



AO GEO

6TH ASIA-OCEANIA GROUP ON EARTH
OBSERVATIONS (AO GEO) WORKSHOP

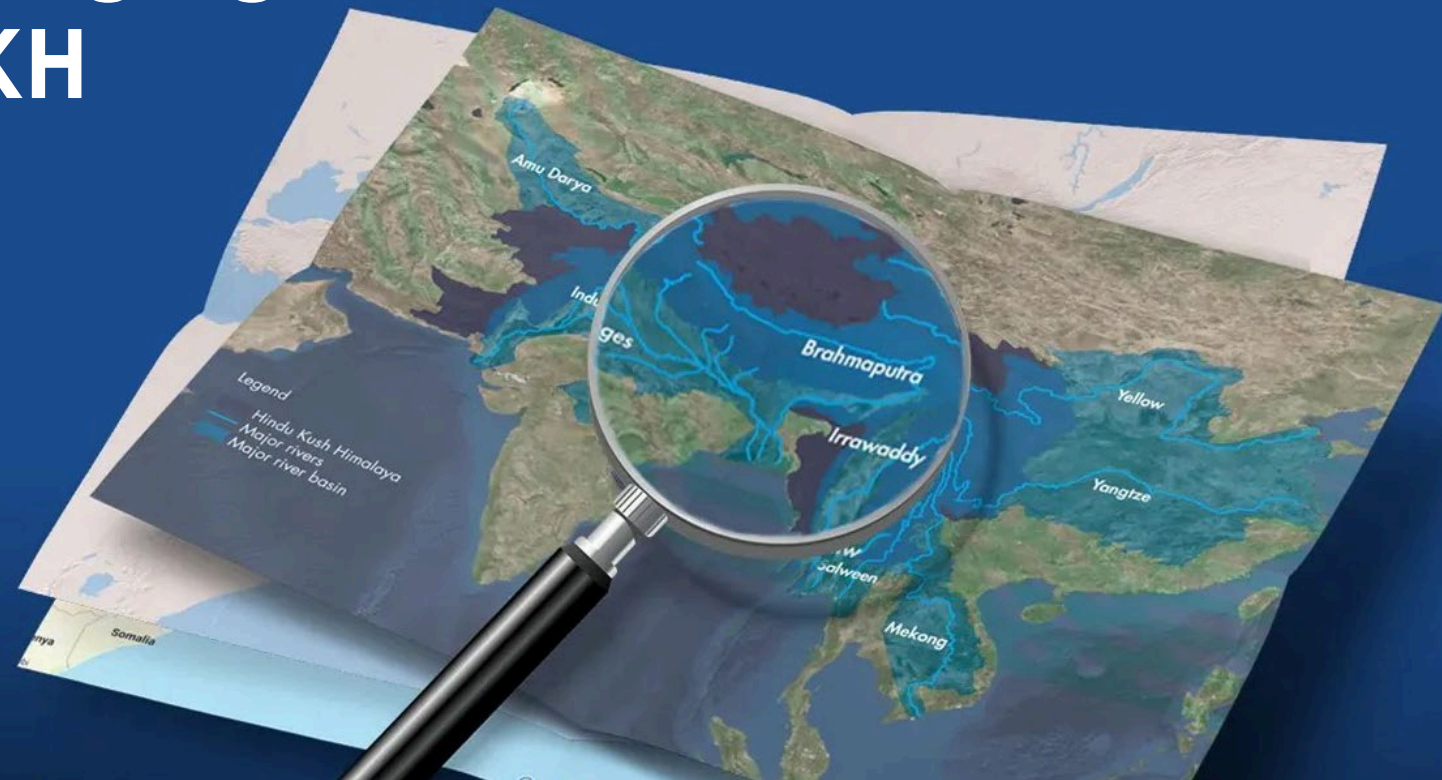
5.29-31 2023


MACAU CHINA

Earth observation for
understanding our changing
environments in the HKH

Birendra Bajracharya

International Centre for Integrated
Mountain Development (ICIMOD)



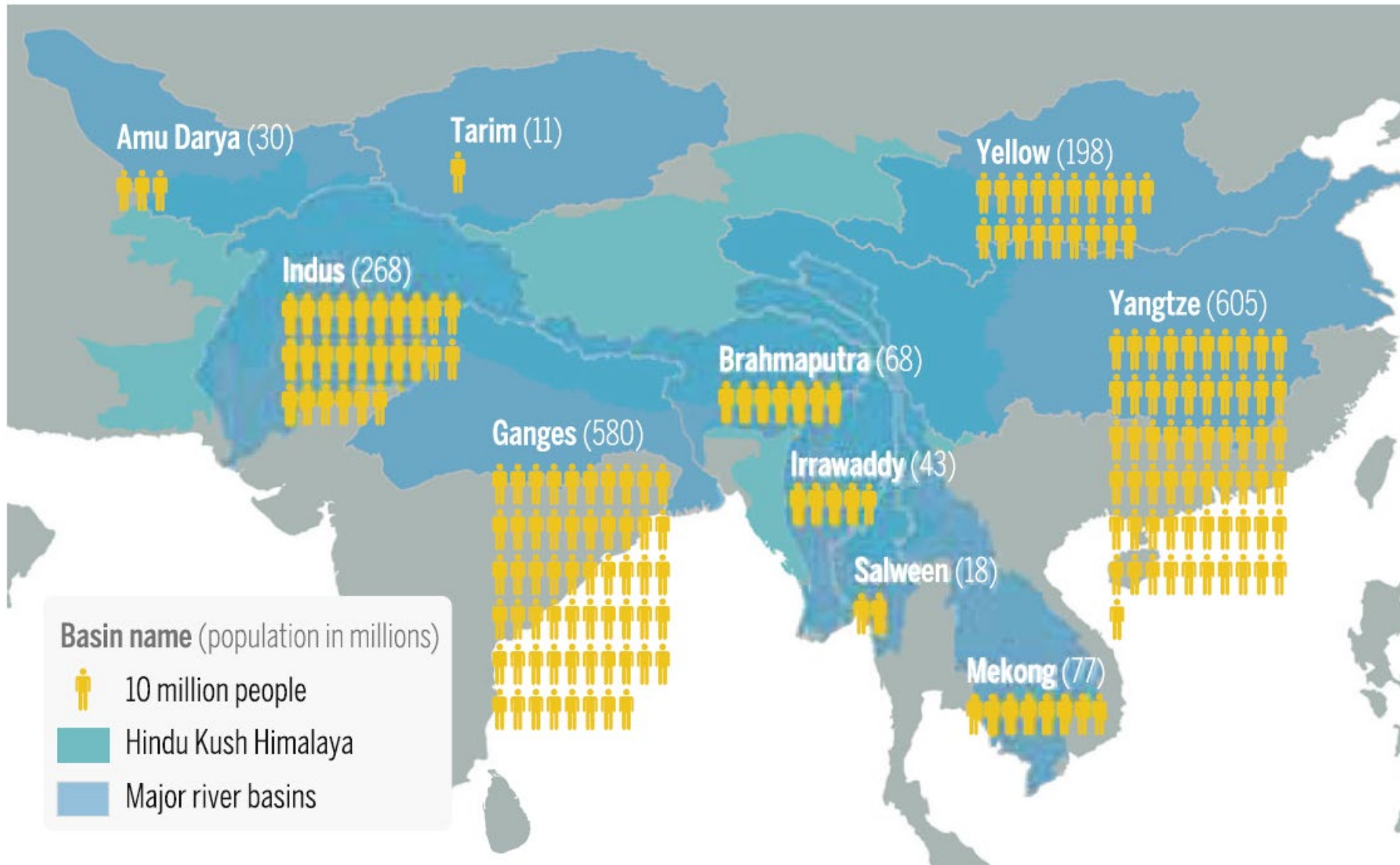


The Hindu Kush Himalaya

Global asset for food, energy, water, carbon, and cultural and biological diversity

Also known as the Third Pole

What happens here affects one-fourth of humanity



240 million
population

1.6 billion
downstream

What is happening?

1.5 DEGREES IS TOO HOT



#SaveOurSnow

The HKH in a 1.5 °C world

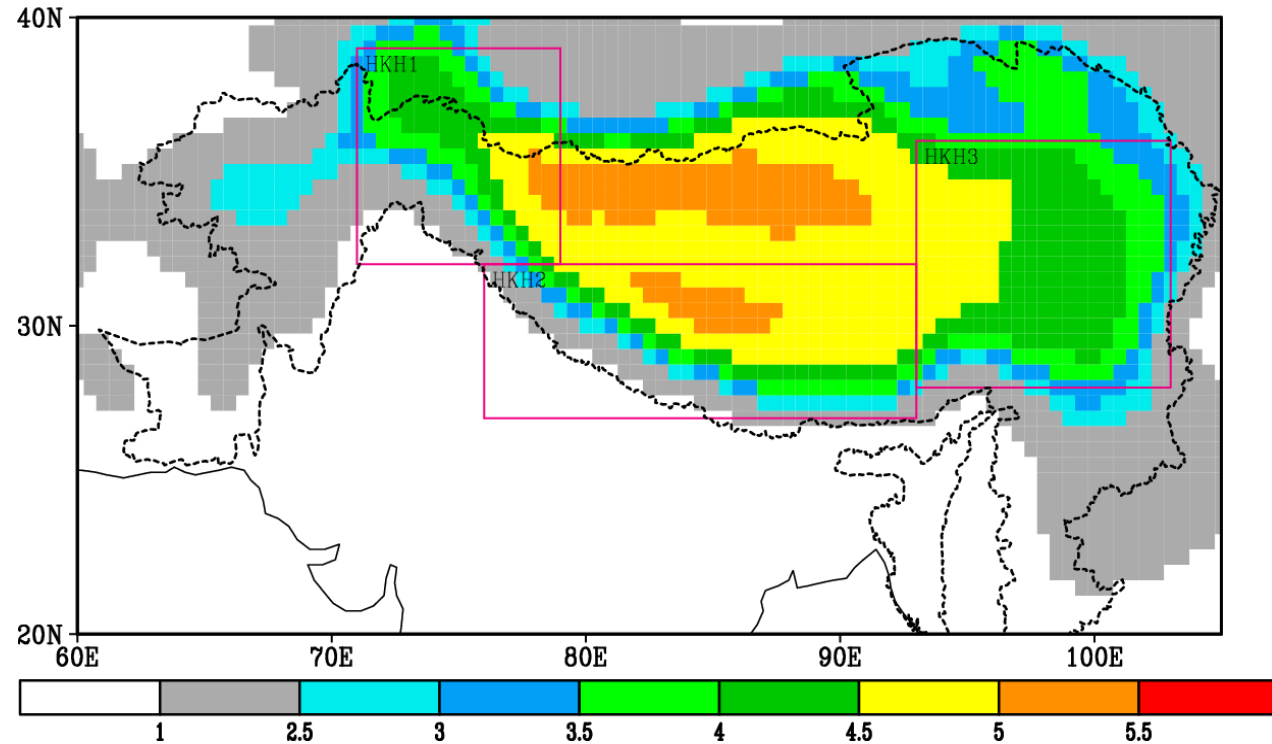
1.5 °C global temperature increase is **too hot** for the HKH region, at least **0.3 °C** higher

Temperature increase of **1.8 ± 0.4 °C** more pronounced in **mountain regions** when compared with 2071-2100 vs 1851-80

Karakoram: 2.2 ± 0.4 °C

Central Himalayas: 2.0 ± 0.5 °C

Southeast Himalayas: 2.0 ± 0.5 °C



HKH glaciers

The HKH region has the highest snow and glaciers concentration outside the polar region

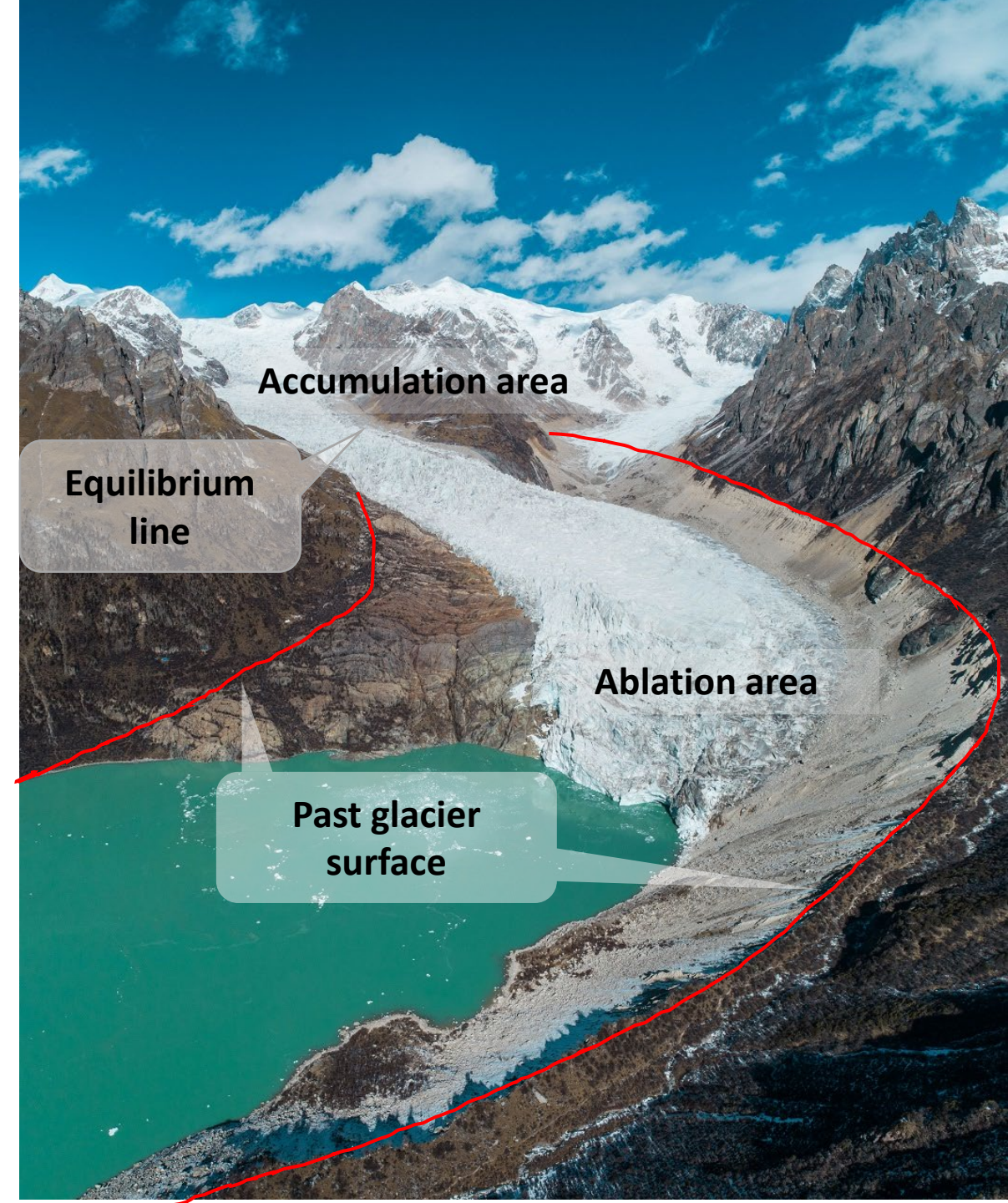
~ **54,000 glaciers** (60,000 km²)

Glaciers are declining faster in the Eastern Himalayas than the in the central or western Himalayas.

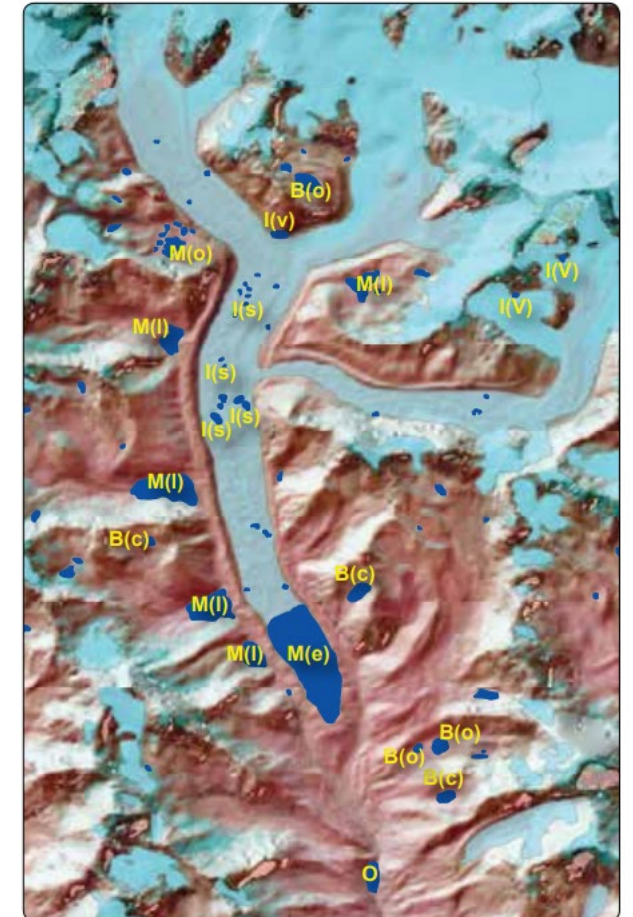
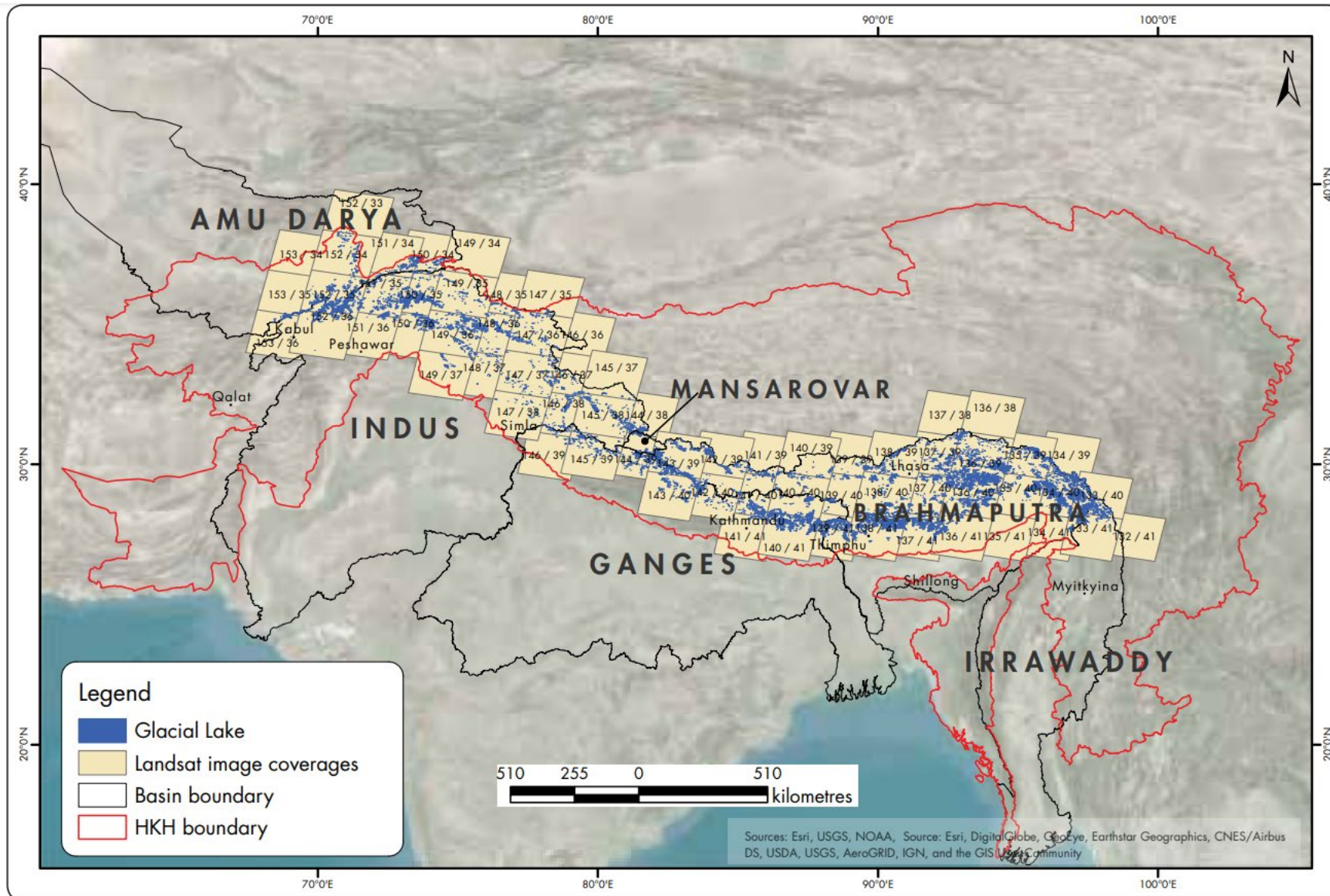
The region lost about **a quarter of the total glacier area** in 30 years

Some glaciers in Karakorum and Pamir are increasing (Karakorum anomaly)

(Bajracharya et al., 2015; Bajracharya et al., 2020; Bolch et al., 2019)



Mapping and monitoring glaciers and glacial lakes

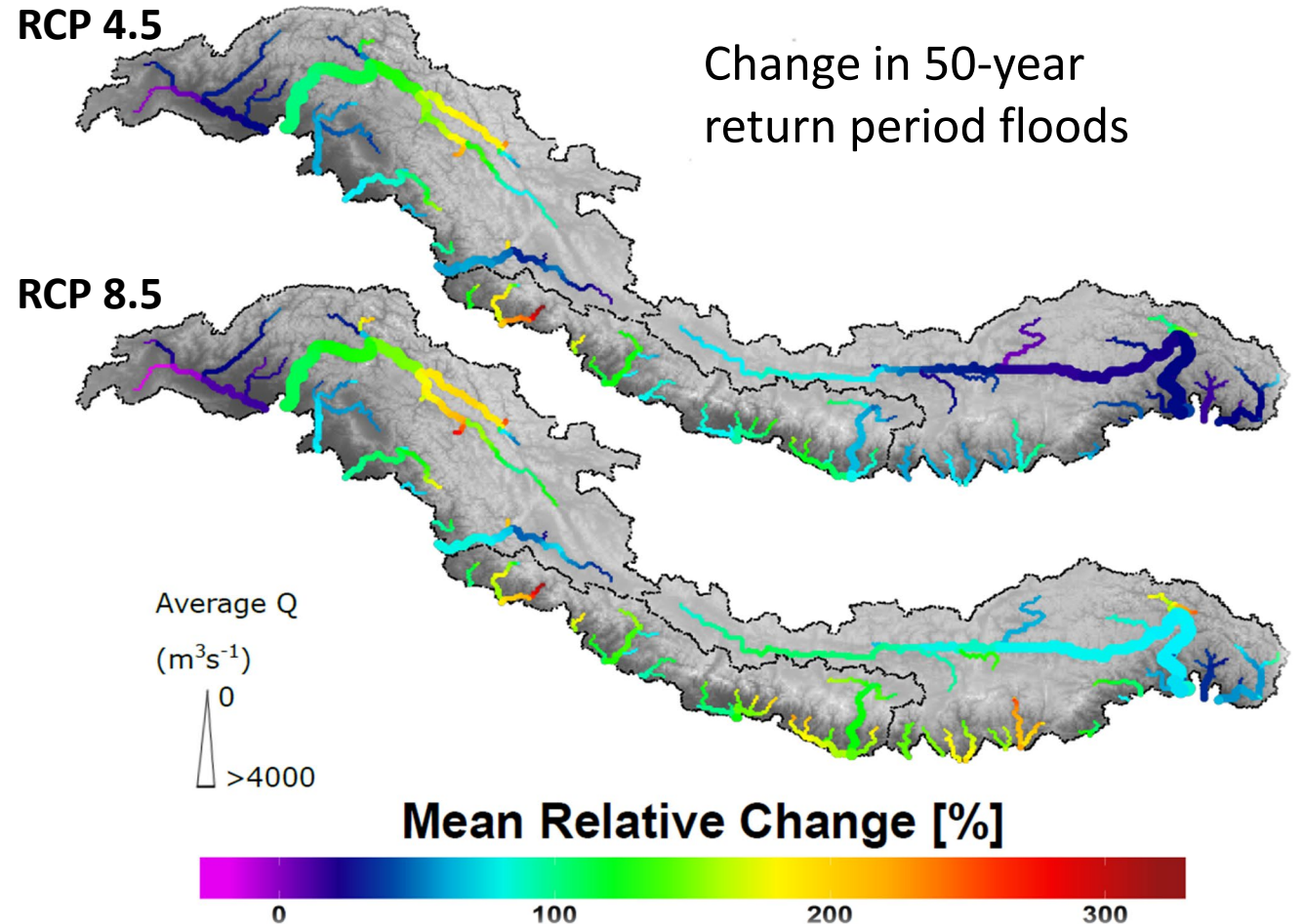


(e) = end-moraine-dammed lake, M(l) = lateral moraine-dammed lake, M(o) = other moraine-dammed lake, I(s) = supra-glacial lake, I(v) = ice-dammed lake dammed by tributary valley glacier, B(c) = cirque lake, B(o) = other bedrock-dammed lake, and O = other glacial lake

Maharjan, SB et.al. (2018) ICIMOD

Changes in extremes: Floods

Extremes will increase strongly in the 21st century, almost doubling in magnitude by the end of the century



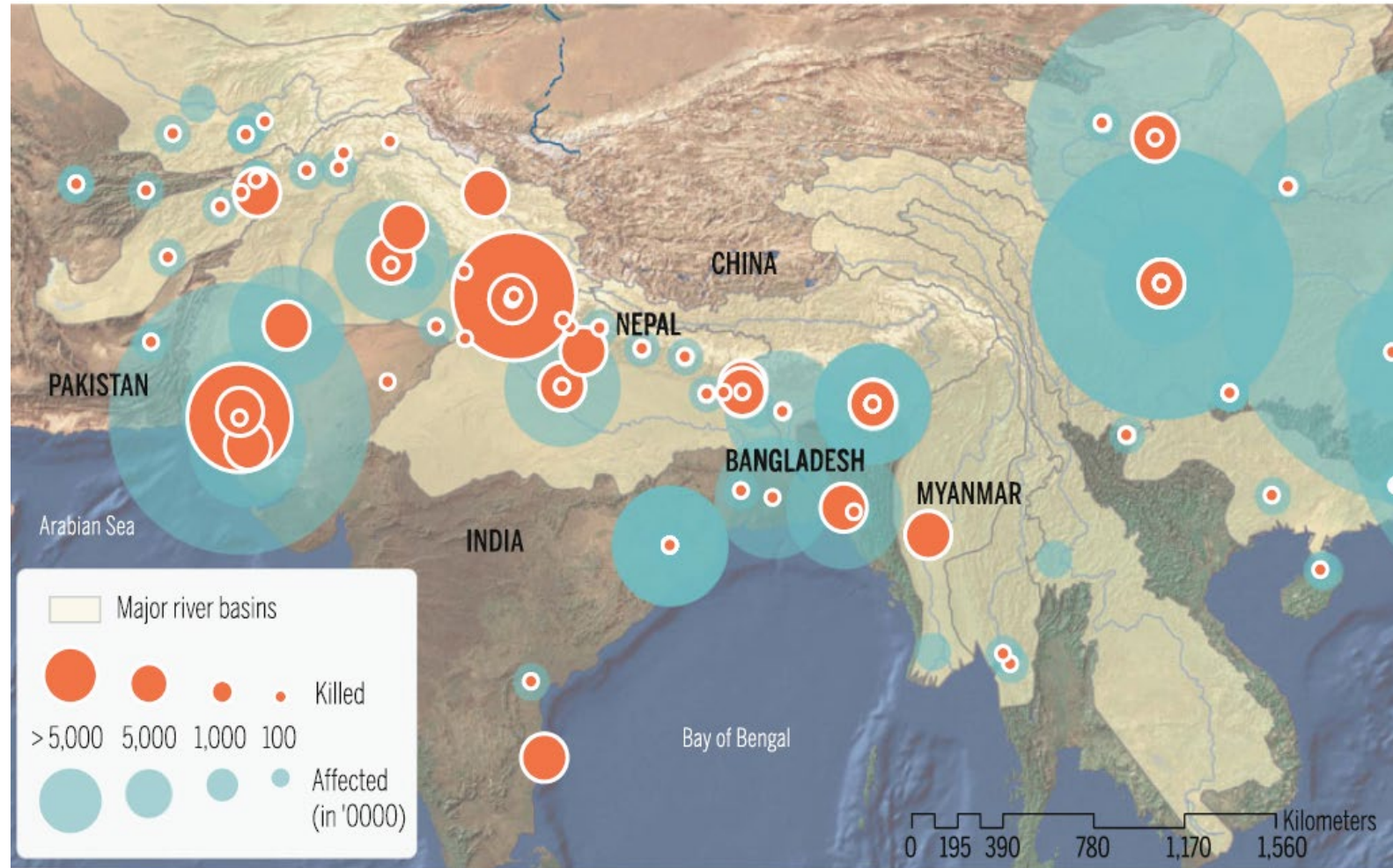
Floods

Floods: 1/3rd share of all disasters

The 2010 floods in Pakistan:
killed > 2,000;
estimated loss: **USD 10 billion**

The 2013 flood in
Uttarakhand: **killed > 5,000**

The 2022 Pakistan floods:
killed >1700 people



Data source: EMDAT OFDA Cred Database

Map prepared in Sept. 2015

ICIMOD

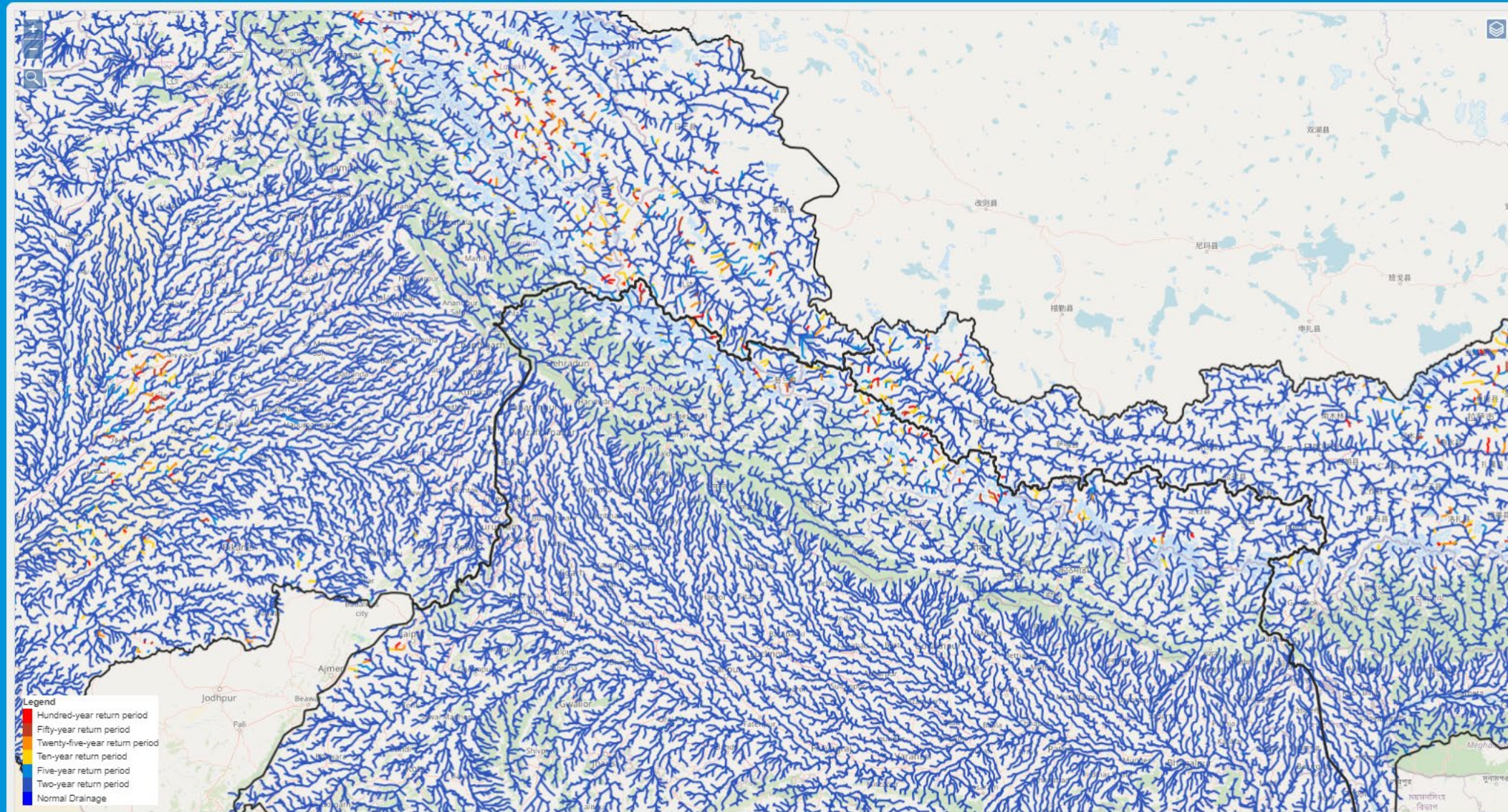
Monitoring weather systems



Stream flow prediction – enhancing early warning

Streamflow Prediction Tool - HKH river basins

ICIMOD



Layers

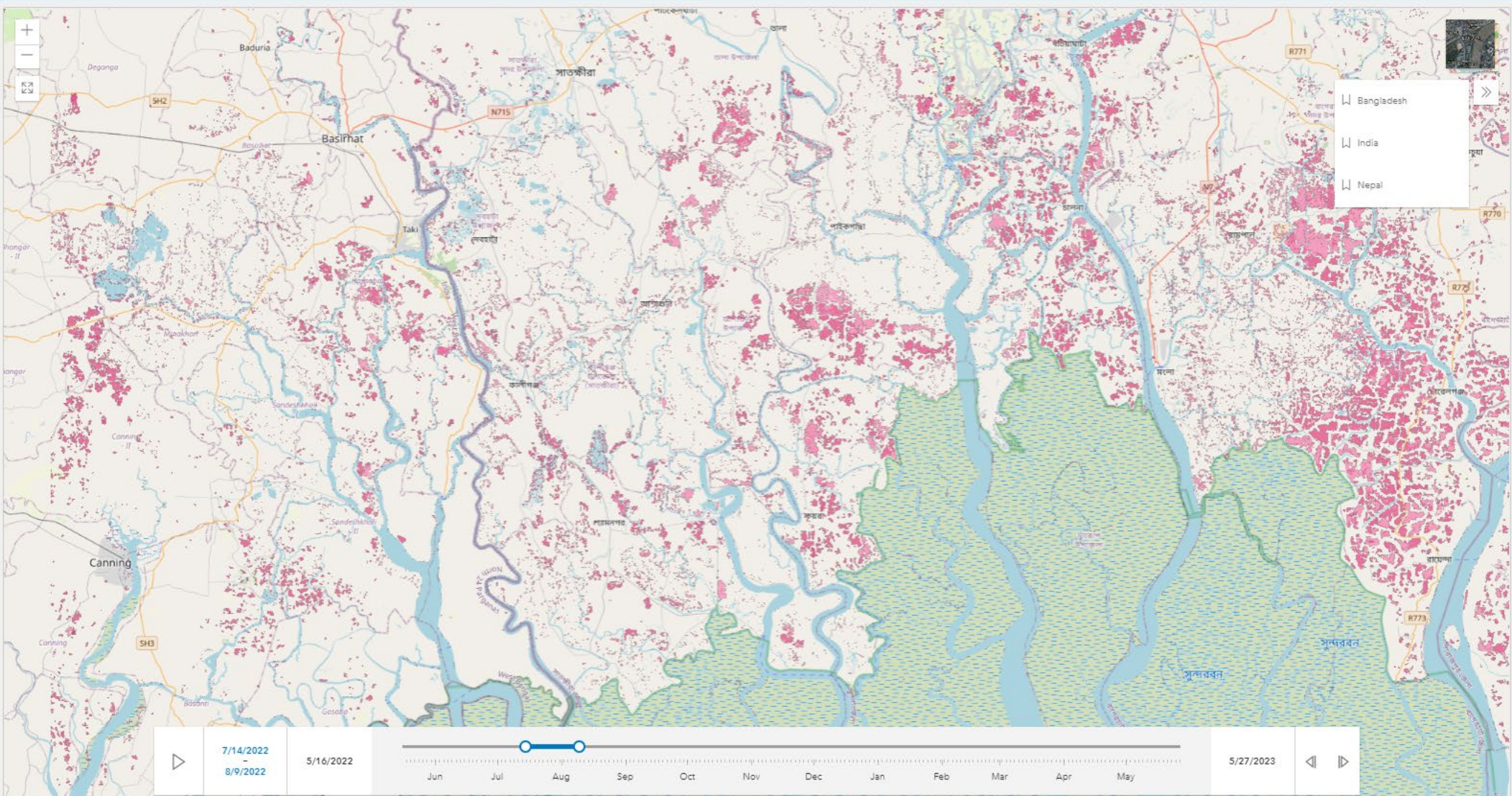
- Amu Darya
- Brahmaputra
- Ganges
- Indus

About Streamflow Prediction Tool

Description:
The Streamflow Prediction Tool for the HKH river basins provides 10-day streamflow forecasts for major rivers within the Amu Darya, Brahmaputra, Ganges and Indus basins in the Hindu Kush Himalayan (HKH) region.

[View More...](#)

Flood inundation monitoring



Layers

- Flood Extent
- Flood Depth
- Perennial Waterbodies
- RGB Layer

Water Non-water

Non-flooded

- 1-2m
- 4-6m
- 6-8m
- >8m

Bangladesh India Nepal

Download Inundation Data

About

Floods are a major disaster in the Hindu Kush Himalaya (HKH) during monsoon season. Timely and accurate mapping of floods is important for efficient and effective management of relief activities.

[View More...](#)

Regional drought monitoring

Map Controls

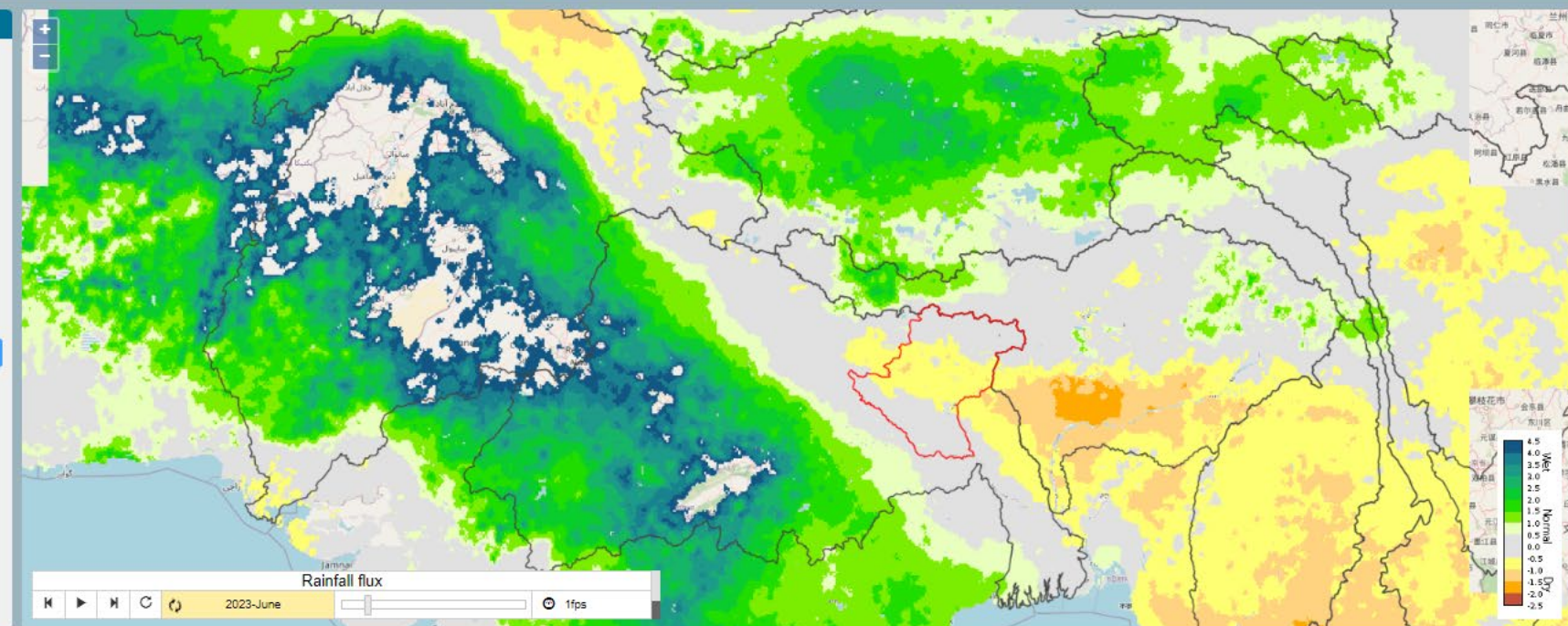
Basin: Koshi

Select Indices: Rainfall flux

Select Periodicity: Monthly Anomaly

Filter Ensemble: Mean

Process Outlook

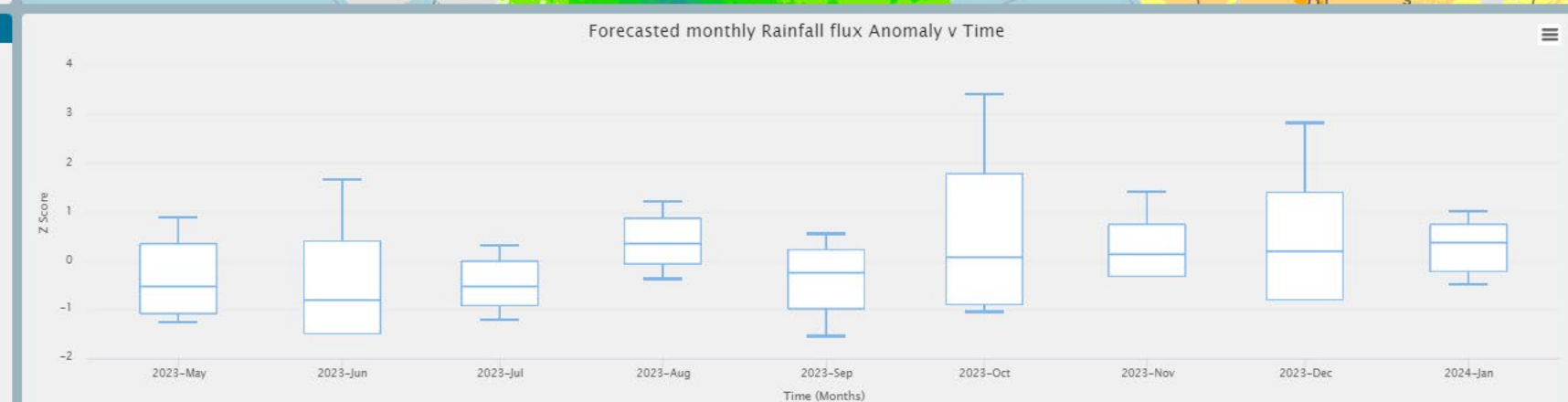


Layers

- SALDAS Layer
- Major Basin

Useful Links

- [Streamflow Prediction - Bangladesh](#)
- [Streamflow Prediction - Nepal](#)
- [Hiwat Extreme Climate](#)
- [Regional Database System](#)
- [Agriculture Information Portal](#)

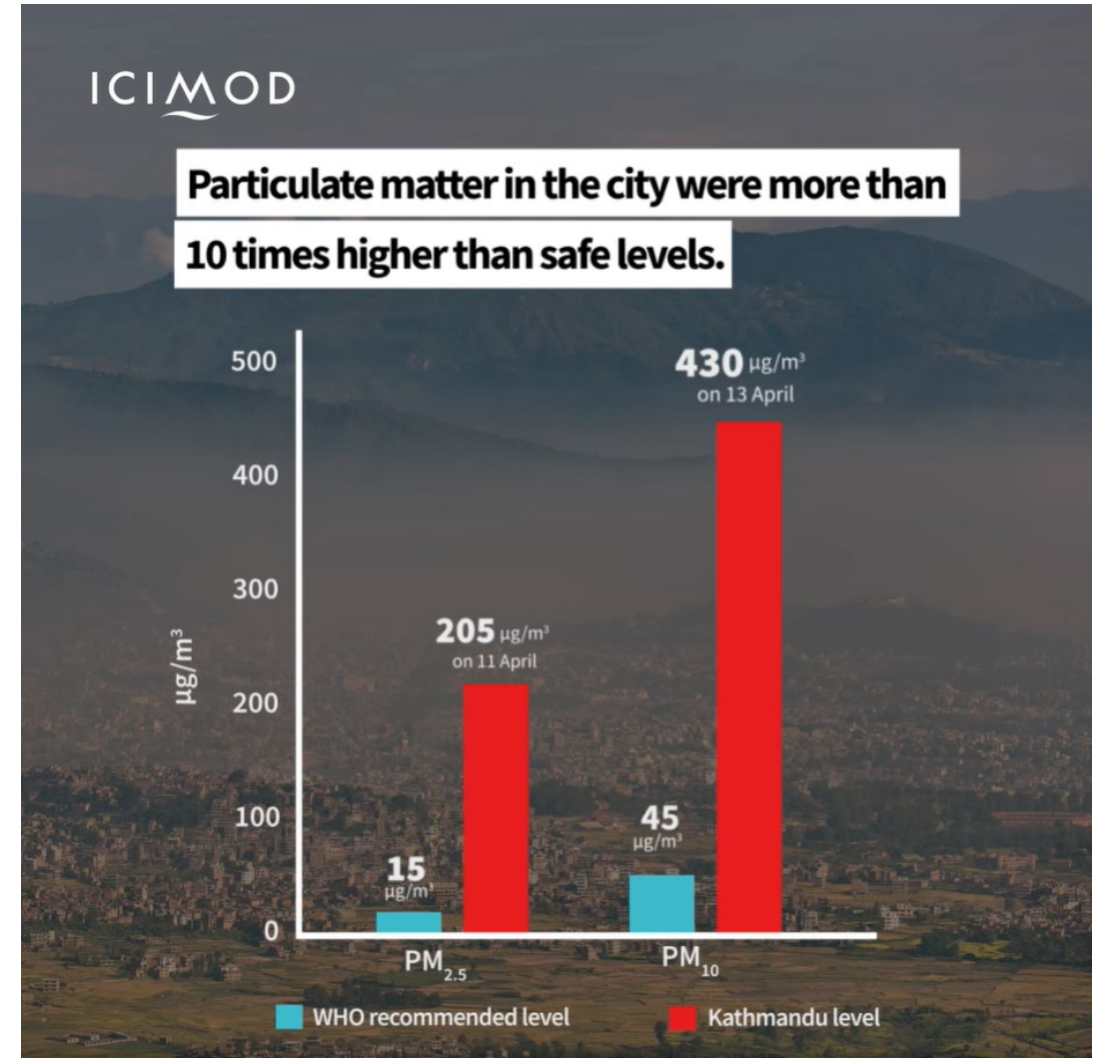


About

The Regional Drought Monitoring and Outlook System for South Asia uses four parameters (soil moisture, precipitation, air temperature, and evapotranspiration) from SALDAS dataset as the drought indicators, which is further grouped into monthly making it more relevant to drought application. The system allows interactive visualization of map for the selected parameter along with the chart on the monthly basis for the selected year.

[View More ...](#)

Air quality – a real health concern



Air quality monitoring

Air Quality Explorer for the HKH

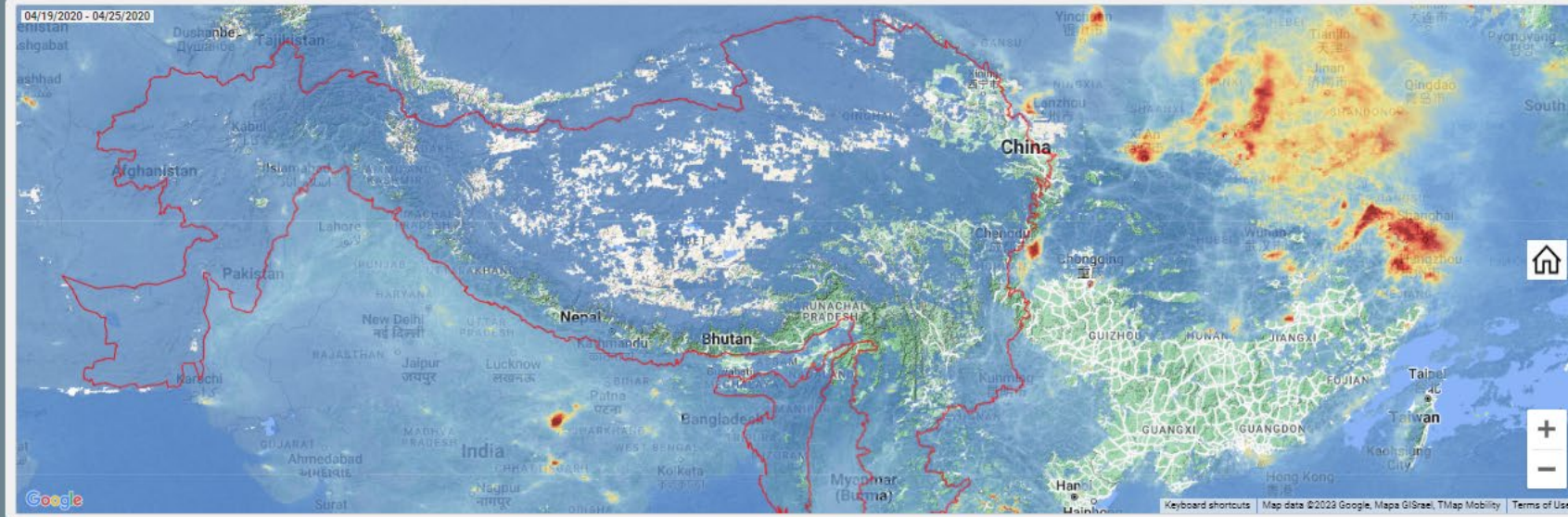
Compare Maps | View Statistics

NO₂ SO₂ AOD

Period 1: 04/19/2020 - 04/25/2020

Period 2: 04/19/2023 - 04/25/2023

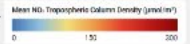
Update Maps



Layers

HKH Outline

Application Layer



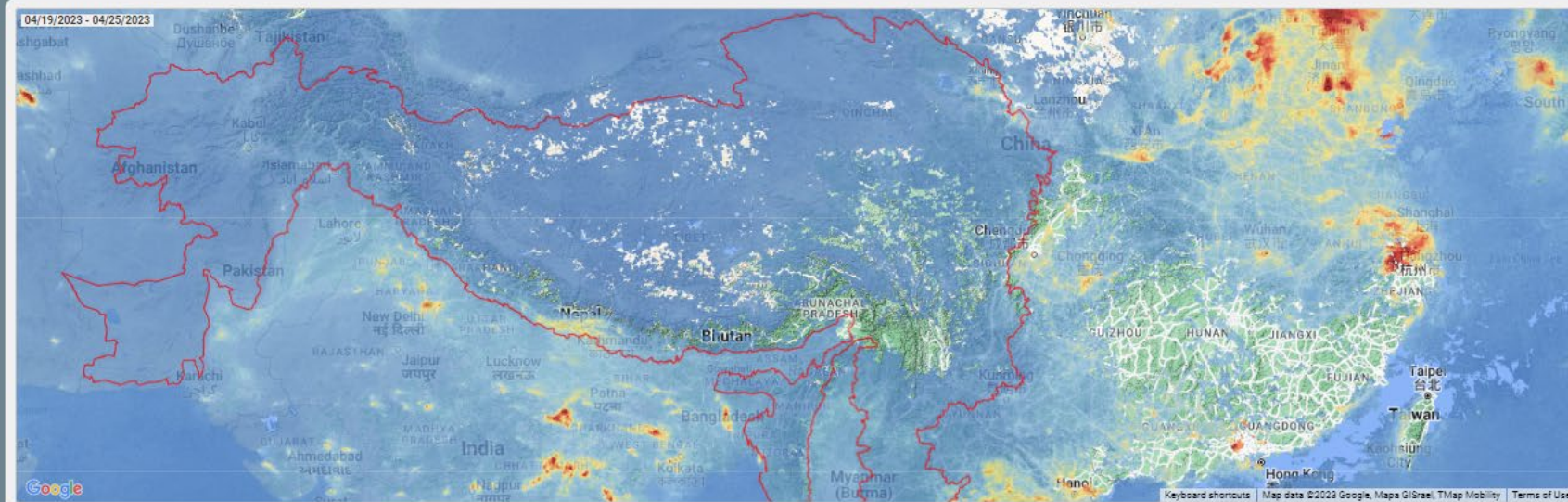
Search and Zoom:

About

The application supports air quality monitoring efforts in the Hindu Kush Himalayan region. It allows visualization of nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and Aerosol Optical Depth (AOD) for any chosen period and location. Users can specify a geographic area and time period to generate weekly or monthly mean values for the aforementioned parameters in the form of a chart.

Useful Links

- Regional Database System
- Resources Accounting Tool



Air quality monitoring



Government of Nepal
Ministry of Forests and Environment
Department of Environment
Babarmahal, Kathmandu, Nepal

Air Quality Watch

Nepali English



Recent Archive Forecast Emission

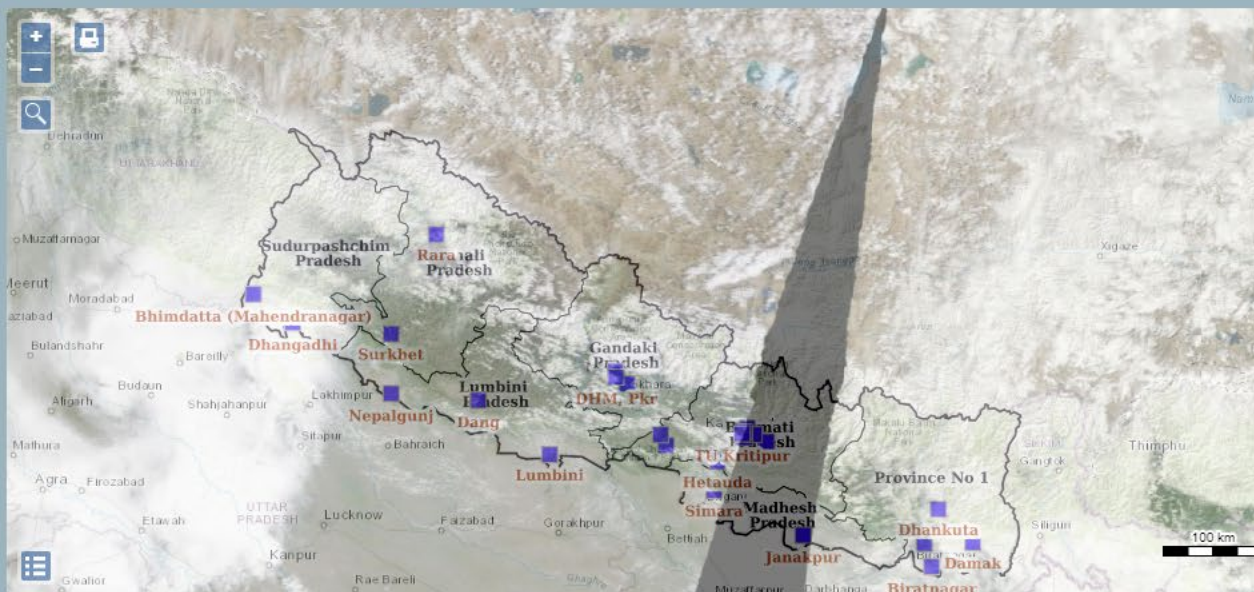
Map Controls

Select By

Pollutants

Select Stations

compute

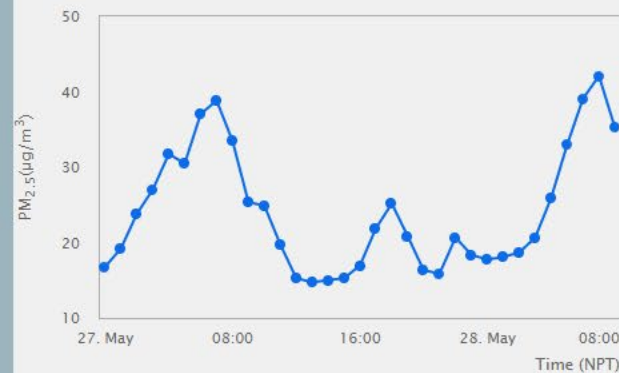


Layer Control

- Country Outline
- Province
- District
- Gaunpalika/Nagarpalika
- TerraModis-TrueColor (2023-05-27)
- Ground Observation-PM2.5

Khumaltar (Last 24 hours)

source: DoEnv, Government of Nepal



Shankapark (Last 24 hours)

source: DoEnv, Government of Nepal



TU Kritipur (Last 24 hours)

source: DoEnv, Government of Nepal



Bhaisipati (Last 24 hours)

source: DoEnv, Government of Nepal



Land degradation and loss of biodiversity

The mountain ecosystems of the HKH have one of the highest diversity of flora and fauna

Four out of 36 global biodiversity hotspots are in the HKH with 35,000+ species of plants and 200+ species of animals

At least 353 new species—242 plants, 16 amphibians, 16 reptiles, 14 fish, two birds, and two mammals, and at least 61 invertebrates—have been discovered in the Eastern Himalaya between 1998 and 2008, equating to an average of 35 new species finds every year

(HKH Assessment)



Monitoring our land

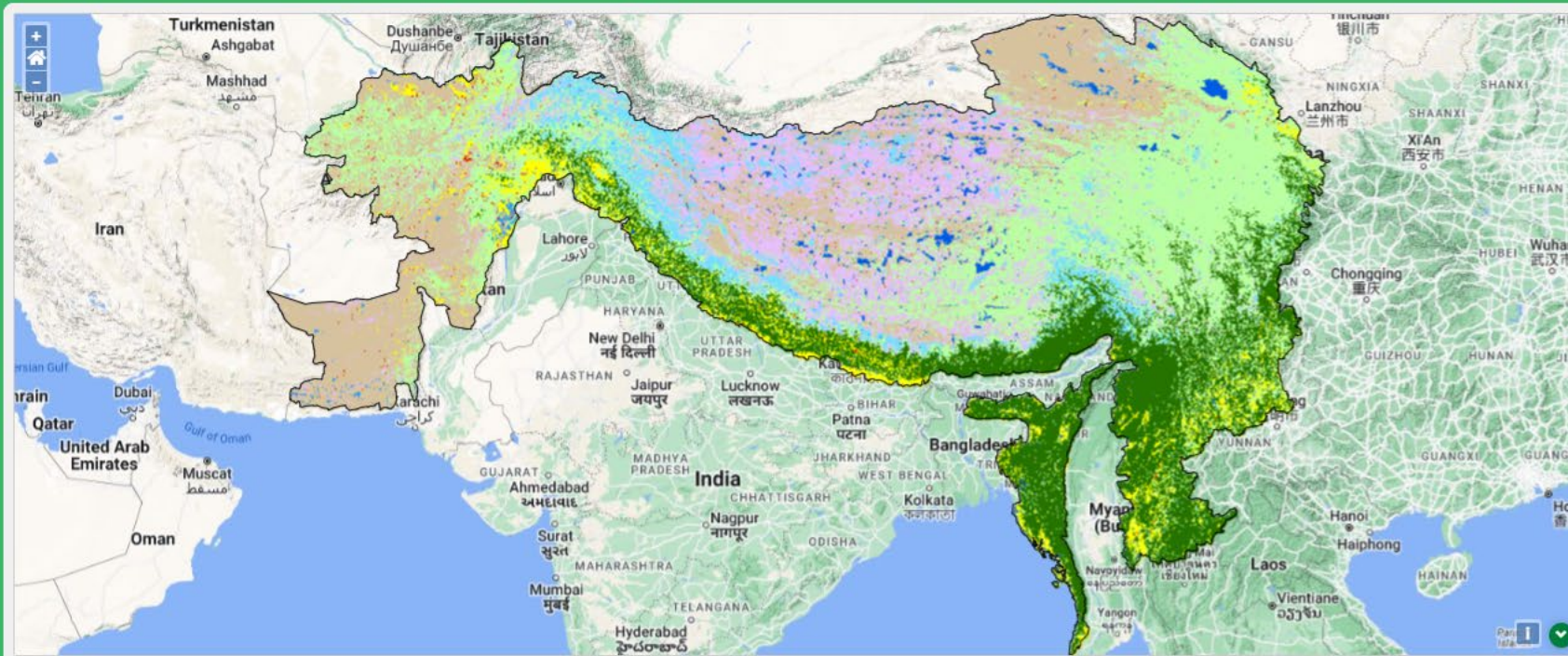
Regional Land Cover Monitoring System

Parameters

- Hindu Kush Himalaya region
- Ecoregion
- Biodiversity hotspot
- Draw polygon

Year: 2021

Show trend



Layers

- HKH boundary
- Ecoregion
- Biodiversity hotspot
- Land cover
 - Forest
 - Grassland
 - Cropland
 - Bare soil
 - Bare rock
 - Built-up
 - Snow and glacier
 - Water body
 - Riverbed

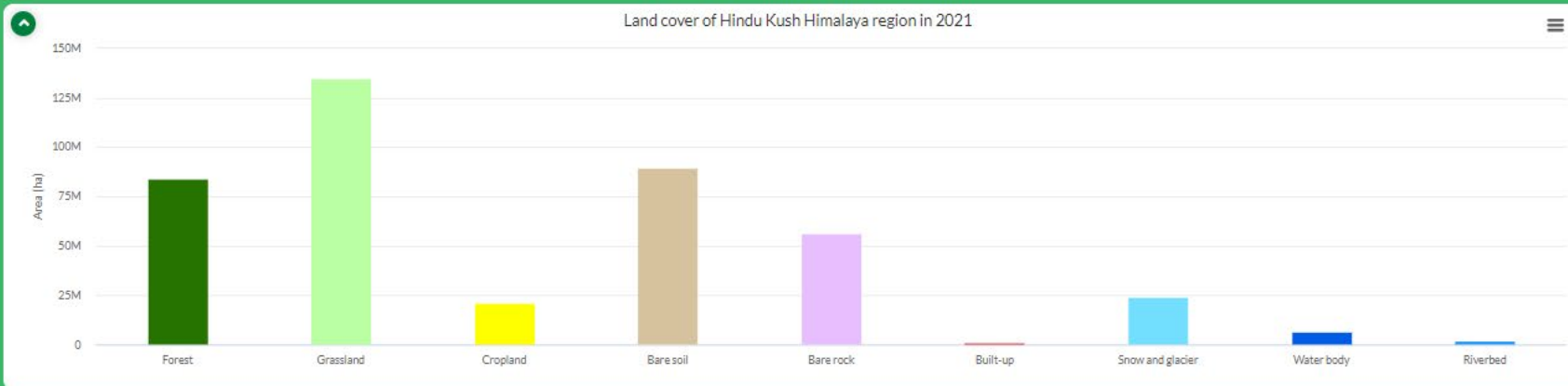
Useful links

Data

- [Land cover of HKH region](#)

Application guide

- [RLCMS user guide](#)



About

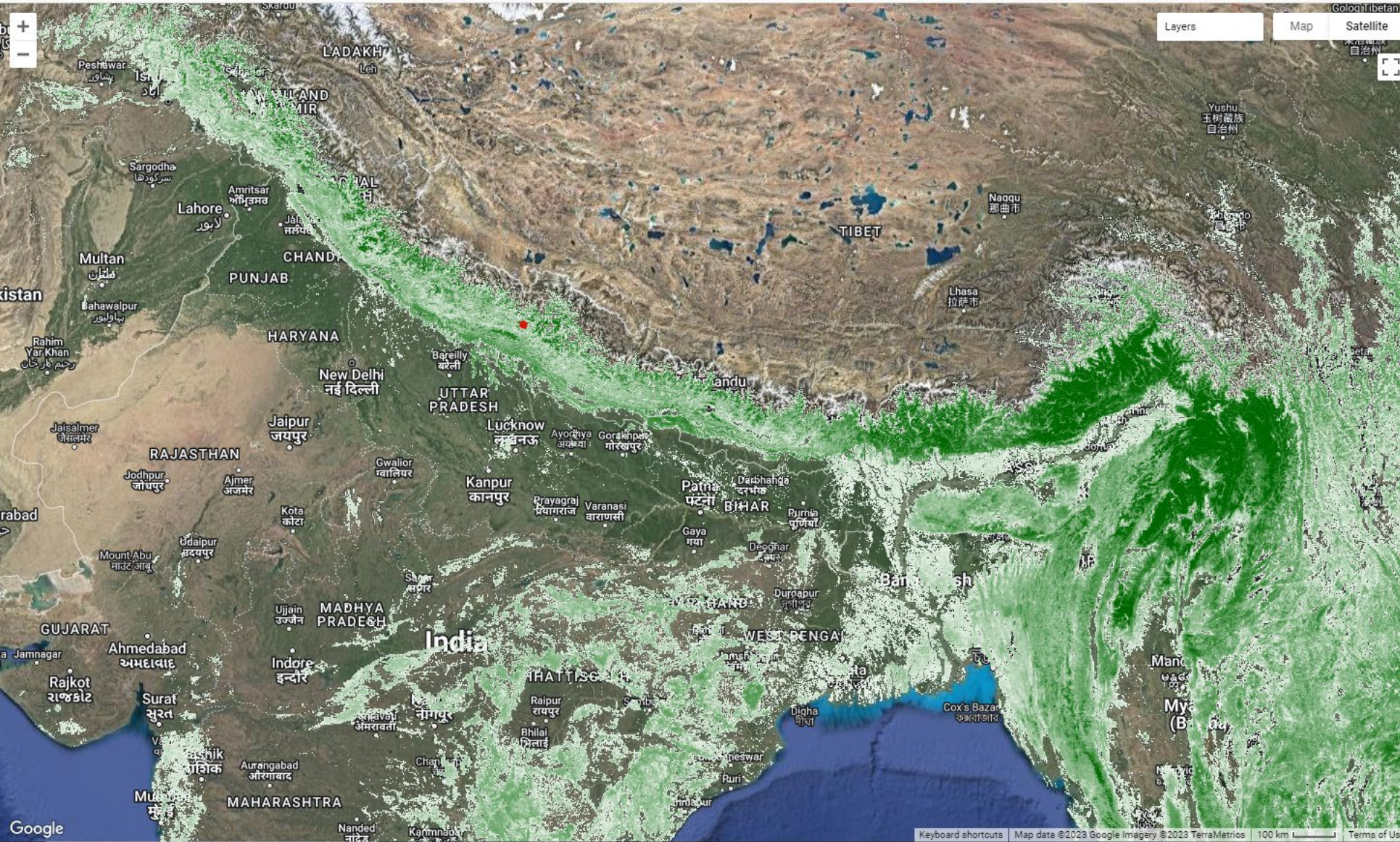
The web-based application provides easy access to the harmonized land cover database for the entire HKH region over 2000–2018.

[View More...](#)

Monitoring forests

Earth Engine Apps

Search places



Global Forest Canopy Height, 2019

P. Potapov, X. Li, A. Hernandez-Serna, A. Tyukavina, M.C. Hansen, A. Kommareddy, A. Pickens, S. Turubanova, H. Tang, C. E. Silva, J. Armston, R. Dubayah, J. B. Blair, M. Hofton (2020).

<https://doi.org/10.1016/j.rse.2020.112165>

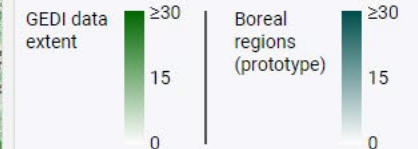
A new, 30-m spatial resolution global forest canopy height map was developed through the integration of the Global Ecosystem Dynamics Investigation (GEDI) lidar forest structure measurements and Landsat analysis-ready data time-series (Landsat ARD). The GEDI RH95 (relative height at 95%) metric was used to calibrate the model. The Landsat multi-temporal metrics that represent the surface phenology serve as the independent variables. The "moving window" locally calibrated and applied regression tree ensemble model was implemented to ensure high quality of forest height prediction and global map consistency. The model was extrapolated in the boreal regions (beyond the GEDI data range, 52°N to 52°S) to create the global forest height prototype map.

GEDI: <https://gedi.umd.edu>

Landsat ARD: <https://glad.umd.edu/ard/home>

Data download: <https://glad.umd.edu/dataset/gedi>

Forest Canopy Height (m)



Select minimum canopy height (m):

Click for forest canopy height value:

Lat: 29.36587, Lon: 81.11991

26 meters

Forest fires as a major cause of forest degradation

Forest Fire Detection and Monitoring System in Nepal

Fire Outlook Query

Province

All

District

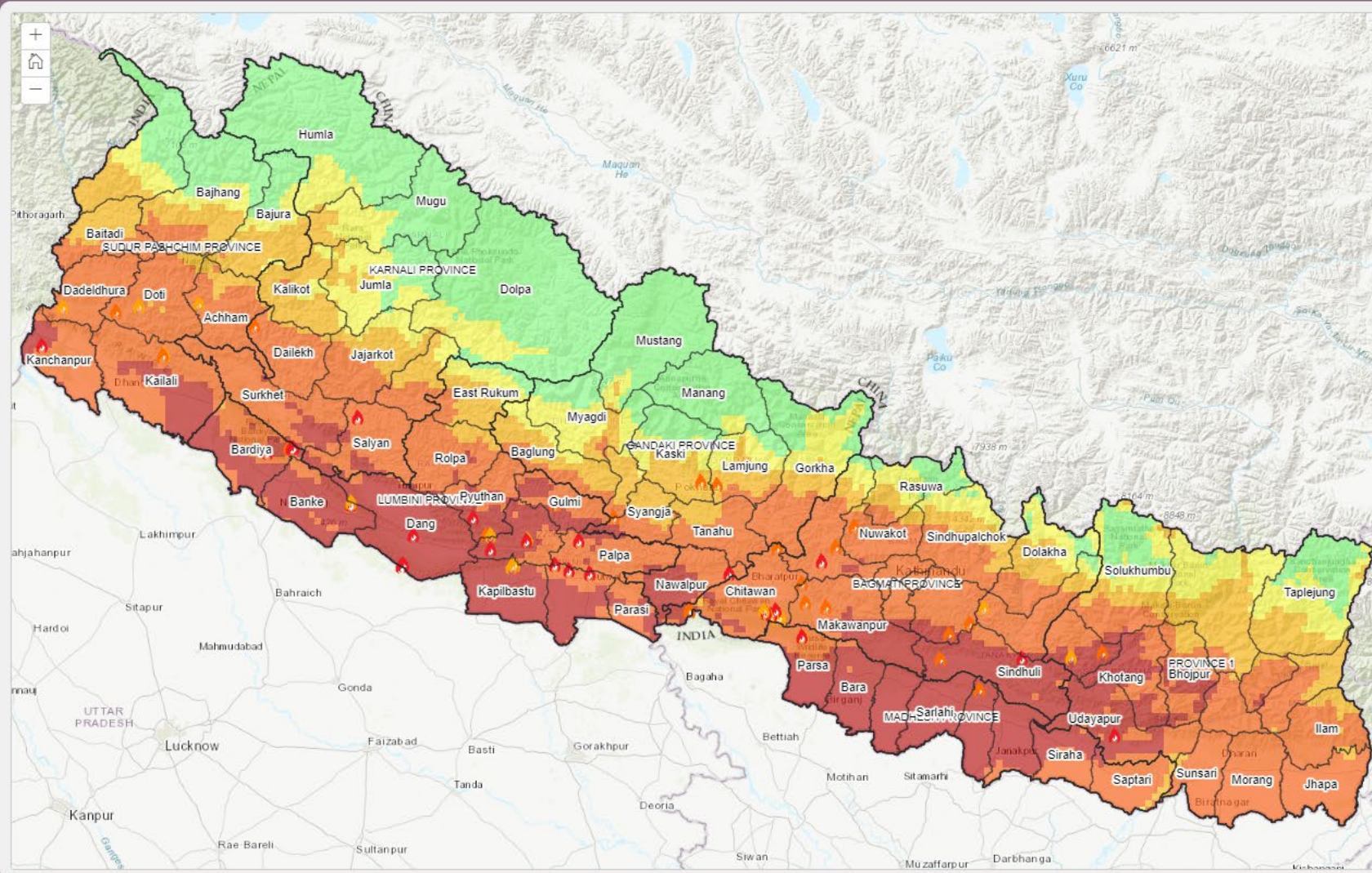
All

Date

2023-Apr-16

Useful Links

- European Forest Fire Information System
- Canadian Forest Fire Weather Index System
- Fire Information for Resource Management System
- Regional Database System
- SERVIR-HKH science applications
- Satellite Data Aids Forest Fire Detection and Monitoring in Nepal



Layer

- Country outline
- Province
- District
- Gaunpalika/Nagarpalika
- Protected area
- VIIRS active fire
- MODIS active fire
 - < 50%
 - 50% - 70%
 - > 70%
- Fire risk outlook (4/16/2023)
 - Very Low
 - Low
 - Moderate
 - High
 - Very High
- Forest and grassland mask

About

The fire risk outlook can be used as a general index of fire danger throughout Nepal's forested areas. We developed the two-day outlook based on temperature (°C), relative humidity (%), wind speed (km/h), and precipitation (mm) data generated by our High-Impact Weather Assessment Toolkit (HIWAT) - Nepal.

[View More](#)

Challenges

- Triple planetary crisis involves complex and interconnected issues
- Advancements in EO provides more options for data, however, data on human dimension still a major gap
- Diverse mountain environments make it more challenging for finding fit for purpose EO data and analysis
- Capacity of institutions limited to adopt the emerging tools and utilize the volume of information for meaningful actions

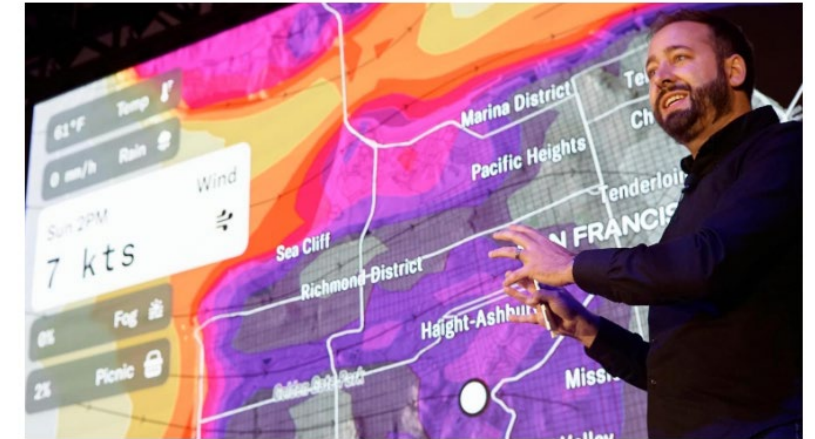
Opportunities

- Triple planetary crisis accepted as a global problem by nations
- More EO data available with free access making it possible to develop new services
- Advancement in platforms and analytics (AI, big data, cloud computing etc) have made generation and dissemination of information more efficient
- Global digital literacy increased significantly after the pandemic

SCIENCE

AI set to take the world of weather forecasting by storm

A revolution in meteorology means far more reliable predictions may be on the horizon



Alex Levy is the co-founder of Atmo, a start-up that claims to have developed the first live global medium-range weather forecast based purely on an AI model



Thank You