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Impacts of land cover changes and global warming on climate in Colombia using the regional climate model WRF

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Deforestation in Colombia has drastically increased in recent years. At the same time, droughts and floods are affecting the country more frequently due to climate change. Analyzing the impacts and interactions of deforestation and global warming is challenging due to the terrain's complexity and the high climate variability along with the severe lack of regional climate modelling.

Here, we quantify the impact of historical anthropogenic global warming (CC) and land cover changes (LCC) on precipitation, temperature and the surface energy balance in Colombia by running the Weather Research and Forecasting model WRF v3.9.1.1. across different land cover and climate scenarios during the study period 2009-2011 for Colombia.

We find that precipitation is increased by CC with a stronger effect over forests. LCC implies a small reduction of precipitation which is strongly enhanced above deforested areas. LCC is found to be a strong driver of regional precipitation changes representing up to 25% and 60% of the CC effects magnitude in Coastal Caribbean and Andean regions, respectively. CC causes a temperature increase across the whole domain, in particular with increasing altitude. Surprisingly however, WRF simulates a slight cooling after deforestation which is not in line with almost all observations and modelling studies regarding biophysical effects of tropical deforestation. This apparent bias is further investigated across different WRF schemes and parameters because of its great importance for climate studies using WRF with default parametrization in tropical contexts.