Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-109

Anonymous Referee #1

Referee comment on "Incorporation of volcanic SO_2 emissions in the Hemispheric CMAQ (H-CMAQ) version 5.2 modeling system and assessing their impacts on sulfate aerosol over the Northern Hemisphere" by Syuichi Itahashi et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-109-RC1, 2021

This paper described a straightforward sensitivity study of volcanic SO2 emission using the hemispheric CMAQ. It conducted two runs, with and without the volcanic SO2 emissions, and the results were mainly compared to surface sulfate measurements for year 2010. This surface sulfate-only verification is not sufficient for volcanic SO2 emissions since that sulfate concentration can be affected by other processes, such as wet scavenging. You may need to compare the modeled SO2 concentrations to surface/aircraft measurements and satellite retrievals. This manuscript did not mention the temporal variations of volcanic SO2 emission used here, and it likely used static emission rates. If so, the corresponding discussions are needed to justify the treatment since the volcanos unlikely erupted at constant rates for whole year of 2010.

Specified comments:

Page 4, line 24: “In this study, the entire year of 2010 was simulated”. Why choose 2010 as the studied year, or is there any specific reason related to the 2010 volcano eruptions?

Page 5, line 7. So the volcano emissions have no plume rise, right? If so, why?

Page 6, section 3.1. As commented above, the verification with only surface sulfate is insufficient. Even with the coarse resolution, the SO2 comparisons are still preferred. Or, you can use a high-resolution regional CMAQ to study certain region for a certain period.

Page 8-9, section 3.3. The volcanic SO2 impact is only shown at two surface sites and for sulfate only, which is insufficient.

Page 9, line 19, "In terms of SO2 concentration, IMPROVE sites do not measure it." The EPA AQS data have some SO2 measurements. You may add them to your comparison.

Figure 6, With the constant rates of volcanic emissions, are all the temporal variations caused by chemical transport/transformation processes etc? If so, the corresponding discussion are needed. You may compare the model to satellite retrieval for its spatial/temporal distribution. The impact on the Florida site was too weak, and could not explain the systemic underprediction.