

Understanding the Relationship Between River Flow and Nutrients in the Lower Apalachicola River

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Earth, Ocean, & Atmospheric Sciences

Introduction

Increasingly prevalent events such as hurricanes and storms carry runoff water downstream into rivers. This streamflow transports nitrogen and phosphorus to downstream estuaries, where their accumulation contributes to water-quality issues such as algal blooms. Through various statistical analyses, this research aims to explore flow-related variability of nutrients (dissolved inorganic nitrogen and phosphorus) in the lower Apalachicola River.

Methodology

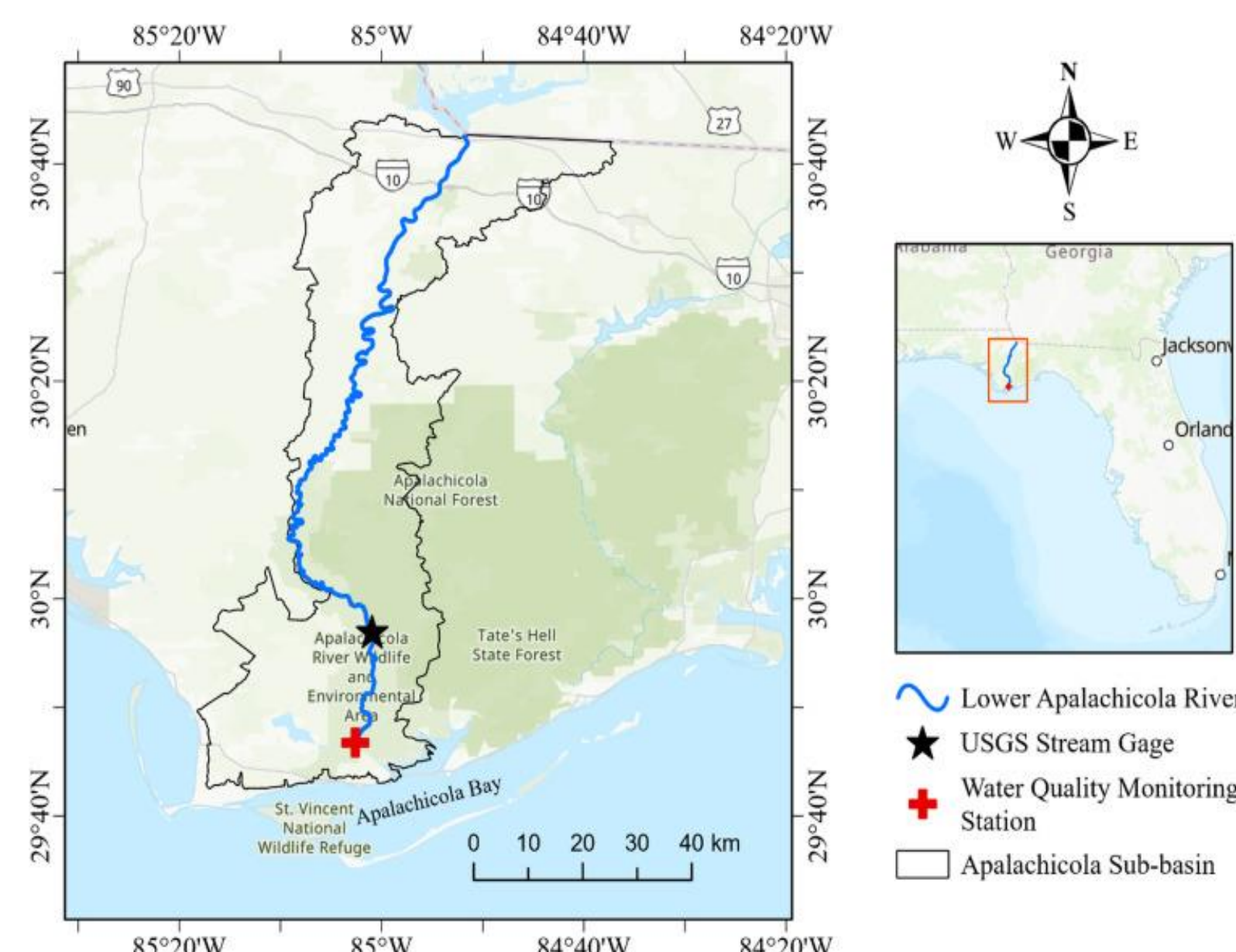


Fig 1: Map of the study area: Lower Apalachicola River (Credit: Rabby et al., 2024)

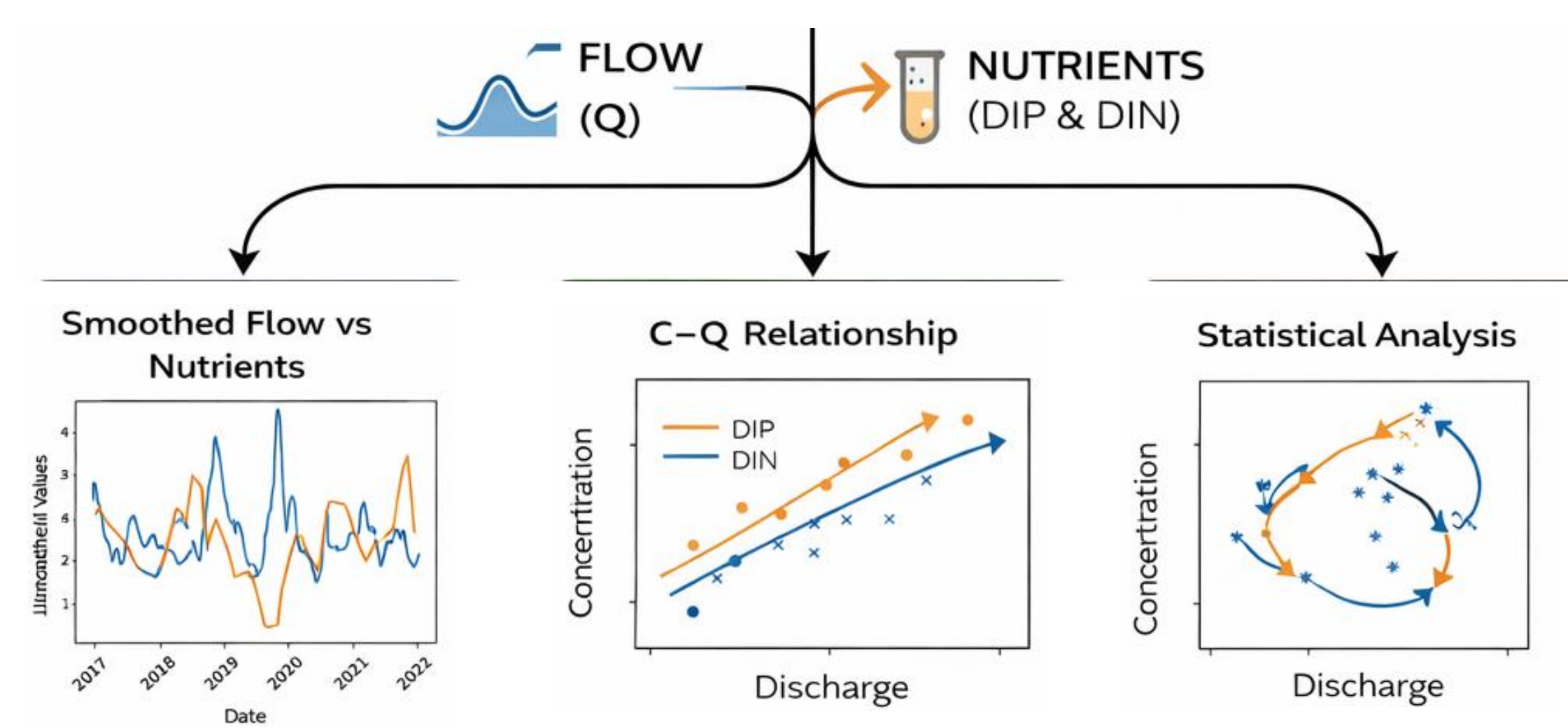


Fig 2: Methodological Framework

Acknowledgements

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Results and Discussions

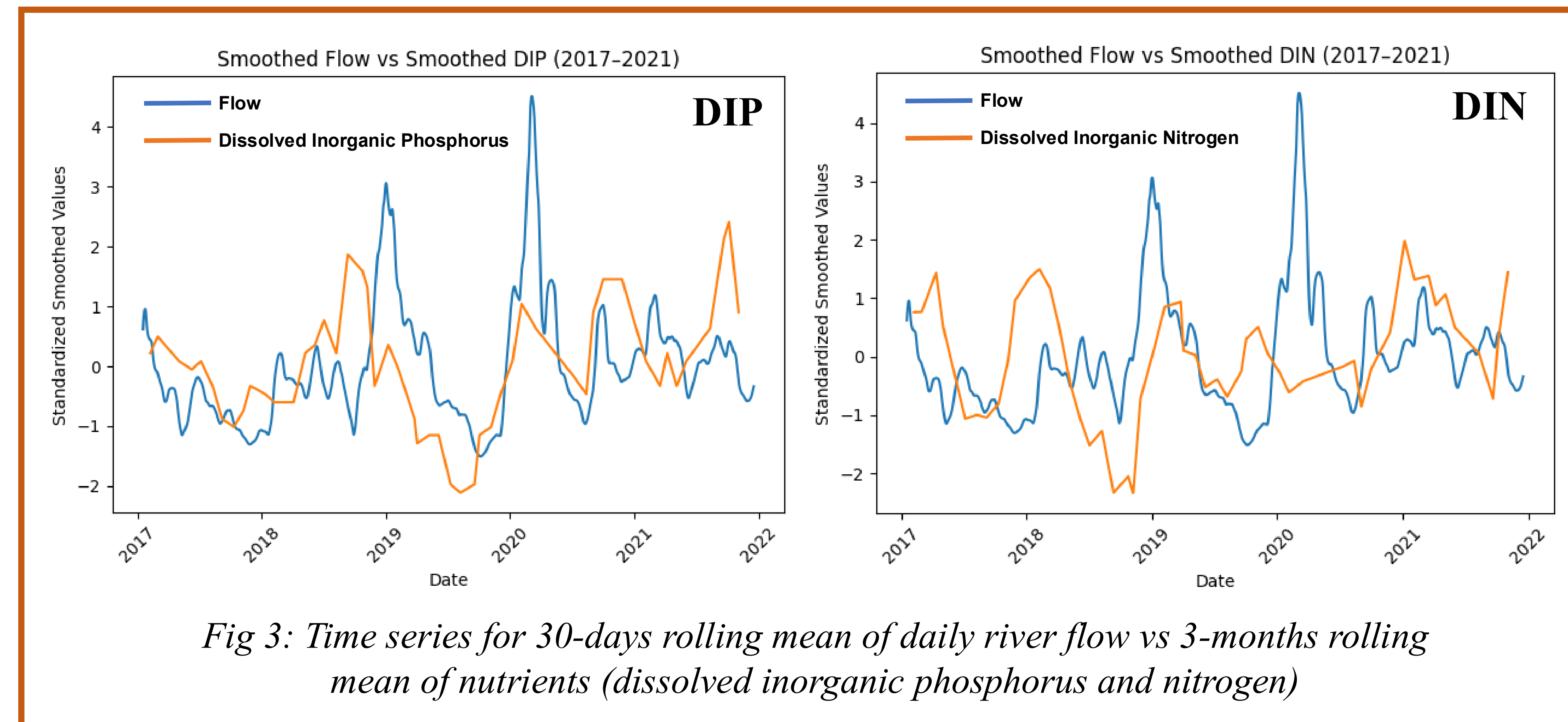


Fig 3: Time series for 30-days rolling mean of daily river flow vs 3-months rolling mean of nutrients (dissolved inorganic phosphorus and nitrogen)

Temporal Co-variability (Fig 3):

Dissolved Inorganic Phosphorus (DIP):

- DIP rises during: Late 2018–early 2019, Early 2020 (large flow), and 2021 moderate events.
- However, DIP does not increase proportionally with the largest 2020 flow spike.
- After the 2020 peak, DIP remains elevated longer than flow in some periods (Fig 3).

Dissolved Inorganic Nitrogen (DIN):

- DIN follows seasonal flow variability more clearly than that of DIP, as highlighted by their strong patterns in 2018–2019 and 2020.
- However, during the largest 2020 spike, DIN does not increase proportionally, and some DIN peaks occur during moderate flows.

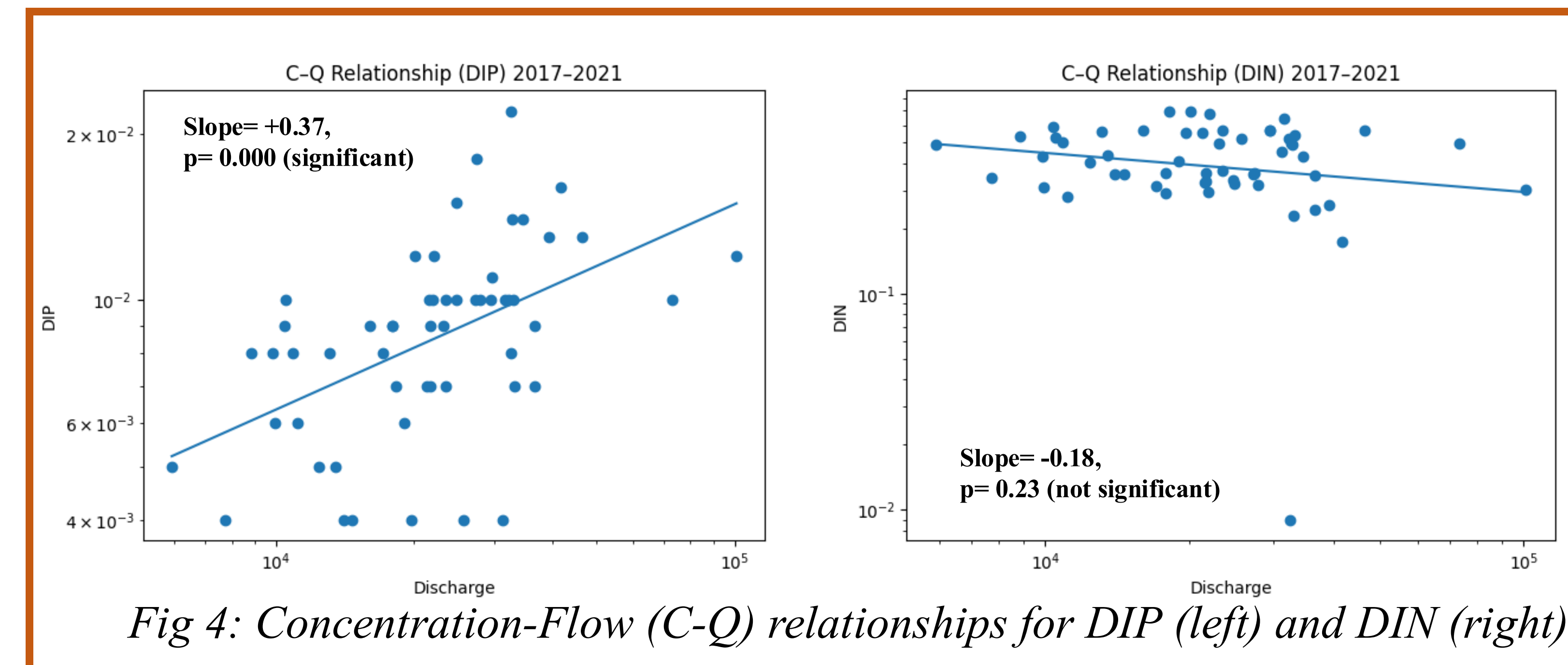


Fig 4: Concentration-Flow (C-Q) relationships for DIP (left) and DIN (right).

C-Q relationships (Fig 4):

- DIP has a strong positive (and statistically significant) relationship with streamflow.
- Contrastingly, DIN is negatively associated with the flow (although the relationship is not statistically significant)

Principal Component Analysis (Fig 5):

- DIP is closely aligned with short-term flow anomaly (STFA), indicating event-driven phosphorus export.
- In contrast, DIN opposes short-term flow anomaly and aligns more with long-term flow anomaly (LTFA).

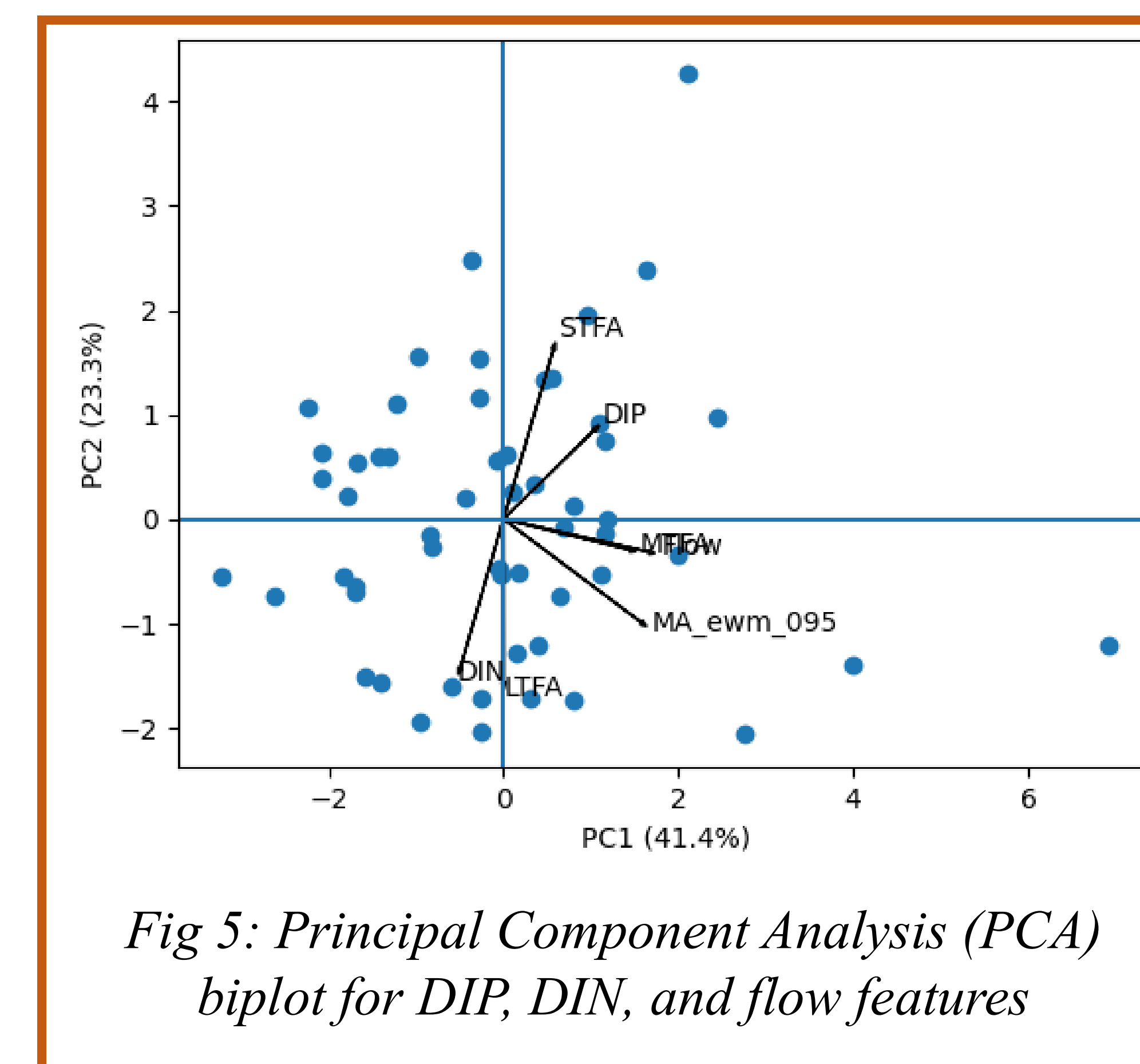
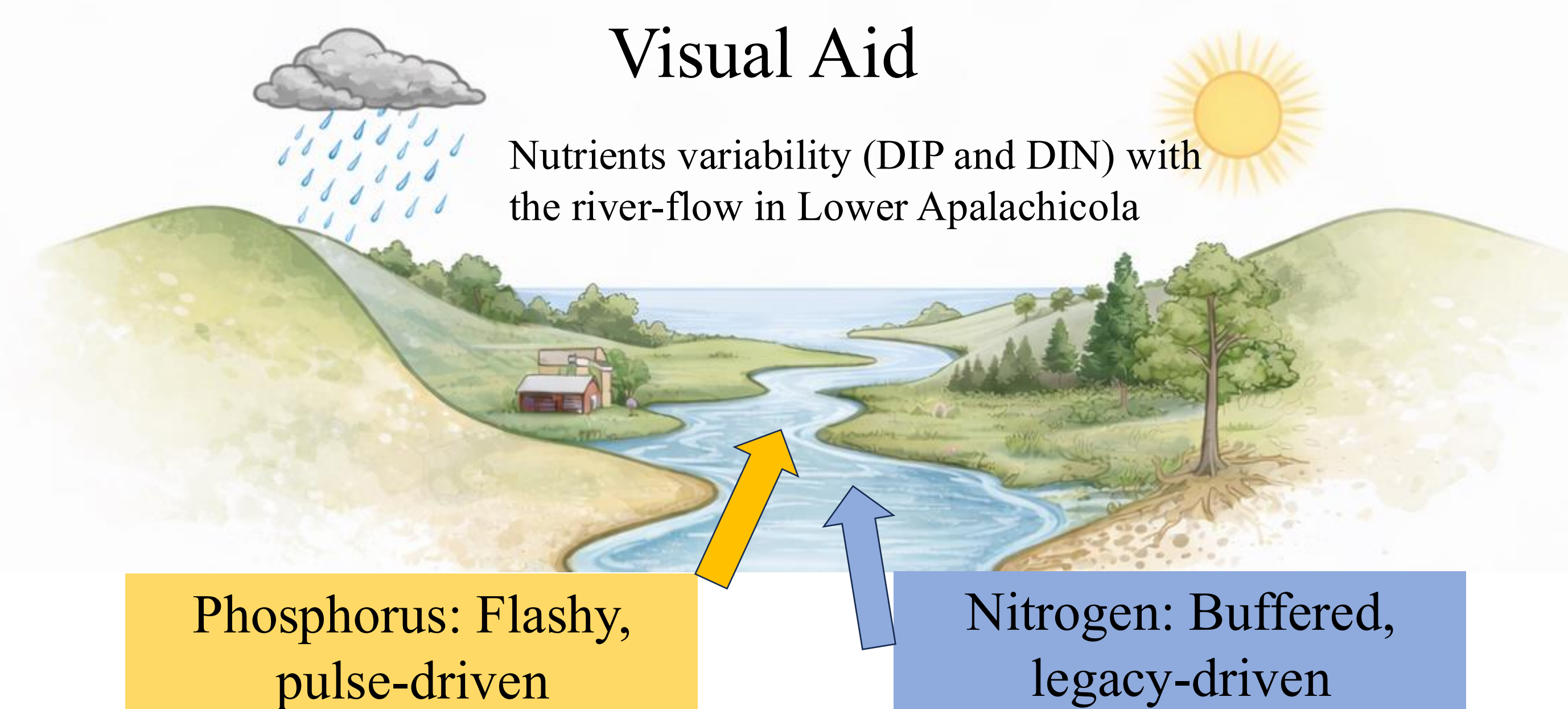


Fig 5: Principal Component Analysis (PCA) biplot for DIP, DIN, and flow features



Reference:

Rabby et al. (2024) Dynamic disparities in inorganic nitrogen and phosphorus fluxes into estuarine systems under different flow regimes and streamflow droughts. *Water Research*, 264, 122238. DOI: 10.1016/j.watres.2024.122238