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## Reply on RC2

Baoye Hu et al.

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Author comment on "Exploration of the atmospheric chemistry of nitrous acid in a coastal city of southeastern China: results from measurements across four seasons" by Baoye Hu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-723-AC2>, 2021

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The manuscript "Exploration of the atmospheric chemistry of nitrous acid in a coastal city of southeastern China: Results from measurements across four seasons" by Baoye Hu et al. reports year-long observations of HONO together with gaseous, particulate, and meteorological parameters which are relevant for investigating HONO sources. The manuscript adds valuable information on HONO concentration level and its temporal variation under coastal condition. I have reviewed the old version which submitted to ACP in 2020. The quality of the new manuscript is significantly improved. I only have the following minor suggestions before it is accepted for publication.

*Response: Thanks for your valuable comments and positive feedback. We have corrected this manuscript according to your suggestion. Below are the point-to-point responses to general and specific comments.*

Line 31-32: an unit is missing here, should be "2.05 ppb h<sup>-1</sup> in winter".

*Response: Thanks for your constructive comments. "ppb×h<sup>-1</sup>" has been added after 2.05.*

Line 209-212: It's far fetched to say the concentration of sea salt during the daytime (2.91 μg·m<sup>-3</sup>) is higher than that during the night (2.73 μg·m<sup>-3</sup>). From my side, these levels are similar. I doubt if this small difference in sea salt could have large effect on the contrasting HONO levels between daytime and nighttime. Figure 4 shows that NO<sub>x</sub> concentration in the daytime is higher than in the nighttime. The higher HONO in the daytime is more likely due to the higher NO<sub>x</sub> or nitrate photolysis as you discussed in following section.

*Response: Thanks for your valuable suggestions. The effect of sea salt and SLBs on the contrasting HONO levels between daytime and nighttime has been deleted from the manuscript. This sentence "The higher HONO in the daytime is likely due to the higher NO<sub>x</sub> or nitrate photolysis as discussed in following section." has been added in the manuscript.*

Line 214: SLB should be defined here.

*Response: Thanks for your careful working. The effect of sea salt and SLBs on the contrasting HONO levels between daytime and nighttime has been deleted from the manuscript.*

Line 216-224 and line 247-256: The two paragraphs are overlapping. I suggest to integrate the two paragraphs. Figure 5 shows the correlation between  $\text{NO}_2$  and HONO, it is better to also display the correlation between  $\text{NO}_x$  and HONO here.

*Response: Thanks for your suggestions. The paragraph from Line 216-224 mainly mentioned why the ratio of HONO/ $\text{NO}_x$  was used and compared with other studies, while the paragraph from Line 247-256 mainly mentioned the diurnal variations of HONO/ $\text{NO}_x$  and the effect of light on HONO formation. Therefore, these two paragraphs have different focus. It is more logical to separately write.*

Figure 5 showed the correlation between  $\text{NO}_2$  and HONO color coded by  $J(\text{NO}_2)$ , which was used to investigate HONO formation during the daytime is more possibly related to light or Reaction (R5). Therefore, the correlation between  $\text{NO}_x$  and HONO did not display here.

Line 251: "the photolysis of  $\text{NO}_2$ " should be changed into "the photolysis rate constant of  $\text{NO}_2$ ".

*Response: Thanks for your careful working. "The photolysis of  $\text{NO}_2$ " has been changed into "the photolysis rate constant of  $\text{NO}_2$ ".*

Line 255-256: "which indicates that HONO formation during the daytime is controlled by light rather than Reaction (R5)." It is hasty to draw this conclusion here. It's better to say "HONO formation during the daytime is more possible to relate to light than Reaction (R5)."

*Response: Thanks for your careful working. This sentence has been changed into "HONO formation during the daytime is more possible to relate to light than Reaction (R5)".*

Line 254: "correspondence" should be changed into "correlation".

*Response: Thanks for your careful working. "Correspondence" has been changed into "correlation".*

Line 269-270: How is the duration of air masses been determined? How do you acquire it?

*Response: Thanks for your careful working. The meaning of the text is that the air mass meets the conditions  $UV < 10 \text{ W}\times\text{m}^{-2}$ , HONO correlating well with  $\text{NO}_x$  ( $R^2 > 0.60$ ,  $P < 0.05$ ),  $\text{NO}_x > 20 \text{ ppb}$  (highest 25 % of  $\text{NO}_x$  value),  $\text{DNO}/\text{DNO}_x > 0.85$ , and the duration of the air mass cannot exceed 2 h (Liu et al., 2019; Xu et al., 2015), which was based on the following two reasons. Firstly, fresh air mass should be short time. An Air mass with high  $\text{NO}_x$  lasting long could not be a local fresh air mass, but an aged air mass transporting from high  $\text{NO}_x$  region, such as city region. Secondly, if the duration of air mass was too long, the HONO observed was easily affected by secondary production, which would overestimate vehicle emission.*

Line 273-277:  $\Delta\text{NO}/\Delta\text{NO}_x$  and  $\Delta\text{HONO}/\Delta\text{NO}_x$  should be clearly defined.

*Response: Thanks for your careful working.  $\Delta\text{NO}/\Delta\text{NO}_x$  and  $\Delta\text{HONO}/\Delta\text{NO}_x$  have been clearly defined in the manuscript.  $\Delta\text{NO}/\Delta\text{NO}_x$  and  $\Delta\text{HONO}/\Delta\text{NO}_x$  represent the linear slope of NO with  $\text{NO}_x$ , and HONO with  $\text{NO}_x$ , respectively.*

Section 3.5: first of all, there are various assumptions on HONO production pathways

been made in the previous sections. It would be better to provide a full picture on how large of each contribution to the HONO formation.

*Response: Thanks for your valuable suggestions. Budget analysis of HONO provide a semi-quantitative understanding of source contribution to the HONO formation. However, it is difficult to provide a full picture on how large of each contributor to the HONO formation due to a lack of atmospheric simulation smog chamber facility. Therefore, parameterization of HONO was used to make up for the shortcomings.*

Line 412-413: "We will discuss... in the next section". Do you mean "in this section"?

*Response: Thanks for your careful working. "in the next section" has been changed into "in this section".*

Line 448-449: "As shown in Fig. 11, the HONO/NO<sub>x</sub> ratios in the four seasons were close to the calculated value (0.02)". What is the calculated value? Do you mean "the calculated value by Elshorbany et al., 2012?"

*Response: Thanks for your careful working. The HONO/NO<sub>x</sub> ratios should be changed into  $\Delta\text{HONO}/\Delta\text{NO}_x$  ratios, which represents the linear slope of HONO with NO<sub>x</sub>. The linear slope of HONO with NO<sub>x</sub> can directly obtained from Fig.11 rather than the calculated value by Elshorbany et al., 2012.*

Fig. 5 and Fig. 11: The correlation between HONO and NO<sub>2</sub> in spring is better than that between HONO and NO<sub>x</sub>. Why?

*Response: The correlation between HONO and NO<sub>2</sub> (0.412,  $P < 0.01$ ) in spring is better than that between HONO and NO<sub>x</sub> (0.257,  $P < 0.01$ ). The correlation coefficients between HONO and NO<sub>2</sub> were 0.376 ( $P < 0.01$ ), 0.487 ( $P < 0.01$ ), and 0.665 ( $P < 0.01$ ) for summer, autumn, and winter, respectively. The correlation coefficients between HONO and NO<sub>x</sub> were 0.588 ( $P < 0.01$ ), 0.597 ( $P < 0.01$ ), and 0.853 ( $P < 0.01$ ) for summer, autumn, and winter, respectively. Therefore, the correlation between HONO and NO<sub>2</sub> was only better than that between HONO and NO<sub>x</sub> for spring. Spring has frequent rains with highest monthly average rainfall (6.99 mm), followed by summer (4.70 mm), winter (0.52 mm), and autumn (0.25 mm). HONO correlates better with NO<sub>x</sub> (0.642,  $P < 0.01$ ) than with NO<sub>2</sub> (0.494,  $P < 0.01$ ) when we only choose the days without rains due to significant increase correlation between HONO and NO from 0.098\* to 0.630\*\*.*

## References:

Liu, Y., Nie, W., Xu, Z., Wang, T., Wang, R., Li, Y., Wang, L., Chi, X., and Ding, A.: Semi-quantitative understanding of source contribution to nitrous acid (HONO) based on 1 year of continuous observation at the SORPES station in eastern China, Atmos. Chem. Phys., 19, 13289-13308, 10.5194/acp-19-13289-2019, 2019.

Xu, Z., Wang, T., Wu, J., Xue, L., Chan, J., Zha, Q., Zhou, S., Louie, P. K. K., and Luk, C. W. Y.: Nitrous acid (HONO) in a polluted subtropical atmosphere: Seasonal variability, direct vehicle emissions and heterogeneous production at ground surface, Atmos. Environ., 10.1016/j.atmosenv.2015.01.061, 2015.

Please also note the supplement to this comment:

<https://acp.copernicus.org/preprints/acp-2021-723/acp-2021-723-AC2-supplement.pdf>