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The influence of orbital configurations on Northern Hemisphere ice sheet evolution during MIS 13 with a coupled climate-ice sheet model

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Antarctic ice core and deep ocean sediment core records imply that the interglacial climate during Marine Isotope Stage 13 (MIS 13) was relatively cold, and ice sheets were likely larger than today. We model the MIS 13 climate with a coupled climate-ice sheet model AWI-ESM1.2-LR under different orbital configurations at 495, 506 and 517 kyr BP. Summer insolation at 65 °N at 495 kyr BP is similar to the preindustrial, but the lower greenhouse gas values lead to an ice sheet buildup relative to today. Boreal summer at perihelion at 506 kyr BP causes a warmer summer over Northern Hemisphere continents, inhibiting the development of Northern Hemisphere ice sheets. Lower obliquity induces cooling over the polar regions and is favorable for the ice sheet buildup. Aside from the polar regions, mountains with high elevation also have favorable conditions for ice sheet buildup. The Cordilleran Ice Sheet is more sensitive and has a faster response to boreal summer insolation change than the other large scale Northern Hemisphere ice sheets. This indicates that different ice sheets might have different development processes. In addition, ice sheets do not build up over northeastern North America and Eurasia in our simulations. In our final set of simulations, we address the multi-stability of the ice sheets which could be a reason for causing this phenomenon.