

## ***Interactive comment on “Evaluation of a regional air quality forecast model for tropospheric NO<sub>2</sub> columns using the OMI/AURA satellite tropospheric NO<sub>2</sub> product” by F. L. Herron-Thorpe et al.***

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Referee said: This manuscript presents a detailed comparison of air quality forecast model output with OMI tropospheric NO<sub>2</sub> data for the Pacific Northwest region of the United States. In addition, comparisons are made between the NASA and KNMI versions of the OMI NO<sub>2</sub> data. Considerable effort has been expended on averaging the model data to the OMI pixels, computing the averaging kernels for the NASA version of the OMI NO<sub>2</sub> data, and the application of both these averaging kernels as the ones from KNMI. An interesting result is that application of the averaging kernel in areas with

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little cloudiness seemed to make very little if any difference in the comparison of model output with OMI NO<sub>2</sub>. In general, the results of the comparisons are well presented. However, the description of the methods used could use to be improved. Details are outlined below. I recommend that the manuscript be published after the improvements listed below are implemented.

Major comments:

p. 27070, Eq 4: Need to explain to the reader why ZHi is subtracted from ZFi.

In response: Done. The equation has been modified to read 2 times ZF-ZH and a sentence has been added to explain this is calculation of layer thickness: "MCIP does not report layer thickness, so LT has been replaced with twice the difference of the layer's full and half height."

p. 27071, lines 2-7: Need to specify that this is the method used by NASA's standard retrieval. Please add an explanation of what KNMI does for the stratosphere.

In response: Done. Both products methods are now independently described.

p. 27071 line 24 through p. 27072 line 9: Need to better explain the overall process of acquiring and employing the averaging kernels. You never say explicitly in this paragraph that you computed the averaging kernels appropriate for the NASA version of the data. Please say that before you mention "We employed the OMI (NASA) averaging kernel...." in line 27. In line 1, you say "This method uses...." without it being clear what method you are talking about. I assume you mean the method of calculating the averaging kernels. Please clarify.

In response: Done. The explanations of using the averaging kernels has been seriously expanded.

p. 27076, line 24: Here it says that the fire emissions come from something less reliable than Blue Sky, whereas p. 27067, line 25 says the fire emissions do come from Blue Sky. Please make these statements consistent. If something other than Blue Sky fire

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emissions was used, please explain what it was.

In response: Done. BlueSky has recently developed a new version that is more reliable. The less reliable method mentioned is an older version of BlueSky that we employed at the time of the analysis. The sentences discussing this have been modified to read: " This may be attributed to the way fire size and progression were estimated in BlueSky which relied only on ICS-209 ground reports; more recent versions of the BlueSky framework merge these reports with satellite detects to produce a more reliable estimate of fire size and progression."

p. 27078, lines 18-20: I don't understand this statement. If for the same value of the total column NO<sub>2</sub> the stratospheric component is larger, then the residual is going to be smaller.

In response: Done. The idea we are trying to get across is that if there is more stratospheric NO<sub>2</sub> in the summer, and NASA algorithms don't correctly account for this, the tropospheric NO<sub>2</sub> columns calculated will be larger because not all of the stratospheric contribution has been subtracted. We have edited this statement and moved it to the end of the paragraph to read: " In short, stratospheric NO<sub>2</sub> is highest in the mid-latitudes during the summer (Cohen, et al, 2003) and NASA's tropospheric NO<sub>2</sub> algorithms do not seem to subtract enough of the stratospheric contribution for those months."

Minor Comments:

p. 27064, lines 4-6: move "(R=0.75)" up to after the word "correlated" and move "(R=0.21)" to earlier in the same line after the word "correlated".

In response: Done.

p. 27066, lines 1-2: this is true for the KNMI version, but not for the NASA version.

In response: We are confused by this statement. Are you saying this because NASA uses a seasonal static model? Or is it due to the below cloud addition? Or possibly

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because KNMI uses the RAM method?

p. 27066, line 6: change AURA to Aura

In response: Done here and in the title.

p. 27069, line 17: "spatially averaging the AIRPACT grid to the pixels within the daily OMI swaths"

In response: Done.

p. 27072, line 3, Where should the (Bucsela, 2008) reference be placed? With the previous sentence?

In response: Yes it does. Placement has been changed.

p. 27078, line 22, What does "NASA timelines show a clear anti-correlation with season" mean?

In response: This statement has been removed and the related sentences have been edited to read: "Tropospheric NO<sub>2</sub> columns calculated by NASA are lower during the winter and higher during the summer, which is evidently due to the way that the tropospheric column is calculated in the OMI NO<sub>2</sub> algorithms. This annual cyclic variance in tropospheric NO<sub>2</sub> is... " This should make the point more clear.

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