Evaluating the Impacts of Agricultural Transformation from Rainfed to Irrigation on Streamflow and Nitrates in a Mediterranean Agricultural Watershed in Spain

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1. Aim

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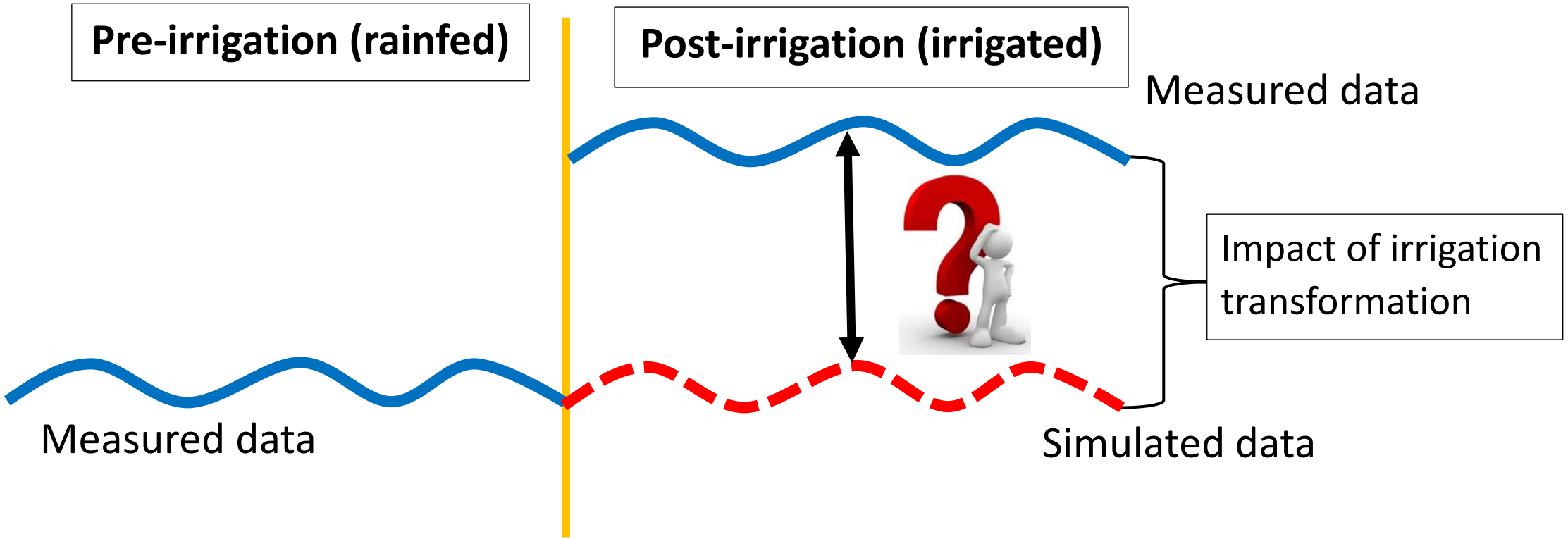
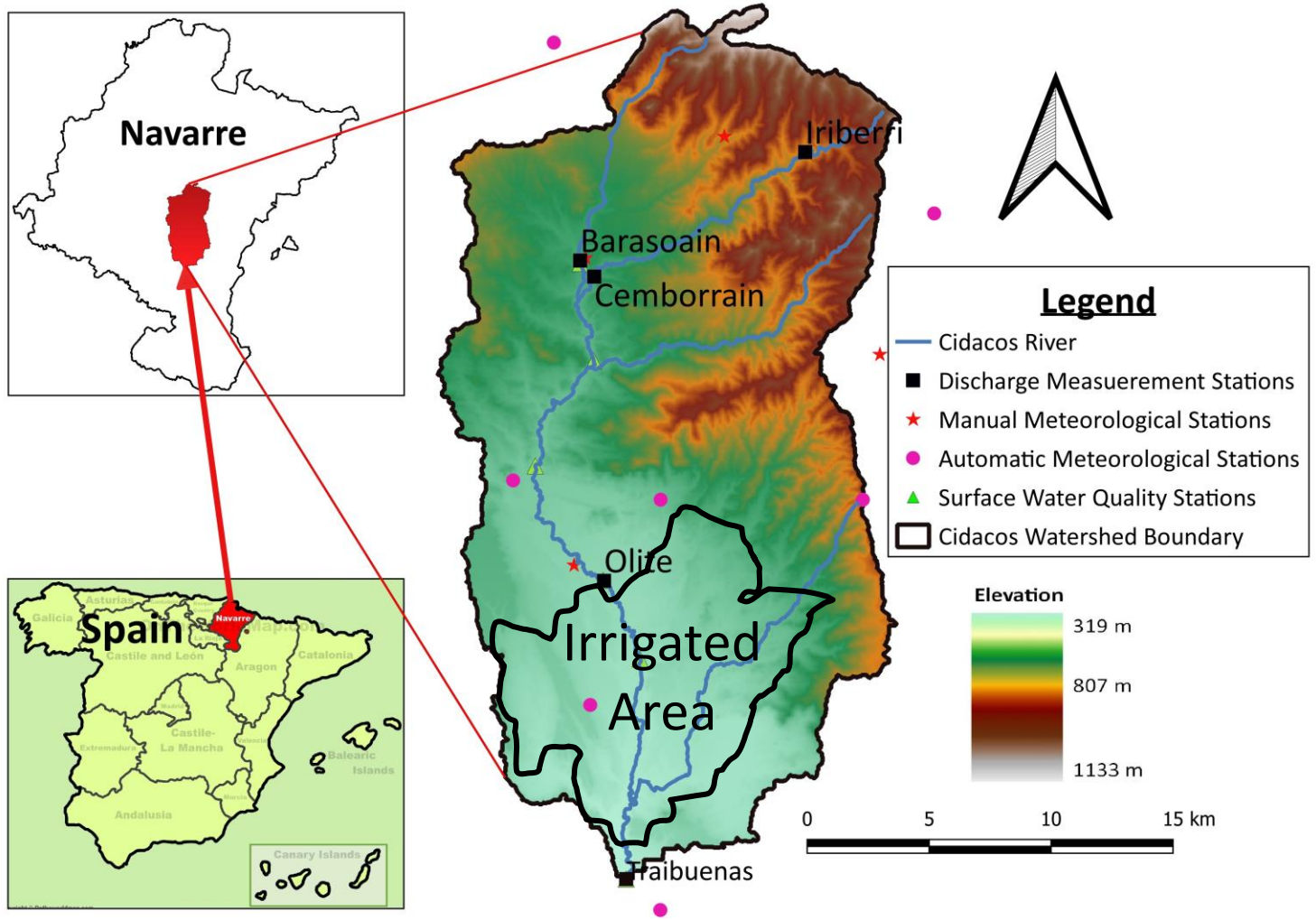
To analyze the **changes** in **streamflow and nitrates before** and **after** the **irrigation implementation** in the **lower reaches** of the Cidacos River Watershed **using the SWAT model**



2. Methodology

Study Area: Cidacos River Watershed

- **Cidacos River** is a tributary of the **Aragón River** which is a tributary to **Ebro River**
- Total Area: approx. **477 sq. km**
- Area under rainfed: **260 km^2 (55%)**
- Area under irrigation: approx. **77 km^2 (16%)**
- Period of transformation to irrigation: **2009-2012**
- Climate: **Mild-Mediterranean**
- Altitude: approx. **300 - 1100m**
- Annual Precipitation – **400mm to 800mm**

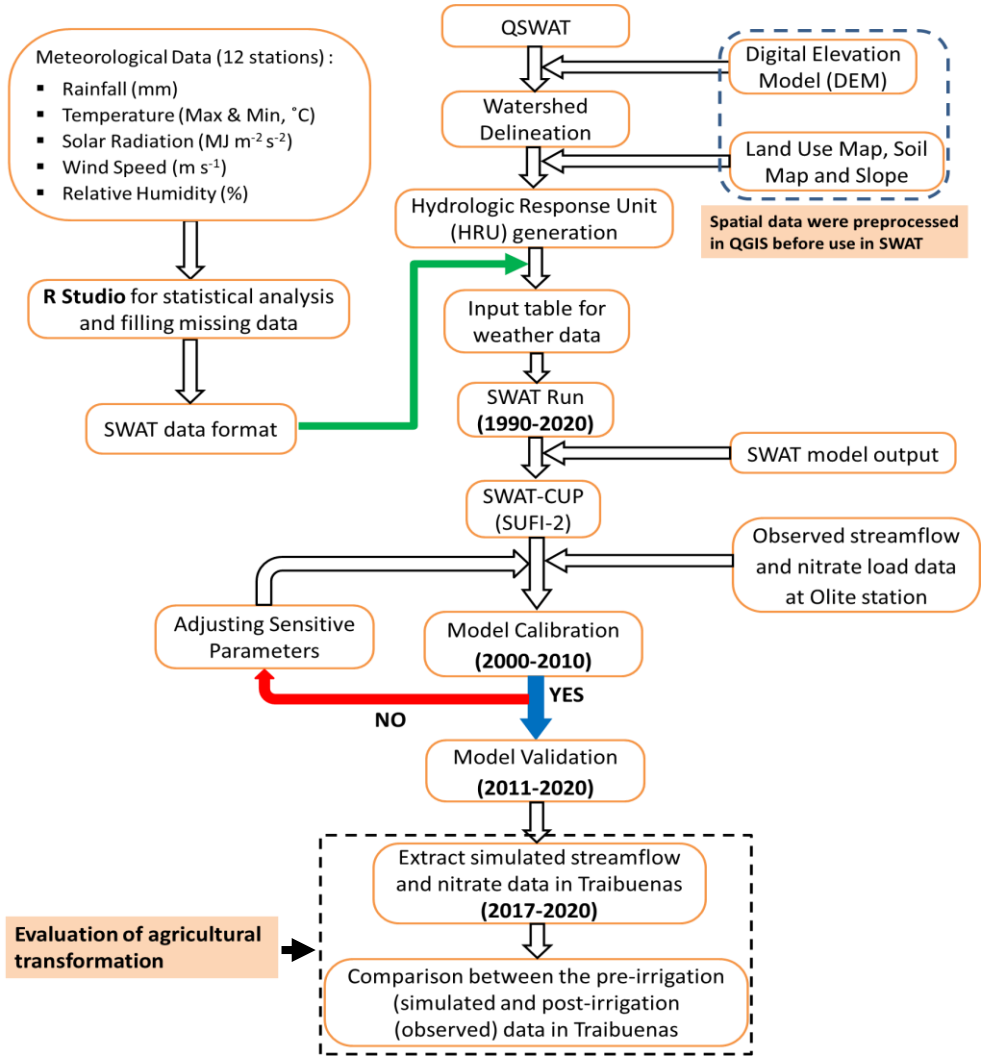


2. Methodology

The SWAT Modeling Approach

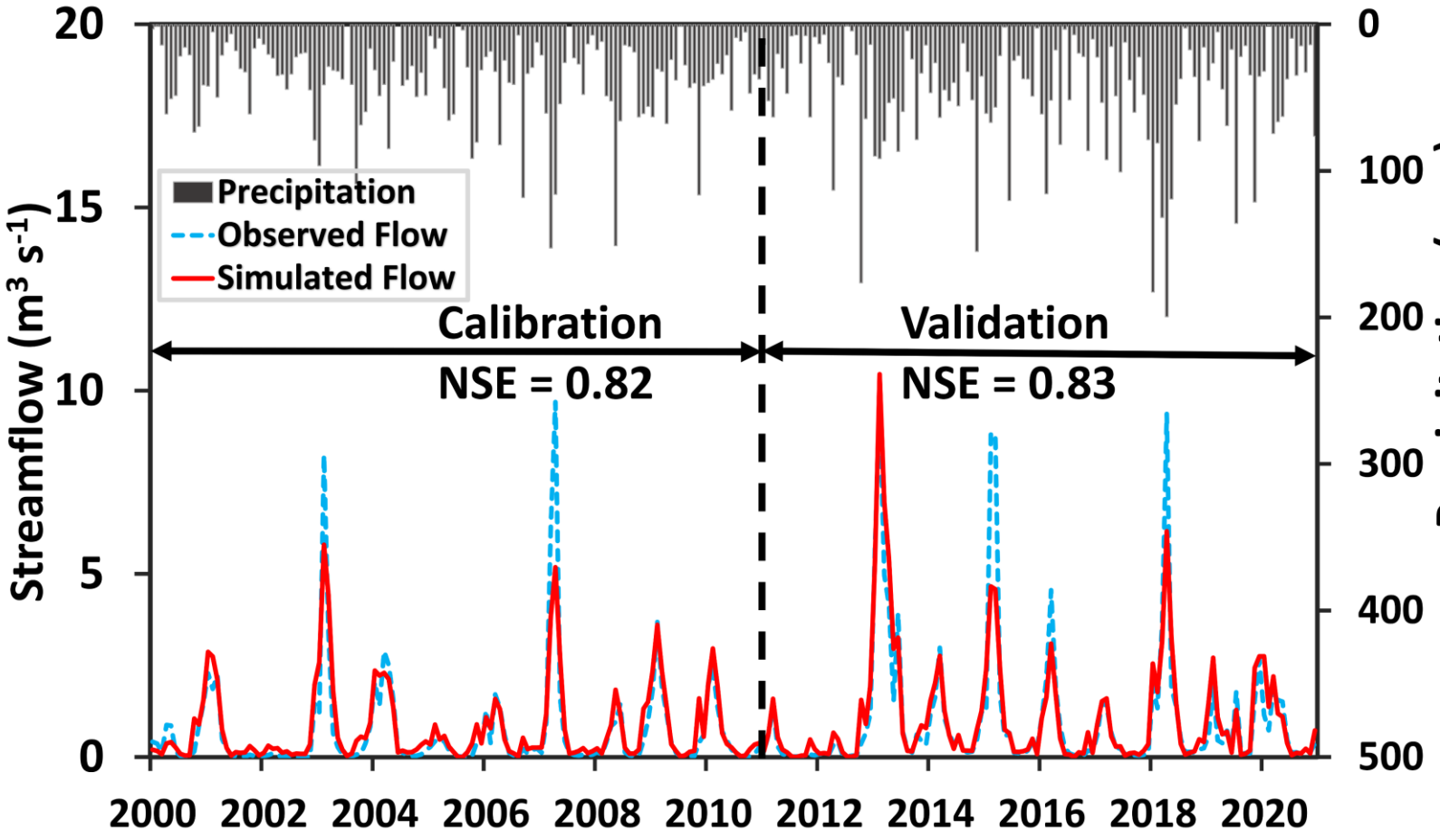
- **Open-source software – USDA-ARS**
- **Semi-distributed**
- **Physically and process-based**
- **Continuous timescale (Daily timestep)**
- The hydrological cycle simulation by SWAT is based on the **water balance equation**:

$$SW_t = SW_o + \sum_{i+1}^{t} \{R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw}\}$$



3. Results & Discussions

Streamflow Calibration & Validation

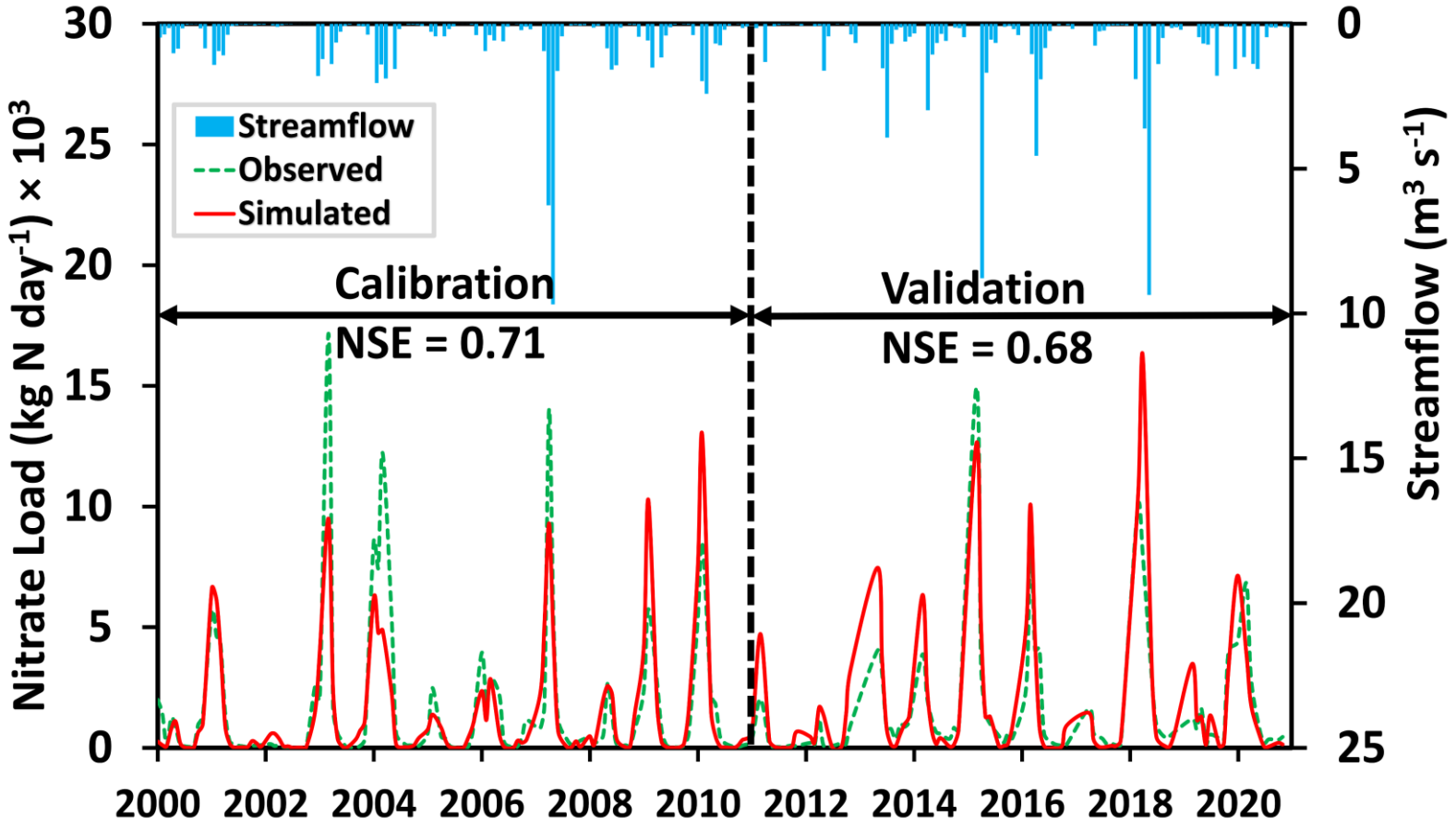


Most sensitive streamflow parameters:

- Groundwater delay time (**GW_DELAY.gw**)
- Soil Evaporation compensation factor (**ESCO.hru↓**)
- Curve number factor (**CN2.mgt↓**)
- Available soil water capacity (**SOL-AWC.sol↑**)
- Baseflow alpha factor (**ALPHA_BF.gw**)

3. Results & Discussion

Nitrates Calibration & Validation



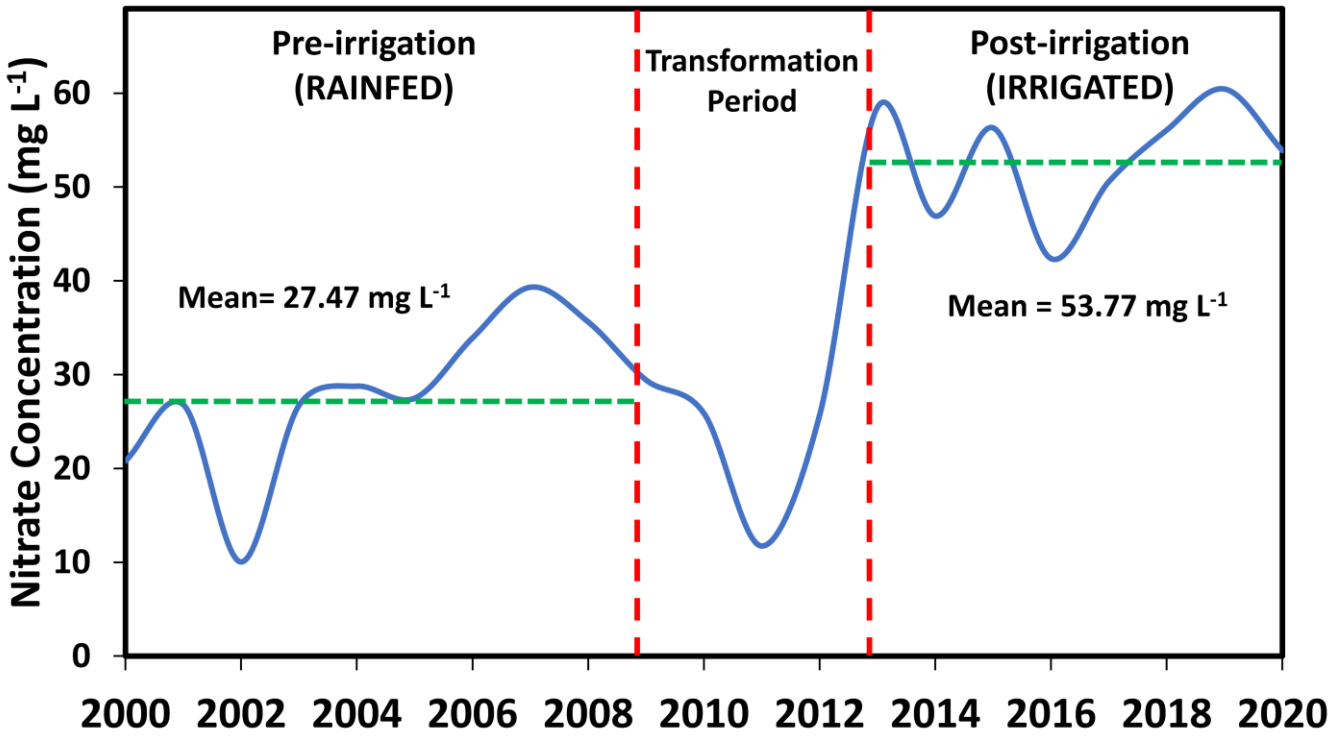
Most sensitive nitrates load parameters:

- Denitrification exponential rate coefficient (**CDN.bsn**)
- Fraction of porosity (void space) from which anions are excluded (**ANION_EXCL.sol**)
- Nitrogen fixation coefficient (**FIXCO.bsn**)
- Nitrogen uptake distribution parameter (**N-UPDIS.bsn**)
- Concentration of NO_3 in GW contribution to streamflow from subbasin (**SHALLST_N.gw**)

3. Results & Discussion

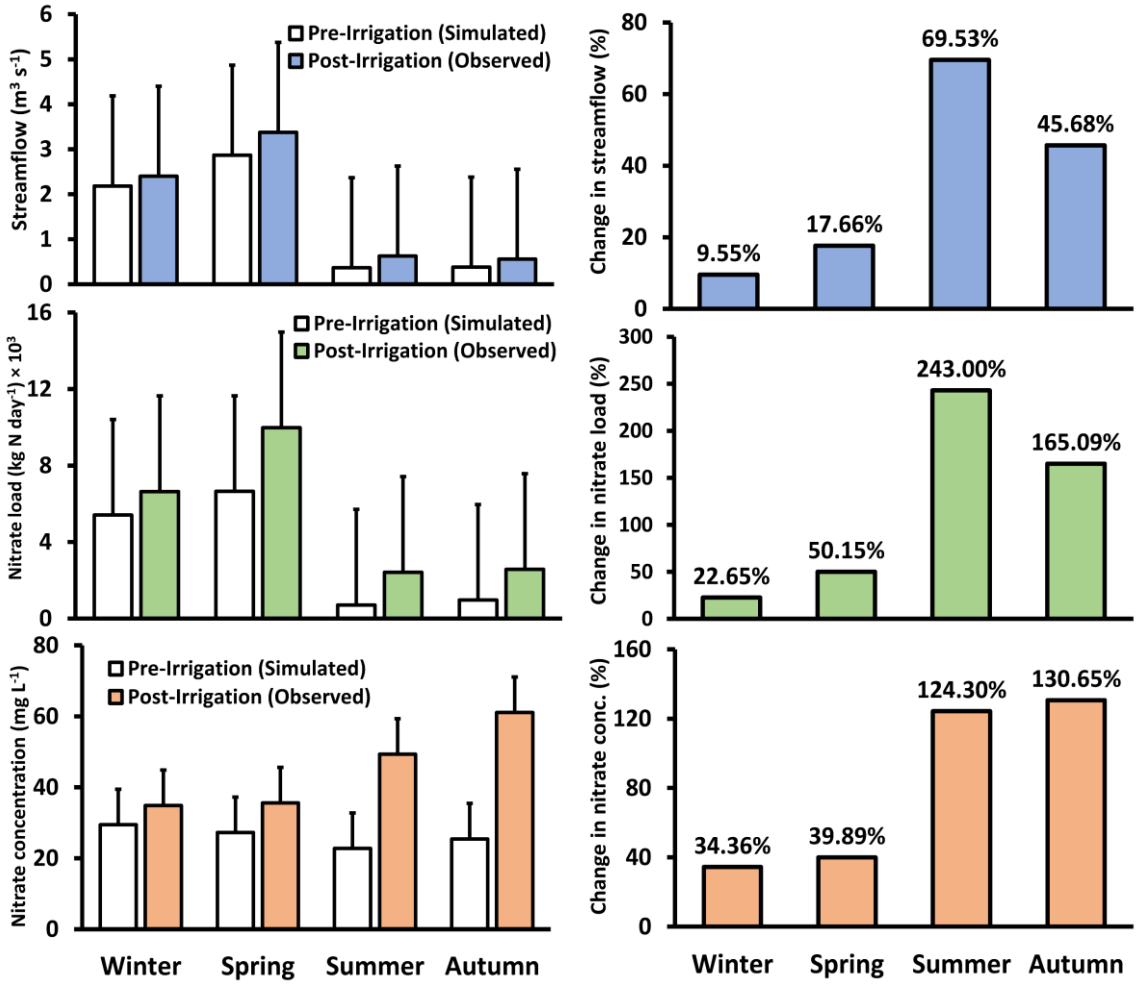
Comparison of pre- and post-irrigation periods in Traibuenas

Nitrate concentration before and after irrigation (2000-2020)



% change in conc. is **+95.7%**

Seasonal Changes (2017-2020)



4. Conclusion

- The SWAT model **successfully simulated** streamflow and nitrate loads in the Cidacos River Watershed with very good statistical performance
- Overestimation or underestimation when **simulating extreme values (high or low)** for both streamflow and nitrate loads
- There was **significant increase** in streamflow, nitrate loads, and nitrate concentration in the post-irrigation period particularly in the **summer** and **autumn** when irrigation was highest

Thank you for your time and attention!

Q&A