Drought severity mediated by plant responses to increasing CO_2

Objective:

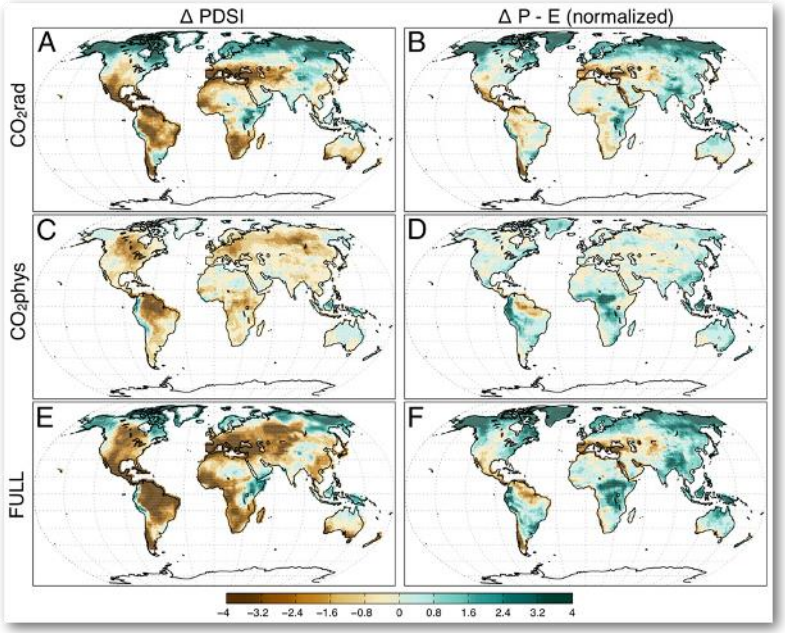
Understand how plant responses to increasing CO_2 affect predictions of future drought stress.

Approach:

- Used seven CMIP5 Earth system models (ESMs) to quantify the effect of increasing atmospheric CO_2 on changes in PDSI and P−E drought metrics.
- Three idealized simulations with different CO_2 couplings were used to distinguish climate effects from vegetation effects.

Results/Impacts:

- We found that plant physiological responses to CO_2 reduced predictions of future drought stress.
- This reduction was captured by plant-centric rather than atmospheric-centric metrics from ESMs.
- Drought metrics that account for plant transpiration responses to changing CO_2 are needed to reduce uncertainties in future assessments.



Maps of the multimodel mean difference for a quadrupling of CO_2 for (A, C, and E) Palmer Drought Severity Index (PDSI) and (B, D, and F) precipitation minus evapotranspiration (P−E) normalized by the standard deviation of the multimodel mean at each point. Green colors indicate more water on land; brown colors indicate less water on land. A and B represent CO_2 radiative coupling, C and D CO_2 physiological coupling, and E and F full CO_2 coupling.

Swann, A. L. S., **F. M. Hoffman**, **C. D. Koven**, and **J. T. Randerson** (2016), Plant responses to increasing CO_2 reduce estimates of climate impacts on drought severity, *Proc. Nat. Acad. Sci.*, 113(36):10019–10024, doi:10.1073/pnas.1604581113.