Savanna

Monsoon forest

Mediterranean vegetation

Analysis of vegetation modelling uncertainties due to soil moisture stress

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Methods

Model setup

- The P-model (Prentice et al. 2014, Wang et al. 2017; Stocker et al. 2020)

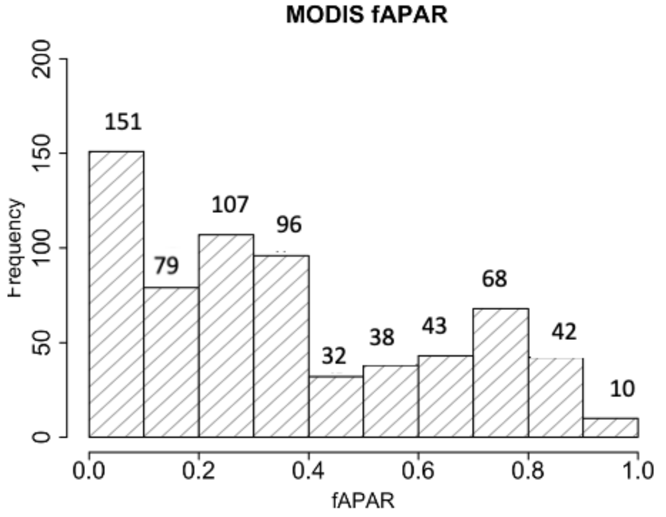
  $$GPP = PPFD \cdot fAPAR \cdot LUE \cdot \boxed{\beta(\theta)}$$

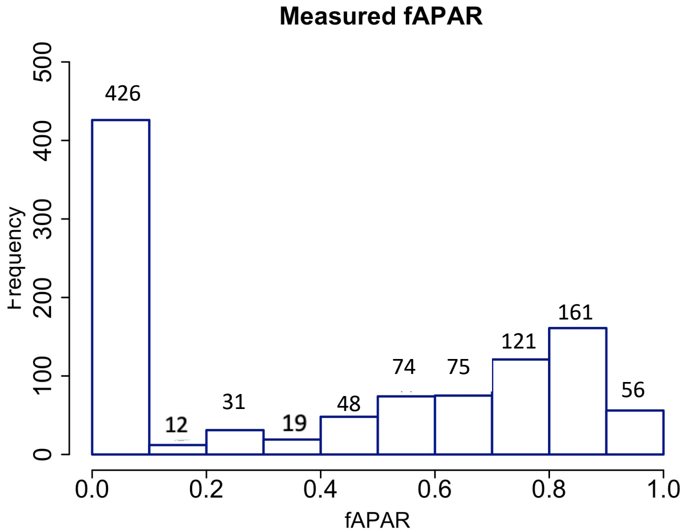
- 73 FLUXNET sites for the uncertainty analysis
  - Satellite fAPAR from MODIS
  - fAPAR converted from measured LAI (using Beer–Lambert law)

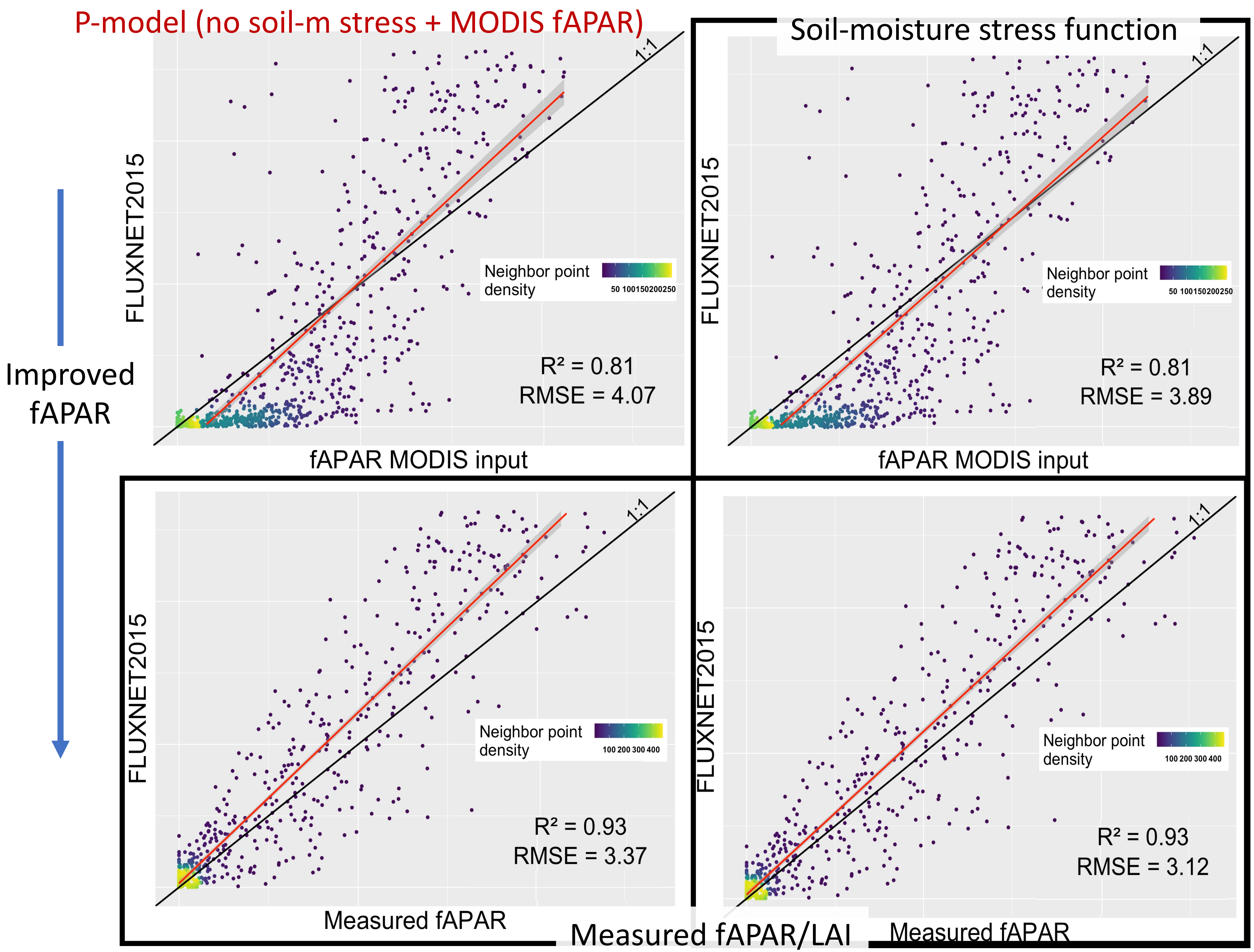
Analysis

- Model Performance: comparing modelled GPP against observed GPP
- Uncertainty Analysis: comparing MODIS fAPAR and back calculated fAPAR from two methods:
  - P-model $\beta(\theta)$
  - P-model Water Deficit (does not compensate fAPAR uncertainties)
- Two ways of fAPAR estimates:
  1. Inversion of Eddy covariance-based GPP
  2. Nonlinear Least Squares + Bootstrapping method

Model Evaluation:
comparison of modelled GPP and observed GPP







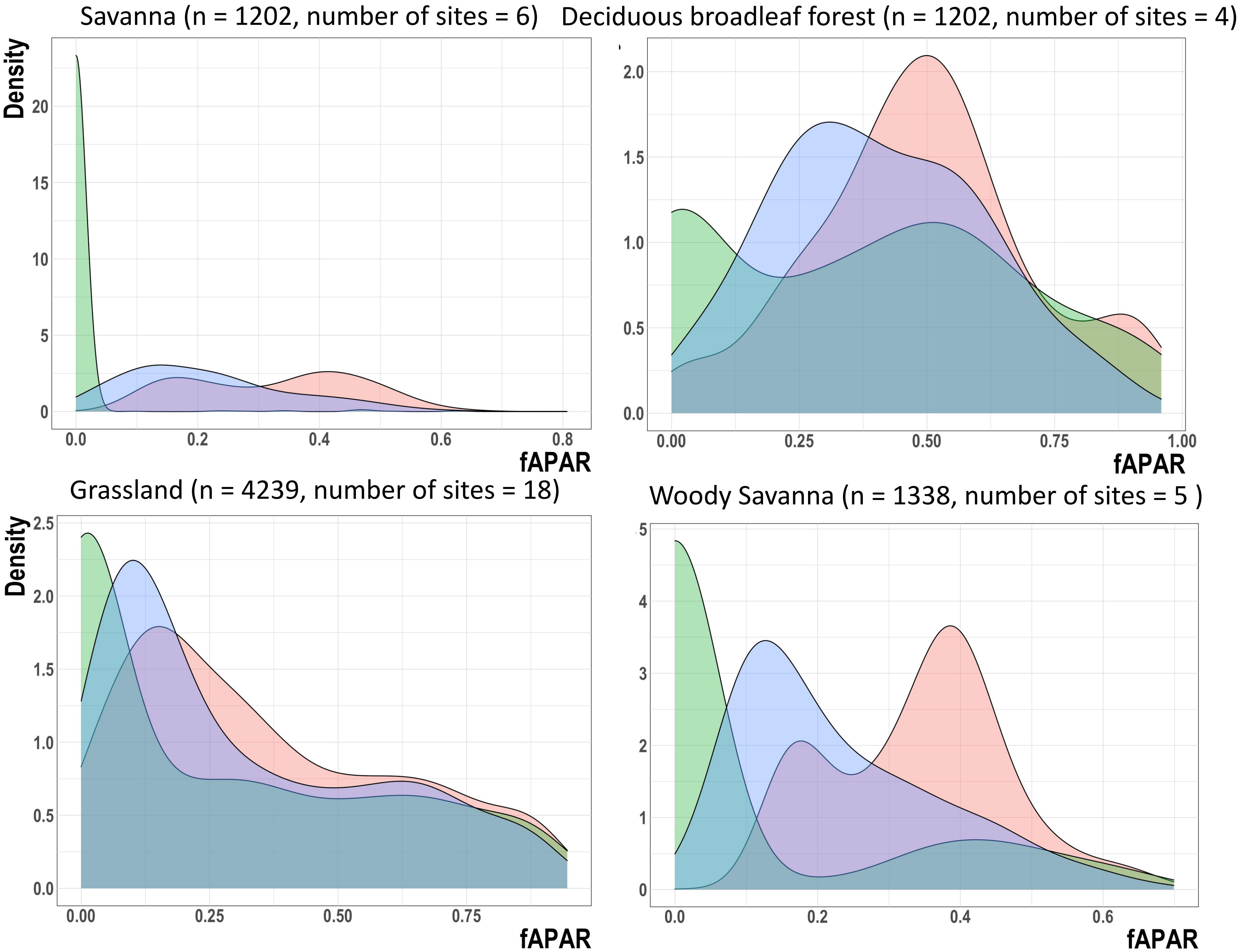
Soil moisture effects

Number of sites = 7, n = 1667, GPP units: g C m^{-2} $8d^{-1}$

Uncertainty analysis

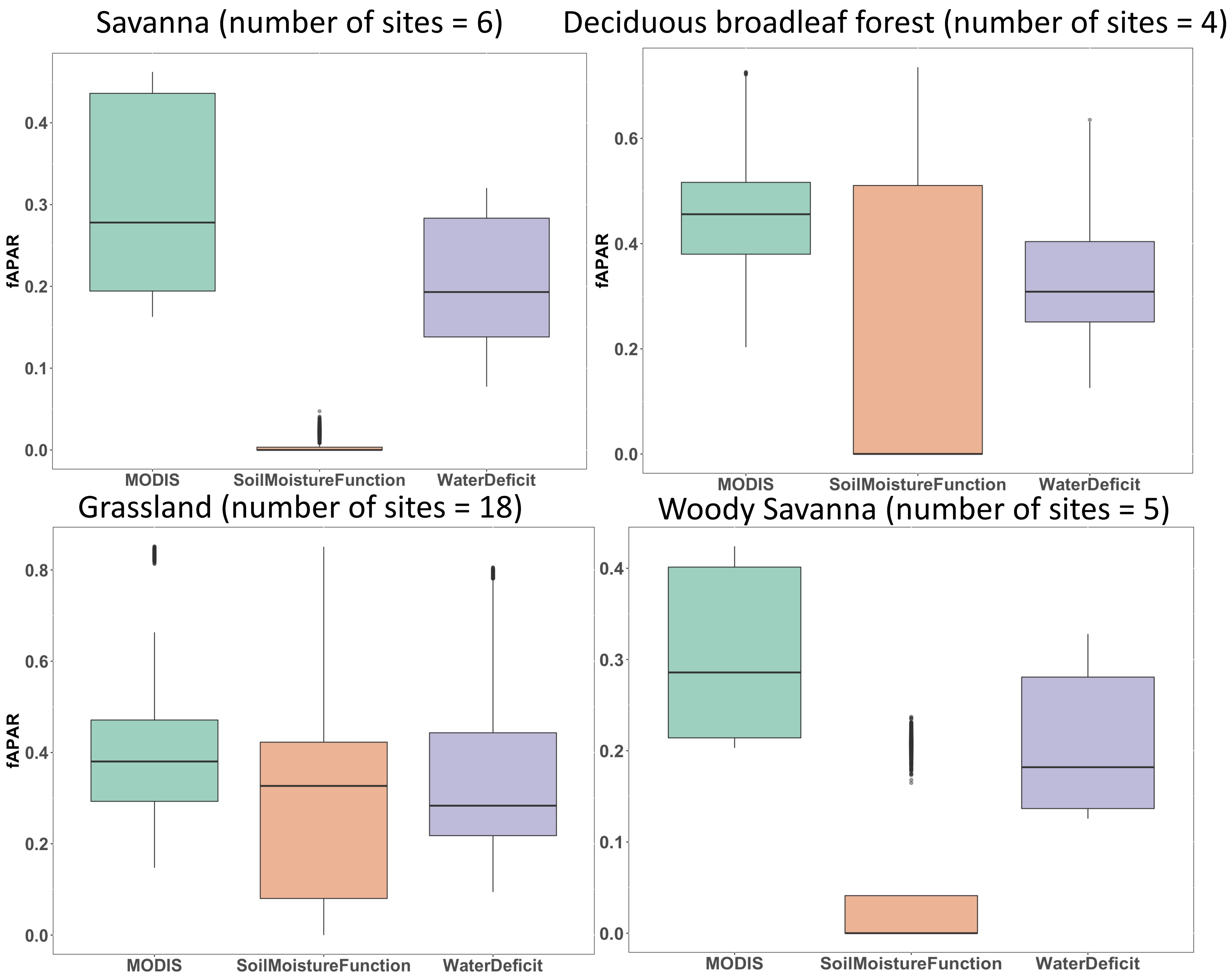
$$fAPAR = \frac{GPP}{LUE \times soi\_water\_stress}$$

fAPAR from methods:



Uncertainty analysis

Nonlinear Least Squares +
Bootstrapping method
(sample size = 999)



Final remarks

1. fAPAR quality highly impacts GPP estimates.
2. In general, soil-moisture stress improves model performance, but sometimes results can be biased.
3. The application of P-model soil-moisture function compensates uncertainties in fAPAR.
4. However, global calibration frameworks can unbalance model performance in sites where fAPAR estimates are reliable.

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