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Discussions

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# *Interactive comment on* "A novel method to derive the aerosol hygroscopicity parameter based only on measurements from a humidified nephelometer system" *by* Ye Kuang et al.

**Anonymous Referee #2**

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In this paper the authors present a novel method to derive the aerosol hygroscopicity parameter based on measurements from a nephelometer tandem. The topic is of interest for the scientific community; however, the performance of the proposed method is not sufficiently addressed and its general validity under different atmospheric conditions and predominant aerosol types is not clear. The paper needs major revision to improve scientific aspects of the presented method but also to improve the organization, grammar and readability of the manuscript.

General comment: If the focus of the manuscript, as stated in the title, is the presentation of a novel method they need to pay more attention to the explanation of the method itself and the validation of the method using additional data (ideally from different mea-

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surement sites) and quantify the uncertainties of using the look-up-table to retrieve aerosol hygroscopicity. Otherwise, the authors are just presenting relationships between variables but not actually a new (usable) method. There are many redundancies in the paper that should be omitted as well as typos and grammar spelling errors. Split sentences into two or more individual sentences to improve readability.

Specific comments: Line21: avoid redundancies like "newly proposed novel approach"

Line22: Replace by "... is that $\kappa$f(RH) can be estimated without any additional information..."

Line34: "...most important factors affecting these..." Introduction: there are too much methodological information in the introduction, that should be moved to the methodology section.

Line104: "similar to"

Line107: "based on"

Section2: This section is very bad organized. Include a table with information about the campaigns (dates, sites, data used here from each campaign, etc). What is the time resolution of the PM2.5 filter samples? 24 hours? How often is the sampling performed?

More information on HH-TDMA measurements and inversion routine should be presented. Same applies for the nephelometers tandem. Include information on nephelometers correction and calibration, humidogram schedule, RH range in the dry neph, where were the RH sensors ocated in the system?, how often were the sensors calibrated?

Line120: replace dot by comma

Section 3.1: Further details on the methods used to derive the $\kappa$ parameter should be given even though the methods were published before. At least the basic information to

allow the reader to understand the manuscript. Concerning the $\kappa$f(RH) method, which chemical species have been considered apart of BC? A table including the chemical species, refractive indices, densities and contribution during the measurement period must be included.

In the Mie routine, is the chemistry considered as constant during the campaign? See my previous comment on PM2.5 sampling schedule.

Section 3.2: The reference of Quinn et al. (2005) is not appropriate here. The gamma parameterization was first introduced in Kasten (1969) and Hanel (1980). Kasten, F., 1969. Visibility forecast in the phase of pre-condensation. Tellus 21 (5), 631-635 Hanel, G., 1980. Technical Note: an attempt to interpret the humidity dependencies of the aerosol extinction and scattering coefficients. Atmos. Environ. 15, 403-406

Line 194: avoid redundancy, this sentence "more details..." could be omitted.

Results: Line207-221: This paragraph could be omitted since basically is a repetition of the results presented in Kuang et al., (2016) and does not provide any additional/useful information.

Line 207: information about nephelometer correction should be moved to the instrument section.

Lines 212, 216 and somewhere else: "a lot" is not very scientific, be more quantitative and avoid colloquial expressions.

Line 257: This paragraph should be rewritten. What is the aim of including these two additional campaigns?

Line 297: "The fitting performance... values" could be omitted. Again, avoid redundancy.

Line 300: The $\gamma$-Method and $\kappa$-Method are just different ways of fitting the experimental f(RH)-RH relationship. Which method is better or worst depends on your specific data,

and many other equations have been previously proposed in the literature (Titos et al., 2016). The discussion in lines 300-306 and figure 4 about which fitting is best do not add much and could be omitted.

Line 316: "pretty good linear relationship" does not sound very quantitative neither scientific. . .. Try to be more specific. . .

Line 333: This is the first time that $\kappa$chem and $\kappa$ext are introduced.

Line 347 and somewhere else: Avoid repetitions like "which is introduced in Section . . ."

Line 359-360: "and then it turns out", "much more complex". . . this is not very appropriate for a scientific paper. . .

References of Titos et al., 2016 and Zieger et al., 2014 are not used appropriately here. The Angstrom exponent was first introduced by Angstrom!

Line 377: Keep in mind that the Angstrom exponent is not a measure of the PNSD, it provides information on mean predominant aerosol size so values close to 2 denote a predominance of fine particles while values below 1 denote a predominance of coarse particles.

Line 393 and Figure 7: This comparison exercise is interesting but it is not appropriately done. The predicted Rk values using the look-up-table are compared with the measured Rk values. However, these measured Rk were used before to generate the look-up-table. Thus, it is clear that a high correlation is expected. A different dataset, with additional Rk values not used to generate the look-up-table should be used for validation of the proposed model. Otherwise, the same data that is used to generate the model is used to validate it, which is meaningless.

If the authors really expect researchers to use their method, they should provide them with an uncertainty range for Rk as a function of the Angstrom exponent and $\kappa$sca. Probably, higher errors are expected at higher $\kappa$sca values? This is certainly needed

if they expect people to use the look-up-table. In general, the manuscript lacks of an appropriate treatment of errors despite the large expected errors for the hygroscopicity parameters.

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