

## FREE OSCILLATIONS OF THE EARTH CLIMATE SYSTEM: A THEORY OF THE 100 kyr CLIMATE CYCLE (Abstract)

by

R.M. MacKay and M.A.K. Khalil

(Institute of Atmospheric Sciences, Oregon Graduate Center, Beaverton, OR 97006, U.S.A.)

A physically plausible theory of the 100 kyr climate cycle is proposed. Free oscillations between the mean ocean temperature and the marine ice-margin colatitude are shown to exist without requiring orbital forcing. It is shown that the curvature of the Earth causes two effects: (1) as the marine ice margin grows towards the equator, the net emission of radiation (solar and terrestrial) per unit surface area increases; and (2) as the poleward extent of the ocean decreases, the net absorption of radiation per unit surface area increases. These radiation balance considerations, included with a realistic meridional transport of energy from the ocean to the marine-ice region and an atmospheric feedback process enhancing the ocean warming, are combined to form two nonlinear differential equations coupling the mean ocean temperature with the marine-ice margin colatitude. Using physically realistic parameters we are able to reproduce the major features of the 100 kyr climate cycle. This can be seen from Figure 1 which shows the  $\delta^{18}\text{O}$  record as given by Imbrie and others (1984), plotted against the model output. In addition we have found that the parameters used to obtain the general features of the ice-volume record also predict temperature "spikes" (1 to 2 K above average) of relatively short duration (5 to 10 kyr) in the mean ocean temperature. We find that there is good qualitative agreement between the model's predicted mean ocean temperature and the estimation of summer sea-surface temperature at RC11-120 presented by Martinson and others (1987).

### REFERENCES

Imbrie, J., and 8 others. 1984. The orbital theory of Pleistocene climate: support from a revised chronology of the marine  $\Delta^{18}\text{O}$  record. In Berger, A., J. Imbrie, J.

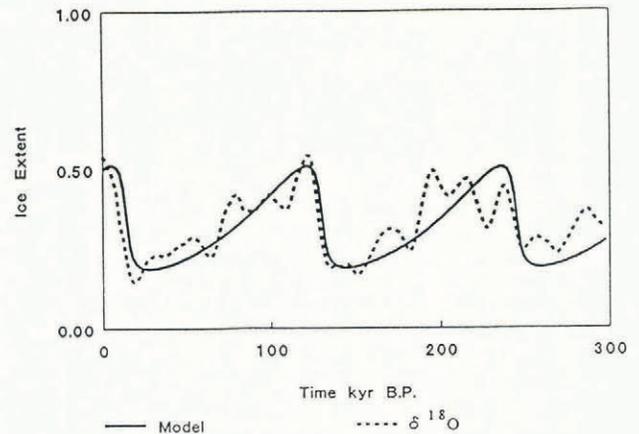


Fig. 1. Comparison of modeled variations in marine-ice extent (solid line; colatitude measured in radians) to the smooth-stacked  $\delta^{18}\text{O}$  record (dashed line) presented by Imbrie and others (1984). The  $\delta^{18}\text{O}$  values have been normalized for the above presentation.

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