ICIMOD

Climate change and its impacts on the HKH region

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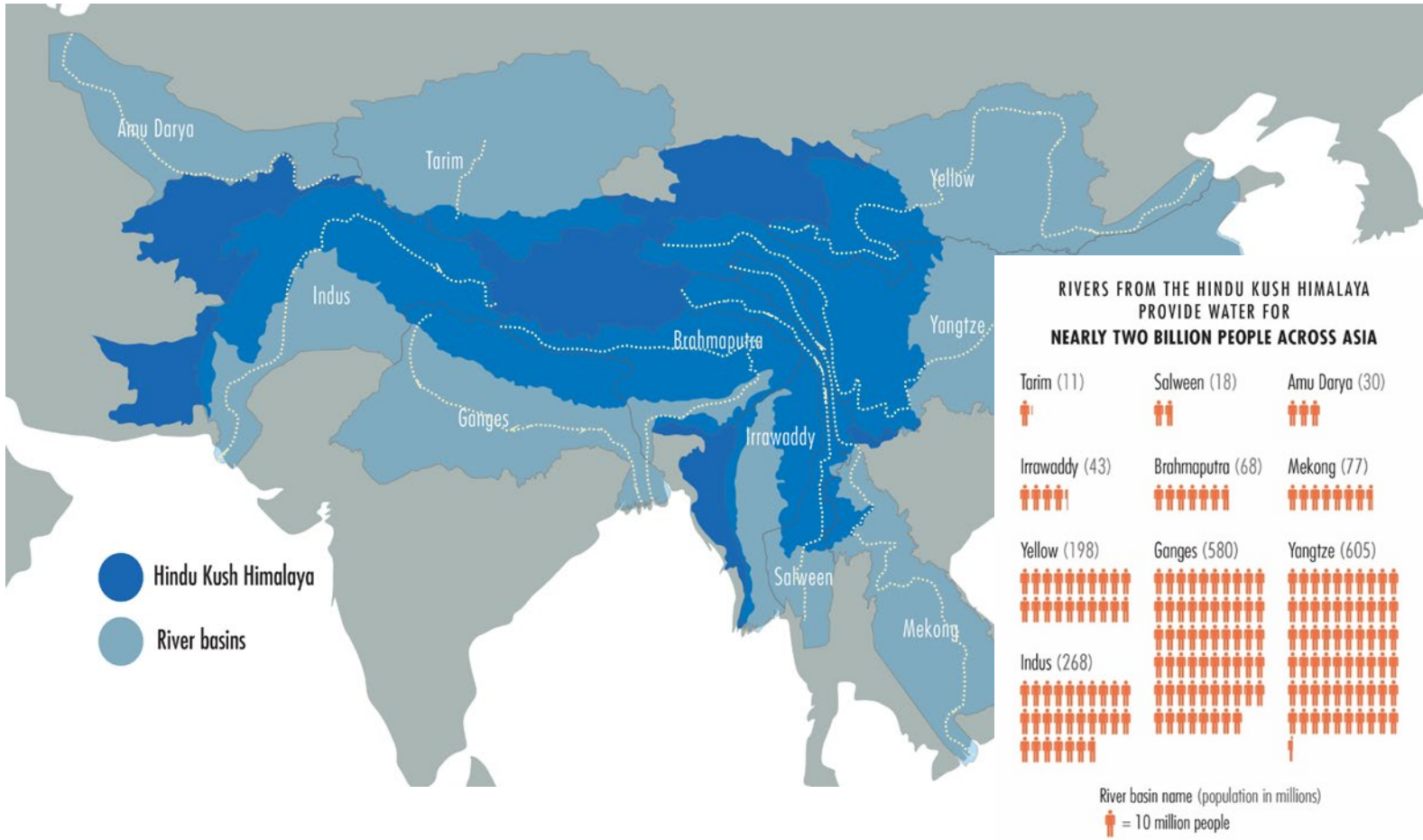
Himalayan region: Source of 10 major river systems – the "water tower" of Asia

240 million people, 1.6 billion d/s

Youngest geological formation - dynamic & fragile mountain ecosystem;

High spatial variations with widely varying physical and climatic conditions;

Third Pole - Largest reserve of snow and ice outside the polar region



Key Issues in the HKH region

Multi-hazard environment

Upstream-downstream linkages

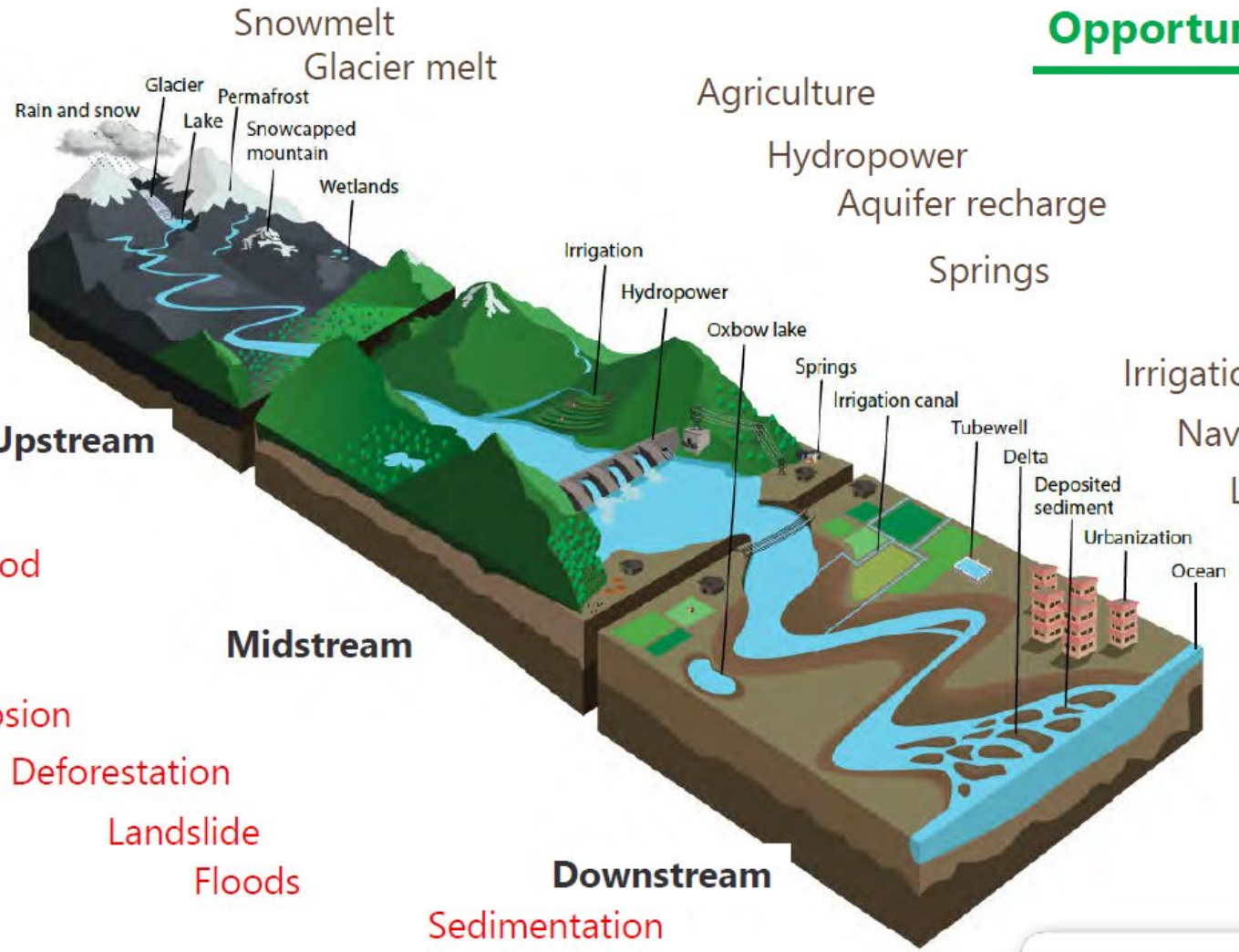
Climate change and variability

Connectivity and physical access

Governance

Hindu Kush Himalayan region u/s d/s linkages

Upstream-downstream Linkages



Opportunities

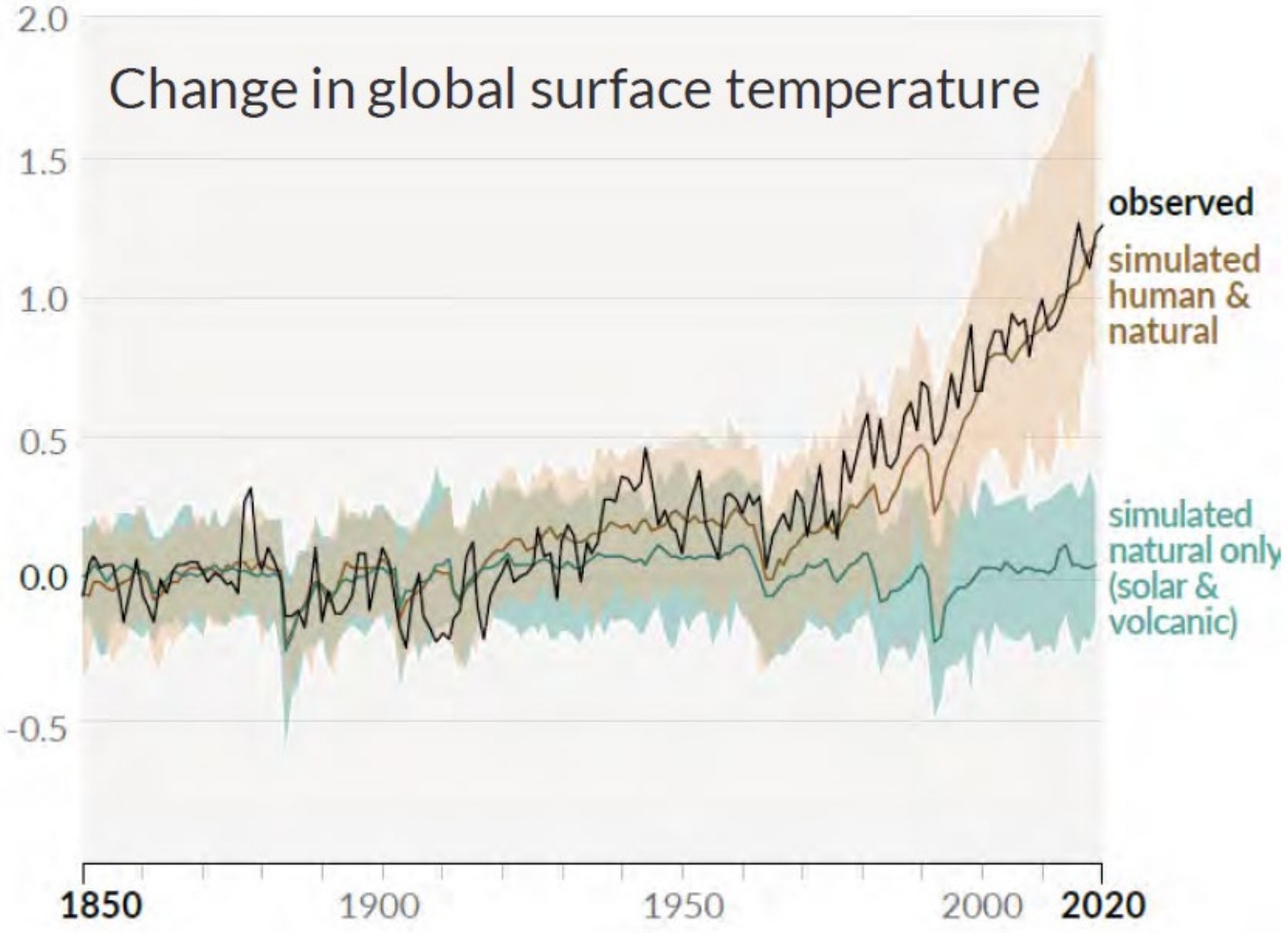
Agriculture
Hydropower
Aquifer recharge
Springs
Irrigation
Navigation
Large settlements

Threats

GLOF
Landslide
Avalanche
Flash flood
Erosion
Deforestation
Landslide
Floods
Sedimentation
Flood
GW depletion

Source: Nepal et al. 2018

Global climate change



IPCC AR6 (2021), summary for policy makers

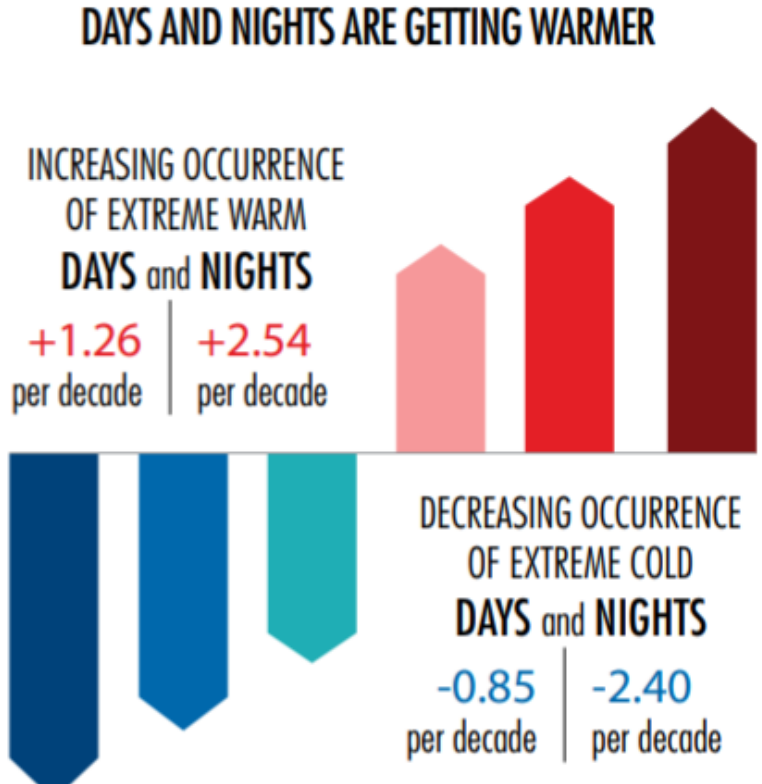
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years (IPCC AR6, 2021)

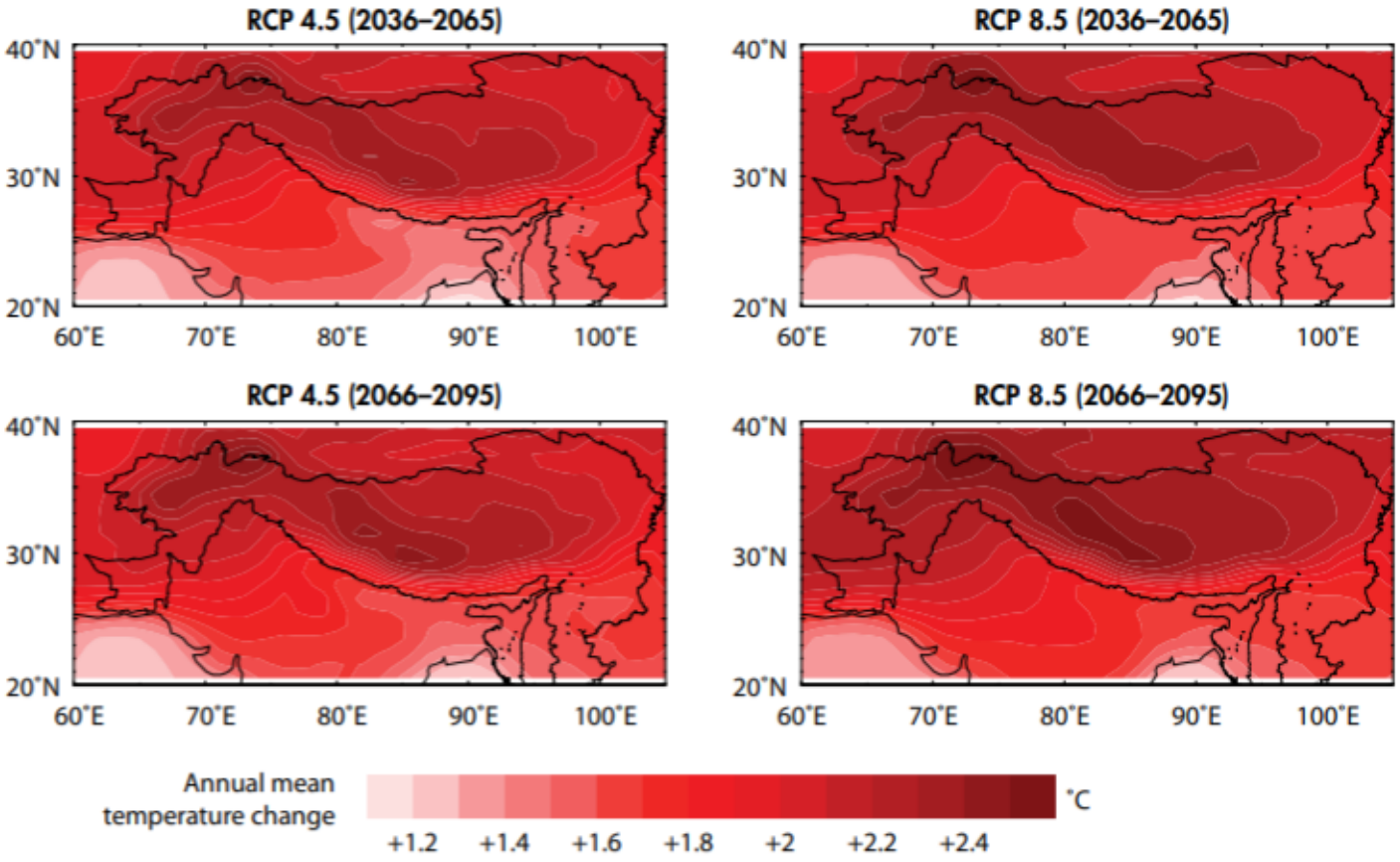
Clear signal of human induced climate change

Very close to 1.5 degree Celsius threshold

The Climate Context

In a 1.5˚C world, warming will likely be at least **0.3˚C higher in the HKH**, and at least 0.7˚C higher in the northwest Himalaya and Karakoram.



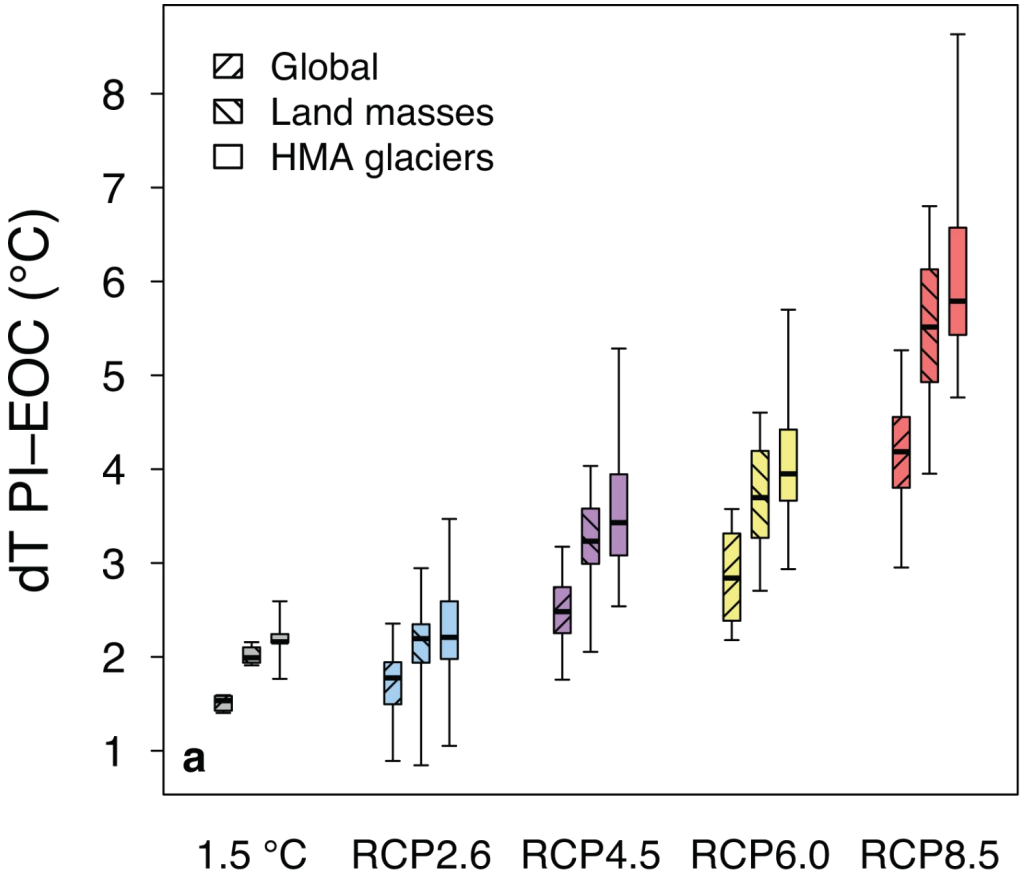


THE HKH WILL WARM MORE THAN THE GLOBAL MEAN AND MORE RAPIDLY AT HIGHER ELEVATIONS

Source: P. Wester, A. Mishra, A. Mukherji, A. B. Shrestha (eds) (2019) The Hindu Kush Himalaya Assessment—Mountains, Climate Change, Sustainability and People, Springer Nature Switzerland AG, Cham.
Download the full assessment at https://doi.org/10.1007/978-3-319-92288-1

Even 1.5˚C is Too Hot for the HKH

and will be amplified by *elevation dependent warming*



HKH will warm more compared to global mean and warm more rapidly at higher elevations

+2.1˚C (± 0.1) by 2100 (rel. to pre-industrial) in a 1.5 degree world

+2.5˚C (± 1.5) by 2100 (rel. to 1976-2005) (RCP 4.5)

+5.5˚C (± 1.5) by 2100 (rel. to 1976-2005) at current emission trends (RCP 8.5)

Source: HIMAP climate change chapter, 2019 and Kraaijenbrink et al. 2017, Nature

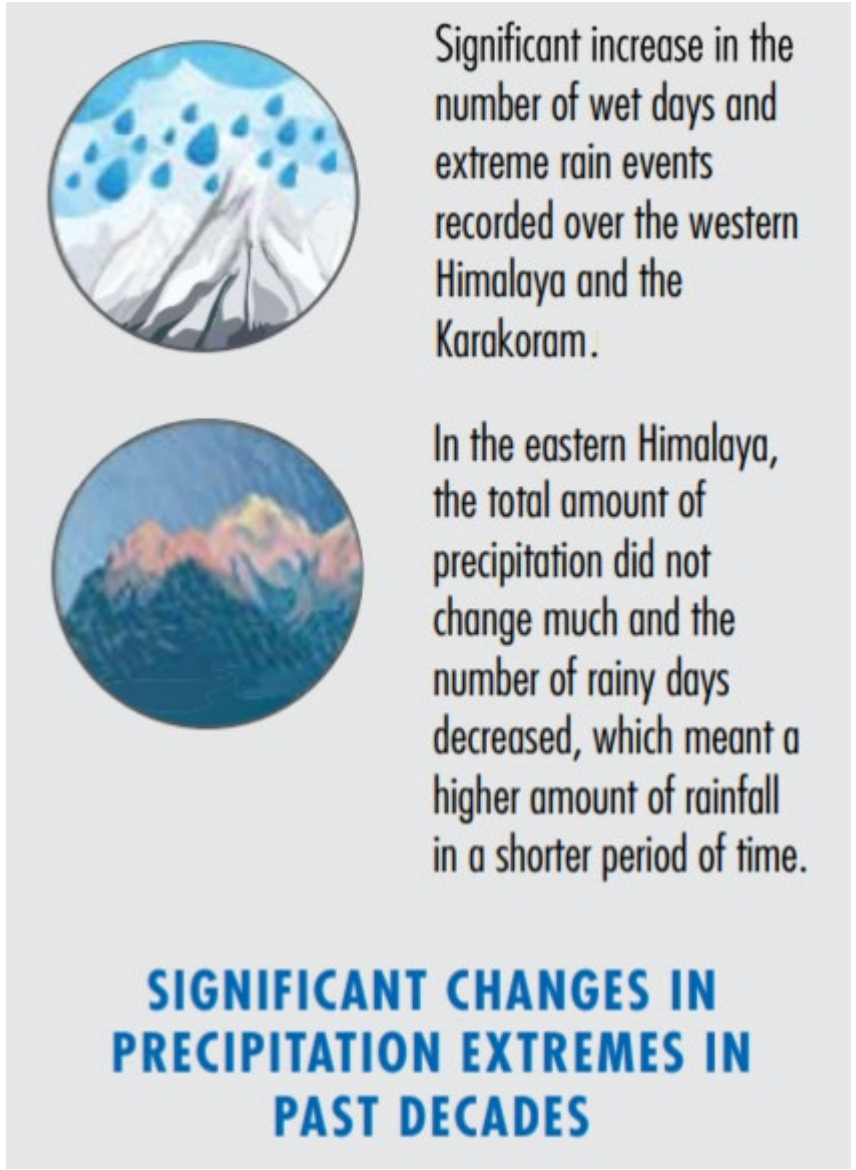
Picture: D. SAMYN

The Climate Context

Precipitation extremes increasing - **extreme and erratic rainfall**

Both warming and precipitation extremes to increase in the future:

2-4 degree C warmer by 2100
Elevation dependent warming
8-12% increase in precipitation
More **extreme precipitation**



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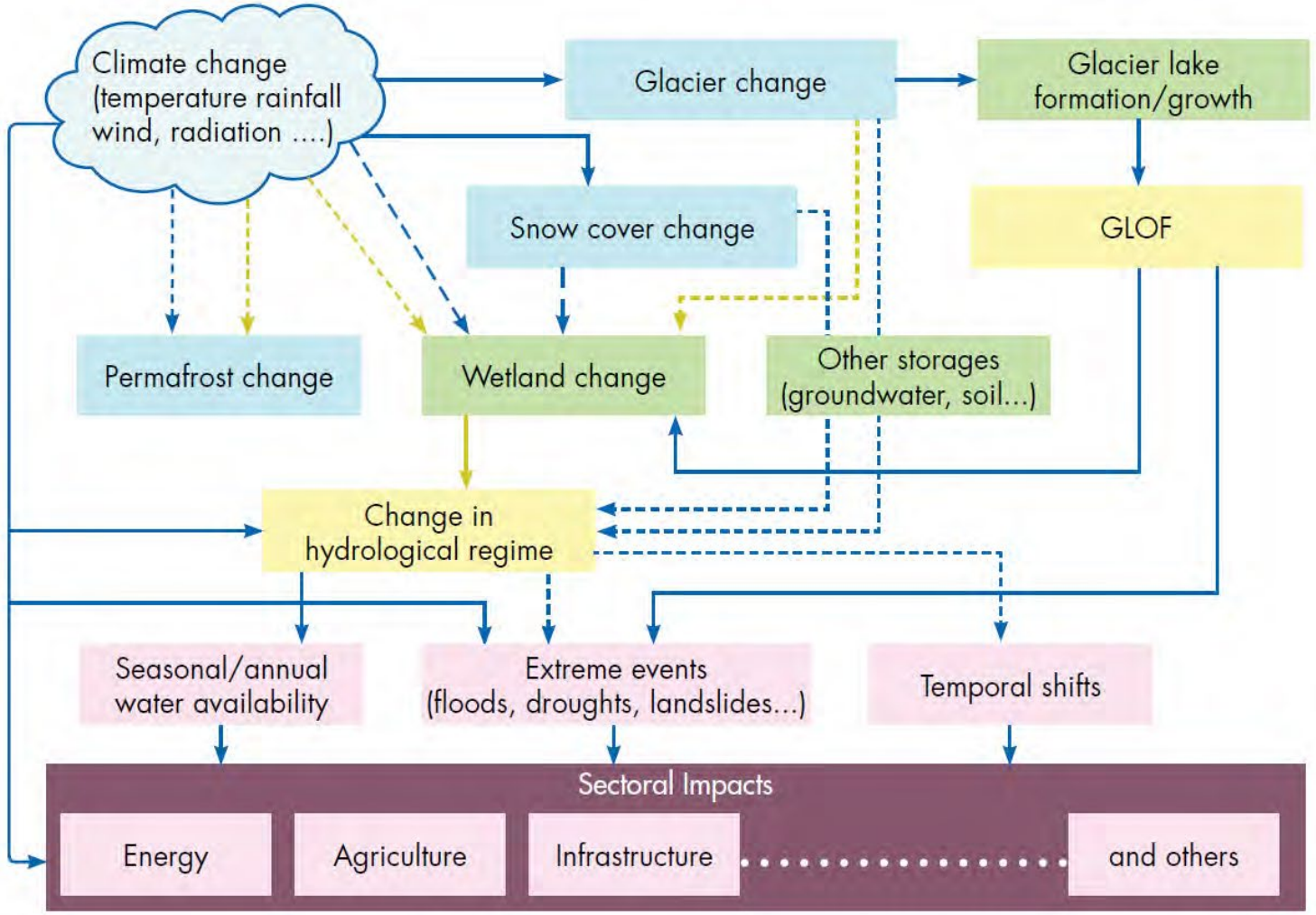
Climate change impact on different sectors

- Climate change and extreme events
- Cryosphere and water resources availability
- Impact on physical system to human system to ecosystems
- Impact on different sectors (water, agriculture, food security, livelihood, energy, infrastructure, ecosystem)



Lutz et al. 2016


What happens here
affects one-fourth
of humanity
Pulse of the Planet

In a 1.5˚C world, glaciers in the HKH will lose 1/3 of their volume by 2100

And 2/3 of their volume under current emission trends

Snow covered areas and snow volumes will decrease and snowline elevations will rise;

Snow melt induced run-off peak will be stronger and occur earlier in the year

Communities dependent on glaciers and snow melt are feeling the impacts

Nang, Ladakh, India
Photo: Karen Conniff

Climate change impacts on water resources

Loss of storage in the form of ice

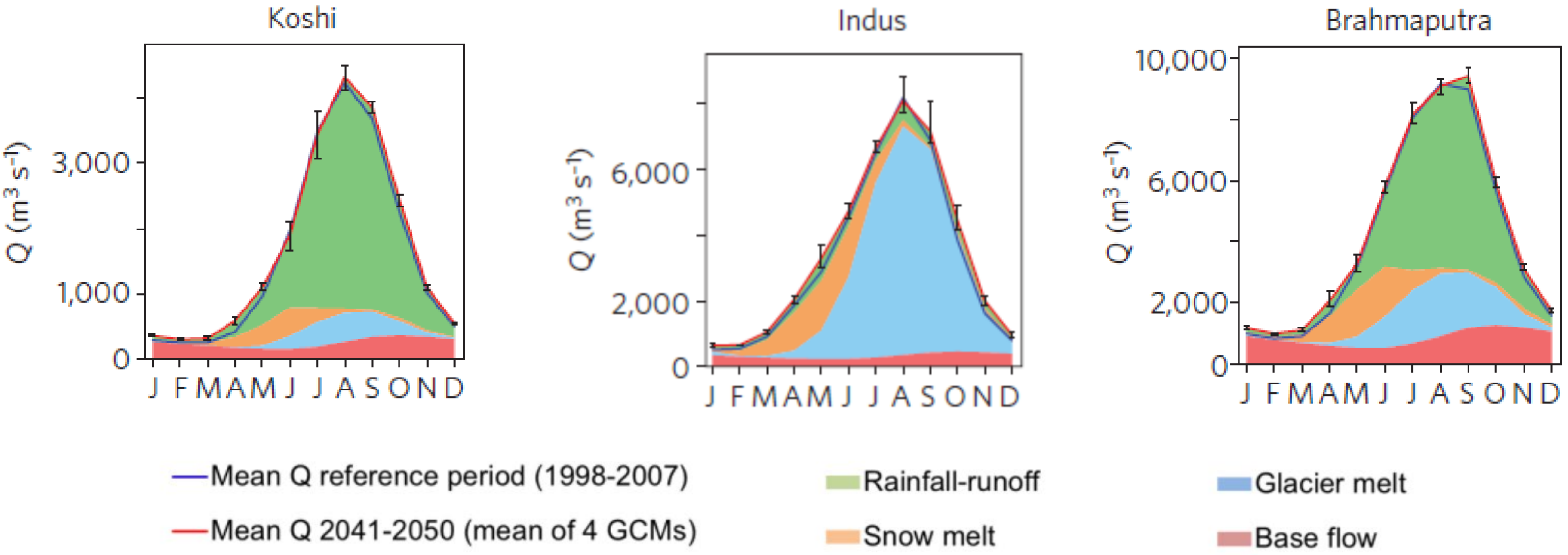
Greater impact for those living closer to glaciers

Changing precipitation and flow patterns – more floods and droughts; high uncertainty

CC also likely to affect springs in the mid-hills of the HKH, but limited evidence.

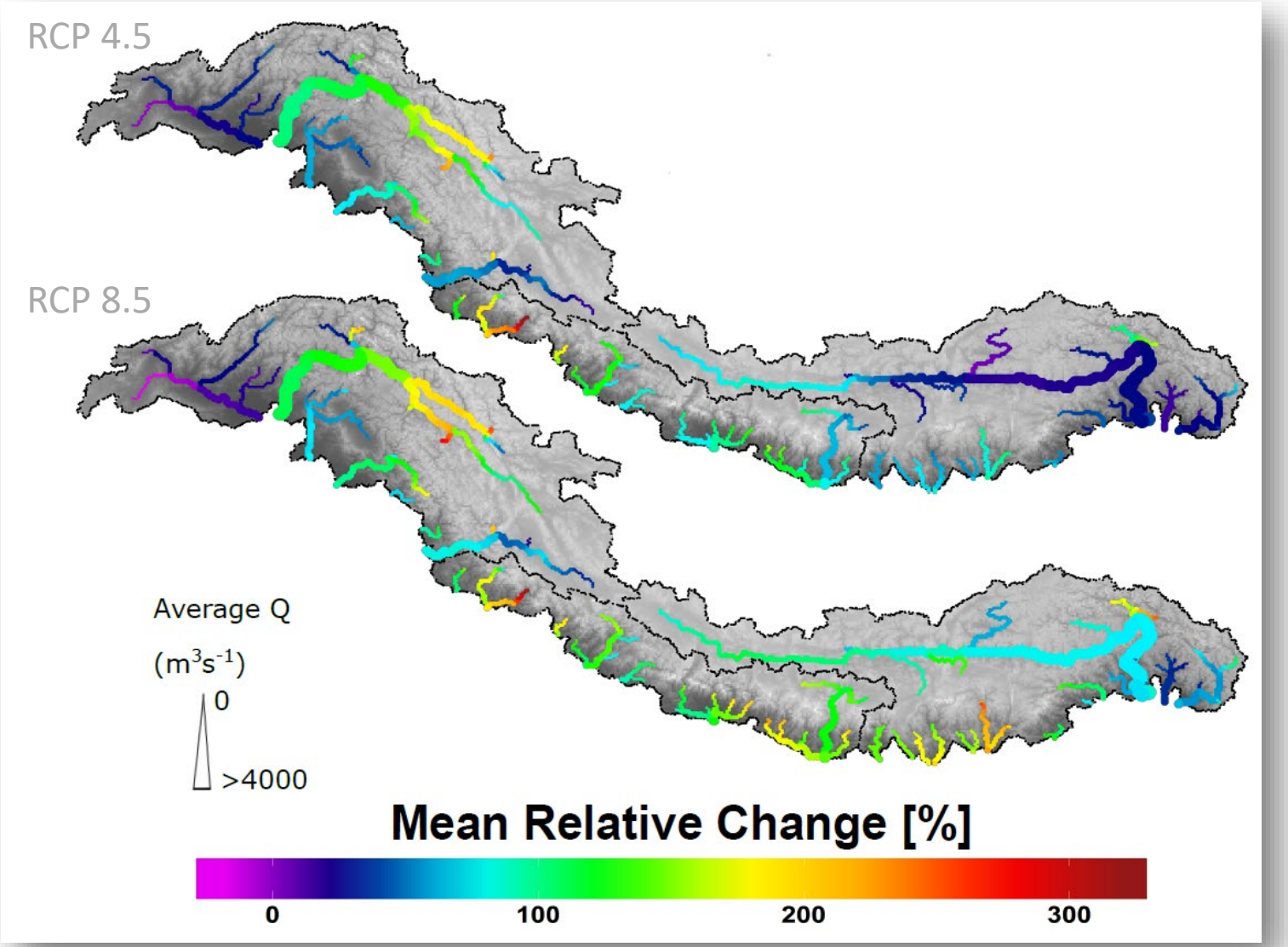
Indus: increased glacier melt, then declines after mid-century
Ganges/Brahmaputra: increased runoff mainly due to precipitation

Future of our water



Source: Lutz, A; Immerzeel, WW; Bajracharya, SR; Litt, M; Shrestha, A (2016) Impact of climate change on the cryosphere, hydrological regimes and glacial lakes of the Hindu Kush Himalayas: A review of current knowledge. ICIMOD Research Report 2016/3. Kathmandu, ICIMOD

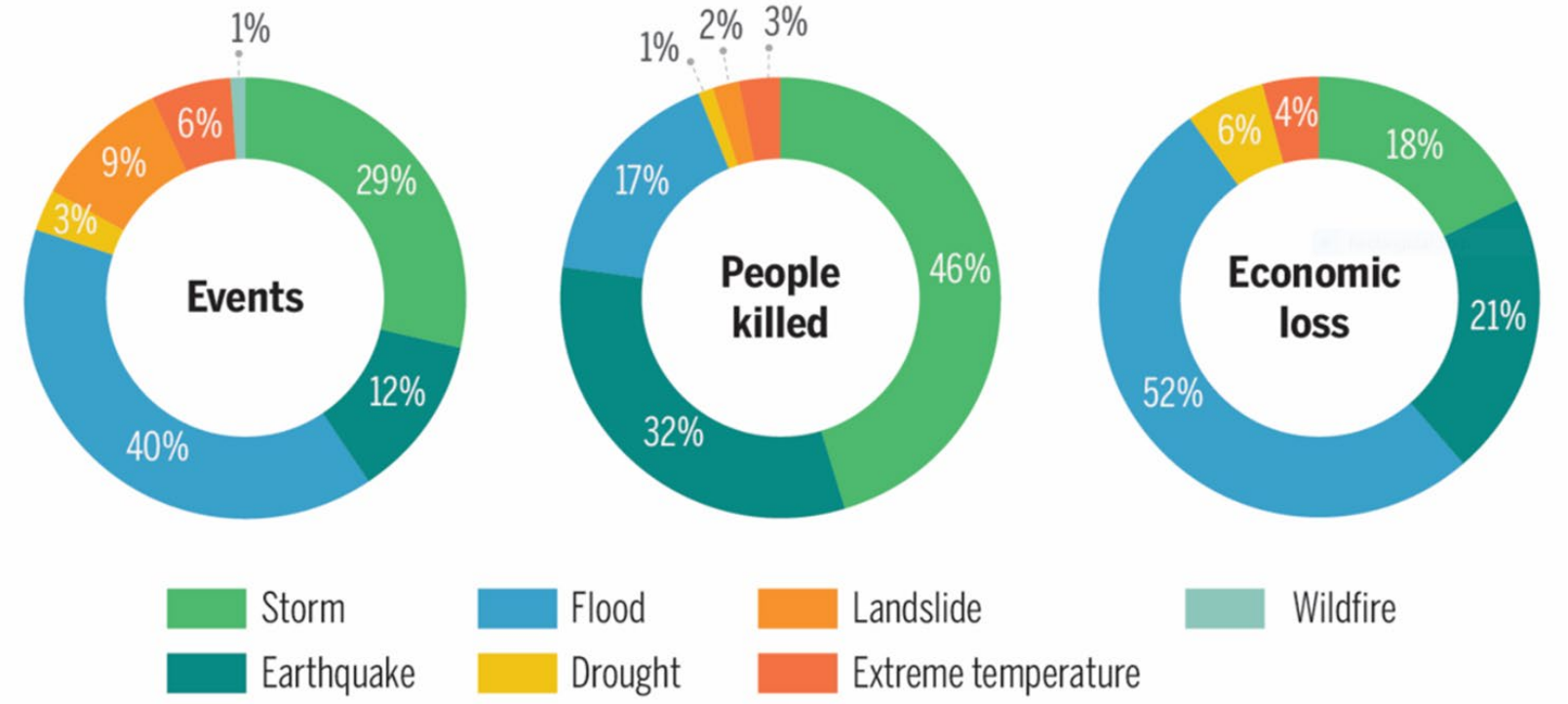
Extremes in the future



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

Source: Wijngaard et al. (2017)

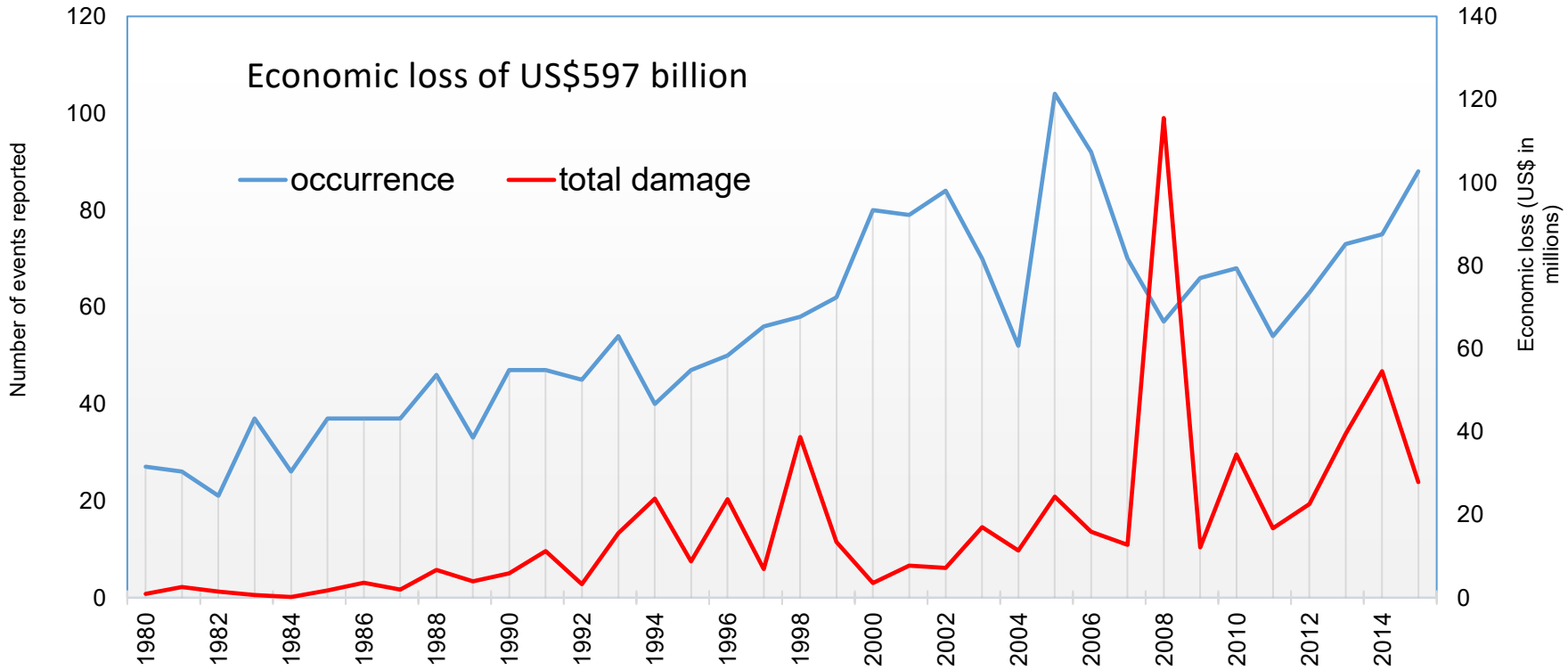
Hindu Kush Himalayan region is prone to disasters



More than 1 billion people are at risk of exposure to increasing frequency and intensity of natural hazards

Increasing trend of disasters in the HKH threatening sustainable development

Why: climate change, population increase, haphazard urbanization, inadequate implementation of policies, plans, preparedness, investments, institutional capacities and governance arrangements.

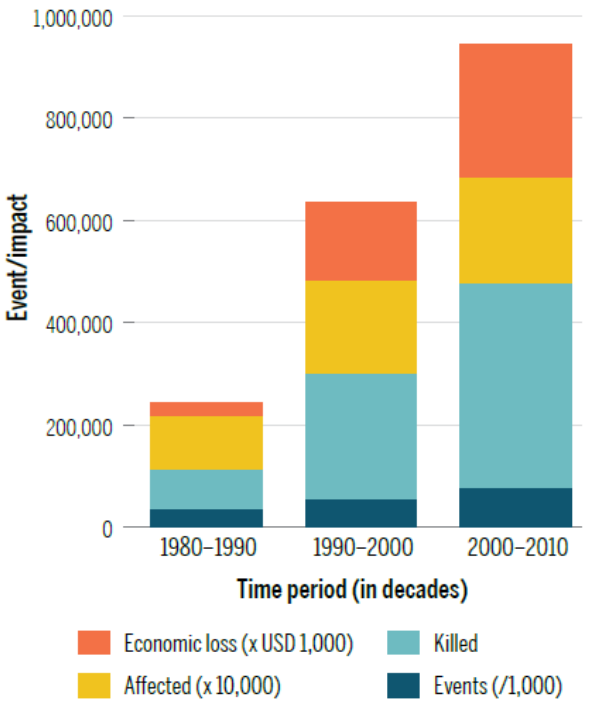


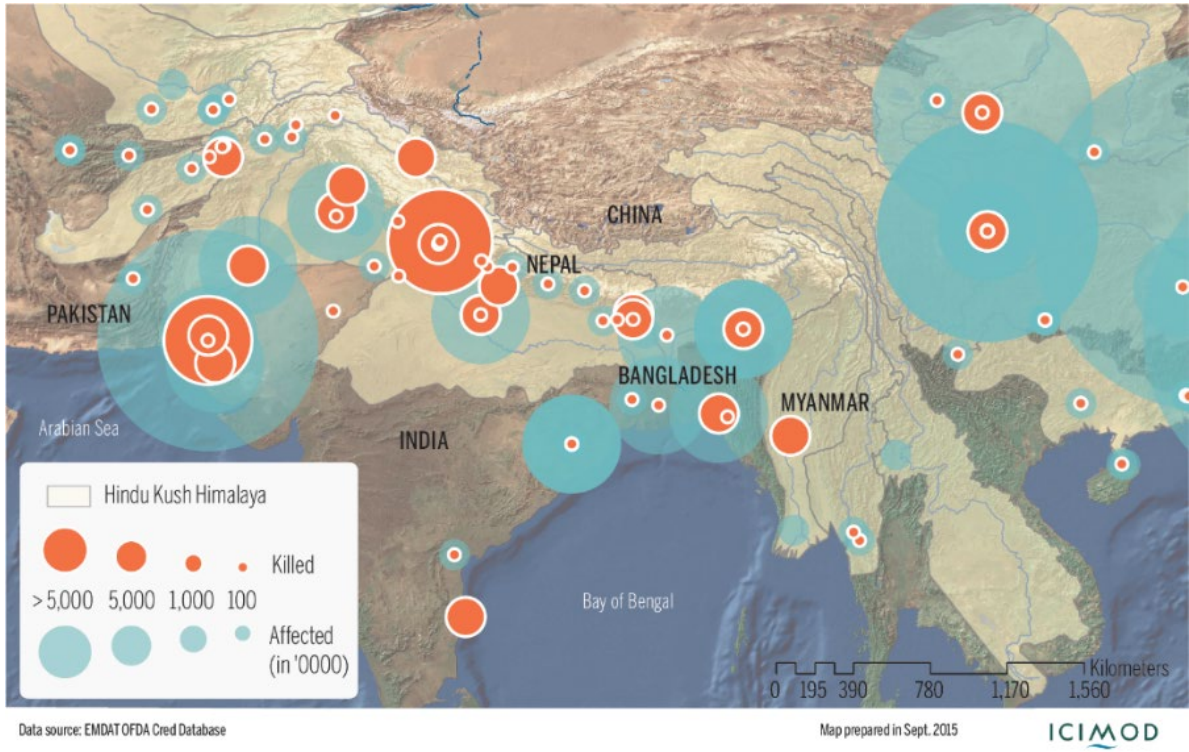
Source:
EM-Dat Database

The economic and human impacts of natural disasters are increasing

1/3 of disasters are floods

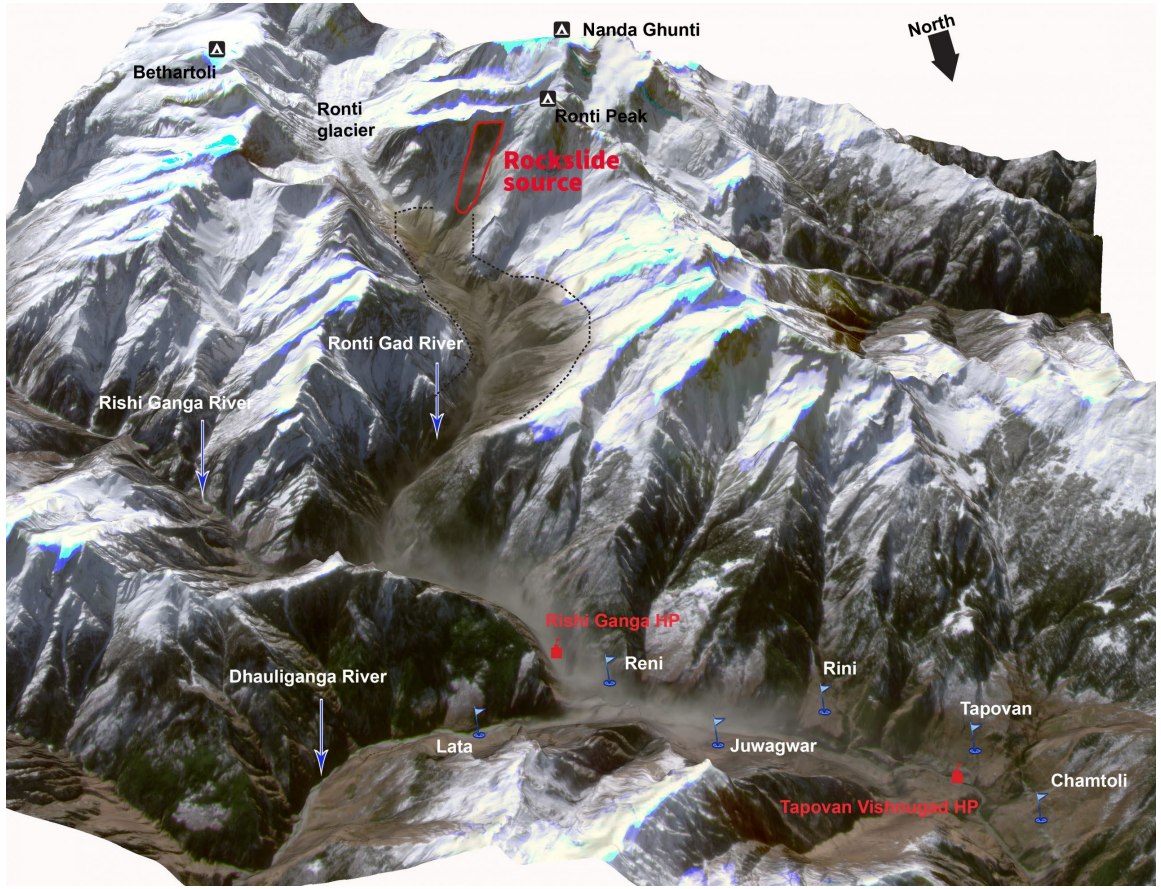
Transboundary floods - shared vulnerability across national borders





Source: Vaidya et al., 2019 (HIMAP report)

Cascading events resulting from a multi hazard environment have u/s d/s linkages often with transboundary impacts



Chamoli disaster triggered by Avalanche/Rockfall

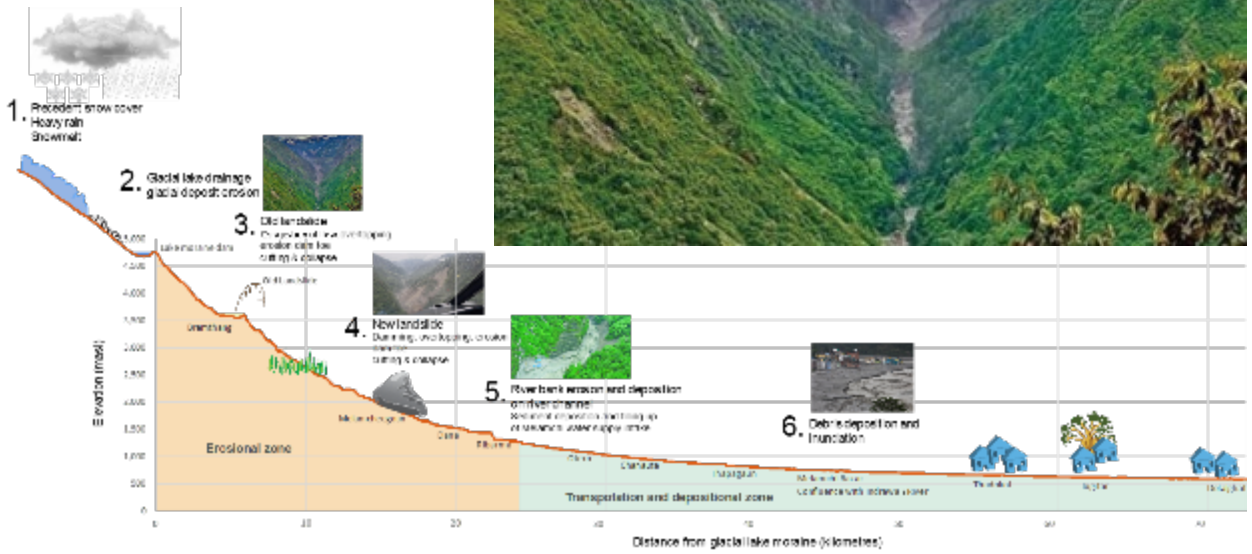
March 2021

Subsequent floods killed >150 people damaged the hydropower plants downstream

Melamchi disaster

Melamchi - 320 km^2 basin – 5200 m

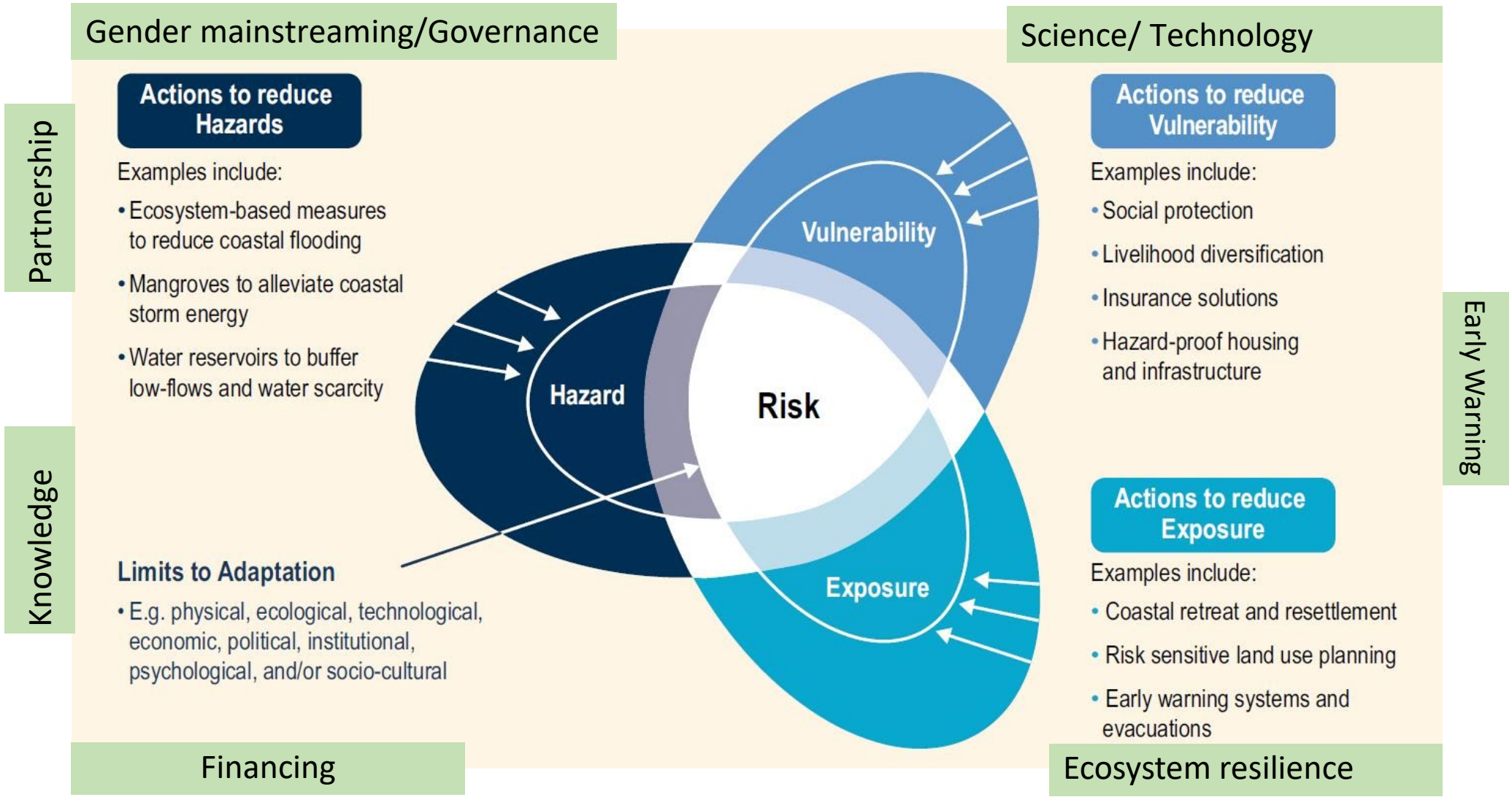
Cascading hazards with GLOF, landslides, LDOF and impacts



Event: June 2021 GLOF- Pemdang Khola a tributary of Melamchi

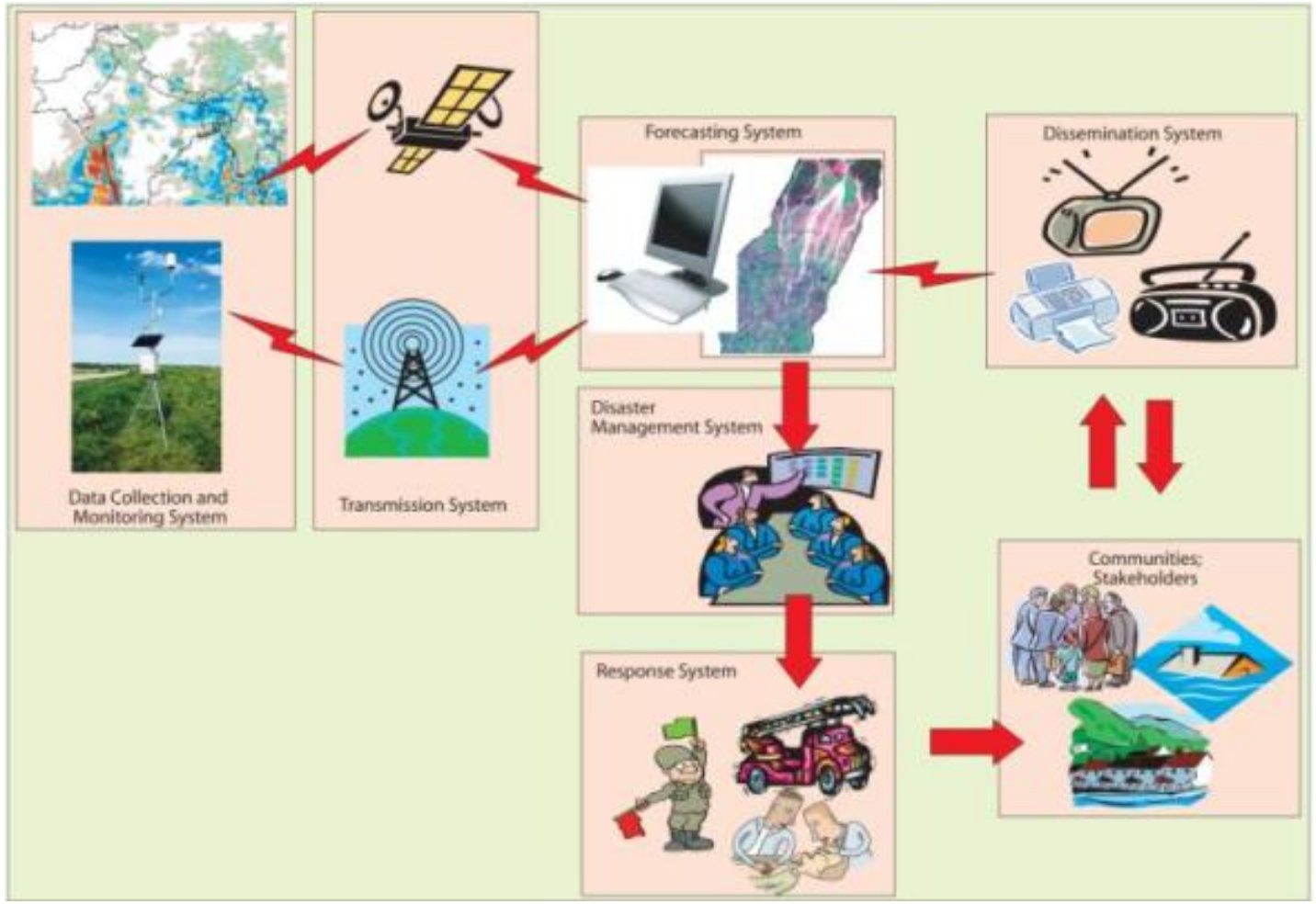
Significant damage to d/s settlements, 6 bridges washed away, 15 meters of aggradation

Reducing risk, vulnerability and exposure



Source: SROCC report (2019)

Innovation in technologies for end to end flood early warning system



- Advancement in technology : real-time data through sensors
- Data transmission through CDMA, GPRS/GSM, and satellite iridium
- ICT for risk communication
- Space based technology using earth observations are increasing the lead time, filling data gaps and risk mapping

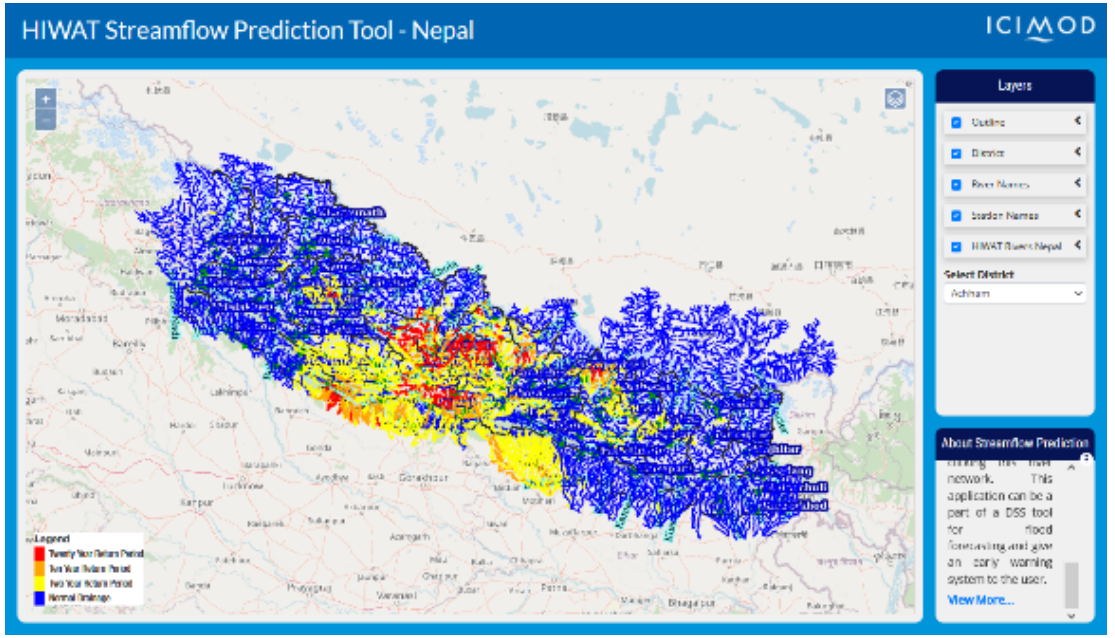
Mapping and modelling for disaster risk management

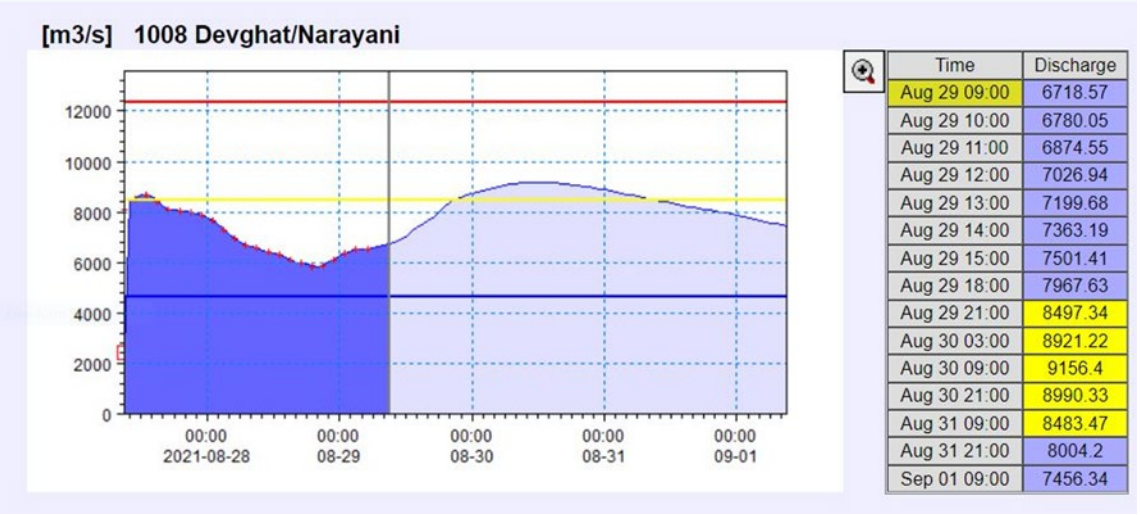
Flood monitoring and modelling

- Flood outlook
- HIWAT modelling

Forest fire monitoring system

- SMS alert system in Nepal and Bhutan

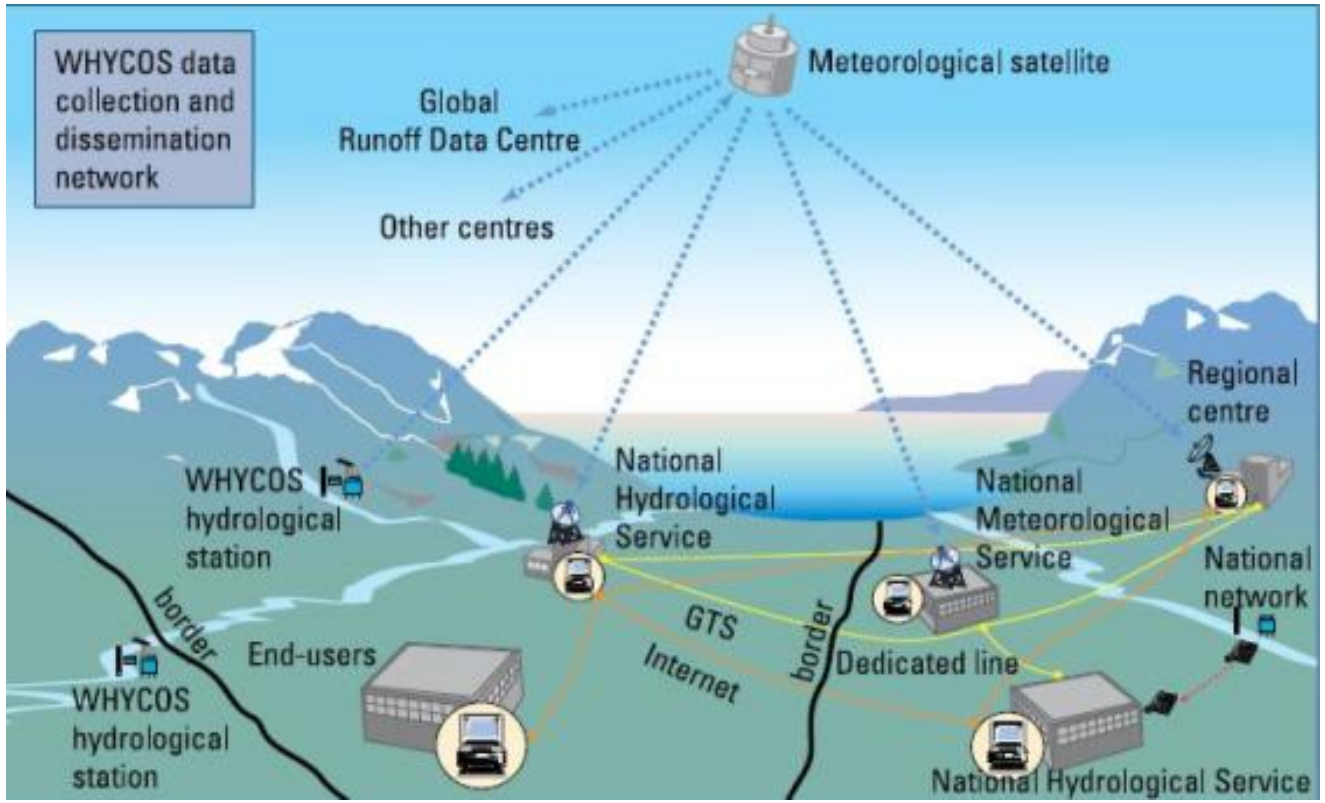




Time	Discharge
Aug 29 09:00	6718.57
Aug 29 10:00	6780.05
Aug 29 11:00	6874.55
Aug 29 12:00	7026.94
Aug 29 13:00	7199.68
Aug 29 14:00	7363.19
Aug 29 15:00	7501.41
Aug 29 18:00	7967.63
Aug 29 21:00	8497.34
Aug 30 03:00	8921.22
Aug 30 09:00	9156.4
Aug 30 21:00	8990.33
Aug 31 09:00	8483.47
Aug 31 21:00	8004.2
Sep 01 09:00	7456.34

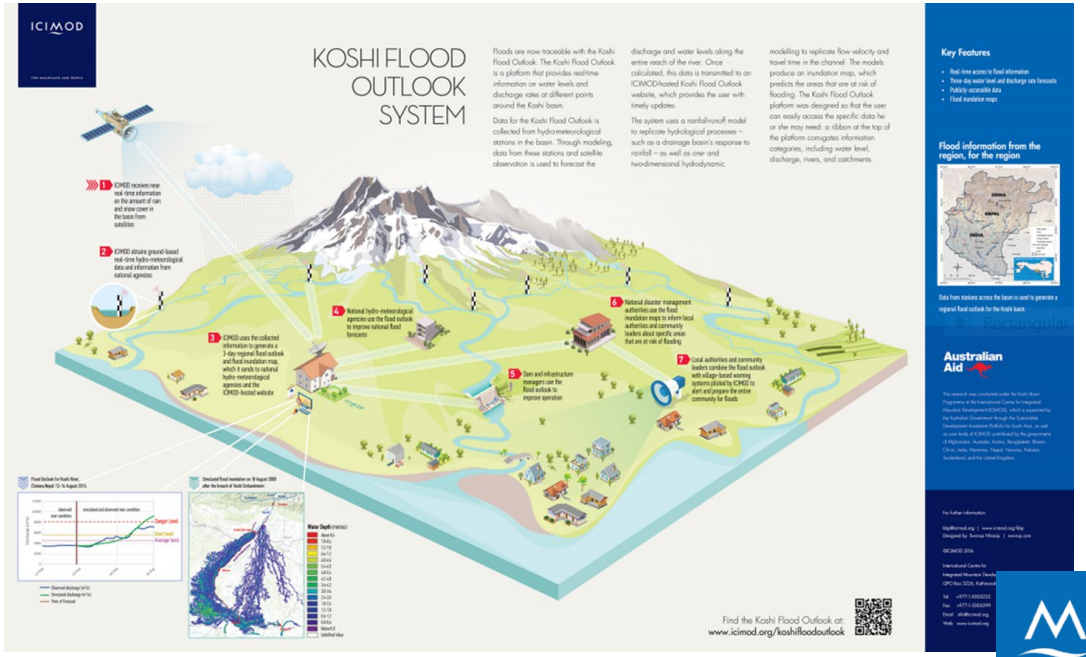
HKH-HYCOS: Setting up monitoring stations and establishment of real-time flood information systems

'Making Information Travel Faster Than Flood Waters'



HYCOS is a vehicle for technology transfer, training, and capacity building

Establishment of a Regional Flood Information System in the HKH-Region - Timely exchange of flood data and information through an accessible and user friendly platform



Opportunities for managing cascading hazards

Integrate risk information into Early Warning Systems with impact based forecast is critical

Improve institutional mechanisms to enhance coordination and communication between institutions and concerned stakeholders

Capacity and co-learning – enhance technical capacity, develop common methodologies, empowering communities; communication and coordination

Intense rainfalls are predicted to happen more often due to changes in climate - **planning is needed to accommodate uncertainties keeping climate projections in mind** to put in place resilient infrastructure

Regional collaboration, partnerships and sharing of information for enhanced climate resilience.

What can we do about climate change impacts?

-More long-term hydrometeorologial monitoring in the -upper elevations of HKH
-Implementation of global climate agreements also important to people of HKH
-Promotion of effective regional and local conservation and disaster management – pro-active HKH-wide cooperation, open data sharing, conflict management.


Thank you
Let’s protect
the pulse.