

GLACIER ATLAS OF BHUTAN 2022

Cryosphere Services Division,
NATIONAL CENTRe FOR HYDROLOGY AND METEOROLOGY

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GLACIER ATLAS OF BHUTAN

CRYOSPHERE SERVICES DIVISION,
NATIONAL CENTRe for HYDROLOGY AND METEOROLOGY



Photo: https://yellow.bt

"We must always stand united in spirit and purpose, we must always be one nation with one common goal"

His Majesty Jigme Khesar Namgyel Wangchuck
9th August 2019

Automatic Weather Station at Zanam Lake

Photo: Wangchuk Namgay, CSD,NCHM,2021



Foreward

[redacted]

(Karma Dupchu)
Director
National Centre for Hydrology and Meteorology



Photo: Lalit K Chhetri, DGM,MoEA,2009

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Photo: Sonam Lhamo,CSD,NCHM,2015

Summary

As per the latest Bhutan Glacier Inventory 2016 there are 700 glaciers covering a total area of 629.55±0.02 km^2. The atlas presents info-graphic information on glaciers of Bhutan summarized from those inventories. The Atlas will act as a visual guide to the Bhutan Glacier Inventory 2018 and will be a glacier image archive for future reference.

The Atlas contains images of prominent glaciers captured during field work along with satellite images (ESRI) of those glaciers which are in-accessible. It contains a summary of glaciers for each basin and images of those prominent glaciers. The atlas also contains detailed information of prominent glaciers such as local name, glacier ID, area, length and elevation. The atlas also highlights the two benchmark glaciers of Bhutan which are currently monitored by the Cryosphere Services Division.

Map showing distribution of Glaciers in Bhutan

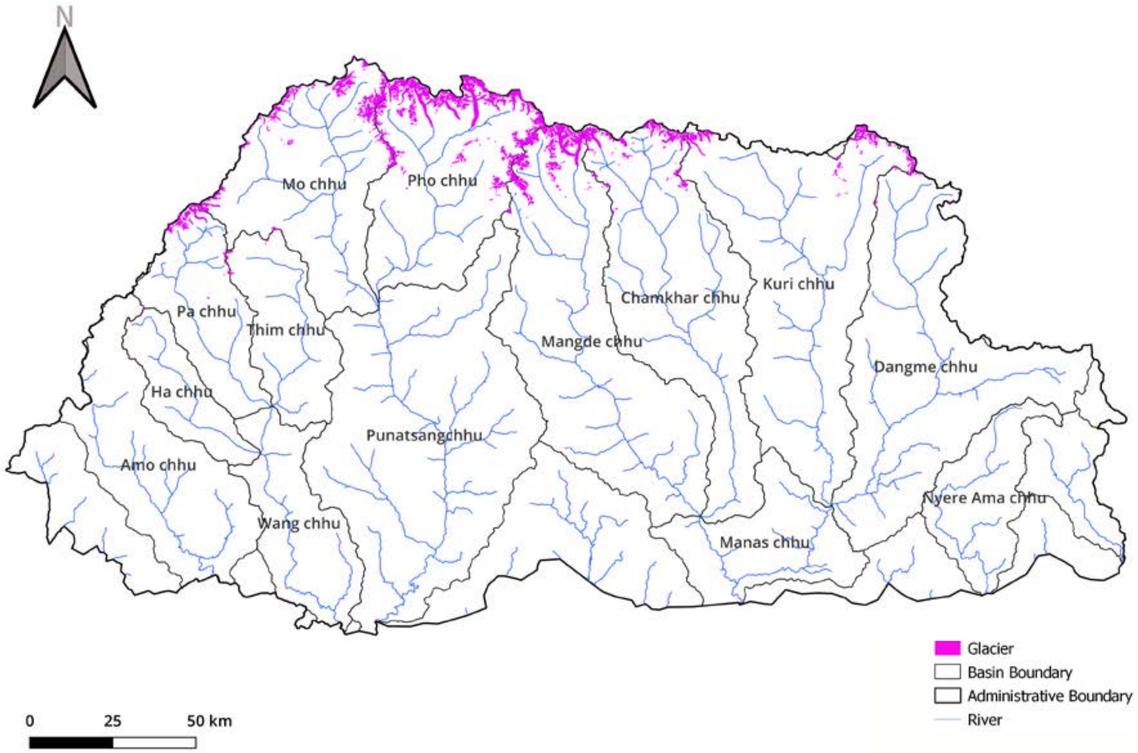


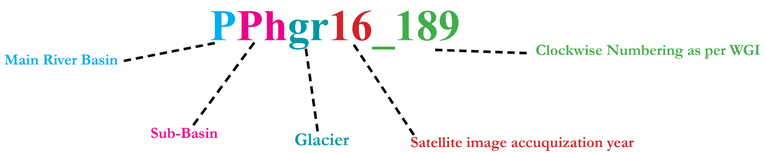


Photo: Tsheten Namgay,CSD,NCHM,2020

Glossary

Bhutan Glacier Inventory_ID nomenclature

The BGI ID for the glaciers were assigned following the set of rules which starts with Main basin, sub-basin,year of the satellite image and finally the local id as shown below. To assign local ID of the glacier, we followed WGI guidelines (Cogley 2009), which assigns glacier ID by numbering glaciers starting from the mouth of major stream and proceeds clockwise round the basin through each and every small tributaries. In the following example P stands for the main river basin name (Punatsangchhu), Ph for the sub-basin (Pho Chhu) , gr for glacier and 16 the year of satellite image accusation and last _number for glacier id (189).



Glacier Symbology

Only prominent glaciers are assigned and displayed on the atlas wand the follwing symbologies were used.

Prominent Glaciers

Benchmarked Glaciers

Basemap for Atlas

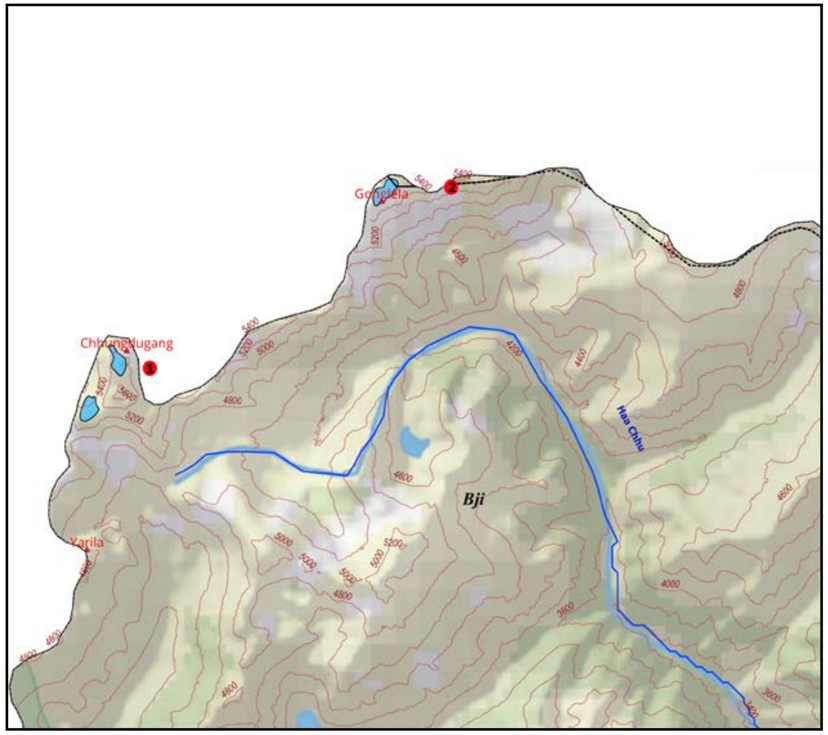
ESRI National Geographic world map provided by Web Map Service (WMS), freely avilable was used as basemap for generating the current Atlas.

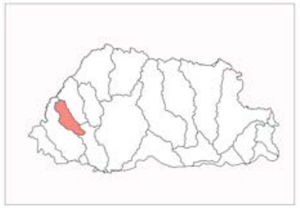
Mt.Gangchen Singye

Basinwise Glacier Distribution

Photo: Wangchuk Namgay,CSD,NCHM,2021

HAA CHHU SUB-BASIN





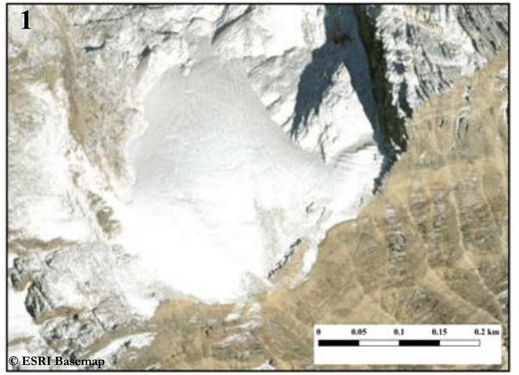
Legend

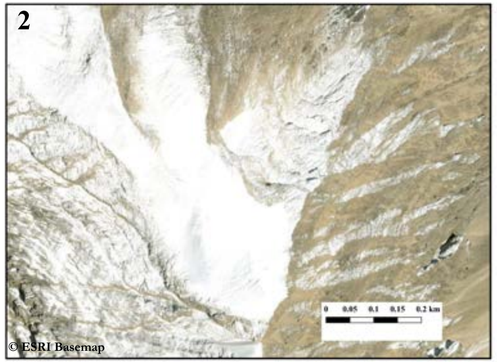
- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

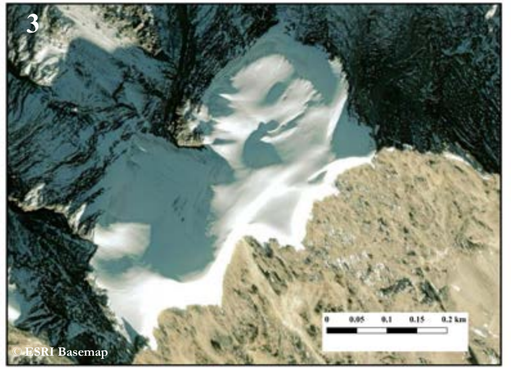
Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	3	0.27



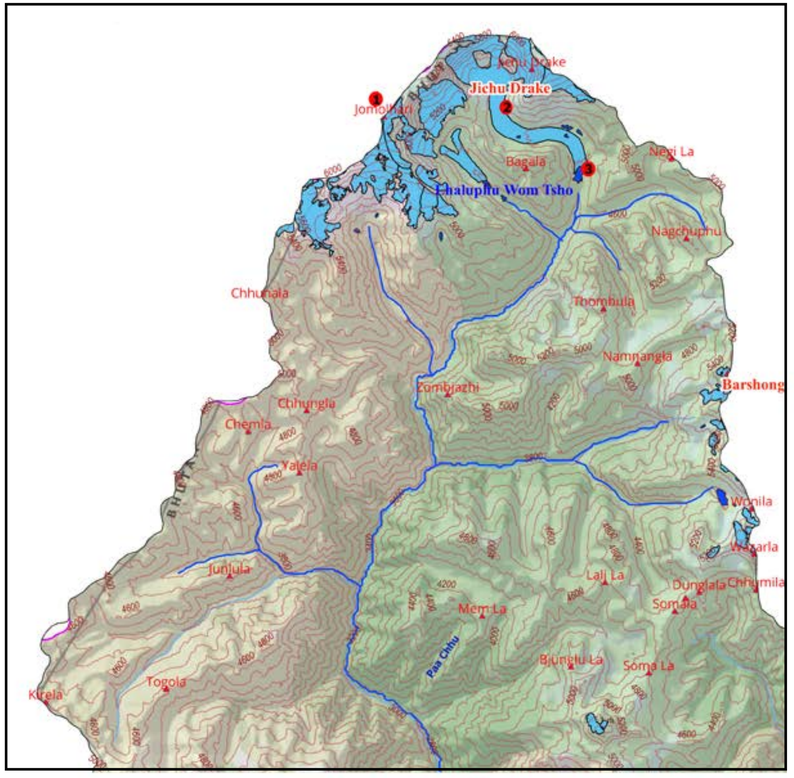


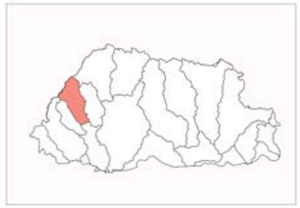




#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	WHagr16_1	NA	0.09	0.33	5248
2	WHagr16_2	NA	0.08	0.53	5460
3	WHagr16_3	NA	0.10	0.32	5524

PA CHHU SUB-BASIN





Legend

- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	31	28.39





1.Jomolhari Glacier





2.Jichudarkey Glacier





3.Karma Lake

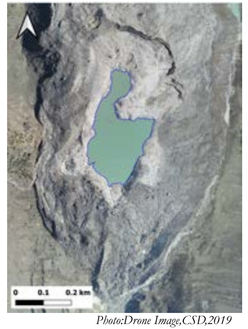
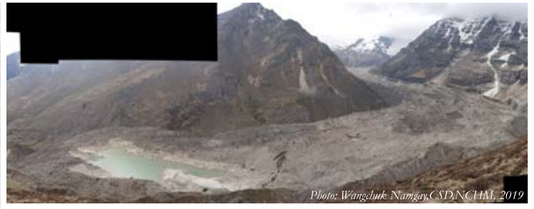


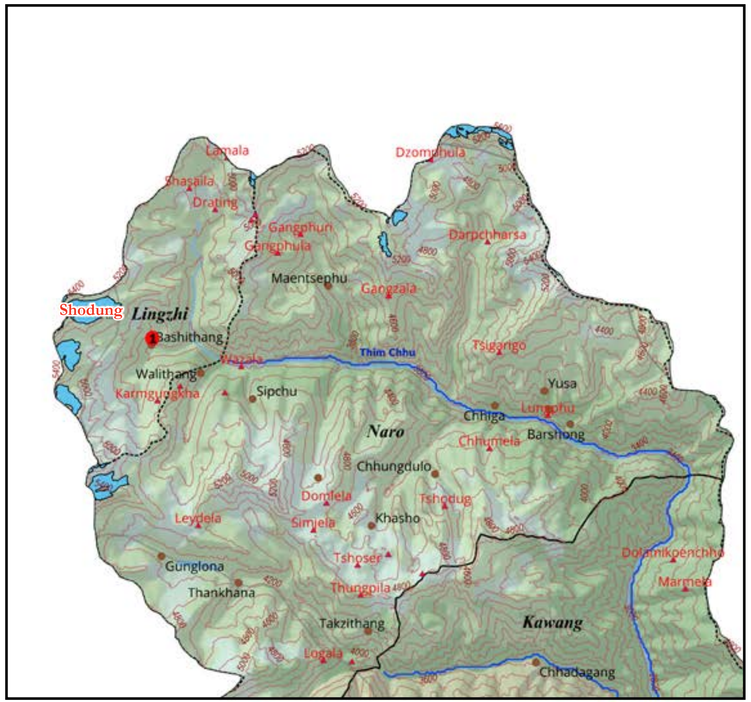
Photo:Drone Image,CSD,2019





#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	WPagr16_32	Jomolhari Glacier	2.64	3.99	5521

THIM CHHU SUB-BASIN



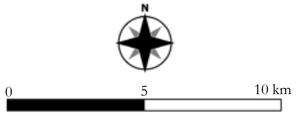


Legend

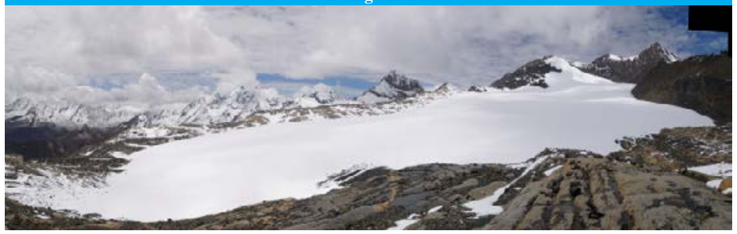
- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

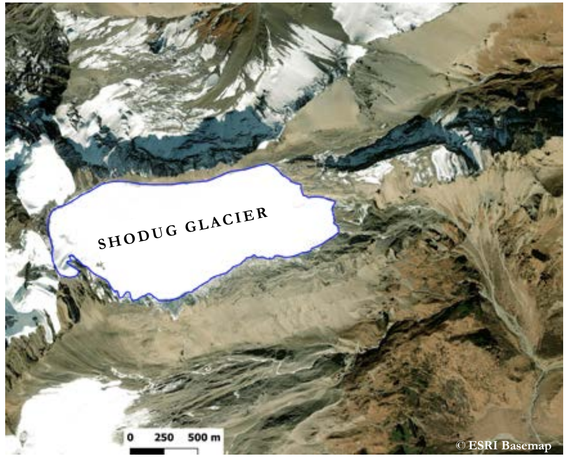
Basin Summary

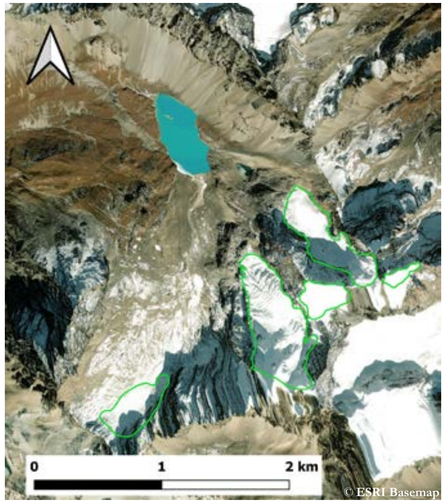
#	Info	Number	Area (km sq)
1	Glacier	13	4.72



1.Shodug Glacier

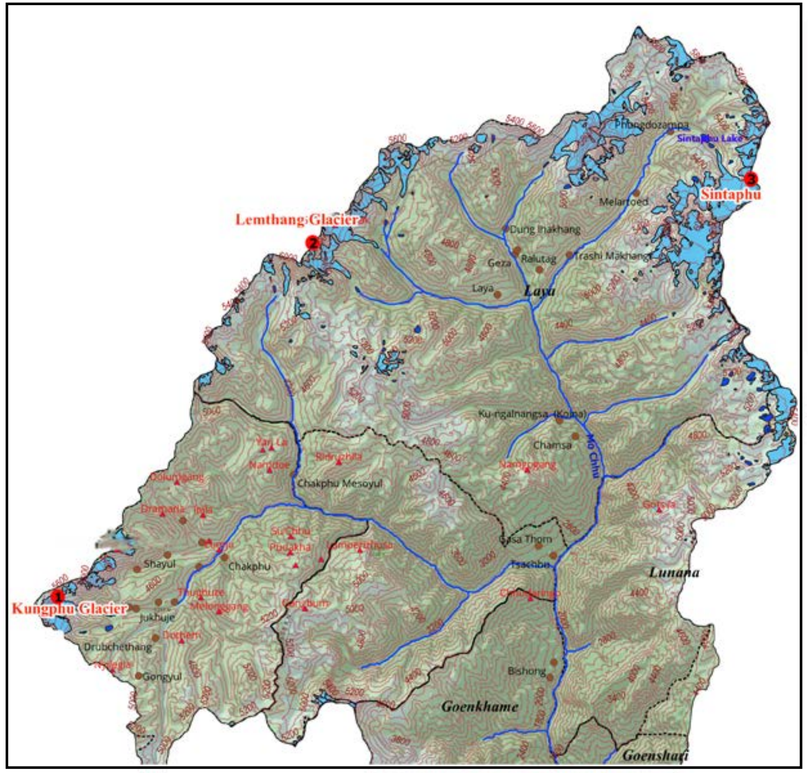


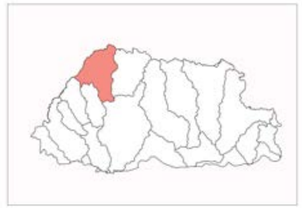




#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	WThgr16_35	Shodug Glacier	1.39	2.12	5271

MO CHHU SUB-BASIN



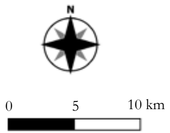


Legend

- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	135	108.64



1.Kungphu Glacier







2.Lemthang Glacier



3.Sintaphu Glacier



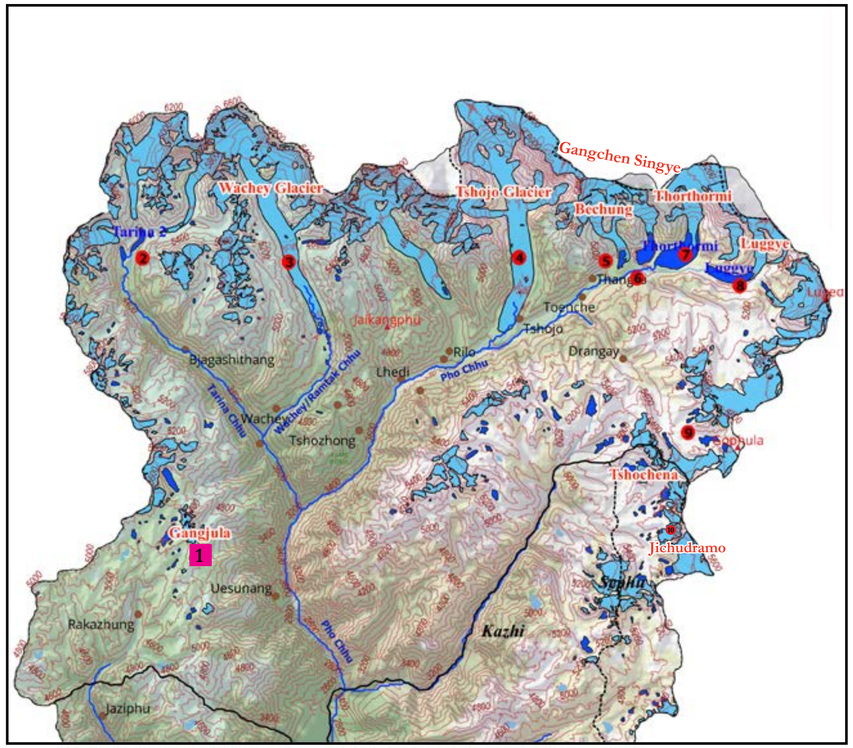


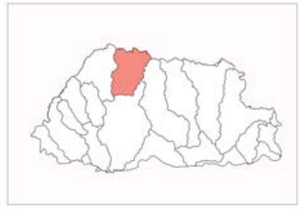
3.Sintphu Glacier



#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	PMogr16_57	Kungphu glacier	4.06	2.44	5029
2	PMogr16_101	Lemthang glacier	3.81	3.61	5229
3	PM0gr16_141	Sintaphu glacier	8.81	4.82	5478

PHO CHHU SUB-BASIN



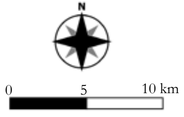


Legend

- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	206	252.42



1. Gangju La Glacier





2.Tarina lake





3.Wachey Glacier

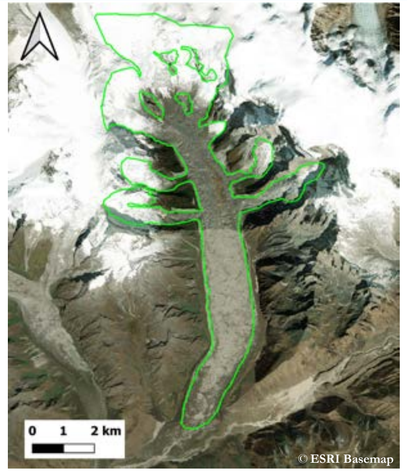






#	BGI ID	Local Name	Area (km²)	Length (m)	Mean Elevation (m.a.s.l)
1	PPhgr16_189	Gangju La glacier	0.24	0.95	5067
2	PPhgr16_228	Tarina I glacier	3.67	7.26	5275
3	PPhgr16_273	Wachey Glacier	28.92	14.69	5223
4	PPhgr16_293	Tshojo Glacier	33.69	15.97	4911
5	PPhgr16_297	Baychung Glacier	9.24	5.03	5411
6	PPhgr16_298	Raphsteng glacier	2.93	2.21	5176
7	PPhgr16_299	Thorthormi Glacier	9.7	5.58	5585
8	PPhgr16_302	Luggye Glacier	4.73	4.01	5257
9	PPhgr16_322	Tshorim Glacier	3.7	1.03	5372

4.Tshojo Glacier



5.Baytsho Glacial Lake



Photo: Karma Namgay, DGM,MoEA, 2021

6.Raphstreng Glacial Lake

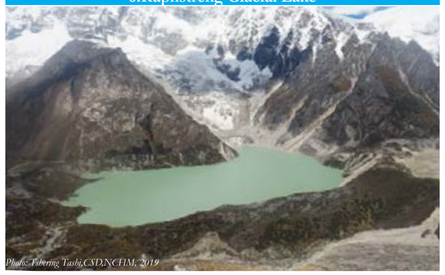
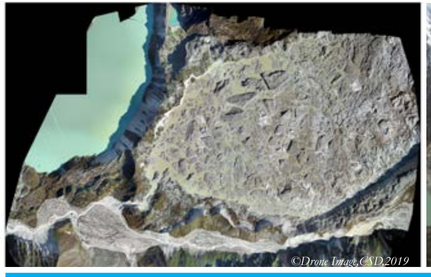


Photo: Tshering Tashi,CSD,NCHM, 2019

7.Thorthormi Glacial Lake



©Drone Image,CSD,2019



Photo: Wangchuk Namgay,CSD,NCHM, 2019



Photo: Wangchuk Namgay,CSD,NCHM, 2021

8.Luggye Glacier and Glacial Lake



Photo: Karma ,CSD,NCHM, 2019



Photo: Wangchuk Namgay,CSD,NCHM, 2019

Gangchen Singye



Photo:NCHM, 2010

9.Tshorim Glacier



Photo: PhuntsoTshering,CSD,NCHM, 2009



Photo: Karma Namgay, DGM,MoEA, 2021

10.Jichudramo Glacier

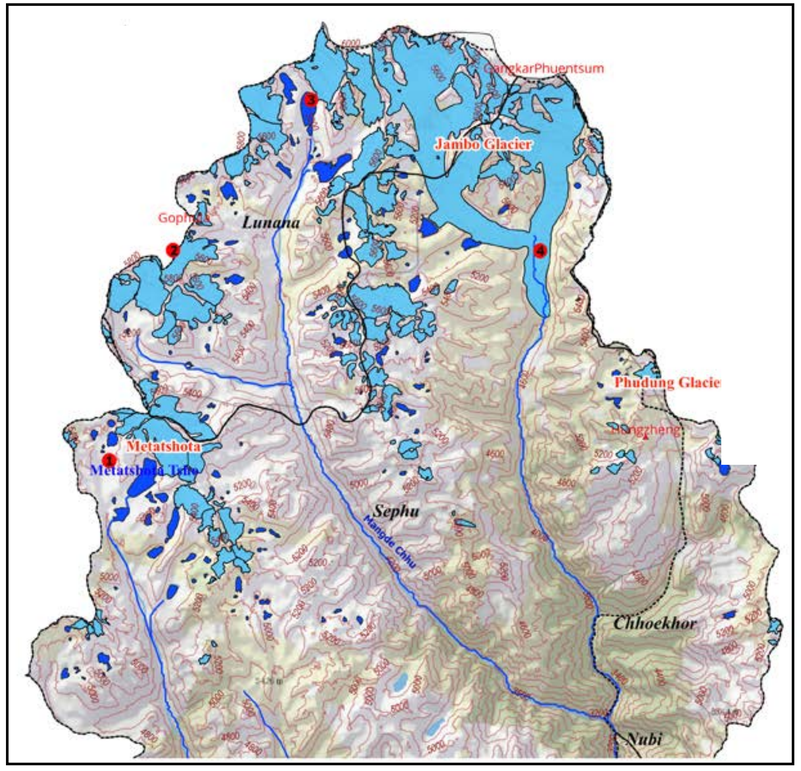


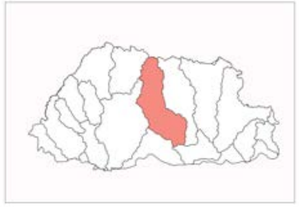
©Naito, 2002



©Matsuda , 2003

MANGDE CHHU SUB-BASIN





Legend

- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	111	108.26

1.Metatshota glacier

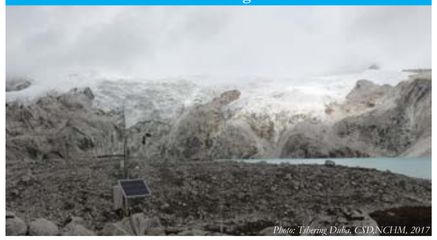


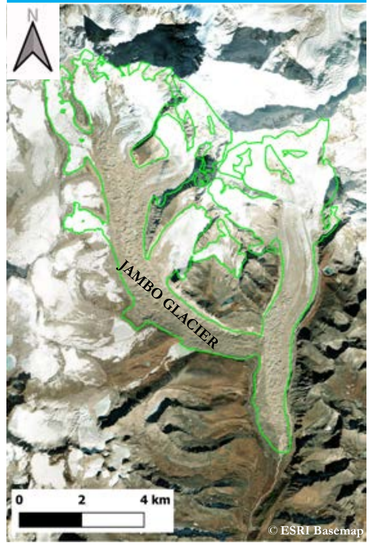
Photo: Tshering Dhar, CSD,NCHM, 2017

3.Zanam A glacier



Photo: Tobten Namgay, CSD,NCHM,2021

4.Jambo Glacier

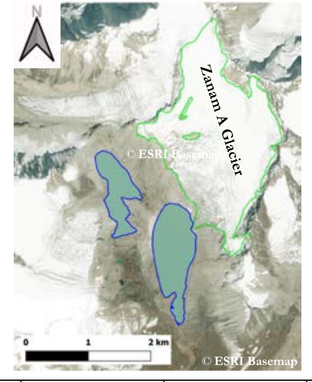


2.Gophula glacier



Photo: Karma Namgay, DGM,MoEA, 2021

3.Zanam A Glacier



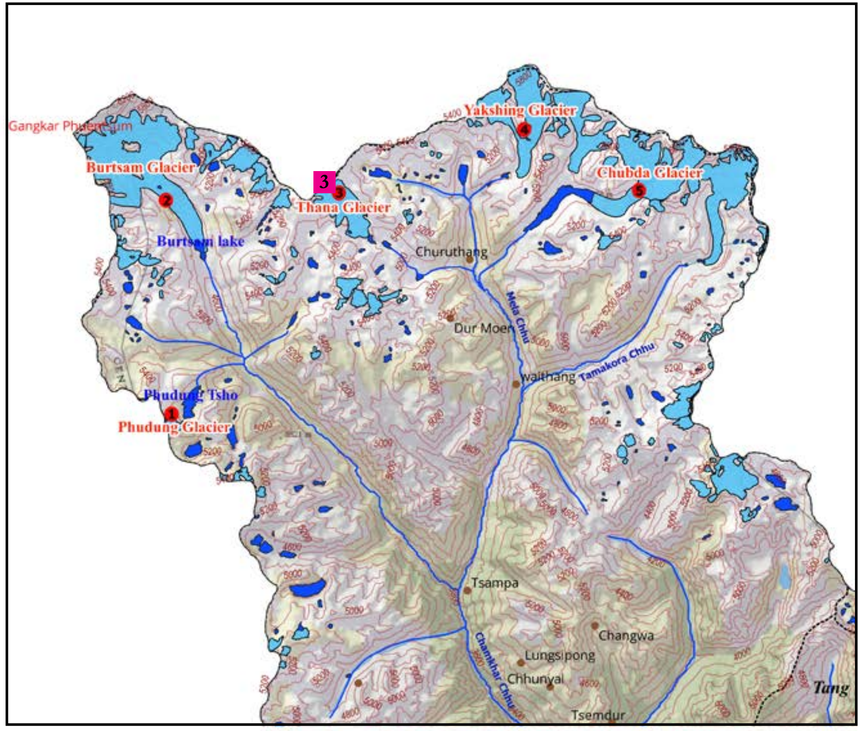
Zanam F glacier

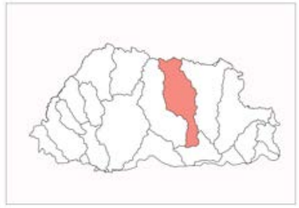


Photo: Wangchuk Namgay,CSD,NCHM, 2021

#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	MMagr16_407	Metatshota glacier	3.85	1.81	5421
2	MMagr16_426	Gophula glacier	2.58	2.82	5559
3	MMagr16_435	Zanam A glacier	3.93	2.38	5680
4	MMagr16_482	Jambo Glacier	45.85	15.27	5485

CHAMKHAR CHHU SUB-BASIN



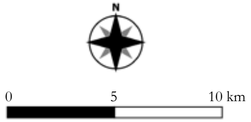


Legend

- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	90	68.28

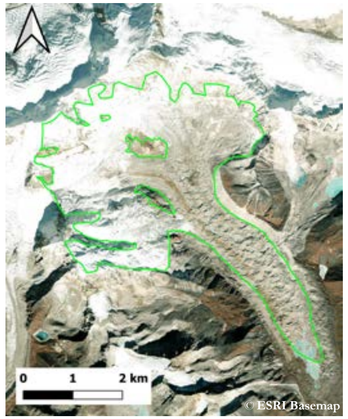


1.Phudung Glacial Lake



Photo: Phuntsho Tshering,CSD,NCHM, 2015

2.Burtsam Glacier



3.Thana Glacier



Photo: Wangchuk Namgay,CSD,NCHM, 2020

4.Yakshing Glacier



Photo: Tshering Tashi,CSD,NCHM, 2019

5.Chubda Glacier



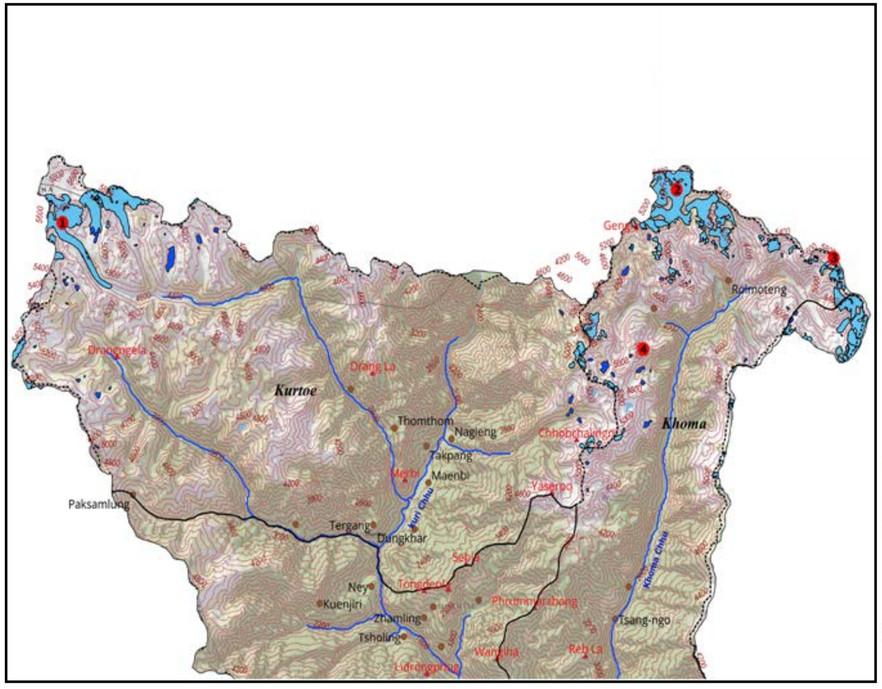
Photo: Tshering Tashi,CSD,NCHM, 2019

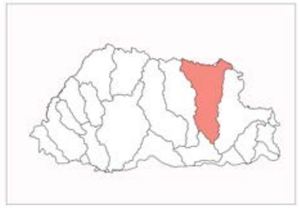


Photo: Tshering Tashi,CSD,NCHM, 2019

#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	MChgr16_508	Phudung Glacier	1.48	1	5342
2	MChgr16_519	Burtsam Glacier	15.43	7.76	5261
3	MChgr16_546	Thana Glacier	3.85	3.14	5476
4	MChgr16_557	Yakshing Glacier	7.41	5.41	5472

KURI CHHU SUB-BASIN



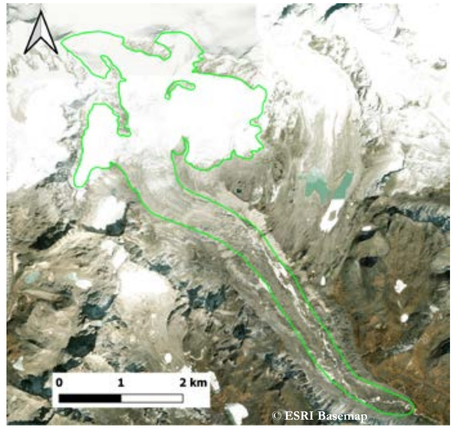


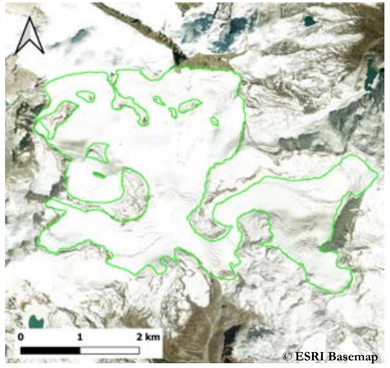
Legend

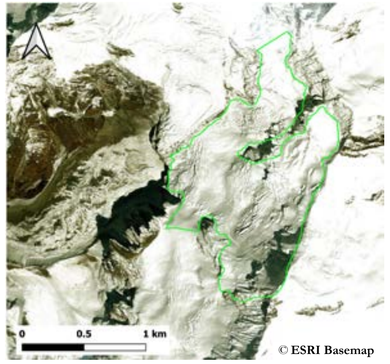
- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

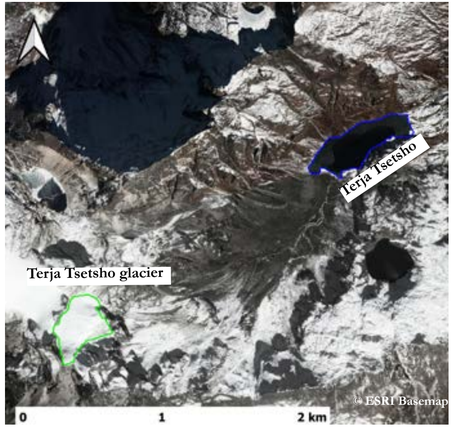
Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	90	55.29



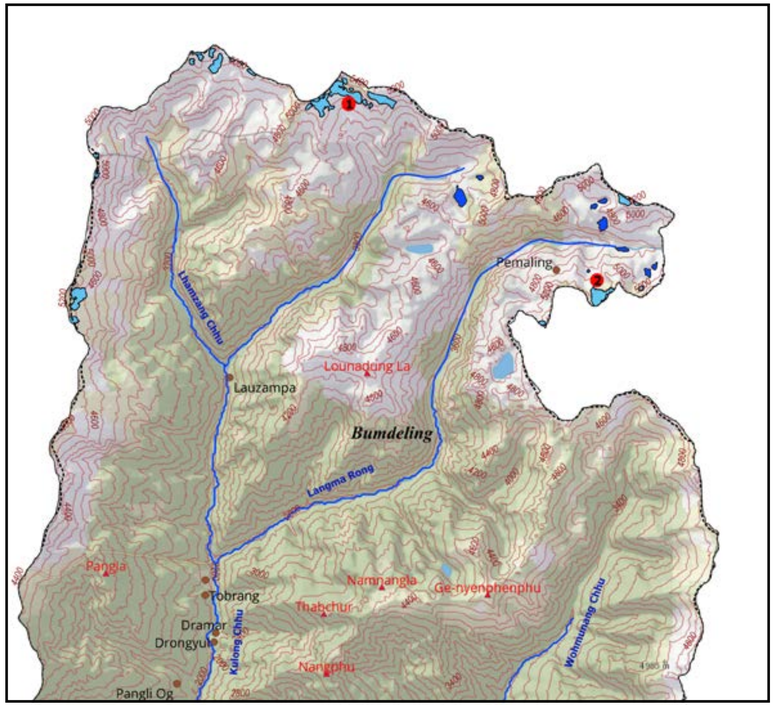






#	BGI ID	Local Name	Area (km²)	Length (km)	Elevation (mean)
1	MKugr16_600	NA	8.46	8.33	5230
2	MKugr16_640	NA	12.18	5.50	5193
3	MKugr16_664	NA	1.66	3.30	5331
4	MKugr16_613	Terja Tsetsho glacier	0.13	0.58	5160

DRANGME CHHU SUB-BASIN



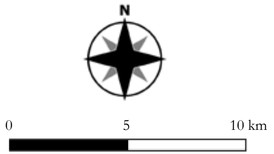


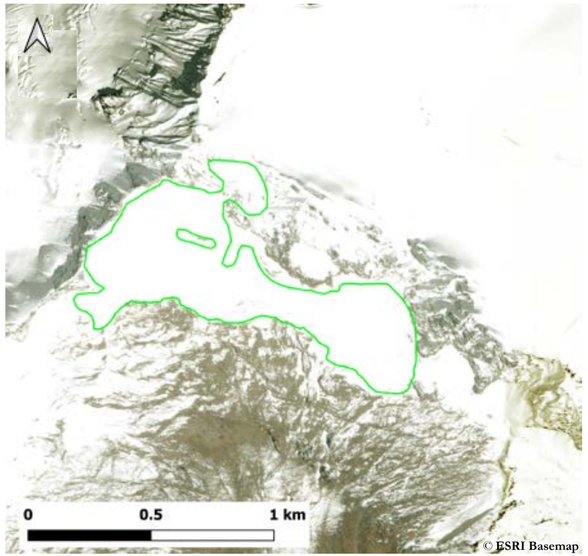
Legend

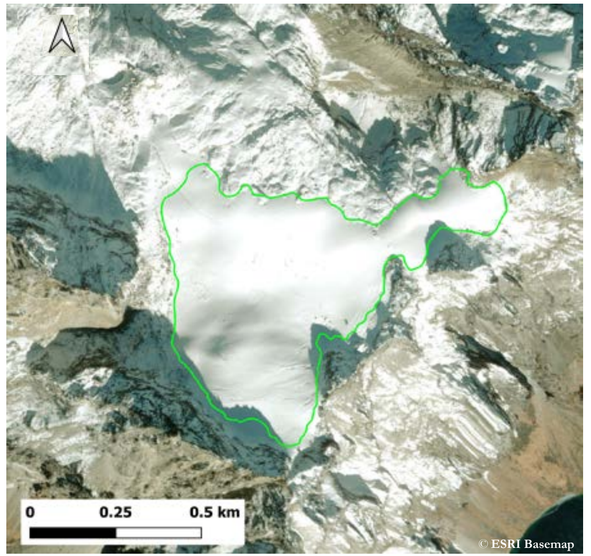
- Mountains
- River
- Contour Lines (100m)
- Basin Boundary
- Glaciers
- Gewog Boundary

Basin Summary

#	Info	Number	Area (km sq)
1	Glacier	21	3.28







#	BGI ID	Local Name	Area (km²)	Length (km)	Mean Elevation (m.a.s.l)
1	MDagr16_691	NA	0.56	1.44	5187
2	MDagr16_699	NA	0.45	0.99	5057

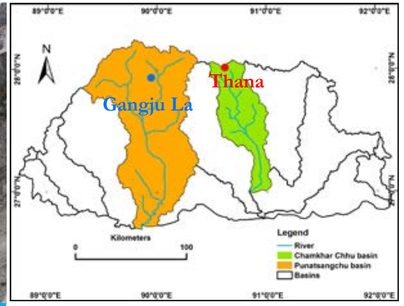

Thana Glacier, 5340 m.a.s.l

Photo: Wangdak Namgyi, CSDNCHM, 2020

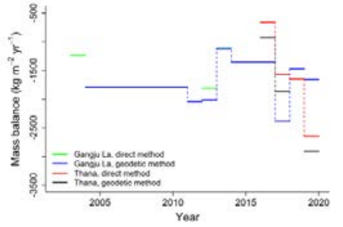
BENCHMARK GLACIERS



Gangju La Glacier



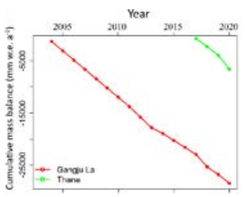
Type: Clean type
Area: 0.215 km^2
Glacier Mass Balance: -1054.07 mm w.e.a^{-1}
Terminus retreat: 209 meters(2004-2021)
Mas Thickness: 96.44 meters
Location: Coordinates:
Latitude: 27°56'24.17"N
Longitude: 89°56'53.70"E
Elevation: 5145m a.s.l
Maximum Elevation: 5200m a.s.l
Minimum Elevation: 4900m a.s.l
Aspect: North-East
Basin: Headwater of Pho Chhu, Punatsang Chhu basin.
Initial Survey: 2004
Status of Study: Ongoing

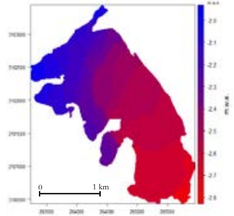


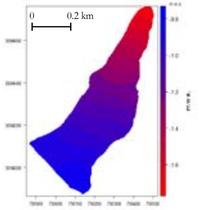


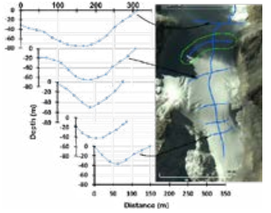
Thana Glacier

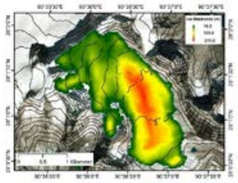
Type: Clean type
Area: 3.0 km^2
Glacier Mass Balance: -2336 mm w.e.a^{-1}
Terminus retreat: 726 meters(1980-2021)
Max Thickness: 228.86 meters
Location: Coordinates:
Latitude: 28° 1'17.90"N
Longitude: 90°36'39.16"E
Elevation: 5340m a.s.l
Maximum Elevation: 5600m a.s.l
Minimum Elevation: 5250m a.s.l
Aspect: South-East
Basin: Headwater of Chamkhar Chhu, Manas Basin
Initial Survey: 2013
Status of Study: Ongoing











BENCHMARK GLACIERS

The first program to monitor glaciers of Bhutanese Himalaya was carried out in the late 1990s in collaboration with foreign institutes such as Nagoya University, Japan and University of Vienna, Austria. Since then only longitudinal retreat was monitored and no specific mass balance of glaciers was reported until 2003 (Tshering and Fujita, 2016) for Gangju La Glacier. Monitoring activity on Thana glacier was conducted with support from the Norwegian Development Agency (NORAD-IV) project from 2012-2013 followed by Cryosphere Monitoring Program in Bhutan (CMP-B) in collaboration with the International Center for Integrated Mountain Development (ICIMOD) from 2014-2017. Currently the National Centre for Hydrology and Meteorology is annually monitoring the two benchmark glaciers carrying out the following activities:

Annual Glacier Mass Balance Measurement using stake method
Annual Glacier Mass Balance using Geodetic Method (dGPS)
Snow Depth survey
Repeat Photography from the predefined spot
Discharge measurement at Outlet
Ice thickness survey using Ice-Penetrating Radar (IPR)


Photo: Tshering Tashi,CSD,NCHM, 2020

Field photos of the Glacier Monitoring Programme








1. Gangju La Glacier


© Kabshima, 2002

Photo: Tshering Dadul,CSD,NCHM, 2017

Photo: Phuntsho Tshering,CSD,NCHM, 2004

Photo: Tshering Tashi,CSD,NCHM, 2019

Photo: Phuntsho Tshering,CSD,NCHM, 2012

Photo: Wangchuk Namgay,CSD,NCHM, 2021

2.Thana Glacier


2013
Photo: Tshering Tashi,CSD,NCHM, 2013

2014
Photo: Tshering Tashi,CSD,NCHM, 2014

2016
Photo: Tshering Tashi,CSD,NCHM, 2016

2018
Photo: Tshering Tashi,CSD,NCHM, 2018

2019
Photo: Wangchuk Namgay,CSD,NCHM, 2019

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https://www.wallpaperflare.com/


Mt.Jomolhari

Photo:Tshering Tashi,CSD,NCHM, 2016


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