

***Interactive comment on* “Treatment of non-ideality in the multiphase model SPACCIM – Part 1: Model development” by A. J. Rusumdar et al.**

Anonymous Referee #2

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The authors have implemented the effects of solution non-ideality in aqueous-phase reaction kinetics in the SPACCIM modeling framework. This manuscript focuses on the model development and numerical aspects of the new treatments while a companion manuscript focuses on the results from detailed modeling studies. The manuscript is recommended for publication after the following minor comments are addressed.

Comments:

Page 4156, line 5: “. . .models do generally not consider. . .” sounds awkward. Suggest revising to “. . .models generally do not consider..”

Page 4156, line 6: Please define SPACCIM (all acronyms should be defined at their first use).

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Page 4156, line 8: Revise “The present paper describes firstly, the performed model development including (i). . .” to “The present paper firstly describes the model developments, including (i). . .”

Page 4156, line 9: the phrase “the kinetic implementation of the non-ideality in the SPACCIM framework” is confusing. Suggest revising it to “the implementation of solution non-ideality in aqueous-phase reaction kinetics in the SPACCIM framework.” Similar sentences elsewhere in the manuscript should also be revised appropriately.

Page 4156, line 13: delete “performed”

Page 4159, line 6: The “Zaveri et al., 2005” citation here should refer to “Zaveri, R. A., R. C. Easter, and A. S. Wexler (2005a), A new method for multicomponent activity coefficients of electrolytes in aqueous atmospheric aerosols, *J. Geophys. Res.*, 110, D02201, doi:10.1029/2004JD004681,” which is presently missing in the list of references. Then on line 11, change “Zaveri et al., 2005” to “Zaveri et al., 2005b”, and make appropriate changes in the references.

Page 4160, line 4: The “Shrivastava et al., 2011” reference is inappropriately cited here as that work makes a highly simplified assumption for SOA partitioning and does not include interactions between organic and inorganic species. I suggest deleting it.

Page 4163, line 12: Please list the total number of particle and droplet classes used in the model. Also how is the size distribution represented in each class of particle/droplet? Is it modal or sectional approach?

This paper will greatly benefit by adding a list of all the notations used. There are many variables, subscripts, superscripts, and indices, which are difficult to keep track of without a systematic list of them.

Table 1. What is m_s ? Should the activity of a solid be unity?

Figure 5. What model does the solid black line refer to? I believe it is AIOMFAC, but it's is not indicated in the figure by an arrow.

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