

## ***Interactive comment on “Observation and analysis of spatio-temporal characteristics of surface ozone and carbon monoxide at multiple sites in the Kathmandu Valley, Nepal” by Khadak Singh Mahata et al.***

**Anonymous Referee #1**

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### **General remarks**

This paper reports air pollution (ozone and CO) in the Kathmandu area over longer time periods than hitherto available. Air pollution in this region is an important problem and reliable information covering all seasons is an important contribution to research on these issues. And I agree with the authors that the high ozone mixing ratios observed during the pre-monsoon period is of a high concern for human health and ecosystems, in the region. Here I would encourage the authors to go beyond what is presented in

C1

the paper and (briefly) discuss possible mitigation options (following the idea of “policy relevant, not policy prescriptive”).

However, I have also some reservations about the interpretation of some aspects of the reported data and also some issues with the presentation. I suggest taking these points into account when revising the paper. If this is done in an appropriate way, I suggest that the Editor accepts the paper for publication in ACP.

### **Comments in detail**

One aspect that is only discussed in passing in the paper is the role of stratospheric intrusions as a source of ozone in the upper troposphere in the region (e.g., Wang et al., 2012). Thus, ozone at higher altitudes in the troposphere could be enhanced independent of tropospheric pollution. I suggest that this aspect should be better discussed in the paper.

Further, I suggest more comparison of the ozone pollution found at the Kathmandu valley with pollution levels elsewhere in the world (e.g. Huszar et al., 2016). Are the close to zero ozone values reported here (due to NO titration) also found in other regions of the world? These question is important for mitigation strategies, because to achieve significant ozone reduction over cities in central Europe, the emission control strategies have to focus on the reduction of VOCs (Huszar et al., 2016).

I repeat my comment on Fig. 1 from the initial/quick review here: I find the Google Earth figure not appropriate. The yellow pins are strange and the blue letters are difficult to read against the background. I suggest changing to a figure showing the locations of the sites in a map showing the orography clearly.

I also suggest to state the calendar months, not just the seasons. This is done in I. 271, but it should also be stated in the introduction and in the abstract.

C2

The value of for the CO flux at Bode is given to three significant numbers, is this really appropriate? Do you have an error estimate for this number? I think this value is an important result from this study so it deserves some attention.

Finally, I could very well imagine that the data presented in this paper are of interest to other researchers as well. Therefore I suggest to add a comment on data availability to the paper.

### Minor issues

- l. 31: drop 'on'
- l. 32: 'pollutants'
- l. 37: add altitude for Naikhandi
- l. 42: State 'how long' extended
- l. 46: state the calendar months, not everybody is familiar with these seasons.
- l. 46/47: 'due to the emissions from brick kiln industries' How do you know? How much of this is speculation/hypothesis how much is really shown in the paper?
- l.50: in which way did the meteorology play a role?
- l. 52: 'Some influence' is a bit vague, can you be more specific here?
- l. 54: The value of 4.92 is given to three significant numbers, is this really appropriate? Do you have an error estimate for this number?
- l. 63: 'as well as': which effect dominates?

### C3

- l. 65: on the basis of which assessment can you say 'due to'?
- l. 80: one further impact of local pollution could also be convective uplift to tropopause altitudes and transport into the extra-tropical stratosphere in the monsoon season (e.g. Tissier and Legras, 2016, and references therein).
- l. 93: 2017 → 2018
- l. 97: also toxic outdoors?
- l. 115: measured → reported measurements
- l. 133: for the Kathmandu ...
- l. 167: O<sub>3</sub>
- l. 227: define 'AWS'
- l. 286: due to a problem
- l. 320, 321: How do you know?
- l. 339: CO mixing ratios
- l. 453: stratospheric intrusions are mentioned here but only in passing.
- l. 472: make → draw
- l. 506: give altitude of Nagarkot here. Also the statement here is a bit vague, can you be more quantitative here (instead of 'but is also').
- Mues et al. (2017); citation is missing
- l. 546: be specific what is meant with 'this'

### C4

- l. 611: change to ‘an observation connected to’
- l. 617: drop ‘the’
- l. 622: episode days → episodes
- l. 632: are these ozone values typical for down-mixing?
- l. 646-650: perhaps two sentences here
- l. 711: This paper is now accepted
- Figs. 5 and 7: can you show error bars in these figures?

## References

- Huszar, P., Belda, M., and Halenka, T.: On the long-term impact of emissions from central European cities on regional air quality, *Atmos. Chem. Phys.*, 16, 1331–1352, doi:10.5194/acp-16-1331-2016, 2016.
- Tissier, A.-S. and Legras, B.: Convective sources of trajectories traversing the tropical tropopause layer, *Atmos. Chem. Phys.*, 16, 3383–3398, doi:10.5194/acp-16-3383-2016, 2016.
- Wang, Y., Konopka, P., Liu, Y., Chen, H., Müller, R., Plöger, F., Riese, M., Cai, Z., and Lü, D.: Tropospheric ozone trend over Beijing from 2002–2010: Ozone-sonde measurements and modeling analysis, *Atmos. Chem. Phys.*, 12, 8389–8399, doi:10.5194/acp-12-8389-2012, 2012.