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A modelling approach to estimate carbon emissions from D.R.C. deforestation

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With its 1.8 million squared kilometres, the Congo basin dense forest represents the second largest contiguous forest of the world. These extensive forest ecosystems play a significant role in the regulation of global climate by their potential carbon dioxide emissions and carbon storage. Under a stable climate, the vegetation, assumed to be at the equilibrium, is known to present neutral emissions over a year with seasonal variations. However, modifications in temperatures, precipitations, CO_2 atmospheric concentrations have the potential to modify this balance leading to higher or lower biomass storage. In addition, deforestation and forest degradation have played a significant role over the past several decades and are expected to become increasingly important in the future. Here, we quantify the relative effects of deforestation and 21st century climate change on carbon emissions in Congo Basin over the next three decades (2005-2035). Carbon dioxide emissions are estimated using a series of moderate resolution (10 km) vegetation maps merged with spatially explicit deforestation projections and developed to work with a prognostic carbon cycle model. The inversion of the deforestation model allowed hindcast land-use patterns back to 1800 by using land cover change rates based on the HYDE database. Simulations were made over the Democratic Republic of Congo (DRC) using the ORCHIDEE dynamic global vegetation model with climate forcing from the CMIP5 Representative Concentration Pathway 8.5 scenario for the HadGEM2. Two simulations were made, a reference simulation with land cover fixed at 2005 and a land cover change simulation with changing climate and CO_2, to quantify the net land cover change emissions and climate emissions directly. Because of the relatively high resolution of the model simulations, the spatial patterns of human-driven carbon losses can be tracked in the context of climate change, providing information for mitigation and vulnerability activities.