Differences of carbon flux between the typical grass and wetland land surfaces on the Tibetan Plateau based on observations and its possible reasons

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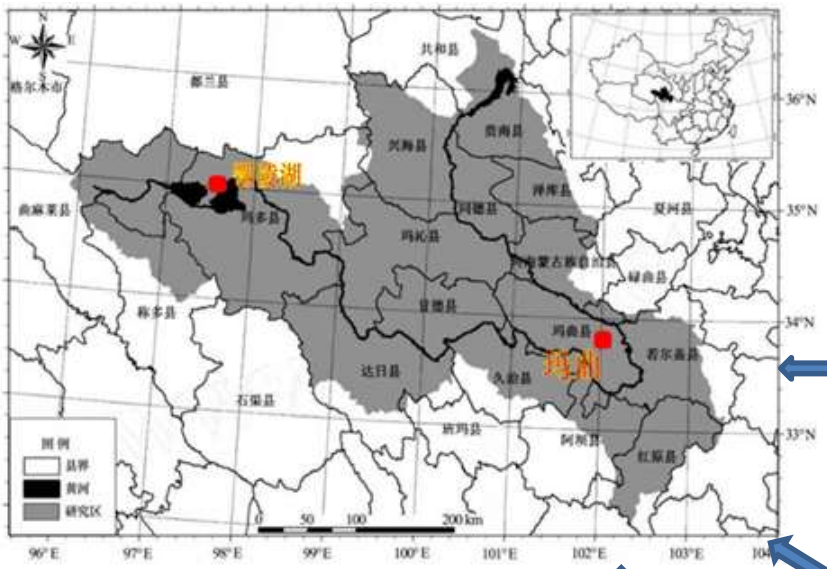
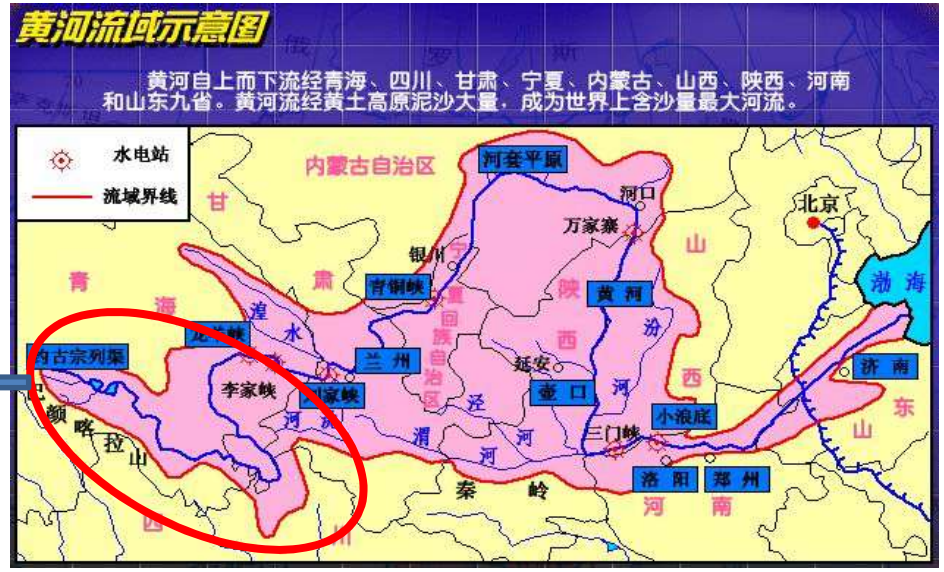
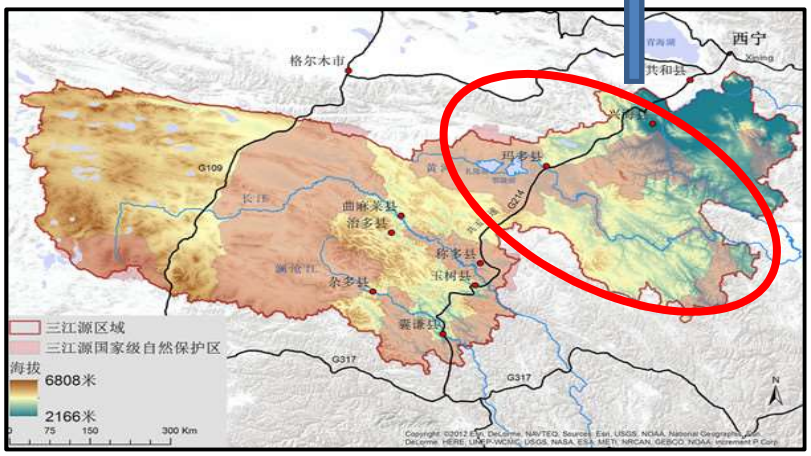
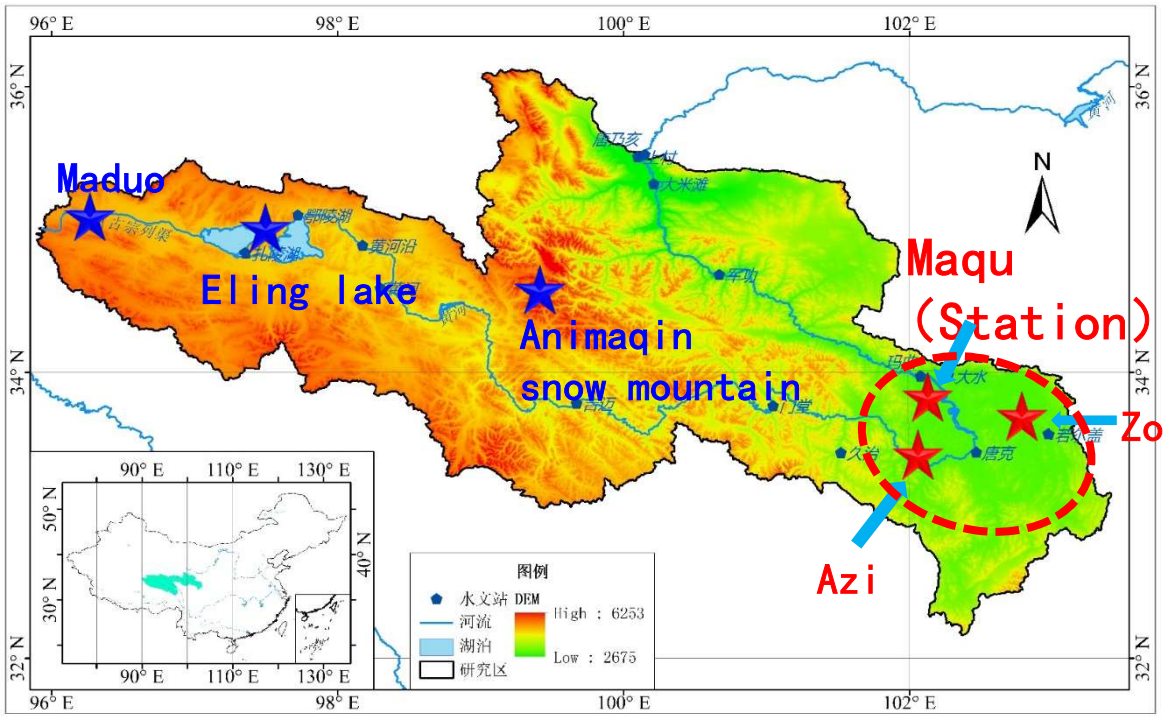
Zoige Station

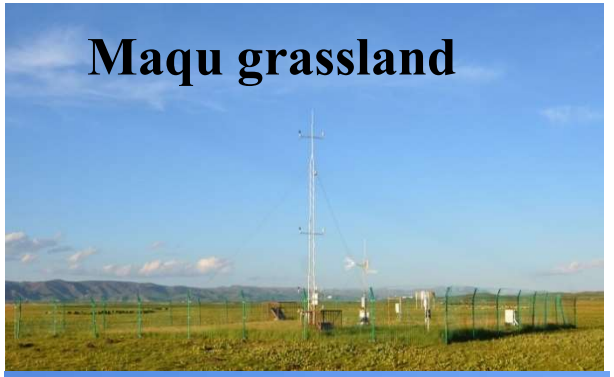






Sites


96° E
98° E
100° E
102° E
36° N
34° N
32° N
Maduo
Eling lake
Animaqin
snow mountain
Maqu
(Station)
Zoige
Azi
N
90° E
110° E
130° E
50° N
30° N
40° N
图例
水文站
河流
湖泊
研究区
DEM
High : 6253
Low : 2675


Maqu grassland

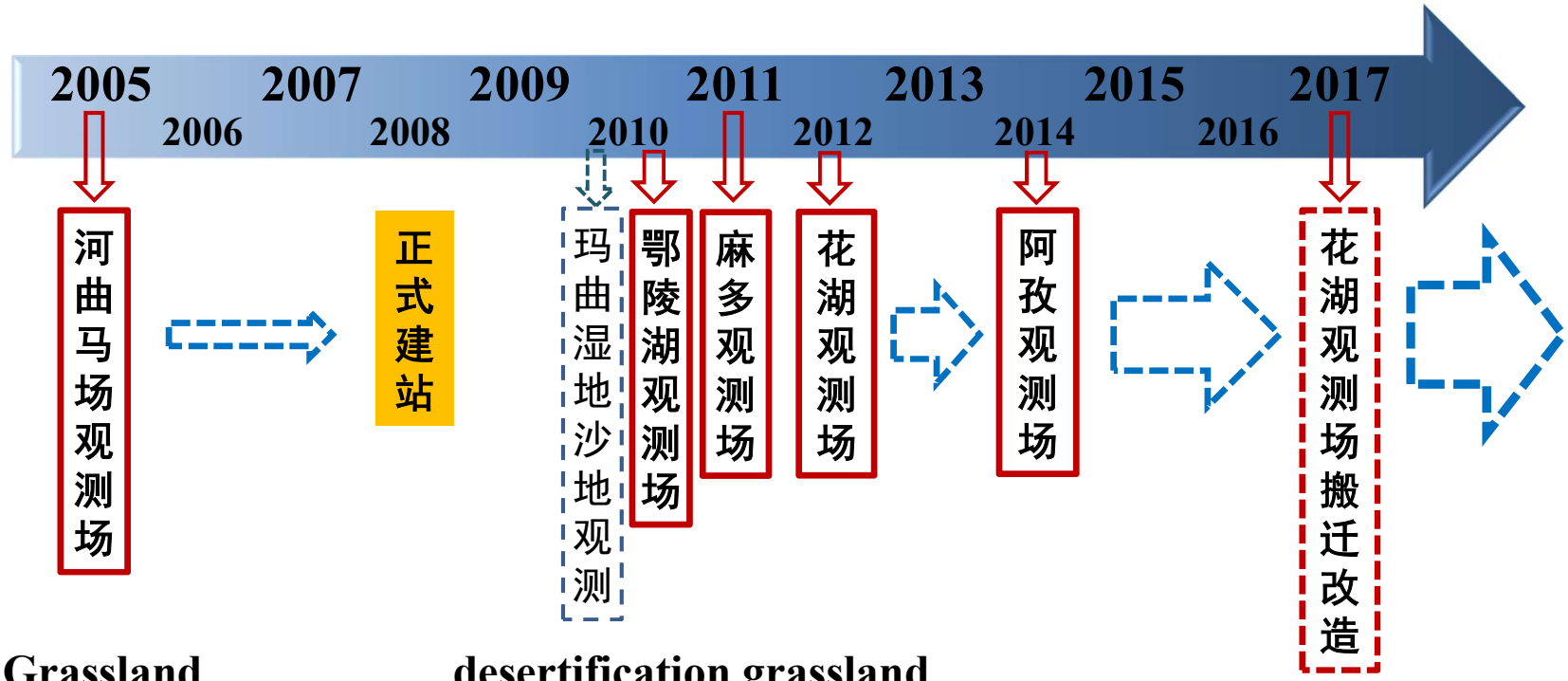

Azi degraed grassland

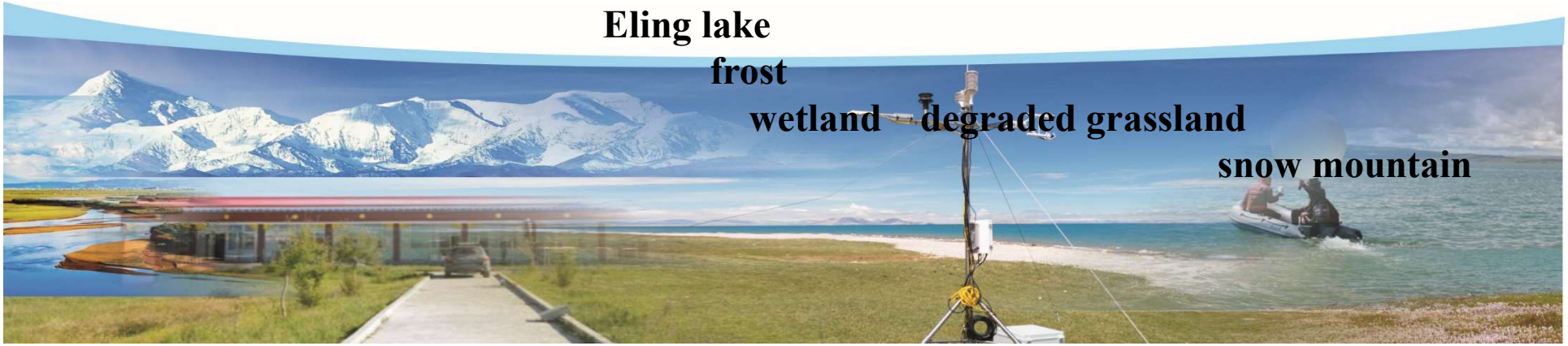

Maduo Frost


Eling lake


Zoige wetland

Observations





Research interests

Land surface processes and land-atmosphere interactions in WRRs

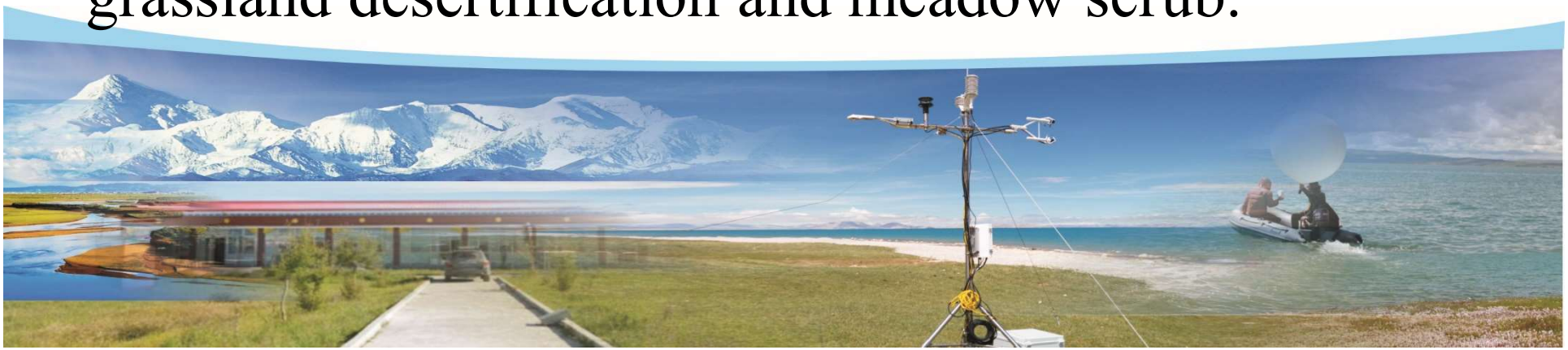
Responses of alphine ecosystem to global warming

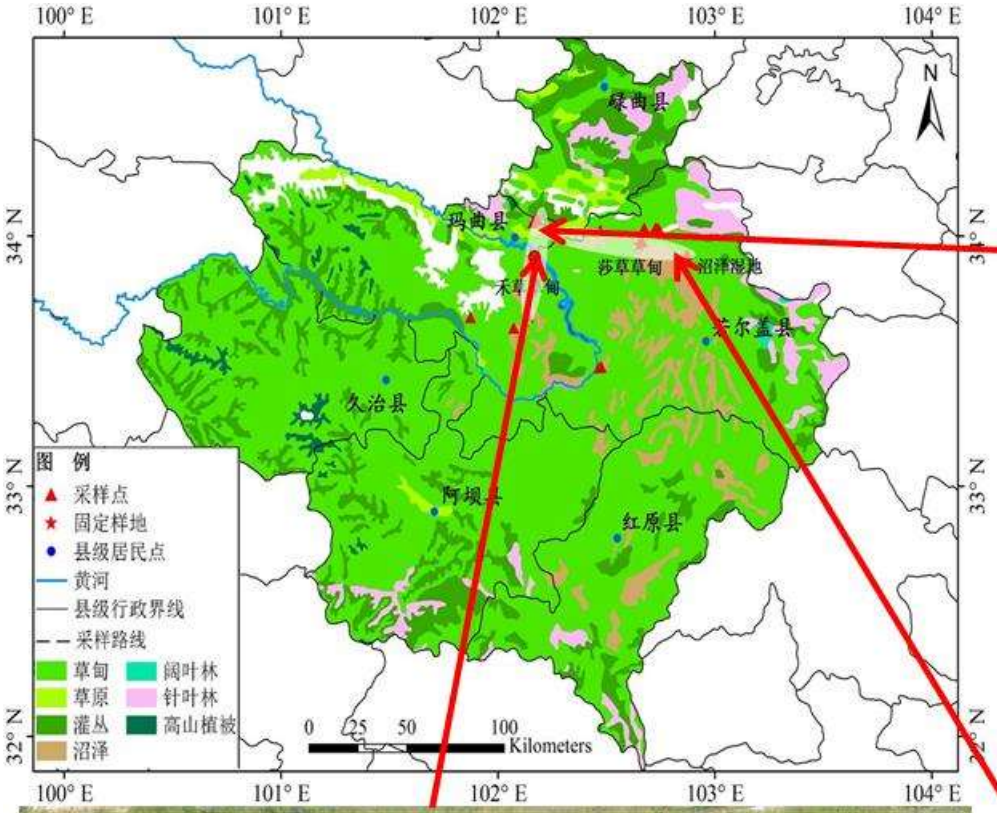
Land surface model development

Research objective： Coordinate the relationship between ecological function and production function.

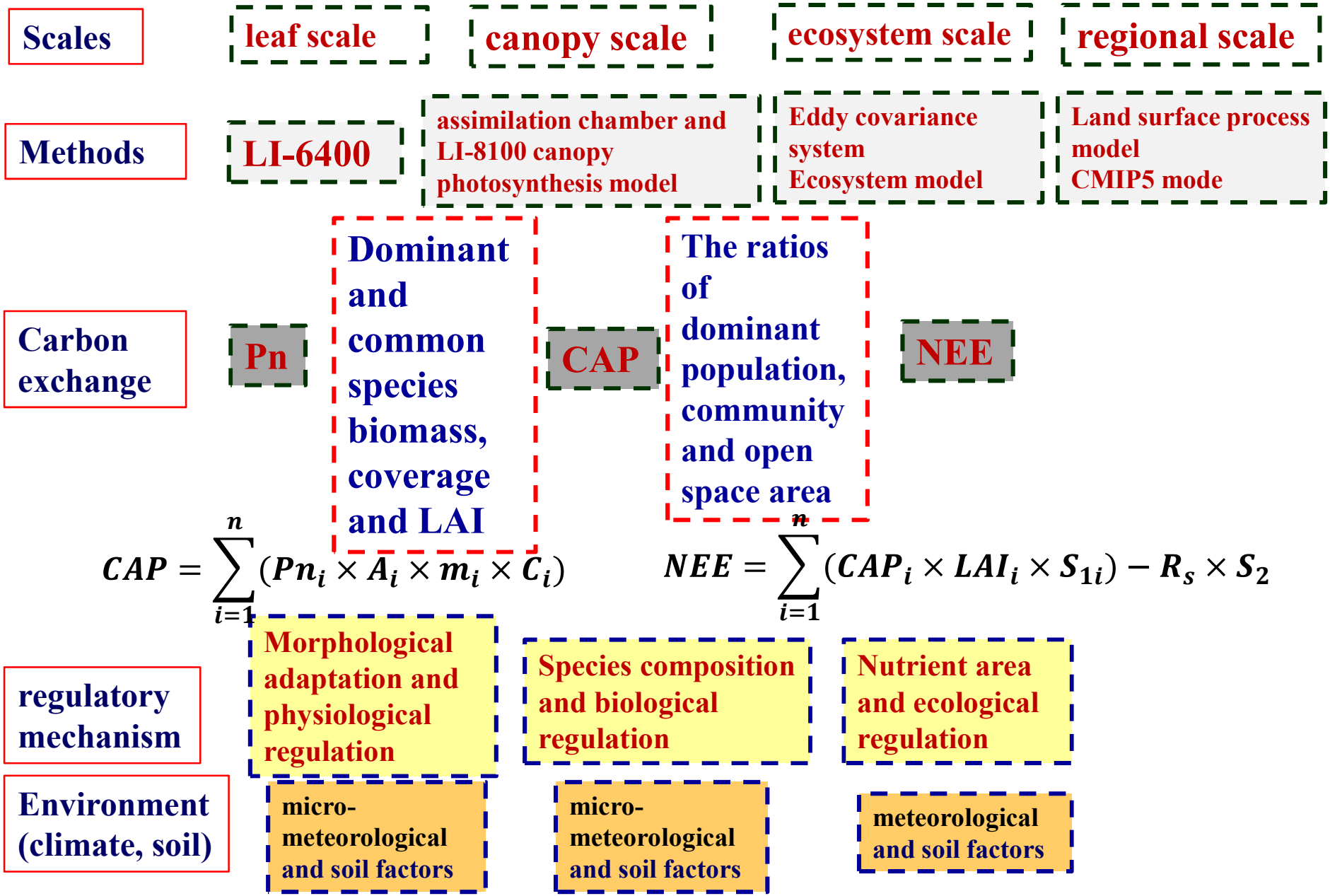
Scientific questions： Carbon assimilation characteristics and carbon sequestration capacity in different scales, and the carbon sequestration status and maintenance degree of ecosystem under climate change.

Production problems: Wetland degradation, grassland desertification and meadow scrub.




100° E
101° E
102° E
103° E
104° E
34° N
33° N
32° N
N
玛曲县
碌曲县
若尔盖县
久治县
阿坝县
红原县
莎草草甸
沼泽湿地
禾草草甸
图 例
采样点
固定样地
县级居民点
黄河
县级行政界线
采样路线
草甸
草原
灌丛
沼泽
阔叶林
针叶林
高山植被
0 25 50 100
Kilometers

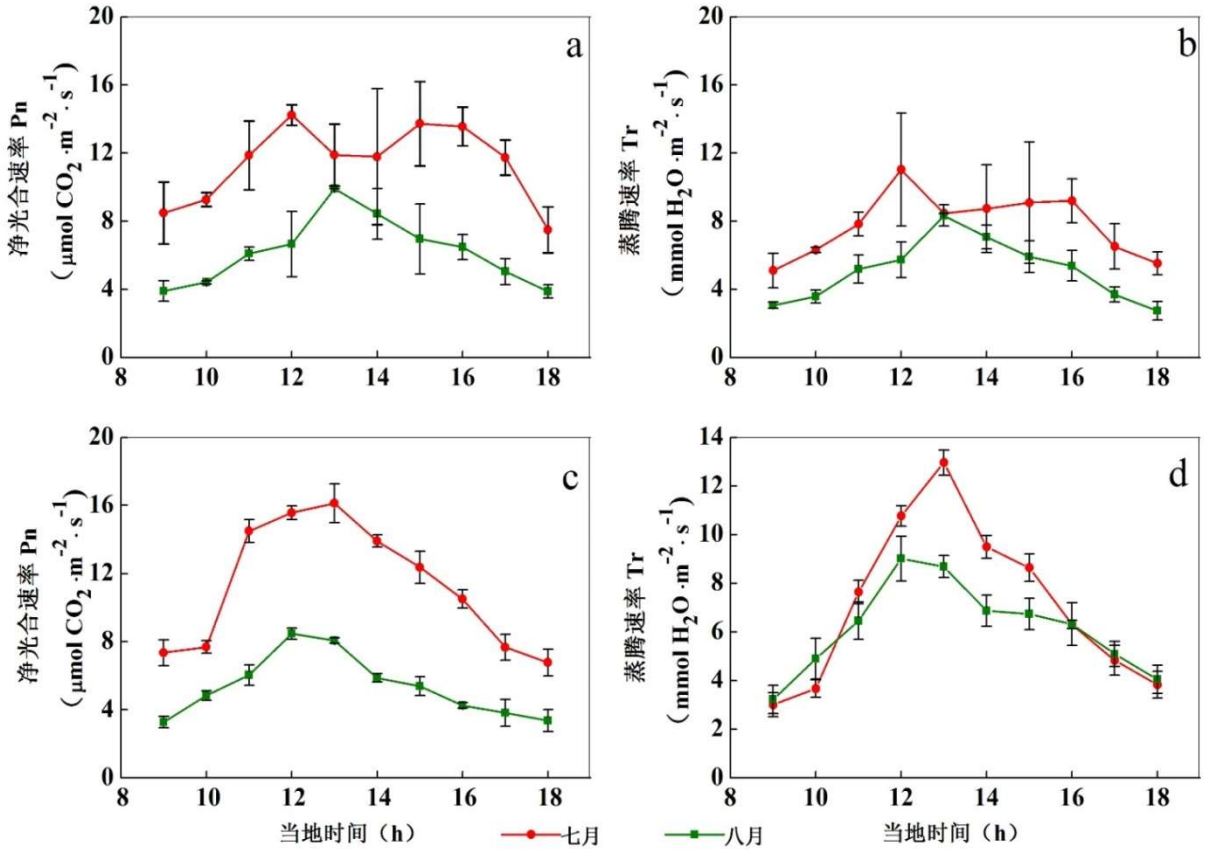
Scales, methods, carbon exchange, regulatory mechanism and carbon-water coupling



Carbon exchange in leaf level (1)

Net photosynthetic rate

Transpiration rate



a, b: *Elymus nutans*

c, d: *Carex muliensis*

EN > CM

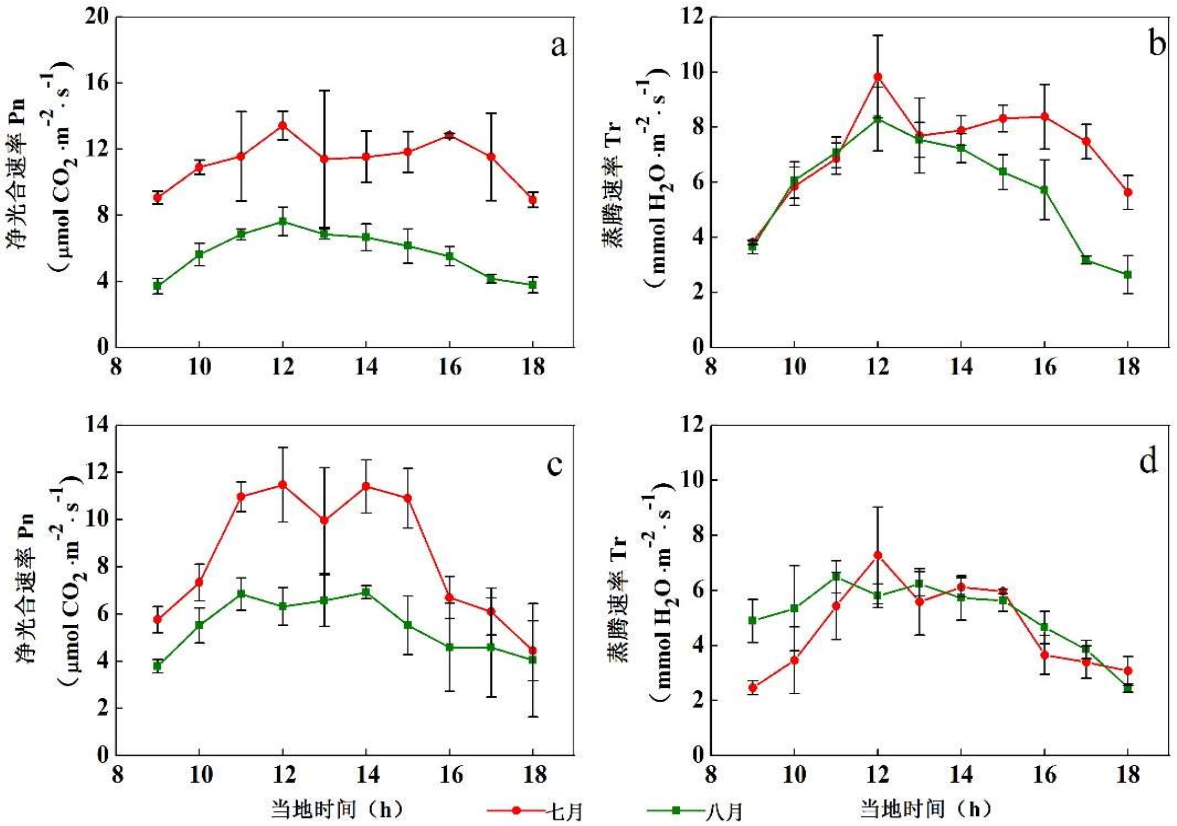
July > August

EN: the diurnal average of Pn in mid-July and mid-August were 11.4 and 6.2 μmol·m^{-2}·s^{-1}, respectively, and the diurnal average of Tr were 7.8 and 5.1 mmol·m^{-2}·s^{-1}, respectively.

CM: the diurnal average of Pn in mid-July and mid-August were 11.3 and 5.3 μmol·m^{-2}·s^{-1}, respectively, and the diurnal average of Tr were 7.1 and 6.1 mmol·m^{-2}·s^{-1}, respectively. The values in July were higher than in August.

Carbon exchange in leaf level (2)

Net photosynthetic rate **Transpiration rate**



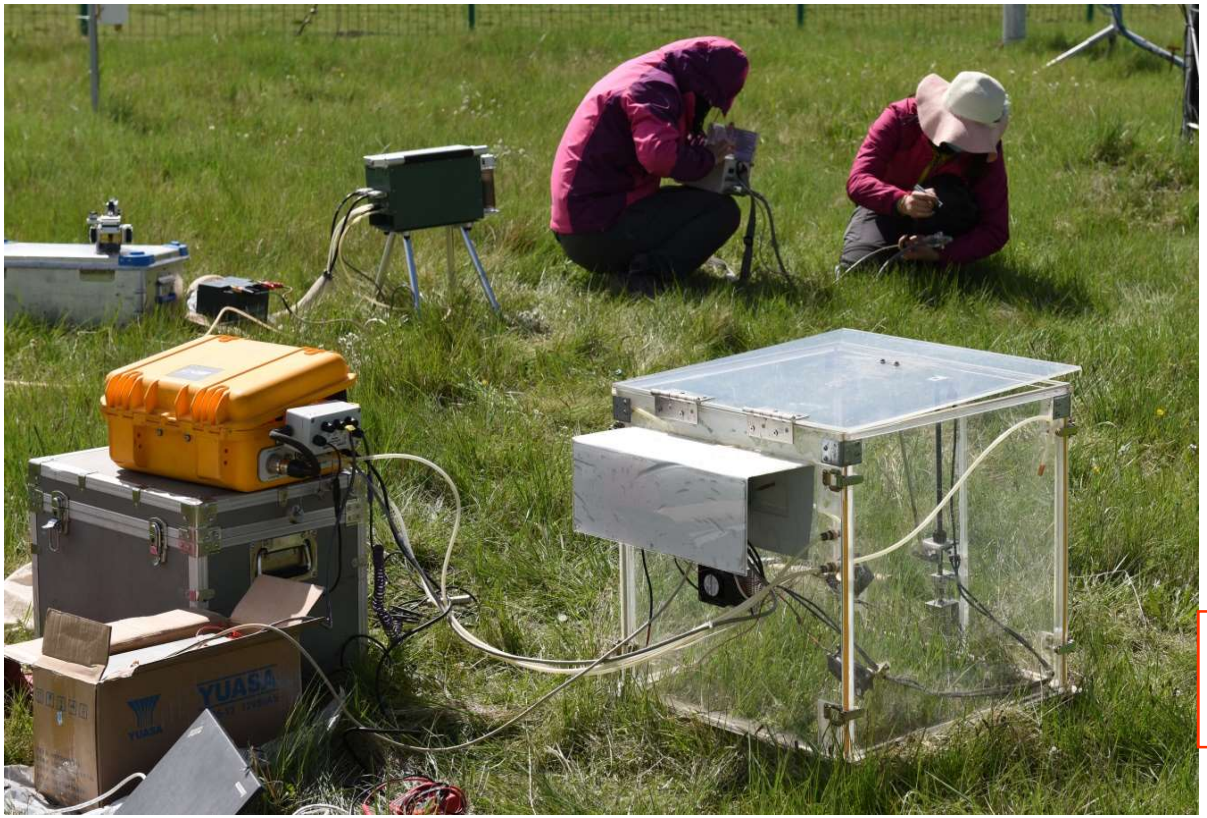
a, b: alpine meadow
c, d: alpine wetland

meadow > wetland

the diurnal average of Pn in July and August were 11.3 and 7.2 μmol·m^{-2}·s^{-1} in alpine meadow, and 8.5 and 4.7 μmol·m^{-2}·s^{-1} in alpine wetland, respectively; the diurnal average of Tr were 5.7 and 5.8 mmol·m^{-2}·s^{-1} in alpine meadow, and 5.5 and 5.1 mmol·m^{-2}·s^{-1} in alpine wetland, respectively.

Carbon exchange in canopy level (1)

$$CAP = -\frac{10 V_A P_{A0}\left(1 - \frac{W_{A0}}{1000}\right)}{RA\left(T_{A0} + 273.15\right)}\left(\frac{\partial C'_A}{\partial t} - n\frac{\partial C'}{\partial t}\right)$$

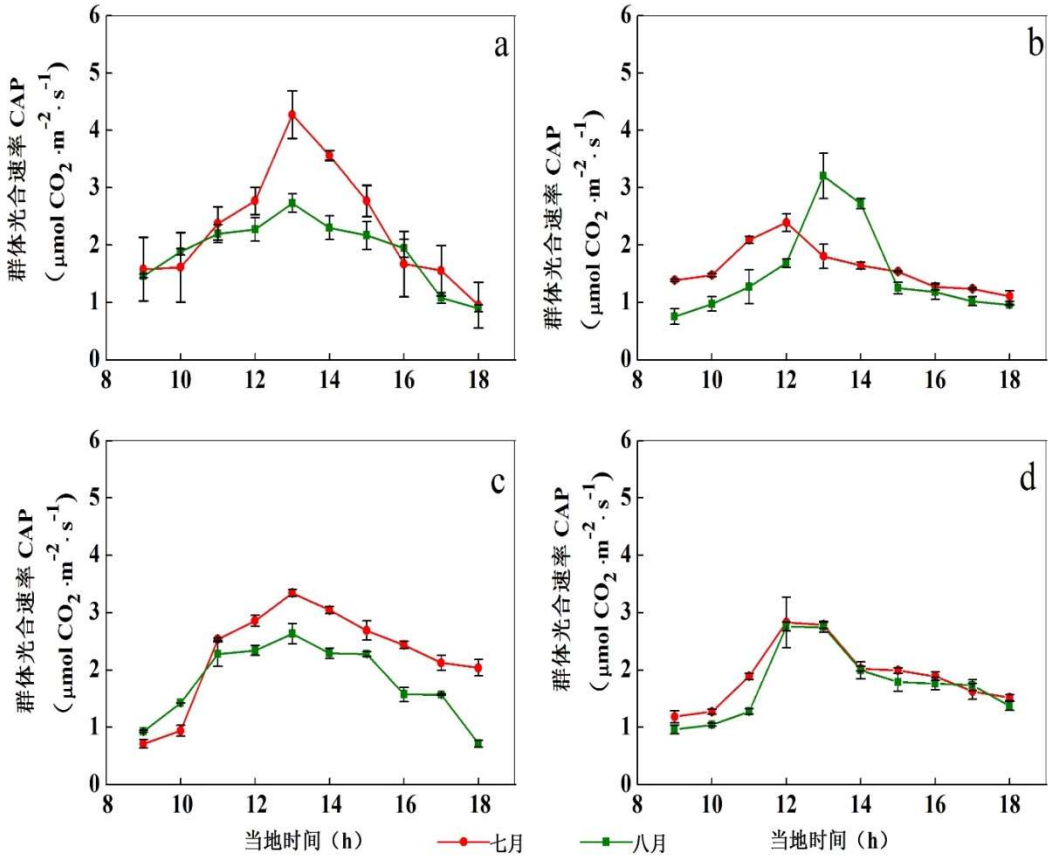


$$n = \frac{V}{S}\frac{S_A}{V_A}$$

Gao Song, Su Peixi . 2010
Su Peixi, Zhou Zijuan. 2013

Carbon exchange in canopy level (2)

Diurnal changes of photosynthesis rate



a: *E. nutans* population b: *C. muliensis* population

c: Alpine meadow community d: Alpine wetland community

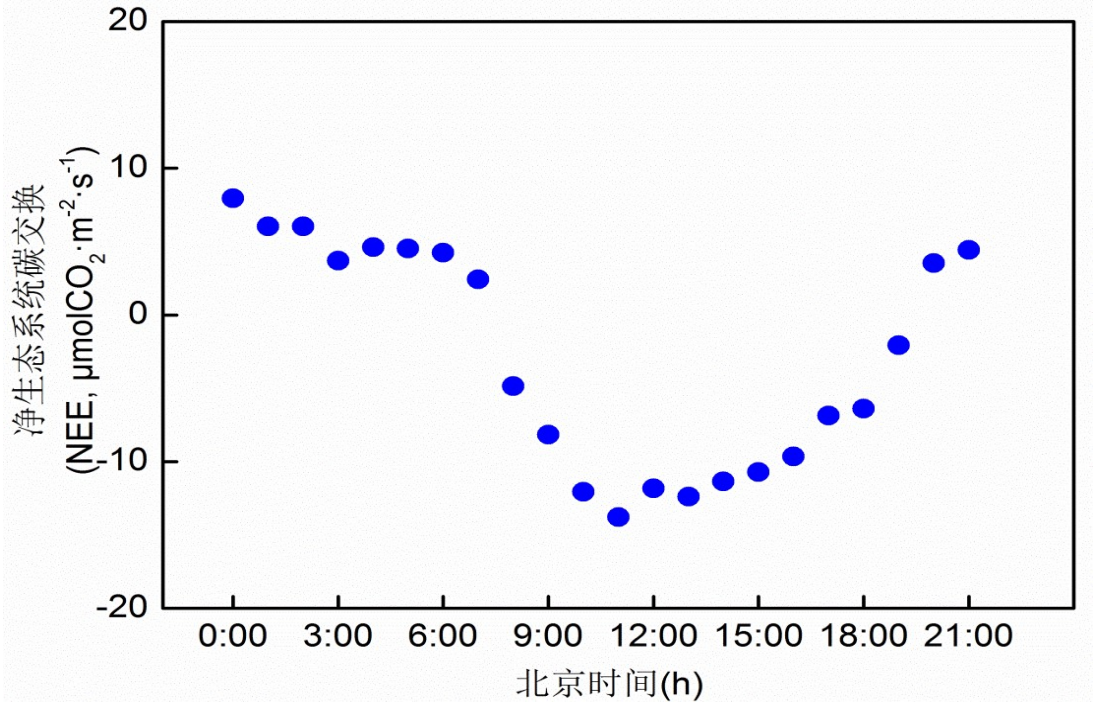
The diurnal average of CAP in ***E. nutans* population** were 2.3 and 1.9 μmol·m^{-2}·s^{-1} in July and August, and the maximum values were 4.3 and 2.7μmol·m^{-2}·s^{-1}; The diurnal average of CAP in ***C. muliensis* population** were 1.6 and 1.5 μmol·m^{-2}·s^{-1} in July and August, and the maximum values were 2.4 and 3.2μmol·m^{-2}·s^{-1}.

The diurnal average of CAP in **Alpine meadow community** were 2.3 and 1.8 μmol·m^{-2}·s^{-1} in July and August, and the maximum values were 3.3 and 2.6μmol·m^{-2}·s^{-1}; The diurnal average of CAP **in Alpine wetland community** were 1.9 and 1.7 μmol·m^{-2}·s^{-1} in July and August, and the maximum values were 2.8 and 2.9μmol·m^{-2}·s^{-1}.

Nutans < Muliensis

Meadow < Wetland

Carbon exchange in ecosystem (1)

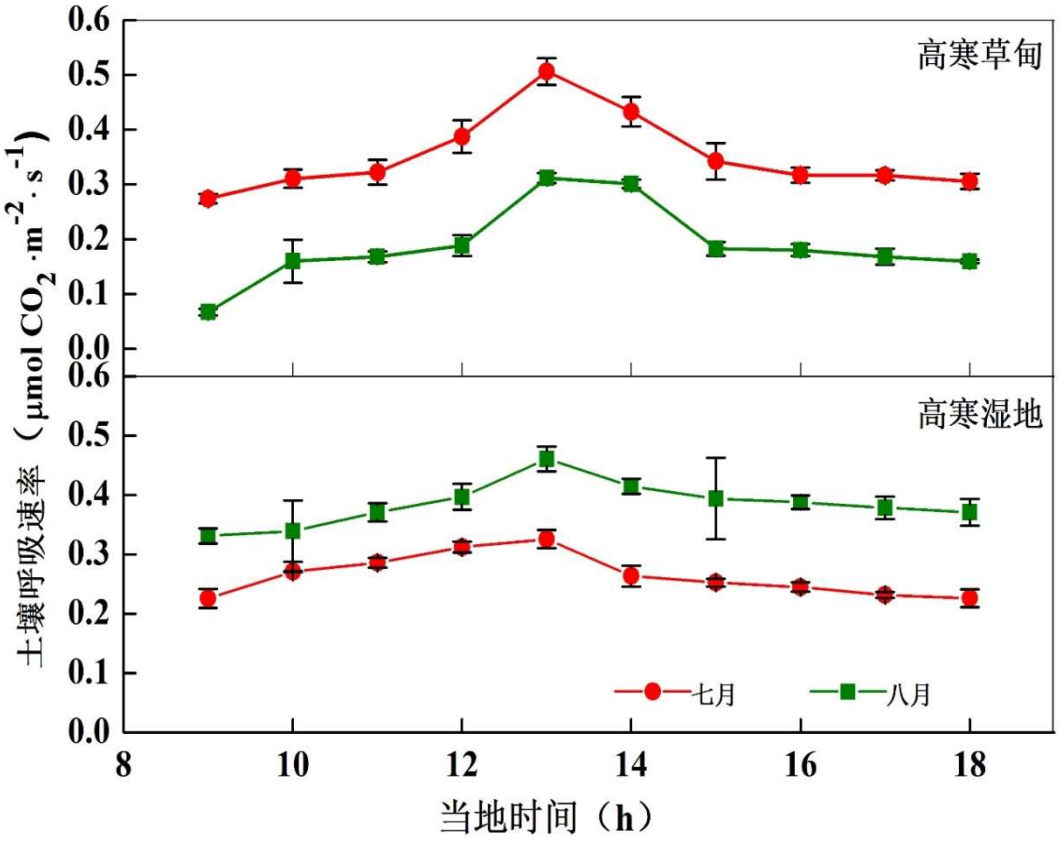


Apparent carbon absorption

- Self - heating effect
- Spectrum effect

The carbon exchange of alpine meadow was negative value (carbon uptake) in the daytime, with an average of -9.2 $\mu molCO_2 \cdot m^{-2} \cdot s^{-1}$, and with positive value (carbon emission) in the nighttime, which was 4.7 $\mu molCO_2 \cdot m^{-2} \cdot s^{-1}$. The daily average was -2.2 $\mu molCO_2 \cdot m^{-2} \cdot s^{-1}$ in 0:00-24:00 .

Soil respiration rate in ecosystem (2)



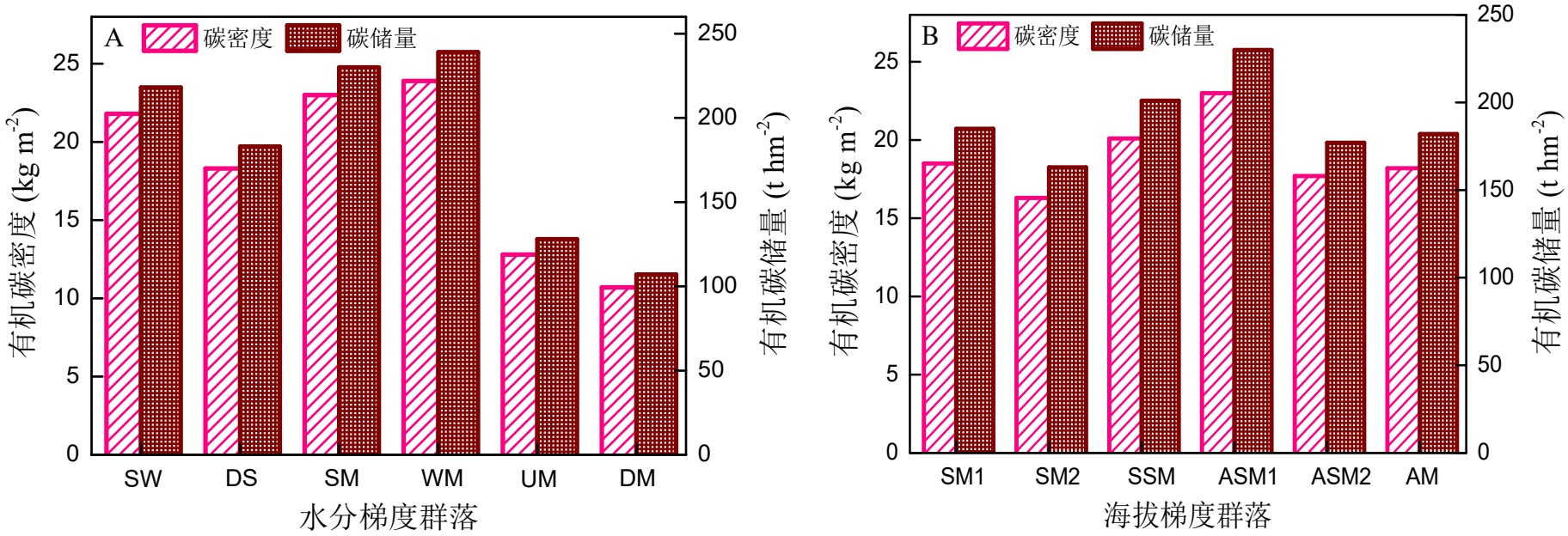
alpine meadow

alpine wetland

The daily average of alpine meadow soil respiration (Rs) in mid-July and mid-August were 0.35 and 0.19 μmol CO_2 m^{-2} s^{-1}, respectively. The daily average of alpine wetland Rs in mid-July and mid-August were 0.26 and 0.38 μmol CO_2 m^{-2} s^{-1}.

July: Meadow > Wetland **August: Meadow < Wetland**

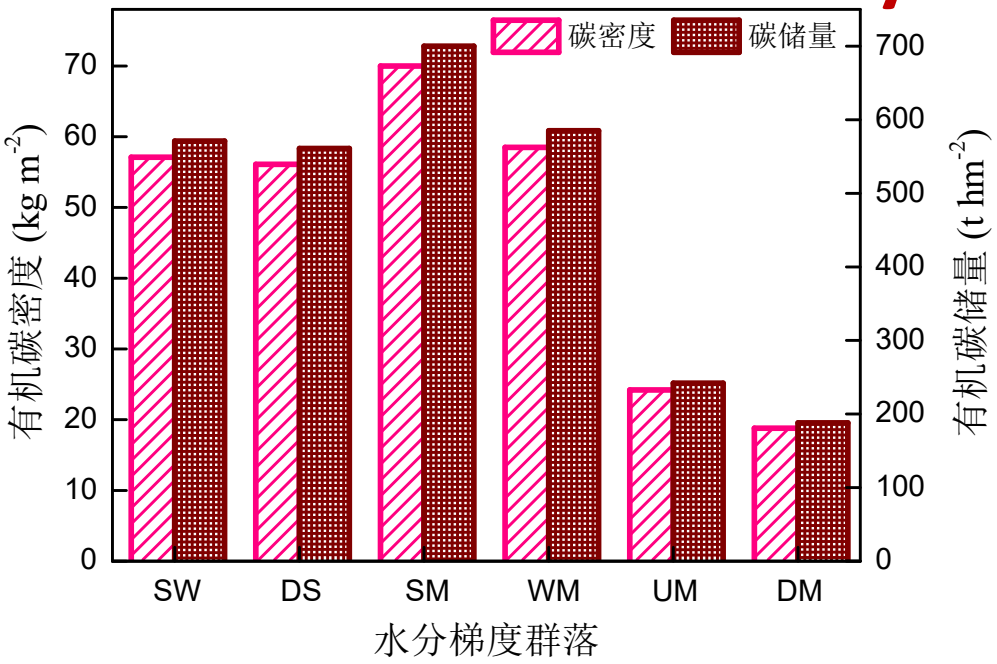
The carbon sequestration capacity of alpine sod layer (1)



Soil organic carbon density and storage of sod layer in communities along the moisture and elevation gradients

The soil organic carbon density of sod layer in different communities varied greatly along the moisture gradients, and decreased with soil water availability decrease between 10-24 kg m^{-2} . The carbon storage in degraded meadow was significantly reduced. There was no obvious law on the elevation gradient, and the average of soil organic carbon density and storage in meadow sod layer were **17.7** kg m^{-2} and **177** t hm^{-2}, respectively, and the shrub meadow were **20.3** kg m^{-2} and **203** t hm^{-2}, respectively.

The carbon sequestration capacity of alpine sod layer (2)



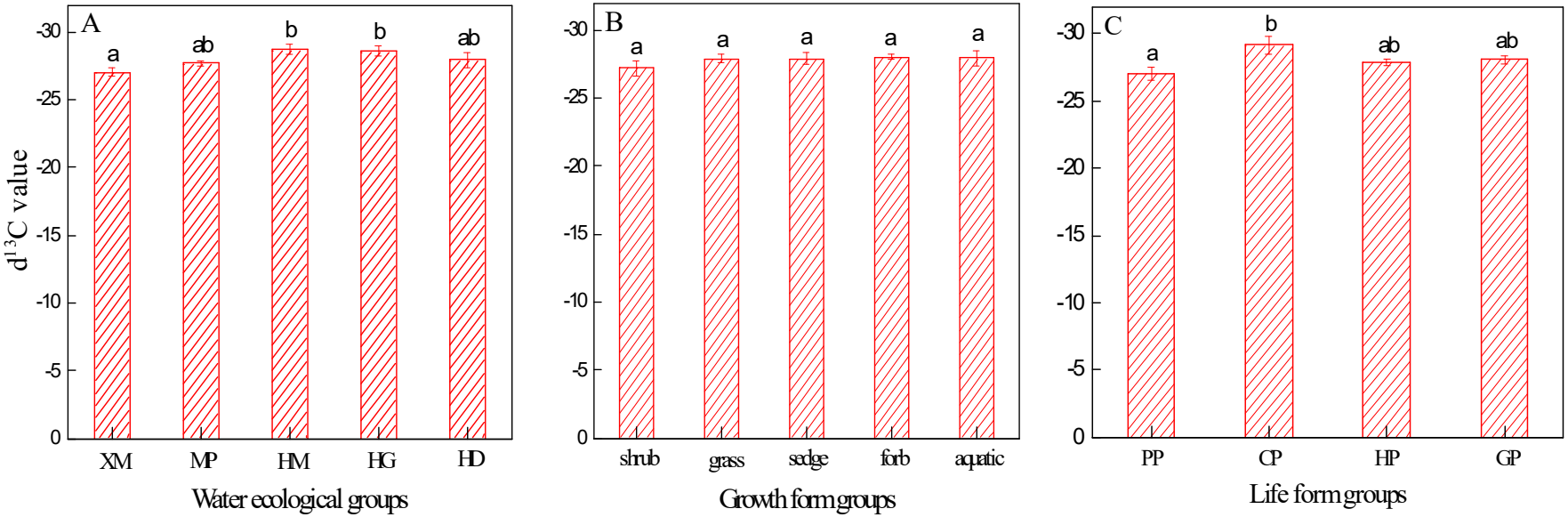
- **The average thickness of sod layer is 30 cm.**
- **The threshold value of quality water content to maintain the stability of sod layer is 30%.**
- **The threshold value of SOC is 30 g/kg.**

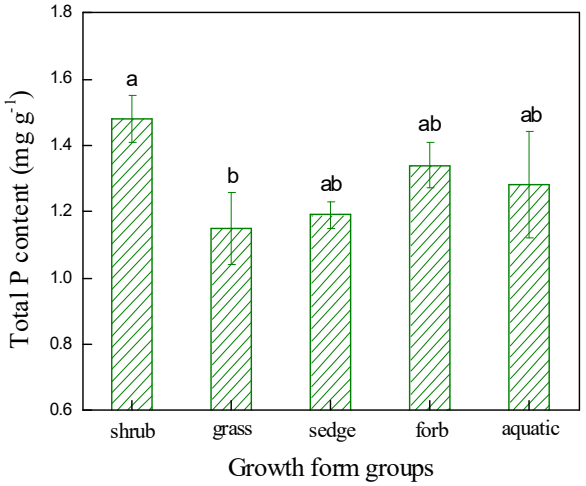
Soil organic carbon density and storage in the 1m soil layer in communities along the moisture gradient

The soil organic carbon density of swamp, degraded swamp, swampy meadow and wet meadow were all above 55 kg m^{-2}, and the average was 60.4 kg m^{-2}. The average of carbon density and storage in dry meadow and degraded meadow were obvious lower, which of the value were 21.5 kg m^{-2} and 215 t hm^{-2}, respectively. Soil organic carbon storage of sod layer/cm were 36%, 53%, 57% , respectively.

Su Peixi, Zhou Zijuan.2017

The indicating meaning of alpine plant functional groups to environmental change



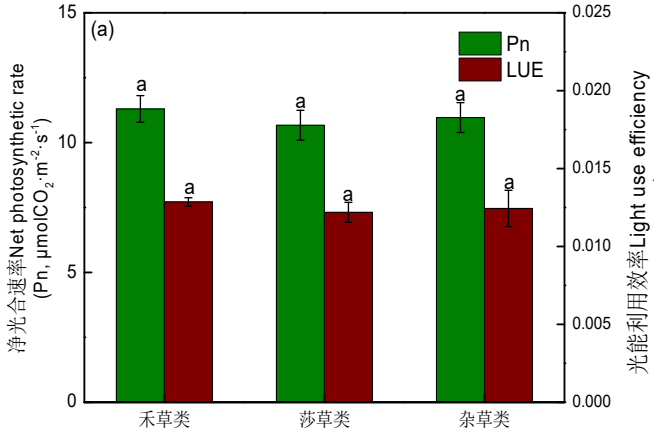


The plants growth in alpine areas are limit by phosphorus, while the greater of the density, the more serious of the P lack.

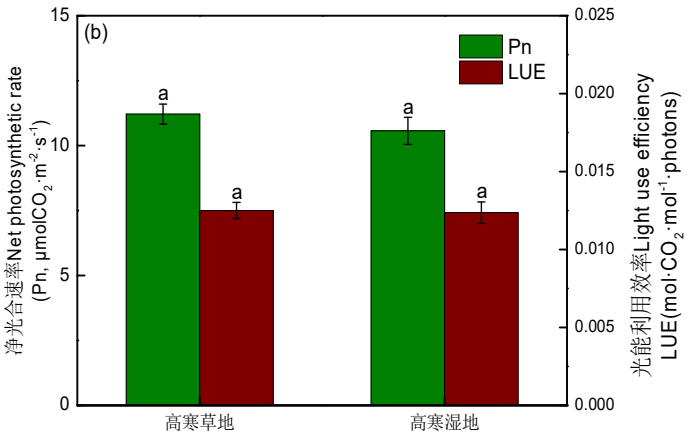
Under climate warming, the alpine meadow have a succession tendency to the alpine shrub meadow.

Su P X. 2016

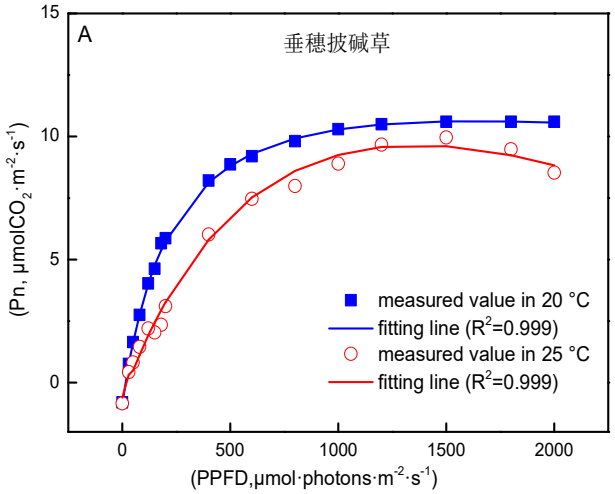
light use efficiency (LUE) of alpine plants

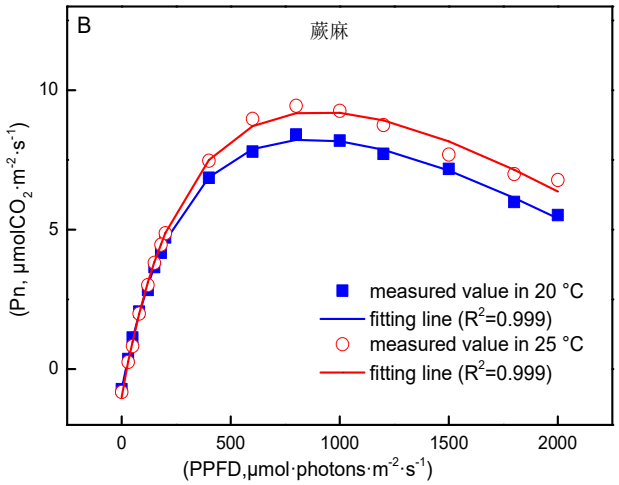


The Pn and LUE in different function groups plants



The Pn and LUE in different ecosystems



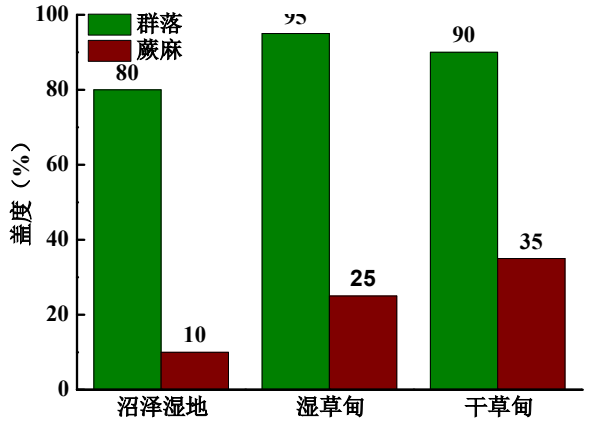


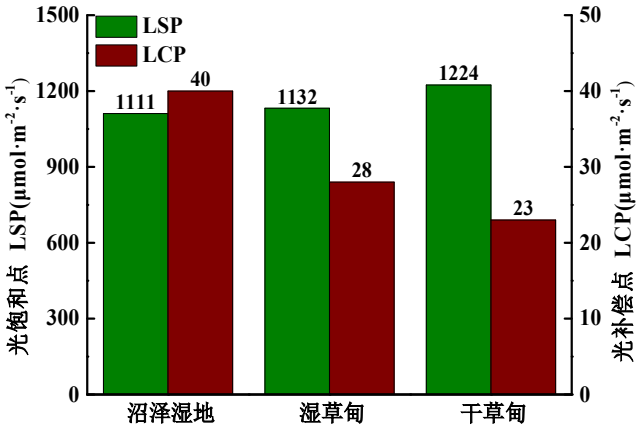
At current, the LUE of grass was higher than forb. Short-term observations indicate that with the temperature rising, the LUE of the grass decreased, while the LUE of forb increased.

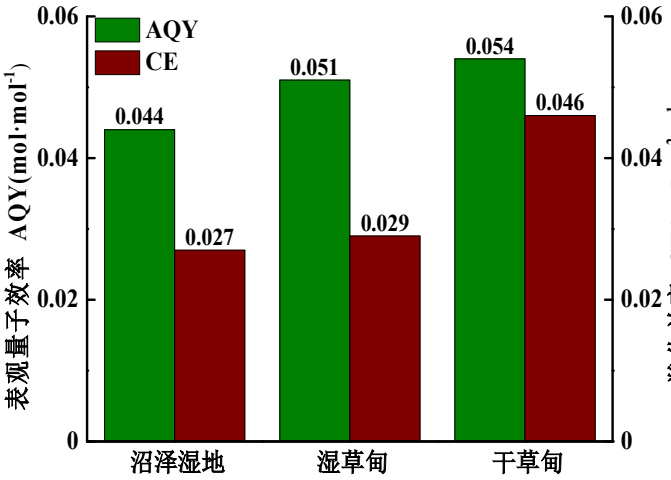
Tendency of grass to forb

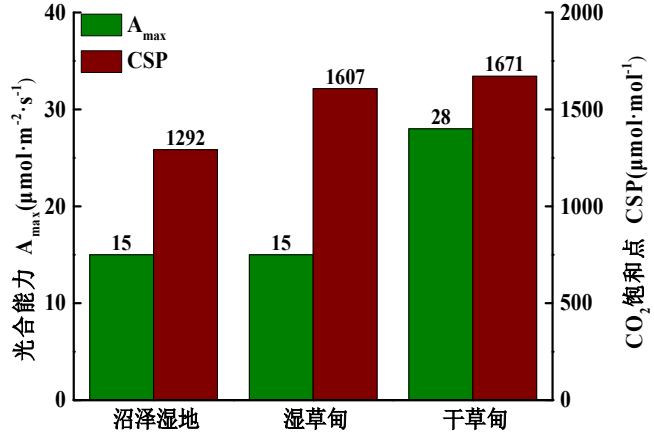
Zhou zijuan, Su peixi. 2017

The habitat adaptability and indicating roles of *Potentilla anserina* which are widely distributed





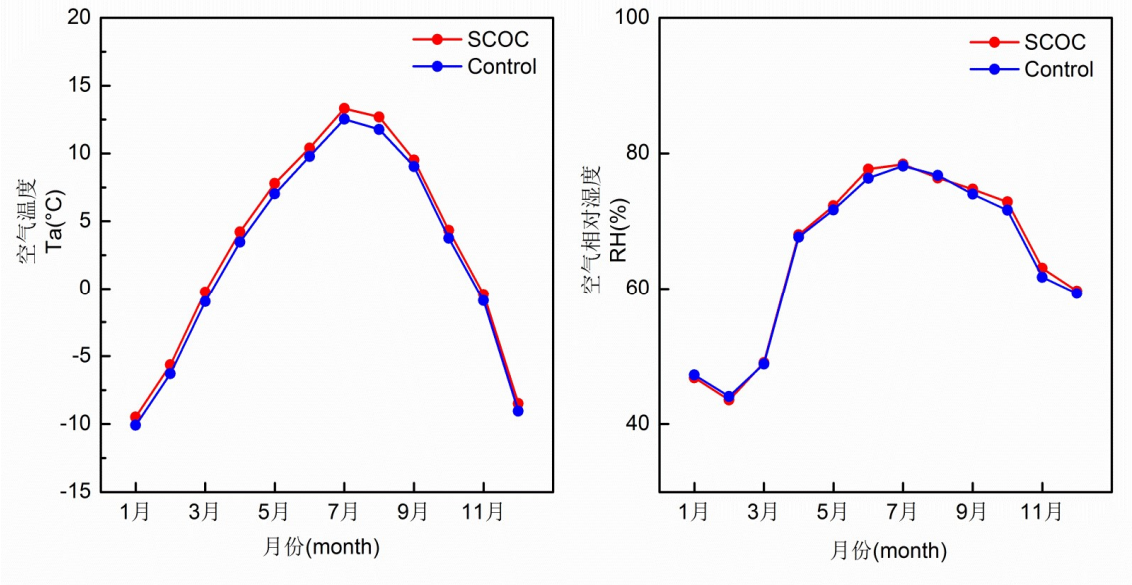




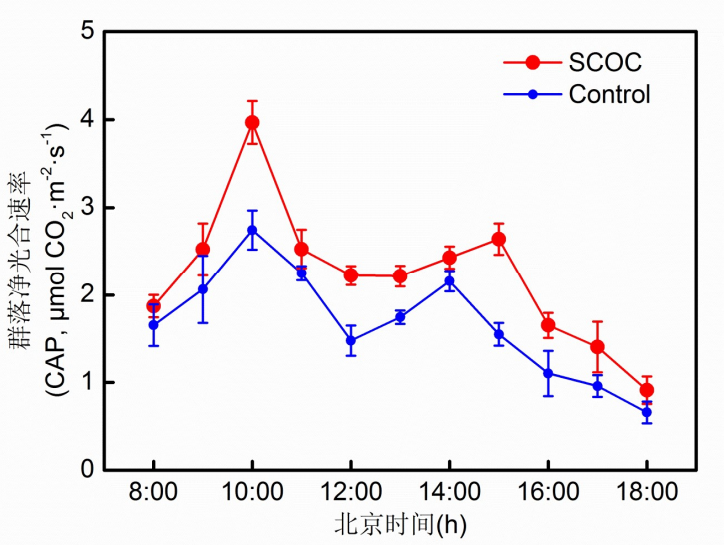
With the soil water availability decreased, the photosynthetic capacity of *P. anserina* increased , which is the indicator of vegetation degradation and the pioneer species of recovery.

Shi R, Su P X. 2016

Changes of photosynthetic carbon assimilation rate in plant communities at simulated warming



Annual changes of micro-meteorological factors in SCOC and the control



Net assimilation rate of communities in mid-July

The average annual air temperature was increased by 0.7℃ in SCOCs, which were more higher in growing season. The average annual air humidity were 66.0% and 65.6%, respectively. The highest temperature in SCOC and the control were 30.2 ℃ and 28.0 ℃, and the lowest values were -30.3℃ and -29.7℃ (Radiation enclosures, blinds)

Simulated warming increased the net photosynthetic rate of alpine meadow communities, and daily average value were 2.22 μmol m^{-2} s^{-1} and 1.67 μmol m^{-2} s^{-1}, respectively. The difference was 0.55 μmol CO_2 m^{-2} s^{-1} .


Thank you !