NOAA Earth System Research Laboratories

Global Systems Laboratory

Research today for better forecasts tomorrow

The Global Systems Laboratory is part of the NOAA Earth System Research Laboratories in Boulder, Colorado. GSL performs innovative research to provide the NOAA National Weather Service (NWS) and the public with rapidly-updating environmental models, state-of-the-art decision support tools, cutting-edge visualization systems, and high-performance computing technology to support commerce and a Weather-Ready Nation.

GSL research impacts

- GSL develops weather prediction modeling systems that improve weather services and provide a benefit of $41B to the American public each year.
- GSL-developed data delivery and decision-support systems are the cornerstone of operations in all 122 NWS forecast offices, helping the NOAA NWS and emergency managers respond to weather threats quickly.
- GSL weather models and decision-support systems help reduce weather aviation flight delays that cost airlines and passengers $28B in 2018.

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Hourly high-impact weather models

Rapid Refresh and High-Resolution Rapid Refresh

Recent GSL successes are NOAA's Rapid Refresh (RAP) and the High-Resolution Rapid Refresh (HRRR) hourly high-impact weather prediction models. The RAP and HRRR predict energy in the atmosphere for severe weather, visibility and ceilings for the aviation industry, turbine-height wind forecasts for the wind energy industry, and wildfire smoke plumes to support air quality advisories. These weather models are considered "game changers" by NWS operations and are upgraded each year with new science advances.

The science behind the models

GSL develops the science and software required to link ocean, land, and atmosphere models. Our expertise in physics, model coupling, data assimilation, modeling, and verification makes GSL a key partner in advancing NOAA's global and regional models.

GSL researchers talk with a NWS Denver/Boulder forecaster about GSL's experimental HRRR model forecasts in development.

Tools to support the weather decision-making process

Hazard Services

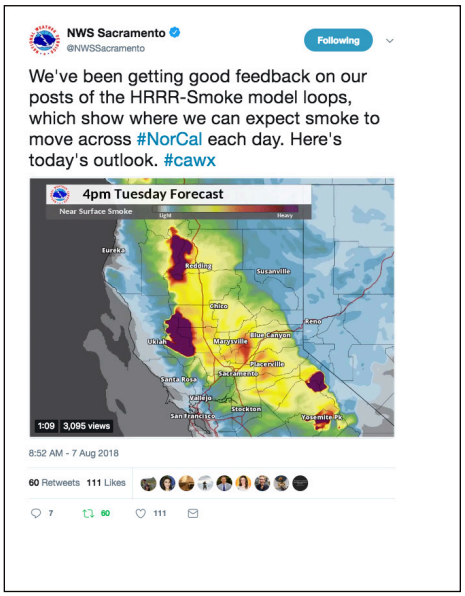
GSL is working on Hazard Services, a system that streamlines NWS watch, warning, and advisory-related services into one interface. This system can also be customized for each office, region, or type of weather, and is regularly tested and improved in preparation for operations.

FACETS

GSL is working on several Forecasting a Continuum of Environmental Threats (FACETs) expansion projects. FACETS is a proposed next-generation watch and warning framework that will help forecasters communicate clear, simple, and timely information about a variety of weather hazards.

WAVE

GSL is advancing the Weather Archive and Visualization (WAVE) Project, a web-based multi-purpose system that fills gaps in current operational software. WAVE enables NWS forecasters to create impact-based graphics and animations about weather hazards on the fly to communicate to users and deliver via their websites and social media.



NWS forecasters use WAVE to quickly create targeted and impact-based graphics to share on social media.

INSITE

GSL developed the INtegrated Support for Impacted air-Traffic Environments (INSITE), a tool that incorporates weather observations, forecast products and near real-time air traffic data. The NWS forecasters can use INSITE to report potential weather impacts to airspace so FAA Air Traffic Managers can re-route aircraft.

ESRL and GSL host the Jet high-performance computing system.

Innovative computing and visualization techniques

High-Performance Computing (HPC)

ESRL/GSL hosts Jet, one of NOAA's high-performance research and development computing systems used by more than 10 laboratories and 12 universities. Jet is used to run research models in real-time to support experimental hurricane forecasts and the extensive testing required to prepare the HRRR and other models for NOAA NWS operations.

Cloud Computing

GSL is exploring the use of cloud computing capabilities as a future platform for weather modeling, decision support, and visualization applications. The shift to cloud computing will increase NOAA's agility to respond to public needs.

Science On a Sphere® goes mobile

GSL developed Science On a Sphere® (SOS), a six-foot animated globe, and SOS Explorer™ (SOSx), a flat screen version to help explain complex environmental processes to the public. GSL's SOS team released SOS Explorer™ Mobile, a free app for iOS and Android devices giving everyone the ability to discover hundreds of Earth science datasets.

Science On a Sphere Explorer™ Mobile app was released lin 2019.