Geophysical Research Abstracts
Vol. 13, EGU2011-9699, 2011
EGU General Assembly 2011

Exploring climatic controls on potential agricultural production

Darren Drewry, Axel Kleidon, and Ryan Pavlick
Max Planck Institute for Biogeochemistry, Jena, Germany

It is widely recognized that the growth of human populations, and the associated increases in consumption, will increase demand for ecosystem services and products. With greater demand for agricultural commodities, and a greater fraction of farmed products used for applications such as energy production, an increase in land conversion to agricultural practice can be expected over the next several decades. These trends indicate a need for approaches to estimate potential agricultural production and its geographical distribution. Here we present a generic approach for simulating potential agricultural productivity and apply it to the examination of the influence of climate on the trait combinations that maximize specific agricultural targets.

The Jena Diversity Model (JeDi) provides a basis for examining the impacts of plant traits on survival, productivity and resource use efficiencies. JeDi has been successfully used to demonstrate the ability of a generic plant model to capture observed global patterns in plant species richness through the application of climatic constraints. The core of JeDi is a plant model that incorporates knowledge of vegetation ecophysiological and hydrological functioning. Here we extend the JeDi framework through the use of a numerical optimization procedure that provides a more efficient exploration of the multi-dimensional trait space that defines species. Here we assume that breeding and genetic modification leads to the maximization of certain products (ie. seed and leaf production) and functional characteristics (ie. water use efficiency). We present the results of several optimization experiments designed to determine the geographical patterns of maximal seed production and above-ground biomass, and the plant traits that result in maximal production. Climate forcings for the last several decades are used to analyze climatic controls on optimal plant trait combinations and the resultant patterns of optimal agricultural productivity across the globe. These findings have implications for ecosystem conservation and societal adaptation to and mitigation of future changes in climate by guiding practices that increase harvest and food security.