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High spatial resolution assessment of climate change impact on an Alpine watershed

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Sometimes called the 'water towers of Europe', the Alps play a fundamental role for continental freshwater accumulation and supply, sustaining numerous water-related economic activities, among which energy production and irrigated agriculture. Climate change is expected to severely impact Alpine hydrology over the next decades, with the anticipated impact varying remarkably in space and time as a consequence of the heterogeneous Alpine landscape, local meteorological conditions, differences in altitude, and presence of glaciers. For these reasons, climate-change-induced hydrological projections should be generated at high spatial resolution to assess the distributed impacts of the change on natural processes and socio-economic activities. In this work, we develop a top-down, high spatial resolution, climate change impact assessment on the Adda river-Lake Como watershed, in the Italian Alps. This system is heavily exploited for human activities, including one large multi-purpose regulated lake, multiple hydropower reservoirs, and a wide irrigation-fed agricultural area. Given the high exposure of this system to the changing climate, current water management practices should beware of possible climate change impacts to timely explore flexible adaptation options. To perform a robust and comprehensive analysis, we consider the outputs of different RCPs scenarios simulated by different global and regional climate models from the EURO-CORDEX database. Statistically downscaled climate projections are fed into Topkapi-ETH model, a high resolution, distributed, physically hydrological model that is used to reproduce the basin response to climate change. Topkapi-ETH simulations provide spatially distributed projections of inflows to the lake and the hydropower reservoirs, glacier thickness, evapotranspiration, and snow water equivalent volume. Inflow time series are used to assess the future impact of climate change on the hydropower reservoirs, lake Como and the irrigation districts downstream. Topkapi-ETH simulations provide spatially distributed projections of inflows to the lake and the hydropower reservoirs, glacier thickness, evapotranspiration, and snow water equivalent volume, ultimately informing about the expected water availability for the different activities in the basin.