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The representation of Northern Hemisphere blocking in current global climate models

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Global Climate Models (GCMs) are known to suffer from biases in the simulation of atmospheric blocking, and this study provides an assessment of how blocking is represented by the latest generation of GCMs. It is evaluated (i) how historical CMIP6 (Climate Model Intercomparison Project Phase 6) simulations perform compared to CMIP5 simulations, and (ii) how horizontal model resolution affects the simulation of blocking in the CMIP6-HighResMIP (PRIMAVERA) model ensemble, which is designed to address this type of question. Two blocking indices are used to evaluate the simulated mean blocking frequency and blocking persistence for the Euro-Atlantic and Pacific regions in winter and summer against the corresponding estimates from atmospheric reanalysis data. There is robust evidence that CMIP6 models simulate blocking frequency and persistence better than CMIP5 models in the Atlantic and Pacific and in winter and summer. This improvement is sizeable so that, for example, winter blocking frequency in the median CMIP5 model in a large Euro-Atlantic domain is underestimated by 32 % using the absolute geopotential height (AGP) blocking index, whereas the same number is 19 % for the median CMIP6 model. As for the sensitivity of simulated blocking to resolution, it is found that the resolution increase, from typically 100 km to 20 km grid spacing, in the PRIMAVERA models, which are not re-tuned at the higher resolutions, benefits the mean blocking frequency in the Atlantic in winter and summer, and in the Pacific in summer. Simulated blocking persistence, however, is not seen to improve with resolution. Our results are consistent with previous studies suggesting that resolution is one of a number of interacting factors necessary for an adequate simulation of blocking in GCMs. The improvements reported in this study hold promise for further reductions in blocking biases as model development continues.