



Northrop Grumman Concept Paper

***A Comprehensive Geospatial Web-based Solution for
NWS***

Impact-based Decision Support Services

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1. Towards Impact-based Decision Support Services

In NOAA's Weather-Ready Nation Roadmap (WRN Roadmap 2013), the National Weather Service (NWS) outlines a new Services Plan. The approach is to enhance NWS services to meet emerging needs by incorporating a better understanding of social and physical sciences. One of the services is the Impact-based Decision Support Services (IDSS). IDSS will provide relevant information and interpretative services to enable decision making when weather, water, or climate has a direct impact on the protection of lives and livelihoods.

The operations concept for IDSS includes a critical requirement that NWS responses be adapted to suit each event and each user's decisions. This requires development of a versatile decision support framework tailored to various end user groups (e.g. water, energy, transportation and emergency planning, coastal infrastructure, public health sector, etc.). New products are needed to support improved decision support. These new products will be derived from foundational datasets blending weather, climate, environmental and social science information.

A key NWS activity to evolve IDSS is to "Develop IDSS toolkit from evolving Common Operations Picture (COP) capability". NWS COP capability will enable all users to pull consistent environmental data and forecasts and assemble them to meet their needs. The development of such a toolkit, or a decision support system, requires integration, manipulation and display of multiple layers of information suitable for planners and decision makers. Multiple components are needed to provide an operationally robust framework for actionable environmental, climate and weather data integration and analysis. Validation and software architecture functions are also required to adequately address spatial and temporal disparity of weather/climate datasets, data gaps, different data formats, etc.

Northrop Grumman supports NOAA's mission to enable personal and property safety and security associated with provision of decision-able information. Appreciating complexities associated with comprehensive decision support systems, Northrop Grumman has developed a functional Environmental Decision Support System (EDSS) prototype. EDSS leverages Northrop Grumman's Environment and Energy Initiative and Internal Research and Development (IRAD) investment to manage and display environmental, weather and climate data to support actionable decisions.

Our motivation for developing EDSS is driven by many valuable conversations with end users and stakeholders in government agencies, research communities and NGOs. Our constituents for EDSS clearly stated the need for translating climate and weather data into actionable information for the purpose of improved decision support.

2. EDSS Functionality and Features

A key NWS goal outlined in the WRN Roadmap is to shift from product-focused services to interpretive services. The objective is to convey potential impacts of environmental events to inform, support, and enhance decision-making and planning. Some of the key NWS service concepts and the Northrop Grumman EDSS features that satisfy these concepts are presented in Table 1.

NWS IDSS Concepts	Northrop Grumman EDSS Features
Real-time, interactive communication of information, forecast, and risks to aid community decision-makers	Ingests real-time data streams and forecasts from OpeNDAP, ftp/http servers, REST and WMS services and interactively presents in a GIS-based web client
Understanding of user information	Export of data layers, graphics and user sessions to

needs, production of user-friendly products and services	support further analysis or collaboration
Impact-driven weather products and more intuitive ways of presenting NWS information, including better, more user-friendly graphics	Displays multiple layers of weather, climate, environmental, infrastructure and demographic information over a GIS basemap; performs spatio-temporal queries for selected location or along a transect line and presents as graph and table
Communication of uncertainty and risk	Performs data analytics on multiple data layers to provide estimates of uncertainty and risks and displays as additional data layers
Rapid deployment	New product creation takes minutes; ncWMS data layer refresh rates as frequently as one minute
High quality, easily accessible, interoperable data, available anytime and anywhere	Supports various data formats (GRIB, netCDF, HDF, GeoTIFF, shape files) displayed simultaneously over a GIS basemap; requires only a web browser
Seamless climate, water and weather information	Allows display and manipulation of geo-located 2D, 3D and 4D weather, climate and environmental datasets at different spatial and temporal resolution

Table 1. Northrop Grumman EDSS features addressing the NWS new impact-driven service concepts outlined in the Weather-Ready Nation Roadmap Document, 2013

3. EDSS Products tailored for emerging NWS Service Sectors

Decision support services using NWS provided foundational observational and model datasets will enable dissemination of actionable information for many applications and sectors, including aviation, surface transportation, renewable energy, and public health. Below we provide examples of EDSS products for emerging NWS service sectors.

3.1. Renewable Energy

The NWS vision of service for the Renewable Energy sector is to foster growth through effective public and private sector partnerships using in-situ and remote observations, numerical modeling, and foundational weather, water and climate predictions. In terms of collaboration with the private sector, NWS plans to assume the role of an “honest broker,” receiving and protecting proprietary data from industry for use in improving the accuracy of foundational weather forecasts.

Figure 2 shows a solar forecast product developed by Northrop Grumman for the state of New Mexico. The figure shows a point query of the total insolation for four forecast lead times (15, 30, 45 and 60 minutes) at the ground level for Albuquerque, NM. EDSS returns the time series in graphical and tabular form, with the option to save as a text file allowing further analysis. This product is tailored for Solar System Operators and provides critical forecast of the solar irradiance for real-time operations.

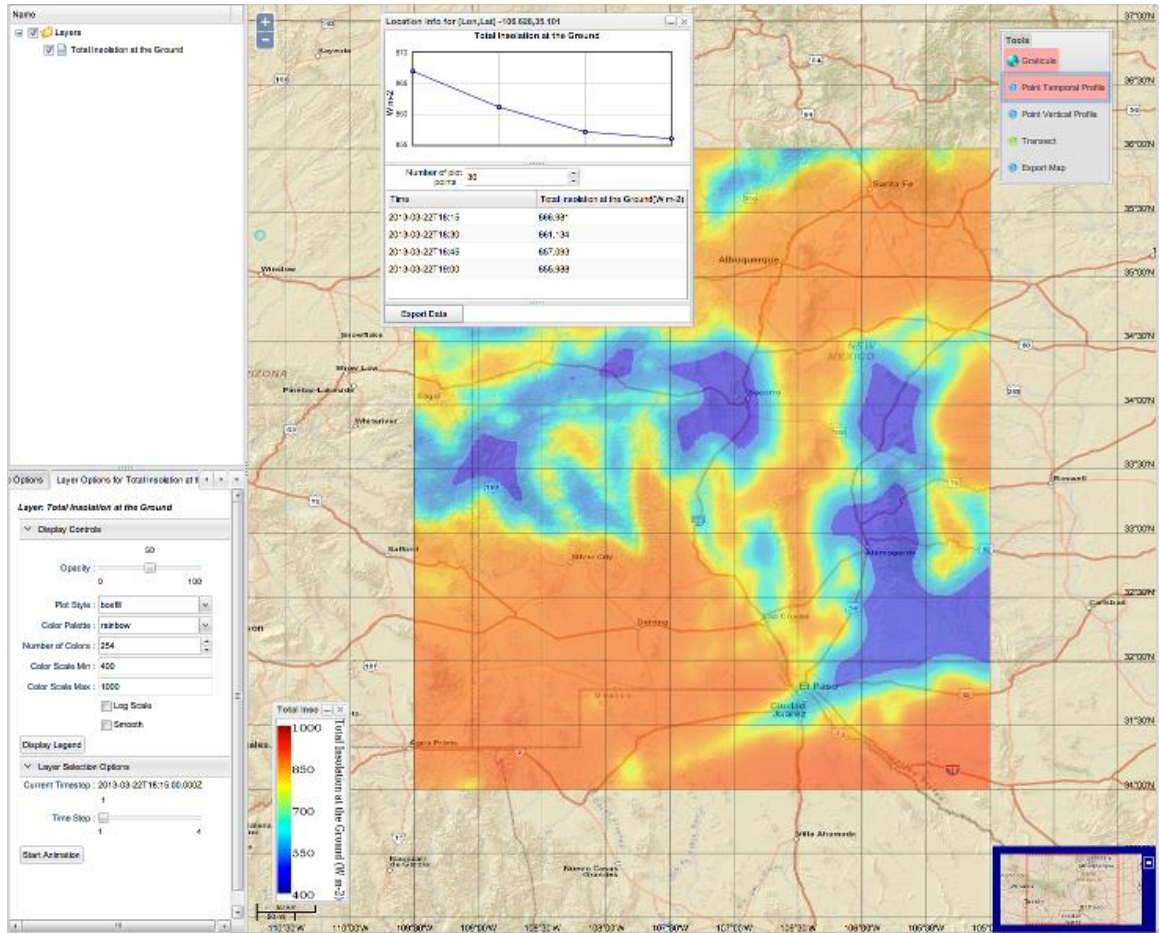


Figure 2. Total Insolation forecast for March 22, 2013 18-19 UTC for New Mexico

3.1. Water Resources

Water resource services require a multidisciplinary approach, taking advantage of all available sources of reliable data and presenting the data in an integrated fashion for water managers and decision makers. This entails combining NWS expertise on climate, water, and weather with expertise in other NOAA line offices, other federal agencies, international core partners, and other core partners.

Figure 3 shows the very wet day precipitation (defined as the annual total precipitation when daily precipitation exceeds the 95th percentile) based on the NOAA Climate Prediction Center's (CPC) Unified Precipitation Data for the 1950-2009 time period. The data layer is overlaid with shapefiles of major US aquifers, water body outlines and existing dams. Extreme precipitation indicators and metrics combined with infrastructure and demographic data can be a powerful tool for water managers to make decisions with respect to their water planning practices at different planning horizons.

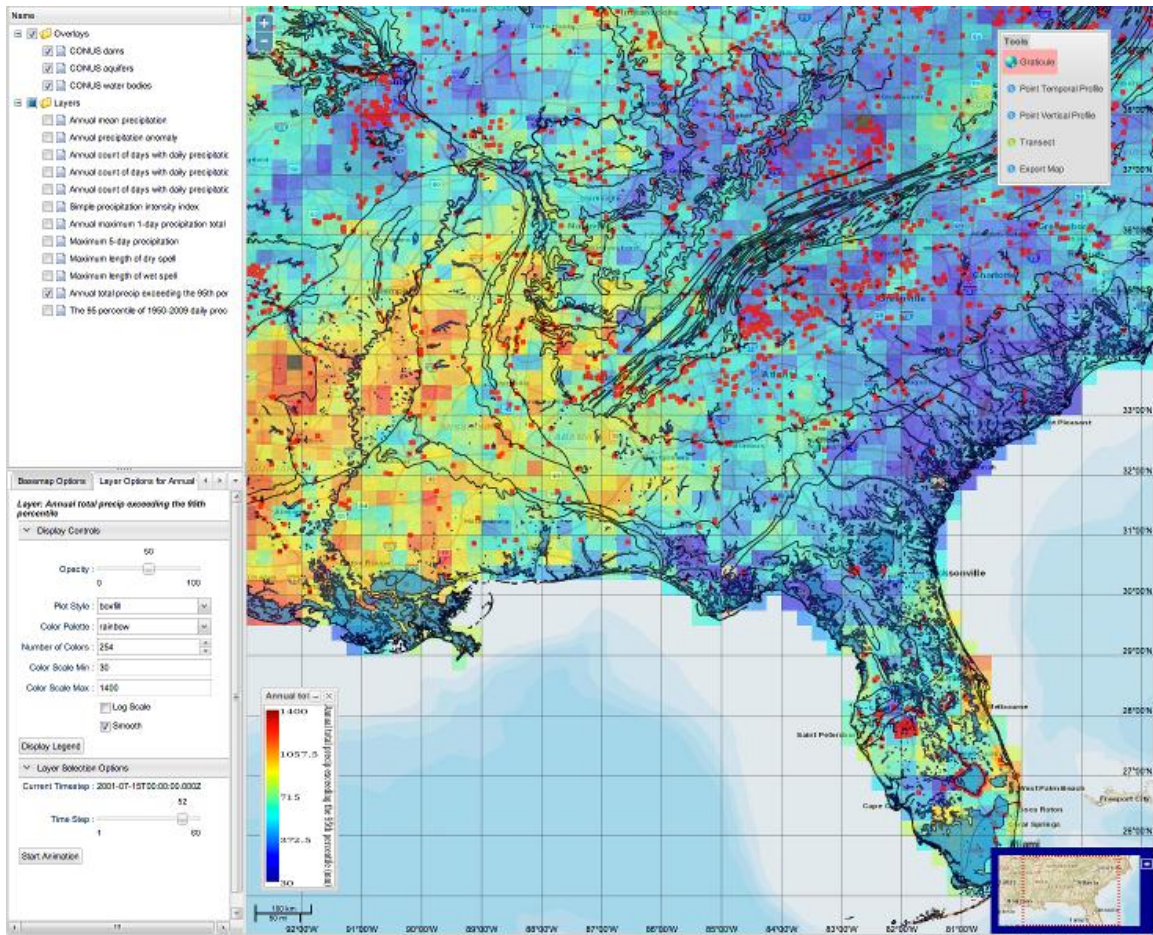


Figure 3. Very wet day precipitation for 2001.

3.1. Public Health

Extreme environmental conditions pose health risks for vulnerable populations. Timely information on impending extreme weather (e.g. heat waves, flooding precipitation) are critical for public health officials to issue warnings. The NWS concept of serving public health is to provide other Governmental Institutions with critical weather and climate information to produce health-based forecasts for public health and safety.

Figure 4 shows the estimated number of *Vibrio Parahaemolyticus*, bacteria associated with gastrointestinal illness. We used a parameterization in EDSS to link the number of *Vibrio Parahaemolyticus* and Sea Surface Temperatures to estimate the number of *Vibrio Spp.* in future climate conditions (2060s).

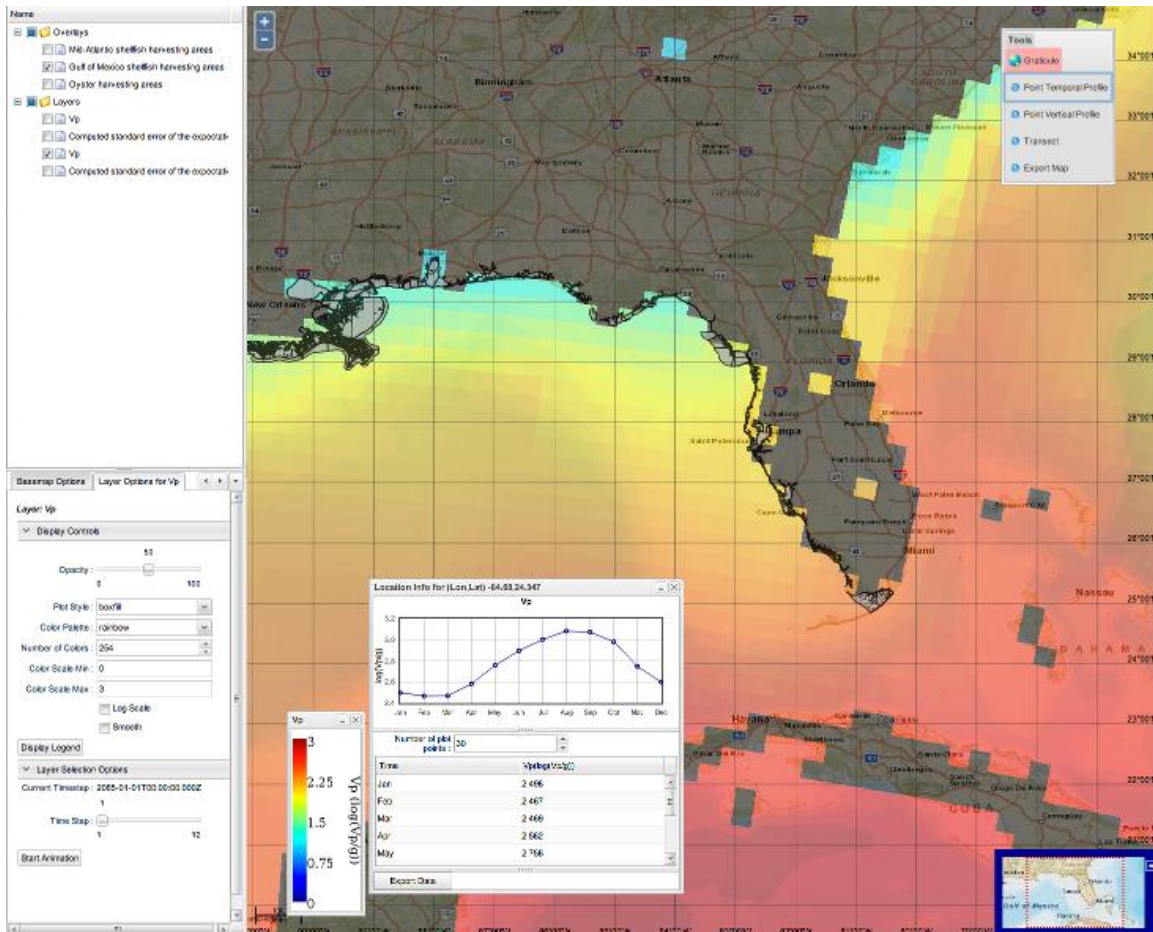


Figure 4. Estimated number of *Vibrio Parahaemolyticus* in sea water for the 2060s

4. Summary

Northrop Grumman is developing the Environmental Decision Support System (EDSS) to address limitations in synergistically presenting weather and climate data for the purpose of decision making.

EDSS includes infrastructure for managing environmental and weather data access, ingest, integration and user interaction through a web portal. We are developing a framework for producing weather and climate decision aids consisting of regional environmental modeling, model validation and bias correction, uncertainty characterization, and decision aid product generation.

EDSS is designed to provide actionable information in probabilistic terms to satisfy a wide range of user needs. Various decision aid products in the areas of water resources, sea level rise, agriculture, public health, traditional and renewable energy, and climate adaptation have been developed and incorporated into EDSS. The Northrop Grumman EDSS is a fully functional prototype system capable of delivering actionable weather, climate and environmental information to support decision-making and planning.