

# RESEARCH SEMINAR

DEPARTMENT OF GEOGRAPHY & RESOURCE MANAGEMENT  
THE CHINESE UNIVERSITY OF HONG KONG

## Soil Moisture Impacts on Land Carbon Cycle: Learning from Observations and Models

7 November 2024 (Thu)  
4:30 – 6:00 pm (UTC+8)  
Rm 221, Chen Kou Bun  
Building, CUHK

Soil moisture (SM) deficit induced drought is emerging as an increasingly important threat to land ecosystem. From the perspective of observations, on the global scale, we use satellite observations to disentangle the relative role of SM and vapor pressure deficit (VPD) in limiting land ecosystem production. We show that SM is the dominant driver of dryness stress across more than 70% of vegetated land areas with valid data. On the regional scale, we find that SM relevant droughts increasingly reduce CO<sub>2</sub> uptake in the tropical lands. However, most state-of-the-art coupled Earth System models (ESMs) and Land Surface models (LSMs) do not reproduce the intensifying water-carbon coupling. From the perspective of models, we utilize two generations of factorial ESM experiments to show that SM consistently dominated the interannual variability (IAV) of tropical land carbon uptake in ESMs. The magnitude of this interannual sensitivity of tropical land carbon uptake to water variations ( $g_{IAV,W}$ ) under future climate shows a large spread across the latest 16 ESMs. Based on the identified significant emergent relationship between  $g_{IAV,W}$  under future climate and present climate, the mean and spread of future  $g_{IAV,W}$  are reduced by about 41% and 44%, respectively, using observations and the emergent constraint methodology. These research help improve the understanding of water-carbon coupling under drought conditions.



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Prof. Laibao Liu is a tenure-track assistant professor at the University of Hong Kong (HKU), affiliated with both the Department of Geography and Institute for Climate and Carbon Neutrality. His research interests are land and climate systems, land-atmosphere interaction, and renewable energy.

He has published about 30 peer-reviewed articles. His leading research outcomes are published in high-impact journals, such as *Nature* (Climate impacts on Land carbon sink), *Nature Energy* (Climate impacts on Renewable energy systems), and *Nature Communications* (Process of Climate-Carbon coupling). He has received several awards for his research and two Highly Cited Papers by Clarivate.



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