Geophysical Research Abstracts
Vol. 16, EGU2014-2783, 2014
EGU General Assembly 2014

The Importance of Considering the Temporal Distribution of Climate Variables for Ecological-Economic Modeling to Calculate the Consequences of Climate Change for Agriculture

Sabrina Plegnière, Markus Casper, Benjamin Hecker, and Georg Müller-Fürstenberger
Germany (pleg@uni-trier.de)

The basis of many models to calculate and assess climate change and its consequences are annual means of temperature and precipitation. This method leads to many uncertainties especially at the regional or local level: the results are not realistic or too coarse. Particularly in agriculture, single events and the distribution of precipitation and temperature during the growing season have enormous influences on plant growth. Therefore, the temporal distribution of climate variables should not be ignored. To reach this goal, a high-resolution ecological-economic model was developed which combines a complex plant growth model (STICS) and an economic model. In this context, input data of the plant growth model are daily climate values for a specific climate station calculated by the statistical climate model (WETTREG). The economic model is deduced from the results of the plant growth model STICS. The chosen plant is corn because corn is often cultivated and used in many different ways. First of all, a sensitivity analysis showed that the plant growth model STICS is suitable to calculate the influences of different cultivation methods and climate on plant growth or yield as well as on soil fertility, e.g. by nitrate leaching, in a realistic way. Additional simulations helped to assess a production function that is the key element of the economic model. Thereby the problems when using mean values of temperature and precipitation in order to compute a production function by linear regression are pointed out. Several examples show why a linear regression to assess a production function based on mean climate values or smoothed natural distribution leads to imperfect results and why it is not possible to deduce a unique climate factor in the production function. One solution for this problem is the additional consideration of stress indices that show the impairment of plants by water or nitrate shortage. Thus, the resulting model takes into account not only the ecological factors (e.g. the plant growth) or the economical factors as a simple monetary calculation, but also their mutual influences. Finally, the ecological-economic model enables us to make a risk assessment or evaluate adaptation strategies.