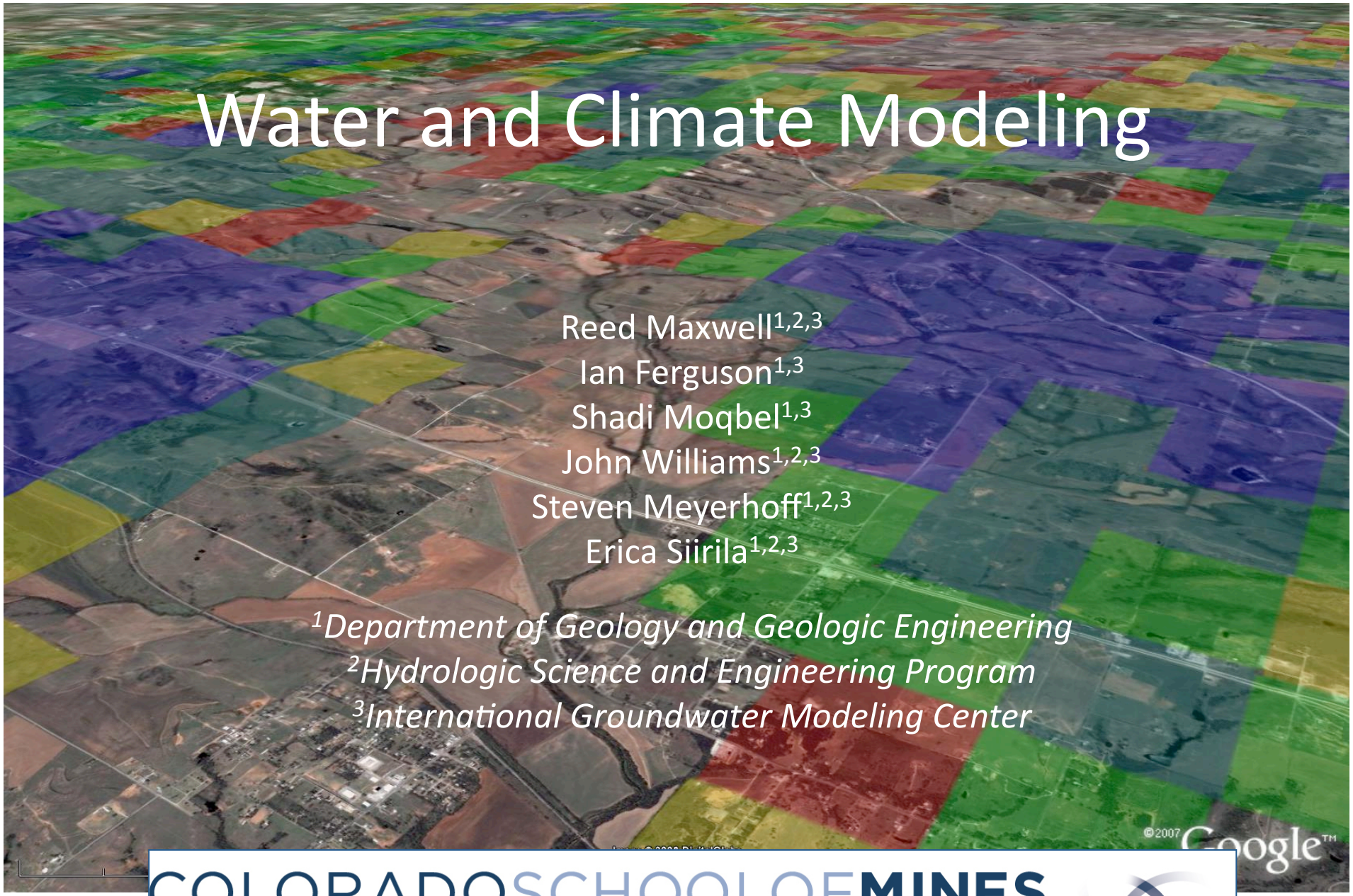
Water and Climate Modeling



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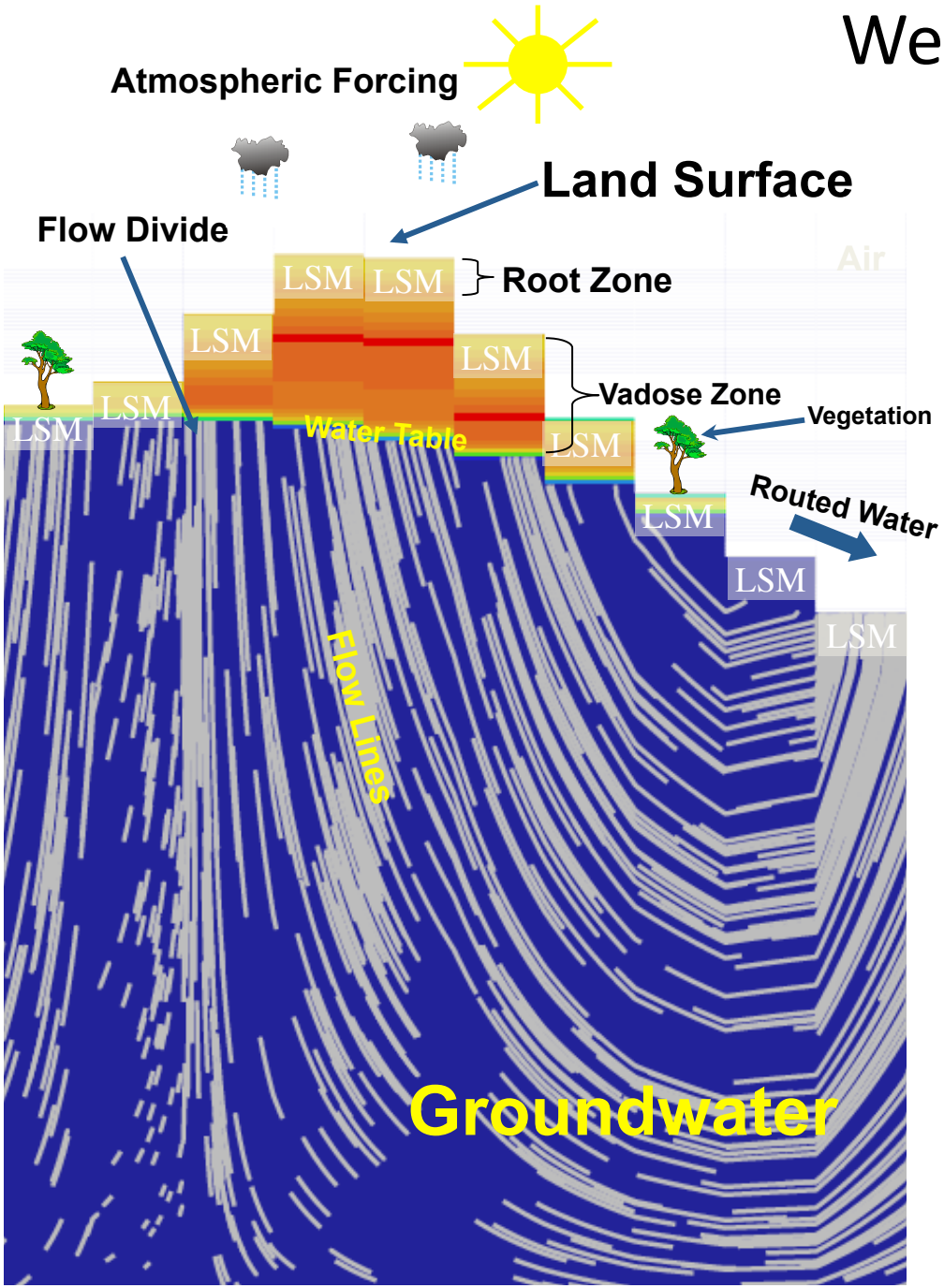

We use the coupled model PF.CLM

- **PF.CLM= Parflow (PF) + Common Land Model (CLM)** Kollet and Maxwell (2008), Kollet and Maxwell (2006), Maxwell and Miller (2005), Dai et al. (2003), Jones and Woodward (2001); Ashby and Falgout (1996)
- **Surface and soil column/root zone hydrology calculated by PF *(removed from CLM)***
- **Overland flow/runoff handled by fully-coupled overland flow BC in PF** (Kollet and Maxwell, AWR, 2006)
- **CLM is incorporated into PF as a module- fully coupled, fully mass conservative, fully parallel**

Dynamically coupled, 2D/ 3D OF/LS/GW Model

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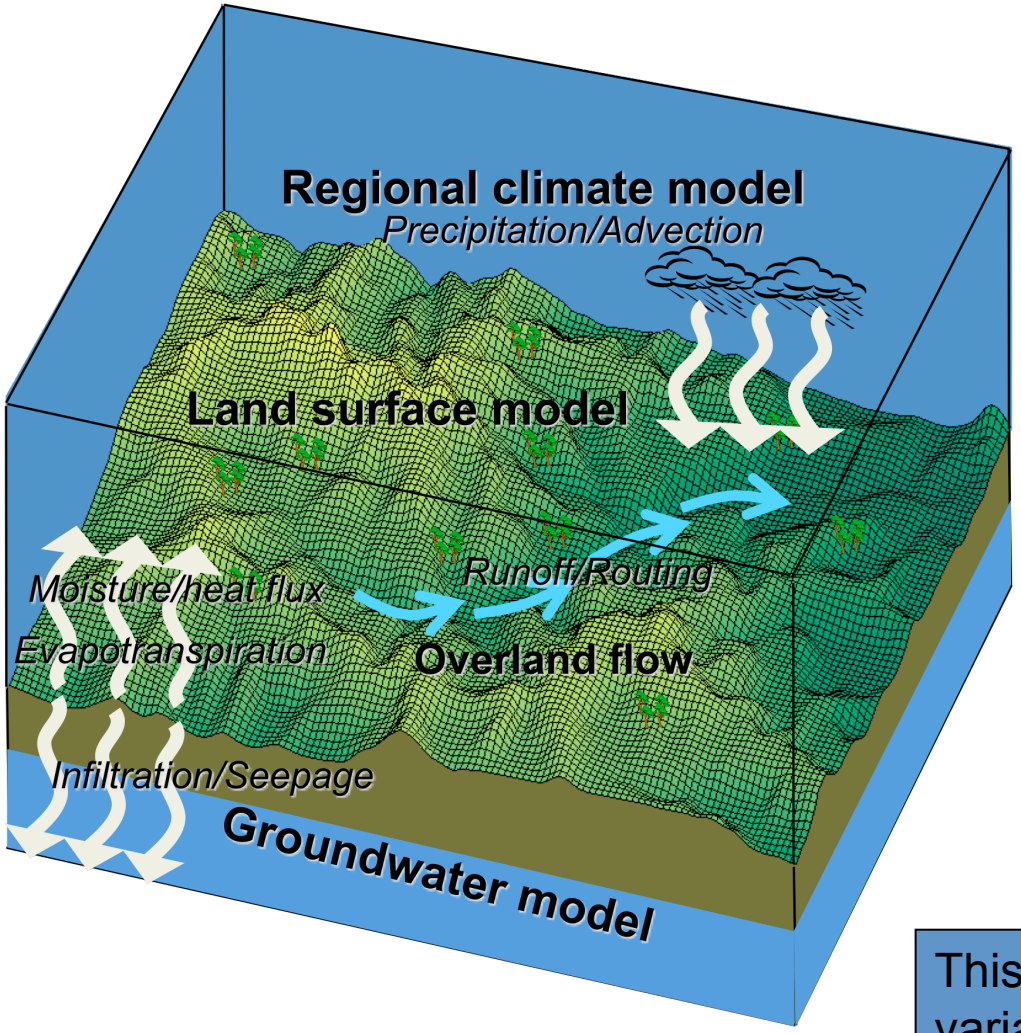
Fully-coupled, HPC Model of the Hydrologic cycle.



Only “bedrock to top of the atmosphere” model in existence

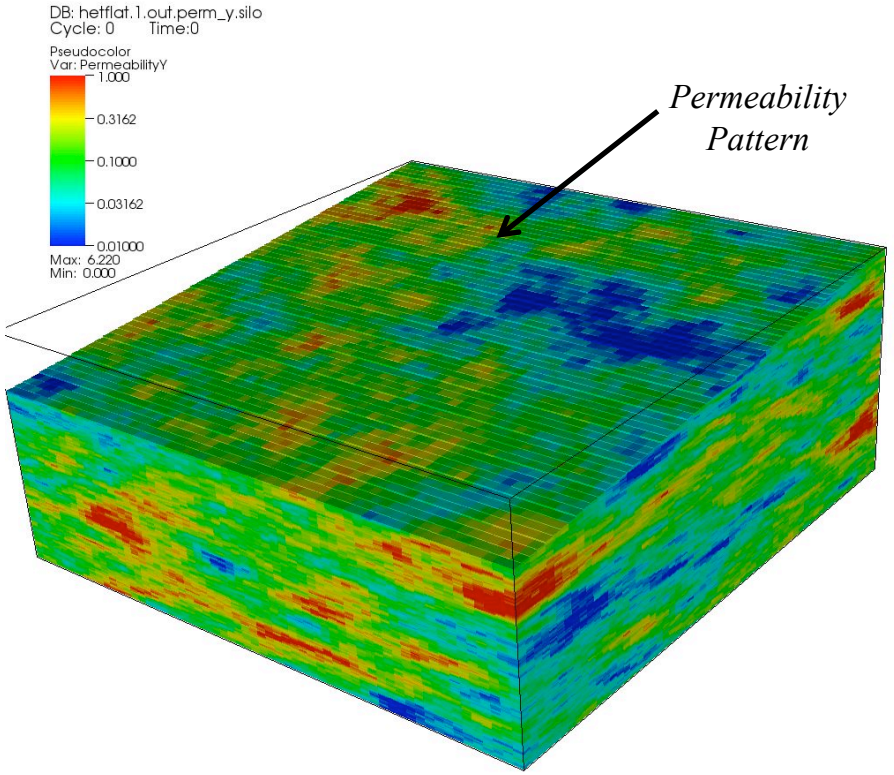
- PF.WRF
  - ParFlow: parallel watershed model
  - Weather Research and Forecast (WRF) Community Mesoscale Atmospheric Model (NCAR)
- Multi-institutional, Interdisciplinary team
- Significant previous coupled model experience

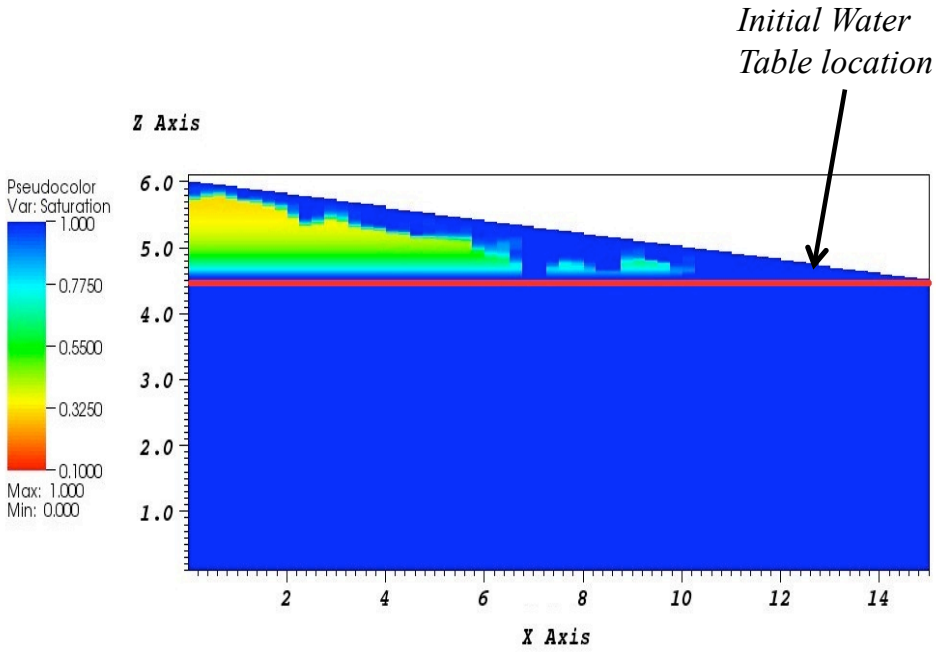
This fully coupled model predicts variations in watershed response driven by atmospheric forcing and feedbacks.

Stochastic Heterogeneous Hillslope Modeling

Methods

1. Ensembles of heterogeneous permeability generated through Turning Bands algorithm
2. Using ParFlow, we model surface runoff and infiltration after a rain storm
3. Particle Tracking methods will be used to determine travel times of rain particles on surface and in subsurface





Different saturation patterns based on heterogeneity

Goals

1. Determine impacts of heterogeneous permeability on dispersion
2. Compare baseflow cases to non-baseflow cases
3. Generate accurate hydrograph separation
4. Upscale processes and parameters to larger scale model

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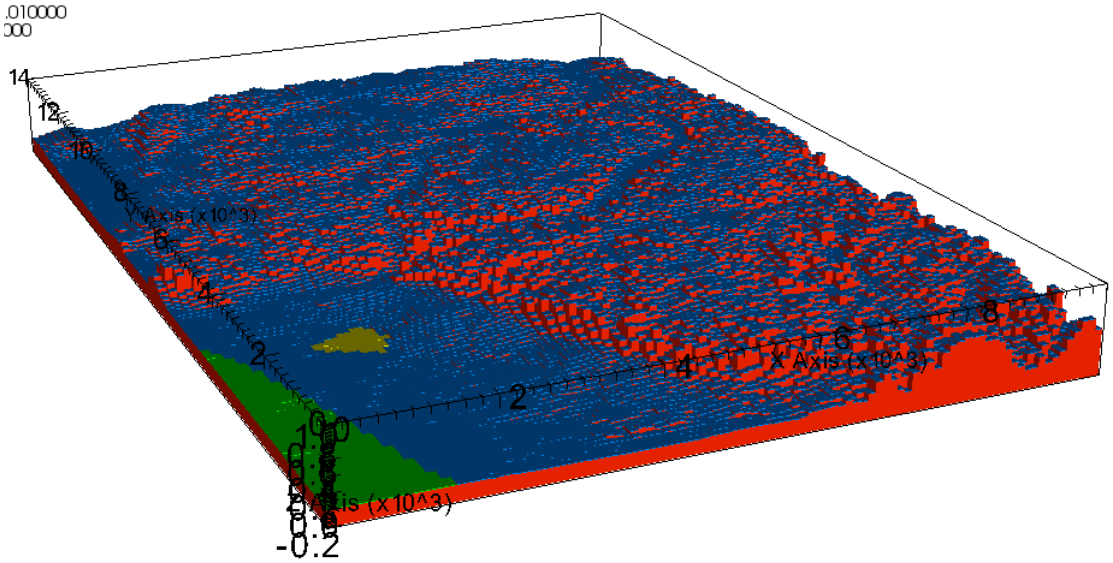
Wind Energy Forecasting



PF.WRF is used to forecast wind availability and potential power output based on land – atmosphere feedbacks and regional-scale weather forecasts

- very high resolution, nested simulations
- studying ramping events

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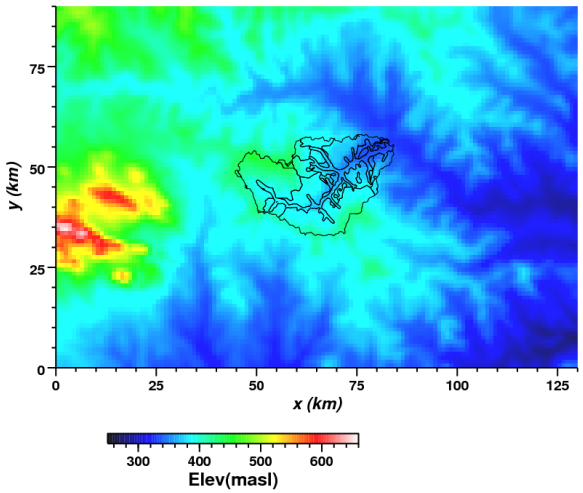
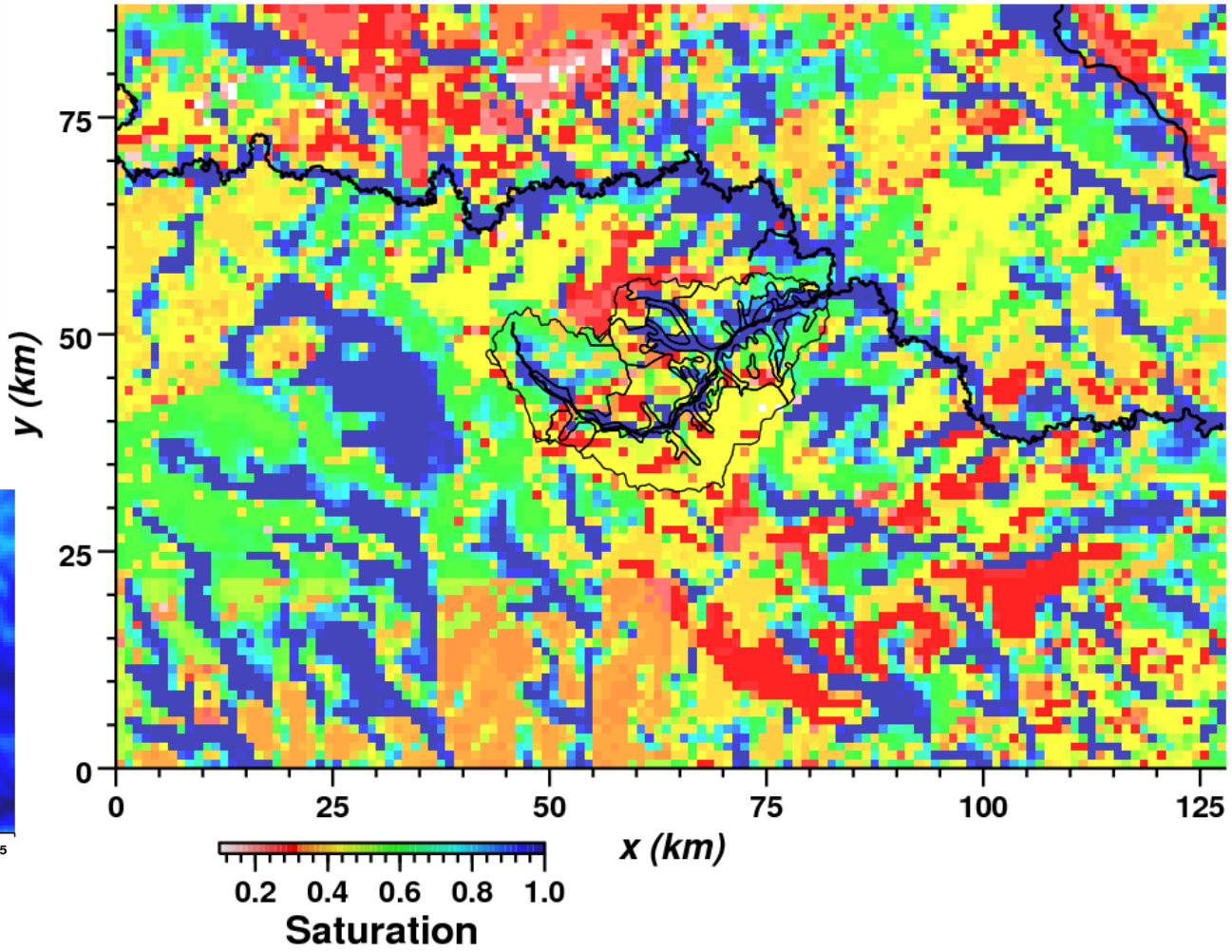
Central Oklahoma domain used for climate change studies

Regional Domain (128 x 88 km), fully-coupled simulations will be used to test a number of water management scenarios.

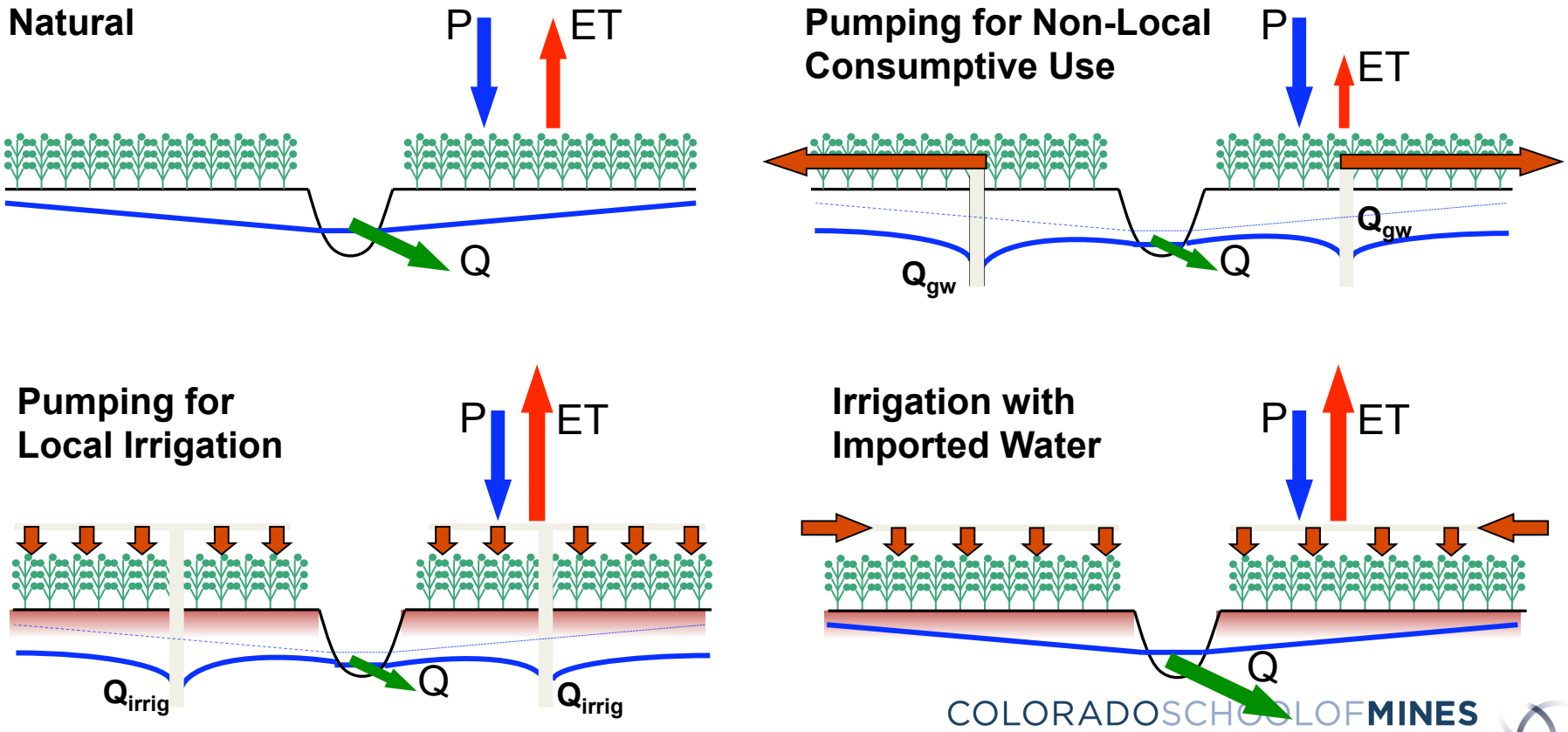
Run on Campus Supercomputer (Ra)





Water Management and Local Climate Feedbacks

Impacts of groundwater pumping and irrigation on watershed processes and feedbacks on surface energy balance, land-atmosphere interactions, and local and regional climate



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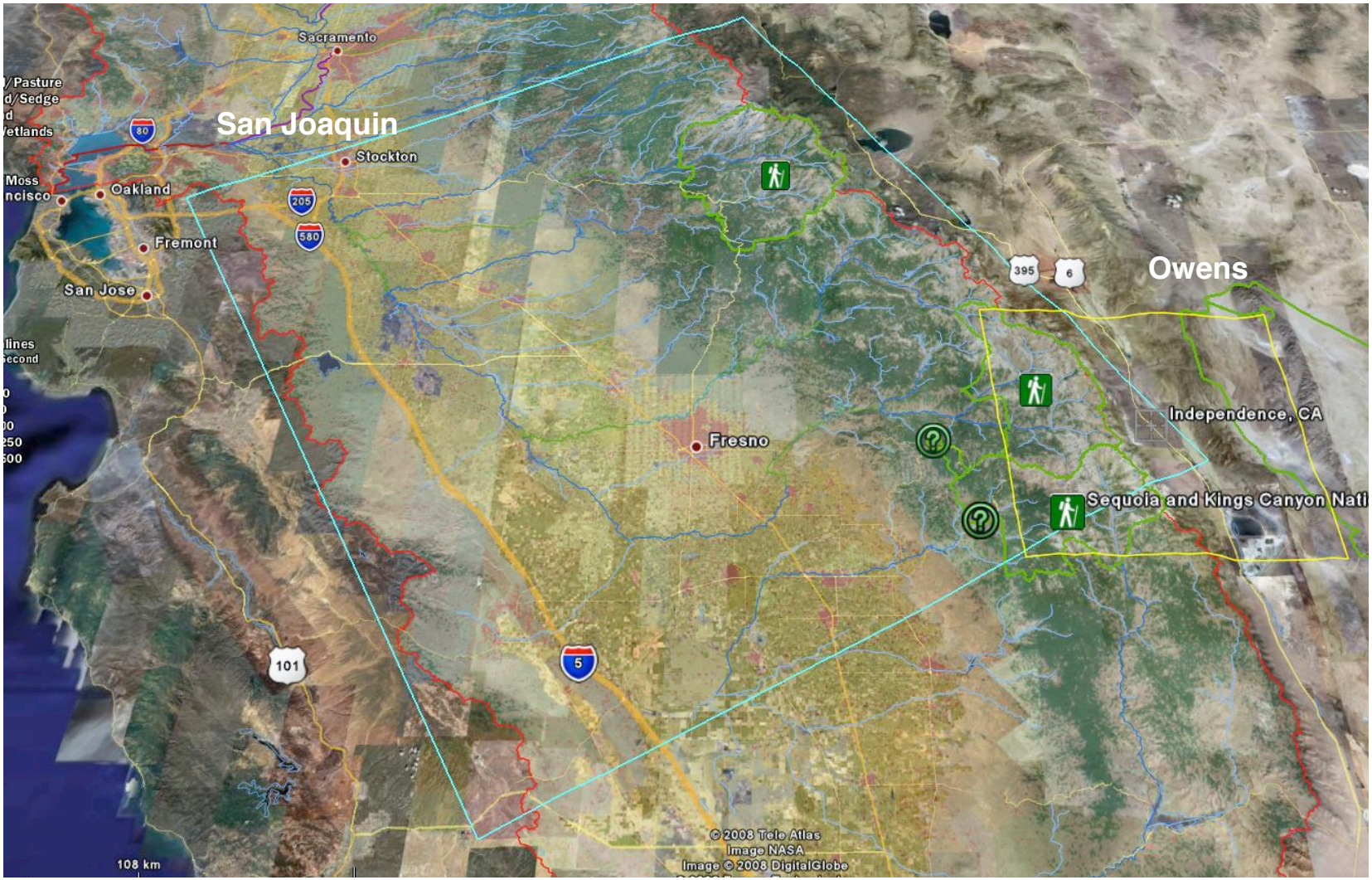
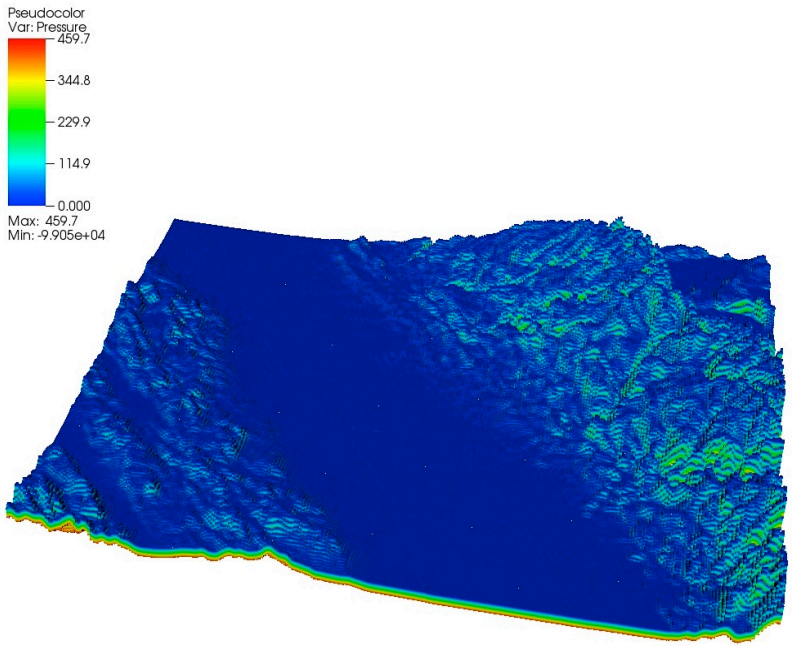
California case studies

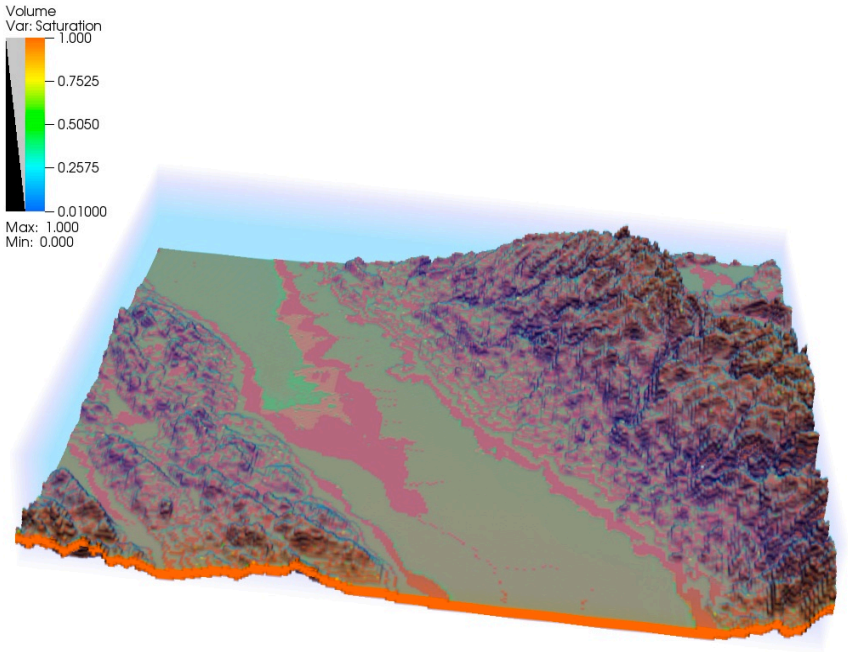


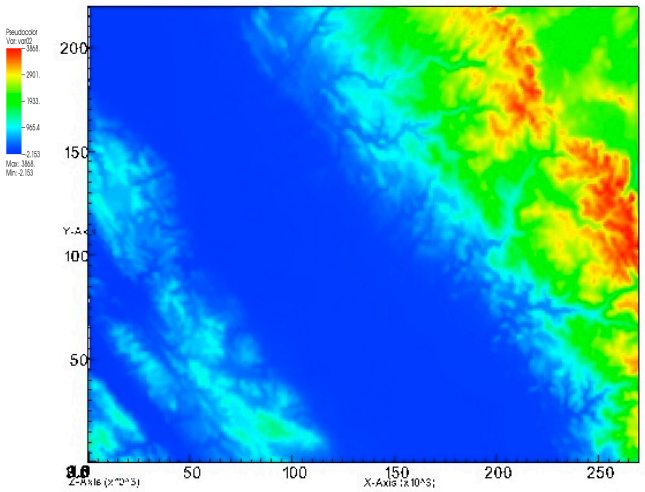
- Mountain Recharge
- Deep alluvial groundwater systems
- Multiple watersheds and scales

- Microcosm for many water related issues
- Pristine to urban gradient
- Bellwether for climate impacts

Central Valley Simulations







Very large (270 x 220 km), fully-coupled simulations of the San Joaquin Watershed.

Fully-integrated model:
Deep Groundwater
Surface Water
Land Surface
processes

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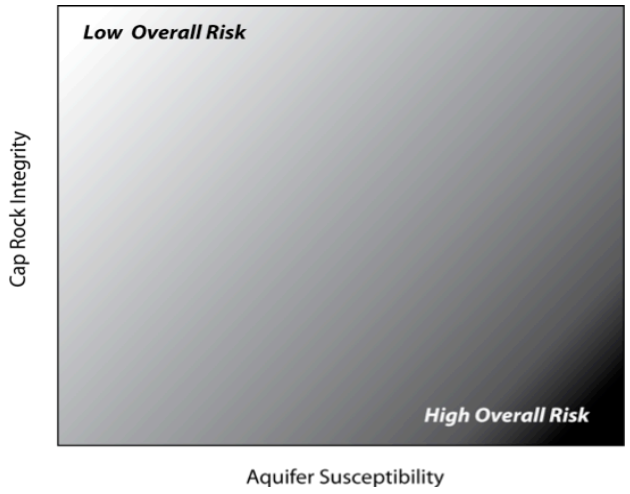
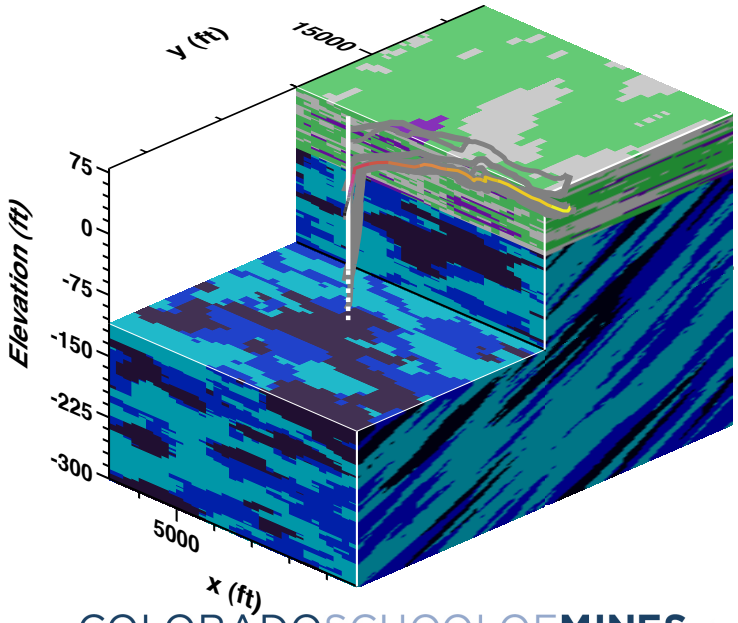
Drinking Water Risk Assessment of CO_2 leakage

- Large, integrated project to determine drinking water risk from CO_2 leakage (and byproducts) into groundwater.
- End-to-end approach, including experiments and model simulations to indentify high and low risk leakage scenarios
- Stochastic, highly resolved approach, combining physical and geochemical heterogeneity via Lagrangian approach





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