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Microbial ice-nucleators in cloud water at the puy de Dôme (France)

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Ice nucleation active (INA) biological particles, in particular microorganisms, were studied in cloud water. Twelve cloud samples were collected over a period of 16 months from the puy de Dôme summit (1465 m, France) using sterile cloud droplet impactors. The samples were characterized through biological (cultures, cell counts) and physico-chemical measurements (pH, ion concentrations, carbon content…), and biological ice nuclei were investigated by droplet-freezing assays from -3°C to -13°C. The concentration of total INA particles within this temperature range typically varied from ∼1 to ∼100 per mL of cloud water; the concentrations of biological IN were several orders of magnitude higher than the values previously reported for precipitations. At -12°C, at least 76% of the IN were biological in origin, i.e. they were inactivated by heating at 95°C, and at temperatures above -8°C only biological material could induce ice. By culture, 44 Pseudomonas-like strains of bacteria were isolated from cloud water samples; 16% of them were found INA at the temperature of -8°C and they were identified as Pseudomonas syringae, Xanthomonas sp. and Pseudoxanthomonas sp.. Two strains induced freezing at as warm as -2°C, positioning them among the most active ice nucleators described so far. We estimated that, in average, 0.18% and more than 1% of the bacterial cells present in clouds (∼104 mL-1) are INA at the temperatures of -8°C and -12°C, respectively.

References:
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