Atmos. Chem. Phys. Discuss., 7, S6015–S6018, 2007
www.atmos-chem-phys-discuss.net/7/S6015/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ion-mediated nucleation as an important global source oftropospheric aerosols" *by* F. Yu et al.

F. Yu et al.

Received and published: 16 October 2007

The authors thank the referee for the thoughtful and constructive comments. Our specific responses are given below (Comments of Anonymous Referee 3 in Italic).

Specific comments

Page 13604, line 9: "At given values of [H2SO4], T, RH, Q, and S0, JIMN can be accurately decided using the look-up tables with an efficient multiple-variable interpolation scheme."

More details would help support the point on the precision of the lookup table interpolation. Can you give a measure of how well the interpolation of the lookup

table reproduces nucleation rates calculated with the detailed model? What is the resolution of the lookup table in the different dimensions? What is the multiple-variable interpolation scheme exactly?

JIMN depends on $[H_2SO_4]$ (cm^{-3}), T (K), RH (%), Q (ion-pairs $cm^{-3}s^{-1}$), and S0 ($\mu m^2 cm^{-3}$).The JIMN lookup table has two sub-tables: one for high T (250 – 300 K) and the other for relatively low T (190 – 250K)

Sub-Table1 (high T range):

Variable	Range	Resolution
T	250 – 300 K	2 K
RH	1 – 99 %	2%
LOG10([H2SO4])	5.7 – 9 ([H2SO4]: 5E5-1E9)	0.1
LOG10(Q)	0.7-1.7 (Q: 5 – 50)	0.1
LOG10(S0)	0, and 1 – 3 (S0: 1, and 10 – 1000)	0.1

Sub-Table2 (low T range):

Variable	Range	Resolution
T	190 – 250 K	2 K
RH	1 – 99 %	2%
LOG10([H2SO4])	5.7 – 8 ([H2SO4]: 5E5-1E8)	0.1
LOG10(Q)	0.18 –1.48 (Q: 1.5 - 30)	0.1
LOG10(S0)	0, and 1 – 2 (S0: 1, and 10 – 100)	0.1

If needed, the JIMN lookup tables can be extended to cover wider ranges and the resolution can be improved as well. The multiple-variable interpolation scheme is similar to

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the one given in Yu (JGR, 111, D04201, 2006) except that the number of variables increases from 3 to 5. The difference between the interpolated values of JIMN and those corresponding values calculated with full model are generally within a few percentage.

Page 13602, line 15: "Due to the uncertainty of the emissions from sporadically erupting volcanoes, we only consider the continuously active volcanoes emission in this study. The emission from eruptive volcanoes is not considered in the study of Lucas and Akimoto (2006) as well."

The first rationale is much better than the latter.

To address the concern, we will delete the latter rational.

Page 13606, line 7: "Observed nucleation events typically last for 3 h a day, ..."

Why not giving a reference here, e.g. [1] or [3]

We will add several references.

Page 13606, line 18 and 25: "Most boundary layer nucleation events in the northern hemisphere (except over remote ocean areas, and Greenland) are associated with anthropogenic SO2 emissions; in the southern hemisphere, nucleation is triggered both by oceanic DMS and anthropogenic SO2. The simulations also indicate that nucleation induced by anthropogenic SO2 emission contributes to particle abundances in the southern hemisphere."

Could you say a few words how you came to these conclusions? While it seems safe to assume that SO2 in the vicinity of strong anthropogenic sources is mainly responsible for nucleation, how do you identify the relative contributions of anthropogenic and natural SO2 to nucleation farther away?

Yes. We were making general statements about the difference in contribution of anthropogenic SO2 emission to nucleation in the northern and southern hemispheres. The general statements are based on the high nucleation rates in the vicinity of anthro-

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pogenic sources and spatial patterns of SO2 concentrations. The relative contributions of anthropogenic and natural SO2 to nucleation farther away are not addressed here. We will revise the sentence to clarify the point.

Page 13608, line 10-12: I disagree with Referee 3 on this point: Transport and mixing can make small particles "pop" up quickly at a measurement location and thus mimick very fast nucleation in conditions that would support nucleation only at a much lower rate. This effect is more likely to occur the larger the smallest particles are that can be detected.

Agree.

Page 13609, line 27: "The general agreement between simulations and observations demonstrated above strongly supports the important role of IMN in generating new particles in global troposphere."

Given the considerable uncertainties involved in the comparison (see "General comments" above) and without considering other nucleation pathways, such as neutral binary and ternary nucleation, and the possible role of organic molecules in aerosol nucleation, a slightly more cautious wording could be justified here.

To address the concern, we will change the sentence to "The general agreement between simulations and observations demonstrated above suggests that IMN may play an important role in generating new particles in global troposphere."

Technical details

All the suggested technical corrections will be considered in the revised version of the paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 13597, 2007.