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Optimization strategies for drinking water distribution systems under climate change: the study case of the Province of Crotone (Southern Italy)

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Increasing water pressures in terms of demand growth and decreasing availability due to climate change require the adoption of appropriate optimization strategies in order to obtain a correct and efficient water resources management, accounting as much as possible for future water availability scenarios, especially in regions potentially very sensitive to climate change, like Southern Italy.
In this paper, a 1717 km2 area corresponding to the Province of Crotone (Calabria) was analyzed as study case. The Province of Crotone is a territory with an agricultural and tourist vocation and is characterized by a sufficient availability of drinking water, but by an unbalanced distribution. Two optimization solutions, for current and future availability respectively, were achieved by means of an original least-cost optimization model aimed at identifying the proper allocation of drinking water resources. The solution related to current water availability was compared to the optimization solution for the expected reduced availability of water resources projected by the COSMO-Climate Limited-area Modeling (CCLM) Regional Climate Model driven by MPI-ESM-LR using the Representative Concentration Pathway (RCP) 4.5 at a resolution of 0.11° in the context of the EURO-CORDEX initiative. The control period and the climate change scenario considered were 1971-2005 and 2016-2050, respectively.
Climate change analysis showed that reduction in precipitation is significant, and it is amplified in the hydrological outflow. The comparison between the optimization solutions achieved with the climate change scenario and the control period showed: 1) in both cases the need to redefine the big distribution schemes; 2) a significantly different redefinition of the water systems in terms of resource distribution and connections between supply sources and users; 3) the feasibility of climate change adaptation measures, provided that overall water resources availability is still sufficient (such as in the proposed case study) and proper planning actions are adopted.