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MIS 7 and MIS 5 glacial inceptions: investigating the asynchronous build-up of Laurentide and Eurasian ice sheets

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During the last glacial cycle, the Laurentide ice sheet was larger than the Eurasian ice sheet. According to ICE-5G multi-proxy and methods reconstruction (Peltier, 2004), the Laurentide was ~ 5 times larger than its Eurasian counterpart (~ 74 m and ~ 17 m Sea Level Equivalent, SLE, respectively. Eustatic sea level was ~ -130 m) while a more recent study based on marine δ18O isotope suggests a smaller difference (Bintanja, 2008). On the contrary, during the penultimate glacial cycle (~245 - 126 kiloyears BP, kyrs BP), the Eurasian ice sheet reached its maximum Quaternary extent (Svendsen et al. 2004). Its volume is estimated to be ~ 60 m SLE based on numerical reconstructions (Lambeck, 2006; Peyaud 2006, Colleoni et al., 2009) implying a smaller ice volume over North America to be consistent with the eustatic sea level (~ -128 m, Waelbroeck et al. 2002). The notion of asynchronous build-ups over North America and Eurasia is supported by recent model estimates of North American and Eurasian ice volume evolution over the last three million years (Bintanja, 2008) which clearly shows a shift in ice volume distribution between the two ice sheets during the penultimate glacial cycle. Before 250 kyrs BP, it seems that the Laurentide ice sheet was always smaller than the Eurasian component. Indeed, the absence of glacial landscape traces from older glacial cycles in North America suggests that the Laurentide ice sheet reached its largest Quaternary extent during LGM, destroying the previous traces of ice dynamics. What could have caused this change in ice distribution over the Northern Hemisphere? A recent study modelling the last glacial inception (~116 kyrs) suggests that the growth of the Eurasian ice sheet was delayed by high oceanic heat transport into the high latitudes regions (Born et al., 2010). This implies an asynchronous building between the Laurentide and the Eurasian ice sheets. To investigate the mechanisms that could have led to a different ice distribution, we focus here on the glacial inceptions of MIS 5 (~ 120 - 116 kyrs BP) and MIS 7 (~ 236 - 228 kyrs BP). We use the CESM earth climate model (in its fully coupled version) to simulate these inceptions. Pseudo transient simulations accounting for changes in orbitals, CO2 and CH4 values are performed at low resolution over the periods defined above and the simulated climates are then analyse to investigate the impact of external forcing and regional feedbacks on the asynchronous building of the Laurentide and Eurasian ice sheets between the two inceptions. References: Peltier W. R., Rev. Earth Pla. Sci., 32, 111-149, 2004. Bintanja, R. & van de Wal, R. S. W., Nature, 454, 869-872, 2008. Svendsen J-I. et al., Quaternary Sci. Rev., 23, 1229-1271, 2004. Lambeck K. et al., Boreas, 35, 539-575, 2006. Peyaud V., PhD thesis, 420pp, 2006. Colleoni et al., Global Planet. Change, 68, 132-148 2009. Waelbroeck, C. et al. Quaternary Sci. Rev., 21, 295-305, 2002. Born et al., Clim. Past, 6, 817-826, 2010.