Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08725, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08725
EGU General Assembly 2008

A comparison of water uptake by aerosols using two thermodynamic models

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The water uptake by hygroscopic aerosols can significantly alter aerosol size, optical properties and direct radiative forcing. Two methods to determine the uptake of water by aerosols are investigated here. Thermodynamic aerosol models determine aerosol water uptake by accounting for a mixing rule, also known as the Zdanovskii-Stokes-Robsin (ZSR) relationship, which is usually solved iteratively for a given equilibrium condition. The Metzger method (Metzger and Lelieveld, ACP, 2007) determines water uptake analytically (without any iteration). This yields a significant reduction of computing time. They assume the water activity is equal to the ambient relative humidity at equilibrium, and hence only use relative-humidity-dependent activity coefficients for volatile aerosol compounds. Here, we examine this new method of uptake of water by aerosols by comparing the results with those of the thermodynamic model currently used in our global chemical transport model (Feng and Penner, JGR, 2007) under typical ambient conditions.