BUREAU OF RECLAMATION

CVP Water Temperature Modeling Platform Project

Final Independent Peer Review

September 12-14, 2023

Photo credit: John Hannon, Reclamation

Welcome and Introductions

Photo credit: John Hannon, Reclamation

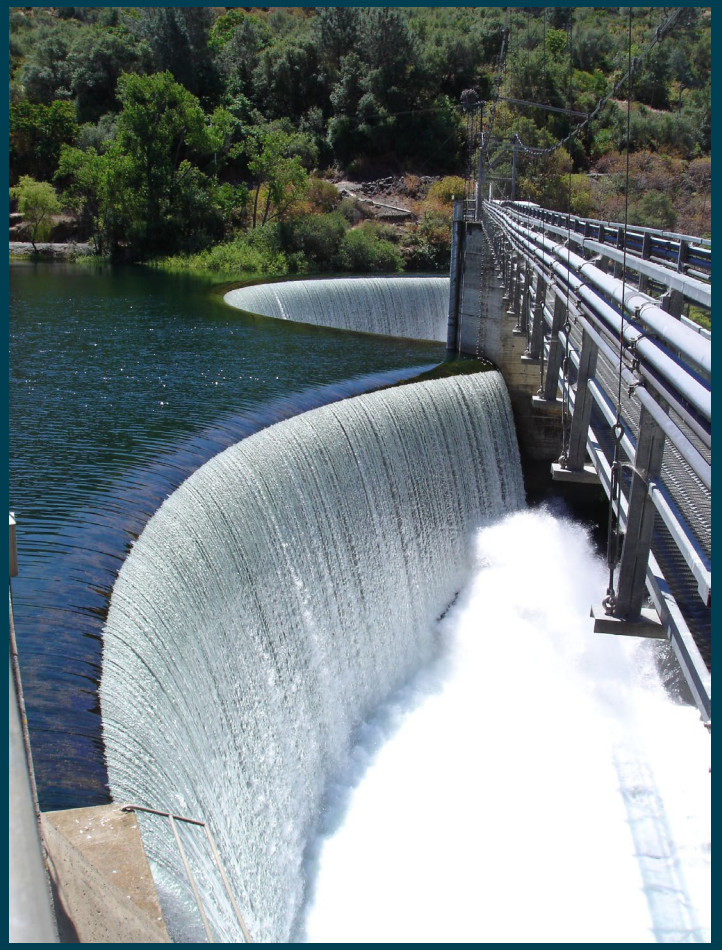
Calibration, Validation and Sensitivity Performance

Randi Field, Hydrologic Engineer

Reclamation, Central Valley Operations Office

Model Performance Discussion

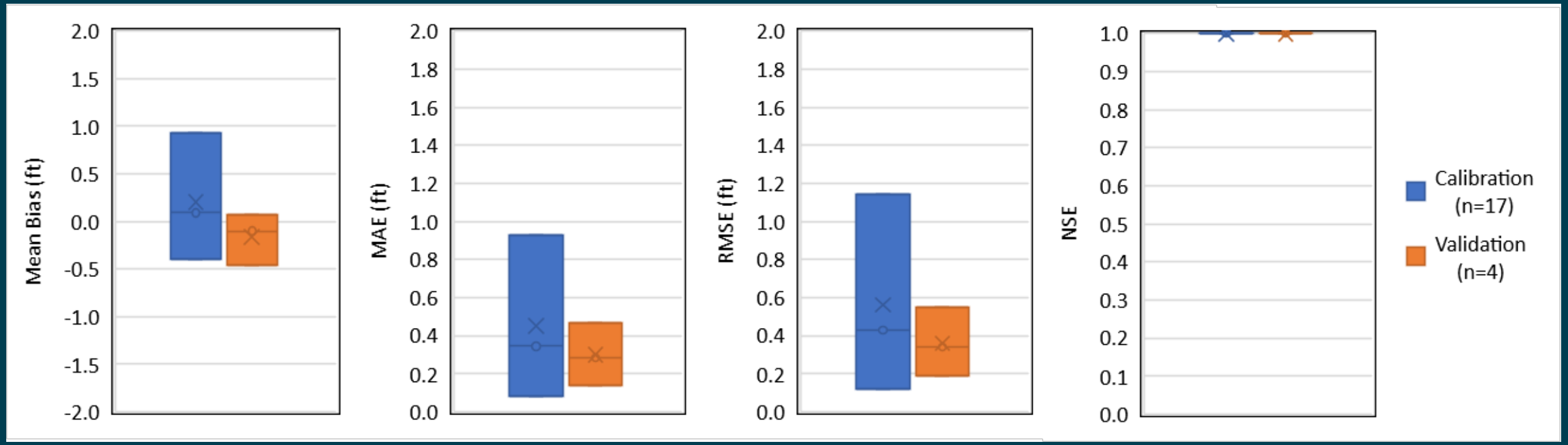
- Watersheds:
  - Sacramento/Trinity
  - American
  - Stanislaus
- Models:
  - CE-QUAL-W2
  - ResSim
- Model Performance:
  - Calibration
  - Validation
  - Sensitivity Analysis



Source: Reclamation

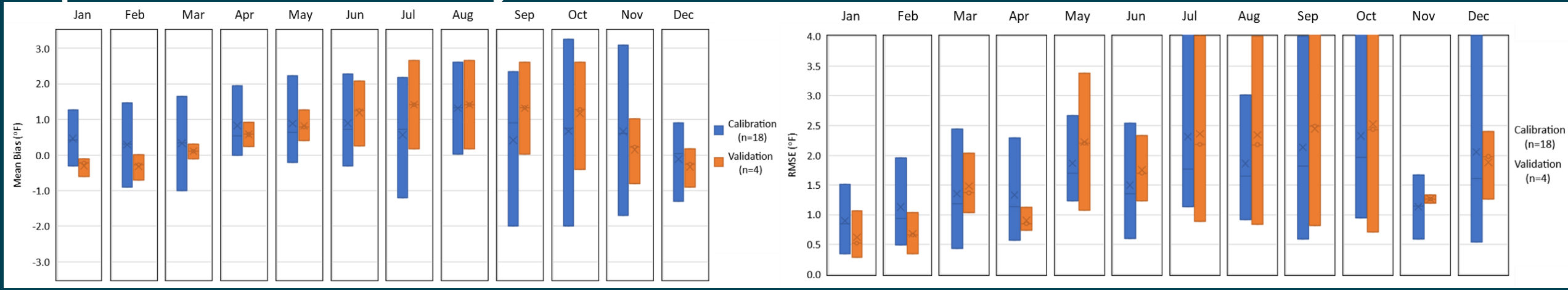
Validation CE-QUAL-W2 Shasta Lake Stage

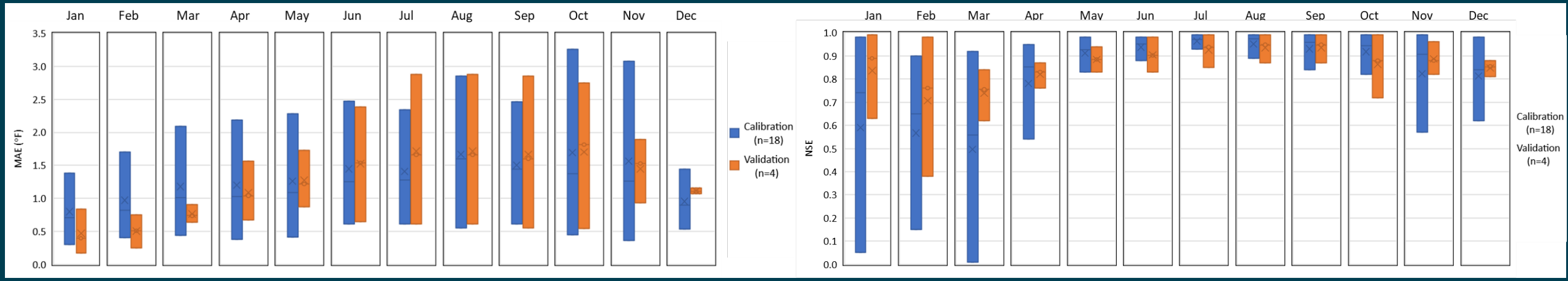
- Stage difference between simulated and measured, hourly for all years.



Validation CE-QUAL-W2 Shasta Lake Vertical Temperature Profiles

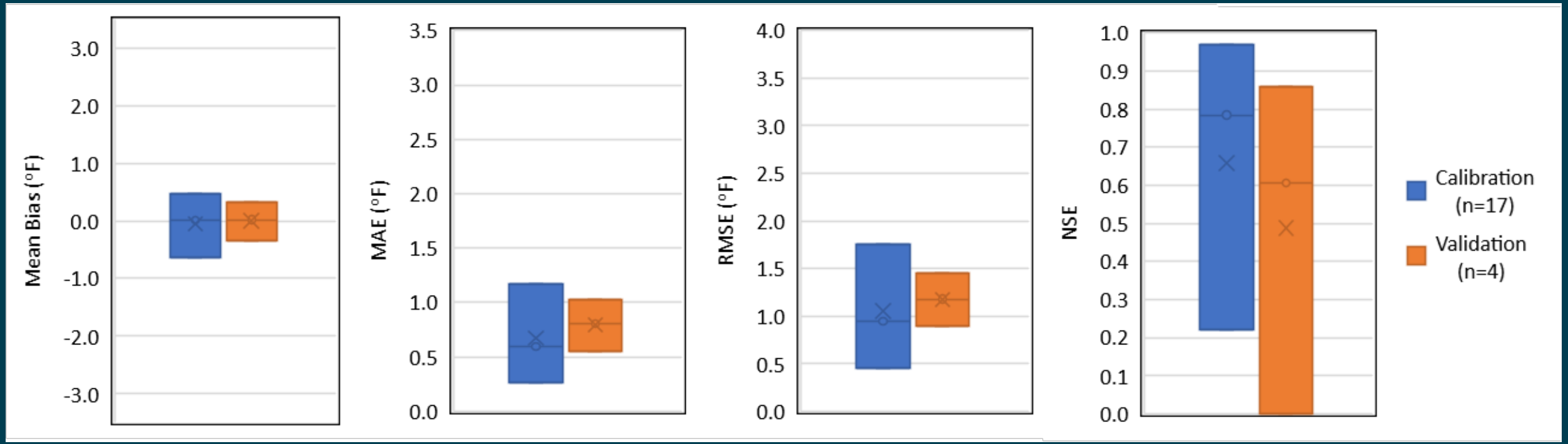
- Profile nearest dam: difference between simulated and measured, by profile month for all years.



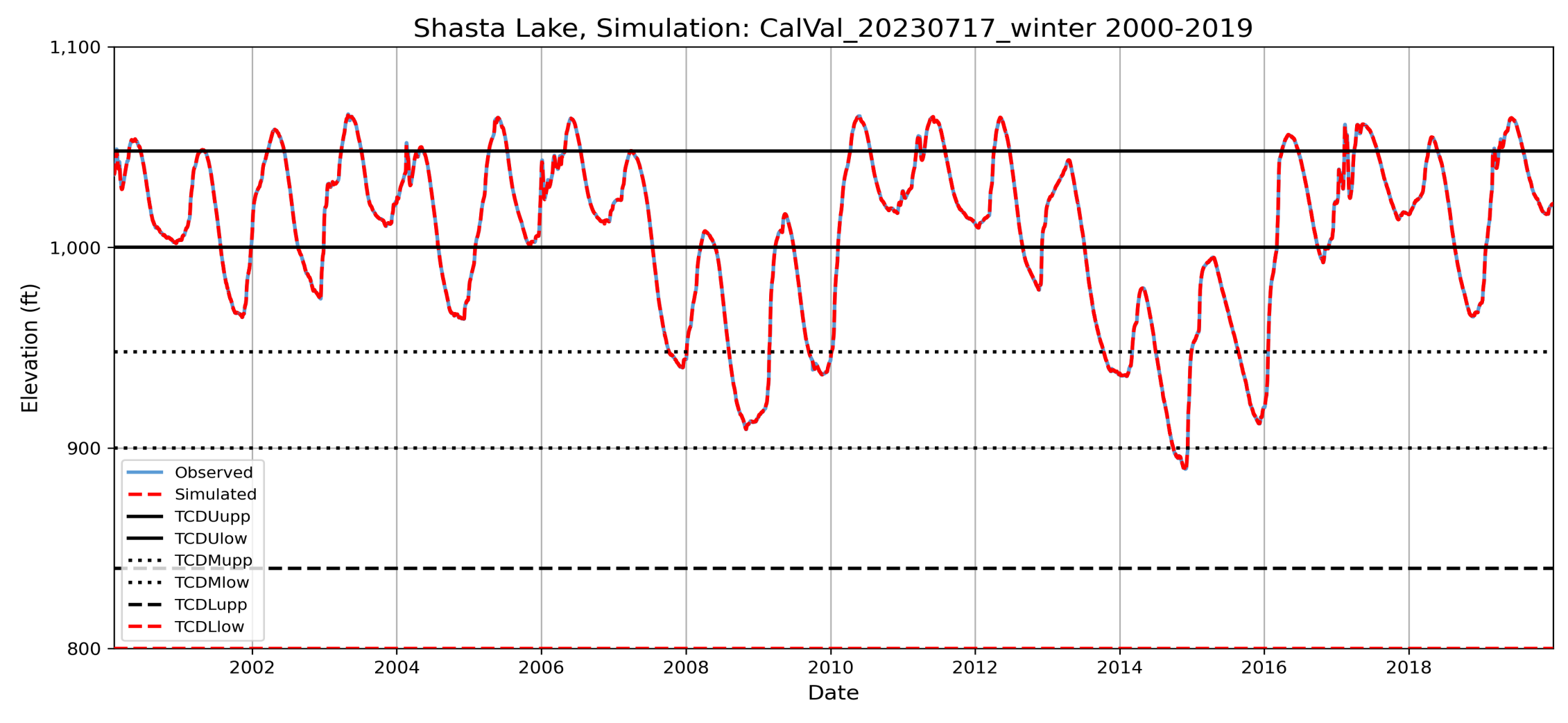


Validation CE-QUAL-W2 Shasta Lake Outflow Temperature

- Temperature difference between simulated and measured, hourly for all years.

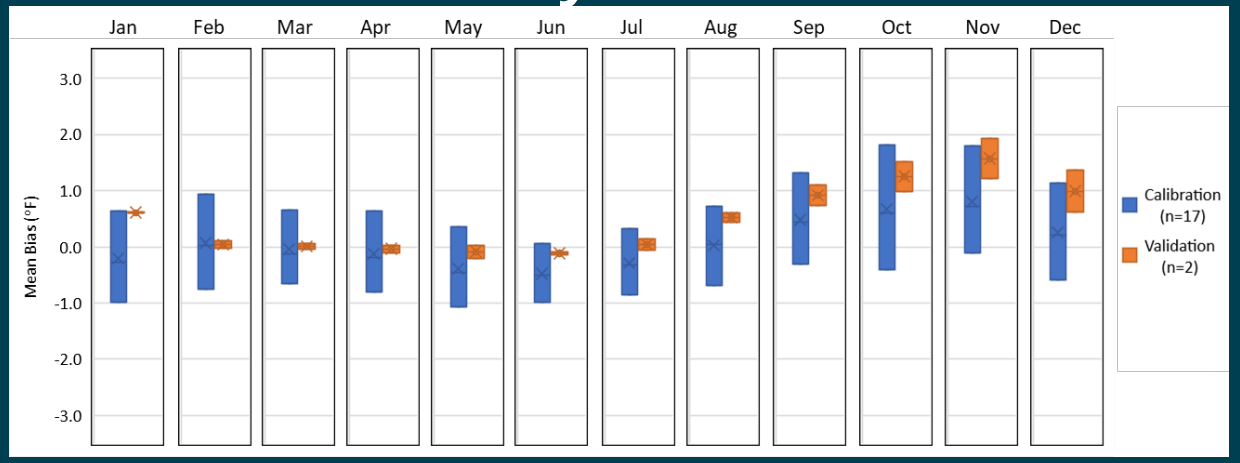


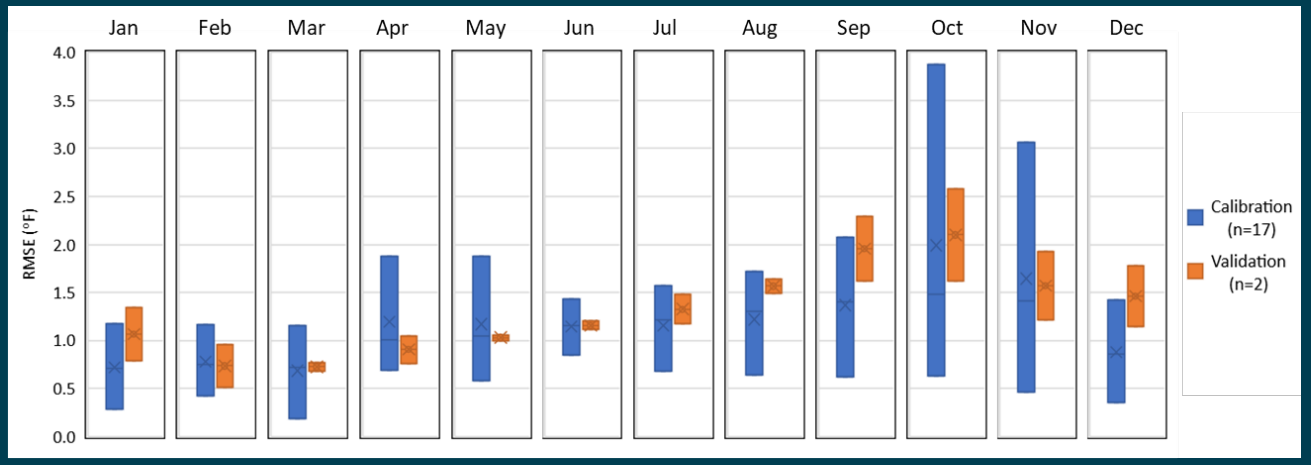
Validation ResSim: Shasta Lake Stage

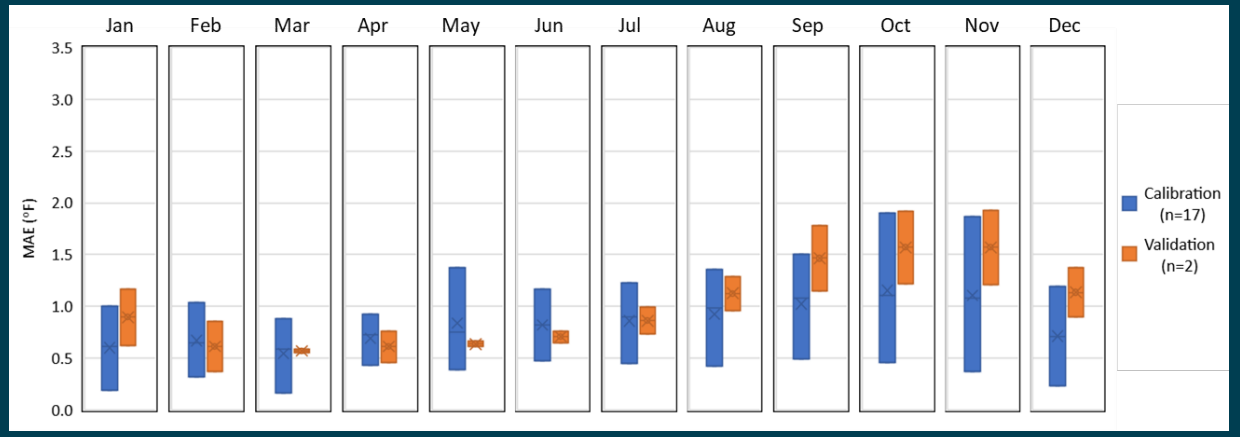


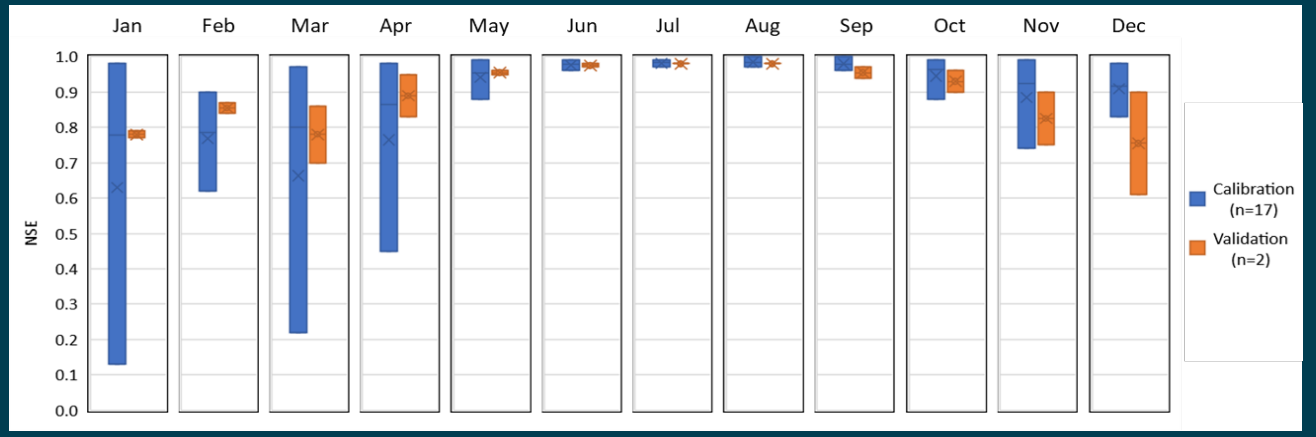
Validation ResSim: Shasta Lake Vertical Temperature Profiles

- Profile nearest dam: difference between simulated and measured, by month for all years.



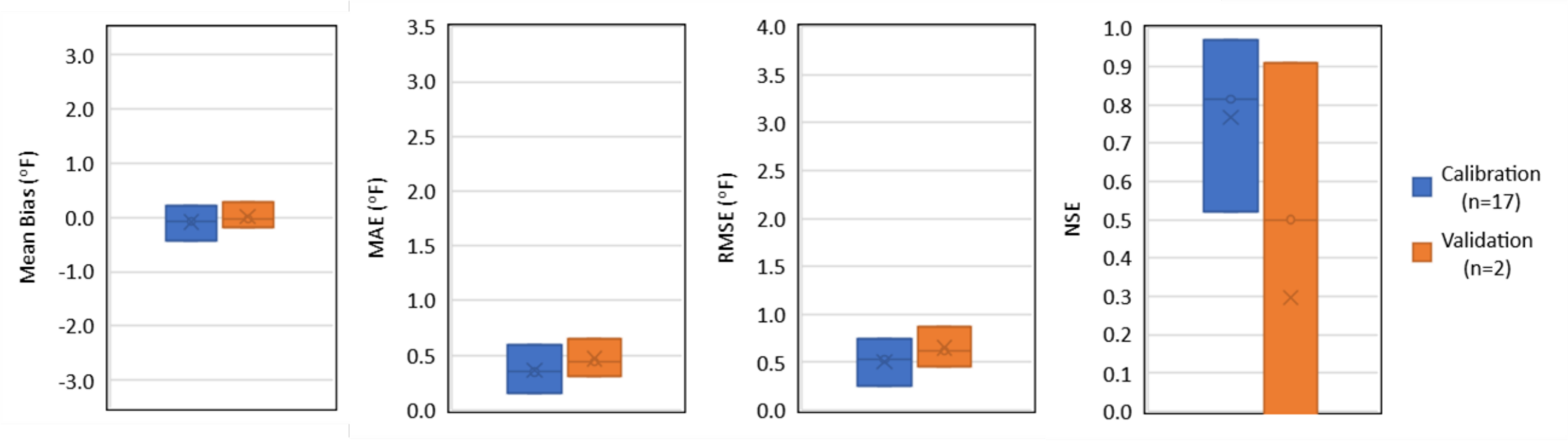






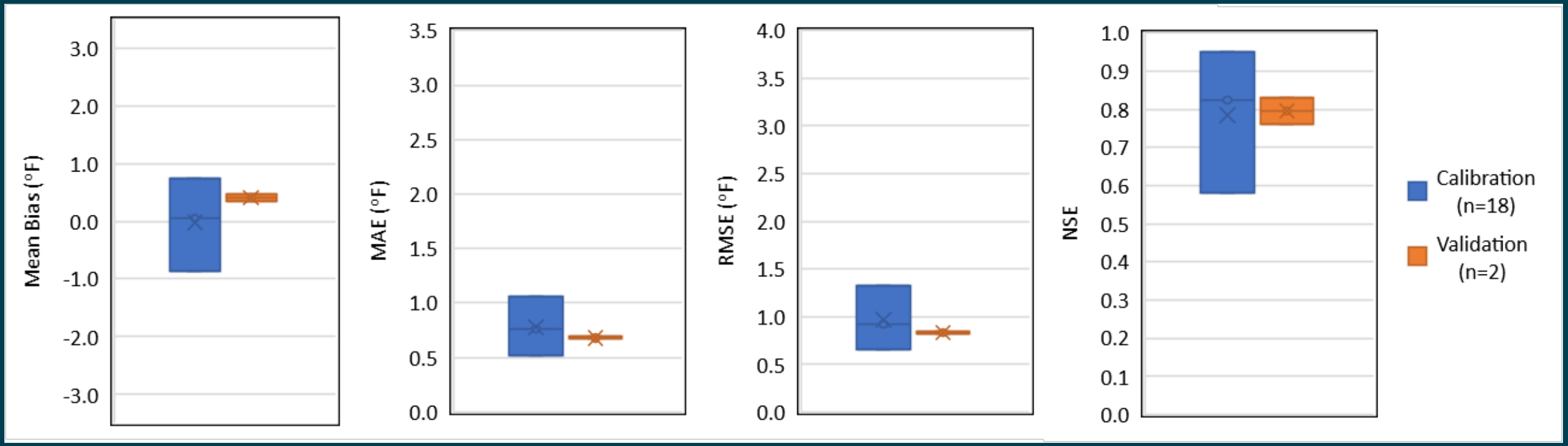
Validation ResSim: Shasta Lake Outflow Temperature

- Temperature difference between simulated and measured, hourly for all years. Winter and some spring month variability during stratification, generally resolved by onset of the subsequent year stratification, can have persisting cold water pool effects.



Validation ResSim: Sacramento River Temperature at Clear Creek

- Temperature difference between simulated and measured, hourly for all years.



CE-QUAL-W2 Sensitivity Results: Sacramento

- Shasta Lake:
  - Most sensitive to evaporative heat flux parameters.
  - Least sensitive to wind sheltering, light extinction, fraction of solar radiation absorbed at water surface, and initial profile.
- Keswick Lake:
  - Generally insensitive to modeling parameters and initial profile due to short travel time and large flows.

ResSim Sensitivity Results: Sacramento

- Shasta Lake:
  - Sensitive to surface wind forcing parameters/effectively meteorological inputs.
- Keswick Lake:
  - Generally insensitive to model parameters due to short residence time and large degree of vertical mixing. Highly influenced by Shasta outflow.
- Sacramento River:
  - Sensitive to atmospheric fluxes/related parameters and some sensitivity to sediment layer thickness related to diurnal temperature cycling.

Validation and Sensitivity Summary (Part I)

- Accomplishments:
  - Project tasks documented calibration of models and validation efforts to test model performance and gain confidence in tool capabilities.
  - Additional model performance testing was documented to assess the sensitivity to model parameters and inputs; this suggests the magnitude of influence and where improvement investments are likely to be effective in the future.

Calibration, Validation, and Sensitivity Performance Summary (II)

- Assessment:
  - Model calibration demonstrated that performance for much of the period is generally good, capturing the onset, persistence, and breakdown of thermal stratification in lakes; representing the highly dynamic nature of reservoirs that receive hydropower peaking flows from dams upstream; and representing the diurnal range of water temperatures in the river reaches.

Calibration, Validation, and Sensitivity Performance Summary (III)

- Assessment:
  - Model validation identified that in most cases the models performed within the model performance metrics, and validation often within the range of calibration period model performance. Deviations were typically restricted to a portion of a year in the validation simulations. Overall, the validation supported that the models are stable over years independent from calibration.

Calibration, Validation, and Sensitivity Performance Summary (IV)

- Assessment:
  - Model sensitivity analysis generally revealed expected results to select inputs and parameters. Larger reservoirs and riverine systems are more likely to be influenced by perturbation of heat flux and meteorologic/wind parameters, where afterbays are generally insensitive to perturbation of parameters due to influences of upstream reservoir operations.