Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union









Atmos. Chem. Phys., 6, 667-688, 2006
www.atmos-chem-phys.net/6/667/2006/


# The transport history of two Saharan dust events archived in an Alpine ice core

H. Sodemann[1], A. S. Palmer[2,*], C. Schwierz[1], M. Schwikowski[2], and H. Wernli[1,3]
[1]Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland
[2]Paul Scherrer Institute, Villigen, Switzerland
[3]Institute for Atmospheric Physics, University of Mainz, Germany
[*]now at: University of Tasmania, Tasmania, Australiainz, Germany

Abstract. Mineral dust from the Saharan desert can be transported across the Mediterranean towards the Alpine region several times a year. When coinciding with snowfall, the dust can be deposited on Alpine glaciers and then appears as yellow or red layers in ice cores. Two such significant dust events were identified in an ice core drilled at the high-accumulation site Piz Zupó in the Swiss Alps (46°22' N, 9°55' E, 3850 m a.s.l.). From stable oxygen isotopes and major ion concentrations, the events were approximately dated as October and March 2000. In order to link the dust record in the ice core to the meteorological situation that led to the dust events, a novel methodology based on back-trajectory analysis was developed. It allowed the detailed analysis of the specific meteorologic flow evolution that was associated with Saharan dust transport into the Alps, and the identification of dust sources, atmospheric transport paths, and wet deposition periods for both dust events. Differences in the chemical signature of the two dust events were interpreted with respect to contributions from the dust sources and aerosol scavenging during the transport.

For the October event, the trajectory analysis indicated that dust deposition took place during 13–15 October 2000. Mobilisation areas of dust were mainly identified in the Algerian and Libyan deserts. A combination of an upper-level potential vorticity streamer and a midlevel jet across Algeria first brought moist Atlantic air and later mixed air from the tropics and Saharan desert across the Mediterranean towards the Alps. The March event consisted of two different deposition phases which took place during 17–19 and 23–25 March 2000. The first phase was associated with an exceptional transport pathway past Iceland and towards the Alps from northerly directions. The second phase was similar to the October event. A significant peak of methanesulphonic acid associated with the March dust event was most likely caused by incorporation of biogenic aerosol while passing through the marine boundary layer of the western Mediterranean during a local phytoplankton bloom. From this study, we conclude that for a detailed understanding of the chemical signal recorded in dust events at Piz Zupó, it is essential to consider the whole transport sequence of mineral aerosol, consisting of dust mobilisation, transport, and deposition at the glacier.

Final Revised Paper (PDF, 2194 KB) Supplement (13082 KB) Discussion Paper (ACPD)

Citation: Sodemann, H., Palmer, A. S., Schwierz, C., Schwikowski, M., and Wernli, H.: The transport history of two Saharan dust events archived in an Alpine ice core, Atmos. Chem. Phys., 6, 667-688, 2006. Bibtex EndNote Reference Manager