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Biological aerosol particles in the atmosphere and their impact on clouds (BIOCLOUDS)

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The project BIOCLOUDS aimed at investigating and quantifying the role of bioaerosols in tropospheric clouds. We focused on the studies on microorganisms, mainly bacteria. To reach our objective we (1) isolated and identified INA bacterial strains in cloud waters, (2) studied in more details IN properties of bacteria isolated from cloud waters in laboratories and cloud chamber, (3) used new data as input to cloud models.
1. Isolation and Identification of INA bacterial strains in cloud waters
Cloud water samples were collected at the puy de Dôme station under sterile conditions, microorganisms were cultured on agar plates and further identified by DNA sequencing coding for16SrRNA. 257 bacterial strains isolated from 25 cloud events were screened and 44 isolates were selected as they belonged to Pseudomonas, Xanthomonas and Erwinia genera which are potential INA candidates. Using the classical "Droplet Freezing method" as ice nucleation test, 7 strains were shown INA+. Their cumulative IN frequency profiles were established and showed that some of them are very efficient, for example the strain Pseudomonas syringae 13b74 started to nucleate a t-3°C and 4% of the cells were active at- 5°C.
2. Further laboratory investigations of IN properties of cloud bacterial strains
All the experiments presented in this section were carried out with 3 Pseudomonas syringae strains.
We tested the influence of O_3, NO, UV and pH, which are atmospheric markers of anthropogenic activity, on the IN activity of the Pseudomonas strains. It was clearly shown that pH had a main influence, acidic pHs decreased the IN activity of the strains. This suggests a negative impact of human emissions on the natural capacity of bacteria to precipitate with rain.
The 3 Pseudomas strains were sprayed in the AIDA cloud chamber. The survival of these strains with time before cloud formation was measured and will be used in the future to parameterize models for bacterial transport. After cloud formation, IN activity of bacteria was followed with time, our results suggest that bacteria are precipitated in the cloud chamber as a result of their IN activity. Also the coating of bacteria with sulfates decreased their IN activity, pointing out the negative potential anthropogenic influence on IN bacteria activity.
3. Modeling study to see if any impact of bacteria on cloud development and/or precipitation is realistic.
Modeling studies were performed with DESCAM (Detailed SCAvenging Model) using as an input the new data from the different campaigns in AIDA.

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