Third Pole Environment (TPE) Programme

Ailikun

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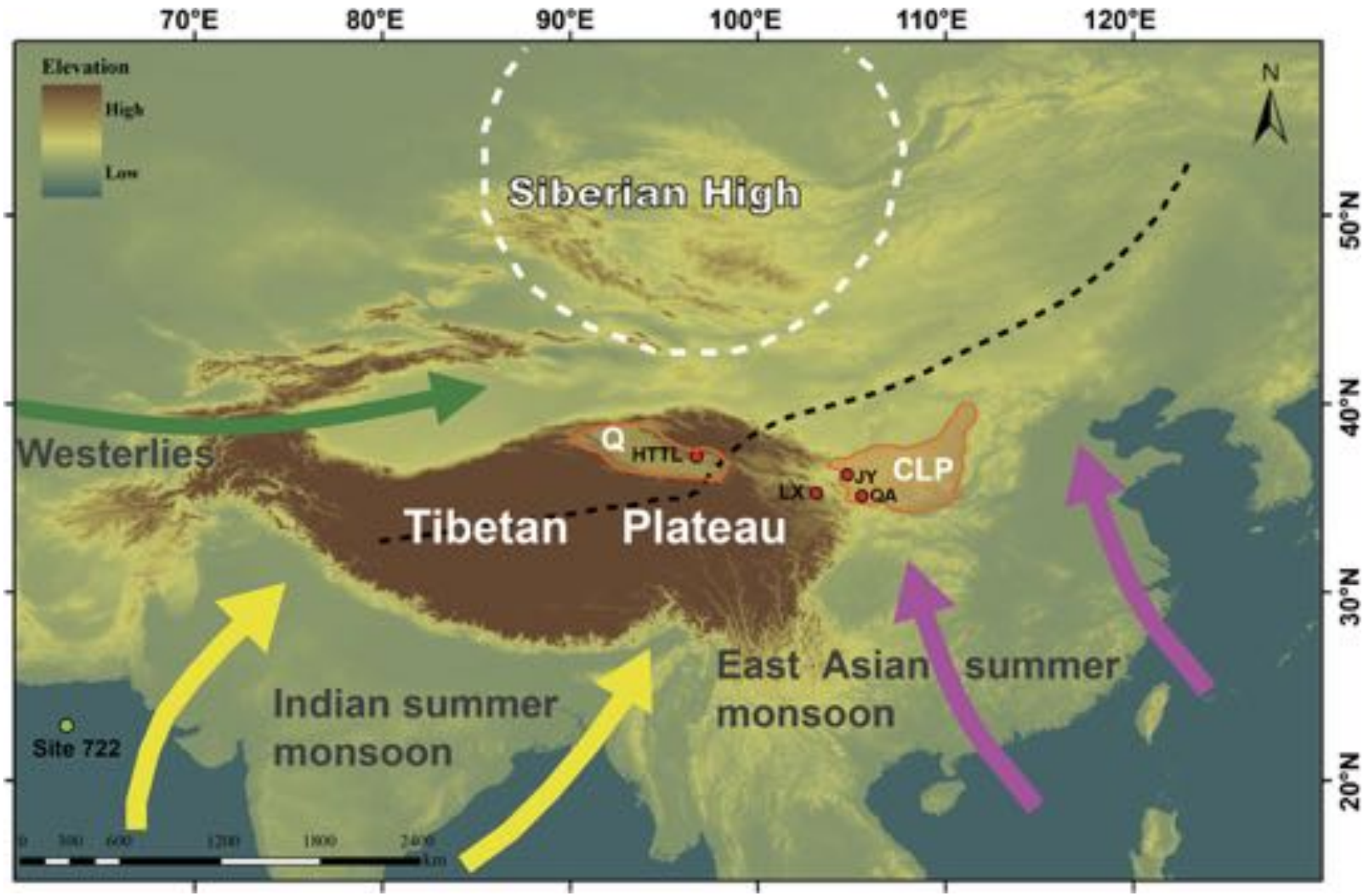
Chinese Academy of Sciences

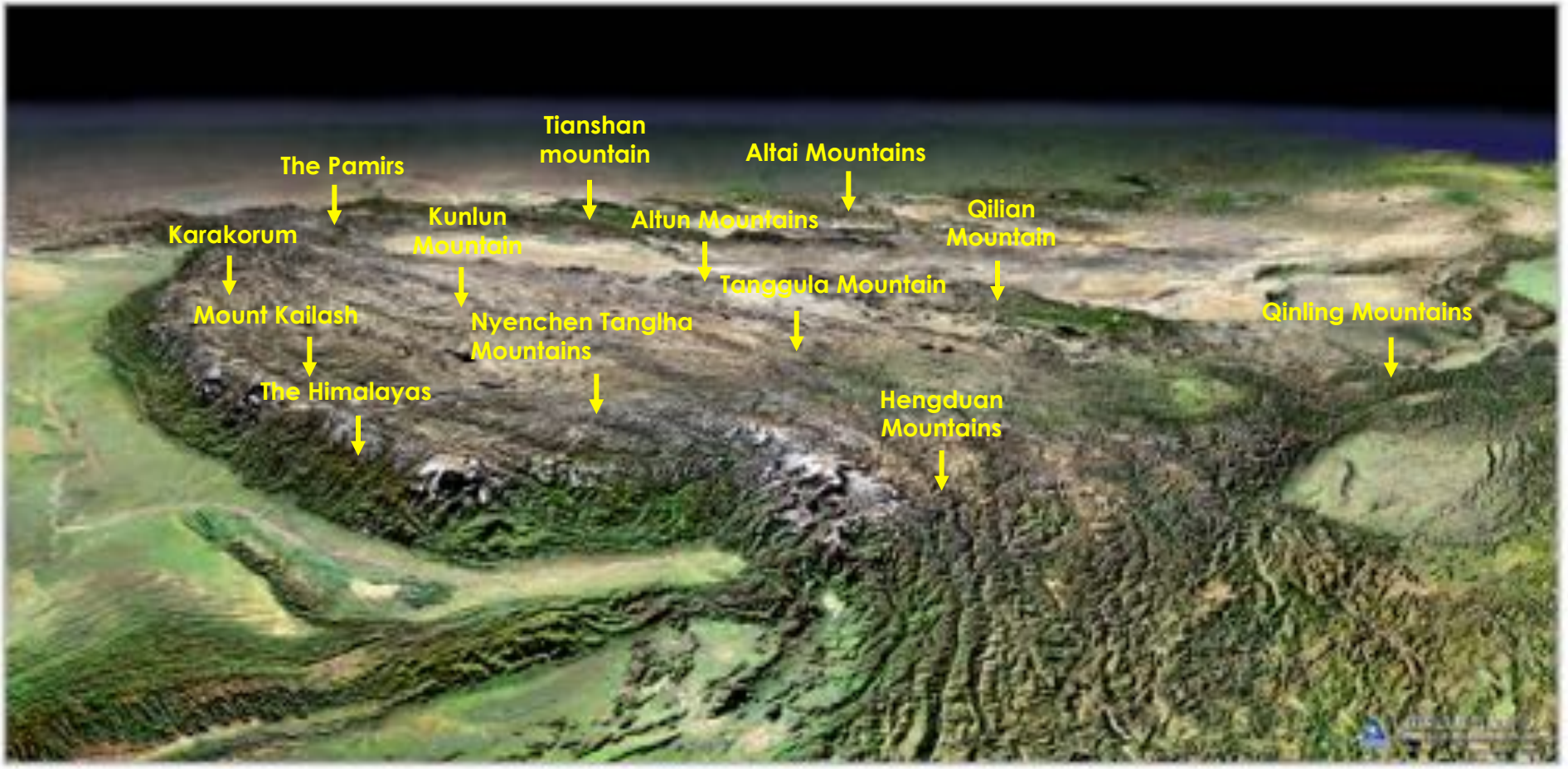
ANDES-INARCH workshop, 24 Oct. 2018, Santiago, Chile


Google

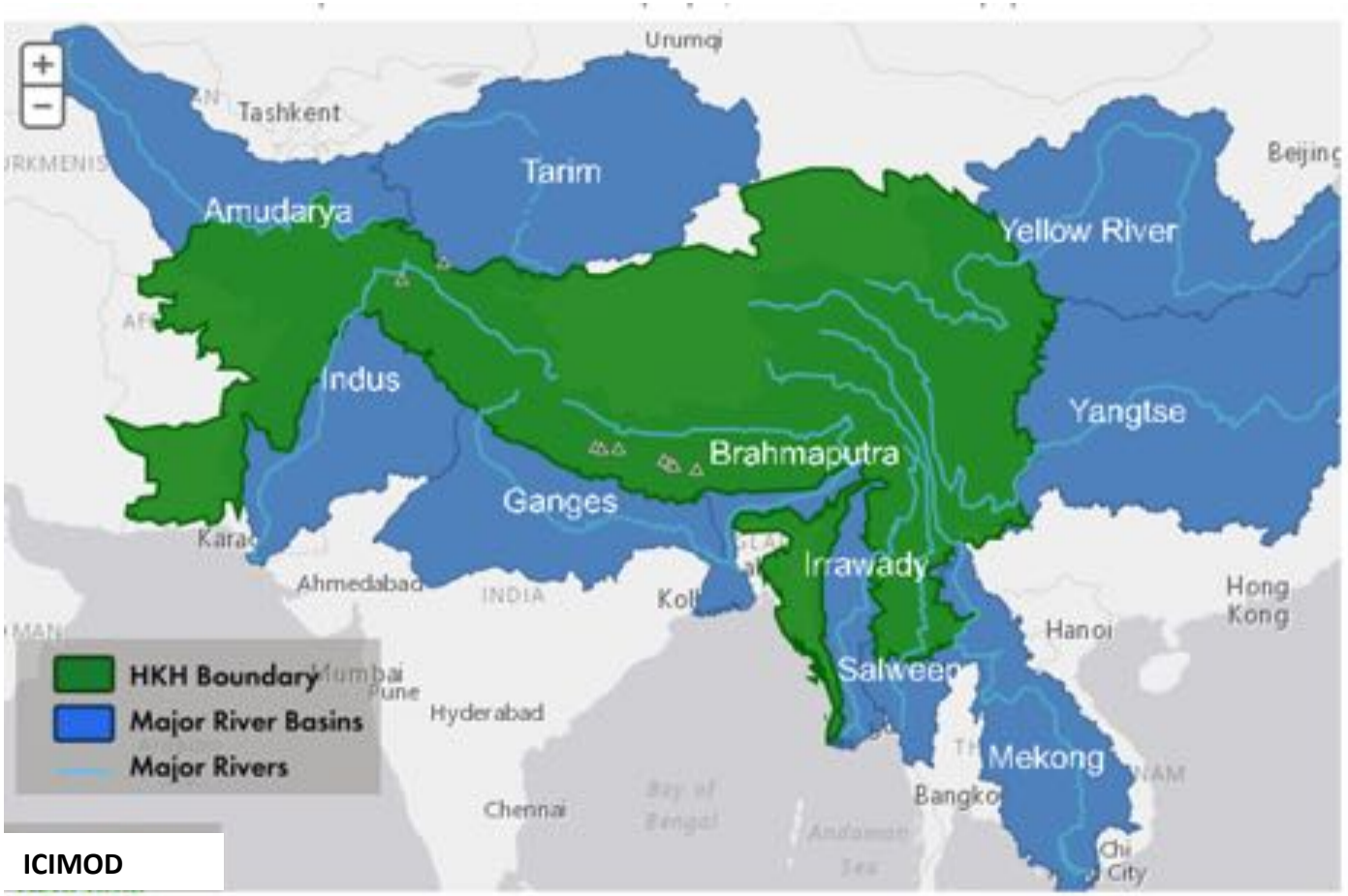
Asian Monsoon



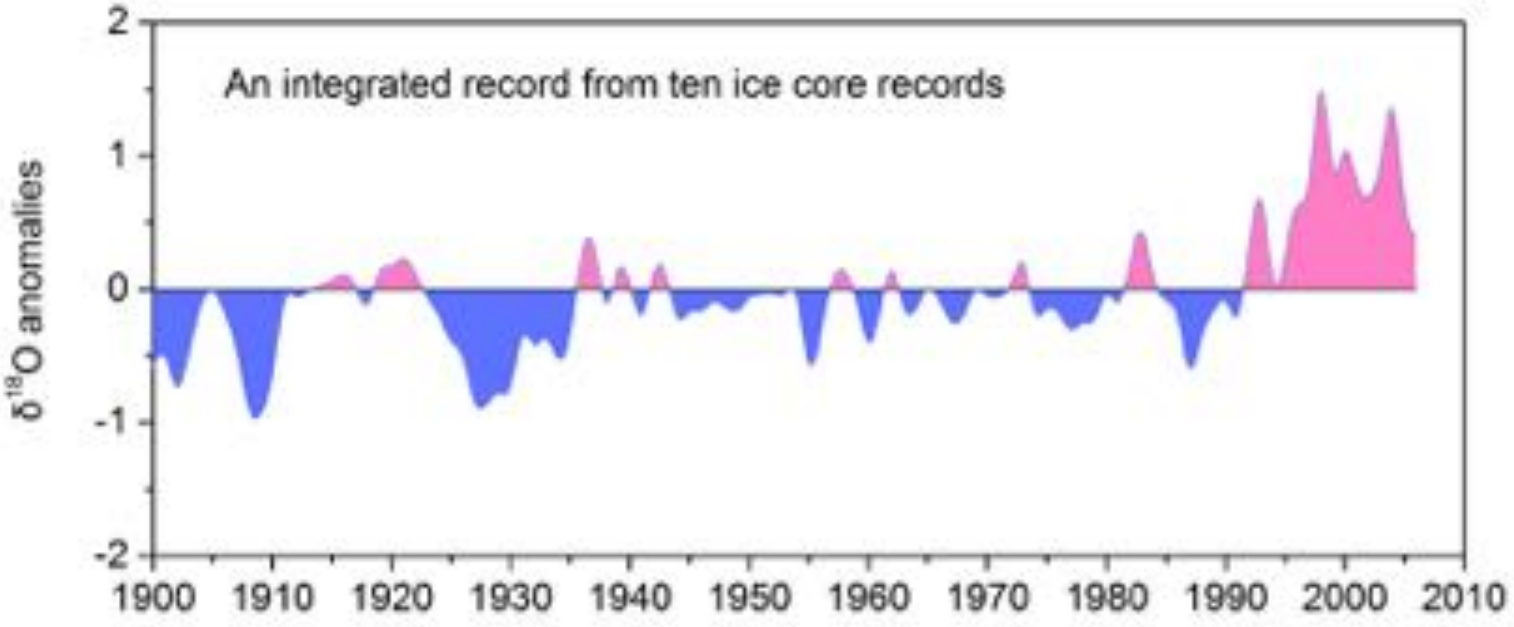
The Third Pole covers nearly 5 million square kilometers. It is the youngest, highest and largest plateau on the Earth. Third Pole environment changes affect more than 2 billion people in the region.



The Third Pole Provides Water Resources and Ecosystem Services for About 2 Billion People



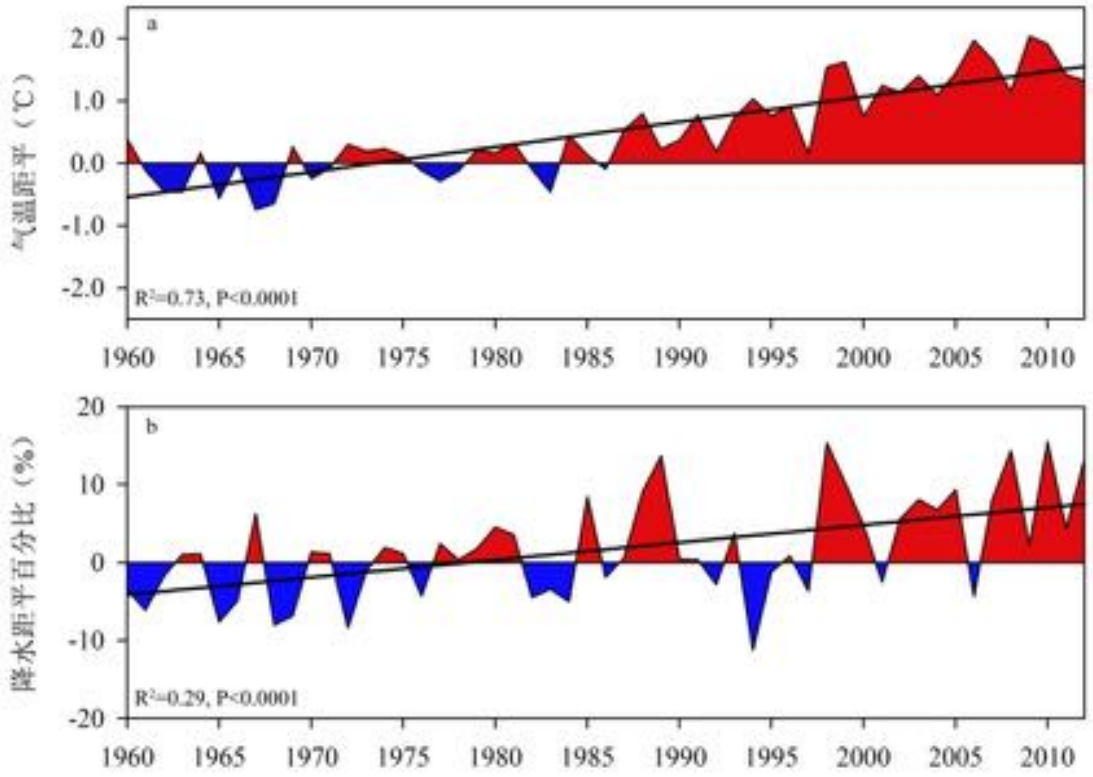
The warmest is after the 1990s in the last 100 years



Data from Gao and Yao et al., J. Geophys. Res., 2015

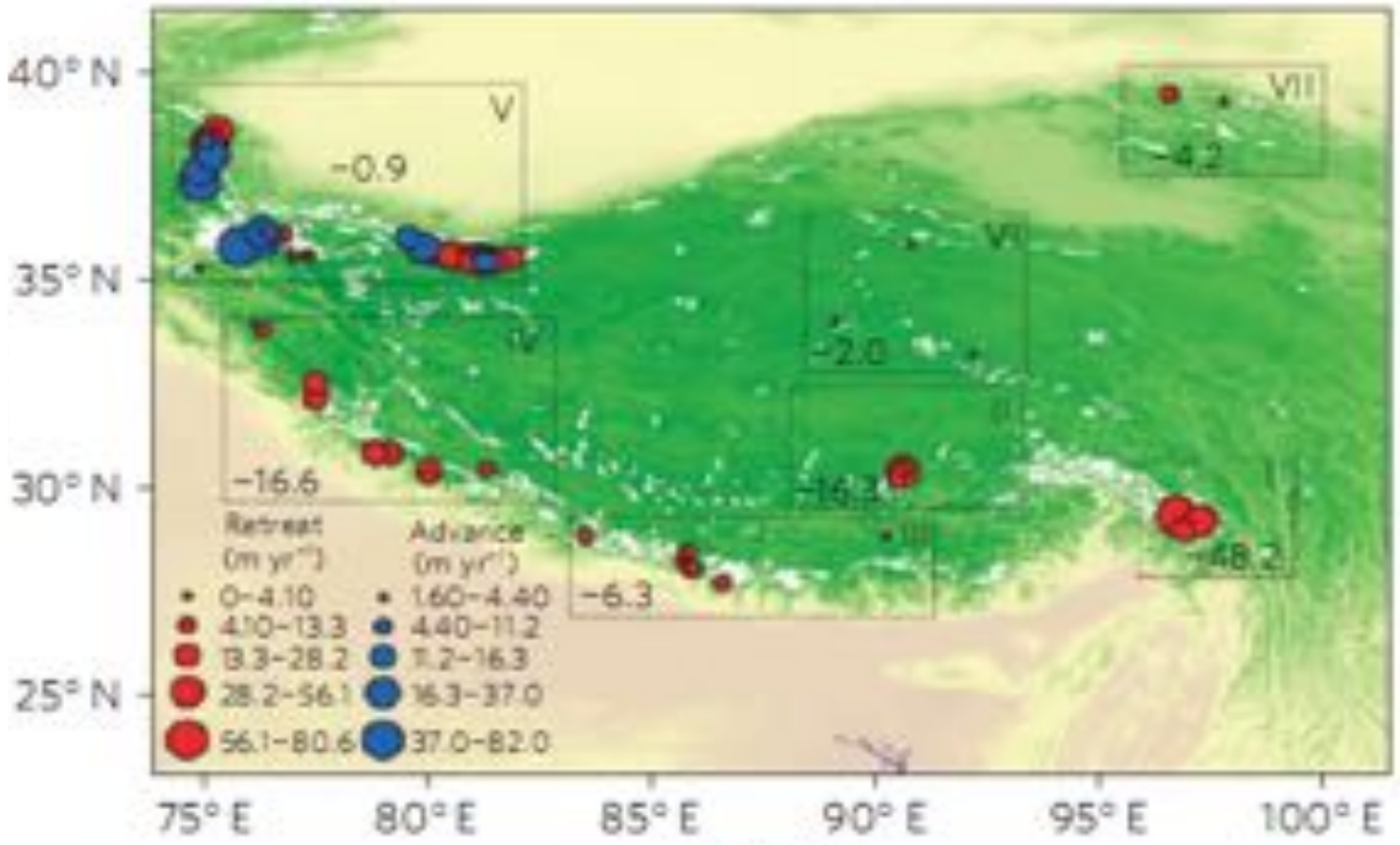
Climate is warming more rapidly

Warming with 0.3-0.4℃/10a from 1960 to 2012



Time series of T anomaly and P anomaly (%) in Tibetan Plateau of China from 1960 to 2012.

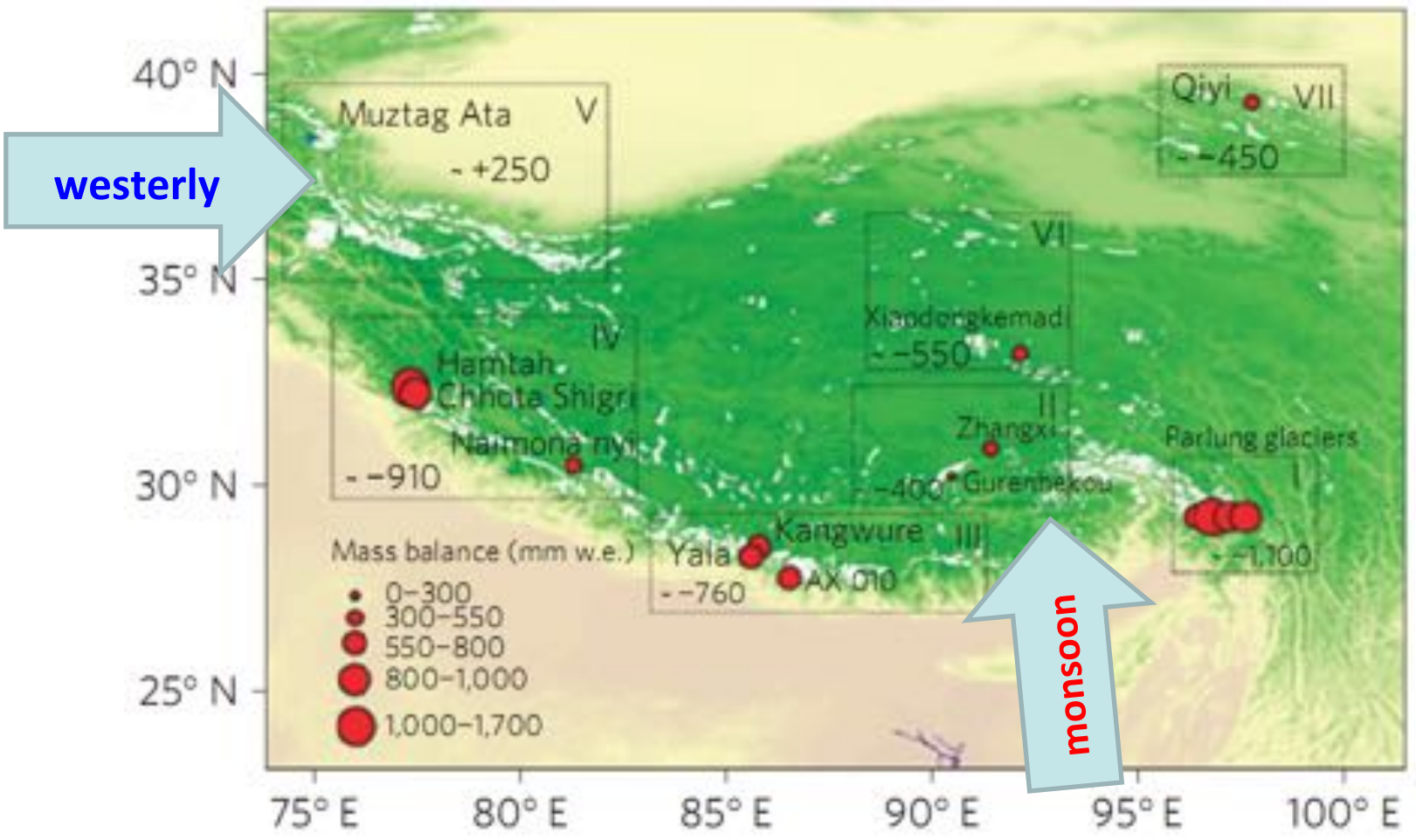
Glacier length change pattern in the Third Pole region



Pattern： **Retreating rates decreased from Himalayas to the interior Plateau, and a certain amount of glaciers advanced in in the northwest Third Pole**

Yao et al., Nature Clim. Change., 2012

Glacier mass balance change in the Third Pole region

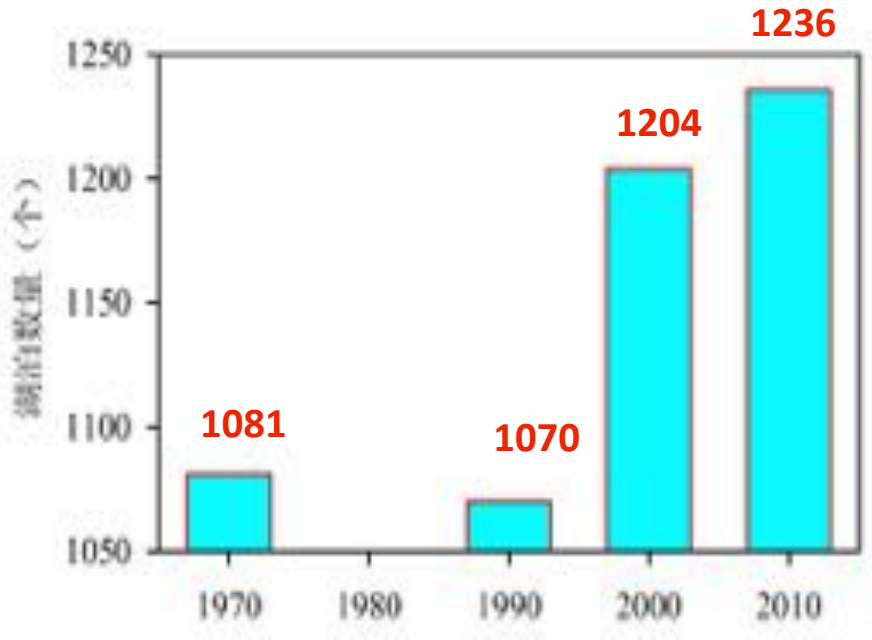


Pattern： **The most negative mass balance in the Himalayas, modest mass loss in continental interior, positive mass balance in in northwest Third Pole**

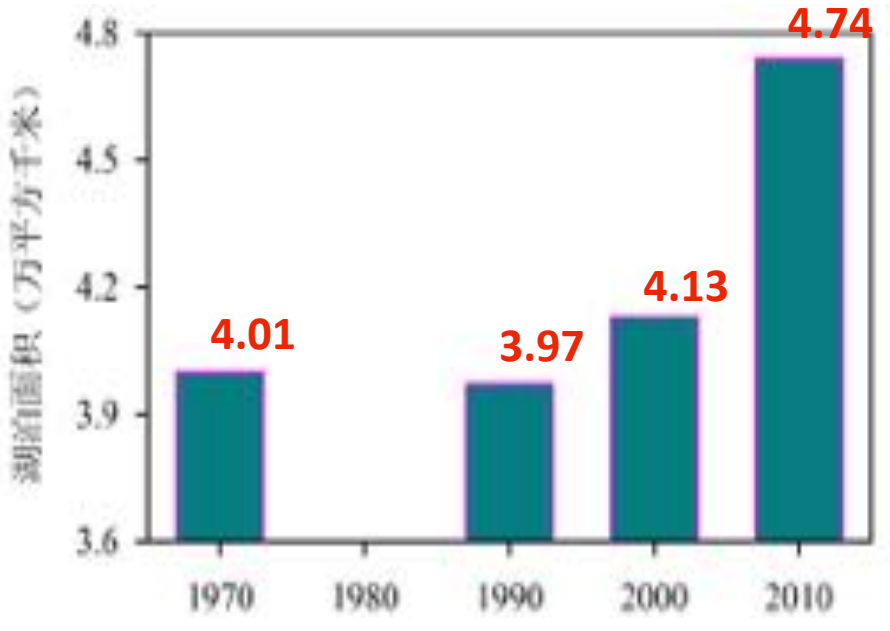
Yao et al., Nature Clim. Change., 2012

Increasing lakes in Tibetan Plateau of China in last 40 years

Changes of lake number

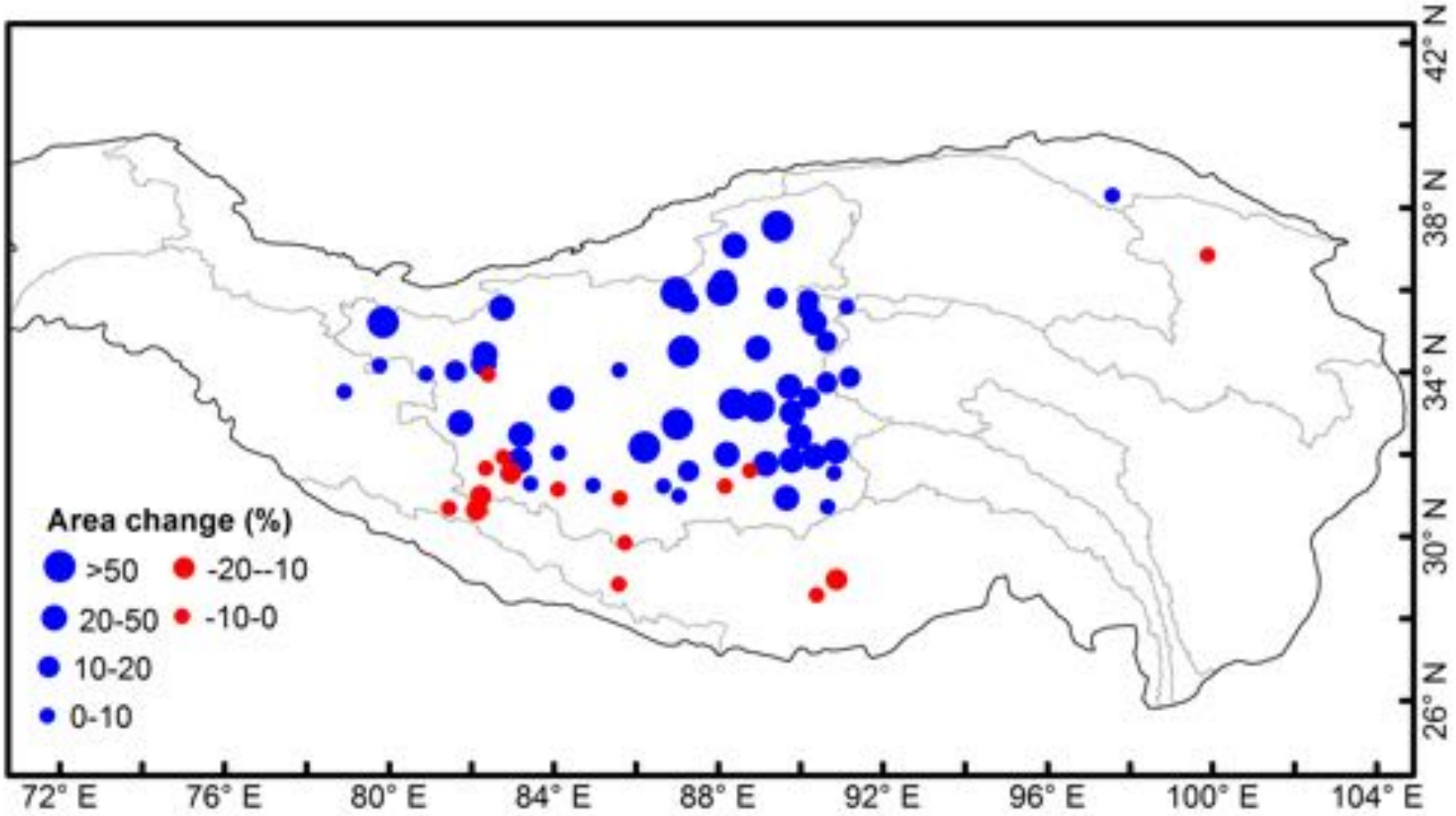


Changes of lake area (10,000 KM^2)



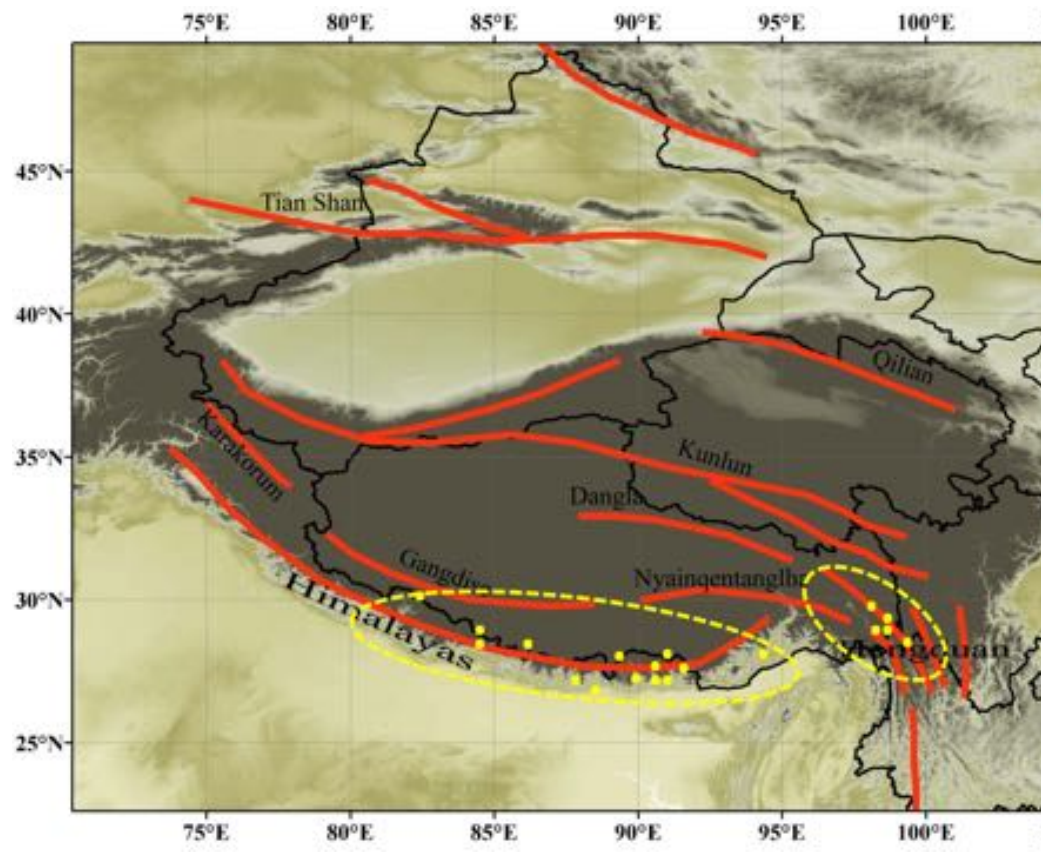
Only calculating the Lakes with area > 1 km^2

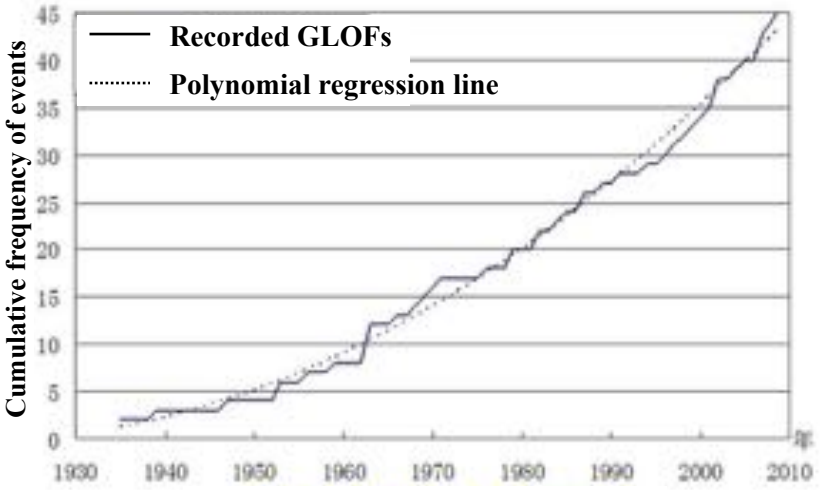
Lake area change pattern in the Third Pole region



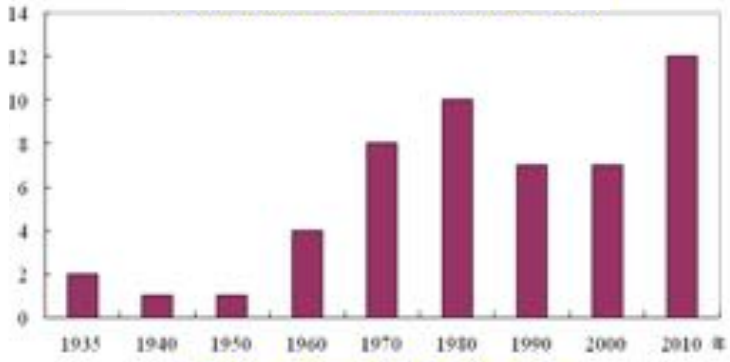
Zhang and Yao et al., Chin. Sci. Bull., 2014

Glacial lake outburst (GLOF) . With global warming and glacial retreat, the frequency of GLOFs has increased in recent years.





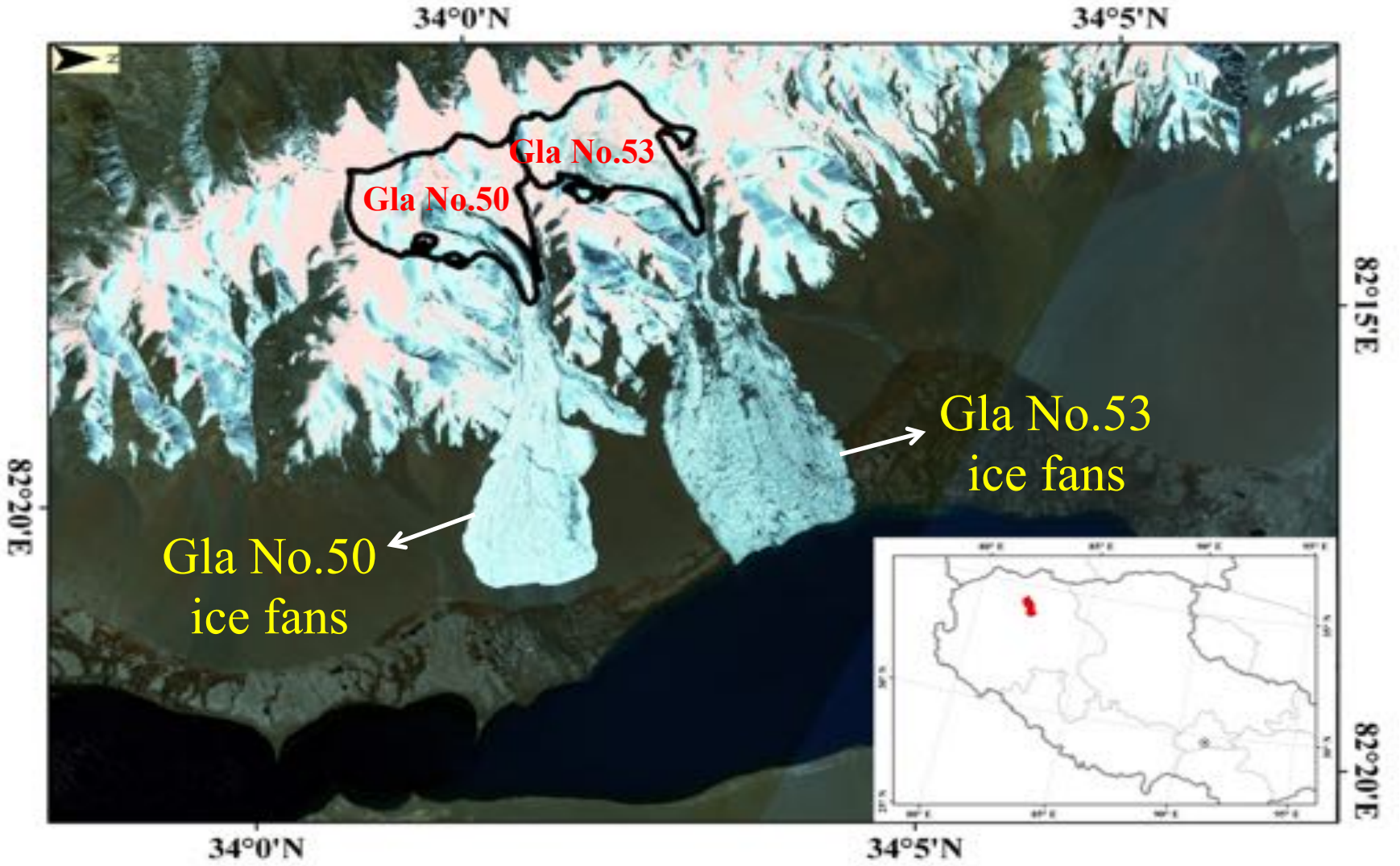
Cumulative GLOFs in China, Nepal and Bhutan



GLOFs in the Himalayas

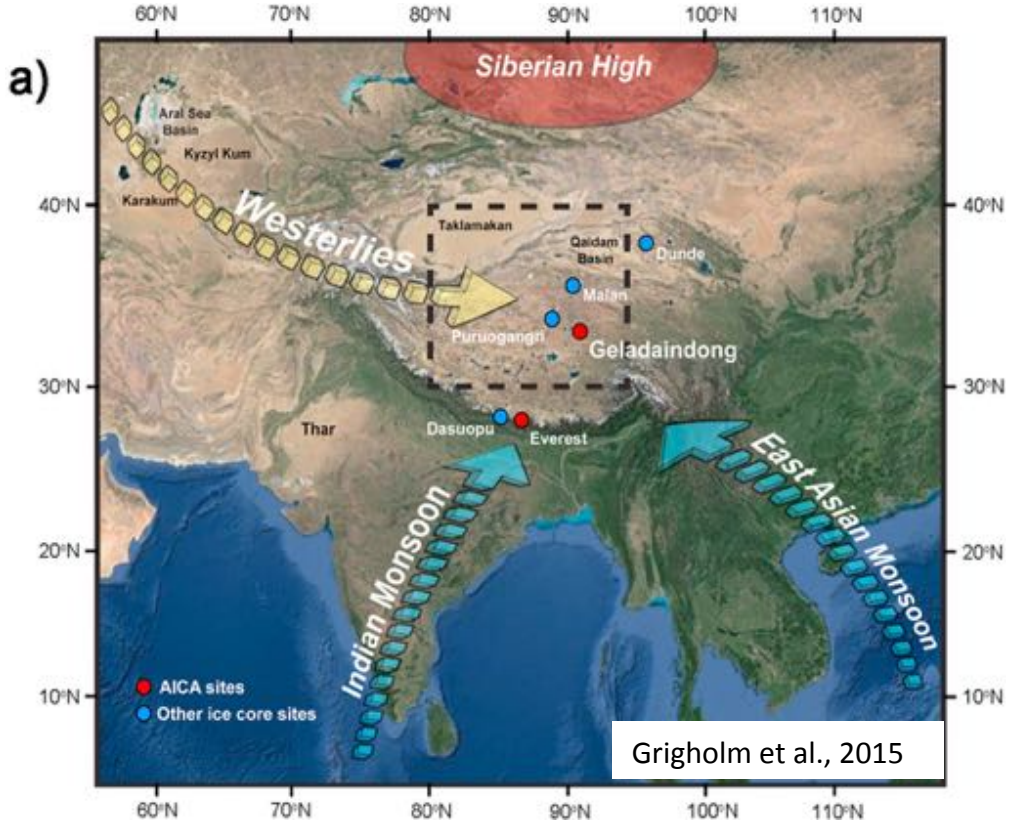
Yao et al., Assessment of Environment Change on the Tibetan Plateau, 2015

Ice Avalanches in the northern Tibet in 2016



Third Pole in regional and global context

Interaction between Asian monsoon and mid-latitude westerlies



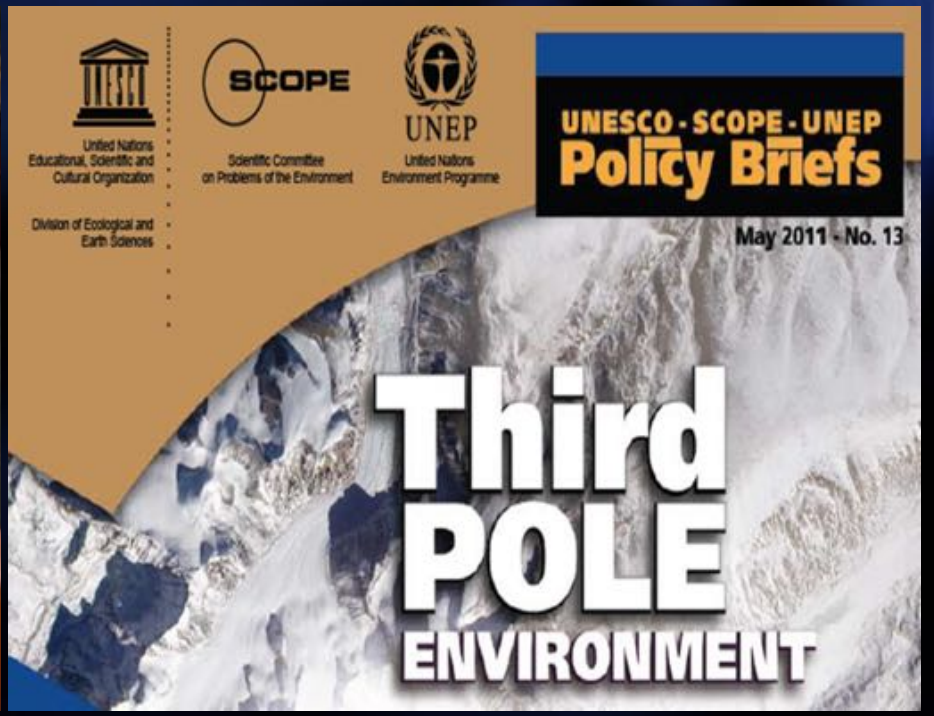
Grigholm et al., 2015

Most atmospheric teleconnection patterns are related to Third Pole

Figure quote from Deliang Chen

How does Third Pole impact on and respond to interaction of westerlies and monsoon? (from Deling Chen)

Third Pole Environment (TPE) Programme Launched in 2009 Supported by CAS



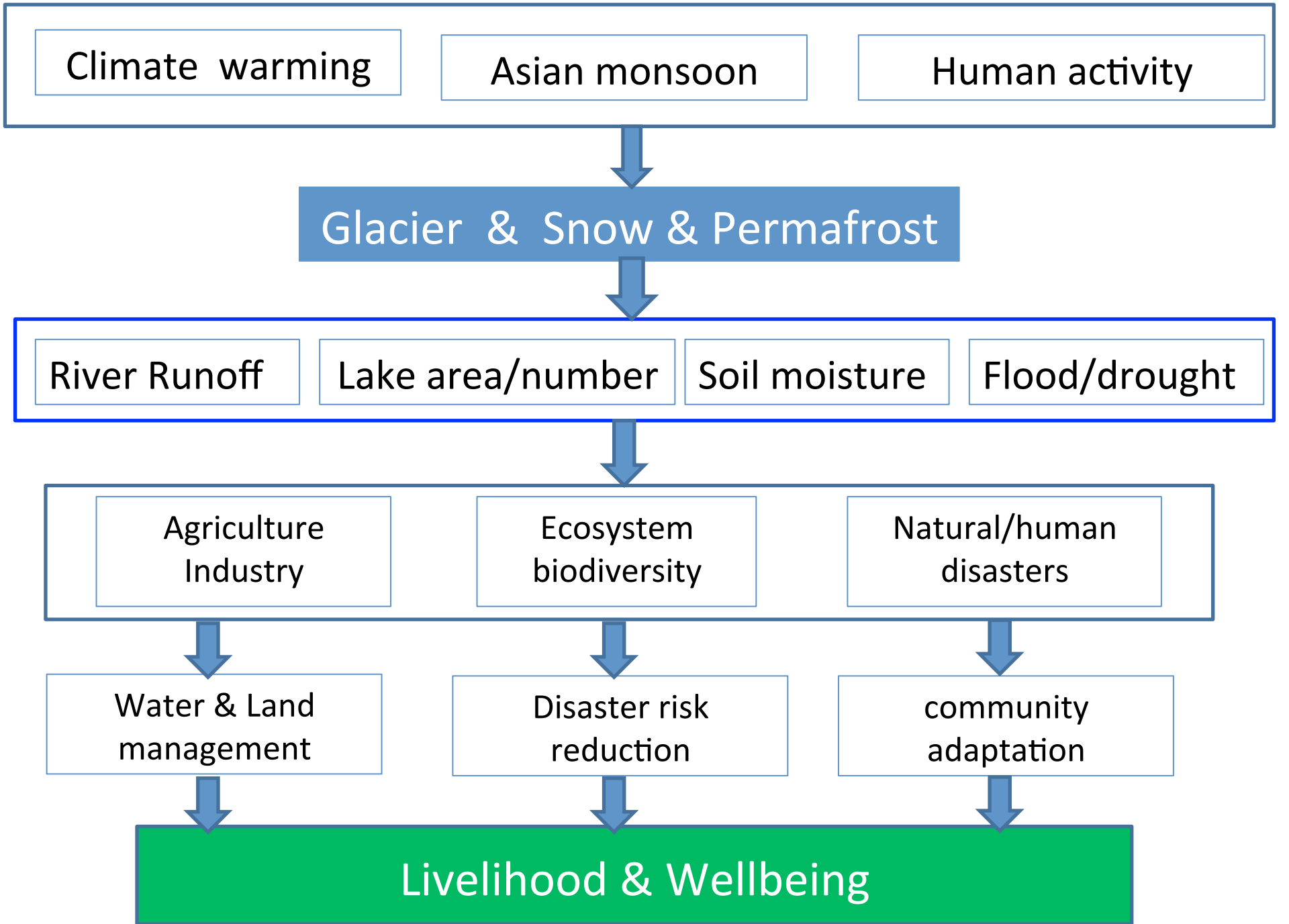
The Objectives of TPE

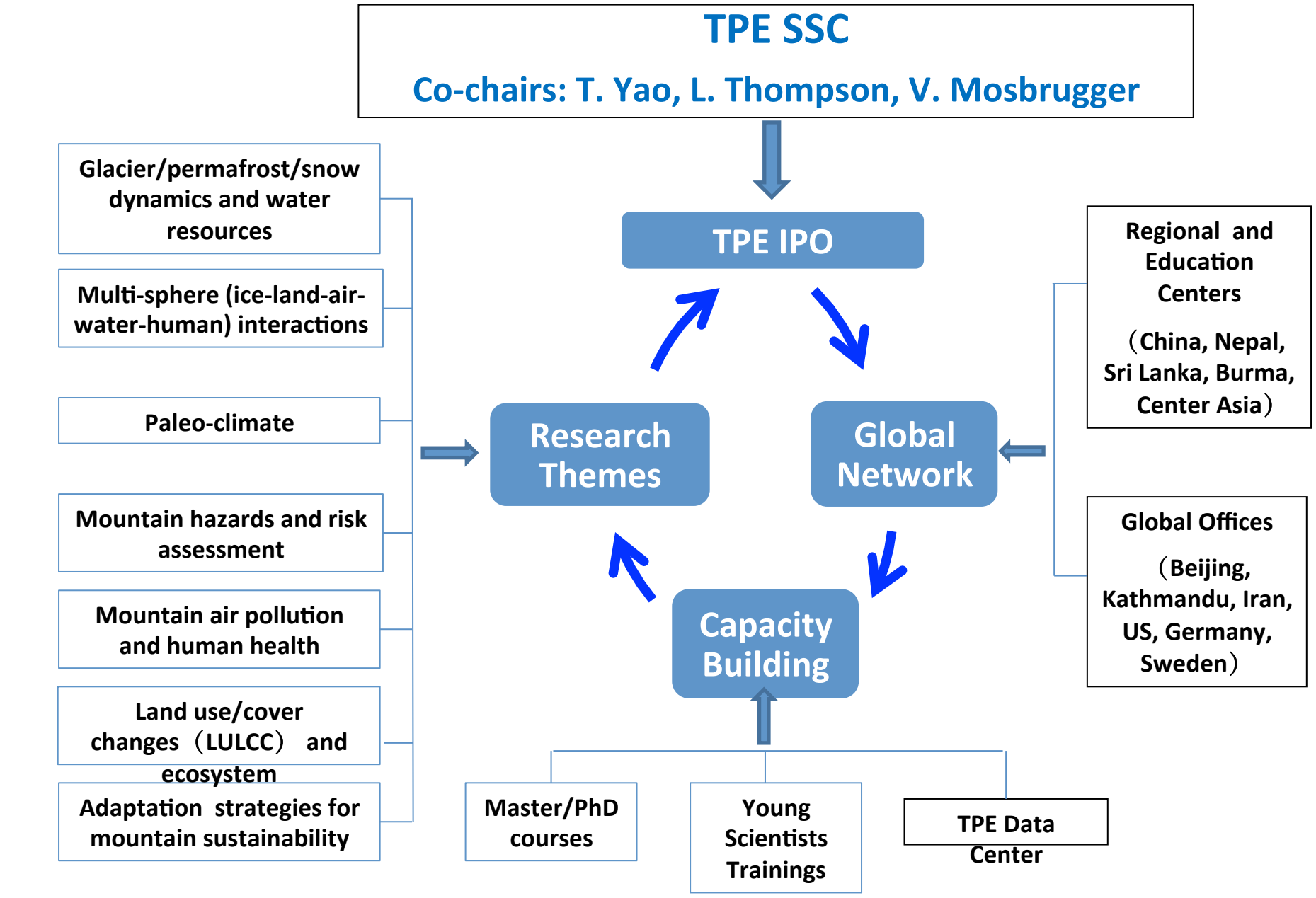
✓ To obtain a system understanding of the evolution of third pole and of its impact on the dynamics of the earth system: past - present - future.

✓ To understand the mechanism of Ice-Water-Atmosphere-Ecosystem-Human interaction in Third Pole region to support the sustainable development of the region.

TPE Research Priorities

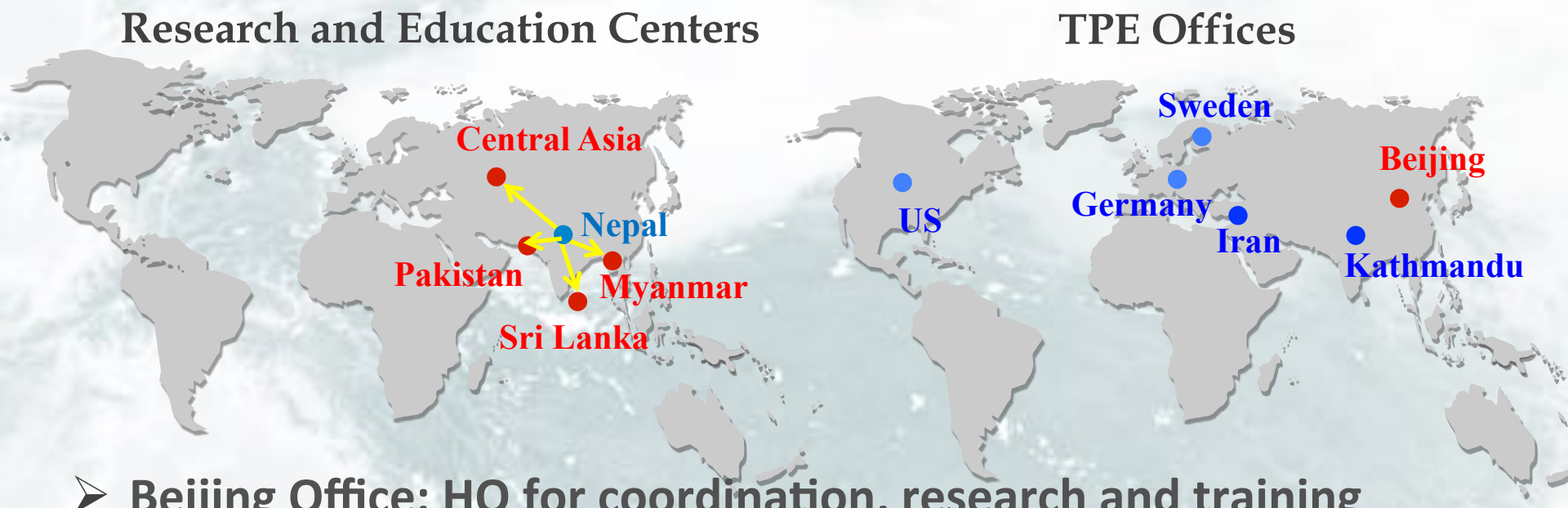
- ✓ The key earth system processes and their interactions among multi-spheres in Third Pole region
- ✓ The impacts of global change to Third Pole environment, livelihood and society.
- ✓ Scientific assessments and adaptation advices to government/ policy makers to support the sustainable development of the society


Climate warming
Asian monsoon
Human activity
Glacier & Snow & Permafrost
River Runoff
Lake area/number
Soil moisture
Flood/drought
Agriculture Industry
Ecosystem biodiversity
Natural/human disasters
Water & Land management
Disaster risk reduction
community adaptation
Livelihood & Wellbeing



Structure of TPE programme

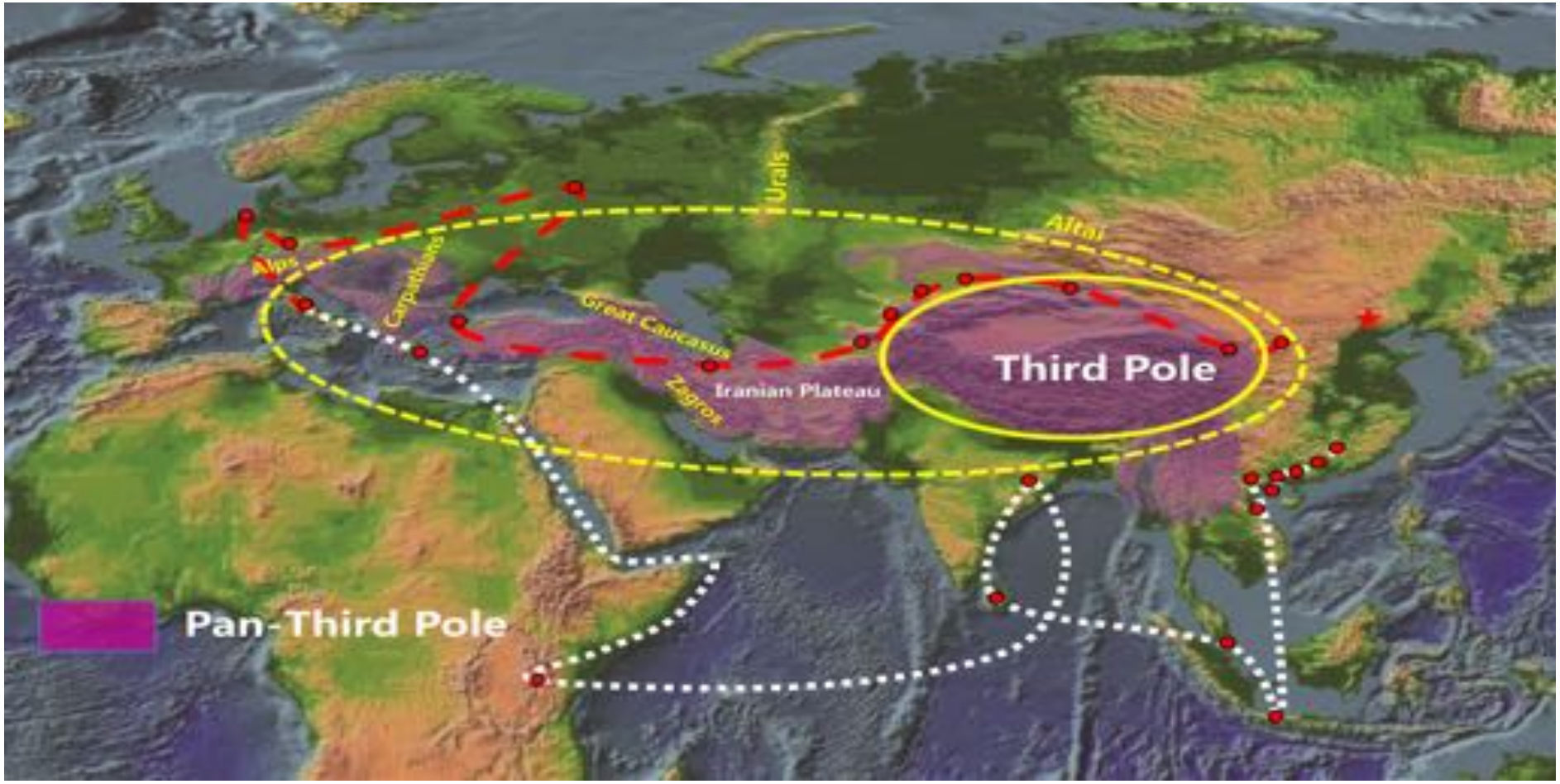
Establishment of TPE Regional/Global Network



- Beijing Office: HQ for coordination, research and training
- Kathmandu Center: Observation and training
- US Office: Glacier dynamics and Paleo-climate
- German Office: Ecosystem and human adaptation
- Iran Office: Observation and training
- Sweden Office: Earth system modeling

TPE Workshops

CAS Strategic Priority A Program: Pan-Third Pole Environment Study for a Green Silk Road (2018-2023, PI: Tandong Yao)



TPE
THIRD POLE ENVIRONMENT

Pan-TPE
PAN THIRD POLE ENVIRONMENT

Objectives of CAS Pan-TPE Program

- To illuminate Water Tower of Asia change and its impacts on the Silk Road associated with climate change and earth system interactions
- To reveal water-ecosystem coupling mechanism and to project future environmental consequences along the Silk Road under different climate scenarios
- To propose new models of green growth for the regions

TPE and GEWEX

GHP-TPE joint workshop

17-19 Oct 2017, Kathmandu

1. Atmospheric circulation in high-latitude and the Third Pole region
2. Remote sensing and data retrieval for cryosphere
3. Land-surface interaction water resource/cycle in high-latitude and the Third Pole region
4. Climate modelling and future projection for Third Pole
6. Natural hazards and human adaptation in Third Pole

Proposal of New GHP Crosscutting Project:

Third Pole Environment (TPE) Water-Sustainability

Third Pole Environment: Water Sustainability (TPEWS)

GHP Cross-cutting Project Science Plan

Started drafting from Nov. 2017, first manuscript in March 2018, revising process finished June 2018. Totally, 15 TPE scientists contributed to this science plan.

TPE Water Sustainability (TPEWS)
----The Science Plan----

Scientific Questions

1. What are the changes in glaciers, snow and permafrost of the high Asian mountain region in last 50 years?
2. Why are these changes happening and what are the main drivers of these changes in Third Pole region? natural variability or human activities?
3. How are the various drivers affecting the hydrological cycle, natural hazard and ecosystem in the region?
4. Can we predict high-impact hydro-meteorological events and future water cycle changes?

TPE Water Sustainability (TPEWS)
----The Science Plan----

Research Priorities

1. Water-energy exchanges and transport over the Third Pole region based on observation (in situ and satellite)
2. Mechanisms and changes in hydrological cycle over the Third Pole region
3. Regional/global modeling focusing on Third Pole, especially improving modeling capacity and providing high resolution model products for the region
4. Data assimilation and prediction of high-impact hydro-meteorological events and future changes in hydrological cycle and water-energy exchanges