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Discussions

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 #2

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The manuscript assessed several satellite- based AOD retrievals (POLDER, MISR, AATSR, and MODIS) in the Alberta oil sands region (AOSR) by using two local AERONET sites and several National Air Pollution Surveillance stations. It is within the scope of this journal and in general well written. However, I am concerns that this manuscript is insufficient to be useful due to lack of substantial materials and logical reasoning in current version.

First of all, I have read the comments from Andrew Sayer, who is an expert on aerosol retrievals from satellite-based remote sensing, especially in MODIS AOD retrievals. His

comments are very useful to improve the understanding of the MODIS AOD retrievals and improve current studies.

My major concerns about this manuscript are the lack of in-depth analysis and lack the necessary explanations. For example, the finding of the ability to capture spatial variability with MISR is generally much worse than the other instruments over AOSR region is very interesting and useful to know the limitation of MISR measurements, however the possible reasons for this will be more important to see the spatial limitation of MISR. In section 3.1, the authors have indicated that all of the satellite retrievals can capture the inter-annual variability of the annual mean AOD observed by AERONET, but the trends estimated based on the each satellite retrievals showed lots of differences, some of positive and some of negative. Thus, what are the main reasons to explain this discrepancy? The authors reported a major issue of satellite AOD retrievals over this region, which is the lack of successful retrieval samples, especially of the MODIS retrievals which has low confidence. It is good information. However, the reasons for the large part of retrievals has low confidence are not well explained. Furthermore, the comparison of coincident AODs observed by satellite-based and AERONET shows large bias (more than 20%) between them, but necessary explanations are not provided.

I found that the correlation between monthly mean of the satellite retrieved AOD and AERONET AOD are analyzed, but I'd suggest to use the individual samples from AERONET to evaluate the satellite AOD retrievals and discuss the bias of each satellite product.

It is not clear to describe how to derive the PM2.5 mass density from satellite AODs. I noticed that the constant ratio of PM2.5 to AOD is used to convert the AOD trends from satellite instruments to PM2.5 trends. However, this is not accurate. The relationship between surface PM2.5 and AOD is not always linear. It is affected by multiple factors, such as the relative humidity since the AOD can be enhanced by aerosol swelling effects but the PM2.5 does not. Meanwhile, the correlation between AOD and surface

level PM2.5 significantly depends on the aerosol vertical distribution and aerosol particle size distribution. Thus, the uncertainties in those analysis and the influences on the results should be discussed.

P6, Line 28: Is this trend statistical significant?

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