

Interactive comment on version 3 of

“Variational assimilation of IASI SO₂ plume height and total-column retrievals in the 2010 eruption of Eyjafjallajökull using the SILAM v5.3 chemistry transport model”

by Julius Vira *et al.*, *Geosci. Model Dev.*, doi:10.5194/gmd-2016-200

My concerns about the assimilation/inversion method have been addressed appropriately by the authors. My misunderstanding was entirely due to the assumption that the assimilation window was 24, 12 or 6 hours which are common choices in Numerical Weather Prediction and Air Quality forecasting systems. Here there is one assimilation window covering the whole duration of the case study (21 days) hence it makes perfect sense to ignore any background term in the cost function.

The confusing paragraphs in Sections 3 and 4 have been corrected, and the revised manuscript is much clearer. In order to address the concerns of the first reviewer, the model results are now also evaluated against CALIOP data. This greatly improves the interest of the paper.

I would only suggest one minor revision in the revised abstract which now states (lines 25-29)

For Eyjafjallajökull, the comparison between results with and without assimilation of plume height retrievals shows that the estimated injection height was mostly constrained by the inversion even using only total column retrievals. However, comparison with the profile observations from the CALIOP instrument showed that assimilating the plume height retrievals improved the vertical distribution during episodes when the estimated injection height was not otherwise not sufficiently constrained.

I think that this is explained in a less optimistic manner, but more clearly, in the revised conclusions (lines 601-603):

The comparisons show that assimilating the plume height retrievals reduced the overestimation of injection height during individual periods of 1-3 days. However, for most of the simulated 21 days, the injection height was constrained by meteorological conditions and assimilation of the plume height retrievals had only small impact.