Interactive comment on "Aerosol hygroscopicity derived from size-segregated chemical composition and its parameterization in the North China Plain" by H. J. Liu et al.

General comments:

Aerosol hygroscopicity is closely related to cloud formation, visibility, and radiative forcing of aerosols. Although the hygroscopic properties of aerosols can be measured in detail using instruments, such as Hygroscopic Tandem Differential Mobility Analyzers (H-TDMA), parameterization methods are highly needed in view of the large spatio-temporal variability of aerosol hygroscopicity and the technical limitations in observations. The authors of this paper present aerosol hygroscopicity data derived from size-segregated chemical components obtained during the HaChi compaign in the North China Plain (NCP). Applying the κ-Köhler theory and the ZSR mixing rule, they have developed an iterative algorithm for calculating the hygroscopicity parameter (κ) from in-situ measurements and laboratory data. The κ values are obtained for 8 size ranges (0.03-8 μm) and well consistent with those derived from the in-situ HH-TDMA measurements (0.05-0.25μm). Futhermore, the authors show an empirical relationship between κ and mass fractions of NH_4^+, SO_4^{2-}, NO_3^-, and WSOC. An evaluation using data also from other Chinese sites suggests that this relationship may be used for parameterization.

The topic of this paper is within the scope of ACP. The methods used in this paper are sound and novel. Assumptions made are valid. The results are of interest and valuable. The paper is well structured and written, and cites properly the related literature . I recommend publication of this paper in ACP after minor revisions.

Specific comments:

1. P20898, L23-24, and P20905, L22-23, you show "NH_4NO_3, H_2SO_4, NH_4HSO_4 and $(NH_4)_2SO_4$" as if these compounds always co-exist. What is the real situation? Can H_2SO_4 exist at significant concentrations under summer conditions at the NCP rural site (higher NH_3 and lower SO_2 levels)? I strongly suggest that you make ion balance calculations to figure out the main co-existing ammonium salts since κ is different for different salts.
2. P20890, L27, add diameter range after "stage 2-9".
3. P20891, L21, please point out that *S* is equivalent to RH because you use RH instead of *S* in the description of iteration calculations (P20895).
4. P20891, L23, change "*T* is the temperature" to "*T* is the **absolute** temperature".
5. P20897, L3-8, the size distribution of OM seems to be very different from that found in Beijing (see, Sun et al., 2010). Any explanation?
6. P20899, L3-4, references are needed here.
7. A recent paper (Xing et al., 2013) can be cited regarding the the OC to OM conversion.
8. Fig. 3, show also the "others" mass fraction on the bottom graph.
9. Fig. 4, are the HGF-derived and Chemistry-derived values exactly from the same time period? Please make it clear.
10. Fig. 6, error bars should be included. In addition, significance tests should be made for the daytime-nighttime differences and included in the related discussions.

References

Sun, et al., Highly time- and size-resolved characterization of submicron aerosol particles in Beijing using an Aerodyne Aerosol Mass Spectrometer, Atmos. Environ, 44, 131–140, 2010.
Xing et al., Seasonal and spatial variability of the OM/OC mass ratios and high regional correlation between oxalic acid and zinc in Chinese urban organic aerosols, Atmos. Chem. Phys., 13, 4307–4318, 2013