

# Review of the paper 'Real time retrieval of volcanic cloud particles and SO<sub>2</sub> by satellite using an improved simplified approach' by S. Pugnaghi et al.

The manuscript describes an improvement to an earlier published Volcanic Plume Removal (VPR) procedure for retrieval of volcanic ash mass, ash particle effective radius and SO<sub>2</sub> mass. In its present form the manuscript more resembles a technical report than a full scientific paper. Some suggestions for improvement are given below.

## Major comments

My main concern is with the rather limited scope of the synthetic data set used for testing of the VPR procedure. As it stands the synthetic data set is too limited and sparse to allow for an adequate testing and understanding of the strengths and weaknesses of the improved VPR procedure. To address this at least the following two tests with accompanying discussions should be included:

- The improved procedure is tested on two idealized synthetic images. This is a very limited and not very instructive comparison for the general usefulness and applicability of the procedure. To demonstrate the real life behaviour of the procedure it should also be tested on real data and examples of such included. For example could the real measurements (or similar) on which the synthetic images are based, be analysed.
- The synthetic data set only includes ash and SO<sub>2</sub>. It is relatively easy to include water and ice clouds into such synthetic data sets and this has been done earlier by other authors. The authors are strongly urged to also include a synthetic test which include water and ice clouds together with ash and SO<sub>2</sub>. Realistic ice and water clouds may be taken from for example ECMWF or similar forecast models. Inclusion of such test cases will greatly improve the testing space for the VPR procedure. This will also allow to include estimates of false positive and false negative ash and SO<sub>2</sub> pixels detection for the VPR procedure. Such estimates are extremely useful in order to fully comprehend the qualities of the VPR procedure.

## Minor comments

- **Page 1, line 19:** Please move the parenthesis listing plume particles from lines 22-23 to line 19 and insert after "particles".

- **Page 1, line 25:** Include the years for the Mt. Etna and Eyjafjallajökull eruptions which the synthetic images resemble.
- **Page 2, line 32:** Give years of eruptions.
- **Page 4, line 10:**  $L_p$  should not be in bold face.
- **Page 4, line 13:** Please explain  $\tau'$ ,  $\tau''$  and  $L'_{u0}$  or point the reader to the Appendix for explanation.
- **Page 7, line 32:** Please also mention that details of synthetic image generation are included in the following two subsections 3.1 and 3.2.
- **Page 8, line 18-19:** Please include the ash mass loading that the optical depths of 0.1 and 1.5 translate into.
- **Page 8, line 19:**  $\delta$  should not be in bold face.
- **Page 10, line 1-23:** Please discuss what approximations in the VPR procedure that are the main reasons for the differences seen between the ash and SO<sub>2</sub> clouds input to the calculation of the synthetic images and the corresponding retrieved values.
- **Page 12, line 8:** Should it not be  $S = 0$ ?
- **Page 27, line 1:** Please write something like “Synthetic RGB images constructed from bands at 8.7, 11, and 12  $\mu\text{m}$  “ instead of “Synthetic images (radiance at the sensor); RGB: bands at 8.7, 11, and 12 m respectively”.