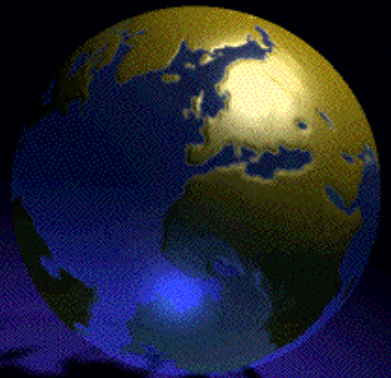
# The new LASG/IAP and ICES partnership



# Himalayas = Third Pole

- The Himalaya Project has been conceived by ICES to improve communication and collaboration among governments, academic and commercial organizations in the 16 nations that are either bordering, exercising jurisdiction or directly impacted by events occurring in the Himalayan region,

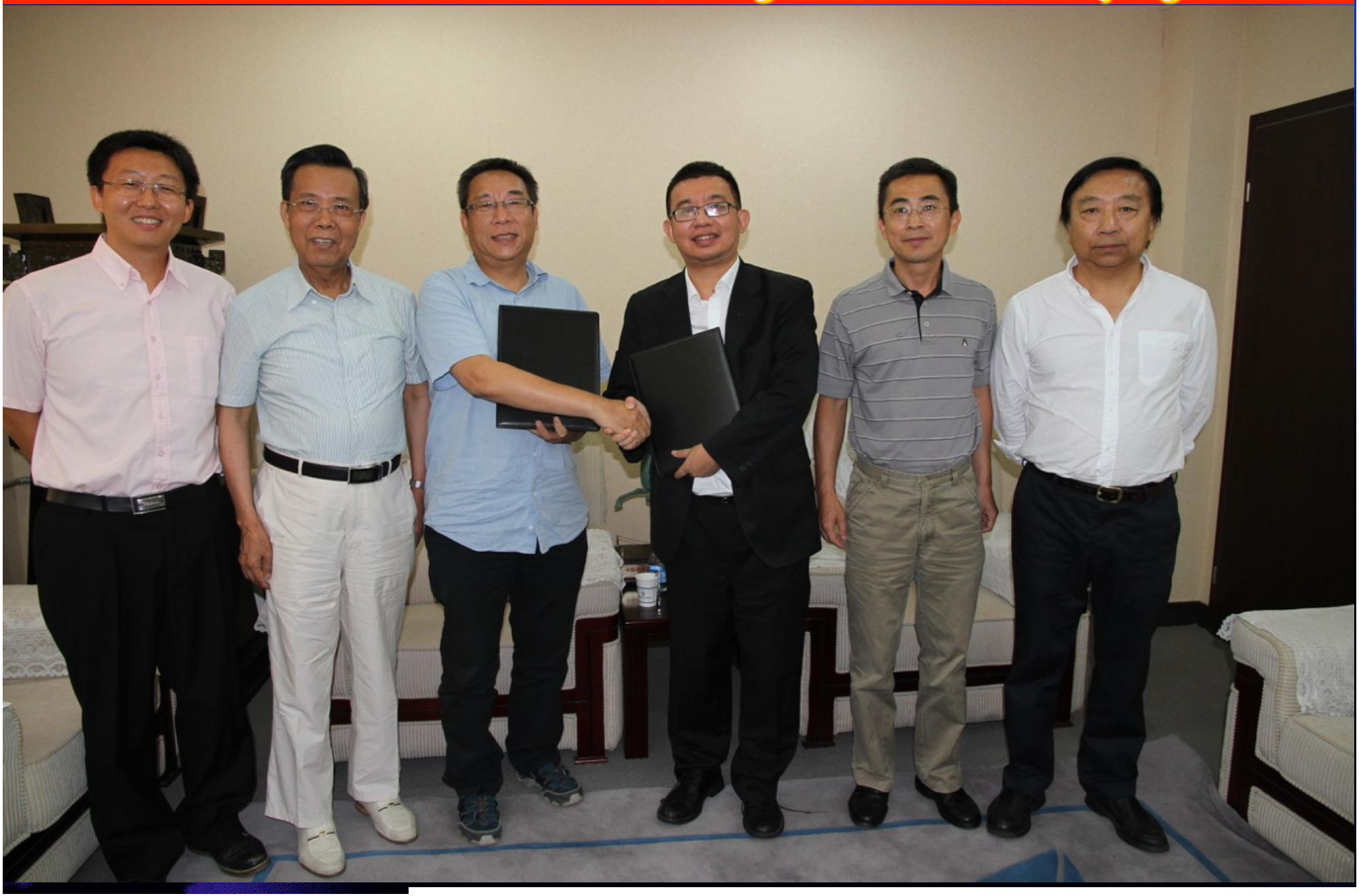
# Why LASG/IAP and ICES

- LASG is top-ranking Key State Laboratory in China under IAP/CAS
- 80+ Scientists focused on Asian Monsoon
- LASG can become the lead Asian resource in the ICES Himalaya Project

# Objectives of Xue Zengyun

- Personal introductions: BB-Prof Wu
- Initiate negotiations ICES-IAP/CAS
- Visitation to LASG by BB
- Build an ICES-IAP/CAS contract

# Signature of Cooperation Agreement signing between LASG/IAP and ICES, Aug 19, 2015, Beijing



# Introduction of the

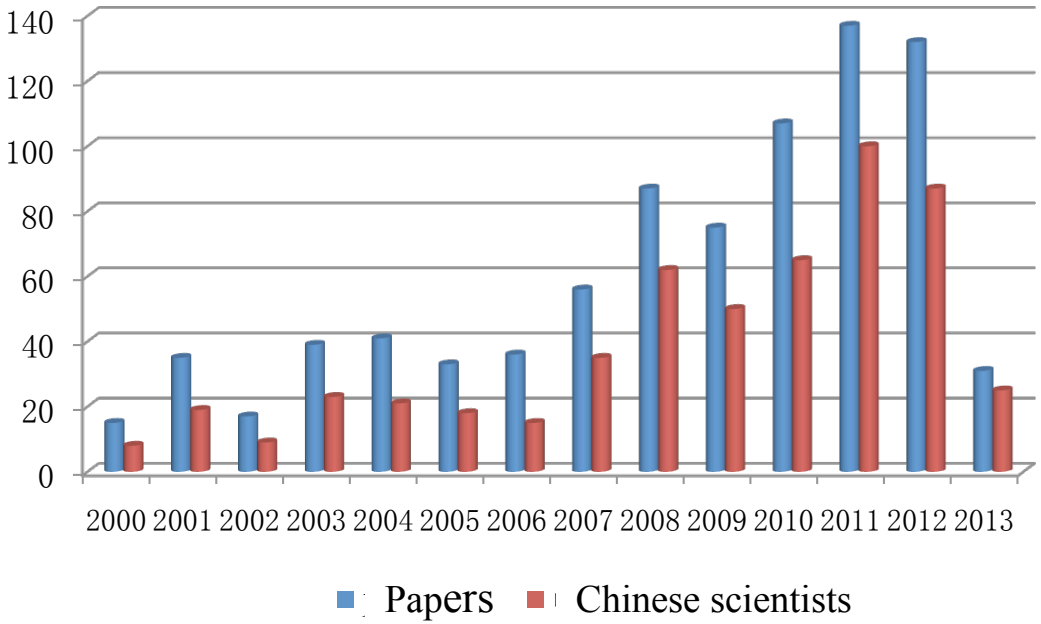
# Asian Centre for Earth System Simulation" ("ACESS")

# And the Himalaya sub-Projects

Guoxiong Wu, Bob Bishop and Aaron Xue

Funding Goal：200 Million RMB

Period：Jan. 2014- Dec. 2023



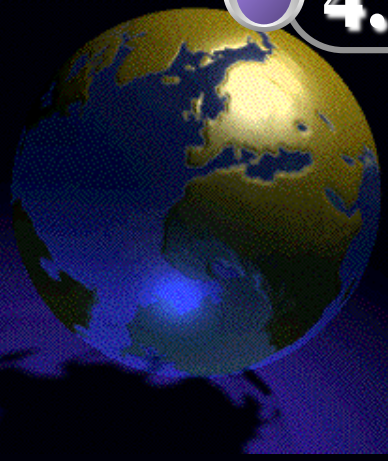

| Year | Annual Papers | Chinese scientists | Ratio(China/total) |
|---|---|---|---|
| 2000 | 15 | 8 | 0.5333333 |
| 2001 | 35 | 19 | 0.5428571 |
| 2002 | 17 | 9 | 0.5294118 |
| 2003 | 39 | 23 | 0.5897436 |
| 2004 | 41 | 21 | 0.5121951 |
| 2005 | 33 | 18 | 0.5454545 |
| 2006 | 36 | 15 | 0.4166667 |
| 2007 | 56 | 35 | 0.625 |
| 2008 | 87 | 62 | 0.7126437 |
| 2009 | 75 | 50 | 0.6666667 |
| 2010 | 107 | 65 | 0.6074766 |
| 2011 | 137 | 100 | 0.729927 |
| 2012 | 132 | 87 | 0.6590909 |
| 2013 | 31 | 25 | 0.8064516 |

# Annual Publications related to TP impacts in the past 10 years

**（From：Web of Science，International Mainstream SCIs（IF>1.8））**

# Outline

1. Science significance
2. Current issues, Obs Infrastructure
3. Research content, implement plans
4. Why ACESS Himalaya projects



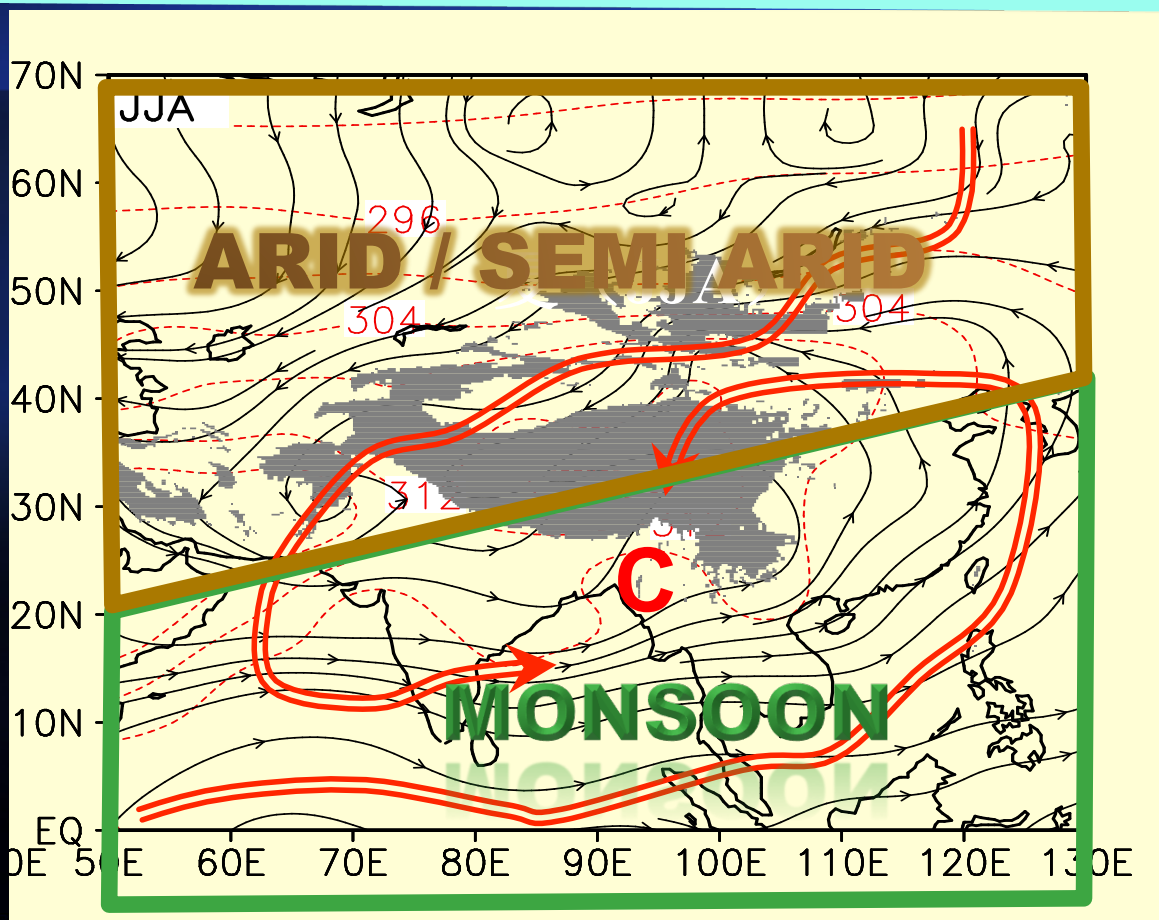
# I. Science significance

**Scale-** crossing the Eurasian continent, one quarter of China's territory


亚洲地形图

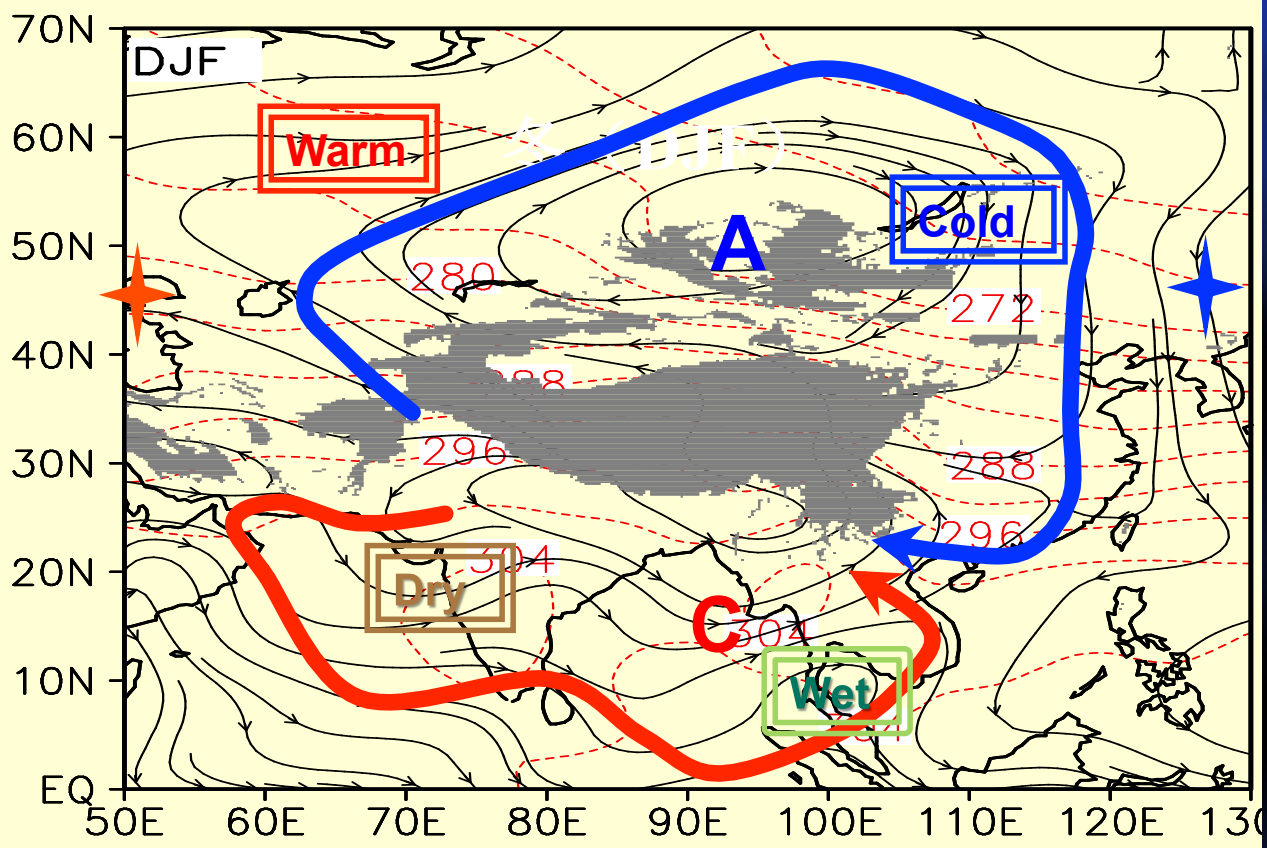
➢ generates continental- scale stationary waves

# TP and Asian Climate- Summer



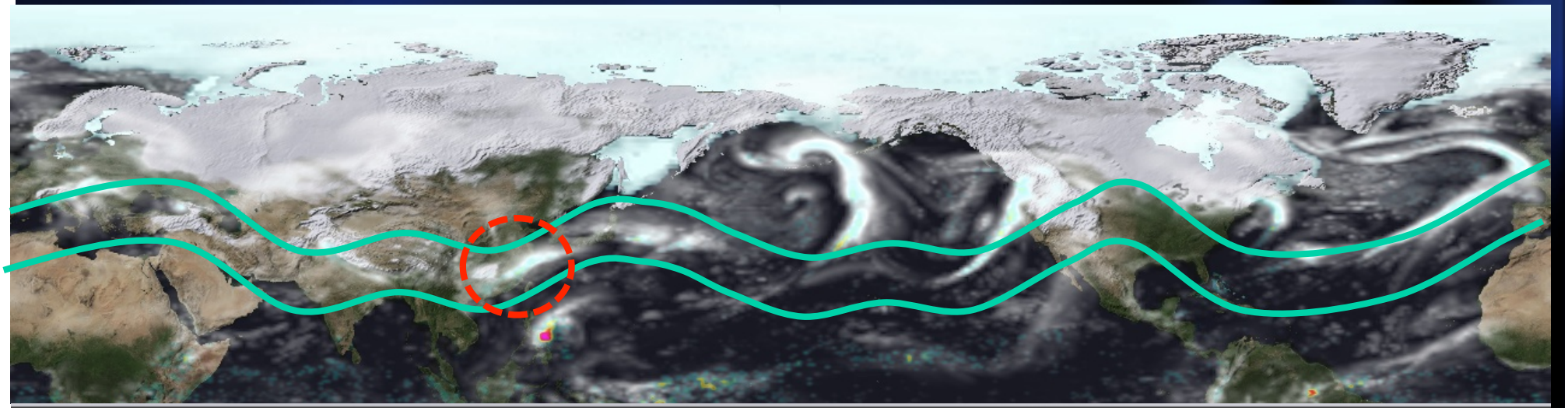

- Summer: generates continental-scale stationary waves

# TP and Asian Climate- Winter




➢ **Winter: generates continental-scale stationary waves**

# Tibetan Plateau affects boreal circulation and climate via Rossby-wave propagation



NUGAM (N216 HadGAM1a) 7 AUG 1978 23h UTC

Model by the UJCC Team and UKMO/NCAS collaborators: http://www.earthsimulator.org.uk

Movie by: R. Stöckli (NASA Earth Observatory, USA) and P.L. Vidale (NCAS, UK)

UK-Japan Climate Collaboration

NASA EARTH SIMULATOR Met Office

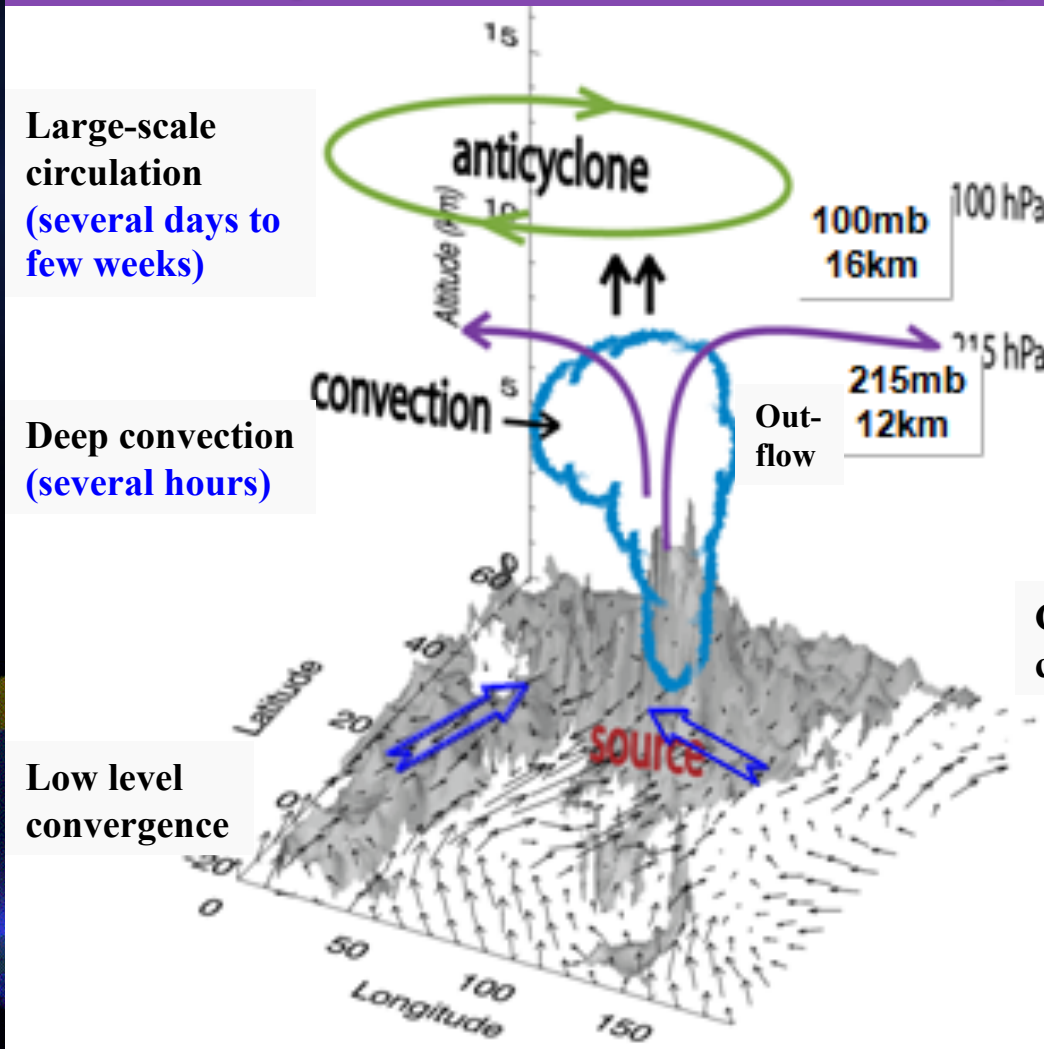
# Height- above 8km in the upper troposphere

## TP is the main path for pollutants being transported into the stratosphere in summer

**Large-scale circulation** (several days to few weeks)

**Deep convection** (several hours)

**Low level convergence**




**Limitation of anti-cyclone** (pathway to stratosphere)

**Large-scale transport** (+ penetrate convection?)

**Convective transport (diurnal cycle)**(outflow height is 200hPa)

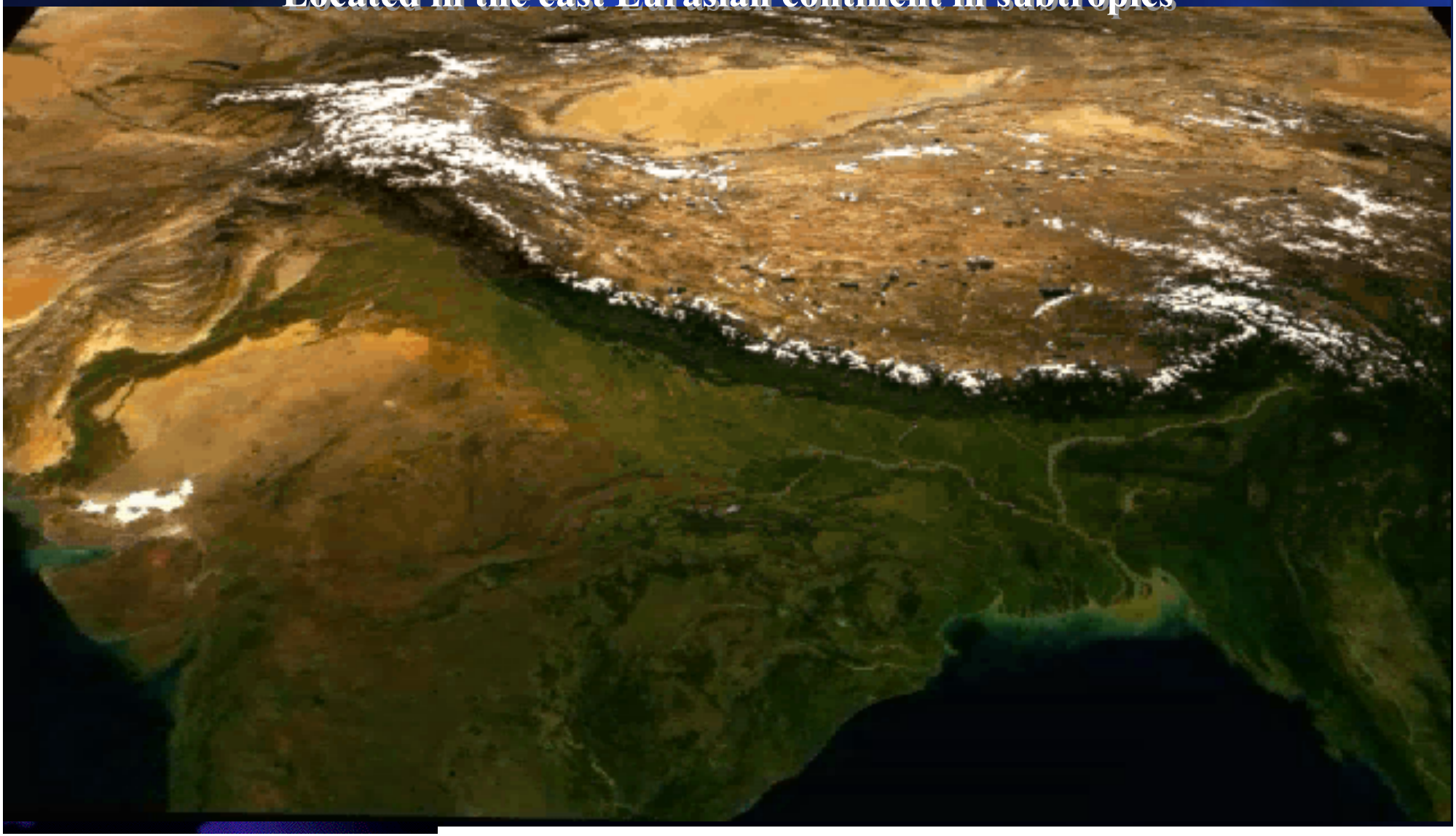
**Surface substance** (TP and surrounding regions)

Park et al, JGR, 2009

# Slope－Steeper topography in the southern and eastern flanks

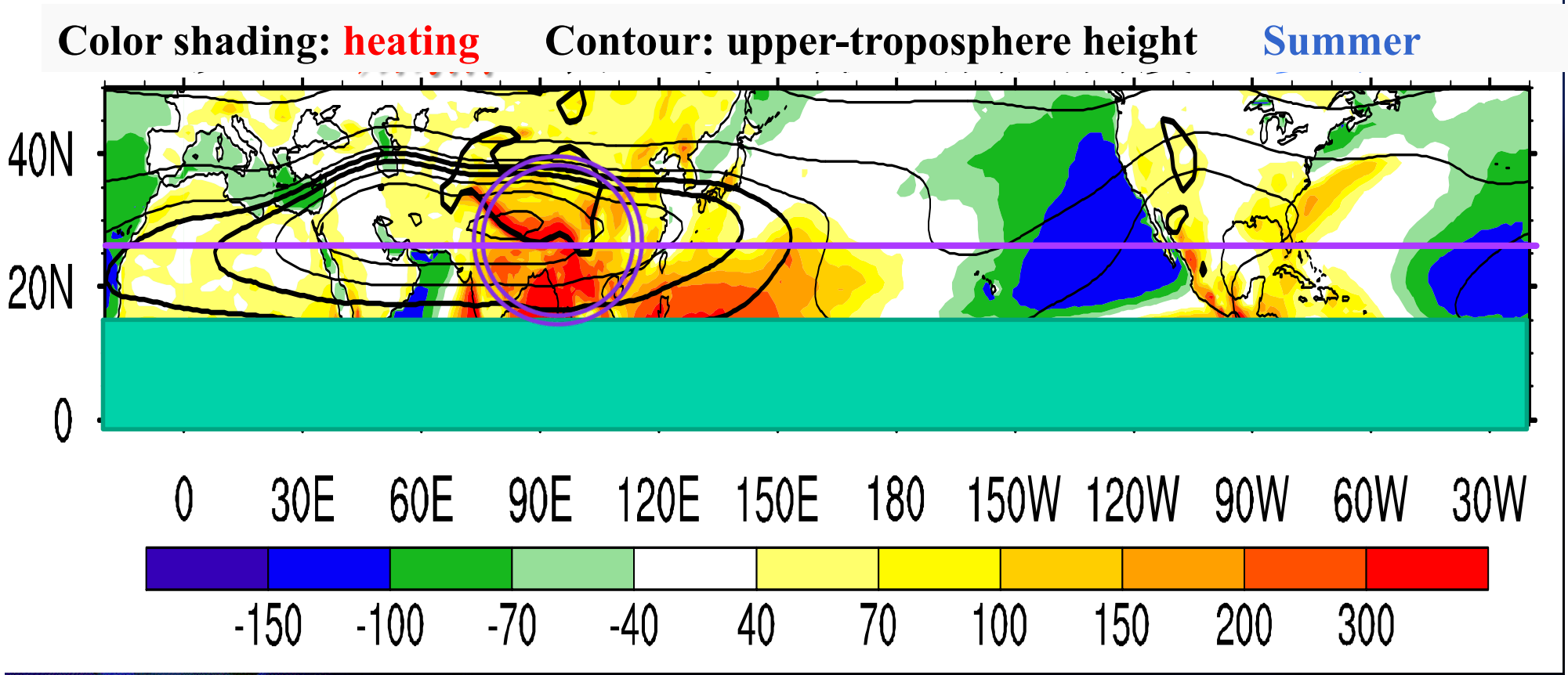
**Averaged height is 4 km; Area is 1/4 ~ 2.5 m km$^2$ of China territory**

**Located in the east Eurasian continent in subtropics**



# Slope—steep in the south and east flanks

**The strongest subtropical heating locates over south slope of TP and Bay of Bengal in boreal summer, and the South Asian High dominates the Eurasian continent; the heating influences the north hemisphere.**




Liu YM et al.，2004， J Climate

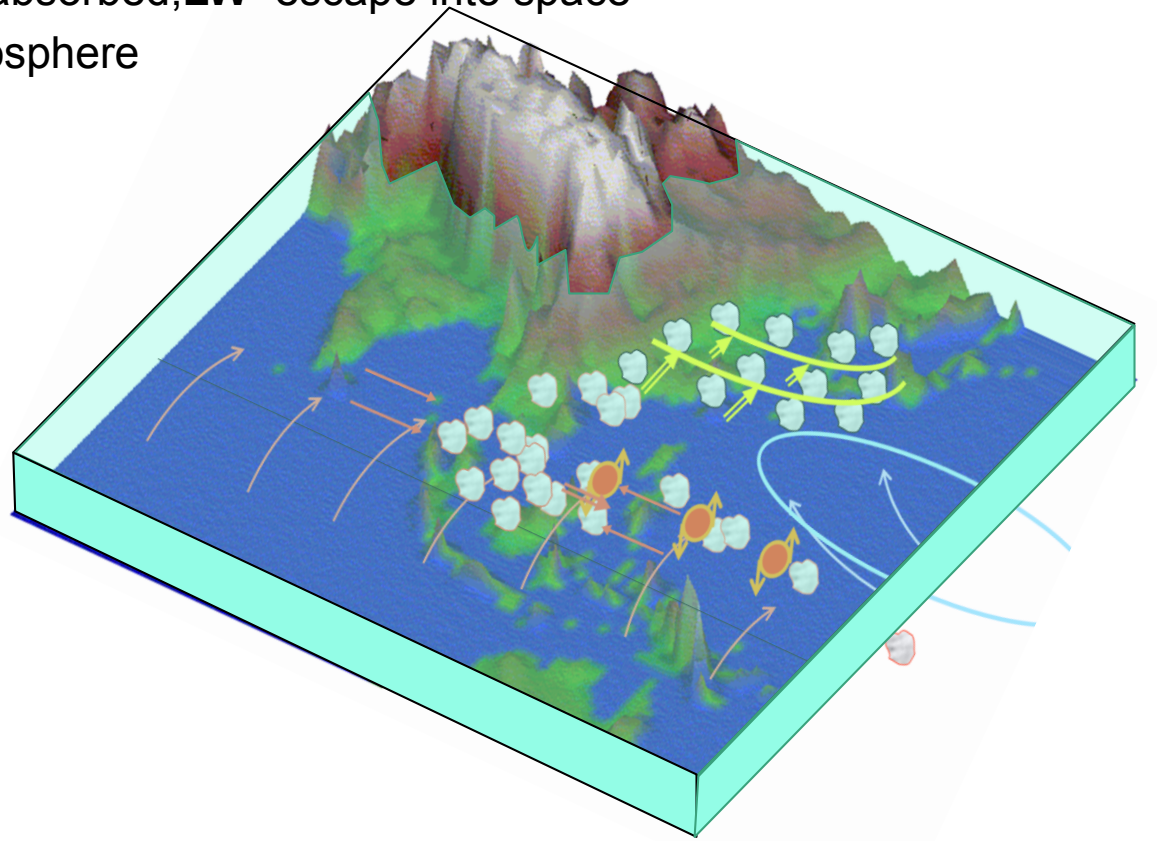
# TP Sensible heating drive air pump (SHAP)—water vapor lifted—Asian monsoon

A. **Monsoon- water vapor:** 85% resides bellow 700mb

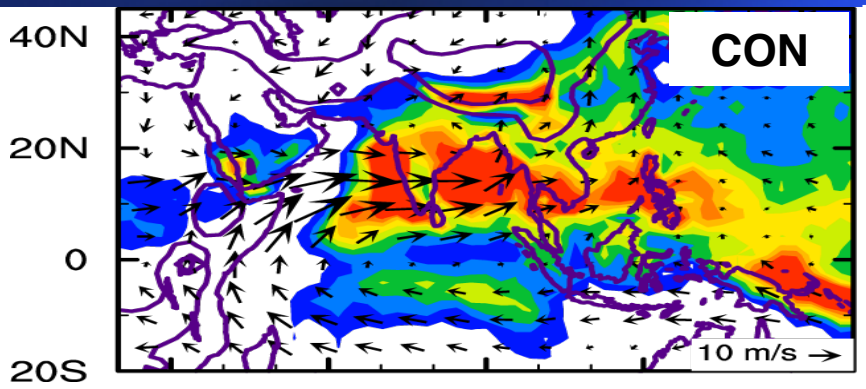
B. **Lifting:**

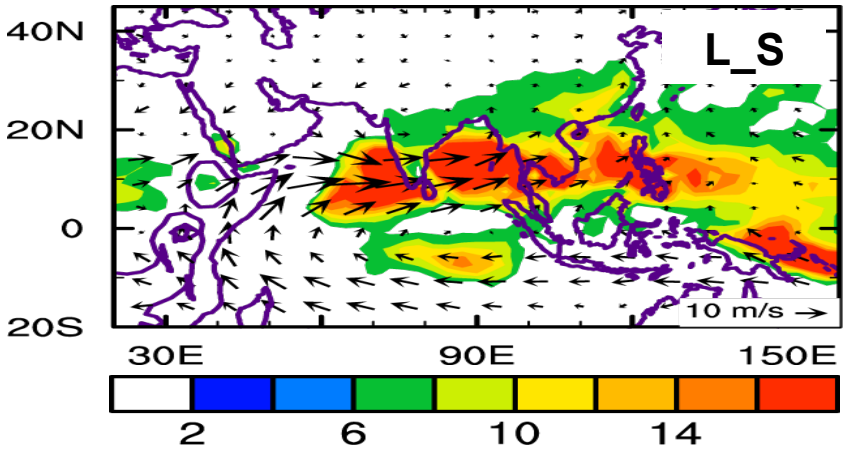
- **Internal- baroclinity:** winter and extratropics
- **External- mechanical:** deflected or lifted <1km
- **External- thermal: SW-** hardly absorbed;**LW-** escape into space

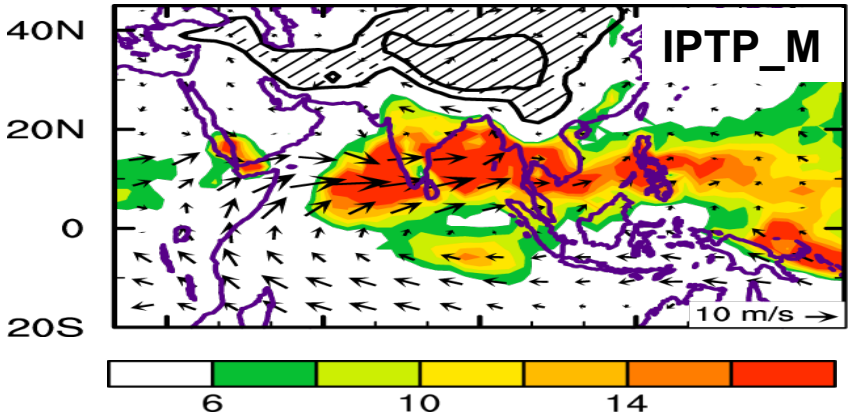
- **Latent heating-** in the free atmosphere
- **Surface Sensible heating**
  **- effective!---mountain slope**

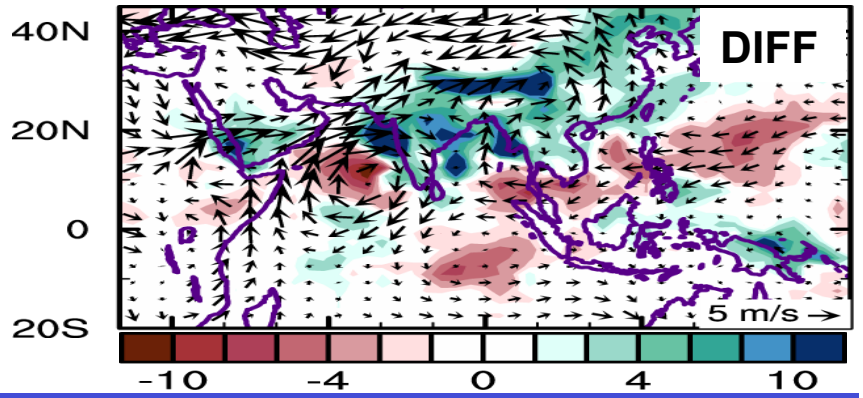


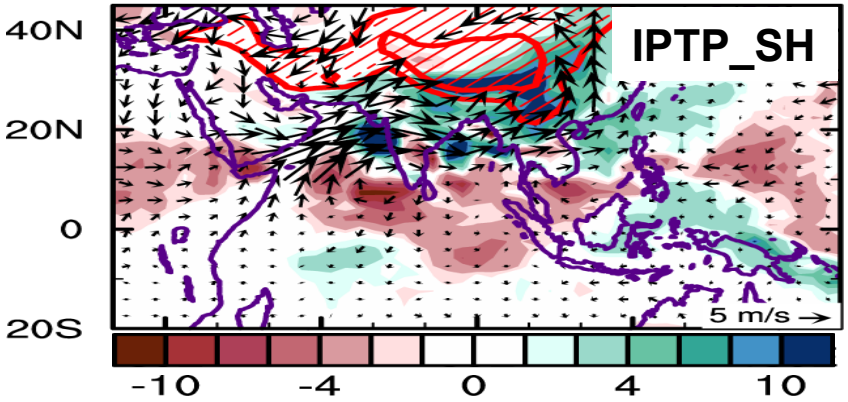
# Impacts of mountain mechanical ~thermal forcing



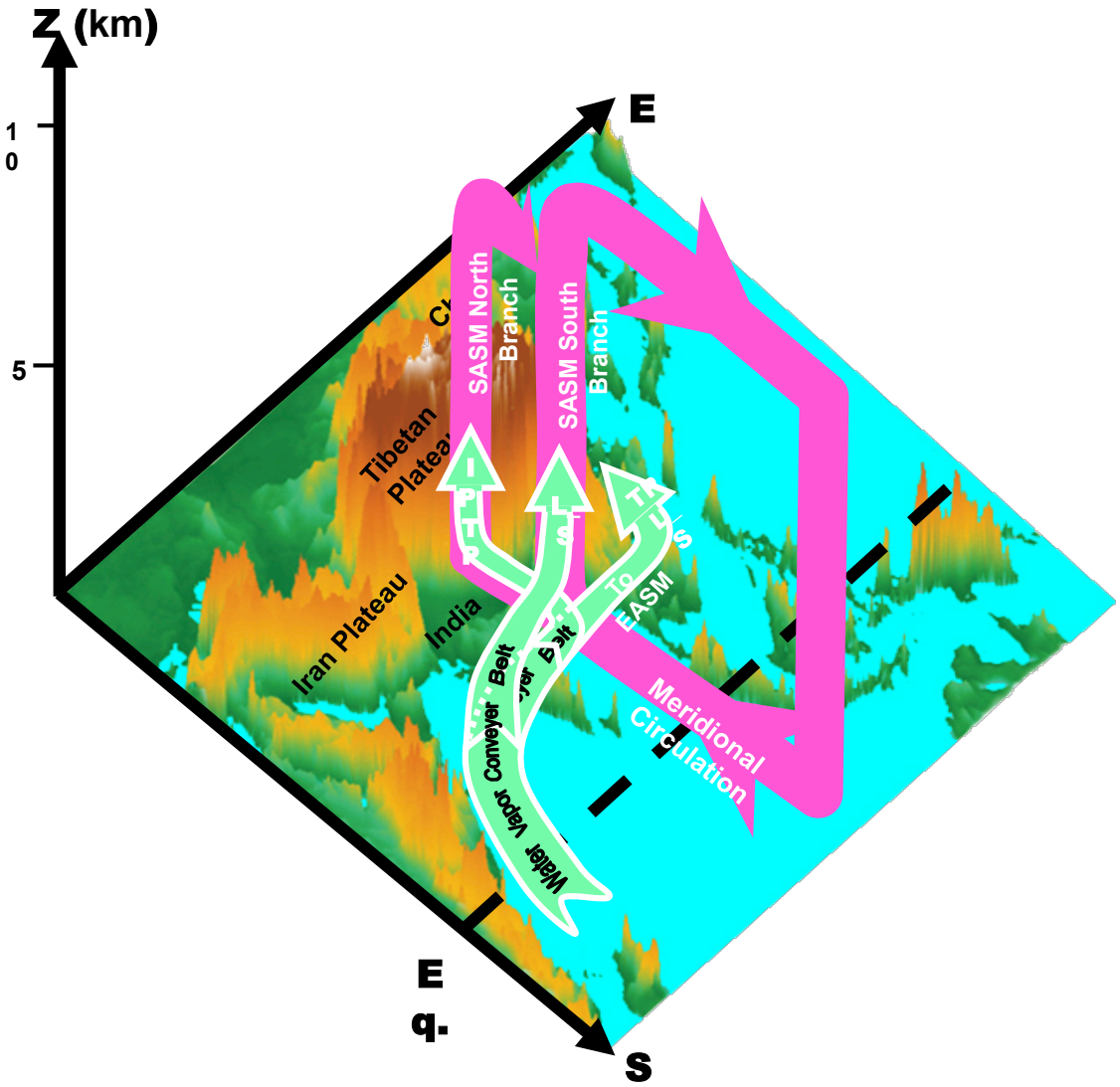




Required Circul. and Precip. to make up the Asian summer monsoon

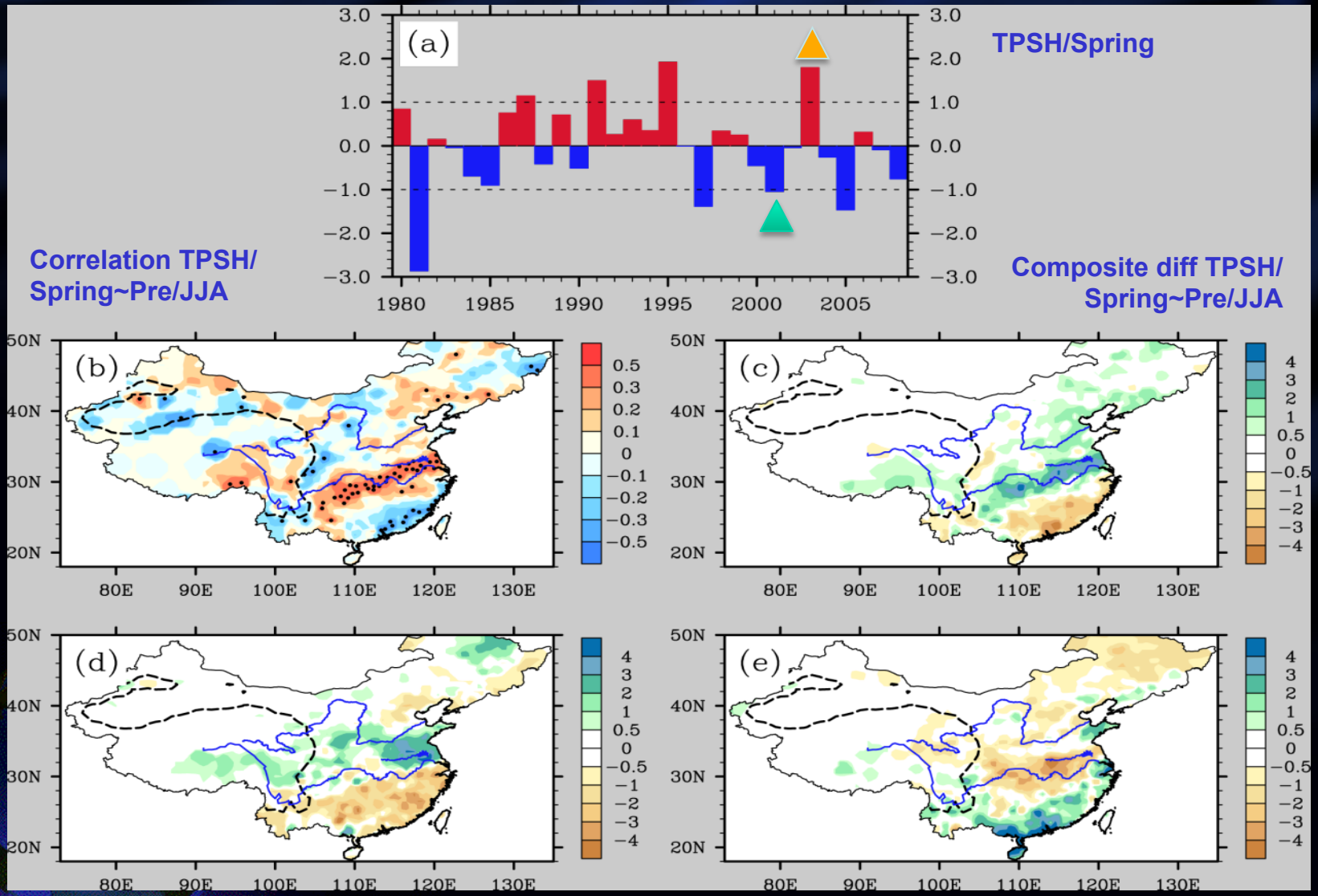
# TP thermal control of the Asian summer monsoon

The thermally driven Asian summer monsoon circulation descending in the Southern Hemisphere, and thereby influence the Southern Hemisphere climate change.



# Interannual variability

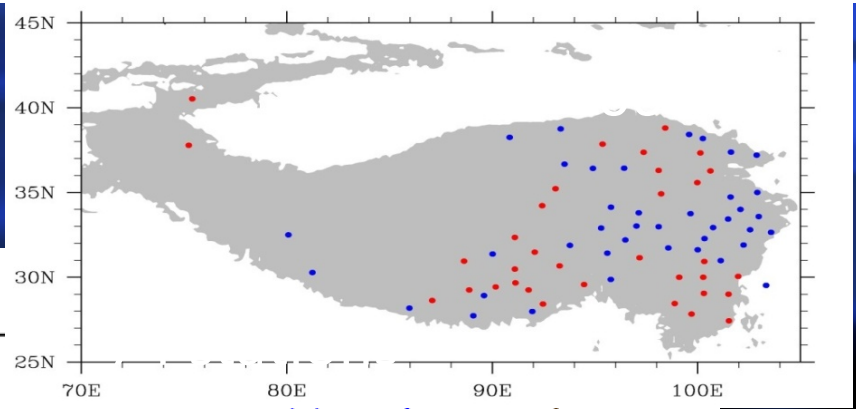
## 高原春季感热对我国夏季降水年际变率的影响

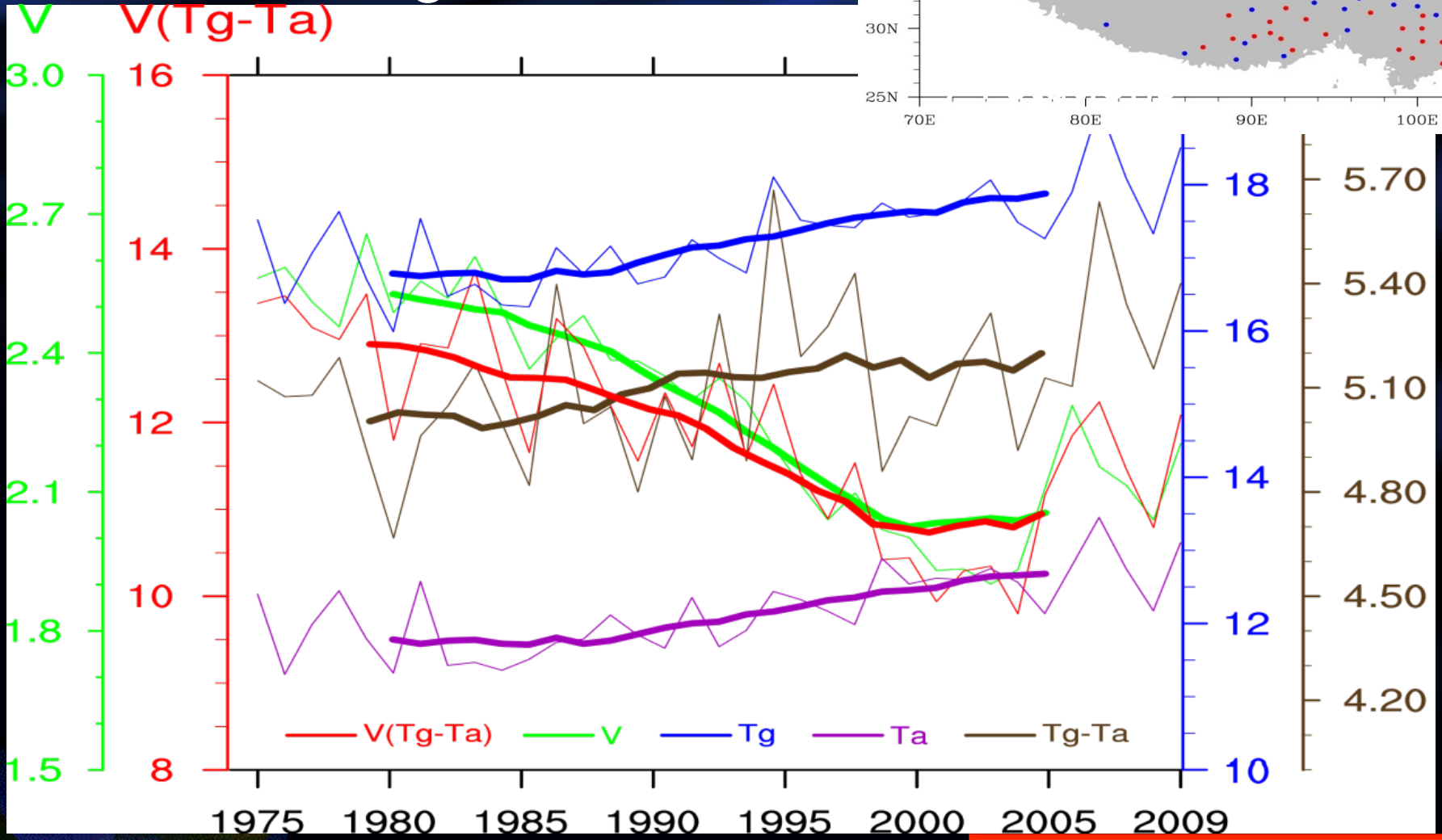



*(Wang et al., 2013)*

# Decadal variation

## Sensible heating over TP



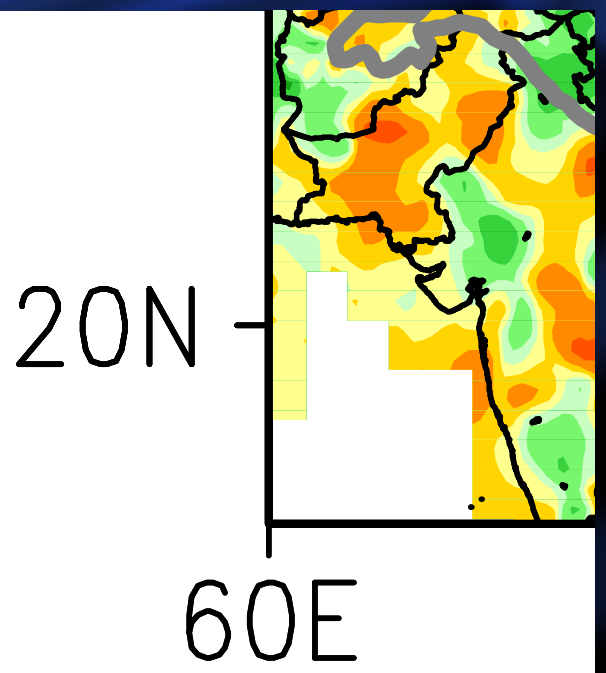




**Mean over the TP, JJA**

**Liu etal. Cli. Dyn 2012**

$$\frac{\Delta SH}{SH} = \frac{\Delta V}{V} + \frac{\Delta(T_g - T_a)}{T_g - T_a} \approx \frac{\Delta V}{V}$$

# TP heating and “Wet in South and Dry in North”




Correlation of SH averaged over TP and Pre_Land, 11-year running mean

SH=(Tg-Ta)V

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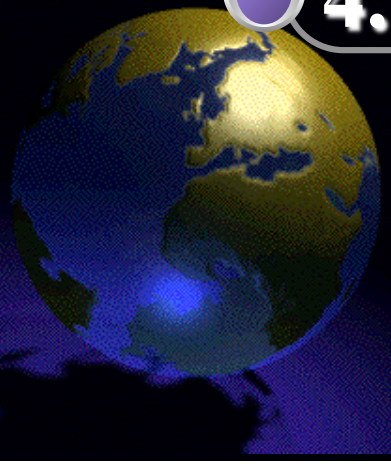
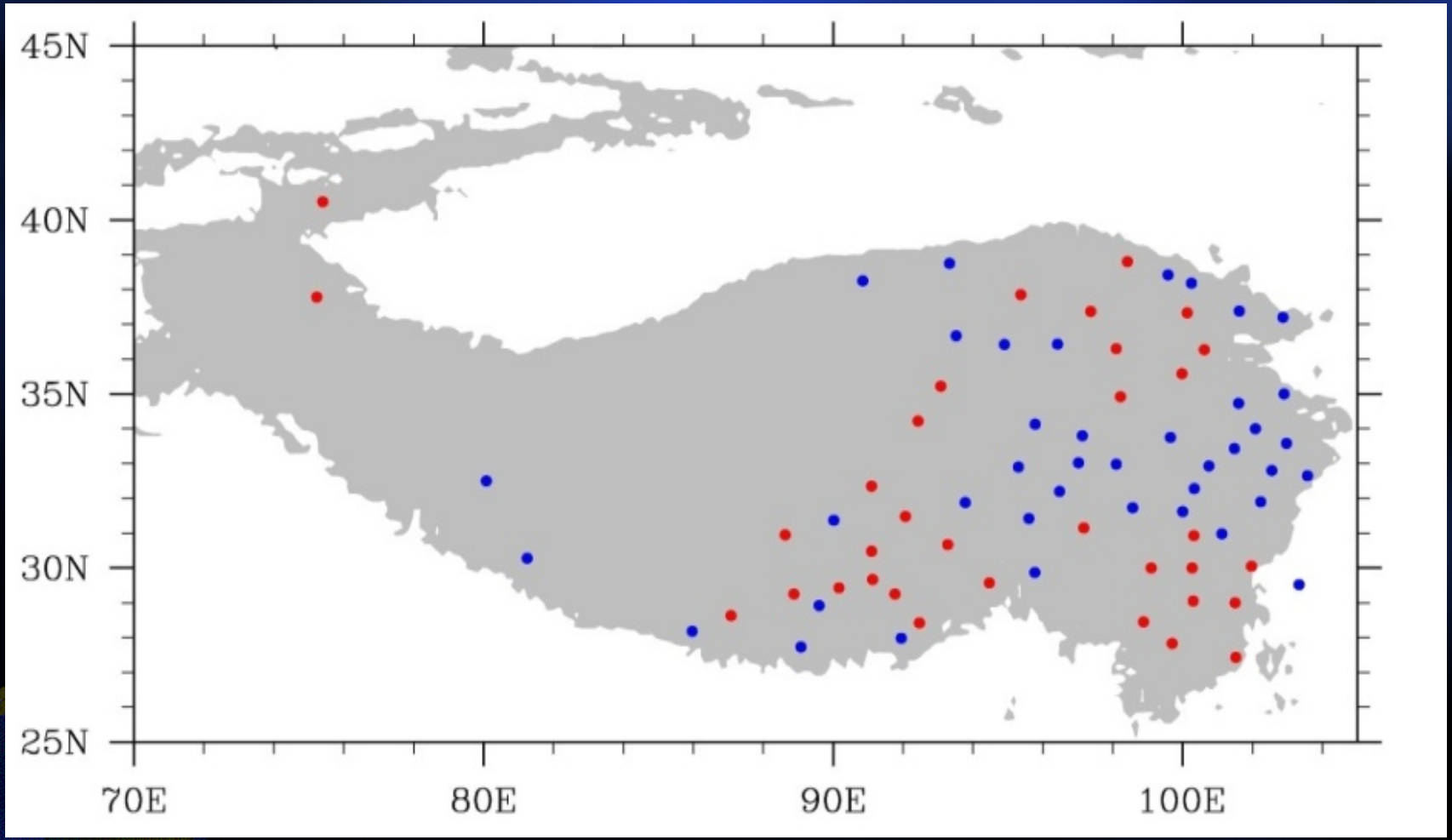
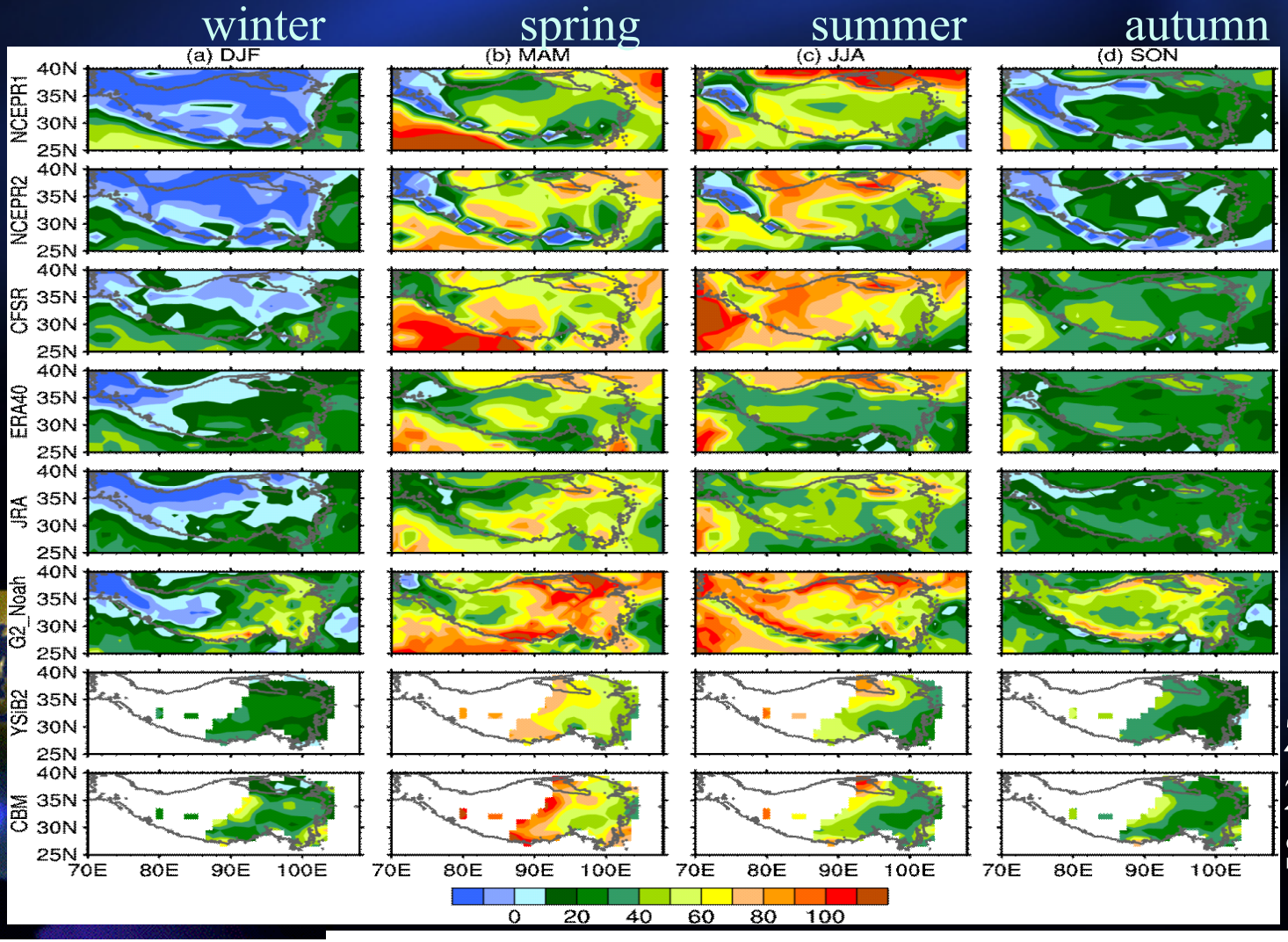


# 1. Observation: density, accuracy, content



# 3. Reanalysis has larger bias over the TP

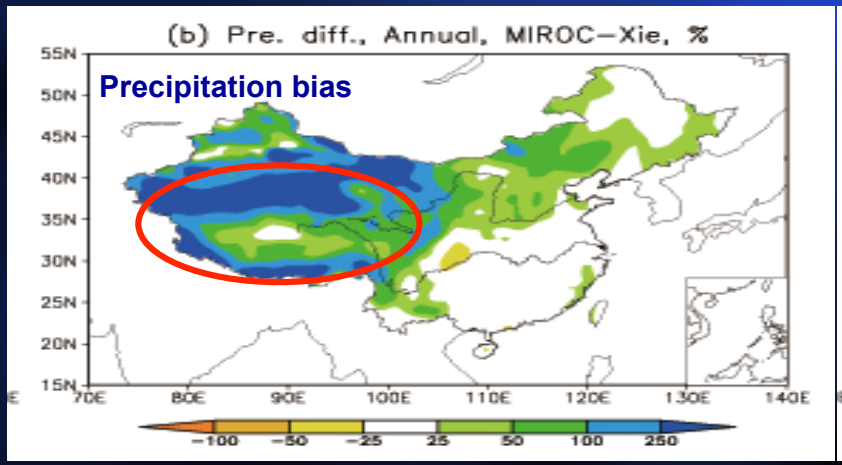
## Surface sensible heating in different reanalysis

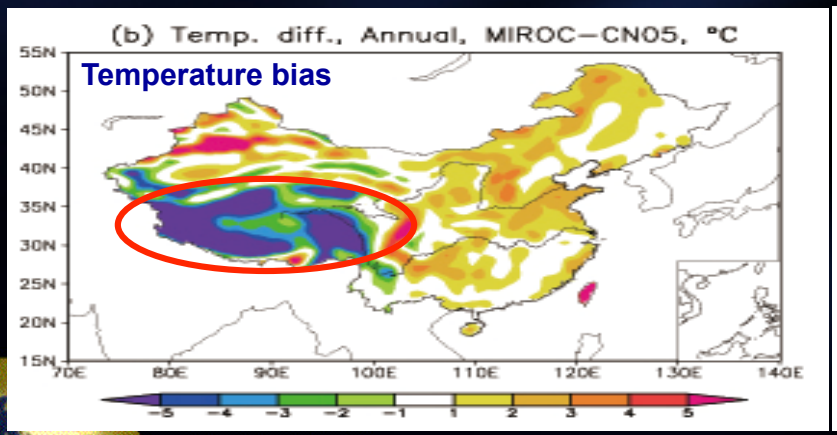



Zhu et al., 2012 SCI China

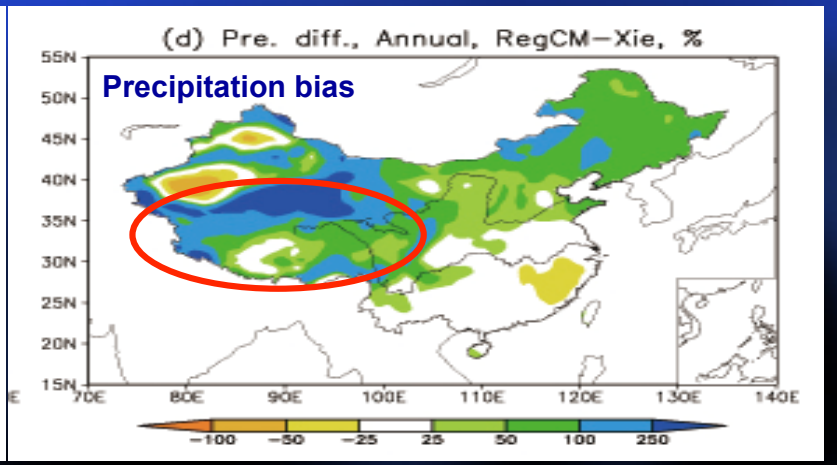
# 4.Big bias on TP in both regional and global models

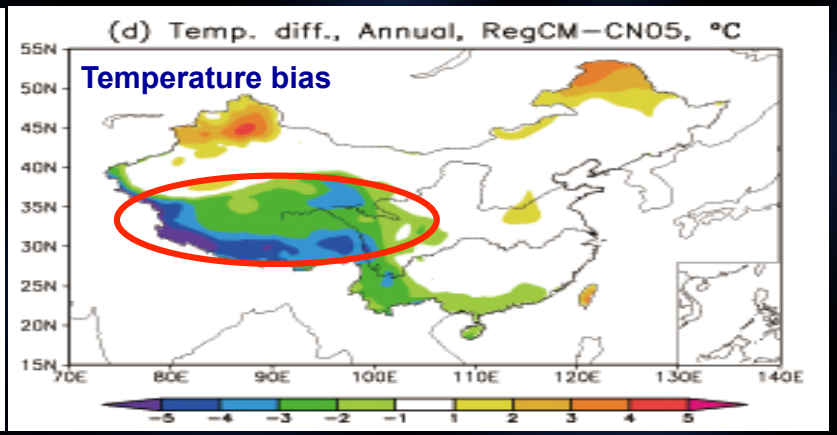
## Global model




## Regional model




Shi Xiaoying, et al. *Geophysical Research Letter,2008*

**Big bias of precipitation and surface temperature on TP region!**

# CMA TP Observation Network Development (2014-2023)

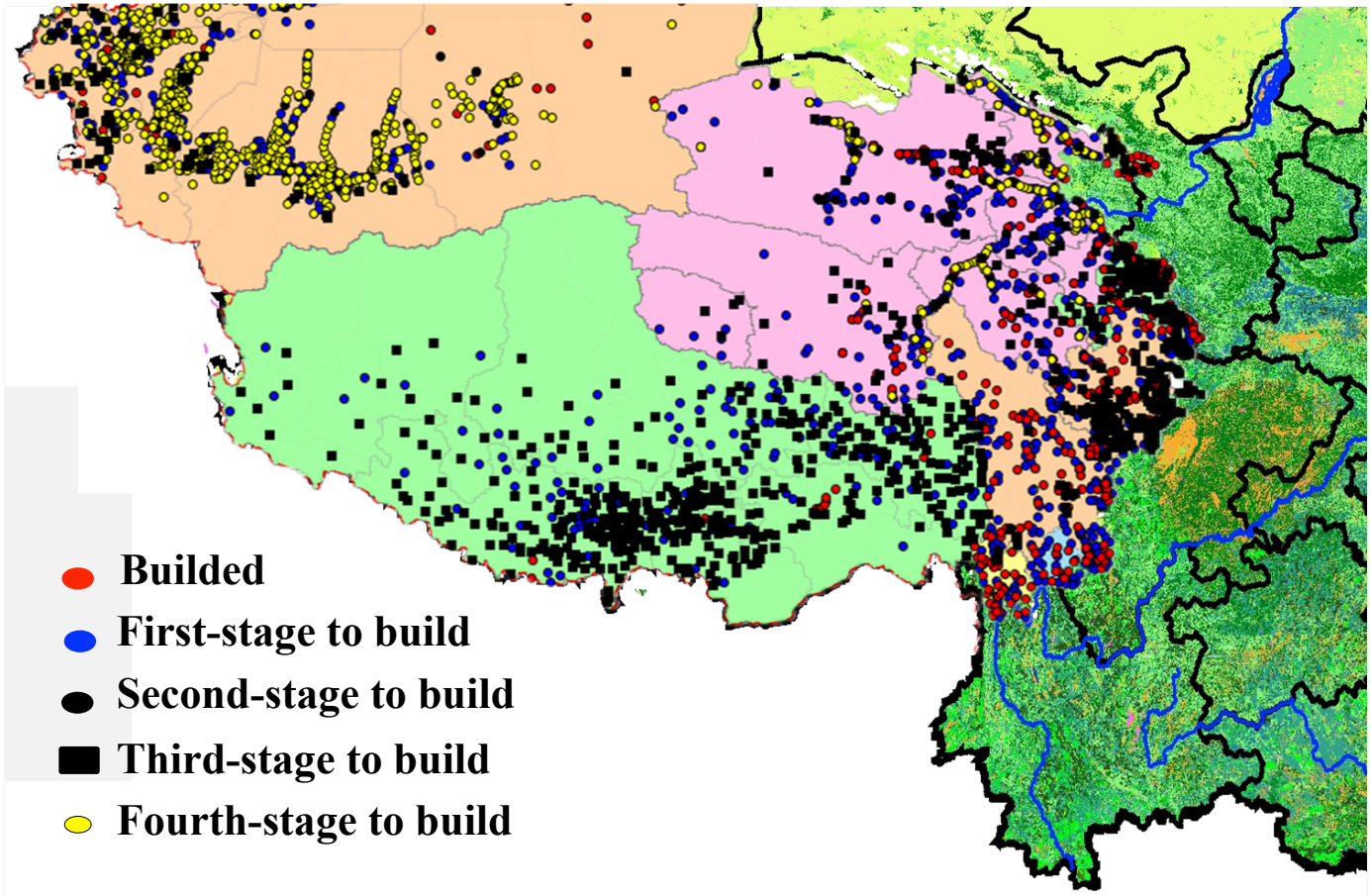
(2.0 Billion Yuan)

# 1、Ground station (453 points)

| Tibet | | Si Chuan | | Yun Nan | | Gan Su | | Qing Hai | |
|---|---|---|---|---|---|---|---|---|---|
| Builded | Add | Builded | Add | Builded | Add | Builded | Add | Builded | Add |
| 39 | 0 | 156 | 0 | 125 | 0 | 81 | 0 | 52 | 0 |

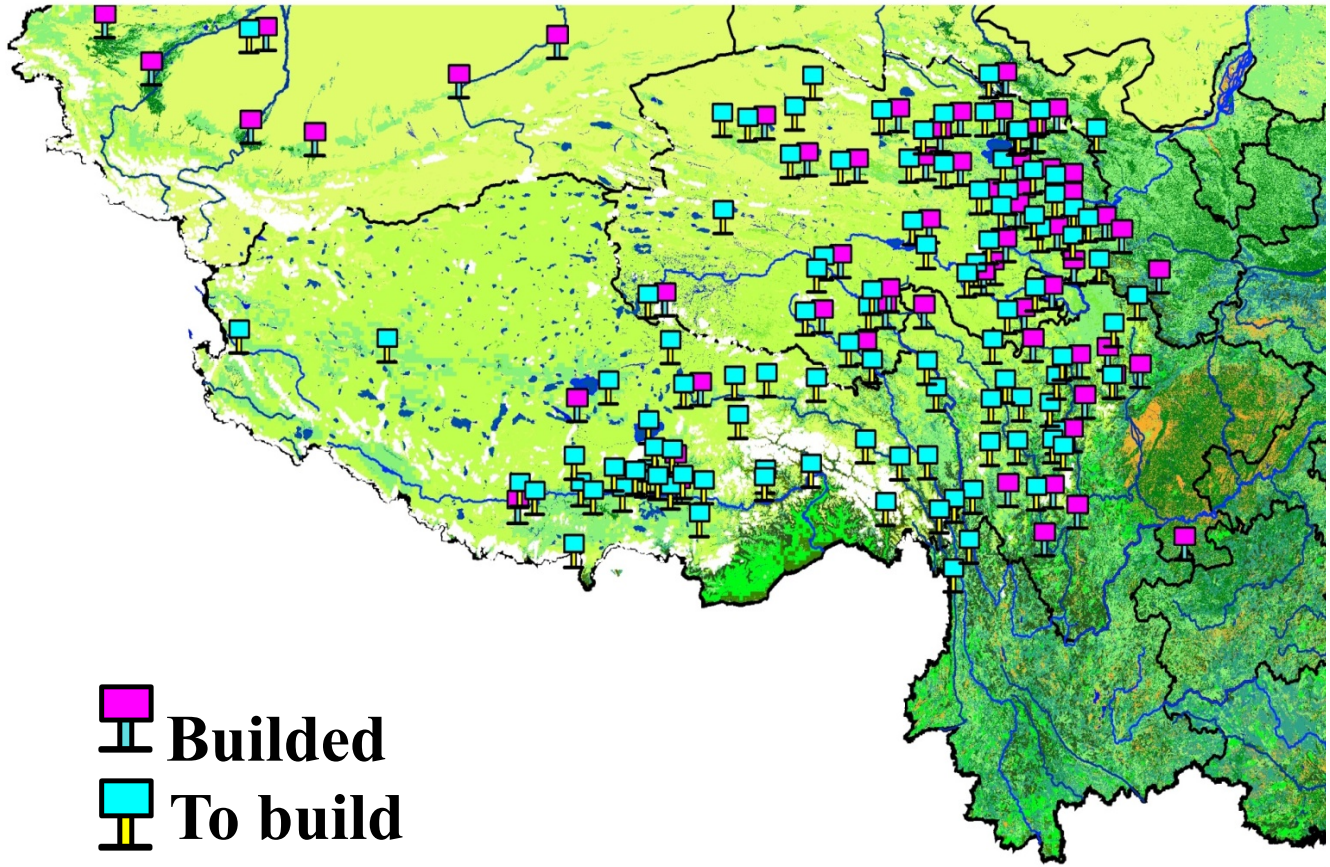
# AWS (6754 points)

| Tibet | | Si Chuan | | Yun Nan | | Gan Su | | Qing Hai | |
|---|---|---|---|---|---|---|---|---|---|
| Builded | To build | Builded | To build | Builded | To build | Builded | To build | Builded | To build |
| 17 | 580 | 2110 | 581 | 1627 | 23 | 900 | 135 | 101 | 680 |

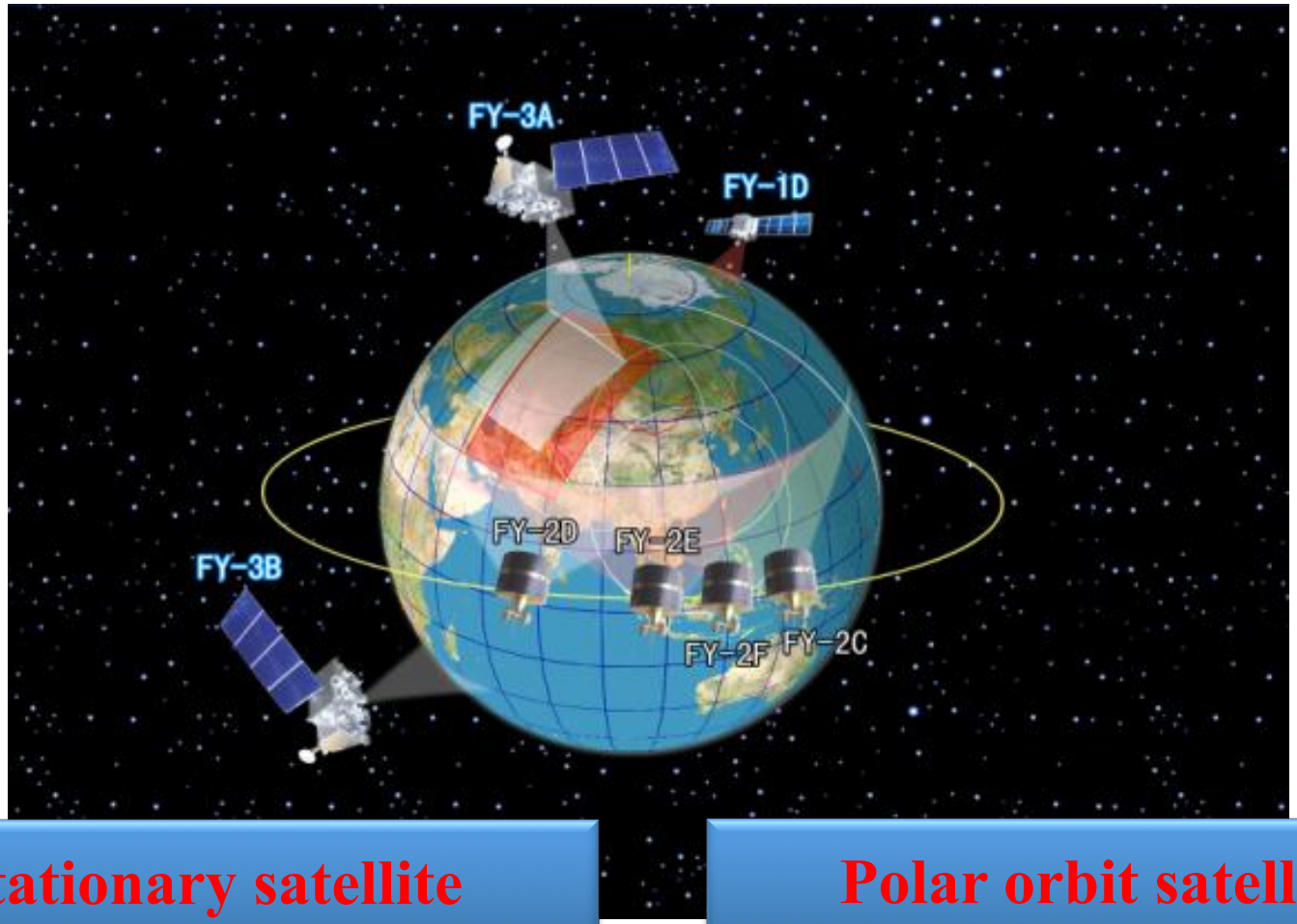


# Soil moisture station (460 points)

| Tibet | | Si Chuan | | Yun Nan | | Gan Su | | Qing Hai | |
|---|---|---|---|---|---|---|---|---|---|
| Builded | To build | Builded | To build | Builded | To build | Builded | To build | Builded | To build |
| 8 | 41 | 197 | 20 | 20 | 3 | 61 | 5 | 55 | 50 |



# FY Meteorology Satellite (7 satellites)




## Stationary satellite

- 28 cloud pictures are captured by each satellite everyday, 48 cloud pictures can be got when intensively observed
- Observed by double satellites can get one cloud picture every 15 minutes

## Polar orbit satellite

- Move across the South and North Pole, the period is about 102 minutes, 14 circles across the earth everyday
- Observe the same place under the satellite point twice, and can get a global merged map

# Outline

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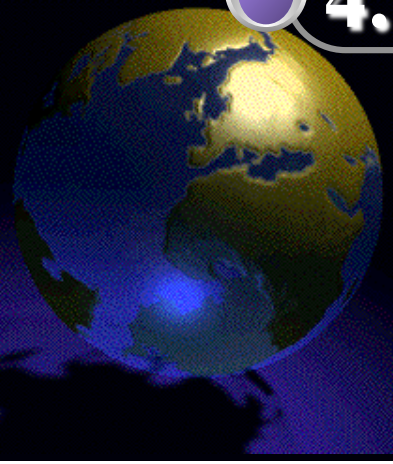


# A Co- Design example--

# NSFC Key Research Program

(国家自然科学基金委员会重大研究计划)

# Land-air Coupling over the Tibetan Plateau and Its Climate Impact

(青藏高原地-气耦合系统变化及其全球气候效应)

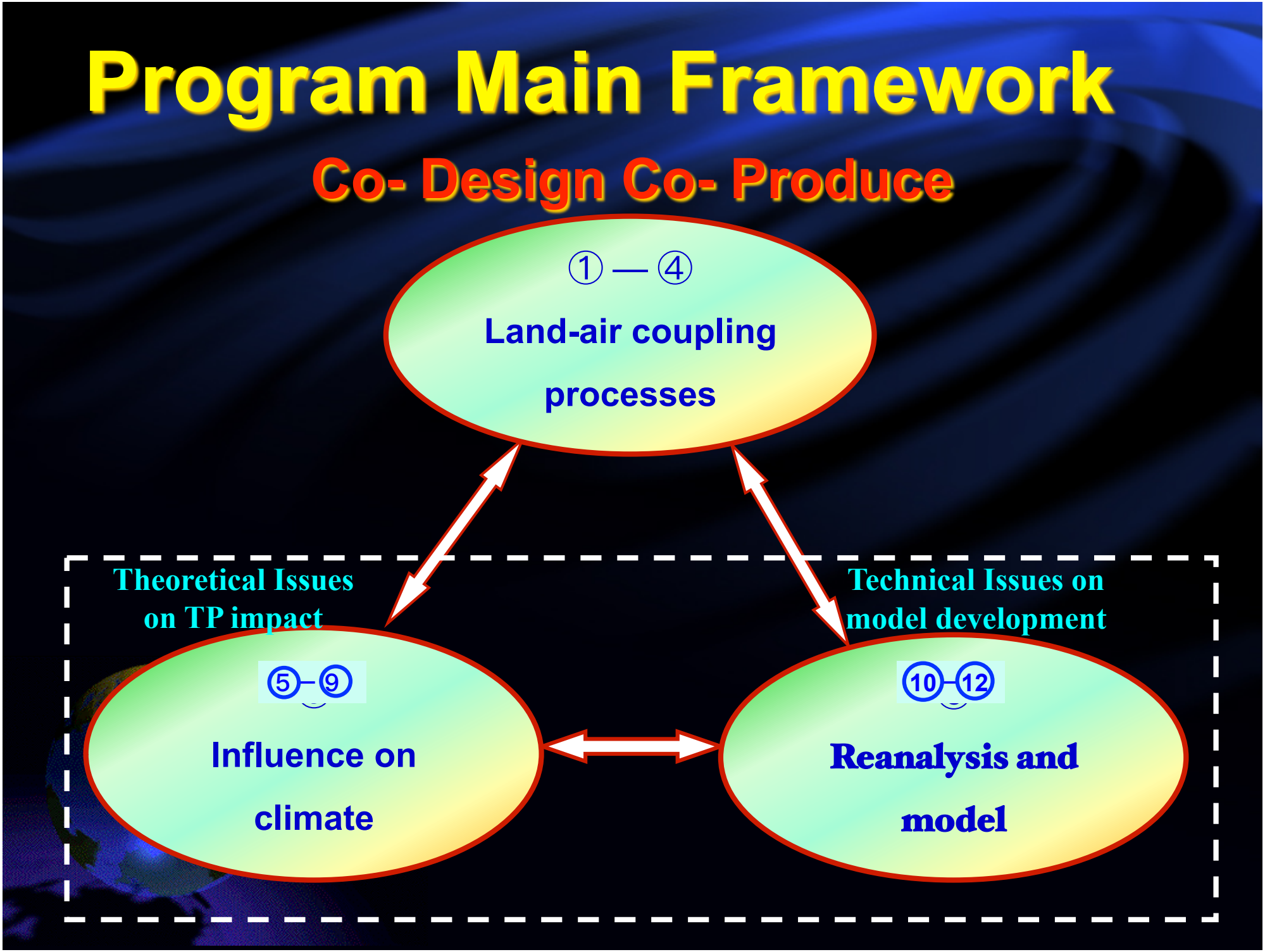
Guoxiong Wu

Funding：200 Million RMB

Period：Jan. 2014- Dec. 2023

# Program Main Framework

## Co- Design Co- Produce



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- We should focus on the TP thermal status and reveal how its variation can affect climate anomaly, so as to improve climate prediction and risk mitigation
- Natural + social sciences =>serve public, stateholders, policy makers => SDG!

# ACCES Key Projects

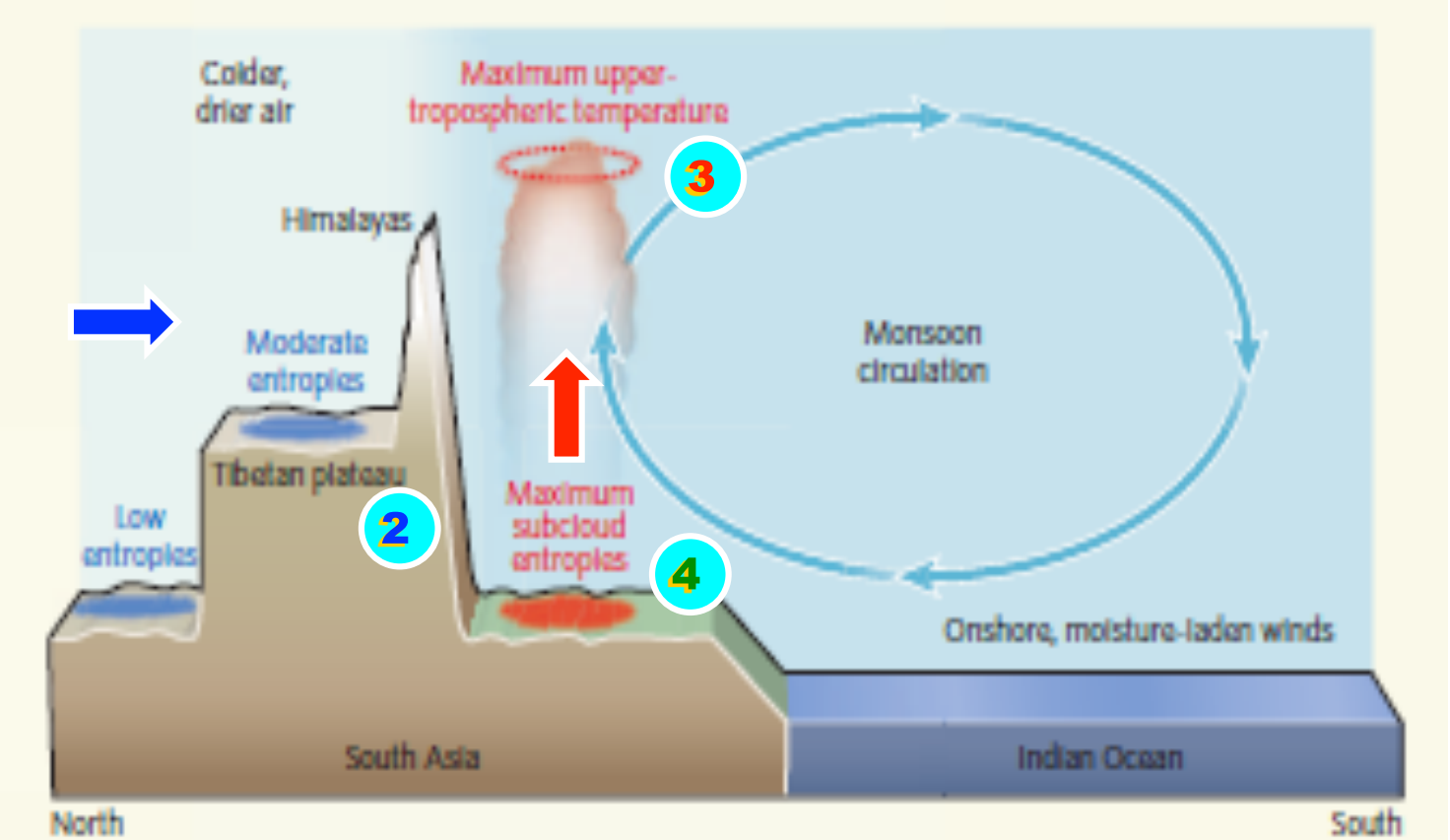
- **Project A1:** The Regional and Global Influences of the Giant Mountains in Asia on Climate and Environment

- **Project A2:** Himalayas climate modeling: development of a high resolution Earth System Model and Asian climate change risk assessment

## Mechanical forcing hypothesis: blocking impact of the TP :

**1. Shield the India from cold and dry advection**

**2. High surface energy and UTTM are coupled by monsoon convection**




Boos and Kuang, 2010, Nature
Cane, 2010, Nature

# Does there exist the TP Shielding of India from cold and dry advection?

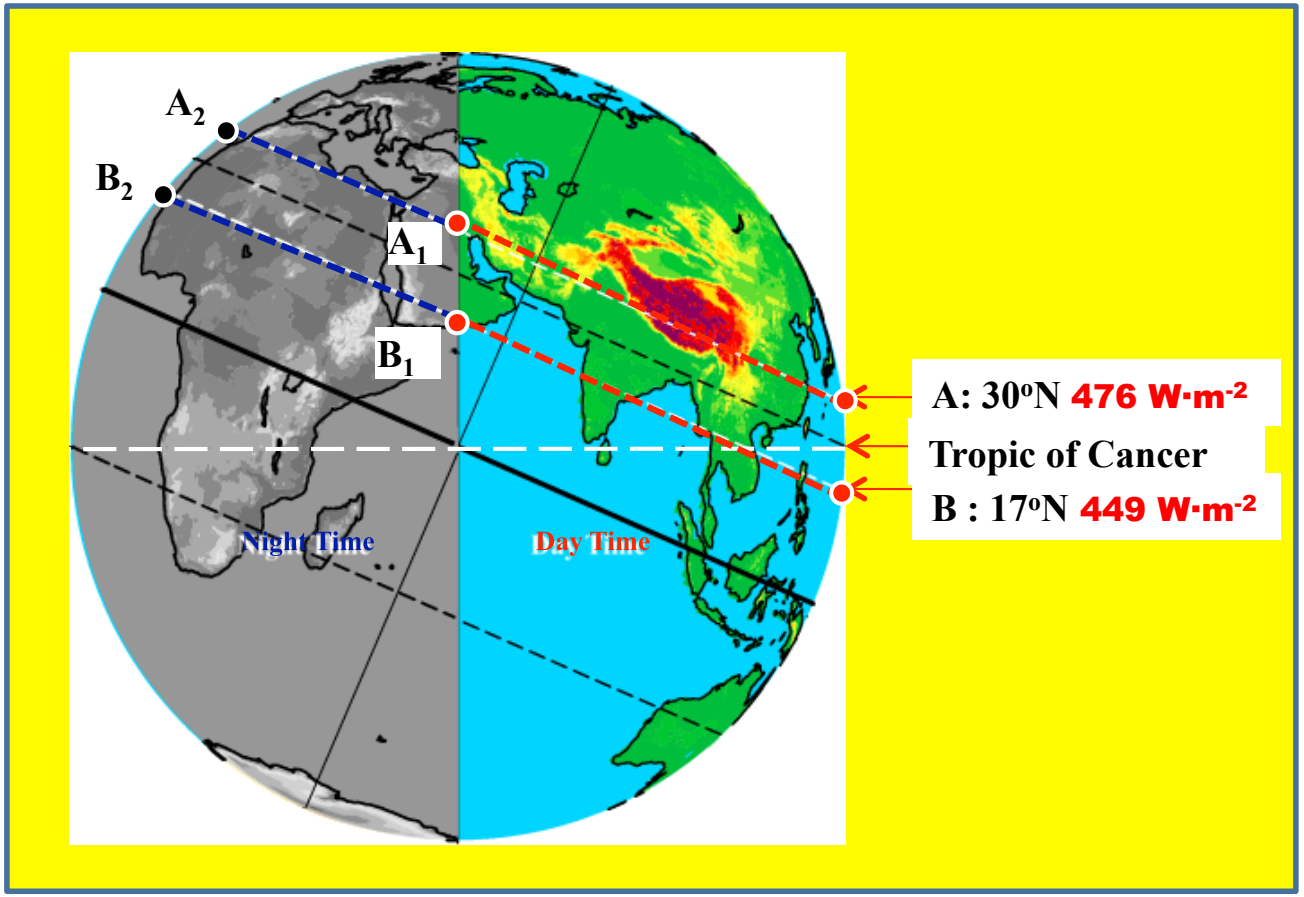



**Fig. 1** (a) At the summer solstice, the solar zenith angle at noon is zero at the Tropic of Cancer ($\phi$= 23.5°N). At the top of the atmosphere (TOA), the intensity of solar radiation (SR) at latitude A (30°N) in the subtropics is the same as that at latitude B (17°N) in the tropics. **However, the length of day (LOD) at A ($AA_1/AA_2$) is about one hour longer than the LOD at B ($BB_1/BB_2$). Thus the daily solar radiation (DSR) at 30°N is more than that at 17°N**

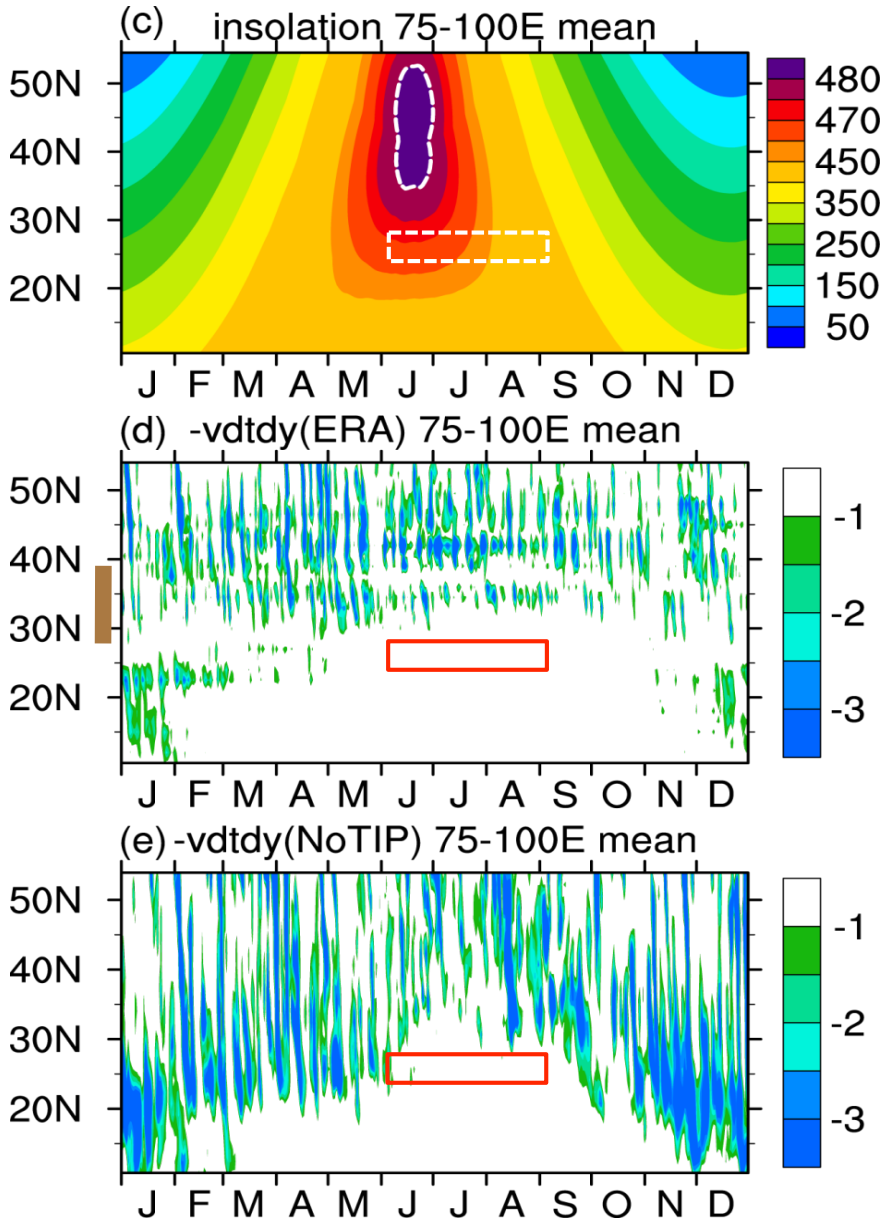
**Nature _Scientific Reports, 2015**

**the daily evolutions in 2001 across the longitude domain 75–100°E of**

**(c) DSR (W m$^{-2}$), with the white dashed curve denoting the 480 W m$^{-2}$ contour,**

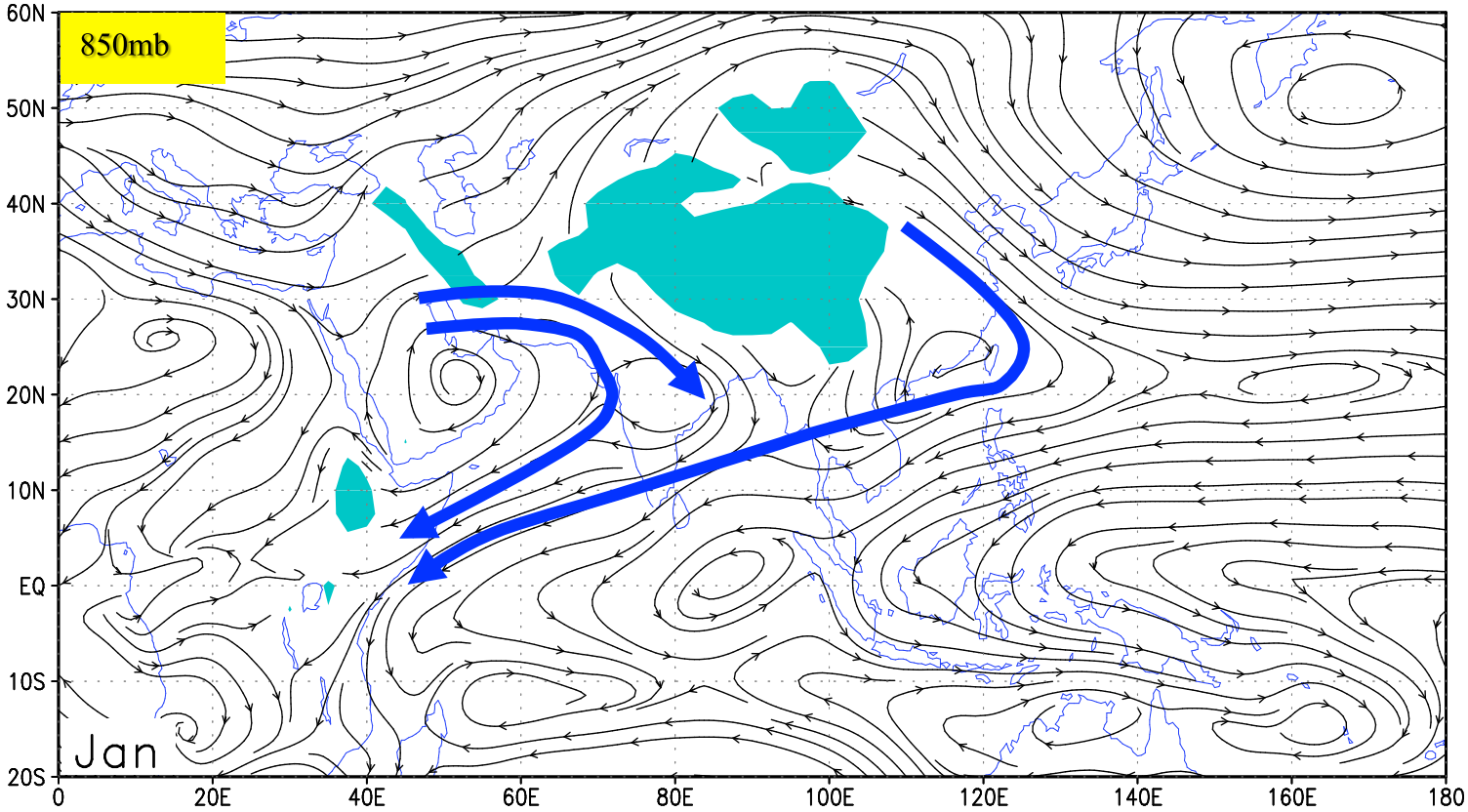
**(d) the cold temperature advection (v<0) at the surface (sigma=0.99) from ERA-interim and**

**(e) from the NoTIP experiment, which is driven with the SST in 2001 and with the removal of the mountain range TIP.** The square in (c-e) indicates the South Asian summer monsoon region between 24 °N and 28°N and during June to August.

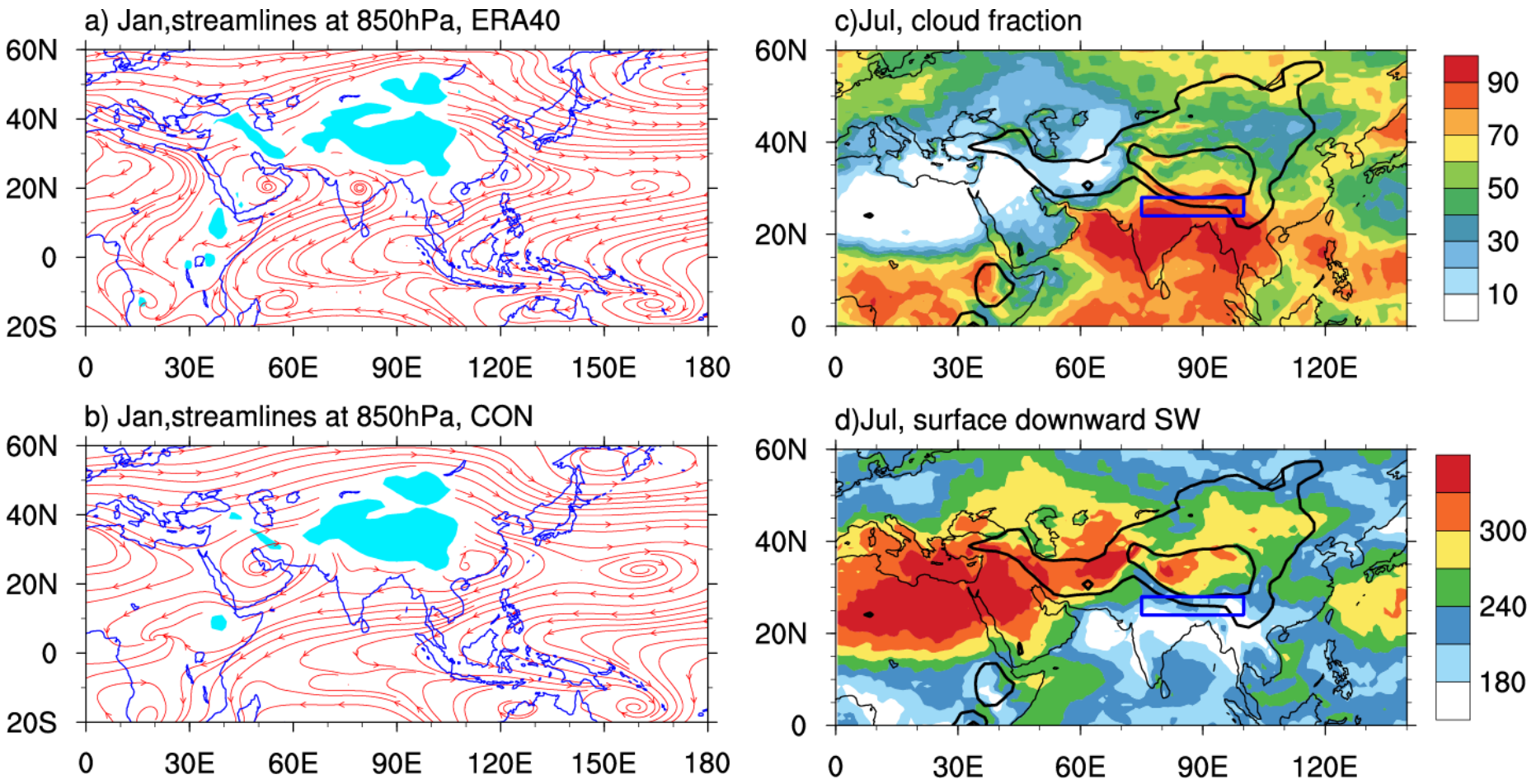



**Summer: Shielding not need!**

**Winter: TP cannot block cold advection!**




# Jan mean streamline at 850 hPa




Climatological mean January streamfield at 850 hPa produced from (a) ERA40 and (b) CON Experiment; and the monthly mean of July, 2001 of (c) cloud fraction in persentage and (d) downward shortwave radiation at the surface ($Wm^{-2}$)produced from CERES.

**Nature _Scientific Reports, 2015**

# Conclusion

**In Winter: TIP cannot block cold advection because the cold northwesterly or northeasterly can move around the TIP and intrude India!**

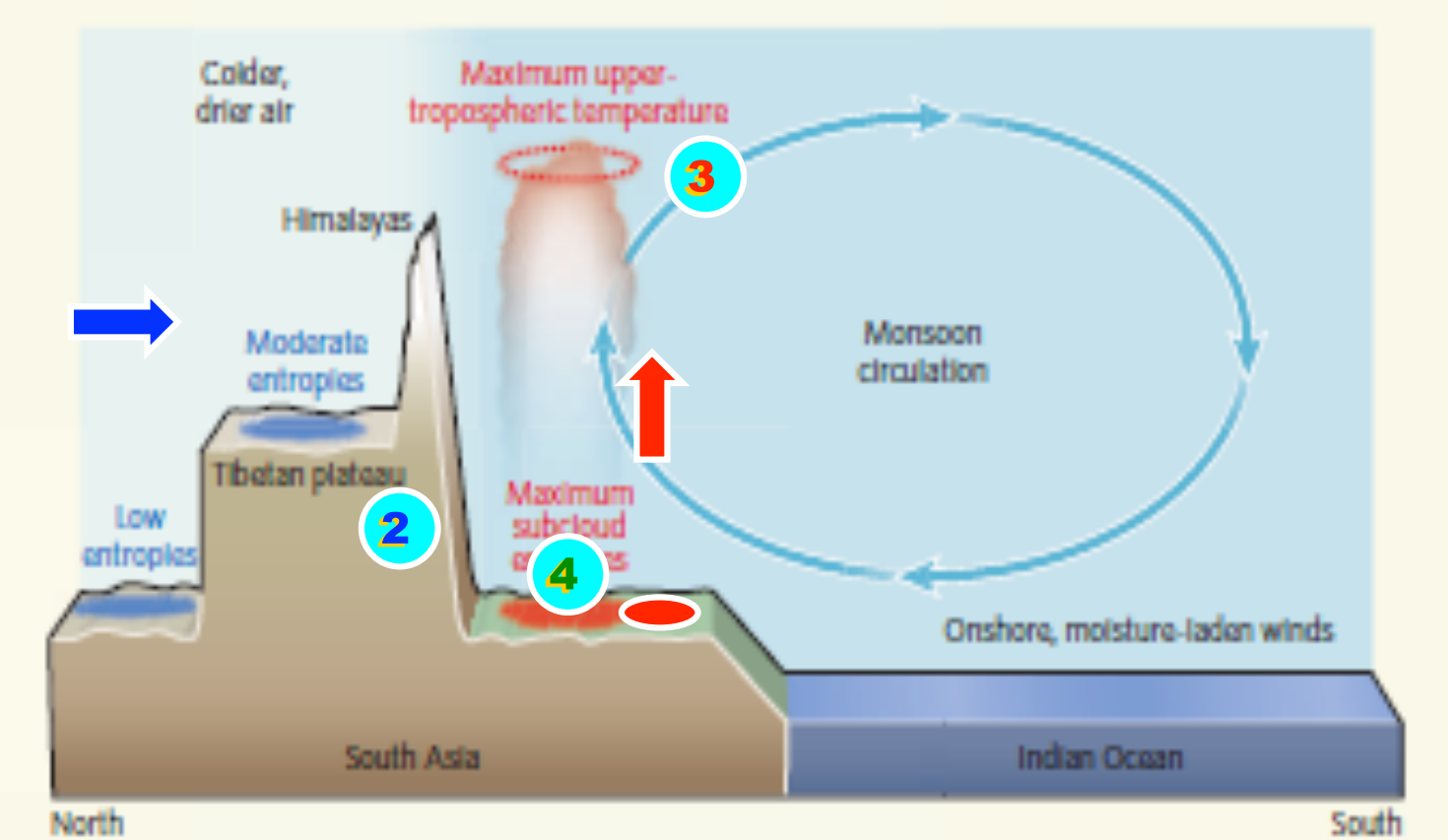
**In Summer: Shielding/blocking of the TIP is not need since there is no cold advection from higher latitudes!**

**Protecting TP's environment can protect its thermal status, producinging resilient ASM and world climate!**

**Mechanical forcing hypothesis: blocking impact of the TP** :

1. Shield the India from cold and dry advection

2. High surface energy and UTTM are coupled by  monsoon convection




**How can the high Water vapor content over land be maintained for the continental monsoon?**

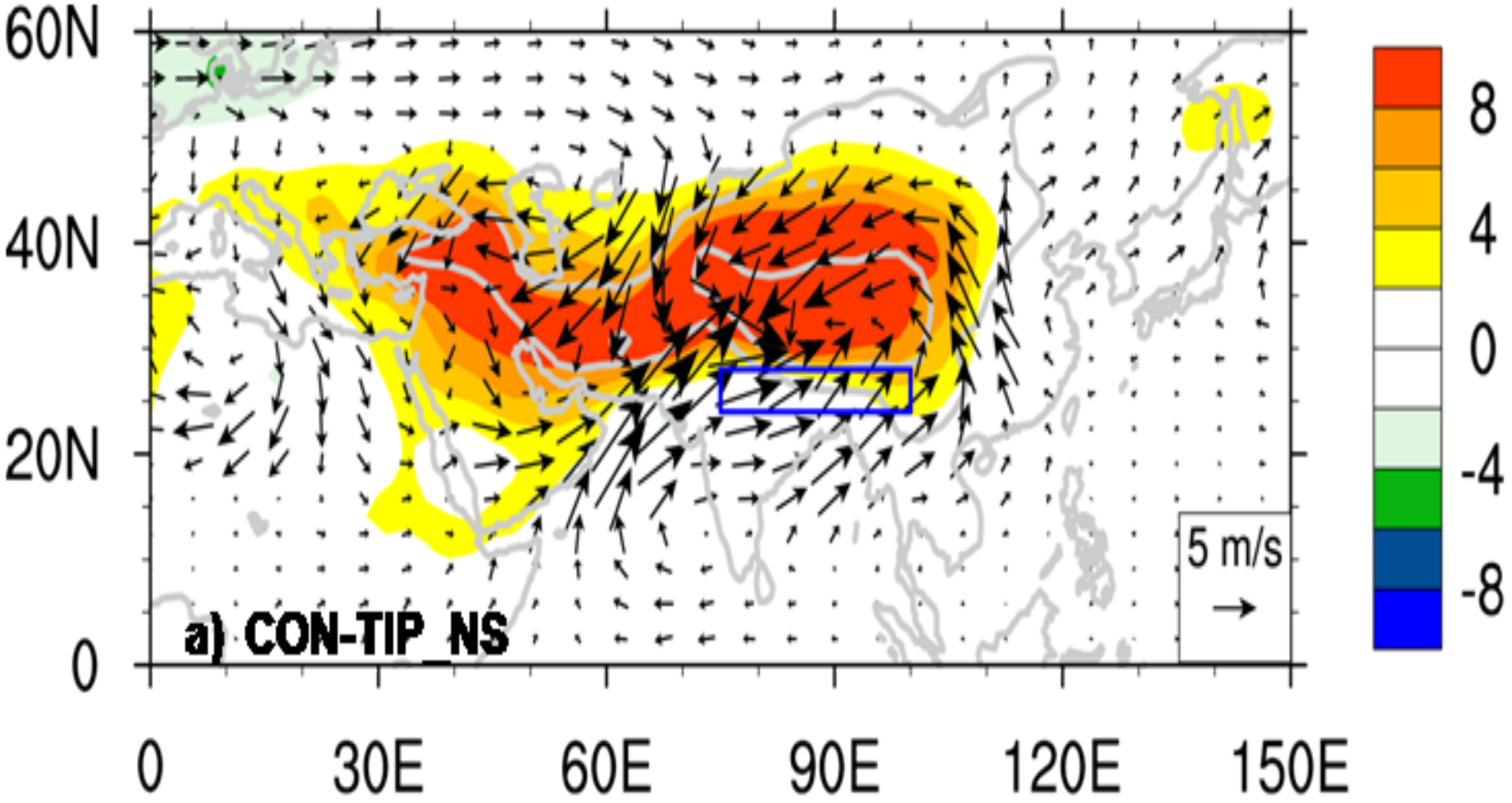
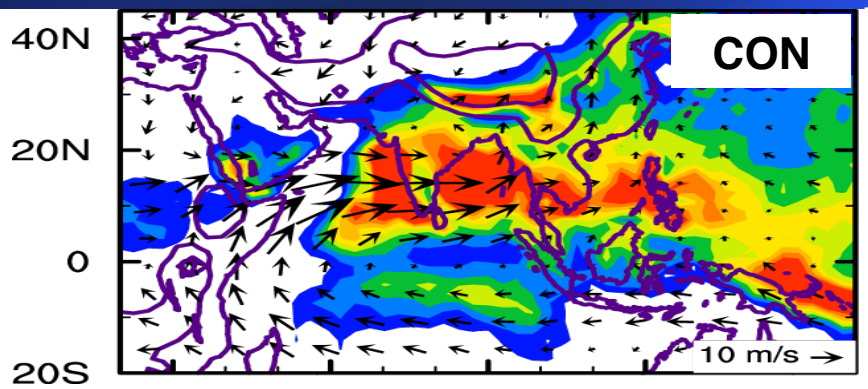
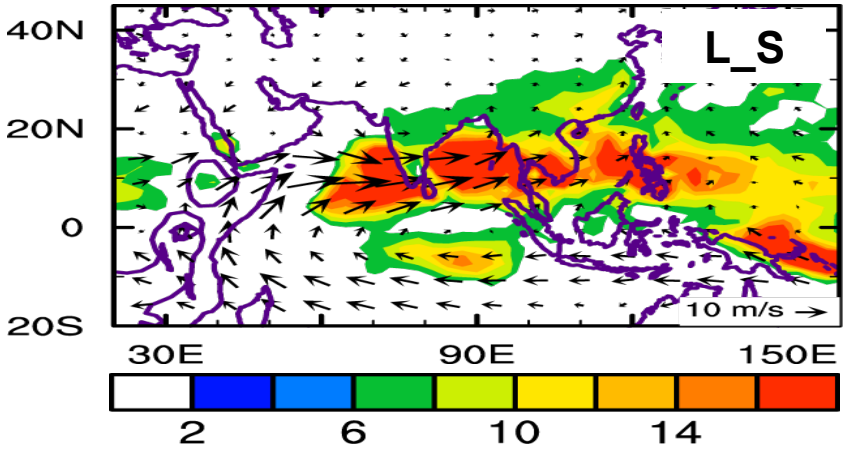
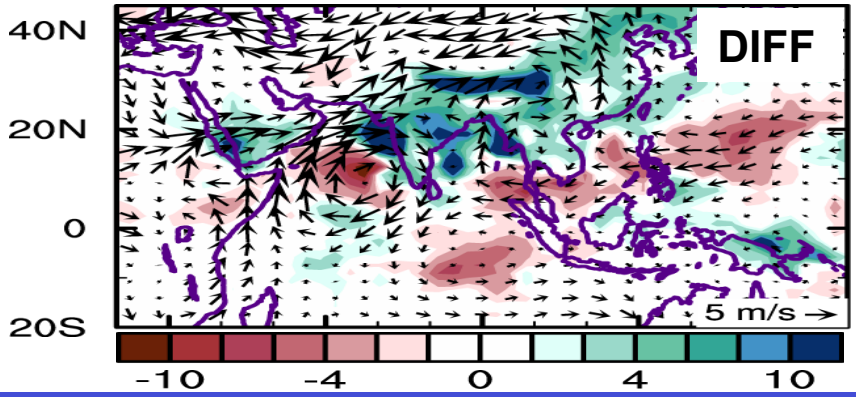


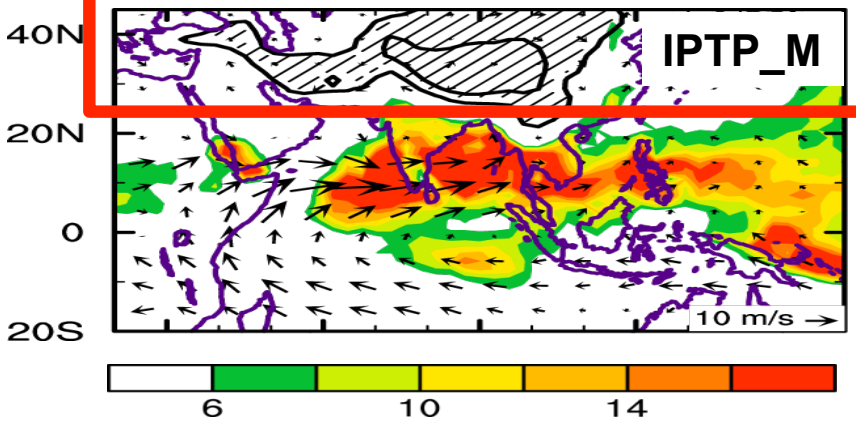

**Fig. 4** JJA mean differences of near-surface (sigma=0.99) potential temperature $\theta$ (K, shading) and circulation (vectors, m $s^{-1}$) between (a) CON and TIP_NS

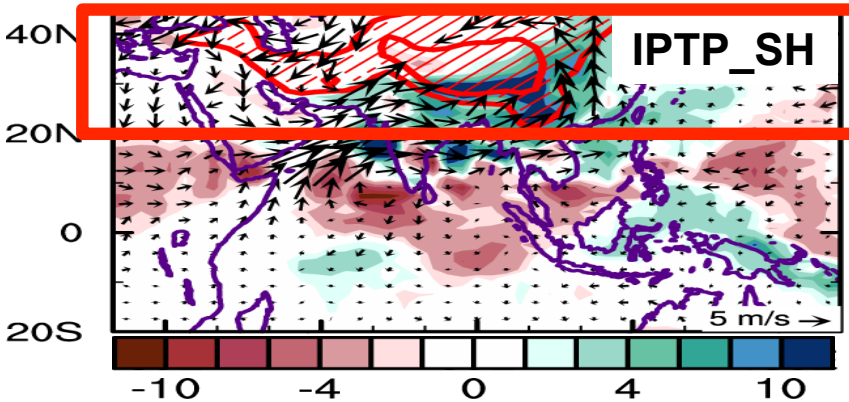
# Impacts of mountain mechanical ~thermal forcing




Required Circul. and Precip. to make up the Asian summer monsoon

# Outlook

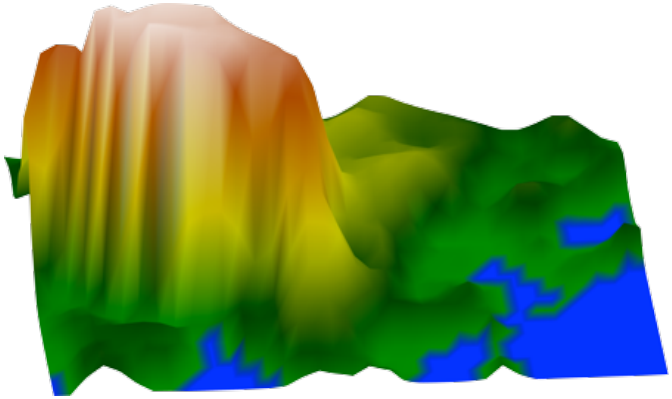
- TP thermal status and the impact of its variation on climate anomaly
- Improvement of climate prediction and risk mitigation

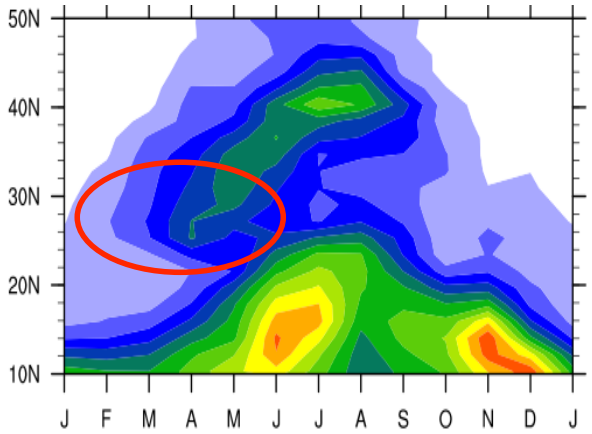
State Key Laboratory of Numerical Modelling for Atmospheric Sciences
and Geophysical Fluid Dynamics(LASG)
Institute of Atmospheric Physics Chinese Academy of Sciences

# Project A2: Himalayas climate modeling:
## development of a high resolution Earth System Model and Asian climate change risk assessment

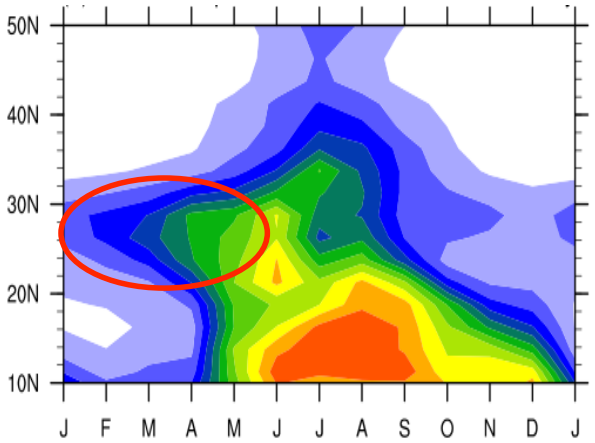
# High resolution modeling of FGOALS

## Low-resolution modeling

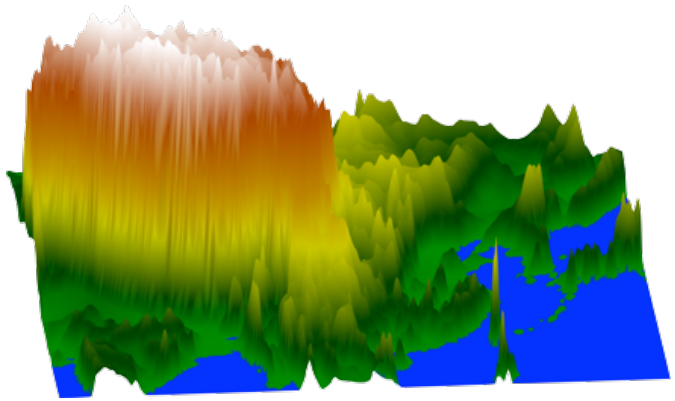


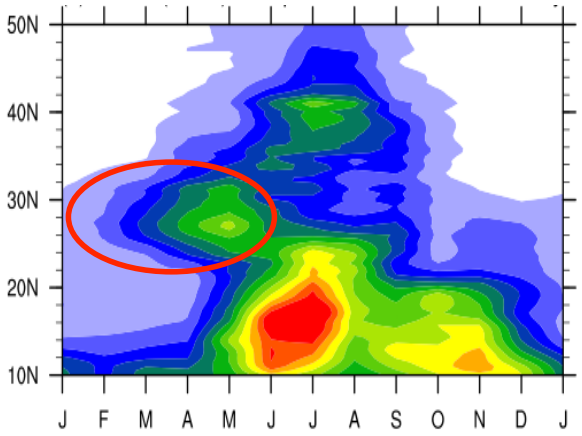



## Observation



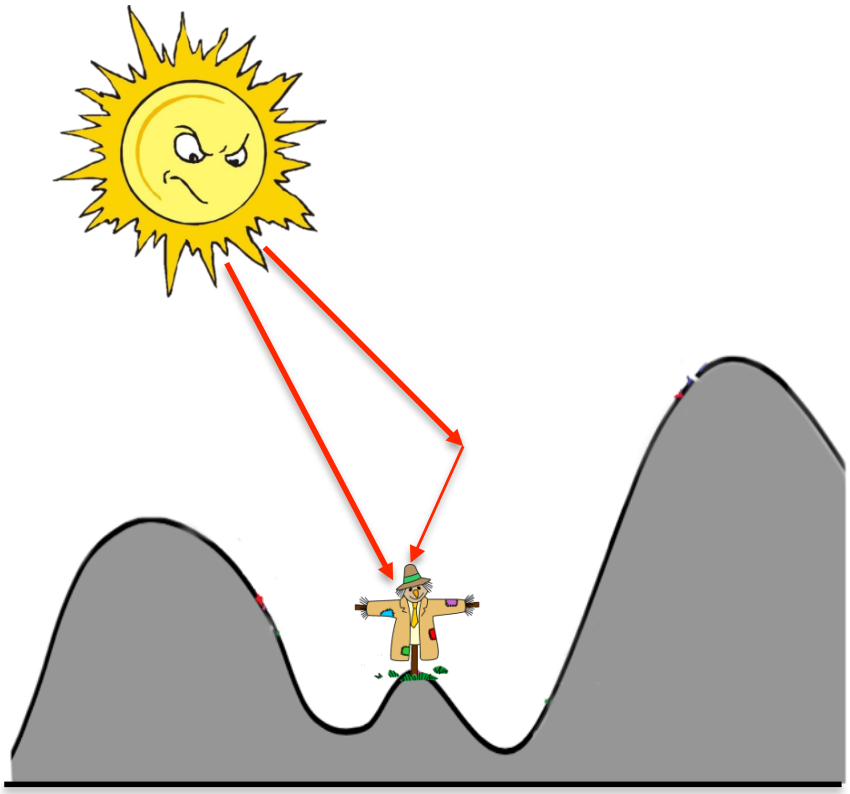

## High-resolution modeling



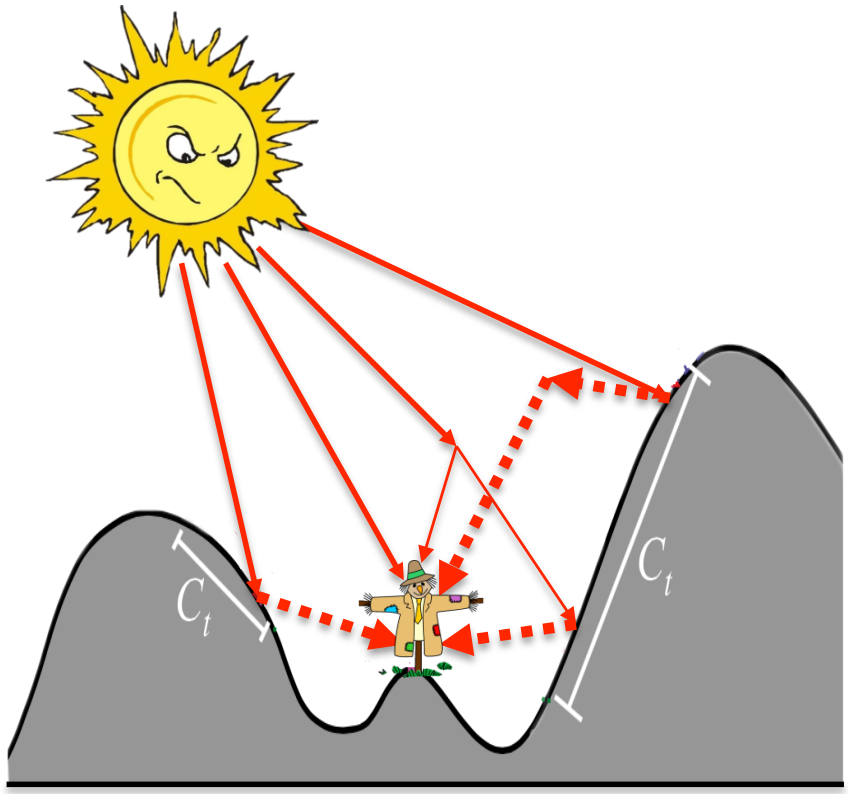



High-resolution modeling reproduces the rainbelt of East Asia realistically

## Traditional radiation in GCM



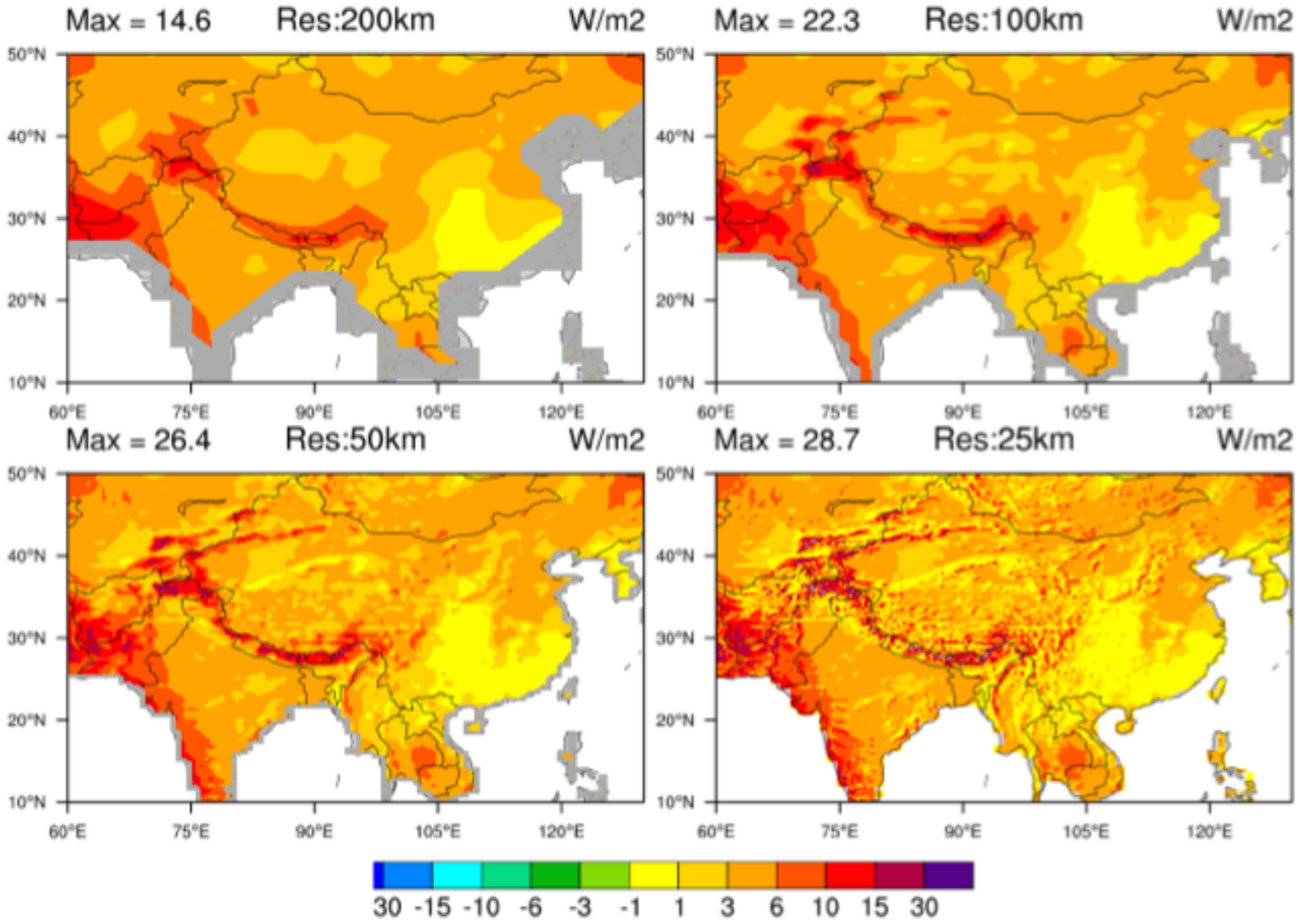
## 3-D Radiation in FGOALS



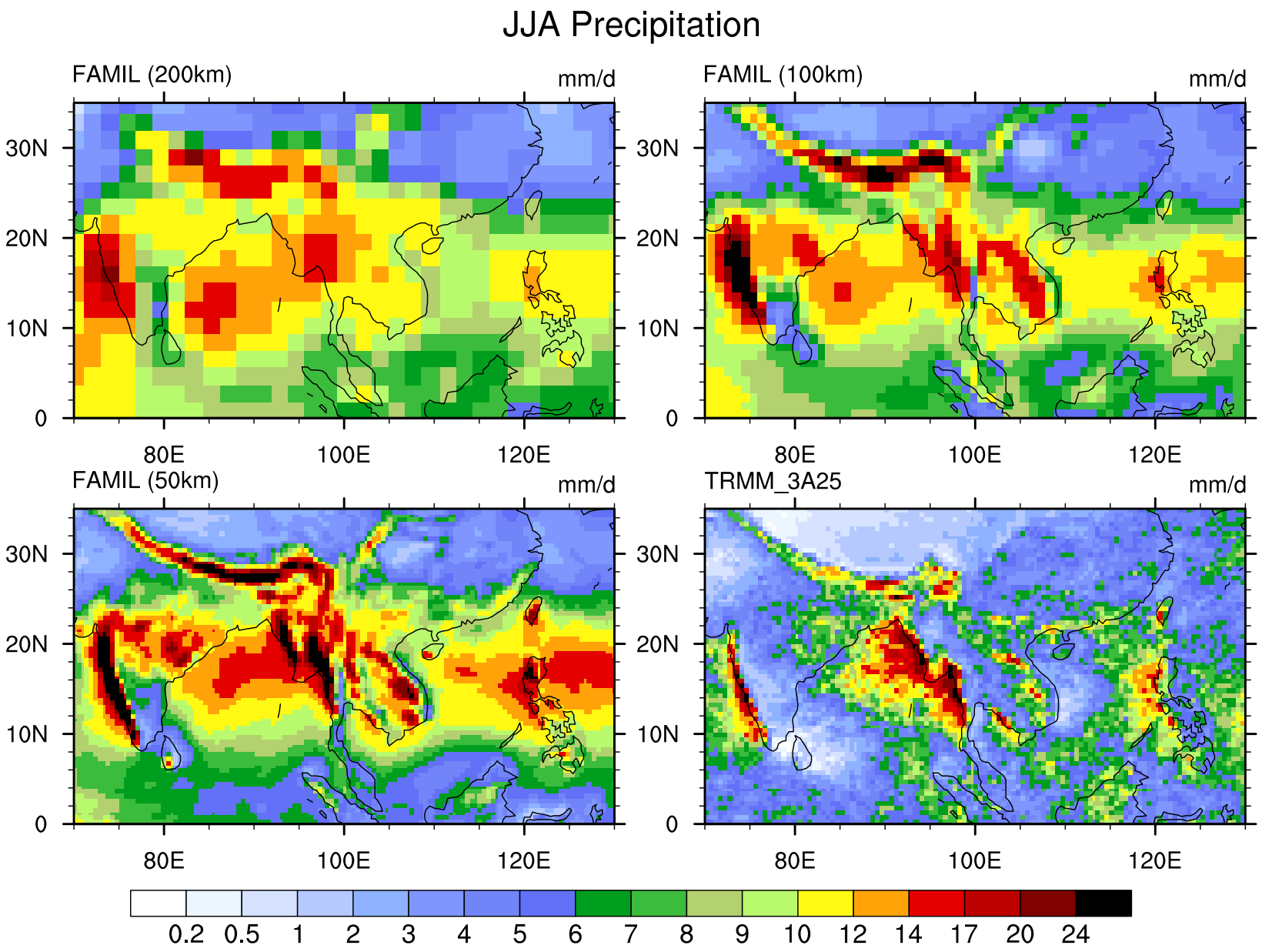

- **3-D radiation is based on the global topography datasets with 90m resolution**
- **3-D radiation effect is up to 100W•m2 with the resolution of 10~20km resolution**
- **The land-air interaction/feedback over TP (Himalayas)will further enhance the effect.**

(Lee et al, 2011)

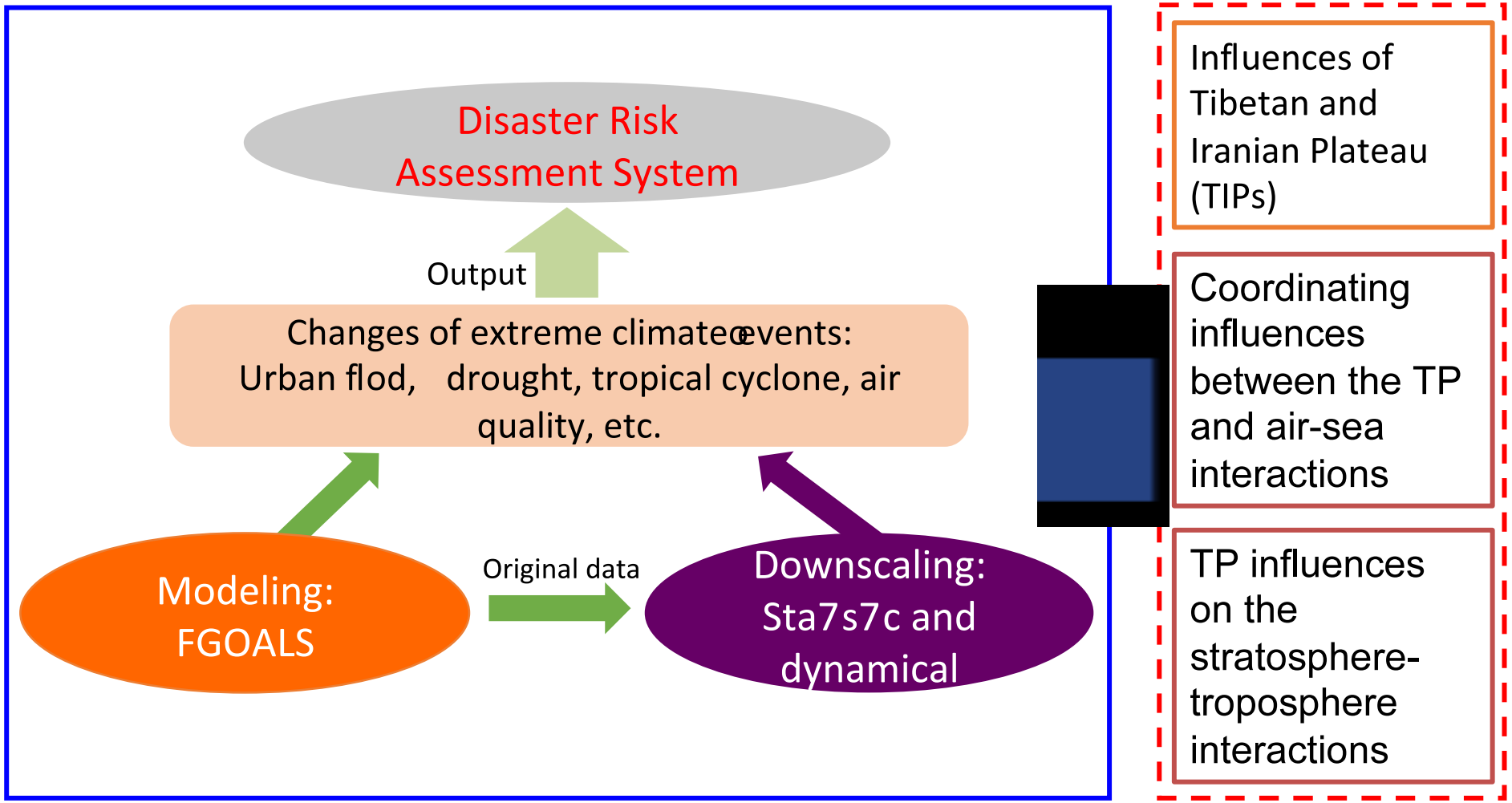
# The impact of 3-D radiation can reach up to 28.7W/m2



# Simulated Asian Summer Monsoon Precipitation with 200km, 100km and 50km resolutions



# Himalayas climate modeling: How to do



# “Mountains as Sentinels of Change”

## Belmont Forum Collaborative Research Action

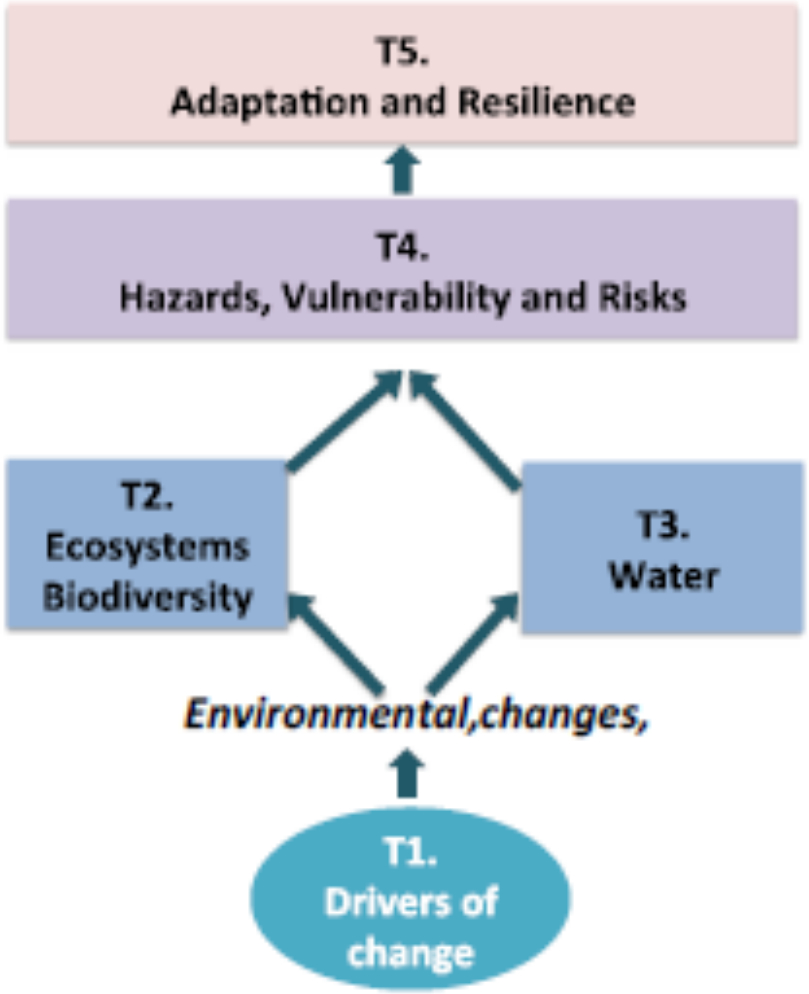
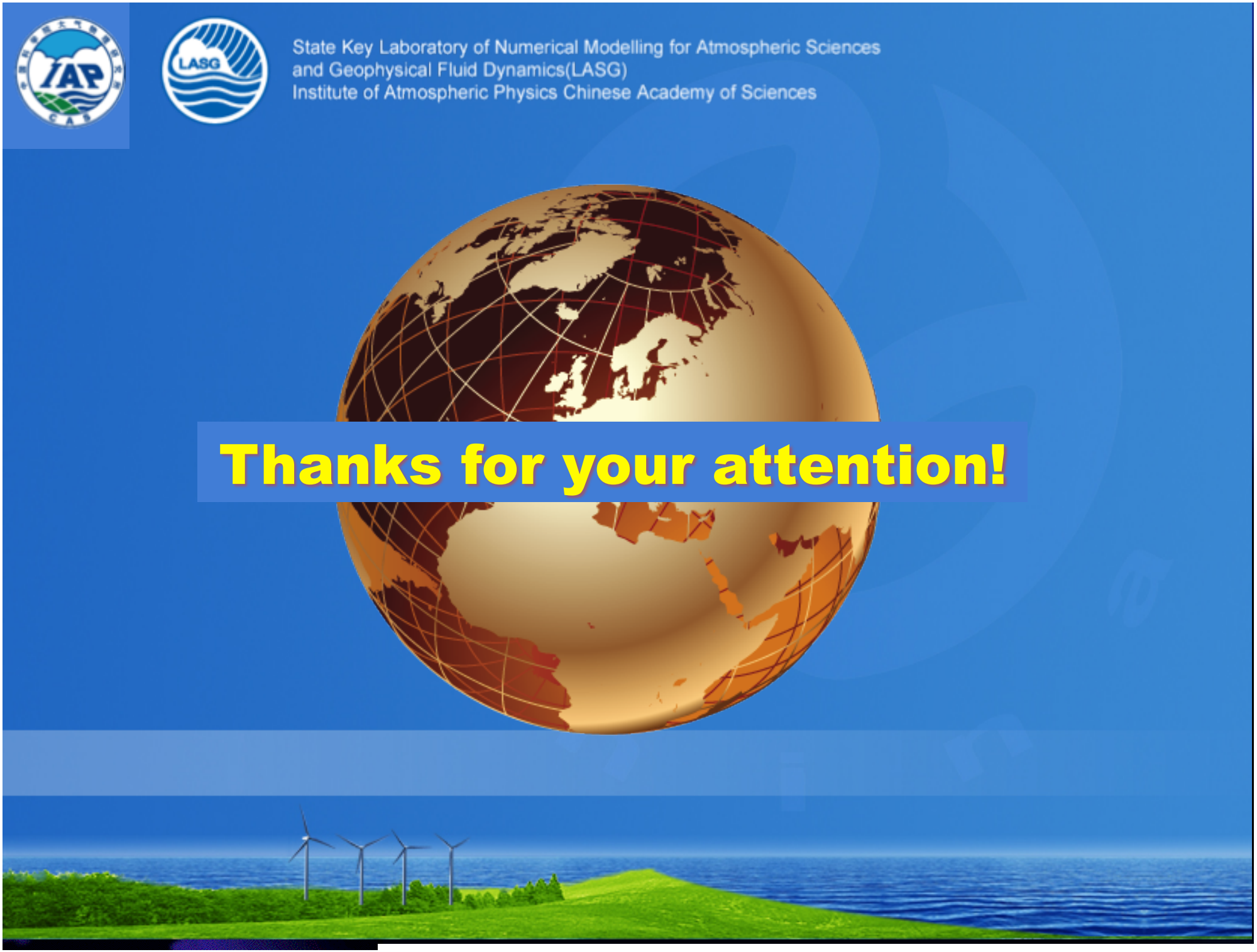



*Figure 1: The Call Themes*

**This fits well the ACESS/ICES Initiative!**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Thanks for your attention!