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How is the extratropical circulation affected by reduced Atlantic and Pacific land-sea thermal contrast?

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Long-term projections of the future climate display a robust reduction of winter land-sea thermal contrast in the Northern Hemisphere (NH), caused by a faster warming of the cold continents compared to the warm oceans. The reduction is expected to be strong in the extratropics, a region where the thermal contrast is relevant for maintaining the strong baroclinicity near the western coasts of the continents and for shaping the NH jets and large-scale stationary waves.

In this work idealised perpetual-winter experiments characterised by a reduced land-sea thermal contrast are compared to control simulations featuring a thermal contrast similar to that observed in present-day climate. We use an intermediate-complexity AGCM with prescribed sea-surface and land temperatures. Warm temperature anomalies in East Asia and/or North America set a reduced thermal contrast in the whole NH or in individual NH sectors. We find that the Pacific-sector land-sea thermal contrast is by far more important than the Atlantic one for the large-scale mid-latitude circulation, as it impacts strongly the jet streams and the stationary planetary waves. While the local effects are coherent with the changes in baroclinicity brought by the surface forcing, the remote effects seem to be mediated by the response of the thermal and orographic components of the stationary waves. Based on the idealised-modelling results it is possible to hypothesise how the projected change in winter land-sea thermal contrast influences climate scenarios for the end of the XXI century. This factor has been rarely considered as a possible source of dynamical changes for the mid-latitude winter season.