# Sandpile on a network as a model for geomagnetic activity

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Various studies have pointed out that the Earth's magnetosphere exhibits self-organized critical (SOC) features, such as the power-law behavior of auroral indices and in-situ observations of the magnetic field in the Earth's geotail. [1] Indeed, the dynamics of the magnetosphere has the basic components expected in a SOC model: an external driver (the solar wind), slow accumulation of energy, and energy release in much shorter timescales (geogmagnetic events such as substorms). Sandpile models [2] are a paradigmatic model for SOC behavior, and studies like Ref. [1] have used them to describe magnetopheric dynamics.

Usually, sandpile models consider a grid of cells, and when load on a cell reaches a given threshold, it is redistributed on neighboring cells, until all loads are below the threshold, thus completing an energy release event (avalanche). However, several studies [3,4] have considered the generalized case of sandpiles on a complex network, whose nodes are loaded, and avalanches redistribute the load on their connections. Network topology modifies the SOC features, and thus it is interesting to study this in the context of magnetospheric physics, where magnetic field distortion and reconnection may modify the direction and intensity of energy release events. In this work we study a simple sandpile model as in [5,6] but now on a complex network that reconnects without breaking itself, as a first step for its application to magnetospheric dynamics.

Some of the results obtained from this type of system are shown in Figure 1. These results represent the total energy of the system every 20 reconnections. The probability distribution function shows that the energy not only decreases as the number of reconnections increase, but also peaks at a certain dominant value. Currently, we are considering a similar analysis in the context of magnetic reconnection and solar flares models, using the Lu-Hamilton model [7].

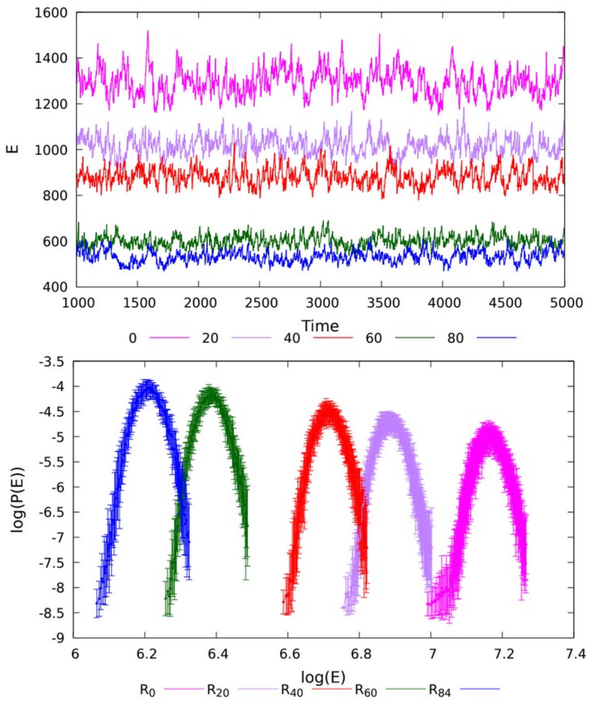


Figure 1: Total system energy per 20 reconnections (top). Probability distribution functions also per 20 reconnections (below).

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