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Future occurrence and magnitude of flood events in the Panaro River (Northern Italy): coupling bias-corrected hourly climate scenarios and semi-distributed rainfall-runoff modelling

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The evaluation of the resilience of flood protection systems requires the assessment of the impact of climate change scenarios on future flood regimes. Due to the high computational effort and to the scarcity of hourly climate modelling chains, expected changes in future floods are often simulated by hydrological models on a daily basis, even for basins with short response times, where hourly simulations would be needed.

In this work, the expected occurrence and magnitude of future flood events is modelled through the coupling of bias-corrected local climate scenarios at hourly time scale and continuous rainfall-runoff modelling, in reference to the Panaro river (one of the OpenAir Laboratories in the OPERANDUM H2020 project), a tributary of the Po River in the Apennines.

The investigation exploits hourly precipitation and daily max/min temperature (used for interpolation at hourly scale) timeseries for a subset of climate modelling chains included in the EURO-CORDEX initiative through the dynamical downscaling of Global Climate Models under the RCP 8.5 concentration scenario. The comparison with observed spatial fields obtained from weather stations and from gridded E-OBS products allows to assess the biases affecting the climate raw data.

The Scaled Distribution Mapping (SDM) bias correction procedure (Switanek et al. 2017), that preserves raw climate model projected changes in the bias-corrected series, is then applied to adjust the raw model output towards observations.

A semi-distributed, continuously simulating rainfall-runoff model is parameterised on the basis of the observed meteorological and streamflow time-series, especially focusing on the reproduction of past flood events. The model is then run to reproduce the continuous hourly streamflow time-series in the Panaro river over past and future decades, providing in input i) observed meteorological forcing based on ground stations, ii) raw and bias-corrected climate scenarios over the control period, iii) bias-corrected climate scenarios for the future decades. Finally, the flood events are extracted from the continuous streamflow simulations and the changes in the flood signals expected over the future decades are analysed, in terms of both peaks and volumes.

References

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