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Interactive comment on "OMI tropospheric NO₂ air mass factors over South America: effects of biomass burning aerosols" *by* P. Castellanos et al.

Anonymous Referee #2

Received and published: 5 May 2015

The article *OMI tropospheric NO$_2$ air mass factors over South America: effects of biomass burning aerosols* by Castellanos et al. is generally well written and investigates the important effects aerosols can have on the retrieval of tropospheri NO$_2$ columns. I recommend it to be *accepted subject to minor revisions*.

1 General comments

A large part of this study is an evaluation of the uncertainties of

1. the effects of aerosols on DOMINOv2 AMFs

2. the effects of aerosols on the O$_2$-O$_2$ cloud pressure.

I would appreciate if the authors would explicitly compare their results to the previously stated uncertainties (e.g., in Boersma et al., 2004, Acarreta et al., 2004, Stammes et al., 2008). Probably, the result of this comparison will be that previous uncertainty estimates were largely under-estimated in the presence of aerosols.

2 Specific comments

- 2684/02: Not *OMI* observations are essential, but rather more general *satellite* observations; OMI is only one example.

- 2684/26: The meaning of the phrase *which was the case for the majority of the pixels considered in our study* is not clear.

- 2686/13: It would help if the authors would explain that f_{eff} could also be called *radiance cloud fraction*.

- 2688/24: The Schreier et al. paper you cite used GOME-2, not OMI. Or, maybe you mean the earlier study by Schreier et al., which was about the tropics, and actually used OMI?

- 2690/08: Shouldn't it be *measured* instead of *simulated* reflectance?

- 2690/25: To my understanding, O$_2$-O$_2$ number density should be a function of the inverse *pressure*, not the inverse *temperature*. Please explain.

- 2691/26: Maybe mention the correction for the temperature-dependence of NO$_2$ absorption in this context?

- 2692/14: Which ECMWF data? Forecast? ERA-Interim?

- 2692/19: Which wavelength are the NO_2 AMFs calculated for? What influence does the wavelength disparity between the O_2-O_2 cloud retrieval and the NO_2 retrieval have?

- 2692/23: Rephrase; on first sight, it looks like the *surface observations* are distinct from the *MAX-DOAS observations*, even though they are the same.

- 2693/07: Please explain what *converted values* are.

- 2693/20: Which RTM was used?

- 2693/26: What does an AI larger than 0.5 mean physically?

- 2694/01: How does one arrive at the "magic number" 1.5km?

- 2694/03: Please explain where the different assumptions on vertical distribution come from for carbonaceous and sulphate aerosols.

- 2694/24: If CALIOP is still measuring today, replace *from* by *since*. Otherwise state the end of the CALIOP time period.

- 2695/05: *ratio of aerosol 180-backscatter to extinction* is not clearly understandable.

- 2695/07: *level 2543nm aerosol extinction*?

- 2695/15: Please comment on the effect of assumed SSA on the extinction profiles.

- 2696/08: Please state exactly which MODIS/Aqua data set you are referring to.

- 2696/19: Here you write that Fig. 1 shows a 2006-2008 average; in the caption of Fig. 1, you talk about only the fire season of 2006-2008. Please be consistent.

- 2696/24: Please define what you mean by *spatial correlation coefficient*. If you simply took the Pearson correlation of the gridded data sets, then the use of "spatial" is not justified, as this correlation coefficient does not really contain spatial information.

- 2698/01: In which context did you *replace* OMAERUV with CALIOP ALH?

- 2699/27: Further reasons for differences include RTM differences, possibly different aerosol parameters in the RTMs, . . .

- 2702/08: Speaking of *cloud pressure [. . .] above [. . .]* is misleading; you could clarify by speaking of *higher clouds*.

- 2717: Please explain the meaning of *average [. . .] MODIS-Aqua active fires*.

- 2717: Doing the collocation based on a 0.5 degree radius means that effectively, your collocation radius is getting smaller towards the South . . .

- 2718: It is not clear if the mean and std stated within the plot itself refer to only the CALIOP ALH (if so, what about OMAERUV ALH?) or the whole data set?

- 2721: Actually, the *solid* grey line is the least-squares fit.

- 2721/2722/2723: Why do you use an additive "error bar" in Fig. 5 and a multiplicative "error bar" in Figs. 6+7?

- 2723: *AMFs* instead of *AMFS*

- 2724/2725: What are the horizontal black lines in the left plots (probably CTP, but that's not written in the legend as in the right plots)?

- 2726: What are the dashed horizontal black lines in all plots?

- 2728: Please explicitly clarify that the solid line is the AL@850hPa, and the dashed lines are clouds.

- 2729: Please speak of *surface spectral reflectance*, as albedo is a quantity averaged over all wavelengths. Also, please state the wavelengths of surface spectral reflectance and AOD.

- 2731: In the discussion of the asymmetry parameter g (see p. 2709), it would be nice to discuss which parameter might be more realistic of biomass burning scenarios.