Systematic mining and reanalysis of volcano seismo-acoustic waveform datasets

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Seismology and acoustics are complementary methods for understanding how volcanoes work and play an important role in volcano monitoring and hazard mitigation. Volcanic seismicity occurs from mantle depths to the surface, and elucidates magmatic, hydrothermal, and faulting processes occurring within and around volcanoes. Infrasound is produced by shallow subsurface and subaerial processes, including explosive eruptions, shallow degassing, surface flow, and mass wasting. We are developing and applying methods for the systematic reanalysis of waveforms from dense seismo-acoustic networks deployed at volcanoes, including event detection and cataloging, high-precision earthquake relocation, acoustic localization, waveform and spectral event classification, and source mechanism inversions. High rates of volcanic seismicity present formidable challenges, but these computations are now tractable owing to steady advances in computer speed, memory, and disk storage. On larger scales, infrasound from major explosive eruptions can propagate thousands of kilometers in atmospheric waveguides. We are developing methodologies to search systematically through multi-year data from regional (15–250 km) and remote (>250 km) seismo-acoustic networks to identify, quantify, and catalog explosive volcanic eruption signals originating anywhere on Earth.

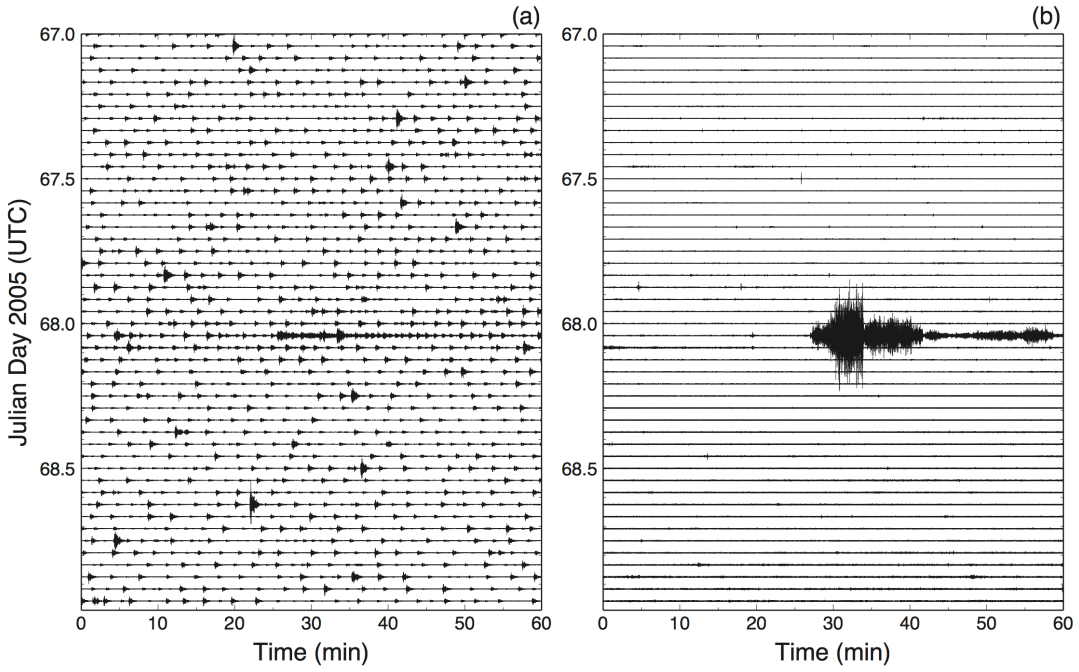

Figure caption
(a) Seismic vertical component velocity and (b) infrasonic pressure recordings of the 8 March 2005 phreatic (steam-driven) explosion of Mount St. Helens, WA. The broadband seismometer was collocated with the central element of a 4-element infrasound array CDWR in a quiet forest site ~13.4 km from the source. In each case, we show data from +/-1 day spanning the event at 9 March 2005 ~01:26:17 UTC (day 68). The seismic tremor accompanying the phreatic explosion has a similar amplitude to seismicity before and after. A large unambiguous infrasound signal delineates the explosive eruption.