Is climate change the sole trigger for a great Fennoscandinavian ice sheet advance in Ukraine?

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Abstract

The amount of ice stored in the ice sheets is a key element of the climate system. The corresponding sea level change record is also of major interest for paleoenvironmental studies. It is generally agreed that to a first approximation, the oxygen isotope record that is recovered by analyzing foraminifera in deep-sea sediment cores gives a history of global continental ice volume and hence of the glacio-eustatic component of sea-level change (Shakleton, 1987; Waelbroeck *et al*., 2002). The European continent was covered by the Fennoscandinavian Ice Sheet (FIS) during the last glacial maximum (LGM) or marine isotope stage 2 (MIS2). A recent study (Rinterknecht *et al*., in review) shows that the FIS, at least its southeastern margin, responded to the abrupt climate changes originating in the North Atlantic Ocean. In addition the study shows that the ice sheet contributed to the abrupt rise in sea level 19,000 years ago, but did not contribute to the similar abrupt sea-level event 14,600 years ago. The most direct analogue for the transition from MIS2 to the Holocone (MIS1) is the transition from MIS6 to the Eemian (MIS5) the penultimate warm period comparable to the modern warm period (Fig. 1). The similarities are striking when the maximum and minimum benthic $\delta^{18}O$ values are compared. Similar maximum values (~2.1‰) are reached during MIS6 and MIS2, and a slightly lower value is reached during the minima of MIS5 (-0.2‰) compare to MIS1 (O‰), corresponding to slightly higher temperatures during the Eemian interglacial. If the MIS are effectively recording the amount of ice stored on land, than the amount of ice stored during MIS6 should be similar to the amount of ice stored during MIS2. We would also expect that land-based ice sheets would have reached similar extents on the European continent during MIS6 and MIS2, unless parameters other than climate (i.e. topography left by previous glacial cycles, lithology,…) modified their progression, which would result in distinguishable ice margin position in the landscape. In Europe, the LGM ice sheet margin was identified and mapped through northern Germany (Brandenburg Moraine), central Poland (Lezno Moraine), and northern Belarus (Orsha Moraine) for its southern most maximum extent (Marks, 2002). Rinterknecht *et al*. (in review), dated the retreat of the ice margin in eastern Poland and Belarus at 19 ^{10}Be ka. The maximum ice margin extent during MIS6 was identified south of the maximum extent of the FIS during the LGM, in Germany (Saalian Moraine) (Fiebig *et al.*, 2004), Poland (Central Polish Glaciation Moraine) and Ukraine (Dniepr Moraine) (Gozhik, 1995), but has not yet been directly dated.