Understanding and Estimating Interbasin Groundwater Flow

Butte County Groundwater Pumpers Advisory Committee
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Hydrologically Interconnected Subbasins

- 12 subbasins in Study area
- Relevant to entire Central Valley
- Provide recommendations to GSAs on methodologies to account for interbasin interaction in their GSPs
What drives groundwater flow?

- Difference in groundwater levels (i.e. head gradient)
- Characteristics of aquifer materials (transmissivity)

**Flow Direction and Magnitude**

- Get a sense of flow direction from groundwater level contour maps
- But how much?...water budget
Water Budgets are Required in Groundwater Sustainability Plan (GSP)

From DWR Water Budget BMP

Figure 5 – Required Water Budget Components
Integrated Groundwater-Surface Water Models

- Integrate lots of different types of data and processes
- Generate water budgets
  - Surface layer system
  - Groundwater system
  - Basin overall

Major Processes
- Groundwater Pumping
- Groundwater Recharge
- Interbasin flow
- Stream-groundwater interaction
- Lake-groundwater interaction
- Tile Drain
- Small watershed surface water Inflow

Major Processes
- Precipitation
- Runoff
- Diversions
- ET
- Applied water, irrigation
- Deep Percolation
- Return flow
- Return flow reuse
Interbasin Flows Example

Water Budget Output from C2VSim

Inflows to “South Vina”

Outflows from “South Vina”

“North Vina”

“South Vina”
Model Evaluation & Comparison

- For available models, GSAs should consider:
  
  How well does the model match my current understanding of the surface layer and groundwater budget in my area?

  How well does the model match historical groundwater level conditions, particularly near subbasin boundaries?

- Want to use a groundwater model that best reflects subbasin conditions

- Cooperate early with neighbors
Model Calibration: GW level comparison

How well does the model match historical groundwater level conditions, particularly near subbasin boundaries?

- Active Irrigation
- Shallow (100 – 120 ft)
Discussed approaches for estimating interbasin flows
- Evaluated available groundwater models
- Provided recommendations to GSAs in the Northern Sacramento Valley and Statewide, and to DWR/USGS

Draft Report posted at project website:
https://www.buttecounty.net/waterresourceconservation/SpecialProjects/InterbasinGroundwaterFlowProject
Report Highlights

- An integrated gw-sw model should be used for water budget and GSP development by GSAs in the Northern Sacramento Valley (and Central Valley as a whole).

- Tools exist, but locals need to evaluate them for their specific area/subbasin
  - Significant differences in water budgets and groundwater level representation

- Existing tools are a valuable starting point, but long term commitment is needed by GSAs and DWR/USGS to make them better for management under SGMA

- Need DWR/USGS to provide tools and guidance to make these models more easily comparable
Acknowledgements

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- Technical Collaborators
- RMC, a Woodard & Curran Company
Discussion
# Technical Collaborators

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Model Comparison & Selection

- Not an obvious choice between CVHM and C2VSIm for the NSV region as a whole
  - Significant differences in land use and crop acreage inputs (although, they are more similar in recent years)
  - Significant differences in estimates of water budget components
  - Significant differences in simulated groundwater levels and how they compare to historical data
Role of Local Models

- Valuable for detailed local analysis to evaluate management actions (e.g., recharge project)
- Feed data upward into regional models
- Differing estimates of interbasin flows may result in the initial GSPs but should tell a similar story
- Differences in part reflect the uncertainty in the modeled systems
- Overtime, regional tools will more closely reflect local data/knowledge and interbasin flow estimates should become more similar.
Perspectives on Models

- Expect a long term commitment - model updates are motivated by desire to better understand the system to support more effective management.
- Models are more reliable in characterizing relative changes rather than predicting the absolute conditions resulting from a scenario.
- Different models will not perfectly agree.
- Acknowledge that there is no “right model”.
- Importance of Adaptive Management - uncertainty inherent in models needs to be accounted for when making decisions based on their results.

“All models are wrong; some are useful” – George Box
Side note: Evaluating Interbasin Flows where the Boundary is Defined by a River/Stream

- C2VSim and CVHM account for stream recharge differently in their model water budgets.
Recommendations for GSAs in NSV

- Evaluate most current version of available models at time of GSP development: C2VSim, CVHM, SVSim (?)

- Compare to local surface layer models or water budget data to select model. Do not mix output from groundwater model with other local water budget sources.

- Over time, work with agencies to incorporate local knowledge/data into the selected regional groundwater model

- When evaluating a groundwater model, consider representation of:
  - Crop acreage
  - Irrigation practices
  - Surface water supplies and diversions
  - Rivers and streams (does it include ones the GSA considers important?)
  - Subsurface flows from outside the subbasin boundaries (eastern or western foothills)
Recommendations for DWR and USGS

- **Important opportunity to provide specific recommendations for technical assistance to GSAs**
- Develop tools and guidance to ease comparison of models (inputs like crop data, and outputs of water budget components)
- Process to incorporate local data into regional tools
- Provide guidance on use of these tools to address the six Undesirable Results defined by SGMA
- Report includes other specific technical assistance needs (e.g., methods for developing water budgets where boundaries align with streams)