Name of research institute or organization:

Hebrew University of Jerusalem

Title of project:

Interactions between aerosols and rain clouds as a function of aerosol type and source

Part of this programme:

ACTRIS

Project leader and team:

Mr. Assaf Zipori, Project leader
Prof. Daniel Rosenfeld
Prof. Yigal Erel

Project description:

As a continuation to our results from CLACE 2014, that showed a substantial concentration of marine ice nuclei (IN) at Jungfraujoch (JFJ), we conducted additional cloud sampling in 2015. We collected snow and cloud samples at the High Alpine Research Station Jungfraujoch during two campaigns, parallel to IN concentration measurements using a Horizontal Ice Nuclei Counter (HINC) operated by Larissa Lacher from ETH. The samples were taken for chemical analysis of metal concentrations using ICP-MS (Agilent 7500cx). In addition, the Strontium isotopic ratio ($^{87}Sr/^{86}Sr$) was examined in the cloud samples using a NEPTON plus high-resolution multi-collector ICP-MS system. The isotopic analysis was done in order to identify the aerosol's source and composition in the cloud. The first campaign took place during Jan 24-Feb 14, 2015, where 20 different cloud samples were collected. The second campaign was during May-June 2015, and 10 different cloud samples were collected.

From the Na/Al ratio of the cloud samples and f(Sr)ss[1] values we can identify several samples that contain a high concentration of marine aerosols (Figure 1.a and 1.b). In addition, several SDE were also detected by the cloud chemical composition with high Al concentration and low Na/Al (Figure 1.c and 1.a). These SDE events were identified also by the automatic system using the single scattering albedo (Coen et al, 2004).

Until now, we did Sr isotopic analysis for the first measurement campaign. From this campaign, only five cloud samples had a sufficient Sr amount in order to perform the isotopic analysis. There was a good correlation between the Sr isotopic ratio and the Na/Al ratio (Figure 2). Additionally, the trend relationship between these two parameters had the same trend as in the results from CLACE 2014, but with offset. From the isotopic and chemical composition two end members can be identified (Figure 2):

(1) Marine aerosols with high Na/Al values and 87Sr/86Sr value of sea water.
(2) Saharan dust with low Na/Al values and 87Sr/86Sr≥0.71 (0.70917; Burk et al., 1982; Faure, 1986).

It is important to mention that these results are in good agreement with the results from CLACE 2014, as can be seen also in Figure 2.

[1] fSr(ss): the fraction of Sr arriving from sea salt. $f(Sr)_{ss} = \left(\frac{Sr}{Na}\right)_{sea} \times Na_{Sample} \Big/ Sr_{Sample}$, where $(Sr/Na)_{sea}$ is the Sr to Na ratio in the sea salt (0.00075) and Na_{samp} and Sr_{Samp} are the Na and Sr concentration in the sample, respectively.

The chemical and isotopic data will be combined with the HINC IN measurements in order to identify IN activity and efficiency for different aerosols type and sources.

Currently we are completing the isotopic analysis for the samples from the second campaign, and results should be available shortly. In addition, cloud samples are still being collected this year be Larissa Lacher parallel to HINC measurements.

References:

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Coen, M.C., Weingartner, E., Schaub, D., Hueglin, C., Corrigan, C., Henning, S., Schwikowski, M. & Baltensperger, U., 2004, Saharan dust events at the Jungfraujoch: detection by wavelength dependence of the single scattering albedo and first climatology analysis, Atmospheric Chemistry and Physics, 4, 2465-2480.

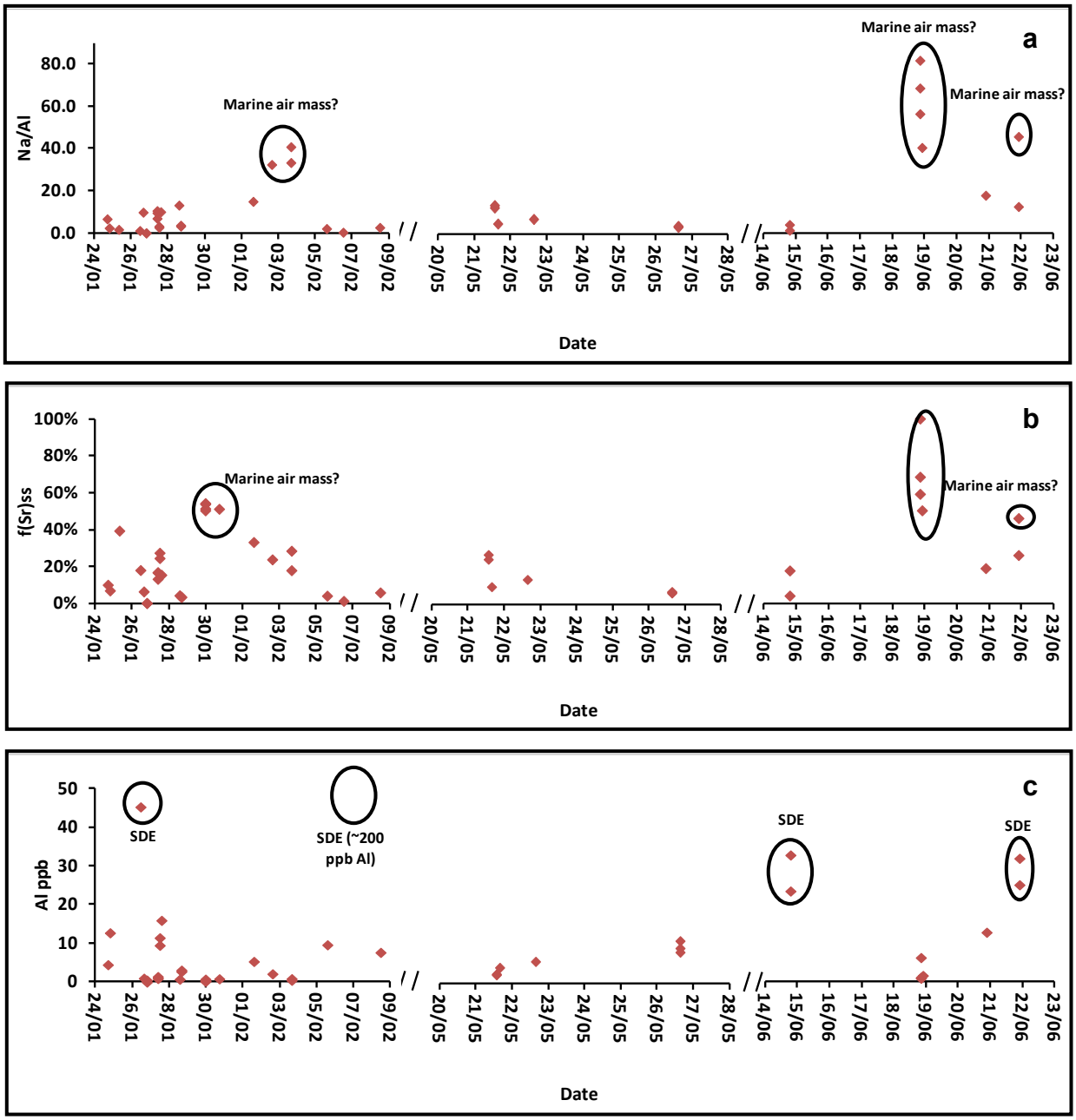

Figure 1. Time series for the first (Jan-Feb 2015) and second (May-Jun 2015) sampling campaigns of Na/Al (a), fSr(ss) (b) and Al concentration (c).

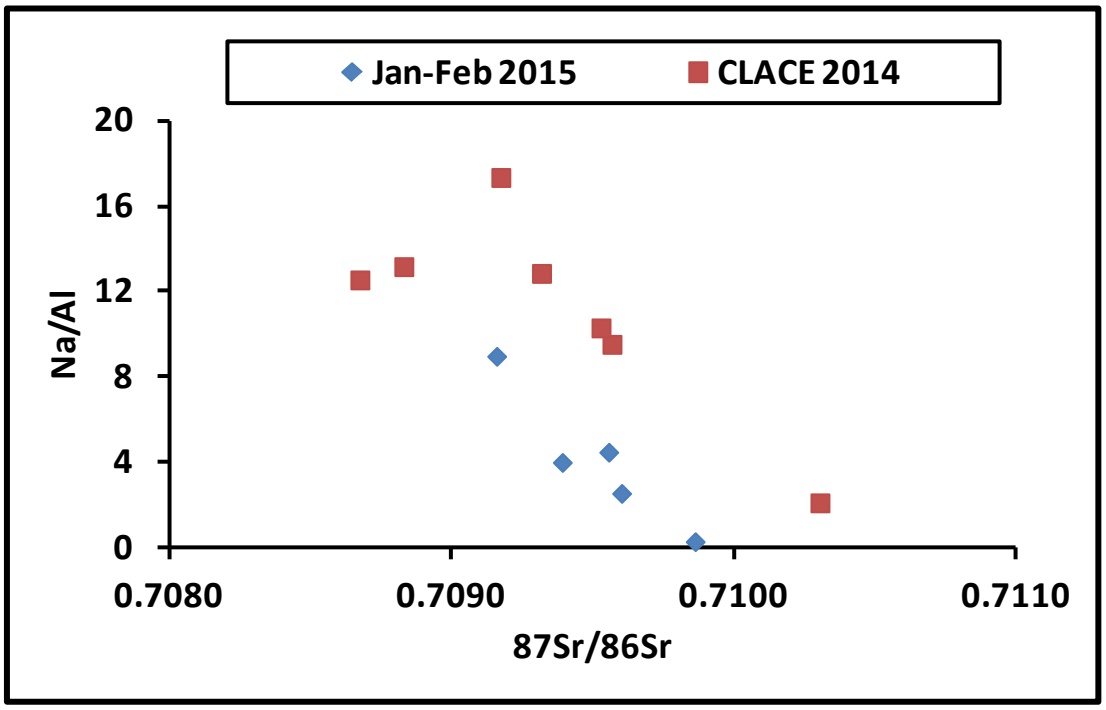

Figure 2. Sr isotopic ratio versus Na/Al ratio of cloud samples that were collected from the campaign that took place in Jan-Feb 2015 (blue rhombus) and from CLACE 2014 (red squares).

Key words:

Aerosols-cloud interactions, Aerosols chemical composition, IN concentrations, Marine IN

Collaborating partners/networks:

Yvonne Boose, Institute for Atmospheric and Climate Science, ETH Zürich
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Scientific publications and public outreach 2015:

Conference Papers

Lacher, L., U. Lohmann and Z. A. Kanji, Field measurements of ice nucleating particles on the High Altitude Research Station Jungfraujoch, Goldschmidt Conference, Prague, Czech Republic, August 16-21, 2015 (*Oral*).

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