Clim. Past Discuss., 5, C307–C310, 2009
www.clim-past-discuss.net/5/C307/2009/

Climate of the Past Discussions

Interactive comment on "The MIS 11 – MIS 1 analogy, southern European vegetation, atmospheric methane and the "early anthropogenic hypothesis"" *by* P. C. Tzedakis

W. Ruddiman

wfr5c@virginia.edu

Received and published: 1 June 2009

Tzedakis' analysis of the alignment of stages 11 and 1 is thoughtful and convincing. I also agree that stage 19 is by several measures the best available insolation analog to the Holocene during the last 800,000 years. The modulation of precession by eccentricity is similarly low in amplitude, and the relative timing of changes in precession and obliquity is very similar (unlike stage 11). These similarities have an added benefit: the ambiguities usually involved in deciding how to align interglaciations are minimal for stages 19 and 1.

However, I disagree with the conclusions based on Tzedakis' comparison of stages

19 and 1. He equates a methane maximum at ∼778K with the one in the late pre-industrial Holocene, and he finds this match suggestive of a natural origin for both. But the stage 19 methane maximum is defined by only two data points separated by about 1000 years (Fig. 1a). Because of its brevity, Loulergue et al (2008) interpreted it as a millennial-scale oscillation. The data support that conclusion.

In comparison, the late Holocene trend shows a methane increase that began near ∼5000 years ago and continued through the onset of the industrial era (Fig. 1a). This longer-term increase appears to be different in kind from the stage 19 oscillation. The contrast between the (natural) longer-term stage 19 decrease and the (anomalous) longer-term stage 1 increase is consistent with the early anthropogenic hypothesis (Ruddiman, 2003).

Tzedakis did not show the stage 19 CO2 data from Dome C (Luthi et al., 2008), but the CO2 data can be plotted at the same EDC3 time scale as the methane signal and compared to stage 1 trends (Fig. 1b). The trends are similar through the earlier parts of the two records, with late-deglacial increases to early-interglacial peaks of 260-270 ppm, followed by initial decreases, but then the trends diverge. Starting 7000 years ago, the Holocene trend rises steadily to a peak of ∼282-283 ppm in late pre-industrial times. In contrast, the stage 19 trend continues to fall to a value of ∼245 ppm by the time equivalent to the present-day insolation configuration. That 245-ppm CO2 value falls at the top end of the 240-245 ppm natural range predicted by the early anthropogenic hypothesis (Ruddiman, 2003).

Figure caption.

1. Dome C greenhouse-gas concentrations plotted at the EDC 3 time scale. (A) Methane concentrations from Loulergue et al. (2008). (B) CO2 concentrations from Luthi et al. (2008). The first insolation minimum in the stage 19 interglaciation is aligned with the current (first) insolation minimum in stage 1.

References

Loulergue, L., et al. (2008). Orbital and millennial-scale features of atmospheric CH4 over the past 800,000 years. Nature 453: 383-386. doi.10.1038/nature06950. Luthi, D. et al. (2008). High-resolution carbon dioxide concentration record 650,000- 800,000 years before present. Nature 453: 379-382. doi:10.1038/nature06949. Ruddiman, W.F. (2003). The anthropogenic greenhouse era began thousands of years ago. Climatic Change 61: 261-293.

Interactive comment on Clim. Past Discuss., 5, 1337, 2009.

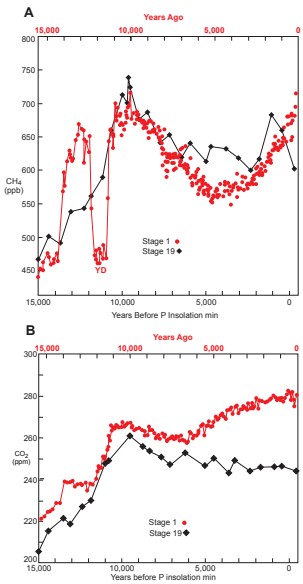

Fig. 1.