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Scale-separation diagnostics and the Symmetric Bounded Efficiency for the inter-comparison of precipitation reanalyses

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The ERA5 global reanalysis has been compared against a high-resolution regional reanalysis (COSMO-REA6) by means of scale-separation diagnostics based on 2d Haar discrete wavelet transforms. The presented method builds upon existing methods and enables the assessment of bias, error and skill for individual spatial scales, separately. A new skill score (evaluated against random chance) and the Symmetric Bounded Efficiency are introduced. These are compared to the Nash-Sutcliffe and the Kling-Gupta Efficiencies, evaluated on different scales, and the benefits of symmetric statistics are illustrated. As expected, the wavelet statistics show that the coarser resolution ERA5 products underestimate small-to-medium scale precipitation compared to COSMO-REA6. The newly introduced skill score shows that the ERA5 control member (EA-HRES), despite its higher variability, exhibits better skill in representing small-to-medium scales with respect to the smoother ensemble members. The Symmetric Bounded Efficiency is suitable for the intercomparison of reanalyses, since it is invariant with respect to the order of comparison.