Geophysical Research Abstracts,
Vol. 11, EGU2009-8147, 2009
EGU General Assembly 2009

Carbon dioxide and water fluxes in grasslands of Inner Mongolia (China)

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Grasslands are one of the dominating vegetation types in the world. In China grasslands capture 400 Mha. This huge area has great influence on water and carbon stocks and fluxes. Water and carbon exchange influence the local concentration of greenhouse gases. In the steppe of Inner Mongolia there are problems of overgrazing, erosion and ongoing desertification. Through these processes the seasonal patterns of the water and carbon cycles are changed. Within the project MAGIM (Matter fluxes in grasslands of Inner Mongolia as influenced by stocking rate), which is a multidisciplinary project bringing together German and Chinese expertise, matter fluxes were measured with eddy covariance method. In this study the results of MAGIM concerning the carbon dioxide and water fluxes were presented.

The study site is in the Xilin River catchment in the Northeast of Inner Mongolia Autonomous Region, China. The region is a continental temperate semiarid zone with cold dry winters and warm humid summers. The annual mean temperature is about 2 °C and the annual precipitation is 350 mm. The EC-measurements include measurements at different steppe types (Leymus chinensis, Stipa grandis) and various land use (overgrazed, winter grazed, continuously crazed, ungrazed since 1979) by one permanent and by two roving towers. From 2002 to 2004 there were continuous measurements at the ungrazed site (Leymus chinensis). The roving tower was used in the vegetation period at the other sites. From 2005 a third tower was available to measure at the overgrazed site continuously.

The results show large differences in the carbon dioxide fluxes of the various land use. In general the carbon dioxide fluxes are small in Inner Mongolia. At the ungrazed site the results show negative net carbon exchange (CO2 sink). The positive net carbon exchange at overgrazed site indicates a CO2 source. The partially grazed sites switch between CO2 sink and source dependent on the environmental conditions. Lower precipitation than the mean annual sum results in reduced carbon dioxide fluxes. So, the precipitation is the major driver controlling the atmospheric fluxes besides the temperature. The seasonal pattern of the precipitation is important for the carbon dioxide as well as for the water budget. In contrast to the carbon dioxide fluxes there is less variability of the water fluxes of various grazing intensities. At all sites evapotranspiration was calculated about 80% of precipitation. The study shows clearly the sensitivity of the carbon dioxide flux and the evapotranspiration on the main drivers during the vegetation period. During drought and heat the CO2 sink is reduced or switched to positive values and CO2 source is increased, respectively. It is assumed that the steppe in Inner Mongolia will be a CO2 source in a changed climate characterised by increased temperatures and lower precipitation. Results from the on-going MAGIM measurements will be used to model carbon dioxide and water fluxes of grasslands in Central Asia by a combination of remote sensing and well parameterised models. This upcoming work is funded by the BMBF-project IWAS (International Water Alliance Saxony).