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Circulation based precipitation bias in a climate model ensemble using Maximum Covariance Analysis

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This study elaborates on an integrated bias correction approach for regionally specific precipitation in the Rhine basin from a climate model ensemble considering circulation statistics and natural variability. Appreciating different causes for the precipitation bias in climate models allows for a conditional bias correction, retaining as much as possible the fraction of the modeled signal.

We first evaluate the ability of the climate ensemble model to reproduce observed circulation statistics that are linked to the precipitation variability in the Rhine basin for the period 1979 - 2008. The significant circulation patterns are defined through the Maximum Covariance Analysis (MCA), associating large-scale sea level pressure distribution (ERA-Interim) with local precipitation data (CHR08). MCA identifies pairs of coupled spatial patterns, with each pattern explaining a fraction of the covariance between these two fields.

Second, we explore the bias present in the precipitation model outputs per circulation pattern. The precipitation bias per circulation regime is described through quantile investigation for 3 zonal regions of the Rhine: North, Central and Alpine. This choice is motivated by the possible differences in the precipitation distribution following the flow of the river from the south to the north and meridional gradients in topography.

In conclusion, this analysis provides an insight to the connection between biases in the precipitation outputs and different circulation mechanism per region. It is illustrated what the added value of a bias correction conditioned on circulation characteristics is.