

Interactive comment on “Investigating the role of dust in ice nucleation within clouds and further effects on the regional weather system over East Asia – Part II: modification of the weather system” by Lin Su and Jimmy C. H. Fung

Anonymous Referee #2

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This paper is Part 2 of a two part series. In the first part updates were made to the WRF-Chem model to be able to quantify the full effect (direct and indirect forcing) of dust as ice nuclei, and in that part, the authors evaluated the model. In this second part, the updates are used to determine the radiative and precipitation effects of dust in East Asia. The paper is well written and relevant. However, I am torn between recommending minor changes and major changes due to some questions I have.

My main question is regarding the setup of the sensitivity tests. My understanding is that in addition to dust as aerosols, there are also other aerosols included (coming from

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the GOCART scheme, with should include as far as I know, sulfates, sea-salts, elemental and organic carbon). When describing the NO-AER and AER runs, the authors state that NO-AER are conducted without dust, and with aerosol radiative feedback turned off. The way I read this is that radiative feedbacks for all aerosols (sulfates, carbon, sea-salt and dust) are turned off. In the same manner, when aerosol radiative feedbacks are turned on (AER runs), I read this as aerosol feedbacks for all aerosols (not only dust) is turned on. If this is true, I think there is a problem with the sensitivity tests, as evaluating the differences between NO-AER and AER actually includes impacts from all aerosols, and not only dust. In this case, more sensitivity tests are needed, where only the radiative effect of dust is turned on or off, and not all aerosols. If I am misunderstanding, and the radiative effects of the remaining aerosols (sulfates, sea-salt and carbon) are always on, then this needs to be explained in the paper. For example, instead of calling the different runs for NO-AER and AER, call them NO-DUST and DUST instead.

Nothing is said about homogeneous freezing in this paper. Is homogeneous freezing of deliquesced aerosols included, which is an important part for cirrus production? Or are the NO-AER runs with a constant 1 per Liter as IN the only way to produce ice in the scheme? If homogeneous freezing is not included, I believe these runs highly overestimate the effect of dust, as increased dust concentration in cirrus regions can actually cause decreases in ice crystal concentration through the competition between homogeneous and heterogeneous freezing process. If homogeneous freezing of deliquesced aerosols are included, then please state that in the paper for clarification.

There are several citations missing in this paper. Make sure all work that is referred to are cited.

In general, I suggest using IN (or INP) as an acronym for ice nuclei, since this is commonly used in the ice (or INP) community.

Minor comments Page 3, line 45: Precipitation should be singular and not precipita-

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tions. Page 4, line 60: Rephrase “very rare work”

Page 4, line 66: The correct name for the Thompson aerosol aware scheme is the Thompson-Eidhammer aerosol aware scheme. Further, a citation to their 2014 paper is needed here. Page 4, Line 67: A citation is needed for the first Part of the series. After searching and finding this paper I am surprised that the authors did not cite it, as they are the authors of the first part of the series as well.

Page 4. Line 79-81: A short description of the calibration factor cf should be included here. Also a short description of the effect of setting RH to 100 % in relation to the ice nucleation parameterization should be explained in this paper. And which ice nucleation scheme is used? Actually, I believe the authors could include a section, summarize briefly part I of the series where they include a short description of the GOCART-Thompson implementation and their findings.

Page 5, line 94: A citation for Shao’s dust emission scheme is needed.

Page 8, line 171: Replace “observed” with “observations”

Page 8, line 190: Replace “reproducing” with “reproduced”

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