THE UNIVERSITY OF HONG KONG
SCHOOL OF BIOLOGICAL SCIENCES

Postgraduate Student Public Seminar

"THE IMPACTS OF THE EXPANSION OF LARGE-SCALE COMMODITY FARMING ON THE AMAZON RAINFOREST CLIMATE"

Mr. ZHANG Jie
PhD Student, School of Biological Sciences, HKU
(Supervisors: Prof. Alice C. Hughes & Prof Eduardo Maeda)

on Thursday 27 February, 2025 at 10:30 am
Room 6N-11, Kadoorie Biological Sciences Building

Abstract

As human activities advance, Amazonian deforestation accelerates. Natural forests give way to settlements, extensive croplands, and pastures. Recently, there has been a notable surge in the expansion of large-scale commodity agriculture in Southern Amazonia. These large-scale commodity farms have been linked to decreased rainfall and increasing temperatures. Nonetheless, the mechanisms driving these climatic shifts and their future implications remain inadequately comprehended. This study investigates the climatic impacts of the expansion of commodity crops in Amazon. The Chemistry Land-surface Atmosphere Soil Slab model (CLASS) and the Weather Research and Forecasting model (WRF) were then applied to simulate changes in the local climate under future climate predictions.

The study first performed simulations to characterize the feedback to climate caused by the replacement of Amazonian forests with soybean and pastures. Our results show that: when compared to deforestation caused by pastures, the conversion of forests into soybean plantations results in more pronounced changes in the atmospheric boundary layer. Although soybean plantations strengthen convective lifting, the decrease in boundary layer water vapor content plays a major role in reducing rainfall. Finally, we show that replacing forests with soybeans could exacerbate climatic effects, leading to significant reductions in water vapor content.

Subsequently, the study applied the forecasting model to evaluate whether the expansion of soybean plantations can amplify climatic changes over the Southern Amazon by 2050. Our results show that areas dominated by soybean plantations will experience higher average temperatures in the dry season and lower average daily precipitation in the wet season. Under the worst-case scenario, soybean-dominated regions experience a slightly higher temperature increase (1.43℃) compared to pasture-dominated areas (1.22℃) during the dry season. Deforestation may heighten climate change effects in the Amazon, yet the impact magnitude will be influenced by the distinct biophysical characteristics of various land uses in the area.

Lastly, the study used the forecasting model to simulate climate conditions across the Southern Amazon over a 10-year average cycle. We tested two land-use scenarios combined with two climate change scenarios by mid-century. Our results show that land use change alone will increase average surface temperatures. The combined effects of climate change and land use changes are expected to raise temperatures by 1.4℃ by 2050. Additionally, land use and climate changes are projected to reduce average annual rainfall. Furthermore, southern Amazon rainfall is increasingly vulnerable to disruption, weakening the region's land-atmosphere system.

This study used simulations to understand how Amazon land use and climate change affect regional climate, highlighting shifts in key meteorological factors. By elucidating the underlying mechanisms and future projection, it establishes a vital scientific foundation for climate governance and human activity planning in the Amazon. These findings offer essential guidance for enhancing policies to improve agricultural output and conservation of the Amazon ecosystem.

--- ALL ARE WELCOME ---