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Assessing ecosystem responses to different drivers of climate change

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Altered precipitation, elevated CO2, increased temperature and atmospheric drought under climate change are expected to jointly affect ecosystem responses in complex and yet uncertain ways, depending on climate and vegetation type. In this work, we study ecosystem responses at 33 sites in North America, belonging to FLUXNET, covering a wide range of climates and biomes, by making use of the continental-wide WRF convection-permitting model simulations of the current and future (RCP8.5) climate (~4km, 1hr). WRF simulations for the first time provide us with the necessary information to fully understand ecosystem dynamics from the hourly to the decadal scales.

Specifically, we employ a stochastic weather generator, informed by the WRF simulations, and the state-of-the-art Tethys & Chloris (T&C) terrestrial ecosystem model to perform multi-year multi-factorial numerical experiments and study the separate and joint effects of;

a) altered precipitation,

b) elevated CO2, increased temperature and

c) atmospheric drought on ecosystems.

We study changes in the interannual variability of carbon and water fluxes at the ecosystem scale and their drivers, benefitting from our stochastically extended “100-year-long" numerical experiments, which allow taking into account climate’s stochasticity. We also focus on between- and within-treatment variability and identify the signal-to-noise ratio, which can have serious implications regarding whether field manipulation experiments, which typically last a few years, can capture the emerging signal. We further investigate the importance of short-term meteorological variability for carbon fluxes at coarser temporal scales, and we quantify changes in

ecohydrological aridity. Finally, we assess changes in the phenological cycle and their impact on the annual cycle of carbon and water fluxes.