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Assessment of Reservoir Storage Capacity Loss and Investigating the Effects of Climate Variability on Reservoir Sedimentation in Italy

Epari Ritesh Patro[1] and Carlo De Michele[2]
[1]Department of Civil and Environmental Engineering, Politecnico Di Milano, Italy (epariritesh.patro@polimi.it)
[2]Department of Civil and Environmental Engineering, Politecnico Di Milano, Italy (carlo.demichele@polimi.it)

Reservoir sedimentation has a prominent impact on the hydropower performance in the future and is a growing concern for hydropower stakeholders. Sedimentation caused by soil erosion is influenced by various parameters. Reservoir sedimentation is one of the most challenging problems that affect hydroelectric production since it overall causes a reduction of the reservoir capacity that overcomes the annual increase in storage volume and implies a dangerous net loss of energy. The first part of this study examined various Italian reservoirs (50 dams) to determine sedimentation rates and storage capacity loss based on available bathymetric surveys. All the reservoirs studied here have reached an average age of 74 years as of 2019, with the highest loss of capacity observed at 90% and the highest annual sediment yield of 2471 m^3/km^2/year. Out of all the reservoirs studied, 25% of them already have reached their half-life as of 2019. The second part of this study extended the work to the specific case study of the Ceppo Morelli hydropower plant. The study was carried out to analyse the water-sediment interaction, future sediment load and prioritizing of critical soil erosion areas using the Soil and Water Assessment Tool (SWAT). The distinguishing feature of this work lies in the possibility to exploit remote sensing data (i.e. actual/potential evapotranspiration) to successfully calibrate hydrological models in scarce data regions. Simulation results indicated that the discharge and sediment load entering Ceppo Morelli reservoir will decline and the rate of reduction of latter is higher than that of former for all the future climate scenarios implemented. This analysis will provide a starting point for management and prioritization of adaptation and remediation policies for addressing the issue of reservoir sedimentation. These results are part of the RELAID project funded through PRIN-Italy. The aim of this project is to integrate updated knowledge on hydrologic, hydraulics, and sedimentation processes to address the water and flood risk management of impounded Italian rivers through a holistic paradigm.

Keywords: reservoir sedimentation; hydropower; hydrological modeling; RELAID; Italy