HydroGeoSphere – San Joaquin Valley Project (HGS-SJV)

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California Central Valley Groundwater Modeling Workshop
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UNIVERSITY OF Waterloo

HGL HydroGeoLogic, Inc

Celebrating 20 Years of Providing Environmental and Engineering Services Worldwide

U.S. DEPARTMENT OF THE INTERIOR
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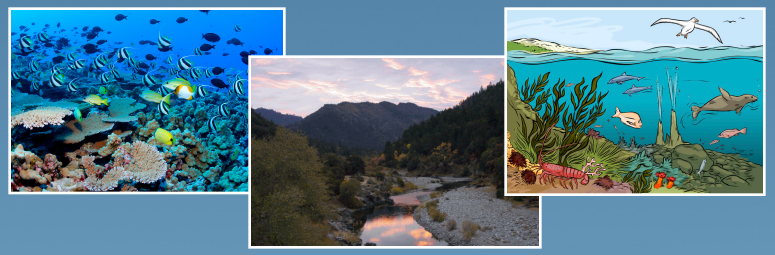
Challenges in Water Resources Facing California

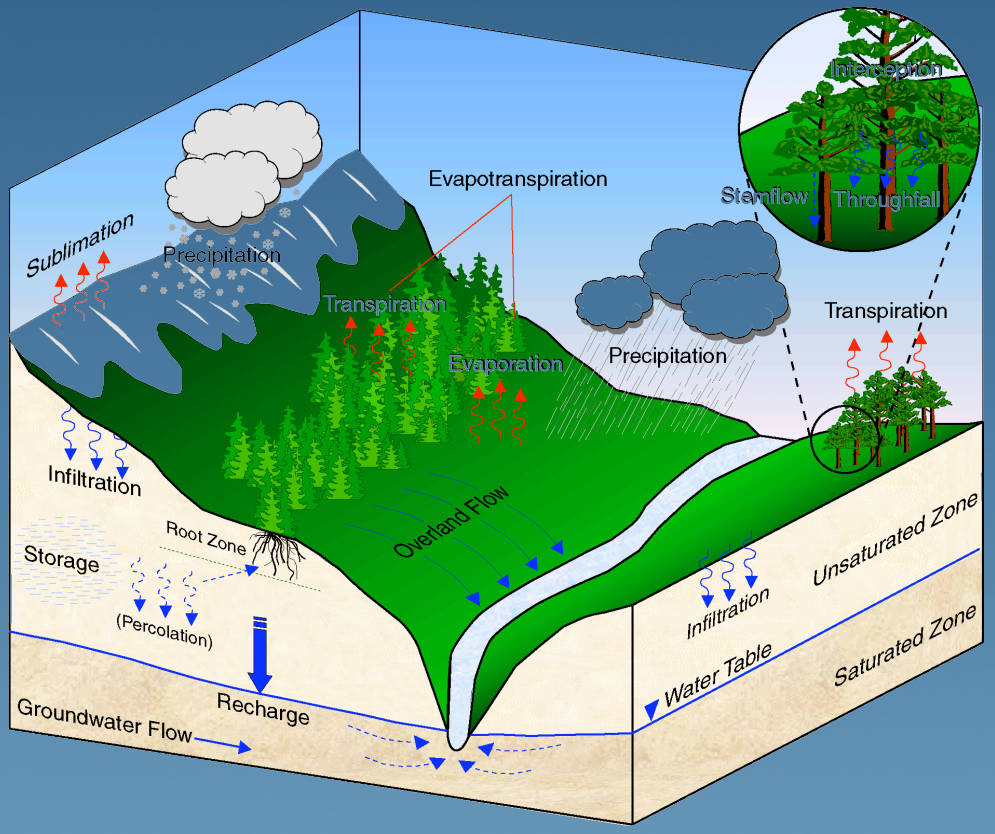
- Water Supply Reliability

- Water Quality Concerns

- Ecosystem Health



HydroGeoSphere: Fully-Integrated Numerical Model



- Collaboratively developed by the University of Waterloo, Université Laval, USBR, and HGL
- Comprehensive, fully-integrated, physically-based, and distributed numerical model
- Integrated with geospatial tools for process simulation and visualization

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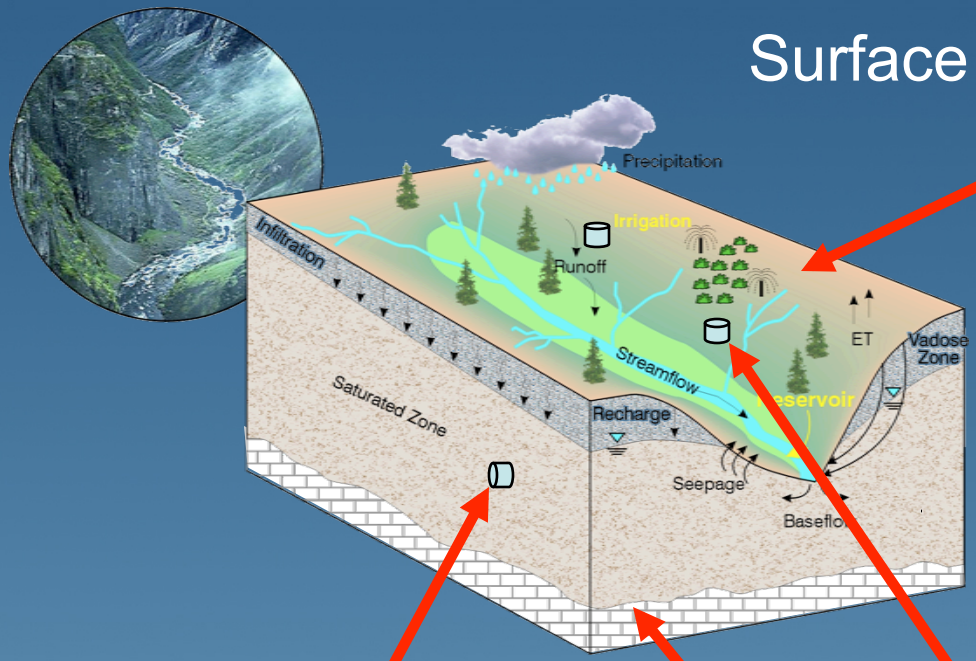
HydroGeoSphere: Conceptualization



Surface Water: 2-D areal
or 2-D areal into 1-D channel

Subsurface Water:
3-D variably saturated

Well: 1-D

Tile drain: 1-D

Macro-pores: 1-D, 2-D or 3-D

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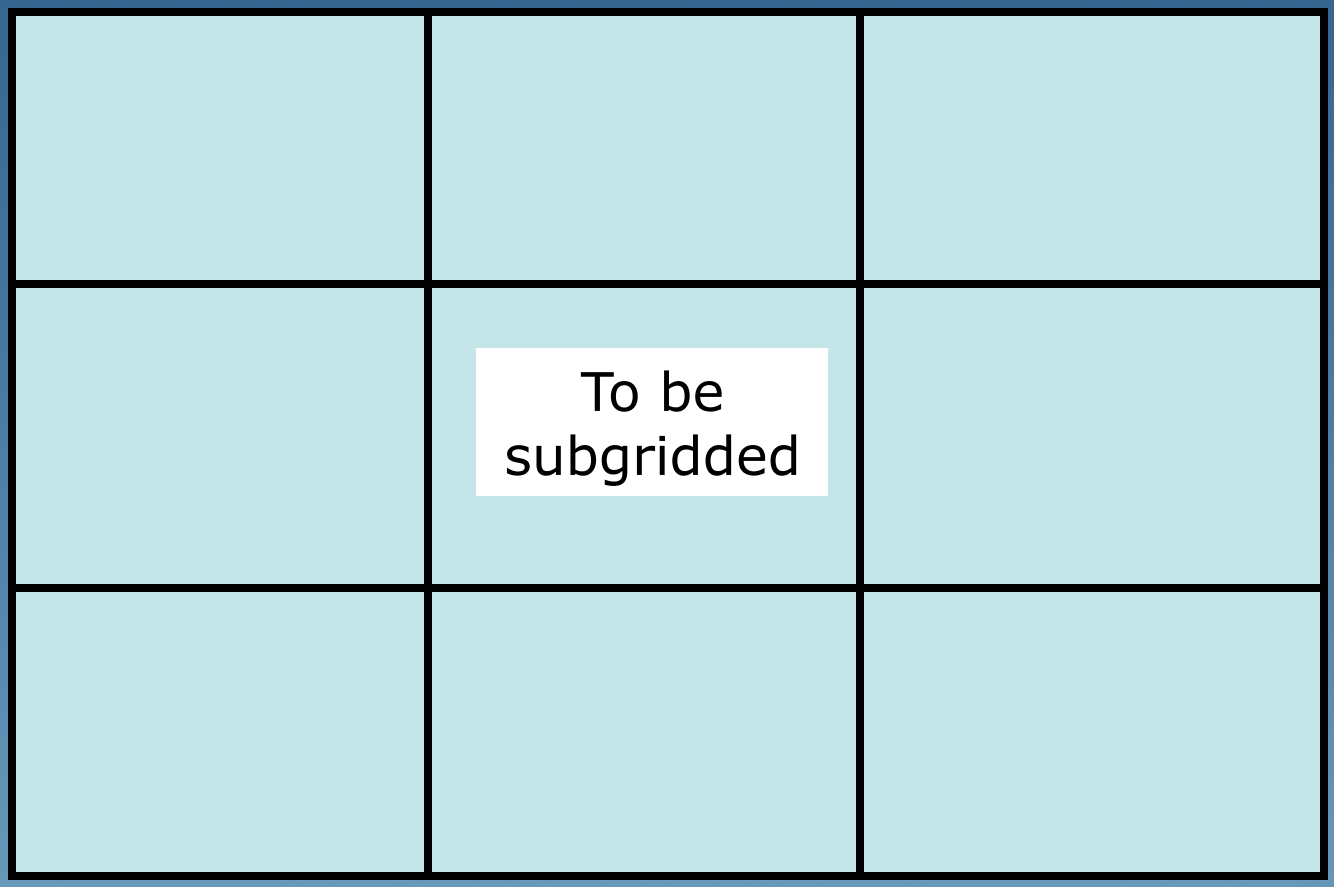
Project Objective

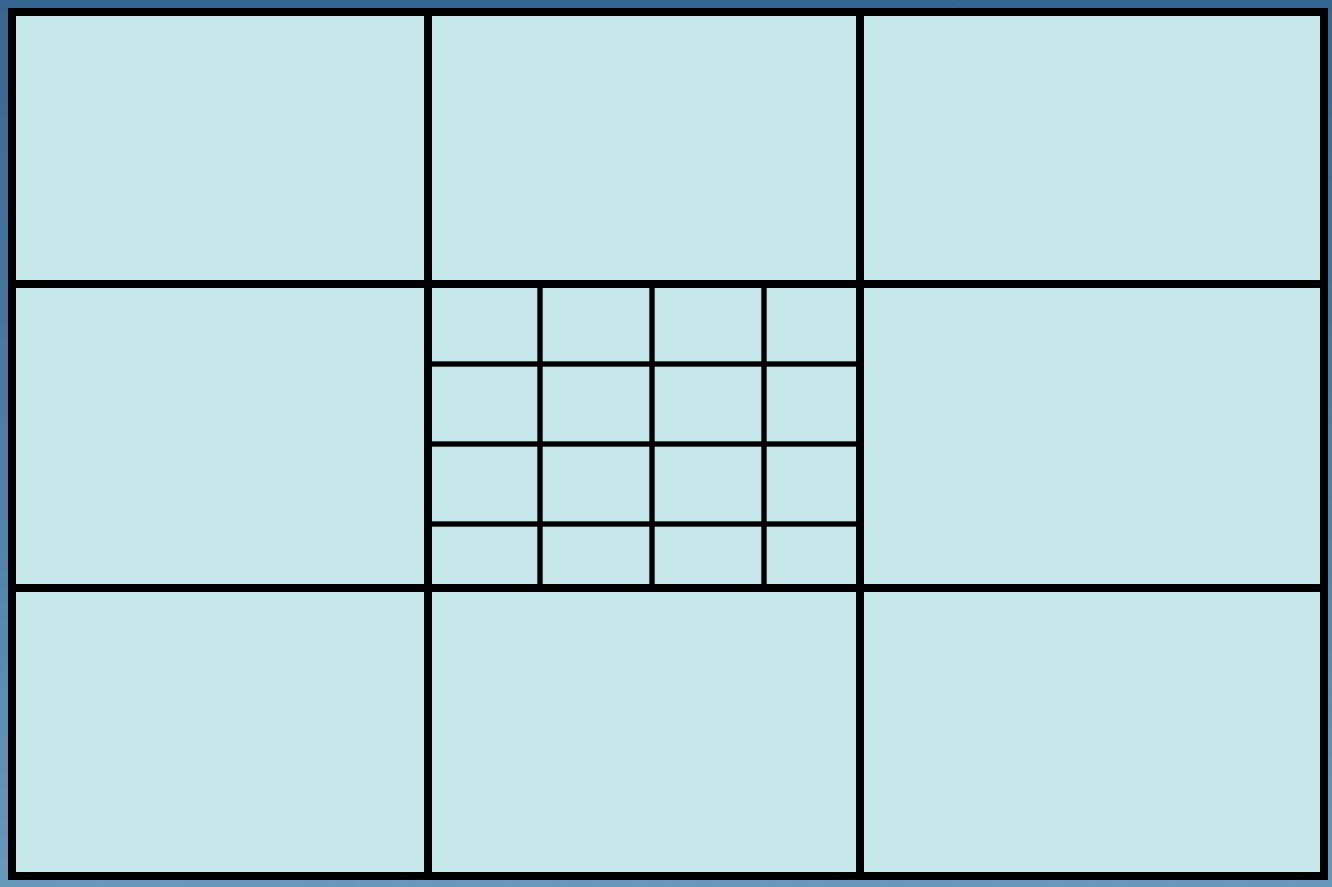
- To test the effectiveness of subtiming and subgridding numerical techniques in facilitating HydroGeoSphere (HGS) application to large river basins over long simulation periods.

HydroGeoSphere: Subgridding



Original Nine Elements

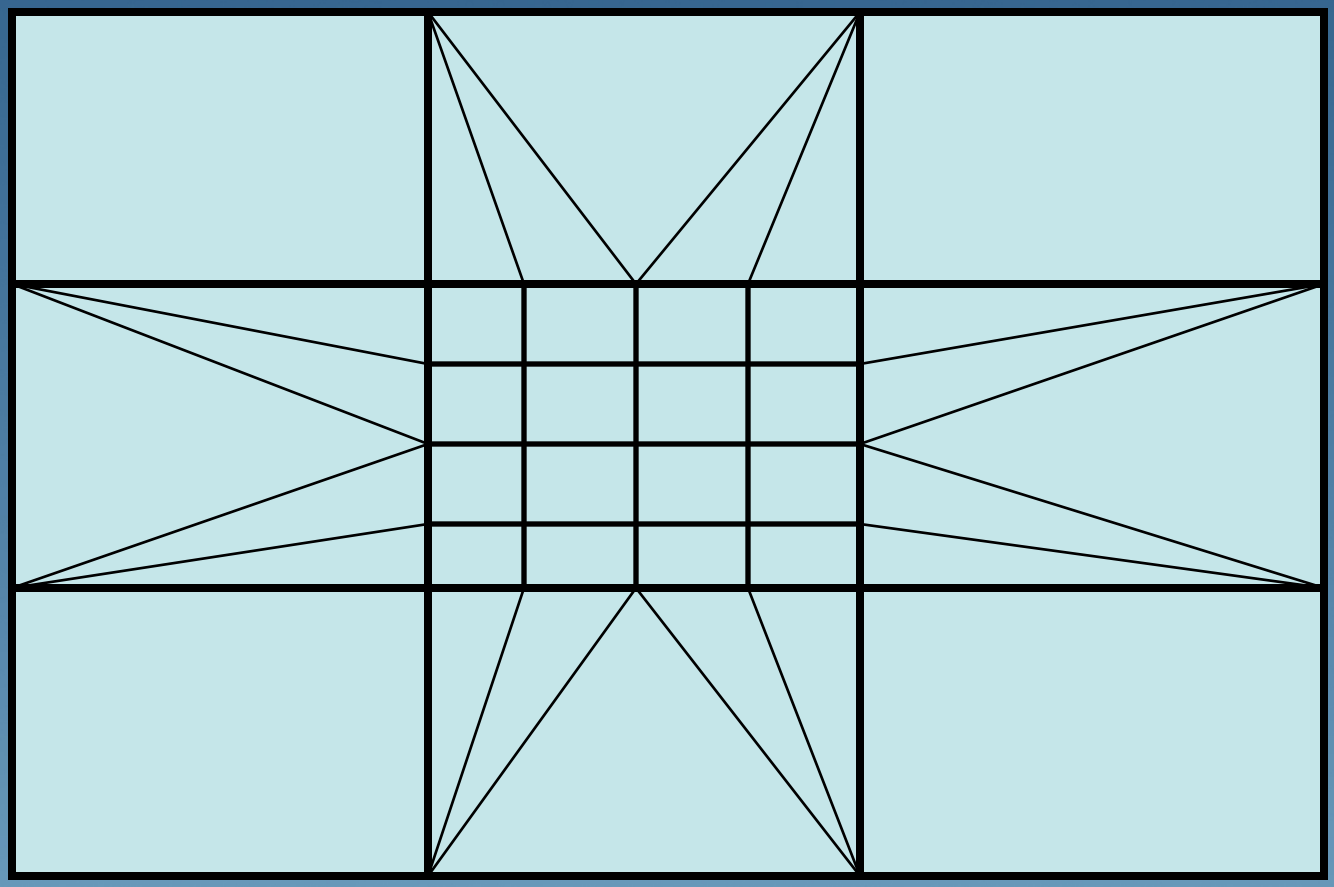
HydroGeoSphere: Subgridding



Central Element Subgridded

Non-linear Elements

HydroGeoSphere: Subgridding

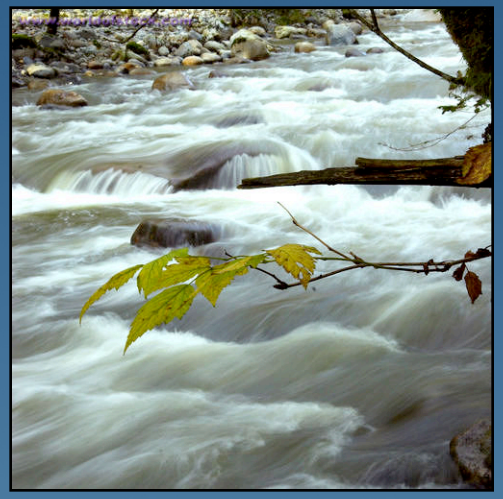


Node

Connection

To linearize

HydroGeoSphere: Subtiming



Fast Temporal Change (ie, Surface Water Flow)

Requires small time step

Slow Temporal Change (ie, Subsurface Water Flow)

Requires large time step

Concept

- Localized time-step refinement applied to highly transient processes

Benefit

- Improves computational efficiency by focusing increase temporal resolution only where required

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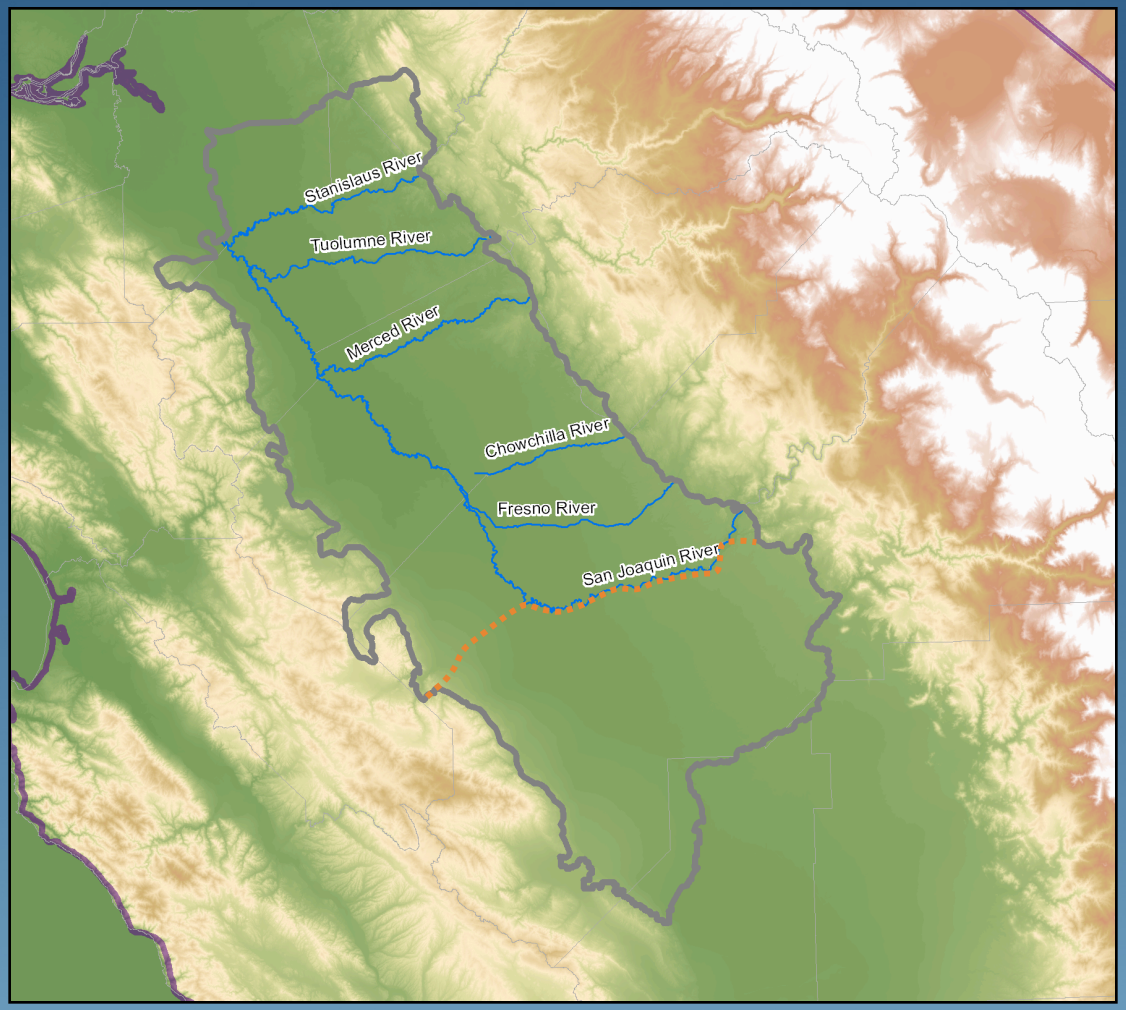
SJV Model Specifications: Model Domain



- Contains all of the San Joaquin Valley (SJV) and the northern portion of the Tulare Basin
- Follows surface water (SW) and subsurface water (SSW) divides
- Downstream of major dams

SJV/Tulare Boundary

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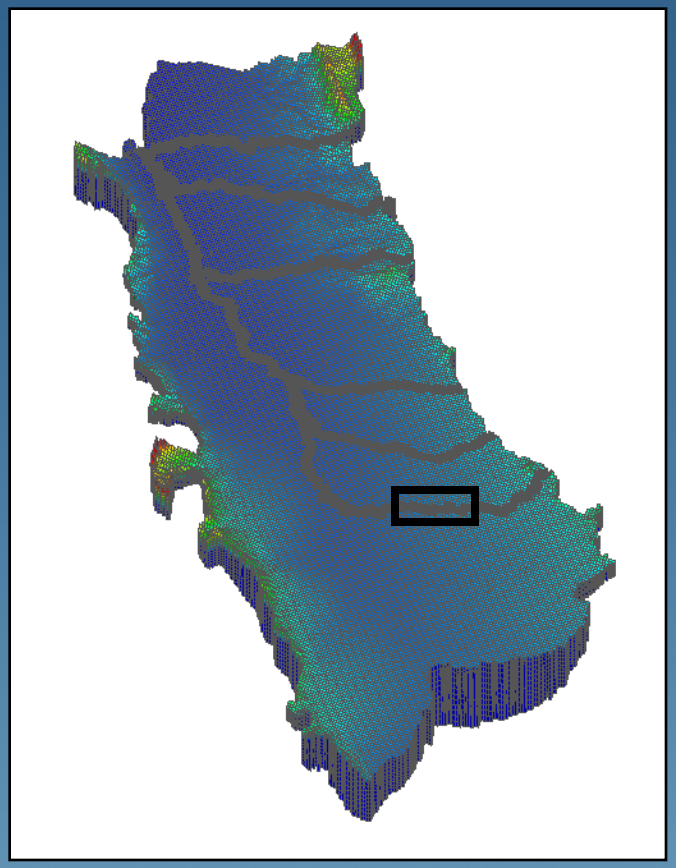
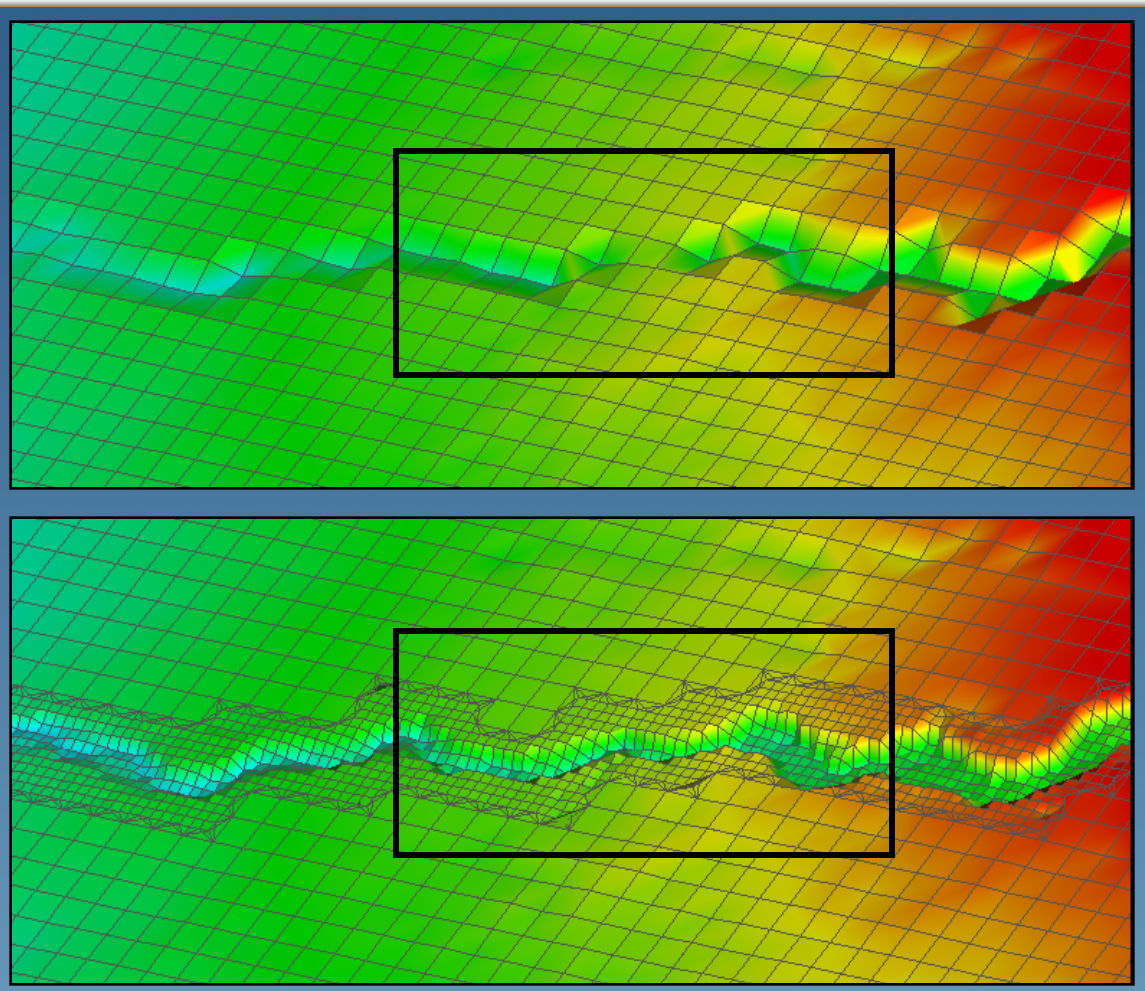
Subgridding – Major Rivers



San Joaquin River Zoom



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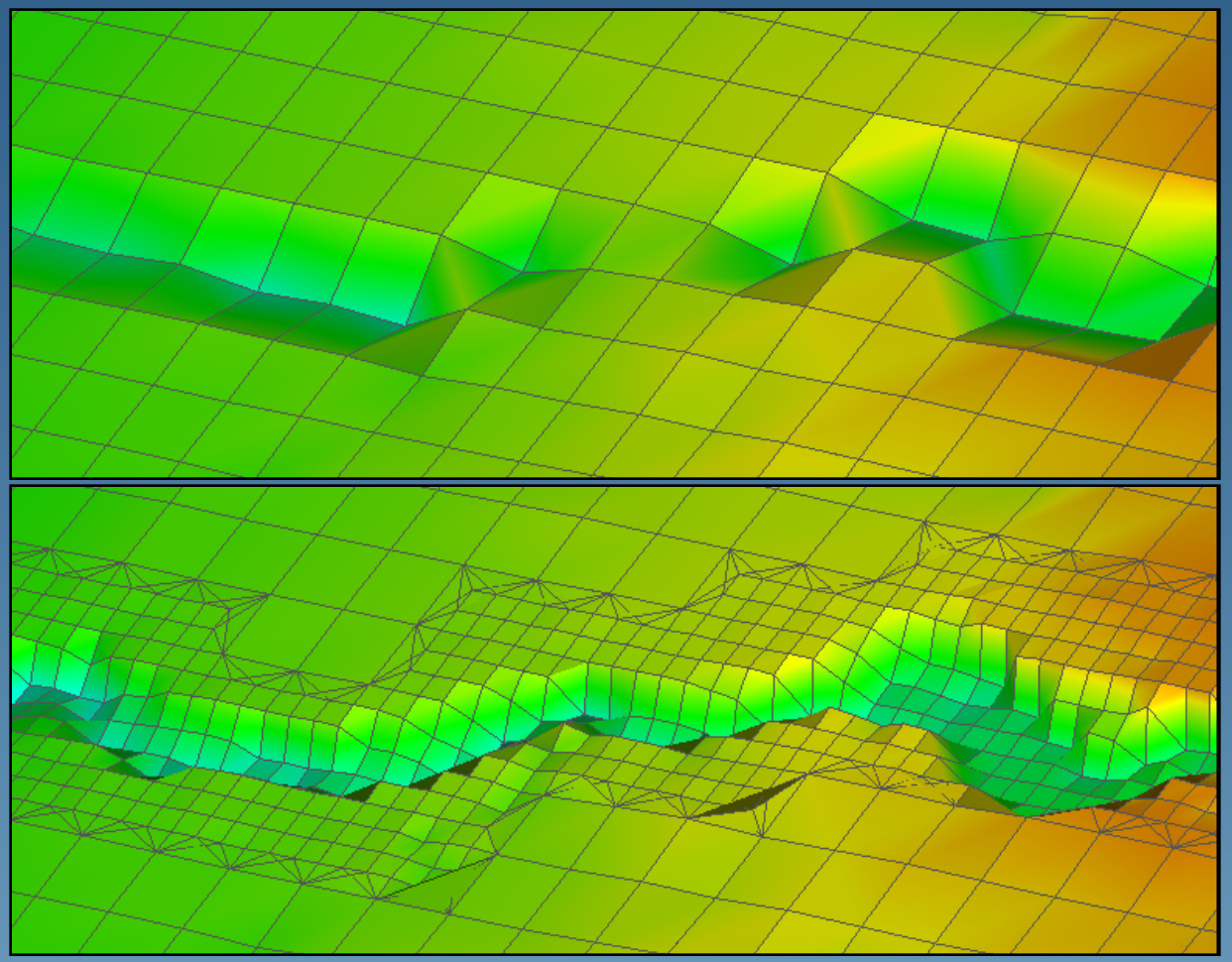
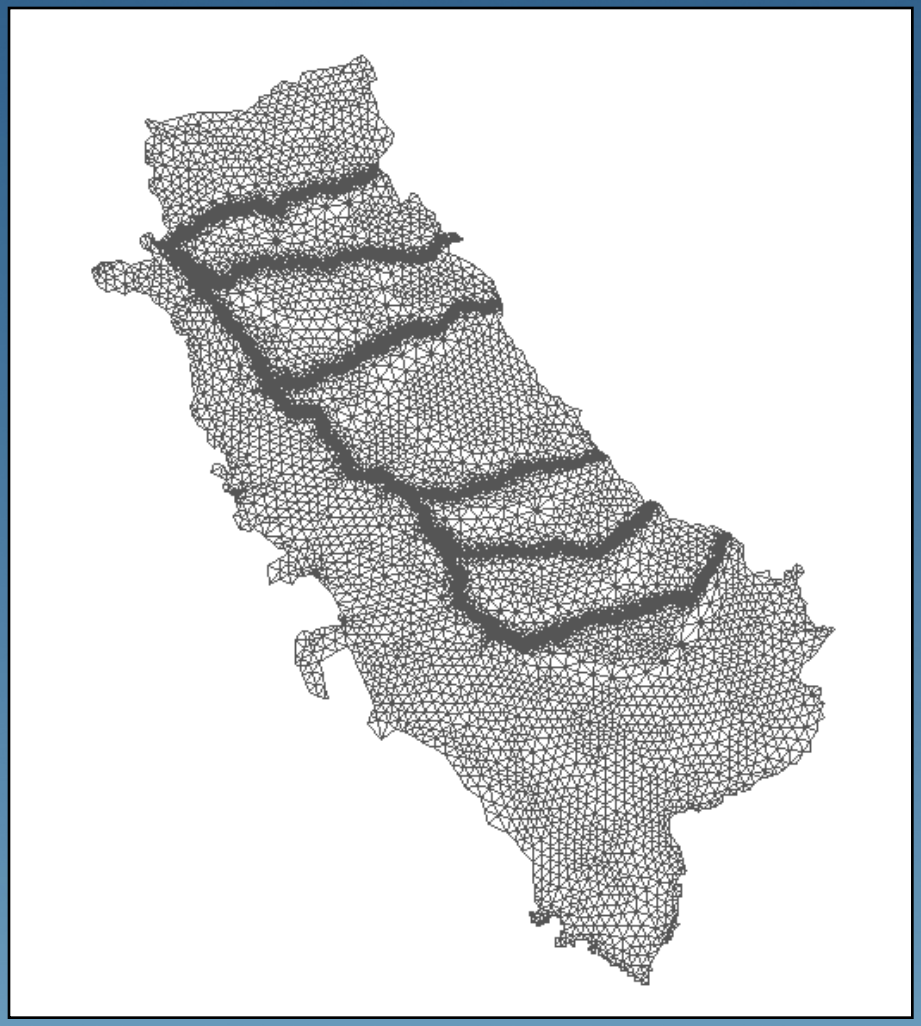
Subgridding – Major Rivers



Model Mesh Comparison – Finite Element



- Elements
  - Dimension: 0.12km^2 or roughly 350m x 350m
  - Per Layer: 144,368
  - Model Layers: 11
  - Total Elements: 1,588,048
- Nodes
  - Per Surface: 72,495
  - Model Surfaces: 12 + 1
  - Total Nodes: 869,940 + 72,495

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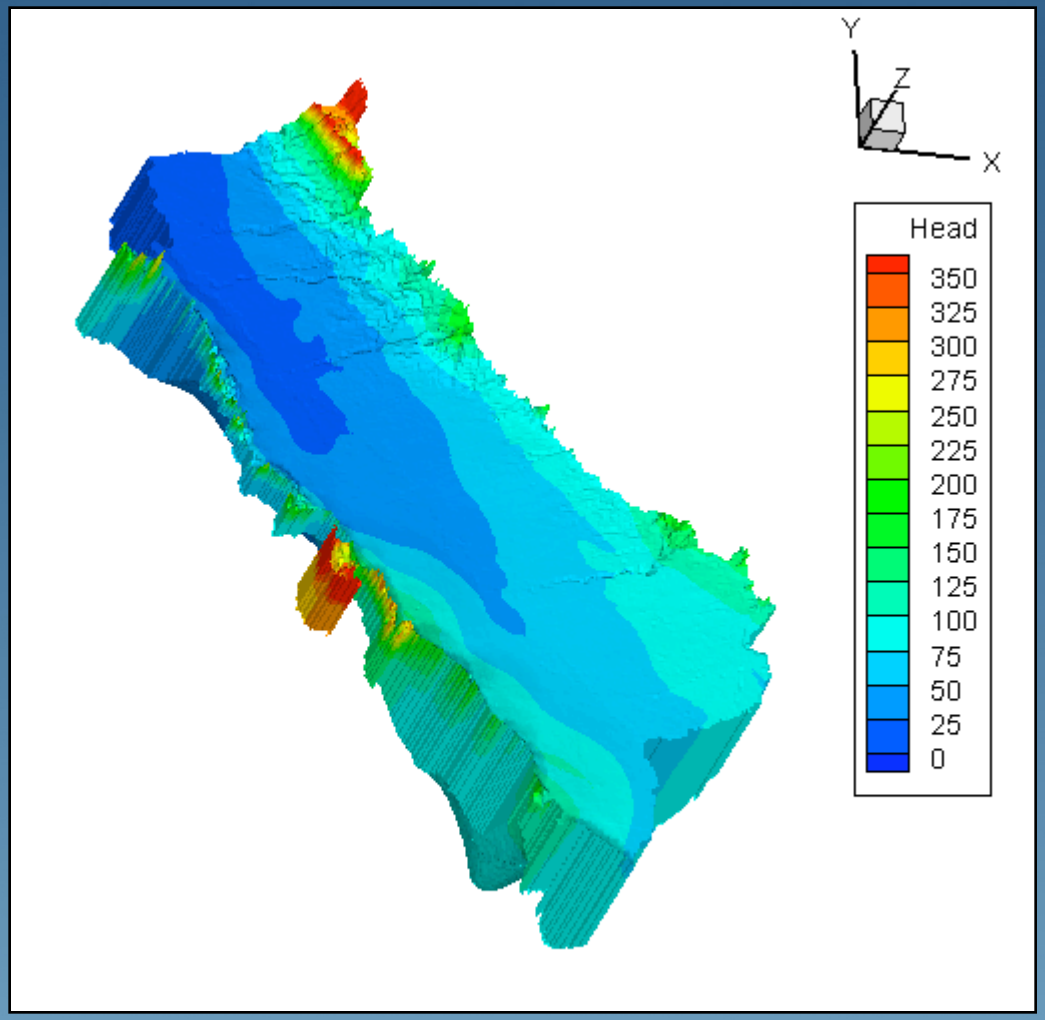
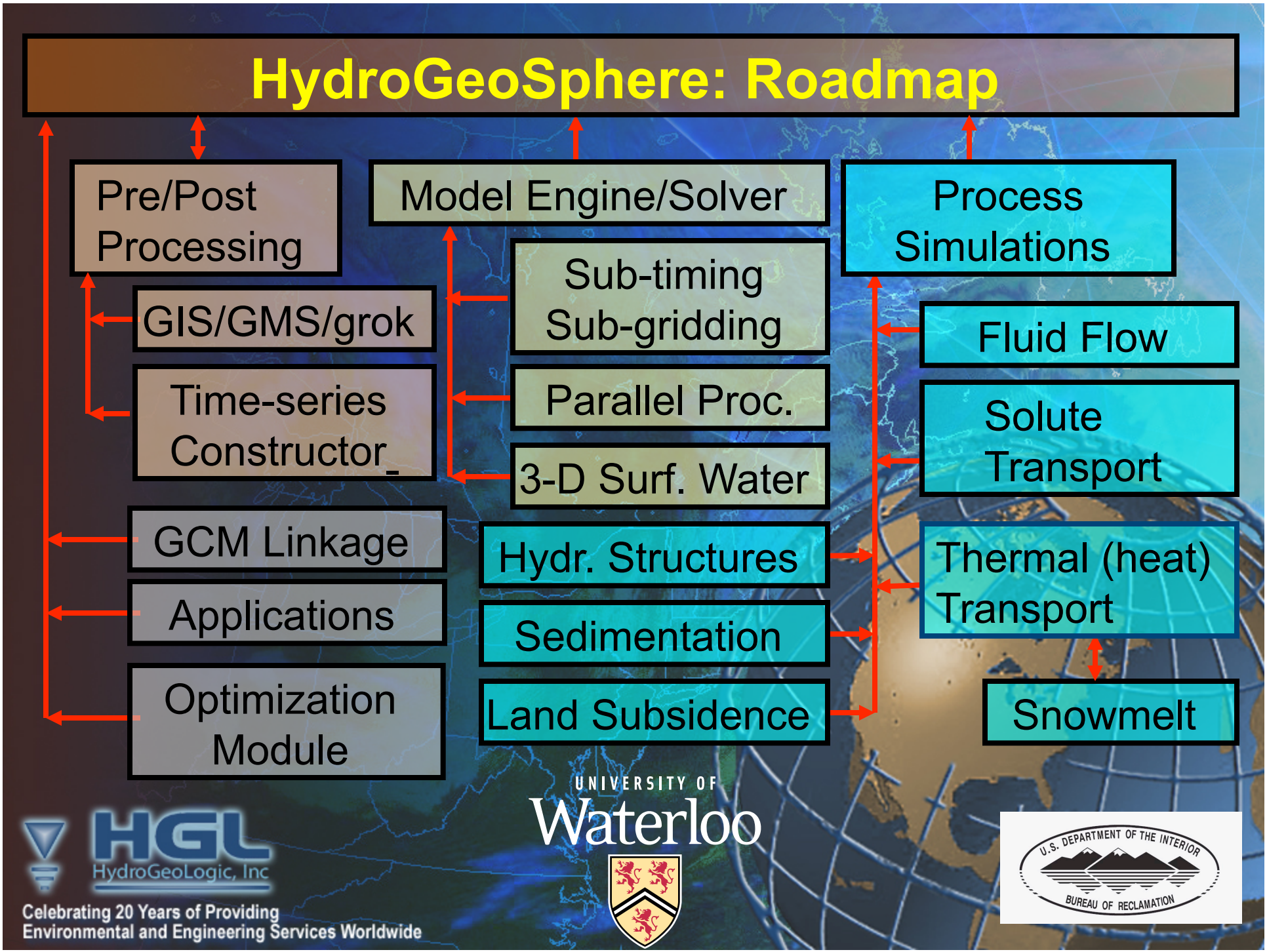
Preliminary Modeling Results



- Head output at the end of the December stress period (i.e. Zone 13).
- General trends indicate subsurface water flow trending towards the Bay Delta region


HydroGeoSphere: Roadmap
Pre/Post Processing
Model Engine/Solver
Process Simulations
GIS/GMS/grok
Time-series Constructor
GCM Linkage
Applications
Optimization Module
Sub-timing Sub-gridding
Parallel Proc.
3-D Surf. Water
Hydr. Structures
Sedimentation
Land Subsidence
Fluid Flow
Solute Transport
Thermal (heat) Transport
Snowmelt
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