Geophysical Research Abstracts, Vol. 7, 03949, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03949

Ice core evidence of secular variability and 200-year dipolar oscillations in the atmospheric circulation over East Antarctica during Holocene

Barbara Delmonte (1,2), Jean Robert Petit (1), Gerhard Krinner (1), Valter Maggi (2), R. Udisti (3).

B. Delmonte

(1) LGGE-CNRS, St.Martin D'Heres, France, (2) Univ. Milano-Bicocca, Dept. Environmental Sciences (DISAT-UNIMIB), Milano, Italy, (3) University of Florence, Sesto Fiorentino, Italy

1. barbara.delmonte@unimib.it

Two Holocene East Antarctic ice cores from Vostok (Vostok-BH7 ice core, 78˚28'S, 106˚48'E) and EPICA-Dome C (EDC, 75˚06'S 123˚21'E) have been analysed for dust concentration and size distribution at temporal resolution of 1 sample per ca. 50 years, each sample representing 3-4 years of accumulation. A series of volcanic markers randomly distributed over the common part of the ice cores (from 9800 to 3500 yrs B.P.) allows a tight stratigraphic link and relative dating of the cores ($\pm$33 years).

The two records of dust size variability display clear oscillations and structured cycles having sub-millennial and secular scale periodicities. Such cycles appear asynchronous between the sites. Interestingly, both Vostok and EDC dust size records show a significant 200-years band of variability. For most of the Holocene ($\sim$5500 yrs), however, the two size records are in antiphase with respect to this band; in other terms, a 100-years lead or lag occurs, a phenomenon that is also reflected by the very pronounced ($>$99% c.l.) 200-years band in the power spectra of the composite difference (Δ) of the two size records.

On the other hand, the power spectra of the composite sum (Σ) of the two dust size records displays a large part of its variability in a band from 150 to 500 years periodicities.

The aeolian dust size for the high-altitude sites of the East Antarctic interior can be considered as associated to the altitude and duration of the long range atmospheric transport. Relatively smaller dust can be associated to upper tropospheric air mass penetration or subsidence over the Antarctic plateau and, conversely, coarser dust to mid-tropospheric air mass incursions.

The Vostok and EDC data analysis suggests a variability of microparticle transport patterns at regional scale and a persistent seesaw phenomenon occurring during most of the Holocene with periodicity of about 200 years leading Dome C and Vostok under different atmospheric regimes.

An analogue seesaw phenomenon was already observed in East Antarctica (Delmonte et al, 2004) during Termination I. Adopting the same interpretation, the dust size variability observed suggests a persistent atmospheric dipole over East Antarctica influencing alternatively Vostok and Dome C. Interestingly, its pronounced 200-years band oscillation opens discussion to its link with the solar activity.

Assuming the long term air mass and long range dust advection over Antarctica depending on the overall meridional pressure gradient with lower latitudes, associated to the southern annular mode or Antarctic Oscillation (AAO), we speculate that the power spectrum of the Σ parameter could represent the long term periodicities of such mode of climate variability of the Southern Hemisphere.