

***Interactive comment on* “Long-term aerosol optical hygroscopicity study at the ACTRIS SIRTA observatory: synergy between ceilometer and in-situ measurements” by Andrés Esteban Bedoya-Velásquez et al.**

Anonymous Referee #2

Received and published: 1 April 2019

General comments:

The manuscript “Long-term aerosol optical hygroscopicity study at the ACTRIS SIRTA observatory: synergy between ceilometer and in-situ measurements” used an experimental setup combining ceilometer, meteorological instruments, and aerosol Chemical Speciation Monitor to study aerosol hygroscopicity. A strict criterion-based procedure was applied on a 4.5-year database at the ACTRIS SIRTA observatory in Palaiseau (France); eight cases were obtained in which the enhancement in the attenuated backscatter coefficient is due to aerosol hygroscopicity. In most remote sensing stud-

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ies, the aerosol hygroscopicity is studied using the relationship of the relative humidity (RH) and the optical properties as a function of height, but in this study, the aerosol hygroscopicity is investigated in a time-window to show time-change in RH and optical properties. This study evidences that the hygroscopicity parameter is anti-correlated with the aerosol organic mass fraction while it shows a positive correlation with the aerosol inorganic mass fraction. I recommend the paper for publication in ACP after the following comments have been addressed.

Specific comments:

1. Introduction: Literature in which they examined the association between lidar-derived aerosol hygroscopic properties and in situ aerosol chemical composition should also appear in the introduction. Some references are given later in the manuscript (ex, zhang et al. 2015), but they could already appear in the introduction. See also: Lv et al., Hygroscopic growth of atmospheric aerosol particles based on lidar, radiosonde, and in situ measurements: case studies from the Xinzhou field campaign, J. Quant. Spectrosc. Ra., 2017.

2. Check and revise all the equations carefully! Some comments here:

1) Use of \equiv or $=$ for equation?

2) P4,L26: check the equation numbering

3) In eq1, z_1, z_2 are used as variable of T , so it should be $T(z_1, z_2)$ instead of $T(z)$. Or you can just use $z_1 = 0, z_2 = z$.

4) Explain t_d before equation 7. You used “time window”, mention it here.

5) Eq7, I suggest not use “ z_{ref} ” here, the z used in your study is a fixed height of 30m which is not a “reference height”, as you used RH_{ref} for the calculation, it could be a bit confusing. Or you should mention the z_{ref} at page 6, line 5.

6) Eq13 only give the expression of $n_{wv}(t)$

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3. Section 3.1. There is no really new methodologies proposed, too many equations (11 equations) in this section, they can be simplified. Ex, Eq8 no need

4. Section 3 and 4 can be one section of methodology.

5. Supplement: It seems that this supplement is related to your previous version of manuscript, please update it (e.g., the cross-reference).

No references cited in the text, whereas you have a reference list in the supplement.

“From now, we will use beta instead of betaatt for simplicity”, but you forgot to mention it in the manuscript.

It would be better to make the table and figure captions directly with the tables and figures.

Minor comments:

1. “Hänel” not Hännel. Also “Hänel parameterization” not Hännel or Hannel, please change them all.

2. Make it clear when you use aerosol backscatter or attenuated backscatter coefficient throughout the paper.

3. In situ or in-situ, water vapor or water vapour.

4. P2, L16-18, introduce “enhancement factor” before the description of its magnitude.

5. P3, L29, V-Trafic report, 2014 is not in the reference

6. P4, L6, are the uncertainties mentioned here for raw data?

7. P7, L7, $q(td)-q(d)$ if you keep using td.

8. P8, L22, “the Hännel parameterization (Eq. 9)”, it is not eq9

9. P8, L25, ii rephrase the sentence

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10. P9, L20, some introduction here will be better
11. P9, L22, in the text, 07:15 to 10:15 UTC, but in figure 07:17 to 10:17 UTC, check.
12. P9, L23 is beta here correspond to attenuated backscatter coefficient?
13. P9, L27 “high contribution of OA (58 %) and SO₄²⁻(15 %),” for case 8 the contribution of so₄²⁻ is higher than case 3, bus in case 3 there is higher contribution of BC,
14. P9, L28 mention that the r here is for beta not for PM₁
15. P9, L29 change 14% to 12%
16. P10, L19 do you mean “than case 3”?
17. P11, L23-24 Change the expression “beta”
18. P11, L30 explain σ_{sp} here, even though with the definition in section 3.1.
19. P11, L31 please rephrase the sentence
20. P12, L4 table1 do not have information about what you discussed here
21. P13, L12 “4.5 years” dataset
22. Figure 1, it would be nice to introduce the in-situ monitoring station here, as fig1a and fig1b
23. Figure2, specify the beta
24. Table 1, please specify the RHref value, also specify the beta
25. Table2, check caption and the table content, to be consistent.
26. Fig S5, change the value-range (y-axis) of the wind speed
27. Reference:

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Petit, J.-E., et al. 2015, not “Mo, N., MoN”, but “G. Mocnik”

Wiegner et al. 2019, already published.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-12>, 2019.

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