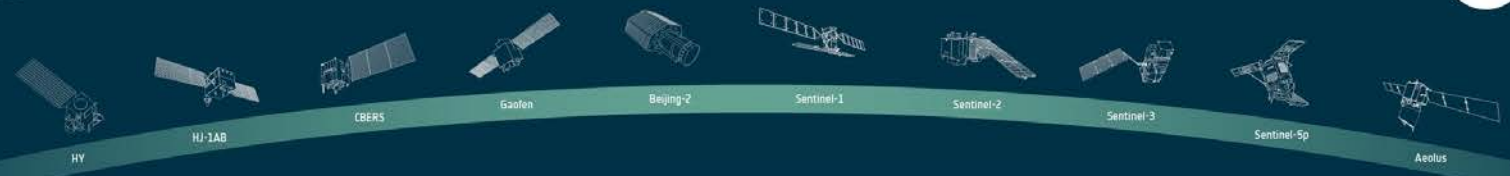


2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

PROJECT ID. 58516

Monitoring and Modelling Climate Change in Water, Energy and Carbon Cycles in The Pan-third Pole Environment (CLIMATE-PAN-TPE)

Dragon 5 Mid-term Results Project

<5:00-6:30PM BST, 11:00-12:30PM CEST 2022-10-17>

ID. 58516

PROJECT TITLE: Monitoring And Modelling Climate Change In Water, Energy And Carbon Cycles In The Pan-third Pole Environment (CLIMATE-PAN-TPE)

PRINCIPAL INVESTIGATORS: Yaoming MA（马耀明）

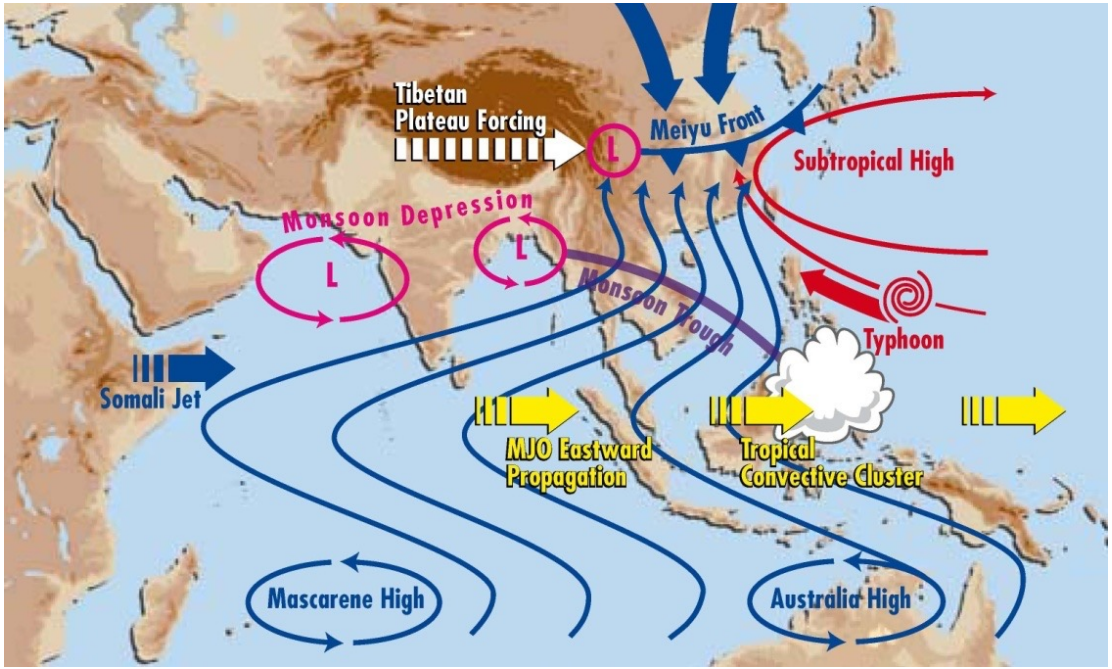
CO-AUTHORS: Z.(Bob) Su（苏中波）, Weiqiang Ma（马伟强）, Lei Zhong（仲雷）, Jun Wen（文军）, Yunfei Fu（傅云飞）, Yanbo He（何延波）

Presented By: Yaoming Ma （马耀明）& Weiqiang Ma（马伟强）

Chinese Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Lian Liu	Institute of Tibetan Plateau Research, Chinese Academy of Sciences	Application of an improved Noah snow albedo scheme in the simulation of snow processes over the Tibetan Plateau	Improve the albedo parameterization scheme in WRF coupled with Noah LSM by combining MODIS albedo products and the in-situ observed and WRF estimated snow depth

Background



- *Vital source of water for 1.5 billion people across 10 countries in SE Asia*
- *Significant role in global atmospheric circulation*
- *Lack of detailed observations, little known about how climate is changing*

Sub-projects and themes

Topic Nr.	Pls	Title
58516_1	Prof. Jun Wen, Prof. Bob Su, Dr. Xin Wang	Observation and modelling of microwave scattering and emission under complex terrains with permafrost and freeze–thawing conditions.
58516_2	Prof. Weiqiang Ma, Dr. Rogier van der Velde, Dr. Jian Peng, Prof. Maria Jose Polo	Advancement of physical understanding and quantification of changes of water and energy budgets in Pan-TPE.
58516_3	Prof. Yaoming Ma, Prof. Jose Sorino, Prof. Lei Zhong, Prof. Bob Su	Advancement of quantifying changes in surface characteristics and monsoon interactions.
58516_4	Dr. Yijian Zeng, Prof. Dr. Harrie-Jan Hendriks Franssen, Prof. Weiqiang Ma, Dr. Rafaerl Pimentel Leiva	Modelling and predicting climate change impacts on water resources and ecosystems in the Pan-Third Pole Environment.

Achievements

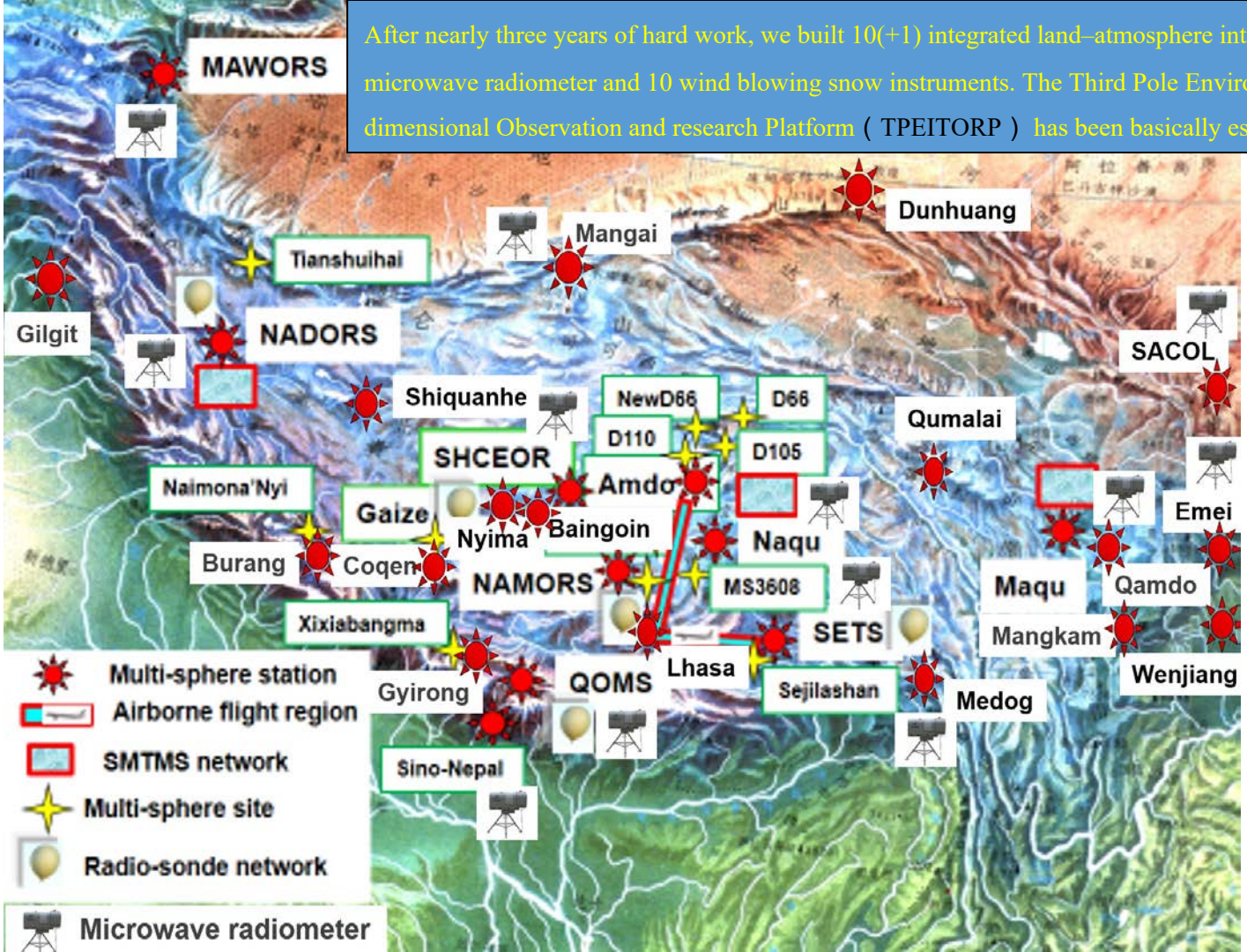
Three-dimensional integrated field observation of Land-Atmosphere interaction over the TP

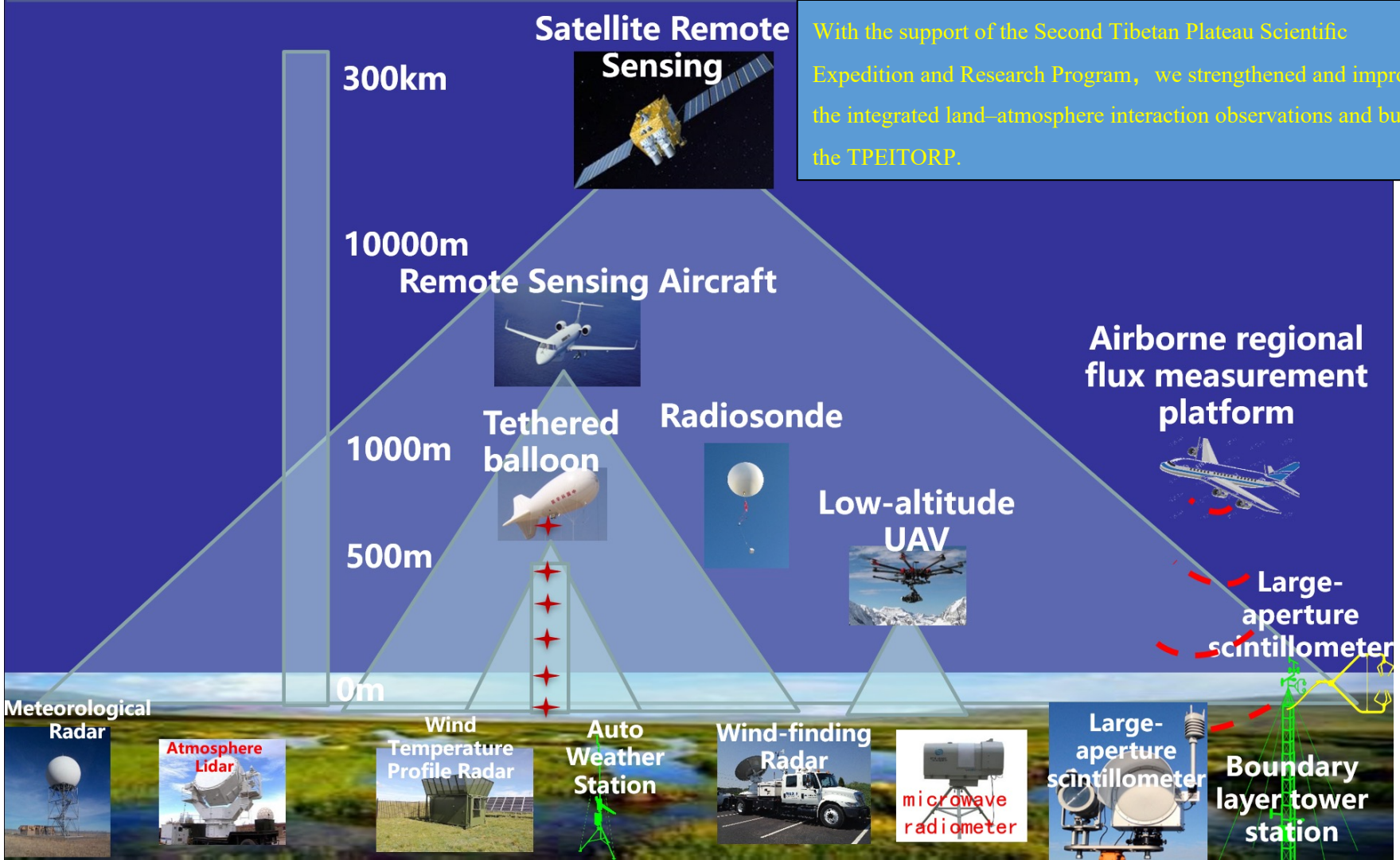
Revealing the spatial and temporal characteristics of surface temperature and turbulent flux by the RS

Interdecadal variation of summer atmospheric heat sources over the TP

Modelling of the development and evolution of heavy snow on the TP

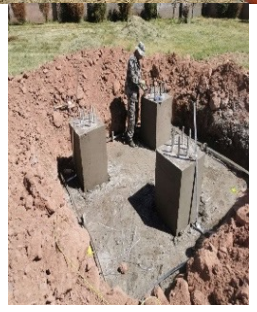
After nearly three years of hard work, we built 10(+1) integrated land–atmosphere interaction observations, 10 microwave radiometer and 10 wind blowing snow instruments. The Third Pole Environment Integrated Three-dimensional Observation and research Platform（TPEITORP）has been basically established on the TP.




With the support of the Second Tibetan Plateau Scientific Expedition and Research Program， we strengthened and improved the integrated land–atmosphere interaction observations and built the TPEITORP.
Satellite Remote Sensing
300km
10000m
Remote Sensing Aircraft
Airborne regional flux measurement platform
1000m
Tethered balloon
Radiosonde
Low-altitude UAV
500m
Large-aperture scintillometer
0m
Meteorological Radar
Atmosphere Lidar
Wind Temperature Profile Radar
Auto Weather Station
Wind-finding Radar
microwave radiometer
Large-aperture scintillometer
Boundary layer tower station

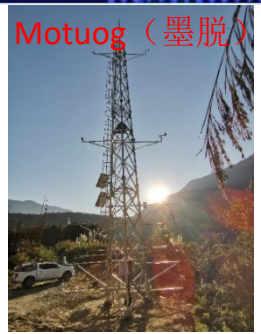
Atmospheric boundary layer tower

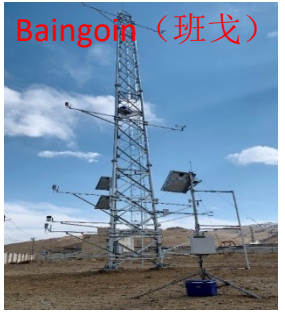
In the past three years, 10 (+1) atmospheric boundary layer towers (+ turbulence observation system) have been built thanks to the hard work of more than 200 Scientific research personnel and students

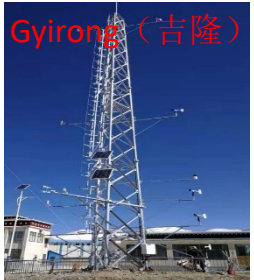


Recently Erected Atmospheric Boundary Layer Towers

11 new Atmospheric Boundary Layer Towers Stations (including atmosphere turbulence observation system and radiation observation system on the TP.





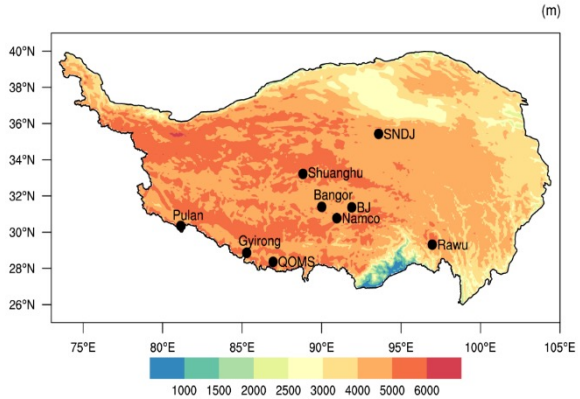


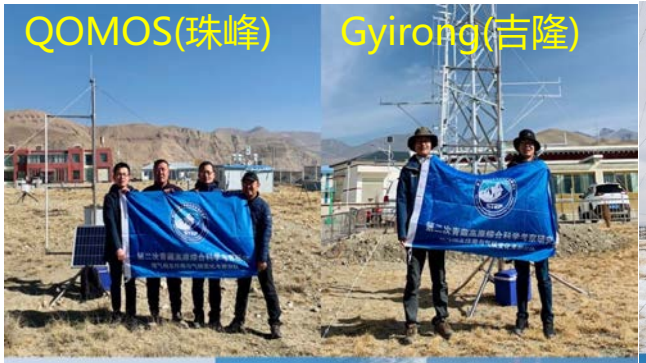
Microwave Radiometer observation network

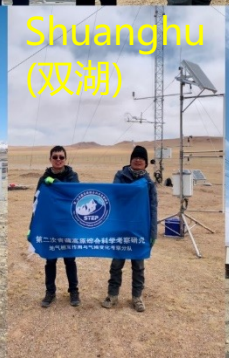
The first observation network of microwave radiometer (10 sets) on the TP has been set and realized the network observation.

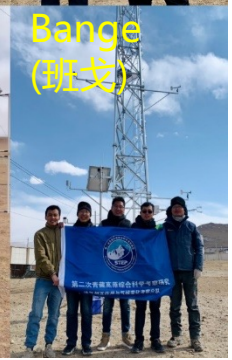
Wind Blowing Snow Instruments

The observation network of Wind Blowing Snow Instruments (10 sets) has been set and realized the network observation.







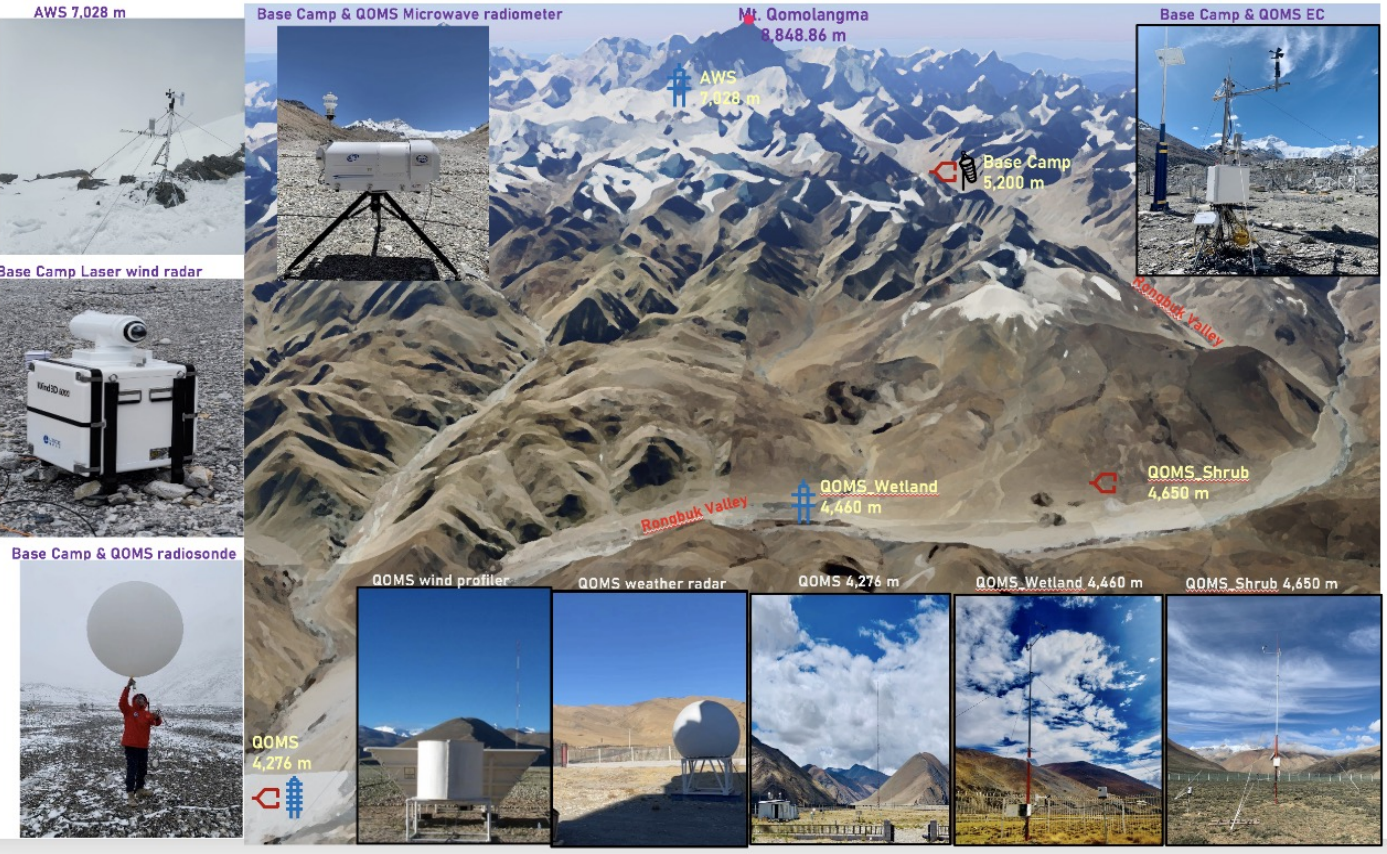


Continuous Observation

Continuous observation at 15 integrated observation stations and 29 land-atmosphere interaction stations was carried out smoothly

Three simultaneous enhanced stereo observations were carried out on 8 stations at TP and Nepal.

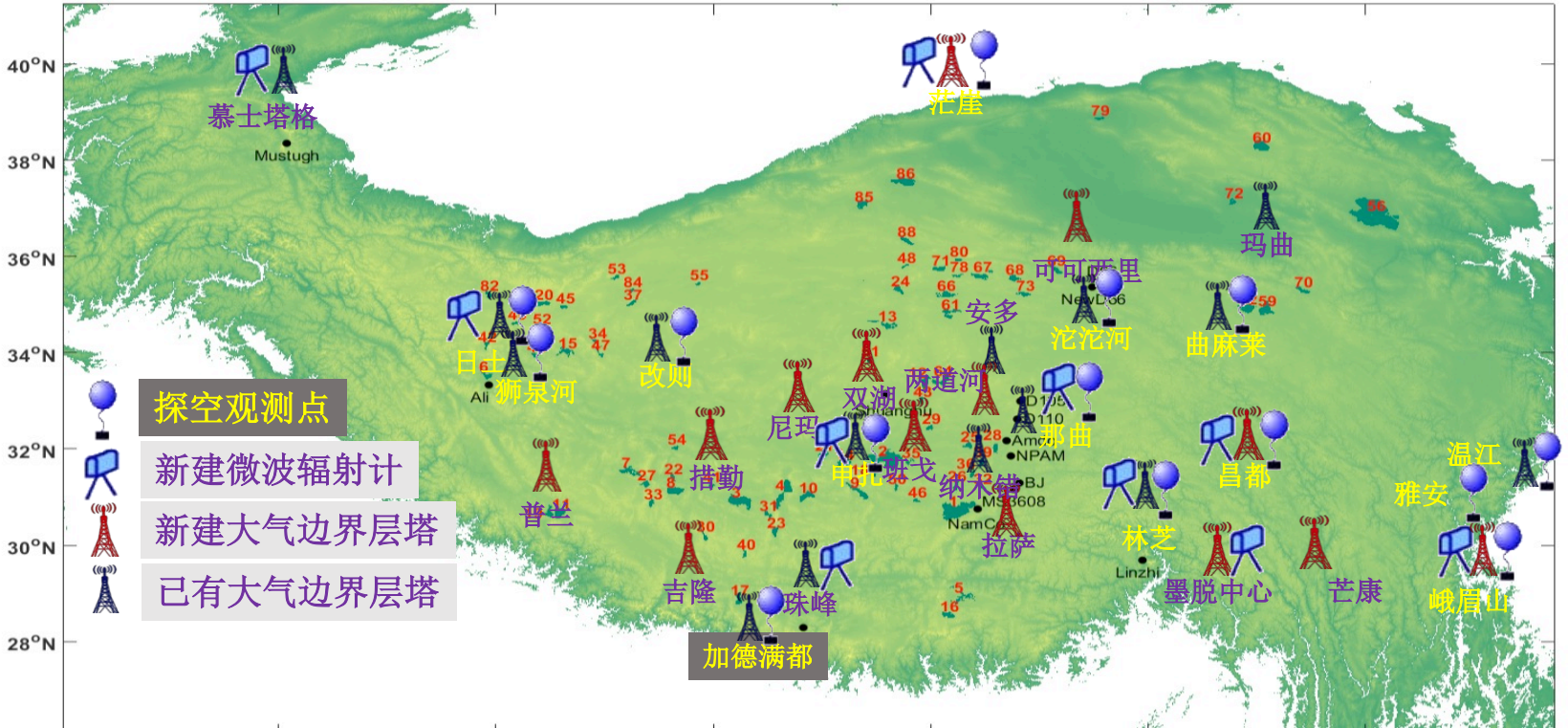
Earth Summit Mission 2022 – Scientific Expedition and Research on Mt. Qomolangma Helps Reveal the Synergy between Westerly Winds and Monsoon and the Resulting Climatic and Environmental Effects



The field research missions of "Atmospheric Vertical Structure Detection" and "Extreme Weather Process Observation and Prediction" have been successfully completed;

It has been widely reported by major media, which has aroused widespread concern from the society.

Site distribution of “Comprehensive stereo observation experiment of plateau vortex network in 2022”




Shiquanhe
Gerze
Shenza
Naqu Meteorological Burcau
NaPlaCE
Qumalai
Tuotuohe
Changdu
NASDE
Linzhi Meteorologic al Bureau
Mangya
SETS
Mount Emei
Katmandu

Achievements

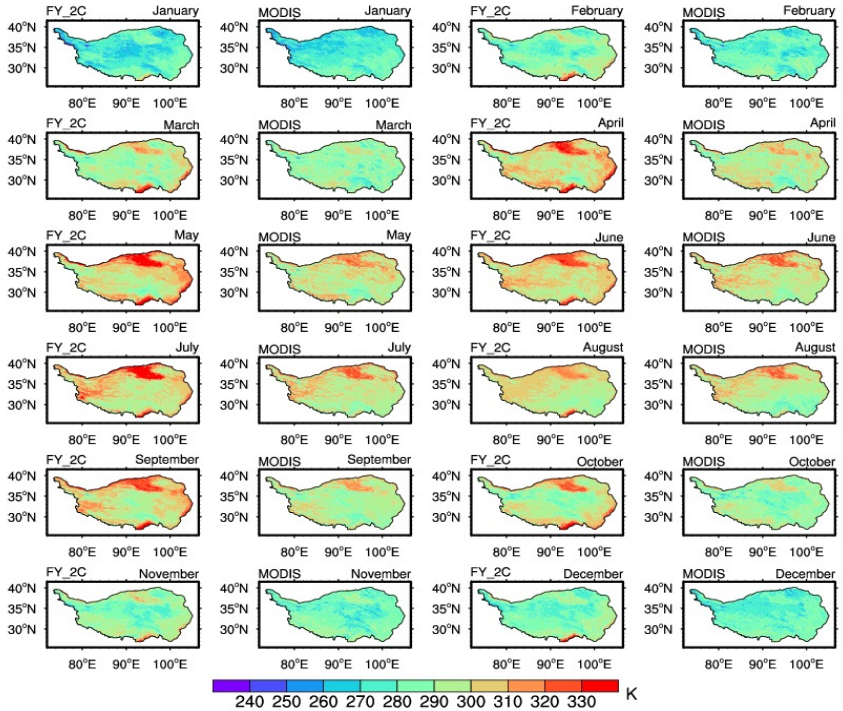
Three-dimensional integrated field observation of Land-Atmosphere interation over the TP

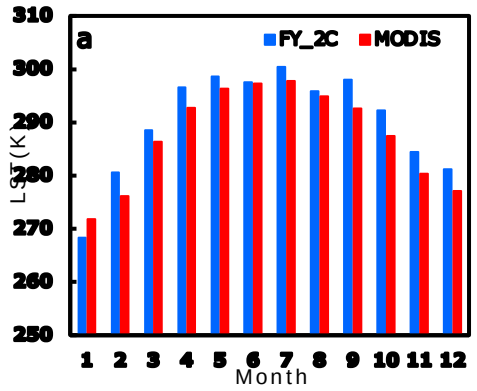
Revealing the spatial and temporal characteristics of surface temperature and turbulent flux by the RS

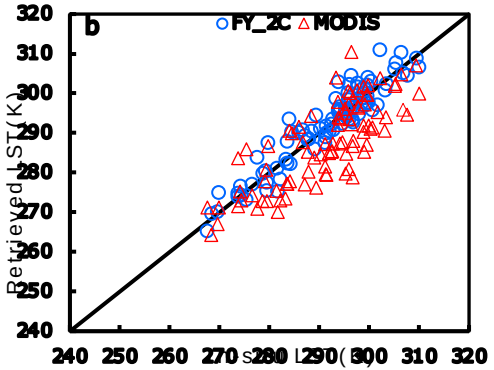
Interdecadal variation of summer atmospheric heat sources over the TP

Modelling of the development and evolution of heavy snow on the TP

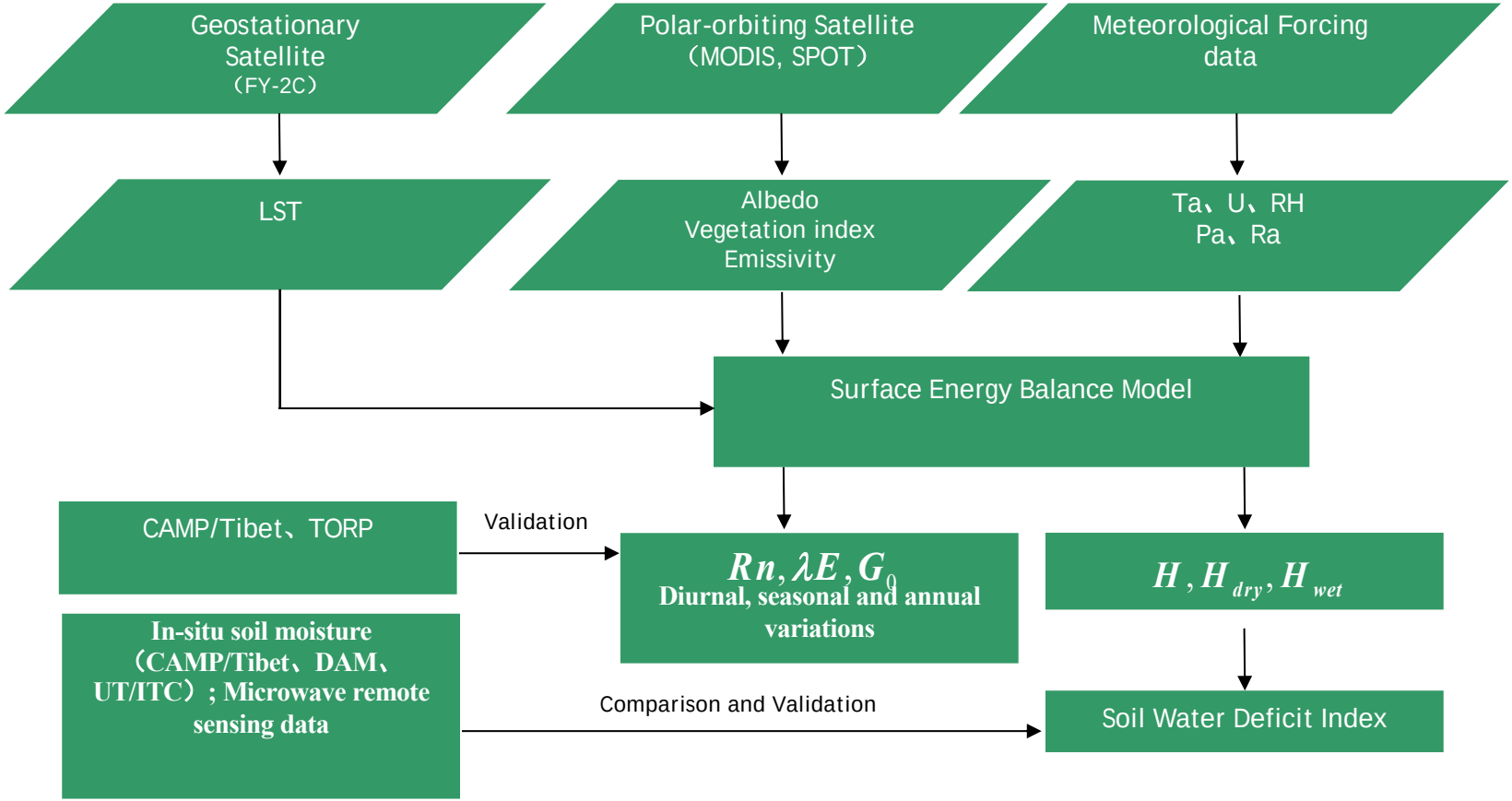
Comparison between FY-2C LST and MODIS product



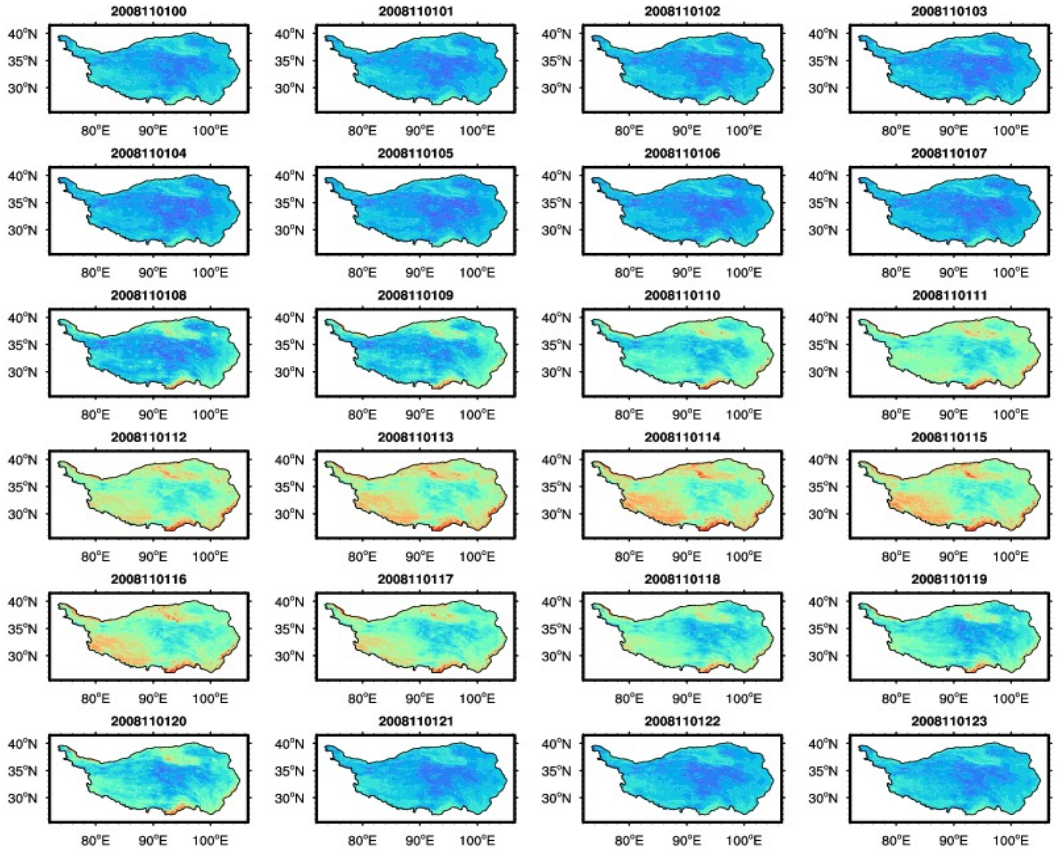




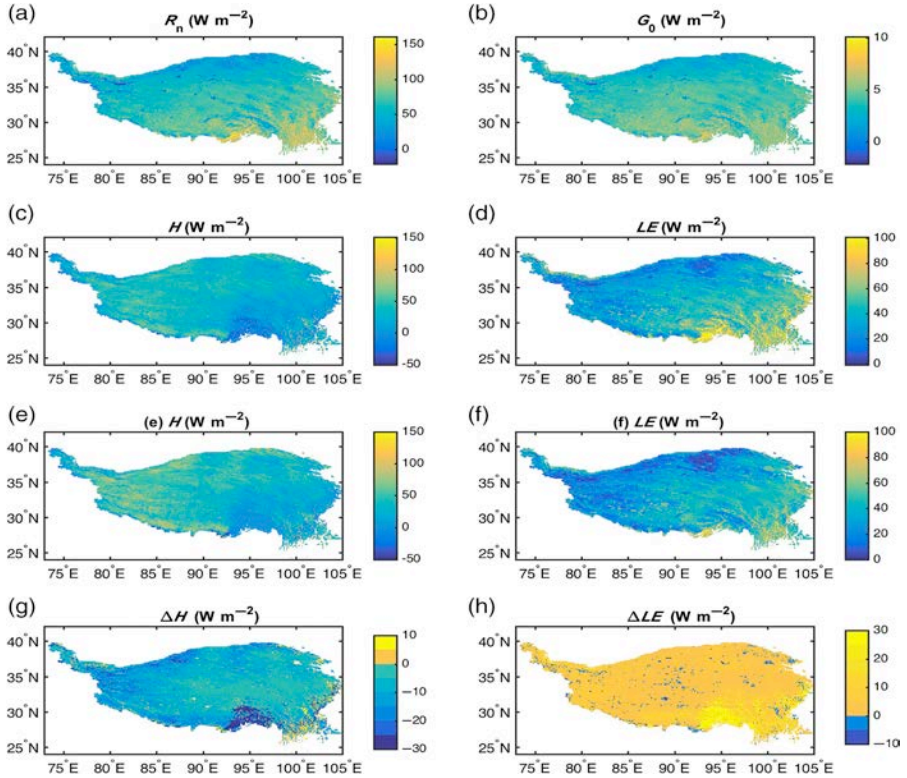
On-going Study



FY-2C LST diurnal cycle



Average annual maps of land surface heat flux values on the TP from 2001 to 2012



Effective roughness length

Traditional roughness length

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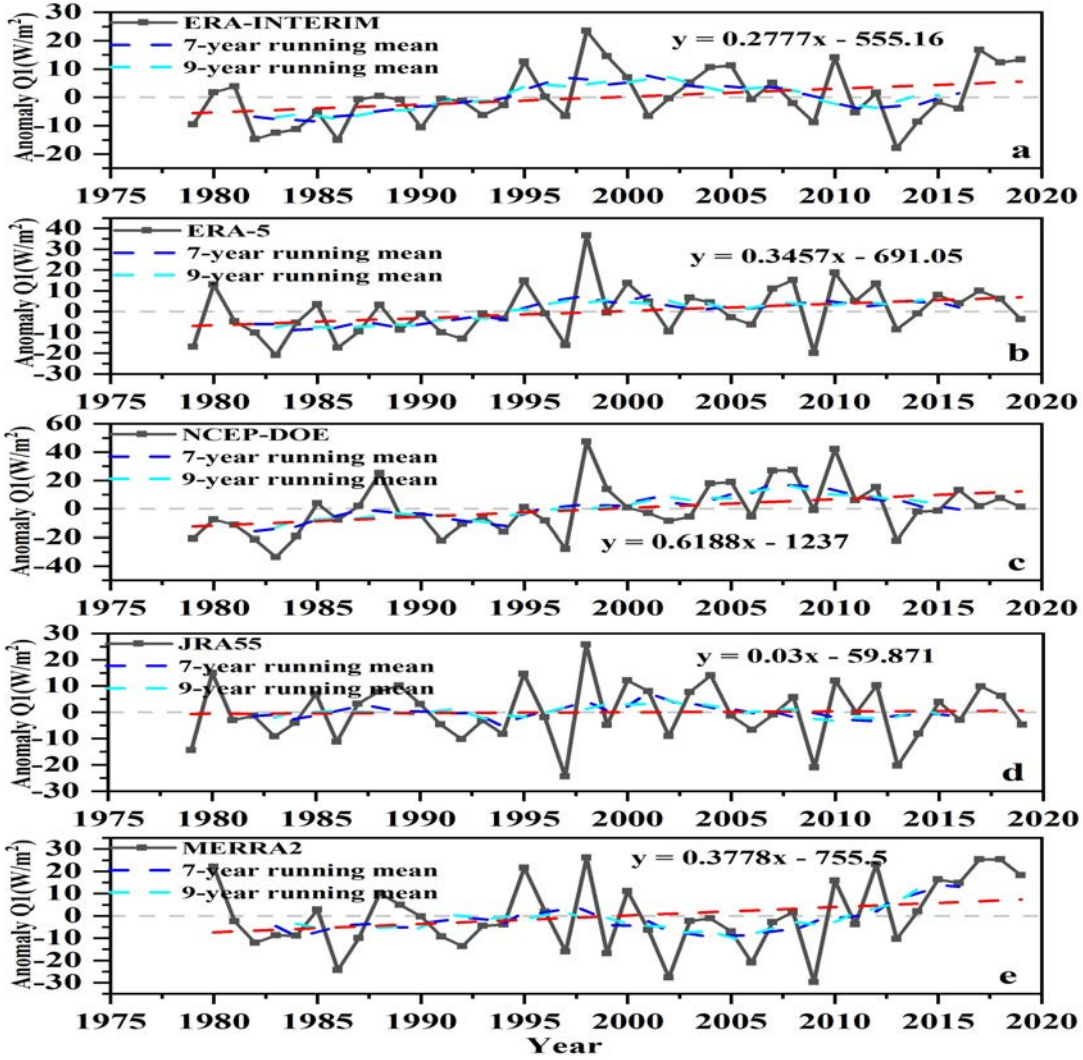
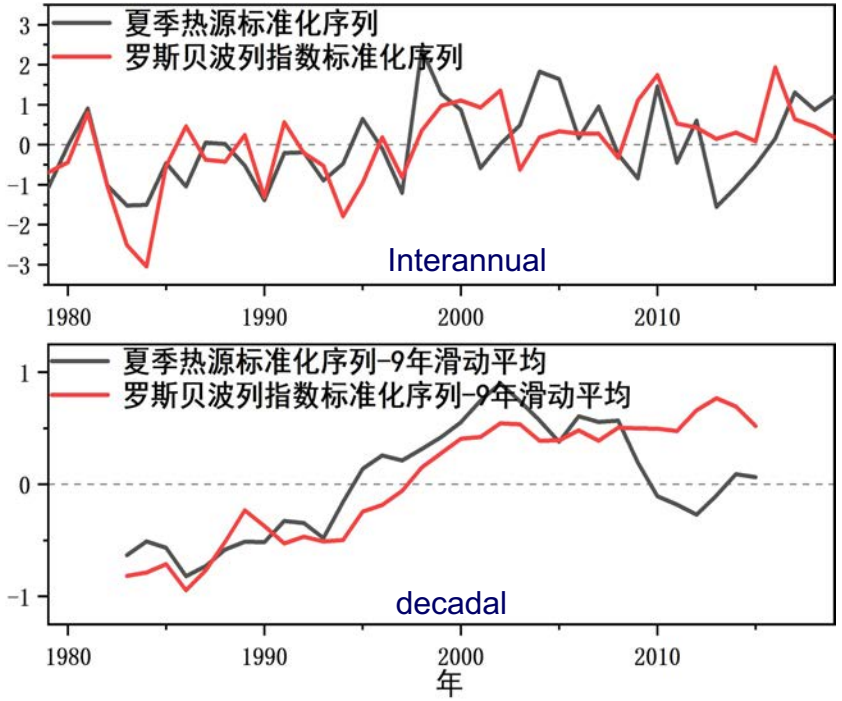


The five sets of data showed that the heat source showed a significant increasing trend in summer;

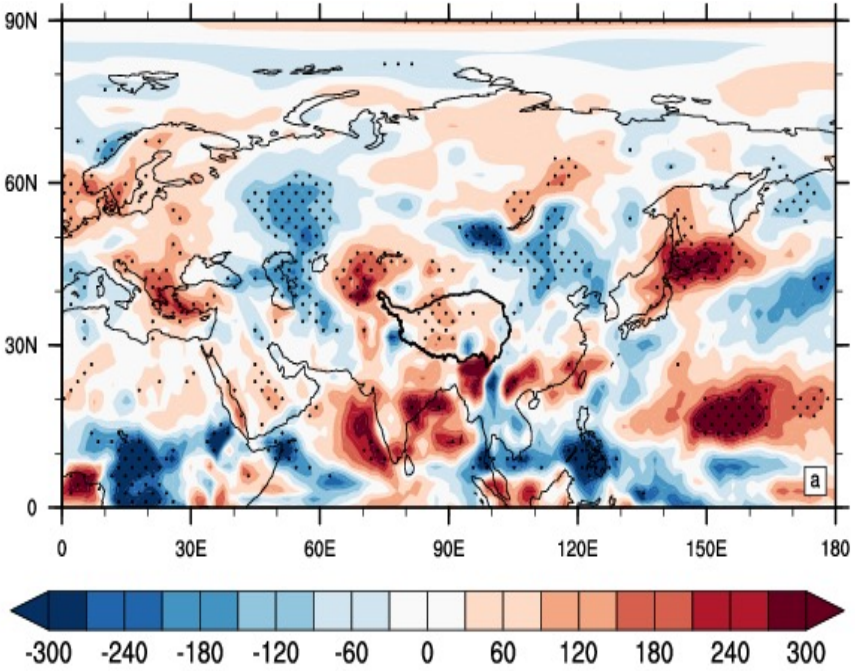
JRA55 has minimum growth trend.

Impacts of the Silk Road Pattern(SRP) on the Inter-decadal Variations of the Atmospheric Heat Source over the TP

Standardized series of teleconnection index and summer Plateau atmospheric heat source

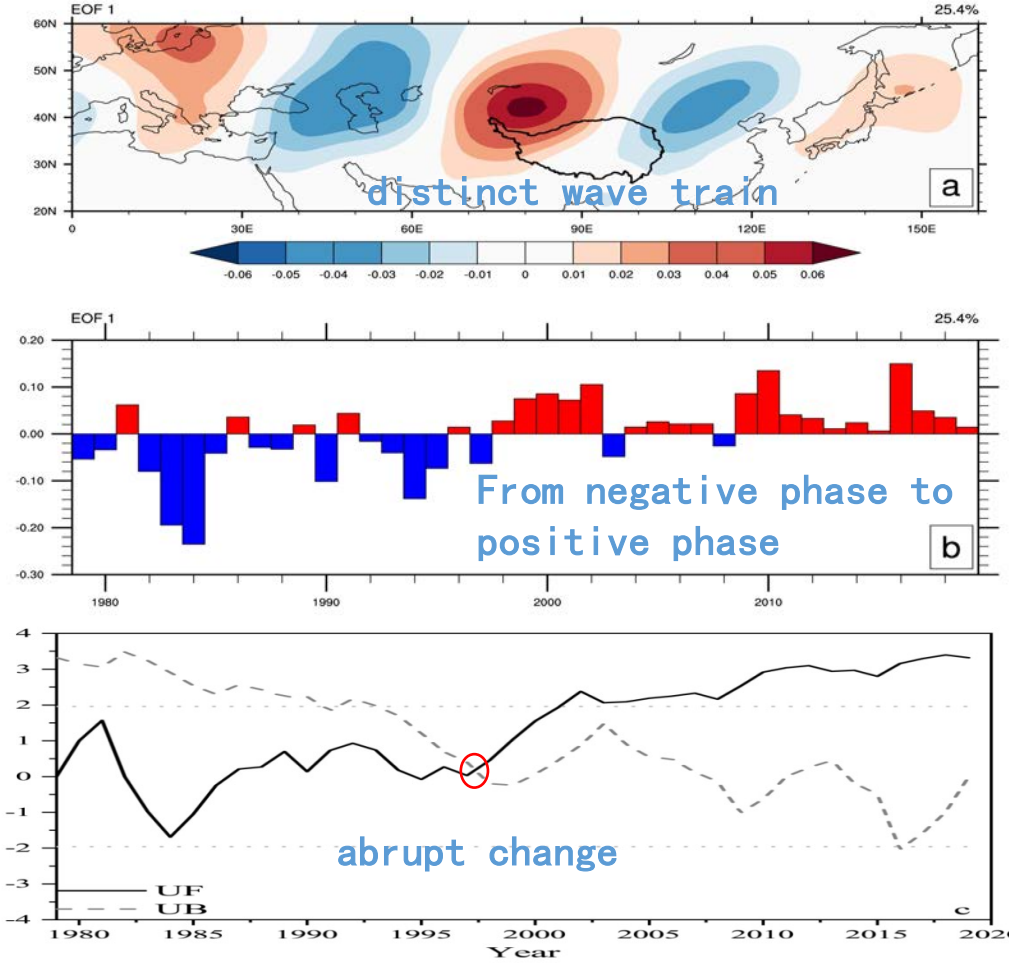


Regression of teleconnection index to summer atmospheric heat source(plot is 0.95 significance)



The Silk Road teleconnection index was significantly correlated with the change of summer plateau heat source from 1979 to 2019

The first mode of EOF in meridional wind field in 200hPa



The phase abrupt change of SRP occurred around 1997, that is, the phase changed from negative phase to positive phase .

Difference between 500hPa wind field, whole layer water vapor field and atmospheric heat source in high and low value years of SRP

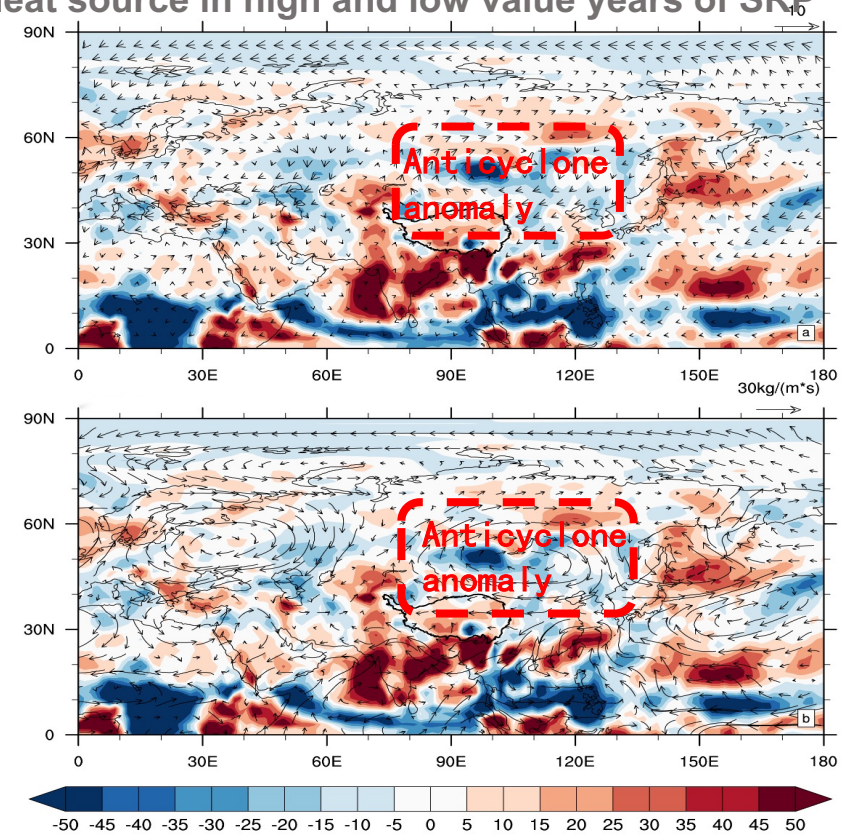
SRP index:

High value year：

1997-2019

Low value year：

1979-1996



500hPa wind field
Fill picture：
atmospheric heat source

Whole layer vapor field
Fill picture：
atmospheric heat source

SRP phase shift in summer → **Anticyclonic anomaly over Lake Baikal** → **Water vapor output was blocked and water vapor content increased** → **Atmospheric heat source is enhanced in summer**

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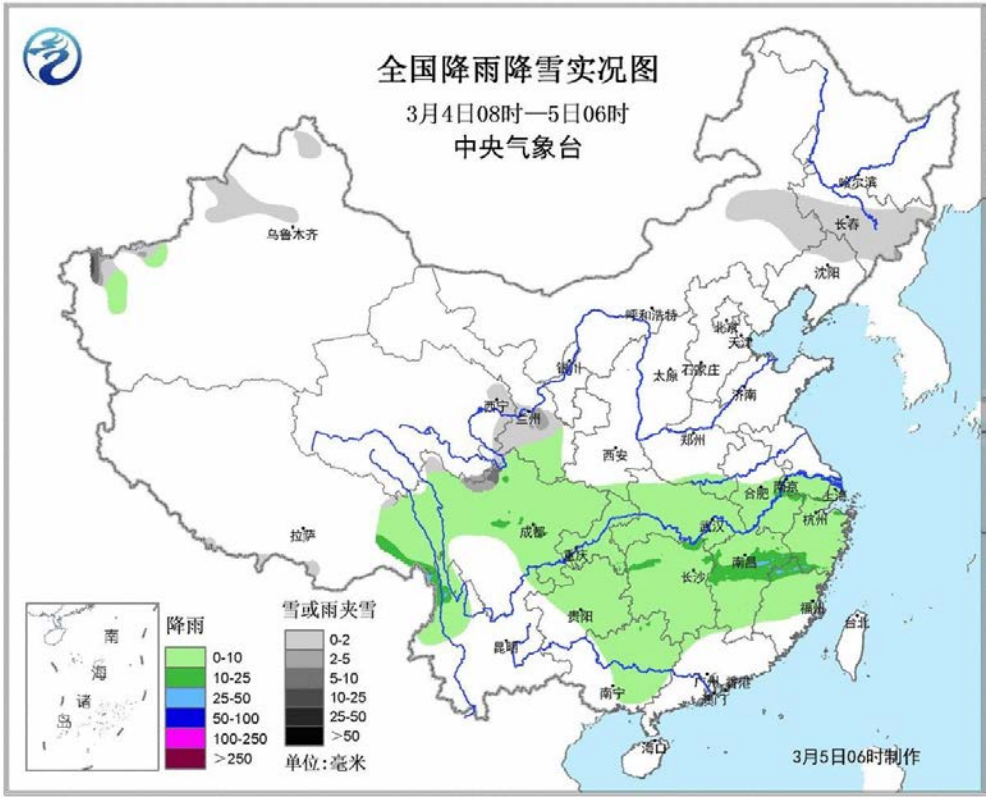
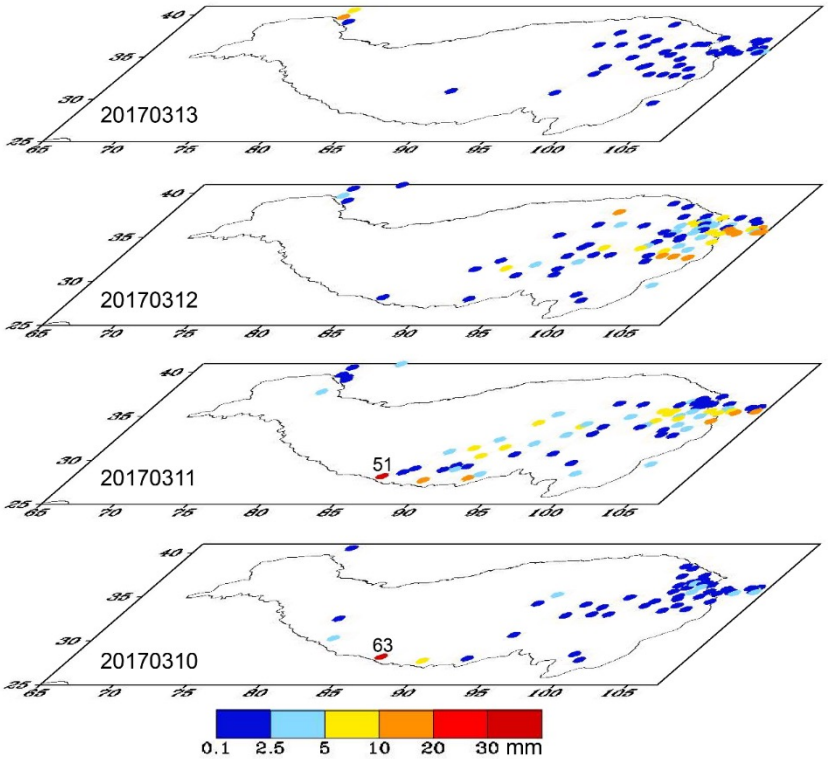
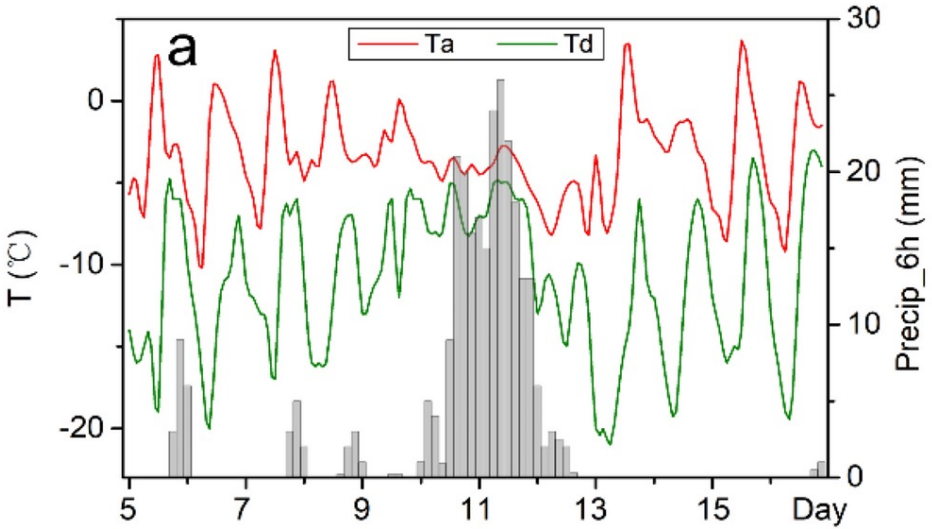
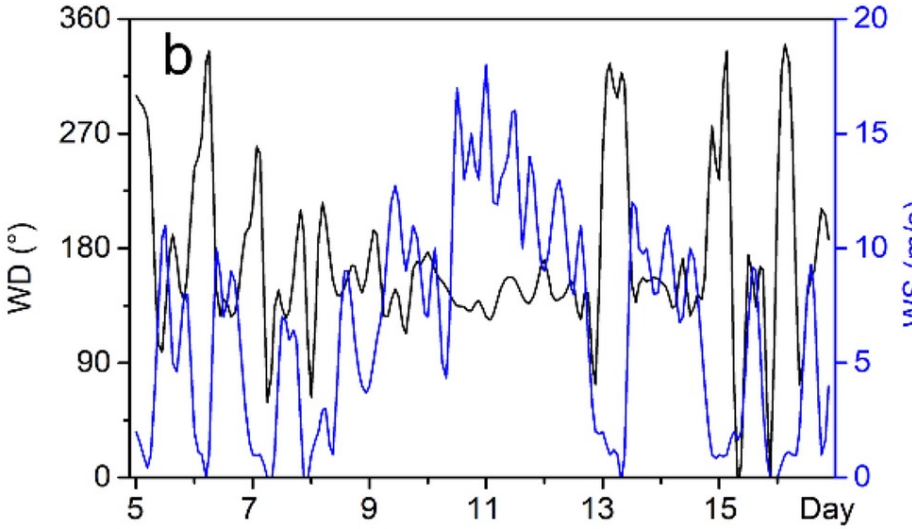
The mechanism and mechanism of a strong snowfall process over the Qinghai-Tibet Plateau





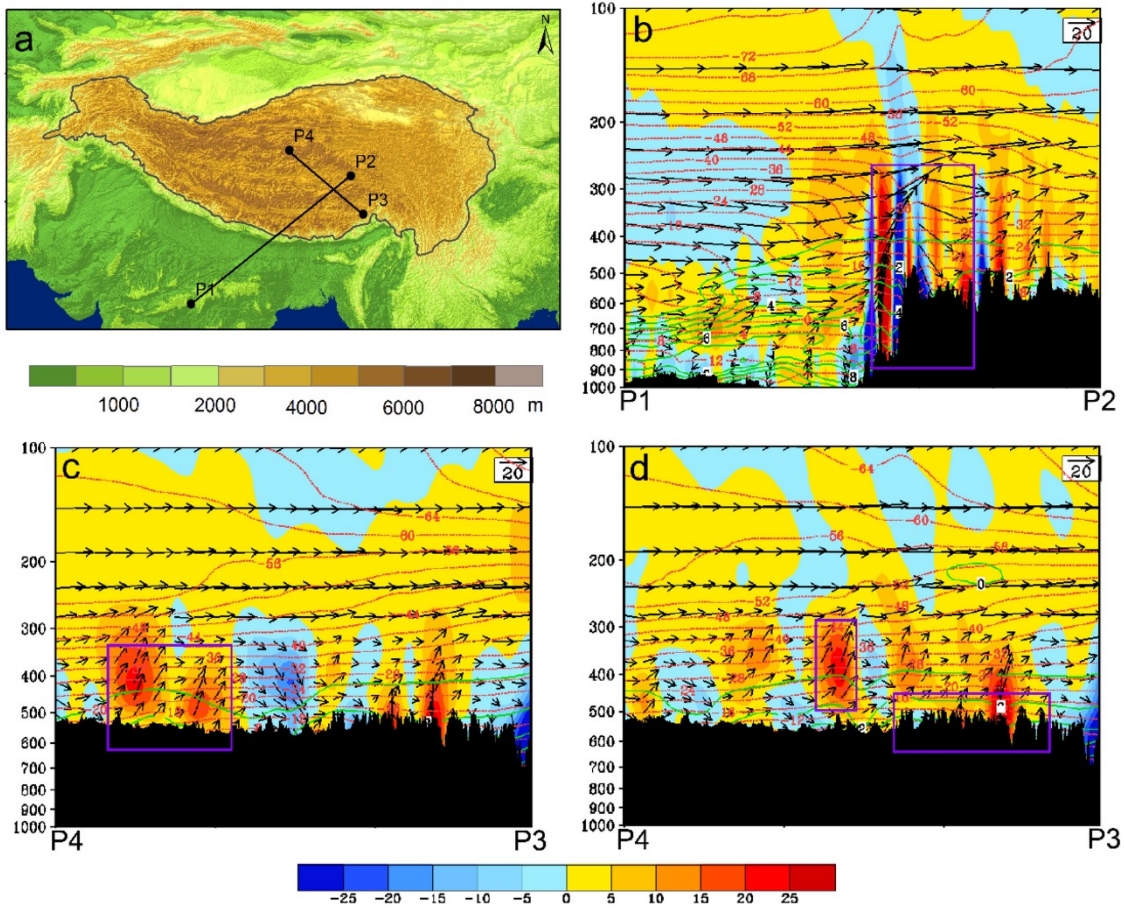
The mechanism and mechanism of a strong snowfall process over the Qinghai-Tibet Plateau





In the middle of March 2017, the average snow depth exceeded 1 m in Nyalam County, and the county suffered through its largest blizzard for recent 30 years.

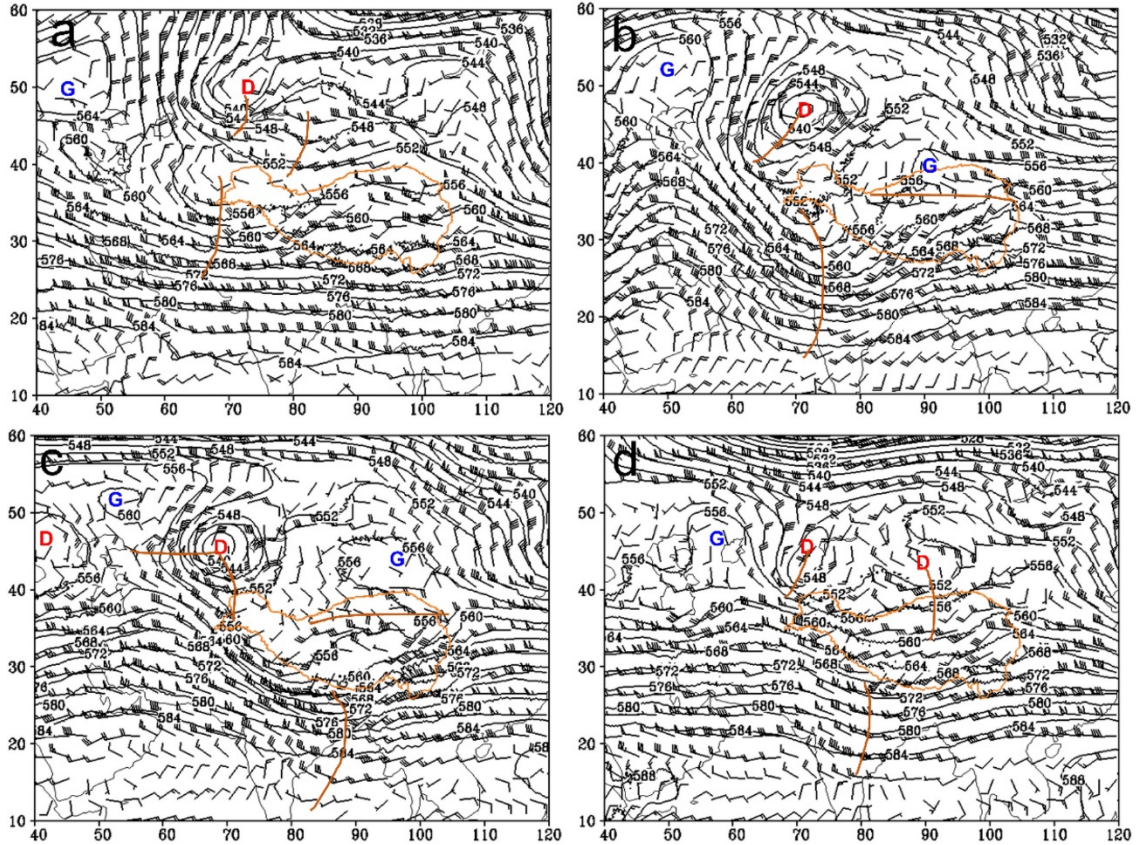
Profiles of the Conventional Meteorological Elements



Severe snowfall took place in the southern Tibetan Plateau where the maximum snow water equivalent and depth were recorded at Nyalam, and a clear narrow snow belt came into being from eastern to southern Tibetan Plateau on March 11, 2019

Model	**Non-hydrostatic WRF model version 3.7.1 coupled with CLM**
Numerical experiment configure	**Single large domain**
Boundary	**Upper right boundary: 41°N, 110°E Lower left boundary: 15°N, 65°E**
Horizontal resolution	**25km**
Dataset	**NCEP Final Analysis dataset with spatial resolution 0.25° and temporal resolution 6h**
Microphysical processes	**The Lin scheme**
Shortwave radiation	**The Dudhia scheme**
Longwave radiation	**The RRTM scheme**
Planetary boundary layer	**The YSU scheme**
Clouds	**The Kain-Fritsch cumulus parameterization scheme**

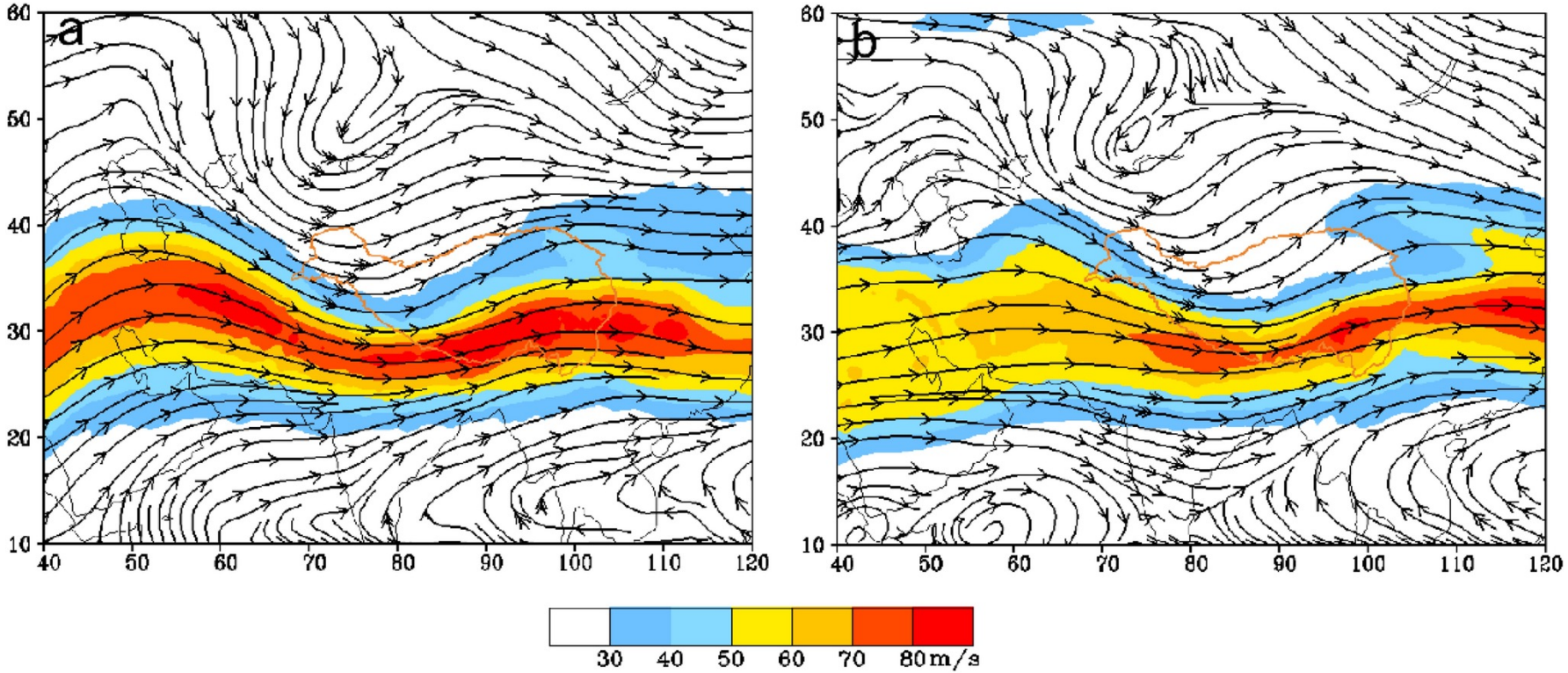
The synoptic situation



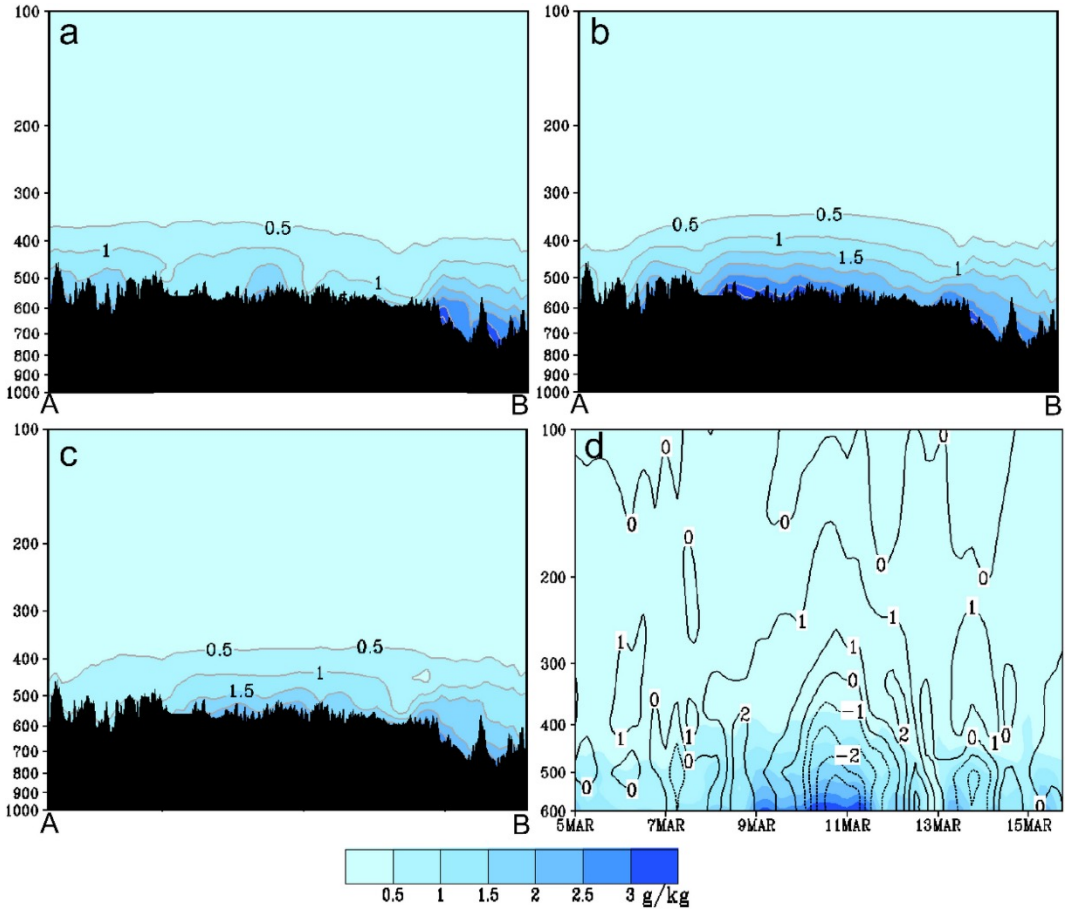
The southwesterly flow in front of the tilted trough cut off the southward movement of cold air, resulting in cold air piling up near the low-pressure center and forming a cold vortex above Lake Balkhash;

A large proportion of the Tibetan Plateau was controlled by the strong southwesterly flow in front of the Southern Branch Trough, which was conducive to water vapor transportation from Bay of Bengal to the Tibetan Plateau

The synoptic situation

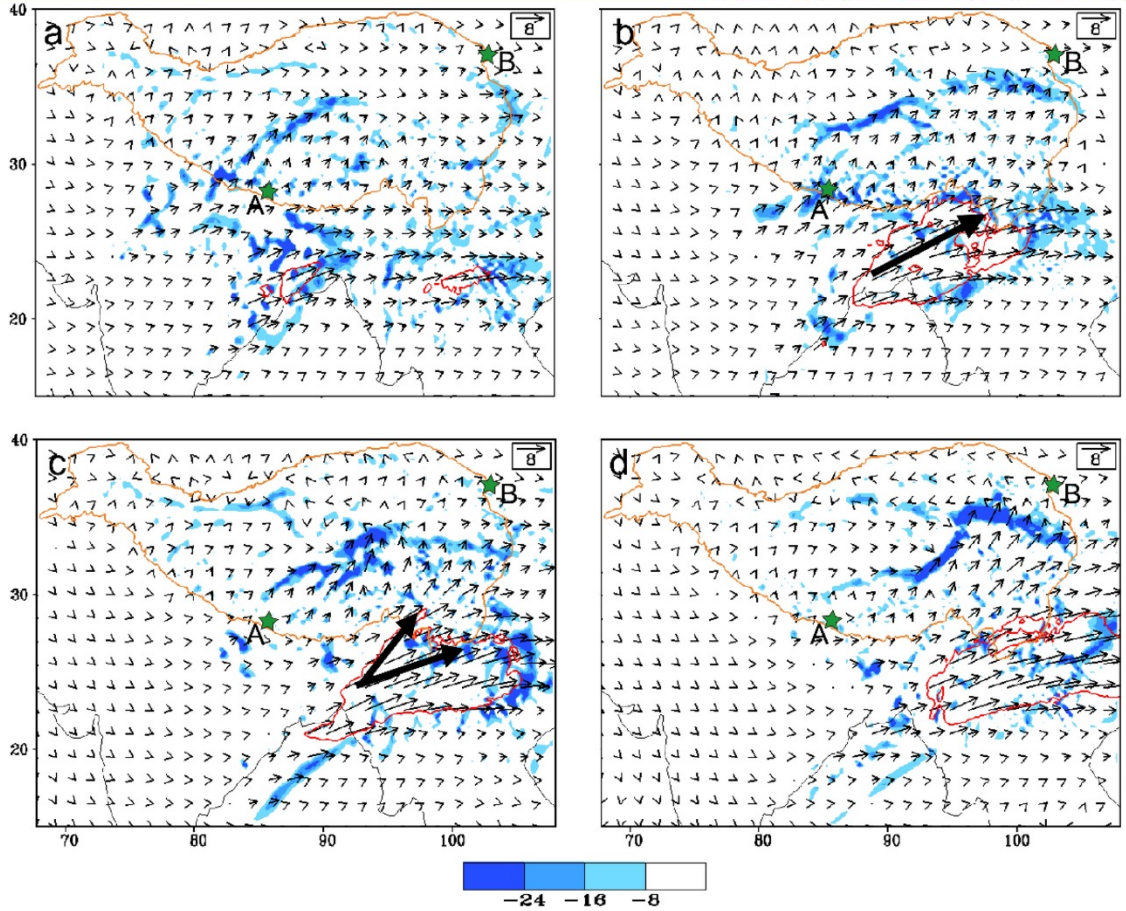


During periods of the severe snowfall event, the lower southwesterly jet sat to the south of the entire Plateau, which allowed for the development of convergence and a rising of the near surface airflow.



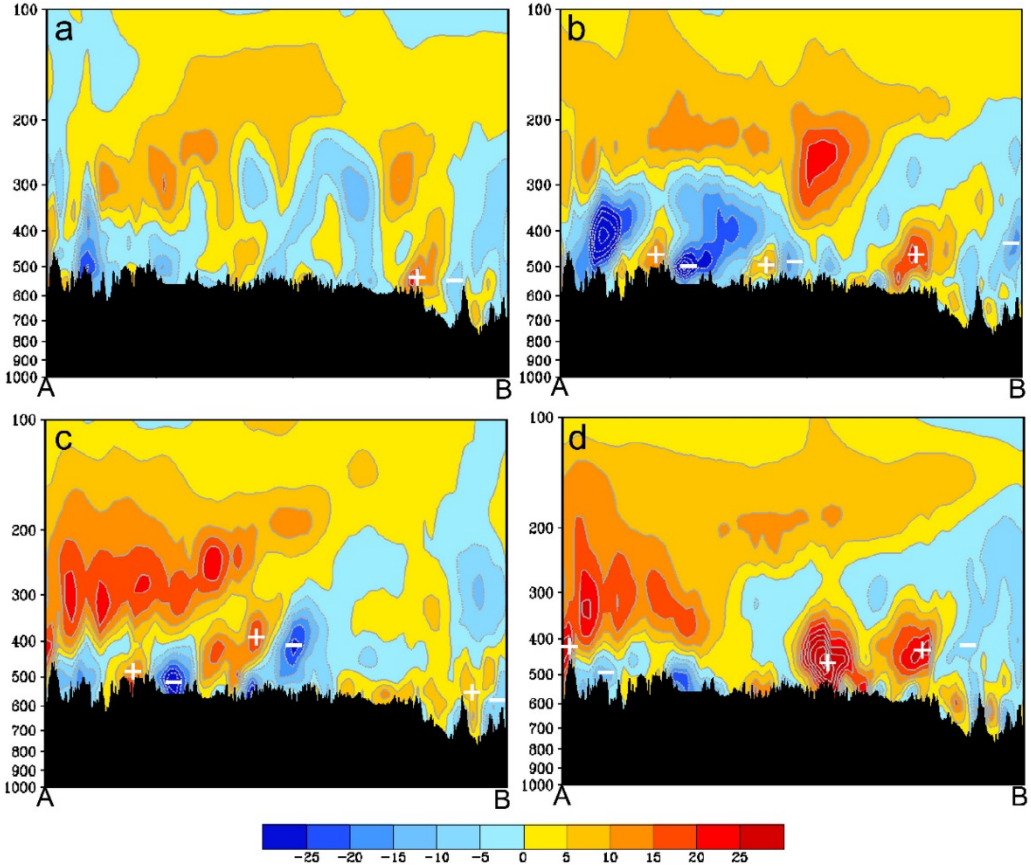
At night on March 11, the air column along the snow belt became extremely wet and deep especially in the central region, which provides considerable water vapor condition for the formation of the large-scale snow belt over the Tibetan Plateau.

Meteorological diagnosis analysis



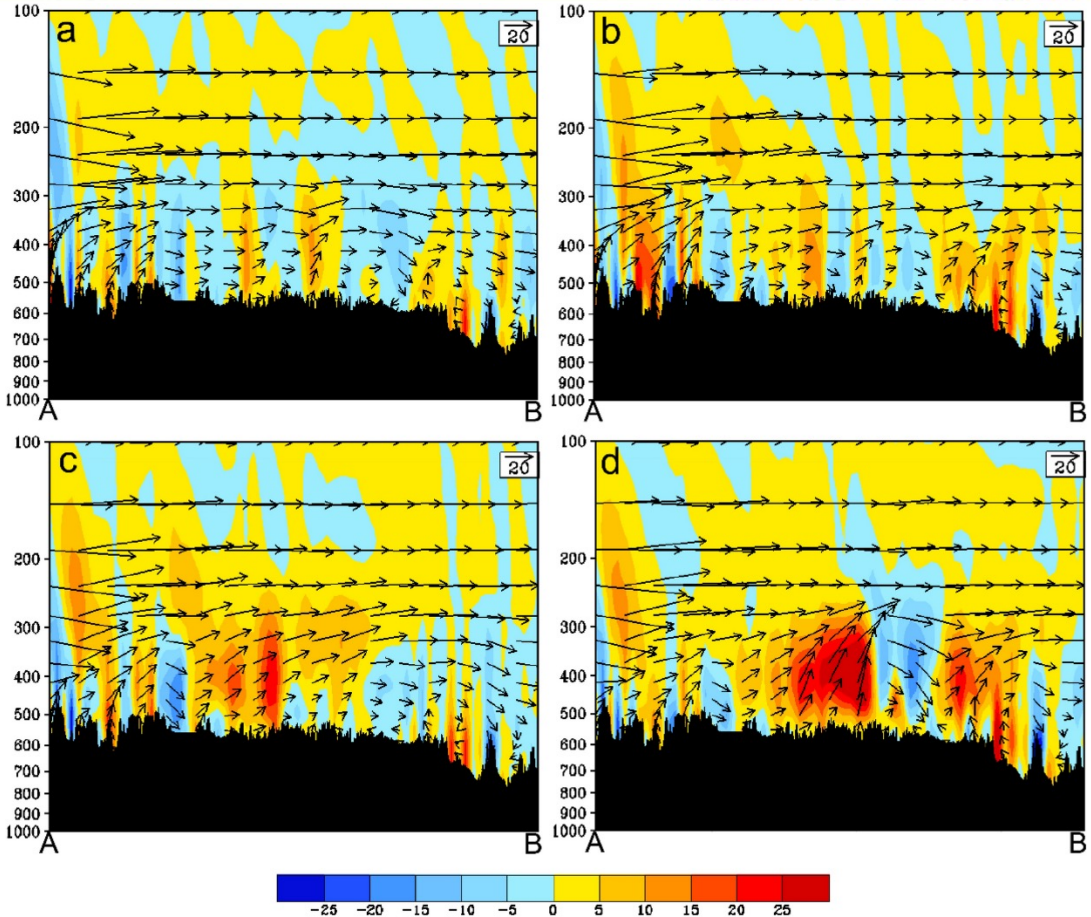
Water vapor in northern India was transported to the northeast, an obvious water vapor flux convergence belt formed on the Plateau

Dynamic Conditions

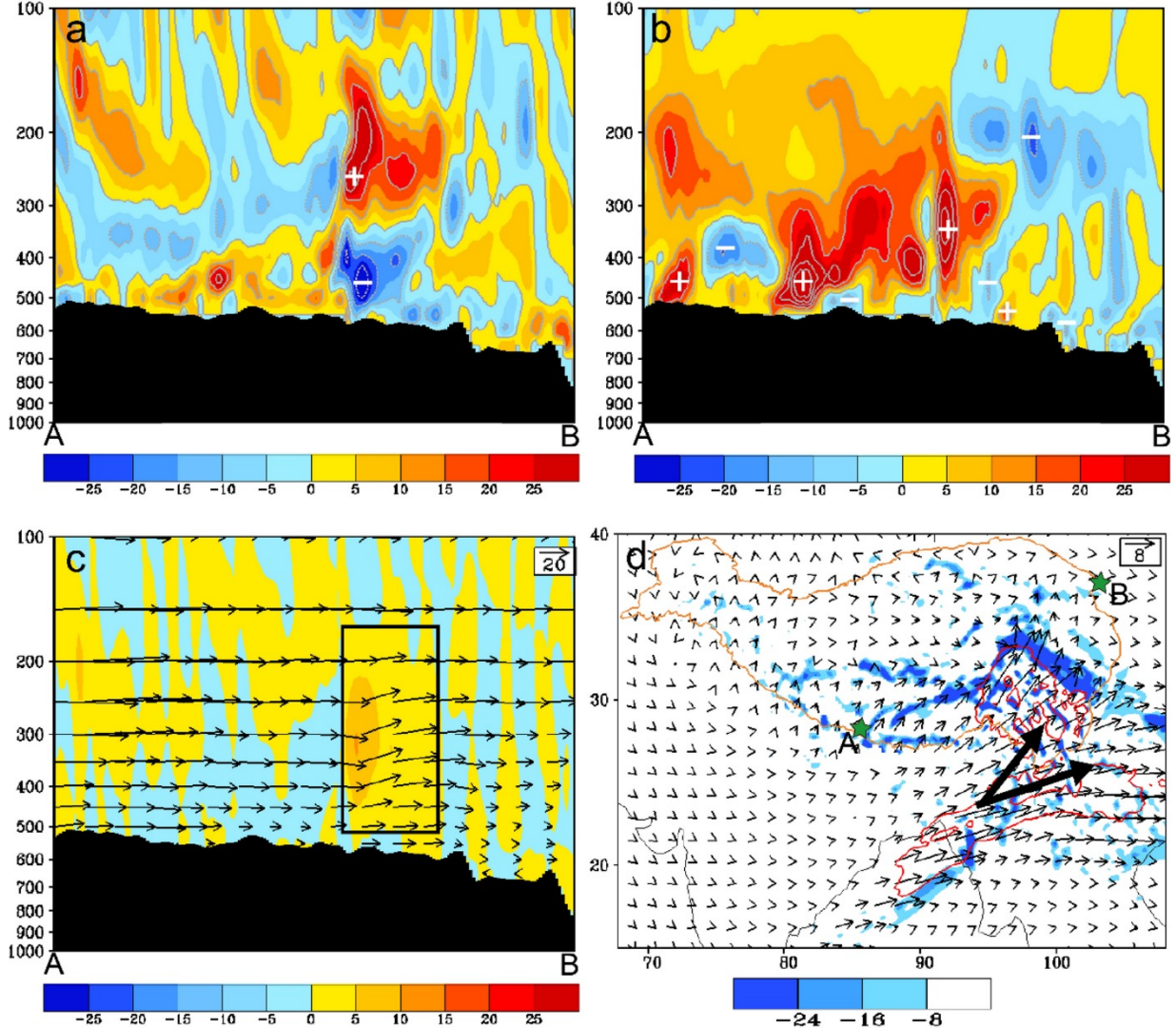


Low-level positive and negative vorticity closely arranged along the snow belt during the period of the snowfall event;
Positive vorticity advection was very strong to the east of this maximum, shown by dense isovorticity lines(d).

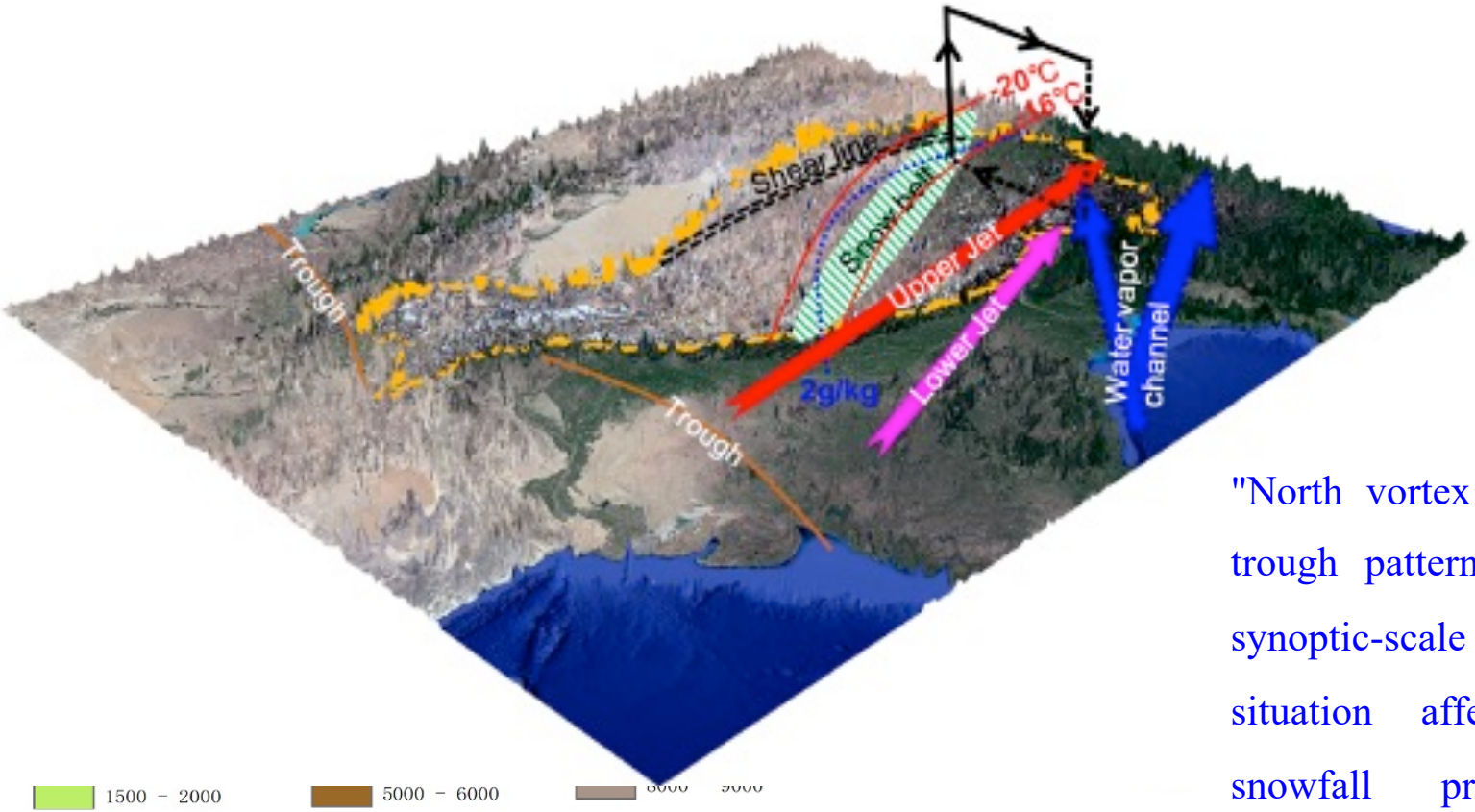
Dynamic Conditions



Positive vorticity advection, lower wind convergence and upper wind divergence all enhance ascending motion, and strong ascending motion is closely related to heavy snowfall.



WRF simulated dynamic and water vapor conditions at 20:00 BST on March 11 when snowfall strengthened in the central snow belt.



Comprehensive map of weather situation, factor allocation and snowfall area

"North vortex and south trough pattern" is main synoptic-scale circulation situation affecting the snowfall process in March 10, 2017.

Young scientists

Weiqiang Ma (Prof. CAS “Hundred Talent”百人计划) (land surface processes, remote sensing)

- Lei Zhong (Prof. “Outstanding youth fund”基金委优秀青年基金) (land surface processes, monsoon climate), Xuelong Chen (Prof. CAS “Hundred Talent”百人计划)
- Maoshan Li (Prof.) (land surface processes, land surface modeling)
- Binbin Wang (Prof.) (land surface processes, remote sensing)
- Cunbo Han(Prof.) (land-atmosphere interactions)
- Chao Xu (Post-D) (remote sensing of aerosol)
- Madan Sigdel (Asso. Prof.) (land surface processes)
- Zhangwei Ding (Post-D) (land surface process)
- Mijun Zou(PhD student) (land surface processes, monsoon climate)
- Yang Wang(PhD student) (ocean-atmosphere interaction)
- Yizhe Han, Jie Xu, Xingyue Gu, Yuanyuan Hu, Jiahe Lang, Wei Hu, Yuan Ling, Surong Mingzhu, Zhang Yachun(Msc)

Academic exchanges

Academic exchanges & cooperation

Provide update & outcomes on:

- Two PhD students have been sent to European partner for joint training (Su Rongmingzhu, Wang Fangfang)

joint publications

Joint publications

1. Yaoming Ma*,W.Ma*,H.Dai，L.Zhang, F.Sun，J. Zhang, N.Yao，J.He， Z. Bai,Y. Xuan,Y.Zhan，Y.Yuan，C.Yang，W. Sun，P.Zhao, M.Ding, K.Zhu，J.Hu，Bian Bazhuga, Bai Juepingcuo, Z.Ma, R. Qingnima, Suo Langwangdui, Yang Zong, H.Wen, 2022, Earth summit mission 2022: Scientific expedition and research on Mt. Qomolangma helps reveal the synergy between westerly winds and monsoon and the resulting climatic and environmental effects, Advances in Atmospheric Sciences, doi: 10.1007/s00376-022-2166-3.
2. Yaoming Ma,L.Zhong*,Z.Su,2022, Energy and Water Cycles in the Third Pole， Water, 14, 1175, doi:10.3390/w14071175.
3. Yaoming Ma*, B. Wang*, X. Chen, LZhong, Z.Hu, W.Ma, C.Han, M.Li, 2022, Strengthening the three-dimensional comprehensive observation system of multi-layer interaction on the Tibetan Plateau to cope with the warming and wetting trend, Atmospheric and Oceanic Science Letters,15, 100224 doi:10.1016/j.aosl.2022.100224.
4. Wang,Y., Z.Ding, Yaoming Ma*,2022, Data processing uncertainties may lead to an overestimation of the land carbon sink of the Tibetan Plateau, Proceedings of the National Academy of Sciences of the United States of America, 119(24), e2202343119, doi: 10.1073/pnas.2202343119.
5. Liu, L., M.Menenti, Yaoming Ma*, W.Ma, 2022, Improved parameterization of snow albedo in WRF + Noah: Methodology based on a severe snow event on the Tibetan Plateau, Advances in Atmospheric Sciences, doi:10.1007/s00376-022-1232-1.
6. Liu, L., M.Menenti, Yaoming Ma*, 2022, Evaluation of Albedo Schemes in WRF Coupled with Noah-MP on the Parlung No. 4 Glacier. Remote Sensing, 14, 3934,doi: 10.3390/rs14163934.
7. Wang,Y., J.Xiao, Yaoming Ma*, Y.Luo,Z.Hu, F.Li, Y.Li, L.Gu, Z.Li, L.Yuan,2021, Corrigendum to “carbon fluxes and environmental controls across different alpine grassland types on the Tibetan Plateau” [Agr. Forest Meteorol. 311(2021) 108,694], Agricultural and Forest Meteorology, 312, 108724, doi: 10.1016/j.agrformet.2021.108714.

For more detailed, please check:
http://sourcedb.itpcas.cas.cn/cn/expert/200907/t20090706_2001505.html

Summary on progress and collaboration

- ✓ Field work in TP and Pan-TPE regions
- ✓ Cooperation in education
- ✓ Visit and training each other

Plans for the next 2 years

Focus on project goals and gradually achieve our desired goals

- ✓ Continue field work in TP and Pan-TPE
- ✓ Enhance the joint training of graduate students
- ✓ Visit each other in EGU, AGU, AOGS and related conference
- ✓ Meet with new questions and discuss at any time by using WeChat and related new media


Thank you !