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# A model study of non-stationary relations between teleconnections in the climate system

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The influence of prominent patterns of climate variability on the regional and global climate and their potential connections are examined by using the millennium simulations of the Max Planck Institute for Meteorology Earth System Model (MPI-ESM). Specifically, the North Atlantic Oscillation (NAO), the El Niño-Southern Oscillation (ENSO), the Pacific decadal oscillation (PDO) and the Pacific North American pattern (PNA) are considered. Firstly, the performance of the model in simulating the observed features of these climate modes was examined. Secondly, it was considered whether there are possible links between these patterns and how they might be connected over annual to centennial time scales. The results demonstrate the prominent skill of MPI-ESM in simulating dominant climate patterns. The results from both reanalysis and modelled data show that NAO and ENSO strongly influence the global climate system, including surface circulation, surface temperature, regional precipitation and circulation at troposphere level. Besides, the model results support the idea that NAO and ENSO show low correlation in winter with several short periods of strong correlation. Moreover, the PNA may play a considerable role in the link between NAO and ENSO. Furthermore, if there is a connection between NAO and ENSO via the troposphere of the North Pacific and North Atlantic, it is suggested that the NAO events are forced by the ENSO rather than vice versa. The influence of North Atlantic sea surface temperature anomalies (SSTNA index) on NAO variability in the North Atlantic sector and the relationship between ENSO and PDO in the Pacific region is confirmed to be significant and stationary in different periods of the past millennium. However, these teleconnections are stronger at seasonal to annual time scales than at decadal time scale. These results suggest that model information is potentially useful in seasonal to annual forecasting based on analyses of prominent climate modes.

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