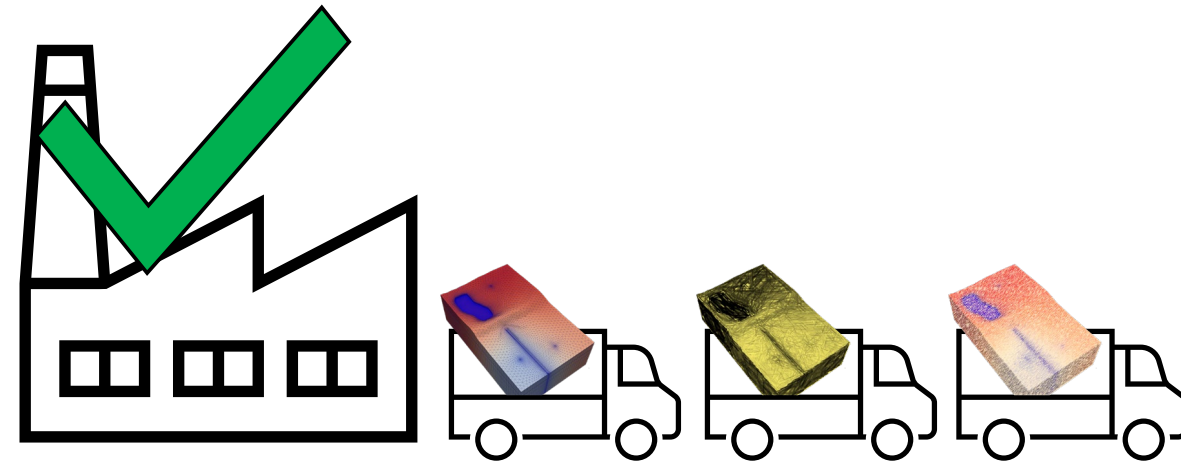
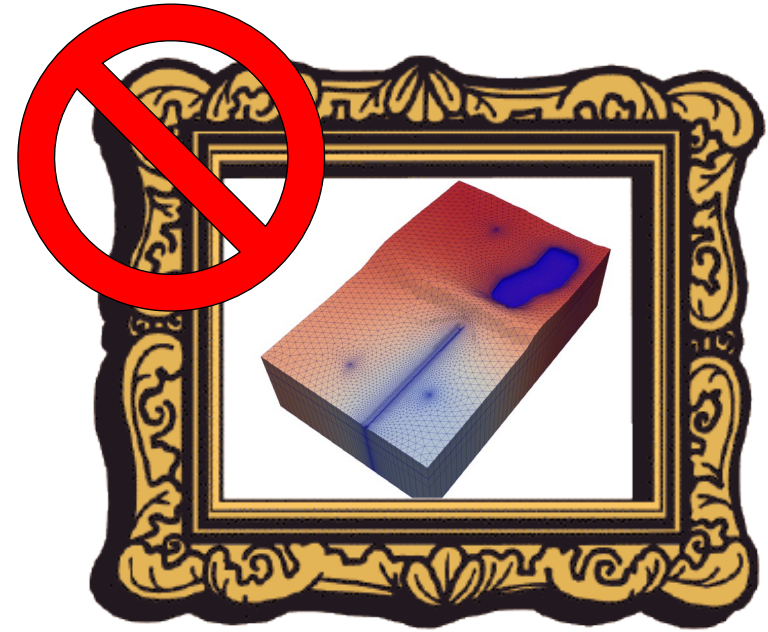


Script-based model development

Revisiting the BLRM model factory.

Motivations for scripted, iterative development:

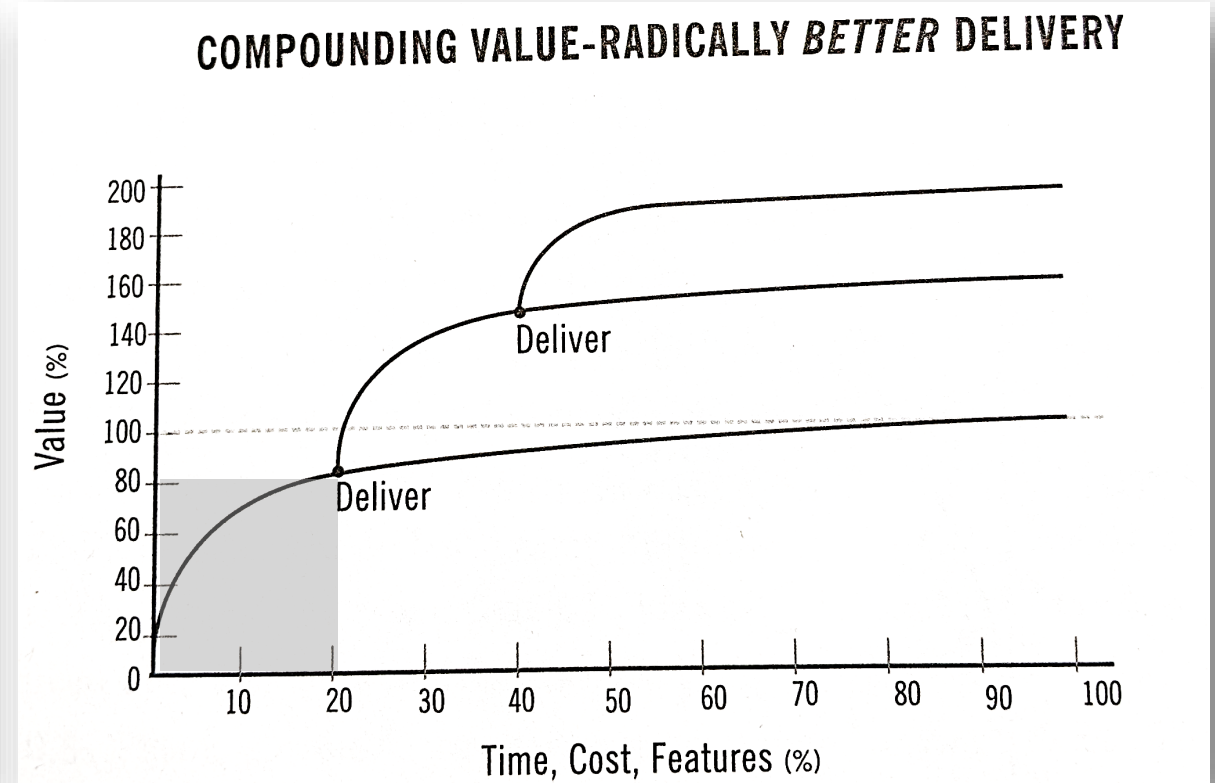
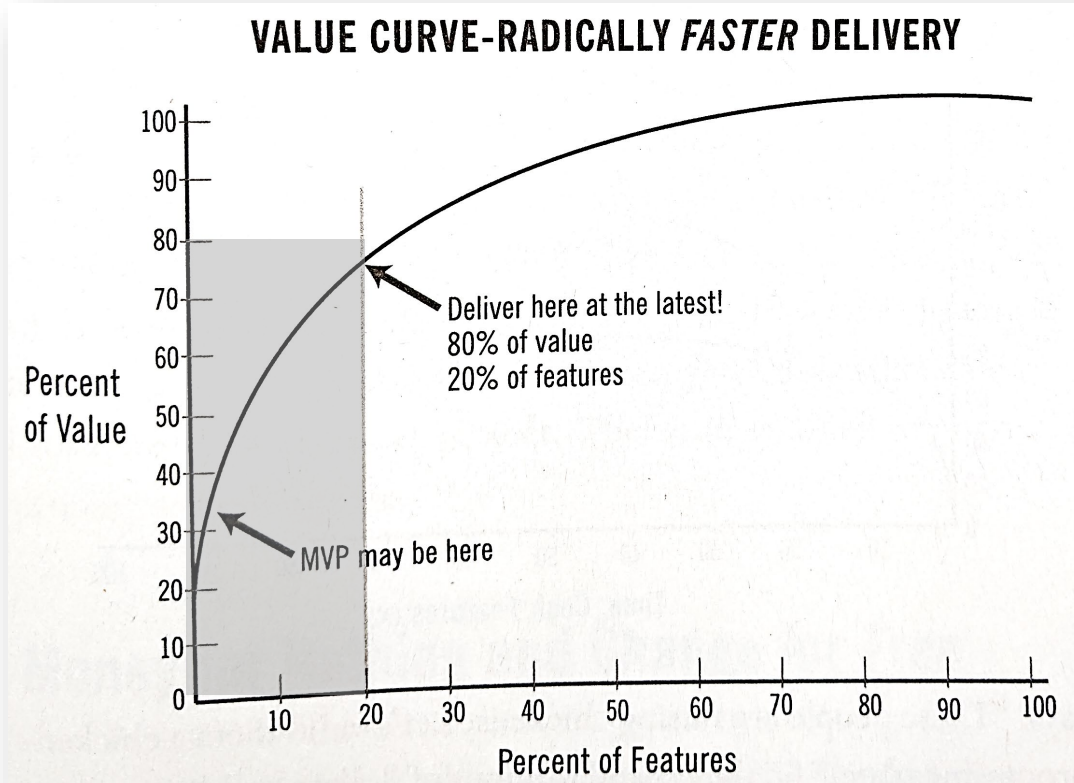
- Survive “the ubiquity of error”
- “Concentrate and store up” our modeling “judgement, dexterity, and care.”
- Automate input/output generation
- Execute *Plan-Do-Check-Act* cycles to move forward in short, quick steps
- Maintain flexibility to change design decisions



Iterative Model Development

MTAC feedback → model design trajectory

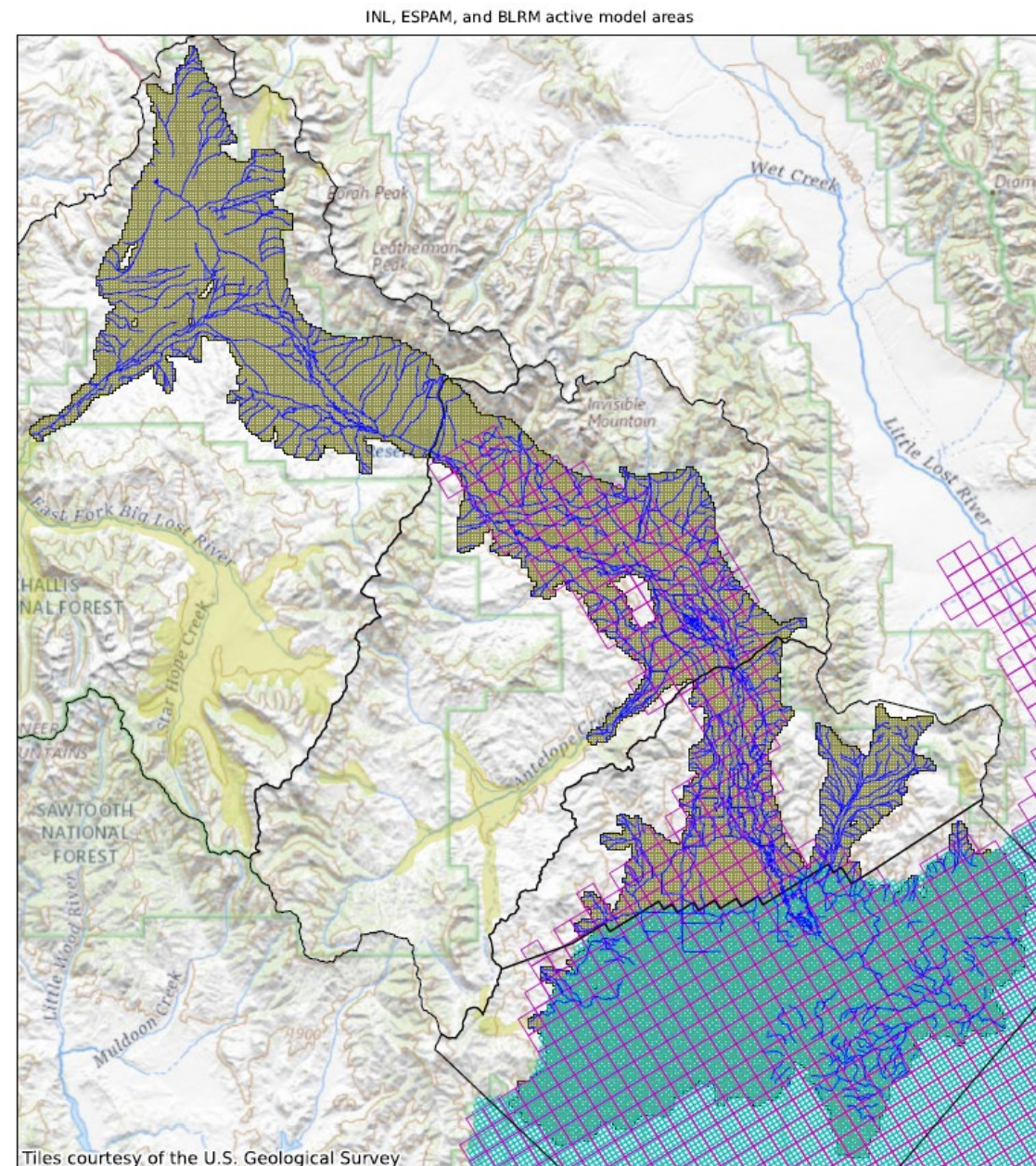
- We will continue to present a “Minimum Viable Product” at each MTAC meeting
- *Your feedback will help set the new model design trajectory.*



The Embarrassingly Simple Model (ESM)

Nov. 2022 minimum viable product

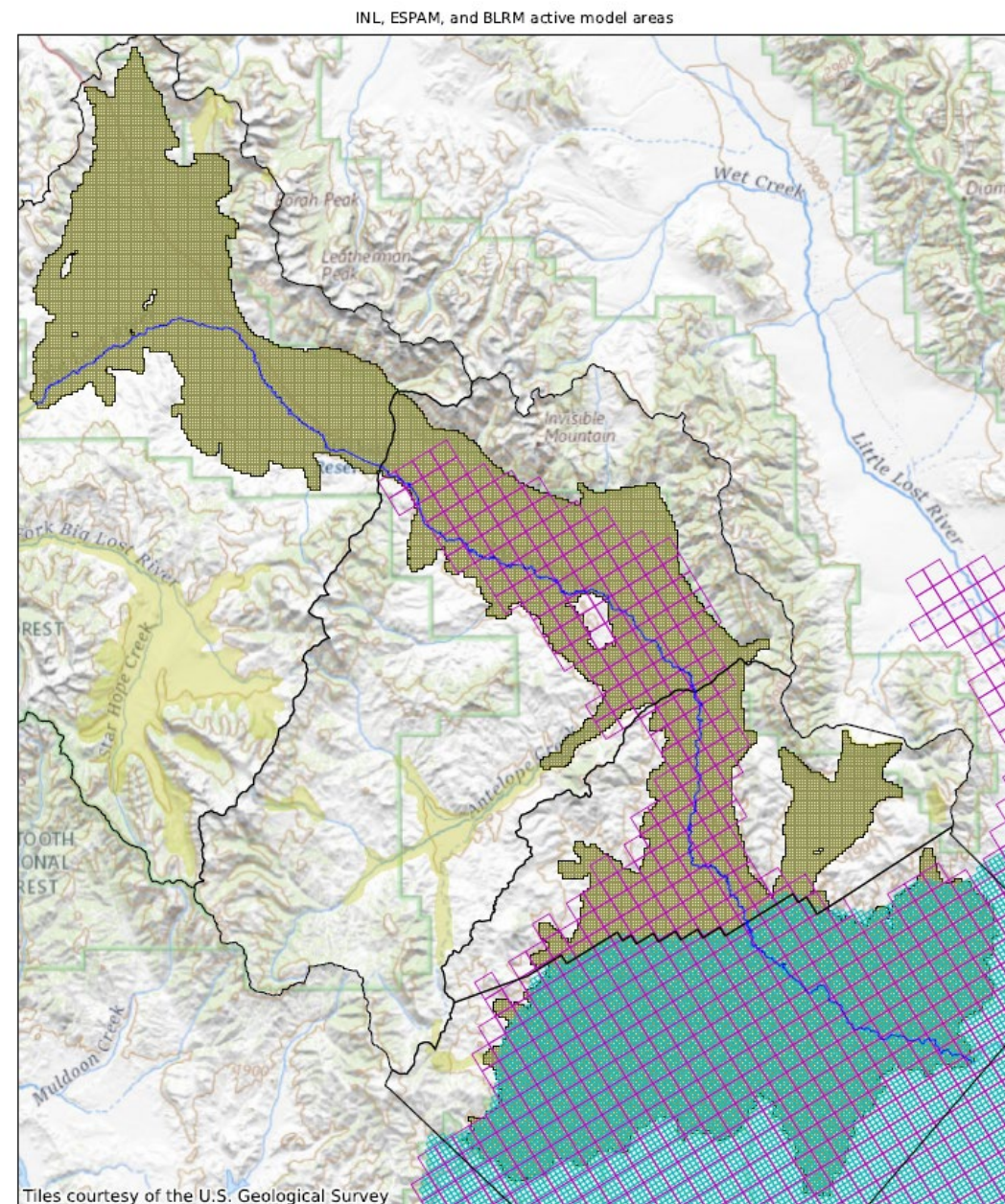
- Strengths:
 - Script-based and fully automated from model build, through parameterization and prior Monte Carlo evaluation, and post-processing
 - Highly flexible, very little “baked in”
 - Fast! (~10 seconds)
- Weaknesses:
 - Steady-state only
 - Uniform RCH and HK
 - No tributary underflow
 - No surface water routing
 - Crude basin depth representation



The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

- Strengths:
 - Transient simulation, monthly stress periods
 - Areal recharge and tributary underflow
 - Surface water routing in BLR mainstem via SFR
 - Still highly flexible, fully reproducible
 - Still Fast! (~2 minutes)
- Weaknesses:
 - Simulation time limited to 2004-2015
 - Uniform HK values
 - Crude basin depth representation
 - Major components missing. No diversions or irrigation
 - *No specific forecasts of interest (yet!)*



The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

- Areal recharge from Reitz and Samford (2019):
 - 1km grid, monthly 10/2003 – 12/2015
 - Effective recharge calculated as water budget residual of precipitation, SWE, EVT, GW-irrigation, runoff
- Will eventually replace with field-scale estimates derived from METRIC ET data



ScienceBase Catalog → USGS Lower Mississippi-Gulf... → @ Mississippi Alluvial Plain (...) → Water Budgets → Modern monthly effective rec...

Modern monthly effective recharge maps for the conterminous U.S., 2003-2015 [View](#)

Dates

Publication Date : 2019-08-30
Start Date : 2003-10-01
End Date : 2015-12-31

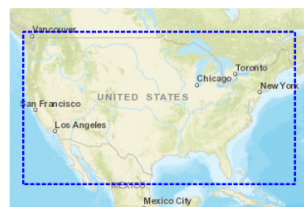
Citation

Reitz, M., and Sanford, W.E., 2019, Modern monthly effective recharge maps for the conterminous U.S., 2003-2015: U.S. Geological Survey data release, <https://doi.org/10.5066/P9NRVQAQ5>.

Summary

This data set includes 1 km resolution monthly timescale estimates of the effective recharge component of the water budget over the time period from October 2003 - December 2015. These estimates were developed as water budget residuals using previously published data sets for other water budget components: PRISM precipitation (Daly et al., 2008), SNODAS snow water equivalent (National Operational Hydrologic Remote Sensing Center, 2004), SSEBop-WB evapotranspiration (Reitz et al., 2017a), a map of groundwater-sourced irrigation (Reitz et al., 2017b), and monthly surface runoff maps (Reitz et al., 2019). The recharge data were estimated as the difference between water supply (precipitation plus snow melt plus irrigation) and the other water budget components (snow accumulation, surface runoff, and ET) for a given month. In locations / months where the SNODAS snow accumulation data indicated greater snow accumulation than PRISM precipitation for that month, the snow accumulation was capped to the precipitation value. The monthly recharge maps represent the implications of these water budget component estimates as residuals.

Map »

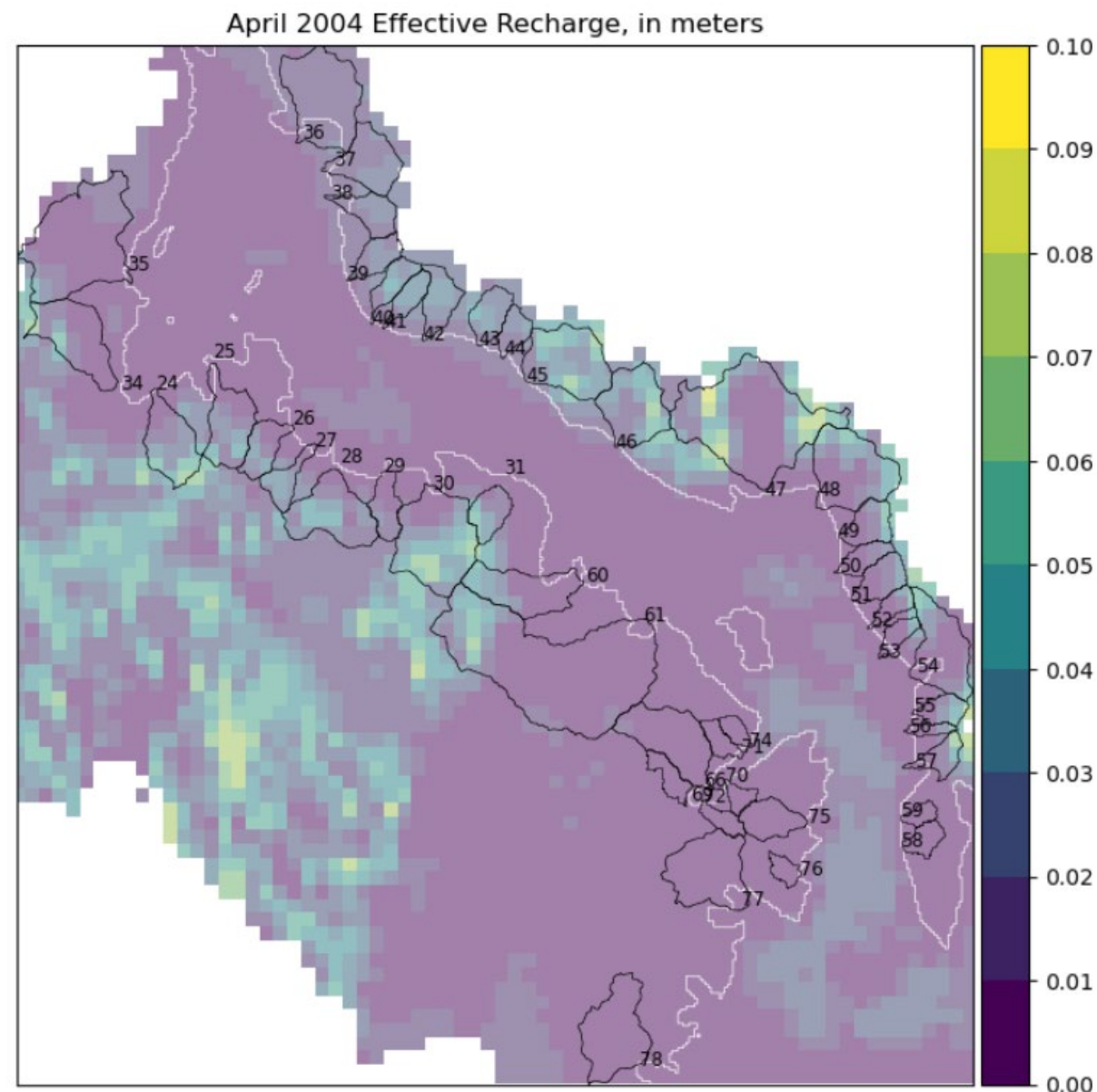


Communities

- USGS Lower Mississippi-Gulf Water Science Center

Associated Items

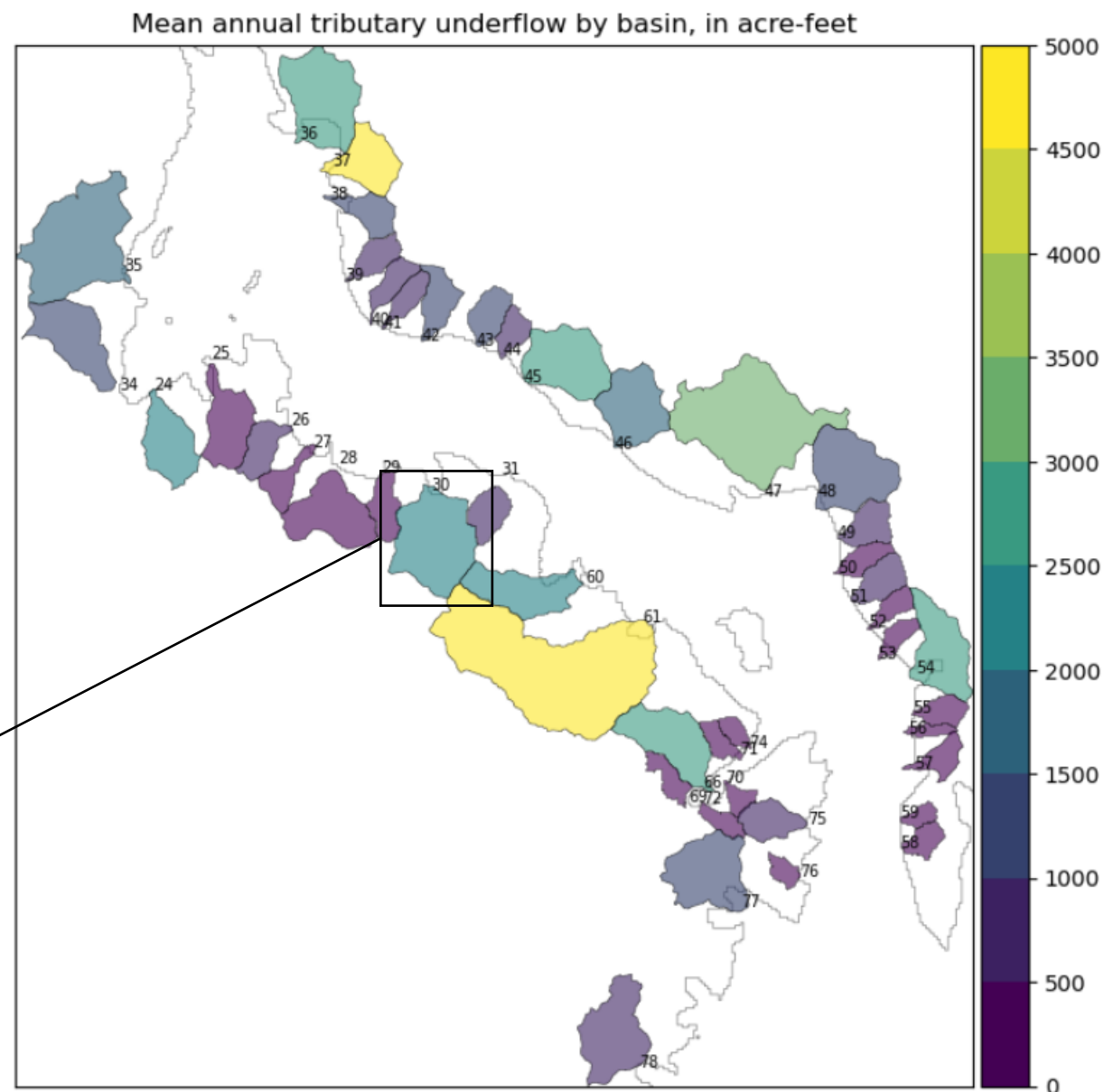
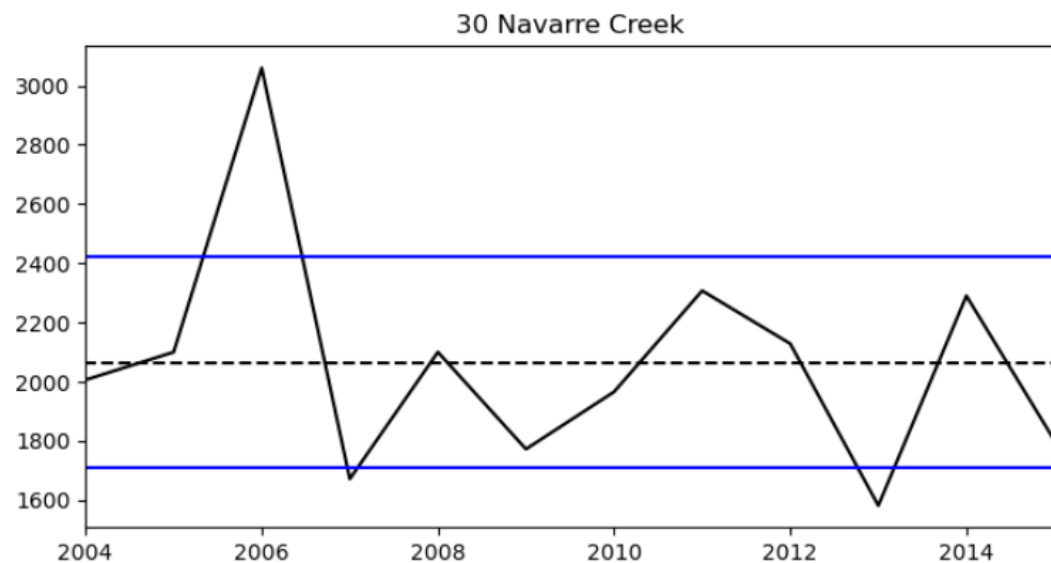
• Derivative of Areal snow accumulation



The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

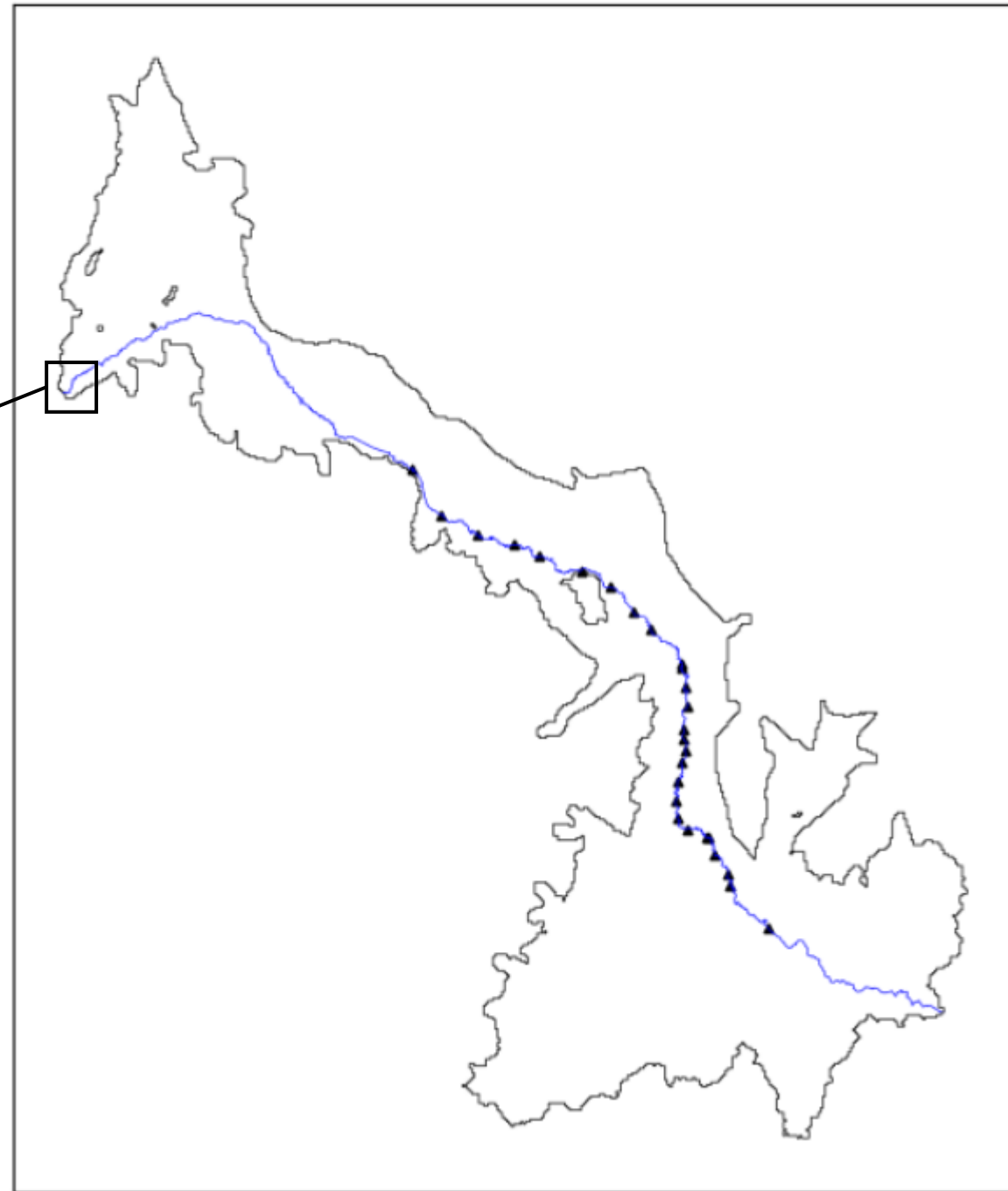
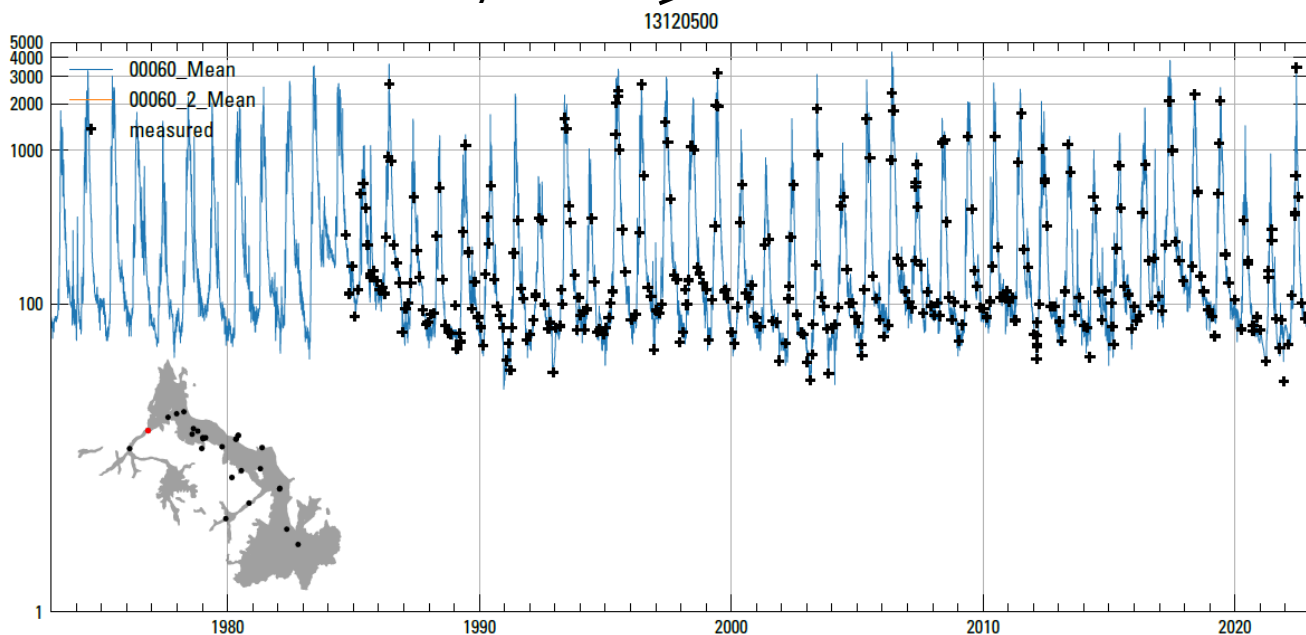
- Tributary Underflow from Clark (2022):
 - From BLRB Water Budget SIR
 - Mean annual underflow by basin 2000 – 2019
 - Includes high- and low-end estimates
 - Results comparable to Crosthwaite (1970)



The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

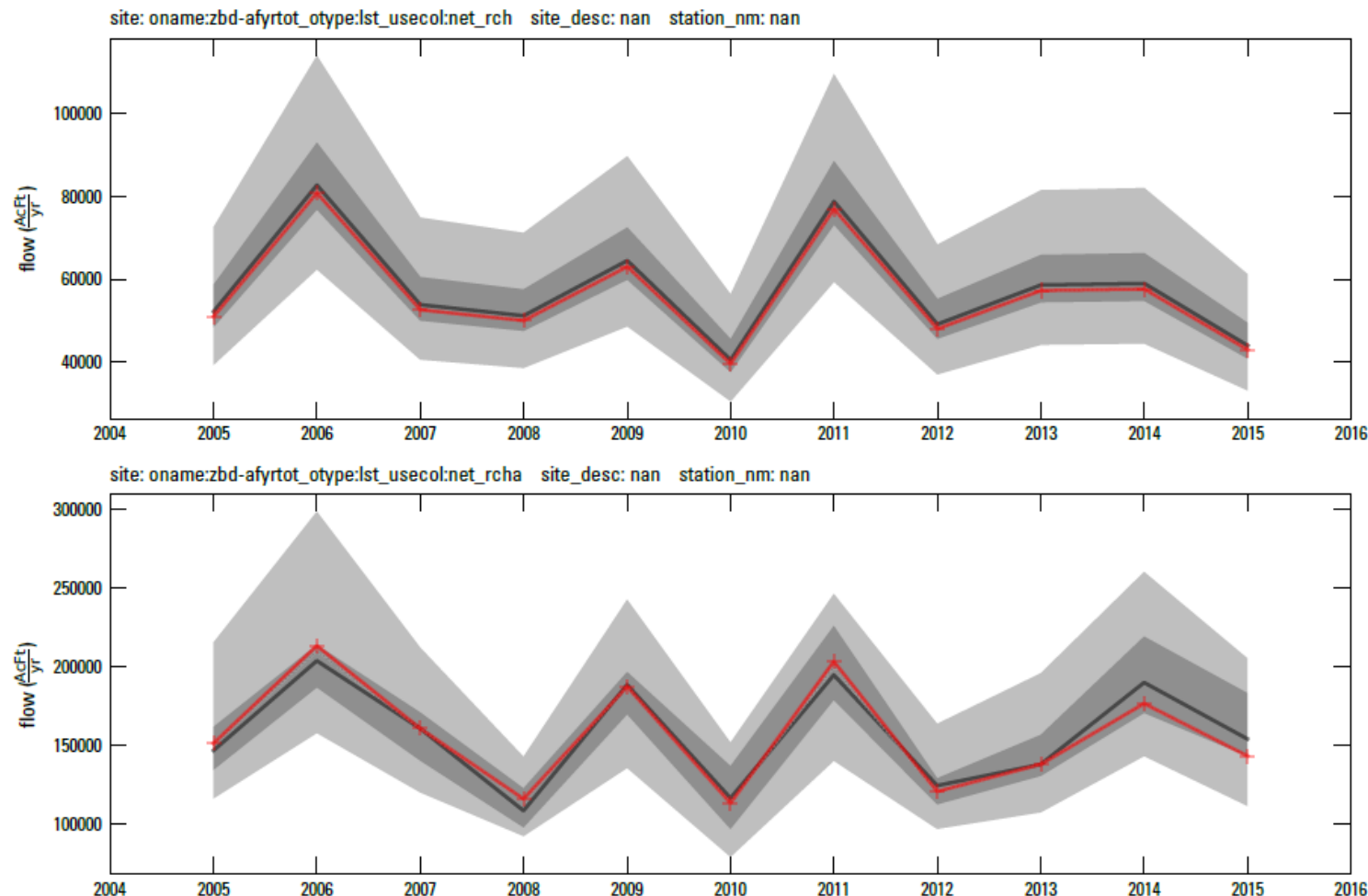
- Big Lost River surface water routing:
 - Preliminary deployment from NHD+ HR flowlines
 - Transient inflow specified at Howell Ranch gage
 - No other tributary inflows yet
 - No diversions yet
 - No reservoir yet



The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

- TSM Prior Monte Carlo results:
 - Outputs reflect wide ranges of uncertainty in model property values and input forcings (e.g. RCH +/- 50%)
 - In future iterations of the Prior, some parameter ranges will be constrained by improved understanding of the system

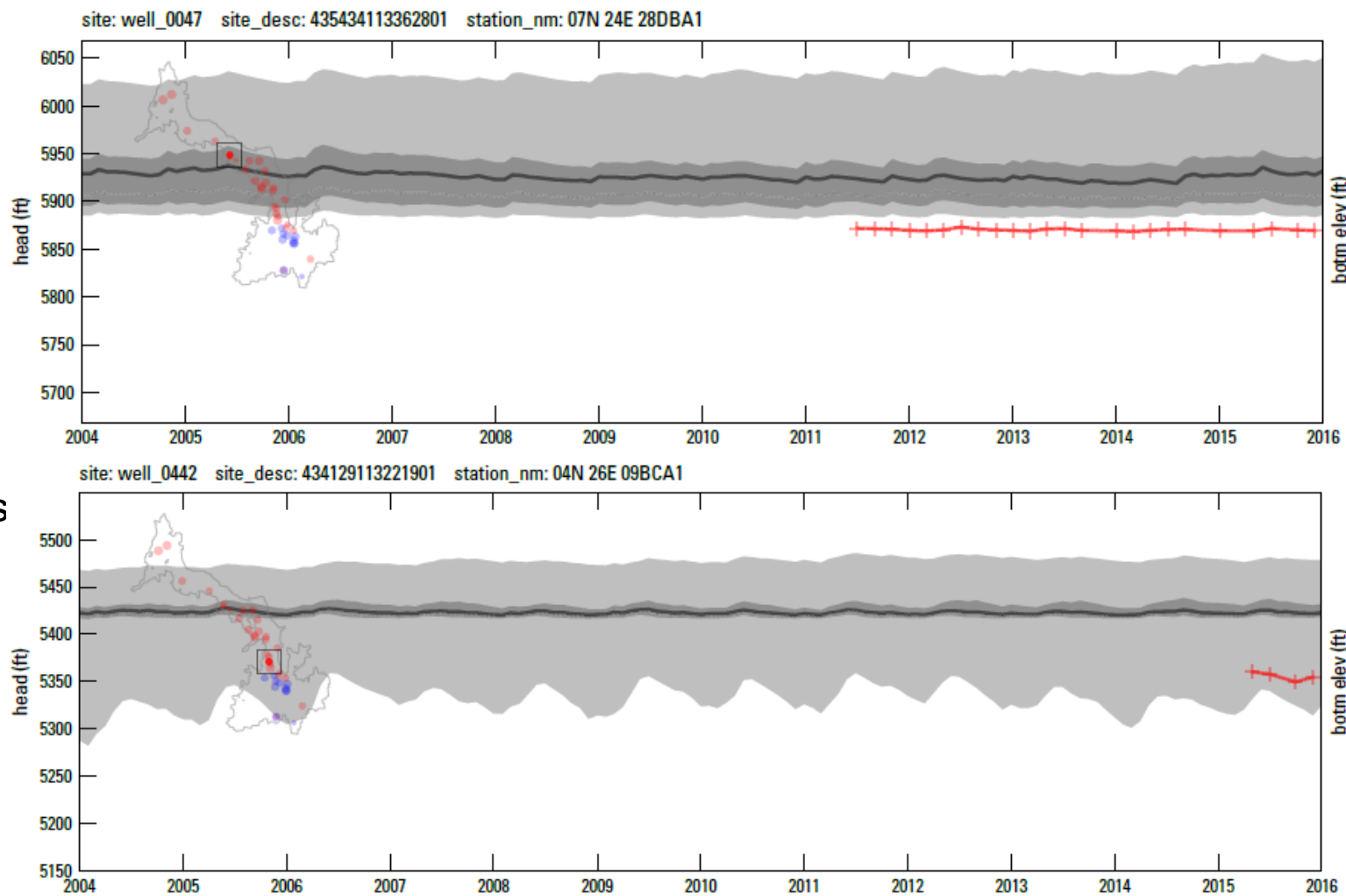


Red=TSM single model, Gray=TSM Prior MC (20 realizations)

The Transient Simple Model (TSM)

Feb. 2023 minimum viable product

- TSM Prior Monte Carlo results:
 - Outputs also reflect incomplete representation of the conceptual model
 - TSM is “source heavy” and “sink deficient,” partially explaining the general over-simulation of GW levels and output fluxes

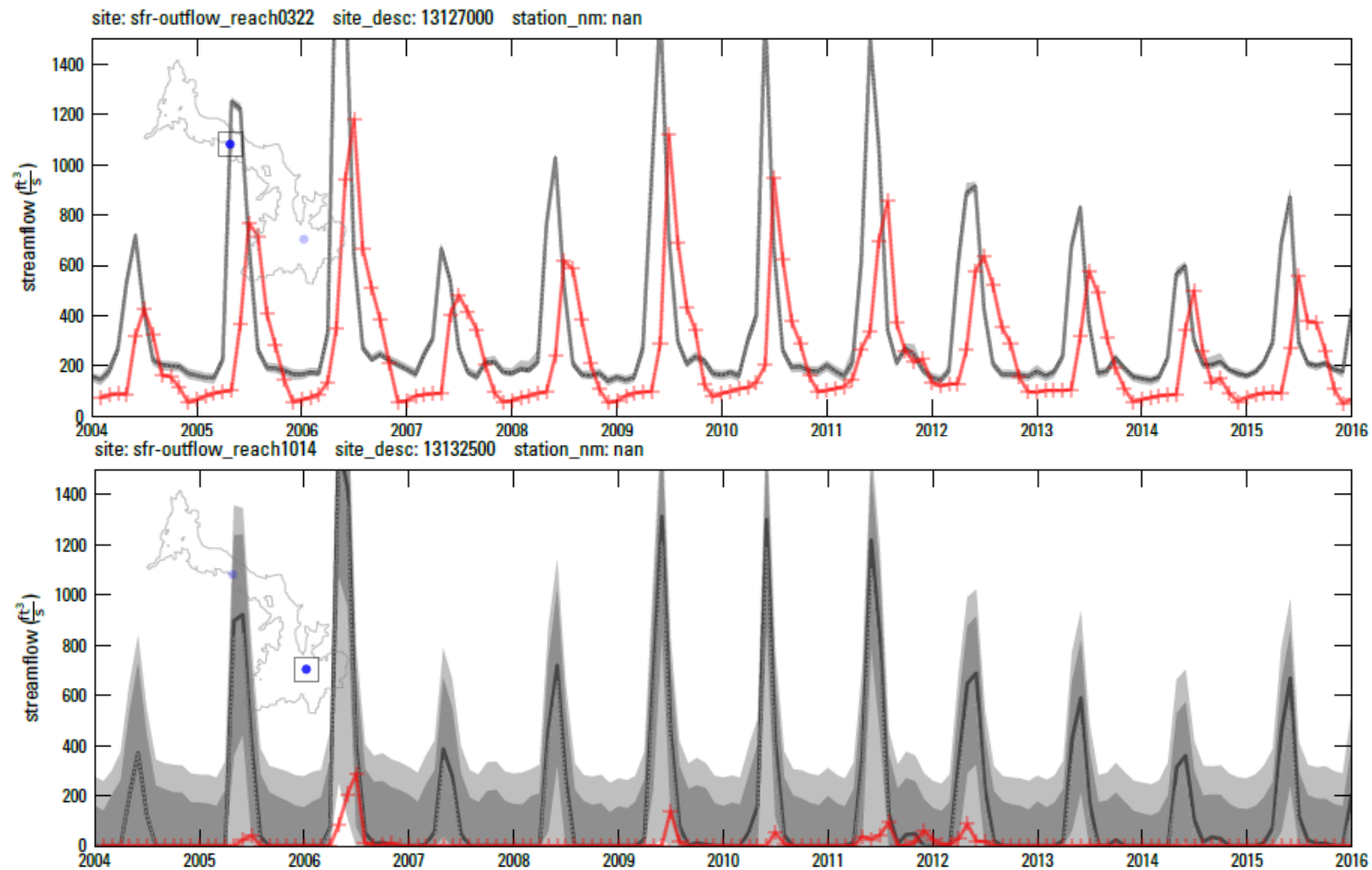


Red=TSM single model, Gray=TSM Prior MC (20 realizations)

The Next Iteration – perhaps not so simple?

May 2023 minimum viable product

- Upcoming model development goals:
 - Assign transmissivity and storage properties based on hydrogeologic framework report and data
 - Preliminary representation of pumping and diversions – in preparation of eventual field-scale simulation of irrigation and infiltration
 - Define and track model-simulated equivalents of observed stream gains/losses reported in seepage study
 - Other priorities motivated by this meeting



Red=TSM single model, Gray=TSM Prior MC (20 realizations)