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Comment on amt-2022-173

Anonymous Referee #1

Referee comment on "Volcanic cloud detection using Sentinel-3 satellite data by means of neural networks: the Raikoke 2019 eruption test case" by Ilaria Petracca et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-173-RC1, 2022

This manuscript presents a neural network model in order to detect volcanic ash clouds using Sentinel-3 SLSTR (Sea and Land Surface Temperature Radiometer) daytime products. The neural network is trained with MODIS daytime imagery from the Eyjafjallajökull eruption in May 2010. Then it is applied to the Raikoke eruption in June 2019. The results show that the neural network model can accurately detect volcanic ash from Raikoke compared with RGB visual inspection and BTD (Brightness Temperature Difference) procedure. Moreover, the plumes identified by neural network model agree well with the plume manually identified for the specific SLSTR images.

The manuscript is very well structured and written. It addresses an important issue in detection of the volcanic ash clouds and presents a solution which is beneficial for remote sensing and modeling volcanic ash dispersion. The methods and assumptions are scientifically sound and the results are well elaborated. Thus, I recommend the manuscript for publication after adressing the following points:

1- The authors should use/cite the published data instead of relying on private communication (L92). Specifically, there are several papers in this special issue that present ash and SO2 mass (e.g. Muser et al 2020, ACP). I strongly suggest that the authors review the published papers related to Raikoke and use them in the introduction and discussions.

2- Raikoke and Eyjafjallajökull are both high-latitude volcanoes. How would the model perform on tropical eruptions like la Soufrière 2021? Is the model transferable to tropical conditions or different ash compositions? It will be interesting to see the application to la Soufrière.

3- I would like to see the R^2 and RMSE of the neural networks during training, validation

and test. The topology of the neural network model (large number of neurons in the hidden layer) and split of the training/validation/test might lead to overfitting. Besides, please add info about the training method.

4- There are no discussions on the uncertainty and the limitations of the presented model.

Specific comments:

L32-34: this part is not precise. Ash is a part of tephra with D<2 mm. Then we have fine and very fine ash. Please revise.

L49: you mean $\Delta T_{11\mu m - 12\mu m}$?

L70-72: NNs are good for what they are trained for. Their transferability to other eruption at different altitudes and with different ash composition (optics) might be challenging. Please comment on this.

L159: What is the measure of accuracy? R^2?

L205: for consistency, use "meteorological clouds" in the whole manuscript.

L226: this argument is too strong. See my previous comments.

Tables 4 and 5: It is very difficult to make any quantitative conclusion from these tables. Use other quantitative measures like SAL.