Development of a Calibrated Hydrological Model and Assessing Climate Change Impacts in the Upper Blue Nile Basin

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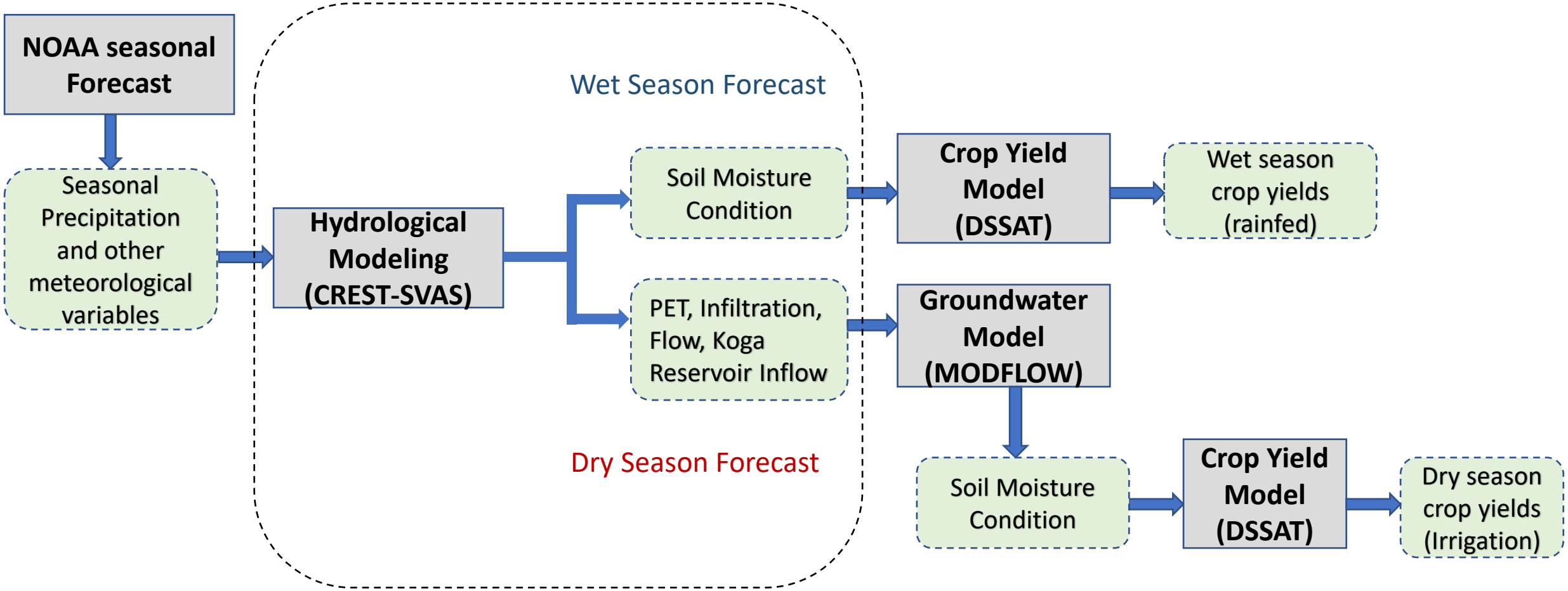
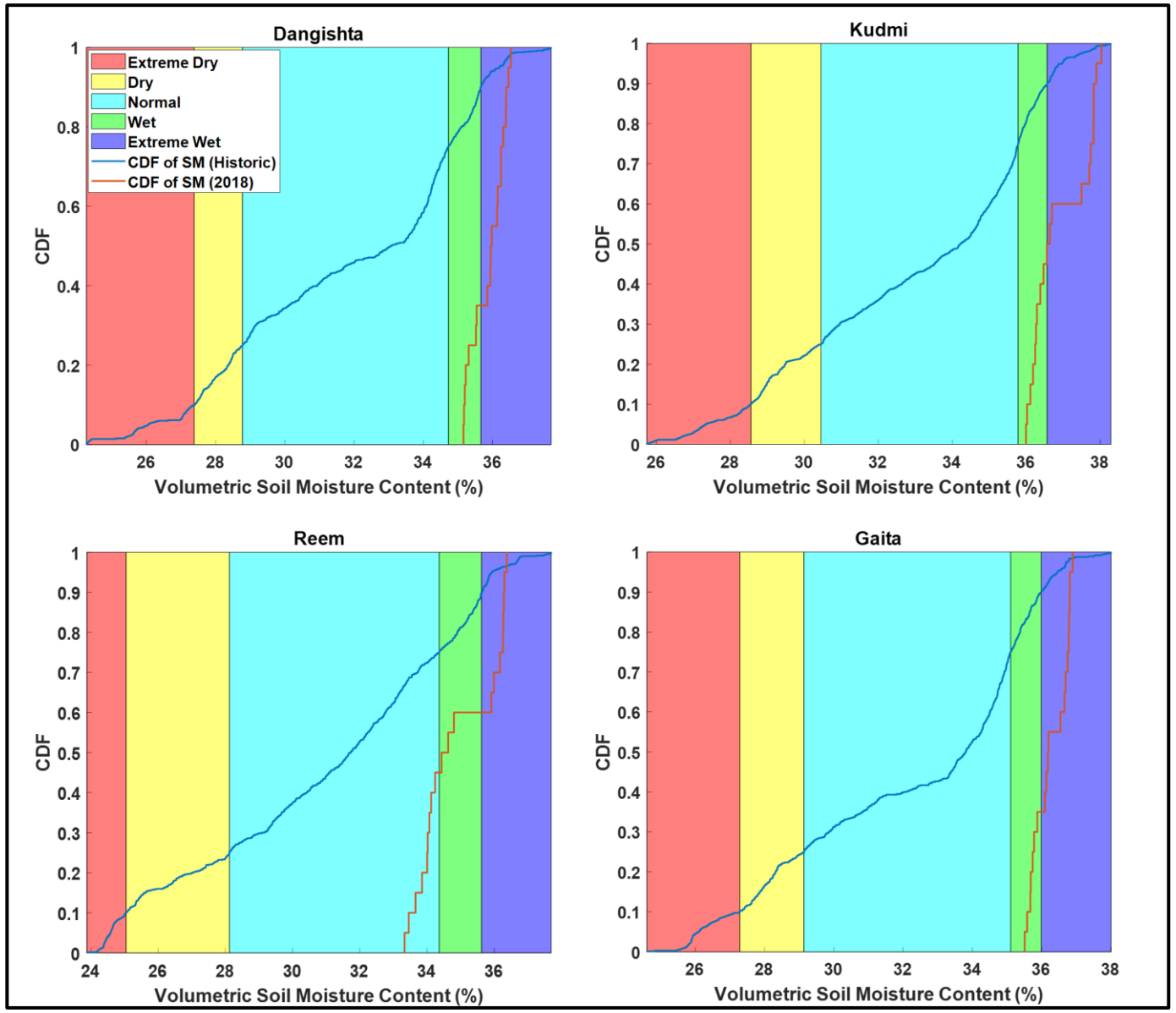
Project Goals and My Contribution in Seasonal Forecast

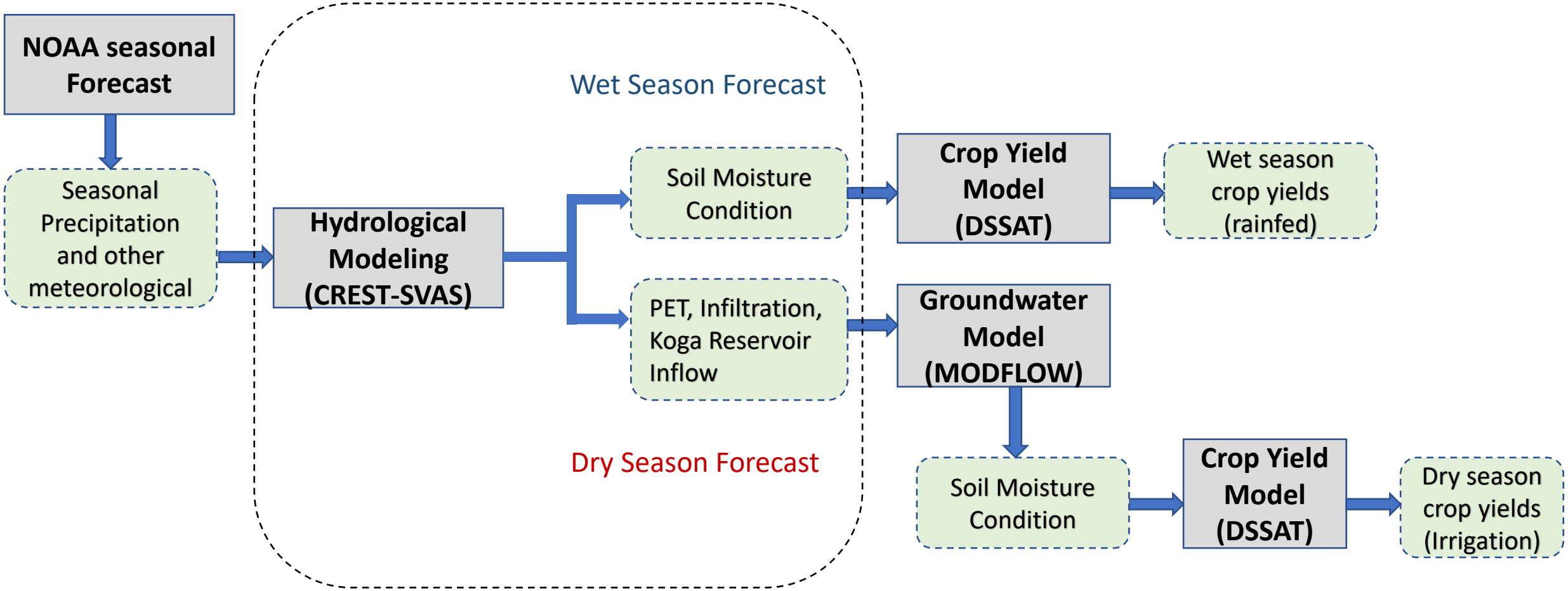


Framework of Physical Modeling for Seasonal Forecast

Soil Moisture Condition (Wet Season Forecast 2018)

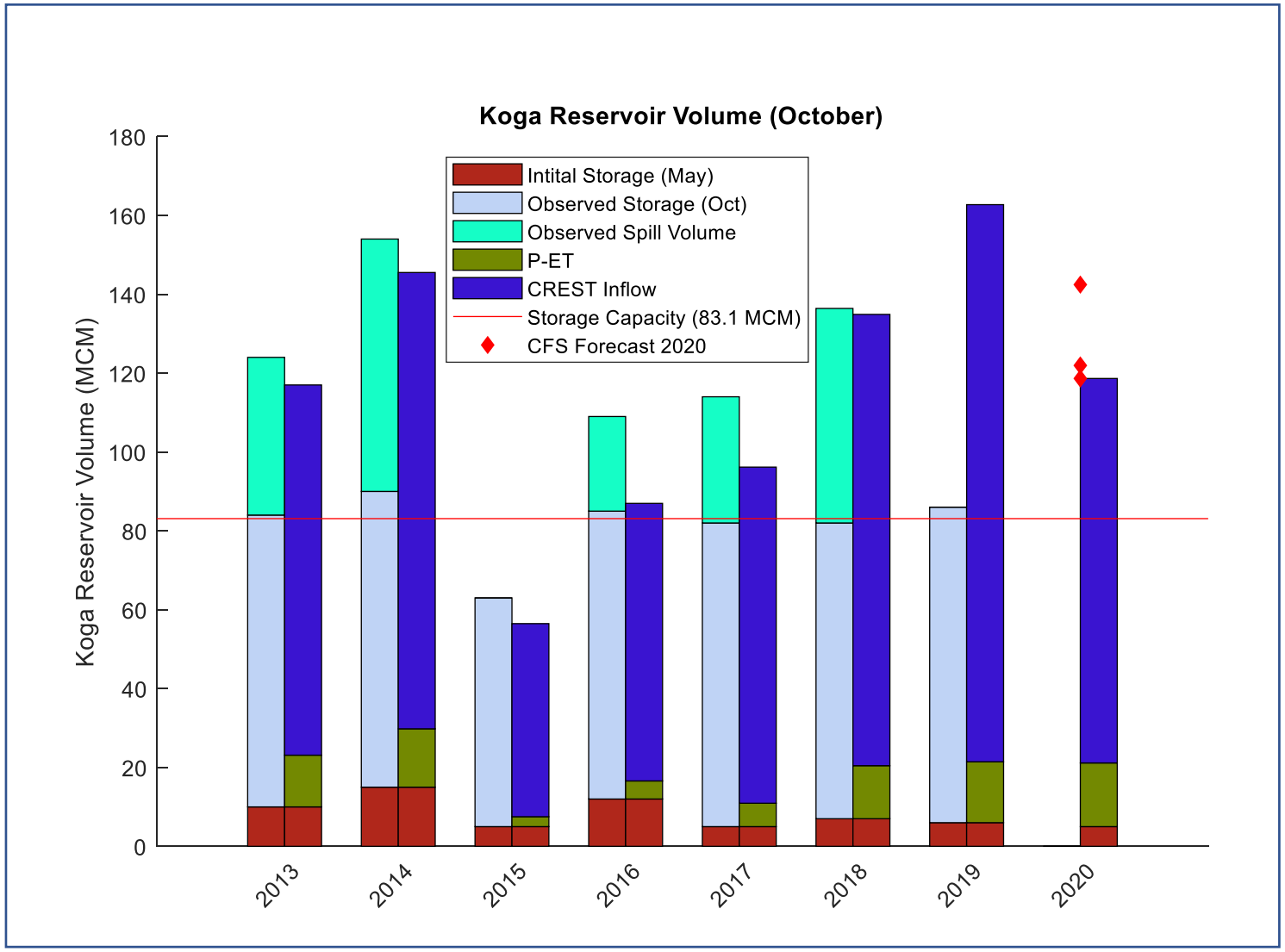


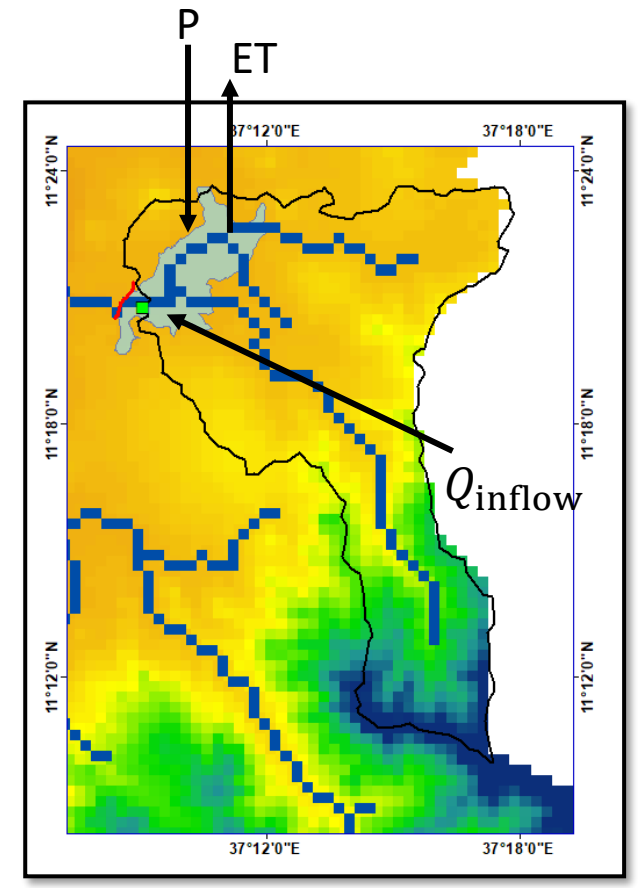
Project Goals and My Contribution in Seasonal Forecast



Framework of Physical Modeling for Seasonal Forecast

Koga Reservoir Volume (JJASO), Dry Season Forecast 2020

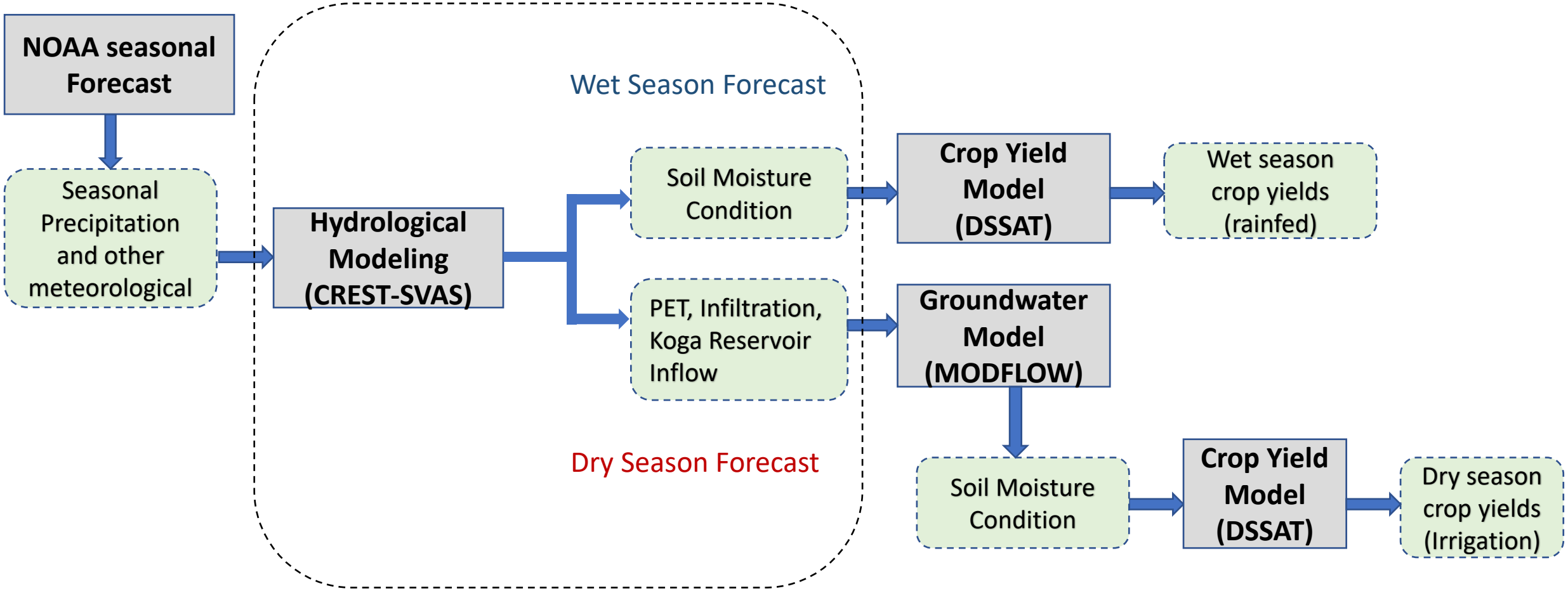




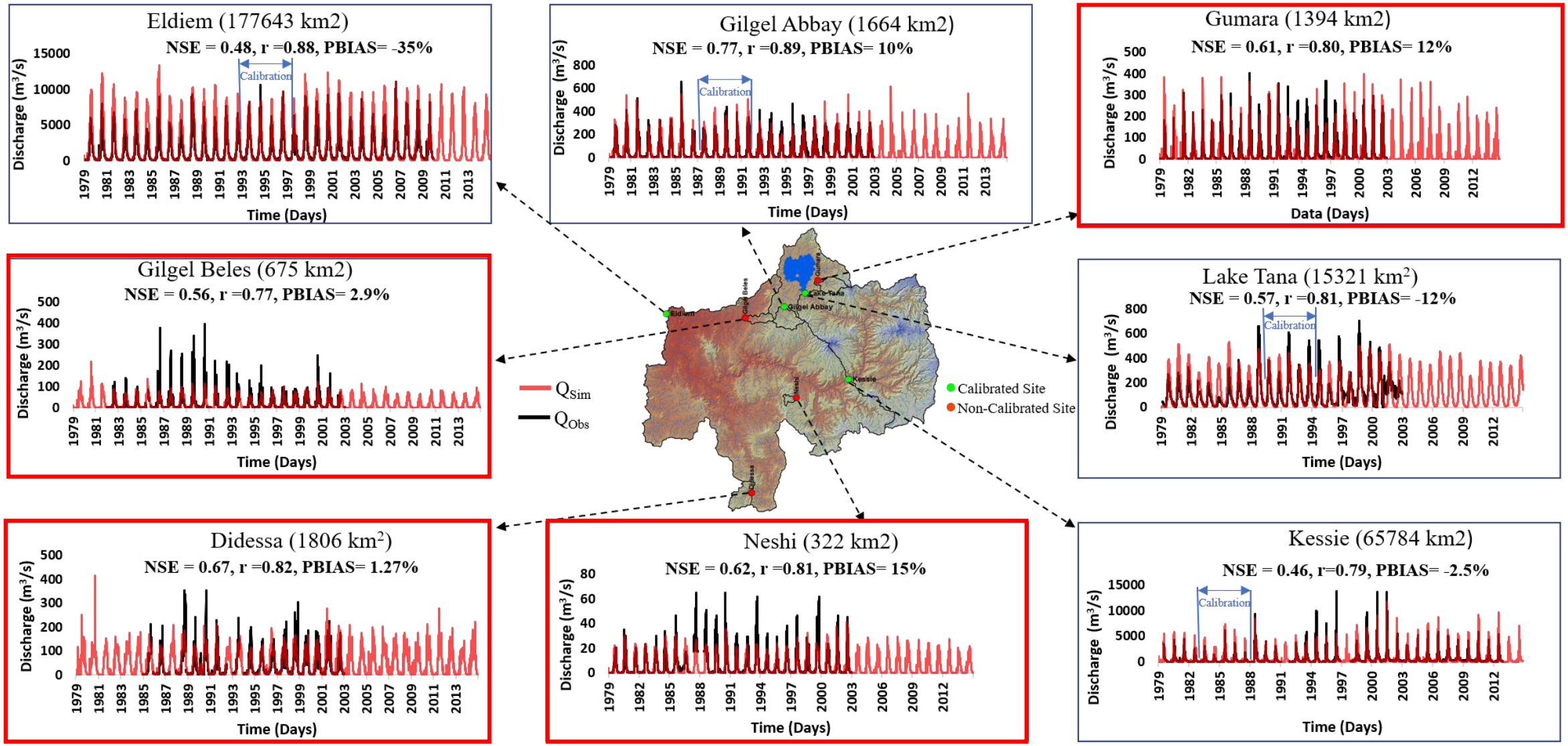
Koga Dam
Koga Reservoir
Stream
Basin Outlet
Basin Boundary

$$S_{Oct} = S_{May} + (P - ET)_{JJASO} + Q_{inflow_{JJASO}}$$

Project Goals and My Contribution in Seasonal Forecast

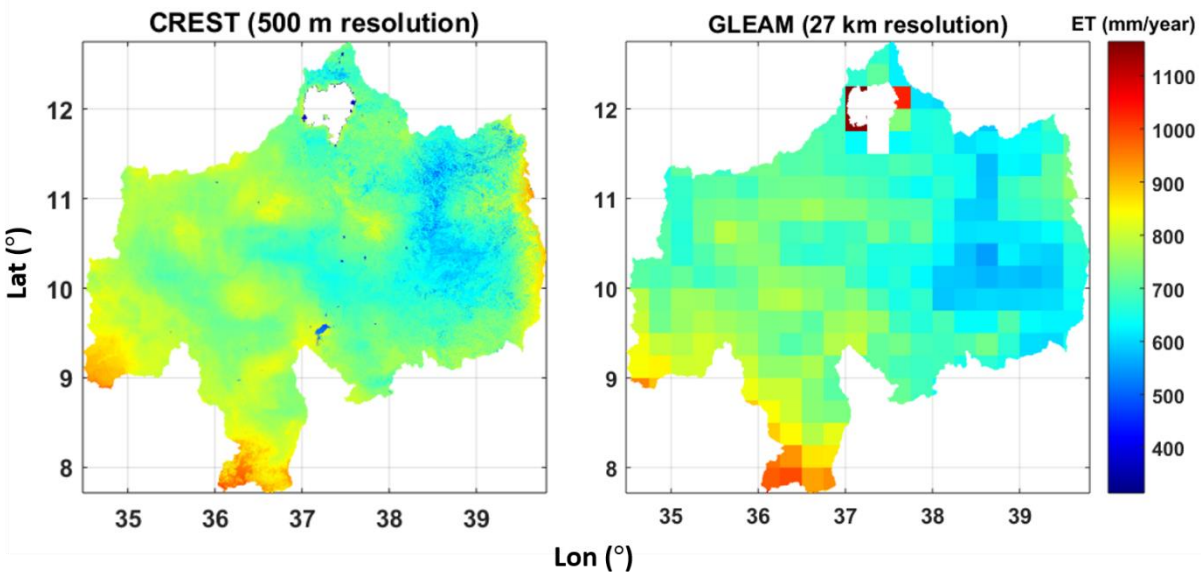


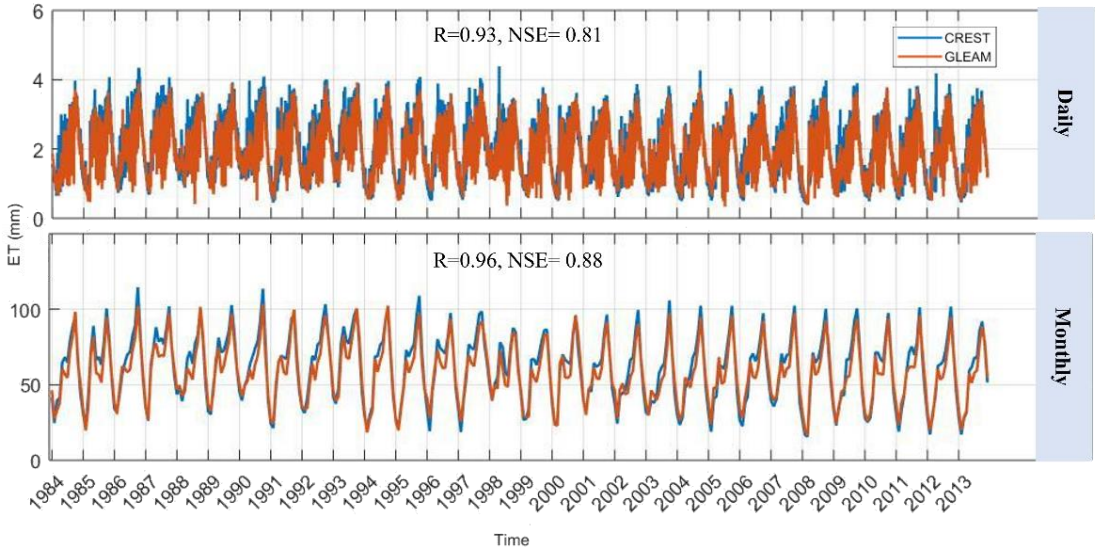
Research Work: Calibrated Hydrological model



Multi-Site Cascade Calibration of Daily Flow

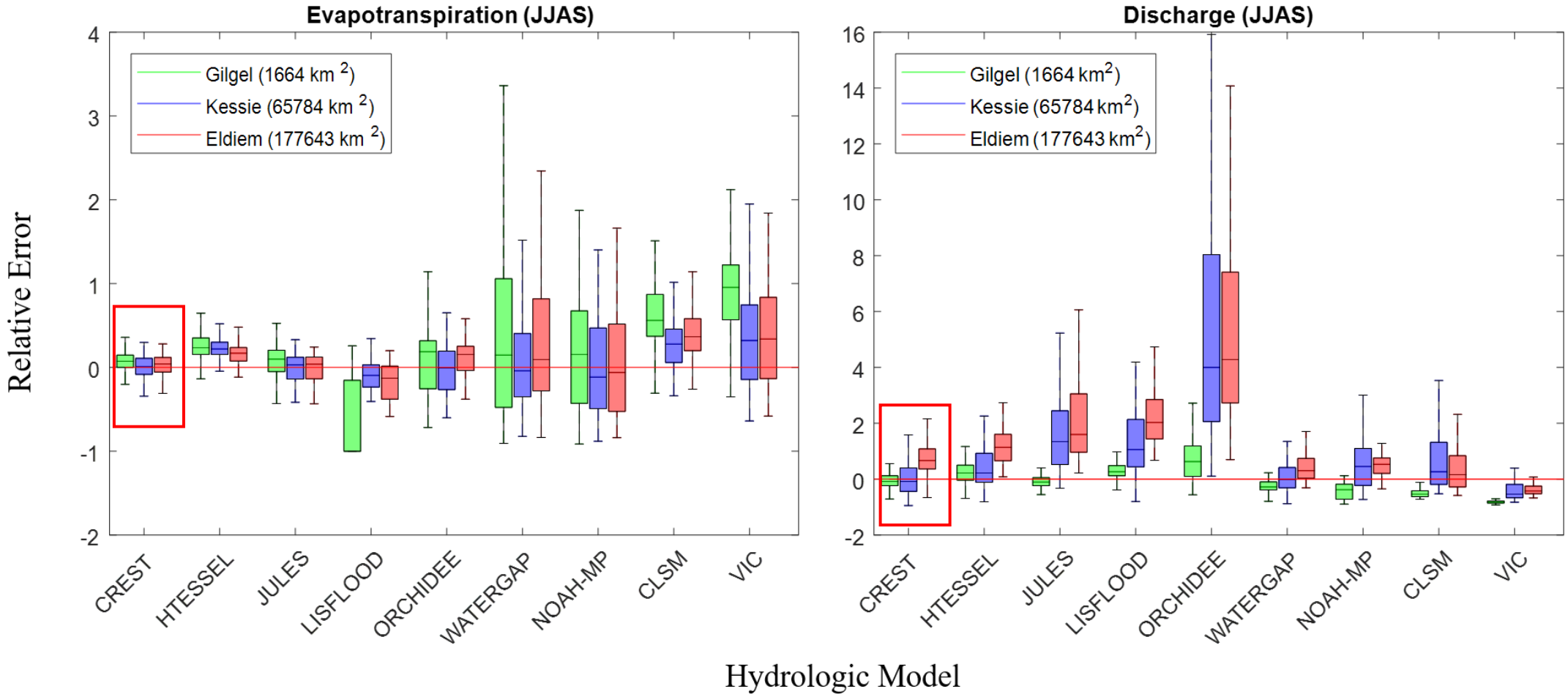
Research Work: Calibrated Hydrological model





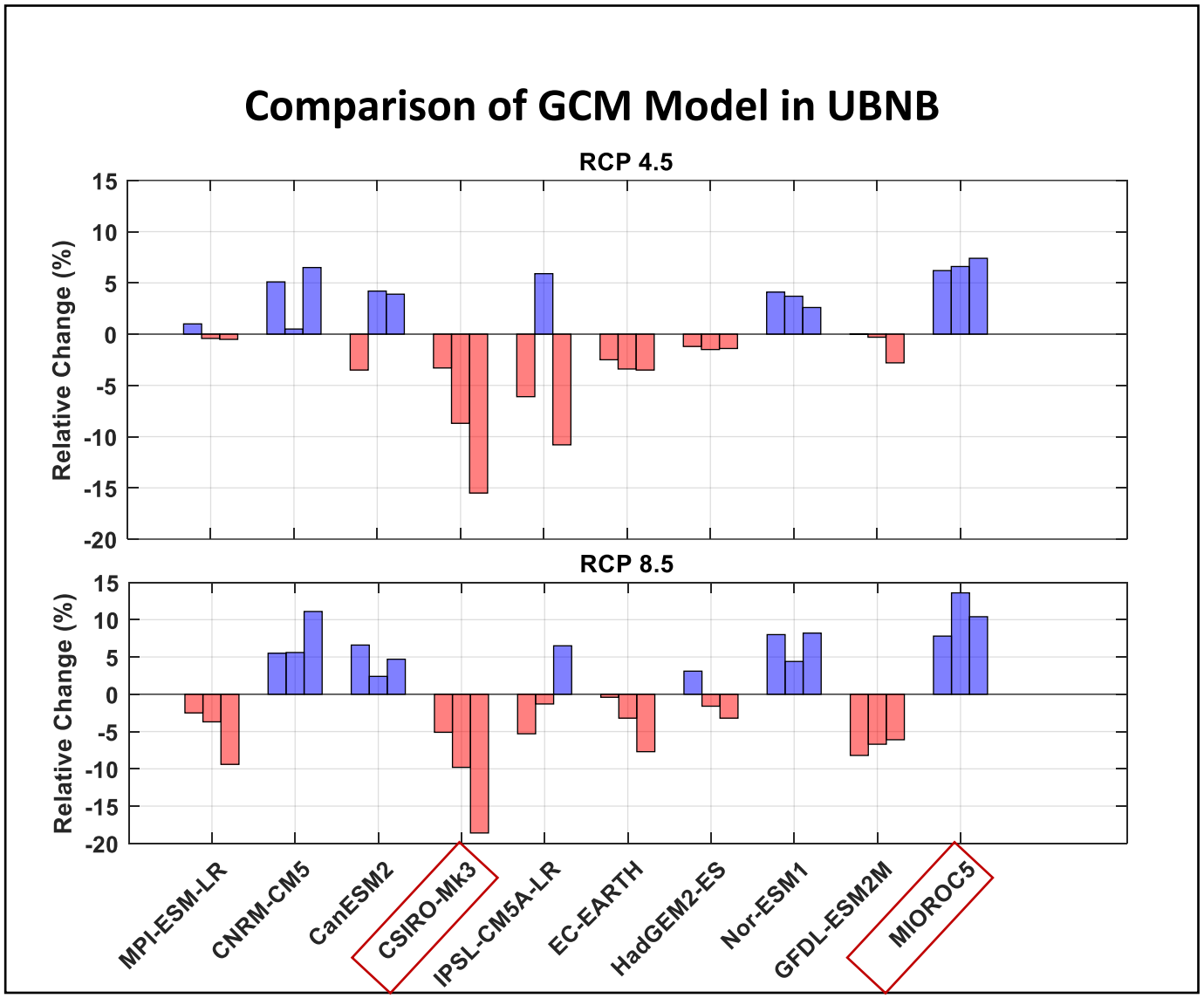
Spatial and temporal evaluation of hyper-resolution ET

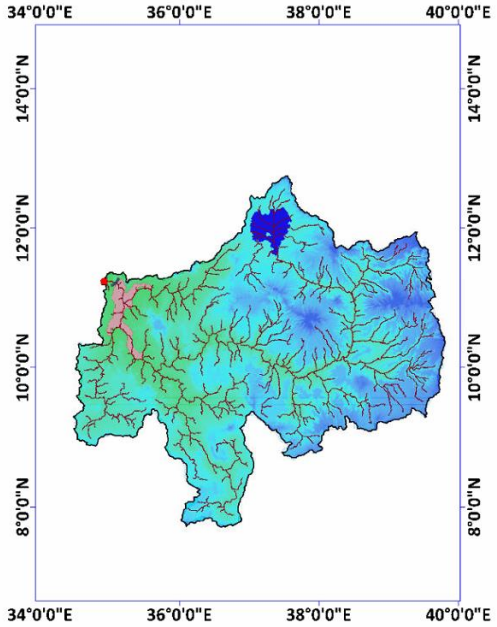
Research Work: Calibrated Hydrological model



Multi-model Comparison of ET and Discharge

Research Work: Climate Change Impacts



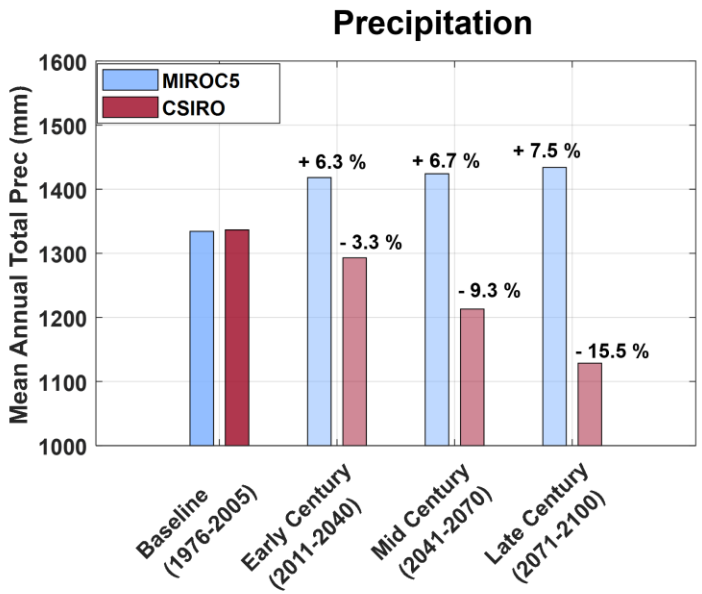


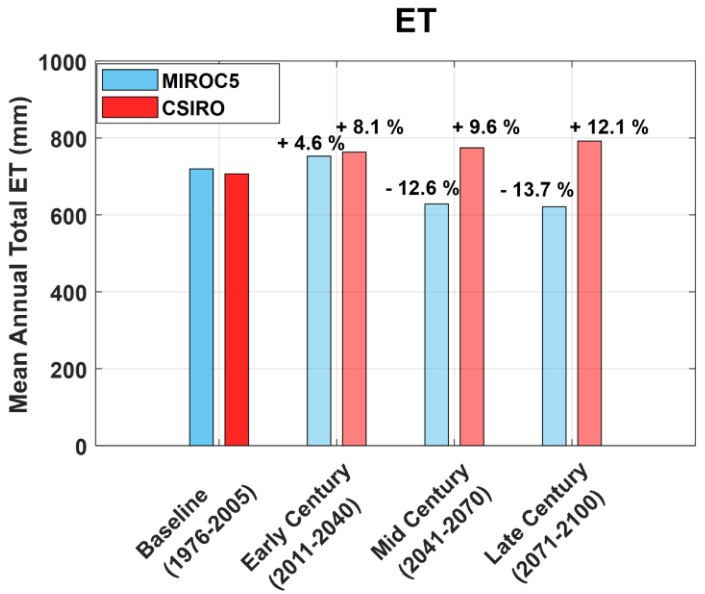
Future precipitation trend (%) in the UBNB against the baseline (1981-2010) precipitation for early (2011-2040), mid (2041-2071), and late (2071-2100) century.

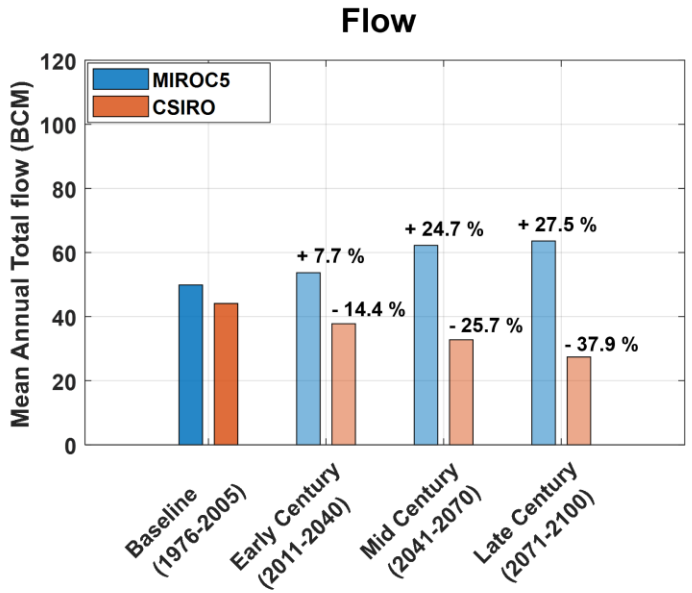
MIROC5 (Wettest)

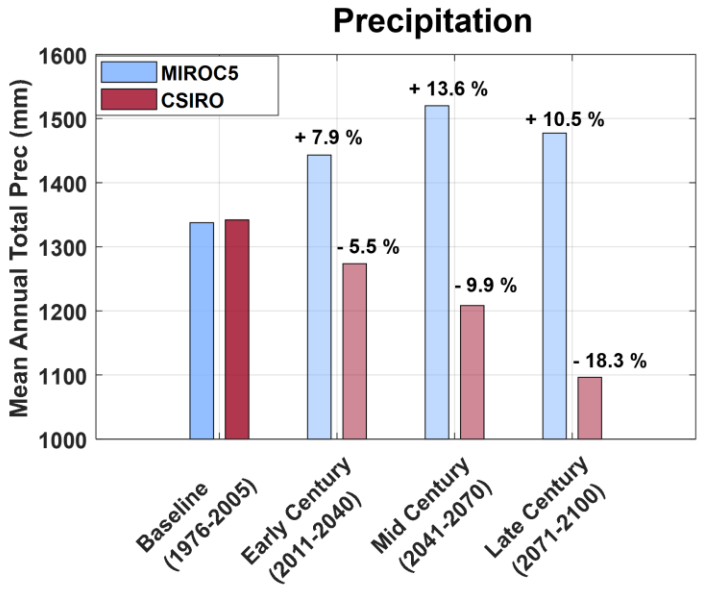
CSIRO-MK3 (Driest)

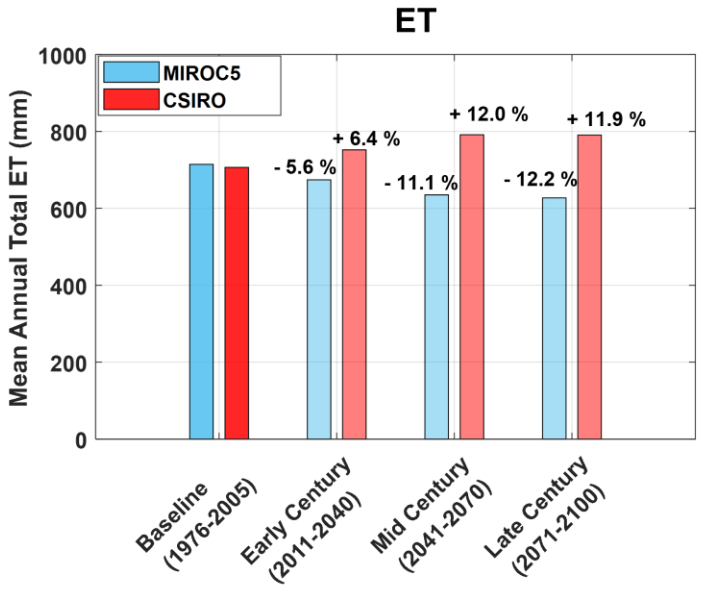
Research Work: Climate Change Impacts

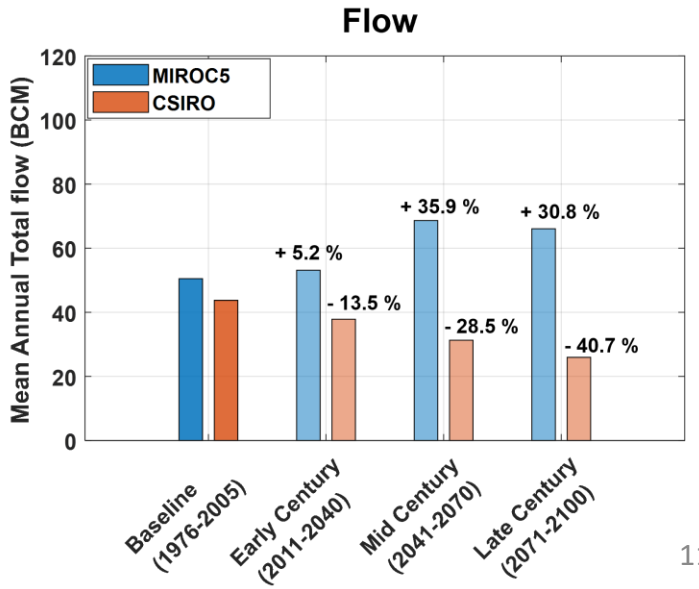




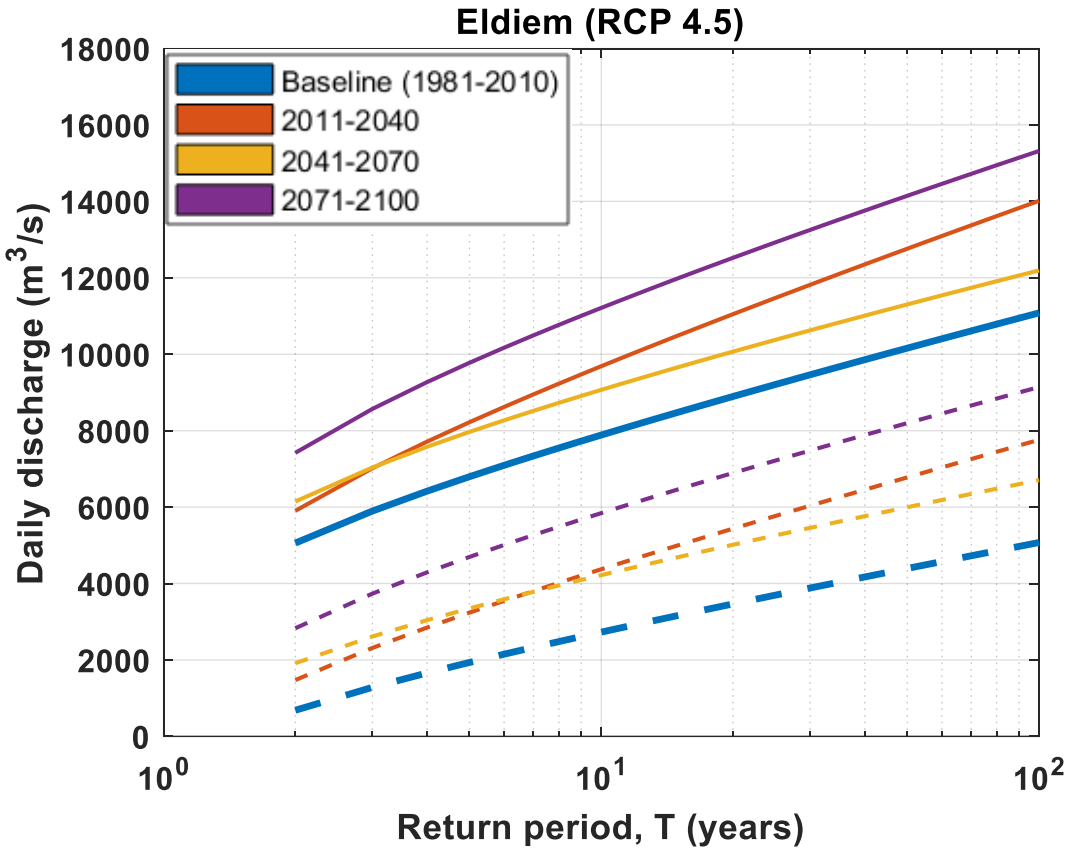


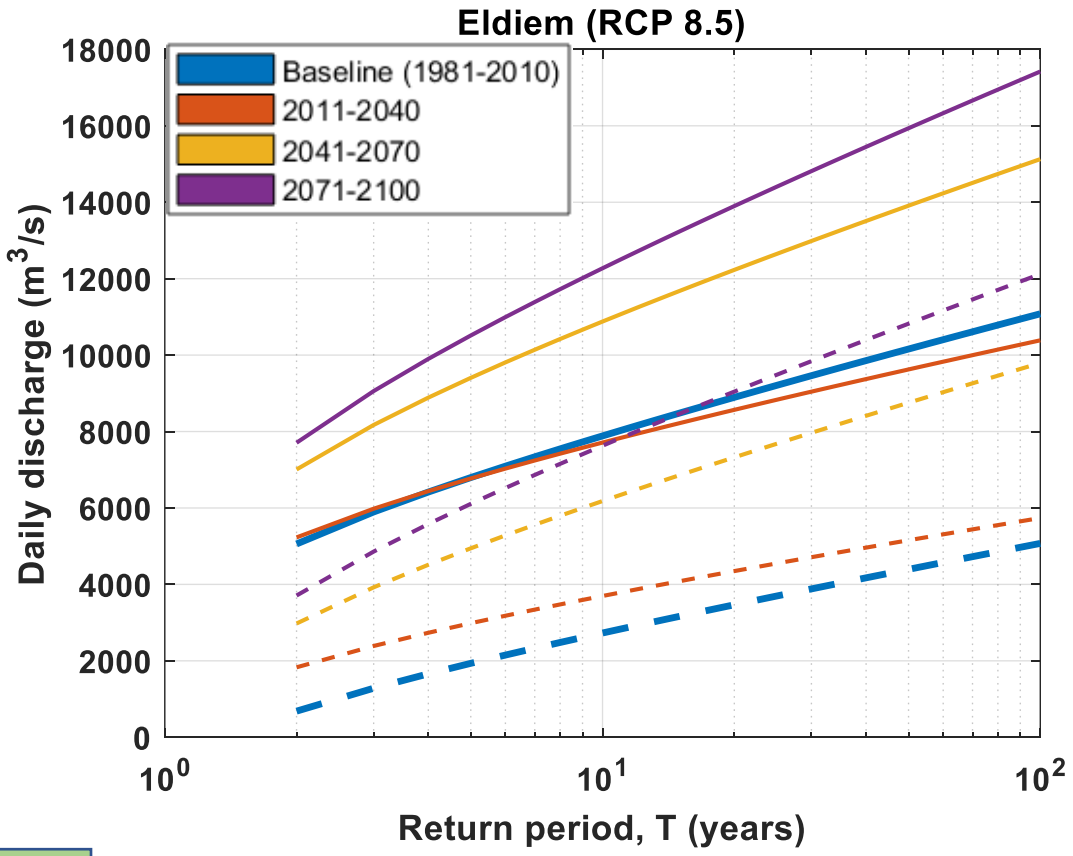






Role of GERD in Reducing Future Flood Severity



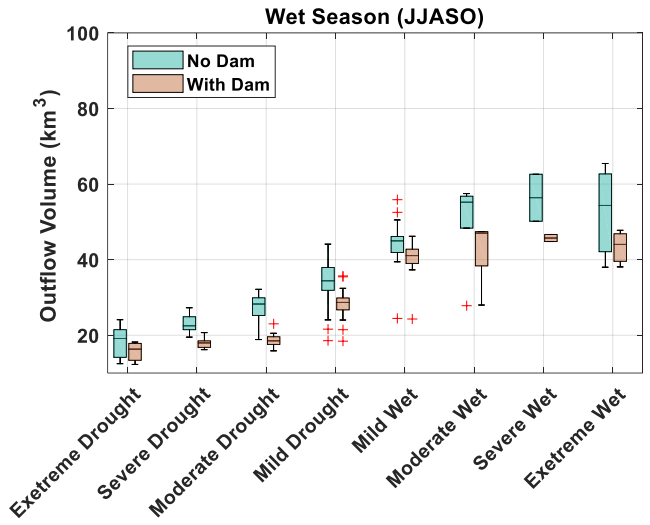


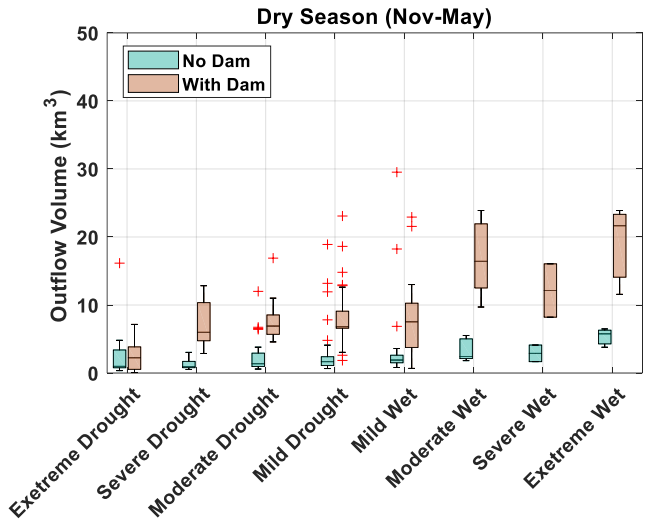
No Dam
With Dam

Reduction of Floods by GERD Dam (MIROC-5 Projections)

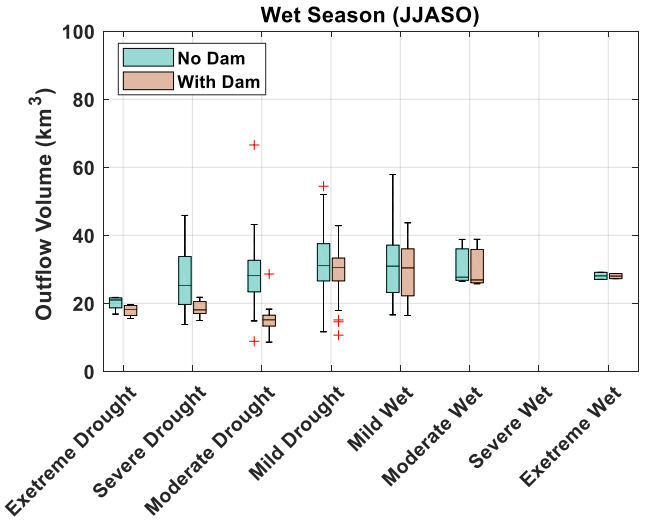
Role of GERD in Reducing Future Drought Severity

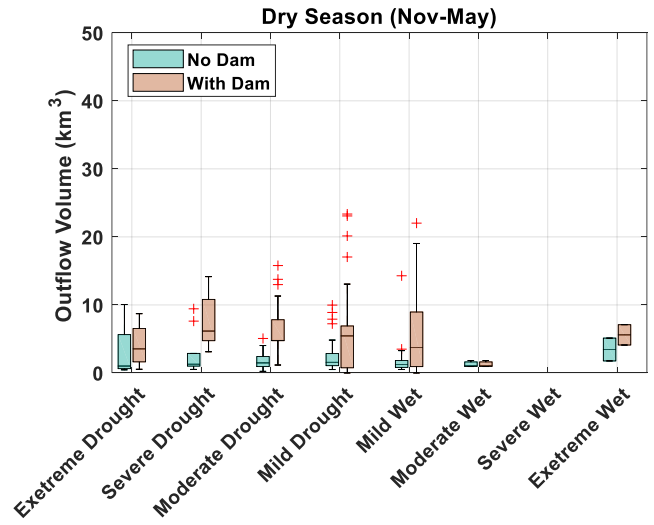
RCP 4.5





RCP 8.5





Reduction of Drought Severity by GERD (CSIRO-MK3 Projections)

Considering climate forecast is available for a specific year and SDI is known, then the dam operation is adjusted based on the drought conditions or SDI value:

- Wet season (18 – 22 hours).
- Dry season (3 – 8 hours).

Research Findings

- The calibrated CREST-SVAS simulated streamflow can be used in locations where observed gauge data is not available and for estimation of reservoir inflow volumes with short term seasonal forecast or long-term climate projections, and extreme event analysis.

- The simulated water cycle components such as infiltration, ET, soil moisture can be also applied to local groundwater model and sectoral crop yield model for further water and food security research.

- The analyses regarding the role of dam to sustain the unavoidable extreme floods or droughts will help planning for more necessary infrastructural development to tackle future climate risks.

- Knowledge of climate risks and future hydrological events can help plan for better sustainable developments, reduce losses and ensure water and food security.

Research Accomplishment from PIRE Project

- **Lazin, R.**, Shen, X., Koukoula, M., Anagnostou, E., (**2020**), "Evaluation of the hyper-resolution model-derived water cycle components over the upper Blue Nile Basin " **Journal of Hydrology.**

- **Lazin, R.**, Shen, X., Moges, S., Anagnostou, E., , "The Role of Renaissance Dam in Reducing Hydrological Extremes in the Upper Blue Nile Basin: Current and Future Climate Scenarios" **(Submitted).**

- Khadim, F. K.,Dokou, Z., **Lazin, R.,** Moges, S., Bagtzoglou, A. C., & Anagnostou, E.(2020). "Groundwater modeling in data scarce aquifers: the case of Gilgel-Abay, Upper Blue Nile, Ethiopia" **Journal of Hydrology.**

- Yang, M., Wang,G., **Lazin, R.,** Shen, X., & Anagnostou, E. (2020). " Impact of planting time soil moisture on cereal crop yield in the Upper Blue Nile Basin: A novel insight towards agricultural water management " **Agricultural Water Management.**

- Yang, M., Wang,G., Wu, S., Anagnostou, E., Lazin, R., Block, P., Alexander, S., Haider. M., Dokou, Z., Koukoula, M., Shen, X., Peña, M., Bagtzoglou, A. Seasonal forecast of crop yield in Ethiopia using analog approach. (Under Review).

- Khadim, F. K.,Dokou, Z., Lazin, R., Bagtzoglou, A. C., & Anagnostou, E. Groundwater modeling to assess climate change impacts in the data Tana Basin, Upper Blue Nile, Ethiopia. (Under Review).

Current and Future Role

- I will graduate in June 2022.
  Thesis: Assessing Climate Change Impacts on Hydrological Extremes and Flood Damages through Physics-Based and AI Modeling.

- I will join as a postdoctoral researcher.
  Position: Machine Learning in Climate Science.

Lawrence Livermore National Laboratory


NSF


PIRE
FOOD & WATER SECURITY

Thank you!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