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Euro-Atlantic climate variability in High-Resolution GCMs: improving atmospheric blocking for the wrong reasons

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The numerical simulation of the mid-latitude climate, in particular over the Euro-Atlantic region, still represents a main concern for the climate modeling community. We here present the Northern Hemisphere winter atmospheric blocking representation in a set of 30 year atmosphere-only simulations using the EC-Earth GCM at five different horizontal resolutions (from 125 to 16 km). Results show that the negative bias in blocking frequency over Europe becomes negligible at resolutions of about 40 and 25 km. A combined effect by the more resolved orography and by a change in tropical precipitation is identified as the source of an upper tropospheric planetary wave. At the same time, a weakening of the meridional temperature gradient reduces the upper level baroclinicity and the zonal mean winds. Following these changes, in the high-resolution configurations the Atlantic eddy-driven jet stream is weakened favoring the breaking of synoptic Rossby waves over the Atlantic ridge and thus increasing the simulated European blocking frequency. However, at high-resolution the Atlantic jet stream is too weak and the blocking duration is still underestimated. This suggests that the optimal blocking frequencies are achieved through compensation of errors between eddies found at upper levels (too strong) and eddies at lower levels (too weak). This also implies that eddies are not necessarily better represented at high resolution.