

## N-AWIPS: AWIPS AT THE NATIONAL CENTERS FOR ENVIRONMENTAL PREDICTION

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### 1. INTRODUCTION

The Advanced Weather Interactive Processing System (AWIPS) is a key component of the National Weather Service (NWS) Modernization Program. When complete, AWIPS will be a highly automated and integrated weather information processing, communications, and display system which will be deployed at Weather Forecast Offices (WFOs), River Forecast Centers (RFCs), and at the National Centers (NCs). The NCs are the service center components of the National Centers for Environmental Prediction (NCEP).

The NCs produce central operational guidance, warnings, and forecasts on a national (or larger) scale. NCEP produces products (grids, graphics) directly from Numerical Weather Prediction (NWP) models. In addition to these automatically generated products, the NCEP service centers produce manually value-added products. Six NCEP service centers issue value-added forecasts or guidance:

- The Hydrometeorological Prediction Center in Camp Springs MD issues hydrometeorological forecasts for 0-7 days for the US.
- The Storm Prediction Center in Norman OK issues hazardous weather guidance for 0-24 hours over the Continental US.
- The Aviation Weather Center in Kansas City MO issues weather guidance, warnings, and forecasts for domestic and international aviation for 0-2 days on a global scale.
- The Tropical Prediction Center in Miami FL issues tropical weather guidance and forecasts and tropical cyclone watches and warnings for 0-5 days for the Western Hemisphere from 0-30 degrees North.
- The Marine Prediction Center in Camp Springs MD issues marine boundary layer and ocean surface guidance, warning, and forecasts for 0-5 days for the Northern Hemisphere.
- The Climate Prediction Center in Camp Springs MD issues climate monitoring and forecasts for Week 2, monthly, seasonal, and multi-seasonal time scales on a global scale.

The fundamental mission of the NCEP AWIPS (N-AWIPS) program is to support the forecast process necessary to generate the value-added forecasts and guidance at the service centers. To successfully fulfill this mission, N-AWIPS must have the capabilities to:

- ingest, analyze, and display meteorological data required for the NCEP forecast process;
- generate and distribute value-added products to the NWS and other users in the meteorological community;
- replace existing NCEP systems, which are expensive to maintain, with a modern UNIX-based, extensible system.

The responsibilities, and thus the system requirements, of the NCs are very different from those at the WFOs and RFCs. The major differences include differences in scale (both time and space); the strong dependence on numerical model data, including experimental models; the products produced by the centers, including text, graphics, and eventually grids; and, the customer base, which includes the aviation and marine communities, as well as the WFOs and RFCs. Because of these major differences, NCEP is tasked by the AWIPS program to write the unique applications that are required.

## 2. NCEP AWIPS DEVELOPMENT APPROACH

The responsibility for the development of the core NCEP capabilities lies in the Computing Development Branch of the NCEP Central Operations division. In addition, development of center-unique applications and tailoring of the system can be done within the service centers. The core development is supported for all NCEP UNIX workstations, whether used specifically for AWIPS or not. The N-AWIPS software development conventions include Motif, X-Windows and Postscript, and the C and FORTRAN programming languages. In addition, since there are many workstations already at NCEP, all software is tested on SGI, SUN, and IBM workstations in addition to HP workstations which will be deployed in AWIPS.

In order to meet the NC responsibilities during the modernization, an evolutionary development process is being used throughout the life cycle. With the evolutionary approach, new capabilities are deployed into operations side-by-side with the existing systems. These older systems can then be gradually phased out as the new N-AWIPS capabilities mature and the forecasters become familiar and confident with the new systems. The evolutionary development process has had the following advantages:

- rapid deployment of basic capabilities;
- continuous feedback between users and developers;
- ability to add enhanced capabilities in a staged fashion;
- gradual replacement of older equipment and methodologies.

### 3. N-AWIPS FUNCTIONAL SUMMARY

The core N-AWIPS code is a set of applications programs, support libraries, and navigation, graphics and formatting routines, used for the decoding, analysis, and display of meteorological data. It provides decoders for a wide variety of data, and a comprehensive set of meteorological parameter calculations for observational and gridded data. Multiple map projections are supported; satellite and radar imagery may be navigated, displayed, animated, and color-enhanced. Capabilities to perform many functions in a batch or research mode are available. The N-AWIPS GUI programs provide an easy-to-use interface to the core capabilities.

The current N-AWIPS GUI programs include:

- NTL Top level program
- NTRANS Model data display program using metafiles
- NSAT Satellite / radar display program
- NWX NWS text display program
- NAFOS AFOS graphics display program
- AFTEXT AFOS text display program
- NALARM Product alarm program
- NMAP Integrated data display & product generation program

These programs have evolved with each software build. Most of the current focus is on the product generation component of the system.

### 4. PRODUCT GENERATION CAPABILITIES:

A major development effort to replace and modernize current product generation capabilities is underway. The NCEP service centers currently produce value-added graphics products, which are distributed via AFOS and FAX circuits. As the center operations are consolidated and relocated, the current methodologies for creating these products must be replaced. With the move of aviation forecasters from Washington to Kansas City, it became imperative to replace the existing CAD-CAM legacy system. In addition to the aviation products, NCEP requires new capabilities to create national watch products, hydrometeorological forecasts (e.g. quantitative precipitation), longer-term forecasts (8 to 14 day), manually created surface analyses, and many other value-added products.

The graphics produced at the service centers have traditionally been distributed as FAX and AFOS charts. They

now are also distributed as AWIPS graphics and WEB graphics. The centers also create text products with embedded graphical information, which can then be used to re-construct some or all of the graphics.

The approach taken at NCEP adds the product generation capability to the NMAP program. This allows the forecaster to edit the graphics product with any data underlaid, with animation, and roaming available. The data that can be underlaid currently includes satellite imagery, radar, observations, model data, and previously-created products.

The graphics objects are stored using an NCEP-defined file format, called a Vector Graphics File (VGF). The classes of objects include fronts, lines, winds, text, symbols, and watch boxes. These objects are stored with latitude / longitude information, and with a set of drawing attributes, such as color, size, etc. The objects can also be "grouped" to form, for example, a weather symbol inside a convective area. These groups can then be used to create text products with embedded graphics.

A variety of actions can be performed on these objects, including ADD, DELETE, MOVE, MODIFY, ROTATE, FLIP, CHANGE ATTRIBUTES, and REFRESH. A set of file management tools is also available.

A VGF can be created and / or modified using the N-AWIPS interactive tools. In addition, application programs can create or add objects to a VGF, which can then be used interactively. This allows the service centers to create a first-guess field, which can then be edited by the forecaster.

After the file is modified, products can be made for distribution in many formats, including Postscript, AFOS, FAX, GIF, and text products with embedded graphics information. In addition, data which does not need to be edited, can be included in the output product automatically.

## 5. CONCLUSIONS

During the past year, the NCEP service centers have begun the transition from the legacy systems used for product generation. The complete transition is expected within the next year.

In the future, tools to create additional products, such a grids which must be edited by forecasters, as part of the NWS end-to-end forecast process will be added.