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The VALUE perfect predictor experiment of statistical downscaling methods: process-based evaluation

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Statistical downscaling methods (SDMs) are techniques used to downscale and/or bias correct climate model results to regional or local scales. The European network VALUE developed a framework to evaluate and intercompare SDMs. One of VALUE's experiments is the perfect predictor experiment that uses reanalysis predictors to isolate downscaling skill. Most evaluation papers for SDMs employ simple statistical diagnostics and do not follow a process-based rationale. Thus, in this paper, a process-based evaluation has been conducted for the more than 40 participating model output statistics (MOS, mostly bias correction) and perfect prognosis (PP) methods, for temperature and precipitation at 86 weather stations across Europe.
The SDMs are analysed following the so-called "regime-oriented" technique, focussing on relevant features of the atmospheric circulation at large to local scales. These features comprise the North Atlantic Oscillation, blocking and selected Lamb weather types and at local scales the bora wind and the western Iberian coastal-low level jet.
The representation of the local weather response to the selected features depends strongly on the method class. As expected, MOS is unable to generate process sensitivity when it is not simulated by the predictors (ERA-Interim). Moreover, MOS often suffers from an inflation effect when a predictor is used for more than one station. The PP performance is very diverse and depends strongly on the implementation. Although conditioned on predictors that typically describe the large-scale circulation, PP often fails in capturing the process sensitivity correctly. Stochastic generalized linear models supported by well-chosen predictors show improved skill to represent the sensitivities.

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