

Interactive comment on “Global and regional impacts of HONO on the chemical composition of clouds and aerosols” by Y. F. Elshorbany et al.

Anonymous Referee #1

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Aerosol effects are one of the largest uncertain factors in predicting climate changes. Knowledge of aerosol chemical composition and the controlling processes is critical for determining its air quality and climatic effects. In this paper, Elshorbany et al. investigate through modeling the impacts of HONO on aerosol and cloud chemical composition at a global scale, focusing on eastern US and China. By applying much more realistic HONO parameterization in the model, they show that simulated HONO mixing ratios increase typically by an order of magnitude, leading to enhanced levels of gaseous OH, H₂O₂, HNO₃ and H₂SO₄, especially in boreal winter. They further demonstrate that such increases in gas precursors significantly enhance surface aerosol sulfate and other composition concentrations as well as their hygroscopicity, improving the agreement with measurements, most apparently over the US. The model

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experiments (sensitivity runs) appear to be meticulously designed to quantify the contributions of different chemical processes, e.g. gaseous and aqueous phase chemistry, to the simulated aerosol concentrations, and the manuscript is also well written and organized. This study is novel in science, and it highlights the importance of HONO for atmospheric oxidizing capacity as well as the significance of chemistry for aerosol-cloud interactions.

Since the title of the paper is on the chemical composition of both clouds and aerosols and the conclusions emphasizes the central role of cloud chemical processing, the authors might consider giving additional figure(s) to Fig. 4 to show simulated concentrations of cloud composition (e.g. O₃(aq), HO₂(aq), H₂O₂(aq) and HSO₃-(aq)) and their relative enhancements in the body of the paper or as Supplementary Materials.

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