

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-863

Anonymous Referee #1

Referee comment on "Canadian and Alaskan wildfire smoke particle properties, their evolution, and controlling factors, from satellite observations" by Katherine T. Junghenn Noyes et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-863-RC1>, 2021

This paper uses MISR observations to determine aerosol properties as a function of land cover type. They assess how these properties change with plume age and also relate their results to other fire and ecosystem factors such as fire radiative power and drought. The authors are able to identify statistical differences in satellite retrieved aerosol properties that depend on the fuel source.

This is a well written paper - a pleasure to read. I have a couple minor science questions and then a few technical suggestions.

Science questions

Line 201 - Isn't deposition a function of particle size? I would expect AOD and REPS to decrease with deposition as the larger particles settle out first.

Table 1 - is the humped SSA dependence in Table 1 expected? For example, Figure 1 in Samset et al. (2018) (<https://link.springer.com/article/10.1007/s40641-018-0091-4>) suggests either increasing or decreasing SSA as a function of wavelength, with both BC and BrC increasing with increasing wavelength and dust decreasing with increasing wavelength.

Figures 8&9 - the arrows to guide the eye - how are the arrow directions defined? is there a quantitative determination? For example, qualitatively looking at the plots I would

consider drawing increasing arrows on figures 9a, 9b and 9f.

Technical corrections

Line 44 - cite Petzold et al. (2013) www.atmos-chem-phys.net/13/8365/2013/. I like the BIS and BrS designation!

Line 87 - perhaps cite Kleinman <https://doi.org/10.5194/acp-20-13319-2020> here

Line 105 - 'Models are uncertain...' Models don't have thoughts...could this perhaps be rephrased?

Line 118 - 'Research Aerosol (RA) retrieval algorithm' I personally would have used RA²: 'Research Aerosol retrieval algorithm (RA²)'. Because later, e.g., line 127 if reading aloud - 'the RA successfully mapped' reads as 'the Research Aerosol successfully mapped' would sound better as 'the RA² successfully mapped' i.e., 'the Research Aerosol retrieval algorithm successfully mapped', but no worries if RA is already accepted nomenclature

Table 2 caption - AGL is only mentioned in the footnotes, so move AGL definition to the footnotes too?

Line 289 MERRA is used several times before being defined (e.g., on 137, 282, 287).

Figure 1 - Perhaps indicated the territories since they are referenced in the first paragraph of the results section?

Line 348-349 - Table 3 defines the land cover types so don't need to repeat definitions here.

Line 363 - spell out woody to be consistent with spelling out other biomes in previous sentence.

Figure 2 and related discussion - Plumes in FT are the same as plumes above PBL described in Table 2 so perhaps it makes sense to change Table 2 to call them plumes in

FT instead of 'above PBL'. The footnote to Table 2 could stay the same.

Figure 2 - Some numbers in Table 2 don't quite match up with Figure 2 - for example Table 2 suggests 33.8% plumes in FT in 2016, while sum for those plumes is 32% in Figure 2. Difference due to rounding?

Line 410 - the only typo I found! there is an extra 'a' at the end of this line

Line 471-473 - This sentence could be clarified - possibly also split into two sentences.

Line 484 - '... some plumes containing as much as 40% non-spherical...' Perhaps quantify 'some' or change 'some' to 'a very few plumes contain...' as several places (line 480 and line 485) indicate very few plumes have much in the way of non-spherical particles but then 40% is a lot!

Line 487 - I assume that the attribution of lower SAE to more non-spherical particles in F plumes is due to the fact that these non-spherical particles are large ($r_e=1.21$ μm), rather than their non-sphericity?

Line 623 'there have been no other large scale regional studies' I guess this depends how large scale and regional studies are defined? For example, Kleinman et al (2020) <https://doi.org/10.5194/acp-20-13319-2020> uses in-situ airborne observations to look at particle property changes due to aerosol aging in smoke plumes in the Pacific Northwest region.