

Interactive comment on “Global analysis of the relation between aerosols and short-lived trace gases” by J. P. Veefkind et al.

Anonymous Referee #2

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General:

I have mixed feelings about this manuscript. On the one hand I like the authors' approach to explore what can be learned from combining AOD and NO₂/SO₂/HCHO retrievals- something which as far as I know, has not yet been attempted.

On the other hand it is my feeling that the analysis does not reveal much more than what was already known. Claims that AOT to NO₂ ratios can be used to estimate local efficiency of combustion are to my opinion not justified. Although combustion efficiency plays some role in determining such ratios, they are more dependent on the specific emission characteristics of the regions (traffic-power generation-industry-biofuel) and the specific abatement technologies installed for primary particles and SO₂.

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It further seems to me that many findings have been found by either individual sensors, surface observations, and models, and the manuscript could be stronger pointing to what unique information is now derived by combining AOT and NO₂ retrievals. In line 23 of the abstract a statement is made that the GEOS-CHEM model calculates grossly similar ratio 'providing some confidence that we understand source, sinks etc.' This statement is of course somewhat peculiar, because there is already a host of evidence from different analysis methods for GEOS-CHEM as well as other models. If one turns it around one could also say that the consistency of model and satellite ratios provides some evidence that the satellite ratios are correct. I think that the paper would therefore need a better analysis of the potential errors involved with these ratios, before making strong claims (see below). This analysis is imperative to prove that the measured ratios are more realistic than the model results.

Finally, not explored in this study, but potentially more relevant is a stronger link to improving emission inventories. If one would 'zoom-in' into specific regions dominated by e.g. industrial emissions, an analysis of these ratios could perhaps lead to an increased knowledge of the effectiveness of e.g. particles abatement measures. I would recommend a stronger connection to emission inventories and to emission modellers.

I have my doubts whether this should be published in its present form, but I do suggest the authors to follow some of my suggestions to improve the significance of the manuscript. Possibly use of CO data could also improve the statements on combustion efficiency and biogenic emissions.

Detailed comments

p. 18919 Title: "global satellite analysis of the relation between aerosols and ..." would be more appropriate. While some use is made of SO₂, and HCHO, the focus is on NO₂.

p. 18920 l. 8 'this suggests'; I think nobody is doubting that aerosol and gases have common sources

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p. 18920 l. 13: I disagree that you can derive combustion efficiency from the ratio's. This would probably be true only if no abatement technology would applied. I would actually be nice to demonstrate how these ratios could change for road transport, power generation, etc, without and with various degrees of abatement technologies.

p. 18926 l. 14 Describe here the uncertainty relate to using the ratios, what is the dependency on surface albedo?

p. 18928 l. 27 The choice of the 'Mediterranean' is rather strange- since the focus of the paper is to say something about emission signatures- and aerosol is mostly dust.

p. 18928 l.3 I guess these are annual averages?

p. 18927 l.23 For emission inventories it is difficult to give uncertainty ranges. To what extend can this product verify or falsify emissions from e.g. EDGAR; or put an 'measurement' based uncertainty range?

p. 18929 l. 5 make clear what is different with the previous section (already include Europe). Seasonal and model comparison

p. 18930 l. 25 this is not per se about combustion efficiency but more about abatement technology. This would be a spot to introduce analysis of these ratios.

Issues with conclusions=>see abstract

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 18919, 2010.