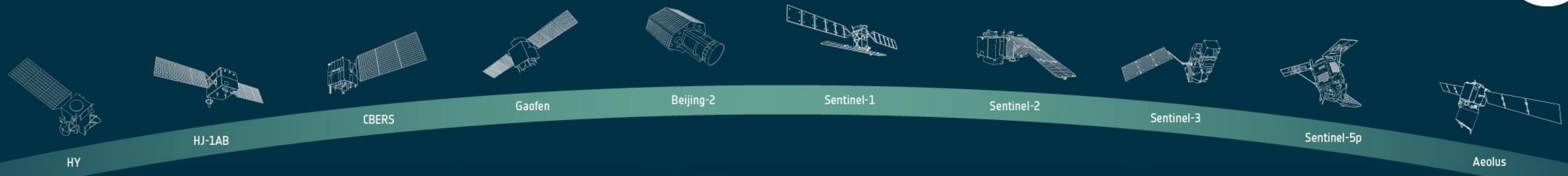


2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

[PROJECT ID. 59344]

DETAILED CONTEMPORARY GLACIER CHANGES IN HIGH MOUNTAIN ASIA USING MULTI-SOURCE SATELLITE DATA

<2020-2024>

ID. 59344

PROJECT TITLE: DETAILED CONTEMPORARY GLACIER CHANGES IN HIGH MOUNTAIN ASIA USING MULTI-SOURCE SATELLITE DATA

PRINCIPAL INVESTIGATORS: LEI HUANG,

CO-AUTHORS: TOBIAS BOLCH, XIN LI

PRESENTED BY: LEI HUANG

OUTLINES

Main Contents

I. Background Introduction

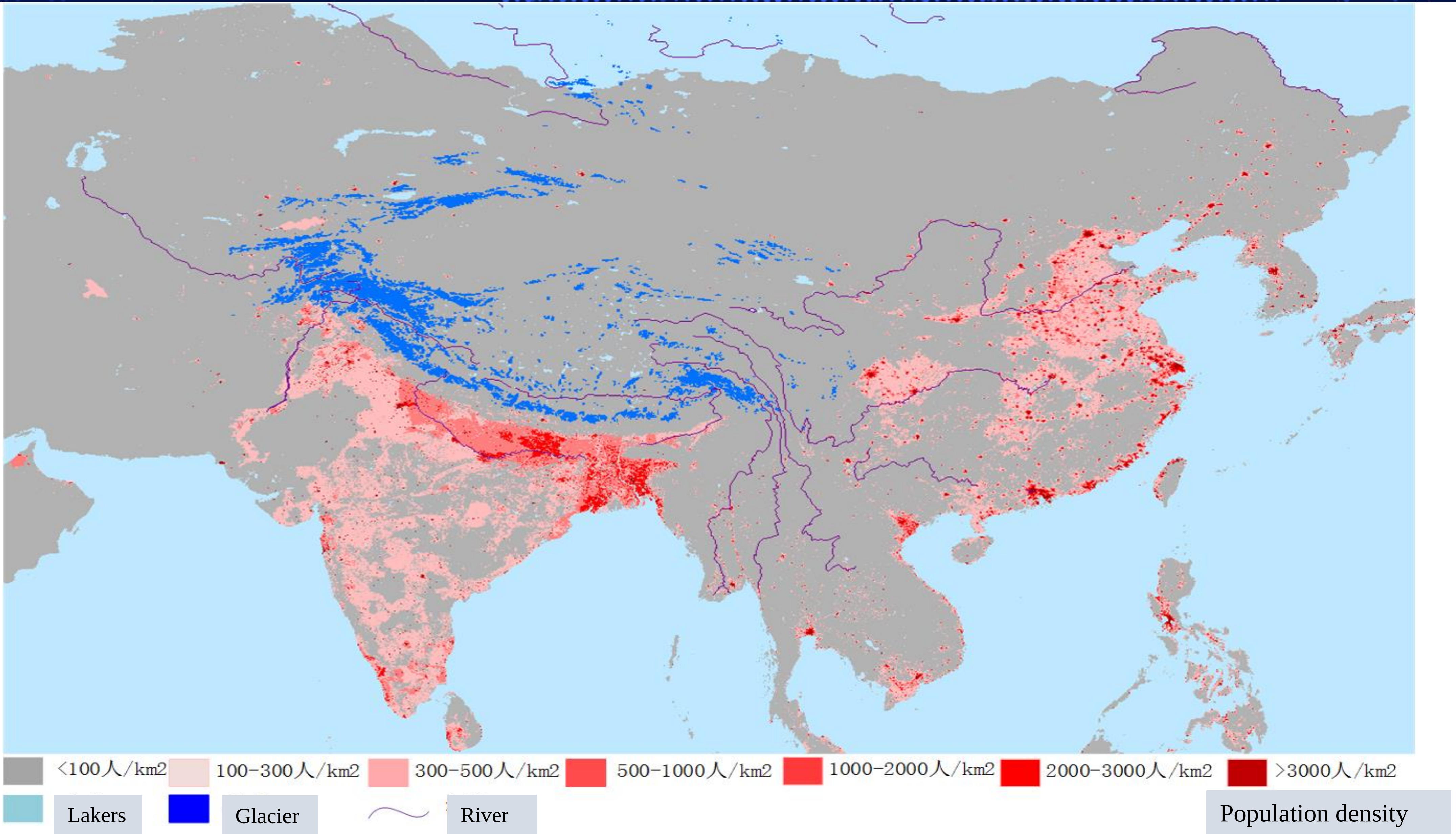
II. Objective and progress

III. Summary and Outlook

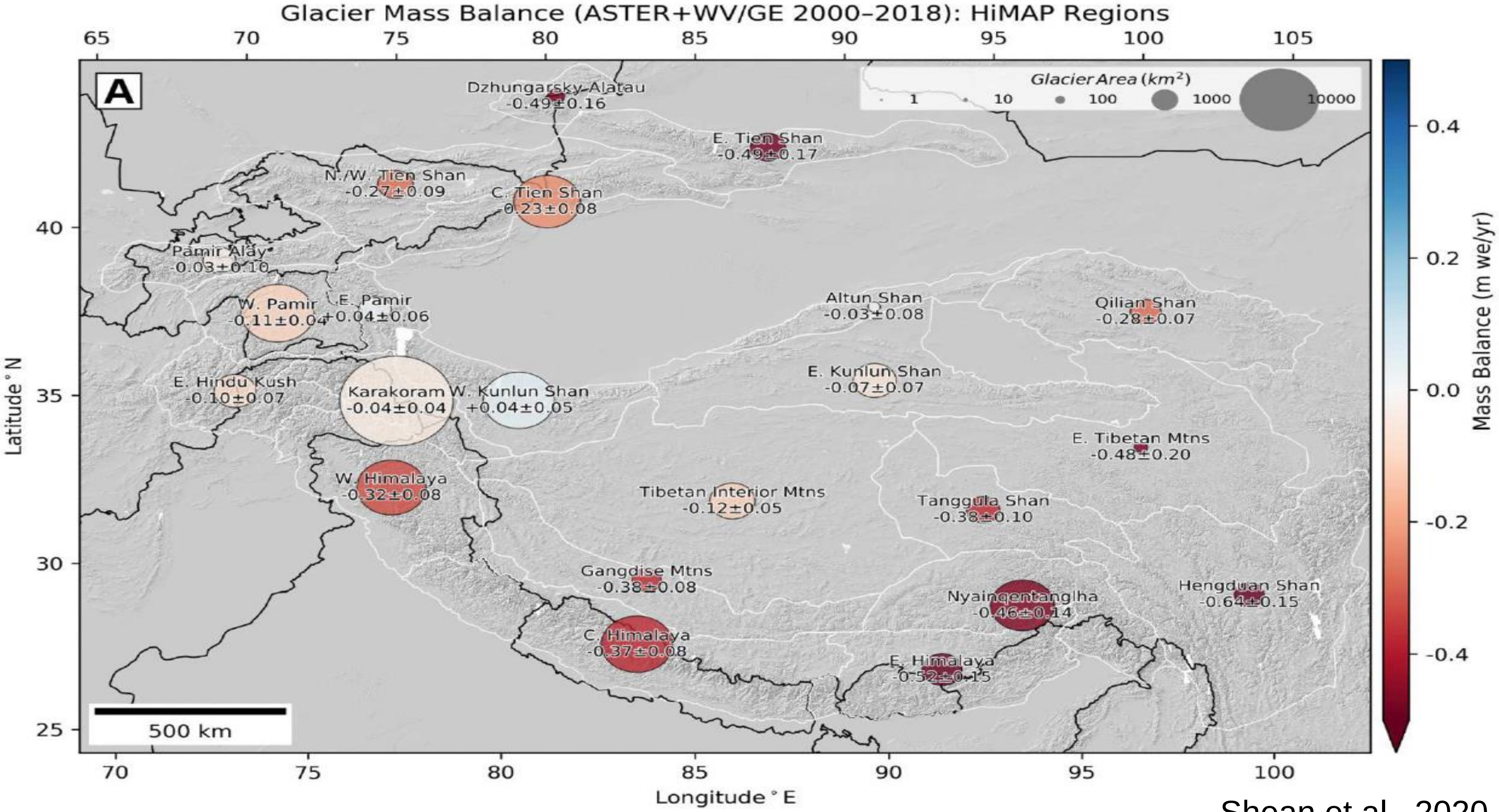
The largest glaciers in temperate areas

Water tower of Asia

The most important water tow … zeel 2020)



Mass balance heterogeneity



Shean et al., 2020

Main Contents

I. Background Introduction

II. Objective and progress

III. Summary and Outlook

Inform on the project's objectives

Objective: present comprehensive observation of the glacier mass balance state

- a. Glacier area change in HMA. Done by Lei
- b. Glacier velocity change observation. Partly done by Tobias
- c. Glacier thickness change observation and surface mass balance. Done by Tobias
- d. Glacier accumulation area ratio change observation. Partly done by Lei
- e. Development, calibration and validation of the results. Delayed
- f. New trend analysis of the glaciers in HMA. Coming soon

1. Glacier area changing in HMA during 1990-2018

Using 30,000 Landsat images and the proposed pixel-collection method, the area change of the all glaciers in HMA during 1990-2018 are extracted.

The employed data for glacier extraction in different periods.

Period	Corresponding years	Satellite/Sensors
1990	1988–1993	Landsat 5/TM
2000	1998–2002	Landsat 5/TM
2010	2008–2012	Landsat 5/TM
2018	2016–2019	Landsat 8/OLI

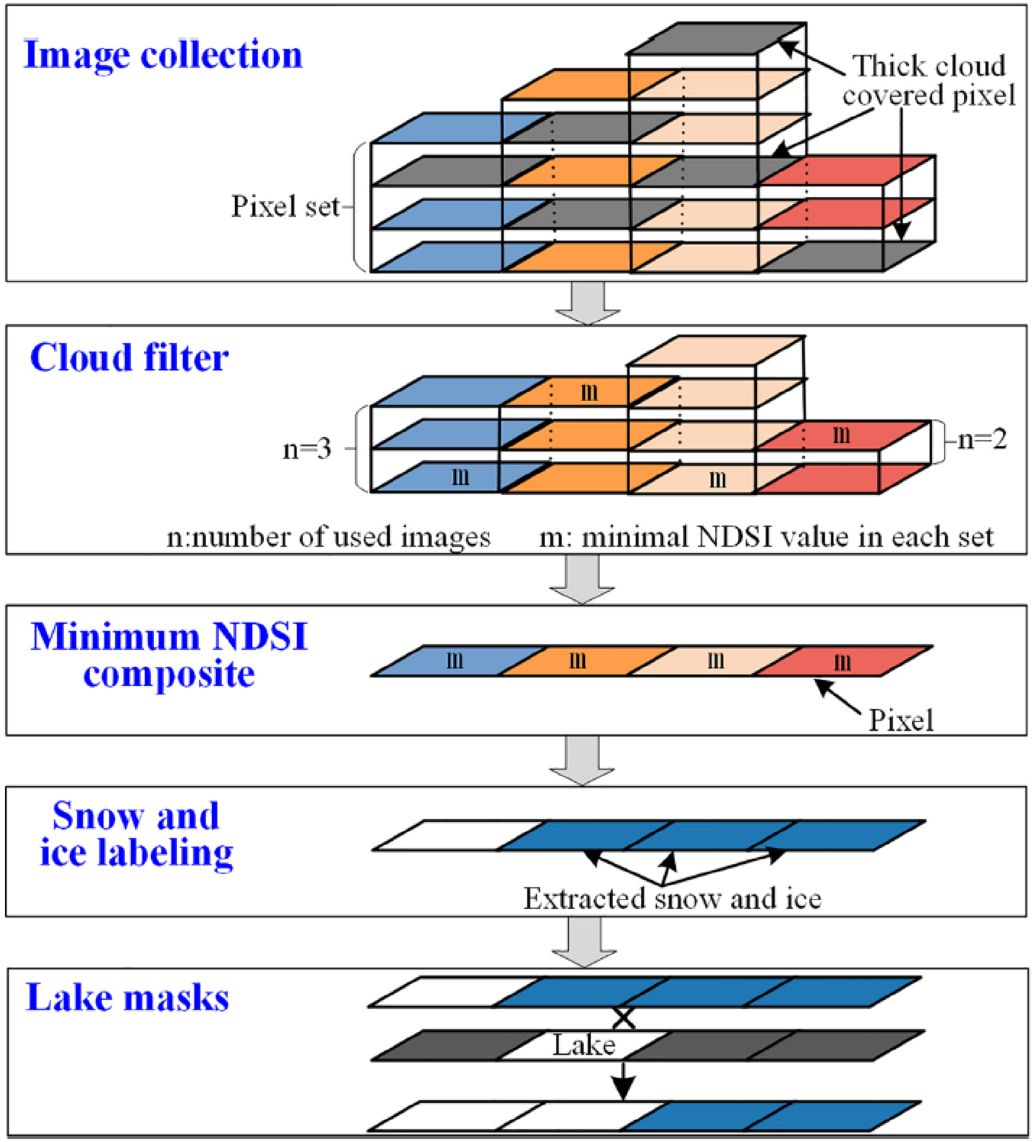
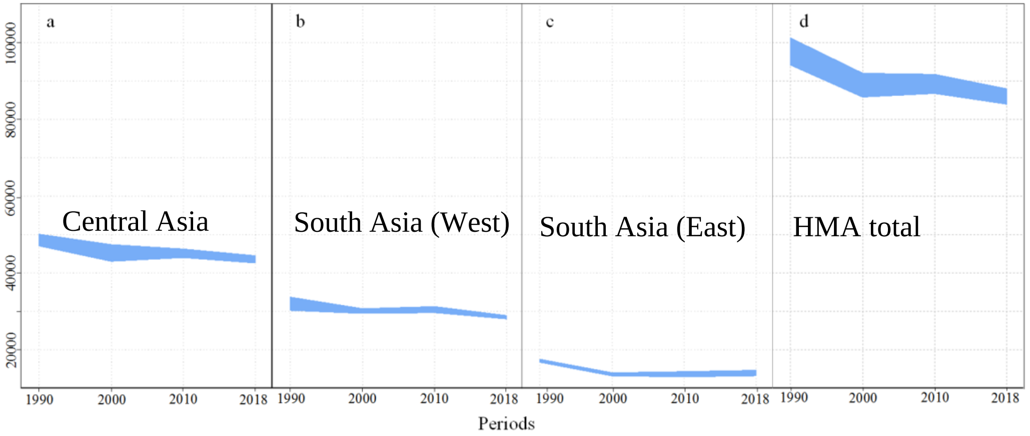
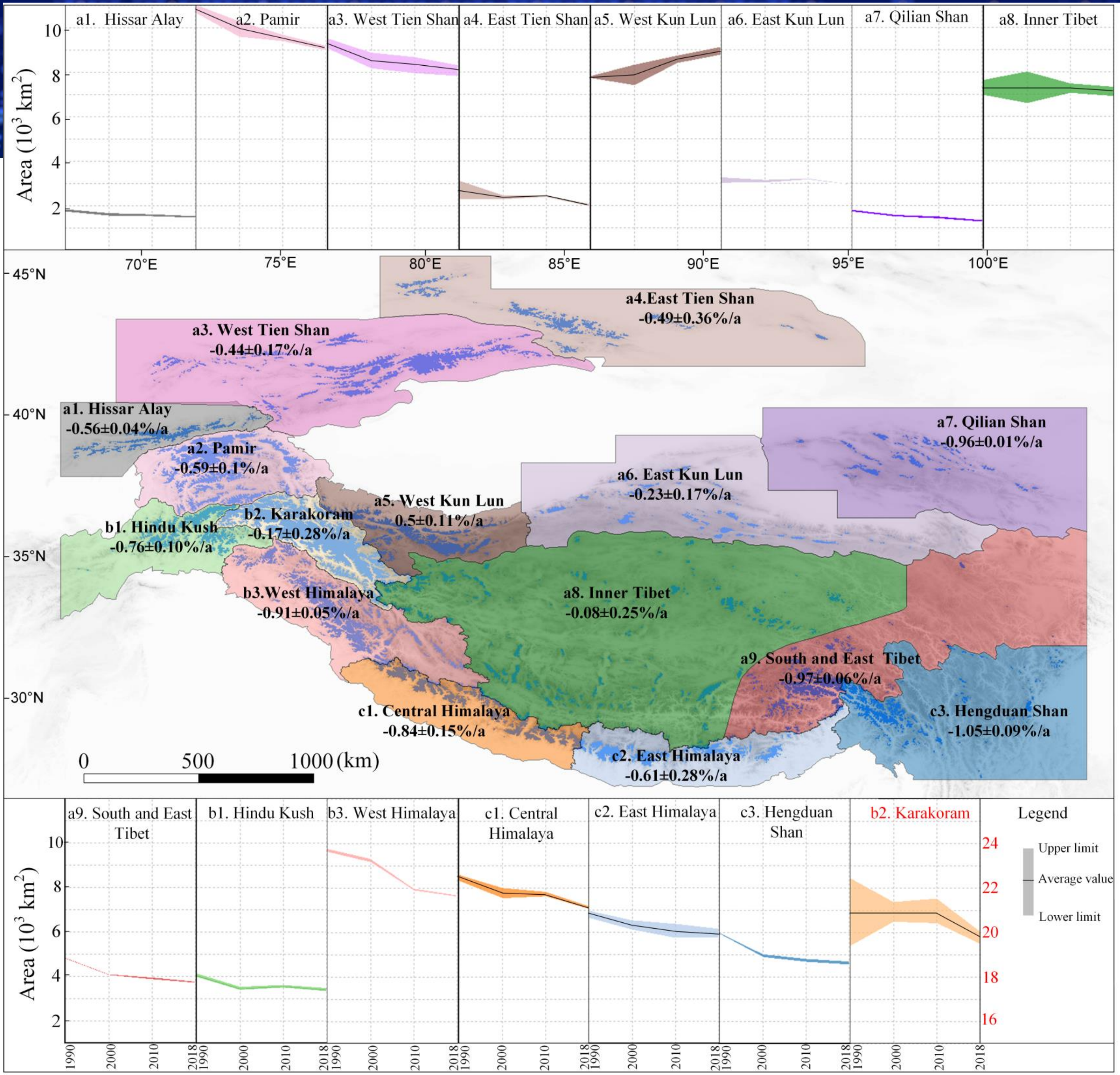


Fig. 1. Workflow of clean glacier and nonseasonal snow extraction.

Debris area change is not considered.

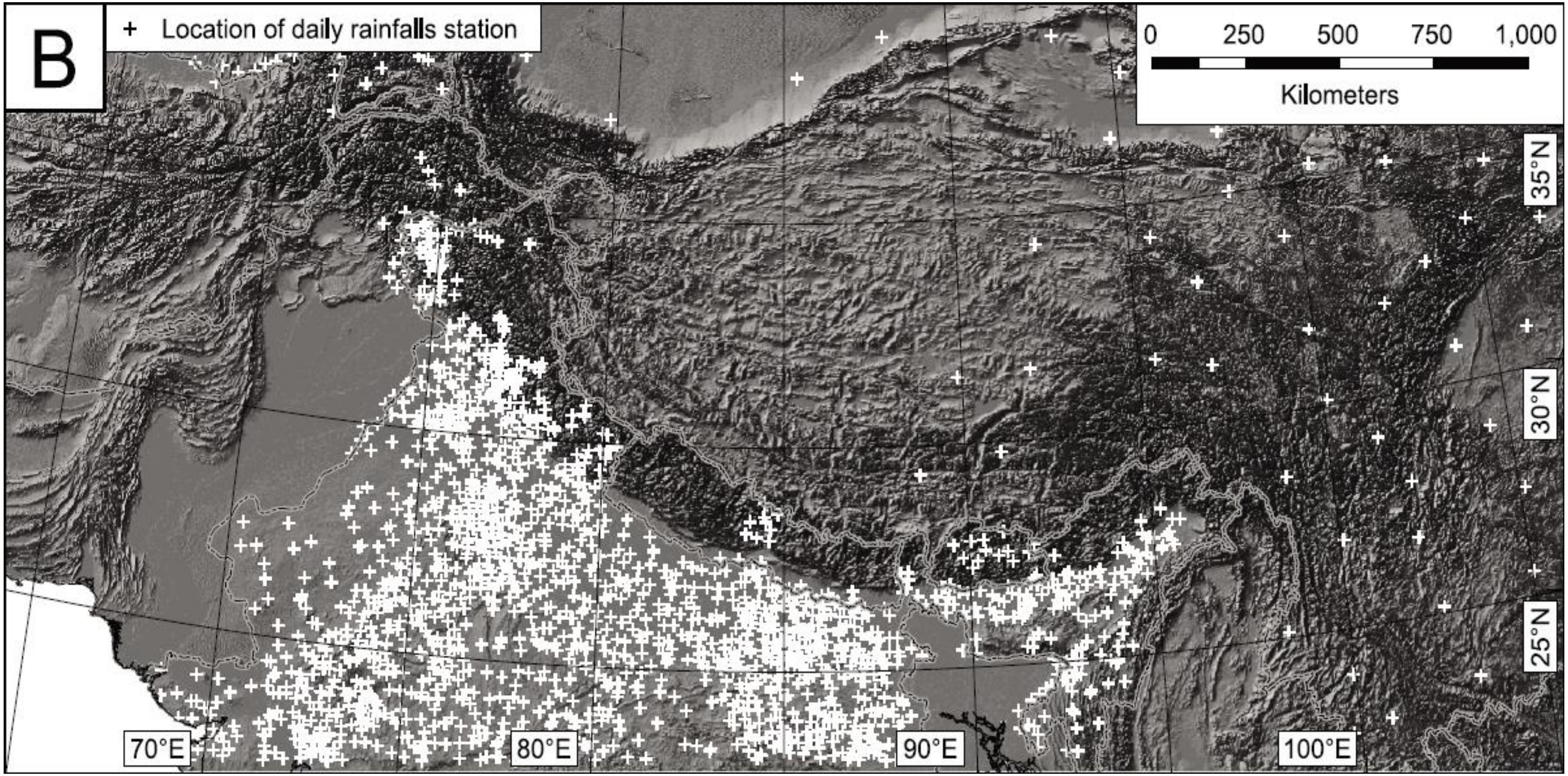
In the whole HMA, the clean glacier area decreased by 12,095± 5084 km2, i.e., 12.39 ± 5.21% of the total glacier area, at a rate of 0.43 ± 0.18% /a from 1990 to 2018.





Huang Lei, et al., An automatic method for clean glacier and non-seasonal snow area change estimation in High Mountain Asia from 1990 to 2018, Remote Sensing of Environment, 2021.

2. Glacier seasonal accumulation in HMA



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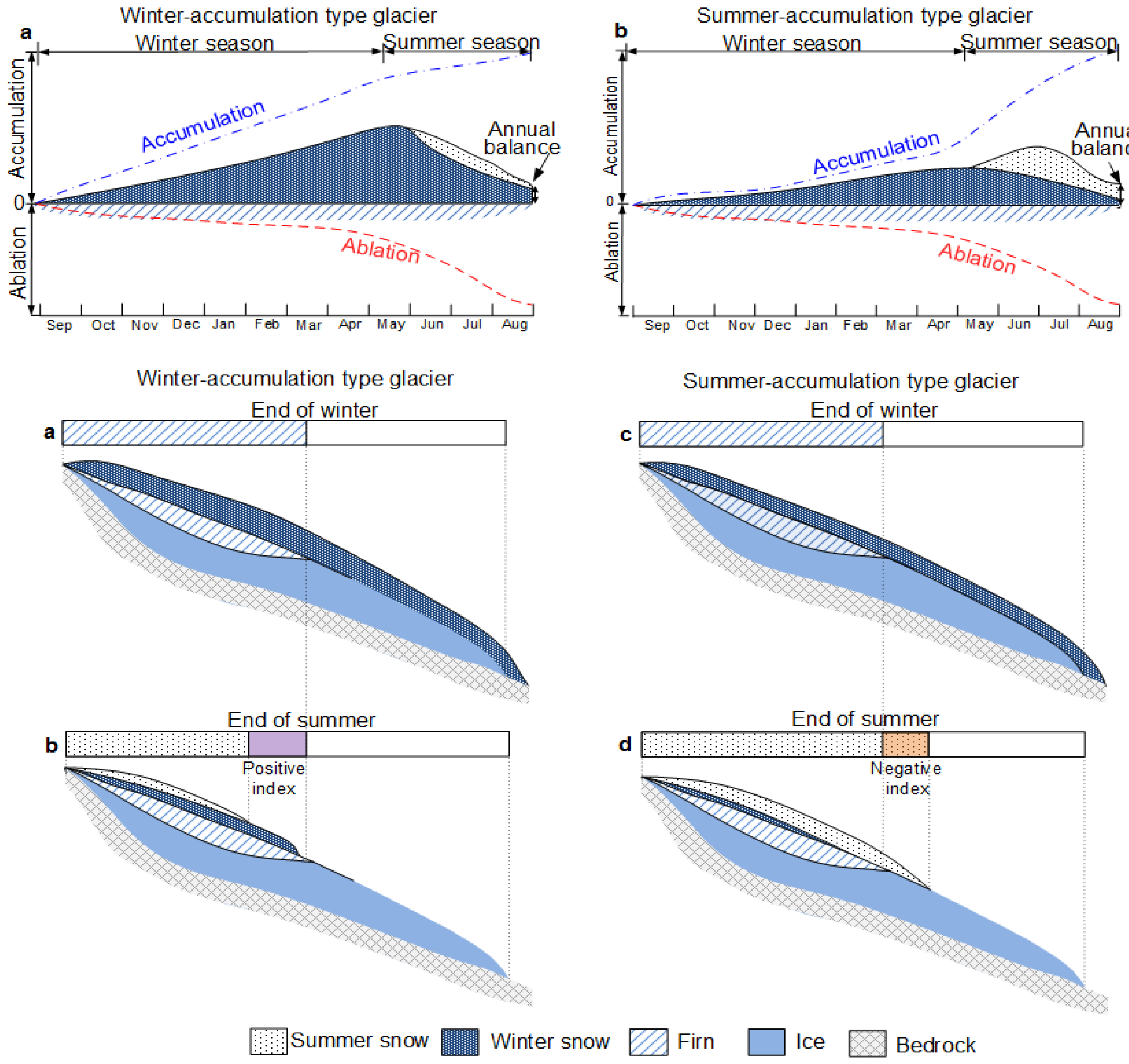
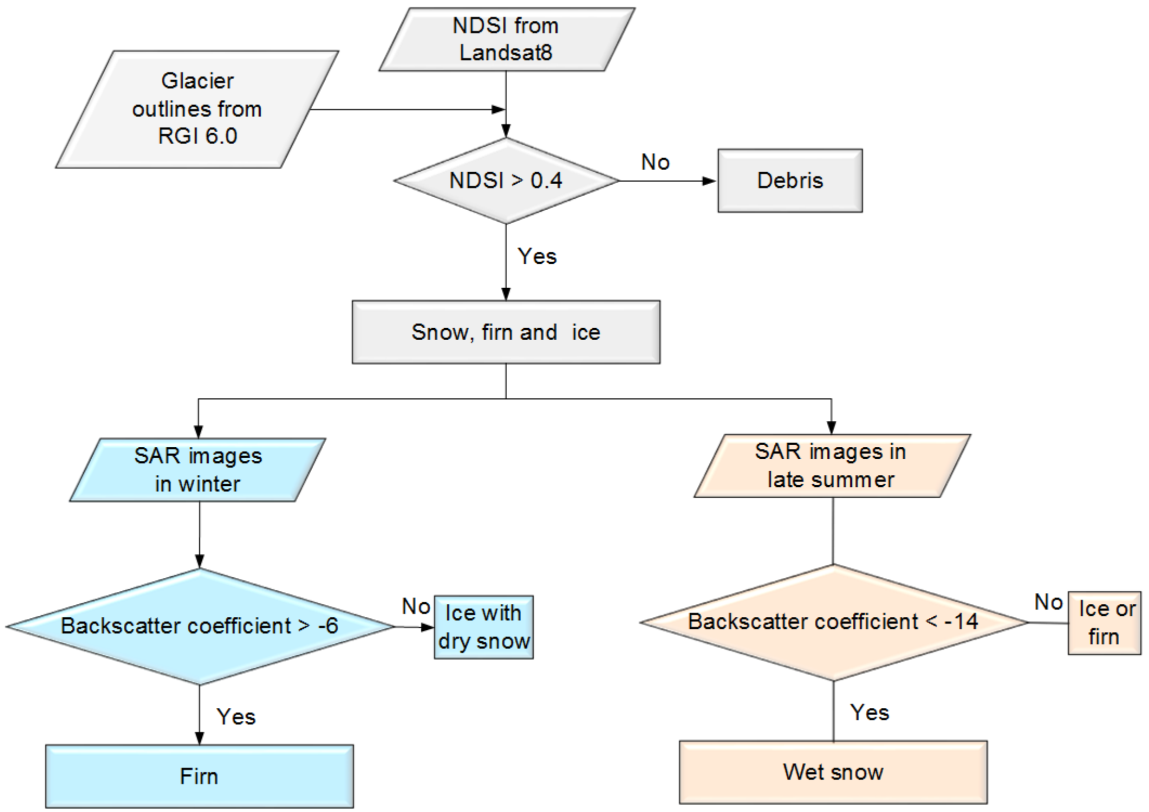


Index
$$I = \frac{A_{firn}}{A_{total}} - \frac{A_{wet\ snow}}{A_{total}}$$



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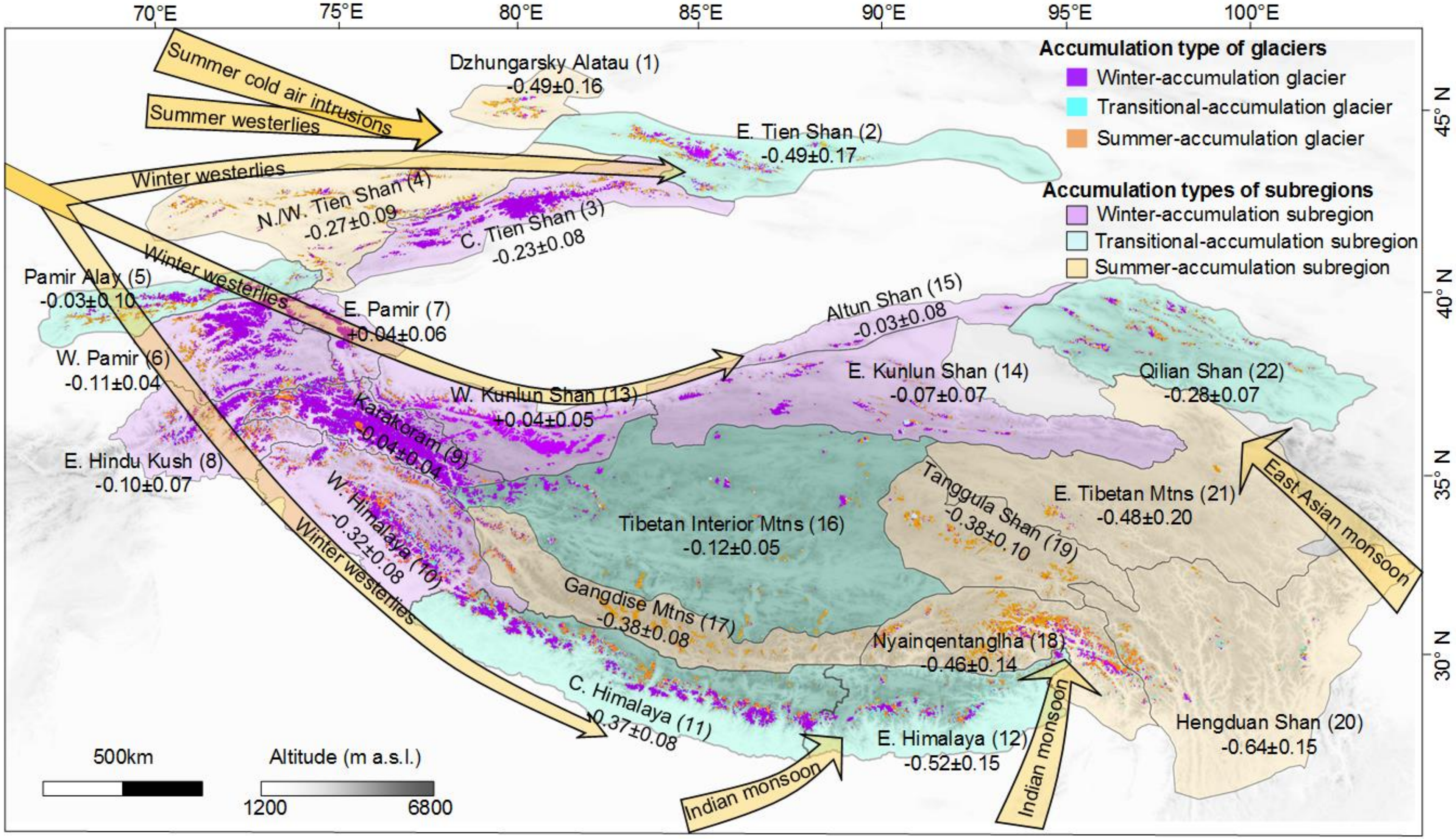

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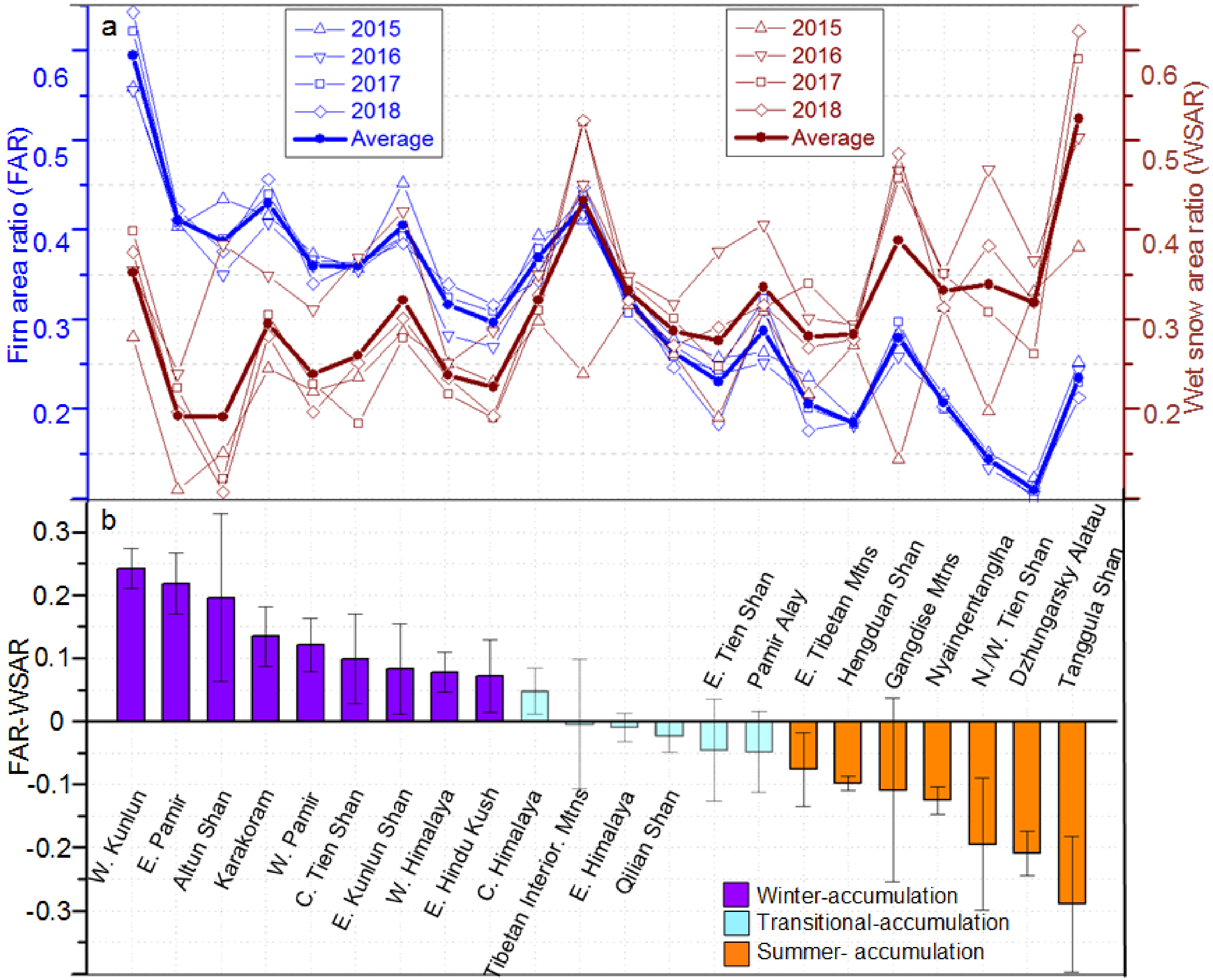
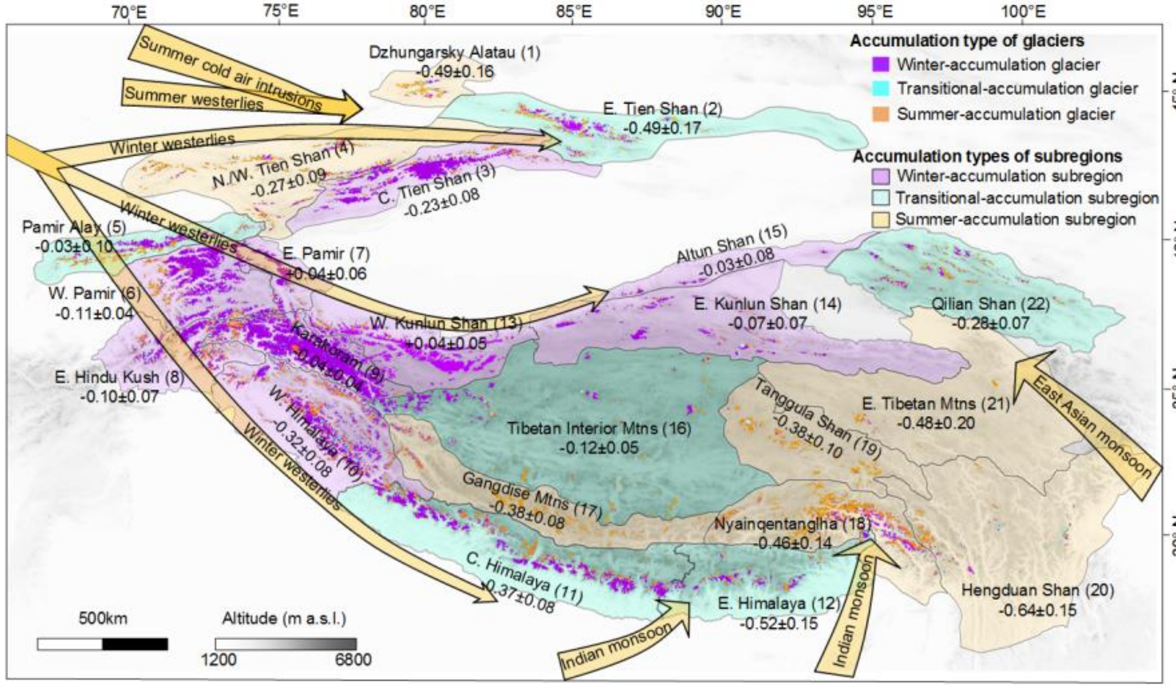
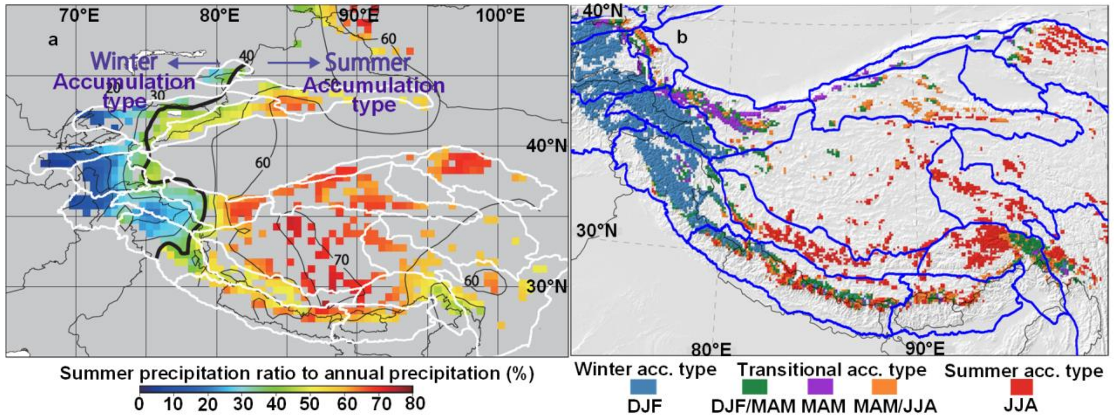
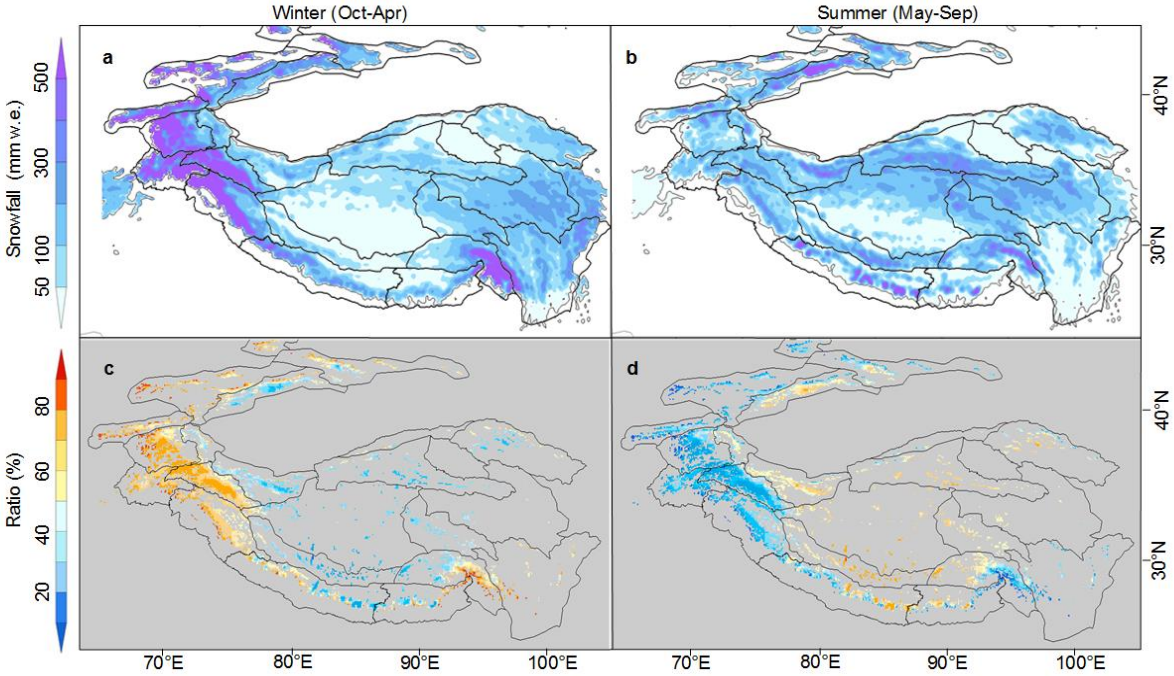


2. Glacier seasonal accumulation in HMA

Accumulation type comparison with precipitation data



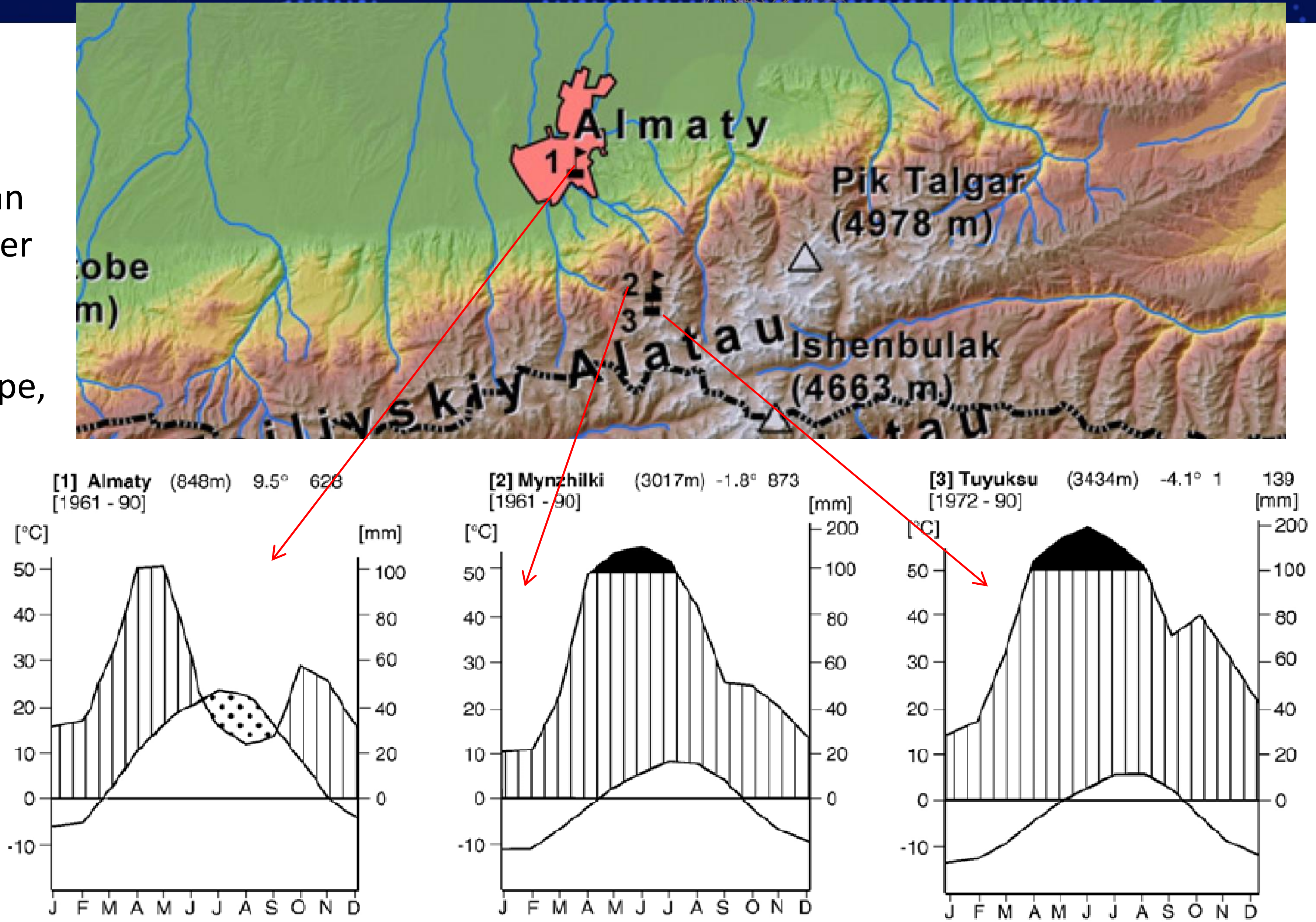




Field Validation 1

In Northern/Western Tienshan
In SAR derived results: summer accumulation type

In re-analysis precipitation type, winter accumulation type

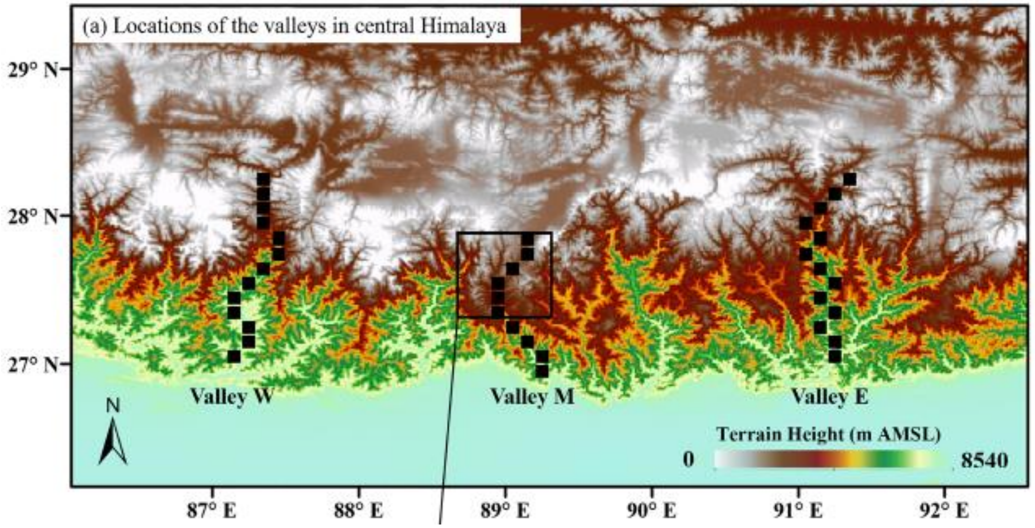


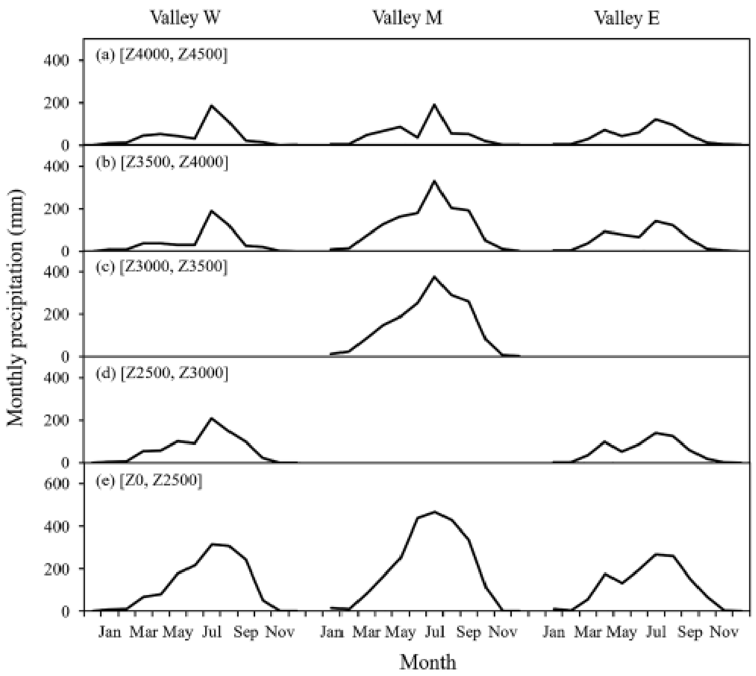
Bolch, 2007, GPC

Field Validation 2

In Eastern Himalaya
In SAR derived results:
transitional accumulation type

In re-analysis precipitation type,
summer accumulation type

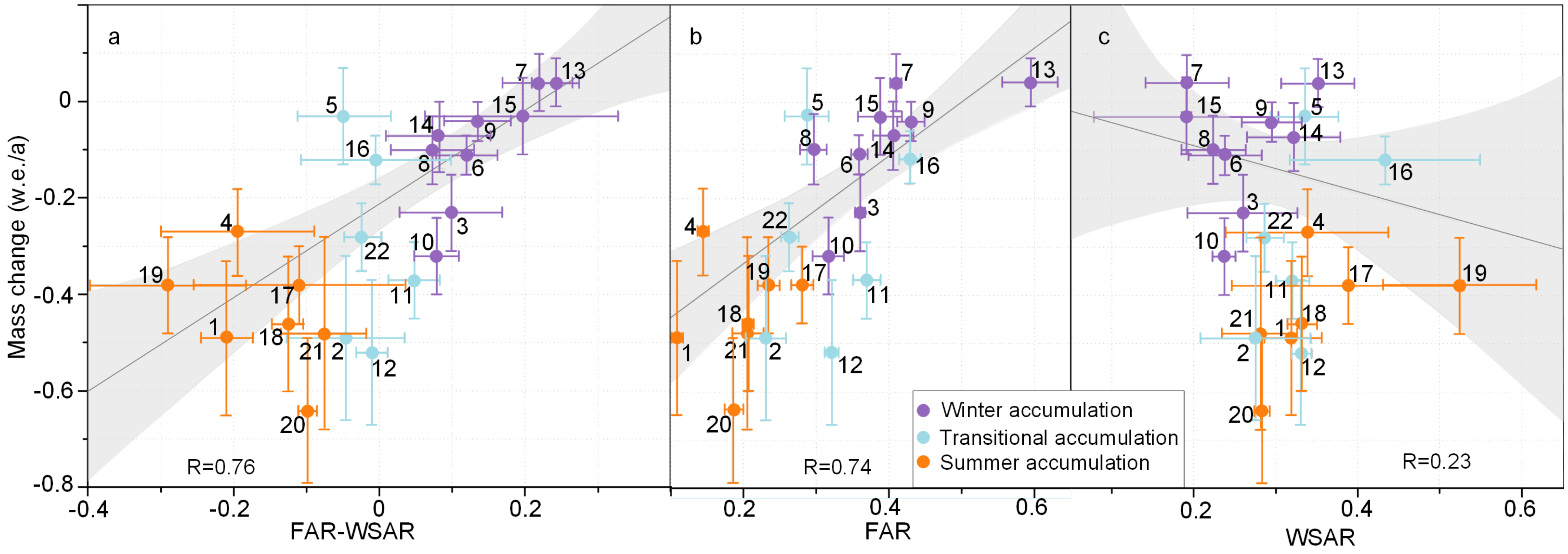




2. Glacier seasonal accumulation in HMA

	Subregion	Accumulation type						
		SAR-based data	Gridded climate data				In situ observations	
			APHRODITE	HAR	HAR v2	ERA5	Weather stations off the glacier	Records of the glacier
1	Dzhungarsky Alatau	Summer	Transitional	Not covered	Winter	Winter		
2	**Eastern Tien Shan**	Transitional	Transitional	Not covered	Transitional	Transitional		
3	Central Tien Shan	Winter	Transitional	Not covered	Summer	Summer	Summer (Kronenberg et al., 2016)	Winter (Kronenberg et al., 2016)
4	Northern/Western Tien Shan	Summer	Winter	Not covered	Winter	Winter	Winter (Kononova et al., 2015)	Summer (Kapitsa et al., 2020)
5	Pamir Alay	Transitional	Winter	Not covered	Winter	Winter		
6	**Western Pamir**	Winter	Winter	Winter	Winter	Winter		Winter (Aizen et al., 2009)
7	Eastern Pamir	Winter	Transitional	Transitional	Transitional	Transitional		Winter (Seong et al., 2009)
8	**Eastern Hindu Kush**	Winter	Winter	Winter	Winter	Winter		
9	**Karakoram**	Winter	Winter	Winter	Winter	Winter		
10	**Western Himalaya**	Winter	Winter	Winter	Winter	Winter		Winter (Azam et al., 2016)
11	**Central Himalaya**	Transitional	Transitional	Transitional	Transitional	Transitional	Summer (Wagnon et al., 2013)	Summer (Wagnon et al., 2013)
12	**Eastern Himalaya**	Transitional	Transitional	Transitional	Transitional	Transitional		Transitional (Ouyang et al., 2020)
13	Western Kunlun Shan	Winter	Summer	Transitional	Transitional	Summer		
14	Eastern Kunlun Shan	Winter	Summer	Transitional	Summer	Summer		
15	Altun Shan	Winter	Summer	Transitional	Transitional	Transitional		
16	Tibetan Interior Mountains.	Transitional	Summer	Transitional	Summer	Summer		
17	**Gangdise Mountains**	Summer	Transitional	Summer	Summer	Summer		
18	**Nyainqentanglha**	Summer	Summer	Summer	Summer	Transitional		Summer (Zhang et al., 2013)
19	**Tanggula Shan**	Summer	Summer	Summer	Summer	Summer		
20	Hengduan Shan	Summer	Summer	Summer	Winter	Transitional	Summer and transitional (Yang et al., 2013)	
21	Eastern Tibetan Mountains	Summer	Transitional	Summer	Transitional	Transitional		
22	Qilian Shan	Transitional	Summer	Summer	Transitional	Summer		

2. Glacier seasonal accumulation in HMA



Huang Lei, Regine Hock, **Xin Li, Tobias Bolch** et al., Winter snow drives the spatial variations in glacier mass balance in High Mountain Asia, Science Bulletin, 2022.

EO Data Delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2020) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert "ftp"

ESA Third Party Missions	No. Scenes
1. Sentienl-1	100
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

ESA Third Party Missions	No. Scenes
1.	
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

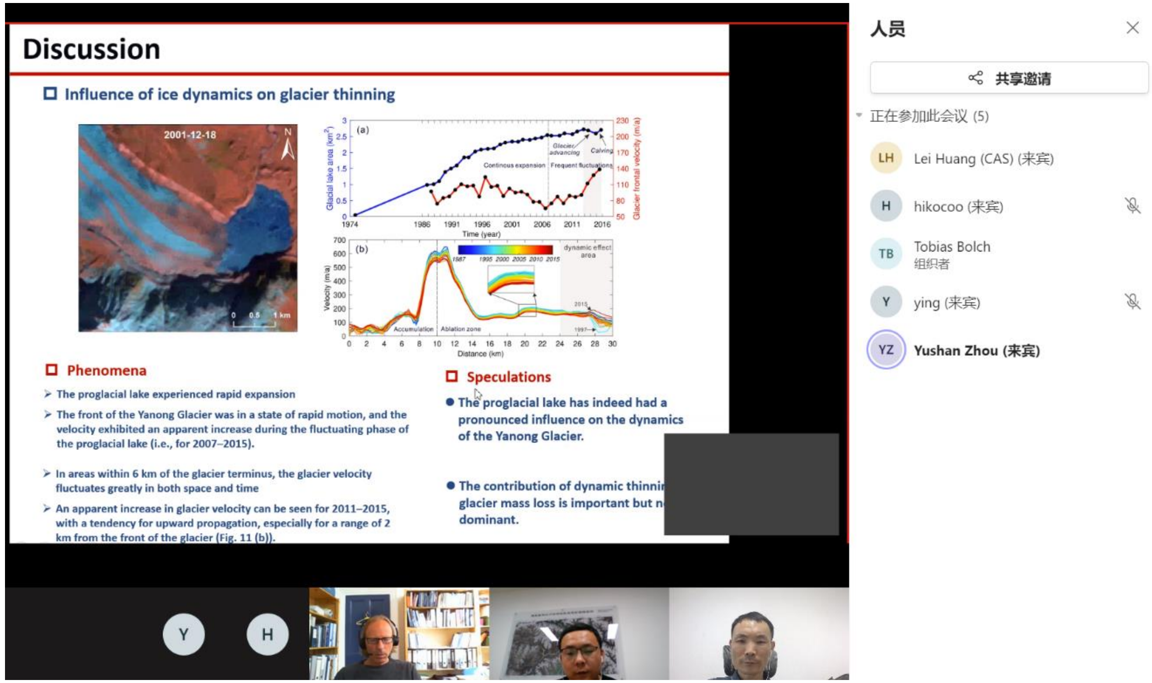
Chinese EO data	No. Scenes
1. Gaofen-1	10
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

Chinese Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Yushan Zhou	Institute of Tibet Plateau Research, CAS.	Evolution of geodetic mass balance over the largest lake-terminating glacier in the Tibet Plateau based on multi-source high-resolution satellite data	High resolution mass balance of glaciers.

Thanks Dragon 5 for providing a chance to our cooperation!

Team discussion in 2019



Team discussion in 2022