Geophysical Research Abstracts
Vol. 13, EGU2011-6382, 2011
EGU General Assembly 2011

On the detectability of Early Warning Signals in a global atmosphere-vegetation model

Sebastian Bathiany (1), Martin Claussen (1,2), and Klaus Fraedrich (2)

(1) Max Planck Institute for Meteorology, KlimaCampus, Hamburg, Germany, (2) Meteorologisches Institut, Universität Hamburg, KlimaCampus, Hamburg, Germany

The existence of early warning signals (EWS) such as rising variance and autocorrelation as a result of so-called slowing down is a generic feature of bistable systems approaching a tipping point. Previous studies have detected such signals in one-dimensional timeseries from a variety of simple ecological models, laboratory experiments, and reconstructions of past climate changes. In addition, spatial EWS such as rising spatial variance and cross-correlations have been proposed as a method to predict tipping points in high-dimensional systems. However, these studies generally assume that the bistable subsystem is already known and that only neighboring elements are coupled.

In our study we investigate the detectability of early warning signals, as well as the region where a rapid transition will occur. We do so by means of the mid-Holocene Saharan vegetation collapse in the intermediate complexity model PlanetSimulator/VECODE, and a conceptual atmosphere-vegetation model. We find that EWS are not detectable in PlaSim-VECODE at individual grid cells because the large variability results in an early transition, and because orbital forcing changes too quickly. In addition, the high dimensionality of the system reduces the detectability of EWS at individual grid cells. Also, rising variance is not a unique feature of cells in the bistable region. In order to exploit the advantage of spatial EWS, the bistable region could be identified via cross-correlations. However, these cannot be detected with more accuracy than the EWS at individual cells.