Geophysical Research Abstracts
Vol. 12, EGU2010-5164, 2010
EGU General Assembly 2010

Hygroscopic Growth and Activation of Particles containing Algea-Exudate

Heike Wex (1), Elena Fuentes (2), Georgios Tsagkogeorgas (1), Jens Voigtländer (1), Tina Clauss (1), Alexei Kiselev (1), David Green (3), Hugh Coe (2), Gordon McFiggans (2), and Frank Stratmann (1)

(1) Institute for Tropospheric Research, Physics, Leipzig, Germany (wex@tropos.de), (2) Centre for Atmospheric Sciences, University of Manchester, Manchester, UK, (3) Scottish Association for Marine Science, Oban, UK

A large amount of the Earth is covered by oceans, which provide a constant source of marine aerosol particles, produced due to bubble bursting processes that depend on wind speed (O'Dowd and de Leeuw, 2007). In general, marine particles can be assumed to play an important role for the Earth atmosphere on a global scale, due to their abundance and due to their effect on clouds. E.g. marine stratus and stratocumulus clouds contribute about 30% to 40% to the Earth's albedo (Randall et al., 1984). The activation of aerosol particles to cloud droplets depends on the hygroscopic properties of the particles, which, in turn, depend on their chemical composition. For marine particles, is has been and still is discussed what the effects of organic substances being present in the particles might be. These substances originate from marine biota where they enrich at the ocean surface.

To mimic marine aerosol particles, algae-exudates of different algae species were mixed with artificial sea-water. These samples were used in the laboratory to produce particles via a bubble bursting process (Fuentes et al., 2009). The hygroscopic growth and activation of the (size selected) particles was measured, using LACIS (Leipzig Aerosol Cloud Interaction Simulator, Stratmann et al., 2004) and the DMT-CCNc (Cloud Condensation Nucleus counter from Droplet Measurement Technologies, Roberts and Nenes, 2005). The hygroscopic growth was measured twice, 3 and 10 seconds after humidification, and no difference in the grown size was detected, i.e. no kinetic effect was observed for the examined time range.

From LACIS and CCNc measurements, the hygroscopicity was deduced through determination of the amount of ions being effective in the particle / droplet solution (Rho(ion), Wex et al., 2007). A concentration dependent non-ideal behaviour was found for particles produced from an artificial sea-water sample that contained only inorganic salts, as can be expected (see e.g. Niedermeier et al., 2008). For particles containing also algae-exudate, however, the concentration dependent non-ideal behaviour was quenched, resulting in a quasi ideal solution behavior. Such solutions could be described by a single-parameter representation for all water-vapour saturations at which measurements had been done (from 0.8 up to supersaturation).

References:

Fuentes, E., H. Coe, D. Green, G. De Leeuw, and G. McFiggans (2009), Laboratory-generated primary marine aerosol via bubble-bursting and atomization, Aerosol Meas. Tech. Discuss., 2, 2281–2320.

O'Dowd, C. D., and G. de Leeuw (2007), Marine aerosol production: A review of the current knowledge, Phil. Trans. R. Soc. A, 365(1856), 1753-1774, doi:1710.1098/rsta.2007.2043.

Niedermeier, D., H. Wex, J. Voigtländer, F. Stratmann, E. Brüggemann, A. Kiselev, H. Henk, and J. Heintzenberg (2008), LACIS-measurements and parameterization of sea-salt particle hygroscopic growth and activation, Atmos. Chem. Phys., 8, 579–590.

Randall, D. A., Coakley, J. A., Fairall, C. W., Kropfli, R. A., and Lenschow, D. H. (1984) Outlook for research on subtropical marine stratiform clouds, Bull. Am. Meteor. Soc., 65, 1290–1301, 1984.

Roberts, G., and A. Nenes (2005), A continuous-flow streamwise thermal-gradient CCN chamber for atmospheric measurements, Aerosol Sci. Technol., 39, 206-221.

Stratmann, F., A. Kiselev, S. Wurzler, M. Wendisch, J. Heintzenberg, R. J. Charlson, K. Diehl, H. Wex, and S. Schmidt (2004), Laboratory studies and numerical simulations of cloud droplet formation under realistic

super-saturation conditions, J. Atmos. Oceanic Technol., 21, 876-887.
Wex, H., T. Hennig, I. Salma, R. Ocskay, A. Kiselev, S. Henning, A. Massling, A. Wiedensohler, and F. Stratmann (2007), Hygroscopic growth and measured and modeled critical super-saturations of an atmospheric HULIS sample, Geophys. Res. Lett., 34(L02818), doi:10.1029/2006GL028260.