

Analysis of time lags between variations of temperature and greenhouse gases atmospheric content at Milankovitch periods from paleoreconstructions

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Analysis of time lags between temperature regime and content of atmospheric greenhouse gases from the Antarctic ice core at the Vostok station during last 420,000 years (Petit et al., 1999; Kotlyakov and Lorius, 2000) is performed (Mokhov et al., 2002; Mokhov et al., 2004). Time series of the temperature variations (T), carbon dioxide (C) and methane (M) content are studied with the use of correlation analysis (CA), cross spectral analysis (CSA) and cross wavelet analysis (CWA). Estimates of temperature variations are based on the deuterium content variations from ice core analysis (Petit et al., 1999).

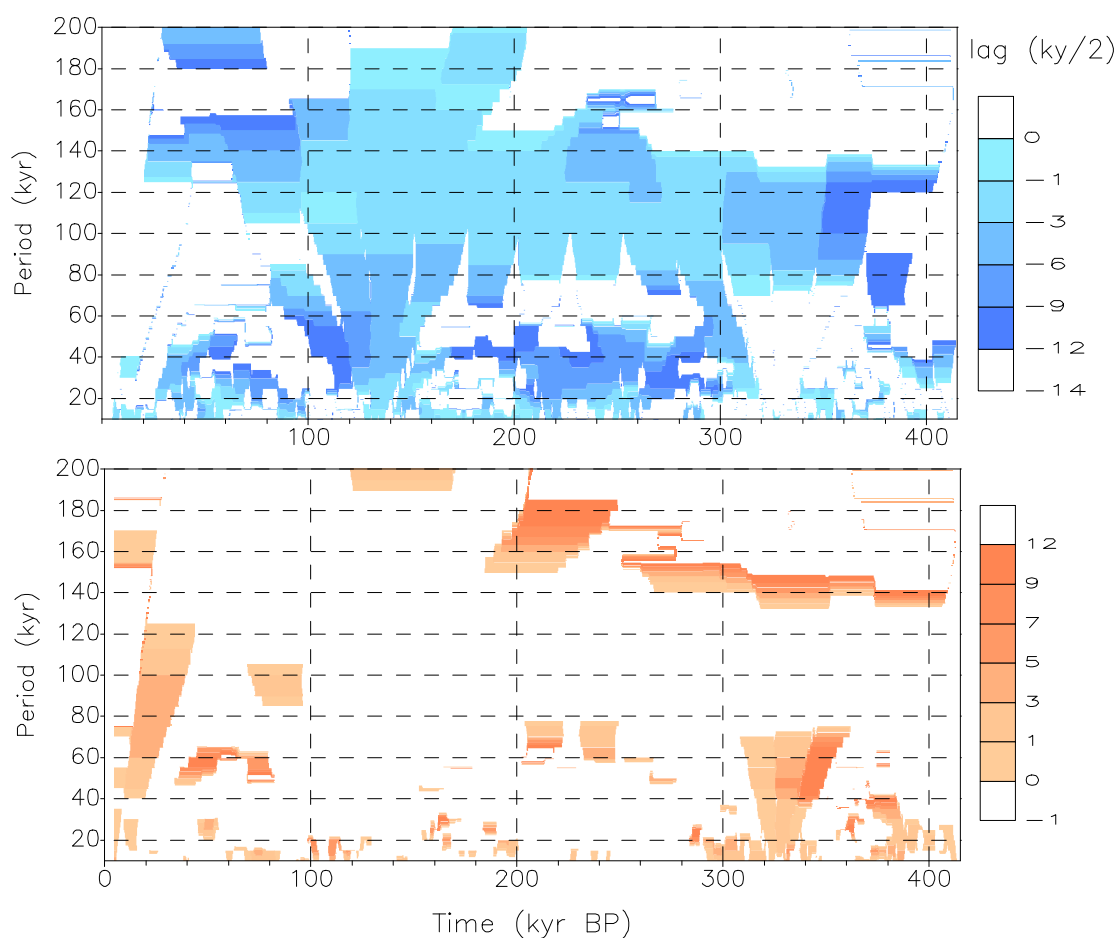
The CA results show the best correlation with delay of C and M variations relative to T variations for the last 420,000 years as a whole. Similar delays are obtained for different 100,000 years sub-periods except sub-period 300,000-400,000 years B.P. (The change in the phase sign of relative variations of temperature and greenhouse gases content can be related with quality and time resolution of the data.)

The CSA results also show a general delay of C and M variations relative to T changes at Milankovitch periods (from about 20,000 years to about 100,000 years) for the last 420,000 years as a whole. Remarkable change of the sign in phase lag between T and M variations is found at periods about 20,000 years (with delay of T changes relative to M changes). It was noted both for the total 420,000 years period and for two sub-periods – for last 200,000 years and for 200,000-400,000 years B.P. (Some changes of the sign in phase lag between T and C variations at Milankovitch periods are slightly exhibited for sub-period 200,000-400,000 years B.P. without changes of the phase lag sign for the last 200,000 years.)

The CWA results display a general delay of C and M variations relative to T variations at Milankovitch time scales with differences for some sub-intervals and for selected modes (Fig.1). In particular, there is a general delay of C and M variations relative T variations for the 100,000 years mode except the last 100,000 years with phase lag of the opposite sign. The delay of T variations relative to M variations is noted also for other Milankovitch modes (with 19, 23 and 41 kyrs periods).

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Figure 1. Local phase lags between T and C variations from CWA: negative (blue colour) – with delay of C relative to T, positive (red colour) – with delay of T relative C (time resolution 500 years).



References

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