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Atmospheric Measurement Techniques Discussions

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

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Review of Gray and Bennartz, AMT 2015

Automatic Volcanic Ash Detection from MODIS Observations using a Back-Propagation Neural Network

1. This paper aims to assess the ability to identify volcanic ash plumes and assess co-incident SO2 concentrations by training a neural net on four thermal IR metrics provided by MODIS. This is a valuable pursuit, given the global nature of MODIS observations and the well-known relationships between volcanic plume properties and the thermal IR bands used. Some additional work assessing more quantitatively the uncertainties

in the MODIS training data, and maybe also the HySplit runs, would add considerable value to this study (see Notes 4 and 5 below).

2. P2, lines 20-23. Just some perspective on this point: Although CO2 concentrations might be reduced due to ocean fertilization, this also depends heavily on the degree to which the iron in the ash is soluble, and on whether iron is the limiting nutrient in the water. This is not likely to be a big effect climatically compared to aqueous carbonate in the ocean, and also, volcanoes can be CO2 sources.

3. P2, lines 26-28. Again for perspective, it is possible that even the much larger number of smaller volcanic eruptions could have a cumulative climate effect by adding sulfate to the stratosphere (e.g., Solomon et al., Science 333, p.866, 2011).

4. P3, line 11. Given the stratosphere-oriented discussion of the previous paragraph, it might be better to say: "...the presence of ash in the troposphere can significantly..."

5. P3, lines 22-23. It might be worth mentioning the estimated uncertainty in the ash concentration derived from HYSPLIT. I'd expect HYSPLIT to produce reasonable indication of ash plume location, but maybe not as good a constraint on ash concentration. Actually, I think you are mainly using ash location from HYSPLIT in this study. Also, more could be reported about the data used to characterize the eruption occurrences for initializing the HYSPLIT runs. (I see now that some qualitative discussion of the uncertainties in the plume characterization applied to HYSPLIT is given toward the end of the Discussion section.)

6. P5, lines 7-8. How good is the HYSPLIT model aerosol concentration over 30 km in the vertical? I guess this bears on the more general question in Point 5 above.

7. P5, lines 28-29. For this technique to be generally useful, the uncertainties in the MODIS-derived volcanic ash discrimination used to train the neural net need to also be assessed. One way might be to compare the results with those from MISR, which has information about aerosol type based on differences in ash vs. sulfate par-

ticle size and shape. Such analysis is presented for a series of Mt. Etna eruptions by Scollo et al. (JGR 117, doi:10.1029/2011JD016625). SO2 discrimination could be validated using the uv detections from the OMI instrument (e.g., Yang et al., JGR 112, doi:10.1029/2007JD008825). MODIS also has an ice-detection channel at 1.38 microns that might be helpful here. There are some MODIS swath-edge issues that might also be relevant when the neural net classification is applied more generally than to the training set.

8. P6, line 18; Figures 1-4. Readers often look at the figures and captions before reading the text in detail. So you might note in the figures or captions the variables actually plotted with the color scales of the right-side images in these figures. Also, it might be helpful to mention in the caption of Figure 1 that there are essentially no ash or SO2 detections in these plots due to high water content.

9. P7, lines 23-27. In Figure 3, the ash detection (upper right panel) seems clearer than the SO2 detection (lower right panel), yet the discussion here seems to suggest the opposite. More generally, I understand that the ash detection might be contaminated with water/ice cloud. Might MODIS cloud masking reduce the ambiguity in these cases?

10. P7, lines 30-32. It is difficult to see the brown color in the RGB image of Figure 4. Also, in line 32, I think you mean “corroborating” rather than “collaborating” here.

11. P9, lines 6-10. For this approach to be used operationally, false-positives as well as false-negatives need to be characterized, and screened if possible. Too many of either error type would limit operational use. This might be worth mentioning.

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