MAIN PATTERNS OF HYDROLOGICAL ALTERATION CAUSED BY RESERVOIRS IN NORTHERN SPAIN.

Abstract type
Oral presentation
Session type
General Session - G3 - Anthropogenic impacts on ecosystems
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Abstract

The functioning of freshwater ecosystems is closely related to flow regime at multiple scales. However, the natural flow regime of most rivers worldwide has been largely altered during the last century which has led to significant degradation of these ecosystems. The assessment of hydrological alteration (HA) has commonly been carried out at a local scale. By contrast, very few studies have analysed the general patters of HA within a larger region. In this regard, recent studies has evidenced that patterns of HA at the regional and national scales differ depending on several factors.The main objective of this study is to assess and define the general patterns of HA caused by reservoirs with different purposes in northern Spain. The analysis has been conducted in 20 rivers located in northern Spain, both in Atlantic, Cantabric and Mediterranean rivers, and following a control-impact experimental design. We have considered 12 impacted sites (flow-regulated), downstream reservoirs with different purposes. Controls were selected based on the principle of paired watersheds and considering an inductive hydrological classification. We used daily flow series from 1976 to 2016 recorded in the impact and control gauges. Following the Indicators of Hydrological Alteration, 82 ecologically meaningful hydrological indices (HIs) representing five attributes of the flow regime were calculated from the daily flow series. Then, we calculated the percentage and direction of deviation of each HI in the impact gauges relative to its control gauge and the change in the range of its natural variability. We analysed the results in term of the characteristics of the reservoir, the type of natural rivers and the type of hydrological attribute. Results revealed that irrigation or combined irrigation/hydropower reservoirs produced larger HA than those dedicated uniquely to hydropower. The most prevalent form of HA in the irrigation reservoirs was the inversion of the monthly flow regime, reaching up HA over 80%, while the hydropower reservoir mainly suffered an increase in the annual extreme minimum flows around 40-60%. Nonetheless, the sub daily HA caused by hydropower reservoir could not be assess here. Results also indicated only a relative importance of the hydrological type of river while critical thresholds of HA, which depends on the range of variability of the HI, varied greatly depending on the HI considered. Results of this study will aid in understanding the impacts of HA on river ecosystem, as it is part of a larger project framed within the EuroFLOW ITN.

Keywords
Natural flow regime, Dams, Flow regulation, Water resources management