

Atmos. Chem. Phys. Discuss., author comment AC3  
<https://doi.org/10.5194/acp-2021-178-AC3>, 2021  
© Author(s) 2021. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## Reply on RC2

Yihang Yu et al.

---

Author comment on "Budget of nitrous acid (HONO) at an urban site in the fall season of Guangzhou, China" by Yihang Yu et al., Atmos. Chem. Phys. Discuss.,  
<https://doi.org/10.5194/acp-2021-178-AC3>, 2021

---

We thank the reviewer for taking the time to review our paper. It is always constructive in a peer-review process to directly point out any concerns and issues from the reviewer's perspective and urge us as authors to provide reasons and clarifications whenever necessary.

It is true that there have been a large body of literatures on the HONO sources and sinks, and many theories and findings have emerged from these studies, many of which are conflicting between each other. As a ripple effect, more confusions and new challenges emerged for studies that followed. As a participant in numerous HONO studies (e.g., Su et al., 2008, Su et al., 2011, Cheng et al., 2013, Yang et al., 2017, Tian et al., 2018), the corresponding author of this paper sincerely shares the reviewer's understanding that it takes patient efforts to make any progress in this small yet important field of atmospheric chemistry, due to the lack of information on many processes being considered in the HONO budget. As such, it is crucial to acknowledge all kinds of uncertainties and be transparent on assumptions and caveats in the process of conducting measurements and calculations, in order to provide useful and accurate information and findings for future studies to rely on to make any further meaningful progress. Bearing these considerations in mind, we tried to consider all possible varying and uncertain factors as far as we deem appropriate and tried to be conservative in our estimates of the terms.

For instance, direct emission is one of the main points of our paper that this source of HONO and its uncertainties need to be further investigated in future studies. We considered multiple methods and estimated a range of possible direct emission rates; we used two emission inventories to account for the uncertainty in this kind of input data in estimating emissions. Yet it is inevitable for such an effort to lead to a lengthy and in some cases tedious documentation of all the methods adopted and all the outcomes derived, which might become a cause of confusions. We hope to do whatever we can to make our paper clear, accurate, and scientifically sound. To answer the reviewer's question why the direct emissions calculated exceeding the observations by over an order of magnitude, it is because the two terms are related but not consistent, since the latter is a result of many processes, e.g., emission, reaction, transport, etc. For example, NO<sub>x</sub> level often decreases at daytime, during which the emission rates of NO<sub>x</sub> are obviously greater than the observed growth rates. To answer another question why the comparison between  $P_{emis}$  and observed HONO was limited to averaged values, it is because averaging can smooth out the influence of fluctuation and uncertainties in various influencing factors (transport, dilution, OH, etc.). Because of the long lifetime of HONO at night, and effect of

transport and large uncertainties in the dilution/diffusion conditions, a temporally-resolved budget appears desirable but would not be meaningful given all uncertainties. Otherwise, the assumption of the nocturnal OH concentration to be  $1.0 \times 10^6 \text{ cm}^{-3}$  appears problematic but is possible in the PRD region. Sensitivity tests also showed limited impact from this assumption on our conclusion about HONO.

In light of the reviewer's comments, we have re-examined and revised our paper for better clarity, accuracy, and completeness toward a good reception of our paper by a broad range of a readers of ACP. Indeed, addressing those critical comments from the reviewer turned out very useful for us to improve our paper. We welcome the reviewer to review our responses and revisions, and provide any further comments and discussions, if any, with the goal of reaching a comprehensive and objective assessment of the scientific contributions made by our paper.