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Exploring the role of observational uncertainty and resolution mismatch in the application of bias adjustment methods

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Systematic biases in climate models hamper their direct use in impact studies and, as a consequence, many bias adjustment methods, which merely correct for deficiencies in the distribution, have been developed. Despite adjusting the desired features under historical simulations, their application in a climate change context is subject to additional uncertainties and modifications of the change signals, especially for climate indices which have not been tackled by the methods. In this sense, some of the commonly-used bias adjustment methods allow changes of the signals, which appear by construction in case of intensity-dependent biases; some others ensure the trends in some statistics of the original, raw models. Two relevant sources of uncertainty, often overlooked, which bring further uncertainties are the sensitivity to the observational reference used to calibrate the method and the effect of the resolution mismatch between model and observations (downscaling effect).

In the present work, we assess the impact of these factors on the climate change signal of a set of climate indices of temperature and precipitation considering marginal, temporal and extreme aspects. We use eight standard and state-of-the-art bias adjustment methods (spanning a variety of methods regarding their nature -empirical or parametric-, fitted parameters and preservation of the signals) for a case study in the Iberian Peninsula. The quantile trend-preserving methods (namely quantile delta mapping -QDM-, scaled distribution mapping -SDM- and the method from the third phase of ISIMIP -ISIMIP3) preserve better the raw signals for the different indices and variables (not all preserved by construction). However they rely largely on the reference dataset used for calibration, thus present a larger sensitivity to the observations, especially for precipitation intensity, spells and extreme indices. Thus, high-quality observational datasets are essential for comprehensive analyses in larger (continental) domains. Similar conclusions hold for experiments carried out at high (approximately 20km) and low (approximately 120km) spatial resolutions.