is the OAR representative to the NOAA Web Committee. The NOAA Web Committee provides coordination and guidance for communicating NOAA information and data using online tools for the overall NOAA Web enterprise. The Committee formulates policy recommendations to the NOAA CIO and Director of Communications and acts as an advisory body to the NOAA CIO Council. The Committee provides support for the development and execution of NOAA Web-related enterprise-wide projects as well as those Web-related policies passed by the DOC/NOAA CIO and Director of Communications. The Committee may also serve as an advisory body to other NOAA committees and group.

