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Representation of blocking in a multi-model ensemble of high-resolution coupled global climate models

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Global climate models (GCMs) suffer from long-standing biases in the representation of atmospheric blocking. Despite recent improvements attributed to increases in horizontal and vertical resolution, and to improved sea surface temperature forcing of the atmosphere in coupled models, state-of-the-art GCMs continue to considerably underestimate blocking occurrence.

In this study, the representation of blocking is evaluated in a new multi-model ensemble of high-resolution simulations. These simulations are conducted as part of the PRIMAVERA project (PRocess-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment), the European contribution to CMIP6-HighResMIP. They are driven by historical forcings during 1950-2014 and both uncoupled (atmosphere-land) and coupled (atmosphere-land-ocean-sea ice) simulations are available. These simulations are designed to test the impact of atmosphere and ocean resolution on the quality of the simulated climate. For each of the six models in the ensemble, at least one high-resolution simulation (typically 25 km grid spacing in the atmosphere and 1/4° resolution in the ocean) is carried out. Lower-resolution counterparts are also available, and re-tuning between the different resolution versions of a given model is kept to a minimum.

Here, a baseline assessment of the representation of blocking in these simulations will be presented using both a one-dimensional and a two-dimensional index of atmospheric blocking. Despite large internal variability, preliminary results show that higher resolution is generally beneficial for the representation of blocking. For example, winter blocking in the Atlantic/European sector continues to be underestimated in all models, yet with the two-dimensional index used here, the blocking frequency in most high-resolution models is about 80% of that seen in a reanalysis-based blocking climatology. The improvement with resolution is larger in coupled than in atmosphere-only models, and appears to concern primarily the geographical pattern of the blocking climatology, whereas the climatological blocking frequency and persistence remain considerably underestimated also in the high-resolution ensemble.