National Wetland Inventory and Assessment

High Altitude Himalayan Lakes

Sponsored by Ministry of Environment and Forests, Govt. of India

Space Applications Centre
Indian Space Research Organisation
Ahmedabad

www.sac.gov.in

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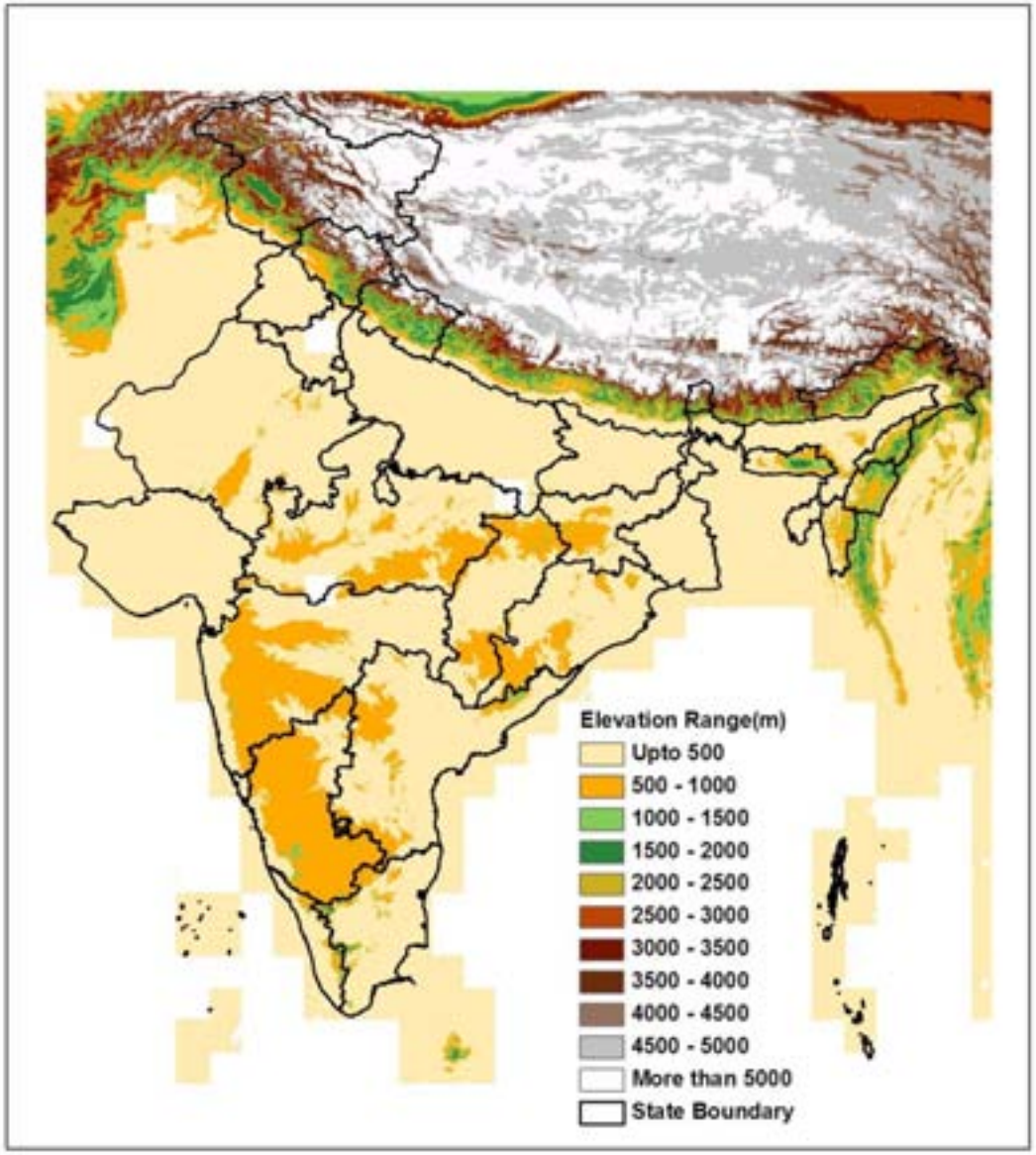

Map showing elevation ranges of India and surrounding area

High Altitude Himalayan Lakes

Under the "National Wetland Inventory and Assessment" project
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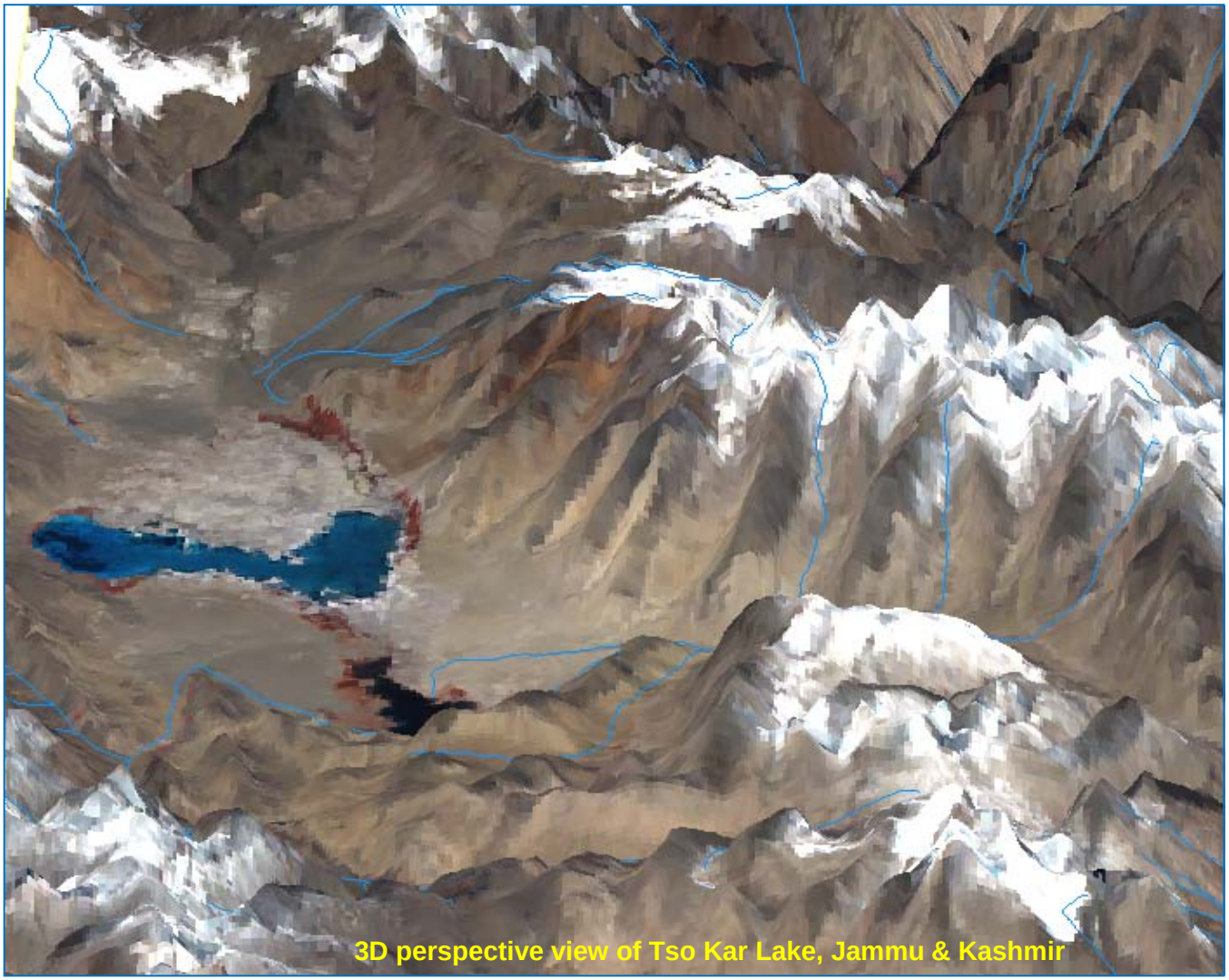


3D perspective view of Tso Kar Lake, Jammu & Kashmir

S. Panigrahy, J. G. Patel, T. S. Singh and T.V.R.Murthy

High Altitude Lakes of Sikkim

BACKGROUND

The Himalayan region is dotted with hundreds of lakes from low elevation to the high elevations. Many of the lakes of Himalaya are fresh water ones, with or without inflow and out flow. The Himalayan lakes show varying chemistry in terms of solutes, bio-geochemistry, and mineralogy vis-à-vis eco-hydrology of the lakes. These are primarily related to enormous altitude variation governing the climate, vegetation, lithology, tectonics and type and intensity of erosion/ weathering at source.

The mountain lakes, caused by glacial activity, are termed as tarns by geographers. Tarns are found mostly in the upper reaches of the Himalaya, above 5500 m. The high altitude lakes are fed by snow-melt, precipitation and springs whereas lakes of lower altitudes receive water from local rains, through streams, Nalas and springs. Many large lakes of Lesser Himalaya are fault basin lakes formed due to tectonic activity resulting in blocking of the streams/rivers during Holocene period. These have main source of water through precipitation and underground springs. Such lakes are found in Kumaun, Himachal Pradesh and Jammu. The Higher Himalayan lakes of Spiti valley, on the other hand, are fed by snow-melt, precipitation and spring water flow. The high altitude lakes are mostly oligotrophic unlike the low altitude lakes, which are in various stages of trophic state due to strong anthropogenic influence, the high altitude lakes are still have a pristine environment.

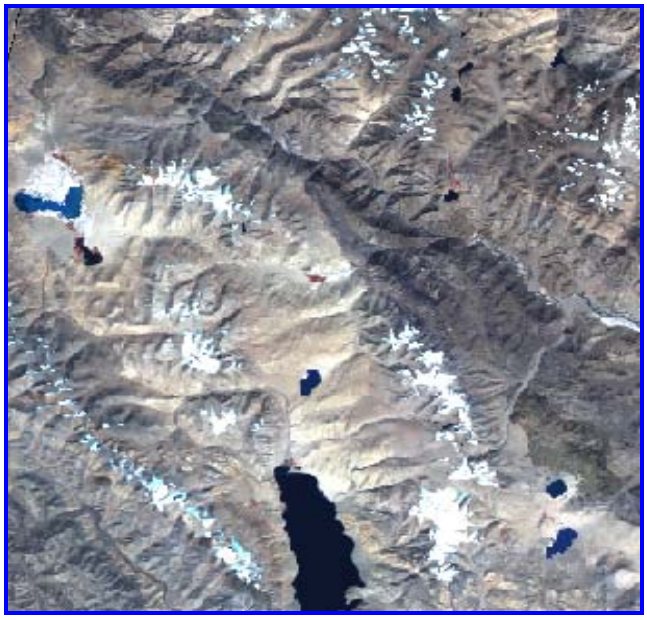
High altitude lakes, apart from their ecological significance, play crucial role in biodiversity, wildlife habitat and socio-economic aspects. The high altitude lakes in Ladakh are the only breeding grounds for migratory bird species like the Black-necked Crane and Bar-headed Goose in India. Local communities living in the region are dependent upon the lakes for their livelihood regardless of whether they are settled or nomadic. Pasture lands near the wetlands are used for grazing livestock. In Ladakh about 90 percent of the economy of local nomadic communities, near the lakes, depend on their livestock which graze on wetland pastures.

Some lakes like Tso Moriri (Jammu and Kashmir) and Manimaheshwar (Himachal Pradesh) are regarded as sacred and are revered by thousands of pilgrims each year. The largest lake in the Himalayas is the Pangong Tso, which is spread across the border between India and Tibet. It is situated at an altitude of 4350 m. It is nearly 134 km long and width of 8 km. A notable high (but not the highest) lake is the Gurudongmar in North Sikkim at an altitude of 5148 m. Other major lakes include the Tsongmo Lake, near the Indo-China border in Sikkim (India). Two high altitude wetlands in India have been designated as Ramsar sites. These include Tso Moriri in the state of Jammu and Kashmir and Chandratal in Himachal Pradesh.

NATIONAL WETLAND INVENTORY AND ASSESSMENT

Mapping of wetlands at 1:50,000 scale using satellite remote sensing data and creating a geospatial data base was taken up by Space Applications Centre under the project "National Wetland Inventory and Assessment (NWIA)' sponsored by Ministry of Environment & Forests. IRS P6 LISS III digital data having four spectral bands: Green, Red, Near Infra Red, and Short Wave Infra Red with spatial resolution of 24 m was used. Two-date data: one acquired during pre-monsoon and another during post-monsoon period was used to decipher the status of wetlands during wet and dry period. The outputs include the wetland boundary, the water spread in pre- and post-monsoon season, area under aquatic vegetation, and qualitative turbidity of water.

A classification system based on IUCN/RAMSAR definition and amenable from remotely sensed data was used to categorise the wetlands. Total 19 types of wetlands were delineated using a hierarchical system. This classification includes inland and coastal wetlands at level-I followed by level-II comprising natural and manmade wetlands within level-I, which were further categorised into 19 types of wetlands at level-III. High Altitude Wetland (HAW) is one of the class mapped, which is first such attempt in the country.

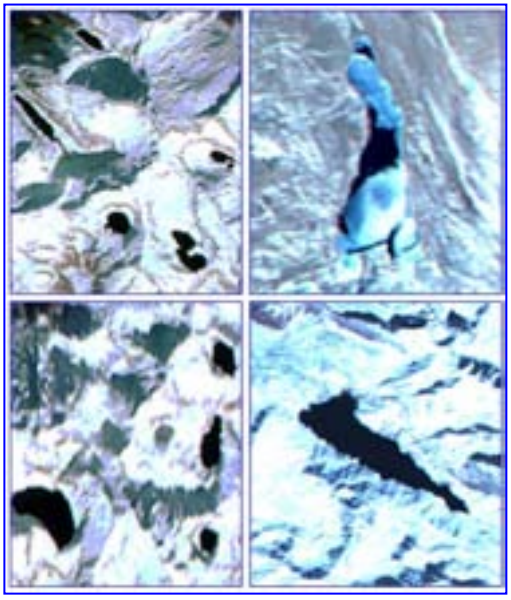


IRS LISS III FCC showing the distinct signature of high altitude lakes during pre-monsoon season

INVENTORY OF HIGH ALTITUDE LAKES

All lakes lying above 3000 m elevation are designated as high altitude ones in this work. Mapping of the lakes is done at 1:50,000 scale. Small lakes (<2.25 ha area) are also mapped as point features and assigned 1.0 ha nominal area.The Digital Elevation Model (DEM) derived from ASTER/SRTM data was used to generate elevation contours and classify the lakes as per altitude range. Spatial database of these lakes was prepared at state, district and topographic map sheet level using coding system, where each lake has a unique identification number.

Lakes give unique signature on the satellite images, Depending upon the state of water whether liquid phase or frozen, the boundary of the lakes are prominent and can be discerned with high accuracy. The pre- and post-monsoon images reflect the status of water, vegetation and state (solid/liquid).



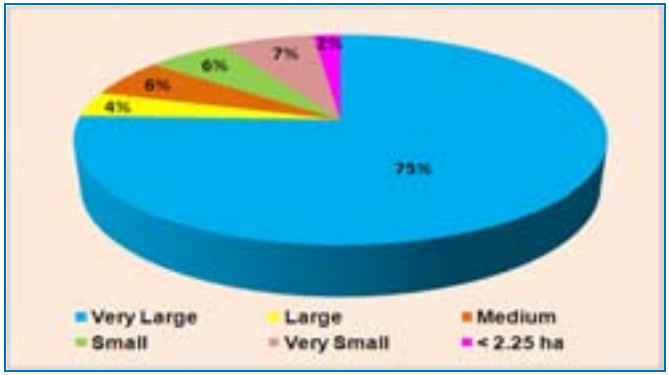
High Altitude lakes in various states (frozen, semi-frozen and liquid) as manifested on LISS-III imagery

Number, Size and Altitudinal Distribution of Lakes

The Indian Himalayas cover approximately 591,000 km^2 or 18 per cent of India's land surface and spread over six Himalayan States viz Jammu and Kashmir, Himachal Pradesh, Uttrakhand, Sikkim, Arunachal Pradesh and some parts of West Bengal. Total 4703 lakes are mapped which lie above 3000 m elevation. This includes 1996 small lakes (<2.25 ha area). The total area of high altitude lakes is 126249 ha. The lakes categorised under various sizes, show that there are only 12 lakes belonging to the very large size category having more than 500 ha area. However, they contribute to highest share of lake area (75.61%). Number wise, the smallest size lakes (<2.25 ha) have the largest share (42.44%), followed by very small ones (<10 ha) with 42.33% share.

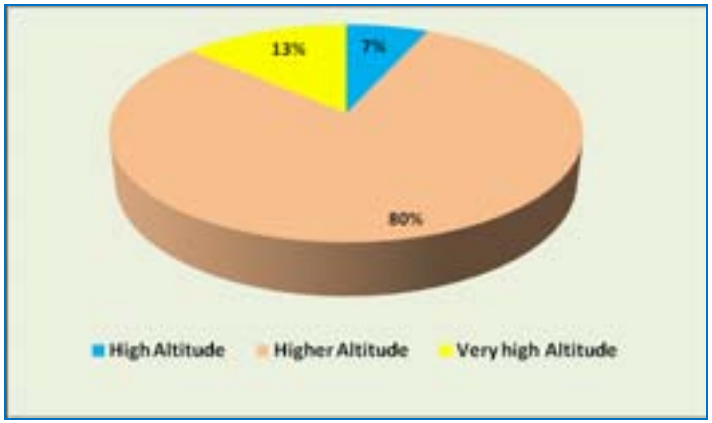
Size-wise distribution of high altitude lakes

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	12	95462
2	Large	100-500 ha	30	4861
3	Medium	25-100 ha	179	7434
4	Small	10-25 ha	495	7559
5	Very Small	< 10 ha	1991	8429
6	< 2.25 ha	< 2.25 ha	1996	2505
Total			**4703**	**126249**



Distribution of lakes as per size

Altitude-wise, maximum numbers of lakes are observed in the elevation range of 4000-5000 m. There are 2642 lakes (56.2% of total number) mapped in this elevation range with 100817 ha area (79.9% area). Very large lakes are also observed in this elevation range. Only 761 lakes are mapped in the very high altitude range of >5000 m elevation.



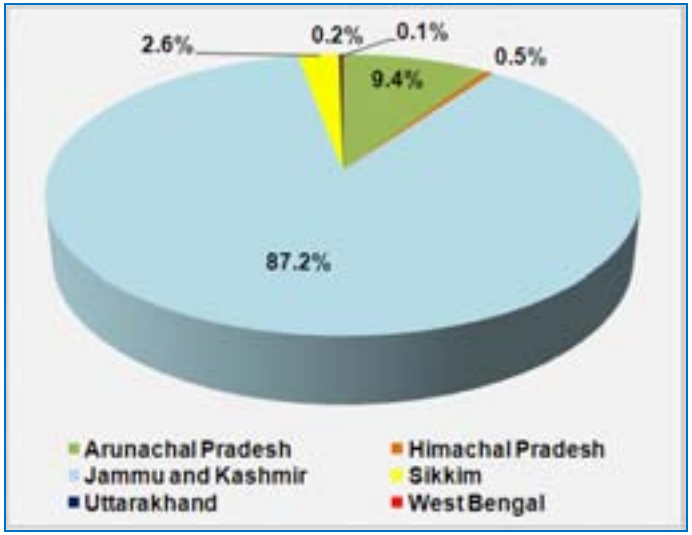
Distribution of lakes as per altitudinal range in Himalaya (high: 3000-4000m, higher: 4000-5000m and very high: >5000 m).

Altitude-wise distribution of high altitude lakes in Himalaya

Sr. No.	Category	Altitude range (m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	1300	8460
2.	Higher Altitude	4000-5000	2642	100817
3.	Very high Altitude	>5000	761	16972
Total			**4703**	**126249**

State-wise distribution

Two states: Jammu and Kashmir and Arunachal Pradesh harbour very large number of high altitude lakes. Jammu and Kashmir has the highest share of lakes. Number-wise, around 44.7% of lakes (2104 number) are found in this state with 87.2% share of total area. Arunachal Pradesh with 1672 lakes contributes 9.4% of area, indicating small size of the lakes. Only 3 lakes are mapped in West Bengal state with 82 ha area (contributing to 0.06% of total lake area).



Distribution of high altitude lakes in Himalayan states, India

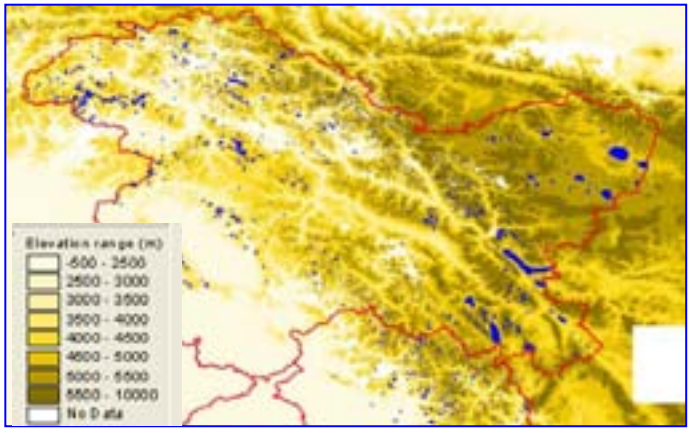
State-wise distribution of high altitude lakes in Himalaya

Sr. No.	State	No. of lakes	Lake area (ha)	% Lake Area
1	Arunachal Pradesh	1672	11863	9.40
2	Himachal Pradesh	272	617	0.49
3	Jammu and Kashmir	2104	110131	87.23
4	Sikkim	534	3325	2.63
5	Uttarakhand	118	231	0.18
6	West Bengal	3	82	0.06
Total		**4703**	**126249**	**100.00**

Jammu and Kashmir

IRS AWiFS FCC (November 2006) of Jammu & Kashmir

Total 1143 lakes are mapped at 1:50,000 scale and 961 small lakes (<2.25ha) are mapped as point features, taking the total number of lakes to 2104. Altitude wise distribution of lakes showed that maximum number of lakes (1221) is in the elevation range of 4000-5000 m. This state also have highest number of lakes situated in very high altitude range of >5000 m.



Altitude-wise distribution of lakes in Jammu & Kashmir

Sr. No.	Category	Altitude Range (m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	468	3104
2.	Higher Altitude	4000-5000	1221	92390
3.	Very high Altitude	>5000	415	14637
Total			**2104**	**110131**

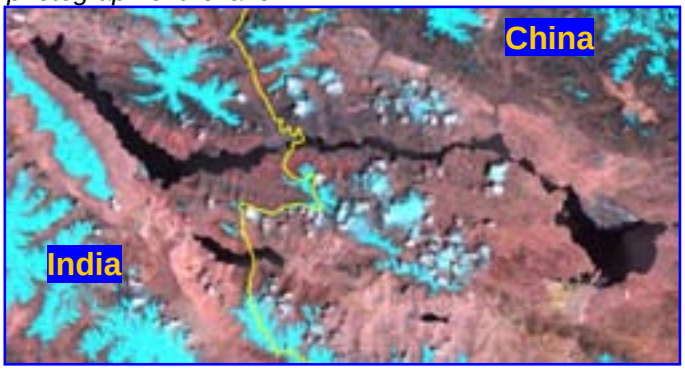
Size wise distribution showed that, among the lakes mapped as polygons, maximum number (848) are in the range of <10 ha area, followed by lakes of the size of 10-25 ha area (182). However, this state have all the 12 large lakes (>500 ha area), found in the Indian Himalaya.

Size-wise distribution of high altitude lakes in Jammu & Kashmir

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	12	95546
2	Large	100-500 ha	23	4015
3	Medium	25-100 ha	78	3292
4	Small	10-25 ha	182	2842
5	Very Small	< 10 ha	848	3475
6	< 2.25 ha	< 2.25 ha	961	961
Total			**2104**	**110131**

The Pangong Tso is at a height of 4350 m above sea level is the largest lake in Ladakh. It is a saline lake. Tso Moriri and Tso Kar are two important lakes, saline in nature are also located in Ladakh. Tso Moairi has been designated as Ramsar Site. Some of the other important lakes in the region are, the Neelang Lake in Budgam, Patlong, Thaled, Longzang, Pangor etc.

The Pangong Tso in Ladakh, India, the largest high altitude lake as seen in LISS III FCC and a scenic photograph of the lake.



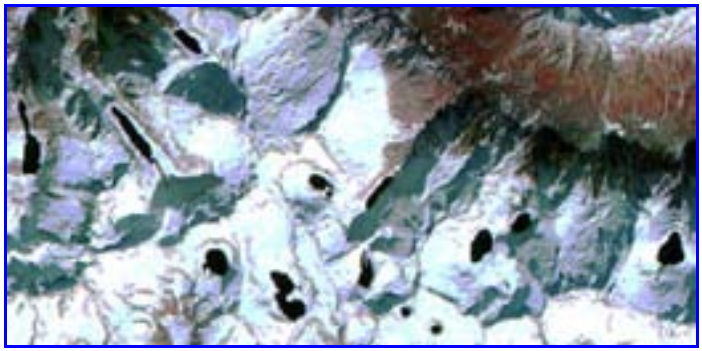
(The Pangong Tso spread across India and China as seen in IRS LISS III FCC. Lake area in India is 29345 ha, altitude: 4350).

LISS III FCC showing the Tso Moriri lake – a Ramsar site (wetland area: 14530 ha, altitude: 4650m). Below: photograph of the lake showing the pristine environment.

Tsokar lake as seen in LISS III during post-monsoon (note the salt encrustation- A)

Arunachal Pradesh

Arunachal Pradesh is the easternmost state of India with geographical area of 81,424 sq km Total 1672 high altitude lakes were delineated. The total area under these lakes is 11863 ha, accounting for about 7.6 per cent of total wetland area of the state. Maximum number of lakes are of small size (below 10 ha). There are no lakes of very large size (>500 ha) in this state.



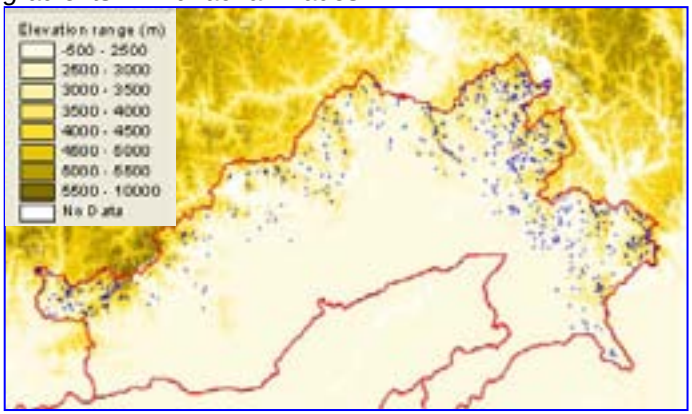
IRS LISS III FCC showing numerous high altitude lakes in Arunachal Pradesh (below: photograph of some of the lakes in Tawang district: courtesy- Dr S Mehta).

Altitudinal distribution pattern of these lakes showed that highest concentration is in the range of 4000-5000 m elevation range.

Size-wise statistics of high altitude lakes in Arunachal Pradesh.

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	-	-
2	Large	100-500 ha	3	363
3	Medium	25-100 ha	77	3170
4	Small	10-25 ha	251	3916
5	Very Small	< 10 ha	900	3974
6	< 2.25 ha	< 2.25 ha	441	441
Total			**1672**	**11863**

Map showing distribution of lakes in relation to elevation gradients in Arunachal Pradesh



Distribution of high altitude lakes in relation to elevation gradient in Arunachal Pradesh

Sr. No.	Category	Altitude range (m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	789	5178
2.	Higher Altitude	4000-5000	864	6636
3.	Very high Altitude	>5000	19	49
Total			**1672**	**11863**

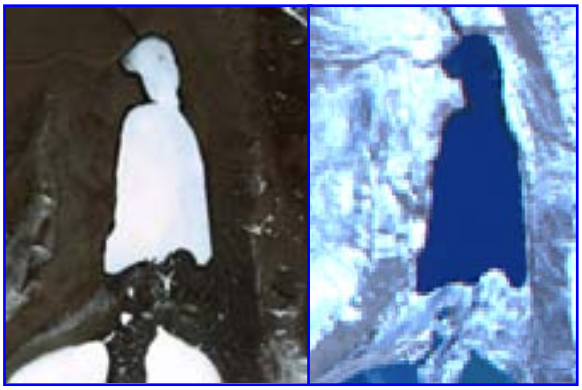
Sikkim

The total geographical area of the state is 7,096 km^2. High altitude lakes accounting for 40.79 per cent of the total wetland area. Total 534 lakes are identified with 3325 ha area. Total lakes mapped as polygons are 259 with 3050 ha area. In addition 275 small lakes (<2.25 ha) are mapped as point features. Maximum number of lakes are of very small size (<10 ha). Unlike Jammu and Kashmir, large size lakes (>500 ha) are not observed in Sikkim.

Size-wise statistics of high altitude lakes in Sikkim

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	-	-
2	Large	100-500 ha	4	511
3	Medium	25-100 ha	20	885
4	Small	10-25 ha	55	823
5	Very Small	< 10 ha	180	830
6	< 2.25 ha	< 2.25 ha	275	275
Total			**534**	**3325**

Gurudongmar Lake is a well known high altitude lake of the state. It is located in North Sikkim district at 5243 m elevation, and is considered a sacred lake. Chholhamu Lake, also in North Sikkim district, at 5300 m elevation is the highest lake in India. The lake is located near Donkiala Pass. It is the source of the river Teesta (Tista). Tsomgu Lake is another important tourist destination in Sikkim.



Satellite image showing the Gurudongmar Lake in frozen and liquid state (below: photograph of the lake in June).

Altitudinal distribution shows that maximum numbers of lakes are found above 4000 m elevation. Distribution-wise, North Sikkim has the maximum number. There are only 6 lakes in the elevation range of 3000-4000 m.

Distribution of high altitude lakes in relation to elevation gradient in Sikkim

Sr. No.	Category	Altitude range (m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	6	19
2.	Higher Altitude	4000-5000	323	1209
3.	Very High Altitude	>5000	205	2097
Total			**534**	**3325**

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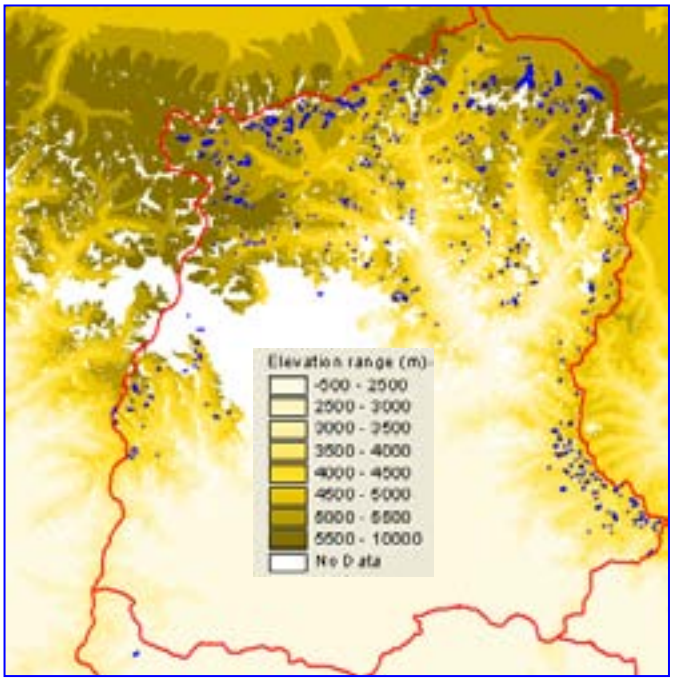
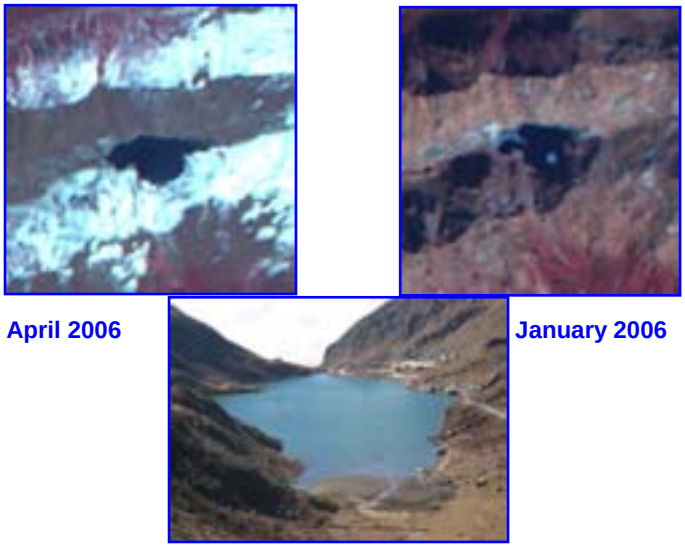


Map showing distribution of lakes in Sikkim in relation to elevation gradient (> 3000 m).



April 2006 **January 2006**

Tsomgu Lake as seen in IRS LISS III data and the photograph of the lake in June

Himachal Pradesh

Himachal Pradesh is almost entirely mountainous with altitudes ranging from 460 to 6600 meters above sea level. Total 272 high altitude lakes were delineated constituting 617 ha area that accounts for less than one per cent of total wetland area of the state. Maximum number of lakes (230) are of very small size (<2.25 ha area). There are no lakes above 100 ha area. Altitudinal distribution pattern of these wetlands showed that highest concentration is in the range of 4000 to 5000 Meter elevation range. Chandratal is the most famous high altitude lake in the state. This beautiful lake is situated at 4300 m, in Lahaul and Spiti district. This is the source of river Chandra. Manimahesh Lake at 4080 m lies in Budhil valley of Chamb district. Annual Manimahesh Yatra takes place after Janamasthami, in the month of August. Suraj Tal Located near Baralacha pass in Lahaul part of Lahaul and Spiti district at a height of 4980 m, is the source of Bhaga river. Dashair Lake at 4270 m lies near Rohtang pass which connects Kullu with Lahaul and Spiti.

Size-wise statistics of high altitude lakes in Himachal Pradesh

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	-	-
2	Large	100-500 ha	-	-
3	Medium	25-100 ha	3	146
4	Small	10-25 ha	5	80
5	Very Small	< 10 ha	34	161
6	< 2.25 ha	< 2.25 ha	230	230
Total			**272**	**617**

Altitude-wise statistics of the lakes in Himachal Pradesh

Sr. No.	Category	Altitude range(m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	27	68
2.	Higher Altitude	4000-5000	167	424
3.	Very High Altitude	>5000	78	125
Total			**272**	**617**

Satellite image showing the Chandratal in semi frozen and melting state (below: photograph of the beautiful lake during July)

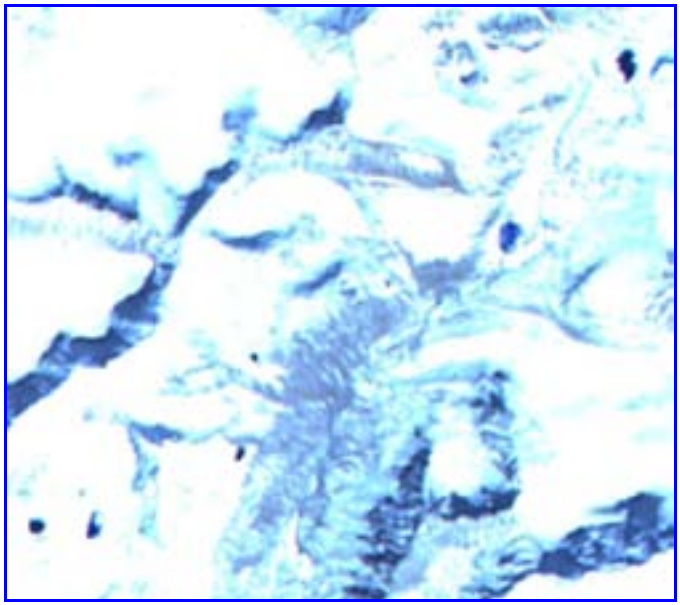
Uttarakhand

In all 118 high altitude lakes were delineated constituting 231 ha area that accounts for less than one per cent of total wetland area of the state. Among the districts, Chamoli has the maximum number (14) with 66 ha area, followed by Pithoragarh district (11) with 62 ha area. Majority of the lakes are of very small size (<2.25 ha) and mapped as point features. There are 28 lakes distributed with range of <10 ha category and one lake in 10-25 ha.

Size-wise statistics of lakes in Uttarakhand state

Sr. No.	Class	Range	No. of lakes	Area (ha)
1	Very Large	> 500 ha	-	-
2	Large	100-500 ha	-	-
3	Medium	25-100 ha	-	-
4	Small	10-25 ha	1	17
5	Very Small	< 10 ha	28	125
6	< 2.25 ha	< 2.25 ha	89	89
Total			**118**	**231**

Altitudinal distribution pattern of these wetlands showed that about 67 wetlands exist in the elevation range of 4000 to 5000 m and 44 wetlands exist in the very high altitude (>5000 m).



IRS LISS III FCC showing the distribution of high altitude lakes in the Uttarkashi district.

Altitude-wise statistics of lakes in Uttarakhand state

Sr. No.	Category	Altitude range (m)	No. of lakes	Area (ha)
1.	High Altitude	3000-4000	7	9
2.	Steep Altitude	4000-5000	67	158
3.	Very Steep Altitude	>5000	44	64
Total			**118**	**231**

Kedar Tal/Lake in Uttarkashi district at 4425 m elevation is a famous one. It is near Gangotri along Kedar Ganga, a tributary of Bhagirathi River. Shasra Lake is a popular destination for tourists, situated at 4572m. This splendid lake is in Uttarkashi district, after crossing the Kyarki Khar pass. Vasuki Tal/Lake in Chamoli district lies at 4135 m, near famous Hindu shrine of Kedarnath. Other well known high lakes in Chamoli district are Rupkund and Hemkund situated at 4450m and 4329 m altitude respectively.

Satellite image showing the Kedar tal lake (below: photograph of the pristine lake in June)

Summary of High altitude wetlands in India derived using LISS III data (2006-7) under NWIA project

Sr. No.	Description	Jammu & Kashmir	Himachal Pradesh	Uttarakhand	Sikkim	Arunachal Pradesh	West Bengal	Total
1	Total Wetland Area (ha)	391501	98496	103882	7477	155728	1107907	1864991
2	High Altitude Lakes (ha)	110131	617	231	3325	11863	82	126249
3	% of total Wetland Area	28.13	0.63	0.22	44.47	7.62	0.01	6.77

Altitudinal distribution of Himalayan lakes in India

Sr. No.	State	High Altitude (3000-4000m)		Higher Altitude (4000-5000m)		Very High Altitude (>5000m)		Total	
		No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area (ha)
1	Arunachal Pradesh	789	5178	864	6636	19	49	1672	11863
2	Himachal Pradesh	27	68	167	424	78	125	272	617
3	Jammu and Kashmir	468	3104	1221	92390	415	14637	2104	110131
4	Sikkim	6	19	323	1209	205	2097	534	3325
5	Uttarakhand	7	9	67	158	44	64	118	231
6	West Bengal	3	82	-	-	-	-	3	82
	Total	**1300**	**8460**	**2642**	**100817**	**761**	**16972**	**4703**	**126249**

Size-wise distribution of high altitude lakes in India

Sr. No.	State	Very Large (> 500 ha)		Large (100-500 ha)		Medium (25-100 ha)		Small (10-25 ha)		Very Small (<10 ha)		<2.25 ha		Total	
		No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area (ha)	No. of lakes	Area* (ha)	No. of lakes	Area (ha)
1	Arunachal Pradesh	-	-	3	363	77	3170	251	3916	900	3974	441	441	1672	11864
2	Himachal Pradesh	-	-	-	-	3	146	5	80	34	161	230	230	272	617
3	Jammu and Kashmir	12	95546	23	4015	78	3292	182	2842	848	3475	961	961	2104	110131
4	Sikkim	-	-	4	511	20	885	55	823	180	830	275	275	534	3324
5	Uttarakhand	-	-	-	-	-	-	1	17	28	125	89	89	118	231
6	West Bengal	-	-	-	-	1	60	1	17	1	5	-	-	3	82
	Total	12	95546	30	4889	179	7553	495	7695	1991	8570	1996	1996	4703	126249

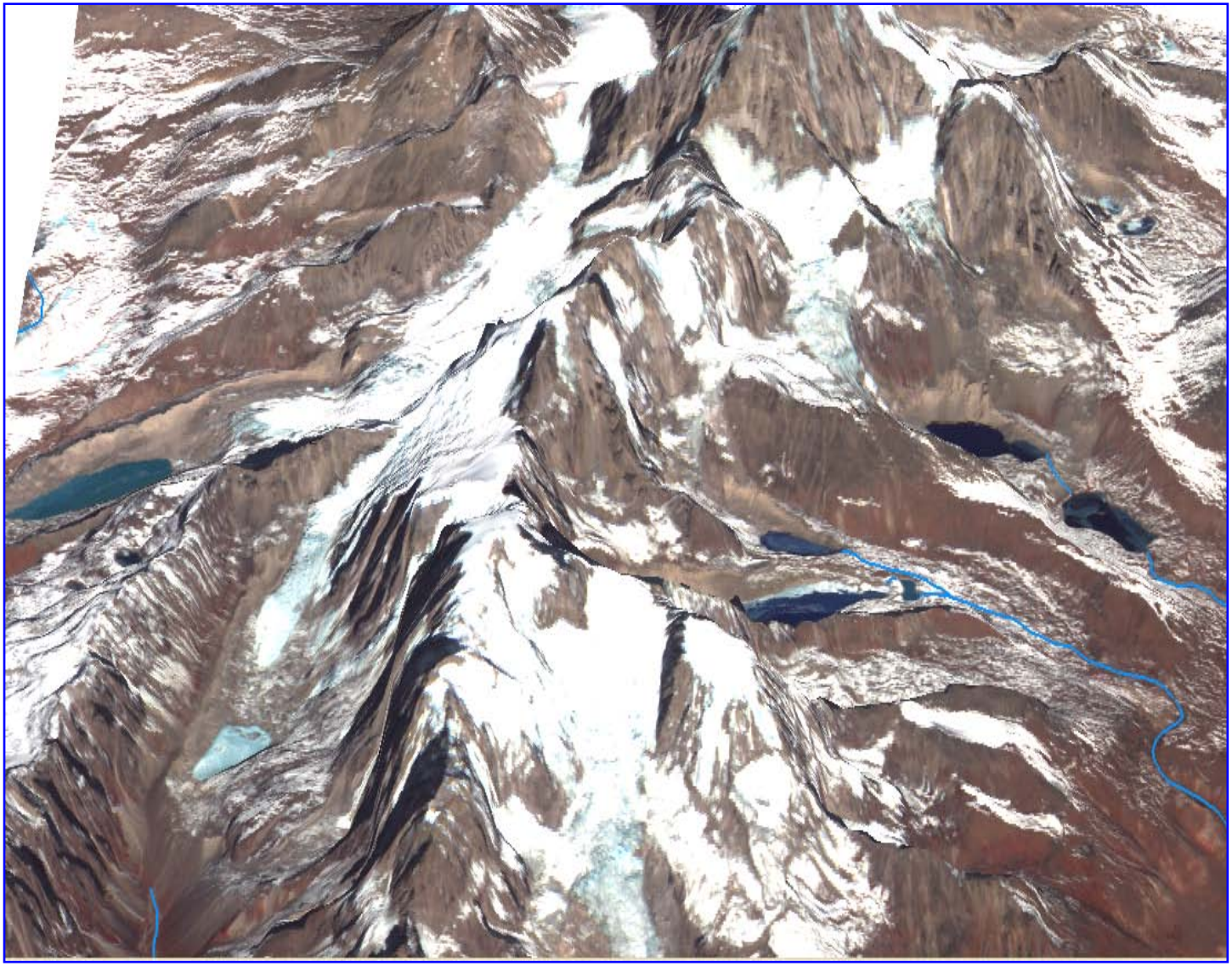
** Nominal assignment*

Database structure of High altitude wetlands created under NWIA project (Example of the 12 large lakes)

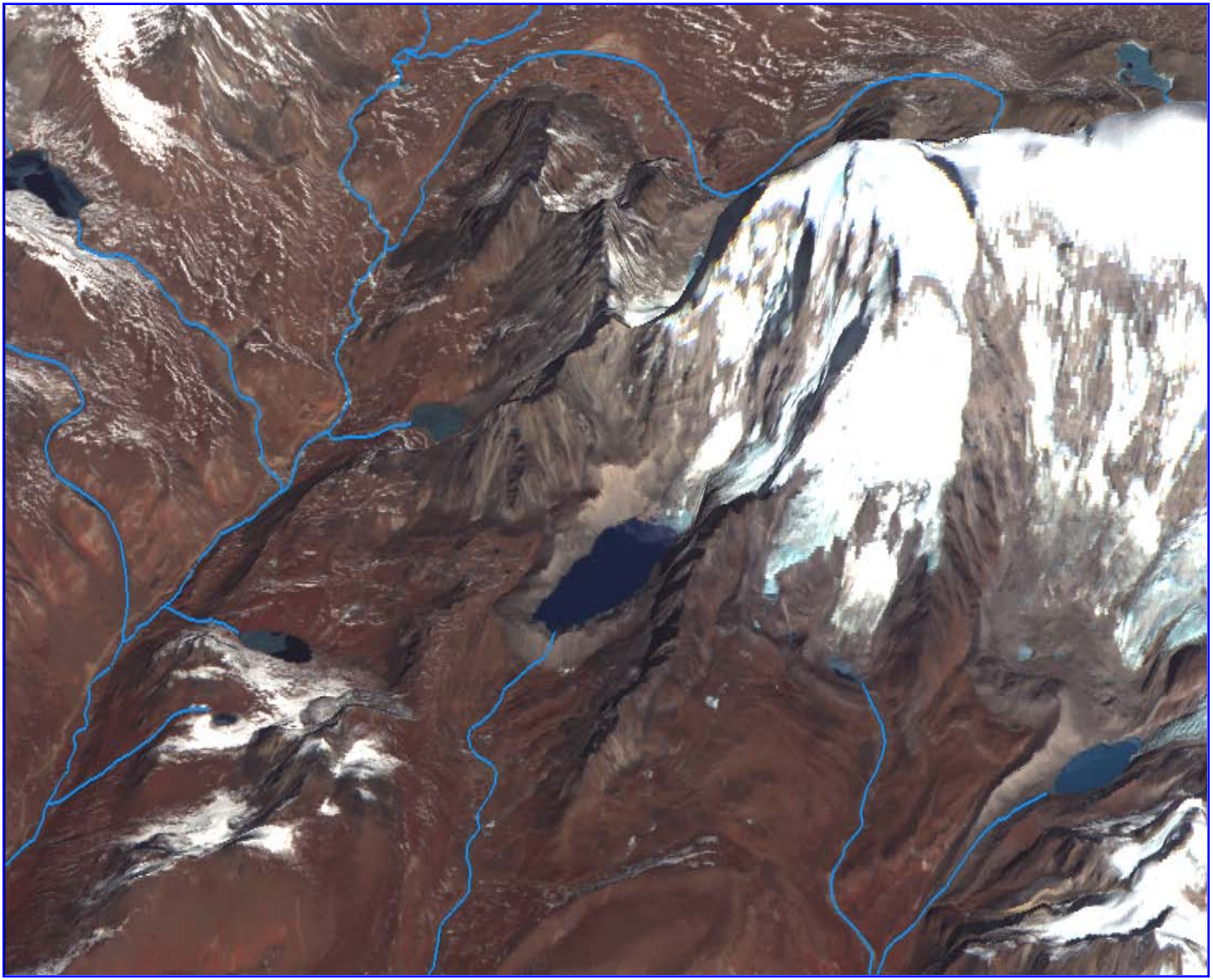
Sr. No.	Wetcode	Wetname	Area (ha)	Perimeter (km)	Altitude (m)	Aqveg (Y/N)	Turbidity	State
1	0107005211090002	Pangong Tso	29345	247.90	4350	N	L	Jammu & Kashmir
2	0115005213160001		22103	69.98	4890	N	L	Jammu & Kashmir
3	0107005212050001	Tso Moriri	14530	108.97	4650	Y	L	Jammu & Kashmir
4	0115005214100002		7026	48.81	5320	N	L	Jammu & Kashmir
5	0107005211030002	Tso Kar	6179	50.51	4760	Y	L	Jammu & Kashmir
6	0115006101040002		5556	43.03	4910	N	L	Jammu & Kashmir
7	0115005214050004		3592	37.27	5325	N	L	Jammu & Kashmir
8	0107005211140002		3473	40.67	4350	N	L	Jammu & Kashmir
9	0115005209150005		1939	69.85	4950	N	L	Jammu & Kashmir
10	0107005212090002		666	14.98	4975	N	L	Jammu & Kashmir
11	0115006102010001		654	12.21	5060	N	L	Jammu & Kashmir
12	0107005211080002		526	9.95	4680	N	L	Jammu & Kashmir

Wetland : Name of the wetland,
Aqveg : Status of Aquatic Vegetation
Wetcode : Unique identification number 16 digit using
State code(2) + District code(2) + Taluka code(2) + SOI toposheet code(6) + Wetland number(4)

Y: Present, N: Absent, L: Low



3D perspective view of part of North District, Sikkim
(IRS P6 LISS-IV image draped on DEM)



3D perspective view of part of West District, Sikkim
(IRS P6 LISS-IV image draped on DEM)

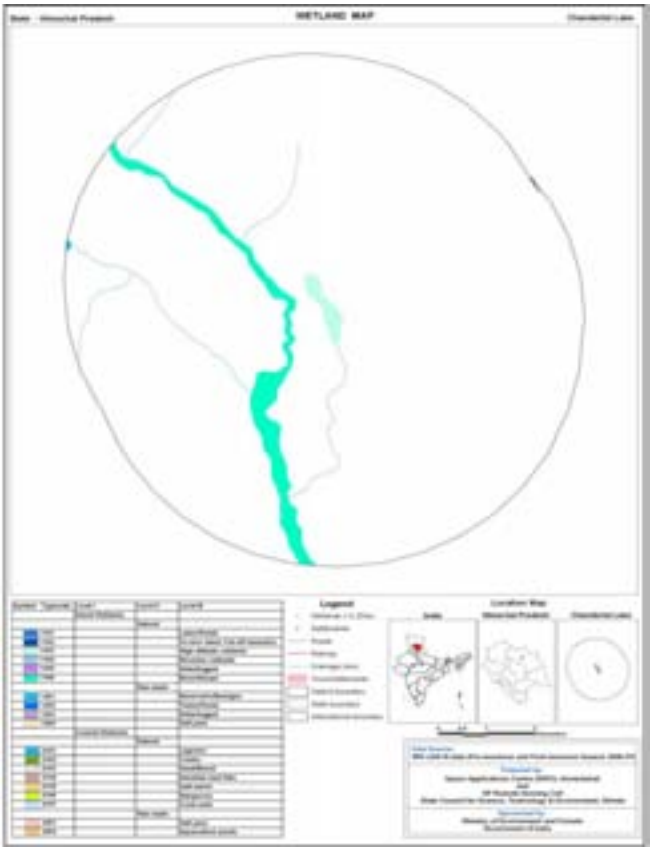
Some of the Important High Altitude Lakes of India

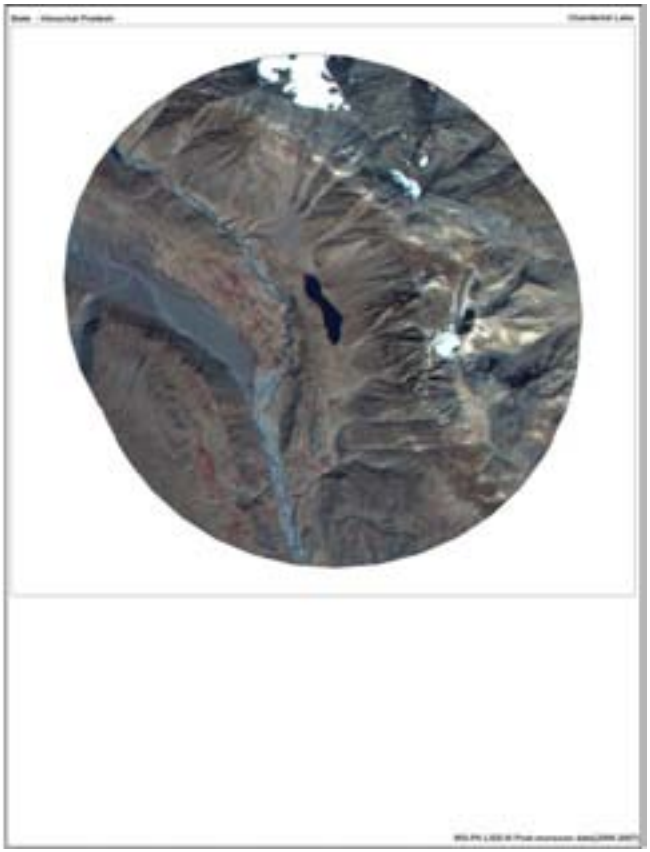
Chandratal Lake (Himachal Pradesh) – A Ramsar Site:

The Chandertal with its deep blue icy water, surrounded by snow and acres of scree, constitute an important high altitude cold desert wetland of western Himalayas. The lake is in Lahul and Spiti district and situated at an altitude of 4270 metres. The clean water of the lake with small marshy patches around attracts many migratory birds. Important species noted are: Snow cock, Chukar, Black winged stilt, Brahmni duck, Golden eagle and Chugh, Hoopoe, Yellow Headed Wagtail, Jungle crow, Blue rock pigeon, Common rose finch, Black redstart, Short toed Eagle, Common Sandpiper, Teal, Magpie Robin etc.

The important wild life species found in the region are Marmota Bobak, Snow leopard, Red fox, Snow wolf, Capra ibex, Blue sheep, and Lynx.

The herbaceous growth in the catchment area is remarkable for its variety. The important species are *Potentila, Ranunculus*, *Acquilegia, Primula, Aconitum, Aster, Asteraglus, Bistorta affinis,Delphinium, Geranium, Oxyria, Potentilla, Polygonum, Ranunculus, Rosularia, Stellaria, and Thymus* species. The common grasses frequently encountered are *Poa* and *Agropyron.* These grasses have rich nutritive value.





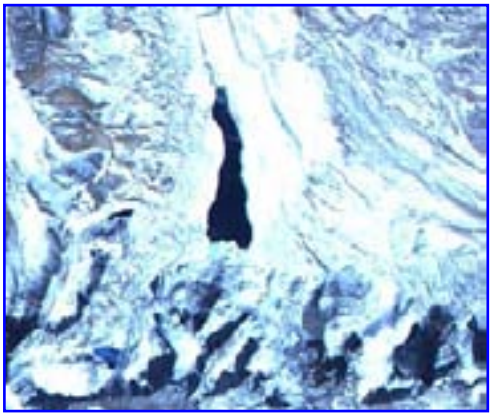
Wetland map of 5 km buffer area: Chandratal Lake

Some interesting facts

A true lake should have some liquid water round the year. Thus, a high altitude lake which freezes solid all the way down to the bottom during the winter may be disqualified as a lake. A true "lake" must occupy at least 1.0 hectare.

NASA declares: "At an altitude of 4727 m, Lake Mansarovar" is one of the highest freshwater lakes in the world.

Chholhamu Lake(102.5ha) in Sikkim, at 5300 m elevation is the highest lake in India. It is the source of the river Teesta (Tista). It lies



IRS LISS III FCC showing Chholhamu lake in Sikkim.

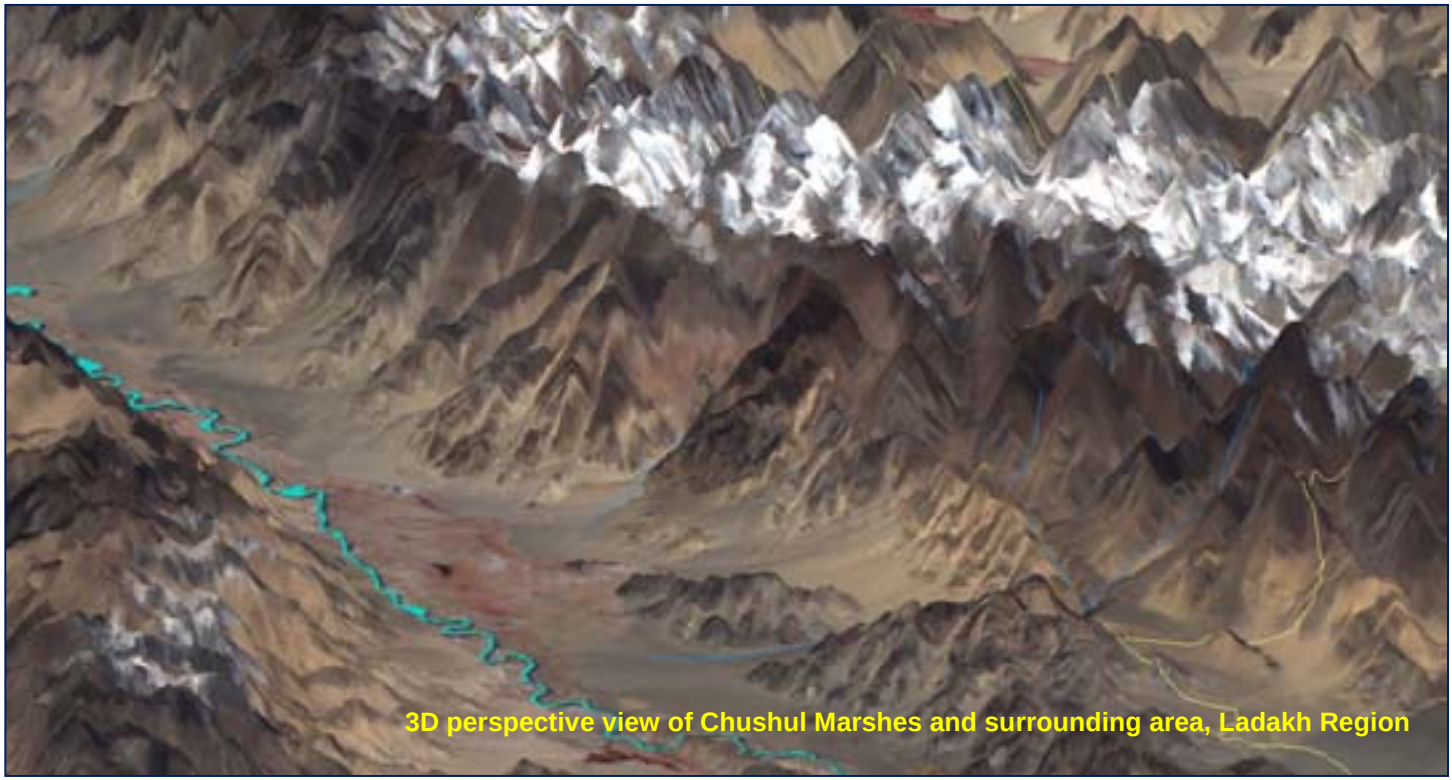
Panch Pokhri is a group of three sacred lakes in Nepal about 6 kilometers east of Ama Dablam (the mountain), is the highest ***named*** lake in the world The main lake is at 5414 m elevation; the other two lakes are at 5430 m and 5494 m elevation respectively. Panch Pokhri (5494 m) is about 700 m long and 400 m wide.

Lake Namtso in Tibet is the largest high altitude lake in the world. The altitude of Lake Namtso is 4700 m and the surface area is 1940 km^2.

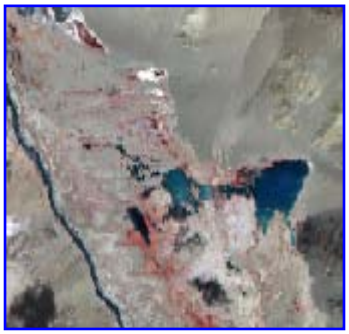
The very high altitude lakes are generally volcanic ones lying on top of a volcano. However, they are very small in size. The lake at 6,390 m, on the east face of **Ojos del Salado**, the highest active volcano on the southeast side of the border between Chile and Argentina is **the highest lake** in the world. It is around 100 m in diameter, circular in shape, thus the surface area is 0.785 hectare.

Proper lake (if size is taken into account), **"Ridonglabo Lake**", around 3.0 hectares in size**,** lying at 5,801 meters may be called the highest lake. The lake is about 14 kilometers northeast of the summit of Mt. Everest. It's actually in a side valley on the northwest side of the main Karda Valley, where the Karda Glacier ends in Karda Lake.

Source:
http://www.highestlake.com/highest-lake-world.html



3D perspective view of Chushul Marshes and surrounding area, Ladakh Region



This is a complex of shallow ponds, marshes, and wet meadows in broad, sandy valley to the east (10000 ha) and west (1000 ha) of Chusul. The ponds and marshes are created by the springs and streams flowing down into the valley from the Ladakh range to the southwest. The average depth of the ponds here is one or two meters.

The aquatic vegetation found are: *Hydrilla, Myriophyllum, and Potamogeton* in the ponds, and *Carex sp*., other sedges, and grasses in the marshes. The surrounding arid steppe is dominated by *Caragana sp*. This is an important breeding area for several species of waterfowl, notably *Podiceps cristatus, Tadorna ferruginea, Charadrius mongolus, Tringa tetanus,* and *Sterna hirundo*. A number of species occur on the surrounding dry plains, including Tibetan partridge (*Perdix hodgsoniae*), Tibetan sandgrouse (*Syrrhaptes tibetanus*), and wild ass (*Equus hemionus*).

Area: 675 ha
Altitude: 4150m

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Cover: 3D Perspective view of Tso Moriri Lake, Jammu and Kashmir

Back cover: Gurudongmar Lake, Sikkim