

Interactive comment on “Intercomparison of daytime stratospheric NO₂ satellite retrievals and model simulations” by M. Belmonte Rivas et al.

Anonymous Referee #2

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This is an interesting paper where the authors compare spaceborne observations (limb and nadir) with model simulations of NO₂ abundances in the stratosphere. Important conclusions are the good agreement between the retrievals from different limb sounders, and the finding that agreement between limb measurements and simulations from CTM's is good in the tropics. Another important conclusion is the observation that there are considerable differences between the columns retrieved from nadir and limb observations, as well as between the nadir observations from OMI and SCIAMACHY.

The paper is well-structured and well-written and therefore I recommend publication in AMT after addressing the following remarks:

- p901 l9: According to Boersma et al., 2007 a third order polynomial is used.
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- p904 l11: Please provide a typical value of α ?
- p904: In Dirksen et al., 2011 it is described that the assimilated stratospheric column is based on the TM4 model field before the observation update. I assume the same approach is used here. Please add a sentence mentioning this. This is relevant information for the argumentation under Point 1 on page 916.
- p903 l20: Explain the terms S and V in Eq. 8. Mentioning the term Kalman filter may be in order.
- p905 l10/11: Is it correct to classify ClONO₂ photolysis as slow when its lifetime is in the order of hours?
- p902 l4/5 21/22: the fixed temperature for the NO₂ x-section was already mentioned on p901.
- p906 l16: Do you use a look-up table or is the photochemical correction (re-)calculated each time it is applied?
- p906 l25: Do you mean to say that the photochemical correction in these areas has large uncertainties due to twilight conditions? If so, please rephrase accordingly.
- p907 l24: Briefly mention how WACCM did perform compared to the other models in the study by Eyring et al., 2010.
- p908 l1-17: Please mention the time steps for updates in transport and chemistry for TM4, same for the WACCM model in the previous section.
- p911 l11-12: This sentence is hard to read/understand, please rephrase.
- p911 l21-26: Please mention/discuss the fact that the plots in Fig 7a show that for 30-60S the peak of the TM4 NO₂ profile occurs at too low altitude. This could also be mentioned in the summary of the paper.

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- p912 l4 17: The concept equatorial production zone of NO_y merits to be discussed in the introduction.
- p912 l25/26: this seems a repetition of the first part of the sentence.
- p913 l1: please provide a reference.
- p913 l1-6: This sentence is too long and difficult to read, please rephrase.
- p914 l23: Water vapor has some absorption features in the DOAS fit window, I'm not sure about liquid water.
- p915 l7: Please elaborate what you mean by retrieval configurations.
- p915 l20: This should be version 1.0.
- p917 l4: What do you mean with "assimilation top"? On p916 l11 you state "biases in nadir stratospheric column" and in the summary of Point #1 (p917 l5) you say "biases in slant column densities" I assume it should be slant column on both occasions. I find this subsection a bit hard to read. To my understanding the message you want to convey is that biases in the observed slant columns lead to biases in the stratospheric NO₂ columns without affecting the tropospheric columns, because only the observations over remote/unpolluted areas are used to assimilate the stratospheric NO₂ model field. Furthermore I am a bit puzzled by the shapes of the averaging kernel shown in Fig 10. Fig 1 of Eskes et al., 2003 shows a much stronger effect of clouds, with the cloudy kernel being almost twice as large as the clear sky kernel at 600 hPa.
- p918 l4/5: This statement appears a bit circular as a tropospheric signal over a presumed clean area would be classified
- as stratospheric, hereby automatically reducing the remaining tropospheric column.

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- p932 (Table 3). Please add the latitude ranges for SH/Eq/NH in the caption.
- p939 (Fig 7a): What is the vertical binsize for the partial columns? I would expect that integration/summation of the partial columns yields the stratospheric column.
- p944 (Fig 10): in clear -> for clear sky. In the middle panel please add a trace indicating unity kernel values.

Spelling-related:

- p896 l17: "... limb observations." add ", respectively"
- p896 l20: long time series -> long-term time series
- p897 l14: long-term studies -> long-term trend studies
- p898 l24: "limb retrieval" add "of NO₂"
- p899 l13: "Fourier" add "transform"
- p899 l20: micron -> μm (applies to p900 as well)
- p900 l10 in -> by
- p901 l26: earth -> Earth
- p903 l6: assimilated gas -> assimilated trace gas
- p906 l16: Equation number is missing.
- p907 l13 22: in -> by
- p908 l5: degrees -> degrees, respectively

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- p908 l6: Equation number is missing.
- p913 l5: renders southern -> renders observations over southern
- p913 l11: long-term time trends -> long-term trends
- p913 l23: a very tight -> close
- p913 l26: we define -> we can define
- p913 l26: tight -> close
- p914 l8: higher -> larger
- p914 l10: or 35% -> (35%)
- p915 l8: New paragraph
- p916 l10: remove "should"
- p916 l17: gas -> trace gas
- p916 l19: clear -> clear sky
- p916 l22: of -> the
- p918 l4: to a 5% -> to 5%
- p920 l7 13: SCIA -> SCIAMACHY

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 895, 2014.