Answer to "Anonymous Referee #1"

Dear referee,

thank you for the detailed reading and commenting of our manuscript. In the following, we would like to reply to the points that you mentioned.

1) **Deposition nucleation as homogeneous or immersion nucleation in pores and cavities**
The recent paper by Marcolli [ACP, 14, 2071-2104, 2014] presents a pretty compelling case that what is typically interpreted as deposition nucleation is, in fact, condensation of water into cavities or pores, followed by freezing in the immersion mode or homogeneous freezing, if the temperature is low enough. Lines 1 through 5 on pg. 18511 of this paper are consistent with that hypothesis. Higher RH with respect to ice is required at higher temperatures while freezing begins at low RH for the colder runs.

This remark refers to our observations that at 250 K ice nucleation occurs at relative humidity values between 112 and 125%, whereas for temperatures below 235 K ice nucleation is already observed slightly above saturation with respect to ice. Indeed, pore condensation freezing could contribute to the observed total ice nucleation. In our setup, deposition nucleation and pore condensation cannot be measured separately because we did not investigate in detail the processes at the particle surface. Therefore, it is not possible to estimate the individual contributions of the two freezing mechanisms.
However, it is a very valid point that pore condensation freezing should be mentioned. Further experiments may focus on the influence of different particle or surface structures on the freezing processes and might be able to capture pore condensation freezing as opposed to deposition nucleation.

We propose to add the following lines on p. 18522, l.21:
"It should be noted that the observed freezing thresholds could also be partly explained by a freezing mechanism other than deposition nucleation, namely pore condensation freezing. Pore condensation freezing was discussed by Marcolli et al. (2014) as an explanation for freezing below water saturation. Note, however, that in our experimental setup we cannot clearly distinguish between these freezing mechanisms and thus make the assumption that ice nucleation is mostly caused by deposition nucleation.

2) Why is a parameterization for Arizona Test Dust in the deposition mode necessary?

Why is this parameterization a valuable addition to the literature, especially considering that measurements of ATD in the deposition mode have already been made. I think the authors could have made the case for these measurements and this analysis a bit more forcefully

We agree that ATD is only a starting point for many experimental studies investigating the ice nucleation properties of natural mineral dusts at low temperatures. It is planned to develop similar temperature and humidity dependent ice nucleation active site density parameterizations for natural mineral dusts in the future. The advantage of ATD is that it is available in large quantities to all interested laboratories and that the results from different instruments can thus more easily be intercompared than results for natural dusts. Our data set differs from previous studies because we have investigated deposition nucleation by ATD particles over a wide range of temperature and humidity conditions. Within the AIDA cloud chamber temperature and humidity can be measured simultaneously and with very small measurement uncertainties. Additionally, we can control the cooling rates, i.e. the time scale, within the AIDA cloud chamber. Thus, being able to study the impact of variations in temperature, humidity and cooling rate is a very unique feature of AIDA cloud chamber studies.
The ATD experiments presented in this work are supposed to be only a first step in rigorously investigating deposition nucleation in order to gain a better understanding of the factors which are relevant for deposition nucleation. More extensive deposition nucleation studies with natural aerosols are planned. These experiments can then be analyzed with the proposed INAS density approach in order to inform ice nucleation parameterizations.

We propose that the following sentences are added to the discussion section:
"The ATD experiments and modeling studies presented in this work are supposed to be a first step in rigorously investigating deposition nucleation over a wide temperature and saturation range in order to gain a better understanding of the factors which are relevant for deposition nucleation. This knowledge was then used to develop a metric which can be easily employed for the comparative analysis of other deposition nucleation studies." (p.18524, l.26)

3) Minor point

Pg. 18512, lines 24-25: "...T represents the numerical value of the prevalent temperature..." What is a prevalent temperature? Is that the average temperature in the chamber? This is a bit confusing to me.

Thank you for this remark – we will change "prevalent temperature" to "average temperature within the cloud chamber".