

Interactive comment on “Contributions of different sources to nitrous acid (HONO) at the SORPES station in eastern China: results from one-year continuous observation” by Yuliang Liu et al.

Anonymous Referee #3

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This manuscript describes continuous ambient measurements of HONO, NO, NO₂, and PM_{2.5} at the SORPES station in Nanjing (eastern China) from November 2017 to November 2018. The main conclusions are:

1. Seasonal average HONO concentrations are comparable to other urban/suburban regions (0.45–1.04 ppb).
2. Direct emissions from combustion sources explain nearly 25% of nocturnal HONO concentrations. The authors determined this by examining fresh plumes.
3. Nocturnal HONO formation is RH-dependent and largely explained by heterogeneous surface chemistry.
4. A missing diurnal HONO formation mechanism is a significant source of HONO around noon (average 1.13 ppb/hr).

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There are not many long-term records of ambient HONO measurements, and this manuscript provides a valuable dataset to the scientific community. It is well within the scope of ACP and will likely be of interest to ACP readers. I recommend publication after the authors address the following comments.

-Figure 6 shows the HONO/NO₂ ratio as a function of RH. The authors state that Fig 6a represents measurements when available surface area is dominated by the ground (i.e., relatively low surface area contributions from aerosols). Can the authors quantify the relative contributions to total surface area from the ground and aerosols? What percentage of the total surface area does the ground represent in clean air and polluted air?

-As shown in Figure 6, HONO/NO₂ ratios in polluted air do not decline at RH between 75-95% as is seen in clean air. The authors should provide some explanation here. Why is there a different RH dependency under high PM_{2.5} conditions?

-The authors claim that the unknown daytime HONO production is different from the heterogeneous nocturnal production (section 3.4). It is not immediately clear how the authors reach this conclusion. They should expand on this statement and provide clear justification.

-A major justification for assuming an unknown HONO source is that the HONO/NO₂ ratio rises around noon at peak solar radiation. I have two problems with this that the authors should address. First, any ratio with NO₂ in the denominator will increase as NO₂ is photolyzed at greater rates. Second – and this is the more serious concern – is that 3-D air quality models predict an increase in HONO/NO₂ ratios in the late morning through noon, but they certainly aren't influenced by missing HONO sources (e.g. Figure 8 in <http://dx.doi.org/10.1016/j.atmosenv.2015.04.048>). While there may well be a significant unknown HONO source during the day, relying on HONO/NO₂ ratios does not sufficiently make the case.

-Assuming the existence of a missing HONO source during the day, to what extent

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could it be explained by soil emissions?

-The authors state that mass concentration of PM_{2.5} is likely not the only factor affecting HONO formation on aerosol surfaces. This makes sense intuitively. Do the authors have speciated PM_{2.5} measurements during this time? How does the chemical composition of aerosols change throughout the year? Would these changes make the NO₂ to HONO conversion more or less likely?

Other minor comments: -Check the in-text references to Figures and Tables. Some of the Figures are mis-referenced (e.g. referencing Fig 5 when, in fact, the figure being referenced is Fig 6). This happens quite often in the latter half of the manuscript. - The last sentence in the second paragraph of section 3.3.2 is particularly confusing. -To improve readability, try to have a native English speaker proofread the manuscript. Some of the phrases are oddly worded and obscure the authors' meaning.

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