Atmos. Chem. Phys. Discuss., 12, C10586–C10588, 2012
www.atmos-chem-phys-discuss.net/12/C10586/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "An advanced scheme for wet scavenging and liquid-phase chemistry in a regional online-coupled chemistry transport model" *by* C. Knote and D. Brunner

Anonymous Referee #1

Received and published: 14 December 2012

General comments

This manuscript describes the incorporation of a wet scavenging and aqueous chemistry scheme into the COSMO-ART regional online-coupled meteorology and chemical transport model. What is unique about this scheme is that the grid-scale clouds are simulated in a consistent manner between the meteorological and chemical transport components. The model explicitly tracks the concentrations of species in the gas phase, cloud water, and rain water, to simulate the release of aerosols to the gas phase upon cloud/rain droplet evaporation.

This is a well-written paper, and I appreciate the effort the authors have put into actually

explaining the algorithms used. I recommend the paper be accepted for publication after the points below are addressed.

Specific comments

I could not understand what was meant by the last sentence of the abstract (dominates over what?) until reading Section 4.6. Please expand and clarify so that the statement in the abstract can be understood by itself.

I had a hard time following the discussion on pages 26107-26109: 26107 line 24 This sentence does not make sense. I think the first word should be some quantity other than f_wght. If f_wght is a fraction, it can't equal a dimensional quantity like qc_max. Also, the name of the variable f_wght for the fraction of the total flux that is considered to be nucleation is not intuitive.

26109 lines 7-9: It would help to give equations describing the transfer of 10% and 90% of the number and mass to the the Aitken and accumulation modes. Presumably the surface area is adjusted accordingly?

26112 lines 25-28: If I am interpreting these lines correctly, reduced nitrogen (NR = NH3 + NH4+) is initially predominantly NH4+. As the air encounters a cloud, some of the NH3 is processed by the cloud and converted to NH4+, with the result that aerosol phase NR is further increased. But is the model conserving N (and S) mass? Similarly, if SO2 decreases by 40% from 5 ug/m3, it seems that SO4 should increase by more than 0.55 ug/m3. The idealized framework is well suited to addressing this question of mass conservation.

Section 4.6: I am not sure what is meant by "diagnostic precipitation." The statement that the meteorological community has already found such a treatment to be inadequate should have a reference. If what is unique in the modeling system here is that chemical composition of rainwater is tracked separately from cloudwater, then it would be nice to show that this makes an important difference in the modeling results. Ad-

ACPD

12, C10586–C10588, 2012

vecting additional tracers for rainwater constituents is computationally expensive. The argument presented in this section and Figure 10 is not very conclusive.

The limitation that only grid-scale clouds are treated, and not subgrid clouds, should be mentioned in Section 2 as well as Section 5.1.

Technical corrections

In the last paragraph of the introduction, the authors use "the first section" to refer to Section 2, "Section 2" to refer to Section 3, and so on.

Athanasapoulou et al. 2012 is not in the list of references. It sounds like an advertisement of a work in progress that does not need to be cited, especially if it has not been submitted.

In Tables 2 and 3, what is k0, and what are the units of k0 and dH/R? The value given for water of 1.0E-16 is not what I expected to see. I suppose the difference is due to rewriting an equilibrium as a kinetic reaction, but please clarify. Should all the quantities on the left side of Table 2 be denoted (aq)?

26104 line 1 Please give the equation or equation number from Tost et al., as done on 26107 line 5.

26104 line 24 I think you mean "down to" or "as low as" 1 km.

26109 line 20 "processed" should be "processes"

Fig. 5: What are the numbers in the upper right corner of each panel? Number of observations?

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26099, 2012.