Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
https://doi.org/10.5194/acp-2020-1255-RC1, 2021

Comment on acp-2020-1255

Anonymous Referee #1

Referee comment on "Impact of regional Northern Hemisphere mid-latitude anthropogenic sulfur dioxide emissions on local and remote tropospheric oxidants" by Daniel M. Westervelt et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1255-RC1, 2021

This study examined the impacts of SO2 emissions from the United States, Europe, and China on tropospheric oxidants and ozone concentrations using GFDL-AM3 nudged towards NCEP wind velocities. They found that OH and HO2 decrease throughout the northern hemisphere mid-troposphere by up to 10%, as well as up to 4% decrease in O3 in the free troposphere and at the surface due to the presence of SO2. They also indicated that aerosols impact oxidation primarily through heterogeneous reactive uptake pathways over photolysis pathways. They topic is interesting and within the scope of the journal. The manuscript is well organized. Before it can be considered to be accepted, a few comments shoud be addressed.

General comments: This study investigates the responses of tropospheric oxidants to SO2 emissions from the United States, Europe, and China. In this case, I would like to see what are the response differences between these three regional sources. The authors only mentioned the oxidative response is greatest for the China perturbation simulation due to this largest emission. More detailed analysis/information should be given.

Specific comments:

Title: This study focused on the SO2 emissions from the United States, Europe, and China instead of the whole northern hemisphere mid-latitude anthropogenic sulfur dioxide emissions. I would suggest to make it more specific.

Lines 19-21: This study zeroed out the regional emissions individually. But this sentence is more like all emissions were zeroed out.

Line 40: The OH response to historical anthropogenic emissions renged from a 12.7% decrease to a 14.6%. Which anthropogenic emissions are inferred here, aerosol, GHGs, ozone?

Line 65: The authors mentioned absolute humidity, temperature, and ultraviolet radiation are thought to predominantly control OH abundance. Aerosol change can also influence humidity and temperature. Why they were not disscussed?

Line 90: Which aspects of the model were evaluated against observations? Since this study focused on the impacts of SO2 on HOx, NOx, and O3, at least, SO2, sulfate and ozone concentrations over China, US and Europe shoud be evaluated.

Line 121: How the authors test the significance of the difference with only one year simulation? The test requires two arrays. With one year simulation for both ctrl and sensitivity simulations, I am not sure how these two arrays were created.

Line 134: The figures only show the relative change in percentage. I do not see the largest perturbation in China, although it shoud be true in absolute concentration change.

Lines 139-144: Many recent studies also analyzed the long-range transport of aerosols between continents and to the Arctic (e.g., Yang et al., 2017, 2018; Ren et al., 2020). The authors may consider to cite more relavent studies.

References:

Yang, Y., Wang, H., Smith, S. J., Easter, R., Ma, P.-L., Qian, Y., Yu, H., Li, C., and Rasch, P. J.: Global source attribution of sul- fate concentration and direct and indirect radiative forcing, At- mos. Chem. Phys., 17, 8903–8922, https://doi.org/10.5194/acp-17-8903-2017, 2017.

Yang, Y., Wang, H., Smith, S. J., Easter, R. C., and Rasch, P. J.: Sulfate aerosol in the Arctic: Source attribution and radiative forcing, J. Geophys. Res., 123, 1899–1918, https://doi.org/10.1002/2017JD027298, 2018.

Ren, L., Yang, Y., Wang, H., Zhang, R., Wang, P., and Liao, H.: Source attribution of Arctic black carbon and sulfate aerosols and associated Arctic surface warming during 1980–2018, Atmos. Chem. Phys., 20, 9067–9085, https://doi.org/10.5194/acp-20-9067-2020, 2020.