Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-255-RC2, 2020
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optical properties and composition of viscous organic particles found in the Southern Great Plains" *by* Matthew Fraund et al.

Anonymous Referee #2

Received and published: 9 June 2020

Fraund et al. conducted observations of characteristics of high viscosity organic particles (HVOP) apportioned as either airborne soil organic particles (ASOP) or tar balls (TB) during the HI-SCALE campaign. Formation mechanisms and properties of ASOP or TB have been paid much attention in recent years in the atmospheric chemistry community because of their role in climate forcing. There are few studies observing ASOP and TB in the same campaign and comparing their differences. As the authors pointed out that it is challenging to differentiate between ASOP and TB, this study is timely and I recommend the publication after the following comments can be addressed.

Major comments:

(1) The analysis of the three particular periods (April 28th, May 5th and 14th) with elevated AAE is reasonable and comprehensive. However, I am curious how these ASOP or TB went through chemical and physical changes after they were emitted? For example, the authors expected that HVOP in the May 14th samples would be present for at least 10 hours after the rain event (Line 295). Why the AAE gradually increased after the rain event and reached the peak ∼10 hours later (Fig. 1)? Did ASOP need this long time to be formed or accumulated? Would chemical ageing affect the particle composition during the 10 hours and make ASOP more viscous (Adachi et al., 2019)? What is the reason AAE decreased quickly after it reached the peak? Does it indicate the life time of HVOP is relatively short? Or they were transported to areas downwind? I understand it may not easy to clearly know the transformation of ASOP and TB, at least some discussions should be added.

(2) Line 322-325: The authors described the solubility of the non-spherical particles, which reminded me that what is the hygroscopicity of ASOP and TB? In recent years there are a lot of experiments measuring the viscosity of SOA formed from various precursors (summarized in Reid et al., 2018) at different relative humidity (RH). I see ASOP and TB are quite different from SOA but is it possible to measure the viscosity values of ASOP and TB varied with RH? Are ASOP and TB too small to measure their viscosity? As highly viscous secondary organic particles were observed frequently in ambient air (Virtanen et al., 2010 and other studies afterwards), I suggest at least add a few sentences describing the HVOP in this study is somehow different from those highly viscous secondary organic aerosol particles.

Minor comments:

(1) Line 38: delete "a" in "strong a climate . . .". Line 40: delete "aerosol" in "organic aerosol carbon". Line 78: should be Springston 2016 not 2011. (2) Line 119: Why the SOM aquatic samples were collected on May 17th? Why not choose 14th, same day that HVOP were sampled? (3) Line 186: The threshold (10 mm/hr) defining the rain events is different from 5 mm/hr described in Line 100. (4) Line 207: Is it certain

that an elevated AAE suggests the presence of spherical HVOP? I think better replace “can” to “may”. (5) Line 217: There are two Moffet et al. together; please delete one. Also Line 234 for Veghte et al and Line 250 for Wang et al. (6) Table 1: what does IOP1 indicate? (7) Supplement: there are two “Figure S1”. (8) Line 256: Cite Wang et al. 2016 after “lab-generated SOA particles”. (9) Figure 1: It seems some grey vertical bars indicating BrC appearance do not have elevated AAE > 1.7, for instance, the night of May 1st. Why it is included in the “BrC events”?

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Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-255, 2020.