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Comment on acp-2021-528

Anonymous Referee #2

Referee comment on "Influence of organic aerosol molecular composition on particle absorptive properties in autumn Beijing" by Jing Cai et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-528-RC2, 2021

In this manuscript, Cai and colleagues discuss their findings on the correlation between the chemical composition and optical properties of organic aerosols based on online Aethalometer and offline FIGAERO CIMS measurements. A discussion on different haze formation mechanisms observed in Beijing is also presented. In general, the manuscript is well written and the discussion is easy to follow. With some necessary clarifications and discussions as outlined below, the manuscript would be suitable for publication in ACP.

Offline FIGAERO-CIMS analysis: I agree with the other referee that more information is needed to validate the method. In addition to thermal decomposition, offline FIGAERO analysis would be susceptible towards sample handling and storage artefacts. For instance, acid-catalyzed reactions such as organonitrate hydrolysis (leaving CHO and HNO3) may occur on the filter. Would the small carboxylic acids desorb during storage? The “sandwich” technique for filter analysis may complicate quantification and/or volatility analysis due to increased vapor-filter interactions (there are now three filters as opposed to the single filter used for online FIGAERO).

Line 257-262: Do low-carbon compounds (e.g. C2-6 or C2-4) compounds have thermograms commensurate with their expected volatility? In other words, do they behave like “real” compounds, decomposition products, or a mixture of both during FIGAERO desorption? Some examples should be provided.

Aerosol water content, Line 146 -151: How sensitive are the ISRROPIA results to ACSM measurements, e.g. contribution to NO3 by orgnaonitrates? Furthermore, detection of HCl and to some extent HNO3 should be possible with the NO3- CI-APi-TOF, and can further constrain the AWC estimations.

Minor Comments

Line 71-79: References to online organic aerosol measurement using extractive electrospray ionization (EESI) technique (e.g. 10.5194/amt-12-4867-2019 and 10.5194/amt-14-1545-2021) should be added.

Line 105-108: A demonstration of IHNO3- time series would be helpful here.

Line 123-125: Because the aerosol composition was presented in rather semi-quantitative manners (i.e. percentage contribution by CHO vs. CHOX, or by individual elements), a note (even if somewhat qualitative) on potential sensitivity biases of I- CIMS should be added here. For instance, does I- CIMS respond equally well to organic acids, organosulfates, organonitrates, and reduced nitrogen species?

Line 141: How is NH3 detected by the NO3- CI-APi-TOF? Was there any consideration taken to minimize wall effects for the quantification of NH3, which can be quite "sticky"?

Line 186: "P_BC > 23%". Should this be "P_BrC"?

Line 288: Does the TOF ACSM have enough mass resolving power for ion assignment? If not, the sentence should be revised to make the assumption here more explicit. Also, C2H4O+ would be found at m/z 44, not at m/z 60.

Line 315, 320, etc.: It would easier to write C6HxO5 (where x is a range of hydrogen atoms observed) instead of "C6 compounds with 5 oxygens"

Line 318: "C6HhO3Nn". Does "h" stand for anything in particular? If not, it would be clearer to write down the ranges of hydrogen atoms observed, e.g. C6H4-10O3Na

Line 370-372: FIGAERO CIMS can only determine the elemental formula, not the molecular identity. The molecular identities (e.g. "malonic acid", "succinic acid", "glutaric acid") should be presented in less definitive tones.

Line 401-405: How consistent (with respect to OA loading and sources) is the POA vs SOA estimation based on ACSM measurements? How sensitive is the conclusion regarding POA vs SOA vs SIA effects to uncertainties in the f44 vs. f57 parameterization?