

Interactive comment on “Differences between the glacial cycles of Antarctic temperature and greenhouse gases” by A. W. Omta

Anonymous Referee #2

Received and published: 6 May 2012

This paper deals with the contribution of the 100-ka cycle associated with CO₂ and of the 41-ka cycle of obliquity to the Antarctic temperature taken from the EPICA ice core. This is an attractive subject which is /was debated in many publications. This paper would benefit from the author focusing more directly to his objective. The introduction is actually covering more topics than necessary. It contains a list of very well known problems for which the author cites some recent references without underlining their possible new contribution. For example, nothing is said about Denton et al (2010) which the author uses in reference to the saw tooth shape of paleoclimate records and the more regular shape of the astronomical parameters, a very well known problem since the early 70s when these curves appeared clearly for the first time. The "striking similarity" between temperature, CO₂ and CH₄, as well as the lag/lead between them, have been largely discussed in many more publications than those cited by the author.

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The spectrum of the Antarctic temperature would deserve to be much more discussed as the objective of the author is to explain this temperature in terms of the 100 and 41-ka cycles. Incidentally, the main contribution of Hays et al (1976) and Imbrie et al. (1993 and other papers) was to show clearly the presence of the astronomical cycles in their proxy records not to determine the frequencies of the astronomical parameters. The average periodicities of eccentricity and obliquity date from the early 20th century (Milankovitch, 1920) and from the beginning of the 19th century for precession. A full list of the more accurate and detailed spectral components has been calculated by Berger (1977 or 1978). Using the radiative forcing of CO₂ to argument that CO₂ cannot explain the amplitude of the glacial-interglacial cycles ignores the fundamental role of the feedback mechanisms which characterize the climate system behavior. As a consequence, I would strongly recommend the whole introduction to be deleted and replaced by a clear presentation of what is known about the spectral components of the Antarctic temperature, CO₂ and CH₄ (this is partly covered in section 2). If the author has some personal reasons to stress the importance of the spectral techniques used to calculate the spectra, more discussions and appropriate references are needed (in particular, the Multi-Taper-Method originates from David Thomson 1982 (IEEE, 70) and its application to paleoclimates dates back from 1990 (Ph Trans R Soc of London, A332)). If more recent papers are referred to, their specific contribution to the problem analyzed by the author must be discussed. Here nothing is said upon the accuracy of the spectra relative to the technique used, to the accuracy of the time scale, or about the influence of any astronomical tuning, a problem which would deserve to be approached. Nothing is said neither about the stability in time of those cycles (see for example Berger et al., Paleoclimatology, 2005). The second central point of the paper deals with the linear relationship between temperature, CO₂ and obliquity. Nothing new seems to be demonstrated here. The author assumes that the 100-ka cycle of temperature is the same as in CO₂. Given the similarity claims by the author between temperature, CO₂ and CH₄ why is CO₂ not a function of obliquity also and in this case what would be the impact on the result presented here? This possibility and

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some others are discussed by the author in section 3, but they are far from being convincing as we find only statements without demonstration. The technique used by the author for the linear relationship (normalization procedure) has the disadvantage to give the same weight to the different variables. One way to solve this would be to simulate the CO₂-forced and the insolation-forced temperatures over Antarctica from an Earth Model of Intermediate Complexity, temperatures that would then be related to the EPICA temperature. Why also not using a band-pass filter instead of taking out the 100-ka cycle from the temperature record ? Would it make a difference? It is difficult to judge the value of the results claimed by the author as there is no quantified result. Why don't we see the relationship between temperature and the 100-ka and 41-ka cycles? What is the significance of the coefficient in a multi linear regression and the variance explained? In summary, a nice idea which deserves much more work to convince.

Interactive comment on Clim. Past Discuss., 8, 987, 2012.

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