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Using RNN for automatic detection and classification of volcano seismic signals at Deception Island Volcano

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Seismic monitoring of active volcanoes is a remote sensing technique used to determine seismic sources deep beneath volcanoes. As a result, the wide range of volcanic-seismic signals reflect the complex underlying physics of volcanic processes. Machine Learning and signal processing algorithms have emerged as a reliable approach to identify active volcanic sources. In this research, we propose a new framework for the detection and classification of volcano-seismic signals based on deep learning. Concretely, this work introduces recurrent neural networks (RNN), long short term memory (LSTM) and gated recurrent unit (GRU), to detect and classify continuous streams of volcanoseismic data. A representative dataset from Deception Island Volcano (Antarctica) containing volcano-tectonic earthquakes, long period events, volcanic tremors and hybrid events is used to train these models. Generalization capabilities are tested with data from the recent seismic survey performed at Deception Island Volcano in 2017 by the XXX Spanish Antarctic scientific expedition. Experimental results show that RNN, LSTM and GRU can exploit temporal and frequency information from continuous seismic data, attaining recognition accuracy above 90% of events correctly detected and classified. Further, despite the variations in geophysical properties of the seismic events within the volcano across eruptive periods, results provide good generalization accuracy. This result expands the possibilities of RNNs for real-time monitoring of volcanic activity, despite seismic sources changes over time.
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