



Atmospheric aridity is a control on the fate of tropical carbon

A. Barkhordarian, K. Bowman *et al*, ERL, (2021) <https://doi.org/10.1088/1748-9326/ac2ce8>

Science Question

Will temperature and water variations from climate change threaten tropical carbon sequestration?

Analysis

Carbon Monitoring System Flux (CMS-Flux) carbon assimilation system constrained by OCO-2 observations, in conjunction with in situ observations, weather reanalysis, and CMIP6 carbon-climate models.

Results

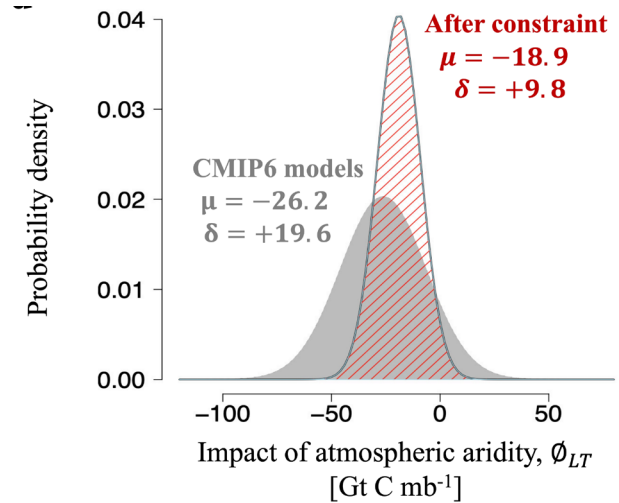
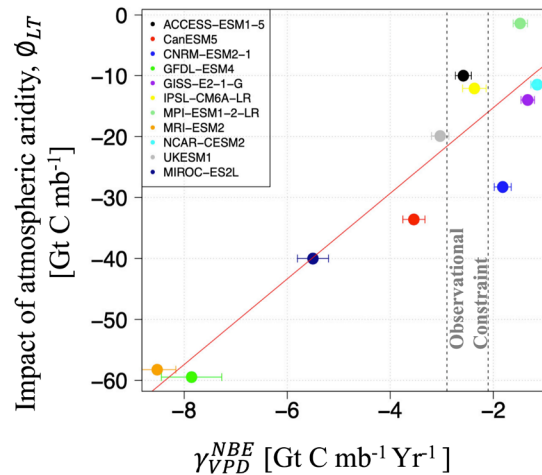
We show that atmospheric aridity – quantified as vapor pressure deficit (VPD) – is strongly correlated and causally linked to the global CO₂ growth rate (CGR) with observed present-day sensitivities of -2.5 ± 0.4 GtC/mb. Earth System Models predict that long-term increases in VPD threaten tropical carbon sequestration but with a substantial inter-model range [$-1.4 - 59.4$ GtC/mb]. Harnessing a hierarchical emergent constraint, which combines observations and models, we show the best estimate of the atmospheric aridity-carbon cycle feedback (ϕ_{LT}) is -19 ± 10 GtC/mb, which is 28% lower than model estimates with an uncertainty reduction of 50%.

Significance

These results bridge the role of moisture and land-atmosphere coupling on net carbon variability to the vulnerability of carbon storage in a changing climate. This information can better help shape climate mitigation targets.

Acknowledgement

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Reference: A. Barkhordarian, K., Bowman, *et al*. (2021). Emergent constraints on tropical atmospheric aridity-carbon feedbacks and the future of carbon sequestration. *Environmental Research Letters*. <https://doi.org/10.1088/1748-9326/ac2ce8>

Figure Caption: (left)

Shows that the interannual sensitivity of tropical carbon to aridity (in millibars) is correlated with long-term reductions in carbon sequestration from increases in aridity due to fossil fuels.

(right) Best estimate of carbon sequestration loss to increases in aridity based on the Hierarchical Emergent Constraint.