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Glacial/Interglacial variability in dust fluxes to the Subantarctic Atlantic during the Plio-Pleistocene

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A combination of organic and inorganic proxies is used to quantify dust fluxes to the Subantarctic Atlantic (ODP Site 1090) during the last 3.65My, extending previous southern high latitude dust records based on ice cores measurements (0-0.8 Ma), and providing the first insights into the variability of atmospheric circulation and dust deposition over the SO since the Pliocene warm period. Lithogenic fluxes through time are derived from the analysis of long chain n-alkanes, three inorganic tracers for lithogenic material (Al, Fe and ^{232}Th), and ^{230}Th$_{ex}$ as an indicator of vertical mass flux. For the last 800ky the age model of the recod is based on the correlation of the alkenone-based SST record of ODP 1090 to the ice core temperature reconstruction from the EPICA project. This allows for direct comparison of the continental and marine records in the same timescale. The good agreement between the organic and inorganic tracers and the EPICA dust and iron records, together with the results from ^{232}Th/^{230}Th analysis, imply that the supply of lithogenic material to our site is dominated by changes in the eolian input of terrigenous material through time.

Our long-term multiproxy reconstruction of dust inputs provides evidence of an increase in the supply of lithogenic material in each of the glacial stages of the last 3.65 My. Moreover, it reveals a first order similarity of dust supply with the global ice volume record, when the former is plotted in a logarithmic scale. The increased dust deposition at Site ODP 1090 is probably reflecting, as in the case of Antarctic ice cores, an increase both in the westerly winds strength and South American aridity during glacial stages. In the late Pleistocene section, dust flux varies from of 1 g m^{-2}y^{-1} of dust for interglacial periods, to around 4-5 g m^{-2}y^{-1} for glacial stages. The G/IG variability is higher than the 2 to 2.5-fold increase found in the equatorial Pacific. This highlights the regional dissimilarities in South American dust source regions, suggesting a key role for local processes occurring in Patagonia in amplifying dust generation in the South Atlantic. The long term trend of the record shows a 4-5-fold increase in the supply of dust (and hence of iron) to the SO that is closely linked to the strengthening of the meridional temperature gradients initiated around 1.8-1.9 Ma. This suggests an intensification of the southern Westerly winds and South America aridity from the Pliocene to the present day. In addition, the cross-spectral analysis of the data shows that dust deposition in the SO led changes in continental ice volume across the Pliocene and early Pleistocene, and that this phase-lead increased to around 4-5 ky after the intensification of the meridional temperature gradients ($\sim$0.9 Ma), which together with the increased dust flux, suggest a more significant role for dust as an active agent of glacial/interglacial variability during the last million of years than during the late Pliocene and early Pleistocene.