Geophysical Research Abstracts, Vol. 9, 02531, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02531

Multiple steady states in the terrestrial atmosphere-biosphere system as a result of a discrete vegetation representation

A. Kleidon (1), K. Fraedrich (2), C. Low (3)

(1) MPI f. Biogeochemistry, Jena, Germany (akleidon@bgc-jena.mpg.de), (2) University of Hamburg, Germany (klaus.fraedrich@zmaw.de), (3) University of Maryland, College Park, USA (charlow@wam.umd.edu)

Multiple steady states in the atmosphere-biosphere system can arise as a consequence of interactions and positive feedbacks. While atmospheric conditions affect vegetation productivity in terms of available light, water, and heat, different levels of vegetation productivity can result in differing energy- and water partitioning at the land surface, thereby leading to different atmospheric conditions. Here we investigate the emergence of multiple steady states in the terrestrial atmosphere-biosphere system and focus on the role of how vegetation is represented in the model: (i) by a few, discrete vegetation classes, or (ii) a continuous representation. We then conduct sensitivity simulations with respect to initial conditions and to the number of discrete vegetation classes in order to investigate the emergence of multiple steady states. We find that multiple steady states occur in our model only if vegetation is represented by a few vegetation classes. With an increased number of classes, the difference between the number of multiple steady states diminishes, and disappears completely when vegetation is represented by 8 classes or more. Despite the convergence of the multiple steady states into a single one, the resulting climate-vegetation state is nevertheless less productive when compared to the emerging state associated with the continuous vegetation parameterization. We conclude from these results that the representation of vegetation in terms of a few, discrete vegetation classes can result (a) in an artificial emergence of multiple steady states and (b) in a underestimation of vegetation productivity. Both of these aspects are important limitations to be considered when global vegetation-atmosphere models are to be applied to topics of global change.