

Response to Referee #2

>> Our recommendation in the preliminary review is still valid. The material presented here is more suitable for a technical note rather than for a research article. It is not clear if the manuscript fills the scope of *Atm. Meas. Tech.* No new measuring/analysis techniques are introduced and the topic has been extensively studied and reported in previous articles.

The paper was actually submitted as a case-study work to a different journal whose major scope is not measurement technique, but was rejected because the editor regarded it a work on measurement technique recommending AMT as an alternative journal. From the comments we have received so far, the paper seems to fall in the middle of a case study of SO₂ plume and a technical report on ozonesonde usage. The paper may not be right in the scope of AMT, but we think it may be appropriate to include this kind of paper in the journal. We would like to leave the final judgment to the editor and the referees.

>> 1) The manuscript needs to be read and corrected by a native English speaker. Some sections are obscure due to grammatical errors.

The manuscript will be corrected by a professional English editing service.

>> 2) This corrected version of the manuscript is shorter than the original, but is still long. Some paragraphs do not provide enough information and others are repetitive.

Introduction is reduced substantially by removing description of well-known ozone effects. Conclusion, which was a mere repetition of the main text, now contains three short sentences mentioning the usefulness of our results for the planning of regular ozonesonde observations in Mexico.

>> 3) There is a lack of references in some sections. A better literature review is needed.

References including those suggested by the referee are added.

>> 4) All acronyms need to be defined the first time they appear (e.g. DOAS, GPS, LST, WRF, FLEXPART, NCEP, WSM, ATI, TLI, CONCAWE, etc.).

As suggested, the acronyms are defined at the first appearance.

>> 5) The number of observations is insufficient to provide conclusive findings. The ozone drops at 5,500 m observed in four ozone-sonde launches may be related with the Popocateptl volcano plume, as suggested and discussed by the authors. But it is difficult to associate (scientifically) the failures in the electrochemical cells with the emissions from the Tula industrial complex using as reference only one observation. In addition, studies designed specifically to investigate the Tulas impact in the air quality of Mexico City, have found that Tulas plume reach only the city during particular meteorological conditions and operational circumstances of the refinery and/or power plant located there. Similarly, studies conducted by the local environmental authority (RAMA, as defined in the article) have concluded that some industries in the north of the

city are still illegally burning dirty fuels, particularly during night-time. Reason why is not uncommon to see high SO₂ concentrations in the north of the city during nights and following mornings.

We added another evidence for the Tula case. On the same day, RAMA stations in the north of MCMA recorded persistent northerly wind and sporadic high peaks of SO₂ concentration. Therefore, it is very unlikely that the high SO₂ event on March 14 was due to emission from the northern industries that are mostly located in the south of these monitoring stations. Although the incident for which we think the Tula emissions are the main cause of the high SO₂ occurred only once, the evidence we presented is much stronger than those given for the Popocatepetl plume. Therefore, we do not find a good reason for removing the Tula complex part while retaining the Popocatepetl part.

In Sect.4.2, we regarded the Tula complex as the sole cause of the sporadic high SO₂ records in MCMA. This was not adequate because we precluded the possibility for the other northern industries to contribute to high SO₂. To be fair, “Tula complex” in this section are changed to “northern industries” or equivalent phrases.

As for the local government, we work very closely with them and consulted the air-monitoring division about this matter. They are aware of illegal burning of low-grade oil in the northern region, but still considers the Tula complex as the major contributor to the high SO₂ in MCMA. However, since both the arguments of the referee and we authors are not based on published studies, we do not think there is an unambiguous solution. Because the revised manuscript presents sufficient evidence for the March 14 interference but does not attribute other high SO₂ incidents to the Tula emission, we believe that there is nothing scientifically inadequate.

>> P294, L24. Which standards (e.g. Mexican standards, USA-EPA, etc.)? Mexican standards. The norm values are mentioned explicitly.

>> P294-P295. Introduction. Consider that readers of AMT are familiar with the ozone pollution details. Better provide information about the use and history of electrochemical cells to measure ozone and their limitations caused by interferences with other trace gases.

Introduction is reduced substantially. General information on the ozone effects is deleted. More emphasis is given to the development of ozonesonde measurement technique.

>> P295, L 11. ... and destruction. Add reference.

Molina et al (2010) and Valesco et al (2008) are added.

>> P296, L19-27. More precise objectives are needed. Explain what you are trying to demonstrate/investigate in this particular study, and not the in the main field campaign.

Introduction is reduced substantially. Mention of the whole campaign is minimized, and the main scope of the paper is clearly stated at the end of In-

roduction.

>> P297, L10-14. Add reference.

Komhyr (1969) has been added.

>> P299, L3. SO₂ emission sources?

Fixed as suggested.

>> P299, L9-10. INEM2008, reference missing.

INEM2008 was provided in person by SEMARNAT. It is not yet available as publicized database. To be clear about the time of production, the date of acquisition is inserted in the manuscript.

>> P299, L12. For the Federal District emissions indicate the base-year of the inventory.

Emissions in the Federal District were extracted from INEM2008. Therefore, the base year is 2008. The revised manuscript clarifies this point.

>> P300, L6. With the aim of unravelling the life cycle of O₃ in MCMA? The O₃ problem in the Valley of Mexico has been well documented in the peer-reviewed literature (e.g. <http://mce2.org/en/publications>).

Ozone life cycle may have been understood by past studies but the three-dimensional structure has not. Our twice-a-day ozonesonde measurement is valuable in estimating daily production of ozone. The concerned part has been re-written as “With the aim of clarifying the three-dimensional structure of O₃ in MCMA,”, and Molina et al (2010) is cited in Introduction.

>> P300, L15. Do you mean ascending speed by rate of climb?

Yes. “rate of climb” is changed to “ascending speed”.

>> P303, L22-26. It would be helpful to indicate the location of the balloon when it reached the 5,500 m height in figure 5b.

By the scale of Figure 5b, the horizontal location of the balloon at 5500 m was almost coincident with the location at the ground level. This is explained in the text, and no additional points are plotted in Figure 5b.

>> P303, L27. How was the thermal ascent of the volcano plume estimated?

The chosen height range is a crude guess from the infrared sideview of Popocatepetl by Grutter et al (2008). A sentence explaining this point has been added.

>> P304, L9. Remove this section. See comment #5.

As mentioned previously, we modified this section to include the possibility for the northern industries other than the Tula complex to contribute to the

high SO₂ incidents. This section is retained.

>> P306, L24-26. What about the month of November? Your study is based on measurements conducted on this month.

In November, the frequency of SE wind is relatively low (3.5%). We consider our encounter with the plume presumably from Popocatepetl as a meteorological variability. A comment regarding this point is inserted in the manuscript.

>> P307, L1. Remove this section. See comment #5.

As mentioned previously, we believe we present sufficient evidence for relating the deficit in the ECC sensor reading on March 14 with the Tula emission. Therefore, we retain this section.

>> P311, Fig. 1. Define all acronyms. Readers may not go to the main text to find their meanings.

All acronyms are defined in the figure caption.

>> P312, Fig. 2. The light and dark blue and green traces are not easy to distinguish. Better use markers or lines+markers.

The traces are changed to markers.

>> P313, Fig. 3. Units? Why is a logarithmic function needed?

Log was suited for showing the whole distribution in single panels. However, it is certainly helpful to be able to view the distribution in the linear scale. Therefore, we modified the figures to nested ones: the outer nest adjusted to the maximum occurrence count, and the inner nest adjusted to reveal the difference in the occurrence counts at high concentration.

>> P314, Fig. 4. Why not presenting the ozone concentrations in units of ppb?

Partial pressure of ozone is shown in Fig. 4 because drawing response curves of the ECC sensor across layers with different total pressure is straightforward in partial pressure rather than in mixing ratio. A sentence is inserted to explain this point.

>> P315, Fig.5 Use an additional panel to show the wind direction profiles.

The panel for wind speed and direction is separated into two showing wind speed and wind direction on each.

>> P316, Fig. 6. Vertical distribution of O₃ concentration and equivalent potential temperature ...

This part has been fixed as suggested.

>> P317, Fig. 7. PED SO₂ data before 6 am?

No valid data was available for SO₂ at PED before 6 am. As mentioned previously, we find it more meaningful to show the monitoring data at northern

stations rather than those at PED. Hence, PED data are removed from Fig. 7.

>> P319, Fig. 9. What does OCENTRAL mean at the top of each panel? Instead of using numbers to indicate the months analysed in each panel, write the months names.

OCNETRAL means SMN, the central observatory. To avoid confusion the label OCENCTRAL has been removed from the figures.

Months numbers are changed to names.

>> References

The references suggested by the referee are included in the manuscript except for Almanza et al (2013), which is still a discussion paper at the time of this revision.