Atmos. Chem. Phys. Discuss., 15, C296–C298, 2015
www.atmos-chem-phys-discuss.net/15/C296/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice phase in altocumulus clouds over Leipzig: remote sensing observations and detailed modelling" *by* M. Simmel et al.

Anonymous Referee #2

Received and published: 19 February 2015

This paper has great potential as a comparison between modeled and observed mixed phase clouds. Its strengths are the high quality remote observations and the relatively direct modeling approach that allows for straightforward implementation and comparison of different ice nucleus (IN) concentrations and ice crystal shapes. The paper stumbles before reaching the finishing line, so I encourage the authors to improve the paper to its potential. There are a number of problems with the analysis and presentation, as detailed below, but these are relatively minor aspects that can be improved with modest effort. The major shortcoming of the paper is the complete absence of comparison between modeled and observed properties in section 5. This is the section where the most interesting science is finally addressed, through variation in IN concentration and ice crystal shape and fall speed. Is it possible to vary these parameters and obtain

results that compare with the lidar and radar observations with higher fidelity? And as such, can the suitability of IN parameterization or crystal habit representation be evaluated? As a single example, there is discussion of the "stronger tilting of the virgae" for nonspherical ice (page 1589). This seems like a perfect aspect to compare to observations. It is only one example, and in general, there needs to be a much more thorough and, to the extent possible, quantitative comparison between modeled and observed mixed-phase properties in this section.

The following points should also be addressed:

- Abstract: "warm temperatures" should be "high temperatures" (air is warm, temperatures are high).

- Pg 1574 line 22: "attributed the aerosol" should be "attributed to the aerosol".

- Pg 1574 line 25: I do not understand the statement that only biological particles form ice above -15 C. In the parameterization employed, which is mostly describing dust, IN exist at much higher temperatures.

- Pg 1575 line 1: should be "to what extent".

- Pg 1575 line 5-6: reference needed for this statement.

- Pg 1576 line 16: define GDAS.

- Pg 1576 line 24: "could be observed" should be "was observed".

- Pg 1577 line 1: "an LWP" should be "a LWP".

- Note: I stopped correcting minor grammatical errors after section 2. Authors, please proofread the paper carefully.

- Pg 1577, sec 3: Asai-Kasahara type model should be described more thoroughly, e.g., be clearer on cylindrical geometry, boundary conditions, etc.

- Sec 3.1.1: Regarding "Immersion freezing occurs as soon as liquid drops above a cer-

ACPD
15, C296–C298, 2015

tain size limit are present", why is there a drop size dependence? Freezing probability should be related to IN properties, not to volume of drop.

- Sec. 3.2.1 and Fig 5: What is the advantage of using a stochastic forcing for vertical velocity? It seems to only add complexity, with no obvious illumination of new physics. Why not force with a deterministic, e.g., sinusoidal, vertical velocity, for example?

- Pg 1583 line 27: I think "presence time" is clearer as "residence time".

- Sec 4: Comparison with figures and reported results is not straightforward: for example, figures are in g/kg, observations are in kg/mˆ3. Please be consistent.

- Fig 1: Left panel should be labeled as log10 of IWC.

- Fig 1: What is the purpose of the dashed box? Maybe I missed it in the text, but it should also be specified in the caption.

- Figs 6, 8, 10, 12: How useful are these comparisons? The differences between the panels are so small that it is not clear to me that they need to be presented graphically. The numerical results such as max LWMR and max IWMR may be adequate, unless details of the plots are specifically discussed in the text.

- Figs 6, 8, 10, 12, 14, 15, 17, 18: Maximum ice and liquid water values are reported with 7 significant digits. It cannot be that such accuracy is valid. (Also note that there is some inconsistency in using max LWMR versus max. drop water, etc.).

- Figs 15 and 18: The captions state that liquid is denoted by color and ice water mass is denoted by contours. That seems to be backwards.

- Fig 16: In the bottom of the left panel, please confirm that all lines are plotted (i.e., are they identical and cannot be distinguished?)

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1573, 2015.