Reviewer #1 Second review

Before publication, the authors should address methods of filtering Pandora data quality as well as a more clear explanation for the chosen Pandoras in this study. This is a much needed comparison paper that shows diurnal trends of Total column NO2 and HCHO, but little explanation is provided as to why OMI disagrees over half the time.

I do not know why OMI and Pandora disagree. Both use similar spectral fitting algorithms with spectrometers that have similar spectral resolution. There are differences. An important difference is that Pandora is a ground-based instrument and observes the boundary layer consistently while OMI as a satellite instrument may not. For NO_2 retrievals in the 410 to 440 nm region, this should not be a problem, but for HCHO retrievals in the UV where there is strong O_3 absorption and Rayleigh scattering, there may be difficulties. The other difference is the much larger field of view of OMI compared to Pandora, which means that OMI is averaging over a much larger area.

The paper by Herman and Mao is a study comparing Total Column HCHO, NO2, and O3 from Pandora Spectrometers to OMI and DSCOVER-EPIC. They included multiple pandora stations located at various locations around the globe and during different seasons. They found that agreement is overall good, however OMI does not always capture the seasonal variation as seen in the pandoras and may not be sensitive to changes in surface concentrations. DSCOVER-EPIC agrees quite well with the diurnal pandora data. This is a much needed comparison study as there are few publications on the validity of pandora spectrometers which are to be used in future satellite validation plans. The authors have addressed some of the previous comments, but not all. Below I note additional questions or comments based on this revised version. Larger suggestions include a more in depth discussion on the Pandora's data quality. The authors use numerous Pandoras around the globe in different figures without providing a reason for the change. Keeping the study limited to a couple would provide a clearer conclusion. The authors also emphasize that there are disagreements between OMI and Pandora without much explanation as to the cause.

Line 22: switch 'OMI' and 'Ozone Monitoring Instrument'. OMI is the abbreviation. **Done**

Line 24: put 'TCHCHO' and 'TCNO2' in parenthesis **Done**

Line 98: I still don't understand why you're not using TROPOMI at all but if you're not using it, remove the mention of it here. Not relevant. **Removed**

Line 100: I still would like to see more explanation of the data filtering in the text. There is only a brief mention on line 145 of the rms. Are you not considering the independent uncertainty, negative values, 'unusable' data, L2 DQ flags, etc.?

time series use all available Pandora data between 07:00 and 17:00 filtered for data quality (values with large RMS errors and with negative values are removed).

Lines 132-126: I still don't think this level of detail is necessary for this publication. This info is needed for a user manual, not an intercomparison paper. **I agree, but the poor file naming notation causes confusion for a reader trying to understand this paper.**

Line 139: 50 km is quite far for these Pandoras. Especially in an area such as NYC where NO2 changes. **The OMI data used is a 0.25^{O} x 0.25^{O} gridded data set that corresponds to about 30 x 30 km^2 for midlatitudes. Most of the OMI data are less than 50 km away from the Pandora location.**

Figure 1: Note the uncertainties for HCHO and NO2. Figure 1: I still don't see the need for both Figure 1 and 2. They both are saying that there is a seasonal dependence at the Bronx. If you want to remove the noise from figure 1, that's fine but then I don't feel figure 1 is necessary. Other than one sentence in line 145, the weekly data in the second and third columns from figure 1 are not discussed.

Figure 1 contains Pandora data between 07:00 and 17:00 local time, whereas Figure 2 contains data near the OMI overpass time showing that the seasonal dependence should be seen by OMI.

Line 155: Is the HCHO seasonal dependence due direct emissions from a park in the Bronx? Not isoprene emissions that break down into HCHO? Figure 7. Upper panels: Better label for legend. Should have 'Pandora' somewhere. Why is 'NO2 OMI' in magenta?

I have modified the sentence concerning the park in the Bronx

The primary emission sources of atmospheric HCHO include direct emissions of HCHO precursors from vegetation and lakes, primarily through the release of biogenic volatile organic compounds such as isoprene and terpenes from vegetation….

Line 222: I still have an issue with this sentence. You are only able to compare Pandora at the OMI overpass time. There is no point in comparing OMI to the entire diurnal data of Pandora.

The sentence has been removed

Line 245: Why only restrict the cases to the 3 days shown? Why not find the agreement for the entire record?

I was showing examples if the diurnal variation observed by Pandora with comparosons to the OMI values. Other graphs show the long-term comparisons. The text says that Figure 8 contains typical examples of highly variable NO_2 variation during the day. The preceding figure 7 shows the longer term offset between Pandora and OMI for two of the three sites (Bronx and Busan) in Figure 8.

Figure 12: The chosen Pandoras jump around too much. I would like each figure to be more consistent, so we are talking about the same location/environment for the entire paper. We can look at different areas but be more consistent. For example, figure 9 we are discussing NYC, South Korea and PA. Figure 10/11 we jump to Toronto, and figure 12 we go to Rome, PA, and CO. I would prefer to see the Lowess lines in Figure 12 of the previously discussed pandoras instead.

Figure 10 was chosen to show a site where the Pandora is located somewhat away from a nearby city. Here Pandora 145 sees the HCHO seasonal variation that is only seen weakly by the large OMI gridded pixel. Also, for NO_2, OMI is seeing the emissions from Toronto, whereas Pandora located on the outskirts does not see the seasonal variation. Figure 11 shows more detail for the Toronto SC and is restricted to 13:00 to 14:00 Pandora data. Figure 12 is intended as a sampling from different regions, US, Japan, and Europe.

Line 327: What influences the agreement? Clouds? Different pandoras? Seasonal dependence. Where was this discussion in the rest of the text?

Ozone agreement between Pandora, OMI and EPIC is better than that for NO2 and HCHO because the large majority of TCO is in the stratosphere and changes slowly over relatively large distances in most regions. Exceptions are in mountain areas where weather driven atmospheric pressure changes can cause TCO to change rapidly over short distances. The same is true when weather fronts pass through any local area. See line 296.

Additional Comments

Because there are now about 150 Pandora instruments operating worldwide. Of those, 75 have relatively long and complete data sets (O3, NO2, and HCHO) available. Of those, I arbitrarily chose a subset of 30 Pandoras as given in Table 1 that covered a moderate latitude and longitude range. When comparing individual days, I selected days that were mostly cloud free as determined from the Pandora data. However, cloud-free as seen by Pandora is not necessarily completely cloud-free as seen by OMI because of OMI's much larger field of view. When there are clouds observed by Pandora the scatter in the successive data points increases. I selected most days that had little data scattering. See lines 142 and 143.

All of the 30 Pandoras in Table 1 have ozone values that agree with OMI. This suggests that the laboratory calibrations of the selected Pandoras between 317.5 and 388 nm are consistent and valid. The same Pandora calibration method was used for the visible range 400 to 525 nm that is needed for NO_2 retrievals.

I have added some comments in the text and the Summary.