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Carbon fluxes of Kobresia pygmaea pastures on the Tibetan Plateau

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With an approximate cover of 450,000 km^2 on the Tibetan Plateau (TP), the Cyperaceae Kobresia pygmaea forms he world's largest alpine ecosystem. This species, especially adapted to grazing pressure, grows to a height of only 2-6 cm and can be found in an altitudinal range of 4000 to 5960 m a.s.l. A special characteristic of this ecosystem is the stable turf layer, which is built up from roots and plays a significant role in protecting soil from erosion. This is of great importance since soils on the TP store 2.5 % of the global soil organic carbon stocks.

The aim of the investigation was the study of the carbon storage and the impact of human-induced land use change on these Kobresia pygmaea pastures. We therefore applied eddy-covariance measurements and modelling as a long-term control of the fluxes between the atmosphere and the pastures and 13C labelling for the investigation of flux partitioning, and chamber measurements to investigate the degradation of the pastures.

Combining CO_2 budgets observed in 2010 with eddy-covariance measurements and relative partitioning of carbon fluxes estimated with 13C labelling enabled us to characterise the C turnover for the vegetation period with absolute fluxes within the plant-soil-atmosphere continuum. These results revealed that this ecosystem indeed stores a great amount of C in below-ground pools, especially in the root turf layer. To further investigate the importance of the root layer, the experiments in 2012 focused on flux measurements over the different surface types which make up the heterogeneity of the Kobresia pygmaea pastures and might result from degradation due to extensive grazing. The three surface types investigated with a LiCOR long-term monitoring chamber system include Kobresia pygmaea with intact turf layer (IRM), a surface type where the turf layer is still present but the vegetation is sparse and mainly consists of Cryptogam crusts (DRM) and finally areas without the turf layer (BS). According to the vegetation cover, net ecosystem exchange and respiration decreased from IRM over DRM to BS while ratio respiration/assimilation increased. Since measurements were conducted in succession and not parallel, a direct comparison would need further investigation.

On the basis of the eddy-covariance data set measured in 2010, two models were applied and tested for Kobresia pastures: one for sensible and latent heat flux and one for carbon dioxide flux. Therefore continuously modelled fluxes were available for the chamber experiment in 2012. Significant differences were found in the carbon uptake, with the highest values on IRM and the lowest on BS.

Conclusion: Kobresia pastures are an ecological system characterized by limited grazing by yaks (nomads). No grazing: other species will dominate; over-grazing: degradation. The preservation of Kobresia pastures is an ecological and political problem!