

## ***Interactive comment on “Hit from both sides: tracking industrial and volcanic plumes in Mexico City with surface measurements and OMI SO<sub>2</sub> retrievals during the MILAGRO field campaign” by B. de Foy et al.***

**B. de Foy et al.**

bdefoy@slu.edu

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The authors are very grateful to the referees for their careful reviews which have been used to improve the quality of this paper.

Referee #1:

**General Comments** 1. Statistical diagrams were added to show model performance on a station by station basis. The discussion of model performance was improved and the results linked to the findings in de Foy et al., 2009. We  
C7810

have performed extra CAMx runs for all three of the simulations described in that paper. Furthermore, we tested the plume release heights for both the Popo and Tula plume, and found small changes in the first case and negligible changes in the second case.

For the OMI results, we have interpolated the swath data to the model grids and evaluated quantitatively the monthly averages for 3 different retrieval products.

In terms of improving the model performance, we wish to stress that this paper reports on a thorough evaluation of the numerical simulations including a description of the flow features that are most problematic: drainage flows and vertical wind stratification. We therefore defer more detailed discussion of model performance and improvements to that paper, and in the current paper focus on the application of those simulations to SO<sub>2</sub> transport. There are inherent limits on model performance given the distance of the source and the complexity of the winds. However given the results of the analysis, we suggest that simulations are of sufficient accuracy for the purposes of discriminating between urban, Popocatepetl, and Tula impacts. Improved simulations would indeed be needed to yield more precise results, but this is beyond the scope of the present paper.

2. Hourly averages were used at the stations for the statistical analysis, and one-minute average for the time series plots. We chose to report maximum concentrations in the MCMA by hour because the paper is focused on identifying sources of large peaks, and that taking the mean across the MCMA would hide the signal of the peak impacts. True, if we were studying baseline levels this would be a poor choice. The statistical performance metrics do not change much with tuning. In fact, alternative choices such as using the mean values or 3-hour averaging yield higher values for the statistical metrics.

3. True. To address this point we have performed simulations with releases  
C7811

at the model surface (4438 m MSL) and with 2000m mast height (6438 m MSL) for the volcano. These lead to small changes in MCMA impacts, but do not modify the conclusions of the paper that the Tula industrial complex is the source of the large SO<sub>2</sub> peaks. There is considerable uncertainty in the model results stemming from the complexity of the flow patterns. To address some of the points raised, a further study could identify many more volcano impacts and analyse them as a group. This is beyond the current work however.

4. Yes, we have addressed this by mapping the swath data onto the model grids and shown a quantitative comparison between the model and 3 different satellite products over the course of the entire campaign.

**Specific Comments**

1. Yes, we have added a table and included results for 3 different sets of model parameters as well as 3 different volcano plume release heights. Further tests with Tula plume rise found that this did not affect the results because the plume is well mixed in the boundary layer by the time it reaches the MCMA. We feel that impacts do indeed come from both sides, and that the dual impacts in rapid succession justify the title.
2. We agree, which is why we suggest this as an avenue for further work in the conclusions. However, the oxidation of SO<sub>2</sub> on these time scales (less than 12 hours) will not impact the statistical metrics or the conclusions of the study.
3. This was removed.
4. We've added a box, thank you for the suggestion.
5. Agreed. We've split the section in two and clarified a bit. The first 3 days are however sufficiently different from section 4.1 that it is worth keeping them in their own section.
6. Easterlies would transport the plume more to the east, weak winds would

C7812

lead to more stratification and lower solar heating would reduce the mixing height. The text was updated to mention these.

**Minor Comments** Thanks, text updated where appropriate.

Referee #2:

**General Comments** Yes, we have added statistical metrics of all the surface stations in the basin and added a quantitative comparison of the OMI retrievals. Please see the reply to referee 1 above.

**Specific Comments**

1. Yes, added to text. As it happens they are both 70 km from La Merced near the city center.
2. Yes, figure added with model vs. measurements.
3. We have greatly improved the quantitative comparison of the model and OMI data by mapping the swath data to the model grid and calculating statistical metrics. This is now discussed much more thoroughly in the text.
4. When you look at the detailed comparisons, there are indeed large discrepancies. And yet at the same time, these figures show that the simulations are able to represent significant flow features even if the details vary. Further inspection of these figures shows how variable and complex the winds are. This is why we elected to show these figures so that each reader can make up their mind about the usefulness or otherwise of numerical simulations. Given that there are twenty stations over a small area, we felt that interpolation was justified and helped visualise the results for this particular case. Showing little coloured squares would be another option, but it does not show up clearly in these plots and was therefore not selected. The figures were updated to include a box of the measurement domain in the simulation results following the suggestions of the first referee.

C7813

5. Added to paper. MEX is the radiosonde identifier for Mexico City, which are launched at GSMN. T1R refers to radiosondes launched at T1, to differentiate them from the Radar Wind Profiler.

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 16563, 2009.

C7814