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System Dynamics Model for mountain water management and climate change adaptation in the south-eastern Alps

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Water management will increasingly become more important under future climate change conditions. This is particularly relevant for those areas of the world where climate impacts were not expected to be severe and instead are already having large impacts on anthropogenic activities. The Alps are among those areas where climate change is endangering the economic activities relying on abundant water availability. These conditions call for a better understanding of the interplays and dependencies between the anthropogenic activities and the environmental processes that can lead to multiple impacts and finally to water disputes and crisis.
For these reasons, a system dynamics model (SDM) provides a view of interactions and endogenous feedback structures applied to explore hydrological processes for a better water management.
This represents the first step towards the assessment of potential water scarcity affecting strategic Alpine economic sectors (i.e. agriculture, tourism, and hydropower). A SDM has been applied to the Noce river catchment in the Province of Trento (Italy), an Alpine area characterized by an intensive apple production, high winter and summer tourism and large reservoirs for hydropower production.
A statistical analysis, considering both environmental and socio-economic conditions, has been coupled with an SDM, simulating past behaviours of river flow and release operational rules from the main reservoir of the catchment (i.e. S.Giustina). Results show that (i) SDM is a useful tool to replicate past hydrological processes (e.g. river flows and water stored in the reservoir) combining a statistical assessment with a more intuitive graphical representation of the interactions using the Stella software; (ii) rainfall and average temperature have a lower contribution on the prediction of water releases from the S.Giustina reservoir compared to hydro energy price, water volume and water inflow to the reservoir.
Finally, this assessment will be extended including climate change scenarios in order to explore potential future critical conditions in water availability and to identify adaptation measures that can contribute to anticipate climate change impacts.