

HUWASI: GLOBAL HUMAN-CENTRIC WATER STRESS ASSESSMENT WITH CLM5

Speaker

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Abstract

Freshwater scarcity is a pressing global challenge exacerbated by climate change and rising human demands. Despite progress in hydrological modeling, current approaches often fail to accurately represent the dynamic interactions between natural water cycles and anthropogenic withdrawals at sub-annual timescales. In this study, we enhance the Community Land Model version 5 (CLM5) by improving its representation of human water withdrawals, incorporating sector-specific extractions from both surface and groundwater sources. This refinement significantly improves model performance, underscoring the critical role of groundwater in meeting global water demands and revealing that many sectors cannot meet historical withdrawal rates with surface water alone. We also introduce the Human Water Stress Index (HuWaSI), a novel two-dimensional metric that captures short-term supply-demand reliability and long-term storage resilience. Applying HuWaSI globally, we identify four distinct water stress archetypes—water-secure, supply-limited, storage-limited, and double-stressed—with most countries falling into the double-stressed category. Monthly analyses reveal distinct seasonal variability, particularly in monsoon regions where water stress fluctuates sharply within a single year—variability often masked by annual indicators.

Biography

Yeonjoo Kim is a professor in the Department of Civil and Environmental Engineering at Yonsei University in Seoul, Korea. She is a hydrologist whose research focuses on understanding the interactions among hydrologic, ecological, and climate processes through the development and application of numerical models—particularly land surface and ecosystem models—integrated with ground-based and remotely sensed observations. She earned her bachelor's degree from Yonsei University, a master's degree from the Massachusetts Institute of Technology (MIT), and a Ph.D. from the University of Connecticut. She completed postdoctoral research at both Harvard University and NASA's Goddard Institute for Space Studies (GISS). Since 2003, she has published approximately 70 peer-reviewed articles in international journals and has supervised 12 graduate theses since 2015. She currently serves as an associate editor for the Journal of Hydrology, Vadose Zone Journal, and JGR: Biogeosciences.



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