Geophysical Research Abstracts
Vol. 20, EGU2018-11415, 2018
EGU General Assembly 2018
© Author(s) 2018. CC Attribution 4.0 license.

When does deforestation affect rainfall? Synergistic hydroclimatic resilience risks in the greater Amazon and Congo regions

Lan Wang-Erlandsson (1), Ruud van der Ent (2), Ingo Fetzer (3), Patrick Keys (4), Hubert Savenije (2), Makoto Taniguchi (1), and Line Gordon (3)

(1) Research Institute for Humanity and Nature, Kyoto, Japan (lan.wang@su.se), (2) Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands, (3) Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, (4) School of Global Environmental Sustainability, Colorado State University, United States

The tropical forests of Amazon and Congo are critical elements of the Earth system in terms of biodiversity, carbon storage, and climate regulation. However, these rainforests are under simultaneous threat of deforestation and climate change, affecting both the internal forest resilience and the resilience of surrounding regions. The water cycle connects rainforests and downwind regions through moisture recycling: changes in forest cover affect evaporation, subsequent atmospheric moisture content, and presumably rainfall over downwind regions. Previous analysis indicates that moisture recycling appears to intensify in dry years, which in turn may weaken forest resilience through synergistic interactions with future deforestation and increased drought occurrence. On the other hand, while many studies have assumed moisture recycling to strongly link evaporation with downwind precipitation, others have suggested only a weak coupling between atmospheric moisture and precipitation in the Amazon, particularly due to pre-existing highly convective conditions. Here, we use 36 years of reanalysis and synthesis precipitation data to analyse inter-annual and inter-seasonal variations in both Amazon and Congo forest-rainfall coupling in terms of: (1) forest moisture contribution to precipitation, and (2) correlation between atmospheric moisture and precipitation. We find that reliance of precipitation on forest evaporation increases significantly in dry years in the Amazon and weakly in the Congo owing to moisture recycling anomalies. In both regions, the correlation between moisture content and precipitation becomes significant only during dry seasons. This suggests that deforestation effects on rainfall are likely to be stronger in dry years and dry seasons – i.e. when rainfall is most needed. Moisture tracking, using the tracking model WAM-2layers, further allows us to identify hotspot regions where forest-rainfall feedback intensifies during dry years, dry seasons, or droughts. These hotspot regions constitute potential risks for downwind regions if they are deforested, but also offer opportunities for co-production of the ecosystem service of vegetation-regulated rainfall through forest protection and management. Finally, we synthesise the implications of our findings for understanding forest resilience synergies in light of predicted future regional land-use and climate change.