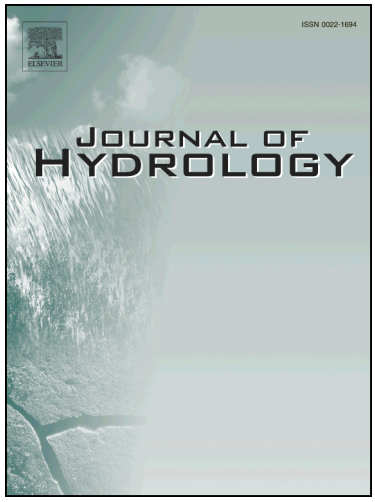

Research papers

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Hydropower generation, flood control and dam cascades: A national assessment for Vietnam

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Abstract

Vietnam is a country with diverse terrain and climatic conditions and a dependency on hydropower for a significant proportion of its power needs and as such, is particularly vulnerable to changes in climate. In this paper we apply SWAT (Soil and Water Assessment Tool) derived discharge simulation results coupled with regression analysis to estimate the performance of hydropower plants for Vietnam between 1995 to mid-2014 when both power supply and demand increased rapidly. Our approach is to examine the watershed formed from three large inter-boundary basins: The Red River, the Vietnam Coast and the Lower Mekong River, which have a total area of 977,964 km^2. We then divide this area into 7,887 sub-basins with an average area of 131.6km^2 (based on level 12 of HydroSHEDS/HydroBASINS datasets) and 53,024 Hydrological Response Units (HRUs). Next we simulate river flow for the 40 largest hydropower plants across Vietnam. Our validation process demonstrates that the simulated flows are significantly correlated with the gauged inflows into these dams and are able to serve as a good proxy for the inflows into hydropower dams in our baseline energy regression, which captures 87.7% of the variation in monthly power generation In other results we estimate that large dams sacrifice on average around 18.2% of their contemporaneous production for the purpose of flood control. When we assess Vietnam's current alignment of dams we find that the current cascades of large hydropower dams appear to be reasonably efficient: each MWh/day increase in upstream generation adds 0.146 MWh/day to downstream generation. The study provides evidence for the multiple benefits of a national system of large hydropower dams using a cascade design. Such a system may help overcome future adverse impacts from changes in climate conditions. However, our results show that there is still room for improvement in the harmonization of cascades in some basins. Finally, possible adverse hydro-ecological impacts due to the proliferation of large upstream dams, including those located beyond Vietnam's border, need to be carefully considered.