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Interactive comment on "An assessment of the impact of a nation-wide lockdown on air pollution – a remote sensing perspective over India" *by* Mahesh Pathakoti et al.

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This is not a full review of the paper and should not be interpreted as such. It is a comment on the aerosol optical depth (AOD) data source and analysis shown, though these comments may well apply to the other data sets involved too. I was involved in the development of the MODIS Deep Blue aerosol data sets used here. As a minor point, the resolution of these level 3 aggregated data products is not 100 km as Table 1 states but rather 1 degree.

The authors state they are using MODIS Collection 6 data products obtained from the Giovanni visualization website. The latest version (public release began late 2017)

is Collection 6.1. There are some important algorithm and calibration differences between the two versions which may affect the conclusions shown here. The authors should ideally use the latest data versions available. These can be obtained from NASA EarthData search (which is where it looks like the gas data were found) or LAADS directly (https://ladsweb.modaps.eosdis.nasa.gov/). Just make sure to get Collection 6.1. File formats are the same as in Collection 6. See Hsu et al (2019, https://doi.org/10.1029/2018JD029688) for the latest algorithm and Sayer et al (2019, https://doi.org/10.1029/2018JD029598) for the validation. Note that site-by-site AOD validation plots, including for sites shown in this study region, are provided in the Supplement of the Sayer paper.

It was a little hard to read the Figure 5 panel titles to see exactly what is shown, but from the looks of things and the text it seems that (1) pre-lockdown and during-lockdown 2020 and (2) lockdown equivalent 2019 and during-lockdown 2020 were compared? Later there is a comparison to a 5-year (2015-2019) period. It is problematic for the aerosol analysis because we know there is a large amount of seasonal and interannual variability in aerosol loading (driven by changes in sources as well as meteorology and the simple facts of when the satellite overpasses occur). Comparing the periods without the long-term context (as in Figure 5) means you can't attribute the observed AOD changes to lockdown vs. month-to-month or interannual variability or longer-term trends (i.e. "would we have seen this anyway this year").

I will note that MODIS (among other sensors) give a roughly 20-year record of AOD which could be used, plus there are decade or longer accurate and stable AERONET Sun photometers at a number of sites in India, mainly in the IGP. Studies such at Lee et al (2018, https://doi.org/10.3390/rs10091326) imply that we need 6 or more years to get a stable (to 0.01) estimate of the annual mean AOD over much of India from monthly composites (their Figure 3); for an estimate of the baseline March-May seasonal AOD climatology they estimates 8-10 years (their Figure A4). This implies that the 5 years used here aren't enough to capture interannual variability within this season.

As a result prominent phrasing such as “Short-term climatological variation of AOD due to lock down” in the Section 3.3 header or the last sentence of the paper, “Thus, exhaustive lock down due to outbreak of COVID-19 has led to improvement in the air quality and short-term climatic effects over India.”, worries me since I don’t believe we can make an attribution without looking at the broader context or quantifying the uncertainty in the conclusions.

I am also not sure whether change in the mean AOD is the right metric to look at here. We know AOD data are often close to Lognormally-distributed, especially on regional and longer than daily time scales (such as used here). See e.g. O’Neill et al (2000: https://doi.org/10.1029/2000GL011581), Sayer and Knobelspiesse (2019: https://doi.org/10.5194/acp-19-15023-2019). A change in the mean could mean either that the baseline values are changing, and/or that the magnitudes (and/or frequencies) of extremes in the distributions are changing. The distinction here may be important for e.g. climate or air quality studies. I would encourage the authors to consider which metrics make most sense to report.

The authors mention that the AOD changes might affect the coming monsoon. Given this paper is almost happening in real time, scientifically it would make sense to wait a few months and then see after the fact whether any attributable behaviour in the monsoon was observed. Further, I see that since submission lockdowns have been imposed in India again due (see e.g. https://www.axios.com/india-coronavirus-lockdowns-regions-35febf3b-5480-4d0c-b98b-621d3ecaeb7f.html, selecting this source as it is regarded as not biased and is not behind a paywall). So again a clearer picture might emerge after the pandemic is over and we have the full picture to look at. I don’t see the scientific driver behind trying to publish while the event is still going on, given this study isn’t to my knowledge being used to guide policy related to the pandemic response.

I expect that similar comments will apply to the trace gas data sets used here as well (depends on sources, lifetimes, transport, variability, and satellite retrieval capabilities),

although am not an expert on those.

This is obviously a topic of great interest at the moment (and I am excited to see studies tackling these questions – though as noted probably it is too soon). I agree that it is seems likely that lockdowns could have had some effect on pollution (including aerosols), but it is quite difficult to quantify that effect. The paper doesn’t appear to contain the words “uncertainty”, “error”, “estimate”, or “confidence” or variants of these as far as I can tell (from a text search of the pdf) and any study trying to do an attribution also needs to make a credible attempt to quantify the uncertainty on any change observed.

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