# Carbon fluxes of *Kobresia pygmaea* pastures on the Tibetan Plateau

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With an approximate cover of 450.000 km² on the Tibetan Plateau (TP) the Cyperaceae *Kobresia pygmaea* inherit the world's largest alpine ecosystem [1, 2]. This species, especially adapted to grazing pressure, is growing only 2-6 cm tall and can be found in an altitudinal range from 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 [2]. This is from great importance since soils on the TP store 2.5 % of the global soil organic carbon (SOC) stocks [1].

To investigate the impact of human induced land use change on these *Kobresia pygmaea* pastures grazing exclosure sites have been installed in different altitudes on the Plateau [3]. The experiments observe changing plant communities and fodder quality, soil carbon stocks and turnover as well as the energy and matter exchange between the lower atmosphere and the ecosystem for different grazing intensities and surface types which are found within these pastures.

A grazing exclosure experiment on sites in Qinghai, established in 2002 between 3300-3600 m a.s.l, showed 2009 great differences in vegetation composition on grazed and non grazed plots. This change had a great effect on fodder quality as well as soil carbon stocks and turnover, which were investigated by soil analysis and $^{13}C$ pulse labelling. These findings suggest that an exclusion of grazing livestock might lead to reduced carbon storage within soils and therefore is not the appropriate choice for management of *Kobresia* meadows [4, 5]. Based on these results multidisciplinary experiments were conducted near Naqu in 2010 and 2012, within the centre of the major distribution of *Kobresia pygmaea* in 4400 m a.s.l with fences established in 2009.

Combining $CO_2$ budgets observed in 2010 with Eddy-Covariance measurements and relative partitioning of Carbon fluxes estimated with $^{13}C$ 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 different surface types, which make up the heterogeneity of the *Kobresia pygmaea* pastures and might result from degradation due to extensive grazing. The three with a LiCOR long-term monitoring chamber system investigated surface types 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 increases. Since measurements were conducted in succession and not parallel a direct comparison is not yet possible. Nevertheless differences were linked to driving atmospheric conditions but for further investigation a modelled reference is needed. Consequently the derived knowledge about the energy and carbon fluxes will be used to setup and validate land surface models which can resolve the special characteristics of this *Kobresia pygmaea* ecosystem.

[1] G. Wang et al., 2002, The Science of the Total Environment, 291, pp. 102-217
[2] G. Miehe et al., 2008, Ambio, 37, pp. 272-279
[3] G. Miehe et al., 2008, Erdkunde, 63, pp. 187-199

[4] S. Unteregelsbacher et al., 2012, Biogeochemistry, 111, pp. 187-201
[5] S. Hafner et al., 2012, Global Change Biology, 18, pp 528-538
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Key words (for online publication): *Kobresia pygmaea,* Carbon fluxes, Eddy Covariance, human induced land use change