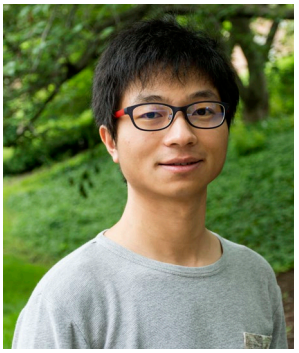
RESEARCH SEMINAR

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

Spatial-temporal Adaptive Planning of Flood Managed Aquifer Recharge Guided by Deep Reinforcement Learning

08th December 2025 (Thu)
4:30 – 6:00 pm (UTC+8)
Rm 233, Chen Kou Bun Building, CUHK

Flood-managed aquifer recharge (Flood-MAR) is a crucial yet untapped solution that can simultaneously mitigate flood and drought risks and boost groundwater supply. The key constraint for this multi-benefit adaptation is how much water and land are available for recharge, which requires effective planning to repurpose existing agricultural landscapes. However, future evolution of such landscapes is subject to uncertainties in changing human-nature systems. Traditional spatial-temporal planning approaches often assume perfect future predictions and rely on static policies, which cannot well adapt to dynamic and uncertain environments. To address these limitations, we propose a multi-objective spatially explicit planning framework leveraging deep reinforcement learning (DRL) to guide adaptive policies for joint agriculture and water management. Our DRL agents dynamically allocate lands for different Flood-MAR related actions over space and time. We apply the DRL framework in California's San Joaquin Valley to identify cost-optimal strategies for a 10-year planning horizon. Our results show that DRL-guided Flood-MAR strategies can avoid groundwater deficits with less economic loss and even better adapt to future drier climate conditions. Our study highlights the role of Flood-MAR in mitigating flood and drought risks in uncertain environments and the efficacy of DRL in guiding spatial-temporal adaptive Flood-MAR policies.



Xiaogang He

Invited by Prof. Jianfeng Li

Assistant Professor

Civil and Environmental Engineering, National University of Singapore

Dr. Xiaogang He is a Princeton-trained hydrologist with expertise in economics, machine learning, and environmental policy. His research focuses on how climate change and human interventions affect drought and flood risks, implementing integrative frameworks including hydrological modeling, remote sensing, and AI to reduce societal impacts. Before joining the National University of Singapore, he was a Water in the West Postdoctoral Fellow at Stanford University. His research has been recognized through the American Geophysical Union (AGU) Natural Hazards Section Early Career Award and Asia Oceania Geosciences Society (AOGS) Kamide Lecture Award. He serves as Associate Editor of Geophysical Research Letters.

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