Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Validation of Aura-OMI QA4ECV NO$_2$ Climate Data Records with ground-based DOAS networks: role of measurement and comparison uncertainties" *by* Steven Compernolle et al.

Anonymous Referee #2

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General Comments

The manuscript entitled 'Validation of Aura-OMI QA4ECV NO$_2$ Climate Data Records with ground-based DOAS networks: role of measurement and comparison uncertainties' by Compernolle et al. describes the results of a validation exercise, comparing satellite-borne QA4ECV tropospheric and stratospheric NO$_2$ partial VCDs with ground-based observations from a large number of stations.

The paper is very well written and represents a significant contribution to the validation

of satellite observations. Data products, validation methodology and data screening are described in detail. Error sources and potential reasons for discrepancies between ground-based and satellite-borne observations are discussed thoroughly. As far as I can judge as a non-native English speaker, there are hardly any grammatical or syntactical errors. I recommend the publication after addressing some minor issues as listed below. In particular, I would appreciate if the processing of the ground-based data sets and the differences between QA4ECV and bePRO data products would be discussed in some more detail.

Specific Comments

Section 2.2.2: I feel that the MAX-DOAS retrieval algorithms should be described in more detail. It should be stated more clearly that the QA4ECV and the bePRO algorithms are distinctly different, with QA4ECD retrieving NO2 VCDs directly by dividing the dSCD from a single elevation angle by the differential AMF, while bePRO VCDs are determined by integrating a vertical NO2 profile retrieved by an OEM algorithm based on measurements from several elevation angles.

There are recent studies on the performance of bePRO in comparison with other profile retrieval algorithms (Frieß et al., Atmos. Meas. Tech., 2019, https://doi.org/10.5194/amt-12-2155-2019; Tirpitz et al., Atmos. Meas. Tech. Discuss, https://doi.org/10.5194/amt-2019-456) which should be cited here. I would furthermore appreciate if it would be discussed to what extent the problems with the stability of the bePRO NO2 vertical profile retrieval identified within these studies affects the quality of the data used here for OMI validation.

P7, L10: Please provide a reference (or an URL) for the description of the NDACC standard procedure.

P8, L31: Given that QA4ECV MAX-DOAS tropospheric NO2 is determined by dividing the tropospheric SCD by the tropospheric AMF, I don't understand how a vertical grid can be involved here.

P12, L6: Explain what you mean with the term 'observation operator'.

P12, L7: Which ray tracing code did you use here?

Last paragraph of Section 3.3 and Figure 7: It is not clear to me in which way the 'bias-correction for the annual mean difference' has been performed - please explain in more detail.

P23, L6: By how much has the satellite a priori profile been shifted?

Technical Comments

P21, L4: 'characterized with' -> 'characterized by'

P21, L22: Insert 'being' before 'tropospheric VCD'

P22, L25: Add right parenthesis: '(see Eq. (1))'

P23, L12 and L30: Add space between number and unit

P31, L1: 'does' -> 'do'