Texas A & M University and U.S. Bureau of Reclamation
Hydrologic Modeling Inventory
Model Description Form
June 2000

Name of Model: **CVGSM (CENTRAL VALLEY GROUNDWATER AND SURFACE WATER MODEL)**

Model Type: **Finite Element, Quasi-three-dimensional.**

Model Objective(s) : **To simulate water distribution/ movement throughout the entire Central Valley of California. This model is actually a specific application of the more general IGSM (Integrated Groundwater/Surface Water Model). CVGSM has been updated and migrated to a new code IWFM (Integrated Water Flow Model) http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/ . The new Central Valley application that succeeds CVGSM is now called C2VSIM. New Reclamation models WESTSIM and MERCEDSIM have been developed as more detailed sub-regional models using the IWFM code.**

Agency and Office: **Bureau of Reclamation, Mid-Pacific Region, Division of Planning and Technical Services, Water Resources Branch.**

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Model Structure and Mathematical Basis: **CVGSM assumes that most water use characteristics for the Central Valley can be described in terms of 21 regional units. It is capable of producing many mass balance budgets for each of the 21 regions. C2VSIM further refines these water budget areas. C2VSIM addresses some of the technical limitations in the original IGSM code and is much better documented than the original model. A new user interface has been developed for IWFM that can be used by C2VSIM, WESTSIM and MERCEDSIM.**

Model Parameters: Model accounts for virtually all parameters associated with both ground water and surface water systems: including, but not limited to, precipitation, ET, pumpage, applications, soil factors, return flows, sub-surface drainage, subsidence, diversions, water rights, cropping patterns and timing, soil moisture, and stream characteristics.

Spatial Scale Employed in the Model: CVGSM model consists of 1392 elements covering the Central Valley floor. The average size of each element is 14 square miles. The finite element method is used. Precision limited by data. IGSM may be applied to any area and segmented into any number of subareas. C2VSIM has the same spatial coverage as CVGSM. WESTSIM is a finer resolution model using square and triangulated elements of 1 mile in size and covers just the west-side of the San Joaquin Valley between Kettleman City and the Delta. MERCEDSIM has the same spatial resolution but covers all of Merced County.

Temporal Scale Employed in the Model: CVGSM is a monthly model; output is either monthly or annual, or combination. C2VSIM. WESTSIM and MERCEDSIM can run either daily or monthly depending on the user specification.

Input Data Requirements: Extensive land use data (cropping, urban and wetland), streamflow regimes, precipitation records, surface water diversions, groundwater pumping records, subsurface tile drainage, small watershed runoff, surface water releases from reservoirs.

Computer Requirements: Fortran Code requiring 2+mb of RAM on 80386 based machine.

Model Output: Stream or groundwater hydrographs. Mass balance budgets for streamflow, groundwater, soil, land and water use, all by regional basis. A user interface and extensive graphics toolbox has been created for all IWFM applications by DWR. http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/ . This allows visulaization of both input data and model output.

Parameter Estimation / Model Calibration: Done internally using calibration data files. IWFM model applications have been designed to work with PEST. C2VSIM has been extensively calibrated using PEST to develop optimal parameter values using inverse methods.

Model Testing and Verification: Basic IGSM code has been extensively used in California on many different applications; The IWFM code upgrade has created a new model that contains all of the innovative features of the original IGSM model code. Peer review of the IGSM code by the California Water and Environmental Modeling Forum revealed some problems with the code : (a) linearization of the groundwater flow equation; (b) problems in the formulation of stream-aquifer exchange; (c) issues with the calculation of tile drainage which created a 1 month lag.

These problems have been addressed in the new IWFM code. IWFM is extensively documented and has undergone extensive testing. The IWFM model and its applications (C2VSIM, WESTSIM and MERCEDSIM) have yet to be formally peer reviewed.

Model Sensitivity: Sensitive to many of the input parameters as well as internal 'switches' for calculations and prioritization.

Model Reliability: IGSM was extensively revised and tested – however problems with the code were revealed after 10 years of use for a large number of applications; the IWFM code has addressed many of the major limitations in the original code. Data sets for C2VSIM and WESTSIM have been updated and model parameter values improved as a result of inverse modeling studies. However, as with all data driven models, the model is as reliable as the data that is obtained for it.

Model Application / Case Studies: CVGSM is an application of the general IGSM model. C2VSIM, WESTSIM and MERCEDSIM are applications of IWFM.

Documentation: Summary report for CVGSM, user's manual and documentation exist for IGSM. Much more extensive documentation exists online for IWFM http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/.

Other Comments:

Strengths: **C2VSIM should be used instead of CVGSM for all future applications. The model lends itself to a wide range of modeling efforts when large scale questions are important. The land use processor in IWFM is unique and allows data to be used that is readily available. It is one of the few models that simulates agric\ultural, wetland, urban and native hydrology. The model also simulates both stream and aquifer hydrology. Model can be uesed with groundwater pumping data or can be used to calculate groundwater pumpage. It is a somewhat flexible model.**

Weaknesses: **The model is very data intensive and rather involved. It is not easily accessible to many first time users.**