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**Geoscientific
Model Development
Discussions**

Interactive comment on "

The multi-scale aerosol-climate model PNNL-MMF: model description and evaluation" *by* M. Wang et al.

Anonymous Referee #1

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The paper presents a very interesting model tools that include small scale processes e.g. convective clouds within a coarse model framework, which is certainly relevant for addressing scientific questions within the scope of EGU. Although the model tools are not new the combination represent a substantial advance in modelling science. The presentation is well structured, but with some deficiencies in the description of the methods and interpretations of results

The title and abstract reflects the content of the paper although I would prefer to replace

the wording "reasonable well" with a quantity at least once, e.g. within a factor of two,

The methods are generally well outlined, but the distinction between convective clouds and "stratiform" clouds are somewhat unclear. If the methods are the same how do you differentiate? The relative importance of convective scavenging is lower in this paper compared to earlier paper by some of the co-authors. Is this due to the speciation of convective or stratiform clouds?

Also I think the authors may be more precise in their description of the wet-scavenging process, in particular since it is emphasized a lot in model-model and model-measurement chapter. I assume that the in-cloud scavenging is modelled explicitly by the activated aerosol fraction?

There are also two other assumptions I would like the authors to comment on. Is the results sensitive to the assumed minimum grid vertical velocity of 0.1 m s-1 and the sub-grid vertical velocity minimum of 0.2 m s-1.

The set-up of the experiments are concisely described, although personally I think 2 months of spin-up is short wrt polar regions, in particular over the Antarctic regions. I do not think it will change any of the conclusions though.

As mentioned above I think the description of scavenging is a weak point. In particular this is the case when it comes to interpreting the budgets, and to some minor extent comparison with measurement. The authors define a wet removal rate coefficient by the inverse of the the residence time. This bulk parameter combine a lot of the physical properties in the model, including updraft velocity, activation rates, cloud volume, moisture convergence precipitation frequency I

assume and understand that the authors would like to include the activation budget together with cdnc calculation and in-direct effect, but I nevertheless ask the authors to consider including numbers for scavenging coeffecients as calculated by the activation.

This may also provide information on whether the relatively low scavenging is due

to the activation or the precipitation distribution. On the other hand I am wondering whether the ccn part of the paper should be included in-direct effect paper, since I find the sometimes large differences between ccn and cdnc interesting in the context of activation more than wrt to theoretical measurements.

Some details.

I assume "hydrometers" should be "hydrometeors" (found several places throughout the paper)

1629, line 22 "addressed" instead of "address" ?

1630 last line "those" –> "these" ?

1634 cloud-borne vs interstital cloud-borne in this connection is inside cloud droplets, not all particle within the cloud volume?

1643 Martensson should be Mårtensson

1646 Long lifetime of sea-salt. Is the gravitational settling 3 dimensional and take into account hygroscopic growth?

1650 Elevated so2 layers over the Pacific. The emission data-set includes a number of volcanoes. The location of active volcanoes will of course vary from year to year so the difference in the position of elevated so2 layers may be caused by variation in volcanic activity

1651-14 sties –> sites

1653-10 middle –> mid

1654-22 Aikten –> Aitken

1656-22 strong —> high ?

1668 Table 1 lifetime range 0.2-2.6 should be 0.6-2.6 ? At least that is what is said in the text

1695 figure 22: Close to impossible to distinguish between 0.4 and 0.6.

Interactive comment on Geosci. Model Dev. Discuss., 3, 1625, 2010.