Office of Hydrologic Development
Hydrologic Software Engineering Branch
Quarterly Activity Newsletter
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Software for NWS Hydrology!

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1   HIGHLIGHTS FOR JULY, AUGUST, AND SEPTEMBER 2006

Most software development efforts during this period were dedicated to a wrap up of AWIPS Release OB7.2, and early development work for OB8 tasks. Other key activities included support for field test and evaluations, and adapting to major changes to software development and maintenance practices associated with the ongoing implementation of the not-so-new AWIPS prime contract.

As reported in a page available via: https://www.ops1.nws.noaa.gov/Secure/awips_softwre.htm, all sites essentially have AWIPS OB6.1.2. The final System Verification Review (SVR) for OB7.1 is scheduled for October 6 and regular deployment will begin October 17. The proposed SVR date for OB7.2 is January 12, 2007, and regular deployment around January 24.

OB7.2 development includes the following major OHD tasks: implementation of Build 1 of the Distributed Hydrologic Modeling (DHM) capability, conversion of the RFC Archive database from Informix to PostgreSQL, upgrades to the Multi-Sensor Precipitation Estimator (MPE) suite of applications, a major enhancement of the HydroView station data display capabilities, and enhancements to the RiverPro formatter to support Valid Time Event Coding (VTEC).

HSEB completed implementation of the Terminal Doppler Weather Radar (TDWR)-based precipitation products (with target SPG Build 3 in 2007), and delivered the software to OS&T for testing. NEXRAD-like precipitation products will be generated from TDWRs with Supplemental Product Generators (SPGs). SPGs have been deployed for a limited number of WFOs with TDWRs, but plans are to deploy SPGs to all 45 WFOs with TDWRs. Support of NEXRAD Dual Polarization (target RPG Build 11, deployment expected 2009) continued. This quarter HSEB continued the requirements definition for the dual polarization Quantitative Precipitation Estimation algorithm.

2   NEXRAD SOFTWARE DEVELOPMENT

The next NEXRAD RPG build, Build 9, is scheduled for deployment in Spring 2007. For that build, HSEB re-hosted the Precipitation Processing System (PPS) to a LINUX operating system

and fixed some minor bugs. Level III radar precipitation product specifications for the last few RPG builds are available on OHD's website: http://hsp.nws.noaa.gov/oh/hrl/wsr88d_prods/index.htm. The updated Build 9 specifications will be available starting in early October 2006.

2.1   Terminal Doppler Weather Radar (TDWR) PPS

The team has adapted the RPG-based PPS to process TDWR data on the SPG, a modified RPG ingesting TDWR data. During the quarter, the coding and developer testing were completed, and the code was provided to OST for formal testing.

The TDWR-based PPS will generate the same set of NEXRAD precipitation products at the same resolutions and about the same update frequency (five minutes). However, due to different scanning strategies and filtering, the TDWR-based PPS has some large differences compared to the NEXRAD PPS. The TDWR-based PPS only uses the data from the first elevation scan, does not use the Radar Echo Classifier (REC) algorithm, and does not account for terrain blockages.

Current plans are to make the TDWR-base precipitation products (such as Storm Total Precipitation) displayable with AWIPS OB8.3. However, the products will not be available from every TDWR until the SPGs are fully deployed.

This project is managed within HOSIP as NID 06-003 and is in Stage 4 (Operational Development). It is funded from the NEXRAD Product Improvement (NPI) budget. The requirement for TDWR-based products was ranked as being very high last summer by regional representatives to the OS&T-led Radar Capability Enhancement Priorities working group. OS&T is managing the overall TDWR effort as OSIP project 05-066.

2.2   Dual Polarization

The HSEB NEXRAD project team continued to support the Dual Polarization project. Deployment of dual polarization is planned to start in Build 11 in 2009. The Dual Polarization project is tracked via the NWS OSIP as project 05-023 (https://osip.nws.noaa.gov/osip/index.php). The project is now in Stage 3 with an expected Gate 3 in mid-October. This project is the NEXRAD team's highest priority, but it still has a way to go before being ready for deployment.

This past quarter, the HSEB, OST/SEC, and OOS/ROC continued requirements definition of the dual polarization software algorithms originally prototyped by NSSL, including the dual polarization QPE algorithm. Walkthroughs were completed, and next quarter we plan to begin implementing the baseline version of the algorithms into the NEXRAD RPG.

The Dual Polarization Software Design Working Group formed and led by HSEB continues to meet at least monthly. The primary goal of the group is to share knowledge, especially software

design, among all collaborators (OHD, OOS/ROC, NSSL, OS&T, and the FAA), and define schedules that will assure smooth transition of NSSL's algorithms into the operational baseline.

In coordination with the ROC, NSSL has begun a Product Development project, whose objective is to make recommendations on the operational polarimetric product suite and formats to implement and use, based on input from operational users and trainers. The project is expected to run through Fall 2006.

3. AWIPS RELEASE OB6

Refer to the OCWWS/HSD web pages for release notes and other relevant documentation:
-- For RFS Support: http://www.nws.noaa.gov/os/water/RFC_support/index.shtml.
-- For OHD Common Support: http://www.nws.noaa.gov/om/whfs/

The primary purpose of the OB6 build was to port our applications to the PostgreSQL database and to the new RHEL 3 operating system. The Red Hat Enterprise Linux Workstation Basic Version 3 Update 4 (RHEL3u4) is the operating system for AWIPS Release OB6 for all systems except the RAX, which stays at Red Hat 7.2.

3.1 NWSRFS

During the last three months, we continued to provide support to the RFC Support team as issues came up with the deployed software.

3.2 VTEC OT&E

An Operational Test and Evaluation (OT&E) of the RiverPro VTEC features began in June, 2006, using RiverPro software provide via AWIPS ATAN 825. The OT&E will continue until July 2007, at which time all offices would use VTEC in RiverPro generated forecast point specific warning products. This coincides with the full implementation of AWIPS OB7.2. Weekly meetings at the OTE and Risk Reduction (RR) sites are used to coordinate the implementation of VTEC and the coincident implementation of the river product content policy, as dictated by NWS Directive 10-922.

3.3 PRECIPITATION PROCESSING

Sites are encouraged to take advantage of a change in OB6 which adds the ability to display locally generated MPE output in D2D. In order to view the local MPE grids in D2D, a minor localization step is needed, which was omitted from the OB6 installation process. This step was added to the OB7.1 installation post-install notes, and can be provided upon request by the OHD Common (i.e., WHFS) support team.

4. AWIPS RELEASE OB7.1

Release OB7.1 is undergoing final testing in preparation of beginning deployment in mid-October.

4.1 NWSRFS

Due to the limited time available after the OB7.1 schedule was announced, no functionality changes or bug fixes were made for the OB7.1 release. NWSRFS in OB7.1 will simply provide the same functionality as in OB6 in the OB7.1 operating system environment. Note that OB7.1 does include all of the fixes issued as interim releases to the OB6 release. The NWSRFS developers have spent the last three months providing support to the AWIPS/Raytheon testers conducting System Integration and System Acceptance Testing.

4.2 OHD COMMON SOFTWARE

As noted in the OB7.1 OHD Common Release notes available on the WHFS web page, enhancements and fixes were introduced in the OB7.1 common software. The noteworthy enhancements include:

- A new River Monitor application for providing automatically updated tabular information summarizing river conditions. This is an initial version delivered in part for RiverPro VTEC monitoring, but provides general monitoring of river data. It is enhanced in Release OB7.2.
- The ability to store and manage low water (i.e., drought) impact statements in the HydroBase application.
- The ability to perform alert/alarm against lower limit thresholds, to complement the existing upper limit exceedance thresholds.
- The improved ability to specify and manage the display of flow-based flood impact statements in RiverPro, beyond the existing traditional stage-based impacts.
- The separation of HydroView /MPE into distinct applications – one for HydroView and another for MPE (more MPE discussion is given in the precipitation processing section below).
- Assorted minor bug fixes including the restored ability to properly restart the SHEF decoder from the HydroBase application.

4.3 PRECIPITATION PROCESSING

In OB7.1, a collection of changes are introduced as part of the general mission to provide an integrated set of QPE tools within the Multi-Sensor Precipitation Estimator (MPE) application. Although the Western Region's Daily QC (DQC) functionality is not introduced until OB7.2, some enhancements from the Tulsa RFC P3 QPE application are introduced in OB7.1.

The changes include the introduction of three new grid types: a) Triangulated Local Bias Corrected Multi-Sensor Mosaic; b) Radar Average mosaic; and c) Radar Maximum Mosaic. A token is used to control which grids are actually generated at a given office. A separate token is used to control which of the radar mosaics is used for the subsequent grids that use a radar mosaic as an input. Either the existing climatologically-based mosaic is used or one of the new average or maximum grids is used. The existing MPE polygon editing tools are extended in OB7.1 to allow the user to apply, save, or delete polygon-based edits. Lastly, the MPE application, which is now separate from the HydroView application, has a split-screen feature to allow side-by-side comparison of grids.

5. AWIPS RELEASE OB7.2

Software for release OB7.2 is undergoing Software Integration & Testing (SWIT) at Raytheon's facility, and is scheduled to begin System Integration & Testing (SIT) on October 9.

5.1 NWSRFS

During the past 3 months we provided some support for Raytheon's testing of AWIPS OB7.2. Aside from general bug fixes, items targeted for OB7.2 include:

5.1.1 VERIFICATION

Raytheon has been unable to test this functionality at their facility because they do not have an OB7.2 RFC test platform. Testing is expected to begin once OB7.1 testing is completed and a test bed is made available.

5.1.2 CONVERSION OF RFC ARCHIVE DATABASE TO RHEL/POSTGRESQL

Again, Raytheon has been unable to test this functionality at their facility because they do not have an OB7.2 RFC test platform. Testing is expected to begin once OB7.1 testing is completed and a test bed is made available.

Raytheon has begun their development of OB7.2 installation scripts and procedures for the RFC Archive machine (RAX), but the AWIPS program's focus on OB7.1 testing has hindered progress on OB7.2.

5.1.3 DISTRIBUTED HYDROLOGIC MODELING (DHM)

HSEB implemented the distributed model as a new operation for NWSRFS, outputting grids in netCDF format so that D-2D can access them. Raytheon's ASM group implemented the

necessary changes to D-2D. Testing of the full end-to-end capability has proved challenging for several reasons; HSEB continues to work closely with ASM to make necessary adjustments to D-2D.

Raytheon will begin testing the complete DHM capability once they acquire an OB7.2 RFC test platform.

5.1.4 HISTORICAL DATA BROWSER (HDB)

Refer to section 5.1.1.

5.2 WHFS/IHFS DATABASE

Changes for OB7.2 include the implementation of the "Mapper" station data display function into WHFS, which currently operates as a local application used primarily in the Western Region. It provides a robust method for displaying hydrometeorological data, similar in many ways to the existing WHFS TimeSeries and HydroView station data display control functions. Its benefits are in its more direct methods for displaying desired data sets (i.e., less mouse clicking), its time-stepping features, and its speed of display. A new simplified TimeSeries feature is included with this new data display feature. This feature, dubbed "TimeSeriesLite", is a scaled-down version of the current WHFS Time Series feature.

The data monitoring tool RiverMon, which was delivered initially in OB7.1, is provided to monitor information related to river forecast points, including the VTEC event status. This application is intended to run continuously, with an automated refresh of color coded tabular information to identify alert/alarm conditions. Related to this is an automated application for monitoring differences between river forecast and observations to better identify unreliable forecasts such as when QPF forecasts are inaccurate. This monitoring tool fits within the existing WHFS Alert/Alarm functionality.

Some minor enhancements are also provided, including a new editor interface in HydroBase for the HydroGen support information, a new feature to adjust the icon sizes in HydroView, and new features in the TimeSeries tabular mode for copying forecast time series data and for globally setting quality code attributes.

Enhancements are also made to the RiverPro VTEC functionality. One of the changes involves full support for operating RiverPro in a practice mode. The changes extend the practice mode to be able to allow simulation of full event life-cycle testing for VTEC. For example, after the initial NEW event issuance, the subsequent EXTended or CONtinued actions can be issued, and culminating CANcel can be issued, all without transmitting any external product information and without interfering with the VTEC event sequencing and tracking associated with operational products.

5.3 PRECIPITATION PROCESSING

Please refer to the January 1, 2006 newsletter supplement for a detailed discussion of the HSEB QPE tasks which are ongoing. Some of this information related to OB7.2 is also mentioned below.

A major change to MPE operations in OB7.2 is the incorporation of the Daily QC functions used in the Western Region into MPE operations. The goal is to provide a nationally-supported and baselined application usable by all offices to perform QPE operations. For OB7.2, the existing Daily QC functionality is integrated into MPE. This involved new temperature and freezing level data quality control features, additional precipitation gage quality control options, and assorted interactive features. The MPE Daily QC in OB7.2 still operates in its 6- and 24-hour domain, solely. In early August, HSEB staff visited CBRFC to demonstrate and discuss the changes.

HSEB is also working to coordinate the delivery of RFC-generated QPE products to the SBN for subsequent receipt and use at WFOs. Changes were made to make these RFC QPE products displayable in D-2D at WFOs, to complement the locally generated QPE products which can be displayed in D-2D as of OB6.

Lastly, a new utility application (build_hourly) was provided to assemble hourly precipitation reports from sub-hourly data, so that the resulting data can be used in MPE operations.

6. AWIPS RELEASE OB8

On October 2 2006 the AWIPS prime contractor, Raytheon, assumed Adaptive and Corrective Maintenance (ACM) responsibility for all of OHD's baseline AWIPS software. The Knowledge Acquisition Process (KAP) began in late July 2006 and has occupied HSEB developers for the majority of the past 2 months. A final briefing by Raytheon to the AWIPS COTR took place on September 27. Although KAP formally ends as of October 1, HSEB will continue to work with Raytheon to bring ASM fully up-to-speed. Details for knowledge transfer from HSEB to ASM on future software development projects have not yet been addressed.

Note that OCWWS/HSD assumes an even more important role in determining project tasking, especially for maintenance work on existing software. Please coordinate your needs through your regional hydrologic representatives, who will work with NWS HQ staff, especially HSD, to manage change requests, whether they be for changing existing functionality or adding new functionality.

Related to the ACM task is the Source Code Transfer (SCT) task, which has involved transfer of all the OHD AWIPS baseline source code into the PVCS Dimensions configuration management tool operated by Raytheon. This activity is still ongoing.

These activities have significantly limited OHD's contribution to AWIPS OB8.1 new functionality because considerable labor has been required of OHD for these projects.

SEC has issued draft tasking letters to all software development organizations. For further information refer to the SREC's web site at: https://sec.noaa3a.awips.noaa.gov/srec/index.htm. Click on the 'Operational Build Information' link.

6.1 NWSRFS

HSEB has begun work on some enhancements which will be included in OB8:

6.1.1 SRA Tools Enhancements

Release OB8.1 will include four significant capability enhancements to the Res-J operation: a hindcasting capability, a "LOOKUP3" capability, diversion from a node, and a variable lag in the LAGK method in Res-J. Riverside Technologies, Inc. (RTi) has completed the software changes which implement these enhancements and HSEB personnel will complete the handoff procedures to get the enhancements into the AWIPS release. Below are further descriptions of each enhancement:

The RES-J operation will be updated to operate properly in ESP hindcasting mode. As RES-J prepares the carryover for returning to NWSRFS, additional logic will test the existence of a user-requested carryover save on the last simulation time step. The results of this test will define accurately the amount of carryover written at the end of simulation. This amount of carryover is included as an index in the carryover itself. The index embedded in the hindcast carryover file will be correct. Using the index, RES-J will successfully read saved hindcast carryover enabling it to simulate through successive periods necessary in hindcasting.

The RES-J operation will be extended to include a new method, LOOKUP3 method, defining a value as a function of two other values. The method will be applicable to RES-J reservoir and node components.

A node is assumed to have zero storage; therefore, the maximum diversion cannot exceed total nodal inflow minus some minimum discharge. A new node component parameter, MINDISCHARGE, will be added. This optional parameter will allow the user to define the minimum outflow discharge at a node similarly to how the MINRELEASE parameter currently defines minimum outflow release at a reservoir component. If not specified by the user, MINDISCHARGE will default to 0.

The RES-J operation's LAGK method will be enhanced to allow use of variable lags. The algorithms existent in the LAG/K operation to address variable lag for instantaneous input flow will be added to the RES-J operation's LAGK method. The mean discharge algorithms in the LAG/K operation will not be included as RES-J only uses instantaneous values.

6.1.2 Enhancements to Deterministic Verification

HSEB has begun the requirements analysis and design work on the next set of enhancements for the Deterministic Verification application. Upon delivery of the software for AWIPS OB8.2, the RFCs will gain new software capabilities that will enable them to compute additional verification statistics and analyze the statistics in a more robust manner. Furthermore, users will be able to verify input to the hydrologic models, including precipitation and temperature, while also verifying output from those models.

6.1.3 Reimplementation of ICP

HSEB finalized a contract with RTi to reimplement the Interactive Calibration Program in an object-oriented framework which will facilitate future maintenance and enhancements of the application. The modernized application which will provide the same functionality as the current baseline is targeted to be included in the AWIPS OB8.2 release.

7. DEVELOPMENT SUPPORT ACTIVITIES

7.1 NEW SOFTWARE ARCHITECTURE

Phase 3 of the contract task to provide tools for use by the Hydrology XML Consortium (HydroXC) has been defined and is awaiting contract award. This third phase will concentrate on crafting tools to manipulate HydroXC-compliant files, tools to convert into and out of HydroXC, and creation of commonly agreed upon object templates. The goal of Phase 3 will be to provide tools that can be used by Consortium members in their operational software as desired.

On the CHPS front, the following initiatives made progress this quarter:

- **CHPS Realization Plan**: Apex Digital Systems, Inc. began work on this task by initiating a "discovery engagement" with all stakeholders. A kick-off meeting was held July 11 in Kansas City; participants included members of the CHPS Acceleration Team (CAT), Apex, and HSEB. CAT members include: CNRFC, ABRFC, NWRFC, NCRFC, and OHD's Senior Scientist. In order to prioritize implementation efforts under CHPS, meetings in August and September focused on discussions of strengths and weaknesses of the current NWSRFS-based forecasting environment. The September meeting revealed a strong and clear desire by the CAT to introduce a completely new suite of forecasting software that is not based on the legacy NWSRFS. WL | Delft's Flood Early Warning System (FEWS) is widely regarded as a viable alternative. Apex has arranged a FEWS demonstration for CAT members during October.

- **Evaluate FEWS for CHPS**: Based on the clear message from the CAT under the Realization Plan task, HSEB re-focused this RTi task to be FEWS-centric rather than NWSRFS-centric. The purpose of this task is to implement a pilot version of FEWS

> running in an operational environment at one of the CAT RFCs; the pilot will incorporate the following key components: a SAC-SMA rainfall runoff model, a snow model, a unit hydrograph operation, a Kinematic and/or dynamic routing technique, and (depending on the scope and complexity) a reservoir operation. This task was awarded during the past week and is expected to begin in October.

> - A third CHPS-related external project to provide RFCs access to the USACE Reservoir Simulation (ResSim) model from NWSRFS also made good progress this period. The solution is to be based on WL | Delft's FEWS infrastructure. Apex Digital Systems, Inc. has worked closely with Rob Hartman, HIC at CNRFC, the USACE's Hydrologic Engineering Center (HEC), and consultants from WL | Delft. Apex plans to provide a progress briefing to OHD in mid-October.

7.2 AWIPS BETA TESTING

The VTEC (Valid Time Event Coding) and NWSI 10-922 features of RiverPro are being tested at field sites beginning in June 2006. This includes evaluation of the OB6-fitted version of the monitoring application RiverMon.

MPE related evaluations are also ongoing or starting soon. The ABRFC is evaluating an updated MPE application with P3 functionality.   Testing the MPE application with Daily QC features is being conducted at CBRFC beginning in August 2006. Also, testing of the HydroView time-step (i.e. "Mapper") functionality is ongoing.

7.3 AWIPS SYSTEM CHANGES

For OB7.1, the AWIPS Software Engineering Group (SwEG) has adopted numerous changes to the AWIPS COTS software. These include changing to the RHEL4u2 operating system version, the gcc 3.4.3 compiler, and the PostgreSQL 7.4.8 database server.

No changes to the AWIPS COTS software including the operating system have been announced for OB7.2 or OB8.1.

8. HYDROMETEOROLOGICAL AUTOMATED DATA SYSTEM (HADS)

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

8.1 HADS SYSTEMS & SOFTWARE

After more than 6 years of steady performance, the computer hardware that executes the HADS program is undergoing a technology refresh. The installation and activation of 5 new Dell servers will be completed during early October. Along with the acquisition of the new hardware, a shift in the physical location of two systems occurred. Equipment that was housed in an OHD's environment has been replaced and located within the NWS Telecommunications

Operations Center (TOC) in order to ensure that all HADS systems reside in a secure facility that provides redundant electrical power resources.

The real-time data processing of the GOES DCP messages and SHEF product creation was transitioned to a new system on September 12th and the benefits of the new processor was immediately recognized. The daily average time between DCP raw message creation and SHEF product distribution decreased by more than 60 seconds. And most noteworthy, the data decoding runtime which averaged 80-90 seconds on the old equipment now completes on average at 20 seconds.

The following chart: (from http://amazon.nws.noaa.gov/hads/charts/Product_Timeliness.html) depicts the improvement in end-to-end performance.
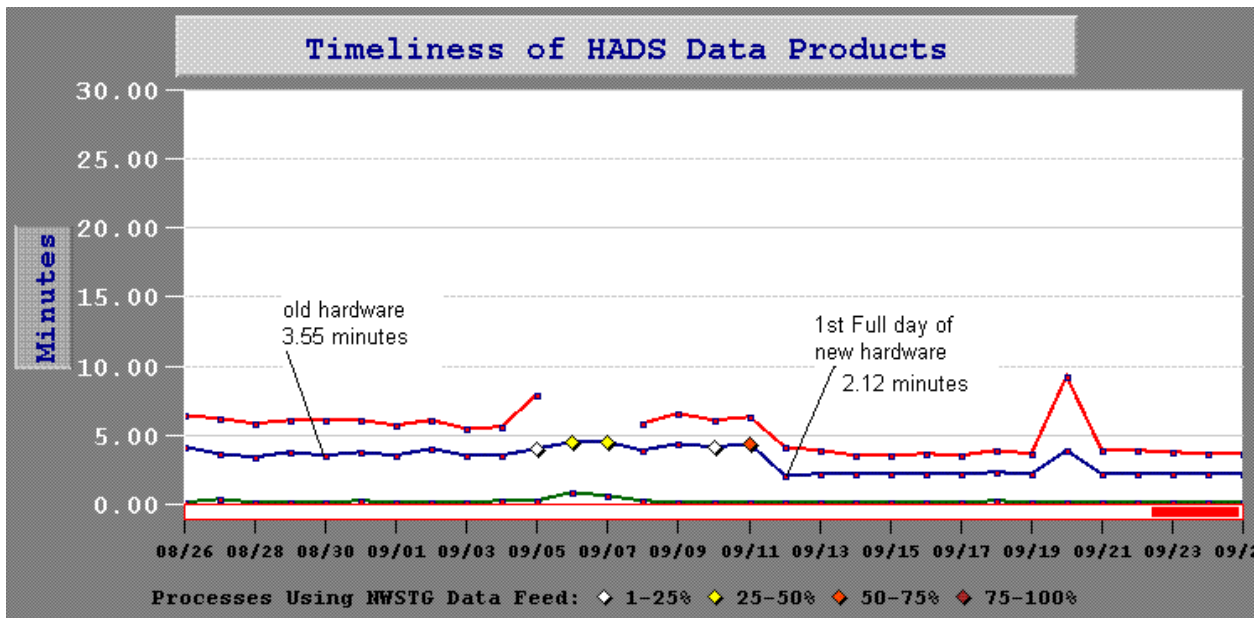
In addition to the technology refresh, the HADS program is nearing the implementation of a long term goal in which the HADS program also executes at the NWS Backup Telecommunication Center (BTG). During November 2006, servers will be installed at this new facility enabling HADS to perform in a 'Continuity of Operations' environment. In the near future, if an event should occur in which the NWS TOC has to switch its operations to its backup facility, HADS will be able to likewise switch operations "on" at the BTG and be capable of providing continuing service.

8.2 HADS DATA NETWORK

The data network continues its dynamic nature. Currently there are 12,331 locations defined in the network. An overall increase of 142 sites since June 30th and the average number of observational values processed each day has risen to nearly 2.1 million.

The NESDIS DCS community - the collaborators of the NWS – continue on a daily basis to deploy new platforms, alter the programs of existing platforms and transition existing platforms to one hourly transmitting High Data Rate (HDR) units.

Thanks to all of you that assist us in maintaining the HADS network, by discovering, coordinating and communicating the critical details required in order to effectively operation this system.