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Impact of climate change on biome distribution and productivity of the tropical ecosystems under RCP scenarios in South Asia

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South Asia is one of the world's most vulnerable regions to climate change and provides a home to approximately 1.7 billion people. South Asian vegetation is essential for ecosystem services, biodiversity and carbon storage in the region. Vegetation distribution and biome niches are likely to be severely altered by future climate change and rising atmospheric CO₂ concentration. Assessing how ecosystems will respond to these changes is of vital importance. We used the aDGVM2 to simulate vegetation patterns of South Asia under RCP4.5 and RCP8.5. We found good agreement between observed and simulated biomass, height and potential vegetation maps.

Model results show that large areas are susceptible to biome shift by the end of the 21st century. Woody encroachment is predicted in open savanna regions which are at high risk of transitioning into forest. We simulated vegetation under both scenarios with fixed CO₂ concentration and found decreased tree dominance and biomass. Simulations under elevated CO₂ concentrations predicted an increase in biomass, canopy cover, tree height and decrease in evapotranspiration. Changes in above ground biomass and canopy cover trigger biome shifts toward trees dominated the system. C3 vegetation is not saturated at current CO₂ concentrations as the model simulated strong CO₂ fertilization effect which will increase further with the rising CO₂. Although there is considerable uncertainty in the biome projections, the geographic patterns of biomes are generally consistent across the RCP4.5 and RCP8.5 scenarios. The results provide potential future trajectories of the response of South Asian vegetation to the climate change. The results will help to understand the regional climate-vegetation interaction and to develop regional strategies for biodiversity conservation to cope with climate change.