

Interactive comment on “Observations of SO₂ and NO₂ by mobile DOAS in the Guangzhou Eastern Area during the Asian Games 2010” by F. C. Wu et al.

Anonymous Referee #1

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The author presents data observed 2010 during the Asian Games in the Southasian Guanzhou area using different instrumentation. The main instrument is a mobile passive DOAS on a car which is able to estimate the emission flux of the encircled area by combining with wind data. The measurements are combined with a static MAX-DOAS to better estimate the vertical column of trace gases of the reference spectrum for the mobile DOAS instrument. Thus the mobile DOAS instrument is not only able to derive Differential Vertical Column Densities (DVCD), but VCD. This is a usefull additional parameter, as now also comparison to satellite observations are possible and presented in the manuscript. Data from an additional LP-DOAS are used to interpret sources. The presented data are resonable to be published in ACP. There are no mayor con-

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cernings. However to my opinion the quality of the manuscript is partly poor and requires improvement. These are mainly no significant corrections, but rather many smaller modifications like the improvement of figures etc.. The comments are given below. Some major corrections are required for the following points: The authors ignore in the data analysis and interpretation that NO₂ has a strong diurnal cycle. These variations result in a spatial variance just due to the fact that the measurements at different locations are taken at different times. Also the estimation of NO₂ flux should better be based on a NO_x flux. In the DOAS data analysis the HCHO reference is missing which may have a significant influence on the data results. Additionally a sufficient error estimation is often missing. E.g. how large is the error if wind direction are used from street level? Please address these points in more detail.

More specific comments: p. 262 Abstract: A statement that the mobile DOAS is a passive DOAS is missing, and that measurements are performed during daylight (specify time of day) is missing.

p. 262 l. 18: The sentence: "NO₂ is an important trace gas in the atmosphere because it readily undergoes photochemical reactions with other air pollutants." is not absolutely correct, as it also reacts with non air pollutants.

p. 263, l. 4: It is worth to mention here that SO₂ has not necessary to increase with higher energy consumption if according filters are used in power plants.

p. 264 l. 12 Clarify that it is "passive" Differential Optical Absorption Spectroscopy

p. 265 l. 4: Which time of day do these data represent?

p. 266 l. 12: specify the field of view of the telescope

p. 266 l. 14: What does "has a stable temperature" mean? Please specify.

p. 266 l. 19: Please specify that the meteorological data are at street level. But the DOAS data are a vertical column density (VCD).

p. 267 l. 24: The statement that airborne measurements cover a limited spatial area is not correct, but difficult to achieve on a regularly basis.

p. 268 l. 16: Offset correction is missing. Is this performed?

p. 268 l. 19: Differential slant column densities are DSCD not SCD and the description has to be corrected.

p. 269 l. 4-6: A description of how the reference spectra are adapted to the instrument resolution is missing.

p. 269 l. 4-6 and 9-11. For both evaluations, SO₂ and NO₂, the references of HCHO are missing

p. 269 l. 11: A description of how the wavelength calibration with the solar spectrum is performed is required, as the question arise if the authors used an instrument function or not.

p. 269 l. 21: The DSCD derived with the MAX-DOAS are averaged over an measurement distance of several km, as this is the typical viewing length of these instruments. If these measurements are directly compared to the mobile measurements, no strong spatial variations over the averaging path should exist. Else the value of the MAX-DOAS is not necessary representative for the instrument location. This has to be shown, e.g. By looking at the variability of the mobile DSCD values within a typical averaging length of the MAX-DOAS in this specific area.

Please specify "in order to eliminate the reference" → "in order to eliminate the NO₂ and SO₂ VCD in the reference"

p. 270 l. 10: The Lidar and LP-DOAS measurements used for the radiative transfer calculations are taken at very different locations than the MAX-DOAS measurements. How much do possible variations in the concentration affect the retrieved results? Please estimate an error.

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p. 271 l. 24: please specify: that the wind data are: "measured wind speed at ground level..."

p. 272 l.4-5: The SO₂ peak irrespective of wind direction can not be seen in the Fig. 6, maybe if plot type/ quality are improved.

p. 272 l.9: please add to SO₂ source "(without dominant NO₂ emission)"

p. 272 l. 24 Specify which mobile DOAS data are used for the comparison. The ones during the OMI overpass at the same location? Or average data of the day. In this section especially the strong diurnal cycle of NO₂ is ignored. As this is typically much stronger than the spatial variability, a comparison of the mobile measurements taken over a day with the OMI data taken at a fixed time of the day is insufficient. A better correction of the diurnal cycle is necessary.

p. 273 l. 11: The statement "while low NO₂ VCDs were likely overestimated" by OMI, seems to be wrong, as I can not see this in Fig. 8.

p. 273 l. 19: Including here the NO₂ and SO₂ surface concentration does not give additional used information and is more confusing than helpfull.

p. 273 l.20: Please clarify the sentense which instrument underestimate NO₂ VCD.

p. 273 l.21 The correlation of the spatial distribution of NO₂ from OMI and mobile DOAS is difficult (or not) visible. Please give a correlation plot. The bad correlation may be due to the ignored diurnal cycle of NO₂.

p. 274 l.10 What does "constant vertical wind" means? First I guess you mean a vertically constant wind. Second what is the margin for constant?

p. 274 l.11 The wind field shown in Fig. 12 for ground and 400m measurements seem to vary on some days significantly. Please clarify which day you select as constant wind within the boundary layer and what are for these days the differences.

p. 274 l. 17 NO₂ freature a strong diurnal cycle due to photochemical reactions. An

emission of NO₂ thus strongly depend on the time of day, solar radiation etc.. The NO_x (NO + NO₂) emissions would be a much better value.

p. 275 I.9 The comparison of the estimated SO₂ emission to the inventory seems to be inconsistent, as the encircled measurement area is much smaller than the whole Guangzhou area and thus the estimated SO₂ emission should be much smaller.

p. 275 I.20 Using 20% for the error of the wind field seems to be too optimistic, as wind speed in Fig. 12 vary by almost a factor of 2. How does this factor 2 is estimated?

p. 276 I.7-11 Description of back trajectories incl. Fig. 14 + 16 seems not to be very useful for the data interpretation and more confusing. Also the Fig. 17 seems to be redundant. Please shorten this section.

p. 276 I.22 Please include the above corrections also to the "Conclusions".

p. 285 Fig. 1 Please indicate LP-DOAS and MAX-DOAS light path/ viewing direction. Also indicate the scales of each map.

p. 286 Fig. 2 This figure is redundant.

p. 288 Fig.4 Please clarify for which times the data points are averaged? Are these daily average or averages only for the time if both data are available?

p. 289 Fig.5 Please clarify for which time the data are average. To increase the clarity of the plot add a line between the data points. Why is this figure not combined with figure 12?

p. 290 Fig.6 The data are displayed in a very unclear way and are not useful. Please change e.g. to 2D plots with colour coded concentrations.

p. 291 Fig.7 Please combine with Fig.1

p. 293 Fig.9 If comparing Fig.8 and Fig.9, in Fig. 9 the axis seem to be wrong labeled (switched).

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- p. 297 Fig. 13 Clarify for which time of day the emissions are estimated.
- p. 299 Fig. 15 Please indicate in the caption what shaded days mean. Also here are days with very high SO₂ when wind is not from south-east. Please explain.
- p. 300 Fig.16 This figure seems to be redundant.
- Technical comments: p. 264 l. 19 Specify the city in Mexico.
- p. 264 l. 19/20 specify the country for Mannheim and Ludwigshafen
- p. 266 l.16 "as well as" → and
- p. 269 l.16 ", these" → the
- p. 287 Fig 3 In caption: "in the text" → "in section ..."
- p. 288 Fig.4 Third figure caption: "add Offset" → "mobile DOAS data + add Offset"
- p. 295 Fig. 11 The track of the mobile DOAS is difficult to see over the OMI map. Please change the display.

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