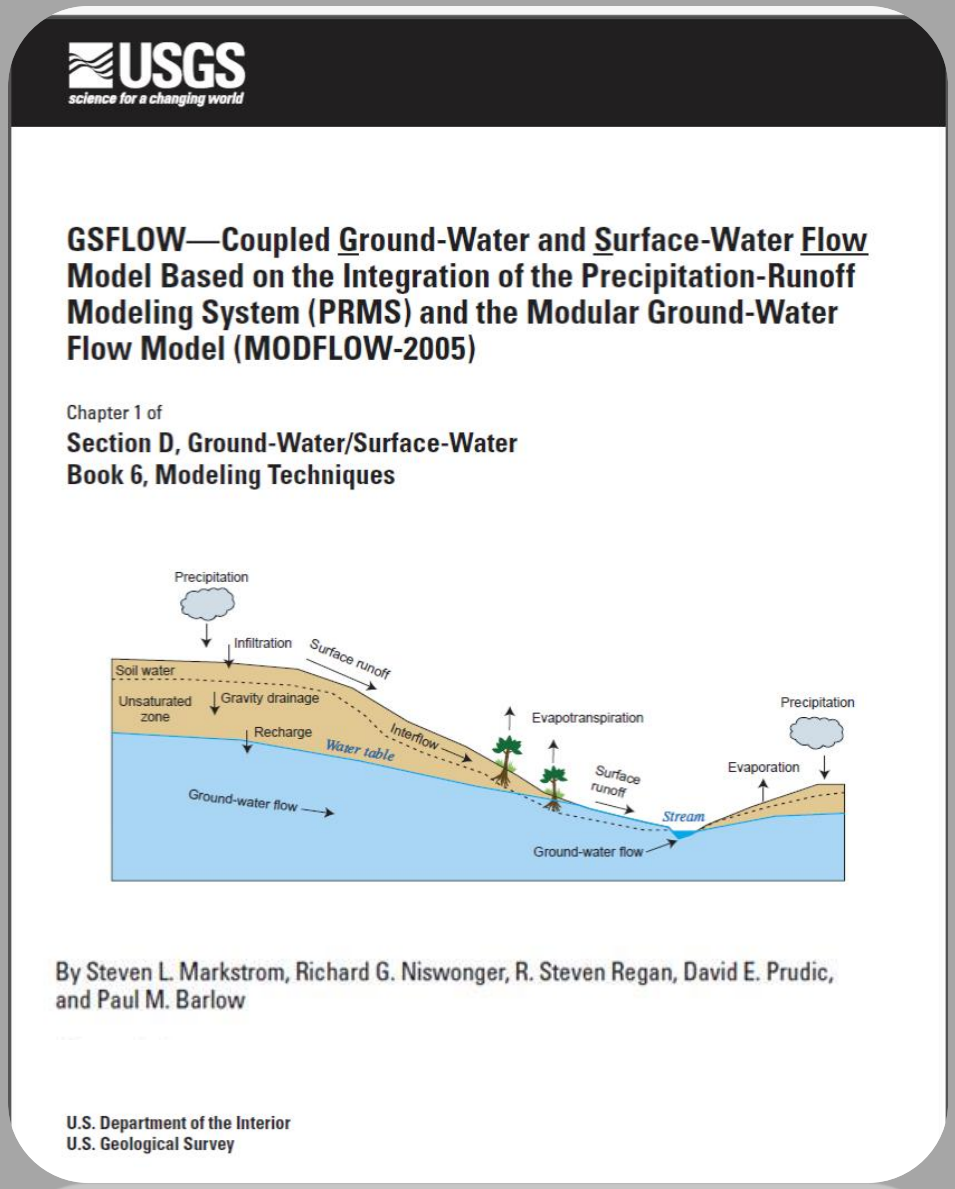
Recommendations: Develop a Numerical Model

Dr. James Constantz

- The lack of stream flow and groundwater monitoring data, water use data as well as the lack of salmonid population and distribution data severely limits identification of priority streams for salmonids and needed water management actions.
- For example, the significance of a dry channel, or intermittent pools, cannot be determined if we do not know what areas of the tributary salmonids use for rearing. If the one reach of good rearing habitat dries up, this would be a significant problem.
- But if that reach is a migration corridor where water is only needed in the winter and spring, a summer dry channel is not a problem for salmonids.
- In California's Mediterranean climate seasonally-dry channels are a natural part of the watershed, and not necessarily the result of water diversions.
- The channel typology developed by the ISRP provides a system to define where summer stream flows are likely to occur and where they are not likely to occur.
- A bedrock channel is likely to have flow in the summer, while an alluvial fan, or valley unconfined alluvial channel, are likely to be dry.
- The suggested stream flow and groundwater monitoring of confined alluvial, semiconfined alluvial, dissected alluvium channels in various tributaries can further define summer time flow locations and allow for the effect of water diversions to be determined.

- The development of the conceptual model of stream flow presented here provides a basis for the development of a quantitative numeric model.
- A conceptual model is made of the composition of concepts which are used to help people know, understand, or simulate a subject the model represents.
- The conceptual model is the initial step in development of a quantitative model.
- The ISRP strongly recommends the development of a physically-based, numeric hydrologic model capable of simulating surface and groundwater interactions coupled with a rainfall-runoff model to simulate stream flow processes in the Russian River basin.
- A numeric model has to be calibrated with stream flow gaging data, stream channel topographic data and groundwater level data and can use the typology developed by the ISRP.
- The numeric model can be developed in stages as data are collected for individual tributaries.
- As the model is developed, more detail for each tributary can be added.
- Through the calibration process any additional data gaps can be identified.



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GSFLOW—Coupled Ground-Water and Surface-Water Flow Model Based on the Integration of the Precipitation-Runoff Modeling System (PRMS) and the Modular Ground-Water Flow Model (MODFLOW-2005)

Chapter 1 of
Section D, Ground-Water/Surface-Water
Book 6, Modeling Techniques

By Steven L. Markstrom, Richard G. Niswonger, R. Steven Regan, David E. Prudic, and Paul M. Barlow

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GSFLOW integrates MODFLOW and PRMS

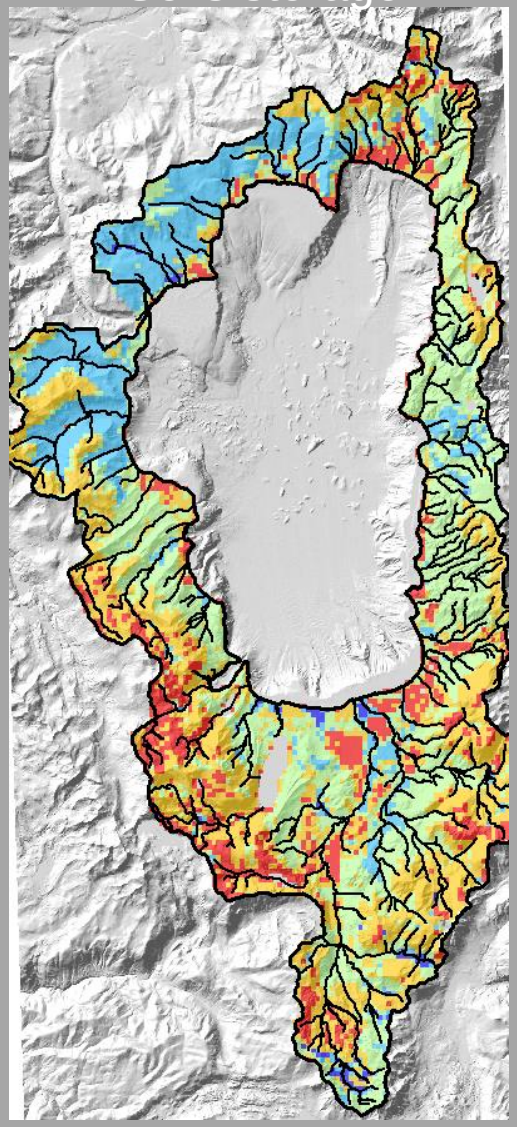
Slides provided by Rich Niswonger

Why Integrate PRMS and MODFLOW?

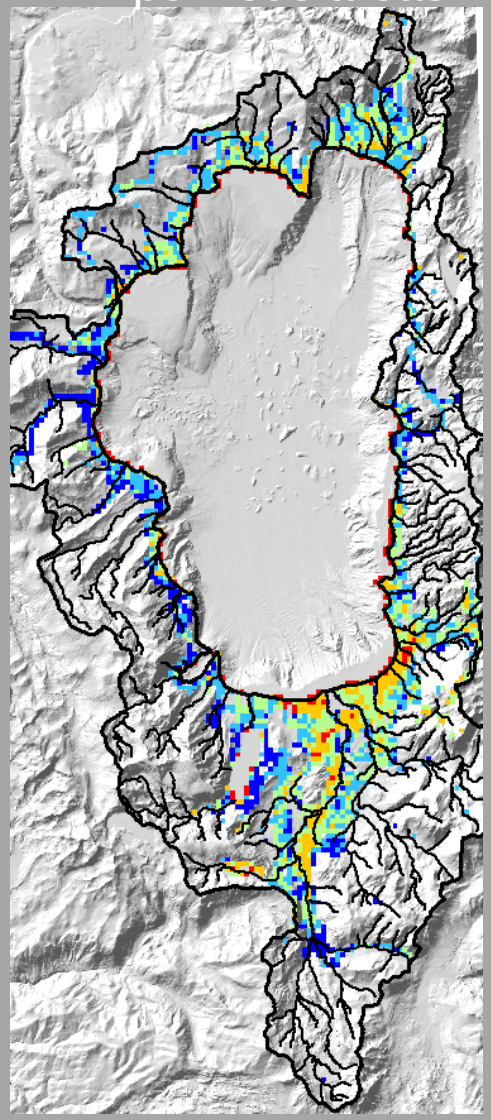
- Simulate complete streamflow hydrograph and feedbacks (bank storage, SW-GW).
- Simulate saturation excess and groundwater discharge areas
- Simulate rejected infiltration
- Simulate losing streams and recharge from streams
- Deal with the ‘where does recharge go’ problem in groundwater models

Fully Distributed Hydrology

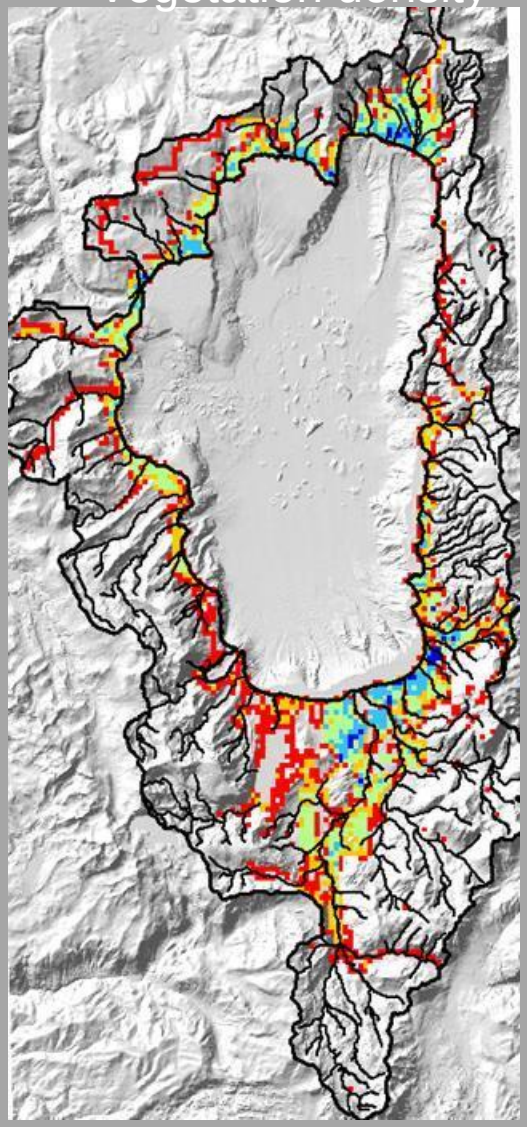
Soils storage



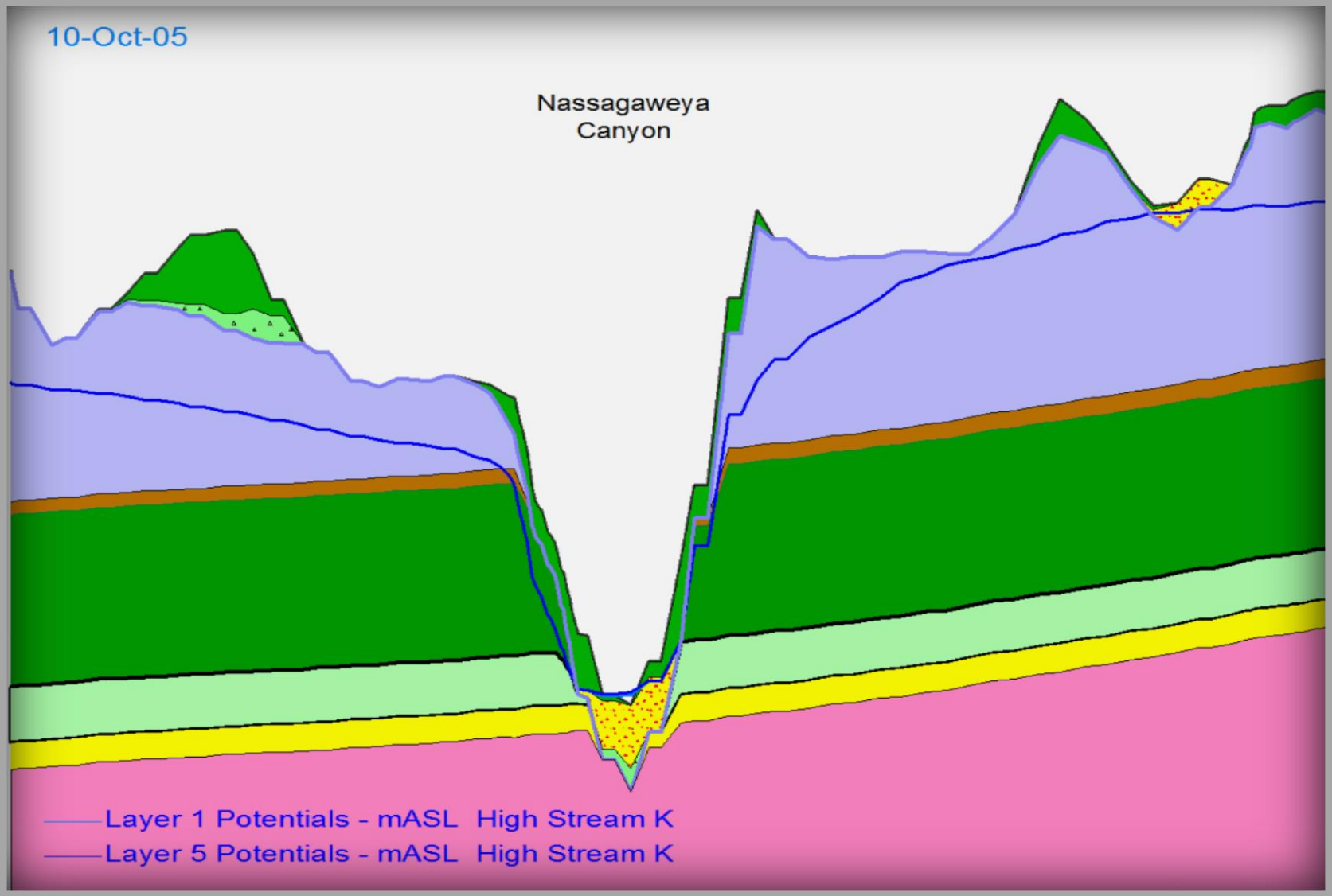
Impervious areas

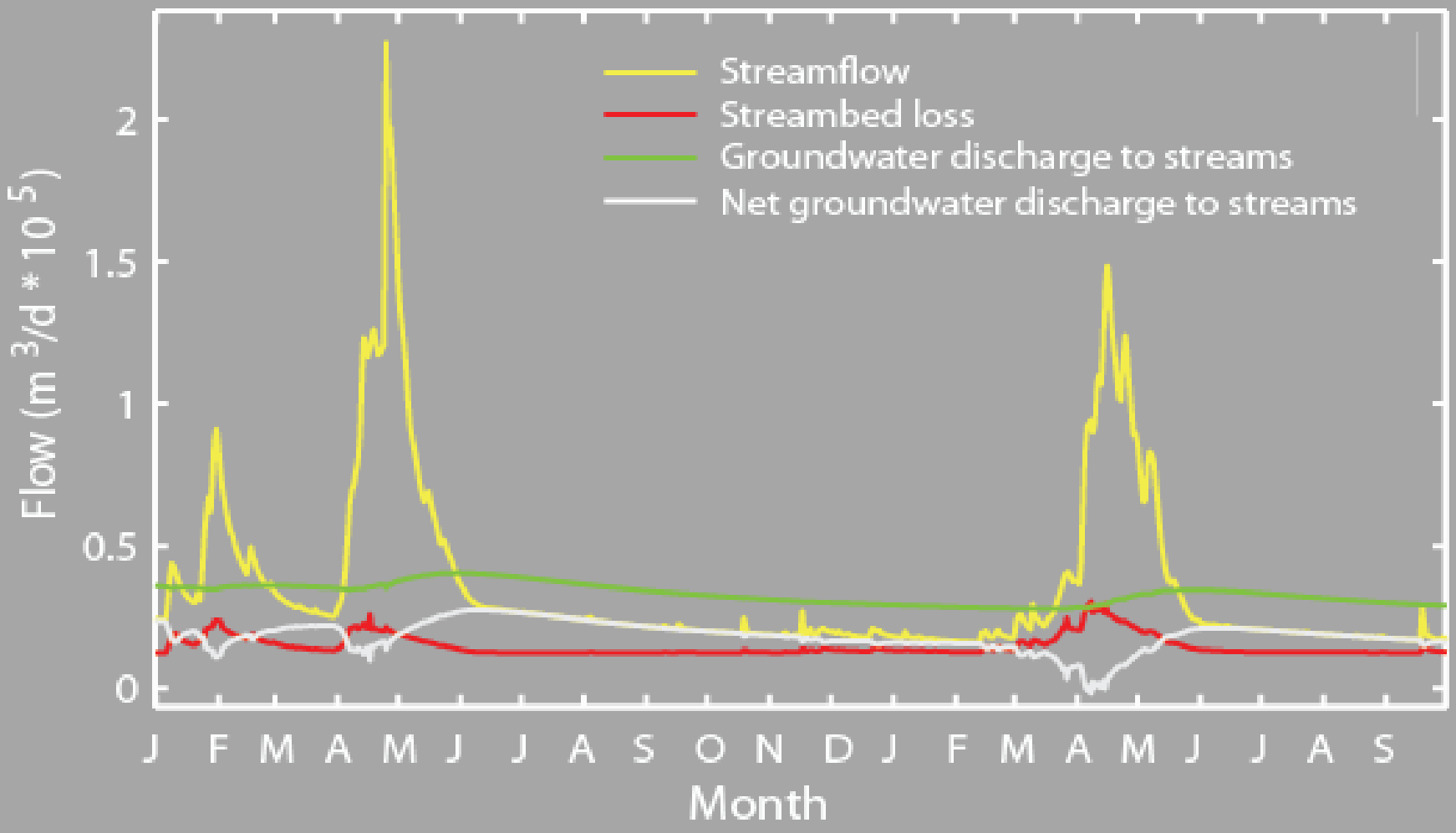


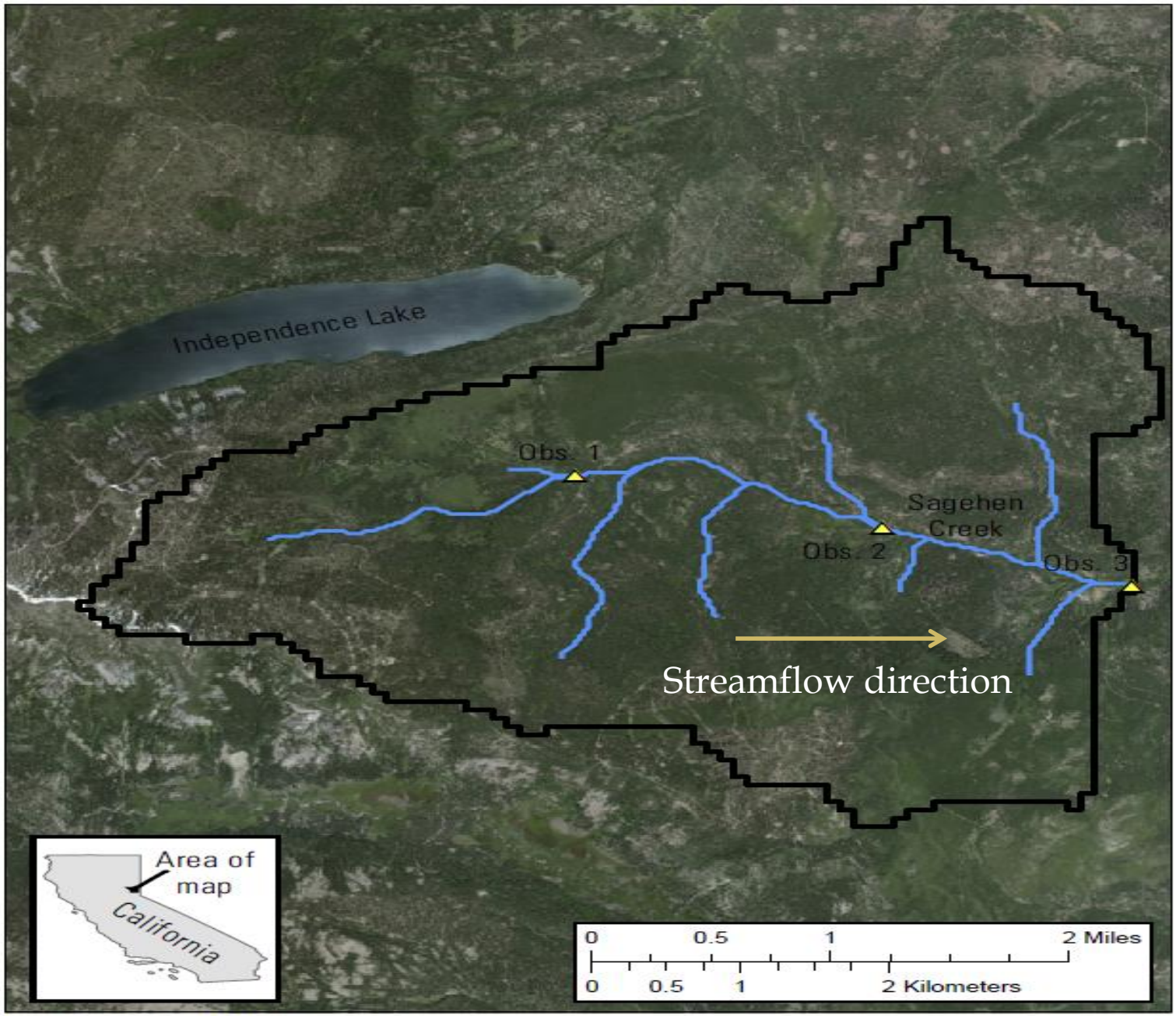
Vegetation density



Simulation of Low Flows Requires Robust Simulation of Groundwater

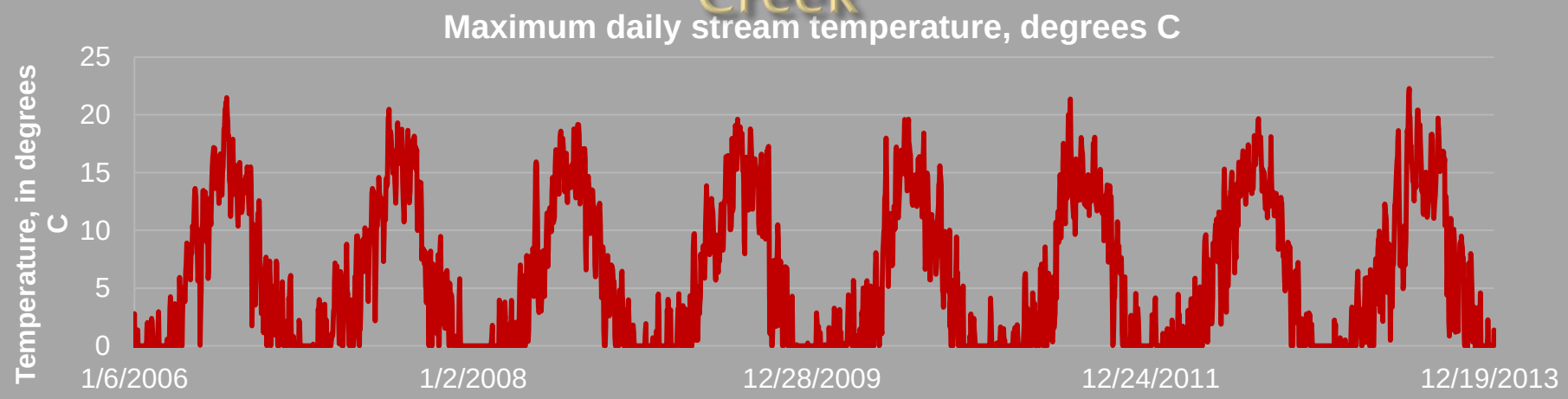


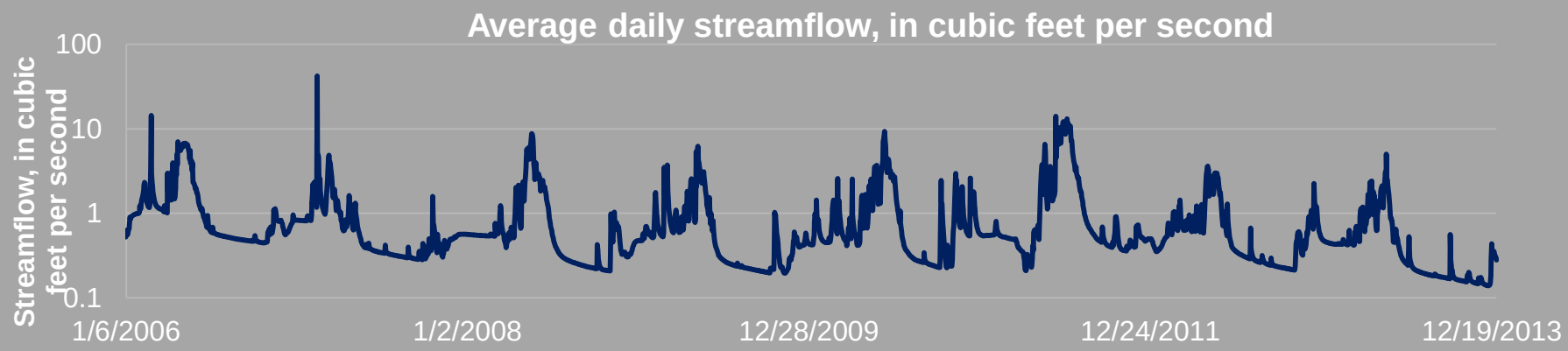

Streamflow
Streambed loss
Groundwater discharge to streams
Net groundwater discharge to streams
Flow (m 3/d * 10 5)
2
1.5
1
0.5
0
J F M A M J J A S O N D J F M A M J J A S
Month

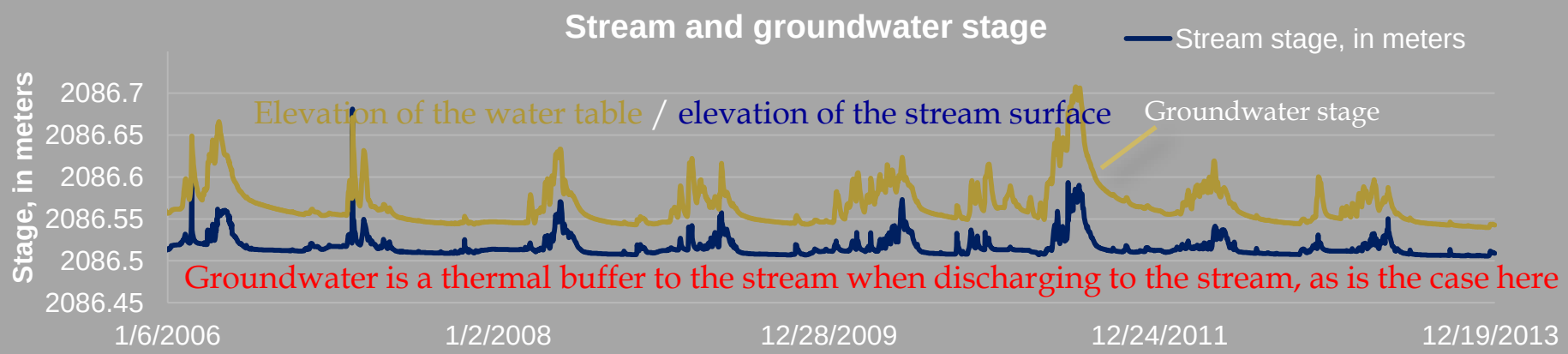


Base from ESRI ArcGIS Online Map Service
http://services.arcgisonline.com/arcgis/service:
World_Imagery, 2015.
Albers projection
North American Datum of 1927

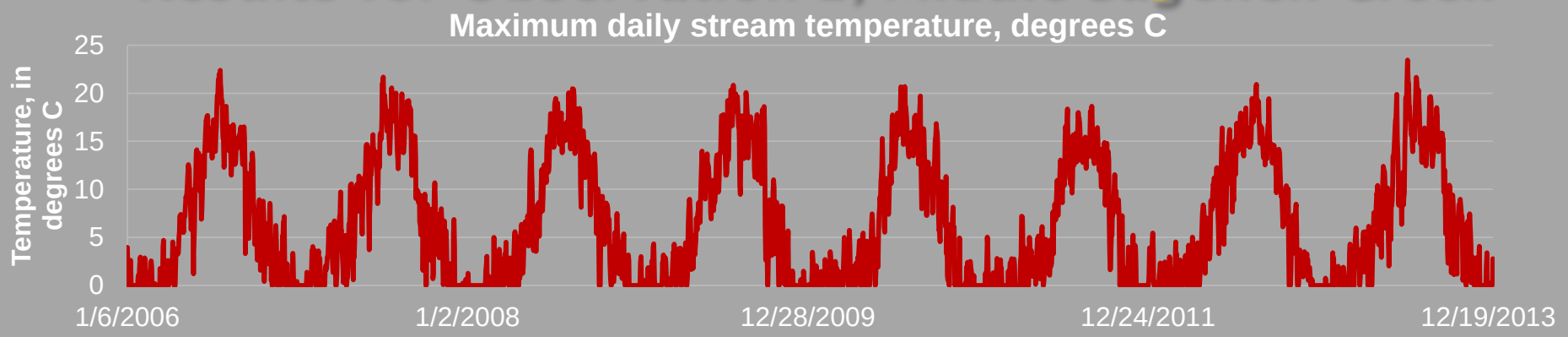
Results for Observation Point 1, Upper Sagehen Creek

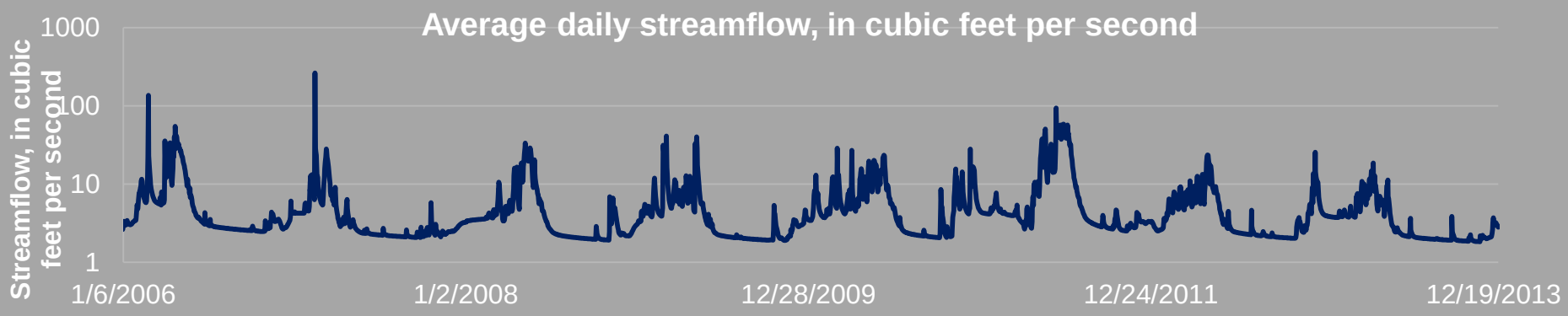


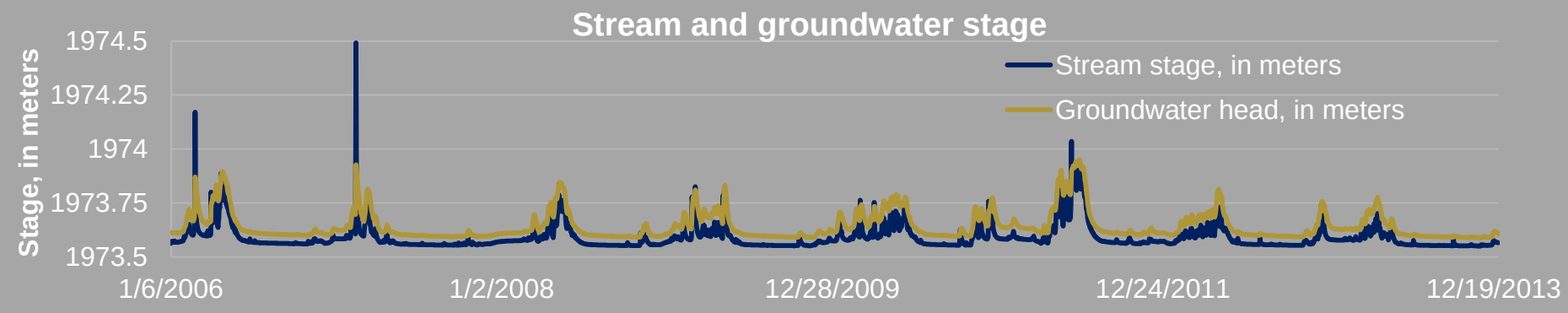




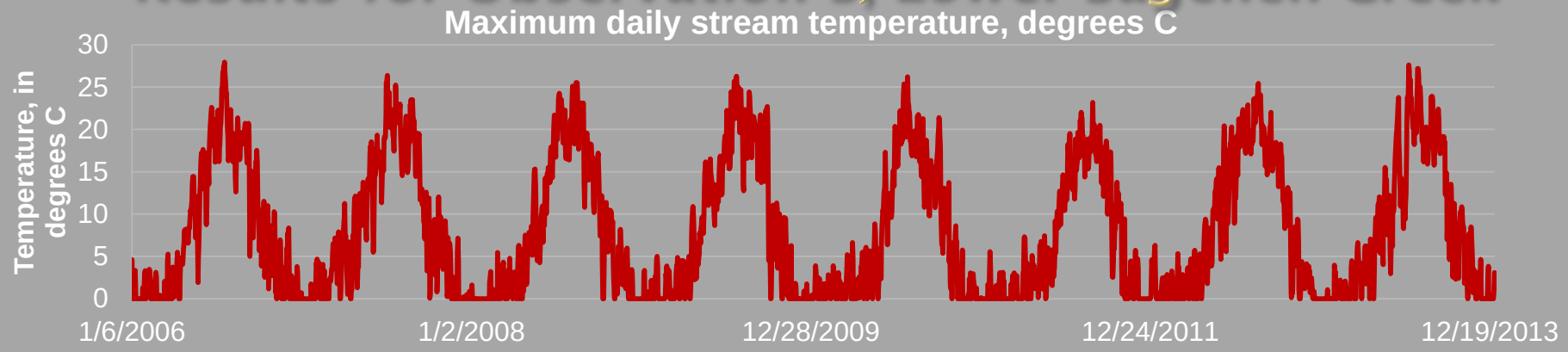
Results for Observation 2, Middle Sagehen Creek

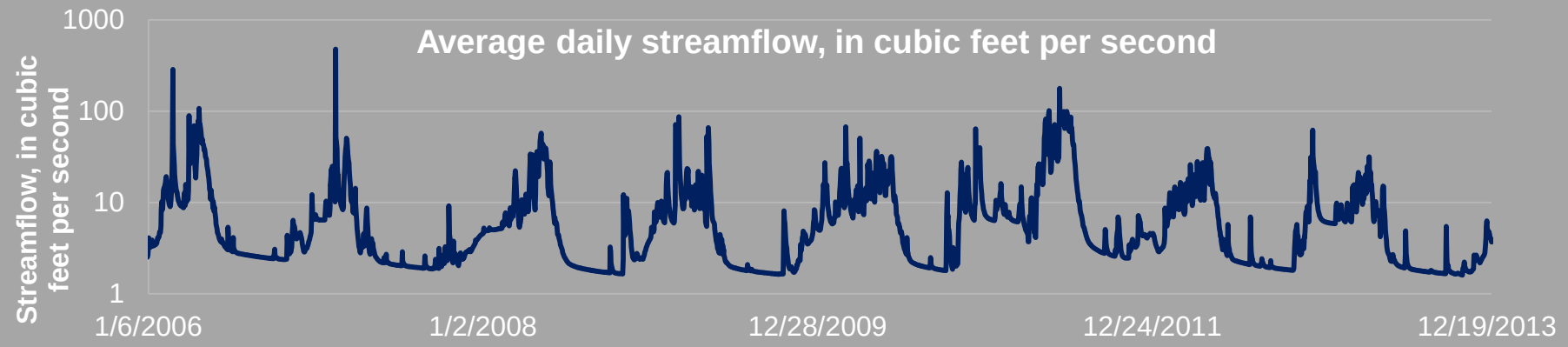


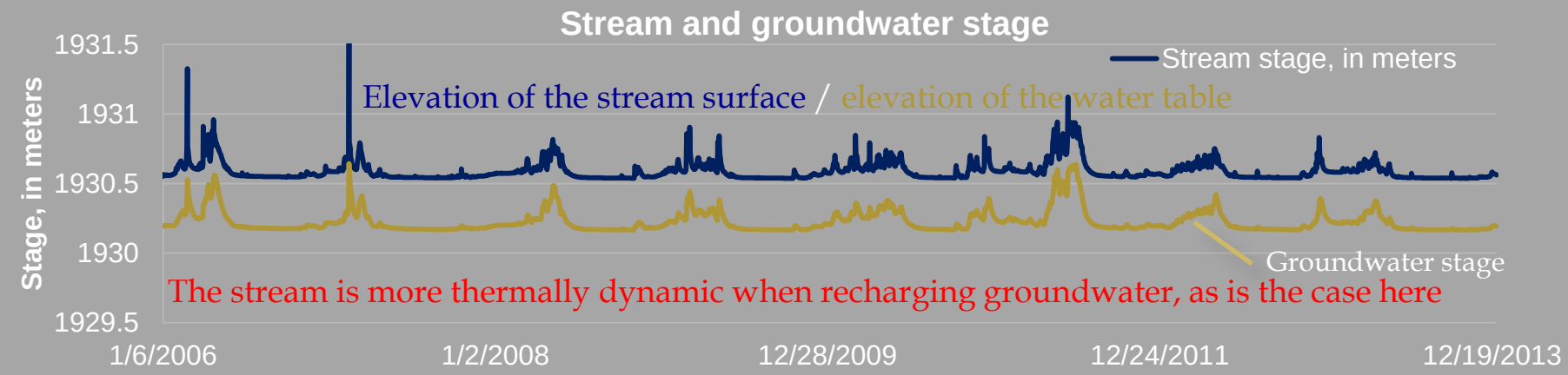




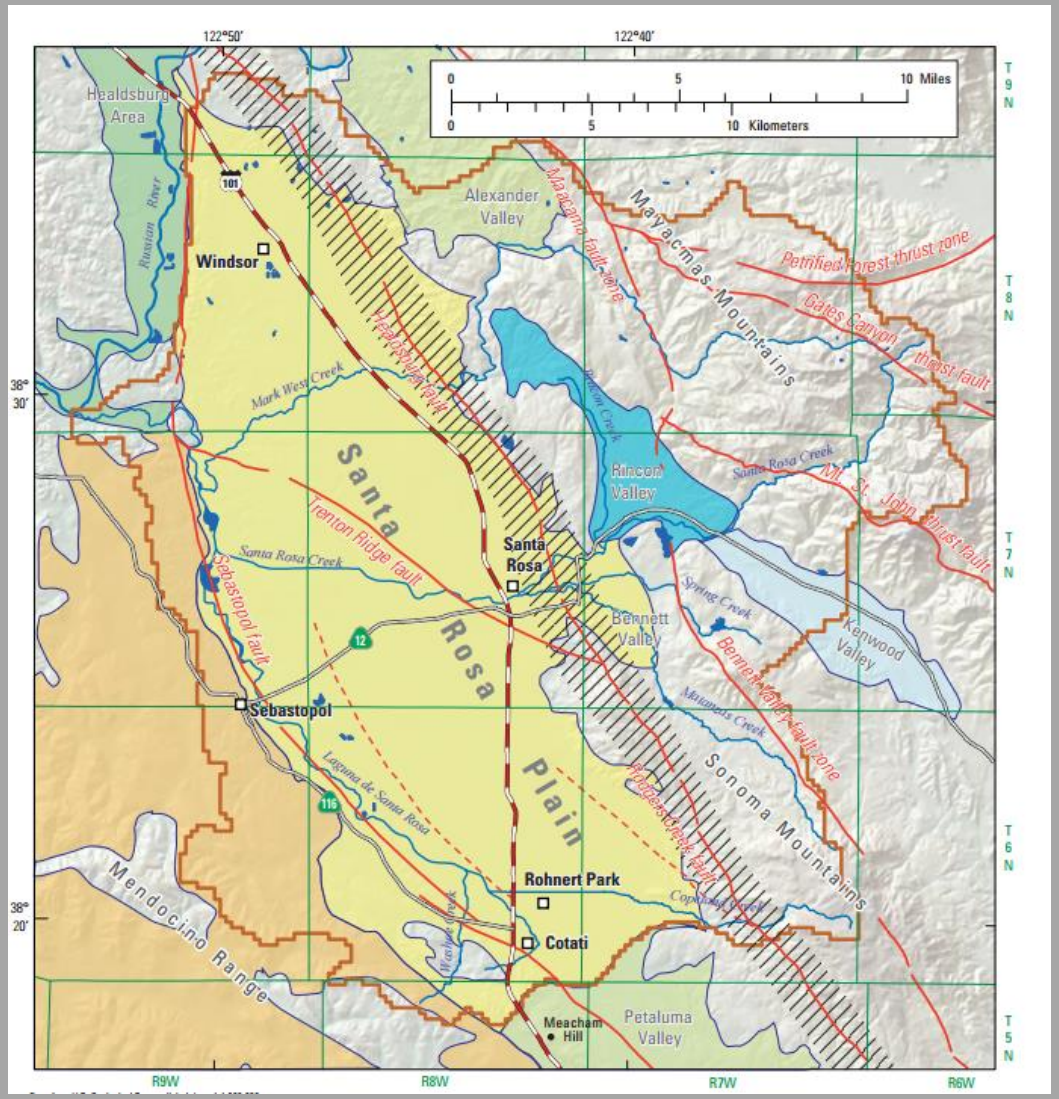
Results for Observation 3, Lower Sagehen Creek







Regional Groundwater Characterization

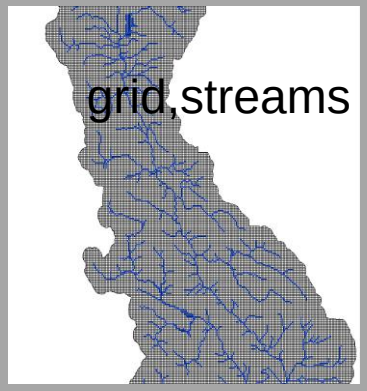


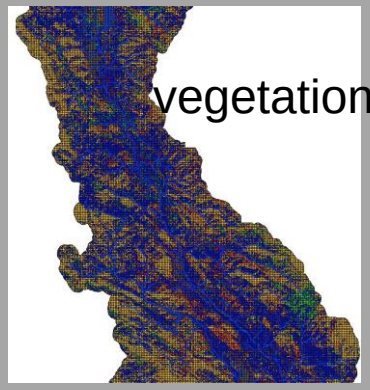
- Geologic contacts
- Hydraulic properties
- Groundwater type
- Recharge/discharge zones
- Water use

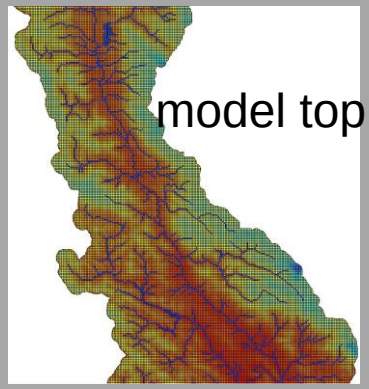
Python Scripts for Building GSFLOW Models

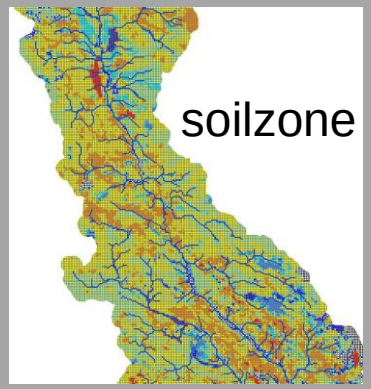
Ancillary data

- Elevation
- Study Area
- Vegetation
- Remap files
- Soil
- Impervious Cover
- Climate
- PRISM
- National Hydrography Dataset (NHD)









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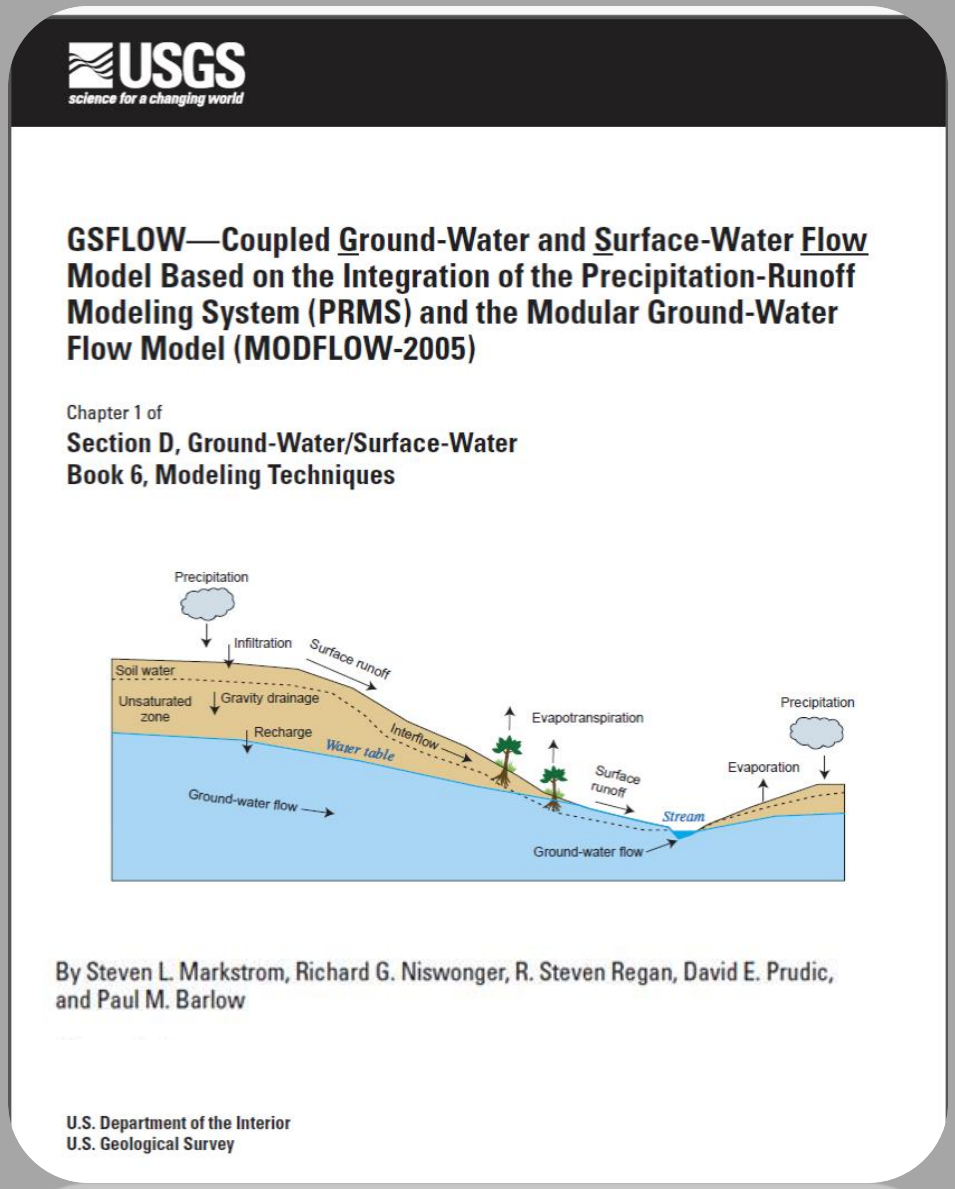

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