



Third Pole Climate Forum



# Seasonal Climate Review in the Third Pole region

## *December 2024—April 2025*

**MA Lijuan, WANG Pengling, YANG Mingzhu,  
YANG Guowei, WANG Dongqian, LIU Yanju**

National Climate Centre, China Meteorological Administration

TPCF-3, New Delhi, 3-5 June 2025



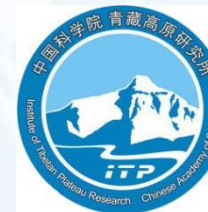
Third Pole Climate Forum

# Products and Services for Climate Monitoring



Agreement on thematic responsibilities for mandatory functions for the entire region of the TPRCC-Network  
(IP, Feb. 2022)

- ❑ **Development of mandatory Climate Monitoring products coordinated by NCC/CMA**
  - Monthly/seasonal/annual monitoring products on Tem, Precip, snow cover, glacier ✓
  - Seasonal Climate Bulletin (climate events included) ✓
  - More products (e.g. EDW, ranking ) and ECVs monitored (extremes, permafrost, etc.) are under development
- ❑ **Development and maintenance of the Network web portal, led by China with support from nodes lead and technical partners, as the interface with end users**
  - [www.rccra2.org/tp-rcc/](http://www.rccra2.org/tp-rcc/) ✓



Joint-construction Institutions  
of TPRCC (Beijing)



国家气候中心 National Climate Center

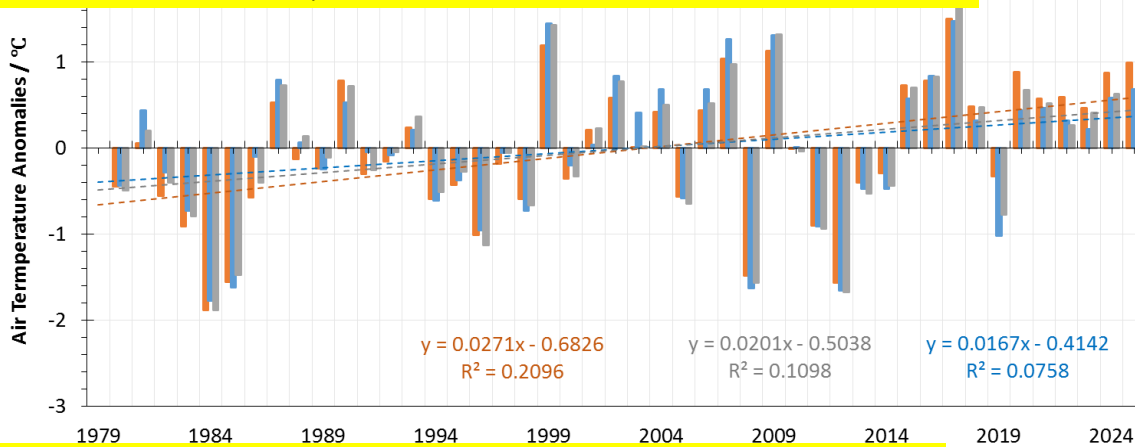


# Content

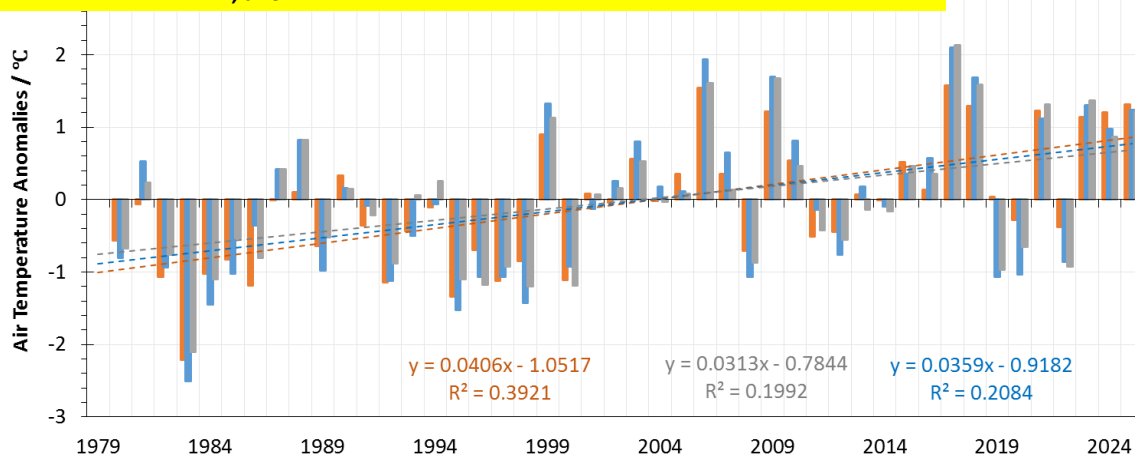
- **Development on Function of Climate Monitoring**
- **Overview of Climate conditions for Dec.2024—Apr.2025**
  - Surface air temperature
  - Precipitation
  - Snow cover
  - Glacier
  - Permafrost
  - High-impact events
- **Takeaway Information**

# Surface Air Temperature (SAT) in the Third Pole region

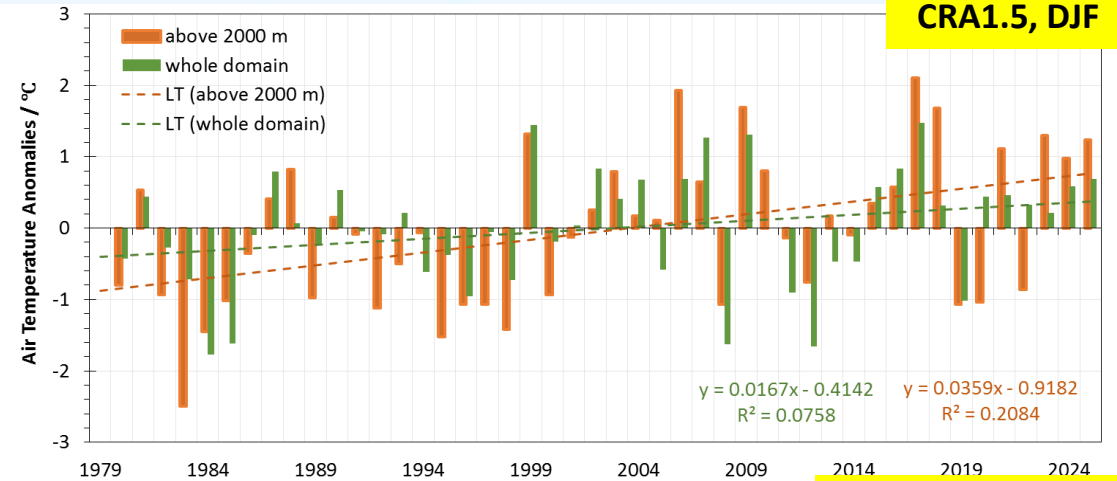
whole domain:  $T_{win, ano} = 0.68 \sim 0.99^{\circ}\text{C}$ , trend =  $0.17 \sim 0.27^{\circ}\text{C}/10\text{a}$



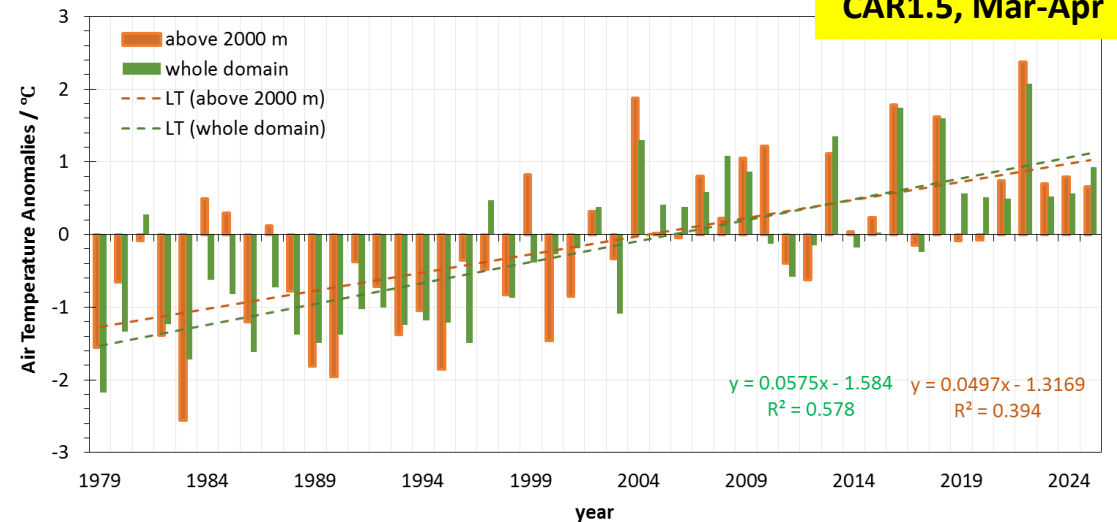
$\geq 2000\text{ m}$ :  $T_{win, ano} = 1.21 \sim 1.31^{\circ}\text{C}$ , trend =  $0.31 \sim 0.41^{\circ}\text{C}/10\text{a}$



CRA1.5, DJF



CAR1.5, Mar-Apr

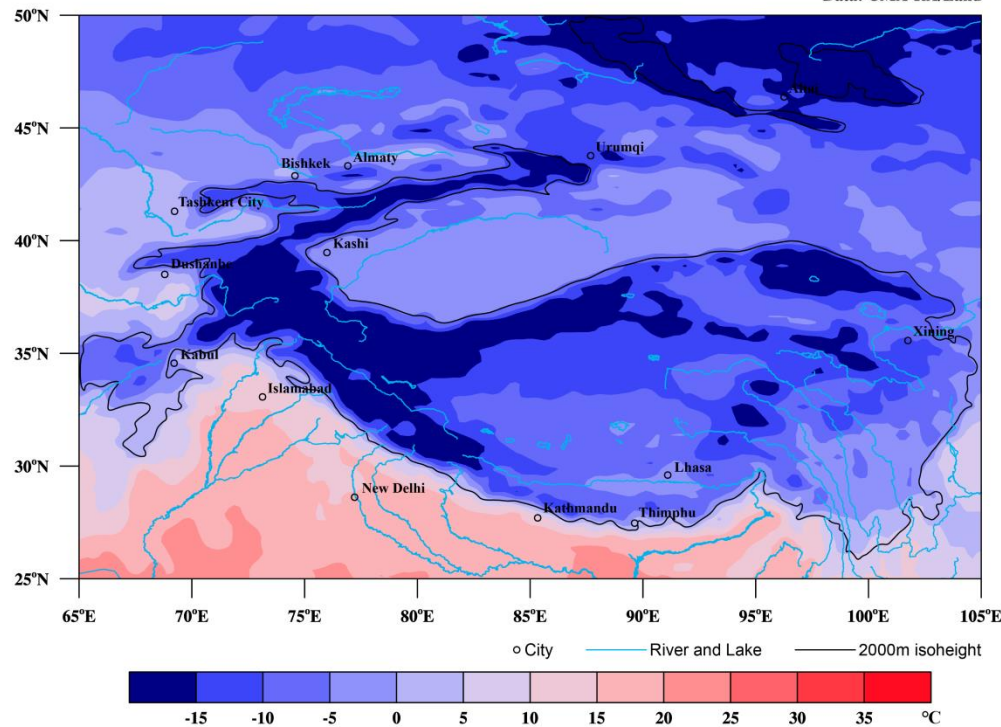


# SAT & anomalies in winter (DJF) 2024/2025

- Correspondingly, the northeastern and northwestern parts of the TP region and most TPCR experienced above-normal SAT, with the SAT in some of the central and southern TPCR exceeding normal levels by 3 to 4°C.
- Most areas along 35° N to 45° N or so recorded below-normal SAT, with negative anomalies in some local areas exceeding -3°C.

Mean Temperature, Winter 2024/2025

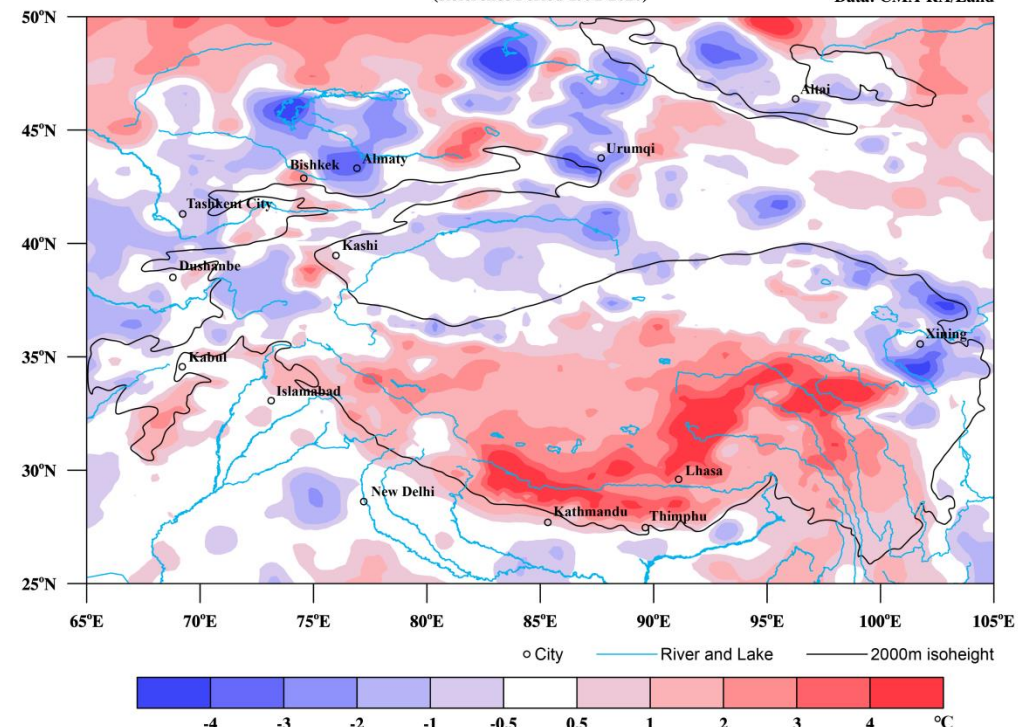
Data: CMA-RA/Land



Mean Temperature Anomaly, Winter 2024/2025

(Reference Period 1991-2020)

Data: CMA-RA/Land



Winter (DJF 2024/2025) SAT and anomalies (relative to 1991-2020)

(Data source: CMA-RA/Land)

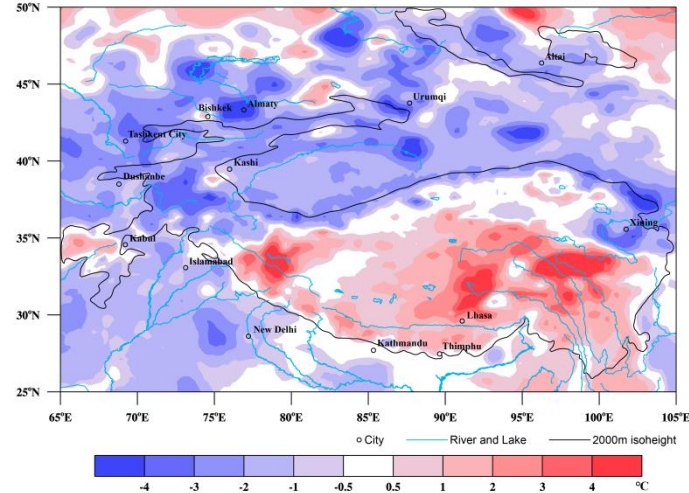


## Dec 2024

### Mean Temperature Anomaly, Dec 2024

(Reference Period 1991-2020)

Data: CMA-RA/Land

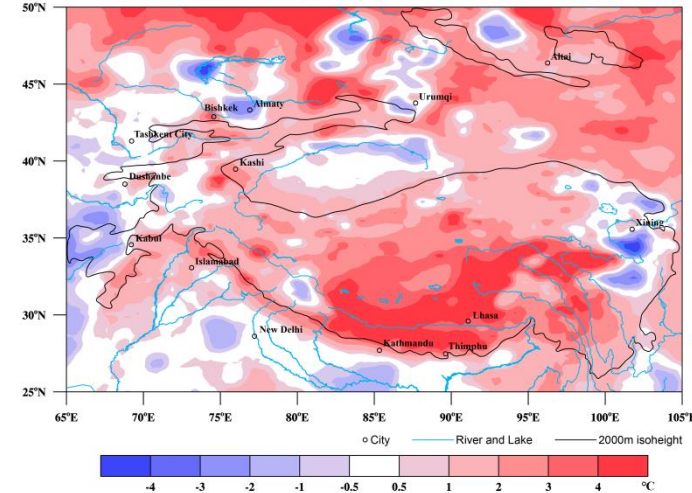


## Jan 2025

### Mean Temperature Anomaly, Jan 2025

(Reference Period 1991-2020)

Data: CMA-RA/Land

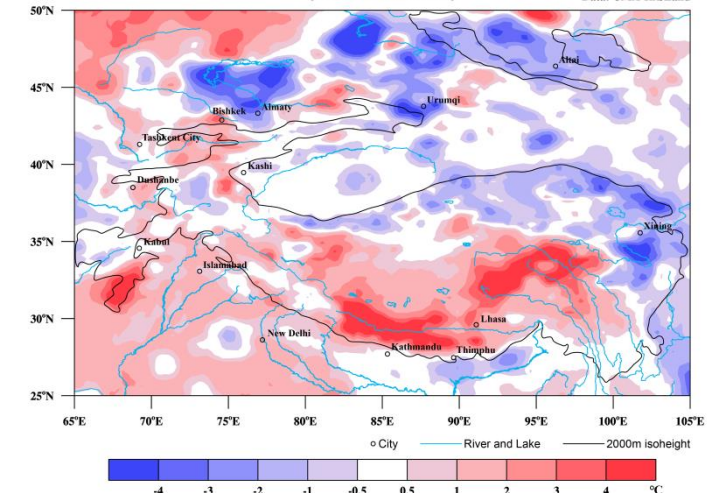


## Feb 2025

### Mean Temperature Anomaly, Feb 2025

(Reference Period 1991-2020)

Data: CMA-RA/Land

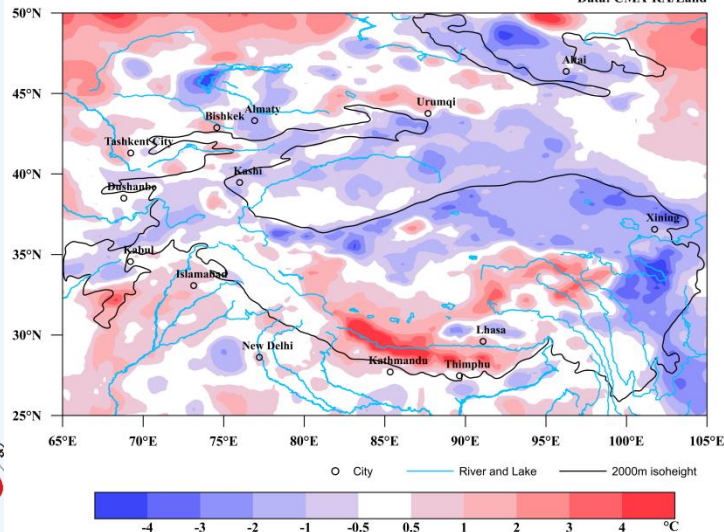


## Mar 2025

### Mean Temperature Anomaly, Mar 2025

(Reference Period 1991-2020)

Data: CMA-RA/Land

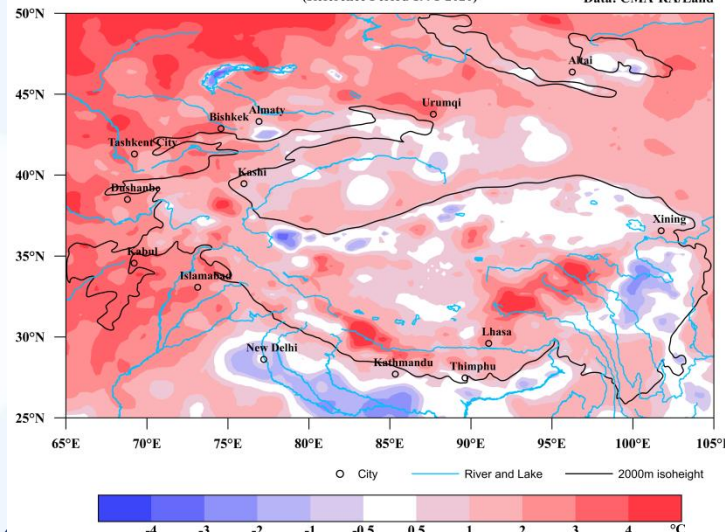


## Apr 2025

### Mean Temperature Anomaly, Apr 2025

(Reference Period 1991-2020)

Data: CMA-RA/Land



- SAT pattern in December, February, and March contributed to the overall sandwich-like pattern, while in January and April warmer condition almost occurred across the whole third pole region.

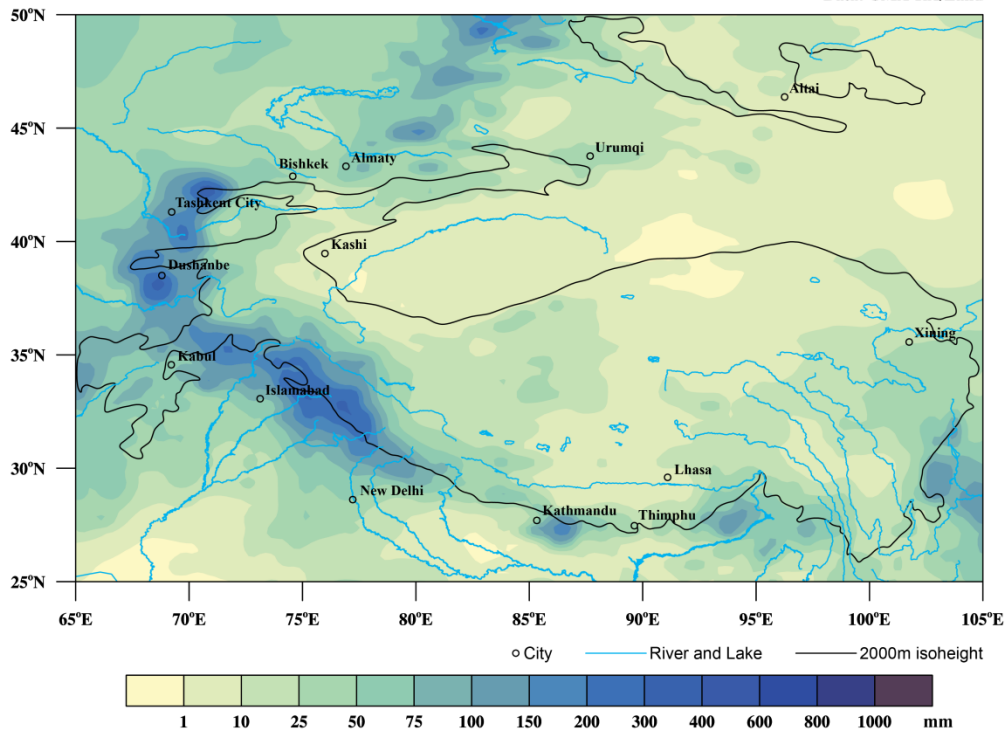


# Precipitation & Ano. percentage in winter (DJF) 2024/2025

- Precipitation in the TP region exhibited a pattern characterized by alternating phases of "drier-wetter-drier, -wetter" from west to east.
- The western Tianshan mountain and the southwestern part of TP region experienced significantly drier conditions (20%-80% less than normal) .

Total Accumulated Precipitation, Winter 2024/2025

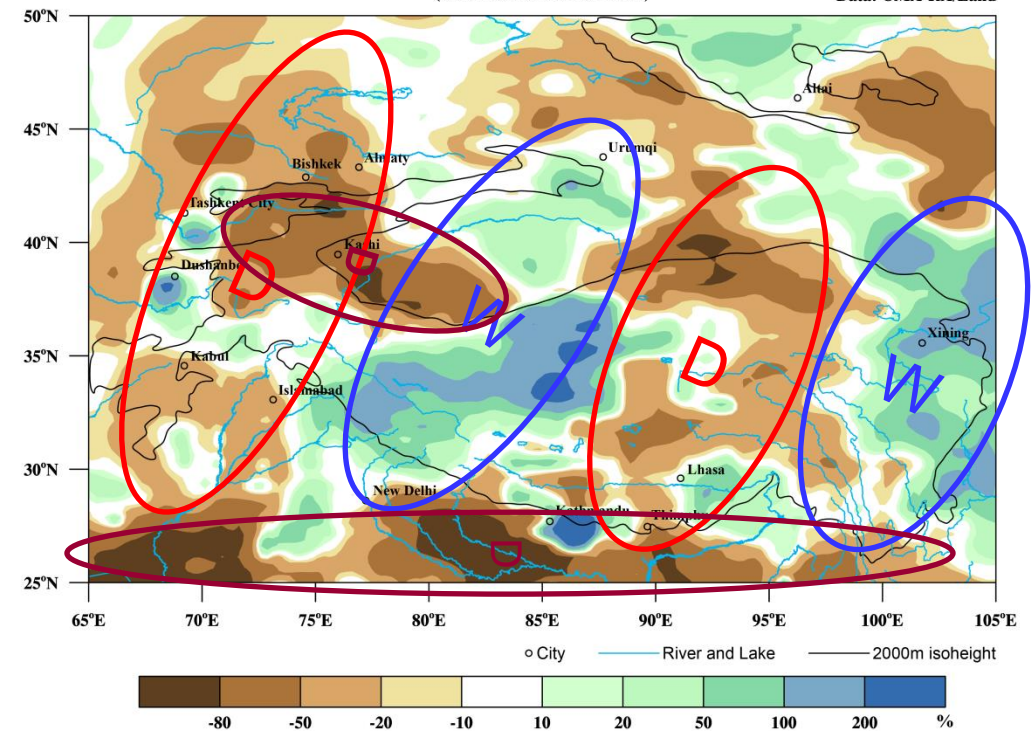
Data: CMA-RA/Land



Total Precipitation Anomaly Percentage, Winter 2024/2025

(Reference Period 1991-2020)

Data: CMA-RA/Land



Winter (DJF 2024/2025) precipitation amount and anomalies percentage (relative to 1991-2020)

(Data source: CMA-RA/Land)



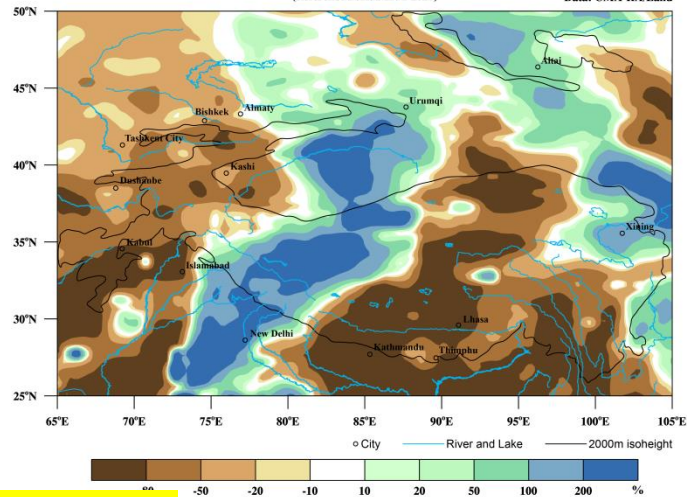
# Precipitation anomalies percentage: Dec 2024 – Apr 2025

**Dec 2024**

Total Precipitation Anomaly Percentage, Dec 2024

(Reference Period 1991-2020)

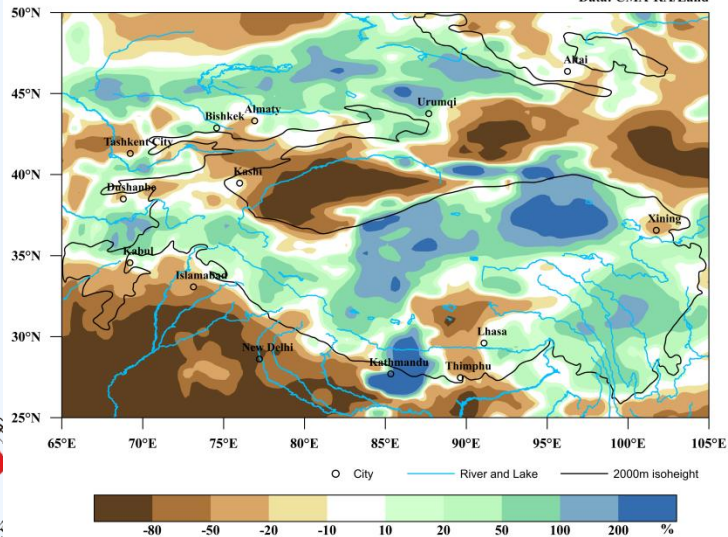
Data: CMA-RA/Land



**Mar 2025**

Total Precipitation Anomaly Percentage, Mar 2025

Data: CMA-RA/Land

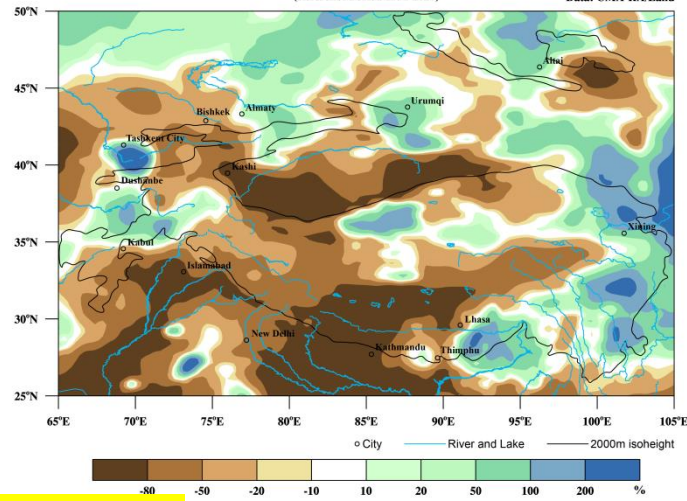


**Jan 2025**

Total Precipitation Anomaly Percentage, Jan 2025

(Reference Period 1991-2020)

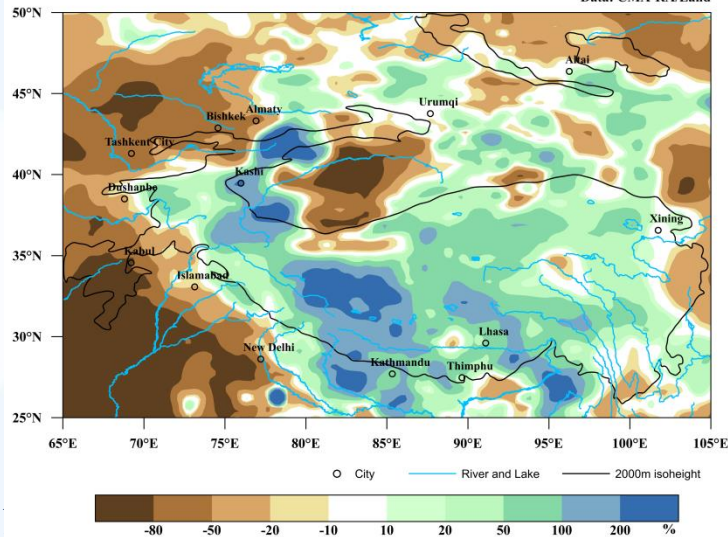
Data: CMA-RA/Land



**Apr 2025**

Total Precipitation Anomaly Percentage, Apr 2025

Data: CMA-RA/Land

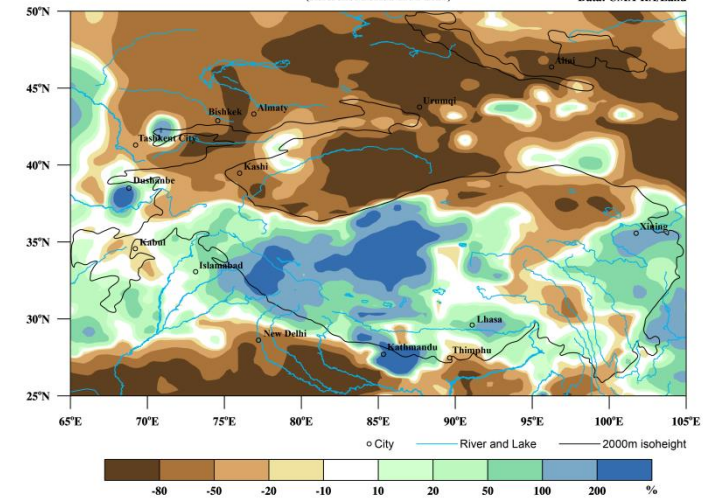


**Feb 2025**

Total Precipitation Anomaly Percentage, Feb 2025

(Reference Period 1991-2020)

Data: CMA-RA/Land

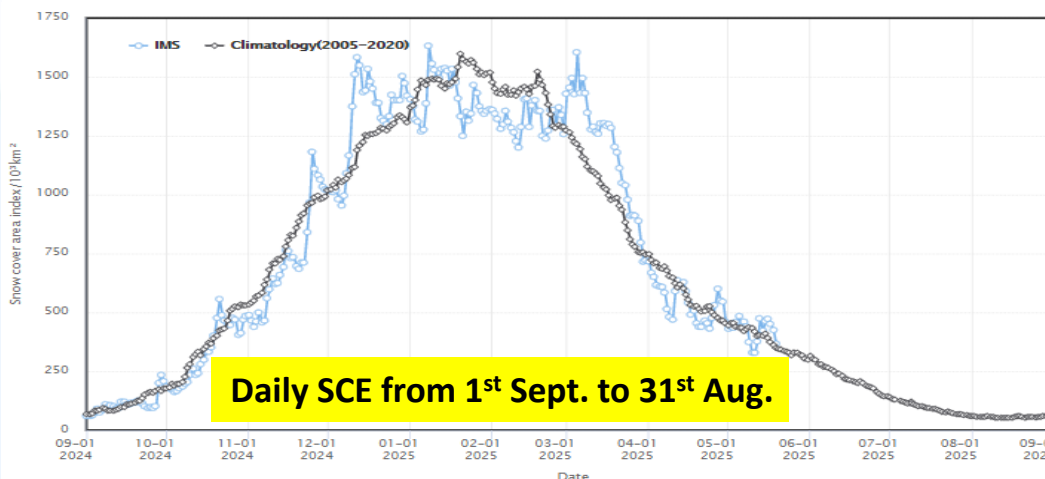
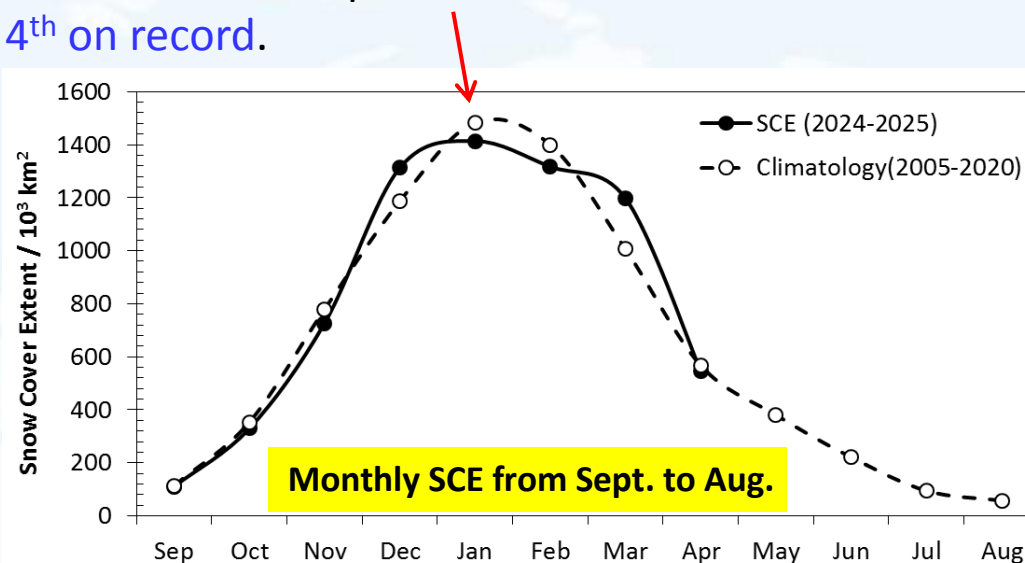
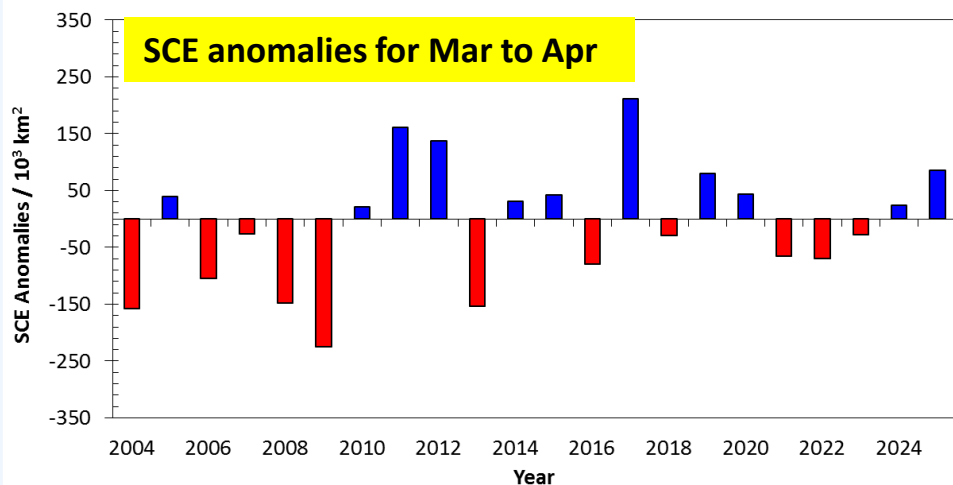
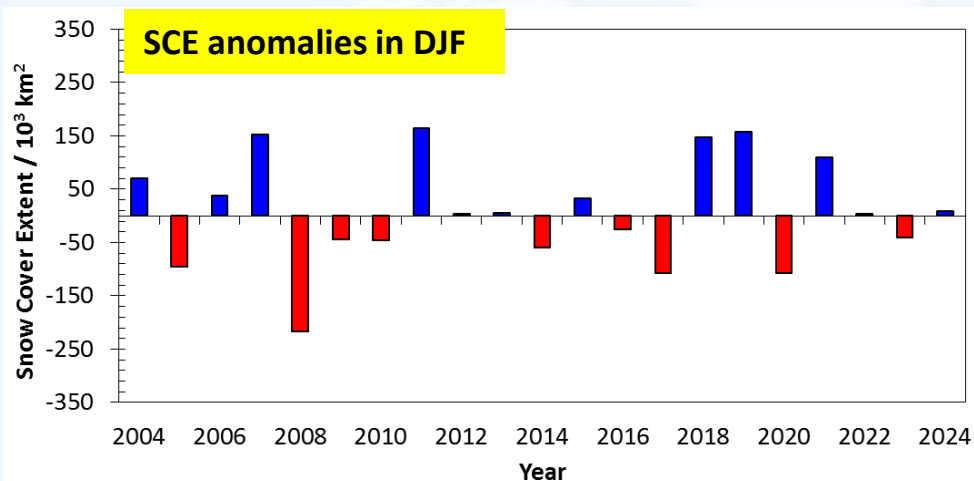


- **Dec-meridian, Feb-zonal**
- **March and April: less precipitation continued and developed in the southwestern TP, with deficits in part areas exceeding 80%.**
- Conversely, most TPCR had maintained more precipitation since Feb, while it exhibited larger positive biases in the central-western TPCR.



# Snow cover conditions: Snow Cover Extent (SCE)

- ❑ SCE in DJF and Mar to Apr was 8.7% and 10.8% higher than the 2005-2020 average, respectively.
- ❑ Larger than normal SCE in Dec and Mar but less in Jan and Feb; the peak SCE in Jan was not as obvious as normal; 19% larger SCE in March, ranking the 4<sup>th</sup> on record.

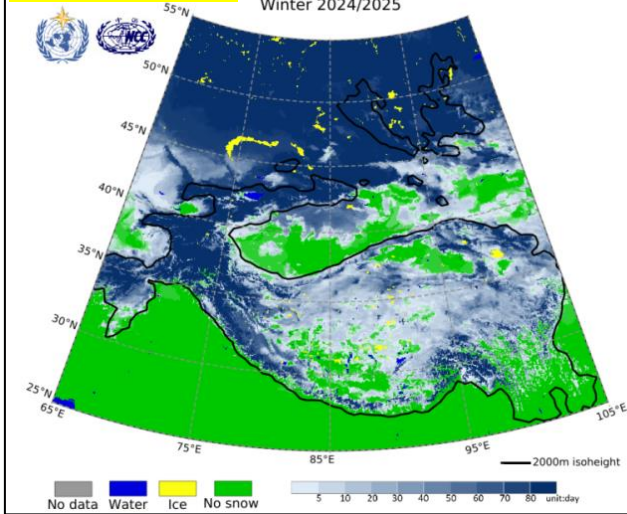


Data source: 4 km IMS/NSIDC

# Number of Snow Cover Days: winter and monthly anomalies

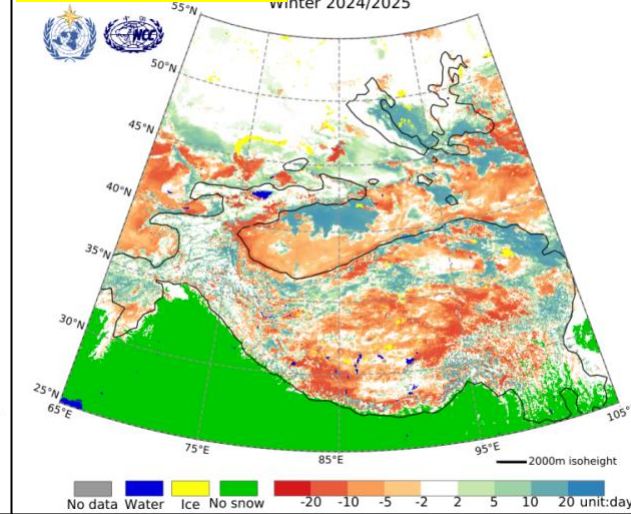
## Winter (DJF)

Snow Cover Days Over The Third Pole  
Winter 2024/2025



## DJF anomalies

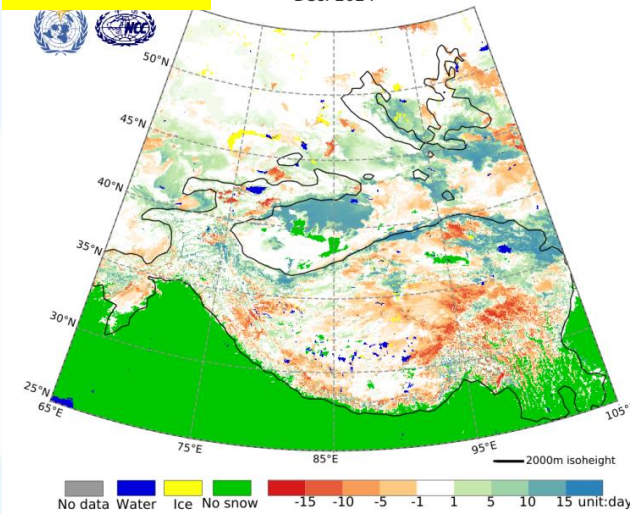
Snow Cover Days Anomaly Over The Third Pole  
Winter 2024/2025



- In winter, generally, there are more snow in the north of TPCR ( $\geq 2000$  m), and less in the central-southern TPCR.
- Till Mar and Apr, consistent less snow maintained in the south edge of TPCR, and in the northern TP there occurred negative anomalies.

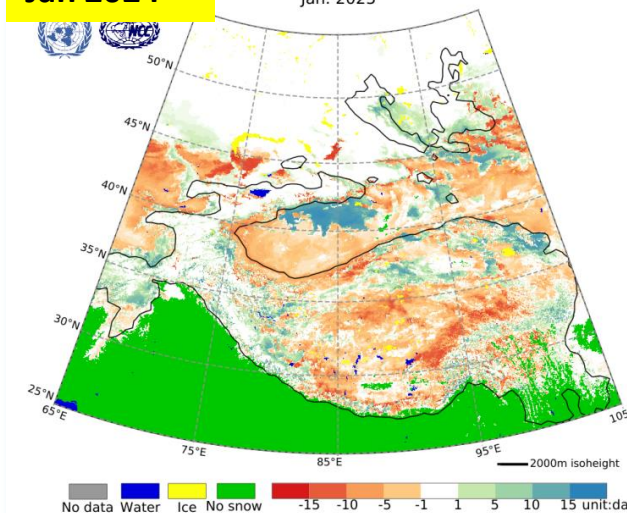
## Dec 2024

Snow Cover Days Anomaly Over The Third Pole  
Dec. 2024



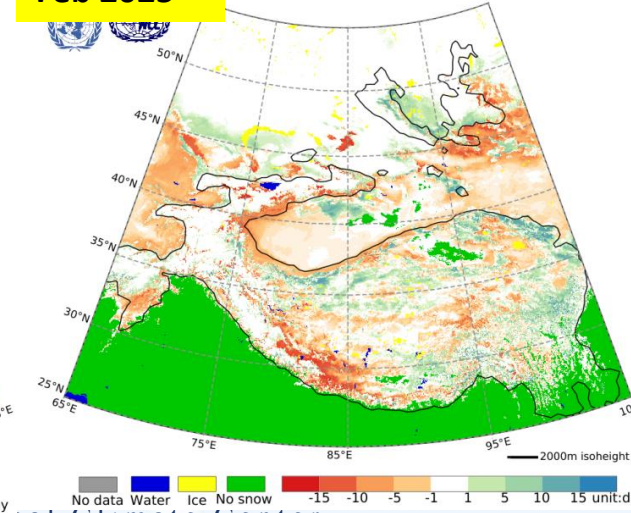
## Jan 2024

Snow Cover Days Anomaly Over The Third Pole  
Jan. 2025



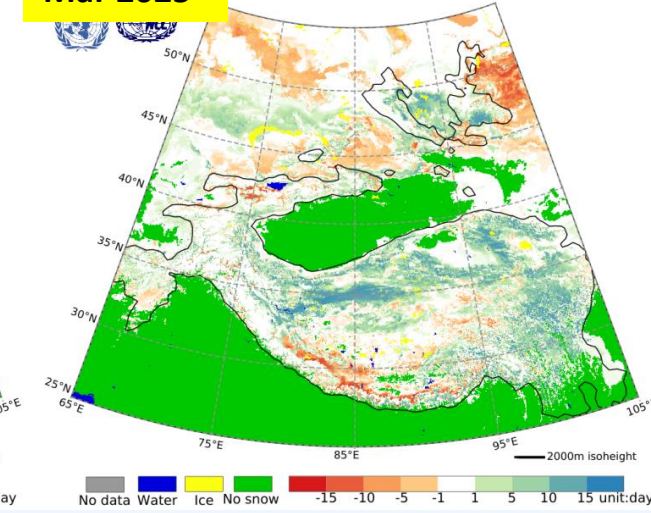
## Feb 2025

Snow Cover Days Anomaly Over The Third Pole  
Feb. 2025



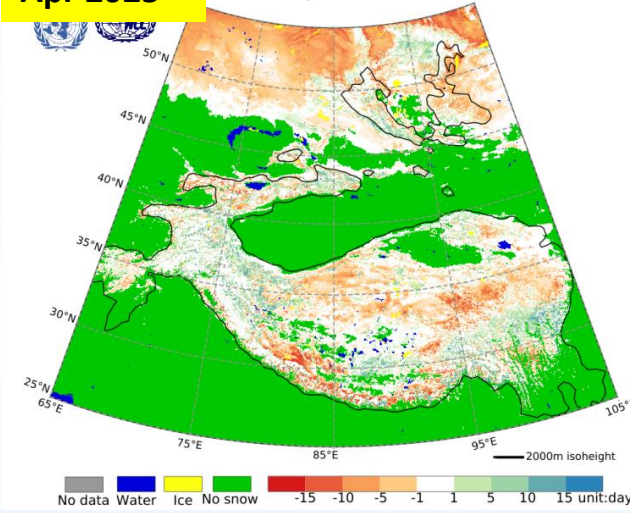
## Mar 2025

Snow Cover Days Anomaly Over The Third Pole  
Mar. 2025



## Apr 2025

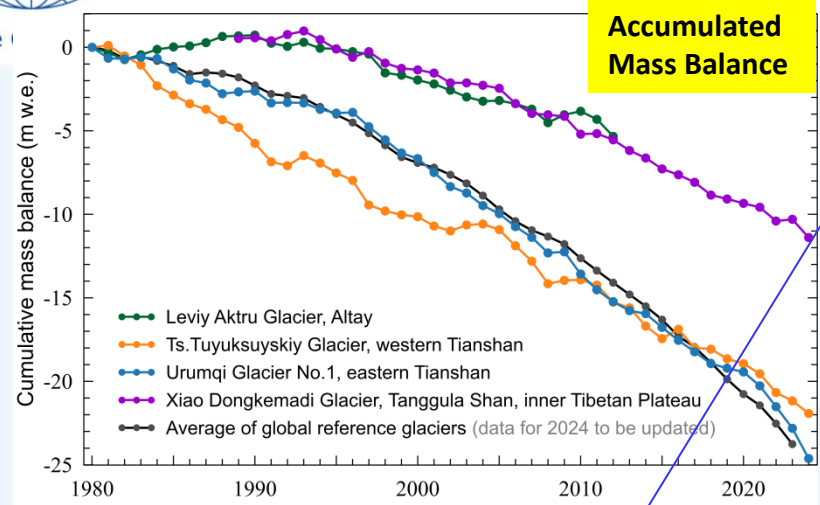
Snow Cover Days Anomaly Over The Third Pole  
Apr. 2025



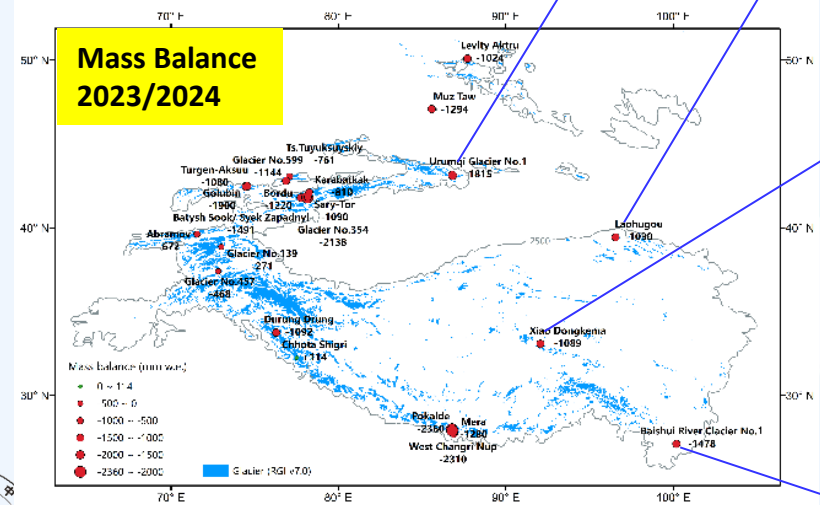
Data source: 4 km IMS/NSIDC



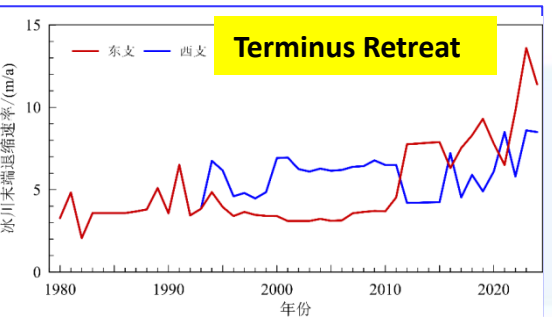
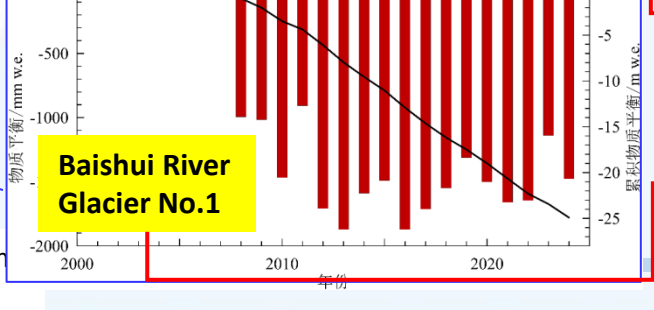
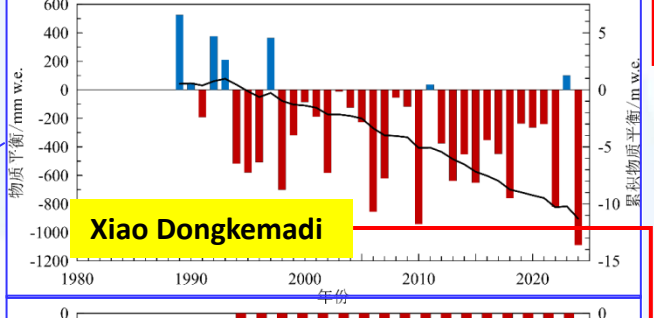
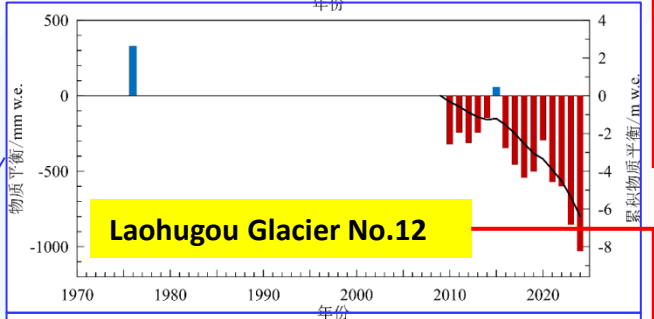
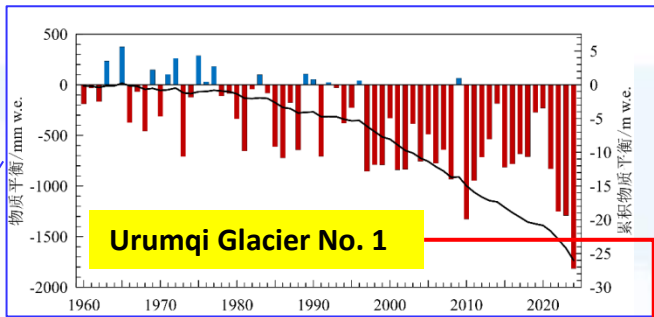
Third Pole



Average mass balance (m.w.e.) of global reference glaciers and cumulative mass balance of four reference glaciers in HMA (Source: WGMS and CAS)



Estimations of the 2023–2024 mass balance of 23 glaciers  
Source: partly from WGMS (original obs from China, India, Kazakhstan Kyrgyzstan, Nepal, the Russian Federation, Tajikistan and Uzbekistan.

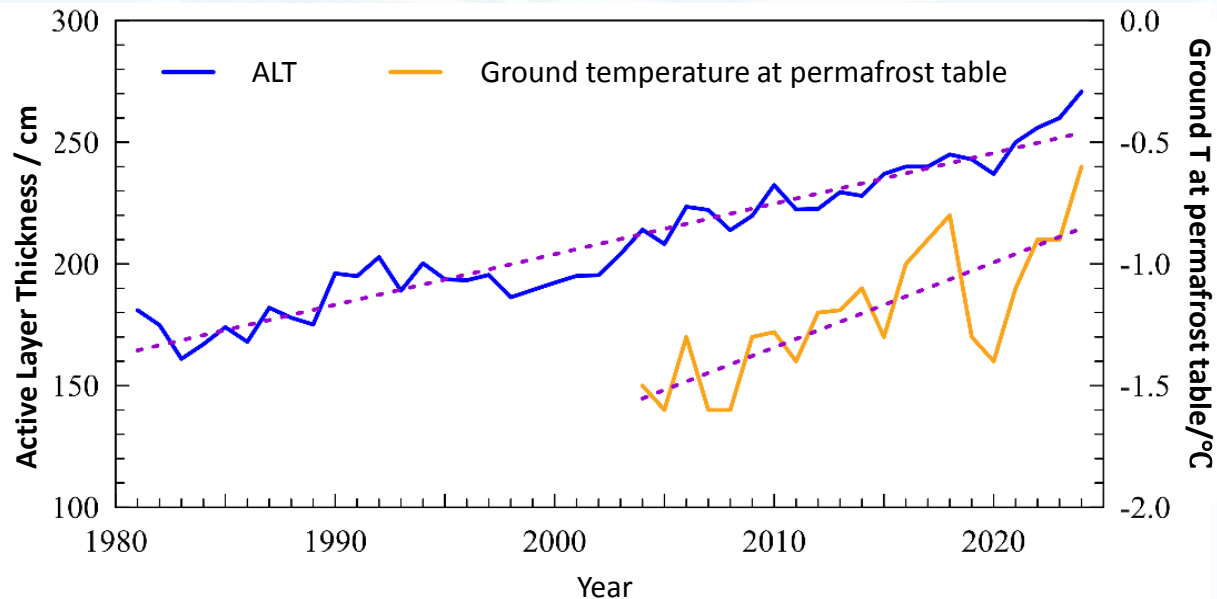


Glacier	Mountain range	Retreating distance of terminus in 2024
Ürümqi Glacier No.1	Mount Tianshan	East branch: 11.4m
		West branch: 8.5 m
Muz Taw	Altai Mountains	16.4 m
Laohugou Glacier No.12	Qilian Mountain	27.5 m
Bailanghe Glacier No.21	Qilian Mountain	12.8 m
Dongkemadi	Tanggula Mountains	Big branch: 15.9 m
		Small branch: 4.9 m
Baishui River Glacier No.1	Yulong Snow Mountain	7.8 m

Source: NIEER, CAS

# Permafrost

The permafrost along the Qinghai-Xizang Highway is experiencing obvious degradation.



Changes in the active layer thickness of the permafrost zone and the ground temperature at permafrost table along the Qinghai-Xizang Highway

Data source: The Cryosphere Research Station on the Qinghai-Xizang Plateau, Chinese Academy of Sciences (CAS)

- Average **active layer thickness** (ALT) along the Qinghai-Xizang Highway
  - exhibited a significant increasing trend during 1981 to 2024, **around 20.8 cm/10a**;
  - was 270.8 cm in 2024, **thickened by 10.8 cm compared to 2023**, reaching the **highest value** since continuous observations began;
- **Ground temperature at permafrost table**, i.e. the bottom of the active layer
  - experienced a significant upward trend during 2004 to 2024, **about 0.35°C /10a**;
  - was **-0.6°C in 2024**, which was **0.3°C higher than that in 2023**.





## High Impact Event ( Dec 2024—Apr 2025 )

- ☐ Heavy snow and cold air activity
- ☐ Frequent sand-dust weather events
- ☐ Extreme drought
- ☐ Extreme high temperature



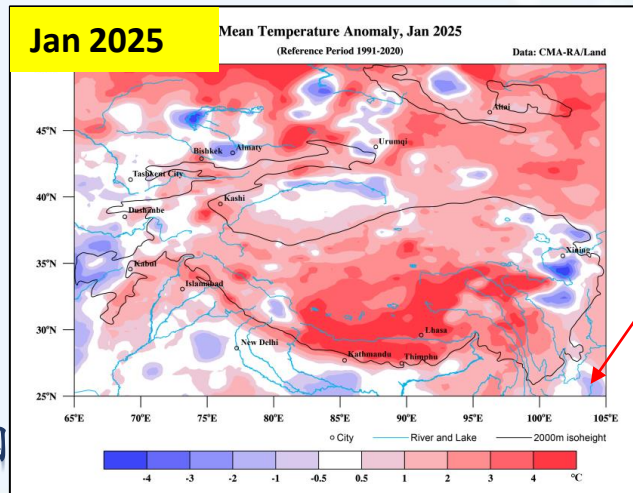
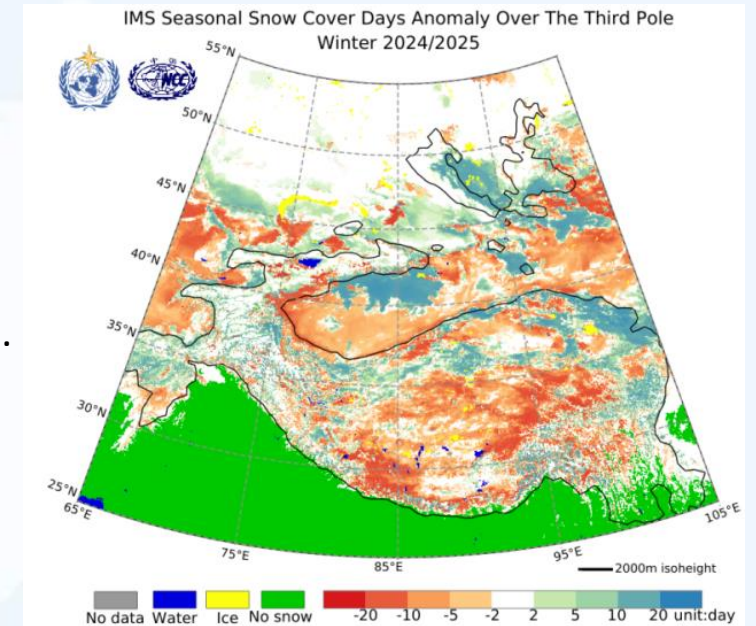
# High Impact Event ( Dec 2024—Apr 2025 )

## Heavy snow and cold air activity in winter

**Mongolia:** Dzud caused by heavy snowfall killed 3,053,437 livestock.

**China:** many areas in Xinjiang have been continuously hit by strong winds and heavy snowfall.

- In early December, heavy snowfall occurred in northwest Xinjiang. Urumqi was hit by the **strongest snowfall** ever since December 1981, causing a **warehouse** to collapse, several **roads** to be closed, eight **flights** to be cancelled and many **trains** to be delayed.
- In mid-December, a 60 cm-depth snow, caused by **snow drift** (level 12), occurred on some sections of the road, with extremely low visibility, causing great inconvenience to people's **travel**.
- Since Jan. 6, most areas have experienced a **drop in temperature and snowfall**. **Heavy snowfall** has trapped over 60 **vehicles**.



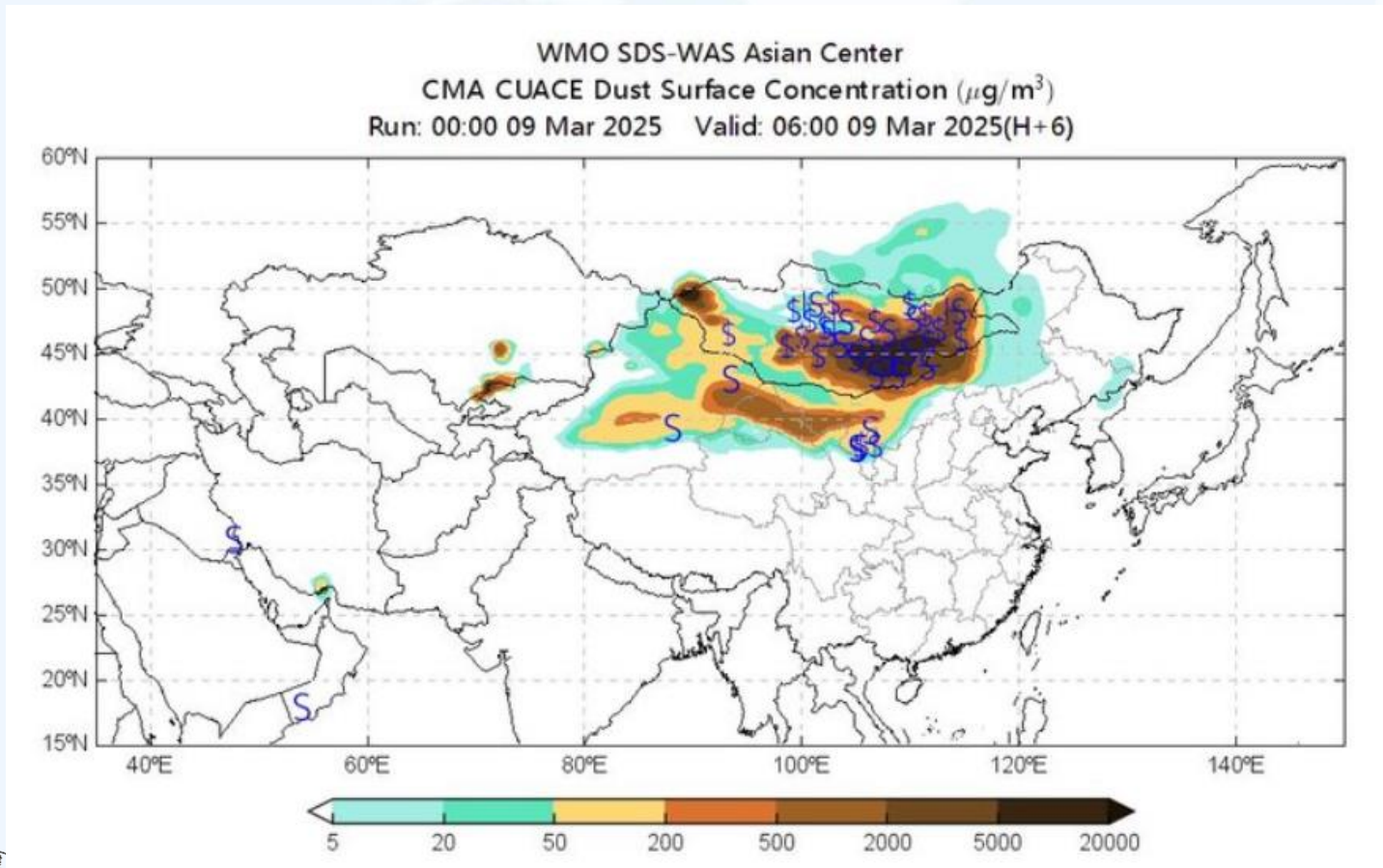
Southwest  
China

**China:** In January 2025, three notable **cold air activities** led to low-temperature stress and snow-related disasters in the southern part of Southwest China.

- From 23 to 27 January, the air temperature in Yunnan province **dropped by 8 to 12°C**. As a result, localized **hail and wind damages** were reported in areas of Yunnan, Guizhou, etc., affecting nearly 1,000 people.



## Frequent sand-dust weather events in northern TP region



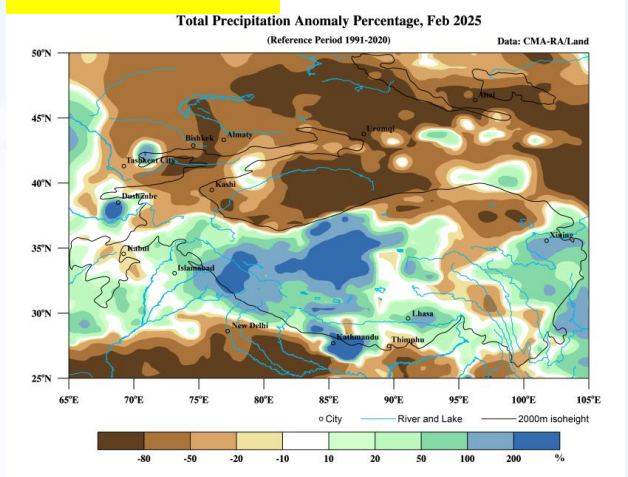
- ❑ Since March, Mongolia and northern China have experienced frequent episodes of sand and dust weather.
- ❑ Notably, a severe sandstorm occurred in Mongolia on 9 March 2025.
- ❑ The northern China was affected by a total of 13 sand-dust weather events from early March onward, including 2 episodes classified as sandstorms and 3 as severe sandstorms.

# High Impact Event ( Dec 2024—Apr 2025 )

## Extreme drought in the southwestern TP region

- During the winter season, **central and northern India** experienced persistent precipitation rainfall deficits. In **February**, the **national rainfall deficit reached 70%** and the **principal wheat-producing regions** registered decreases in monthly rainfall.
- The average temperature across India in **February 2025** was  $1.34^{\circ}\text{C}$  above the normal, marking **the warmest February in 125 years**.

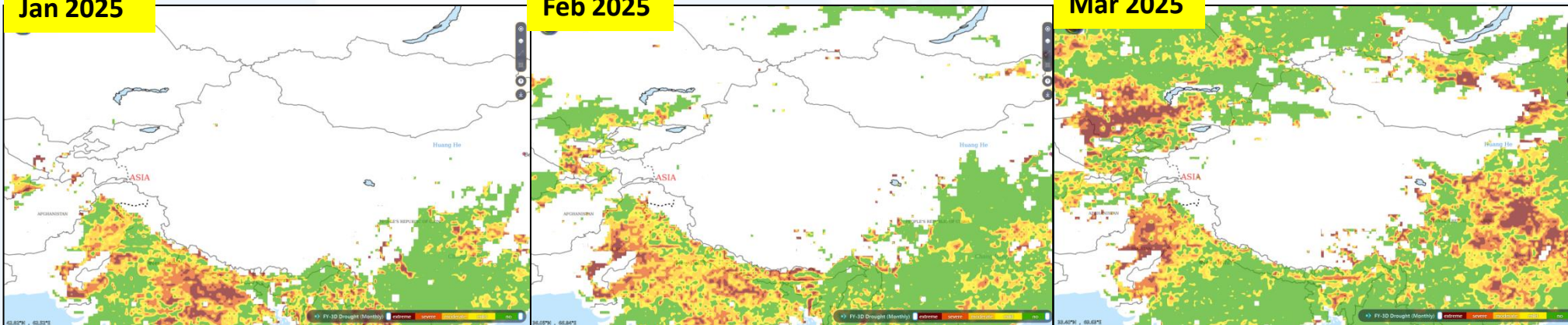
Prep, Feb 2025



Jan 2025

Feb 2025

Mar 2025



FY-3D satellite monitoring on monthly Meteorological Drought from WMC Beijing

- Under conditions of higher temperatures and severe rainfall shortages, extreme drought developed in the northwestern India, posing substantial challenges to agricultural production and crop growth.

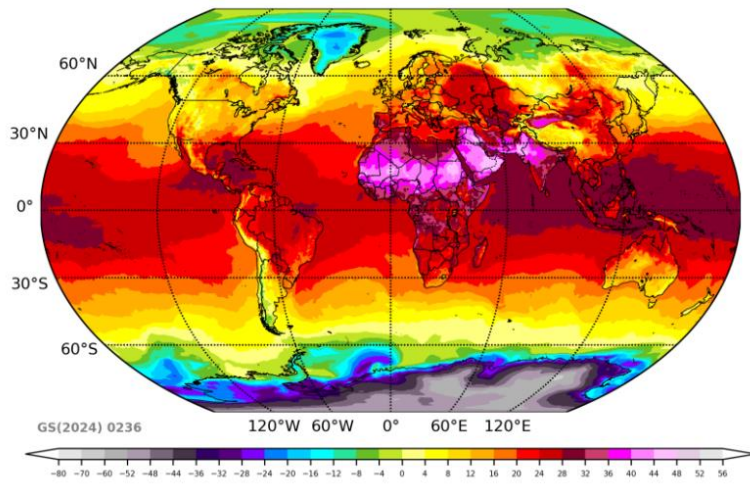


## Extreme high temperature in western and southern TPCR

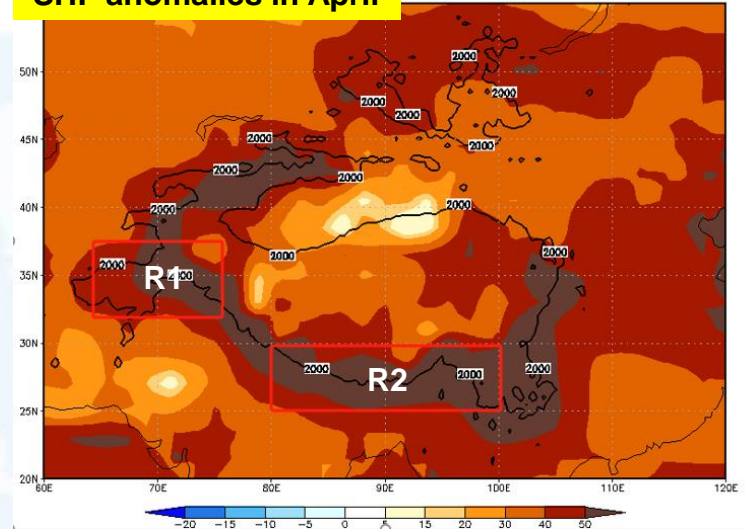
6 Hourly 2m Temperature(°C)

2025-05-27 12UTC

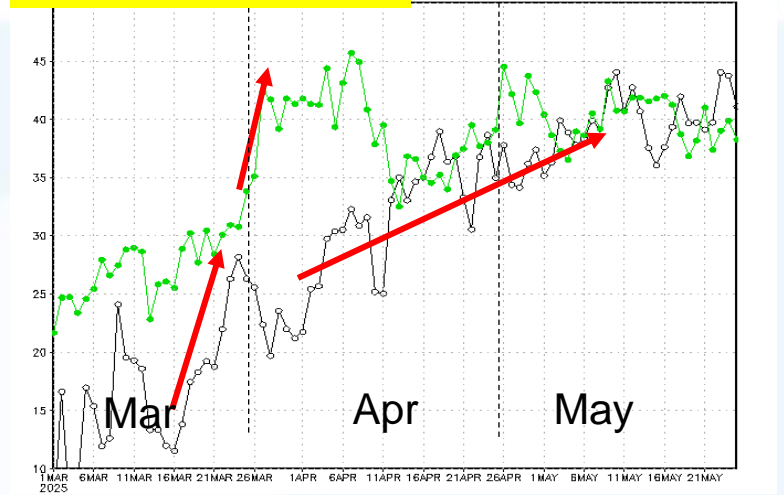
CMA-RA/Land



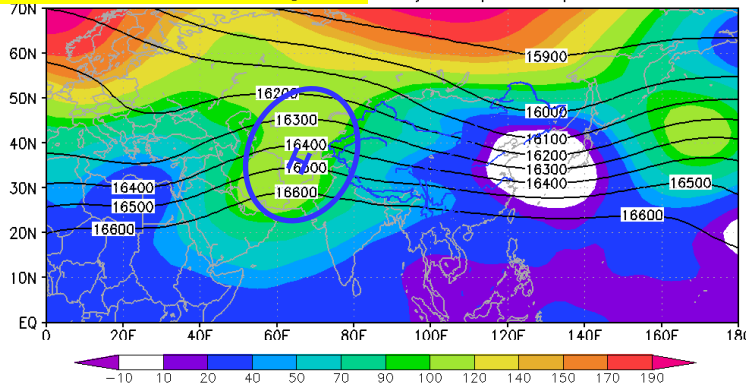
SHF anomalies in April (191\_2020)\_4



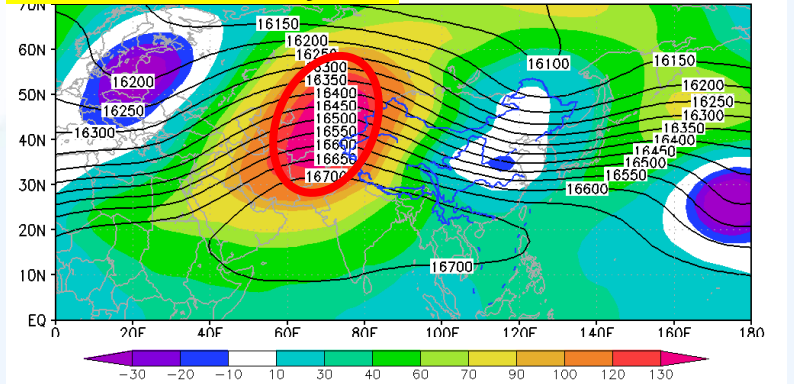
Daily SHF in R1 and R2 (green) and region2 (black)



1000hPa HGT in April anomaly 01Apr-30Apr 2025



100hPa HGT in May anomaly 01May-26May 2025



- Since April, the maximum temperature in the southeast of Pakistan and the southwest of India has remained above 40 °C.
- In late May, western and southern TPCR experienced continuous high temperatures, incl. India and Pakistan.
- SHF increased in the western TPCR (R1) → surface Rossby wave train → high pressure ridge in Central Asia → dry and hot weather.
- SHF enhanced continuously in the southern side of Himalayas (R2) → summer thermal low pressure intensified → enhanced the south branch of the westerlies → sinking and warming over northern India.



# Take-home Messages

- In **DJF 2024/2025**, SAT over the **Third Pole region was around  $0.8^{\circ}\text{C}$  above** the 1991-2020 average, while that over **TPCR was about  $1.25^{\circ}\text{C}$  higher** than normal. Correspondingly, the northeastern and northwestern parts of the TP region and **most TPCR experienced above-normal SAT**, with the SAT in some of the **central and southern TPCR exceeding normal levels beyond  $3^{\circ}\text{C}$** ; Most areas **along  $35^{\circ}\text{N}$  to  $45^{\circ}\text{N}$  recorded below-normal SAT**, with negative anomalies in some local areas exceeding  $-3^{\circ}\text{C}$ , during which some location of the western China experienced **cold air outbreaks**.
- The southern TP consistently recorded **large precipitation deficits from Dec to Apr**, particularly extending across the **southwestern TP in March and April**, which caused **extreme drought across the northwestern India**, significantly impacting agricultural production. Consistent warmer and drier condition in Mongolia and the northern China also contributed to the **frequent sand and dust events**, incl. severe **sandstorms** since March.
- From December 2024 to April 2025, the observed mean SCE in the TP region was 6.1% higher than the 2005—2020 average, with **March SCE ranking as the fourth highest on record**.
- Glaciers in HMA have lost mass significantly over the past 40 years. In 2023/2024, **22 out of 23 glaciers** observed in the HMA region **continued to exhibit negative mass changes**, with **Urumqi Glacier No.1 recording its most negative mass balance since 1959**. Reduced winter snowfall and extreme summer heat in the central Himalayas and the Tian Shan have exacerbated the mass loss.
- Permafrost ALT along the Qinghai-Xizang Highway increases significantly during 1981–2024 ( **$\sim 20.8\text{ cm}/10\text{a}$** ); **in 2024, the ALT and the Ground T at permafrost table was  $10.8\text{ cm}$  thicker and  $0.3^{\circ}\text{C}$  higher than that in 2023**.



# Thank you



**WMO OMM**

**World Meteorological Organization  
Organisation météorologique mondiale**

PoC of Northern Node: Dr WANG Pengling  
National Climate Centre, CMA  
[wangpl@cma.gov.cn](mailto:wangpl@cma.gov.cn)