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Future change and its uncertainty in atmospheric blocking

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In this study, the future change in the wintertime Northern Hemisphere atmospheric blocking was investigated using 20-km, 60-km, 120-km, and 180-km mesh Japan Meteorological Agency (JMA) / Meteorological Research Institute (MRI) Atmospheric General Circulation Model (AGCM)s. We focused on the frequency and the duration of the blocking for the Northern Hemisphere winter (December – February) in the present-day (1979–2003), the near future (2015-2039), and the future (2075–2099) climates. Also, in order to estimate uncertainty in the future projection of the blocking, Sea surface temperature (SST) and initial value ensemble simulations were conducted using a 60-km mesh AGCM.

In the present-day climate, the 20-km model shows a good agreement with the Japanese reanalysis (JRA25) in respect to the Euro-Atlantic blocking frequency. The higher the horizontal resolution is, the better the blocking frequency is simulated. The 20-km model can simulate the long-lived blocking well, whereas the lower-resolution models cannot sufficiently simulate the long-lived blocking. On the other hand, the horizontal resolution might not be important for the simulation of the Pacific blocking. The 180-km model simulates the Pacific blocking frequency well, whereas the higher-resolution models tend to overestimate it.

In the near future climate, the Euro-Atlantic and the Pacific blocking frequencies are likely to decrease slightly. The decrease might depend on the climate sensitivity of AGCM. There is a possibility that the blocking frequencies do not change.

In the future climate, the Euro-Atlantic and the Pacific blocking frequencies are likely to decrease. In particular, the significant decreases tend to appear at the west of the peak of the Euro-Atlantic and the Pacific blocking frequencies. The ensemble simulations have revealed that the more the global warming proceeds, the more the Euro-Atlantic and the Pacific blocking frequencies decrease. The number of the Euro-Atlantic blocking decreases in all categories of durations, whereas that of the Pacific blocking decreases particularly in categories of long durations.