

## ***Interactive comment on “Automatic volcanic ash detection from MODIS observations using a back-propagation neural network” by T. M. Gray and R. Bennartz***

**T. M. Gray and R. Bennartz**

ralf.bennartz@vanderbilt.edu

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Reply to Reviewer #1 comments dated Sep 9, 2015

We thank the reviewer for her/his valuable comments. Below please find a detailed response to all reviewer comments.

General comments by the Reviewer: The reviewer appreciates that the authors extended the Introduction since the first stage of the review process (usually foreseen for technical corrections) and included a broader discussion of the role of the paper in the context of previous work. The authors included the references recommended by the re-

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viewer. I recommend the paper for publication and would like to highlight two aspects: - The authors make use of HYSPLIT data which is an interesting and promising approach. - The paper discusses volcanic eruption events which are not heavily exploited by existing studies, in particular compared to papers demonstrating neuronal net ash retrievals on the MODIS instrument. The paper can be considered as a first demonstration of the described methods only, in particular because both the training dataset and the verification are based on quite a small amount of data (see also specific comments below). The paper is written well and the authors present useful additional details in the appendix.

RESPONSE: Thank you. We appreciate your insights as well as your initial review, which helped us write a better and more targeted paper.

1.) p. 8758, line 1-5: Granules from the three eruptions in the appendix are used to train the neural net while the four eruptions in the paper are events independent of the dataset used for the training of the neural net (if I got it correctly). Maybe one could make this a bit more clearly here (or in section 2.4.1). I would also recommend to move the list of granules used for training from the supplement to the paper (sect. 3 of the supplement could be a table in the paper while additional details could be left in the supplement as it is).

RESPONSE: IN a revised version we will clarify the issue about which granules were used in training and which were used for validation. Rather than moving the granule table out of the online supplement we suggest to highlight more strongly in the main text where this information can be found. This will allow keeping the text short shorter, but at the same time allow readers to quickly find the information should they need it.

2.) Supplement sect. 3: It should be discussed if it is appropriate to use one neuronal network for both MODIS instruments or if separate neuronal networks for Terra and Aqua are necessary. The instruments may suffer from different biases and degradation effects. Overpass times/observation geometries are also different and it appears that

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this is not taken into account by the presented algorithm.

RESPONSE: While there are known differences in the calibration of some infrared channels between Terra- and Aqua-MODIS (in particular band 27 around 6.7 micron), we believe that for this study minor radiometric differences between these two instruments can be neglected. The same holds true for sensor drift. If this method was to be implemented operationally, differences between different sensors would have to be accounted for (e.g. between VIIRS and MODIS).

3.) If the algorithm is dedicated to be used both for day- and nightside, it would be good to demonstrate the applicability for at least one event on the nightside using an eruption independent of the training dataset.

RESPONSE: We have focused here on daytime in particular, exactly because it allows to independently assess accuracy using VIS/NIR RGB images. Since our algorithm only uses true infrared channels with no solar intrusion, we believe it is safe to say that nighttime accuracy will be comparable.

4.) The algorithm clearly shows unreasonable high amount of ash cases at the edges of the granules. Is this effect caused by instrumental effects (e.g. biases in the satellite data) or more likely caused by the neuronal network algorithm (observation angles need to be taken into account in addition?)

RESPONSE: We agree fully with the reviewer's suggestion and will address/discuss in more detail in a revised version. The effect is caused by longer radiative pathlengths toward the edge of the scan and resulting saturation effects in some of the channels. In order to mitigate this effect we would have to create a much larger training database and include satellite zenith angle.

5.) p. 8764 line 14-16: This sounds as if it is intended to use the algorithm operationally. I think the results shown in the paper do not yet demonstrate the applicability of the algorithm for operational use, because only 4 cases are shown. It is not clear from the

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paper how many mismatches are given by the algorithm if applied on a global data set (false ash positives far from eruptions). The sensitivity of the algorithm to transported volcanic ash far from source is not a topic of the paper as well. The paper should be considered more as a demonstration of the general applicability of the described methods.

RESPONSE: We fully agree with the reviewer's suggestion and will revise this part accordingly.

6.) Fig. 1-4: Please add to the caption if MODIS/Terra or MODIS/Aqua granules are shown. The term "RGB" should be renamed to something like "ASH-RGB", "DUST-RGB" or just "false-color RGB" to make clear on a first look that this image is a composite of BT and BT in the TIR rather than a visual image (some readers may not know which wavelengths corresponds to the MODIS bands)

RESPONSE: We fully agree with the reviewer's suggestion and will revise this part accordingly.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8753, 2015.

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