

Interactive comment on “Mass-based hygroscopicity parameter interaction model and measurement of atmospheric aerosol water uptake” by E. Mikhailov et al.

Anonymous Referee #4

Received and published: 12 January 2012

In the manuscript the single parameter (κ -Köhler) theory for hygroscopicity has been expanded to take into account the effect of solution nonideality on the water uptake. The model developed can be used to calculate hygroscopic properties of aerosol particles. What comes to computational cost and degree of details, the interaction model can be considered as a compromise between accurate thermodynamical models and single parameter description with the ideality assumption. Some first results are presented to show that the model works for the well known aerosol, namely sodium chloride. Further also data from field campaign is used to show the model can be fitted to measured data. From both dataset three different regimes of hygroscopicity behavior can be recognized. The main usage of model can be considered to be its efficiency

C14176

in estimating the CCN properties of aerosol samples based on their below supersaturation water uptake. The new model is described mainly with enough details, but its performance is not evaluated as well as it should be. The topic of the manuscript is suitable to ACP, but I feel some major revisions are needed prior to the publication.

The main criticism is that I am not sure if the manuscript is meant to describe the new model and somehow evaluate its performance, or is it just used as a tool to analyze RH dependent hygroscopicity parameter and a method to estimate CCN properties. At the moment it is somehow failing in both. For model evaluation I would have liked to see more comparison on the full thermodynamical models like AIM so that the model would be tested against the mixtures of several inorganic species and then for some well known organics. At the moment in the manuscript only two extreme examples are presented, one with well known substance and the second with atmospheric mixtures without knowledge of exact composition. I would like to see how the model works with few compounds and is it actually bridging the “gap between the results of simplified single parameter models widely used in atmospheric or climate science and the results of complex multi-parameter ion- and moleculeinteraction models frequently used in physical chemistry and thermodynamics” like authors claim.

If the main message of the manuscript is a new method to estimate CCN-properties of aerosol, then authors should concentrate more on that part and somehow show this method is better than the others used. More data would be needed also for that and also information how many data points at different RH is needed and how much better results can be achieved compared to estimating CCN-properties from one single RH. The measurement data for NaCl is fine, but comparison to field data is not so well justified, especially from Saint-Petersburg. There are only measurements showing the water uptake of aerosol without any other information about composition. It only shows that aerosol in the area is different to aerosol in Amazonian area, but as there is no idea how much different, then the presentation of different fit parameters is meaningless. I have also some concerns about using bulk aerosol samples, like done with

C14177

FDHA method, to estimate aerosol hygroscopicity, which is quite often size dependent and aerosol is even externally mixed. However, that method is not evaluated in this manuscript.

Minor comments

Equation 16: Where do you take the definition for y_{mi} ?

Page 30881, equation 2: Equation is approximation, so maybe "=" should be "≈"

page 30893, line 15-17: How sure you are that it is the particle size causing the difference in the efflorescence RH? I guess particles do coagulate on the filter at high RH making them much larger during evaporation than they were during wetting. Could the filter surface then maybe trigger the efflorescence?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 30877, 2011.

C14178