Authors' response to comments are highlighted in **red.**

This paper proposes a new algorithm to retrieve aerosol optical depth, fine mode fraction, surface properties as well as fine-and-coarse aerosol particle properties. The algorithm has been applied to three cases and evaluated with AErosol Robotic NETwork (AERONET). The results proves that the algorithm works well in retrieving in aerosol properties including AOD, single scattering albedo and fine mode fraction. The paper is well written. I would suggest to accept the paper after minor revisions. Specific comments are give below.

The authors thank reviewer one for their feedback.

1) The modules are looped through fixed numbers of times instead of optimal numbers of times. Does it serve for parallel programming? Could you explain how you determine the certain numbers the different modules are looped? Have you done any experiments to prove that there is really a need to have so many loops? I would like to know how long it takes to process a 50-by-50-pixel region?

The loop numbers were determined experimentally with the Camp Fire case (only 1 imager available), and then were applied to all 3 case studies. We experimented with optimal looping structure (error < x), but results did not improve much and run time increased substantially. The algorithm is parallelized extremely efficiently, as each 50x50 (configurable) region is run independently on a separate core (if available). Because there is no pixel-to-pixel cross-talk for this algorithm, it is inherently well-suited for parallelization. A 50-by-50 pixel region (run over 2 weeks of data) will take no more than a few hours on a single core of a modern (post 2020) machine.

2) In "Aerosol/Surface retrieval iteration" section of Fig. 3, "If iterInd==4" should be "If iterInd==5".

It is correct as indicated, iterInd references the loop above (4 is the maximum value).

3) In Fig. 5, the aerosol loading over water in some area (eg. upper left area on 24, 25, 27 October) should be large, while the retrieved AOD values are small. Could you give some explanation?

We believe you mean Figure 9. This is a convolution of multiple issues.

1) **The over-water surface appears to not be sufficiently well-characterized for these regions.**
    a. **Partially due to insufficient initial cloud-screening (in general a likely culprit for this algorithm).**
    b. **Probably partially due to variation (over multiple days) in 10-m wind, which could cause large changes in the TOA radiation field, even for a Rayleigh atmosphere.**
2) **Cloud/Quality screening should probably have screened these higher AOD retrievals out.**
3) **Logarithmic scale shows these artifacts much more prominently at lower AOD.**

Using a Cox-Munk model in the future would probably alleviate these issues to some extent, as would improvement in quality masking. We have added these points to the discussion of Figure 9 in the text.

4) Please add unit on x axis in Fig. 8.

Units are already listed on the x-label (pixel).