

Analysis of critical transitions at the Global Forest

Power laws are ubiquitous in nature [1] and much of them are related to vegetation, like patch patterns in semi-arid regions [2] photosynthetic biofilms [3], savanna forest transitions [4] and tree size structure in tropical forest [5]. Several of these power laws are related to patch sizes which define fragmentation [6]. Fragmentation is a global issue and have multiple impacts on ecosystems from reducing biodiversity to changes on nutrient cycling [7]. The concept of percolation shows that there is a critical threshold where suitable habitat patches are essentially isolated [8]. Here we analyzed forest at a global scale to determine if some regions are close to the fragmentation threshold. Following percolation theory, if a system is near a threshold its patch structure must follow a power-law, beside this is not a proof is a necessary condition. If we are near the fragmentation threshold the biggest patch will have big fluctuations, also characterized by power law tails. And if we are approaching the threshold the fluctuations will increase with time and show negative skewness. We observed that the forest patch structure follows power laws in four major continental biomes: Africa, North America, South America tropical and subtropical, South East Asia; and it follows a log-normal distribution in Eurasia. The same is observed with regard to fluctuations, only Eurasia do not follow a power law. Africa and South America show all the signals of a close fragmentation transition, increasing fluctuations and negative skewness. South East Asia shows a positive skewness and big fluctuations but not significant trend. North America instead have negative skewness and a decreasing fluctuations are near a fragmentation threshold, both last regions seem to be moving away from the threshold. Eurasia have a pattern of increasing fluctuations but the other signals are not present. This is an alarming signal because the two most extensive regions of tropical forest show trends that put in danger it functioning as an ecosystem and its role as attenuators of the global climatic change.

Results

Related papers

- About fitting power laws [9] [10]
- About global maps [7] [11] [12]
- About cluster statistics [13] [14]

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