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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Predicting cloud ice nucleation caused by atmospheric mineral dust" *by* Slobodan Nickovic et al.

Anonymous Referee #1

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This work presents the implementation of DeMott et al., 2015 and Steinke et al., 2015 ice nuclei parameterizations in the regional atmospheric and dust transport model NMME-DREAM. Comparisons with satellite and ground measurements of cloud properties indicate a promising behavior of the new model version.

I would recommend publication in ACP after the authors address the following comments in order to clarify certain aspects of the manuscript.

Specific Comments:

In general: My main concern is that at this stage the authors compare model ice nuclei with observations of ice water path which are not directly comparable. It would be more appropriate to calculate the corresponding modeled cloud properties and use them for model evaluation. Model results with the old version of the model should be

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Discussion paper

also presented for comparison.

Page1, Line 1 (title): Predicting cloud ice nucleation caused by atmospheric mineral dust. The title could be more specific and declare that the paper shows the implementation of existing ice-nucleation parameterizations in NMME-DREAM.

Page2, Line 28: To our knowledge, this is the first time that all ingredients needed for cold cloud formation by dust are predicted in operational forecasting mode within one modeling system. Please provide more support for this statement since a variety of coupled dust-ice models seem to be already available (e.g. Zhang et al.,2012; Liu et al., 2012; Atkinson et al., 2013)

Page 4, Line 14 : In this study, dust concentration, atmospheric temperature and moisture as predicted by the atmospheric component of the coupled model are used to calculate. The parameterization consists of two parts applied to warmer and colder glaciated clouds. The vertical wind component is a crucial parameter for CCN/IN activation processes. Do you consider w in your calculations?

Page 5, Line 20: to identify the different aerosol types (Papagiannopoulos et al., 2015) taking advantage of the large number optical properties they are able to provide, i.e. lidar ratio at two wavelengths, the Angstrom exponent, the backscatter-related Angstrom exponent, and linear particle depolarization ratio. This aerosol typing capability allows to classify the aerosol type acting Nin, and especially to separate mineral dust from other types of aerosol Please add Papagiannopoulos et al., 2015 in your Reference list. Also check carefully your references and edit your list in ACP format.

Page 6, Line 15: The model resolution has been set to 25km in the horizontal. Could you please justify how you resolve cloud-scale features at this resolution?

Page 7, Line 4. On the other hand, a visual inspection shows considerable similarity between NL and the IWPL patterns (columns (B) and (C)) with respect to their shapes and locations. These two quantities are not directly comparable. Could you please

show what is the NMME predicted IWP? Also show the difference between the control run (without IN parameterization) and the new run.

Figure 2. If I interpret correct the plots in Figure 2, it seems that the model predicts IN even at areas without dust. If your only aerosol source is dust (Eq.1, Eq.2) could you please explain more on this?

Page 7, Line 29: The forecasts are translated horizontally over the observations until the minimum squared error (MSE) is achieved Please explain.

Page 8, Line 8: Anyhow, in order to predict IWC we need to incorporate predicted Nin into a cloud microphysics scheme, which is a future task of our project. Therefore, the comparison using a semi-quantitative approach is the only available at the current stage of the analysis. Why don't you incorporate the NMME microphysics scheme? Please show also the modeled IWC.

Page 8, Line 14: Most of the ice, observed by the cloud radar below 4.0-4.5 km above ground level (AGL), is not predicted by the model. Is there any dust at these layers? If there is no dust in the model and your only IN source is dust, this could make sense.

Page 8, Line 23: Moreover, like for the case of May 2010, the model tends to under-predict the lowest ice water layers observed with the radar below 4.5 km AGL. Again it is a little confusing when you refer to IN and when you refer to ice water. Also to me it looks like there is no IN below 6km which means that the model fails to represent half of the clouds in this cross-section.

Page 8, Line 27 and Figure 5 caption. Replace upper and lower panel with left and right

Page 9, Line 18: On the contrary, in South Italy, the volcanic layer, observed at Potenza up to an altitude of about 8 km above sea level Please provide some evidence for this argument

Page 9 Line 20: did not observed? Typo - observe

Page 9, Line 29 : The model has been validated Avoid the use of the term validation (here and elsewhere in the text) since you are only referring to specific case studies. A validation process would require much more comparisons with observations and for a much longer time period until the model could be verified to produce validated products.

Page 9, Line 32: wormer negative temperatures Typo - warmer

Page 10, Line 6: What do you mean by “unfired modelling system”

Throughout the text Please check again the text for grammar and spelling and provide an improved manuscript.

References

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