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Unraveling the anthropogenic alteration of streamflow regimes in Tyrol and South Tyrol

Katja Schmölz (1), Simone Persiano (1,2), Giacomo Bertoldi (1), Alessio Pugliese (2), Attilio Castellarin (2), and Erich Tasser (1)

(1) Eurac Research, Institute of Alpine Environment, Bolzano, Italy , (2) Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna, Bologna, Italy

River ecosystems are strongly influenced by landform and human activities within their catchments. Most rivers worldwide have been severely altered by a combination of different anthropogenic interventions, leading to dramatic changes in the aquatic habitat and the organism community. With information about species composition, abundance, dominance and population structure it is possible to make reliable predictions about the status of the river ecosystem. Therefore, fishes have been established as a biological indicator for the good water status in the European Union in accordance with the European Water Framework Directive. In this context, the ALFFA (holistic multiscale Analysis of the factors and their effect on the Fish Fauna in inner-Alpine space) INTERREG project between Italy and Austria has the aim of evaluating the effect of human activities on water quality and streamflow regimes, and therefore on the fish fauna, with special focus on Tyrol and South Tyrol. For this study area, 80 sampling points have been selected, where the impact of all influencing drivers (e.g. land cover, agriculture, fisheries, fish-eating birds, water chemistry, pesticides, hydrology, etc.) needs to be evaluated. From the hydrological perspective, a crucial aspect is the estimation of the anthropogenic alteration (i.e. degree of disturbance) of streamflow regimes, due to e.g. irrigation, dams, hydro-power plants, diversion structures, etc. However, most of the sampling points are in ungauged locations. To this aim, we consider empirical period-of-record flow-duration-curves of daily streamflow (FDCs) for ca. 110 gauged sites located in the study area. Each sampling point and gauged site is categorized as undisturbed or disturbed on the basis of qualitative information provided by the regional authorities of Tyrol and South Tyrol. Then, we apply a geostatistical procedure (i.e. Total Negative Deviation Top-kriging, TNDTK) for estimating the unknown undisturbed streamflow regime (i.e. FDCs) at disturbed sites on the basis of the FDCs collected at undisturbed gauged sites. The value of TNDTK for predicting FDCs in ungauged conditions, already known in the literature, is further evidenced by the outcomes of its preliminary application in a leave-one-out cross-validation scheme for undisturbed sites only (i.e. median Nash-Sutcliffe Efficiency for natural and log-transformed FDCs equal to 0.88 and 0.97, respectively). For any gauged disturbed site, the comparison between the observed disturbed FDC and the estimated undisturbed FDC can provide a measure of the degree of disturbance of the streamflow regime. The final aim is to transfer this degree of disturbance from the gauged disturbed sites to the 80 sampling points, for which empirical FDCs are not available due to the lack of continuous daily streamflow data.