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Climatic parameters influencing Glacial Interglacial changes in dust concentration in Antarctic ice cores

Jean Robert Petit (1) and Barbara Delmonte (2)

(1) CNRS, LGGE, St Martin d'Hères, France (petit@lgge.obs.ujf-grenoble.fr), (2) DSAT, Università degli Studi di Milano-Bicocca, Piazza della Scienza, 1, 20126 – Milano, Italy

Model simulations have difficulties to reproduce the 50-to-70 fold dust enhancement observed from polar ice core records over the last glacial period. For the Southern Hemisphere and Antarctica, large changes in dust sources have been suggested, while not supported by recent South Atlantic marine records (e.g. Kumar, et al, 1995, Martinez Garcia, 2008) which indicate that changes for the Southern south American source does not exceed a factor $\sim$4, for last glacial period and previous glacials.

Amongst parameters other than source influencing the dust cycle, Yung et al.(1996) suggested that aerosol life time is very sensitive to the climate through the hydrological cycle. The atmospheric water vapour (and temperature) finally governs the efficiency of aerosol transport to the polar regions.

A semi-empirical model has been developed to reproduce the large glacial-interglacial changes of Antarctic dust concentrations. The model assumes that dry deposition is the dominant process in impurity fallout over Antarctica and uses a life-time parameter that depends on atmospheric temperature (stable isotope content of ice) and that applies to conceptual pathways for aerosols. The model reproduces most of the increase in dust concentration during cold periods with respect to Holocene climate, as observed in Epica Dome C (EDC) and Vostok ice records, on the basis of synergetic changes of three main factors associated with temperature. These are the glacial/interglacial change of accumulation rate in Antarctica, accounting for an increase by a factor of up to 2, the atmospheric life-time of aerosols, accounting for an increase by a factor of $\sim$4, and a source factor accounting for an increase by a factor of 3 to 5. The calculated source factor almost mimics the dust flux from the south Atlantic marine record over the last 300.000 yr (Martinez Garcia, 2008) with peaks coeval with sea ice extents. Up to 80% of the signal variance is explained and dust concentrations can be reproduced to within a factor of 2 on the average.

From the dust behaviour with respect to temperature as it becomes colder, climate coupling between Antarctica and troposphere over the Southern Ocean would operate below a first temperature threshold, and then below a second threshold, would encompass southern South America enduring growing aeolian deflation as sea ice is expanding over the South Atlantic Ocean. Our model suggests a $\sim$4°C glacial– interglacial temperature change over the southern Ocean that is consistent with other estimation.

With respect to previous approaches and GCM results, the hydrological cycle would affect significantly the aerosols life-time and the overall efficiency of the dust transport.