Name of research institute or organization:

Institut für Umweltgeowissenschaften, Universität Basel

Title of project:

Towards understanding the importance of biological ice nucleators in rising air

Project leader and team:

Dr. Franz Conen, project leader
Dr. Wlodek Zahorowski, Ms. Yu Xia, Mr. Lukas Zimmermann

Project description:

Biological ice nucleators (IN) are known to be the most active ones in nature that can catalyze ice formation at temperatures warmer than -10 ^{o}C. Yet, the relevance of biological ice nucleation for cloud processes, such as initiating precipitation, remains ambiguous. Very little is known about the numbers of biological IN at relevant cloud altitudes, their sources and spatio-temporal variability.

This project aims to quantify numbers and sources of biological IN in rising air where clouds may form, specifically, where boundary layer air is topographically lifted, cools, and is vented to the free troposphere. In this project we sample such air and analyse the number concentration of biological ice nuclei active at temperatures warmer than -15 ^{o}C in immersion freezing tests. Number concentrations of total bacteria, the most abundant biological ice nucleators, are determined by fluorescense microscopy. We continuously measure ^{222}Rn activity concentrations to distinguish between free tropospheric and boundary layer air. The ^{222}Rn measurements are also useful to other groups working on Jungfraujoch, such as our colleagues in the Group for Climate Gases at Empa (Swiss Federal Laboratories for Materials Testing and Research).

From June to October 2010 we conducted four short campaigns, sampling aerosol with liquid impingers. When ^{222}Rn in air was < 0.5 Bq m^{-3} , what we assume to be representative of free tropospheric air, concentration of total bacteria was on average 3.4 x 10^{4} cells m^{-3} (s.d. = 0.8 · 10^{4} cells m^{-3}). When conditions preceeding sampling were calm, or when the station was in clouds during sampling, there was little difference in bacterial cell concentrations between free tropospheric and boundary layer air (^{222}Rn ~1 to 4 Bq m^{-3}). One campaign was preceeded by a storm. Here, boundary layer air reaching the station was enriched in bacterial cells (up to 7.5 · 10^{4} cells m^{-3}). Estimated flux density during this campaign was 441 (± 128) cell m^{-2} s^{-1}. Numbers of ice nuclei active at temperatures warmer than -15 ^{o}C were small, mostly < 10 m^{-3}, which may have to do with predominantly calm, high pressure conditions during sampling.

Key words:

atmosphere, biological ice nuclei, ^{222}Rn

Internet data bases:

http://radon.unibas.ch
http://pages.unibas.ch/environment

Collaborating partners/networks:

Dr. Cindy Morris, INRA Avignon
Dr. Dominik Brunner, Empa Dübendorf

Scientific publications and public outreach 2010:

Bacteria and ice nuclei in the atmosphere are a new area of activity for us. Ms. Yu Xia spent the thrid year of her PhD thesis on it. There is one publication in preparation (probably submitted by the end of 2010). Ms. Xia will defend her thesis in January 2011.

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