

Geosci. Model Dev. Discuss., referee comment RC2  
<https://doi.org/10.5194/gmd-2021-385-RC2>, 2022  
© Author(s) 2022. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## **Comment on gmd-2021-385**

Anonymous Referee #2

---

Referee comment on "Implementation of HONO into the chemistry–climate model CHASER (V4.0): roles in tropospheric chemistry" by Phuc Thi Minh Ha et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-385-RC2>, 2022

---

### **A review report for manuscript entitled "Implementation of HONO into the chemistry-climate model CHASER (V4.0): roles in tropospheric chemistry" by Phuc et al., 2021.**

The study investigates the impacts of including HONO three formation paths (gas phase, heterogeneous, and emissions sources) on the levels of PM<sub>2.5</sub>, SO<sub>4</sub><sup>2-</sup>, HNO<sub>3</sub>, CO, O<sub>3</sub>, in the model compared to measurements from different platforms. However, the study does not account for major HONO sources via night and daytime heterogeneous NO<sub>2</sub> conversion on-ground sources, and nitrate photolysis. In addition, the study presents the results of comparison but without a sufficient or reasonable explanation of these differences. This is a major issue, and the authors should carefully review the article and provide adequate clarifications accounting for HONO impact on each species beyond increase or decrease in species concentrations.

### **Specifics**

Abstract: remove "for the first time" since HONO has been parameterized in several previous studies (e.g., Elshorbany et al., 2012; Zhang et al., 2021).

Page 1, line 24: the 51% contribution of heterogeneous NO<sub>2</sub> to HONO formation on aerosol, and emissions sources are very high compared to current literature (e.g., Zhang et al., 2021).

Page 1, line 30: Why does reducing NO<sub>x</sub> (NO<sub>2</sub>+NO) reduce the atmospheric oxidation capacity? For instance, reducing NO<sub>2</sub> would increase OH in high NO<sub>x</sub> conditions. Please clarify.

Page 6, line 169: I don't see the value of the OLD simulations which assumed no HONO chemistry since all models have at least gas-phase HONO chemistry (OH+NO=HONO; HONO=OH+NO; and HONO+OH).

Page 6, table 2: How is the heterogeneous loss of HONO (R6) leads to NO?

Page 7, line 175: I suggest you differentiate NO from NO<sub>2</sub> in model calculations throughout the paper.

Page 9, line 230: Please report the calculated surface aerosol density for each aerosol type.

,

Page 10, lines 238-247: Please elaborate on "O<sub>3</sub>-reducing effects of HONO chemistry". The authors should explain how HONO would reduce O<sub>3</sub> when its photolysis is a source of OH, supposedly increasing the oxidation capacity?

Page 11, line 262-264: The authors are advised to explain the causal factors leading to increase or decrease in the impacted species (PM<sub>2.5</sub>, SO<sub>4</sub><sup>2-</sup>, HNO<sub>3</sub>, O<sub>3</sub>..etc) rather than stating the numbers.

Page 11, line 285: Again, an explanation of causal factors is missing.

Page 14, line 344: Again, the authors should explain how the inclusion of gas-phase HONO sources led to increased CO in some regions but decreased CO in other regions...

Page 17, line 382 and Figure 7: Figure 7 does not show the vertical profiles of simulated HONO. I also don't think that HONO will have any impacts at 200 hPa??

Page 21, lines 445: HONO values at these heights are extremely high. HONO values of 70 ppt at 2000m are almost impossible given its ground-based sources and its fast photolysis. Authors should show some evidence that these numbers are reasonable.

## **References:**

Zhang, S., Sarwar, G., Xing, J., Chu, B., Xue, C., Sarav, A., Ding, D., Zheng, H., Mu, Y., Duan, F., Ma, T., and He, H.: Improving the representation of HONO chemistry in CMAQ and examining its impact on haze over China, *Atmos. Chem. Phys. Discuss.* [preprint], <https://doi.org/10.5194/acp-2021-47>, 2021.

Elshorbany, Y. F., Steil, B., Brühl, C., and Lelieveld, J.: Impact of HONO on global atmospheric chemistry calculated with an empirical parameterization in the EMAC model, *Atmos. Chem. Phys.*, 12, 9977-10000, doi:10.5194/acp-12-9977-2012, 2012.