Geosci. Model Dev. Discuss., 3, C213–C214, 2010
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**Geoscientific
Model Development
Discussions**

Interactive comment on "An analytical solution to calculate bulk mole fractions for any number of components in aerosol droplets after considering partitioning to a surface layer" *by* D. Topping

Anonymous Referee #1

Received and published: 28 July 2010

This manuscript describes an analytical treatment of the bulk to surface partitioning of surface active components in aerosol particles, effectively reducing the computational costs of including such a level of detail in the modelling of aerosol properties. The efficiency of the model is compared to other previously reported iterative approaches. The manuscript is clearly written and should be published once the author has had the opportunity to respond to the following comments.

- The approach, while applicable to multicomponent systems, has been applied to the bulk depletion of binary aerosol containing an organic component and water. The impact of the paper could be greatly improved by extending the application to multi-

component aerosol. Indeed, extending the predictions to a mixed inorganic/organic system would be helpful, demonstrating the application of the model to a system for which, for one of the components, the surface tension is set to increase with increasing concentration, rather than to decrease.

- It should perhaps be made clear that the model considers only the partitioning between bulk dissolution and surface enrichment. For atmospheric aerosol, the ubiquitous presence of inorganic components can significantly reduce the critical micelle concentration. Under these circumstances the importance of partitioning into micelles must be considered.

- Discussion of the computational efficiency repeatedly states that the efficiency is 'less' for the analytical treatment. Given that the analytic expression reduces the computational cost of a calculation, this would to me seem to indicate that the model is more efficient. This should be corrected throughout.

- The temperature T in equation 10 appear in the numerator where as it should appear in the denominator. This error is repeated in equations 11, 13, 18 and 19, although the correct expression is arrived at in equation 20. gamma_iB all appears in the subscript of the last derivative in equation 14 and this is not correct.

- At the bottom of page 1099, the bulk mole fractions with and without surface partitioning seem to be very similar (1.3512 and 1.3368 x 10-4) although the text states that only 50 % of the material remains in the bulk. I do not understand this statement.

- Powers of 10 should be written as powers of 10. The molar volume of water expressed in equation 29 seems to be incorrect.

Interactive comment on Geosci. Model Dev. Discuss., 3, 1089, 2010.