DSM2UG

Newsletter

Summer 2009

Delta Modeling Section

Annual Report (Ralph Finch, DWR)

The 2009 Annual Report is currently going through DWR's approval process, and should be publically available by the end of August. The five chapters included in this year's report are:

- Data Quality Associated with EC Values in the DICU Model
- Comparison of Model Results between DSM2 Versions 6 and 7 without Gates and Barriers
- Comparison of Model Results between DSM2 Versions 6 and 7 in Historical Simulation
- A Proposed Method for Sea Level Rise Exceedance Probability
- Adjustment of Export Using DSM2-PTM and PEI

Calculated Bromide Validation at Clifton Court Forebay and Jones Pumping Plant (Siqing Liu, DWR)

Calculated historical bromide at Clifton Court Forebay based on DSM2-simulated EC has been compared to measured bromide at Banks Pumping Plant. A brief background and summary of results are provided below.

At times, Delta Modeling Section provides long-term forecasts of EC and bromide at Banks and Jones Pumping Plants in support of the Real Time Data Forecasting program. While EC is simulated directly by DSM2, Bromide is calculated at the two locations using conversions developed by Paul Hutton and based upon DSM2-simulated volumetric fingerprints:

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California Department of Water Resources

1) Bromide (mg/l) = max (0.000552*EC (µS/cm) - 0.0073, .04 mg/l)
   When volumetric fingerpoint at Clifton Court Forebay and Jones Pumping is less than 0.4%
2) Bromide(mg/l) = max (0.000827*EC (µS/cm) - 0.112, .04 mg/l)
   When volumetric fingerpoint at Clifton Court Forebay and Jones Pumping is greater than 0.4%

These regressions are based upon grab samples in which both EC and bromide were tested and during the period for which fingerprinting of historical conditions exists (1991 through present).

In order to validate this method of estimating bromide based on DSM2-simulated EC, available measured bromide at Banks Pumping Plant (stations HRO and HBP) was compared to calculated bromide based on simulated EC, simulated volumetric fingerprint at Clifton Court Forebay, and the above regressions. In addition observed bromide was compared to calculated bromide using observed EC at Clifton Court Forebay and Banks Pumping Plant (HBP).

Figure 1 shows how DSM2-simulated EC at Clifton Court Forebay compares to measured EC at Clifton Court Forebay and Banks Pumping Plant (HBP) for January through May of 2009. DSM2-simulated EC was consistently lower than the observed EC, often by 100 µS/cm. This trend is also shown in Figure 2 in which bromide calculated from DSM2-simulated EC at Clifton Court Forebay is compared to bromide calculated from observed EC at Clifton Court Forebay and Banks Pumping Plant. Figure 3 directly compares calculated bromide based on DSM2-simulated EC at Clifton Court Forebay to observed bromide at Banks Pumping Plant. The daily average bromide observed at HRO and HBP significantly differ from each other in February of 2009. The average absolute error between calculated daily average bromide at Clifton Court Forebay and observed daily average bromide at HBP and HRO from February through May of 2009 are .04 mg/l and .06 mg/l respectively. At least for the 2009 data, calculating bromide from DSM2-simulated EC doesn't appear to introduce additional error beyond that which is occurs in simulating EC.

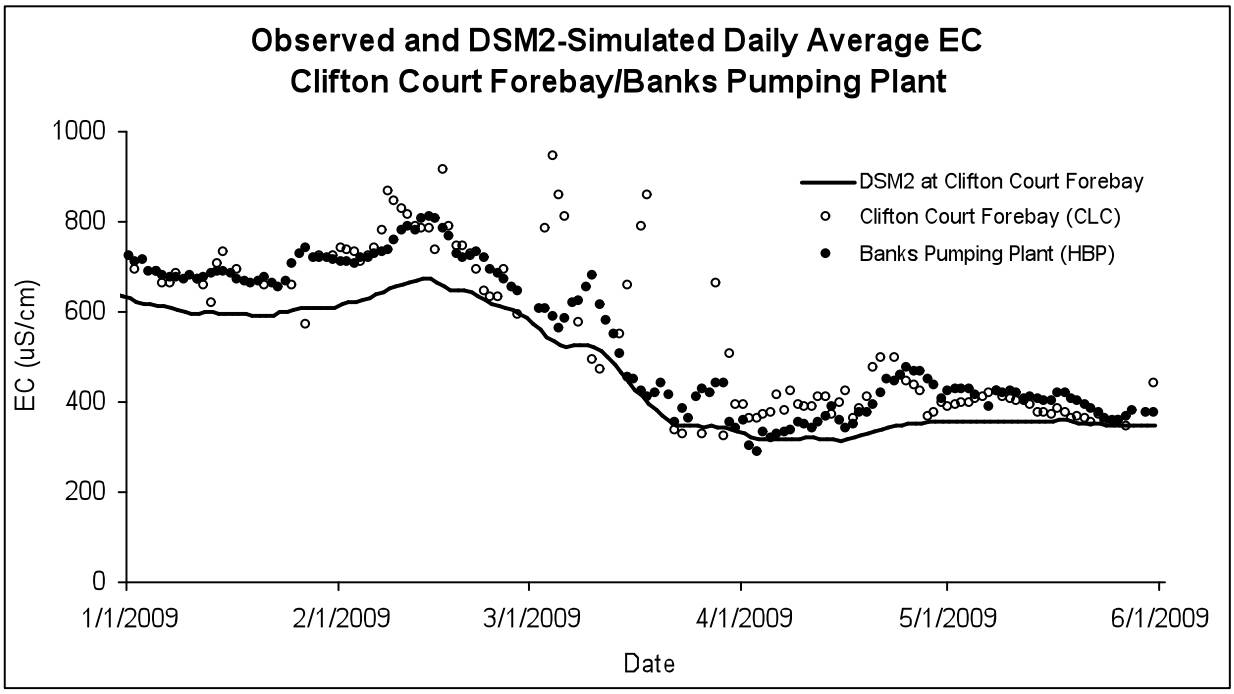

Figure 1. Comparison of DSM2-Simulated EC to Observed EC at Clifton Court Forebay/Banks Pumping Plant.

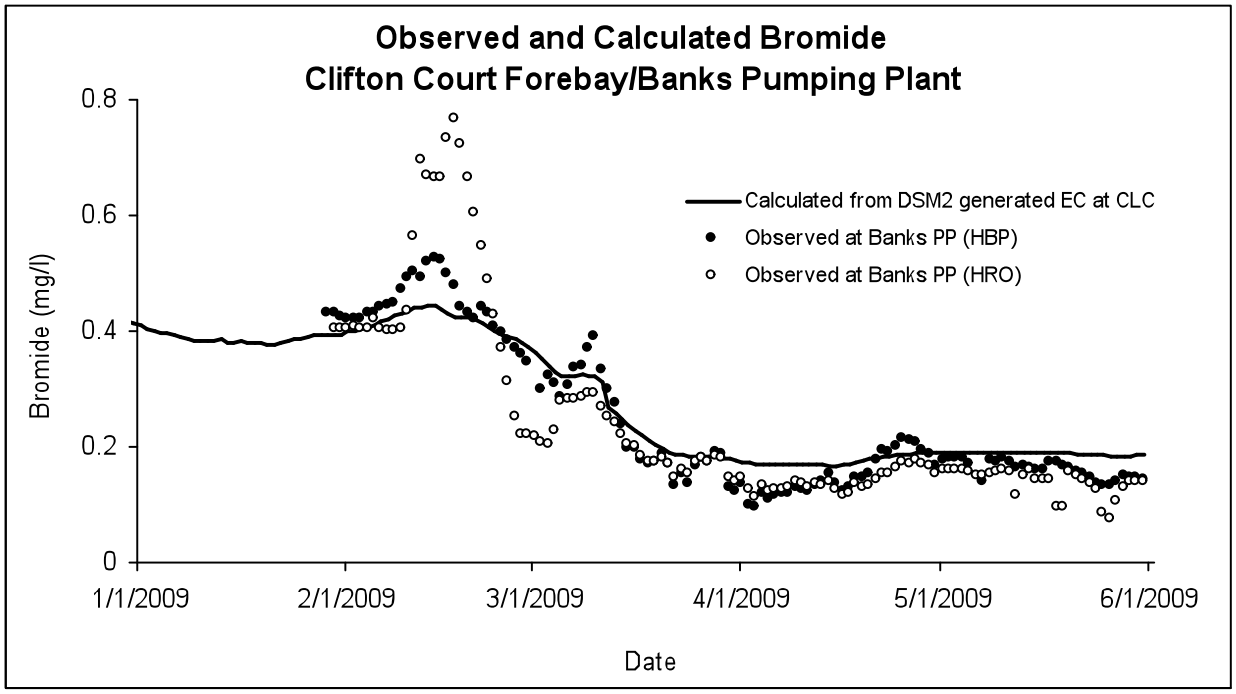

Figure 2. Comparison of Calculated Bromide at Clifton Court Forebay based on DSM2-simulated EC and observed EC.

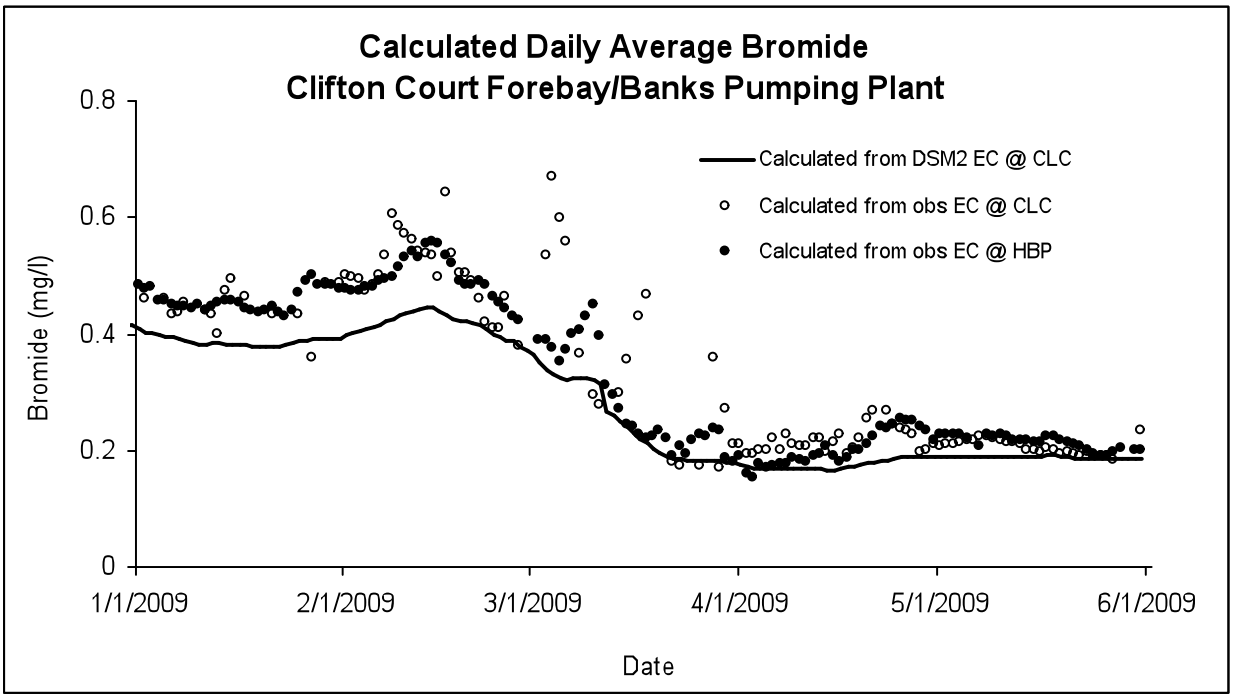

Figure 3. Comparison of Calculated Bromide based on DSM2-simulated EC to Observed EC at Clifton Court Forebay/ Banks Pumping Plant.

Update on Calibrating QUAL's Nutrient Model for Temperature and Ammonia, 1990 – 2008 (Marianne Guerin, RMA)

The majority of the work needed to calibrate and validate the Historical period (1990 - 2008) QUAL nutrient model has been completed. An extensive set of data has been gathered to inform boundary conditions, and for calibration and validation. USGS data is located on the Sacramento River, BDAT-sourced data (mainly EMP data) had good Delta-wide spatial coverage but variable temporal coverage, and Stockton WWTP receiving water data has good coverage on the San Joaquin R. from 1992 – present. All of this data is grab sample data, so in the form of irregular time series. In two large regions in the Delta, I currently have extremely sparse (Suisun Marsh) or no (Yolo/Cache) nutrient measurements, as shown in Figure 1 for two representative data sets. This presents a challenge for setting boundary conditions, particularly in the Yolo/Cache area. In addition, there are implications for modeling constituent concentrations in locations downstream of Rio Vista due to tidal exchange in low flow periods.

The temperature calibration and validation is complete, and the results are very good in general, apart from the inability to apply regional boundary conditions for meteorological input., as noted in previous talks. Six regions, shown in Figure 2, were chosen for calculating regional residual statistics, two of which have only one measurement location. Figure 3 shows water temperature output at Three Mile Slough in the Critically Dry calibration year 2008 as an example. The top plot compares data and model output, the middle figure shows the residual (data – model), and the lower plot is a histogram of the residuals. Various residual statistics are included in the plots – the residual statistics are defined in (Moriasi, et al., 2007).

The nutrient model calibration is very good at most locations, particularly for Ammonia (see Figure 4) and also, surprisingly, for algae. Hari's calibration along the San Joaquin River during DO studies has held up extremely well in the extended time frame. Current work consists of fine-tuning the parameterization at troublesome locations and developing calibration and validation statistics. (And, writing the report!)

Reference:

Moriasi, D.N., J.G. Arnold, M.W. Van Liew, R.L. Bingner, R.D. Hamel, T.L. Veith. (2007) Model evaluation guidelines for systematic quantification of accuracy in watershed simulations. Trans. ASABE, Vol. 50(3): 885 – 900.

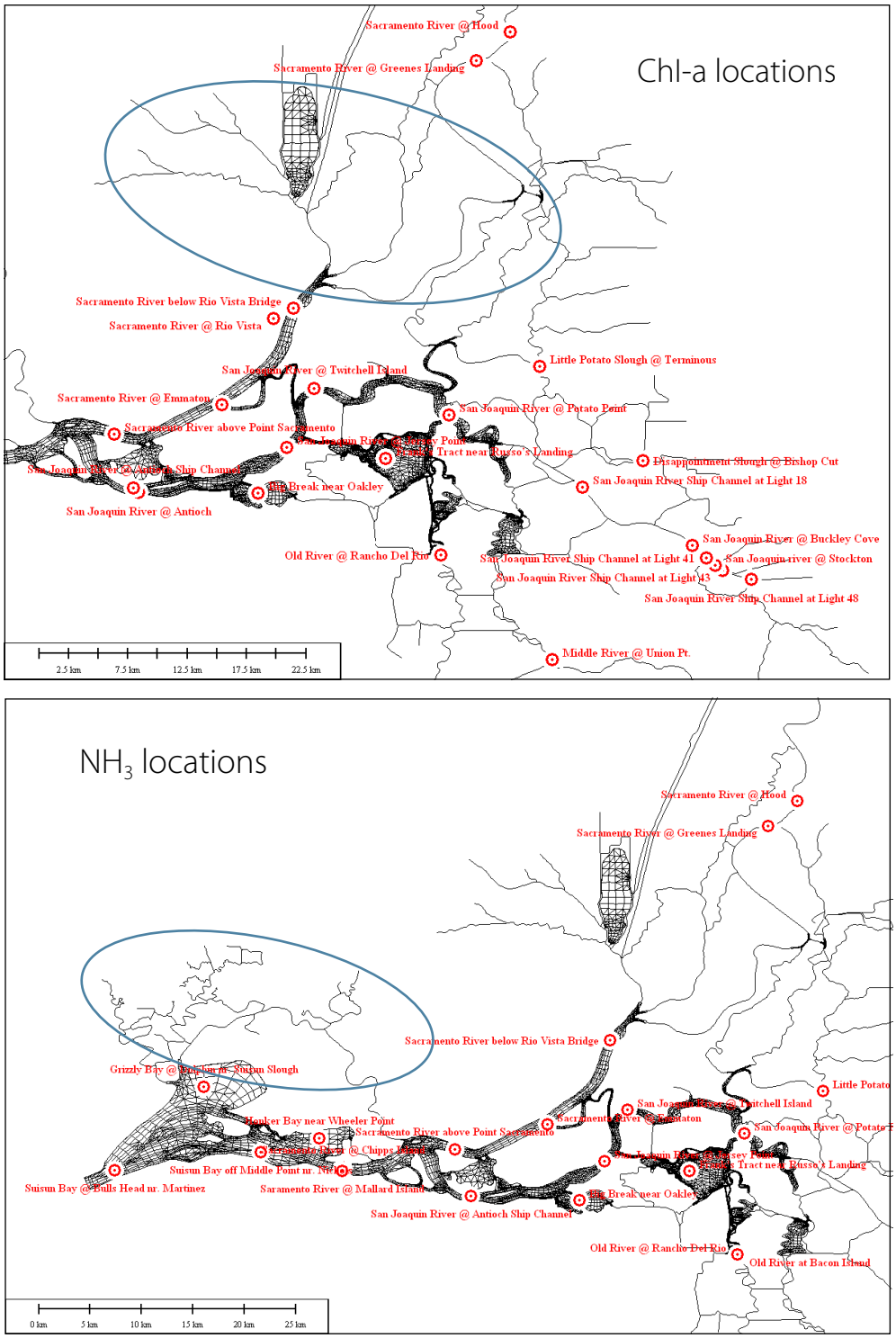

Figure 1 Two large regions of the Delta, the Yolo/Cache region and eastward through Steamboat Slough to the forks of the Mokelumne River (upper figure) and Suisun Marsh (lower figure) are essentially unconstrained due to a lack of calibration data.

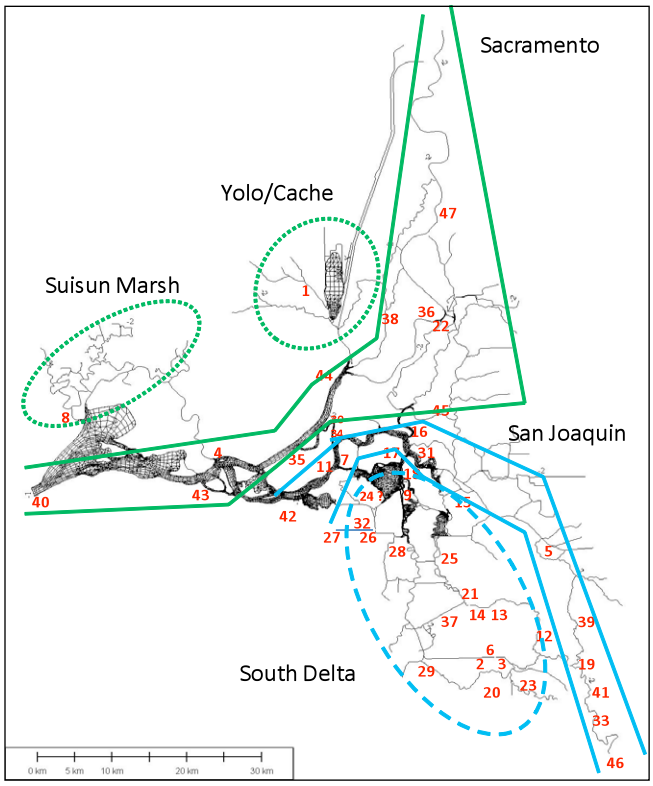

Figure 2 – Regions used in preparing temperature statistics.

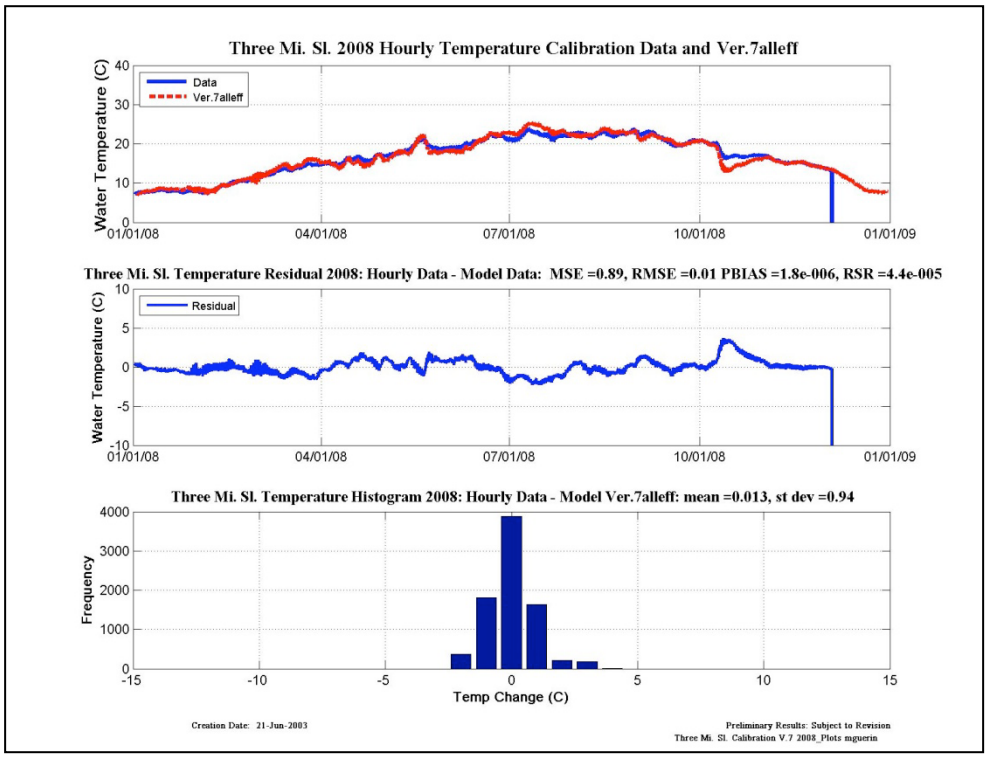

Figure 3. Water temperature calibration results at Three Mile Slough in 2008.

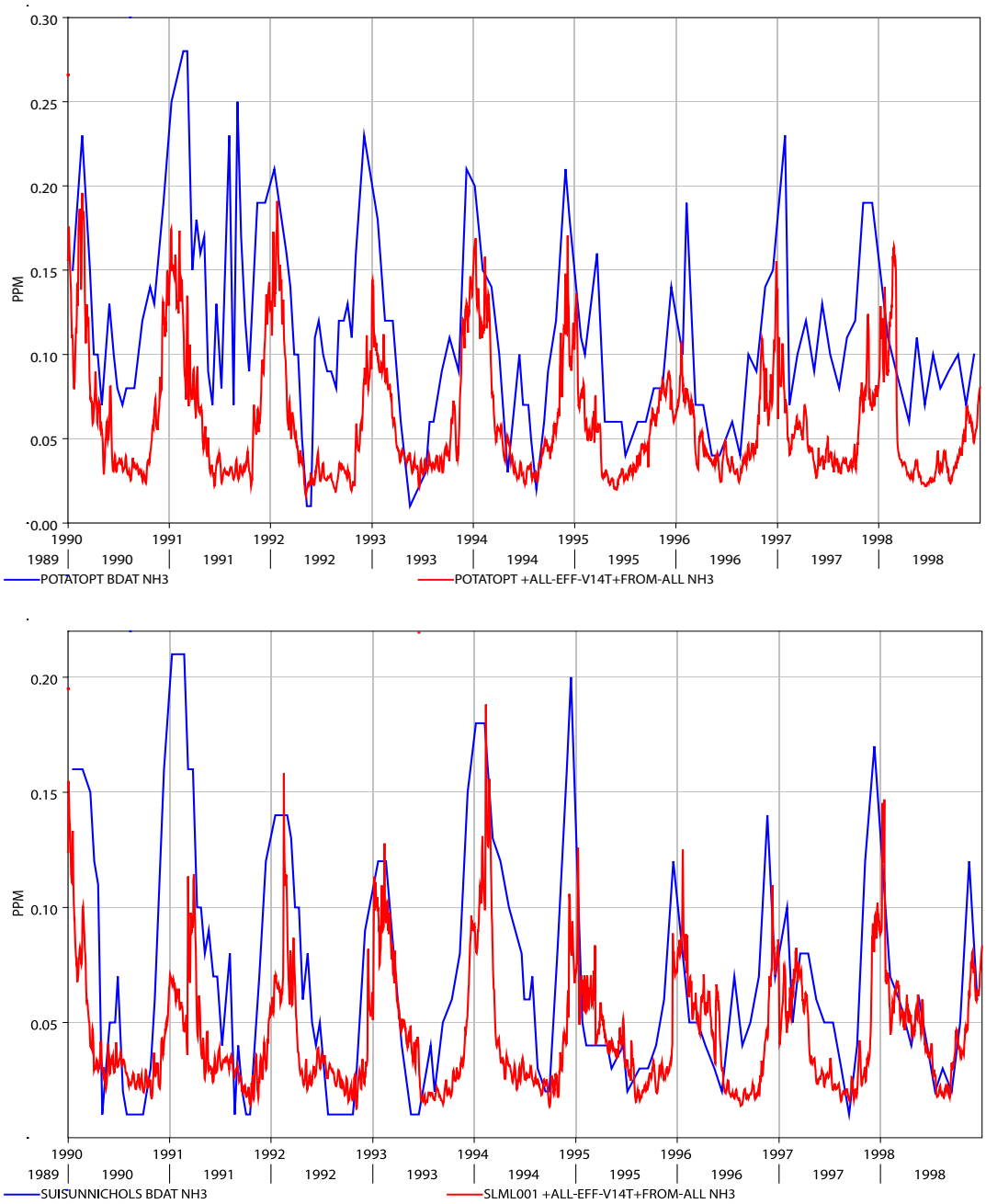

Figure 4. Ammonia calibration results at Potato Point (upper) and In Suisun Bay (at Middle Point, near Nichols). Blue lines are data and red lines are daily model results. Many nutrient measurements are taken (approximately) monthly or bi-monthly.

DSM2 Sediment Transport Module (Jamie Anderson, DWR)

Did you ever wonder how mud moves in the Delta? We are working with UC Davis to answer that question. Professor Fabian Bombardelli and his graduate student Kaveh Zamani are working with Delta Modeling staff to develop a one-dimensional sediment transport module for DSM2. The first stage of the model development is underway. A technical advisory committee (TAC) with representatives from agencies, universities and consulting firms meet on July 20th to make sure that we are on track and not wallowing in the mud. Materials from the TAC meeting can be found at ftp://ftpmodeling.water.ca.gov/pub/SLR/STM_TAC/. For more information on the project or to join the TAC, contact Jamie Anderson at jamiea@water.ca.gov.

DETAW (Lan Liang, DWR)

Delta Evapotranspiration of Applied Water (DETAW) model has been rewritten using Python scripts to reduce output size, allow more control of output, and enable sensitivity analyses. Originally written in Borland Professional C++ by UC Davis, DETAW estimates the soil water balance of evapotranspiration (ET), precipitation, seepage, irrigation, and soil water content in the Sacramento-San Joaquin Delta. DETAW uses newer methods to compute daily crop ET, the ET of applied water, seepage, effective rainfall, and net application for 15 land use categories and 168 subareas in the Delta. The new Python version replaces many EXCEL output files with three DSS files (daily, monthly, and yearly values) for all the land use categories and subareas. This reduces running time by 2/3 and output space by 4/5.

DSM2 Version 8 (Eli Ateljevich, DWR)

DSM2 Version 8 is ready for release! The new version is available now internally to DWR users on our website. On August 12, the release will become public -- available to everyone on the DSM2 website on an early-release basis. Feel free to try out Version 8, familiarize yourself using the tutorials and report any concerns or suggestions. The Delta Modeling Section will offer a 2.5 day training course for all users in early September.

As you may know, Version 8 is being released as a text-driven model due to vendor reliability concerns with the database connectivity software used in Version 7. Nevertheless, design-wise the Version 8 release is based on many of the same versioning and data management principles as Version 7. All of the modeling features of Version 7, including operating rules and new gate capabilities, are available in Version 8. The distribution contains reference documentation, several sample simulations, syntax highlighting in Notepad++, and some useful new pre and post-processing scripts.

From a physical modeling standpoint, the main features of the new model are the improved gates and operating rules. The new gates allow arbitrary numbers of structures or “devices”. The new devices are more configurable, and can represent radial gates, bottom operated gates, flap gates and culverts. Modelers can also completely install or uninstall gates easily mid-simulation. Operating rules allow the model to respond to its own internal state:

for instance, closing a gate to protect stage in the South Delta or changing pumping to match a diurnal pattern or to respond to cavitation concerns in Clifton Court Forebay.

Although it solves the same equations, Version 8 of HYDRO features faster numerical convergence than its predecessor. Version 8 automatically synchronizes channel width with area to numerical precision, avoiding the dreaded “max iteration” problem and speeding the model by 30-50%. At the same time, a few redundant state variables were introduced that ensure the new version conserves continuity at nodes to very high precision (thousandths of a cfs). In PTM, the flow field is phased using time-centered rather than one-sided velocities, with the result that Version 8 does not suffer accuracy limitations when used with a 1 hour tidefile.

The tidefile in Version 8 is now based on HDF5, a NASA-pioneered data format for numerical models and enormous data sets. HDF5 is widely supported, and the files can be opened in Matlab and Python. HDF5 is self-describing and you can open the tidefile up and look inside it. Each tidefile contains a list of the text input files that were used in the HYDRO simulation, all the input data, as well as the flow field at every time step. An HDF5 output file for QUAL is due in release 8.1, and should facilitate water quality mapping in GIS.

The Version 8 input system will seem pretty familiar to Version 6 users, but a few things may take some adjustment. We have designed a series of 6 tutorials that introduce the new tools and input system on a simplified grid, and 5 tutorials that cover topics on the Delta. In class we will go over the nuances of the new capabilities, covering “gotchas” and making sure everyone is aware of the more subtle new capabilities. At the same time, this will be an excellent opportunity to get your feedback.

DSM2 Mini-Calibration (with Flooded Liberty Island) (Subir Saha, Parviz Nader-Tehrani, DWR)

Photo by Ralph Finch, DWR

The last DSM2 calibration was conducted in 2000. This calibration used a DSM2 bathymetry that did not include a flooded Liberty Island. Since a number of Bay Delta Conservation Plan (BDCP) alternatives call for creation of new habitat throughout the Delta, it was decided that the addition of the Liberty Island flooding in the DSM2 grid is essential. Generally, changes of this magnitude require adjustments to certain model parameters (i.e. calibration). Preliminary results indicated that the addition of Liberty Island flooding improved the model’s prediction for flow in Rio Vista and nearby areas.

The main focus of this “Mini-Calibration” effort is to match observed data with the model results at primary calibration locations, Rio Vista and Emmaton on Sacramento River, Three Mile Slough and Jersey Point on San Joaquin River well. Because the tidal influence for Liberty Island doesn’t impact model results in the central, south and east Delta, it was anticipated that most of the changes to the calibration parameters would be in and around Liberty Island. In addition to the Liberty Island flooding, a few other changes were also included in this effort:

1 Extension of the Sacramento River Boundary- Ideally, a flow boundary should be located at a place far enough upstream, such that tidal influences are minimal. The current version of DSM2 has the boundary located at Sacramento River at I Street. Results indicate that tidal influences are somewhat noticeable at this location. As a result, the boundary was extended approximately 8 miles upstream to eliminate any tidal reflections. Extension of the San Joaquin River boundary was not required as there is little tidal influence in the area.
2 Relocation of some of the nodes in Sacramento River to coincide more closely with the proposed intake locations for the isolated facility.
3 Updating the bathymetry to create consistency with the changes in Sacramento River.
4 Changing the roughness (manning's n) of the channels in the vicinity of primary calibration locations to better match with the observed flow data.
5 Changing dispersion coefficient in the vicinity of primary calibration locations to better match with the observed EC data.

The "Mini-Calibration" is a part of the Department of Water Resources Delta Habitat Conservation and Conveyance Program's (DHCCP) contract to CH2MHILL. The HYDRO calibration is completed and QUAL calibration in its final stage of completion. CH2MHILL will prepare a report on the DSM2 "Mini-Calibration". Figures 1 and 2 show the improvement of modeled flow at Rio Vista and Cross-Delta Flow (combined flow through Georgiana Slough and the Delta Cross-Channel).

DWR is in the process of releasing a new version of the Delta Simulation Model, DSM2v8, to public. The changes made in the "Mini-Calibration" will be implemented into the new version and will be released to the public and CH2MHILL for BDCP/DHCCP analysis.

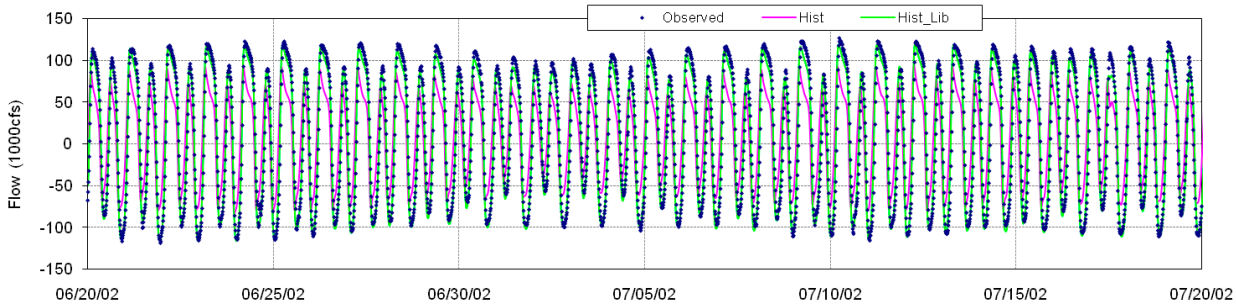

Figure 1: Flow comparison on Sacramento River at Rio Vista (Hist: 2000 Calibration; Hist_Lib; Mini-Calibration with Liberty Island).

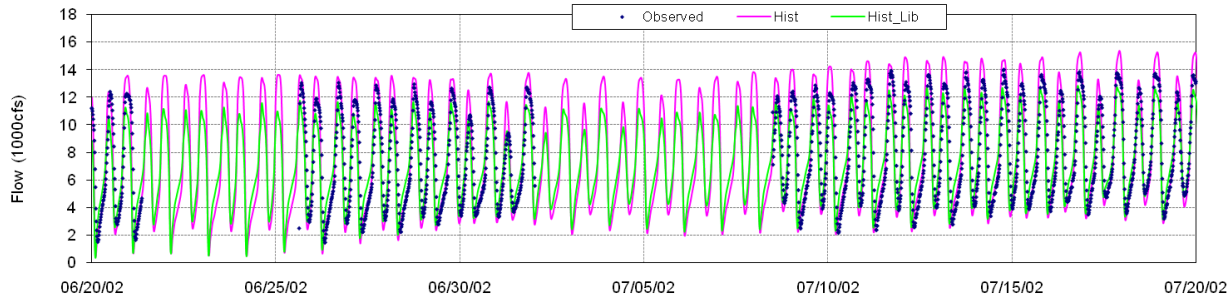

Figure 2: Comparison at Cross-Delta Flow (Hist: 2000 Calibration; Hist_Lib: Mini-Calibration with Liberty Island).

Ralph Finch is also using the flooding of Liberty Island, and the mini-calibration, to examine the basic premise of DSM2 planning studies: that while individual runs may contain sizeable error at times, by comparing alternatives to a base run, errors tend to cancel and therefore DSM2 is a valid tool for comparing the effects of alternatives.

New Senior Staff – The Return of Nicky (Min Yu, DWR)

We are pleased to announce that Nicky Sandhu has joined the Delta Modeling Section (DMS), filling the Senior Engineer position previously held by Parviz Nader-Tehrani. Many in the Delta modeling community may remember him from when he was a member of DMS in the 1990s. During that time, Nicky was a major player on the development team. Besides developing many visualization tools (i.e., VISTA, updated PTM animation) that we still use today, Nicky's also helped develop the first ANN model, rewrote the DSM2-PTM module in Java, and created a new modeling language known as WRESL (Water Resources Engineering Simulation Language) which is used in CALSIM II.

In 1999, after 6 years in DMS, Nicky left State service and joined a dot-com company. His dot-com company gig didn't last long for him; he was wise enough to bail before the company went bust when the bubble burst in 2000. Nicky then joined IBM for six years, leading a variety of projects ranging from designing small devices to smart appliances. During that time, Nicky traveled all over the country to work with vendors including Palm, Motorola, Whirlpool, and Cingular on a wide range of activities. In 2006, Nicky took a job as an IT Architect for Raley's Supermarkets in order to spend less time traveling. His main task was to providing guidance to the CIO in selecting new technologies to optimize the company's operations and performance.

Nicky returns to DMS as a seasoned software development manager. He reports that he's ready to work on 'anything and everything', but his first goal is to catch up on what is new since he left. He is getting familiar with the new version of DSM2 and helping to resolve remaining issues for the production version. He also wants to have a strong understanding of the BDCP program so that he can guide his team to conduct the modeling studies needed in the future. All in all, Nicky is happy to be back 'home' and is ready for the next chapter of his career.

If you have any questions or comments regarding this issue of the newsletter, please contact the facilitator of the DSM2 Users Group:

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This newsletter can be accessed at the DSM2 Users Group website: *http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/dsm2usersgroup.cfm*