Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01642, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01642
EGU General Assembly 2008
© Author(s) 2008

Testing the observed dust-climate relationship over the past 800'000 years from the EPICA Dome C ice core within the assumption of a semi empirical dust model: application for detecting outliers and for refining the ice core chronology

Petit J. R. (1), Lambert F. (2), Delmonte B. (3), Debret M. (1), Lemieux-Doudon B. (1), Parrenin F. (1), Kaufmann, P. (2), Stocker T. F. (2), Maggi V.(3)

(1) LGGE-CNRS, Université Joseph Fourier, UMR 51230, St Martin d'Hères Cedex, France, (2) Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland, (3) DISAT, University Milano-Bicocca, Milano, Italy

The high-resolution aeolian dust record from the EPICA Dome C ice core in East Antarctica provides an undisturbed climate sequence over the last 8 climatic cycles. The dust record is strongly connected to patterns of the Pleistocene glaciations and it appears increasingly correlated to Antarctic temperature as climate becomes colder. This property is interpreted by a progressive coupling between the Antarctic and the lower latitudes climate.

A semi-empirical model was initially developed from low resolution records covering the last 4 climatic cycles to account the magnitude change in the interglacial/glacial ratio of dust concentrations and here applied to the high resolution record. Dry deposition is assumed to be the dominant impurity fallout process over Antarctica and a temperature-dependent life-time parameter has been applied to conceptual poleward pathways for aerosols at high altitude within the troposphere while assuming constant poleward transport. From the dust-isotope relationship, the Antarctic and Southern Ocean troposphere appear to be coupled below a first temperature threshold (i.e. $\sim 1^{\circ}$C below the mean Holocene Antarctic temperature), involving the dust life-time

change, and then a second temperature threshold ($\sim 4^{\circ}$C below) involving a synergetic increase in aeolian deflation in southern South America (the main source of dust) as sea ice expands significantly over the South Atlantic Ocean. Within such assumption the mid-latitude atmospheric dust load that was 3 to 5 times higher for the last climatic period.

The dust concentration could be expressed through a polynomial function with respect to isotope content. The 5188 laser data (the mean value over 0.55 cm) and corresponding isotope content from the undisturbed climate record were tested against the model. As a result, the model reproduces the dust concentration within a factor 2 for 68% of the data, and within a factor 4 for 96% of the data, while only 38 dust values remain unexplained.

Once plotted against time, the EDC dust residuals show orbital frequencies on the precession timescale, a property already observed on EDC and Vostok records over the first 4 climate cycles. The long term insolation-related modulation of aerosol input could provide a chemical pacemaker useful for refining the ice core chronology.