Stochastic sensitivity analysis of volcanic activity

Dmitri Alexandrov[1], Irina Bashkirtseva[1], and Lev Ryashko[1]

[1]Ural Federal University named after the first President of Russia B N Yeltsin

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Abstract

In the present paper, we study the stochastically-induced behavior of a non-linear volcanic model containing three prognostic variables: the plug velocity u, the pressure under the plug, and the conduit volume V. The nouvelle phenomena of noise-induced transitions from the equilibrium to the cycle in the bistability parametric zone and noise-induced excitement with the generation of spike oscillations in the monostability zone are found in the presence of N-shaped friction force. To study these phenomena numerically, we used the computations of random solutions, the phase trajectories and time series, the statistics of interspike intervals, and the mean square variations. To study these phenomena analytically, we applied the stochastic sensitivity function technique and the confidence domains method. This approach is used to predict the noise-induced transition from a "dormant volcano" state to the "active volcano" mode. From the physical point of view, the volcano is capable to become active under the influence of external noises in the friction force, which model various compositions and properties of volcanic rocks. What is more, the volcanic plug can pop out when it is slipping heavily, and the volcano can erupt.

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