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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Temporal trends of anthropogenic SO_2 emitted by non-ferrous metal smelters in Peru and Russia estimated from Satellite observations" *by* M. F. Khokhar et al.

Anonymous Referee #1

Received and published: 13 October 2008

The paper "Temporal trends of anthropogenic SO2 emitted by non-ferrous metal smelters of Peru and Russia estimated from Satellite observations" by Khokhar et al. reports on SO2 columns retrieved from data of the GOME satellite instrument over three metal smelters for the time period 1996 - 2002. The assumptions made for the conversion of slant columns to vertical columns are discussed, the temporal evolution of the signals is evaluated and absolute emissions of the three smelters are estimated.

The paper is overall well written but can be shortened substantially (see below). The subject of the paper is within the scope of ACP, and some new and interesting data are presented. However, in my opinion, major revisions are needed before the paper can

be considered for publication in ACP. This concerns mainly three points:

Major points

1) The paper is repetitive and contains a lot of unnecessary information. Examples are tables 1 and 3 which are summaries of information found on the internet and in my opinion are not necessary for the paper. Also, details on who owns the smelters or the description of the volcanic zones in South America in Sec. 4.6 do not add to the main points of the study. Similarly, the discussion of the benefits of satellite remote sensing (sec. 2., sec. 4.3, conclusions) appear unnecessary and in parts a bit out of date (see below). I therefore recommend shortening the paper by removing unnecessary parts.

2) The study of the Peruvian smelters has a lot in common with the paper of Carn et al., 2007 who looked at the same emissions using OMI data. That work also discusses SO2 retrieval over the smelters, the possible influence of volcanic signals, the life time of SO2 in the lower atmosphere and estimated emissions. While the work of Carn et al. is cited in the manuscript, it is in my opinion not made clear how similar the two studies are, and should be discussed in more detail in a section dealing with earlier work on the topic. Also, the work of Thomas et al. on airmass factors and the impact of aerosols deserves more attention in the section on arimass factors. I therefore recommend adding a more detailed discussion of previous work.

3) The main new information in this paper is the temporal evolution of the SO2 emissions from the three smelters as derived from GOME data. Considering the large scatter in Fig. 3 and 5, the question is how significant the trends derived are. For this, estimates of the uncertainties for the individual weekly and 10 day averages of SO2 columns are needed which can then be used to investigate the significance of the trends derived. So far, the manuscript contains only a few numbers on uncertainties, and these are not explained at all. I'm also surprised by the magnitude of the estimates for the uncertainties of the emissions (between 7

Minor points:

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Title: check capitalisation

Authors: correct affiliation of U. Platt

p 17396, l3: amount => amounts

p 17396, l 8: region => regions

p 17396, first paragraph of sec. 2: unnecessary general statements, please remove

p 17397, l3 / 4: references not appropriate - paper of Platt et al. was published before launch of GOME, Wagner et al. deals only with BrO. Replace by more general references, e.g. Burrows et al., 1999 and Wagner et al., 2008

p 1789, airmass factors: it is stated in the text, that an average cloud fraction of 0.3 is assumed. The effect of this assumption depends on cloud top height and cloud optical thickness relative to the assumed vertical profile of SO2. Did you assume that the SO2 is completely shielded by the clouds in 30

p 17399, l 16/17: while the choice of parameters might not influence the trends much, it does have a large impact on the estimated emissions!

p 17400 / 17401: the discussion of emissions here is too early as you have not yet introduced your own calculations (sec. 4.5)

p 17401, l 16 - 20: Something appears to be wrong with these sentences. Also, I don't think there is much need to explain what polar night is.

p 17401, l 22: "snow cover extension with in selected region" => snow cover within selected region

p 17403, first para: considering the paper of Carn et al., 2007, the statement on the distinctness of GOME measurements appears out of date

p 17403, l 12: showed => shows

p 17403, l 14: showed => shows

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Interactive Comment

p 17404, l 16: I don't think you need a special tool to derive the distance between two points on the Earth's surface at the accuracy level needed here

p 17405, first paragraph: are the emission estimates for Norilsk really from Carn et al. or did they only cite it? What are the emission estimates Carn et al. derive for the Peruvian smelters?

Fig. 5: To me, this doesn't look like a linear trend but rather like a decrease in the first two years followed by a small increase

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