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Nonlinear behavior of the Arctic ice ridges system

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The ice ridges system in the Arctic represents a dynamic process of permanent alterations visible on synthetic aperture radar (SAR) imagery. We assume that the nonlinear system of ice ridges falls into an equilibrium critical state when fracture density ceases to alternate, though new fissures continue to appear in the system. We consider this state from the point of view of self-organized criticality (SOC) theory. In particular, the theory implies three key points, which were consequentially analyzed in the presented study. (i) The new fractures in ice ridges system can be of any length. However, the fractures/leads distribution follows a power law. It is illustrated by data of MODIS satellite imagery (2004, 2005) analysis. (ii) The fracture/leads appearance is not strictly periodic by time and, finally, (iii) The Arctic ice ridges system has a fractal nature.

Following to these study directions, we propose an ice ridges lengths distribution power law and describe a simple topological approach to assess the ice ridges system fractal dimension. The results show that ice ridges probability density function (PDF) might be approximated by power law with significance level of 0.2. The range of ice ridges fractal dimension varying from 1.05 to 1.5 in the Arctic.