15.6 NATIONAL WEATHER SERVICE DIGITAL SERVICES OPERATIONS CONCEPT

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1. INTRODUCTION

Government agencies, private sector partners, the academic sector, and citizens rely on the National Weather Service (NWS) information for organizational and personal decision-making as well as research. Recent advances in technology have enabled the NWS to explore innovative approaches for enhancing our information systems as well as the capabilities for generation and delivery of forecast products and services. The NWS is now completing the first stages of a paradigm shift in the manner in which forecast information is generated and disseminated.

Traditionally the NWS has provided human generated forecast products in alphanumeric format that were manually prepared. Today as we make the transition to official digital services, we have transformed our local office forecast process and are providing new products and dissemination services using the latest technologies and new techniques (Ruth 2003).

Over the past several years the NWS has strived to improve the efficiency of forecast preparation. We have invested in high performance hardware systems that support higher resolution data. We have developed interactive tools for forecast preparation on computer workstations that create digital databases of forecast information. Forecasters are now more able to focus on weather events and maintaining an up to date digital database.

NWS forecasters at local offices across the Nation are now generating forecasts of gridded sensible weather elements using new computer workstation capabilities provided with the Interactive Forecast Preparation System (IFPS, Ruth 2002). This system provides capabilities for generation of a local digital database via graphical forecast editing (Mathewson 2000), and has revolutionized how local NWS forecasts are prepared.

NWS forecasts in alphanumeric, graphical, and gridded format are now derived from the local digital database and made available both with traditional dissemination systems and the Internet (Boyer and Ruth 2003)

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A National Digital Forecast Database (NDFD) has been developed to provide customers and partners access to new digital products. The NDFD is comprised of local forecaster generated gridded weather elements that are made available as national and regional scale mosaics. This digital data is designed to provide an enhanced level of services to customers and partners, by making more useful presentations and data formats available than alphanumeric information alone (Glahn and Ruth 2003).

2. OPERATIONAL PHILOSOPHY

The overarching policy for digital services is to meet the NWS mission to provide timely and accurate forecasts, warnings, and forecast information to protect life and property and enhance the national economy. Provision of digital services provides an opportunity to more effectively meet the NWS mission.

Specific policy for the NWS digital products and services, the local digital databases and the NDFD are described in the NWS Directives System, Instruction 10-506 Digital Data Products/Services Specification (NWS Instruction 2004).

National priorities have been established for NWS forecast operations to define practices for digital services (NWS Digital Services Operations Concept, 2004). The highest priority of NWS forecasters is to serve as local experts, decision makers, and information sources for hazardous and high impact events.

Human resources are realigned to focus where and when they are needed. Redistribution of tasks from one center or office is done to meet event demands such as

the issuance of warnings. We have transitioned from a scheduled driven forecast preparation process to event driven product generation.

Feedback from local and national customers and partners is used to help define and refine product and service requirements. This is accomplished through an iterative process to optimize NWS products and services.

The NWS digital forecasts are prepared using a collaborative process that emphasizes the communication of forecast strategy and selection of guidance. Numerical and statistical guidance from NWS national centers is used for initialization of the forecasts. Forecasters from neighboring offices coordinate and collaborate using tools that ensure products with known threshold levels of spatial consistency are generated.

High temporal and spatial resolution digital products and traditional alphanumeric products are all generated locally from a digital database, ensuring consistency between products in various formats. The forecasters strive to prepare spatially consistent forecasts so that near seamless national mosaics of digital forecasts are derived.

3. STRATEGY FOR PROVISION OF DATA

The local digital database is maintained and updated on an event driven basis. Service backup capabilities are provided to allow neighboring offices to prepare the local digital database and derive official products when needed. This ensures the gridded and graphical forecasts are prepared on an operational basis without interruption.

The national database is continually updated and maintained with redundant backup servers. Quality assurance practices are used to ensure high levels of system reliability and product quality. The NDFD architecture is designed to be sufficiently robust to provide a highly accessible and streamlined interface for data acquisition.

The digital data is made available in an internationally recognized standard format for gridded binary data, Gridded Binary Edition 2 (GRIB2) (Glahn 2002). Gridded forecast data in GRIB2 format can be downloaded from the NWS telecommunications gateway via the use of anonymous ftp. Information on how to download these data is available at: http://weather.gov/ndfd/technical/.

Graphics of these digital forecast data are displayed in a user-friendly graphical user interface on the Internet at: http://weather.gov/forecasts/graphical/ that provides national, regional and local depictions of the forecasts. The NWS has chosen to provide digital products graphically to better communicate forecast information to customers.

Verification and assessment of digital products is routinely conducted and statistics for forecast quality are now made publicly available to partners and customers at http://weather.gov/ndfd/verification/index.htm. The accuracy of gridded forecasts is obtained by a comparison to observations collected from more than 1200 observational platforms by the National Oceanic and Atmospheric Administration (NOAA) and other federal agencies. Skill is derived for these forecasts by comparison to statistical forecasts at the same locations. We are working to develop an analysis of record to verify forecasts at gridpoint locations.

A national archive of the gridded digital data is maintained at NOAA's National Climatic Data Center (NCDC), located in Asheville, NC. Customers may download historical gridded NDFD data from: http://has.ncdc.noaa.gov.

4. BENEFITS OF DIGITAL DATA

To maximize the forecast detail provided by human forecasters, the NWS now provides them as digital data. These products are up-to-date, always available, and in high spatial and temporal resolution.

NWS partners are able to download gridded forecasts of digital data that can be used for the provision of tailored products. Customers have access to graphical forecasts from the Internet that are easy to access and interpret.

Partners and customers are able to provide the NWS feedback on their satisfaction with the digital data in a variety of manners, such as: web-based surveys, by interactions at local and national meetings and workshops, and from e-mail. These dialogues and exchanges provide the NWS opportunities to better understand requirements for digital data and allow for the establishment of an evolutionary process for enhancement to NWS digital products and services.

5. INITIAL STEPS

The NWS has provided forecasts of 12 sensible weather elements experimentally since 2002, as a part of a demonstration project for digital data. Digital gridded forecasts are made experimentally available for the Continental U.S., Puerto Rico, Hawaii and Guam. Forecasts for Alaska are expected to become available during June of 2005. These forecasts are prepared at high spatial and temporal resolution, at a 5 kilometer horizontal resolution and up to 3 hour temporal resolution for selected elements.

Today the NWS provides experimental gridded forecasts for: Maximum and Minimum Temperature, Temperature, Dew point, Weather, Wind Speed, Wind Direction, Significant Wave Height, Sky Cover, Probability of Precipitation, Snow Amount, and Quantitative Precipitation Forecast via the NDFD.

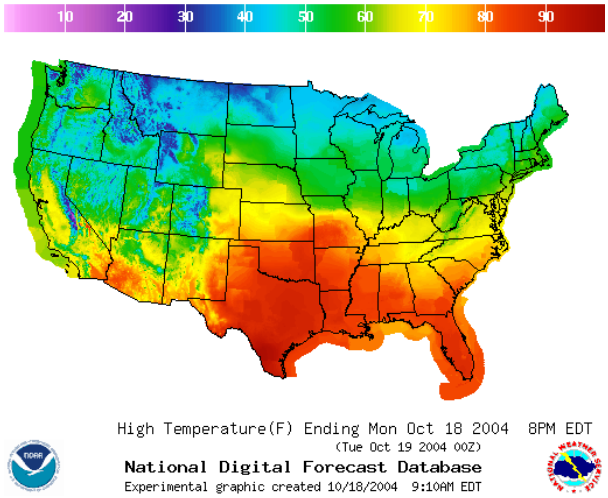

Figure 1. Maximum Temperature Forecast (Degrees F)

By providing these forecasts to customers and partners experimentally the NWS has been able to obtain feedback on the products as we continue to improve their spatial consistency, timeliness, and completeness.

Three of these forecast elements will transition to official NWS products on December 1, 2004: Maximum Temperature, Minimum Temperature, and the 12h Probability of Precipitation. Official products are those which are defined in NWS policy and produced operationally, on a reliable and continuous basis.

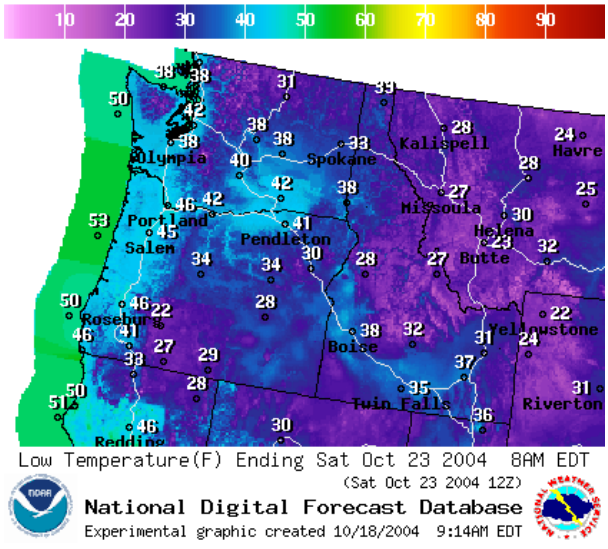

Figure 2. Minimum Temperature Forecast (Degrees F)

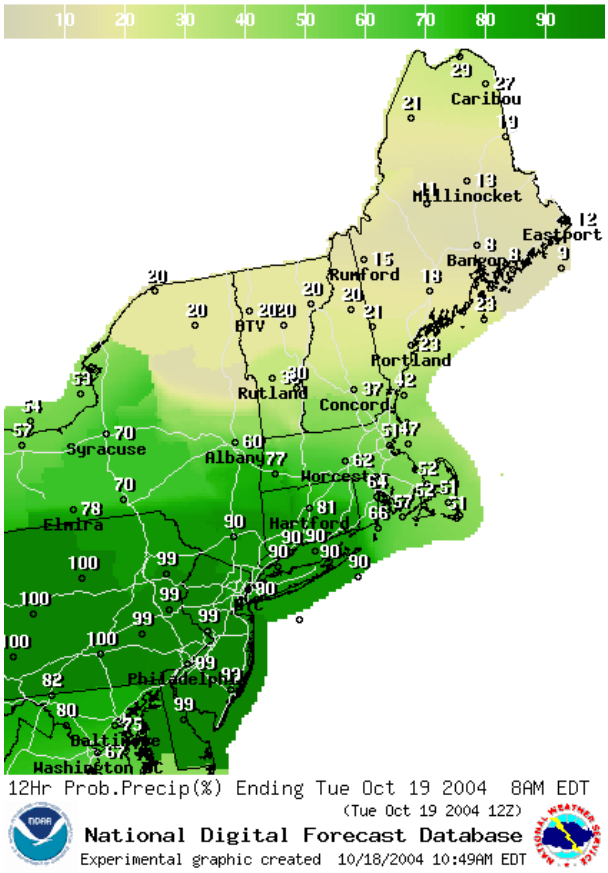

Figure 3. Probability of Precipitation (Percentage)

An example of the Maximum Temperature forecast for the contiguous U.S. is depicted in Fig. 1. The Maximum Temperature is the expected highest temperature for the daytime expressed in degrees Fahrenheit (F).

An example of the Minimum Temperature forecast for the Pacific-Northwest region is depicted in Fig. 2. The Minimum Temperature is the lowest temperature expected overnight, expressed in degrees F. An example of the 12h Probability of Precipitation for the Northeast region is depicted in Fig. 3. The Probability of Precipitation is the likelihood of measurable precipitation (0.01 inch or more) during the valid period, expressed as a percent.

6. FUTURE STEPS

The NWS will continue to enhance and extend digital products and services to meet evolving customer and partner requirements.

In the next few years we intend to establish performance metrics for digital products and services. From a baseline, we will strive to continually improve our digital service performance.

The NWS will continue to transition the experimental elements to official products as we improve the reliability, consistency and timeliness of these elements. In parallel, the NWS will seek out best practices and new product concepts, and begin to provide access to new experimental forecast elements via the NDFD. We welcome customer and partner feedback on these experimental and official products. We intend to work to refine requirements for new products and services with input from customers and partners.

We plan to seek out methods and capabilities that will enhance the communication of digital products. The NWS will continue to investigate the application of emerging technologies such as the use of XML for dissemination of digital data.

We expect to optimize the digital product quality by enhancing our product assessment and verification. We hope to create coalitions and partner with organizations to help define the thresholds of consistency required to support their businesses and services.

The NWS plans to enhance our customer relations management for digital services by periodically measuring customer satisfaction, conducting workshops and needs assessments, and distributing outreach materials.

Our long term goals are to enhance the digital database by extending the geographic domain of the forecasts, providing forecasts for parameters on vertical levels, providing hydrological and climatological forecasts, and adding additional probabilistic forecasts.

7. SUMMARY

The NWS has reached an important milestone in digital services by transitioning new digital products to official status. We intend to continue to investigate new products and services through interactions with customers from local communities and the private, public, and academic sector organizations.

Our long term goal is to continue to extend our suite of digital products and services by providing a four dimensional digital database comprised of various data types such as observational, forecast, probabilistic with uncertainty information, and verification data. This digital database will provide weather enterprise partners and customers access to high quality forecast products and a wide range of environmental information to meet their needs.

8. REFERENCES

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