2016

CALIFORNIA DEPARTMENT OF WATER RESOURCES

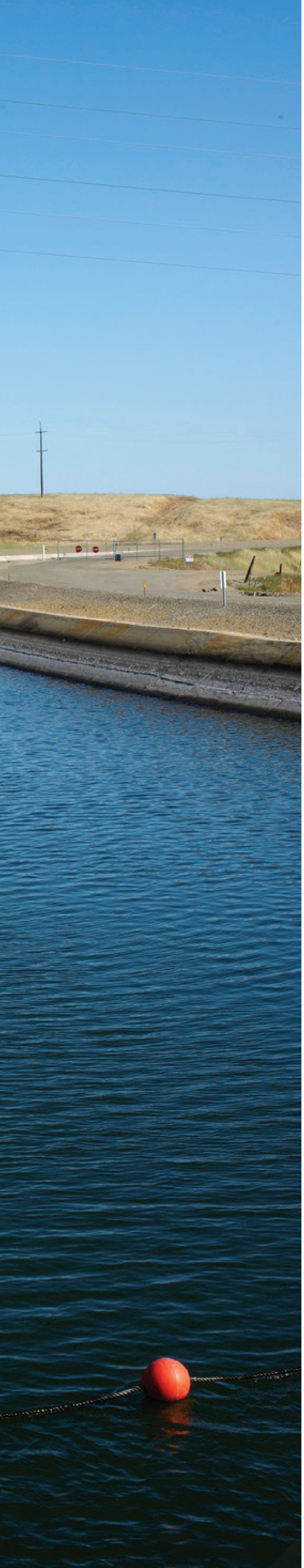
BAY DELTA OFFICE DELTA MODELING SECTION

DELTA SIMULATION MODEL 2 USER GROUP

# DSM2UG

# Contents







# 2016 | Annual Report

*Min Yu, Senior Engineer WR, DWR*

**The following are brief summaries of modeling work conducted during 2015, which is presented in the 2016 Annual Report to the State Water Resources Control Board (http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm).**

## CHAPTER 1 Initial Investigation of Inflatable Barrier in South Delta

The agricultural rock barriers constructed in the South Delta, under the Temporary Barriers Program of the California Department of Water Resources, Bay-Delta Office (BDO), are installed to provide increased water levels and improved circulation patterns in the South Delta area.

BDO is investigating the feasibility of using inflatable barriers (i.e., rubber-bladder barriers) instead of the current rock barriers. The potential benefits of the inflatable barriers are lower cost and ease of installation. This chapter provides a summary of the preliminary investigation of using inflatable barriers.

## CHAPTER 2 A New GIS Tool for Creating DSM2 Grid and Cross Sections

DSM2 cross sections are defined using bathymetry data as a guide. The Cross Section Development Program (CSDP) was developed for this purpose and has been used extensively in the past for creating DSM2 cross sections (Tom 2001). CSDP was developed almost 20 years ago when geographic information system (GIS) tools were not very sophisticated. Since then, ArcGIS has developed many features for geospatial analysis and visualization. To leverage these capabilities a tool was proposed for ArcMap that would add cross-section drawing capabilities for DSM2. A contract was executed with Tom Heinzer, GIS Manager/Software Developer, U.S. Bureau pf Reclamation, to implement this new tool.

With the new tool as an add-in to ArcMap, users can use both standard ArcMap functions and the new tool's functions. The add-in allows users to:

- Add, remove, and edit the locations of the nodes.
- Add the flowlines of channels, which are used to determine the length of the channels.
- Cut cross sections from a Digital Elevation Model (DEM) by using a vertical plane's intersection to determine the profile.

**Delta Simulation Model 2** requires boundary conditions to fully define and drive the system; upstream boundary conditions are usually provided as flow hydrographs while downstream boundary conditions are given as water-surface elevation.

- Edit the profiles of cross-section shapes.
- Calculate the area, width, and wetted perimeter for user-defined levels from profiles.
- Export the channel grid and cross-section data in DSM2 format.

This chapter is a brief tutorial on how to use the tool. Delta Modeling Section staff have been using the tool to develop a new refined grid and cross sections.

### CHAPTER 3 DSM2 Extension: A GIS-Based Approach

As with other hydrodynamic and hydraulic models, DSM2 (Delta Simulation Model 2) requires boundary conditions to fully define and drive the system; upstream boundary conditions are usually provided as flow hydrographs while downstream boundary conditions are given as water-surface elevation. Additionally, boundaries are located where observed data is available and are located away from areas of interest that might influence the boundary conditions. For water quality simulations, constituent concentrations must also be provided at all boundaries. In a tidal system, such as the Delta, where most of the salinity originates in the ocean, the salt concentration at the downstream boundary is crucial because it drives the water quality conditions in the Delta.

Situated at the eastern end of the Carquinez Strait, Martinez is the location of the downstream (western) boundary condition for DSM2. While the waterways of the legal Sacramento-San Joaquin Delta are fully contained within the DSM2 boundaries, depending on the details of a particular study, the boundary condition location at Martinez can be less than ideal.

This chapter describes the investigation of a method for extending the DSM2 grid to San Francisco Bay at the Golden Gate. The method uses a one-dimensional grid, extensive and detailed geoprocessing of geometry data, and sophisticated calibration software. The goal of this grid extension is to reflect the volume of water and salinity transported from the Golden Gate to Martinez for Delta simulations, and it is not intended to provide a detailed model of hydrodynamics and salinity in San Francisco Bay. Preliminary results show promise that the method presented in this chapter can be applied successfully.

### CHAPTER 4 Delta Salinity Simulation with DSM2-GTM

The California Department of Water Resources' (DWR's) Delta Modeling Section is developing a new DSM2 transport module, called the General Transport Model (DSM2-GTM). Progress on this effort was previously reported in Hsu et al. (2014). DSM2-GTM employs a fixed (Eulerian) mesh rather than one that moves with flow and follows virtual parcels of water in a Lagrangian scheme. The fixed grid will make it easier for this model to interact with other models, georeferenced data, data assimilation, optimization, and visualization, as well as to couple inline to DSM2-HYDRO. It is also more straightforward to extend the new model to new physical processes, with sediment, dissolved oxygen, and mercury cycling models that are currently being developed. Because of its extensibility, DSM2-GTM is expected to replace DSM2-QUAL.

This chapter provides a detailed description of the technical background and accomplishment so far of the DSM2-GTM development.

## CHAPTER 5 Estimating Net Delta Outflow, Summary of March 2016 Report to the State Water Resources Control Board

In fall 2015, the State Water Resources Control Board (SWRCB) requested that DWR provide technical guidance on the best available consumptive use models and, more broadly, on the subject of Net Delta Outflow calculations. DWR produced a report, titled *On Estimating Net Delta Outflow (NDO), Approaches to Estimating NDO in the Sacramento-San Joaquin Delta* (California Department of Water Resources 2016) and submitted it to the SWRCB in March 2016. This chapter is a brief outline and a summary of the report.

# The Current Status of the DSM2 Historical Simulation

*Lan Liang, Engineer Water Resources, DWR*

### Time period of DSM2 historical simulation

DSM2 simulations of historical hydrodynamics and EC and DICU-generated Delta channel depletions have been extended to now cover 1989 through February of 2016.

### Modifications in the latest DSM2 historical simulation

In previous DSM2 updates, most all flow, stage and EC input data were obtained from the CDEC database. Over time, some stations have been discontinued and some new stations have been found to provide more representative inflows for DSM2. In addition, a new temporary barrier was installed on False River in 2015 which had to be modeled. These changes are described below:

#### 1. Yolo Bypass flow

In the latest update of the DSM2 simulation of historical conditions, the Yolo Bypass flow data was obtained from CDEC station Yolo Bypass at Lisbon (LIS). Updates before 2013 used the flow at Cache Creek at Rumsey Bridge (RUM) to represent the Yolo Bypass flow. While Cache Creek flows into Yolo Bypass, RUM is far upstream of the bypass. LIS, however, is along the main toe drain of Yolo Bypass. In the summer, the flow at RUM flow can be as high as several hundred cfs, while LIS flow is nearly always close to zero or negative because of irrigation. LIS better represents Yolo Bypass flow in summer. In dry or critical years, such as the period of 2013-2015, no water flowed from the Sacramento River into Yolo Bypass and LIS well represented Yolo Bypass flow. However, during a high flow event in the Sacramento River, LIS might not represent the whole region well.

In DAYFLOW,
Yolo Bypass flow = Yolo Bypass flow at Woodland + Sacramento Weir Spill + South Fork Putah Creek flow
However, these flow stations in this region do not have long-term continuous data. More discussion is needed to determine the best estimate of historical Yolo Bypass flow for the next DSM2 historical simulation update.

#### 2. False River barrier.

Since the False River temporary barrier was installed in 2015, the grid and gate operation INP files in DSM2 have been modified. The names of those two files are:

gate_std_delta_grid_20160502_FalseRiver.inp oprule_hist_temp_barriers_2060502_FALSERiver.inp.

Another INP file (historical_hydro.inp) listing all the INP files HYDRO module requires has been modified accordingly.

**3. Delta cross channel gate operations**

Bureau of Reclamation posts the cross channel gate operations historical log at:

http://www.usbr.gov/mp/cvo/

The date, time, and action of each operation are posted. The gate operations of Delta cross channel in DSM2 were updated based on this historical log.

**4. Mokelumne River flow**

CDEC has not included the flow data near DSM2 Mokelumne River inflow boundary for many years. East Bay Municipal Utility District (EBMUD) collects the raw data. Generally, EBMUD sends the checked data to USGS once a year. USGS names the station Mokelumne River below Woodbridge Dam, with the station number 11325500.

Since USGS does not post Mokelumne River flow in the current water year, the raw flow from EBMUD was requested and filled in the missing part of Mokelumne River inflow in the latest DSM2 update.

### The link to download the latest DSM2 historical simulation

Since the INP files of DSM2 historical simulation have been modified in the latest update, the complete package has been made available. The completed package of DSM2 historical simulation includes the updated DSS and INP files and all other old files that DSM2 historical simulation requires. It has been uploaded to DSM2 User Group Portal with link below.

https://dsm2ug.water.ca.gov/library/-/document_library/view/316154

**In previous DSM2 updates,** most all flow, stage and EC input data were obtained from the CDEC database. Over time, some stations have been discontinued and some new stations have been found to provide more representative inflows for DSM2.

# Estimation of Delta Residence Times using DSM2-PTM

*Chandra Chilmakuri, Project Manager, CH2M*

**In an estuary, residence times can be used as a broad indicator of the retention time of any water quality constituents, suspended particles, biomass etc. whose transport would primarily be a function of the hydrodynamics.**

**Residence time** can be defined as the time it takes for a water parcel originating at a location in a waterbody to leave the waterbody. It captures the amount of time a water parcel remains in the waterbody.

Residence time can be defined as the time it takes for a water parcel originating at a location in a waterbody to leave the waterbody. It captures the amount of time a water parcel remains in the waterbody. Residence times in an estuary are dependent on local hydrodynamics processes and would vary spatially. Therefore, residence times can be an indicator of a biological or chemical process in a subarea within a larger domain (Monsen et al. 2002). In a recent analysis involving Sacramento-San Joaquin Delta, DSM2 PTM was used to estimate the Delta residence times in summer and fall months for different sub-regions of the Delta, under varying hydrologic conditions.

In applying DSM2 PTM to estimate residence time in the Delta, Delta channels and open water bodies were divided into 25 sub-regions. The sub-regions are consistent with the sub-regions used in the US Fish and Wildlife Service's Delta Smelt Life Cycle Model (Newman, 2014). Particles were released uniformly over each sub-region at the DSM2 nodes shown in Figure 2.

PTM simulations were conducted for selected periods with representative combinations of the expected inflow, outflow and exports in the Delta. For each selected period, PTM runs were simulated for a 90-day period with particles released uniformly over the first day of the PTM simulation at locations shown in Figure 2. Four thousand particles were released per sub-region, and were evenly divided between the release locations within each sub-region. 25 PTM simulations, one for each sub-region, were performed in a batch mode, for each of the selected periods.

Hourly timeseries of number of particles remaining in each sub-region were saved from each PTM run over the 90-day simulation period. Using this information, residence time (in hours) was calculated as the time since the start of the simulation *i* weighted by the number of particles remaining in the sub-region at time *i*:

$$Residence\ time\ (hours) = \frac{\sum_{i=1}^{90*24} (No.\ of\ particles\ in\ the\ subregion)_i * i}{\sum_{i=1}^{90*24} (No.\ of\ particles\ in\ the\ subregion)_i}$$

Figure 3 shows some example results of the estimated residence times for various sub-regions in the Delta. As expected, residence times are smaller when both the inflows and outflows are high, and the times are longer at lower outflows. However, residence times are widely different depending on the sub-region. As noted above residence times are a function of the local processes. As such particles in the Holland

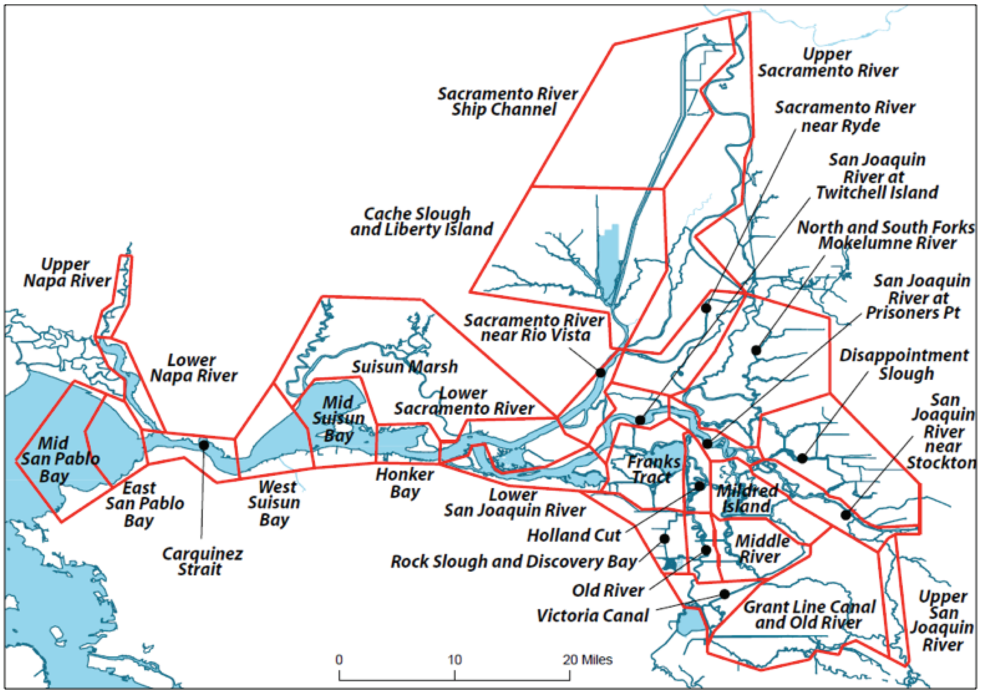



**Figure 1** | Sub-regions Used in the Analysis of Residence Time Based on DSM2-PTM.

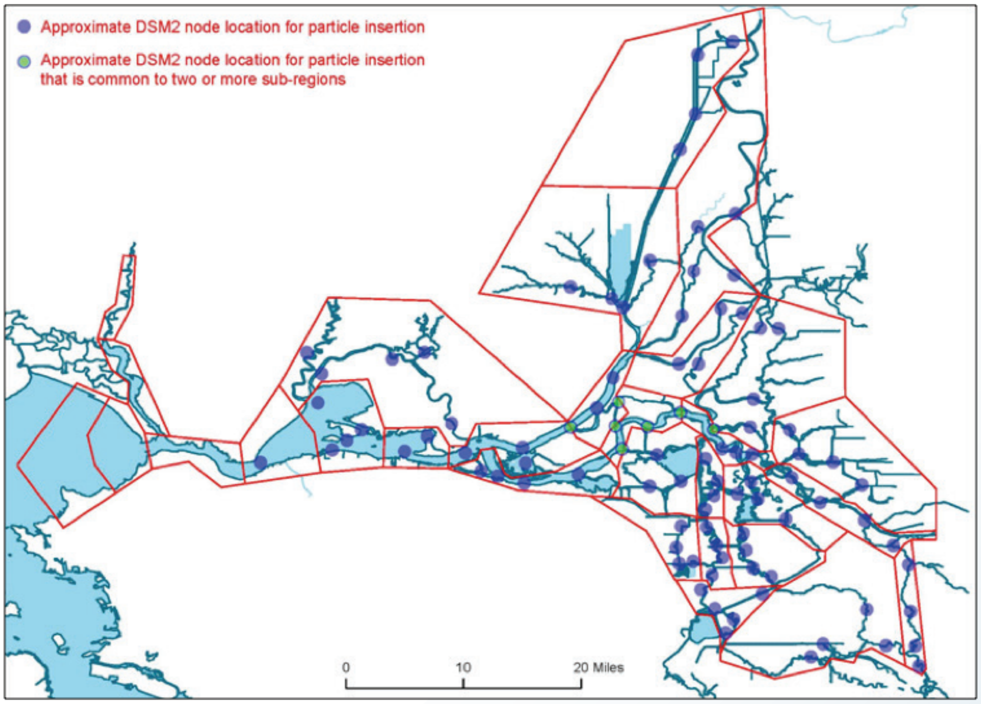



**Figure 2** | Particle Release Locations Within the Sub-regions Used in the Analysis of Residence Time Based on DSM2-PTM.

Cut sub-region, which are relatively closer to the export locations, have the lowest residence times. Conversely particles originating in the Cache Slough Complex have high residence times owing to the open water bodies such as Liberty Island and numerous dead end channels and sloughs. Results for Lower Sacramento River sub-region suggest the effects of tidal dispersion leading to moderately large residence times. These results are generally in line with the common understanding of the Delta hydrodynamics processes. This analysis demonstrates the utility of DSM2 PTM in estimating residence times in the Delta quickly and efficiently under numerous hydrologic and physical conditions.

**Acknowledgements:**

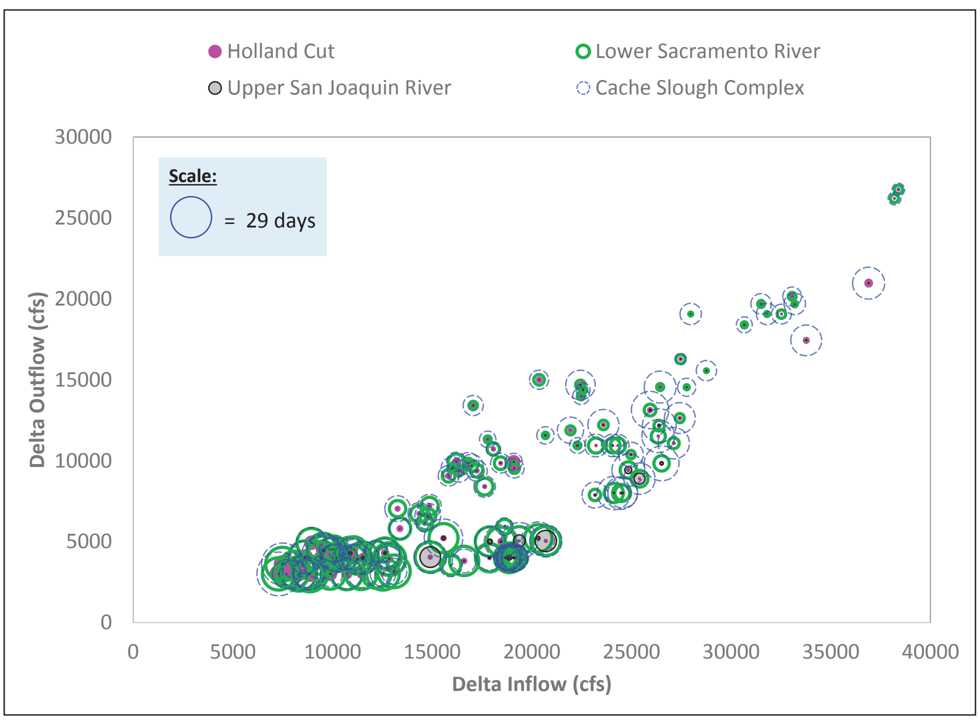
Marin Greenwood/ICFI for collaboration on the weighted residence time computation; Rosemarie Dimacali/CH2M for assistance with DSM2 PTM simulations.

**References:**

Monsen, N., Cloern, J., Lucas, L., and Monismith, S. 2002. A comment on the use of flushing time, residence time, and age as transport time scales. Limnol. Oceanogr., 47(5), 2002, 1545–1553.

Newman, K. 2014. Recent Developments in a State-Space Model for Delta Smelt Population Dynamics. Annual Interagency Ecological Program Workshop. Folsom, CA.

**Figure 3** | Residence Times for Various Delta Sub-regions in relation to Delta Inflow and Outflow.



# DSM2 Particle Tracking Model Update

*Xiaochun Wang, Senior Engineer Water Resources, DWR*

**Delta Simulation Model II (DSM2) Particle Tracking Model (PTM) simulates the transport and fate of individual notional particles through the Sacramento - San Joaquin Delta. In order to use this model as a tool to evaluate the impacts of water management actions on fish survival through the Delta, DWR has been working with NOAA Marine Fishery Services (NMFS) and U.S. Geological Survey (USGS) to improve the model by attaching fish-like behaviors to the particles.**

Currently, three types of behaviors are being implemented: swimming, survival and route selection. The statistical models of these behaviors are being developed and incorporated in PTM. The parameters of the statistical models are being calibrated using acoustic fish tag data. The status of the behavior model development and PTM improvement are described below:

**An XT model** is used to calculate fish survival probability through the Delta channels. The XT model relates fish survival through the Delta to the fish travel distance (X) and time (T). The model has been implemented in PTM.

### Swimming Behavior Model

The fish swimming behavior model is developed based on hypotheses such as tidal confusion, diel holding, and selective tidal stream transport. The statistical distributions of the stochastic variables in the behavior models (e.g., fish travel time) were obtained from literature and fitted to the tag data. Literature review, research and various numerical experiments have been conducted to find the best-fit distribution. Currently the swimming behavior model is implemented in PTM. The calibration of the statistic parameters is underway using the Particle Swarm Optimization method. Because of a large number of PTM runs needed for the calibration, PTM has been ported to the Linux platform so that the calibration can be conducted in the USGS high performance computing center.

### Survival Behavior Model

An XT model is used to calculate fish survival probability through the Delta channels. The XT model relates fish survival through the Delta to the fish travel distance (X) and time (T). The model has been implemented in PTM. Currently, DWR staff is working on

**The statistical relationship** between fish cross-sectional distribution to river flow and tidal effects can be established by analyzing two-dimensional tracks of acoustic tagged juvenile salmon.

modifying the model implementation so that fish travel distance (the distance in the channel from an entrance point to the furthest point that the fish traveled) will be used as the distance X instead of using fish path length (the length fish actually traveled) in the XT model.

### Route Selection Model

Recent research has indicated that in a junction, the proportion of juvenile salmon entering certain channels is mainly determined by the fish distribution across the upstream channel. The information that the PTM has is too limited to calculate such a distribution as the PTM only takes one-dimensional hydrodynamic data from DSM2 Hydro. However, the statistical relationship between fish cross-sectional distribution to river flow and tidal effects can be established by analyzing two-dimensional tracks of acoustic tagged juvenile salmon. This statistical relationship can then be implemented in PTM to predict the probability of an individual particle entering a certain channel in the junction. The relationships will be established for the major delta junctions where two dimensional tracks of acoustic tag data are available. Currently, USGS researchers are working on the relationship for the Georgiana Slough junction.

In addition to the behavior model implementation and calibration described above, efforts will also be made to establish an open source platform for PTM in an online version control repository hosting service such as GitHub to make a collaborative development effort possible and to make the model accessible for more users.

# Progress on DSM2 Calibration with PEST

*Lianwu Liu, Engineer WR, DWR and Nicky Sandhu, Senior Engineer Water Resources, DWR*

**The parameter estimation software (PEST) is a commonly used automated calibration and uncertainty analysis software. It is highly efficient in optimizing parameters through minimizing objective functions composed of discrepancies between dynamic model output and measurement. PEST has been used in DWR's Delta Modeling Section for various other calibration tasks. We have recently started using PEST to calibrate DSM2. The hope is that PEST will eventually replace time-consuming manual calibrations that have been done in the past.**

PEST's objective function is formulated as the weighted sum of squared residuals:

Objective function: $\Phi = \Sigma w_i^2(q_i - o_i)^2 = \Sigma w_i r_i^2$.
Where
q as field/lab measurement,
o is model output,
r is residual between field measurement and model output,
w is observation weight,
i is measurement index.

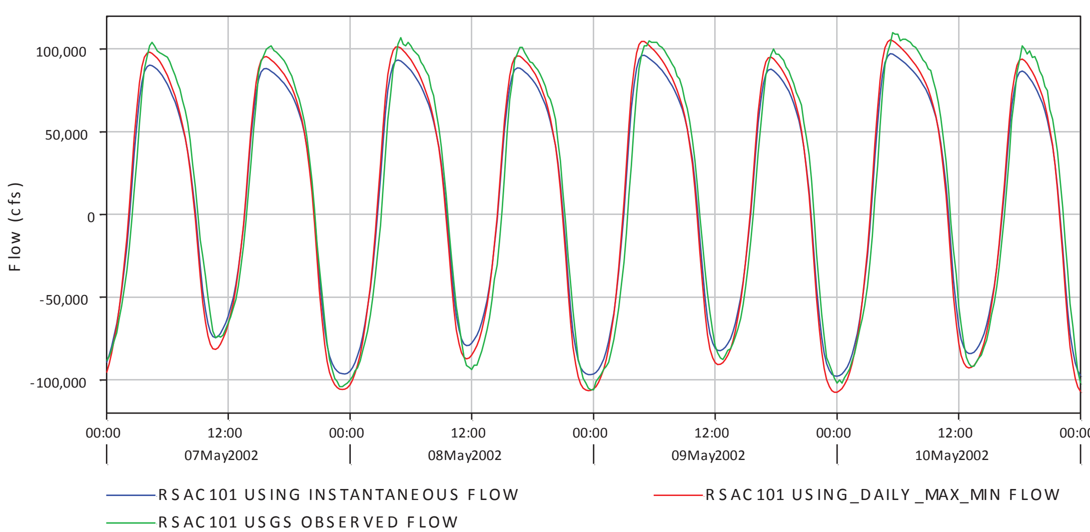
Our tests show that if we use the primitive variable directly, e.g. flow at 15-minute intervals, then minimizing the objective function yields poor results due to a phase shift between model output and measured data (Figure 1). Therefore, we formulated the objective function using daily maximum and minimum flows. As shown in Figure 1, the calibrated flow (red line) fits the observed flow (green line) much better. Therefore, our preliminary tests will use the daily max/min flow.

Prior to estimating parameters using PEST, weights are assigned to different observations or observation groups. According to the PEST User Manual (6th Edition, 2016), these weights can be balanced between observation groups "so that no observation group will dominate the objective function, nor will be dominated by other observation groups. The information contained in each observation group will thus, hopefully, be equally 'visible' to PEST."

Our preliminary tests indicate some limitations of the approach PEST proposes. The objective function is defined as the weighted sum of squared discrepancies of model output and measurement of "all" observation stations. The significance of each station can be specified by a weight parameter. However, we found that weights become a very sensitive parameter to the calibration target, such as Manning's n. This is not desired. During the testing, we also discovered there is no easy way to assign weights to each station. Even when contributions to the objective function from each station are balanced, the result may not be as expected due to the complexity of the channel network and the locations of stations. The influence of one station (e.g. RSAC101) may be overwhelmed by a small group of stations that are close to each other (e.g. RSAC123, RSAC128, DCC, GSS). Obtaining a reliable calibration by balancing weights is not likely as the results will in a sense be a compromise of all the weights assigned. Making calibration even more challenging, adding more regularization requires regularization weights having to be balanced against observation weights.

To resolve these issues, we tested a step-wise approach and were able to obtain a preliminary working calibration. In this approach, no weights were assigned. We first calibrated the entire model using PEST and then inspected the contributions from all the observation stations to find the largest contributing stations (there can be more than one). We then assigned to a few of these stations a zero weight, and the nearest (controlling) channels' parameters 'fixed'(a key word and function in PEST). Then PEST was rerun.

**Figure 1** | Comparison of flows at Rio Vista (RSAC101)



**The underlying concept** is that the channel parameters near the largest contributing stations should be those most optimized. This process was repeated until the whole model was calibrated.

Since the largest contributors had been removed from the calculation for objective function, the next larger group of contributors became the largest. The underlying concept is that the channel parameters near the largest contributing stations should be those most optimized. This process was repeated until the whole model was calibrated.

In this preliminary test, we used the DSM2 V8.1 grid, a very short period of time (i.e., two months of data, July 2002 and July 2008) to calibrated to flow by adjusting Manning's n values. Channels were divided into groups in a way similar to previous manual calibrations (Table 1). In this test, we didn't include all the groups—Middle River and Upper San Joaquin River were omitted.

Dividing channels into groups is called manual regularization by PEST. This is to well define the inverse problem and provide a unique solution.

The steps we used can be briefly described as following:

1. Run PEST calibration of the entire model, using default weight values of 1.0 for all stations, with each observation station defined as an observation group).
2. Assign the largest contributing stations' weights of 0 (RSAC101, RSAN018), fix adjacent channel group parameters (Sac. R below Rio Vista, Lower SJR) and then rerun PEST.
3. Since the largest contributors have been fixed and removed from the calculation, the next group of larger contributors becomes the largest. Station weights are assigned 0 at SLTRM004 and FALSE RIVER, channel groups' parameters (Three mile Sl., False River) 'fixed', and PEST is again rerun.
4. To refine the calibration for Sutter Slough, Steamboat Slough, and Miner Slough areas, a weight of 0 is assigned to stations RSAC123, RSAC128, RSAC155 and 'fixed' channel group parameters for Sac. R. above Rio Vista and Sac R. above Sutter Slough, and PEST rerun.
5. A weight of 0 is assigned to stations SSS, SUT, HWK and channel group parameters (Steamboat Sl., Sutter Sl. and Miner Sl.) 'fixed', and PEST rerun.

**Table 1** | Comparison of PEST Calibrated Manning's n Values to V8.1.2 Manual Calibration

| Group Name | Channel Numbers | Manning's n V8.1.2 | PEST Recalibrated | Difference |
|---|---|---|---|---|
| Delta Cross Channel | 365 | 0.028 | 0.0275 | -0.0005 |
| Dutch Slough | 274 to 275 | 0.027 | 0.0281 | 0.0011 |
| False River | 276 to 279 | 0.025 | 0.0276 | 0.0026 |
| Geogiana Slough | 366 to 374 | 0.028 | 0.0256 | -0.0024 |
| Lower SJR | 45 to 53, 285 to 301 | 0.026 | 0.0283 | 0.0023 |
| Miner Slough | 388 to 390 | 0.036 | 0.0342 | -0.0018 |
| North Moke River | 345 to 364 | 0.028 | 0.0314 | 0.0034 |
| Moke near SJR | 348 to 349 | 0.028 | 0.0313 | 0.0033 |
| Montzuma Slough | 455 to 544 | 0.021 | 0.0209 | -0.0001 |
| Lower Old River | 81 to 124, 214 to 257 | 0.025 | 0.0227 | -0.0023 |
| Sac R. below Rio Vista | 430 to 454, 570 to 575 | 0.019, 0.022 | 0.0203 | 0.0013, -0.0017 |
| Sac R. above Sutter Sl. | 410 to 418 | 0.028 | 0.0329 | 0.0049 |
| Sac R. above Rio Vista | 420 to 429 | 0.03, 0.031 | 0.0278 | -0.0022, -0.0032 |
| Steamboat Sl. | 383 to 387 | 0.029, 0.031 | 0.0285 | -0.0005, -0.0025 |
| Sutter Sl | 375 to 380 | 0.025 | 0.0261 | 0.0011 |
| South Moke | 311 to 344 | 0.024, 0.026 | 0.0247 | 0.0007, -0.0013 |
| Three Mile Sl. | 309 to 310 | 0.032 | 0.0324 | 0.0004 |

A preliminary test shows that this approach can lead to a reasonable calibration. Table 1 shows that PEST calibrated Manning's n values are close to the manually-calibrated values in DSM2 V8.1. The calibration results still need to be evaluated by using the calibration metrics plots. To date, we have tested the flow calibration. Next stages and EC will be included and tested. Once this approach is verified as working well, we will then start to calibrate a new GIS-based grid.

# Fully Integrated HYDRO and GTM

## A suggestion on DSM2 development

*Gang Zhao, Project Manager, Flow Science Inc.*

**The model DSM2 has three components: HYDRO, QUAL and PTM. HYDRO is derived from the USGS's FOURPT model, which solves one-dimensional unsteady open channel flow over fixed (i.e., Eulerian) grids. QUAL is derived from the USGS's Branched Lagrangian Transport Model (BLTM) model, which solves the one-dimensional advection-diffusion equation using a Lagrangian frame. PTM was developed to track transport and fate of particles in the Delta. For a DSM2 simulation, a HYDRO run needs to be completed first, QUAL and PTM runs can then be started using results from HYDRO as model inputs. This type of interface between the models is often referred to as one-way coupling in that HYDRO provides data to QUAL and PTM, but HYDRO has no access to QUAL and PTM data of the same DSM2 simulation.**

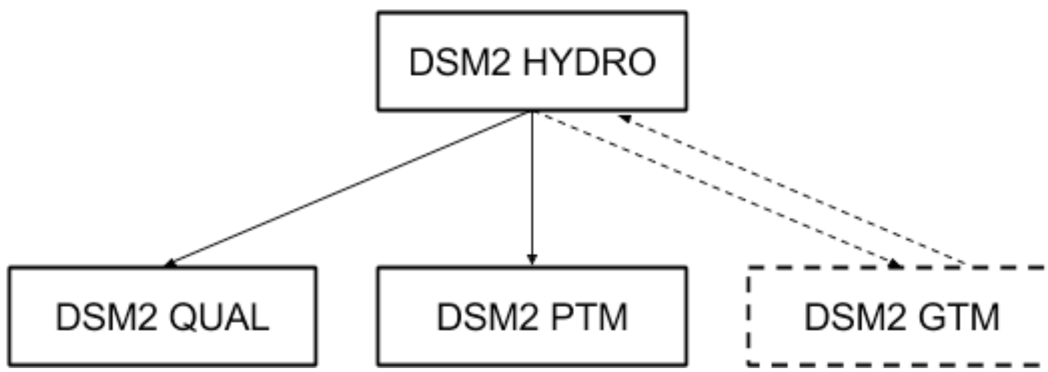
One constraint imposed by this one-way coupling is that operations of hydraulic structures/diversions in HYDRO cannot be based on water quality criteria since HYDRO has no access to water quality data of the same simulation. Contra Costa Water District's (CCWD) intakes in Central and South Delta is an example of diversions based on water quality criteria. When high quality, low salinity water is available at CCWD's intakes, water is pumped from the intakes to Los Vaqueros Reservoir (LVR); when only low quality, high salinity water is available at CCWD's intakes, water is released from LVR to mix with the water diverted from the intakes to make the water quality acceptable to customers and water plants. This has not been a problem for DSM2 simulations so far, but as Delta water quality issues become increasingly important, more water quality based operation rules for hydraulic structures/diversions could be put into practice in the future.

The Delta Modeling Section is developing a general transport model (GTM) for DSM2, which solves the advection-diffusion-reaction equation using an Eulerian frame. It is a good opportunity to remove the one-way coupling constraint by fully integrating HYDRO and GTM. Not only does HYDRO provide data to GTM, but it can also read GTM results at every time step so that operations in HYDRO can be based on water quality criteria. The fact that

**The Delta Modeling Section** is developing a general transport model (GTM) for DSM2, which solves the advection-diffusion-reaction equation using an Eulerian frame.

both HYDRO and GTM uses Eulerian grids also makes the integration easier than dealing with both the Eulerian and Lagrangian frames. The GTM is planned to be capable of simulating EC, DO, sediment, mercury and other non-conservative constituents. The DSM2 will definitely be a more powerful tool if HYDRO can access the wealth of GTM results. Of course, a switch can be added to the DSM2 input file so that users can choose to run just HYDRO or the fully integrated HYDRO and GTM. The suggested structure of DSM2 is summarized in the figure below.

It is possible that the fully integrated HYDRO and GTM may not see any application for a while, but nonetheless, it is beneficial to plan the model structure and interfaces one step ahead in model development.




Solid lines: available models. Dash lines: model under development

# DSM2-GTM Sediment Module Development Update

*En-Ching Hsu,*
*Engineer Water Resources, DWR*

*Jamie Anderson,*
*Senior Engineer Water Resources, DWR*

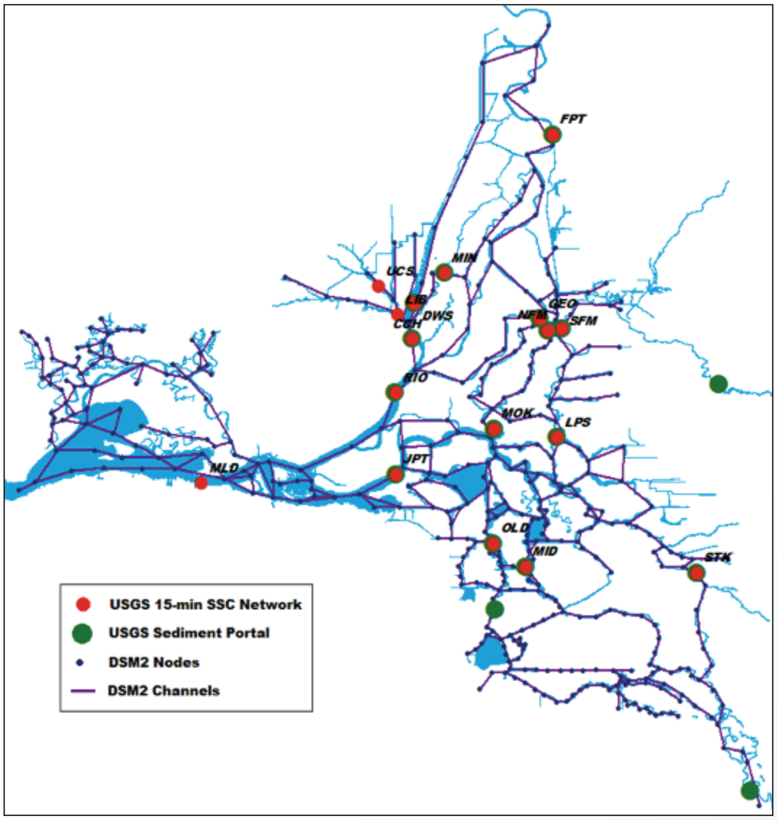
*Nicky Sandhu,*
*Senior Engineer Water Resources, DWR*

## Background

The California Department of Water Resources' Delta Modeling Section is developing a new DSM2 transport module, called the General Transport Model (DSM2-GTM). DSM2-GTM employs a fixed (Eulerian) grid, and it is more straightforward to extend the new model to new physical processes. It includes the transport processes of advection, dispersion and reaction or sources. A salinity (EC) simulation for the entire Delta with DSM2-GTM has been developed and tested. The results for historical salinity simulation from DSM2-GTM are consistent with the results from DSM2-QUAL. The developing effort now has continued by adding a sediment module, so we can announce that DSM2 has the capability to simulate suspended sediment. The sediment module is a standalone model that can be adopted for other applications and integrations. The sediment model is essential to the investigation of the Delta Mercury Total Maximum Daily Load (TMDL) requirements and simulation of mercury cycling in the Delta.

**The sediment model** is essential to the investigation of the Delta Mercury Total Maximum Daily Load (TMDL) requirements and simulation of mercury cycling in the Delta.

**Figure 1** | USGS 15-minute and USGS sediment portal sediment data network overlapping DSM2 grid

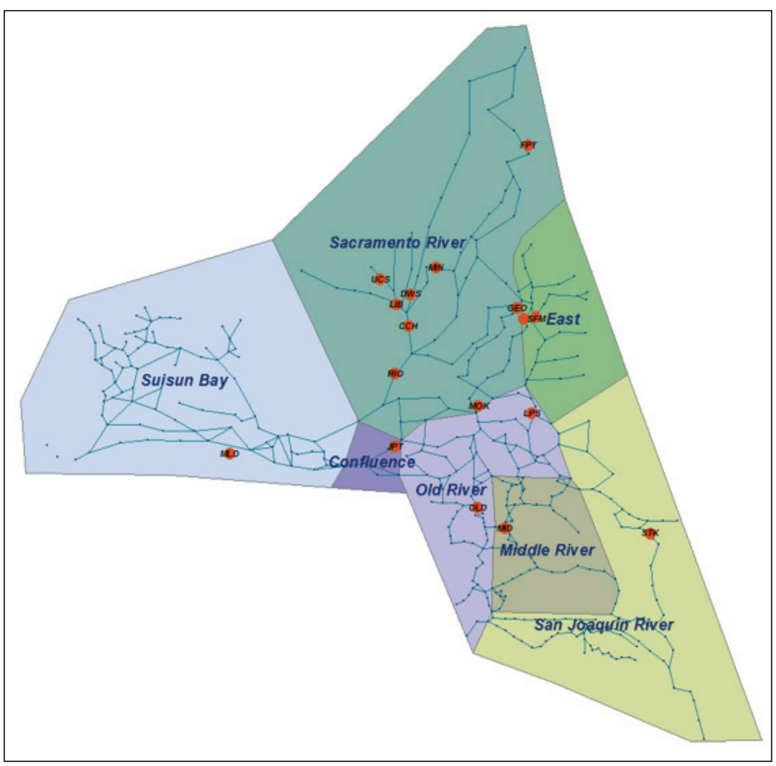



## Data

USGS has continuous measuring stations for suspended sediment concentration (SSC) which is derived from backscatter sensors measurements every 15 min, and the sensors are calibrated approximately monthly with bottle samples. There are 17 stations in the 15-minute sediment network, and mostly they have data from 2010 to present (Morgan-King and Wright, 2013). Those data were obtained by personal communication from USGS Sacramento. An overlapping map of those 15 minutes data network and DSM2 grid is shown in Figure 1.

USGS also hosts a sediment portal website that provides long-term daily continuous and discrete SSC data. Those locations are shown in Figure 1 as well. There are more than 40 years of continuous daily suspended sediment concentration data available at Freeport and Vernalis. However, long-term daily data in the interior Delta are fairly sparse and will not be considered for calibration. Instead, the 15-minute continuous data will be used for calibration.

**Figure 2** | Preliminary subregions for the calibration of suspended sediment concentration




## Model Boundary Conditions

Existing studies suggest that the Sacramento River and the San Joaquin River accounts for more than 90% of total sediment inflow into the Delta. Using those two sediment discharge boundaries should be sufficient for initial model calibration. The Yolo Bypass and east tributaries are minor sources of sediment, and for initial model development only the Yolo Bypass will be included as a minor sediment boundary source. The 15-minute sediment data at Freeport is available for the Sacramento River boundary. However, Vernalis was added to the continuous monitoring network recently in 2014. The daily sediment data is used for Vernalis for San Joaquin River boundary. Yolo Bypass is added as the boundary by using data from Cache Slough near Hastings Tract.

## Methodology

Sediment entrainment and deposition are complex physical processes, and they are usually approximated by empirical equations. The DSM2-GTM suspended sediment module provides options to calculate suspended sediment as non-cohesive sediment, cohesive sediment, or conservative constituents. The sediment entrainment for non-cohesive sediment is estimated by Garcia and Parker (1991) empirical equation. Erosion of cohesive sediment occurs whenever the flow velocity or the flow-induced shear stress over the bed exceeds a certain critical value. The erosion rate of cohesive sediment is calculated according to the formula of Partheniades (1962) while the deposition flux is expressed by a classical Krone (1962) formula. The net vertical sedimentation fluxes are treated as source and sink terms in DSM2-GTM.

### Initial Calibration and Findings

The calibration period is from October 2010 to September 2012, and the validation period is from October 2012 to February 2016. Basically, the simulation period utilizes all the available 15-minute data. This helps us to understand the variations of this relatively new constituent for DSM2. The hydrodynamic information, such as flow velocity, cross-sectional area, water depth, and channel roughness, are obtained from DSM2-HYDRO. The parameters that can be perturbed in the sediment module are sediment particle sizes for sand and fines (silt and clay), coefficients in the empirical equations, and the choice of equations.

**Figure 3** | Preliminary results of calibration (a) and validation (b) at Sacramento River at Georgiana Slough

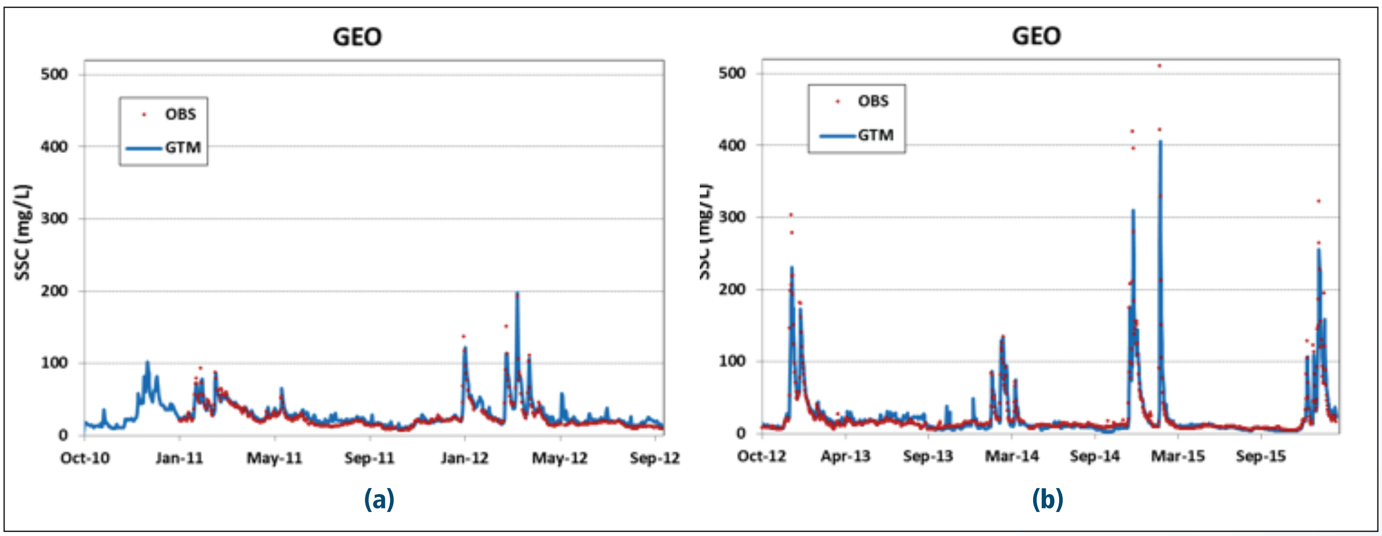
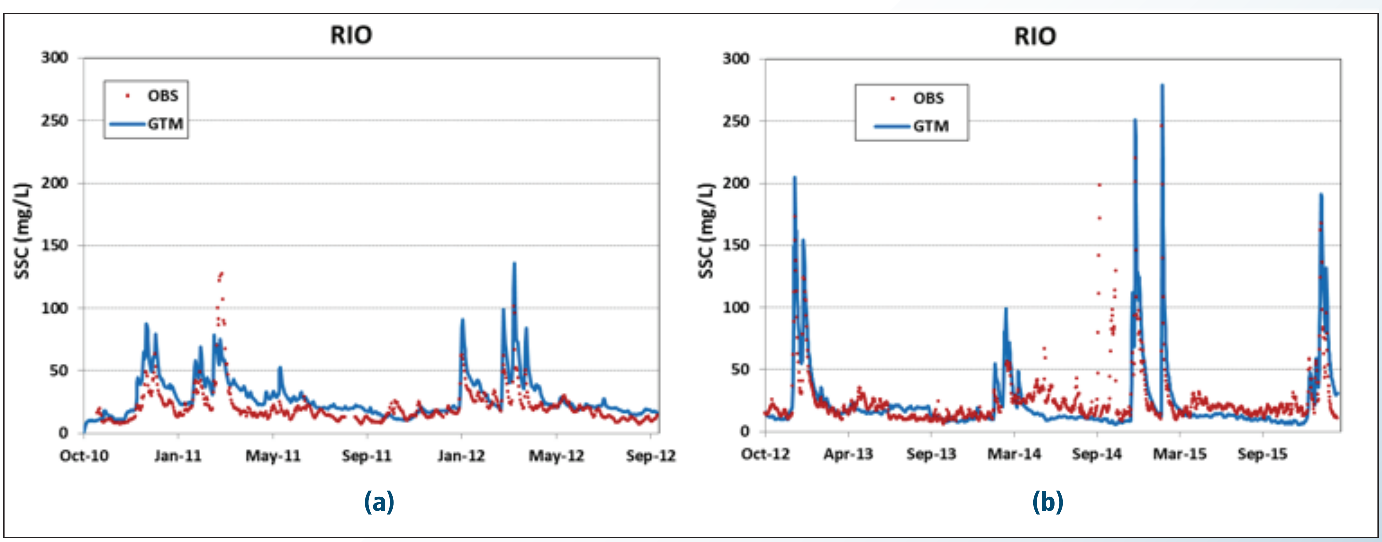



**Figure 4** | Preliminary results of calibration (a) and validation (b) at Sacramento River at Rio Vista



Initial testing was simply applying those variables globally to observe overall response and sensitivity to the perturbation, especially for places that are overestimated or underestimated. This practice helps us to group locations with similar sediment transport characteristics, and thus the Delta is subdivided into several sub-regions. The preliminary results suggest that at least seven sub-regions (Figure 2) are needed to adjust the parameters locally to match the observed data.

## Summary

The sediment model development and calibration are still in progress. The biggest challenge of the simulation of suspended sediment is that the sharp

**Figure 5** | Preliminary results of calibration (a) and validation (b) at Little Potato Slough

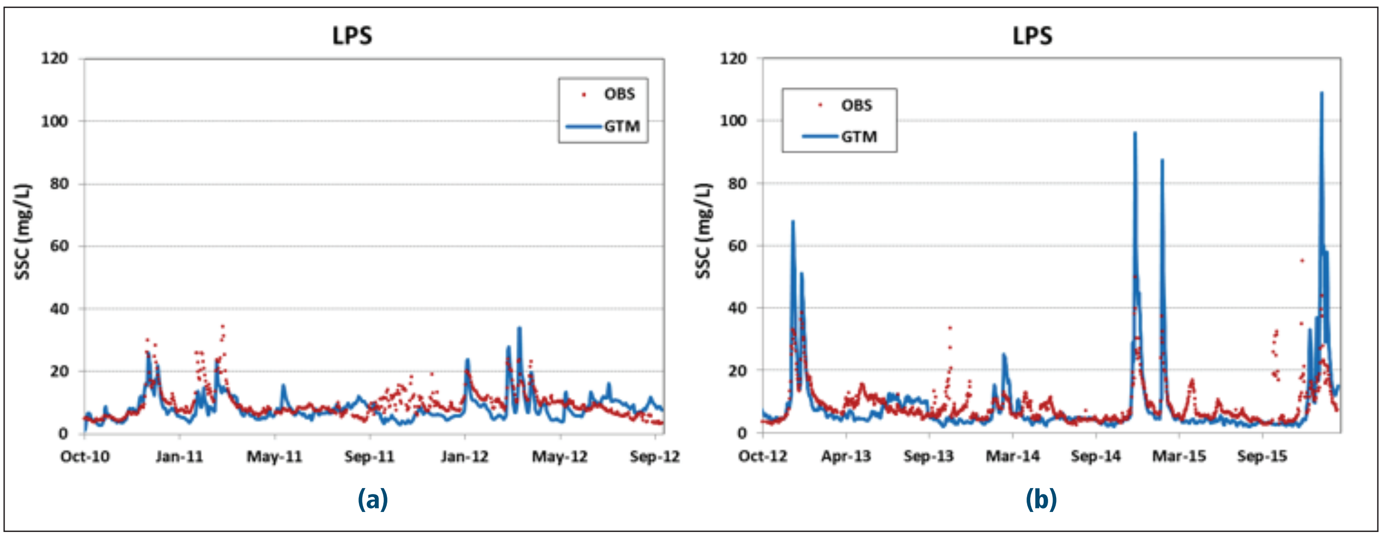
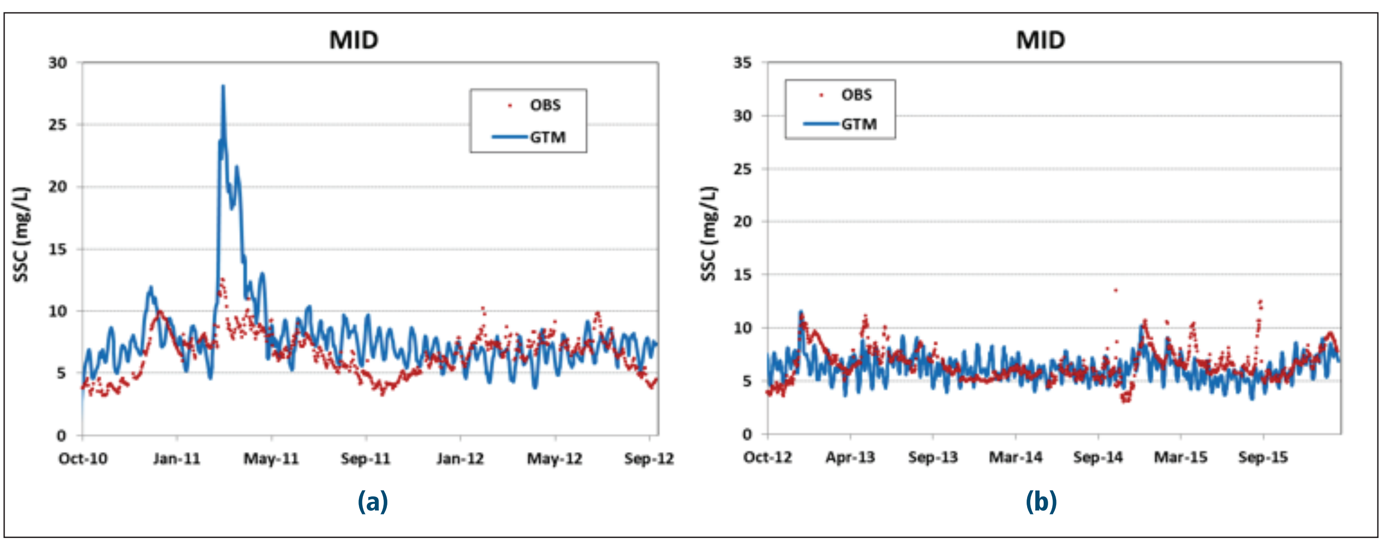



**Figure 6** | Preliminary results of calibration (a) and validation (b) at Middle River at Middle River



spikes usually occur during storm event and the amplitude of those spikes can be over ten times the normal concentration. The preliminary results of the calibration and validation are shown in Figure 3-8. The red dots are 15-minute observed data, and the blue lines are model outputs from DSM2-GTM. They are not final yet, but seem promising. Once the calibration is settled, we will finalize the design for users' input system and that involves the decision of which variables will be global, regional or embedded inside the model. We expect to have a chapter write-up in the 2017 annual report to summarize the developing efforts in details.

**Figure 7** | Preliminary results of calibration (a) and validation (b) at San Joaquin River at Jersey Point

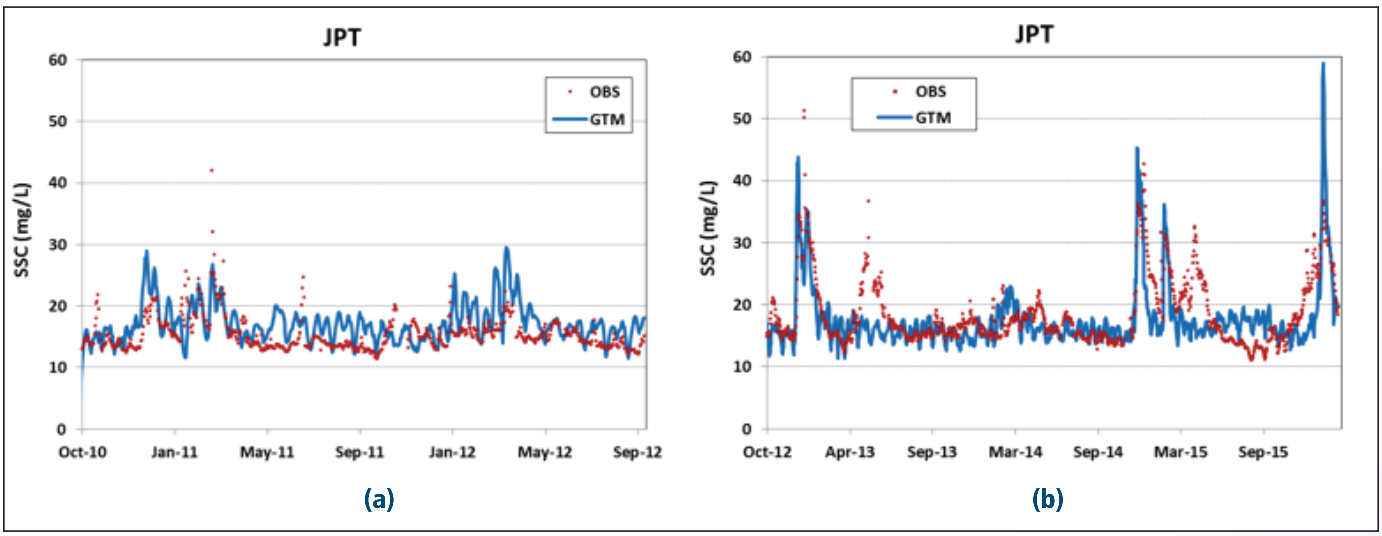
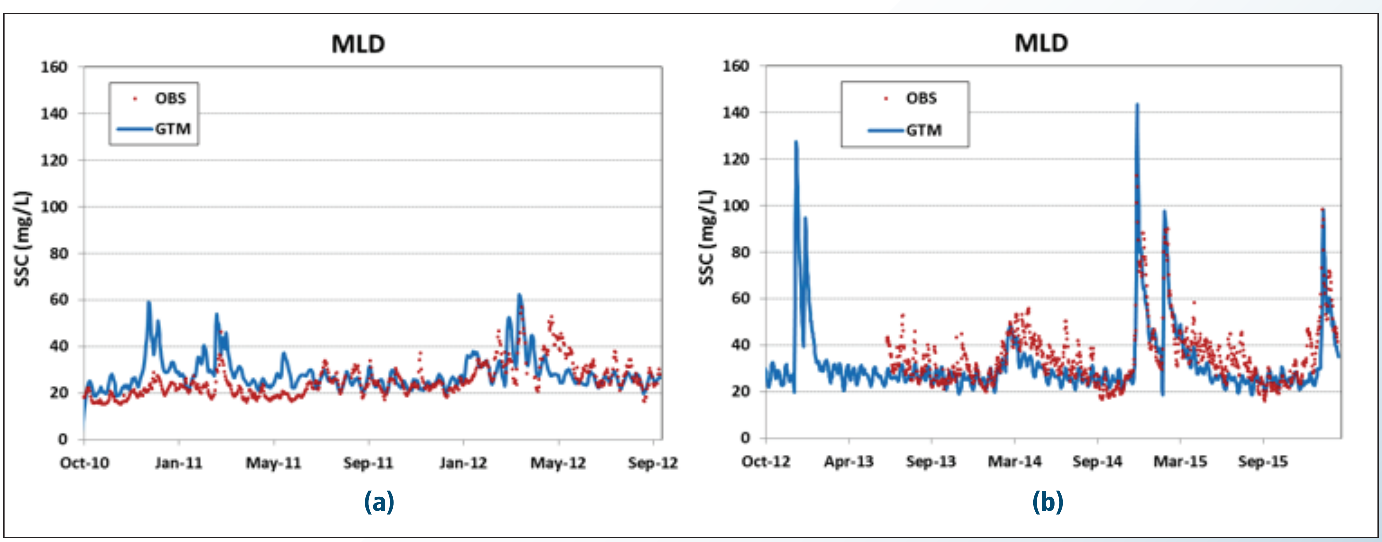



**Figure 8** | Preliminary results of calibration (a) and validation (b) at Sacramento River at Mallard Island



Paul and his family at Oak Farm Vineyards in Lodi.

# Paul A. Marshall

## 20 Things You Don't Know About Me

**Paul, a Principal Engineer, and Chief of the Bay Delta Office of DWR, is leaving State Service after 30 years.**

**Before his retirement next month, Paul candidly shared with us 20 fun facts about himself.**

**1** My first job, at age 12, was stuffing envelopes for a home schooling curriculum company. It was a small shop on my way home from school. I remember having to go to the Vice Principal to get a work permit for the after school job. I got paid between a couple of cents to a nickel to fold lessons and stuff them in various sizes of envelopes. The pennies and nickels added up to spending money for a pre-teen. This was also the company where I got my first promotion. After several months of stuffing envelopes, the owner asked if I had any friends that would want to stuff envelopes too. Before long, I had two school mates working with me – I would set them up for work and make sure they were performing what the owner wanted – and for this I got another couple of cents per envelope.

**2** In college, I studied constantly. I had a group of friends that all studied together. It was as though we owned a table in the library. When mid-terms would come around and other students started coming to the library to study, we would say to each other, "where have they been all semester?" I tried to learn principles instead of solving methods. Then the principles could be applied to other problems. I was also a part of a Christian students group on campus where I connected with people that are still in my life today.

**3** Originally, I didn't want to be an engineer; I wanted to be a doctor. I was an active kid who was on a first name basis with the emergency room staff, so it seemed natural for me to want to go into medicine. But, my dad was an engineer and I had two engineering uncles. My grandfather was also an engineer. Electrical, mechanical, and electronic. As a kid I tore everything apart to see how it worked; I didn't always get them put back together. By the time I was 14 I was repairing the family cars. My career counselor in high school said all of my testing and classes indicated that I should go into engineering, but I still resisted. After a few years working in a grocery store, I relented, went to college and started engineering. The first third of my career was in water quality which stemmed from the marine biology course I took in high school. One of our assignments was to take water quality samples at points in the San Rafael Canal out into San Pablo Bay.

**4** I have been with DWR since April 1998, as a Senior Water Resources Control Engineer in the CalFed Bay Delta Program. I was the only Senior Water Resources Control Engineer in the building because CalFed had borrowed the position from the SWRCB to hire me. My assignment was to build a group of stakeholders and get the stakeholders to write the CalFed Water Quality Program Plan. Two years and 70 stakeholders later, we had the plan out draft with the rest of CalFed.

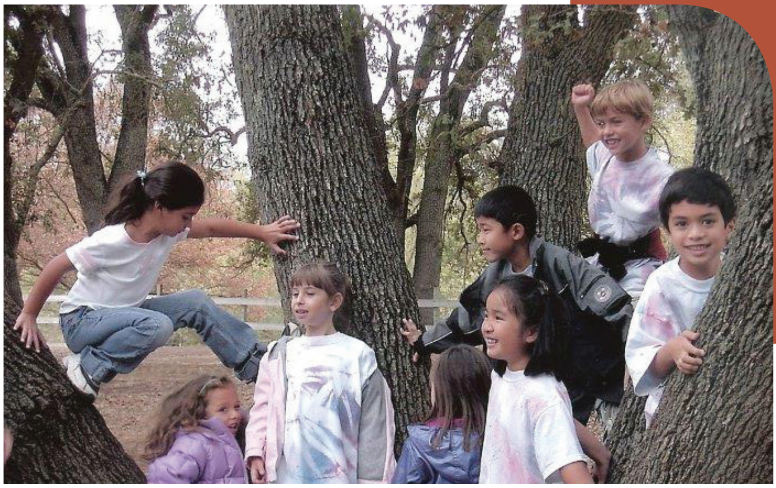
**5** Aside from the drought we are in, the most challenging part of being the chief is personnel. Often, personnel are great at doing the job at hand. But getting them to think about the goals of the Department as a whole and grow into the next position they may take is very challenging. Growth professionally is painful and stressful, just like growing physically. Therefore, many people avoid the growing pains until absolutely necessary. So I started some succession planning times where the senior staff of the office could share insights we have learned over the years with younger staff in hopes they would benefit from it. I would say the results were poor. I started too late or I didn't launch it properly, maybe both.

6 As my favorite cities go, I don't much like them. I was raised in an area where wilderness was within a quarter mile and downtown was six miles away. We played on the Bay, went crabbing at China Camp, camping in the open space, and shooting small calibers in the hills. We did those things that I would never allow my kids to do here in Sacramento, not that there are any crabs. The "City" I always went to was San Francisco. I was born there. I still have family and friends there. It afforded me the culture the mudflats behind my home could never provide. What I appreciate about the City is the Museums, the aquarium, the zoo, restaurants, the sailing, and Stern Grove. At times I have had subscriptions to the symphony and ballet. My parents taught me to love art. My mom loved classical music and my dad always had some art project going on (stained glass, tapestry, wood sculptures.) San Francisco gave me a place to experience culture common to other countries around the globe. I also learned to love sourdough bread there. As a kid we would visit Playland on the San Francisco beach and visit the zoo. In high school I would sail on the Bay with friends. Also in High School, a local band called Journey came out with a song called "Lights" that talks about their city by the bay, I always figured they were referring to my city.


**As a kid** we would visit Playland on the San Francisco beach and visit the zoo.

7 When I really like a movie, I usually buy the DVD. My current Favorite is "The Martian." The science is very close to reality and Matt Damon keeps the situation light. I have seen this one at least five times. Another movie that I really enjoyed was "Interstellar", not so much for the acting but the physics concepts they portray.

8 I live in a nice neighborhood in Elk Grove called Camden Park. It is where my wife and I have raised our kids, gone to church, and watched many events happen around us. I suspect it is very different than many other neighborhoods these days. Many of our neighbors have been there since we moved in. The couple of houses that have been sold have turned over a few times, but all else remains constant. My two kids were fortunate



enough to grow up in this environment. They had many friends within a block or two from their front door.

9 My daughter, Cassandra, will be graduating from Azusa Pacific University this December with a Liberal Studies degree in preparation for a career in teaching elementary school. I find it humorous that she will be teaching elementary school since I was her 4th grade science teacher and she wasn't the best student. I wasn't the best teacher either. That experience gave me a great deal of respect for elementary school teachers.

CJ and the neighborhood kids at the park. Most of these kids were school mates all the way through high school. Now they are off to colleges across the country.

My son, Caleb, who just started at Baylor University in Electrical Engineering, had four other boys his same age within one block. The five of them went to school together, ran track and cross country together, played in the school band together, celebrated the holidays together, played video games together, most went to church together, and they had their high school graduation party together. Now that they have graduated, they are all heading off to different colleges. I told my son that friendships like he has had are rare.

My wife, Christina, works for a non-profit group that is getting kids out of sex slavery in India. The economics there often force children in some towns into the industry to support their families. Her organization finds new industries for the towns to stop the cycle and free the kids.

10 I like many different books and authors. On the spiritual side, Henri Nouwen and Wm. Paul Young strike good chords. Some really good reads are: "The Disappearing Spoon" a must read for chemistry students. "The Ghost Maps" is a fascinating water quality case study in 1854 London. "Mountains Beyond Mountains" is a fascinating narrative about world health. The last few years have been hard to find time for reading.

Caleb (CJ) and Cassandra white water rafting on the South Fork American. Great kids, great fun.

**I don't play** any music instrument, but I can play a stereo.

11 My music, like my reading, is eclectic. I listen to jazz, new age, country, 70's rock, classical, big band, and contemporary Christian. People like George Winston, Super Tramp and the Eagles all occupy some of my disk space. But the one artist that has touched me the most is named Sara Groves. Her songs provoke thought and emotion for me. There is something about her music that has drawn me in and held me captive for many years.

12 I don't play any music instrument, but I can play a stereo.

13 My favorite class in high school was philosophy, taught by Dr. Allan Barahal. He was one of three teachers from high school I refer to as one of my professors. When Dr. Barahal first got to the west coast, he worked as a longshoreman on the San Francisco piers, while he was attending UC Berkeley. He taught us critical thinking and abstract logic. Most of us were headed to college anyhow, but Dr. Barahal gave us a great intro to the experience.

14 My first car in high school was my parent's 1967 VW Bug. That was a reliable car and it was easy to work on.

15 I am a coffee-drinker, but if I have Asian food, I drink tea. Straight tea. None of that milk and sugar stuff.

16 My hobby is wine making.

17 My stress reliever is wine drinking.

18 My consistent favorite wine is an Old Vine Zinfandel from Lodi.

19 I have my bucket list. One item is the Northern Lights. I would also like to see the fall colors in New England, and the Great Barrier Reef.

20 One thing that I would like to share and people might be surprised is that I was an adrenaline junkie in high school. Rock climbing, hang gliding, scuba diving, snorkeling, skiing, mountain climbing, sailing (really small boats on San Francisco Bay), cycling, backpacking, and whitewater rafting. Those were some fun times. I have few scars, but lots of memories.

Watercolor painting of Daffodils, August 2016

# Simple Yet Real

## (平平淡淡才是真) – Lan's Philosophy

*Min Yu, Senior Engineer Water Resources, DWR*

**Lan is a name that most DSM2 users are acquainted with. To those who conduct the historical simulation studies, Lan is more like a 'Data Queen'. She keeps up to date with all the historical boundary inputs and plays a vital role in supporting Delta Island Consumptive Use, DICU, a key model dataset of great interest to our DSM2 users.**

Lan is also one of the engineers in our office of whom I am most familiar—not only because we work in the same office but also we are 'virtual friends' on WeChat (a Chinese version of FaceBook). Moreover, I was on her interview panel back in 2007. Now, for someone who doesn't know Lan, here is how I describe her: petite, smart, kind, artistic, somewhat shy but easy-going, and very pleasant.

Lan is originally from ChongQing, a city in southwest China known for two things: being the commercial capital of China, and having the well-earned nickname of "hot furnace" for its unbearable summer time heat and humidity. Lan studied River Engineering at Wuhan University for her undergraduate program and Hydraulic and River Dynamics for her Master of Science degree at the same university. In 2000, Lan received a full scholarship to study abroad at UC Davis for her

**Lan had long been interested** in working in the modeling group ever since she worked at UCD on theoretical model development of watershed hydrology, sediment and water quality.

Ph.D. degree in Water Resources Engineering. Her advisor was Professor Kavvas.

After obtaining her Ph.D with a dissertation on simulating stochastic processes of solute transport in natural rivers, Lan worked for three years as a research engineer at UCD. Her projects included developing hydrodynamic and environmental modules for stream networks as part of the Water Environmental Hydrology (WEHY) model, utilizing the software Flow-3D to design three-dimensional hydraulics of a flume with fish ladders, and conducting hydraulic design and testing of the Devil Canyon physical model. In 2007, Lan was ready to move on and try her hand with the real world of engineering. She undertook a job with Ayres Associates, a consulting firm on the east coast with a branch office located in Sacramento. Working in this branch office, Lan used RMA and HEC-RAS models to conduct hydrodynamics modeling studies of the Sacramento River. Even though Lan stayed with Ayres for only 6 months, she was able to build upon her skills and gain more experience to better prepare for her dream job.

New York City, July 2016

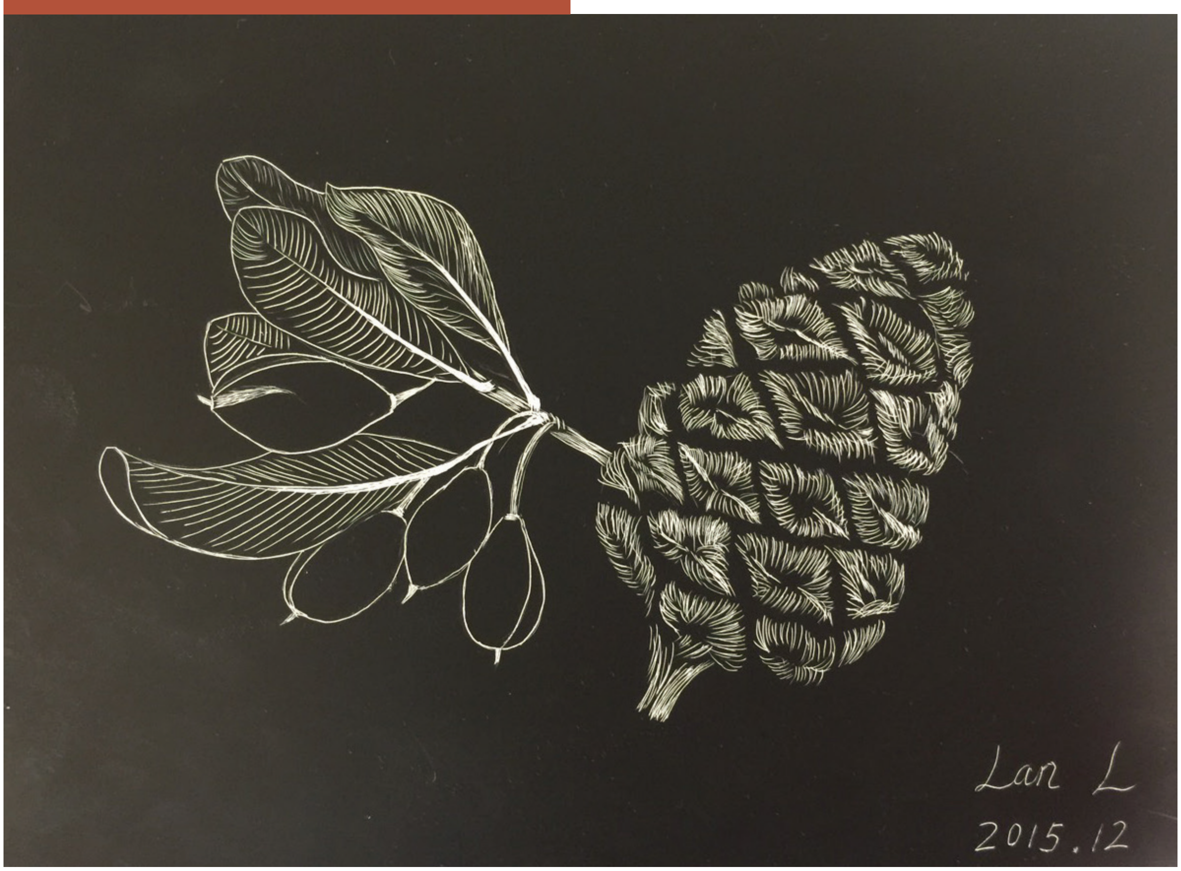
United States Capitol, Washington DC, July 2016

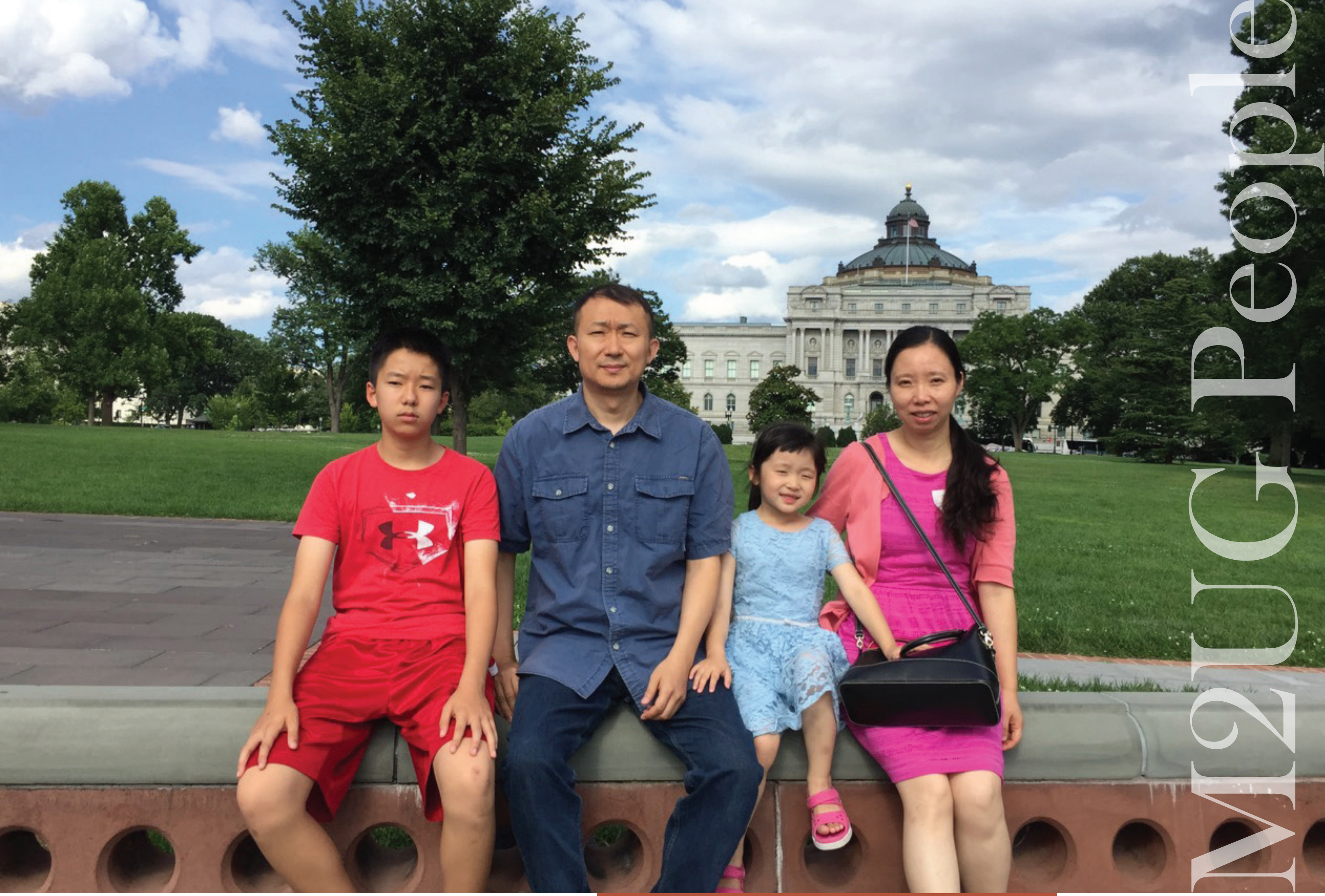
Speaking of Lan's dream job, it was her passion for modeling that led her to seek a position with theBay-Delta Office. Lan had long been interested in working in the modeling group ever since she worked at UCD on theoretical model development of watershed hydrology, sediment and water quality. When Lan learned that DWR's Delta Modeling Section (DMS) had its own river network model which employed a comparable approach to what she had researched, her sense of curiosity was heightened. The opportunity to explore the difference between theoretical and production models motivated Lan to pursue a career with the modeling group. However, the road to her dream job wasn't exactly straight.

In 2007, Lan applied three times for a job with the Modeling Branch for the Engineer Water Resources position. Due to the challenging parking and unfamiliarity with the Sacramento downtown area, Lan was late for her first two interviews. To this day, Lan still considers herself fortunate for being on time for her last interview at which she performed well. That interview was led by Bob Suits, who is a Senior Engineer with DMS and Lan's current supervisor. I was on that interview panel as well. In addition to Lan's experience and skills, what struck me the most was Lan's closing statement. While every other candidate might have summarized their experiences in the closing statement to emphasize their qualifications, Lan actually had a question for the panel, "Have I got a shot?" A question was so direct that it made us all burst into laughter while being impressed by Lan's sincerity and simple directness.

They say the third time's a charm. Lan's wish finally came true after that interview, and she has been with DMS ever since. During the last 9 years, Lan has experienced a broad range of DSM2-related projects. Today, Lan's main responsibilities include conducting various DSM2 historical studies, improving the estimation of Delta consumptive use, and extending the function of DETAW to produce Delta channel depletion. I asked Lan about her all-time favorite projects and the most challenging ones. Lan shared that she enjoys running studies to simulate hydrodynamics and water quality in the Delta. To Lan, modeling studies is more like an art of estimating the uncertainties. Concerning her most challenging project so far, Lan lists her collaboration with the Central Valley Modeling Group for the channel depletion work beginning in 2009. Lan explains that estimating Delta channel depletion is highly complicated because 1) it depends on many parameters and processes, such as crop Evapotranspiration(ET), seepage, leaching, irrigation, drainage, deep percolation, and runoff, and 2) it also relates to the interaction between the surface water and the subsurface water. Currently, except for crop ET, the other processes are difficult to directly verify due to a lack of the field data. Collecting the observed data needed requires much communication, cooperation and support among staff with DWR and other agencies and stakeholders. While the complexity of this project might overwhelm, Lan remains determined and optimistic.

First time trying the scratchboard, December 2015





Library of Congress, Washington DC, July 2016

While Lan's career has flourished since joining DMS, her family life has also prospered. Lan and her family live in Davis. She and her husband, an IT professional at CalEPA, have been happily married for 18 years. Besides having an 12 year old boy David, they have a 6 year old daughter Linda, who came along after Lan's modeling career took off. Lan often jokes that Linda was a DMS baby. The family enjoys simple yet satisfying lives: taking long walks in the neighborhood, hiking on the weekends, and visiting National Parks and museums on their family vacations. Recently, Lan started painting, a 'new' hobby inspired by Tara Smith, Chief of DMS. I teased Lan if her new hobby was a midlife crisis moment but only discover that painting was actually an interest from her childhood under her father's influence. Since calligraphy and painting are the classical twin arts in China, Lan practiced calligraphy for 18 years growing up. "I think it's time for me to go back to my roots" Lan laughed and said this to me at the end of our interview. "Painting and calligraphy allow me to calm my mind and cultivate my patience. While I seek perfection in my work, I'm always content with the simple things in life." Well, that is our Lan, who's got a shot in many ways.

"**Painting and calligraphy** allow me to calm my mind and cultivate my patience. While I seek perfection in my work, I'm always content with the simple things in life."

# Life is an Adventure

## Steve Micko's Story

*Min Yu, Senior Engineer WR, DWR*

I can clearly remember the first time I met Steve. It was last November at the DSM2 User Group quarterly meeting. Young and enthusiastic, with long wavy blond hair, Steve projected a quiet confidence and looked like a rock star you'd see on the cover of Rolling Stone Magazine. Of course, once we started chatting about the Delta and DSM2, there was no doubt that Steve is a true engineer at heart.

At the meeting, Chandra Chilmakuri, a Project Manager at CH2M, introduced Steve as a new hire to their team. Steve had just graduated with a MS degree in Civil and Environmental Engineering from UC Davis where his advisors were the prominent professors Dr. Fabian Bombardelli and Dr. Bill Fleenor. Steve's Master's thesis focused on implementing algorithms for simulating weirs in three dimensional computational models. His work was a part of a collaboration between Resources Management Association and UCD. Steve developed the FORTRAN code to model the Delta Cross Channel, the Temporary Barriers, and Suisun Marsh Salinity Control Gate. He tested different algorithms to find the most computationally efficient and stable one for each structure.

Steve also has a BS degree in Civil Engineering from UCD, and throughout his time there, he had several internships to gain experiences and hone his skills. During his undergraduate years, Steve was an assistant to Professor Thomas Harter in the Hydrology Department. Later he worked in the construction management field with the Santa Clara Valley Water District. In graduate school, his major gigs included a graduate student researcher with the Center for Watershed Sciences and the head teaching assistant for a hydraulic laboratory class.

Mountain Biking, Moab, Utah, 2016

Steve reports that, while all his internship experiences were interesting, his most intriguing one was overseas in the summer of 2015. Steve is a fan of rock climbing and had been fascinated by the dizzying heights of Norwegian mountains (more details later on about Steve's hobbies). That summer, Steve received the opportunity with the Norwegian University of Science and Technology to work as a research assistant on climate change-related projects in the Civil Engineering Department. While he wasn't at his computer simulating sea level rise, Steve was living his dream hopping across sheer cliff faces in the Norwegian mountains.

Mountaineering, Sangre de Cristos, Colorado, 2015

For the last ten months with CH2M, Steve has been with the Water Business Group, taking on many projects that require in-depth knowledge and extensive modeling skills to conduct studies simulating different attributes of the Delta. Steve's main focus is DSM2. He has utilized DSM2-PTM to simulate juvenile Delta smelt behavior, a project for the US Fish and Wild Life Service. Steve also worked on DICU-related studies and technical documentation for DWR's Water Storage Investment Program. In addition, Steve is using the new HEC-RAS 2D model to simulate regions of Sacramento River volume. All in all, he finds it is gratifying to work on such a broad range of diversified projects. He enjoys the experience and also the people he works with at CH2M. He hopes that he will continue learning from his peers and stay abreast of current Delta issues and any modeling development.

When Steve is not at his computer tackling the actual issues of the Delta, he enjoys his time pursuing interests in traveling, rock climbing, backpacking, and photography. You would be amazed by the number of

**When Steve is not** at his computer tackling the actual issues of the Delta, he enjoys his time pursuing interests in traveling, rock climbing, backpacking, and photography.

Mountaineering, Sangre de Cristos, Colorado, 2015

countries Steve had been to. The magic number is 25! Right after he obtained his BS degree in Civil Engineering from UCD, Steve visited Asia for two months, spending time in Cambodia, Thailand, and Singapore. However, Steve's favorite part of the world is Europe. In the fall of 2011, Steve took a semester off to be in France for half a year. During that time, Steve attended University De Bordeaux studying French (a little trivia, Steve also has a minor in French from UCD). Those 6 months gave Steve plenty of time to trek around Europe. His favorite place was Lithuania, mostly because of the friendly people he met there. One of his most rewarding experiences occurred in a beautiful Portuguese town located on the Mediterranean Coast called Lagos. Here he worked on a small goat cheese farm for a month. His daily tasks included cooking meals for everyone, building fences, herding 50 goats, constructing a building out of adobe, maintaining a garden, and training a donkey named Ed. Why training a donkey? Well, according to Steve, being an equestrian growing up and having the experience training horses, he was duty-bound to be the appointed trainer for Ed.

These days, Steve is more duty-bound to his work. After spending seven years living in Davis, Steve moved to one of the most incredible neighborhoods in Sacramento, the "Grid", aka midtown. Besides cooking for his roommates and biking around the neighborhood, Steve enjoys the art and tantalizes his taste buds in this trendy neighborhood. Steve favorite restaurant is The Coconut Thai restaurant in midtown. His go-to item on the menu is usually something spicy and with curry. I guess his taste buds typify his personality: driven, fun and adventurous.

Rock Climbing, Ha Long Bay, Vietnam, 2013

# ASK A MODELER

**IF YOU HAVE THE QUESTIONS,**
WE HAVE THE ANSWERS!

**Q: I'm hoping to get a shapefile for the DSM2 mini-recalibration grid (with the upstream extensions on the Sac River.). Where can I find this type of shapefile?**
*(Dr. Marianne Guerin, Associate, RMA)*

**A:** I have zipped shapefiles for the grid that I georeferenced. I found a file geodatabase with an extended grid that was created before, but there is no metadata unfortunately. The files are available at https://dsm2ug.water.ca.gov/library/-/document_library/view/339849
*Answer provided by Jane Schafer-Kramer, GIS Specialist, DWR*

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**Q: Could you please help me with "DSM2 boundary flow from 1/1/2014 through 10/1/2015." I thought I would be able to download from CDEC but I need the CDEC node numbers.?**
*(Farrukh Mohsen, Senior Managing Engineer, Exponent®, Inc.)*

**A:** Here is a list of CDEC IDs for the Delta boundaries:

Sacramento: FPT + SPE
San Joaquin: VNS
Yolo Bypass: RUM + FRE
Mokeumne: WBR *(unfortunately this is not updated for flow)*
Cosumnes: MHB
Calaveras: NHG
Clifton Court: CLC or HRO
Jones: TRP
CCWD: INB + IDB + CCW
Barker Slough: BKS
Martinez: MRZ

*Answer provided by Aaron Miller, Supervising Engineer WR, DWR*

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**Q: I noticed that the configuration file (in the historical simulation setup posted online) was looking for "gates-v8-05292013.dss", but the gates file in the link you provided is titled "gates-v8-201602.dss." Could you please let me know which gates file I should be using?**
*(Steve Micko, Water Engineer, CH2M)*

**A:** Please use the link below for downloading the updated version:

https://dsm2ug.water.ca.gov/library/-/document_library/view/316154
*Answer provided by Min Yu, Senior Engineer WR, DWR*

## If you have any questions

or comments regarding this issue of the Newsletter, please contact the facilitator of the DSM2 User Group:

**Min Yu, P.E., Senior Engineer WR**
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Bay-Delta Office

Department of Water Resources
1416 9th Street
Sacramento, CA 95814

**Email:** Min.Yu@water.ca.gov
**Phone:** 916.653.5225

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