Abstract Details

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Title: (IWG6) Optimum Root-Shoot Partitioning of Terrestrial Vegetation Determined by Maximization of Biotic Entropy Production

Abstract:
The Maximum Entropy Production (MEP) principle states that diabatic processes with sufficient degrees of freedom maintain a macroscopic steady state at which the production of entropy is maximized, or, in other words, a state of maximum available work. Applied to the large-scale energy uptake of terrestrial vegetation by photosynthesis, MEP translates into a macroscopic state for which the gross primary production is maximized. The underlying assumption of why MEP should apply is that the terrestrial biota is sufficiently diverse, i.e. it exhibits sufficient degrees of freedom reflected in the many different ways in which carbon is allocated and respired. Here we apply MEP to the SIMBA dynamic global vegetation model, which is embedded in the PUMA-2 climate system model of intermediate complexity [1]. SIMBA provides a dynamic, macroscopic description of land surface parameters, which are affected by terrestrial vegetation, such as surface albedo, aerodynamic roughness length, and rooting zone depth. We introduce an additional parameter into the model, which allows for flexibility regarding the partitioning of carbon between aboveground and belowground biomass (root-shoot partitioning), thus affecting light absorption and soil water availability. We then maximize gross carbon uptake with respect to root-shoot partitioning at every grid point of the model. The optimization leads to a very reasonable geographic variation of belowground allocation, showing generally higher values of belowground allocation in arid regions. We discuss the climatic differences of the optimized vegetation state by comparing variables of the energy- and water balance to the simulated climate of the control setup of the model. References [1] F. Lunkeit, K. Fraedrich, H. Jansen, E. Kirk, A. Kleidon, U. Luksch, http://puma.dkrz.de/planet/downloads/plasim-reference-guide.pdf, (2004).

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