



On the difference of aerosol hygroscopicity between high and low RH environment in the North China Plain

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Simultaneous measurements of aerosol hygroscopicity and chemical composition were performed at a suburban site in the North China Plain in winter 2018 using a self-assembled hygroscopic tandem differential mobility analyzer (H-TDMA) and a capture-vaporizer time-of-flight aerosol chemical speciation monitor (CV-ToF-ACSM), respectively. During the experimental period, aerosol particles usually show an external mixture in terms of hygroscopicity, with a less hygroscopic particles mode (LH) and a more hygroscopic mode (MH). The average ensemble mean hygroscopicity parameter (κ_{mean}) are 0.16, 0.18, 0.16, and 0.15 for 60, 100, 150, and 200 nm particles, respectively. Two episodes with different RH/T conditions and secondary aerosol formations are distinguished. Higher aerosol hygroscopicity is observed for all measured sizes in the high RH episode (HRH) than in the low RH episode (LRH). In LRH, κ decreases as the particle size increases, which may be explained by the large contribution of non- or less-hygroscopic primary compounds in large particles due to the enhanced domestic heating emissions at low temperature. The number fraction of LH mode at 200 nm even exceeds 50%. Closure analysis is carried out between the HTDMA-measured κ and the ACSM-derived hygroscopicity using different approximations for the hygroscopic parameters of organic compounds (κ_{org}). The results indicate that κ_{org} is less sensitive towards the variation of its oxidation level under HRH conditions but has a stronger O: C-dependency under LRH conditions. The difference in the chemical composition and their corresponding physical properties under different RH/T conditions reflects potentially different formation mechanisms of secondary organic aerosols at those two distinct episodes.

