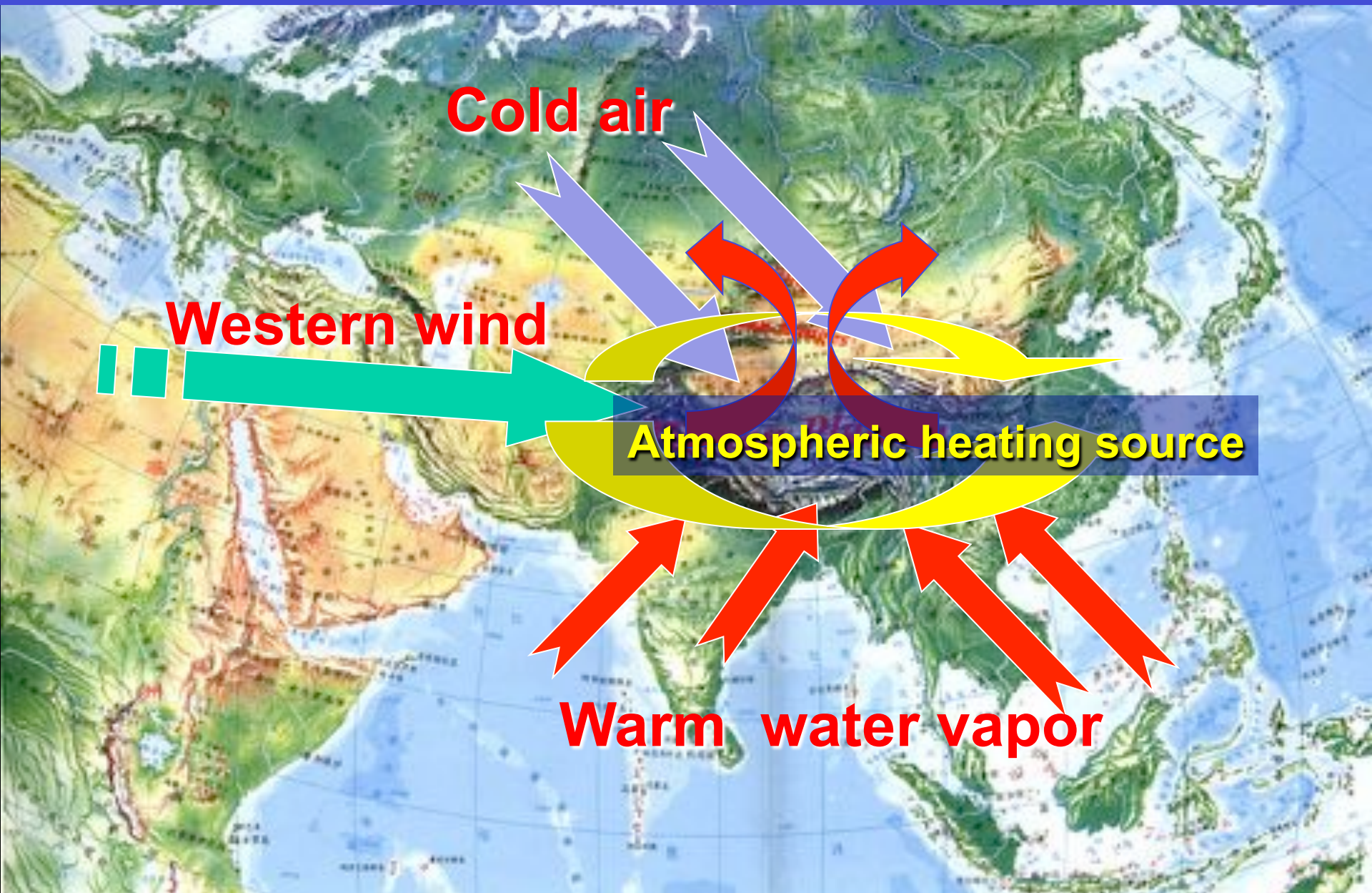
Monitoring and modeling the "water-cryosphere-atmosphere-biosphere" interactions over the Third Pole region

Yaoming Ma, Weiqiang Ma

1. Institute of Tibetan Plateau Research, Chinese Academy of Sciences
2. CAS Center for Excellence in Tibetan Plateau Earth Sciences, CAS
3. University of Chinese Academy of Sciences
4. Qomolangma Station for Atmospheric and Environmental Observation and Research, CAS

(6-11 May 2018,Canmore, Alberta, Canada)

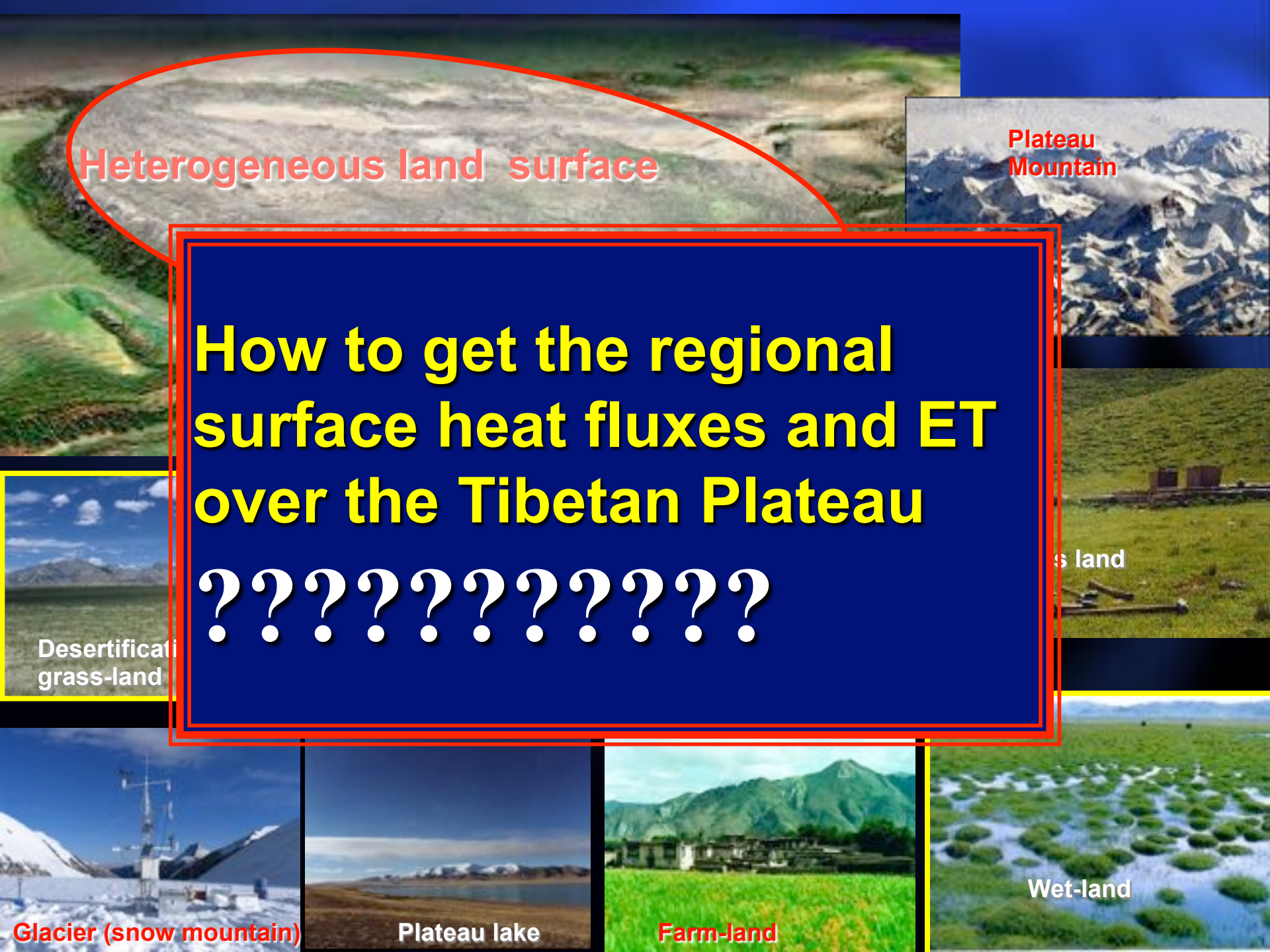
Why do we have this kind of study?

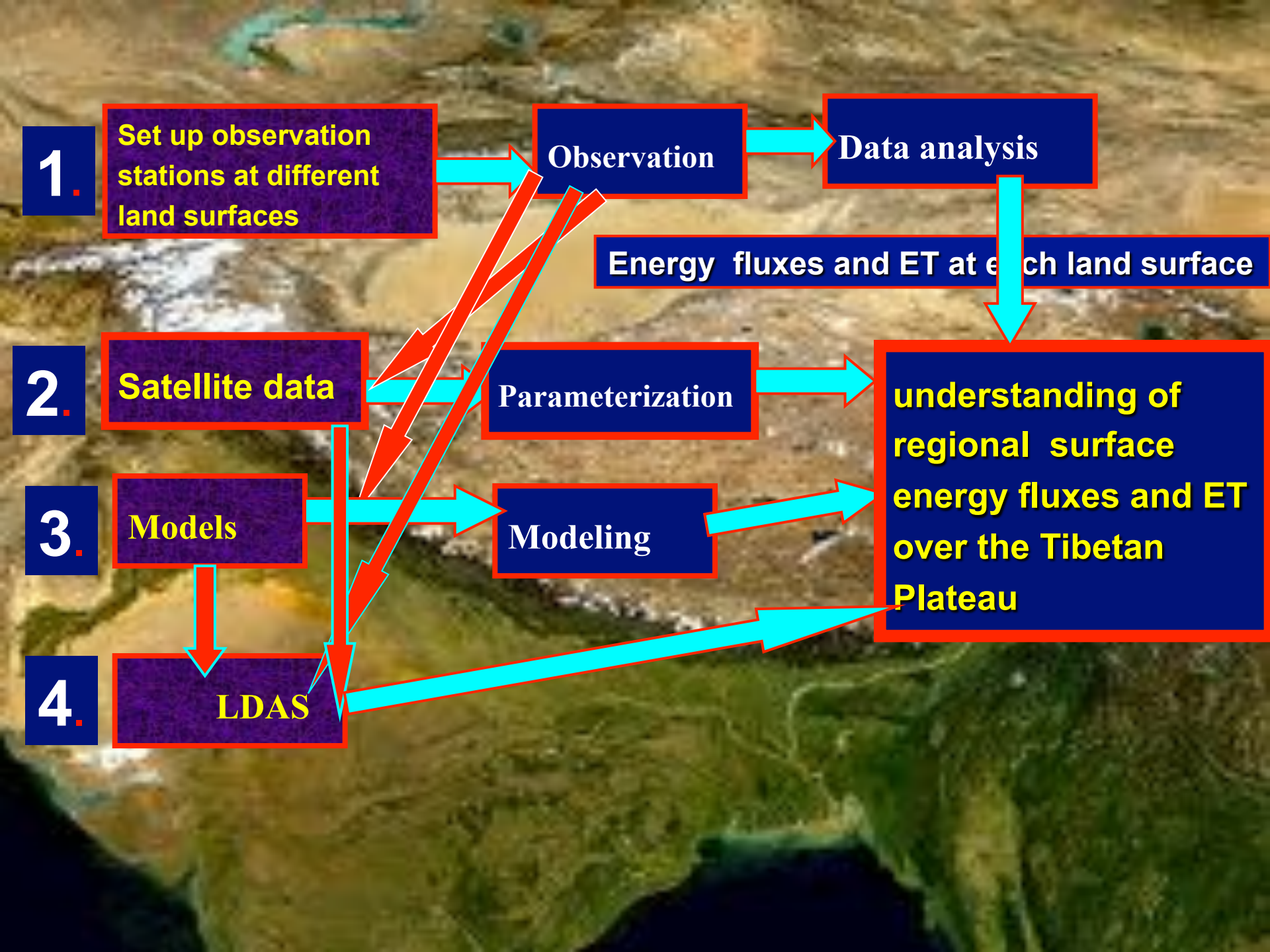


Tibetan Plateau

Heating to the atmosphere

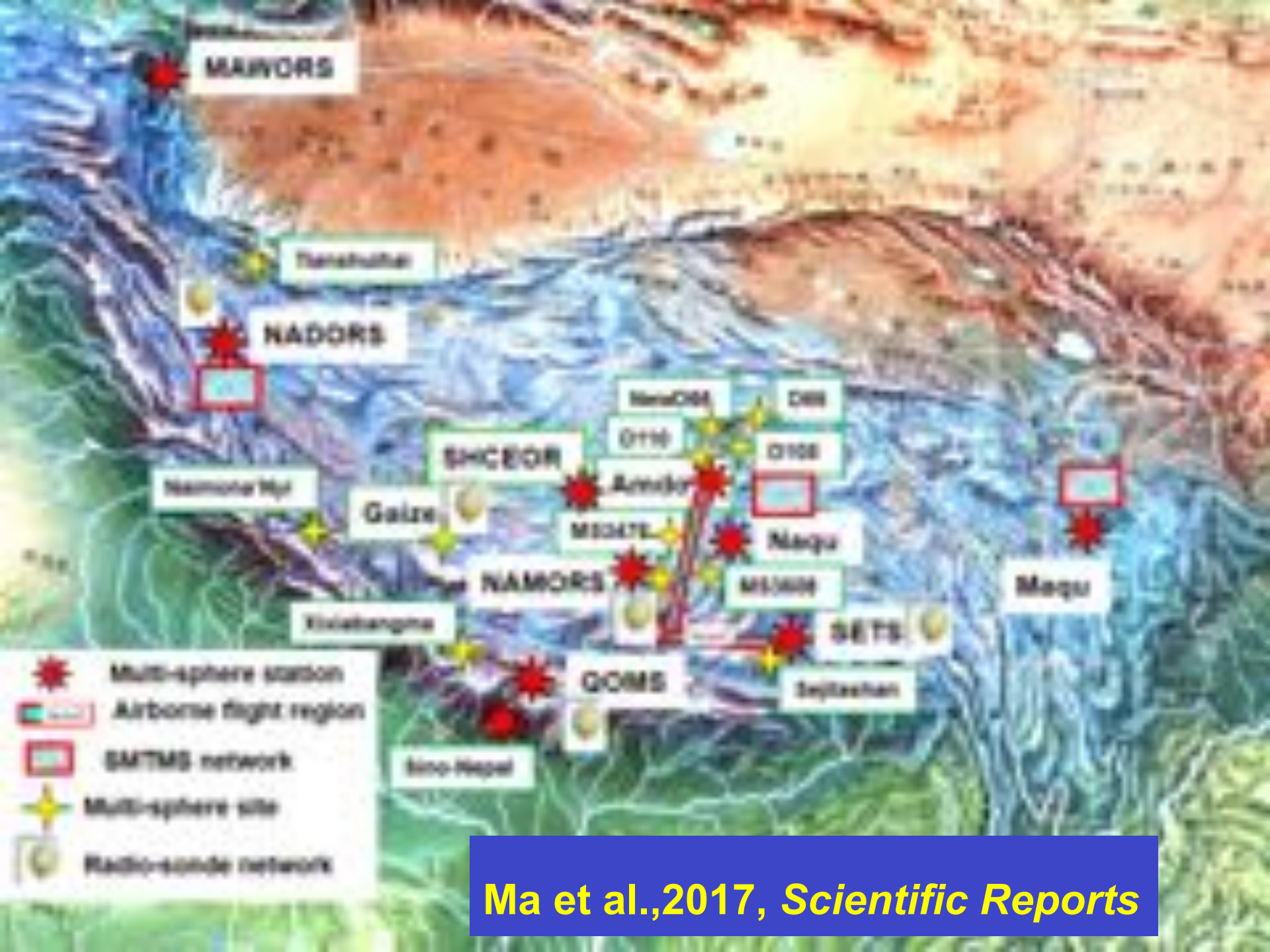
Energy fluxes and water vapor flux exchange between the land surface and near surface atmosphere


Heterogeneous land surface
Plateau Mountain
How to get the regional surface heat fluxes and ET over the Tibetan Plateau
??????????
Desertificati grass-land
s land
Glacier (snow mountain)
Plateau lake
Farm-land
Wet-land


1.
Set up observation stations at different land surfaces
Observation
Data analysis
Energy fluxes and ET at e ch land surface
2.
Satellite data
Parameterization
understanding of regional surface energy fluxes and ET over the Tibetan Plateau
3.
Models
Modeling
4.
LDAS

Tibetan Observation and Research Platform

---TORP



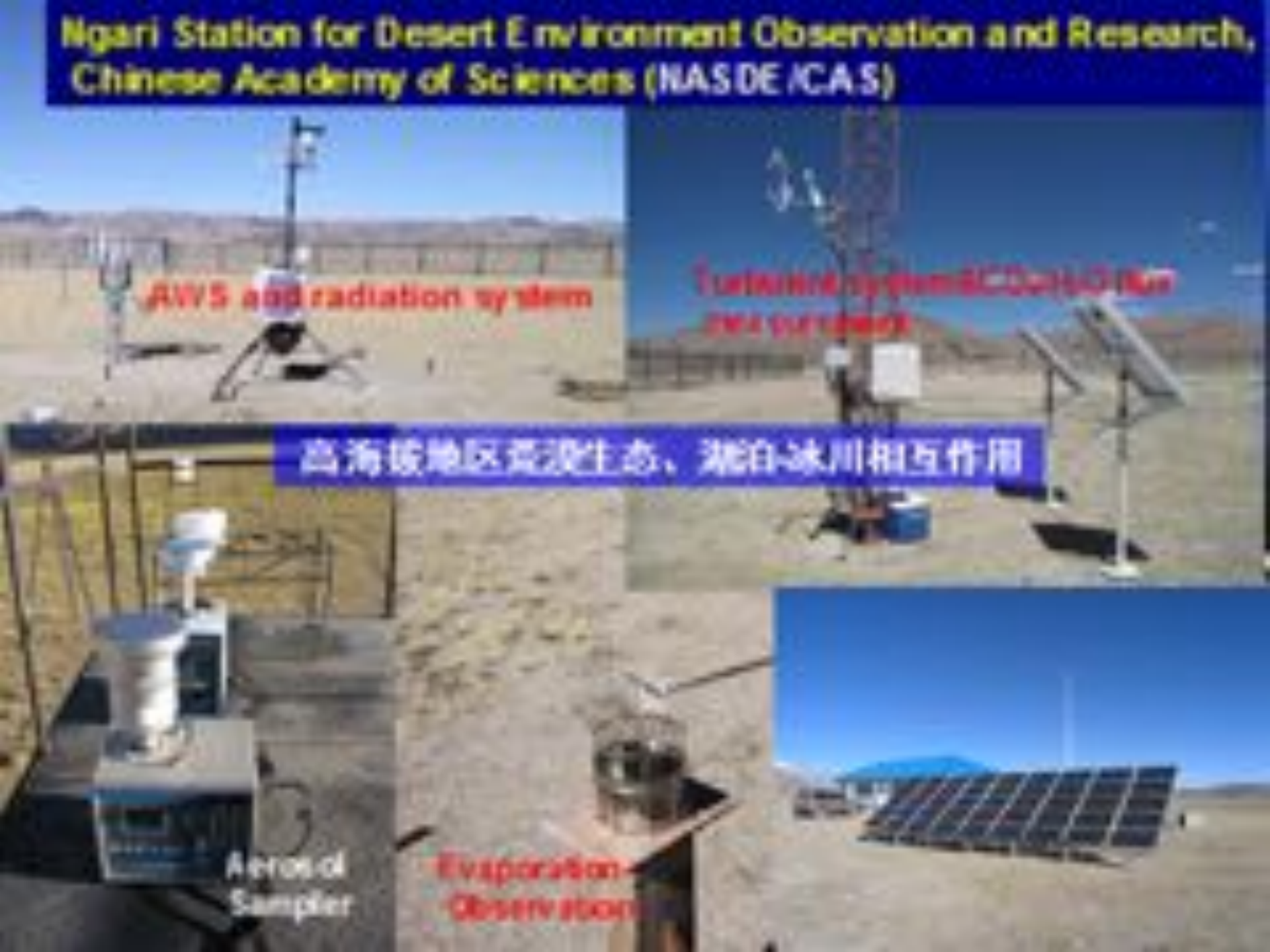
Ma et al.,2017, *Scientific Reports*

7 ITP/CAS comprehensive observation stations in TP

Qomolangma Station for Atmospheric and Environmental Observation and Research (QOMS/CAS)

Nam Co Station for Multisphere Observation and Research (NAMORS/ CAS)

Southeast Tibet Station for Alpine Environment Observation and Research (SETS/CAS)


Ngari Station for Desert Environment Observation and Research, Chinese Academy of Sciences (NASDE/CAS)
AWS and radiation system
高海拔地区荒漠生态、湖泊冰川相互作用
Aerosol Sampler
Evaporation Observation

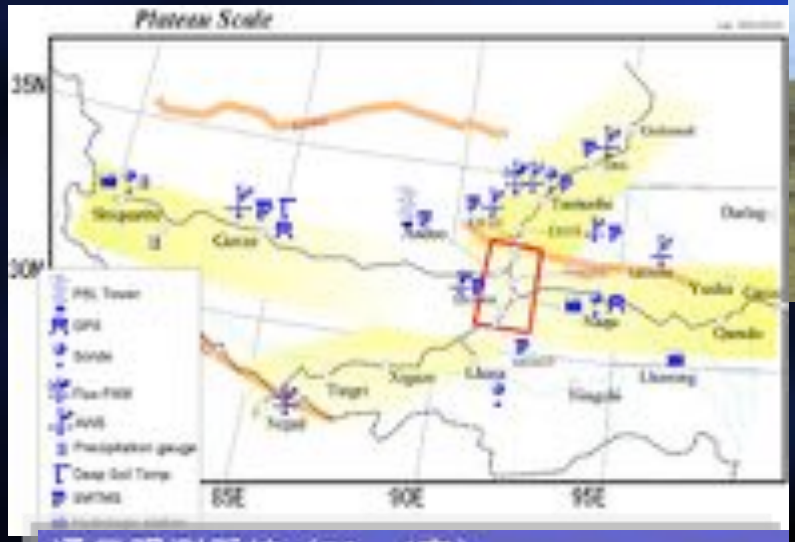
Muztagh Ata Station for Westerly Environment Observation and Research, Chinese Academy of Sciences (MASWE/CAS)

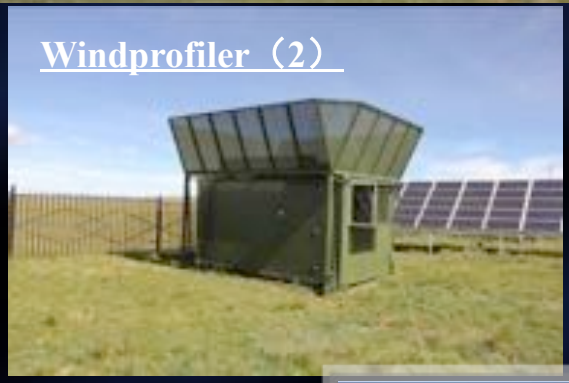
AWS

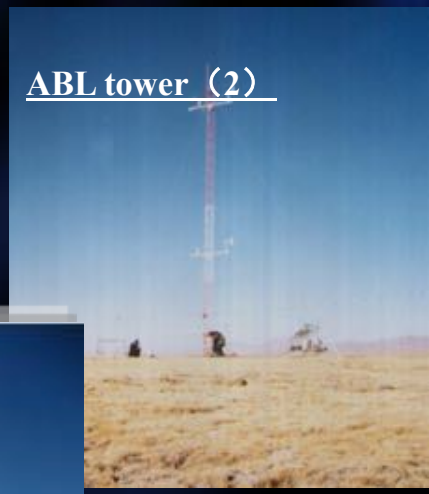
POPS

Aerosol Sampler

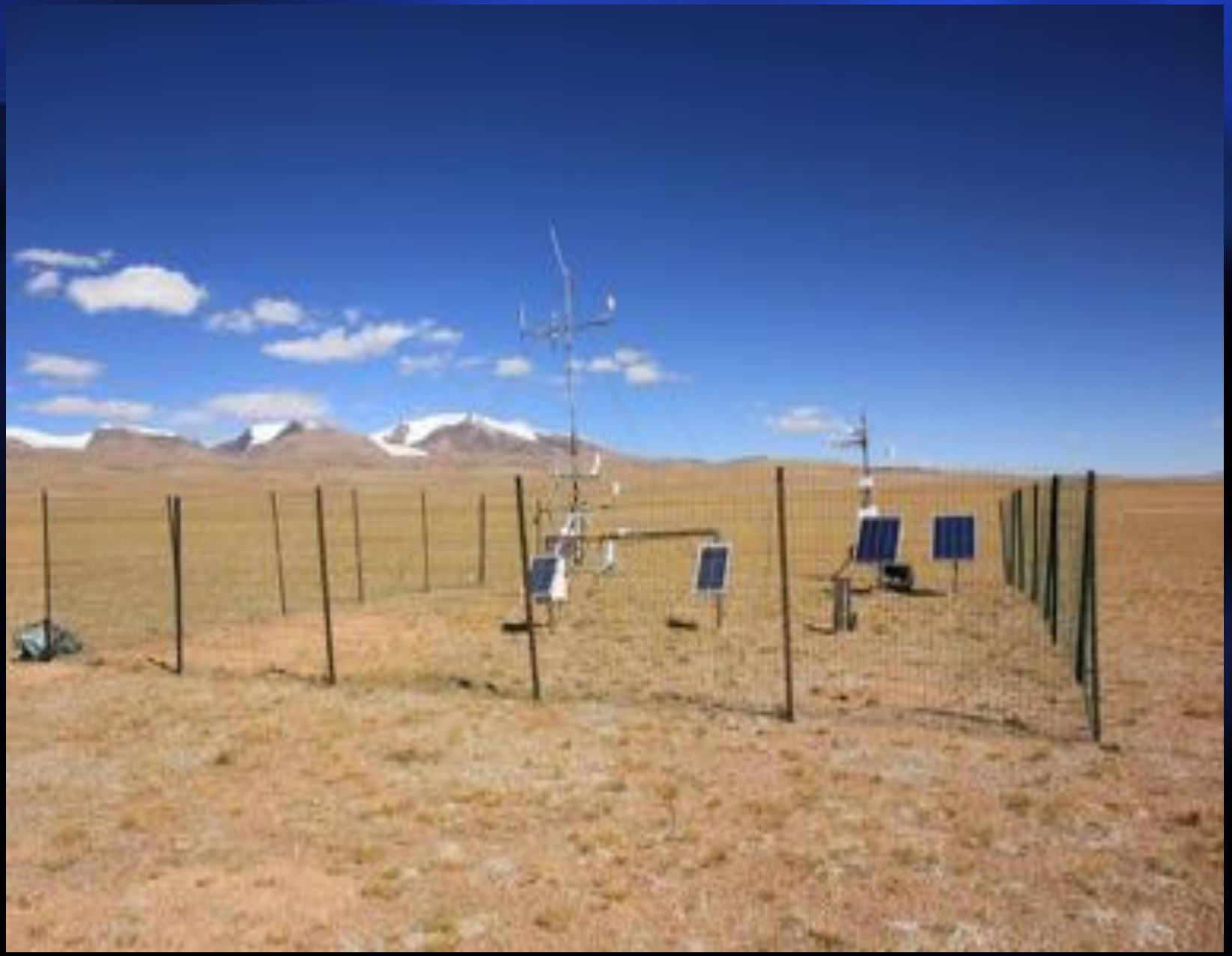
Nagqu Station of Plateau Climate and Environment (NPCE)

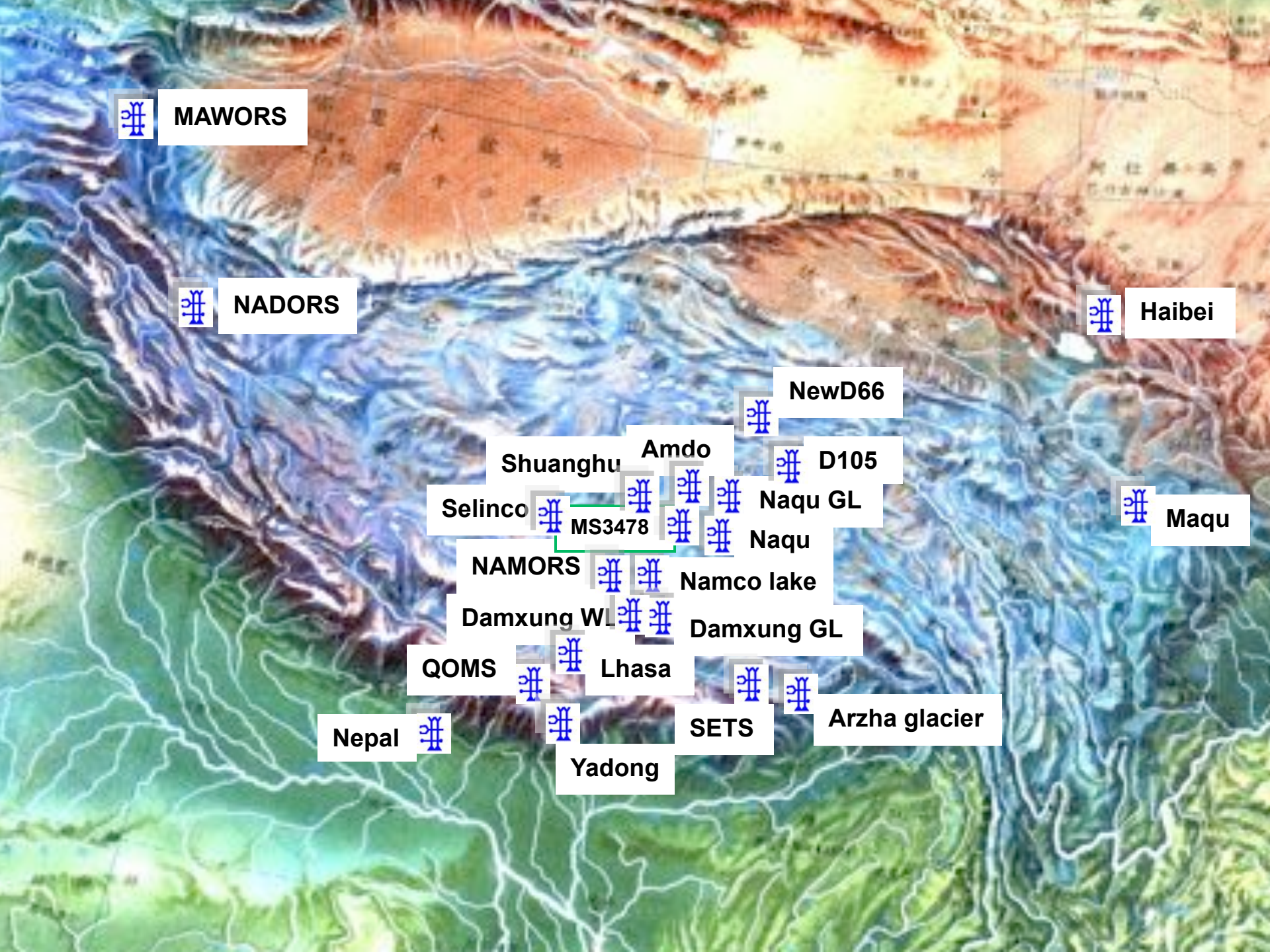






Kekexili Station（Shuanghu）




MAWORS
NADORS
Haibei
NewD66
Shuanghu
Amdo
D105
Selinco
Naqu GL
Maqu
MS3478
Naqu
NAMORS
Namco lake
Damxung WL
Damxung GL
QOMS
Lhasa
Arzha glacier
Nepal
SETS
Yadong

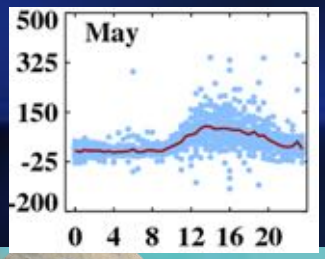
Flux stations over the different land surface

Lhasa

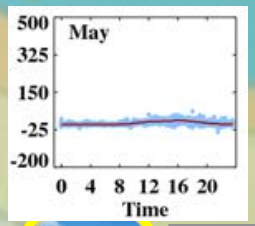
Selinco Lake

ET-by eddy covariance system

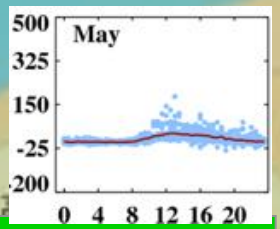
Pre-monsoon



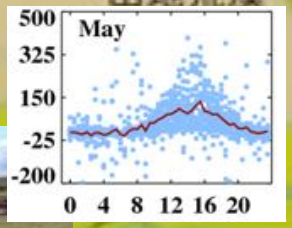
❑Mustagata Station



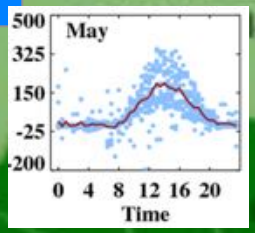
❑Ali



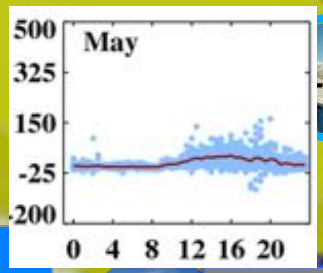
❑Kekexi



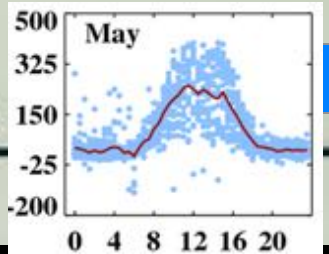
❑Naqu



❑SETS



❑Namco

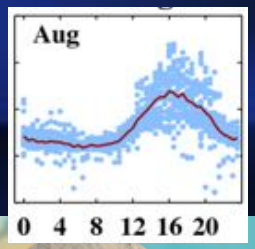


❑Nepal

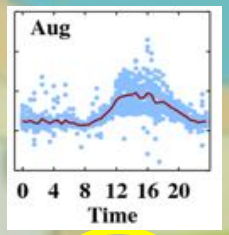
❑QOMS

❑Yadong

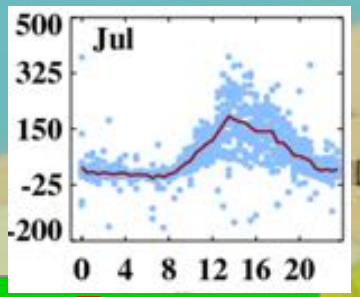
Monsoon



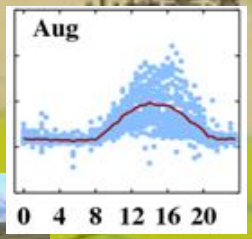
❑Mustagata Station



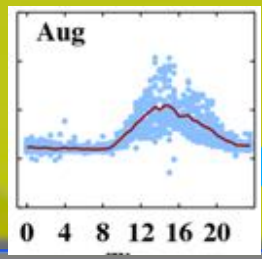
❑Ali Station

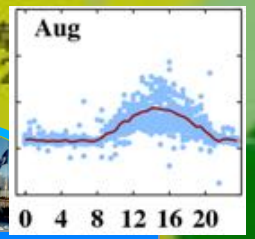


❑Kekexili

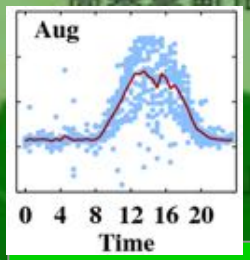


Naqu station



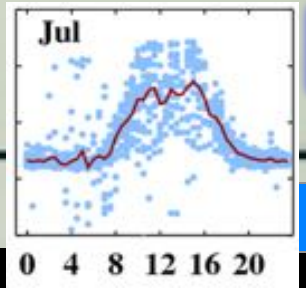


Namco



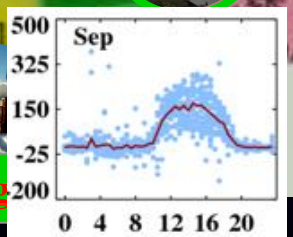
❑SETS

QOMS

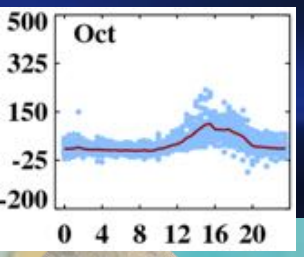


Nepal

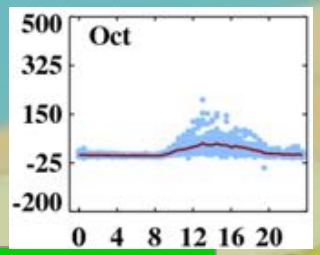
❑Yadong



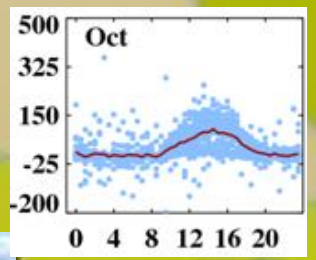
Post-monsoon

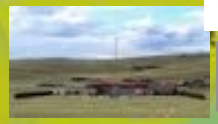


❑Mustagata Station

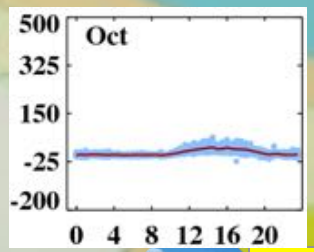


❑Kekexili

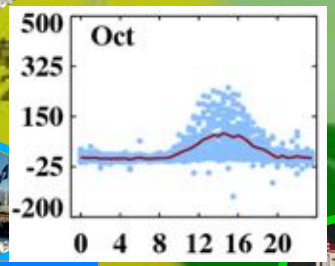


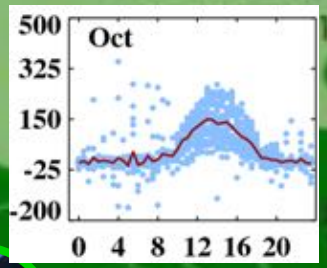


❑Naqu

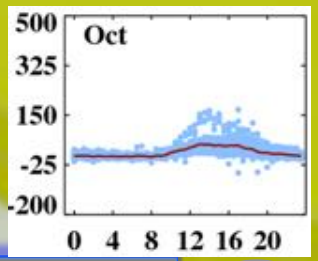


❑Ali

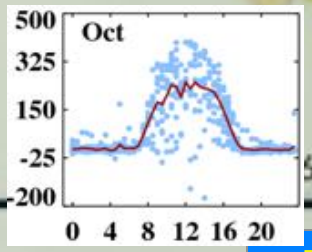




❑SETS



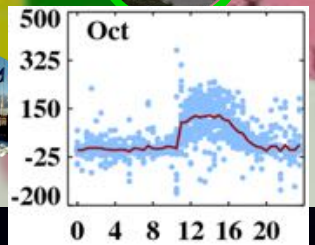
❑Namco



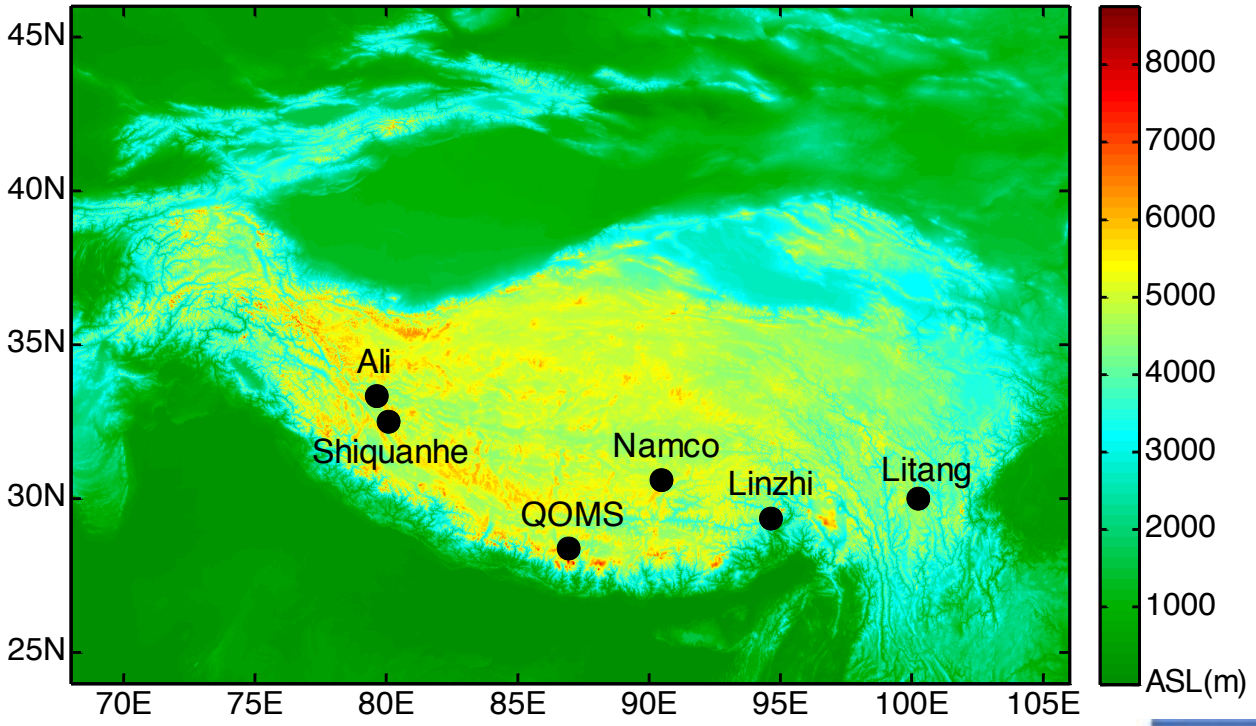
❑QOMS

❑Nepal

❑Yadong



Effective aerodynamic roughness length and zero-plane displacement height



Radio-sonde data ,Wind Profiler data and turbulent data

Effective aerodynamic roughness length and zero-plane displacement height （Ma et al., 2018,IJRS)

Station	z_{0m}^{eff} (m)	d_0 (m)
QOMS(15)	62.6 ± 12.3	470.3 ± 48.0
NAMOS(8)	1.7 ± 1.1	19.4 ± 11.9
Linzhi(14)	86.0 ± 6.6	516.1 ± 39.7
Ali(11)	1.9 ±1.1	8.1 ± 5.5
Shiquanhe(12)	10.2 ±4.3	81.9 ± 34.5
Litang(9)	6.0 ±1.1	60.7 ±11.1

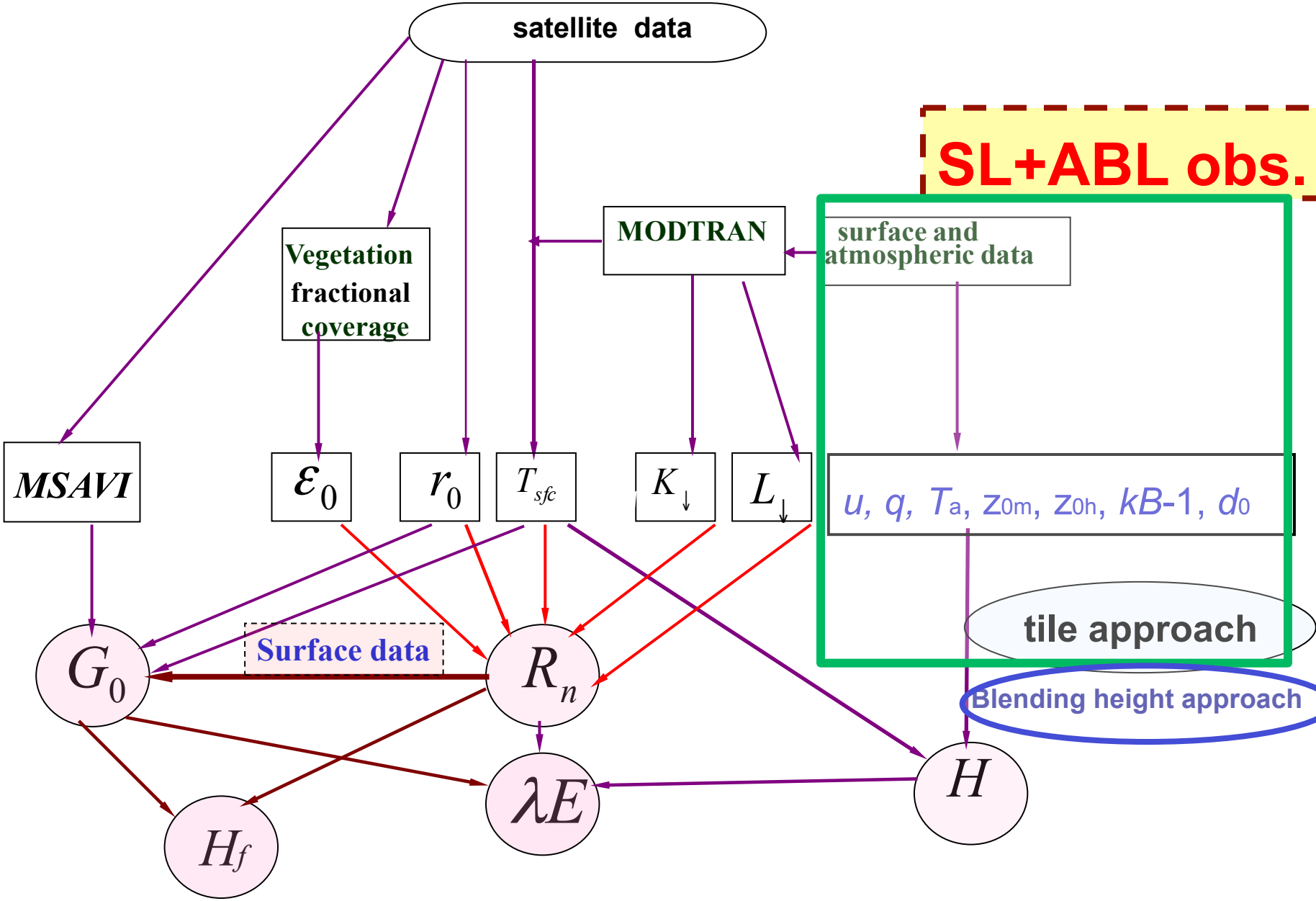
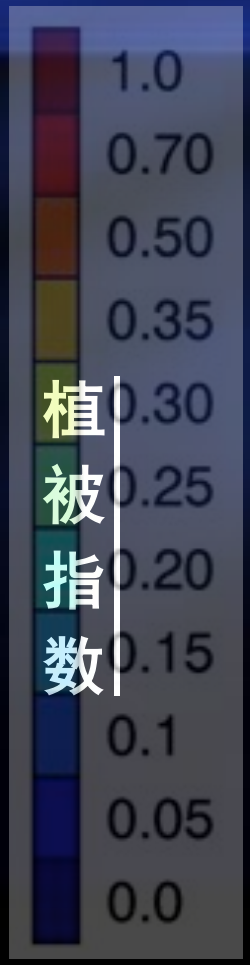
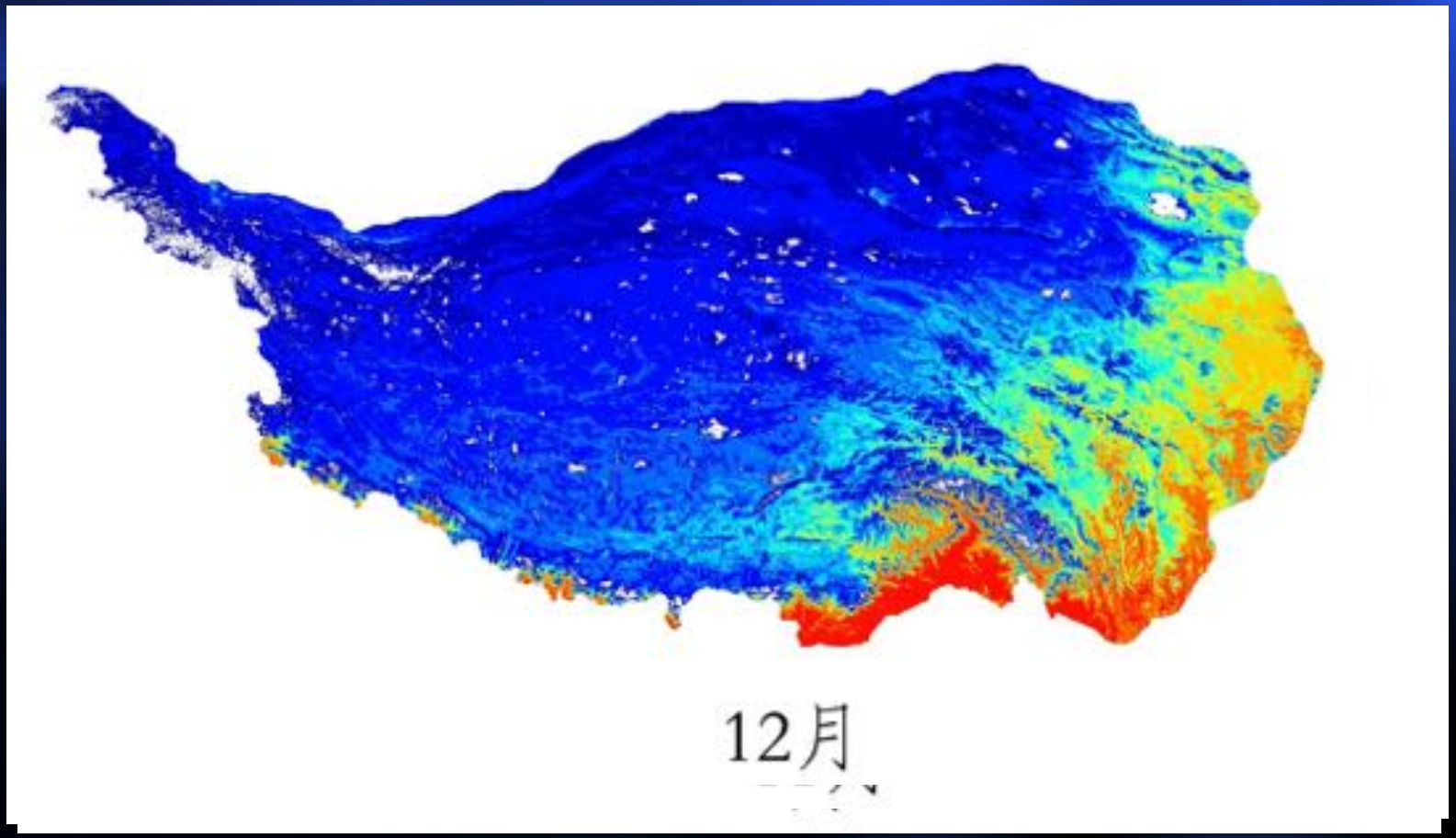


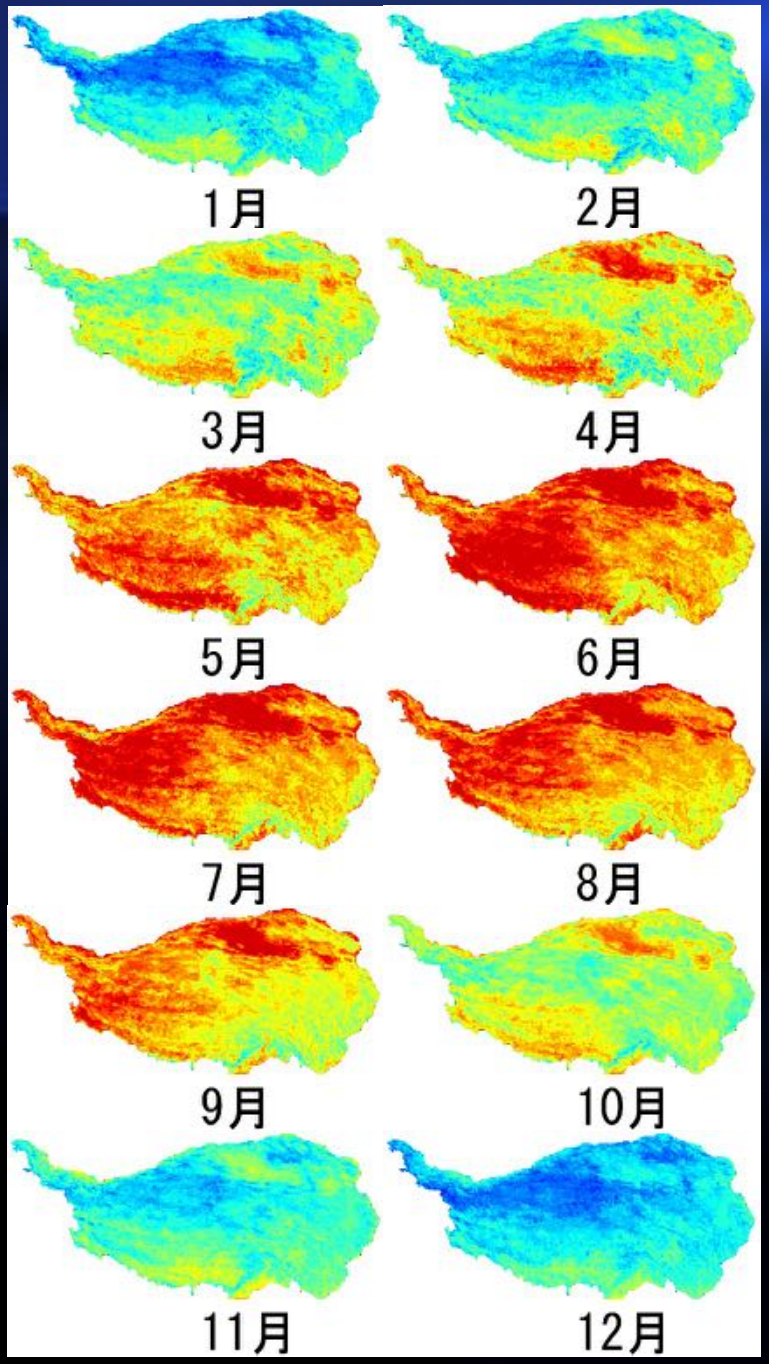
Fig.1 Diagram of parameterization procedure by MODIS data with field observations (Ma et al., 2011, AAS; Ma et al., 2014, ACP)

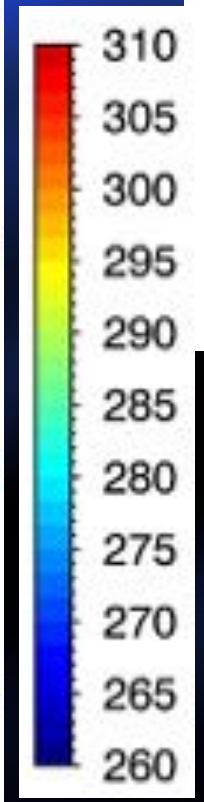
NDVI

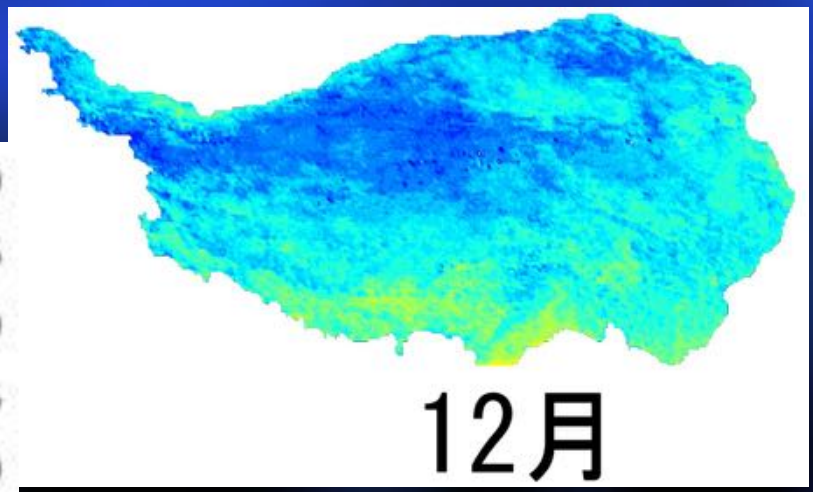


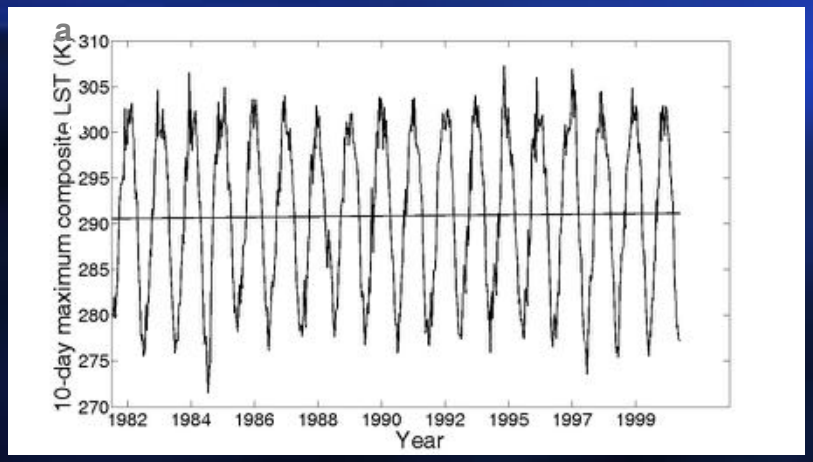


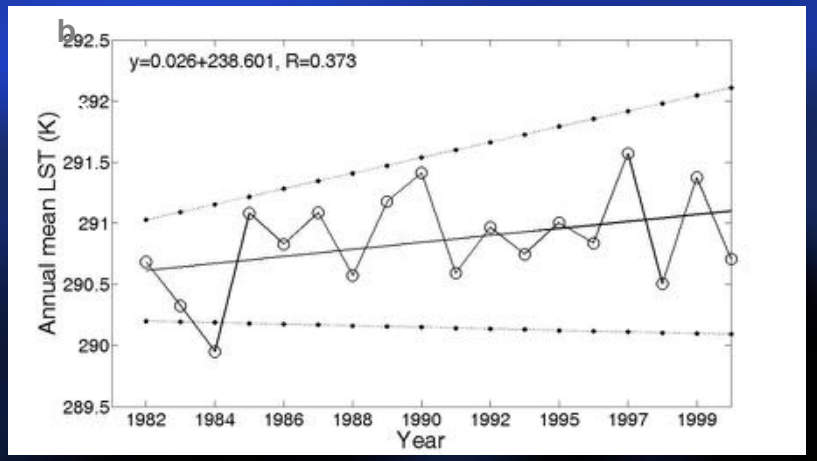
Surface temperature

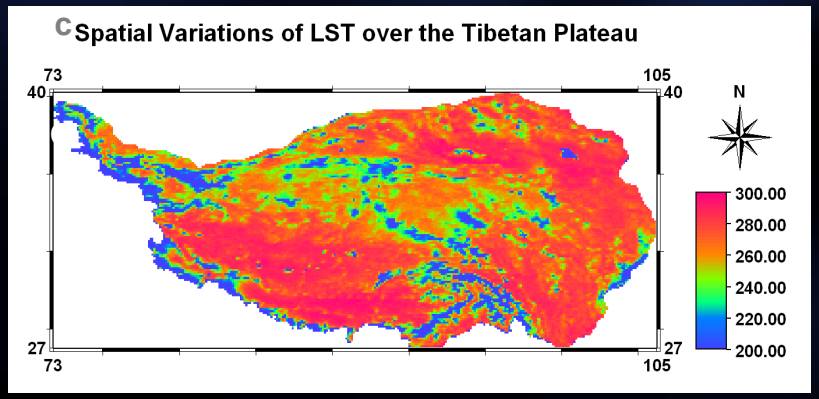


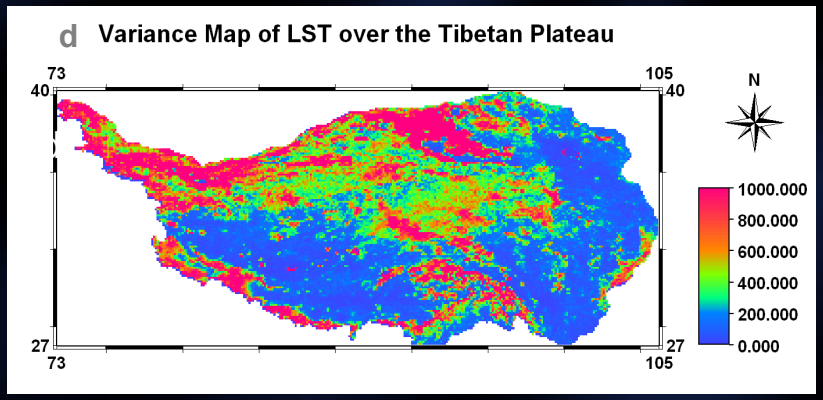






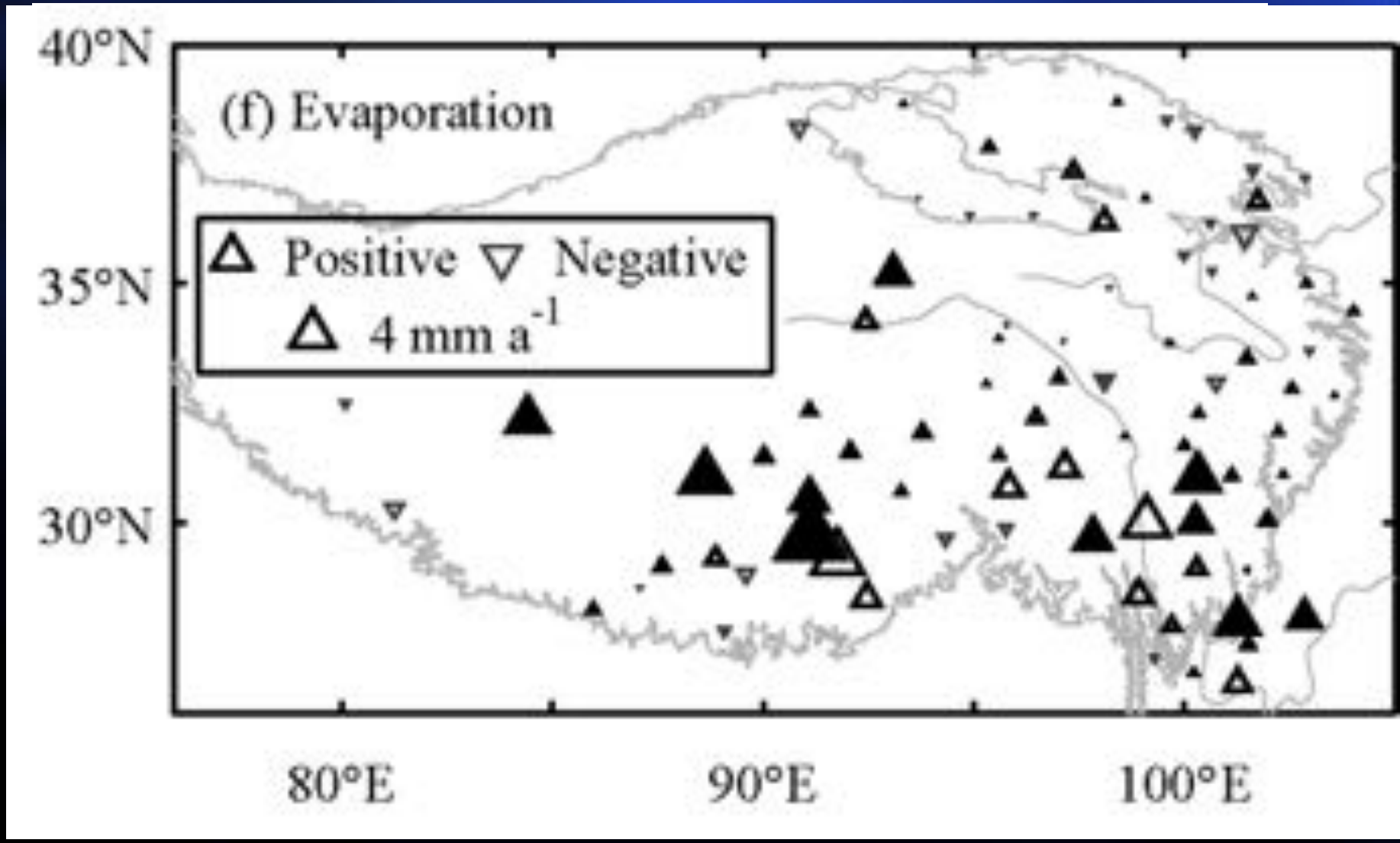


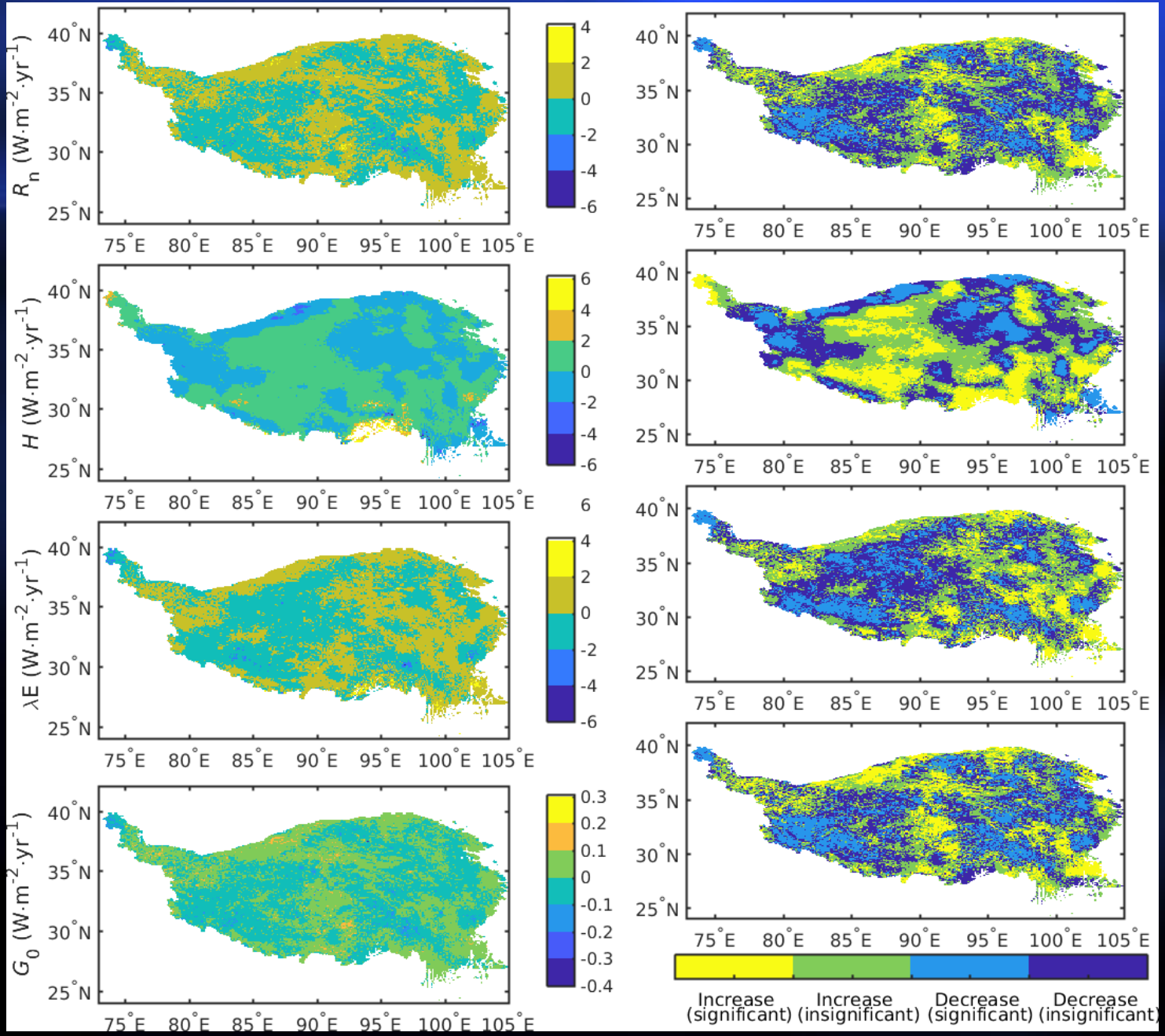




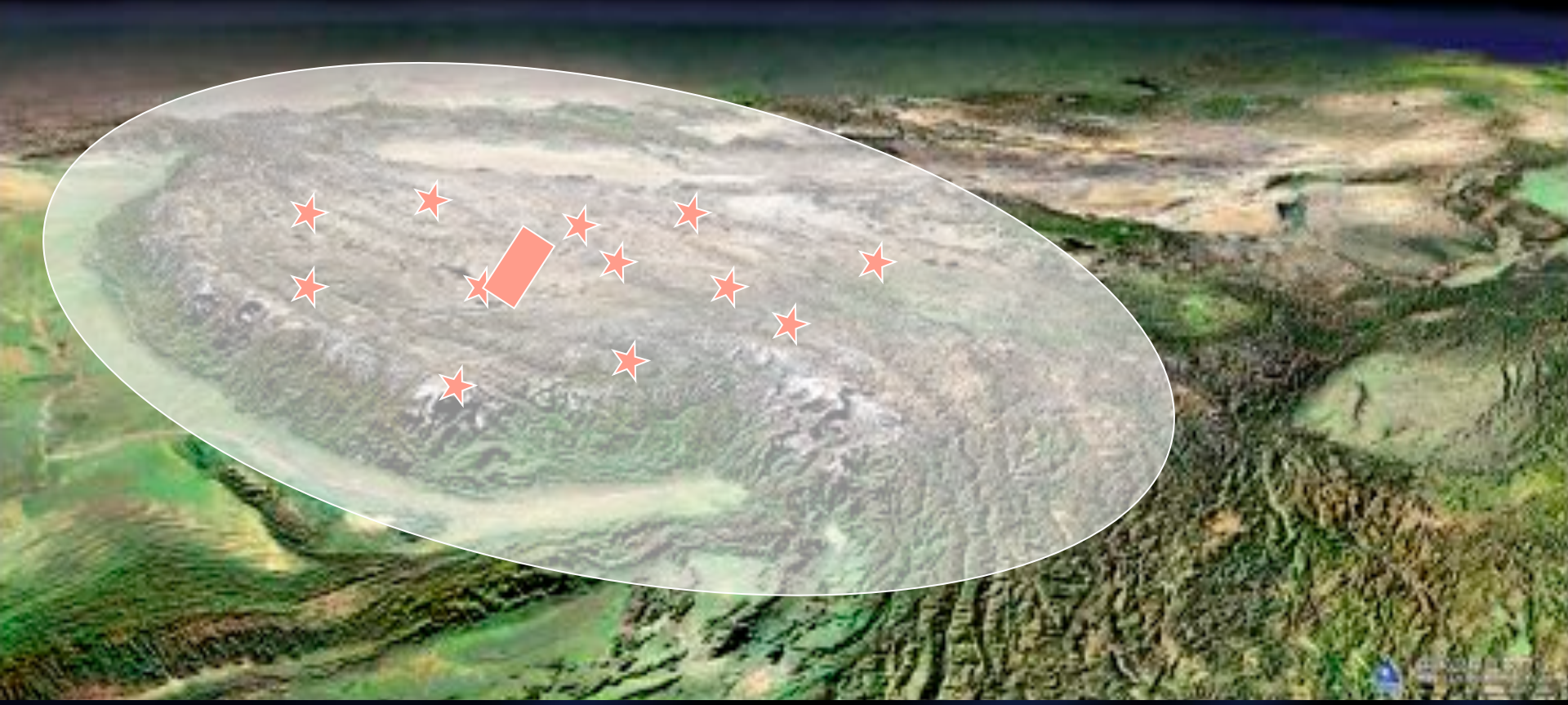
- 0.26C /10y incresing (1980-2000)
- Big variance in the northwest Tibetan Plateau.

(Han and Ma et al, 2017,IJOC) (2001-2012)





(2001-2016) (Ma et al, 2018,IJRS)

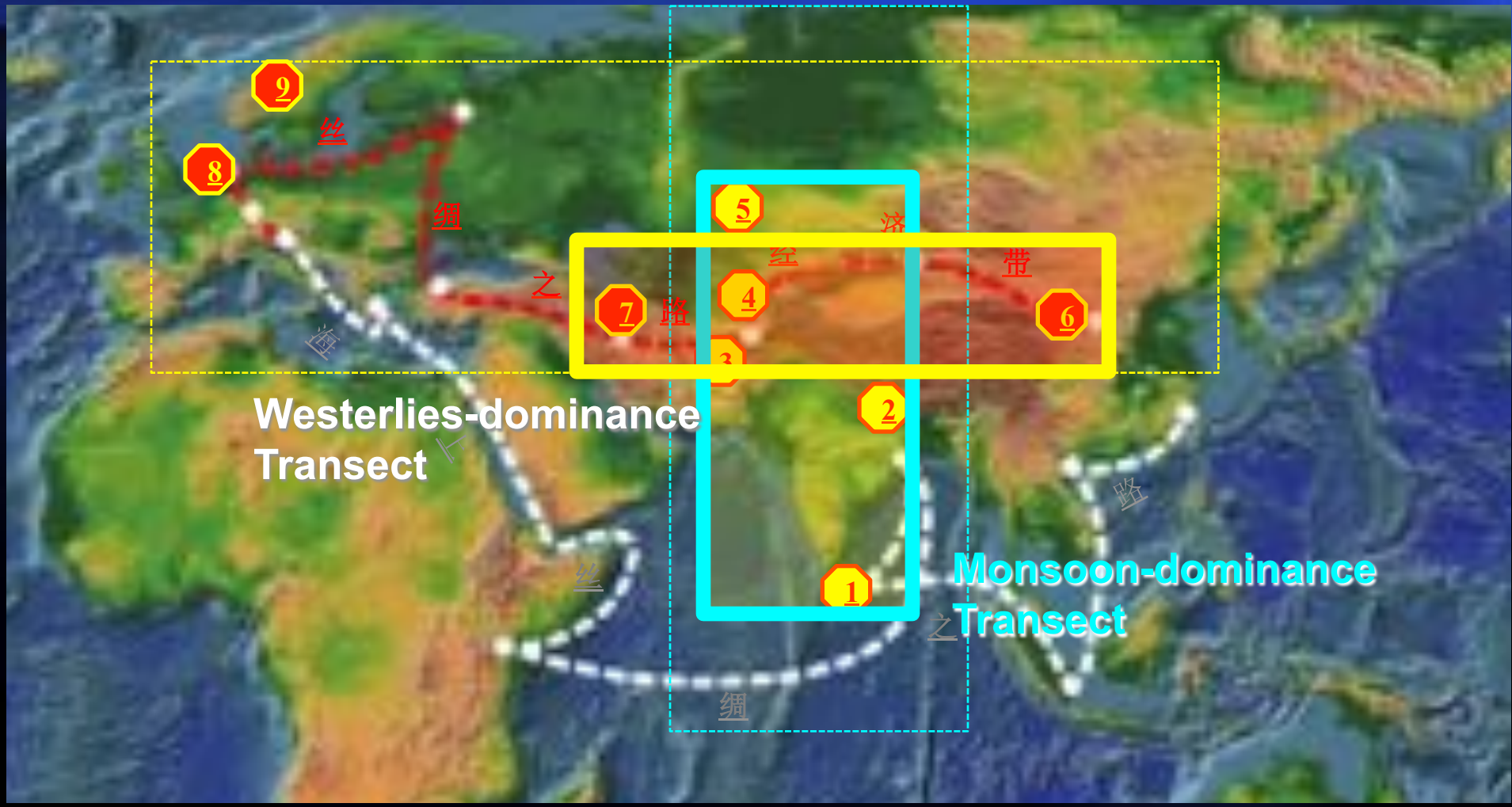


Future work :

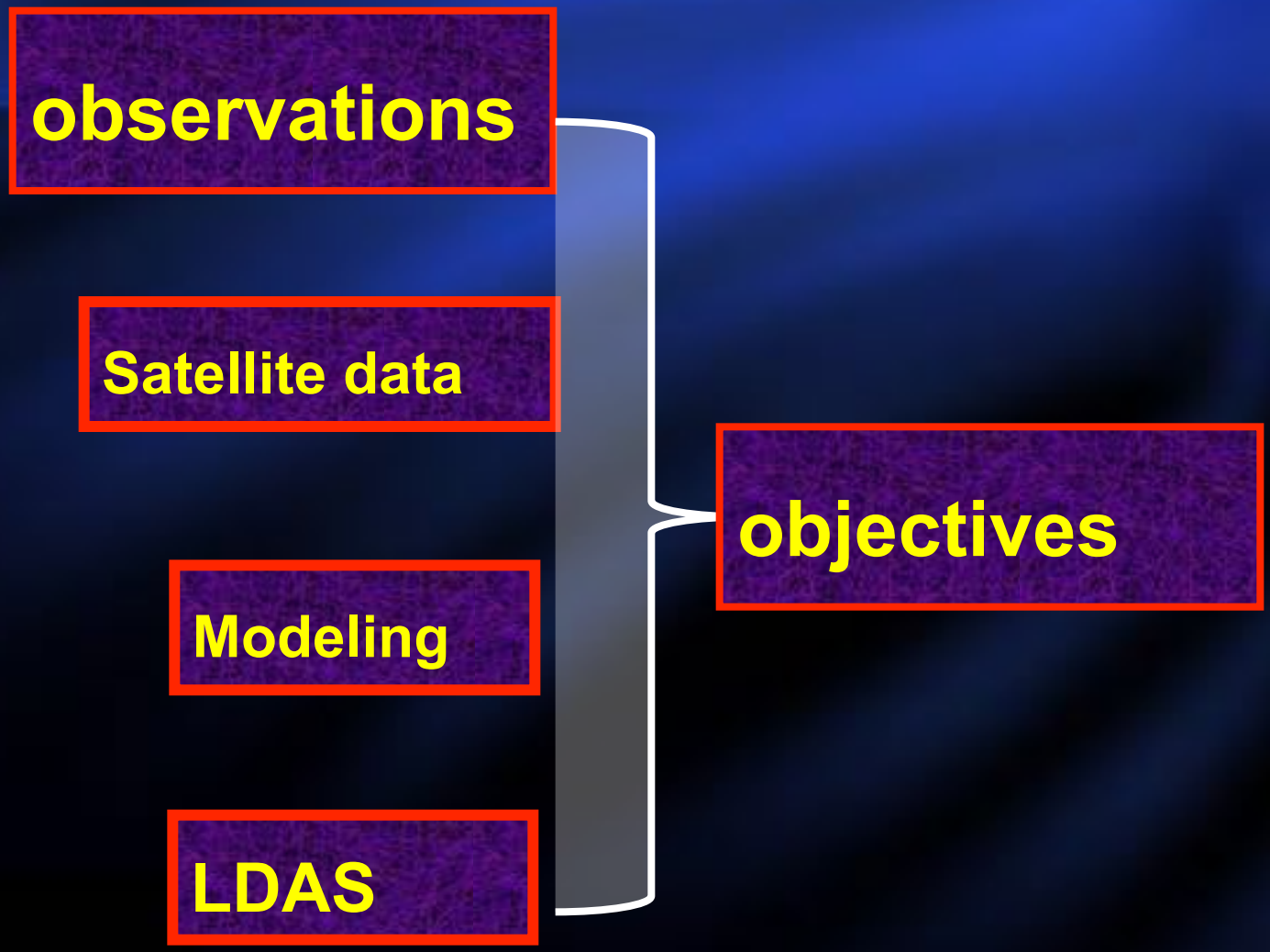
How to entire Third Pole region (Tibetan plateau and nearby surrounding region) and Pan-third pole region …??

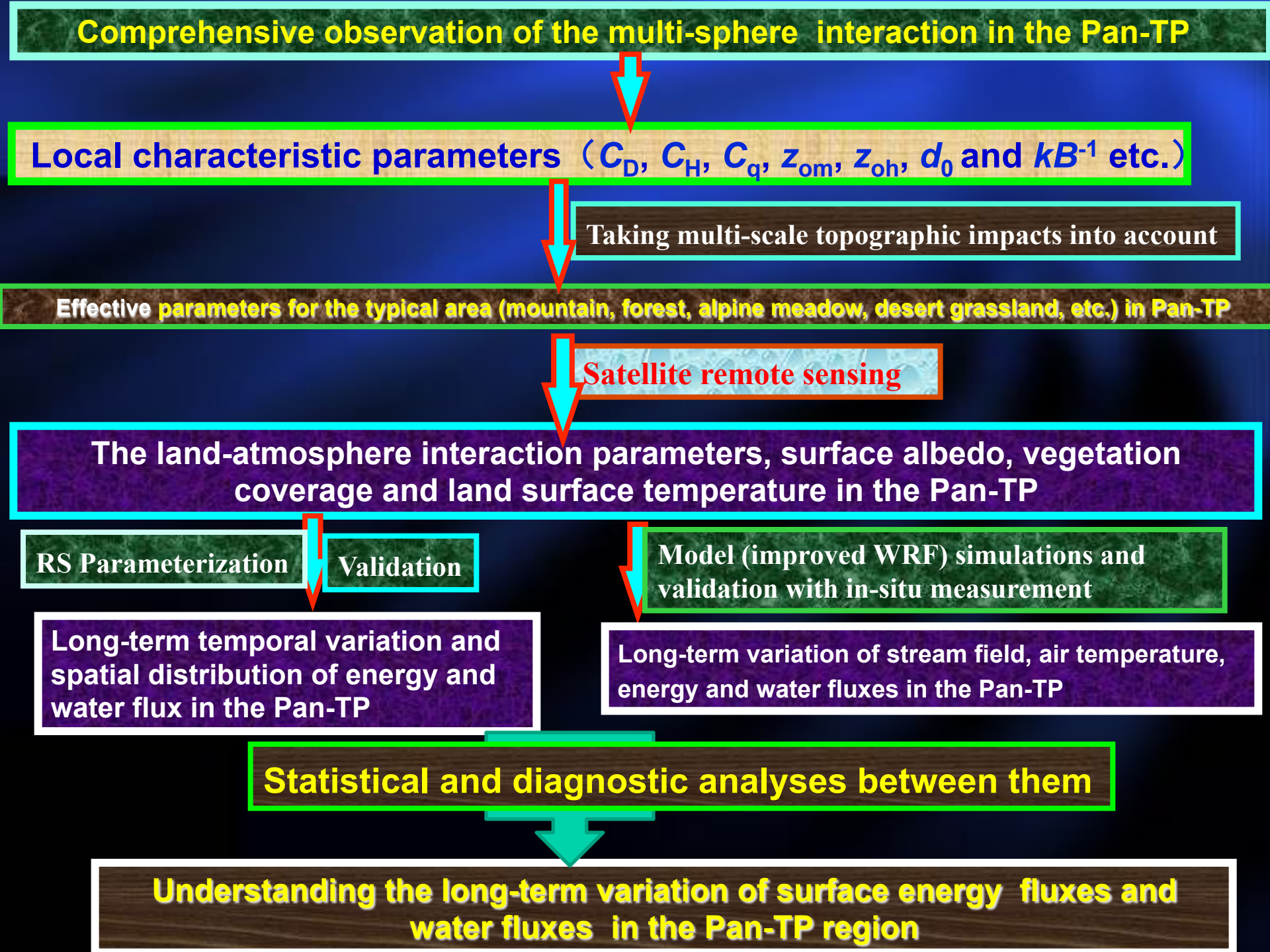

Pan-Third Pole
Tibetan Plateau
Third Pole

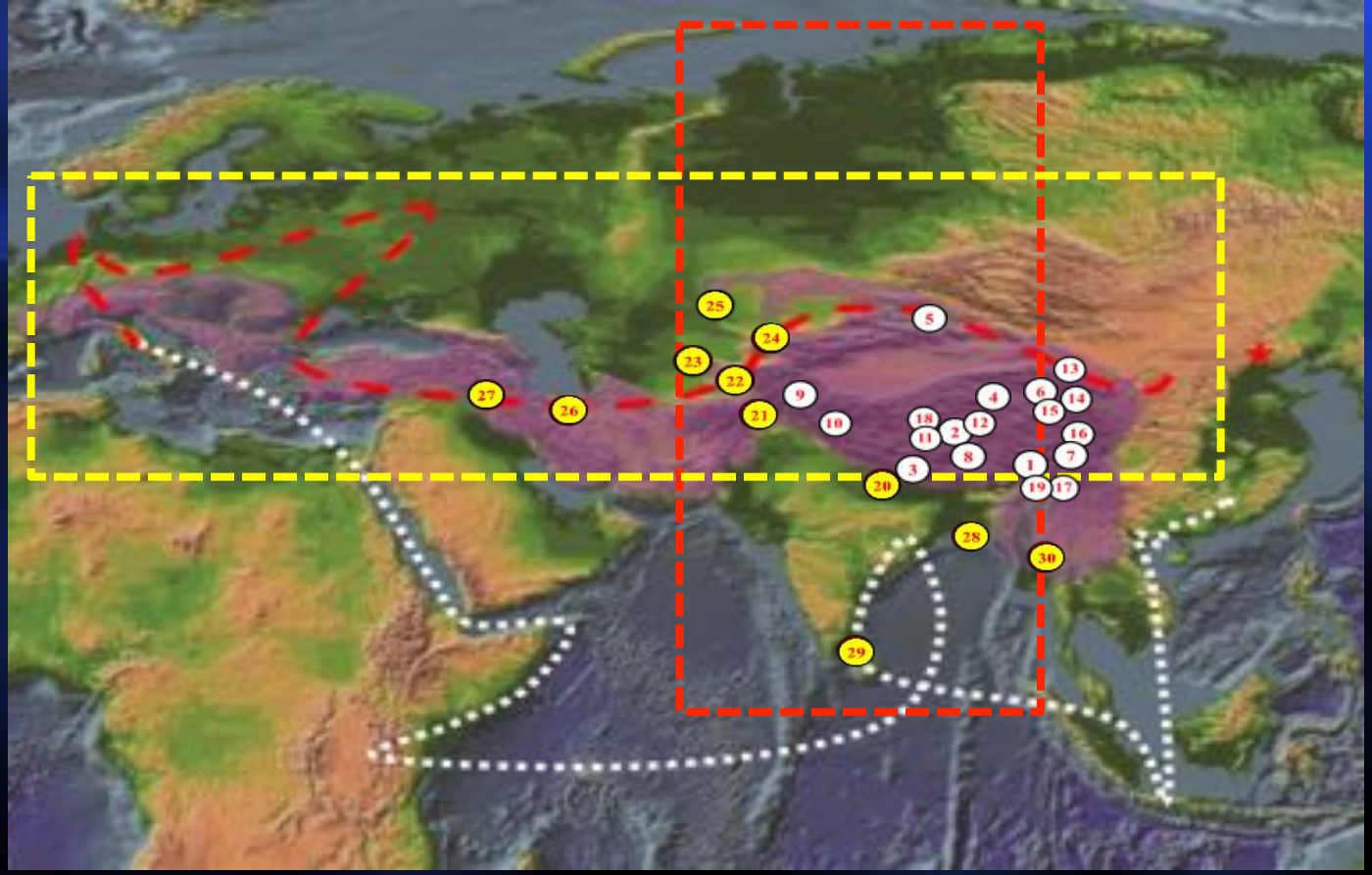
Pan-TPE: Regional longitudinal and latitudinal transects



1 Sri lanka
2 Kathmandu
3 Pakistan
4 Tajikistan
5 Kazakhstan
6 Lanzhou
7 Iran
8 Germany
9 Sweden

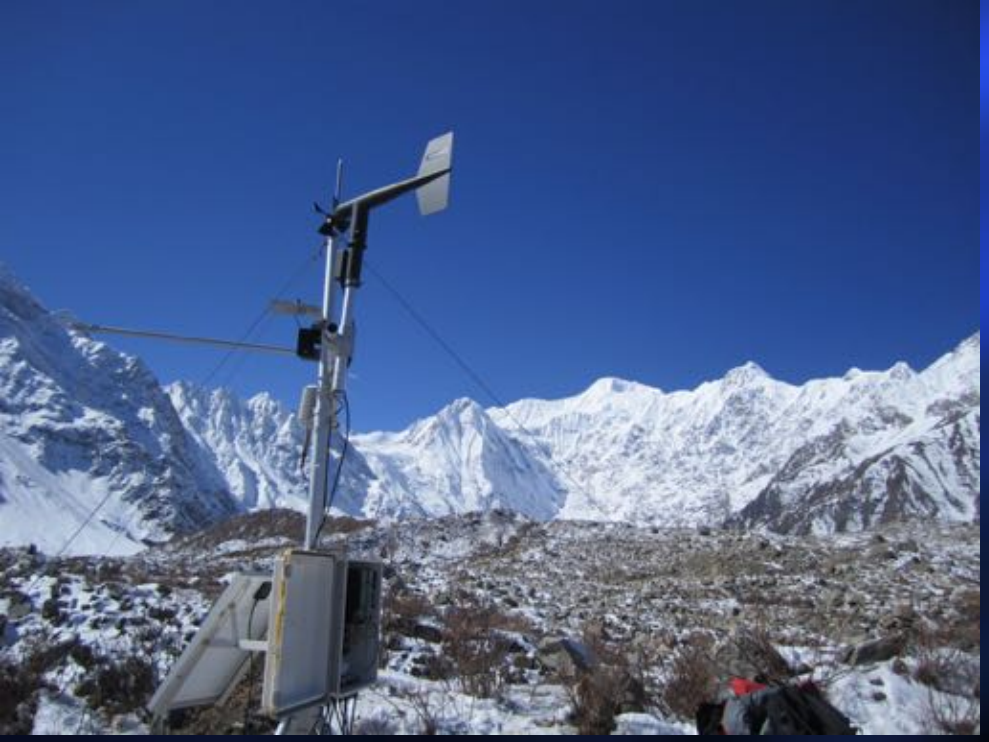

observations
Satellite data
Modeling
LDAS
objectives


Comprehensive observation of the multi-sphere interaction in the Pan-TP
Local characteristic parameters（C_D, C_H, C_q, z_{om}, z_{oh}, d_0 and kB^{-1} etc.）
Taking multi-scale topographic impacts into account
Effective parameters for the typical area (mountain, forest, alpine meadow, desert grassland, etc.) in Pan-TP
Satellite remote sensing
The land-atmosphere interaction parameters, surface albedo, vegetation coverage and land surface temperature in the Pan-TP
RS Parameterization
Validation
Model (improved WRF) simulations and validation with in-situ measurement
Long-term temporal variation and spatial distribution of energy and water flux in the Pan-TP
Long-term variation of stream field, air temperature, energy and water fluxes in the Pan-TP
Statistical and diagnostic analyses between them
Understanding the long-term variation of surface energy fluxes and water fluxes in the Pan-TP region



1. Southeastern TP station
2. Namco station
3. Qomolangma station
4. Golmud station
5. Tienshan station
6. Haibei station
7. Gongga station
8. Lahsa station
9. Muztagh Ata station
10. Ngari station
11. Shenzha station
12. Nagqu station
13. Qilianshan station
14. Qinghai lake station
15. Three rivers sources station
16. Norgay station
17. Mt. Yulong station
18. Shuanghu station
19. Motuo station
20. Katmandu(Nepal)
21. Gilgit(Pakistan)
22. Tajikistan（3）
23. Uzbekistan（3）
24. Kyrghyzstan（3）
25. Kazakhstan(6)
26. Iran-1
27. Iran-2
28. Dacca
29. Sri Lanka
30. Myanmar


Lumle
Langtang
TU, Kathmandu
Simara



Pakistan

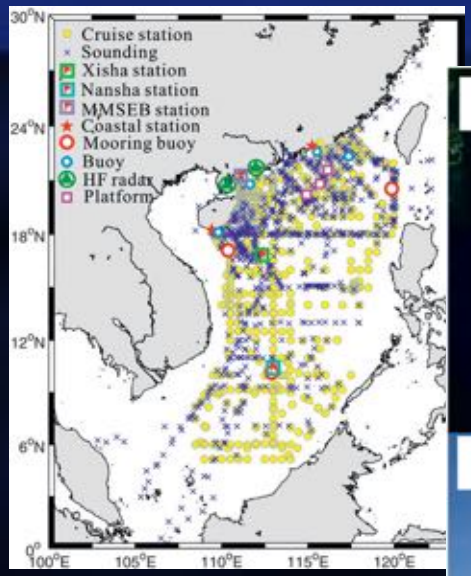
Tajikistan stations

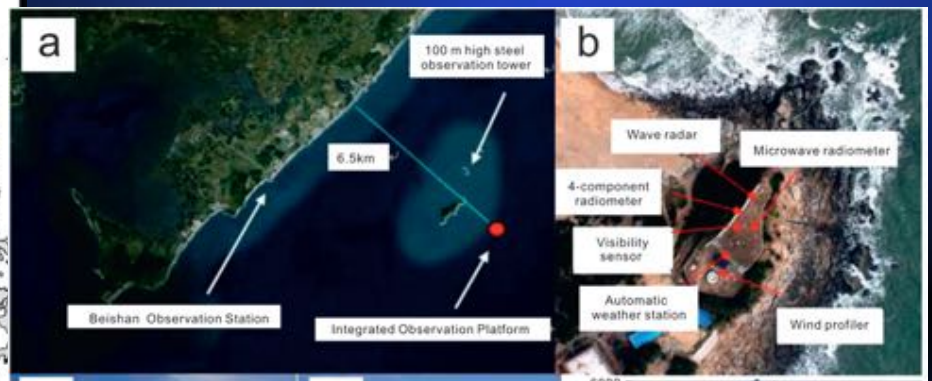


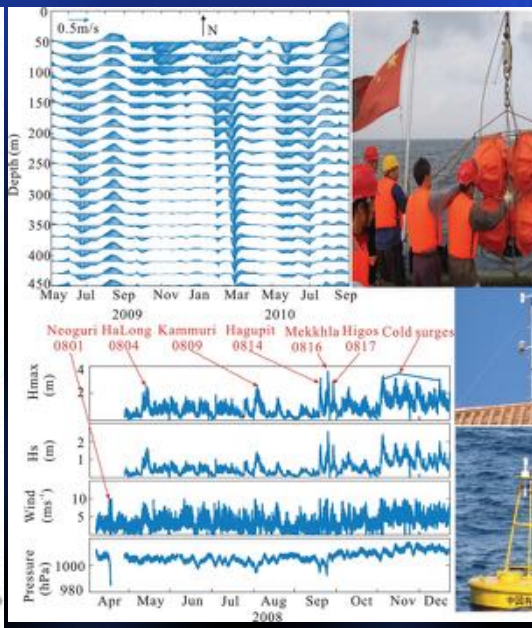
Station	Country	Lon(E)/Lat(N)	Elevation (m)	Ecosystem Type	Start year
Kalabalik	Kazakhstan	62°06’07/53°50’52	195	grassland	2012
Shchuchinsk	Kazakhstan	70°13'10/52°56‘52	400	forest	2012
Atyrau	Kazakhstan	51°56'52/47° 9'54	20	desert	2012
Kyzylorda	Kazakhstan	60°59'7/46°1‘54	55	wetland	2012
Almaty	Kazakhstan	76°13‘6/44°38‘25	500	oasis	2012
Kyzyl-Suu	Kyrgyzstan	78°12'00/42°11‘29	2540	mountain ecosystem	2012
Kondara	Kyrgyzstan	68°49′51/38°53′37″	1411	mountain ecosystem	2013
Danghara	Tajikistan	69°19'/38°05′	600	cropland	2014
Zangiota	Uzbekistan	69°07.74’/41°10.61’	370	oasis cropland	2012

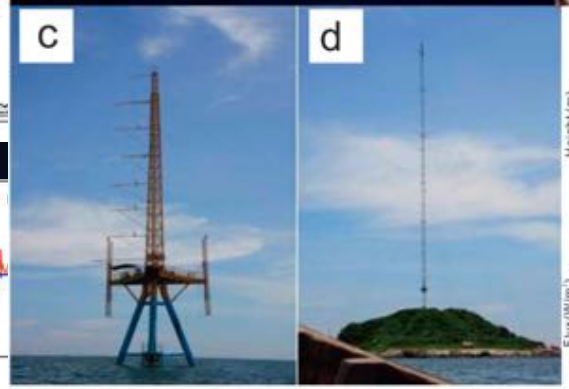


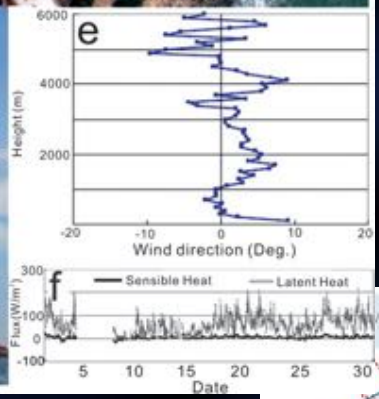
A MESOSCALE HYDROLOGICAL AND MARINE METEOROLOGICAL OBSERVATION NETWORK IN THE SCS

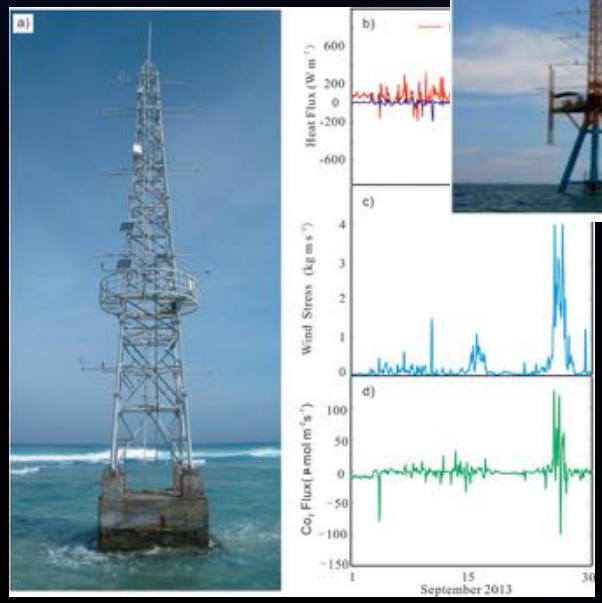


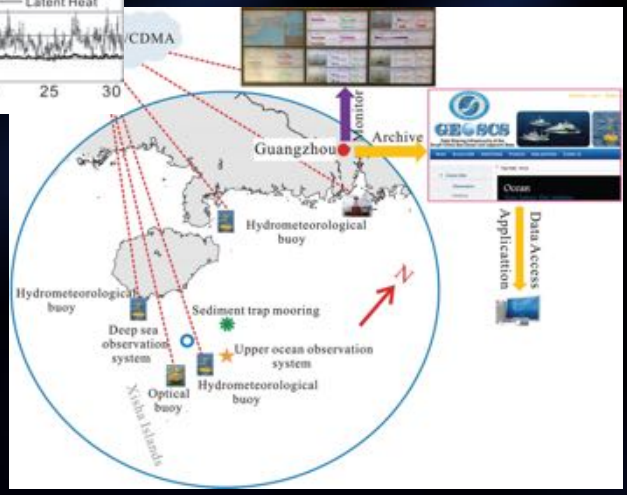










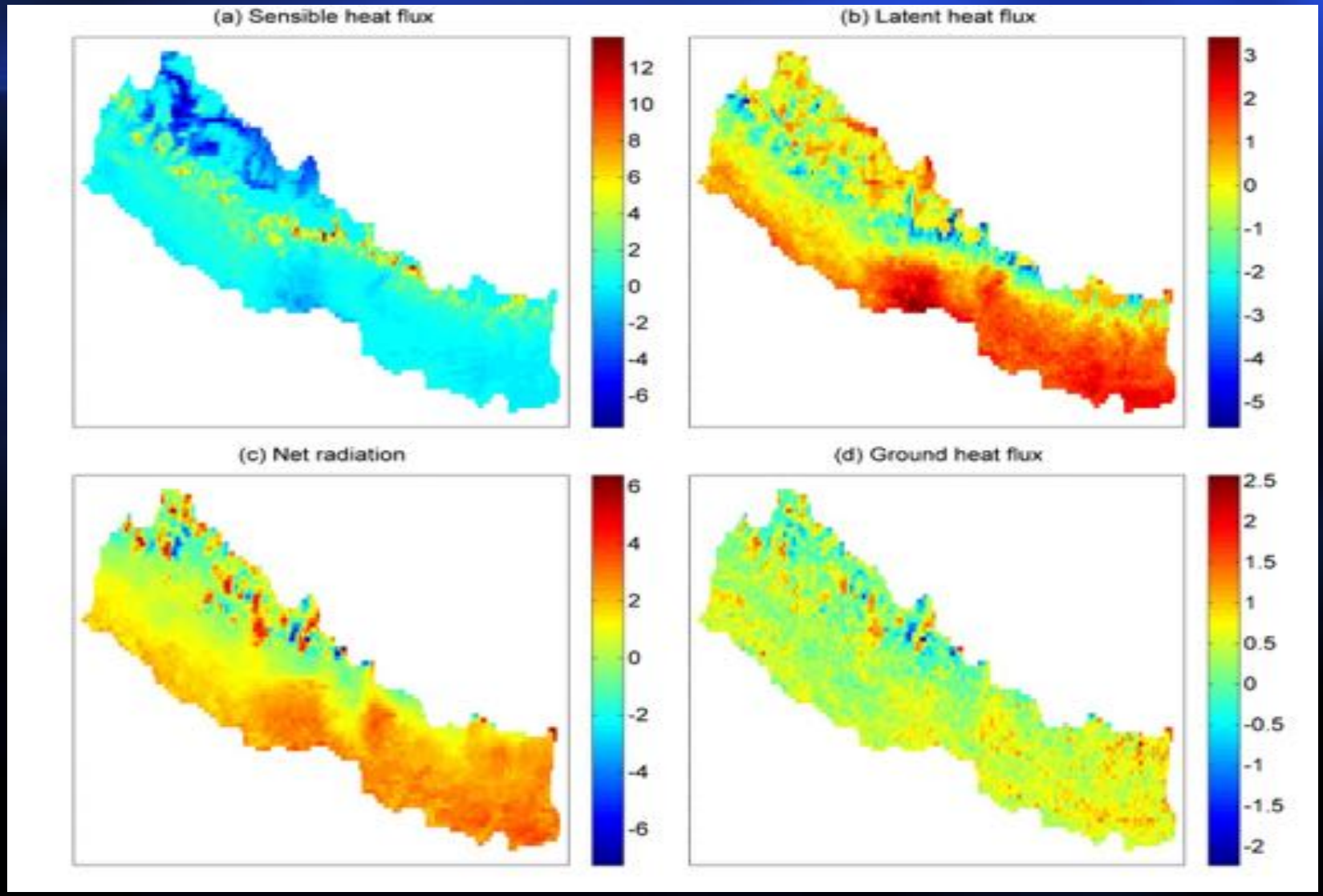



Tehran
Ashkhabad
Baghdad
Kuwait
Manama
Iran
©FWI

Organization and Cooperation

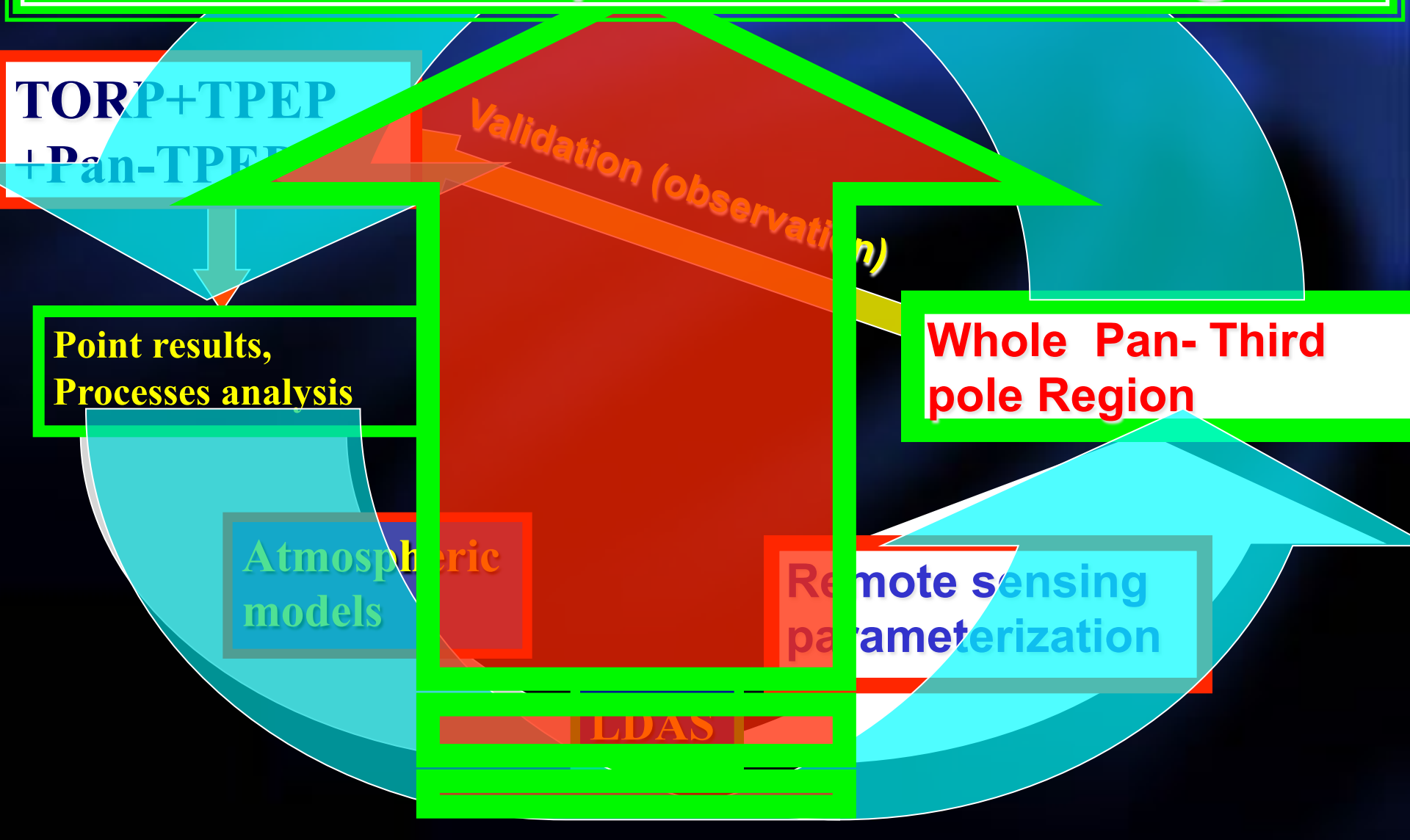
Promote the scientific research, Educational Training, Capacity Building and environmental assessment in PTP countries

The variations of land surface heat fluxes for 11 years (2003–2013)



(Pukar and Ma et al., 2015, JGR-Atmospheres)

Interactions between the monsoon and westerlies over the Pan-Third pole region and its relationship to the climate change



Thank you!

ymma@itpcas.ac.cn