

Introduction

We study the impact of changes in rainfall on **33 flux tower sites** over **North America** with a state-of-the-art **ecohydrological model**, based on rainfall projections made by a **convection permitting model (~4km, 1 hour)** which are then extended in time with the use of a **stochastic weather generator**. We generate **5 different 100-year scenarios** for each site to disentangle the separate effects of changes in (a) **mean annual rainfall**, (b) **seasonality** and (c) rainfall **temporal structure** at finer scales.

Motivation

- Most field and numerical experiments impose very heavy potentially unrealistic rainfall manipulation schemes irrelevant to GCM projections
- Coarse resolution GCMs exhibit biases in simulating rainfall
- The stochastic nature of rainfall cannot be easily captured with experiments of short duration

Methods

We use:

- The state-of-the-art **Tethys & Chloris (T&C)** ecohydrological model (Fatichi 2012)
- Two 13-year simulations of the present and future (RCP8.5) climate from the WRF convection permitting climate model (~4km, 1 hour) (Liu 2017)
- The Advanced Weather Generator (AWE-GEN) (Fatichi 2011)

References

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- Liu, C., Ikeda, K., Rasmussen, R., Barlage, M., Newman, A. J., Prein, A. F., ... Yates, D. (2017). Continental-scale convection-permitting modeling of the current and future climate of North America. *Climate Dynamics*, 49(1–2), 71–95. <https://doi.org/10.1007/s00382-016-3327-9>
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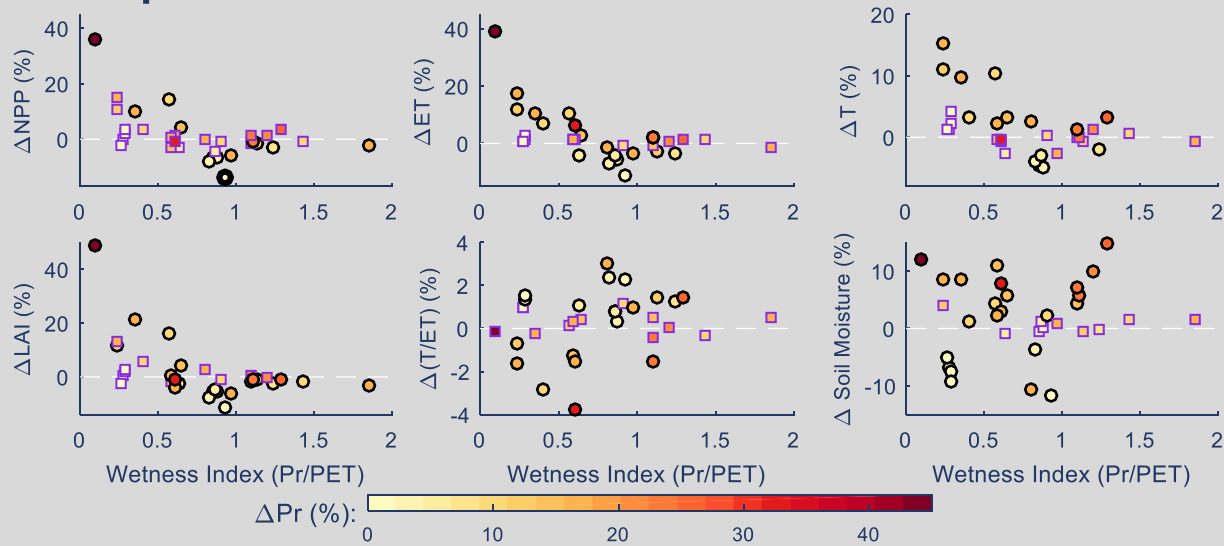


Figure 1: Impact of rainfall intensification on **Net Primary Productivity (NPP)**, **Evapotranspiration (ET)**, **Transpiration (T)**, **Leaf Area Index (LAI)**, **T/ET ratio** and **Soil Moisture** over the 33 Sites. The color shading represents changes in mean annual rainfall. Statistically significant changes ($p < 0.1$) are marked with circles.

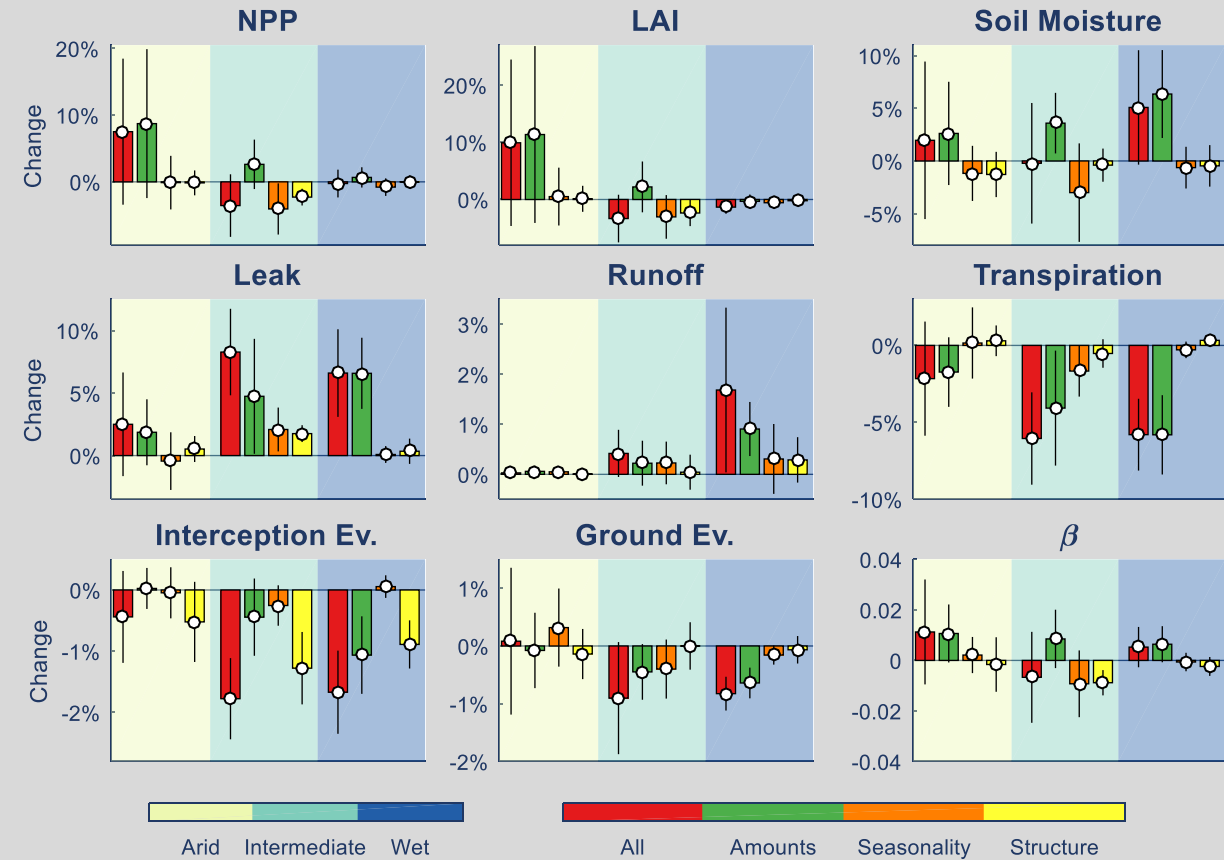


Figure 2: The effect of the different aspects of rainfall intensification for different ecohydrological variables, lumped over arid, intermediate and wet sites. Changes in the water fluxes (i.e. Leakage to bedrock, runoff, transpiration, evaporation from intercepted water and ground evaporation) refer to changes in the ratio: **flux/(Total precipitation)**. β is the plant water stress factor (increased β refers to reduced plant water stress)

Concluding Remarks

Productivity:

- Wet sites are insensitive to rainfall intensification.
- Arid sites are sensitive to changes in annual rainfall amounts
- Intermediate sites are relatively insensitive to rainfall intensification.

Water partitioning

 among the various aspect of the water cycle:

- Leakage to bedrock fraction generally increases at the expense of the transpirative fraction
- Runoff is increased in wet sites
- An intensified temporal structure of rainfall reduces the fraction of water evaporated by canopy interception
- Changes in seasonality can have a negative impact on productivity over intermediate sites in cases where growth season rainfall is decreased.
- Multi-year experiments are needed to capture the variability and assess the significance of estimated changes

Heavy rainfall manipulation might overestimate the impact of rainfall intensification on the water/carbon ecosystem dynamics

You can watch a more detailed video presentation of our research by scanning (or clicking on) the following QR code

