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Adaptive Reservoir Operation under the Challenges of Transboundary Dams: Example from the Nile River Basin Using Satellite Remote Sensing

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Abstract

The Nile River Basin (NRB) is home to more than 200 million people sharing the water resources for agriculture, industry, municipal uses, in-stream navigation, and hydropower generation. A central and existential water management issue for the region is the sustainable supply of water for an increasing population, more recurrent droughts, and climate change. Recent published datasets on future dams reveal an increasingly impounded NRB for hydropower development by upstream and transboundary nations, notably Ethiopia. This work harnesses multiple satellite earth observations for water management making decisions through an operationalized web portal system (namely, Nile Basin Reservoir Advisory System or NiBRAS;
means "light" in Arabic). The system is currently in the development stage; it integrates complex physical land surface and reservoir models in the back end with a front-end user interface to facilitate decision making. NiBRAS is based on open-source and non-proprietary tools and popular cloud computing functionalities such as the Google Earth Engine API. The system's lean architecture needing low CPU and internet bandwidth can facilitate the understanding of the water management issues associated with reservoir operation and evaluate scenarios as potential solutions in resource-constrained settings of the decision maker. In addition, NiBRAS can assist water managers and dam operators to make informed decisions by assessing various operational procedures and their impacts more interactively. Furthermore, the NiBRAS system is intended to promote the societal applications of various water-related satellite and forecast products in the Nile Basin; communicate the potential of such products to understand water management issues; and provide an open-source, fully transparent and reproducible platform to facilitate negotiations between competing stakeholders on new dam plans.

Keywords: Nile River Basin, Transboundary dams, Nile Basin Reservoir Advisory System (NiBRAS), Adaptive reservoir operation

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