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Influence of deforestation on the future of the Amazonian climate and water cycle

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The extent of the Amazon rainforest is projected to drastically reduce in future decades because of land-use changes. Previous climate modelling studies have found that the biogeophysical effects of future Amazonian deforestation will likely increase surface temperatures and reduce precipitation locally. However, the magnitude of these changes and the potential existence of tipping points is still highly uncertain.

Using a Regional Climate Model (RCM) at a resolution of about 50 km over the South American continent, we perform four ERA-interim-driven simulations with prescribed land cover map corresponding to present day, mid- and late XXIst century deforestation scenarios, and a totally-deforested Amazon case. The results are presented in a recent study (Lejeune et al., submitted). In response to projected land cover changes for 2100, we find an annual mean surface temperature increase of 0.5°C over the Amazonian region and an annual mean decrease in rainfall of 0.17 mm/day compared to present-day conditions. These estimates reach 0.75°C and 0.22 mm/day in the total-deforestation case.

We also synthesize the results from 26 previous modelling studies and compare them to our results. We show that the historical developments of climate models did not modify the median estimate of the Amazonian climate sensitivity to deforestation, but led to a reduction of its uncertainty, with the most recent generation of Global Circulation Models (GCMs) showing less spread in the climate response compared to earlier GCMs. Based on this synthesis and on our results, we suggest that the biogeophysical effects of deforestation alone are unlikely to lead to a tipping point in the evolution of the regional climate under present-day climate conditions. The greenhouse gas-induced climate forcing and biogeochemical feedbacks should however also be taken into account to fully assess the future climate of this region.

Reference : Q. Lejeune, E.L. Davin, B.P. Guillod and S.I. Seneviratne, submitted to Climate Dynamics, Influence of deforestation on the future of the Amazonian climate and water cycle