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Different response of the Northern and Southern Hemisphere climates to obliquity and precession

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The climate response of different latitudes in both Northern (NH) and Southern (SH) Hemispheres to the astronomical parameters during MIS-13 around 500 ka BP is studied using numerical simulation with the LOVECLIM model. A more than 90,000-year long transient simulation starting from 511 ka BP is performed with varying insolation forcing. The results of surface air temperature (SAT), sea surface temperature (SST) and sea ice are analyzed. Our results show that in the NH, precession plays a dominant role on sea ice mainly due to its response to the local summer insolation. In addition, the Arctic sea ice is also influenced, but to a lesser degree, by the northward oceanic heat transport (mainly via the Atlantic meridional overturning circulation). Precession plays also a dominant role on the SAT and SST, especially at low latitudes where vegetation, sea ice feedbacks, and also meridional oceanic heat transport are all involved. Compared to low latitudes, middle and high latitudes are more influenced by obliquity. This is partly due to the increased role of obliquity on the daily insolation towards the high latitudes, but it is also due to the increased role of the atmospheric heat transport on SAT at high latitudes. The climate response in the SH is obviously different from the response in NH. In the SH, obliquity plays a dominant role on sea ice. First, a smaller obliquity leads to lower insolation in high latitudes and finally to a cooling and more sea ice formation. Second, a smaller obliquity leads to larger latitudinal temperature and pressure gradients, and then to stronger westerly winds, which cool the sea surface and leads to more sea ice formation in the Southern Ocean. Precession is dominant in the SAT at the SH low latitudes and the driving mechanism is the same as in the NH. More details on the atmospheric and oceanic processes and feedbacks will be presented.