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## ***Interactive comment on “Development of an aerosol chemical transport model RAQM2 and predictions of Northeast Asian aerosol mass, size, chemistry, and mixing type” by M. Kajino et al.***

**Anonymous Referee #2**

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The authors describe the development of a simplified version of the MADMS aerosol model and its incorporation into the chemical transport model RAQM. The new model, dubbed RAQM2, is then applied to an annual simulation for the year 2006 over a North-east Asian domain with 60 km grid spacing. The model is evaluated by comparison with observational data from relatively remote sites in Japan.

The RAQM2 aerosol model uses four log-normal modes. It does not assume that the gas and aerosol phases are in equilibrium, but instead simulates condensation and evaporation dynamically. RAQM2 also includes six parameterizations related to aerosol dynamics: (1) new particle formation, (2) CCN activation, (3) IN activation (4)

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explicit grid-scale cloud microphysics, (5) dry deposition, and (6) subgrid convection and scavenging. The model uses offline-coupled meteorology from the WRF model, so CCN and IN activation do not lead to differences in the meteorology, but are used to determine scavenging and wet deposition.

The paper is well organized and for the most part the model is very well described. The model application and evaluation are reasonably rigorous and comprehensive: annual simulation period, hourly measurements of various gas-phase species and bulk PM<sub>2.5</sub> and PM<sub>10</sub> concentrations, weekly or biweekly filter pack measurements of gases and aerosol components, plus hourly AMS data at one site. I recommend publication in ACP if the minor points listed below are addressed.

#### Specific comments

- Please explain why the WRF-RAQM2 simulations were performed in monthly segments with two-week spin-up periods. Is this the case for both WRF and RAQM2, or only WRF?
- The paper refers to four aerosol "categories": ATK, ACM, AGR, and COR. I believe these are synonymous with "modes" but the terminology was confusing to me. Please clarify.
- In a few places (e.g., pg 13413 lines 11 and 20) the phrase "fix the LNSD" is used. I believe "characterize (or describe) the LNSD" is what is meant; "fix" sounds like the moment parameters are not varying in time.
- Within the aerosol code, what are the variables that describe each mode? On 13413 line 11 it says N, Dg, and sigma\_g, but on line 25 it says M0, M2, and M3, or for coagulation M0, M3, and M6. A few additional equations showing the relationship between these sets of variables would be helpful so that the reader can understand how the code progresses along the aerosol subprocesses shown in Figure 2. What are the transported variables defining each LNSD? Is sigma\_g calculated for each

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Comment

mode, or is it held constant, or not allowed to exceed some maximum value?

- The conclusion is a simple summary of the main points in the previous section. I encourage the authors to go beyond that restatement and make some additional remarks, such as the next two points below.

+ As noted in the introduction, in terms of complexity this model lies between the GATOR-GCMOM of Jacobson and regulatory models such as CMAQ, which rely on assuming thermodynamic equilibrium for the fine aerosol modes. How computationally expensive is the new RAQM2 model, particularly the aerosol component? Is it feasible for urban airshed modeling?

+ Are there plans to make the coupling between WRF and RAQM2 a two-way coupling, so that the aerosol microphysics affects the clouds and/or radiation in the meteorology model?

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 13405, 2012.

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