Name of research institute or organization:

Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology

Title of project:

Measurement of biological particles during desert dust events

Project leader and team:

Dr. Martin Schnaiter, project leader
Dr. Emre Toprak

Project description:

Within this project the seasonal variability of biological aerosol particles in the free troposphere is investigated. A special focus is put on possible correlations between high biological particle fractions detected in the ambient aerosol and Saharan desert Dust Events (SDE) observed at the High Altitude Research Station Jungfraujoch (JFJ). By using the latest version of the Wideband Integrated Bioaerosol Sensor (WIBS-4) we have monitored the seasonal variability of fluorescing bioaerosol particles at JFJ over a one year period from June 2013 to May 2014. By comparing averaged number concentrations for the four seasons at JFJ with the results of WIBS-4 observations at the environmental research station Schneefernerhaus (2650 m a.s.l.) and at KIT, Leopoldshafen (112 m a.s.l.), the same seasonal trend with a maximum in the summer and a minimum in winter could be observed. The observed decrease in number concentration from Leopoldshafen over Schneefernerhaus to Jungfraujoch at the same fluorescence fingerprint (as represented by the three fluorescence channels of WIBS-4) clearly reflects the vertical transport of the bioaerosol particles from the boundary layer to the free troposphere. The results were corrected by taking into account the cross-sensitivity of the WIBS detection method to non-biological fluorescent aerosols.

During the above monitoring period five SDE were observed at JFJ, taking advantage of the SDE alert system that has been developed by the Paul Scherrer Institute and which is based on measurements of spectral aerosol light scattering and absorption properties (Coen et al., 2004). The strongest event was observed on August 3rd, 2013 and lasted for almost five days. In general, the events showed similar fluorescence fingerprints with the main bioaerosol mode, dominated by long wavelength channels F2 and F3. In some cases, temporary changes in the fluorescence fingerprints have also been observed. Although the fluorescing particle fraction at JFJ is lower during SDE events, their number concentrations are increased by factors between 10 to 100 with respect to non-SDE periods.

On February 19th, 2014 the transported Saharan dust was in contact with cold clouds (-7 to -17°C) at JFJ. During this SDE the WIBS-4 instrument was operated downstream the Ice Selective Inlet jointly developed by the Paul Scherrer Institute, Switzerland and KIT. From these measurements we got first hints pointing to an enrichment of the biological aerosol particles in the measured ice residues, i.e. indicating a higher ice nucleation ability of bioaerosol particles for upper negative temperatures compared to mineral dust.

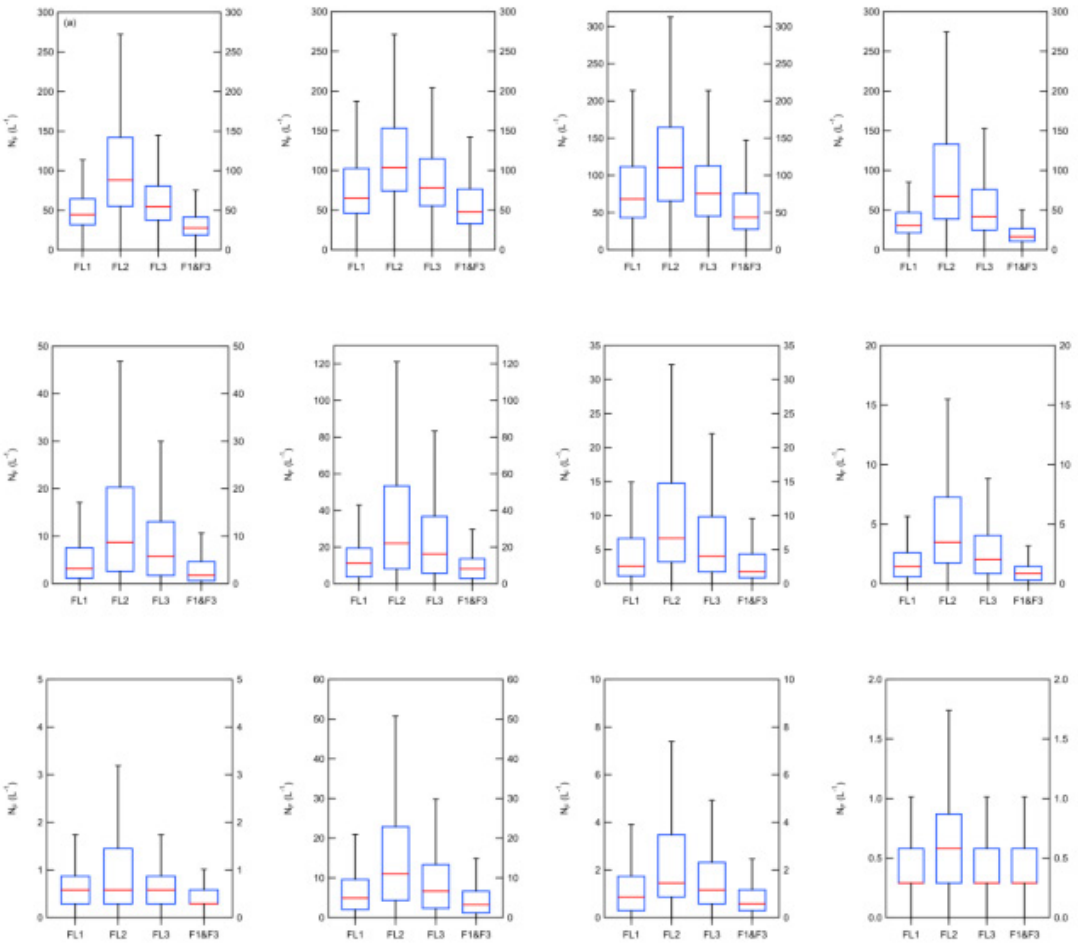

Figure 1. Seasonal change of fluorescent biological aerosols (given in particles per liter) at three different locations. Upper panel: Leopoldshafen, Germany (112 m a.s.l.); central panel: Zugspitze, Germany (2650 m a.s.l.); lower panel: Jungfraujoch research station, Switzerland (3580 m a.s.l.). Season from left to right: spring, summer, autumn, and winter. F1, F2 and F3 represent the three different fluorescence channels of WIBS-4.

Key words:

Fluorescent biological aerosol particles, long range transport of Saharan dust

Collaborating partners/networks:

Paul Scherrer Institute
EMPA
University of Manchester

Scientific publications and public outreach 2014:

Refereed journal articles and their internet access

Toprak, E., and M. Schnaiter, Saharan dust and bioaerosols over Central Europe (in preparation), 2015.

Conference papers

Schnaiter, M., and E. Toprak, Bioaerosol Transport to Central Europe by Saharan Dust Outbreaks, International Conference on Atmospheric Dust (DUST 2014), Castellaneta Marina, Italy, June 1-6, 2014.

Theses

Toprak, E., Real Time Detection of Primary Biological Aerosol Particles (PBAP) and investigation of interactions between biological aerosols with non-biological aerosols and cloud particles, PhD Thesis, Karlsruhe Institute of Technology (KIT), 2014.

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