Simultaneous dry and ambient measurements of aerosol size distributions at the Jungfraujoch

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In a field campaign at the high-alpine site Jungfraujoch (JFJ, 3580 m asl), in-situ aerosol size distributions were measured simultaneously outdoor at ambient conditions (temperature T <-5 degreesC) and indoor at dry conditions (T 25 degreesC And relative humidity RH <10%) by means of two scanning mobility particle sizers (SMPS). In addition, measurements of hygroscopic growth factors were performed with a hygroscopicity tandem differential mobility analyzer (H-TDMA). The measured growth factors, being a monotonic function of the relative humidity (RH), were fitted with a modified Kohler model. A comparison between dry and ambient size distributions shows two main features: First, the dry total number concentration is often considerably smaller (on average 28%) than the ambient total number concentration, and is most likely due to the evaporation of volatile material at the higher temperature. These particle losses mainly concern small particles (dry diameter D less than or similar to 100 nm), and therefore have only a minimal affect on the surface and volume concentrations. A slight correlation between ambient RH and the magnitude of particle loss was observed, but it was not possible to establish an empirical model for a quantification. Second, the dry number size distribution is shifted towards smaller particles, reflecting the hygroscopic behavior of the aerosols. To link the ambient and the dry size distributions we modeled this shift using the H-TDMA measurements and a modified Kohler model. The corrected dry surface and volume concentrations are in good agreement with the ambient measurements for the whole RH range, but the correction works best for RH <80%. The results indicate that size distribution data measured at indoor conditions (i.e. dry and warm) may be successfully corrected to reflect ambient conditions, which are relevant for determining the impact of aerosol on climate.

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