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Simulating streamflow in a temporary karst river system

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Most of the basins in the Mediterranean Region are characterized by a large spatial gradient in rainfall and temperature and heterogeneity in lithology, soil, and land use. Such environmental factors determine a specific hydrological regime of the river systems that generally includes periods of absence of flow and flash flood events.

In the past decades, several countries in South Europe did not invest resources for the monitoring of the intermittent river systems. Currently, several basins have limited time series of streamflow and water quality data. In addition, it is not rare the case of climate stations not well distributed in the basin as well as the presence of several gaps in the time series.

The lithology and geological features are among the main factors affecting the flow regime, playing a crucial role in groundwater and surface-water interaction and water exchange for which the flow may appear and disappear along with the river network. In such a complex environment, the hydrological and water quality model set up and run may be challenging.

Through a case study, this work aims to face some challenges and to define problem-solving in simulating hydrology in Mediterranean basins. The area is characterized by (i) heterogeneity in lithology with karst areas, (ii) limited flow data availability for calibrating the model, (iii) flow intermittence in the river network. The Soil and Water Assessment Tool (SWAT) was applied to the Canale D'aiedda (Puglia, Italy), a temporary karst river basin under the Mediterranean climate and with limited data availability. Different solutions were tested to simulate the hydrological processes in the karstic areas including both GIS elaborations and model parameters settings and modifications. Among the main parameters, infiltration and transmission losses and soil hydraulic parameters resulted in the most relevant in simulating hydrology in the karst areas. To calibrate the model, a split-in-space procedure was adopted to overcome the limited streamflow measurement availability. Finally, a zero-flow threshold was introduced to predict the number of zero-flow days in the intermittent river reaches, simulating accurately the flow intermittence and the extreme low flow.

The results show that by using specific strategies in setting-up and calibrating the model, the SWAT model is able to simulate daily streamflow with acceptable performances in complex river basins.