Summary of DSM2 Sediment Transport Module Technical Advisory Committee Meeting
July 20, 2009

The first Delta Simulation Model 2 (DSM2) Sediment Transport Module (STM) Technical Advisory Committee (TAC) meeting was held on July 20, 2009 in Sacramento. About 25 people attended in person and another half dozen people called-in to the meeting. After group introductions, Francis Chung (DWR) made opening remarks about DWR's interest in this project, and he encouraged members of the TAC to take partial ownership of the development and later use of the STM. Jamie Anderson (DWR) then provided an overview of DSM2, the STM project, the proposed STM implementation plan and data resources. Fabian Bombardelli (UCD) then presented technical details of the project. Kaveh Zamani, the graduate student working on the STM code, was introduced. Key points from the discussions are summarized below.

Delta Sediment Transport Issues
The TAC came up with the following list of key sediment transport issues for the Delta

- Channel bed level changes
- Conveyance alternatives
- Dredging
- Gates and barriers
- Environmental issues
  - Food web
  - Habitat
  - Mercury/heavy metal transport
  - Water quality/water chemistry
- Levee failures/setbacks/modifications
- Marsh restoration
- Turbidity / fish migration

Proposed STM Implementation Plan
It was proposed that the first phase of the STM implementation would include:

Proposed Phase 1
- Suspended sediment
- Single sediment particle size
- Deposition only
- STM would run sequentially after running DSM2 HYDRO (e.g. HYDRO would provide input to STM, but STM would not provide feedback to HYDRO)

Proposed later implementation
- Bed load
- Erosion
- Multiple sediment particle sizes
- Coupling STM and HYDRO to run in series (e.g. HYDRO and STM would run together at every time step, and the bed level changes from STM would then affect the HYDRO calculations for the next time step

The TAC discussion strongly encouraged including erosion in the first implementation phase. Although deposition dominates over longer time scales, on a tidal timescale, both erosion and deposition are important.

The TAC also encouraged writing the code to handle multiple sediment classes but only implementing one or two class sizes at the beginning.

The TAC agreed that resolving bedforms would not be possible due to the spatial scale of DSM2.

STM may never need to run in series with HYDRO because bed changes in the Delta are typically small relative to the depth and flow rates. This is a lower priority task.

Based on these comments, the implementation plan has been revised as follows:

Revised Phase 1

- Suspended sediment
- Index sediment particle size variables for multiple parameters but only use one or two particle sizes for initial development and testing
- Deposition and erosion
- STM would run sequentially after running DSM2 HYDRO (e.g. HYDRO would provide input to STM, but STM would not provide feedback to HYDRO)

Proposed later implementation

- Bed load
- Testing with multiple sediment particle sizes
- Coupling STM and HYDRO to run in series (e.g. HYDRO and STM would run together at every time step, and the bed level changes from STM would then affect the HYDRO calculations for the next time step

Available Sediment Data for the Delta

As part of the STM project, a list of available Delta sediment data is being compiled by Jamie Kohne, a graduate student at UCD. When completed, the information will be posted on a public website. A draft list of available data was presented to the TAC and feedback on additional data sources or data issues was requested. Key points from that discussion are summarized below:

Data Sources

- USGS 1998-2003 most intensive data sampling, 2002 extra flow data
- Some sediment bed particle size sampling at USGS Optical Backscatter Sensor (OBS) sites
- 2003ish USGS did a two week laser study that would provide some information on flocculated sediment. There is some general information on coarser and finer material during the tidal cycle, but not size class information.
- Dave Schoellhammer has some data for Cache Slough.
- 2001-2002 data near Freeport, Randall Dinehart USGS

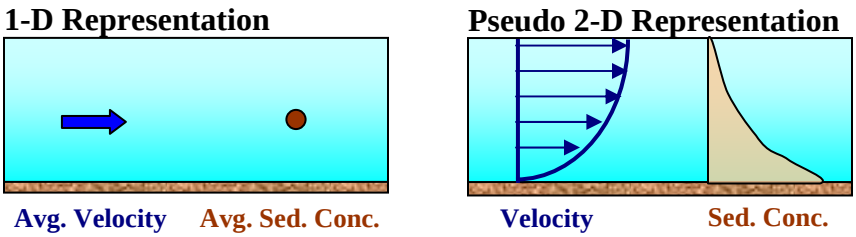
- Freeport and Vernalis have daily sediment information from samples analyzed in the lab
- 2002 Frank's Tract and Mildred Island data used by RMA for calibration. Contact Jon Bureau or Scott Wright at USGS.
- Ted Swift from DWR may have some sediment data for Delta tributaries
- DWR Central District is putting YSI turbidity sensors in the Delta, check with Chris Enright DWR
- There may be sediment and turbidity data together at Mallard Island, used by Neil Ganju (USGS nganju@usgs.gov) in his dissertation. Pete Smith e-mailed two papers with regressions between turbidity and concentration of suspended sediment, obtained by David Schoellhamer and Neil Ganju. That e-mail was forwarded to the TAC.
- There may be turbidity and suspended sediment data for the Bay in USGS annual reports
- There is turbidity and suspended data near Jones Tract after the levee failure
- 2008 CalFed study looked at changes in flow friction on ebb and flood tide.
- The Sacramento River and Three Mile Slough have large dunes. Randall Dinehart at USGS has investigated bedform/flow relationships.
- Maureen Martin at Contra Costa Water District may have some sediment data from her dissertation work

Data Issues

- Partial data sets can be tricky. Where, when and how the data were collected is essential for putting the data in perspective, especially in a tidal system (spring/neap, ebb/flood)
- It is important to identify data needs and strategies for dealing with data deficiencies.
- Rick Oltmann from USGS looked at flow and sediment data around 2000 and found relating the data to be very challenging and frustrating.

Technical Issue with Code Development

- An issue was raised about considering using a pseudo-2D approach instead of the proposed 1-D approach in the STM (Figure 1). In the 1-D approach, average velocities computed by DSM2 HYDRO are used in the STM model to compute average suspended sediment concentrations. In the pseudo 2-D approach, the 1-D velocity from DSM2 HYDRO is expanded to a 2-D vertical profile using approximations similar to those used in the DSM2 Particle Tracking Model (PTM). The rationale was that the pseudo-2D approach would provide more accuracy, and better boundary information for the bed load computations, since the concentration and velocity profiles will be represented in the model. Fabian Bombardelli countered that this is not usually the case because those profiles are not known with accuracy and, therefore, they will be approximations. In this regard, the higher computational cost will not yield the promise of higher accuracy.



1-D average flow & velocity directly from DSM2

1-D velocity from DSM2 expanded to 2-D vertical profile similar to Particle Tracking Model (PTM)

Figure 1: Proposed 1-D and Pseudo 2-D Model Representations

While the pseudo 2-D approach is conceptually appealing, at this time the large uncertainties and small amount of available field data do not seem to support changing approaches. If anyone has strong opinions to the contrary, please present your case soon. We would like to resolve this issue within a few weeks.

- Flow splits at channel junctions will be a challenge in the model.
  - It is proposed that sediment concentrations will initially be split relative to the flow split.
  - It was cautioned that areas such as the Delta Cross Channel (DCC) where one channel is significantly deeper/shallower than the others may not be adequately represented by a simple flow split. In the case of the DCC most of the water taken from the Sacramento River is taken from the surface. This may be important for sediment concentrations.
  - Using the proposed Modified Method of Characteristics may have issues at junctions if the characteristic extends beyond the junction. Shorter or variable time steps may address that issue.

Additional Comments/Questions

- Grain size is very important for Delta sediment transport, especially at the bed.
- The Yolo Bypass is a large source of sediment during high flows. That sediment is not monitored where the Bypass flows back into the Delta.
- Wind waves are very important for suspended sediment concentrations in broad shallow areas such as Frank's Tract. DSM2 doesn't represent wind waves.
- Salinity affects flocculation. This will be represented empirically.
- Is chemical precipitation important in the Delta? Does it significantly affect sediment transport processes?
- Erosion after levee failures is a separate issue from erosion during the normal tidal cycle.
- Field studies may be conducted on Liberty Island in the next few years since it hasn't filled in as quickly as expected.

- Susan Huston at UCD is studying the relationship between turbidity and submerged aquatic vegetation. When turbidity goes down, submerged aquatic vegetation goes up. There are also seasonal relationships. Boating and Waterways clears the vegetation.
- What is the target time scale for analysis, e.g. tidal cycle, annual averages, etc?
- What is the first planned DSM2 STM application type, a historical, planning or forecasting application? First we plan to test the model against historical data.
- Which method of DSM2 application –historical, planning or forecasting—is the highest priority for DWR?
- Encouraging and supporting long term data collection is essential.

Next Meeting
The next meeting will be scheduled for January 2010.