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Post-treatment of calibrated model parameters to ensure transferability in a changing climate: an experiment based on a 122 catchments set

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Long time-series of climate forcings and runoff observations can be used to diagnose one of the most complex issues in hydrological model parameterization: the temporal and climatic transferability of parameters. We started this analysis with a set of 600 catchments in France and Australia and two parsimonious precipitation-runoff models (GR4J and Mordor6). By focusing on the correlations between climatic conditions and model error, we identified a sub-group of 122 catchments where simulation biases are correlated with changes in mean air temperature between calibration and validation periods.
We analyse specifically these 122 catchments, and study how the parameters involved in the water balance adjustment also vary with temperature changes. From these results, we test the delta change approach as a post-treatment on these parameters, to assess whether it could help suppress the dependency between climate and model error.
A procedure was therefore built to establish a relationship linking parameters variations and temperatures changes on half of the 122 catchments. This regression was then used on the other half to post-treat models parameters after calibration. Results show a slight improvement of models robustness for GR4J and a more significant improvement for Mordor6, where average performances errors remain stable for all temperature differences between periods. Validation biases reaching an average of 20% for highest temperature gaps without parameters correction remain centred around 0% for Mordor6 when the procedure is used.
Although we recognize that post-treatment as a curative measure is conceptually inferior to a preventive measure, this work shows how robustness issues can sometimes be controlled if an appropriate diagnosis scheme is implemented.