



Cascading effects of deforestation and drying trends on reduced forest resilience in the Amazon region

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Increasing dryness in the Amazon region combined with forest degradation could potentially lead to critical transitions of parts of the tropical evergreen forest into seasonal forest or savanna with substantial consequences for regional as well as continental climate. In the assessment of these risks and processes involved, vegetation-climate feedbacks play a central role. In particular, the degradation of tropical forest affects cascading moisture recycling that accounts for about 10% of total South American annual precipitation. Unlike tropical dense forest with deep-rooted trees, a degraded forest experiences water deficit and decreases evapotranspiration rate during the dry season. As a result, the moisture recycling weakens, intensifying the dry season locally and downwind. This in turn affects the resilience of the remaining forested areas, which gives rise to a self-amplifying feedback – loop of forest degradation and reduced dry season precipitation.

Here, we examine how perturbations of the hydrological cycle (induced by deforestation or reduced incoming moisture from the ocean) lead to cascading effects of increased dryness and reduced forest resilience. We combine a simple empirical model based on remote sensing data together with an Eulerian moisture tracking model to quantify the probability of cascading vegetation change in present day and future Amazonian rainforest.