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Time series analysis of the 800-ka dust records from the EPICA Dome C ice core

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Secular dust records have been hardly paid attention from the viewpoint of Milankovitch theory. In the present study, we address dust records from Antarctica, which may grip a key to the mystery of nonlinear mechanisms for secular climate changes. Dust flux fluctuations have a prominent ~ 100-ka cycle, which precedes eccentricity cycle as well as changes of ice volume and atmospheric CO_2.

We have analyzed a record of eolian dust from the EPICA Dome C ice core in East Antarctica. This record has some significant features; (a) it covers the past 800-ka, having passed through eight glacial-interglacial climatic cycles, (b) dust peaks with the 100-ka cycle appear during Glacial Maxima, and (c) it has apparently suppressed sawtooth shapes with an exponential change, different from a lot of other records such as ice volume and atmospheric CO_2.

For this dust record, we have performed time series analyses, one of which is for slowly varying components with 10- to several 100-ka periods related to Milankovitch cycles, and another is a high frequency component analysis paying attention to surface parts of the ice core associated with sources and destinations of the dust. The low frequency analysis shows that the dust record reflects well Milankovitch cycles, and there exists the dominant 100-ka signal as can be found in other geologic records. Moreover, when the dust record is displayed in the logarithm, it reveals well apparent sawtooth shapes, which may suggest accumulation effects of dust on climate change. From the high-frequency analysis, periodicities of about 2450- and 4500-yr are found as well as about 300 to 500-yr cycles. Comparing these with records from high latitudes in the northern hemisphere we can evaluate whether the fluctuations are global or local.

Keywords: Milankovitch theory, glacial-interglacial cycle, eolian dust