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Added value and signal-to-noise in an eight-member ensemble of the KNMI regional climate model RACMO2 at 12 km resolution.

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Projections of future climate derived from multi-model ensembles with regional climate models, like those in CORDEX, often show large changes at regional (10-500 km) scales, in particular for precipitation. However, the inter-model differences in such ensembles are often of the same size. It is therefore not clear which part of the regional/local information from these regional climate model integrations can be trusted, and for users of climate information this is an undesirable situation. Thus, it is important to determine the cause of the inter-model differences within these multi-model ensembles. In general, three main causes can be distinguished: i) differences in future emissions (uncertainty in the forcing), ii) differences in modeling the response to this forcing (uncertainty in the climate models), and iii) differences due to natural variations not related to the forcing (natural variability). In multi-model ensembles, such as those in CORDEX, where different regional models are driven by different global climate models with different emission scenarios it is difficult to unravel the cause of differences in the projected changes. Here, we therefore investigated an eight-member ensemble with the regional climate model RACMO2 driven by one global climate model (EC-EARTH) using one emission scenario (RCP8.5). In this ensemble inter-model differences are solely attributed to natural variations. We determined the size of these natural variations compared to the forced climate change signal (defined as the average response over all ensemble members). In particular, we investigated whether the forced climate change signal contains persistent small scale features that would not be captured in the GCMs output ("added value"). Within a perfect model approach we also investigated whether these small scale structures can be reliably estimated from a limited number of model simulations.