Sandpile on a network as a model for geomagnetic activity

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Abstract: Various studies have pointed out self-organized critical (SOC) features in the Earth's magnetosphere, such as the power-law behavior of auroral indices and in-situ observations of the magnetic field in the Earth's geotail. [1] Magnetospheric dynamics has the basic components of a SOC model: an external driver (the solar wind), slow accumulation of energy, and energy release in short timescales (geomagnetic events such as substorms). Sandpile models [2] are a paradigmatic model for SOC behavior, and have been used to describe magnetospheric dynamics [1]. 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 an energy release event (avalanche) is completed. However, several studies [3] have considered the generalized case of sandpiles on a complex network, whose avalanches redistribute the load on connected nodes. 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 [4,5] but now on a complex network, as a first step for its application to magnetospheric dynamics.

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