

Interactive comment on “Detecting volcanic sulfur dioxide plumes in the Northern Hemisphere using the Brewer spectrophotometer, other networks, and satellite observations” by Christos S. Zerefos et al.

Anonymous Referee #2

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This article provides an interesting assessment of the detection of volcanic sulfur dioxide by Brewer spectrometers in the Northern hemisphere. It uses surface station and satellite measurements as well as trajectory models to evaluate the performance of the Brewer instruments in case of elevated SO₂ levels due to the passage of volcanic plumes. Although the Brewer instruments are not accurate enough to monitor SO₂ on the long term, it is argued, by using trajectory models in order to trace large (VEI>4) volcanic plumes from recent eruptions in the Northern hemisphere, that Brewer instruments can detect the volcanic SO₂ signals. Since the Brewer network set up for the monitoring of total ozone includes a large number of stations, the authors suggest

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to use this measurement capability to forecast the evolution of volcanic plumes and provide a new SO₂ forecasting tool. The paper is correctly written and informative regarding SO₂ measurement capacity of Brewer instruments. I recommend publication in ACP, provided that important comments for improvement are taken into account.

Main comments

→ The measurement capability of Brewer instruments should be better explained. Since the paper focuses on the detection of small SO₂ signals, the methodology to derive SO₂ total content should be summarized in the paper itself. An assessment of the mean SO₂ values generally provided by Brewer instruments should be provided.

→ As optical instruments, the Brewer measurements can be perturbed by ash present in the volcanic plumes. This issue should be addressed in the article.

→ For readers not familiar with total SO₂ measurements by Brewer spectrometers, it is rather intriguing to see negative total SO₂ values. So it would be worth explaining why such negative values have to be considered in the general Brewer (and satellite) retrieval.

→ Two lagrangian models are used for the analysis: FLEXPART and HYSPLIT. An explanation is needed on why two different models need to be used (paragraph 2.3).

→ In the case of the Baraorbunga volcano, the FLEXPART model has been used to simulate SO₂ levels in air masses sampled at Hohenpeissenberg station. But there is no detail on the simulation and on the initial emitted SO₂ levels.

→ For the same volcano, it is not completely clear that the elevated SO₂ levels detected by ground stations correspond to the volcanic plume. Also a better explanation should be given on why the plume is not seen in OMI and GOME 2 measurements shown in Figure 5. The case for the detection of this volcanic plume by the satellite instruments over Europe and for the attribution of increased SO₂ levels from these measurements (page 8) is not completely made.

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â€¢ The fact that the 2011 GrimsvÃ¶th volcanic plume was not detected by the European Brewer instrument does not bring much to the article. This paragraph should be removed.

â€¢ Again for the EyjafjallajÃ¶kul volcano, OMI and GOME 2 do not seem to detect the SO₂ signal. An explanation is needed on the lack of detection by satellite instruments. Also, the left panel of Figure 16 is redundant with the right panel.

â€¢ 2008 Kasatochi case: it is not clear from the article why the plume is not detected in Taiwan by the satellite instruments, contrary to the observations in Europe and North America. This issue should be addressed.

â€¢ The conclusion should better summarize in which general conditions (SO₂ levels, time after eruption) Brewer instruments can be useful for the detection of SO₂ volcanic plumes. The article is qualitative in general and such a summary would provide a quantified assessment of the measurements capability of Brewer instruments with respect to SO₂ measurements. Comparison with OMI and GOME 2 measurements capacity in similar cases would be useful. It would be also worth mentioning why IASI and AIRS measurements are not included in the analysis.

Minor comments

In general, figures' legends should be more informative, with the description of the various plots and the name of the volcano case to which the figure refer (when SO₂ levels are plotted).

Figure 7: can the authors comment on the spot of elevated SO₂ observed between Italy and Greece?

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