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Assessing the impact of climate change on Southeast Asia's hydropower availability

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Southeast Asia's electricity supply largely depends on the hydropower resources of the Mekong, Chao Phraya, Irrawaddy, and Salween River Basins. Uncertain precipitation patterns, rising temperature, and other climate-driven changes are exposing these resources to unprecedented risks, prompting decision makers to re-evaluate existing reservoir management strategies through climate change risk assessments. These assessments are important in shaping the operators' response to hydro-climatic variability and are necessary to ensure energy security in the region. In this study, we developed high-resolution, semi-distributed hydrological models to examine the potential changes of hydropower availability under projected future climate scenarios in the four largest river basins in South East Asia. Specifically, we relied on a novel variant of the Variable Infiltration Capacity (VIC) model that integrates reservoir operations into the routing scheme, warranting a more accurate representation of cascade reservoir systems. Climate change impacts were derived from the outputs of five Global Circulation Models (GCMs) forced by two Shared Socioeconomic Pathways (SSPs 2.6 and 8.5) emission scenarios in the Coupled Model Intercomparison Project Phase 6 (CMIP6). We find that hydropower generation would be altered significantly in all scenarios in terms of temporal variability and magnitude due to the changes in duration and magnitude of the summer monsoon. Our findings further stress the importance of exploring how the impact of climate change on hydropower availability propagates through water-energy systems and call for adaptive reservoir operation strategies.