

Research Project

Biological ice nucleators at tropospheric cloud height (4th year)

Third-party funded project

Project title Biological ice nucleators at tropospheric cloud height (4th year)

Principal Investigator(s) [Conen, Franz](#) ;

Co-Investigator(s) [Alewell, Christine](#) ;

Organisation / Research unit

Departement Umweltwissenschaften / Umweltgeowissenschaften (Alewell)

Department

Project start 01.09.2015

Probable end 31.08.2016

Status Completed

The objective of this research project is to shed light on the relevance of biological ice nucleation for the development of precipitation, inside the wider frame of the debate on climate change and land use interaction. The activity started in 2012 with the familiarisation of our PhD student, Emiliano Stopelli, with the technique of immersion freezing for ice nuclei (IN) detection. This led to a constant improvement of the method resulting in the finalisation of a new apparatus (LINDA) and the publication of a paper describing the potential of this apparatus for research on biological IN. The first year of field observation (11 sampling campaigns, total of 123 samples) of IN in fresh snow samples collected at Jungfraujoch is completed. Some more time than what had been planned was necessary, mainly to implement the methodologies employed in field and to carry out all the samplings. Additional measurements were done on the samples, including the analysis of stable water isotopes content (^{18}O and ^2H) and the direct counting of microorganism with fluorescence microscopy. Information on meteorological parameters, potential source region of air masses, trace gas concentrations and aerosol parameters was collected for the sampling periods. The amount and complexity of data collected, brought us to resort to different statistical approaches to gain a maximum of insight from the observations. The analysis of the whole set of data is almost complete and a second manuscript is close to submission. A strong interest of students in this research led to the parallel development of a total of 2 MSc and 1 BSc thesis projects.

Biological IN activity is constituted by a complex mosaic of living and dead material from different sources, which requires a series of treatments considering the major classes of biological IN. Finding a suitable method for biological IN characterisation proved less simple than expected and is our main reason to apply for an extension of the project. The initially planned approach was based on the subsequent treatment of samples with polyglycerol, lysozyme and heat (90 °C), to progressively distinguish between the activity of *Pseudomonas syringae*, other bacterial and fungal IN and organic substances. Recent literature, combined with the laboratory assays we carried out, showed that results obtained with lysozyme and with polyglycerol are unreliable and heat treatment (90 °C) is too unspecific in deactivating IN active in the temperature range of interest. Therefore, we developed a completely new approach based on two more moderate heat treatments (40 °C; 80 °C) combined with three size separations (<5 µm, <1.2 µm, <0.22 µm). Testing the effectiveness of the new approach with laboratory assays on pure substances (e.g. soil dust, pure clay, bacteria) has been time consuming. Currently, we are testing our new approach in the field. To detect *P. syringae*, we are comparing two different methods at Jungfraujoch: one is based on direct plating and the other on enrichment cultures prior to DNA extraction and analysis. We expect our new approaches to provide great new insights into the atmospheric dynamics and composition of biological IN. Yet, a 4th year of funding will be necessary to complete the analysis of the observations that have started and publish all the results obtained.

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Swiss National Science Foundation (SNSF)

Follow-up project of [1121996 Biological ice nucleators at tropospheric cloud height](#)

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ID	Kreditinhaber	Kooperationspartner	Institution	Laufzeit - von	Laufzeit - bis
2821040	Conen, Franz	Nicolas Bukowiecki and Erik Herrmann, scientists	Paul Scherrer Institut	01.09.2015	30.08.2016
2821041	Conen, Franz	Cindy Morris, director of research	INRA, Plant Pathology Research Unit	01.09.2015	30.08.2016