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Atmospheric Measurement Techniques Discussions

Interactive comment on "The version 3 OMI NO_2 standard product" *by* Nickolay A. Krotkov et al.

Anonymous Referee #4

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Review of the manuscript "The version 3 OMI NO2 standard product" by Krotkov et al.

The manuscript describes the new V3 algorithms for OMI NO2 retrievals. The new algorithm includes significant improvements compared to the previous algorithms, for example, the new spectral fitting algorithm for NO2 slant column density (SCD) retrieval and the higher resolution a priori NO2 and temperature profiles. The manuscript is clear and well written but I think it requires additional comparison with ground-based observations. Therefore, I recommend publication after addressing the following comments:

1) P6 L10-11 How much do you expect this choice of the monthly spectra to affect the correct representation of the day-to-day variability?

2) Fig. 3 I think it would be useful to have the same plots for June or July in order to have an idea of the difference at northern high latitudes, which are uncovered in

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December.

3) Fig. 6 This large difference over NCP, China made me think about the impact this change in the algorithm could have on emission estimation, in particular in China where recently significant emission reduction has been probed from space-based observations. Can you estimate or at least speculate on how top-down emission estimates might be affected by these algorithm changes, as compared to some of the conclusions provided in existing literature?

4a) Section 5.2 In a previous work (Ialongo et al., 2016) where V2.1 and V3 total columns are compared to Pandora observations in Helsinki (Finland), the difference between V3 and V2.1 retrievals are quite systematic, with V3 sensibly smaller than Pandora (as compared to V2.1). Can you speculate about the difference between your results with this previous paper?

Ialongo, I., Herman, J., Krotkov, N., Lamsal, L., Boersma, K. F., Hovila, J., and Tamminen, J.: Comparison of OMI NO2 observations and their seasonal and weekly cycles with ground-based measurements in Helsinki, Atmos. Meas. Tech., 9, 5203-5212, doi:10.5194/amt-9-5203-2016, 2016.

4b) In general, I think the manuscript could get stronger with slightly more comparison to independent ground-based observations, similarly to what was presented by (Lamsal et al., 2014). While the main scope of this manuscript might not be the comprehensive validation of the V3 product (this could be addressed in a separate paper, perhaps), I would suggest including one or two more pictures, for example something similar to fig. 6 and 7 in Lamsal et al. (2014), including for example Pandora measurements or additional max-doas stations. According to this previous paper, such ground-based data should be available to the authors.

Lamsal, L. N., Krotkov, N. A., Celarier, E. A., Swartz, W. H., Pickering, K. E., Bucsela, E. J., Gleason, J. F., Martin, R. V., Philip, S., Irie, H., Cede, A., Herman, J., Weinheimer, A., Szykman, J. J., and Knepp, T. N.: Evaluation of OMI operational standard NO2

column retrievals using in situ and surface-based NO2 observations, Atmos. Chem. Phys., 14, 11587–11609, doi:10.5194/acp- 14-11587-2014, 2014.

5) Vasilkov et al. (2017) discussed the effect of the varying observation geometry on the NO2 vertical column retrieval. Their findings suggest that the NO2 vertical columns would typically increase (at least in this test orbit over the American continent), when taking into account a geometry-dependent Lambertian equivalent reflectivity (LER) in the NO2 retrieval algorithm. Can you comment in the manuscript on how this could affect your retrievals?

6) Section 5.3 P14 L18 Among other differences, there is difference in spatial resolution between OMI and GOME-2 (or SCIAMACHY). Can you comment on how you think this affects the comparison? Can you specify which details of the retrievals might produce the largest differences?

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