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The impacts of elevated CO_2 on forest growth, mortality, and recovery in the Amazon rainforest

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Table S1 Summary of eCO_2 fertilization effects.

Time period	Term	Magnitude	Method	Reference
1980-2019	AGB gain (DBH>10 cm)	Amazon rainforest: 5% per decade	ORCHIDEE model with climate impacts on growth and mortality, CO_2, stand level demography	This study
2001-2016	GPP	Global 4.1% per decade EBF: 4.8% per decade	Analytical approach	Chen et al (2022)
2001-2016	GPP	EBF: 1.61-5.78% per decade	TRENDY models (S1)	Chen et al (2022)
1981-2020	GPP	Global: 3.4% per decade	Remote sensing + ecological optimality theory	Keenan et al (2023)
1982-2011	NPP	Tropical: 2.7% per decade	CMIP5	Kolby Smith et al (2016)
1980-2016	GPP	Tropical: 3.7% per decade	CABLE model	Haverd et al (2020)

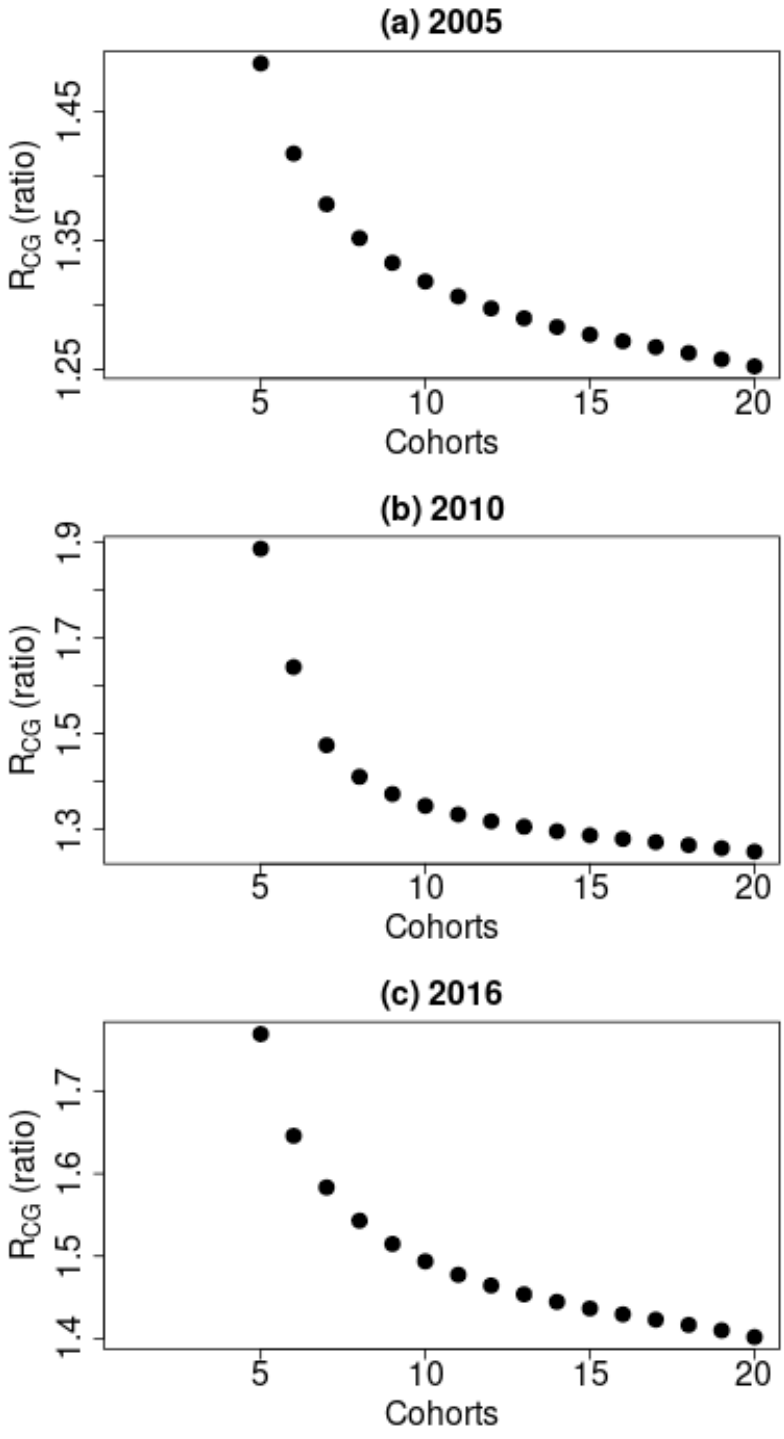

Fig. S1 The effect of eCO_2 on biomass carbon gains over different cohorts during three drought events, (a) 2005, (b) 2010, and (c) 2016. The average of R_{CG} over drought epicenter is shown for each cohort.

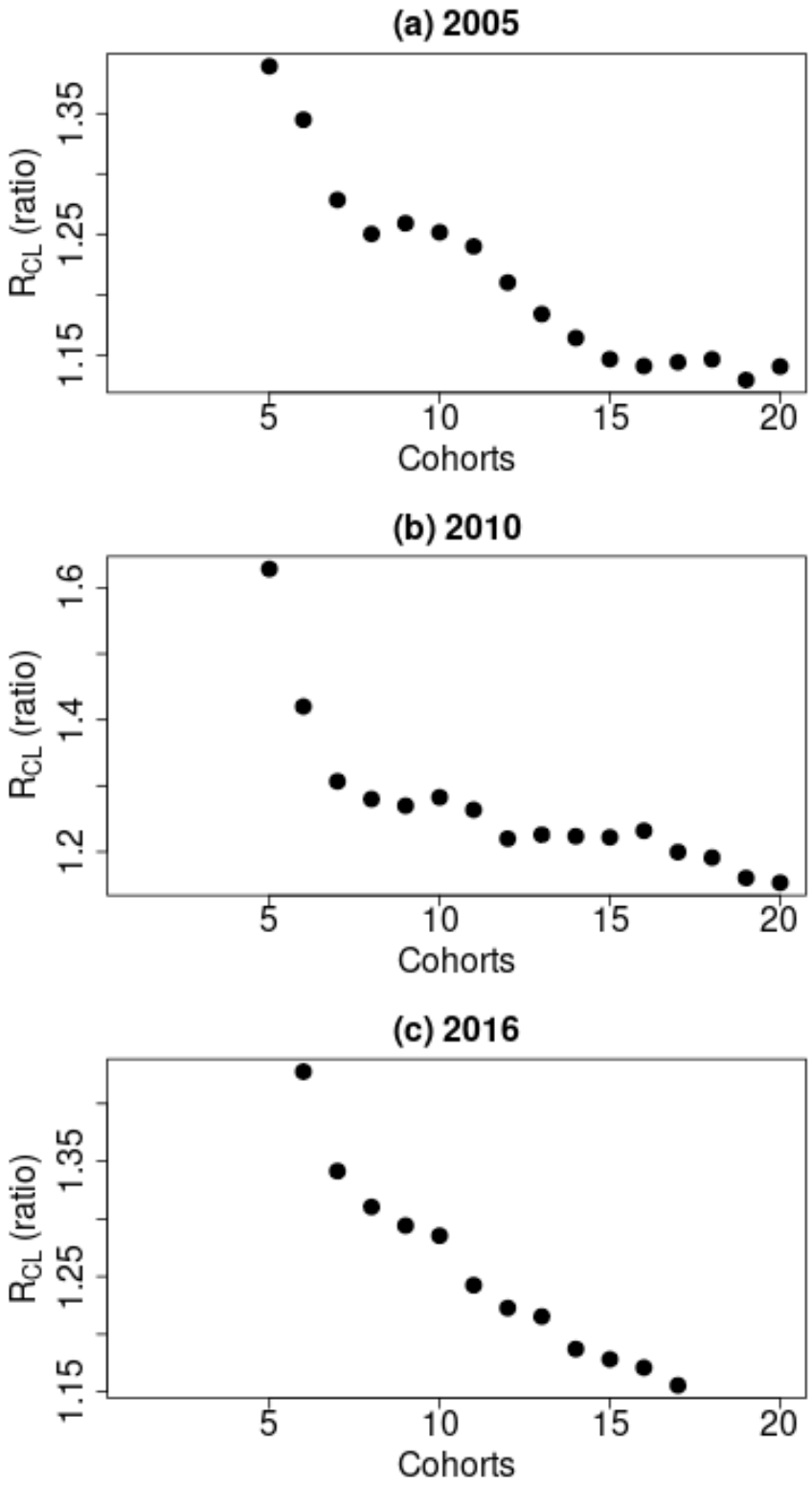

Fig. S2 The effect of eCO_2 on biomass carbon losses over different cohorts during three drought events, (a) 2005, (b) 2010, and (c) 2016. The average of R_{CL} over drought epicenter is shown for each cohort.

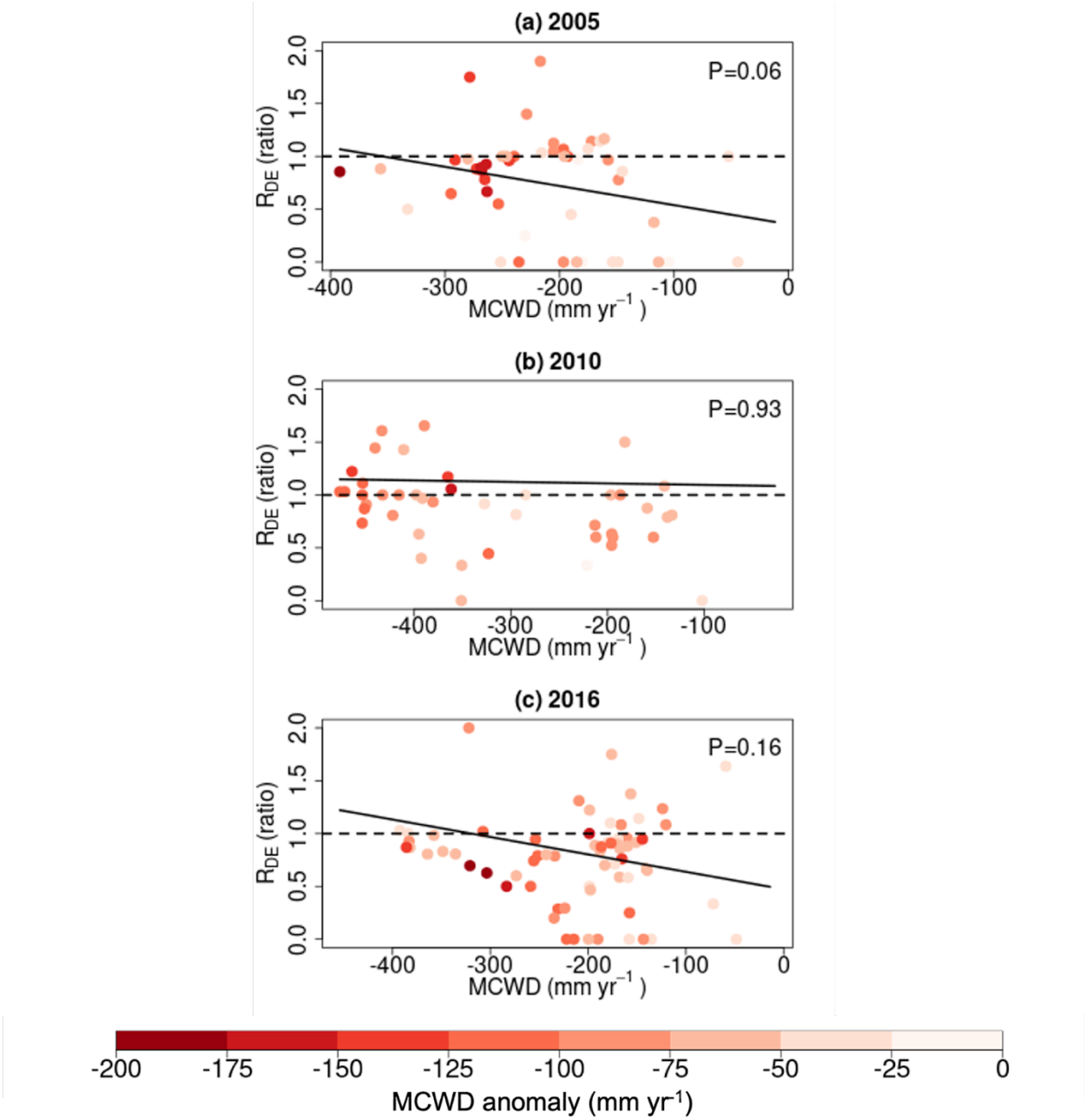

Fig. S3 The effect of eCO_2 on drought exposure days. Dots are color-coded to reflect the drought intensity characterized by MCWD anomaly, with darker colors indicating more severe water deficits. The dots shown in the panel correspond to pixels located in the epicenter of the drought, featuring Z_{MCWD} values below -1. This threshold is set to ensure an adequate number of pixels for our analysis.

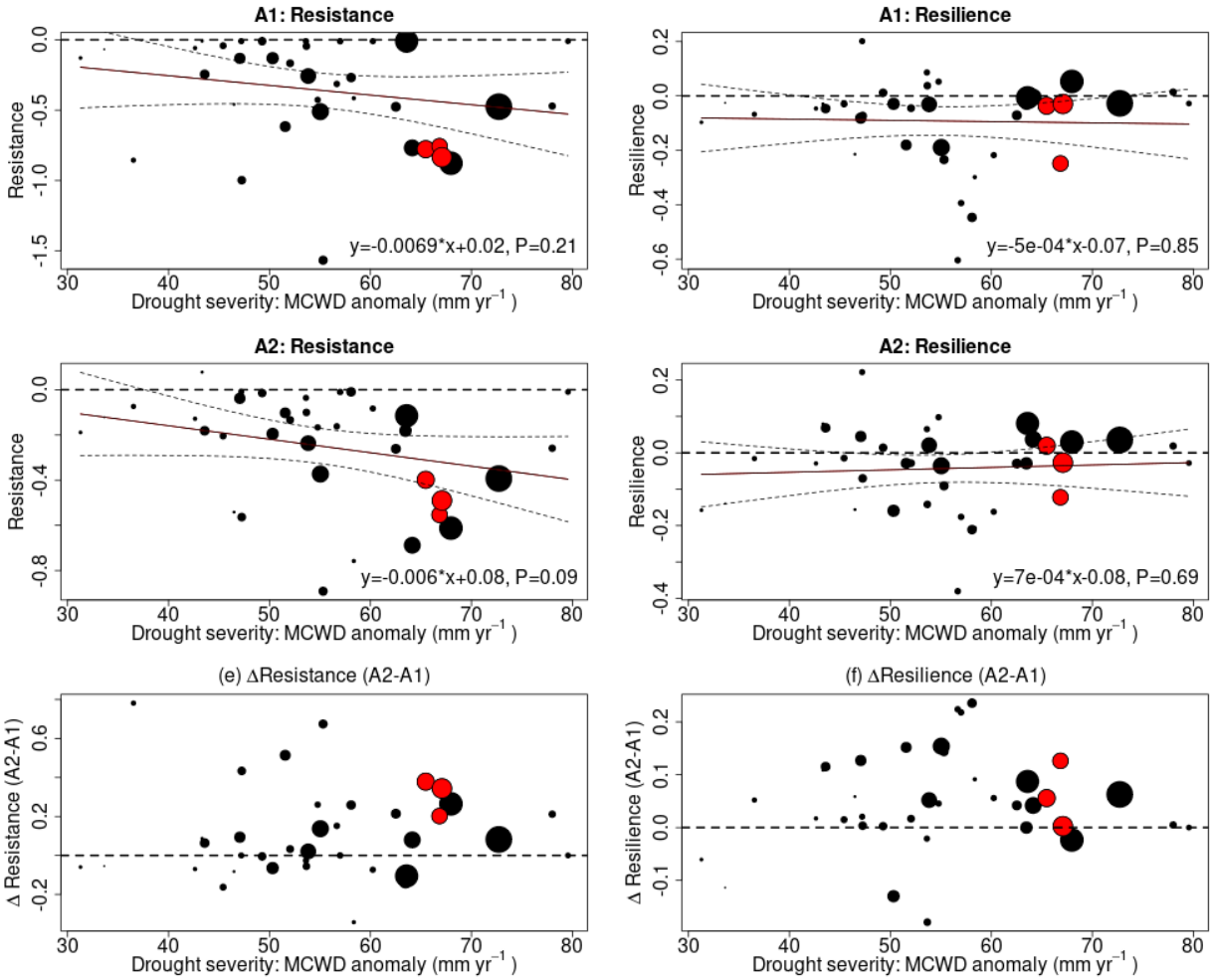

Fig. S4 Similar to Figure 6 but using MCWD anomaly as drought severity metric on the horizontal axis.

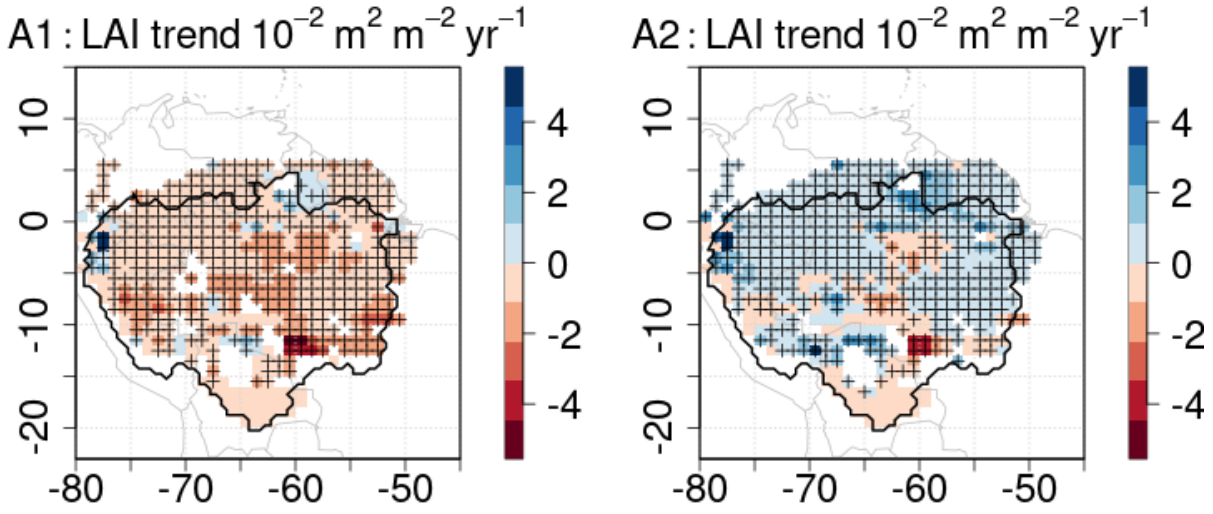

Fig. S5 Spatial distribution of LAI trend over the Amazon rainforest. Markers in the panel denote significant LAI trends over the past four decades (P<0.05).

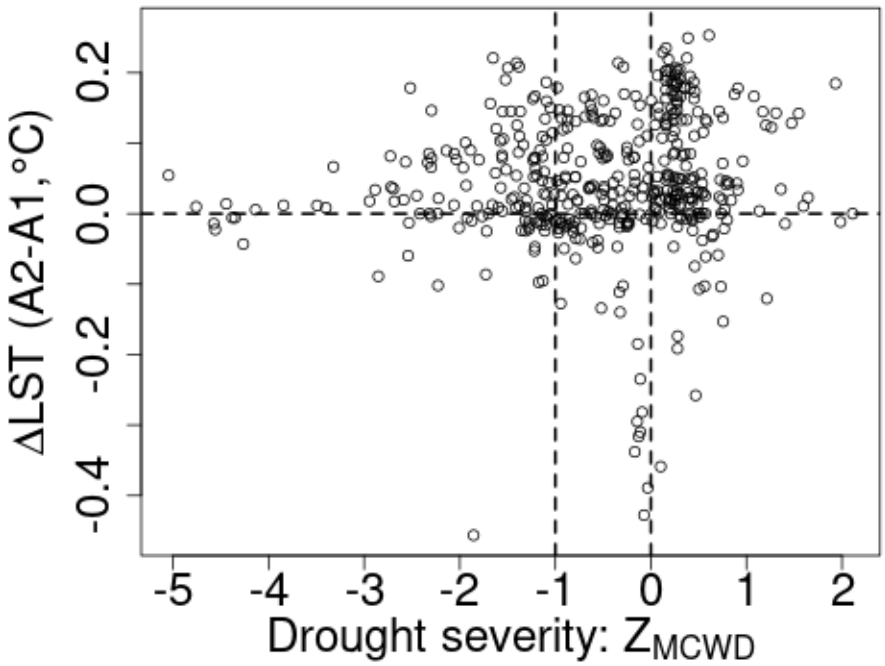

Fig. S6 The land surface temperature change (ΔLST) in relation to Z scores of MCWD due to eCO_2 during 2015-16 El Nino.

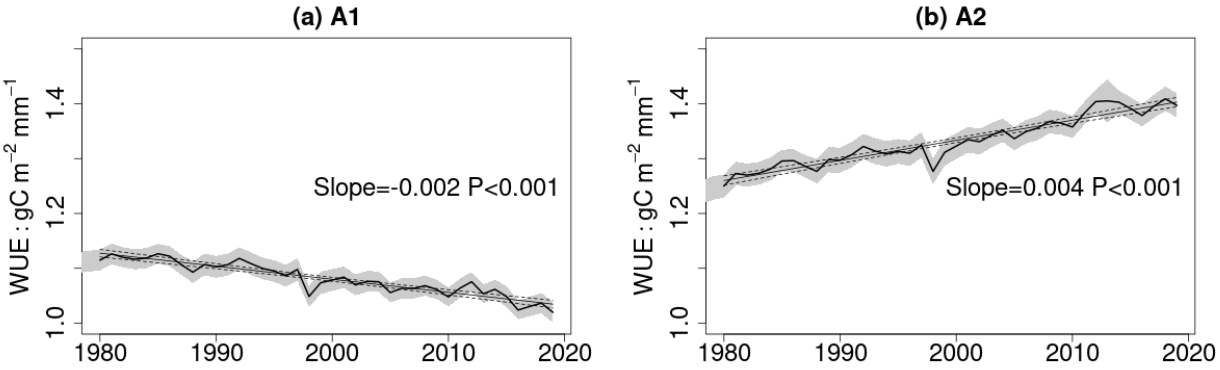

Fig. S7 Trends in water use efficiency (WUE) in (a) A1 and (b) A2. Here WUE is calculated as the ratio between annual GPP and annual ET.

References

Chen, C., Riley, W. J., Prentice, I. C., & Keenan, T. F. CO2 fertilization of terrestrial photosynthesis inferred from site to global scales. *Proc. Natl. Acad. Sci.*, *119*(10), e2115627119, 2022.

Fleischer, K., Rammig, A., De Kauwe, M. G., Walker, A. P., Domingues, T. F., Fuchslueger, L., ... & Lapola, D. M. Amazon forest response to CO2 fertilization dependent on plant phosphorus acquisition. *Nat. Geosci.*, *12*(9), 736-741, 2019.

Haverd, V., Smith, B., Canadell, J. G., Cuntz, M., Mikaloff-Fletcher, S., Farquhar, G., ... & Trudinger, C. M. Higher than expected CO2 fertilization inferred from leaf to global observations. *Glob. Change Biol.*, *26*(4), 2390-2402, 2020.

Keenan, T. F., Luo, X., Stocker, B. D., De Kauwe, M. G., Medlyn, B. E., Prentice, I. C., ... & Zhou, S. A constraint on historic growth in global photosynthesis due to rising CO2. *Nat. Clim. Change*, *13*(12), 1376-1381, 2023.

Kolby Smith, W., Reed, S. C., Cleveland, C. C., Ballantyne, A. P., Anderegg, W. R., Wieder, W. R., ... & Running, S. W. Large divergence of satellite and Earth system model estimates of global terrestrial CO2 fertilization. *Nat. Clim. Change*, *6*(3), 306-310, 2016.

Sitch, S., Smith, B., Prentice, I. C., Arneth, A., Bondeau, A., Cramer, W., ... & Venevsky, S. Evaluation of ecosystem dynamics, plant geography and terrestrial carbon cycling in the LPJ dynamic global vegetation model. *Glob. Change Biol.*, *9*(2), 161-185, 2003.