Water chemistry and greenhouse gases emissions in the rivers of the "Third Pole"/"Water Tower of Asia"

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学习工作经历

2006年

- 山东师范大学

2010年

多次青藏高原冰川考察（珠峰）

- 中国科学院青藏高原研究所

2013年

- 芬兰 Lappeenranta University of Technology

- Short visit to Yale Twice
- AGU
- 青藏高原河流考察

2017年

- 耶鲁-南信大大气环境中心
- 南京信息工程大学

The Tibetan Plateau

- The “Roof of the World” and the “Third Pole”,

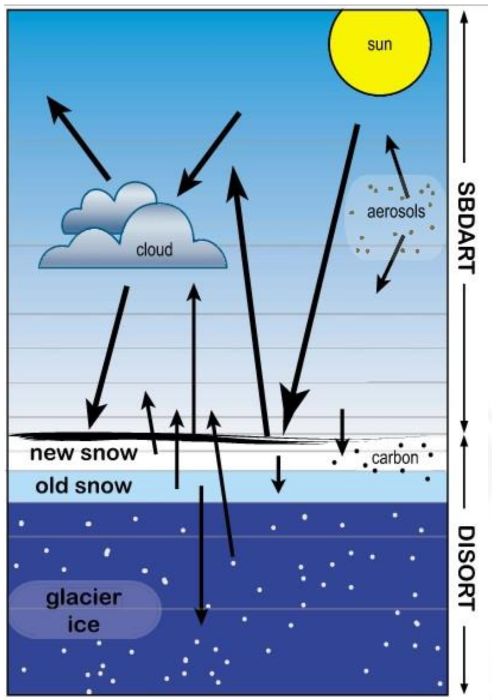
  The world's highest plateau, average elevation exceeding 4,500 m a.s.l., 2,500,000 km^2.

- “Water tower of Asia”

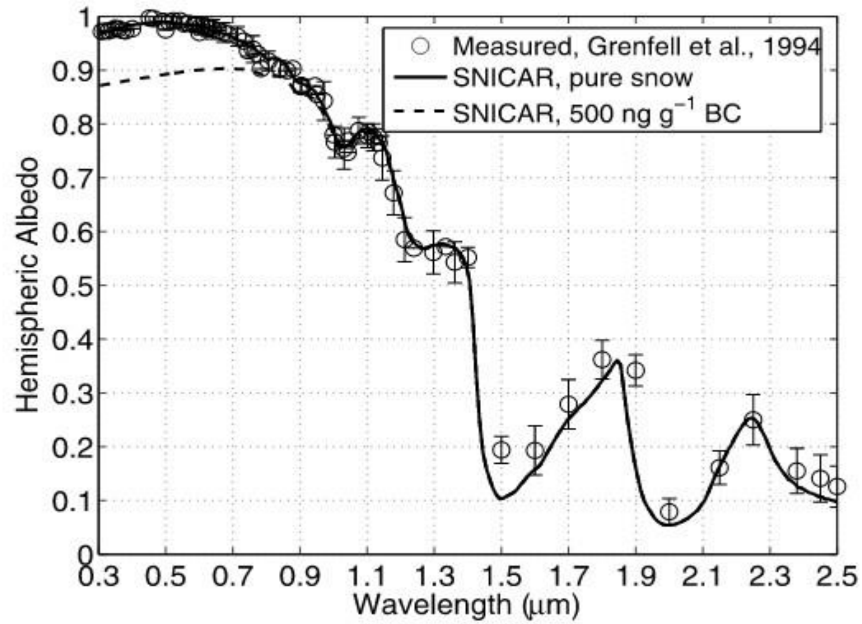
  Head waters of more than ten large rivers in Asia.

Work during master program

SNICAR（Snow Ice Aerosol Radiative）



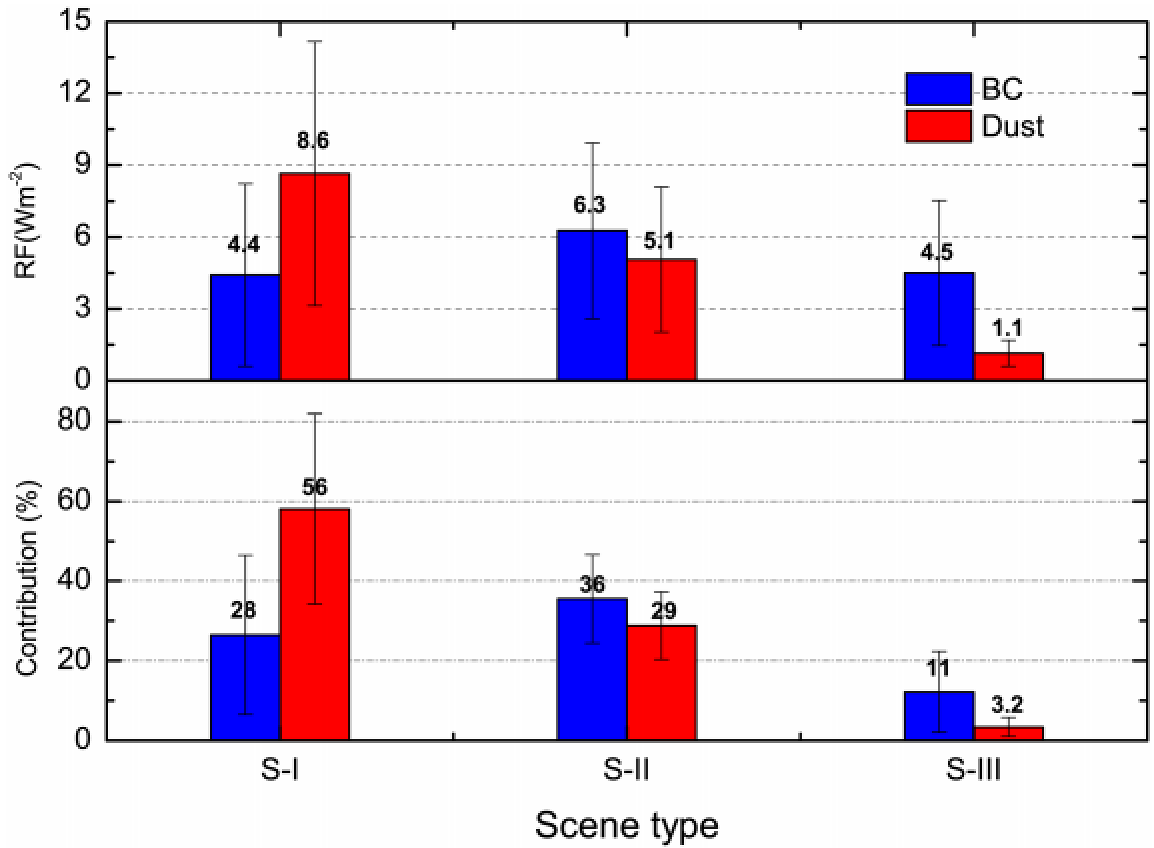
（Gardner， A. S. and M. J. Sharp 2010）



实测数据与SNICAR模拟数据的对比验证

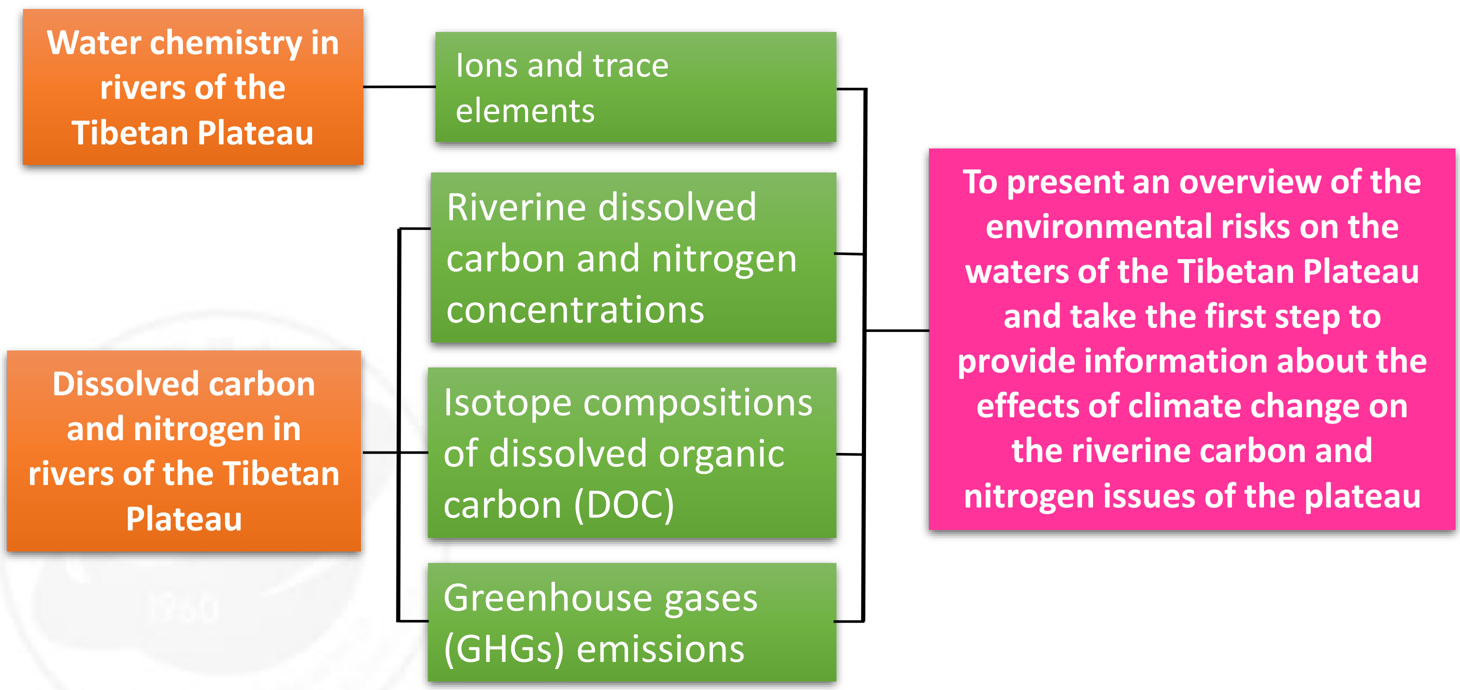
（Flanner et al. 2007）

SNICAR

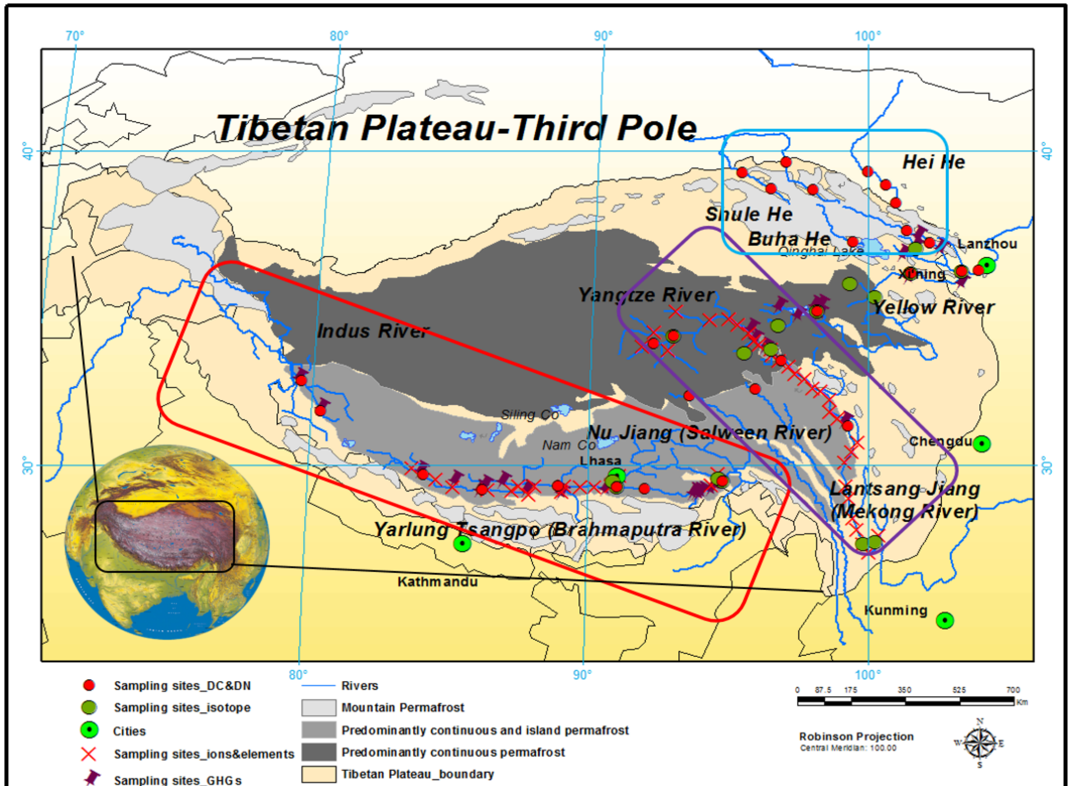


BC、粉尘对2011年7月扎当冰川附加冰带反照率降低的贡献率

Work during doctoral program



Study area and sampling sites

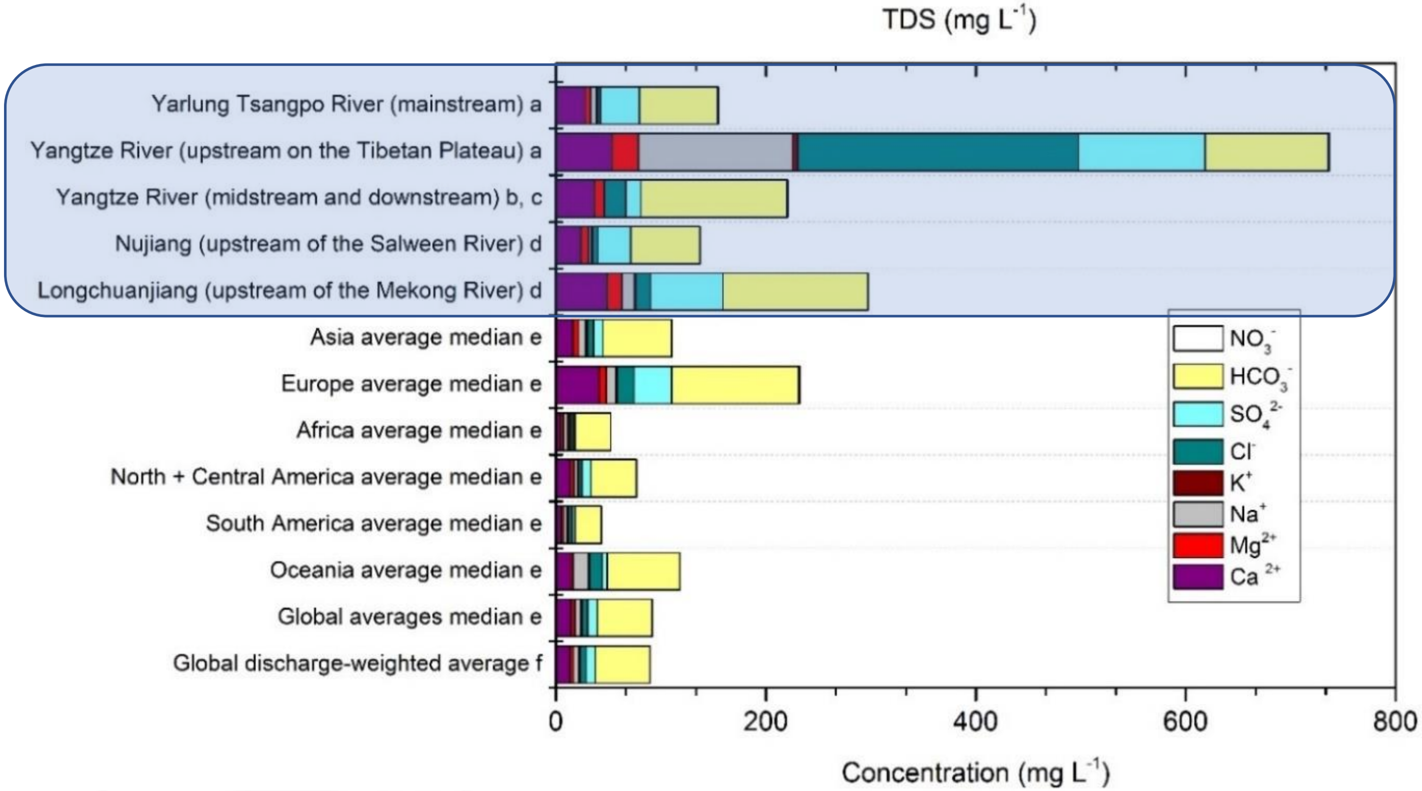


Inland river watershed	Shule He (IL-S)	
	Hei He (IL-H)	
	Buha He (IL-B)	

Pacific Ocean Water System	Yangtze River (P-YZ)
	Lancang Jiang (Mekong, P-L)
	Yellow River (P-YL)

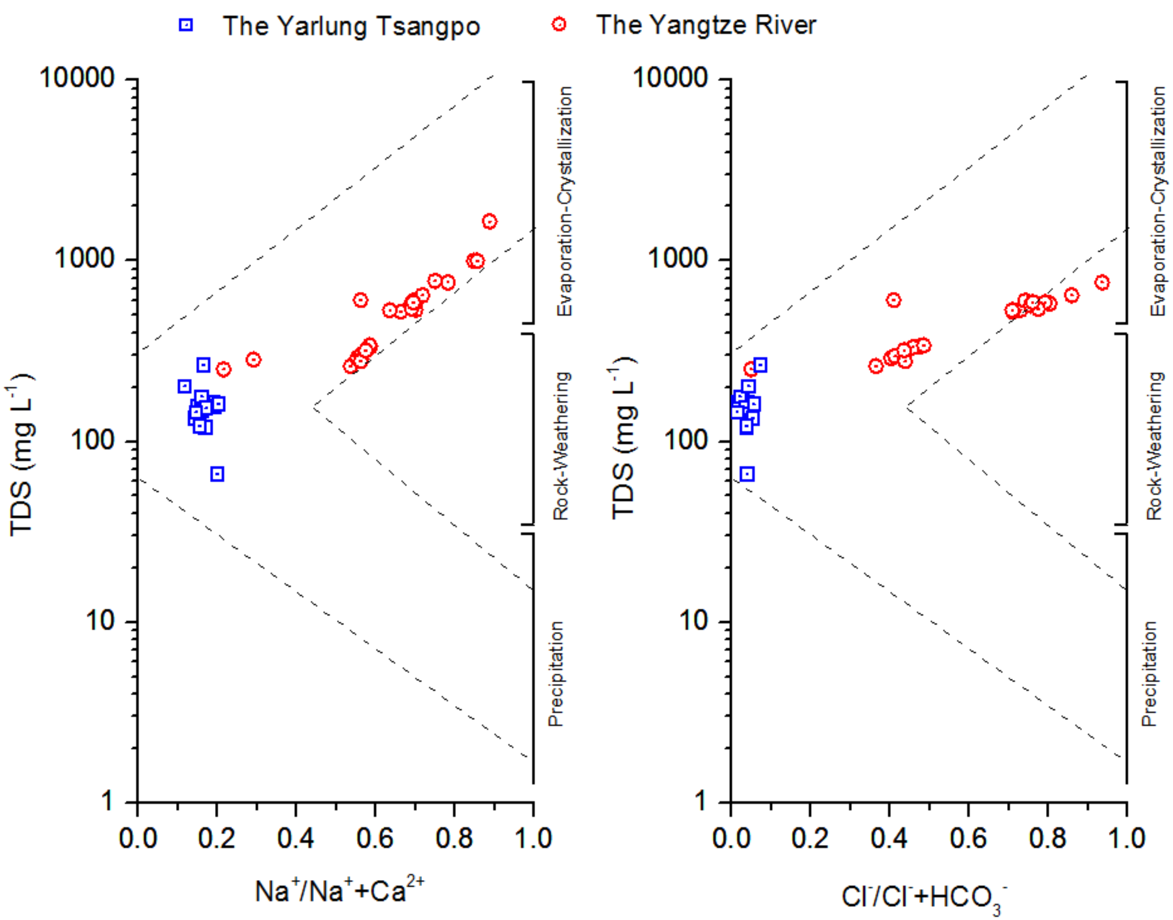
India Ocean Water System	Indus River (Indus I-I)
	Yarlung Tsangpo (I-YT)
	Nujiang (Salween, I-N)

Water ionic chemistry in rivers of the Tibetan Plateau



Average concentrations of major ions of the rivers on the Tibetan Plateau and in the world.

Data source: a. this study; b. Müller et al. (2008); c. Chen et al. (2002); d. Huang et al. (2009); e. Meybeck and Ragu (2012); f. Meybeck and Helmer, (1989).



The Gibbs graph of major ion compositions (weight ratio) in the Yangtze River and the Yarlung Tsangpo.

Water quality assessment in rivers of Tibetan Plateau —

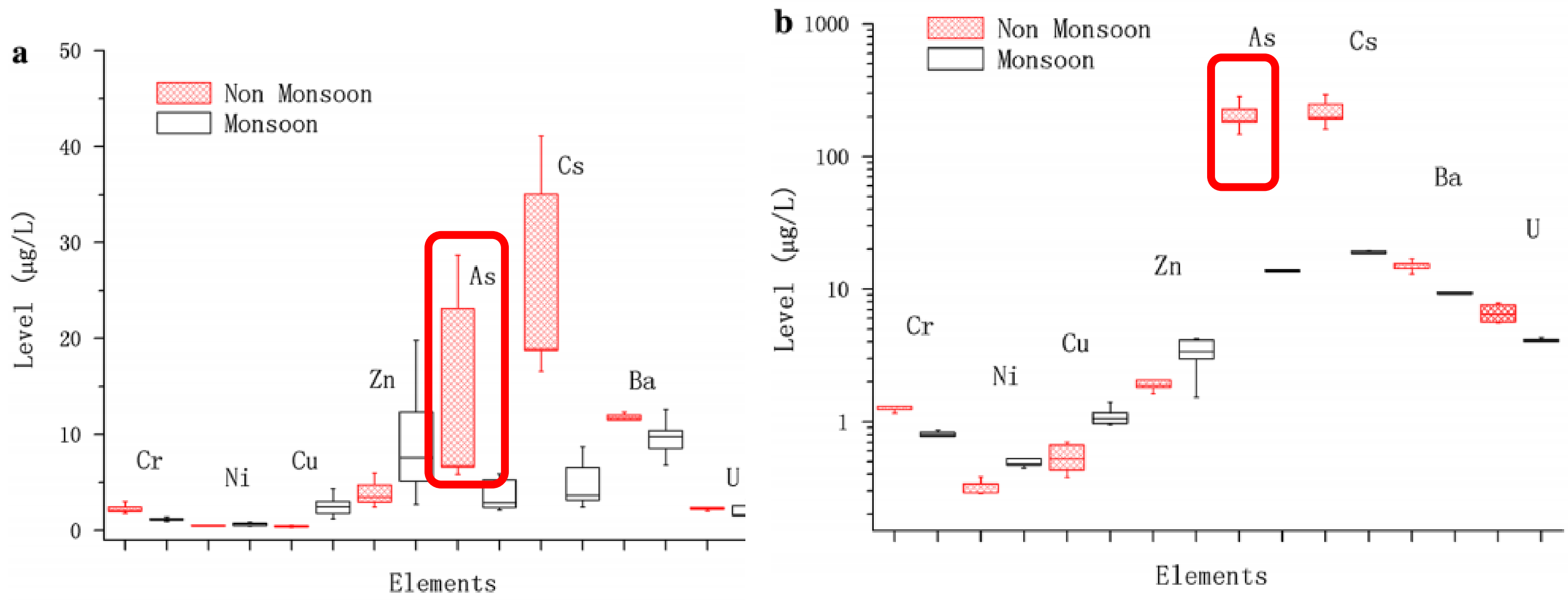
concentrations of several elements in rivers were higher than that of WHO guideline for drinking.

		Sr	Rb	Ti	Tl	B	Ba	Hg				
Yangtze River	Mainstream	1.1	654.6	1.9	**4.2***	69.5	46.6	2.6				
		Mn	**Cr**	**Ni**	**Cu**	**Zn**	**Cd**	**Sb**	**Ba**	**Pb**	**U**	**Mo**
Yarlung Tsangpo	Mainstream	30.7	2.8	2.8	1.9	20.5	**3.6***	4.3	15.3	**15.8***	2.4	1.4
Yarlung Tsangpo tributaries	Lhasa River	19.4	3.5	0.9	3.1	2.2	0.2	4.1	12.1	1.6	2.3	1.8
	Doxung Tsangbo	24.3	1.1	2.0	1.3	6.9	0.9	2.5	21.3	4.7	2.2	1.6
	Xiabu Qu	**265.0***	**12.0***	11.9	7.4	26.6	0.2	1.9	20.8	5.1	0.7	0.1
	Nianchu River	3.2	3.1	1.2	0.7	8.3	0.6	18.4	11.1	3.4	2.4	0.7
	Nyang River	0.8	1.7	1.7	1.1	3.4	2.1	2.5	8.6	9.3	1.3	0.8

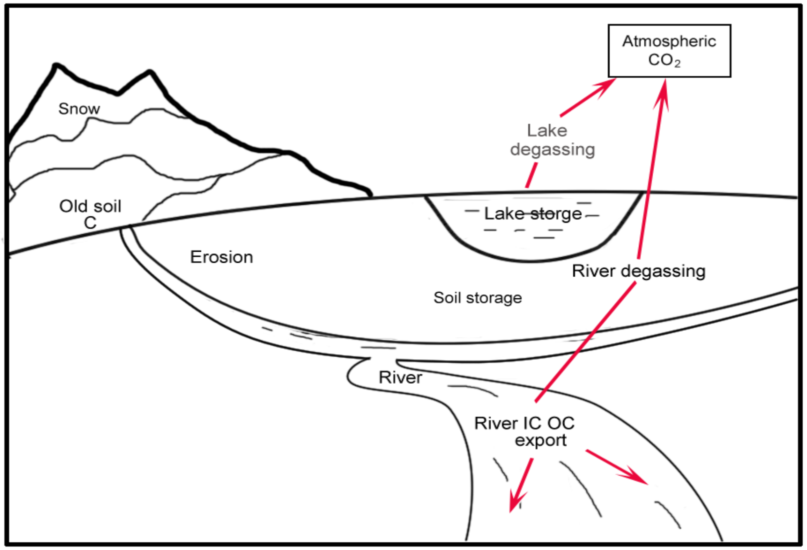
Note: unit for Hg concentration is ng L^{-1}, others are μg L^{-1}

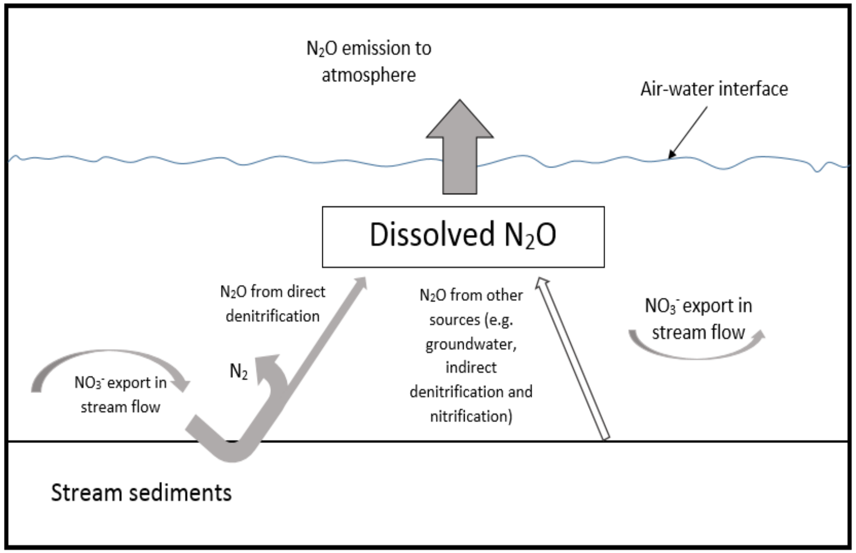
Waters quality assessment in rivers of the Tibetan Plateau

—arsenic concentrations in rivers were higher than that of WHO guideline for drinking.



Seasonal variations of dissolved trace metal levels of Lhasa River (a) and Duilong Qu (b) (Li et al., 2014).

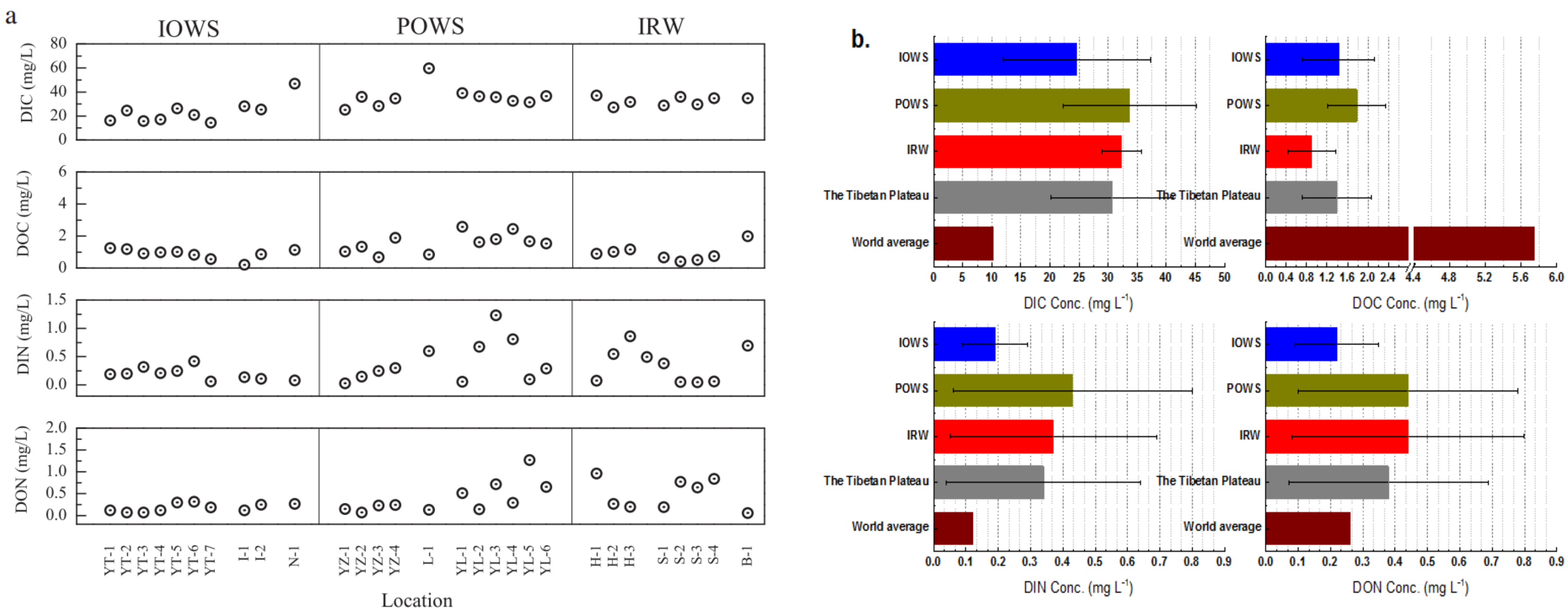




Carbon emission and discharge from rivers, figure is modified from (Raymond, 2005 Nature).

Dissolved nitrogen and GHGs emissions from aquatic system, figure is modified from (Beaulieu et al., 2011).

Dissolved carbon and nitrogen in rivers of the ‘Third Pole’



a. Concentration distributions of dissolved C and N in the rivers of the Tibetan;

b. Mean concentrations of dissolved C and N in river of the Tibetan Plateau and the global average Plateau (Qu et al., 2017).

Correlation between riverine C and N in rivers of the Tibetan Plateau and the related influential factors

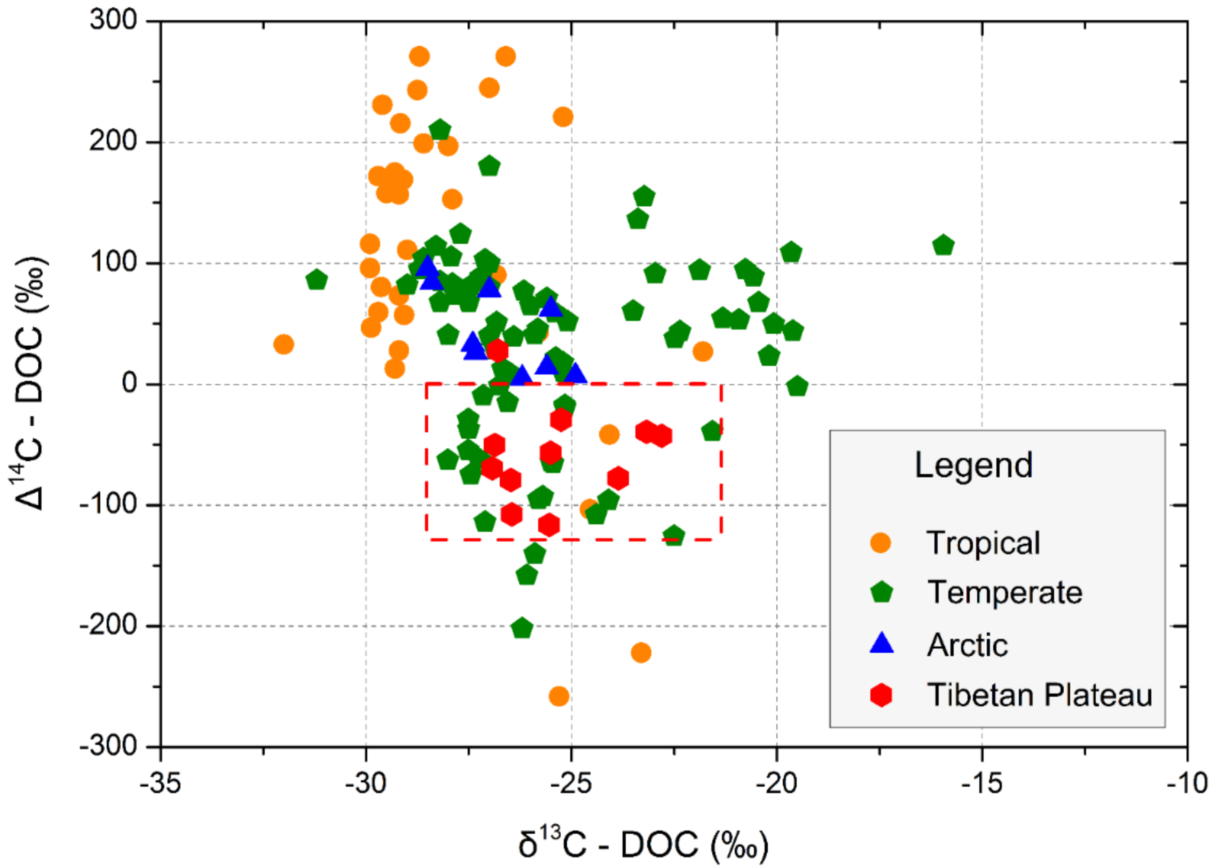
	Natural vegetation (n = 27)	Cultivated vegetation (n = 27)	Water temperature (n = 27)	TDS (n = 27)	Runoff (n = 19)
DIC	−0.105	−0.034	−0.038	0.415*	−0.590**
DOC	0.100	0.021	−0.548**	0.457*	−0.015
DIN	0.048	0.452*	−0.229	0.326	−0.031
DON	−0.403*	0.408*	0.297	0.174	−0.145

TDS: total dissolved solid; DIC: dissolved inorganic carbon; DOC: dissolved organic carbon; DIN: dissolved inorganic nitrogen; DON: dissolved organic nitrogen.

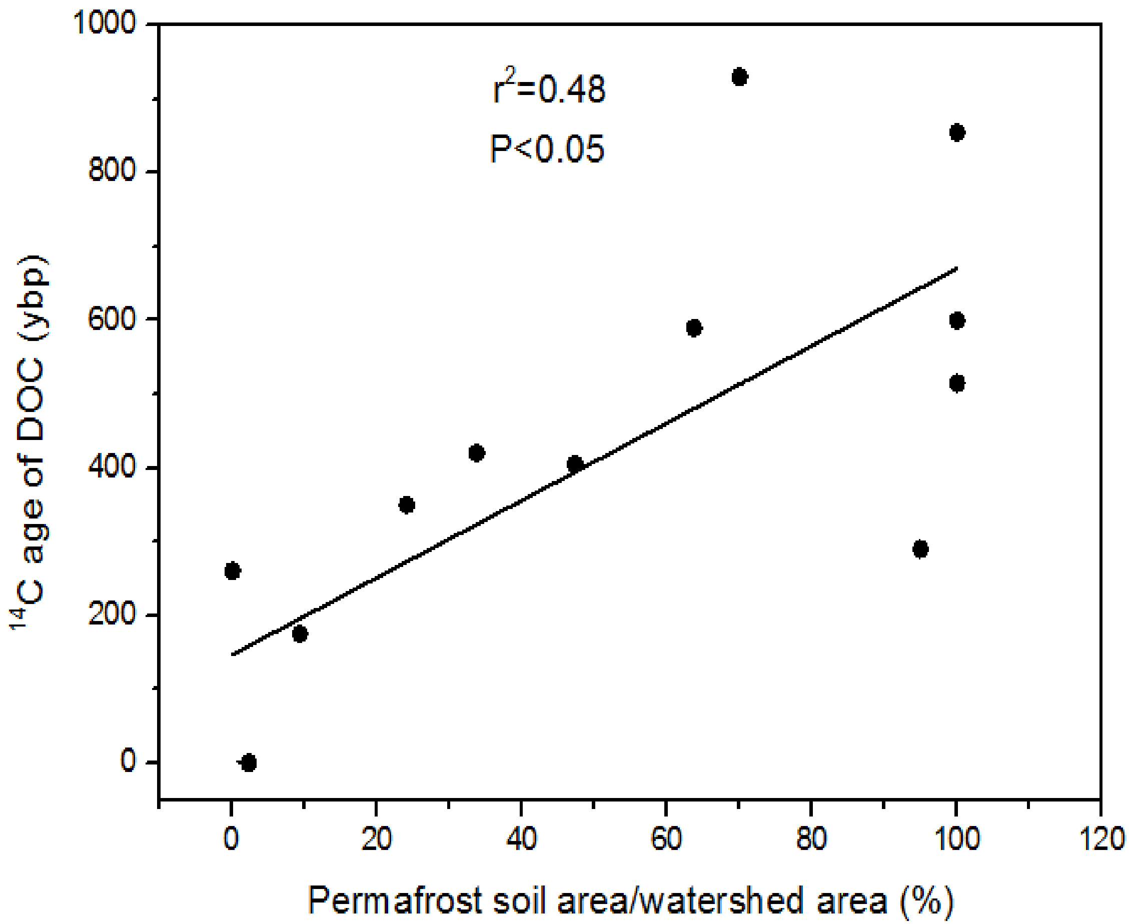
* Significant at 0.05 (2-tailed);

** Significant at 0.01 (2-tailed).

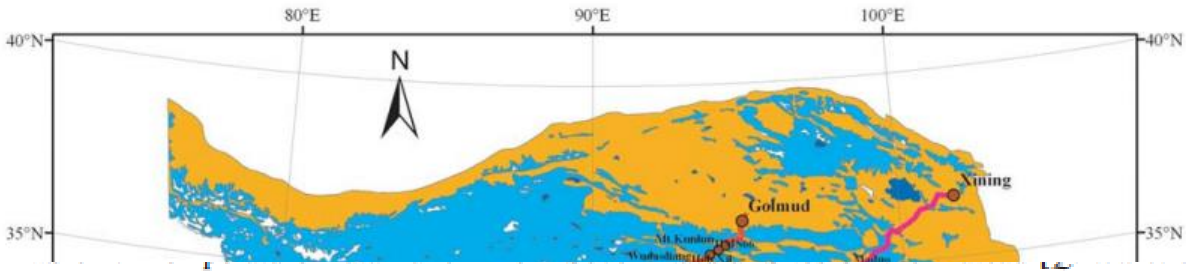
(Qu et al., 2017)



Distributions of $\Delta^{14}C$ and $\delta^{13}C$ of dissolved organic carbon for rivers of the Tibetan Plateau and other regions in the world.
(**Qu et al., 2017**).



Significant relationship between permafrost soil area as a percentage of watershed area (%) and ^{14}C age of dissolved organic carbon (DOC) in years before present (ybp) (Qu et al., 2017)

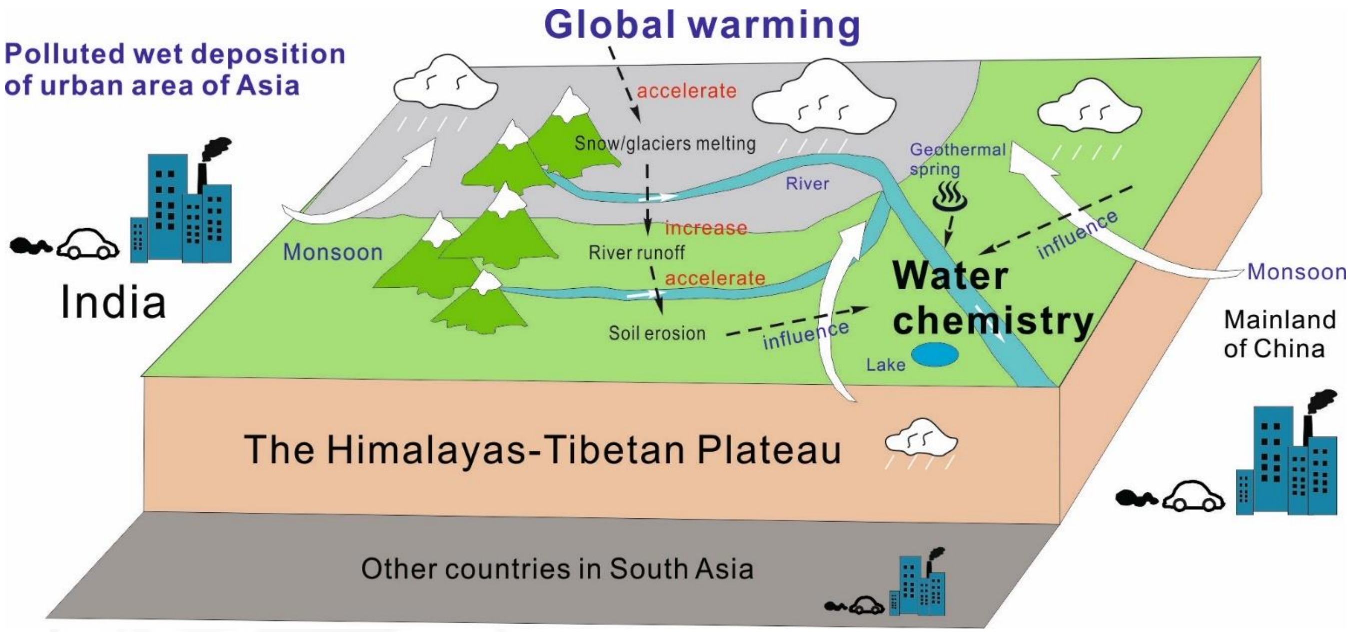


Site	Permafrost Table, m		TTOP, °C		TP_6^*,[a] °C	
	1996	2001	1996	2001	1996	2001
Number 1 site at Kunlun Pass	1.09	1.50	−3.05	−2.68	−3.19	−2.90
Number 2 site at Kunlun Pass	1.22	1.40	−3.08	−2.78	−3.06	−2.77
Mt. Fenghuo	1.26	1.60	−3.73	−3.36	−3.67	−3.48
Wudaoliang	2.53	2.75	−1.82	−1.75	−1.63	−1.50
HohXil	1.64	2.00	−2.14	−1.63	−2.01	−1.69
HMS 66	1.94	2.40	−0.82	−0.63	−0.91	−0.83
Cumar Riverside	3.24	3.50	−0.43	−0.30	−0.56	−0.40

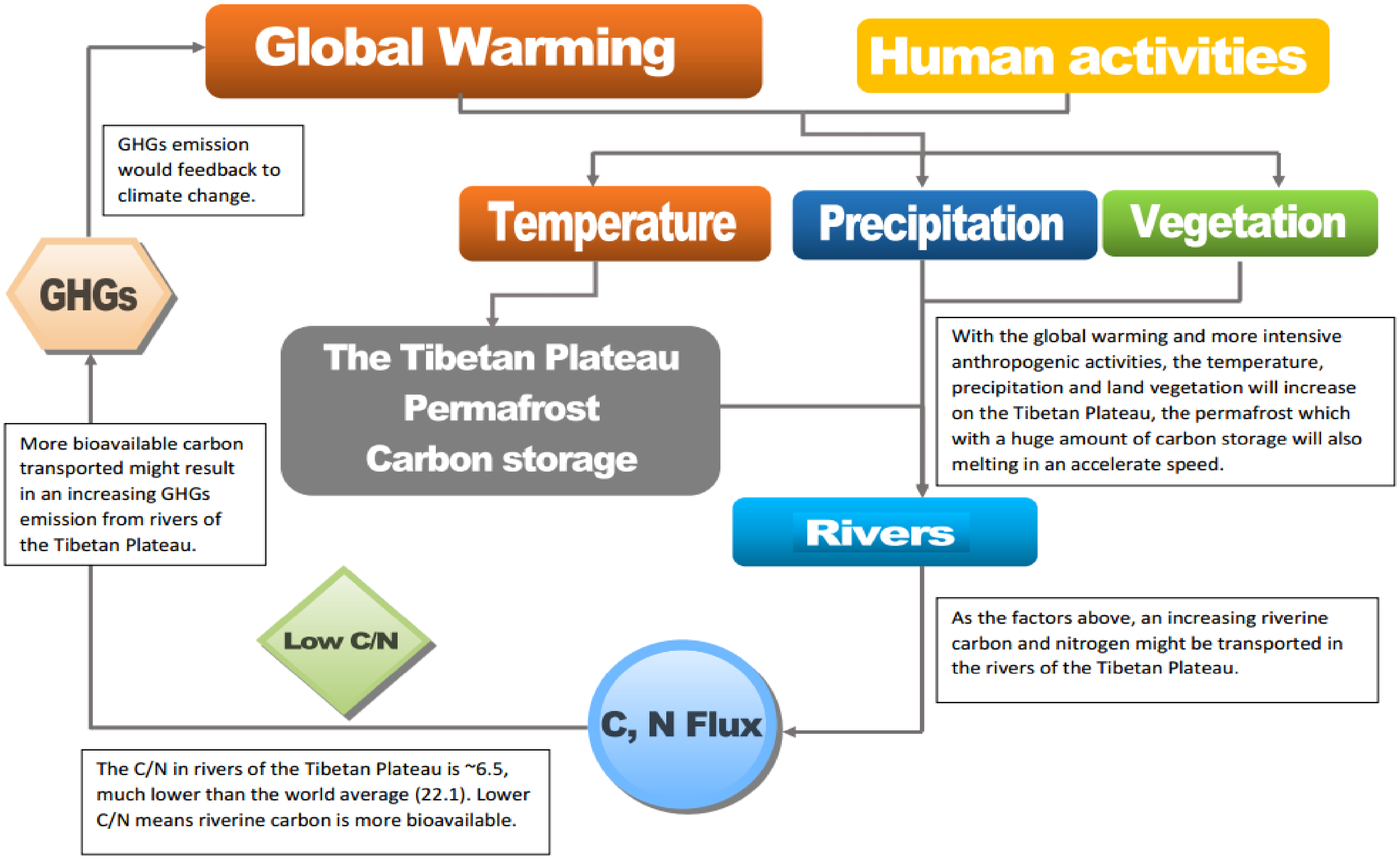
[a]TP_6^* denotes permafrost temperature taken at 6 m depth.

The thickness of the active layer has increased by 0.15 to 0.50 m and ground temperature at a depth of 6 m has risen by about 0.1℃ to 0.3 ℃ between 1996 and 2001 (**Cheng et al., 2007**)

Summary and perspectives



Water chemistry in the Himalayan region was influenced by the natural process (e.g. global warming, snow/glacier melting, runoff and soil erosion changing) as well as anthropogenic activities in the surrounding area.


Global Warming
Human activities
GHGs emission would feedback to climate change.
Temperature
Precipitation
Vegetation
GHGs
The Tibetan Plateau Permafrost Carbon storage
With the global warming and more intensive anthropogenic activities, the temperature, precipitation and land vegetation will increase on the Tibetan Plateau, the permafrost which with a huge amount of carbon storage will also melting in an accelerate speed.
More bioavailable carbon transported might result in an increasing GHGs emission from rivers of the Tibetan Plateau.
Rivers
Low C/N
As the factors above, an increasing riverine carbon and nitrogen might be transported in the rivers of the Tibetan Plateau.
C, N Flux
The C/N in rivers of the Tibetan Plateau is ~6.5, much lower than the world average (22.1). Lower C/N means riverine carbon is more bioavailable.

Future work

Next。。。

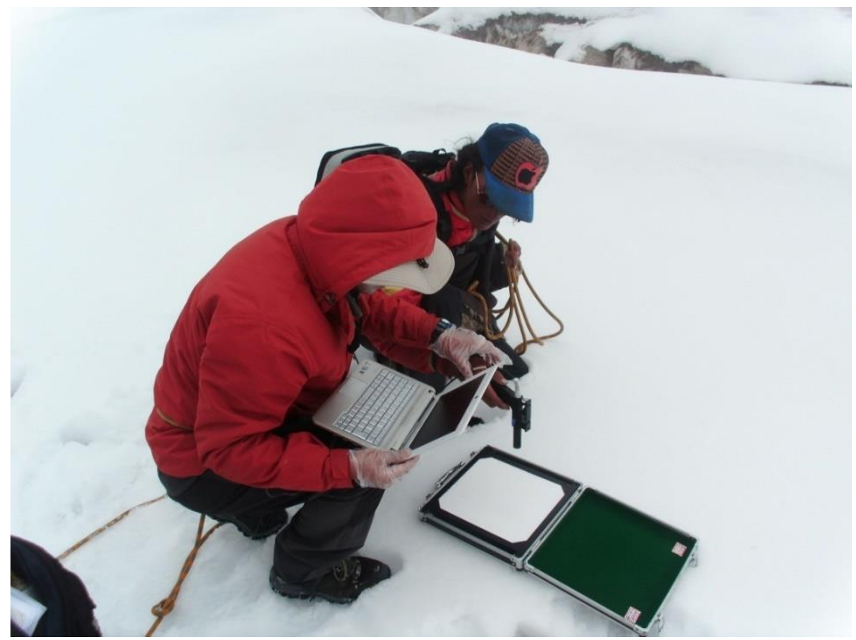
课题组的优势：
1. 温室气体的多年连续积累观测；
2. 物理过程的解释；
3. 最关键-人员

尝试解决的科学问题：

1. 以高原（黄河源）为依托，探索碳（包括温室气体）在河水中的迁移（排放）机制；

2. 目前观测到的一些利用物理过程比较难解释的现象，尝试引入化学的方法；

3. 基于温室气体排放的观测，探索湖泊（自然开放水体，如太湖；封闭水体，全椒鱼塘）中碳的含量，成分，来源及其归宿。

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暨中国生态学学会稳定同位素生态专业委员会2017年学术年会

谢谢！

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Nanjing, Jiangsu Province, China 210044

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http://news.cntv.cn/2013/05/02/VIDE1367465282138989.shtml
（2：47开始）

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