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DSM2 Model Development

DSM2-Qual External/Internal Flow Revision

DSM2-Qual's handling of external and internal (object-to-object) flows and concentrations was reworked. The basic concept is the separation of the physics of flow and mass movement from accounting needs. In other words, the model does not care whether a flow is labeled as a rim flow or an agricultural drainage, but for study purposes it is important to track those separately. Accounting labels were introduced to allow flows to be treated the same general way physically, but tracked separately for reporting purposes. Generalized internal flow transfers between nodes and/or reservoirs were added. This allows a way to pump water within the system between canals and reservoirs.

As an adjunct to this work, intake screen efficiency was introduced. This allows some fraction of the mass to be left behind at the extraction point, whether node or reservoir, and either external or internal sink. If the mass is assumed to represent fish, for instance, this could be used to estimate how screen efficiency affects where the mass (fish) moves.

DSM2-Hydro Fully Implicit Version

Eli Ateljevich, a Civil Engineering graduate student at the University of California, Berkeley, working with DSM2, needed a more efficient version of the skyline solver that is used in DSM2-Hydro. He located a somewhat faster and much more memory-efficient sparse-matrix solver written in C, in the mid-1980's, by a UC Berkeley computer science student, Kenneth S. Kundert.

While replacing the skyline solver, Eli also reworked the way reservoirs are handled in the system. In the fully implicit version of Hydro, the reservoir stages and flows between reservoirs and connecting channels are incorporated into the system of linear equations to be solved at each time step and Newton-Raphson iteration. This allows a 15-minute time step to be used in most cases, and will allow the same gate formulation used in channels to be used for reservoirs.

Interagency Ecological Program Project Work Team DSM2 Recalibration

The Interagency Ecological Program DSM2 Project Work Team has been meeting for several years to discuss work items related to DSM2. The PWT is composed of staff from Federal, State and local agencies, as well as university students and interested parties.

In the last year the PWT, led by Chris Enright of the Department's Suisun Marsh Branch, Environmental Services Office, and Rick Oltmann of the U.S. Geological Survey, has taken on the task of recalibrating DSM2-Hydro and -Qual. A new grid has been developed which incorporates the newest channel bathymetry data and reduces the use of reservoirs to model open bodies of water, replacing them with channels, especially in the lower Sacramento area (west of Chipp Island and Sherman Lake), and has the best available gate and barrier information. The calibration will make use of recently collected data to better determine the propagation of stage and flow phases and amplitudes, residual flows, and flow splits at crucial stream junctions.

The calibration process is fully public, using Web page technology to disseminate each calibration run, and to facilitate discussion of the results and what to do next. The Web page, designed and implemented by ESO, contains fixed, instantaneous and residual plots for each run, information about what went into each run, and comments from all participants. The runs are split into two groups. The first group consists of several 1- to 3-week periods designed to calibrate Hydro over different hydrologic conditions. The second group consists of a single 3- to 4-year run of both Hydro and Qual, designed to provide information on salt transport to calibrate both Hydro and Qual. ESO will run the first group on their PC's, and the second group run will be performed by Delta Modeling on their Sun equipment.

Missing stage and EC data at Martinez, the downstream boundary, is a serious problem, as there are many periods of more than a few hours of missing or corrupted data, some periods are weeks or even months long. Eli Ateljevich developed a method to fill in missing stage data, using a combination of astronomical stage and nearby observed-stage stations. A similar technique could probably be used for EC, with the additional incorporation of Net Delta Outflow, but may not be ready in time for calibration. If not, a simpler daily average regression from nearby stations will be used. A final product is expected at the end of 1999.

Channel Bathymetry Measurement

It has been recognized for some years that the bathymetry of the Delta channels plays a crucial role in accurately modeling Delta flows and salinity movement. Beginning in 1993 ("Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun March", June 1993), the Delta Modeling Section started assembling and organizing existing bathymetry data and developed viewing and editing programs leading to the current Cross Section Development Program (CSDP), written in Java.

Using existing, available data improved model performance. However, many areas of the Delta have only very old data from the 1930's, of questionable accuracy. Therefore, large numbers of channels should be resurveyed to eliminate uncertainty in the channel geometry. In recent years, technological advances have made channel bottom surveys much cheaper. These advances include the use of the Global Positioning System (GPS) satellite receivers to accurately and quickly locate the moving boat horizontally, integrated GPS and depth sounding software and hardware to reduce post-field work analysis, and laser range finders to reduce or eliminate the need to conduct land-based surveys of the levees.

Accuracy requirements to estimate channel bottom contours are less than those for, say, studies involving sediment movement and scouring. For modeling purposes, error of a few feet horizontally and 1-2 feet vertically are acceptable. Therefore, traditional cross-section surveys, perpendicular to the channel, are not needed and may be inefficient.

Howard Mann, of the Central District, DWR, was commissioned to perform boat surveys of selected areas of the Delta. The first survey, conducted in May and June of 1998, was in the area from Chipps Island to Sherman Lake. A zigzag boat track, where the boat was run diagonally from one bank to another, up and down channels, was used and deemed a success, as it increased the channel distance covered for a given amount of time in the water at an acceptable error level. The collected data was processed by Howard and his staff and incorporated into the DSM2 bathymetry database. A second survey is scheduled to be conducted in May and June of 1999, this time covering the central Delta south of the San Joaquin River.