

Dear Prof. Knopf,

Thank you for your revision of our manuscript and for your comments. Here we provide our replies to them:

1. Throughout the manuscript when discussing lambda and omega values the units are missing. You indicate both parameters are in units "K-1". However, for a reader not familiar with this approach, Eq. (10) does not result in a parameter with this unit, but units of omega appear to be $\ln(s^{-1} cm^{-2})/K$. This likely reflects the empirical nature of this approach (maybe an approximation). Lambda is also a proportionality factor and its units are correct. For the purpose discussing these two proportionality factors, I am fine as is in this manuscript, however, you need to elaborate on the units of omega (especially since it is different from Eq. 7 by surface area from Vali 2014), so a reader going through the math understands the approach of this method and how you can compare it to lambda.

The units of lambda and omega indeed appear to be $\ln(s^{-1} cm^{-2})/K$. This stems from their similar definition in equations 7 and 10, and that the units of R/A and J are the same. Nevertheless, the quantity with $\ln$ is generally (but incorrectly) treated as dimensionless in order to get rid of this awkward unit above (e.g., in Herbert et al, 2014; or Budke and Koop, 2015). This reflects the empirical definition of lambda and omega. We added these information to the discussion after equations 7 and 10.

2. Line 28: Typo "coefficient".

Corrected.

3. Line 204, after Eq. 15: I believe there is an error in derived nucleation time. Should it be "...1 K min⁻¹, and a typical lambda value of 2 K⁻¹, a total observation time of 30 seconds is obtained."?

Yes, thank you for this catch. We have corrected to "30 seconds"

4. Line 274: Please include newest references on this matter. Please add reference Knopf et al. (2020) to Alpert and Knopf (2016) that provides proof that surface area variance and stochasticity explains NX illite immersion freezing, also topic of this study. The issue of surface variability was also discussed in Barahona (2020) and could be mentioned in separate sentence. Knopf et al. (2020) and Barahona (2020) should be included in conclusions section on page 26.

We extended the discussion near line 274 and the conclusion with the findings of Knopf et al. (2020) and Barahona (2020).

Furthermore, we submitted the data sets plotted on the figures to zenodo.org. They will be published and available under doi:10.5281/zenodo.4436153 as given now in line 606. The final publishing of the data set will be conducted as soon as the doi of the published paper is generated.

Yours sincerely,

Miklós Szakáll

Institute for Atmospheric Physics Physik der Atmosphäre
Johannes Gutenberg University Mainz, Germany