Office of Hydrologic Development
Hydrologic Software Engineering Branch
Quarterly Activity Newsletter
January 1, 2008

Software for NWS Hydrology!

Chief, HSEB, Jon Roe
Project Area Leaders: Larry Cedrone, Chris Dietz, Mark Fresch, Mark Glaudemans, Joe Gofus

1   HIGHLIGHTS FOR October, November, and December 2007

Most AWIPS software development efforts during this period were dedicated to development work for OB8.3 tasks. Other key activities included support for field test and evaluations, and continued guidance to the AWIPS prime contractor (Raytheon) regarding the software development, maintenance, build, and release practices. HSEB also supported the final testing stages of AWIPS Release OB8.2 which begins deployment in January 7, 2008.

For NEXRAD, HSEB continued implementing a dual polarization Quantitative Precipitation Estimation (QPE) algorithm and associated products. This software is targeted for deployment in NEXRAD RPG Build 11, along with the dual polarization initial operating capability. Deployment of the initial dual polarization operating capability and Build 11 is planned to begin in 2009.

The Community Hydrologic Prediction System (CHPS) project made significant progress this quarter; the main highlight was a workshop hosted at NCRFC during the week of December 17th to present the latest (and final) version of the CHPS FEWS Pilot system. The CHPS Acceleration Team (CAT) concluded at the end of the first day of the workshop that their evaluation of FEWS was complete; the team is now ready to present a formal recommendation regarding use of FEWS as the software infrastructure component for CHPS. Details are found in section 5.1.

HSEB also has devoted more resources for AWIPS-II in support of the Office of Science and Technology (OST) - details below.

2   NEXRAD SOFTWARE DEVELOPMENT

NEXRAD Build 10 is scheduled to begin deployment in March 2008. For Build 10, earlier this year, OHD made a small change to add the source ID of the mean field bias to a few of the PPS products (STP, OHP, and THP). As part of AWIPS OB8.2, WFOs will have the option to send to their associated RPG(s) either their locally-computed mean field bias or an RFC-computed mean field bias. The source ID is the ID of the AWIPS site which computed the bias.

2.1   Terminal Doppler Weather Radar (TDWR) PPS

OST is deploying Supplemental Product Generators (SPGs) to WFOs near TDWRs, with a scheduled completion date of September 2008. An SPG is a modified RPG which ingests Terminal Doppler Weather Radar (TDWR) data to produce NEXRAD-like products. In SPG Build 3, HSEB adapted the NEXRAD PPS to the SPG so that it produces TDWR-based precipitation products with the same names and formats as NEXRAD precipitation products such the Storm Total Precipitation. SPG Build 3 is scheduled to deploy in spring 2008. TDWR-based precipitation products are displayable on AWIPS D2D with Release OB8.2.

2.2   Dual Polarization

HSEB continues to implement the dual polarization QPE algorithm and products into the Radar Product Generator (RPG). This past quarter, HSEB completed coding the new dual polarization products and supported the Global System Division's (GSD/Boulder) testing of those product displays and menus in AWIPS, which will be available in AWIPS Release OB8.3 (upon deployment of NEXRAD dual polarization). The dual polarization QPE algorithm is planned for NEXRAD Build 11, and Build 11 software is due in spring 2008. Build 11 and the hardware for the upgrade to NEXRAD are currently planned to start deployment in 2009. The large gap between delivery and deployment is to allow extensive testing of the new dual polarization hardware and software.

3   AWIPS RELEASE OB8.2

AWIPS Release OB8.2 deployment begins in early January 2008. During the past quarter, HSEB developers have been supporting the AWIPS testing process and addressing a few problems which have been discovered in the testing. The release notes for OHD software are accessible from the following two main web pages:

https://ocwws.weather.gov/intranet/whfs/ (OHD Common release notes for OB8.2)
http://www.nws.noaa.gov/om/water/RFC_support/ (RFC Only release for OB8.2)

3.1   NWSRFS

AWIPS Release OB8.2 will include enhancements to three NWSRFS areas: Deterministic Verification (IVP), Distributed Hydrologic Modeling, and DIURNAL technique for Mean Areal Temperature calculations at some RFCs. For more details of the enhancements, please refer to earlier newsletters.

3.2   Precipitation Processing

3.2.1 RFC Bias Transfer to WFO RPG

This OB8.2 change enables RFCs to send their mean-field bias to WFOs, and for WFOs to send the RFC bias on to the NEXRAD RPG. The quality control of rain gage data results in better bias information, and RFCs have staff that specializes in this task. The WFO will be able to a) select the RFC from which they receive the bias, b) use the RFC generated bias in local MPE operations, and c) select whether to send the RFC generated or locally generated bias to their associated RPG.

3.2.2 Satellite-Radar-Gage Products

Three new QPE products using satellite data are incorporated into MPE operations for OB8.2. A raw satellite and a locally unbiased satellite product already exist, but no products existed that integrated radar and gage data with the satellite data. The three new products are: satellite-radar, satellite-gage, and satellite-radar-gage (SRG). The automatic generation of these fields is expected to replace the manual cut-and-paste now required to combine the satellite field with the radar-gage multi-sensor field in areas with poor radar and gage coverage. This project includes both the generation (through MPE_fieldgen) and display (through MPE_Editor) of the new fields.

3.2.3 RFC QPE Products

OB7.2 MPE allowed RFCs to transmit their best estimate hourly QPE grids for external distribution, and for the WFOs to receive these products and display them in D2D and WHFS applications (HydroView, MPEeditor). This ability complemented the ability provided in OB6 for displaying the locally generated MPE best estimate grid in D2D. Unfortunately, approval issues prevented the grids from being available on the SBN data stream and a decoding problem prevented their storage and use at the WFOs.

The ZETA98 products have since been approved, and OB8.2 included a fix to the GRIB decoder to allow this end-to-end functionality. Offices do need to perform some minor configuration changes to enable this feature. Please contact HSD for configuration and users information upon delivery of OB8.2. These grids represent the best hourly QPE the NWS has available, and can be of great benefit for many activities, including real-time analysis, QPF verification, etc.

3.2.4 RFC GFE

The Graphical Forecast Editor (GFE) is being installed at RFCs for the first time in OB8.2. Even with operational concerns about performance issues, the GFE offers powerful tools and opportunities to perform processing of gridded data sets at RFCs.

To support this deployment, a 4-day workshop was held at GSD in Boulder, CO the week of October 15, 2007. Two representatives from each RFC attended, and Mark Glaudemans and Paul Tilles from the HSEB also attended.

3.3   WHFS and Other Changes

Some other noteworthy changes include a new color selection dialog to manage colors for point data and for gridded overlays in HydroView and MPE_editor. The Site Specific headwater model also received numerous enhancements such as the added ability to save QPE and QPF

defined interactively within SSHP, and to load those in for later runs of the model, and the added ability to select an alternate unit hydrograph per event. Some deficiencies in RiverMonitor were addressed and some new features were added.

For a full list of changes, please refer to formal release notes accessible from the web page noted above.

4 AWIPS RELEASE OB8.3

During the quarter, HSEB completed development for AWIPS Release OB8.3. We formally delivered the software in mid-November and participated in Pre-Integration Testing (PIT) in December. We integrated a new version of the PostgreSQL data server into all the OHD applications. Our major projects for this build are summarized below.

4.1 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.

4.1.1 Re-implementation of ICP

HSEB accepted the software produced by RTi to re-implement the Interactive Calibration Program in an object-oriented framework. 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.

4.1.2 NWSRFS Reservoir Tool Enhancements

HSEB also accepted the software produced by RTi to incorporate two enhancements to 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.

4.1.3 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 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 QPF data whenever it is available. DHM was modified to accept as input rainfall and snowmelt grids created by the prototype Hydrology Lab Research Distributed Hydrologic

Model (HL-RDHM), which incorporates the SNOW-17 model, in addition to the current QPE grids.

4.2   Multi-Sensor Precipitation Processing

Major work has been completed towards the goal of integrating the QPE operations of DailyQC within the Multi-sensor Precipitation Estimator (MPE). Also, a "disaggregation" operation is now incorporated within MPE to use hourly gridded estimates to time-distribute 6-hour estimates into 1-hour estimates. HSEB has been coordinating these activities with RFCs and regional representatives. HSEB uses a requirements spreadsheet to track their implementation; this spreadsheet can be provided upon request.

4.3   High-resolution Precipitation Estimator (HPE)

HSEB completed development of the High-resolution Precipitation Estimator (HPE, formerly called the Enhanced MPE (EMPE)). HPE will be a separate application from MPE, and will produce precipitation grids as small as 1 km by 1 km and as often as every 5 minutes. This change in conjunction with planned changes to FFMP will allow frequent high resolution mosaics (from multiple radars) to be used within FFMP. This quarter, HSEB continued field tests at the WFOs in Salt Lake City, UT and Houston, TX, and completed field tests at the ABRFC, MARFC, and LMRFC, and at the WFO in Melbourne, FL.

4.4   RFC Archive Database Synchronization

This project involves new software to perform two tasks. First, a set of automated tools are available to synchronize select meta-data in the RFC Archive (RAX) database with the Integrated Hydrologic Forecast System (IHFS) database. Data from the IHFS database can be copied to the RAX database. Because one can not copy from the RAX database to the IHFS database it is important to ensure the IHFS database contains the latest data. Second, a new application called "RAXBase" is provided to manage select data sets in the RAX database. RAXBase is similar to HydroBase in concept, although it has a different look and feel. The software has been actively evaluated by MBRFC, CNRFC, and APRFC; HSEB is very appreciative of the critical support these RFCS have provided.

4.5   WHFS

OB8.3 includes a collection of minor changes to HydroBase and assorted utility programs such as the ObsFcstMonitor application, which automatically compares observed and forecast value to check for consistency. RiverPro provides a new, much more user-friendly 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 significantly to allow automatic monitoring of precipitation data, in addition to its existing ability to monitor river data. The table displayed by the "PrecipMonitor" mode lists precipitation data station locations (i.e., not basins) on each row

of the table and the columns provide accumulation values for different durations along with the Flash Flood Guidance (FFG) value for the area containing the location. Difference and ratio comparisons between precipitation and FFG values are also provided. This information is meant to provide a hands-free, automatically updating, location-based complement to the basin-based mode used in FFMP. 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.

5 AWIPS RELEASE OB9

During the next quarter, HSEB will work mostly on software development for OB9 projects including the following:

- High-resolution Precipitation Nowcaster (HPN) – provides mosaicked radar-based high-resolution forecasts of precipitation rate and accumulation up to 1-hr.
- Variational Data Assimilation (VAR) in the Site Specific Hydrologic Predictor model - this processing will be used to update information about soil moisture conditions, thereby improving accuracy of the resulting stream forecasts. The stream routing that was also planned for OB9 has been deferred indefinitely due to unanimous regional concerns.
- Enhancements to the Sacramento Model to Handle Implications of Frozen Ground on Watershed Runoff (SAC-HT) – A new operation will be added which incorporates an improved heat transfer algorithm and frozen soil effects into the Sacramento Model.
- Assorted enhancements are scheduled. The specific changes to be completed are still being determined. Much more detail for OB9 will be available in the next quarterly Newsletter.

6 DEVELOPMENT SUPPORT ACTIVITIES

6.1 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/).

6.1.1 HydroXC

In October Apex Digital Systems and Dr. Michael Piasecki from Drexel University submitted to OHD a proposal for the FY08 Hydrology budget that would build upon work completed in previous fiscal years, and help make the HydroXC work successful and self-sustaining. The Apex/Piasecki proposal suggests aligning the Hydro XML with the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI)'s WaterML schema (ref. http://www.cuahsi.org/his/documentation.html); this would provide sorely needed resources to the overall hydrologic XML effort. OHD expects to finalize the FY08 Hydrology budget during the next quarter.

6.1.2 CHPS FEWS Pilot

As of January 1, 2008 WL | Delft Hydraulics became part of Deltares, an independent Dutch institute. Visit http://www.wldelft.nl/gen/intro/english/index.html for more information.

At a workshop hosted by the NCRFC in Chanhassen, MN during the week of December 17, Delft Hydraulics (now Deltares) presented and demonstrated the final version of the CHPS FEWS Pilot system. The most recent set of enhancements include:

- Install the Pilot at ABRFC (3rd Pilot site, joining NWRFC and NCRFC)
- Develop a MODs-like capability for the SAC-SMA model states
- Configure all Pilot sites as client-servers (formerly standalone)
- Provide additional segment definitions for the Santiam River for NWRFC
- Provide more in-depth training to all Pilot sites; and more detailed documentation
- Provide access to SNOW-17 (replaces Delft's SNOWMELT in the original Pilot)

At the end of the first day of presentations, the CHPS Acceleration Team (CAT) concluded that it was ready to make a recommendation to the NOAA Hydrology Program Manager (Gary Carter, Director OHD) concerning use of FEWS for CHPS. Based on the CHPS FEWS Pilot system, the team is now satisfied that FEWS is a comprehensive platform which can be adapted to meet the current operational needs of NWS RFCs (i.e., is a suitable foundation for an NWSRFS replacement); and additionally has the potential to meet future needs of CHPS as a whole.

The CAT is now in the process of preparing a final recommendation paper to be delivered to the OHD Director.

During the upcoming weeks the CAT will work closely with Deltares and other contractors to define a migration strategy which will introduce the first operational version of CHPS at all RFCs. HSEB expects to present details of the strategy to HICs at the HIC meeting in Silver Spring in January 2008.

6.1.3 CHPS-AWIPS II

Raytheon concluded their analysis of CHPS (FEWS), and delivered a proposal to OHD at the end of October for an approach to the CHPS-AWIPS II interface. Delft (Deltares) played a significant role in the task. The report suggested a 3-phased approach as follows:
- Phase 1 – CHPS co-exists with AWIPS II in its existing form. Neither CHPS nor AWIPS II will impact the other. This allows deployment of CHPS to proceed independently of the AWIPS II deployment.
- Phase 2 – Extend AWIPS II services to support CHPS-specific input and output data needs. No changes to FEWS (or CHPS) would be required.
- Phase 3 – Optionally extend FEWS to provide certain AWIPS II-specific extensions.

HSEB is waiting for Raytheon to submit a cost/technical proposal for Phase 2 activities.

6.1.4 ResSim

Acceptance testing at CNRFC occurred during November. An adequately functional version of ResSim was installed, along with OHD's/Apex's enhanced version of NWSRFS. An outstanding issue concerning ResSim's ability to execute a warm start in the manner expected by RFC forecasters was never resolved. As the necessary changes to ResSim would be extensive, CNRFC agreed that their plan to move forward with ResSim in their operations could proceed with minor impact. The USACE HEC will submit a proposal to the YCWA to make the necessary design and code changes to ResSim. This HEC activity will delay Phase 2, which is expected to add processing of ensemble forecasts in ResSim.

CNRFC will continue to run ResSim over the winter to evaluate its behavior/performance.

6.1.5 HEC-RAS

Phase 1 of the project began with a kick-off conference call in December where a proposed project schedule was discussed. The project team consists of the following members:

- Delft (Deltares) as the overall software project lead.
- LMRFC (David Welch, Dave Ramirez) will provide the RFC forecaster perspective, as well as technical support for potential use of local applications. [Note: OHD has also contacted OHRFC to request their participation on the team.]
- HEC will identify the level of effort required to port their existing Sun Solaris-based RAS software to Linux.
- OHD HSMB will represent OHD's requirements for getting RAS into operations as a replacement for FldWav.
- OHD HSEB will monitor the contract task with Apex (mechanism used to access Deltares), and also the MOA between HEC and OHD.

Deltares plans to travel to the U.S. at the end of February to meet with HEC, OHD, and LMRFC, and begin the process of prototyping/designing a solution.

Phase 2 of the project - implementation of the final solution - is expected to begin later this FY.

6.1.6 Experimental Ensemble Forecast System (XEFS)

On October 19 HSEB submitted a "High Level Analysis and Design" document to the XEFS Implementation Team for review. This document contained a proposed software design to meet the requirements specified in the XEFS Design and Gap Analysis Report (available at http://www.weather.gov/oh/rfcdev/docs/XEFS_design_gap_analysis_report_final.pdf).

In December HSEB held a meeting to address feedback received on the document. However the discussion prompted a re-think of the implementation strategy, which – until that point – had been to develop a solution based on CHPS concepts but independently of FEWS.

Since it was becoming clear that FEWS would be the solution of choice for CHPS the XEFS Execution Manager, in consultation with the XEFS Oversight Group and numerous other subject matter experts, determined that the XEFS software design should be based entirely on FEWS. This is the most cost effective and least risky path to take.

HSEB will prepare a Statement Of Objectives (SOO) for release once: a) the final FY08 budget for Core Goal #8 (forecast uncertainty) is approved; and b) an appropriate contractual vehicle is in place. Deltares's technical proposal in response to the SOO will provide the necessary input for a new XEFS implementation plan.

6.2   AWIPS II

As part of their overall NWS contract, Raytheon is migrating the national baseline software suite into a new, modern services-oriented architecture (SOA). This generally will not include the RFC software, but will include the WHFS, Precipitation Processing, and Data Ingest software which HSEB is responsible.

The Continuous Technology Refresh (CTR) Product Improvement Plan (PIP) describes the plan that Raytheon is executing with oversight from the NWS, to perform a migration of the AWIPS baseline software. The migrated system is being referred to as AWIPS II, with the actual migration performed as part of (4) separate task orders, labeled as Task Orders 8, 9, 10, and 11. Each task order is scheduled to last 6 months. Roughly speaking, the four task orders are for D2D, GFE, "Hydro", and "SCAN, MDL software", in that order. The software for the T08 D2D functionality is to be delivered in late January 2008. The bulk of the OHD software is scheduled for Task Order 10, which begins in July 2008 and ends January 2009. Subsequent deployment of this new system is scheduled to phased in after the OB9 releases, with full deployments beginning in summer 2009.

HSEB has been involved in support planning to help prepare for the mandate that most of the AWIPS local application software needs to be migrated into the new architecture, including transition of the local software which accesses any PostGreSQL database. OHD is also developing a training plan for its staff to become proficient in the new software engineering technologies employed by AWIPS-II.

6.3   GENERAL TESTING

Informal evaluations at certain offices are ongoing or are being readied:

- WGRFC is ingesting NSSL-provided Q2 QPE grids into the MPE environment for informal side-by-side comparison.
- ABRFC is providing feedback on the MPE application as HSEB continues to work on improving the speed of MPE re-run analyses performed interactively.
- WGRFC and FWD (Fort Worth WFO) are or will soon be testing the Site-Specific VAR components.

- Selected WFOs in the CNRFC area, particularly SGX (San Diego WFO) will be testing changes to the station precipitation accumulations algorithm used for ALERT stations.
- NWRFC will be testing the OB8.3 MPE/DailyQC operations.

6.4   AWIPS SYSTEM CHANGES

HSEB is aware of the following changes to AWIPS infrastructure packages in upcoming releases.

6.4.1 OB8.2

This release will include a Java callable graphing package, ChartDirector 4.1.

6.4.2 OB8.3

AWIPS will upgrade a number of infrastructure packages for OB8.3, but this list has changed slightly from that provided in the previous newsletter. The current list of packages upgraded is:

- PostgreSQL to version 8.2.5 (or possibly to 8.2.6 due to a recent security release)
- Grib2 decoder – degrib, version 1.85
- Python, version 2.5
- scientific python, version 2.6
- numeric python, version 24.2
- LDM, version 6.6.4
- Swig, version 1.3.31

6.4.3 OB9

The AWIPS Software Engineering Group (SWEG) is still considering upgrades to infrastructure packages for the OB9 releases. However, it is likely that an upgrade to the RedHat Enterprise Linux operating system will occur as a maintenance release within OB9.

7   HYDROMETEOROLOGICAL AUTOMATED DATA SYSTEM (HADS)

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

7.1   HADS SYSTEMS & SOFTWARE

HADS systems continued their stable performance and no operationally significant software modifications were implemented during the past several months.

A significant systems event that occupied quite some time and effort during the past 8 weeks was the preparation of the HADS IT Security Certification and Accreditation (C&A) process, and in having the systems tested for their security configurations. The C&A was completed just as the calendar closed on 2007.

HADS at the Back-up Telecommunications Gateway (BTG), although operationally capable from a data processing perspective, still awaits certain actions by NWSTG personnel and their ability to provide an operational GOES DCS data feed to the BTG. We hope to have this remedied during the next couple of months and to then have a truly redundant operating facility to support the HADS program.

7.2   HADS DATA NETWORK

As of December 31st, there were 13,009 data points defined in the network providing 2.2 to 2.3 million data values each day. The network continues to expand at rates of 4% - 5% per year and 552 new reporting sites were added to the network during 2007.

During the winter months the number of malfunctioning data platforms increases on a nearly daily basis and typically peaks during the last week of January. The following chart depicts the variation in the number of platforms 'off-line' each morning at 12Z. The chart covers the time period from 10/1/2005 through January 1, 2008.
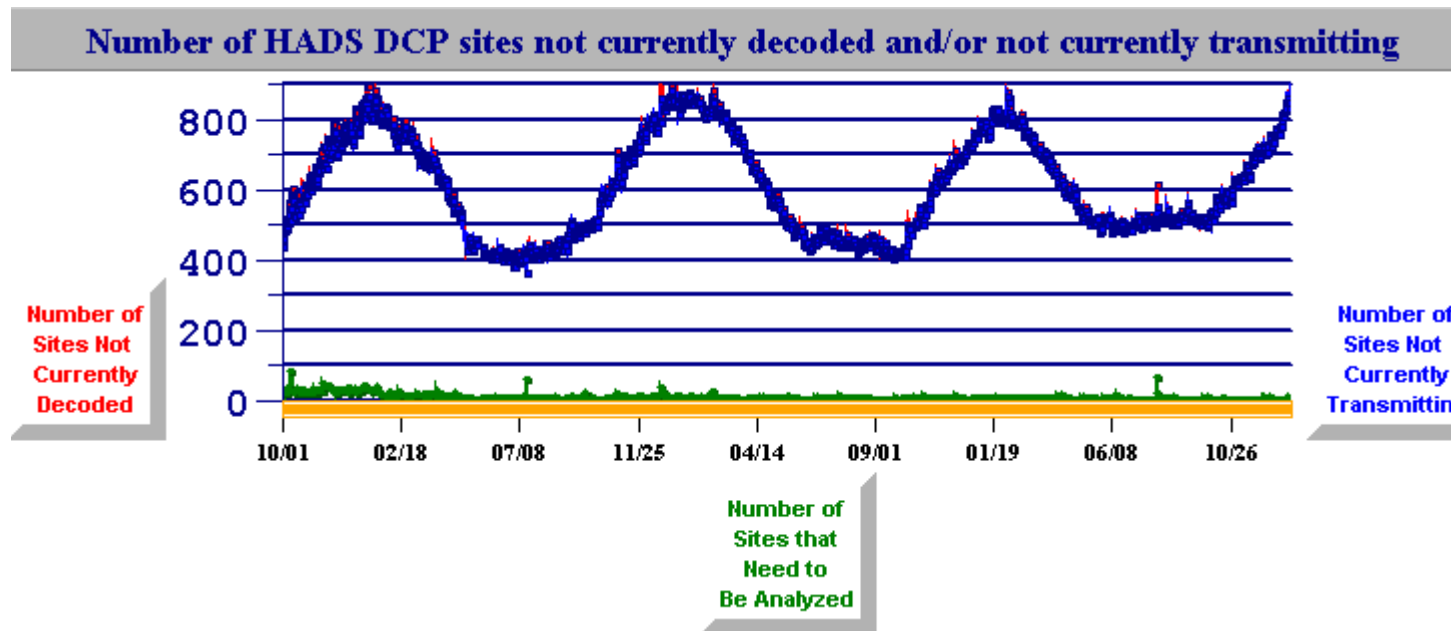
During the peak outage of the season approximately 6% (820 – 880) of the data points are not transmitting.

The owners/operators of the GOES DCS platform continue their efforts to migrate their older platforms to the High Data Rate (HDR) systems and change their transmission frequencies to a 1-hour cycle. This activity continues to represent a major portion of the work involved in

maintaining the HADS data network, as a number of DCPs are replaced each day. On January 1, 2007 there were 6,457 HDR platforms defined in HADS, and on this New Year's Day 2008, there were 8,067 HDR locations.