

**Using field observation and satellite  
data for the air-land interaction study  
over heterogeneous landscape  
of the Tibetan Plateau and  
surrounding area**

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**Institute of Tibetan Plateau Research,**

**Chinese Academy of Sciences**

**(23 October 2013, High Summit, Lecco, Italy)**





# 1. Why do we have this study?

**Cold air**

**Western wind**

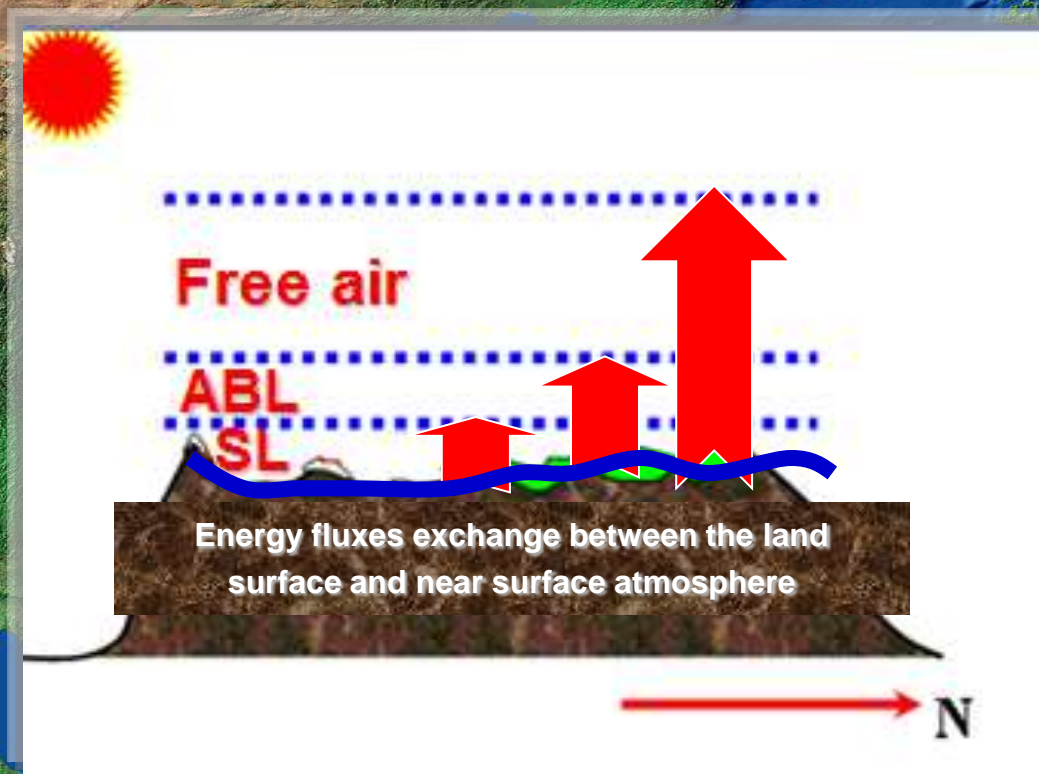
**Atmospheric heating source**

**Warm water vapor**



# Tibetan Plateau

Heating to the atmosphere







Heterogeneous land surface



Plateau Mountain

How to get the regional surface heat fluxes and evaporation over the Tibetan Plateau area

????????????



Desertification grass-land



nd



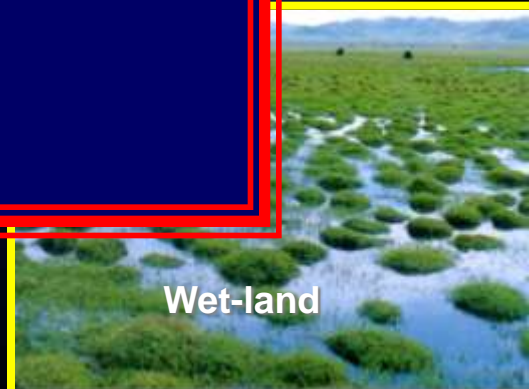
Glacier (snow mountain)



Plateau lake



Farm-land



Wet-land





# Observation:

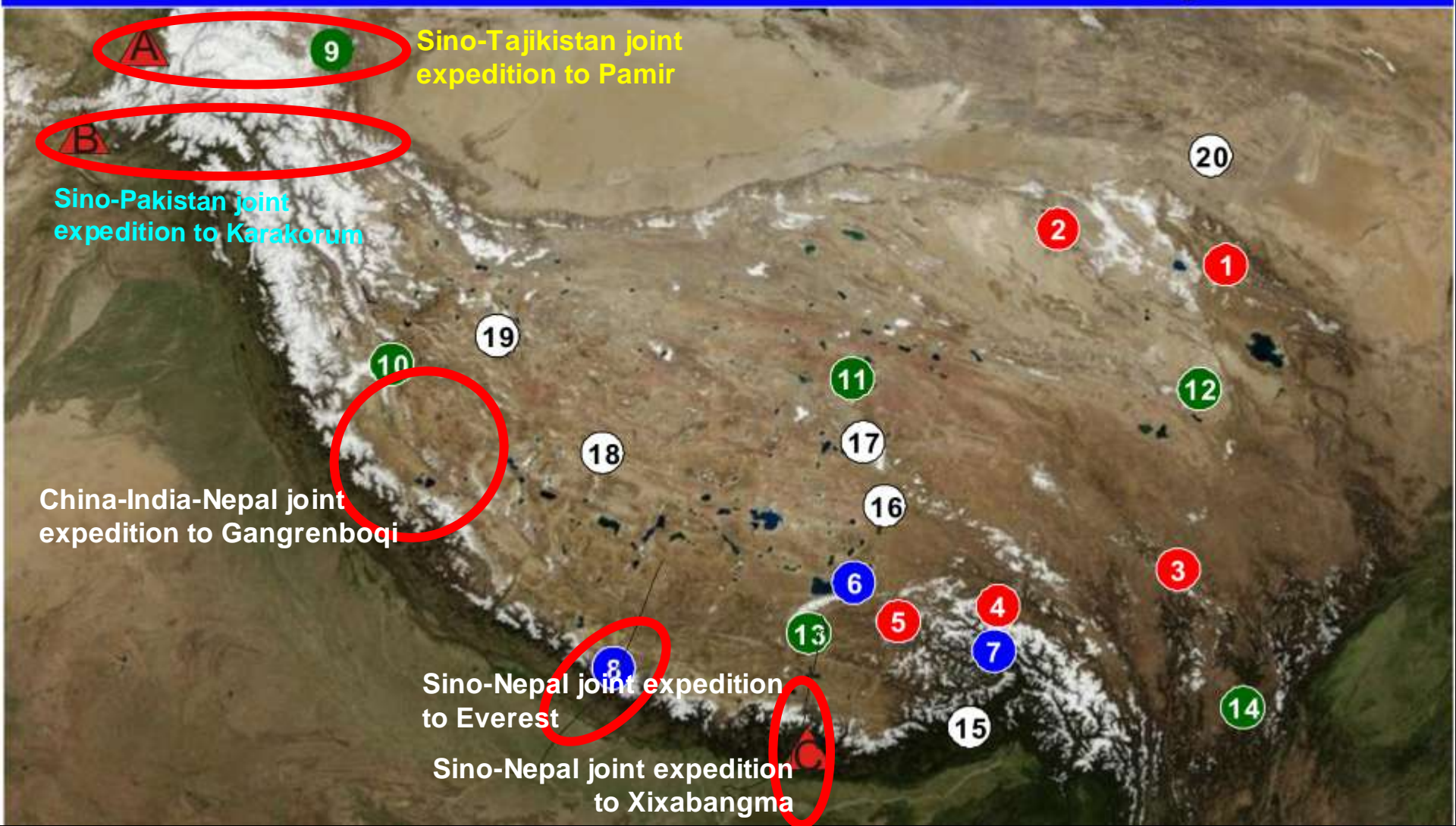
Tibetan Observation and

Research Platform

---TORP



- |                 |                     |                |              |                                 |
|-----------------|---------------------|----------------|--------------|---------------------------------|
| 1 Haibei        | 2 Northern Plateau  | 3 Mt Gongga    | 4 Nyingchi   | A Sino-Tajikistan joint station |
| 5 Lhasa         | 6 NAMORS            | 7 SETS         | 8 QOMS       | B Sino-Pakistan joint station   |
| 9 Mutztag Ata   | 10 NAWORS           | 11 Beiluhe     | 12 Maqin     | C Sino-Nepal joint station      |
| 13 Yazhog Yumco | 14 Yulong Glacier   | 15 Metog       | 16 Naqqu     | 21 Waliguan                     |
| 17 Mt Tanggsha  | 18 Qangtang Plateau | 19 Tianshuihai | 20 Mt Qilian |                                 |



# 7 comprehensive observation stations







1) Qomolangma Station for Atmospheric and Environmental Observation and Research (QOMS), Chinese Academy of Sciences

**Constructed date:**

**End of August, 2005**



Qomolangma St.



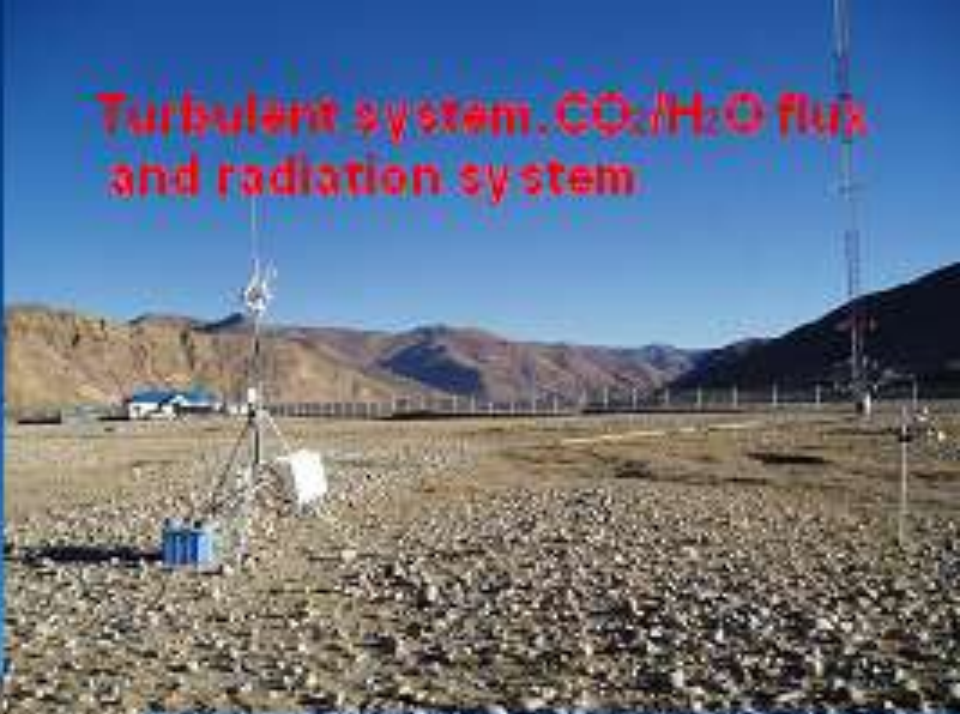
高山大气与环境过程















Turbulent system, CO<sub>2</sub>/H<sub>2</sub>O flux  
and radiation system

6500m



5200m



4475m



Radio sonde system

5200m



# AWSs and Isotope monitoring in the middle of Himalaya





**2). Nam Co Station for Multisphere  
Observation and Research  
(NAMOR), Chinese Academy of Sciences**

**Nam Co Station**

**Constructed date:**

**End of September, 2005**





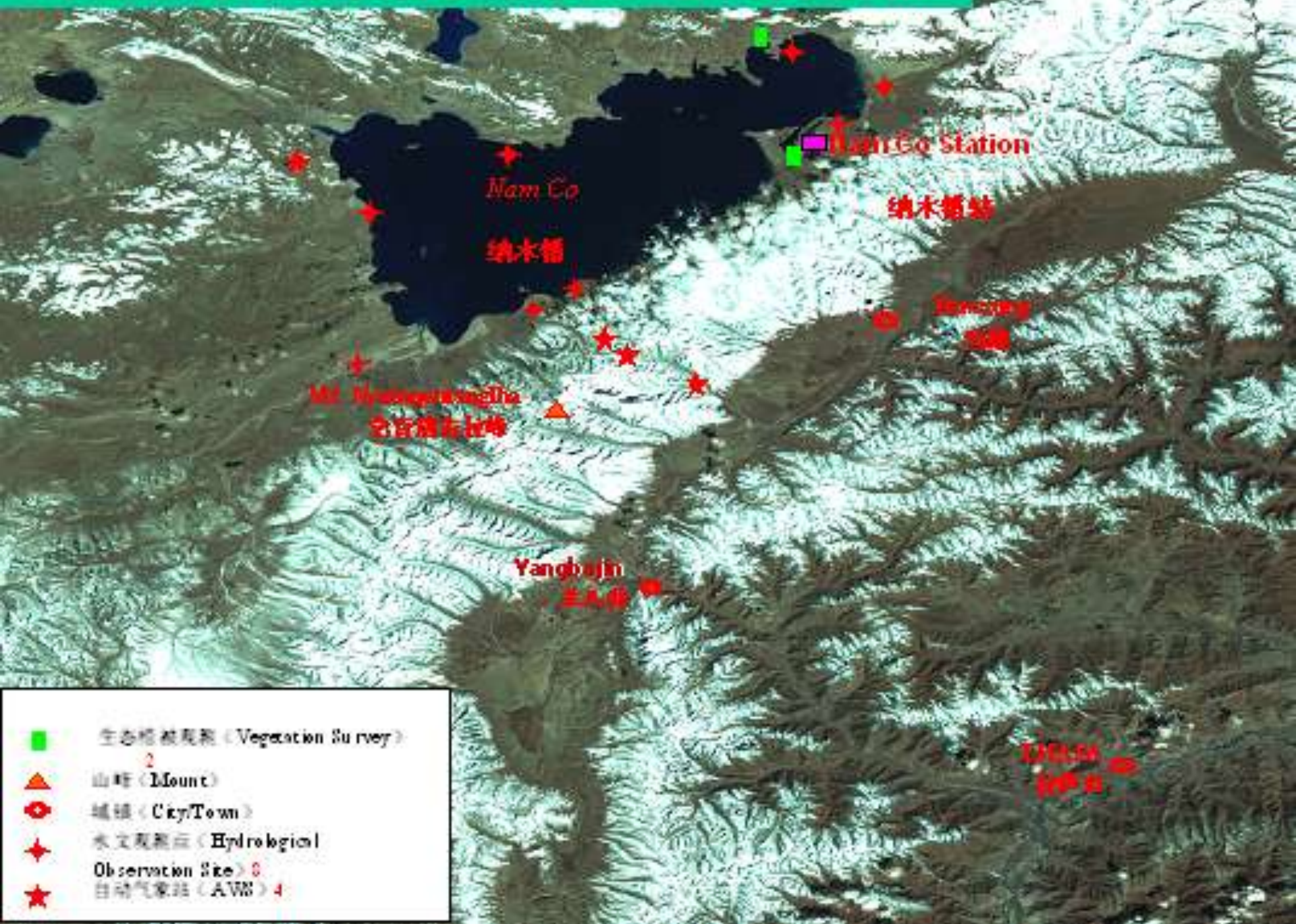


Nam Co St.

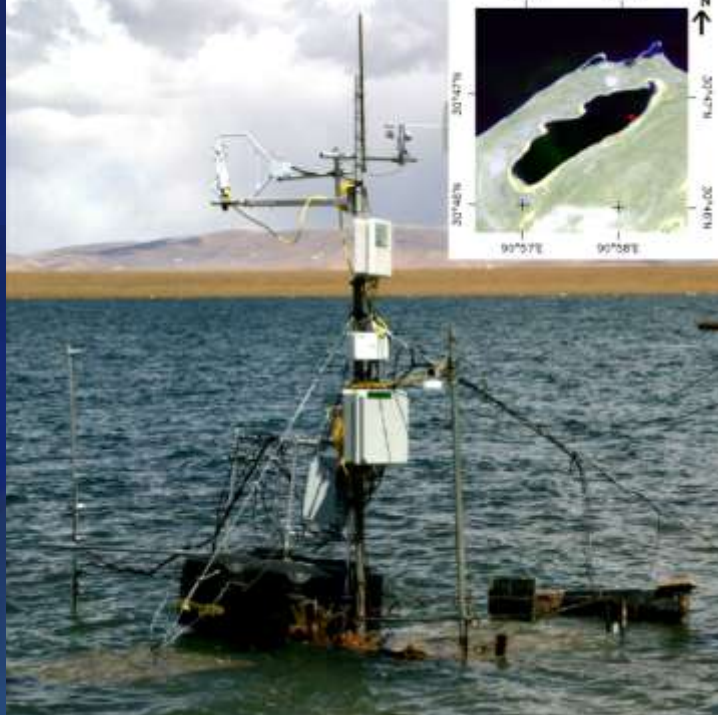




# The observational sites around the Nam Co station







## Turbulent system, $\text{CO}_2/\text{H}_2\text{O}$ flux and radiation system

**52m PBL tower  
( Radiation system  
and SMTMS)**







**AWS around the  
Nam co Station**







**Evaporation Observation**



### 3). Southeast Tibet Station for Alpine Environment Observation and Research (SETS), CAS (Linzhi Station)

**Constructed date:** Beginning of November, 2006







**20m PBL tower  
(SMTWS)**



**Turbulent system & CO<sub>2</sub>/H<sub>2</sub>O flux**



**Radiation system**







# Ngari Station for Desert Environment Observation and Research, Chinese Academy of Sciences (NASDE/CAS)





# Ngari Station for Desert Environment Observation and Research, Chinese Academy of Sciences (NASDE/CAS)





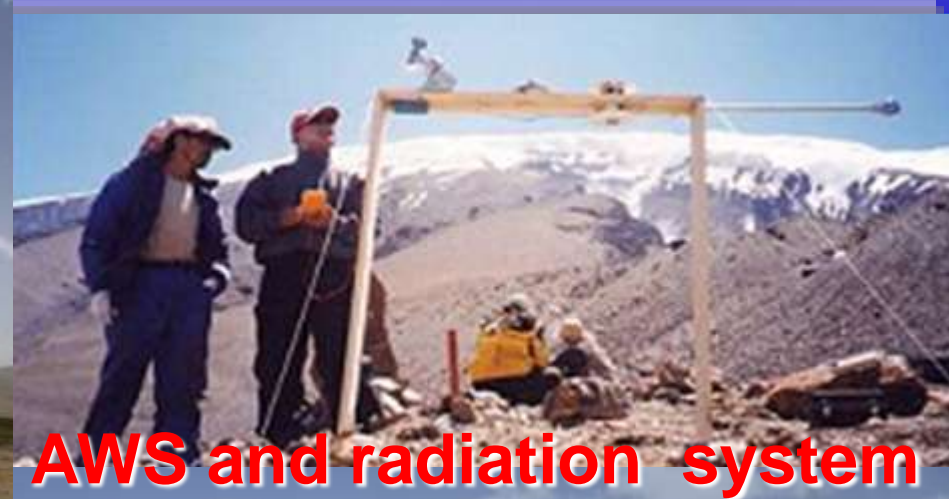


**5) Muztagh Ata Station for Westerly Environment Observation and Research, Chinese Academy of Sciences (MASWE/CAS)**





# Muztagh Ata Station for Westerly Environment Observation and Research, Chinese Academy of Sciences (MASWE/CAS)

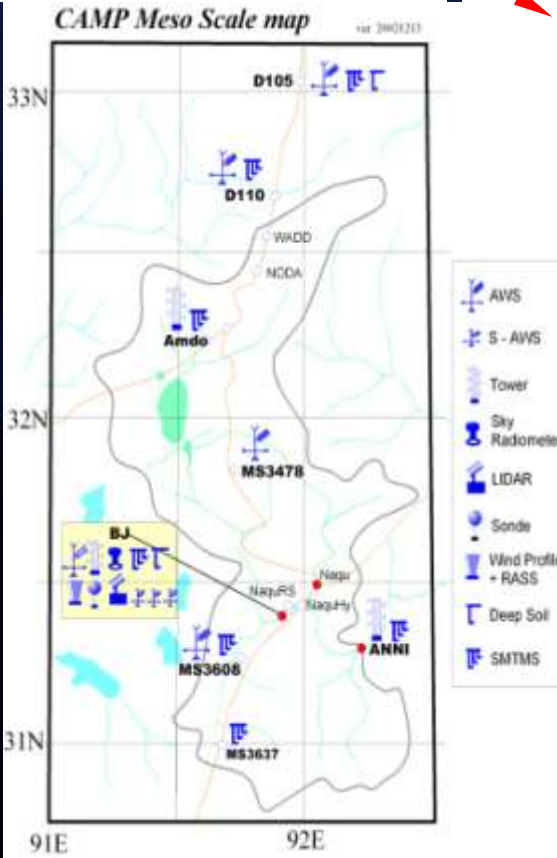
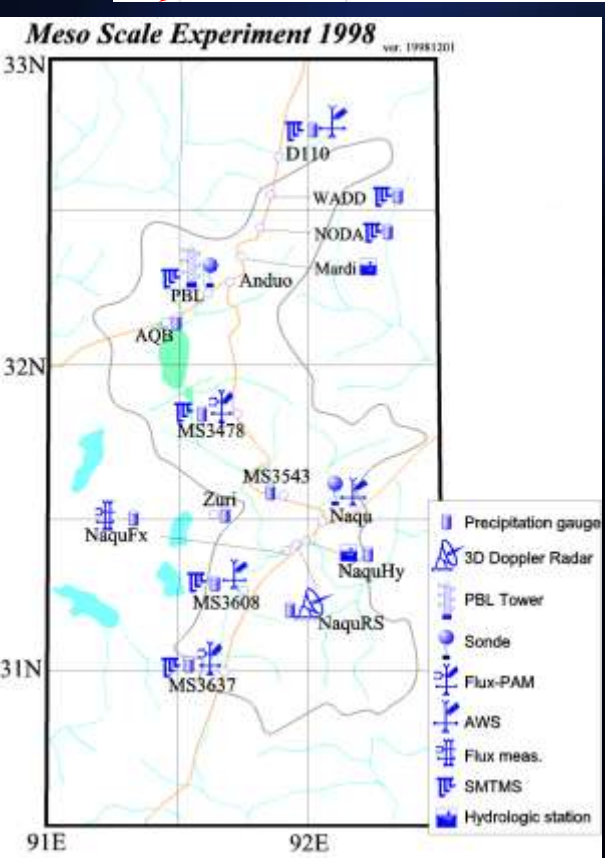
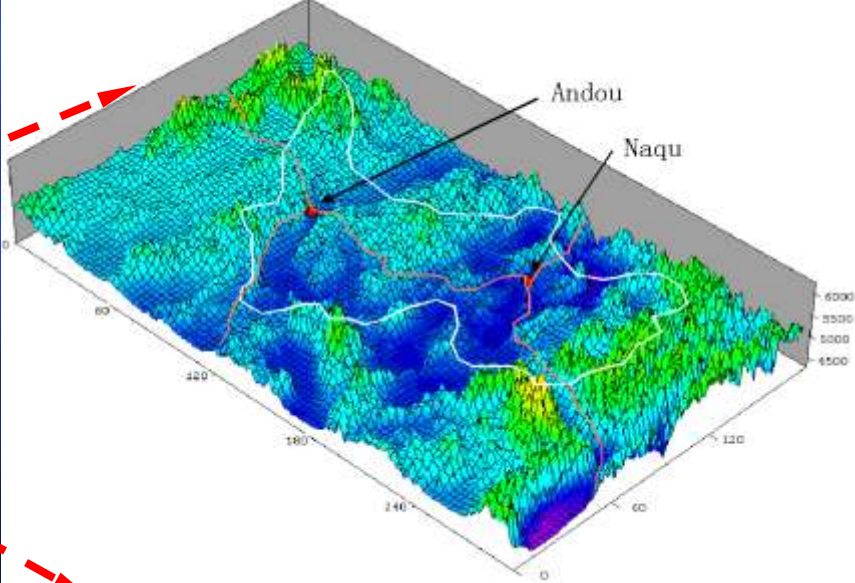
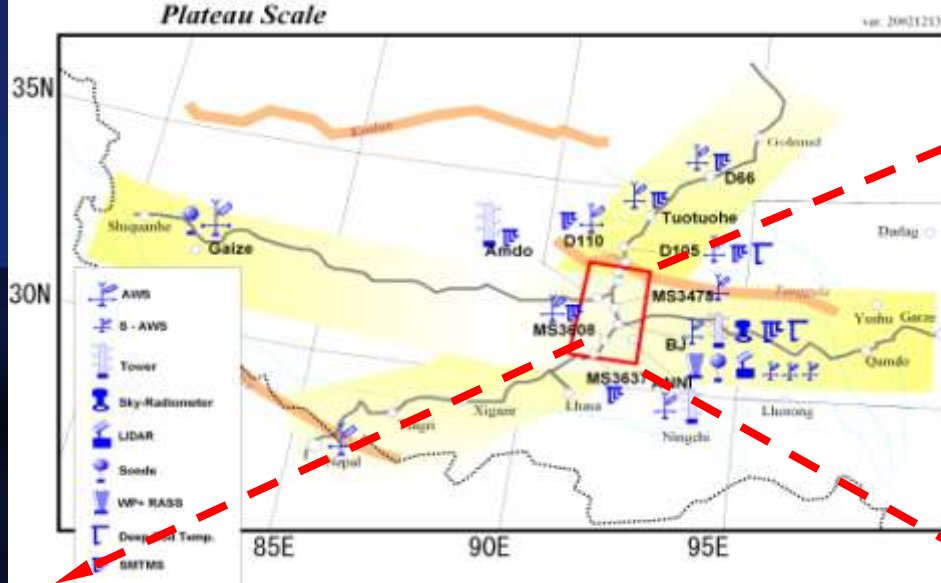




# **Monitoring net work in the north Tibetan Plateau area**

**The observation sites have been set up from 1997 during the GAME/Tibet and CAMP/Tibet and they will be continued as long as possible.**





**GAME/Tibet**  
**CAMP/Tibet**







Transmitter



Receiver

**The Large Aperture Scintillometer**



# Nagqu Station of Plateau Climate and Environment (NPCE)

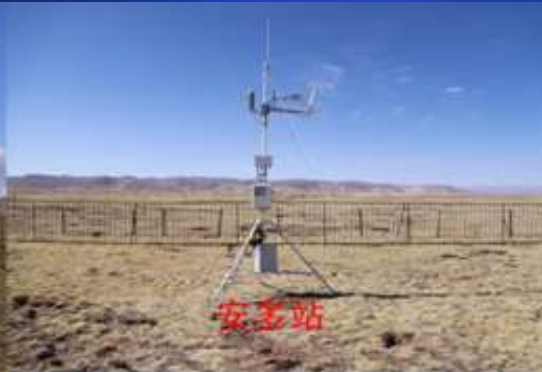
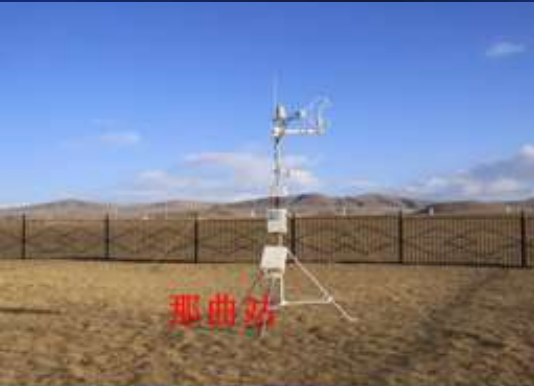


# Maqu Station





# Flux stations(16)





Radiation stations(19)



安多站



珠峰站



当雄草地站



D105站



当雄草地站



那曲站





**Office building**



**Lhasa Branch of Institute of Tibetan Plateau Research (ITP), Chinese Academy of Sciences (CAS)**



**Guest house**

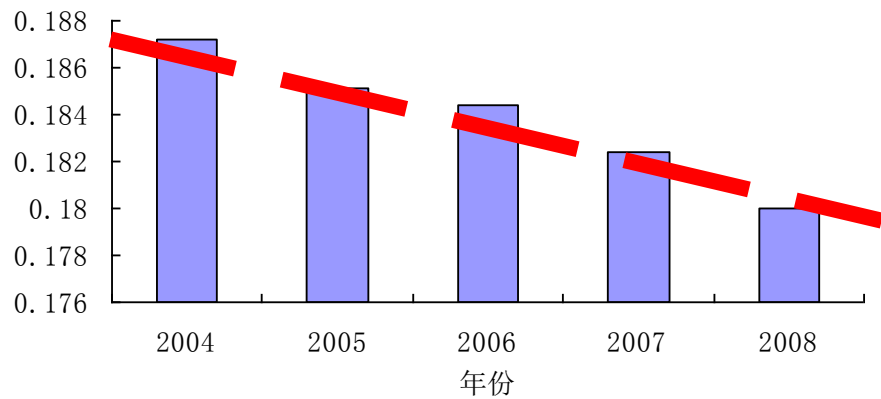


**Dining hall**

# Results from the field observations



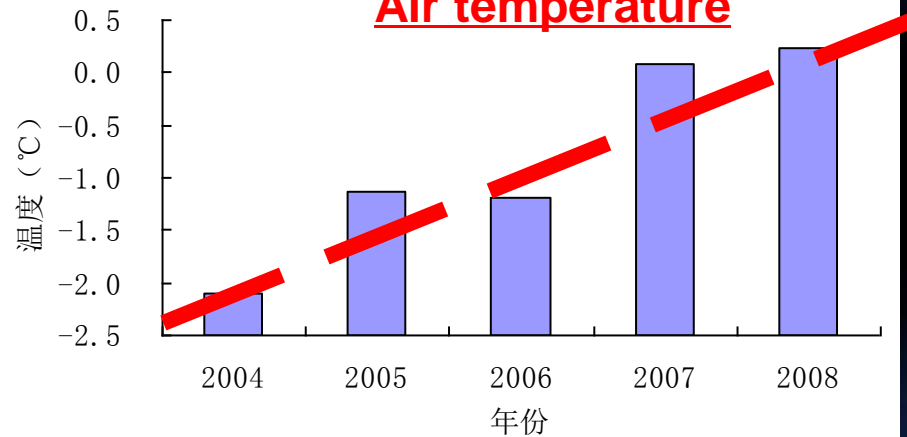
反照率



(Hu et al., 2012)

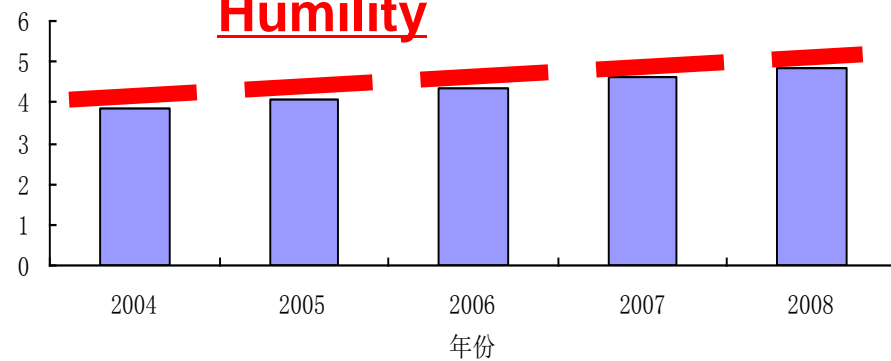
AT-1.0m

**Air temperature**

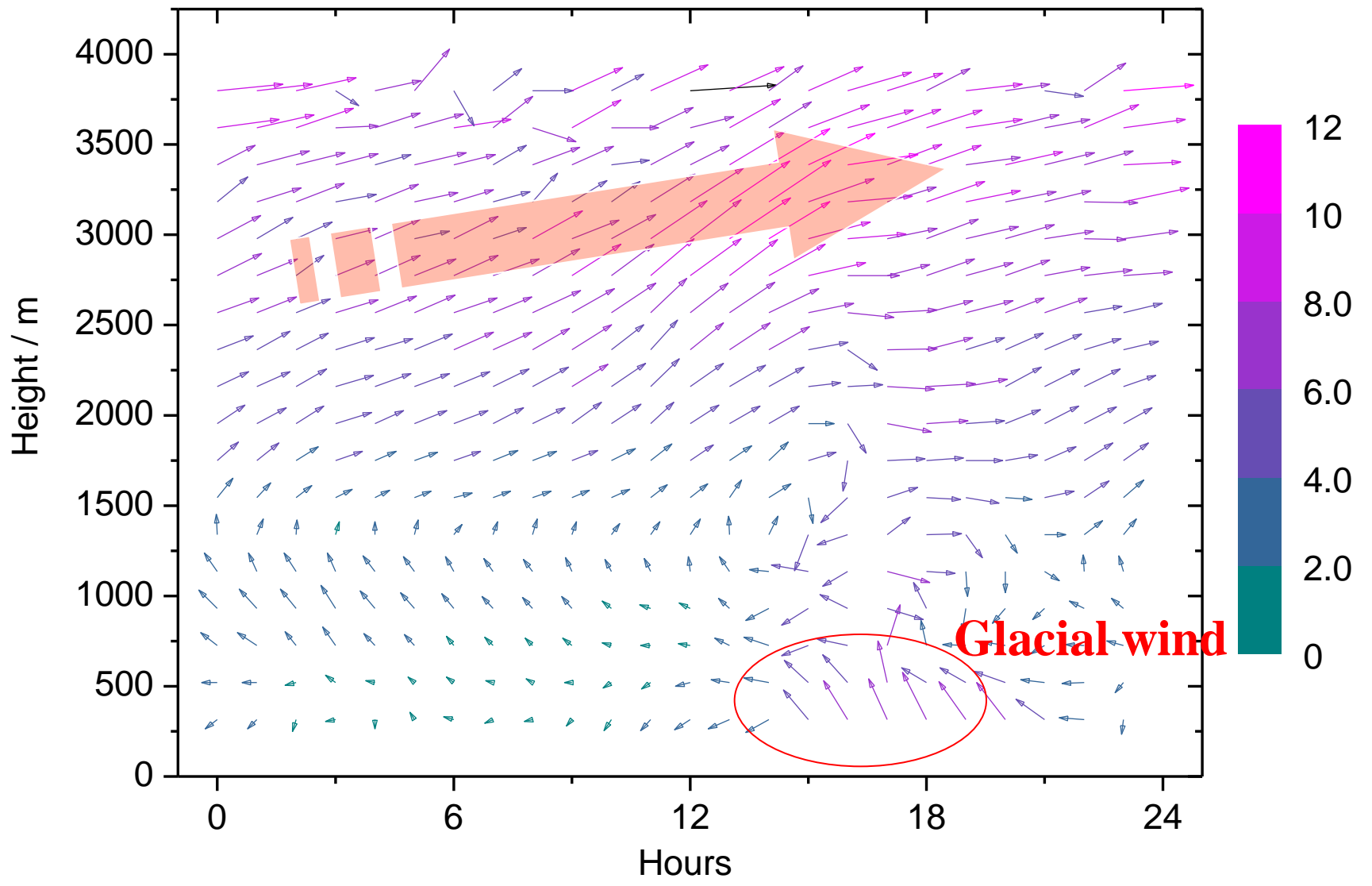


1.0m-比湿

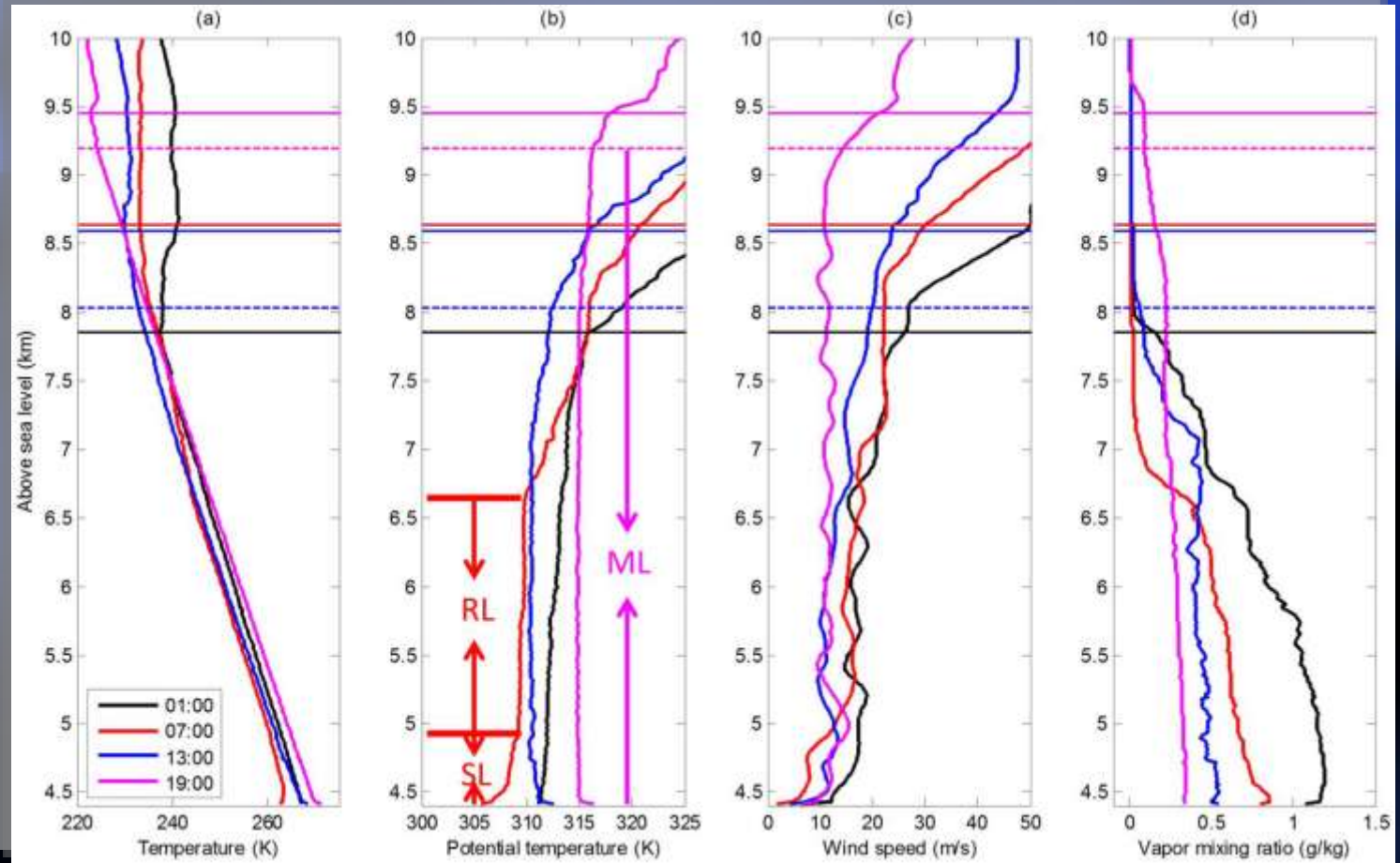
**Humidity**



West wind







(Chen et al., 2013, PlosOne)

# Aerodynamic and thermodynamic roughness Length

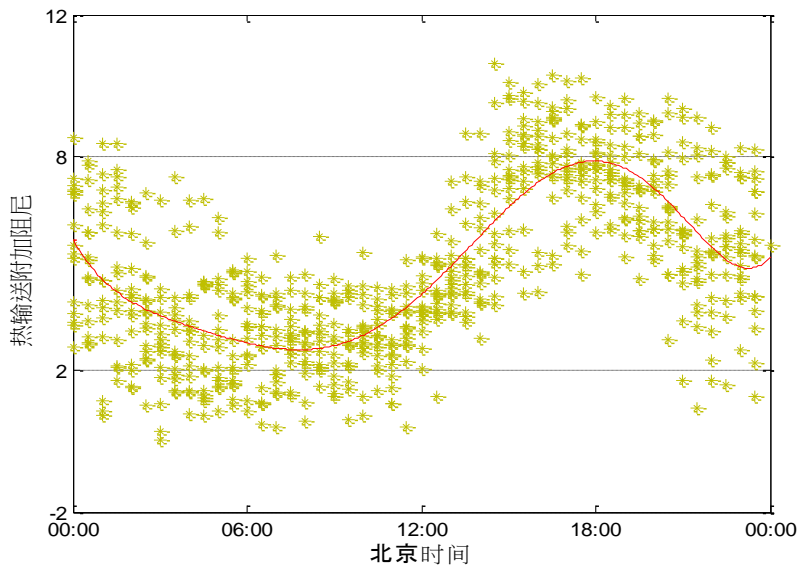
**Table 1.** Aerodynamic Roughness Length  $z_{0m}$  Derived From Different Land Surfaces by Using the Independent Method

Land surface	Grass land	Grass land	Sand desert	Gobi	bean	wheat	corn
Observation	~5 cm	~15 cm	2.90	2.90	2.90	2.90	4.90
$z_{0m}$ , m	0.00436	0.0139	0.00267	0.0028	0.061	0.168	0.302

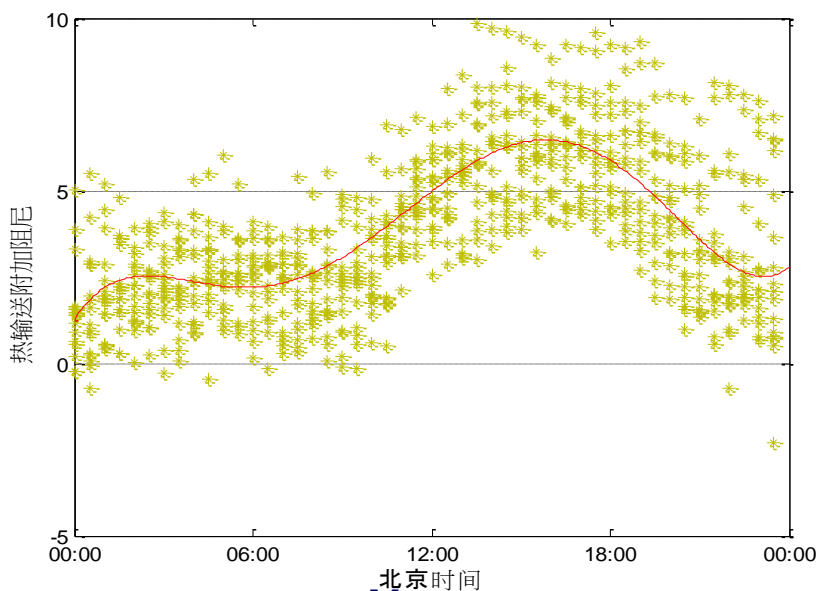
**Table 2.** Thermodynamic Roughness Length  $z_{0h}$  Derived From Different Land Surfaces

Land surface	Amdo	NPAM	HEIFE	HEIFE	HEIFE	HEIFE	AECMP'95
Height of observation, m	grassland ~5 cm	grassland ~15 cm	Sand desert	Gobi	bean	wheat	corn
$z_{0h}$ , m	0.00041	0.00114	0.000049	0.000011	0.000685	0.00132	0.00227

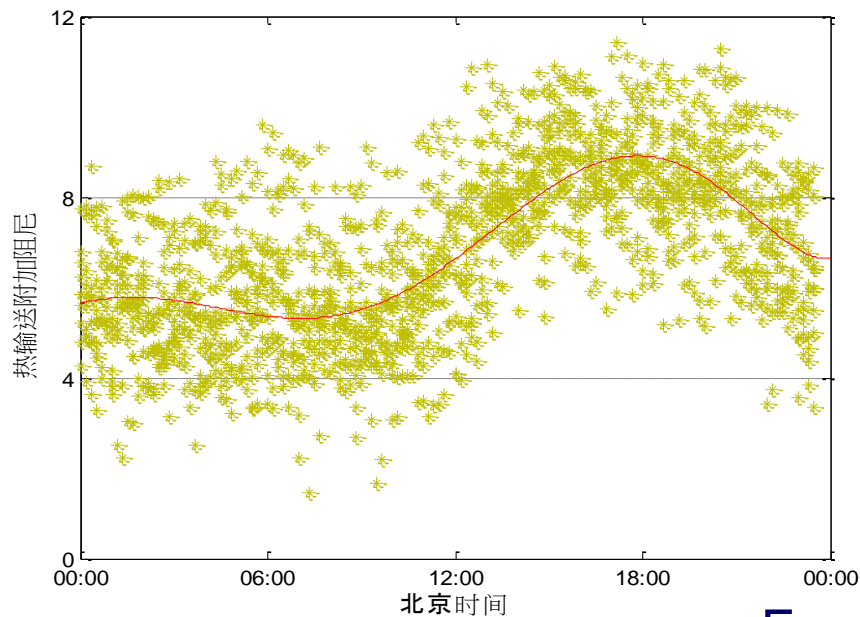




**Mt.Everest**



**Namco**



**Linzhi**

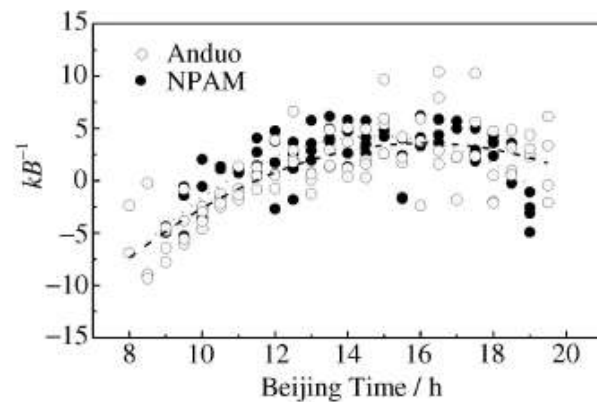


Fig.2. Diurnal variations of the excess resistance to heat transfer  $kB^{-1}$  of Anduo Station and NPAM Station.

**Excess resistance to heat transfer ( $kB^{-1}$ )**

**Satellite Remote Sensing Results for  
the surface heat fluxes and the  
evaporative fraction**



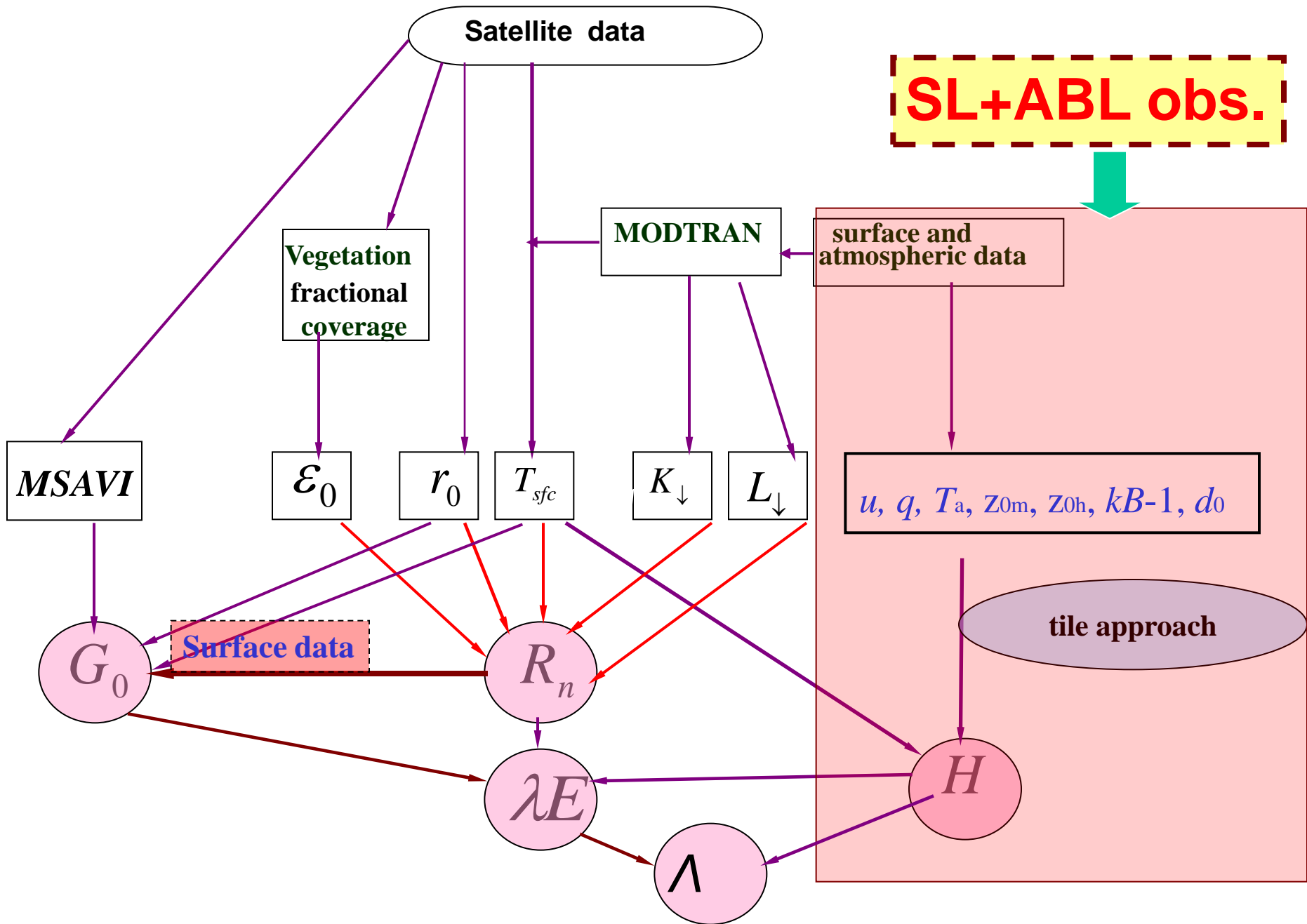


Diagram of parameterization procedure by combining satellite data with field observations

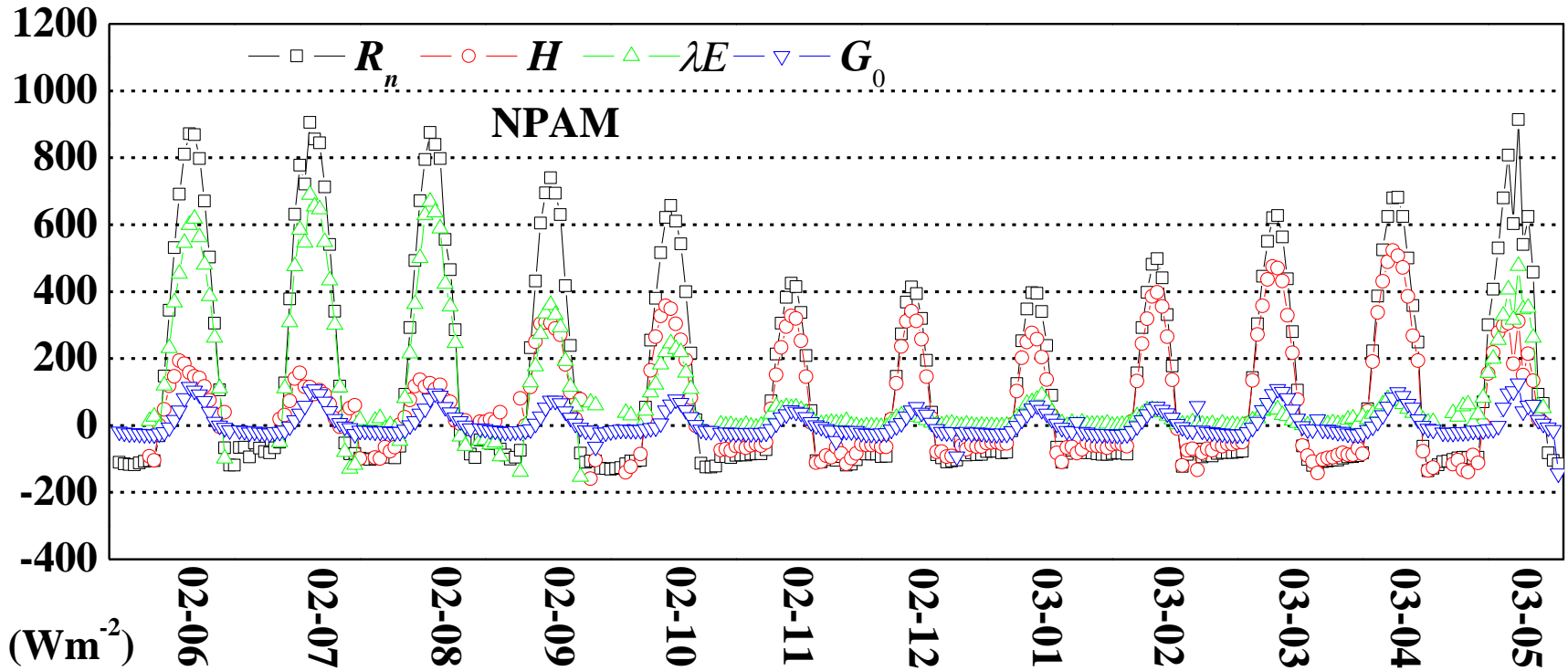


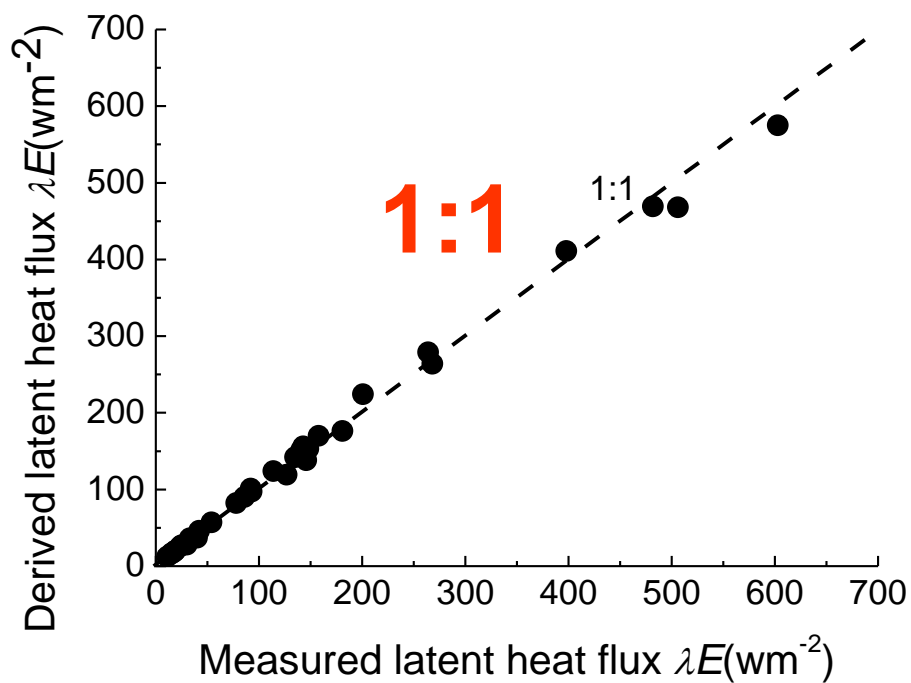
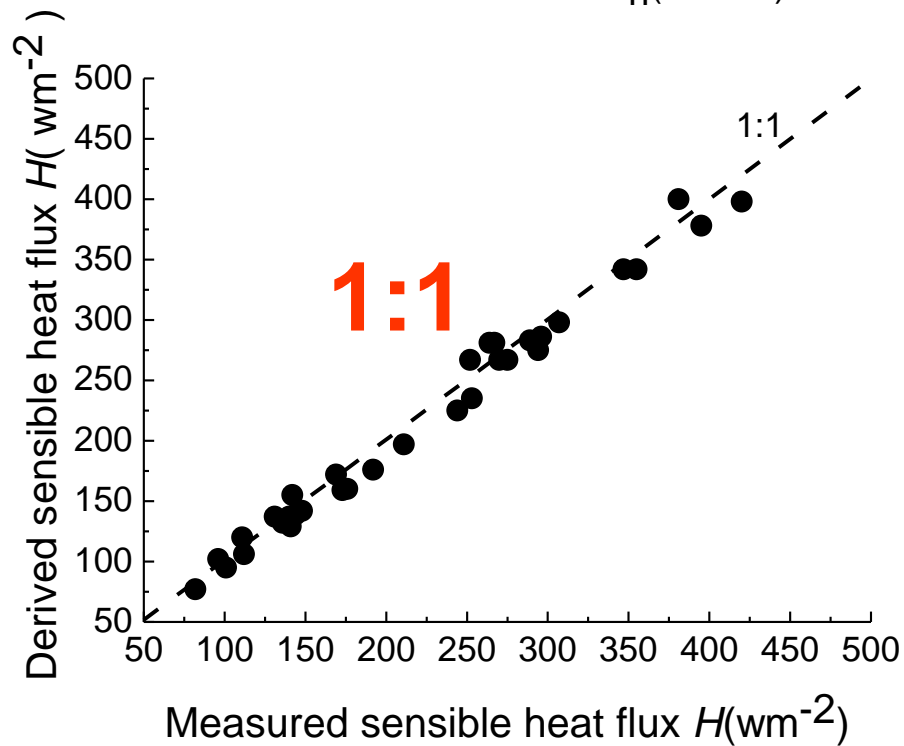
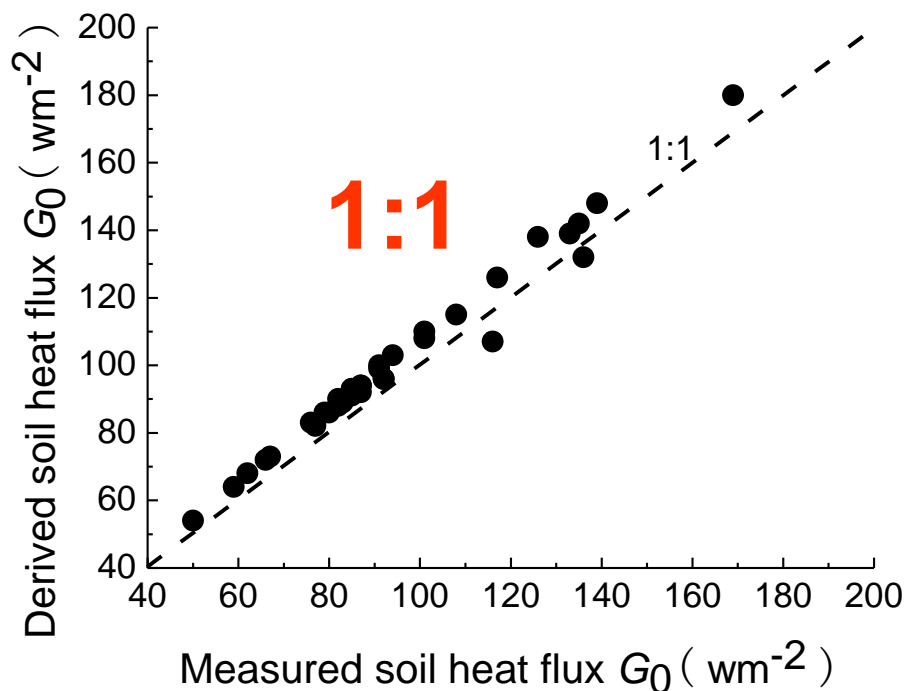
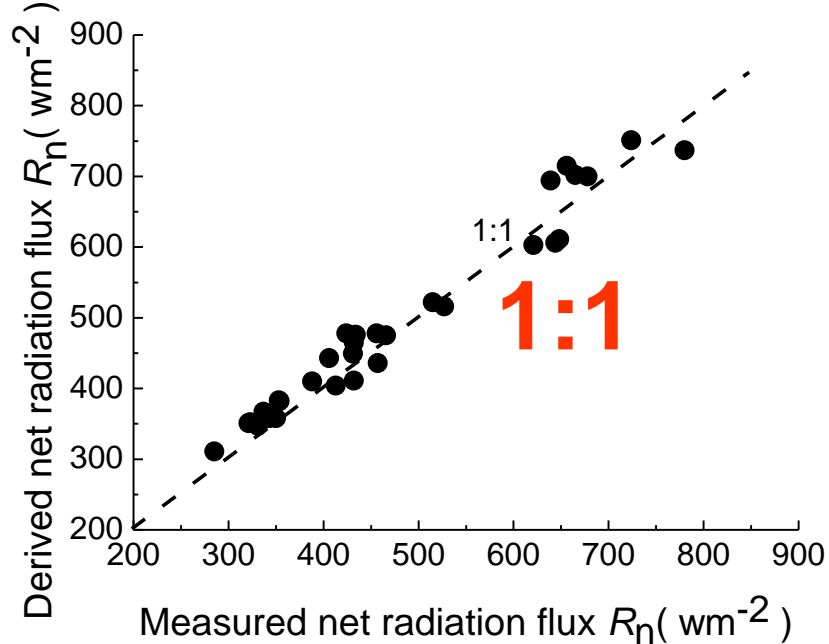


# Latent heat flux

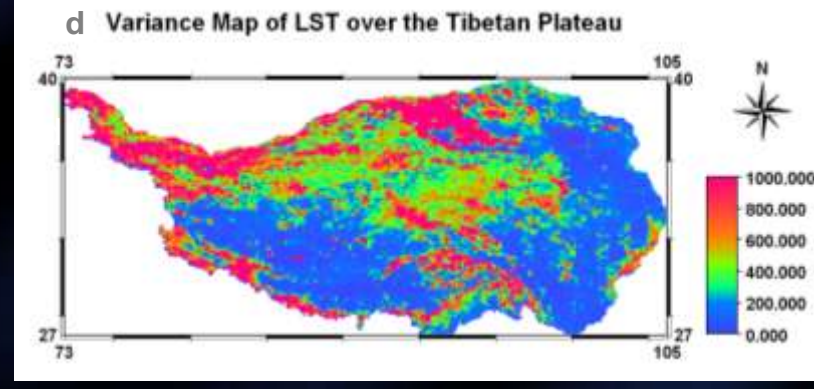
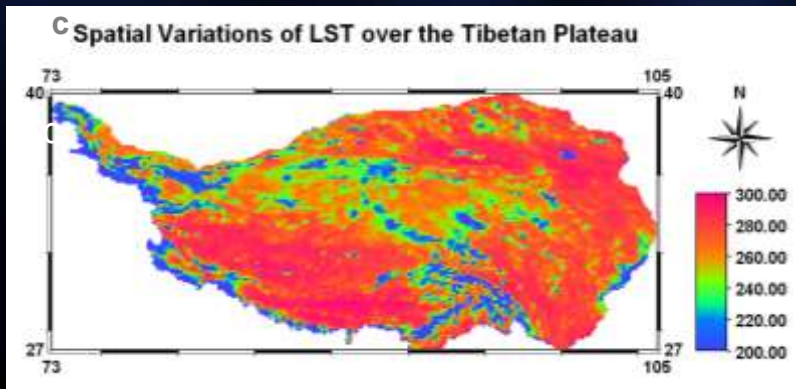
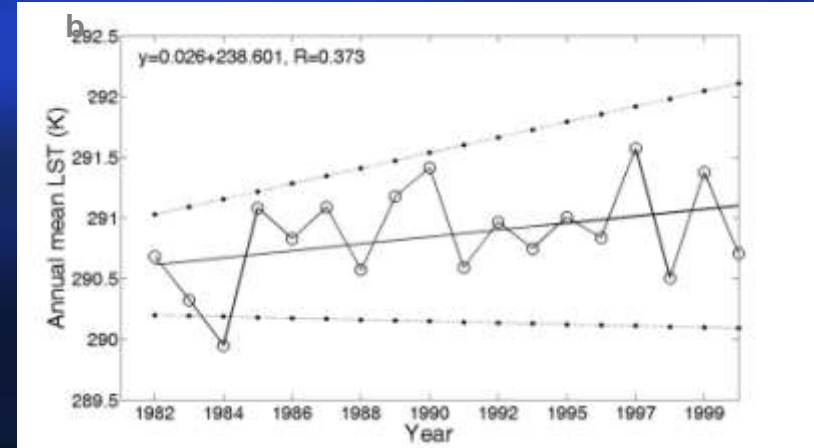
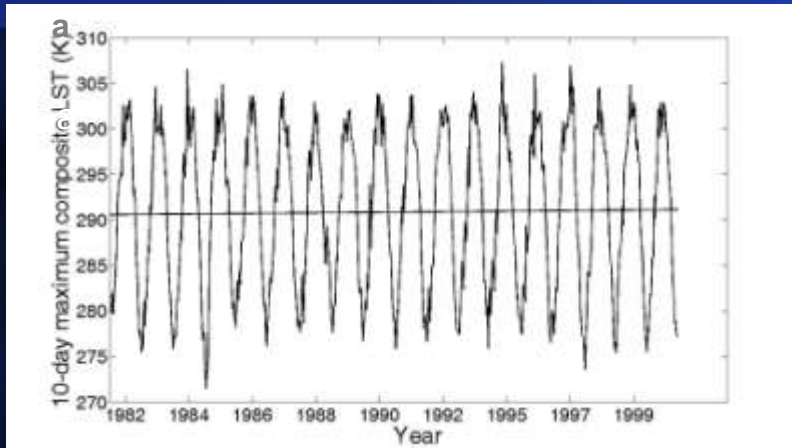
Latent h

$\text{Wm}^{-2}$   
≤40







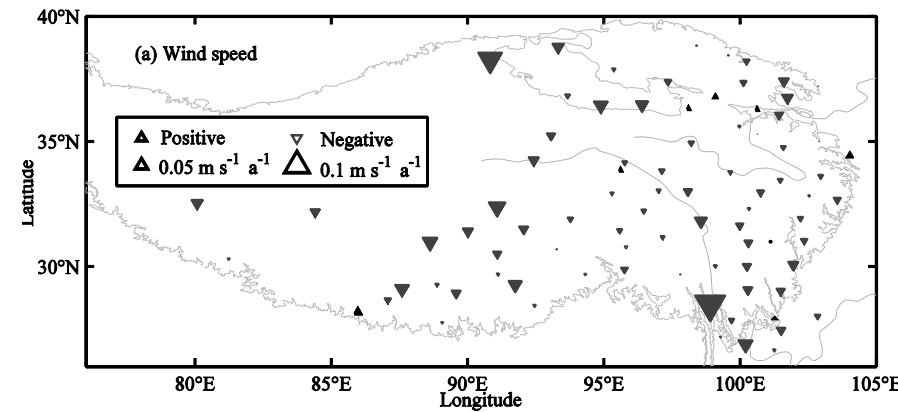
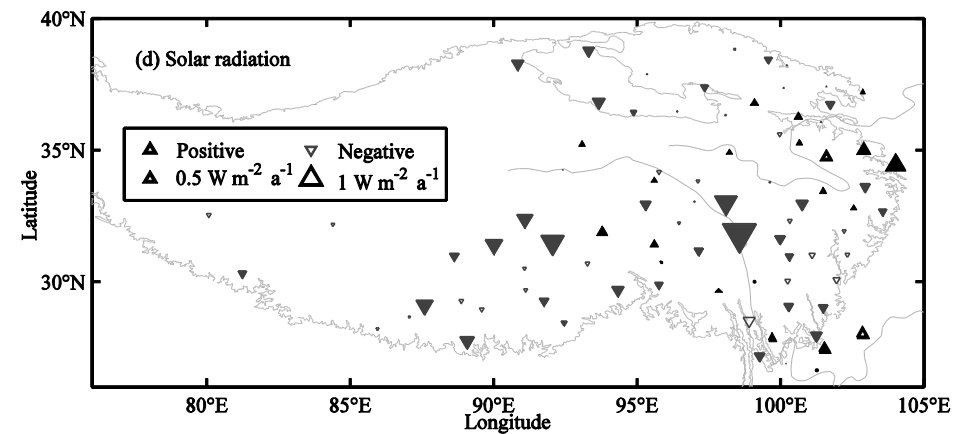
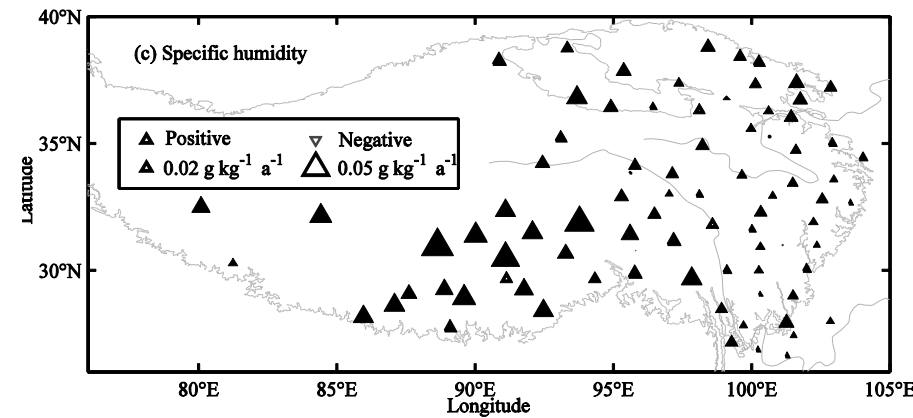
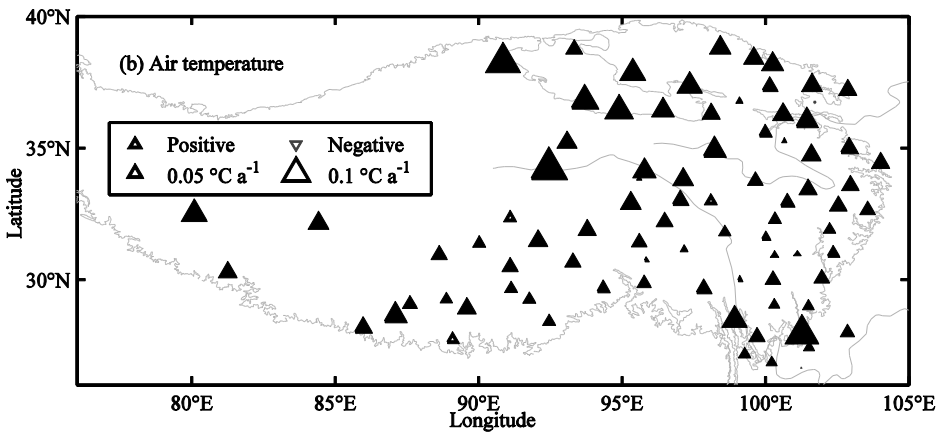


0.26C /10y increasing

Big variance in the northwest Tibetan Plateau.

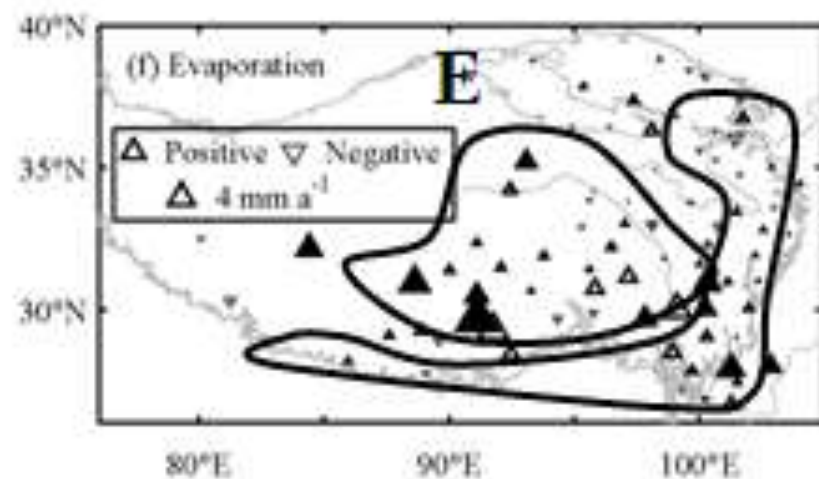
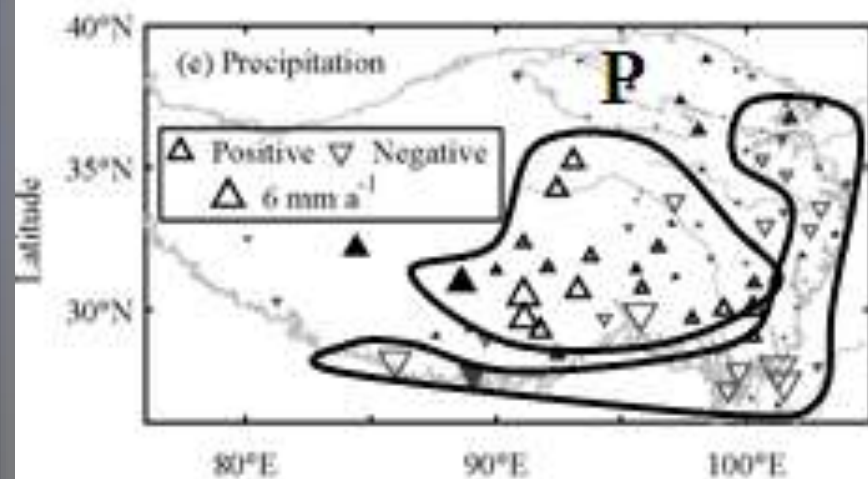
**Zhong et al., 2011, *Journal of Climate***

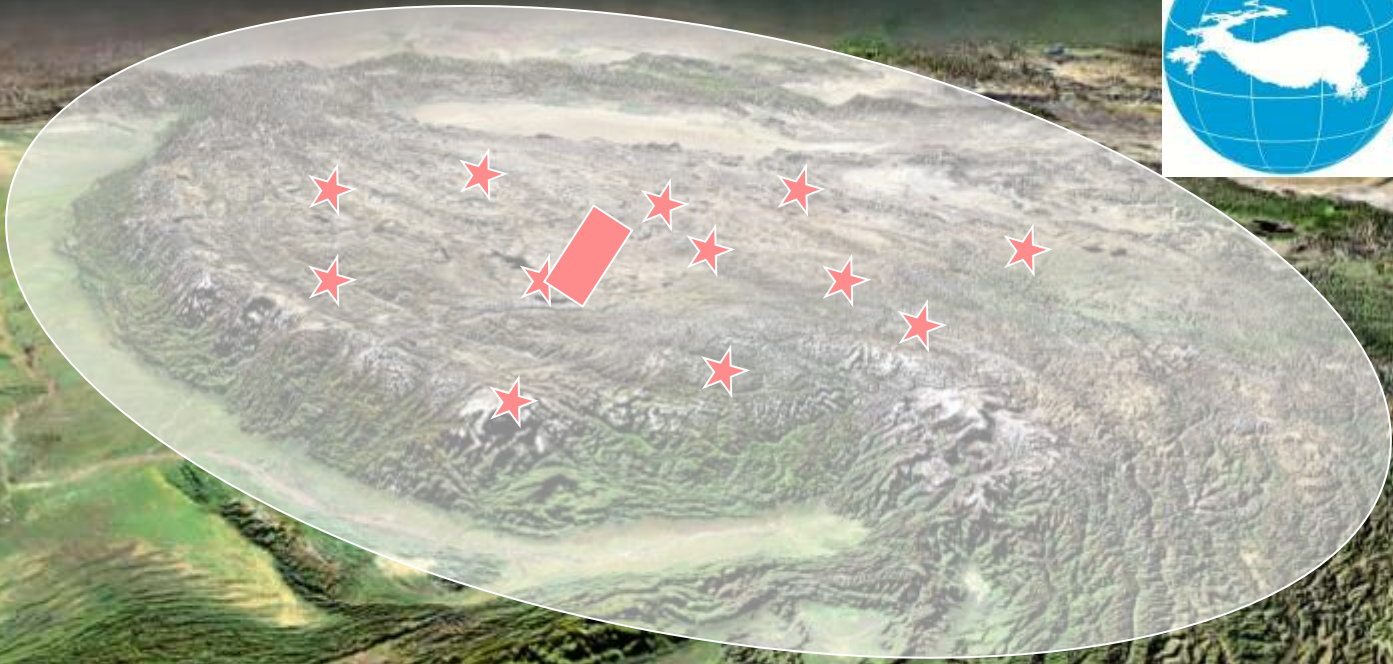
# How climate change affects water budget over the TP?





## Trend in water budget components

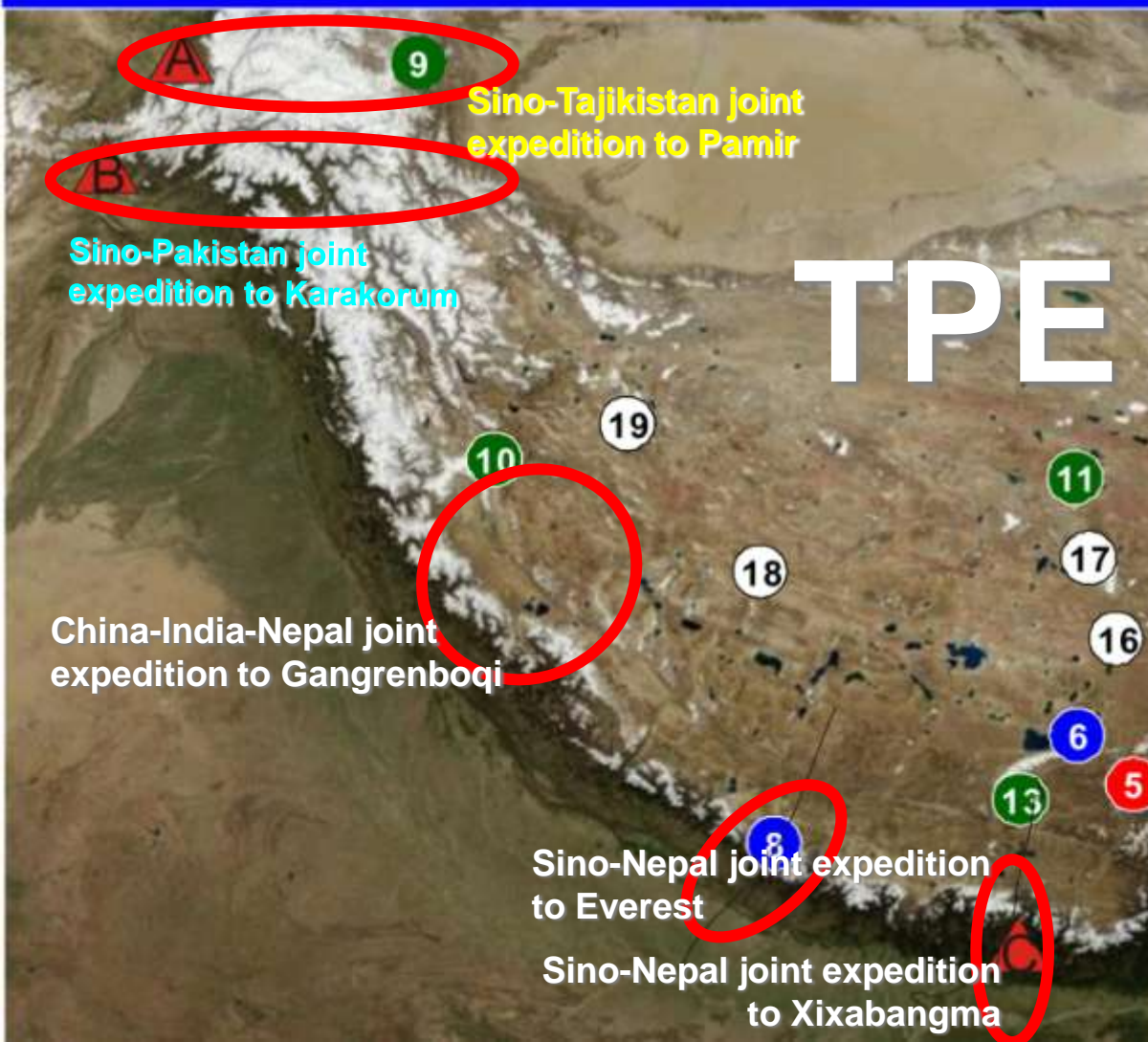




**Future work in the TPE (Third Pole Environment Programme):**  
How about the entire Third Pole area ...??



- |                 |                     |                |              |                                 |
|-----------------|---------------------|----------------|--------------|---------------------------------|
| 1 Haibei        | 2 Northern Plateau  | 3 Mt Gongga    | 4 Nyinchi    | A Sino-Tajikistan joint station |
| 5 Lhasa         | 6 NAMORS            | 7 SETS         | 8 QOMS       | B Sino-Pakistan joint station   |
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 **To s**

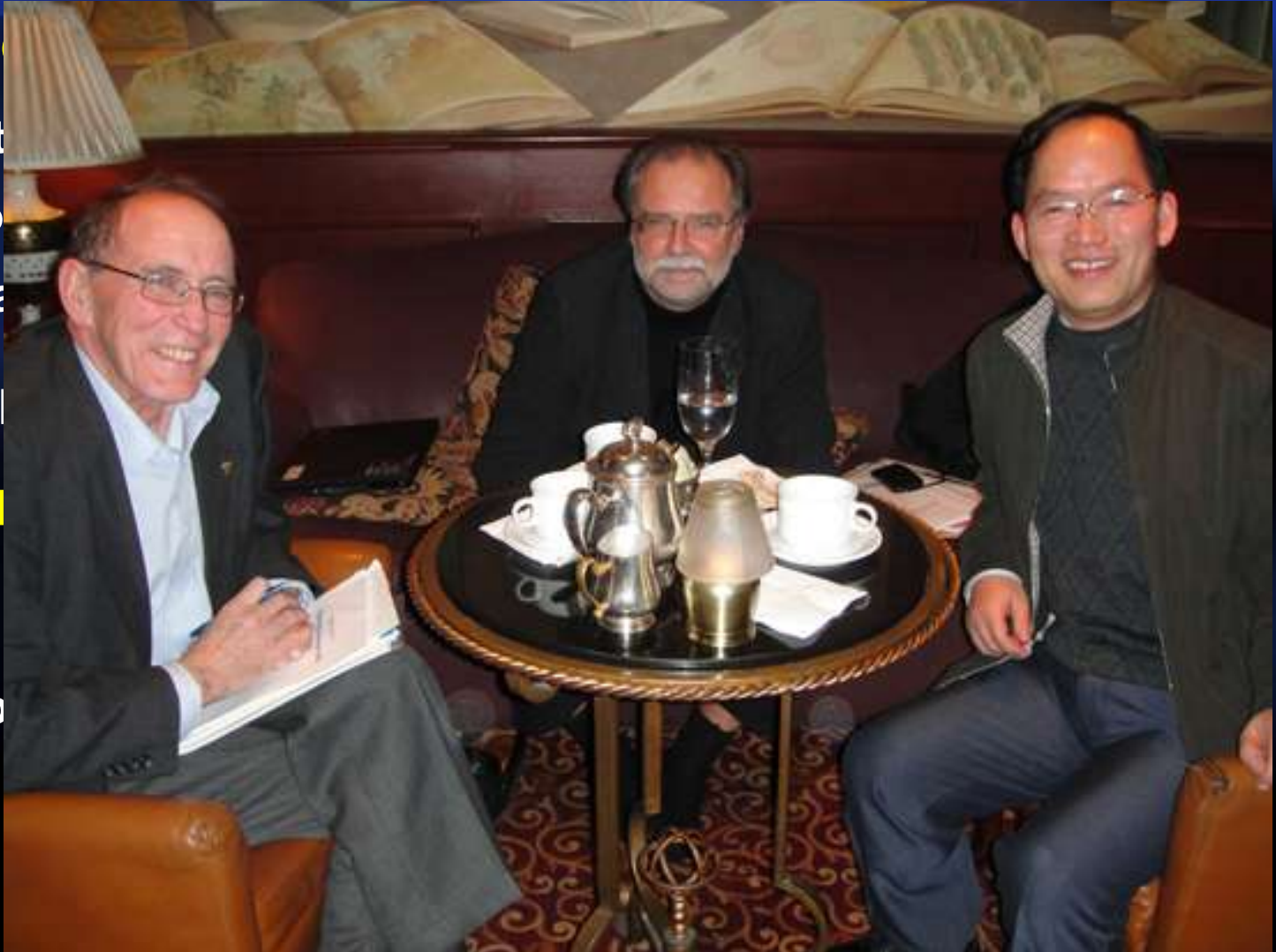
scient  
propo  
evalua

to res

**Loni**

**Mus**

memb





# **The committee also nominated members for Scientific Committee of TPE**

**Tandong Yao, Lonnie Thompson, Volker Mosbrugger, Toshio  
Koike, Baldev Arora, Rahmatullah Jinani, Lochan Devoketa,  
Evgenevich Fayziev, Gregory Greenwood , Gianni Tartari ,  
Daqing Yang, Yaoming Ma, Matthias Winiger, Masayoshi  
Nakawo**

📌 **To formulate the TPE office** to be mainly in charge of program implementation, including the organization of programs, international workshop, summer schools for young talents, as well as TPE website operation and correspondence or news letter.





A group of 14 people, including men and women of various ages, are standing in a line on a grassy, high-altitude plain. They are holding a long, bright red banner that spans across the middle of the group. The banner has yellow text printed on it. The people are dressed in outdoor, high-altitude clothing such as jackets, hats, and scarves. In the background, there are rugged, brown mountains with patches of snow or ice. A utility pole with cross-arms is visible behind the group. The sky is overcast and grey.

**THE THIRD POLE ENVIRONMENT (TPE) PROGRAM**  
Sino-Nepal Joint Expedition to South Himalaya, 4. 2010









## Pakistan





# Third Pole Environment (TPE) Workshop

August 14-16, 2009, Beijing, China



2009, Beijing

2010, Nepal



2011, Iceland

2013, India





□ To hold training schools for international young talents

**2011 TPE-TiP Science & Technology Training**

**Nepal Oct.31-Nov.12**



**3rd SCO NAS Summer School for Young Scientists**

**Beijing Jul. 16-Aug. 5, 2012**





# 2013 TPE-TiP Science & Technology Training

Aug.11-25, Germany





青藏高原研究所现有的外国留学生

						
Dambaru Ballab Kattel (尼泊尔)	Tek Bahadur (尼泊尔)	Dawadi Binod (尼泊尔)	Luthi Zoe Lucia (瑞士/意大利)	Nasir Jawad (巴基斯坦)	Farhan Suhaib (巴基斯坦)	Pukar Man Amatya (尼泊尔)
						
Aminov Jovid (塔吉克斯坦)	Tripathee Lekhendra (尼泊尔)	Zaman Qamar ul (巴基斯坦)	Upendra Baral (尼泊尔)	shiva Ebrahimi (伊朗)	Satybaev maksatbek (吉尔吉斯斯坦)	

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3

- **To cooperate and coordinate with international programs, organizations and research institutions**







Prof. Tandong Yao discusses TPE with UNESCO Assistant Director-General, for the Natural Sciences, Gretchen Kalonji in Beijing.

Apart from the CAS support, the TPE has been endorsed by the UNESCO, SCOPE, and UNEP in 2011.



United Nations  
Educational, Scientific and  
Cultural Organization

Division of Ecological and  
Earth Sciences



Scientific Committee  
on Problems of the Environment



UNEP  
United Nations  
Environment Programme

UNESCO · SCOPE · UNEP  
**Policy Briefs**

May 2011 - No. 13

A satellite-style image of a high-altitude, mountainous region, likely the Third Pole area, showing rugged terrain, snow, and glaciers.

# Third POLE ENVIRONMENT



# Impacts of TP on Asian monsoon and climate change

**TORP+TPE**

Point results,  
Processes analysis

Atmospheric  
models

Validation (observations)

Whole Thrid  
pole area

Remote sensing  
parameterization

ITDAS



**Welcome you join TPE!**

**Welcome you to the Tibet Plateau!**