Geophysical Research Abstracts, Vol. 9, 01758, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01758

Synergy between microscale vegetation-soil water and macroscale vegetation-precipitation feedbacks in semi-arid ecosystems

S.C. Dekker (1), M. Rietkerk (1), M.F.P. Bierkens (2)

(1) Department of Environmental Sciences, Copernicus Institute, Utrecht University, Utrecht, The Netherlands, (2) Department of Physical Geography, Utrecht University, Utrecht, The Netherlands (m.bierkens@geo.uu.nl / Fax: +31 30-2531145 / Phone: +31 30-2532777)

At macroscale, land-atmosphere exchange of energy and water in semi-arid zones such as the Sahel constitutes a strong positive feedback between vegetation density and precipitation. At microscale however, additional positive feedbacks between hydrology and vegetation such as increase of infiltration due to increase of vegetation, have been reported and have a large impact on vegetation distribution and spatial pattern formation. If both macroscale and microscale positive feedbacks are present in the same region, it is reasonable to assume that these feedback mechanisms are connected. In this study we develop and analyse a soil-vegetation-atmosphere model coupling large-scale evapotranspiration-precipitation feedback with a model of microscale vegetation-hydrology feedback to study the integration of these nonlinearities at disparate scales. From our results two important conclusions can be drawn: 1) it is important to account for spatially explicit vegetation dynamics at the microscale in climate models (the strength of the precipitation feedback increased up to 35% by accounting for these microscale dynamics); 2) studies on resilience of ecosystems to climate change should always be cast within a framework of possible large-scale atmospheric feedback mechanism (substantial changes in vegetation resilience resulted from incorporating macroscale precipitation feedback). Analysis of full-coupled modelling shows that both type of feedbacks markedly influence each other and that they should both be accounted for in climate change models.