Atmos. Chem. Phys. Discuss., 14, C12491–C12493, 2015
www.atmos-chem-phys-discuss.net/14/C12491/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice nucleation terminology" *by* G. Vali et al.

Dr Murray

b.j.murray@leeds.ac.uk

Received and published: 3 March 2015

I have a few further comments to this very useful document:

1. 'Homogeneous deposition nucleation' has now been defined. The nucleation of liquid (or solid amorphous water) directly from the vapour phase is more likely than the formation of ice and may be important in certain locations of the atmosphere. It therefore needs to be defined. To be consistent with the term 'homogeneous deposition nucleation' we could refer to nucleation of amorphous material as 'Homogeneous condensation nucleation'. This is important because, experiments clearly show that it is amorphous material which homogeneously nucleates in preference to ice from the vapour phase. Below around -40oC these droplet rapidly freeze homogeneously. The work of Wolk and Strey (an others) is a good example of measurements of the homogeneous condensation nucleation rate down to ∼220 K (Wolk et al. J. Chem.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Phys., Vol. 117, 2002, DOI: 10.1063/1.1498465). Most importantly, homogeneous condensation nucleation may be important in the polar summer mesopause region (Jensen and Murray, Homogeneous nucleation of amorphous solid water particles in the upper mesosphere. Journal of Atmospheric and Solar-Terrestrial Physics 72 (2010) 51–61; doi:10.1016/j.jastp.2009.10.007). In this region gravity waves cause temperature perturbations of 10s K which our modelling showed can lead to supersaturations so extreme that homogeneous nucleation may take place. This even happens in the presence of a population of heterogeneously nucleated particles. Hence, I think that homogeneous condensation nucleation should be defined and it should be acknowledged that it may be important.

2. INP, INM, INE. I feel uncomfortable introducing all of these new terms in addition to INP. INP (ice nucleating particle) may be all we need. We can discuss the identity of the INP, but to refer to INM for example seems too specific. What evidence is there really that INPs are really macromolecules? Are we sure that the material from pollen is not an aggregate of molecules, i.e. something more like a colloid? Just referring to these materials as particles seems to get around the sticky problem of identity. The word particle is all encompassing – grains, colloids, molecules, atoms, sub atomic entities. . ...

3. I agree that 'ice nuclei' should no longer be used to refer to the particles which heterogeneously nucleate ice. An important additional argument is that the ice physics community use the term 'ice nucleus' or 'ice nuclei' to refer to clusters of water molecules. This causes confusion, which is avoided with INP. E.g. Moore and Molinero THE JOURNAL OF CHEMICAL PHYSICS 132, 244504 2010, doi:10.1063/1.3451112.

4. Condensation freezing. I think the authors have handled the definition of this mode very well. The only change I suggest is to replace 'is thought to take' with 'is defined as taking'.

5. Section 3.12 'comparison of stochastic and site-specific descriptions. In the second

ACPD
14, C12491–C12493, 2015

paragraph I think it should be stressed how important it is to experimentally test the time dependence. This is the only way of determining which of the two models is appropriate for a particular material. A data set at a single cooling rate could be fitted equally well by a stochastic description or a site-specific model. But, our experience is that most ice nucleating materials are better represented by a site-specific model. Assuming a stochastic model for these materials would over predict the time dependence (e.g. Herbert et al. 2014).

Typos: 3.3: extra 'be' towards end of last sentence. The reference numbers in bold need to be checked. 3.12: extra 'is' at end of sentence in second para. 3.14: previous not pervious.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 22155, 2014.

ACPD

14, C12491–C12493, 2015