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Climate of the Past Discussions

Interactive comment on "Strong asymmetry of hemispheric climates during MIS-13 inferred from correlating China loess and Antarctica ice records" *by* Z. T. Guo et al.

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Guo et al. have done a nice job of assembling a wide range of data that show that marine isotopic stage 13 is unusual in several respects: warm in the northern hemisphere, cold in the southern hemisphere, and thus imbalanced between the two. The paper merits publication after minor revision. Most of the trends shown in figures 2 and 3 are interpreted in a sensible, straightforward manner, but I detected two areas that I feel deserve more thought and explanation.

The evidence for warmth across large parts of the northern hemisphere is pervasive and convincing: in Greenland ice, in North Atlantic plankton, in European pollen, and

in Asian pollen and winter-monsoon dust fluxes. Yet the benthic oxygen isotope stack has values that are unusually positive for an interglaciation. The authors (correctly) infer that this anomalous signal did not come from ice in a warm Northern Hemisphere. They suggest that it must come from extra ice on Antarctica. But ice volume on Antarctica is constrained by sea level, which is largely determined by ice in the Northern Hemisphere. With a northern ice volume that was if anything small for a Northern Hemisphere interglaciation, the high sea level in stage 13 would have kept Antarctic ice volume low. For these reasons, I doubt that changes in Antarctic ice volume account for the anomalously heavy oxygen-isotope values.

The authors briefly mention and then dismiss, changes in deep-water temperature, but this explanation deserves another look. Because the Antarctic deuterium record shows that air temperatures were some 4C colder than in the Holocene, that cold anomaly would almost certainly have chilled the bottom waters sinking around Antarctica and thereby shifted the benthic O18 signal toward heavier values.

A second issue is the apparent inconsistency between the low methane values (compared to typical interglacials) and various proxies that indicate a strong stage 13 summer monsoon (magnetic susceptibility, pollen on Tibet, etc). Because summer monsoons are thought to be the strongest control on the methane signal via filling of tropical wetlands, this is baffling. More confusing still is the evidence that high-latitude temperatures in the northern Hemisphere were very warm. This would appear to indicate that the second most likely source of methane — boreal wetlands — would have been omitting large amounts during warm summers.

The authors (reasonably) invoke suppression of southern hemisphere methane sources (such as the Amazon) by cold temperatures to explain the reduced methane values. But the methane signal at orbital time scales has generally had a phase consistent with the forcing of northern wetlands, so it seems a bit odd that the southern hemisphere wetlands would have taken control.

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One possibility the authors might consider is methane emitted from sources very near the equator but offshore of the Asian continent. The northward movement of the ITCZ caused by the hemispheric asymmetry they have so well demonstrated might have brought unusually cool temperatures to those regions and suppressed methane emissions.

Other (minor) points:

p. 1065: Clarify the phrase 'of dust intensity' (or eliminate)

p. 1067: As far as I know, chemical weathering is too slow a process to have large effect on glacial/interglacial cycles and the CO2 values in stage 13

Interactive comment on Clim. Past Discuss., 4, 1061, 2008.