सत्यमेव जयते

Monitoring of Glacial Lakes & Water Bodies in the Himalayan Region of Indian River Basins for August, 2021

Morphology & Climate Change Directorate
Central Water Commission
Department of Water Resources, River Development & Ganga Rejuvenation
Ministry of jal Shakti, New Delhi

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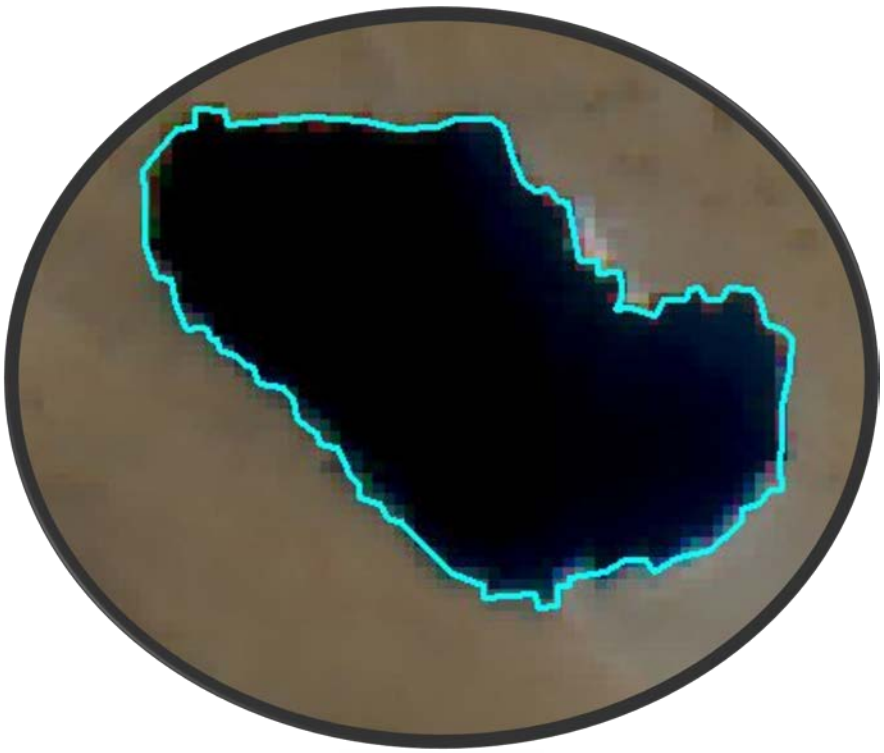

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This document presents the details on monitoring of glacial lakes and water bodies in the Indian Himalayan region during the month of August 2021 using satellite remote sensing technique including the data used and methodology followed in this study.

Keywords: Glacial Lake, Water Bodies, Himalayas, Remote Sensing, GLOF, AWiFS</td></tr>
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ABBREVIATIONS	
AP	Arunachal Pradesh
AWiFS	Advanced Wide Field Sensor
DEM	Digital Elevation Model
DIFF	Difference
FCC	False Colour Composite
GL	Glacial Lake
GLOF	Glacial lake Outburst Flood
HA	Hectare
HP	Himachal Pradesh
J&K	Jammu & Kashmir
LAT	Latitude
LONG	Longitude
LU/LC	Land Use /Land Cover
NRSC	National Remote Sensing Centre
SRTM	Shuttle Radar Topography Mission
UID	Unique Identification
UK	Uttrakhand
WB	Water Body
UT	Union Territory

Executive Summary

Glacial lakes are common in the high elevation of glacierised basin. They are formed when glacial ice or moraines impound water. These lakes normally drain their water through seepage in front of the retreating glacier. Flash floods caused by the outburst of glacial lakes, called as Glacial Lake Outburst Flood (GLOF), are well known in Himalayan terrain, where such lakes are formed due to landslides. Satellite remote sensing based mapping and monitoring of the glacial lakes and water bodies, covering Indian Himalayan region, was taken up. The analysis done for August 2021 and comparison with inventory year of 2009 is presented here.

Based on the current inventory, 415 glacial lakes & water bodies with a water spread area more than 50 ha are monitored. Apart from this, another 62 glacial lakes & water bodies with water spread area in the range 44 to 50 ha also have been monitored. Accordingly, a total of 477 glacial lakes & water bodies were considered for monitoring during August 2021.

***The inputs for this report are received from NRSC, Hyderabad**. Cloud free satellite data was available for only 114 glacial lakes & water bodies during August 2021. Water spread areas for the same were computed and compared with inventory area. Among them, 60 have shown decrease in water spread area, 37 have shown increase and 17 have not shown any significant change. It is also noted that 26 out of 60 have decreased by more than 20% and 11 out of 37 water bodies have shown increase in area by more than 20%.*

1. Introduction

1.1 Background

Glacial lakes are common in the high elevation of glacierised basin. They are formed when glacial ice or moraines impound water. There are varieties of such lakes, ranging from melt water ponds on the surface of glacier to large lakes in side valleys dammed by a glacier in the main valley. These lakes normally drain their water through seepage in front of the retreating glacier. The moraine creates topographic depression in which the melt water is generally accumulated leading to formation of glacial lake. When this lake is watertight, melt waters will accumulate in the basin until seepage or overflow limits the lake level. Such moraine-dammed lakes appear to be the most common type of glacial lakes. The impoundment of the lake may be unstable, leading to sudden release of large quantities of stored water. Failure of these ice or moraine dams as very destructive events has been documented throughout the world. Flash floods caused by the outburst of glacial lakes, called as Glacial Lake Outburst Flood (GLOF).

Satellite remote sensing techniques are used to map, inventory and monitor the glacial lakes & water bodies in Indian Himalayan region, which is formed by joining the catchment of rivers draining in India.

1.2 Remote Sensing Technology

Remote sensing is the science of acquiring information about the Earth's surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information. Satellite remote sensing technology contributed significantly to the acquisition of Earth's resources and thus helping for better management of these resources. Satellite remote sensing plays a complementary role to other means of spatial data acquisition i.e., through conventional procedures. Satellite remote sensing offers several unique advantages quick data collection, reliability, more accurate, repetitive collection, geometric integrity and digital storage, which makes it an ideal tool for mapping, inventorying and monitoring the natural resources.

Glaciers and glacial lakes are generally located in remote areas, where access is through tough and difficult terrain. The inventory of glacial lakes using conventional methods requires extensive time and resources together with undergoing hardship in the field. Creating inventories and monitoring of the glacial lakes can be done quickly and correctly using satellite images and aerial photographs. Use of these images and photographs for the evaluation of physical conditions of the area provides greater accuracy. The multi-stage approach using remotely sensed data and field investigation increases the ability and accuracy of the work. Visual and digital image analysis techniques integrated with techniques of geographic information systems (GIS) are very useful for the study of glacier, glacial lakes.

1.3 Objectives

The objectives of the study are based on the inventory of glacial lakes & water bodies in the Indian Himalayan region using satellite data of the year 2009 (Ref: NRSC Report No. NRSC-RS&GISAA-WRG-CWC-Lakes-May2011-TR255), with glacial lakes having spatial extent greater than 50 ha (during the inventorying year) -

1. Monitoring the spatial extent of the glacial lakes & water bodies on monthly basis during August to October months
2. Monitoring the spatial extent of few/selected lakes, if required, with high-resolution data on event basis,

The inventory of glacial lakes & water bodies in the Indian Himalayan region using satellite remote sensing has been carried out using base year of 2009 and monitoring has been done for the years 2011-2020. The changes in the current years will be analysed with respect to the year 2009.

This report presents the details on the data used and methodology followed in monitoring of glacial lakes & water bodies in the Indian Himalayan region using satellite data in the month of August 2021.

2. Study Area & Materials

2.1 Study Area

The present study is carried out for the area covering Indian Himalayas. The study area extends across different countries namely India, Nepal, Bhutan and China. The index map showing study area is given in Figure 1.

2.2 Materials

Advanced Wide Field Sensor (AWiFS) data from the Indian remote sensing satellite, Resourcesat-2 has been used in the study for monitoring of glacial lakes pertaining to current month.

2.2.1 Satellite Data - For the purpose of monitoring glacial lakes and water bodies from satellite images, it is preferable to have cloud free satellite images during the time of monitoring. Since the monitoring is carried out during monsoon period, probability of availability of cloud free data is less. Hence all the possible satellite data were browsed and checked for their coverage of the study area and cloud cover. The list of satellite data used for monitoring during August 2021 is given in Table 1.

Table 1. List of satellite data used

S No	Path	Row	Date
1	93	47	18- August -2021
2	94	47	23- August -2021
3	97	48	14- August -2021
4	102	49	15- August -2021
5	105	51	30- August -2021
6	112	51	17- August -2021

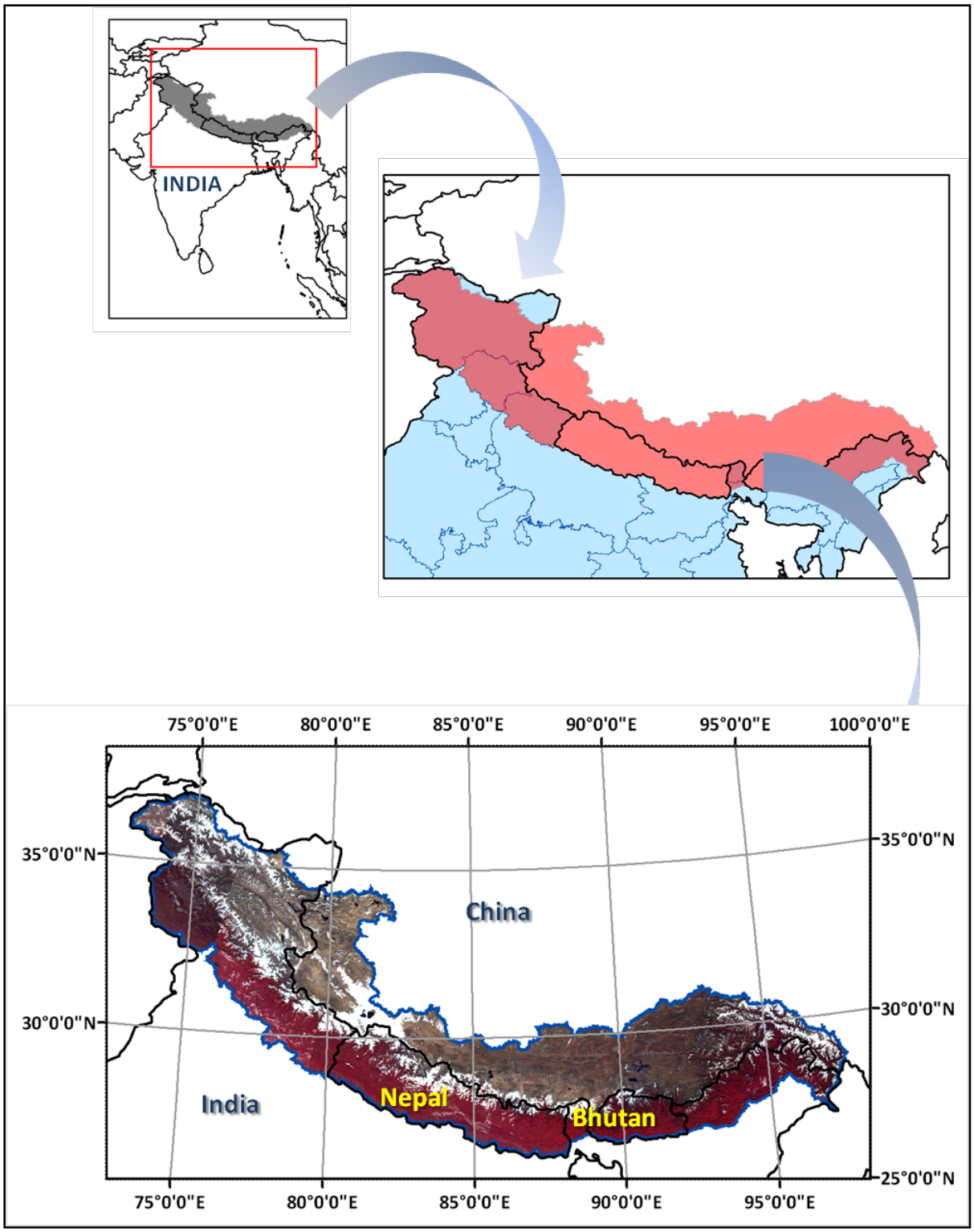


Figure 1. Index map of study area

3. Methodology

The monitoring of glacial lakes and water bodies in the Indian Himalayan region using satellite images involves the following steps.

- Ortho-rectification of satellite data
- Identification & digitization of glacial lakes & water bodies
- Organisation of database

This chapter discusses each of the above steps in detail.

3.1 Ortho-rectification of Satellite Data

Ortho-rectification is the process by which the geometric distortions of the image are modelled and accounted for, resulting in a plan metrically correct image. 3D world is imaged by most sensors in 2D and Ortho-rectification corrects for many of the anomalies resultant from this conversion. Orthorectified imagery is particularly useful in areas of the world with exacerbated terrain features such as mountains, plateaus, etc. The Ortho-rectification process yields map-accurate images which can be highly useful as base maps and may be easily incorporated into a GIS. The success of the Ortho-rectification process depends on the accuracy of the DEM and the correction method.

In this study, Orthorectified data generated under AWiFS derived LU/LC project has been used.

3.2 Monitoring of Glacial Lakes & Water Bodies

The glacial lakes & water bodies are delineated based on the visual interpretation of satellite images of Resourcesat2 AWiFS sensor. Identification of features was done through panchromatic mode and/or different colour combinations of the multi-spectral bands namely green, red, near infrared and shortwave infrared.

To identify the glacial lakes & water bodies, different image enhancement techniques are used to improve the visual interpretation. This method is complimented with the knowledge and experience of the Himalayan terrain conditions for inventorying glacial lakes and water bodies. With different spectral band combinations in false colour composite (FCC) and in individual spectral bands, glacial lakes and water bodies can be identified. The knowledge of image interpretation keys: colour, tone, texture, pattern, association, shape, shadow, etc. will also enhance the capability of identifying these features.

The water spread area of the lakes in false colour composite images ranges in appearance from light blue to blue to black. The frozen lakes appear white in colour. Sizes of water bodies are generally small, having circular, semi-circular, or irregular shapes with very fine texture. They are generally associated with glaciers in the case of high lying areas, or rivers in the case of low lying areas.

The present study proposed to monitor all the glacial lakes & water bodies that are larger than 50 ha in area. Even though during inventory, glacial lakes and water bodies having area more

than 10 ha were digitised, monitoring was carried out only for the glacial lakes & water bodies that are larger than 50 ha. The boundary of glacial lakes and water bodies are digitized as polygon feature using on-screen digitisation techniques. The polygons are geo-processed and the water spread area of glacial lakes & water bodies were computed digitally. These steps were repeated for each date of satellite data and water spread area was computed. The maximum water spread area for each water body among the different dates of satellite in the month of August 2021 has been considered for the final analysis of the change in water spread. The following criteria were followed while monitoring the water bodies.

- A change in water spread area within +/- 5% is considered to be no change.
- Partly or fully cloud covered or frozen water bodies have not been considered in monitoring.
- The spatial extent of water spread area during the current month has been mapped and compared with the spatial extent of water spread area mapped during 2009

4. Results

4.1 Results

The analysis of water spread area of glacial lakes & water bodies monitored in August 2021 was done for only 114 glacial lakes & water bodies using cloud free satellite data. Based on this, it is found that

- 60 glacial lakes & water bodies have shown decrease in water spread area, 37 have shown increase, 17 have not shown any significant change (± 5%).
- 26 out of 60 have decreased by more than 20% and 11 out of 37 water bodies have shown increase in area by more than 20%. The list of such glacial lakes & water bodies is given in Table (4).

Table (2): List of glacial lakes & water bodies monitored during August, 2021

Month	Monitored	Increased			Decreased			No Change
August, 2021	114	> 20%	< 20%	Total	> 20%	< 20%	Total	17
		11	26	37	26	34	60	

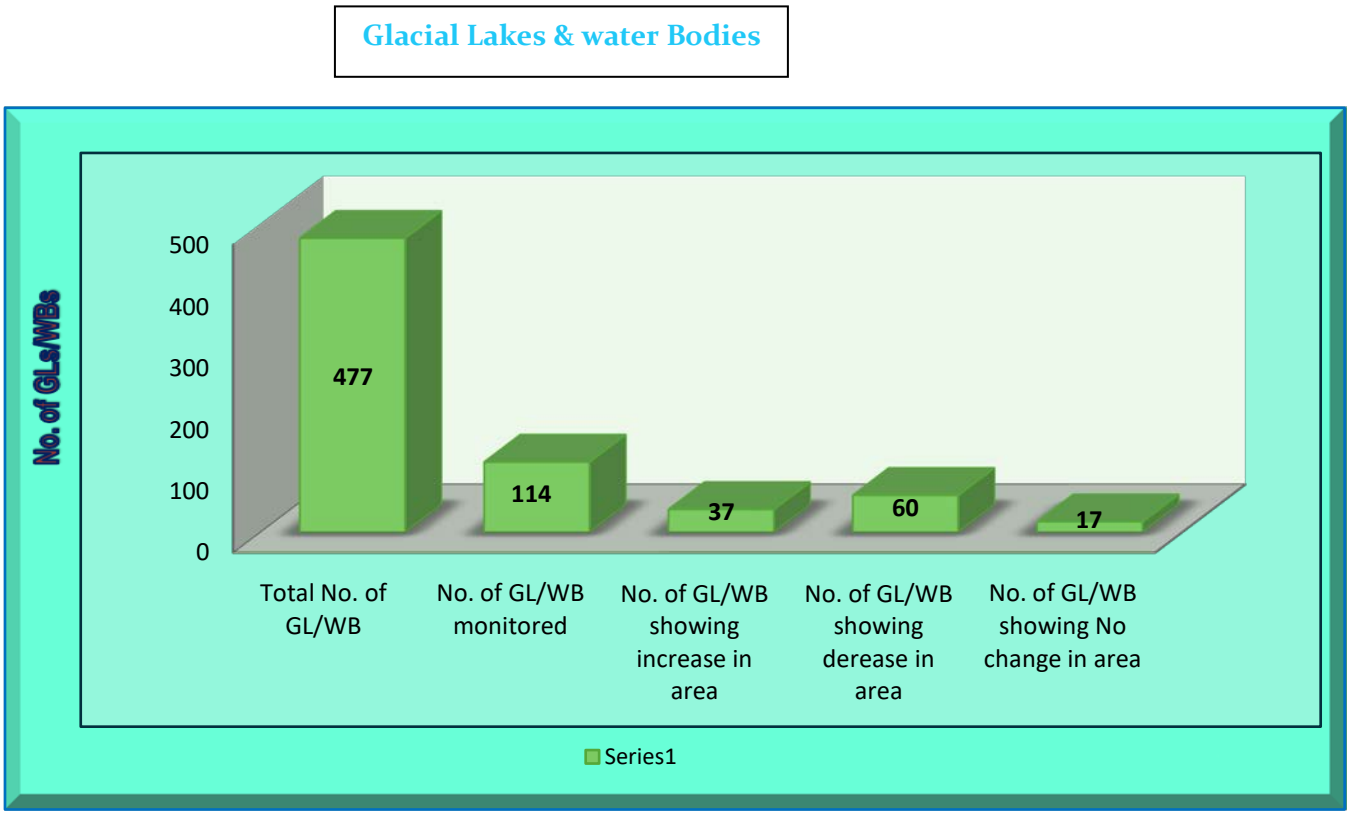


Figure 2: Glacial Lakes/ Water Bodies Monitored during the month August 2021

5. Conclusions

5.1 Conclusions

i. GL & WB having Lake Id's (CH_33, CH_55, HP_3, HP_5), (HP_3, *HP_5*), SK_20 may affect **Jammu & Kashmir/Ladakh, Himachal Pradesh and Sikkim** respectively as shown in Table (3). The area for the above-mentioned GL/WBs has been increased by more than 40%, therefore these GL/WBs required **vigorous monitoring in order to avoid any future disasters**.

ii. Water spread area of glacial lakes & water bodies showing Increase in water spread area (>20%) are shown in **Table 5(a).** Also last five year trends of these glacial lakes & water bodies are shown for comparison in **Table 6(a)**. **These Glacial lakes & water bodies requires continuous monitoring in order to avoid any future disaster.**

iii. Water spread area of glacial lakes & water bodies showing Decrease in water spread area (>20%) are shown in **Table 5(b).** Also last five year trends of this glacial lakes & water bodies are shown for comparison in **Table 6(b)**.

Table (3): List of GL/WBs showing more than 40% increase in area as compared to Base Year (Required Vigorous monitoring)

S. No.	UID	Lake_ID	Water spread area in Ha		% Diff in Water Spread Area						State/ UT	Country	Basin	River	State/UT which may likely to affect
			2009 (Inventory)	August 2021	August 2021	2020	2019	2018	2017	2016					
1	CH_33	01_61C_005	139	493	254.68	273.38	238.13	176.62	-54.98	76.26		China	Indus	Indus	J&K/Ladakh
2	HP_5	01_52H_004	46	139	202.17	260.87	252.17	243.48	157.88	178.26	HP	India	Indus	Chenab	HP, J&K/Ladakh
3	CH_55	01_61D_003	46	84	82.61	63.04	65.22	63.42	66.97	-4.35		China	Indus	Indus	J&K/Ladakh
4	SK_20	03_78A_014	94	145	54.26	59.57	65.96	65.96	5.20	40.43	Sikkim	India	Brahmaputra	Teesta	Sikkim
5	HP_3	01_52H_002	62	91	46.77	70.97	72.58	74.57	44.58	25.81	HP	India	Indus	Chenab	HP, J&K/Ladakh

Table 4 – Comparison of water spread area during August 2021 with inventory area

Table 4(a) - GL & WB that have shown INCREASE in water spread area

S.No.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
1	CH_33	01_61C_005			China	Indus	Indus	33.7486	80.6416	4480	139	493	254.68	WB
2	HP_5	01_52H_004	HP	Lahul and Spiti	India	Indus	Chenab	32.4964	77.5516	4150	46	139	202.17	GL
3	CH_55	01_61D_003			China	Indus	Indus	32.4232	80.8653	4452	46	84	82.61	WB
4	SK_20	03_78A_014	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9119	88.1986	5199	94	145	54.26	GL
5	HP_3	01_52H_002	HP	Lahul and Spiti	India	Indus	Chenab	32.5247	77.2183	4069	62	91	46.77	GL
6	CH_38	01_61C_010			China	Indus	Indus	33.7247	80.6903	4492	88	120	36.36	WB
7	CH_583	03_77P_012			China	Brahmaputra		28.5287	91.6651	4973	66	89	34.85	WB
8	HP_12	01_53E_001	HP	Mandi	India	Indus	Beas	31.673	77.0791	898	72	92	27.78	WB
9	SK_19	03_78A_013	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9188	88.161	5441	63	79	25.40	GL
10	CH_39	01_61C_011			China	Indus	Indus	33.7204	80.7213	4490	408	509	24.75	WB
11	CH_1076	03_91C_025			China	Brahmaputra		29.2945	96.8344	4013	97	120	23.71	GL
12	CH_30	01_61C_002			China	Indus	Indus	33.7511	80.5977	4492	685	821	19.85	WB
13	CH_6	01_52O_003			China	Indus	Indus	33.5621	79.963	4246	148	177	19.59	WB
14	CH_298	03_62J_026			China	Brahmaputra		30.256	82.2095	5057	103	121	17.48	GL
15	CH_63	01_61G_002			China	Indus	Indus	33.6727	81.3712	4677	1134	1326	16.93	WB
16	JK_159	01_43N_032	J&K/ Ladakh	Anantnag (Kashmir South)	India	Indus	Jhelum	34.0937	75.4979	3575	49	57	16.33	WB
17	CH_551	03_77L_042			China	Brahmaputra	Kuri Chu	28.099	90.7398	5008	50	58	16.00	GL
18	CH_52	01_61C_024			China	Indus	Indus	33.0352	80.5811	4321	4486	5187	15.63	WB
19	JK_120	01_43M_003	J&K/ Ladakh		India	Indus	Shigar (Indus)	35.2319	75.6304	2635	208	237	13.94	WB
20	JK_187	01_52C_003	J&K/ Ladakh	Kargil	India	Indus	Indus	33.1573	76.9843	4479	45	51	13.33	GL

S.NO.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
21	CH_36	01_61C_008			China	Indus	Indus	33.7344	80.6771	4492	151	171	13.25	WB
22	CH_46	01_61C_018			China	Indus	Indus	33.367	80.5531	4289	1779	2014	13.21	WB
23	CH_43	01_61C_015			China	Indus	Indus	33.4879	80.3162	4284	742	829	11.73	WB
24	JK_100	01_43J_022	J&K/ Ladakh	Baramula (Kashmir North)	India	Indus	Jhelum	34.1198	74.8307	1580	60	67	11.67	WB
25	JK_115	01_43K_014	J&K/ Ladakh	Anantnag (Kashmir South)	India	Indus	Jhelum	33.5131	74.7686	3486	112	125	11.61	WB
26	HP_1	01_52D_001	HP	Chamba	India	Indus	Ravi	32.6147	76.0316	1141	688	761	10.61	WB
27	CH_49	01_61C_021			China	Indus	Indus	33.1046	80.2862	4345	1155	1266	9.61	WB
28	CH_50	01_61C_022			China	Indus	Indus	33.0976	80.3928	4337	1501	1640	9.26	WB
29	CH_78	01_62E_003			China	Indus	Indus	31.4584	81.0907	5101	136	148	8.82	WB
30	CH_61	01_61F_004			China	Indus	Indus	34.0222	81.6133	4812	36392	39575	8.75	WB
31	CH_42	01_61C_014			China	Indus	Indus	33.4992	80.35	4277	286	311	8.74	WB
32	CH_261	02_77D_006			China	Ganga	Arun Kosi	28.056	88.4265	4886	80	86	7.50	GL
33	CH_285	03_62J_013			China	Brahmaputra		30.4189	82.3022	4931	854	911	6.67	WB
34	CH_29	01_61C_001			China	Indus	Indus	33.9535	80.9036	4525	11154	11866	6.38	WB
35	CH_203	02_71P_015			China	Ganga	Arun Kosi	28.5766	87.5441	4152	1012	1070	5.73	WB
36	CH_56	01_61D_004			China	Indus	Indus	32.1569	80.3033	4989	550	578	5.09	WB
37	CH_102	01_62J_001			China	Indus	Satluj	30.6377	82.1351	4784	5571	5850	5.01	WB

Table 4(b) - GL & WB that have shown DECREASE in water spread area

S.NO.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
1	CH_69	01_62A_003			China	Indus	Indus	31.5778	80.9895	5140	1355	1284	-5.24	WB
2	CH_54	01_61D_002			China	Indus	Indus	32.5367	80.2286	4306	1560	1478	-5.26	WB
3	CH_81	01_62E_006			China	Indus	Indus	31.292	81.2447	5050	524	496	-5.34	WB
4	JK_222	01_52K_014	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	33.2519	78.0429	4532	405	383	-5.43	WB
5	CH_429	03_71K_006			China	Brahmaputra		29.6251	86.2473	4846	2096	1982	-5.44	WB
6	CH_499	03_77J_003			China	Brahmaputra		30.4793	90.9662	5035	89	84	-5.62	WB
7	CH_66	01_61H_001			China	Indus	Indus	32.1188	81.2694	4612	282	265	-6.03	WB
8	JK_154	01_43N_027	J&K/ Ladakh	Srinagar	India	Indus	Jhelum	34.3881	75.1185	3663	48	45	-6.25	WB
9	JK_1	01_42H_001	J&K/ Ladakh		India	Indus	Gilgit	36.8806	73.7013	4286	276	258	-6.52	WB
10	BH_14	03_77L_035			Bhutan	Brahmaputra		28.2497	90.1871	5455	58	54	-6.90	GL
11	CH_158	02_71L_003			China	Ganga	Arun Kosi	28.8322	86.5225	5319	258	238	-7.75	WB
12	JK_226	01_52L_002	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	32.9819	78.5954	4985	442	405	-8.37	WB
13	CH_95	01_62F_004			China	Indus	Satluj	30.4308	81.4329	5484	196	179	-8.67	WB
14	CH_79	01_62E_004			China	Indus	Indus	31.3568	81.1498	5157	233	212	-9.01	WB
15	CH_156	02_71L_001			China	Ganga	Arun Kosi	28.8869	86.5145	5098	85	77	-9.41	WB
16	CH_80	01_62E_005			China	Indus	Indus	31.3133	81.5171	5174	189	171	-9.52	WB
17	CH_580	03_77P_009			China	Brahmaputra		28.5463	91.5255	5083	94	85	-9.57	WB
18	BH_40	03_77L_072			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	28.0155	90.3741	5185	91	82	-9.89	GL
19	CH_93	01_62F_002			China	Indus	Satluj	30.8018	81.5652	4591	333	300	-9.91	WB
20	CH_88	01_62E_013			China	Indus	Indus	31.2415	81.6861	5341	166	149	-10.24	WB

S.NO.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
21	CH_157	02_71L_002			China	Ganga	Arun Kosi	28.8581	86.5201	5254	76	67	-11.84	WB
22	JK_98	01_43J_020	J&K/ Ladakh	Baramula (Kashmir North)	India	Indus	Jhelum	34.2499	74.6695	1579	191	167	-12.57	WB
23	CH_287	03_62J_015			China	Brahmaputra		30.3978	82.1923	5203	82	71	-13.41	WB
24	CH_127	02_71H_007			China	Ganga	Arun Kosi	28.6238	85.5094	5127	125	108	-13.60	GL
25	CH_283	03_62J_011			China	Brahmaputra		30.4685	82.0592	5180	401	346	-13.72	WB
26	CH_284	03_62J_012			China	Brahmaputra		30.4315	82.3617	4882	165	142	-13.94	WB
27	JK_219	01_52K_011	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	33.4274	78.4879	5284	186	160	-13.98	WB
28	JK_217	01_52K_009	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	33.4643	78.6109	4914	204	175	-14.22	WB
29	JK_220	01_52K_012	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	33.313	78.4781	4684	166	142	-14.46	WB
30	CH_216	02_71P_028			China	Ganga	Arun Kosi	28.206	87.0521	4980	54	46	-14.81	GL
31	BH_137	03_78I_056			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	27.8618	90.591	4770	76	63	-17.11	WB
32	CH_251	02_72M_005			China	Ganga	Arun Kosi	27.9492	87.9311	5106	74	60	-18.92	GL
33	CH_490	03_77H_020			China	Brahmaputra		28.1499	89.3497	4472	4972	3994	-19.67	WB
34	CH_252	02_72M_006			China	Ganga	Arun Kosi	27.9506	87.9088	5165	71	57	-19.72	GL
35	HP_6	01_52H_005	HP	Lahul and Spiti	India	Indus	Chenab	32.4816	77.6146	4276	45	36	-20.00	WB
36	JK_227	01_52L_003	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	32.9208	78.6002	4982	648	509	-21.45	WB
37	CH_85	01_62E_010			China	Indus	Indus	31.2741	81.5949	5228	156	122	-21.79	WB
38	HP_9	01_53A_001	HP	Kangra	India	Indus	Beas	31.9894	76.0504	407	21867	16976	-22.37	WB
39	CH_90	01_62E_015			China	Indus	Satluj	31.1823	81.1945	5413	51	39	-23.53	WB
40	CH_576	03_77P_005			China	Brahmaputra		28.7653	91.675	4616	110	84	-23.64	WB

S.NO.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
41	CH_577	03_77P_006			China	Brahmaputra		28.6629	91.6796	4616	5683	4296	-24.41	WB
42	CH_77	01_62E_002			China	Indus	Indus	31.6162	81.0168	5137	161	121	-24.84	WB
43	CH_442	03_71O_006			China	Brahmaputra		29.556	87.0275	4729	104	77	-25.96	WB
44	CH_128	02_71H_008			China	Ganga	Arun Kosi	28.6171	85.5265	5113	94	64	-31.91	GL
45	CH_418	03_71G_009			China	Brahmaputra		29.5258	85.6437	5031	178	121	-32.02	WB
46	CH_587	03_77P_016			China	Brahmaputra	Dangme Chu	28.3302	91.9633	4747	251	168	-33.07	WB
47	CH_584	03_77P_013			China	Brahmaputra		28.5301	91.5619	5153	53	35	-33.96	WB
48	JK_67	01_43G_001	J&K/ Ladakh		India	Indus	Jhelum	33.2131	73.7116	335	22154	14410	-34.96	WB
49	CH_479	03_77H_004			China	Brahmaputra		28.3271	89.4288	4426	201	130	-35.32	WB
50	CH_488	03_77H_018			China	Brahmaputra		28.1807	89.5344	4694	80	49	-38.75	WB
51	CH_64	01_61G_003			China	Indus	Indus	33.6333	81.3874	4872	63	38	-39.68	WB
52	HP_10	01_53A_002	HP	Bilaspur	India	Indus	Satluj	31.3855	76.535	506	13679	7751	-43.34	WB
53	CH_671	03_82C_016			China	Brahmaputra		29.6666	92.3935	4677	54	30	-44.44	WB
54	CH_614	03_78M_003			China	Brahmaputra	Dangme Chu	27.9011	91.8969	4452	207	114	-44.93	WB
55	JK_191	01_52G_003	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	33.3107	77.997	4531	1502	755	-49.73	WB
56	UK_2	02_53K_002	Uthrakhand	Udham Singh Nagar	India	Ganga	Ramganga	29.3194	78.9203	265	1597	758	-52.54	WB
57	CH_106	02_62B_001			China	Ganga	Karnal	30.618	80.6304	5214	47	22	-53.19	WB
58	CH_522	03_77L_006			China	Brahmaputra		28.8945	90.4054	4529	44	20	-54.55	WB
59	CH_73	01_62B_001			China	Indus	Satluj	30.823	80.743	4527	440	199	-54.77	WB
60	CH_565	03_77O_002			China	Brahmaputra		29.8996	91.1667	3798	100	22	-78.00	WB

Table 4(c) - GL & WB that have shown NO CHANGE in water spread area

S.No.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
1	CH_438	03_71O_002			China	Brahmaputra		29.7047	87.0169	4903	48	50	4.17	WB
2	CH_410	03_71G_001			China	Brahmaputra		29.8928	85.2471	5162	720	748	3.89	WB
3	CH_137	02_71H_017			China	Ganga	Arun Kosi	28.4954	85.6359	5278	472	490	3.81	GL
4	CH_44	01_61C_016			China	Indus	Indus	33.4329	80.4666	4287	344	355	3.20	WB
5	CH_550	03_77L_041			China	Brahmaputra	Kuri Chu	28.1235	90.5667	5178	56	57	1.79	GL
6	CH_94	01_62F_003			China	Indus	Satluj	30.6848	81.4701	4585	40552	41260	1.75	WB
7	CH_135	02_71H_015			China	Ganga	Arun Kosi	28.533	85.6086	5352	506	512	1.19	GL
8	CH_59	01_61F_002			China	Indus	Indus	34.2987	81.2015	5274	55	55	0.00	WB
9	CH_165	02_71L_010			China	Ganga	Sun Kosi	28.3486	86.225	5348	47	47	0.00	GL
10	CH_40	01_61C_012			China	Indus	Indus	33.5459	80.1506	4280	290	288	-0.69	WB
11	JK_225	01_52L_001	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Satluj	32.8967	78.3135	4522	14110	13985	-0.89	WB
12	CH_92	01_62F_001			China	Indus	Satluj	30.6888	81.232	4570	25486	25235	-0.98	WB
13	JK_224	01_52K_016	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Satluj	33.1062	78.3036	4671	507	501	-1.18	WB
14	BH_4	03_77H_011			Bhutan	Brahmaputra		28.2302	89.8875	4921	143	141	-1.40	GL
15	CH_51	01_61C_023			China	Indus	Indus	33.0993	80.1774	4346	633	623	-1.58	WB
16	CH_8	01_52O_005			China	Indus	Indus	33.3903	79.367	4353	780	759	-2.69	WB
17	JK_47	01_43E_023	J&K/ Ladakh		India	Indus	Gilgit	35.865	73.7452	4140	82	79	-3.66	WB

Table 4(d) - GL & WB that are Covered by Clouds

S.No.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
1	JK_3	01_42H_003	J&K/ Ladakh		India	Indus	Gilgit	36.6465	73.6473	3925	97	Cloud	NA	WB
2	JK_5	01_42H_005	J&K/ Ladakh		India	Indus	Gilgit	36.2491	73.3615	2217	52	Cloud	NA	WB
3	JK_22	01_43A_001	J&K/ Ladakh		India	Indus	Gilgit	35.995	72.6126	3622	203	Cloud	NA	WB
4	JK_23	01_43A_002	J&K/ Ladakh		India	Indus	Gilgit	35.9451	72.5947	3761	91	Cloud	NA	WB
5	JK_30	01_43E_006	J&K/ Ladakh		India	Indus	Gilgit	35.9453	73.3646	4162	71	Cloud	NA	WB
6	JK_82	01_43J_004	J&K/ Ladakh		India	Indus	Jhelum	34.9209	74.5208	4045	65	Cloud	NA	WB
7	JK_85	01_43J_007	J&K/ Ladakh		India	Indus	Jhelum	34.8292	74.0617	3680	95	Cloud	NA	WB
8	JK_95	01_43J_017	J&K/ Ladakh	Baramula (Kashmir North)	India	Indus	Jhelum	34.4321	74.9242	3571	164	Cloud	NA	WB
9	JK_128	01_43N_001	J&K/ Ladakh		India	Indus	Shingo (Indus)	34.9912	75.2361	4138	127	Cloud	NA	WB
10	JK_147	01_43N_020	J&K/ Ladakh		India	Indus	Jhelum	34.6973	75.1369	4103	63	Cloud	NA	WB
11	JK_149	01_43N_022	J&K/ Ladakh		India	Indus	Jhelum	34.6665	75.1793	4234	72	Cloud	NA	WB
12	JK_99	01_43J_021	J&K/ Ladakh	Bagdam	India	Indus	Jhelum	34.1184	74.861	1585	1238	Cloud	NA	WB
13	JK_157	01_43N_030	J&K/ Ladakh	Srinagar	India	Indus	Jhelum	34.1392	75.1474	3780	86	Cloud	NA	WB
14	JK_111	01_43K_010	J&K/ Ladakh	Rajauri	India	Indus	Jhelum	33.519	74.5837	3934	66	Cloud	NA	WB
15	JK_167	01_43P_002	J&K/ Ladakh	Jammu	India	Indus	Ravi	32.6969	75.1456	664	52	Cloud	NA	WB
16	JK_218	01_52K_010	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	33.4549	78.4984	5308	152	Cloud	NA	WB
17	JK_212	01_52K_004	J&K/ Ladakh		India	Indus	Shyok	33.5303	78.9105	4353	5741	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
18	JK_189	01_52G_001	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	33.9992	77.9789	4991	45	Cloud	NA	WB
19	CH_4	01_52O_001			China	Indus	Shyok	33.75	79.24	5064	65825	Cloud	NA	WB
20	CH_1	01_52L_008			China	Indus	Satluj	32.3264	78.7238	3861	50	Cloud	NA	WB
21	JK_197	01_52J_001	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	34.4577	78.1351	5295	97	Cloud	NA	GL
22	JK_198	01_52J_002	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	34.2331	78.4262	5350	67	Cloud	NA	WB
23	JK_202	01_52J_006	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	34.1733	78.4378	5393	110	Cloud	NA	WB
24	JK_201	01_52J_005	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	34.1861	78.5078	5424	44	Cloud	NA	WB
25	JK_205	01_52J_009	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Shyok	34.1506	78.5532	5562	57	Cloud	NA	WB
26	CH_5	01_52O_002			China	Indus	Indus	33.9803	79.5432	5259	135	Cloud	NA	WB
27	CH_3	01_52N_001			China	Indus	Indus	34.1589	79.7794	4961	11564	Cloud	NA	WB
28	JK_188	01_52E_001	J&K/ Ladakh		India	Indus	Shyok	35.418	77.6046	5098	51	Cloud	NA	GL
29	JK_196	01_52I_004	J&K/ Ladakh		India	Indus	Shyok	35.3911	78.2188	5140	124	Cloud	NA	WB
30	JK_195	01_52I_003	J&K/ Ladakh		India	Indus	Shyok	35.4105	78.2844	5154	180	Cloud	NA	WB
31	CH_28	01_61B_003			China	Indus	Indus	34.2349	80.5058	5071	224	Cloud	NA	WB
32	CH_60	01_61F_003			China	Indus	Indus	34.2751	81.0521	5255	558	Cloud	NA	WB
33	CH_62	01_61G_001			China	Indus	Indus	33.8202	81.6446	4968	85	Cloud	NA	WB
34	CH_53	01_61D_001			China	Indus	Indus	32.8015	80.4836	5590	70	Cloud	NA	WB
35	CH_101	01_62F_010			China	Indus	Satluj	30.3864	81.9299	5229	45	Cloud	NA	GL
36	CH_288	03_62J_016			China	Brahmaputra		30.3622	82.0548	5283	44	Cloud	NA	GL
37	CH_303	03_62J_031			China	Brahmaputra		30.1039	82.2696	4876	166	Cloud	NA	GL
38	CH_304	03_62J_032			China	Brahmaputra		30.0785	82.3423	4849	77	Cloud	NA	GL
39	NP_19	02_62J_003	Nepal		Nepal	Ganga	Karnal	30.0678	82.1264	4829	49	Cloud	NA	WB
40	NP_12	02_62F_019	Nepal		Nepal	Ganga	Karnal	30.1296	81.7791	5015	58	Cloud	NA	WB

S.No.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
41	NP_28	02_62K_010	Nepal		Nepal	Ganga	Karnal	29.5306	82.0914	2970	1051	Cloud	NA	WB
42	NP_30	02_62K_012	Nepal		Nepal	Ganga	Bheri	29.1966	82.9485	3692	469	Cloud	NA	WB
43	CH_386	03_62O_041			China	Brahmaputra		29.511	83.4443	4959	206	Cloud	NA	WB
44	CH_387	03_62O_042			China	Brahmaputra		29.4989	83.4279	4959	57	Cloud	NA	WB
45	CH_383	03_62O_038			China	Brahmaputra		29.6047	83.3773	4889	124	Cloud	NA	WB
46	CH_385	03_62O_040			China	Brahmaputra		29.5824	83.3556	4888	107	Cloud	NA	WB
47	CH_377	03_62O_032			China	Brahmaputra		29.6893	83.1901	5007	49	Cloud	NA	WB
48	CH_375	03_62O_030			China	Brahmaputra		29.7263	83.1046	5021	97	Cloud	NA	WB
49	CH_316	03_62K_012			China	Brahmaputra		29.7355	82.9739	5337	73	Cloud	NA	GL
50	CH_313	03_62K_009			China	Brahmaputra		29.8405	82.7835	5058	250	Cloud	NA	GL
51	CH_306	03_62K_002			China	Brahmaputra		29.9801	82.5881	4853	45	Cloud	NA	WB
52	CH_305	03_62K_001			China	Brahmaputra		29.9856	82.5346	4829	370	Cloud	NA	WB
53	CH_273	03_62J_001			China	Brahmaputra		30.8805	82.8592	5446	147	Cloud	NA	WB
54	CH_326	03_62N_009			China	Brahmaputra		30.5908	83.5187	5227	288	Cloud	NA	WB
55	CH_321	03_62N_004			China	Brahmaputra		30.6681	83.6252	5166	878	Cloud	NA	WB
56	CH_320	03_62N_003			China	Brahmaputra		30.7106	83.6086	5210	57	Cloud	NA	WB
57	CH_318	03_62N_001			China	Brahmaputra		30.8889	83.5802	5101	14300	Cloud	NA	WB
58	CH_392	03_71B_002			China	Brahmaputra		30.4355	84.0592	5387	8185	Cloud	NA	WB
59	CH_338	03_62N_021			China	Brahmaputra		30.4308	83.9969	5429	197	Cloud	NA	WB
60	CH_334	03_62N_017			China	Brahmaputra		30.4654	83.9845	5450	77	Cloud	NA	WB
61	CH_339	03_62N_022			China	Brahmaputra		30.2042	83.2422	4598	198	Cloud	NA	WB
62	CH_347	03_62O_002			China	Brahmaputra		29.9607	83.2699	4585	52	Cloud	NA	WB
63	CH_369	03_62O_024			China	Brahmaputra		29.8574	83.2516	4635	721	Cloud	NA	WB
64	CH_373	03_62O_028			China	Brahmaputra		29.7947	83.5558	4574	932	Cloud	NA	WB
65	CH_372	03_62O_027			China	Brahmaputra		29.8131	83.6543	4574	47	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
66	CH_84	03_62O_039			China	Brahmaputra		29.5893	83.9888	4554	306	Cloud	NA	WB
67	CH_388	03_62O_043			China	Brahmaputra		29.4704	83.7638	5281	86	Cloud	NA	WB
68	CH_396	03_71C_003			China	Brahmaputra		29.8666	84.624	5395	47	Cloud	NA	GL
69	CH_398	03_71C_005			China	Brahmaputra		29.8455	84.6756	5536	57	Cloud	NA	GL
70	CH_403	03_71C_010			China	Brahmaputra		29.311	84.4304	4558	49	Cloud	NA	WB
71	CH_404	03_71C_011			China	Brahmaputra		29.2312	84.37	4679	119	Cloud	NA	WB
72	CH_419	03_71G_010			China	Brahmaputra		29.347	85.083	4483	304	Cloud	NA	WB
73	CH_423	03_71G_014			China	Brahmaputra		29.0838	85.1896	4605	140	Cloud	NA	WB
74	CH_420	03_71G_011			China	Brahmaputra		29.1221	85.3985	4618	1192	Cloud	NA	WB
75	CH_422	03_71G_013			China	Brahmaputra		29.1021	85.0971	4541	244	Cloud	NA	WB
76	CH_415	03_71G_006			China	Brahmaputra		29.6532	85.7377	5063	956	Cloud	NA	WB
77	CH_416	03_71G_007			China	Brahmaputra		29.654	85.8088	5149	191	Cloud	NA	WB
78	CH_417	03_71G_008			China	Brahmaputra		29.5586	85.8807	5184	60	Cloud	NA	WB
79	CH_430	03_71K_007			China	Brahmaputra		29.5795	86.261	4749	80	Cloud	NA	WB
80	CH_432	03_71K_009			China	Brahmaputra		29.5573	86.2663	4749	170	Cloud	NA	WB
81	CH_434	03_71K_011			China	Brahmaputra		29.4758	86.2308	4759	387	Cloud	NA	WB
82	CH_123	02_71H_003			China	Ganga	Arun Kosi	28.6862	85.9542	4643	216	Cloud	NA	WB
83	CH_122	02_71H_002			China	Ganga	Arun Kosi	28.7236	85.8796	4646	2152	Cloud	NA	WB
84	CH_141	02_71H_021			China	Ganga	Trisuli	28.4685	85.5188	4445	48	Cloud	NA	GL
85	CH_132	02_71H_012			China	Ganga	Arun Kosi	28.5638	85.6041	5366	89	Cloud	NA	GL
86	CH_121	02_71H_001			China	Ganga	Arun Kosi	28.8923	85.5857	4602	26825	Cloud	NA	WB
87	NP_45	02_71D_004	Nepal		Nepal	Ganga	Trisuli	28.4888	84.4857	4181	74	Cloud	NA	GL
88	NP_36	02_62P_003	Nepal		Nepal	Ganga	Trisuli	28.6922	83.8525	4910	315	Cloud	NA	GL
89	NP_37	02_62P_004	Nepal		Nepal	Ganga	Trisuli	28.217	83.9455	798	406	Cloud	NA	WB
90	NP_48	02_71D_007	Nepal		Nepal	Ganga	Trisuli	28.1755	84.0994	705	300	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
91	NP_49	02_71D_008	Nepal		Nepal	Ganga	Trisuli	28.1538	84.1121	624	98	Cloud	NA	WB
92	NP_57	02_72E_001	Nepal		Nepal	Ganga	Baghmati	27.6018	85.157	1545	142	Cloud	NA	WB
93	NP_41	02_63M_002	Nepal		Nepal	Ganga	Rapti	27.6211	83.1017	110	153	Cloud	NA	WB
94	UK_1	02_53K_001	Uthrakhand	Pauri Garhwal	India	Ganga	Ramganga	29.5695	78.763	347	6790	Cloud	NA	WB
95	UK_8	02_53O_005	Uthrakhand	Udham Singh Nagar	India	Ganga	Ramganga	29.1352	79.2888	239	1510	Cloud	NA	WB
96	UK_10	02_53P_002	Uthrakhand	Udham Singh Nagar	India	Ganga	Ramganga	28.9515	79.5869	213	734	Cloud	NA	WB
97	UK_11	02_53P_003	Uthrakhand	Udham Singh Nagar	India	Ganga	Ramganga	28.901	79.623	207	1078	Cloud	NA	WB
98	UK_9	02_53P_001	Uthrakhand	Udham Singh Nagar	India	Ganga	Ganga	28.9583	79.8424	210	2054	Cloud	NA	WB
99	UK_4	02_53O_001	Uthrakhand	Naini Tal	India	Ganga	Ramganga	29.3859	79.4599	1942	46	Cloud	NA	WB
100	CH_621	03_82A_002			China	Brahmaputra		31.1201	92.8332	4902	319	Cloud	NA	WB
101	CH_623	03_82A_004			China	Brahmaputra		31.1025	92.6988	5003	46	Cloud	NA	WB
102	CH_626	03_82A_007			China	Brahmaputra		31.0362	92.7869	4909	85	Cloud	NA	WB
103	CH_632	03_82B_006			China	Brahmaputra		30.9338	92.7744	4835	124	Cloud	NA	WB
104	CH_635	03_82B_009			China	Brahmaputra		30.9061	92.8171	4960	156	Cloud	NA	WB
105	CH_631	03_82B_005			China	Brahmaputra		30.9346	92.8292	4886	195	Cloud	NA	WB
106	CH_630	03_82B_004			China	Brahmaputra		30.9489	92.8896	4892	97	Cloud	NA	WB
107	CH_628	03_82B_002			China	Brahmaputra		30.9759	92.9413	4904	405	Cloud	NA	WB
108	CH_622	03_82A_003			China	Brahmaputra		31.1092	92.952	4894	99	Cloud	NA	WB
109	CH_721	03_82E_003			China	Brahmaputra		31.1036	93.1435	5024	98	Cloud	NA	WB
110	CH_722	03_82E_004			China	Brahmaputra		31.0647	93.2924	5047	47	Cloud	NA	WB
111	CH_725	03_82E_007			China	Brahmaputra		31.004	93.0878	5040	71	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
112	CH_636	03_82B_010			China	Brahmaputra		30.8784	92.8806	4982	52	Cloud	NA	WB
113	CH_634	03_82B_008			China	Brahmaputra		30.8961	92.9098	4943	254	Cloud	NA	WB
114	CH_633	03_82B_007			China	Brahmaputra		30.8947	92.9507	4958	199	Cloud	NA	WB
115	CH_720	03_82E_002			China	Brahmaputra		31.1315	93.1768	5007	659	Cloud	NA	WB
116	CH_564	03_77O_001			China	Brahmaputra		29.9188	91.0895	3873	154	Cloud	NA	WB
117	CH_563	03_77N_004			China	Brahmaputra		30.009	91.8609	3869	1296	Cloud	NA	WB
118	CH_665	03_82C_010			China	Brahmaputra		29.7789	92.3881	4916	153	Cloud	NA	WB
119	CH_709	03_82D_003			China	Brahmaputra		28.8937	92.1287	4403	50	Cloud	NA	WB
120	CH_710	03_82D_004			China	Brahmaputra		28.8819	92.1515	4476	390	Cloud	NA	WB
121	CH_588	03_77P_017			China	Brahmaputra	Dangme Chu	28.2972	91.9457	4756	2345	Cloud	NA	WB
122	CH_716	03_82D_010			China	Brahmaputra	Dangme Chu	28.1915	92.043	5036	76	Cloud	NA	WB
123	CH_589	03_77P_018			China	Brahmaputra	Dangme Chu	28.1016	91.9429	4705	154	Cloud	NA	WB
124	CH_590	03_77P_019			China	Brahmaputra	Dangme Chu	28.0588	91.9397	4631	220	Cloud	NA	WB
125	CH_617	03_78M_016			China	Brahmaputra	Dangme Chu	27.8419	91.8929	4638	142	Cloud	NA	WB
126	BH_188	03_78M_010			Bhutan	Brahmaputra	Dangme Chu	27.8772	91.6338	4480	50	Cloud	NA	WB
127	BH_195	03_78M_020			Bhutan	Brahmaputra	Dangme Chu	27.8377	91.6051	4135	65	Cloud	NA	WB
128	BH_197	03_78M_022			Bhutan	Brahmaputra	Dangme Chu	27.8339	91.5536	4521	67	Cloud	NA	WB
129	BH_194	03_78M_019			Bhutan	Brahmaputra	Dangme Chu	27.8472	91.5833	4656	55	Cloud	NA	WB
130	CH_592	03_77P_021			China	Brahmaputra	Dangme Chu	28.0375	91.4518	4737	53	Cloud	NA	GL
131	CH_591	03_77P_020			China	Brahmaputra	Kuri Chu	28.0879	91.2572	4630	63	Cloud	NA	WB
132	CH_593	03_77P_023			China	Brahmaputra	Kuri Chu	28.0321	91.0017	4204	45	Cloud	NA	WB
133	CH_552	03_77L_043			China	Brahmaputra	Kuri Chu	28.0894	90.7885	5165	181	Cloud	NA	GL

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
134	BH_34	03_77L_066			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	28.0226	90.7083	4868	148	Cloud	NA	GL
135	BH_36	03_77L_068			Bhutan	Brahmaputra	Kuri Chu	28.0035	90.9051	4754	86	Cloud	NA	WB
136	CH_543	03_77L_027			China	Brahmaputra	Kuri Chu	28.2738	90.7368	4510	163	Cloud	NA	WB
137	CH_547	03_77L_032			China	Brahmaputra	Kuri Chu	28.2424	90.7273	4654	88	Cloud	NA	GL
138	CH_545	03_77L_029			China	Brahmaputra	Kuri Chu	28.273	90.5901	5419	45	Cloud	NA	GL
139	CH_640	03_82B_014			China	Brahmaputra		30.4936	92.6433	4817	157	Cloud	NA	WB
140	CH_641	03_82B_015			China	Brahmaputra		30.349	92.7353	5112	75	Cloud	NA	WB
141	CH_646	03_82B_020			China	Brahmaputra		30.2164	92.5166	4981	49	Cloud	NA	WB
142	CH_647	03_82B_021			China	Brahmaputra		30.2128	92.5711	5037	48	Cloud	NA	WB
143	CH_654	03_82B_028			China	Brahmaputra		30.0495	92.4432	4993	48	Cloud	NA	WB
144	CH_729	03_82F_004			China	Brahmaputra		30.6212	93.1805	4499	692	Cloud	NA	WB
145	CH_733	03_82F_008			China	Brahmaputra		30.5349	93.0581	4817	83	Cloud	NA	WB
146	CH_732	03_82F_007			China	Brahmaputra		30.5205	93.4448	4780	115	Cloud	NA	GL
147	CH_735	03_82F_010			China	Brahmaputra		30.4703	93.5332	5014	44	Cloud	NA	GL
148	CH_739	03_82F_014			China	Brahmaputra		30.3478	93.5067	4537	49	Cloud	NA	GL
149	CH_741	03_82F_016			China	Brahmaputra		30.3188	93.3424	4612	49	Cloud	NA	WB
150	CH_745	03_82F_020			China	Brahmaputra		30.2675	93.4563	4076	71	Cloud	NA	GL
151	CH_747	03_82F_022			China	Brahmaputra		30.2418	93.6373	4181	103	Cloud	NA	GL
152	CH_755	03_82F_030			China	Brahmaputra		30.0205	93.9681	3475	2675	Cloud	NA	WB
153	CH_847	03_82J_017			China	Brahmaputra		30.1259	94.09	3802	282	Cloud	NA	WB
154	CH_848	03_82J_018			China	Brahmaputra		30.1152	94.1881	3905	99	Cloud	NA	GL
155	CH_849	03_82J_019			China	Brahmaputra		30.0971	94.2697	3896	45	Cloud	NA	GL
156	CH_850	03_82J_020			China	Brahmaputra		30.0503	94.2482	3830	439	Cloud	NA	WB
157	CH_853	03_82J_023			China	Brahmaputra		30.0461	94.1569	4294	105	Cloud	NA	WB
158	CH_863	03_82K_007			China	Brahmaputra		29.9588	94.2918	4282	130	Cloud	NA	WB

S.No.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
159	CH_865	03_82K_009			China	Brahmaputra		29.9469	94.3579	4148	116	Cloud	NA	WB
160	CH_855	03_82J_025			China	Brahmaputra		30.0049	94.3838	4020	59	Cloud	NA	WB
161	CH_858	03_82K_002			China	Brahmaputra		29.9874	94.4354	3989	75	Cloud	NA	WB
162	CH_854	03_82J_024			China	Brahmaputra		30.0129	94.4716	4327	67	Cloud	NA	WB
163	CH_862	03_82K_006			China	Brahmaputra		29.9405	94.5884	4509	52	Cloud	NA	WB
164	CH_874	03_82K_018			China	Brahmaputra		29.8904	94.57	4149	165	Cloud	NA	WB
165	AP_77	03_83A_012	AP	Tawang	India	Brahmaputra	Dangme Chu	27.5185	92.034	4273	63	Cloud	NA	WB
166	CH_785	03_82G_024			China	Brahmaputra		29.5405	93.345	4631	95	Cloud	NA	WB
167	CH_809	03_82G_048			China	Brahmaputra		29.421	93.291	4643	55	Cloud	NA	WB
168	CH_823	03_82G_062			China	Brahmaputra		29.2403	93.276	4914	58	Cloud	NA	WB
169	CH_770	03_82G_009			China	Brahmaputra		29.6295	93.5615	4563	51	Cloud	NA	WB
170	CH_778	03_82G_017			China	Brahmaputra		29.5423	93.8304	4419	53	Cloud	NA	WB
171	CH_780	03_82G_019			China	Brahmaputra		29.5025	93.9367	4444	59	Cloud	NA	WB
172	CH_930	03_82K_074			China	Brahmaputra		29.5261	94.0573	4533	88	Cloud	NA	WB
173	CH_924	03_82K_068			China	Brahmaputra		29.5447	94.0668	4299	52	Cloud	NA	WB
174	CH_931	03_82K_075			China	Brahmaputra		29.5176	94.1208	4501	118	Cloud	NA	WB
175	CH_933	03_82K_077			China	Brahmaputra		29.5045	94.1329	4577	100	Cloud	NA	WB
176	CH_936	03_82K_080			China	Brahmaputra		29.4727	94.2363	4509	47	Cloud	NA	WB
177	CH_901	03_82K_045			China	Brahmaputra		29.8167	94.133	4558	49	Cloud	NA	WB
178	CH_873	03_82K_017			China	Brahmaputra		29.9168	94.2796	4385	179	Cloud	NA	WB
179	CH_876	03_82K_020			China	Brahmaputra		29.8966	94.4615	4346	77	Cloud	NA	WB
180	CH_896	03_82K_040			China	Brahmaputra		29.8079	94.5005	4301	66	Cloud	NA	WB
181	CH_893	03_82K_037			China	Brahmaputra		29.8278	94.462	4133	55	Cloud	NA	WB
182	CH_895	03_82K_039			China	Brahmaputra		29.8127	94.4325	4083	224	Cloud	NA	WB
183	CH_892	03_82K_036			China	Brahmaputra		29.8296	94.632	4231	69	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
184	CH_898	03_82K_042			China	Brahmaputra		29.7791	94.6008	4216	205	Cloud	NA	WB
185	CH_905	03_82K_049			China	Brahmaputra		29.7755	94.5724	4161	50	Cloud	NA	WB
186	CH_916	03_82K_060			China	Brahmaputra		29.5454	94.9649	4300	93	Cloud	NA	WB
187	CH_1032	03_82O_029			China	Brahmaputra	Dihang	29.3049	95.639	3322	68	Cloud	NA	WB
188	CH_1023	03_82O_016			China	Brahmaputra	Dihang	29.3721	95.8718	4344	91	Cloud	NA	WB
189	CH_1037	03_82O_044			China	Brahmaputra	Dihang	29.1797	95.4852	3533	92	Cloud	NA	WB
190	CH_1039	03_82O_047			China	Brahmaputra	Dihang	29.1628	95.491	3544	44	Cloud	NA	WB
191	CH_1046	03_82O_054			China	Brahmaputra	Dibang	29.1283	95.4383	3284	51	Cloud	NA	WB
192	AP_49	03_82O_042	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.1768	95.6156	3063	44	Cloud	NA	WB
193	AP_54	03_82O_061	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.0112	95.8849	3763	54	Cloud	NA	WB
194	AP_55	03_82O_062	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.0051	95.9054	3601	52	Cloud	NA	WB
195	AP_108	03_91D_009	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	28.9279	96.3388	4011	47	Cloud	NA	WB
196	AP_109	03_91D_010	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	28.919	96.383	3302	46	Cloud	NA	WB
197	AP_118	03_91D_022	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	28.8761	96.3941	3119	44	Cloud	NA	WB
198	AP_135	03_91D_041	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	28.7757	96.5315	3510	115	Cloud	NA	WB
199	CH_1136	03_91D_081			China	Brahmaputra	Luhit	28.5162	96.6984	3330	304	Cloud	NA	WB
200	CH_1135	03_91D_080			China	Brahmaputra	Luhit	28.5416	96.6176	4268	45	Cloud	NA	WB
201	AP_57	03_82O_064	AP		India	Brahmaputra	Dihang	29.0616	95.2625	3668	44	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
202	AP_84	03_91C_034	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.3018	96.0822	4274	134	Cloud	NA	WB
203	AP_91	03_91C_045	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.229	96.1915	3473	113	Cloud	NA	WB
204	AP_92	03_91C_046	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.2257	96.16	3313	61	Cloud	NA	WB
205	AP_95	03_91C_049	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.1962	96.2028	4246	57	Cloud	NA	WB
206	AP_90	03_91C_044	AP	Upper Dibang Valley	India	Brahmaputra	Luhit	29.2231	96.2781	4207	63	Cloud	NA	WB
207	AP_89	03_91C_042	AP		India	Brahmaputra	Dibang	29.2439	96.2442	4459	50	Cloud	NA	WB
208	AP_87	03_91C_040	AP		India	Brahmaputra	Luhit	29.2553	96.2447	4406	94	Cloud	NA	WB
209	AP_85	03_91C_038	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.269	96.1567	3991	113	Cloud	NA	WB
210	CH_796	03_82G_035			China	Brahmaputra		29.4765	93.6314	4369	81	Cloud	NA	WB
211	CH_784	03_82G_023			China	Brahmaputra		29.5125	93.6199	4362	84	Cloud	NA	WB
212	CH_806	03_82G_045			China	Brahmaputra		29.4054	93.7079	4505	70	Cloud	NA	WB
213	CH_811	03_82G_050			China	Brahmaputra		29.3826	93.6403	4717	44	Cloud	NA	WB
214	CH_812	03_82G_051			China	Brahmaputra		29.3697	93.6939	4725	49	Cloud	NA	WB
215	CH_816	03_82G_055			China	Brahmaputra		29.3322	93.7214	4610	62	Cloud	NA	WB
216	CH_821	03_82G_060			China	Brahmaputra		29.2872	93.7363	4562	59	Cloud	NA	WB
217	CH_826	03_82G_065			China	Brahmaputra		29.038	93.8357	4116	59	Cloud	NA	WB
218	CH_971	03_82L_009			China	Brahmaputra		28.8539	94.0002	3865	54	Cloud	NA	GL
219	CH_835	03_82J_005			China	Brahmaputra		30.6263	94.445	4095	67	Cloud	NA	GL
220	CH_834	03_82J_004			China	Brahmaputra		30.6605	94.4855	3917	378	Cloud	NA	GL
221	CH_838	03_82J_008			China	Brahmaputra		30.4502	94.6041	3998	156	Cloud	NA	GL

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
222	CH_975	03_82N_004			China	Brahmaputra		30.6011	95.1831	4278	92	Cloud	NA	GL
223	CH_990	03_82N_019			China	Brahmaputra		30.4735	95.5751	4866	55	Cloud	NA	WB
224	CH_1001	03_82N_030			China	Brahmaputra		30.2508	95.6038	4442	132	Cloud	NA	GL
225	CH_1004	03_82N_033			China	Brahmaputra		30.2213	95.5834	4342	89	Cloud	NA	GL
226	CH_959	03_82K_103			China	Brahmaputra		29.2951	94.2017	3931	50	Cloud	NA	WB
227	AP_101	03_91C_069	AP	Upper Dibang Valley	India	Brahmaputra	Dibang	29.051	96.1445	3199	78	Cloud	NA	WB
228	AP_100	03_91C_064	AP		India	Brahmaputra	Dibang	29.0794	96.1447	3945	89	Cloud	NA	WB
229	CH_1089	03_91C_059			China	Brahmaputra	Dibang	29.0917	96.2109	4261	98	Cloud	NA	WB
230	CH_1102	03_91C_074			China	Brahmaputra	Dibang	29.03	96.223	4199	47	Cloud	NA	GL
231	CH_1106	03_91C_078			China	Brahmaputra	Dibang	29.0084	96.2179	3664	48	Cloud	NA	WB
232	CH_1098	03_91C_070			China	Brahmaputra	Dibang	29.0437	96.1935	4178	57	Cloud	NA	WB
233	CH_1085	03_91C_052			China	Brahmaputra	Luhit	29.1745	96.3256	4375	64	Cloud	NA	WB
234	CH_1065	03_91C_014			China	Brahmaputra		29.599	96.1413	4073	51	Cloud	NA	GL
235	CH_1075	03_91C_024			China	Brahmaputra		29.2981	96.8164	3952	239	Cloud	NA	GL
236	CH_1079	03_91C_033			China	Brahmaputra		29.2297	96.8013	4263	153	Cloud	NA	GL
237	CH_1078	03_91C_029			China	Brahmaputra		29.2377	96.8237	4214	211	Cloud	NA	WB
238	CH_1170	03_91H_005			China	Brahmaputra	Luhit	28.9778	97.2141	4092	58	Cloud	NA	WB
239	CH_1175	03_91H_010			China	Brahmaputra	Luhit	28.9398	97.2614	4412	79	Cloud	NA	WB
240	CH_1182	03_91H_017			China	Brahmaputra	Luhit	28.877	97.3554	4569	46	Cloud	NA	WB
241	CH_1190	03_91H_025			China	Brahmaputra	Luhit	28.783	97.1519	3712	85	Cloud	NA	WB
242	CH_1194	03_91H_029			China	Brahmaputra	Luhit	28.7623	97.0567	3285	50	Cloud	NA	WB
243	CH_1176	03_91H_011			China	Brahmaputra	Luhit	28.9454	97.0981	4412	50	Cloud	NA	WB
244	CH_844	03_82J_014			China	Brahmaputra		30.1735	94.3457	3654	183	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
245	BH_104	03_78I_023			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	27.9396	90.5348	5036	51	Cloud	NA	GL
246	BH_129	03_78I_048			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	27.8669	90.8162	4135	52	Cloud	NA	WB
247	BH_35	03_77L_067			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	28.0383	90.364	5216	78	Cloud	NA	GL
248	BH_132	03_78I_051			Bhutan	Brahmaputra	Manas Chu & Mangde Chu	27.8906	90.2901	5059	103	Cloud	NA	GL
249	BH_99	03_78I_018			Bhutan	Brahmaputra	Puna Tsang Chu	27.9772	90.2323	5072	63	Cloud	NA	GL
250	BH_45	03_77L_077			Bhutan	Brahmaputra	Puna Tsang Chu	28.0151	90.2103	5127	51	Cloud	NA	WB
251	BH_19	03_77L_044			Bhutan	Brahmaputra	Puna Tsang Chu	28.1058	90.2471	4369	123	Cloud	NA	GL
252	BH_22	03_77L_051			Bhutan	Brahmaputra	Puna Tsang Chu	28.092	90.3	4513	143	Cloud	NA	GL
253	BH_13	03_77L_033			Bhutan	Brahmaputra		28.2658	90.0688	5149	177	Cloud	NA	GL
254	BH_15	03_77L_037			Bhutan	Brahmaputra		28.2377	90.1043	5126	542	Cloud	NA	GL
255	BH_12	03_77L_030			Bhutan	Brahmaputra		28.2787	90.2258	5301	79	Cloud	NA	GL
256	CH_533	03_77L_017			China	Brahmaputra		28.3857	90.3192	5337	74	Cloud	NA	WB
257	CH_530	03_77L_014			China	Brahmaputra		28.4387	90.1736	5283	48	Cloud	NA	WB
258	CH_529	03_77L_013			China	Brahmaputra		28.4489	90.2569	5188	318	Cloud	NA	WB
259	CH_528	03_77L_012			China	Brahmaputra		28.5663	90.3964	5013	28771	Cloud	NA	WB
260	CH_476	03_77H_001			China	Brahmaputra		28.8297	89.8518	4248	442	Cloud	NA	WB
261	CH_523	03_77L_007			China	Brahmaputra		28.8242	90.8334	4508	1478	Cloud	NA	WB
262	CH_527	03_77L_011			China	Brahmaputra		28.7597	90.847	4510	1209	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
263	CH_525	03_77L_009			China	Brahmaputra		28.7892	90.8941	4511	522	Cloud	NA	WB
264	CH_524	03_77L_008			China	Brahmaputra		28.8255	90.6864	4446	85	Cloud	NA	WB
265	CH_526	03_77L_010			China	Brahmaputra		28.8113	90.4929	4459	47	Cloud	NA	WB
266	CH_520	03_77L_001			China	Brahmaputra		28.9557	90.711	4442	55435	Cloud	NA	WB
267	CH_519	03_77K_017			China	Brahmaputra		29.011	90.4473	4445	3853	Cloud	NA	WB
268	CH_517	03_77K_015			China	Brahmaputra		29.1176	90.3359	4451	108	Cloud	NA	WB
269	CH_521	03_77L_003			China	Brahmaputra		28.9493	90.517	4442	4065	Cloud	NA	WB
270	CH_425	03_71K_002			China	Brahmaputra		29.8012	86.9456	4969	2248	Cloud	NA	WB
271	CH_426	03_71K_003			China	Brahmaputra		29.7664	86.9226	4976	72	Cloud	NA	WB
272	CH_453	03_77B_002			China	Brahmaputra		30.1477	88.6267	5011	227	Cloud	NA	WB
273	CH_452	03_77B_001			China	Brahmaputra		30.1682	88.6197	5029	52	Cloud	NA	WB
274	CH_460	03_77C_006			China	Brahmaputra		29.5875	88.2317	4506	102	Cloud	NA	WB
275	CH_511	03_77K_009			China	Brahmaputra		29.467	90.1723	3933	69	Cloud	NA	WB
276	CH_149	02_71H_029			China	Ganga	Sun Kosi	28.3206	85.8392	5067	474	Cloud	NA	GL
277	CH_148	02_71H_028			China	Ganga	Sun Kosi	28.3303	85.8687	5167	200	Cloud	NA	WB
278	CH_147	02_71H_027			China	Ganga	Sun Kosi	28.3612	85.8701	5212	434	Cloud	NA	GL
279	CH_155	02_71H_035			China	Ganga	Sun Kosi	28.1825	85.9229	4355	45	Cloud	NA	WB
280	CH_166	02_71L_011			China	Ganga	Sun Kosi	28.3354	86.1917	5422	58	Cloud	NA	GL
281	CH_168	02_71L_013			China	Ganga	Sun Kosi	28.3034	86.1576	5307	64	Cloud	NA	GL
282	CH_445	03_71O_009			China	Brahmaputra		29.3088	87.1895	4298	2123	Cloud	NA	WB
283	CH_446	03_71O_010			China	Brahmaputra		29.204	87.3914	4291	813	Cloud	NA	WB
284	CH_448	03_71P_001			China	Brahmaputra		28.8324	87.56	5296	112	Cloud	NA	WB
285	CH_183	02_71L_028			China	Ganga	Sun Kosi	28.1358	86.5293	4984	77	Cloud	NA	GL

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
286	CH_178	02_71L_023			China	Ganga	Arun Kosi	28.1974	86.5817	5094	116	Cloud	NA	GL
287	CH_181	02_71L_026			China	Ganga	Sun Kosi	28.1857	86.5317	5025	59	Cloud	NA	GL
288	CH_187	02_71L_032			China	Ganga	Sun Kosi	28.0445	86.5137	5241	55	Cloud	NA	GL
289	CH_188	02_71L_034			China	Ganga	Sun Kosi	28.0336	86.4962	5057	46	Cloud	NA	GL
290	NP_59	02_72I_003	Nepal		Nepal	Ganga	Sun Kosi	27.951	86.6897	4726	45	Cloud	NA	GL
291	NP_58	02_72I_002	Nepal		Nepal	Ganga	Sun Kosi	27.9752	86.6812	4834	67	Cloud	NA	GL
292	NP_62	02_72I_007	Nepal		Nepal	Ganga	Sun Kosi	27.9237	86.7866	4516	56	Cloud	NA	GL
293	NP_67	02_72I_014	Nepal		Nepal	Ganga	Sun Kosi	27.8614	86.4764	4550	137	Cloud	NA	GL
294	CH_244	02_72I_004			China	Ganga	Sun Kosi	27.9461	86.4465	5046	121	Cloud	NA	GL
295	NP_78	02_72I_025	Nepal		Nepal	Ganga	Sun Kosi	27.779	86.6136	4831	106	Cloud	NA	GL
296	NP_80	02_72I_027	Nepal		Nepal	Ganga	Sun Kosi	27.7548	86.958	4940	82	Cloud	NA	GL
297	NP_76	02_72I_023	Nepal		Nepal	Ganga	Sun Kosi	27.7831	86.9569	5204	81	Cloud	NA	GL
298	NP_64	02_72I_011	Nepal		Nepal	Ganga	Sun Kosi	27.8995	86.9211	5003	100	Cloud	NA	GL
299	NP_92	02_72M_016	Nepal		Nepal	Ganga	Arun Kosi	27.7985	87.0926	4538	161	Cloud	NA	GL
300	CH_223	02_71P_035			China	Ganga	Arun Kosi	28.152	87.1575	5141	107	Cloud	NA	WB
301	CH_242	02_71P_054			China	Ganga	Arun Kosi	28.21	87.1	4852	102	Cloud	NA	GL
302	CH_235	02_71P_047			China	Ganga	Arun Kosi	28.0693	87.0483	5589	71	Cloud	NA	GL
303	CH_210	02_71P_022			China	Ganga	Arun Kosi	28.2294	87.591	5410	80	Cloud	NA	GL
304	CH_213	02_71P_025			China	Ganga	Arun Kosi	28.2142	87.4683	4781	123	Cloud	NA	WB
305	CH_217	02_71P_029			China	Ganga	Arun Kosi	28.1784	87.5615	5011	80	Cloud	NA	GL
306	CH_231	02_71P_043			China	Ganga	Arun Kosi	28.0935	87.6375	5178	66	Cloud	NA	GL
307	CH_228	02_71P_040			China	Ganga	Arun Kosi	28.1139	87.6553	4954	135	Cloud	NA	WB
308	CH_215	02_71P_027			China	Ganga	Arun Kosi	28.1945	87.6407	5352	49	Cloud	NA	GL

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
309	CH_204	02_71P_016			China	Ganga	Arun Kosi	28.4991	87.4522	4177	137	Cloud	NA	WB
310	CH_258	02_77D_003			China	Ganga	Arun Kosi	28.3092	88.3253	4364	88	Cloud	NA	WB
311	CH_259	02_77D_004			China	Ganga	Arun Kosi	28.2939	88.121	4383	1273	Cloud	NA	WB
312	CH_256	02_77D_001			China	Ganga	Arun Kosi	28.4045	88.2286	4422	5831	Cloud	NA	WB
313	CH_206	02_71P_018			China	Ganga	Arun Kosi	28.3577	87.8852	4204	51	Cloud	NA	WB
314	CH_207	02_71P_019			China	Ganga	Arun Kosi	28.3524	87.8751	4199	48	Cloud	NA	GL
315	CH_264	02_77D_009			China	Ganga	Arun Kosi	28.0103	88.2582	5256	58	Cloud	NA	GL
316	CH_263	02_77D_008			China	Ganga	Arun Kosi	28.0184	88.2873	5268	44	Cloud	NA	GL
317	CH_262	02_77D_007			China	Ganga	Arun Kosi	28.0233	88.3545	5195	54	Cloud	NA	GL
318	CH_271	02_78A_005			China	Ganga	Arun Kosi	27.9281	88.0028	5345	89	Cloud	NA	GL
319	CH_253	02_72M_007			China	Ganga	Arun Kosi	27.9264	87.7699	4913	90	Cloud	NA	GL
320	NP_86	02_72M_009	Nepal		Nepal	Ganga	Tamur Kosi	27.8703	87.8676	4910	64	Cloud	NA	GL
321	CH_269	02_78A_003			China	Ganga	Arun Kosi	27.9463	88.0752	5488	124	Cloud	NA	GL
322	CH_270	02_78A_004			China	Ganga	Arun Kosi	27.9328	88.0668	5562	84	Cloud	NA	GL
323	SK_26	03_78A_021	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.8245	88.2492	5427	56	Cloud	NA	GL
324	SK_16	03_78A_009	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9477	88.3313	5034	54	Cloud	NA	GL
325	SK_3	03_77D_003	Sikkim	North Sikkim	India	Brahmaputra	Teesta	28.0132	88.7558	5094	96	Cloud	NA	WB
326	SK_2	03_77D_002	Sikkim	North Sikkim	India	Brahmaputra	Teesta	28.0261	88.71	5148	105	Cloud	NA	GL
327	SK_4	03_77D_004	Sikkim	North Sikkim	India	Brahmaputra	Teesta	28.0071	88.7128	5236	106	Cloud	NA	GL
328	SK_5	03_77D_005	Sikkim	North Sikkim	India	Brahmaputra	Teesta	28.0091	88.6979	5209	79	Cloud	NA	GL
329	SK_9	03_78A_001	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9917	88.8155	5303	156	Cloud	NA	GL
330	SK_11	03_78A_003	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9753	88.6164	4960	58	Cloud	NA	GL

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
331	SK_8	03_77D_008	Sikkim	North Sikkim	India	Brahmaputra	Teesta	28.0073	88.4949	5023	46	Cloud	NA	GL
332	CH_612	03_78E_023			China	Brahmaputra		27.8549	89.2666	5192	58	Cloud	NA	GL
333	CH_613	03_78E_026			China	Brahmaputra	Amo Chu	27.8087	89.227	5137	60	Cloud	NA	GL
334	CH_609	03_78E_017			China	Brahmaputra		27.8766	89.2961	5236	65	Cloud	NA	GL
335	CH_611	03_78E_019			China	Brahmaputra		27.8779	89.312	5001	60	Cloud	NA	GL
336	CH_598	03_78A_018			China	Brahmaputra	Amo Chu	27.8554	88.9448	4874	67	Cloud	NA	WB
337	CH_607	03_78E_012			China	Brahmaputra		27.9424	89.3879	4584	279	Cloud	NA	WB
338	CH_605	03_78E_009			China	Brahmaputra		27.9603	89.3964	4576	175	Cloud	NA	WB
339	CH_604	03_78E_006			China	Brahmaputra		27.9699	89.3782	4568	67	Cloud	NA	WB
340	CH_606	03_78E_010			China	Brahmaputra		27.9636	89.4127	4576	49	Cloud	NA	WB
341	CH_495	03_77H_030			China	Brahmaputra		28.0256	89.4271	4791	66	Cloud	NA	WB
342	CH_482	03_77H_008			China	Brahmaputra		28.2272	89.6382	4568	1256	Cloud	NA	WB
343	CH_483	03_77H_012			China	Brahmaputra		28.2404	89.6948	4693	76	Cloud	NA	GL
344	CH_484	03_77H_013			China	Brahmaputra		28.2089	89.7452	4949	48	Cloud	NA	GL
345	CH_481	03_77H_007			China	Brahmaputra		28.2738	89.3457	4425	924	Cloud	NA	WB
346	CH_478	03_77H_003			China	Brahmaputra		28.4005	89.0614	4712	208	Cloud	NA	WB
347	CH_492	03_77H_023			China	Brahmaputra		28.1374	89.5348	5292	47	Cloud	NA	WB
348	BH_60	03_78E_007			Bhutan	Brahmaputra	Puna Tsang Chu	27.9414	89.93	5002	61	Cloud	NA	GL
349	BH_57	03_78E_002			Bhutan	Brahmaputra	Puna Tsang Chu	27.9725	89.9299	5076	58	Cloud	NA	GL
350	BH_166	03_78I_085			Bhutan	Brahmaputra	Puna Tsang Chu	27.7996	90.2306	4758	70	Cloud	NA	WB
351	BH_73	03_78E_029			Bhutan	Brahmaputra	Puna Tsang Chu	27.6438	89.4611	4220	45	Cloud	NA	WB
352	BH_72	03_78E_028			Bhutan	Brahmaputra	Puna Tsang Chu	27.6392	89.7401	2130	47	Cloud	NA	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
353	CH_159	02_71L_004			China	Ganga	Arun Kosi	28.3947	86.3792	5481	86	Cloud	NA	GL
354	CH_161	02_71L_006			China	Ganga	Arun Kosi	28.3741	86.3046	5346	379	Cloud	NA	GL
355	AP_204	03_92A_006	AP	Lohit	India	Brahmaputra	Luhit	27.6973	96.452	1167	83	Cloud	NA	WB
356	AP_203	03_92A_005	AP	Lohit	India	Brahmaputra	Luhit	27.6899	96.8606	3371	50	Cloud	NA	WB
357	AP_67	03_82P_010	AP	Lower Dibang Valley	India	Brahmaputra	Dibang	28.1481	95.9433	1655	99	Cloud	NA	WB
358	AP_163	03_91D_107	AP	Lohit	India	Brahmaputra	Luhit	28.2024	96.8977	3751	67	Cloud	NA	WB
359	AP_185	03_91H_067	AP	Lohit	India	Brahmaputra	Luhit	28.0957	97.289	3762	56	Cloud	NA	WB
360	AP_206	03_92E_001	AP	Lohit	India	Brahmaputra	Luhit	27.9898	97.3691	4185	45	Cloud	NA	WB
361	CH_1205	03_91H_040			China	Brahmaputra	Luhit	28.4123	97.4646	4300	51	Cloud	NA	WB
362	CH_575	03_77P_004			China	Brahmaputra		28.81	91.1452	4450	211	Cloud	NA	WB
363	CH_1056	03_91C_005			China	Brahmaputra		29.8231	96.3507	4870	86	Cloud	NA	GL

Table 5 – List of GL & WB with extreme change in water spread area

Table 5(a). List of GL&WB that have shown INCREASE in water spread area (>20%)

S.NO.	UID	Lake_ID	State/ UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August -2021		
1	CH_33	01_61C_005			China	Indus	Indus	33.7486	80.6416	4480	139	493	254.68	WB
2	HP_5	01_52H_004	HP	Lahul and Spiti	India	Indus	Chenab	32.4964	77.5516	4150	46	139	202.17	GL
3	CH_55	01_61D_003			China	Indus	Indus	32.4232	80.8653	4452	46	84	82.61	WB
4	SK_20	03_78A_014	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9119	88.1986	5199	94	145	54.26	GL
5	HP_3	01_52H_002	HP	Lahul and Spiti	India	Indus	Chenab	32.5247	77.2183	4069	62	91	46.77	GL
6	CH_38	01_61C_010			China	Indus	Indus	33.7247	80.6903	4492	88	120	36.36	WB
7	CH_583	03_77P_012			China	Brahmaputra		28.5287	91.6651	4973	66	89	34.85	WB
8	HP_12	01_53E_001	HP	Mandi	India	Indus	Beas	31.673	77.0791	898	72	92	27.78	WB
9	SK_19	03_78A_013	Sikkim	North Sikkim	India	Brahmaputra	Teesta	27.9188	88.161	5441	63	79	25.40	GL
10	CH_39	01_61C_011			China	Indus	Indus	33.7204	80.7213	4490	408	509	24.75	WB
11	CH_1076	03_91C_025			China	Brahmaputra		29.2945	96.8344	4013	97	120	23.71	GL

Table 5(b). List of GL&WB that have shown DECREASE in water spread area (>20%)

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	August-2021		
1	HP_6	01_52H_005	HP	Lahul and Spiti	India	Indus	Chenab	32.4816	77.6146	4276	45	36	-20.00	WB
2	JK_227	01_52L_003	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	32.9208	78.6002	4982	648	509	-21.45	WB
3	CH_85	01_62E_010			China	Indus	Indus	31.2741	81.5949	5228	156	122	-21.79	WB
4	HP_9	01_53A_001	HP	Kangra	India	Indus	Beas	31.9894	76.0504	407	21867	16976	-22.37	WB
5	CH_90	01_62E_015			China	Indus	Satluj	31.1823	81.1945	5413	51	39	-23.53	WB
6	CH_576	03_77P_005			China	Brahmaputra		28.7653	91.675	4616	110	84	-23.64	WB
7	CH_577	03_77P_006			China	Brahmaputra		28.6629	91.6796	4616	5683	4296	-24.41	WB
8	CH_77	01_62E_002			China	Indus	Indus	31.6162	81.0168	5137	161	121	-24.84	WB
9	CH_442	03_71O_006			China	Brahmaputra		29.556	87.0275	4729	104	77	-25.96	WB
10	CH_128	02_71H_008			China	Ganga	Arun Kosi	28.6171	85.5265	5113	94	64	-31.91	GL
11	CH_418	03_71G_009			China	Brahmaputra		29.5258	85.6437	5031	178	121	-32.02	WB
12	CH_587	03_77P_016			China	Brahmaputra	Dangme Chu	28.3302	91.9633	4747	251	168	-33.07	WB
13	CH_584	03_77P_013			China	Brahmaputra		28.5301	91.5619	5153	53	35	-33.96	WB
14	JK_67	01_43G_001	J&K		India	Indus	Jhelum	33.2131	73.7116	335	22154	14410	-34.96	WB
15	CH_479	03_77H_004			China	Brahmaputra		28.3271	89.4288	4426	201	130	-35.32	WB
16	CH_488	03_77H_018			China	Brahmaputra		28.1807	89.5344	4694	80	49	-38.75	WB
17	CH_64	01_61G_003			China	Indus	Indus	33.6333	81.3874	4872	63	38	-39.68	WB
18	HP_10	01_53A_002	HP	Bilaspur	India	Indus	Satluj	31.3855	76.535	506	13679	7751	-43.34	WB
a	CH_671	03_82C_016			China	Brahmaputra		29.6666	92.3935	4677	54	30	-44.44	WB
20	CH_614	03_78M_003			China	Brahmaputra	Dangme Chu	27.9011	91.8969	4452	207	114	-44.93	WB

S.NO.	UID	Lake_ID	State/UT	District	Country	Basin	River	LAT	LONG	Elevation	Water spread area in Ha		% diff	GL/ WB
											2009 (Inventory)	Augus t-2021		
21	JK_191	01_52G_003	J&K/ Ladakh	Ladakh (Leh)	India	Indus	Indus	33.3107	77.997	4531	1502	755	-49.73	WB
22	UK_2	02_53K_002	Uthrakhand	Udham Singh Nagar	India	Ganga	Ramganga	29.3194	78.9203	265	1597	758	-52.54	WB
23	CH_106	02_62B_001			China	Ganga	Karnal	30.618	80.6304	5214	47	22	-53.19	WB
24	CH_522	03_77L_006			China	Brahmaputra		28.8945	90.4054	4529	44	20	-54.55	WB
25	CH_73	01_62B_001			China	Indus	Satluj	30.823	80.743	4527	440	199	-54.77	WB
26	CH_565	03_77O_002			China	Brahmaputra		29.8996	91.1667	3798	100	22	-78.00	WB

Table 6 (a) – Comparison of Water Spread Area for GL/WBs showing INCREASE in water spread area (>20% in August, 2021) from 2016 – August 2021 with inventory area

S.No.	UID	Lake_ID	Water spread area in Ha		% Diff in Water Spread Area					
			2009 (Inventory)	August, 2021	August-2021	2020	2019	2018	2017	2016
1	CH_33	01_61C_005	139	493	254.68	273.38	238.13	176.62	-54.98	176.62
2	HP_5	01_52H_004	46	139	202.17	260.87	252.17	243.48	157.88	243.48
3	CH_55	01_61D_003	46	84	82.61	63.04	65.22	63.42	66.97	63.42
4	SK_20	03_78A_014	94	145	54.26	59.57	65.96	65.96	5.20	65.96
5	HP_3	01_52H_002	62	91	46.77	70.97	72.58	74.57	44.58	74.57
6	CH_38	01_61C_010	88	120	36.36	59.09	61.36	35.23	27.78	35.23
7	CH_583	03_77P_012	66	89	34.85	4.55	19.70	7.58	-10.89	7.58
8	HP_12	01_53E_001	72	92	27.78	140.28	98.61	90.54	81.65	90.54
9	SK_19	03_78A_013	63	79	25.40	38.10	66.67	57.07	28.29	57.07
10	CH_39	01_61C_011	408	509	24.75	53.43	45.59	33.33	27.30	33.33
11	CH_1076	03_91C_025	97	120	23.71	45.36	54.64	32.99	7.47	32.99

Table 6 (b) – Comparison of Water Spread Area for GL/WBs showing DECREASE in water spread area (>20% in August, 2021) from 2016 – August 2021 with inventory area

S.No.	UID	Lake_ID	Water spread area in Ha		% Diff in Water Spread Area					
			2009 (Inventory)	August, 2021	August-2021	2020	2019	2018	2017	2016
1	HP_6	01_52H_005	45	36	-20.00	17.78	20.00	8.89	-10.13	-7.54
2	JK_227	01_52L_003	648	509	-21.45	-9.10	-4.78	-4.78	-6.77	-6.91
3	CH_85	01_62E_010	156	122	-21.79	8.33	61.54	6.41	-0.26	-13.18
4	HP_9	01_53A_001	21867	16976	-22.37	0.17	8.17	2.28	0.74	-1.65
5	CH_90	01_62E_015	51	39	-23.53	21.57	5.88	8.95	-5.97	-19.84
6	CH_576	03_77P_005	110	84	-23.64	-21.82	9.09	7.55	-4.78	27.94
7	CH_577	03_77P_006	5683	4296	-24.41	-12.26	2.57	2.79	-5.64	-5.63
8	CH_77	01_62E_002	161	121	-24.84	8.07	12.42	2.48	2.55	-12.60
9	CH_442	03_71O_006	104	77	-25.96	16.35	32.69	16.32	19.70	8.65
10	CH_128	02_71H_008	94	64	-31.91	32.98	37.23	31.91	14.98	4.87
11	CH_418	03_71G_009	178	121	-32.02	-4.49	3.93	-1.12	-12.32	-12.32
12	CH_587	03_77P_016	251	168	-33.07	-2.39	5.98	3.19	-13.34	-13.12
13	CH_584	03_77P_013	53	35	-33.96	13.21	24.53	31.90	-7.21	3.49
14	JK_67	01_43G_001	22154	14410	-34.96	27.34	20.80	20.80	21.20	-1.34
15	CH_479	03_77H_004	201	130	-35.32	-35.82	0.00	7.75	-3.57	-37.31
16	CH_488	03_77H_018	80	49	-38.75	6.25	31.25	33.75	-20.68	-20.68
17	CH_64	01_61G_003	63	38	-39.68	-4.76	46.03	14.29	0.85	22.22
18	HP_10	01_53A_002	13679	7751	-43.34	-13.26	7.29	-1.29	-2.89	-18.56
19	CH_671	03_82C_016	54	30	-44.44	-1.85	7.41	0.65	-10.26	1.13
20	CH_614	03_78M_003	207	114	-44.93	8.21	15.46	7.25	Cloud	2.89

S.No.	UID	Lake_ID	Water spread area in Ha		% Diff in Water Spread Area					
			2009 (Inventory)	August, 2021	August-2021	2020	2019	2018	2017	2016
21	JK_191	01_52G_003	1502	755	-49.73	-1.86	6.46	6.47	-7.27	-10.56
22	UK_2	02_53K_002	1597	758	-52.54	-20.66	-3.82	-8.27	-16.62	-54.38
23	CH_106	02_62B_001	47	22	-53.19	-4.26	25.53	25.53	0.51	-10.64
24	CH_522	03_77L_006	44	20	-54.55	6.82	18.18	9.09	-80.74	10.89
25	CH_73	01_62B_001	440	199	-54.77	-27.73	-2.73	-2.60	-26.14	-18.94
26	CH_565	03_77O_002	100	22	-78.00	-10.00	5.00	0.88	-16.12	-11.29

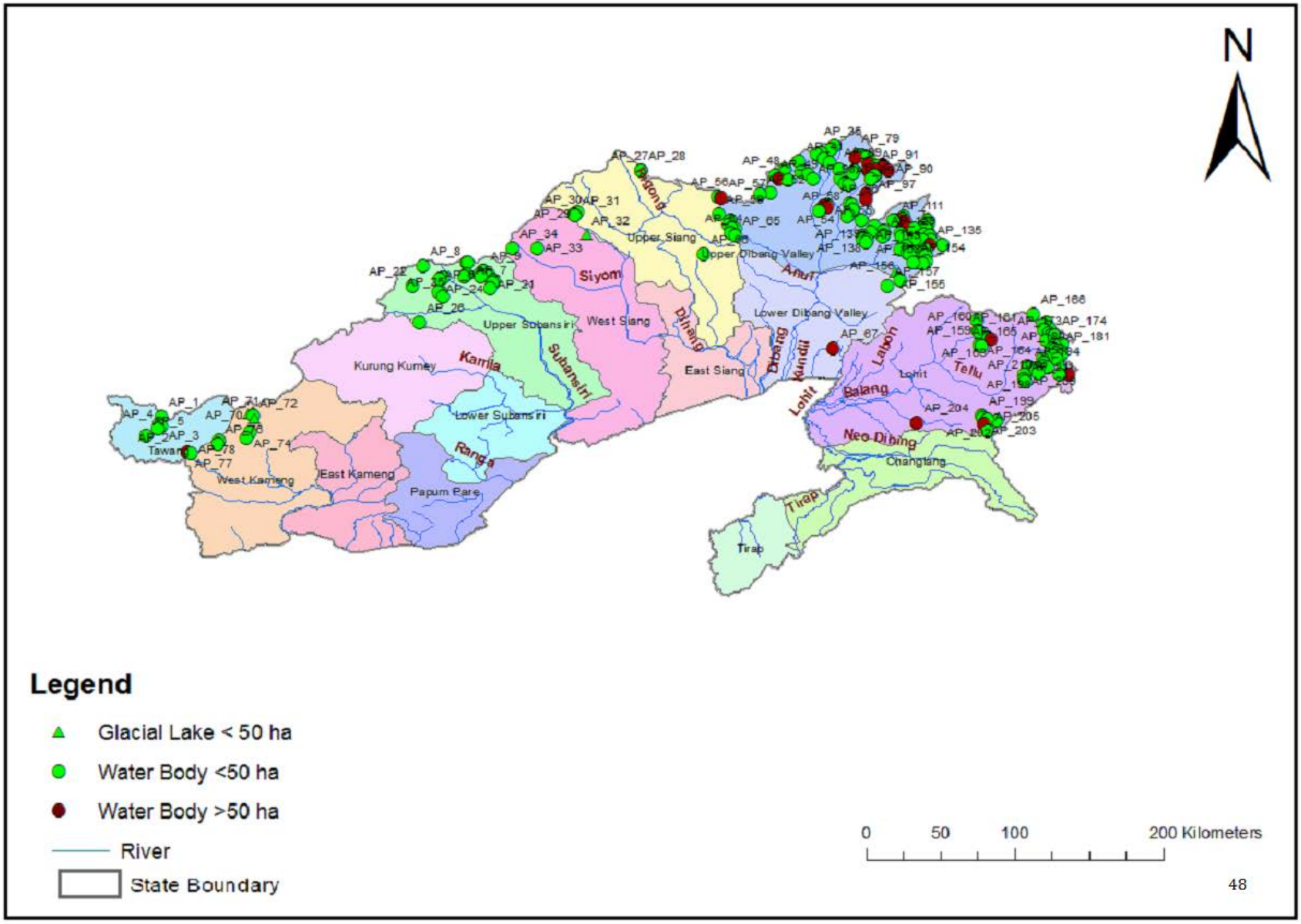


Figure 3 (a): Glacial Lakes & Water Bodies in Arunachal Pradesh

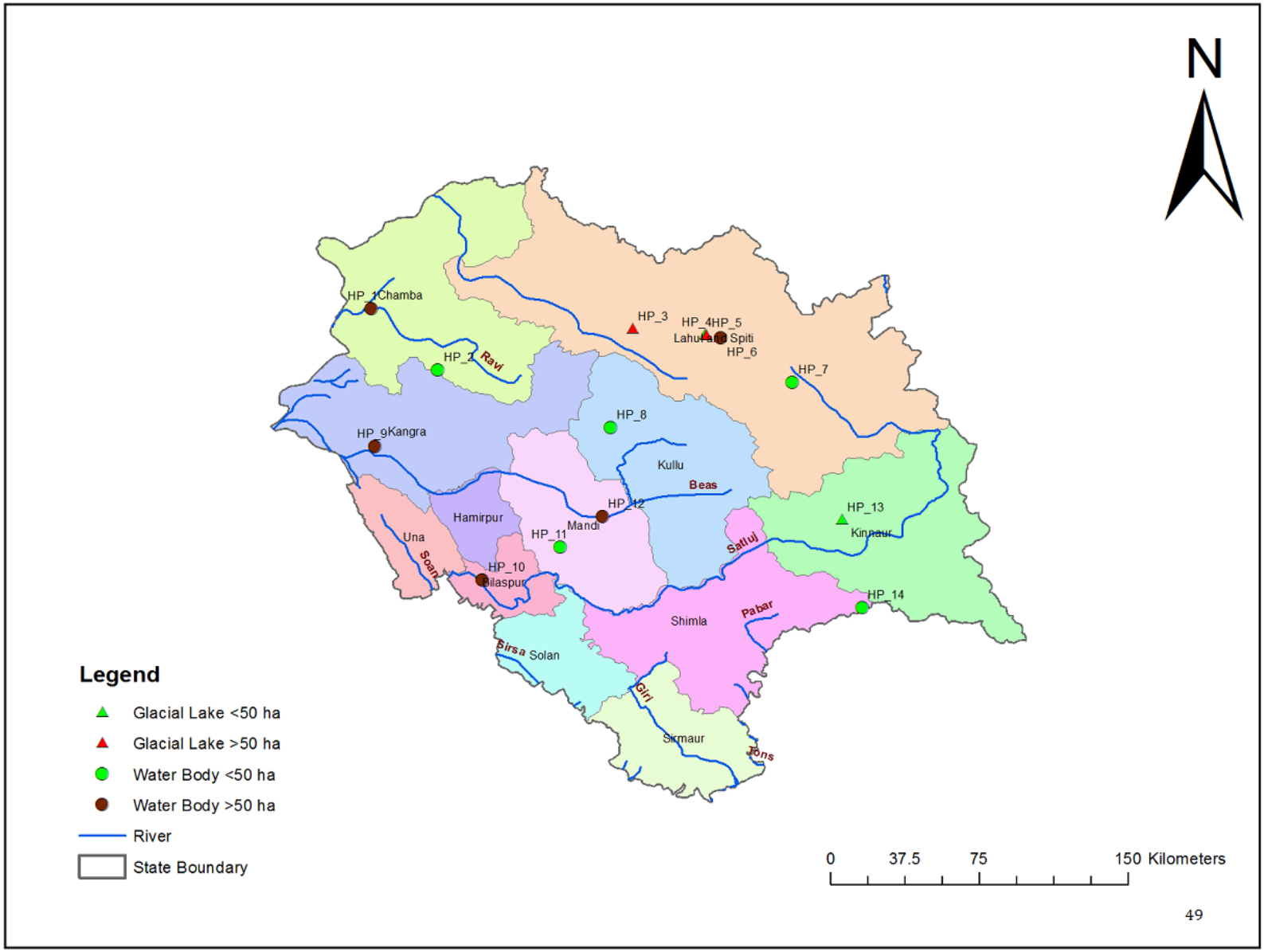


Figure 3 (b): Glacial Lakes & Water Bodies in Himachal Pradesh

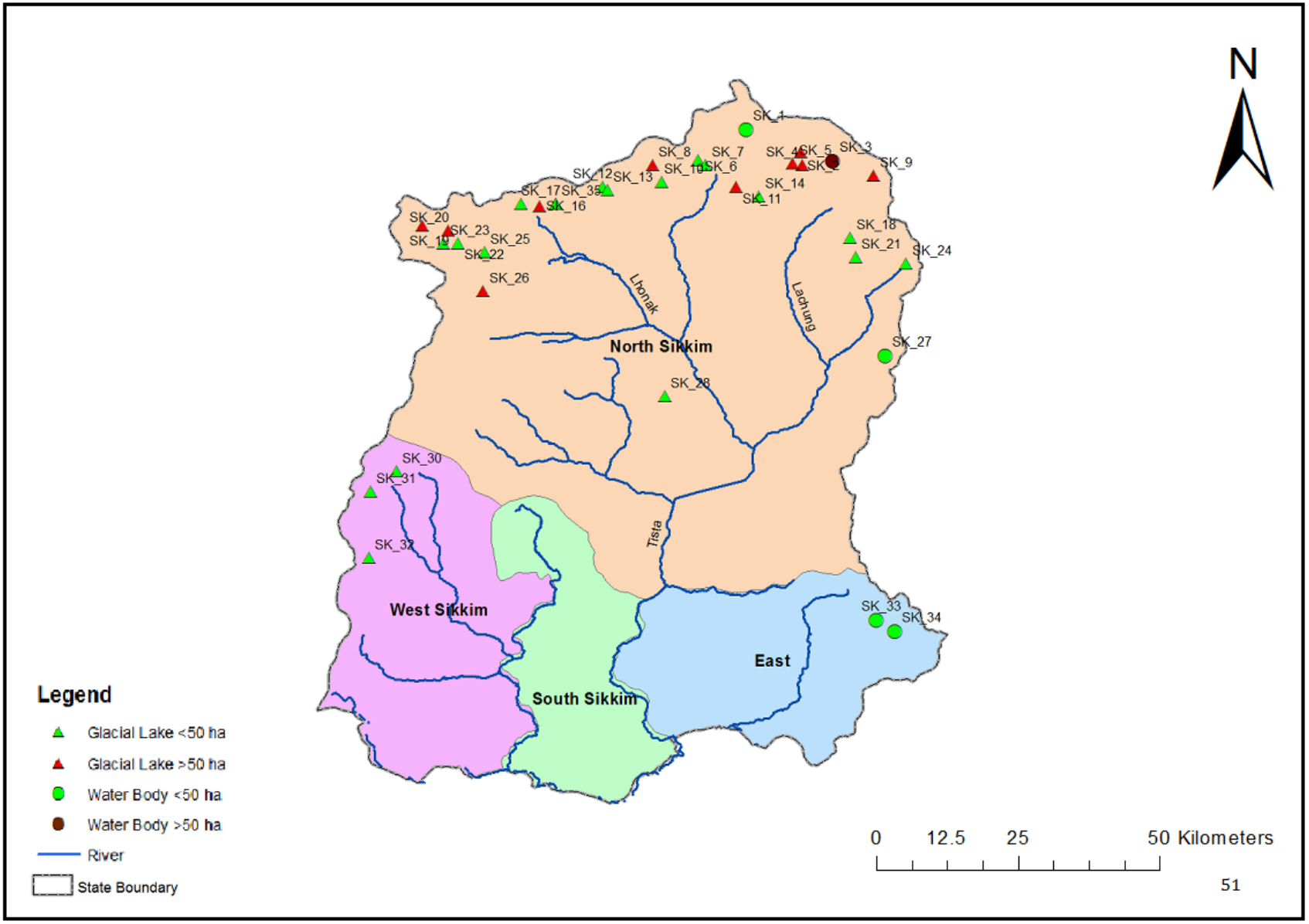


Figure 3 (c): Glacial Lakes & Water Bodies in Sikkim

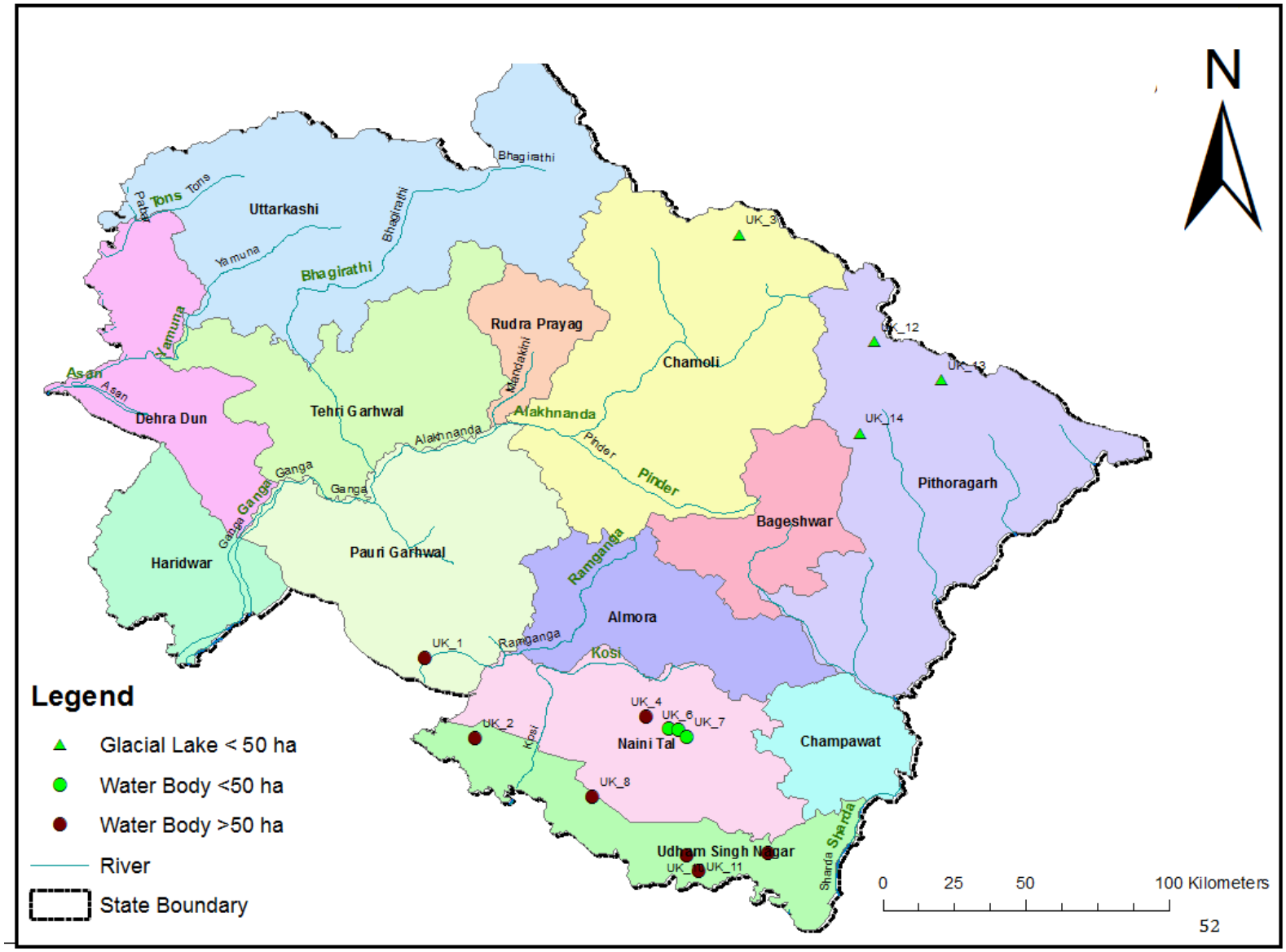


Figure 3 (d): Glacial Lakes & Water Bodies in Uttrakhand

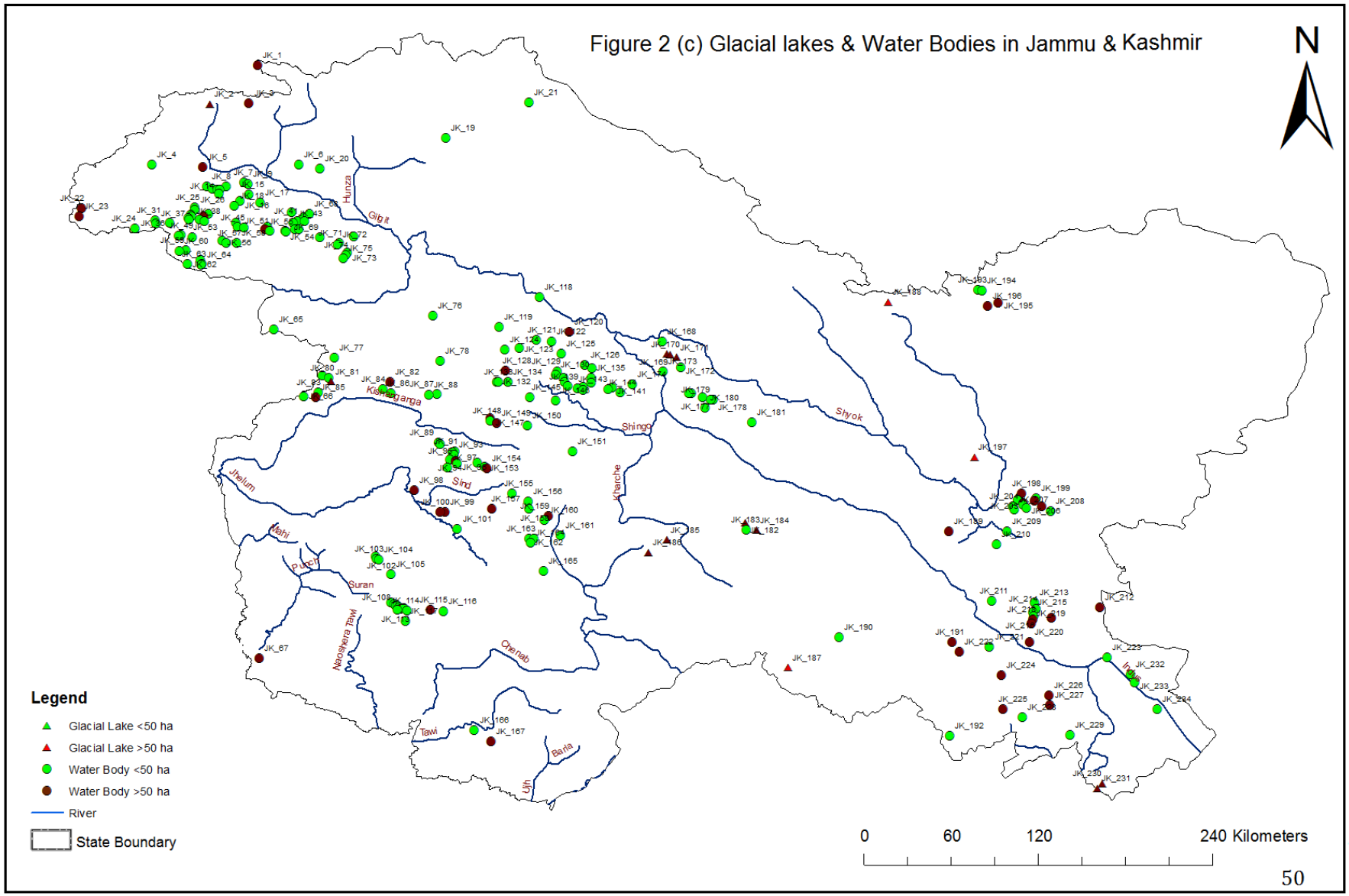
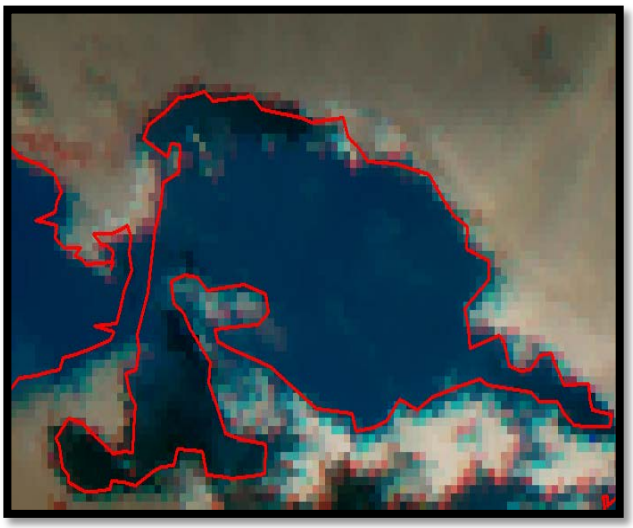


Figure 3 (e): Glacial Lakes & Water Bodies in Jammu & Kashmir including Ladakh

Figure 3 (f): Satellite Imageries of GL & WB that have shown INCREASE in water spread area (> 40%)



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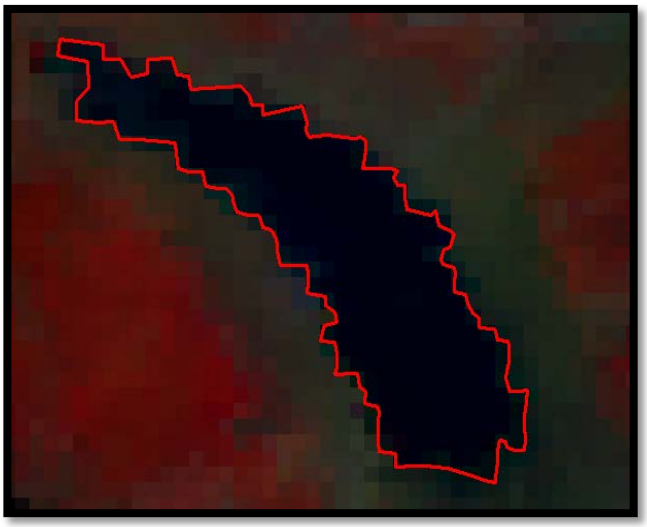

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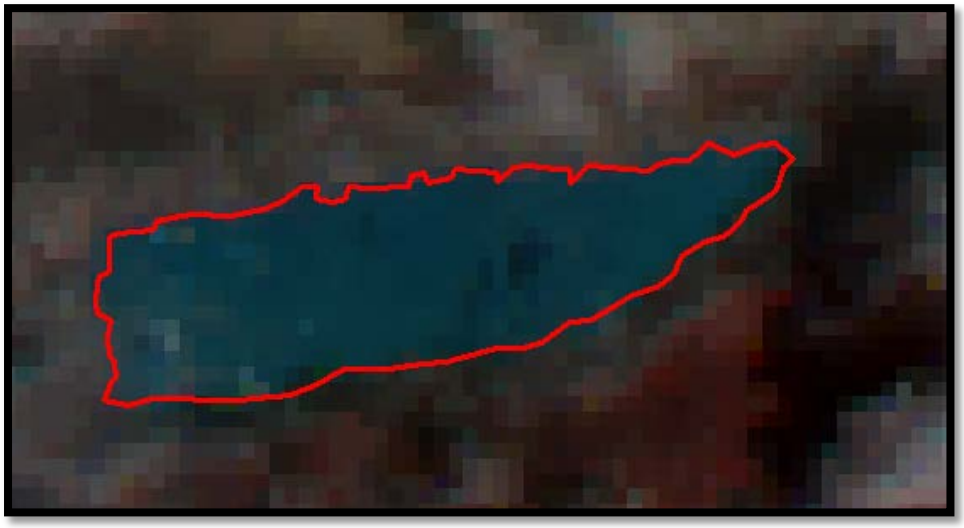

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