Title:

Mathematical analysis of a non-local tree-grass interactions model for savanna ecosystems experiencing pulse fire perturbations

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Abstract:

The aim of this talk is to present a spatio-temporal tree-grass interactions model within fire-prone savanna ecosystems. Fires and mean annual rainfall are major factors that regulate woody and grassy biomasses in savanna ecosystems. Savannas display several spatial structures along the climatic gradient and the goal of this paper is to analyze and explain, with a mathematical model, how these spatial structures may occur and behave. In savanna biomes, biotic interactions between plants influence the dynamics of woody and herbaceous communities and therefore the dynamics of the savanna. Although facilitative interactions are relevant in areas with abiotic stress, such as arid and semi-arid ecosystems, competitive interactions also take place in those ecosystems. Competitive and facilitative interactions frequently act simultaneously, usually affecting woody and herbaceous communities at different spatial scales. While facilitation is a local process, competition for limiting resources (mainly water in arid and semi-arid environments, and light availability in tropical regions) can present a longer range of influence. In this paper, we propose a new mathematical framework to model tree-grass interactions that takes into account, the impulsive nature of fire occurrence, size-dependent fire sensitivity (via two classes of woody plants) and spatial mechanisms of tree-grass interactions. Specifically, the proposed model acknowledges local seed production, non-local seed dispersal as well as non-local competition/facilitation that may exist between vegetation components. A qualitative analysis of the model is carried out and numerical simulations are also provided in order to illustrate the theoretical part. The conditions under which contrasted spatial patterns may be stable (e.g. forest vs. savannas) are investigated using both analytical and simulation approaches.