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n-Aldehydes (C6-C10) in snow samples collected at the high alpine research station Jungfraujoch during CLACE 5

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C6-C10 n-aldehydes were analyzed in samples of freshly fallen snow collected at the high alpine research station Jungfraujoch, Switzerland, during the Cloud and Aerosol Characterization Experiments (CLACE) 5 in February and March 2006. Sampling was carried out on the Sphinx platform. Headspace - solid phase dynamic extraction (HS-SPDE) combined with gas chromatography/mass spectrometry (GC/MS) was used to quantify n-aldehydes in melted snow samples. n-Hexanal was identified as the most abundant n-aldehyde (median concentration 1.324 μg L-1) followed by n-nonanal, n-decanal, n-octanal and n-heptanal (median concentrations 1.239, 0.863, 0.460 and 0.304 μg L-1, respectively). A wide range of concentrations of n-aldehydes was found in snow samples from Jungfraujoch, even for samples collected at the same time during the same snowfall event. According to their physical and chemical characteristics, n-aldehydes are expected to be primarily linked to aerosol particles in the atmosphere suggesting the uptake of n-aldehydes into snow via the particle phase. Particle scavenging can occur during snow formation in clouds. The high concentration variations of the n-aldehydes among the snow samples can be explained assuming that aerosol particles, which are loaded with n-aldehydes, are heterogeneously distributed throughout the snow samples.
Higher median concentrations of all n-aldehydes were observed when air masses reached Jungfraujoch from the north-northwest in comparison to air masses arriving from the southeast-southwest.
The sources of atmospheric n-aldehydes present at Jungfraujoch are most likely to be related to direct and indirect biogenic emissions. The presence of n-aldehydes as semivolatile constituents of direct biogenic emissions from vegetation has been reported previously in studies of Ciccioli et al. [1], Yokouchi et al. [2] and Kesselmeier and Staudt [3]. The distribution pattern of the n-aldehydes in emissions from vegetation largely matches with the n-aldehyde pattern found in snow collected at Jungfraujoch. One exception is the significantly higher proportion of n-hexanal in the Jungfraujoch samples compared to vegetation emission.
Additionally, indirect biogenic emissions can contribute to the atmospheric concentrations of n-aldehydes through oxidation of precursor compounds of biogenic origin. In this context, Moise and Rudich [4] and Thornberry and Abbatt [5] proposed the preferential formation of n-nonanal and n-hexanal from the cleavage by ozonolysis of double bonds in unsaturated fatty acids (namely oleic acid and linoleic acids). The predominance of n-hexanal and n-nonanal among the C6-C10 n-aldehydes in the snow samples collected at Jungfraujoch during CLACE 5 is therefore an argument for the formation of the aldehydes through oxidation of unsaturated fatty acids in the atmosphere. Anthropogenic emissions of n-aldehydes i.e. from fossil fuel burning are thought to be negligible in the air masses reaching Jungfraujoch.

References:
[1] P. Ciccioli, E. Brancaleoni, M. Frattoni, A. Cecinato, A. Brachetti, Atmos. Environ., Part A 27 (1993) 1891.
[2] Y. Yokouchi, H. Mukai, K. Nakajima, Y. Ambe, Atmos. Environ., Part A 24 (1990) 439.
[3] J. Kesselmeier, M. Staudt, J. Atmos. Chem. 33 (1999) 23.
[4] T. Moise, Y. Rudich, J. Phys. Chem. 106 (2002) 6469.
[5] T. Thornberry, J.P.D. Abbatt, Phys. Chem. Chem. Phys. 6 (2004) 84.