

Interactive comment on “

Bacteria in the ECHAM5-HAM global climate model” by A. Sesartic et al.

A. Sesartic et al.

ana.sesartic@env.ethz.ch

Received and published: 24 June 2011

We would like to thank Corinna Hoose for the helpful comments and careful evaluation of the manuscript. The referee's comments and our responses follow.

1 General comments

Inconsistencies between the numbers listed in the tables, shown in the figures and cited literature: Corrected.

C5440

Treatment of bacteria as fully interacting aerosols [...] could be further exploited: We would like to thank Dr. Hoose for her suggestions, which we will keep in mind for a future study. For the scope of this study, we limited ourselves to adding an explanation on the detailed bacterial coagulation mechanism in the manuscript, and investigating the contribution of bacteria to freezing as compared to other aerosols. As the current study focuses on the role of bacteria as IN, we will consider their impact as CCN in a future study.

What is ignored in this study is the fact that even within INA bacteria species/strains, by far not all cells act as IN: This point has been taken into account in our study by the fact that we conducted sensitivity studies where we assumed between 1% and 100% of the total bacteria to be IN active. This has now been better explained in the manuscript.

2 Detailed comments

p 1459, line 14: noted and added.

p 1460 | 5: corrected.

p 1460 | 5: corrected.

p 1460 | 25: corrected.

p 1462 | 19: Rephrased and corrected.

Equation (1): It would be worthwhile to repeat the values of F_i which you are using, because Burrows et al (2009a) is giving a range of different values and it is not clear which ones you are referring to. Done.

p 1463 | 12: Is coagulation with sea salt excluded? Why? (I don't think it's important.): Yes. The treatment of the coagulation is now further explained in the manuscript.

C5441

p 1463 | 25: It would be good to give the mean diameter (although that can be calculated from the mass and density). Done.

p 1464 | 5: Are the direct effects and bacteria acting as CCN included as well? Direct effects of bacteria are included, but they do not yet act as CCN.

p 1464 | 11: Done.

p 1465 | 11: What is meant by "extrapolated"? This contradicts the caption of Fig. 4 ("for the gridbox containing the measurement location"). The latter was reformulated in order to avoid confusion. It should actually mean interpolated. Interpolation in this context means that as at T42 resolution one ECHAM gridbox is very large, the same value would be valid for an area of 2.8×2.8 degrees. In order to compare the data at the exactly same location, the gridbox data was interpolated to the exact longitude/latitude of the sampling site.

p 1467 | 7: "size of crystals" - as this has not been shown, could you give some information on how large this effect is. The effect is rather small and is therefore not mentioned anymore in the revised manuscript.

Table 2: Re-calculated, corrected and discussed. Table 2 is now Table 5.

Table 3: Re-calculated and corrected. Table 3 is now Table 6.

Table 3: As you compare to observations, are the model data over land only? What about the model data at the corresponding location? Please give more details about this comparison. Please note that Table 3 is now Table 6. The model emissions data are an average over land, while the deposition data are an average over the whole globe. The observations are point measurements over land, and only data where actual fluxes were given are used. All other data – as collected by Burrows et al. – stem from number concentration measurements.

Fig. 4: I'm surprised by the low observed bacteria concentrations shown here. Are the publications included here counting total or viable bacteria? This should be stated at

C5442

some point; as you are using the Burrows et al. emissions, these refer to total bacteria, and viable bacteria concentrations can be much lower. Only a few measurement points show low observed bacteria concentrations. All others are in – or exceed – the simulations by one order of magnitude. The observations refer to total bacteria counts. As Burrows et al. also noted, most measurements of airborne bacteria were conducted by collecting particulate matter via impaction on a culture medium, subsequently counting the colonies. Although a substantial number of bacteria in the environment are viable, they still remain non-culturable (see e.g. Roszak, D. and Colwell, R.: Survival strategies of bacteria in the natural environment, Microbiol. Rev., 51, 365, 1987).

In Fig 1, I actually find it a bit surprising that immersion freezing of bacteria starts "only" below -10°C . In Diehl et al (2004), a median freezing temperature of -7°C is given. Is this an artifact of the droplet size dependence? For what droplet size are the values in Fig. 1? The droplet radius is $10\mu\text{m}$. We added that.

3 Technical comments

p 1465, | 7: What is "it"? The observational data. Corrected.

p 1465, | 28: "maximum in ICNC" - shown is the difference in ICNC. Corrected.

Table 2: Remove "Tg/yr" from the third column. Corrected. Note that Table 2 is now Table 5.

Table 3: For the OBS Wet Dep. data, the numbers seem to be misformatted. Corrected.

Fig. 3 e) and f): The colortable extends to 300000 and the units are given as g/m². This is impossible. Corrected.

Fig. 4: If the error bars refer to the observations, they should be horizontal. Corrected and axes switched.

C5443

References: For Hoose et al (2010), please add volume and page numbers. Corrected.

Shaffer and Lighthart should read Shaffer and Lighthart. Corrected.

The Phillips et al (2009) paper has a different title and also more authors than listed here. Corrected, as erroneously the discussion paper has been cited.

Simmons and Gibson: Shin?eld: Corrected to Shinfield.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1457, 2011.

C5444