"Nonlinear Dynamics and Complex Networks in the Earth System"

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Topics

Climate Dynamics 1

Modeling the glacial cycles of the Pleistocene

The timing of Pleistocene glaciations from a simple multiple-state climate model

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Climate Dynamics 2

Classic box model of the Atlantic Meridional Overturning Circulation
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Climate Dynamics 3

Model of the Great Oxygenation Event

Bistability of atmospheric oxygen and the Great Oxidation

Colin Goldblatt, Timothy M. Lenton & Andrew J. Watson
Model for a self regulation in the earth system

Biological homeostasis of the global environment:
the parable of Daisyworld


(Manuscript received October 20, 1982; in final form February 14, 1983)

ABSTRACT

The biota have effected profound changes on the environment of the surface of the earth. At the same time, that environment has imposed constraints on the biota, so that life and the environment may be considered as two parts of a coupled system. Unfortunately, the system is too complex and too little known for us to model it adequately. To investigate the properties which this close-coupling might confer on the system, we chose to develop a model of an imaginary planet having a very simple biosphere. It consisted of just two species of daisy of different colours and was first described by Lovelock (1982). The growth rate of the daisies depends on only one environmental variable, temperature, which the daisies in turn modify because they absorb different amounts of radiation. Regardless of the details of the interaction, the effect of the daisies is to stabilize the temperature. The result arises because of the peaked shape of the growth temperature curve and is independent of the mechanisms by which the biota are assumed to modify the temperature. We sketch out the elements of a biological feedback system which might help regulate the temperature of the earth.
Overview on tipping points in ecosystems

Catastrophic shifts in ecosystems

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Conceptual model for interactions between different carbon stocks

The topology of non-linear global carbon dynamics: from tipping points to planetary boundaries

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Socio-Ecology systems 2

Model for the interplay between economic growth and atmospheric carbon concentrations

Emergent dynamics of the climate–economy system in the Anthropocene

By Owen Kellie-Smith* and Peter M. Cox

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Macrosopic description of complex adaptive networks coevolving with dynamic node states

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Model for the collapse of a small, isolated community like the Easter-Islands

The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use

By James A. Brander and M. Scott Taylor *

This paper presents a general equilibrium model of renewable resource and population dynamics related to the Lotka-Volterra predator-prey model, with man as the predator and the resource base as the prey. We apply the model to the rise and fall of Easter Island, showing that plausible parameter values generate a "feast and famine" pattern of cyclical adjustment in population and resource stocks. Near-monotonic adjustment arises for higher values of a resource regeneration parameter, as might apply elsewhere in Polynesia. We also describe other civilizations that might have declined because of population overshooting and endogenous resource degradation. (JEL Q20, N57, J10)
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A more complex treatment of stability

How basin stability complements the linear-stability paradigm

Peter J. Menck\textsuperscript{1,2,*}, Jobst Heitzig\textsuperscript{1}, Norbert Marwan\textsuperscript{1} and Jürgen Kurths\textsuperscript{1,2,3}
Epidemic spreading on an adaptive network

Many real-world networks are characterized by adaptive changes in their topology depending on the state of their nodes. Here we study epidemic dynamics on an adaptive network, where the susceptibles are able to avoid contact with the infected by rewiring their network connections. This gives rise to assortative degree correlation, oscillations, hysteresis, and first order transitions. We propose a low-dimensional model to describe the system and present a full local bifurcation analysis. Our results indicate that the interplay between dynamics and topology can have important consequences for the spreading of infectious diseases and related applications.
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Modeling different scenarios of a zombie apocalypse

Bayesian Analysis of Epidemics - Zombies, Influenza, and other Diseases
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A simple rule for the evolution of cooperation on graphs and social networks

Hisashi Ohtsuki\textsuperscript{1,2}, Christoph Hauert\textsuperscript{2}, Erez Lieberman\textsuperscript{2,3} & Martin A. Nowak\textsuperscript{2}
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Socio-Economic systems 2

Opinion dynamics on a network

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Nonequilibrium phase transition in the coevolution of networks and opinions

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