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Aerosol hygroscopic growth closure by simultaneous measurement of hygroscopic growth and chemical composition at the high-Alpine station Jungfraujoch

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During several Cloud and Aerosol Characterization Experiments (CLACE) conducted at the Jungfraujoch (3580 m asl) between 2000 and 2005, simultaneous measurements of the chemical composition, hygroscopic growth and various other aerosol parameters were performed. The aerosol chemistry (sulfate, nitrate, ammonium and organic components) was investigated with an Aerodyne aerosol mass spectrometer, along with black carbon (BC) measurements by a multiangle absorption photometer and a multiwavelength aethalometer. A Hygroscopic Tandem Differential Mobility Analyser (H-TDMA) was deployed to measure the hygroscopic growth factor (HGF, defined as the relative particle diameter increase from dry to humidified state, d/do). This instrument was operated at ambient conditions (i.e. at external temperatures $T < 0^{\circ}C$). Furthermore, aerosol size distributions (by electrical mobility and optical techniques), aerosol number, and mass were determined as well. Except for occasional pollution events, the hygroscopic growth data exhibited only one growth factor for a single size, indicating that the particles were internally mixed. The chemical data were used to calculate theoretically expected growth factors using the Zdanovskii-Stokes-Robinson (ZSR) relation and assuming HGFs of d/d_o (inorganic) = 1.52, d/d_o (organic) = 1.1, and d/d_o (BC) = 1.0 at RH = 85%. The measured growth factors and

their temporal variability were well predicted with this straightforward hygroscopic model, and it was found that the temporal variability of hygroscopic growth factors was mainly a result of varying fractions of organic/inorganic mass, yielding lower HGFs for higher fractions of organic components.