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Northern Hemisphere atmospheric blocking in 228-year ensemble simulation with the MRI-AGCM3.2

Mio MATSUEDA[1*], Hirokazu ENDO[2]

[1]JAMSTEC, [2]MRI

In this study, we conducted 228-year ensemble integration using a 60-km-mesh MRI-AGCM (TL319L64). Model integration was conducted for the period 1872-2099 using observed and prescribed, interannually varying SSTs as lower boundary conditions. The prescribed SST was estimated by the CMIP3 multi-model ensemble mean to which the detrended interannual variations in HadISST have been added. The IPCC SRES A1B scenario was assumed for future emissions of greenhouse gases. We focused on Euro-Atlantic (EA) and Pacific (PA) atmospheric blockings in winter (November-February) and summer (May-August).

The TL319L64 AGCM performs well in simulating the blocking frequency and duration throughout the year, compared with the NCEP/NCAR reanalysis data for the period 1950-2005. It is known that there are significant relationships between PA blocking and the El Nino(EL)/La Nina(LA) conditions: wintertime western PA blocking is observed more frequently during the LA condition than during the EL condition, whereas wintertime eastern PA and summertime PA blockings are observed more frequently during the EL condition than during the LA conditions. The relationships between the PA blocking and the EL/LA conditions are well simulated for the period 1950-2005. No apparent relationships between EA blocking and the EL/LA conditions are observed and simulated for the period 1950-2005.

In terms of the timeseries of simulated areal-mean blocking frequency for the period 1872-2099, the wintertime EA blocking frequencies show the most remarkable decreasing trend, whereas the summertime EA blocking frequencies show a decrease trend mainly in the 21st Century. Given that EL condition is predicted to be preferable in the future climate and that there are no possible relationships between the EA blocking and the EL/LA conditions, the reduction in the EA blocking frequency might result from other possible reasons. On the other hand, the wintertime western and eastern PA blocking frequencies show decreasing and increasing trends for the period 1872-2099, respectively. The trends in the PA blocking frequency might be related to preferable EL condition in the future climate, unlike that in the EA blocking frequency.

Keywords: high-resolution climate model, atmospheric blocking, extreme events, long-term variation