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Automatic detection of volcanic eruptions in Doppler radar observations using a neural network approach

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Immediate detection of volcanic eruptions is essential when trying to mitigate the impact on the health of people living in the vicinity of a volcano or the impact on infrastructure and aviation. Eruption detection is most often done by either visual observation or the analysis of acoustic data. While visual observation is often difficult due to environmental conditions, infrasound data usually provide the onset of an event. Doppler radar data, admittedly not available for a lot of volcanoes, however, provide information on the dynamics of the eruption and the amount of material released. Eruptions can be easily detected in the data by visual analysis and here we present a neural network approach for the automatic detection of eruptions in Doppler radar data. We use data recorded at Colima volcano in Mexico in 2014/2015 and a data set recorded at Turrialba volcano between 2017 and 2019. In a first step we picked eruptions, rain and typical noise in both data sets, which were the used for training two networks (training data set) and testing the performance of the network using a separate test data set. The accuracy for classifying the different type of signals was between 95 and 98% for both data sets, which we consider quite successful. In case of the Turriabla data set eruptions were picked based on observations of OVSICORI data. When classifying the complete data set we have from Turriabla using the trained network, an additional 40 eruptions were found, which were not in the OVSICORI catalogue.

In most cases data from the instruments are transmitted to an observatory by radio, so the amount of data available is an issue. We therefore tested by what amount the data could be reduced to still be able to successfully detect an eruption. We also kept the network as small as possible to ideally run it on a small computer (e.g. a Rasberry Pi architecture) for eruption detection on site, so only the information that an eruption is detected needs to be transmitted.