UNIVERSITY
OF TRENTO - Italy
Department of Physics

Prof. Amos Maritan

Department of Physics and Astronomy University of Padova – Italy

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Statistical Physics of Ecosystems

https://www.liphlab.com/

Abstract:

For more than 50 years now, ecologists have collected census data for several ecosystems around the world from diverse communities such as tropical forests, coral reefs, plankton, etc. However, despite the contrasting biological and environmental conditions in these ecological communities, some macroecological patterns can be detected that reflect strikingly similar characteristics in very different communities. This suggests that there are ecological mechanisms that are insensitive to the details of the systems and that are responsible of the emergence of general patterns. These are the right pre-requisites for a playing field where statistical physicists can play and score goals! A classical and standard approach is the one proposed by Lotka[1] and Volterra[2], where the dynamics of interacting ecological species is described by asymmetrical interactions between predator-prey or resource- consumers systems. The Lotka and Volterra equations have provided much theoretical guidance. For instance, MacArthur[3] developed a model for studying interactions among consumers which exploit common resources. However, none of these models are able to explain the empirically and universal observed patterns.
We will present the neutral (stochastic) model of biodiversity[4], [5] and the metabolic theory of biodiversity for forests[6], [7] and how they are able to predict the observed emergent patterns.
Forests cover about 30% of the land surface and they contribute 50% of the terrestrial net primary productivity thus playing a critical role in the dynamics of earth-climate systems.
We demonstrate an astounding simplicity underlying the apparent bewildering complexity of forests.

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Contacts:
Department of Physics
Via Sommarive, 14
38123 Povo, Trento
df.supportstaff@unitn.it

Scientific Coordinator:
prof. Albino Perego