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Amazon rainforest increases photosynthesis in reponse to atmospheric dryness

Julia K. Green, Pierre Gentine, Yao Zhang, Joe Berry, and Philippe Ciais
Laboratoire des Sciences du Climate et de l'Environnement (LSCE), Gif sur Yvette, France (julia.green@lsce.ipsl.fr)

Earth system models predict that atmospheric dryness reduces photosynthesis due to its reductive effect on stomatal conductance. However, while this representation may be appropriate in many environments, in the wet Amazonian tropical rainforest, this is not the case. Using remote sensing data combined with machine learning techniques (k-means clustering and artificial neural networks), we show that in the wettest parts of the Amazon rainforest, gross primary production and evapotranspiration continue to increase alongside atmospheric dryness, i.e. vapor pressure deficit, despite reductions in ecosystem conductance. On the other hand, Earth system models have the opposite photosynthetic response to vapor pressure deficit in the wettest part of the Amazon, overestimating its reductive effect on tropical vegetation photosynthesis and evapotranspiration, leading to an exaggerated carbon source to the atmosphere. As vapor pressure deficit is expected to increase with climate change, our study highlights the importance of reframing how we understand and represent the response of ecosystem photosynthesis to atmospheric dryness in the wettest ecosystems, to accurately quantify the future land carbon sink and atmospheric CO2 growth rate.