

Introduction & Background

The frequency and severity of drought in the Amazon is becoming more of a concern in today's climate. More frequent and severe drought will have adverse effects on the Amazon rainforest, such as forest dieback. The Amazon basin is not only under stress from drought, but is also burdened by deforestation. Expansion of soybean and cattle production has been the main driver of deforestation in the Amazon (Bagley et al., 2014). Deforestation can affect local precipitation rates and may further impact global circulations and climate patterns.

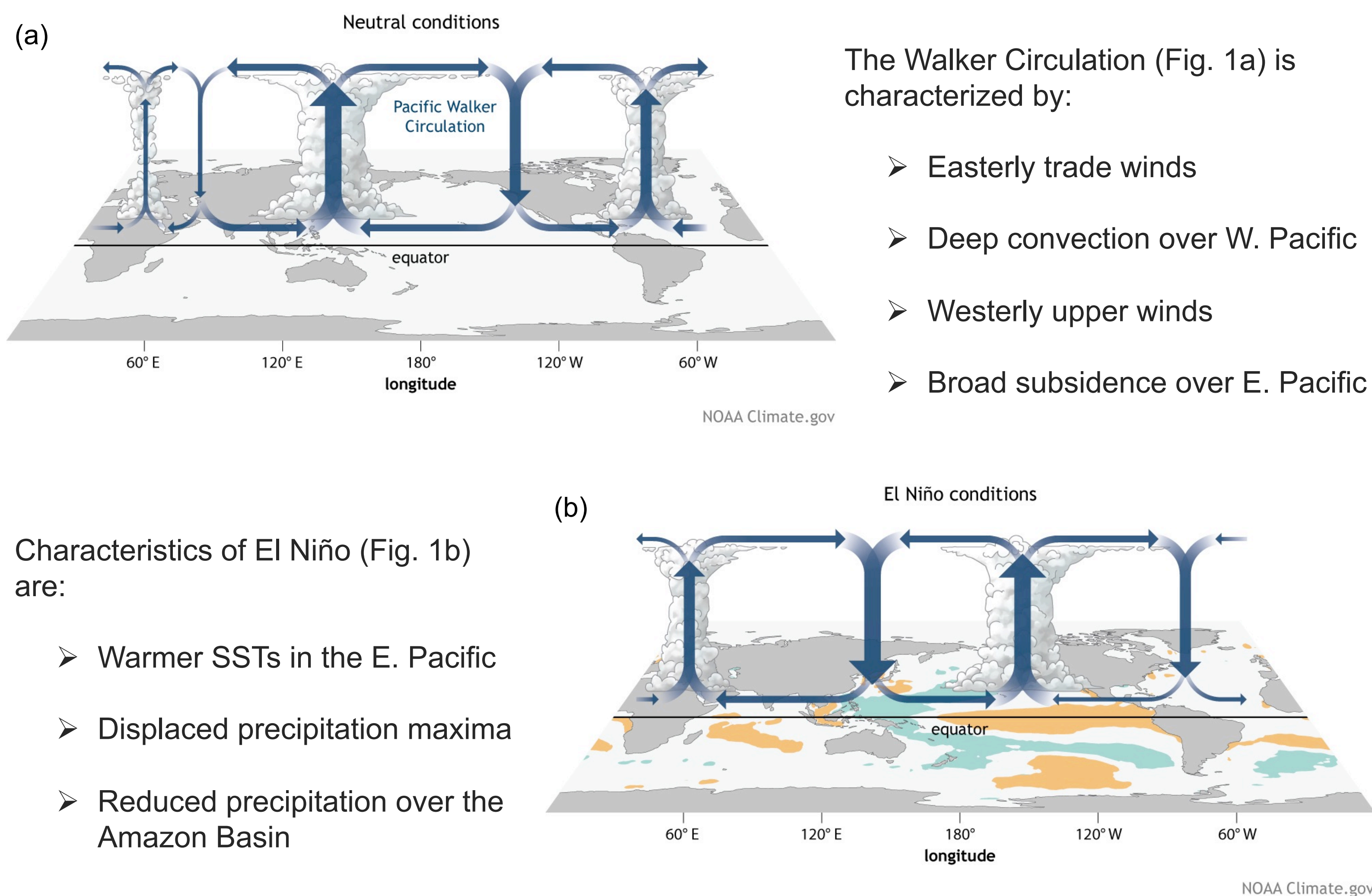


Fig. 1: Schematic of Walker circulation under (a) neutral and (b) El Niño conditions. NOAA Climate.gov drawing by Fiona Martin.

The Walker Circulation can affect rainfall rates over the Amazon, but can changes in Amazonian precipitation caused by deforestation feedback into the system and impact circulations over the Pacific?

Teleconnections

Circulation patterns over the Pacific ocean are strongly connected to the state of the Amazon basin. The teleconnection maps below display how Amazon precipitation correlates with other atmospheric parameters globally.

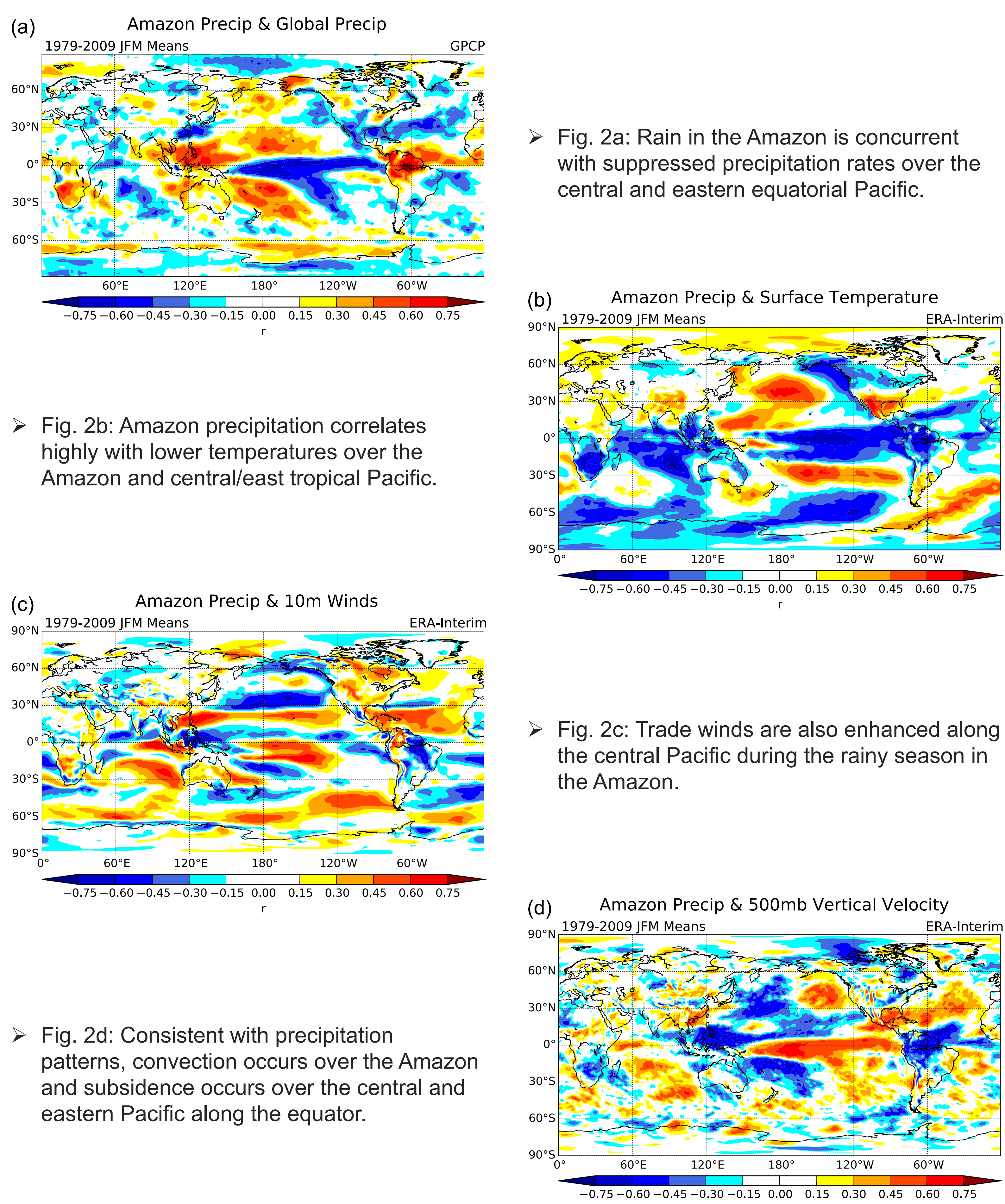


Fig. 2: Teleconnections between Amazon precipitation and (a) global precipitation, (b) surface temperature, (c) 10m surface winds, and (d) 500mb vertical velocity

Deforestation Experiments

An extreme case of Amazon deforestation was carried out using the Community Earth System Model (CESM). A similar experiment was run by Nobre et al. (2009). The model was run for 10 years using prescribed climatological SSTs and coupled atmosphere and land models (CAM 5.0 + CLM 4.5). The control (CTRL) case was run using standard vegetation input (Fig. 3a). The deforested Amazon (DEFOR) case was run with modified plant functional types (PFTs) over the Amazon, where broadleaf evergreen trees (BET) were replaced with C4 grass (Fig. 3b).

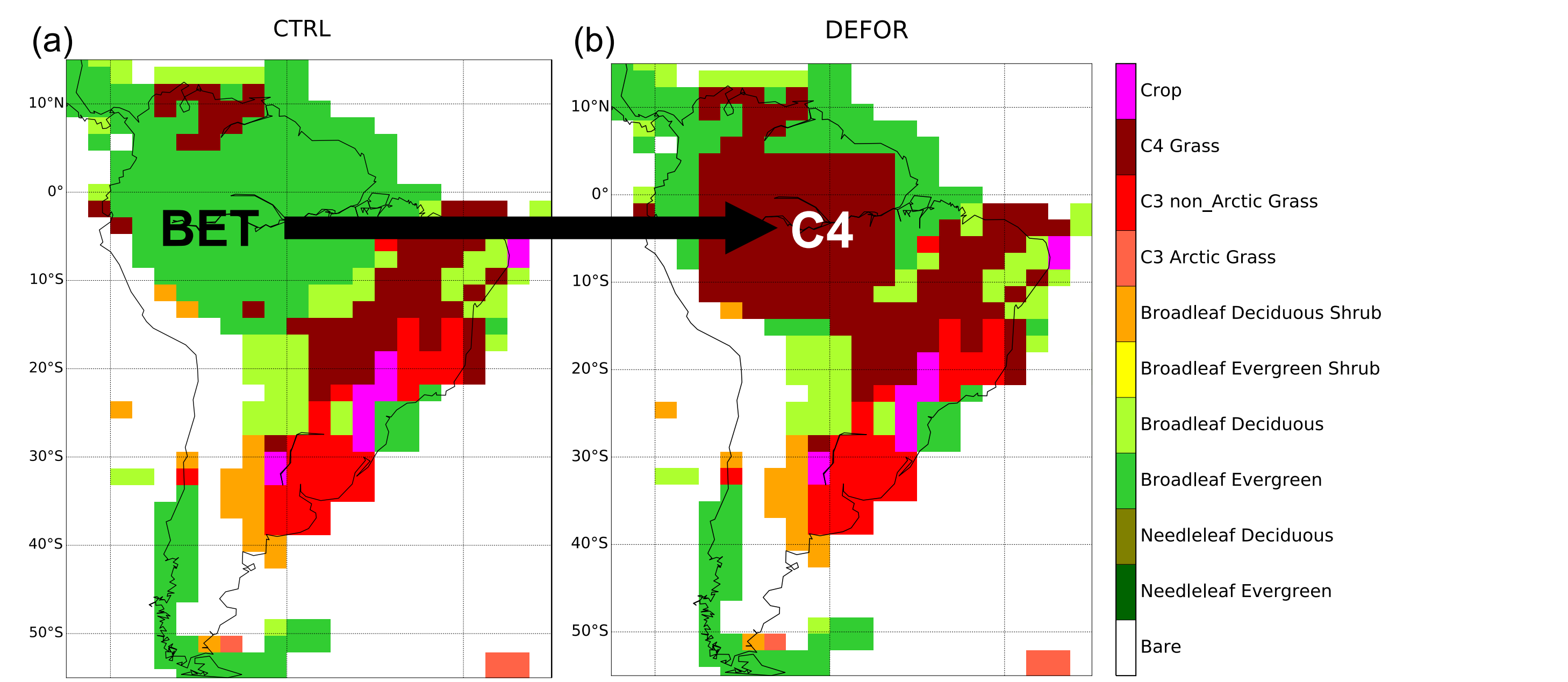


Fig. 3: Map of PFTs for the (a) CTRL and (b) DEFOR cases.

Results

The plots below highlight differences in the deforestation case:

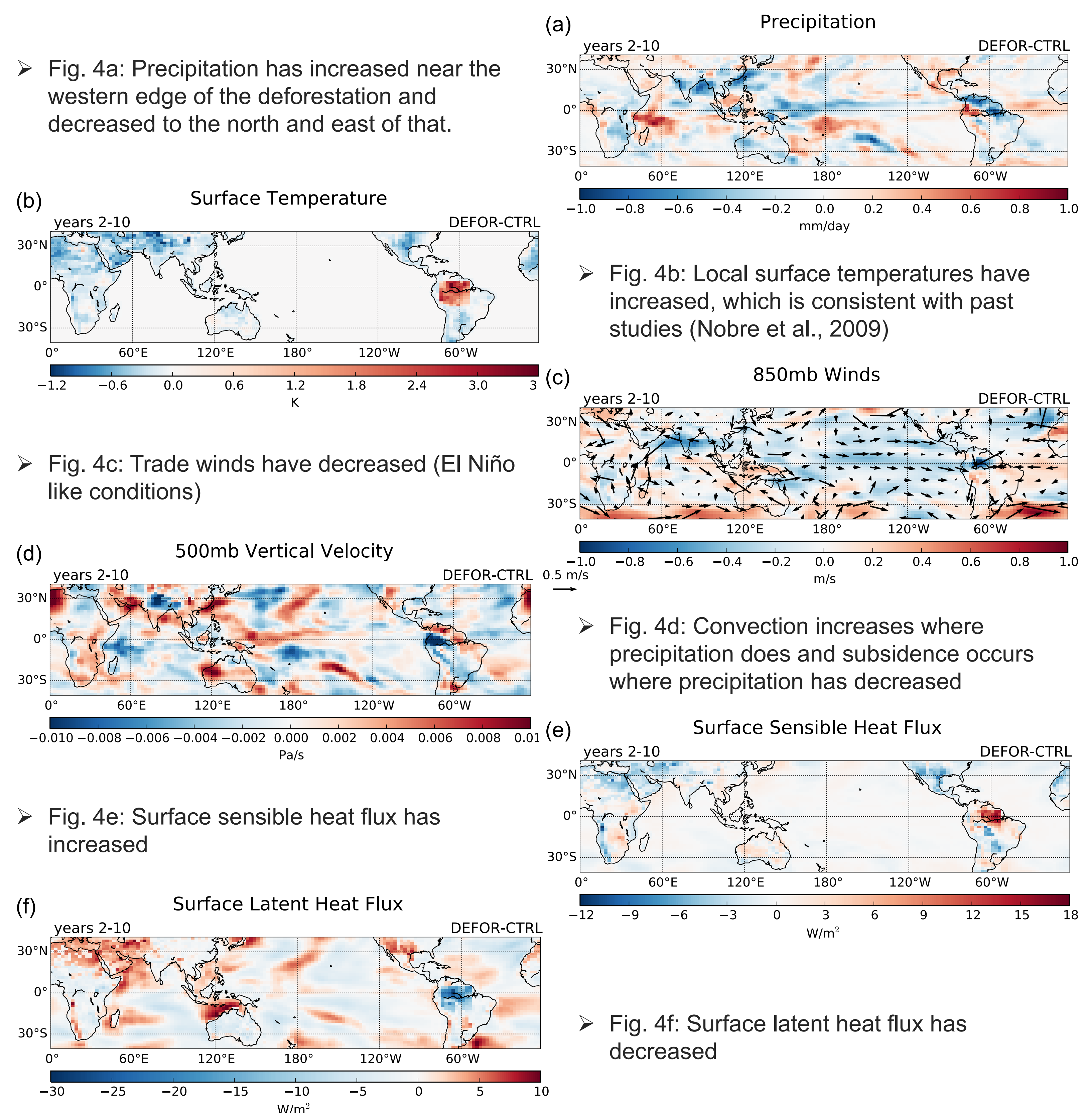


Fig. 4: Difference between the control and deforested cases (DEFOR - CTRL) for (a) precipitation, (b) sfc. temperature, (c) 850mb winds, (d) vertical velocity, (e) sfc. sensible heat flux, and (f) sfc. latent heat flux

Next Steps

The plots on this poster have shown that the Pacific climate is closely linked to the state of the Amazon. What they do not show is causality. El Niño and Pacific SSTs are known to have an effect on Amazon precipitation, but to what extent can changes in rainfall over the Amazon affect the Pacific climate?

We will run numerical experiments using the CESM, which will consist of a simplified planet with a single continent initially covered in forest, transitioning to grassland, then back into forest. These experiments will help us investigate the impacts of Amazonian deforestation the Pacific climate.

References

- Bagley J. E., A. R. Desai, K. J. Harding, P. K. Snyder, and J. A. Foley, 2014: Drought and Deforestation: Has Land Cover Change Influenced Recent Precipitation Extremes in the Amazon?. *J. Climate*, **27**, 345-361.
- Nobre P., M. Malagutti, D. F. Urbano, R. A. F. de Almeida, and E. Giarolla, 2009: Amazon Deforestation and Climate Change in a Coupled Model Simulation. *J. Climate*, **22**, 5686-5697.