Tampa Bay Water's Seasonal Water Resources Allocation

Tirusew Asefa, PhD, PE, D.WRE, F.ASCE

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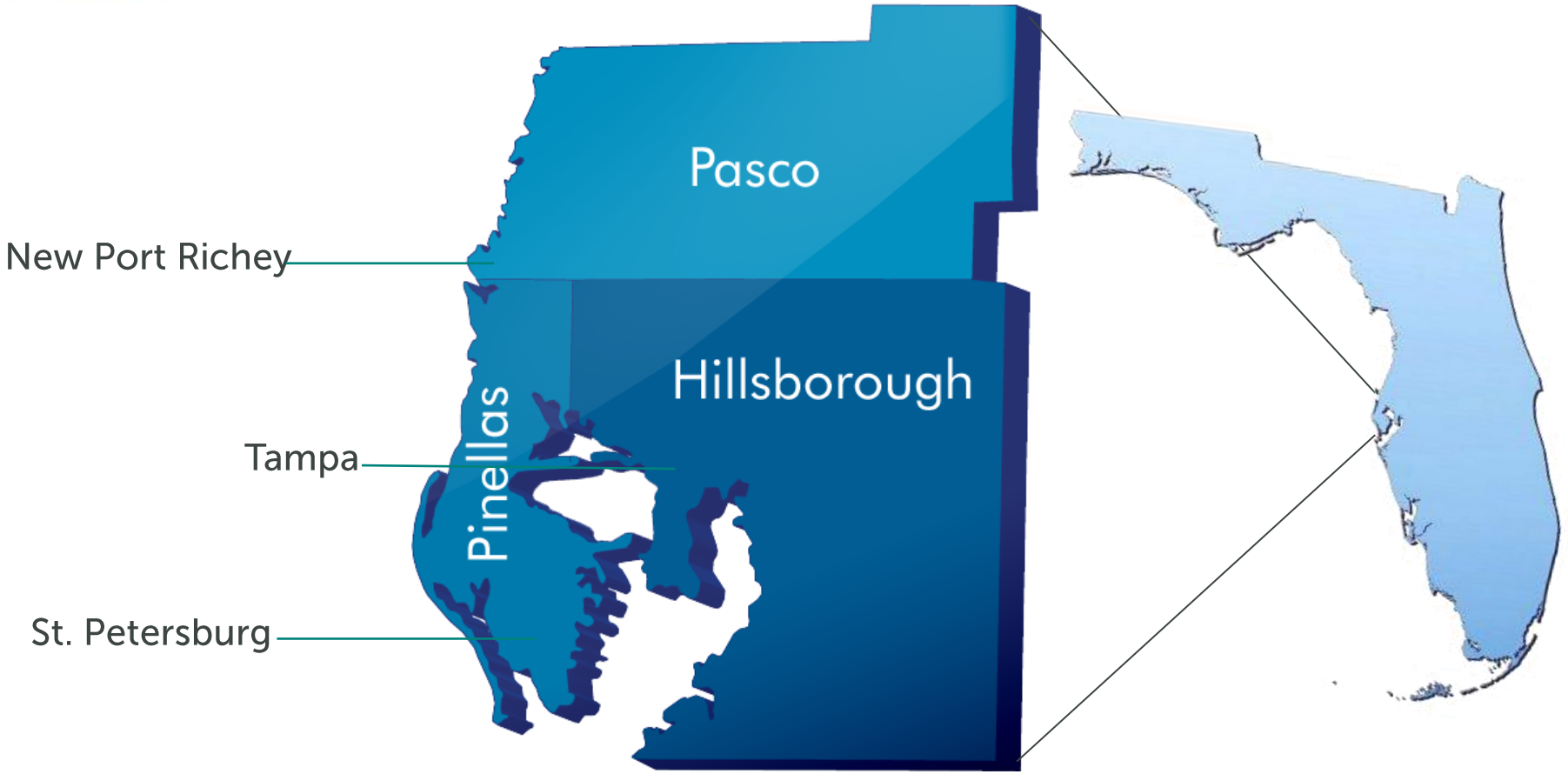
Tampa Bay Water's Member Governments



The Seasonal Water Allocation Problem

- Objective: Given range of seasonal demands and flow condition, what is the best way to operate a diversified portfolio

- Optimality: Cost effectiveness, no over or under utilization (= permit compliance), End of Year reservoir storage

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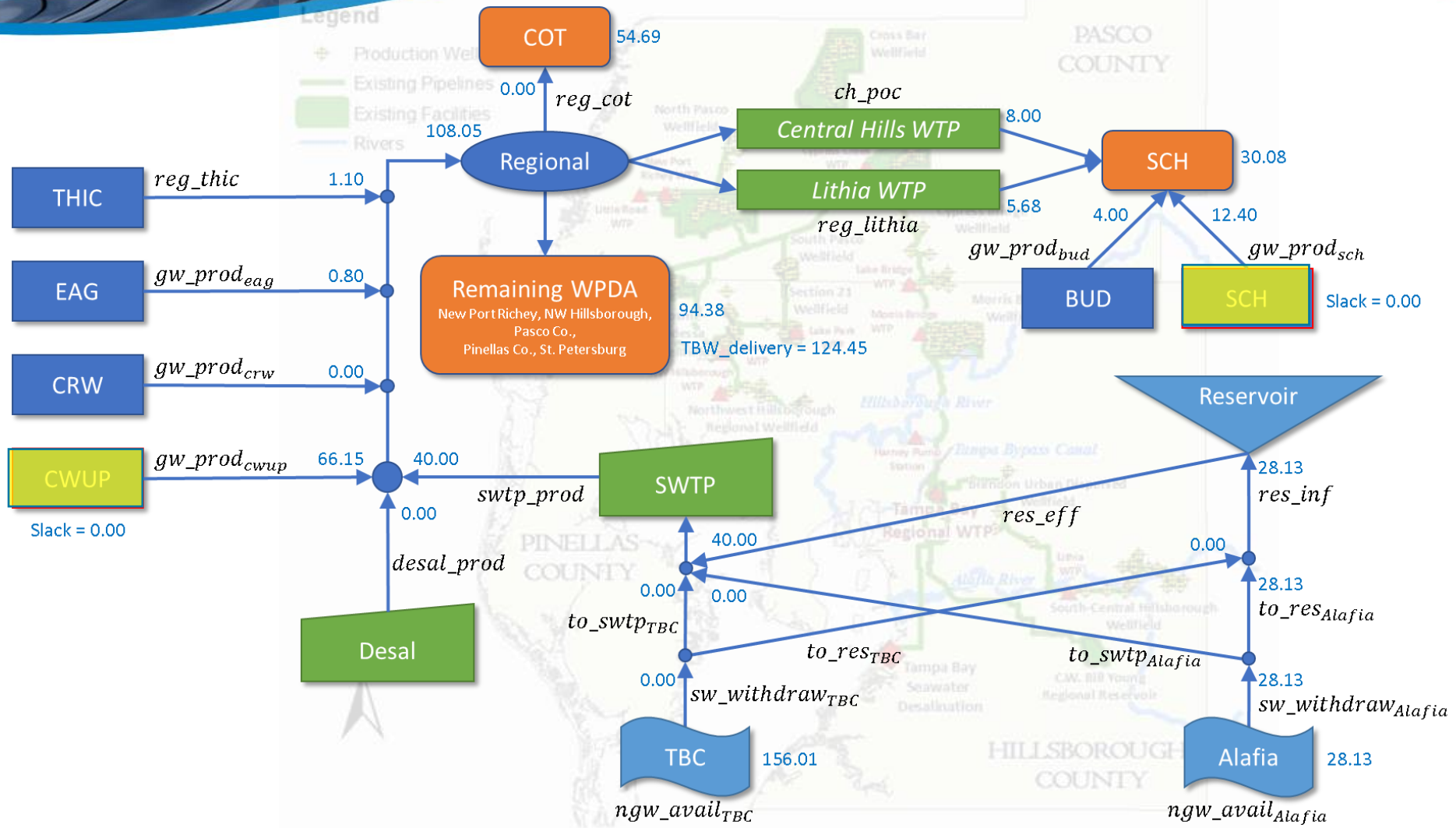
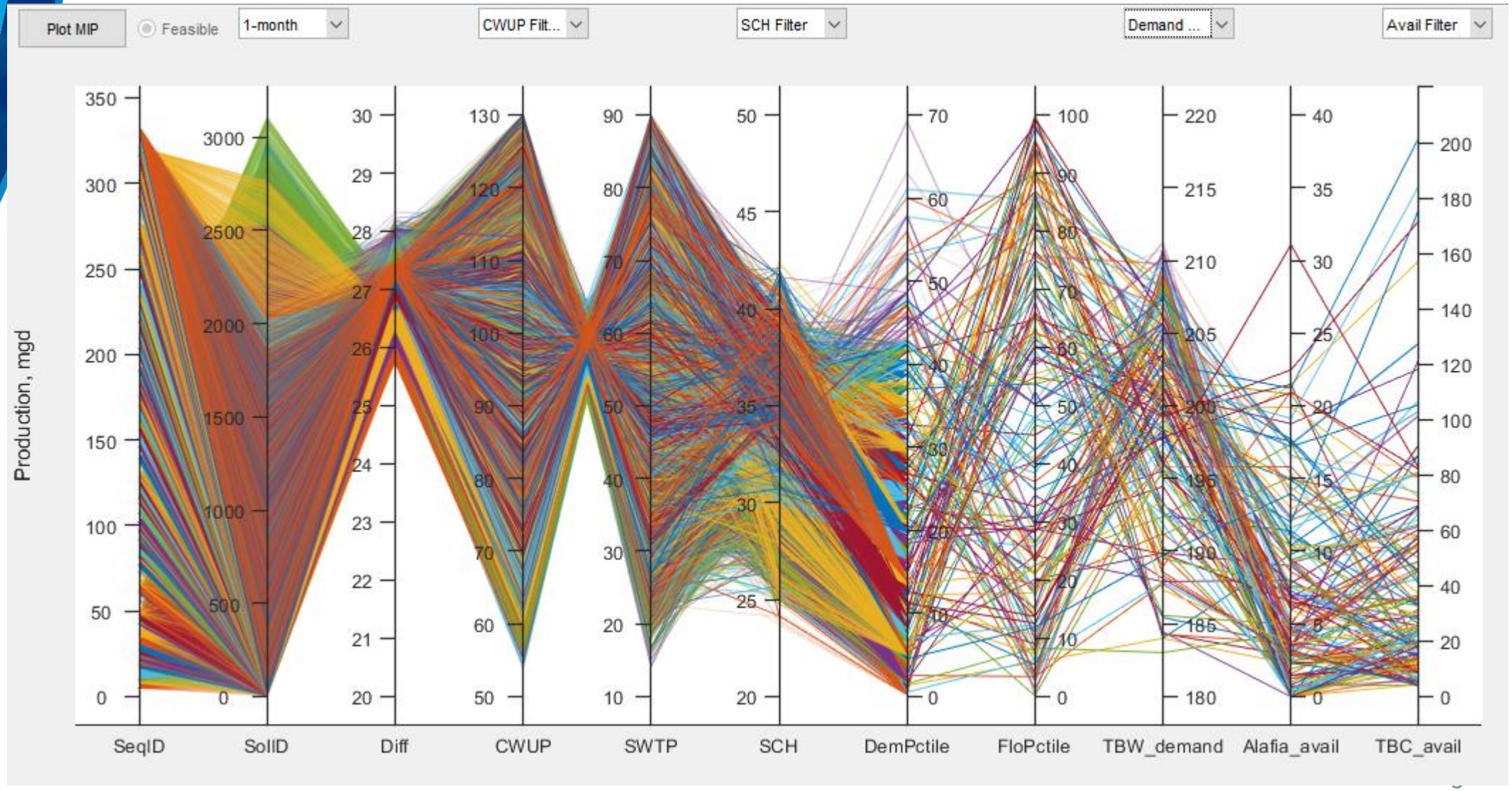
Simplified TBW water supply system



Filtering of equally likely solutions



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Customized Regional Climate Model Outputs to Enhance Dry-season Streamflow Forecasts

Hui Wang, PhD, PE

April 15, 2022

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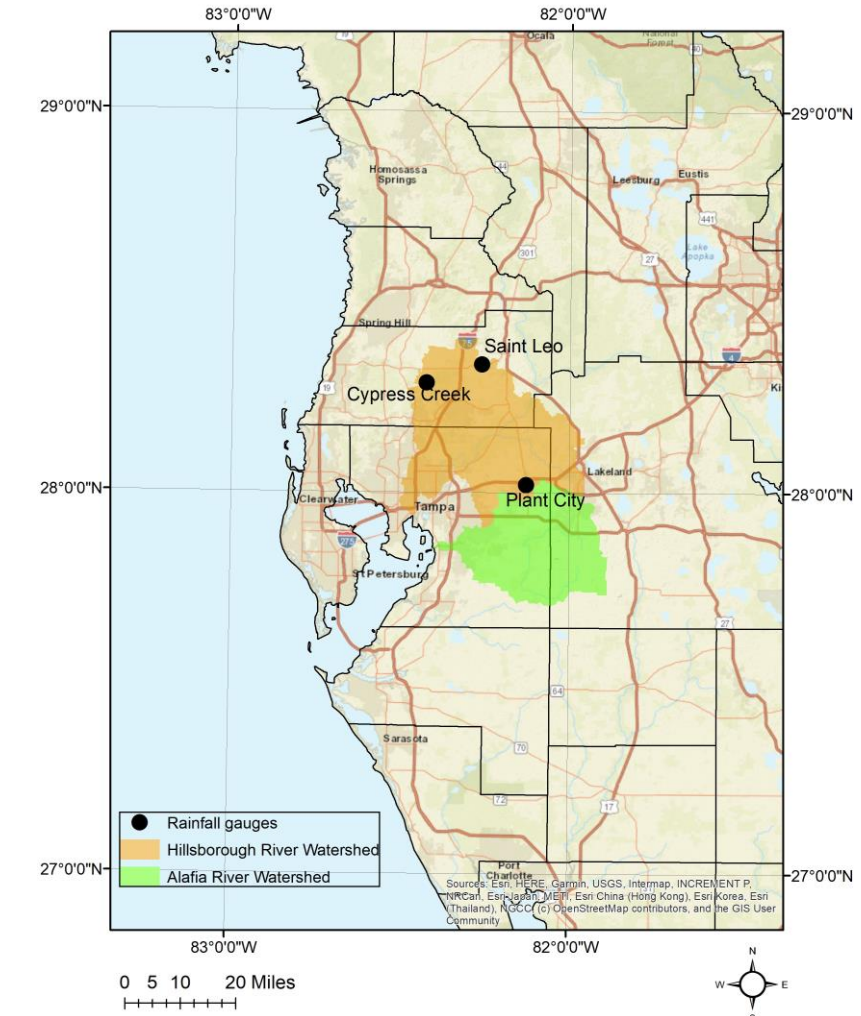
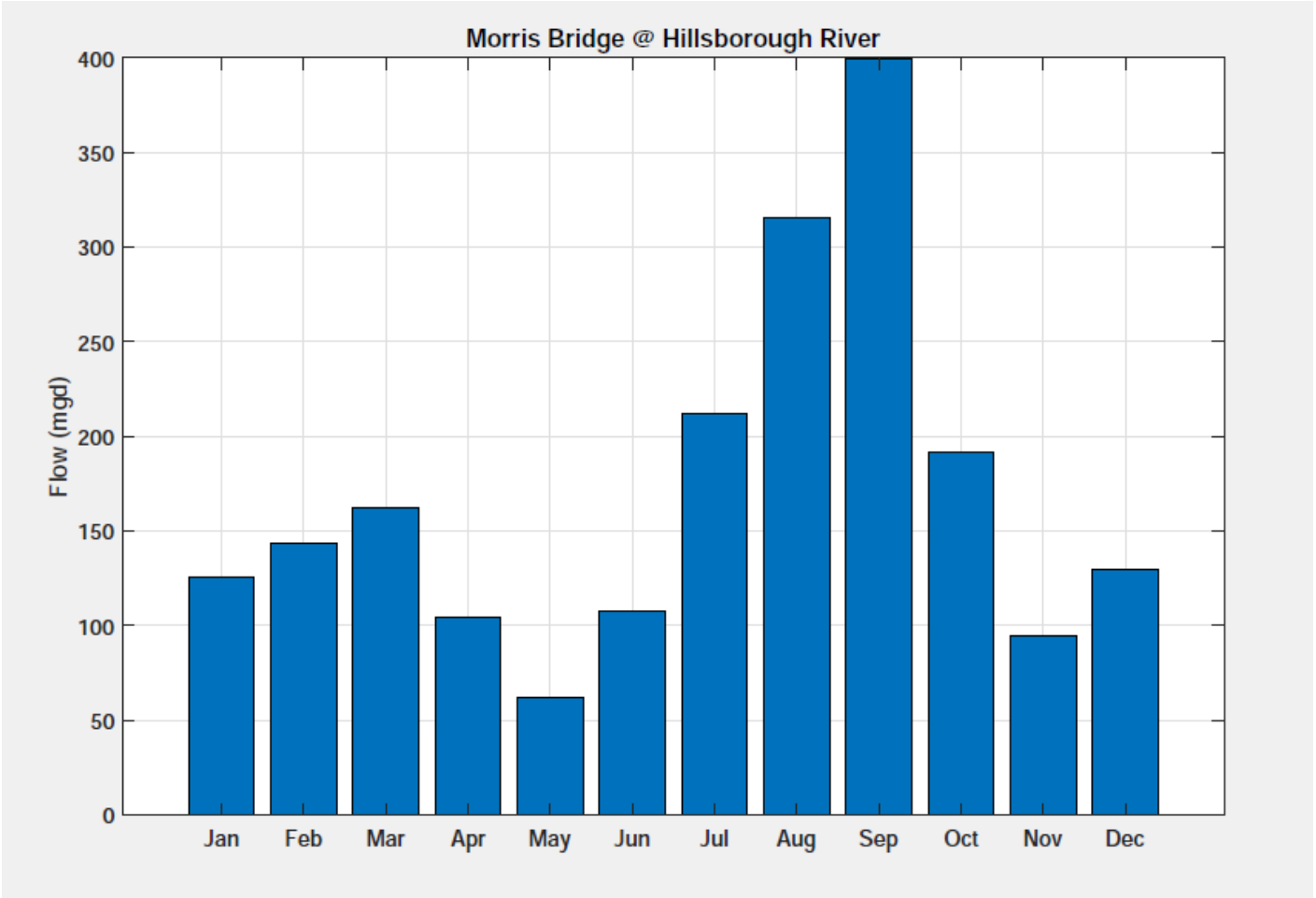
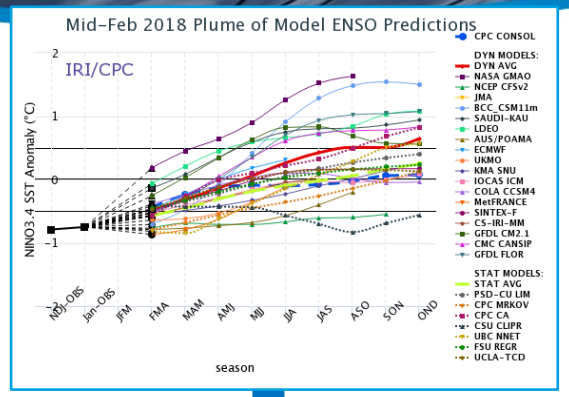
Study area – streamflow seasonality

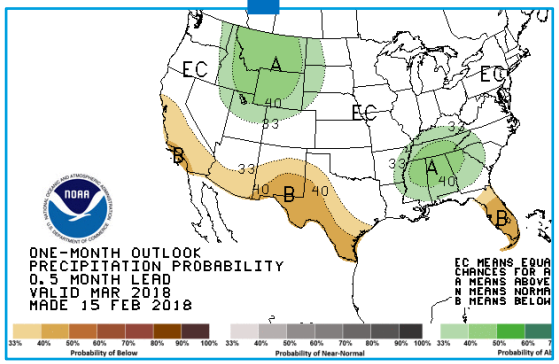




Stochastic seasonal flow generation

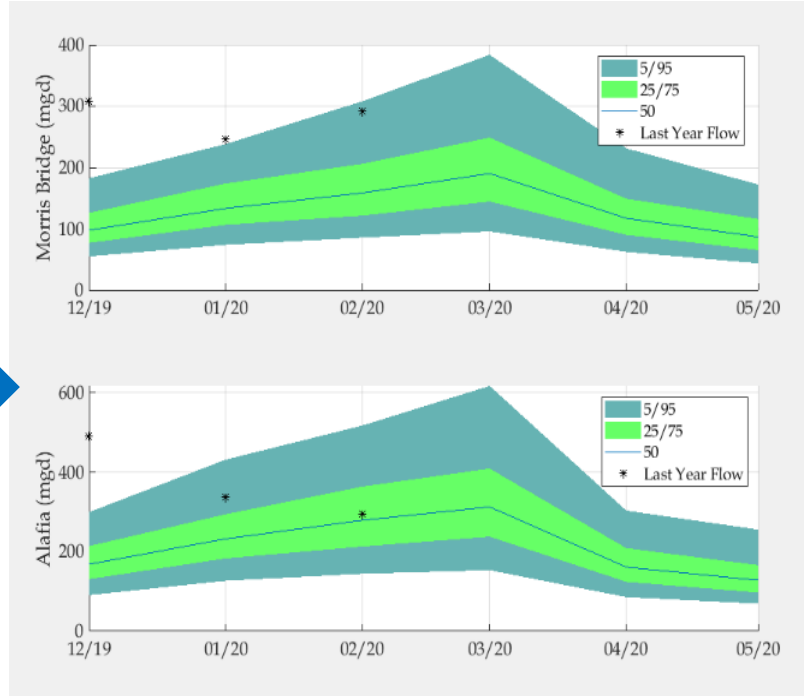


Climate Outlook & NOAA forecasts



Hidden Markov Chain Rainfall Model*

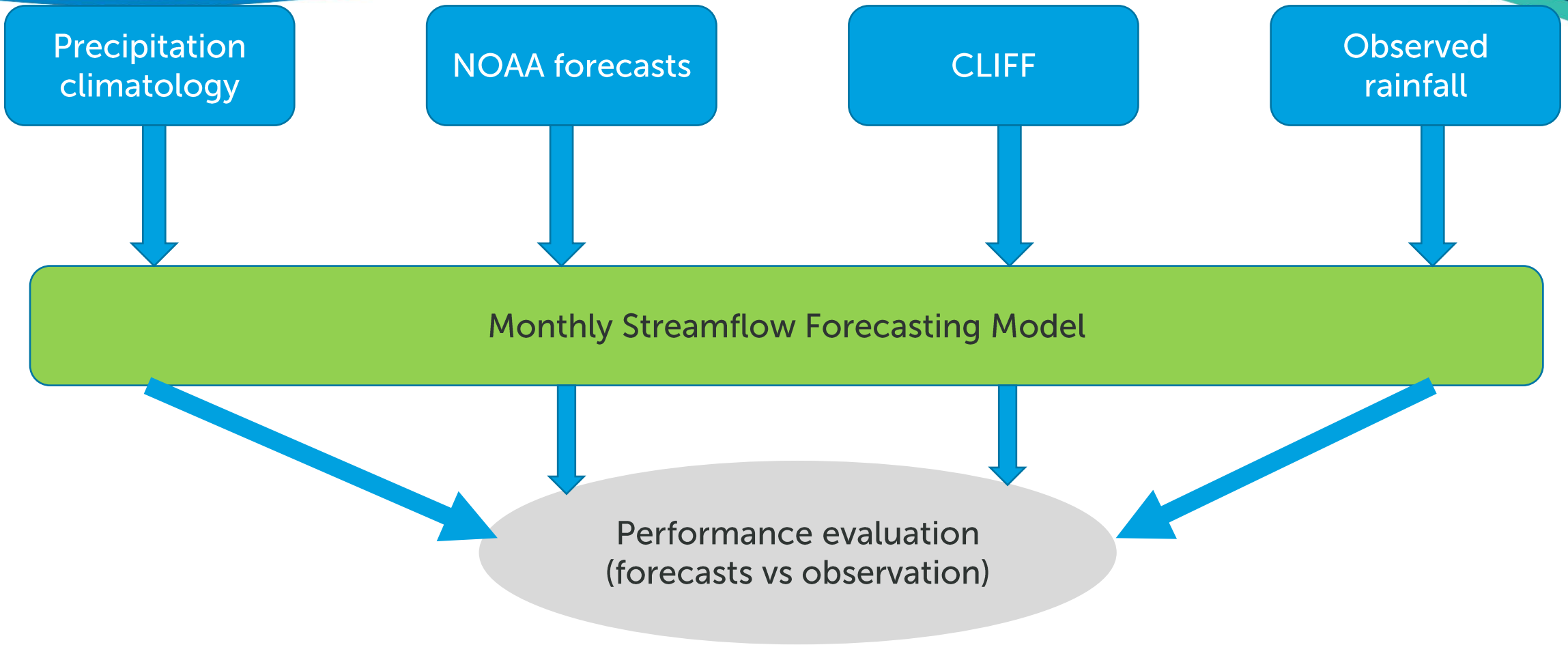
Seasonal Multi-linear Regression Model**



*Wang, H., T. Asefa, N. Wanakule and A. Adams (2020). Application of Decision-Support Tools for Seasonal Water Supply Management that Incorporates System Uncertainties and Operational Constraints. Journal of Water Resources Planning and Management. https://doi.org/10.1061/(ASCE)WR.1943-5452.0001225

**Asefa., T., J. Clayton, A. Adams, D. Anderson (2014). Performance evaluation of a water resources system under changing climatic conditions: Reliability, Resilience, Vulnerability and beyond. Journal of Hydrology. 508, 53-65. https://doi.org/10.1016/j.jhydrol.2013.10.043

Evaluation framework: diagram*



*Wang. H., T. Asefa. Assessing the Value of a Regional Climate Model's Rainfall Forecasts in Improving Dry-season Streamflow Predictions. *Journal of Water Resources Planning and Management*, doi: 10.1061/(ASCE)WR.1943-5452.0001571, In press.

Evaluation metrics

Deterministic forecasts (ensemble mean vs observed streamflow):

- correlation
- mean absolute percent error (MAPE):

$$e_{t,j} = \frac{|f_{t,j} - o_t|}{o_t} \times 100\%$$

$$\bar{e}_j = \frac{1}{n} \sum_{t=2000}^{t=2019} e_{t,j}$$

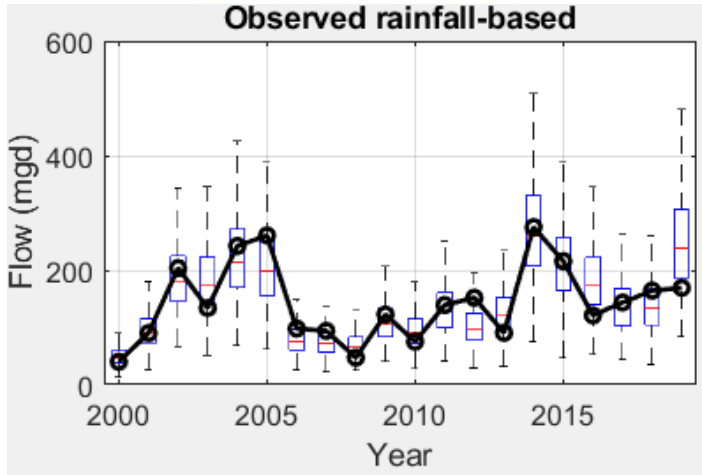
t: Year 2000-2019;

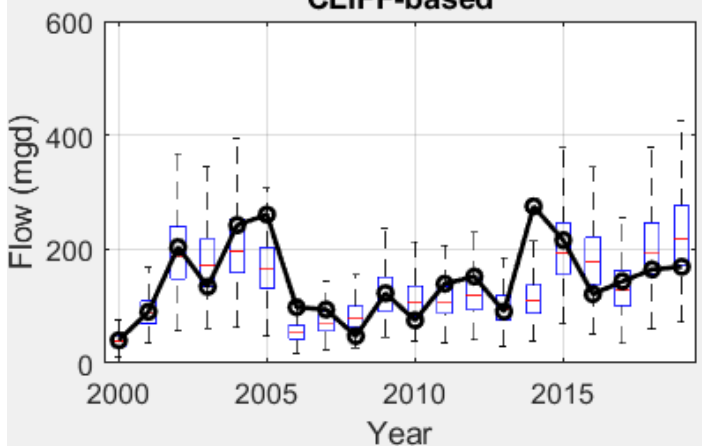
j: deterministic forecasts

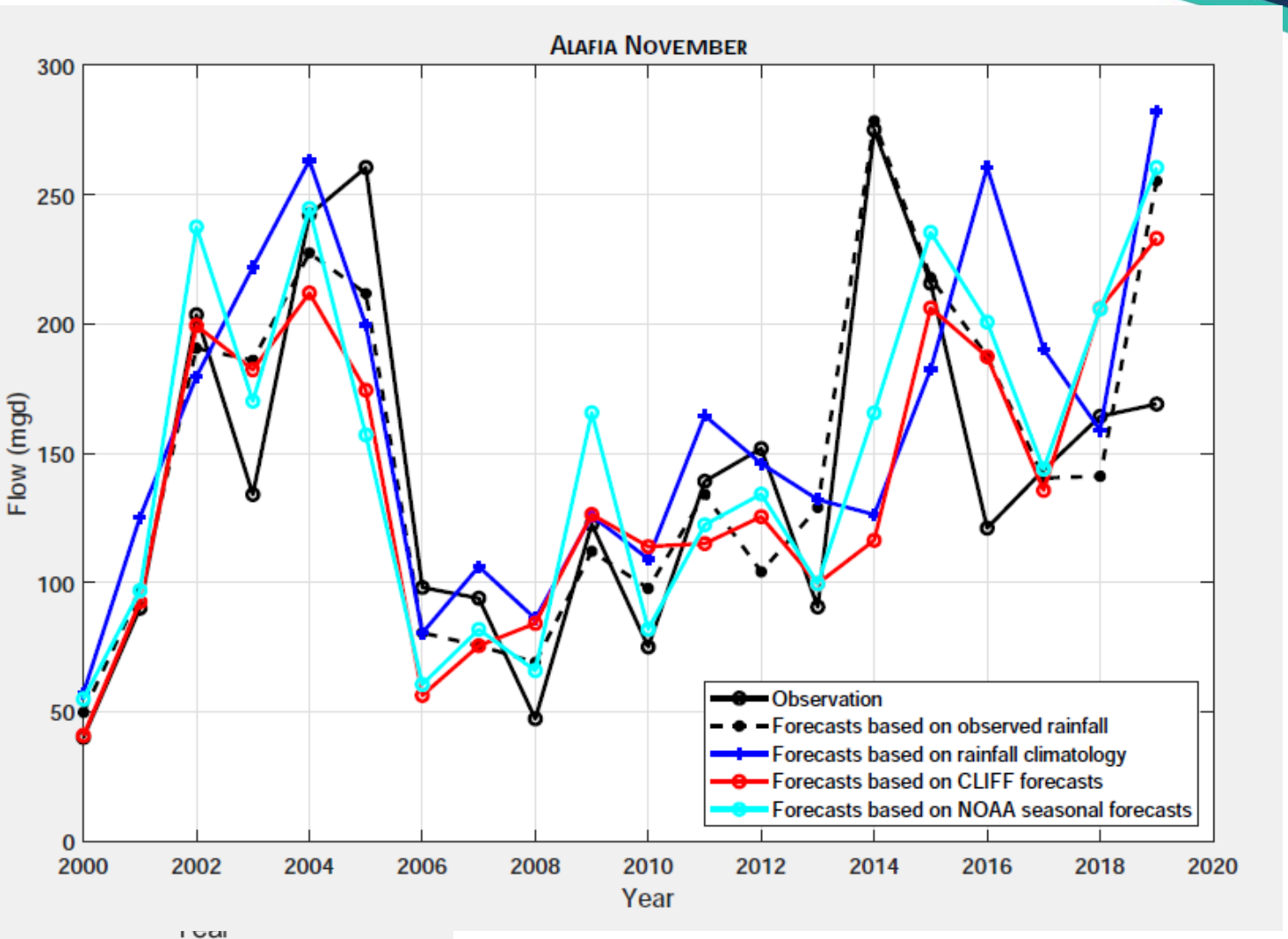
Probabilistic forecasts (ensemble members vs observed streamflow):

- Rank Probability Score

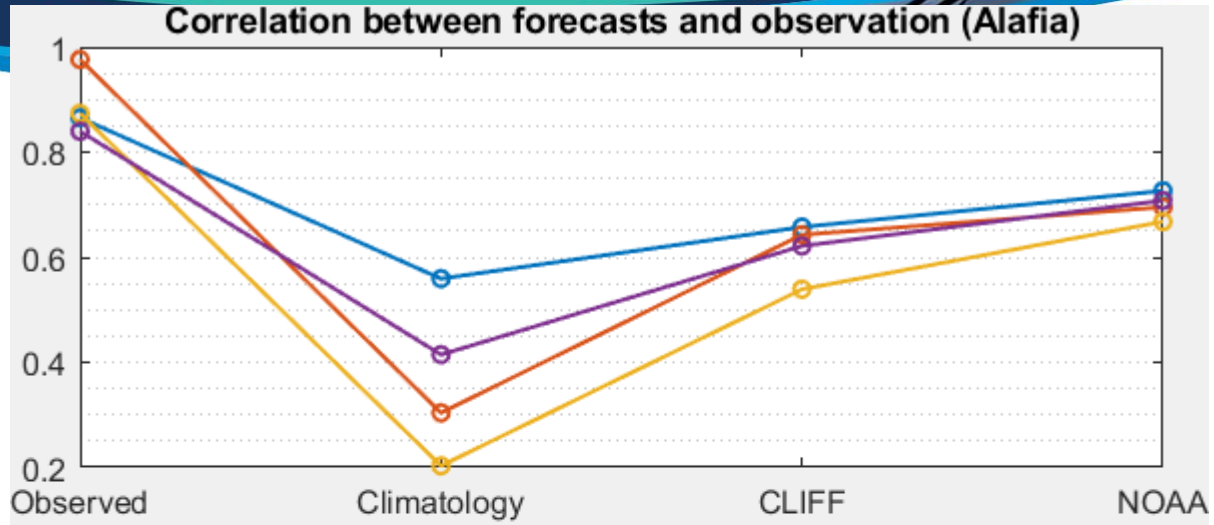
Evaluation results: November forecasts for Alafia river

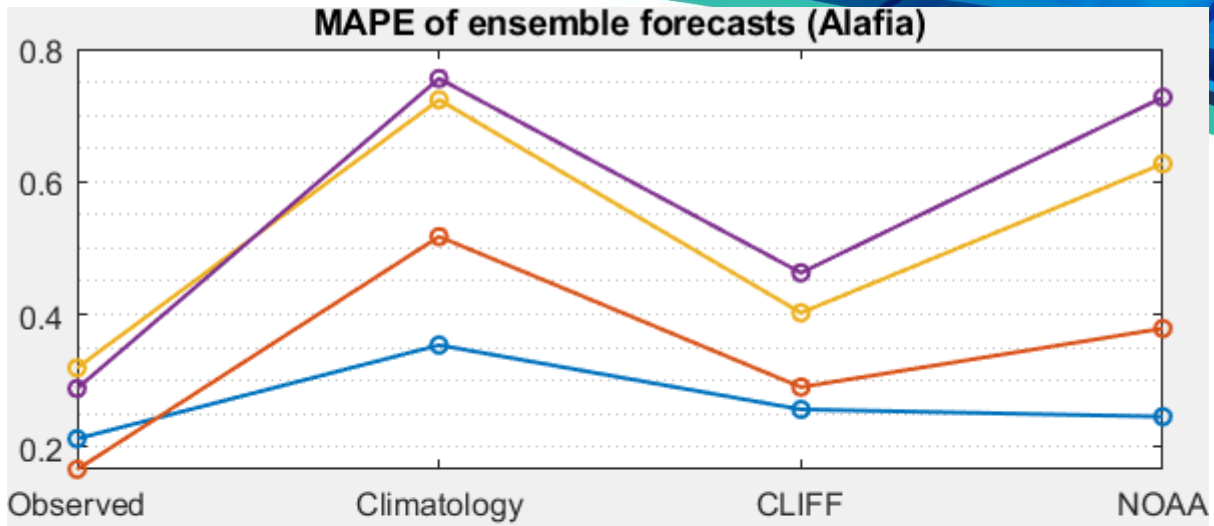


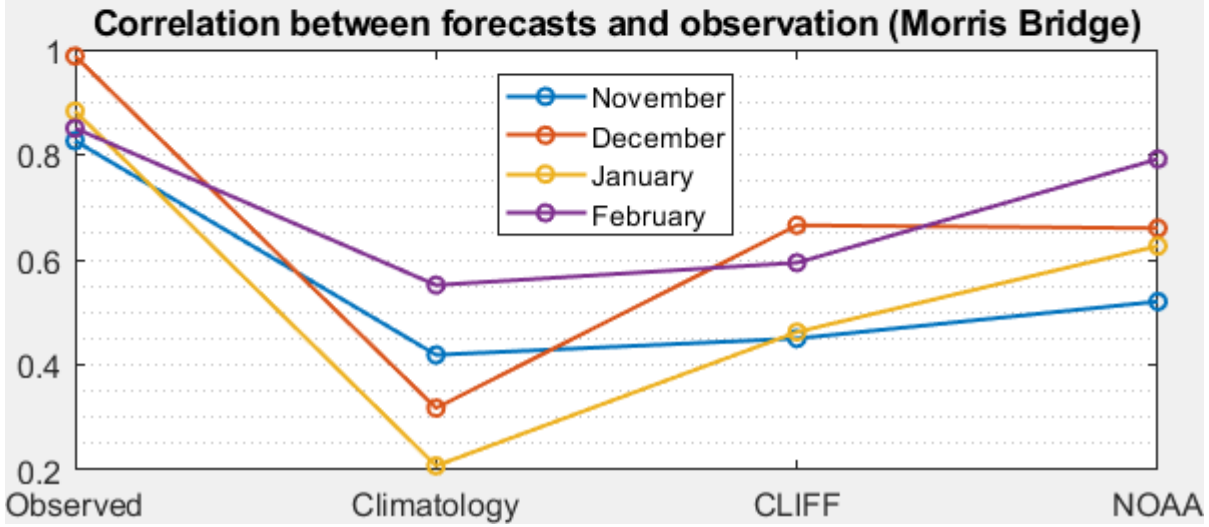


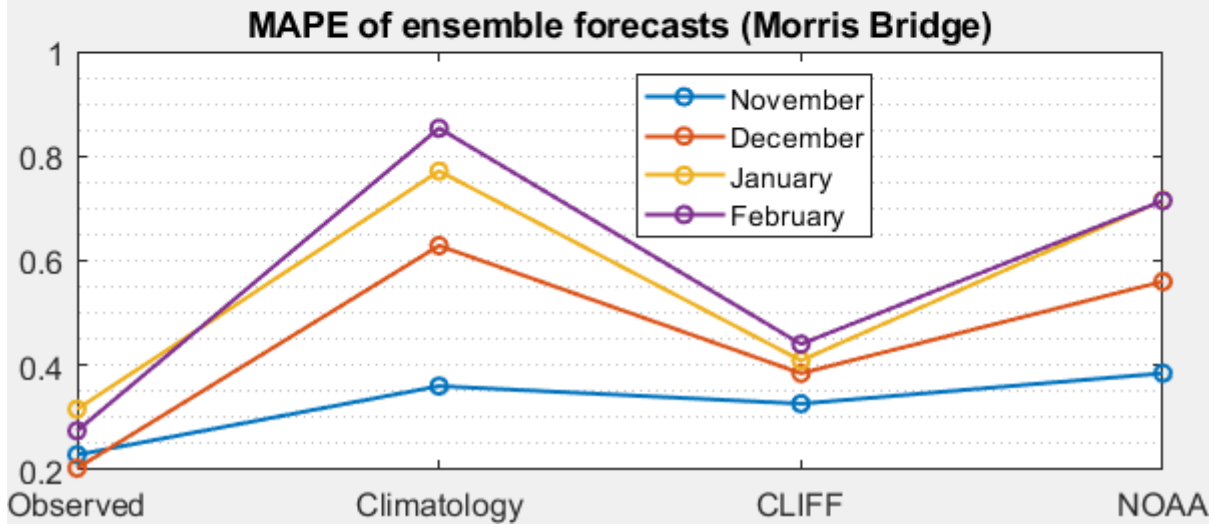


Evaluation results: Correlation and MAPE

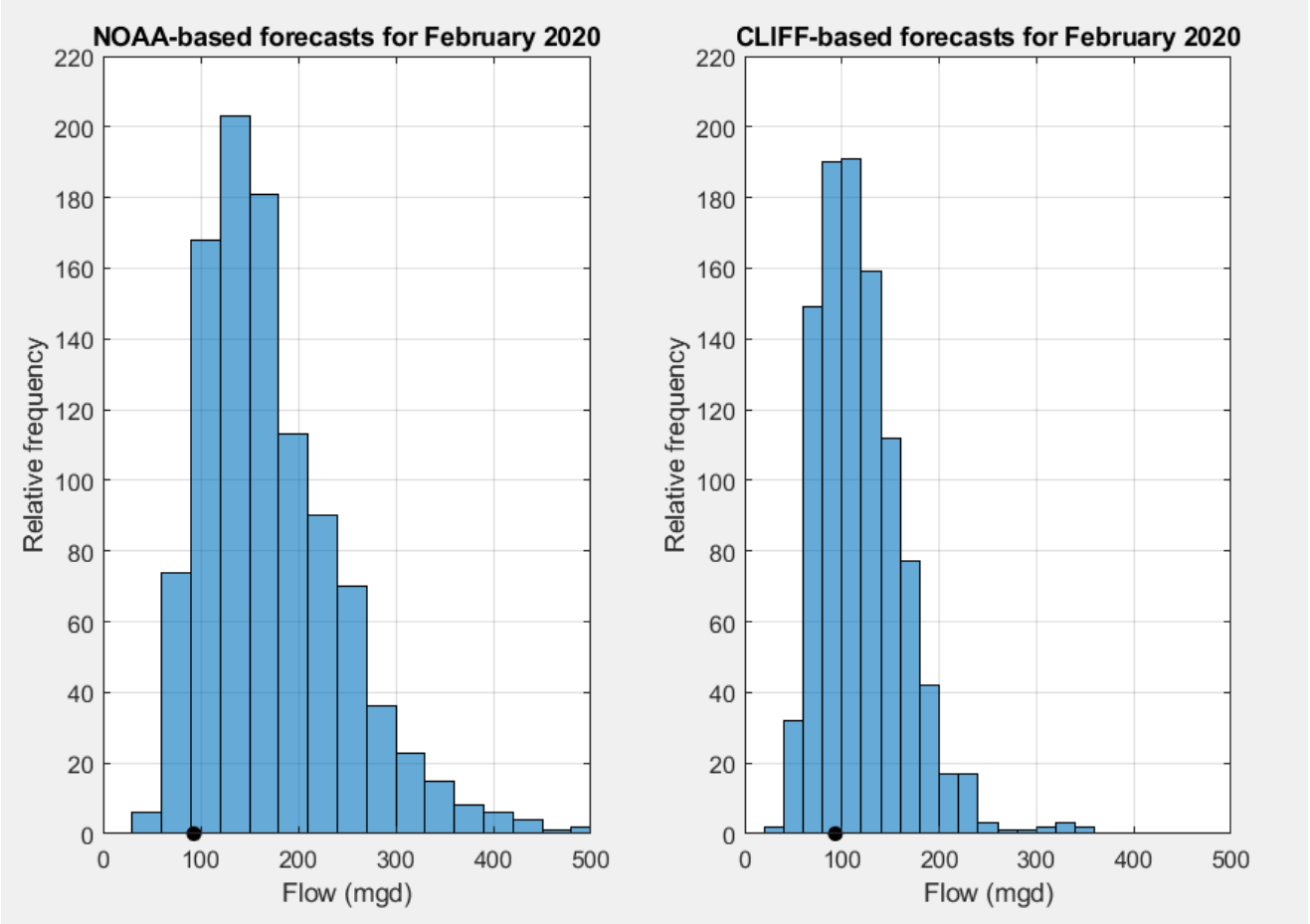




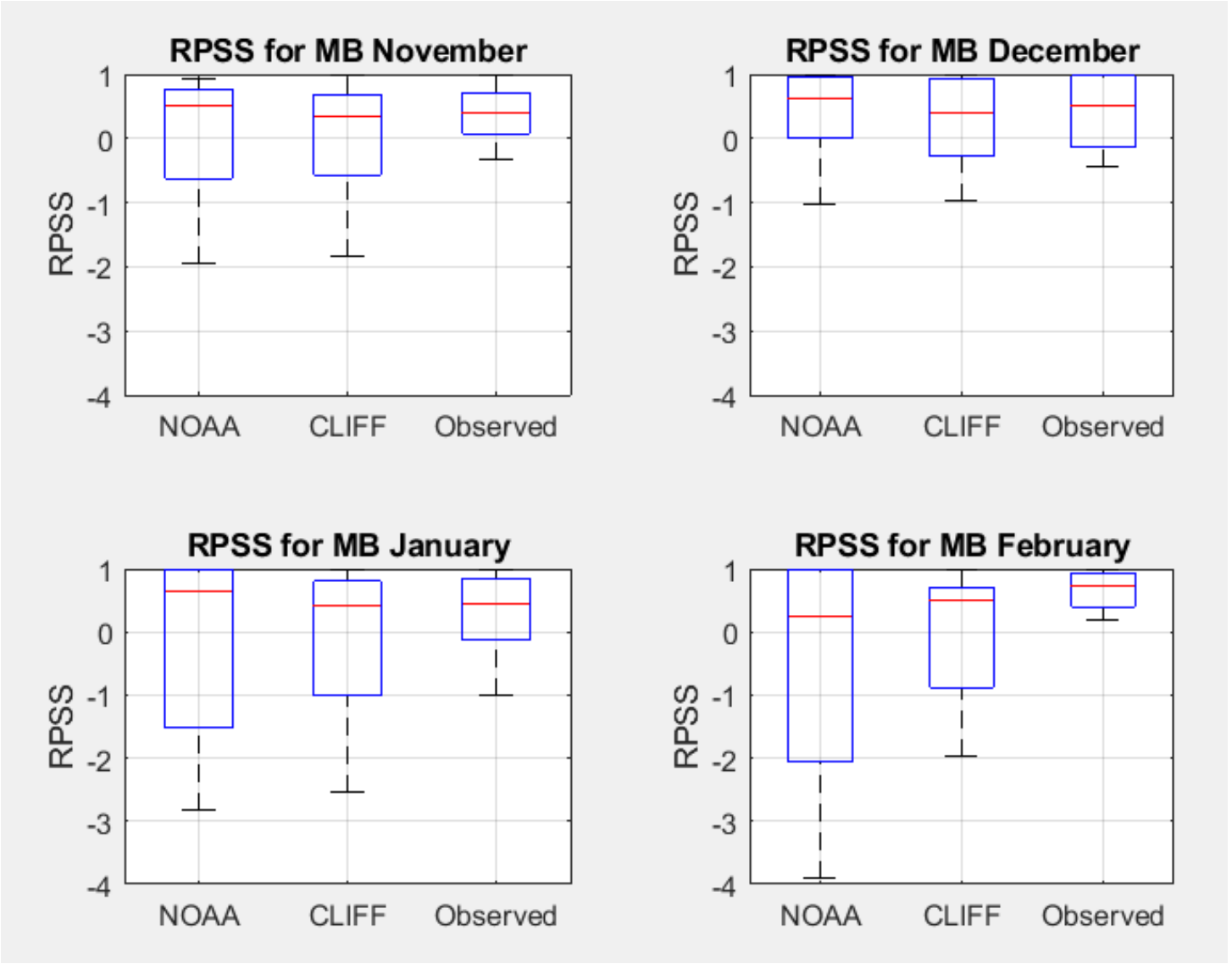




Illustrative example of ensemble forecasts



Comparison of skill score of different forecasts



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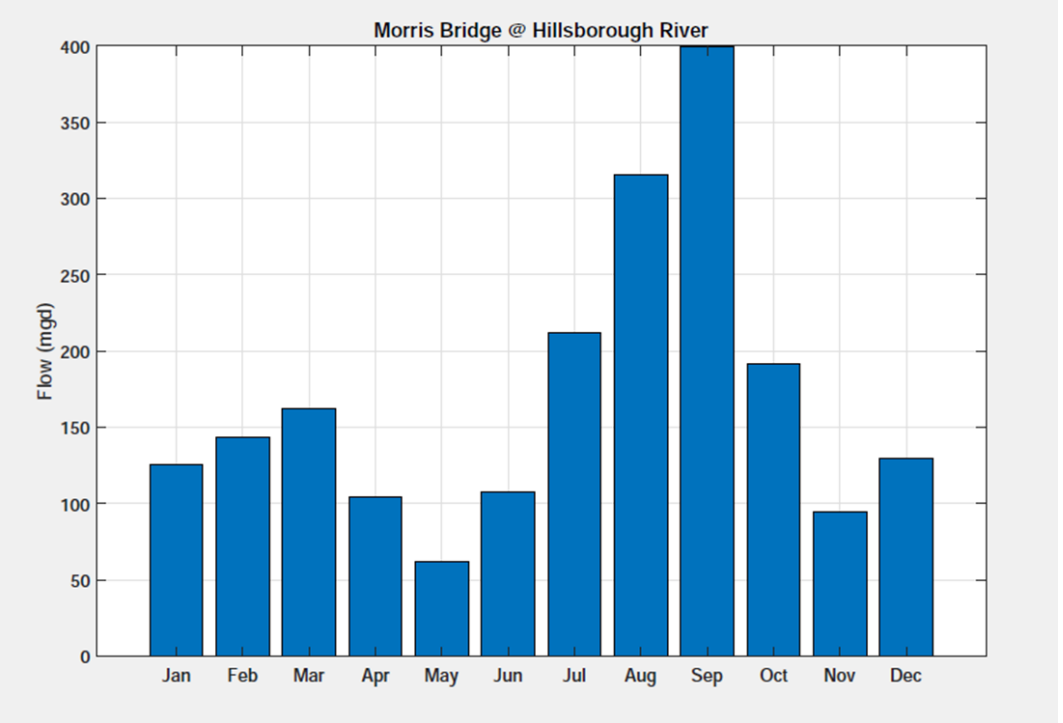
Conclusions

- Retrospective forecasts from CLIFF can be used as a promising alternative of rainfall forecast
- Streamflow forecasts skill decays from November to February
- This study primarily focuses on the dry season; transition months, as well as rainy season, are also important



Using Regional Climate Model Outputs to Enhance Urban Water Demand Forecasts

Solomon Erkyihun, PhD

April 15, 2022

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Seasonal Demand Model

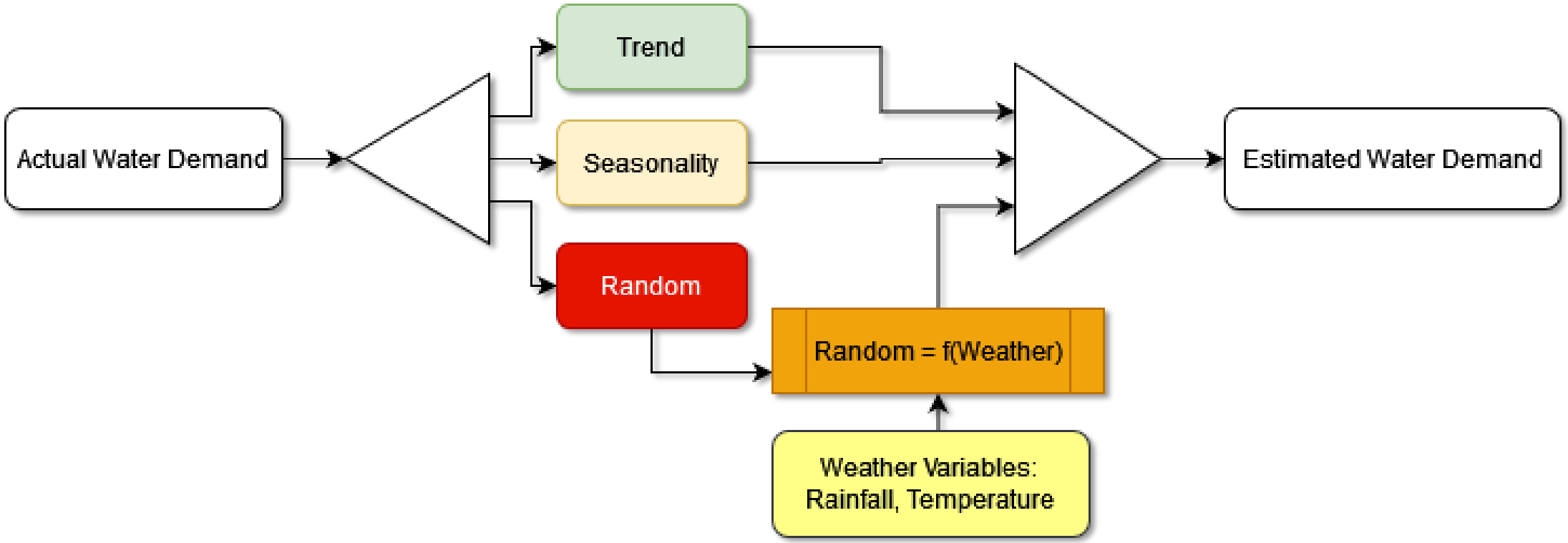
- Water demand (Demand) is proposed to be represented as a product of its Components: Trend (T), Seasonality (S) and Random (R) components

$$Demand = T.S.R$$

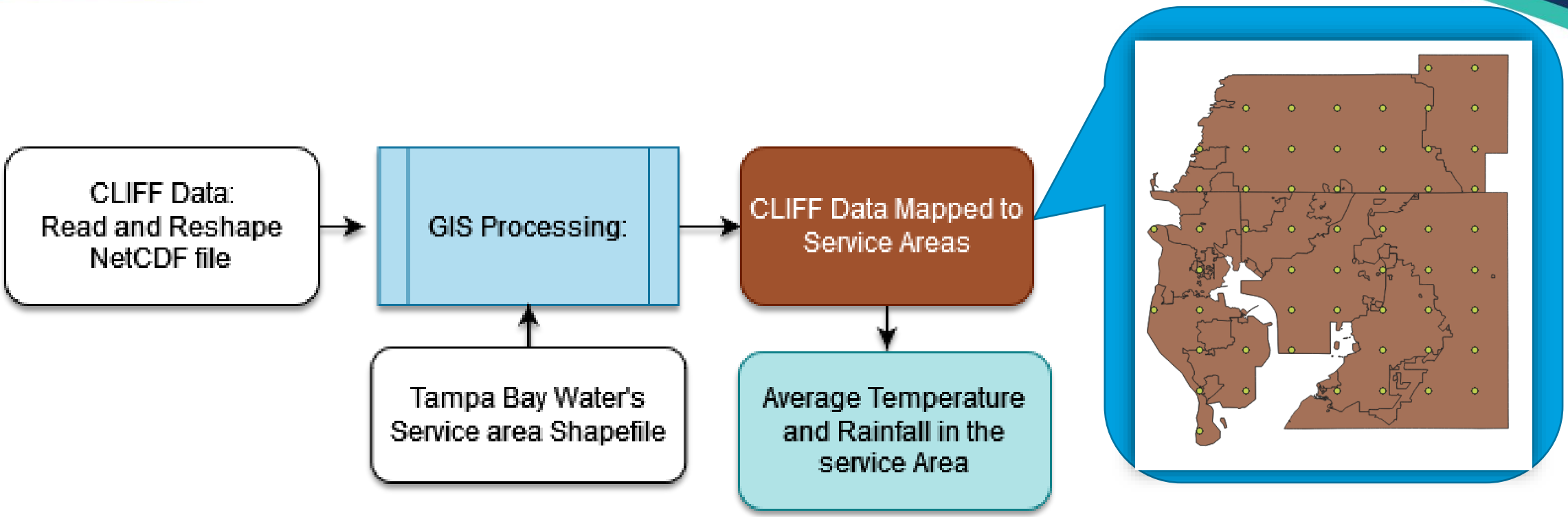
- Trend (T) is a proxy for demand variability due to Socio-Economic factors.
- Seasonality (S) represents a typical within a year monthly demand variability.
- Random component (R), is a residual component and is given by

$$R \sim f(Rainfall, Temperature)$$

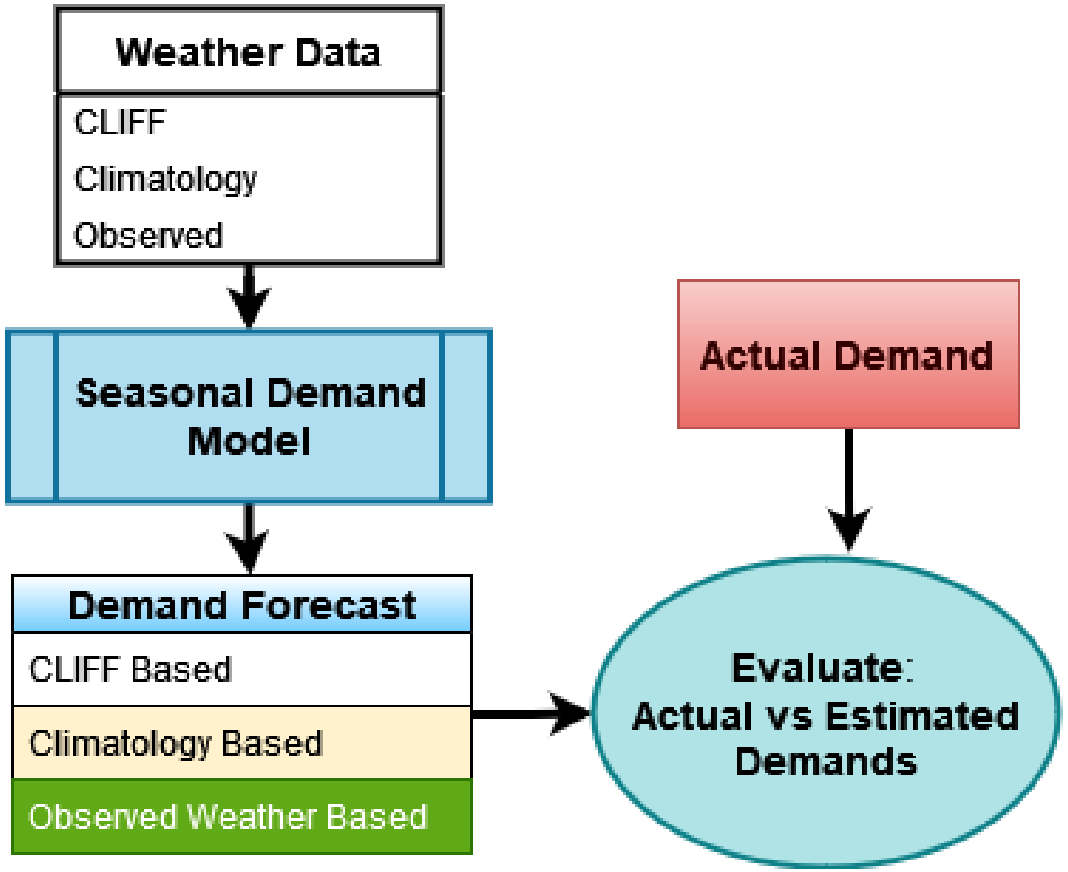
Seasonal Demand Model Structure



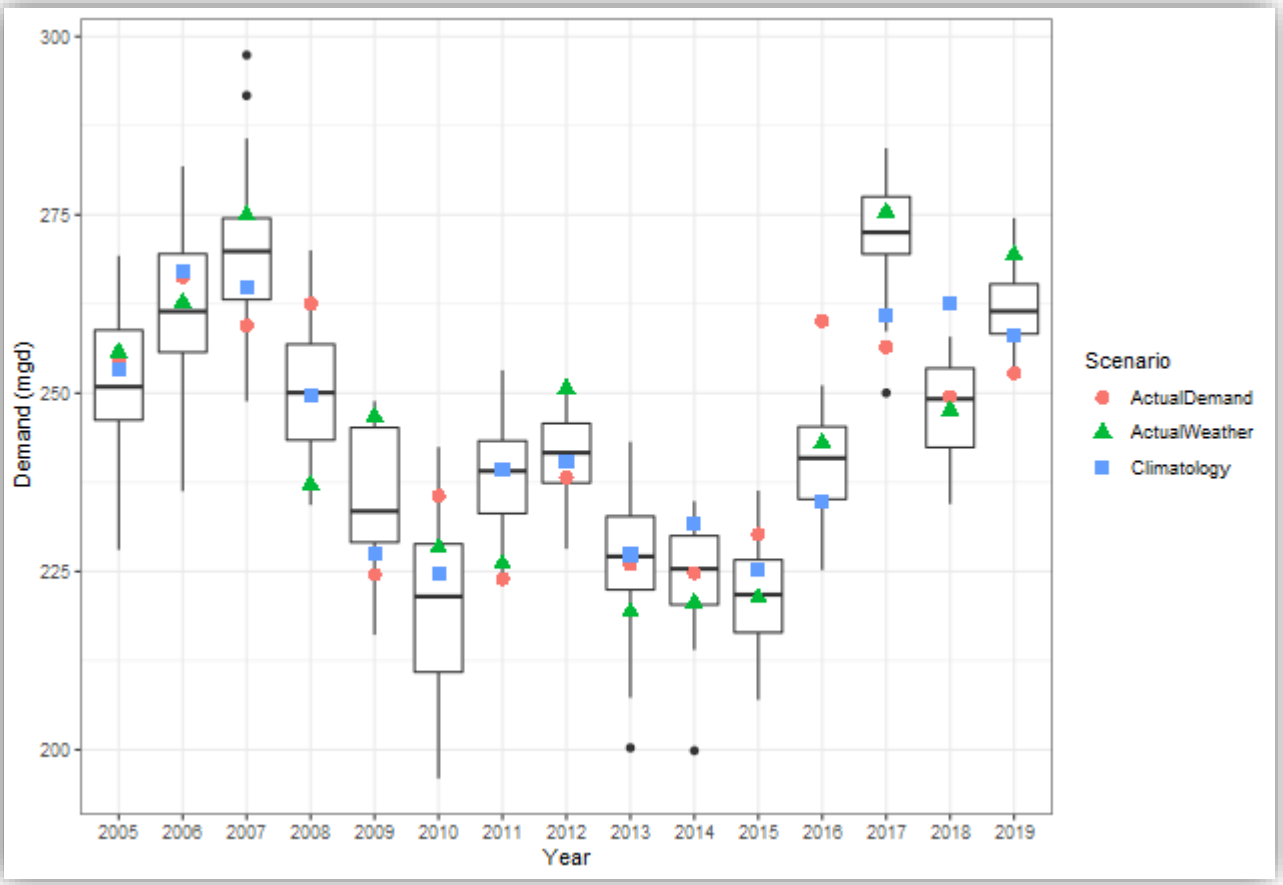
CLIFF Data to Service Areas



Seasonal Demand Forecast and Evaluation

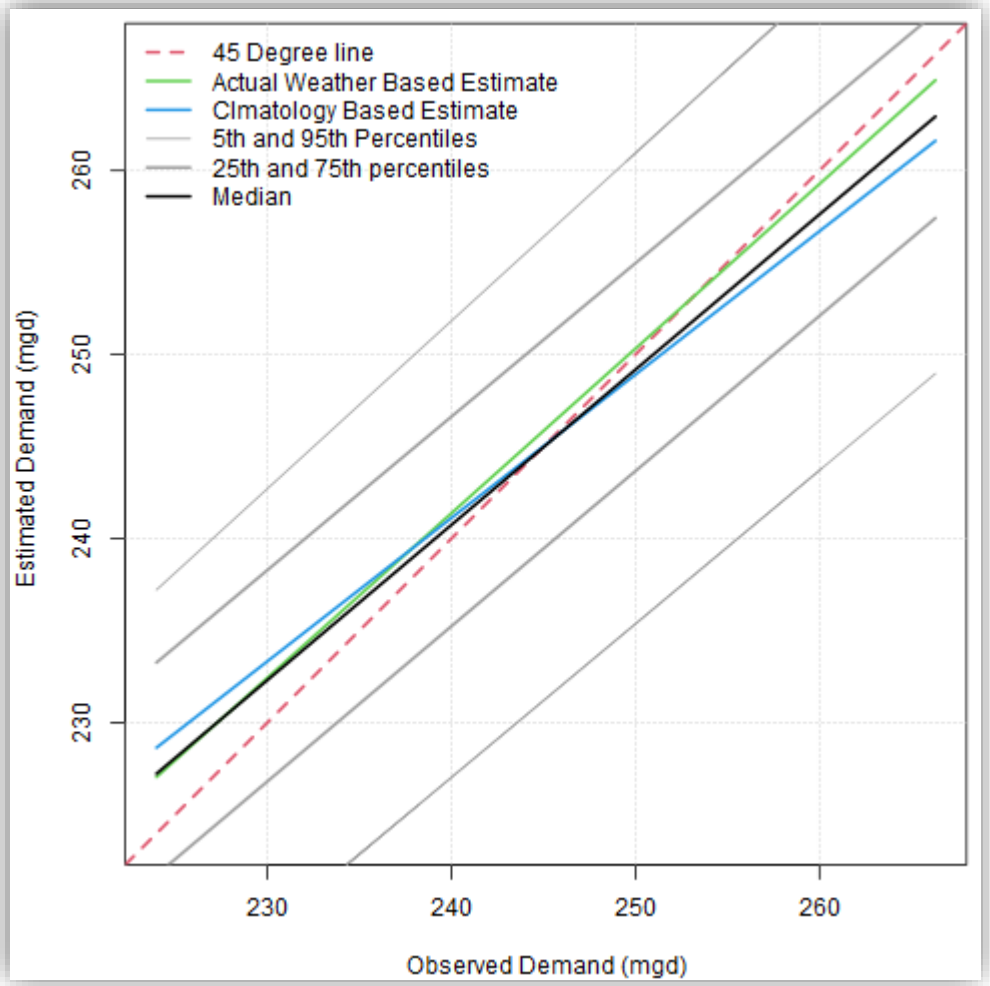


Demand Forecast Results: November

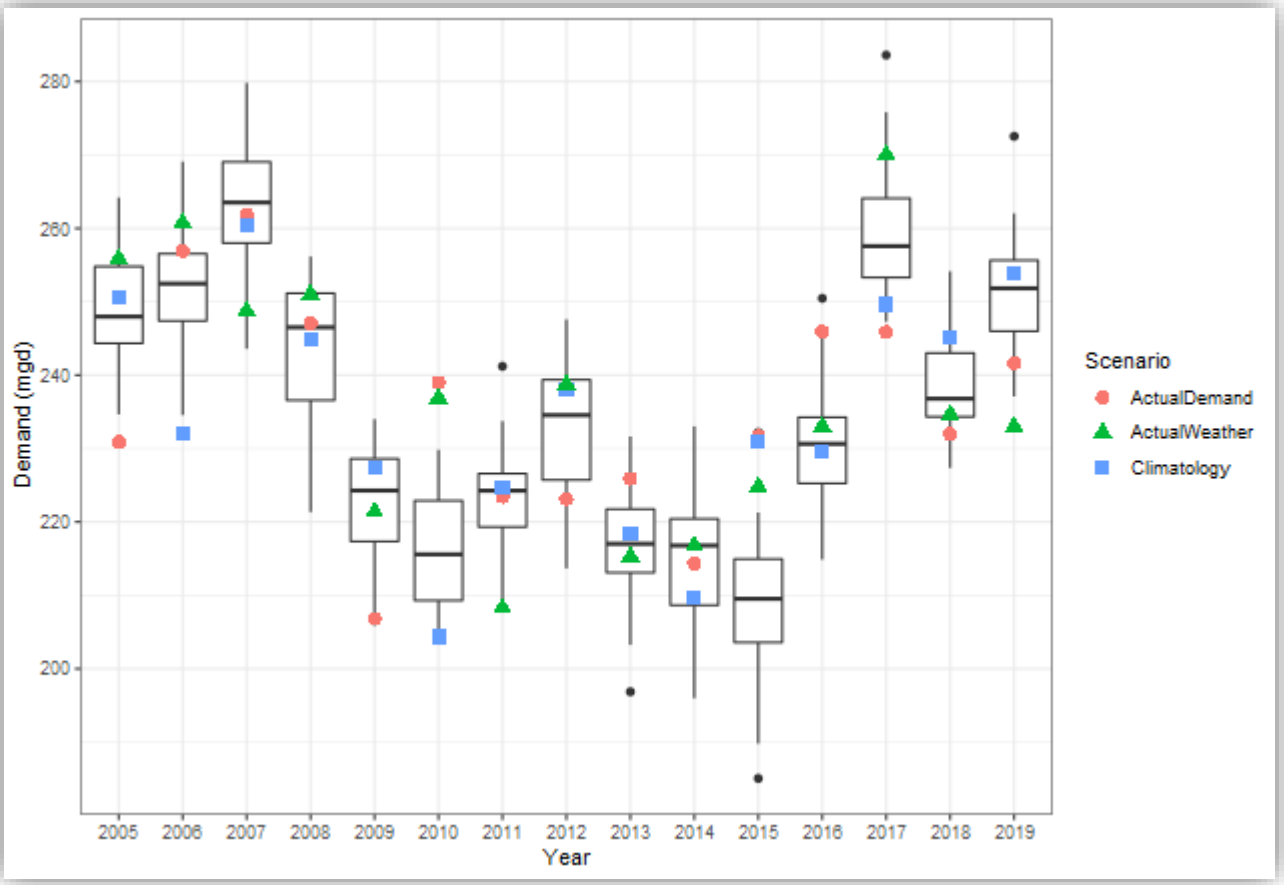


Boxplots of the November Projections

Regression lines of the Observed Demand VS Estimations for November

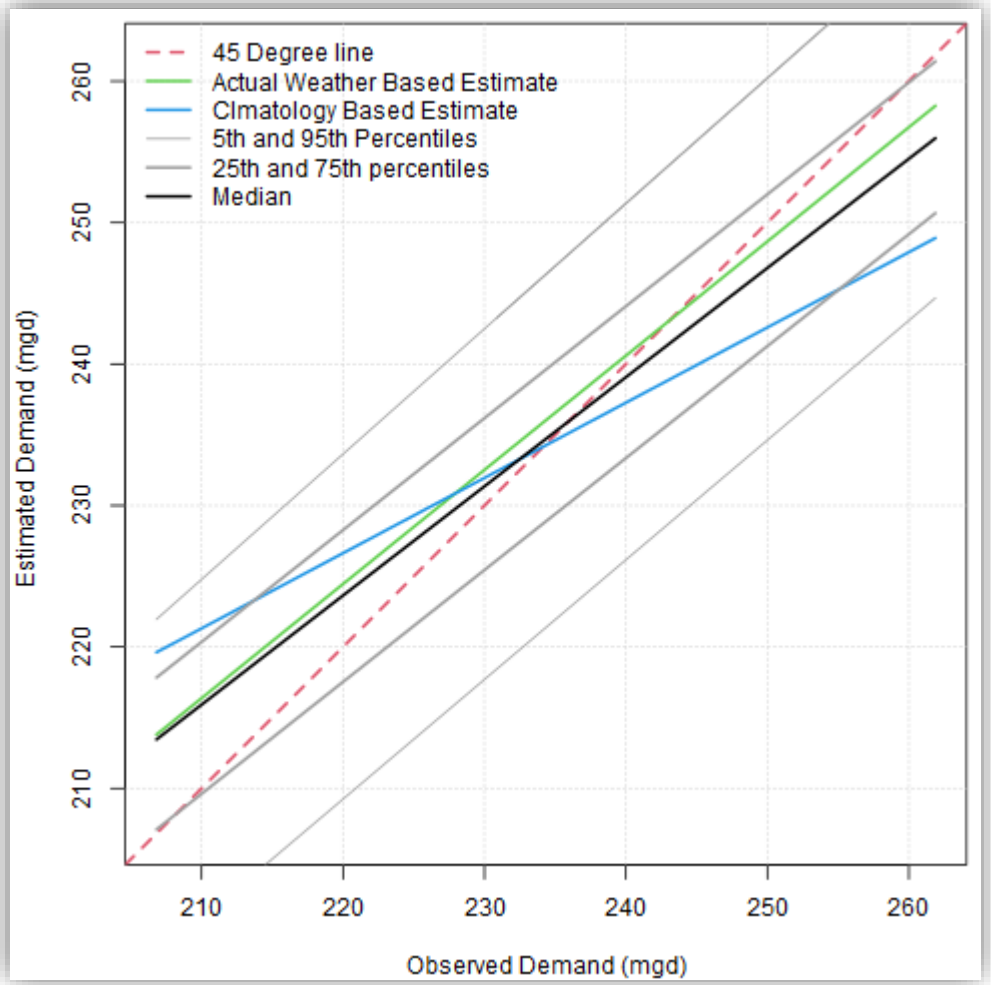


Demand Forecast Results: December

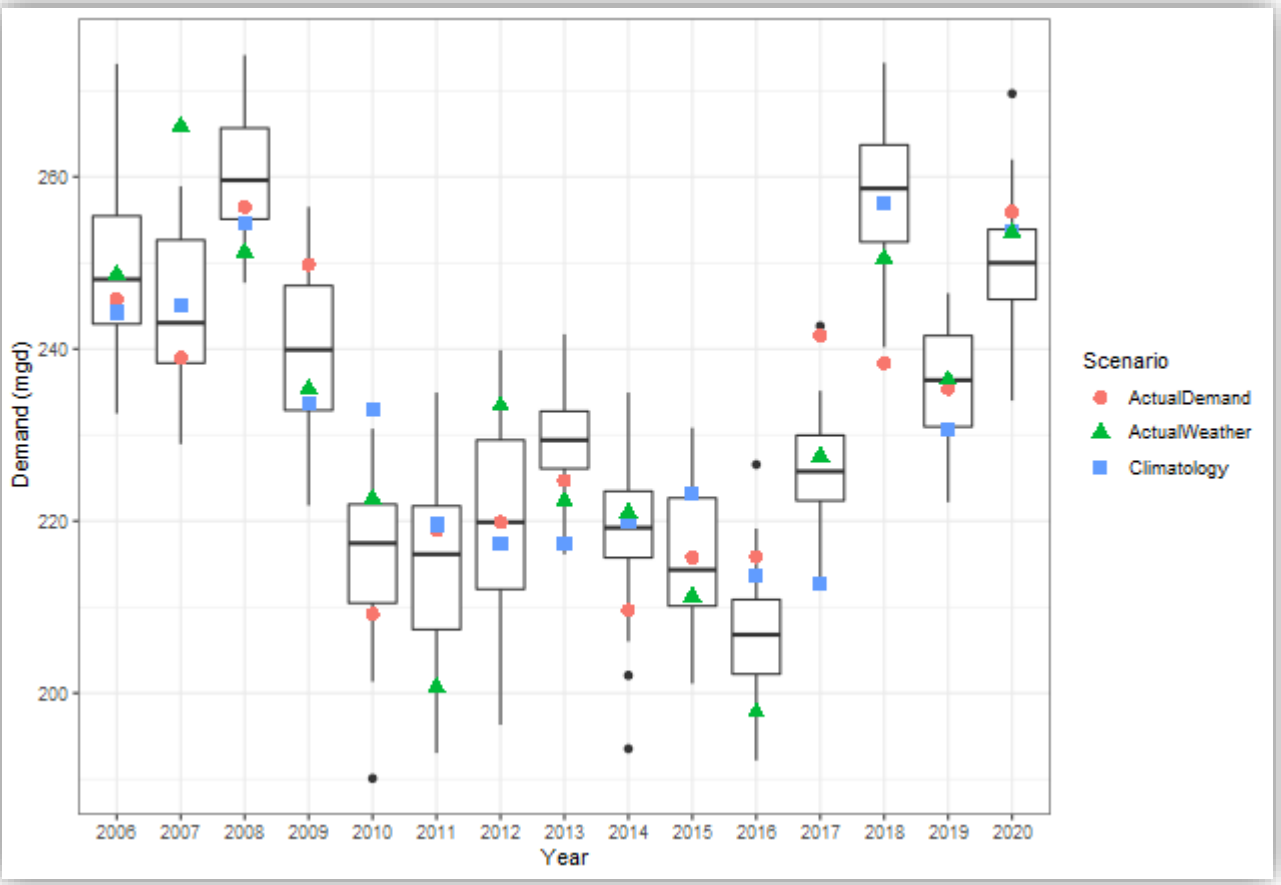


Boxplots of the December Projections

Regression lines of the Observed Demand VS Estimations for December

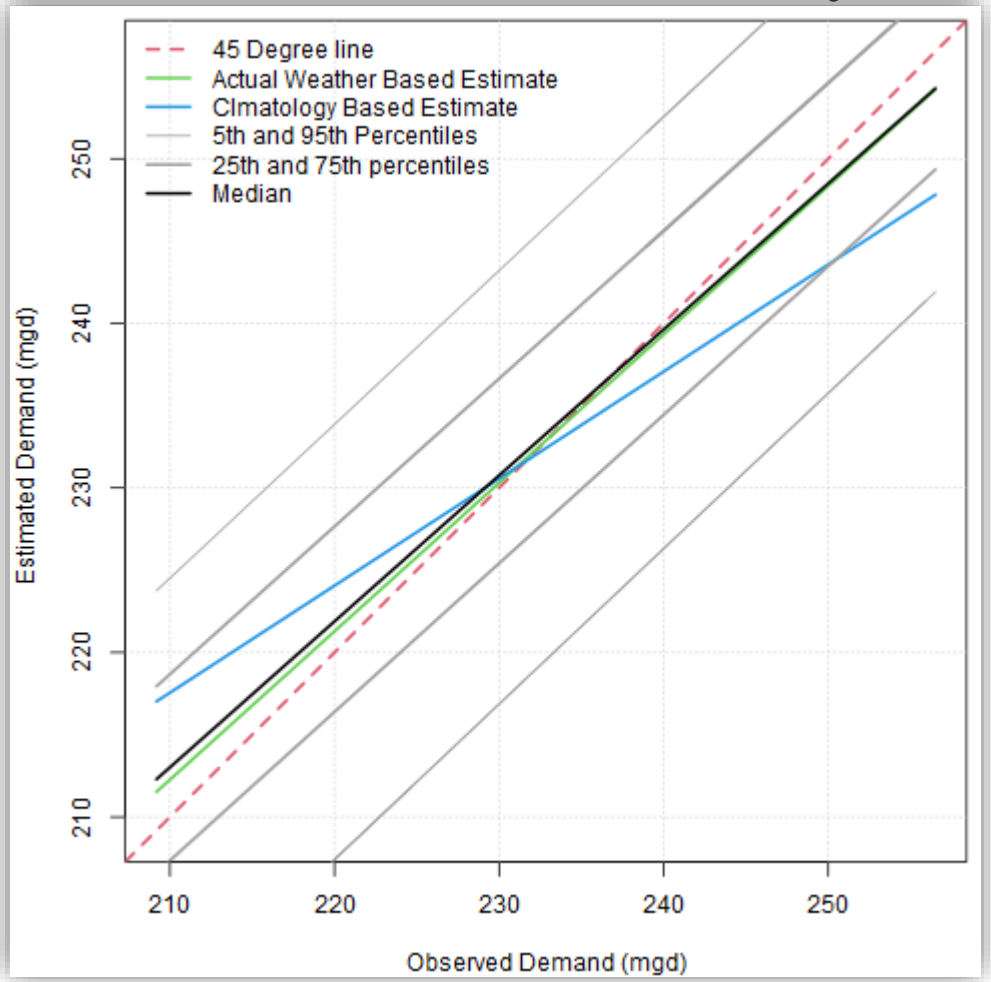


Demand Forecast Results: January

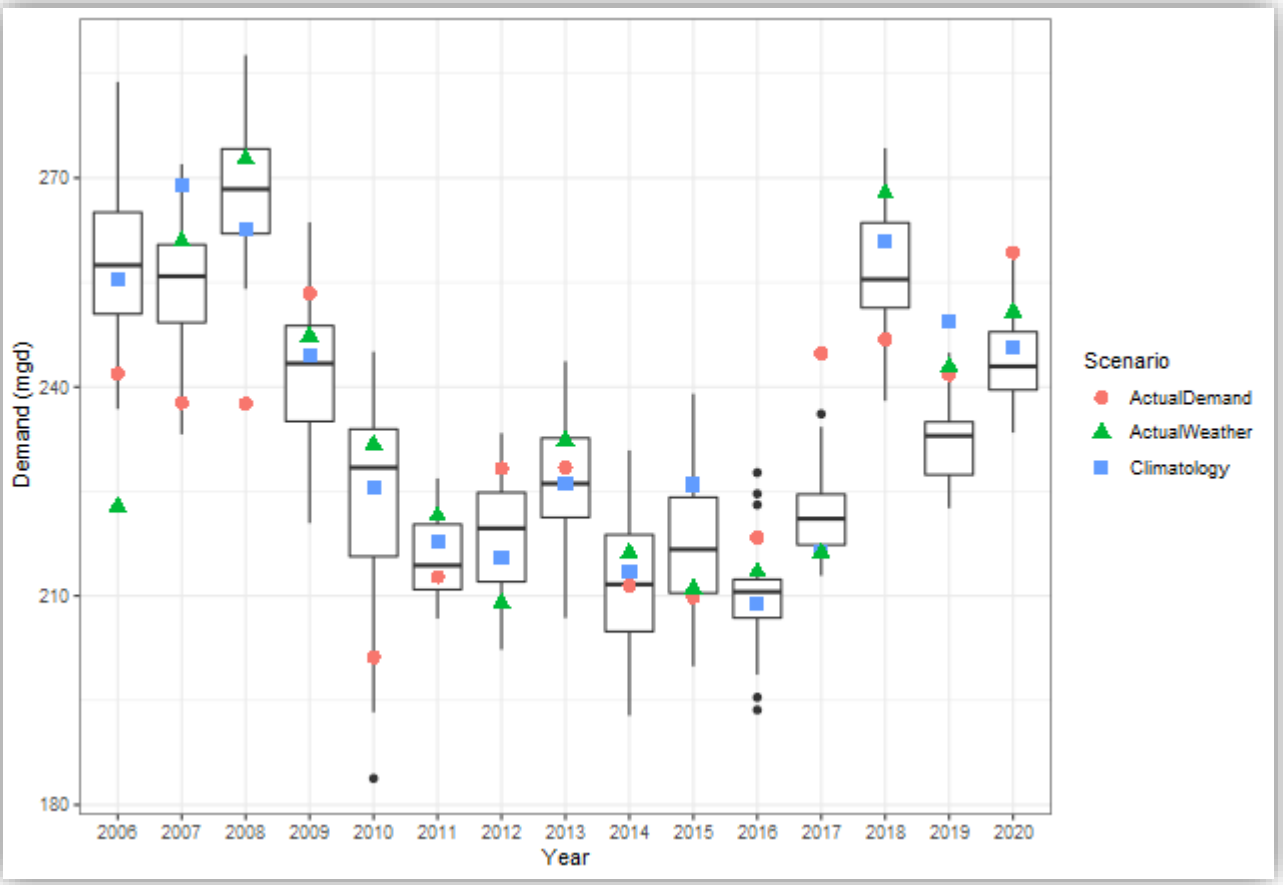


Boxplots of the January Projections

Regression lines of the Observed Demand VS Estimations for January

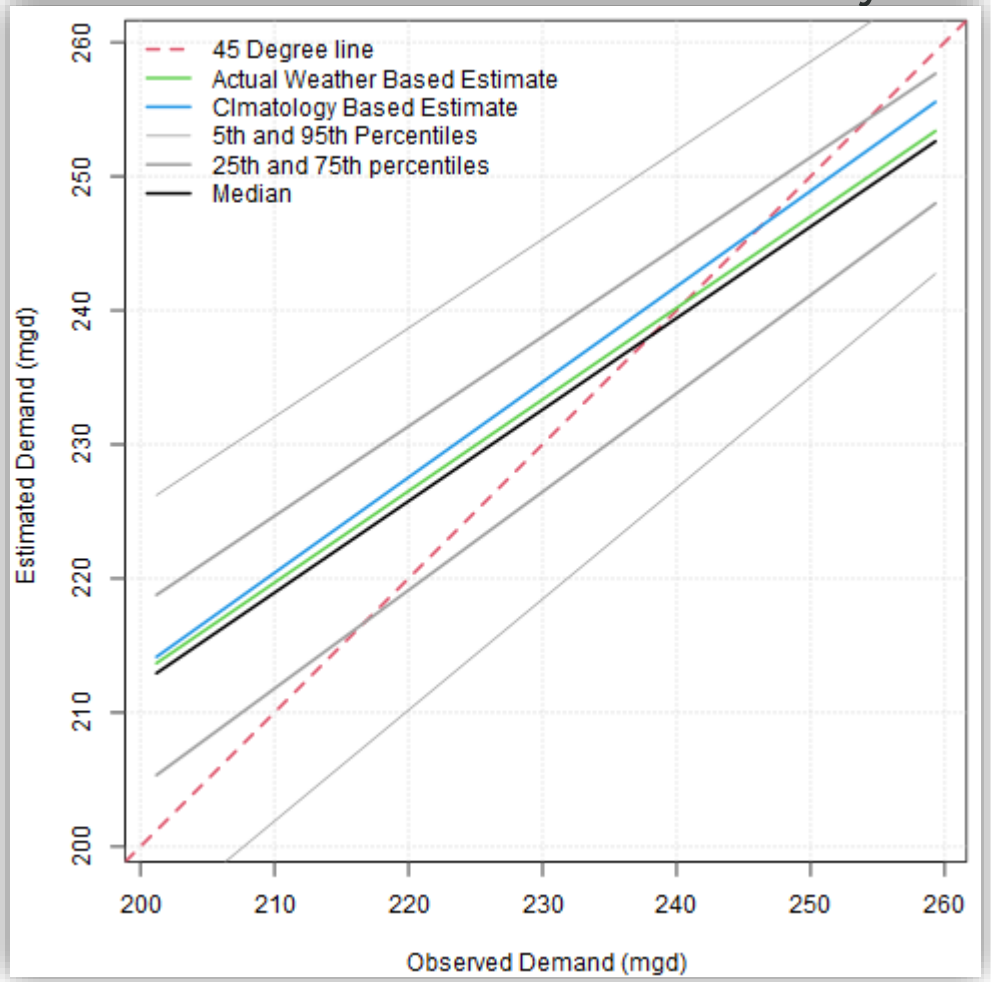


Demand Forecast Results: February



Boxplots of the February Projections

Regression lines of the Observed Demand VS Estimations for February



Conclusion

- Proposed CLIFF based forecast approach performs well in capturing the water demand it:
  - Captured the observation within the inter quartile range except for few years.
  - Performs much better than the current climatology-based estimate.
- Skill of the February demand is relatively low.