Role of Impoundment and Irrigation in Intensive Agricultural Watersheds: Implications for Streamflow Modeling and Stormwater Management

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I. Introduction

- **Impact of Human Activities on Streamflow:**

Human actions—such as irrigation withdrawals, drainage modifications, and land-use change—disrupt natural hydrological cycles. These changes reshape streamflow patterns, surface runoff, and stormwater storage, directly affecting water availability and stormwater design efficiency.

- **Role of Impoundments (iSWAT):**

Impoundments (lakes, reservoirs, wetlands, ponds) serve as natural stormwater regulators. They capture runoff, attenuate peak flows, and sustain baseflow during dry periods. The iSWAT model enhances representation of these effects for better stormwater and flood-risk planning.

- **Influence of Irrigation Practices (iiSWAT):**

Irrigation activities linked with crop cycles significantly influence streamflow and stormwater balance by modifying withdrawal timing and return flows. The iiSWAT framework integrates realistic irrigation schedules to improve low-flow predictions and guide sustainable stormwater strategies.

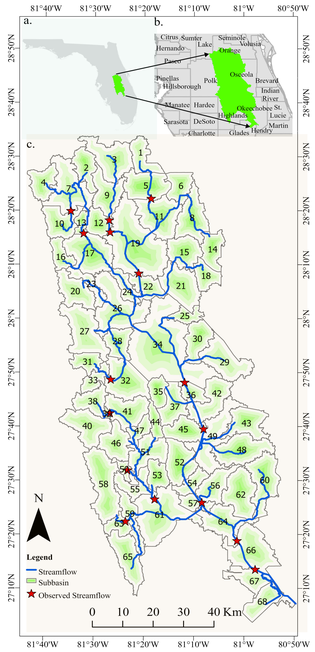
II. Gaps and Objectives

Gaps:

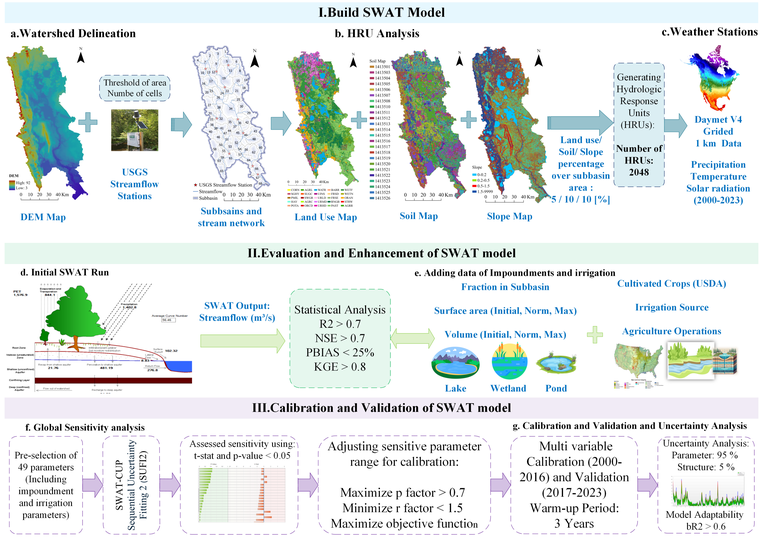
integration of impoundment and irrigation processes reduces streamflow prediction accuracy and weakens stormwater management in agricultural watersheds.

Objectives:

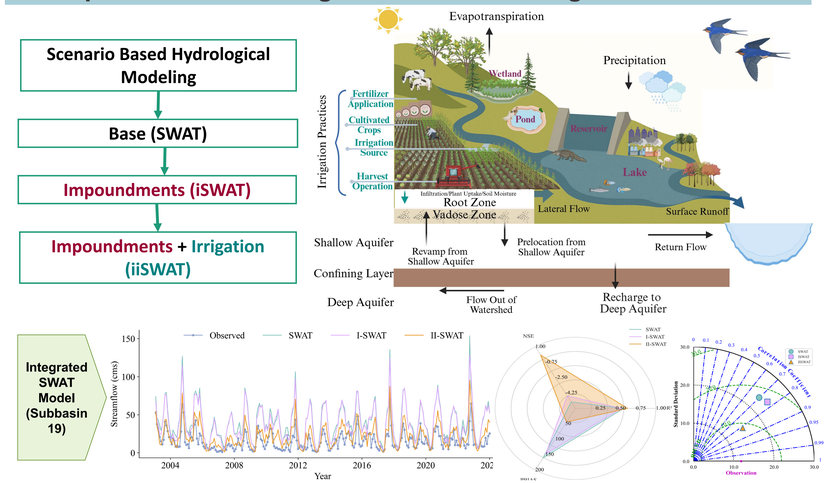
- ✓ **Develop an enhanced SWAT-based framework** that couples impoundment dynamics, irrigation schedules, and crop growth to better represent managed hydrology.
- ✓ **Quantify how impoundments and irrigation influence stormwater responses,** including peak-flow attenuation, baseflow support, and low-flow reduction across agricultural basins
- ✓ **Identify effective computational strategies** to incorporate complex human-natural interactions into the SWAT model, addressing challenges in parameterization, data availability, and computational efficiency to improve streamflow simulation and decision-making accuracy.



V. Results



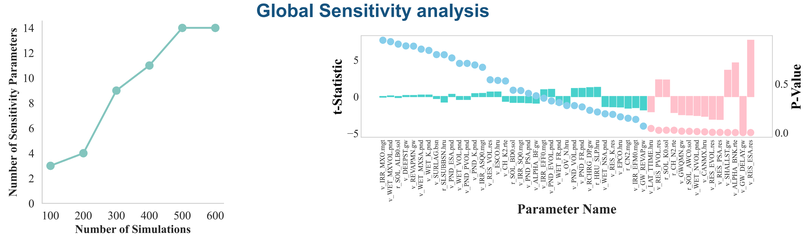
IV. Impoundment and Irrigation Practices Integration



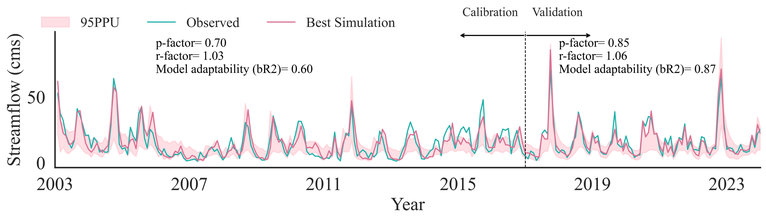
III. Methodology

We calibrated and validated our iiSWAT model at 10 stations. We present example subbasin 19 plot performance as below.

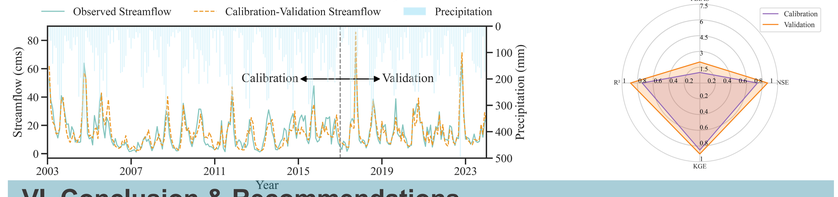
Global Sensitivity analysis



Uncertainty distribution of monthly streamflow simulations



Evaluation of monthly streamflow simulations



VI. Conclusion & Recommendations

- ✓ The model accurately captured storage and release processes that sustain baseflow and attenuate peak flows, key for stormwater control and flood mitigation.
- ✓ Incorporating realistic irrigation timing and water-use schedules enhanced prediction of withdrawals and low-flow behavior in agriculture-dominated regions.
- ✓ Sensitivity analysis emphasized the importance of localized calibration to represent soil, land-use, and management variability across subbasins.
- ✓ Despite data and parameterization challenges, iiSWAT demonstrated adaptability under diverse hydrological regimes, providing a strong basis for stormwater and water-resource planning.
- ✓ Future work should integrate finer-resolution remote sensing and crop growth dynamics to further refine stormwater simulation and resilience assessment.

For more information, scan the QR code or visit:

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