Hydrol. Earth Syst. Sci. Discuss., 3, S957–S958, 2006
www.hydrol-earth-syst-sci-discuss.net/3/S957/2006/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Dynamics of resource production and utilisation in two-component biosphere-human and terrestrial carbon systems" *by* M. R. Raupach

Anonymous Referee #3

Received and published: 20 September 2006

The article considers conceptual models for production-utilisation systems in the framework of nonlinear dynamics. Two- dimensional systems with increasing complexity studied with analytical methods (in particular linear stability analysis) are presented. The paper is well written and introduces the method applied in a way that a reader not familiar with the methodology of nonlinear dynamics is able to understand it. The content of this paper fits perfectly into the scope of HESS and contributes substantially to Earth-system analysis from a conceptual point of view.

The first part is about coupled biosphere-human systems exhibiting multiple equilibria, while the second part focuses on a more specific plant-soil model as an example for a

socalled processor system. This makes the paper a little bit lengthy containing over 10 figures. Furthermore, I have the following specific remarks:

The plant-soil model is driven by Gaussian white noise. Random forcing is also possible for the first type of models (production-utilisation systems). In contrast to the stability analysis no analytical treatment of the randomly forced system is made. The system dynamics can be described by a Fokker-Planck equation. If one of the variables is assumed to be a slow process then the two equations can be reduced to one. This allows to define a potential U=–grad f for the one-dimensional system dx/dt=$f(x)$. The average residence time in the different domains of attraction can be estimated from the potential U. A short discussion should be added to the article.

The author discusses the possible chaos in the randomly forced plant-soil model and compares the system with the Lorenz model. The occurrence of chaos by an external driver is similar to the case of a driven nonlinear pendulum. The pendulum as a twodimensional system exhibits no chaos while periodically driven chaos is induced. In summary I recommend to accept the article after minor revisions.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 2279, 2006.