Geophysical Research Abstracts
Vol. 21, EGU2019-433-1, 2019
EGU General Assembly 2019

Evaluating proposed Godavari to Krishna inter-basin water transfers in Southern India under changing climate and human demands

Sai Veena (1), Riddhi Singh (1), David Gold (2), Patrick Reed (2), and Ajay Bhave (3)

(1) Indian Institute of Technology Bombay, Indian Institute of Technology Bombay, Department of Civil Engineering, Mumbai, India (saiveena26@gmail.com), (2) School of Civil and Environmental Engineering, Cornell University, Ithaca, New York, (3) Sustainability Research Institute, School of Earth and Environment, University of Leeds, Leeds, United Kingdom

Inter-Basin Water Transfers (IBWTs) are a common approach for managing water scarcity that seeks to take advantage of the regional differences in the variability of water resources. Globally, there is broad interest in evaluating the impact of implemented IBWTs on the ecology of donor and recipient basins. But, there are challenges in how best to represent and evaluate the operational dynamics of the water transfers, (i.e. the timing and volume of transfers). Identifying such strategies is particularly challenging in monsoon-dominated regions because donor and recipient basins receive most of the annual rainfall within a single season. In this study, we evaluate the trade-offs that emerge across alternative water transfer strategies that can be employed when donor and recipient basins both have monsoon dominated rainfall. As India embarks on the (∼$75 billion) Interlinking of Rivers Project, we evaluate an IBWT scheme in southern India named Inchampalli-Nagarjuna Sagar link for transferring water from Godavari river basin to Krishna river basin. The objectives used to generate and evaluate alternative water transfer strategies are reliability, resilience, and, vulnerability of demand satisfaction, reliability of flood protection and minimum environmental flows.

We employ many-objective robust decision making method (MORDM) to characterize the trade-offs between flooding protection, water demands, and environmental flows as well as their robustness to a changing climate and human demands. Within the MORDM framework, three variants of the problem are explored. The first is an intertemporal formulation where the optimized strategy is defined as a sequence of monthly water transfers, assumed to be fixed year to year similar to the operation of proposed transfer. Based on the diagnostics of the intertemporal results, we found that the driving factors for the transfer volume are demand and storages in the reservoir. Accordingly, two other variants of direct policy search (DPS) formulations are defined where the decision to transfer water depends upon the storage and demand states of the donor basin, or, on storage and demand states of both donor and recipient basins. DPS strategies are adaptive to the specific states that are observed within the system considered (i.e. a closed-loop control feedback). The strategies generated by optimizing these three formulations under historical uncertainties are further evaluated for changing climate (long-term precipitation and temperature) and demands in both the basins. Results indicate that DPS derived strategies perform significantly better than the intertemporal strategies as long-term climate and demands change. Moreover, strategies that consider the demands and storages in donor and recipient basins simultaneously when deciding upon the amount of water to be transferred outperformed those that only act on donor conditions. The robustness of the proposed transfer from the report of the National Commission for Integrated Water Resource Development performs acceptably for approximately 40% of the tested scenarios whereas the best solution of DPS derived strategies attains acceptable performance in 60% of the long-term climate and demand change scenarios. This study strongly highlights the importance of information coordination and feedback between the donor and recipient basins with the help of adaptive strategies.