Further to previous comment by Referee #1

8. Resolution:

In Section 4.1 you specify that you use a 1 h time step and 250 m altitude step leading to 15 840 emission domains. You do not specify how much AIRS satellite data you have, the temporal resolution and number of SI values. Do the AIRS satellite data contain enough information to constrain the emissions at this high resolution? Would the emission subdomain at 16.25 km altitude be sufficiently different from 16.5 km altitude? This also relates to the resolution of the meteorological data (both vertically, and the 3-6 hourly temporal resolution) you used for the unit simulations. Please elaborate.

Authors response:

In this study, we tried to discretize the emission domain as finely as possible as permitted by the computing resources. This way, it is possible to reveal more local details of the emissions in case that high resolved meteorological and satellite data are available. It can also provide us information for the further development of an adaptive strategy for discretizing the emission domain, which will be considered in future work. During the time period 12 to 18 June AIRS detected volcanic SO2 in nearly 75.000 satellite footprints, which means that the inversion is constrained by a large number of individual satellite observations. We added text on page 17 lines 14-16 in the revised manuscript (with tracked changes): "During this time period AIRS detected volcanic SO2 in nearly 75.000 satellite footprints. Hence, the inversion of volcanic SO2 emissions is constrained by a large number of satellite observations."

New comment:

You mention that "*For the numerical computation, we discretized the emission domain as finely as technically feasible in order to reveal local details of the SO2 emissions at high temporal and spatial resolution. This way, we expect to obtain more reliable simulation results*." You further say "*This way, it is possible to reveal more local details of the emissions in case that high resolved meteorological and satellite data are available*."

I am a little concerned about the very high resolution of the source term you here use and whether the satellite data contain enough information to well constrain this. Rather than specifying the emission domain according to what is technically feasible permitted by the computing resources (in case high resolution data is available), one needs to consider how much information is available to solve the actual problem – i.e. how much satellite data you have for your specific case and how finely discretized emission domain is possible to extract from those particular data. In this case you use around 75000 footprints of satellite data to solve 15840 emission domains. If we use a rough #obs/#source domains factor you have a factor of ~5. Stohl et al. (2011) used 2.3 million particles for 6232 emission domains, giving a factor 370, whilst Kristiansen et al. (2014) for the Kelut case increased the resolution of the source term and used about 23300 observations for 938 emission domains (factor ~25). So comparing these rough factors you do have quite a low factor. It is unclear if this really is an issue, and I miss some discussion on how well your source term is constrained by the satellite data, particularly the single emission domains. Such information is shown for example in Stohl et al (2011) Figure 3. Please include some discussion and preferably some statistics about how well the problem is constrained.

Comment to GMD manuscript version 4, Page 5:

"distinct advantage of this approach is that the proposed inverse modeling and simulation system requires no a-priori information on the emissions"

Without a priori your method provides a qualitative emission source term (relative distributions). Most other methods you have mentioned in this paragraph would already provide quantitative results. In your method, quantitative results can only be obtained by assuming a priori information on the total SO2 mass. Please make this clear here.