Session title

Advances in Modeling Groundwater Dynamics from Regional to Global Scales

Description

Recent decades have seen rapid advances in the modeling of groundwater dynamics, driven by increasing computational power, expanding observational and remote-sensing datasets, and growing demand for regional-to-global assessments under climate change and intensifying human pressures. Building on recent syntheses that highlight groundwater as an increasingly dynamic component of the Earth's water cycle (e.g., Kuang, Zheng* et al., 2024, Science), this session focuses on state-of-the-art modeling approaches that resolve groundwater processes across spatial scales, from catchments and river basins to continental and global systems. Contributions are encouraged on integrated groundwater-surface water modeling, representation of vadose-zone and deep groundwater processes, coupling with climate and Earth system models, and data-informed or hybrid approaches that combine process-based modeling with remote sensing, machine learning, and data assimilation. The session aims to synthesize recent methodological progress, identify remaining challenges related to scaling, parameterization, and uncertainty, and explore how advanced groundwater models can improve predictions of water availability, hydrologic extremes, ecosystem resilience, and long-term sustainability.

Keywords

- Groundwater modeling
- Regional-to-global scale modeling
- Groundwater-surface water coupling
- Integrated and Earth system models
- Climate and human impacts
- Data assimilation and machine learning

Session Chair

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