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Automated infrasonic Detection and Source Location of Explosive Volcanic Eruptions Using Empirical Climatologies

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Explosive volcanic eruptions produce powerful infrasound that can propagate thousands of kilometers in atmospheric waveguides. The International Monitoring System (IMS) infrasound network has now captured numerous acoustic signals from explosive volcanic eruptions. Remote infrasound has proven useful to locate and characterize subaerial volcanic source parameters (e.g. eruption chronology and timing), but signals are subject to spatiotemporal atmospheric variability and detectability. We developed a methodology that aims to improve rapid automated global source detection, location, and characterization with a first-order approach based on empirical climatologies (HWM14/NRMSIS2.0) and 3-D ray-tracing (infraGA). Using a brute-force computational approach, we tabulate corrections that represent predictions of the atmospheric effects (e.g. azimuth deviation) on the propagation raypaths for volcanic signals to the IMS infrasound stations. We test our methodology on the energetic eruptions of Puyehue-Cordón Caulle 2011 (Chile) and Calbuco 2015 (Chile), as well as the smaller, nearly continuous eruptions of Mount Michael (South Sandwich Islands), and the most active volcanoes of the Vanuatu Archipelago. We obtain source location improvements for individual events and enable improved signal identification of repetitive volcanic infrasound with year-long azimuth deviation predictions. Our methodology could be easily extended for all IMS infrasound stations for near real time monitoring.

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Promotional text

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