Geophysical Research Abstracts, Vol. 9, 00203, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00203

A semi-empirical model for reproducing glacial/interglacial changes of dust and sea salt in central East Antarctica.

J.R. Petit (1), B. Delmonte (2)

(1) LGGE-CNRS BP96, 38402 Saint Martin d'Hères Cedex, France, (2) University Milano-Bicocca, DISAT, Piazza della Scienza 1, Milano, Italy

Polar ice cores revealed a consistent increase in aerosol concentrations during cold Quaternary times, in tandem with global temperature decrease. A major challenge today is reproducing with GCM the magnitude of glacial/interglacial (G/I) changes, especially for continental mineral dust reaching the poles from remote continental regions. Thanks to the availability of two ice core records from central East Antarctica (EPICA-Dome C, 75˚ 06'S, 123˚ 21'E, 3233 m a.s.l. and Vostok, 78˚S, 106˚E, 3488 m a.s.l.) we developed a semi-empirical model for reproducing the magnitude of the large dust and Na (sea salt proxy) concentration changes during G/I cycles and with respect to Holocene climate.

Our approach is based on the importance of temperature on the *life-time* of aerosol that follows previous suggestion from Hansson (1994, 1995) as well as modelling from Yung et al (1996). Dry deposition is assumed as the dominant process for impurity fallout over Antarctica, and an *en-route* temperature-related *life-time* parameter depending on aerosol type is introduced. G/I dust changes are reproduced on the basis of synergetic changes of three main factors related to temperature: first, (I) the snow accumulation changes, accounting for a factor of ∼2, second (II) the atmospheric *life-time* of aerosols accounting for a factor around 4, and finally (III) an "Apparent Source Efficiency Factor" (ASEF) accounting for an increase of 3 to 5. The model accounts for ca. 80% of the signal variance and dust concentrations can be reproduced to within a factor 2 on average. When applied to Na, varying of a factor ∼5 during G/I cycles, we took into account contribution from (I) the accumulation rate, accounting for a factor of 2, and (II) from the aerosol *life-time*, accounting for a factor of ∼2.5. In this

case the model accounts for about 90% of the signal variance, and concentrations are reproduced within a factor of 1.2.

The different behaviour of dust and sodium with respect to atmospheric temperature suggests the climate of Antarctica becomes progressively coupled to climate over the lower latitudes as it becomes colder and colder. The first changes registered in the Antarctic temperature are related to troposphere and sea ice cover in the surrounding Southern Ocean. For extreme glacial, the changes are reinforced as sea ice expands to its maximum and the southern South America source becomes active, with severe aeolian deflation processes.

From our model, the G/I troposphere temperature change over the southern troposphere is about 4˚C and consistent with estimation from deuterium excess for water source (Stenni et al, 2003), and the dust source change (ASEF) also appears consistent with estimations from the DIRTMAP database (Kohfeld and Harrison, 2001) for the last climatic period. Moreover, the sodium variations could be interpreted as resulting from the G/I troposphere temperature changes around Antarctica which parallel that from Antarctic troposphere (8˚C). In this conjuncture, longer transport time for marine aerosol resulting from sea ice variations, would be compensated by a corresponding lower temperature and longer li*fe time*. For sodium, source and transport effect for glacial period would be of secondary importance, in agreement with GCM suggestions.

Such an approach may help GCM simulation to reproduce the glacial dust and sodium fluxes.