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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of GEOS-5 sulfur dioxide simulations during the Frostburg, MD 2010 field campaign" *by* V. Buchard et al.

Anonymous Referee #1

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The manuscript "Evaluation of GEOS-5 sulfur dioxide simulations during the Frostburg, MD 2010 field campaign" by Buchard et al. uses in-situ observations and field campaign measurements to evaluate their global model simulations. The model was driven by MERRA and two different emission inventories. The main conclusion is that the model tends to overestimate the sulfur dioxide concentration at the surface because of (1) the low injection height and (2) the higher emission rates in the 2005 inventory. I do have some minor comments mostly for clarification. I also have some questions regarding the results, but I understand that some of them might be beyond the scope of this study and should be answered in a different paper. Overall, I find this manuscript well-prepared, concise, scientifically sound, and that it fits well with ACP. Therefore, I recommend this manuscript to be published on ACP after a minor revision.

Here are my questions/minor comments:

1. Page 21768, line 19-21: You mentioned that the model was run at various (actually just two) resolutions, but you only showed the results from the 0.23 x 0.315 resolution simulation. So, I suggest that you revise this sentence to something like "The model was run at a horizontal grid spacing of 0.23 x 0.315".

2. Page 21768, line 24-26: What fields are provided to constrain the model's meteorology?

3. Page 21768, line 26: I do not understand the difference between the GEOS-5 and the CTM (e.g., GEOS-Chem). Could you elaborate?

4. Page 21769-21770: Regarding the difference between CR and RR, there seem to be two differences: (1) they use different emission inventories, and (2) they use different injection heights. Is that correct? If so, how can one separate the effect from one another? For example, in Figure 10 and 11, you mentioned that the different injection heights between CR and RR is responsible for the different surface SO2 concentration. Is this because the two emission inventories have roughly the same SO2 emission rates? In any event, I suggest that you replace Figure 1 and 2 with contour plots of SO2 emission rates (column integrated) from the two inventories, and then show the difference between the two inventories.

5. Figure 4, 10, 11, 12, 13: Please consider to change the colors, with observations in black (with gray shading) and simulations in red and blue.

6. Page 21771, line 3: Did Lee et al. (2011) use the same emission inventory?

7. Page 21772, line 5: I do not understand how you define the standard deviation of the two datasets. We usually view standard deviation of a dataset as its variability. What does standard deviation of two datasets mean? Please explain.

8. Page 21772, line 8: You mentioned "the scatter . . . is significant". I do not understand this statement. Do you mean the observations and simulations are significantly

different (or similar)? Please explain the significance test you used to support this statement (i.e., what significance test, what null hypothesis, at what significance level, etc).

9. Figure 5, 7: It seems that the model overestimates the SO2 concentration in general (as you stated), but especially when the observed values are very low. Do you have an explanation?

10. Figure 6, middle column, top and middle plots: it seems that the model has different behaviors between the northeast US and the mid-west US. Do you have an explanation?

11. Figure 6 and 8: Why did you reverse the color bar for the middle and right plots on the top panel?

12. Regarding the comparison between model simulations and aircraft measurements (Section 4.3): What is the frequency of the measurement? What is the model output frequency? What is the model time step?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21765, 2013.