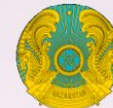




Aga Khan Agency for Habitat



Cryosphere and related hazards in High Mountain Asia in a changing climate

1–4 November 2022 | Almaty, Kazakhstan

Presenter(s): SHER MUHAMMAD

Date: 3 November 2022

Meltwater variability and its downstream impacts in the Indus Basin

Introduction

Published

40 papers

Reviewer

35 journals

Editor

PLOS One

PLOS Water

PLOS Climate

Journal of Mountain Science

Journal of Himalayan Earth Sciences

Working at



Postdoc



PhD



Previously worked



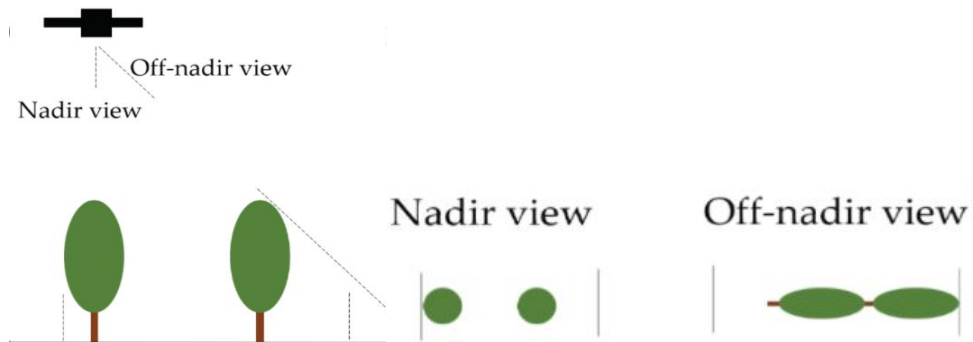
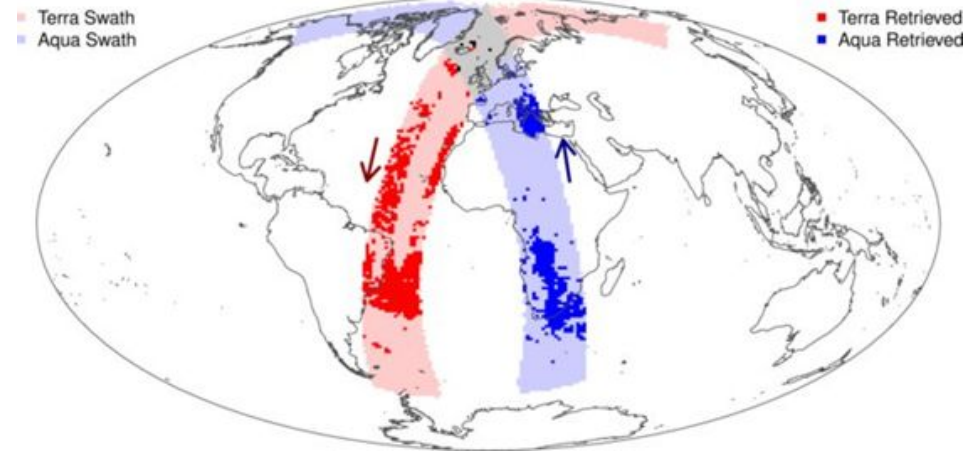
- Background
- Global Snow datasets
- Snow data quality improvement
- Case studies of improved snow data
- ❖ Anomalous snow 2020
- ❖ Below normal snow and heatwaves in 2022
- ❖ Downstream impacts
- ❖ Conclusion and recommendations
- ❖ Questions and Answers

Popular snow products

Product Name	Terra Prod ID/ DAAC Link	Aqua Prod ID/ DAAC Link
MODIS Snow Cover 5-Min L2 Swath 500m	MOD10_L2	MYD10_L2
MODIS Snow Cover Daily L3 Global 500m Grid	MOD10A1	MYD10A1
MODIS Snow Cover Daily L3 Global 0.05Deg CMG	MOD10C1	MYD10C1
MODIS Snow Cover 8-Day L3 Global 500m Grid	MOD10A2	MYD10A2
MODIS Snow Cover 8-Day L3 Global 0.05Deg CMG	MOD10C2	MYD10C2
MODIS Snow Cover Monthly L3 Global 0.05Deg CMG	MOD10CM	MYD10CM

Product Name	Product ID
NPP/VIIRS Snow Cover 6-Min L2 Swath 375m	VNP10
NPP/VIIRS Snow Cover Daily L3 Global 375m SIN Grid	VNP10A1
NPP/VIIRS Snow Cover Cloud-Gap-Filled Daily L3 Global 375m SIN Grid	VNP10A1F

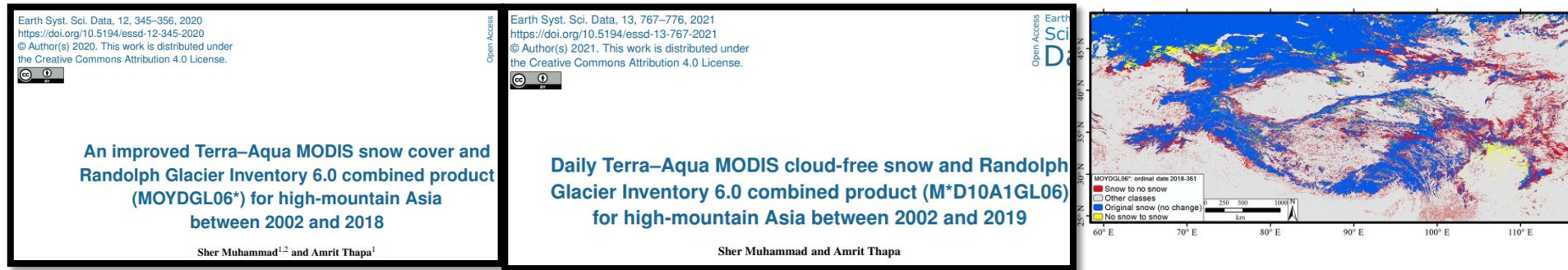
- Existing **MODIS snow products** contain **significant clouds**
- On an average **46%** of the images in High Mountain Asia are cloud cover
- **Off nadir view** also causes overestimation in snow data



Source, amount, and details of the improved product

Both the products are derived from ~500K individual satellite images for the period 2003 – 2019

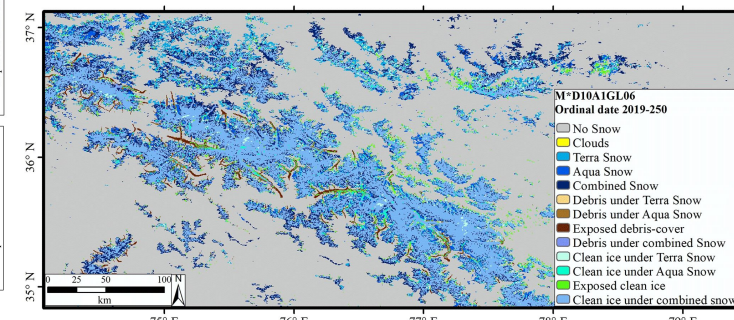
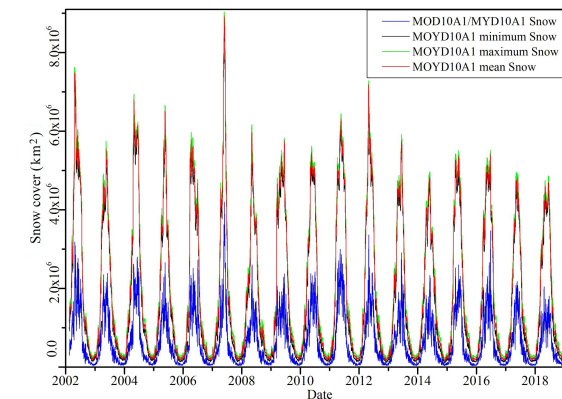
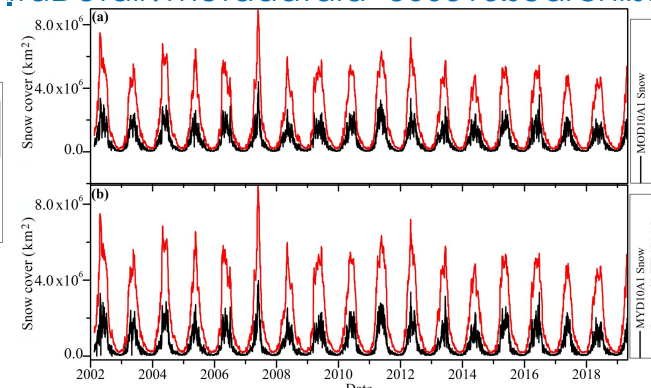
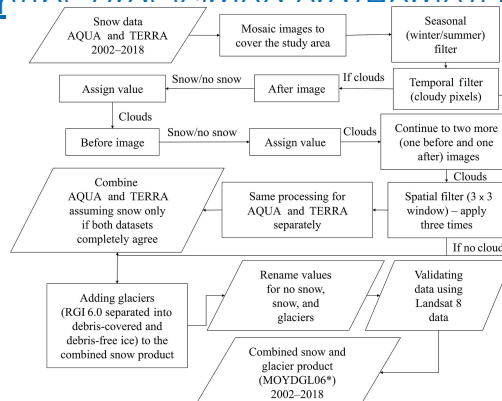
Code are available for extending the observation period

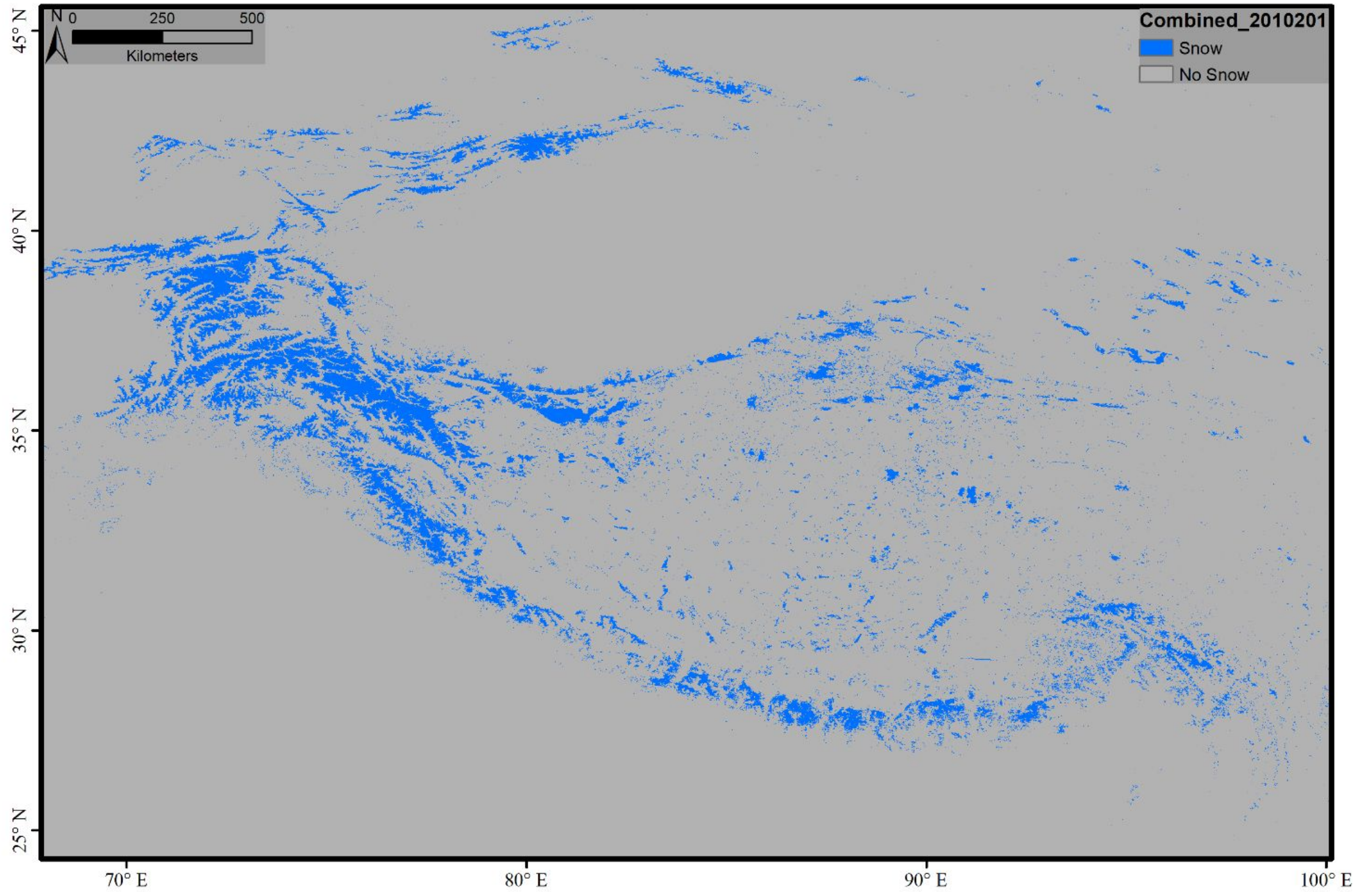


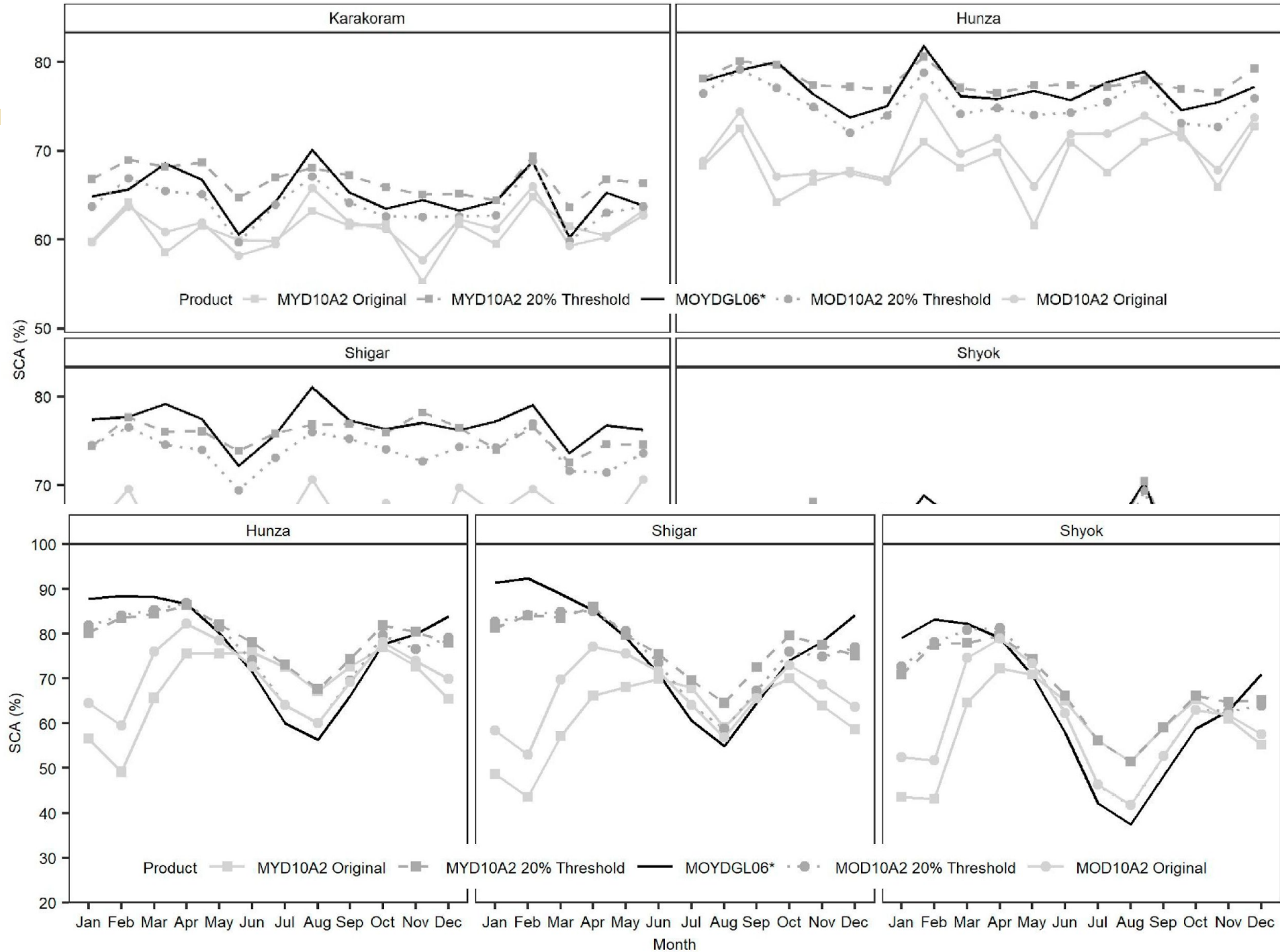
1. Earth System Science Data Journal. <http://dx.doi.org/10.5194/essd-13-767-2021>
2. Earth System Science Data Journal <http://dx.doi.org/10.5194/essd-2019-78>

Data:

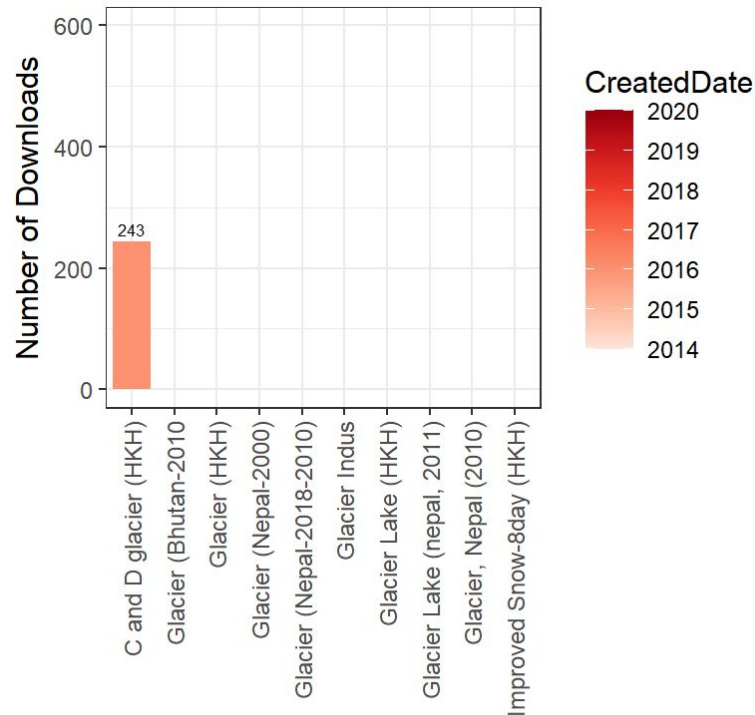
1. <https://rds.icimod.org/Home/DataDetail?metadataId=1972585&searchlist=True>
2. <https://rds.icimod.org/Home/DataDetail?metadataId=36031&searchlist=True>







Data usage



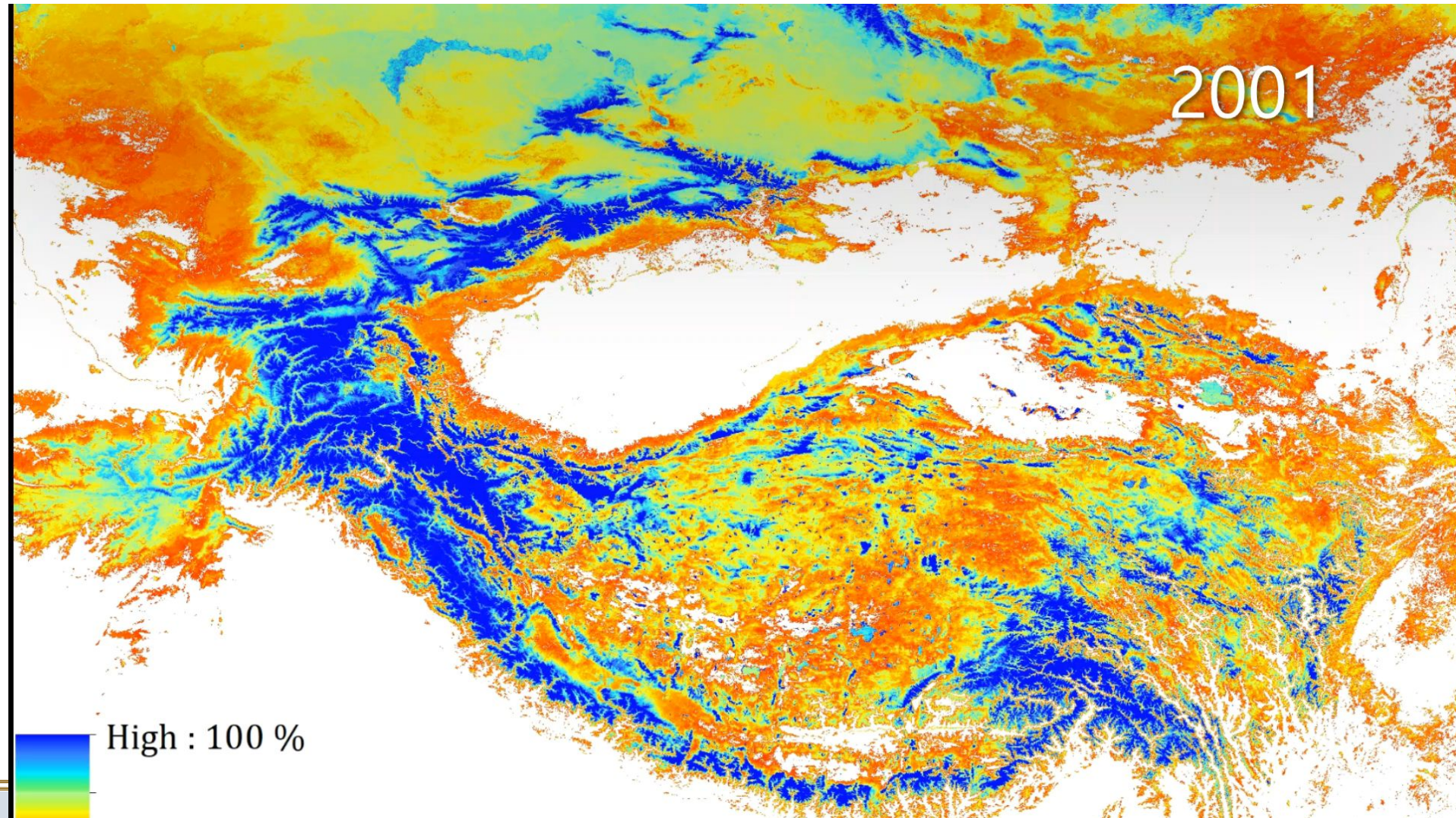
Including our snow products,
a total of over 100 cryosphere
datasets uploaded to ICIMOD
RDS

Over 5000 cryosphere data
downloaded

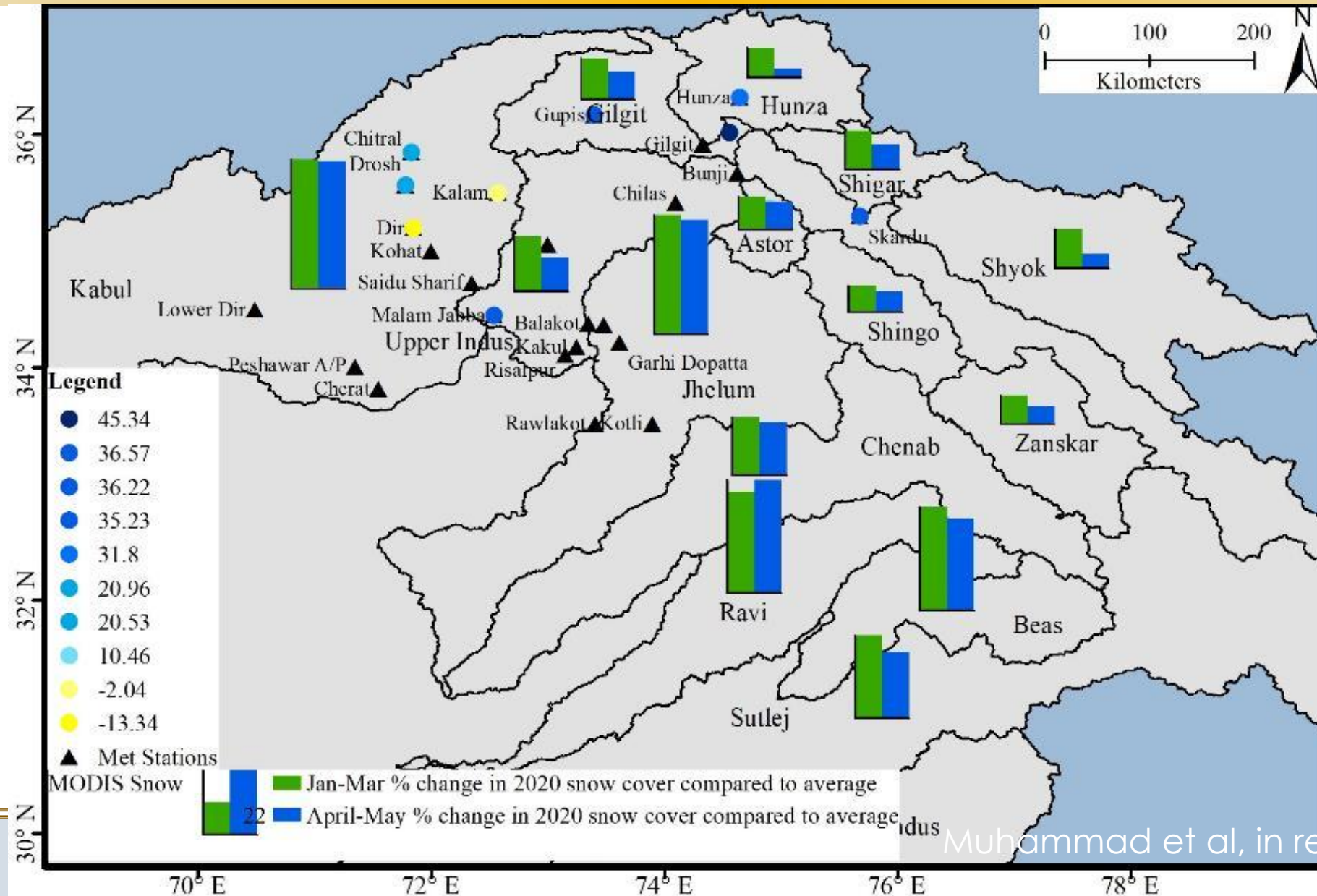
Glacier and glacier lake
inventory, field-based AWS
data used in several
glacio-hydrological studies

Regularly sharing data with
partners (Eg: DHM, Nepal)

Improved daily MODIS snow data

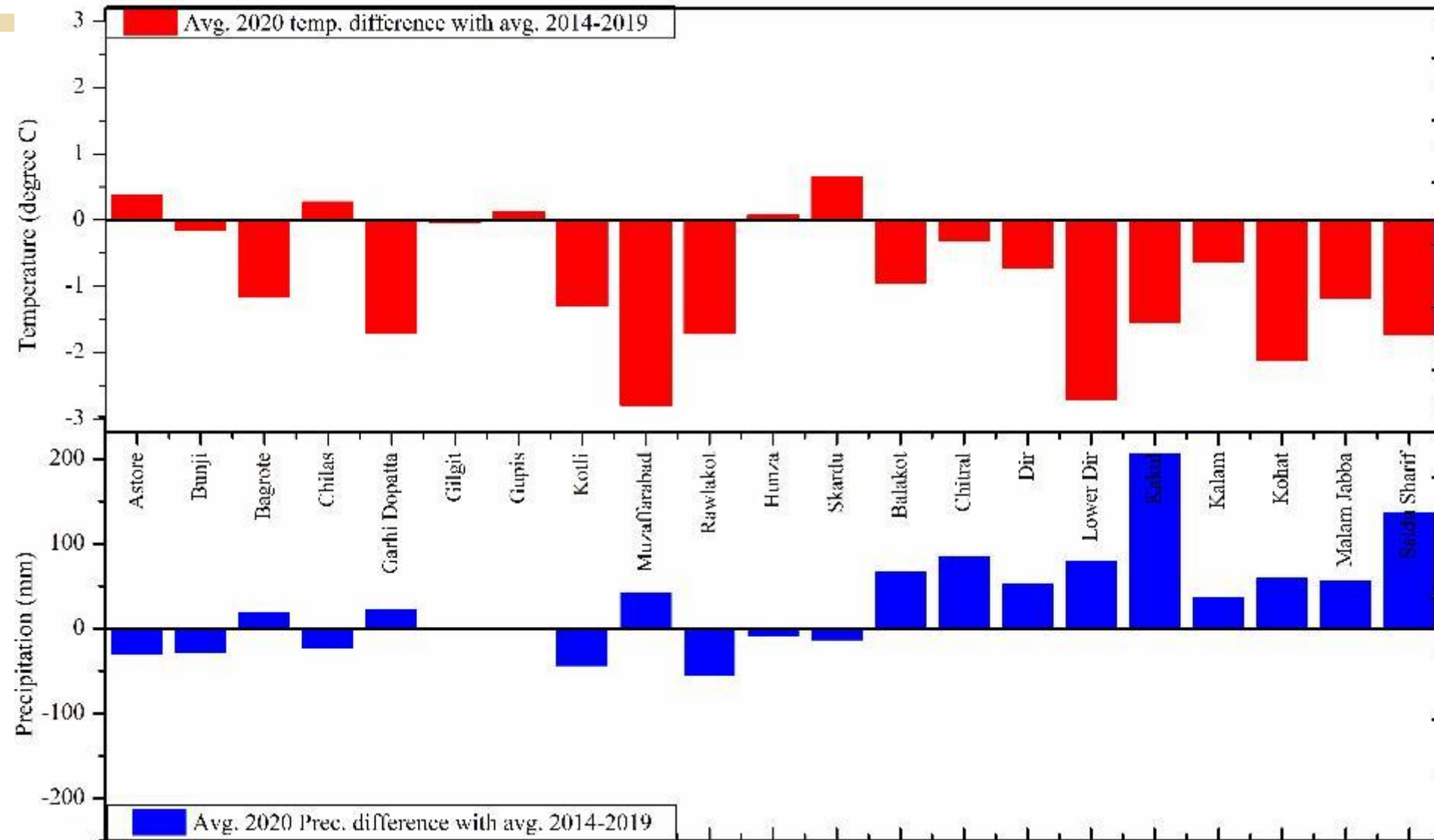


Winter snow anomaly and agriculture production



Muhammad et al, in review

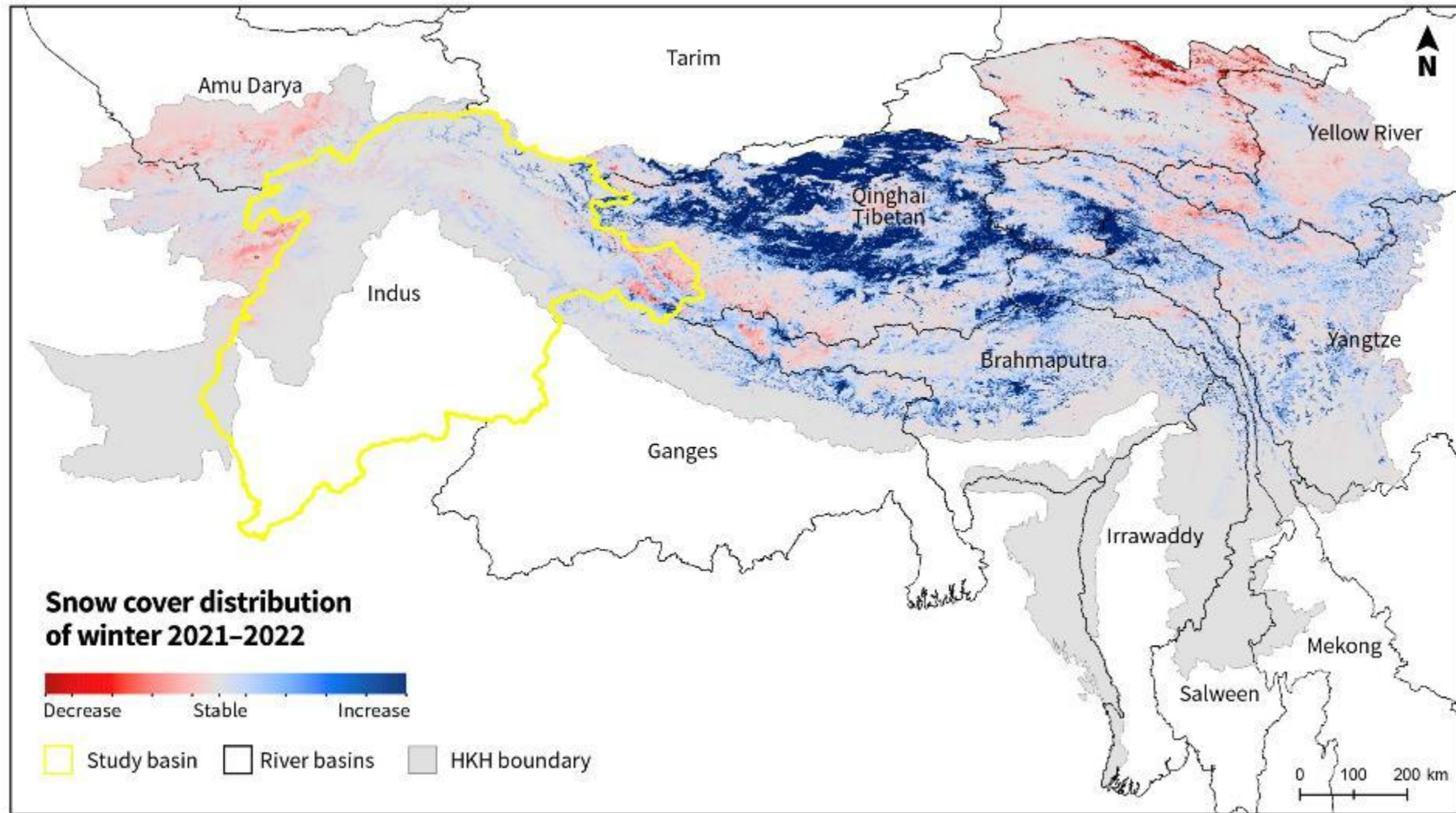
Changes in temp and Precipitation



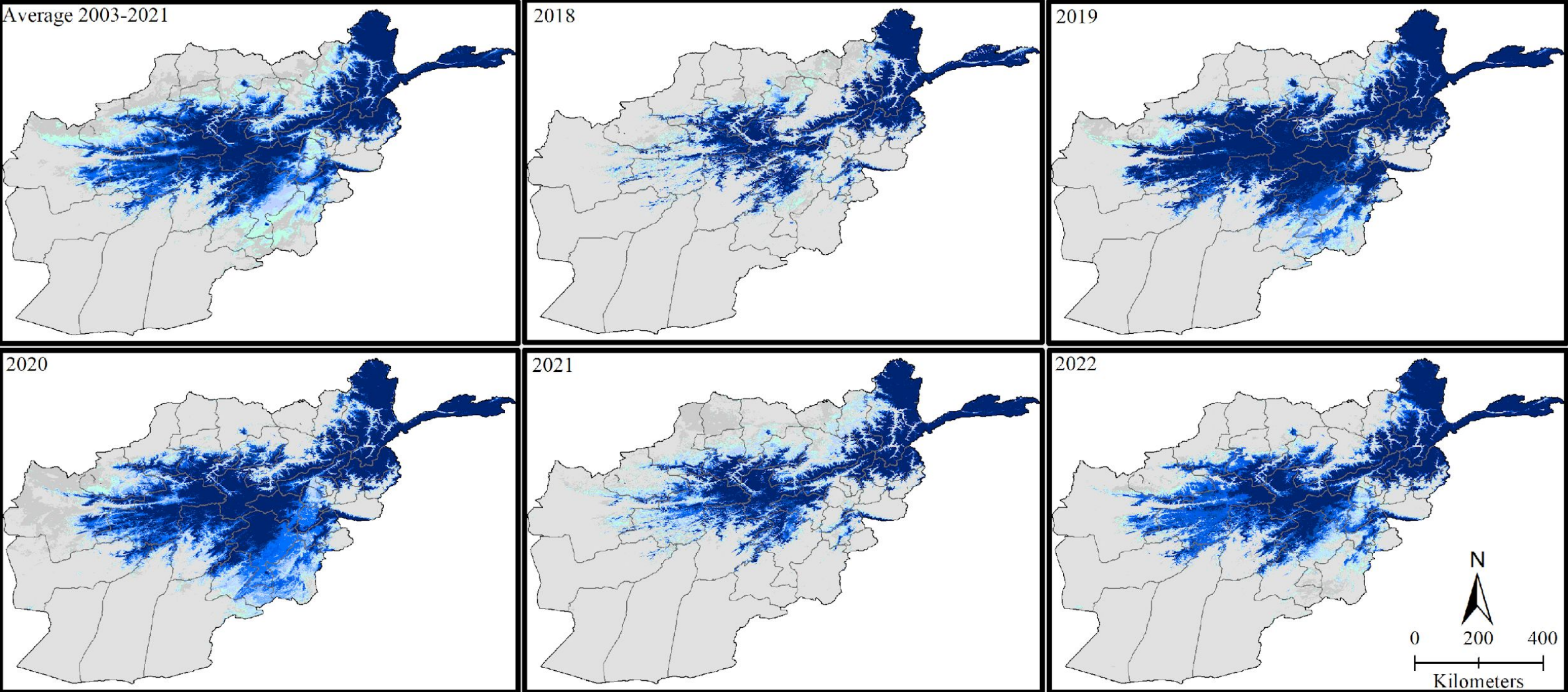
Reported ground information		Village (district)				
		Gulmit (Nagar)	Baramas (Juglote)	Tarashing (Astore)	Chakarkote (Gilgit)	Roundu (Skardu)
Altitude (meter above sea level)		2,400	1,500	2,200	2,300	2,200
Cropping zone*		Single	Double	Marginal double	Marginal double	Marginal double
Main crop(s) being cultivated during April and May		Potato & vegetables	Wheat & vegetables	Potato	Maize	Wheat, maize & millets
Contribution of local food production in annual food consumption (%)		41-60	21-40	41-60	≈20	41-60
Local Perception of average snowfall in the last winter (Nov 2019 – April 2020)		↑	↑	↑	↑	↑
Ending time of winter in 2020		▼	▼	■	■	●
Local people's perception of current situation (16 April - 31 May in 2020) compared with the average situation in same period during last 5 years	Average temperature	↓	↓	↓	●	↓
	Snow and glacier melting rate	↓	↓	↓	↓	↓
	Melting of snow from agricultural fields	▼	▼	■	●	▼
	Melting of snow from pastures	▼	▼	■	■	▼
	Water availability in streams largely fed by melt water	↓	↓	■	↓	↓
	Water availability in traditional irrigation systems (<i>kuhls</i>) fed by melt water	↓	↓	↓	■	●
	Overall water availability for crops	↓	↓	■	↓	↓
	Overall water availability for livestock	↓	↓	■	↓	↓

Increase = ↑; Decrease = ↓; No change = ■; Do not know = ●; Delayed = ▼

2022 snow change with normal in HKH

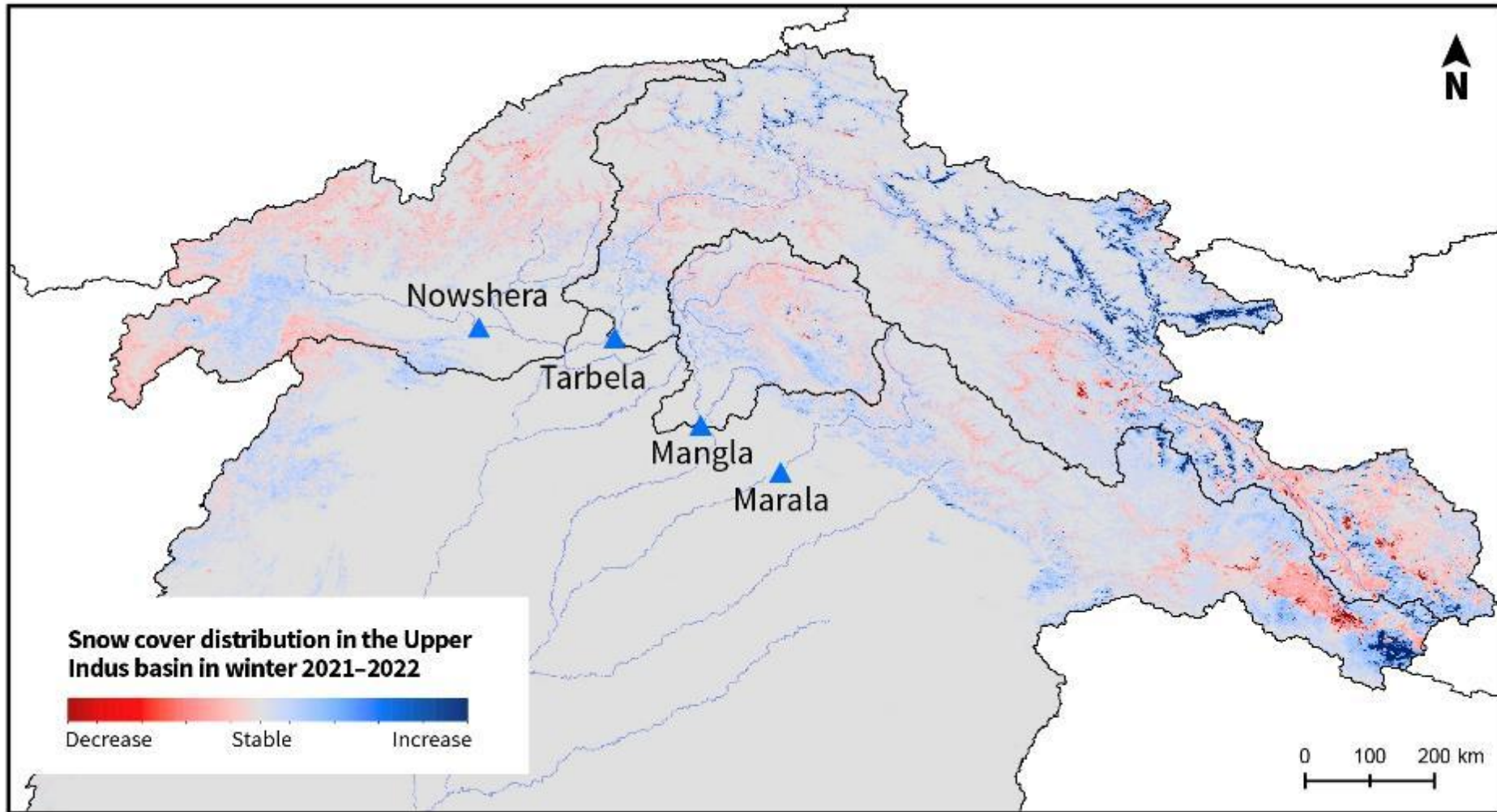


Snow distribution pattern (January -

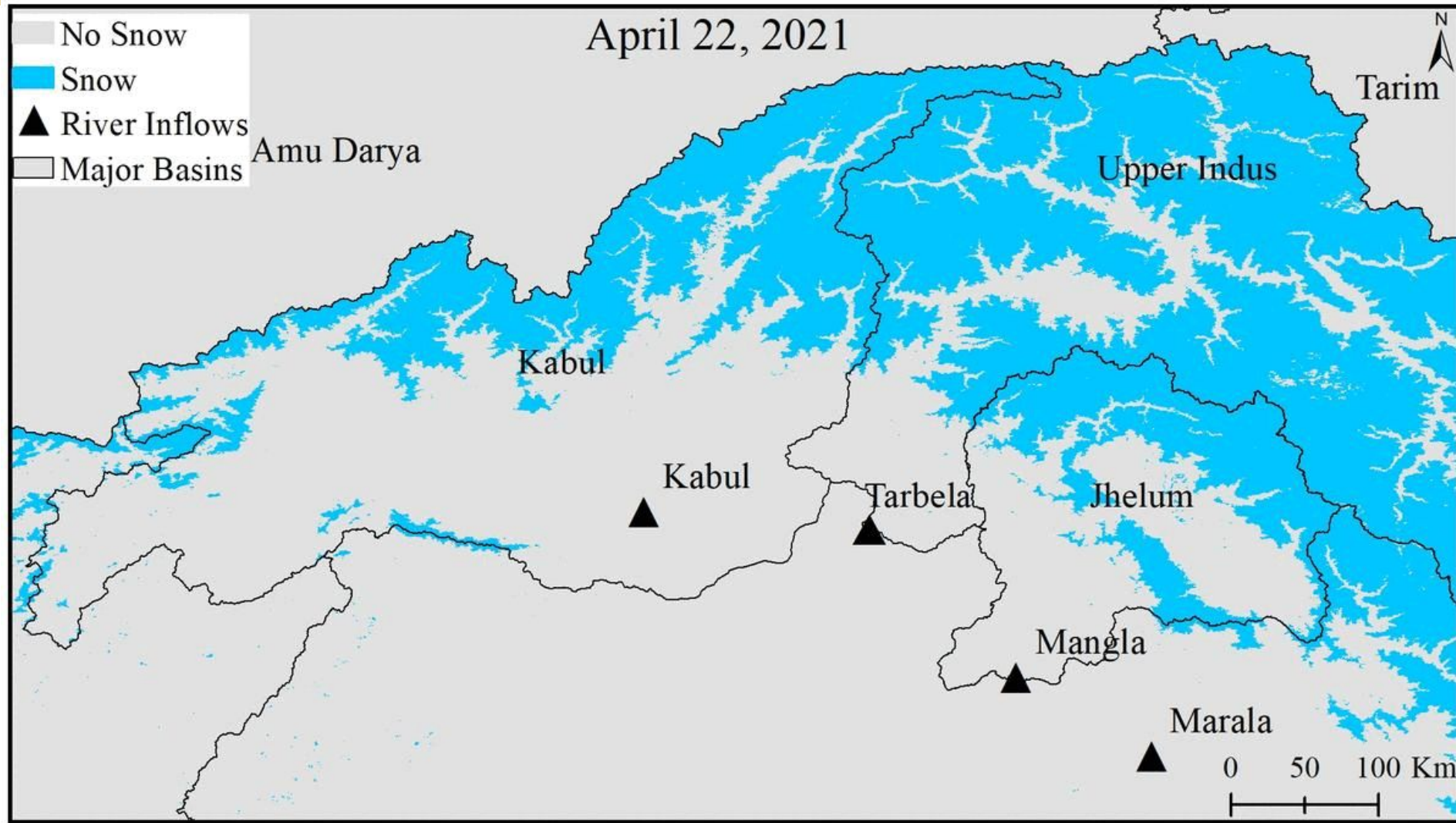


Snow % 0 - 10 11 - 20 21 - 30 31 - 40 41 - 50 51 - 60 61 - 70 71 - 80 81 - 90 91 - 100

2022 snow change with normal in Indus



Comparison of 2021 and 2022 snow



Impact on river flow in the Indus

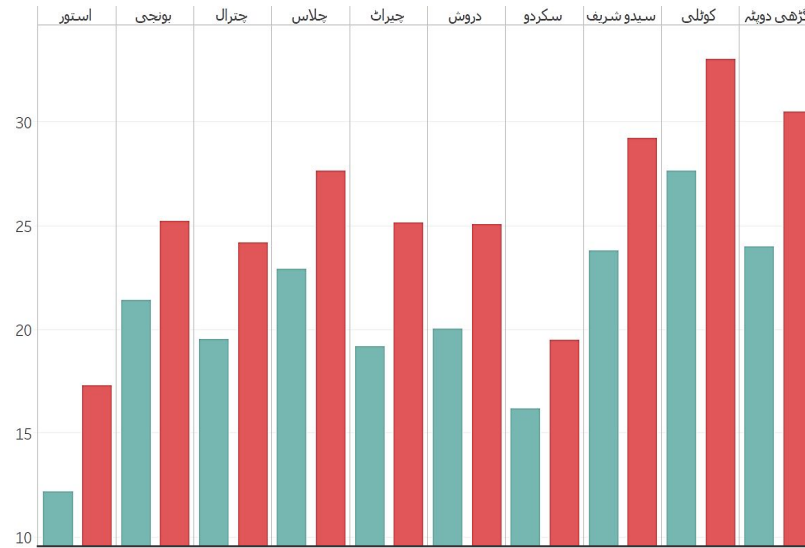


Figure: Comparison of temperature conditions from 01 March – 26 April during 2022 and long-term average at the high elevation snowy mountain regions in the upper Indus basin.

Long-term average mean temperature

2022 mean temperature



Figure: Inflow discharge pattern of the Indus Basin River System including Indus at Tarbela, Kabul at Nowshera, Jhelum at Mangla and Chenab at Marala during the early melting season.

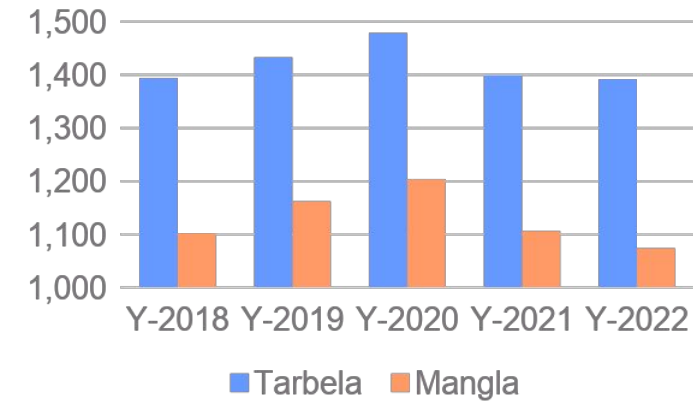


صفحہ اول پاکستان آس پاس ورلڈ کھیل فن فنکار سائنس ویڈیو

تربیلا اور منگلا ڈیموں میں پانی کی کمی: کیا پاکستان کو اب ہر سال ایسی صورتحال کا سامنا ہو گا؟

محمد زبیر خان
صحافی

29 مئی 2022



Reservoir levels on 28th April from 2018 - 2022

Seasonal water outlook and implications for farmers in the Indus basin

FAISAL MUEEN QAMAR AND SHER MUHAMMAD

8 MINS READ





Sher Muhammad @Dr_MSher · May 4

#ALERT Our assessment of the ice-dammed lake due to #Shisper glacier #surge indicate that the lake may outburst anytime as the extent of the lake is at #peak since the last #outburst.



ICIMOD @icimod · May 4

This GIF shows recent expansion of the ice-dammed lake created by the surge in #ShisperGlacier. Researchers estimate this expansion is close to the extent before the past outburst.

This blog highlights the impacts of 2021 dam breach
icimod.org/article/gender...
#CryosphereWednesday



Sher Muhammad @Dr_MSher · May 7

#Update Shisper lake is reportedly #outburst



PAMIR TIMES @pamirtimes · May 7

Glacial lake outburst flood in #Hunza damages bridge, #KKH and threatens Hassanabad settlement
#GlobalWarming #ClimateChange #GLOF



BBC NEWS | اردو

صفحہ اول پاکستان آس پاس ورلڈ کھیل فن فنکار سائنس ویڈیو

گلگت بلتستان: شیشپر گلیشیئر پر بننے والی جھیل پھٹنے سے سیلابی صورتحال، حسن آباد پل ٹوٹ گیا، شاہراہ قراقرم ٹریفک کے لیے بند

محمد زبیر خان
صحافی

6 مئی 2022

اپ ڈیٹ کی گئی 7 مئی 2022

Title: As Himalayan Glaciers Melt, a Water Crisis Looms in South Asia

<https://e360.yale.edu/features/himalayas-glaciers-climate-change>

- **Timely snow** accumulation and melt are crucial for downstream water resources
- **Continuous cryosphere monitoring** is the key to managing water resources and coping with **related hazards**
- **Multi-disciplinary** cryosphere research is significant to understand the potential impacts
- **Coordinated** and connected research with **stakeholders** is crucial
- Strengthening Science to policy communications

Acknowledgments



**NORWEGIAN MINISTRY
OF FOREIGN AFFAIRS**



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

**Swiss Agency for Development
and Cooperation SDC**

Thank you

