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Hygroscopic growth of sub-micrometer and one-micrometer aerosol particles measured during ACE-Asia

A. Massling[1], S. Leinert[2], A. Wiedensohler[1], and D. Covert[3]
[1]Leibniz-Institute for Tropospheric Research, Permoserstr. 15, 04318 Leipzig, Germany
[2]Environmental Protection Agency, Richview, Clonskeagh Road, Dublin 14, Ireland
[3]Department of Atmospheric Sciences, University of Washington, Box 354235, Seattle, WA 98195-4235, USA

Abstract. Hygroscopic properties of aerosol particles in the sub-micrometer and one-micrometer size ranges were measured during the ACE-Asia study (Aerosol Characterization Experiment-Asia) in spring 2001. The measurements took place off the coasts of Japan, Korea, and China. All instruments contributing to this study were deployed in a container on the forward deck of the NOAA Research Vessel Ronald H. Brown. Air masses with primarily marine influence and air masses from the Asian continent affected by both anthropogenic sources and by the transport of desert dust aerosol were encountered during the cruise.

Results showed very different hygroscopic behavior in the sub-micrometer size range compared to the one-micrometer size range. In general, for all continentally influenced air masses, the one-micrometer particle population was characterized by two different particle groups – a nearly hydrophobic fraction with growth factors around 1.0 representative of dust particles and a sea salt fraction with hygroscopic growth factors around 2.0. The number fraction of dust particles was generally about 60% independent of long-range air mass origin.

For sub-micrometer particles, a dominant, more hygroscopic particle fraction with growth factors between 1.5 and 1.9 (depending on dry particle size) consistent with ammonium sulfate or non-neutralized sulfates as major component was always found. In marine air masses and for larger sizes within the sub-micrometer range (Dp=250 and 350 nm), a sea salt fraction with growth factors between 2.0 and 2.1 was also observed. For all other air masses, the more hygroscopic particle fraction in the sub-micrometer size range was mostly accompanied by a less hygroscopic particle fraction with growth factors between 1.20 and 1.55 depending on both the continental sources and the dry particle size. Number fractions of this particle group varied between 4 and 39% depending on dry particle size and air mass type. Nearly hydrophobic particles indicating dust particles in the sub-micrometer size regime were only found for particles with Dp=250 and 350 nm during a time period when the aerosol was influenced by transport from Asian desert regions.

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