Improving Water Resource Management in the Salton Sea Basin using an Integrated Modeling Framework

Hoori Ajami, Juan S. Acero Triana
Department of Environmental Sciences
University of California Riverside

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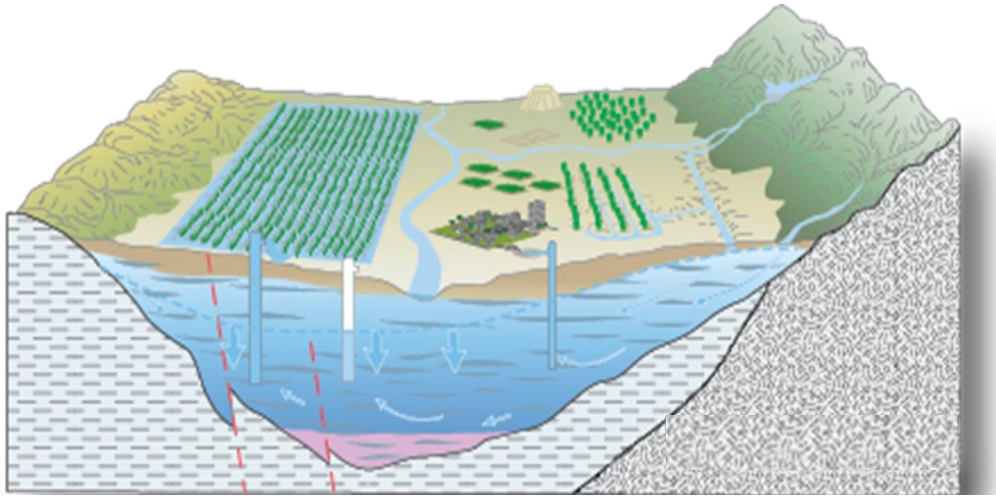
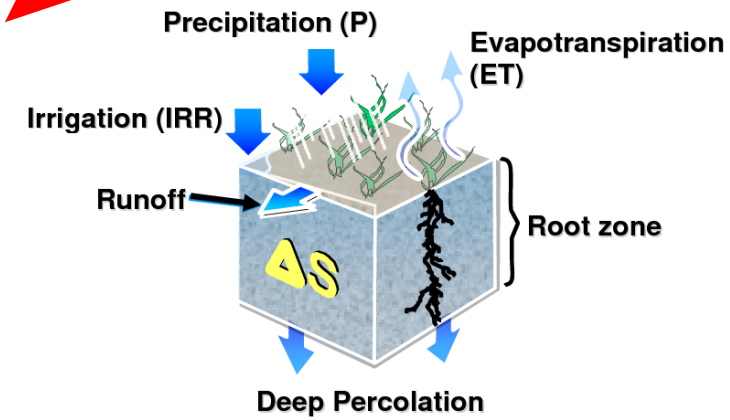
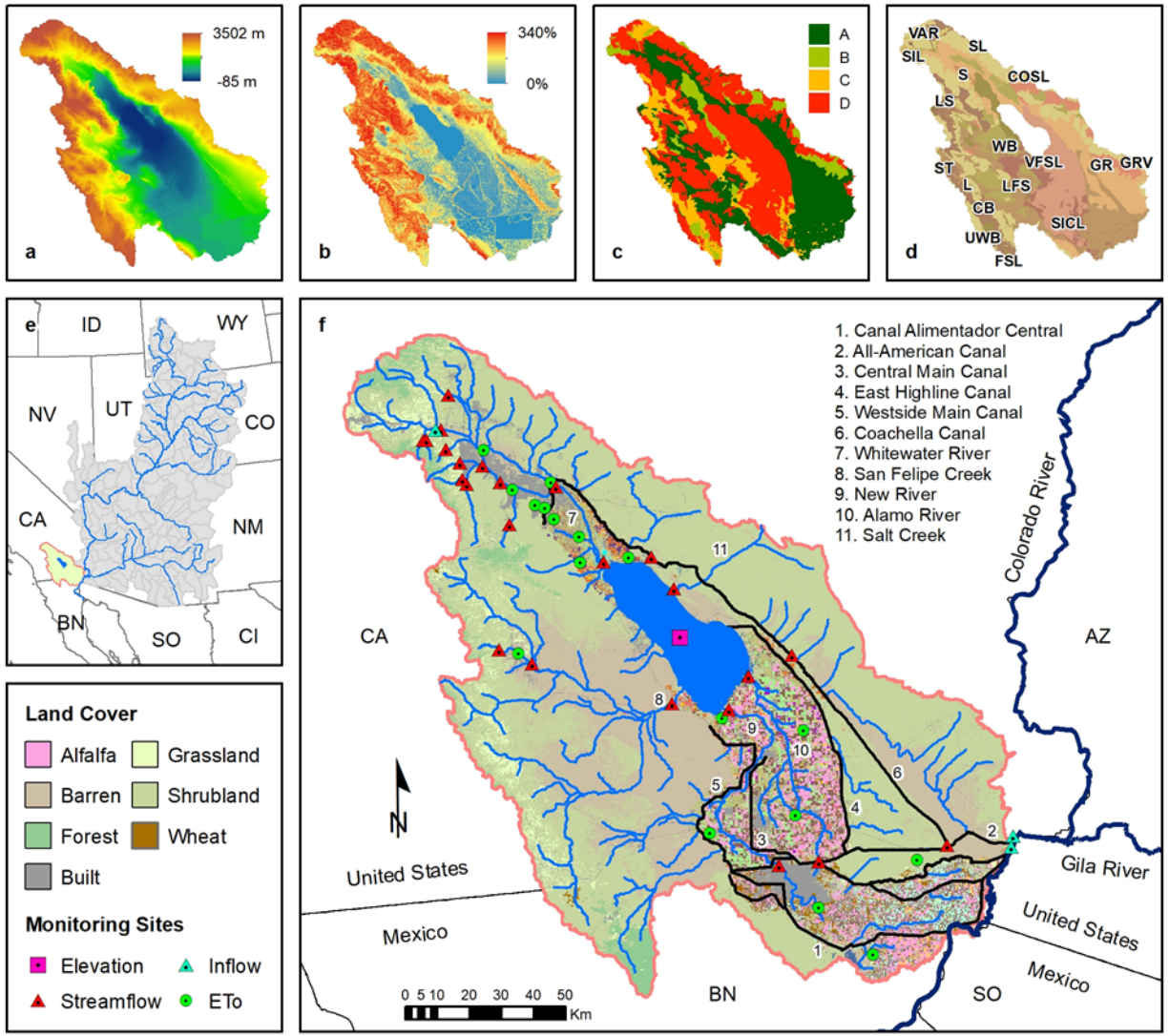
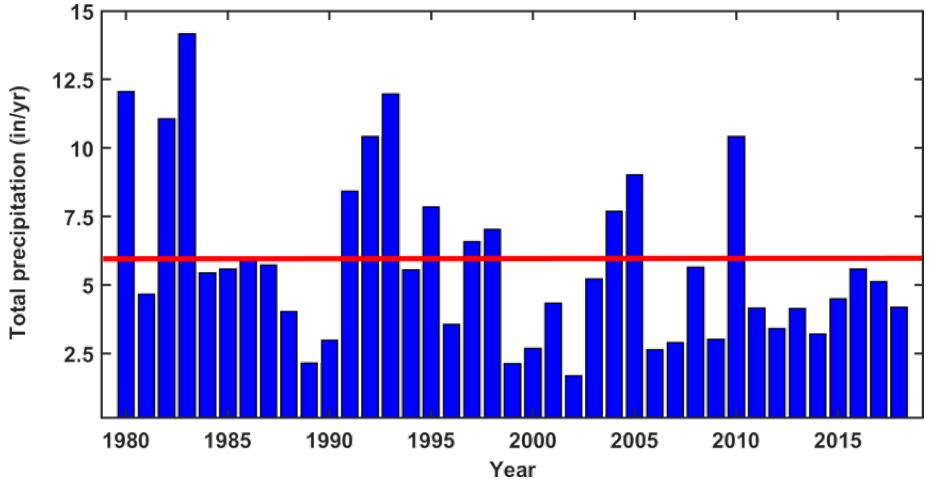
Accurate estimates of the basin water balance is needed for successful water management.

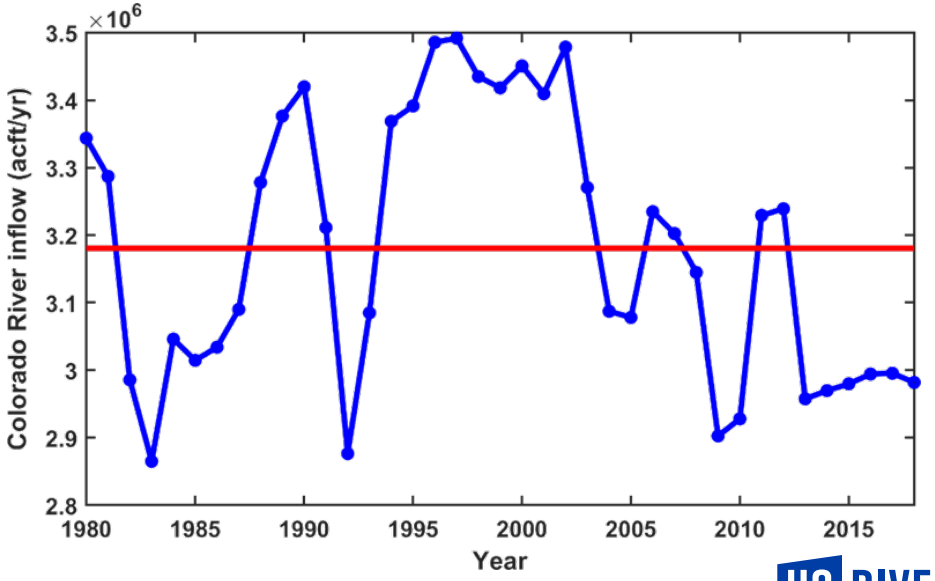




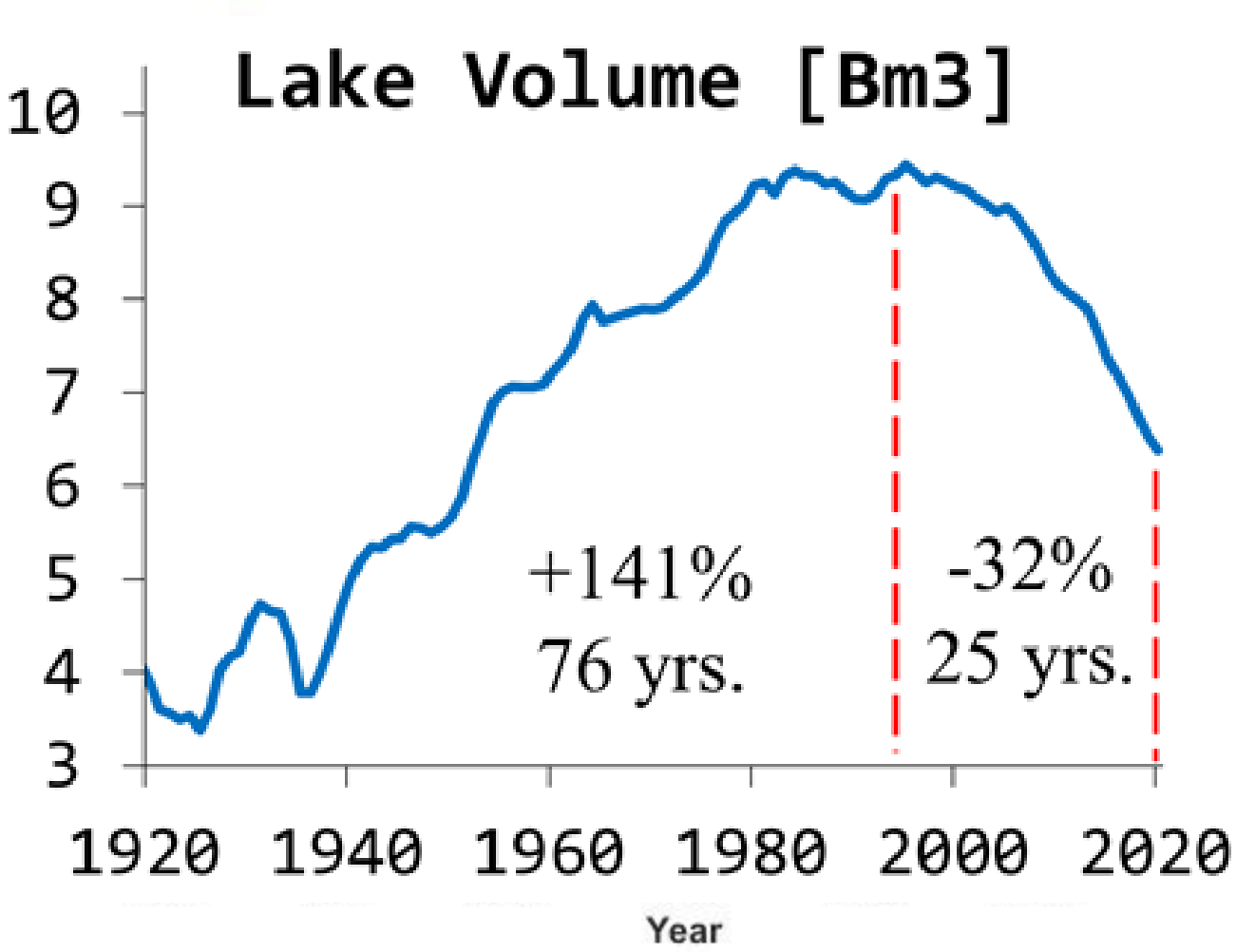
Salton Sea basin is one of the most productive agricultural regions in the US relying on the Colorado River water.







Lake water level dynamics has been impacted by irrigation expansion and cycles of wet/dry periods.



Utilized a semi-distributed hydrologic modeling approach with water management options.

Soil & Water Assessment Tool – SWAT

Why?

- **Useful** — Simulates water movement and sediment/nutrient transport in highly managed basins.
- **Versatile** — Enables the simulation of field operations, reservoirs/lakes, water transfers, and point sources.
- **Suitable** — Simulates plant growth and hence estimates plant biomass and crop yields.

How?

- **HRU** — Soil + Slope + Land cover/land use
- **Subbasin** — Clusters based on given drainage area
- **Outlet** — Routing to the basin outlet ~ lake

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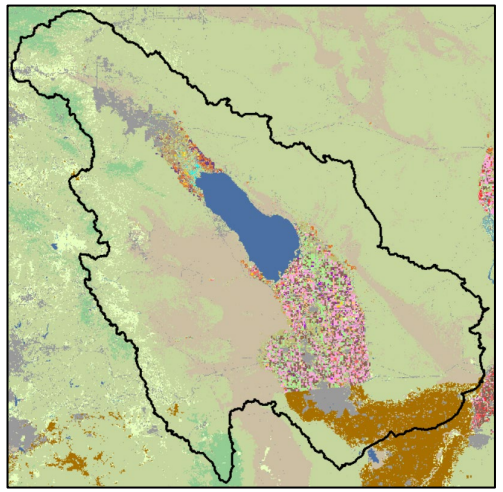
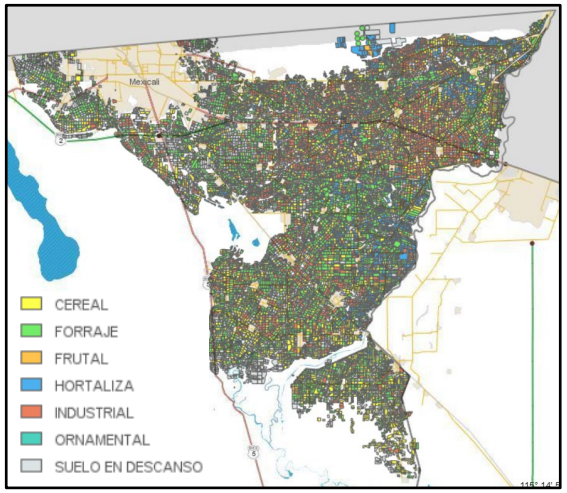
Model parameterization challenges in a transboundary watershed

Land Cover

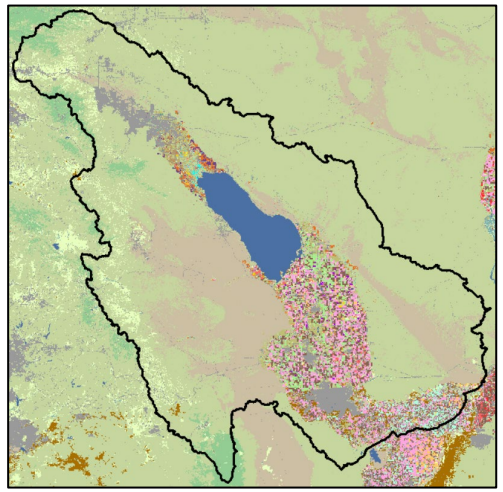
NASS (USA) + CONABIO (MEX)



SEDEAGRO (MEXICALI)

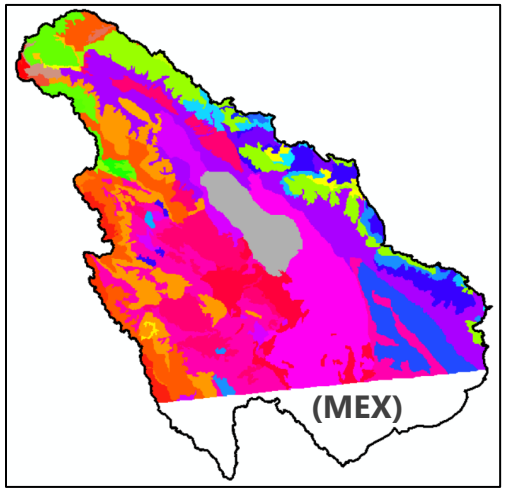


NASS (USA) + CONABIO (MEX) + SEDEAGRO (MEXICALI)



Soil Type

STATSGO2 (USA)

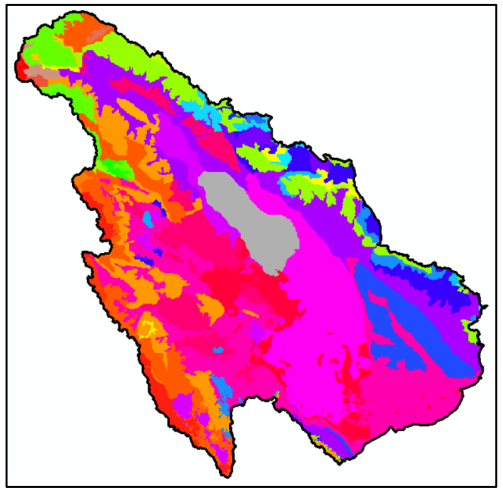


Random Forest - Classification

I. **Target Variable (250 m):**
   - STATSGO2 mukey code

II. **Predictor variables (36 at 250 m):**
   - x, y coordinates (matrix indices)
   - Terrain elevation
   - Land cover (general classification)
   - DAAC: Hydrologic soil group
   - ISRIC World Soil Information:
     - Soil class
     - Clay, silt, sand, and coarse material content (6 soil layers each)
     - Bulk density (6 soil layers)

STATSGO2 (USA+MEX)



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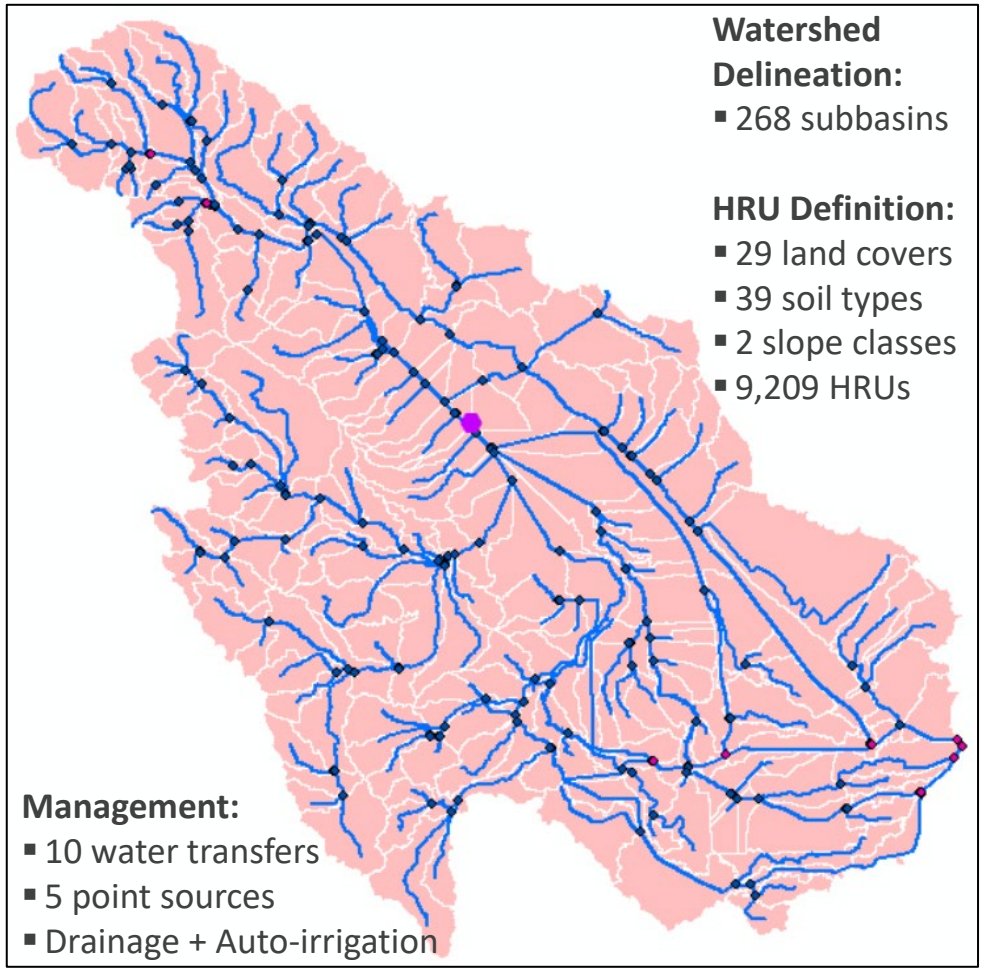
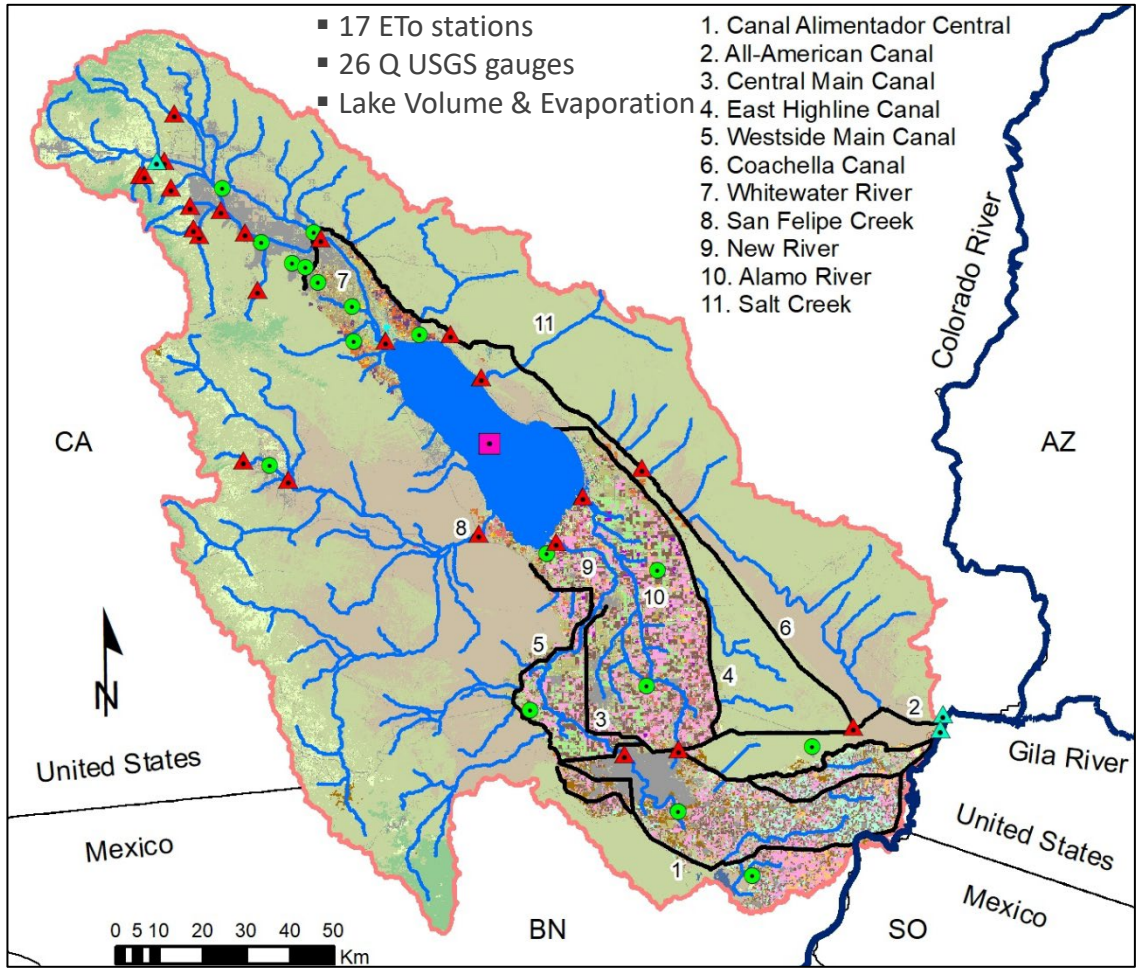
Salton Sea basin model set-up and calibration/validation data

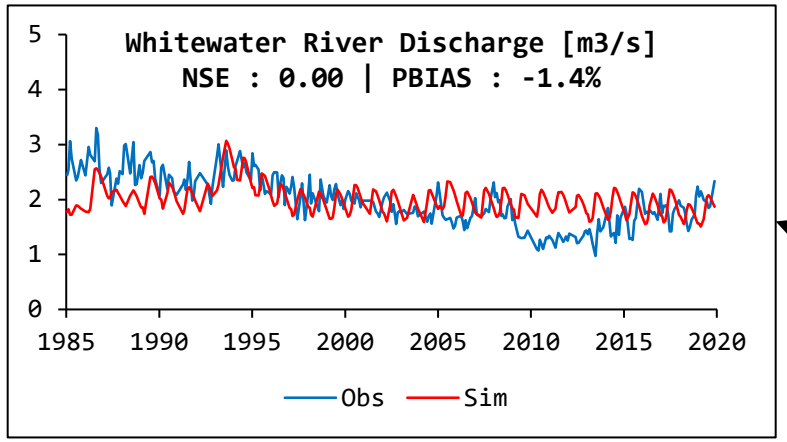
Basin Configuration in SWAT

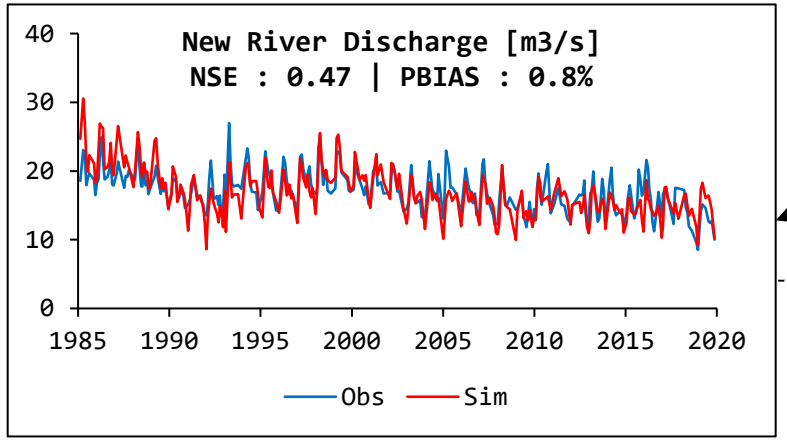


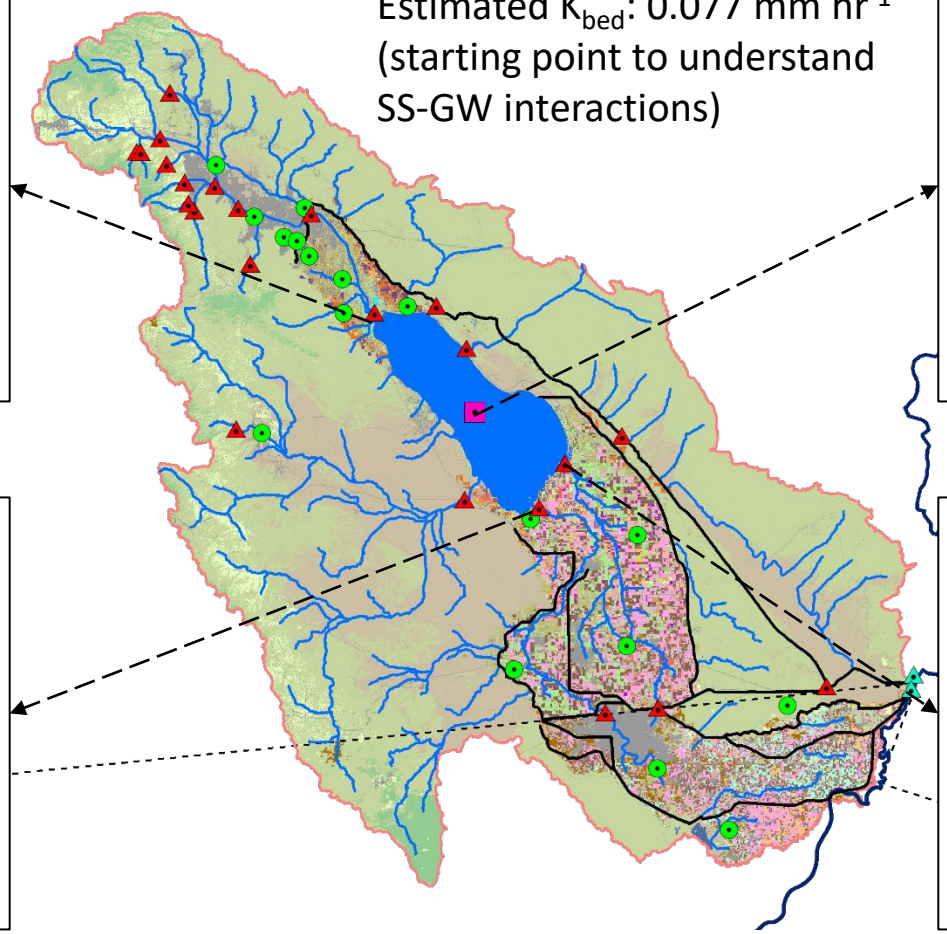
Calibration/Validation: 1985-2019



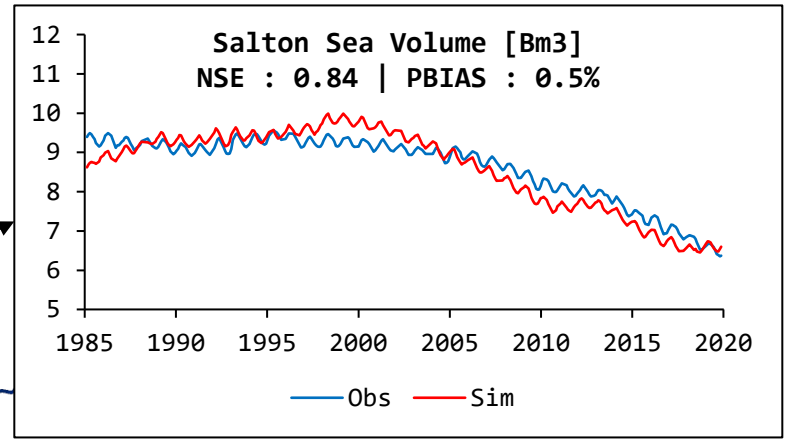
Model performance deteriorates due to conjunctive use in the Coachella Valley.

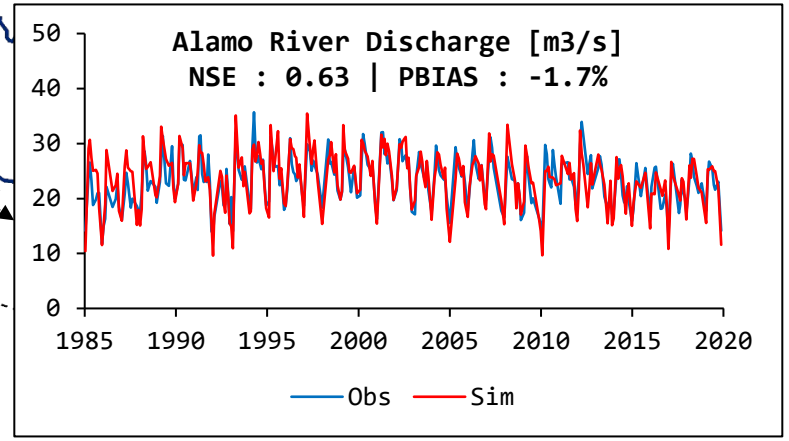






Estimated K_{bed}: 0.077 mm hr^{-1} (starting point to understand SS-GW interactions)





70% of the records used for calibration

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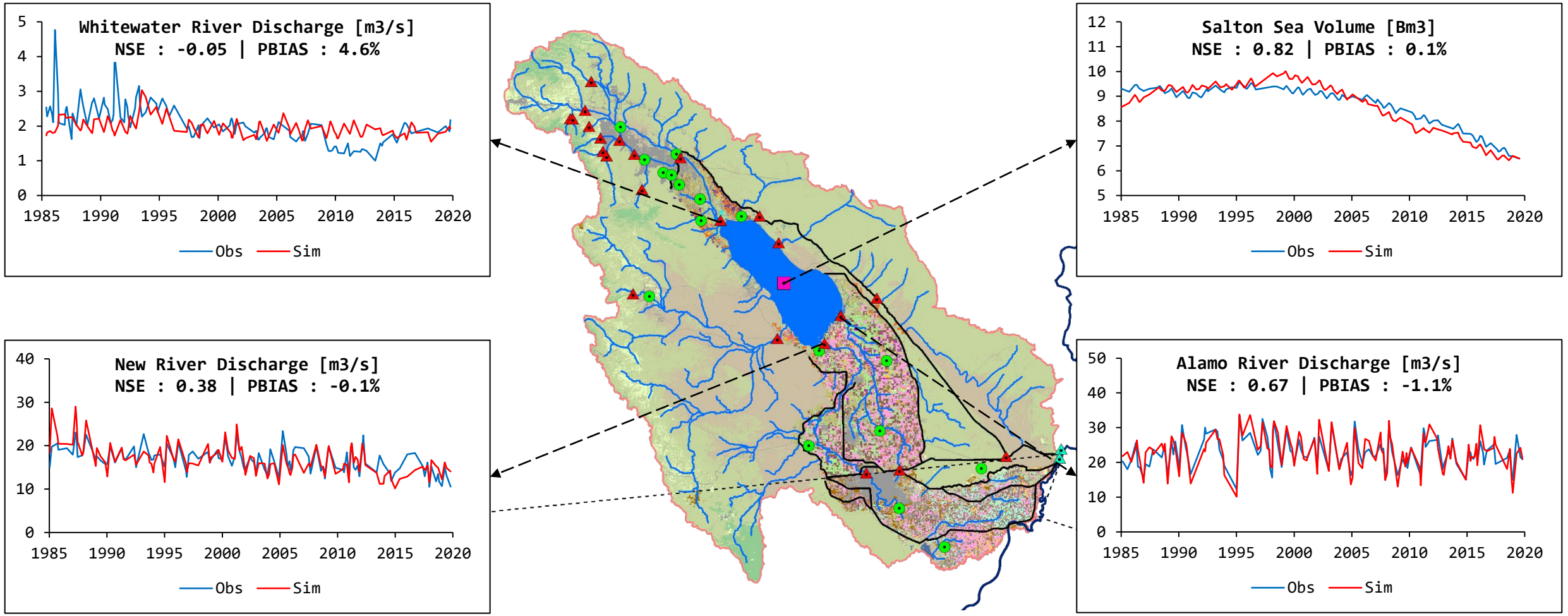
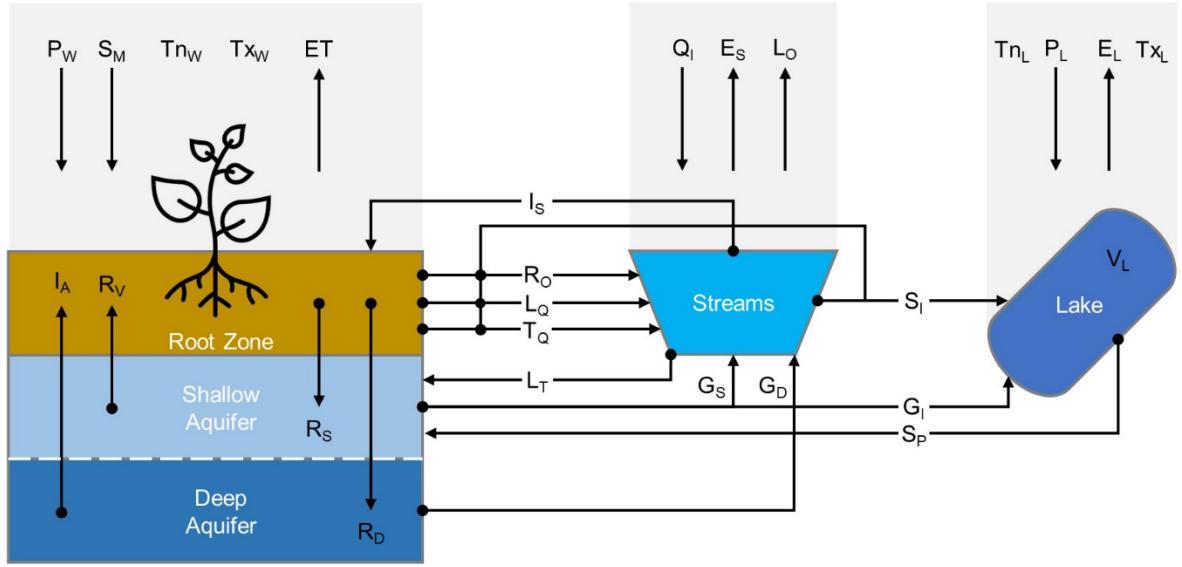
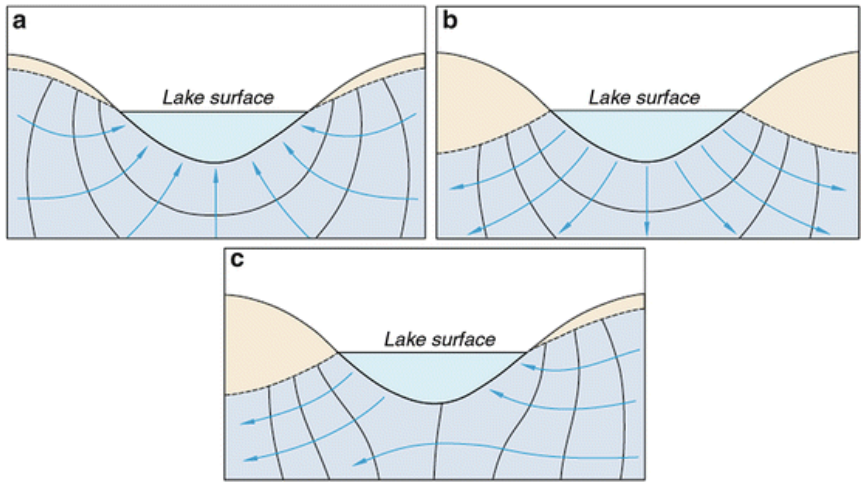
Validation results are satisfactory.

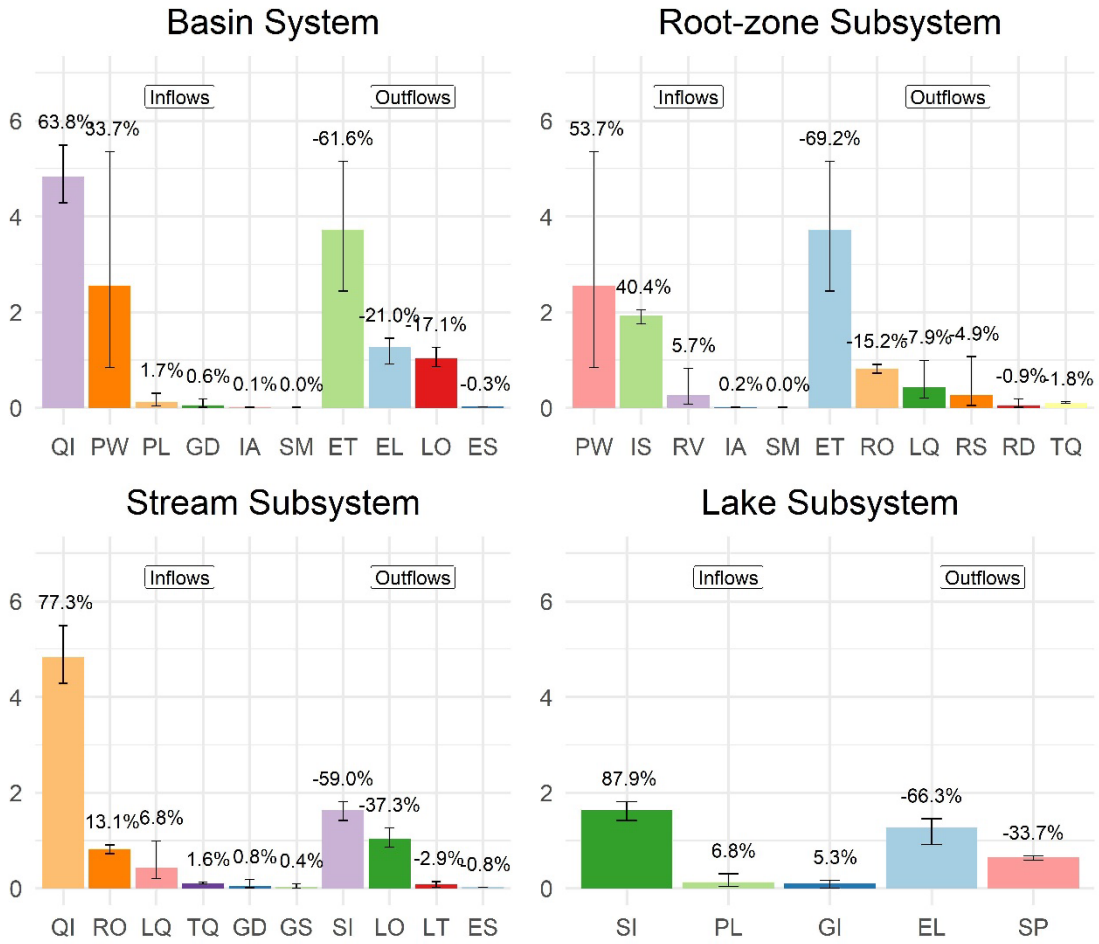


30% of the records used for validation

Lake water balance is mainly controlled by the surface inflows, evaporation and seepage losses.



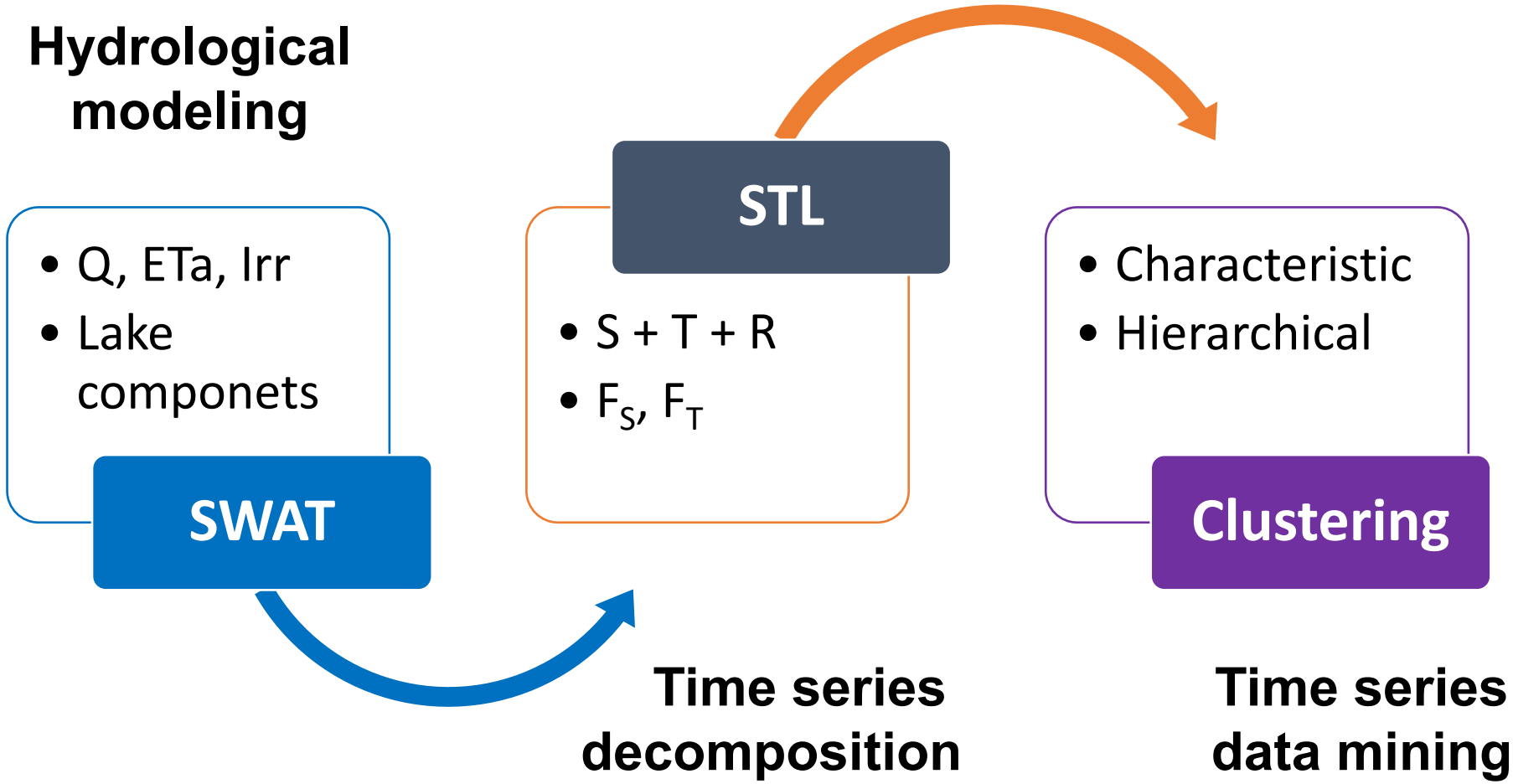




*Annual water budget in km^3. Color-bar height represents the long-term mean, while the black-error bars indicate the minimum and maximum.

Acero Triana & Ajami. *In Review*

Implemented time series data mining to identify major drivers of hydrologic variability and lake water depletion.



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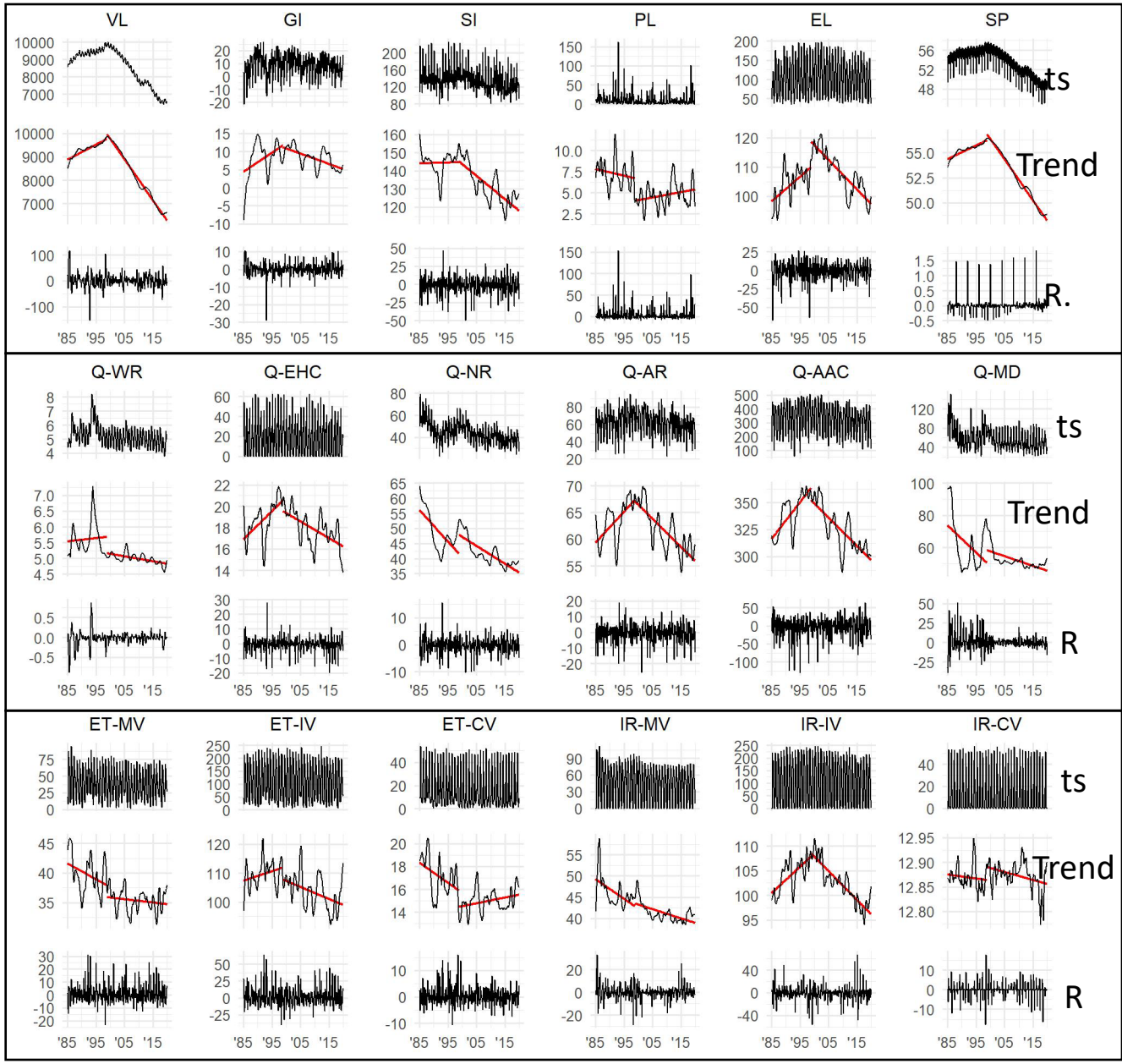
Signs of the lake depletion after Nov. 1998.

- Long-term water balance seasonality has remained unchanged.

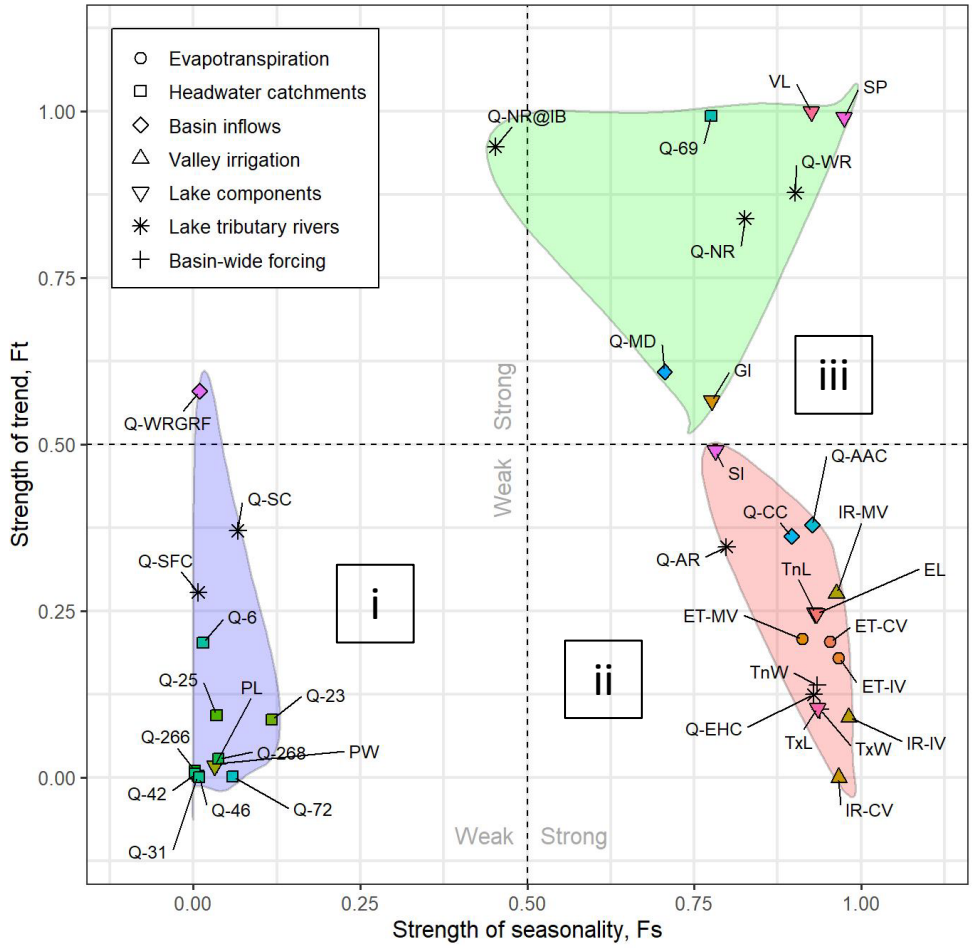
- Declining lake level coincides with the 1998 IID-SDCWA conserved water transfer agreements (up to 247 $Mm^3\ yr^{-1}$) and the 1999 Colorado River Water Use 4.4 Plan (CA: -1 $km^3\ yr^{-1}$).



*Monthly STL-decomposition in Mm^3.

Acero Triana & Ajami. *In Review*

Identified three major hydrologic signatures across processes based on the strength of seasonality and trend.



i. Precipitation is the main hydrologic driver in non-agricultural catchments.

ii. Processes with a predominant seasonality are primarily driven by temperature.

iii. Colorado River inflows through Mexico has a strong impact on the Salton Sea ~ declining New River flows is the major hydrologic driver of lake depletion.

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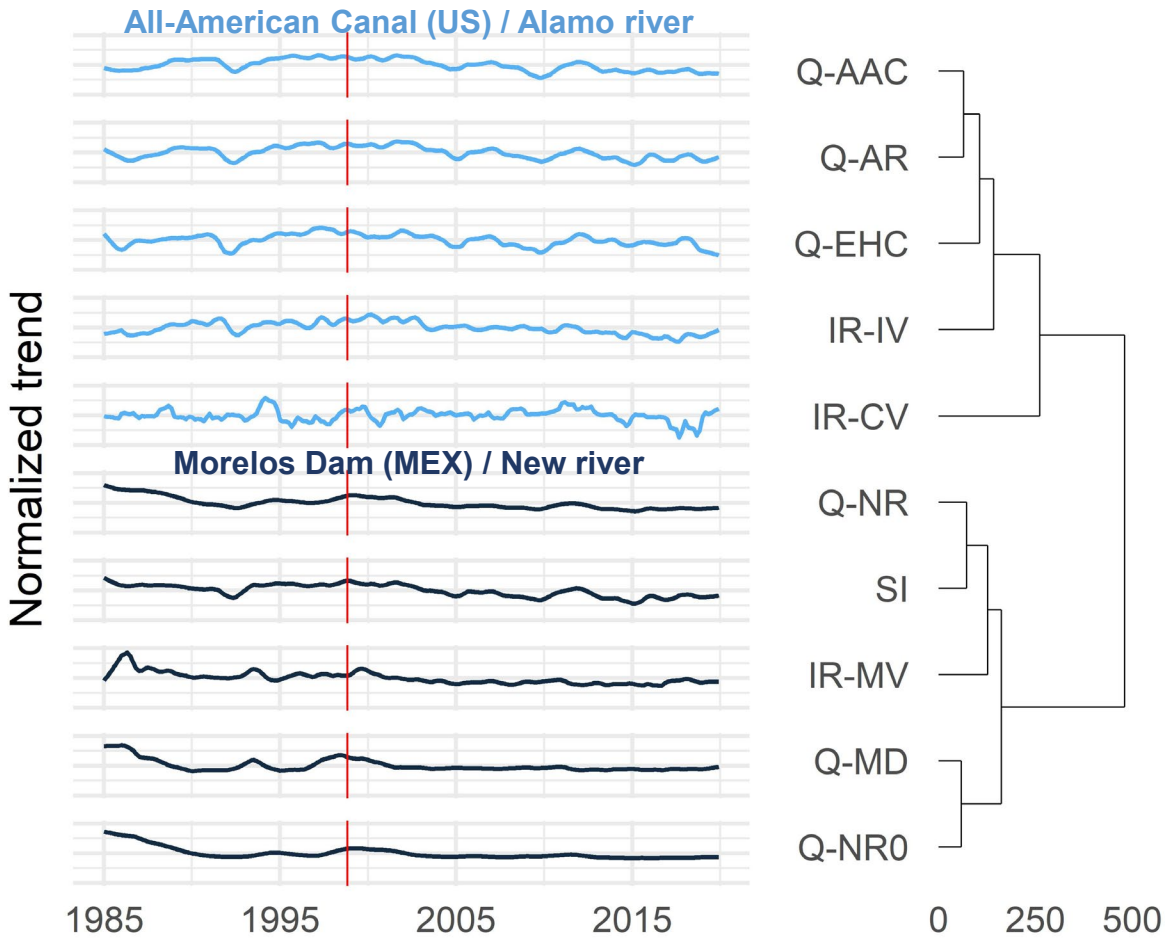
Depletion patterns correspond to changes to basin water imports



- Declining patterns of the main lake tributaries can be traced back to the All-American Canal and Morelos Dam inflows.
- Decreases in irrigation volumes caused by the decline in flows in rivers/canals.

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Main Conclusions

- Salton Sea crisis seems to be caused by the decline in surface inflows, which originates at the intake of the All-American Canal and the Morelos Dam ~ decreases in the Colorado River allocation.

- It is not clear if the Salton Sea depletion is mainly caused by the implementation of the IID-SDCWA water agreements and the California 4.4 Plan, the decline of Colorado River flows due to global warming, or both.

- A holistic approach that considers both basins is required to mitigate the health and environmental impacts.

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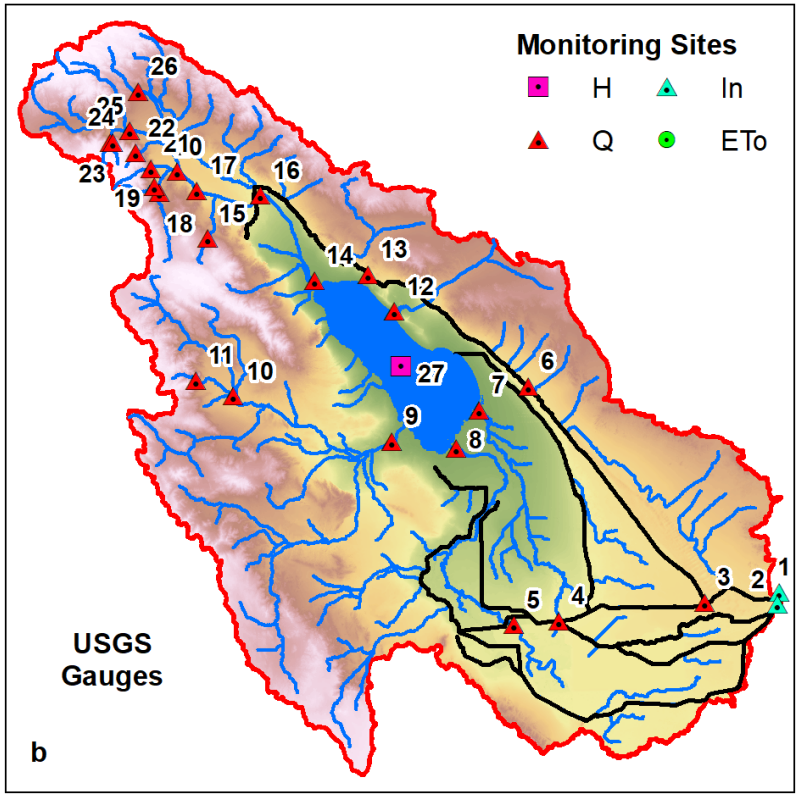
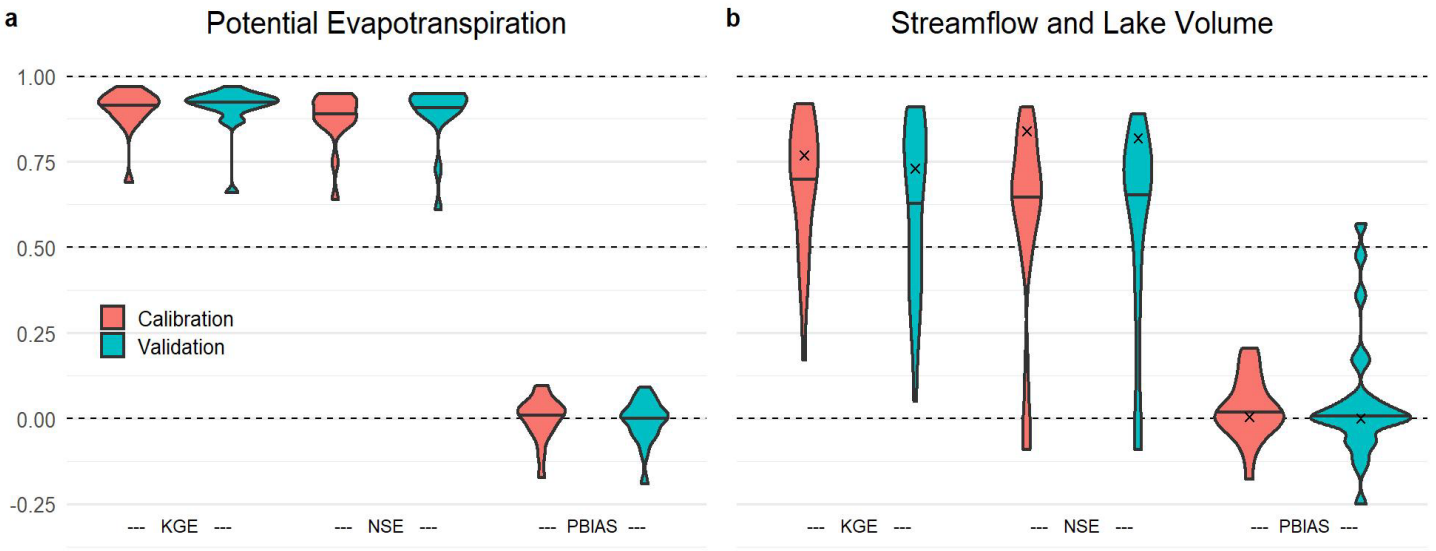
THANK YOU

Hoori Ajami: hooria@ucr.edu
Juan S. Acero Triana: juanseba@ucr.edu

Q calibration results are satisfactory across majority of the gauges.





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