

Interactive  
Comment

## ***Interactive comment on “Ice-nucleation negative fluorescent pseudomonads isolated from Hebridean cloud and rain water produce biosurfactants” by H. E. Ahern et al.***

**R. Psenner (Referee)**

roland.psenner@uibk.ac.at

Received and published: 27 October 2006

### General comments

Since the detection of microorganisms in clouds biologists, physicists and meteorologists have discussed possible implications, not only with respect to microbial physiology, species distribution and biogeography, but also regarding their potential contribution to the cycling of elements in the biosphere. Recently, the role of ice nucleation bacteria has raised much interest among practitioners, e.g. those who study plant pathogens, but also among theoretical biologists focussed on strategies of bacteria that may favour their dispersal and success. In addition, the transport and survival of

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

bacteria in the atmosphere has become also a topic for human health affairs.

I think, therefore, that this paper is of wide importance. In my view, it addresses a number of interesting aspects. First of all, it shows that - contrary to my expectation - no ice-nucleation activity was found. This is an important finding, especially if one considers that a large number of clones and isolates has been studied. Second, the presence of biosurfactants in more than 50% of all isolates suggests that these compounds play a role in the process of droplet formation, droplet growth and shrinking. This suggests to me, that microorganisms in the atmosphere do not only use the substances they find in cloud droplets, but that they actively "shape their environment" by adjusting size, chemical composition and - eventually - the fate of cloud droplets. I do not argue for teleology but in a way those pseudoñmonads are engineering their environment to make it either more stable or a better conveyor for their dispersal.

The authors have used state of the art techniques to avoid the drawbacks of common isolation techniques. Certainly, it would have been nice to see more samples collected during different occasions under varying atmospheric conditions (temperature, humidity etc.), but I admit that the techniques used do not allow to test a large number of samples.

What I missed and what I deem necessary to better understand such extreme and peculiar microbial habitats, is the number of bacteria, the size and quantity of droplets and the (statistical) distribution of cells per droplet. I think that more meteorological data (especially regarding the distribution of cloud droplets and aerosols) and cell counts (in the microscope or flow cytometer) would increase the impact of this paper.

Another aspect of importance is the chemical composition of rain and cloud water which had a very high conductivity (Table 2). What was the concentration of nutrients (nitrogen, phosphorus) and of dissolved organic carbon in your samples? Did this organic carbon consist also of surfactants, i.e. is there an indication of in situ surfactant production?

**BGD**

3, S687–S689, 2006

---

Interactive  
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

So I consider this paper as an important first glance at the phylogenetics and the physiological potential of airborne bacteria. It shows how to combine phylogenetic and physiological methods to tackle a problem that I consider important for both atmospheric chemistry and microbial ecology. If one considers global warming, the capacity/absence of ice nucleation and production of surfactants can play a crucial role for survival, growth and dispersal of bacteria. Taking into consideration that especially the effect of cloud cover (nowadays ~60%), cloud density and related characteristics are an important issue in the study of global warming, we badly need more studies about other aspects of cloud formation and cloud droplet lifetimes: if bacteria turn out to significantly alter the chemistry, the size and thus the dispersal of cloud droplets, we may need a new paradigm in microbial meteorology.

#### Specific comments

As a non-native English speaker, I stumbled over this sequence of words: "Ice-nucleation negative fluorescent pseudomonas isolated Ě". Is it OK to say "Fluorescent pseudomonads isolated from Hebridean cloud and rain water produce biosurfactants but do not cause ice nucleation"? The discussion of ice nucleation and of the potential effect of biosurfactants is well written.

#### Technical comments

I cannot add much to the methods section - except what I already said above - but I would have liked to see results from the Hebrides (or another location) under conditions where one could expect ice nucleation with or without the presence of ice-nucleating bacteria, i.e. under meteorological conditions with cloud droplets and ice crystals. Summarizing, I would like to see more meteorological and chemical data and/or samples collected during different weather conditions.

---

Interactive comment on Biogeosciences Discuss., 3, 1561, 2006.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)