Comment on acp-2022-110

Anonymous Referee #2

Referee comment on "Peculiar COVID-19 effects in the Greater Tokyo Area revealed by spatiotemporal variabilities of tropospheric gases and light-absorbing aerosols" by Alessandro Damiani et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-110-RC1, 2022

The paper by Damiani et al. is well structured and well written, with English of high quality. The paper has high-quality and informative figures. Combining different type of measurements for multiple species with model outputs and weather information provides a very complete record of changes in composition during lock-down, weekends and end-of-year holidays. I am in favour of publishing this paper after my major and minor comments have been addressed by the authors.

Major comment:

In general I am of the opinion that the list of references does not well reflect the detailed studies conducted to document the COVID-19 lockdown impact on air pollution levels in the past two years. The authors could add reviews on this topic, like Gkatzelis et al., https://doi.org/10.1525/elementa.2021.00176 and add some extra citations about the interaction between ozone, NOx and aerosol during the lockdowns. The authors remark that "many studies" on the relation COVID-19 and air quality have been conducted in the past two years, including results for the country of Japan. The authors should cite more extensively papers discussing the East-Asia region to provide the reader with a good overview on what is already published on COVID-19. Starting from this the authors should subsequently indicate what is new in the present work, and how this complements the earlier studies.

Minor remarks:

Abstract :

l15: "NO2 concentrations". It would be good to mention if this refers to surface, lower troposphere, column or all. Same for aerosol.

l18: Maybe better remove "in recent years", or do the authors mean that this happens both in 2021 and 2020?

Figure 1: The time axis (x-axis labels) in panel (a) is difficult to interpret: 2020.4 seems to coincide with the end of May. Would be useful to have 12 major ticks with months "Jan", "Feb" etc. For panel (b) could you please indicate that the period 7 April - 25 May was used. How is the 0% level determined?

l90: "In this study, we apply an integrated approach ..". See my general comment: why is this study unique, and what new result(s) are obtained?

l105: "FWHM = 0.4 nm at 357 and 476 nm". Why mention these two wavelengths instead of saying something like ""FWHM = 0.4 nm for this wavelength range". Is there a large change in FWHM as a function of wavelength?

l106: "wavelength calibration was performed daily to account for .. signal degradation" ? Do you mean "radiometric calibration" ?

l113: "relative humidity over water ". Why "over water"?

l115: "This procedure is expected to better account". Can this be tested, e.g. by comparing the four measurements?

ll119: "but sampled at higher accuracy". Please explain.

l127: "we used the NO2 and HCHO datasets". Please provide the processor versions of both datasets.

l128: "interpolated over a regular grid of 0.1 × 0.1°". Why was this done? One extra interpolation step will potentially degrade the comparison, adding extra representativity uncertainty.

l132: "Screening of TROPOMI NO2 data involved retaining data with a quality flag (QF) value higher than 0.5 and a cloud fraction (CF) lower than 0.2." The README file of TROPOMI suggests the removal of data with a quality value < 0.75. Why did the authors use a different filtering? Why is the cloud fraction limit different from OMI?

l187: I assume that wind, PBL height and temperature are also available in the CAMS reanalysis data record? Why do the authors use also MERRA? Does this have advantages over CAMS?

l196: Could you please explain what "transit stations" means. Is this bus and train only? Road traffic would be more relevant for emissions I guess. Does the transit station class scale well with the number of cars and trucks?

l206: "were estimated to be described" Please reformulate.

l215: I found this part very difficult to understand. At which altitude was the wind speed sampled? Is it the 10m wind, or PBL averaged wind, or something else? What is high, and what is low wind? "we computed NO2 as the difference between the composite values of days with high and low wind speed." Please explain the logic behind this. What does this difference represent? Is the difference plotted in Fig. 3, or the TROPOMI NO2 value itself?

l221. What are "communication routes"? Do you mean "transportation routes"?

l240: "does not align the urbanized region" -> does not align with the urbanized region

l242: "application of cloud screening ". The filtering of the data follows the TROPOMI readme file. Does this remark mean that an additional or reduced cloud screening was applied on top of the standard filtering? Please explain what was done. "somewhat different": what is the reference here?

l246: "sensitivity" please rephrase or explain.

l258: "recovered" A strange word for PBL ozone. "increased" would be better.

l270: "assimilate satellite observations of tropospheric NO2" CAMS is adjusting concentrations, which implies that the impact of the assimilation is expected to be

relatively short, and a short range (12h or 1 day) forecast is expected to differ only slightly from a run without NO2 satellite data assimilation. What kind of CAMS product was used? Is it the analysis or the short range forecast? (may be good to mention this in 2.1.6)

l302: Figure 5c is a bit unclear. What are the steps between the red and black contours? Is it OMI (suggested by the caption) or TROPOMI (suggested by the text) based? It may be useful to introduce a separate figure for the 5-c panel.

l411-419: The absence of an ozone weekend effect is indeed somewhat surprising. I was wondering if a more clear signal is found when only winter or summer months are selected? One expects more titration in winter, and more formation in summer.

Section 4 discussion: This section lists the main conclusions, but could be extended by listing shortcomings and with suggestions for future improvements and outlook on new datasets to be explored in the future (e.g. new satellite missions).