Atmos. Chem. Phys. Discuss., 14, C5254–C5256, 2014
www.atmos-chem-phys-discuss.net/14/C5254/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Integrating laboratory and field data to quantify the immersion freezing ice nucleation activity of mineral dust particles" *by* P. J. DeMott et al.

Anonymous Referee #1

Received and published: 24 July 2014

In this paper DeMott et al. report a simple parameterisation for estimating the concentration of mineral dust ice nucleating particles (INP) based on the concentration of particles larger than 0.5 um. This is an extension of a previous study (DeMott et al., 2010) in which a similar parameterisation was defined for all aerosol types. The paper makes use of both laboratory and field studies and a compelling case is presented that desert dusts from multiple locations can be described with the same parameterisation. This is a well-written and valuable study and is suitable for publication in ACP once the following comments have been addressed:

1. My main concern with the paper is the inclusion of a 'correction factor' (cf) in eq

2. I am concerned that the validity of the approach outlined by the authors in this and previous papers is undermined by the inclusion of what could be interpreted as a 'fudge factor' and I am not convinced it is needed. My suggestion is to not include cf, but instead estimate uncertainties in the various fits employed in the paper.

The factor cf is defined by fig 7 in which nINP from the CFDC set at a S of 105% vs the highest value of S which can be achieved before water droplets contaminate the signal. The idea is that not all aerosol that could serve as immersion INP do so at the lower S, but do so at the higher S. I do not think this is satisfactory. The upper limit to S is simply defined by the instrument limitation. If the instrument were redesigned to allow for a larger S again, would the INP concentration increase further, would cf then increase? It is well worth noting that the CFDC *may* undercount INP, but I do not think it should be used to correct INP concentrations.

I would like to see an error analysis. What is the uncertainty in the INP concentration predicted by the parameterisation based on the scatter of the data around the best fit lines. Looking at Fig 6, for example, there is significant scatter around the parameterisation line – this probably accounts for more than a factor of 3 in uncertainty. Then when it comes to Fig 10 I suggest plotting the comparisons between measurement, the D10 scheme, direct field measurements and the prediction of the Niemand equation on 1:1 plots in which the uncertainties are indicated (probably for the dusty layer only; the point made about the INP in the MBL is valuable, but the key topic here is the mineral dust). I suspect that the cf=1 (i.e. no correction) curve would match the Niemand prediction within uncertainty in which case there is no need to introduce a correction factor. Similarly, the Niemand parameterization has some uncertainty with scatter of up to 1 order of magnitude either side of the best fit line (fig 3 of Neimand et al.); this should also be reflected in Fig 6. Given the uncertainty in both the new dust parameterization and the Neimand line, I suspect there will be good agreement between the various data sets in Fig 10 without invoking a correction factor.

2. Concerning the point made about 'mineral dust particles from locations as separate

as the Saharan or Asian regions may be parameterized as a common particle type for numerical modelling purposes'. This is an interesting observation and as the authors point out in line with what has been suggested previously by Neimand. A brief discussion of why this is the case is needed. An explanation is that there is a common component of these dusts which triggers ice formation. Atkinson et al. (Nature, 498, 2013, doi: 10.1038/nature12278) suggest that this minor component is feldspar which is ubiquitous in natural soil dusts.

3. Keys within figure 5 and 7 would be helpful for the reader. Having to refer to the caption takes longer than referring to a key.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 17359, 2014.