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2011-2020: A Decade of global volcanic events observations at the IMS Infrasound network

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INTRODUCTION AND MAIN RESULTS

This work evaluates remote detections of explosive volcanic activity by infrasound monitoring.

Using Global Volcanism Program (GVP) data (2011–2020), 69 eruptions with VEI>3 from 46 volcanoes were analyzed.

Signals from the International Monitoring System (IMS) infrasound network stations within 4,500 km of each volcano were processed with PMCC and cross-bearing methods.

Results show correlations with GVP eruptions and CTBTO bulletins (LEB, SEL3, REB).

DISCLAIMER: This work was supported by FCT, I.P., the Portuguese national funding agency for science, research, and technology, under the Projects UID/00643/2023.

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Introduction

Volcanic eruptions spam from lava flows to violent explosive events able to generate ash clouds traveling hundreds of kilometers, making monitoring essential for risk assessment and aviation safety. The Global Volcanism Program (GVP) includes a worldwide comprehensive list of 1,281 potentially active volcanoes and their eruptions over the last 12,000 years.

In this study (Fig.2), GVP data were correlated with detections from the International Monitoring System (IMS) Infrasound network for 2011–2020, and then compared with CTBTO IDC bulletins: Latest Event Bulletin (LEB), Standard Event Lists (SEL3), and Reviewed Event Bulletin (REB).

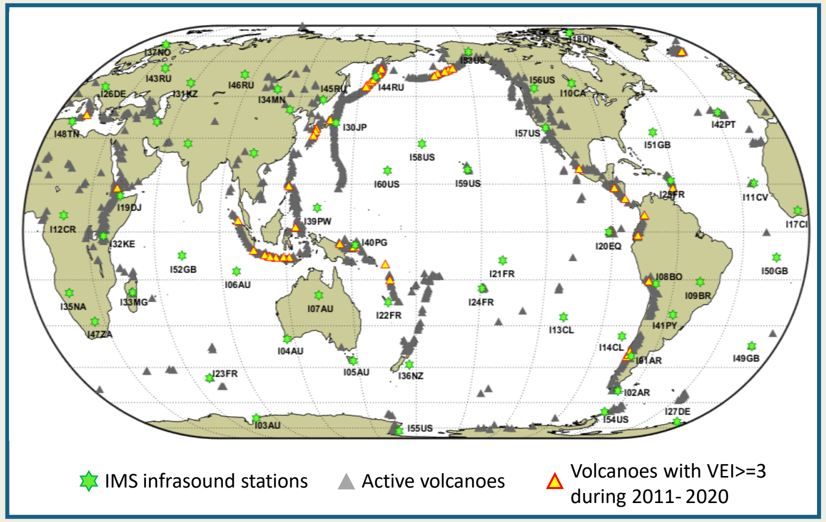

Fig. 1 – Selected volcanoes and IMS infrasound stations.

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Data and methods

A total of 69 confirmed eruptions, with 186 discrete events associated, were selected from 46 volcanoes. Data from 43 IMS infrasound stations located within 4,500 km of the selected volcanoes were processed and analyzed for each specified time-period, using an adapted Progressive Multi-Channel Correlation (PMCC) algorithm (Fig.2). A station-to-source back-azimuth deviations of 5° and 10° was considered, using a cross-bearing azimuth methodology. Atmospheric parameters were retrieved (Fig.3) and used to calculate, e.g., the effective speed of sound ratio ($v_{eff\text{-}ratio}$), and attenuation (Att) (Fig.4).

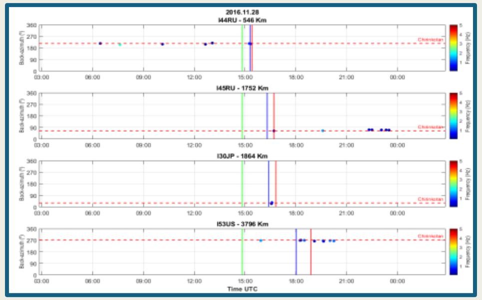

Fig. 2. Example of final processing image.

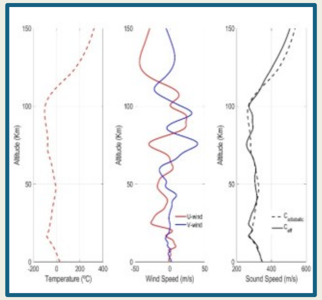

Fig. 3. Atmospheric parameters.

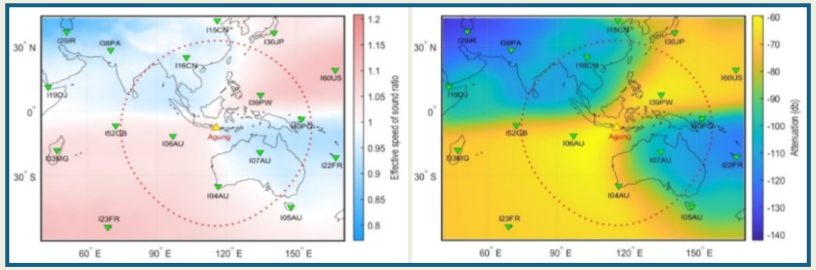

Fig. 4 – Example of $V_{eff\text{-}ratio}$ and attenuation determined for the 2017 November 26th on Agung volcano region.

Results and conclusions

A total of 102 discrete events were identified from 47 eruptions (Fig.5), showing strong temporal agreement with LEB events.

The results confirm the robustness of the detection algorithm and highlight its reliability for global volcanic infrasound monitoring. Its structure allows automation using the nearest IMS infrasound stations for routine monitoring. Moreover, it can be adapted to specific volcanoes or regions by integrating regional propagation conditions through available atmospheric profiles, ensuring effective use in different volcanic contexts.

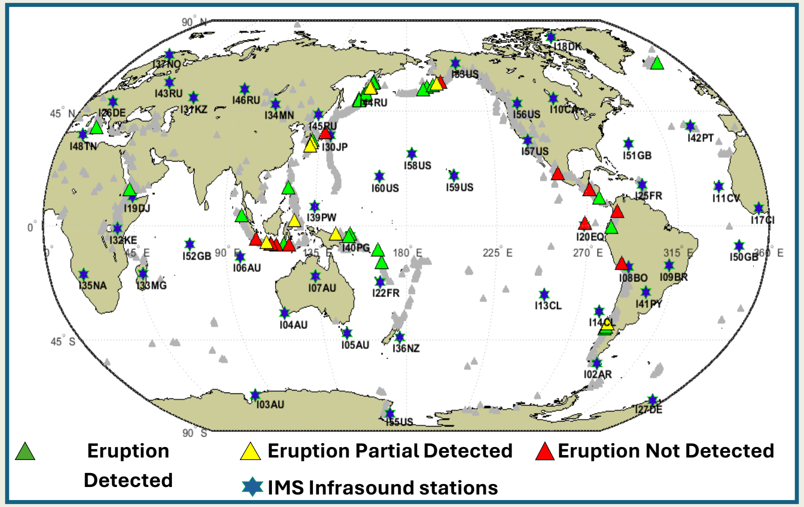

Fig. 5 – Algorithm detection performance for the 46 volcanoes analyzed.

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