Master Thesis

Modelling Land Use Change in the Catchment Area of the São Francisco River in Brazil

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Abstract

Due to climate change agricultural production will become more and more difficult in north-eastern Brazil. Knowledge about agricultural land use and its interaction with other sectors like water, biodiversity or emissions in the catchment area of the Rio São Francisco in Brazil (RSF) is a valuable prerequisite to meet the future challenges.

The aim of this study is to disaggregate the global land use model MAgPIE and simulate land use patterns in RSF. The purpose is to determine whether a global land use model is able to reliably simulate data about regional land use patterns. To this end, MAgPIE, which is soft-coupled with a global vegetation model (LPJmL), was disaggregated to simulate high resolution data for RSF. After the technical implementation, the simulation results from MAgPIE were validated with agricultural production data from the Instituto Nacional de Pesquisas Espaciais (IBGE 2012) and a land use dataset with measured data for the year 1995 from Portmann et al. (2010). After the validation process, this study tries to make suggestions about which parameters need to be calibrated.

The simulation results are compared with data about the three crops with the highest production rate in RSF in the years 1995 and 2005: soybean, maize and sugarcane. Results from the validation for RSF show that the production quantity for soybean and sugarcane are underestimated whereas the quantity for maize is overestimated. The production quantity of soybean is underestimated by 0.9 million t in 1995 (57.5%) and by 3.9 million t in 2005 (84.3%). Sugarcane is also underestimated: by 1.9 million t (whole plant) in 1995 (14.1%) and by 7.4 million t in 2005 (40.7%). The production quantity of maize is overestimated by about 1.6 million t both in 1995 (58%) and 2005 (37.6%). The results about the goodness-of-fit (Willmott coefficient) from the comparison between the simulated data with the measured data from Portmann et al. (2010) are 0.64 for maize, 0.24 for soybean and 0.44 for sugarcane.

To augment the goodness-of-fit, MAgPIE was calibrated by reducing the rotational constraints for cereals and by adjusting the potential yields of the input data from LPJmL. The results from model runs with these adjustments did not improve the goodness-of-fit as expected and highlighted the need about further calibration.