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Atmospheric Measurement Techniques
Discussions
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Interactive comment on "The 2018 fire season in North America as seen by TROPOMI: aerosol layer height validation and evaluation of model-derived plume heights" *by* Debora Griffin et al.

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1. Abstract, Conclusions, and Introduction paragraph 3. Recently a third global plume-height product has been created. It is a thermal technique, similar to one used for volcanic plumes in the past, and has been applied to MODIS. The reference is:

Lyapustin, A., Y. Wang, S. Korkin, R.A. Kahn, and D. Winker, 2019. MAIAC thermal technique for smoke injection height from MODIS. IEEE Geosci. Remt. Sens. Lett., doi: 10.1109/LGRS.2019.2936332.

2. Introduction, P2, lines 30-31. Also Section 6, P15, lines 4-6. MISR provides global coverage about once per week (about every 8 days near the equator, every 2 days near the poles). CALIPSO covers effectively 10-4 of the global surface, once every 16

days. This difference could be made clearer.

3. Introduction, P3, lines 6-10. MISR stereo heights have also been validated against ground lidars.

4. Section 2.1, P4, lines 22-23. I don't understand why a different (better) solar spectrum would be applied to the OFFL product than to the NRTI product. Once you have the better spectrum, can't it be used for the NRTI product too?

5. Section 2.1, P4, lines 25-26. As described, the "quality flag" sounds more like a plume detection flag; if so, this might be a better description. Have you evaluated its actual quality, e.g., by using the MODIS FRP product?

6. Section 2.2, P5, line 2. Martonchik et al. (2004) did not evaluate the MISR plume height products. The main references for this product would be Muller et al. (2002) and Moroney et al. (2002).

7. Section 2.2, P5, line 5. MISR actually has a standard stereo-height product, which is described in Muller et al. (2002) and Moroney et al. (2002). It runs on all the MISR data, and produces a reflectance-layer-reference-altitude, but does not call out aerosol plumes explicitly.

8. Section 2.2, P5, line 17. The narrow MISR swath limits the frequency of global coverage.

9. Section 2.3, P5, lines 27-28. The CALIOP "swath" is really a curtain, having a width of ~100m, not several km. The data are usually averaged to several kilometers, but only along-track.

10. Section 2.3, P5, lines 30-31. Here you are using the CALIOP aerosol classification scheme, for which the key reference is: Omar, A.H., et al., 2009. The CALIPSO Automated Aerosol Classification and Lidar Ratio Selection Algorithm. J. Atm. Oce. Tech. 26, pp1994-2014, doi: 10.1175/2009JTECHA1231.1.

11. Section 2.4, P6, line 5. Small fires are also missed often by FRP, as well as those under heavy smoke plumes.

12. Section 3.1, P7, line 23. For MISR, the contrast is assessed at a spatial scale of 1.1 km, which probably provides a lot more of the plume vertical structure than the model simulation – in particular, more extreme height maxima and minima.

13. Section 3.1, P8, line 2. Note that these are very large indices of refraction, both real and especially imaginary. Might apply to BC near source, but probably not hydrated or aged smoke particles.

14. Section 4.2, P11, lines 29-30. CALIOP samples a curtain, so the data can be aggregated along-track to 5 km, but the cross-track width is still $\sim$ 100m. There is nothing you can do about this, but it is worth noting that the sampling footprints of CALIOP and TROPOMI are still quite dissimilar.

15. Section 4.2, P12, lines 14-15 and Fig. 4. Here you might emphasize that by "thick," you mean geometrically thick, and not optically thick. One would expect the differences in sampling among methods to be minimized for optically thick, geometrically thin plumes.

16. More generally, it might be helpful to identify explicitly the goal of the model and measurement comparisons in Sections 4 and 5. One would expect differences, due to different spatial and temporal sampling, as well as sensitivity to optical depth and optical depth vertical distribution, among the measurements. The model assumptions contribute to differences among the simulations and with the measurements. So this is not really a "validation," as these could all be "correct" in the context of what they measure or simulate. Rather, I think you are exploring the sensitivity of the "plume height" result to different plume properties, measurement techniques, and modeling assumptions. As such, I find most useful the conclusions presented where you interpret the differences in terms of attributes of the derivation methods and plume properties.

17. Section 6, P15, lines 18-19. I'm wondering whether the "exact plume height" is really well defined when there are multiple layers.

18. Section 6, P15, lines 19-20. Actually, most aerosol plumes are not uniform in optical thickness, and when multiple layers are present, they rarely cover exactly the same area. As such, MISR will often pick up multiple layers, not in a single 1.1 km pixel, but over the plume area imaged by the instrument.

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