Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., author comment AC2
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Reply on RC2

Hao Yin et al.

Author comment on "Spaceborne tropospheric nitrogen dioxide (NO_2) observations from 2005–2020 over the Yangtze River Delta (YRD), China: variabilities, implications, and drivers" by Hao Yin et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-1089-AC2, 2022

Response to Referee #2:

Thanks very much for your comments, suggestions and recommendation with respect to improve this paper. The responses to all your comments are listed below.

Yin et al., present a comprehensive study to look insight to the NO_x trend from 2005 to 2020 over the Yangtze River Delta China by using the OMI space borne observations. Observations revealed that the NO_x experienced an upward and downward trend during 2005-2020, with a threshold of 2011. And they applied the multiple linear regression model to understand the role of anthropogenic emissions and meteorological factor in NO_x level. Model results showed that the seasonal change is mainly attributed to meteorological factor and the long-term trend of NO_x is attributed to emissions. Overall, the dataset and analysis make sense and the topic is with the scope of ACP, I only have some minor comments to be addressed.

Response: All your comments listed below have been addressed. Please check the point by point response as follows.

General comments:

Comment [1]: Section 4.1, could you please provide more information about which two or three meteorological factors influence the level of NO_x more significantly and conduct more discussions about the reasons in the main text?

Response: Thanks for your suggestions. We have provided more information about which two or three meteorological factors influence the level of NO_x more significantly and conduct more discussions about the reasons in the main text. As shown in Figure S2, the vast majorities of meteorological contributions over all megacities are from temperature and additional minor contributions over some cities such as Nanjing, Shanghai, and Suzhou are attributed to relative humidity, pressure, or surface incoming shortwave flux (SWGDN) (Agudelo–Castaneda et al., 2014;Parra et al., 2009). Significant negative correlations between temperature and NO_2 VCD_{trop} are observed in all megacities (Figure S3, Table 5). Higher temperature tends to decrease NO_2 VCD_{trop} and vice versa. This is because higher temperature conditions could accelerate the chemical reaction that destructs NO_2 in the troposphere (Pearce et al., 2011;Yin et al., 2021). In addition, surface pressure shows high positive and both surface relative humidity and SWGDN show negative correlations with NO_2 VCD_{trop}, but their contribution levels are much lower than the temperature. All other meteorological variables only have weak correlations with NO_2 VCD_{trop} (Table 5) . Please check the marked up file for details.

Comment [2]: Inspired by the text in Line 422-423, I suggest the authors supply two figures (same as Figure 2 and 3 but from 2011-2019) in SI to take a look at the influence of COVID-19 to the NO_x trend from 2011-2020.

Response: Thanks for your suggestions. We have added this two figures in supplement information (Figure S5 and Figure S6). We also obtained the same conclusion as that from Figure 6, indicating the drivers of seasonal cycles of NO_2 VCD_{trop} deduced above are consistent over years. Please check the marked up file for details.

Comment [3]: I can understand the motivation of using the GDP data in the discussions, while it seems that the GDP cannot be a perfect explanation for the trend of NO_x emission, so I believe Figure 8 is not so important and can be moved to SI. By the way, I encourage the authors to collect some information about the motor vehicle emissions and major industrial emissions data in this region and analysis the NO_x trend with these emissions.

Response: Thanks for your suggestions. We have moved Figure 8 to supplement information (Figure S11). In Figure S12, we further analyzed the variabilities of NO_x emissions over the YRD region from 2008 to 2017 by category provided by the MEIC inventory, including motor vehicle emissions, major industrial emissions, resident emissions and power emissions (http://meicmodel.org, last accessed: February 25, 2022) (Li et al., 2017;Zheng et al., 2018). The results show that the decreases in NO_2 VCD_{trop} over the YRD during 2011 to 2013 are attributed to the reductions of industrial and power emissions, during 2013 to 2014 are mainly attributed to the reductions of motor vehicle emissions and power emissions, and after 2014 are attributed to the reductions of motor vehicle emissions, power emissions and industrial emissions. We have added the corresponding content to line 370-380. Please check the marked up file for details.

Comment [4]: Line 271-273, please check the decrement of Anhui and the total YRD, as the data values are the same, may be a typo.

Response: Thanks for your reminder. We have revised this mistake in the correspond content. The total decrements over Anhui in 2020 relative to 2011 is (4.82 ± 0.35) ´ 10^{15} molecule/m^2 (43.26 ± 3.07) % (Line 266-267). Please check the marked up file for details.

Comment [5]: Figure S2, NO_2 change to subscript.

Response: Thanks for your reminder. We have modified the figure in supplement. Please check the marked up file for details.

Reference

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