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A model for Strombolian tremor

E. De Lauro, S. De Martino, **M. Falanga** and M. Palo
Department of Physics, Salerno University, S. Allende street, I-84081, Baronissi (SA), Italy

We study the volcanic tremor time series recorded by broadband three-component seismic network installed at Stromboli volcano in 1997. We prove that Strombolian tremor, in high frequency band ($>$0.1Hz) can be decomposed into independent components, which are similar in time and frequency domain with those obtained for explosion-quakes, with the only difference in the amplitude enhancement. We prove that the low dimensional dynamical system that rules tremor is the same of the explosion-quakes. A first approximate model for tremor field can be induced by simple considerations accounting for the complex processes of magma flow and turbulent degassing, making a parallel with the sound production in the organ pipe instruments. In this scheme, the modulations in time and amplitudes of tremor waveform are attributed both to variation of flux of degassing bubbles and to a not perfectly elastic medium between source and seismometer. The distribution of tremor amplitudes is Gaussian while the inter-times between the maxima in amplitude in a given time and length scale are described by a Poisson clustered process, characterised by a time dependent rate. In this first approach, we assume that the bubble flux is simply Poissonian in time and it takes Gaussian values. Elastic vibrations are, instead, described by an equation which gives limit cycles (different observed "nonlinear modes") ruled by a threshold which represents the bubble flux. The geometrical distribution of scatterers is supposed to be simply Gaussian and it acts like a radiance function modulating the frequency of the limit cycle. The proposed model is able to reproduce both waveforms, spectrum, and phase space dimensions of observed volcanic tremor.

References

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