Geophysical Research Abstracts, Vol. 8, 05389, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05389
© European Geosciences Union 2006

Did stomatal conductance adapt optimally to past climatic change?

A. Kleidon
University of Maryland, USA (akleidon@umd.edu)

One of the key aspects to understand vegetation behavior in the climate system is that vegetation is able to adapt to changing conditions. Here I use the example of stomatal conductance as one aspect of vegetation functioning. Stomatal conductance of vegetation canopies links the exchange fluxes of energy, water, and carbon at the land surface. Consequently, stomatal conductance and how it adapts to global change plays a critical role in shaping the emerging characteristics of the climate near the land surface and the terrestrial carbon cycle. Reconstructions of stomatal density indicate that the maximum stomatal conductance has changed considerably in the past, likely due to variations in atmospheric concentrations of carbon dioxide. Here I ask the question whether terrestrial vegetation adapted its stomatal conductance optimally, thereby maximizing terrestrial productivity subjected to the prevailing climatic conditions in the past. The predicted trends that follow from the maximization can then be compared to those from reconstructions, and the impacts on climate sensitivity can be quantified. To do so, I use a coupled dynamic vegetation - climate system model of intermediate complexity and perform sensitivity simulations to maximum stomatal conductance at different concentrations of atmospheric carbon dioxide. These simulations demonstrate the existence of an optimum stomatal conductance that shifts to smaller values as the concentration of atmospheric carbon dioxide increases. This trend in optimized stomatal conductance is consistent with reconstructed changes in stomatal density in life and fossil plant leaves. The approach presented here provides an opportunity to use paleoreconstructions not solely as model input or consistency check, but as a way to directly test first principles of biospheric functioning.