Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh

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Chapter 2:
Hydrodynamics

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DSM2-HYDRO is an implicit hydrodynamic model based on FOURPT, a public domain code written by Lew Delong and his colleagues at the U.S Geological Survey. The main advantages of using DSM2-HYDRO over the Department of Water Resources' existing hydrodynamics module are that the model:

❑ Is implicit; therefore it is unconditionally stable, meaning it does not have to use small time-steps, and more importantly, it can handle larger flows and flood conditions.
❑ Has the capability to handle rectangular, trapezoidal, and completely irregular channels. It can also handle prismatic and nonprismatic channels.
❑ Is set up to include the effect of density driven flow (baro-clinic).

The following describes the Delta Modeling Section's efforts in implementing new features in DSM2-HYDRO during the past year. For a description of the features and characteristics of DSM2-HYDRO and FOURPT, please refer to the Delta Modeling Section's 1993 Annual Progress Report (Methodology 1993).

Hydro File

The "hydro" file, the main link between DSM2-HYDRO and DSM2-QUAL, contains the hydrodynamic simulation output which is used by for constituent transport simulation. DSM2-QUAL requires flow, flow area, and top width for each grid point (there can be two or more in every channel) and for every time step. These requirements can lead to a massive file for a long simulation unless some simplifications are made.

In the Department's current Delta model, DWRDSM, the "tide" file contains only the hourly stage data, averaged over the length of the channel for a period of one tidal day. Flows are recalculated in the transport module using continuity principles. The disadvantage of this simplification is that the recalculated flows are slightly different than the ones calculated in the hydrodynamic module and can potentially cause constituents to travel through barriers. Further adjustments were made to correct for the slight differences; however, the user should be very careful when placing barriers and one-way gates.

Currently, the hydro file in DSM2-HYDRO is a binary file, and it contains flows and flow areas at both ends of every channel, written at a time interval specified by the user. These flows are not instantaneous values; they are averaged over the time interval to ensure continuity is fully maintained. Flow values are then interpolated in DSM2-QUAL over the length of the channel to calculate the flows at intermediate grid points. The time interval is currently fixed, but the model can be easily modified to accommodate variable time intervals.

Restart File

A "restart" file contains hydrodynamic information (flow and stage at every grid point) at the end of the simulation period. This information can be used as the initial conditions in a subsequent model run. This option existed in FOURPT, but the following improvements were made to the DSM2-HYDRO option:

- ❑ The flows in and out of the open water reservoirs were added to the restart file.
- ❑ A time stamp was added to the restart file; the time stamp specifies the exact simulated date and time the restart file was written.
- ❑ Three new flags were added.

RESTART_WRITE   If this flag is set, then a restart file is created at the end of the model run.

RESTART_READ   This flag instructs that the initial conditions are to be read from a restart file.

IGNR_START_DATE   This flag instructs the model to ignore the start date and time requested by the user, rather this is read from the restart file. This override is especially helpful in case of an accidental interruption in a long-term model run. During a model run, temporary (backup) restart files are generated automatically at a user-specified time interval. In case of an interruption, the model can continue from the date the last backup restart file was written.

The hydro file and restart file contain very similar information. The main differences are their uses: the hydro file is unformatted to save disk space and improve read/write speed, while the restart file is formatted text (ASCII) so it can be edited by the user. The hydro file spans the entire model run and has average values over a short time period (typically 1 hour or 15 minutes), while the restart files records the last instantaneous values.

Reference

"Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and San Francisco Bay," *Fifteenth Annual Progress Report to the State Water Resources Control Board.* California Dept. of Water Resources, 1994, 5.1 - 5.13.