Hydrologic Database(HDB): Developments and Use

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Abstract: HDB was developed as the center of the WARSMP DSS tool chest in a collaboration between Reclamation and the University of Colorado Center for Advanced Decision Support for Water and Environmental Systems (CADSWES). HDB is implemented in an Oracle database, and includes applications to manage data, derive new data from existing data, and provide data to modeling systems. Recent work on HDB has focused on providing better archives of data and automatically recalculating data when source data changes. Collaboration with the USGS has resulted in the ability to use HDB with the DECODES software, which handles telemetry data and provides standard computation functionality for use in both agencies. This paper gives an overview of the capabilities of HDB, focusing on the results of recent work to make HDB a "database of record" and provide more information about where the data came from.

INTRODUCTION

Overview Several Reclamation offices in 4 of 5 regions are using HDB in various capacities. HDB has been in production use in the UC and LC regions of the Bureau of Reclamation since 1996. The original use was to allow the two regions to be custodians of their data, yet allow cooperative modeling of the entire basin. Operations of Glen Canyon Dam and Hoover Dam can interrelate, so modeling operations becomes an iterative process, supported by the database. Data enters HDB from many sources, including satellite and radio telemetry, state and federal agencies, and various Reclamation water users. With the use of an Oracle database and a reasonable database schema, access to hydrologic data from many applications becomes possible.

Hydromet, a VMS-based telemetry and database system has been in use in Reclamation for more than 20 years. It has been challenging to store data in HDB as the repository for modeling and reporting, but have realtime data and computations occurring in a separate system. Recently, the DECODES system developed by the USGS has been adapted to use HDB as the repository for the telemetry metadata and the decoded messages.

Database of Record In 2001, a database was envisioned that ensured consistent, timely and historical views of the data. To make this occur, when data is changed or deleted, all calculations that depend on that data must be revisited. This vision drove the HDB community to develop HDB2, which allowed for the automated aggregation of summary data when the

underlying data changed as well as archive and retrieval functionality. The beginning of this development was described in Davidson et al. (2002). HDB2 was put into production in 2004.

The "derivation application," the result of this development, accomplished its goals. However, it only performs aggregations, and is an external application that runs slower than desired and runs on a schedule. Therefore, when a user places data in the database, the aggregations dependent on that data are not updated until the next scheduled run.

Usage Among others, the WARSMP supported modeling systems, MMS and RiverWare, have the capability to read from and write data to HDB. One example of data flow is the use of HDB on the Gunnison river, where several external and internal data sources supply climatic and reservoir conditions, MMS is used to generate river flow ensembles, and RiverWare is used to evaluate the resulting reservoir conditions and operations. The data flows into and out of HDB to ensure that each model is using a consistent set of data.

HDB is also used as a data source for reports. Several applications use HDB as the data repository from which standard or ad hoc reports are created. Recently, off-the-shelf (OTS) software such as Crystal Reports has been found to be very useful in creating these types of reports directly from the database.

FUTURE DEVELOPMENTS

Calculation The calculation functionality is recognized as a superset of the aggregation functionality already developed. Reclamation is partnering with the USGS to develop a "computation processor" which will be available to both agencies. Key features are the ability for users to create new computations and alter old ones, automatic triggering of new computations when data changes, and the cascading of deletions of data through computations to delete their results. This development will replace the current derivation application.

The challenges involved in writing code to replace a working 20+ year old system are evident. Most challenging is replacing the ability to alter and create new algorithms to hydrologists and engineers. The approach selected is a Java based language, with templates and a controlled GUI to do the behind the scenes work to integrate this system into the rest of the computation processor. As of this writing, this work has been designed and is underway. A status report and future directions will occur with presentation and discussion of this paper.

Other work Other current efforts involve the use of HDB to store data to calculate the consumptive use and losses in the Colorado River basin. This work involves storing seasonal,

annual, and multi-year timeseries at multiple spatial scales. The source data and algorithms for this work also vary from state to state. The calculation of consumptive uses and losses and natural flow for use in the Colorado River Simulation System (CRSS) has been a manual, labor intensive process. HDB will be used as the storage and calculation system to streamline the future calculations of these important numbers, as well as the re-computation of past results.

Since USGS continues to publish realtime streamflow from their gages on the Internet, receiving telemetry and computing flows for their gages has become much less important. For use as a backup against network or system problems outside Reclamation's control, HDB will have the capability to use USGS algorithms and up-to-date streamflow rating tables to compute realtime streamflow, resulting in the same numbers as the USGS. Since Reclamation operates many satellite telemetry sites, the processing and storage of the USGS telemetry is a small additional burden.

Data Sources Reclamation owns and operates a separate GOES downlink station in Boise, ID. Future upgrades to the capacity of that system will allow HDB to directly receive the telemetry data from the downlink, or from backup DOMSAT receiver stations. The end result will be that HDB has a robust, efficient, and capable replacement for the Hydromet system, and is available for access from many OTS packages with little effort.

CONCLUSION

HDB is used for many different purposes. The vision of the database of record has resulted in an expansion of its use, and the future replacement of the Hydromet system. Reclamation welcomes the participation of the USGS in the telemetry and calculation arenas, and is expecting a effective system for the future. As other modeling systems and software allow connections to Oracle based databases, HDB will also gain those abilities. The future of HDB is bright.

REFERENCES

Davidson, P., Hedrich, R, Leavy, T., and Wilson, N. (2002). "Information systems development techniques and their application to the hydrologic database derivation application", Proceedings of the Second Federal Interagency Hydrologic Modeling Conference, http://cadswes.colorado.edu/PDF/RiverWare/DavidsonLV2002.pdf.