UNIVERSITY OF BAYREUTH

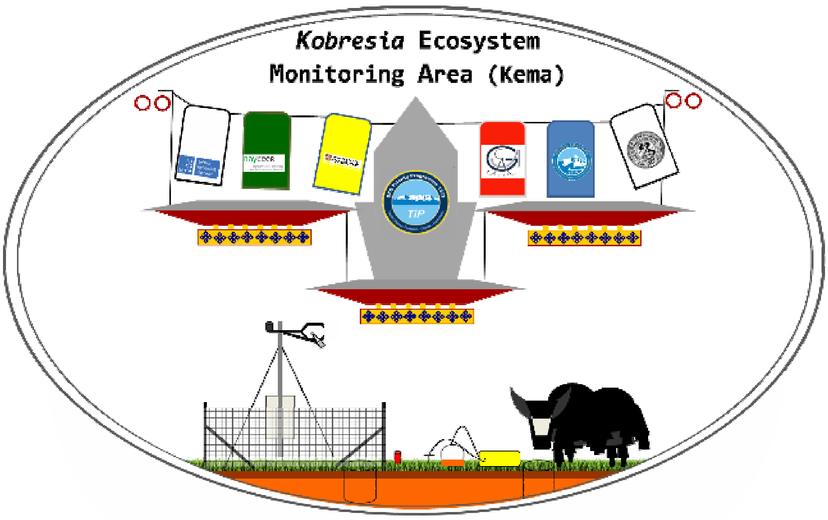
Department of Micrometeorology

Tibet **P**lateau **A**tmosphere-**E**cology-**G**laciology Cluster

Joint *Kobresia* Ecosystem Experiment:

Documentation of the first Intensive Observation Period

Summer 2010 in Kema, Tibet



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1 Introduction

From May till September 2010 the TiP Atmosphere-Ecology-Glaciology (AEG) cluster conducted an interdisciplinary experiment in Kema on the Tibetan Plateau. The work was carried out in the framework of the DFG Program SPP 1372 (TiP) (1.1) and the EU Program CEOP-AEGIS (1.2), with collaborating scientists from the Departments of Micrometeorology and AgroEcoSystem Research at the University of Bayreuth, from University of Marburg and Göttingen, the Institute of Soil Science University of Hannover, Senckenberg Museum of Natural History Görlitz and the University of Cambridge UK. The partners in China were the Institute of Tibetan Plateau Research (ITP) form the Chinese Academy of Science (CAS), Cold and Aried Regions Research Institute (CAREERI), the Lhasa University and the Beijing Normal University, which helped with logistical support.

The research area is located in the center of the major distribution of *Kobresia pygmaea*. The purpose of the experiment is to investigate the energy and matter exchange between soil, plants and atmosphere as well as plant distribution and growth at different land use types on the Tibetan Plateau. It was designed to quantify the effect of increased grazing on the plateau, which is a basic requirement to understand Asian monsoon variability, effects of climate change and the role of the ecosystem under these conditions. During the experiment surface fluxes of grazed and ungrazed *Kobresia* mats, in particular CO_2 and water in soil and plants and the exchange with the lower atmosphere was measured. For this grazing experiment an area of 100m by 250m was fenced in 2009 to exclude yaks and other livestock, additionally some fences excluding also small mammals were set up in order to quantify the different contribution to the overall grazing effect. On degraded slopes fences were set up to monitor the recovery of the ecosystem when grazing is excluded. Furthermore grazing exclosure plots were set up in the swamps, close to the river. This vegetation type is used as winter pasture and therefore it is of high importance for the local land use. Due to the minor impact of pikas on this vegetation type the setup only contains livestock exclosures and control plots. A second grazing exclosure area was fenced in

2010 for further experiments, since the above mentioned area is quite dry and only reduced grazing took place during the summer 2010. An overview of the complete setup is given in Figure 2-4. Only with observations of all three most common vegetation types the whole grazing system can be examined and suggestions for a more effective land use can be worked out. Within the meteorological part of the project the focus lies on CO_2 and H_2O fluxes and their upscaling to the grid scale of limited area models by footprint modeling. The acquired data will be used to evaluate the output of the mesoscale ATHAM model, which is used to model atmospheric flow, clouds, precipitation and radiation of the area. The eddy-covariance measurements will also be used for ecological studies within TiP, to compare to chamber based soil respiration measurements and a ^{13}C labeling experiment as well as measurements concerning the water balance within the soil-plant compartment. In the CEOP-AEGIS Project the data of radiation, turbulent fluxes and soil moisture, together with further stations operated by the CAS, will be used to improve data quality and footprint analysis for up-scaling on satellite grid elements. Another objective was to investigate, if changes in Monsoon intensity effect evaporation and vegetation. The project is well connected with a glacier project (DynRG) within TiP which is conducting measurements on the glaciers in the Nyainqentanglha range, at Nam Co.

1.1 DFG SPP 1372 Tibet Plateau: Formation-Climate-Ecosystems

The German Science Foundation (DFG) priority program 1372 Tibet Plateau: Formation-Climate-Ecosystems (TiP) studies the Tibetan Plateau focusing on the three interlinked processes, plateau formation, climate evolution and human impact and Global Change. This study is motivated by the importance of the Tibetan Plateau on a global scale comparable to the importance of Antarctica and the Arctic. Its formation had a profound impact on the environmental evolution at regional and global scales and until today directly influences the habitat of billions of people. Moreover, the Tibetan Plateau, like the polar regions, proves to be particularly sensitive to anthropogenic Global Change. The different interactions and research areas of different subprojects are displayed in Figure 1-1. Within the project the key processes are analyzed with respect to their impact on ecosystems on three different time scales. The first being the Plateau formation, with the uplift dynamics and related climate change during the last millions to several tens of millions of years, he second being the Late Cenozoic climate evolution and environmental response during the last tens of thousands to hundreds of thousands of years with decadal to centennial resolution. And finally the phase of human impact and Global Change is analyzed focusing on the present stage, the past ~ 8000 years, and perspectives for the future, Figure 1-2. Further Information: http://www.tip.uni-tuebingen.de/

1.2 CEOP AEGIS

"Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon systEm with Ground satellite Image data and numerical Simulations" (CEOP-AEGIS) is a collaborative research project with a medium-scale focus and financed by the European Commission under FP7 topic ENV.2007.4.1.4.2 "Improving observing systems for water resource management", and is coordinated by the Université Louis Pasteur, Strasbourg, France. It is motivated to support water resources management in South-East Asia. Currently only sparse observations are available lacking accuracy, spatial density and temporal frequency. Therefore an integrated use of satellite and ground observations is necessary to assist water resources management and to clarify the interactions between the land surface and the atmosphere over the Tibetan Plateau in the Asian monsoon system. CEOP-AEGIS aims at two goals, the first one being the construction of an observing system to monitor the plateau's water yield by a combination of ground measurements and satellite based observations and secondly the monitoring of climate relevant parameters as snow cover, vegetation cover, surface wetness and surface fluxes in order to analyze land-atmosphere interactions influencing the Asian Monsoon System. The duration of this project is 48 months and it builds upon 10 years of experimental and modeling research on the Tibetan Plateau carried out by a consortium of 17 partners from 8 countries. On the long-term the observing system, once established, is very likely to remain in operation beyond project completion. The time-series of hydrological satellite data products will be the basis for an early warning system on droughts and on floods each. Further Information: http://www.ceop-aegis.org/

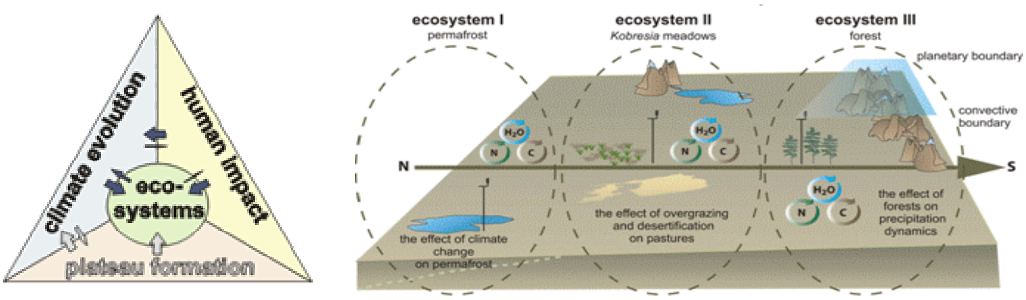

Figure 1-1: Scheme of the different research areas covered in the TiP Project.

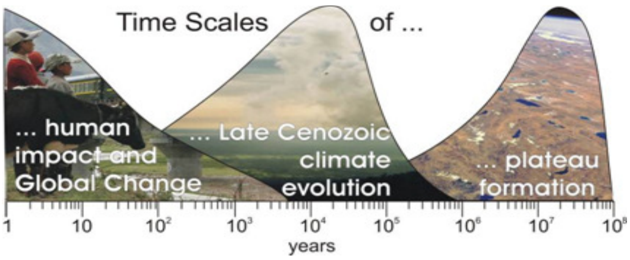

Figure 1-2: Time scales on which the importance of processes is analyzed within the TiP Project.

2 *Kobresia* Ecosystem Monitoring Area (KEMA)

Elke Seeber [1], Tobias Biermann [2], Thomas Leipold [2], Wolfgang Babel [2], Lena Becker [3]

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2.1 Location and permanent setup

The measurement sites are located near to the small village Kema, which is about 40 km in the SE of Nagchu City and 270 km NE of Lhasa. The sites are located at an altitude of about 4410 m a.s.l. (Figure 2-1 and Figure 2-2). The research area Kema was selected since it lays in the center of the main distribution of *Kobresia pygmaea* ecosystems, which is the dominant vegetation type on the Tibetan Plateau (Figure 2-3, Miehe et al. 2008). The main field site is located on a gentle slope, tilted NNW. On this site an area of 100m by 250m is fenced to exclude the grazing by livestock, mainly Yak but also sheep and goat. Additionally four 15 by 15 meter fences excluding small mammals, mainly the Plateau Pika (*Ochotona curzoniae*), are set up inside and outside of the big exclosure in order to quantify the impact of different herbivores to the overall grazing effect. The whole ungrazed area is fenced with a one and a half meter high netting wire. At the grazed site a smaller area is fenced just around the eddy-covariance station to protect it of the grazing yaks. Additionally fences were set up on degraded slopes to monitor the recovery of the ecosystem when grazing is excluded. Furthermore grazing exclosure plots were set up in the swamps, close to the river. Due to the minor impact of pika on this vegetation type the setup only contains livestock exclosures and control plots. This work was conducted in 2009 by Georg Miehe, University of Marburg and Elke Seeber, University of Göttingen. A second grazing exclosure area was fenced during the IOP1 in 2010 for further experiments, since the above mentioned area is quite dry and only reduced grazing took place during the summer 2010. An overview of the complete setup is given in Figure 2-4. The nomenclature of the plots and setup is the following, vegetation monitoring plots (VMP) are labeled according to the treatment; C = control, P = no pikas, Y = no livestock, YP = no herbivores, replicates are numbered from 1-4 starting from the plots in the SW corner and ending in the NW corner. The big exclosure from 2009 is labeled Km. The two overall treatments with no herbivores are referred to as KemaU for inside the big exclosure and KemaG for outside the exclosure, this nomenclature is also valid for the meteorological setup. The nomenclature of chamber, lysimeter and ^{13}C sampling points are equal to the VMP. The degraded plots are called St, and the plots in the wetlands S.

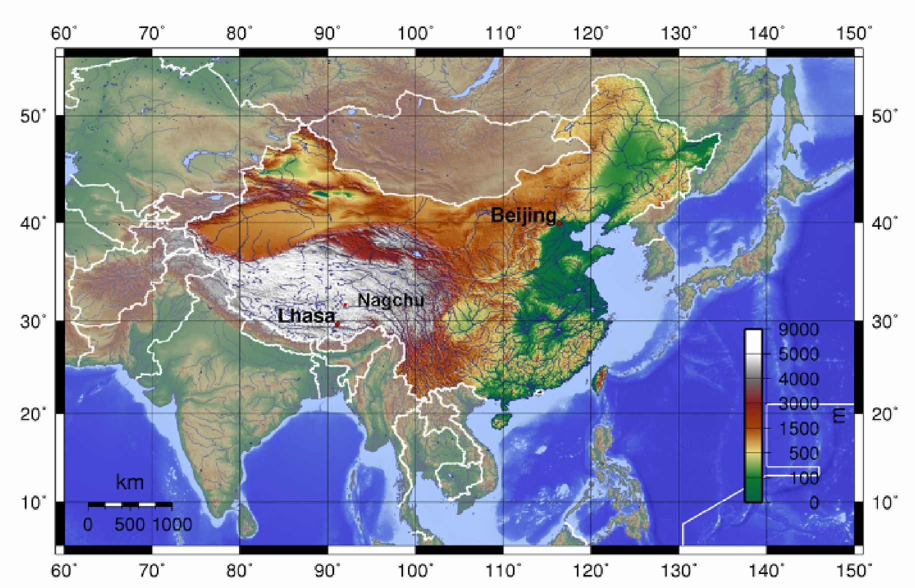

Figure 2-1: Map of the Autonomous Region Tibet and the PR China. The red square marking Nagchu, the city near the Kema Station.

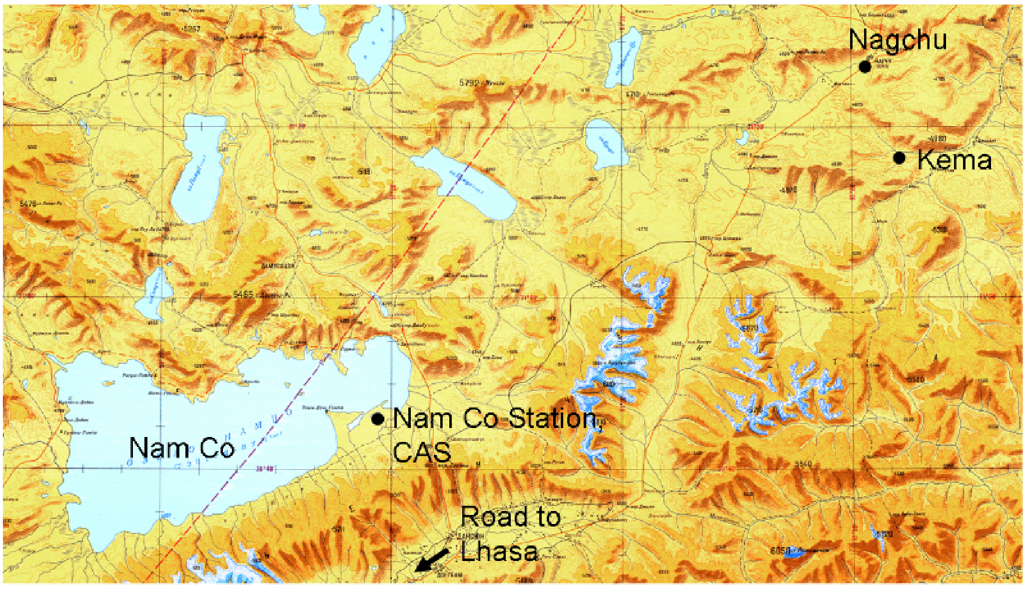

Figure 2-2: Location of the Kema experimental site inside Tibet (http://en.poehali.org/maps).

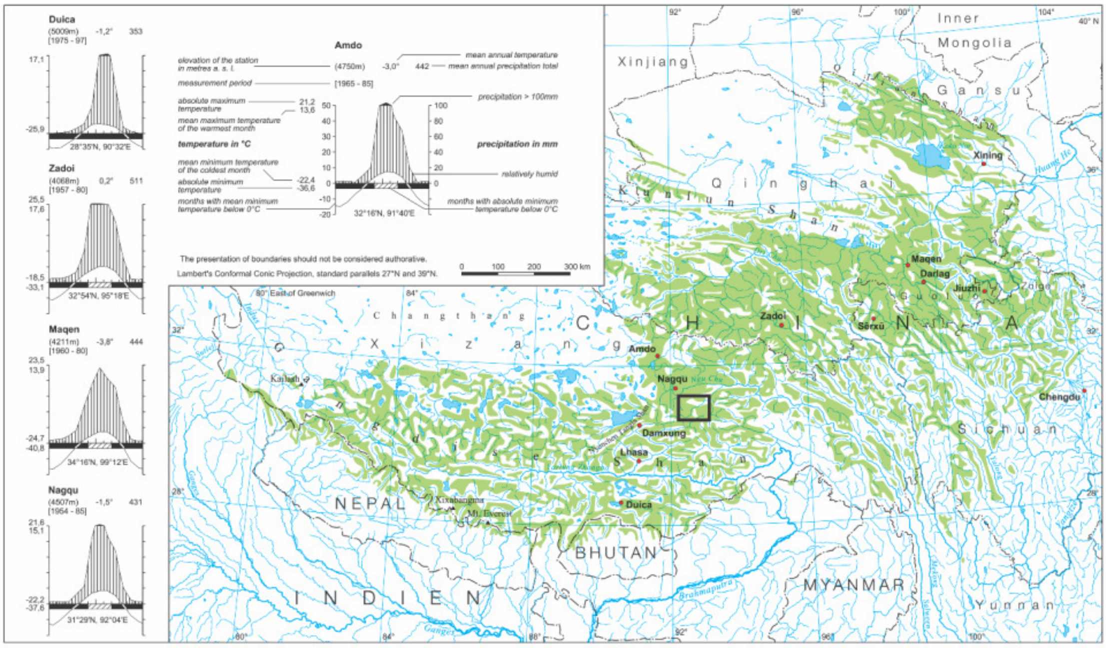

Figure 2-3: Distribution of Kobresia on the Tibetan Plateau. The research area Kema marked with the square (Miehe et al. 2008).

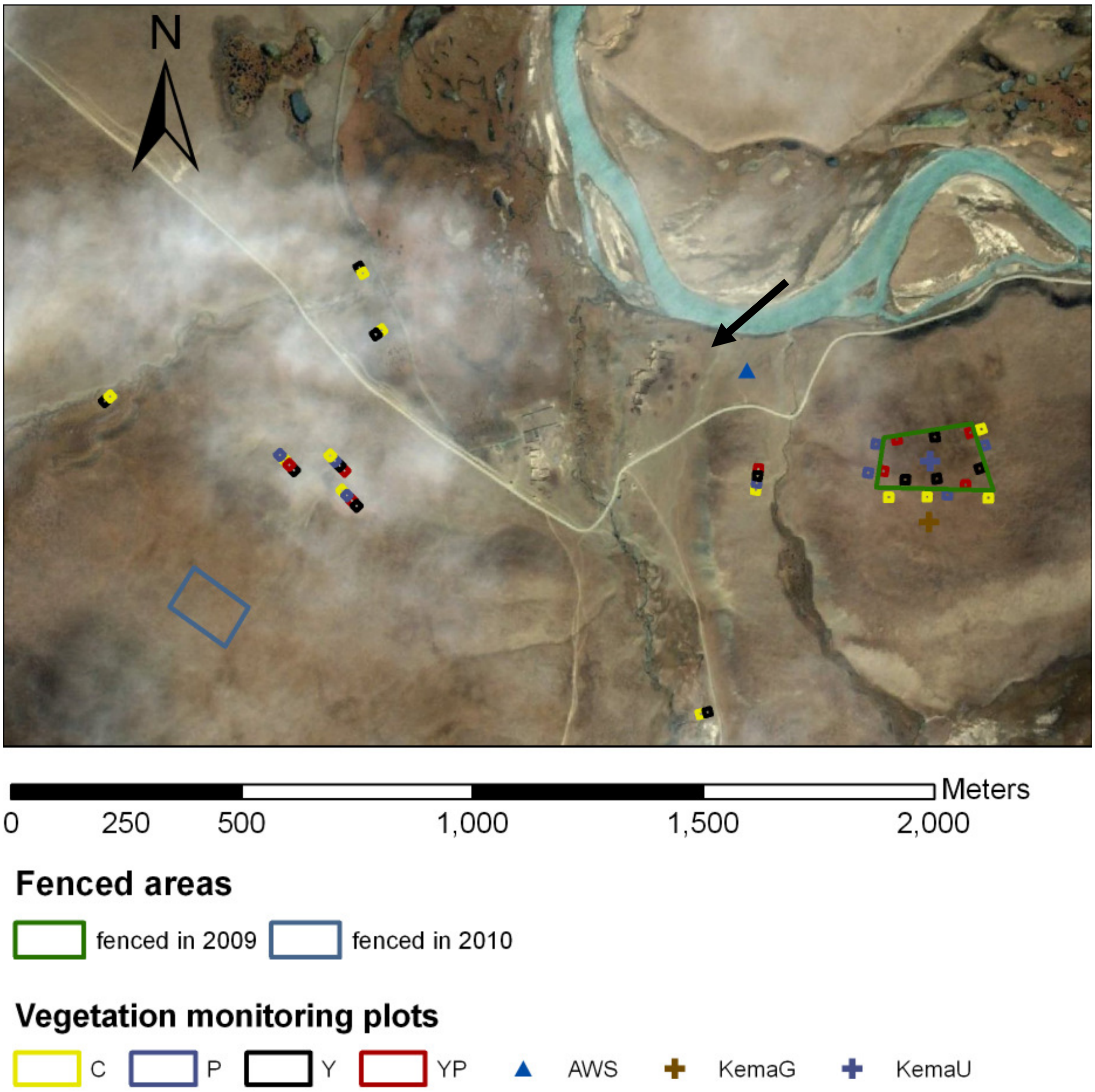

Figure 2-4: Setup of the permanent vegetation monitoring plots (VMP), the fenced area for flux measurements and the 2010 positions of the Automatic Weather Station (AWS) and the EC Stations KemaG and KemaU. The VMP are labeled according to the treatment; C = control, P = no pikas, Y = no livestock, YP = no herbivores. The position of the research station is indicated by an arrow (The background image is taken from Google Earth in Dec. 2010).

2.2 Setup during IOP1

During the observation period in summer 2010 two eddy covariance (EC) stations, a soil chamber and also ^{13}C labeling was used to quantify CO_2 fluxes. The EC systems were also used to investigate the latent- and sensible heat flux, additionally the radiation and ground heat flux was recorded to estimate the energy balance. The evapotranspiration was estimated with lysimeters and the EC systems. A weather station was used to record basic meteorological parameters. The soil chambers were operated by the University of Hannover and the lysimeter by the University of Göttingen. The ^{13}C labeling experiment was carried out by AgroEcoSystem Research of the University of Bayreuth. The turbulent fluxes and meteorological parameters were measured by the Department of Micrometeorology University of Bayreuth. Additional lysimeter to monitor dew fall were set up by the University of Cambridge. The plant monitoring was carried out by the University Göttingen and Marburg and the Senckenberg Museum of Natural History Görlitz. An Overview of all conducted measurements can be found in Table 2-1. In Figure 2-5 an overview of the measurement periods and sampling days is given. Lines stand for continuous measurements, and in case of the irrigation experiment for the duration of the water application. The points mark the sampling dates of non continuous measurements. Figure 2-6 shows the position of the used instruments and sampling points.

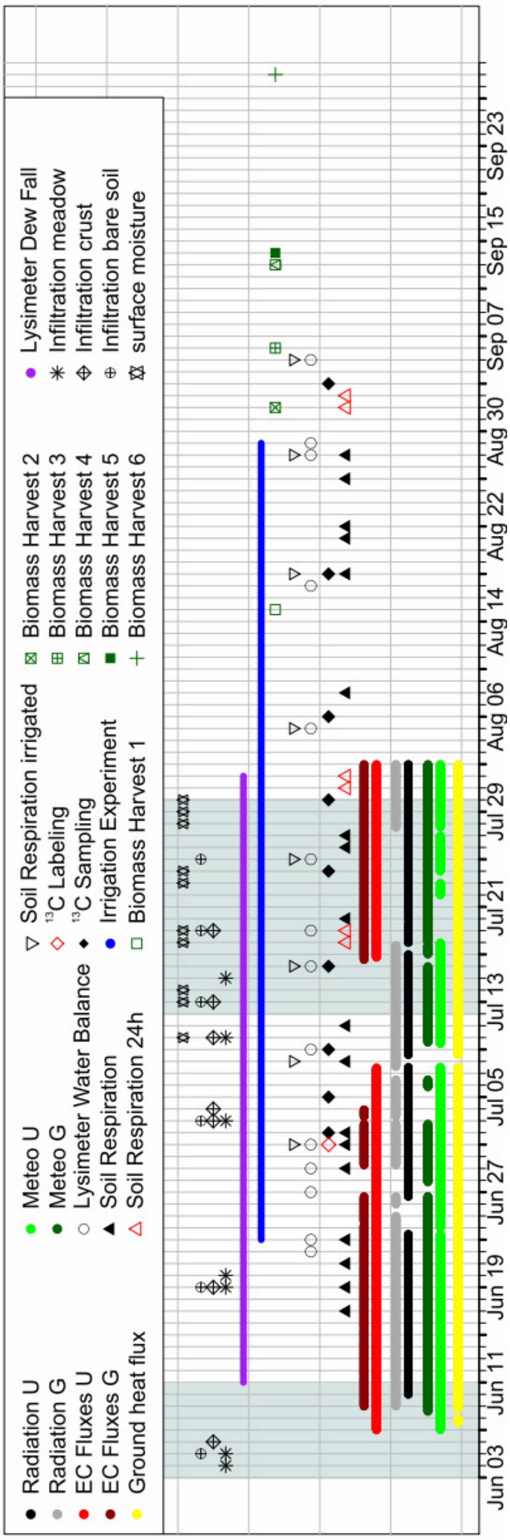

Figure 2-5: Measurement days and periods of the different parameters measured during the 2010 field campaign in Kema. More detailed information on sampling periods, data availability and quality is given in the specific sections of the experiments. The grey areas mark dryer periods, more information can be found in chapter 4.2.

Table 2-1: Overview of the conducted Measurements and contributing groups.

	Meteorology	Soil	Hydrology	Ecology
Dept. of Micrometeorology, University of Bayreuth	2x Eddy Covariance Measurements, 2x Radiation, 1 AWS, 1x Rain	3x Soil Temperature profiles, 3x Soil Moisture measurements		
Dept. of AgroEcoSystem Research, University of Bayreuth		13 C Pulse labeling Experiment		
Institute of Soil Science, University of Hannover		Weekly measurement of soil CO_2- efflux by a LI-8100 Soil Survey Chamber, Estimation of soil properties		
Dept. of Plant Ecology, University of Göttingen	Soil surface temperature, On-site small weather station (both short term)		Evapotranspirati on, soil water content	Root biomass, necromass, surface area
Dept. of Geography, University of Cambridge	Dew fall measurements	Estimation of soil properties	Evapotranspirati on, soil water content	
Dept. of Plant Ecology, University of Göttingen				Vegetation records Harvest of peak standing crop biomass

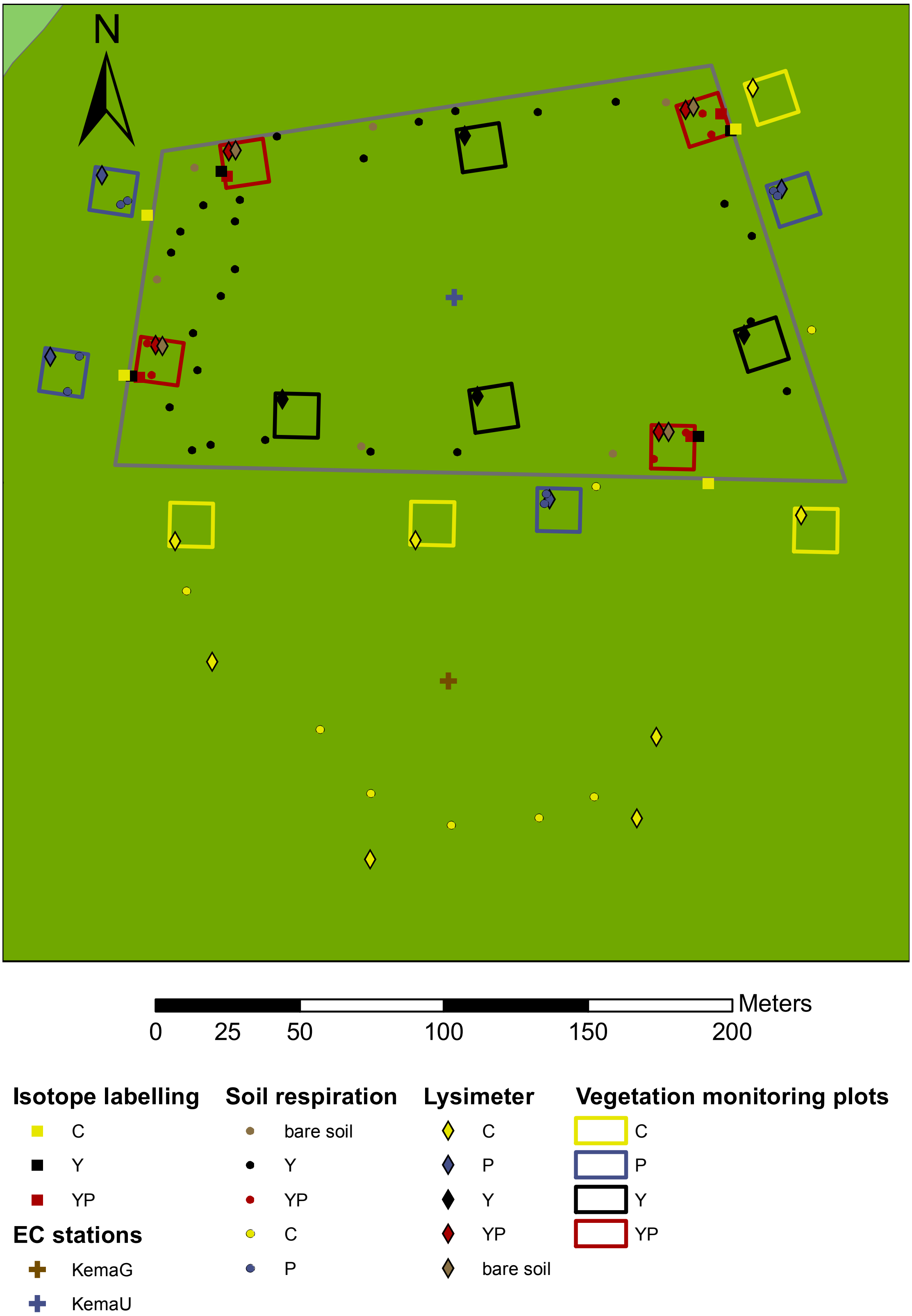

Figure 2-6: Setup and sampling points during the 2010 experiment in Kema. The grey line marks the big fence, which was installed in 2009 to exclude livestock, the small hollow squares mark the smaller fences which also exclude Pikas and the Control plots. They are labeled according to the treatment; C = control, P = no pikas, Y = no livestock, YP = no herbivores. The filled squares mark the labeling and sampling points of the ^{13}C labeling Experiment and the circles mark the positions of the collars for the

soil respiration chamber measurements. The diamonds marl the position of the weighing Lysimeter. For these experiments the labels are analog to the vegetation plots. The crosses represent the position of the EC Stations.

2.3 Surface parameters

2.3.1 Land use classification

Based on field observations, a Landsat image (source: Global Land Cover Facility, www.landcover.org) and a Google earth picture from December 2010 the map in Figure 2-7 was drawn. This map show the distribution of different land use types and the big exclosures in the research area Kema. The explanation and photos of the different land use types can be found in the further down in this chapter. The classification of the land use types follows the degradation of the *Kobresia* mats, starting with mat G and U (exclosures) followed by D1-3 to ruderal. Riverbed is a teporarly flooded area. Road and village are permanent constructions.

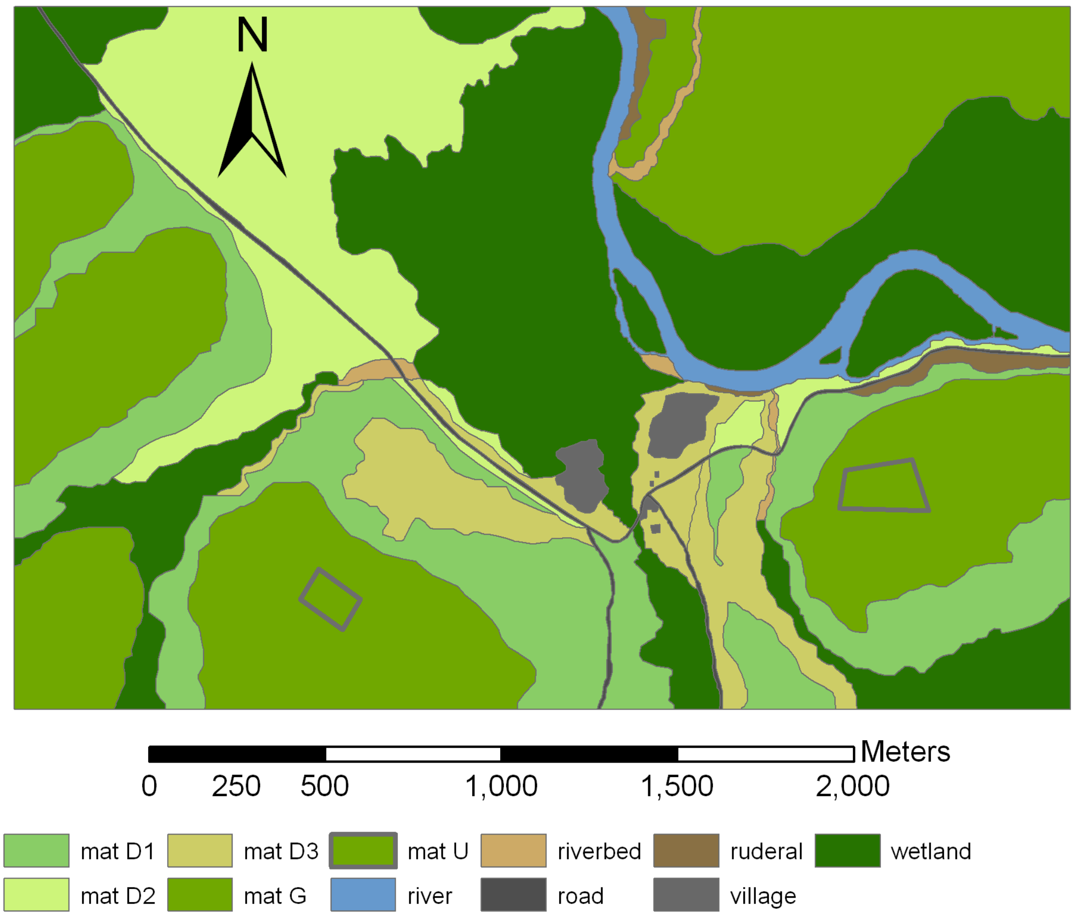

Figure 2-7: Distribution of land cover classes in the study sites (for explanation of classes see text). The grey polygons represent the two large exclosures.

***Kobresia* pastures (mat G, U, D1, D2, D3)**

The *Kobresia* pastures (Figure 2-7) are the most common and most important vegetation types on the Tibetan Plateau. The eponymous species is *Kobresia pygmaea* (Cyperaceae) which is mostly the dominant species and accounts for a total cover of up to 98%. This species produces the bulk of biomass und is an important fodder plant for herbivores, for livestock as well as for small mammals as Pikas (*Ochotona curzoniae*). *Kobresia pygmaea* produces an extremely firm turf, also called sods or mats which cover the soil (2.3.2) and thus prevent wind and water erosion. Degradation leads to spots with bare soil.

The mats are mainly composed of monocotyledons like *Carex* spec., *Festuca* spec., *Kobresia humilis, Kobresia pygmaea, Poa* spec., *Stipa purpurea* and *Trisetum* spec. and to a minor degree perennial herbs as *Androsace tapete, Aster flaccidus, Astragalus strictus, Dasiphora parviflora, Gentiana* spec., Gentiana veitchiorum**,** *Incarvillea younghusbandii, Iris* spec., *Lagotis brachystachya, Lamiophlomis rotata, Lancea tibetica, Leontopodium* spec., *Lomatogonium* spec., *Potentilla bifurca, Potentilla saundersiana, Ranunculus* spec., *Saussurea* spec., *Sedum perpusillum, Sibbaldianthe adpressa, Stellaria decumbens, Thalictrum alpinum, Veronica ciliata* and *Youngia simulatrix.*

In contrast, species composition on bare soil is characterized by a higher proportion of annual and biennial species like *Axyris prostrata, Chenopodium nepalense, Galium* spec., *Hypecoum leptocarpum, Microgynecium tibeticum, Microula tibetica, Plumbagella micrantha* and *Youngia simulatrix.* Additional species on bare soil are *Aster flaccidus, Astragalus strictus, Carex* spec., *Dasiphora parviflora, Draba ellipsoidea, Festuca* spec., *Heteropappus semiprostratus, Iris* spec., *Kobresia humilis, Lagotis brachystachya, Lamiophlomis rotata, Lancea tibetica, Leontopodium* spec., *Persicaria glaciale, Potentilla bifurca, Potentilla saundersiana, Przewalskia tangutica, Saussurea* spec., *Stellaria umbellata Stipa* spec., *Thalictrum alpinum* and *Veronica ciliata.*

The defined land cover classes of *Kobresia* pastures differ in the ratio of sods and bare soil:

Figure 2-8: Intact *Kobresia* pastures on flat terrain and degraded slopes, indicated by arrows.

Mat G and mat U

The mat G (grazed) and U (ungrazed) are the most intact stages of a *Kobresia* pasture with 81 to 100 % cover of *Kobresia* turf. This type mainly exists on flat terrain or gentle slopes (Figure 2-8).

Mat D1 and mat D2

The land use class D1 has a turf cover of 51 to 80 %. D2 is the more degraded stage with 6 to 50 % turf cover (Figure 2-9). These classes occur on slopes, near the villages and close to roads.

Figure 2-9: Degraded *Kobresia* pasture due to Yak grazing.

Mat D3

This vegetation type represents the most advanced degradation stage of (former) *Kobresia pygmaea* pastures. The *Kobresia* turf is destroyed due to overgrazing or direct anthropogenic influence. Only zero to five percent of the surface are covered by small remains of turf with sods being at most 10 centimeters in diameter, partly with living *Kobresia* plants (Figure 2-10). The substrate is mainly sand and small gravel, sometimes also silt dug out by the Pikas.

This stage of degradation occurs on steep slopes near the villages and roadsides. The total plant cover is about 50 to 65%. Vegetation is dominated by perennial species that cover up to 60% of the surface. The most common species are *Ajuga lupulina, Lancea tibetica, Potentilla bifurca, Saussurea* spec., *Stracheya tibetica, Leontopodium pusillum*. High quality fodder plants like *Kobresia* spp. or grasses (*Koeleria, Stipa, Poa*) are rare.

Annual species like *Axyris prostrata* and *Kochia* spec. can also become dominant and cover about 10%. The abundance and composition of annual plants varies strongly between different years depending on water availability and germination conditions at the beginning of the vegetation period.

Other species of this vegetation type are *Anaphalis xylorhiza, Arenaria bryophylla, Artemisia hedinii, Artemisia santolinifolia, Artemisia stricta, Artemisia tridactyla,* *Aster flaccidus, Astragalus strictus, Chenopodium nepalense, Comastoma pedunculatum, Dontostemon glandulosus, Draba ellipsoidea, Dracocephalum heterophyllum, Gentiana pseudosquarrosa, Heracleum millefolium, Heteropappus semiprostratus, Hypecoum leptocarpum, Incarvillea younghusbandii, Lamiophlomis rotata, Lasiocaryum munroi, Microula tibetica, Persicaria glaciale, Plumbagella micrantha, Sedum perpusillum, Sibbaldianthe adpressa, Thalictrum rutifolium, Trigonotis tibetica, Veronica ciliata, Youngia simulatrix.*

Ruderal herb vegetation

This vegetation type is common on steep slopes along the river and at road sides, where there is heavy disturbance by trampling and sliding soil substrates. The vegetation covers only up to 25% of the surface, constituted by small bunches of Poaceae (*Elymus, Festuca*, *Stipa*) (Figure 2-11) and mainly by *Urtica* spec. (Figure 2-12) .

Figure 2-10: Advanced degradation stage of a former *Kobresia pygmaea* pasture; a small remain of turf is indicated by an arrow.

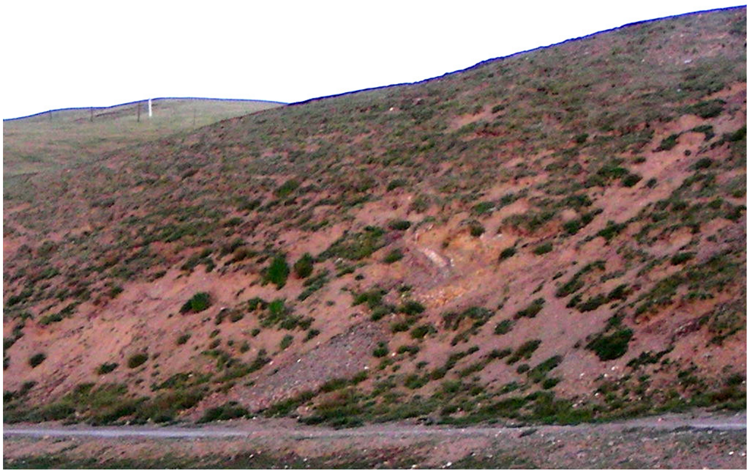
Figure 2-11: Ruderal vegatation dominated by grasses.


Figure 2-12: Urtica spec.

Wetland

The vegetation in swamps is dominated by *Kobresia schoenoides*. This species forms hummocks up to 20 centimeter high which cover up to 70% of the surface (Figure 2-13). In between the bumps grow perennial herbs of the genera *Potentilla*, *Lancea*, *Ranunculus* and other. Annuals like *Axyris prostrata* and *Pedicularis longiflora* are rare. Small depressions in the swamps are regularly flooded and become temporary ponds. These are dominated by other Cyperaceae. The most important species are *Carex sagaensis* and *Blysmus compressus* covering about 95% of the depressions. Poaceae like *Poa* spec. *Elymus* spec. and *Trisetum* spec. are rare.

Additional species comprise the genera *Aster, Artemisia, Astragalus, Galium, Gentiana, Lagotis, Lamiophlomis, Leontopodium, Lomatogonium, Parnassia, Plantago, Polygonum, Primula, Ranunculus, Saussurea, Swertia, Taraxacum* and *Veronica*. Mosses are common. The two species *Glaux maritima* and *Triglochin maritima* indicate increased salt content in the substrate.

In the study area around Kema, the swamps are used as pastures over the entire year. Therefore the vegetation is grazed down to less than two centimeters in the depressions, and to less than ten centimeters on the hummocks, which are protected by the robust basal sheaths of *Kobresia schoenoides*. Due to the grazing no litter is present. The vegetation is practically closed, being occasionally interrupted by soil heaps accumulating around a few burrows of pikas.

Figure 2-13: Swamp near Kema with typical hummocks of *Kobresia schoenoides.*

2.3.2 Soil properties

During the installation of the soil measurement field next to EC KemaU more information about the soil properties were estimated. The excavated soil pit had a depth of about 40 cm. The rooting depth of the grass was 40 cm, too. The root density decrease from top to the bottom. The profile could be separated into three horizons. The first horizon with the most organic content and high root density (turf) stretches from 0-7 cm depth. The second stretches from 7-23 cm with an high amount of roots and the third with a middle amount of roots from 23-40 cm. Table 2-2 summarizes the soil characteristics as recorded in the field. Figure 2-14 gives an impression of the profile.

Table 2-2: Soil profile at the measurement site, characterized after WRB.

Depth [cm]	Signature (WRB)	Description	Color	Compactness of the packing [$g*cm^{-3}$]
0-7	Us	Sandy silt, high organic fraction, high root density (felty)	very dark grayish brown (10YR 3/2), dry	0,8
7-23	Us	Sandy silt	very dark grayish brown (10YR 3/2), dry	1,0
23-40	Tu3	Clay loam	light brownish gray (10YR 6/2)	1,8

Figure 2-14: Soil profile at Kema site inside the fence from 2009.

3 Vegetation monitoring and fertilization experiment

Elke Seeber [(1)], Karsten Wesche [(2)]

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3.1 Setup and measurements

3.1.1 Grazing experiment

Within each of the permanent fences, a 10 by 10 meter plot was marked for vegetation records. Total percentage vegetation cover was recorded on species level; records were taken annually in September, corresponding to the end of the vegetation period and thus the maximum cover of the vegetation.

On each plot / treatment, 25 cm x 25 cm subplots were additionally marked. On these subplots flower and fruit stalks were counted as proxies for the reproductive success of the most important species under different grazing conditions. Moreover, peak standing crop biomass was harvested, differentiated into *Kobresia pygmaea,* other Cyperaceae, Poaceae, short-lived (annual or biennial) herbs and perennial herbs. The number of replicates varied according to the magnitude of small-scale heterogeneity within plots of the different vegetation types: There were 3 plots each at the *Kobresia* pasture, 4 replicates at the degraded pastures and 4 replicates on each on the hummocks and hollows in the wetlands.

3.1.2 Fertilization Experiment

In September 2009 a fertilization experiment was set up in a randomized block design with 5 treatments á 4 replicates. The aim was to determine soil nutrient limitations to plant growth. The differentially tested nutrients included nitrogen, phosphate, and potassium (Table 3-1).

Table 3-1: Overview of the nutrient addition treatments, the employed fertilizers, and the respective concentrations for the fertilization experiment.

Nutrition	Fertilizer	Concentration
nitrogen, potassium	KNO_3	10 g/m², 34 g/m²
phosphate, potassium	KH_2PO_4	5 g/m², 34 g/m²
Potassium	K_2SO_4	34 g/m²
nitrogen, phosphate, potassium	KNO_3, KH_2PO_4, K_2SO_4	10 g/m², 5 g/m², 34 g/m²
Control		

In September 2009, for each treatment a plot of one square meter was fertilized and protected from grazing with 50 cm high wire cages (Figure 3-1). The fertilizer was dissolved in 3 liter ground water and applicated with a watering can. This corresponded to an irrigation equivalent to 3 mm, which was also given to the control. The fertilization was repeated in September 2010 on the same plots.

On two subplots (25 cm x 25 cm) flower and fruit stalks were counted. A first biomass harvest was carried out in August 2010 to assess the impact of the fertilization on total biomass productivity. A second harvest was carried out in September 2010 in order to assess the impact of fertilization on regrowth. Biomass of *Kobresia pygmaea*, other Cyperaceae, Poaceae, annual or biennial herbs and perennial herbs was harvested separately.

Additionally, soil samples were taken in August 2010 at the horizons 0-5 cm and 6-20 cm for analysis of (remaining) soil nutrient pools.

Figure 3-1: Block of the fertilization experiment, protected from grazing by meshed wire cages.

3.2 Data availability

Given that we used different numbers of replicates and treatments, data structures differ among experiments. Table 3-2 summarises the basic characteristics of the respective designs.

Table 3-2: Overview of dates, number of replicates, treatments and subplots per treatment for vegetation samples, biomass harvests and assessments of reproductive success between August and September 2010.

Experiment and vegetation type	**Date**	**Number of replicates**	**Number of treatments**	**Number of subplots**
Fertilization experiment, first harvest *Kobresia* pasture	15.08.2010	4	5	2
Fertilization experiment, reproduction *Kobresia* pasture	15.08.2010	4	5	2
Grazing experiment, biomass Wetland	30.08.2010	4	2	8
Grazing experiment, reproduction Wetland	30.08.2010	4	2	8
Grazing experiment, biomass Degraded pasture	01.09.2010	4	4	4
Grazing experiment, reproduction Degraded pasture	01.09.2010	4	4	4
Grazing experiment, vegetation record Degraded pasture	11.09.2010	4	4	1
Grazing experiment, vegetation record *Kobresia* pasture, fenced 2009	12.09.2010	4	4	1
Grazing experiment, biomass *Kobresia* pasture, fenced 2010	13.09.2010	4	4	3
Grazing experiment, reproduction *Kobresia* pasture, fenced 2010	13.09.2010	4	4	3
Grazing experiment, vegetation record *Kobresia* pasture, fenced 2010	13.09.2010	4	4	1
Grazing experiment, biomass *Kobresia* pasture, fenced 2009	14.9. 2010	4	4	3
Grazing experiment, reproduction *Kobresia* pasture, fenced 2009	14.9. 2010	4	4	3
Fertilization experiment, second harvest *Kobresia* pasture	29.9.2010	4	5	2
Grazing experiment, vegetation record Wetland	29.9.2010	4	4	1

4 Micrometeorological measurements

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4.1 Eddy Covariance and meteorological measurement sites

From the 03. June till 03. August two Eddy Covariance (EC) Stations were there installed. One over a ungrazed (U) and one over a grazed (G) *Kobresia* mat. The coordinates of the sites are 31,27418°N and 92,11037°E for U respectively 31,27298°N and 92,11036°E for G. Most of the measurement site has a gentle slope. The EC Stations were equipped with a CSAT3, a LICOR 7500 and a HMP. Additionally to the EC Stations a CNR1 Net Radiometer was installed at both sites and a rain gauge at U. At U two soil complexes below different land cover types were installed. One covered with *Kobresia* mat and one below bare soil. At G just one soil complex was installed below *Kobresia* mat. The complexes contained temperature measurement with PT100, heat flux measurement at 15 cm, water content measurements with TDR Probes and two tensiometers. While the whole ungrazed area is fenced with a one and a half meter high netting wire, a smaller area at the grazed site was fenced just around the devices to protect them fom the grazing yaks. An overview of the complete setup is given in Figure 2-6. An overview of each site and the distances between the different devices and obstacles can be seen in Figure 4-1, Figure 4-2 and in Table 4-1 and Table 4-2.

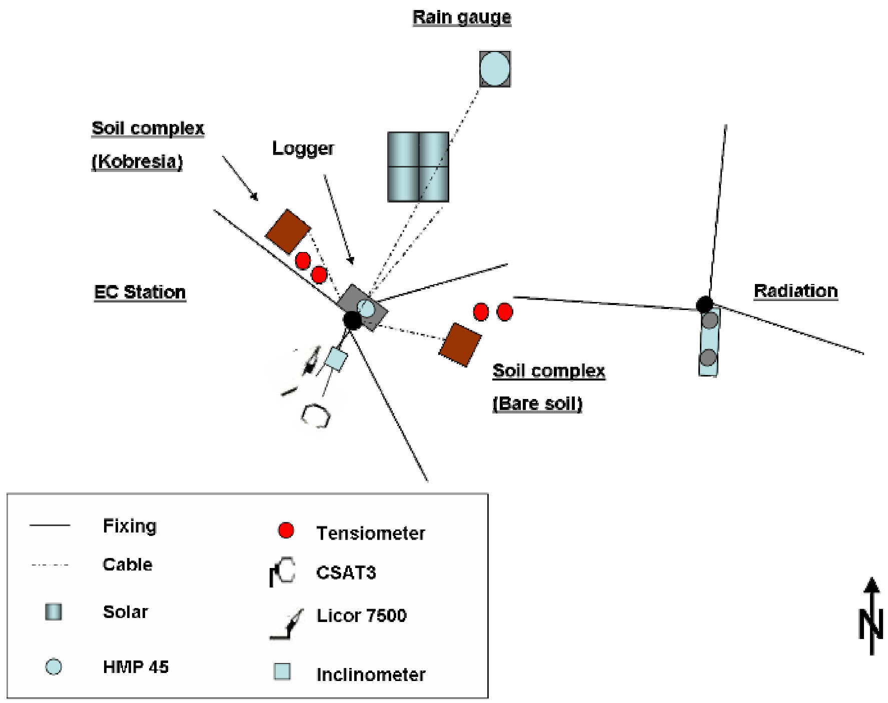

Figure 4-1: Setup details at the ungrazed measurement site

Table 4-1: Distances on the ungrazed measurement site, as shown in Figure 2-5

Obstacle	**Distance [m]**	**Angle against north [°]**
EC Station – Soil complex *Kobresia*	1.36	280
EC Station – Soil complex Bare Soil	1.53	36
EC Station – Tensiometer *Kobresia*	1.09	280
EC Station – Tensiometer Bare Soil	1.80	36
EC Station – Radiation	4.97	36
EC Station – Rain gauge	6.77	0
EC Station – Solar panels	3.70	0

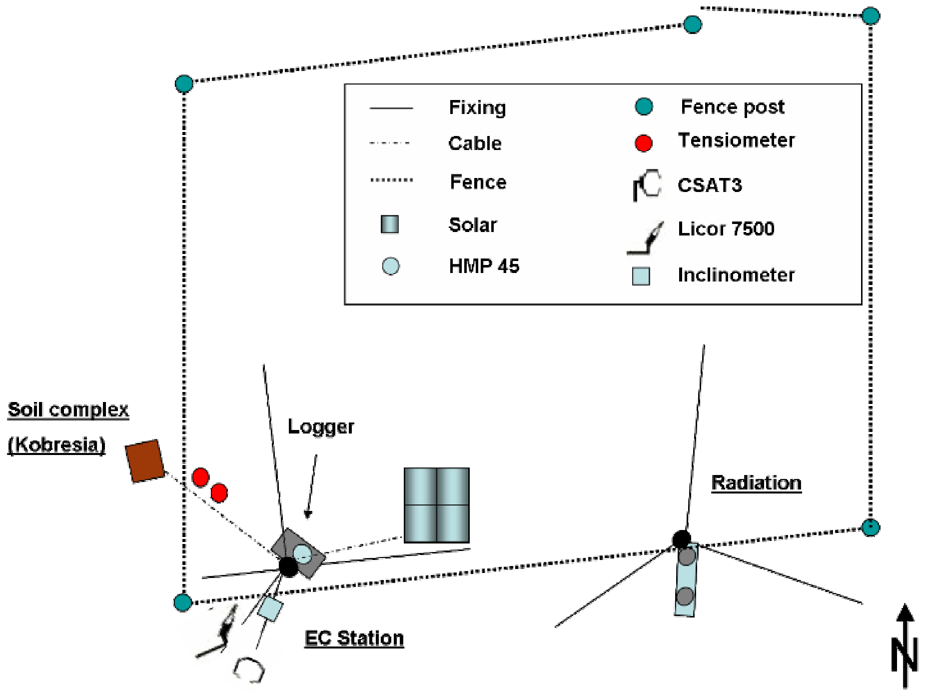

Figure 4-2: Setup details at the grazed measurement site

Table 4-2: Distances on the grazed measurement site, as shown in Figure 4-2

Obstacle	**Distance [m]**	**Angle against north [°]**
EC Station – Soil complex *Kobresia*	1.45	270
EC Station – Tensiometer *Kobresia*	1.02	270
EC Station – Radiation	6.05	148
EC Station rain Solar panel	1.35	54
EC Station – Fencepost SW	1.07	150
EC Station – Fencepost SE	8.85	54
EC Station – Fencepost NW	8.90	150
EC Station – Fencepost NE	13.80	54

4.1.1 Turbulence measurement complexes

The following section will list the measurement devices which were used to equip the turbulence measurement complex. An overview of the alignment and specifications of these devices are given in Table 4-3 for the ungrazed and in Table 4-4 for the grazed site. Figure 4-3 shows a schema of the distances and angels between the Licor and the CSat3.

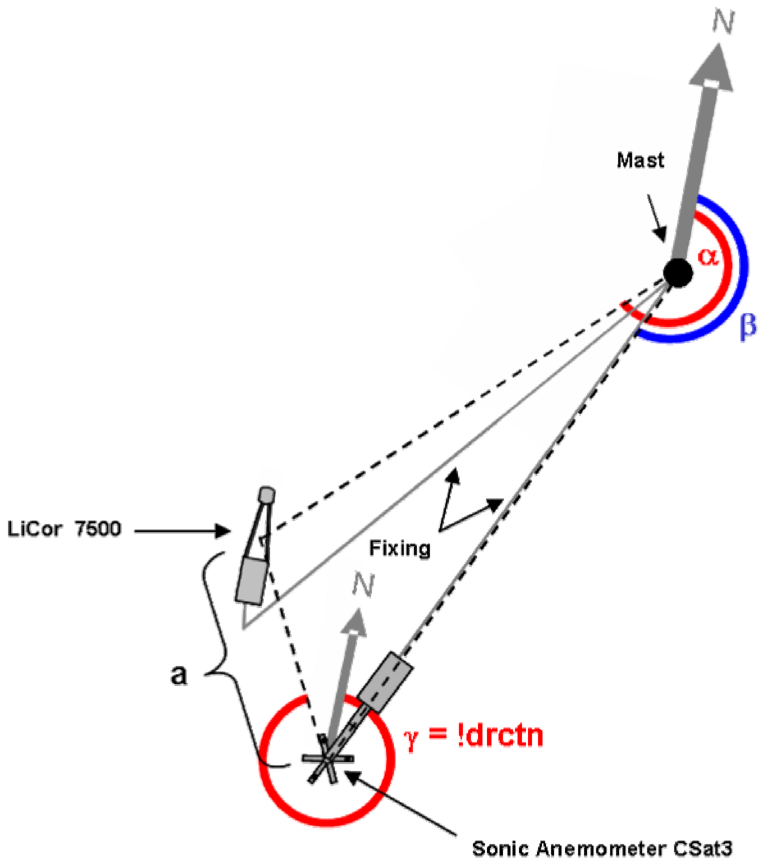

Figure 4-3: Scheme of the angels and distances between the fast sensors installed at the two EC Stations.

Table 4-3: Specifications of the devices of the ungrazed site.

Parameter	**Device**	**SN**	**Calibration factor**	**Calibration/ Conversion**	**Height [m]**	**Angle**	**Logger channel**
Wind vector and sonic temp.	CSAT3	1756		Calibration in device	2.20	β = 200°	SDM
Humidity	LI7500	75 H-1200	Licor Calibration Appendix B	Calibration in device	2.19 Distance To CSAT: a = 0.26	α = 206° γ = 313° (!drctn, in TK3)	SDM
CO_2	LI7500	75 H-1200	Licor Calibration Appendix B	Calibration in device	2.19 Distance to CSAT: a = 0.26	α = 206° γ = 313° (!drctn, in TK3)	SDM
Humidity	HMP	T46 500 15		Conversion in Logger mV to g m^{-3}			Diff. 1
Temperature	HMP	T46 500 15		Conversion in Logger mV to °C			Diff. 1
Pressure	Vaisalla	E18 100 03	0-5V equals 500-1100 hPa	Conversion in Logger mV to hPa			SE 3

Table 4-4: Specifications of the devices of the grazed site

Parameter	**Device**	**SN**	**Calibration factor**	**Calibration /Conversion**	**Height [m]**	**Angle against north**	**Logger-channel**
Wind vector and sonic temp.	CSAT3	032 2-2		Calibration in device	2.21	β = 186	SDM
Humidity	LI7500	75 H0 220	Licor Calibration Appendix B	Calibration in device	2.16 Distance to CSAT: a = 0.29	α = 200° γ = 296 (!drctn, in TK3)	SDM
CO_2	LI7500	75 H0 220	Licor Calibration Appendix B	Calibration in device	2.16 Distance to CSAT: a = 0.29	α = 200° γ = 296 (!drctn, in TK3)	SDM
Humidity	HMP	T46 500 13		Conversion in Logger mV to g m^{-3}			Diff. 1
Temperature	HMP	T46 500 13	---	Conversion in Logger mV to °C			Diff. 1

4.1.2 Radiation and Precipitation

The radiation was measured separatly from the turbulent quantities with a CNR1 Net Radiometer from Kipp & Zonen, mounted to a black pole northeast of the turbulence complexes. The precipitation was measured at KemaU with a weighting rain gauge north of these turbulence complex.

Table 4-5: Instrumentation of radiation and precipitation complex

Parameter	SN	Sensor	Calibration factor [μV/Wm²]	Calibration /Conversion	Height [m]	Angle against north	Logger-channel
Radiation "U"	CNR 1/990197	upper SW	E=(10.95±0.002)	Calibration in Logger	1,88	156°	Diff. 8-12
		upper LW	E=(10.81±0.026)				
		lower SW	E=(10.81±0.002)				
		lower LW	E=(10.54±0.013)				
Radiation "G"	CNR 1/970059	upper SW	E=(9.63±0.002)	Calibration in Logger	1,91	148°	Diff. 8-12
		upper LW	E=(9.77±0.007)				
		lower SW	E=(9.84±0.002)				
		lower LW	E=(10.05±0.026)				
Rain at U	Rain Gauge /010291		1 Pulse = 0.1 mm		1		P 1

4.1.3 Soil measurement complex

The soil complex was installed close to the turbulence complex. Figure 4-4 and Figure 4-5 show a scheme of the setup of the measurements while Table 2-6 contains calibration coefficients and more specifications concerning the used devices. A more detailed discussion of the soil properties can be found in chapter 2.3.2.

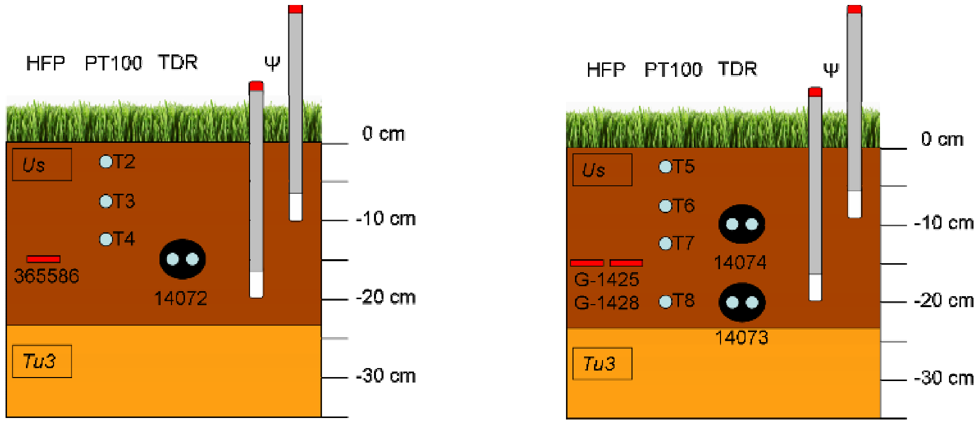

Figure 4-4: Soil profile of U below *Kobresia* (right) and bare soil (left) with installation to measure water content, temperature and heat flux, including serial numbers and information about the horizons of the soil profile.

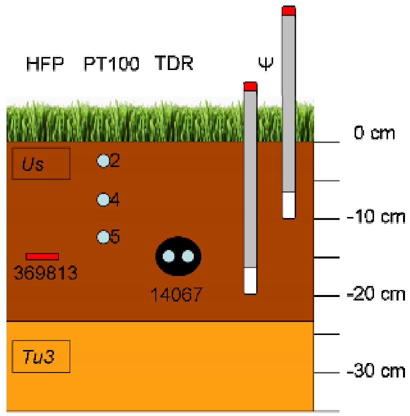

Figure 4-5: Soil profile of G with installation to measure water content, temperature and heat flux, including serial numbers and information about the horizons of the soil profile.

Table 4-6: Instrumentation of soil pit

Parameter	Device	SN	Calibration factor	Calibration/ Conversion	Height [m]
SoilTmp1	Pt100	T2	---	mV to °C in Logger	-0.025
SoilTmp2	Pt100	T3	---	mV to °C in Logger	-0.075
SoilTmp3	Pt100	T4	---	mV to °C in Logger	-0.125
SoilTmp4	Pt100	T5	---	mV to °C in Logger	-0.025
SoilTmp5	Pt100	T6	---	mV to °C in Logger	-0.075
SoilTmp6	Pt100	T7	---	mV to °C in Logger	-0.125
SoilTmp7	Pt100	T8	---	mV to °C in Logger	-0.200
SoilTmp8	Pt100	2	---	mV to °C in Logger	-0.025
SoilTmp9	Pt100	4	---	mV to °C in Logger	-0.075
SoilTmp10	Pt100	5	---	mV to °C in Logger	-0.125
Matrix potential	Tensiometer				
Soil moisture	TDR-IMKO	14067	---	---	-0.15
Soil moisture	TDR-IMKO	14072	---	---	-0.15
Soil moisture	TDR-IMKO	14073	---	---	-0.20
Soil moisture	TDR-IMKO	14074	---	---	-0.10
Ground heat flux	HP3	69813	227µV/mW/cm²	----	-0.15
Ground heat flux	HP3	65586		---	-0.15
Ground heat flux	HP	G 1425		---	-0.15
Ground heat flux	HP	G-1428		---	-0.15

Table 4-7: Soil water content estimated with soil cores, 100 cm^3.

Location	Depth	Nr.	Weight moist	Weight dry	Weight cylinder	Qg [%]	Mean Qg [%]
EC-U *Kobresia*	Us, 9-13 cm	M 47	242,3	229,9	124,4	11,8	
		M 20	250,5	237,6	124,7	11,4	
		M 21	259,3	239,1	125,1	17,7	11,6
	Us, 18-22 cm	M 48	253,5	242,8	123,6	9,0	
		M 03	263,8	253,3	125,6	8,2	
		M 29	260,9	250,4	125,3	8,4	8,5
	Tu3, 24-28 cm	M 26	224,9	216,4	124,8	9,3	
		M 23	277,6	262,5	125,0	11,0	
		M 33	273,3	258,4	124,0	11,1	10,4
EC-U Bare soil	Tu3, 22-26 cm	M 9	264,4	250,4	125,2	11,2	
		M 46	258,9	243,5	124,7	13,0	
		M 28	276,9	259,5	124,4	12,9	12,3
EC-G	Us, 15-19 cm	M 45	204,1	196,8	124,8	10,1	
		M 24	257,1	255,8	124,0	1,0	
		M 5	203,1	197,7	125,3	7,5	8,8
	Tu3, 22-26 cm	M 40	277,4	264,2	124,7	9,5	
		M 37	239,4	232,0	124,2	6,9	
		M 19	270,2	261,5	125,8	6,4	7,6

During the excavation of the pit for the soil measurements, soil cores, 100 cm^3, were taken as a reference to the installed TDR-Probes in order to estimate the soil water content. The individual soil core results are documented in the Table 4-7. The results from core M21 and M24 were not used for the averaging since they seem to be wrong, due to some loss of soil or other mistakes.

4.2 Meteorological site characteristics and footprint analysis

The wind roses in Figure 4-6 display the wind direction and wind speed for the two stations over the whole measurement period. Only slight differences in the distribution and wind speed occur between the two different stations. The diurnal distribution of wind directions over the measurement period is displayed in two Hovmøller plots (Figure 4-7). An overview of the air temperature, absolute humidity and precipitation is given in Figure 4-8. Hovmøller plots of the measured fluxes and the bowen ratio are shown in Figure 4-9 and Figure 4-10, the fluxes are the net ecosystem exchange, the latent and the sensible heat flux. The bowen ratio is the fraction of the two heat fluxes and is a measure for the dominance of one of them. A positive bowen ratio indicate dryer and a negative bowen ratio a more moist period. In the case of the IOP1 the bowen ratio indicates dryer periods in early June and late July and a more most period in with higher a latent heat flux (evapotranspiration) in late June. This can be also reaction of the vegetation in the net ecosystem exchange. In order to display the source of the measured fluxes footprints for the two EC Stations were calculated. The footprint climatology for the whole period is displayed for all stratifications (Figure 4-11 (all) and Figure 4-12 (all) and separately for unstable, stable and neutral conditions (Figure 4-11 (unstable, stable and neutral) and Figure 4-12 (unstable, stable and neutral). The footprint climatology was calculated using TERRAFEX. The underlying footprint model is a lagrangian stochastic forward trajectory model, as proposed in Göckede et al. (2008), who adapted the original model from Rannik et al, (2003).

a) b)

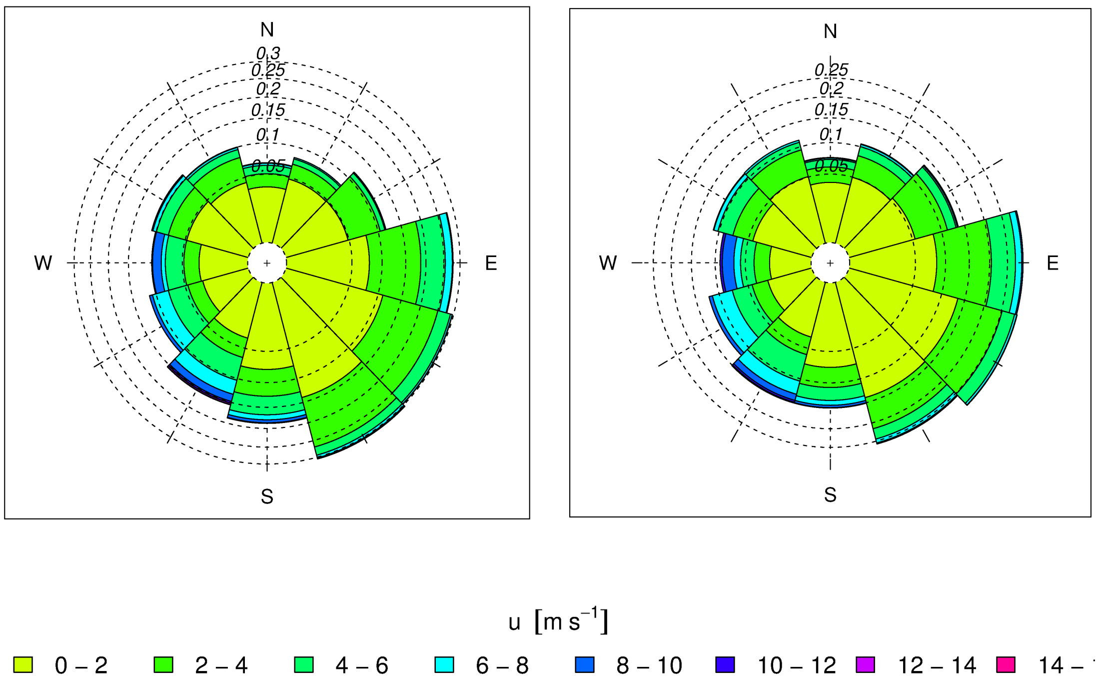

Figure 4-6: Wind rose displaying the wind direction and wind speed over the whole measurement period. The left side (a) shows the data from KemaU and the right side (b) from KemaG.

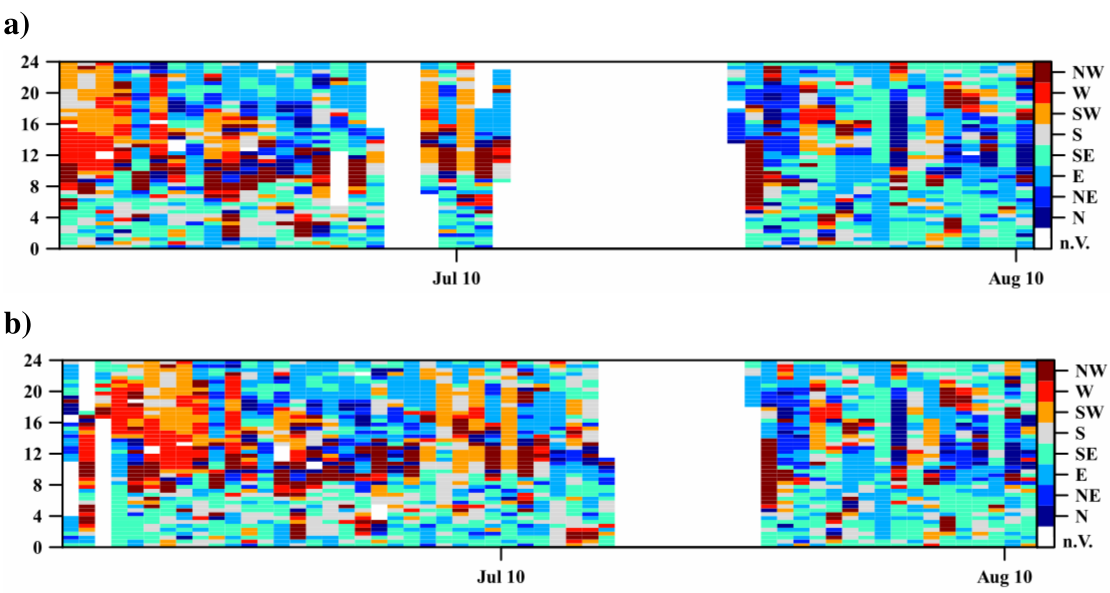

Figure 4-7: Wind distribution for the measuring period. Figure a) displays the Wind direction for the EC on the ungrazed plot, from June 4th till August 2nd, figure b) displays the wind direction measured on the grazed plot from June 9th till August 1st. The left y axis indicating the hours of the day, the right y axis the classes of the wind direction and the x axis the day during the measuring period, the abbreviation of the month indicates the first day of the month the 10 stands for 2010.

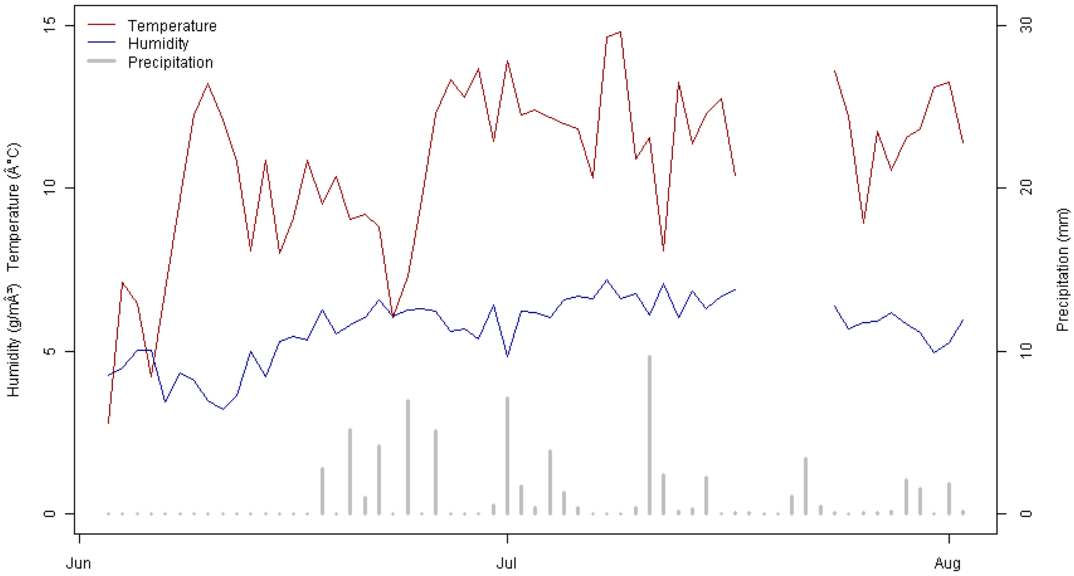

Figure 4-8: Observations of air temperature, absolute humidity and precipitation from Jun. 3rd till Aug. 2nd. Due to some problems with the rain gauge no values for precipitation are available till Jun 17th. During thunderstorm or days with high wind velocities the rain gauge might have overestimated the amount of rain to shaking of the setup, high values have been have been removed at Jun 27th,28th and Jul 20th.

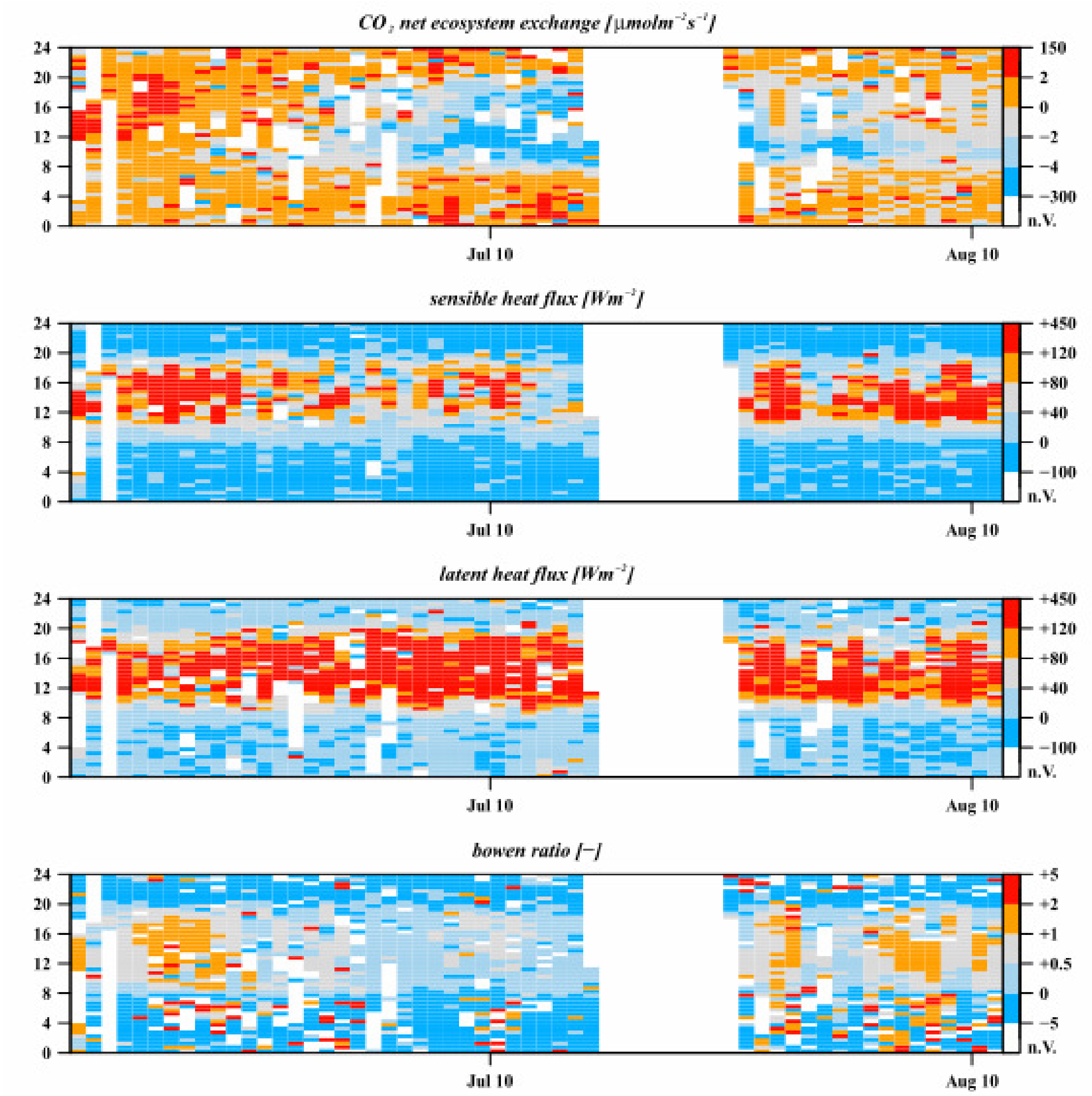

Figure 4-9: Hovmøller plots of the fluxes and the bowen ratio measured at the EC Station KemaU. On the y axis the daily cycle is plotted for every day on the x axis. On the right side the color coding of the assigned classes is drawn. The bowen ratio plot shows two dryer periods, one in early June the other in late July. Additionally it the reaction of the vegetation to the more moist period can be sin in the plot of the net ecosystem exchange.

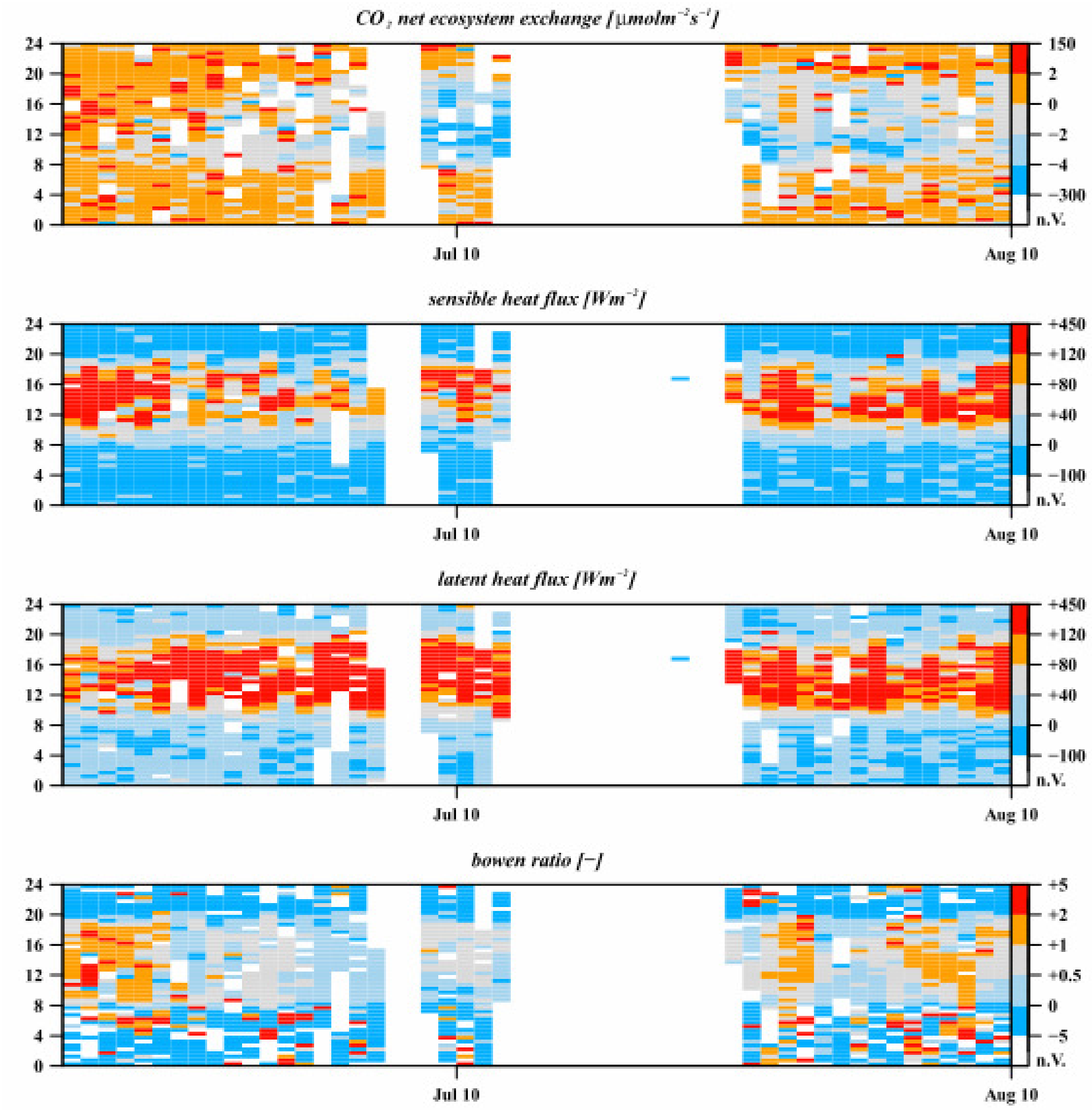

Figure 4-10: Hovmøller plots of the fluxes and the bowen ratio measured at the EC Station KemaG. On the y axis the daily cycle is plotted for every day on the x axis. On the right side the color coding of the assigned classes is drawn. The bowen ratio plot shows two dryer periods, one in early June the other in late July. Additionally it the reaction of the vegetation to the more moist period can be sin in the plot of the net ecosystem exchange.

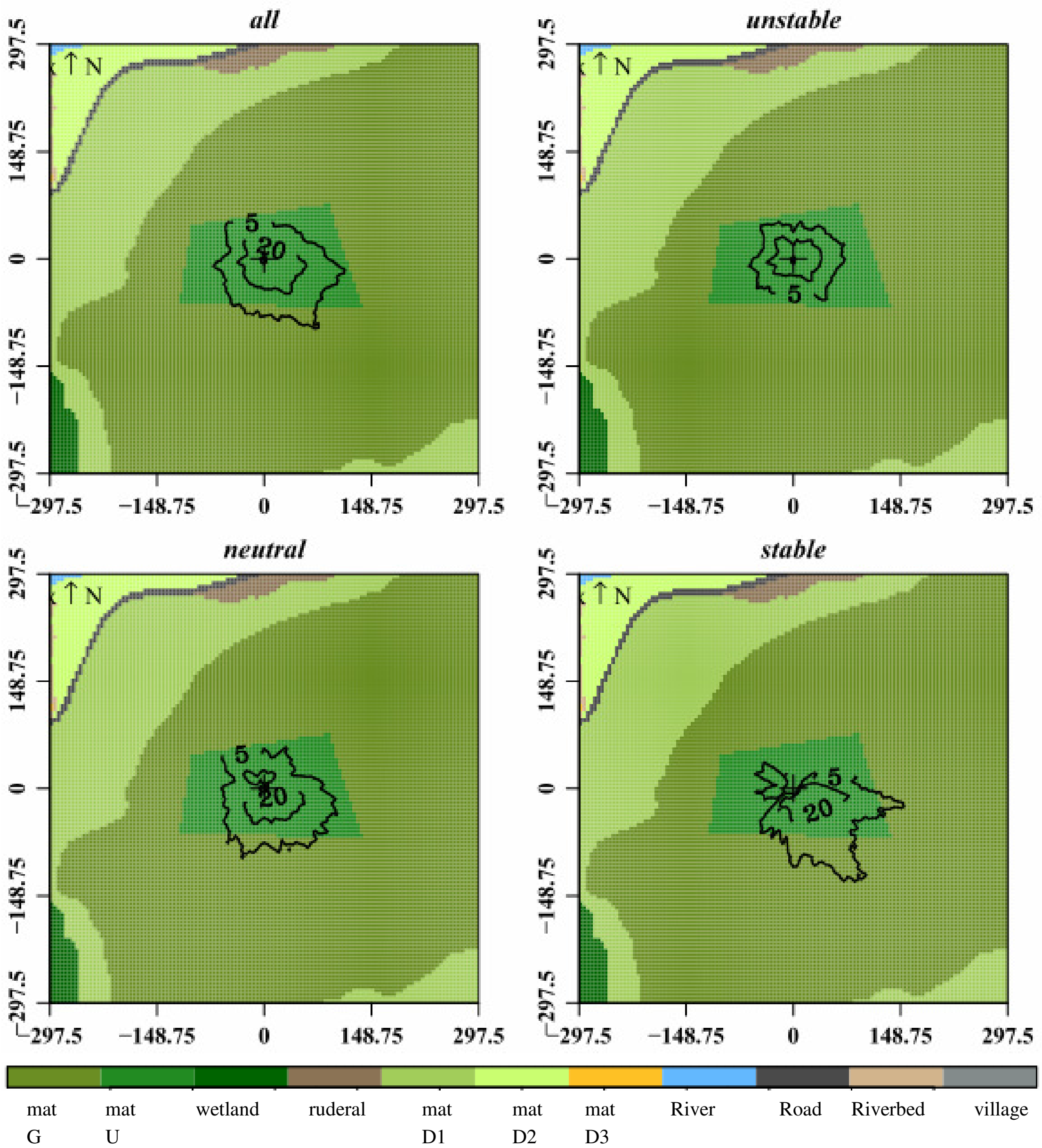

Figure 4-11: Footprint climatology of the EC Station KemaU, marked by the black cross, including an overview of the land use types surrounding the station. The line marked with 20 enclosed 80% and the line marked with 5 enclosed 95% of the data. The footprints are calculated for a combination of all stratification regimes (all), for the stratification regime unstable, neutral and stable.

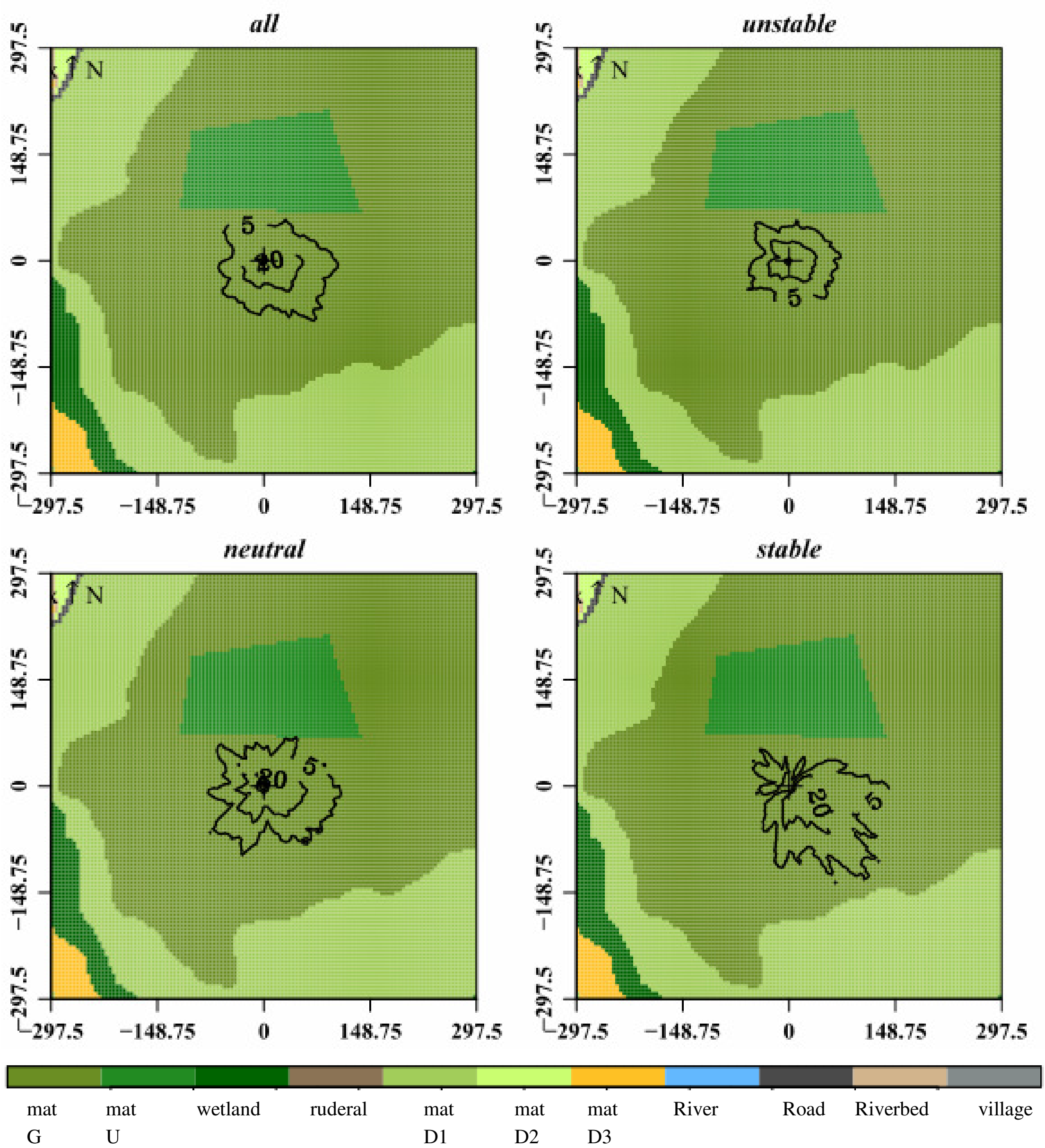

Figure 4-12: Footprint climatology of the EC Station KemaG, marked by the black cross, including an overview of the land use types surrounding the station. The line marked with 20 enclosed 80% and the line marked with 5 enclosed 95% of the data. The footprints are calculated for a combination of all stratification regimes (all), for the stratification regime unstable, neutral and stable.

4.3 Data logging and structure

Data from the EC Stations was logged with an Cr3000 Logger, from Campbell Scientific.

Data was collected with high and low frequency. The logging time was Beijing Standard Time, which is UTC/GMT +8 hours and has no daylight savings time in 2010. Specifications of the wiring and a list of the used logger program can be found in Appendix A. The Table 4-8 lists the measured parameter and additional Information. Additionally to the parameters measured at the EC Stations wind speed, wind direction, precipitation, humidity, temperature and radiation was measured at a Automatic Weather Station (AWS) close to the station building.

The Figure 4-13 and Figure 4-14 show the availability and quality of the data measured with the eddy-covariance stations. The colors in the plots show the flagging used by the Department of Micrometeorology to show data quality. Flags are assigned to every half hour value and range from 1 till 5, indicating good to bad quality of the measurements. Quality flags were calculated after Foken et al. (2004), the overall flags follow the scheme of Rebmann et al. (2005). All half hours indicated with red (Flag 5) contain either no or very bad data. These gaps need to be filled by model approaches.

Table 4-9: Overview of logged parameter, their Units, the measurement devices and the structure of the stored data.

Parameter	Unit	Device	File name	Stored in	Frequency
Wind components	m s^{-1}	CSat3	NamCoHxxxx	B_1	20Hz
Sonic temperature	° C	CSat3	NamCoHxxxx	B_1	20Hz
CO_2	mmol m^{-3}	Licor 7500	NamCoHxxxx	B_1	20Hz
H_2O	mmol m^{-3}	Licor 7500	NamCoHxxxx	B_1	20Hz
H_2O	mmol m^{-3}	KH 20	NamCoHxxxx	B_1	20Hz
Inclination	mV	Inclinometer	NamCoHxxxx	B_1	20Hz
H_2O	mmol m^{-3}	HMP 45	NamCoLxxxx	B_2	5 min
Temperature	° C	HMP 45	NamCoLxxxx	B_2	5 min
Pressure	hPa	Vaisalla PS	NamCoLxxxx	B_2	5 min
Precipitation	counts	Rain gauge	rain_xxxxxx	B_4	5 min
Net radiation	W m^{-2}	CNR 1	rad_xxxxxx	B_5	10 sec *)
Soil heat flux	W m^{-2}	HFP	pt_xxxxxx	B_6	5 min
Soil temp.	° C	Pt 100	pt_xxxxxx	B_6	5 min
Soil moisture	mV	TDR	tdr_xxxxxx	B_6	1 sec

*) starting from 29.06.09, before 5minData availability

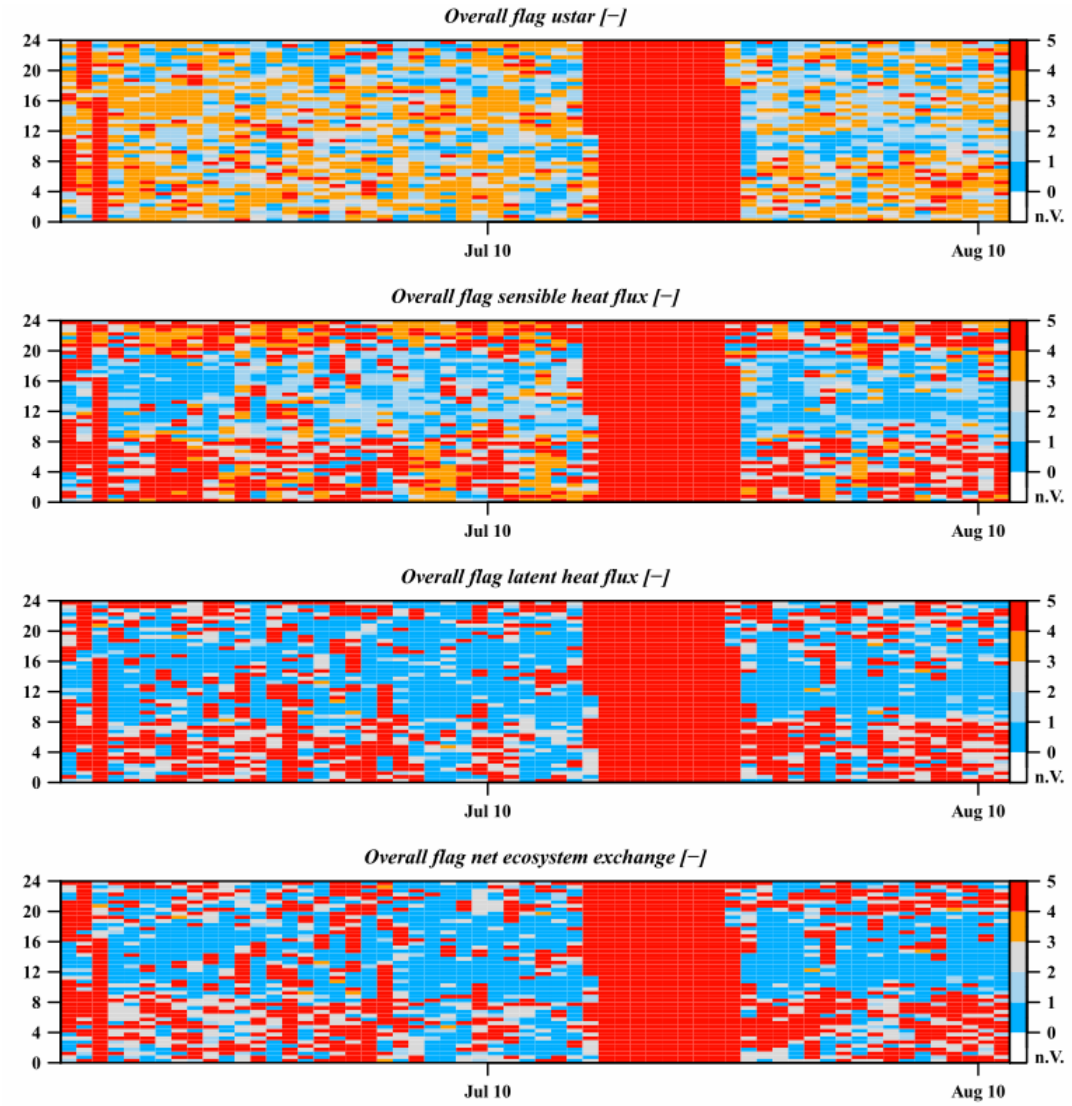

Figure 4-13: Data quality of the EC Data measured at KemaU. The Hovmöller plots show the daily cycle on the y axis and the different days during the measurement period on the x-axis. Jul10 and Aug10 indicate the start of the month. The color coding indicates quality flags calculated for every half hour value according to Foken et al. (2004) following the scheme of Rebmann et al (2005). 1 indication good and 5 data with poor data quality, missing data also is marked by flag 5. Therefore the plots also give an overview of the data availability.

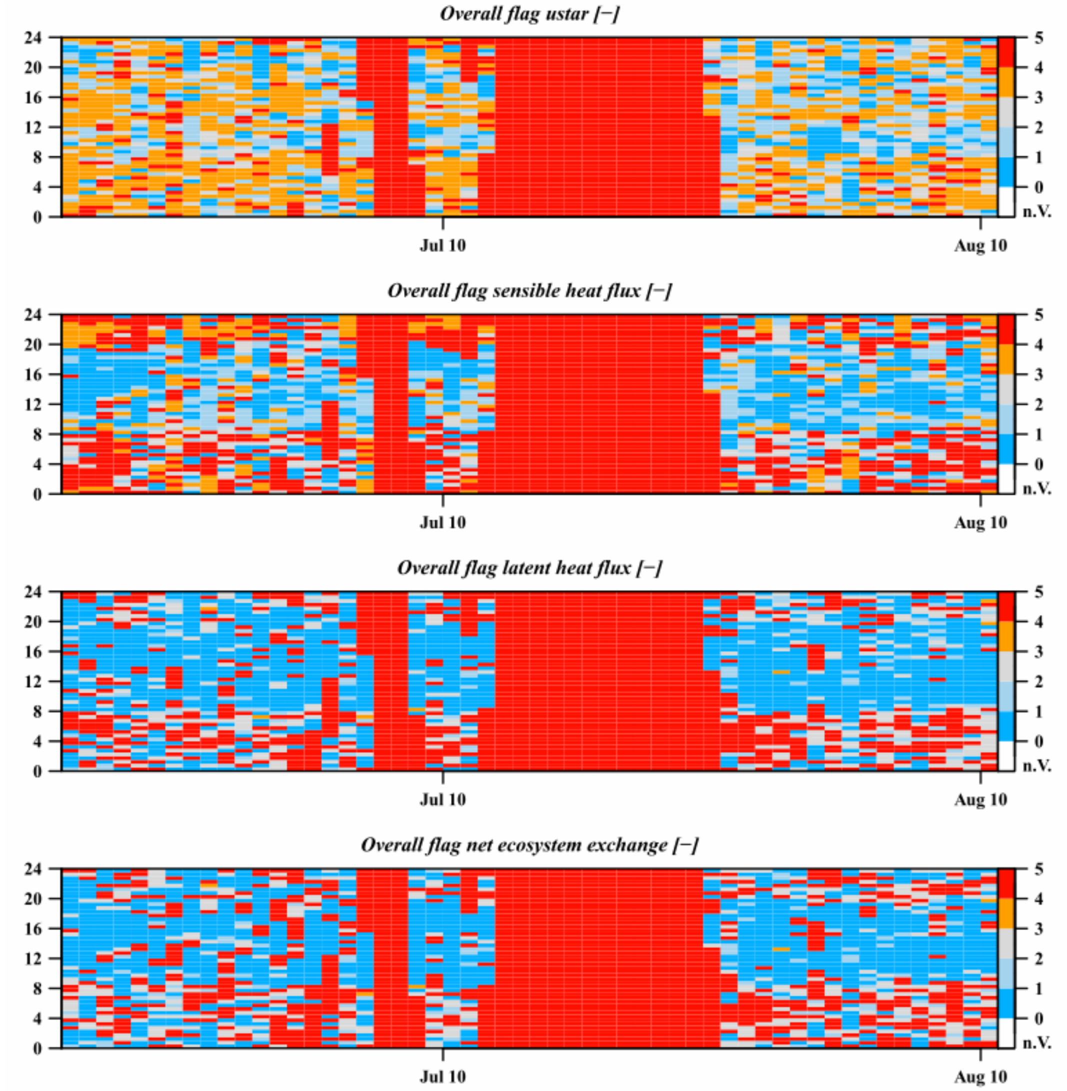

Figure 4-14: Data quality of the EC Data measured at KemaG. The Hovmöller plots show the daily cycle on the y axis and the different days during the measurement period on the x-axis. Jul10 and Aug10 indicate the start of the month. The color coding indicates quality flags calculated for every half hour value according to Foken et al. (2004) following the scheme of Rebmann et al (2005). 1 indication good and 5 data with poor data quality, missing data also is marked by flag 5. Therefore the plots also give an overview of the data availability.

Table 4-10: File structure of high frequent input Data from the ungrazed Plot for TK2, Eperiment June-August 2010 Kema Tibet, responsible Persons: Thomas Leipold, Tobias Biermann (contact: tobias.biermann@uni-bayreuth.de)

Filename	Begin Time	End Time
KemaU_H0003	"2010-06-03 11:08:38.45"	"2010-06-03 23:59:59.95"
KemaU_H0004	"2010-06-04 00:00:00"	"2010-06-04 03:29:45.65"
KemaU_H0005	"2010-06-04 03:29:45.7"	"2010-06-04 23:59:59.95"
KemaU_H0006	"2010-06-05 00:00:00"	"2010-06-05 17:34:54.8"
KemaU_H0007		
KemaU_H0008	"2010-06-06 16:56:16"	"2010-06-06 23:59:59.95"
KemaU_H0009	"2010-06-07 00:00:00"	"2010-06-07 19:25:49.25"
KemaU_H0010	"2010-06-07 19:25:49.3"	"2010-06-07 23:59:59.95"
KemaU_H0011	"2010-06-08 00:00:00"	"2010-06-08 18:47:42.7"
KemaU_H0012	"2010-06-08 18:52:47.15"	"2010-06-08 23:59:59.95"
KemaU_H0013	"2010-06-09 00:00:00"	"2010-06-09 12:10:45.85"
KemaU_H0014	"2010-06-09 13:01:11.75"	"2010-06-09 23:59:59.95"
KemaU_H0015	"2010-06-10 00:00:00"	"2010-06-10 23:59:59.95"
KemaU_H0016	"2010-06-11 00:00:00"	"2010-06-11 13:13:54.15"
KemaU_H0017	"2010-06-11 13:29:56.25"	"2010-06-11 23:59:59.95"
KemaU_H0018	"2010-06-12 00:00:00"	"2010-06-12 23:59:59.95"
KemaU_H0019	"2010-06-13 00:00:00"	"2010-06-13 23:59:59.95"
KemaU_H0020	"2010-06-14 00:00:00"	"2010-06-14 15:46:20.25"
KemaU_H0021	"2010-06-14 15:46:20.3"	"2010-06-14 23:59:59.95"
KemaU_H0022	"2010-06-15 00:00:00"	"2010-06-15 23:59:59.95"
KemaU_H0023	"2010-06-16 00:00:00"	"2010-06-16 23:59:59.95"
KemaU_H0024	"2010-06-17 00:00:00"	"2010-06-17 11:23:54.2"
KemaU_H0025	"2010-06-17 13:07:22.8"	"2010-06-17 23:59:59.95"
KemaU_H0026	"2010-06-18 00:00:00	"2010-06-18 23:59:59.95"
KemaU_H0027	"2010-06-19 00:00:00"	"2010-06-19 10:26:57"
KemaU_H0028	"2010-06-19 11:12:10.2"	"2010-06-19 23:59:59.95"
KemaU_H0029	"2010-06-20 00:00:00"	"2010-06-20 23:59:59.95"
KemaU_H0030	"2010-06-21 00:00:00"	"2010-06-21 23:59:59.95"
KemaU_H0031	"2010-06-22 00:00:00"	"2010-06-22 23:59:59.95"
KemaU_H0032	"2010-06-23 00:00:00"	"2010-06-23 11:48:26.55"
KemaU_H0033	"2010-06-23 10:51:20.8"	"2010-06-23 23:59:59.95"
KemaU_H0034	"2010-06-24 00:00:00"	"2010-06-24 23:59:59.95"
KemaU_H0035	"2010-06-25 00:00:00"	"2010-06-25 23:59:59.95"
KemaU_H0036	"2010-06-26 00:00:00"	"2010-06-26 15:20:10.4"
KemaU_H0037	"2010-06-26 15:20:10.45"	"2010-06-26 23:59:59.95"
KemaU_H0038	"2010-06-27 00:00:00"	"2010-06-27 23:59:59.95"
KemaU_H0039	"2010-06-28 00:00:00"	"2010-06-28 23:59:59.95"
KemaU_H0040	"2010-06-29 00:00:00"	"2010-06-29 08:06:05.5"
KemaU_H0041	"2010-06-29 08:06:05.55"	"2010-06-29 23:59:59.95"
KemaU_H0042	"2010-06-30 00:00:00"	"2010-06-30 23:59:59.95"
KemaU_H0043	"2010-07-01 00:00:00"	"2010-07-01 23:59:59.95"
KemaU_H0044	"2010-07-02 00:00:00"	"2010-07-02 18:05:36.7"
KemaU_H0045	"2010-07-02 18:05:36.75"	"2010-07-02 23:59:59.95"
KemaU_H0046	"2010-07-03 00:00:00"	"2010-07-03 23:59:59.95"
KemaU_H0047	"2010-07-04 00:00:00"	"2010-07-04 23:59:59.95"
KemaU_H0048	"2010-07-05 00:00:00"	"2010-07-05 23:59:59.95"
KemaU_H0049	"2010-07-06 00:00:00"	"2010-07-06 23:59:59.95"
KemaU_H0050	"2010-07-07 00:00:00"	"2010-07-07 13:00:44.35"
KemaU_H0051	"2010-07-08 10:50:02.5	"2010-07-08 11:24:50.15"
KemaU_H0052	"2010-07-08 13:12:11.45"	"2010-07-08 23:59:59.95"
KemaU_H0053	"2010-07-09 00:00:00"	"2010-07-09 11:00:55.2"
KemaU_H0054	"2010-07-09 12:32:58.7"	"2010-07-09 23:59:59.95"
KemaU_H0055	"2010-07-10 00:00:00"	"2010-07-10 23:59:59.95"
KemaU_H0056	"2010-07-11 00:00:00"	"2010-07-11 23:59:59.95"
KemaU_H0057	"2010-07-12 00:00:00"	"2010-07-12 23:59:59.95"

KemaU_H0058	"2010-07-13 00:00:00"	"2010-07-13 16:47:10.8"
KemaU_H0059	"2010-07-13 16:47:10.85"	"2010-07-13 23:59:59.95"
KemaU_H0060	"2010-07-14 00:00:00"	"2010-07-14 23:59:59.95"
KemaU_H0061	"2010-07-15 00:00:00"	"2010-07-15 23:59:59.95"
KemaU_H0062	"2010-07-16 00:00:00"	"2010-07-16 17:46:37.55"
KemaU_H0063	"2010-07-16 18.05:22.6"	"2010-07-16 23:59:59.95"
KemaU_H0064	"2010-07-17 00:00:00"	"2010-07-17 18:25:05.7"
KemaU_H0065	"2010-07-17 18:25:05.75"	"2010-07-19 14:09:56"
KemaU_H0066	"2010-07-19 14:05:56.05"	"2010-07-21 19:05:49.9"
KemaU_H0067	"2010-07-21 19:05:49.95"	"2010-07-24 13:03:30.7"
KemaU_H0068	"2010-07-24 13.03.30.75"	"2010-07-27 16:44:46.9"
KemaU_H0069	"2010-07-27 16:44:46.95"	"2010-07-27 23:59:59.95"
KemaU_H0070	"2010-07-28 00:00:00"	"2010-07-28 23:59:59.95"
KemaU_H0071	"2010-07-29 00:00:00"	"2010-07-29 13:15:48.1"
KemaU_H0072	"2010-07-29 13:15:48.15"	"2010-07-29 23:59:59.95"
KemaU_H0073	"2010-07-30 00:00:00"	"2010-07-30 23:59:59.95"
KemaU_H0074	"2010-07-31 00:00:00"	"2010-07-31 23:59:59.95"
KemaU_H0075	"2010-08-01 00:00:00"	"2010-08-01 23:59:59.95"
KemaU_H0076	"2010-08-02 00:00:00"	"2010-08-02 23:59:59.95"
KemaU_H0077	"2010-08-03 00:00:00"	"2010-08-03 11:17:24.35"

Table 4-11: File structure of high frequent input Data from the grazed Plot for TK2, Eperiment June-August 2010 Kema Tibet, responsible Persons: Thomas Leipold, Tobias Biermann (contact: tobias.biermann@uni-bayreuth.de)

Filename	**Begin Time**	**End Time**
KemaG_H0001	"2010-06-08 13:08:14.55"	"2010-06-08 23:59:59.95"
KemaG_H0002	"2010-06-09 00:00:00"	"2010-06-09 15:43:11.7"
KemaG_H0003	"2010-06-09 15:57:36.35"	"2010-06-09 23:59:59.95"
KemaG_H0004	"2010-06-10 00:00:00"	"2010-06-10 23:59:59.95"
KemaG_H0005	"2010-06-11 00:00:00"	"2010-06-11 11:52:17.85”
KemaG_H0006	"2010-06-11 12:33:57.3"	"2010-06-11 23:59:59.95"
KemaG_H0007	"2010-06-12 00:00:00"	"2010-06-12 23:59:59.95"
KemaG_H0008	"2010-06-13 00:00:00"	"2010-06-13 23:59:59.95"
KemaG_H0009	"2010-06-14 00:00:00"	"2010-06-14 16:13:22.8"
KemaG_H0010	"2010-06-14 16:18:02.5"	"2010-06-14 23:59:59.95"
KemaG_H0011	"2010-06-15 00:00:00"	"2010-06-15 23:59:59.95"
KemaG_H0012	"2010-06-16 00:00:00"	"2010-06-16 23:59:59.95”
KemaG_H0013	"2010-06-17 00:00:00"	"2010-06-17 13:10:40.4"
KemaG_H0014	"2010-06-17 13:10:40.45"	"2010-06-17 23:59:59.95"
KemaG_H0015	"2010-06-18 00:00:00"	"2010-06-18 23:59:59.95"
KemaG_H0016	"2010-06-19 00:00:00"	"2010-06-19 12:35:54.95”
KemaG_H0017	"2010-06-19 12:44:38.1"	"2010-06-19 23:59:59.95"
KemaG_H0018	"2010-06-20 00:00:00"	"2010-06-20 23:11:02.55"
KemaG_H0019	"2010-06-21 00:00:00"	"2010-06-21 23:59:59.95"
KemaG_H0020	"2010-06-22 00:00:00"	"2010-06-22 23:59:59.95"
KemaG_H0021	"2010-06-23 00:00:00"	"2010-06-23 12:21:02.25"
KemaG_H0022	"2010-06-23 12:21:02.3"	"2010-06-23 23:59:59.95"
KemaG_H0023	"2010-06-24 00:00:00"	"2010-06-24 23:59:59.95"
KemaG_H0024	"2010-06-25 00:00:00"	"2010-06-25 23:59:59.95"
KemaG_H0025	"2010-06-26 00:00:00"	"2010-06-26 15:55:44.9"
KemaG_H0026	"2010-06-29 07:14:58.45	"2010-06-29 23:59:59.95"
KemaG_H0027	"2010-06-30 00:00:00"	"2010-06-30 23:59:59.95"
KemaG_H0028	"2010-07-01 00:00:00"	"2010-07-01 23:59:59.95"
KemaG_H0029	"2010-07-02 00:00:00"	"2010-07-02 18:20:46.3"
KemaG_H0030	"2010-07-03 08:39:41.75"	"2010-07-03 23:09:45.95"
KemaG_H0031		
KemaG_H0032	"2010-07-05 20:29:39.5"	"2010-07-05 23:59:59.95"
KemaG_H0033	"2010-07-06 00:00:00"	"2010-07-06 02:38:09.65"

KemaG_H0034	"2010-07-06 12:40:16.85"	"2010-07-06 23:59:59.95"
KemaG_H0035	"2010-07-07 00:00:00"	"2010-07-07 23:59:59.95"
KemaG_H0036	"2010-07-08 00:00:00"	"2010-07-08 23:59:59.95"
KemaG_H0037	"2010-07-09 00:00:00"	"2010-07-09 13:35:02.5"
KemaG_H0038	"2010-07-09 13:49:37.4"	"2010-07-09 23:59:59.95"
KemaG_H0039	"2010-07-10 00:00:00"	"2010-07-10 23:59:59.95"
KemaG_H0040	"2010-07-11 00:00:00"	"2010-07-11 23:59:59.95"
KemaG_H0041	"2010-07-12 00:00:00"	"2010-07-12 23:59:59.95"
KemaG_H0042	"2010-07-13 00:00:00"	"2010-07-13 16:33:10.65"
KemaG_H0043	"2010-07-13 00:00:00"	"2010-07-13 23:59:59.95"
KemaG_H0044	"2010-07-14 00:00:00"	"2010-07-14 23:59:59.95"
KemaG_H0045	"2010-07-15 00:00:00"	"2010-07-15 23:59:59.95"
KemaG_H0046	"2010-07-16 00:00:00"	"2010-07-16 12:52:13"
KemaG_H0047	"2010-07-16 12:52:19.05	"2010-07-16 18:51:04.45"
KemaG_H0048	"2010-07-16 18:51:04.5	"2010-07-16 23:59:59.95"
KemaG_H0049	"2010-07-17 00:00:00"	"2010-07-17 18:35:53"
KemaG_H0050	"2010-07-17 18:35:53.05"	"2010-07-19 14:32:57.55"
KemaG_H0051	"2010-07-19 14:32:57.6	"2010-07-21 19:19:10.55"
KemaG_H0052	"2010-07-21 19:19:10.6"	"2010-07-24 12:47:46.8"
KemaG_H0053	"2010-07-24 12:47:46.85	"2010-07-27 16:18:02.3"
KemaG_H0054	"2010-07-27 16:18:02.35"	"2010-07-27 23:59:59.95"
KemaG_H0055	"2010-07-28 00:00:00	"2010-07-28 23:59:59.95"
KemaG_H0056	"2010-07-29 00:00:00"	"2010-07-29 12:04:08.55"
KemaG_H0057	"2010-07-29 12:11:19.55	"2010-07-29 23:59:59.95"
KemaG_H0058	"2010-07-30 00:00:00	"2010-07-30 23:59:59.95"
KemaG_H0059	"2010-07-31 00:00:00	"2010-07-31 23:59:59.95"
KemaG_H0060	"2010-08-01 00:00:00	"2010-08-01 23:59:59.95"
KemaG_H0061	"2010-08-02 00:00:00	"2010-08-02 11:16:38.1"

4.4 Weather observations

An Automatic Weather Station (AWS) was installed close to the station building, wind speed and direction, global radiation, air temperature and relative humidity as well as precipitation were measured in 2 m. The AWS is a WS-GP1 from Delta-T, the location can be seen in Figure 2-4. Weather conditions, cloud amount and cloud species were observed approximately every 4 hours by eye.

Date	Time	Oktas	Clouds	Remarks
04.06.2010	8:00	0		Frost at night, hoar-frost, no wind
	12:00	2	Cs neb., Ci, Cu hum. u. med. ra	Halo
	16:00	7	Cu con., Cb, Ci fib.	Weak rain a. hale, frequent wind direction change
	17:30			Thunderstorm, strong hale, extreme temperature decrease
	20:00	8	St neb. op	
05.06.2010	8:00	8	Ns	No rain
	12:00	7	Cb, Sc, Cc, Ci fib. u. unc.	Strong hale, rain a. wind the last 2h
	16:00	7	Cu con., Cb, Cu hum. a. med.	Strong hale, rain a. wind the last 2h, between periods with 4/8 a. Cu. hum.
	20:00	4	As, Ac, Cu, Ci unc.	
06.06.2010	3:00	8	Ns pra.	Rain
	4:30	8	Ns pra.	Weak snowfall
	8:00	8	Ns, St neb.	Snow at thesites, Thaw at the station
	12:00	8	St neb. op	Cold, wet, weak drizzle, fog that partly cover the hilltops
	16:00	5	Cu spec., Ac, Sc,Ci	
	20:00	3	Cu hum., Ac, As, Ci unc.	Sunny
07.06.2010	8:00	4	Ac/As, Ci	Like a sunny spring morning
	16:00	6	Cu spec., Sc vir	Rain at the horizont
08.06.2010	8:30	7	Sc pe/op	
	12:30	3	Cu spec., Ac, Sc	In between weak rain
	16:00	2	Ac, As, Cb, Sc, Cs, Cc, Cc flo	In between Ns with storm a. rain. Now sunny again
	20:00	1	Cu spec., Ci	At night, about 23:30, heavy storm
09.06.2010	8:00	0		Developing Cu at horizont
	16:00	6	Sc, As, Cu spec.	Stormy
	20:00	3	Cu con. vir, Cb, Ac/As	Stormy
10.06.2010	8:00	0		Developing Cu at horizont
	12:00	4	Cu spec.	Pleasant T-feeling, like summer
	20:00	1	Cu spec.	
11.06.2010	8:00	1	Cu hum.	No wind
	12:00	4	Cu hum., Sc	Strong wind
	16:00	5	Cu spec., Sc, As	Strong wind
	20:00	5	Cu spec., Cb, Sc	No wind
12.06.2010	8:00	1	Cu hum.	
	12:00	7	Sc	Weak rain, gusty wind
	16:00	4	Cu. spec., Sc op, Ac	Gusty wind

Date	Time	Oktas	Clouds	Remarks
	20:00	7	Sc pe	Weak rain
13.06.2010	8:00	7	Sc op	Weak rain
	12:00	7	Sc op, Cu spec., As	
	16:00	3	Cb, Cu spec., Ac, As	Less wind, sunny
14.06.2010	4:00	7	Sc pe	
	6:00	4	Sc pe	
	8:30	1	Sc pe., Cu hum.	
	12:30	6	Cu spec., Cb, Sc	
14.06.2010	16:00	4	Sc, Cu hum. ra.	
	20:00	2	Cu spec., Ci	
15.06.2010	8:00	7	Cb, Sc op., Cu con.	Less wind, rain
	8:30	6	Cb, Sc tr., Cu con.	
	12:00	7	Cb, Sc, St neb. op. a. fra	Thunderstorm, heavy rain a. hale,
	16:00	7	Cb cal a. cap, Sc	In between thunderstorms with hale a. rain
	20:00	4	Cu con., Sc, Cb, Ac flo a. len	
16.06.2010	4:00	1	Sc	
	9:00	5	Sc pe un	
	12:00	3	Cu. spec. ra., Cb cap.	
	16:00	4	Cb, Ns, Sc, Ac, As	
	20:00	0		
17.06.2010	8:00	6	Cu hum., Sc, Ac, As, Cs fib a. un du	No wind, sunny
	12:00	7	Sc pe. ra., As tr. a. pe. un., Cb	
	16:00	5	Sc, Cu spec., Ci fib. a. neb.	Weak rain
	20:00	6	Sc, As, Ac, Cu spec., Ci	
18.06.2010	6:00	8	Sc op.	
	8:00	7	Sc pe., Cb	
	12:00	7	Sc, Ns	In between often rain
	16:00	7	Cs, Sc op., Cu spec. ra.	
	20:00	3	Sc, Cb, Cu spec., Ci fib, Ci flo	
	0:00	4	Cb cal., Cb cap., Ac flo.	Cal. in the east with lightnings, cap. in the west without lightnings, Ac in between
19.06.2010	8:00	2	Ci, Cc, Cu hum. a. med., Sc	Sunny
	12:00	4	Cu med. ra., Cu hum. a. con., Cb	
	16:00	6	Cb, Cu spec., Ac	Weak rain but developing thunderstorm
	20:00	2	Cb cal, Cu spec.	
20.06.2010	8:00	6	Sc pe	
	12:00	6	Sc pe., Cb	Freshing up wind
	16:00	8	Ns, Cb	Constant rain a. sometimes thunderstorms
	20:00	4	Ci, Ci unc., Sc	
21.06.2010	8:00	7	Sc pe.	
	12:00	8	Ns	Weak rain

Date	Time	Oktas	Clouds	Remarks
	18:30		Cb-front	Heavy thunderstorm, with hale about 2cm in diameter
	20:00	7	Sc tr.	
	21:00	3	Ac, Ci, Ci fib	
22.06.2010	8:00	8	Sc un	
22.06.2010	12:00	8	Sc pe	Weak rain, Cb at horizont. In between bright period with Ac, Ci, Ci dup.,As, sunny
	16:00	8	Sc pe	
	20:00	7	Cb, Ac, As, Ci	Coming thunderstorm
23.06.2010	8:00	8	St neb. op	Fine rain, Cu at horizont
	12:00	6	Sc ra., Cu spec., Ac flo.	
	16:00	6	Ac str. tr., Cu str. ra., Cu spec.	
	20:00	6	Sc, Ac, Ac flo	Rain
24.06.2010	8:00	8	St neb., Ns pra.	Hilltops in fog and clouds, weak a. gently rain
	16:00	2	Cb, Sc, Cu spec., Ci, Ci unc., Cc	
	20:00	2	Cb, Ci, Ac, Sc	
25.06.2010	8:00	4	Cu spec., Ac, Ci	
	12:00	5	Cu spec., Ac, Ci, Cc, Cb	
	16:00	8	Cb	Thunderstorm
	20:00	5	Cb mam, Ci, Cu spec.	
26.06.2010 (Horseing)	8:00	5	Cb cal., Ac, Ac flo., Cu spec.	
	12:00	6	Cb, Cu con., Cu spec. ra.	
	16:00	7	Cb, Sc	Thunderstorm
	20:00	4	Ci, Cu spec.	
27.06.2010	8:00	6	Cu spec., Cb	
	12:00	6	Cu spec., Sc	Partly sunny
	16:00	4	Cu spec., Ci, As, Cb	
	20:00	8	Cb, Ns tr. vir	
28.06.2010	6:00	7	Ns	Less wind,
	7:10	6	Cu spec.	Dissapearing Ns, Sunrise
	8:00	6	Cu spec., Sc, Ac, Ci	
	12:00	7	Sc, Cu spec.	
	16:00	6	Sc, Cu spec.	Strong wind
	20:00	5	Cu spec., Ci, Cb	
29.06.2010	6:00	6	Cu, Sc, Ac, Ac flo.	
	7:00	4	Sc	
	12:00	7	Sc	
	16:00	5	Cu spec. ra., Cb	
	20:00	1	Cu spec., Cb, Ci	
30.06.2010	8:00	7	Sc tr., Ns vir	
	13:00	7	Cb, Ns, Ci	
	16:00	7	Cb cap., Cu spec. ra., Sc	
	20:30	2	Cb, Cu, Ac	
01.07.2010	7:00	5	Sc, Cu spec.	Calm
	8:00	7	Sc, Cu spec.	Increasing wind, wind direction north
	12:00	6	Cu spec. ra., Cu spec.	
	16:00	6	Cu spec. ra.	
	20:00	5	Cb, Sc, Cu con. Ac	

Date	Time	Oktas	Clouds	Remarks
	12:00	6	Cb, Cu con.	Fine rain, in between thunderstorms
	16:30	4	Cb, Ac, Cu spec.	
	21:00		Sc, Cu con. vir, Ac, As, Ci, Cs, Cb	
03.07.2010	4:00	7	Sc	
	8:00	6	Sc	
04.07.2010				NamTso - Station
05.07.2010				NamTso - Station
06.07.2010	8:30	1	Ac, Ac flo. a. un.	
	12:00	3	Cu spec.	
	16:00	8	Ns pra.	Rain
	20:00	7	As, Ac	
07.07.2010	12:30	6	Ac, Cu spec.	
	20:00	8	As, Cu spec.	
08.07.2010	9:00	7	As, Cu spec.	
	16:00	8	Cb	Strong thunderstorm
	20:00	8	Ns	Weak thunderstorm
09.07.2010	9:00	7	Sc	Weak north wind
	12:00	4	Cu hum. str.	Very sunny
	17:00	3	Cu hum., Cu con.	
10.07.2010	12:00	2	Cu hum., Cu con., Ac	
	16:00	7	Cu hum. a. con., Cb	Cb with less structure
	20:00	6	Cb	
11.07.2010	8:30	5	Ac str.	Nearly no wind
	12:10	3	Cu con. a. hum., Ac	12:17 rain
	17:00	4	Cu con., Ac	Ac in vanishing
	20:15	6	Cu spec., Ac	
12.07.2010	9:00	7	Sc pe	Bevor raining
	20:30	3	Dissappearing clouds	Constant cloudy and rainy till up now
13.07.2010	8:30	3	Ac, Ac len	Sunny
	12:10	5	Cu hum. a. con.	Strong wind from the south
	16:00	3	Cu hum. a. con.	
	20:00	4	Cu con., Ci, Cu hum., Ac	
14.07.2010	20:00	8	Sc	
15.07.2010	9:00	7	Cs	
16.07.2010	9:00	7	As, Ac, Sc	
	12:30	7	Cu spec., As, Cu spec. ra.	
	16:00	6	Ac, As, Cu spec.	
	20:00	7	As, Ac flo. a. un., Cu spec.	
17.07.2010	9:00	8	Ns	Fine rain
	12:00	8	Ns	Fine rain
	16:00	8	Ns	Fine rain
	20:00	6	Cu spec., Ac	
18.07.2010	8:00	6	Cu spec., Sc	
	12:00	4	Cu spec.	
	17:00	5	Cu spec.	
	20:00	6	Cu spec.	
19.07.2010	8:30	1	Cu hum.	No clouds in the night, hoar-frost
	12:00	1	Cu hum.	
	14:00	2	Cu hum.	
	16:00	1	Cu hum.	

Date	Time	Oktas	Clouds	Remarks
20.07.2010	9:00	4	Ci, Cs, Ac, As	
	12:00	7	Cu hum. ra., Cu med., As, Cs	
20.07.2010	16:00	7	Ac, As, Ci, Cu, Sc vir	
	20:00	8	Ns, As, Cu	
21.07.2010	9:00	8	Ns	Weak rain
	12:00	7	Ns, Sc vir	
	16:00	8	Ns, Cb vir	No rain, thunder
22.07.2010	9:00	8	Ns	Weak rain
	12:00	7	Ac, Ac flo, As, Ci, Cu spec.	
	16:30	8	Ns	
	20:00	8	As, Sc, Cu spec.	Drizzle
23.07.2010	9:00	8	Sc, Ns	
	12:00	5	Cu spec., Cu med. a. con. ra., Ac flo., As, Ci, Cs	
	16:00	7	Ns pra.	Rain
	20:00	8	Ns pra.	Rain
24.07.2010	7:00	7	Ns pra.	Rain
	12:00	6	Cu hum. ra.	Direction ca. 220-250°
	17:00	7	Cu spec., As	
	20:00	7	As, Cu spec.	
25.07.2010	8:00	1	Cu spec.	
	12:00	4	Cu spec.	
	16:00	5	Cu con., Cb, As	Strong wind
	20:00	8	As, Sc, Cu spec.	
26.07.2010	8:30	7	Ns pra., Sc	Rain
	12:00	7	Sc, Ac, Ac flo, Ci, Cu hum. ra.	Direction ca. 45°
	16:00	8	Ns, Cb	Thunder, rain start 16:30
	20:00	8	As, Ns, Sc vir	
27.07.2010	8:30	7	Ns, Sc, As, Cu spec.	Just some rain drops
	12:00	7	Cu med. ra. str., Ac, Ac flo. a. un., As, Ns vir, Cb	Direction ca. 0°
	16:00	6	Cu spec. ra., Cb, Cb vir, Cs, Ci, Ac, As	Direction ca. 285°
	20:00	8	Sc pra. vir	Weak rain, in between frequently strong wind, rain a. hale
28.07.2010	3:00	8	Sc tr	
	9:00	7	Sc op., Sc tr. a. per.	
	12:30	5	Cu. con. med. ra., Cu con., Ac, Ci fib., Ac vir unc.	Rad direction ca. 250°, Ac developing to As, Cu developing to Cu str.
	16:00	8	Cb pra. vir, Ns, Cu spec., As	In between frequent thunderstorms, rain a. hale
	20:00	7	Cb pra. vir, Ns, Cu spec.	
29.07.2010	9:30	1	Ci, Ci unc., Ac	
	13:15	6	Cu med. cog. ra., Cb	Direction ca. 190°
	16:30	7	Cb pra. vir, Cu spec.	Hale, rain, heavy thunderstorm
	20:30	3	As, Sc, Cb cal, Cu spec.	
30.07.2010	8:00	1	Cu hum. a. med.	

Date	Time	Oktas	Clouds	Remarks
	16:00	5	Sc, Cb, Cu med. ra.	Direction ca. 230°
	20:00	4	Cb, Cb cal, Ac, Cu spec.	
31.07.2010	8:30	0		
	12:00	1	Cu hum. a. med.	
	16:00	4	Cu med. a. con. ra.	Direction 360° around Kema, S a. N ca 180°, E a. W. 280-360°
	20:00	7	Ac/As, Cu spec.	
01.08.2010	7:00	7	Sc, Cu str. hum., As	
	8:00	4	Ac flo. a. un., Sc pe. un., Sc pe., Sc op., Cu spec., Ci	
	11:00	1	Ac, Cu spec.	
	12:00	3	Cu spec. ra.	Direction 360°
	15:30	4	Cu spec. ra., Cb, Cb cap.	16:00-16:30, heavy thunderstorm, hale
	20:30	8	Cb vir, Cb, As, Sc	Thunderstorm
02.08.2010	9:45	1	Sc op, Cu spec., Cb, Ac un.	
	11:16	5	Cu spec., Sc tr.	
	13:00	7	Cu spec. ra. str., Sc un. vir., Cb	
	16:00	7	Ns, Sc, Cb, As	
	20:00	7	Sc, Ns, Cb	
03.08.2010	8:30	8	Ns, Cu spec.	
	10:00	8	Ns, Cu spec.	Drizzle
	12:30	6	Sc tr., Ac, Ac flo., Cu spec. ra., Cb, Ci	Direction ca. 250°
	16:30	7	Ns, Ns vir, Sc, As, Cu spec.	
	20:00	8	Ns, Cb	Weak rain
04.08.2010	5:00	8	Ns	Fine rain
	9:30	8	Sc tr. a. pe. a. op.	Fine rain
	12:00	8	Sc tr. a. pe. a. op., Cu hum. ra.	Direction ca. 250°, no rain

Latin name	Description	Abbreviation
Cloud genera		
Cirrus	High fleecy cloud	Ci
Cirrocumulus	High fluffy cloud	Cc
Cirrostratus	High misty cloud	Cs
Altocumulus	Rough fluffy cloud	Ac
Altostratus	Middle high misty cloud	As
Nimbostratus	Rain layer cloud	Ns
Stratocumulus	Layer heap cloud	Sc
Stratus	Lower layer cloud	St
Cumulus	Heap cloud	Cu
Cumulonimbus	Thundercloud	Cb
Cloud species		
fibratus	fibrous	fib
uncinus	hook-shaped	unc
castellanus	turreted	cas
floccus	fluffy, baggy	flo
stratiformis	layer-shaped	str
nebulosus	nebular	neb
lenticularis	lentoid, almond-shaped	len
fractus	disrupted	fra
humilis	low	hum
mediocris	moderate developed	med
congestus	high-piled	con
calvus	bare	cal
capillatus	hairy	cap
Sub species		
undulatus	wavelike	un
radiatus	radial, parallel bands	ra
duplicatus	two or more layers	du
perlucidus	see-through (gaps)	pe
translucidus	transparent	tr
opacus	close, dark	op
Concomitant clouds		
incus	with ambos	inc
mamma	bag-like outgrowth at the bottom side of the clouds	mam
virga	visible rain bands	vir
praecipitatio	with rain	pra
Remark	mixture of hum, med, con	spec

5 Soil Respiration Measurements

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5.1 Setup and Measurements

Soil CO_2 efflux from the *Kobresia* experiment site was measured using an Infrared Gas Analyser (Li-8100, LI-COR Lincoln, NE, USA) supplied by a LI-8100 Soil Survey Chamber at a weekly basis. Two days before the first measurement, PVC soil collars of 20 cm inner diameter (21 cm outer diameter) and seven Centimeters height were inserted 2 cm deep into the soil and left there until the end of the measuring period. The intersection between plastic ring and root mat was sealed with sieved silt and fine sand (see Figure 5-1). Because of missing grazing in the beginning of the measuring period in the mid of June, the collars on the grazed site were installed at the end of June, two weeks after the ones inside the fence. Preliminary tests have shown that the influence of the aboveground biomass on the CO_2 flux was negligible while measuring with the non-transparent chamber. Thus cutting of the vegetation before measurement was not necessary. Since the major goal of the study was to assess temporal and spatial variability of the CO_2 efflux with respect to the history and intensity of the ecosystem grazing pressure, the study was carried out in four different treatments of the permanent setup (see chapter 2.1, Figure 2-3). On the grazed and ungrazed sites outside the footprint borders of the two EC Stations, eight soil collars were installed randomly within the livestock exclosure and control plots, respectively. In addition, two collars were inserted within each pika fence.

To estimate a spatial heterogeneity of the soil CO_2 efflux due to the spatial distribution of vegetation inside the fence in livestock exclosure around the estimated footprint of the EC Stations, additional soil collars were installed on vegetation covered spots and on bare soil (17 and 8 collars, respectively).

Figure 5-1: Soil collar for soil CO_2 flux measurements, sealed with silt against boundary effects

Diurnal soil CO_2 efflux measurements on the grazed and ungrazed sites were performed over a 24 h period at a 2 h interval in three particular days representing different plant phenology phases (July, 18, July, 31 and September, 1)

Simultaneously to the analysis of soil CO_2 efflux rate, the soil temperature was measured at 6 cm soil depth with a LI 8100-201. The volumetric soil water content at 0.06 m depth was measured adjacent to each PVC collar with a theta probe (ML2, Delta-T Device Ltd, Cambridge, UK). For each of the treatments mean CO_2 efflux rates were calculated from the all chamber measurements obtained during individual sampling events.

5.2 Data availability

Table 5-1: Overview over soil respiration measurements from June to September 2010

Filename	Date	Begin time	End time
20100617945	2010-06-17	09:00	12:14
20100619945	2010-06-19	10:13	12:48
KU20100621day	2010-06-21	10:00	16:00
KU20100623 and KU20100623afternoon	2010-06-23	11:24	13:15
KU20100629	2010-06-29	09:56	17:30
KU20100701	2010-07-01	10:43	13:41
KU2010072	2010-07-02	15:49	19:01
KU20100708	2010-07-08	15:47	15:58
KU20100711	2010-07-11	11:15	18:46
KU20100716	2010-07-18 to 2010-07-19	05:21	04:07*
KU20100719	2010-07-19	15:45	18:55
KU20100720	2010-07-20	11:14	14:14
KU20101725	2010-07-26	15:14	18:17
KU20100727	2010-07-27	10:29	11:26
KU20100731	2010-07-31 to 2010-08-01	23:35	22:11*
KU20100808	2010-08-08	10:28	16:02
KU20100818	2010-08-18	10:03	17:58
KU20100821	2010-08-21	10:14	11:39
KU20100822	2010-08-22	10:25	11:55
KU20100826	2010-08-26	11:17	17:36
KU20100828	2010-08-28	10:14	13:36
KU20100901	2010-09-01 to 2010-09-02	09:51	13:53*

*following day

6 ^{13}C labeling-chasing study

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6.1 Aim

The aim of the ^{13}C pulse labelling is to assess the allocation of assimilated Carbon in the shoot-root soil-system. Carbon is assimilated by plants and subsequently allocated to different Carbon pools. Pulse labelling allows tracking the Carbon within the system on the background of C already present in the soil, and thus to assess the partitioning of the assimilate Carbon into different pools in the shoot-root-soil-system.

6.2 Experiment

Plants are labelled with ^{13}C enriched CO_2 in transparent chambers (Figure 6-1). Therefore the plots were covered with transparent plastic foil. In the chamber was a plastic vial with a known amount of ^{13}C enriched Na_2CO_3 (99% ^{13}C) dissolved in purified water. The foil was buried into the soil and additionally sealed with wet soil. By injection of 5 M Sulfuric Acid on the Carbonate, the Carbon was released as $^{13}CO_2$ into the chamber. Thus, the plants in the chamber assimilate labelled Carbon. The chamber was opened again after approximately 4 hours.

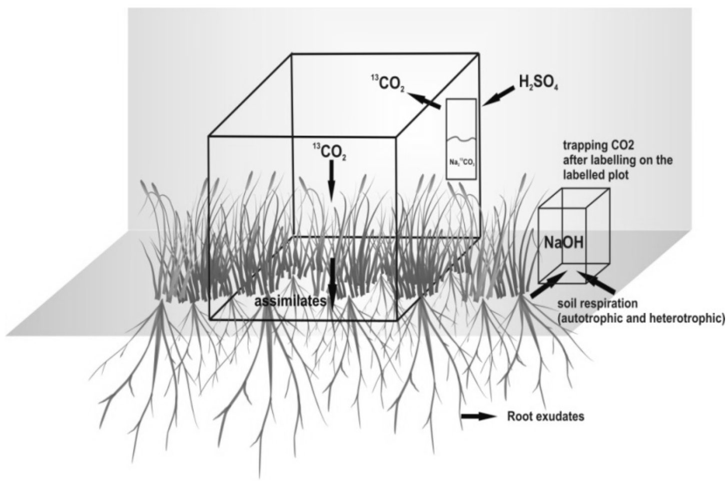

Figure 6-1: Isotope Labeling in a chamber with enriched CO_2 (Silke Hafner).

Directly after the labeling the first sampling was performed. On every plot two samples were taken and mixed. Aboveground Biomass was clipped with a scissor on a defined area. The belowground pools were differentiated into two layers (0-5 cm and 5-15 cm). Soil samples were taken with a soil corer (2.6 cm diameter). After drying the samples they were sieved (2 mm) and separated into the three belowground pools: 1) soil, 2) living roots and 3) dead roots. Soil respiration was measured by NaOH-traps. After each sampling a defined amount of 1 M NaOH (20-30 ml) was placed on one of the clipped areas. An opaque aluminum chamber (Budweiser beer can) was put above it and sealed on the ground. The CO_2 emerging from the soil thus gets captured in the NaOH. On the next sampling day the chamber was removed and the amount of captured CO_2 was determined by titration with 0.1 M HCl. Afterwards the Carbonate was precipitated with $SrCl_2$-Solution, washed with water and dried for Isotope analysis. The samples are analyzed for total C- and N-content and isotopic signature ($\delta^{13}C$), with an Isotope-Ratio Mass Spectrometer (IRMS) at the University of Bayreuth. Additionally to the labelling width ^{13}C, a ^{15}N label was applied with NO_3^-, NH_4^+ and Glycine at the same location. Samples were taken on consecutive on the 5 days following the application.

Table 6-1: Setup of the 13C-pulse-lableling experiment

Labeling	1st of July
Plot size	0.6 m x 0.6 m
Treatments	Grazed (C) Yak-Exclosure (Y) Full exclosure (PY)
Replicates	4
Sampling dates	1.7., 2.7., 5.7., 9.7., 16.7., 24.7., 30.7. 6.8., 18./19.8, 3.9.
Pools	Aboveground BM, soil respiration 0-5 cm: soil, living roots, dead roots 5-15 cm: soil, living roots, dead roots

7 Soil-Plant water balance

Heinz Coners, Christoph Leuschner

Department of Plant ecology, University of Göttingen

7.1 Setup

Small weighing lysimeter were used to monitor evapotranspiration, infiltration and volumetric soil water content. The lysimeter consist of a Plexiglas tube (15 cm diameter) with a Plexiglas plate glued to the bottom. The bottom plate is covered with a spread bundle of 20 glass wicks (2 mm diameter) leading through a 10 cm long downward pipe (15 mm diameter) into a plastic bottle (Figure 7-1). Via this hanging water column a suction of 10hPa is applied to soil monolith, thus maintaining a constant drainage. Soil cores (3.3cm diameter, 30cm depth) were taken near every lysimeter on June 29th to July, 1st. The soil samples were weighted fresh and after drying in the laboratory at Lhasa. By relating the given water content to the weight of the corresponding lysimeter at that data, we were able to calculate volumetric soil water content for each lysimeter over the whole measuring period.

7.1.1 Grazing experiment

In the second half of June 2010 a total of 36 lysimeter were installed. On each plot in fig 2-4 one lysimeter was installed in the NW-corner resulting in 4 treatments with 4 replicates. Outside the yak fence 4 additional lysimeters were set up in the fetch of the EC Station.

Control	4 lysimeters
Extra control in fetch of EC Station	4 lysimeters
Yak exclusion	4 lysimeters
Pika exclusion	4 lysimeters
Yak and Pika exclusion	4 lysimeters

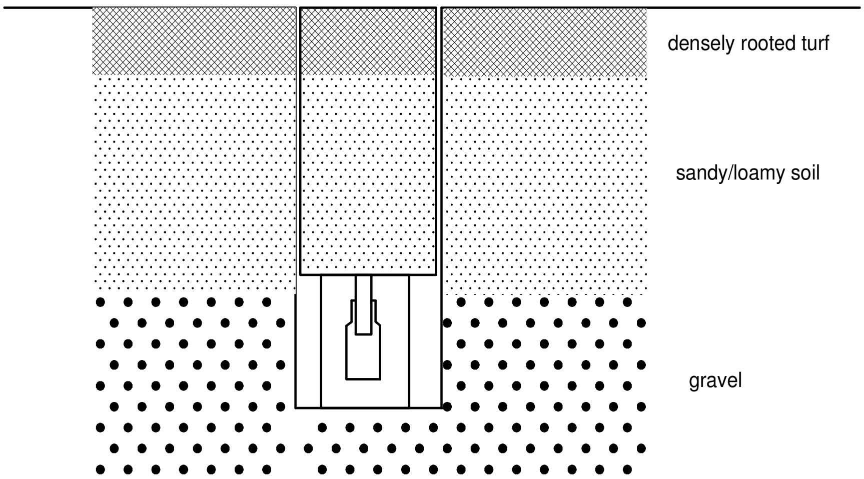

Figure 7-1: Small weighing Lysimeter in normal position. The undisturbed soil monolith is in its original position.

7.1.2 Surface comparison

In order to investigate the evapotranspiration from disturbed soil patches in comparison to undisturbed soil, 4 additional lysimeters were installed in bare soil spots in all yak and pika exclusion plots.

Undisturbed	4 lysimeters (same as Yak and Pika exclusion in 7.1.1)
Bare soil	4 lysimeters

7.2 Lysimeter Measurements

Lysimeters were weighted at the following days:

22.6.10 11:45 Start
23.6.10 14:30
26.6.10 15:30
27.6.10 18:30
29.6.10 14:45
1.7.10 17:00
9.7.10 12:00
16.7.10 16:00
25.7.10 11:00
5.8.10 18:30
17.8.10 15:00
28.8.10 16:00
29.8.10 14:30
5.9.10 10:15 End

7.3 Additional Measurements

From June 26th to July 2nd 2010, 10 iButton Thermochrons were installed in the upper 2cm of the soil inside and outside different lysimeters (Table 7-1). In the same period (June 26th to July 2nd) a Easylog 80 miniature measurement and logging device was installed in 1.5m height near Plot KmYP4, logging air temperature, relative humidity, dew point and atmospheric pressure in 15 minute intervals.

7.4 Root biomass

Root biomass was harvested in September 2009 on all 16 Plots in Fig 2-4 and on 4 swamp plots to get an estimate of the standing crop root biomass before the long term grazing exclusion experiement. In September 2010 soil cores for root harvesting were taken from all 12 irrigation treatments decribed in section 7.1.3.

The soil cores (3,3 cm diameter, 30 cm deep) were devided into the horizons 0-5cm, 5-15cm and 15-30 cm. All roots in each sample were rinsed from soil particles keeping small root fragments by means of a stack of fine sieves.

The root fragments were devided into living and dead roots under a stereo microscope, a method originally developed in the Department of Plant Ecology in Göttingen for separating living and dead tree fine roots.

Before determining necro- and biomass by drying the root surface area of subsamples was measured with an optical system (WinRhizo, Regent Inc., Quebec, Can).

Corresponding above ground biomass samples were harvested by Elke Seeber (see chapter 3).

Table 7-1: Location of iButton Thermachrons.

Plot	Location	Treatment
KmK1	Inside lysimeter	Control without exclusion
KmYP4	Inside lysimeter	yak and pika exclusion
KmYP4	Outside lysimeter	yak and pika exclusion
KmP1	Inside lysimeter	pika exclusion
KmY4	Inside lysimeter	yak exclusion
KmYP4S	Inside lysimeter	yak and pika exclusion Bare soil
DL3	Inside lysimeter	yak and pika exclusion 8.6 mm/day irrigation
DL2	Inside lysimeter	yak and pika exclusion 4.3 mm/day irrigation
Soil collar	Inside soil collar	-
Soil collar	Outside soil collar	-

8 Soil moisture monitoring and dewfall measurements

Siyuan He, Keith Richards

Department of Geography, University of Cambridge

Soil moisture monitoring and dewfall measurements were conduct by Siyuan He, from Department of Geography, University of Cambridge. The experiment focuses on understanding the soil water balance and water movement along the soil-plant-atmosphere continuum under different surface conditions. Within this context, a particular interest is to understand the quantitative importance of dew and its effects on soil moisture under different surface conditions. On the premise of soil degradation and the special topographic unit of mountain-ranged basin, it may be hypothesised that degradation-induced land cover change alters the moisture fluxes by suppressing the dewfall, so that evapotranspiration and the energy balance are changed, which then influences cloud formation and precipitation, and therefore may have effects over a wider region. A wider hypothesis may be that the surface condition influences the whole water transport from infiltration to the following evapotranspiration and then precipitation, with dewfall as one of the water gain for the ecosystem.

8.1 Setup and Measurements

8.1.1 Lysimetry

Two types of Lysimeter have been designed for this experiment: one is for the measurement of the normal soil water balance, and the other is for dewfall. Basically, they are made up of an internal tank resting on a load cell and set within an external tank. Internal and external walls are made of 2 mm thickness aluminium sheet; bases and supporting pieces are made of plastic. The surface of the internal tank is 0.2×0.2 m square, and the depth for the normal and dewfall measurement are 30 cm and 5 cm respectively. The normal Lysimeter has a tipping bucket set under the tank to measure infiltration drainage from the hole drilled in the base of the tank, which is part of the whole water balance. Every tip is 0.01″ water which can be calibrated to a depth in mm for direct comparison with rainfall and other components in the water balance; this requires adjustment according to the ratio of surface areas of Lysimeter and the rain gauge from which the tipping bucket was taken. The capacity of the load cells for the normal and dewfall Lysimeters are 15 kg and 3 kg respectively, both are Platform Load Cell Model 1022. Their operating temperature range is -20°C to 70°C and the deflection is undetectable (<0.4 mm). The Rate Output is 2mV/V. The full logging range of ±25 mV has a sensitivity of 3.33μV. Since the supply power of the data logger is a regulated 10V, if 15 kg and 3kg are applied respectively, the output is 1.33 μV and 6.66 μV per gram so the dewfall Lysimeter has a high precision of 0.5 g, which is 0.0125mm water, while the normal Lysimeter has a precision of 2.5 g. This is why the dewfall Lysimeter is built separately. Another tipping bucket rain gauge is used to measure rainfall continuously which is the same type of tipping bucket for drainage measurement. The weight change of the two Lysimeters and the seepage water measured by the tipping bucket and the rainfall will be connected to the CR10X data logger for continuous logging. There will be a clear plastic shelter set over the shallow Lysimeter to prevent rainfall. For the dewfall measurement the water balance equation is

$$Dew - ET - \Delta S = 0$$

where *Dew* is dewfall, *ET* is evapotranspiration, ΔS is change of water in the monolith. For the normal Lysimeter, the water balance equation is

$$P + Dew - ET - D - \Delta S = 0$$

where *D* is drainage measured by the tipping bucket; however, dewfall is undetectable under the whole weight of the monolith. With the combination of the two Lysimeters, the amount of the different water components in a daily cycle can be estimated. Dewfall and *ET* are taken as opposite phenomenon with the sign of figure either positive or negative. There were two sets of the Lysimeter combination installed, one in a *Kobresia* meadow surface and one in a crust, and both referring to one rain gauge, and the sets will be installed within the footprint of the EC tower. Weight change and tipping bucket measurement will be recorded every 60s and averaged or totalized to half-an-hour. The measuring period lasted from June, 11th to August, 1st. However, considering the life span of the shallow Lysimeters, long term measurement may be difficult to secure, and it is likely that frequent rainfall, storm and night rainfall will disturb the equipment. To make sure of continuous dewfall measurement, dead turf will be replaced by living one at certain interval, or the turf will be irrigated regularly to keep it alive. One water balance monitoring system has been established in the protected plot as explained above, and includes a 30 cm-deep Lysimeter with a built-in tipping bucket for drainage measurement, a 5 cm-deep Lysimeter, two tensiometers inserted at a depths of 10 cm and 20cm respectively, two temperature probes, for soil temperature at a depth of 10 cm and for air temperature at 10 cm above ground, and a tipping bucket rain gauge (Figure 8-1). The shallow Lysimeter was protected from precipitation under a transparent rain shelter. The depth of turf (Afe) is about 18 cm in the protected plot, but the turf had to be cut to only 5 cm depth to fit the shallow Lysimeter. From mid-July there were more pika in the field, and they sometimes grazed grass growing in the Lysimeter. On July 15th, a small wire fence was built around the Lysimeters to protect the turf surface.

The second lysimetry system was installed on a soil with a lichen covering crust, except for the deep Lysimeter, which was installed in bare soil (Figure 8-2). That was necessary because the tools used were not robust enough to install the deep Lysimeter in soil with a compact crust. The other devices in this system are the same as in the first, except that there is no separate rain gauge. The soil profiles in both of the deep

Figure 8-1: Monitoring system on turf

Figure 8-2: Monitoring system on crust

Lysimeters had to be artificially rebuilt from sequential layers dug from nearby soil pit. All of the devices in each set were connected to a CR10X data logger (Campbell Ltd.). Two 12 V batteries were used for the logger, one of which provided power for the data logger, while the other provided a regulated 10 V supply through a regulator to supply the pressure transducers in tensiometers, and the load cells.

8.1.2 Surface wetness measurement

For the measurement of surface moisture, 0.2×0.2 m chromatography paper is used instead of blotting paper. The number of pieces used for one sample depends on the observed moisture. Dry paper is weighed by a 0.1g balance before use. In the morning of measuring day before sun rise, pieces of paper are pressed evenly onto the surface of the turf, in order to absorb all the moisture (dew and guttation). The wet paper is weighed immediately to avoid evaporation. 3-5 replicates are needed in one plot. The difference between the wet and dry paper is the moisture on the area of surface sampled, which may be transformed to a depth of water (mm). Using this method, wetness differences among the three types of surfaces can be detected roughly, and wetness converted to water depth can be compared with the recorded amount of rainfall. The locations have been randomly selected in the field. Soil particles have been erased carefully if they adhere to the paper, especially on bare soil surface. Similar height of precipitation should fall over different types of surfaces before precipitation water reaches the soil-vegetation surface, but the wetness on leaves afterwards will differ because of the vegetation cover, which in turn influences water transport after sunrise. Water or vapour condensation as forms of precipitation are directly dependent on vegetation cover. For example, there were several days when dew and frost occurred on leaves but were not sensed on the soil surface. When frost formed, chromatography paper absorbed water melted from frost when pressed on to the soil-vegetation surfaces before sunrise to prevent evaporation under sunshine. The sampling day and surface coverage is recorded in Table 8-1.

Table 8-1: Surface wetness measurement

Day	Surface coverage		
	Kobresia	Crust	Bare soil
Jul.10	N/A	N/A	N/A
Jul.13	N/A	N/A	N/A
Jul.14	N/A	N/A	N/A
Jul.18	N/A	N/A	N/A
Jul.19	N/A	N/A	N/A
Jul.23	95%	20%	40%
Jul.24	95%	10%	40%
Jul.28	95%	50%	30%
Jul.29	95%	40%	30%
Jul.30	95%	50%	50%

8.1.3 Soil bulk sampling

Sampling to detect the heterogeneity of soil in the protected field has been carried out along a diagonal transect from NW to SE across the field. Six points were chosen, and at each point three segments of the soil profile have been sampled, according to the soil textural stratification. The total depth sampled is 35 cm which is controlled by the length of the soil auger used.

Soil samples were also collected from the soil profiles exposed in the pits dug to enable extracting of soil to place in the deep Lysimeters, with a 5 cm-segment interval from the surface to a depth of 40 cm. Gravel created difficulty when soil sampling, and hindered Lysimeter installation; this problem was worse in the bare soil, for gravel is more common in the soil under this surface.Regular soil moisture sampling was delayed until July because of a lack of suitable tools. Samples were then taken down soil profiles under three types of surface, at a frequency about a week, and according to weather condition. A 10 cm sampling interval was conducted from the surface to a depth of 40 cm, and three replicates were collected in each interval. Moist soil

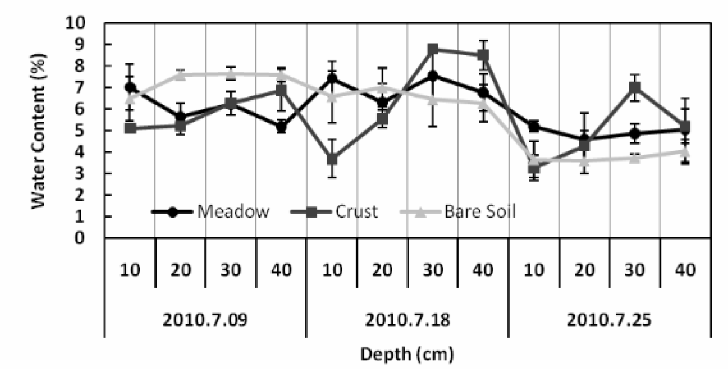

Figure 8-3: Soil water content of air-dried soil

samples were weighed on a field balance (resolution 0.1 g) immediately, and then they have been air dried for about a week. Dry weight has been recorded afterwards to estimate soil moisture content by weight percentage. Soil water contents of air-dried soil taken from the three surfaces are displayed in Figure 8-3. From July 14th, it rained less and soil moisture contents changed significantly.

8.1.4 Infiltration experiment

The infiltrometer used is a constant head apparatus, and the feeder bottle is a 1 m long plastic tube with an internal diameter of 52 mm. This graduated tube could provide about 2123 ml water. The internal diameter of the steel cylinder is 98 mm. Before taking it to the field, a 5 cm interval is marked on both inside and outside of the steel cylinder to indicate the depth of insertion, and the bottom of the shorter feeder tube also has a 5 cm distance to the soil surface. The two feeder tubes are adjusted with a difference of about 0.5 cm between the projecting lengths. The graduated tube is filled with water and mounted on the steel frame on top of the steel cylinder so that it stands stable during experiment, and the frame is adjusted parallel with the ground surface with spirit levels before the graduated tube is amounted. The infiltrometer has been set up on three types of surface (Figure 8-4). It was planned that 10 replicates would be taken to represent a whole field; however, the weather condition in the research area cannot guarantee completion of this plan, and the existence of diverse soil-vegetation combination makes a comparison among these soil surface conditions more attractive. Thus, experiments have taken place over time at different vegetation growth stages, and in different locations in the protected field and the grazed field. Measurements were also taken at times when there had been no rain in the previous 24 hours. This condition is hard to meet in the rainy season, but it did occur in mid-July when dry weather lasted for almost three days. Experimental results show that in the same field the infiltration capacity still has high heterogeneity, but that the difference in infiltration capacity among three surfaces is nevertheless distinct. Antecedent soil moisture also influences infiltration capacity, which is shown from two consecutive experiments carried out in ungrazed turf over a 15-hour interval.

The design of the infiltrometer is in fact not very convenient for windy weather on the plateau, for the erected feeding tube is too tall to withstand heavy wind. The instability adds to uncertainty of water level readings, and to the possibility of failed experiments.

Table 8-2: Infiltration experiments

Surface	meadow	crust	bare soil	K_s (mm/min)			f_f(mm/min)		
Date	Jun.4	Jun.6	Jun.5	0.6537	N/A	3.5627	0.83935	N/A	3.44079
	Jun.5	Jun.19	Jun.19	N/A	N/A	2.4997	N/A	N/A	3.45261
	Jun.19	Jul.3	Jul.3	1.1666	0.4245	2.2028	1.35686	0.52264	2.49449
	Jun.20	Jul.4	Jul.13	0.8746	0.7078	4.0313	1.17577	0.95745	4.29605
	Jul.3	Jul.10	Jul.19	1.6686	0.8354	1.5069	1.8888	0.99383	1.79636
	Jul.10	Jul.13	Jul.25	1.7325	0.691	N/A	2.04008	0.94676	N/A
	Jul.15	Jul.19		1.4383	0.8398		1.35487	1.13051	

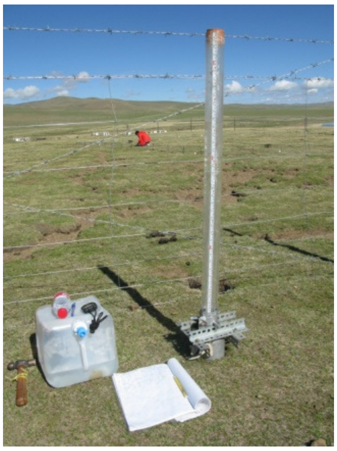

Figure 8-4: One experiment carried out on protected turf

8.1.5 Stable isotope sampling

Different sources of water have been sampled and stored in 12 ml Exetainers. Precipitation has been sampled every morning around 8:00 am if it has accumulated in a self-made plastic plate under the rain collector. This sampling started on June 4th and ended on August 3th. In total 42 samples have been taken covering the pre-monsoon and the monsoon season (Table 8-3). This rain collector was modified from a tipping bucket rain gauge, and it reduces water evaporation which causes fractionation, although sand, dust and bugs are unavoidable. Each sample is from water accumulated in the previous 24 hours, which has been well mixed, so the maximum amount of sample collected usually has not exceeded the capacity of an Exetainer. Sampling atmosphere water vapour is highly reliable on ice availability (needed to lower the temperature and cause condensation). Because of lack of ice, there was no certain sampling frequency in June, and sampling could only be when ice had been brought from Lhasa or Xining. A continuous ice supply was however □ohannes from July, 7th (Table 8-3), and water vapour samples have been taken 80-100 cm aboveground on top of a hill daily around 10 am. Sometimes it has been taken from other places in the afternoon or in the evening in bad weather. The sampling has lasted about one hour and the airflow has been controlled by a medical drip tube with a manual valve. Vapour was condensed in the Exetainer, and if frozen, it has been melted to water at room temperature. The volume of condensed vapour is dependent on humidity; normally the volume of a single sample is about 0.5 ml to 1 ml. Water samples have been collected from other water bodies around 8:00 am, every 5 days from early June (Table 8-3),water from creek started from early July. The well is ca. 5 m deep, and is a representative for ground water. It is prevented from receiving direct by being covered by a small house. The creek is a branch of the Nagqu River, flowing from south to north, and it is obviously rain-fed. In addition, a sample from Namco Lake has been taken on its periphery; this may be a regional source of water vapour contributing to precipitation. Soil water and plant tissue samples have been taken together three times on each sampling day, although samples from grazed and protected sites have been taken on two consecutive days (Table 8-3). Using this method, the sets of samples may be subject to different weather conditions; however, it can guarantee quantity and quality of one set of samples from single surfaces. The reason for this is that it has ensured enough time to collect soil samples which are always interfered with the presence of gravels in the soil, and to peel the plant crown from the persistent leaf sheath. It is quite time consuming to obtain enough crown, and this peeling procedure cannot be finished in limited time, especially during the time before sunrise. Daily weather change has some regularity in rain season, which reduces weather diversity on different days and may provide comparability between two sets of soil-vegetation samples. Soil samples have been taken from the upper 5 cm and at a depth of 20 cm. Additional samples from bare soil have also been taken as a comparison with those taken from *Kobresia* mat (both grazed and ungrazed). Sampling started from early June when *Kobresia pygmaea* began turning green. In total 10 sets of samples have been taken. There were not enough 40 ml glass vials because of the unplanned extra samples of bare soil, and the shortage has been remedied by using 12 ml Exetainers. Soil water contents measured from the air-dried soil samples showed that the lowest water content is 2.5%, so a 12 ml Exetainer should hold enough soil to yield sufficient water (~0.2 g) for isotopic analysis.

Table 8-3: Water stable isotope sampling summary

	Rainfall	Water vapour	River	Creek	Well	Dewfall	Soil	Plant tissue
Jun.2		x	x		x			
Jun.3								
Jun.4	x							
Jun.5	x	x						
Jun.6	x							
Jun.7	x		x		x			
Jun.8								
Jun.9								
Jun.10								
Jun.11	x						x	x
Jun.12			x		x		x	x
Jun.13								
Jun.14								
Jun.15	x	x						
Jun.16						x	x	x
Jun.17	x		x		x		x	x
Jun.18	x	x						
Jun.19								
Jun.20		x						
Jun.21	x						x	x
Jun.22			x		x		x	x
Jun.23	x	x						
Jun.24	x							
Jun.25	x							
Jun.26	x							
Jun.27			x		x			
Jun.28								
Jun.29								
Jun.30		x						
Jul.1	x						x	x
Jul.2		x	x		x		x	x
Jul.3	x							
Jul.4	x	x						
Jul.5	x	x						
Jul.6	x						x	x
Jul.7	x	x	x	x	x		x	x
Jul.8	x	x						
Jul.9	x	x						
Jul.10	x	x						
Jul.11	x	x					x	x
Jul.12	x	x	x	x	x		x	x
Jul.13	x	x						
Jul.14	x	x						
Jul.15	x	x						
Jul.16	x	x					x	x
Jul.17	x	x	x	x	x		x	x
Jul.18		x				x		
Jul.19		x				x		
Jul.20		x				x		
Jul.21	x	x					x	x
Jul.22	x	x	x	x	x		x	x
Jul.23	xx	x						
Jul.24	x	v						

	Rainfall	Water vapour	River	Creek	Well	Dewfall	Soil	Plant tissue
Jul.25		v						
Jul.26		x					x	x
Jul.27	x	x	x		x		x	x
Jul.28		x		x				
Jul.29	x	x						
Jul.30	xx	x				x		
Jul.31	xx	x					x	x
Aug.1		x	x	x	x		x	x
Aug.2	x							

9 Irrigation Experiment

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9.1 Setup and Measurements

On a Yak and Pika exclosure plot, a joint irrigation experiment was established in a random block design with 3 treatments and 4 blocks. Plots were fenced against both small mammals and large livestock to eliminate the influence of herbivores on the biomass.
Each block consisted of 3 lysimeters (Figure 7-1) for monitoring evapotranspiration, infiltration and volumetric soil water content, 3 PVC soil collars (Figure 5-1) for soil CO_2 efflux measurements (respiration collars), and 3 PVC soil collars for assessments of biomass productivity (biomass collars) (Figure 9-1Figure 9-2). The lysimeters and collars were irrigated manually from June 26th to August 28th 2010 with 0, 2.5 or 5 mm per day, in addition to the natural occurring precipitation, estimated from data from Nagchu Weather Station, Chinese Weather Service.
The 12 lysimeters were installed in a row at the eastern plot edge with ca. 50 cm distance analogous to 7.1. Additionally, 3 lysimeters were installed in bare soil. The respiration collars were set up as described in chapter 5.1. Simultaneously to the analysis of soil CO_2 efflux rate, the soil temperature was measured at 6 cm soil depth with a LI 8100-201. At the same depth volumetric soil water content was measured adjacent to each respiration collar with a theta probe (ML2, Delta-T Device Ltd, Cambridge, UK), and also in the middle of the biomass collar to have an indication of the horizontal water flow.To examine the differences in peak standing crop biomass and regrowth, vegetation in biomass collars was cut to 1 mm at the beginning of the experiment whereas the vegetation in respiration collars was unchanged. In September, total plant cover and plant height were estimated. Biomass was harvested on all collars.

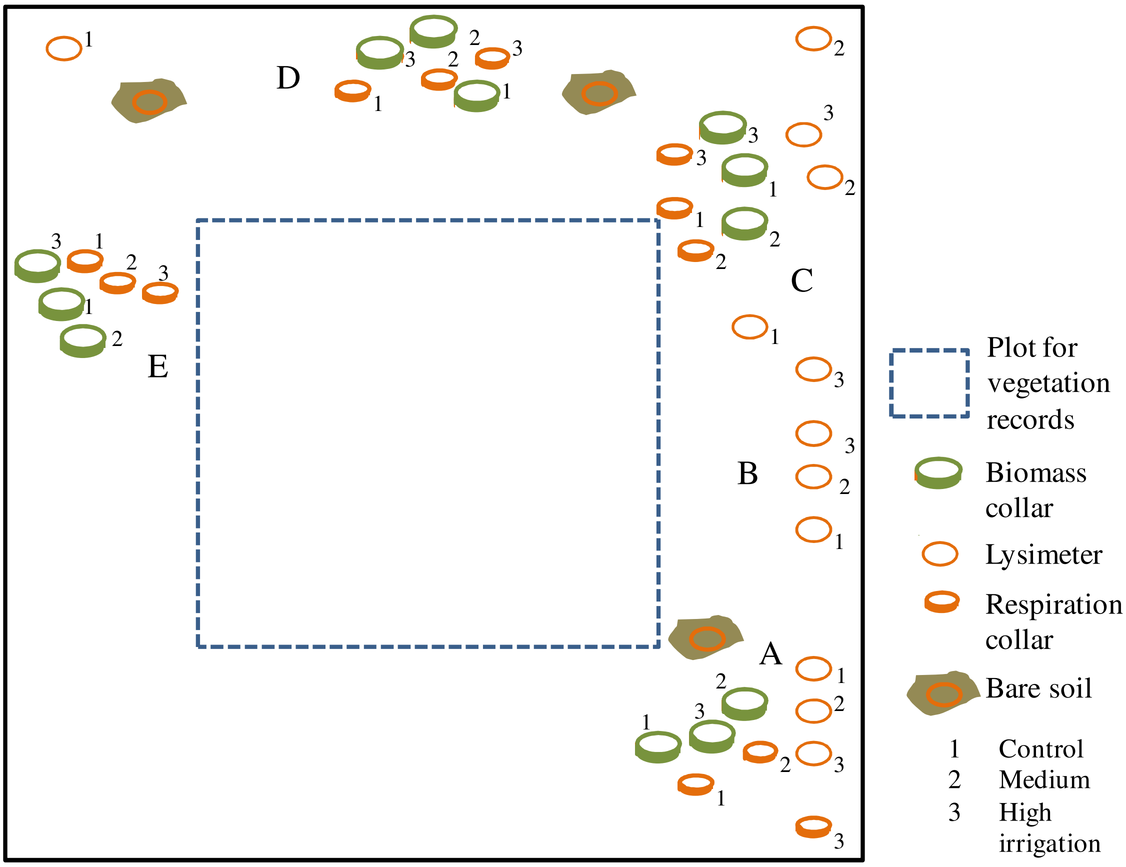

Figure 9-1: Block design of the irrigation experiment on a herbivore exclosure plot

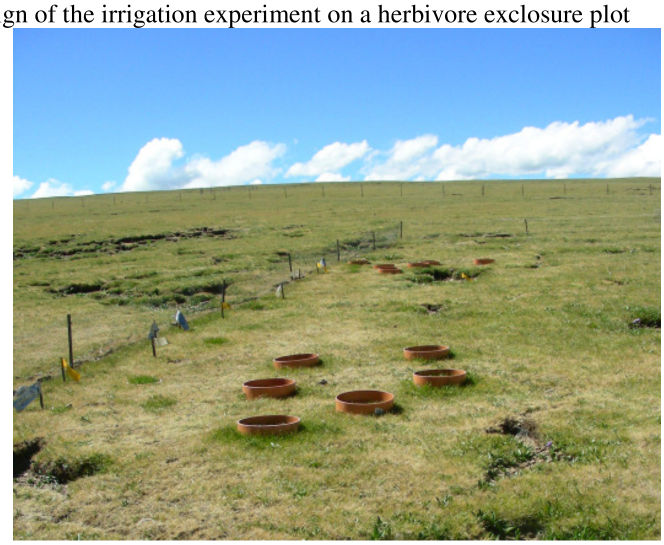

Figure 9-2: Block C of the irrigation experiment with 3 lysimeters (left), 3 respiration collars and 3 biomass collars (centre of the picture).

9.2 Data availability

Table 9-1: Overview of time, number of replicates, treatments and subplots per treatment of lysimeter, soil CO_2 efflux measurements and vegetation records from July to September 2010.

Experiment	**Date**	**Number of replicates**	**Number of treatments**	**Number of subplots**
Lysimeters	09.07.2010	4 + 1 in bare soil	3	1
Lysimeters	16.07.2010	4 + 1 in bare soil	3	1
Lysimeters	25.07.2010	4 + 1 in bare soil	3	1
Lysimeters	05.08.2010	4 + 1 in bare soil	3	1
Lysimeters	17.08.2010	4 + 1 in bare soil	3	1
Lysimeters	28.08.2010	4 + 1 in bare soil	3	1
Lysimeters	05.09.2010	4 + 1 in bare soil	3	1
soil CO_2 efflux	09.07.2010	4	3	1
soil CO_2 efflux	16.07.2010	4	3	1
soil CO_2 efflux	25.07.2010	4	3	1
soil CO_2 efflux	05.08.2010	4	3	1
soil CO_2 efflux	17.08.2010	4	3	1
soil CO_2 efflux	28.08.2010	4	3	1
soil CO_2 efflux	05.09.2010	4	3	1
Plant cover and height	06.09.2010	4	3	3
Biomass production	06.09.2010	4	3	2

10 Logbook of IOP1

Table 10-1: Logbook of IOP1, dates and remarks for data loss and disturbance of measurement

Date	Remark
11.06	9:30 NN, LB arrived at unfenced plot, walked along fence N-W-E
	9:45 SH check data logger
	9:50 NN walk along fences, check traps
	10:00 SH leave
	10:05 NN finisheded
	10:15 LB back down
	10:25 LB up again on plot
	10:45 LB, NN back down
	11:00 SH collect plant samples
	11:30 TL, TB entered grazed □ohannes□nt field
	11:40 TL, TB started work on EC grazed
	11:45 ML visit Germany at EC grazed
	12:15 SH finisheded
	12:30 ML finisheded
	12:55 TL, TB walked to EC ungrazed
	13:00 TL, TB started work at EC ungrazed
	13:36 TL, TB left measurement field
	18:00 SH collected samples
	19:00 SH finisheded
12.06	6:54 LB, NN arrived at grazed plot
	6:59 LB, NN arrived cell Y3
	7:05 SH outside of the fence, collecting
	8:00 LB, NN back to station
	8:05 SH back to station
	9:35 LB, NN up the hill
	9:40 LB, NN start work at cell Y3
	10:11 LB, NN left plot
	14:20 LB enter plot
	14:25 LB arrived at cell Y3
	14:30 NN at Y3
	14:34 NN walk along the fence, check traps
	14:45 NN finished
	15:00 LB, NN back to station
	22:00 ML looking for TB
	22:15 ML left plot
13.06	9:44 NN walk along the fence, check traps
	9:55 NN finished
	10:18 NN leave
14.06	9:00 LB, NN arrive at fence
	9:06 ?
	9:11 NN check traps
	9:22 NN finished
	9:22 Pika plot
	9:55 leave
	9:55 NN cut grass in the rings
	12:50 NN leave
	15:11 NN cut grass in the rings
	15:16 ML and Driver install soil measurement system
	15:26 TB, TL start work at EC-Station “U”
	15:55 TB, TL finsh work at EC-Station “U”, walking to “G”

	16:03	TB, TL sprayed fence at “G”
	16:15	TB, TL new logger program at “G”
	16:20	TB, TL walk back to station
	18:40	ML □ohann
	18:49	NN finished cutting and leave
15.06	7:40	TB download dataB download data
	8:05	TB left
	9:50	LB at gate, forgotten key, LB back to station
	10:05	LB back at gate
	10:05	NN finished checking traps outside
	10:12	NN check traps inside
	10:20	NN finished
16.06	9:40	LB, NN arrive
	9:55	NN check traps
	10:08	NN finished and leave
	10:10	LB at H3
	10:36	LB at Y1
	10:50	LB leave
	13:55	SH change battery
	14:05	SH left
17.06	9:30	LB, NN arrive
	9:38	NN check traps
	9:34	LB, NN at Y24
	9:40	SH check data logger
	9:48	NN finished checking traps
	9:50	SH finished
	10:23	LB, NN at Y1
	10:36	LB, NN at Y4
	10:30	TB, TL start work at EC-U
	10:48	LB, NN at H04
	10:50	SH sampling, Lysimeter
	11:03	LB, NN at H09
	11:13	LB, NN at 04
	11:37	LB, NN at Y13
	11:48	LB, NN at Y15
	11:58	LB, NN at Y16
	12:07	LB, NN at H19
	12:23	LB, NN finished
	12:25	SH finished
	13:00	TL start data collection at EC-G
	13:12	TB, TL finished work at EC-U
	13:20	TL finished data collection at EC-G
	14:00	HC, MU, LR, start Lysimeter installation
	15:59	TB work on EC-U
	16:20	SH sampling
	16:33	TB finished work at EC-U
	18:10	SH finisheded
	18:24	HC, MU, LR finisheded Lysimeter installation
18.06	9:43	NN check traps
	10:00	NN leave
	12:00	NN check traps
	12:00	MU, LR, install Lysimeters
	12:00	SH check logger
	12:15	SH leave
	13:10	MU, LR, leave
	14:11	NN outside fences

	14:40	SH change soil bulk
	14:55	NN finished and leave
	16:20	HC, MU, LR install Lysimeters
	17:10	SH finished and leave
	18:10	HC, MU, LR leave
19.06	9:30	LB, SH, NN arrive
	9:45	NN check traps
	9:45	HC, MU, LR Lysimeter
	9:55	NN finished
	10:23	TB, TL start work at EC-U
	12:30	TL to EC-G
	13:00	All went down (Thunderstorm)
	14:45	HC, MU, LR start Lysimeter installation
	15:00	SH infiltration near the gate
	18:30	HC, MU, LR leave
	18:50	SH leave
20.06	9:22	NN check traps
	9:22	SH check logger, infiltration
	9:30	HC, MU, LR start Lysimeter installation
	9:30	LB and car
	9:56	TB, TL □ohanne check at EC-U
	10:16	Sheep on G and under radiation and EC
	10:16	Stop □ohanne check at EC-U, go to EC-G, □ohanne check, 1st Kite test
	10:50	NN leavee
	11:55	SH finished and leave
	13:15	TB, TL finished Kite
	13:40	LB leave
	17:50	HC, MU, LR Lysimeter
	19:10	HC, MU, LR finished
21.06	11:20	NN check traps
	11:35	NN finished and leave
	15:05	LB arrive
	16:00	LB leave
	17:00	LB arrive
	17:15	LB leave
22.06	6:30	SH sampling
	7:55	SH leavee
	10:45	SH sampling, checking logger
	11:15	HC weighing lysis
	12:15	SH leave
	12:15	HC leave
	18:00	SH sampling, NN cutting gras
	19:00	SH, NN leave
		Sheep grazing
23.06	9:30	SH collecting data
	9:50	HC, MU, LR inst. A. weighing Lysimeter
	10:00	SH finished
	10:14	TB, TL work at EC-U
	10:55	LB measure soil respiration
	11:00	HC, MU, LR finished
	11:59	TB, TL finished work at EC-U, start work at EC-G
	12:27	TB, TL finished work at EC-G
	13:22	LB leave
	14:35	LB, L, SH, HC, NN, MU arrive
	15:20	LB leave
	16:25	LB back

	16:50	LB leave
	16:58	TB, TL walk to kite start place
	17:05	LB, SH, HC, MU leave
	17:35	NN finished □ohanne weed and leave
	17:35	LR passed by 6 village people around E2 till 17:40
	17:52	HC weighing Lysis and installing raingauges
	18:48	HC finished
	19:03	TB, TL finished kiting
24.06	14:30	HC, MU, LR Lysimeter installation
	17:00	HC, MU, LR finished
25.06	9:50	HC, MU, LR Lysimeter installation
	10:48	NN check traps
	11:45	HC, MU, LR finished
	12:00	NN leave
	12:15	HC, MU, LR work
	13:45	HC, MU, LR finished
26.06	9:00	MU
	9:10	MU leave
	14:20	HC, MU, LR
	15:03	TB checking Eddy, new radiation fixing
	15:59	TB finished
	16:05	HC, MU, LR finished
	17:00	NN cut weed inside the collar
	18:40	NN leave
27.06	9:40	LB arrive
	9:50	NN arrive
	10:00	LB leave
	11:30	HC, LB arrive
	11:40	LB leave
	12:30	HC leave
	13:00	NN leave
	16:45	NN arrive
	17:35	HC weighing Lysis
	18:50	NN leave
	19:20	HC leave
28.06	6:15	TB, TL Kite
	8:30	TB, TL end kiting
	17:50	HC at YP4 for irrigation
	18:40	HC finished
29.06	5:56	TB, MU, TL kite
	7:10	Kite crash
	7:45	Data and Tensio “G” start
	7:50	Data and Tensio “U” start
	8:05	Stop “G” and “U”
	9:25	LB, NN arrive
	9:40	HC, MU, LR install Lysimeter
	10:50	LB leave
	11:40	NN leave
	12:05	HC, MU, LR finished
	14:40	HC, MU, LR weighing, photosynthesis
	15:00	TB, TL kite
	16:05	NN arrive
	17:50	NN leave
	17:55	HC, MU, LR finished
	18:51	TB, TL end kite

01.07	6:07	TB, TL kite
	6:24	AEC, 4 persons, N-labling
	8:35	TB, TL end kite
	9:25	AEC, 4 persons, end labling
	10:05	HC, KW, MU, LR Lysimeter
	10:15	ES, LB, OS arrive
	11:00	AEC, 7 persons, C.labling
	13:15	AEC, 7 persons, end labling
	13:50	ES, LB, OS finished
	14:05	HC, KW, MU, LR finished
	15:30	Lysimeter crew back, AEC back, short before, TL getting kite
		HC, KW, ES, MU, LR soil samples and weighing
	17:00	KW, MU, LR exit
	17:17	TL off
	17:18	HC, ES end weighing
	18:45	AEC, finished, whole area empty
	20:10	TL start looking for his jacket
	20:45	TL found jacket and leave
02.07	6:50	SH sampling
	8:50	SH finished
	10:00	MU, LR install flags
	11:00	SH sampling
	12:00	SH and MU, LR finished
	14:40	AEC, 5 persons
	15:30	KW, GG, OS, ES
	16:50	SH sampling
	17:00	KW, GG, OS, ES finished
	17:50	HC and TB, TL at EC-U
	18:25	TB, TL at EC-G and kite
	18:40	SH finished
	18:45	HC finished
	20:45	TL card change EC-G and GG, OS at ungrazed area
	21:00	TL finished
	22:00	TB card change EC-G
	22:30	TB finished
03.07	7:25	KW
	7:40	KW finished
	8:30	TB at EC-G
	8:57	TB finished
	10:15	SH infiltration
	12:00	SH finished
04.07	9:50	SH infiltration
	11:50	SH finished
05.07	16:23	AEC, 4 persons
	20:15	AEC, end
	21:35	Card input EC-G
	21:45	finished
06.07	10:00	TB, TL
	13:15	TB, TL finished
07.07	6:30	SH sampling
	8:00	SH finished
	11:15	SH sampling
	11:37	TB check EC-U
	12:00	OS control cagos G and U
	12:30	OS finished
	12:30	TB, both EC systems failed

	12:50	SH finished
	17:00	SH samling
	18:45	ES Pika tour
	19:00	SH finished
	19:30	ES finished
08.07	12:00	ES Pika tour
	12:10	SH Lysimeter
	12:30	ES finished
	13:15	SH finished
	14:45	JI, SH
	16:00	ES Licor YP4
	16:38	5 persons leave
	17:00	ES finished
	18:30	ES irrigation YP4 and Pika tour
	18:40	SH Lysimeter
	19:15	ES finished
	19:20	SH finished
09.07	9:30	SH setting data logger near gate
	9:53	TB work on EC-U
	10:00	SH finished
	11:00	JI and companion
	11:00	ES and Benpa Lysimeter tour
	14:43	JI +1 leave
	14:43	ES and Benpa finished
	15:00	SH checking
	15:25	SH finished
	17:07	ES Pika tour
	17:19	JI Control tour
	19:00	ES finished
10.07	11:15	SH infiltration
	13:30	SH leave
	14:46	JI and companion respiration
	15:00	SH infiltration
	16:40	SH leave
11.07	10:25	ES, JI Licor
	13:37	ES, JI finished
	16:00	ES Licor and Pika tour
	19:24	ES finished
12.07	6:30	SH sampling
	8:15	SH finished
	11:10	SH sampling
	12:45	SH finished
	18:45	ES, irrigation PY4
	19:15	ES finished
13.07	11:10	SH change turf
	12:15	SH finished
	15:00	JI sampling, PY1, PY2, PY3, C3, C1
	15:00	ES Pika YP1
	15:25	SH infiltration
	16:44	JI end sampling
	17:21	ES finished
	17:50	SH finished
14.07	10:00	SH infiltration
	12:30	SH finished
15.07	9:30	SH infiltration

	11:30	JI, TB
	12:50	SH finished
	13:00	JI, TB finished
	14:10	SH check data logger
	14:50	SH finished
	15:00	ES, TB, JI, THE SMOKING PIKA
	17:00	ES, TB, JI over and out
16.07	14:40	JI sampling
	18:40	JI finished
17.07	11:40	SH sampling
	13:15	SH finished
	17:35	SH check logger
	18:00	SH finished
	18:20	TL chang cards
	18:45	TL finished
	19:00	JI, ES Licor
	19:45	JI, ES finished
18.07	4:45	JI start 24h Licor measurements
	5:15	JI PY1
	5:45	JI PY2
	6:00	JI at G, C3, C4, C5
	7:00	JI stop at G, go to PY1
	7:10	SH wetness measurements, Lysimeter
	7:30	SH finished
	7:45	JI PY2
	8:00	JI at G, C3, C4, C5
	10:00	JI end
	10:45	ES start Licor measurements
	11:00	SH data harvesting
	11:25	SH finished
	16:00	ES finished
	16:25	JI Licor
	22:10	JI finished
	23:00	ES Licor
19.07	4:30	ES stop 24h Licor measurement
	11:10	SH infiltration
	13:30	SH finished
	13:45	TL chang cards
	14:40	TL finished
	14:40	SH infiltration
	15:00	ES Licor
	17:10	SH finished
	19:00	ES finished Licor
	19:00	ES irrigation PY4
	19:30	ES finished
20.07	10:45	Licor, area homogeneity at U
	14:15	Licor finished
	14:55	JI nutrient sampling, PY1, PY2, PY3, C3, C2, C1, C4, PY4
	15:58	JI finished
21.07	19:00	TL change cards
	19:30	TL finished
	20:30	TL change ventilator at G
	21:00	TL finished
22.07	11:30	ES Pika tour
	11:40	SH sampling

	13:00	SH finished
	13:15	ES finished
	17:00	SH sampling
	17:15	ES Pika tour
	18:30	ES finished
	19:10	SH finished
23.07	17 :00	ES irrigation and Pika tour
	18 :44	ES finished
24.07	10:25	JI start sampling
	12:30	TL
	13:30	TL, JI leave
	18:20	ES irrigation and Pika tour
	19:10	ES finished
25.07	10:20	ES Lysimeter and Licor PY4
	13:40	ES finished
	14:50	SH infiltration
	16:45	SH finished
	18:00	ES irrigation PY4 and Pika tour
	19:00	ES finished
26.07	14:35	JI Licor
	18:15	JI finished
27.07	10:00	JI Licor
	11:30	SH sampling
	13:10	SH finished
	16:05	TL change cards
	16:45	Wangbin and team start work
	16:50	TL finished
	17:30	Wangbin and team leave
	17:30	SH sampling
	18:00	SH finished
	20:00	ES irrigation
	20:40	ES finished
28.07	18 :30	ES irrigation and Pika tour
	19 :10	ES finished
29.07	8:00	ES pictures of grazing, EC, soil sampling and fertilisation
	10:00	ES finished
	11:45	TL and Wangbin change cards and fix radiation at EC-G
	13:30	TL and Wangbin finished
	18:00	ES irrigation and Pika tour
	19:00	ES finished
30.07	10:00	SH checking logger
	10:15	SH finished
	10:55	JI sampling
	13:28	JI finished
	21:00	TB, JI, TL irrigation and Pika tour
	21:20	TB, JI, TL finished
01.08	4 :45	JI Licor PY1, PY2, C5, C3, C2, C7
	6 :00	JI finished
	6 :45	JI Licor PY1, PY2, C5, C3, C2, C7
	7 :00	SH sampling
	8 :00	JI finished
	8 :20	SH finished
	8 :45	JI Licor PY1, PY2, C5, C3, C2, C7
	10 :00	JI finished
	10 :45	JI Licor PY1, PY2, C5, C3, C2, C7

	12 :00 JI finished 12 :45 ES Licor PY1, PY2, C5, C3, C2, C7 14 :00 ES finished 14 :45 ES Licor PY1, PY2, C5, C3, C2, C7 16 :00 ES finished 16 :45 ES Licor PY1, PY2, C5, C3, C2, C7 18 :00 ES finished 18 :45 JI Licor PY1, PY2, C5, C3, C2, C7 20 :00 JI finished 20 :45 JI Licor PY1, PY2, C5, C3, C2, C7 22 :10 JI finished

11 Data Storage and access

10.1 Vegetation

For access to the data and additional information please contact: Seeber.elke@gmx,net.

10.2 Micrometeorological Experiment

The raw data and additional information can be found in the DVD archive of the Department of Micrometeorology, University of Bayreuth, on DVD Nr. 515.

For Access to the Data please contact: Tobias.Biermann@uni-bayreuth.de, Thomas.Foken@uni-bayreuth.de

10.3 Soil Respiration

For access to the data please contact: becker@ifbk.uni-hannover.de

10.4 Pulse Labeling

For access to the data please contact: kuzyakov@uni-bayreuth.de

10.5 Lysimeter

For access to the data please contact: hconers@gwdg.de

10.6 Water Balance

For access to the data please contact: sh615@cam.ac.uk

10.7 Irrigation experiment

For access to the data please contact: becker@ifbk.uni-hannover.de (soil respiration), hconers@gwdg.de (lysimeters), Seeber.elke@gmx,net.(biomass)

11 Participants and contact information

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Literature

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http://en.poehali.org/maps

http://www.ceop-aegis.org/

http://www.tip.uni-tuebingen.de/

Appendix

Logger configuration Micrometeorology

CR3000 Logger configuration   S/N Logger: 3545 (ungrazed)
Experiment: Kema (Tibet) 2010

Channels					
SE	**Diff**	**Device**	**Serial nr**	**Wiring**	**Comments**
1	1H	HMP	T4650015	yellow	blue = 12V, purple = ground
2	1L	HMP	T4650015	brown	
Ground		HMP		red	
3	2H	pressure transmitter	E 1810003	white	pink = 12 V, blue = ground
4	2L				
Ground		Pressure transmitter	E1810003	brown	
5	3H	MUX	E4938	yellow	to MUX COM Even H
6	3L	MUX	E4939	white	to MUX COM Even L
Ground					
7	4H	Inclinometer	Inc.02	green	yellow = 12V, grey = ground
8	4L	Inclinometer	Inc.02	white	
Ground		Inclinometer	Inc.02	brown	
9	5H				
10	5L				
Ground					
11	6H				
12	6L				
Ground					
13	7H				
14	7L				
Ground					
15	8H	CNR1	990197	red	radiation
16	8L	CNR1	990197	blue	
Ground					
17	9H	CNR1	990197	white	
18	9L	CNR1	990197	black	
Ground					
19	10H	CNR1	990197	grey	
20	10L	CNR1	990197	yellow	
Ground					
21	11H	CNR1	990197	brown	
22	11L	CNR1	990197	green	
Ground					
23	12H	CNR1	990197	yellow	pink = IX1, grey = IXR
24	12L	CNR1	990197	green	(second cable)
Ground					
25	13H	TDR	14074	blue	external power
26	13L	TDR	14073	bluee	black = 12V, red = ground

Ground		TDR		2 x grey	*Kobresia*, 10cm, 20cm
27	14H	TDR	14072	blue	bare soil, 15 cm
Ground				grey	
Excitation Voltage					
VX1					
VX2					
Ground					
VX3					
VX4					
Ground					
Continuous Analog Outputs					
CAO1					
CAO2					
Ground					
Excitation Current					
		Device	**Serial nr**	**Wiring**	**Comments**
IX1		CNR1	990197	pink	
IX2		MUX	E4939	green	to MUX COM Odd H
IX3					
IXR		CNR1/MUX		grey/brown	brown to MUX COM Odd L
Pulse Count					
Ground		Rain gauge	010291	white/red	no matter which cable is ground
P1		Rain gauge	010291	white	Cal.: 0.1mm per count
Ground					
P2					
Ground					
P3					
Ground					
P4					
COM Ports					
C1	Tx1	MUX	E4939	green	to MUX Res / white = 12V
C2	Rx1	MUX	E4939	yellow	to MUX CLK / brown = ground
C3	Tx2				
C4	Rx2				
Ground					
C5	Tx3				
C6	Rx3				
C7	Tx4				
C8	Rx4				
Ground					

Power out					
5V					
Ground					
12V S1					
12V S2					
Ground					
12V 1					
12V 2					
Ground		Licor	75H-1200	black + white	
		Csat3	1756	black	
SDM					
SDM1		Licor	75H-1200	grey	
		Csat3	1756	green	
SDM2		Licor	75H-1200	blue	
		Csat3	1756	white	
SDM3		Licor	75H-1200	brown	
		Csat3	1756	brown	
Power in					
Ground					
12V					

Multiplexer AM 16/32B   S/N Multiplexer: 4939

Experiment: Kema (Tibet) 2010

Channels					
SE	Diff	Device	Serial nr	Wiring	Comments
1	1H	PT100 short	T5	black	*Kobresia*, 2.5 cm
	1L	PT100 short	T5	orange	
	Ground				
	2H	PT100 short	T5	brown	
	2L	PT100 short	T5	red	
	Ground				
2	3H	PT100 short	T6	black	*Kobresia*, 7.5 cm
	3L	PT100 short	T6	orange	
	Ground				
	4H	PT100 short	T6	brown	
	4L	PT100 short	T6	red	
	Ground				
3	5H	PT100 short	T7	black	*Kobresia*, 12.5 cm
	5L	PT100 short	T7	orange	
	Ground				

	6H	PT100 short	T7	brown	
	6L	PT100 short	T7	red	
	Ground				
4	7H	PT100 short	T8	black	*Kobresia*, 20.0 cm
	7L	PT100 short	T8	orange	
	Ground				
	8H	PT100 short	T8	brown	
	8L	PT100 short	T8	red	
	Ground				
5	9H	PT100 long	T2	green	bare soil, 2.5 cm
	9L	PT100 long	T2	brown	
	Ground				
	10H	PT100 long	T2	yellow	
	10L	PT100 longt	T2	white	
	Ground				
6	11H	PT100 long	T3	green	bare soil, 7.5 cm
	11L	PT100 long	T3	brown	
	Ground				
	12H	PT100 long	T3	yellow	
	12L	PT100 longt	T3	white	
	Ground				
7	13H	PT100 long	T4	green	bare soil, 12.5 cm
	13L	PT100 long	T4	brown	
	Ground				
	14H	PT100 long	T4	yellow	
	14L	PT100 longt	T4	white	
	Ground				
8	15H				
	15L				
	Ground				
	16H				
	16L				
	Ground				
9	17H				
	17L				
	Ground				
	18H				
	18L				
	Ground				
10	19H				
	19L				
	Ground				
	20H	Heat flux plate	HP3 65586	blue	bare soil, 15 cm
	20L	Heat flux plate	HP3 65586	brown	
	Ground				
11	21H				
	21L				
	Ground				

	22H	Heat flux plate	G-1428	redwhite	*Kobresia*, 15cm
	22L	Heat flux plate	G-1482	white	
	Ground				
12	Ground				
	23H				
	23L				
	Ground				
	24H	Heat flux plate	G-1425	redwhite	*Kobresia*, 15 cm
	24L	Heat flux plate	G-1425	white	
	Ground				
13	25H				
	25L				
	Ground				
	26H	Tensiometer	9,5 cm	yellow	*Kobresia*, blue=12V
	26L	Tensiometer		green	
	Ground				
14	27H				
	27L				
	Ground				
	28H	Tensiometer	20,0 cm	yellow	*Kobresia*, brown=ground
	28L	Tensiometer		green	
	Ground				
15	29H				
	29L				
	Ground				
	30H	Tensiometer	10,0 cm	yellow	bare soil, blue=12V
	30L	Tensiometer		green	
	Ground				
16	31H				
	31L				
	Ground				
	32H	Tensiometer	20,0 cm	yellow	bare soil, brown=ground
	32L	Tensiometer		green	0.105 mV/hPa
	Ground				

	RES	Logger		green	to Logger C1 Tx (Com1)
	CLK	Logger		yellow	to Logger C1 Rx (Com1)
	Ground	Logger		brown	power from Logger
	12V	Logger		white	power from Logger
COM	Odd H	Logger			
	Odd L	Logger		green	to Logger IX2
	Ground	Logger		brown	to Logger IXR
	Even H	Logger			
	Even L	Logger		yellow	to Logger Diff 3H (SE5)
	Ground	Logger		white	to Logger Diff 3L (SE6)

CR3000 Logger configuration S/N Logger: 4496 (grazed)
Experiment: Kema (Tibet) 2010

Channels					
SE	**Diff**	**Device**	**Serial nr**	**Wiring**	**Comments**
1	1H	HMP	T4650013	yellow	blue = 12V, purple = ground
2	1L	HMP	T4650013	brown	
Ground		HMP		red	
3	2H				
4	2L				
Ground					
5	3H	MUX	E5504	yellow	to MUX COM Even H
6	3L	MUX	E5504	white	to MUX COM Even L
Ground					
7	4H	Inclinometer	Inc.03	green	yellow = 12V, grey = ground
8	4L	Inclinometer	Inc.03	white	
Ground		Inclinometer	Inc.03	brown	
9	5H	Tensiometer	10	yellow	*Kobresia*
10	5L	Tensiometer		green	
Ground					
11	6H	Tensiometer	20	yellow	blue=12V, brown=ground
12	6L	Tensiometer		green	
Ground					
13	7H				
14	7L				
Ground					
15	8H	CNR1	970059	red	
16	8L	CNR1	970059	blue	
Ground					
17	9H	CNR1	970059	white	
18	9L	CNR1	970059	black	
Ground					
19	10H	CNR1	970059	grey	
20	10L	CNR1	970059	yellow	
Ground					
21	11H	CNR1	970059	brown	
22	11L	CNR1	970059	green	
Ground					
23	12H	CNR1	970059	yellow	pink = IX1, grey = IXR
24	12L	CNR1	970059	green	second cable
Ground					
25	13H	TDR	14067	blue	external power
26	13L				black=12V, red=ground
Ground		TDR	14067	grey	
27	14H				

Ground					
Excitation Voltage					
VX1					
VX2					
Ground					
VX3					
VX4					
Ground					
Continuous Analog Outputs					
CAO1					
CAO2					
Ground					
Excitation Current					
		Device	**Serial nr**	**Wiring**	**Comments**
IX1		CNR1	970059	pink	
IX2		MUX	E5504	green	to MUX COM Odd H
IX3					
IXR		CNR1/MUX		grey/brown	brown to MUX COM Odd L
Pulse Count					
Ground					
P1					
Ground					
P2					
Ground					
P3					
Ground					
P4					
COM Ports					
C1	Tx1	MUX	E5504	green	to MUX Res / white = 12V
C2	Rx1	MUX	E5504	yellow	to MUX CLK / brown = ground
C3	Tx2				
C4	Rx2				
Ground					
C5	Tx3				
C6	Rx3				
C7	Tx4				
C8	Rx4				
Ground					
Power out					

5V					
Ground					
12V S1					
12V S2					
Ground					
12V 1					
12V 2					
Ground		Licor	75H-0220	black + white	
		Csat3	0322-2	black	
SDM					
SDM1		Licor	75H-0220	grey	
		Csat3	0322-2	green	
SDM2		Licor	75H-0220	blue	
		Csat3	0322-2	white	
SDM3		Licor	75H-0220	brown	
		Csat3	0322-2	brown	
Power in					
Ground					
12V					

Multiplexer AM 16/32B   S/N Multiplexer:

Experiment: Kema (Tibet) 2010

Channels					
SE	Diff	Device	Serial nr	Wiring	Comments
1	1H	PT100 long	2	green	*Kobresia*, 2.5 cm
	1L	PT100 long	2	brown	
	Ground				
	2H	PT100 long	2	yellow	
	2L	PT100 longt	2	white	
	Ground				
2	3H	PT100 long	4	green	*Kobresia*, 7.5 cm
	3L	PT100 long	4	brown	
	Ground				
	4H	PT100 long	4	yellow	
	4L	PT100 longt	4	white	
	Ground				
3	5H	PT100 long	5	green	*Kobresia*, 12.5 cm
	5L	PT100 long	5	brown	
	Ground				
	6H	PT100 long	5	yellow	
	6L	PT100 longt	5	white	

	Ground				
4	7H				
	7L				
	Ground				
	8H				
	8L				
	Ground				
5	9H				
	9L				
	Ground				
	10H				
	10L				
	Ground				
6	11H				
	11L				
	Ground				
	12H				
	12L				
	Ground				
7	13H				
	13L				
	Ground				
	14H				
	14L				
	Ground				
8	15H				
	15L				
	Ground				
	16H				
	16L				
	Ground				
9	17H				
	17L				
	Ground				
	18H	Heat flux plate	HP3 69813	blue	*Kobresia*, 15 cm
	18L	Heat flux plate	HP3 69813	brown	
	Ground				
10	19H				
	19L				
	Ground				
	20H				
	20L				
	Ground				
11	21H				
	21L				
	Ground				
	22H				
	22L				

	Ground				
12	Ground				
	23H				
	23L				
	Ground				
	24H				
	24L				
	Ground				
13	25H				
	25L				
	Ground				
	26H				
	26L				
	Ground				
14	27H				
	27L				
	Ground				
	28H				
	28L				
	Ground				
15	29H				
	29L				
	Ground				
	30H				
	30L				
	Ground				
16	31H				
	31L				
	Ground				
	32H				
	32L				
	Ground				

	RES	Logger		green	to Logger C1 Tx (Com1)
	CLK	Logger		yellow	to Logger C1 Rx (Com1)
	Ground	Logger		brown	power from Logger
	12V	Logger		white	power from Logger
COM	Odd H	Logger			
	Odd L	Logger		green	to Logger IX2
	Ground	Logger		brown	to Logger IXR
	Even H	Logger			
	Even L	Logger		yellow	to Logger Diff 3H (SE5)
	Ground	Logger		white	to Logger Diff 3L (SE6)

Licor 7500 Calibration

Device			must value	actual value	
LiCor7500 SN 1200	zero	CO2	0	0.04	mmol/(m^3)
	zero	H20	0	-8.5	mmol/(m^3)
	span	CO2	381.07	382	ppm
	span	H20	16.46	16.39	°C (Dew point T)
LiCor7500 SN 0220	zero	CO2	0	-0.2	mmol/(m^3)
	zero	H20	0	83.3	mmol/(m^3)
	span	CO2	381.07	387.5	ppm
	span	H20	16.46	15.5	°C (Dew point T)

Licor 7500 SN 1200

	A	B	C	D	E	XS	Z
CO_2	153.342	4598.71	4.88349e+07	-1.480160e+10	1.912250e+12	0.0043	-0.0005
H_2O	4936.129	4089080	-1.615060e+08			-0.0006	0.0177

Licor 7500 SN 0220

	A	B	C	D	E	XS	Z
CO_2	144.1820	18309.20	3.812930e+07	-1.082680e+10	1.593250e+12	0.008600000	0.001200000
H_2O	4764.359	2912180	2.160920e+08			-0.0048	-0.002

Volumes in the series ‚University of Bayreuth, Department of Micrometeorology, Arbeitsergebnisse'

Nr	Author(s)	Title	Year
01	Foken	Der Bayreuther Turbulenzknecht	01/1999
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04	Foken et al.	Nachfrostgefährdung des ÖBG	03/1999
05	Hierteis	Dokumentation des Experimentes Dlouhá Louka	03/1999
06	Mangold	Dokumentation des Experimentes am Standort Weidenbrunnen, Juli/August 1998	07/1999
07	Heinz et al.	Strukturanalyse der atmosphärischen Turbulenz mittels Wavelet-Verfahren zur Bestimmung von Austauschprozessen über dem antarktischen Schelfeis	07/1999
08	Foken	Comparison of the sonic anomometer Young Model 81000 during VOITEX-99	10/1999
09	Foken et al.	Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales, Zwischenbericht 1999	11/1999
10	Sodemann	Stationsdatenbank zum BStMLU-Projekt Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales	03/2000
11	Neuner	Dokumentation zur Erstellung der meteorologischen Eingabedaten für das Modell BEKLIMA	10/2000
12	Foken et al.	Dokumentation des Experimentes VOITEX-99	10/2000
13	Bruckmeier et al.	Documenation of the experiment EBEX-2000, July 20 to August 24, 2000	01/2001
14	Foken et al.	Lufthygienisch-bioklimatische Kennzeichnung des oberen Egertales	02/2001
15	Göckede	Die Verwendung des Footprint-Modells nach Schmid (1997) zur stabilitätsabhängigen Bestimmung der Rauhigkeitslänge	03/2001
16	Neuner	Berechnung der Evaporation im ÖBG (Universität Bayreuth) mit dem SVAT-Modell BEKLIMA	05/2001
17	Sodemann	Dokumentation der Software zur Bearbeitung der FINTUREX-Daten	08/2002
18	Göckede et al.	Dokumentation des Experiments STINHO-1	08/2002
19	Göckede et al.	Dokumentation des Experiments STINHO-2	12/2002
20	Göckede et al	Characterisation of a complex measuring site for flux measurements	12/2002
21	Liebethal	Strahlungsmessgerätevergleich während des Experiments STINHO-1	01/2003
22	Mauder et al.	Dokumentation des Experiments EVA_GRIPS	03/2003
23	Mauder et al.	Dokumentation des Experimentes LITFASS-2003, Dokumentation des Experimentes GRASATEM-2003	12/2003
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