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Interactive comment on "Long-term trends in air quality in major cities in the UK and India: A view from space" *by* Karn Vohra et al.

Anonymous Referee #2

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The manuscript by Vohra et al entitled "Long-term trends in air quality in major cities in the UK and India: A view from space" uses satellite observations of NO2, AOD, HCHO and NH3 to look at long term trends in UK and Indian cities. Overall, the manuscript implements suitable and robust methods to estimate long term trends in key satellite observed trace gas quantities, as proxies for air pollutants. The authors show, that in general, the variability in the satellite observations are comparable to that of surface observations, suitably justifying the use of satellite data for long term trend analysis. Therefore, the manuscript is suitable for publication in ACP subject to some moderate changes.

Main comments:

The authors need to add some more justification or clarity to why they chose these

countries and cities to investigate. For instance, why investigate UK cites and Indian cites when you could easily apply these methods to e.g. U.S. and Chinese cities?

The authors, in several places, say that air quality networks in cities are costly, inconsistent and only monitor a few species. I feel that this statement is misjudged and misleading. Compared with satellite platforms or aircraft campaigns, surface measurement sites are extremely cheap and are affordable for local authorities. As for inconsistent, temporal sampling from e.g. AURN will be superior to satellite observations as they measure hourly and are not influenced by cloud, which is a major hindrance for satellites over the UK. And the surface network generally measures key air pollutants, which local authorities are required to monitor from central government legislation. There is no point local authorities spending money on monitoring certain trace gases, which provide no useful service or information to them. Therefore, I think the authors would be more accurate in saying that space based observations can complement existing air quality monitoring networks, as all measurement types have issues.

I do not follow the point of comparing MODIS AOD with AERONET AOD. The authors show that there is limited agreement in variability between surface PM obs and satellite AOD measurements, so instead they compare MODIS AOD with AERONET. If you are comparing surface PM variability with satellite AOD variability to try and justify using MODIS AOD to look at long-term changes in AOD, as a proxy for PM, then using AERONET to compare with MODIS AOD is not particularly useful. All this tells you how one column quantity compares with another. Therefore, I suggest the AERONET analysis is removed.

Minor comments: L29: Here, and a few other places, the authors discuss "concentrations" in context of satellite quantities. This is incorrect and should be column amounts or column densities.

L31: "...Birmingham likely due..." should be "...Birmingham are likely due...".

L33-35: Are the causes of increased NMVOCS discussed here fact or speculation?

Mis-leading to put into key points in an abstract if speculation.

Abstract Table: The arrows showing significance are confusing. I assume the lighter the colour, the less significant it is? I suggest the authors come up with another way of showing this.

L41: Replace ". This" with "and".

L42: "The current surface network of air quality . . ..". Which network are you refereeing to..be clear!!

L43: "sparse in time and space". This is true for space, but not time. Surface networks of AQ go back long before sat obs. Secondly, the temporal sampling of surface sites is much higher than that of polar orbiting satellites.

L43-45: Unclear, so please reword.

L47-49: I think it is safe to say London and Birmingham are both developed cities, where both have regions of current urban development. Do you have a reference for the description of the status of Dehli and Kanpur?

L60: Should be "following the WHO".

L81: Remove "exceedingly". Surface coverage in London is reasonably good.

L88-95: The text is a bit confusing. I suggest this is re-worded (several typos in there as well).

Page 7: Both OMI and IASI have two overpass times. However, as IASI is an IR instrument, it can monitor at night also. Make this clear that both polar orbiters overpass a location twice a day, but OMI only observes in the day time.

L167: Where were these previous comparisons of surface and sat NH3 obs undertaken?

L174: Which QC flags were applied to the MODIS AOD data?

L176: Satellite do NOT retrieve concentrations.

L181-186: This is a long sentence and needs splitting up into several sentences.

L198-200: This methodology to distinguish between ppbv and ug/m3 is unclear. Please rewrite with more detail. Page 9 (but general point): Do you taken into account the types of surface sites used (e.g. urban background vs urban traffic)? Ideally, urban traffic and kerbside sites should not be used as they are point measurements subject to large variability from local emissions, which satellites will not capture.

L244-246: Nice result.

L255: I do not follow how the surface obs can be used to determine if IASI is over/underestimating column NH3. At Auchencorth Moss, the R value is 0.37, so I think it is difficult to infer too much about the satellite NH3 retrieval if there is no robust relationship between the satellite and surface NH3 variability. I could have missed something here, but I think the authors need to be crystal clear in what they are saying here.

L308-310: I think this information has already been mentioned.

L319: B is the linear trend.

L321: The CI range for the Theil-Sen approach requires more discussion. How are the Cis calculated?

L328: Remove "seasonality in" at the second occurrence.

L341: Lightning is not the only source of NO2 in the free troposphere….power station emissions?

L347: Can the authors add some information on why India and London column values are similar, but Indian surface values are much larger than in the UK?

L380: I assume N is nitrogen? Make clear in first instance if so.

L385: Do we expect much agriculture in London?

L437: State what NO2 stands for as you do for the other species.

Figure 1: Can you trust surface data from Kanpur if you only have two sites worth of information?

Figure 1: What do you mean by the term "supersite"?

Figure 8: "Absolute errors on the Theil-Sen trend (95% CI) are large (> 150%) and not shown". Can you please expand this as it is not clear what you are referring to?