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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical and physical influences on aerosol activation in liquid clouds: an empirical study based on observations from the Jungfraujoch, Switzerland" *by* C. R. Hoyle et al.

Anonymous Referee #1

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This paper reports on an empirical study of parameters influencing aerosol activation in liquid clouds. Four data sets obtained at the high altitude station Jungfraujoch are considered, and a parameterization of cloud droplet numbers as a function of aerosol particles larger than 90 nm, ozone, CO, updraught velocity, and height above cloud base was inferred. With these five parameters it appears to be possible to describe (and predict) the cloud droplet number concentration (CDNC) in a liquid cloud at the Jungfraujoch very well. The paper is well written, it is certainly within the scope of ACP, it presents an interesting and novel approach, therefore I recommend publication after my comments below have been considered.

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General comments

My main concern is that the authors describe their approach as a "model". To my understanding a model is something that uses a theoretical approach with known physical relationships that is used to predict experimental results. These predictions are then compared to the experimental results and, based on this, model parameters can be adjusted. What has been done here is a parameterization. Different variables that are known (or assumed) to have an influence on CDNC are correlated to the observed CDNC, and an empirical parameterization is built from this. For example, in panel a) of Figure 5, the "N_act predicted" is simply the number of CCN (particles larger than 90 nm) that are linearly correlated to the observed CDNC (here called N_act). In section 5.1 the authors seem to realize it and use the wording "statistical relationships". No physical explanations (e.g. from Kohler theory) for the factors in equation (2) can be given. Thus, I would strongly suggest replacing "model" by "parameterization" in the whole manuscript.

Specific comments

Page 15477, lines 22-25:

Removal of anthropogenically influenced data: How were these data identified? Particle number concentrations? CO levels? Please specify.

Page 15479, lines 3 – 12:

Why are different definitions for cloud conditions used? The difference is justified with different SMPS operation conditions (simultaneously scanning total and interstitial vs sequentially scanning both inlets), but the cloud conditions do not depend on the SMPS scanning time.

Page 15480, Line 15:

"The height of the JFJ above the cloud base (calculated from the total water content and temperature measured at the JFJ). . ." This reads as if it was clear to everyone how

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the height above cloud base is calculated, but I must admit that I don't understand how this is done. Also the calculation of the air temperature at cloud base seems to be a very simple approach. Please be more specific and mention the uncertainties in these calculations.

Page 15484, line 25:

One of the most interesting aspects here is the CCN size threshold of 90 nm that seems to work best. The authors mention that they tried 70 and 80 nm (but why not 100, see line 19 on page 15478?). I would suggest including a graph showing the results for 70, 80, 90 and 100 nm (predicted N_act only from CCN without the other variables)

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 15469, 2015.