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Ecosystem Resilience and Predictability

Stephan Alexander Pietsch
(Stephan.Pietsch@boku.ac.at)

The changes in global climate expected over the course of the 21st century are among the major challenges natural ecosystems face today. Due to the unprecedented speed of temperature change and the lack of direct experience from past changes, models are the common tools used to assess the impacts of different scenarios of climate change on the performance of terrestrial ecosystems.
Recent research, however, revealed that inconclusive outputs of terrestrial ecosystem models may occur, and that they resulted from instabilities in model dynamics. Ergodic theory provides numerical measures like (i) Lyapunov exponents, (ii) entropy and (iii) the Hausdorff-, (iv) information- and (v) correlation-dimensions, which give a numerical description of aspects related to system dynamics like the dimensional characteristics of the attractor, the rate of information generation and the temporal and conditional scale of model stability. If the model behaves stable, then predictions will stay within the accuracy and precision range determined by model validation. If the model behaves unstable it may indicate either a reduced predictability or a reduction in the stability of a real world ecosystem!
If a model serves as representation of reality, then unstable model situations should be consistent with instabilities of the real world ecosystem the model intends to mimic. If model instabilities are inconsistent with real world observations, then arbitrary estimates may be more accurate than model predictions. From the applied prospective the separation of the two possibilities is currently one of the main difficulties in forecasting and scenario analysis.
This research presents numerical measures of ecosystem predictability and resilience for the rain forest and savannah biomes of the Congo basin under past, present and possible future climate conditions.