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Climate of the Past Discussions

Interactive comment on "Mending Milankovitch theory: obliquity amplification by surface feedbacks" *by* C. R. Tabor et al.

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Strong obliquity also during the Middle and Late Pleistocene?

Tabor et al. present results of a modeling study, which nicely illustrates the high sensitivity of ice volume changes to obliquity compared to precession. They specifically investigate positive feedback mechanisms between mean annual insolation and sea-ice coverage, ocean heat fluxes and vegetation changes. As mean annual (and integrated summer) insolation is dominantly controlled by obliquity, the study of Tabor et al. can readily explain the observed cyclicity during the (Early) Pleistocene. The manuscript is concise, well-structured and written, and should be published in Climate of the Past.

One aspect, which could be additionally addressed in a revision, would be the continu-

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ous obliquity forcing during the Middle and Late Pleistocene (Huybers, 2007). Obtaining robust direct age control for glacial chronologies is challenging, but obliquity may in fact have triggered climate and environmental changes in northeast Siberia (and elsewhere) during the last glacial cycle (Zech et al., 2011).

I also wonder whether it would be possible to include soil organic carbon in the model (in the future). Recent studies have shown that the amount of soil organic carbon in permafrost regions has been hugely underestimated (Tarnocai et al., 2009). As permafrost regions expanded during glacials, enhanced terrestrial carbon storage might help explaining reduced atmospheric CO2 levels and constitute an important positive feedback. It may even be the case that annual (and integrated summer) insolation at high latitudes triggered changes in permafrost extent and, via greenhouse gases, the rhythm of the Pleistocene ice ages (Zech, 2012). This 'permafrost hypothesis' could readily explain the '40 ka world' during the Early Pleistocene and the 'obliquity skipping' after the mid-Pleistocene transition, but awaits evaluation by modeling studies.

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Interactive comment on Clim. Past Discuss., 9, 3769, 2013.