Interactive comment on “An improved retrieval of tropospheric NO₂ from space over polluted regions using an earthshine reference” by J. S. Anand et al.

Anonymous Referee #1

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The authors present a novel DOAS-based algorithm for the retrieval of tropospheric NO₂ columns from nadir-viewing satellite observations. In this ESrs-DOAS method (EarthShine reference sector DOAS), spectra averaged from measurements over unpolluted regions are used as reference instead of a solar reference spectrum. A good consistency is obtained with other retrieval algorithms and the retrieval uncertainty is found to be reduced. ESrs-DOAS would potentially avoid the need of a solar reference, which could simplify the design of future missions.

This study fits well with the scope of AMT and the manuscript is well written and clearly structured. I recommend publishing the manuscript in AMT after addressing the follow-
General comment:

The authors claim that the ESrs-DOAS method could simplify the design of future satellite missions. However, it is not clear to me whether ESrs-DOAS could be implemented in an operational algorithm (which is the case of the retrievals based on a solar reference spectrum) or is only suitable for specific studies over limited areas/regions and periods of time. The major drawback of the presented method comes from the difficulty in the selection of an appropriate reference sector: can this selection be done in an automated way based on pre-defined criteria for the location of the reference sector(s) and the level of NO2 the latter can contain (e.g. how to automatically reject reference sectors contaminated by pollution transport events ?) ? Another point is the time difference between measurements in the reference sector and in other regions: should a reference sector be defined on daily, weekly, monthly or yearly basis ? In the case of monthly or yearly selection, what is the impacts of the stratospheric NO2 seasonality and possible instrumental degradation on the retrieved tropospheric NO2 columns ? How to deal with cloudy scenes ? To my opinion, these points need to be addressed more carefully in the manuscript, maybe in the form of table with recommendations for the different steps of the ESrs-DOAS retrieval. This could be very useful for people interested in implementing this method but also for the potential design of an operational ESrs-DOAS algorithm.

Specific comment:


Technical corrections:

1/Please define SCD on page 6702, line 15 instead of line 24.

2/The publication year of Platt and Stutz is 2008 and not 2006.

References: