A regime view of future atmospheric circulation changes in Northern mid-latitudes

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Abstract

Future changes in the mid-latitude wintertime atmospheric circulation are studied from a weather regimes perspective. The analysis is based on daily geopotential height at 500 hPa during the extended winter season (NDJFM) from both CMIP5 and CMIP6 historical and scenario simulations. The model performance in reproducing the observed weather regimes during the historical period in the Euro-Atlantic (EAT) and Pacific-North American (PAC) sectors is first evaluated, showing a general improvement of CMIP6 models in terms of regime patterns, frequencies and variance ratio.
The projected circulation changes in the future climate (2050-2100) under the different scenarios are analysed in terms of the change in the frequency and persistence of the regimes. Significant positive trends are found for the frequency of NAO+ and negative trends for the Scandinavian Blocking and Atlantic Ridge regimes. This confirms the tendency for the zonalization of the circulation in the EAT sector, with decreased latitudinal variability of the jet stream. For the PAC sector, significant changes are seen for the Pacific Trough regime (increase) and the Bering Ridge (decrease), while there is no agreement in the response of the two PNA regimes. The spread among the model responses in the most extreme scenarios is analysed through a multi-linear regression approach and linked to different levels of warming in the polar stratosphere, the tropical upper troposphere, the North Atlantic and the Arctic.

Keywords: mid, latitude, large scale circulation, CMIP6

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