

Referee comment on

“Fourteen months of on-line measurements of the non-refractory submicron aerosol at the Jungfraujoch (3580 m a.s.l.) – chemical composition, origins and organic aerosol sources”

by Fröhlich et al., *Atmos. Chem. Phys. Discuss.*, 15, 18225-18284, 2015

Anonymous referee #3

This manuscript reports results obtained with a time-of-flight aerosol chemical speciation monitor (ToF-ACSM) during a long-term measurement period (14 months) at the Jungfraujoch research station, Switzerland. The authors described the seasonal and diurnal variations of non-refractory submicron particles (NR-PM₁), and discussed the properties of NR-PM₁ as a function of the air mass origin. The exceptional situation of the Jungfraujoch (a high elevation site in the heart of Europe) allowed the authors to compare on one hand free tropospheric air masses with periods influenced by the planetary boundary layer (PBL), and on the other hand air masses from different regions of Europe. They also performed a source apportionment of organics by PMF analysis, and discussed in detail the sources and processes of organics based on mass spectra (also f_{44} vs f_{43}), diurnal and seasonal variations.

This manuscript is very interesting, and fits totally the scope of the journal. I recommend its publication in ACP after the authors address the following comments.

Specific comments:

- 1) Page 18229, line 25 to page 18230, line 2: if the authors used UTC for the entire dataset, it means that they did not take into account the daylight saving time in summer. This introduces a bias in the diurnal patterns of anthropogenic species, given that human activities are shifted by 1-hour between summer and winter.
- 2) Page 18231, lines 12-16: it would be very useful for ToF-ACSM users to include in the supplementary material a table with the details of the different calibrations for each month with the statistics (average, standard deviation, etc.). This information is important to assess the stability of these instruments, and to determine at which frequency they need to be calibrated.
- 3) Page 18234, line 5: I am surprised that the authors performed a back trajectory analysis over 10 days. This is too much, given that beyond 3 days, the uncertainty on the back trajectory calculation is already high. Indeed, according to Rolph and Draxler (1990), the horizontal deviations are between 200 and 700 km at 4 days, depending on the spatial and temporal resolution of the meteorological data.
- 4) Page 18248, line 6: in the absence of a thermodenuder and information on the volatility of the particles, I think it is not appropriate to use the “LV-OOA” terminology in this study. Even “more oxidized OOA” (MO-OOA), which is found in papers with HR-ToF-AMS datasets, cannot be used, given that we do not have the O/C ratios. I would suggest to use “OOA I” and “OOA II” throughout the manuscript, which is recommended by Zhang et al. (2011) in this case.

Technical corrections:

- 5) Page 18226, line 8: “Backward transport simulations shows that the highest”.
- 6) Page 18228, line 17: “Due to its well-developed infrastructure and ~~and~~-unique location many decades of scientific measurements of ~~e-g-~~gas-phase constituents”.
- 7) Page 18229, line 25: “All data are reported in UTC, which is local time minus 1 h in winter and ~~UTC-local time~~ minus 2 h in summer”.
- 8) Page 18230, line 2: “which is described in detail in (~~Fröhlich et al.,~~ (2013))”.
- 9) Page 18235, lines 8-9: “were selected and applied (~~cf. Sect. 2.5~~)”. (this sentence is already in section 2.5!)
- 10) Page 18237, line 5: “In ~~the~~-summer-~~months~~, average concentrations”.
- 11) Page 18237, line 9; page 18238, lines 9, 18 and 27; page 18240, line 9; page 18243, line 26; page 18245, lines 4 and 7: given that EBC is included in the discussion and in the figures, I suggest replacing “NR-PM₁” by “PM₁” in these sections.
- 12) Page 18238, line 7: “(note the logarithmic ~~y~~-scale ~~of the y-axes~~)”.
- 13) Page 18241, lines 7 and 9: “air~~_~~mass”.
- 14) Page 18242, line 17: “(Sect. 3.1.2) suggesting that ~~suggesting that~~-the aerosol”.
- 15) Page 18252, line 22: “which contains no f₄₄ and about 6% f₄₃ (see Fig. S11) leads to an increase”.
- 16) Page 18257, line 7: “and last but not least the ~~the~~-custodians of the Research Station”.
- 17) Page 18261, line 28 to page 18262, line 3: do not forget to update the reference Fröhlich et al. (2015) with the final AMT paper!
- 18) Figure 2: given that EBC is present in the pie charts, I suggest including it in the box plots as well.
- 19) Figures 10 and S14: please scale all the x- (from 0 to 0.25) and y- (from 0 to 0.35) axes the same way.
- 20) Table S2: the caption does not correspond to the content of the table.
- 21) Figure S1: please replace all the labels of the x-axes by “ACSM NR-PM₁ total mass + EBC (µg/m³)”.
- 22) Figures S6 and S7: the labels of the y-axes are partially hidden in Figure S6. Please also add a label for the x-axes (just the bottom axis) of both figures.

References:

G. D. Rolph, R. R. Draxler. Sensitivity of Three-Dimensional Trajectories to the Spatial and Temporal Densities of the Wind Field. *Journal of Applied Meteorology*, 29 (10), 1043-1054, 1990.

Q. Zhang, J. L. Jimenez, M. R. Canagaratna, I. M. Ulbrich, N. L. Ng, D. R. Worsnop, Y. Sun. Understanding atmospheric organic aerosols via factor analysis of aerosol mass spectrometry: a review. *Analytical and Bioanalytical Chemistry*, 401 (10), 3045-3067, 2011.