Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-866

Anonymous Referee #1

Referee comment on "Measurement report: Variations in surface SO_2 and NO_x mixing ratios from 2004 to 2016 at a background site in the North China Plain" by Xueli Liu et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-866-RC1, 2022

General Comments

This paper reports on NOx and SO_2 measurements at a background site in the North China Plain. The site, the instrumental setup, quality control and the data processing procedures have been described in detail. Data are compared to other data from other measurement sites. The long-term trend of both SO_2 and NOx, their diurnal and seasonal behavior are discussed and compared to emission data. As publications of long time series of NOx and SO2 are rare, the manuscript should be published after these questions have been answered:

Specific Comments

Line 66 and following

Here the authors describe the setup of the instrument. For NOx detection, a chemiluminescence analyzer has been used. Unfortunately, it is not stated how NO_2 is converted to NO for detection.

Has a thermal or a photolytical converter been used? If a thermal converter has been used this would mean that a large fraction of the NOx would be in fact NOy, as nitric acid and nitrates would cause significant interferences in the NO_2 channel (Jung et al., 2017, Steinbacher et al., 2007). This interference should be discussed.

How frequent was the conversion efficiency determined? Was an NO_2 gas standard used or was it done by gas phase titration?

How was mixing depth determined?

Line 162 and following

The authors state that there is a lag between SO_2 mixing ratios and emissions. What can cause such a lag? Change in meteorology would only lead to a decoupling of emissions and measured SO_2 and NO_2 values but not to a time shift.

Line 166 and following

The authors write that the 2008 Olympic games should affect the emissions. However, in figure 5 the measured SO_2 values are highest in 2008 and low in 2009. Is it possible the effect of the worldwide economic crisis in 2009 is larger than the effect of the Olympic games and not well represented in the emission data?

Line 246 and following

In chapter 4.3. the authors explain the different diurnal features of SO_2 and NOx. The profile of NOx coincides with the change in mixing depth while the diurnal profile of SO_2 is opposite to it. The profile of SO_2 is explained by transport from SO_2-rich air from above which originate from remote, not necessarily elevated, sources, which will increase SO_2 concentration during daytime. However, during nighttime an efficient loss process must reduce the SO_2 concentration again. What is the loss process that reduces the concentration of SO_2 reduced during nighttime?

Line 246 and following

With respect to the daily profile of NOx it was argued that it is the result of transport processes during noontime. But isn´t it more likely that NOx is emitted from local sources close to the ground, as motor vehicles and small burners This was observed at the background site at Linan (Yin et al., 2022), which showed similar diurnal cycles and similar mean NOx concentrations.

Jung, J., Lee, J., Kim, B., & Oh, S. (2017). Seasonal variations in the NO2 artifact from chemiluminescence measurements with a molybdenum converter at a suburban site in Korea (downwind of the Asian continental outflow) during 2015–2016. *Atmospheric Environment*, *165*, 290-300. https://doi.org/https://doi.org/10.1016/j.atmosenv.2017.07.010

Steinbacher, M., Zellweger, C., Schwarzenbach, B., Bugmann, S., Buchmann, B., Ordóñez, C., Prevot, A. S. H., & Hueglin, C. (2007). Nitrogen oxide measurements at rural sites in Switzerland: Bias of conventional measurement techniques [https://doi.org/10.1029/2006JD007971]. *Journal of Geophysical Research: Atmospheres*, *112*(D11). https://doi.org/https://doi.org/10.1029/2006JD007971

Yin, Q., Ma, Q., Lin, W., Xu, X., & Yao, J. (2022). Long-term variations in surface NOx and SO2 mixing ratios from 2006 to 2016 at a background site in the Yangtze River Delta region, China. *Atmos. Chem. Phys.*, *22*(2), 1015-1033. https://doi.org/10.5194/acp-22-1015-2022

Technical corrections

Line 91 High values in winter and low values in summer

Line 102 lower mixing depth heights

Line 112 6.27 ppb (ppb is missing)

Line 112 I think a one-digit precision of the values is sufficient here

Line 238 More difficulties

Line 247 high values in winter and low values

Line 249 greatly different from each other

Line 284 low values in

Line 285 exhibited great differences