Office of Hydrologic Development
Hydrologic Software Engineering Branch
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Software for NWS Hydrology!

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1.   HIGHLIGHTS OF July, August and September 2008

AWIPS software development efforts during this period were focused on supporting formal testing of Operational Build 9 (OB9). Initial delivery of OB9 software was completed by late May 2008. After contractor integration and testing, it will start full deployment in late January 2009. Other key activities included support for field test and evaluations, and continued guidance to the AWIPS prime contractor (Raytheon) regarding the AWIPS-I software development, maintenance, build, and release practices. HSEB also provided support for evolving and ongoing AWIPS-II activities, in coordination with the NWS Office of Science and Technology (OS&T).

For Next Generation Radar (NEXRAD), HSEB continued implementing the dual polarization Quantitative Precipitation Estimation (QPE) algorithm and associated products. This software and the dual polarization initial operating capability are targeted for operational deployment in NEXRAD Radar Product Generator (RPG) Build 12. Deployment of the initial dual polarization operating capability and Build 12 is scheduled to start in 2010.

There was a great deal of activity in the Community Hydrologic Prediction System (CHPS) area this quarter! OHD developers made their first delivery to Deltares of the initial set of modeling software migrated from NWSRFS to CHPS. NOAA negotiated and awarded a multi-year contract with Deltares for implementation of CHPS. The Northeast RFC (NERFC) is quickly coming up to speed a front-runner RFC. The Northwest RFC (NWRFC) hosted a workshop in early August to discuss operational needs for an interactive forecasting GUI. A prototype hardware purchase for the CAT RFCs has been initiated. The US Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) officially began work on the "HEC-RAS into CHPS" project; also the task order for RTi was awarded, enabling Deltares to begin their work on HEC-RAS. The NWS Employees Organization (NWSEO) has now named a representative for the CHPS project. On the Experimental Ensemble Forecasting System (XEFS) side, OHD kicked off requirements gathering work for the Ensembles Product Generator (EPG). For more details see section 5.1 below.

2.   NEXRAD SOFTWARE DEVELOPMENT

NEXRAD Builds 10 and 10.1 have been deployed. For Build 10, OHD made a small change to display the source identifier of the mean field bias in the text portions of a few of the Precipitation Preprocessing Subsystem (PPS) products, including the Storm Total Precipitation (STP), One-Hour Precipitation (OHP), and Three-Hour Precipitation (THP). Build 10.1 is an IT security release. The next major release, Build 11 is scheduled to begin deployment in spring 2009.

2.1   Terminal Doppler Weather Radar (TDWR) PPS

Nearly all of the 45 Supplemental Product Generators (SPGs) have been deployed to WFOs near TDWRs. An SPG is a modified RPG which ingests TDWR data to produce NEXRAD-like products. Coinciding with this deployment is SPG Build 3 which includes TDWR-based precipitation products with the same names and formats as NEXRAD precipitation products (such as the Digital Hybrid-scan Reflectivity (DHR). The full suite of TDWR-based PPS products are displayable on AWIPS, and the appropriate products can be ingested by Flash Flood Monitoring and Prediction (FFMP), Multi-sensor Precipitation Estimator (MPE), and High-resolution Precipitation Estimator (HPE).

2.2   Dual Polarization

HSEB continues to implement the dual polarization QPE algorithm and products into the RPG. OHD delivered a non-operational version of their dual polarization software for testing with Build 11. However, the operational dual polarization capability is scheduled for NEXRAD Build 12. Deployment of the Build 12 and the dual polarization enhancement begins in late 2010 and lasts into 2012.

3.   AWIPS RELEASE OB8.3

During the quarter, AWIPS Release OB8.3 has been installed at all offices. Highlights of our major projects for OB8.3 are summarized below.

There are also a few AWIPS releases after OB8.3 but before OB9. These include the OB8.3.0.1 Super Res (RPG products) emergency release which began deployment in mid-July, the OB8.3.1 maintenance release which began deployment at the end of September 2008, and the OB8.3.2 maintenance release planned to begin deployment in December 2008.

3.1   NWS River Forecast System (NWSRFS)

For more detailed information about the OB8.3 projects below, the development documents are available at http://www.nws.noaa.gov/oh/hrl/hseb/software_dev_doc.html.

3.1.1 Re-implementation of ICP

While there is little new functionality in this application, re-implementing it in a modern language should make it easier to maintain and enhance in the future. Users should also notice that some functions which did not work correctly in the old ICP have been corrected.

3.1.2 NWSRFS Reservoir Tool Enhancements

Two enhancements have been incorporated into tools available in NWSRFS for modeling reservoirs. The first will allow the LOOKUP3 operation to have access to multi-value time series for use in regulation modeling. The second enhancement is to allow the Res-J MAXSTAGE method to use regular NWSRFS rating curves rather than separate Res-J specific curves and to enhance the MAXSTAGE method to support specifying a maximum discharge for cases where operations are based on discharge rather than stage.

3.1.3 Distributed Hydrologic Modeling (DHM)

Several enhancements to DHM have been made for OB8.3. The user will be able to specify MODs to the SAC-SMA model states as a percentage of storage zone capacity in addition to as a multiplier of the current value. DHM will now use hourly observed precipitation data rather than disaggregated Quantitative Precipitation Forecast (QPF) data whenever it is available. DHM was modified to accept as input, rainfall and snowmelt grids created by the prototype Hydrology Laboratory Research Distributed Hydrologic Model (HL-RDHM), which incorporates the SNOW-17 model, in addition to the current QPE grids.

3.2   RFC Archive Database Synchronization

The first of this project's two tasks involves a set of automated tools to synchronize select meta-data in the RFC Archive (RAX) database with the Integrated Hydrologic Forecast System (IHFS) database and a new application called "RAXBase" is provided to manage select data sets in the RAX database.

3.3   Multi-Sensor Precipitation Processing

Work included integration of the gage-focused DailyQC methods within the MPE application suite. Other changes include the addition of a "disaggregation" operation within MPE to use hourly gridded estimates to time-distribute 6-hour estimates into 1-hour estimates. A fix to the operation which mosaics RFC QPE products at the WFO using the World Meteorological Organization (WMO) ZETA98 product was also provided.

3.4   High-resolution Precipitation Estimator (HPE)

HPE produces a grid of instantaneous precipitation rate and 1-hour accumulation with a resolution of about 1 km by 1 km and as often as every 5 minutes. HPE mosaics data from multiple radars covering your area of responsibility reducing the need to have multiple instances of FFMP to monitor storms close to multiple radars. To configure your FFMP to use HPE go to the FFMP, see (http://www.nws.noaa.gov/mdl/ffmp/FFMPAsourceFile.pdf).

3.5   WFO Hydrologic Forecast System (WHFS)

Information on the WHFS, data ingest, and precipitation processing (e.g., MPE) applications are accessible on the NWS Office of Climate, Water and Weather Services Hydrologic Services Division (OCWWS/HSD) support web page at: https://ocwws.weather.gov/intranet/whfs/.

OB8.3 includes a collection of minor changes to HydroBase and assorted utility programs such as the ObsFcstMonitor application. RiverPro provides a new window for viewing the river stage/discharge data in a time-series form, and then allowing the user to make edits to the Valid Time Event Coding (VTEC) fields. The RiverMonitor application was expanded to monitor precipitation data, in addition to its existing ability to monitor river data. A few enhancements were also made to the river monitoring mode to allow information to be filtered better, including VTEC product time filters and forecast data time filters.

4.   AWIPS RELEASE OB9

HSEB delivered software for OB9 projects in May 2008; deployment is scheduled to begin in late January 2009. Our major OB9 projects and work are summarized in the below sections.

There are a few special releases scheduled after OB9 but before AWIPS-II, including OB9.1 which will involve an update to the Linux operating system.

4.1   High-resolution Precipitation Nowcaster (HPN)

HPN provides mosaicked radar-based high-resolution forecasts of precipitation rate every 5 minutes. The forecasts are at 15 minute increments up to an hour and of 1-hour precipitation accumulation. HPN uses HPE mosaic grids as input. The HPN forecast accumulation can be used as input to FFMP and to the Site-Specific Hydrologic Predictor (SSHP) model. Also, both the forecast rates and accumulations can be viewed in D2D.

4.2   Variational Data Assimilation (VAR) for SSHP

VAR capability has been added to the SSHP model to update information about soil moisture conditions, thereby improving accuracy of the resulting stream forecasts.

4.3   WHFS Improvements

The RiverPro application was modified to incorporate Common Alert Protocol (CAP) codes around the call-to-action section, in coordination with CAP changes planned for all watch, warning, advisory products. Also, the ability to perform basic arithmetic operations on numeric template variables was added, and the existing latitude and longitude template variables will be useful for more locations as the feature was expanded beyond just river locations.

The rate-of-change quality control operation ("roc checker") was modified in a small but important way by designating data that fails the check as being "bad", rather than just "questionable". Bad data is ignored for use in data intensive applications such as precipitation derivations. Also, a change in the format options for the hydrologic IHFS "alert_alarm" data reports was made.

4.4   Precipitation Processing Improvements

Noteworthy changes include the revamping of the MPE gage table, allowing improved user interaction and supporting more precipitation fields. The satellite-radar-gage products also have a numerical adjustment algorithm incorporated to smooth the transition between areas of different sourced precipitation estimates. Lastly, some minor but important changes to the point precipitation derivation algorithms will provide improved derivations of irregularly reporting data, such as from the NWS Automated Local Evaluation in Real Time (ALERT) networks. These changes will affect values displayed in HydroView point data displays (ad-hoc and time step modes), HydroView point precipitation utility window, RiverPro precipitation extractions, and the precipitation monitoring component of PrecipMon.

5.   DEVELOPMENT SUPPORT ACTIVITIES

5.1   New RFC Software Architecture: CHPS

Visit the CHPS web site at http://www.nws.noaa.gov/ohd/hrl/chps/index.html. The "News & Activities" section contains reports from these HSEB quarterly newsletters. The CHPS page can also be accessed from the main OHD page (http://www.nws.noaa.gov/ohd/).

5.1.1 CHPS Implementation

The big news this quarter was the award of NOAA's multi-year contract with Deltares for implementation of CHPS. The award comes just over three years since Deltares (then WL | Delft) first demonstrated their Flood Early Warning System (FEWS) at OHD.

CHPS Acceleration Team

NERFC is quickly coming up to speed as a new member of the CAT:
> ➢   During August OCWWS HSD and OHD assisted with NERFC's setup of a Pilot system ready for initial configuration by Deltares.
> ➢   Deltares visited NERFC in August to provide a Delft-FEWS overview and first-level training session to NERFC staff.
> ➢   Deltares has begun to configure a sample ("pilot") basin for NERFC, and will incorporate some basic training for NERFC staff during the CHPS Preparation workshop in Taunton, MA, held the week of September 29.

The NWS Employees Organization (NWSEO) has now named a representative for the CHPS

project: he is Ron Horwood, Senior Hydrologic Analysis and Support (HAS) forecaster at NERFC.

CHPS Requirements

The Northwest RFC (NWRFC) hosted a workshop in early August to discuss with Deltares the NWS RFC operational needs for an interactive forecasting GUI. The 3-day session was extremely productive, with screen mock-ups being generated in real time, and a keen interest on the part of Deltares in making some suggested improvements to FEWS. Among other things participants were able to show Deltares some of the "IFP companion" tools they use, and also described some of the more desirable features coming with AWIPS II. Deltares demonstrated some early concepts and their progress at the CHPS Preparation workshop in September.

CHPS Software Development

HSEB's developers continued the process of migrating selected NWSRFS models and operations into the new CHPS framework. We have made great progress; migrated versions of all but two of the models identified for the CHPS Baseline Operational Capability (BOC) have been provided to Deltares for testing in combination with the next release of the Delft-FEWS package. Work is underway to complete and test those two operations as well as beginning the migration of the five additional model operations which will be needed by the remaining RFCs. In addition, developers are implementing changes in several models to mesh with the CHPS design for real-time MODs. We expect to meet the goal of delivering all of the BOC models by December, 2008 and the remaining models by March, 2009.

During this quarter, the developers also completed, tested and deployed to the CHPS Acceleration Team (CAT) RFCs an enhanced version of the ofsde program which will extract additional information for storage in the database within CHPS. We have created and are currently testing software for the second phase of the data process, which will pass the ofsde data to the internal Delft-FEWS database ingest process and transfer data from CAT RFCs to Deltares to support CHPS testing and transition activities.

The BOC for CHPS includes a long-term ensemble capability equivalent to the one available in NWSRFS. While Delft-FEWS already incorporates a climatology-based ensembles capability, the CAT requested that OHD migrate the esp and espadp software applications from NWSRFS to CHPS. So far, esp has been migrated; and a model adapter has been developed that will allow for Delft-FEWS to generate esp format binary files that can be read and displayed within espadp (a slightly modified version of the AWIPS OB9.0 baseline copy). These enhancements will provide the necessary CHPS BOC functionality until the much greater capabilities of XEFS become available. Note that this effort is independent of the XEFS project work described below.

Sudha Rangan, who was the software architect for the CHPS project and lead developer of the OHD components of the CHPS Pilot system, left in early July to return to India. She will be greatly missed. Meanwhile Lee Cajina has assumed the technical leadership of the CHPS software development efforts and with the help of the entire team, is successfully meeting or

exceeding all of the HSEB software development goals.

CHPS Workshops

CHPS Preparation Workshop #2 was held in Taunton, MA (at NERFC) during the week of September 29. This is the second of three preparation workshops, resulting in a BOC CHPS that will be installed at the CAT RFCs by the end of this year.

Migration from NWSRFS to CHPS (CAT RFCs)

The CAT RFCs will migrate their existing segments to CHPS beginning January 2009; this is expected to be a 9 month activity, with the CAT RFCs sharing their progress and experiences along the way and providing valuable feedback as part of an effort designed to positively influence the experience for other RFCs. Much of the basic migration will be automated. Progress on the NWS-specific migration tools was presented to the CAT at the workshop.

CHPS Hardware

Based on specifications provided by Deltares, the CAT agreed on a suite of hardware for the CHPS prototype system to be deployed at the CAT RFCs.

The purpose of this hardware purchase is to:
a) provide insight into the performance requirements for CHPS, and help define the delta between NWSRFS and CHPS performance
b) provide technical requirements for OSIP project 07-059 (RFC AWIPS configuration)
c) provide additional computing power for all RFCs as they undergo migration from NWSRFS to CHPS (i.e., while running both) so as not to disturb operations or the AWIPS II project

The NOAA Hydrology Program has provided funds for systems at four RFCs, each comprising one server for the Master Controller (MC), one server for the Forecasting Shell Server (FSS), and one server for the Database. The Operator client software will run on existing AWIPS workstations. These are the basic components of a FEWS-based system with no failover or offline testing capabilities. The hardware has been procured; delivery is expected in October.

Through the OSIP mechanism, OHD will initiate discussions with OS&T on an approach for AWIPS hardware configurations to meet RFC needs in a CHPS environment, with an eye to the future (e.g., to accommodate XEFS and DHM).

5.1.2 HEC-RAS

The US Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) began work on the "HEC-RAS into CHPS" project, recently announcing that their contractor has completed a first version of the Java library needed by Deltares. Things are going well and are on schedule.

The task order for RTi was awarded, enabling Deltares to formally begin work on the adapter

and conduct testing. NERFC provided RTi/Deltares with a working version of HEC-RAS for testing.

HSMB is investigating two approaches to implementing HEC-RAS models at RFCs: one is to convert existing FLDWAV/DWOPER models; the other is to get existing USACE models and implement those. The HSMB task, scheduled to complete in January 2009, is on track.

5.1.3 Experimental Ensemble Forecast System (XEFS)

In August, OHD kicked off requirements gathering work for the Ensembles Product Generator (EPG), as defined in the XEFS Design & Gap Analysis report. The project leader is Hank Herr; his team includes representatives from OCWWS, OHD HSMB, CNRFC, CBRFC, and Deltares. Technical consultants will be added as needed. The team is in the process of defining product requirements for XEFS, and has begun by considering a range of products currently available in various RFC/regional web pages, reports, and presentations.

OHD hosted a visit in early September by Albrecht Weerts of Deltares; Albrecht is the Deltares focal point for ensembles in CHPS.

5.2   AWIPS II

Raytheon is migrating the national AWIPS baseline software suite into a new, modern services-oriented architecture (SOA). This migration is part of the overall AWIPS evolution process described at: http://www.nws.noaa.gov/ost/SEC/AE/index.htm. Technical aspects of the AWIPS-II software are discussed in the "awips2dev" list server to which NWS staff are encouraged to subscribe.

The AWIPS software migration is being performed under four task orders: Task Orders (TO) 8, 9, 10, and 11. The TO 8 software was delivered in February 2008, and the TO 9 software was delivered in September 2008. The Systems Engineering Center (SEC) within the NWS OS&T is managing the testing and evaluation of this and all AWIPS II task orders.

Most of the legacy RFC software is not planned for migration in the primary AWIPS II migration. CHPS will be implemented into AWIPS as part of the AWIPS II Extended phase. However, the WHFS, Precipitation Processing, and Data Ingest software (a.k.a. "OHD-Common" software since it runs at both WFOs and RFCs) are planned for migration.

TO 9 includes a basic SHEF data decoder and database poster, with the existing IHFS relational database being left unchanged. A time series application with some of the WHFS time series capabilities is also part of TO 9. OHD is currently working to install TO 9 and evaluate its contents.

In September, another Technical Interchange Meeting (TIM) was held in Silver Spring between HSEB staff and Raytheon developers. This is in support of TO 10 activities, as TO 10 is scheduled to include many OHD Common functions. Raytheon has indicated that they will leave considerable blocks of functionality relatively unchanged, including MPE Fieldgen,

Riverpro, and SiteSpecific. HSEB is especially interested in having the HydroView capabilities merged into the AWIPS-II CAVE display environment. TO 10 (Hydro) will be delivered for government evaluation in February 2009.

5.3   General Testing

Evaluations at certain offices are ongoing or are being readied:

- Fort Worth (FWD) WFO and West Gulf RFC (WGRFC) continue to test the SSHP VAR components until OB9 is delivered.
- Oxnard (LOX) and San Diego (SGX) WFOs continue to testing changes to the station precipitation accumulations algorithm used for ALERT stations until OB9 is delivered.
- NWRFC continues to evaluating the OB8.3 MPE/DailyQC operations in the OB8.3 beta phase.
- Multiple RFCs are beginning to test a modified version of MPE which supports the NSSL Q2 radar-based QPE product. The modified MPE also generates two derived products from this raw product: an alternate local bias corrected product and the multi-sensor product.
- Selected RFCs are configuring and evaluating the DailyQC features in the OB9 version of MPE.
- Springfield, MO (SGF) WFO and Cleveland, OH WFO are field testing HPN.

5.4   AWIPS System Changes

The AWIPS Software Engineering Group (SwEG) approved an upgrade to the FORTRAN compiler from Portland Group very late in the OB9 development process. An upgrade to the RedHat Enterprise Linux operating system is planned as a maintenance release, OB9.1.

6.   HYDROMETEOROLOGICAL AUTOMATED DATA SYSTEM (HADS)

Visit our web page at: http://www.nws.noaa.gov/ohd/hads/.

6.1   HADS Systems & Software

A significant enhancement regarding the processing of water level/stage data from certain USGS data platforms is being developed and tested. This activity is directly related to the USGS activity of expanding the type of information made available via its web based National Water Information System (NWIS).

The USGS, on a state-by-state basis, will be providing access to their gage correction values. A HADS background/utility processes will, on a daily basis, retrieve the gage correction page for

each USGS site defined within the HADS network. When a difference is encountered between the USGS correction value and the HADS offset value (HADS metadata Base Elevation field), a notification of the difference is e-mailed to HADS network technicians. The HADS definition is then altered to align it to the USGS correction value. Although this currently involves manual insertion of gage corrections, the process will be eventually be automated as development and testing of these procedures expand.

In addition to these gage correction values there is another type of data adjustment identified by the USGS as 'draw down corrections'. These data value adjustments are quite different; they are variable and are dependant upon the location of the water level measuring device and the effects of nearby structures that negatively impact the observational values. As HADS learns of these draw-down sites, we obtain the various correction factors from the USGS and insert the required computation actions into the automated data processing steps for these specific gages. The activity of accounting for the draw-down computations will be an ongoing event as different data platforms may affect different data decoders. Therefore over time, various HADS decoders will have to be altered.

At the time of this newsletter, gage corrections for the following states are being processed: TEXAS, ARKANSAS, MONTANA, WASHINGTON, MISSOURI, PENNSYLVANIA, GEORGIA, MINNESOTA, and KENTUCKY.

Based upon information received from the USGS, we expected to receive gage correction information from the remaining areas, by these approximate dates, in this approximate order:

By October 12
MISSISSIPPI
ILLINOIS
FLORIDA
ALASKA
MARYLAND
MICHIGAN
NORTH CAROLINA
NEW JERSEY
OHIO
CARIBBEAN
VIRGINIA
WEST VIRGINIA
ARIZONA
COLORADO
IOWA
IDAHO
LOUISIANA
NORTH DAKOTA
NEBRASKA
UTAH

October 14 to October 26
CALIFORNIA
PACIFIC ISLANDS
KANSAS
NEW MEXICO
NEVADA
OKLAHOMA
OREGON
SOUTH DAKOTA
WYOMING

October 27 to November 9
ALABAMA
INDIANA
NEW ENGLAND
NEW YORK
SOUTH CAROLINA
TENNESSEE
WISCONSIN

6.2   HADS Data Network

There are currently 13,292 data points defined in the network providing approximately 2.45 million operational data values each day.   Details describing numbers and primary types of sensors processed can be found at: http://amazon.nws.noaa.gov/hads/parms/parms.html

On October 1st an important change occurred regarding the availability of observed data from what was know as the NERON network. The operation and maintenance of the network was transitioned to Eastern Region and the network became identified as the New England Pilot Project (NEPP). With this change in ownership, HADS was permitted to once again provide the observational values on the HADS public web pages. These data locations have "NEPP" within their location descriptions.

During recent discussions with the program manager of NCDC's Climate Reference Network (CRN), there was a request for WFOs to re-evaluate the need to acquire CRN data via HADS. As a result, the CRN sites that are not being processed are once again posted onto the HADS newdcps web page. In an effort to enhance the visibility of the CRN network and to make its data available to both primary and secondary users of HADS, please obtain NWSLI definitions for these locations. The CRN sites are easily identified on the newdcps web page via their owner identifier of "NOACRD". These sites provide on an hourly basis, 5 minute air temperature and 5 minute incremental rainfall, along with hourly values of average wind speed and solar radiation.