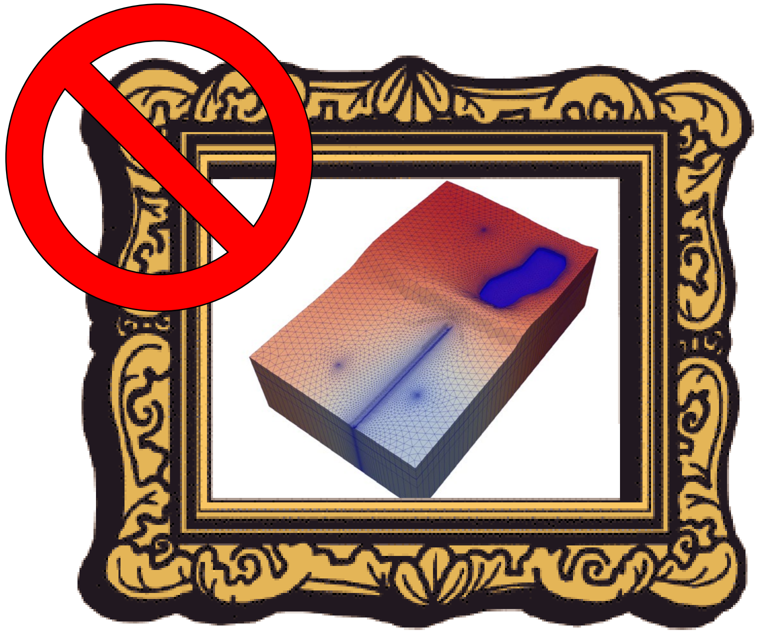
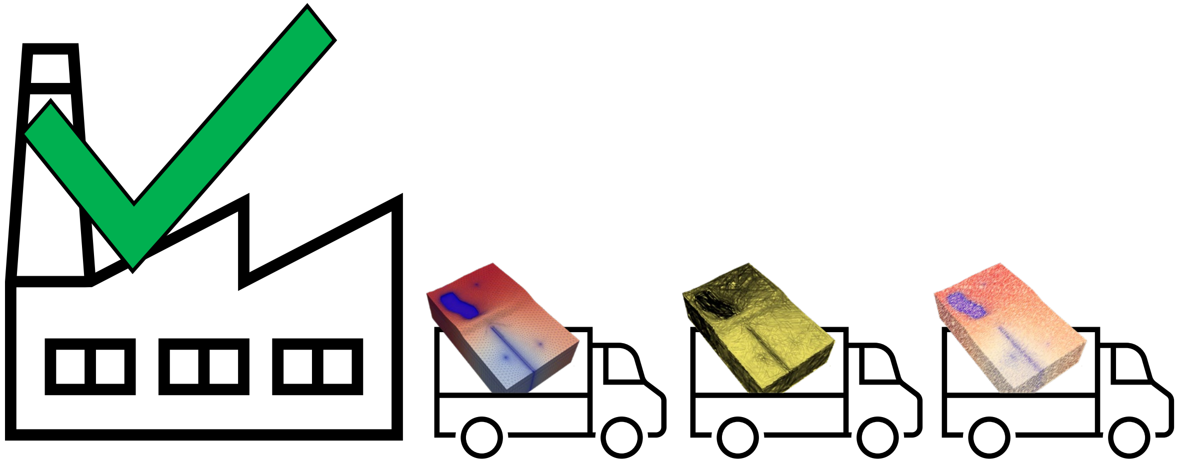
Script-based model development

Revisiting the BLRM model factory.



Motivations for scripted, iterative development:

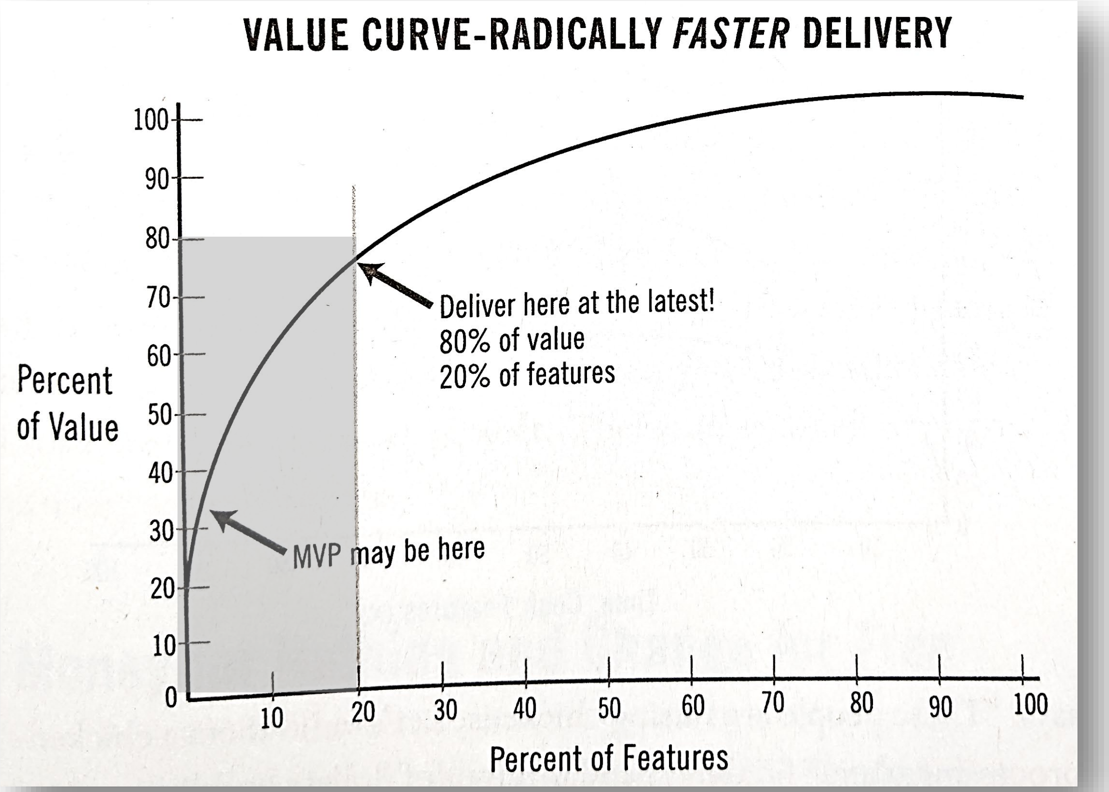
- Survive “the ubiquity of error”
- “Concentrate and store up” our modeling “judgement, dexterity, and care.”
- Automate input/output generation
- Execute *Plan-Do-Check-Act* cycles to move forward in short, quick steps
- Maintain flexibility to change design decisions

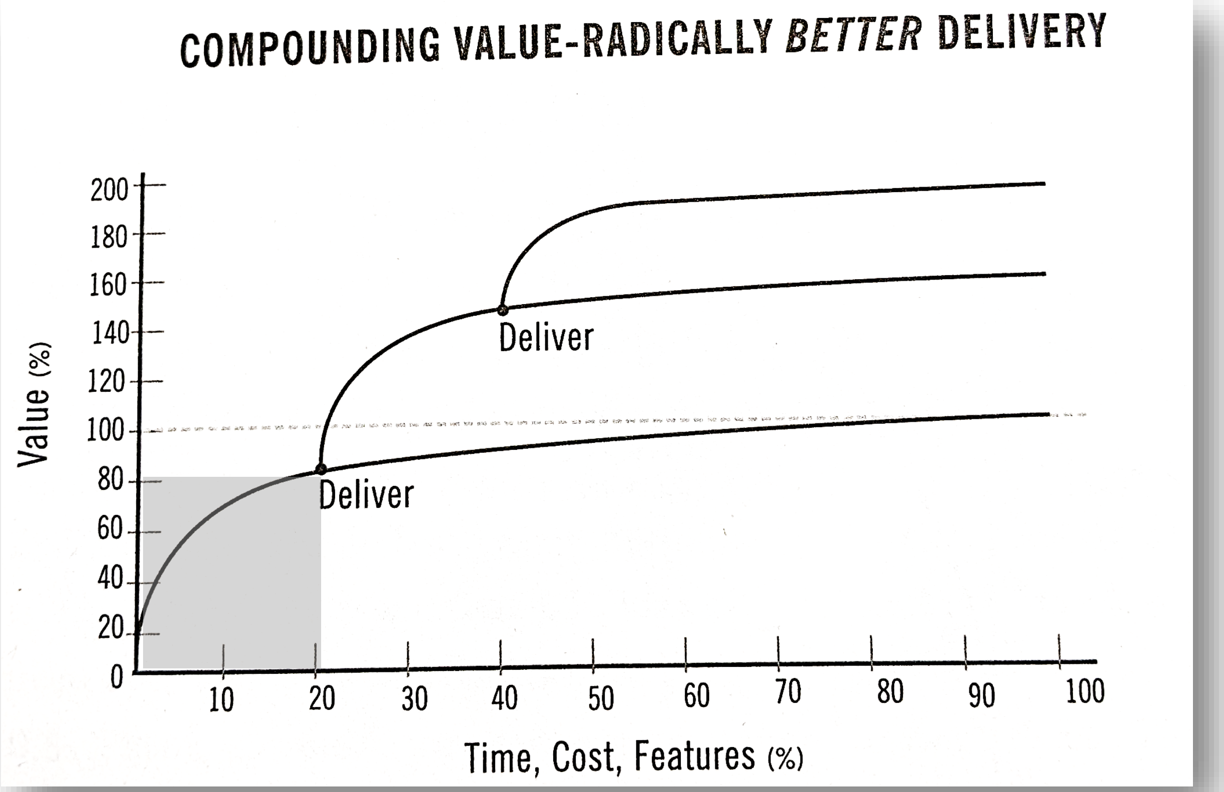


Iterative Model Development

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 development trajectory.*

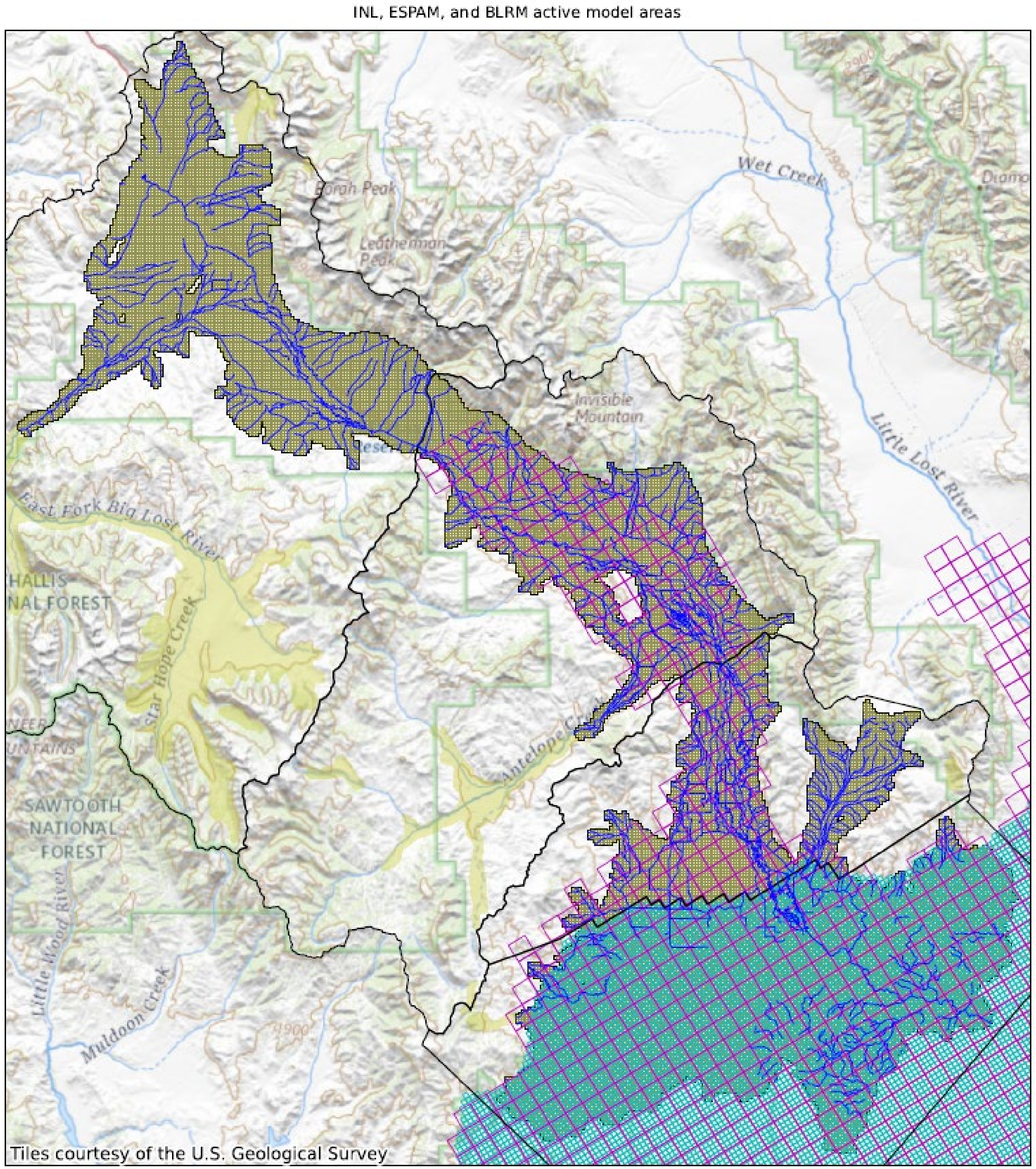




The Embarrassingly Simple Model (ESM)

Nov. 2022 minimum viable product

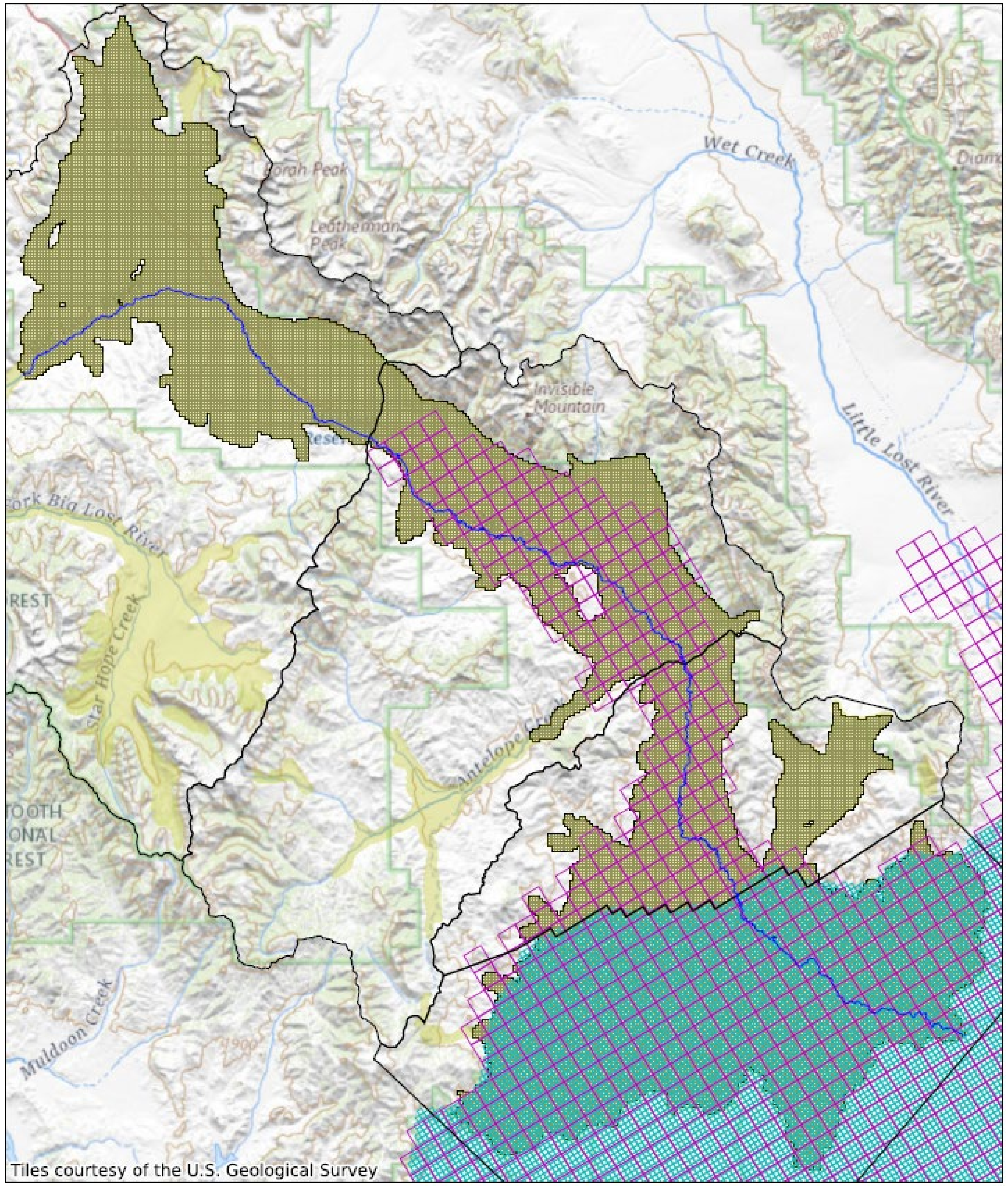
- Strengths:
  - Script-based and fully automated from model build, through parameterization and prior Monte Carlo evaluation, and post-processing
  - Highly flexible, very little “baked in”
  - Fast! (~10 seconds)
- Weaknesses:
  - Steady-state only
  - Uniform RCH and HK
  - No tributary underflow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

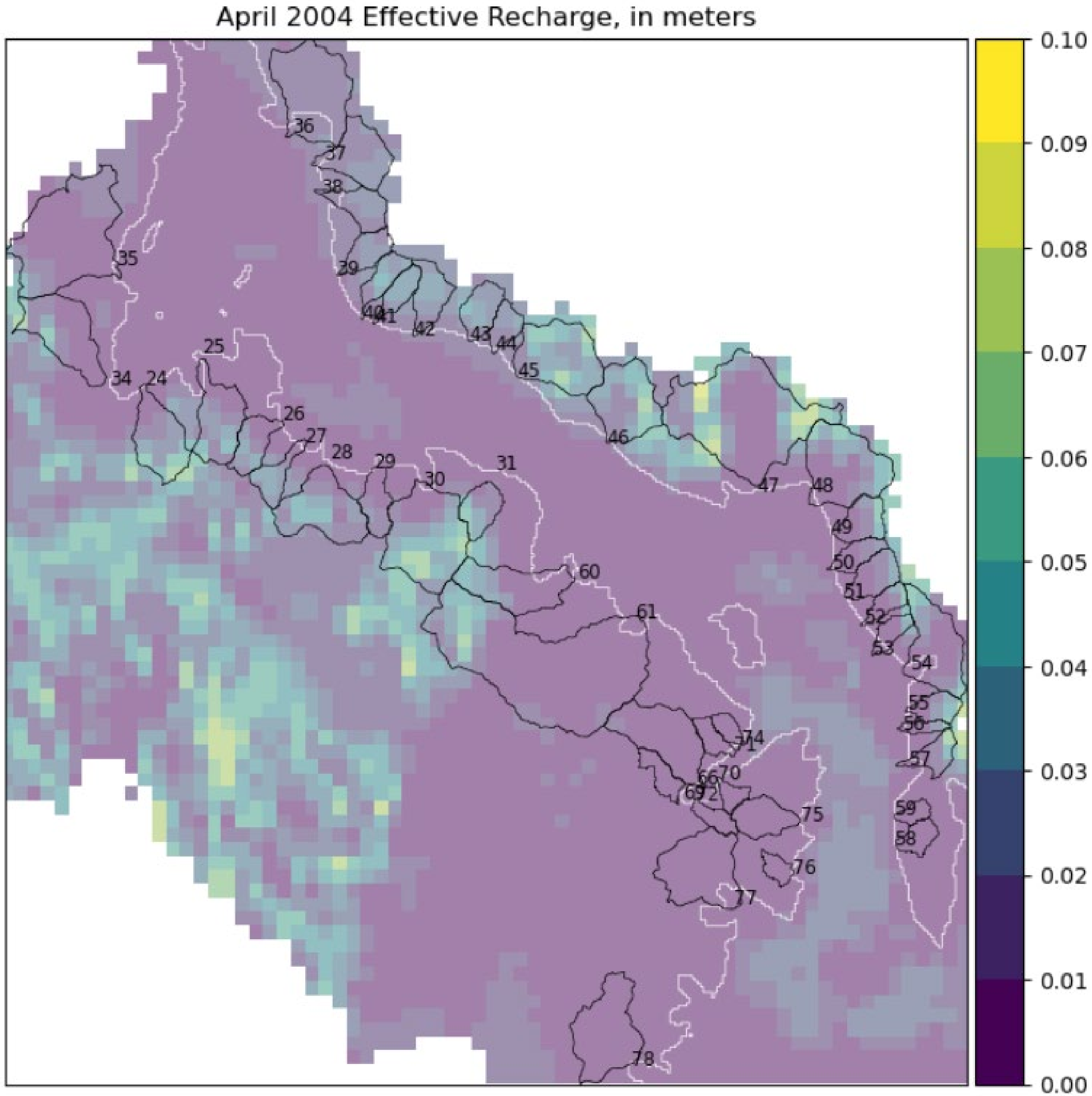
INL, ESPAM, and BLRM active model areas



The Transient Simple Model (TSM)

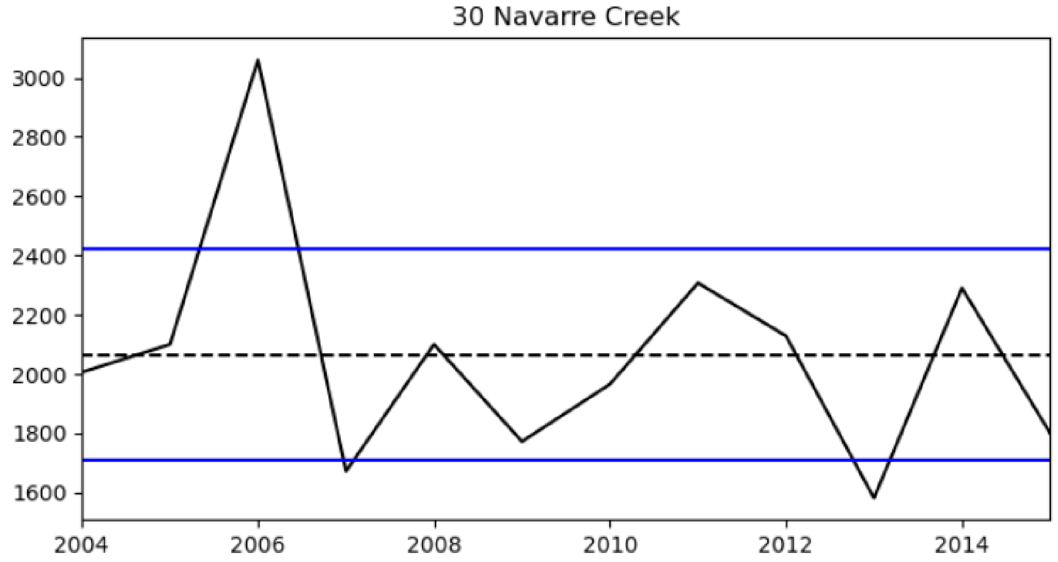
Feb. 2023 minimum viable product

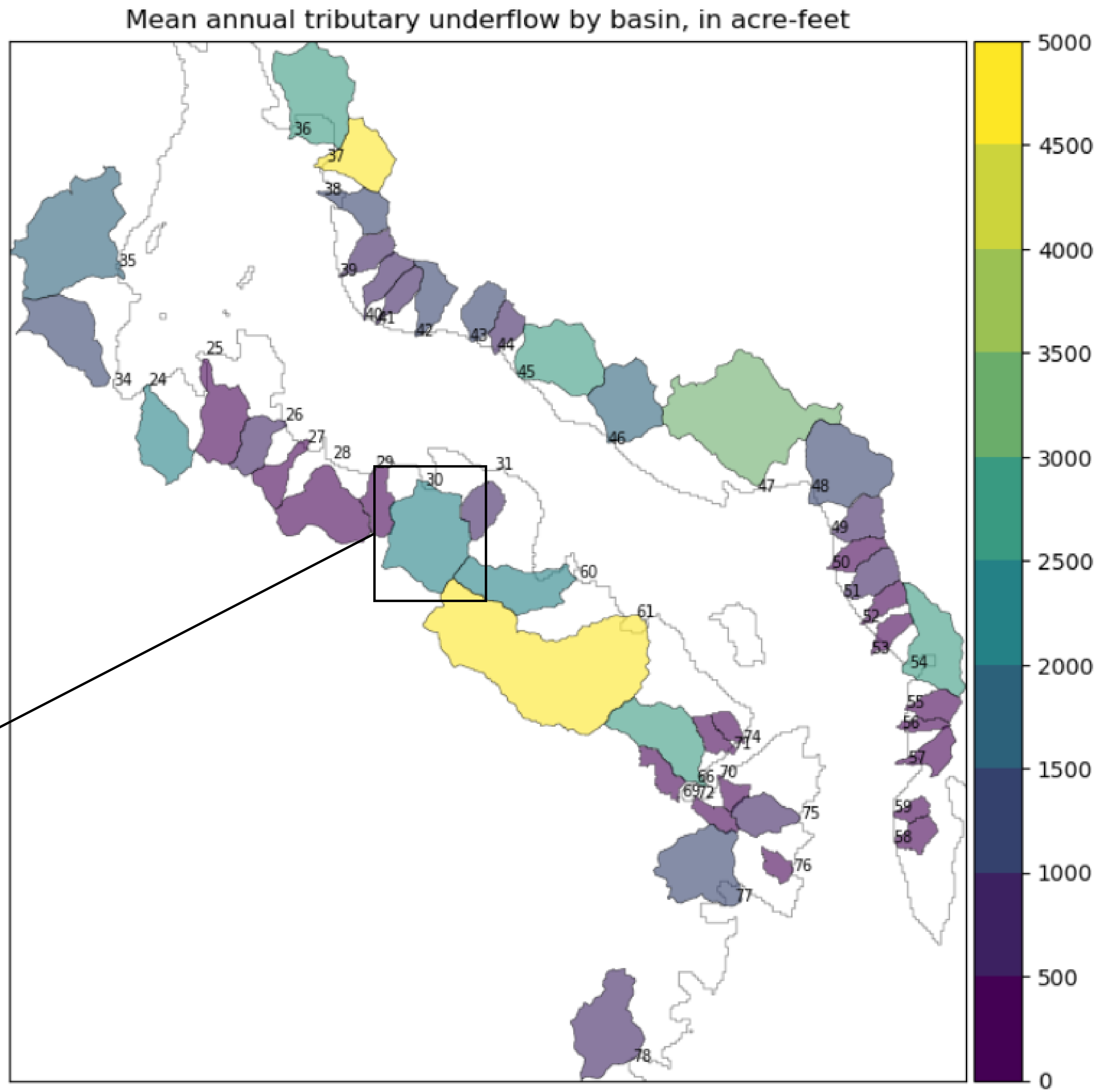
- Areal recharge from Reitz and Samford (2019):
  - 1km grid, <u>monthly</u> 10/2003 – 12/2015
  - Effective recharge calculated as water budget residual of precipitation, SWE, EVT, GW-irrigation, runoff
- Will eventually replace with field-scale estimates derived from METRIC ET data



The Transient Simple Model (TSM)
Feb. 2023 minimum viable product

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

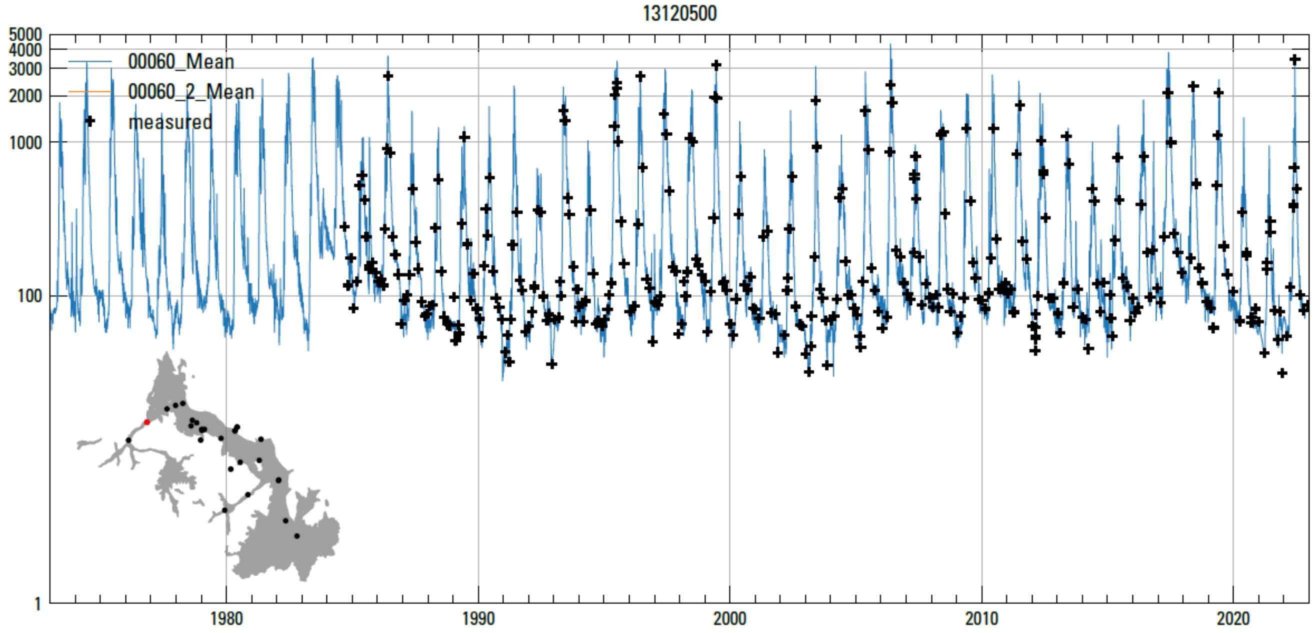


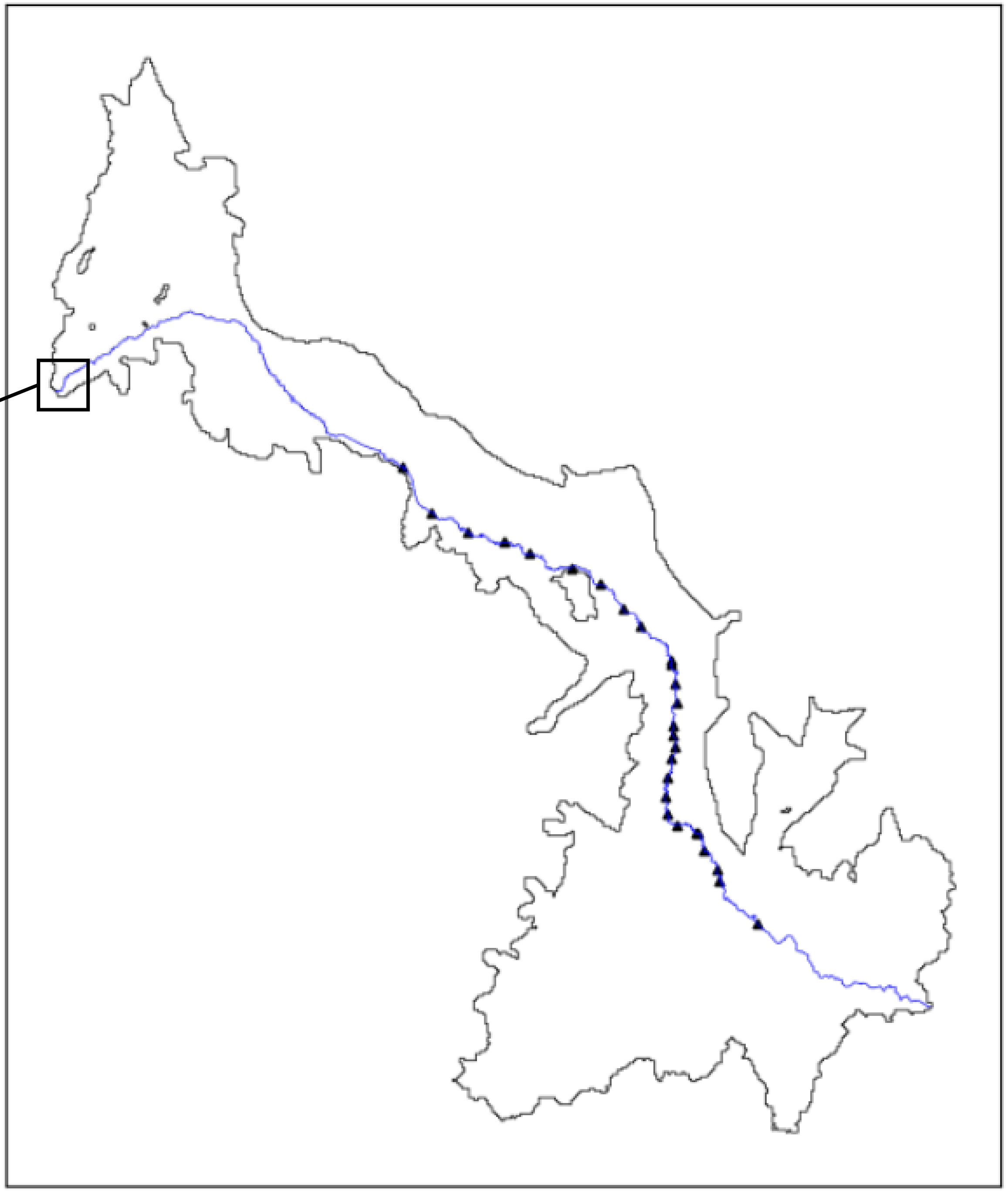


The Transient Simple Model (TSM)

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

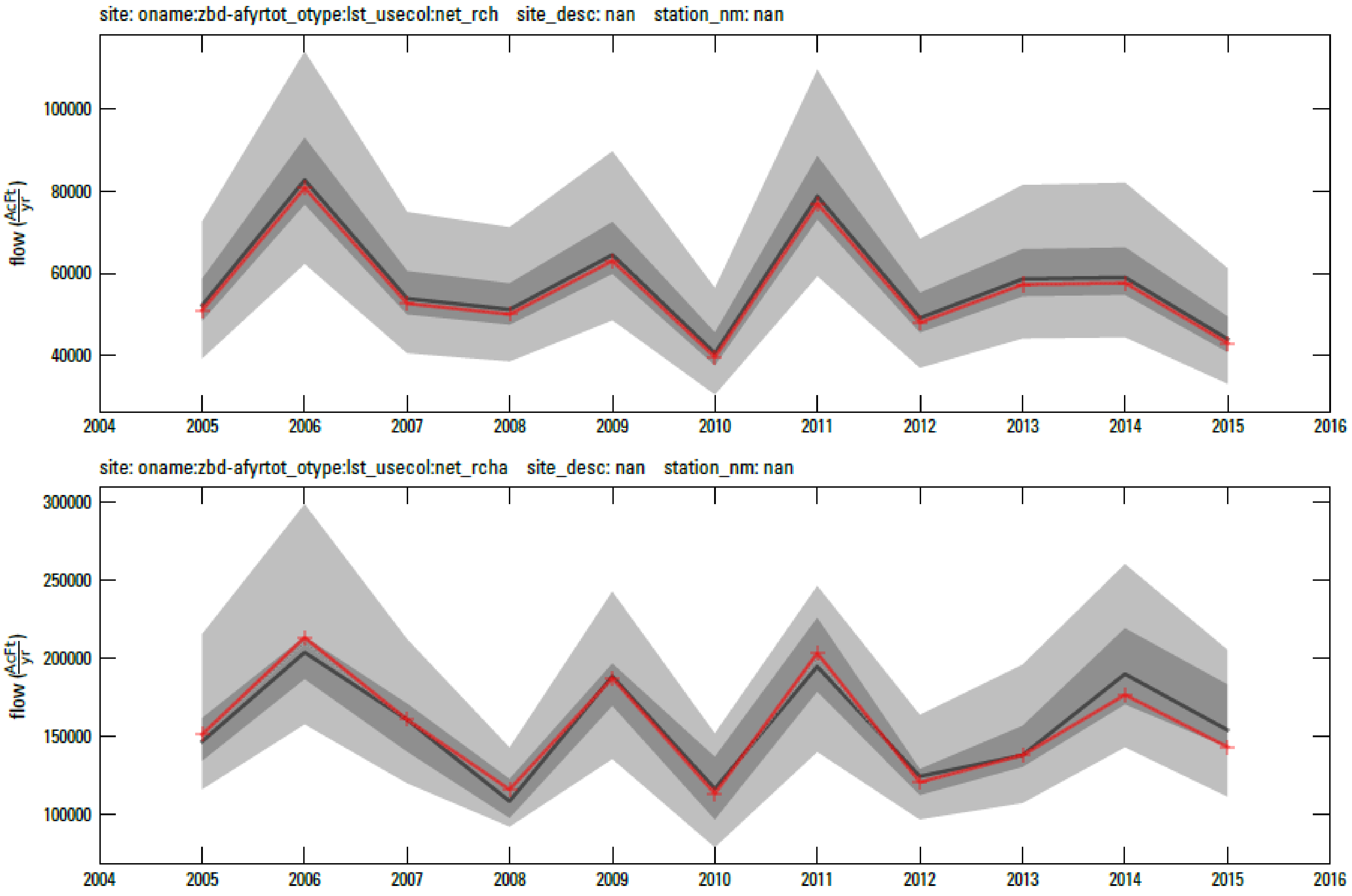




The Transient Simple Model (TSM)

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

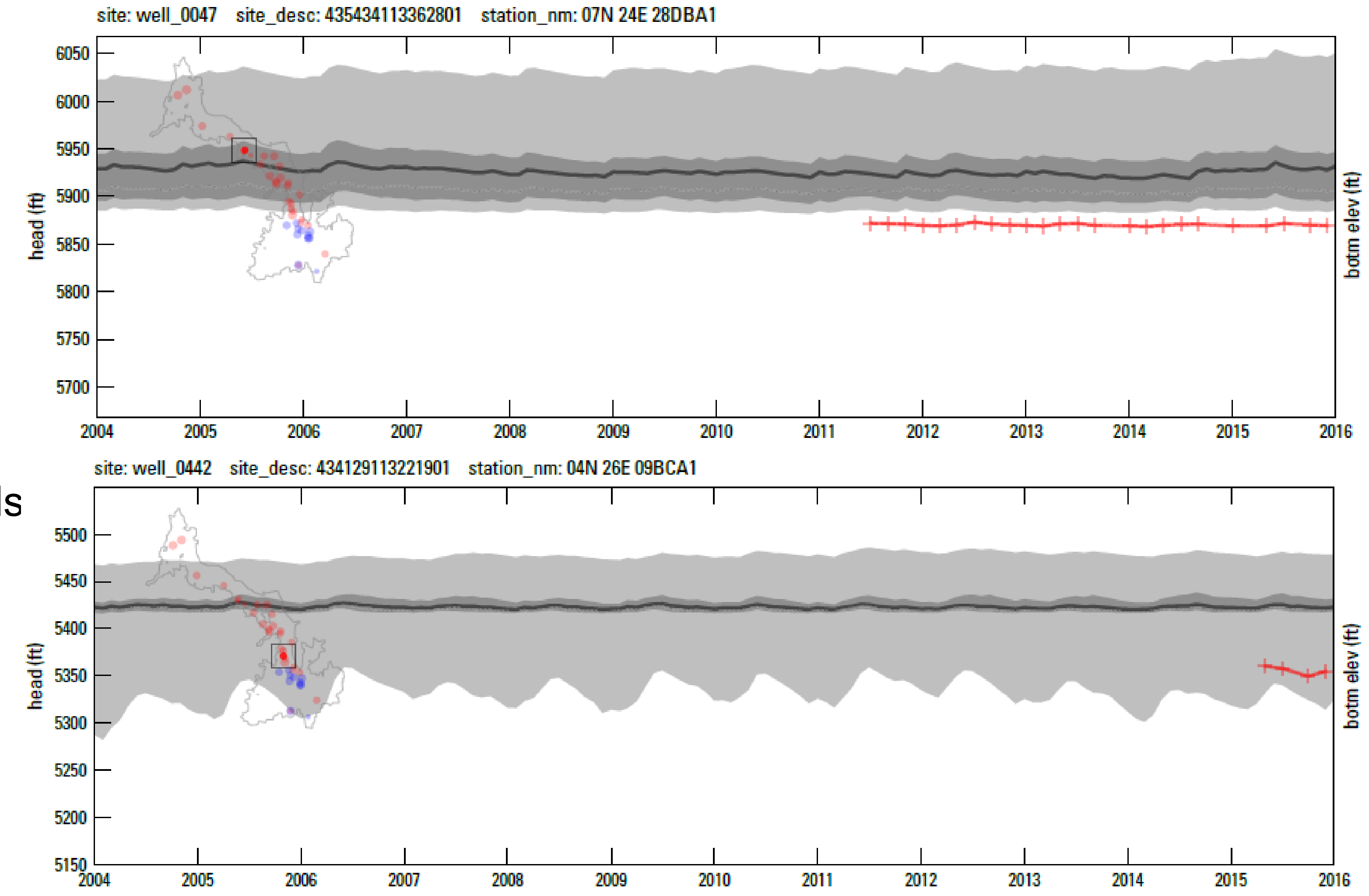


Red=TSM single model, Gray=TSM Prior MC (20 realizations)

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

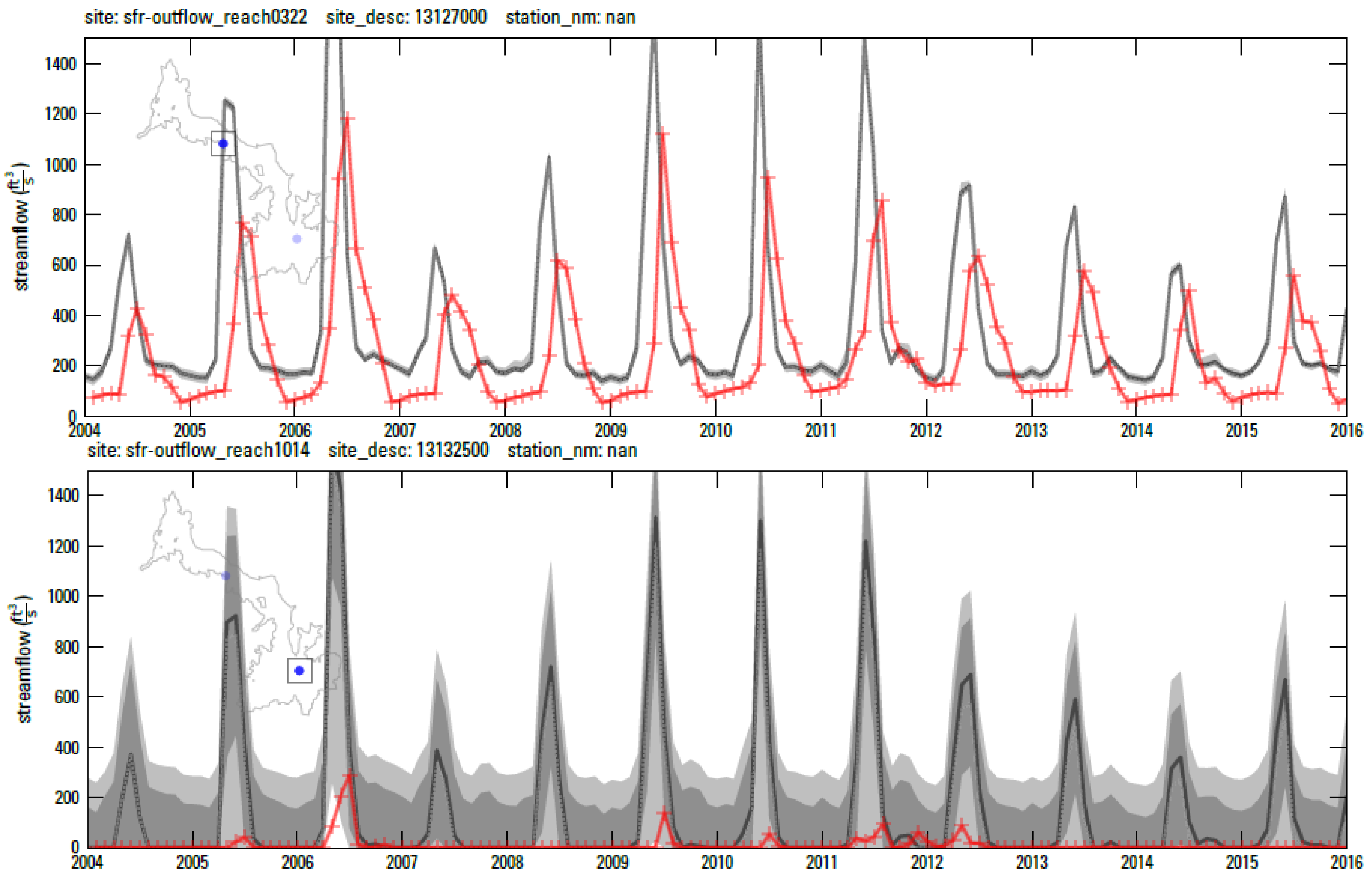


Red=TSM single model, Gray=TSM Prior MC (20 realizations)

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)