ESA - MOST Dragon 2 Programme

2011 DRAGON 2 SYMPOSIUM

中国科技部-欧洲空间局合作 "龙计划"二期

"龙计划"二期2011年学术研讨会

Drought monitoring, prediction and adaptation under climatic changes

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on behalf of the Chinese Dragon Drought Team

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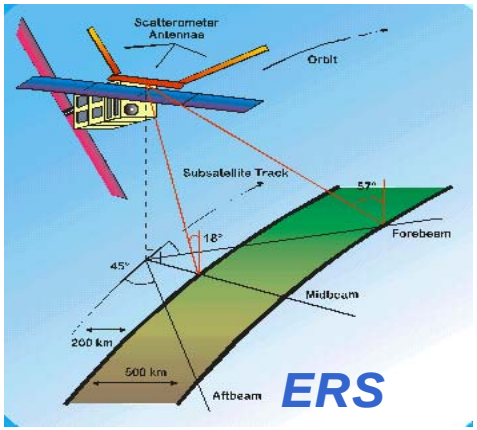
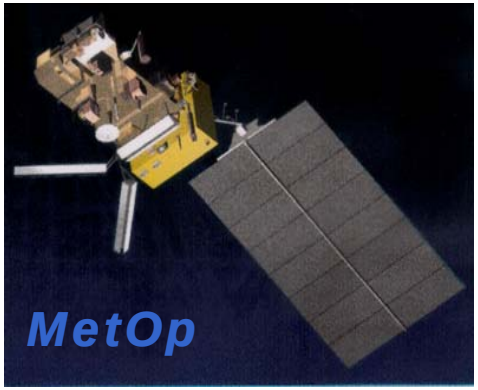
Outline

- EO data acquisition and ground data collection campaigns
- Progresses – soil moisture, surface fluxes, and DSI retrievals
- The role of young scientists
- Publications
- Plans for 2011-2012

Microwave remote sensing of soil moisture



Chinese TPM Satellites



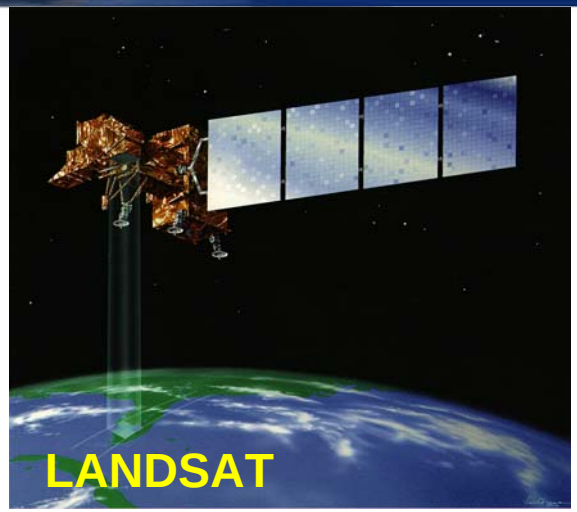
SMOS

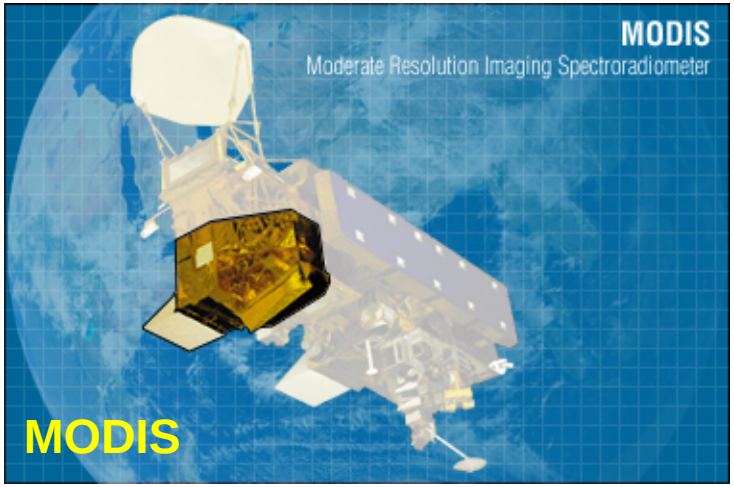
GOCE

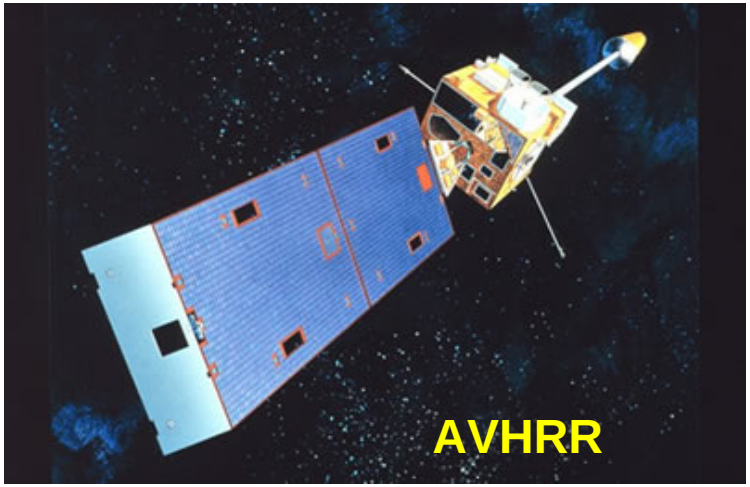

NASCC
esa


ASTER


SPOT


LANDSAT


MODIS
Moderate Resolution Imaging Spectroradiometer
MODIS


AVHRR

Ground Data Collection Sites

- 9 field experiment sites for the development and validation of algorithms.
  - 4 sites in Europe (Barrax in Spain, Cabauw, Speulderbos and Lattrop sites in the Netherlands)
  - 5 sites in China (TORP/CAMP/Tibet site, The Heihe Oasis-Desert Site, CAS Luancheng agro-ecological Observation Station (Hebei), CAS Xiaotangshan & Shunyi field experiment sites in Beijing, Maqu & the Yellow River Headwater Site, Ngari).
- 700 application demonstration sites with routine meteorological observations made by the China National Meteorological Center.

The Role of the Tibetan Plateau in Global Climate

(Chinese Academy of Sciences)

ESA Dragon programme
EU FP7 CEOP-AEGIS

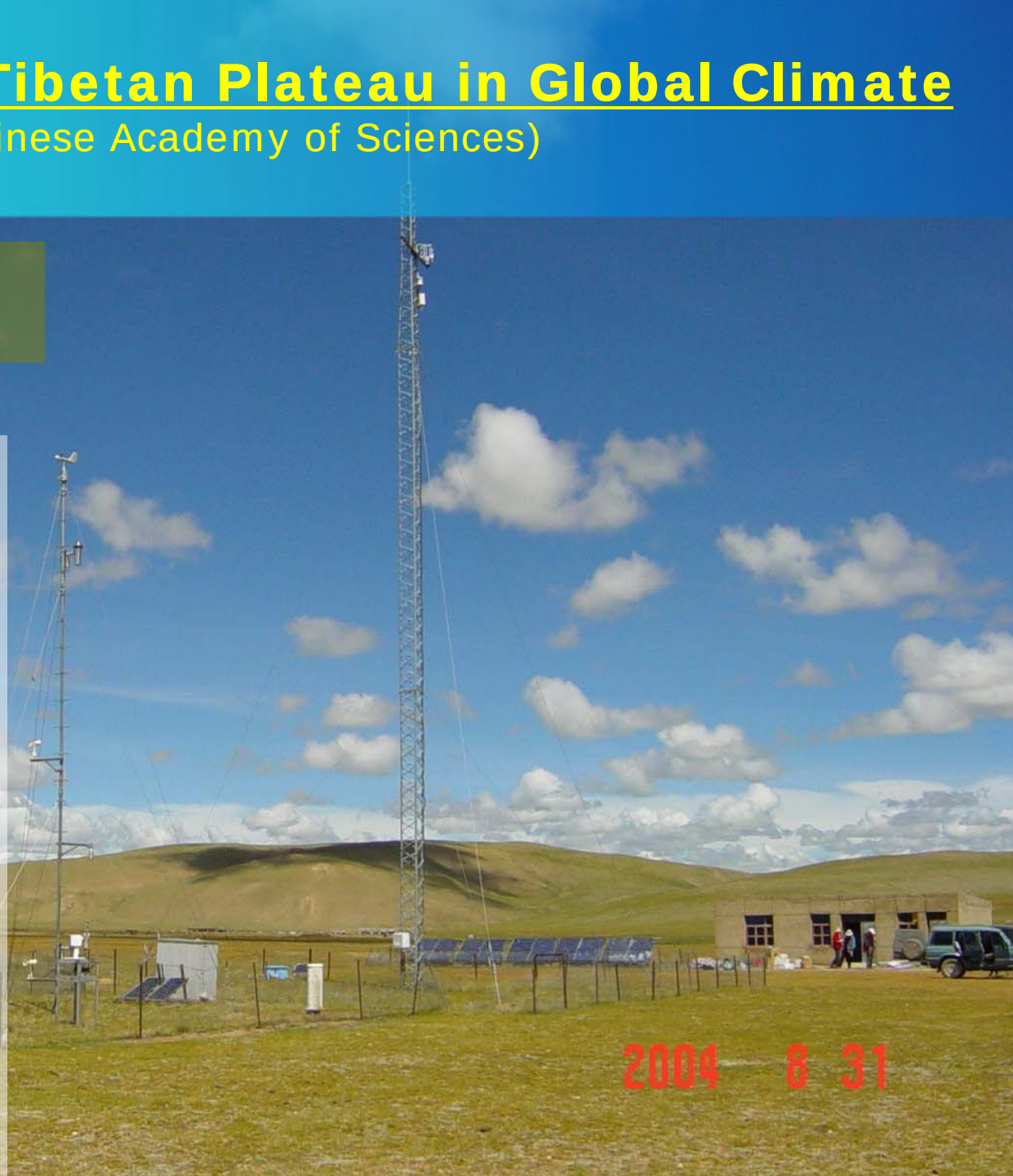
GEWEX Asian Monsoon Experiment (GAME) in the Tibet Plateau (GAME/Tibet,1996-2000)

CEOP (Coordinated Enhanced Observing Period) Asia-Australia Monsoon Project in the Tibetan Plateau (CAMP/Tibet, 2001-2010)

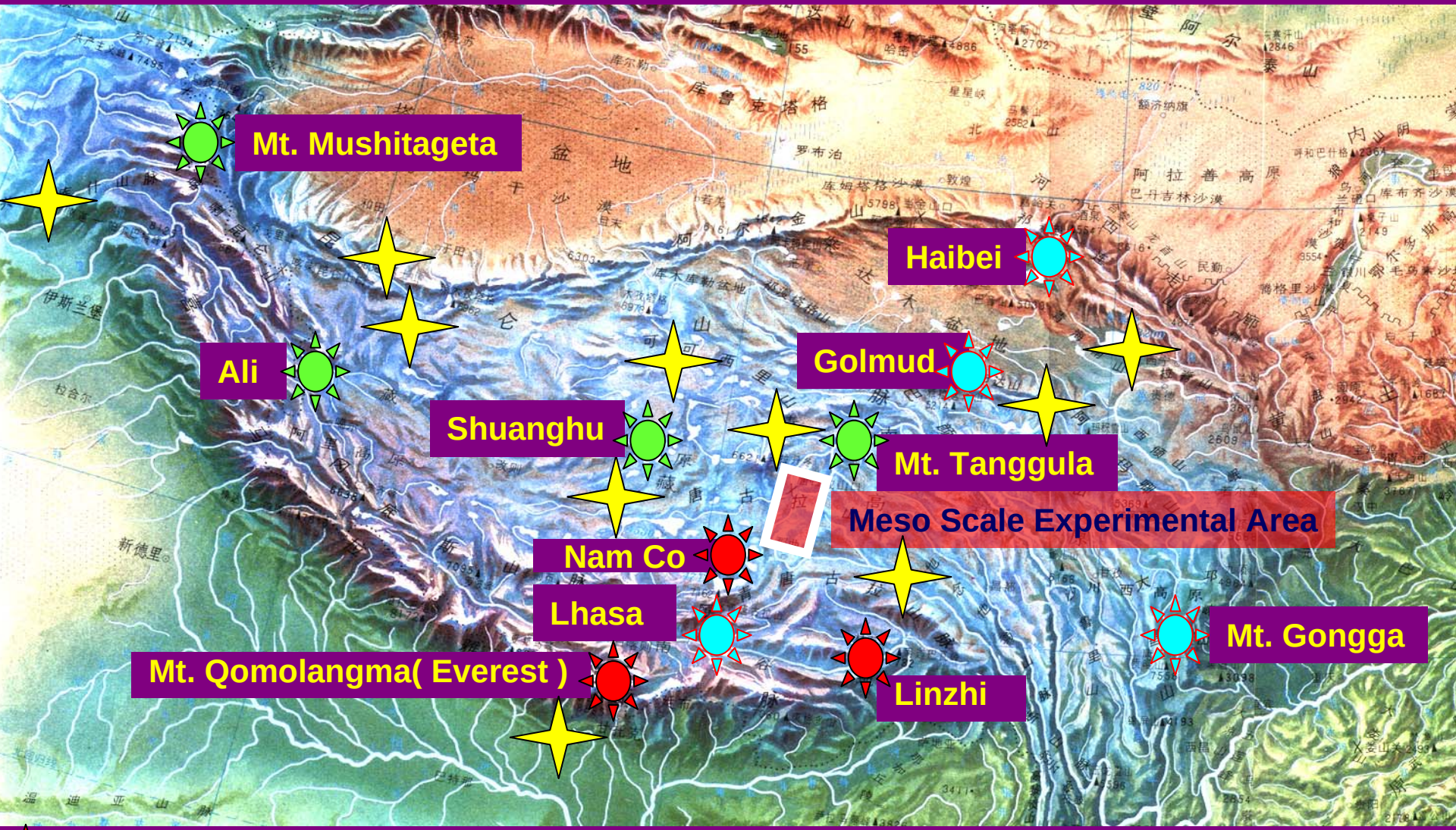
Tibetan Observation and Research Platform (TORP, 2005 -2010)

Third Pole Environment (2009 -2019)

Coordinators: Y.Ma & T.Yao (China)



Chinese Academy of Sciences (CAS) is now implementing 11 comprehensive observation and study stations and 10 observational sites



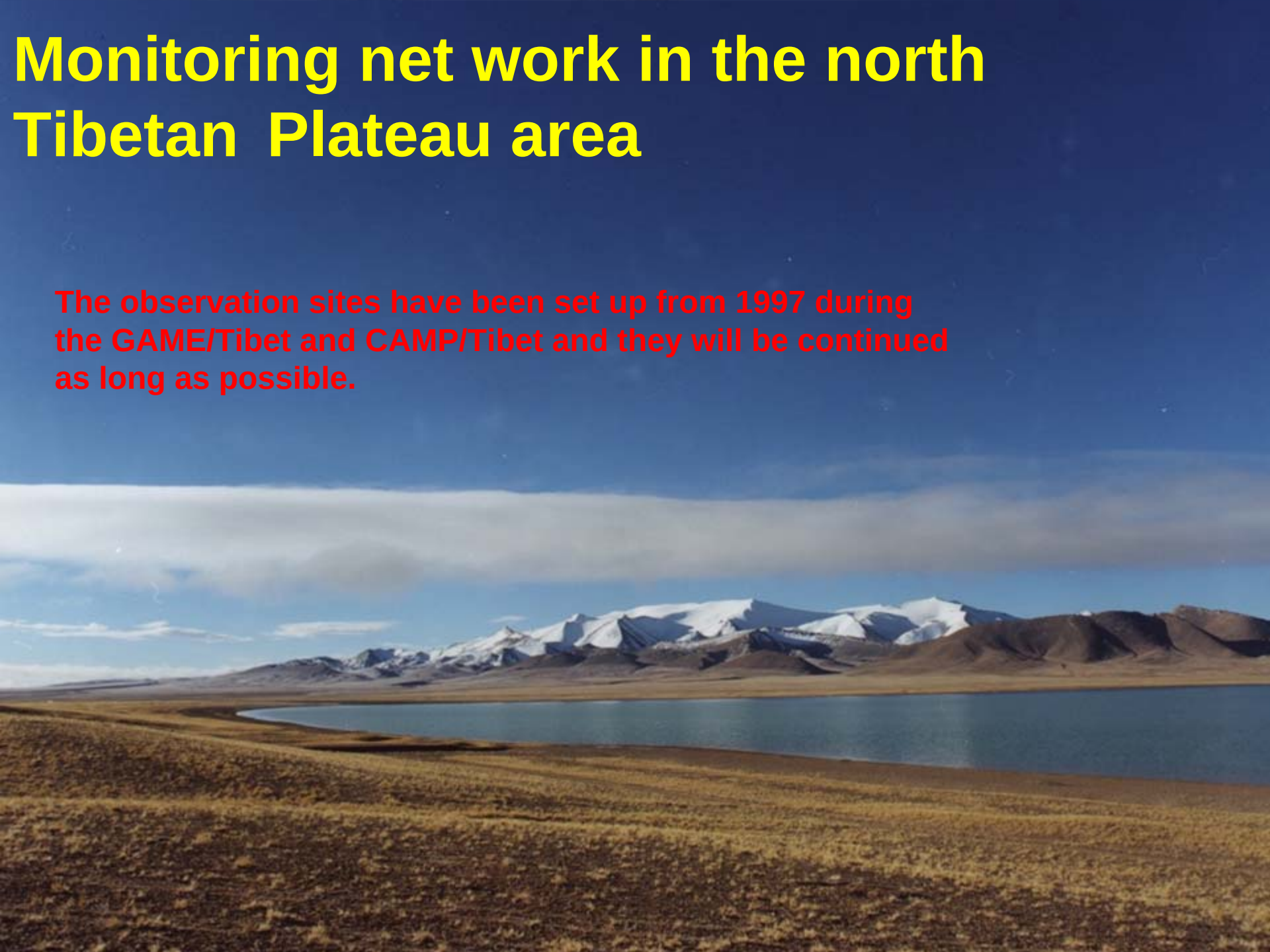
Constructed stations, ITP,CAS

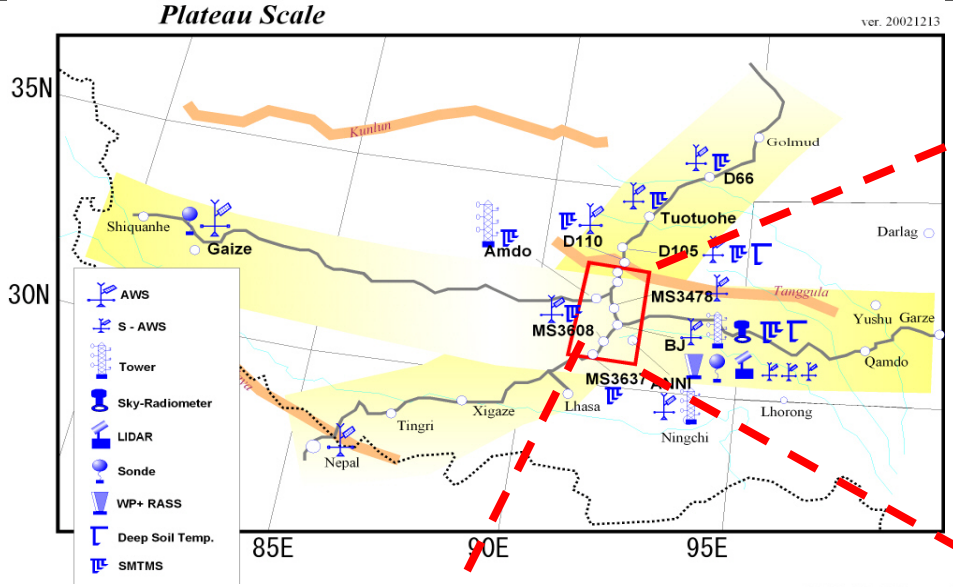
Constructed stations, another institute, CAS

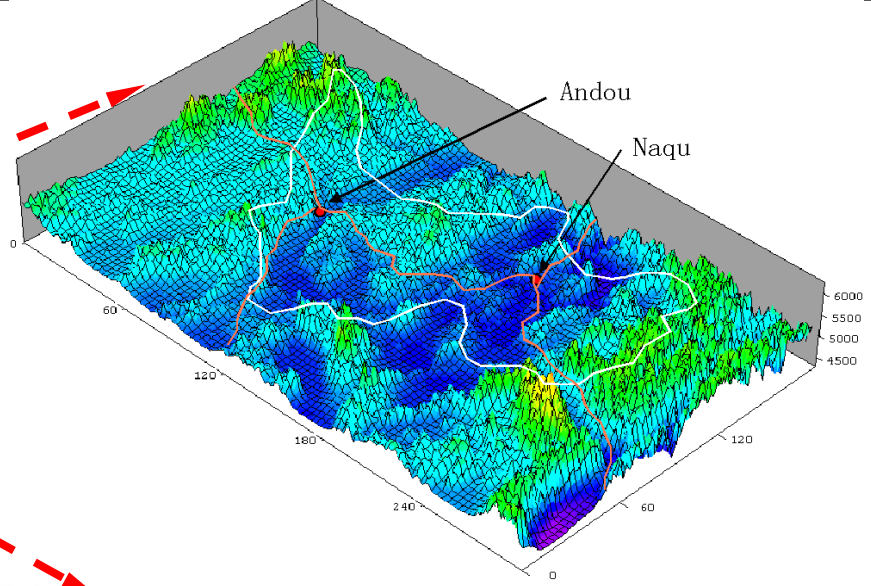
Planning stations, ITP,CAS

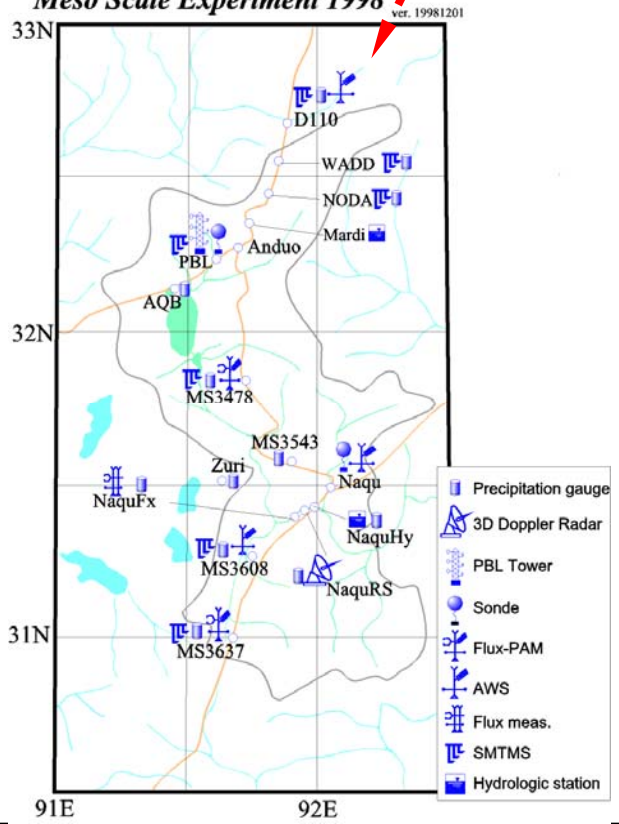
Monitoring net work in the north Tibetan Plateau area

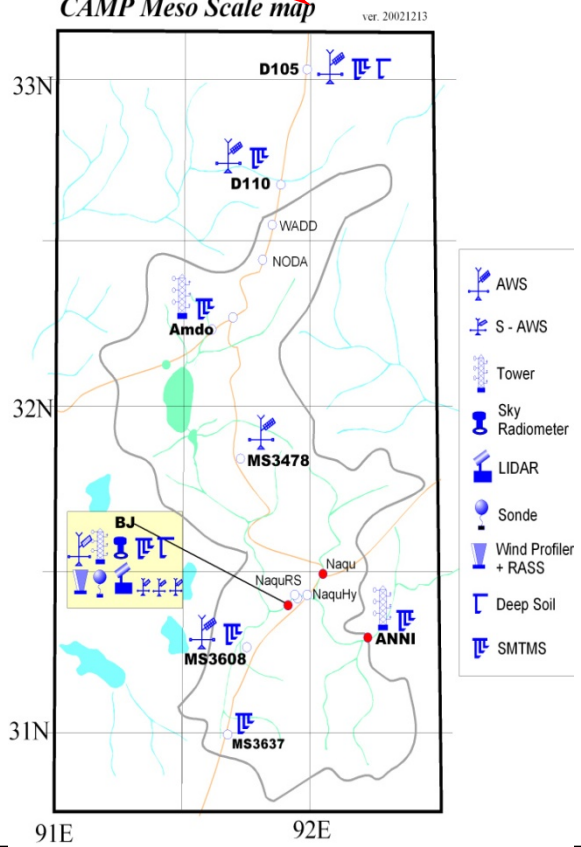
The observation sites have been set up from 1997 during the GAME/Tibet and CAMP/Tibet and they will be continued as long as possible.



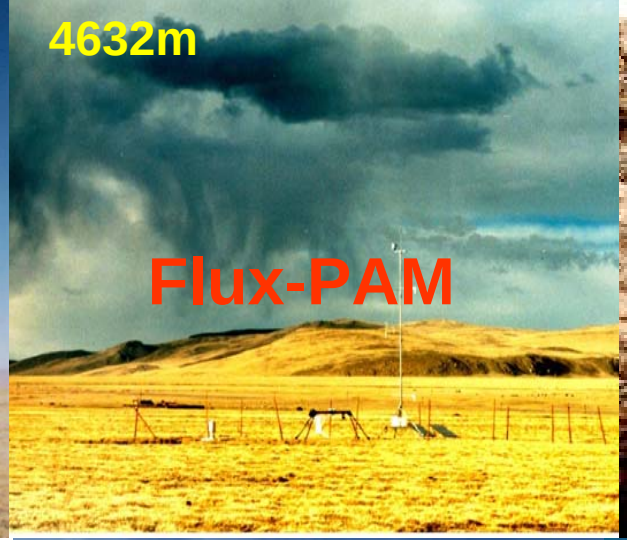

Plateau Scale
ver. 20021213
35N
30N
85E
90E
95E
Kunlun
Tanggula
Golmud
D66
Tuotuohe
D105
D110
Amdo
Shiquanhe
Gaize
Darlag
MS3478
MS3608
BJ
MS3637
ANNI
Yushu
Garze
Qamdo
Lhasa
Xigaze
Tingri
Nepal
Lhorong
Ningchi
AWS
S - AWS
Tower
Sky-Radiometer
LIDAR
Sonde
WP+ RASS
Deep Soil Temp.
SMTMS


Andou
Naqu
0
60
120
180
240
0
60
120
6000
5500
5000
4500


Meso Scale Experiment 1998
ver. 19981201
33N
32N
31N
91E
92E
D110
WADD
NODA
Mardi
Anduo
PBL
AQB
MS3478
MS3543
Zuri
Naqu
NaquFx
NaquHy
MS3608
NaquRS
MS3637
Precipitation gauge
3D Doppler Radar
PBL Tower
Sonde
Flux-PAM
AWS
Flux meas.
SMTMS
Hydrologic station


CAMP Meso Scale map
ver. 20021213
33N
32N
31N
91E
92E
D105
D110
WADD
NODA
Amdo
MS3478
BJ
NaquRS
Naqu
NaquHy
ANNI
MS3608
MS3637
AWS
S - AWS
Tower
Sky Radiometer
LIDAR
Sonde
Wind Profiler + RASS
Deep Soil
SMTMS

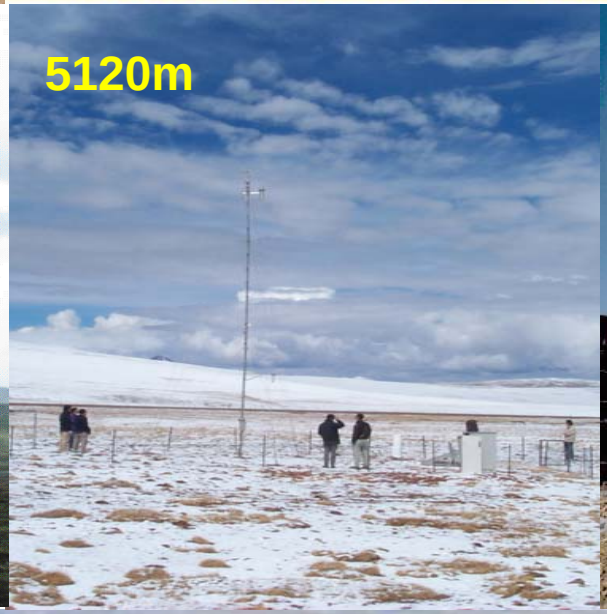

4716m
ABL tower


4632m
Flux-PAM


4688m
SMTMS

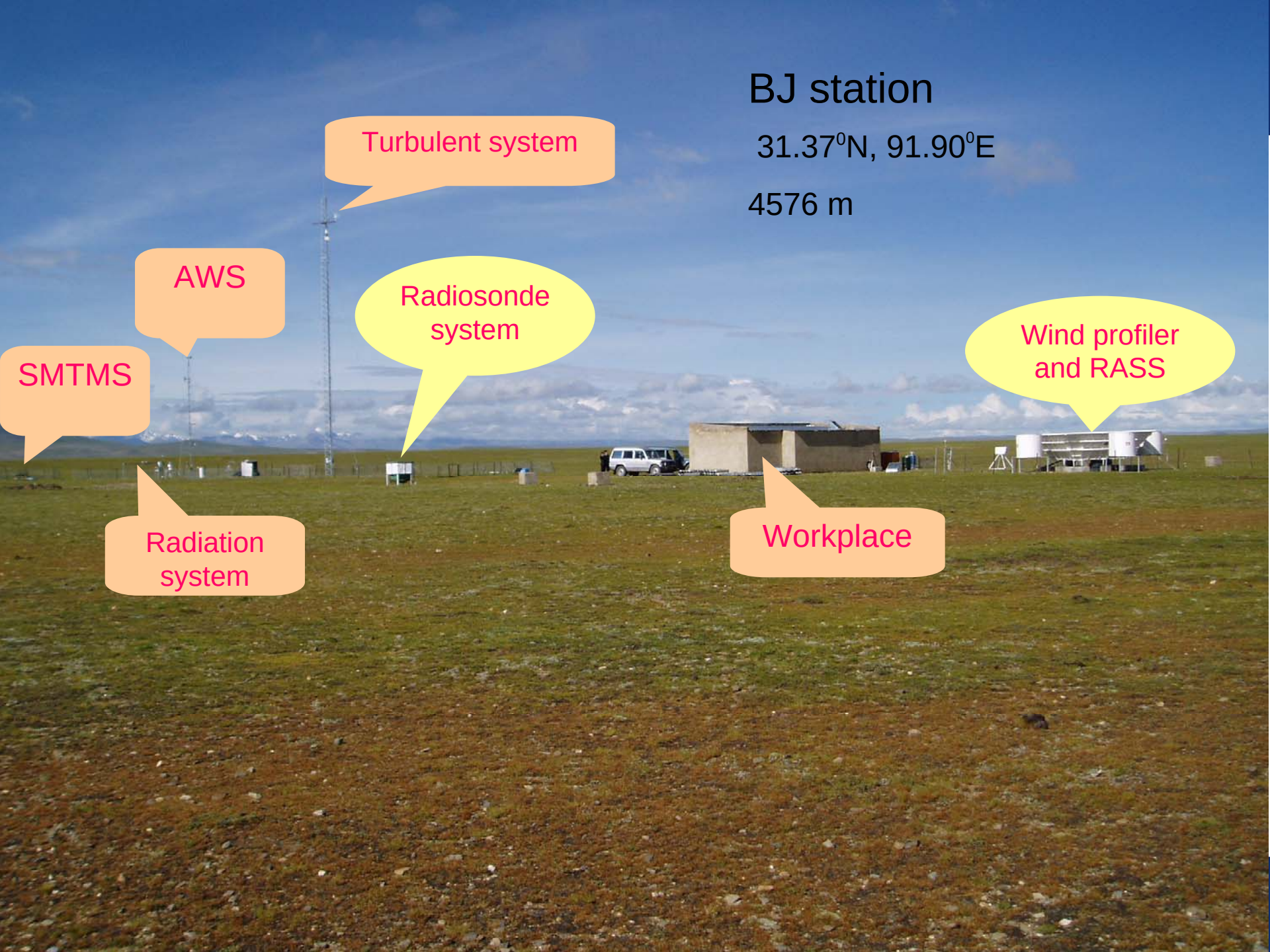

4678m
Rain Gauge


5012m
AWS


5120m


4647m
3-D Doppler radar
NASDA
NASDA

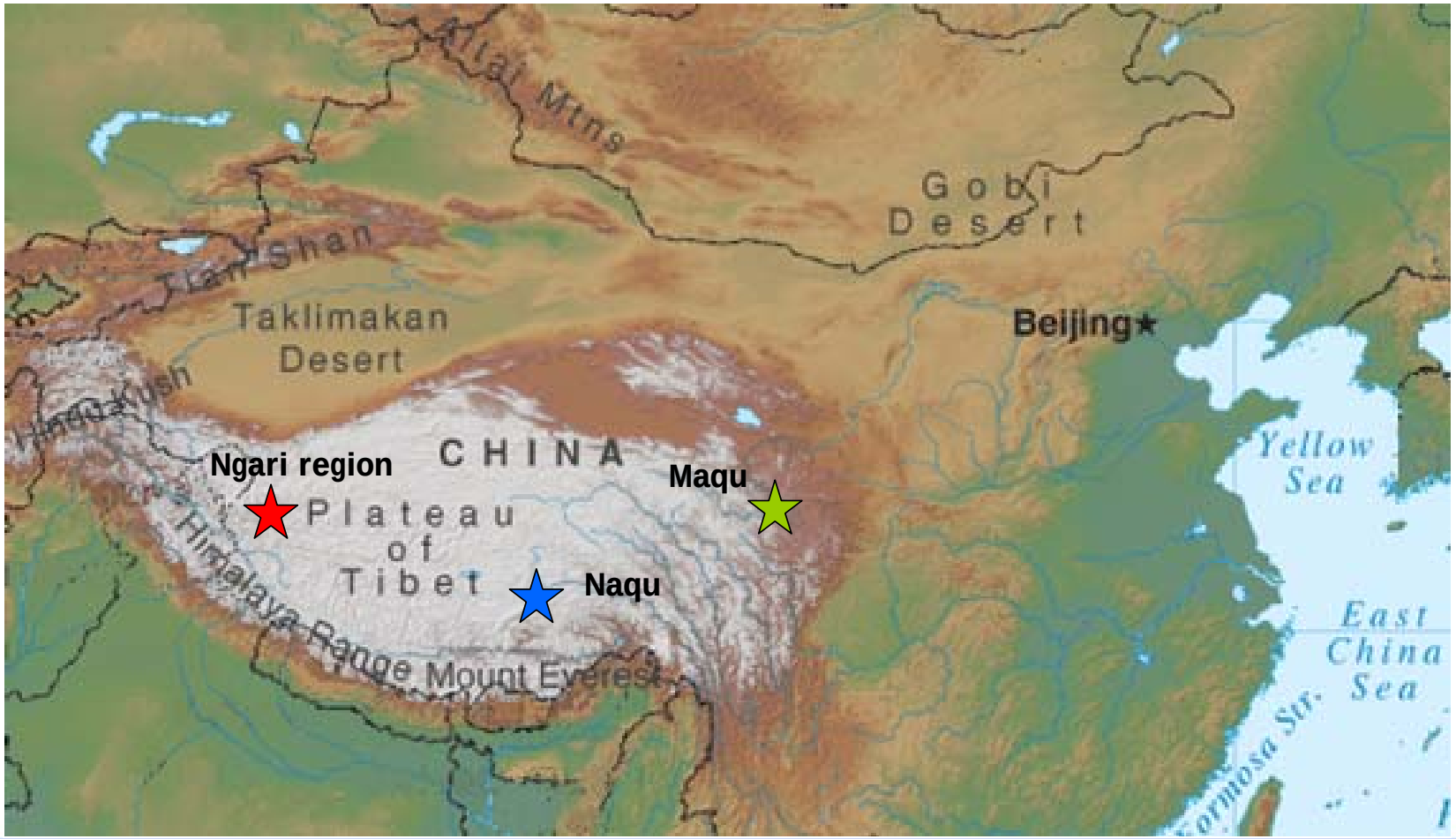

Naqu BJ Basic station (4576m)


BJ station
31.37^{0}N, 91.90^{0}E
4576 m
Turbulent system
AWS
SMTMS
Radiosonde system
Wind profiler and RASS
Radiation system
Workplace

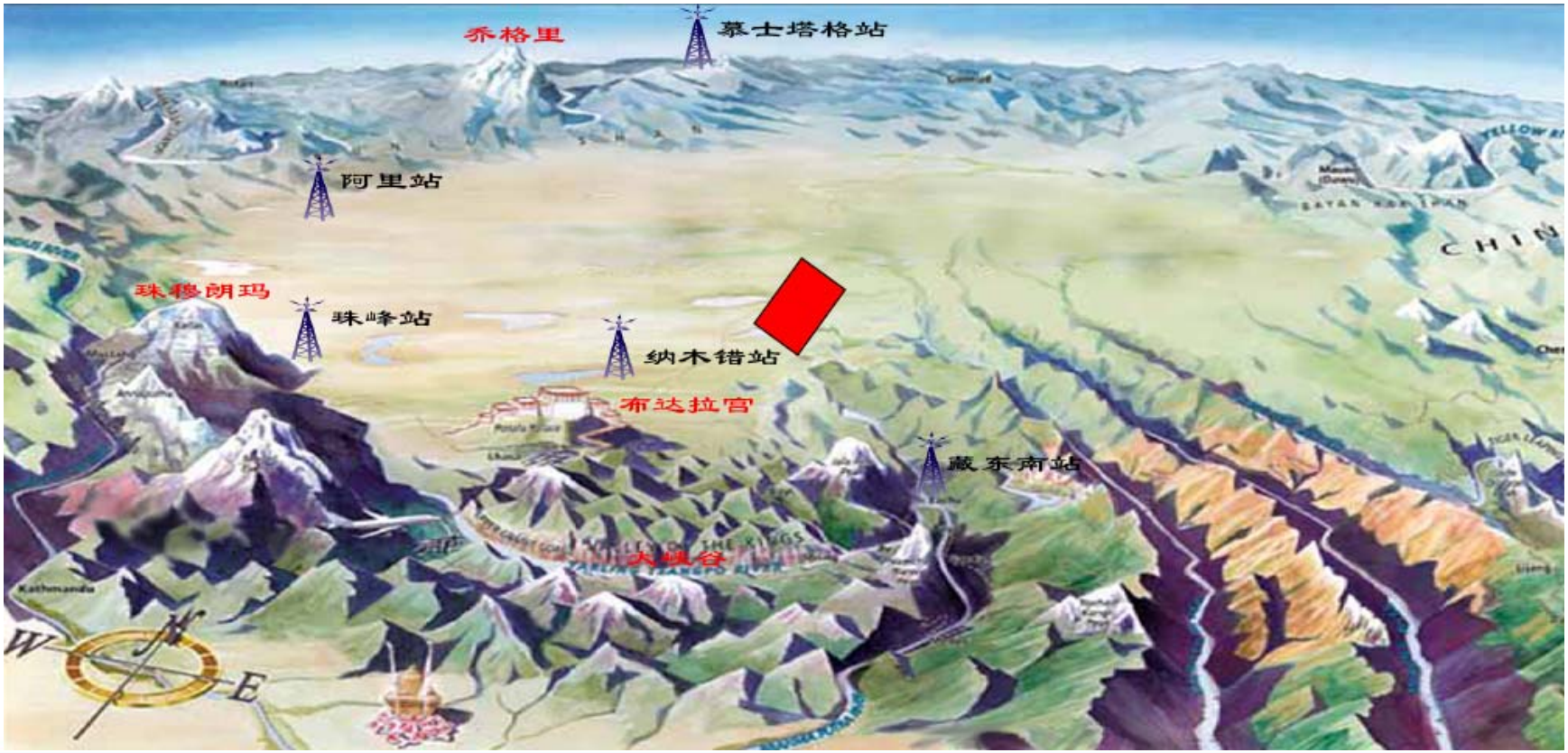
Naqu Station

Maqu Station

ITC/CAS Soil Moisture Networks



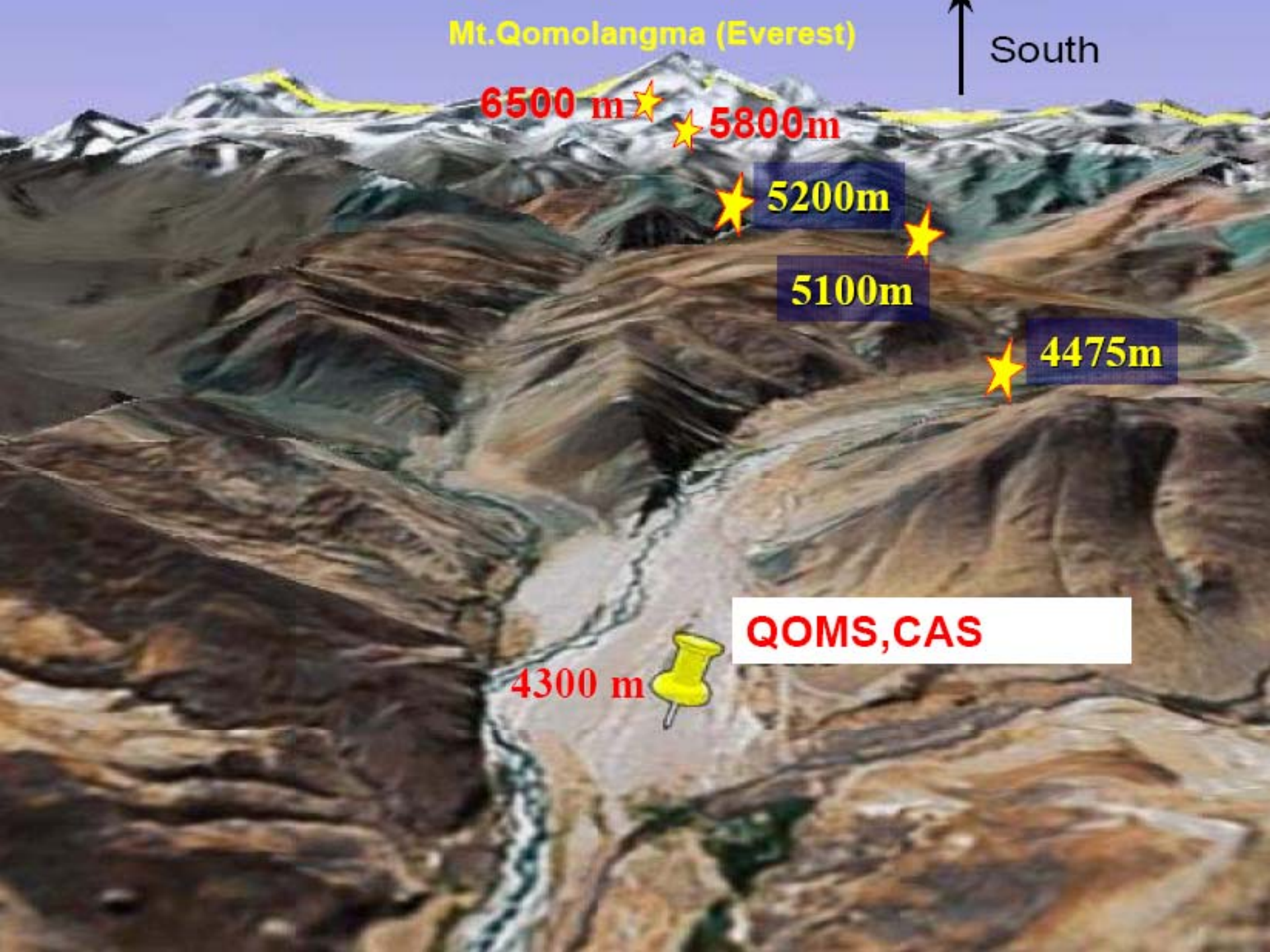
TORP(Tibetan Observation and Research Platform)



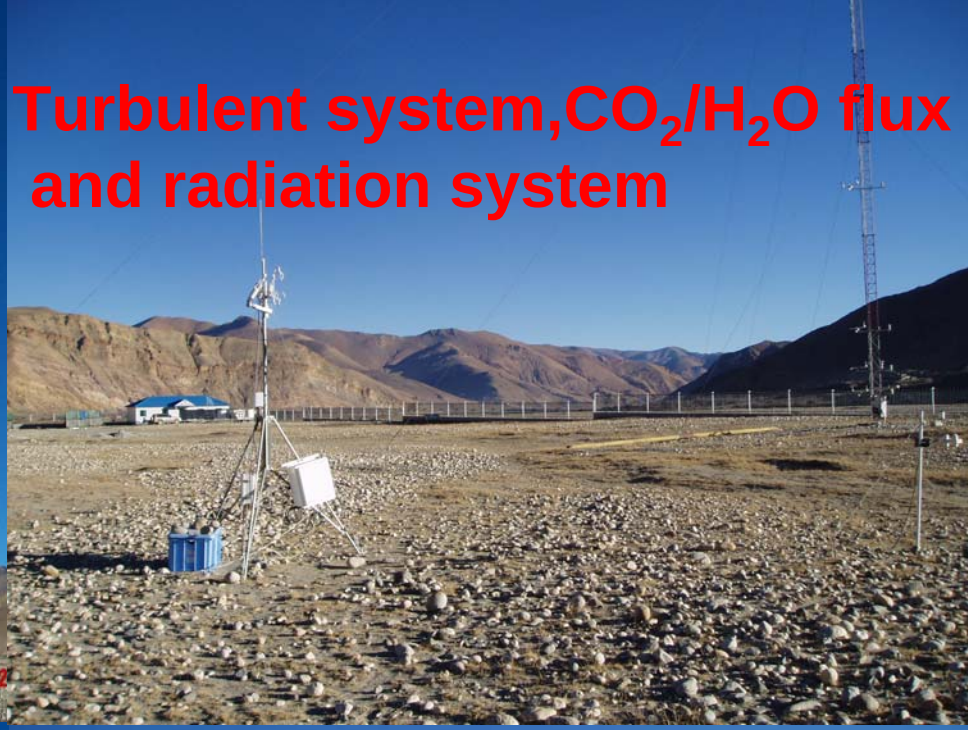
Atmospheric and Environmental Comprehensive Observation and Research Station on Mt.Qomolangma (AECORSQ), Chinese Academy of Sciences

珠穆朗玛峰大气与环境综合观测研究站

Constructed date:
End of August, 2005


Mt.Qomolangma (Everest)
South
6500 m
5800m
5200m
5100m
4475m
QOMS,CAS
4300 m

Mt. Everest station




6500 m


5200 m

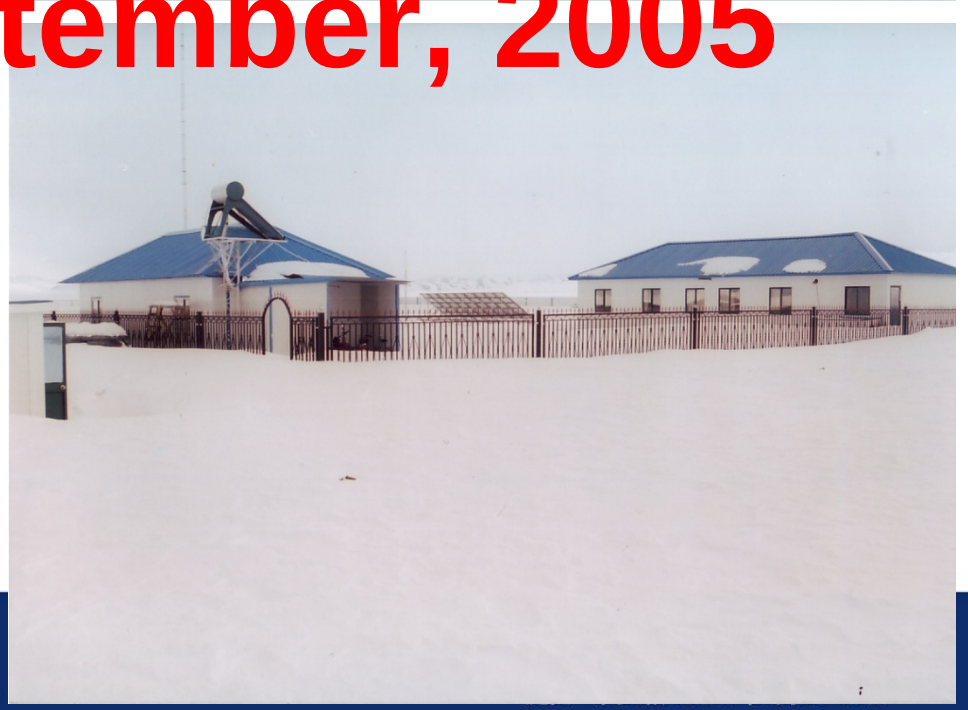

4475 m


Radio sonde system
5200 m

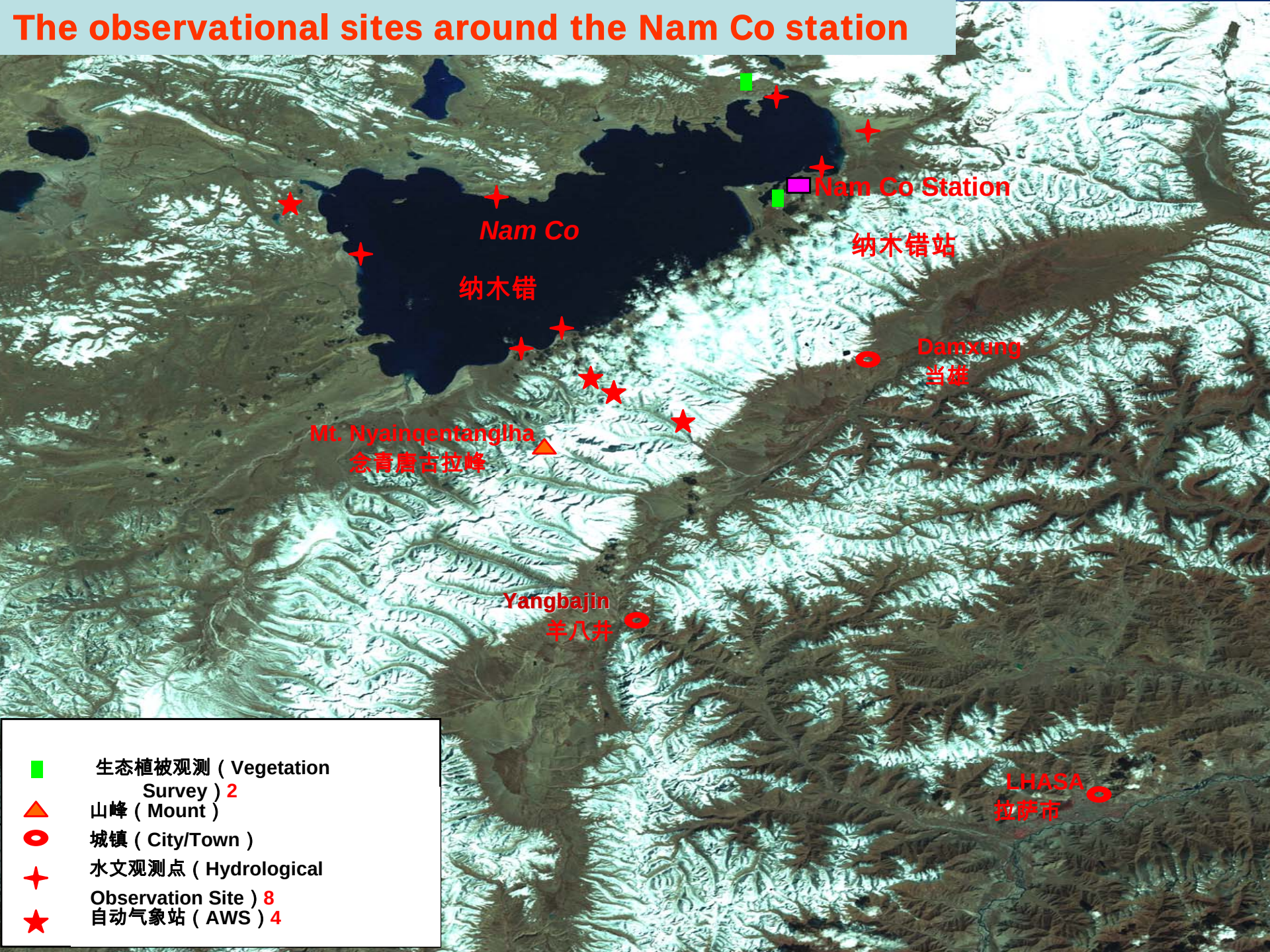
2.纳木错多圈层综合观测研究站
Nam Co Station

Constructed date:

End of September, 2005

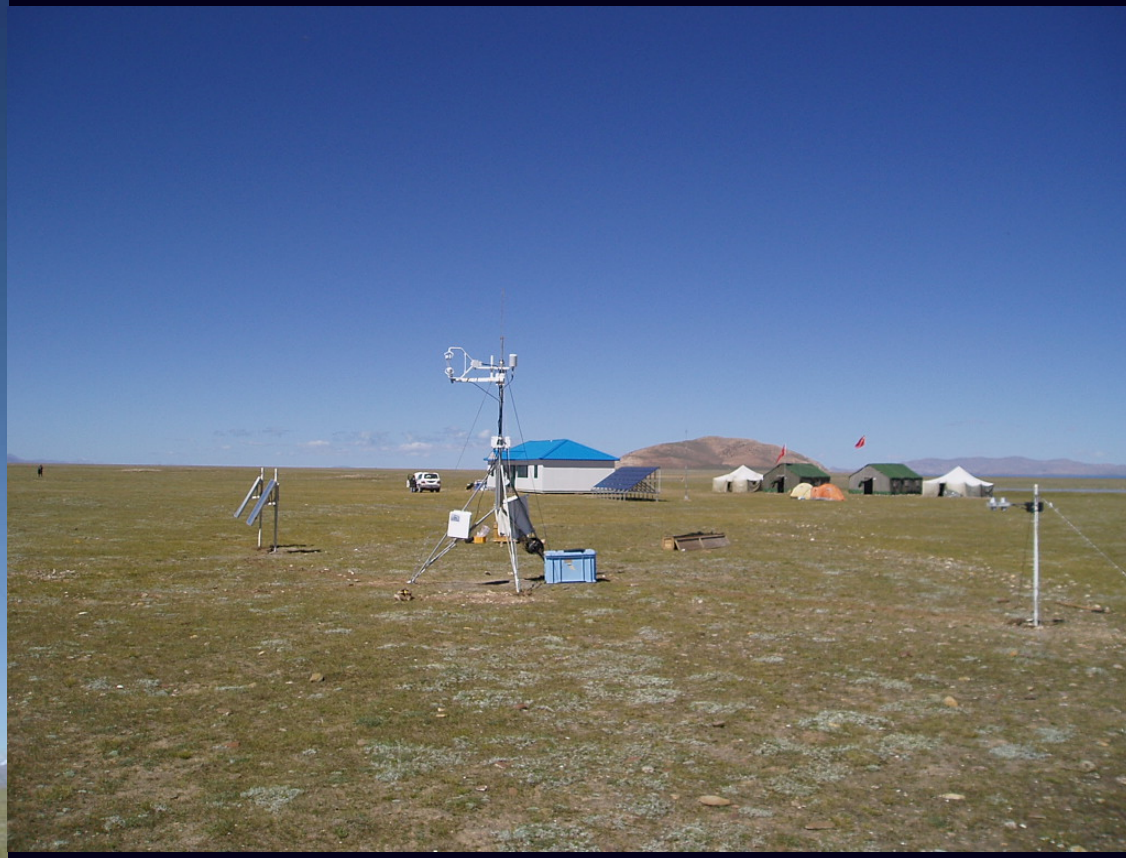


The observational sites around the Nam Co station



Nam Co station

52m PBL tower
(Radiation system and SMTMS)



Turbulent system,
CO_2/H_2O flux and radiation system

Lake observation


Evaporation Observation

3.藏东南高山环境综合观测研究站
Linzhi Station

Constructed date:

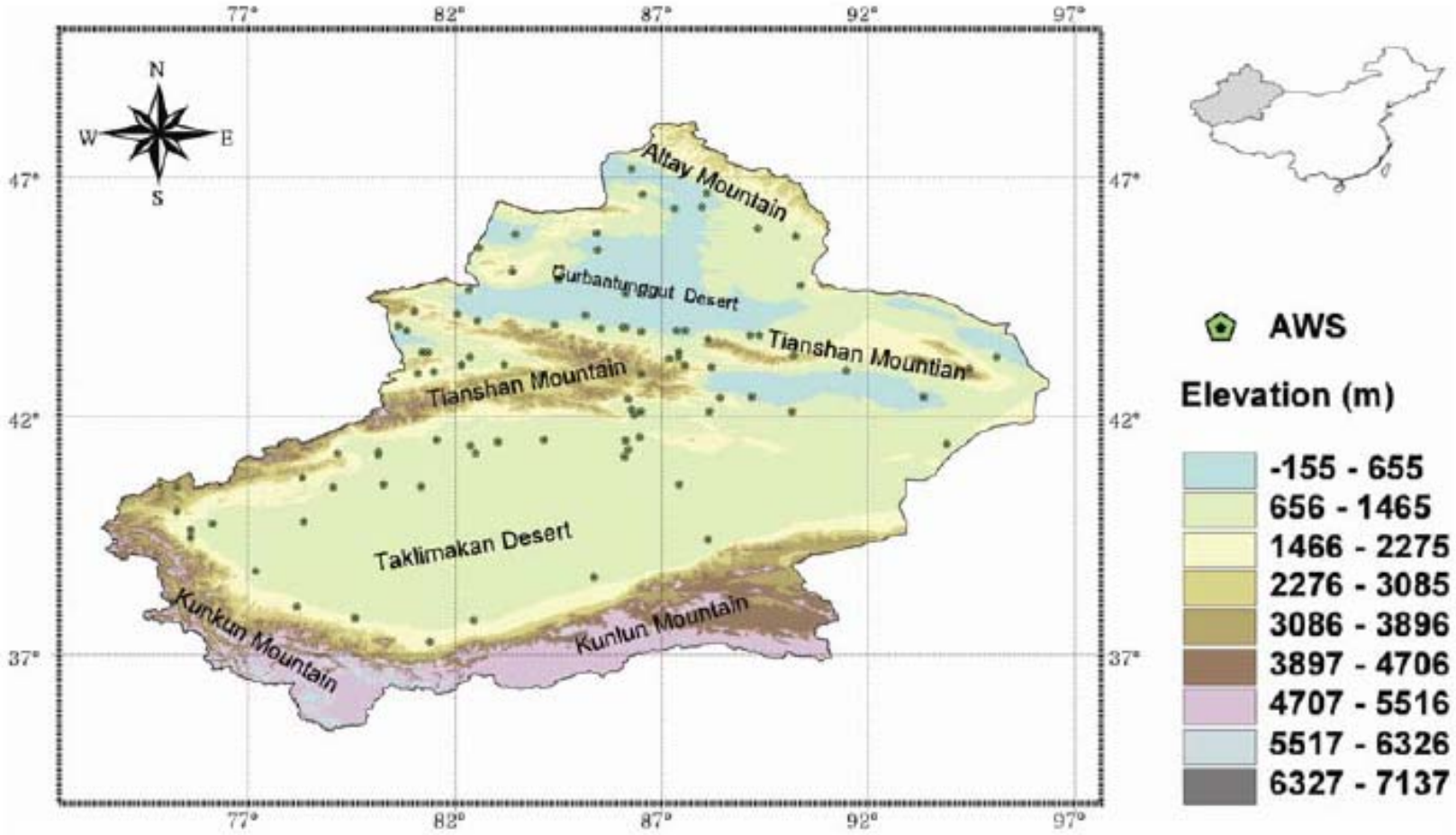
Beginning of November, 2006

20m PBL tower
(SMTMS)

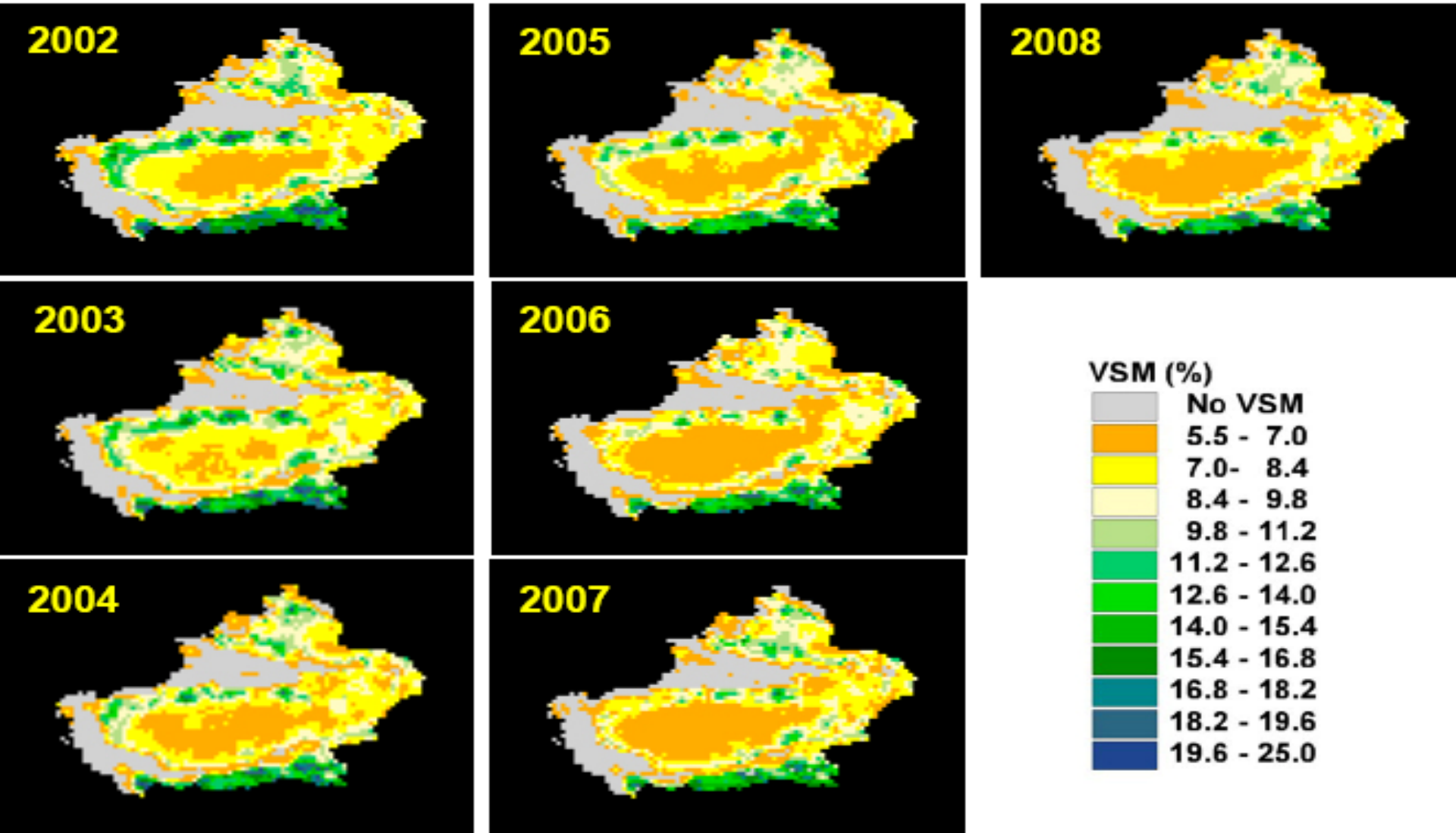
Turbulent system &
CO2/H2O flux

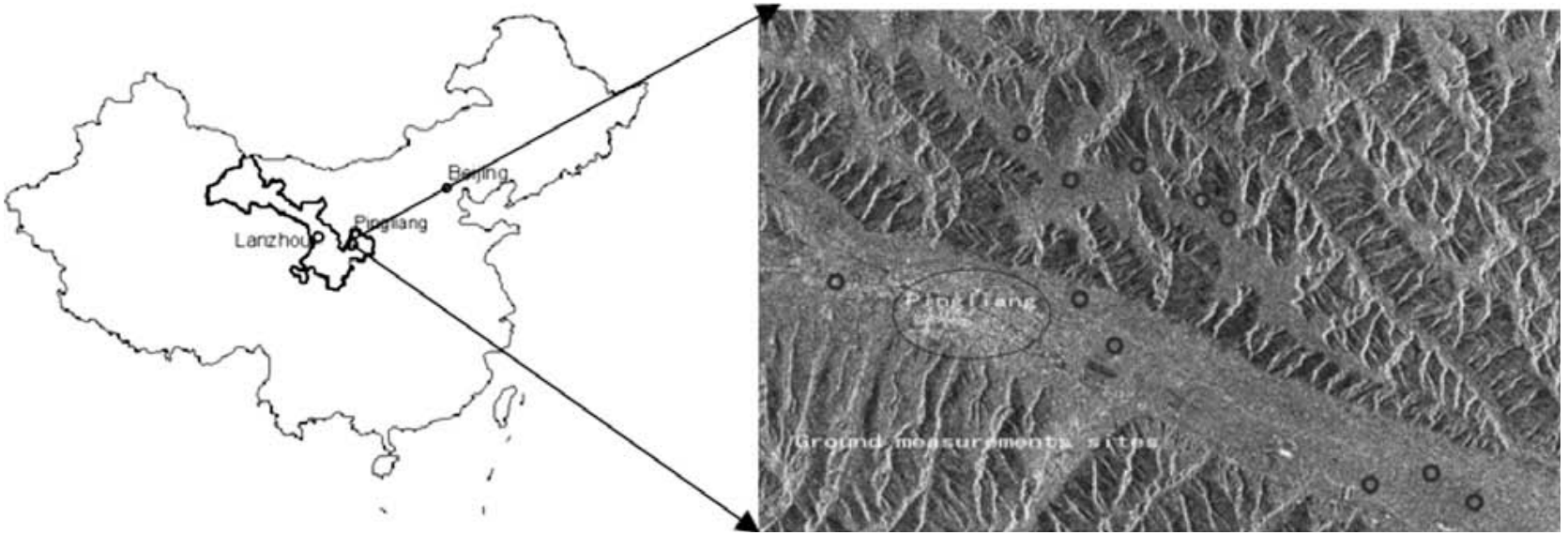
Radiation system

Progresses – soil moisture, surface fluxes, DSI (Drought Severity Index)


77°
82°
87°
92°
97°
47°
42°
37°
N
W
E
S
Altay Mountain
Gurbantunggut Desert
Tianshan Mountian
Tianshan Mountain
Taklimakan Desert
Kunkun Mountain
Kunlun Mountain
AWS
Elevation (m)
-155 - 655
656 - 1465
1466 - 2275
2276 - 3085
3086 - 3896
3897 - 4706
4707 - 5516
5517 - 6326
6327 - 7137

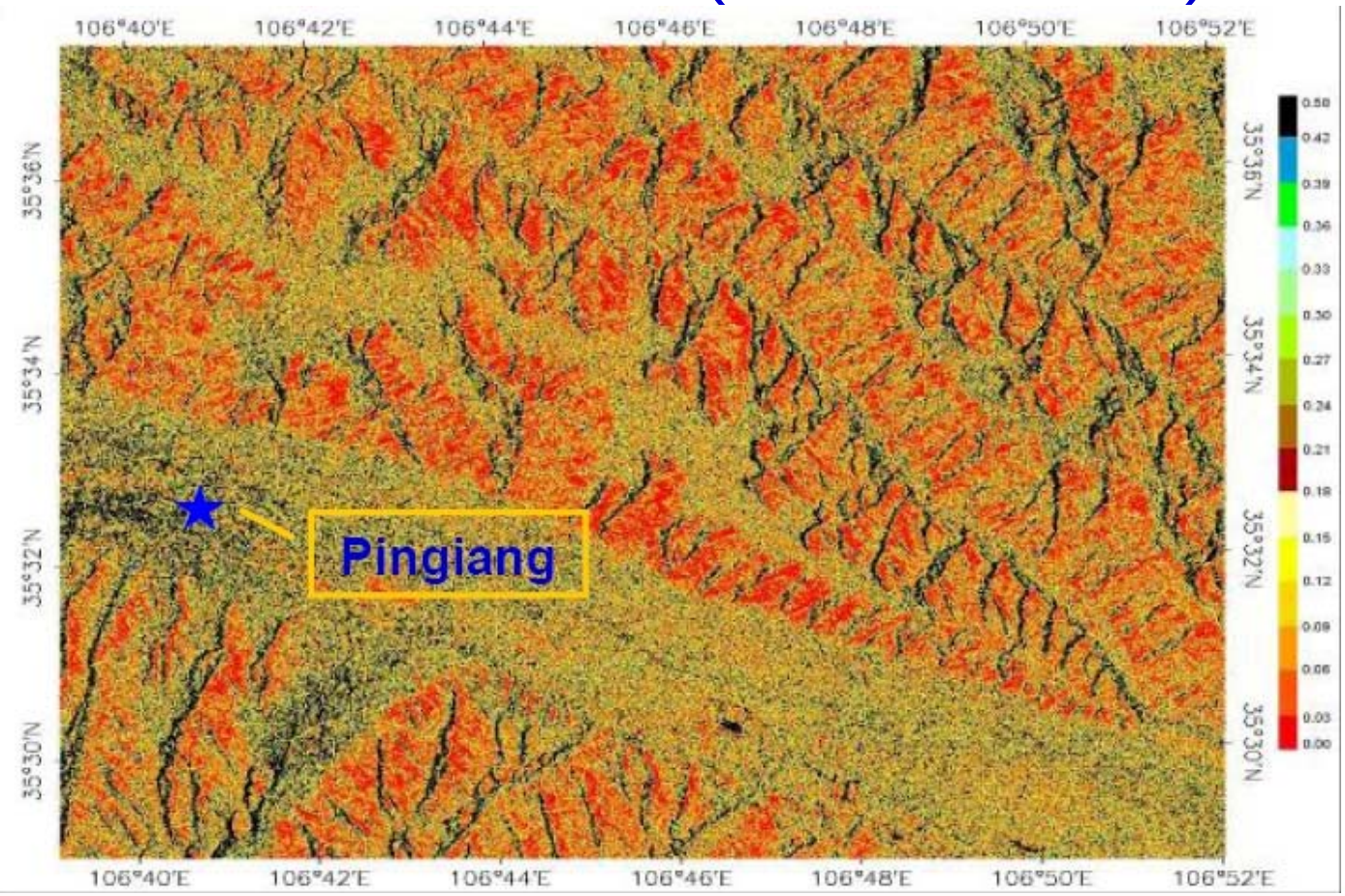
Soil moisture over Xinjiang area





Geographic location (left), ENVISAT/ASAR image (right) and sample sites (circle) of the LOPEX05 study area (Zhang et al 2009)

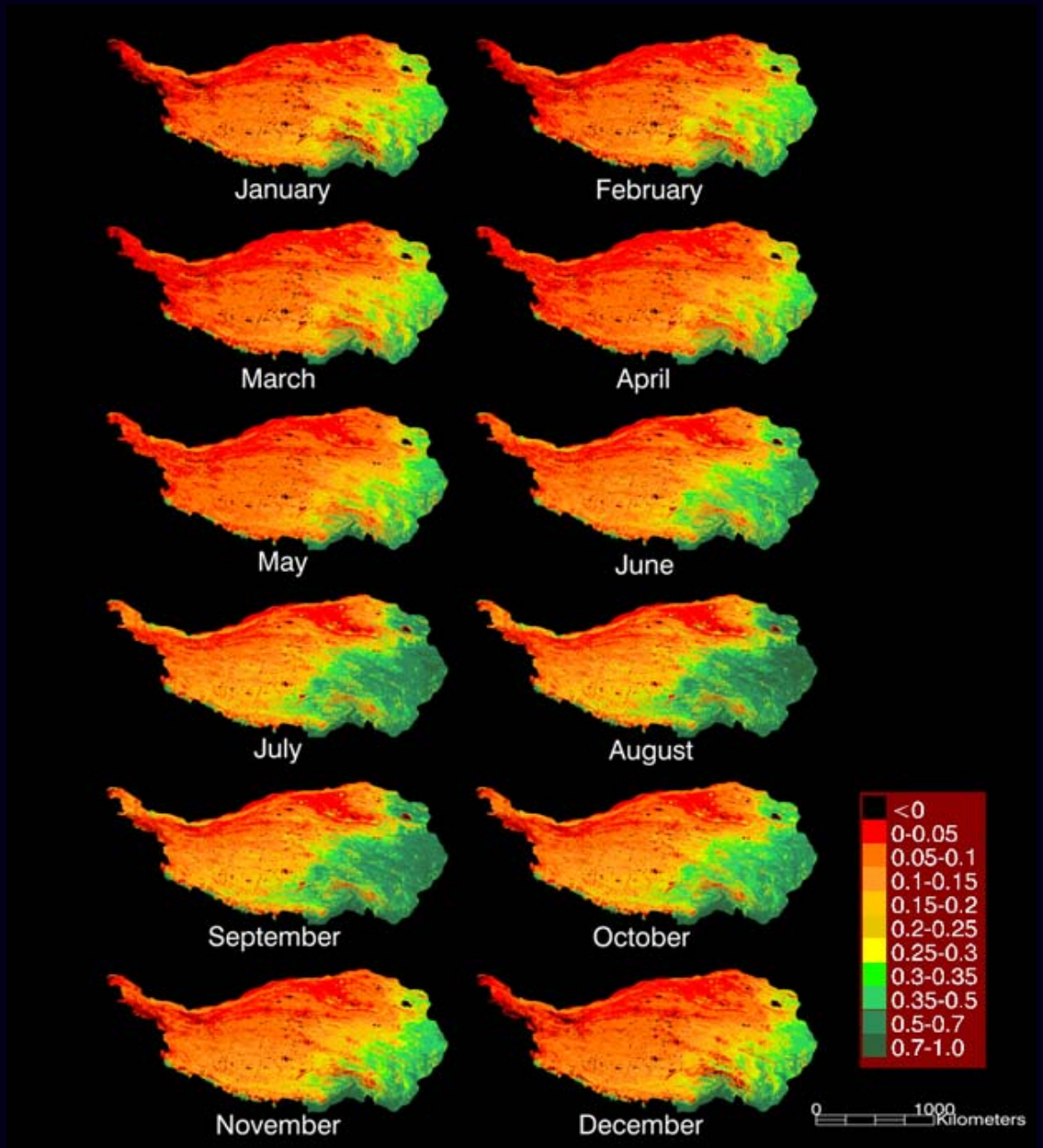
The regional soil moisture distribution in the study area(Loess Plateau)



The validated results indicate that an average difference between the soil moistures estimated from the microwave remote sensing and ground measurements is less than 0.02 cm3/cm3, with a RMS error of 2.0%.

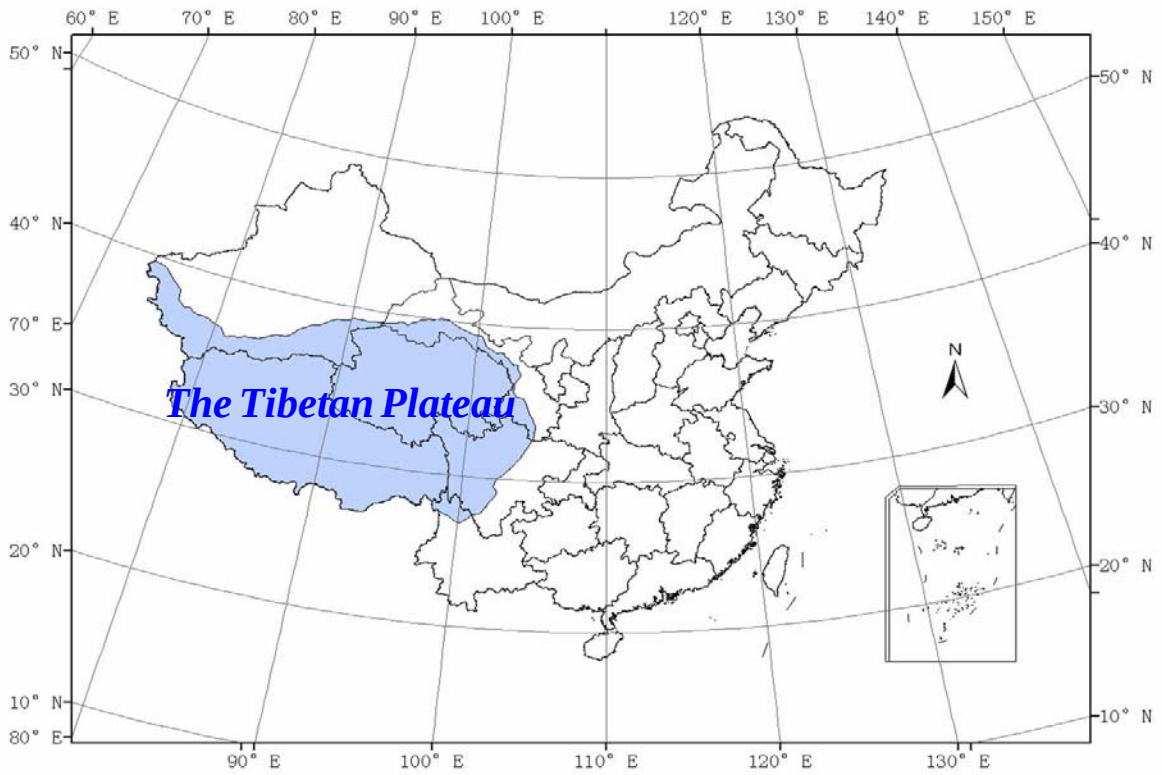
Zhang,2009

Average seasonal mean NDVI variations over the Tibetan Plateau



Zhong et al. 2010

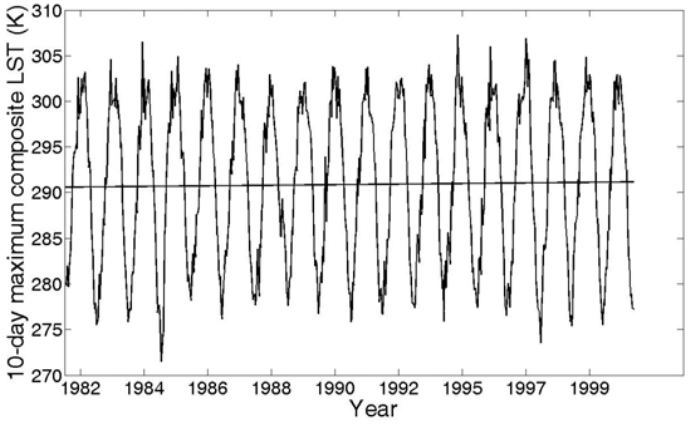
Changing trends of land surface parameters of the Tibetan Plateau for recent 20 years

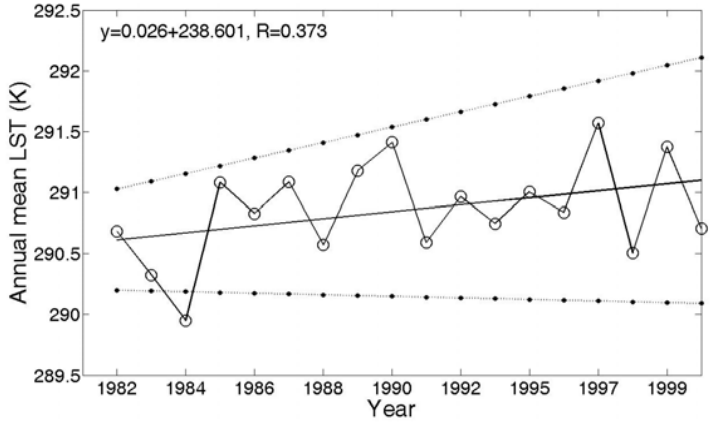


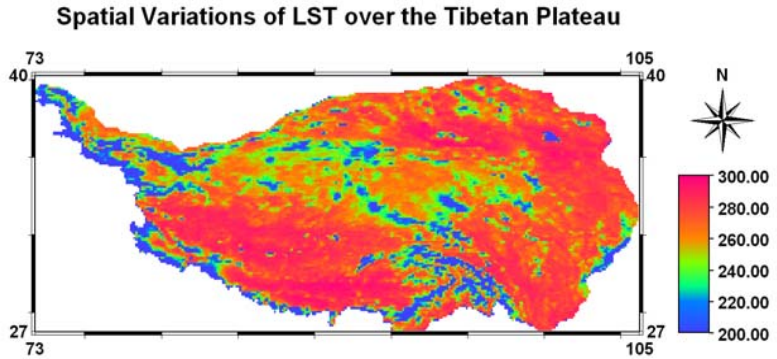
Data

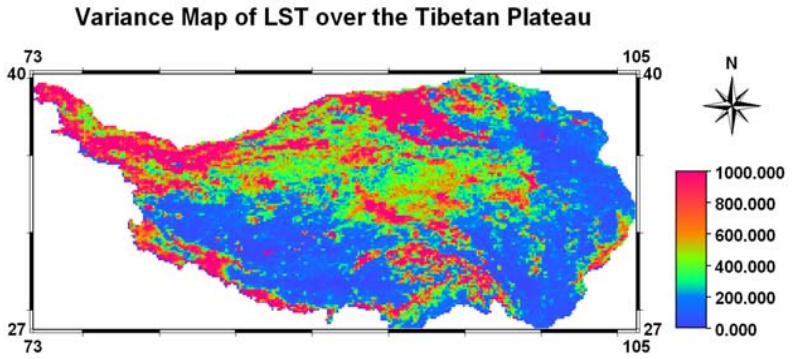
- **NOAA/NASA Pathfinder AVHRR Land (PAL) data**
  - **Spatial resolution: 8 km**
  - **Time series: 1982-2000**
- **ECMWF 40 Years Re-Analysis (ERA-40) data**
  - **Spatial resolution : 2.5 degree**
  - **Air temperature at 2 m，wind speed at 10 m ，precipitation**
- **Global Land Data Assimilation System (GLDAS)**
  - **Spatial resolution ：1 degree**
  - **Sensible and latent heat fluxes**

Temporal variations and spatial distribution of LST over the TP









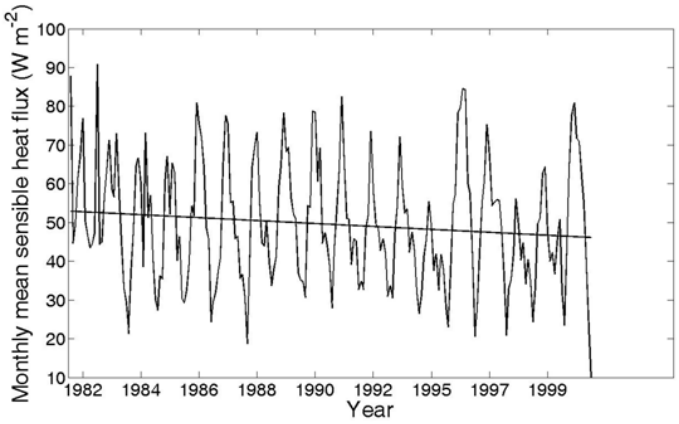
- Empirical method

  (Ye and Gao, 1979; Chen et al., 1985; Duan and Wu, 2008)

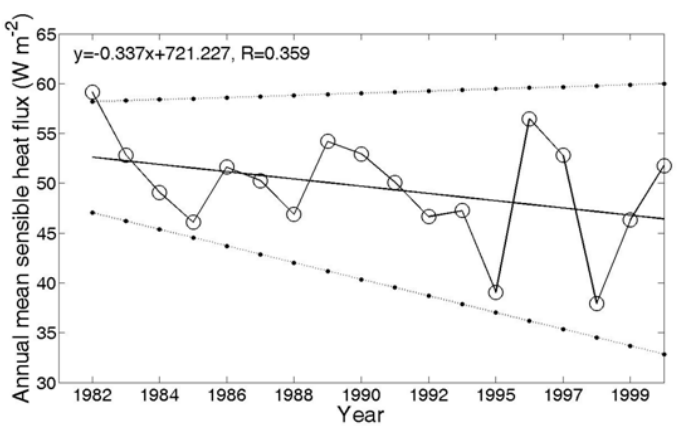
$$H_s = C_p \rho C_{DH} V_0 (T_s - T_a)$$

Temporal variations and spatial distribution of sensible heat flux over the TP

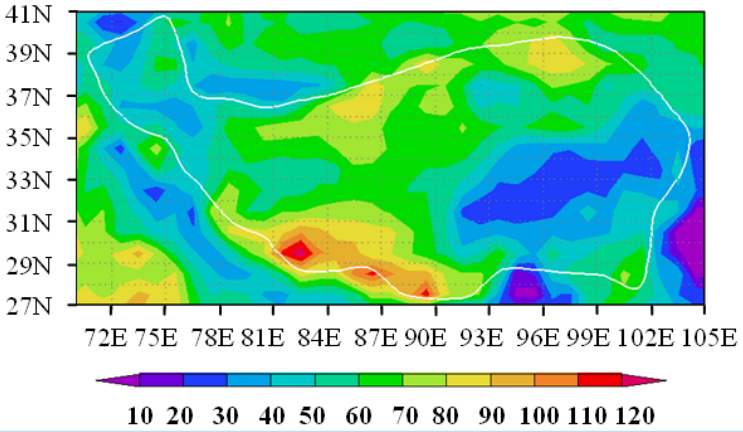
a



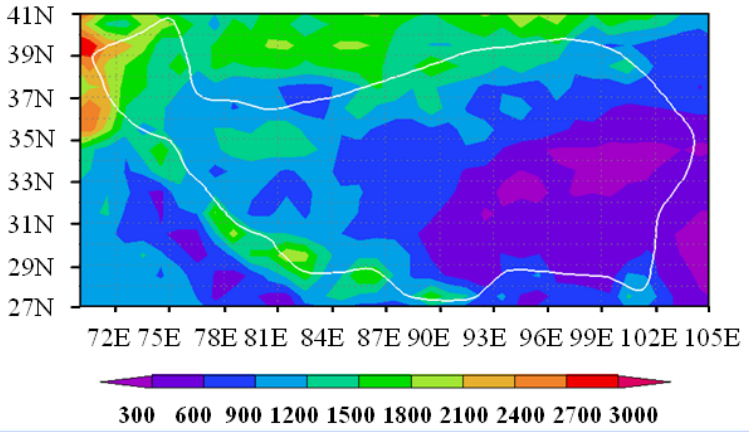
b



c



d



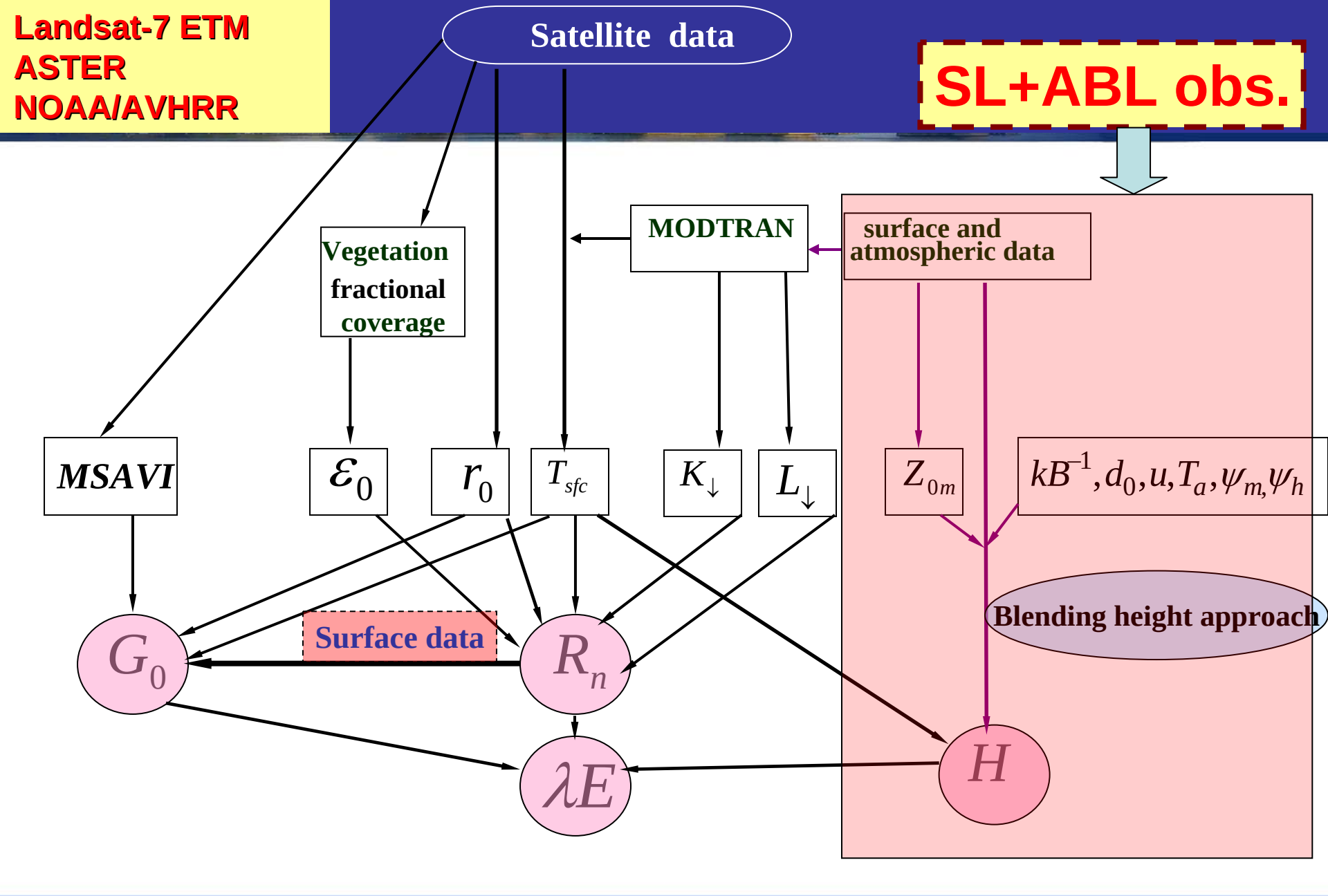
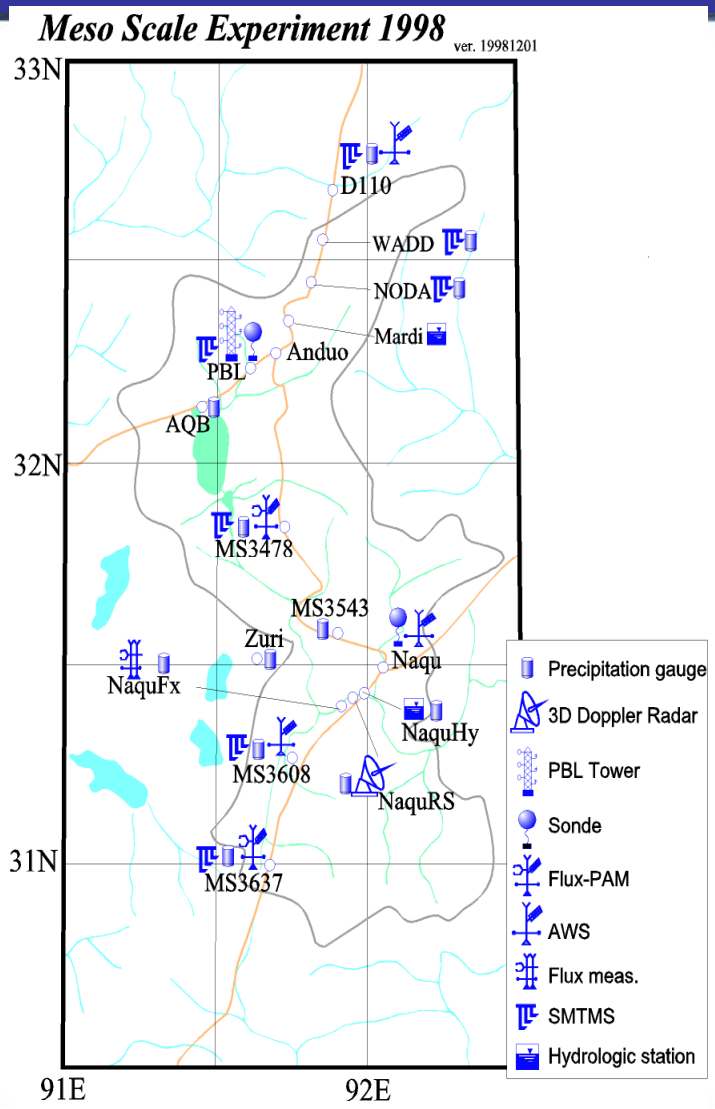
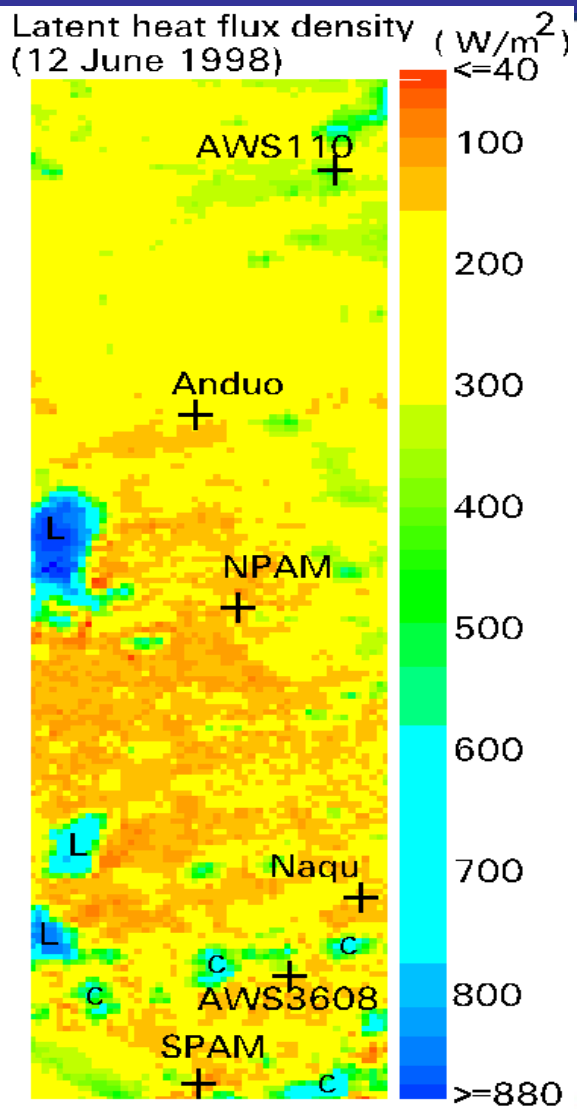


Diagram of parameterization procedure by combining satellite data with field observations

Case study and validation (NOAA/AVHRR)

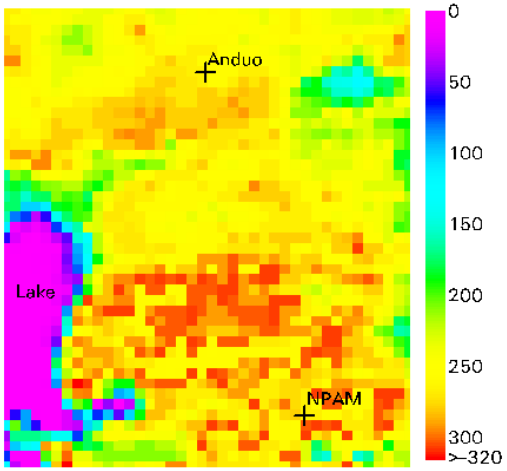


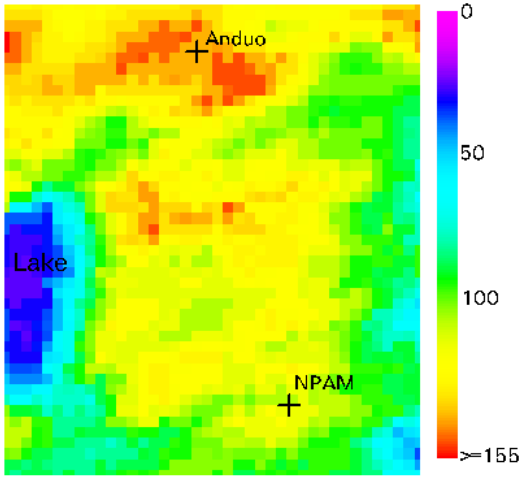


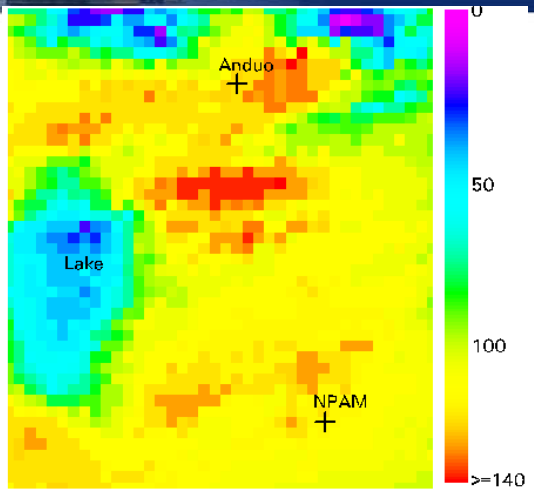
June 12 (Pre-Monsoon)

July 16 (Monsoon)

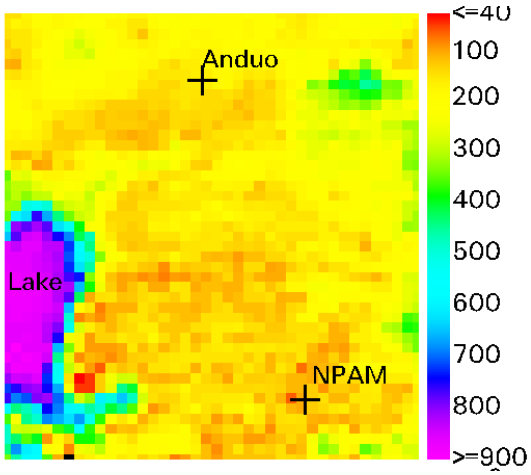
August 21 (Post-Monsoon)

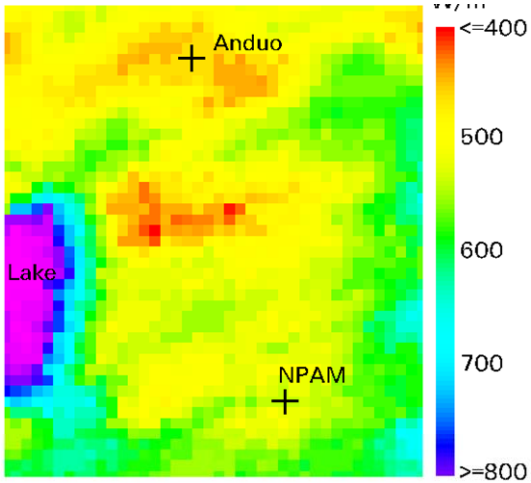


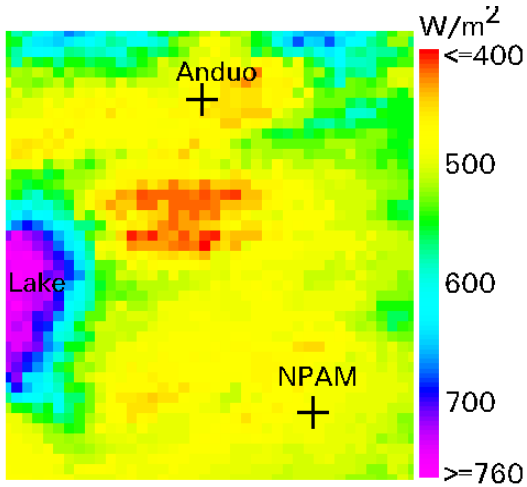




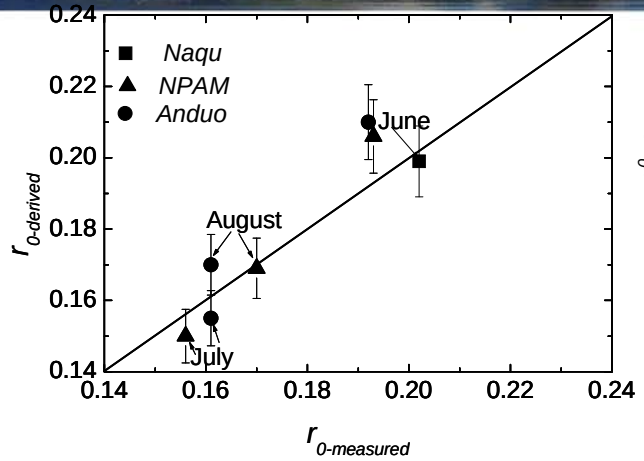
Sensible heat flux

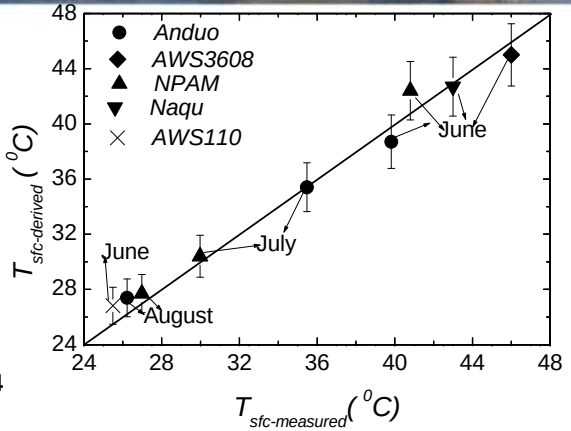


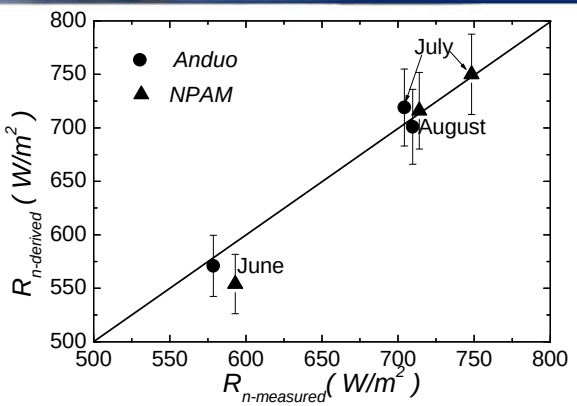


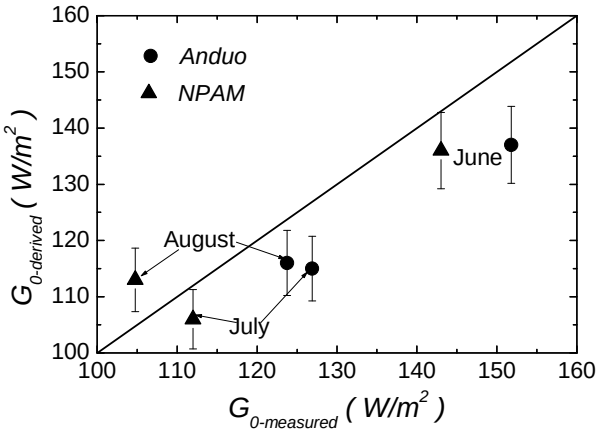


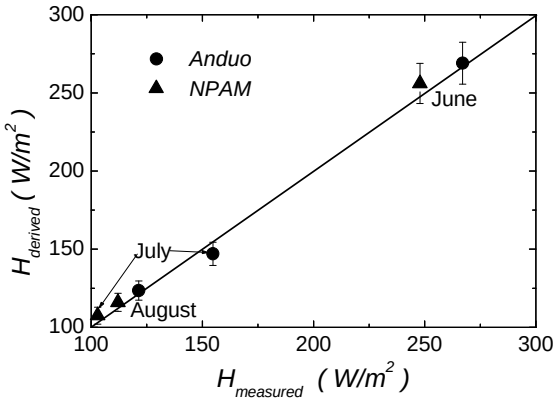
Latent heat flux

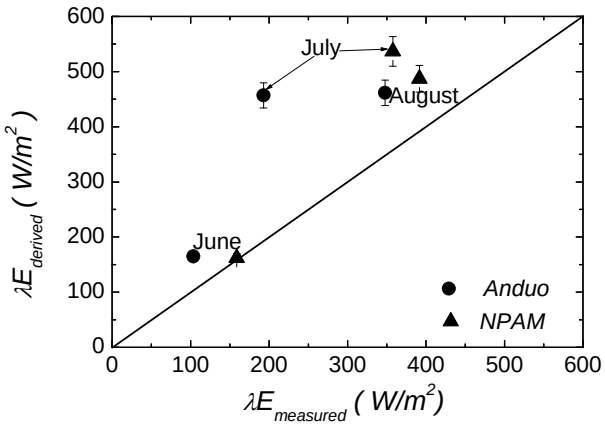






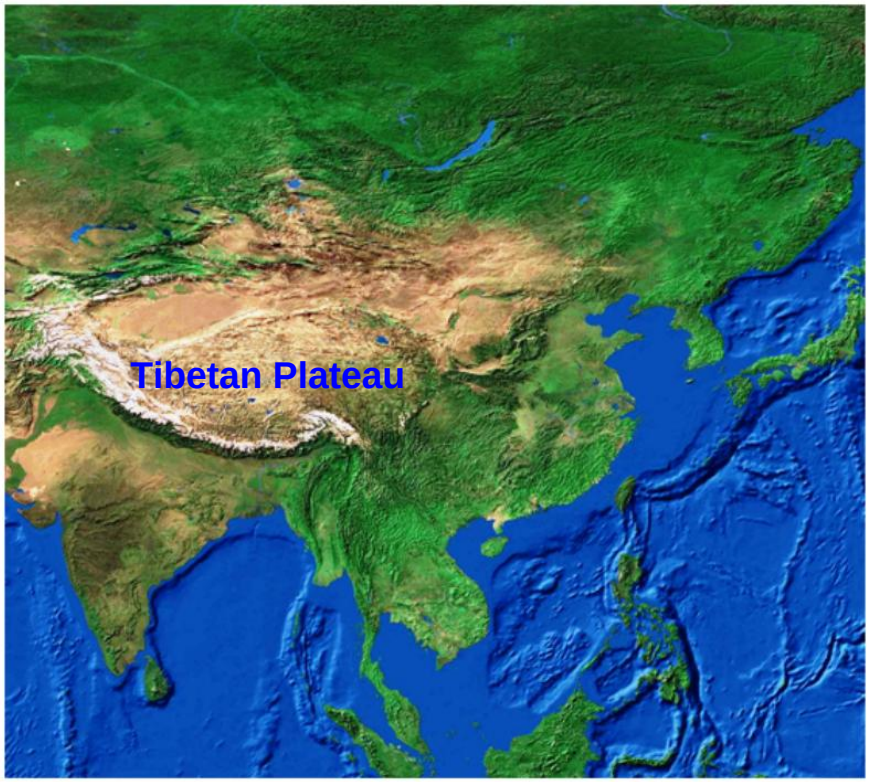




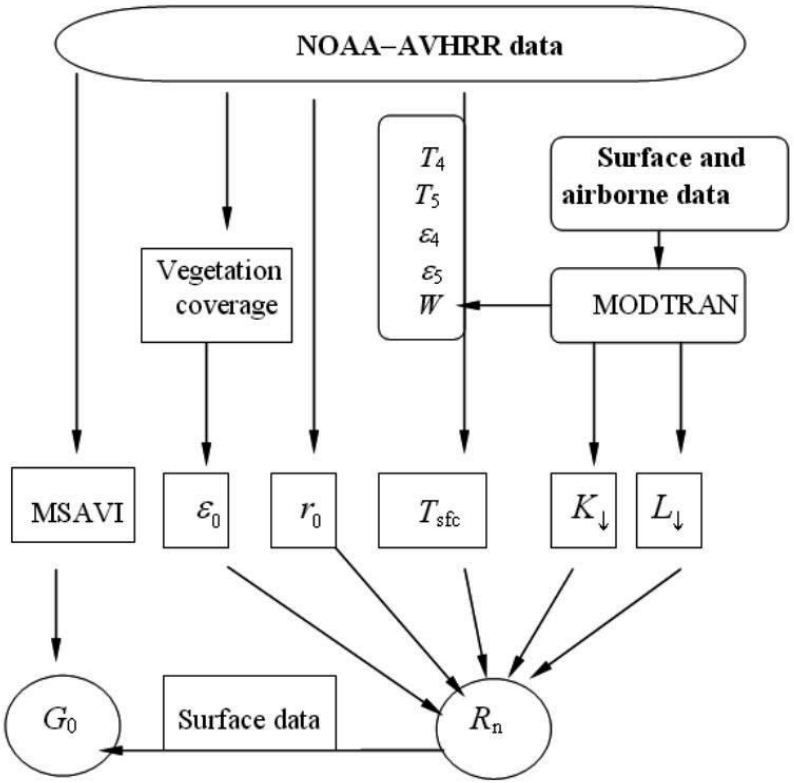


Validation of the derived results against the field measurements for the surface reflectance, surface temperature and land surface heat fluxes over the GAME/Tibet area, together with 1:1 line.

Using NOAA/AVHRR data to determinate regional net radiation and soil heat fluxes over heterogeneous landscape of the Tibetan Plateau

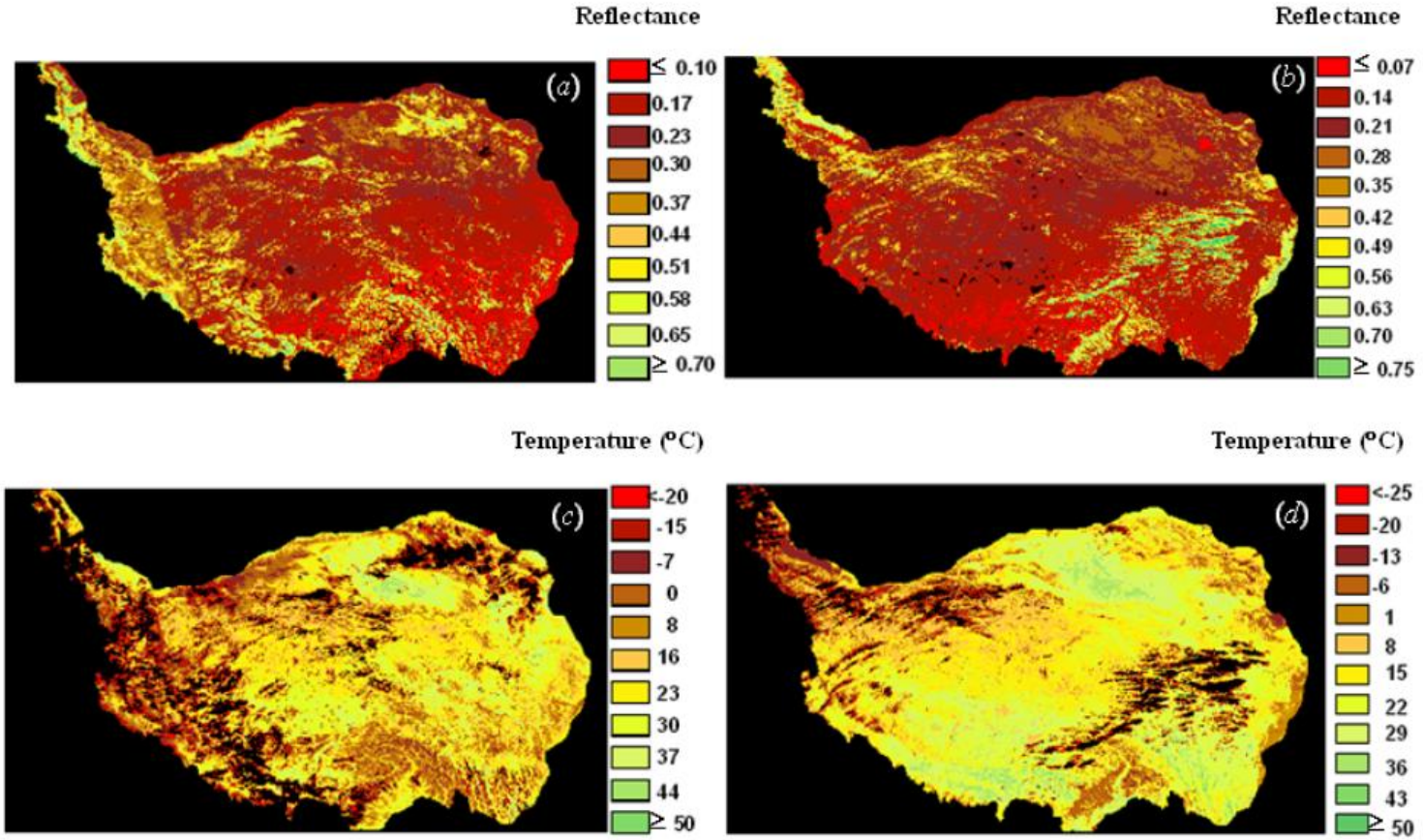


The Diagram of parameterization procedure to determine net radiation and soil heat fluxes by combining NOAA-16/AVHRR data with field observations

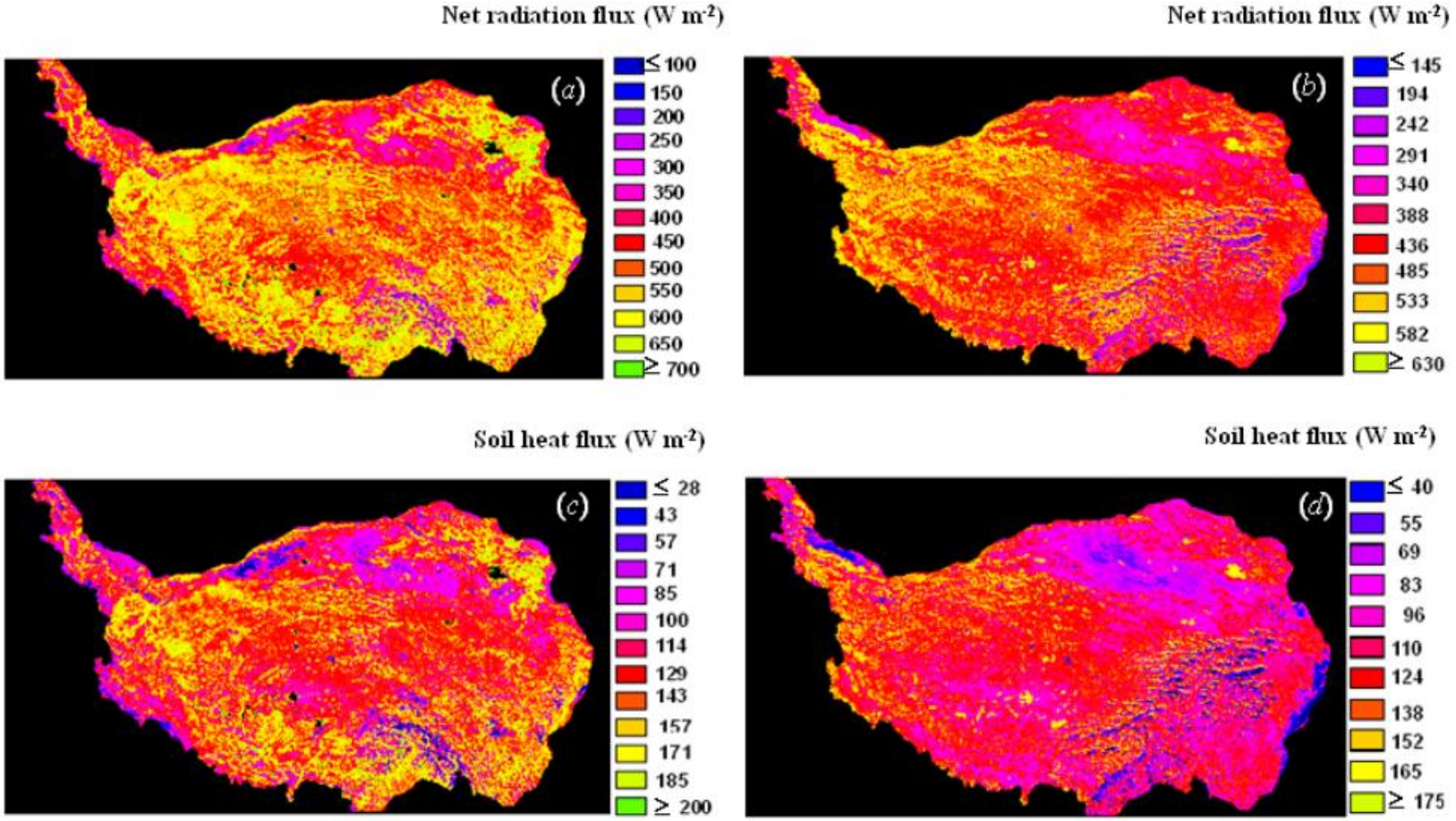


Ma, Zhong et al., 2011, Accepted by IJRS

The distribution maps of surface reflectance and surface temperature over the Tibetan Plateau area



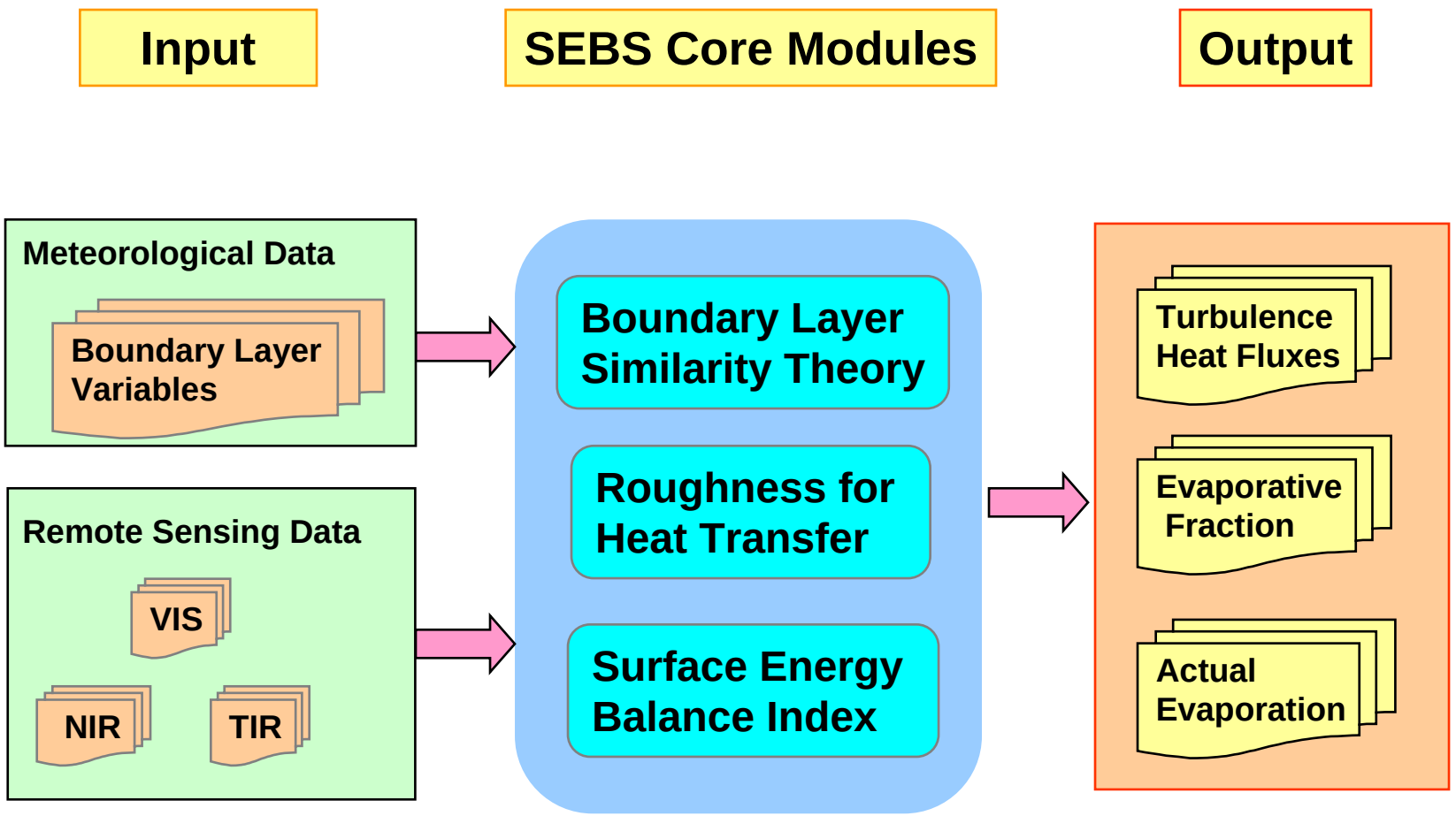
The distribution maps of net radiation and soil heat fluxes over the Tibetan Plateau area



Comparison of the derived results for *R*n and *G*0 (Cal.) versus those measured values (Meas.) with APD

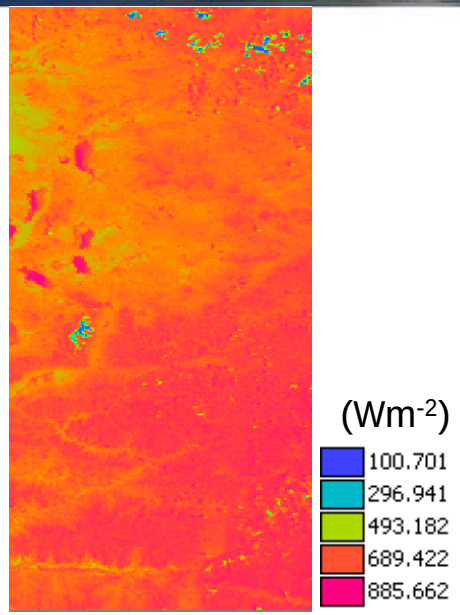
Station	14 April 2003			16 October 2003		
	Cal. (W m^{-2})	Meas. (W m^{-2})	APD(%)	Cal. (W m^{-2})	Meas. (W m^{-2})	APD(%)
Rn						
D105	399	371	7.5	411	375	9.6
NPAM	544	582	6.5	454	464	2.2
BJ	432	410	5.4	336	314	7.0
ANNI	532	549	3.1	535	567	5.6
G_0						
D105	152	143	8.9	128	119	7.6
NPAM	135	124	6.3	105	99	6.1
BJ	148	137	8.0	134	125	7.2
ANNI	145	134	8.2	120	110	9.1

SEBS - The Surface Energy Balance System (Optical/Thermal satellite data)

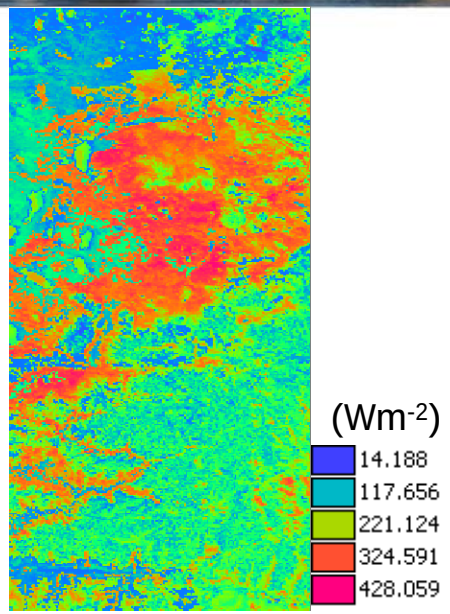


Z. Su, 2002, The Surface Energy Balance System (SEBS) for estimation of turbulent heat fluxes, *Hydrology and Earth System Sciences*, 6(1), 85-99.

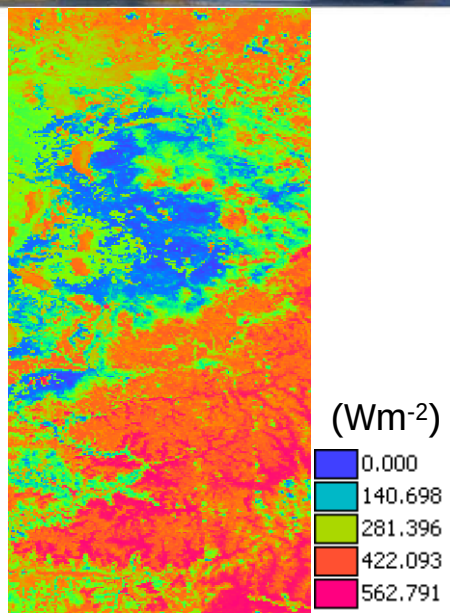
Rn



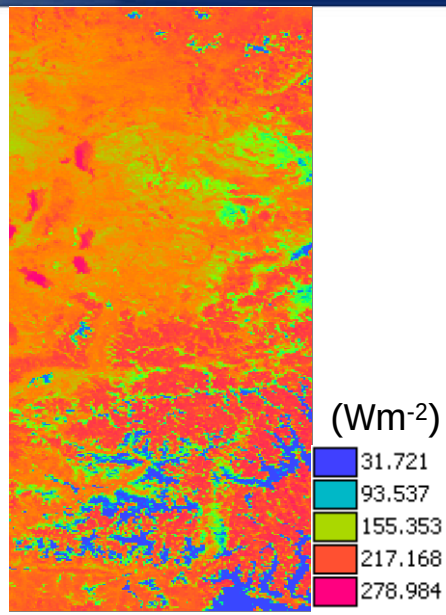
Hs



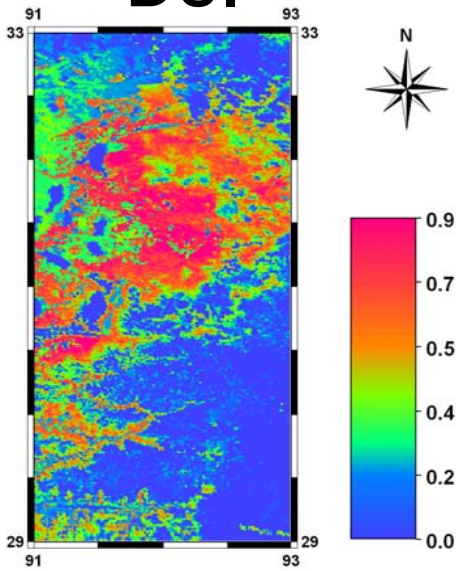
LE



G

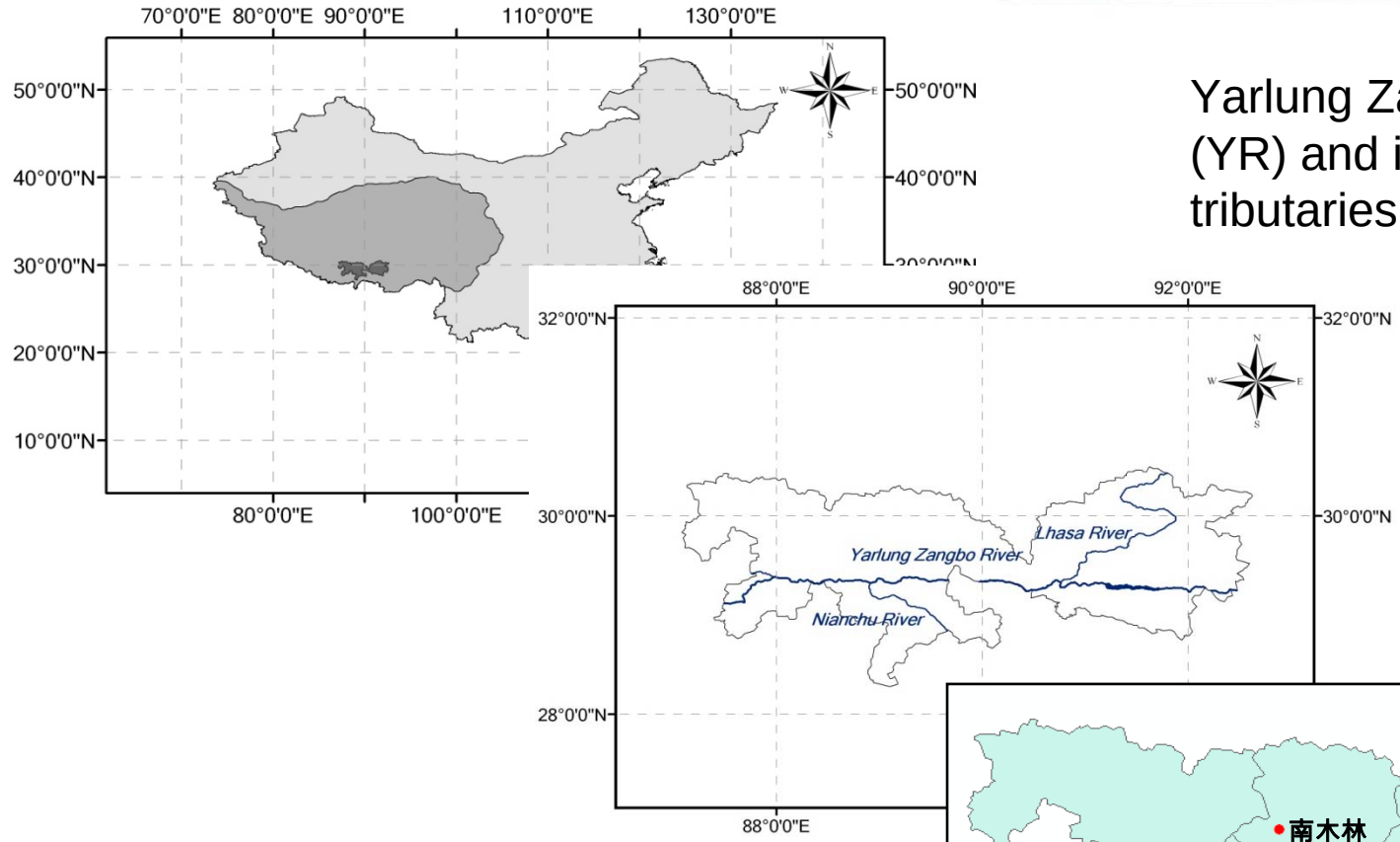


DSI



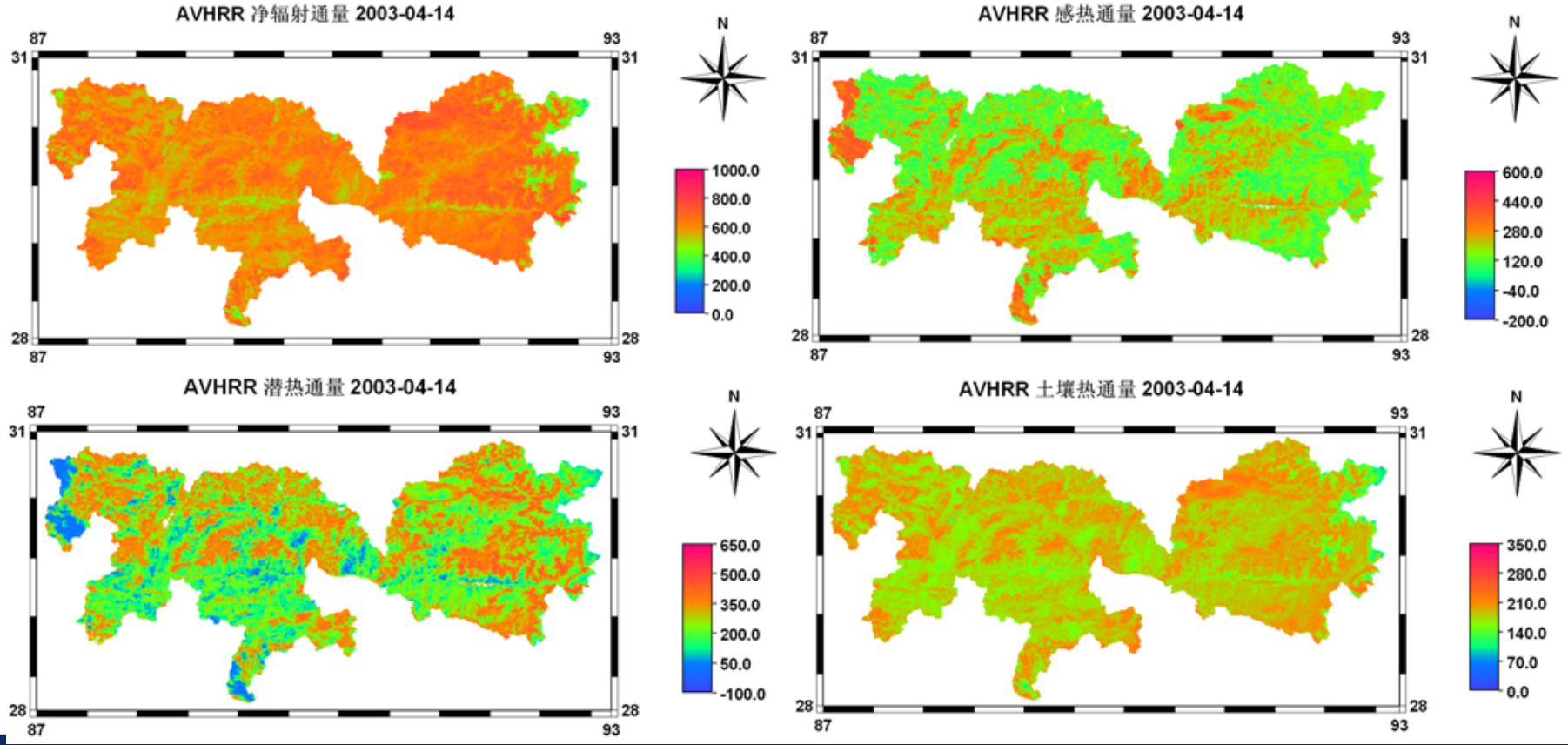
MODIS images

DOY 163

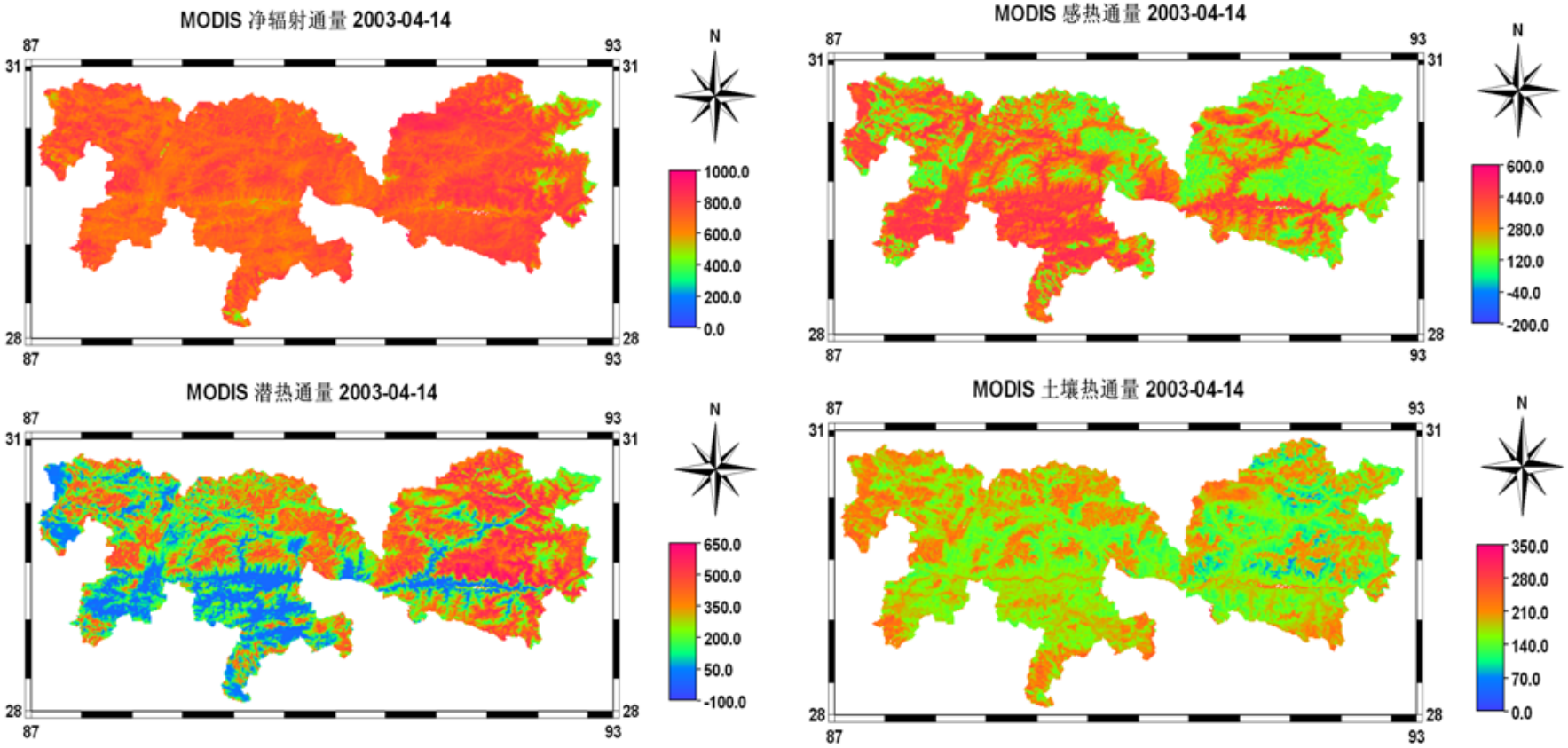


Yarlung Zangbo River (YR) and its two tributaries

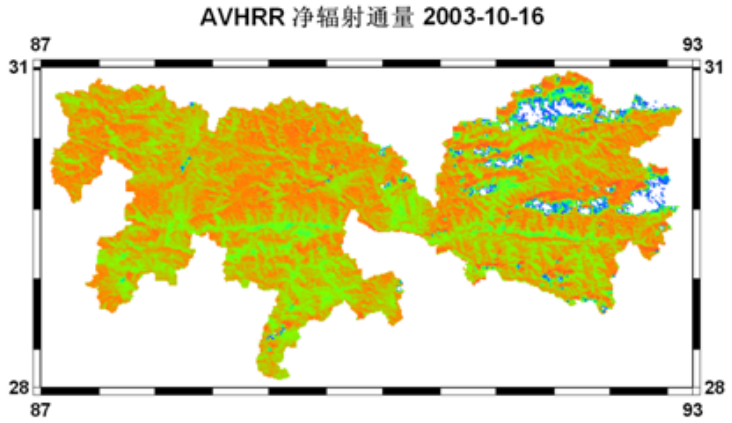
Land surface heat fluxes derived from AVHRR (April)

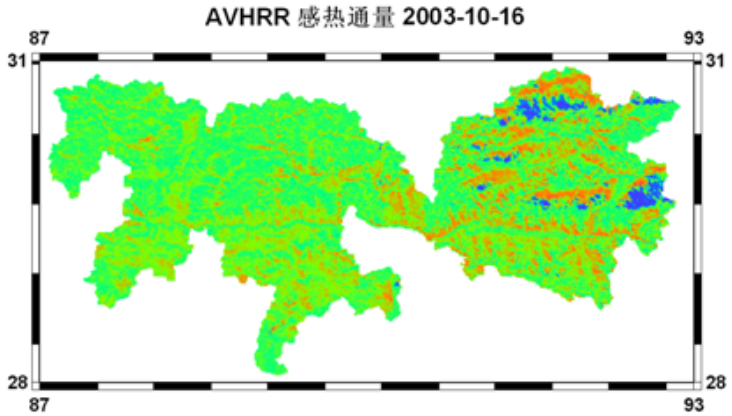


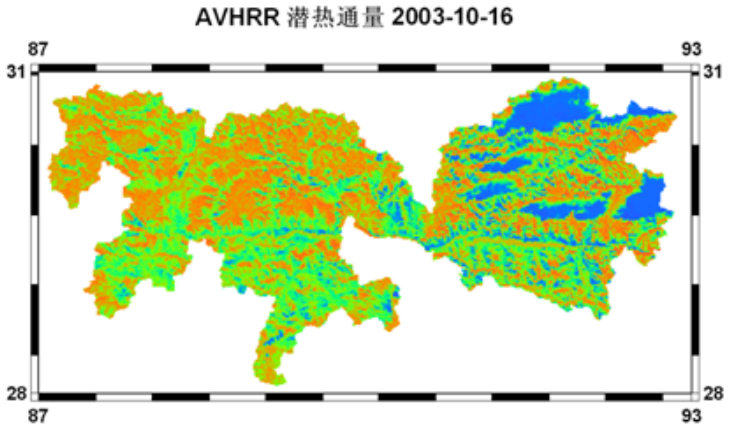
Land surface heat fluxes derived from MODIS (April)

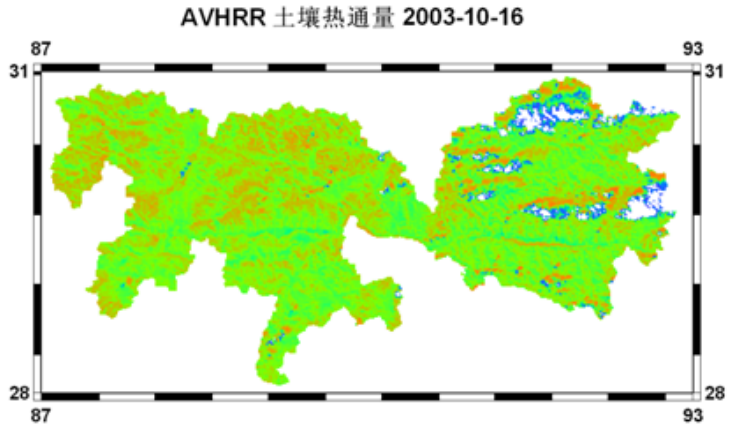


Land surface heat fluxes derived from AVHRR (October)

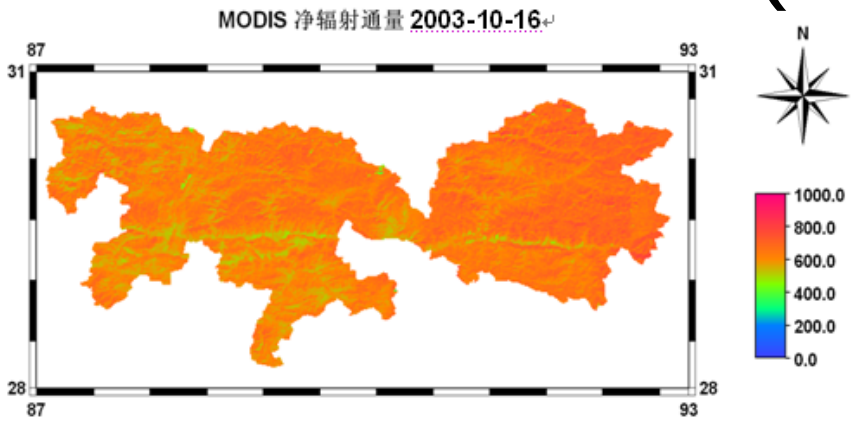


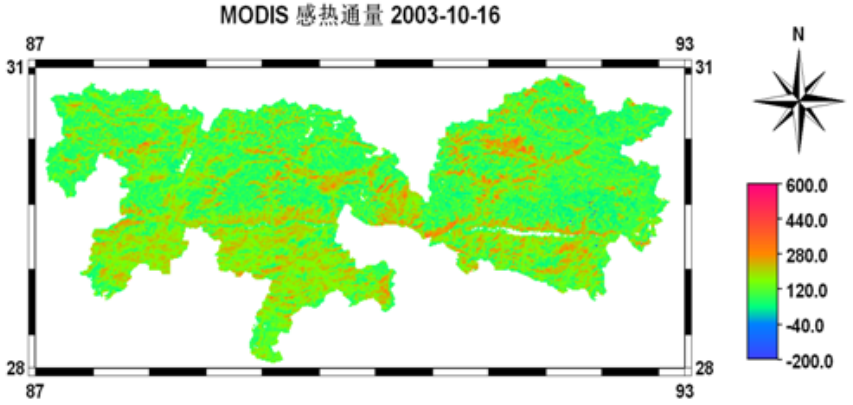


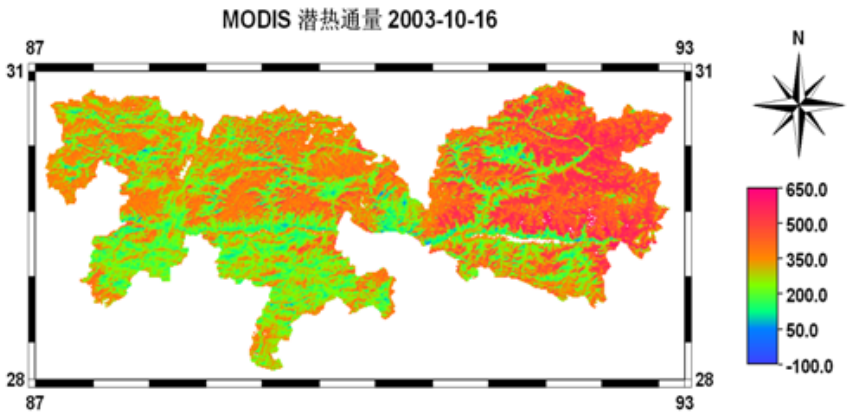


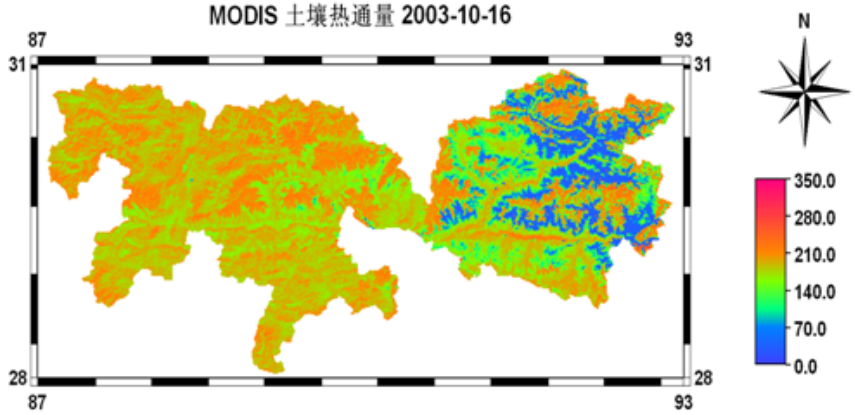


Land surface heat fluxes derived from MODIS (October)

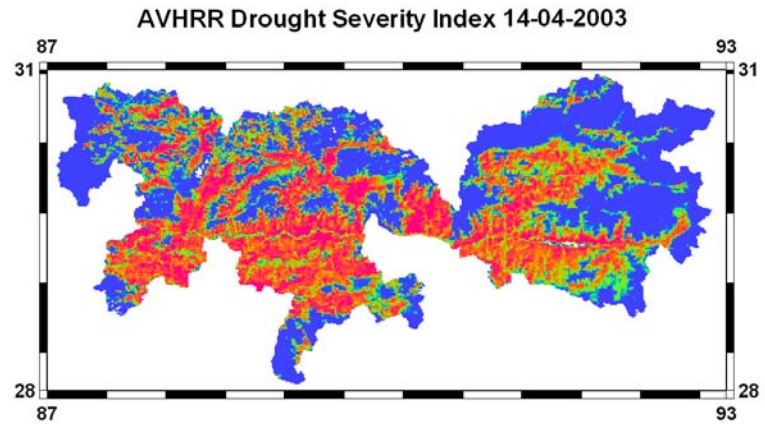


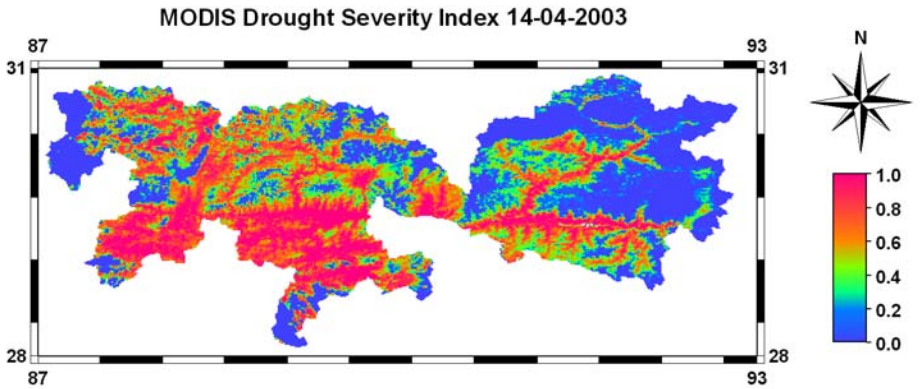


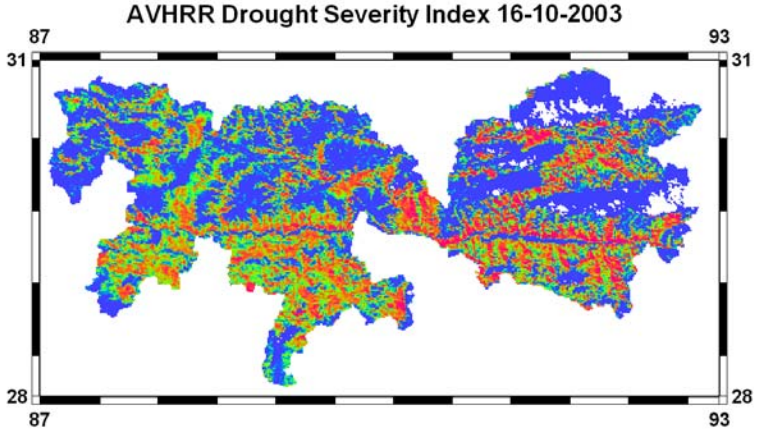


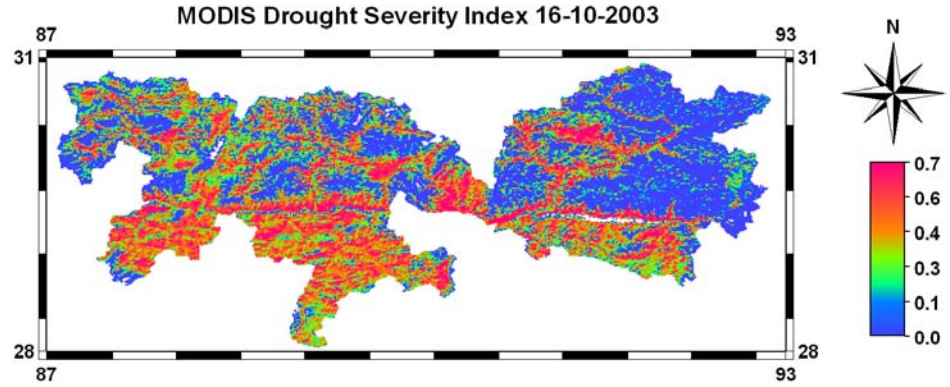


Drought Severity Index (DSI)









Young scientists

- Lei Zhong (PhD) (land surface processes, monsoon climate)
- Weiqiang Ma (PhD) (land surface processes, remote sensing)
- Xuelong Chen (PhD student) (air-land interaction)
- Rogier van der Velde (PhD student) (land surface processes, soil moisture, ASAR, drought monitoring)
- Laura Dente (PhD student) (Soil moisture, SMOS, drought prediction)
- Yijian Zeng (PhD student) (land surface and unsaturated zone processes)
- Xin Tian (PhD student) (forest ecological processes and SAR, ALOS)
- Longhui Li (PhD student) (agroecological processes, crop water use)
- Changbo Qin (PhD student) (integrated water resources management)

Publications

1. Ma, Y., Zhong, L, Wang, Y., Su, Z. , 2011, Using NOAA/AVHRR data to determinate regional net radiation and soil heat fluxes over heterogeneous landscape of the Tibetan Plateau. *International Journal of Remote Sensing*, Accepted.
2. Ma, W., Ma, Y. Su, Z. , 2011,Feasibility of retrieving land surface heat fluxes from ASTER data using SEBS : a case study from the Namco area of the Tibetan plateau, *Arctic, Antarctic and Alpine Research*, 43, 239-245.
3. Ma, Y., Menenti, M., Feddes, R., 2010, Parameterization of Heat Fluxes at Heterogeneous Surfaces by Integrating Satellite Measurements with Surface Layer and Atmospheric Boundary Layer Observations. *Adv. Atmos. Sci.*, 27, 328-336
4. Zhong, L, Ma, Y., Su, Z., Salama, M.S., 2010, Estimation of Land Surface Temperature over the Tibetan Plateau using AVHRR and MODIS Data, *Adv. Atmos. Sci.*, doi: 10.1007/s00376-009-9133-0.
5. Zhong, L., Ma, Y., Salama, M.S., Su, Z., 2010, Assessment of vegetation dynamics and their response to variations in precipitation and temperature in the Tibetan Plateau. *Climatic change*, DOI 10.1007/s10584-009-9787-8.
6. Ma, Y., Y. Wang, R. Wu, Z. Hu, K. Yang, M. Li, W. Ma, L. Zhong, F. Sun,X.Chen, Z.Zhu, S.Wang, and H. Ishikawa, 2009, Recent advances on the study of atmosphere-land interaction observations on the Tibetan Plateau,Hydrology and Earth System Sciences, 13, 1103-1111.
7. Zhong, L., Y. Ma, Z. Su, L. Lu, W. Ma, Y. Lu, 2009, Land-Atmosphere Energy Transfer and Surface Boundary Layer Characteristics in the Rongbu Valley on the Northern Slope of Mt. Everest, *Arctic, Antarctic, and Alpine Research*, 41(3), 396-405.
8. Ma, W.,Y. Ma, Z. Hu, B. Su,J.Wang, and H. Ishikawa, 2009,Estimation of surface heat flux over middle and up stream of the Heihe River basin with ASTER Imagery, HESSD, 6, 4619–4635
9. Ma, W., Ma, Y., Li, M., Hu, Z. Zhong, L., Su, Z., Ishikawa, H. and Wang, J., 2009, Estimating surface fluxes over the North Tibetan plateau area with ASTER imagery. Hydrology and Earth System Sciences, 13, pp. 57-67.
10. Zhang, T., J. Wen, Z. Su, R. van der Velde, J. Timmermans, R. Liu, Y. Liu, Z. Li, 2009, Soil moisture mapping over the Chinese Loess Plateau using ENVISAT/ASAR data, *Advances in Space Research*, 43(7), 1111-1117.
11. Ma, Y., S. Kang, L. Zhu, B. Xu, L. Tian, and T. Yao, 2008, Tibetan Observation and Research Platform- Atmosphere–land interaction over a heterogeneous landscape, Bull. Amer. Meteor. Soc., 89: 1487–1492;
12. Ma, Y., M. Menenti, R. A. Feddes, J. Wang, 2008, The analysis of the land surface heterogeneity and its impact on atmospheric variables and the aerodynamic and thermodynamic roughness lengths, Journal of Geophysics Research-Atmospheres, 113, D08113, doi: 10.1029/2007JD009124.
13. Yang, K., Rachel T. Pinker, Y.Ma, T.Koike, Margaret M. Wonsick, Stephen J. Cox, Y.Zhang, and P.Stackhouse, 2008, Evaluation of satellite estimates of downward shortwave radiation over the Tibetan Plateau, J. Geophys. Res., 113, D17204, doi:10.1029/2007JD009736.

Plans for 2011-2012

- Continuous in-situ observations
- Continuous cal/val of EO data products
- Validation & improvements of model parameterization
- Assimilation of EO data into modeling system
- Setting-up of drought monitoring & prediction system


Thank you!
Welcome to visit Lhasa and our stations in the Tibetan Plateau!