

## ***Interactive comment on “Assessment of the aerosol optical depths measured by satellite-based passive remote sensors in the Alberta oil sands region” by Christopher E. Sioris et al.***

**Anonymous Referee #1**

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As the title suggests, this paper compares aerosol optical depth (AOD) retrieved by MISR, MODIS, POLDER, and AATSR over the Alberta oil sands region (AOSR). Additionally, using surface based PM<sub>2.5</sub> measured by 10 National Air Pollution Surveillance (NAPS) stations, the authors model yearly averaged PM<sub>2.5</sub> (and trends) for the various satellite sensors by correlating AOD to PM<sub>2.5</sub> for the 10 NAPS sites. Their results indicate that MODIS Deep Blue retrieved AOD and NAPS PM<sub>2.5</sub> (at multiple sites) have increased from 2003 through 2014 in a region located within the AOSR. This work is within the scope of ACP and is appropriate for publication after major revisions are made.

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### Major Comments:

As Andrew Sayer is an expert on aerosol retrievals from satellite-based remote sensing, I strongly recommend the authors fully take his suggestions.

Kahn et al., 2005 describes validation of a previous version of the algorithm and should be replaced with Kahn et al., 2010. The title is “Multiangle Imaging SpectroRadiometer global aerosol product assessment by comparison with the Aerosol Robotic Network”. Particle mixtures have changed, but many of the notes the authors have made about MISR remain valid.

Although the paper is focused on AOD trends from satellite-remote sensing, I would recommend also including an analysis of the Fort McMurray AERONET site as well.

Page 8, Line 18-19: The higher SNR is probably irrelevant over land (especially bright surfaces).

### PM<sub>2.5</sub> Assessment:

I strongly recommend that the authors remove the AOD-to-PM<sub>2.5</sub> aspect of this paper. I don't think it adds much to the paper, as the authors have in-situ PM<sub>2.5</sub> data for 10 sites anyways, and the correlation between AERONET AOD and satellite remote sensing retrieved AOD is much higher than the correlation between NAPS PM<sub>2.5</sub> and satellite remote sensing retrieved AOD. There are also a lot of caveats to converting between an integrated aerosol retrieval (AOD) and a surface aerosol retrieval (PM<sub>2.5</sub>), many of which I don't see discussed (please correct me if I missed it). Here are some of them:

1. For instance, MISR is viewing this area of the planet at roughly 10:15 AM local time. It is possible that the planetary boundary layer (PBL) is not always fully developed at this time, which would mean that a comparison between MISR AOD and surface based PM<sub>2.5</sub> would not be possible.
2. Unmasked transported smoke that happens to be lofted above the PBL may not be

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seen by NAPS.

3. Variation in the PBL height from day to day and season to season will cause discrepancies between retrieved AOD and measured PM<sub>2.5</sub> using a static ratio.
4. Large-scale differences in land-surface/water coverage may cause systematic discrepancies in PBL height at individual stations.

Although the results of the AOD-to-PM<sub>2.5</sub> analysis show a positive trend in PM<sub>2.5</sub> from space, I don't really see how useful this is, as the same thing can be shown from the 10 NAPS instruments with a much higher degree of confidence. Additionally, while I may trust the day-to-day changes in AOD retrieved from space, I would never put that kind of faith in converting AOD to PM<sub>2.5</sub> on a daily basis. I recognize that the authors did not do this and are basically only using PM<sub>2.5</sub> from AOD for yearly analysis, but some people may take this work and try to expand it in ways that probably shouldn't be done.

General Comments:

Is it possible that the drop in 550 nm AOD (Figure 5) and NAPS PM 2.5 during 2015 is related to the fall in oil prices affecting activity in the region? If so, it may be worthwhile to note, as this would likely continue to the present day.

Figure 1: Figure 1 could be improved in a number of ways. In addition to what Andrew Sayer suggested, I recommend putting the locations of your AERONET sites and NAPS stations on the map (maybe as circles and stars). If you wanted to make the plots even more useful, you could color the circles and stars using the same color scale for AERONET, and a different scale for PM<sub>2.5</sub>.

Figure 5: The authors should include the Fort McMurray AERONET site on this plot as well.

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