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The organization of the atmospheric flow during the Last Glacial Maximum. Results of a climate simulation

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The aim of this study is to gain a deeper understanding of the atmospheric flow during the Last Glacial Maximum (LGM). Therefore, a simulation is performed with the complex Earth System Model COSMOS (COmmunity earth System MOdelS) according to the Paleoclimate Modeling Intercomparison Project 3 (PMIP3) protocol for the LGM. The analysis focuses on the atmospheric response to the increased mid-latitude meridional temperature gradient.

The temperature response of the COSMOS simulation is in the range of the PMIP1 and PMIP2 simulations. The cooling is comparably strong and an intense mid-latitude meridional temperature gradient is found. The global circulation displays a stronger and narrower North Atlantic jet stream which is slightly shifted equator-wards.

The increased sea-ice cover and the presence of the Laurentide ice-sheet and thus higher orography, induce a stationary wave atop Canada, which leads to a southward shift of the jet stream over Newfoundland and a narrower storm-track in the western North Atlantic. The North Atlantic synoptic activity is enhanced during the LGM w.r.t. the preindustrial climate, while the North Pacific synoptic activity decreased. More precisely, an extension to the eastern part of the North Atlantic storm-track is shown.

During the LGM the heat and energy transport is mainly associated with the standing low frequent short wave in the Atlantic sector. Most of the wave variance decreased. Thus, there are much less eastward travelling high frequency short waves at high latitudes (around 60°N) and more standing high frequency long waves at lower latitudes (around 45°N). Hence the circulation is characterized by shorter standing waves during the LGM with respect to the PI period. In contrast to the Pacific region, the Atlantic sector was dominated by standing waves. Both regions are characterized by a strong decreased propagating wave variance. In sum, the short standing wave over Newfoundland increased the meridional heat and momentum transport and thereby reduced the synoptic scale wave variance.