CALIFORNIA DEPARTMENT OF WATER RESOURCES

MSS Data Assimilation: an Introduction

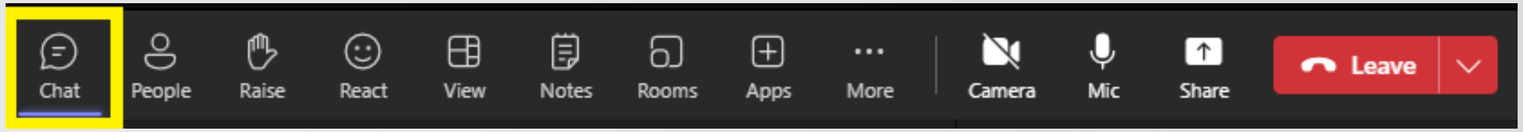
December 12, 2023

Meeting Logistics: In-Person

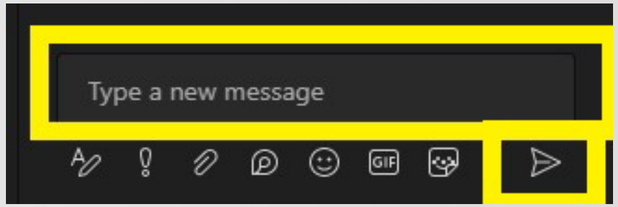
- Restrooms—Down the hallway. No access code needed.
- Emergency Exit—Down the same stairwell you came up.
- To also join Teams Meeting
  - Click meeting link to join

Virtual Logistics

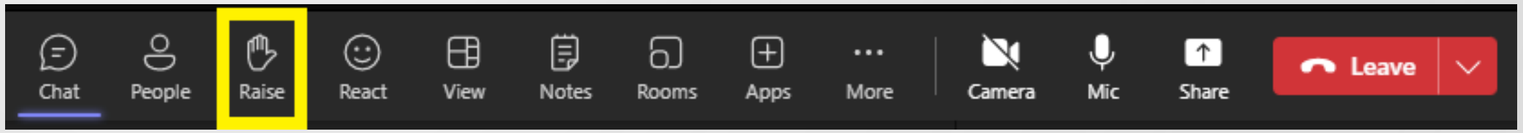
If you have a question or comment:



- Type it in the **Chat** box:
  - 1st, click "Chat" in the upper right of your screen
  - 2nd type in the chat box that opens on the right & hit "Send"



- OR, ‘Raise your hand’ to speak. Commenters will be called on in the order in which they ‘raise their hands’



- When called on to speak:
  1. Unmute
  2. State your name and affiliation, then your question/comment

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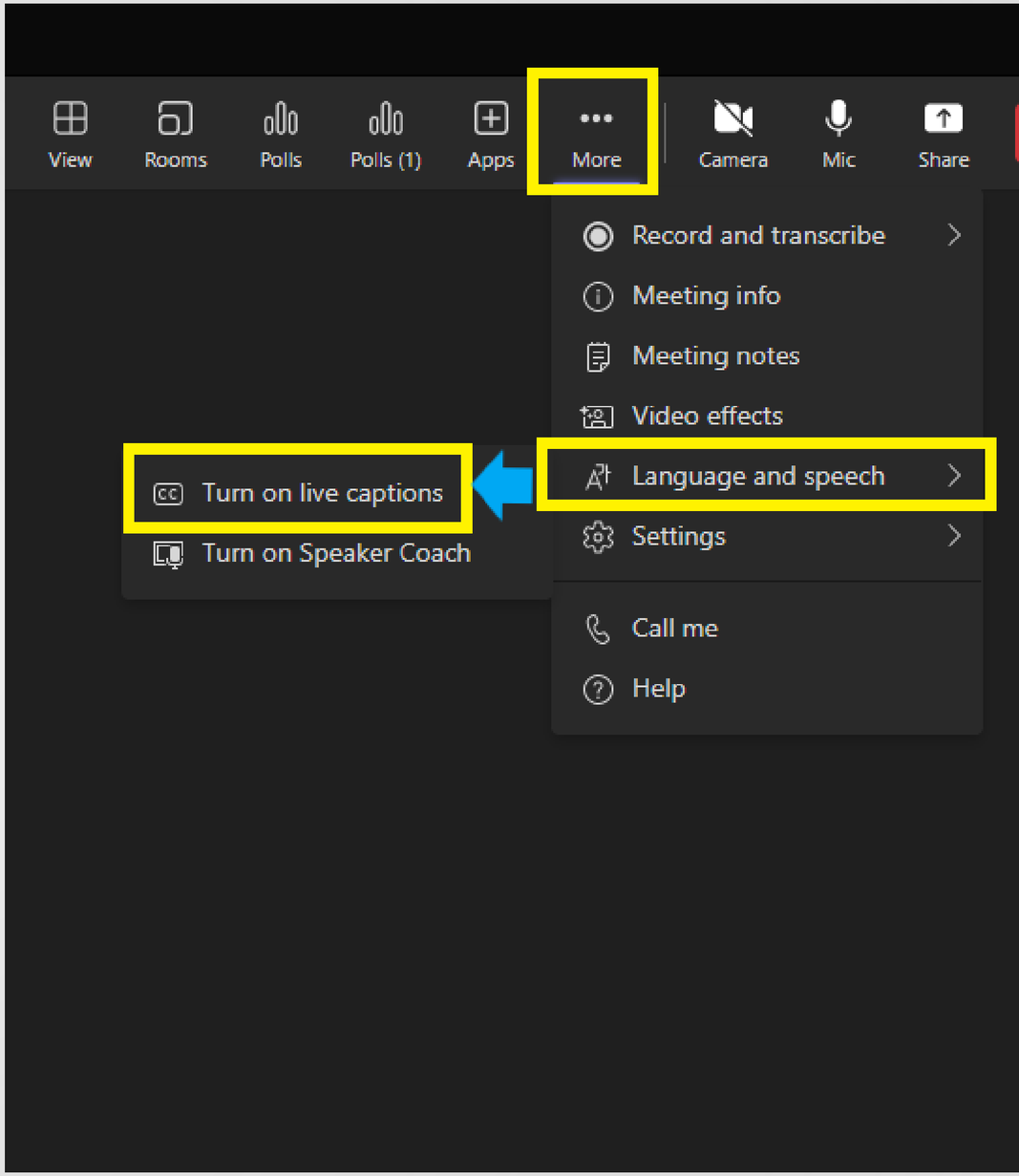
Virtual - Accessibility

This meeting is being transcribed in real time with closed captions

To turn on closed captioning:

- Click on “More”
- Then click on “Turn on live captions”



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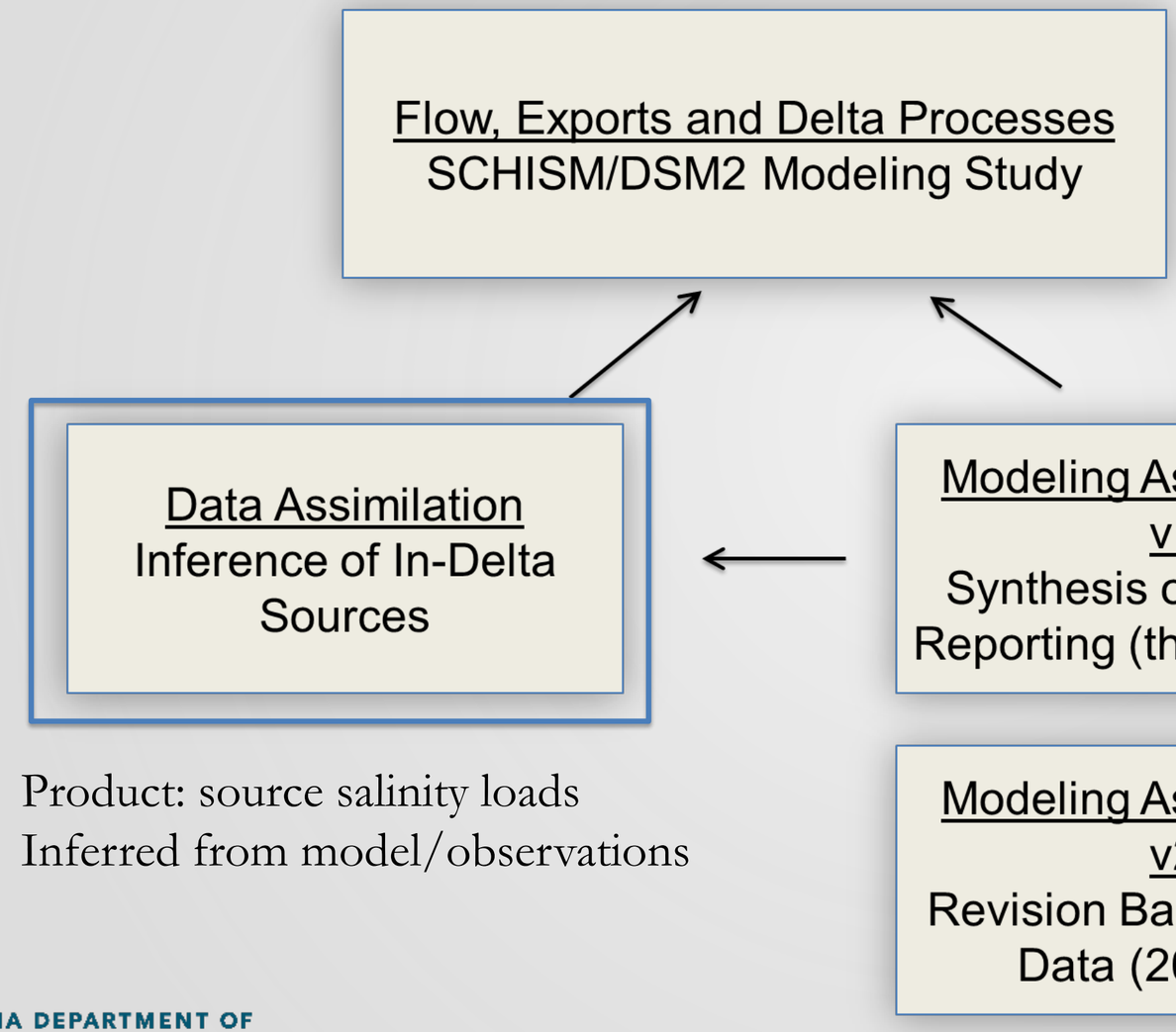
Agenda

Start time	Agenda Item
9:30 am	Welcome (5 minutes)
9:35 am	Logistics & Agenda (5 minutes)
9:40 am	Data Assimilation and Data Integration Workshop (90 min)
11:10 am	Discussion and Q&A (15 min)
11:25 am	Closing & next steps (5 minutes)

Ground Rules

- Everyone is encouraged to participate and with comments or questions
- This session is intended to be interactive
  - Raise your hand to speak (in-person or virtually)
  - When called to speak: 1. State your name and affiliation, 2. Your question/comment
- Facilitator will:
  - Manage meeting agenda and time clock
  - Track order of raised hands (in person and virtual)
  - Intervene when discussions become overly detailed, off topic, or repetitive

MSS Modeling Components



Main objective
Litmus test of fitness-for-purpose

Product: flow volume
Based on observations
Implemented as channel depletions

Product: source salinity loads
Inferred from model/observations

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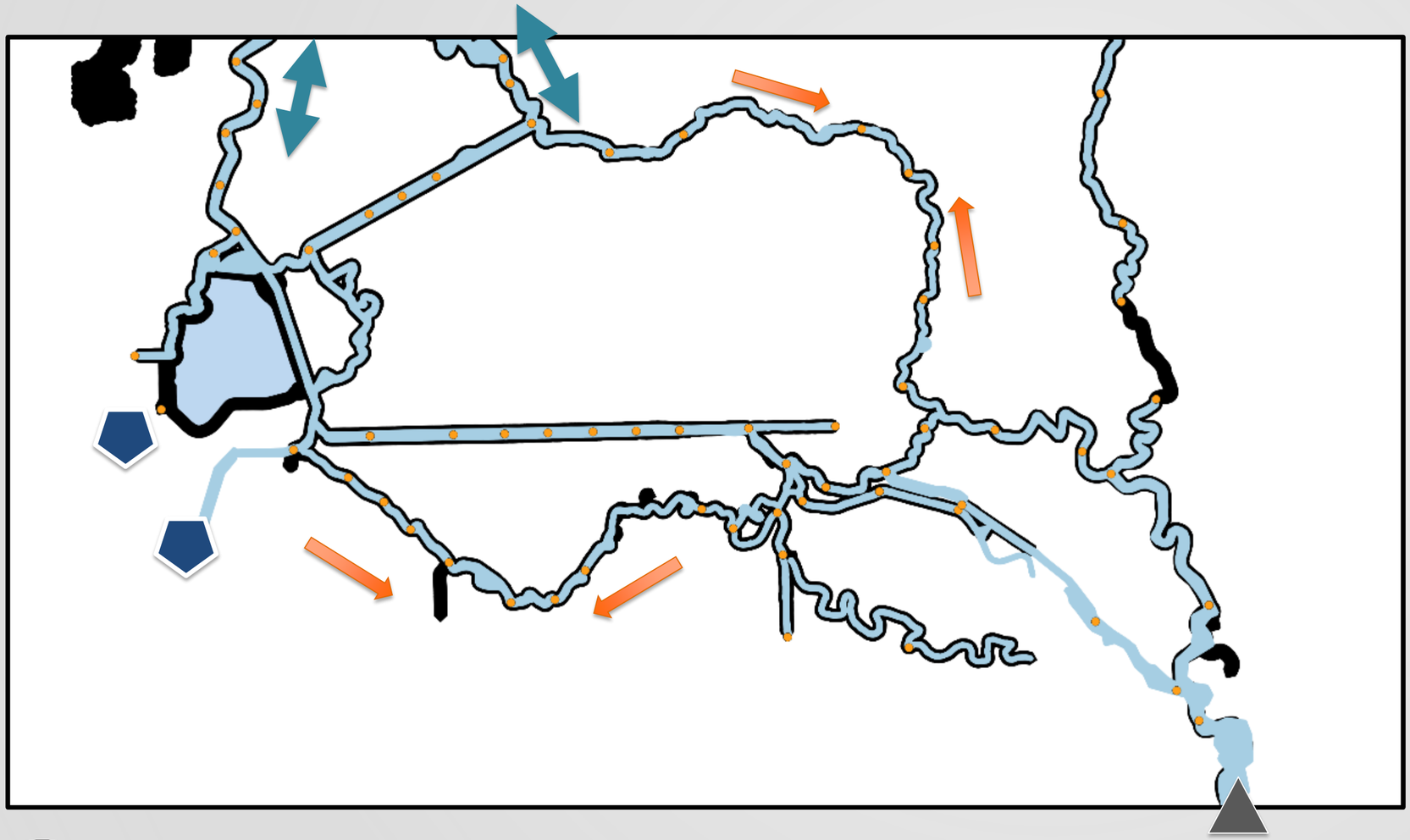
South Delta and Source Inference



San Joaquin inflow

Known/understood

Freshwater input

Exports

Tidal flow

Uncertain driver

In-Delta source/sink

Source-driven circulation (null zones)

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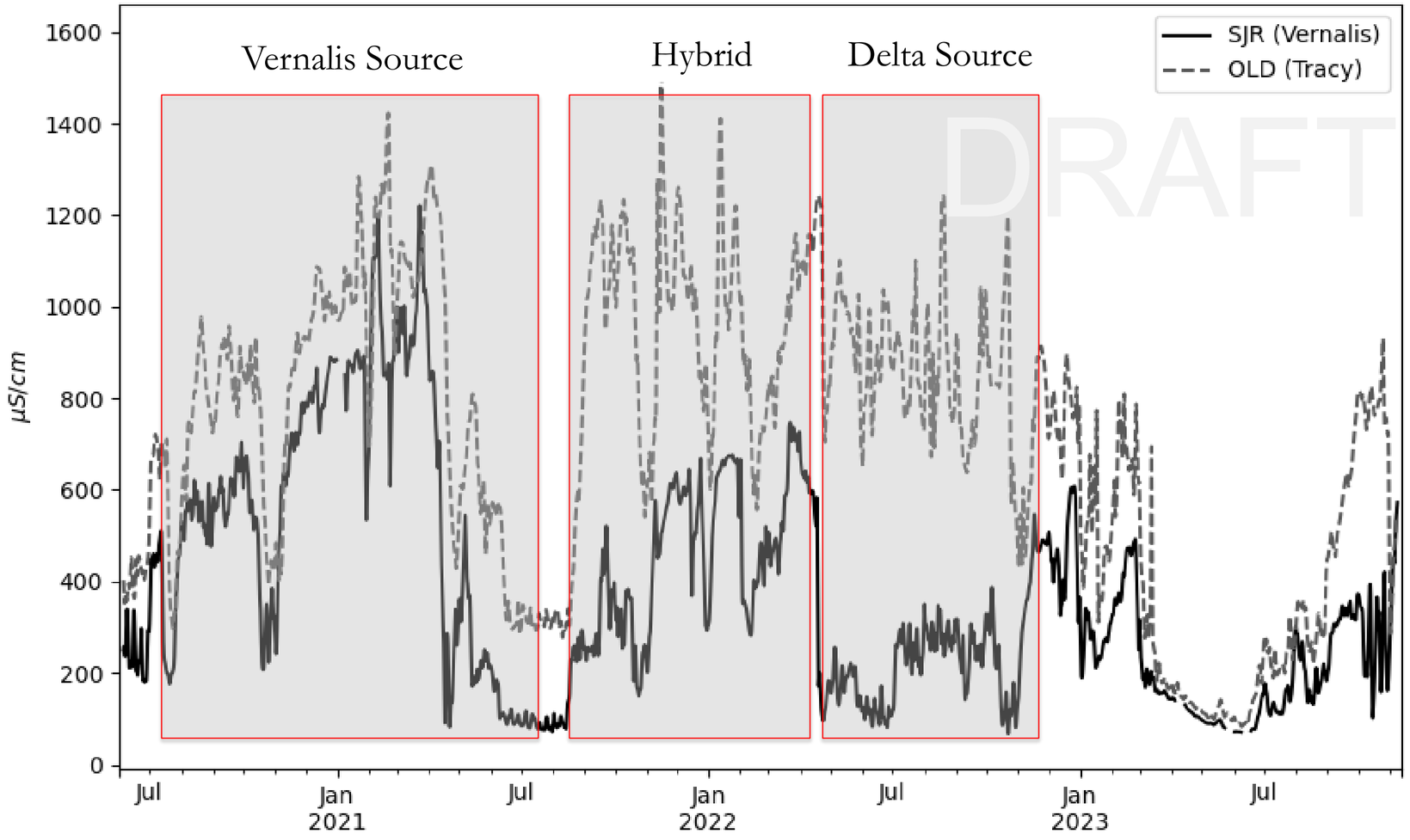

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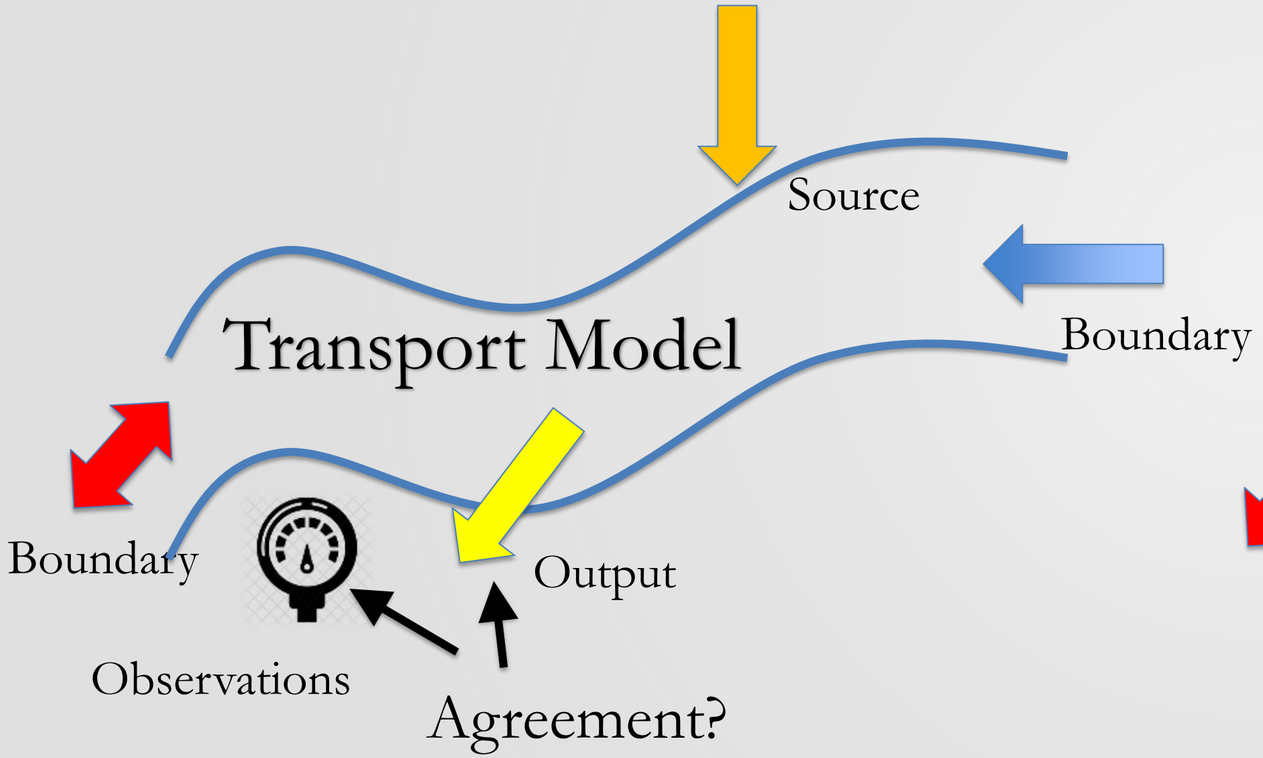
Inverse modeling is a formal approach for using observations of a physical system to better quantify the variables driving that system.

Data assimilation combines observations and models in a way that accounts for the uncertainties and gaps in each ….

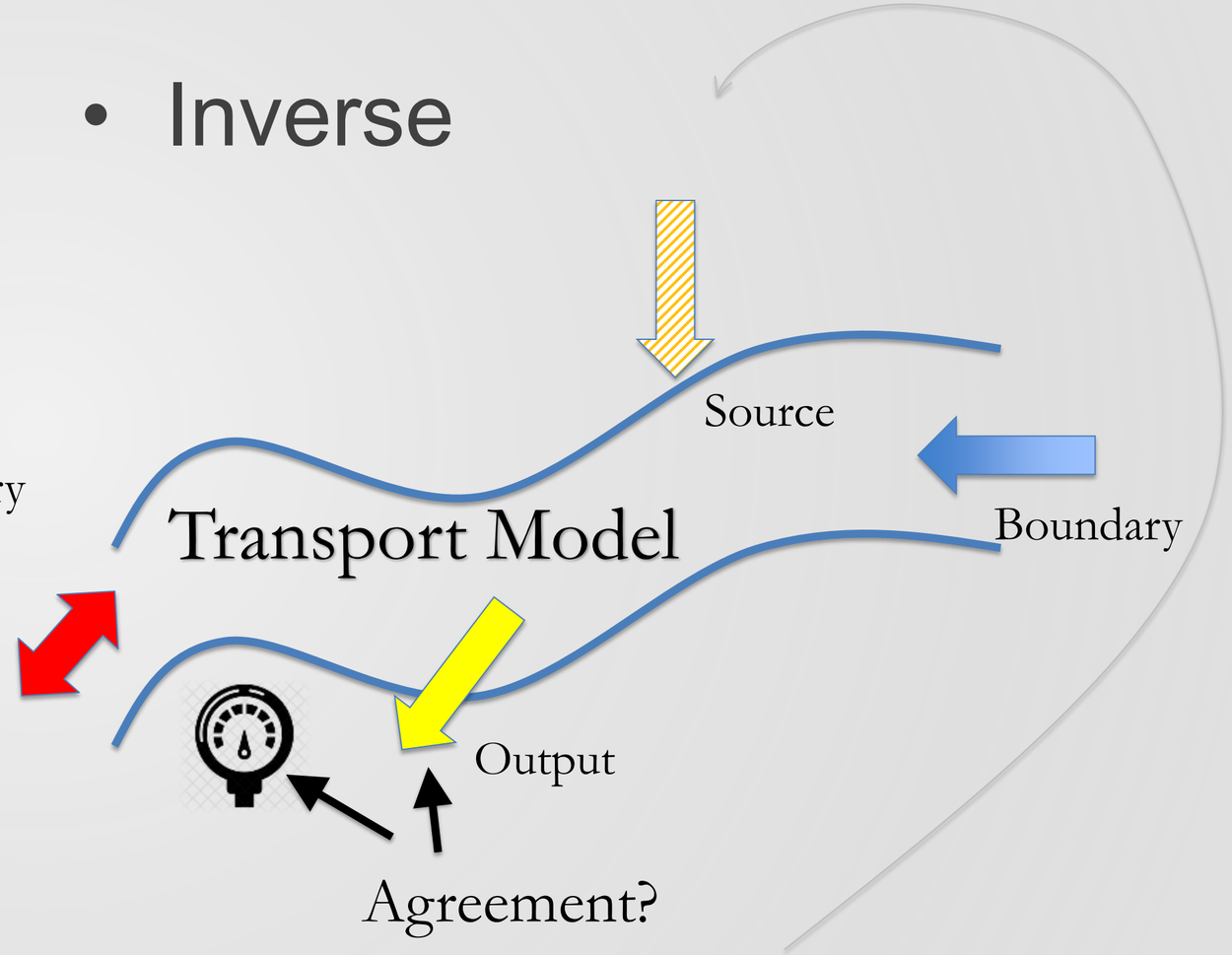
Model calibration can be defined as finding a “unique” set of model parameters that provide a good description of the system behavior

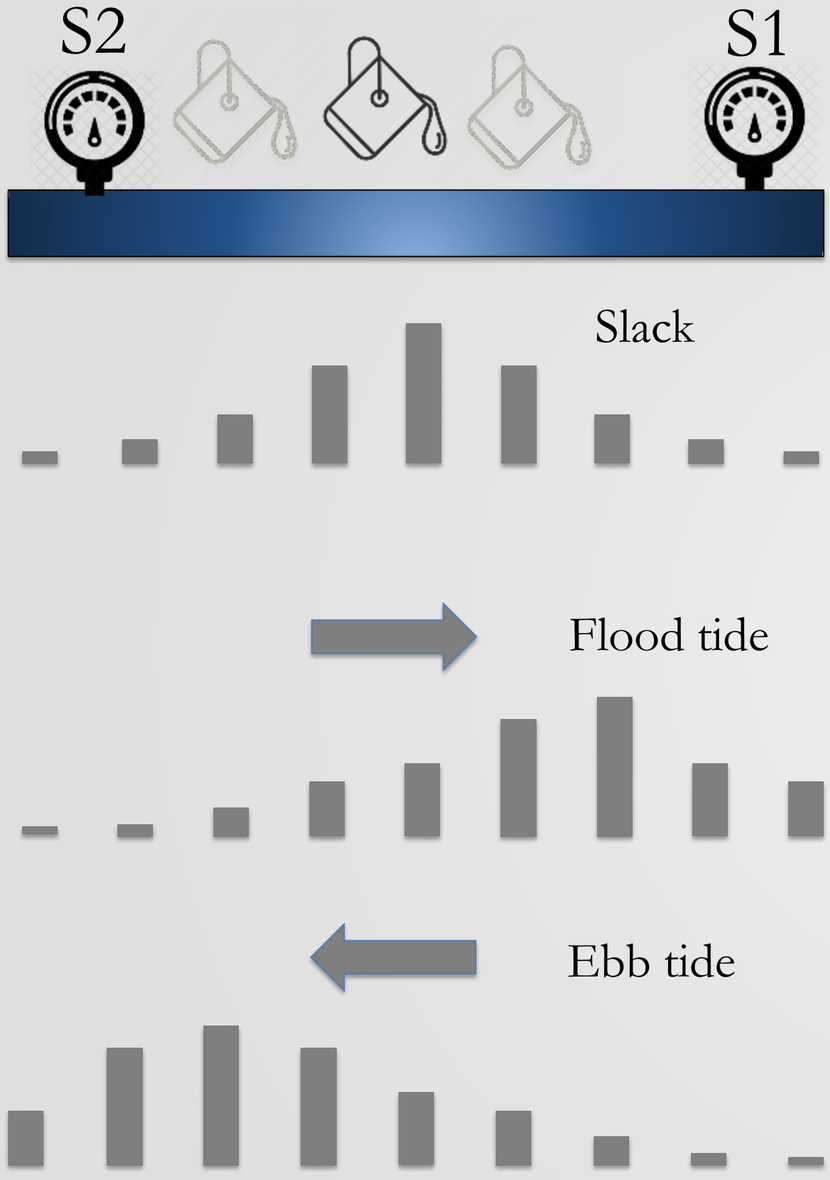
Forward Modeling vs Inverse Modeling

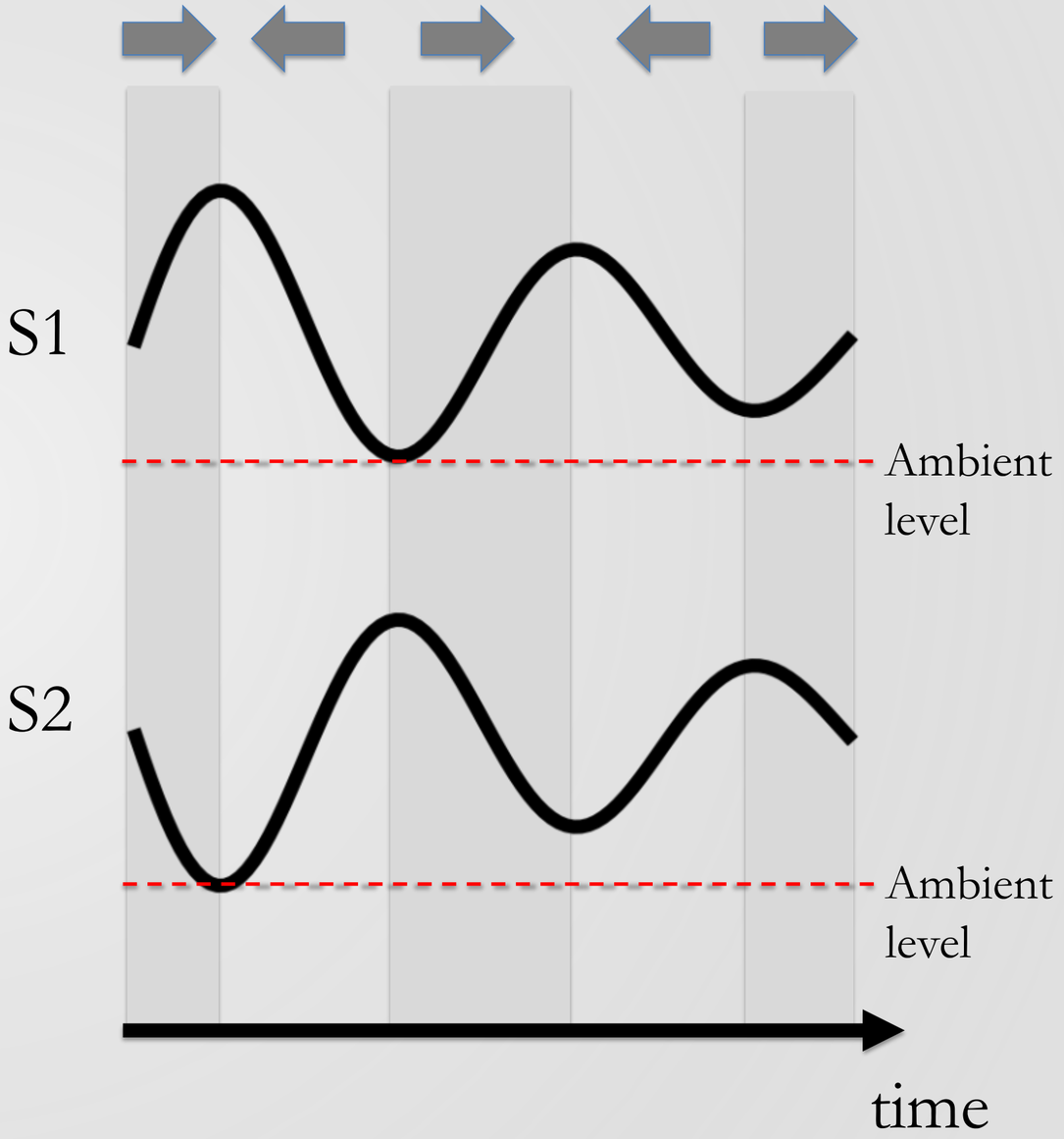
- Forward



- Inverse







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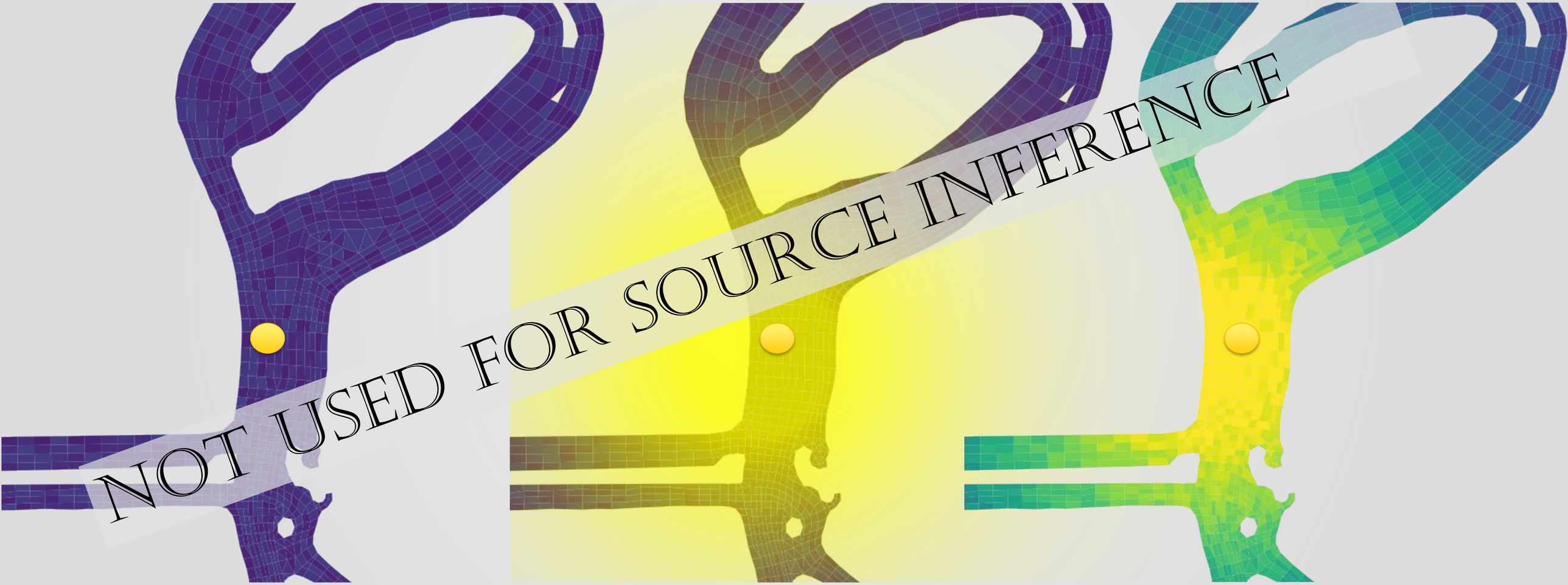
Flavors of Data Assimilation/Inverse

- Nudging
- Response/fingerprint based inverse modeling
- Kalman filters

Nudging (Newtonian Relaxation)



SCHISM

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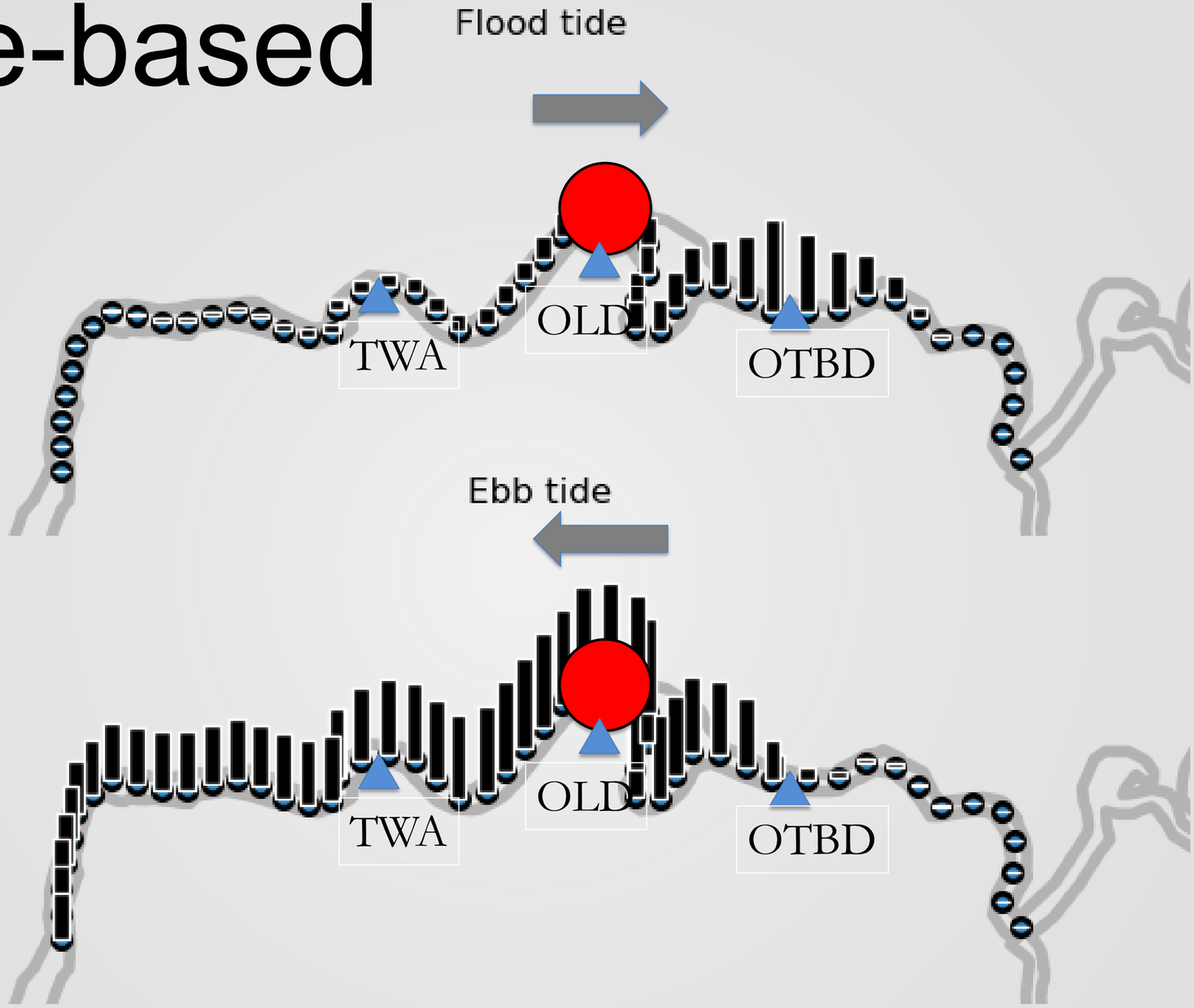
Response-based

- Source location
- EC Stations



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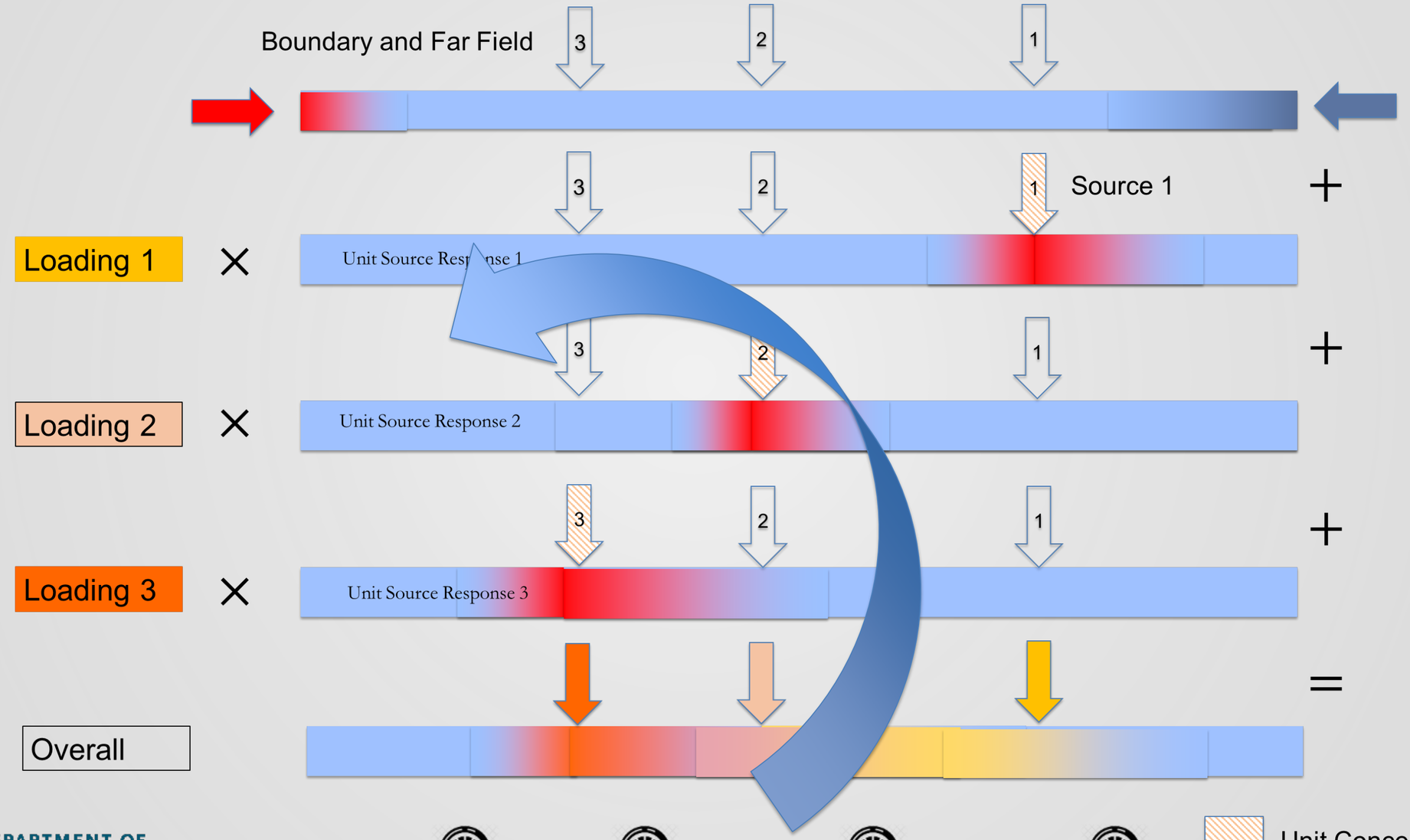
DSM2 Unit Source Concentration response
Source sustained 120 days, this is on Day 1

Superposition (fingerprinting)



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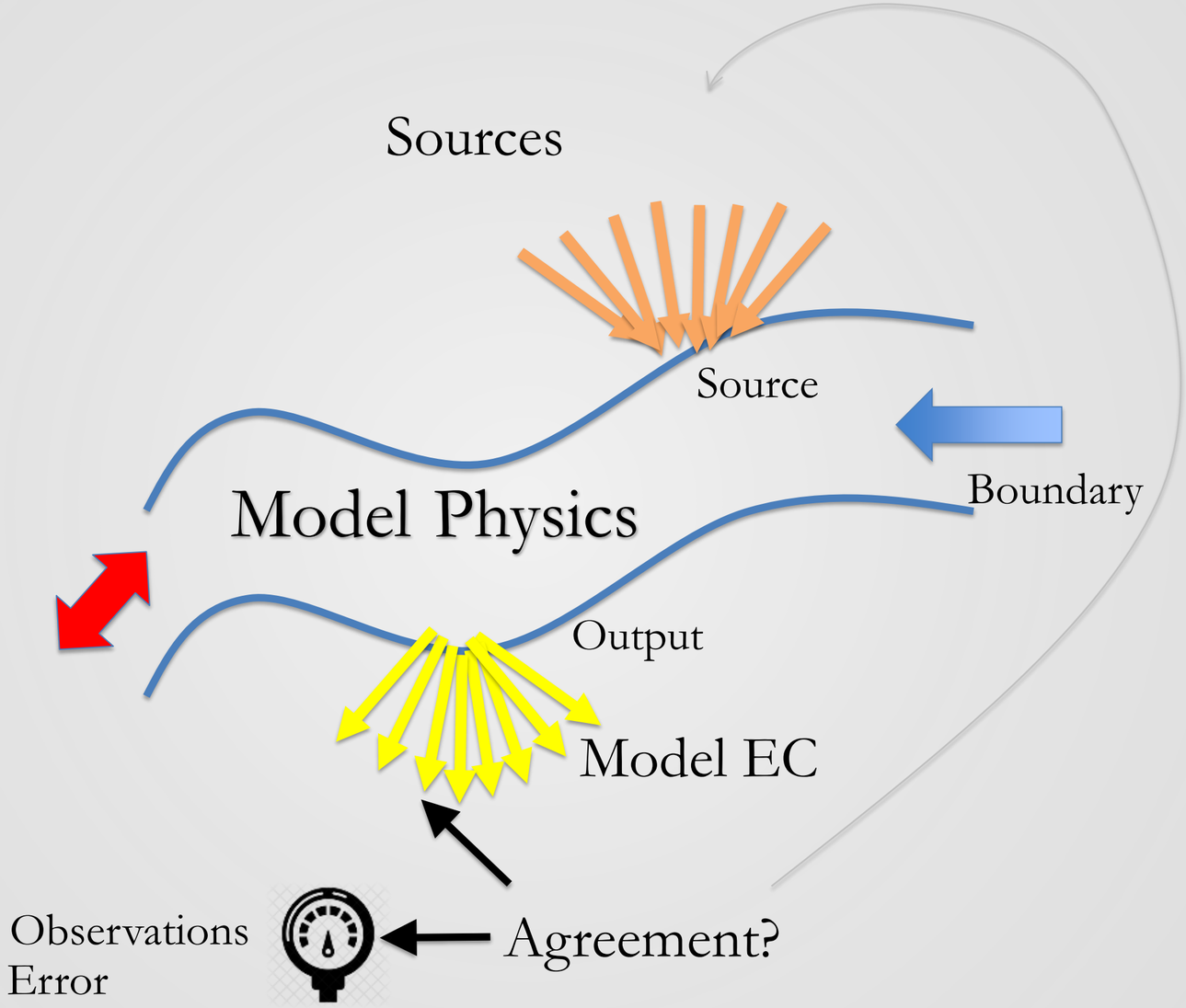
(Ensemble) Kalman Filter

Uncertainties:

- EC source
- Model
- Observations

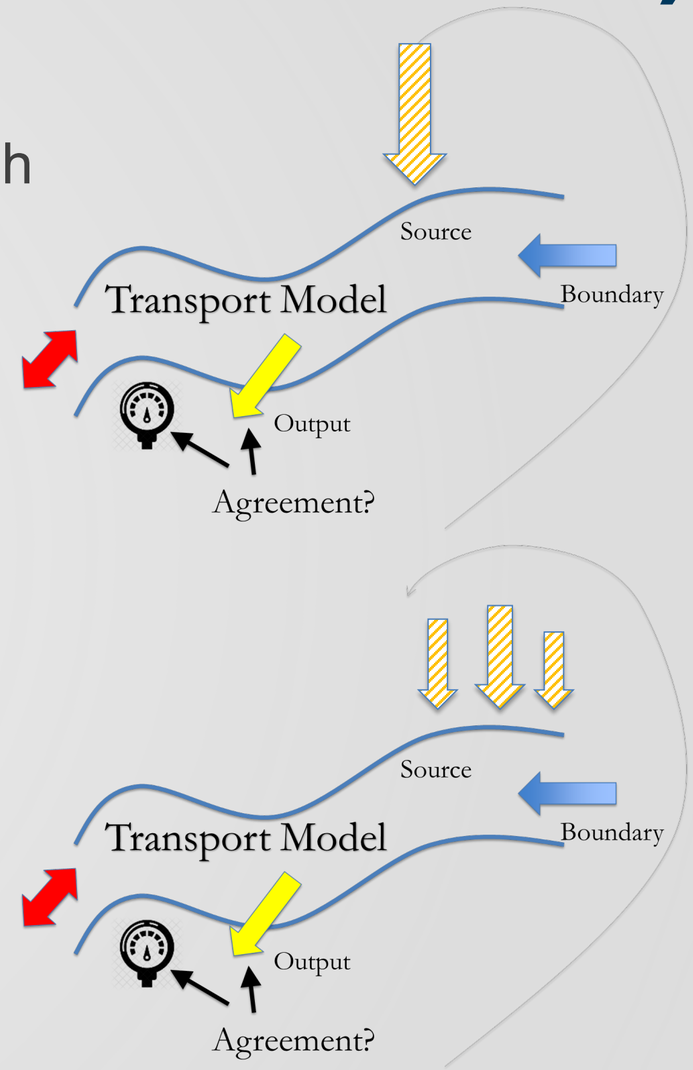


Ensemble Kalman Filter Traits

- Supports mild nonlinearity
  - Can include flow uncertainty
- On-line
  - Good for real time applications or estimating “this year”
  - Key question is “how will we use it for planning”
- Assume known candidate source locations

Concerns/limitations(Our Starter List)

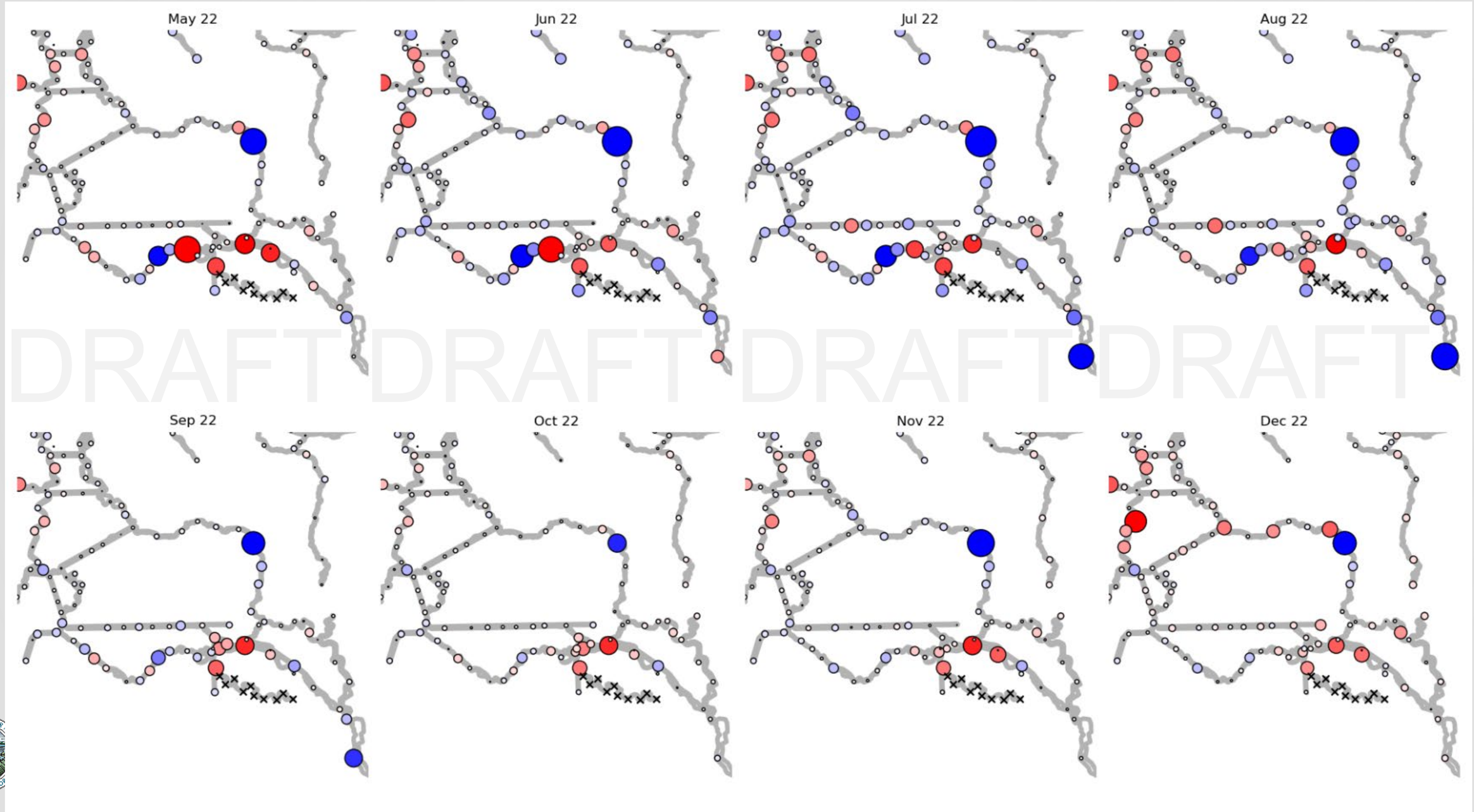
- Validation
  - EC time series used in the assimilation process not enough
    - Reserved stations
    - Spatial transects
  - Inferences should benefit both DSM2 and SCHISM
- Expected technical problems requiring checks:
  - Lack of uniqueness (regularized problem is stable)
  - Precision:
    - Reach level only
    - No differentiation of origin (groundwater, drain)
  - Behavior under misspecification of flow (indicators)
- Non-technical such as liability



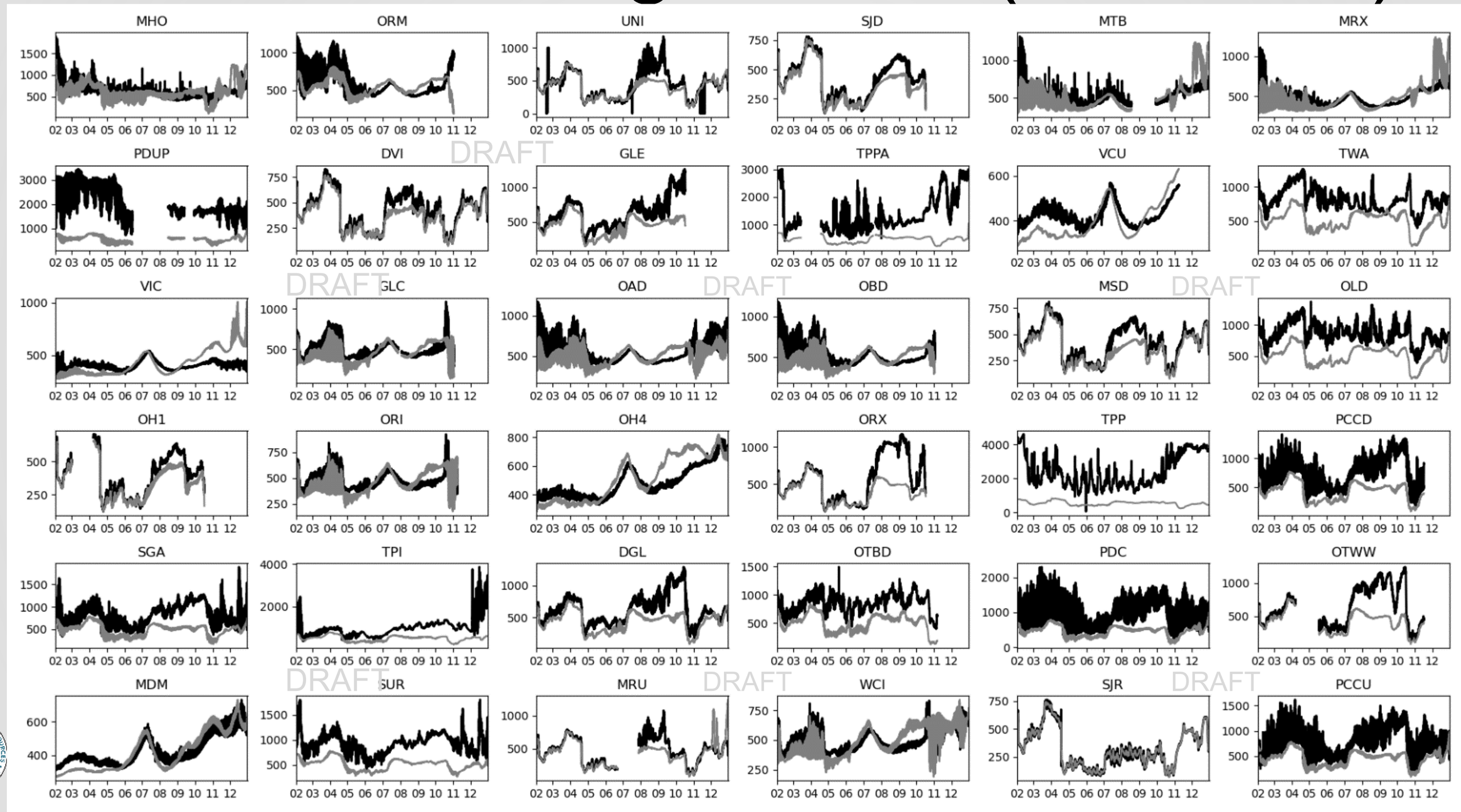
Example Application and Results

- Response/fingerprint method
- Every DSM2 node in South Delta a candidate
- Few sources (exact # not specified)
- Source EC piecewise linear, weekly increments.

Salt load map

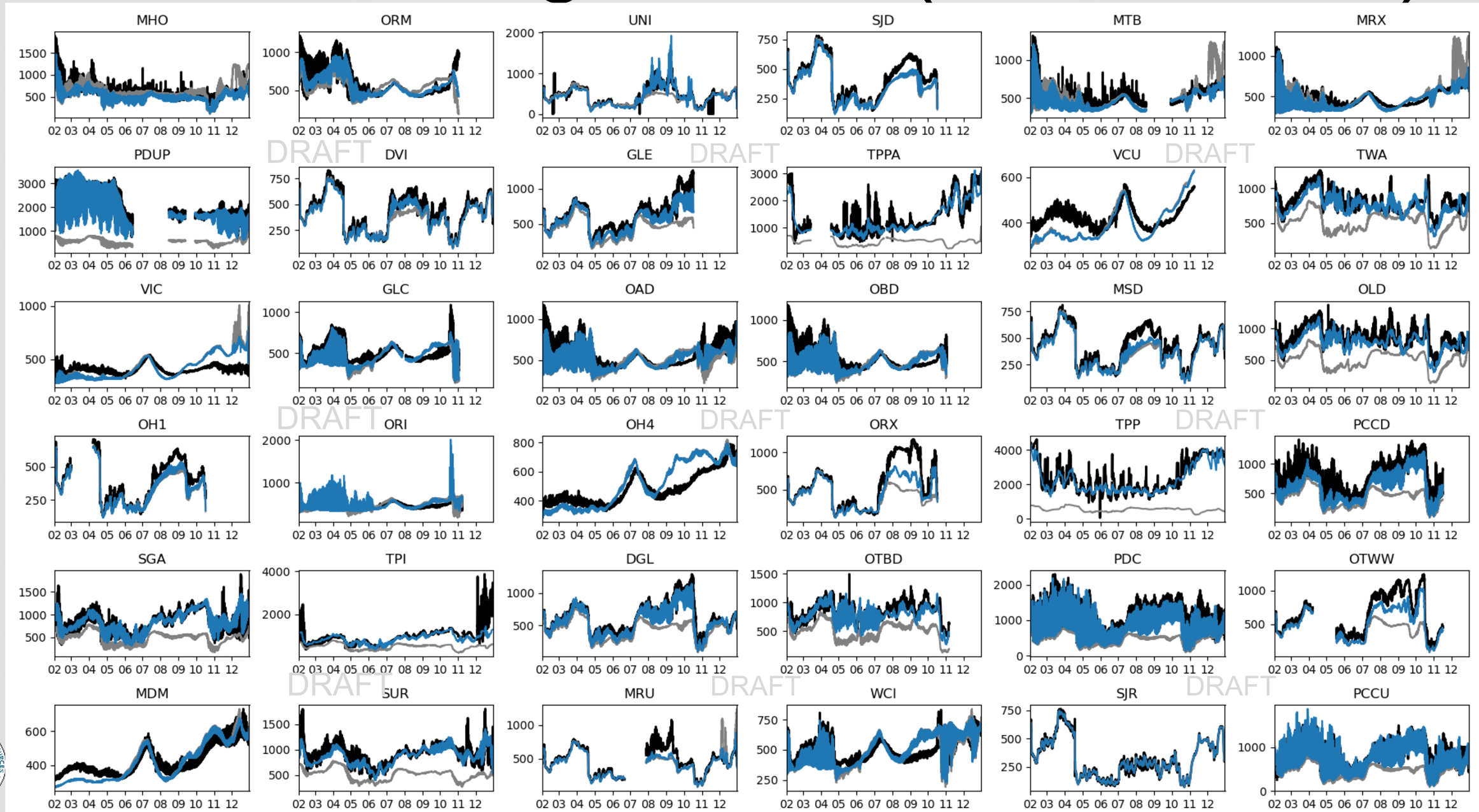


DSM2 modeling results (base run)

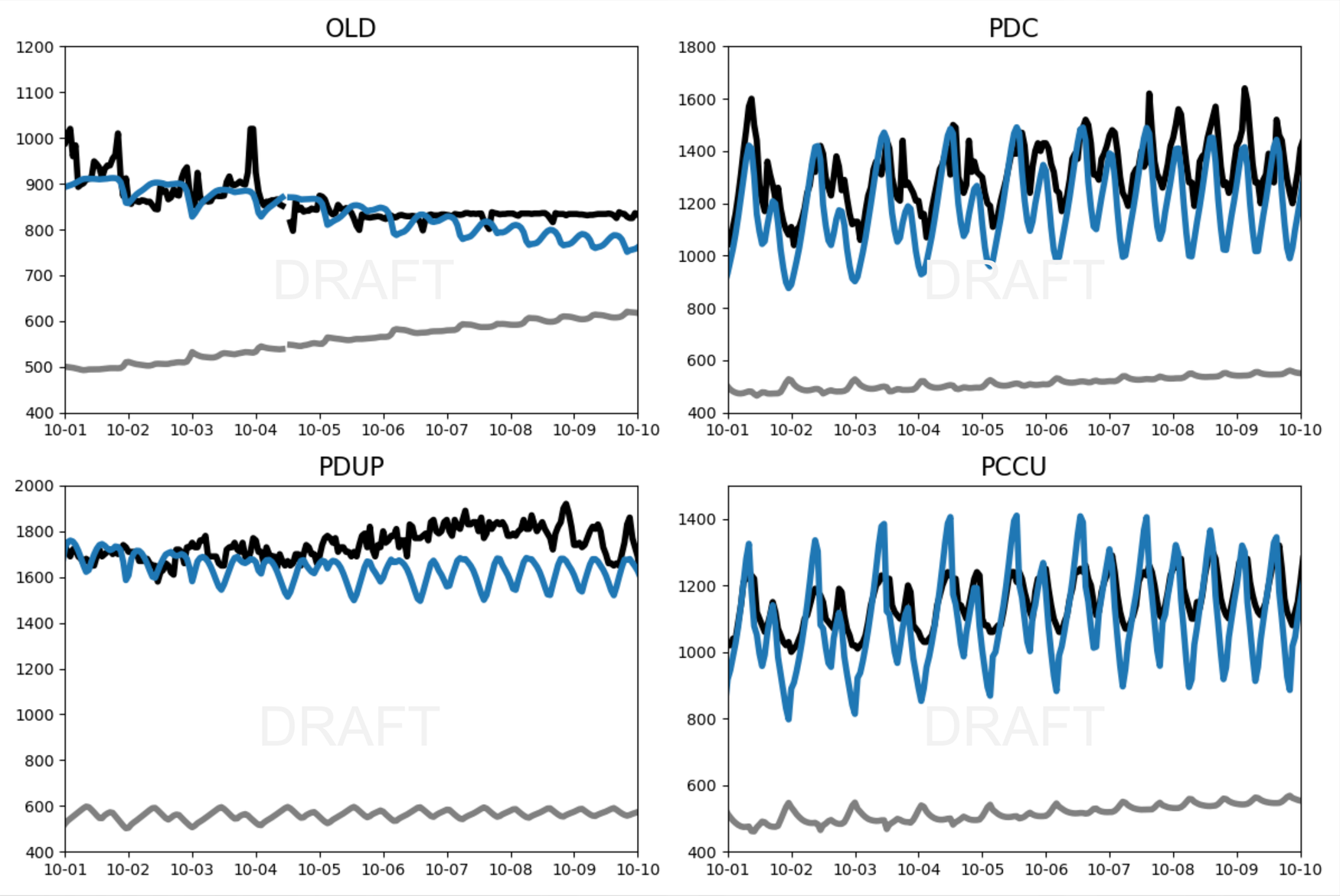


DSM2 modeling results (with source)

EC (µS/cm)



EC (µS/cm)



Observed EC

Modeled EC (base)

Modeled EC (with source)

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Discussion

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- Zhenlin.Zhang@water.ca.gov
- Eli.Ateljevich@water.ca.gov

Closing & Next Steps

- Most field data collection ending at the end of 2023 and transitioning into analysis and preparation of MSS Report.
- The draft MSS report will be shared with the Technical Workgroup for review in summer 2024.
- New MSS Web Page: https://water.ca.gov/Programs/State-Water-Project/Operations-and-Maintenance/Monitoring-Special-Study

THANK YOU!!

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Contacts

Bill McLaughlin, PE
Department of Water Resources
Division of Operations and Maintenance
Water Initiatives Planning and Management Branch
William.McLaughlin@water.ca.gov
Phone: (916) 873-5748

Teresa Trinh, PE
Department of Water Resources
Division of Operations and Maintenance
Water Initiatives Planning and Management Branch
Teresa.Trinh@water.ca.gov
Phone: (916) 902-9898

Grace Windler, PhD
U.S. Bureau of Reclamation
Regional Water Quality Coordinator
Interior Region 10 - California-Great Basin
Gwindler@usbr.gov
Phone: (916) 978-5088

Erika Britney, PMP
ICF
Erika.Britney@icf.com
Phone: (206) 801-2802

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