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The impact of using bias-corrected precipitation in estimating extreme discharge: A study over the Italian Territory

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A common way to study the impact of climate change on water resources is through hydrological models fed by precipitation from global or regional climate models (GCMs and RCMs, respectively). However, precipitation from climate models is usually affected by systematical biases that may produce inadequate streamflow estimations. For this reason, users find it necessary to apply some bias-corrected technique to reduce errors in precipitation before its use in hydrological simulations. Among the different methods, quantile mapping (QM) is a widely used method as it has shown satisfactory results for historical conditions.

In recent years, several studies have investigated the QM method, with a focus on mean precipitations. However, it remains quite uncertain how bias-corrected precipitation modifies river discharges, particularly the extreme discharges on a sub-daily timescale. In this framework, this study aims to quantify differences between simulated river discharges using corrected and uncorrected precipitation to feed a hydrological model in the context of flood hazard assessment in Italy.

To adequately estimate flood events, high spatiotemporal resolution data are required. Therefore, sub-daily precipitation outputs from the ICTP RegCM Regional Climate Model driven by the HadGEM2-ES model at 12 km were contemplated in this study. Precipitation outputs for the period 1976-2100 were bias-corrected concerning the observations from GRIPHO, which is a high-resolution observational product. Then, bias-corrected and uncorrected precipitations were used to feed the CETEMPS Hydrological Model (CHyM) completing thus, a set of hydrological simulations covering the entire Italian Territory, in both present-day and future conditions. Analyses focused on the comparison between simulated and observed discharges for present-day conditions, but also on the comparison between corrected and uncorrected values in the future.

The results of this study could provide valuable information on whether the use of the QM method is appropriate for studying extreme discharges on a sub-daily scale, an essential issue for assessing the impacts of climate change on extreme hydrological events.

Keywords: flood hazard assessment, quantile delta mapping, CHyM model, RegCM model, Italy

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