Scaling up: Can point scale calibration using NEON data improve coupled carbon-water cycle in CLM at a regional scale?

LAND MODEL / BIOGEOCHEMISTRY WORKING GROUP MEETING 2023

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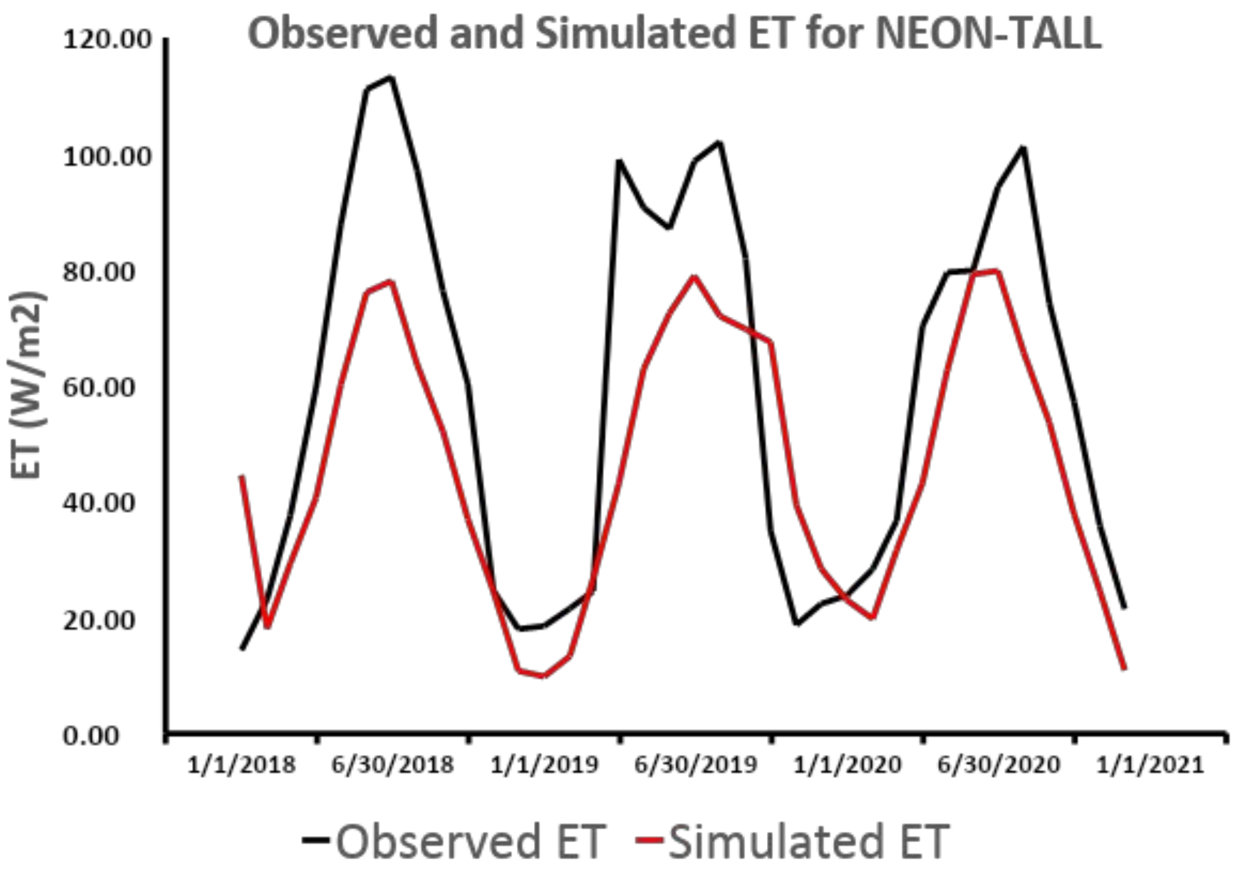
OUTLINE

- Introduction
- Addressing ET uncertainties
- Methods and Data
- Results

INTRODUCTION

- Estimates of change in ET are key for understanding the terrestrial hydrological cycle under changing environments.

- There are significant uncertainties between simulated and observed ET fluxes

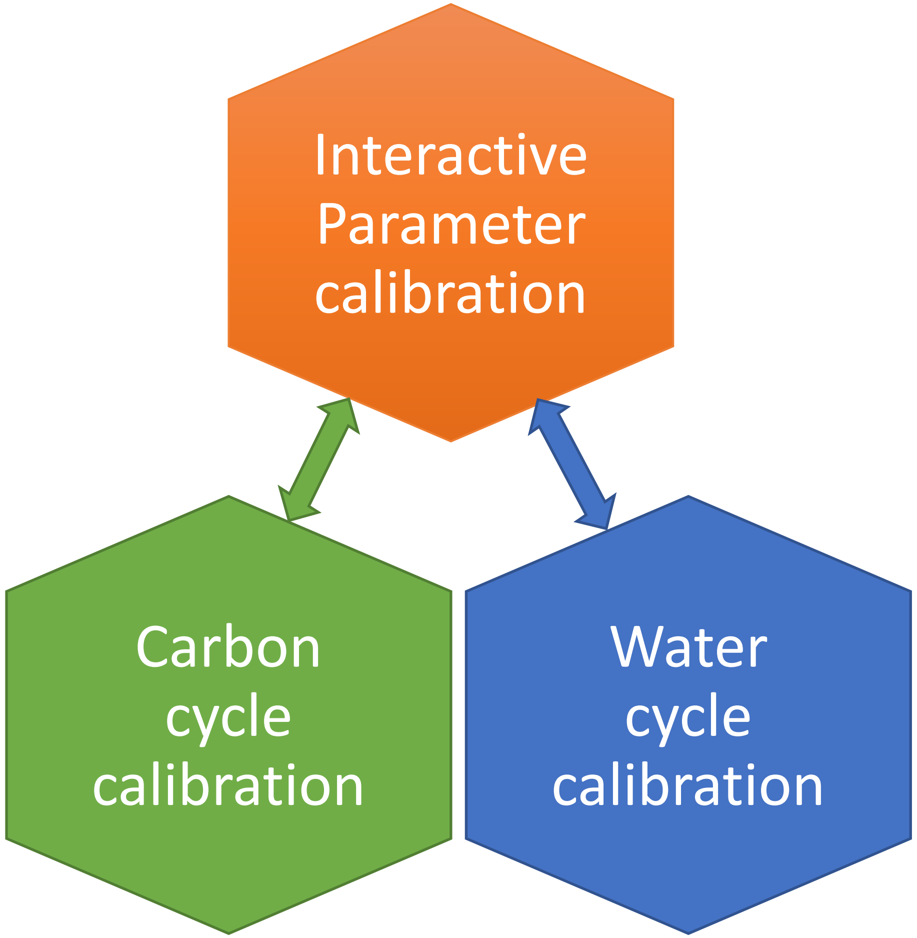


ADDRESSING ET UNCERTAINTY

- High-resolution forcing datasets
- Model calibration and parameterization
- Use of AI and Machine learning techniques to optimize model parameters

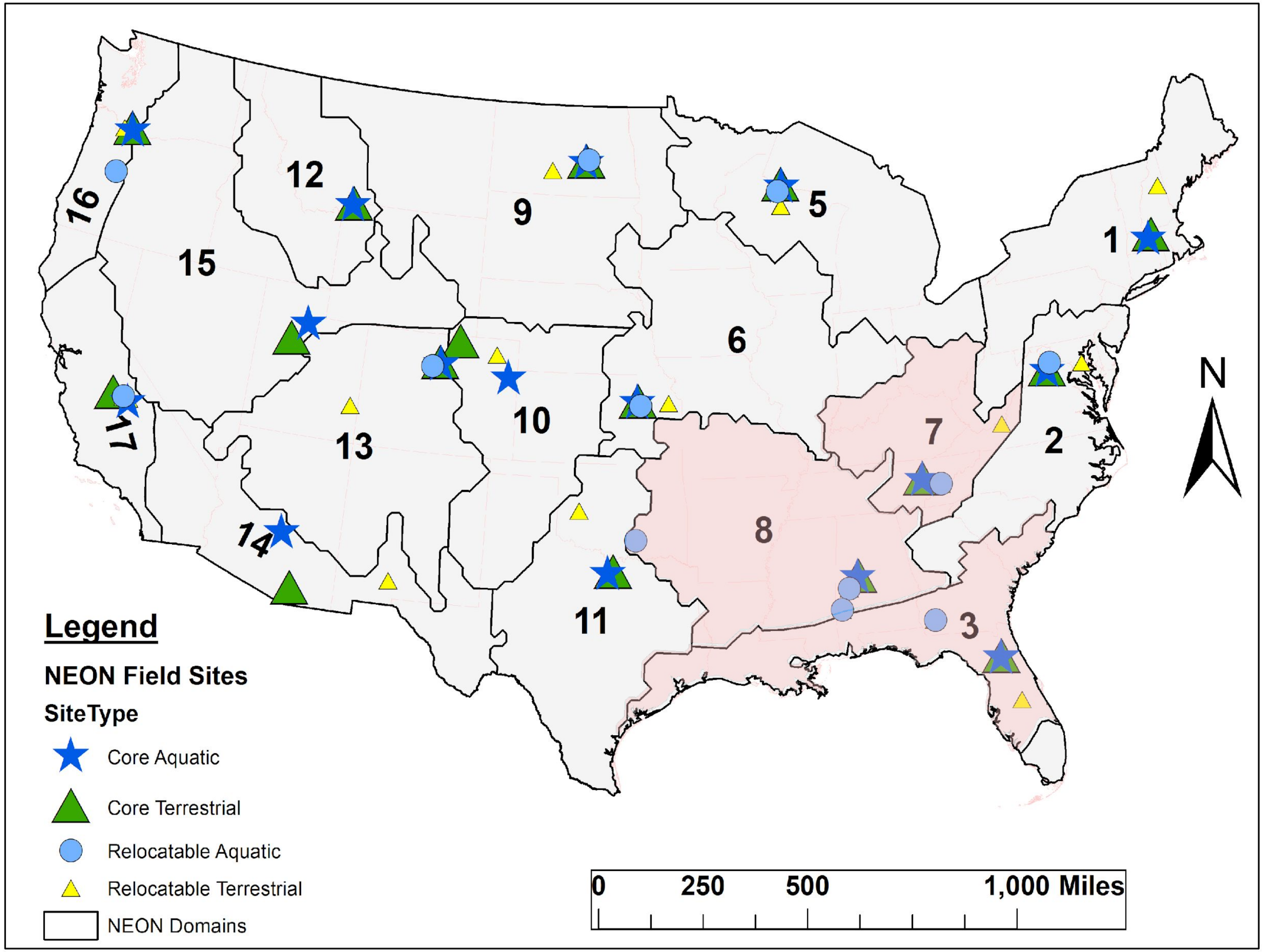
However, global calibration is a challenge – many parameter sets and high computational demands

Can point scale calibration improve coupled carbon-water cycle in CLM?

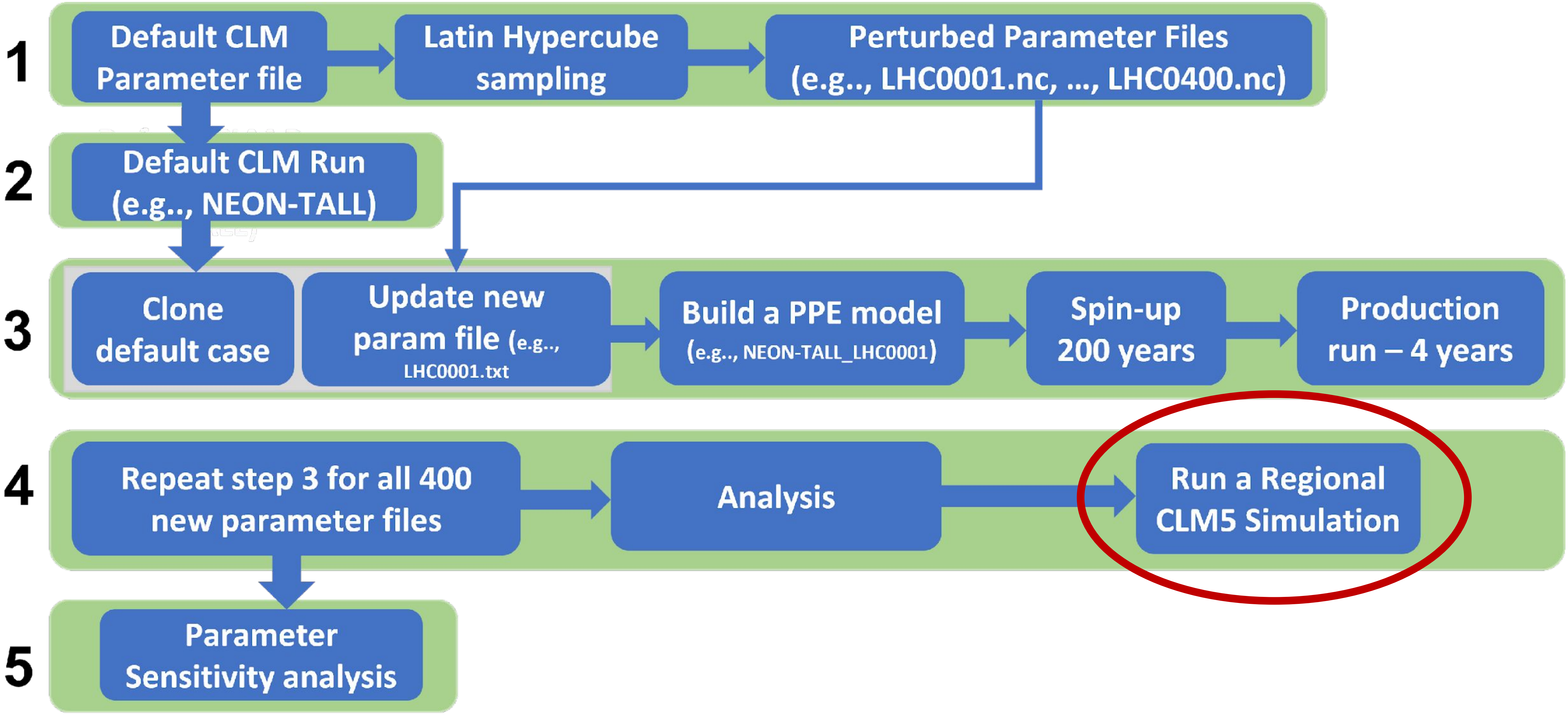


METHODS & DATA

- NEON data is a new resource that can be utilized to constrain land surface model parameters
- CLM-NEON Tool has enabled use of NEON data to test various hypothesis



NEON-PPE EXPERIMENT DESIGN



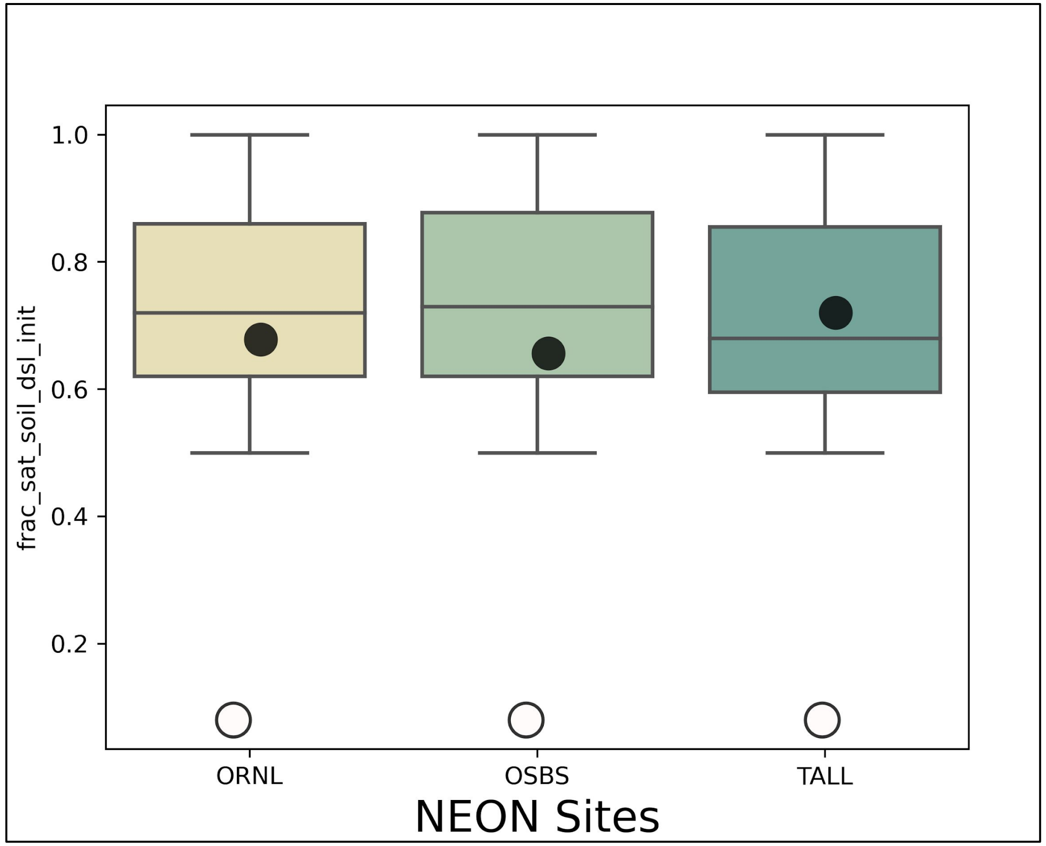
PARAMETER SENSITIVITY ANALYSIS

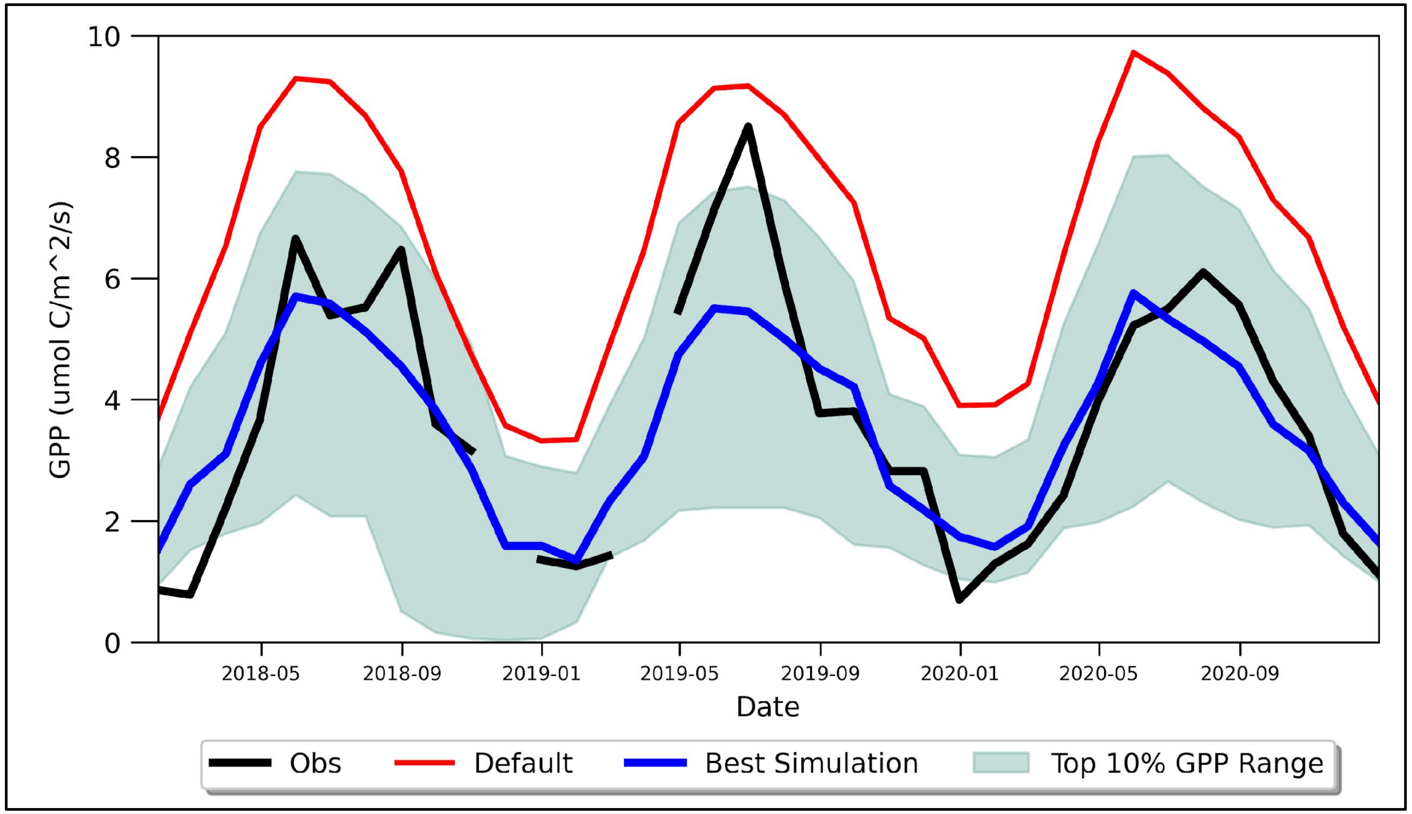
- Method applied – **V**ar**I**ance-based **S**ensitivity analysis using **CO**pula**S** (VISCOUS) (**Sheikholeslami et al., 2021)**
- Recycles existing data (400 model runs and 30 parameter files) to determine parameter sensitivity
- Approximates joint PDF of given data and characterizes its dependency structure using copulas.

$$E[Y|X = x_c] \approx 1/N_{MC} \sum_{j=1}^{N_{MC}} F_Y{}^{-1}(v^{(i)} c_g\ (v^{(i)} u_i : \mathbf{\Theta})$$

$$Var[E(Y|X = x_c)] \approx 1/2N_{MC}{}^3 \sum_{j=1}^{N_{MC}} \sum_{i=1}^{N_{MC}} \left(\sum_{k=1}^{N_{MC}} F_Y{}^{-1}(v^{(k)} c_g\left(v^{(k)}, u_c{}^{(i)} : \mathbf{\Theta}\right) - \sum_{k=1}^{N_{MC}} F_Y{}^{-1}(v^{(k)} c_g\left(v^{(k)}, u_c{}^{(j)} : \mathbf{\Theta}\right) \right)^2$$

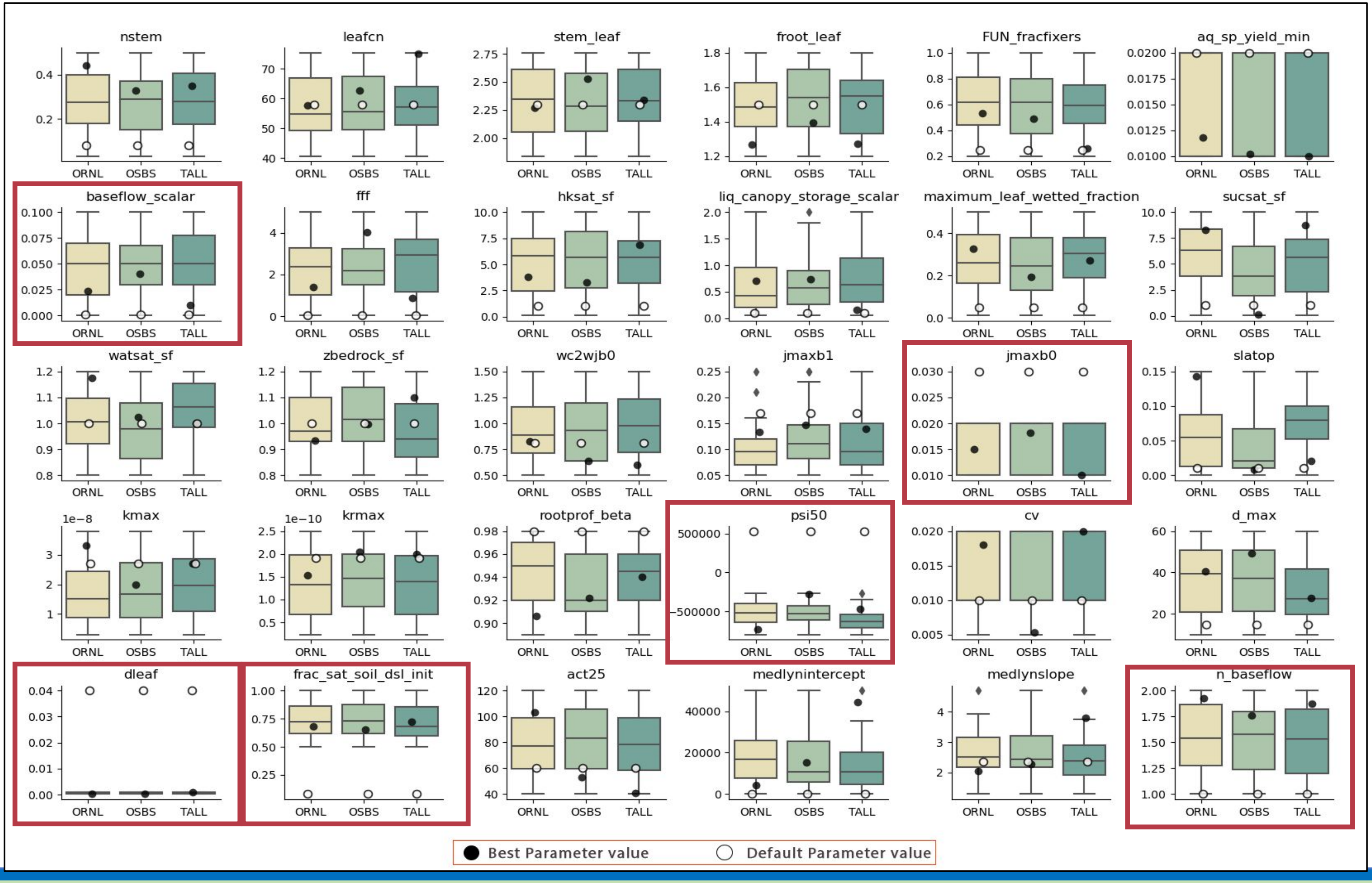
RESULTS PRESENTATION



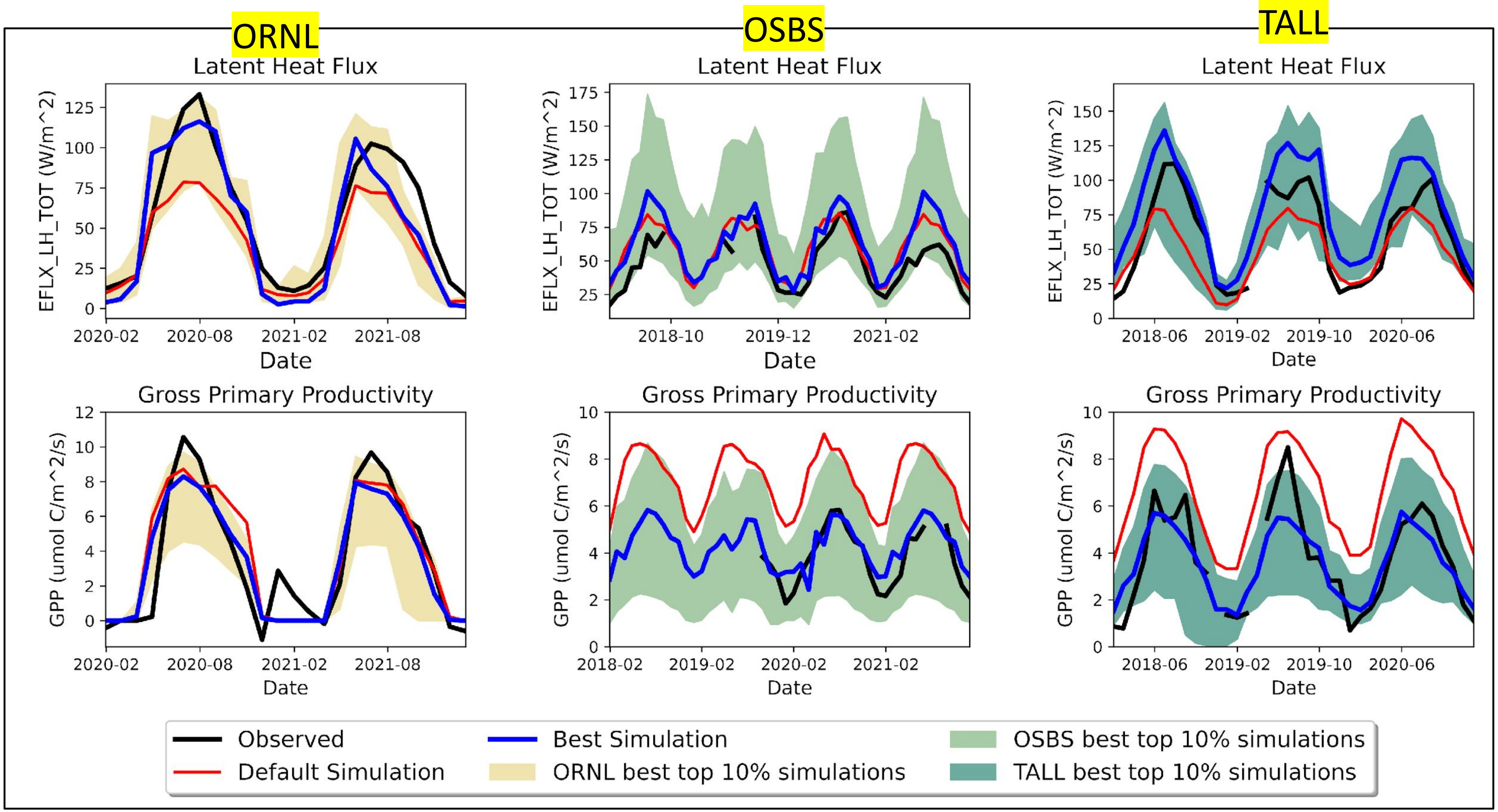


RESULTS 1: MODEL PERFORMANCE - PARAMETER OPTIMIZATION

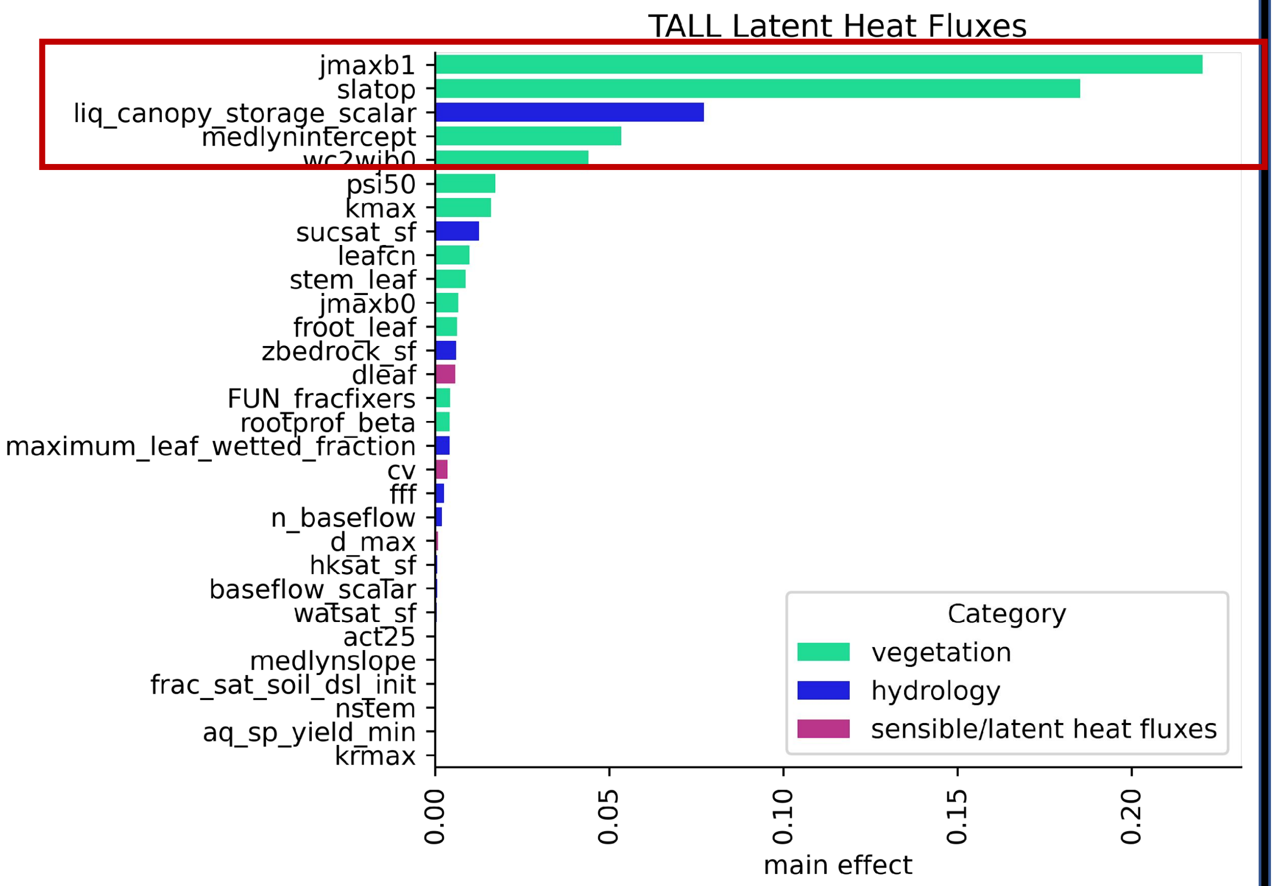
Optimized parameters can be considerably different and can be constrained



RESULTS 1: MODEL PERFORMANCE – ET & GPP



RESULTS 3: SENSITIVITY ANALYSIS



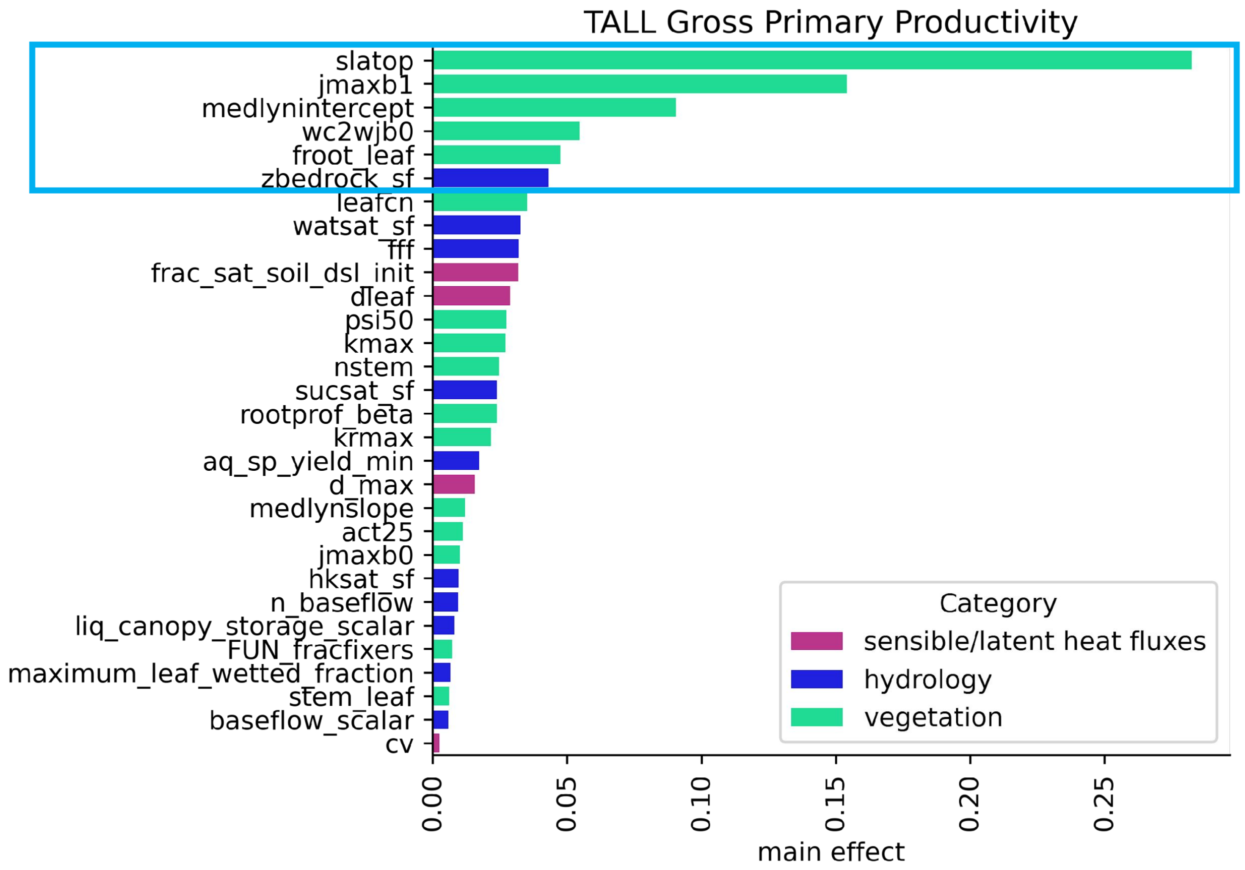
Latent Heat Flux

- Out of the selected parameter sets, vegetation, and hydrology related have strong influence on Latent Heat fluxes
- These include; jmaxb1, slatop, liq_canopy_storage_scalar, medlynintercept, and wc2wjb0

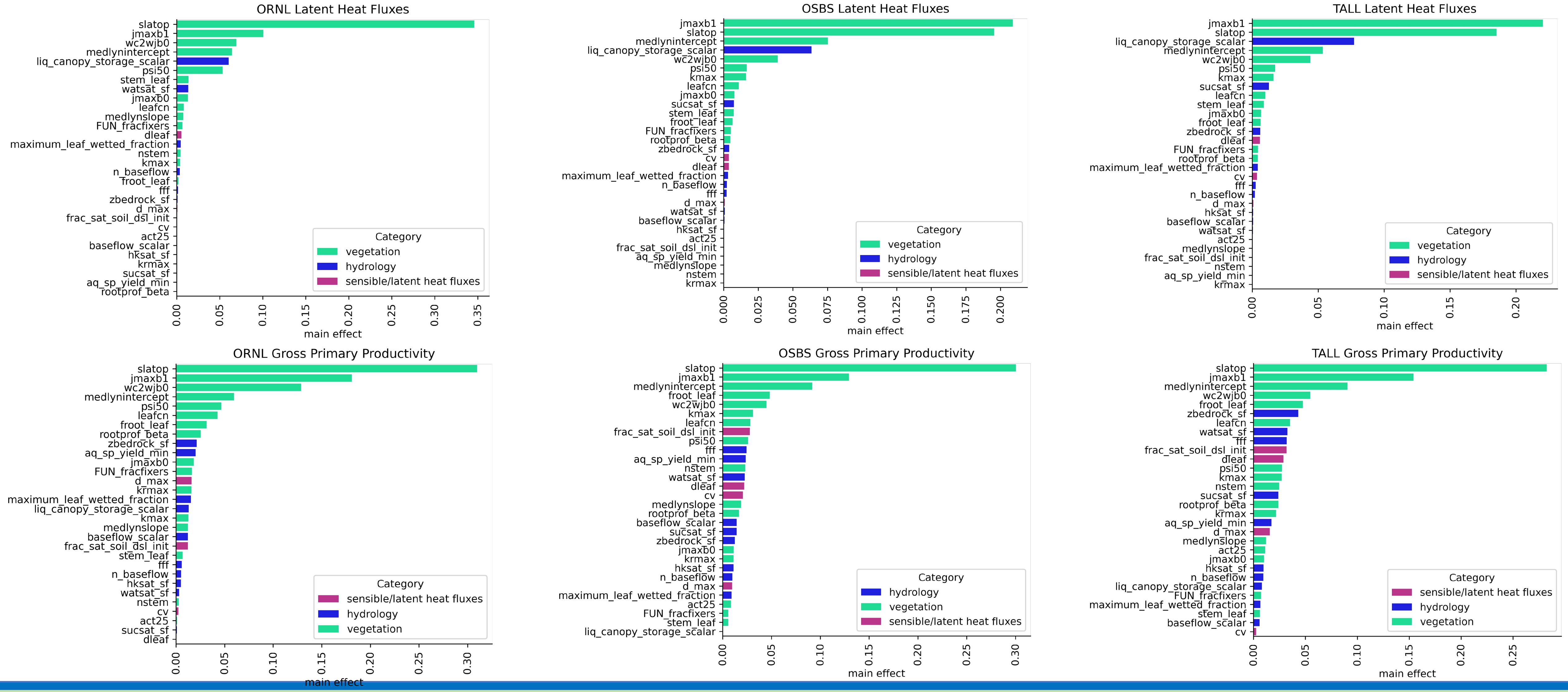
RESULTS 3: SENSITIVITY ANALYSIS CONT'.

Gross Primary Productivity

- Only vegetation and hydrology-related parameters have a significant influence on gross primary productivity
- These include; slatop, jmaxb1, medlynintercept, wc2wjb0, froot_leaf, and zbedrock_sf



RESULTS 3: SENSITIVITY ANALYSIS CONT'.



Thank you