CALIFORNIA DEPARTMENT OF WATER RESOURCES

SCHISM (and DSM2) System Modeling for Monitoring Special Studies

Jan 2022

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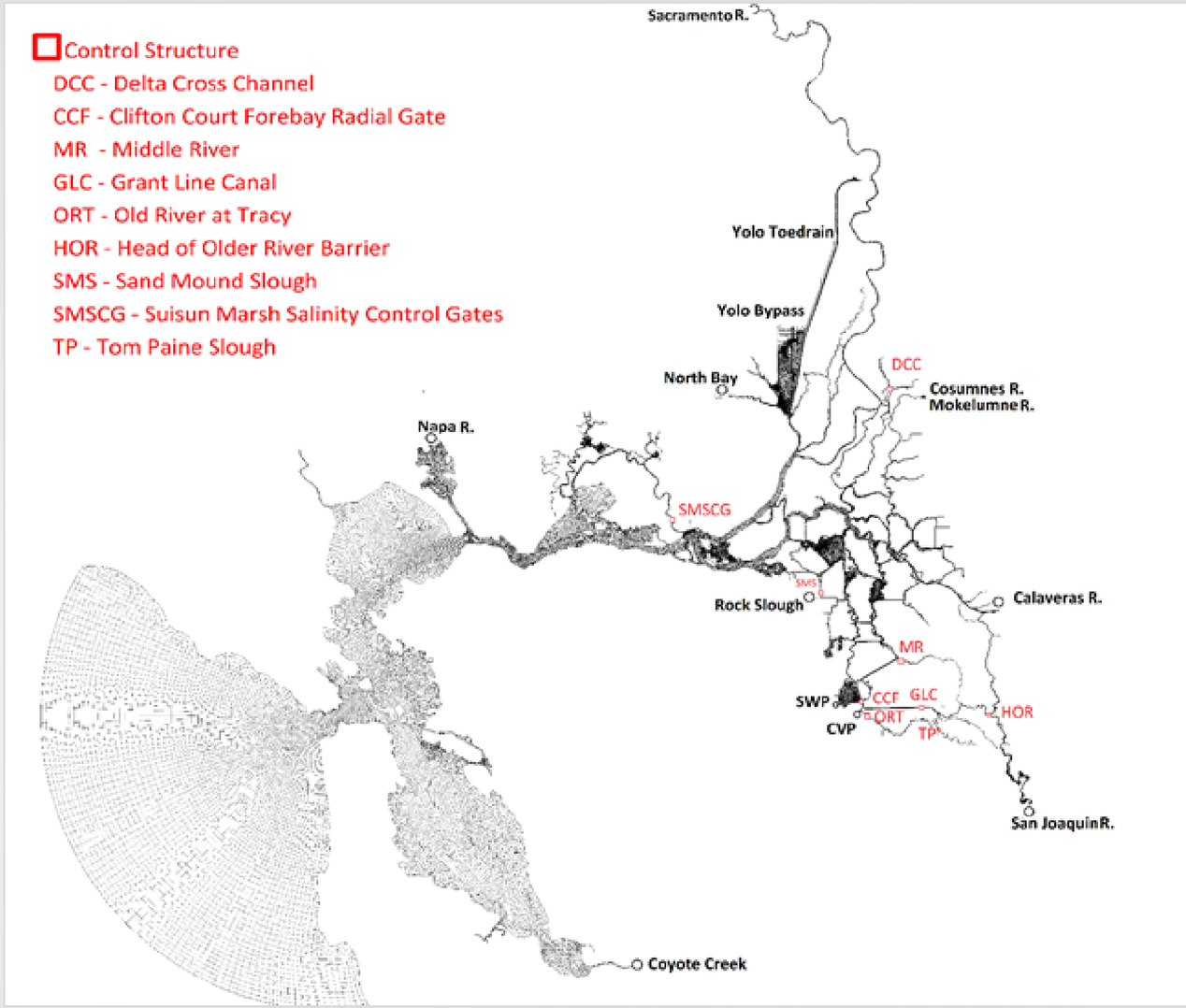
Outline

- Intro to modeling, SCHISM and DSM2
- Ongoing refinements
- Applications
  - Study SJR-South Delta-Export system
  - Synthesize observations from MSS
  - Virtually try reach-based monitoring ideas
  - Operational modeling

Bay-Delta SCHISM

- SCHISM model
- Farallon to Vernalis/Knights Landing Domain
  - 300K+ elements
  - 23 vertical max
- Major flows, exports, structures, channel depletions
- Approximate run speed:

  ½ year per day on cluster



Ateljevich E, Nam K, Zhang Y, Wang R, Shu Q. 2014. “Bay Delta Calibration Overview.” In:*Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 35th Annual Progress Report*. Sacramento (CA): California Department of Water Resources.

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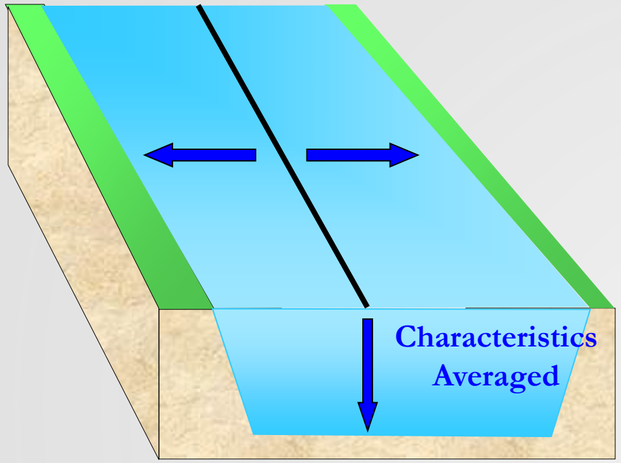
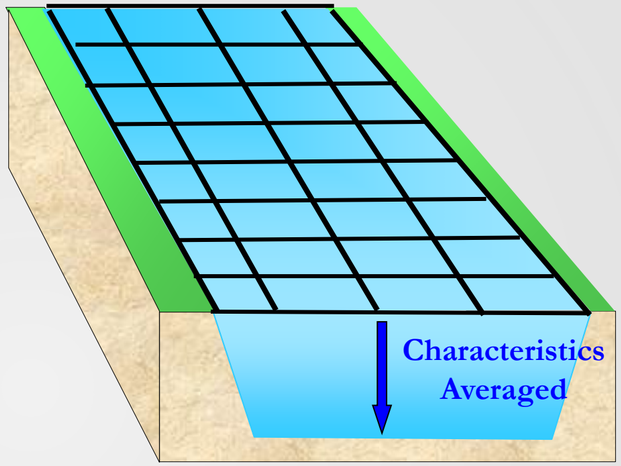
Model Dimensionality

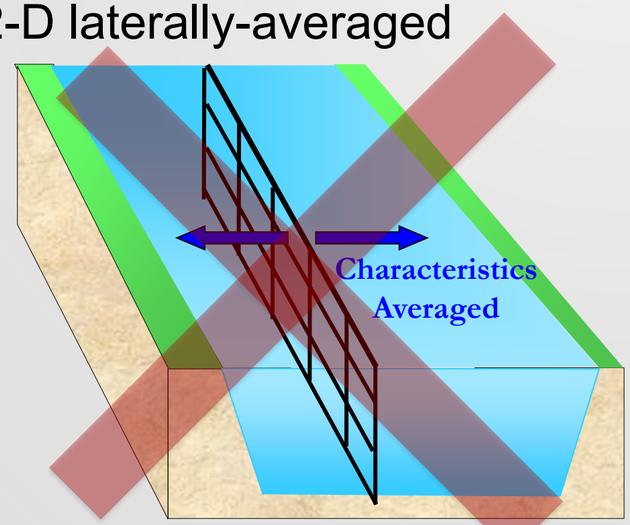
a) 1-D



b) 2-D depth-averaged

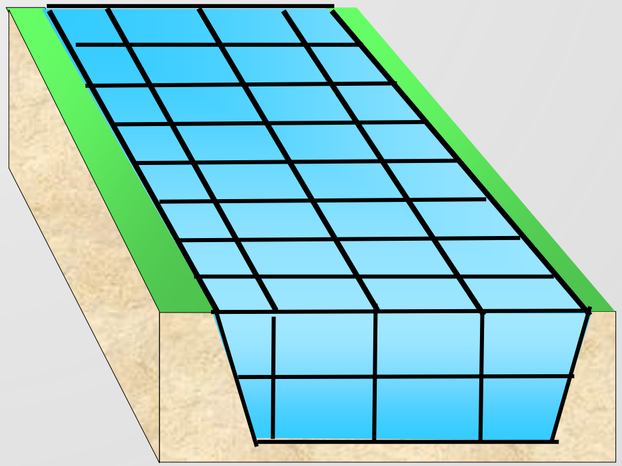


c) 2-D laterally-averaged



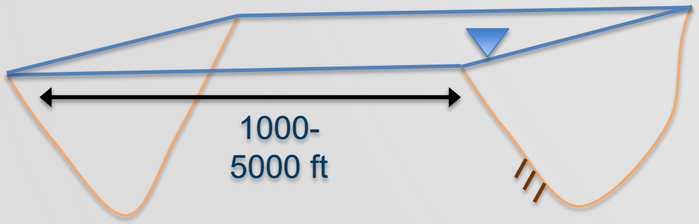
(Uncommon at full field scale)

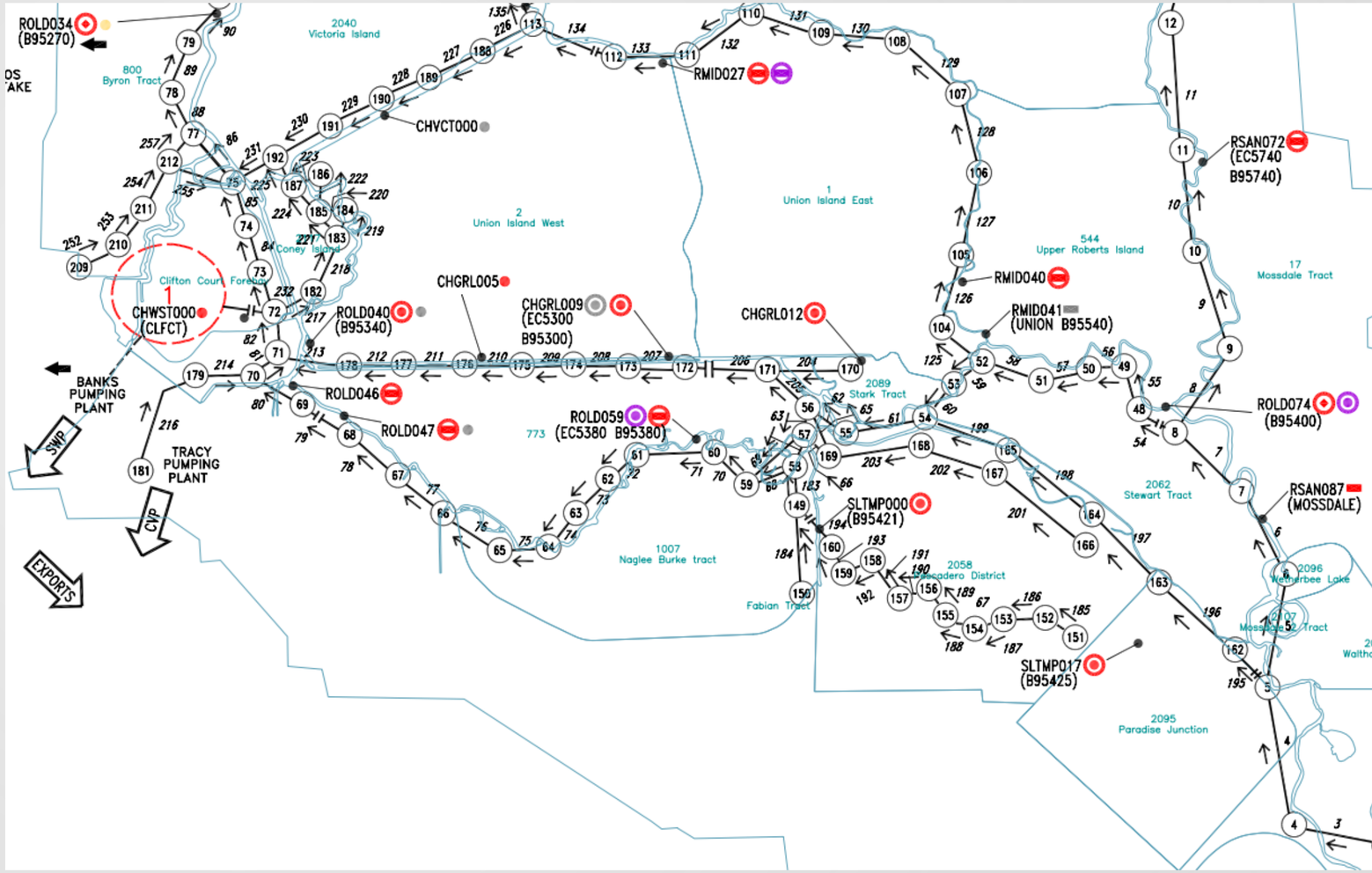
d) 3-D



DSM2

- 1-dimensional network
  - Fast: years in minutes
  - Key physics for S.Delta
- Spatially resolved laterally
- Spatially coarse along channel (MSS=1000ft, standard=5000ft)
- Data assimilation insights good
- Culturally slow





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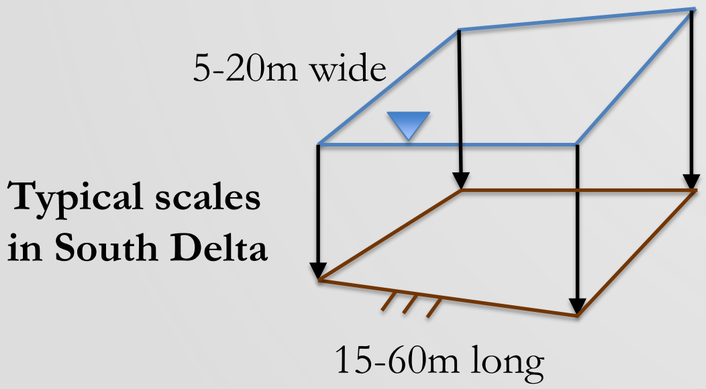
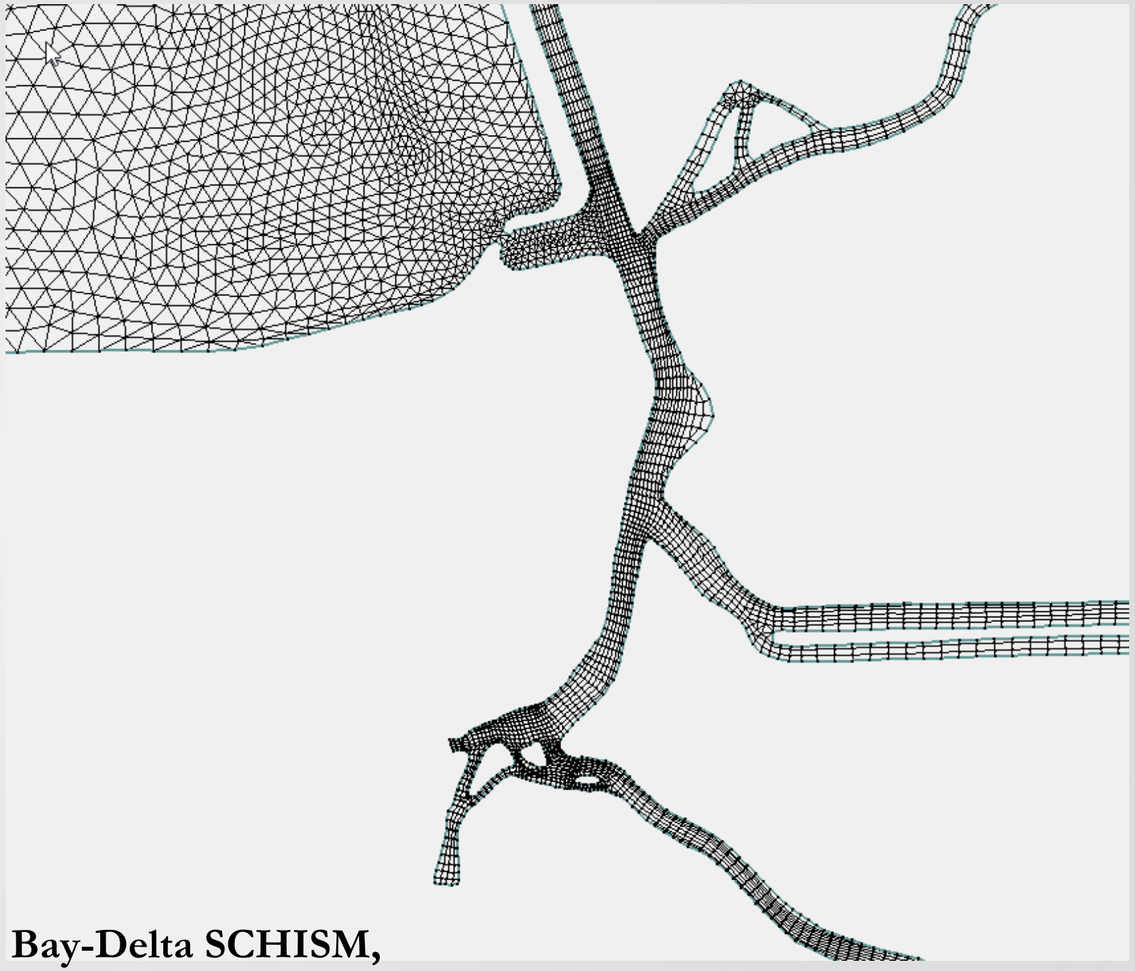
SCHISM

- 3-dimensional grid
  - Year-in-2-days speed on cluster
  - Other physics: some help
  - Good for vegetation
- Adaptive grid resolution, detailed
- Culturally flexible





Bay-Delta SCHISM,
Export region in South Delta

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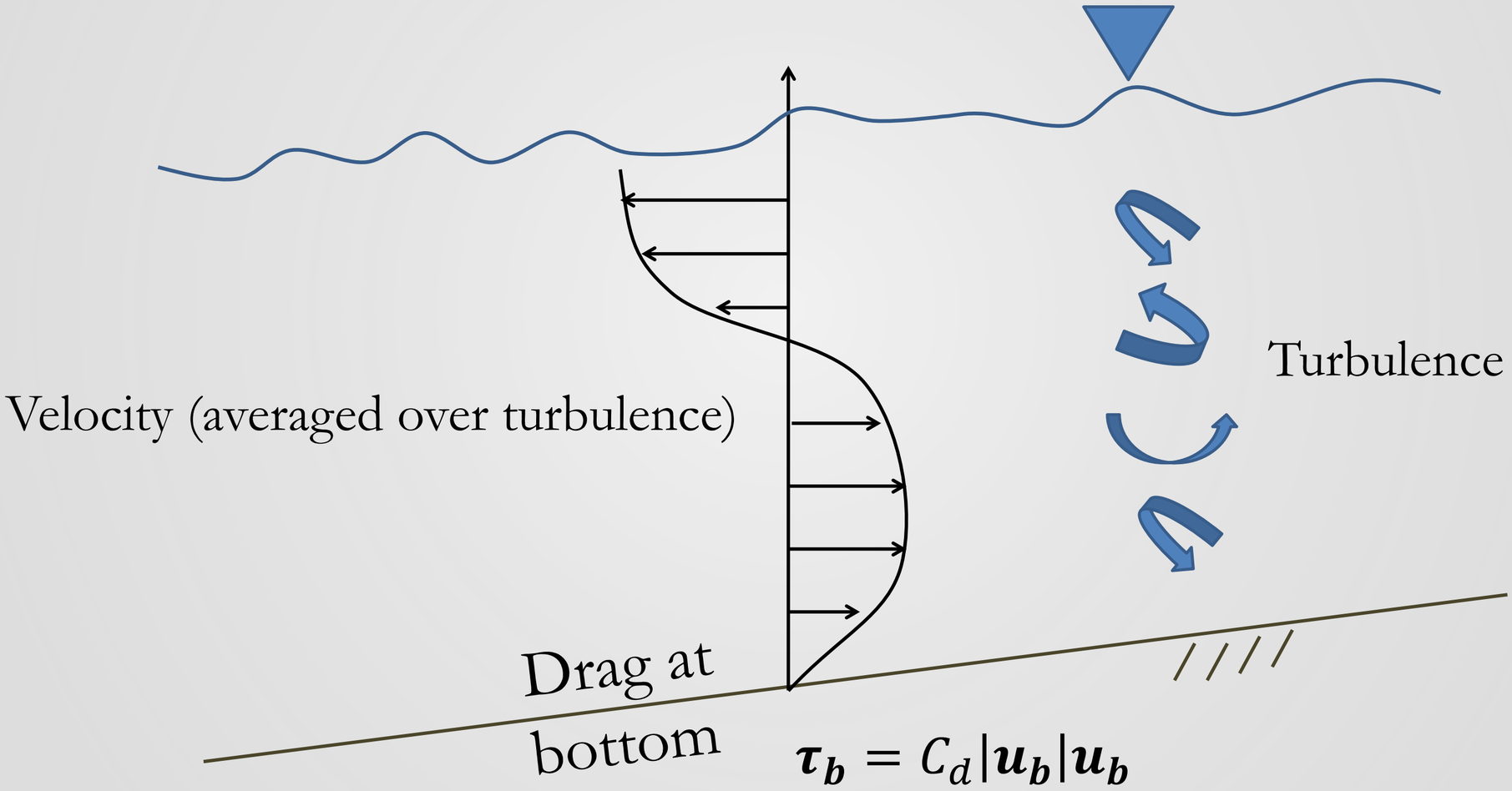
Drag in 3D



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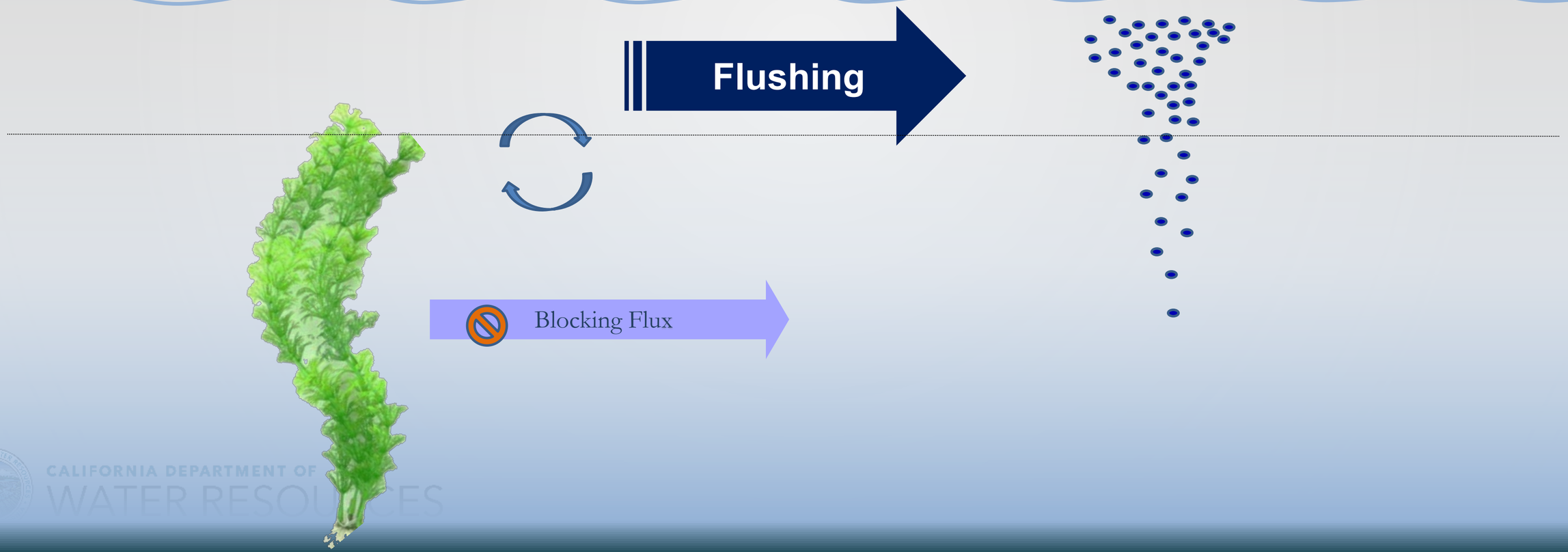
Feedback from SAV to Flow



Boundary/Initial Conditions

- Major inflows/ boundaries like SJR/exports:
  - “Easy” in hindcast. SJR/exports are measured redundantly
  - “Hard” in applied operational/forecast settings
- Source/sink terms less well understood
  - treatment plants, ag diversions, Pescadero etc.
  - general fluxes/concentrations good but …
  - flow direction makes a big difference

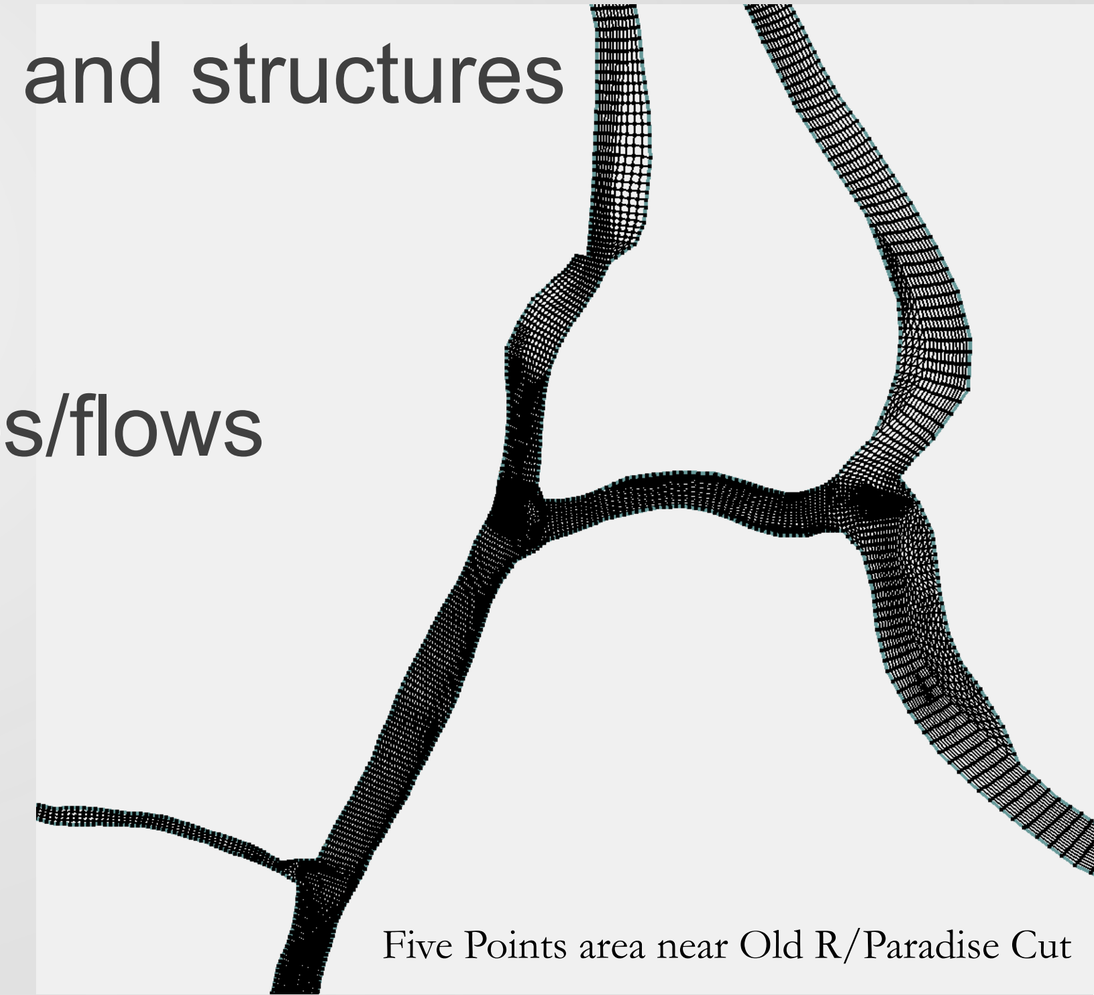
SCHISM South Delta Improvements

- Higher resolution where dispersion is critical
- Measure and recalibrate barriers and structures
  - So far Old River culverts
- Incorporate bathymetry
- Fill in knowledge gaps on sources/flows

Comment:

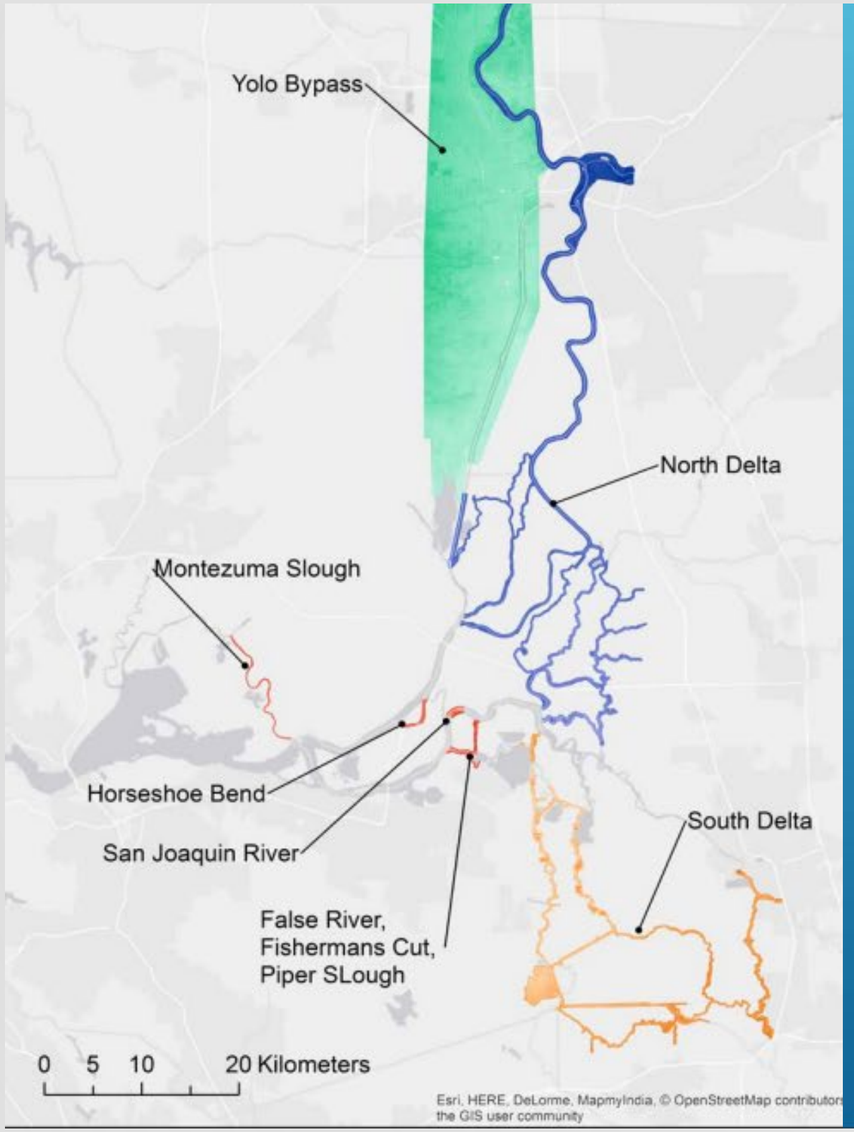
Data is trickling in asynchronously,

So a lot of schedule revision



Five Points area near Old R/Paradise Cut

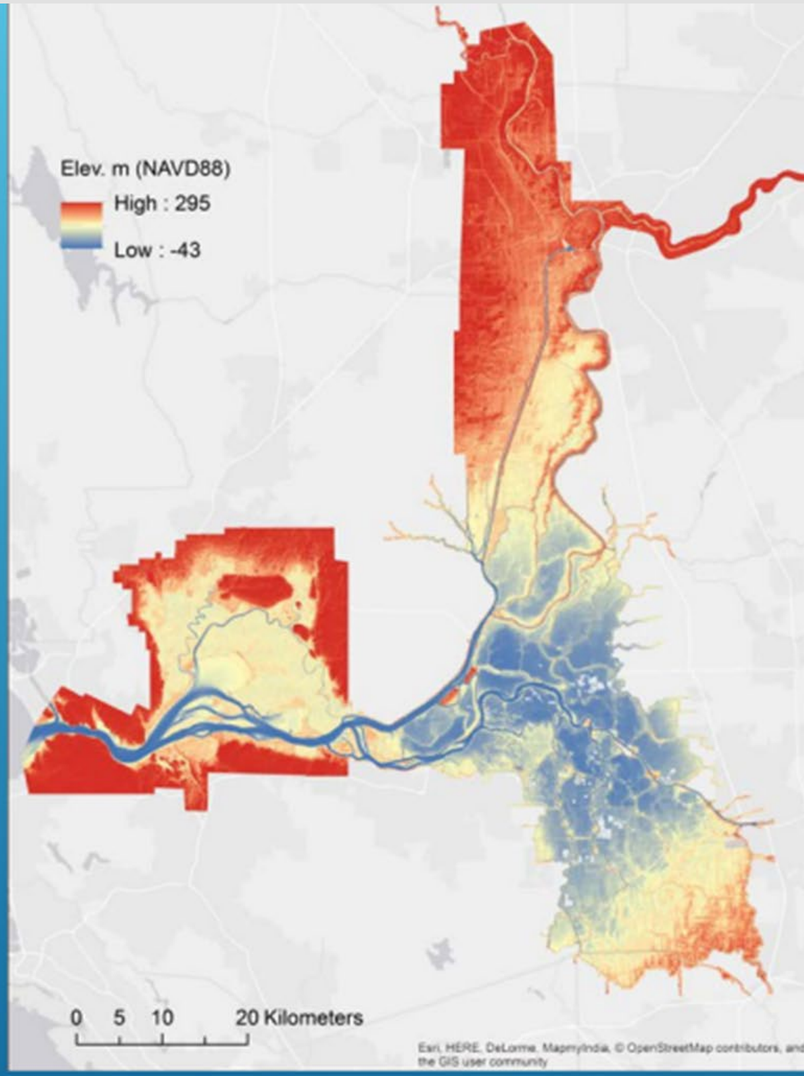
Bathymetry Mapping



- 2m DEMs
- 10m DEM
- Work done in 2m

Lineage:

- Foxgrover (2005) [USGS]
- Wang (2012) [USGS]
- Fregoso (2017) [USGS-DWR]
- Wang (2018) [DWR-USGS]

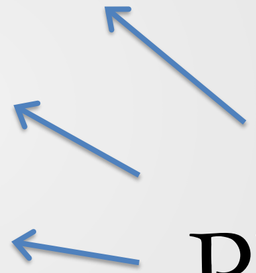


Bathymetry Caveats

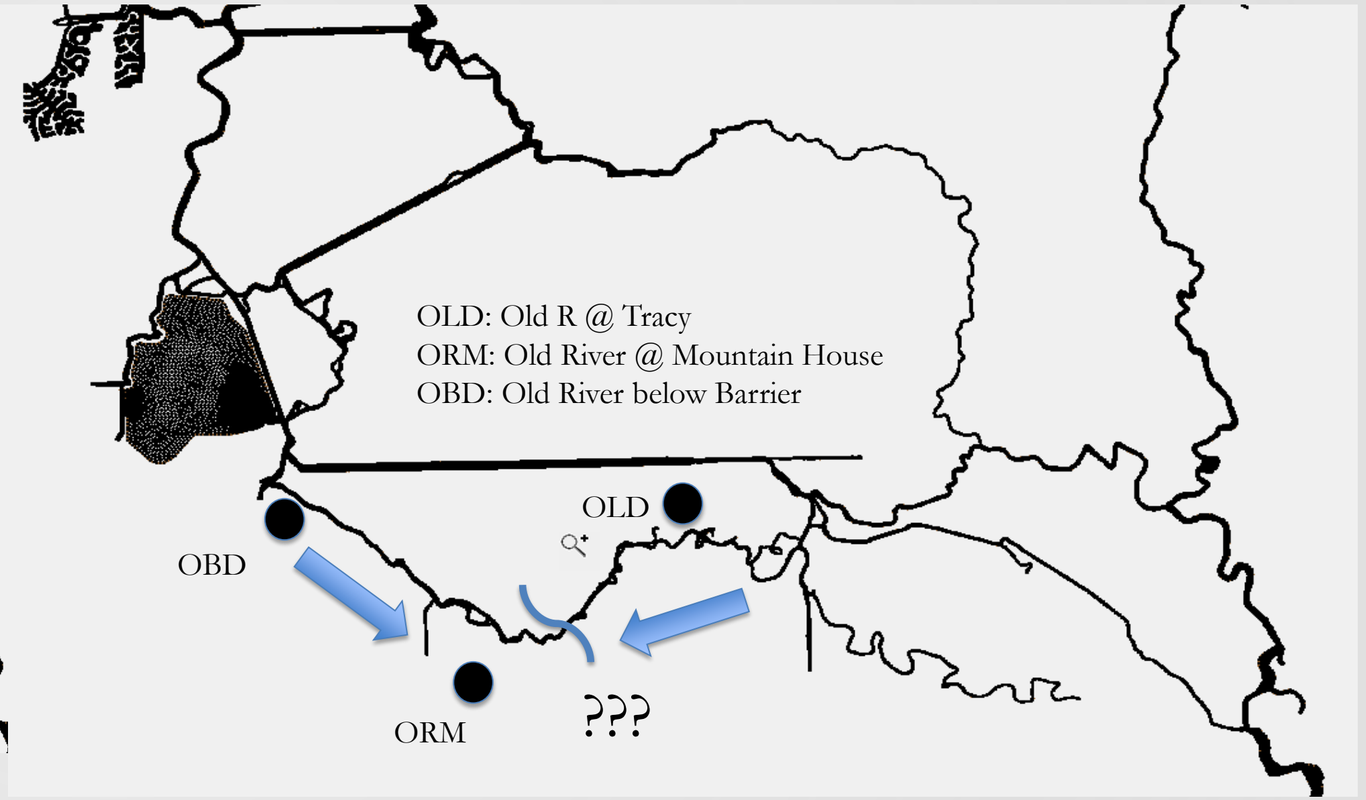
- Need fairly complete incoming data
- “Cross sections” at points not helpful
  - Not even great for DSM2
- Local bathy issues:
  - Often have big effects on local questions
  - Sometimes have effects on system questions
- Funding/time for bathymetry is balanced

Information Gaps, Approximations

- Water flux and null zones:
  - Diversions to match observed null zones on Old/Middle R
  - South Delta Water Agency estimates of diversions/returns on Paradise and Tom Paine
- Salinity loadings of return flows:
  - Data assimilation
  - Comparisons to high speed data
  - Measurements of discharges
- Treatment plant flows:
  - Flow/EC available but with a lag.
- “Best science so far” approach

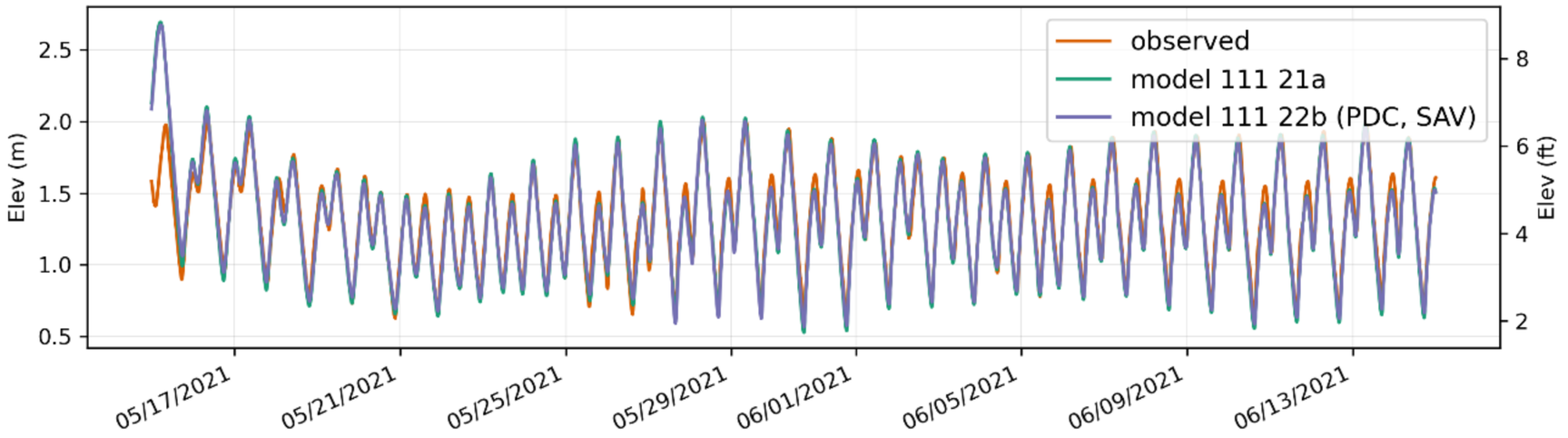


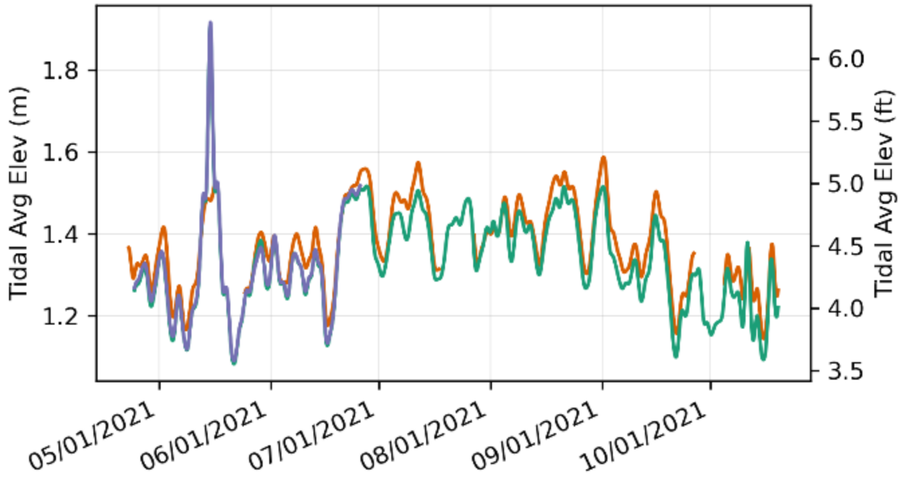
PESCADERO

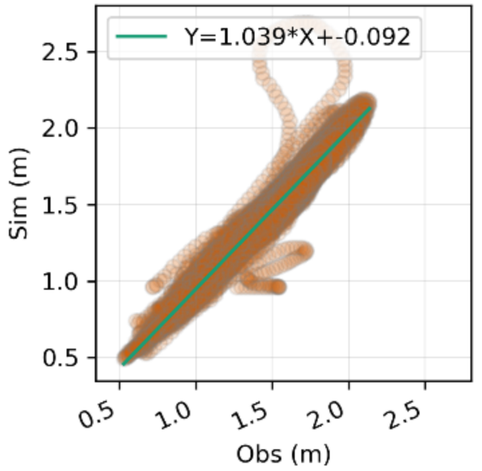

OLD: Old R @ Tracy
ORM: Old River @ Mountain House
OBD: Old River below Barrier
OLD
OBD
ORM
???

Status so far …

Grant Line Canal at Tracy Rd Bridge
Source: WDL, ID: GCT



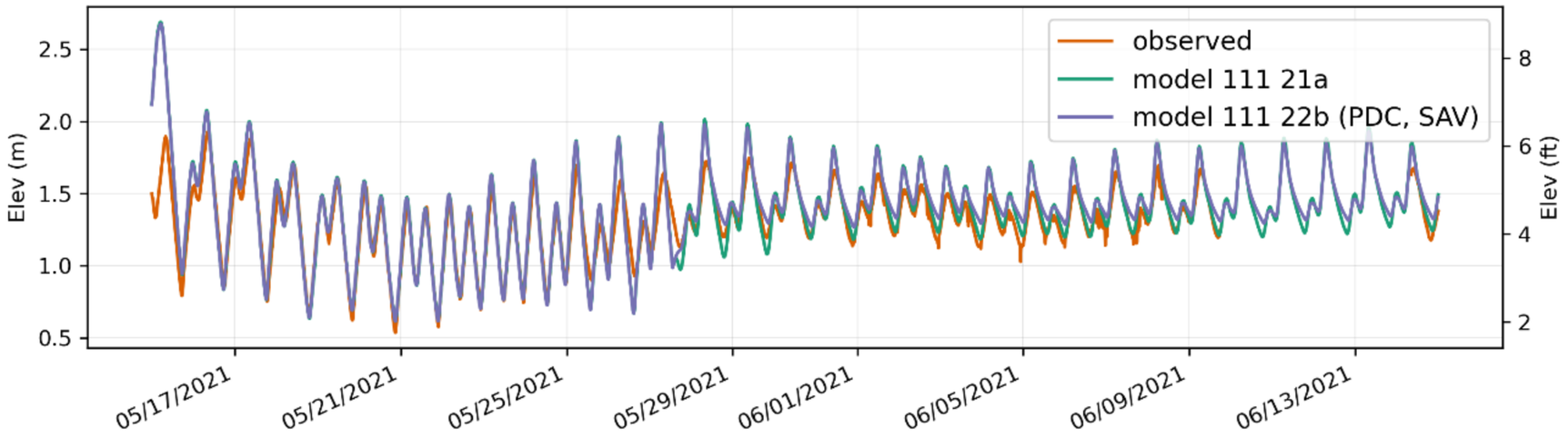


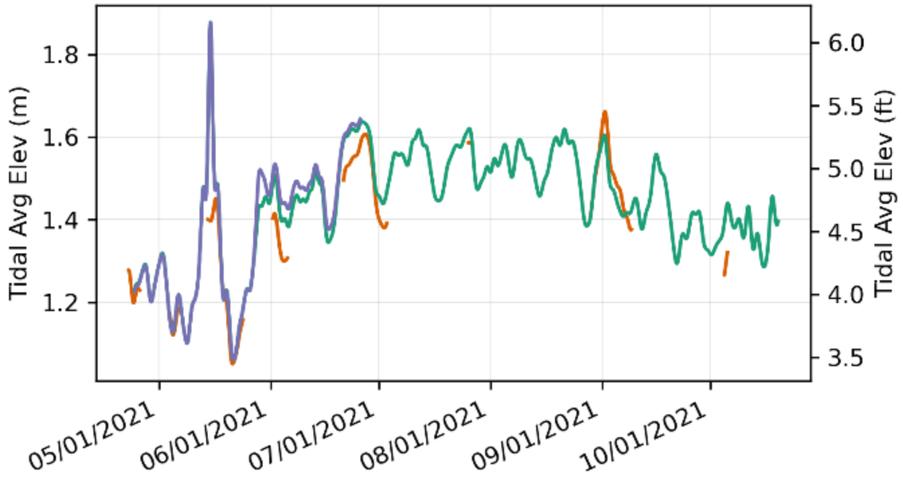


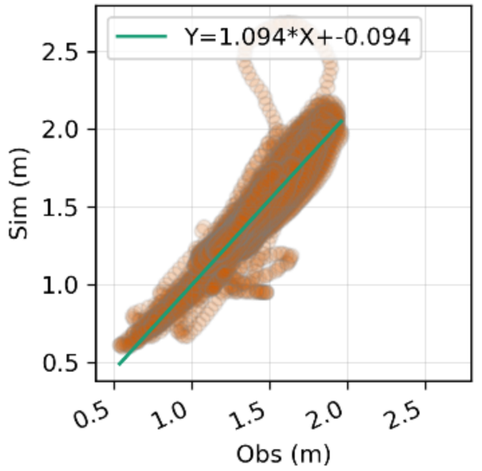
model 111 21a: RMSE=0.086 m Lag=<-11 * Minutes> $Bias_\phi$=-0.039 NSE_ϕ=0.923 R_ϕ=0.973

model 111 22b (PDC, SAV): RMSE=0.098 m Lag=<-6 * Minutes> $Bias_\phi$=-0.027 NSE_ϕ=0.896 R_ϕ=0.957

Old River upstream of Mountain House Creek
Source: CDEC, ID: ORM



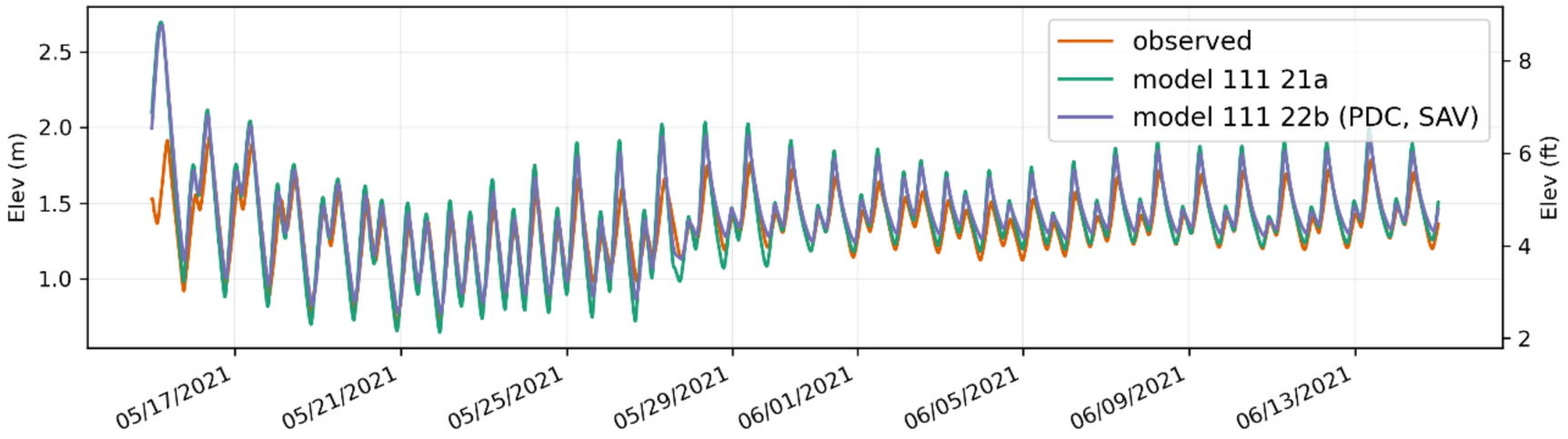


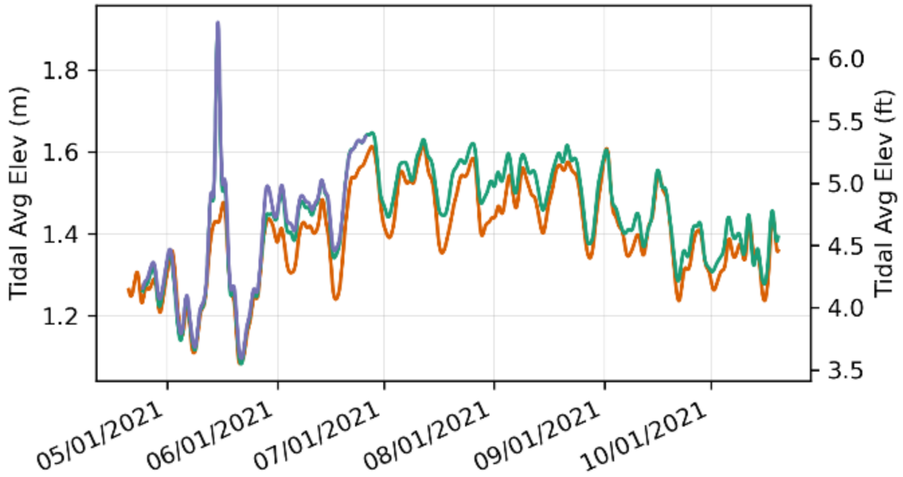


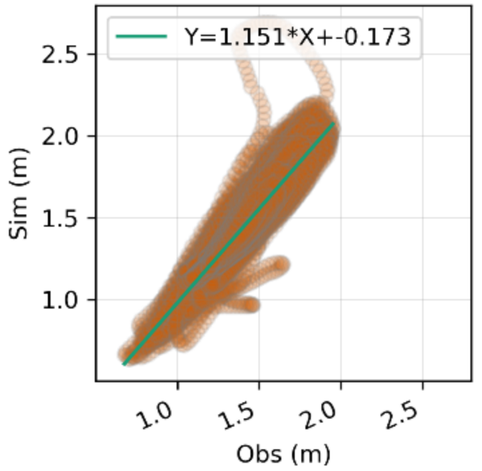
model 111 21a: RMSE=0.103 m Lag=<-22 * Minutes> $Bias_\phi$=0.038 NSE_ϕ=0.773 R_ϕ=0.930

model 111 22b (PDC, SAV): RMSE=0.129 m Lag=<-24 * Minutes> $Bias_\phi$=0.053 NSE_ϕ=0.748 R_ϕ=0.927

Old River at Tracy Blvd
Source: WDL, ID: OLD





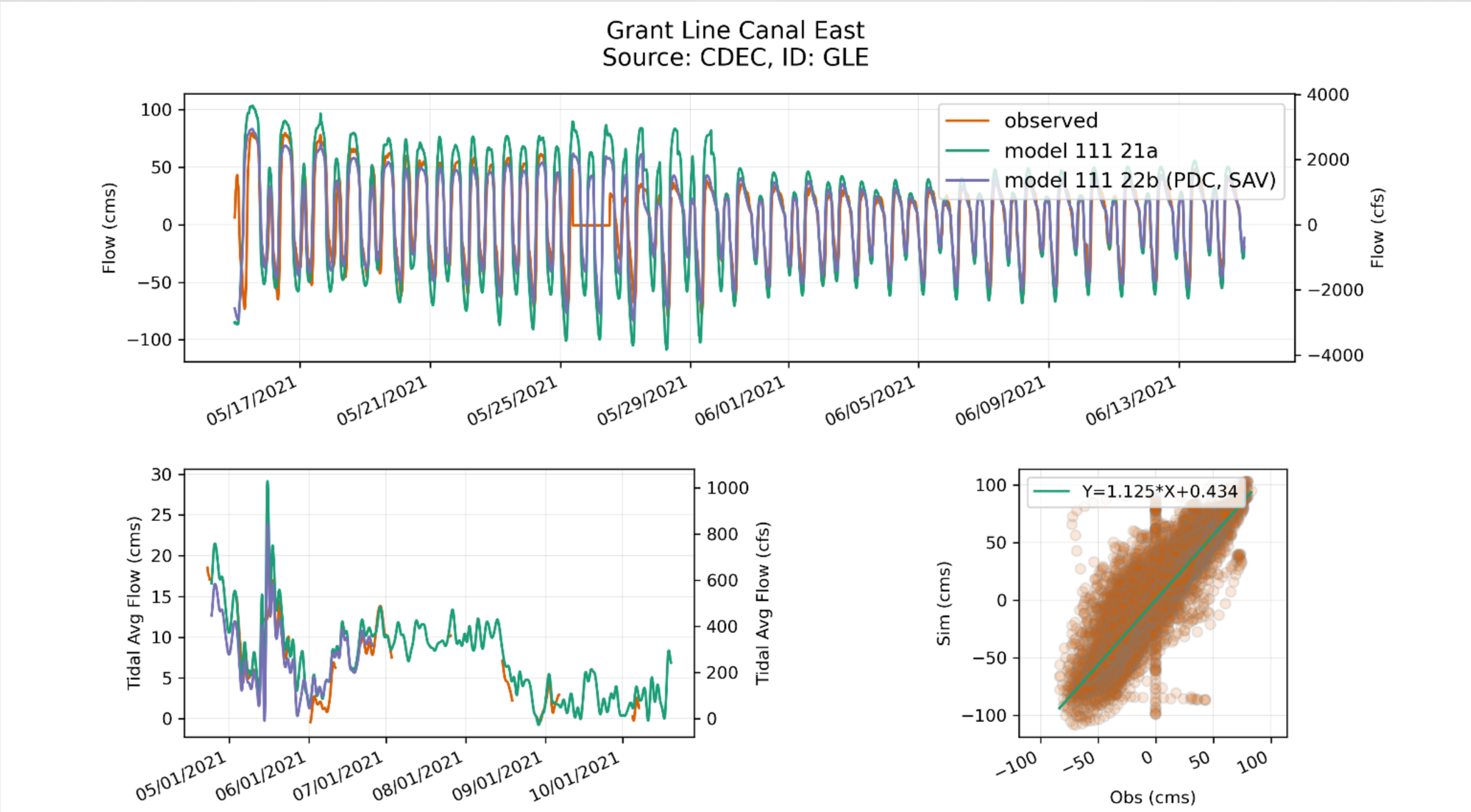


model 111 21a: RMSE=0.117 m Lag=<-56 * Minutes> $Bias_\phi$=0.039 NSE_ϕ=0.636 R_ϕ=0.903

model 111 22b (PDC, SAV): RMSE=0.117 m Lag=<-25 * Minutes> $Bias_\phi$=0.052 NSE_ϕ=0.732 R_ϕ=0.922

Water level/elev notes

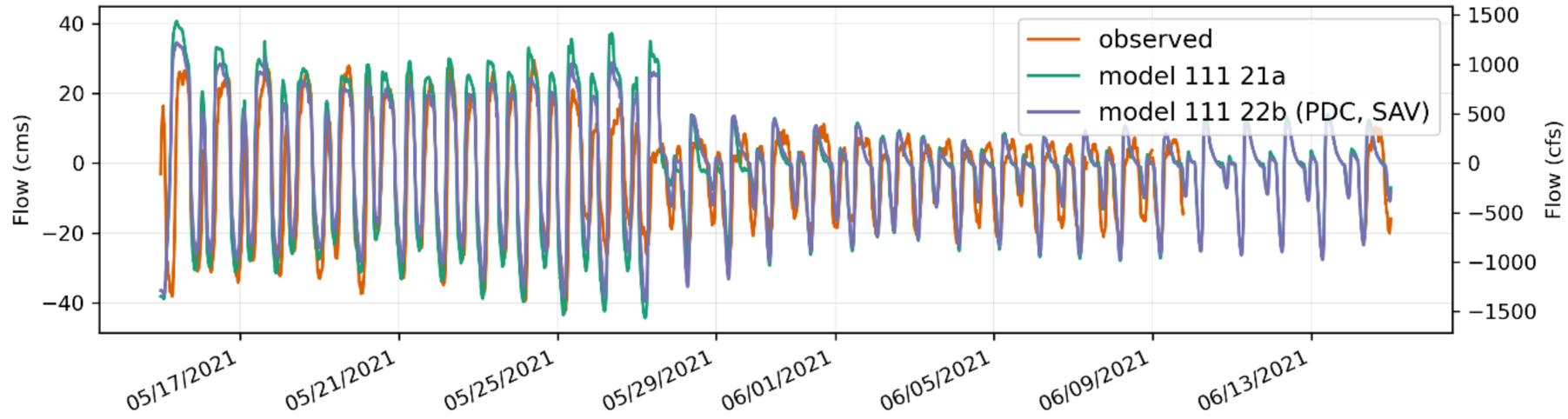
- General model skill high given good boundaries
- Even the error that is there may be bias-correctable
- Interpretation or specific clogged spots may require a slog
- The prediction problem is much harder
  - Model error is small compared to unknown press/wind

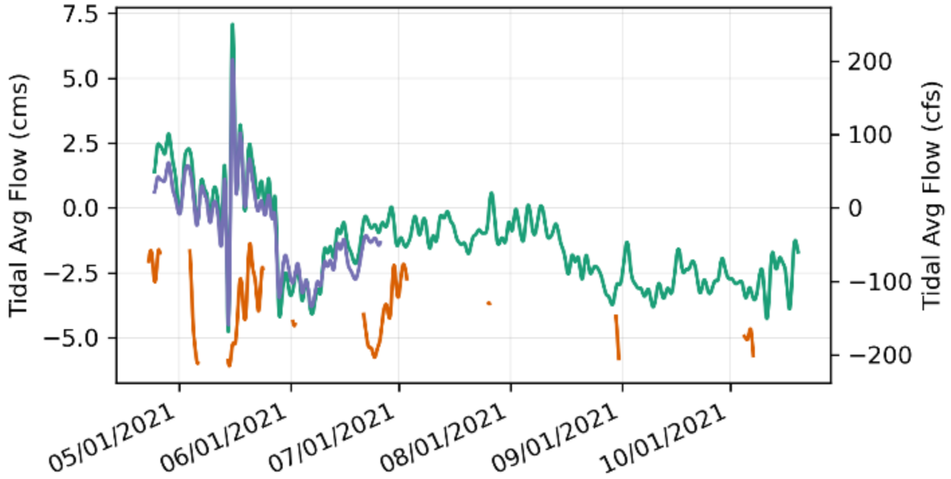


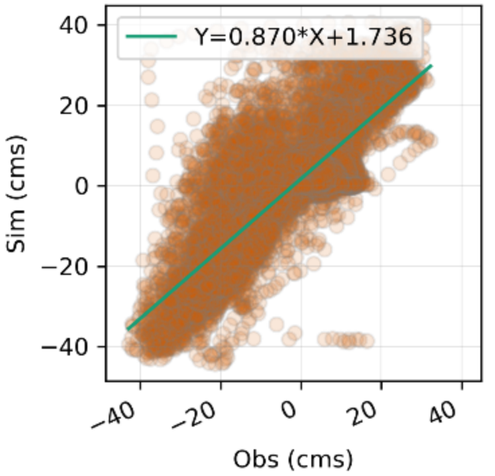
model 111 21a: RMSE=17.283 cms Lag=<-31 * Minutes> $Bias_\phi$=1.213 NSE_ϕ=0.715 R_ϕ=0.909

model 111 22b (PDC, SAV): RMSE=16.200 cms Lag=<-30 * Minutes> $Bias_\phi$=-0.585 NSE_ϕ=0.812 R_ϕ=0.904

Old River upstream of Mountain House Creek
Source: WDL, ID: ORM

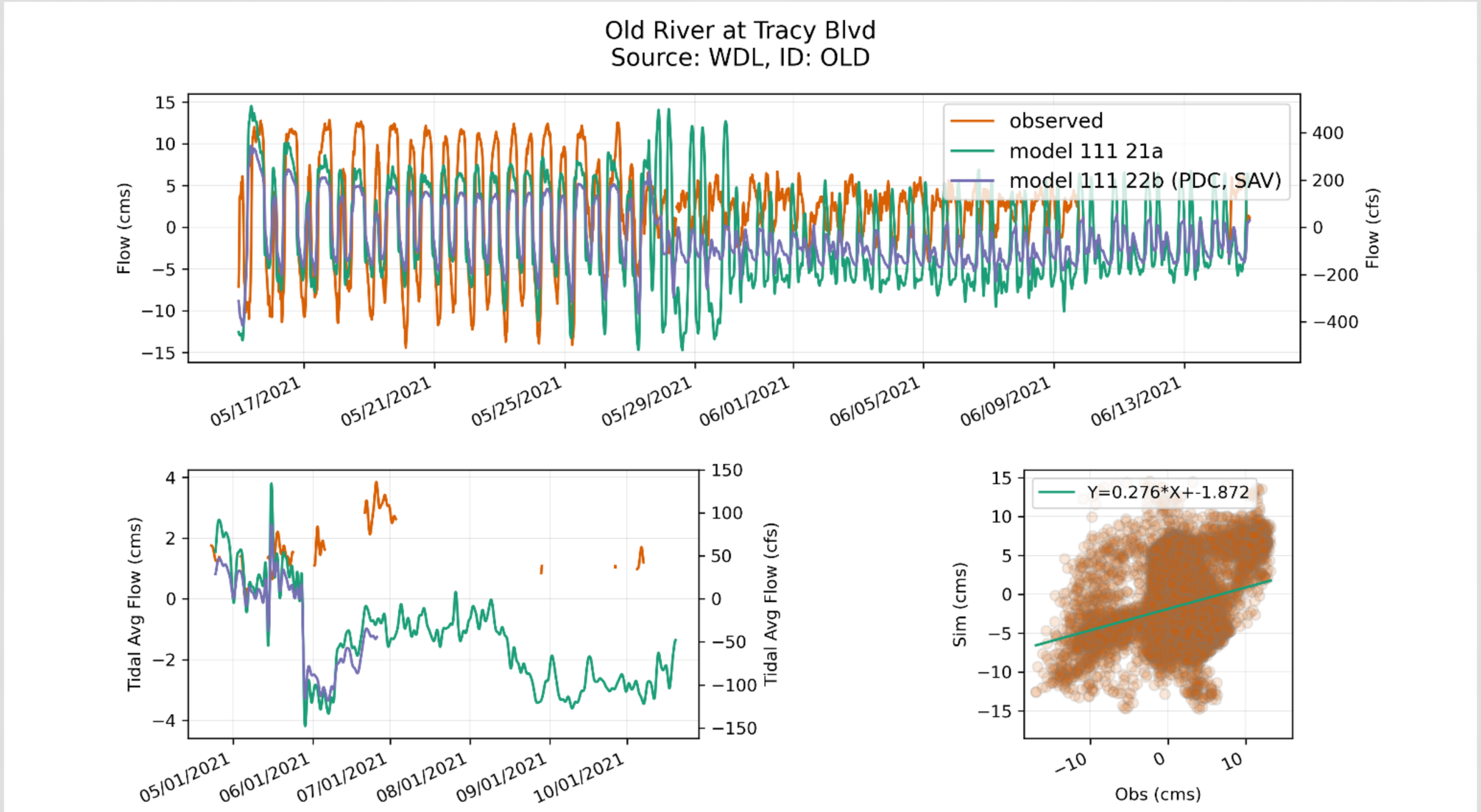






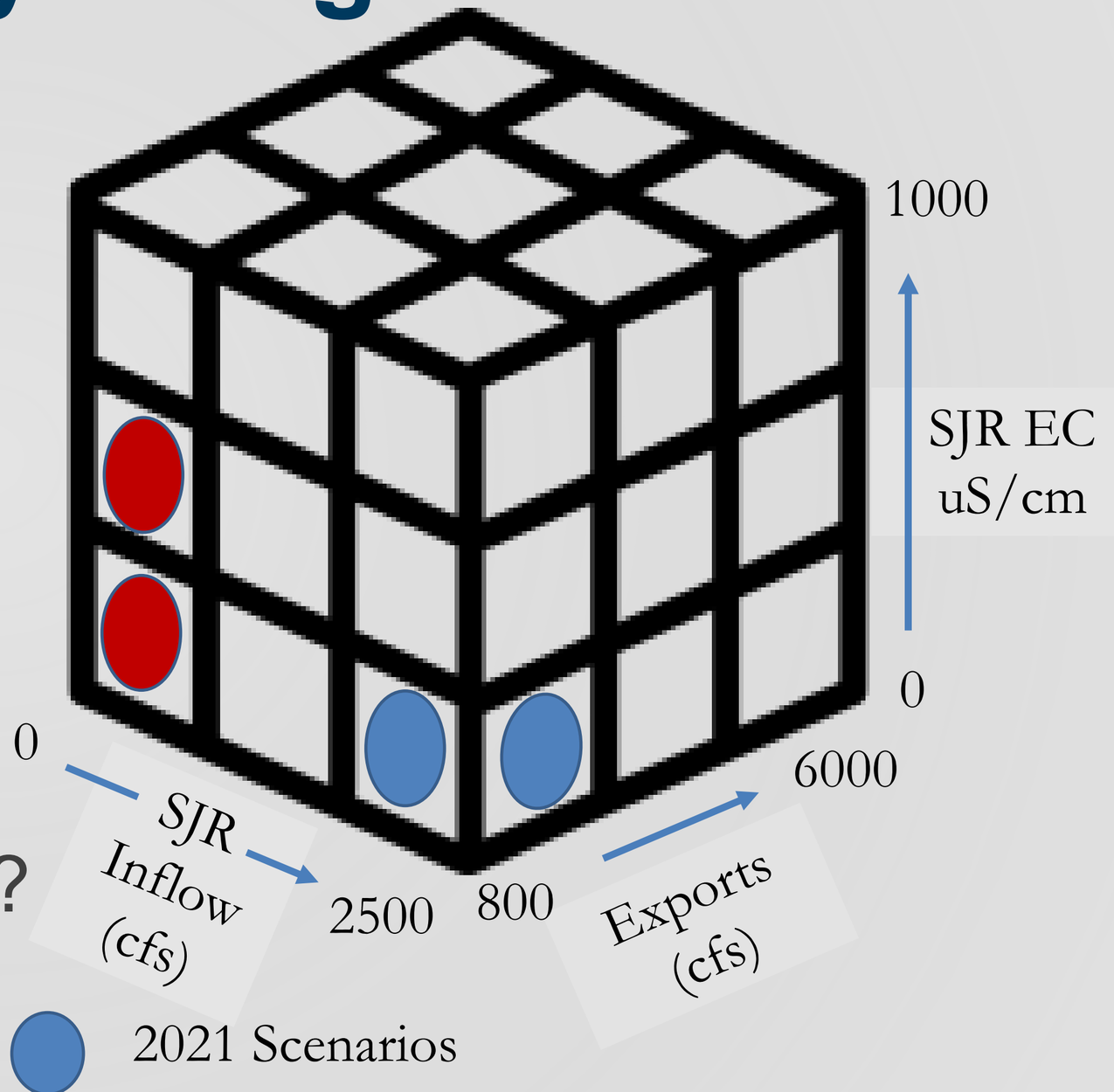
model 111 21a: RMSE=8.802 cms Lag=<-42 * Minutes> Bias$_\phi$=2.190 NSE$_\phi$=0.596 R$_\phi$=0.822

model 111 22b (PDC, SAV): RMSE=9.187 cms Lag=<-34 * Minutes> Bias$_\phi$=3.371 NSE$_\phi$=0.728 R$_\phi$=0.879


Old River at Tracy Blvd
Source: WDL, ID: OLD
observed
model 111 21a
model 111 22b (PDC, SAV)
Flow (cms)
Flow (cfs)
05/17/2021
05/21/2021
05/25/2021
05/29/2021
06/01/2021
06/05/2021
06/09/2021
06/13/2021
Tidal Avg Flow (cms)
Tidal Avg Flow (cfs)
05/01/2021
06/01/2021
07/01/2021
08/01/2021
09/01/2021
10/01/2021
Y=0.276*X+-1.872
Sim (cms)
Obs (cms)
model 111 21a: RMSE=6.552 cms Lag=<-72 * Minutes> Bias$_\phi$=-3.253 NSE$_\phi$=-1.187 R$_\phi$=0.252
model 111 22b (PDC, SAV): RMSE=5.687 cms Lag=<-36 * Minutes> Bias$_\phi$=-2.451 NSE$_\phi$=0.302 R$_\phi$=0.674

Export – SJR Study Design

- Vary:
  - SJR Inflow
  - SJR EC
  - Exports
- Seeking:
  - Right flows categories?
  - Other scenario covariates?



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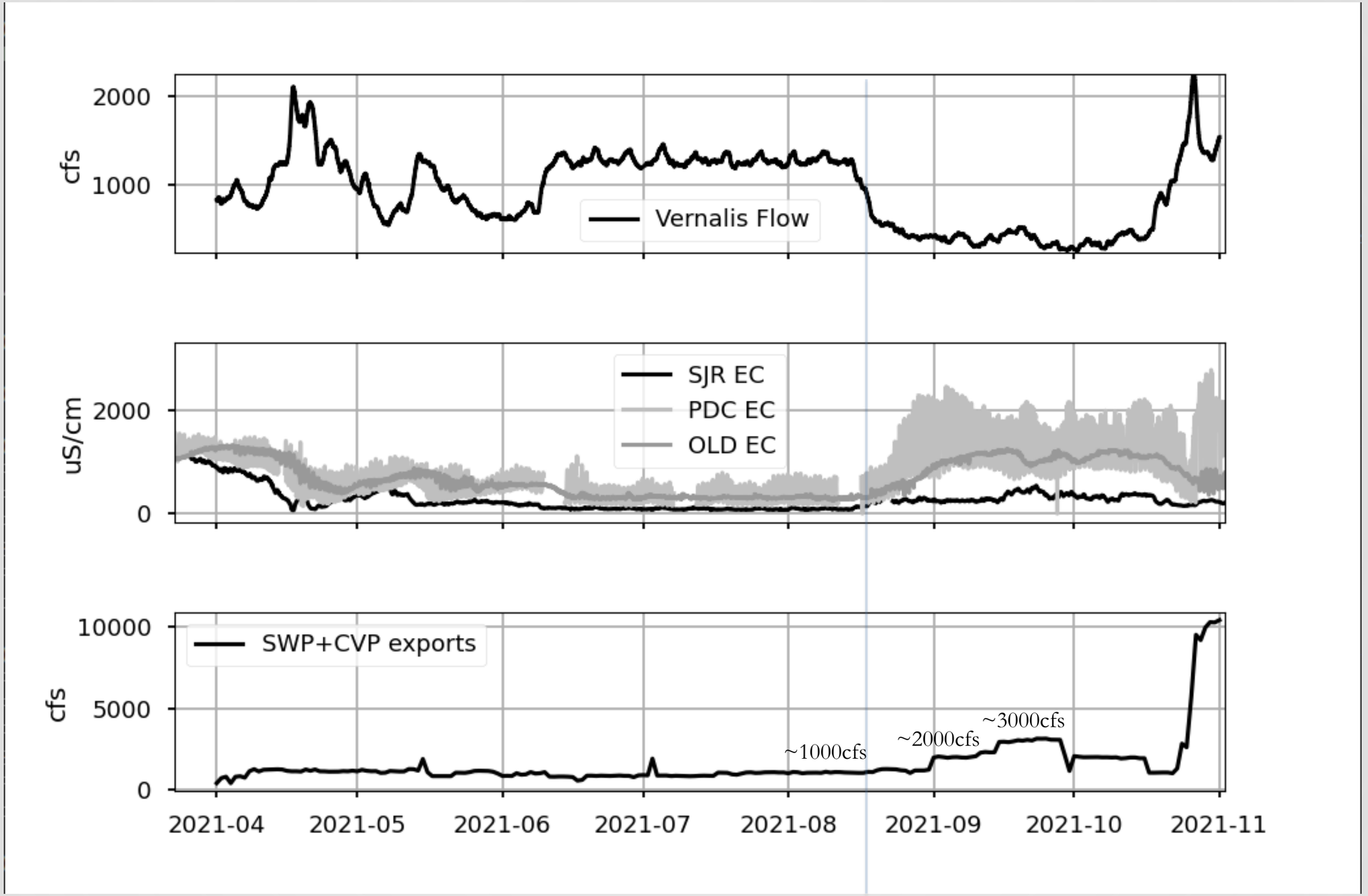

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