Atmos. Chem. Phys. Discuss., 11, C85–C88, 2011
www.atmos-chem-phys-discuss.net/11/C85/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "

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

Anonymous Referee #3

Received and published: 2 February 2011

Major Comments:

The main results and the methodology used in this paper are all in all very similar to those of Hoose et al., (2010a, 2010b), although a different global model (ECHAM5 vs. CAM-Oslo) was used. While I believe these main results to be very important, I strongly recommend to extend the present paper, for example by addressing the second major point raised in the referee comment by Dr Hoose in some detail.

Specific comments/questions/suggestions:

1. Several assumptions regarding scavenging, coating with H_2SO_4, coagulation with

dust, etc. of bacteria are rather uncertain. Do these assumptions have any influence at all on the main results? If yes, which are the largest sensitivities?

2. The presence of ice-nucleating bacteria can act either to increase or to decrease ICNC. Increases in ICNC due to ice-nucleating bacteria can occur where they outnumber other types of IN. Decreases in ICNC could be due to the fact that some bacteria nucleate at higher temperatures than other (possibly more numerous) IN. Do both of these effects actually occur in your simulations and, if yes, could you try to better sort out their respective roles?

3. In the second case, i.e. when ice nucleating bacteria lead to a decrease in ICNC, even a relatively small number of bacteria IN could potentially play a fairly large role. The importance of this effect is, however, limited by (a) the spatially inhomogeneous distribution of bacteria IN in the atmosphere and (b) the condition that ice crystal growth needs to be fast enough in order for super saturation to be sufficiently depleted before other (possibly more numerous) IN start playing a role. Could you provide some estimate regarding the relative roles of (a) and (b)?

4. Abstract:

"... changes in the liquid and ice water path can be observed, specifically in the boreal regions where tundra and forests act as sources of bacteria" -> Would a change in the color scale of Figs. 7 and 8 help to show this point more clearly? You might also want to mention the Arctic here, to where the bacteria are transported according to your findings.

5. p. 1460, l. 25: you could also cite Grützun et al. (2008).

6. Sect 2: Please make clear that the ECHAM5 version you are describing here differs from the one described in Roeckner et al., 2003.

7. p. 1462, line 9: which variables are nudged? Is water vapor among them?

8. p. 1465, line 8: You make it sound as if the observations do not reproduce the

observed variability. Please re-formulate.

9. p. 1565, line 15: on the danger of outing myself as a nitpicker: but this sounds as if standardized long-term observations with world wide coverage could help the fact that the model underestimates the variability in the bacteria concentrations? And: would setting up such a worldwide network of measurements be something that you would recommend based on your findings (other aspects aside)?

10. p. 1466, lines 1-7: Good point. Think about mentioning it in the abstract/conclusions.

11. p. 1466, l. 26-27: Could it be that the increased OLR is due to the reduction in N_i in this run (Table 4)? How do you know that it is due to the decrease in LWP?

12. Table 3, 3rd column: why do dry and wet deposition not add up to the total deposition for for 100BT-100?

13. Table 3, 4th column: what does $6.9^{o}\mathrm{E}{\times}10^{-12}$ mean?

14. Table 4: is it straight forward to find the N_l number directly from Han et al. (1998)? I must have overlooked this.

15. Fig. 5a: Is there any physical meaning in the patchiness of this figure or could it be that an averaging period of one year is too short even for a nudged run?

16. Please cite Hoose et al. 2010a.

17. Please address the issues raised in the referee comments by Dr Hoose thoroughly.

Technical comments:

1. Table 4, caption: (Schulz et al. 2006) -> Schulz et al. (2006)

2. p. 1463, l. 24: set on -> set to

3. Table 4, Fig 5: if possible use either N_i or ICNC.

References:

Grützun, V., Knoth, O., Simmel, M.: Simulation of the influence of aerosol particle characteristics on clouds and precipitation with LM-SPECS: Model description and first results. Atmos. Res., 90, 233–242, 2008.

Hoose, C, Kristjánsson J. E., and Burrows, S. M.: How important is biological ice nucleation in clouds on a global scale?, Environ. Res. Lett.., 5, 024009, doi:10.1088/1748-9326/5/2/024009, 2010a.

Hoose, C, Kristjánsson J. E., Chen, J.-P., and Hazra, A.: A classical-theory-based parameterization of heterogeneous ice nucleation by mineral dust, soot and biological particles in a global climate model. J. Atmos. Sci., 67, 2483–2503, doi: 10.1175/20103425.1, 2010b.

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