Rossby wave activity associated with Euro-Atlantic weather regimes in the PRIMAVERA historical runs.

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In this study we aim to assess how the upper tropospheric Rossby wave activity is represented in the PRIMAVERA models. The low and high resolution historical coupled simulations will be compared with ERA5 reanalysis (spanning the 1979-2014 period) to enlighten model deficiencies in representing the spatial distribution and temporal evolution of Rossby wave activity and to emphasize the benefits of increased resolution. Our analysis focuses on the wintertime large scale circulation over the Euro-Atlantic sector.

A diagnostic based on Local Wave Activity (LWA) in isentropic coordinates is used to identify Rossby waves and to quantify their amplitude. LWA is partitioned into its stationary and transient components, to distinguish the contribution from planetary versus synoptic scale waves (i.e. wave packets). This diagnostic is then combined with another one to identify persistent and recurrent large scale circulation patterns, the so called weather regimes. Weather regimes in the Euro-Atlantic sector are identified with the usual approach of EOF decomposition and k-mean clustering applied to daily anomalies of Montgomery streamfunction, in order to have a consistent framework with LWA (which is defined in isentropic coordinates). A composite of transient LWA is realised for each weather regime to obtain the spatial distribution of Rossby wave activity associated with each weather regime.

Results show a marked intermodel variability in the ability of reproducing the correct (i.e. the one observed in reanalysis data) LWA distribution. Many of the models in fact fails to reproduce the localized (in space) maxima of LWA associated with each weather regime and to distribute LWA over a larger region compared to reanalysis. High resolution helps to correct this bias in the majority of the models, in particular in those where the low-resolution LWA distribution was already close to reanalysis. Finally, the temporal behaviour of the spatially averaged LWA in the examined period is discussed.