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HKH monsoon outlook 2025

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Summary

The Hindu Kush Himalaya (HKH) region is highly susceptible to the influence of monsoon, a periodic wind system, especially in the Indian Ocean and southern Asia. The summer monsoon, between June and September, is the major source of precipitation in the region with significant impacts on the hydrology of its rivers, which form the lifeline of nearly two billion people in the region.

While a good monsoon is essential for replenishing these river systems, malevolence of water-related disasters such as floods, landslides, storms, heat waves, wildfires, droughts, glacial lake outburst floods (GLOFs), is becoming more pronounced in this region under the exacerbating effects of climate change. For instance, in the last forty years or so more than 70% of the flood events in the region took place during the summer monsoon season.

Against this backdrop, the HKH Monsoon Outlook 2025 serves as a preliminary frame of reference into the summer monsoon conditions likely to prevail in the region during June – September 2025, based on seasonal forecasts for South Asia at large. The seasonal estimates are collated from the APEC[1] Climate Centre (APCC), Copernicus Climate Service (C3S), International Research Institute for Climate and Society (IRI), 31st Session of South Asian Climate Outlook Forum (SASCOF -31) and several national agencies for meteorological assessments.

With the forecasters unanimously predicting oceanic and atmospheric phenomena that usually affect (read disrupt) monsoon patterns in South Asia – such as, the El Nino Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD), and the Madden-Jullian Oscillation (MJO) activities – to be neutral and /or weak during June-July-August 2025, the likelihood of summer monsoon precipitations is potent this year.

However, based on the incidence of below-normal snow cover in the Northern Hemisphere, especially between January and March 2025, along with an estimated mean summer temperature anomaly in South Asia ranging from 0.5°C to 2°C above normal, they also predict high probability of above-normal precipitations for most of South Asia, including HKH swathes. Looking at this possibility, we surmise that the HKH region is likely to be exposed to intensifying risks of rain-induced hazards like flash floods, landslides, and GLOFs if precipitations are intense or prolonged.

[1]Asia-Pacific Economic Cooperation

Overview of summer monsoon conditions in South Asia

The HKH Monsoon Outlook 2025 analyses projected precipitation and temperature patterns for South Asia, at large, including the Hindu Kush Himalaya (HKH) region, drawing on insights from global and regional institutions such as the APEC Climate Centre (APCC), International Research Institute for Climate and Society (IRI), Copernicus Climate Change Service (C3S), and the 31st session of the South Asian Climate Outlook Forum (SASCOF-31), along with data from national hydrometeorological departments. The estimates are indicative of significant influence of regional and / or local climate drivers in shaping the summer monsoon precipitation patterns for South Asia.

Despite the neutral El Niño-Southern Oscillation(ENSO) conditions, the 2025 Southwest Monsoon (June–September) is projected to bring above-normal precipitation across most parts of South Asia (WMO, 2025). The ENSO cycle is a key global climate driver that significantly affects interannual variability in the South Asian monsoon. Historically, ENSO phases, particularly El Niño, have been associated with reduced summer monsoon precipitation across the region.

However, for the 2025 monsoon season, ENSO-neutral conditions are prevailing in the equatorial Pacific, with forecasts from global coupled models indicating a high likelihood of these neutral conditions persisting throughout the season. According to the consensus statement from SASCOF-31, neutral ENSO and Indian Ocean Dipole (IOD), along with a weak Madden-Jullian Oscillation (MJO) effect predicted for June-July-August 2025, is unlikely to exert a strong influence on this year's summer monsoon; while below-average Northern Hemisphere snow cover – at its 4th lowest in January 2025 and 6th lowest in March 2025 in the last 59 years – is likely to have an inverse effect on summer monsoon rainfall.

SOURCES OF SEASONAL MONSOON FORECASTS FOR SOUTH ASIA

APCC

Provides seasonal forecast based on multi-model ensemble (MME). MME is based on 16 climate models with spatial resolution of 1°x 1°. The forecast is for June-July-August (JJA).

Copernicus Climate Change Service (C3S)

The changes in precipitation and temperature forecast for JJA is calculated against the reference period of 1993-2016. In total nine models are used with the ensembled output of 1°x 1°.

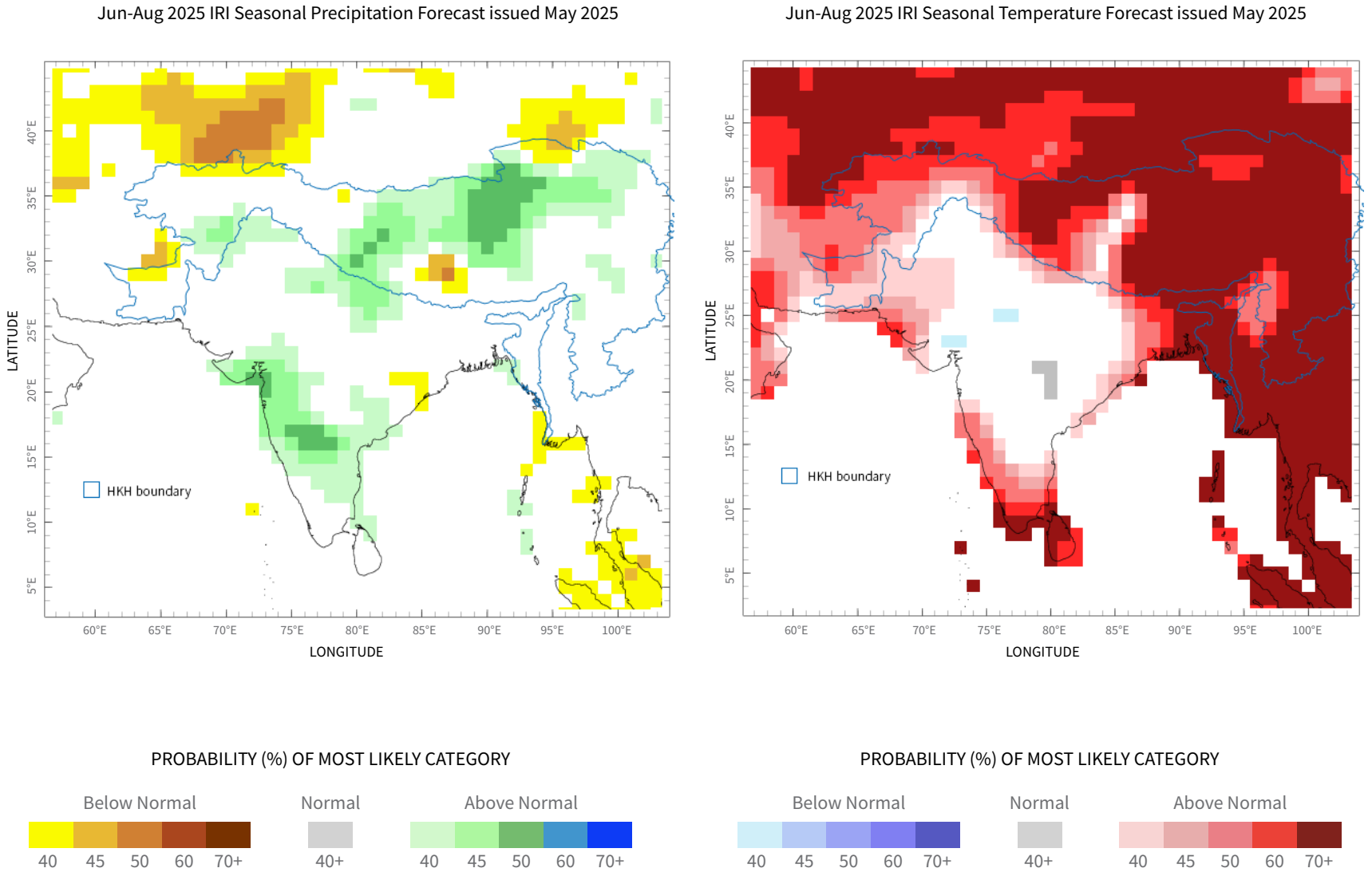
IRI

JJA forecast from IRI is based on six models. The output of the MME is at a resolution of 1°x 1°. The data is made possible by Columbia University, USA.

SASCOF

Monsoon outlook for JJAS based on National Meteorological and Hydrological Services (NMHS)s in the south Asian region. Forecast available at 1°x 1° horizontal resolution.

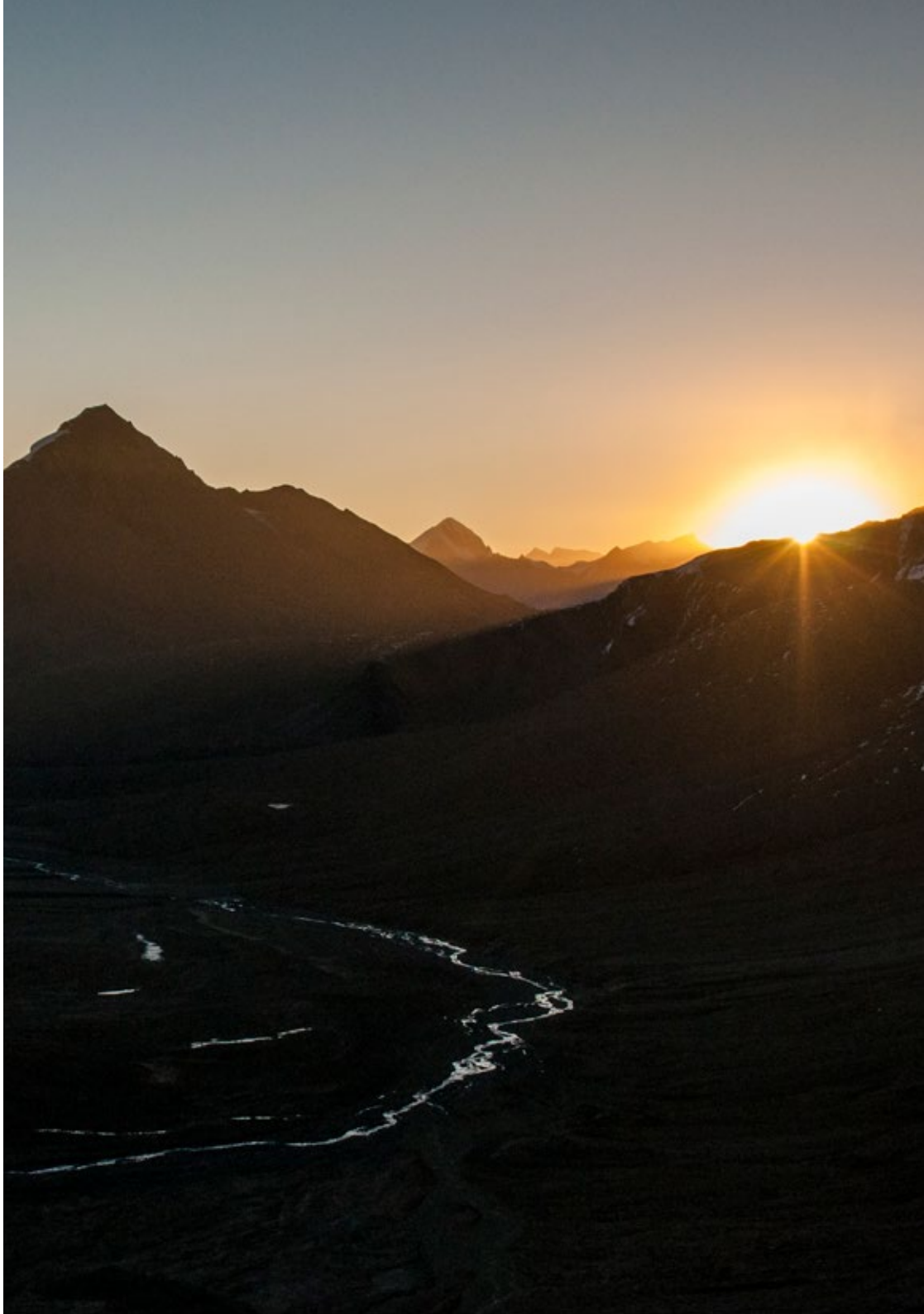
FIGURE 1: **SUB-SEASONAL MEAN PRECIPITATION AND TEMPERATURE ANOMALY AS INDICATED BY IRI MULTI-SYSTEM FORECAST**



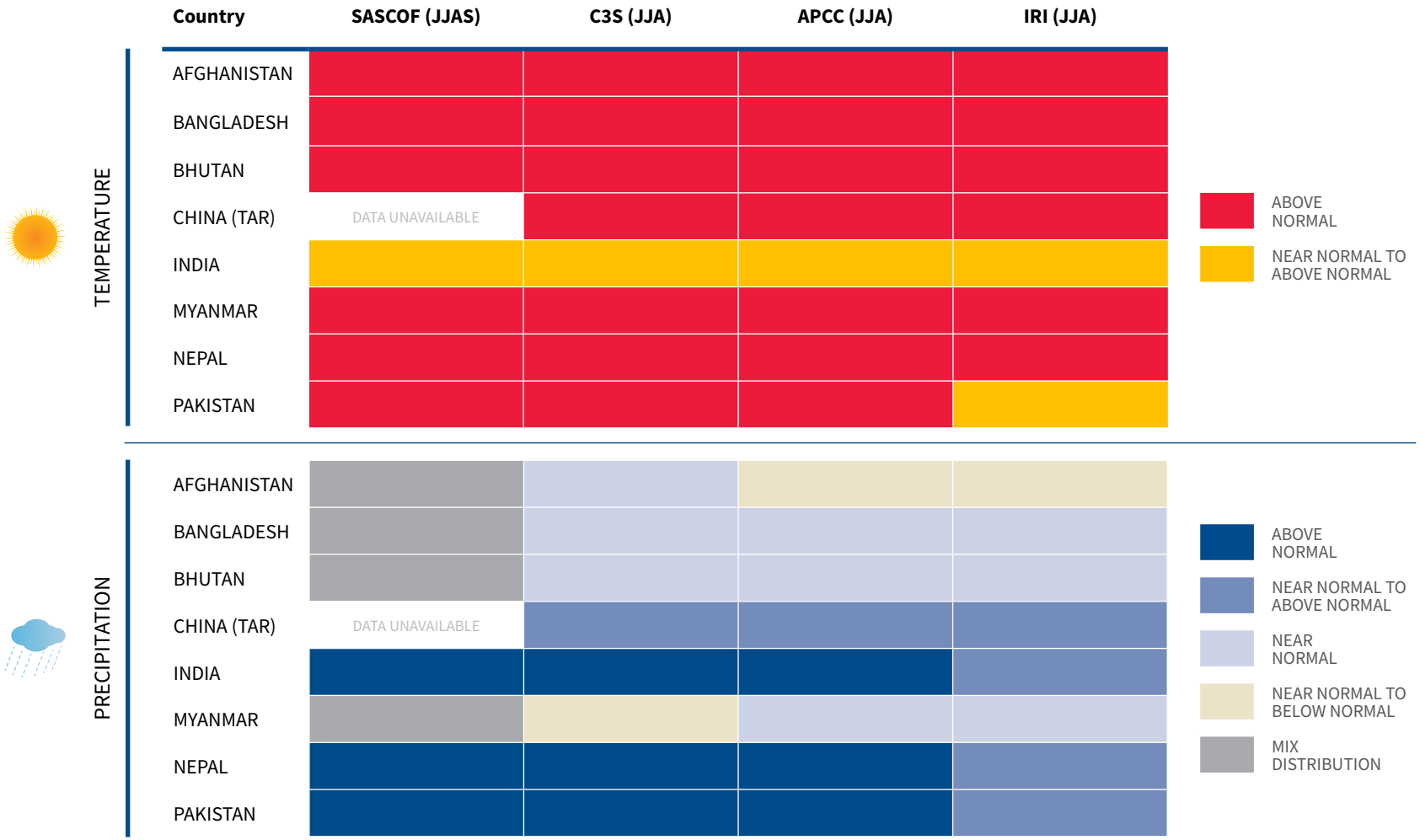
According to the SASCOF-31 forecasts positive summer temperature anomalies are likely in most parts of the north, east, northeast and southern South Asia, while most of the central and a few areas in the south are anticipated to face normal and below-normal conditions. APCC, C3S and IRI predict strong above-normal sub-seasonal temperatures for June–August. According to APCC and IRI, there is a tendency of above-normal temperatures across Afghanistan and Tibet Autonomous Region (TAR) of China, with C3S indicating a 0.5°–2°C increase in mean temperature anomaly.

Simultaneously, SASCOF-31 predicts above-normal precipitations this summer monsoon (from June to September) in most parts of South Asia, with the a few exceptions in the northern, northeastern, eastern and southern parts of the region that are likely to have below and near-normal precipitations. The seasonal forecasts by C3S and IRI show above-normal sub-seasonal (between June and August) precipitations, notably in the northern regions and western coastline of India and in western Nepal, and the APCC predicts the probability of wetter-than-normal monsoon in most parts of India, Nepal and Pakistan.

With above-normal monsoon precipitations projected for much of South Asia, HKH will remain vulnerable to hydrometeorological hazards such as floods, landslides, and GLOFs, especially if monsoon precipitation is intense or prolonged.



Country-wise summer monsoon conditions



Above normal: Higher than long-term average conditions
Normal/Near normal: Close to the long-term average conditions
Below normal: Lower than long-term average conditions

Mix distribution: Mix of at least two different forecast categories across various regions within the country
JJAS: June-July-August-September
JJA: June-July-August

AFGHANISTAN

According to SASCOF-31, most parts of Afghanistan are likely to experience below-average rainfall (55%–75% probability) between June and September, with severe dryness in the west. IRI, C3S, and APCC suggest near-normal precipitation for the June–August period. Temperatures are expected to rise across the country, with a ≥75% chance of increased minimum temperatures and a 55%–75% chance of higher maximum temperatures according to SASCOF-31. IRI, and APCC also indicate increased temperatures, with C3S showing a 0.5°C–2°C rise in mean temperatures.

BANGLADESH

SASCOF-31 predicts near-normal to slightly below-normal precipitation conditions, while IRI, C3S and APCC forecast near-normal conditions. SASCOF-31 estimated positive anomalies of both minimum and maximum temperatures. APCC and IRI also show at least 60% probability for above average temperatures across the country, with C3S indicating an increase ranging from 0.2°C–0.5°C.

BHUTAN

APCC, C3S, IRI and SASCOF-31, all predict near-normal precipitations. However, mean temperatures are likely to exceed the long-term averages with a probability of 65%–80% increase in minimum and maximum temperatures. The National Center for Hydrology and Meteorology also corroborates with the likelihood of above-normal temperatures. C3S shows that temperatures may rise by 0.5°–1°C during this period.

CHINA (TIBETAN AUTONOMOUS REGION)

APCC, C3S and IRI, all estimate normal to above normal rainfall in the Tibetan Autonomous Region (TAR) of China. Whereas above normal temperatures are expected with at least 80% probability and C3S predicts an increase of 0.5°–2°C across TAR.

INDIA

India Meteorological Department's long-range forecast shows a strong probability (59%) of the southwest monsoon seasonal precipitation to be above normal (>104% of Long Period Average (LPA)) with a model error of ± 5%. Above-normal seasonal precipitations are very likely over most parts of the country, except in some parts of northwestern, northeastern and south Peninsular India, where below-normal precipitations are likely. The LPA of seasonal precipitations in the country from 1971–2020 is 87 cm.

MYANMAR

SASCOF-31, IRI and APCC all predict near normal precipitations across the country with C3S estimating a potentially dry condition in the southern part of the country. Temperatures are likely to increase during this summer monsoon with a 60%–80% probability for above normal temperatures.

NEPAL

According to the 2025 Monsoon Outlook published by the Department of Hydrology and Meteorology, Nepal, most parts of the country are expected to receive above-normal precipitations during this summer monsoon. There is a 55%–65% probability that the Gandaki Province, the western part of Karnali Province, and the northern part of Lumbini Province will experience higher-than-average precipitation. Both minimum and maximum temperatures are forecasted to be above the long-term averages across the country. The northern parts of Sudurpaschim, Karnali, and Gandaki Provinces, as well as central Bagmati and western Madhesh Provinces, have a 55%–65% probability of positive anomaly of long-term mean temperatures.

PAKISTAN

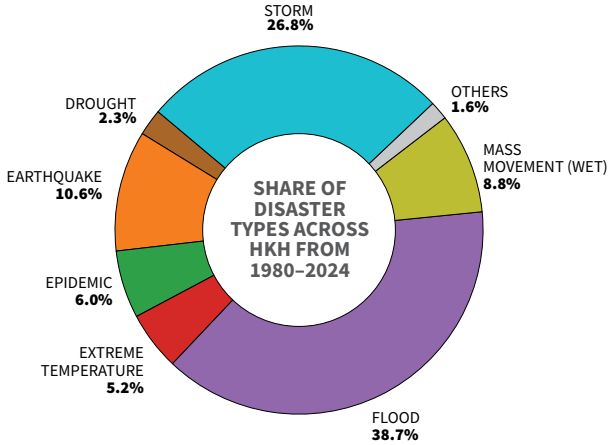
According to the forecasts from the Pakistan Meteorological Department, precipitations across the country is expected to range from normal to slightly above normal, with the most significant increases anticipated in northern Punjab, southern Khyber Pakhtunkhwa, northern and southwestern Balochistan. In contrast, northern Khyber Pakhtunkhwa and western half of Gilgit-Baltistan are projected to receive below-normal precipitation during the forecast period of July-August-September. Mean temperatures across the country are projected to stay above normal, with the most pronounced increases expected in Gilgit-Baltistan and Kashmir. The average temperature of the country is expected to increase by 0.3°C–0.8°C compared to long-term average conditions.

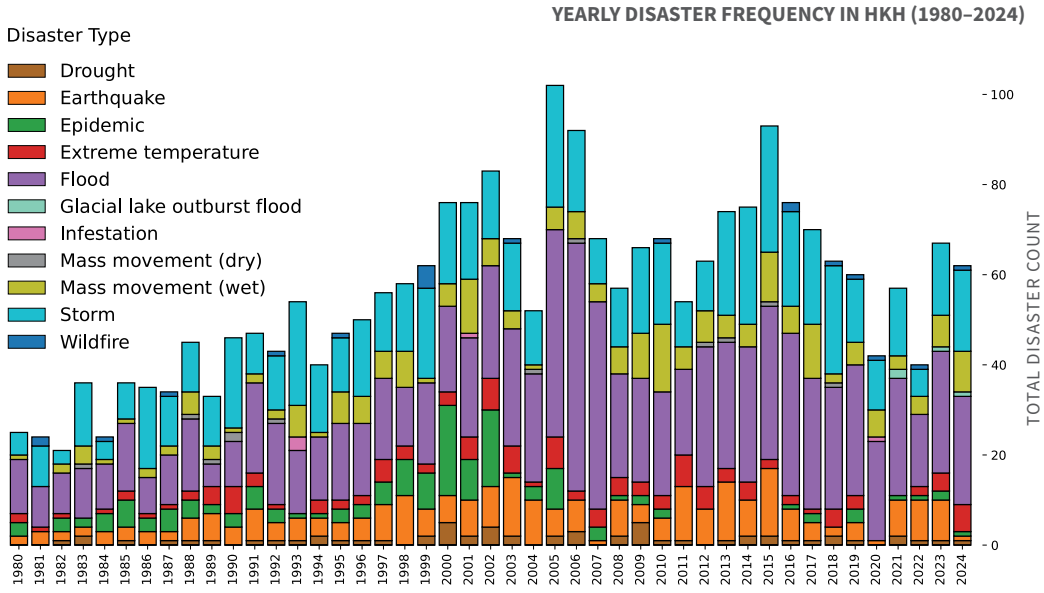
Implications of summer monsoon predictions for the HKH region

The HKH region is highly vulnerable to climate-induced disasters. Climate change has intensified these hazards and amplified the risks of cascading disasters. Among the most palpable effects of exacerbating climate change, erratic summer monsoon patterns and rising temperatures (see maps in the Annexe for an overview of summer monsoon 'climate-normal' in the HKH) are intensifying the frequency and magnitude of extreme weather events. Irregular monsoon precipitation patterns disrupt water availability and threaten food and livelihood security of two billion people dependant on the HKH river systems across Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan.

Above-normal precipitations between June and September 2025, as predicted by the various meteorological agencies, is fraught with the high risks of disastrous flash floods and landslides along the mountainous terrains. Historical records of flood events in the region show that 72.5% of the total number of flood events recorded between 1980 and 2024 occurred during the summer monsoon months (between June and September) (Figure 2 and 3).

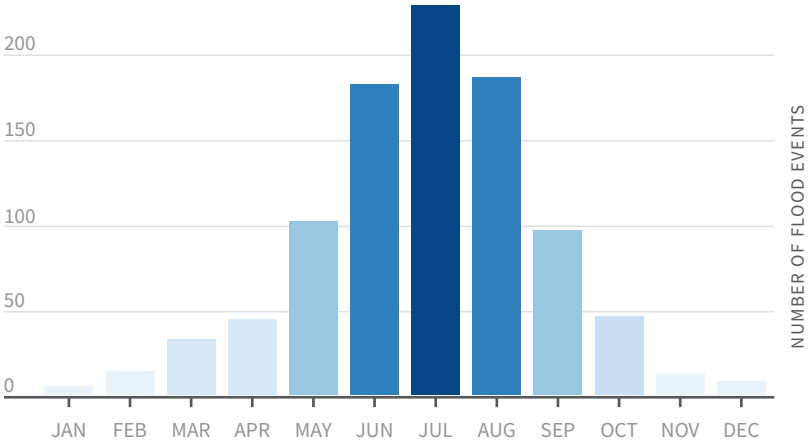
FIGURE 2
DISASTER INCIDENCE ACROSS HKH FROM 1980–2024





Data Source: EM-DAT, 1980-2024

FIGURE 3: **FREQUENCY OF FLOOD EVENTS IN THE HKH DURING SUMMER MONSOON SEASON**



Data Source: EM-DAT, 1980–2024

On the other hand, rising temperatures in the HKH region can accelerate glacial and snowmelt, contributing to short-term increases in river discharge and heightening the risk of GLOFs. Warmer conditions also reduce snow accumulation, threatening the long-term water supply for millions downstream. Increasing temperatures may adversely affect human health and livelihoods. In agriculture, for instance, higher temperatures can lead to heat stress on crops and livestock, reduce crop yields, and shorten growing seasons—particularly in already marginal mountain farming systems. Elevated temperatures can also intensify evapotranspiration and soil moisture loss; compounding drought impacts even during years with average rainfall.

With the frequency and intensity of these events being on the rise in the region, there is immediate need for preparedness against hydrometeorological hazards, including planning for adaptive risk mitigation measures. Therefore, it is equally important to conduct impact-based forecasting of key weather parameters in a climate disaster-prone region like the HKH, alongside forecasts done at the beginning of the season. Although these longer-term forecasts provide critical insights into the likely seasonal conditions at large, these do not provide spatially and temporally localised signals of climatic anomalies that are crucial for impact-based forecasting.

While it is strongly recommended to regularly consult regional and national hydro-meteorological organisations for the most up-to-date predictions, ICIMOD has developed several models capable of accurate short-term forecasts. These include the High-Impact Weather Assessment Toolkit (HIWAT) for forecasts on precipitation, temperature and lightning over Bhutan, Bangladesh, Nepal, and Pakistan up to two days in advance, Flash Flood Prediction Tool (FFPT) for discharge forecasts, specifically of rivers prone to flash floods, across Bangladesh and Nepal up to two days in advance, Streamflow Prediction Tool (SPT) specifically designed for predicting discharge of larger rivers in Bangladesh, Bhutan and Nepal for up to 10 days in advance, and the Prakop Alert mobile app, available on the Google Play Store, for weather and river discharge forecasts across Nepal using estimates from the HIWAT and FFPT tools.

	BANGLADESH	BHUTAN	NEPAL	
HIWAT WEATHER ASSESSMENT TOOL				
FLOOD PREDICTION TOOL				PRAKOP ALERT APP
STREAM FLOW PREDICTION TOOL				

Annexe

The following maps (Figures 4–6), representing the long-term average conditions (climate normal), provide a broad overview of typical patterns in precipitations, and minimum and maximum temperatures, during the summer monsoon season (June to September (JJAS)) for an overall understanding of what this season usually looks like in the HKH region. These maps are based on 25 years' data (from 2000 to 2024) generated using the South Asian Land Data Assimilation System (SALDAS) from ICIMOD's online data portal.

FIGURE 4: **LONG-TERM AVERAGE PRECIPITATION FOR THE SUMMER MONSOON SEASON (JJAS) BASED ON THE OBSERVATION FROM 2000–2024**

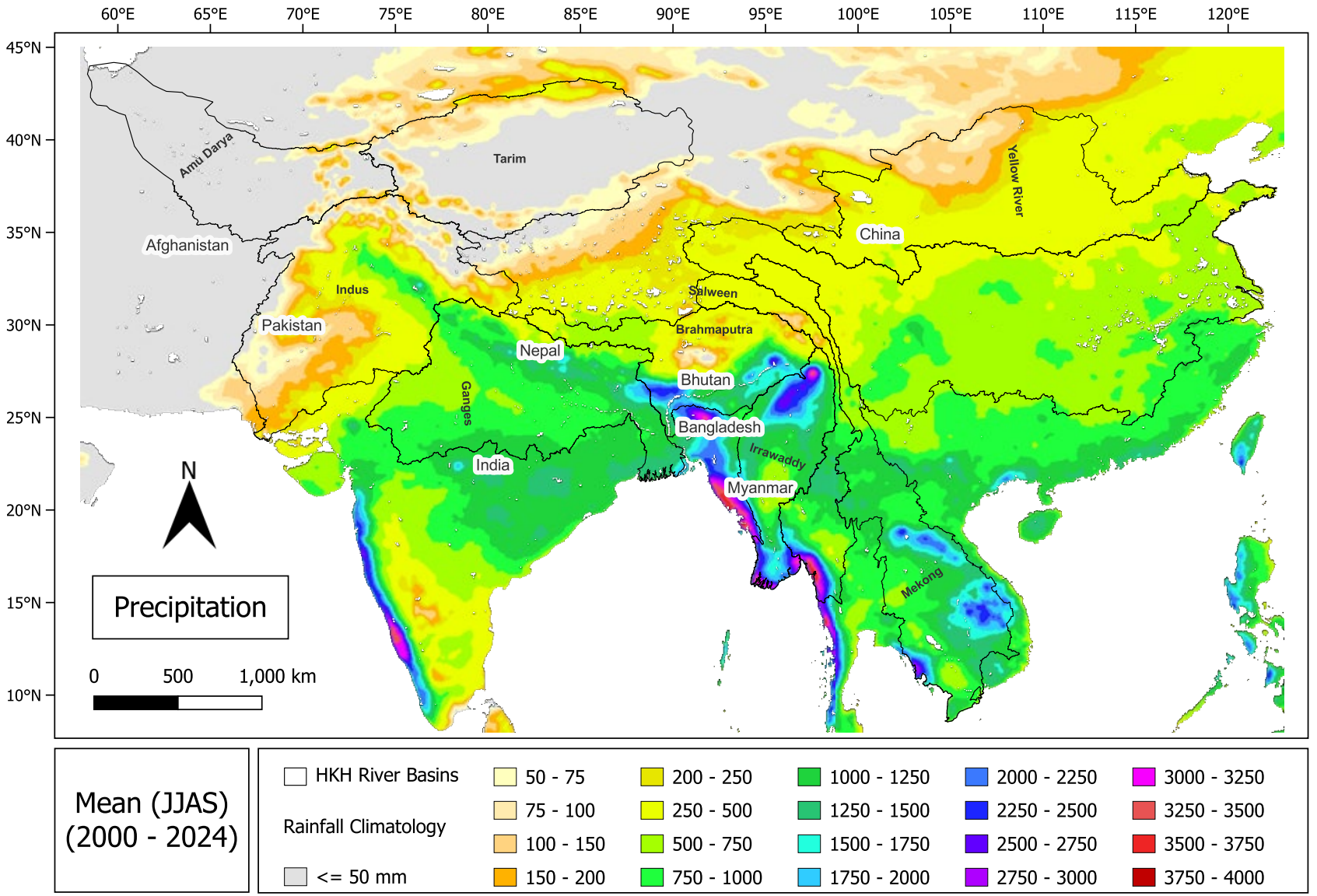


FIGURE 5: **LONG-TERN AVERAGE MINIMUM TEMPERATURE FOR THE SUMMER MONSOON SEASON (JJAS) BASED ON THE OBSERVATION FROM 2000–2024**

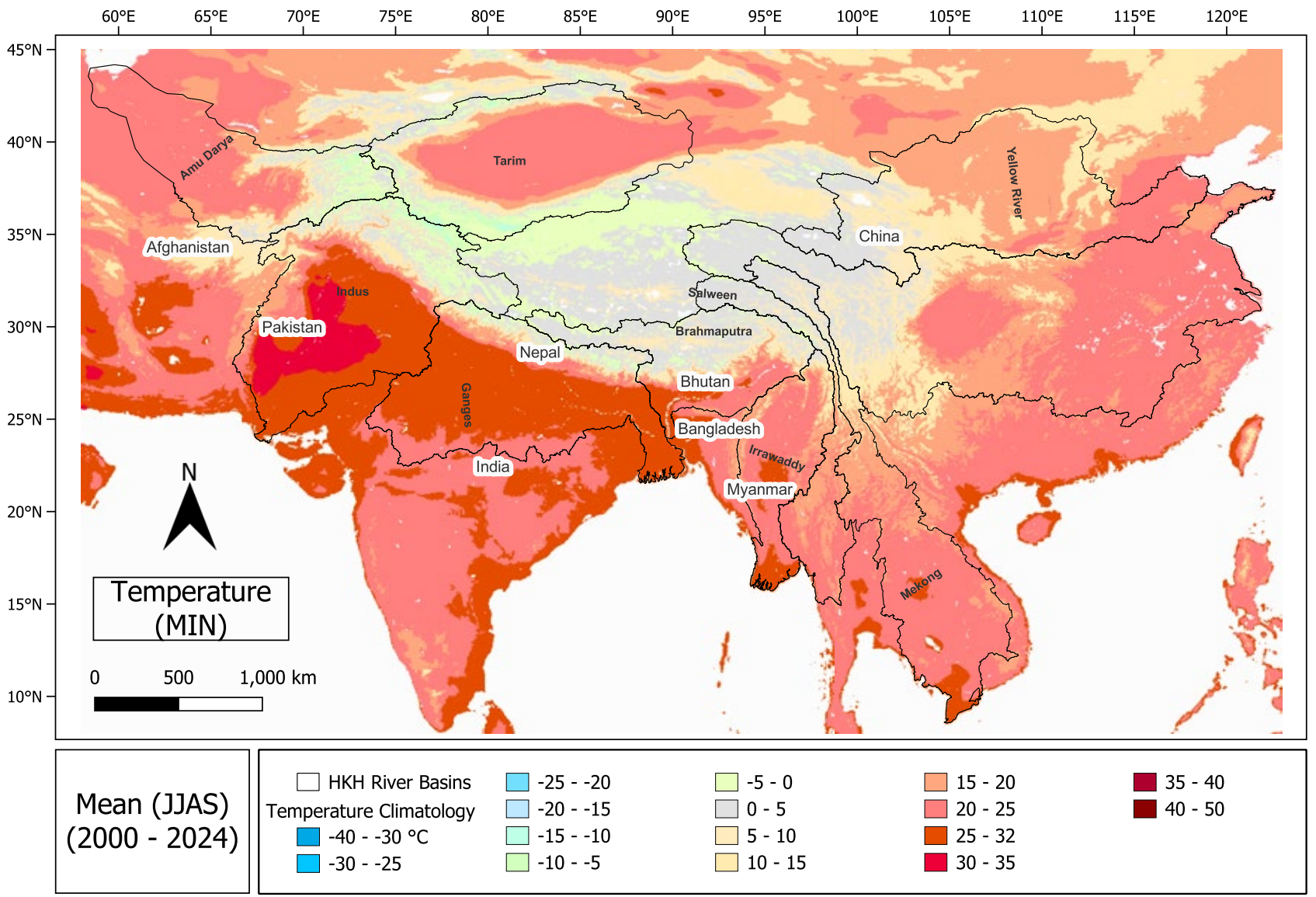
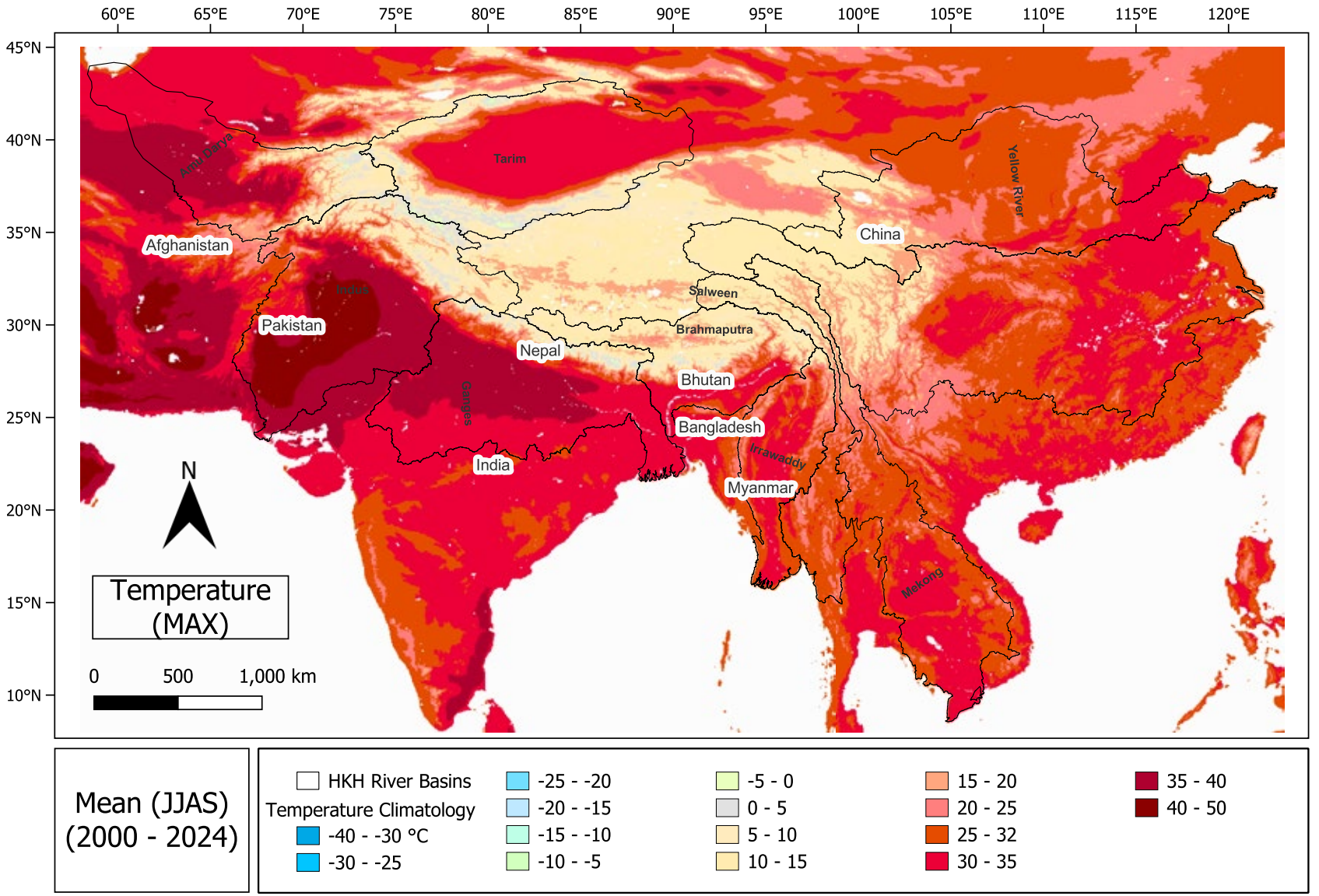


FIGURE 6: **LONG-TERM AVERAGE MAXIMUM TEMPERATURE FOR THE SUMMER MONSOON SEASON (JJAS) BASED ON THE OBSERVATION FROM 2000–2024**



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