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Blending Pan-European and local hydrological models for water resource assessment in Mediterranean areas: lessons learnt from a mountainous catchment

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Global hydrological models provide scientists and technicians with distributed data over medium to large areas from which assessment of water resource planning and use can be easily performed. However, scale conflicts between global models' spatial resolution and the local significant spatial scales in heterogeneous areas usually pose a constraint for the direct use and application of these models' results. The SWICCA (Service for Water Indicators in Climate Change Adaptation) Platform developed under the Copernicus Climate Change Service (C3S) offers a wide range of both climate and hydrological indicators obtained on a global scale with different time and spatial resolutions. Among the different study cases supporting the SWICCA demonstration of local impact assessment, the Sierra Nevada study case (South Spain) is a representative example of mountainous coastal catchments in the Mediterranean region. This work shows the lessons learnt during the study case development to derive local impact indicator tailored to suit the local end-users of water resource in this snow-dominated area.
Different approaches were followed to select the most accurate method to downscale the global data and variables to the local level in a highly abrupt topography, in a sequential step approach. 1) SWICCA global climate variable downscaling followed by river flow simulation from a local hydrological model in selected control points in the catchment, together with 2) SWICCA global river flow values downscaling to the control points followed by corrections with local transfer functions were both tested against the available local river flow series of observations during the reference period. This test was performed for the different models and the available spatial resolutions included in the SWICCA platform. From the results, the second option, that is, the use of SWICCA river flow variables, performed the best approximations, once the local transfer functions were applied to the global values and an additional correction was performed based on the relative anomalies obtained instead of the absolute values. This approach was used to derive the future projections of selected local indicators for each end-user in the area under different climate change scenarios.
Despite the spatial scale conflicts, the SWICCA river flow indicators (simulated by the E-HYPEv3.1.2 model) succeeded in approximating the observations during the reference period 1970-2000 when provided on a catchment scale, once local transfer functions and further anomaly correction were performed. Satisfactory results were obtained on a monthly scale for river flow in the main stream of the watershed, and on a daily scale for the headwater streams. The accessibility to the hydrological model WiMMed, which includes a snow module, locally validated in the study area has been crucial to downscale the SWICCA results and prove their usefulness.