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Uncertainty of precipitation reference dataset for climate change impact studies

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Abstract.

Climate change impact studies typically require a reference climatological dataset providing a baseline period to assess future changes. The reference dataset is also used to perform bias correction of climate model outputs. Various reliable precipitation datasets are now available over regions with a high-density network of weather stations such as over most parts of Europe and in the United States. In many of the world's regions, the low-density of observation stations (or lack thereof) renders gauge-based precipitation datasets highly uncertain. Satellite, reanalysis and merged products can be used to overcome this limitation. However, each dataset brings additional uncertainty to the reference climate. This study compares ten precipitation datasets over 1091 African catchments to evaluate dataset uncertainty contribution in climate change studies. The precipitation datasets include two gauged-only products (GPCC, CPC), four satellite products (TRMM, CHIRPS, PERSIANN-CDR and TAMSAT) corrected using ground-based observations, three reanalysis products (ERA5, ERA-I, and CFSR) and one merged product of gauge, satellite, and reanalysis (MSWEP).

Each of those datasets was used to assess changes in future streamflows. The climate change impact study used a top-down modelling chain using 10 CMIP5 GCMs under RCP8.5. Each climate projection was bias-corrected and fed to a lumped hydrological model to generate future streamflows over the 2071-2100 period. A variance decomposition was performed to compare GCM uncertainty and reference dataset uncertainty for 51 streamflow metrics over each catchment. Results show that dataset uncertainty is much larger than GCM uncertainty for most of the streamflow metrics and over most of Africa. A selection of the best performing reference datasets (credibility ensemble) significantly reduced the uncertainty attributed to datasets, but remained comparable to that of GCMs in most cases. Results show also relatively small differences between datasets over a reference period can propagate to generate large amounts of uncertainty in the future climate.