

WAITING TIME BETWEEN AVALANCHES

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ABSTRACT: One of the requirements for a self-organized critical system is scale invariance in the time or frequency domain. Sandpile avalanches and other types of avalanches have been analyzed from the perspective of common characteristics of critical systems. However, snow avalanches have not been completely analyzed, particularly in the frequency domain. Snow avalanches constitute a natural hazard and they are of much more practical importance than other types of avalanches so far analyzed.

In this paper, a waiting time analysis of 15,990 slab avalanche events collected in two avalanche areas over 23 years from 110 avalanche paths is given. The objective is to analyze the frequency spectrum for waiting time between avalanches for scale invariance and the presence of $1/f$ noise as suggested for a characteristic of self-organized criticality. The assumptions of the rare events approximation are used: namely that the events and paths are independent, they do not overlap in time and space and the probability of events is small over a suitable time scale. Random Poisson events are assumed with the waiting time being exponential for an individual avalanche path.

The results of the analyses show that a $1/f$ frequency spectrum is unlikely for either avalanche area over any significant range of frequency. Further, scale invariance of waiting time is possible for the entire avalanche areas only over a short time frame of a few hours. However, self-similar clustering of event waiting times is possible for some individual avalanche paths with long mean waiting times between events. Mean waiting times range between about 2 days to 540 days for the individual paths.

In combination, the results suggest that neither the time arrival nor waiting time between avalanche events conform to that of a critical system as defined for self-organized criticality or thermodynamics. If snow avalanches are to conform to a critical system in geophysics then a revision of the requirements or definition is called for.

Key words: snow avalanches, waiting time, critical system, self-organized criticality

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