Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-306-RC2, 2018
© Author(s) 2018. This work is distributed under
the Creative Commons Attribution 3.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variations in surface ozone and carbon monoxide in the Kathmandu Valley and surrounding broader regions during SusKat-ABC field campaign: Role of local and regional sources" *by* Piyush Bhardwaj et al.

Anonymous Referee #3

Received and published: 9 February 2018

The manuscript presents observations of ozone, carbon monoxide and some of the hydrocarbons at Bode in the Kathmandu Valley for a period of 6 months. A correlation analysis and comparison with stations in the northern Indian subcontinent are conducted, and effects of biomass burning are studied. However, manuscript in its present form adds limited new insights into the chemistry and dynamics over this region, and the observations of ozone and carbon monoxide shown here for a period of about 6 months are subset of full year data at same station presented in Mahata et al., 2017. The discussions in the present version are qualitative and general, as elaborated in

Printer-friendly version

Discussion paper

following comments

Regional sources are suggested as the driver of springtime ozone enhancement over Bode, however, Fig. 10 clearly shows that during both winter and spring the ozone production is faster over Bode (and Paknajol) as compared to that over IGP stations. For the transport to be the driver, one would expect just an enhancement in the levels with lesser local production, not being evident here.

Springtime enhancement in ozone at Bode appears primarily due to a broader ozone maxima in the noontime which authors attribute to solar radiation (Page 14, lines: 3-5), and higher ozone levels during the nighttime attributed to lower titration with NOx (Page 20, Line 2). Both of these processes are of local origin.

Effect of biomass burning: It would be more appropriate to show a time series of fire counts over potential source region in north India, a running mean of fire counts would be even better as done previously (Kumar et al., JGR, 2011) to classify High and low fire activity periods. Presently, the selected period shows only small enhancements in CO, while larger CO enhancements are seen starting from middle-April.

Page 10, lines.4-5: Why a high-resolution regional-scale model is not used to study transport from such nearby regions of north India to Nepal?

Page 13: l.17-20: It should be useful to substantiate the statements by calculating the variations in ventilation coefficients using measured boundary layer height and wind speed.

Section 3.5: Correlation between ozone and CO: This section needs thorough revision. The anti-correlation is being explained by contrasting seasonality of ozone and CO. Then what is learnt from plotting correlations? Correlating between noontime ozone and CO showing positive relationship is useful. Fig. 7 could be removed.

Stratosphere-to-troposphere transport (STT) could be important in ozone variations over the Himalayas during winter (Phanikumar et al., 2017) as well as spring (Sarangi

CC BY

et al., 2014). Smaller enhancements in CO but high ozone levels could have some effects of STT. Mountain regions in Nepal also experience such effects. What is the contribution of STT from northern India, or high altitudes in Kathmandu in the ozone enhancements during May event, and in general from Jan to May?

Other comments

Section 2.1.: There should be a description of emission sources, and as paper aims to highlight the differences in the emissions from India and Kathmandu, it should have been substantiated by showing emission maps from recent inventories for some of the chemical tracers.

Too general statements should be removed. Such as Page 11: l.17-18: "The solar radiation. . ...the valley"

Page 11: l.11 "The regional contribution in this regard can not be ruled out". Can it be ruled out in other seasons / or other stations?

With availability of data, there should have been some quantitative discussions. For example: Page 20, l.2-4: "indicating somewhat lesser polluted kind of environment in Bode. . ..However this does not necessarily mean that NOx emissions are lower in Kathmandu valley."

Page 15: l.19: "Methane levels are much higher than the global average". Mention a global average value for the period or from some reference and indicate by how much % it is found to be higher at Bode?

Page 16, l.1-3: ". . .hydrocarbons are much higher than at Nainital. . ..". Mention some % or factor.

Page 21: l.18-21: This discussion is about aerosol forcing, which is not studied in this paper so it can either be moved to introduction or can be skipped.

Page 21: l.22-23: CO enhancement seems small and within the variations, while ozone

CC BY

enhancements are observed in the following days too.

References

Kumar, R., M. Naja, S. K. Satheesh, N. Ojha, H. Joshi, T. Sarangi, P. Pant, U. C. Dumka, P. Hegde, and S. Venkataramani(2011), Influences of the springtime northern Indian biomass burning over the central Himalayas, J. Geophys. Res., 116, D19302, doi:10.1029/2010JD015509.

Mahata, K. S., Rupakheti, M., Panday, A. K., Bhardwaj, P., Naja, M., Singh, A., Mues, A., Cristofanelli, P., Pudasainee, D., Bonasoni, P., and Lawrence, M. G.: Observation and analysis of spatio-temporal characteristics of surface ozone and carbon monoxide at multiple sites in the Kathmandu Valley, Nepal, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-709, in review, 2017.

Phanikumar, D. V., K. N. Kumar, S. Bhattacharjee, M. Naja, I. A. Girach, P. R. Nair, and S. Kumari (2017), Unusual enhancement in tropospheric and surface ozone due to orography induced gravity waves, Remote Sensing of Environment, 199, 256-264. https://doi.org/10.1016/j.rse.2017.07.011

Sarangi, T., M. Naja, N. Ojha, R. Kumar, S. Lal, S. Venkataramani, A. Kumar, R. Sagar, and H. C. Chandola (2014), First simultaneous measurements of ozone, CO, and NOy at a high-altitude regional representative site in the central Himalayas, J. Geophys. Res. Atmos., 119, 1592–1611, doi:10.1002/2013JD020631.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-306, 2017.

CC BY