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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "A new thermal gradient ice nucleation diffusion chamber instrument: design, development and first results using Saharan mineral dust" *by* G. Kulkarni et al.

**Anonymous Referee #1**

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General Comments

The paper describes a method and an instrument for measuring the onset of ice nucleation on aerosol particles. The concept of the new instrument relies on the static diffusion chamber that has been used for many years. The new feature of this instrument is the ability to vary the supersaturation with respect to ice (SSi) that the particles are exposed to. This is done by lifting the stage on which the particles reside from the lower cold plate toward the upper warmer plate. The linear temperature difference between the plates and the non linear relationship of vapor pressure with temperature produces different SSi at different heights in the chamber. By viewing the aerosol sam-

ples through a microscope, the onset of nucleation can be determined. This innovative and simple idea is shown to be practical in order to answer the questions posed by the authors, namely, determine the onset of ice nucleation temperature and SSi of the samples on the cold stage.

Specific comments

The paper fails to mention some recent development of instruments for ice nucleation that are also capable of measuring the onset of nucleation and which have other advantages over the presently proposed method. For example, no mention or comparison is made with the FRIDGE or FINCH instruments (Bundke et al, 2008, Atmos. Res.; Klein et al, 2008, and Ardon et al, 2008, both at the Inter. Confer. on Clouds and Precipitation, Cancun, Mexico). In the introduction, the authors argue that some of the dust particles are transported upward in the atmosphere without becoming internally mixed with hygroscopic material. Many measurements of the composition of dust showed that sometimes as much as 35-50% of the dust particles are internally mixed. Going through clouds on their way up the particles will certainly be subject to mixing with other material, either by dry of wet processes. This point should be addressed in the paper with appropriate references. One disadvantage of the present instrument in its present configuration is the inability to directly sample aerosols from the air. The method used here for placing the particles on the Teflon substrate is not specific enough. The authors mention that the particles are sieved, thus selecting only those smaller than 38 microns. These are certainly giant particles, most of which are not transported over long distances and are probably not the ones that make a difference in clouds. Even the particles shown in Fig. 6 are very large (˜20 microns in my estimate). Since most dust particles are about 1 micron in size, how good is the resolution of the proposed set up to be able to detect nucleation on particles that are much smaller. Although the paper describes the measurements of temperature in the chamber, it is not clear how the temperature of the Teflon surface is measured. This is the most critical temperature for nucleation. In section 4.2 the paper mentions calibration using the melting point of



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ice. The procedure for this calibration is not clear, because it should depend on the rate of temperature change and the ability to control the temperature. This procedure should be mentioned. In the conclusion the authors state that the onset of deposition nucleation on the dust particles varied from -17 to -33 C and from 3% to 10% SSi. It would be valuable if the distribution in the form of scatter plot is also included in the paper.

Minor comments

On Page 166 the abbreviation DRH should follow immediately after “deliques-cence relative humidity”. The temperature of the experiment in Fig.6 should be specified.

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Interactive comment on Atmos. Meas. Tech. Discuss., 2, 153, 2009.