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Hypersensitivity of modeled ice sheet complexes at the last glacial maximum to climate model resolution

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Modeled geometries of continental-scale ice sheets depend strongly on the applied climate forcing. In paleoglacial modeling studies, the uncertainties in the external forcing are especially large, and one is forced to use various combinations of paleoclimate proxy records with present-day observational climate datasets or products of climate model intercomparison initiatives that often suffer from low spatial resolution. In this study we explore the sensitivity of the modeled geometries of Northern Hemisphere ice sheet complexes during the last glacial maximum (LGM) to climate input resolution. We perform an ensemble of LGM ice sheet simulations forced by near-surface climate fields from global climate simulations conducted at three different resolutions (T31, T42 and T85). While ice-sheet simulations driven by highest-resolution climate fields (T85, 1.4º) arrive at ice sheet geometries that are largely consistent with available geomorphological constraints, the use of the lower-resolution model outputs (T31, 3.75º and T42, 2.8º) either inhibits the growth of the documented ice masses or triggers an undocumented ice sheet buildup. The modeled geometry of the Eurasian Ice Sheet appears to be especially sensitive to the decreases in the climate forcing resolution. When forced by low-resolution fields, the ice sheet fails to extend to the British Isles and gains too much volume across Northern Eurasia. We demonstrate that this is the result of important differences between the three climate model solutions that diverge across large portions of the North Atlantic and the Arctic. Our study indicates that such deficiencies of the low-resolution climate experiments cannot be corrected by the use of local down-scaling techniques.