Integrated Groundwater and Surface Water Modeling For San Joaquin County

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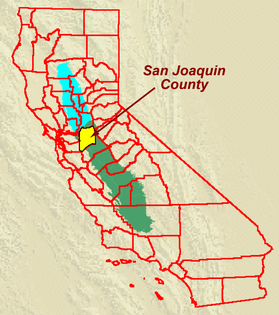
1. Background

Increasing groundwater overdraft in the Eastern San Joaquin Basin has the potential to severely impact San Joaquin County's long-term economic and environmental sustainability. The overdraft has caused depressed groundwater levels, as much as 50 ft below sea level in some locations, and eastward migration of saline groundwater into previously freshwater aquifers.



2. Planned Management Measures

In response to the increasing reliance on groundwater due to rapid urban growth, agricultural demands, and environmental requirements, San Joaquin County is implementing a number of programs with the aim of improving the sustainability of the groundwater resources.

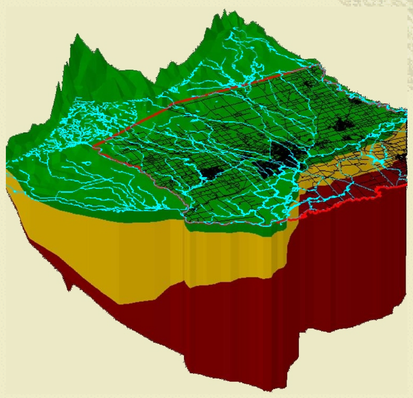
An important tool for planning and managing these programs is the development and application of an integrated groundwater-surface water model to improve the understanding of the behavior of the basin, and the processes impacting water quality.

3. Modeling Approach

DYNFLOW, including groundwater flow, "Ag," and "River" modules, was the selected modeling tool. DYNFLOW is a finite element code that CDM has used extensively on similar studies around the world.

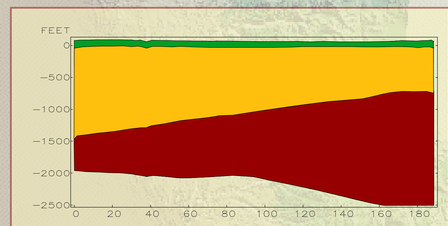
DYNFLOW is powerful modeling code, with excellent graphical and GIS linkages. This is particularly important when models are used in support of consensus-based decision making and where buy-in to the model is desirable.

More information on the DYNSYSTEM suite of codes can be found at: www.dynsystem.com

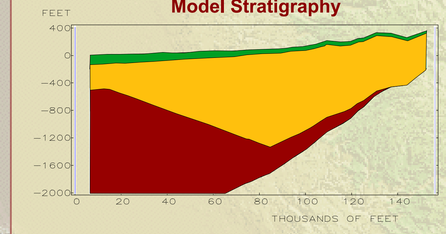


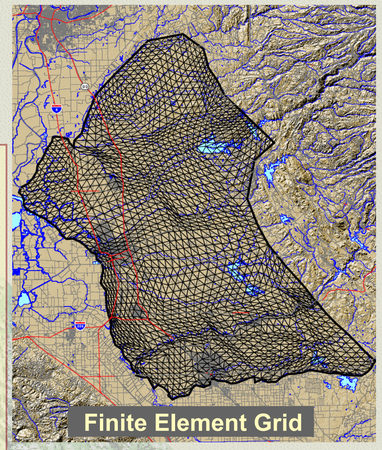
4. Model Domain and Stratigraphy

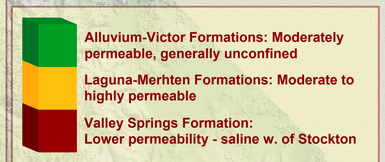
The model domain extends from the San Joaquin River east to the Sierra foothills, north to the Cosumnes River in Sacramento County, and south to the Tuolumne River in Stanislaus County.



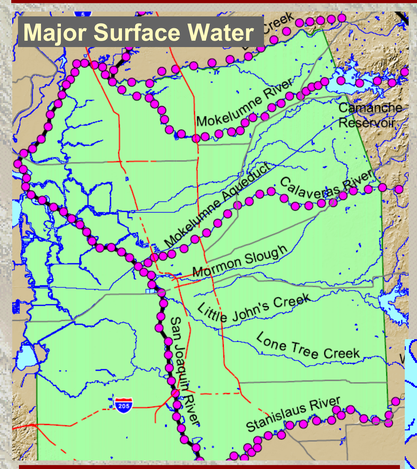
Model Stratigraphy







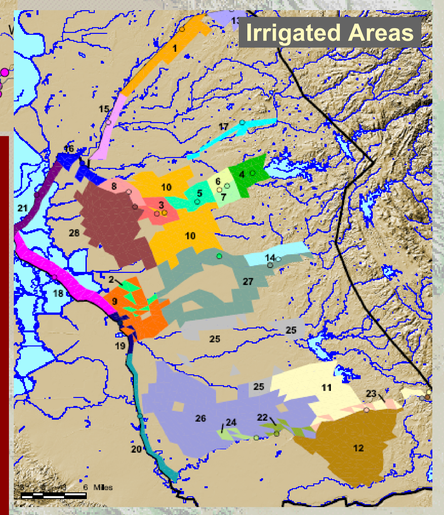
5. Hydraulic & Hydrologic Parameters



Surface water is hydraulically connected to groundwater in the Eastern San Joaquin Basin. Groundwater pumping significantly impacts surface water availability and operations. Thus, in addition to the familiar groundwater model parameters, a sufficient level of detail in surface water hydrology and landuse must be incorporated into the model.

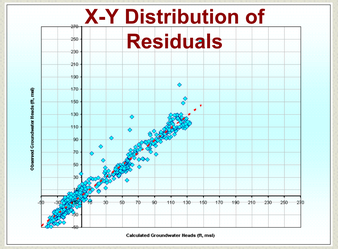
Main Input Parameters

- Land use & crop types
- Crop irrigation requirements
- Hydrologic soil classification
- River boundary inflows & diversions
- River geometry and streambed characteristics
- Irrigation patterns and practices
- Rainfall & ET

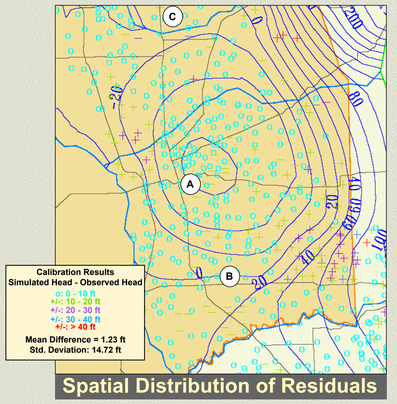


6. Model Calibration

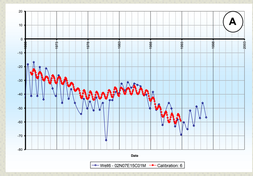
Model was calibrated to both steady-state and transient conditions

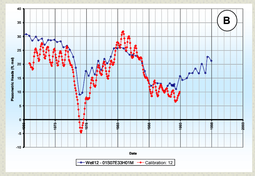


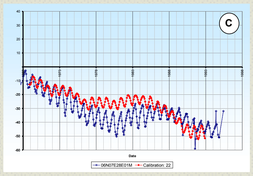
Good calibration was achieved. Model was able to replicate both long-term historical trends, as well as seasonal variation in groundwater levels.



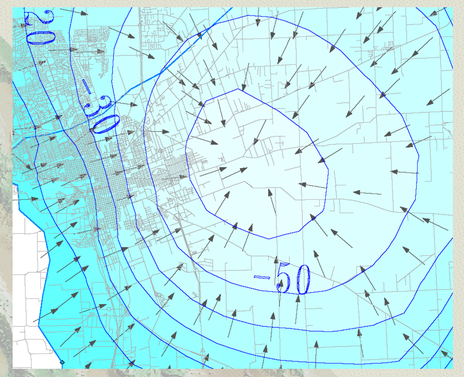
Spatial Distribution of Residuals



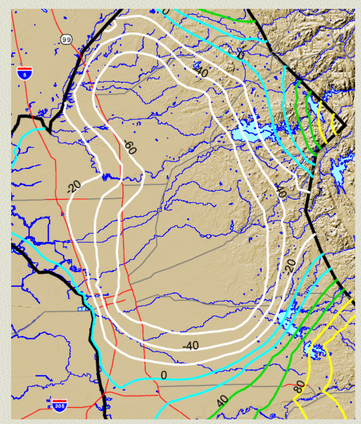




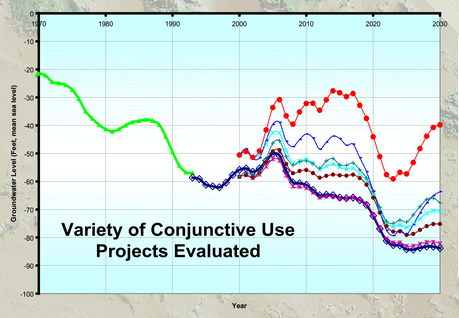
7. Model Application



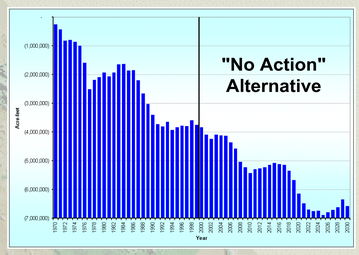
Rate of eastward migration of high TDS groundwater evaluated.



Groundwater conditions over 30-year period assessed.



Simulate conjunctive use alternatives to assess benefits in terms of increasing groundwater levels, and rate of lateral intrusion.



Loss of stored groundwater estimated.

CDM