THE SENSITIVITY OF THE CONGO BASIN RAINFORESTS TO CLIMATE CHANGE

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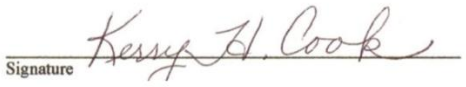
Abstract

Tropical rainforests require significant attention from the scientific community, not only because of their biodiversity and the valuable resources they bear but also due to their indispensable role as climate regulators. They modulate the greenhouse gas levels and global temperature, control the water cycle and help stabilize the regional and global climate. For this reason, it is crucial to understand how these biomes may change in a warming climate. My study is centered around the Congo Basin rainforests which constitute the second-largest tropical rainforest massif in the world and have a pivotal role in the tropical climate system. Understanding the responsiveness of these forests to climate variations is a pressing theme as Congo is one of the most understudied forest regions in the tropics, with uncertainties in the long-term climate trend and forest evolution.

The objective of this study is to understand if the changing climate of the Congo Basin would be less favorable for the existence of tropical rainforests. To address this issue, we will adapt a Potential Vegetation Model (PVM; Oyama and Nobre 2004) for analysis over the Congo Basin. This model represents the potential biomes in equilibrium with the given climatological data. The biome types are decided based on a PVM algorithm that uses five environmental variables, derived from the input climate data. Given a 40-year monthly mean climatology (from 1979 to 2020) with 0.25^{o} spatial resolution from the ECMWF Re-Analysis 5 (ERA5) dataset, the PVM is run over the Congo Basin area. The output is validated using different satellite-derived observational land cover maps for the Congo Basin. Besides the 40-year climatological mean data, the model is run with monthly mean climatology of four decades derived from the ERA5 record (1979-2021). In addition, the PVM is used on future NCAR-Weather Research and Forecasting (WRF) model projections to predict how the equilibrium changes in the Mid-21^{st}, and Late 21^{st} century time periods under changing atmospheric CO2 levels.

The PVM run outputs show that the region marking the rainforest-attributable climate is seen to recede over the 40-year period and has been replaced by climate conditions that accommodate savanna. The WRF model climatology also gives a retreat of the forest-favoring climate in its PVM run. Further analysis reveals the control of the PVM moisture parameters as the decisive factor in these changes. The results indicate that the Congo Basin rainforests, particularly the open forest classes and semi-deciduous classes in the peripheral basin areas respond to alterations in climate.



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