Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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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 PM2.5, $SO4^{2-}$, HNO3, CO, O3, in the model compared to measurements from different platforms. However, the study does not account for major HONO sources via night and daytime heterogeneous NO2 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 NO2 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 NOx (NO2+NO) reduce the atmospheric oxidation capacity? For instance, reducing NO2 would increase OH in high NOx 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 NO2 in model calculations throughout the paper.

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

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Page 10, lines 238-247: Please elaborate on “O3-reducing effects of HONO chemistry”. The authors should explain how HONO would reduce O3 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 (PM2.5, $SO4^{2-}$, HNO3, O3..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.