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Comment

## ***Interactive comment on “Impact of external industrial sources on the regional and local air quality of Mexico Megacity” by V. H. Almanza et al.***

**Anonymous Referee #2**

Received and published: 11 December 2013

In this paper, the authors aimed to investigate how the air quality in terms of SO<sub>2</sub> is affected by emission reductions by two major external contributing sources by taking Mexico City Metropolitan Area (MCMA) as a case study. Basically, they utilized the WRF-Chem model nudged with surface observations from RAMA as well as surface and wind profiles from MILARGO campaign to determine an optimum model configuration and then perform sensitivity tests by taking into account five emission scenarios involving different emission reduction strategies. The model results suggest that “reductions in both external sources by 2017 tend to affect more the northern part of the basin (-16.35 to -45.58 %), whilst reductions of urban sources by introducing high quality fuel in the megacity tend to greatly diminish SO<sub>2</sub> levels in the central, southwest, and southeast regions (-30.71 % to -49.75 %)”. This indicates that “a combination of tech-

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nological changes in external sources could drive long-term changes in urban sources within the megacity, which in turn could result in lower levels of SO<sub>2</sub>". They also evaluate the influence of TIC region to ozone levels. Overall, this is interesting study appropriate for the scope of Atmospheric Chemistry and Physics. However, some issues with respect to datasets and method descriptions sound vague. I think the clarification of these issues is critical to understand comprehensive results presented in this study. For instance, they neglected the consideration of aerosol module in the WRF-Chem simulation. This may bring a large uncertainty since SO<sub>2</sub> is easily oxidized to sulfate aerosol in the air. Additional simulations may be required to address this issue. Moreover, the quality of figures needs to be improved while the context needs some rearrangement. Hence, a major revision of the manuscript is recommended before the publication in ACP by addressing my following comments.

Specific comments:

1. In this study, the authors chose the last week of the MILAGRO campaign as a study episode (i.e., the period from 00:00 UTC March 22 to 00:00 UTC March 28). de Foy et al. (2009) show there are multiple peaks of SO<sub>2</sub> emissions along the entire MILAGRO campaign (e.g., March 4, March 18, etc ). I am curious the reason the authors choose the last week as the study episodic event since the amount of SO<sub>2</sub> on March 18 is almost twice as much as that on March 25 (de Foy et al., 2009). I am also curious if the influence from TIC (MHR+FPRPP) and cement plants on the MCMA SO<sub>2</sub> and O<sub>3</sub> level would change if choosing different episode.

de Foy, B., Krotkov, N. A., Bei, N., Herndon, S. C., Huey, L. G., Martínez, A.-P., Ruiz-Suárez, L. G., Wood, E. C., Zavala, M., and Molina, L. T.: 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, *Atmos. Chem. Phys.*, 9, 9599–9617, doi:10.5194/acp-9-9599-2009, 2009.

2. P.26587 I.4-5, the authors stated to neglect aerosol chemistry in the present work

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and they just simply assumed that “the conversion to sulfate aerosol has a small impact in the final model concentration” without any justification. According to Karydis et al. (2011), very high sulfate concentration (over 25  $\mu\text{g}/\text{m}^3$ ) was found during the MILAGRO campaign. Moreover,  $\text{SO}_2$  can be easily oxidized to  $\text{SO}_4^{2-}$  in the air. I am curious to know the difference in the predicted model concentration if the aerosol chemistry module is switched on compared to those presented in this work. Please provide the quantitative justification using the WRF-Chem model.

3. P.26590 I.4, the authors stated “The model show northeasterly wind from 00:00 LST to 12:00 LST”. Could you specify which figure I should look at? It's not clearly shown in either Fig. 1 or Fig. 2. Also, it's not clear for me the locations of RAMA stations compared to the MILAGRO supersites. Thus, it's hard to understand the discussion made in the first paragraph on page 26590. Could you show the RAMA stations in Figure 1?

4. It's confusing to connect all points with purple line in Figure 6 in which the points represent average concentration of  $\text{SO}_2$  at different stations. Also, could you move the definition of 23 RAMA monitoring stations in page 26600 to the section where you start discussing Figure 6?

5. In page 26593, the authors stated that the highest contribution in the NW comes from TIC. That's not true for site VAL and TAC where urban sources also play role. Besides, it seems like there is high contribution from TIC for site T1. However, given in the backward trajectory in Fig. 3, the backward trajectory of T1 looks irrelevant to the external sources from TIC region. This is also shown in Figure 5 in which major emissions from TIC (orange color) does not get a chance to reach T1 although the author unclearly claimed that “under favorable meteorological conditions they can reach T1” on page 26594. Please clearly explain why T1 site has significant contribution from TIC.

6. Could you define the TIC contribution to regional ozone levels given in Figure 8?

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How does it relate to the total regional ozone? In other words, how do you separate the TIC contribution to regional ozone levels from other external or local sources? Also, can you make the color bar exactly same for all subplots shown in Figure 8 (with warm and cold color representing positive and negative values, respectively)? The current version look very confusing by using different color bars. In contrast to this absolute contribution (given in Fig. 8), could you also provide the relative contribution (fraction) to the total ozone concentration?

7. Section 3.2.3, the ozone formation is also related to NO<sub>x</sub> (and VOC) available in the air. Specifically, HNO<sub>3</sub>(gas)/NO<sub>3</sub>-(aerosol) coexist in both gas and particulate phase. Back to your assumption without including aerosol module, it would be interesting to know how the modeled ozone levels change when including aerosol module in the WRF-Chem model simulation.

8. What does the blue curve in Figure 9 stand for?

9. The subsection from page 26599 line 1 to page 26602 line 2 (Figure 10) is related to SO<sub>2</sub>. I would suggest moving this discussion to somewhere prior to the discussion on the ozone formation (Section 3.2.3). It's not relevant to ozone formation at all.

10. Since the major discussion in this manuscript is on SO<sub>2</sub> and ozone instead of all substances in the air (e.g., NO<sub>x</sub>, particulate matter, etc), I think it would be accurate to have a title like “Impact of external industrial sources on the air quality in terms of SO<sub>2</sub> and O<sub>3</sub> in Mexico Megacity”.

Technical comments:

1. Page 26580 line 14, define “NE” region.

2. Page 26580 line 23, define “CFD”.

3. All labels and texts in Figure 1 are too small. I can barely see the location of sites. Could you enlarge the font size? What does the shaded brown area in Figure 1c?

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4. Also, please enlarge all labels or texts in all figures. They are too small to be acceptable for the publication. For example, I have to enlarge the original Figure 1 like 200% - 400% to see the labels or texts shown in the figure.
5. The statement in p.26582 l.22- p.26583 l.18 sounds more like the description of methods used in this study and can be moved to the section of methodology.
6. The subsection “1.1” (from page 26584 line 19 to page 26585 line 2) sounds very strange in the Section of introduction. Maybe the authors could consider to move it to the section of methodology.
7. The subsection “2.1” and “2.1.1” seem redundant in Section 2. Could you combine them into one?
8. P.26588,l.13, what does “a.g.l” stand for? Above ground level?
9. P.26592,l.3, specify green solid or dash line in the context.
10. Please clearly define NW, SW,NE, SE, C in the context.
11. Please define PAHs on page 26595.
12. Is “Flaring” a subsection as 3.2.4 on page 26597?
13. There are so many acronyms in the text and figures, could you define them when you start using them for the first time?

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 26579, 2013.

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