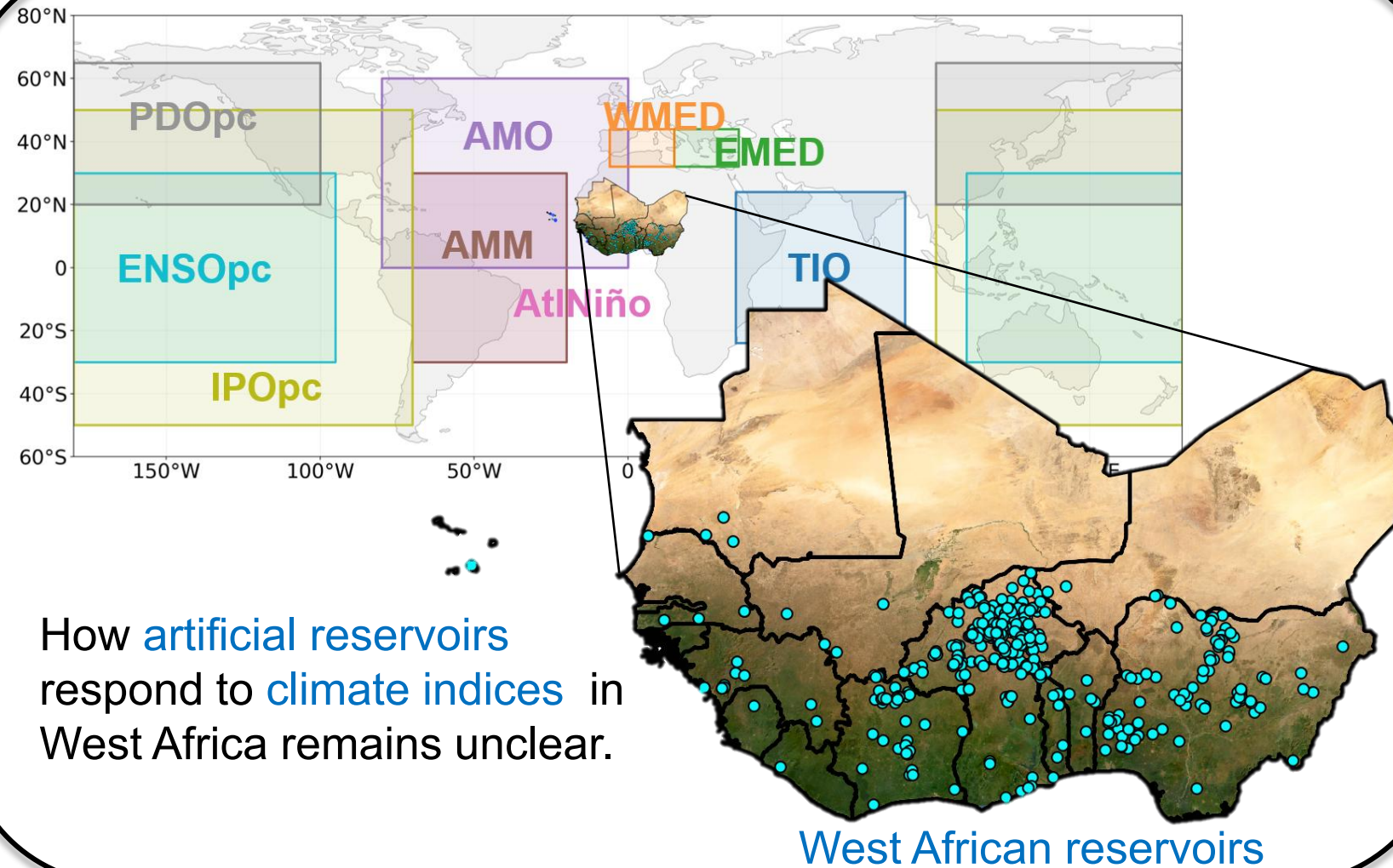


# Influence of Large-Scale Climate Indices on Reservoir Surface Extent (RSE) Variability in West Africa



## Methods

Sea Surface Temperature Anomalies (SSTAs)

+

Reservoir Surface Extent (RSE)



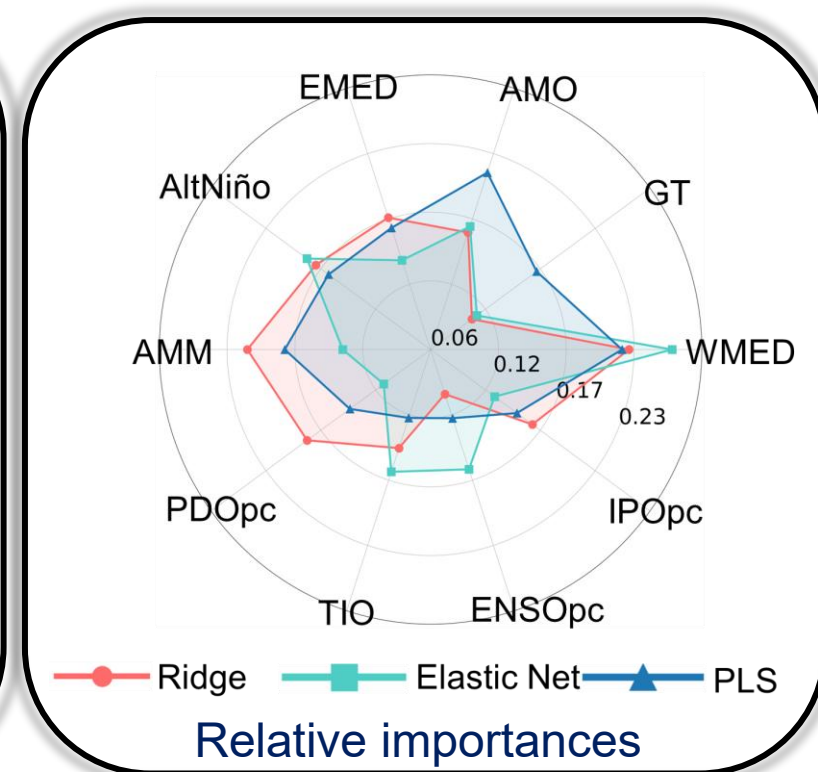
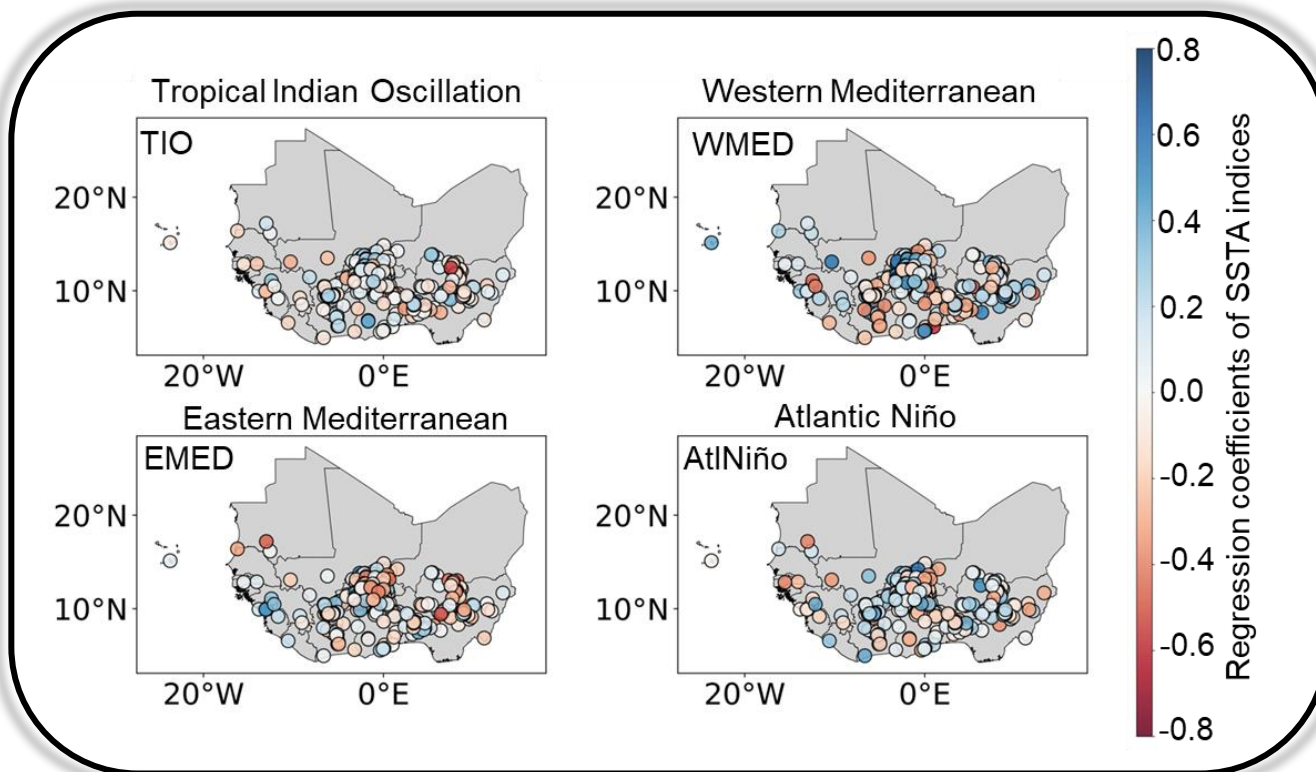
Machine Learning Models



Predicted RSE anomalies

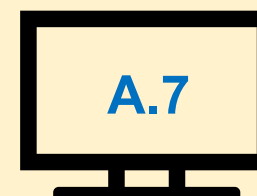
# Influence of Large-Scale Climate Indices on Reservoir Surface Extent (RSE) Variability in West Africa

## Results & Take home



- ✓ Reservoirs are **unevenly** sensitive to climate indices.
- ✓ Reservoirs respond to **combined** teleconnection signals.
- ✓ **WMED** is the most influential mode.
- ✓ **Partial Least Square + PCA** is the best approach.

Screen



# Influence of Large-Scale Climate Indices on Reservoir Surface Extent (RSE) Variability in West Africa



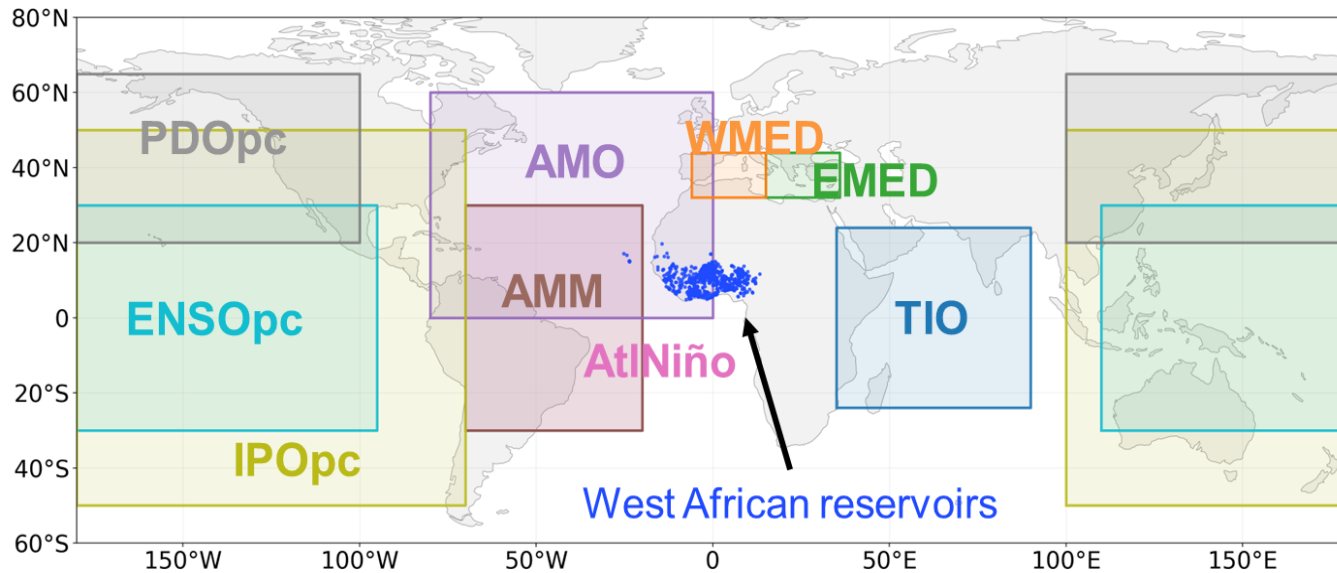
Valery Kouassi



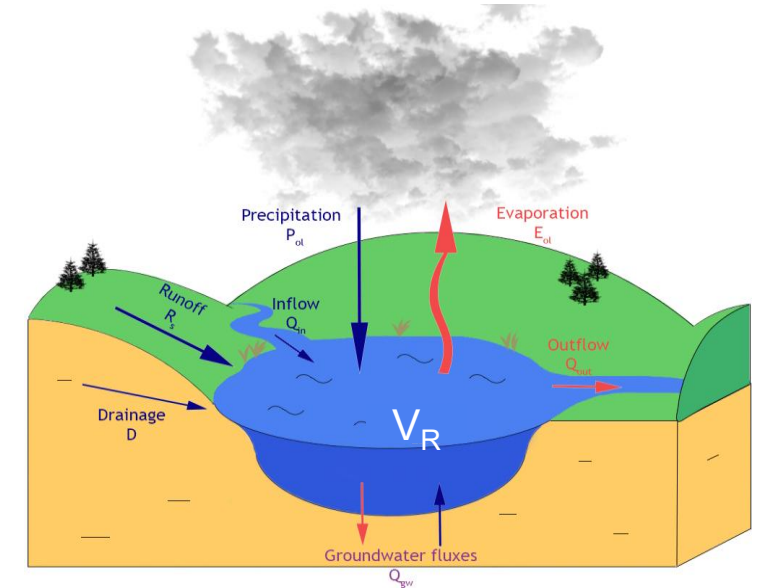
# Influence of Large-Scale Climate Indices on RSE Variability in West Africa

## 1. Background

**+1000** artificial reservoirs in West Africa



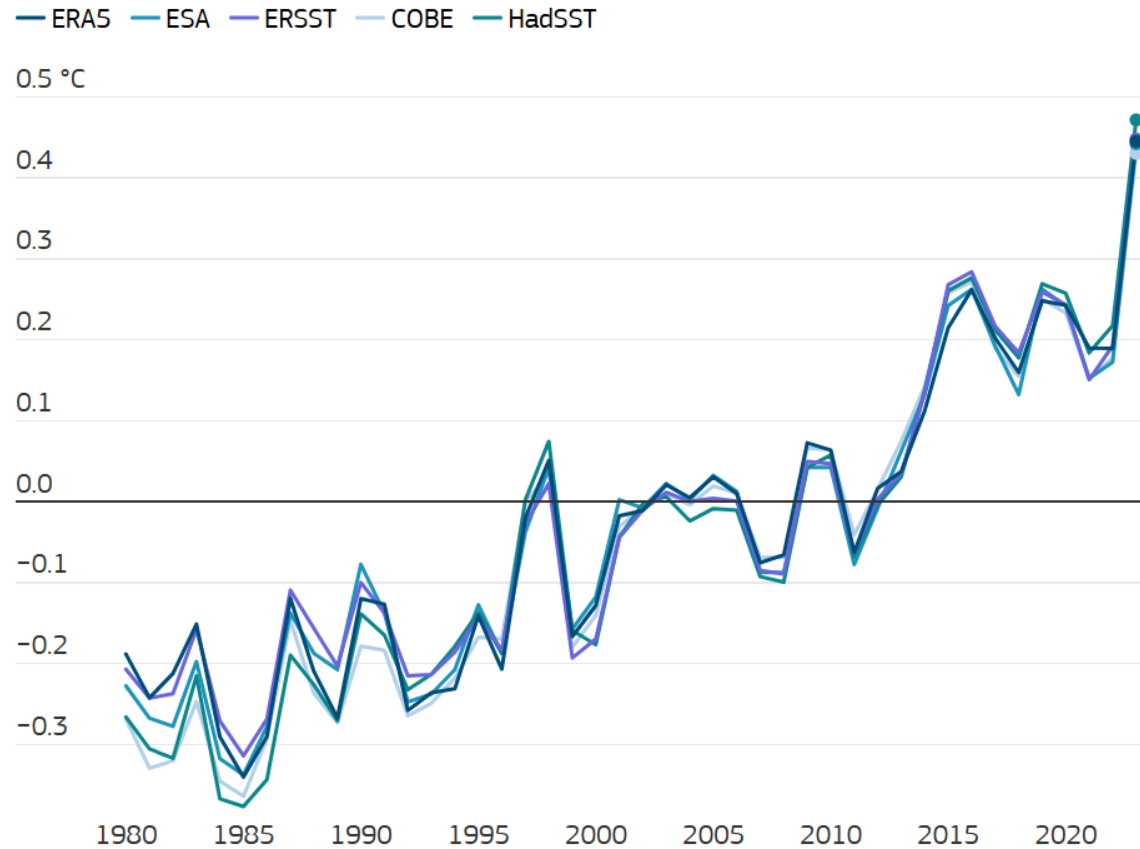
Hydroclimatic variability controls **Storage**



By shaping moisture and rainfall distribution, **climate indices** affect hydrological processes.

(Wang et al., 2004; Owusu et al., 2022; Chun et al., 2021; Hounkpè et al., 2025; Zhang et al., 2026)

## 1. Background

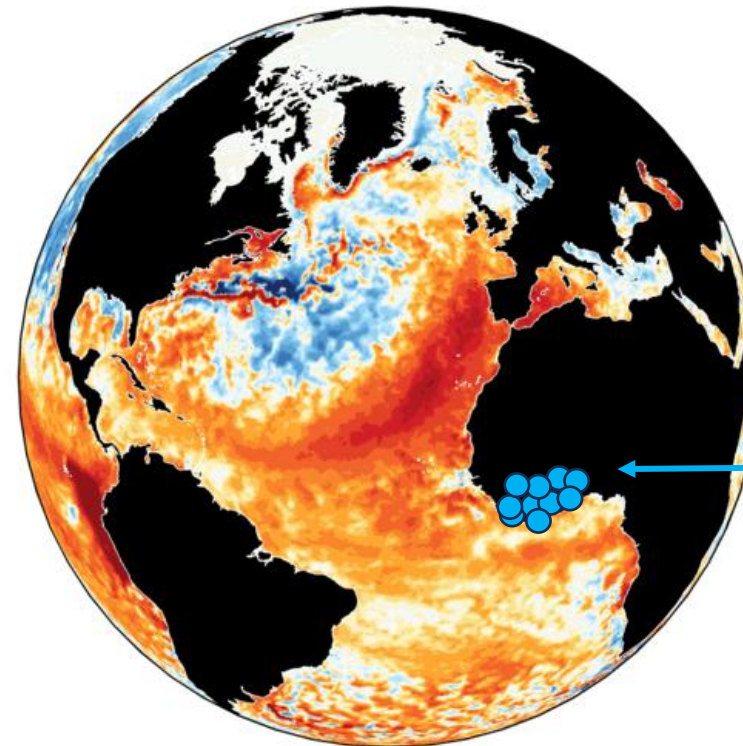


Annual mean SSTA for 60°S-60°N for the 1991-2020  
(Copernicus, 2024)

- Warming of SST (Copernicus, 2024)
- Impacts on hydrology is established.
- Different and pronounced effects of SSTAs on West African Monsoon (Chun et al., 2021; Mampo et al., 2025).
- Yet, how reservoirs respond to climate indices (SSTAs) in West Africa remains unclear.

## 2. Research question

Do climate indices produce consistent or heterogenous effects on reservoirs across West Africa?

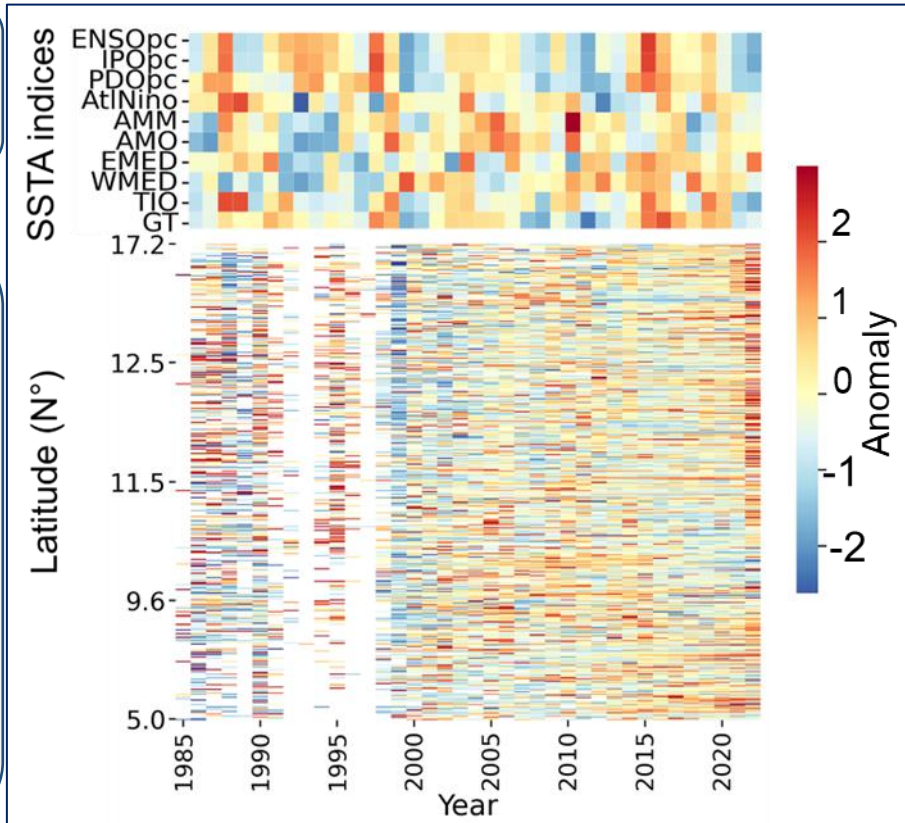


Sea Surface Temperature Anomaly

## 3. Data and methods

SSTA indices  
(ERSSTv5)

Reservoir  
Surface  
Extent (RSE)  
of 412  
reservoirs  
from Global  
Water Watch



Principal Component-Filtered (PCA)

Without

With

Ridge

Elastic Net

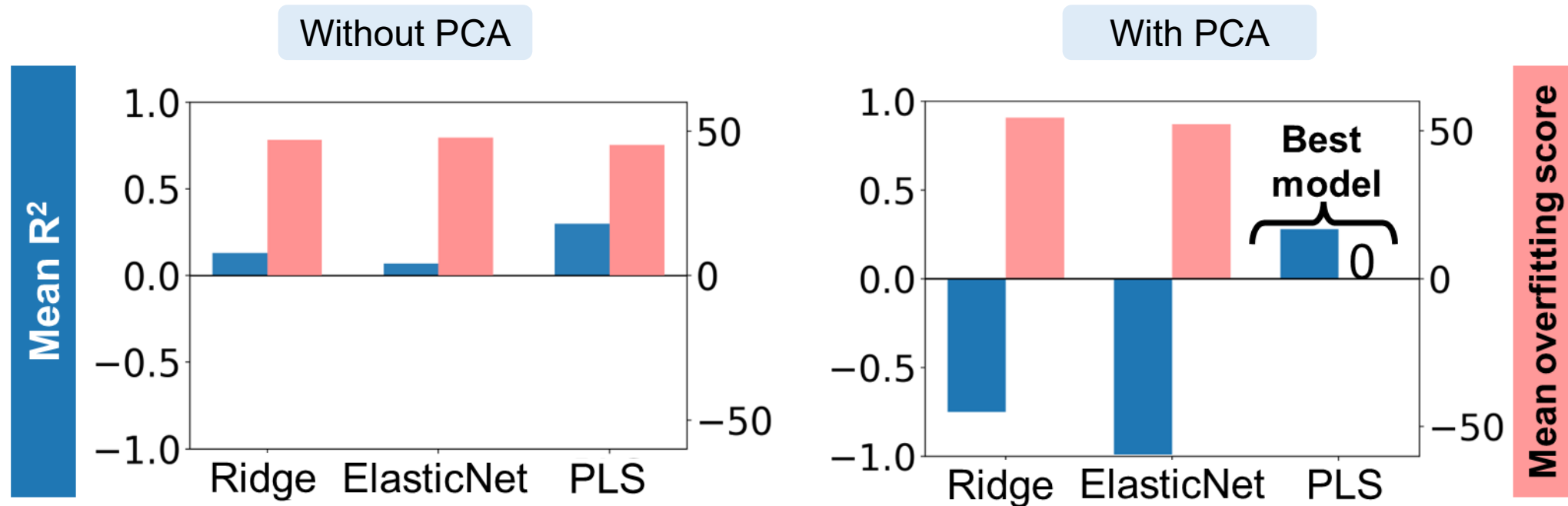
Partial Least Square (PLS)

- Performance metrics
- Relative importance of SSTA
- Regression coefficients

Global and  
Local Moran's I

Clustering detection in reservoir responses

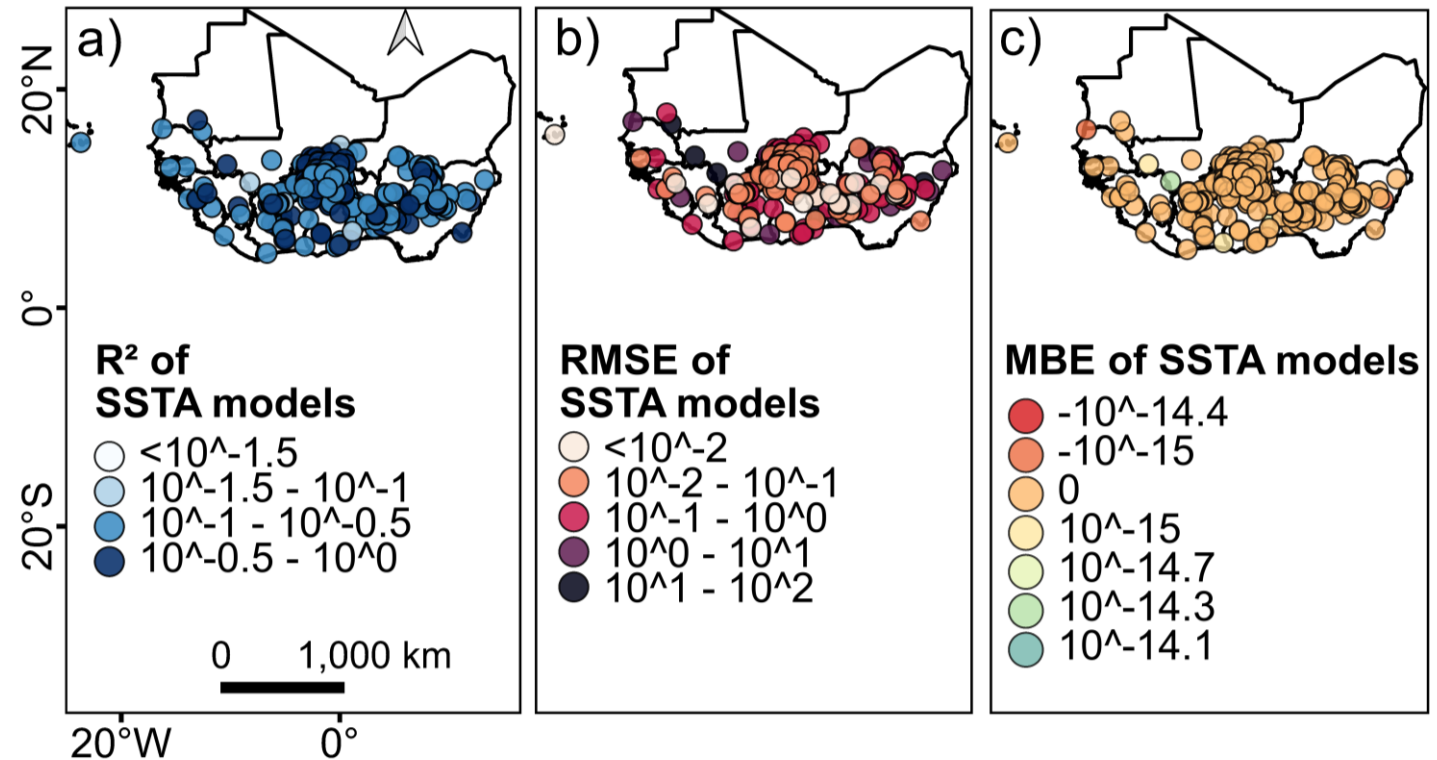
## 4. Results: Model's performance



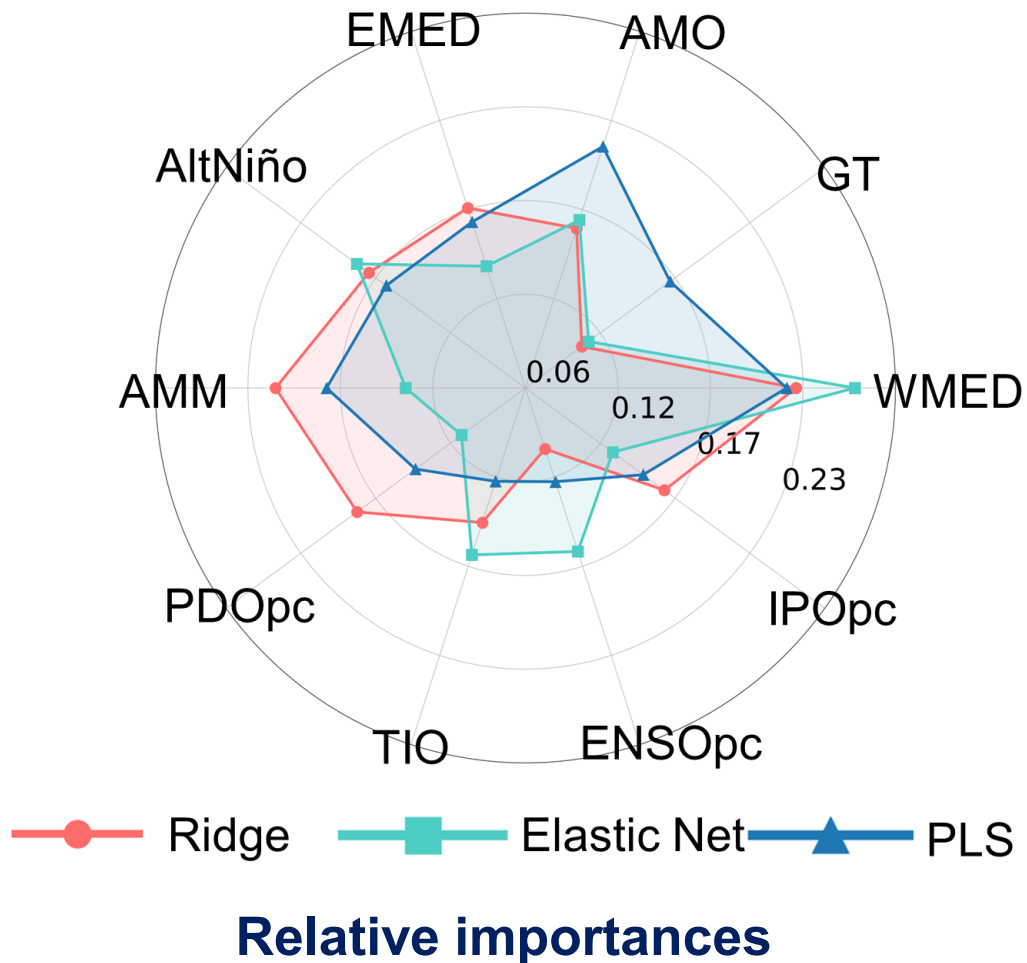
- **PLS + PCA + Low collinearity** is the most robust approach.
- This is due to dimensionality reduction (Angel and McCabe, 2022).

## 4. Results: Model's performance

- The **predictive** skill of the SSTA-based models is spatially **heterogeneous**.
- The models show negligible bias (**MBE  $\approx 0$** ).
- **SSTA** forcing alone accounts for a **modest** to **moderate** portion of the RSE variability.



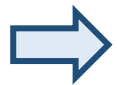
## 5. Results: The dominant climate index



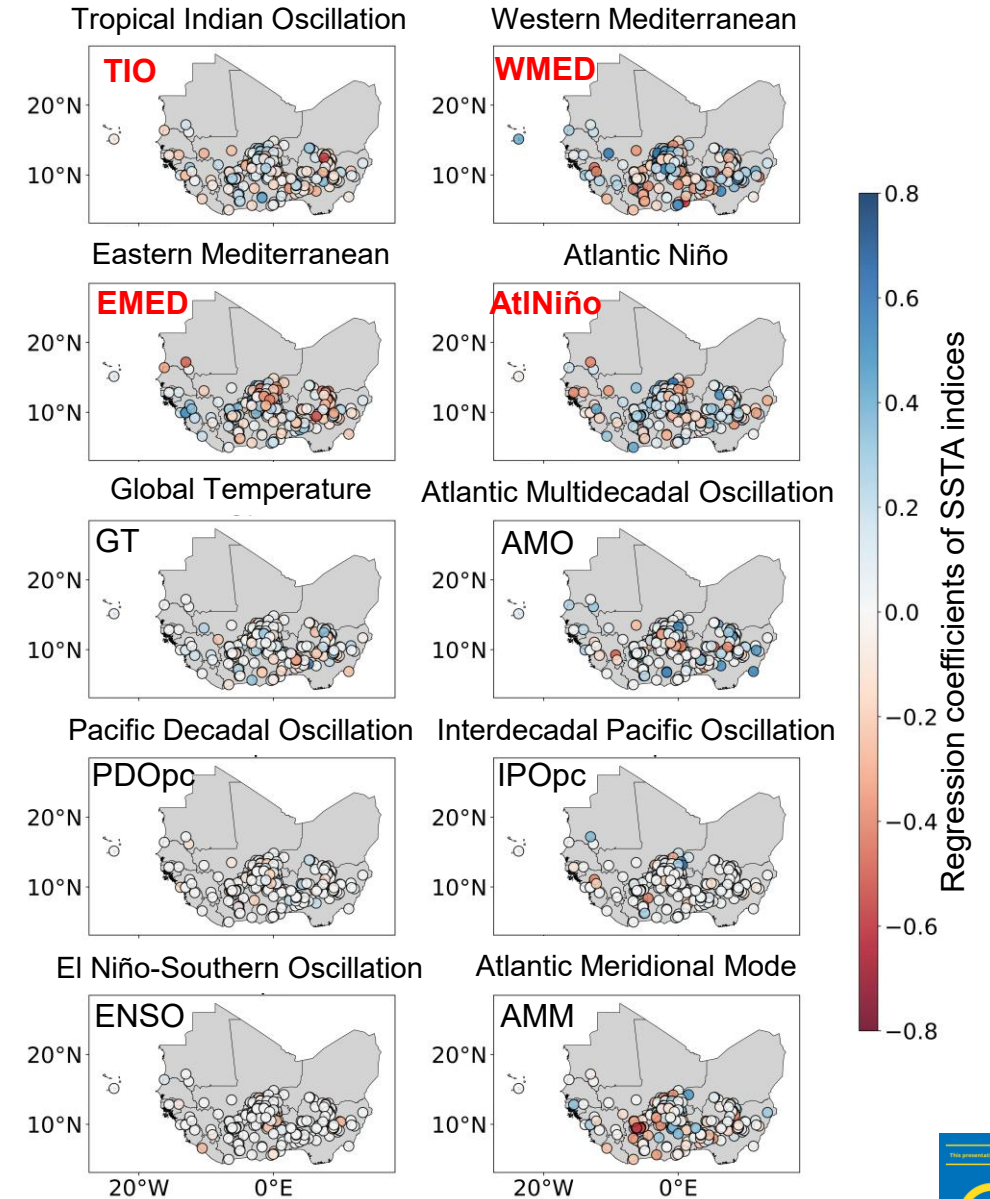
- **WMED** is the most influential mode.
- **ENSOpc** shows the lowest average relative importance.

## 5. Results: Reservoir sensitivity

- Heterogeneous influence of SSTA indices.
- Mediterranean modes (WMED and EMED) have opposite impact direction.
- The Indo-Mediterranean-Atlantic modes emerge as the most pervasive influences.



Chun et al., 2021; He et al., 2021; Mampo et al., 2025

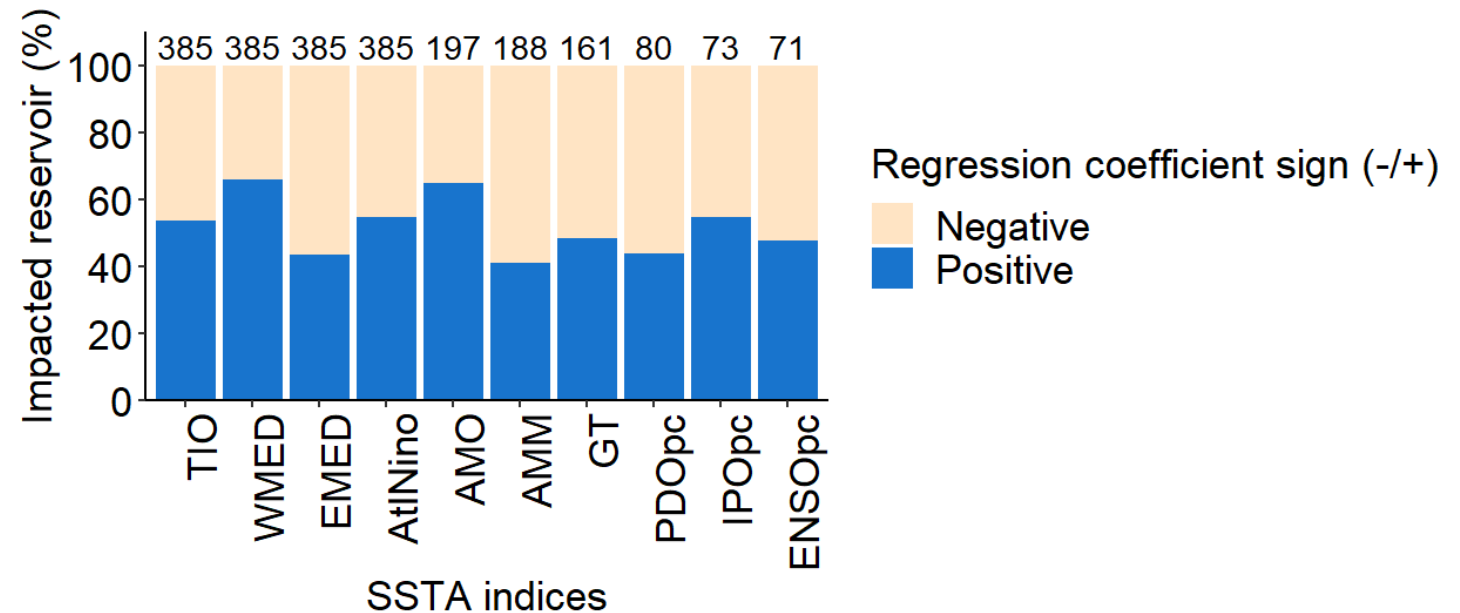


## 5. Results: Individual effects of SSTA indices

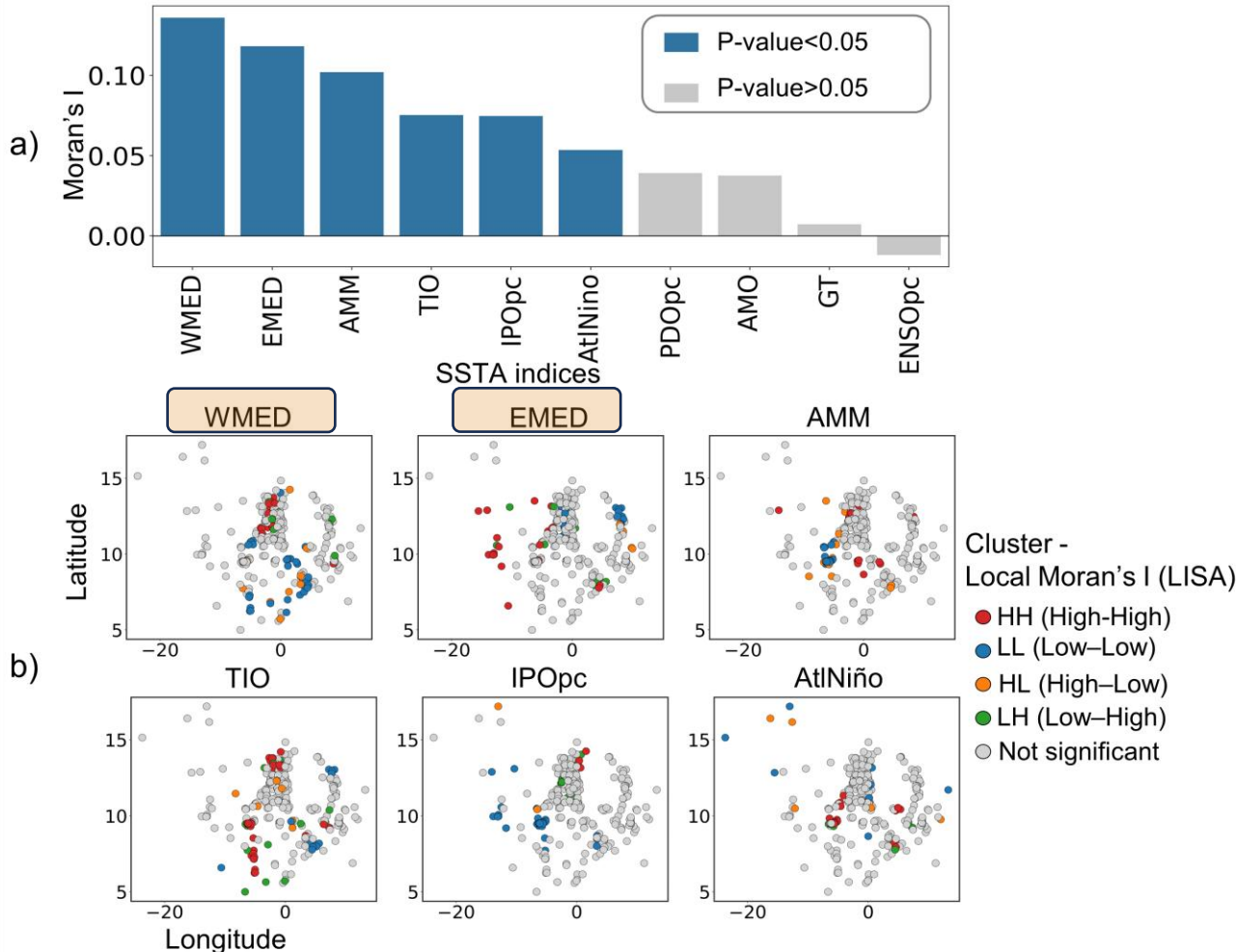
### ■ 3 categories of SSTA:

- Positive effects
- Negative effects
- Mixed effects

- The **mixed effects** imply more spatially heterogeneous influence and indirect transmission through global-scale atmospheric circulation (He et al., 2025).



## 5. Results: Any regional clustering in reservoir responses?



- Identifiable cold and hot spot clusters.

- South-north gradient → **WMED**
  - West-east gradient → **EMED**
- (Fontaine et al., 2010)

- Non-uniformity in SSTA influences suggests a potential control of **local factors**.

## 6. Conclusion

Do climate indices produce consistent or heterogeneous effects on reservoirs across West Africa?

- ✓ Influence of climate indices on reservoirs is **mode-specific** and **spatially heterogeneous**.
- ✓ Coupled **Indo-Mediterranean-Atlantic** has widespread influence.
- ✓ **WMED** is the **dominant** influential mode and associated with **positive effects**.
- ✓ Mediterranean modes (**WMED** and **EMED**) have **contrasting** influences on RSE dynamics.

**Thank you for  
your attention**



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