



## **Temporal variations of randomness in seismic noise during the 2009 Redoubt volcano eruption, Cook Inlet, Alaska**

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Redoubt volcano is a stratovolcano in the Cook Inlet, south-central Alaska, that has erupted several times in the last fifty years. Its latest eruption in March 2009 was preceded first by volcanic tremor, which was immediately followed by a swarm of low-frequency earthquakes. Due to its proximity to sensitive infrastructure (oil platforms and storage facilities) and the fact that it lies in the way of air traffic routes, Redoubt has been closely monitored by permanent and temporary seismic stations. One of these stations (REF) equipped with a short-period, vertical component sensor was located very near the summit and was continuously recording before, during and after the 2009 eruption. Here we quantify the randomness levels of the continuous seismic signal at REF by calculating Permutation Entropy (PE), which is a nonlinear statistical measure of the amount of randomness in a time series. The time window for this calculation starts 1 January 2009 about two months before the first earthquake swarm, and ends 2 May 2009 when the main explosive activity ceased. The temporal variation of PE during this period shows two significant features: (1) a large decrease about 20 days prior to the onset of the earthquake swarm of 26 February, and (2) smaller decreases that occur shortly (few hours to a day) before phreatic/magmatic explosions. These decreases in PE also coincide with depletion of higher frequencies ( $> 6$  Hz) in the seismic signal, confirming previous findings where reduced randomness in seismic noise may indicate increased absorption losses as hot magmatic fluids reach shallow levels within the volcano edifice.