

## ***Interactive comment on “Atmospheric inversion of SO<sub>2</sub> and primary aerosol emissions for the year 2010” by N. Huneus et al.***

**Anonymous Referee #3**

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This paper describes the results of assimilating MODIS AOD and optimizing emissions of primary emissions. This paper is well-written and is a well-defined application of data assimilation for emission estimation, with the advantage that this process can be performed earlier than bottom-up revisions. I have several comments and suggestions that the authors should consider before the paper can be accepted.

Major comments:

My only concern with the overall approach is that there is no mention of the potential role that secondary-organic aerosols could play in the overall distribution of aerosols, and how that would affect the results of the inversion. It is clear that modeling SOA is still very much an open question, but it is nevertheless worth asking the question how much of the biases that lead to changes in emissions could be attributed to missing

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aerosols.

My other comment relates to the sole use of optical depth as verification. It seems that this could be considerably improved by using comparisons against surface measurements of aerosol concentrations.

Minor comments:

Page 6172, line 10: duplicate (2)

Page 6173, line 24: 80% still seem like a rather large threshold for potential cloud interference. How was that number selected?

Page 6173, line 27: the statement “thinned” is somewhat puzzling. Should it be “averaged”? What is the procedure to identify the importance of and take into account the variability within the 3.75x2.5 grid box?

Page 6174, line 16: while the physical process is the same everywhere, the biases in wind speed are probably not.

Page 6176, line 5: there has been a significant number of small volcanoes that lead to the observed increase in stratospheric aerosols. Any indication of how that would affect the results (for 2011)?

Page 6177, lines 23-24: It is hard to see the connection between the CO<sub>2</sub> inversion (and the adjustments on error) and this research. Please expand.

Page 6178, lines 1-3: isn't it obvious that increasing the model error leads to improvement against observations?

Page 6181, line 4: add reference to ACCMIP

Page 6182, line 25: it is probably important to comment on the degree of independence between MODIS and AeroNET? Was AeroNET used by MODIS for ground-truthing?

Page 6185, lines 25-27: it could also be that the observations over those areas are so

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biased that they bring no information to the assimilation.

Page 6187, line 22: change "coincide" to "agree"

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 6165, 2013.

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