

## ***Interactive comment on “The Berkeley High Resolution Tropospheric NO<sub>2</sub> Product” by Joshua L. Laughner et al.***

### **Anonymous Referee #1**

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#### General Comments

This article summarizes updates to the Berkeley OMI NO<sub>2</sub> product (BEHR). The authors describe the production of the product and the updates made to their previous version v2.1C and now included in version v3.0A and v3.0B. Overall I believe the quality of the data is acceptable and the analysis is thorough. The BEHR product has been used in several scientific studies and an updated version with the latest model profiles, surface reflectance etc will be welcome. I downloaded some data without any problems, and what I have looked at seems to be very complete.

Many of my critiques are stylistic or requests for clarity. I found this paper quite difficult to get through, despite good organization and good English. There are a lot of details (sometimes, maybe too many), but occasionally something quite key will be missing.

C1

The paper also includes a 16 page supplement (several interesting figures are contained here). A short sentence on one small point may reference two figures in the supplement and two tables within the paper, sending the reader off to more details, and at times I felt a bit confused trying to follow all the references to other sections and the supplement. There are several figures with multiple panels and a lot of detail within the captions, but I think the figures could do with in-figure titles (for instance, add “JJA” and “DJF” to the ones sorted by season). Individual panels are frequently referenced throughout the text, and it’s a hard slog to re-read long captions at each reference. Figures are often not introduced in a general way, but an individual panel may be referred to quickly in a discussion. I think the paper would be a lot clearer if each figure were introduced at its first mention in a concise way by something like “Figure 6 shows fill in blank”.

The paper describes updates to V3.0A and V3.0B but it wasn’t clear to me why there are two versions to discuss. Why not just discuss version 3.0B (presumably the most recent version)? Have people already published with V3.0A? Also, it is not mentioned in the paper what version is provided in the data files.

#### Specific comments

The title: This paper describes an algorithm update to the product for one specific satellite instrument (OMI). I think it would be more useful to give a more descriptive title, as there already exists a former “Berkeley High Resolution Tropospheric NO<sub>2</sub> Product” and perhaps there will be more in the future. Something like: “The Berkeley High Resolution Tropospheric NO<sub>2</sub> Product: Updated version 3.0 for the Ozone Monitoring Instrument” for example.

Abstract: Does this paper and dataset only include data over the US? OMI is global but the paper only shows US region so tell the reader early on.

It’s not clear to me what years of data are available. You use 2012 as an example throughout the paper but don’t talk about other years. I only get that other years other

C2

than 2012 are available because it's mentioned to use some years with caution. Be specific in abstract and text.

You discuss V3.0 here but V3.0A and 3.0B in text. Is this V3.0B that is actually listed and discussed in abstract, and provided on repository?

Page 1, Line 19: While I guess anything in the atmosphere could have some effect on the radiative balance, the radiative effects of NO<sub>x</sub> of any significance are indirect, not direct.

Page 1, Line 23: You give other thorough details, but then end with "NO<sub>x</sub> itself is harmful". Be more precise – not clear what this means. Harmful in what way?

Page 2, Line 4: actually, GOME-2 came after OMI. Reword to make sense. For context, give approx spatial resolutions of various resolutions to clarify OMI's ability to look at urban and point sources.

Page 2, Line 17: "also" and "as well" are repetitive

Page 2, Line 24: Lots of molecules are detected using remote sensing in the UV. If you want to mention NO, give specific reason it is not detectable.

Page 3, Line 8: It's not clear to me why the surface elevation is necessary for a radiative transfer model. Is this something in your particular setup?

Page 3, Line 15: You discuss the effects of increasing the resolution in different studies, but relative to what original resolutions?

Page 3, Line 21: "restricted to a region of the world" is awkward phrasing. Any region is a region. Be more specific.

Page 3, Line 22: I don't think you should use the word "retrieval" here to describe your product. That implies you are doing a retrieval, which is really the spectral to slant column step (performed by NASA).

### C3

Page 3, Line 24: Is v2.1C described elsewhere? Reference it.

Section 1 in general: I think you should list the science studies that have used the BEHR product specifically so that you can show importance of this product.

Page 3, Line 27: The use of the word "visible" to describe an AMF here and elsewhere is confusing, but particularly in this section, where you have just discussed the visible (spectral) absorption of NO<sub>2</sub>. I had no idea what you were talking about until later in the paper.

Page 3, Line 31: What were the old emissions? These update descriptions don't make sense without context.

Page 3, Line 2: vague statement

Page 4, Line 20: is g(p) mixing ratio or partial column? Specify

Page 4, Line 24: Confusing to me what is provided in data until I looked at it.

Page 10: I'm not sure why so much detail is provided on RAA here. Is the definition different from what is standard or included in the OMNO<sub>2</sub> files? If not, I would suggest you move it to the supplement.

Line 18: Give reference for this empirical correction

Page 6, Line 6: Useful to know spatial resolution here for MODIS products

Page 6, Line 28: Mention this is modeled resolution

Table 1: What does "atmospheric profile" mean? (p, T, O<sub>3</sub>?)

Page 7, Line 1: Why do you need an independent surface pressure of an OMI pixel? If the model resolution was larger than OMI, this would be more obvious. Why can't you use some kind of average of the modeled surface pressures?

Page 7, Line 2: For what is tropopause pressure used? Is it to define the height of the troposphere for equation 2?

### C4

Page 8, Line 6: You give a lot of other details. . . . But what is source of OMI geometric and radiance cloud fractions? Is cloud fraction from the O2O2 algorithm cloud pressure? Why is there a MODIS cloud fraction included? I don't see this MODIS data mentioned anywhere else so not sure why it's here. It's from a different satellite which seems like a dodgy cloud product for use in OMI analysis.

Section 2.6: Again, I'm confused about what years are analyzed, what years are modeled with WRF-Chem and why. Why is MOZART not available 2005-2006?

Page 8, Line 28: Is MOZART only used for boundary conditions? This sentence is confusing.

Page 8, Line 31: What is GEOS-Chem resolution?

Page 9, Line 14 and Line 21: what does "when possible" mean? What years are available and what determines this?

Page 9, Line 22: I'm not sure I understand what you are doing here. Is this making a single climatology for the entire month? Why not make 24 1-hour climatologies for each month and take the nearest profile of each observations?

Figure 1: Caption needs to mention what this is relative to, and version (ie., changes between V2.1C and V3.0A or whatever).

Since the VIS AMF is actually a separate AMF product in the datafiles, I find it very confusing to have it included in the changed parameters. Could it be moved to its own figure and discussion? It feels confusing to have it brought up in the middle of the other discussions of input parameters.

Page 10, Line 7: Here and elsewhere: Figure and table referred to without contextual introduction. I think Figure 1 should be introduced and discussed concisely before a panel is mention in brackets with other tables).

Table 2: Mention data version and change relative to what.

C5

Tables 2 and 3: Probably unnecessary significant figures after decimal place?

Page 13, Line 1: Specify what is the other approach

Page 14, Line 28: Reference to v3.0B but still in V3.0A section.

Figure 4: First reference is to panel c on page 18, but I think need an introduction to general figure for context. Include some titles on figures panels for readability. Also, mention change is relative to what. And what is the version?

Page 15, Line 6: I find this discussion a bit hard to follow, with references to a previously undiscussed figure (I need a sentence to help me interpret it first) and to the supplement. Also, "it" on line 6 refers to what? What is "order of averaging"?

Figure 5: What is data version here?

Figure 6: Need some intro discussion in text. I found I was with a reference to this figure but not much assistance on how to interpret it.

Page 8, Line 15: Not sure what is (2) at end of sentence.

Section 4.1: You give 6 points early. Break up this section for better organization.

Page 19, Line 10: I believe you mean "average average difference" instead

Page 19, Line 30: Just to clarify, these scattering weights are from the OMI SCD product?

Page 20, Line 3: I'm not really clear why users could expect to reproduce at all without cloudy scattering weights and surprised it's so small, unless really low cloud fractions are being considered. Seems like this should not be attempted as obviously information is missing. I'm not sure you really need to go into the details here. Just saw you need to provide it for reproducibility/completeness. Line 5: If people start using their own cloud fractions, will they be consistent with the cloud top heights? Not sure this is something that should be encouraged for any except most advanced users.

C6

Page 22, Line 13: Why are some years available and others not? (Can mention earlier in paper.)

Page 25, Line 19: Remove "This"

Technical Comments

Page 1, Line 7: remove "has"

Page 2, Line 34: change "conversion of factor" to "conversion factor"

Page 5, Line 1: Change semicolon to comma

Page 5, Line 2: Change to "denominator in"

Page 6, Line 3: Remove extra "in"

Page 8, Line 20: change to "year's"

Page 10, Line 10: change to "changes in the surface reflectance"

Page 15, Line 8: change to "influenced"

Page 19, Line 11: change to "1 hour in some"

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Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2018-66>, 2018.