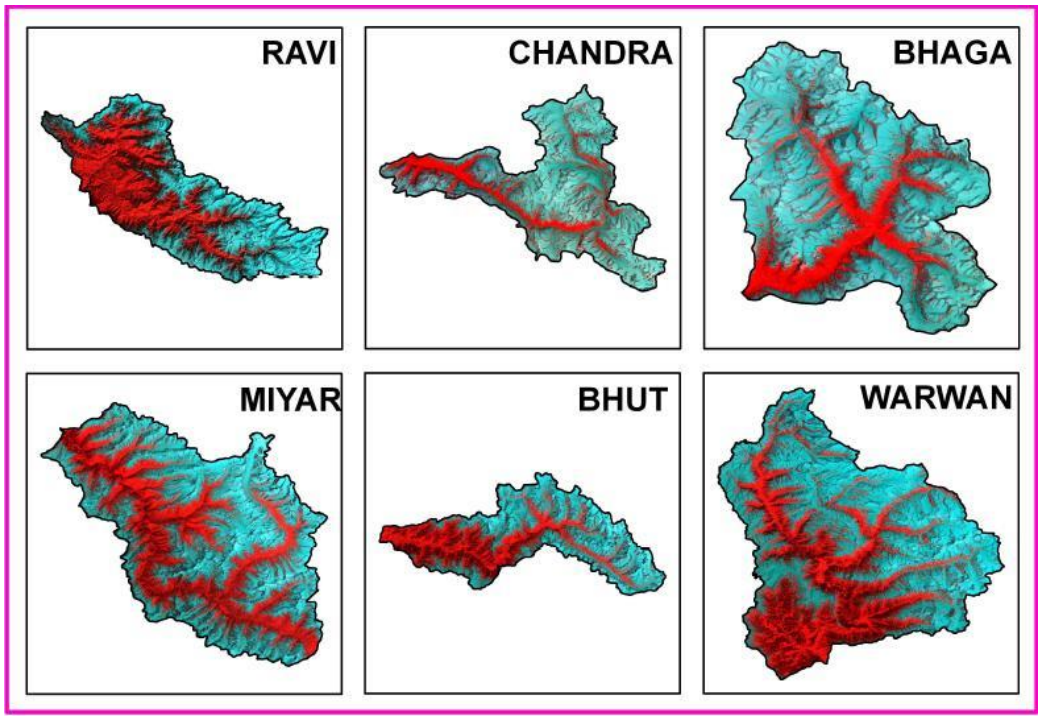
SNOW COVER ATLAS OF THE CHENAB BASIN

Sub-basins: Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan

(Integrated *Studies of Himalayan Cryosphere*

A Project of Indian Space Research Organisation)

Year 2015-2016



Prepared by
Space Applications Centre (ISRO)
Ahmedabad-380015

April, 2017

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Abstract	This atlas gives sub-basin wise distribution of snow cover in the Chenab basin from October 2015 to June 2016. The sub-basins included in this report are Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan. The areal extent of snow cover was estimated in fully automatic mode using Normalized Difference Snow Index (NDSI) based algorithm. For this purpose, AWiFS sensor of Resourcesat satellite was used. This atlas gives snow cover products, statistics and seasonal snow depletion curve. It is expected that this data will be useful for hydrological and climatological applications.
Key words	Snow cover, NDSI, AWiFS, depletion curve, Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan basins.
Security Classification	Unrestricted
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1. **Introduction**

Snow covers almost 40 per cent of the Earth's land surface during Northern Hemisphere winter. This makes albedo and areal extent of snow as important component of the Earth's radiation balance (Foster and Chang, 1993). In addition, large areas in the Himalayas are also covered by snow during winter. Area of snow can change significantly during winter and spring. This can affect stream flow for rivers originating in the higher Himalayas. All the rivers originating from higher Himalayas receive almost 30-50 % of annual flow from snow and glacier melt run off (Agarwal et al., 1983). In addition, snow pack ablation is highly sensitive to climatic variation. Increase in atmospheric temperature can influence snowmelt and stream runoff pattern (Kulkarni et al., 2002). Therefore, mapping of the areal extent and reflectance of snow are important parameter for various climatological and hydrological applications. In addition, extent of snow cover can also be used as input for numerous other applications.

Mapping and monitoring of seasonal snow cover using field methods are normally very difficult in a mountainous terrain, like the Himalayas. Therefore, remote sensing techniques have been extensively used for snow cover monitoring. Snow cover monitoring using satellite images were started by using the TIROS-1 satellite from April 1960 (Singer and Popham 1963). Since then, the potential for operational satellite-based mapping has been enhanced by the development of higher temporal frequency and satellite sensors with higher spatial resolution. In addition, satellites with better radiometric resolutions, such as NOAA have been used successfully for snow mapping (Hall et al., 1995). This is possibly due to the distinct spectral reflectance characteristics of snow in visible and near infrared regions. India has launched series of Indian Remote Sensing satellite (IRS) to study the different earth resources. Previously launched satellites have flown with many sensors having different spatial, temporal and spectral resolutions. Recently launched RESOURCESAT-1 satellite has three different sensors namely LISS III, LISS IV & AWiFS with different spatial, temporal and spectral resolutions as desired for different applications. AWiFS (Advanced Wide Field Sensor) is an advanced version of earlier Indian satellite sensor WiFS (Wide Field Sensor) with improved spectral and spatial resolutions maintaining the same repetivity. There are a series of other polar orbiting satellites, like Landsat, NOAA and MODIS etc., which have provided information on different aspects of

snow. Geo-stationary satellites also proved their utility in mapping/monitoring the snow-covered regions. Information generated from satellite observations has been extensively used for snowmelt runoff modeling (Kulkarni et al., 1997).

2. Study Area:

This Atlas gives distribution of snow cover in six subbasins of the Chenab basin. These are Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan sub basins. Locations of these basins are shown in Figure 1.

3. Data used:

AWiFS data from October 2015 to June 2016 were used in this study.

4. Normalised Difference Snow Index (NDSI):

In general, the reflectance of snow is high at the red end of the visible spectrum. It tends to decline in the near-infrared region until 1090 nm, where slight gain in reflectance occurs and gives a minor peak at approximately 1090 to 1100 nm. One of the important difficulties in snow cover monitoring is the presence of cloud cover. Cloud has strong reflectivity in visible, NIR and SWIR regions while snow absorbs in SWIR, and this difference can be utilized for snow/cloud discrimination. Normalized Difference Snow Index (NDSI) utilize the normalized ratio of green and SWIR and is used as an automated approach for snow mapping addressing the shadow and cloud problems in snow bound areas.

Normalized Difference Snow Index was calculated using the ratio of green wavelength (band 2) and SWIR (band 5) of AWiFS sensor:

$$Normalized\,Difference\,Snow\,Index(NDSI) = (band2 - band5)/(band2 + band5) \quad ..(1)$$

To estimate NDSI, DN numbers were converted into reflectance. This involves conversion of digital numbers into the radiance values, known as sensor calibration, and then estimation of reflectance from these radiance values. Various parameters needed for estimating spectral reflectance are maximum and minimum radiances and mean solar exo-atmospheric spectral irradiances in the satellite sensor bands, satellite data acquisition time, solar declination, solar zenith and solar azimuth angles, mean Earth-Sun distance etc. (Markham and Barker, 1987; Srinivasulu and Kulkarni, 2004).

5. Snow cover monitoring algorithm

An algorithm is developed to provide changes in the areal extent of snow (Kulkarni et. al., 2006). Snow extent is estimated at an interval of 5-days and 10-days, depending upon availabilities of AWiFS data. In 5-daily product, snow extent is generated scene-wise. In this product, snow and cloud extents are given. Estimate of cloud is important because, at times, snow is covered by cloud and this may be classified as non-snow area, leading to erroneous conclusions. In 10-daily product, three scenes are analyzed, if available. For example, 10 March product data of 5, 10 and 15 March was used. If any pixel is identified as snow on any one date then this pixel will be classified as snow on final product. This provides snow cover at an interval of 10 days, an important requirement in hydrological applications. Therefore, this product is generated basin-wise. Since this product is using three scenes, probability becomes high that at least in one scene, pixel may be cloud-free and this helps in overcoming problem associated with snow under cloud cover. If three consecutive scenes are not available, then all available scenes in 10 days window was used in the analysis. Differentiation between water and snow is difficult using NDSI image. In addition, separation of snow and water pixels is also difficult based on reflectance due to mountain shadow. Therefore, in the present algorithm, water bodies are marked in pre-winter

season and are masked in the final products during winter. Flow diagram of the algorithm is given in Figure 2.

6. Results and discussions

In this atlas, basin-wise snow cover statistics, maps, and seasonal depletion curves have been provided from October 2015 to June 2016. Snow ablation pattern varies from basin to basin, depending on area altitude distribution in the basins. Accumulation and ablation pattern in Chandra and Bhaga river basin is almost same and significant amount of melting was observed in early part of winter. From January to end of April almost entire basin is covered by snow for Chandra, Bhaga and ablation starts from the mid of April. In the Bhut, Warwan and the Miyar sub-basins accumulation starts from mid of December and in the mid of February melting was observed. Ablation starts from April onwards. In case of Ravi sub-basin no accumulation is found till mid of December then in the month of January, maximum snow was observed 70% and it reduces up to 38% in the mid of February and accumulation and ablation continuous till mid of March then ablation starts continuous.

Acknowledgements

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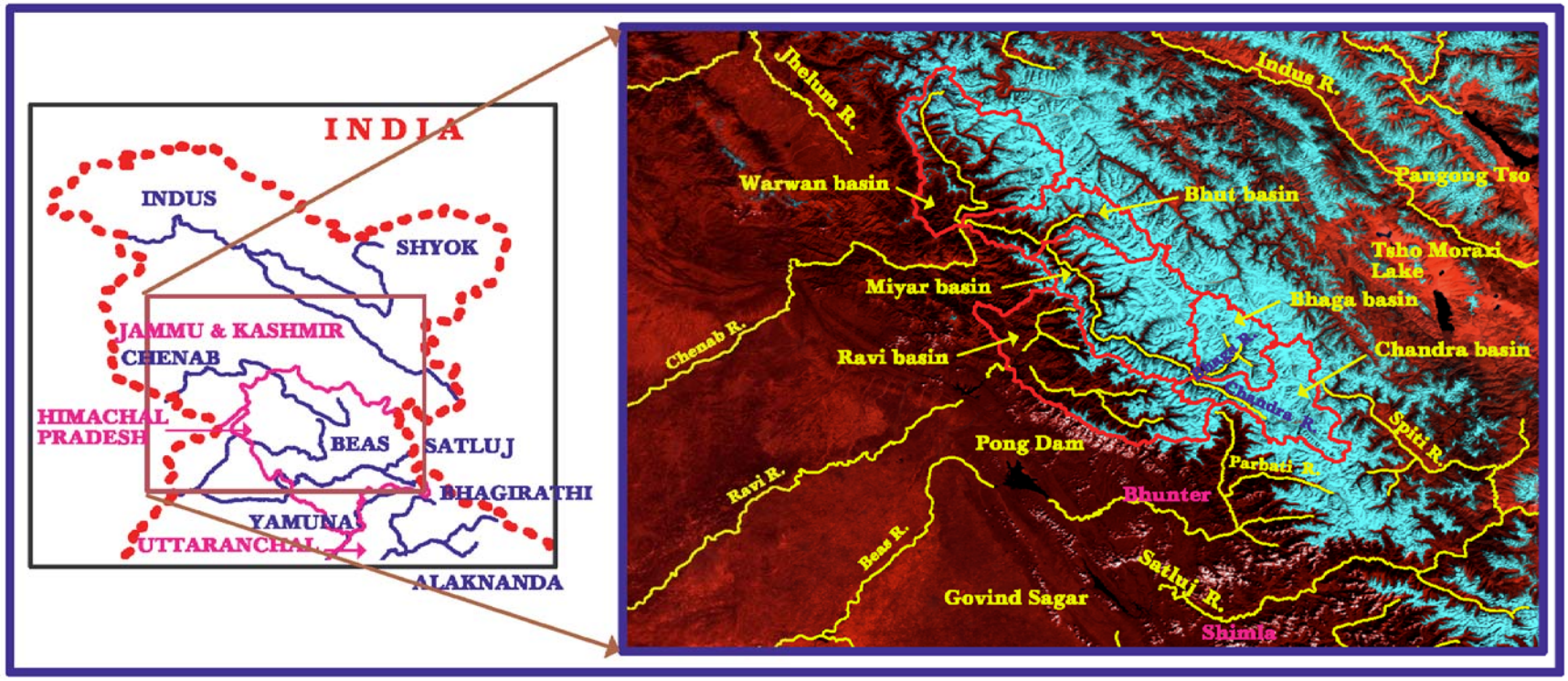


Figure 1: Location map of Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan sub-basins (Part of Chenab basin)

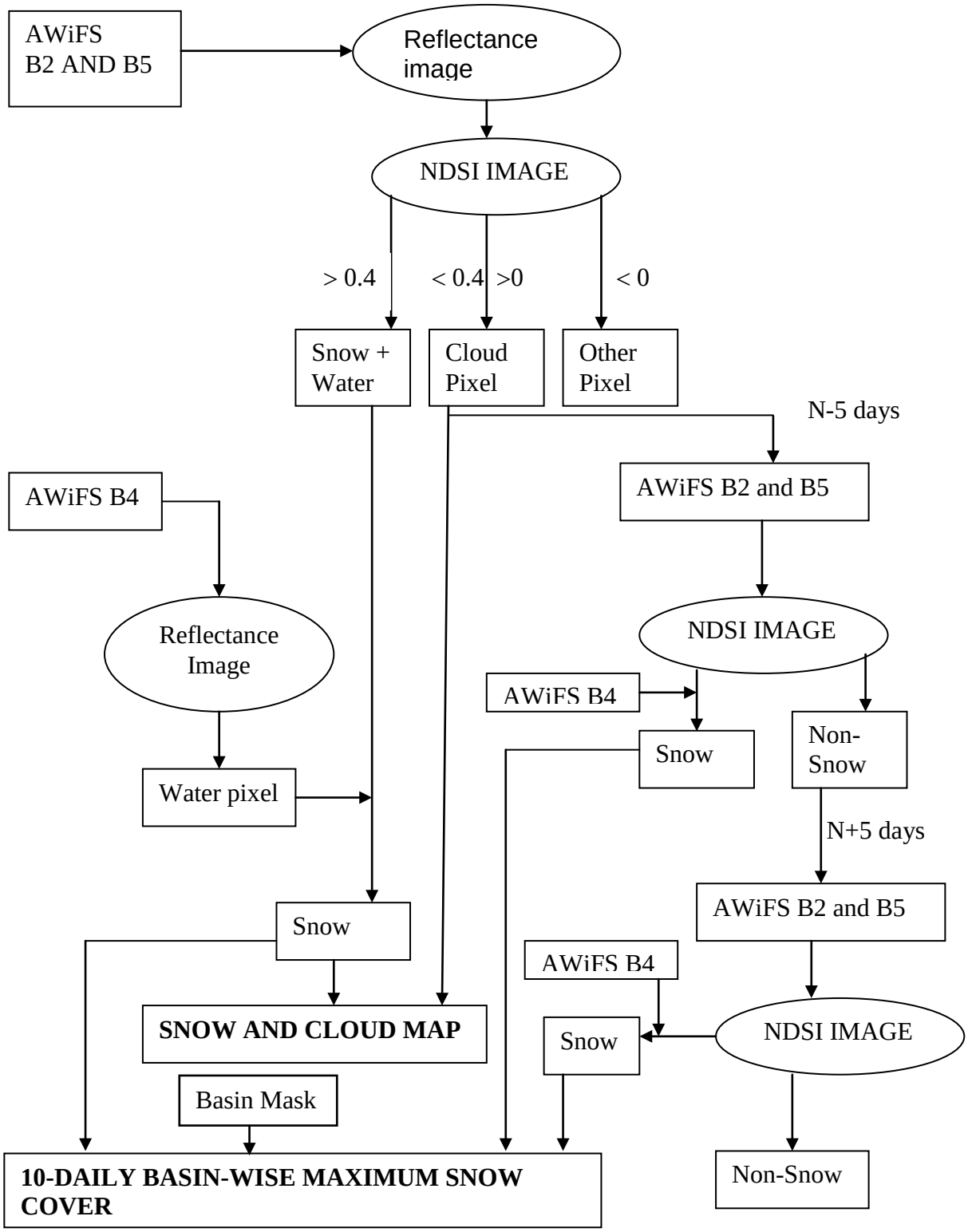


Figure 2: Algorithm for snow cover mapping using AWiFS data

RAVI SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: RAVI **BASIN AREA: 4907 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	01/10/15	588	12	4	28/10/15	1495	30
2	03/10/15	540	11	5	30/10/15	1130	23
November 2013							
6	01/11/15	725	15	8	08/11/15	1063(C)	22
7	06/11/15	1930	39	9	15/11/15	1216	25
December 2013							
10	05/12/15	1254	26	12	07/12/15	1306	27
January 2014							
13	02/01/16	1889	38	16	19/01/16	948(c)	19
14	03/01/16	1917	39	17	27/01/16	1503(c)	31
15	05/01/16	2719	55				
February 2014							
18	01/02/16	2127	43	21	10/02/16	1534(c)	31
19	03/02/16	2004	41	22	12/02/16	3431	70
20	05/02/16	1800	37		17/02/16	2329	47
	08/02/16	3463	71		27/02/16	1850	38
March 2014							
23	03/03/16	1435	29	25	22/03/16	2629	54
April 2014							
27	07/04/16	1538	31	30	24/04/16	1789	36
29	20/04/16	1049(c)	21	31	27/04/06	1128(c)	23

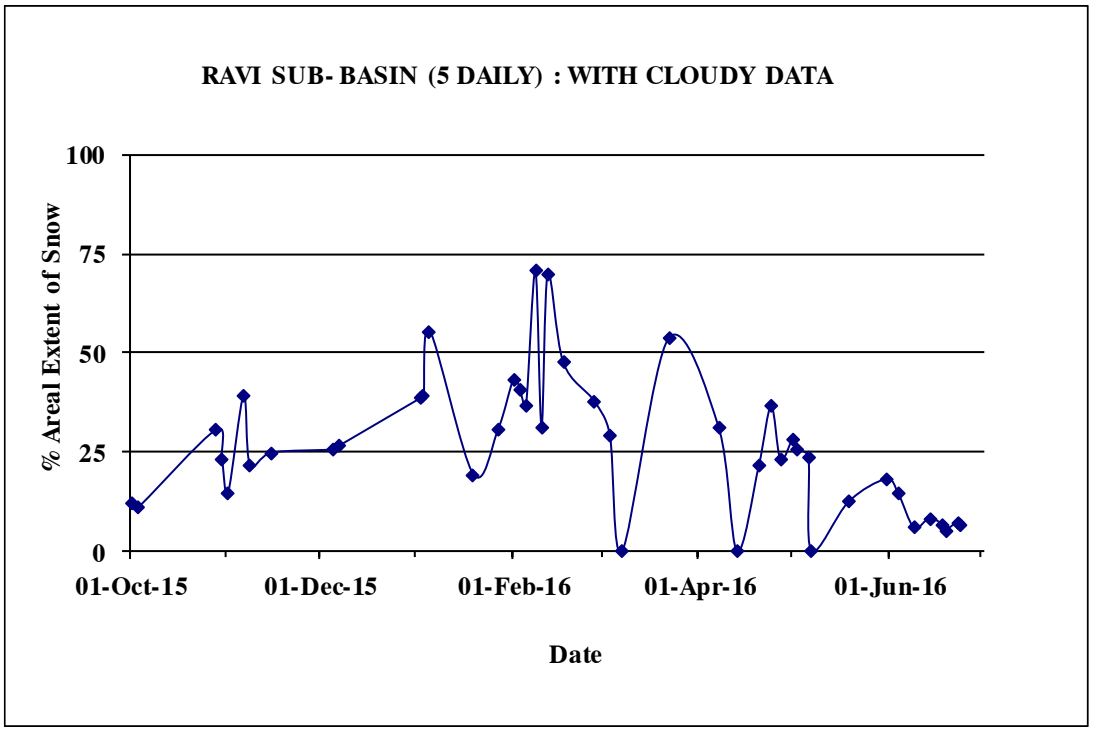
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May-2014							
33	01/05/16	1391	28	35	19/05/16	610(c)	12
34	02/05/16	1263	26	36	31/05/14	886	18
	06/05/16	1157	24				
June-2014							
37	04/06/16	708	14	41	19/06/16	257(c)	5
38	09/06/16	291(c)	6	42	23/06/16	356	7
39	14/06/16	405(c)	8	43	24/06/16	320	7
40	18/06/16	333(c)	7				

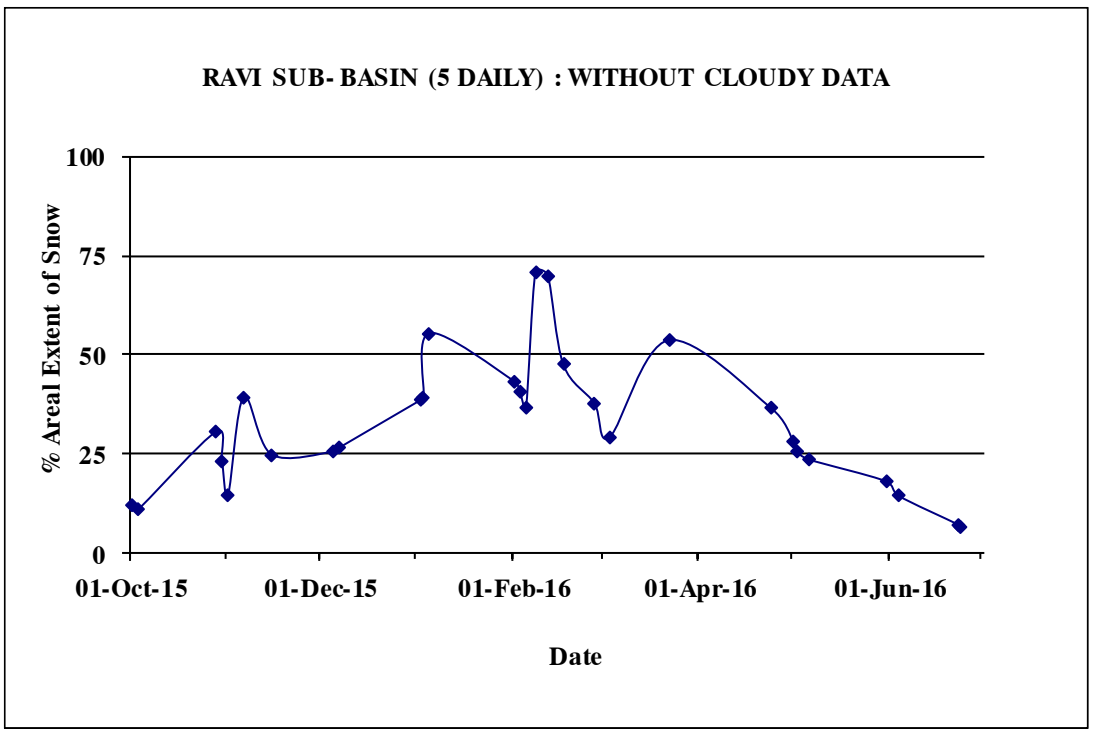
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: RAVI **BASIN AREA: 4907 sq km**

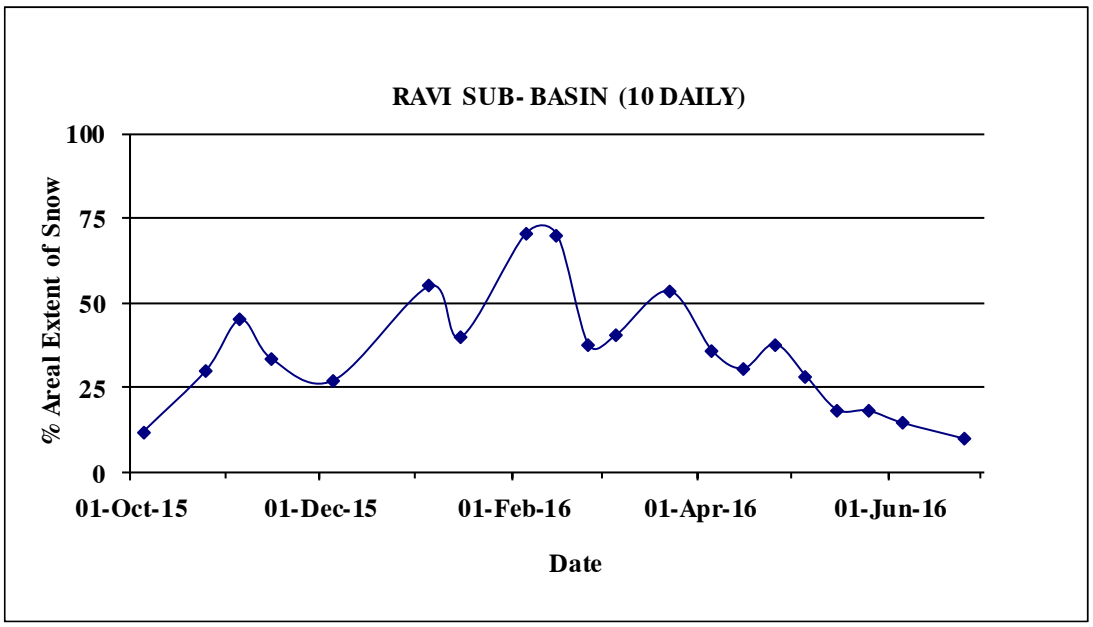
S No	Date	Snow cover (sq km)	Snow cover (%)	S. No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	05/10/15	588	12	2	25/10/15	1472	30
November 2015							
3	05/11/15	2208	45	4	15/11/15	1641	33
December 2015							
5	05/12/15	1325	27				
January 2016							
7	05/01/16	2699	55	9	15/01/16	1955	40
February-2016							
10	05/02/16	3468	71	12	25/02/16	1850	38
11	15/02/16	3439	70				
March 2016							
13	05/03/16	1989	41	14	25/03/16	2629	54
April-2016							
15	05/04/16	1749	36		25/04/16	1855	38
	15/04/16	1502	31				
May-2016							
16	5-May-14	1391	28	18	25-May-14	886	18
17	15-May-14	899	18				
June-2016							
19	05/06/16	708	14	21	25/06/16	476	10

SNOW COVER DEPLETION CURVE



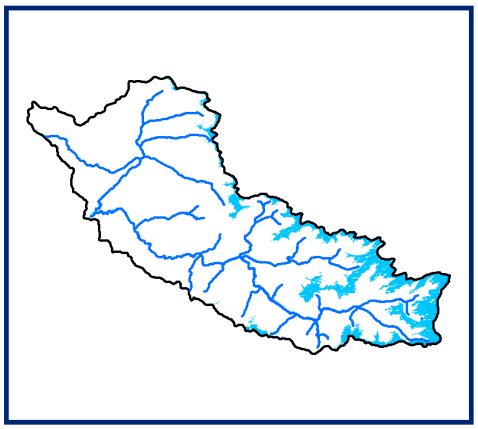


SNOW COVER DEPLETION CURVE



SNOW COVER MAP

SNOW COVER MAP : RAVI SUB-BASIN



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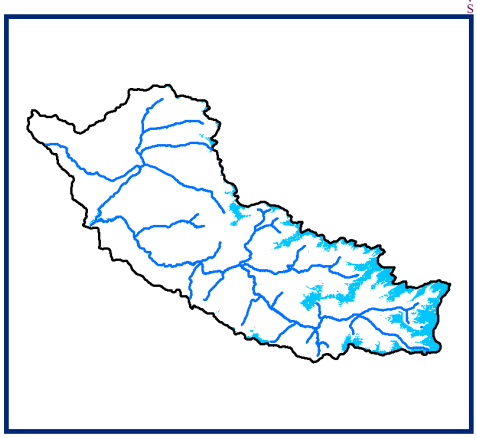

03 OCTOBER 2015

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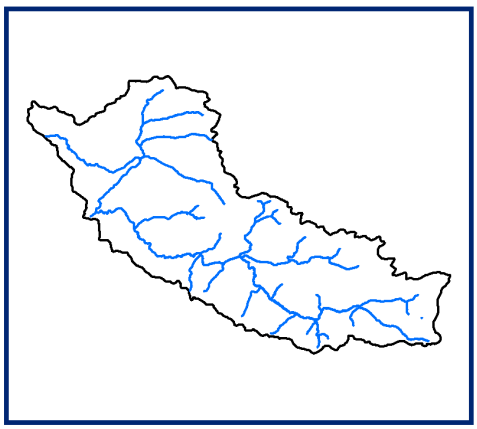

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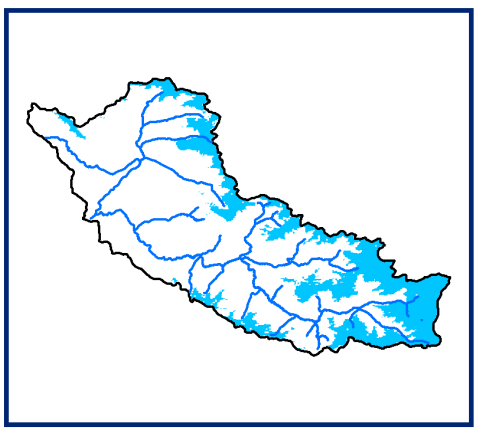

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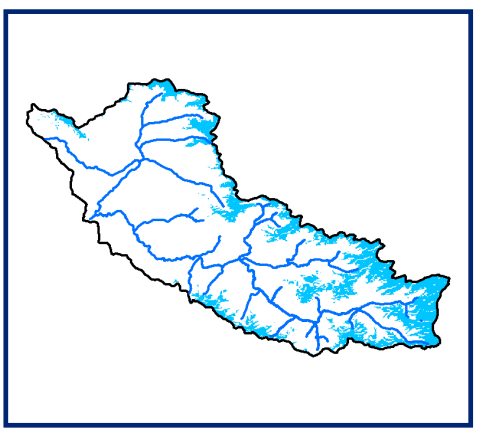

30 OCTOBER 2015

SNOW

40 20 0 40 80 120

Kilometers

10 DAILY SNOW COVER MAP : RAVI SUB-BASIN

DATA USED
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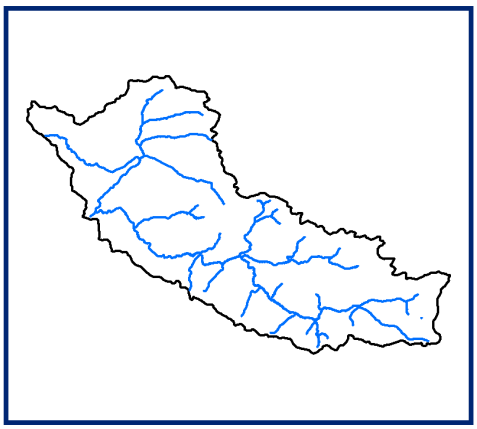
03 OCTOBER 2015



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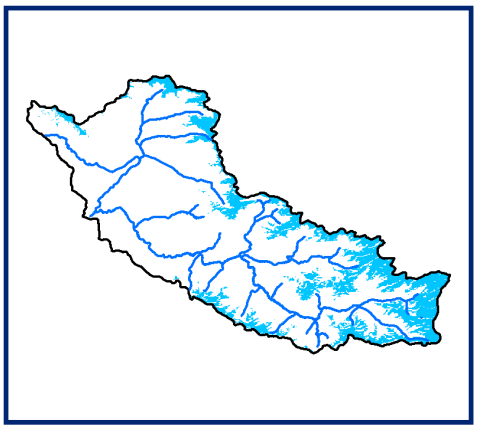

DATA USED
28 OCTOBER 2015
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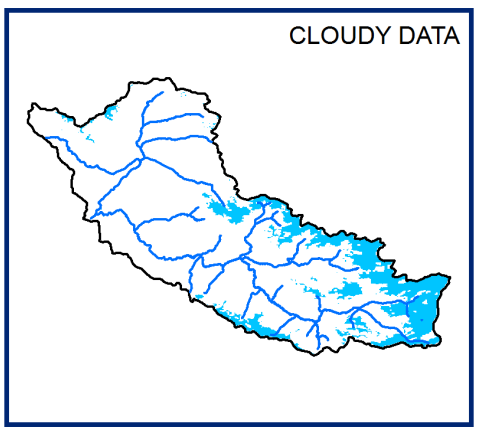
SNOW

40 20 0 40 80 120
Kilometers

SNOW COVER MAP : RAVI SUB-BASIN

01 NOVEMBER 2015

06 NOVEMBER 2015



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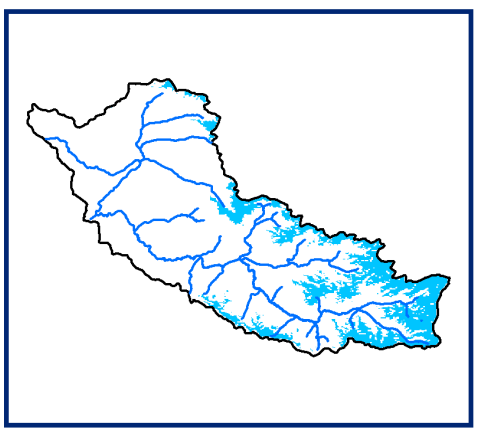

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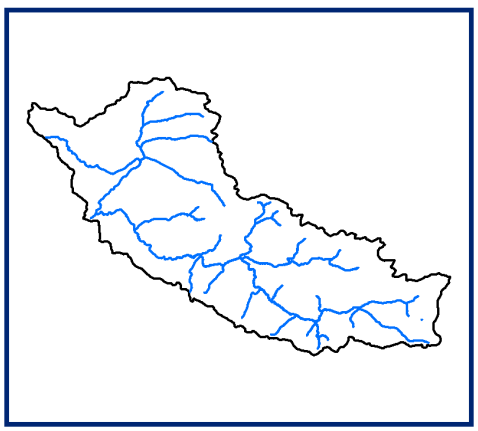

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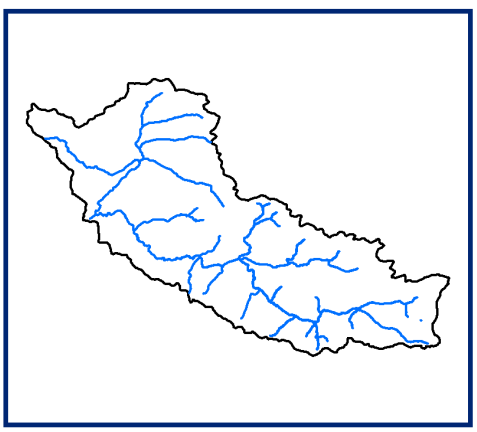

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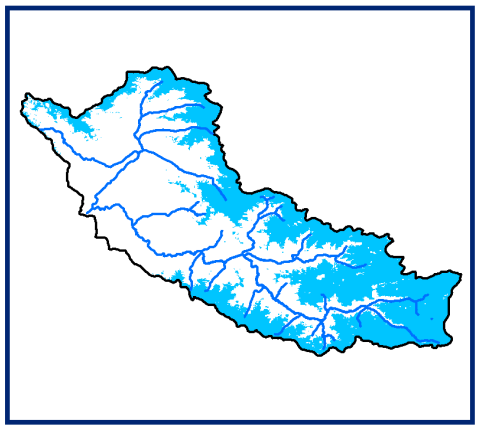
SNOW

40 20 0 40 80 120

Kilometers

10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



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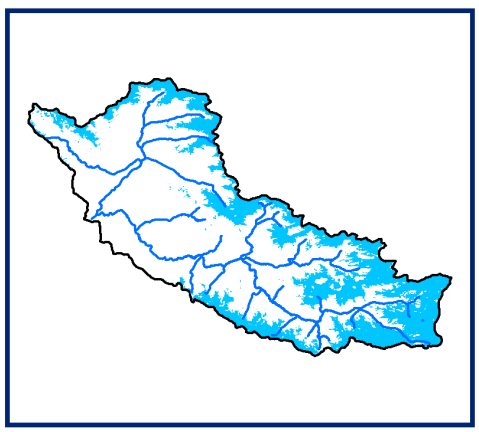

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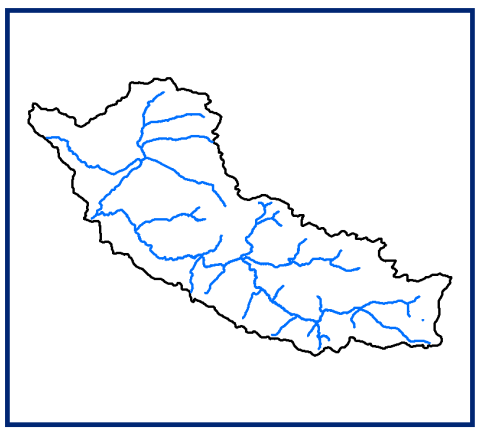

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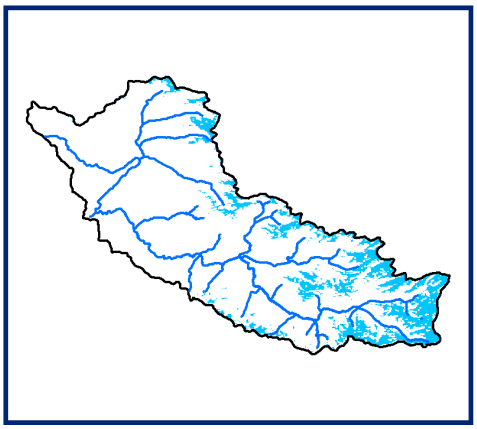
SNOW

2512.5 0 25 50 75
Kilometers

SNOW COVER MAP : RAVI SUB-BASIN



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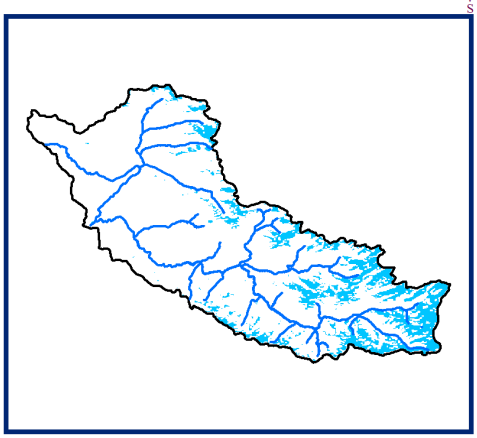

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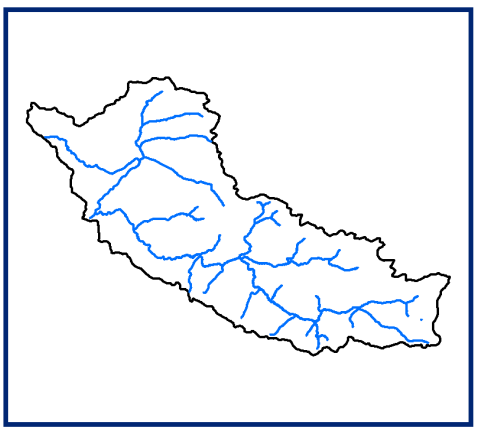

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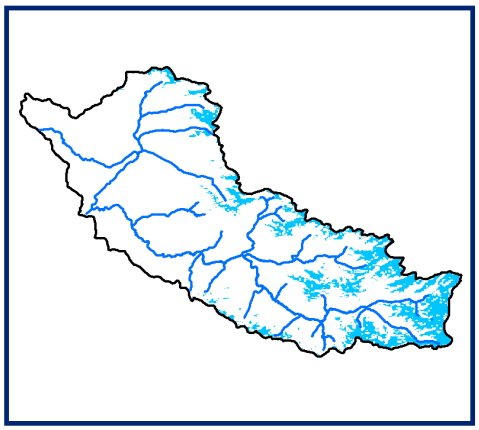
DATA NOT AVAILABLE

SNOW

40 20 0 40 80 120

Kilometers

10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



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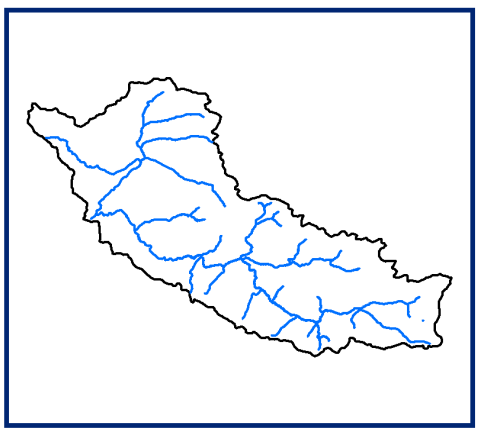

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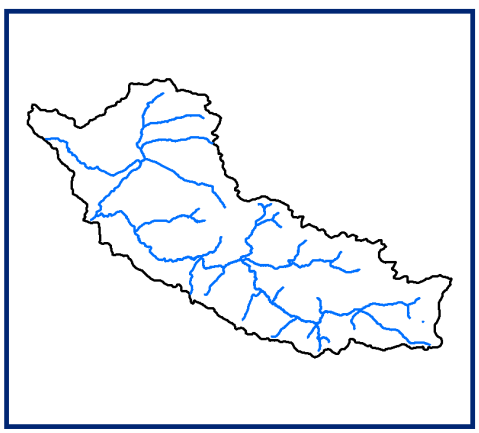

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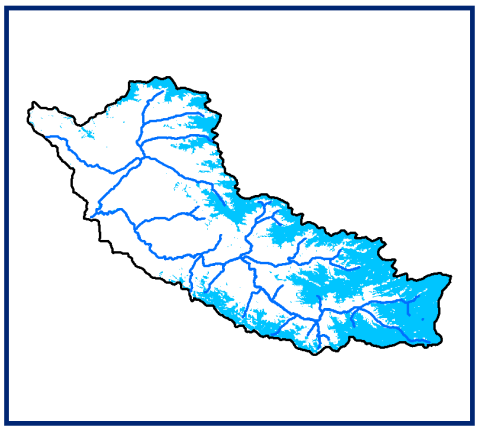
SNOW

40 20 0 40 80 120
Kilometers

SNOW COVER MAP : RAVI SUB-BASIN



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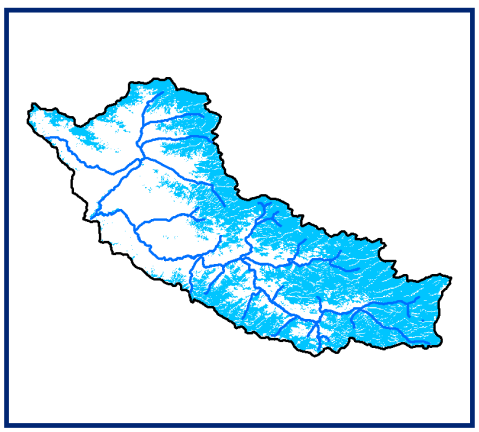
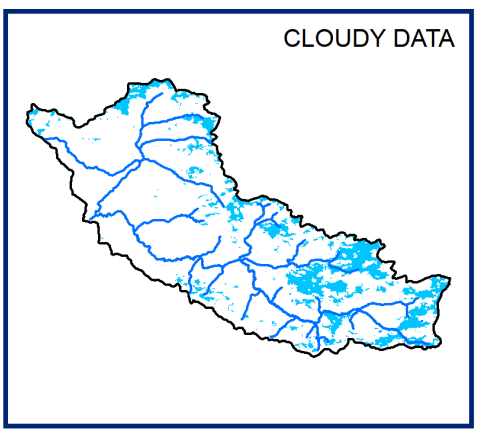
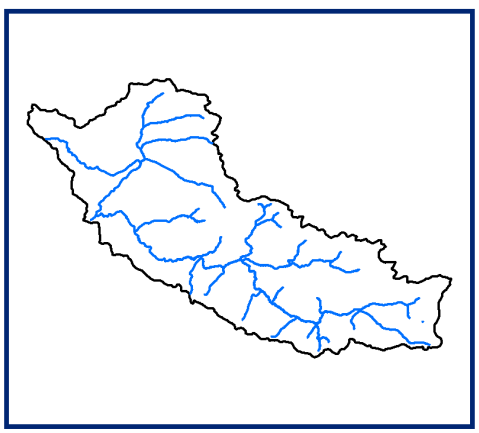


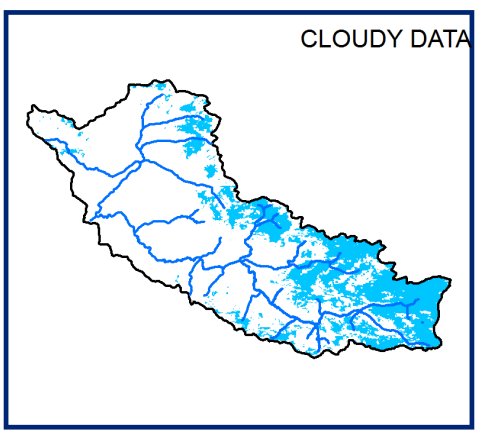
05 JANUARY 2016



19 JANUARY 2016



DATA NOT AVAILABLE



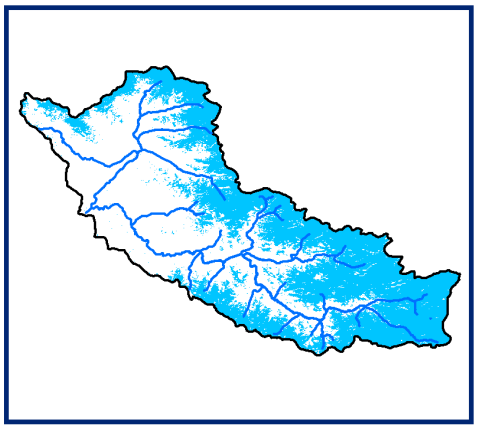
27 JANUARY 2016

SNOW

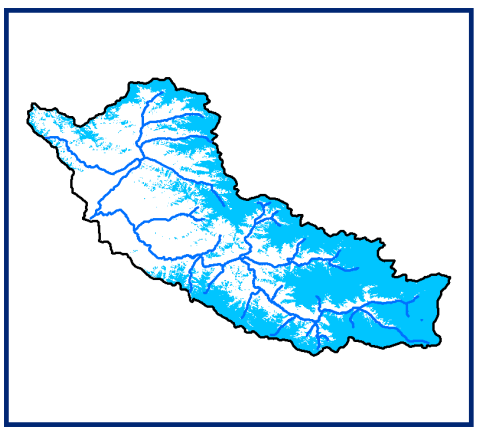
40 20 0 40 80 120

Kilometers

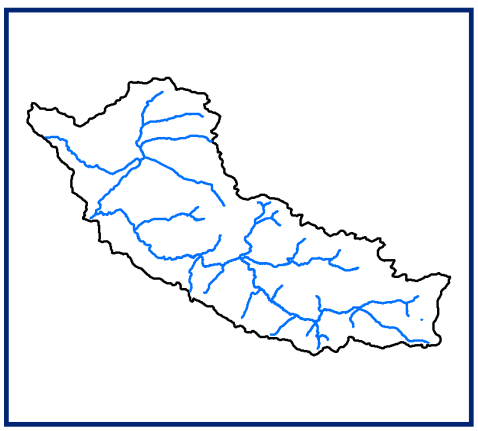
10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
02 JANUARY 2016
03 JANUARY 2016
05 JANUARY 2016



DATA USED
19 JANUARY 2016

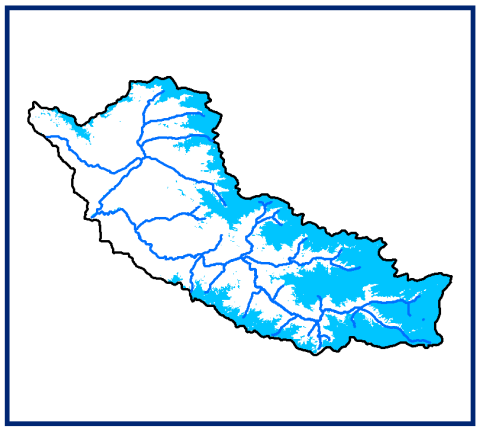


DATA NOT AVAILABLE

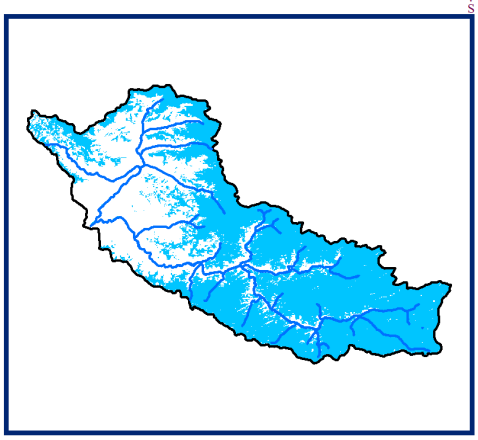
SNOW

25 12.5 0 25 50 75
Kilometers

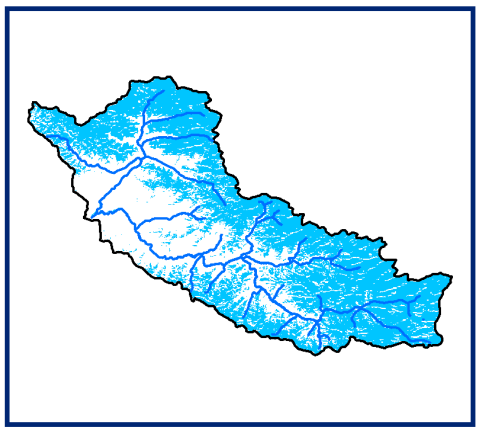
SNOW COVER MAP : RAVI SUB-BASIN



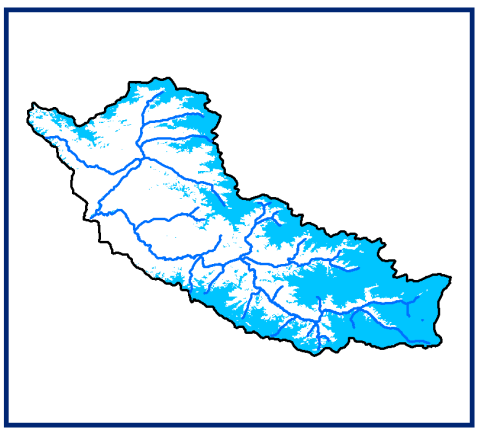
01 FEBRUARY 2016



08 FEBRUARY 2016



12 FEBRUARY 2016



17 FEBRUARY 2016

DATA NOT AVAILABLE

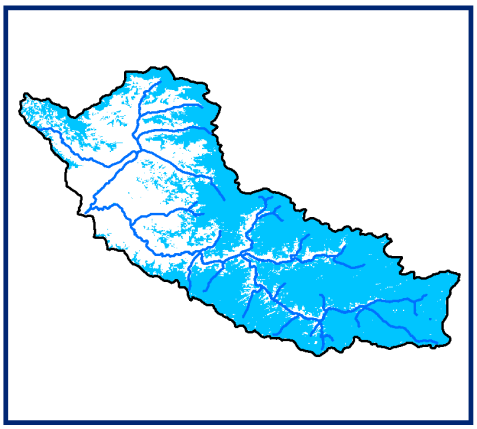
27 FEBRUARY 2016

SNOW

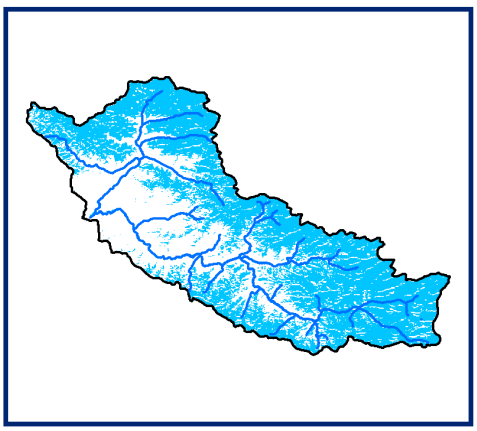
40 20 0 40 80 120

Kilometers

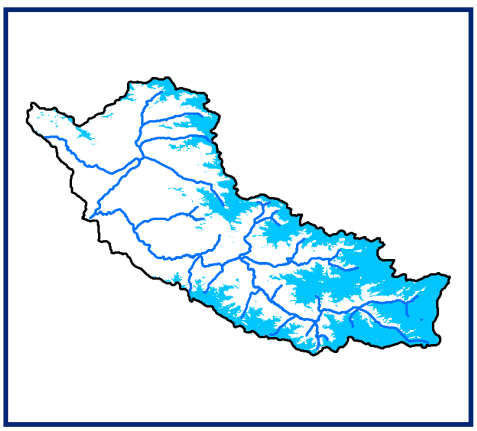
10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
01 FEBRUARY 2016
05 FEBRUARY 2016
08 FEBRUARY 2016



DATA USED
12 FEBRUARY 2016
17 FEBRUARY 2016

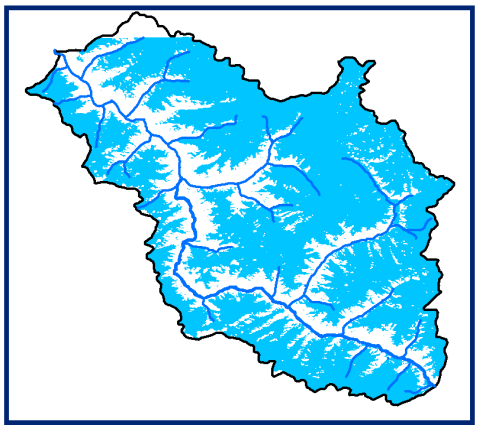


DATA USED
27 FEBRUARY 2016

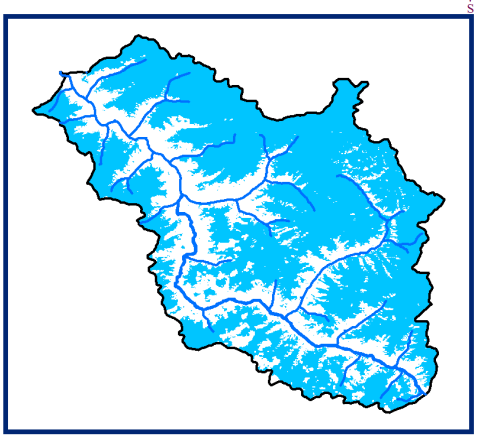
SNOW

40 20 0 40 80 120
Kilometers

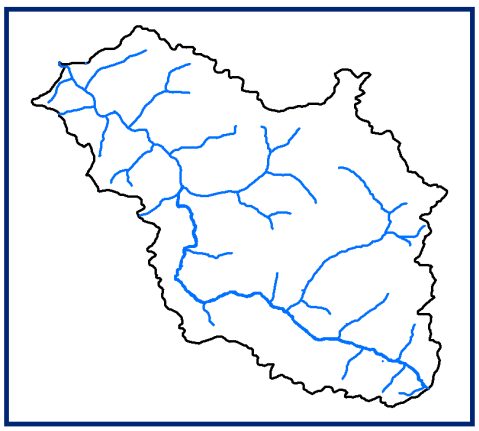
SNOW COVER MAP : MIYAR SUB-BASIN



03 MARCH 2016



05 MARCH 2016



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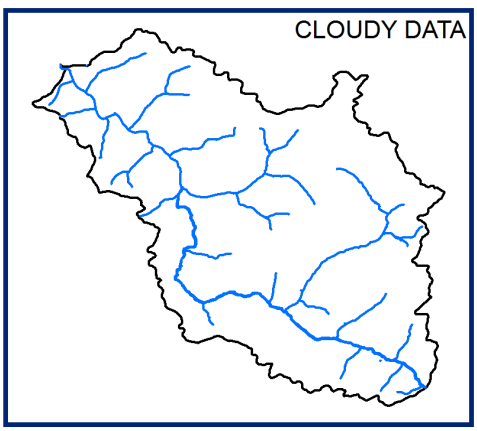

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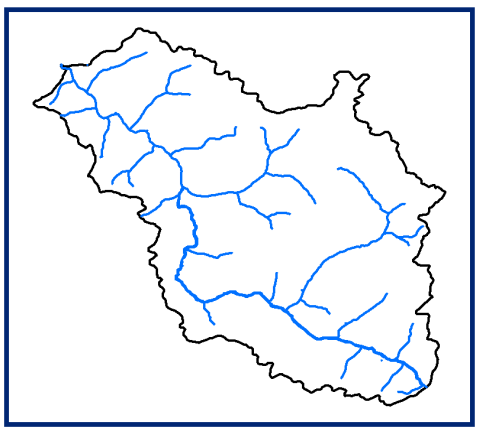
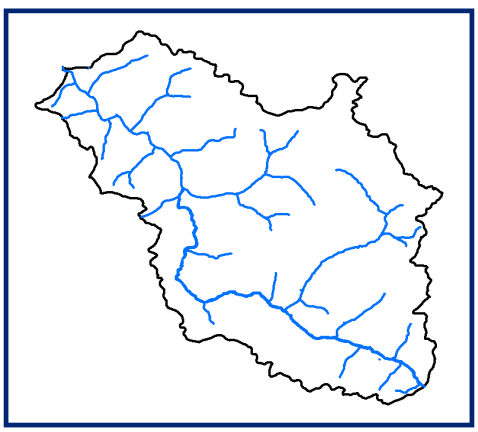


DATA NOT AVAILABLE



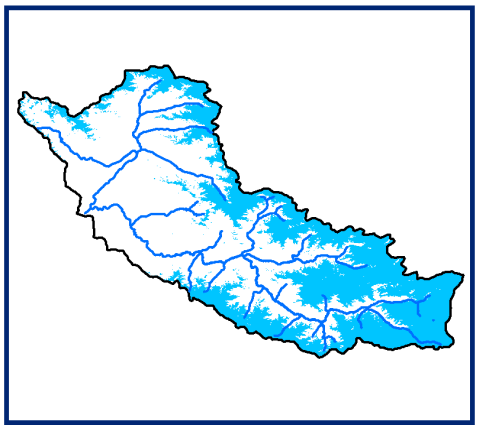
DATA NOT AVAILABLE

SNOW

25 12.5 0 25 50 75

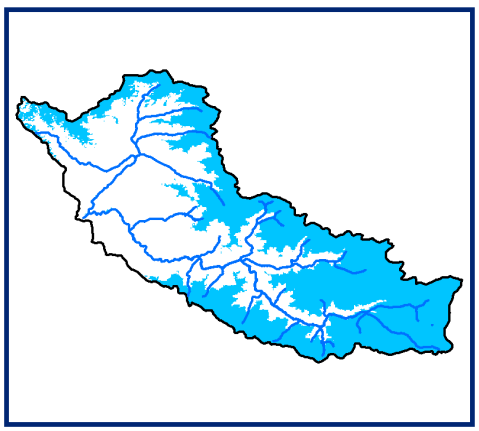
Kilometers

10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
03 MARCH 2016
07 MARCH 2016

DATA NOT AVAILABLE



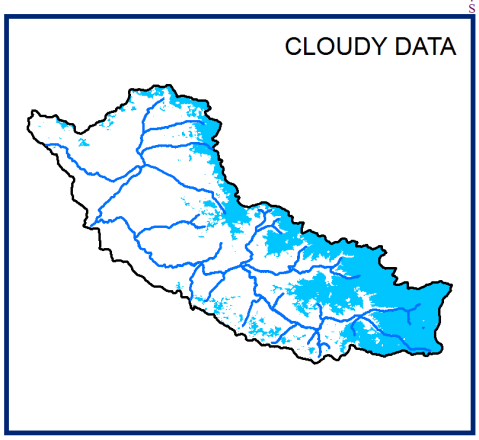
DATA USED
22 MARCH 2016

30 15 0 30 60 90
Kilometers

SNOW

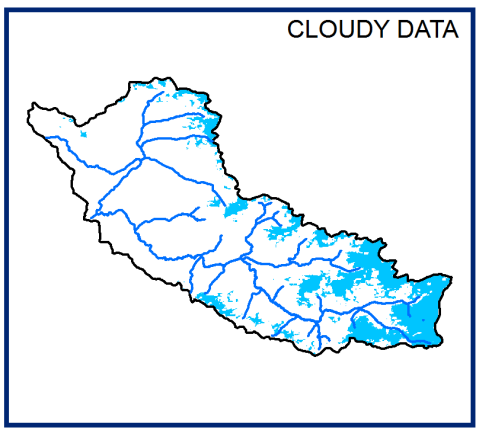
SNOW COVER MAP : RAVI SUB-BASIN

DATA NOT AVAILABLE

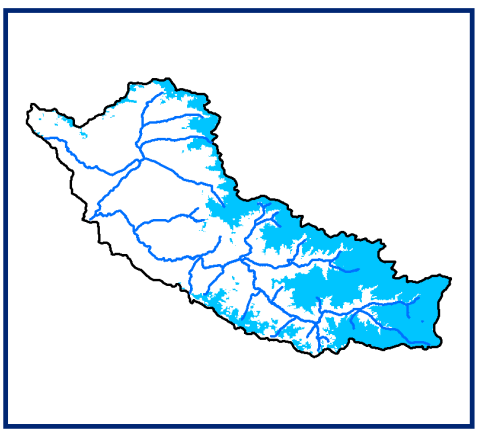


07 APRIL 2016

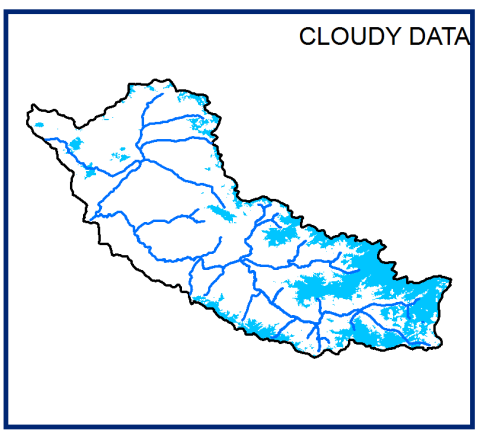
DATA NOT AVAILABLE



20 APRIL 2016



24 APRIL 2016



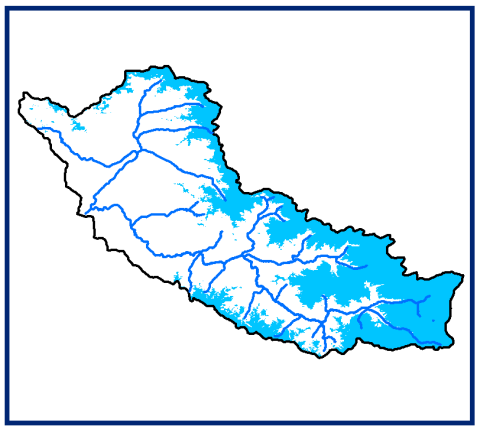
27 APRIL 2016

SNOW

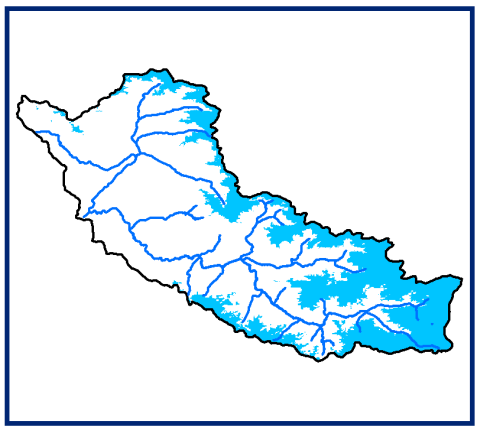
40 20 0 40 80 120

Kilometers

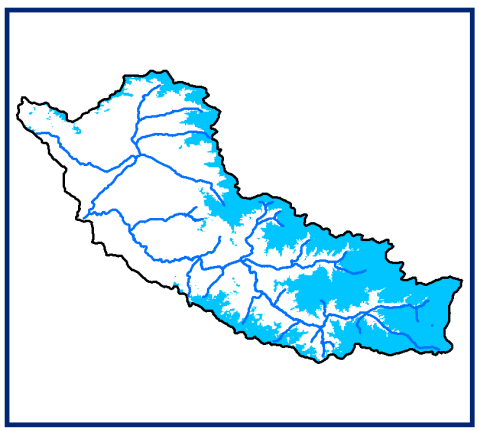
10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
07 APRIL 2016



DATA USED
13 APRIL 2016
20 APRIL 2016



DATA USED
24 APRIL 2016
27 APRIL 2016

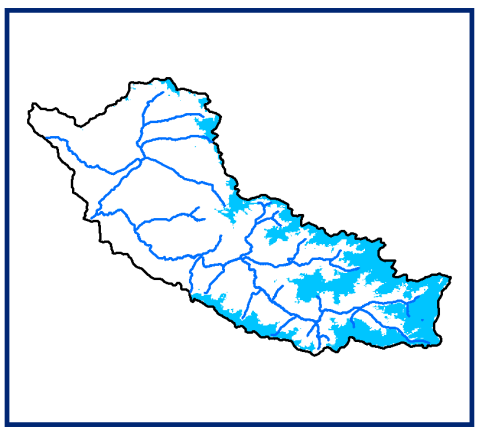
20 10 0 20 40 60
Kilometers

SNOW

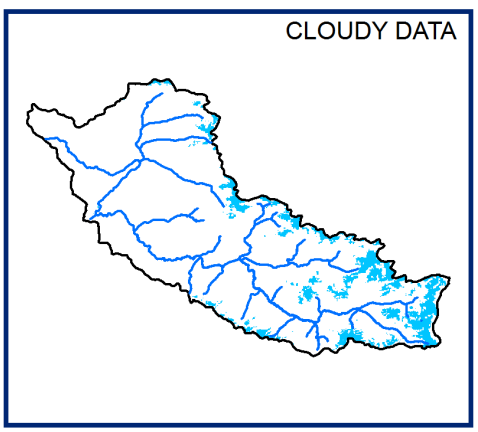
SNOW COVER MAP : RAVI SUB-BASIN

01 MAY 2016

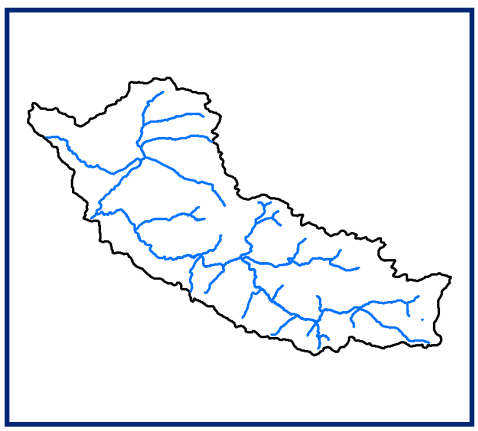
02 MAY 2016



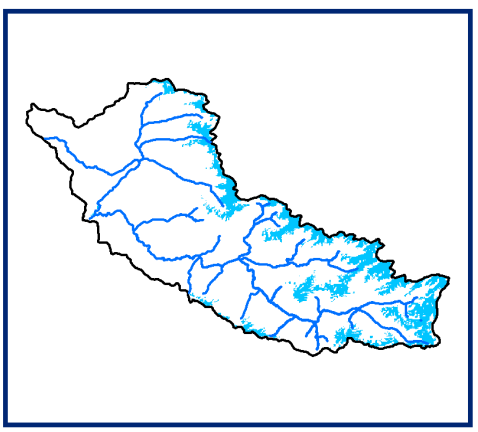
06 MAY 2016



19 MAY 2016

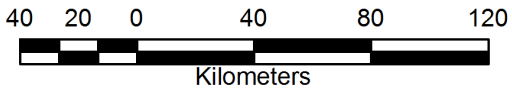


DATA NOT AVAILABLE

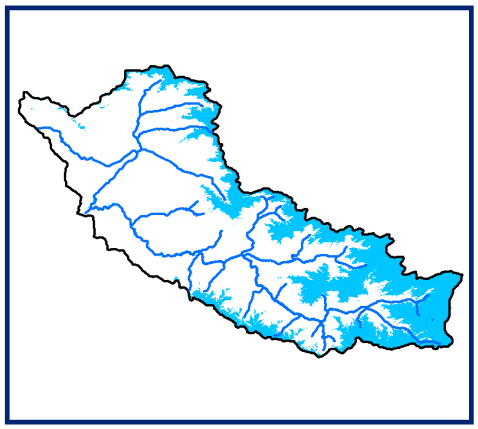


31 MAY 2016

SNOW

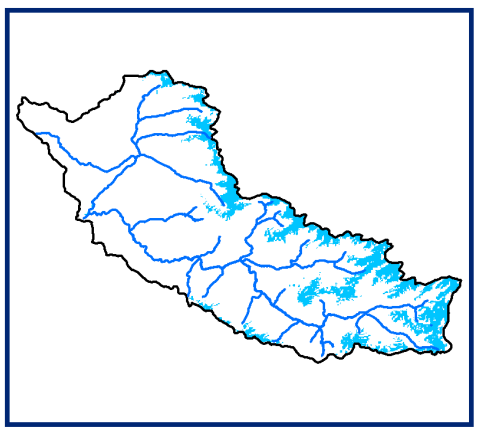


10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
01 MAY 2016
02 MAY 2016
07 MAY 2016

DATA USED
19 MAY 2016



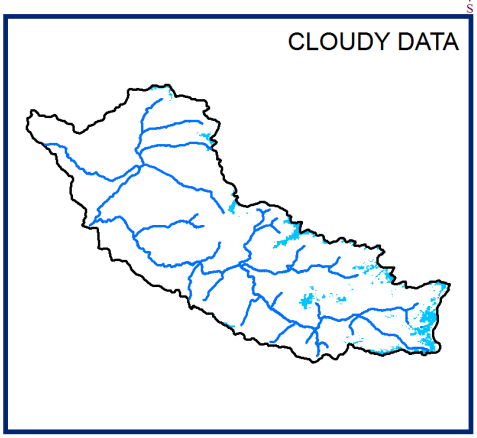
DATA USED
31 MAY 2016

SNOW

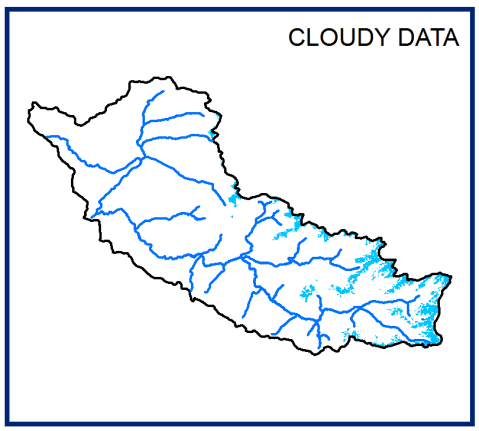
40 20 0 40 80 120
Kilometers

SNOW COVER MAP : RAVI SUB-BASIN

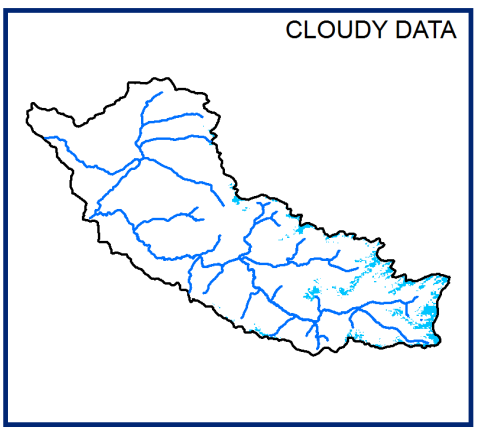
04 JUNE 2016



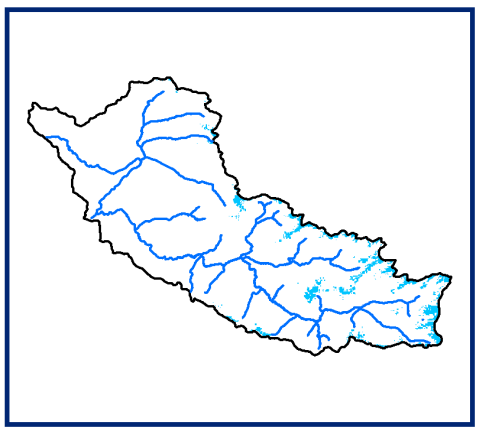
09 JUNE 2016



14 JUNE 2016



18 JUNE 2016



23 JUNE 2016

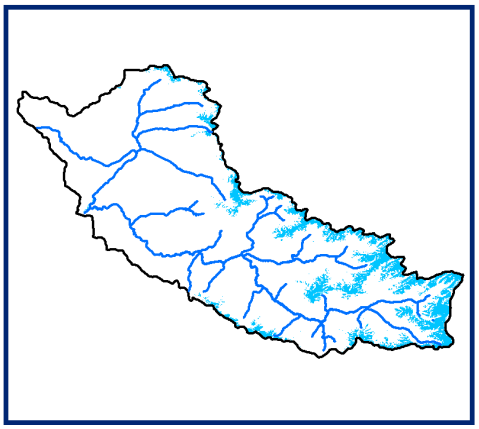
24 JUNE 2016

SNOW

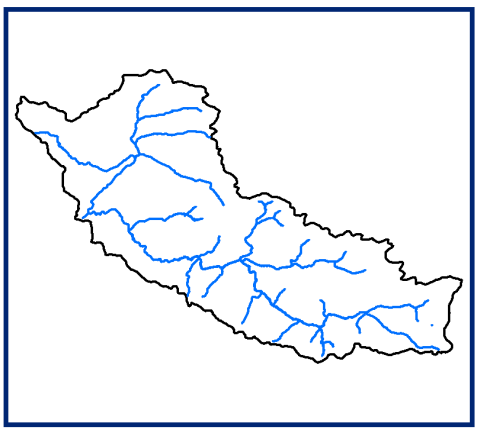
40 20 0 40 80 120

Kilometers

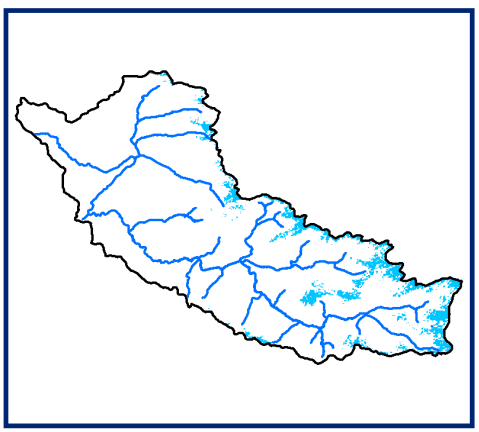
10 DAILY SNOW COVER MAP : RAVI SUB-BASIN



DATA USED
04 JUNE 2016
09 JUNE 2016



DATA NOT AVAILABLE



DATA USED
23 JUNE 2016
24 JUNE 2016

30 15 0 30 60 90
Kilometers

SNOW

CHANDRA SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: MIYAR **BASIN AREA: 2433 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	01/10/15	1529	63	4	28/10/15	2142	88
2	03/10/15	1505	62	5	30/10/15	1823	75
3	04/10/15	1368(c)	56				
November 2013							
6	01/11/15	1636	67	8	06/11/15	2368	97
7	02/11/15	1571	65	9	08/11/15	2177(c)	89
December 2013							
10	05/12/15	2057	85	12	20/12/15	2397	99
11	07/12/15	1833(c)	75				
January 2014							
13	03/01/16	2345	96	16	19/01/16	1937(c)	80
14	05/01/16	2236	92	17	27/01/16	2327	96
15	13/01/16	2404	99				
February 2014							
18	01/02/16	2380	98	21	10/02/16	2285	94
19	03/02/16	2322	95	22	12/02/16	2390	98
20	05/02/16	2399(c)	99		17/02/16	2419	99
	08/02/16	2436	100		27/02/16	2389	98
March 2014							
23	01/03/16	2391	98	25	05/03/16	2273(c)	93
24	03/03/16	2357	97	26	22/03/16	2444	100
April 2014							
29	20/04/16	2253	93	31	27/04/06	2283	94
30	24/04/16	2340	96	32	30/04/16	2251	93

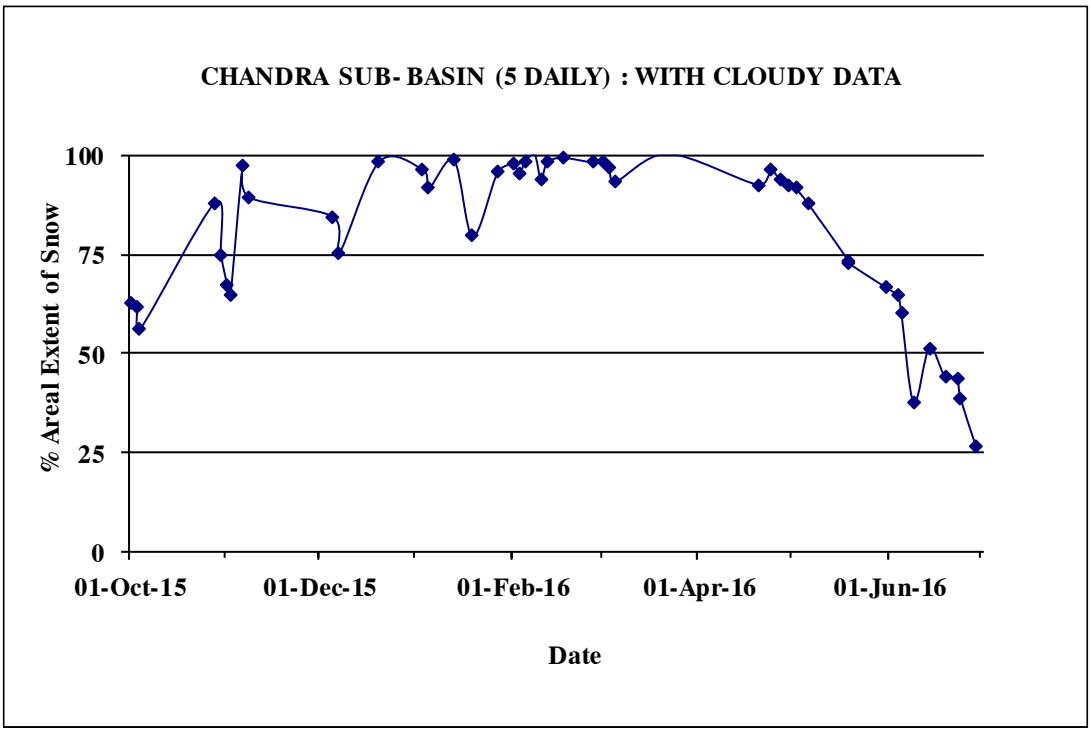
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May-2014							
33	02/05/16	2233	92	35	19/05/16	1771(c)	73
34	06/05/16	2137	88	36	31/05/14	1622	67
June-2014							
37	04/06/16	1570	65	41	19/06/16	1076	44
38	05/06/16	1466	60	42	23/06/16	1060	44
39	09/06/16	912(c)	37	43	24/06/16	944	39
40	14/06/16	1249	51	44	29/06/16	645(c)	27

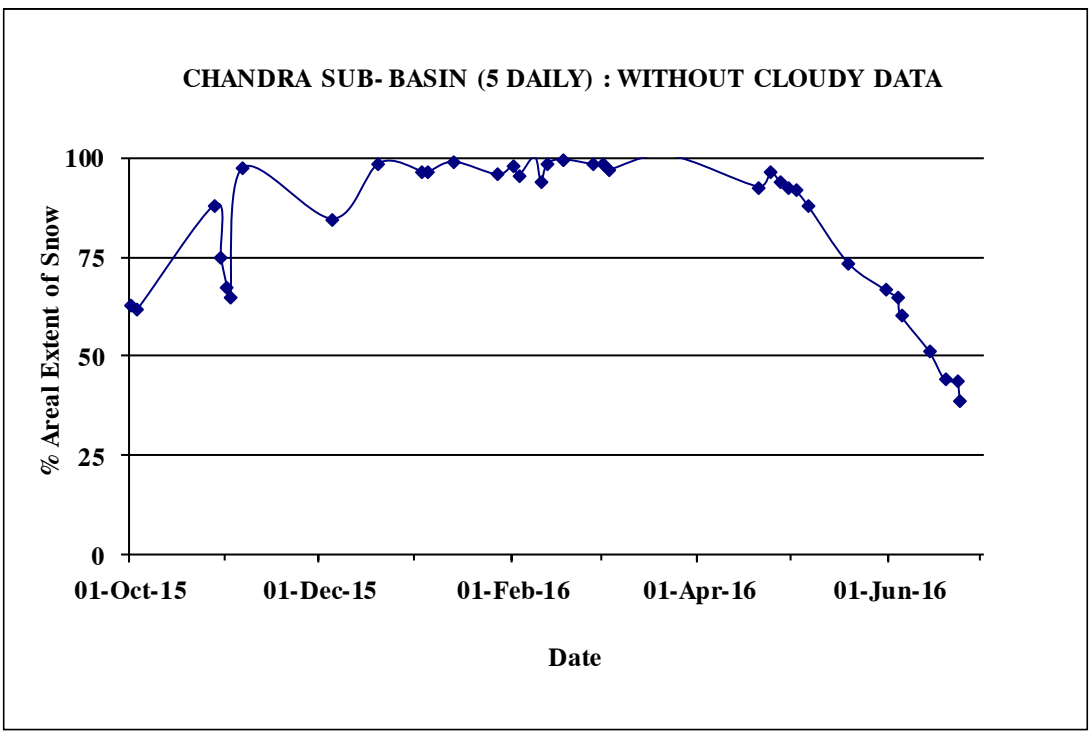
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: MIYAR **BASIN AREA: 2433 sq km**

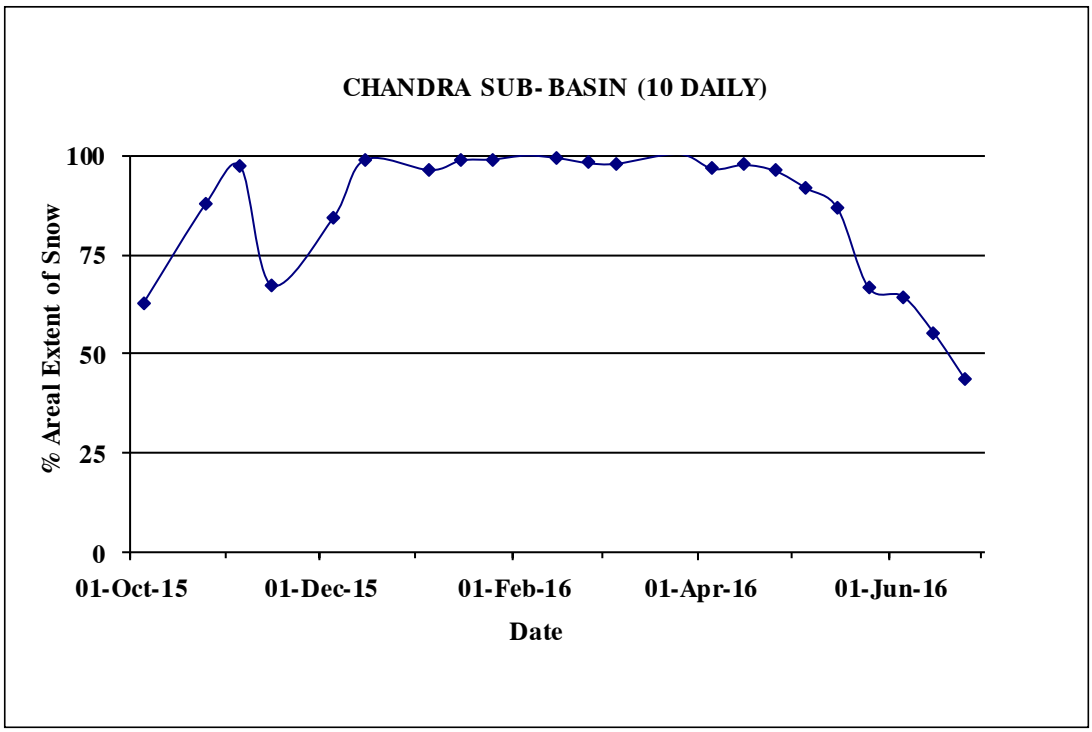
S No	Date	Snow cover (sq km)	Snow cover (%)	S. No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	05/10/15	1533	63	2	25/10/15	2143	88
November 2015							
3	05/11/15	2368	97	4	15/11/15	1637	67
December 2015							
5	05/12/15	2056	85	6	15/12/15	2409	99
January 2016							
7	05/01/16	2345	96	9	25/01/16	2411	99
8	15/01/16	2405	99				
February 2016							
10	05/02/16	2435	100	12	25/02/16	2388	98
11	15/02/16	2419	99				
March 2016							
13	05/03/16	2384	98	14	15/03/16	2444	100
April 2016							
15	5/04/16	2352	97	15	25/04/16	2340	96
15	15/04/16	2377	98				
May-2016							
16	5-May-14	2233	92	18	25-May-14	1622	67
17	15-May-14	2111	87				
June-2016							
19	05/06/16	1569	64	21	25/06/16	1060	44
20	15/06/16	1343	55				

SNOW COVER DEPLETION CURVE



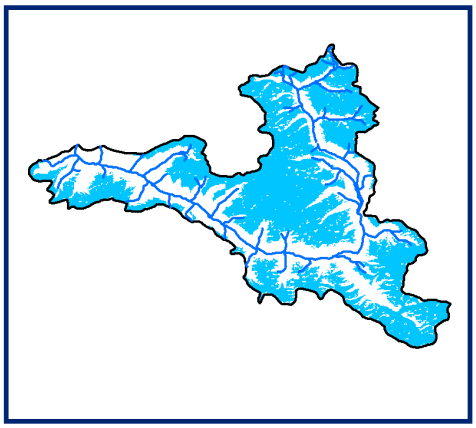


SNOW COVER DEPLETION CURVE

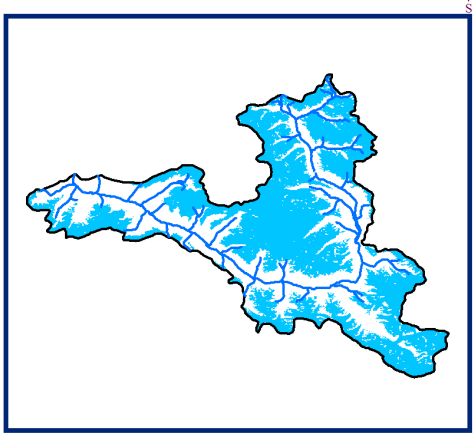


SNOW COVER MAP

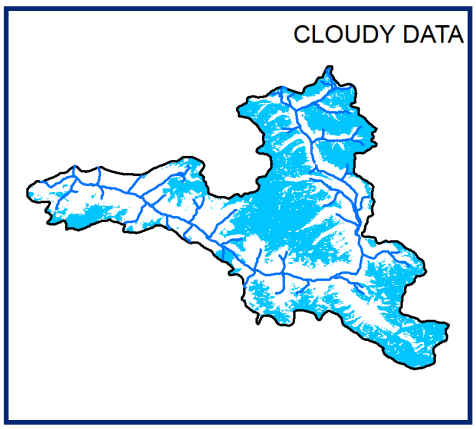
SNOW COVER MAP : CHANDRA SUB-BASIN



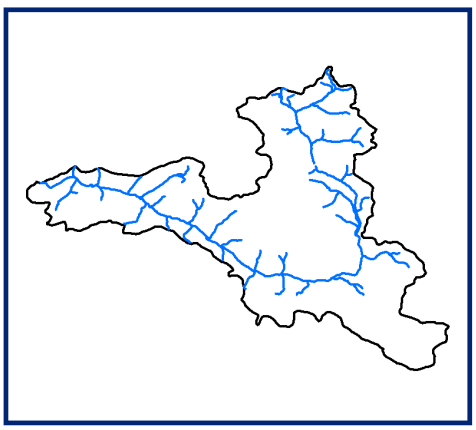
01 OCTOBER 2015



03 OCTOBER 2015



04 OCTOBER 2015



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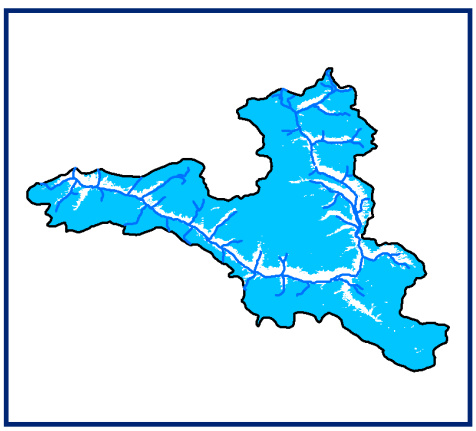
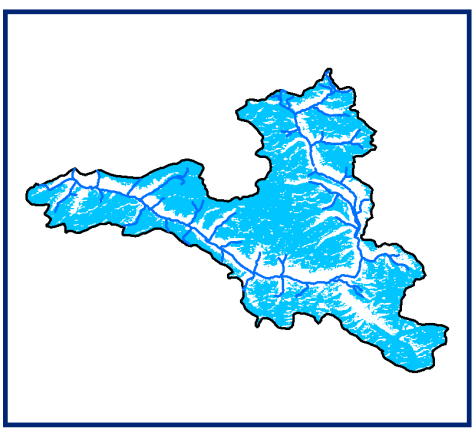


28 OCTOBER 2015



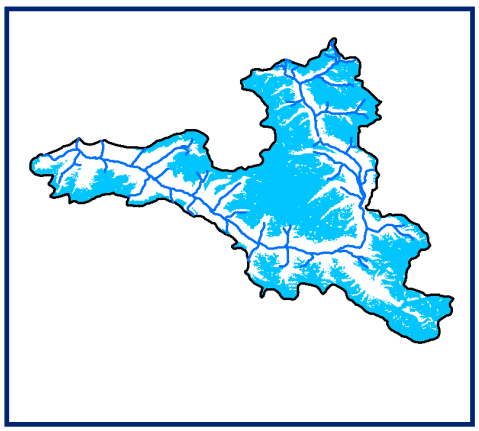
30 OCTOBER 2015

SNOW

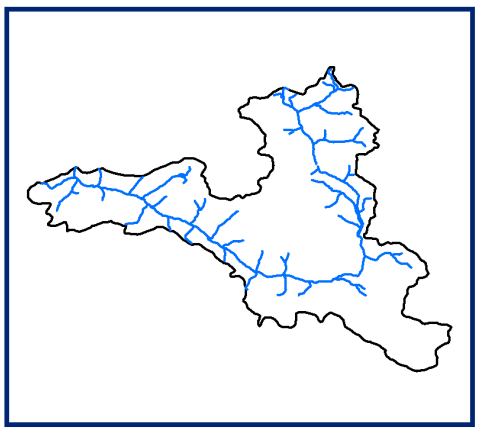
0 5 10 20 30 40

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
01 OCTOBER 2015
03 OCTOBER 2015



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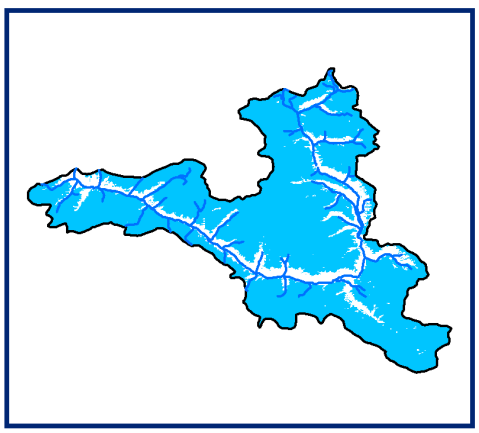
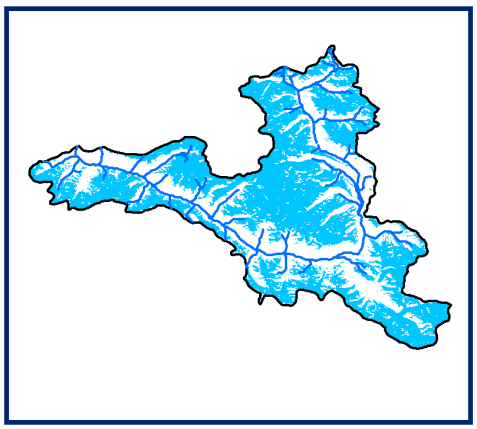


DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

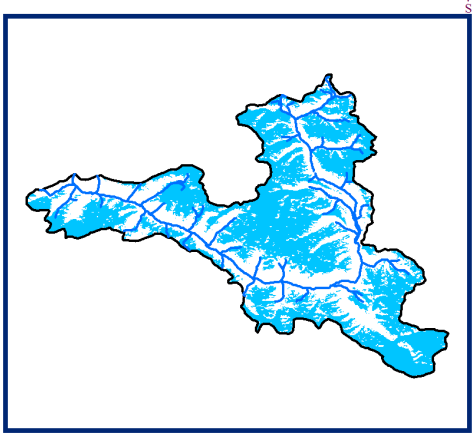
SNOW

30 15 0 30 60 90
Kilometers

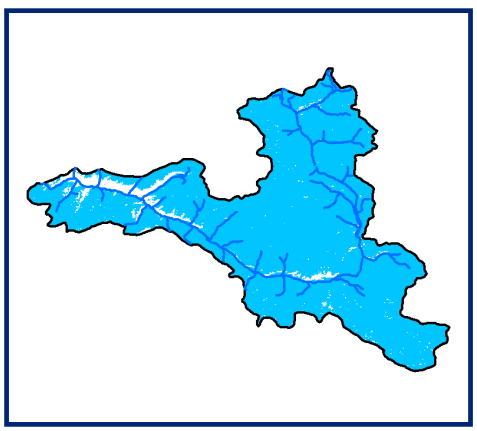
SNOW COVER MAP : CHANDRA SUB-BASIN



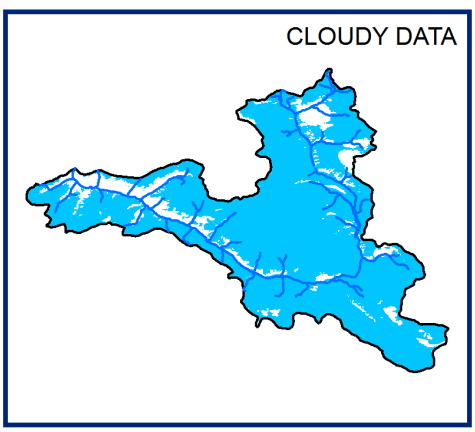
01 NOVEMBER 2015



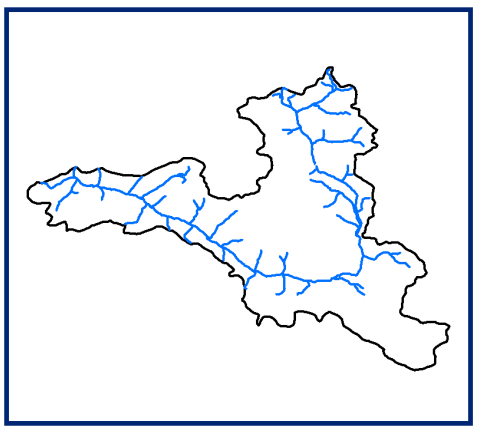
02 NOVEMBER 2015



06 NOVEMBER 2015



08 NOVEMBER 2015



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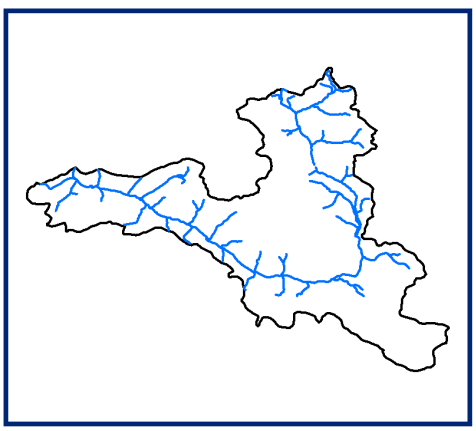


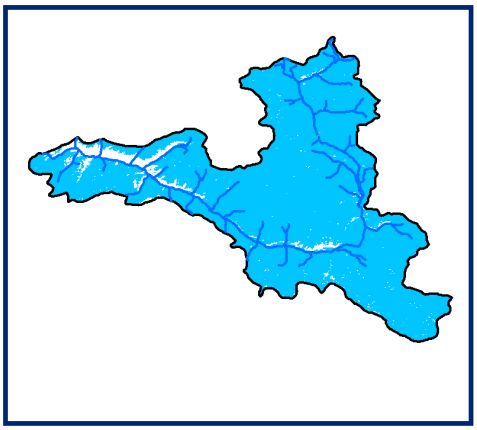
DATA NOT AVAILABLE

SNOW

30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
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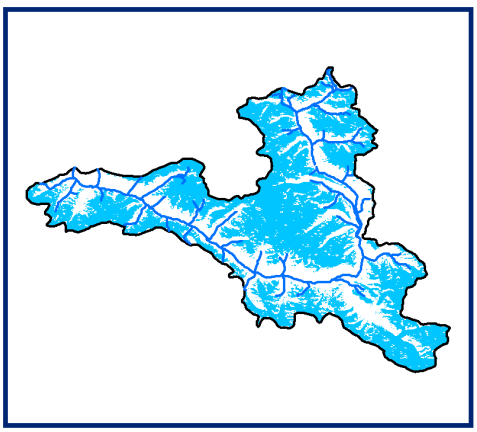
06 NOVEMBER 2015



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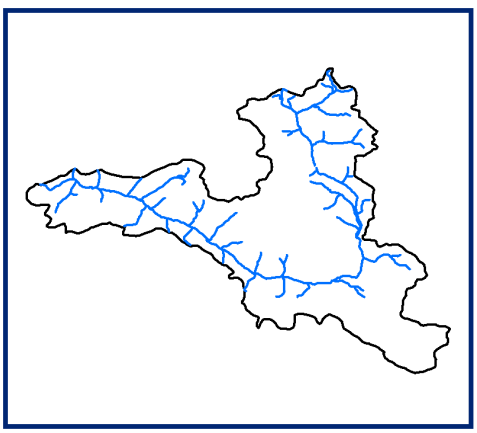
15 NOVEMBER 2015

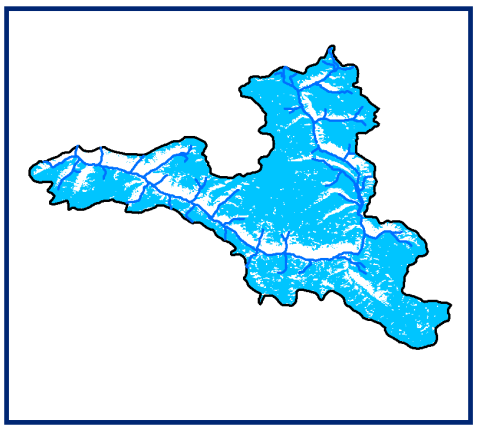


DATA NOT AVAILABLE

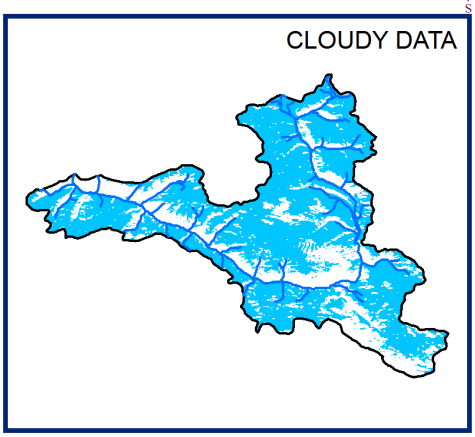
SNOW

30 15 0 30 60 90
Kilometers

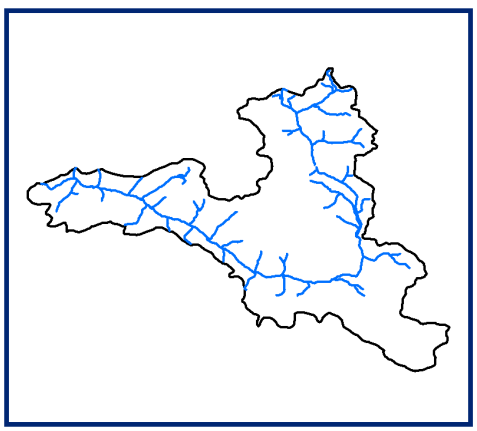
SNOW COVER MAP : CHANDRA SUB-BASIN



05 DECEMBER 2015



07 DECEMBER 2015



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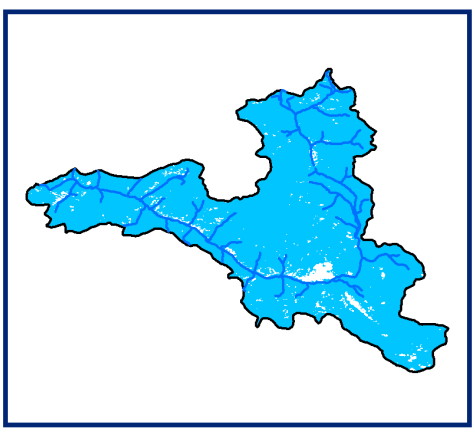
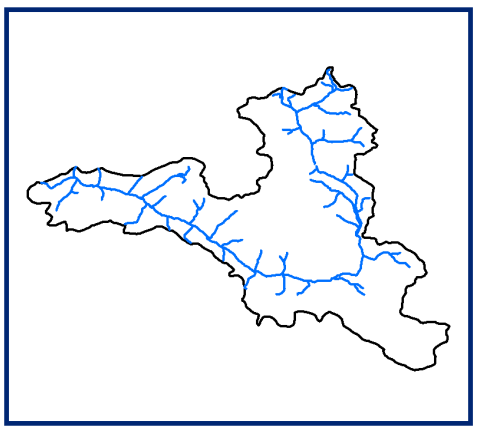


20 DECEMBER 2015



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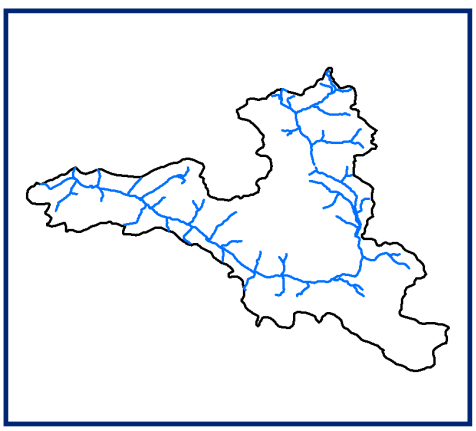


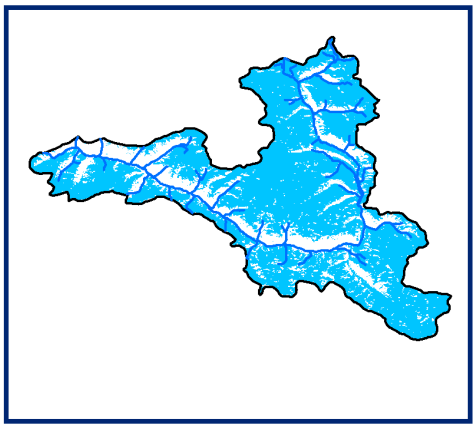
DATA NOT AVAILABLE

SNOW

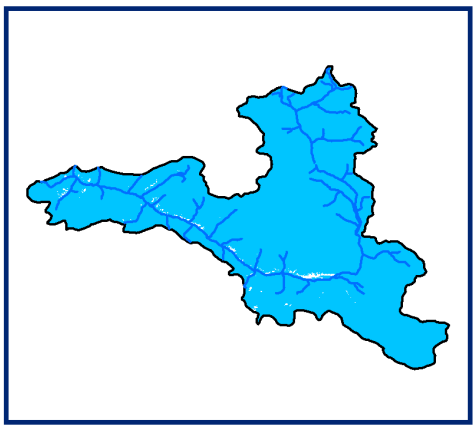
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
05 DECEMBER 2015
07 DECEMBER 2015



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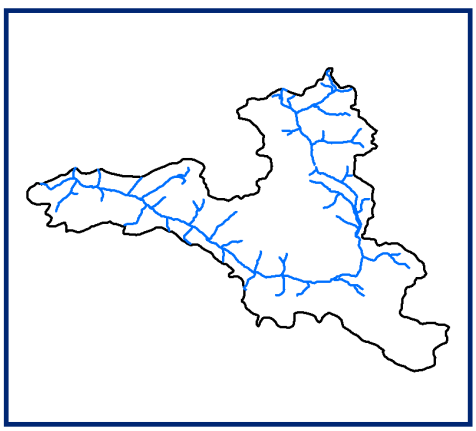
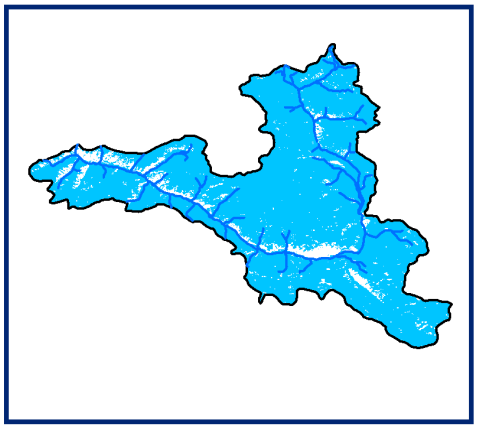


DATA NOT AVAILABLE

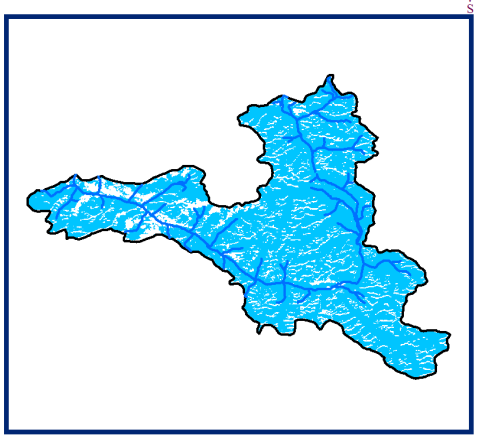
SNOW

30 15 0 30 60 90
Kilometers

SNOW COVER MAP : CHANDRA SUB-BASIN



03 JANUARY 2016



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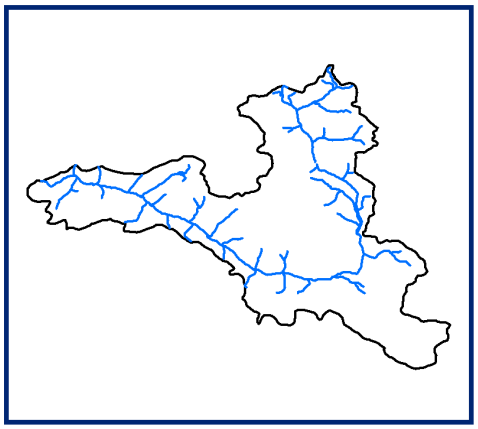

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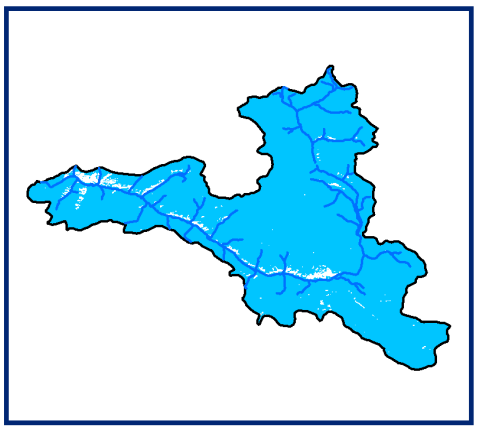
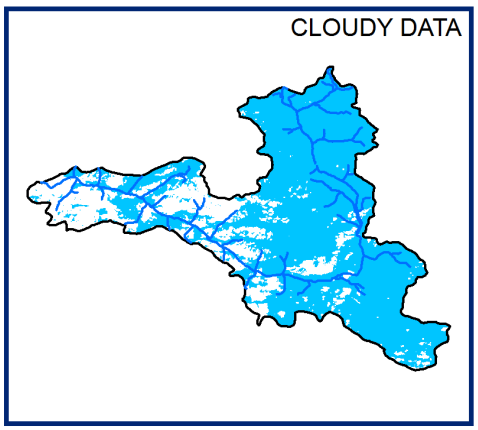
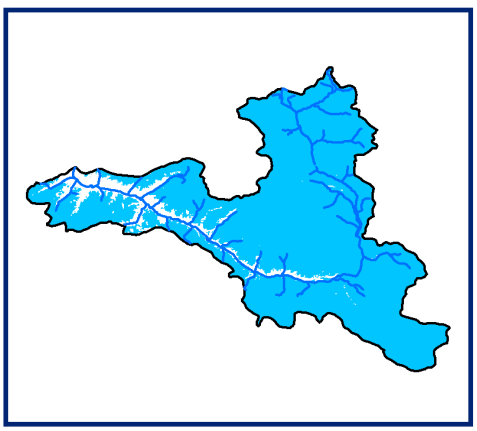


13 JANUARY 2016



19 JANUARY 2016



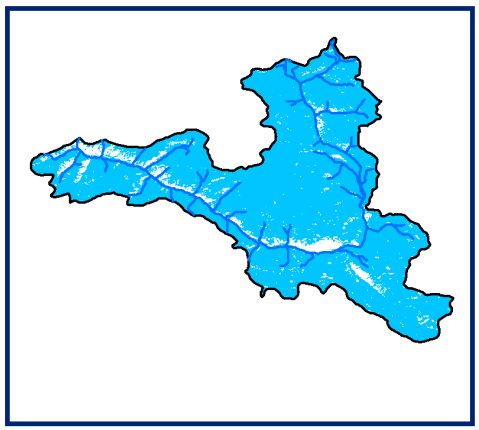
27 JANUARY 2016

SNOW

30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
03 JANUARY 2016
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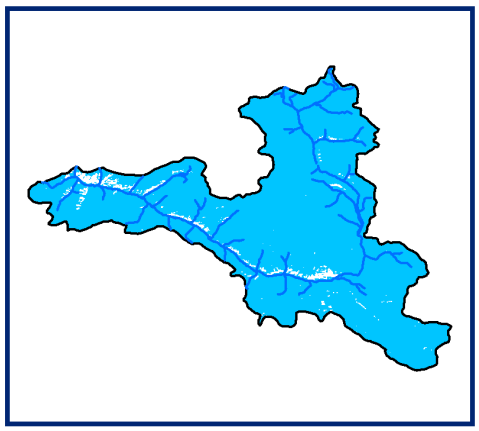
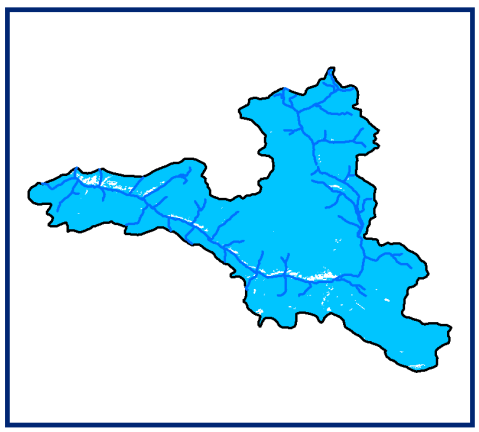


DATA USED
13 JANUARY 2016
19 JANUARY 2016

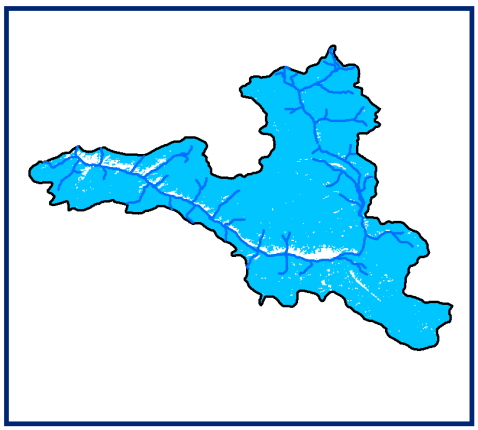


DATA USED
27 JANUARY 2016

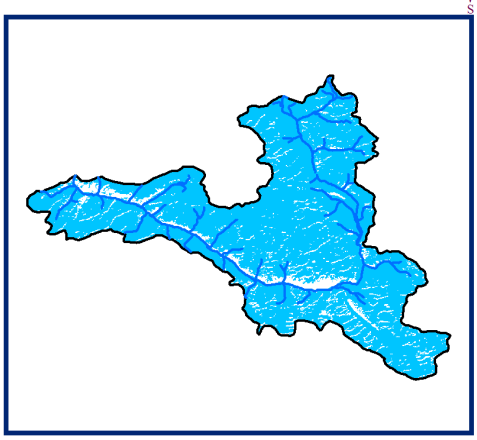
SNOW

30 15 0 30 60 90
Kilometers

SNOW COVER MAP : CHANDRA SUB-BASIN



01 FEBRUARY 2016



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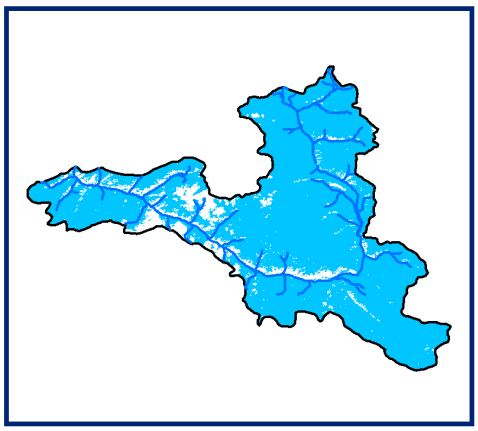

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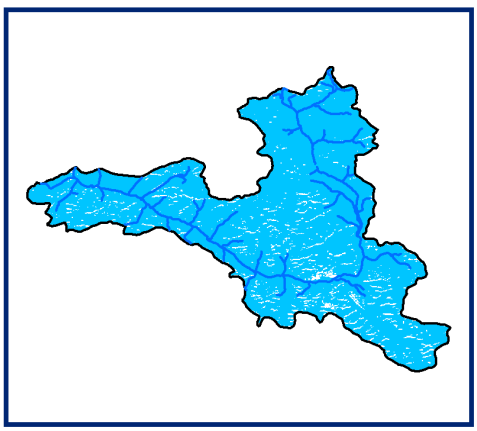

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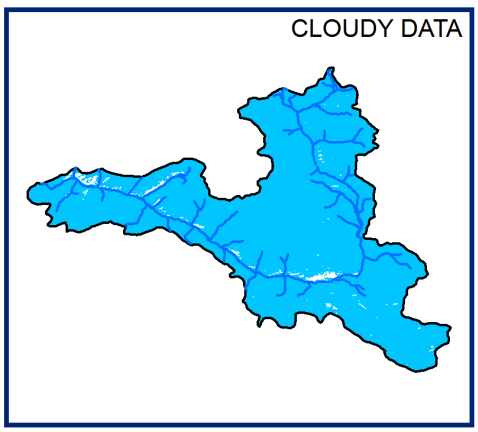

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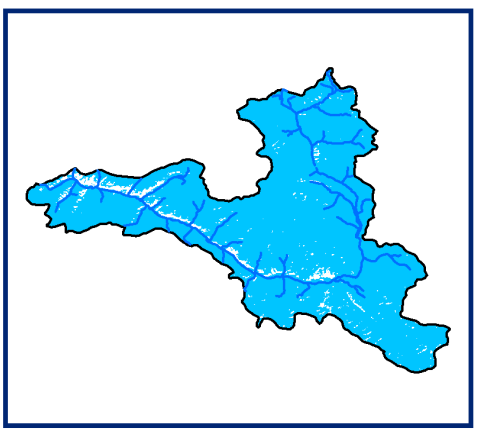


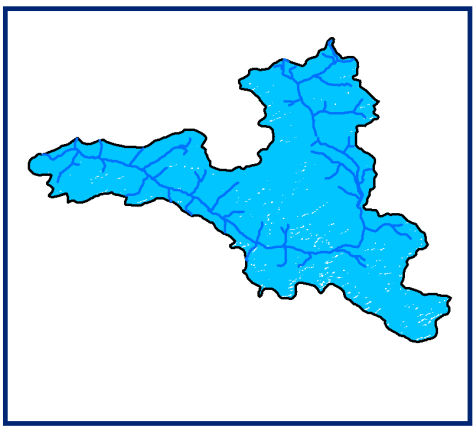
27 FEBRUARY 2016

SNOW

30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
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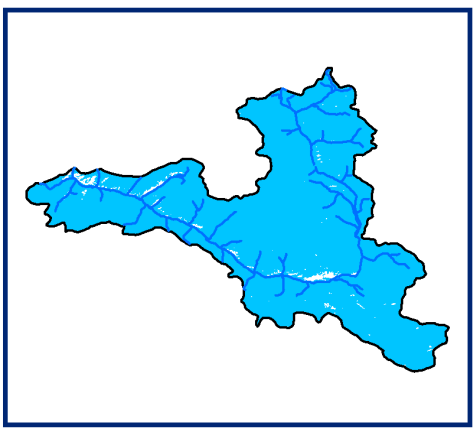
08 FEBRUARY 2016



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12 FEBRUARY 2016
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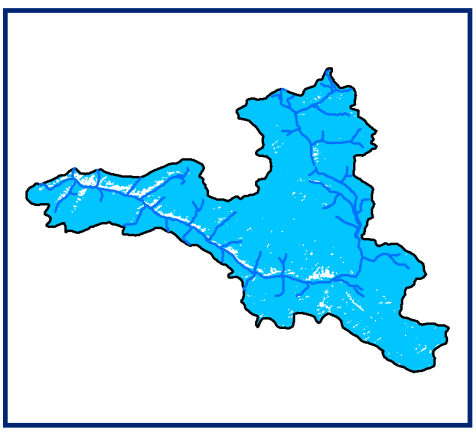
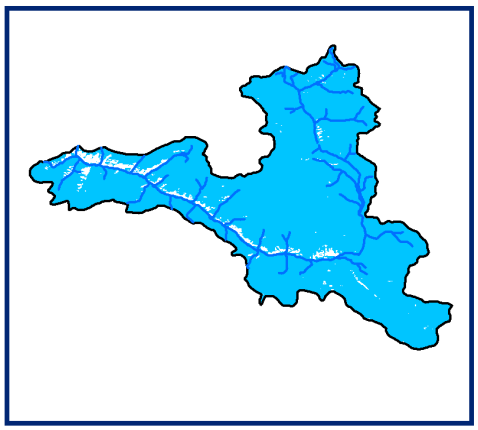


DATA USED
27 FEBRUARY 2016

SNOW

30 15 0 30 60 90
Kilometers

SNOW COVER MAP : CHANDRA SUB-BASIN



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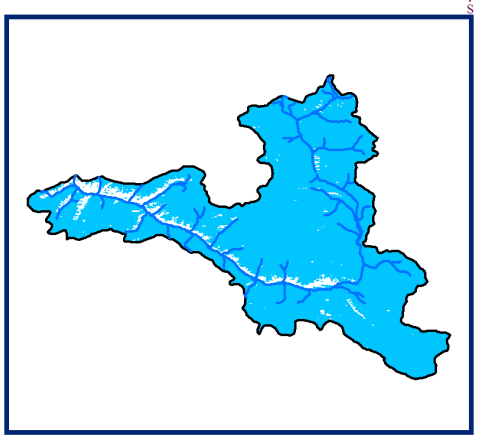

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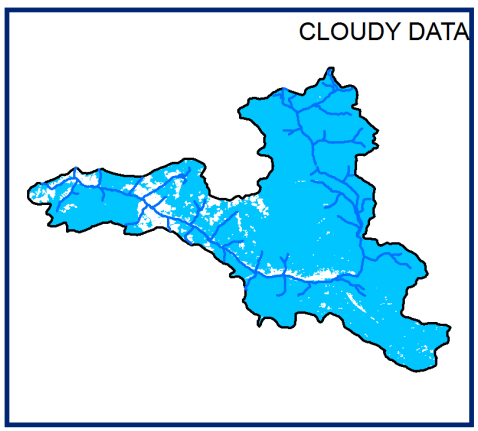

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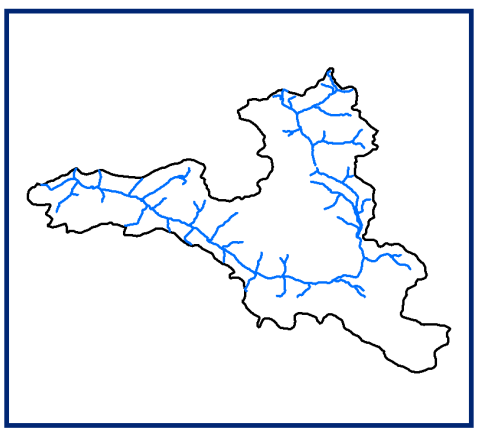

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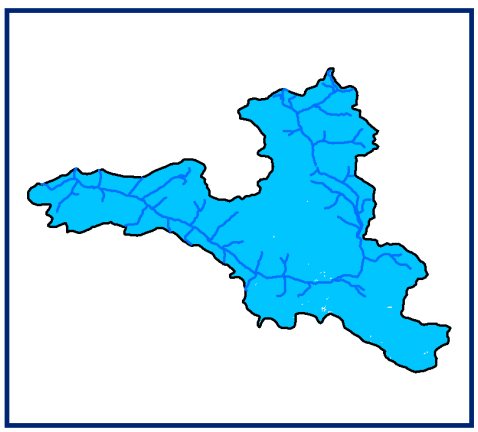
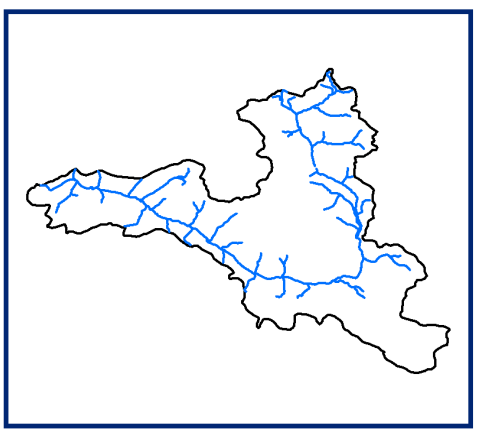


22 MARCH 2016



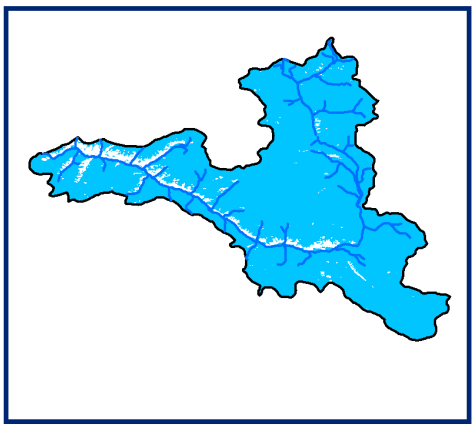
DATA NOT AVAILABLE

SNOW

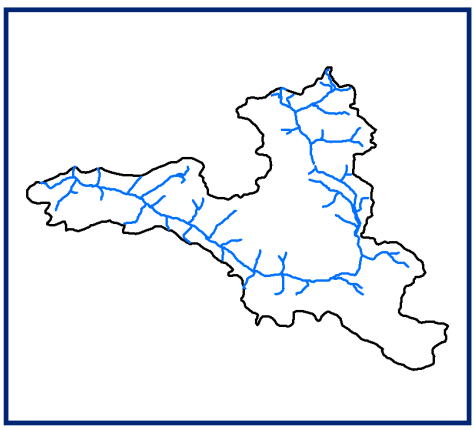
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
01 MARCH 2016
03 MARCH 2016



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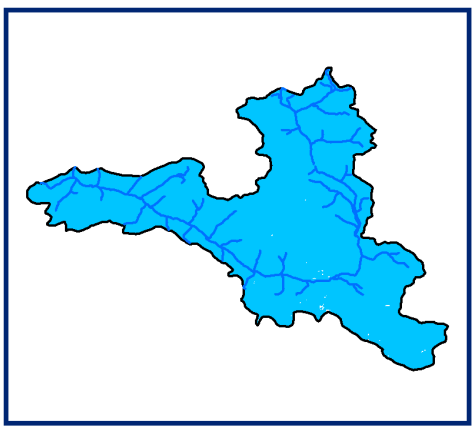
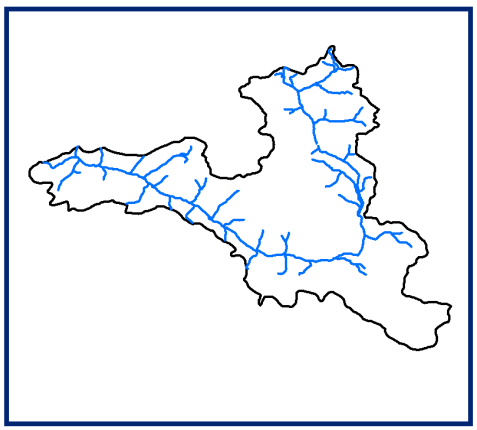


DATA USED
22 MARCH 2016

SNOW

30 15 0 30 60 90
Kilometers

SNOW COVER MAP : CHANDRA SUB-BASIN



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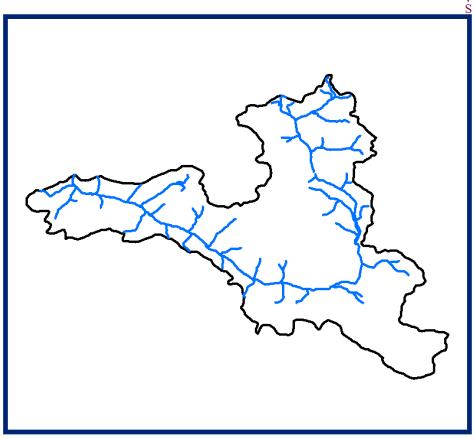

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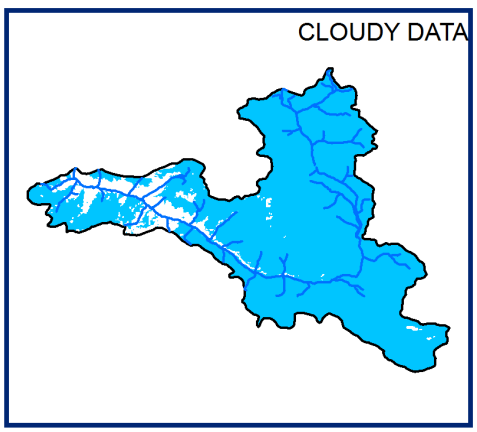
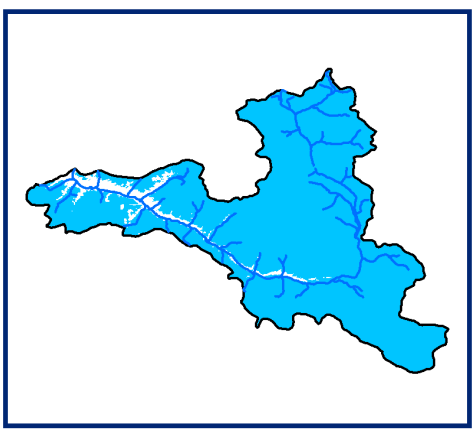
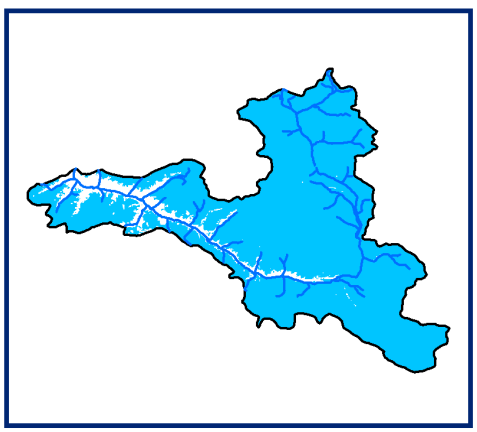


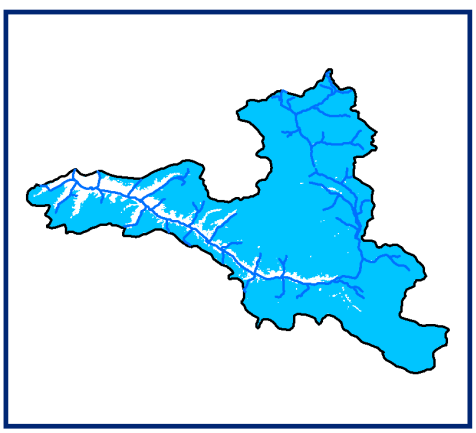
20 APRIL 2016



24 APRIL 2016



27 APRIL 2016



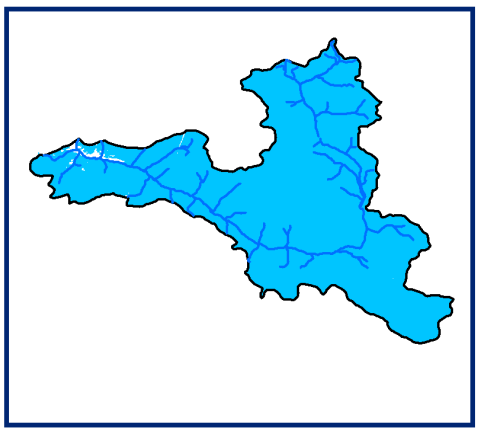
30 APRIL 2016

SNOW

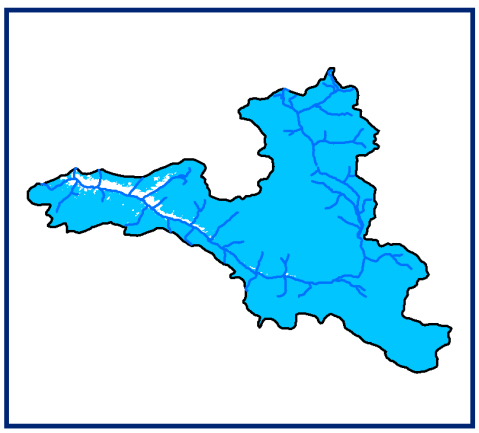
30 15 0 30 60 90

Kilometers

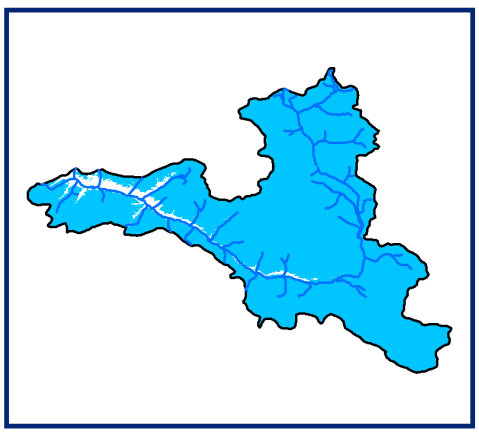
10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
07 APRIL 2016



DATA USED
20 APRIL 2016

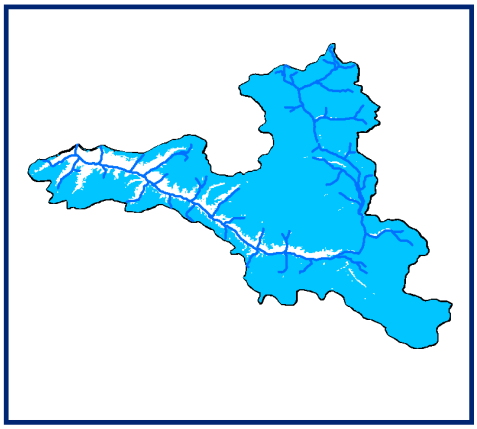


DATA USED
24 APRIL 2016
27 APRIL 2016
30 APRIL 2016

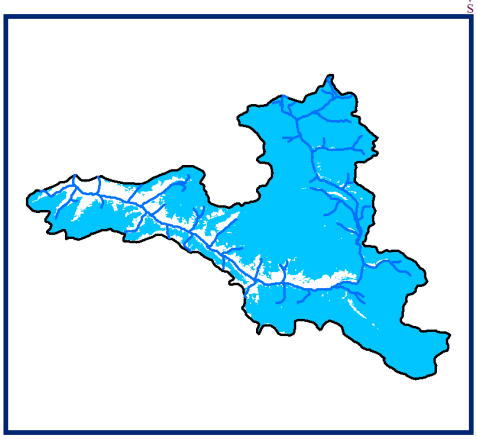
SNOW

25 12.5 0 25 50 75
Kilometers

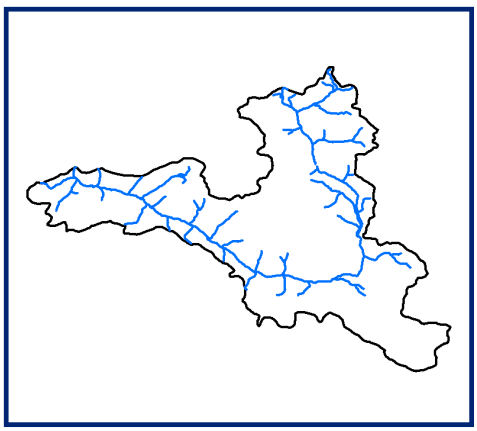
SNOW COVER MAP : CHANDRA SUB-BASIN



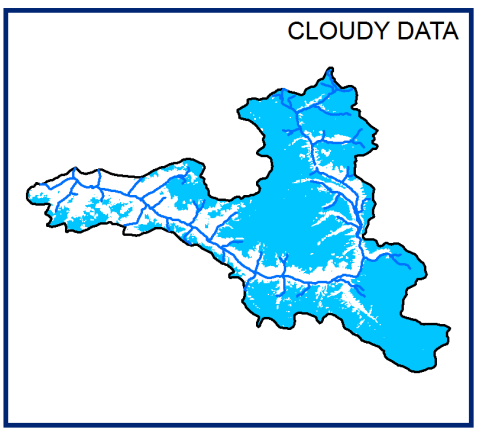
02 MAY 2016



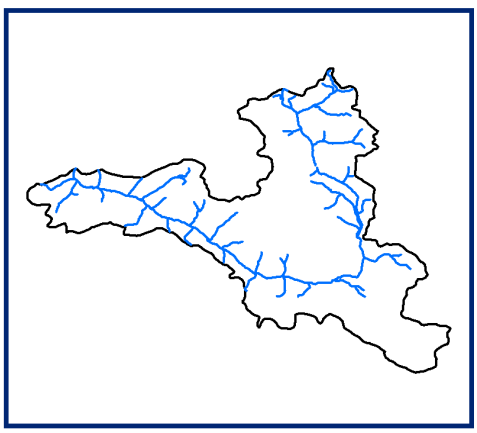
06 MAY 2016



DATA NOT AVAILABLE



19 MAY 2016



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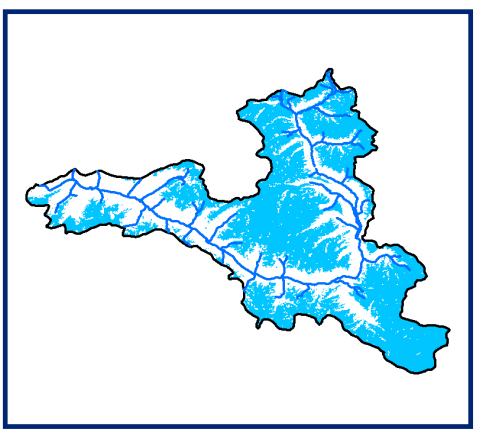


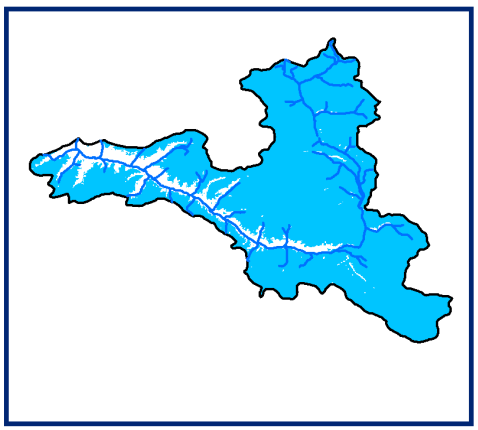
31 MAY 2016

SNOW

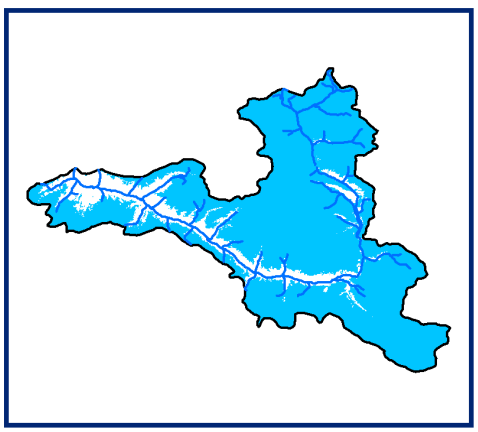
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
02 MAY 2016
06 MAY 2016



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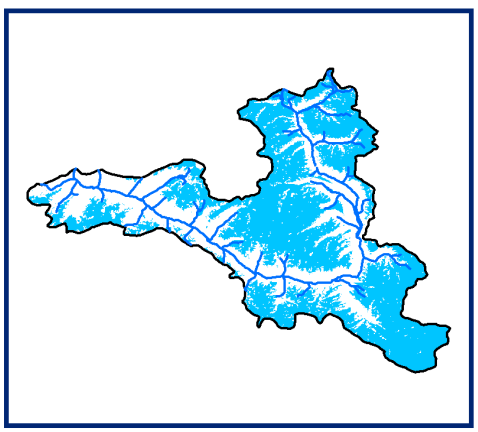
19 MAY 2016

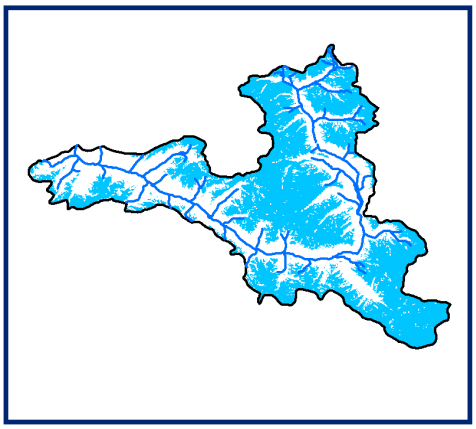


DATA USED
31 MAY 2016

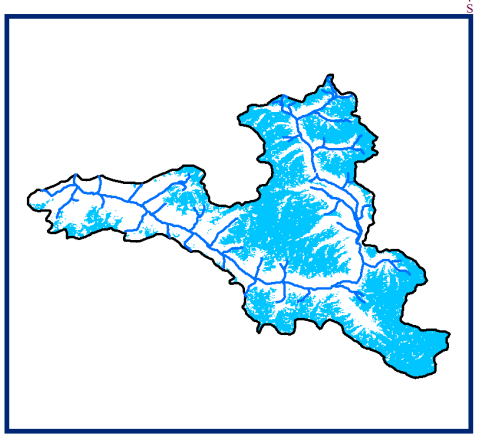
SNOW

25 12.5 0 25 50 75
Kilometers

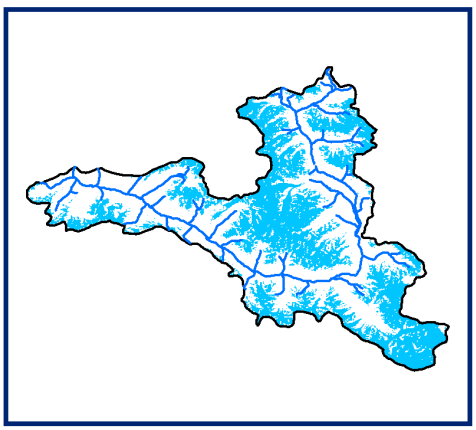
SNOW COVER MAP : CHANDRA SUB-BASIN



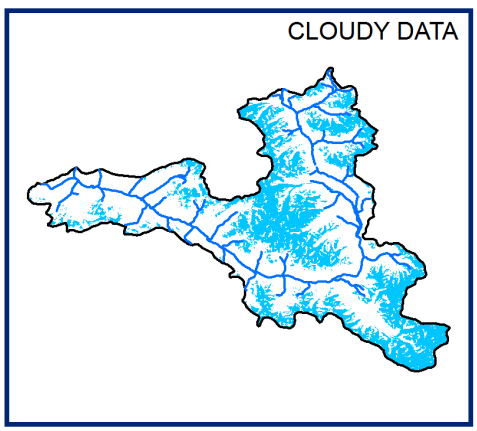
04 JUNE 2016



05 JUNE 2016



14 JUNE 2016



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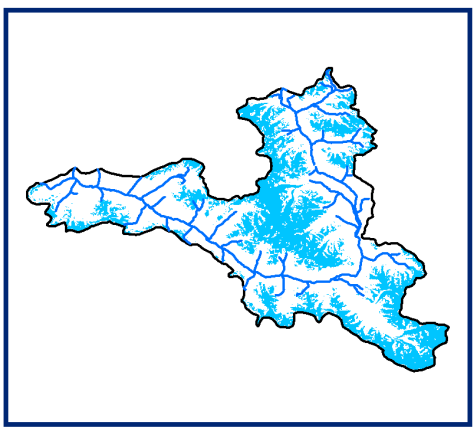
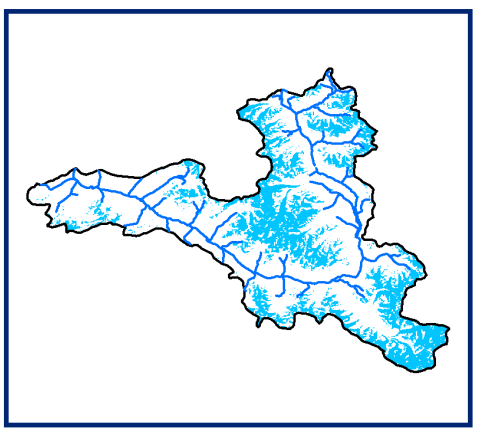


23 JUNE 2016



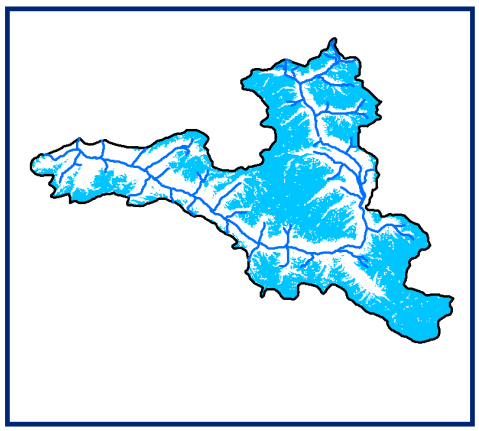
24 JUNE 2016

SNOW

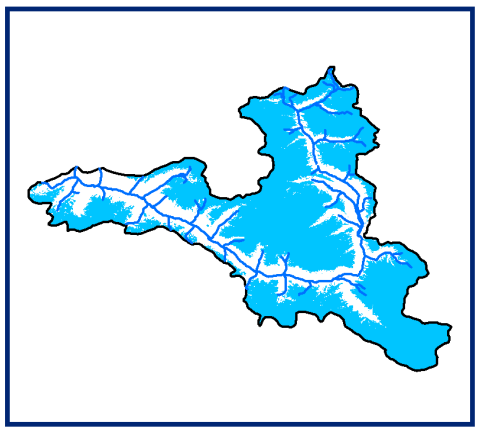
30 15 0 30 60 90

Kilometers

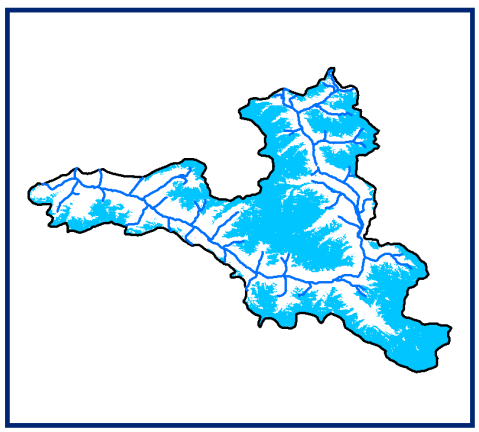
10 DAILY SNOW COVER MAP : CHANDRA SUB-BASIN



DATA USED
04 JUNE 2016
05 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
23 JUNE 2016
24 JUNE 2016

SNOW

25 12.5 0 25 50 75
Kilometers

BHAGA SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: BHAGA **BASIN AREA: 1680 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
01/10/15							
1	01/10/15	1070	64	4	28/10/15	1544	92
2	03/10/15	1037	62	5	30/10/15	1397	83
3	04/10/15	933(c)	55				
01/11/15							
6	01/11/15	1232	73	8	06/11/15	1502	89
7	02/11/15	1219	73	9	08/11/15	1216(c)	72
01/12/15							
10	05/12/15	1333	79	12	20/12/15	1629	97
11	07/12/15	1296	77				
01/01/16							
13	03/01/16	1611	96	16	19/01/16	1369(c)	81
14	05/01/16	1381(c)	82	17	27/01/16	1589	95
15	13/01/16	1622	97				
01/02/16							
18	01/02/16	1625	97	21	10/02/16	1580	94
19	03/02/16	1589	95	22	12/02/16	1631	97
20	05/02/16	1657(c)	99		17/02/16	1610	96
	08/02/16	1670	99		27/02/16	1609	96
01/03/16							
23	01/03/16	1604	95	25	05/03/16	1569	93
24	03/03/16	1558	93	26	22/03/16	1676	100
April 2016							
27	03/04/16	1688(c)	100	30	24/04/16	1513	90
28	18/04/16	1419(c)	84	31	27/04/06	1487	89
29	20/04/16	1383(c)	82	32	30/04/16	1461	87
May-2016							
33	02/05/16	1443	86	35	19/05/16	1025(c)	61
34	06/05/16	1385	82	36	31/05/14	1058	63

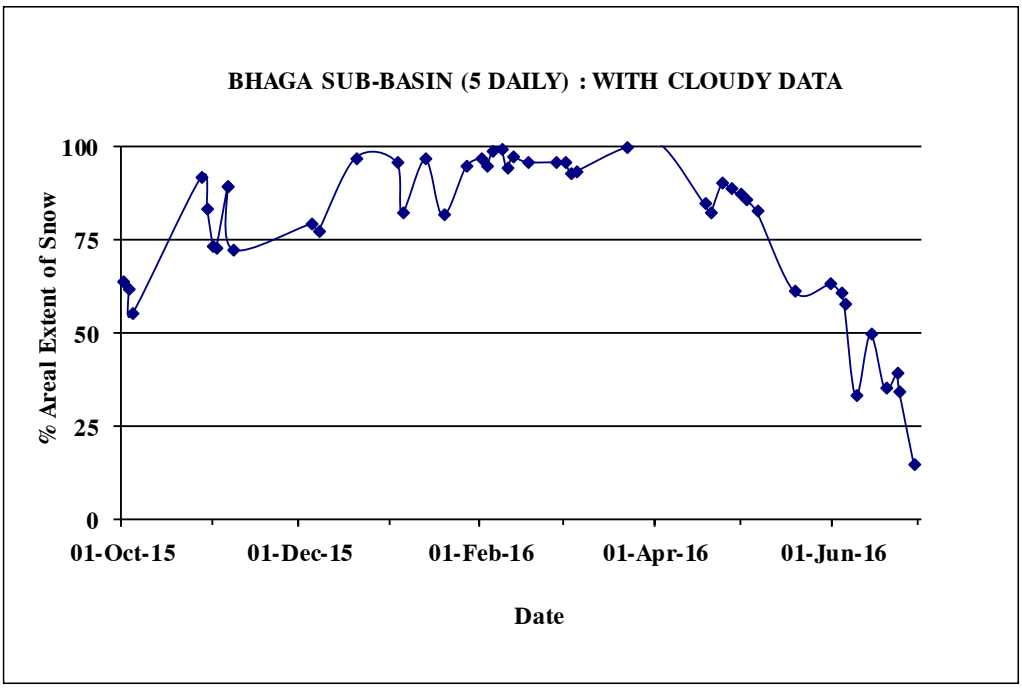
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
June-2016							
37	04/06/16	1016	60	41	19/06/16	589(c)	35
38	05/06/16	972	58	42	23/06/16	654	39
39	09/06/16	554(c)	33	43	24/06/16	574	34
40	14/06/16	835	50	44	29/06/16	247	15

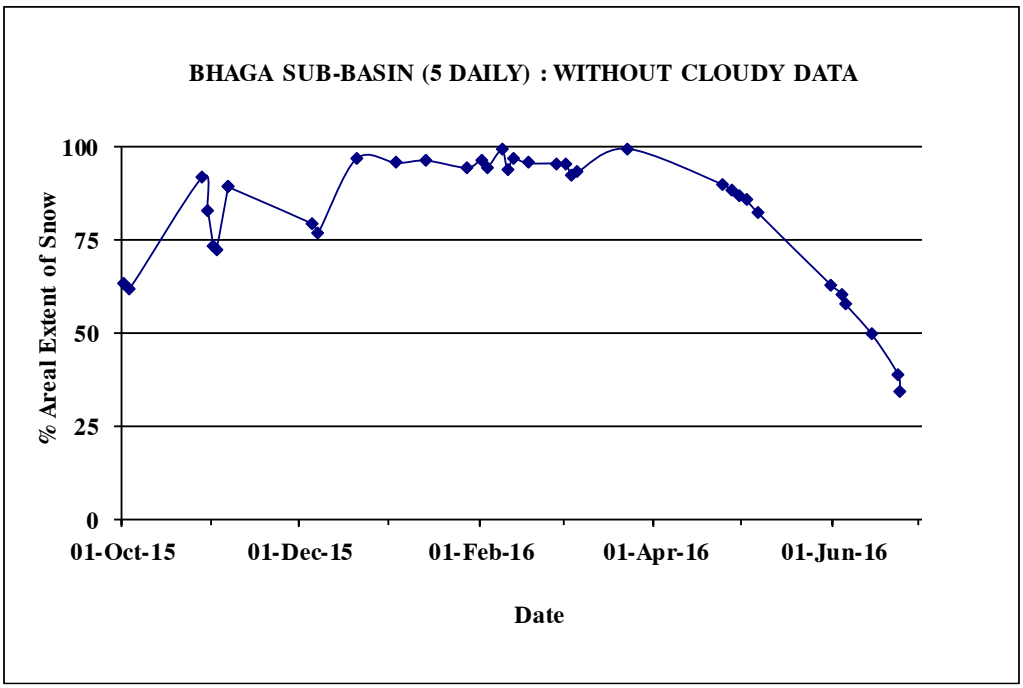
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: BHAGA **BASIN AREA: 1680 sq km**

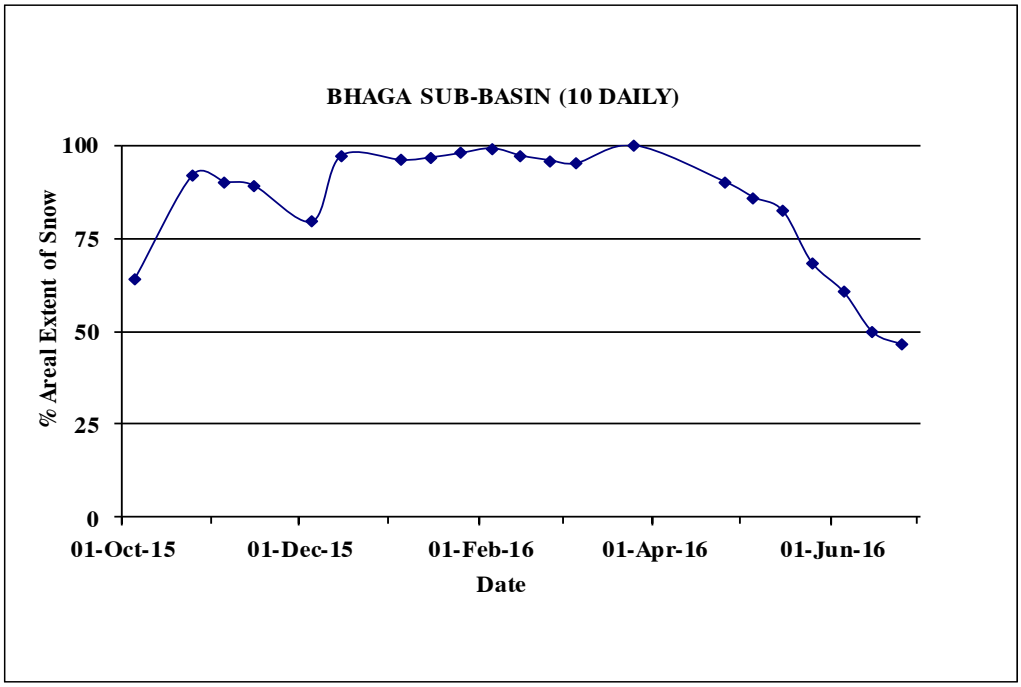
S No	Date	Snow cover (sq km)	Snow cover (%)	S. No	Date	Snow cover (sq km)	Snow cover (%)
01/10/15							
1	05/10/15	1075	64	2	25/10/15	1544	92
01/11/15							
3	05/11/15	1495	89	4	15/11/15	1411	84
01/12/15							
5	05/12/15	1333	79	6	15/12/15	1629	97
01/01/16							
7	05/01/16	1610	96	9	25/01/16	1641	98
8	15/01/16	1622	97				
01/02/16							
10	05/02/16	1663	99	12	25/02/16	1609	96
11	15/02/16	1630	97				
01/03/16							
13	05/03/16	1596	95	14	15/03/16	1676	100
01/04/16							
15	25/04/16	1513	90				
May-2016							
16	5-May-14	1442	86	18	25-May-14	1149	68
17	15-May-14	1382	82				
June-2016							
19	05/06/16	1016	60	21	25/06/16	780	46
20	15/06/16	835	50				

SNOW COVER DEPLETION CURVE



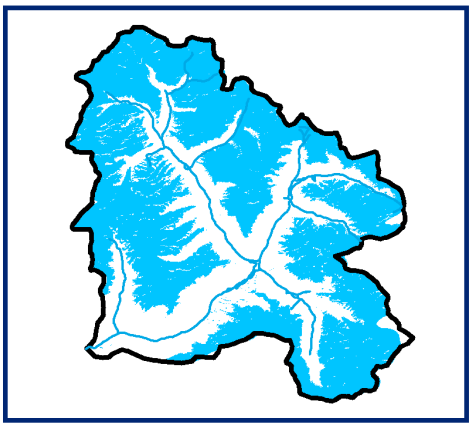


SNOW COVER DEPLETION CURVE

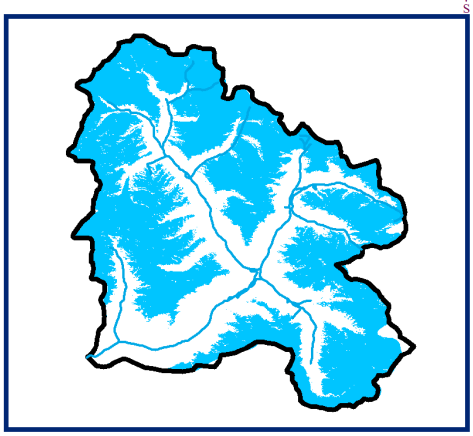


SNOW COVER MAP

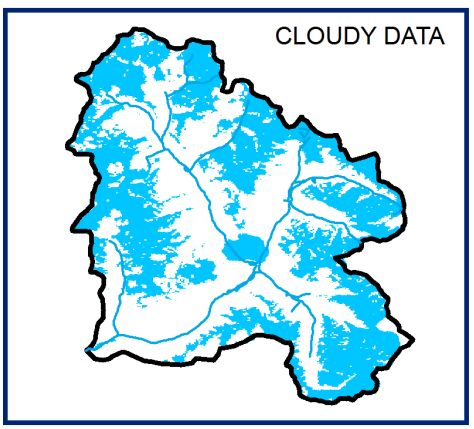
SNOW COVER MAP : BHAGA SUB-BASIN



01 OCTOBER 2015



03 OCTOBER 2015



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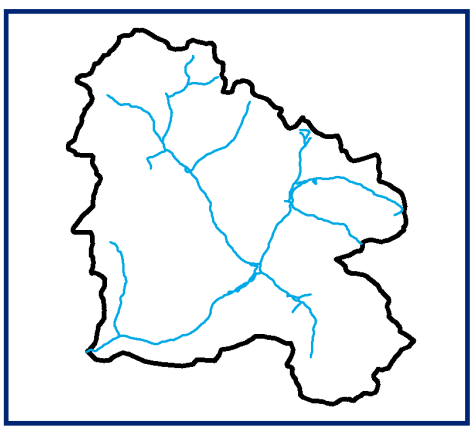

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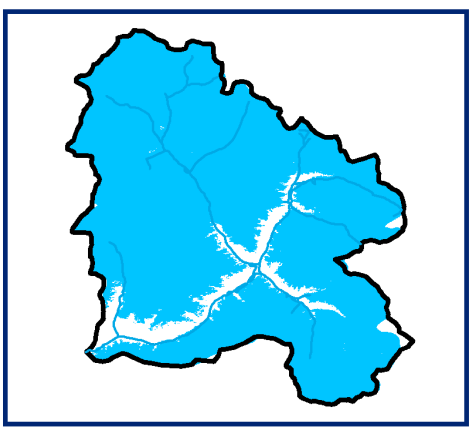
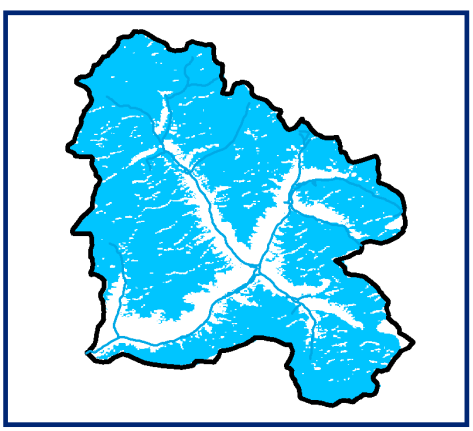


28 OCTOBER 2015



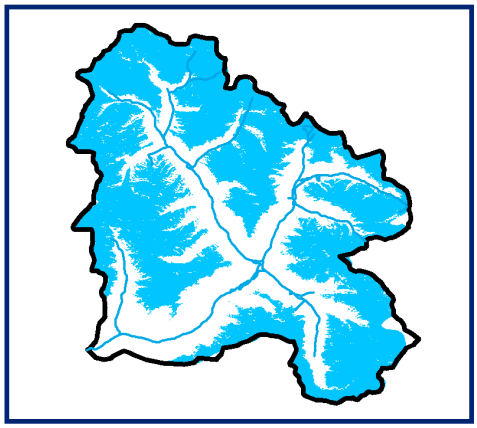
30 OCTOBER 2015

SNOW

0 10 20 40 60 80

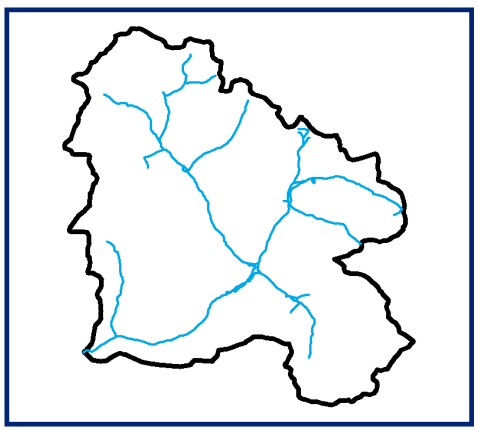
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



DATA USED

01 OCTOBER 2015
03 OCTOBER 2015



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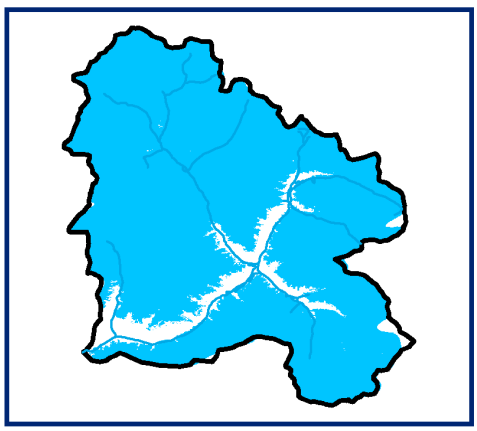


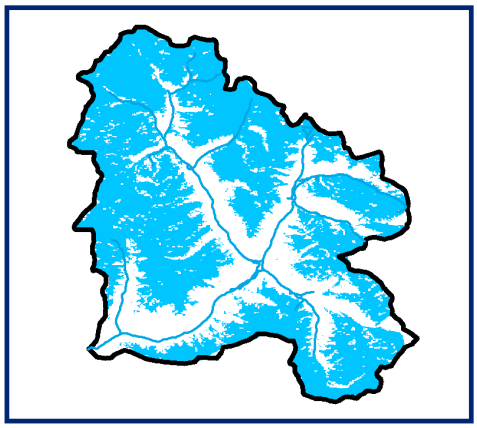
DATA USED

28 OCTOBER 2015
30 OCTOBER 2015

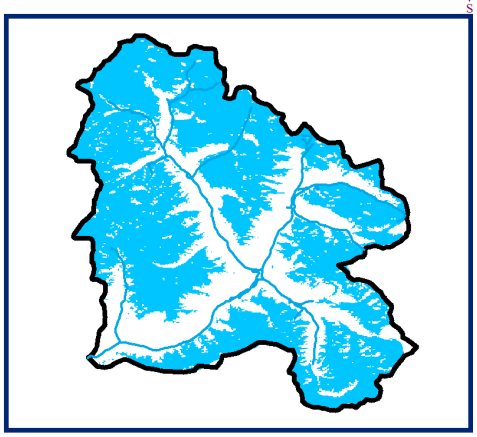
SNOW

0 5 10 20 30 40
Kilometers

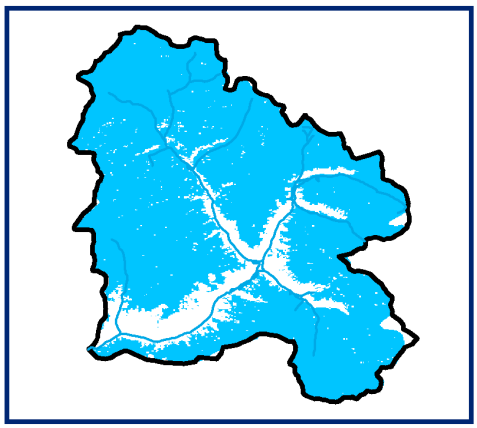
SNOW COVER MAP : BHAGA SUB-BASIN



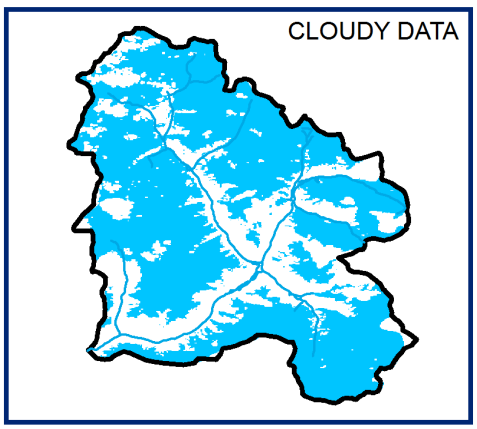
01 NOVEMBER 2015



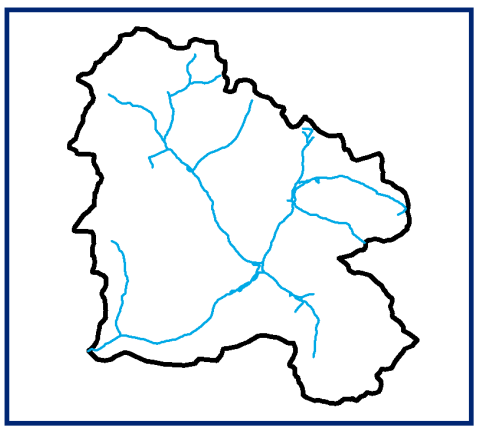
02 NOVEMBER 2015



06 NOVEMBER 2015



08 NOVEMBER 2015



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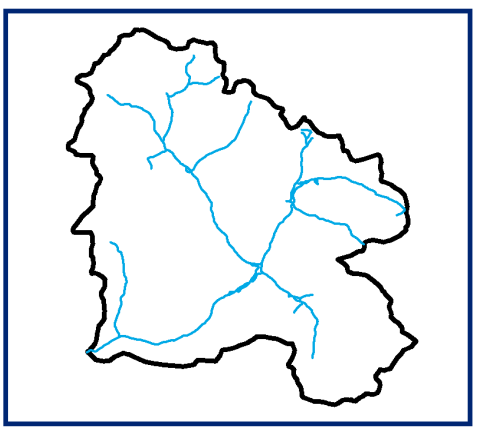


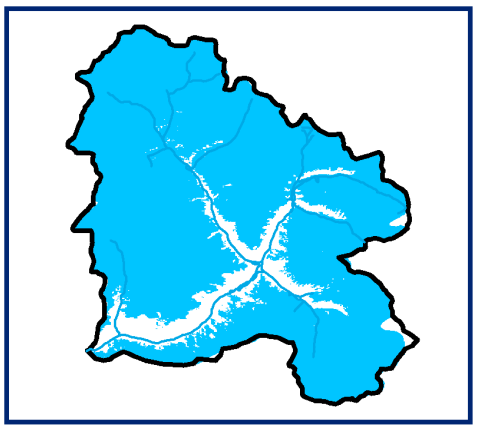
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

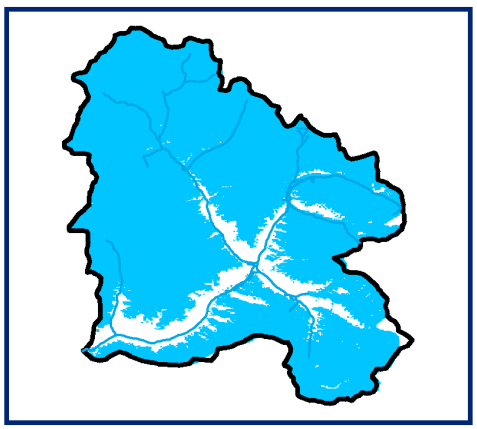
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



DATA USED

02 NOVEMBER 2015
06 NOVEMBER 2015



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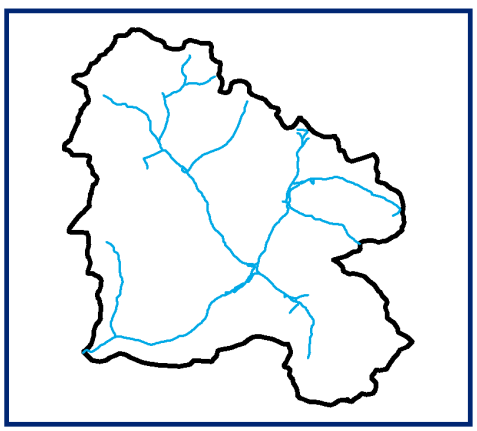


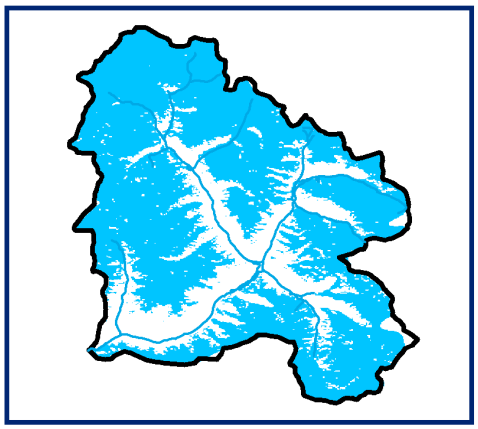
DATA NOT AVAILABLE

SNOW

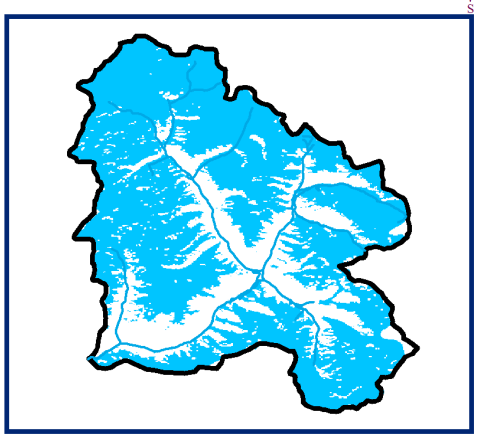
0 5 10 20 30 40

Kilometers

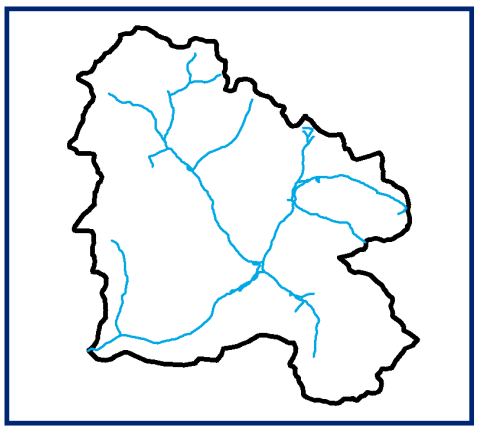
SNOW COVER MAP : BHAGA SUB-BASIN



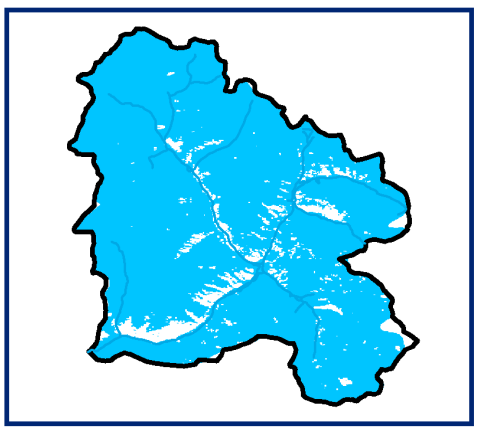
05 DECEMBER 2015



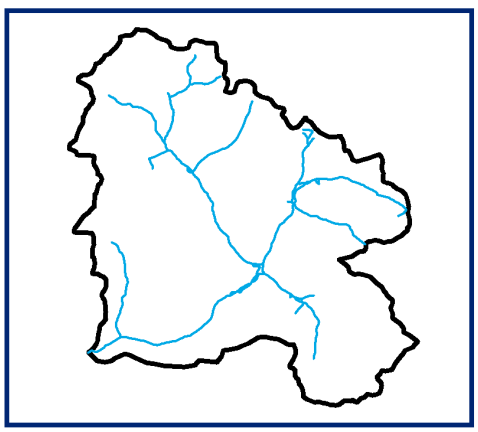
07 DECEMBER 2015



DATA NOT AVAILABLE



20 DECEMBER 2015



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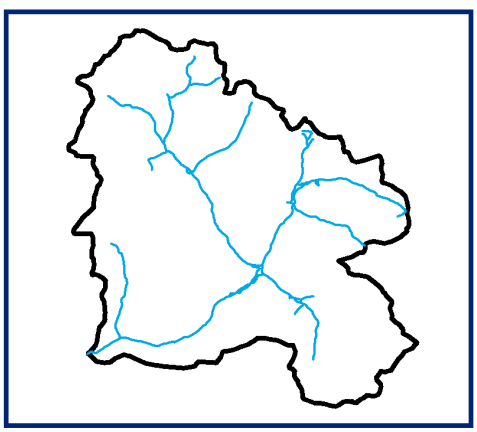


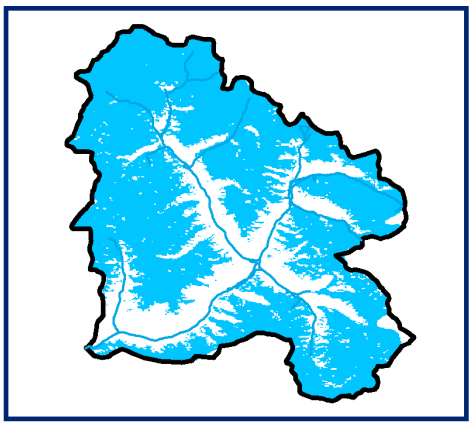
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

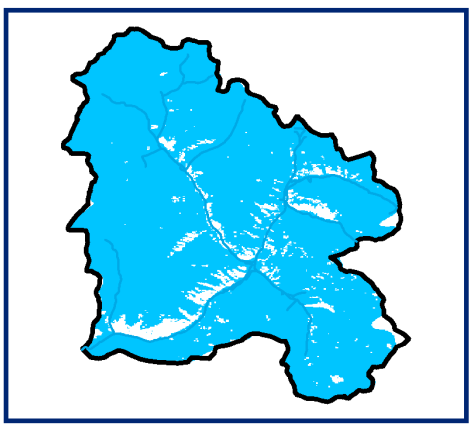
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



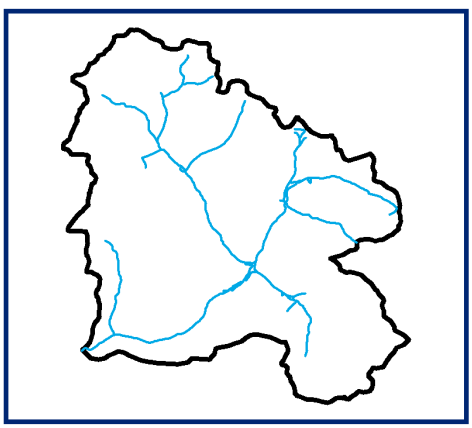
DATA USED

05 DECEMBER 2015
07 DECEMBER 2015



DATA USED

20 DECEMBER 2015



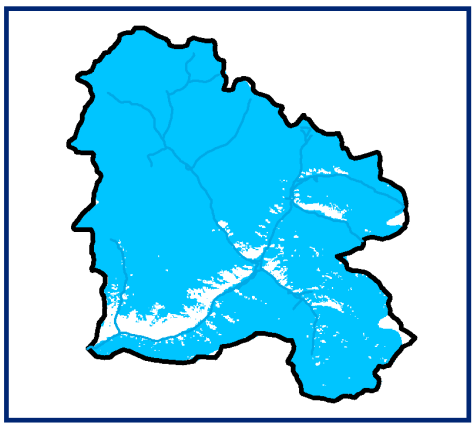
DATA NOT AVAILABLE

SNOW

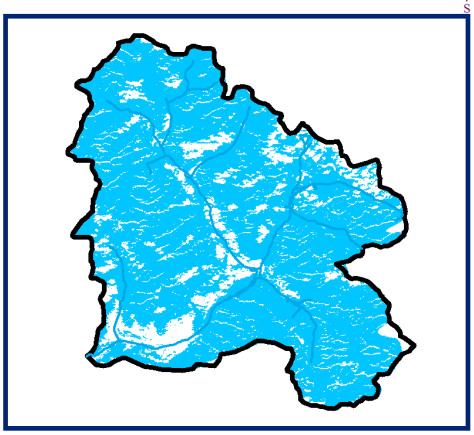
0 5 10 20 30 40

Kilometers

SNOW COVER MAP : BHAGA SUB-BASIN



03 JANUARY 2016



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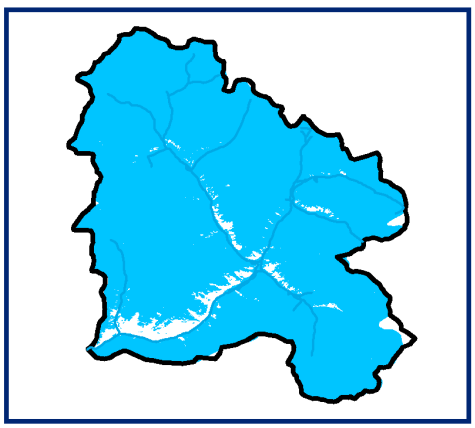
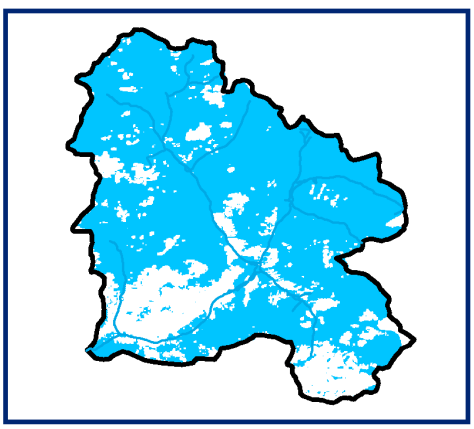
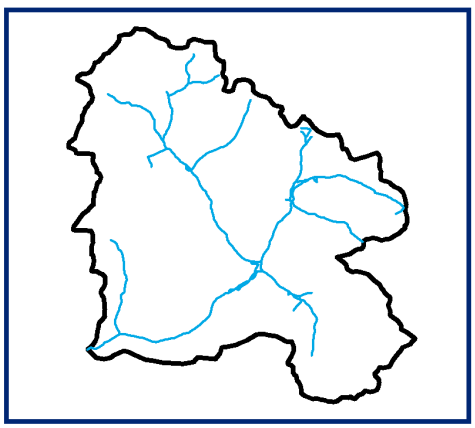


13 JANUARY 2016



19 JANUARY 2016



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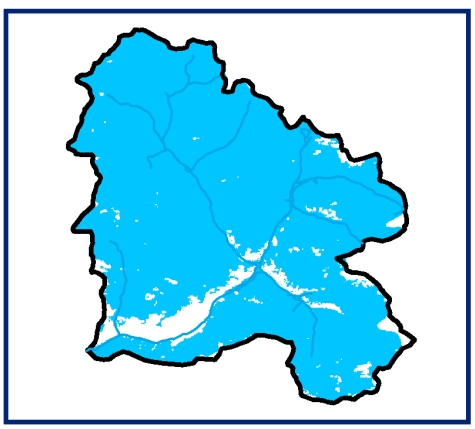


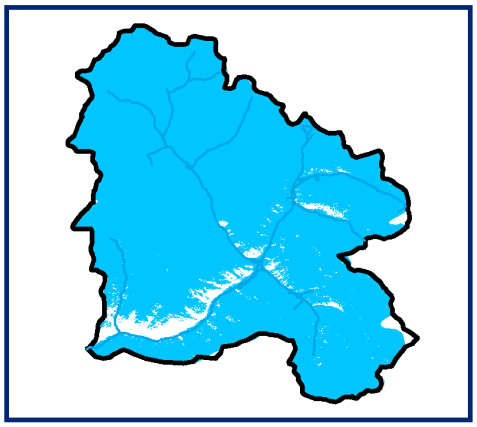
27 JANUARY 2016

SNOW

0 10 20 40 60 80

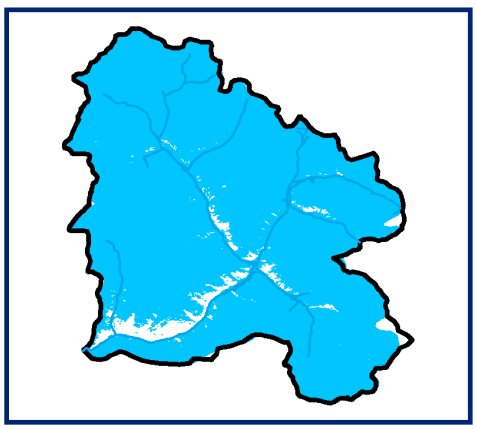
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



DATA USED

03 JANUARY 2016
05 JANUARY 2016



DATA USED

13 JANUARY 2016
19 JANUARY 2016

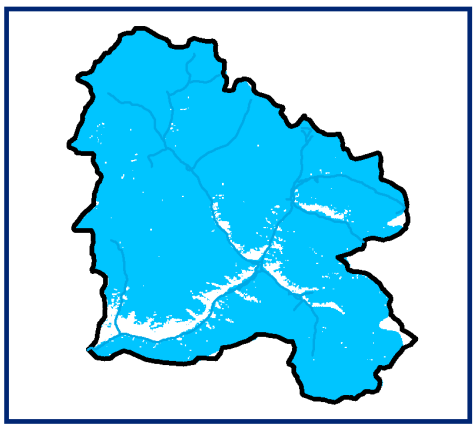
DATA USED

27 JANUARY 2016

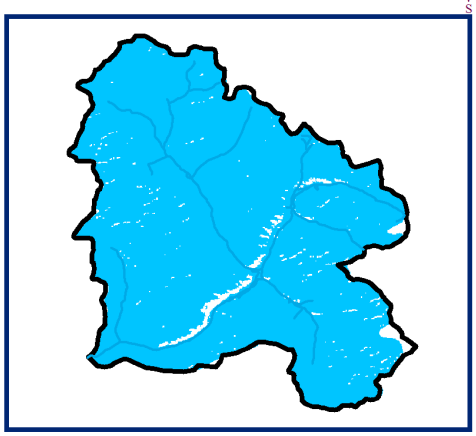
SNOW

0 5 10 20 30 40
Kilometers

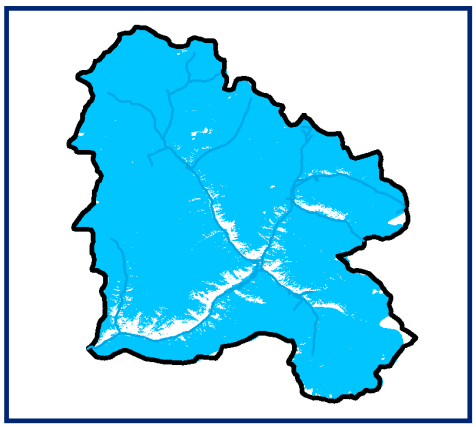
SNOW COVER MAP : BHAGA SUB-BASIN



01 FEBRUARY 2016

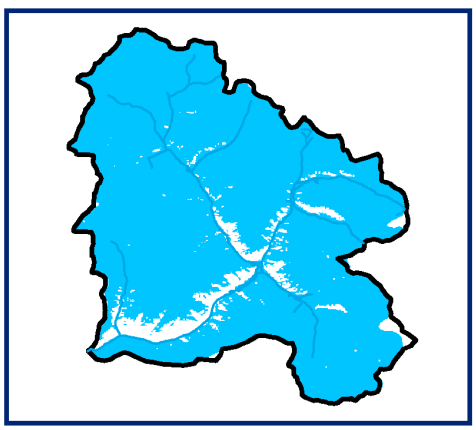


08 FEBRUARY 2016

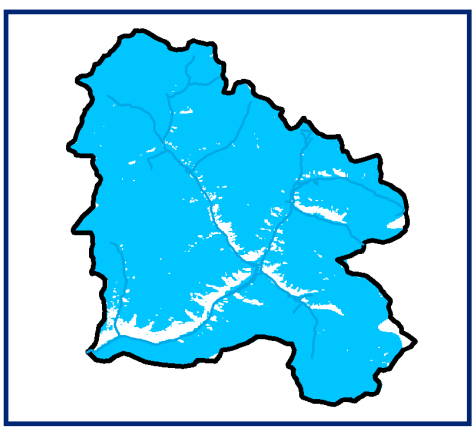


10 FEBRUARY 2016

12 FEBRUARY 2016



17 FEBRUARY 2016



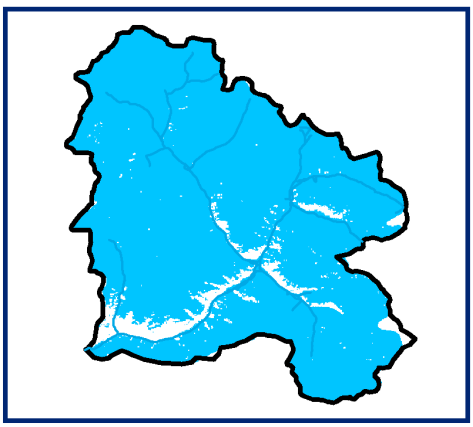
27 FEBRUARY 2016

SNOW

0 10 20 40 60 80

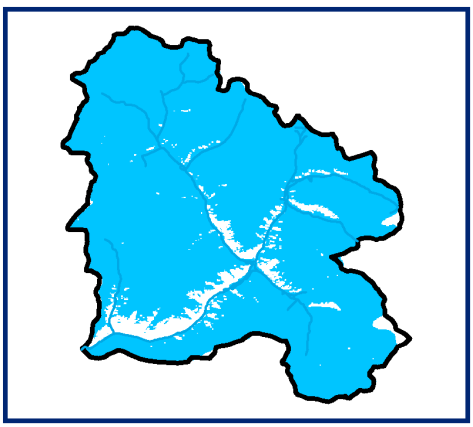
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



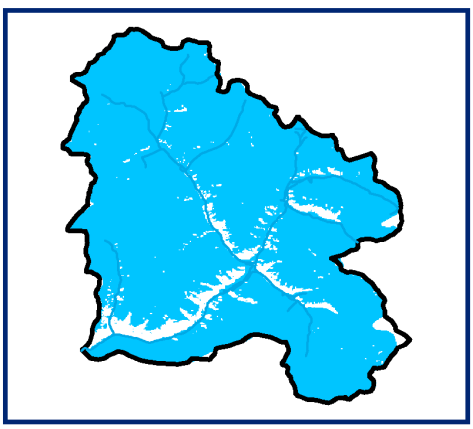
DATA USED

03 FEBRUARY 2016
10 FEBRUARY 2016



DATA USED

12 FEBRUARY 2016
17 FEBRUARY 2016



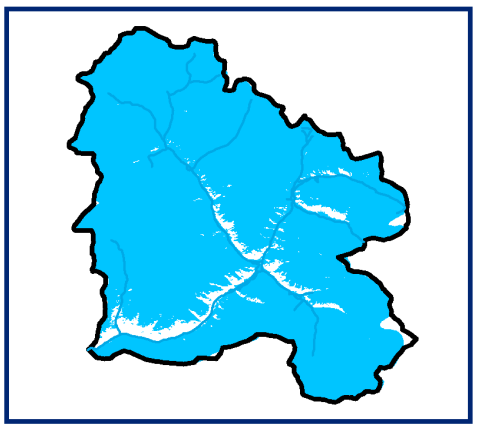
DATA USED

27 FEBRUARY 2016

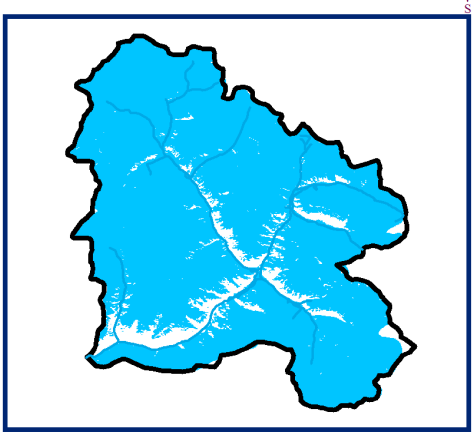
SNOW

0 5 10 20 30 40
Kilometers

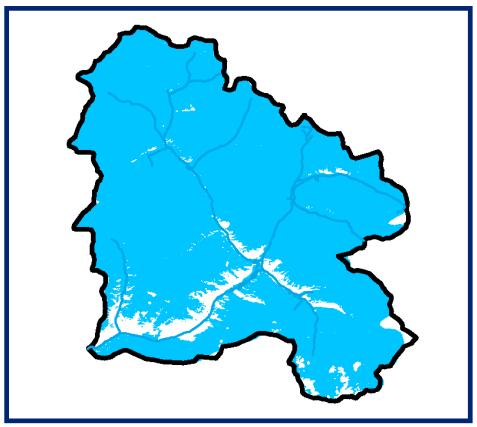
SNOW COVER MAP : BHAGA SUB-BASIN



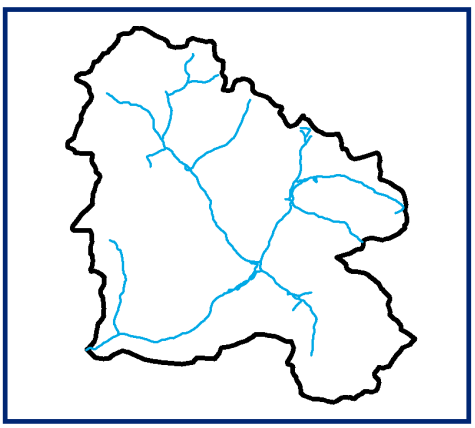
01 MARCH 2016



03 MARCH 2016



05 MARCH 2016



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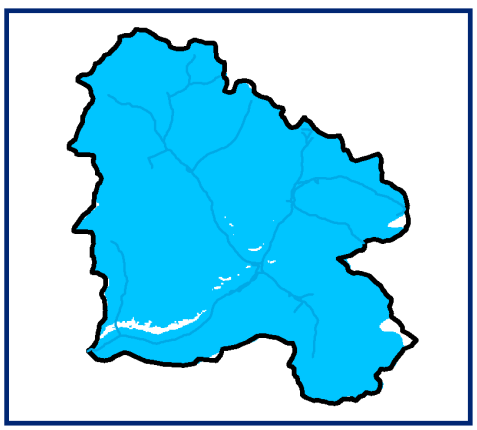
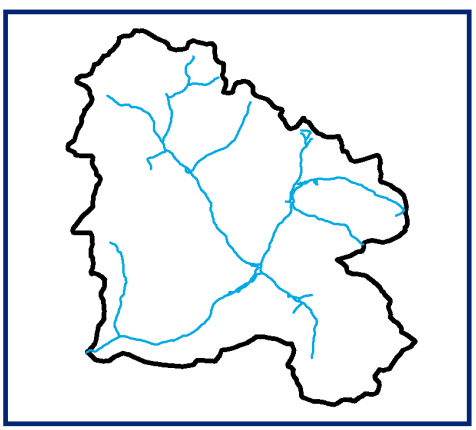


22 MARCH 2016



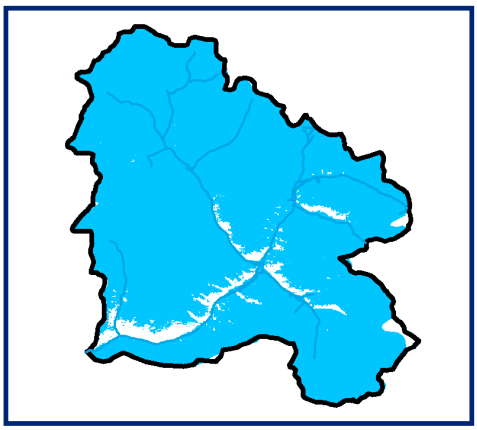
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

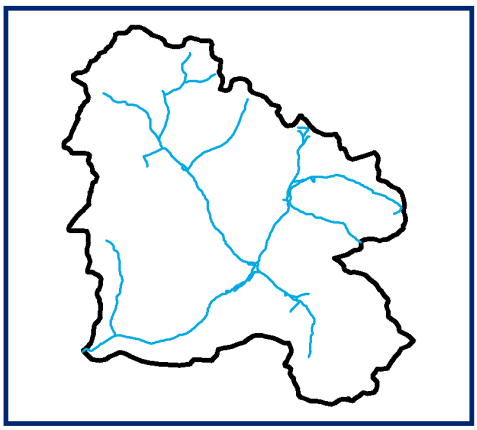
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



DATA USED

01 MARCH 2016
05 MARCH 2016



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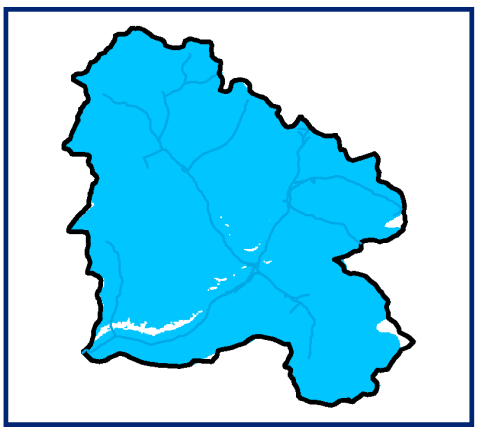


DATA USED

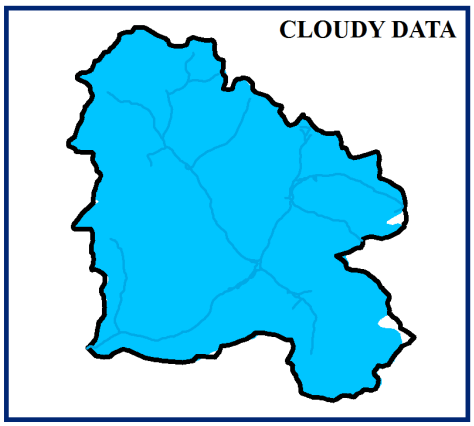
22 MARCH 2016

SNOW

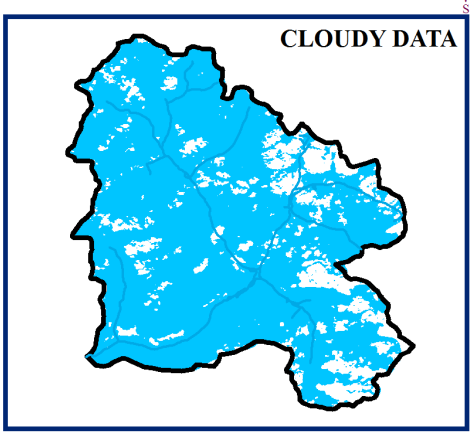
0 5 10 20 30 40

Kilometers

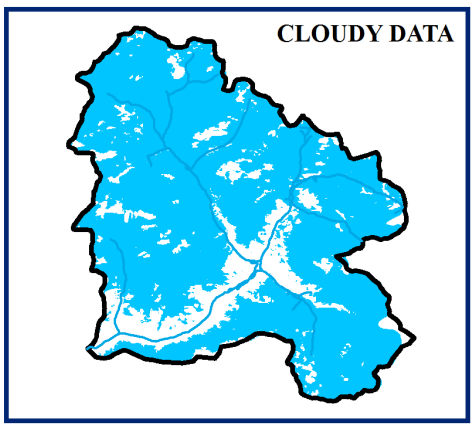
SNOW COVER MAP : BHAGA SUB-BASIN



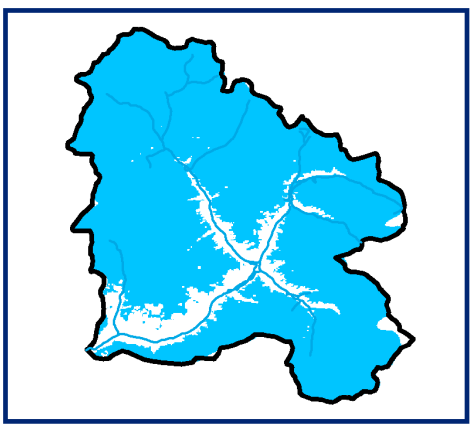
03 APRIL 2016



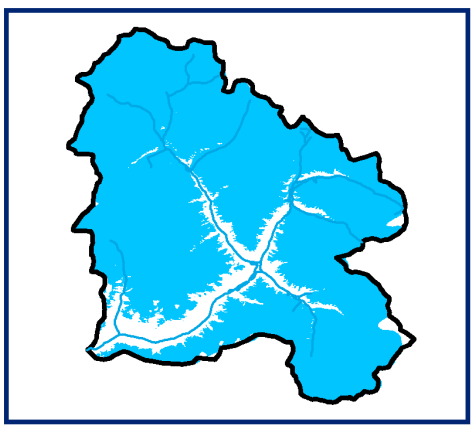
18 APRIL 2016



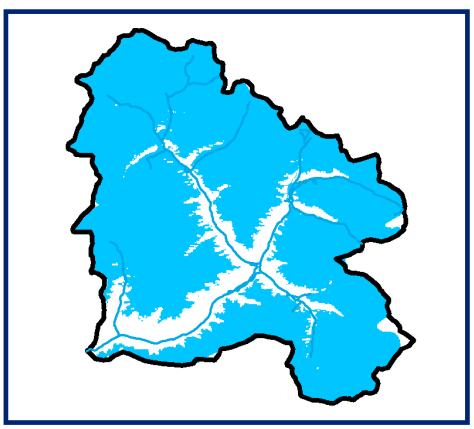
20 APRIL 2016



24 APRIL 2016



27 APRIL 2016



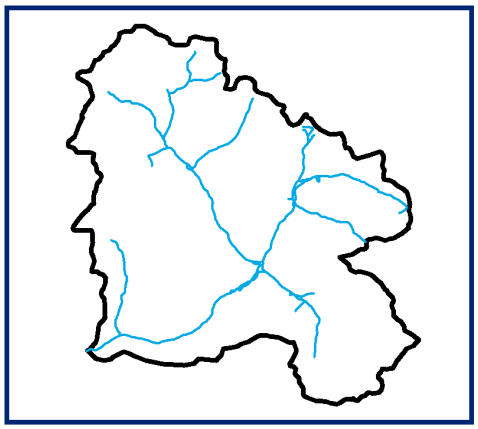
30 APRIL 2016

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



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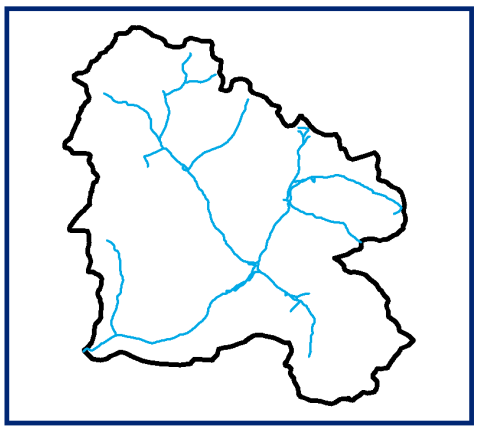

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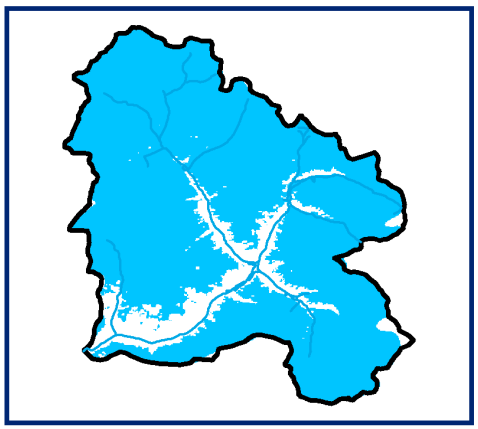


DATA USED

24 APRIL 2016

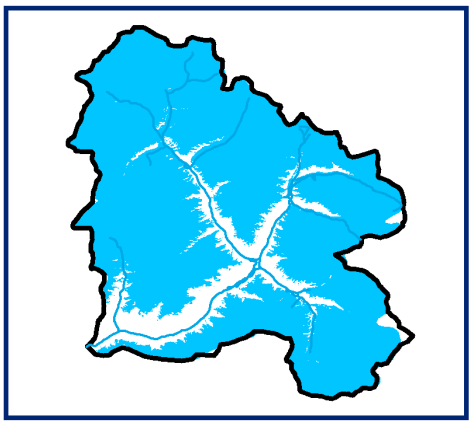
30 APRIL 2016

SNOW

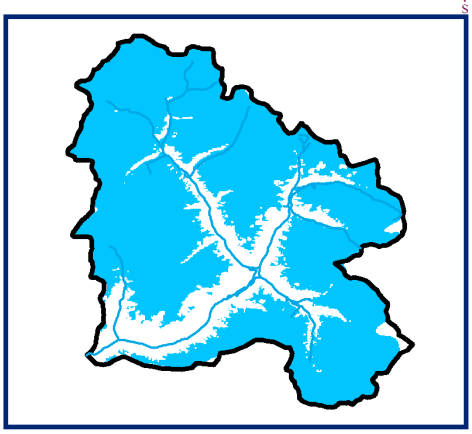
0 5 10 20 30 40

Kilometers

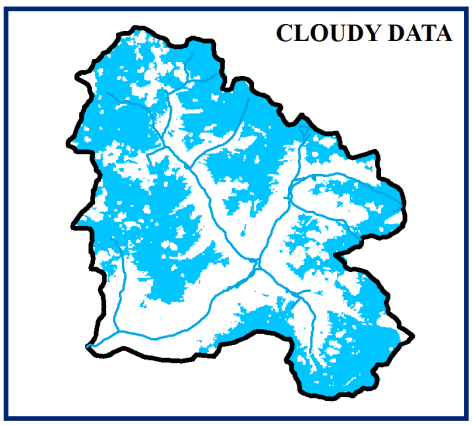
SNOW COVER MAP : BHAGA SUB-BASIN



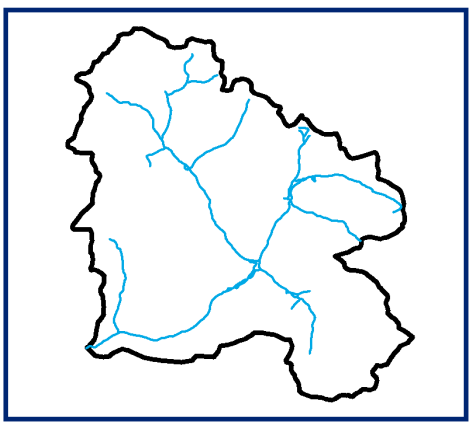
02 MAY 2016



06 MAY 2016



19 MAY 2016



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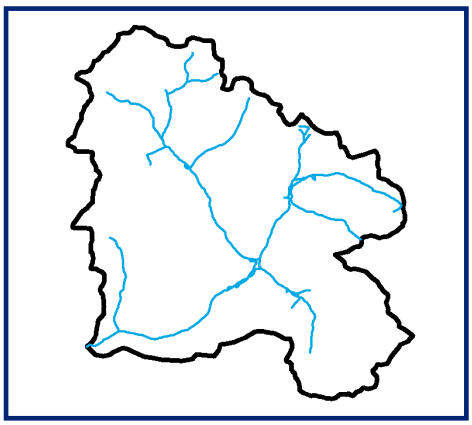

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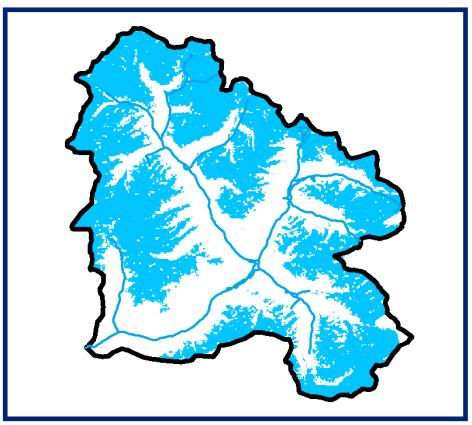


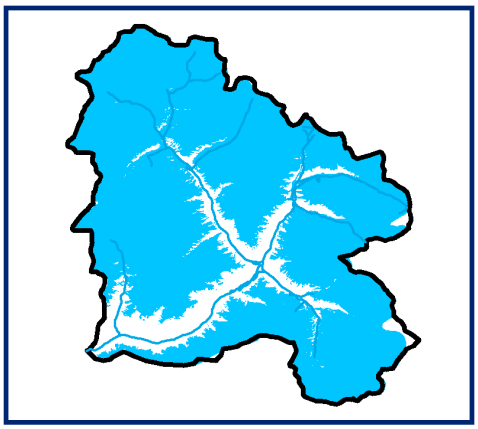
31 MAY 2016

SNOW

0 10 20 40 60 80

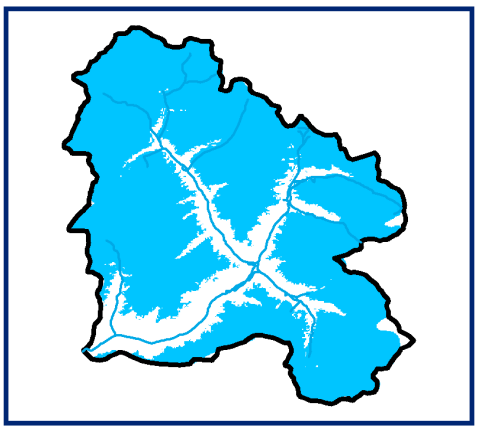
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



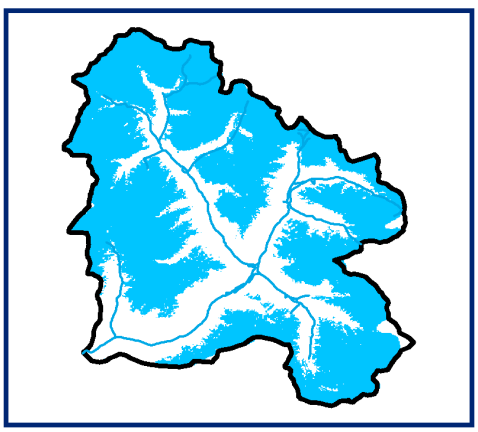
DATA USED

2 MAY 2016
6 MAY 2016



DATA USED

19 MAY 2016



DATA USED

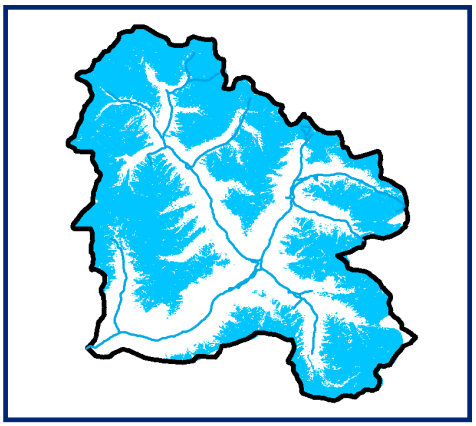
31 MAY 2016

SNOW

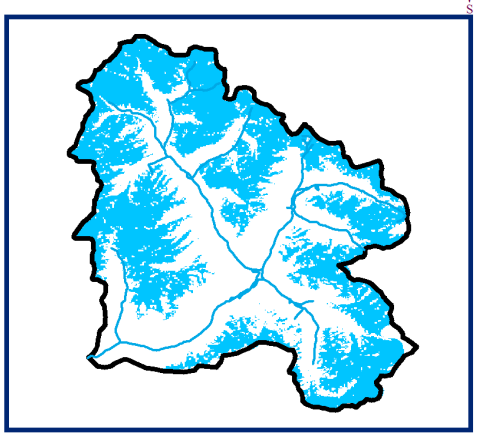
0 5 10 20 30 40

Kilometers

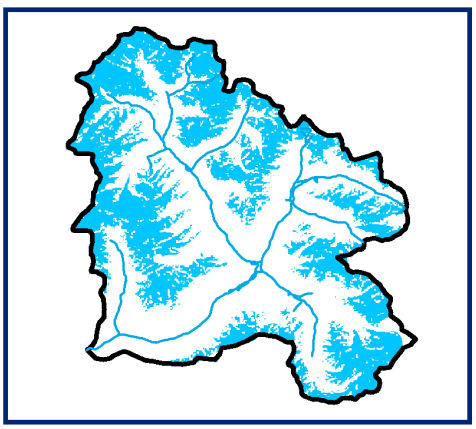
SNOW COVER MAP : BHAGA SUB-BASIN



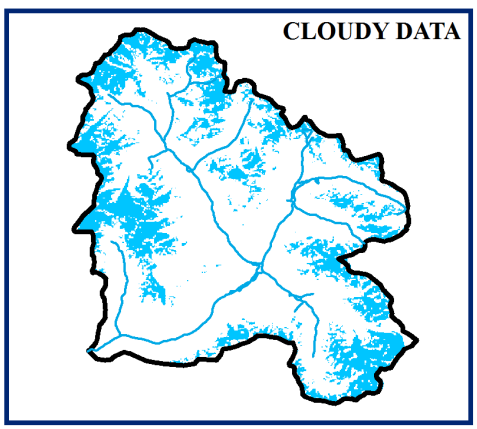
04 JUNE 2016



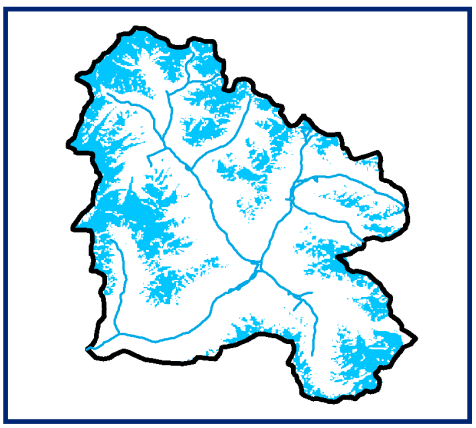
05 JUNE 2016



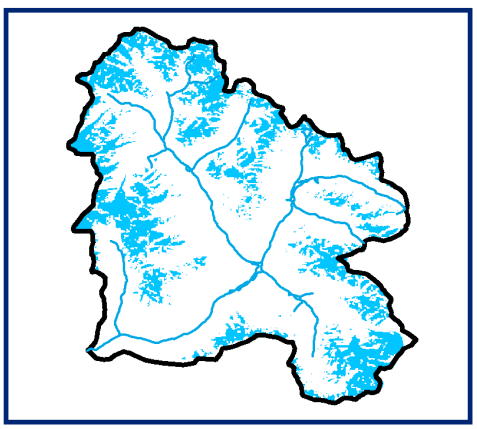
14 JUNE 2016



19 JUNE 2016



23 JUNE 2016



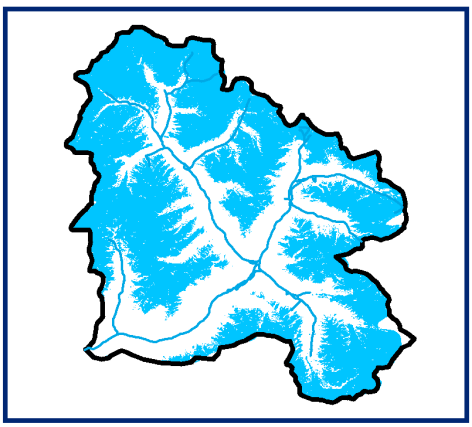
24 JUNE 2016

SNOW

0 10 20 40 60 80

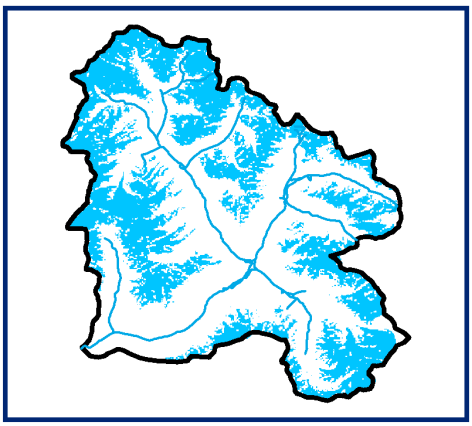
Kilometers

10 DAILY SNOW COVER MAP : BHAGA SUB-BASIN



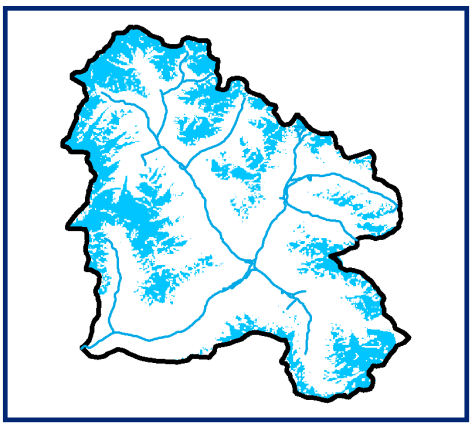
DATA USED

4 JUNE 2016
5 JUNE 2016



DATA USED

14 JUNE 2016



DATA USED

23 JUNE 2016
24 JUNE 2016

SNOW

0 5 10 20 30 40

Kilometers

MIYAR SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: MIYAR **BASIN AREA: 4449 sq km**

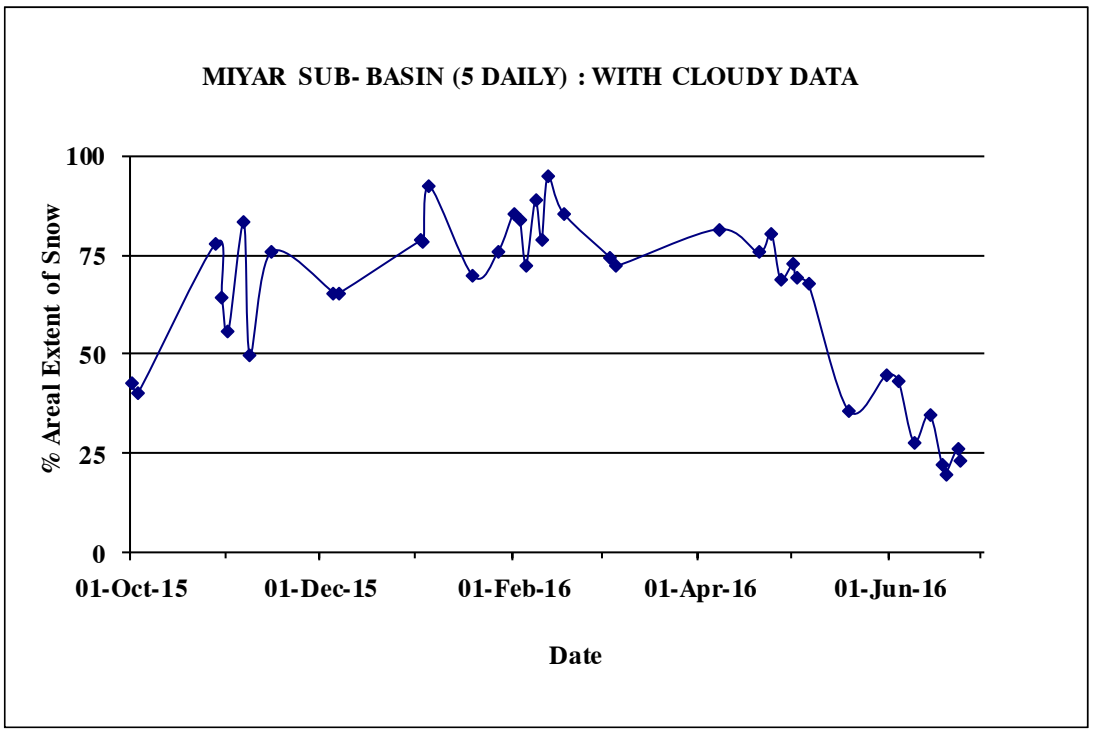
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	1-Oct-15	1892	43	3	28-Oct-15	3465(c)	78
2	3-Oct-15	1791	40	4	30-Oct-15	2862	64
November 2015							
5	1-Nov-15	2469 (c)	55	7	8-Nov-15	2217 (c)	50
6	6-Nov-15	3697	83	8	15-Nov-15	3372	76
December 2015							
9	5-Dec-15	2914	65	10	7-Dec-15	2911	65
January 2016							
11	2-Jan-16	3498	79	14	19-Jan-16	3096 (c)	70
12	3-Jan-16	3491	78	15	27-Jan-16	3372 (c)	76
13	5-Jan-16	4102	92				
February 2016							
16	1-Feb-16	3804	86	20	10-Feb-16	3504 (c)	79
17	3-Feb-16	3736	84	21	12-Feb-16	4213	95
18	5-Feb-16	3226 (c)	73		17-Feb-16	3806	86
19	8-Feb-16	3947	89				
March 2016							
22	3-Mar-16	3309	74	23	5-Mar-16	3211 (c)	72
April 2016							
24	7-Apr-16	3624	81	26	24-Apr-16	3575	80
25	20-Apr-16	3365 (c)	76	27	27-Apr-16	3070 (c)	69
May-2016							
28	1-May-16	3234	73	31	19-May-16	1585 (c)	36
29	2-May-16	3079	69	32	31-May-16	1980	45
30	6-May-16	3008	68				
June-2016							
33	4-Jun-16	1923	43	37	19-Jun-16	861(c)	19
34	9-Jun-16	1236 (c)	28	38	23-Jun-16	1163	26
35	14-Jun-16	1551	35	39	24-Jun-16	1034	23
36	18-Jun-16	983 (c)	22				

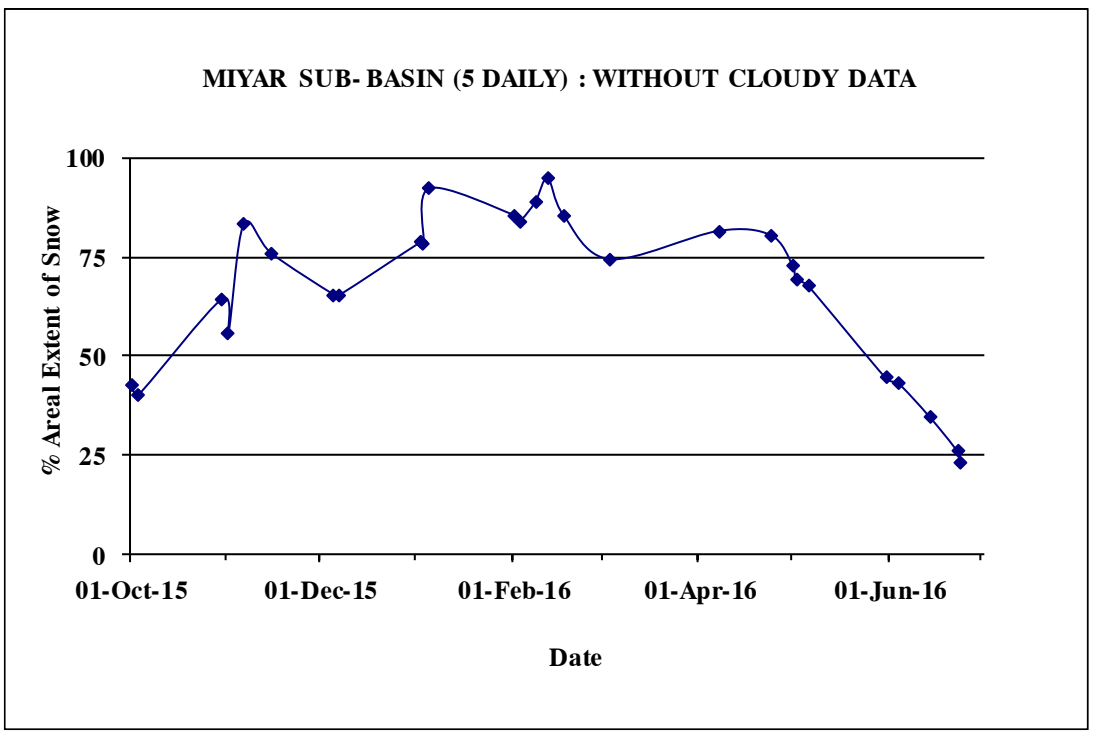
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: MIYAR **BASIN AREA: 4449 sq km**

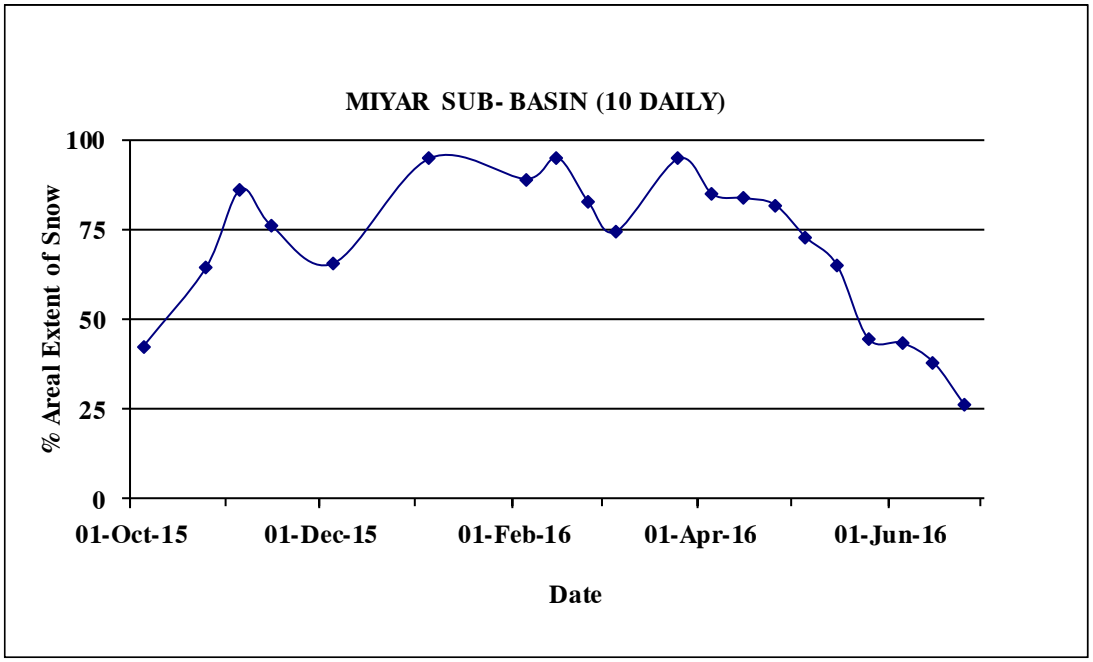
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	5-Oct-15	1891	43	2	25-Oct-15	2861	64
November 2015							
3	5-Nov-15	3827	86	4	15-Nov-15	3381	76
December 2015							
5	5-Dec-15	2912	65				
January 2016							
6	5-Jan-16	4216	95				
February-2016							
7	5-Feb-16	3960	89	9	25-Feb-16	3672	83
8	15-Feb-16	4227	95				
March 2016							
10	5-Mar-16	3309	74	11	25-Mar-16	4211	95
April-2016							
12	5-Apr-16	3767	85	14	25-Apr-16	3640	82
13	15-Apr-16	3722	84				
May-2016							
15	5-May-16	3234	73	17	25-May-16	1980	45
16	15-May-16	2891	65				
June-2016							
18	5-Jun-16	1924	43	20	25-Jun-16	1157	26
19	15-Jun-16	1685	38				

SNOW COVER DEPLETION CURVE



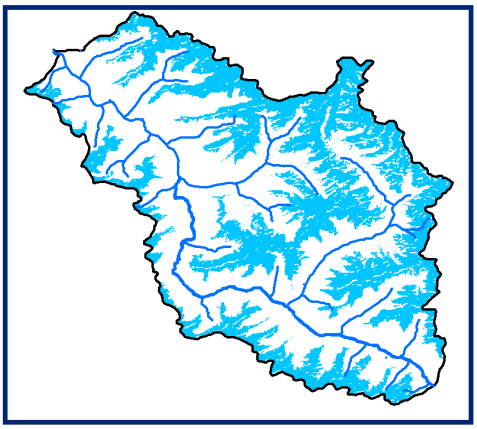


SNOW COVER DEPLETION CURVE

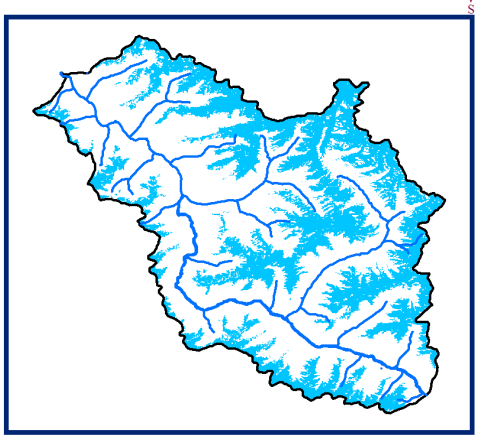


SNOW COVER MAP

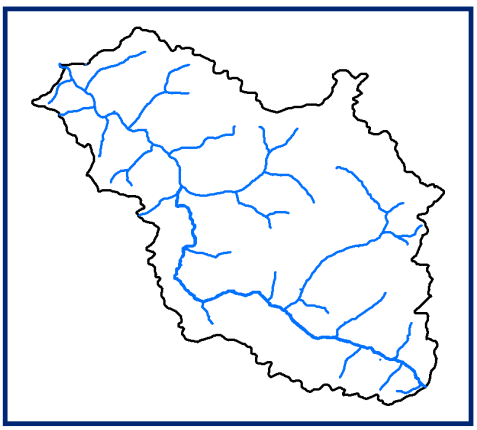
SNOW COVER MAP : MIYAR SUB-BASIN

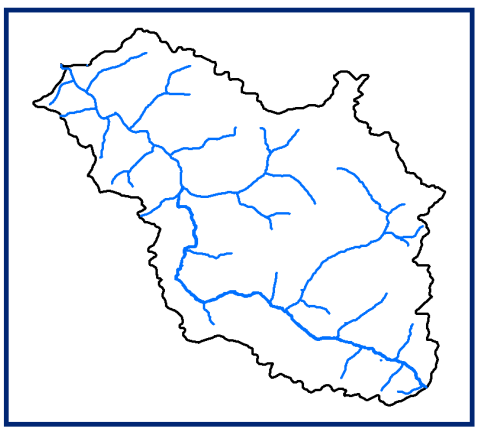


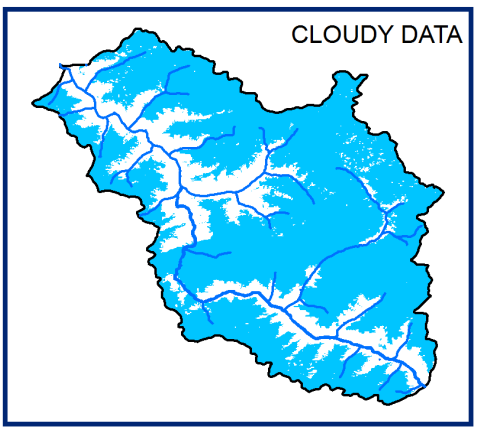
01 OCTOBER 2015



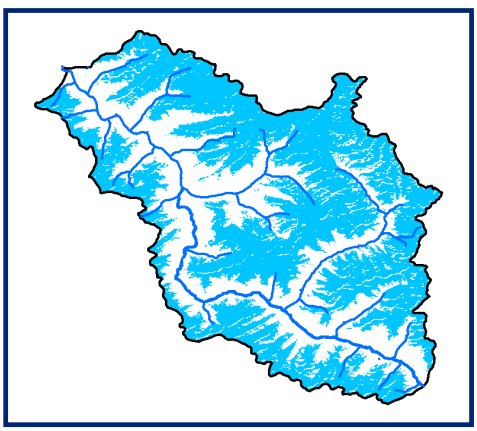
03 OCTOBER 2015







28 OCTOBER 2015



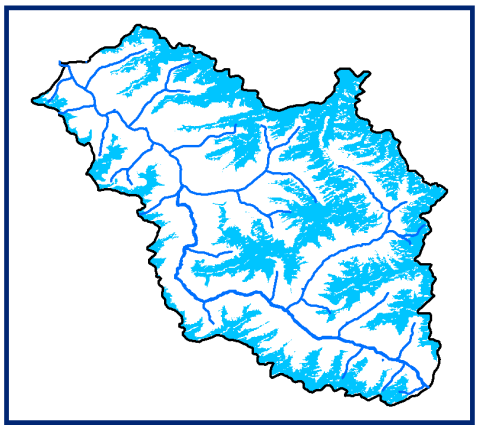
30 OCTOBER 2015

SNOW

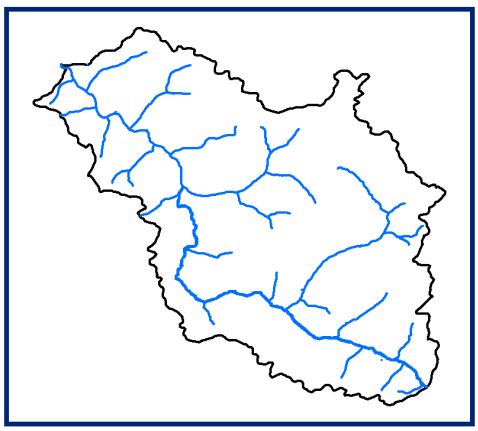
25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
01 OCTOBER 2015
03 OCTOBER 2015



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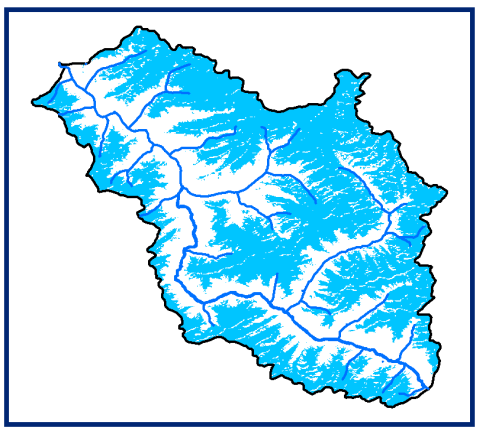
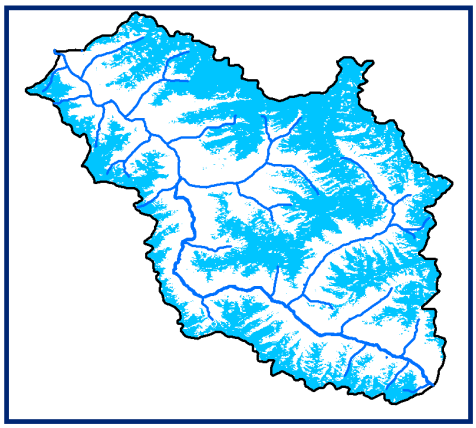


DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : MIYAR SUB-BASIN



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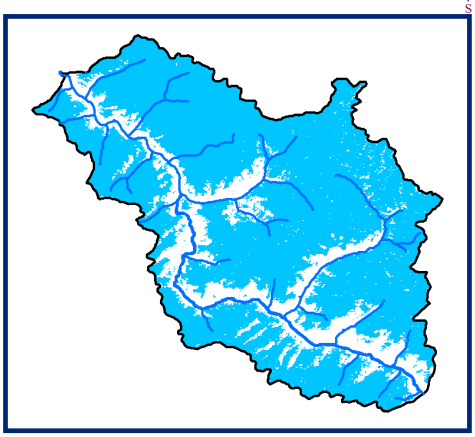

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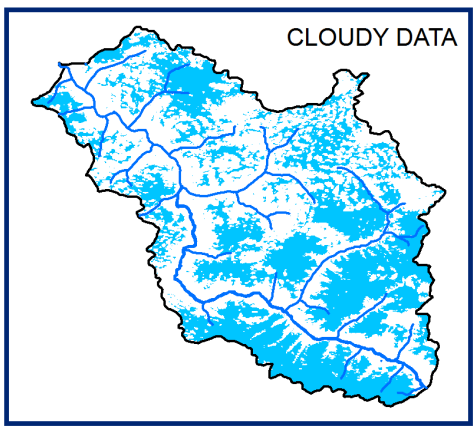

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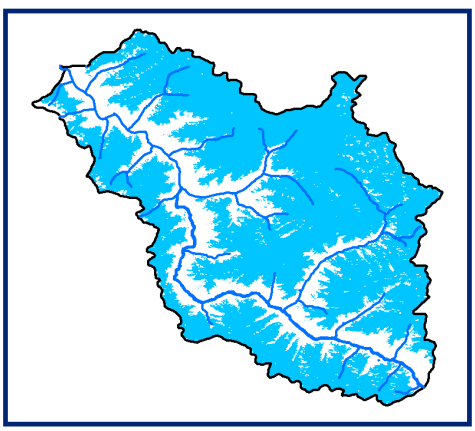
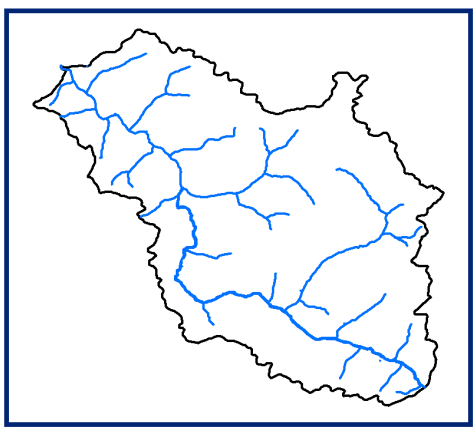


15 NOVEMBER 2015



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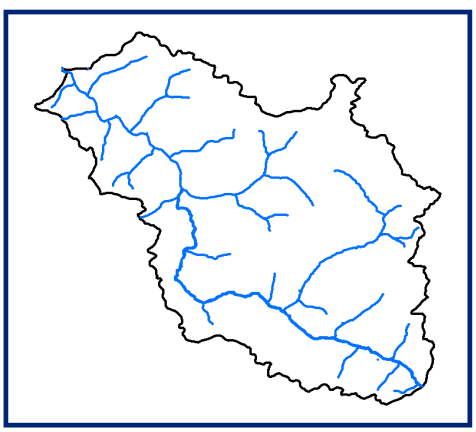


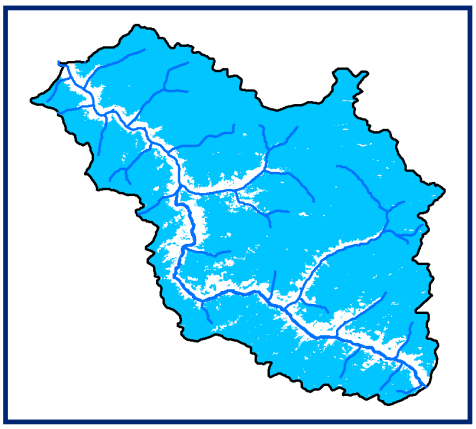
DATA NOT AVAILABLE

SNOW

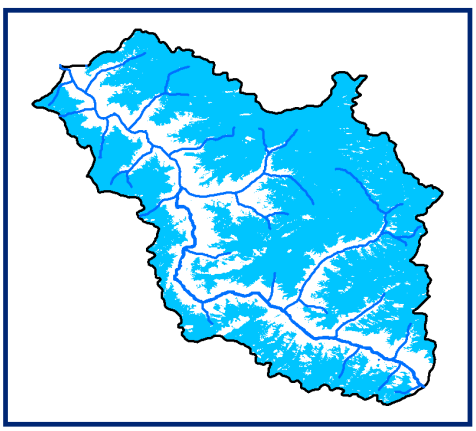
25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
01NOVEMBER 2015
06 NOVEMBER 2015



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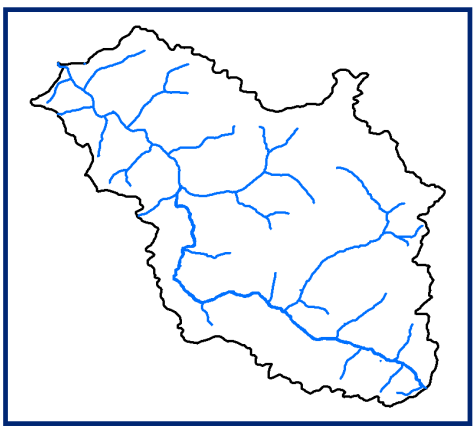
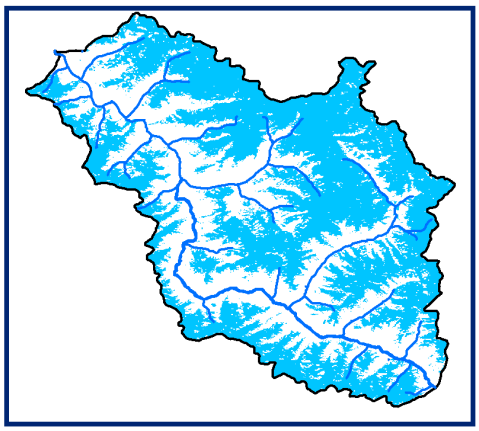


DATA NOT AVAILABLE

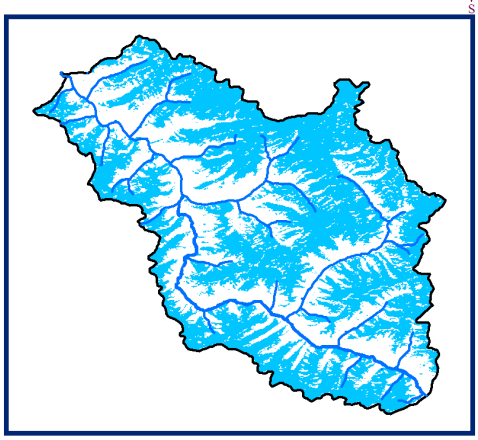
SNOW

20 10 0 20 40 60
Kilometers

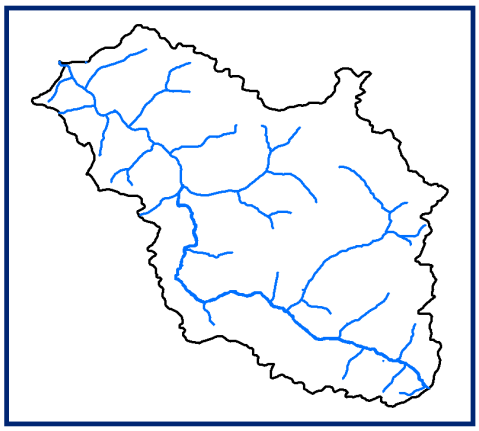
SNOW COVER MAP : MIYAR SUB-BASIN



05 DECEMBER 2015



07 DECEMBER 2015



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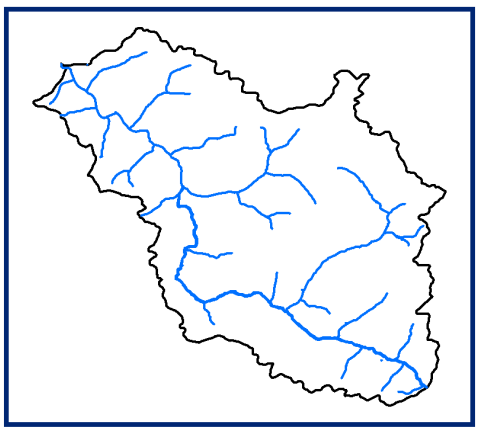

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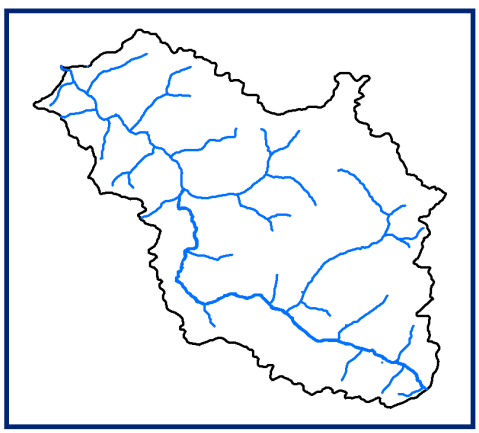

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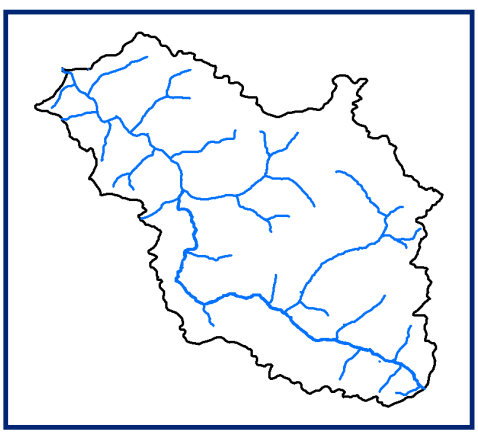


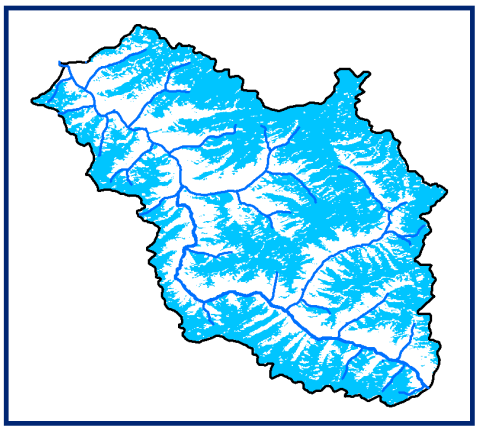
DATA NOT AVAILABLE

SNOW

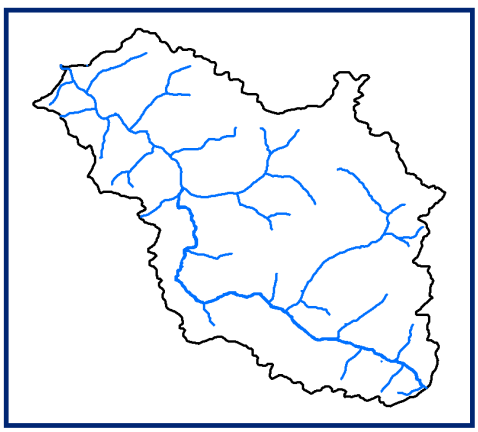
25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
05 DECEMBER 2015
07 DECEMBER 2015



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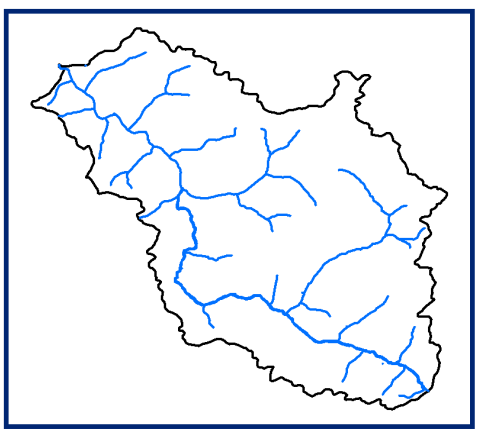
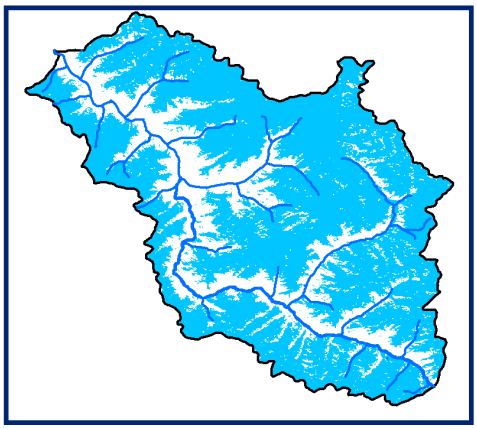


DATA NOT AVAILABLE

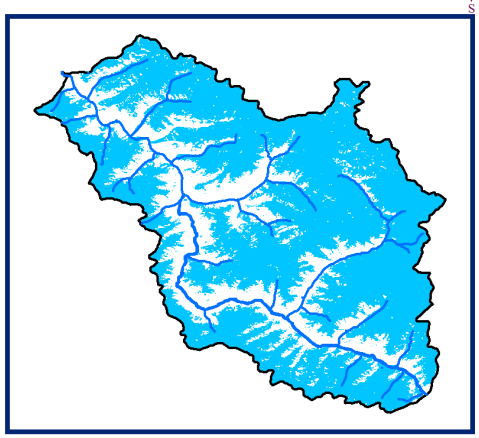
SNOW

20 10 0 20 40 60
Kilometers

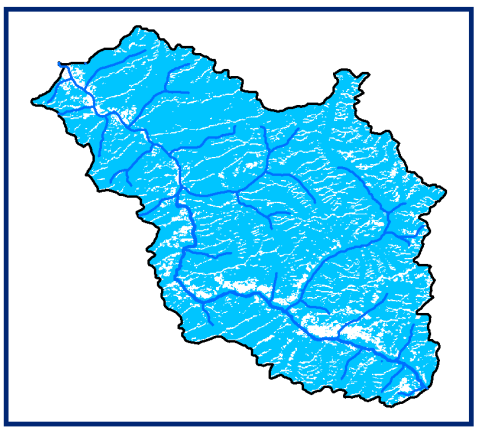
SNOW COVER MAP : MIYAR SUB-BASIN



02 JANUARY 2016



03 JANUARY 2016



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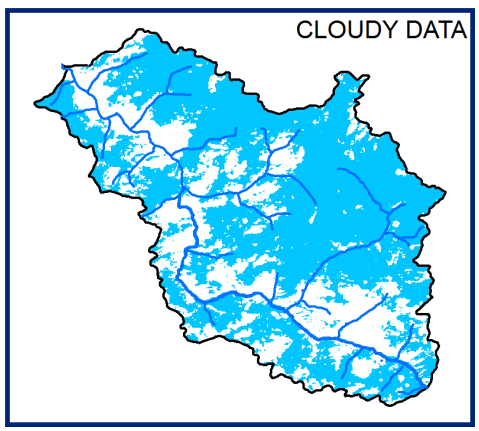
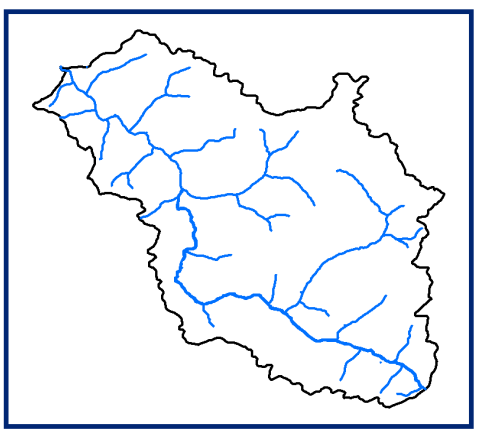


19 JANUARY 2016



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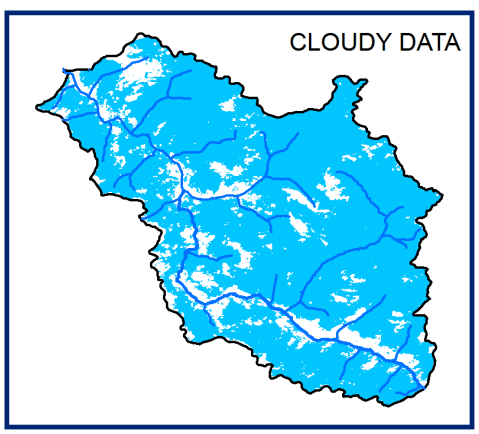


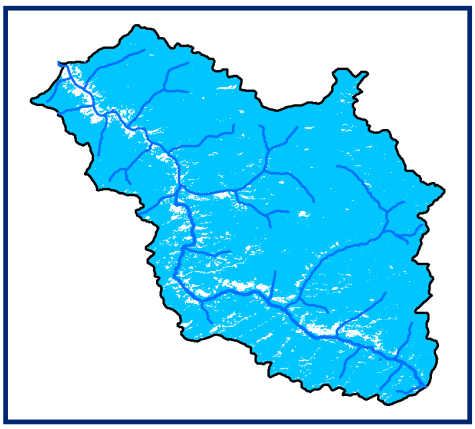
27 JANUARY 2016

SNOW

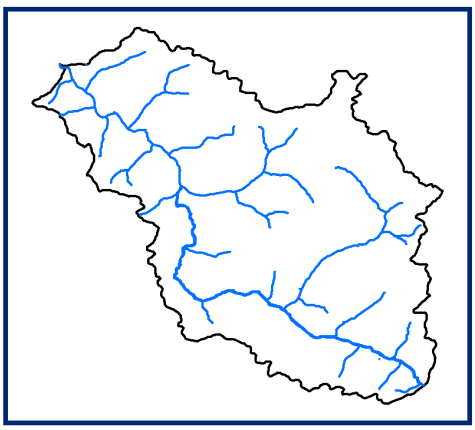
25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
02 JANUARY 2016
03 JANUARY 2016



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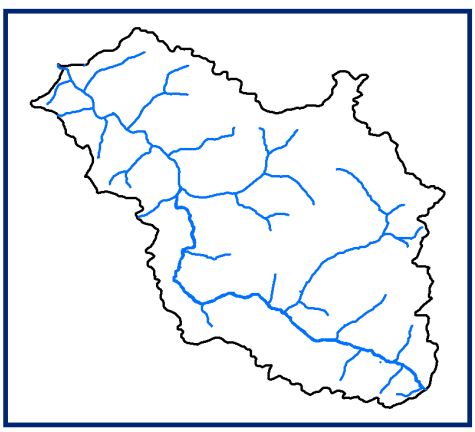
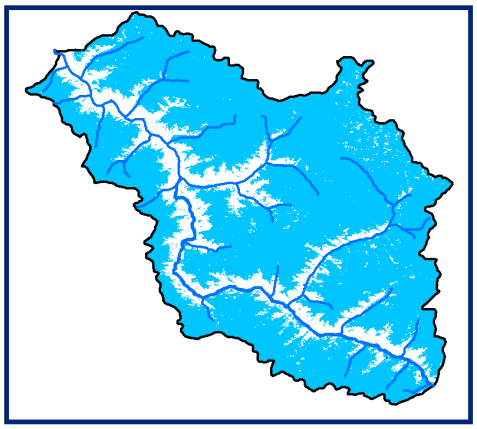


DATA NOT AVAILABLE

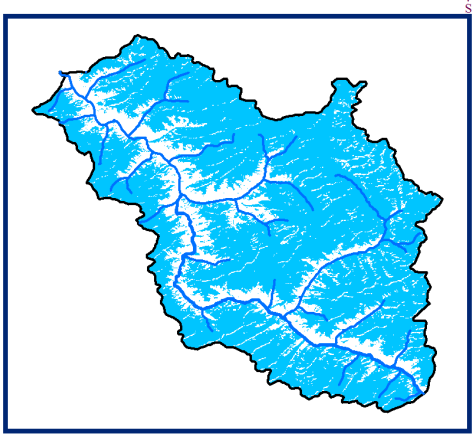
SNOW

20 10 0 20 40 60
Kilometers

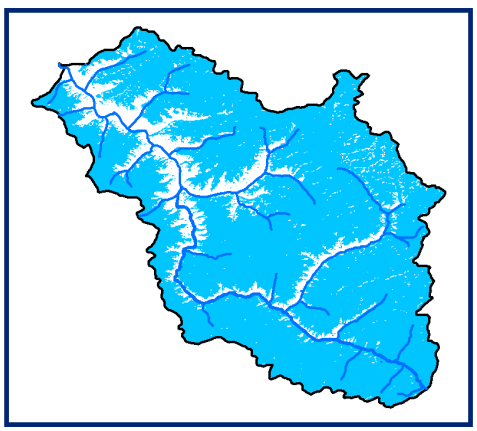
SNOW COVER MAP : MIYAR SUB-BASIN



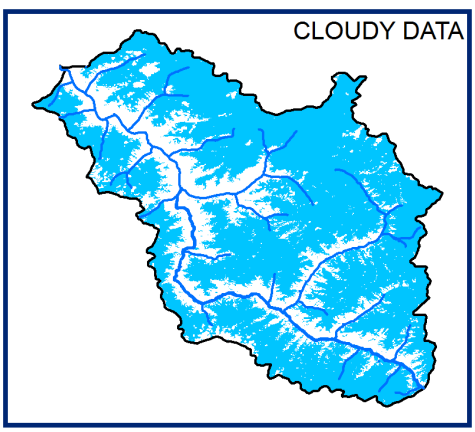
02 FEBRUARY 2016



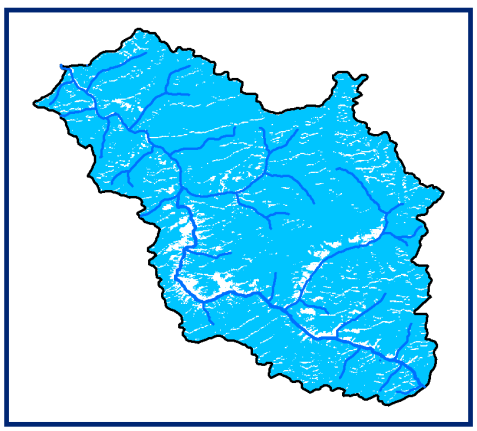
03 FEBRUARY 2016



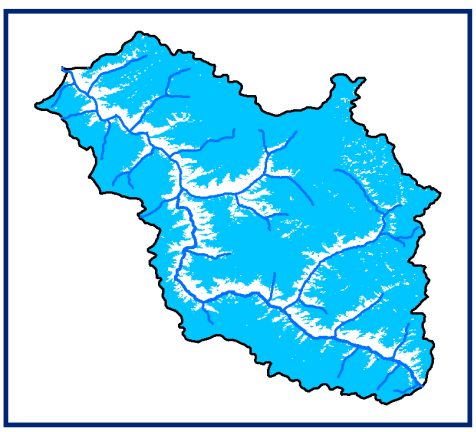
08 FEBRUARY 2016



10FEBRUARY 2016



12 FEBRUARY 2016



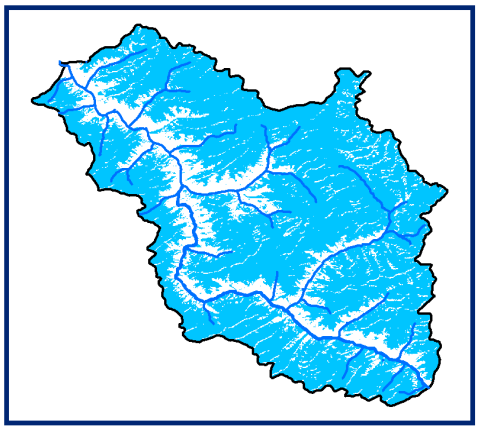
17 FEBRUARY 2016

SNOW

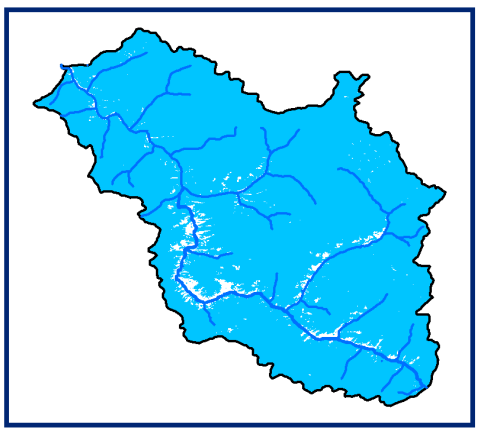
25 12.5 0 25 50 75

Kilometers

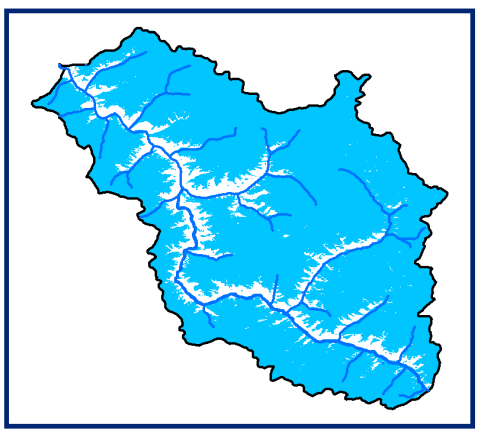
10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
01FEBRUARY 2016
08 FEBRUARY 2016



DATA USED
12 FEBRUARY 2016
17 FEBRUARY 2016

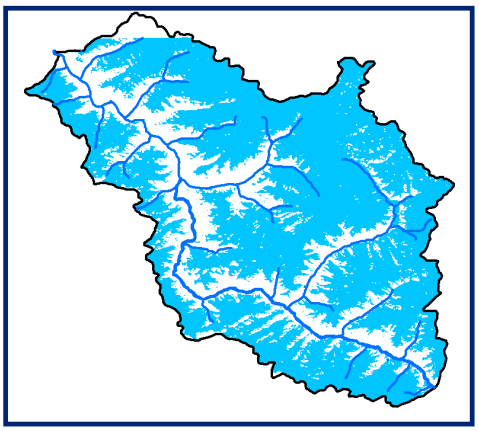


DATA USED
27 FEBRUARY 2016

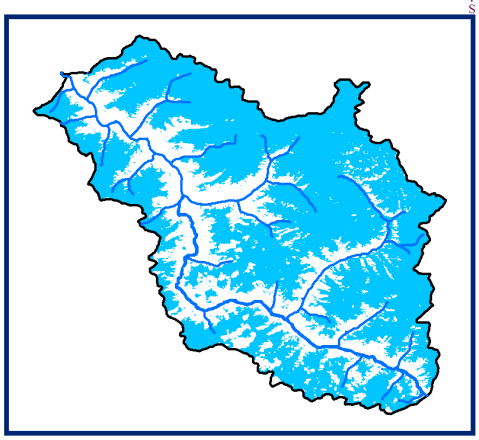
SNOW

20 10 0 20 40 60
Kilometers

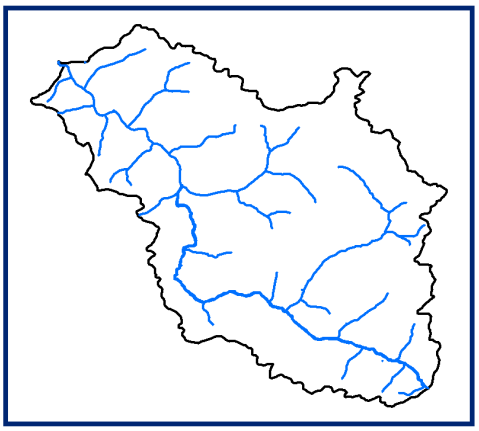
SNOW COVER MAP : MIYAR SUB-BASIN



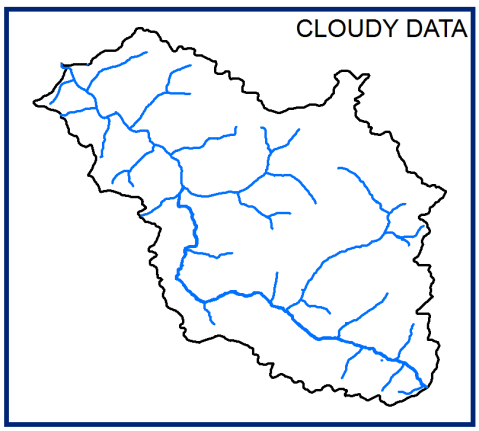
03 MARCH 2016



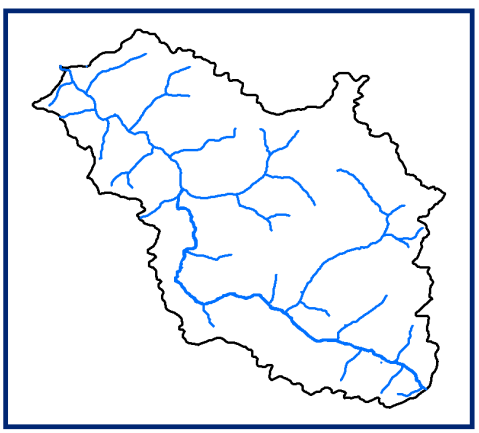
05 MARCH 2016



DATA NOT AVAILABLE



DATA NOT AVAILABLE



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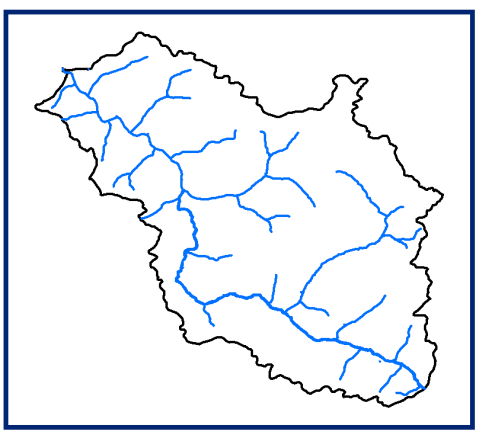


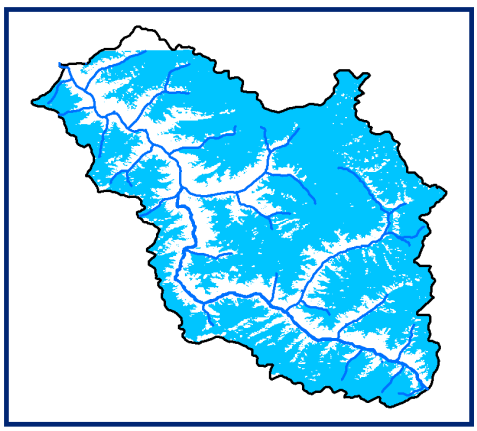
DATA NOT AVAILABLE

SNOW

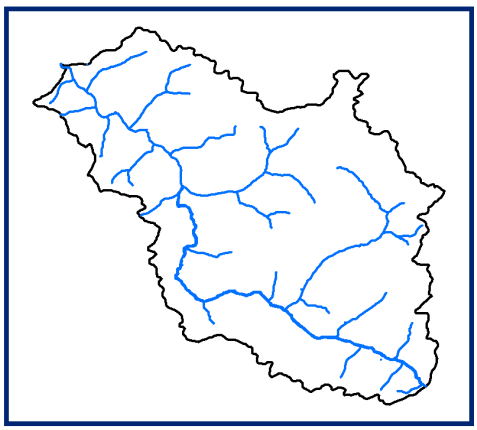
25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
03 MARCH 2016
05 MARCH 2016



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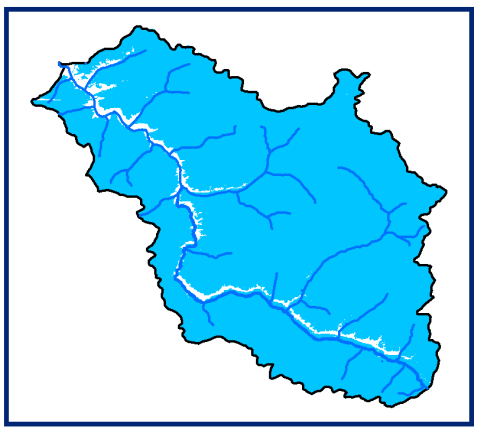
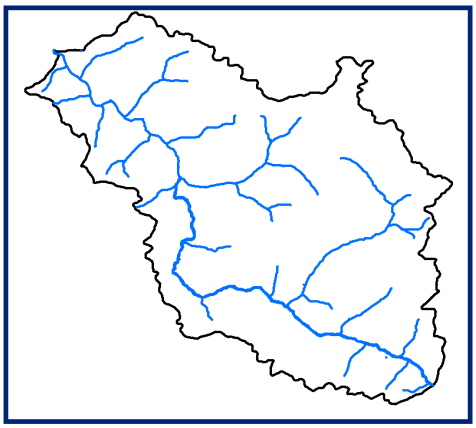


DATA USED
22 MARCH 2016

SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : MIYAR SUB-BASIN



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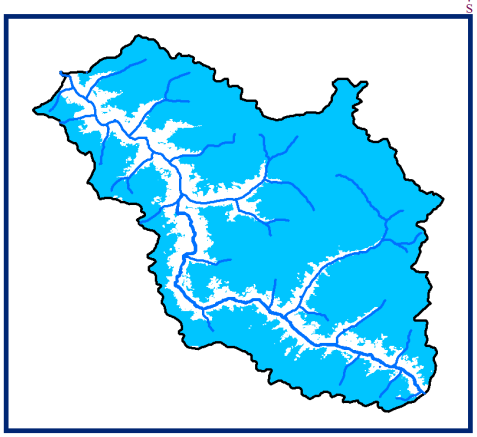
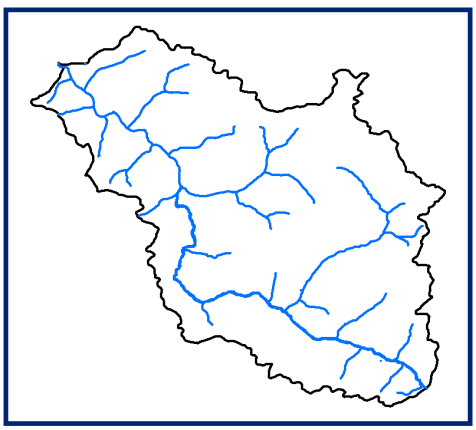


07 APRIL 2016



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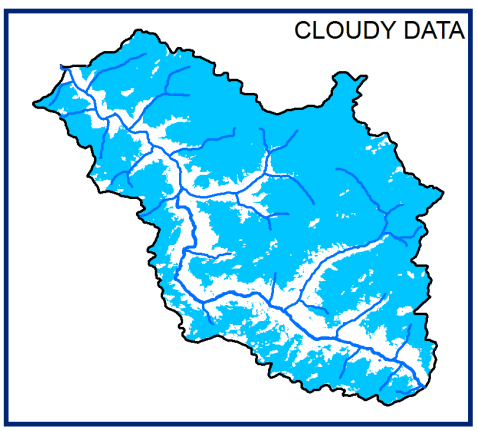
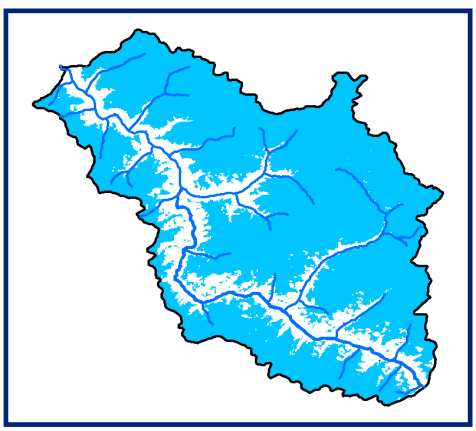
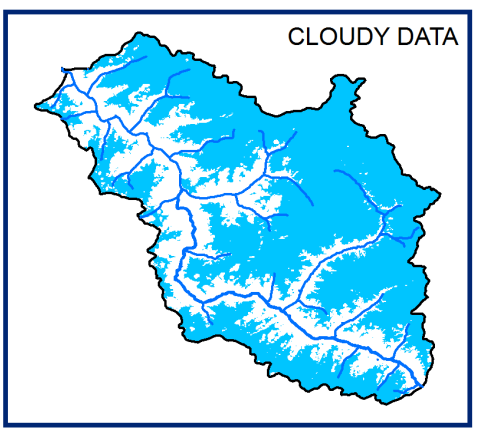


20 APRIL 2016



24 APRIL 2016



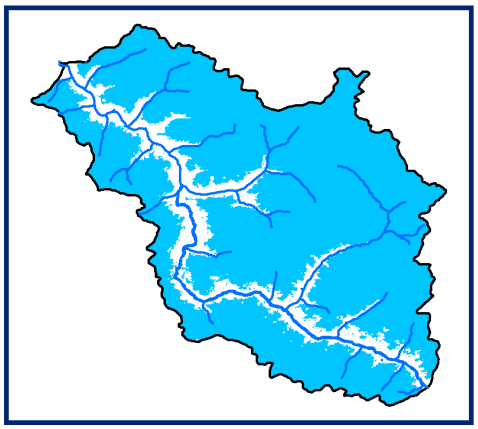
27 APRIL 2016

SNOW

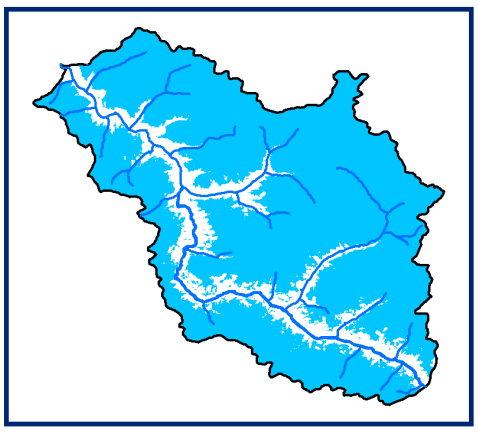
25 12.5 0 25 50 75

Kilometers

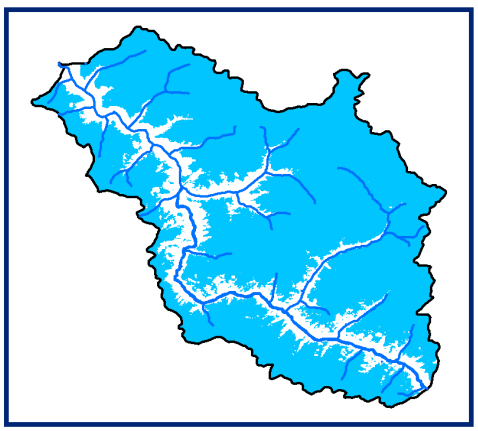
10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
07 APRIL 2016



DATA USED
20 APRIL 2016

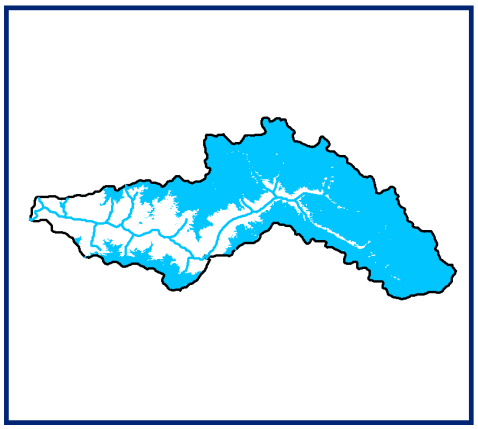


DATA USED
24 APRIL 2016
27 APRIL 2016

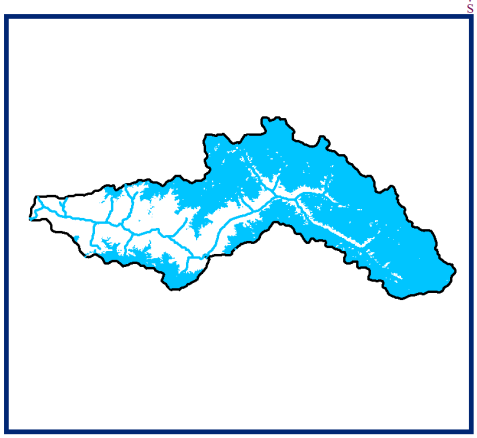
SNOW

20 10 0 20 40 60
Kilometers

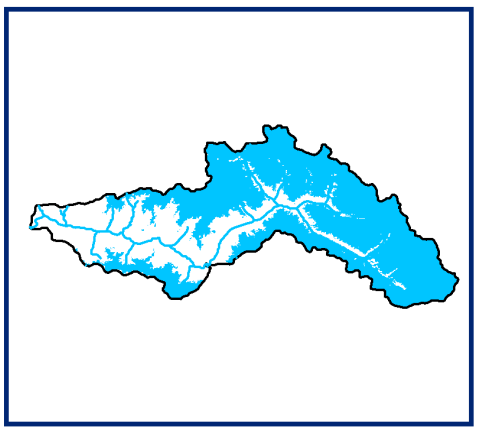
SNOW COVER MAP : BHUT SUB-BASIN



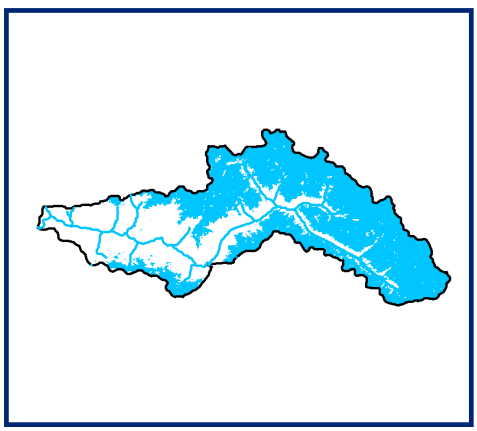
01 MAY 2016



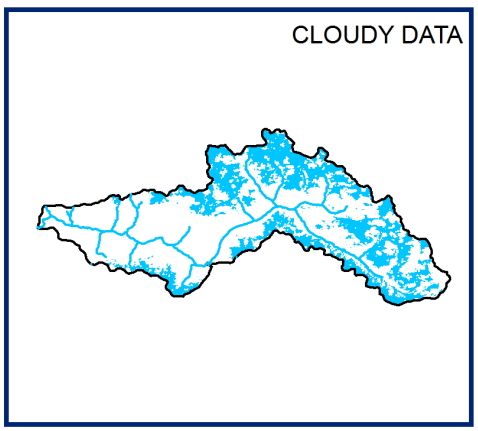
02 MAY 2016



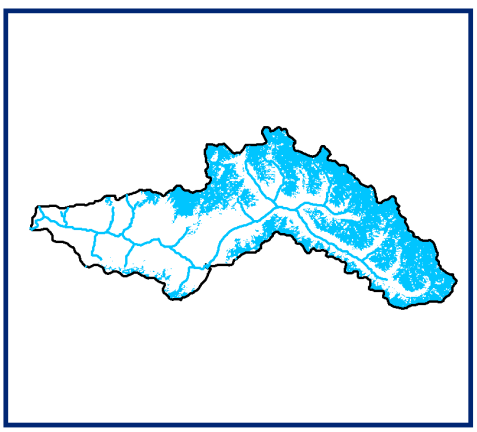
06 MAY 2016



07 MAY 2016



19 MAY 2016



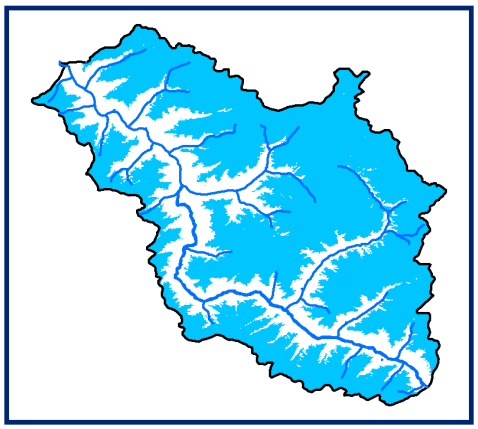
31 MAY 2016

SNOW

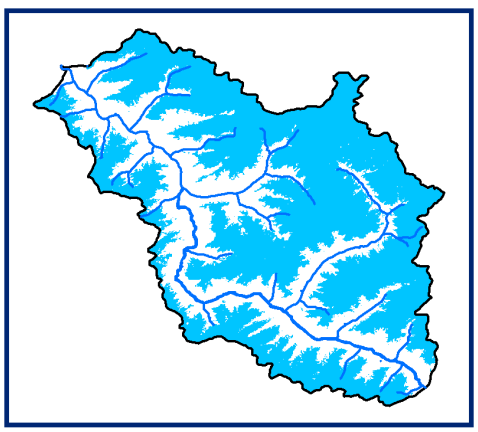
20 10 0 20 40 60

Kilometers

10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
01 MAY 2016
06 MAY 2016



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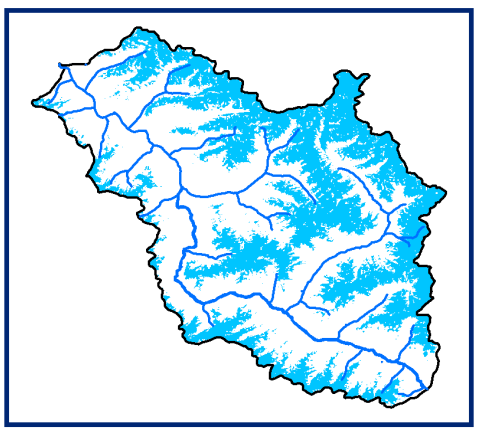
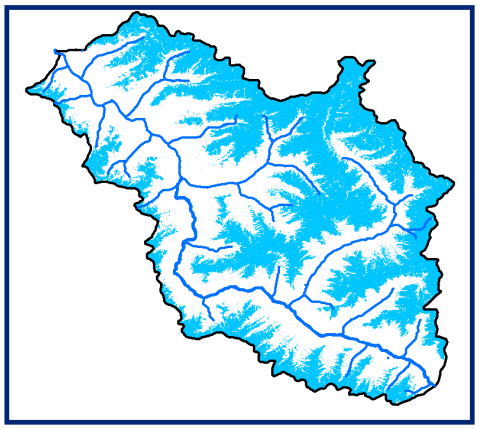


DATA USED
31 MAY 2016

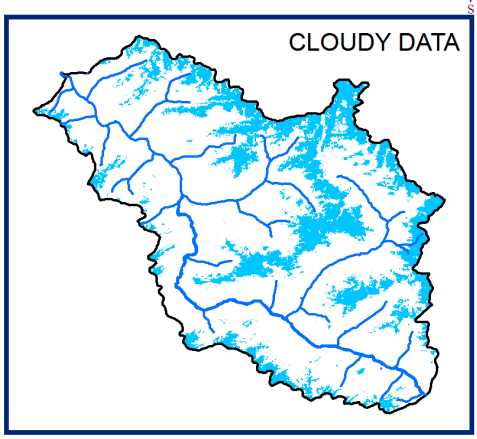
SNOW

20 10 0 20 40 60
Kilometers

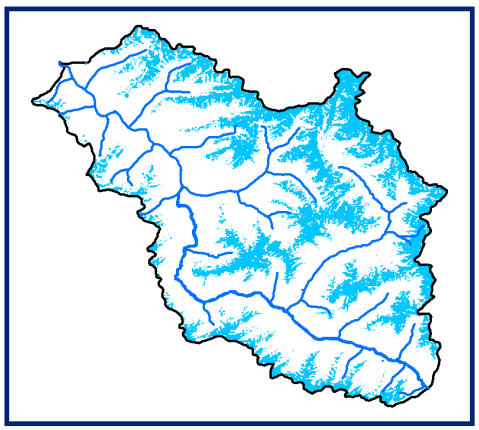
SNOW COVER MAP : MIYAR SUB-BASIN



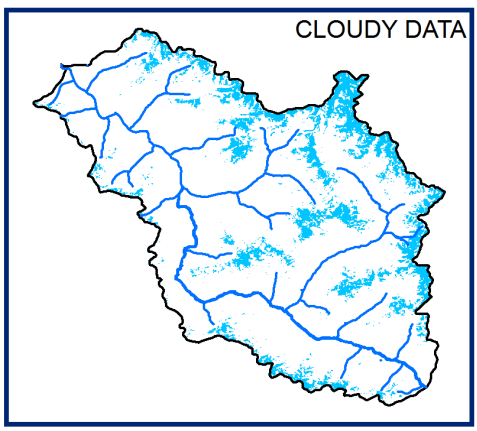
04 JUNE 2016



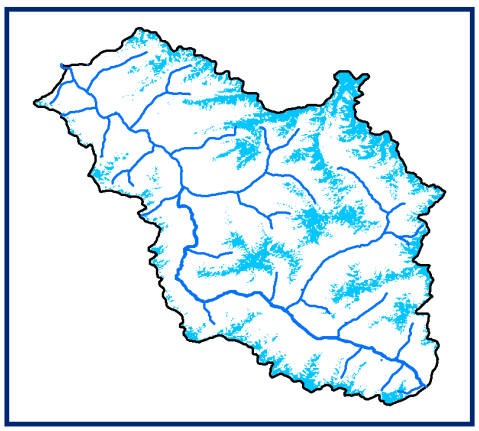
09 JUNE 2016



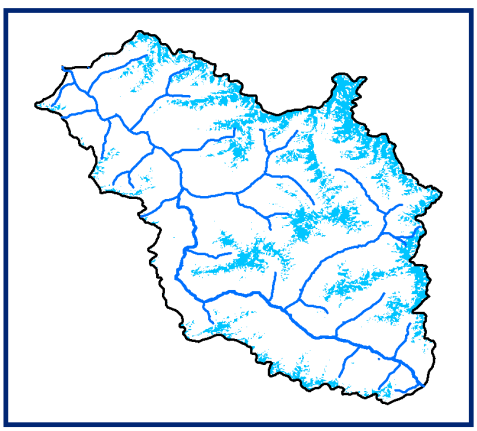
14 JUNE 2016



19 JUNE 2016



23 JUNE 2016



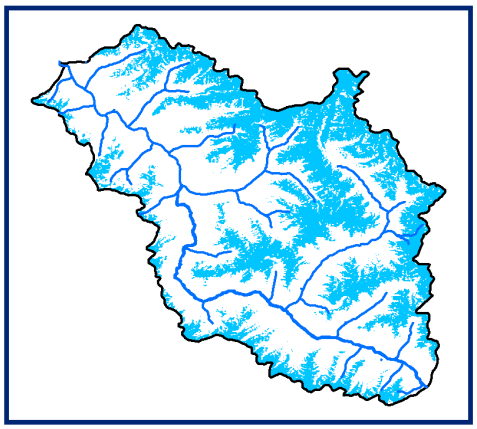
24 JUNE 2016

SNOW

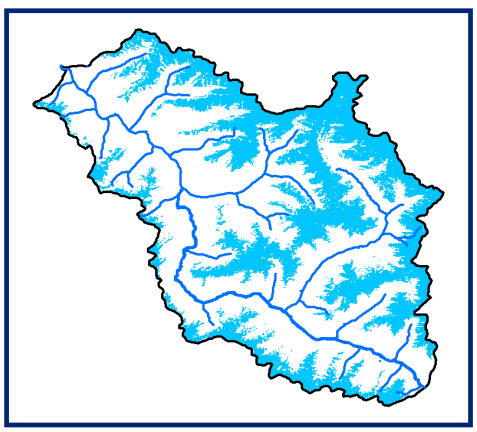
25 12.5 0 25 50 75

Kilometers

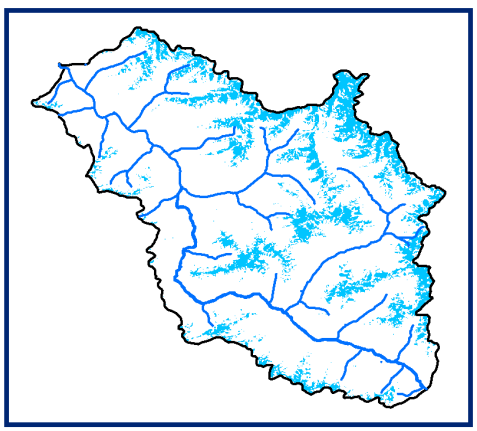
10 DAILY SNOW COVER MAP : MIYAR SUB-BASIN



DATA USED
04 JUNE 2016
09 JUNE 2016



DATA USED
14 JUNE 2016
18 JUNE 2016



DATA USED
23 JUNE 2016
24 JUNE 2016

SNOW

20 10 0 20 40 60
Kilometers

BHUT SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: BHUT **BASIN AREA: 2218 sq km**

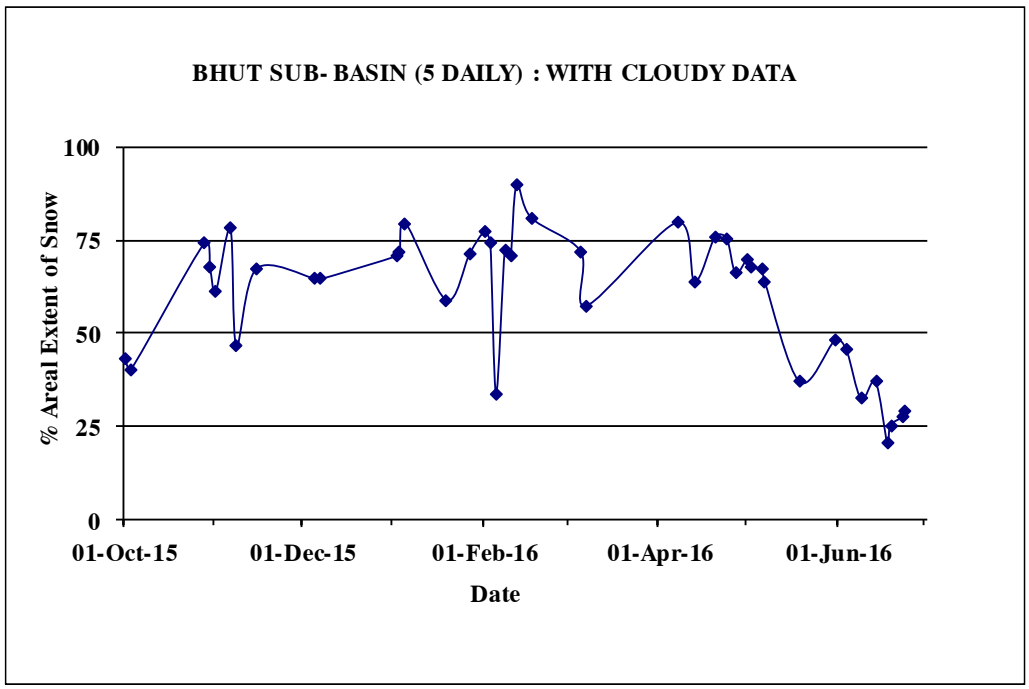
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	01/10/15	954	43	3	28/10/15	1643	74
2	03/10/15	896	40	4	30/10/15	1499	68
November 2013							
5	01/11/15	1359	61	7	08/11/15	1036(c)	47
6	06/11/15	1732	78	8	15/11/15	1495(c)	67
December 2013							
9	05/12/15	1434	65	10	07/12/15	1432	65
January 2014							
11	02/01/16	1569	71	14	19/01/16	1306(c)	59
12	03/01/16	1594	72	15	27/01/16	1585(c)	71
13	05/01/16	1764(c)	80				
February 2014							
16	01/02/16	1713	77	20	10/02/16	1575(c)	71
17	03/02/16	1652	74	21	12/02/16	1990	90
18	05/02/16	749(c)	34		17/02/16	1797	81
19	08/02/16	1609	73				
March 2014							
22	05/03/16	1596	72	23	07/03/16	1274(c)	57
April 2014							
24	07/04/16	1769	80	27	24/04/16	1674	75
25	13/04/16	1748	64	28	27/04/16	1467(c)	66
26	20/04/16	1683	76				
May-2014							
29	01/05/16	1552	70	32	07/05/16	1418	64
30	02/05/16	1506	68	33	19/05/16	819(c)	37
31	06/05/16	1490	67	34	31/05/16	1064	48
June-2014							
35	04/06/16	1009	45	38	19/06/16	560(c)	25
36	09/06/16	719(c)	32	39	23/06/16	609(c)	27
37	14/06/16	819(c)	37	40	24/06/16	646	29

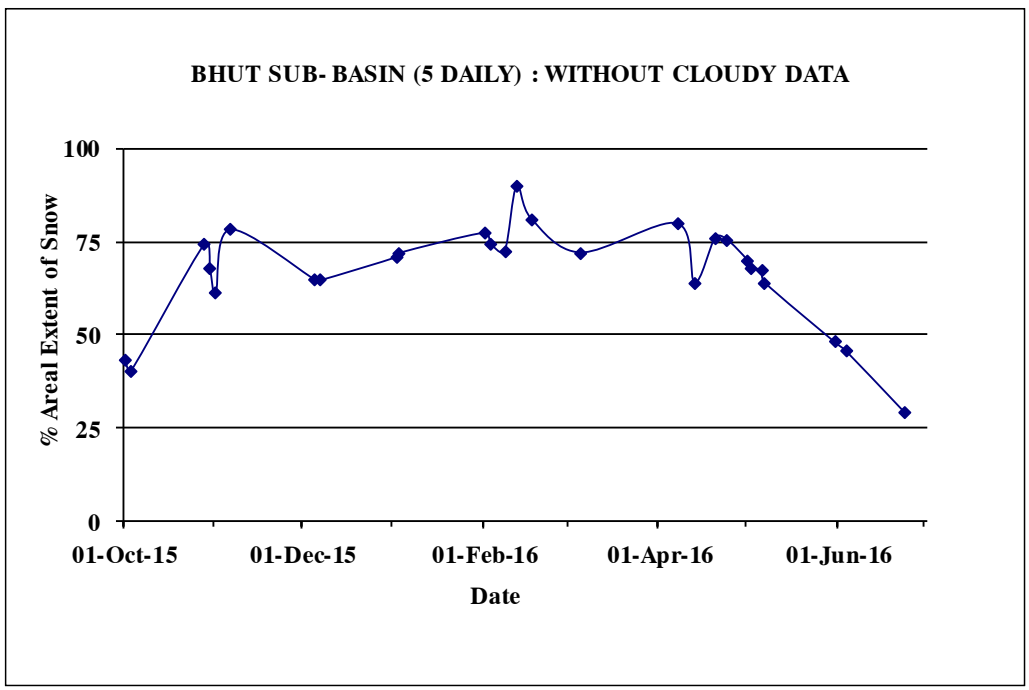
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: BHUT **BASIN AREA: 2218 sq km**

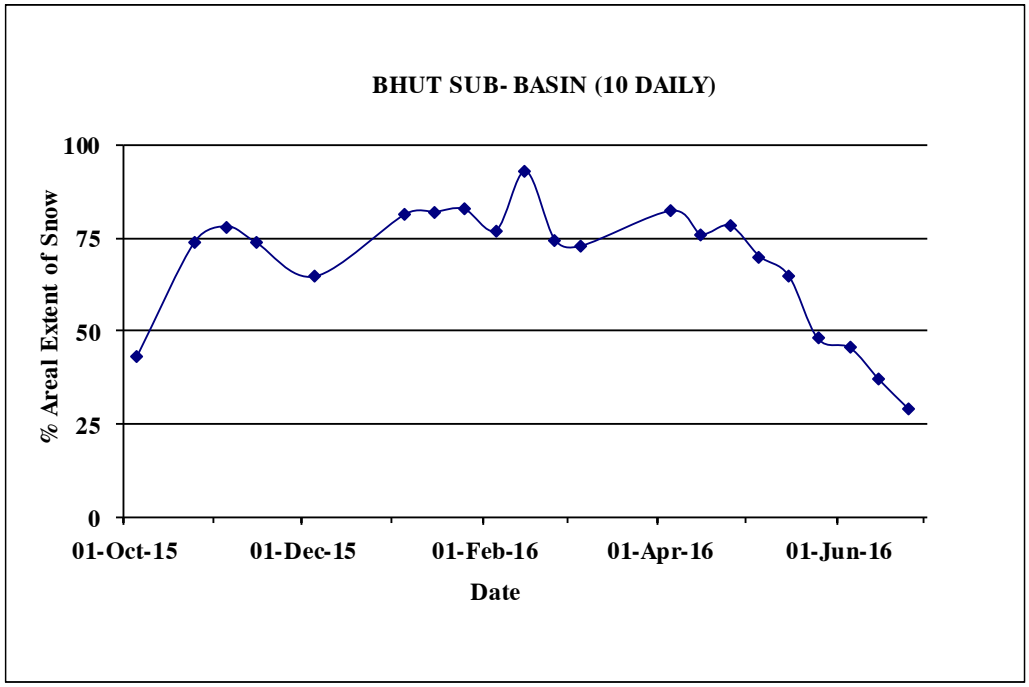
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	05/10/15	953	43	3	25/10/15	1641	74
November 2013							
5	05/11/15	1730	78	6	15/11/16	1633	74
December 2013							
7	05/12/15	1433	65				
January 2013							
10	05/01/16	1804	81	12	25/01/16	1833	83
11	15/01/16	1816	82				
February-2014							
13	05/02/16	1609	73	15	25/02/16	1174	53
14	15/02/16	2058	93				
March 2014							
16	05/03/16	1614	73				
April-2014							
19	05/04/16	1823	82	21	25/04/16	1734	78
20	15/04/16	1529	69				
May-2014							
22	05/05/16	1553	70	23	25-May-14	1064	48
24	15/05/16	1438	65				
June-2014							
24	05/06/16	1009	45	26	25/06/16	647	29
25	15/06/16	819	37				

SNOW COVER DEPLETION CURVE



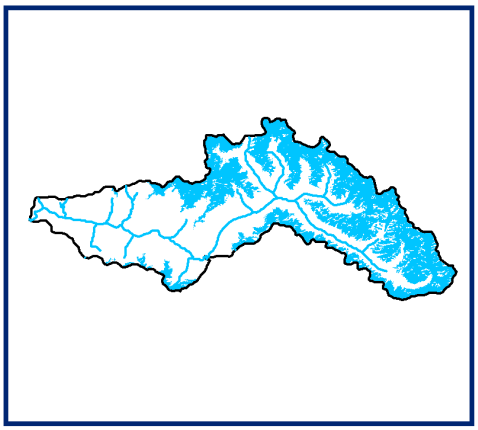


SNOW COVER DEPLETION CURVE

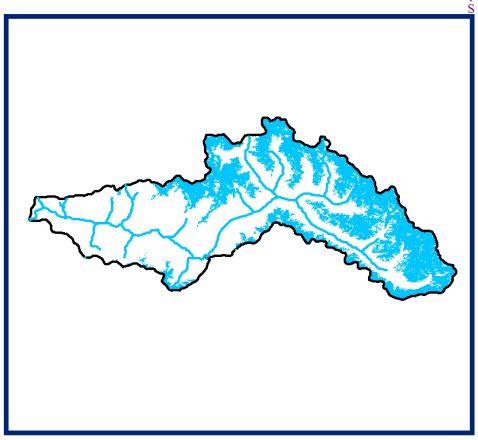


SNOW COVER MAP

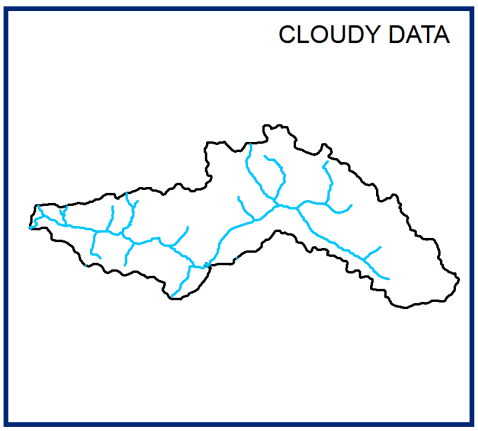
SNOW COVER MAP : BHUT SUB-BASIN



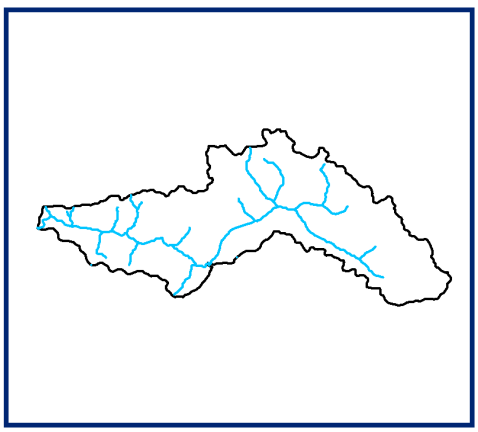
01 OCTOBER 2015



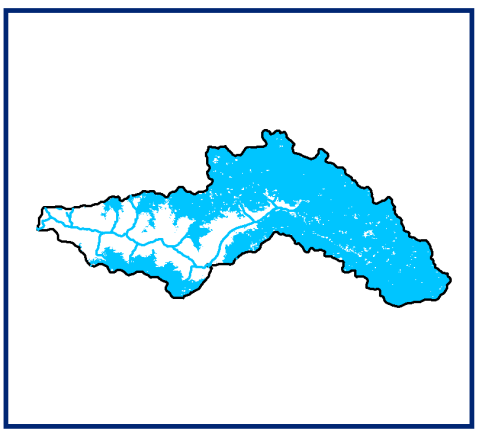
03 OCTOBER 2015



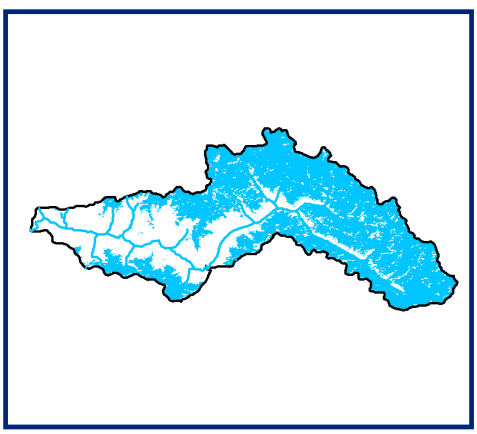
DATA NOT AVAILABLE



DATA NOT AVAILABLE



28 OCTOBER 2015



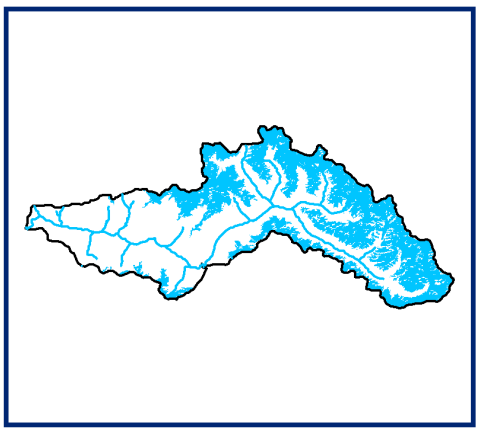
30 OCTOBER 2015

SNOW

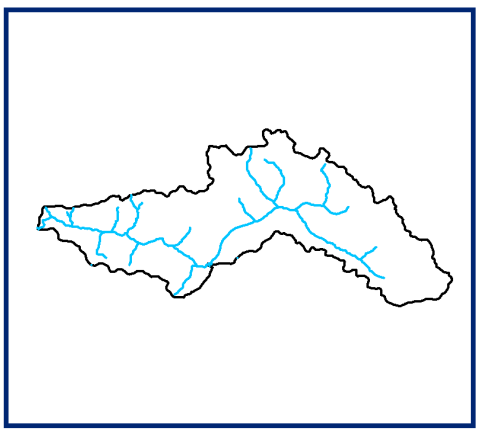
30 15 0 30 60 90

Kilometers

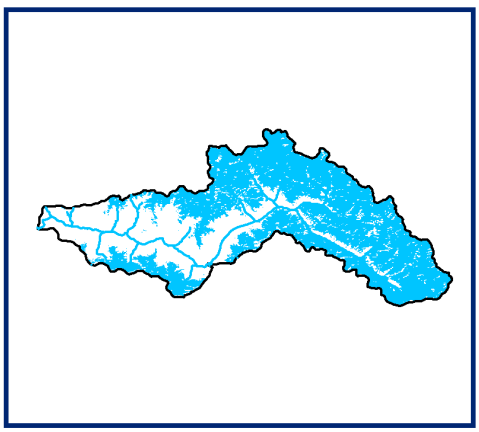
10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
01 OCTOBER 2015
03 OCTOBER 2015



DATA NOT AVAILABLE

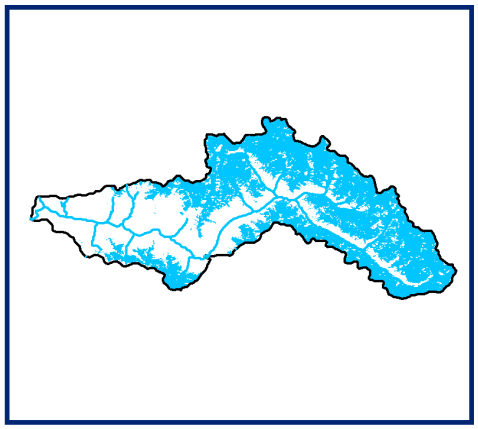


DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

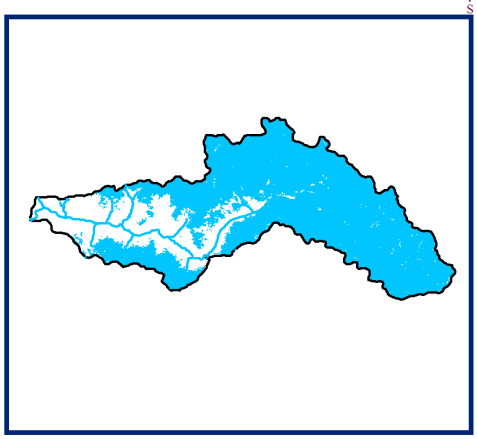
SNOW

25 12.5 0 25 50 75
Kilometers

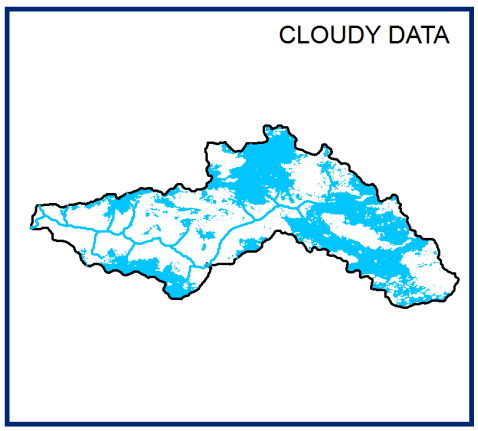
SNOW COVER MAP : BHUT SUB-BASIN



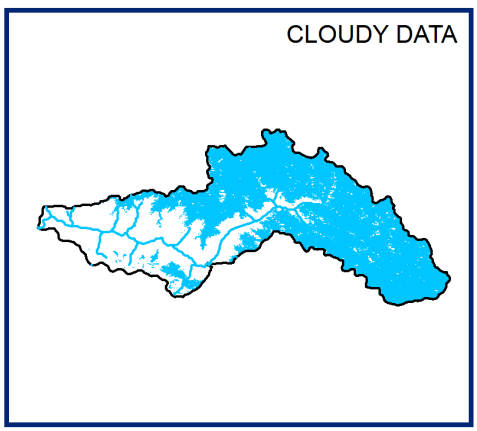
01 NOVEMBER 2015



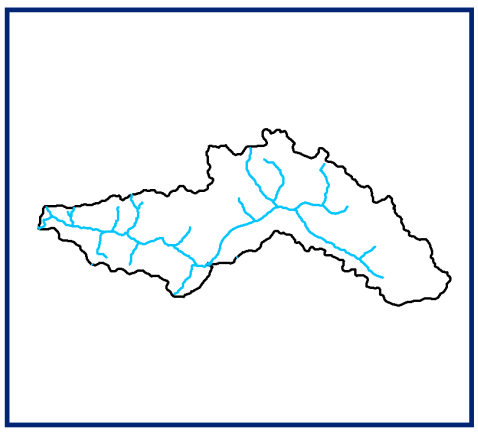
06 NOVEMBER 2015



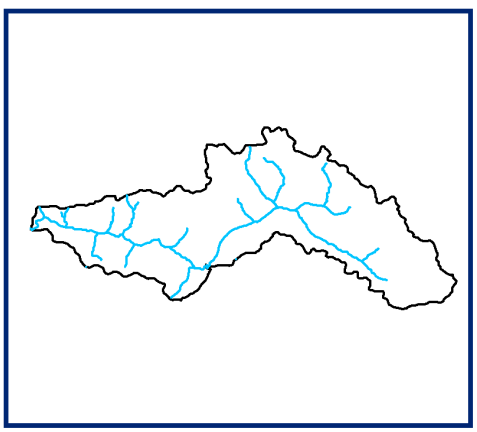
08 NOVEMBER 2015



15 NOVEMBER 2015



DATA NOT AVAILABLE



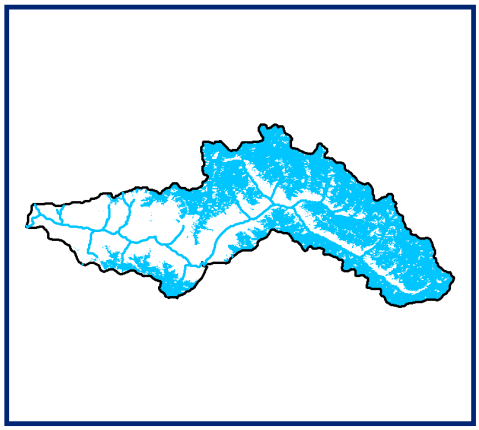
DATA NOT AVAILABLE

SNOW

25 12.5 0 25 50 75

Kilometers

10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
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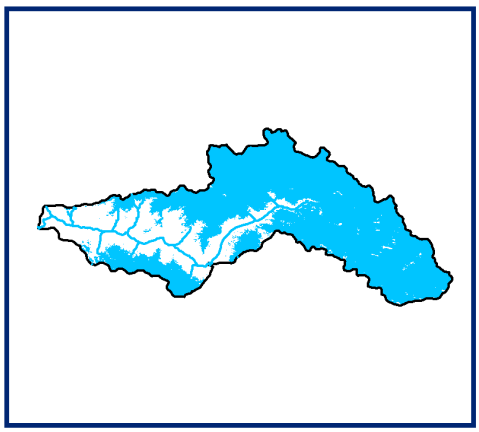
06 NOVEMBER 2015



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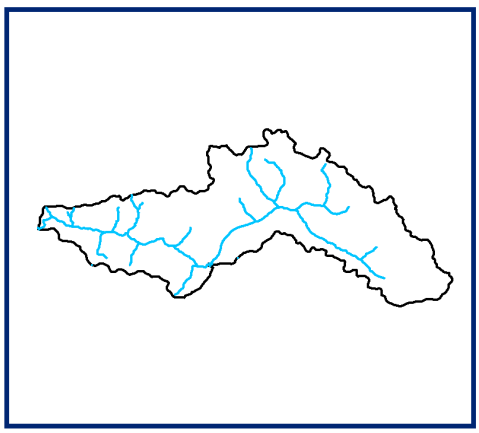
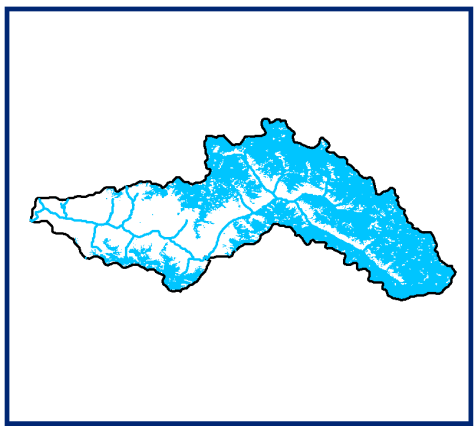


DATA NOT AVAILABLE

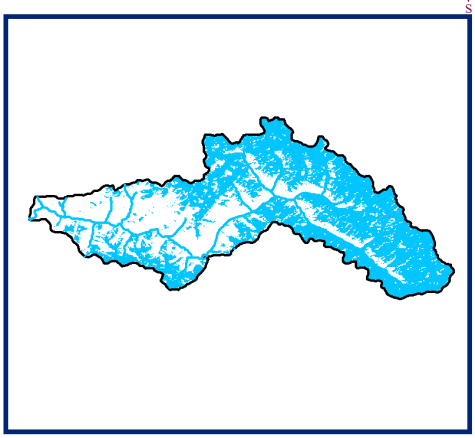
SNOW

20 10 0 20 40 60
Kilometers

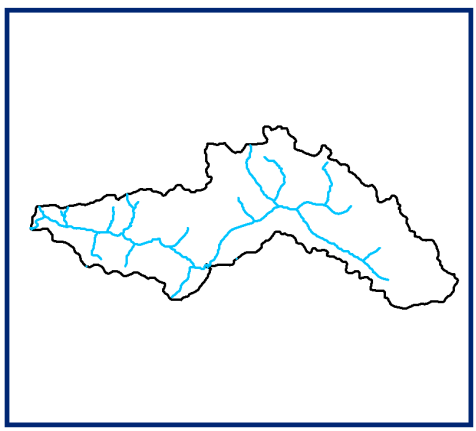
SNOW COVER MAP : BHUT SUB-BASIN



05 DECEMBER 2015



07 DECEMBER 2015



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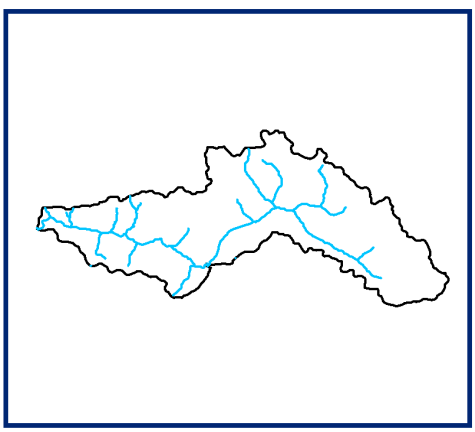

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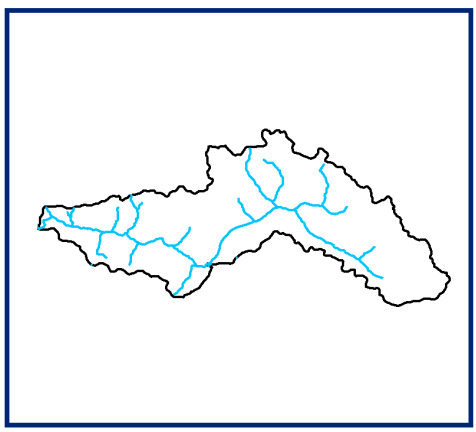

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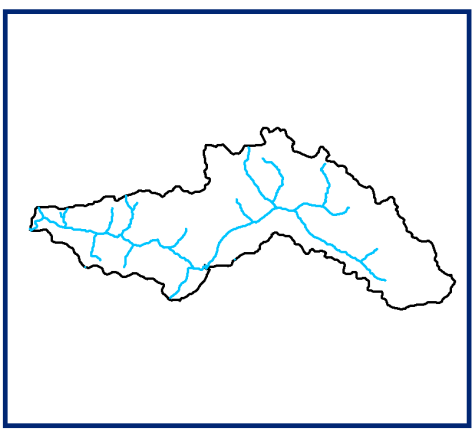


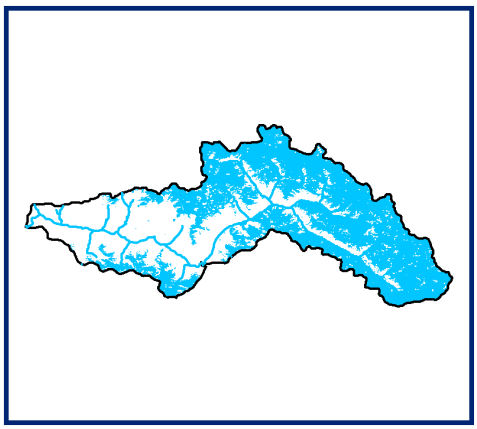
DATA NOT AVAILABLE

SNOW

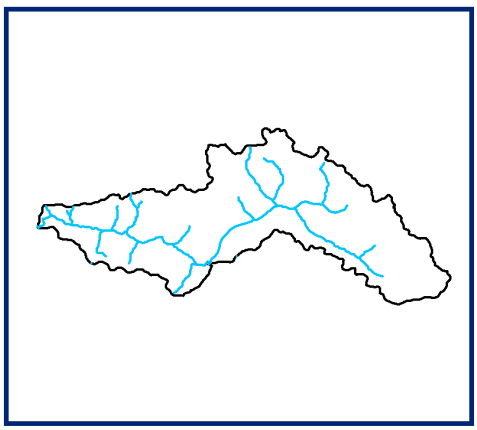
20 10 0 20 40 60

Kilometers

10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
05 DECEMBER 2015
07 DECEMBER 2015



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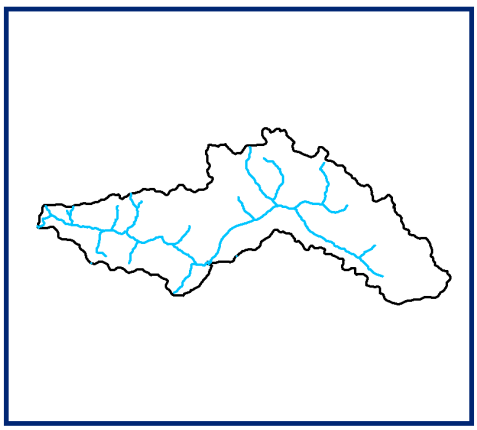
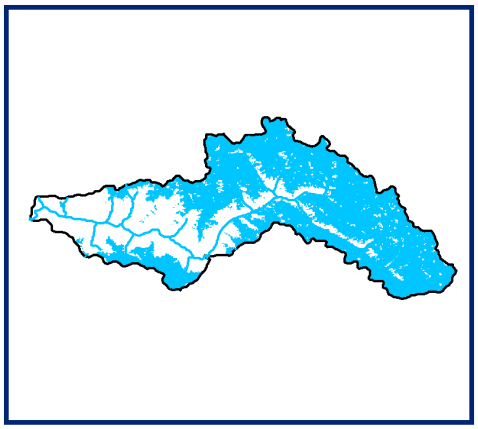


DATA NOT AVAILABLE

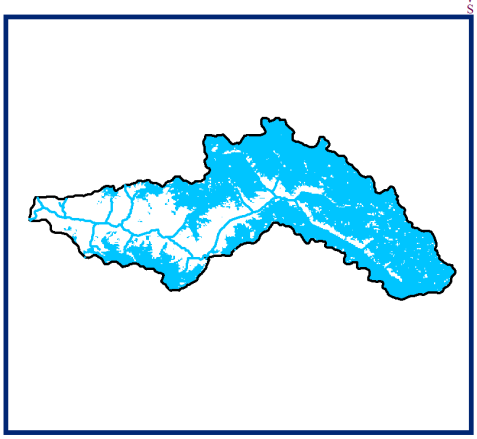
SNOW

20 10 0 20 40 60
Kilometers

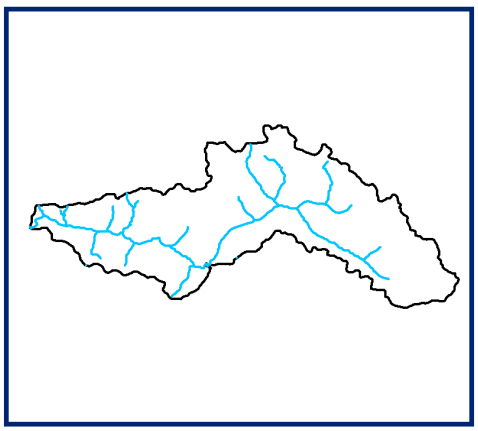
SNOW COVER MAP : BHUT SUB-BASIN



02 JANUARY 2016



03 JANUARY 2016



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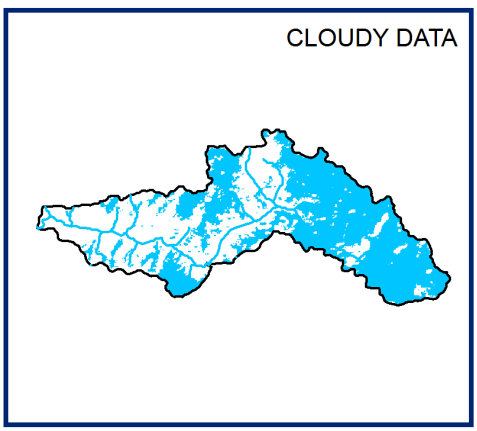

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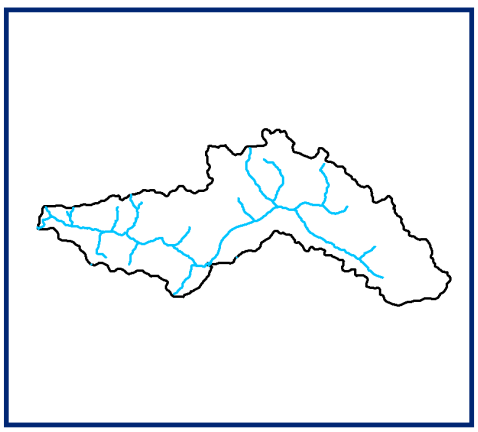

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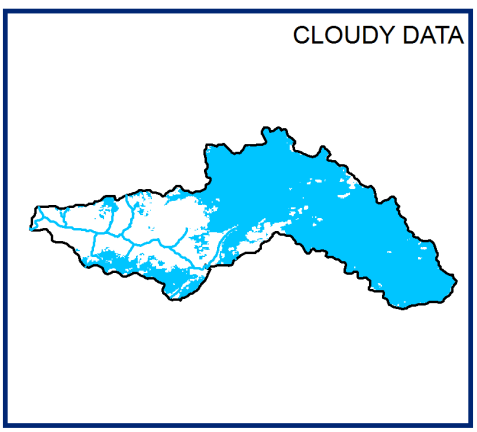


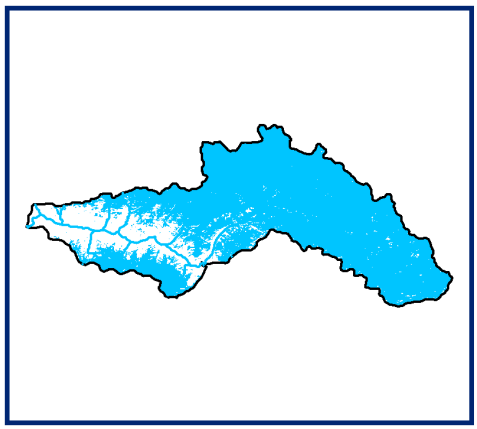
27 JANUARY 2016

SNOW

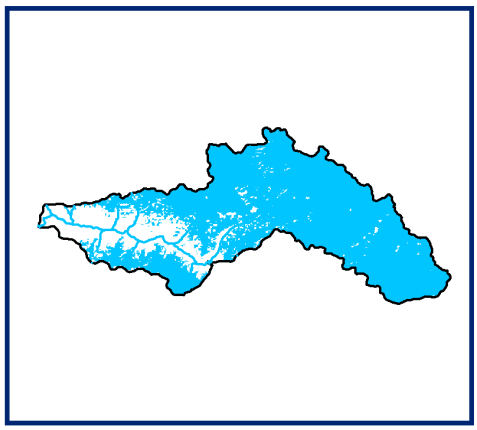
20 10 0 20 40 60

Kilometers

10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
02 JANUARY 2016
03 JANUARY 2016



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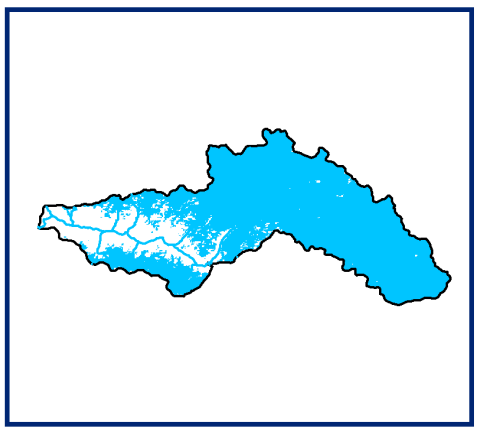
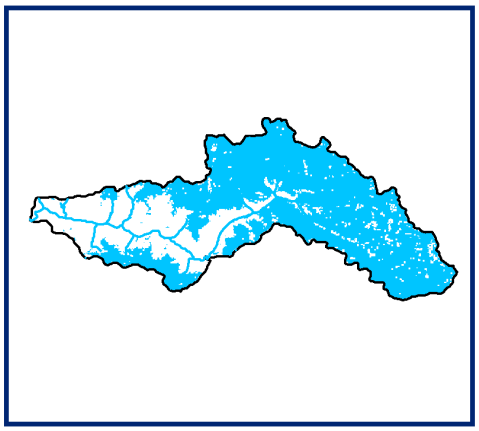


DATA USED
27 JANUARY 2016

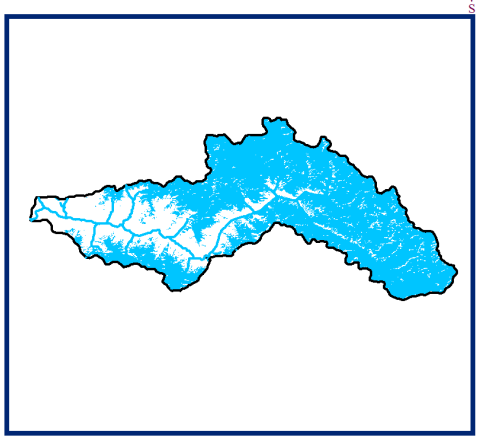
SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : BHUT SUB-BASIN



01 FEBRUARY 2016



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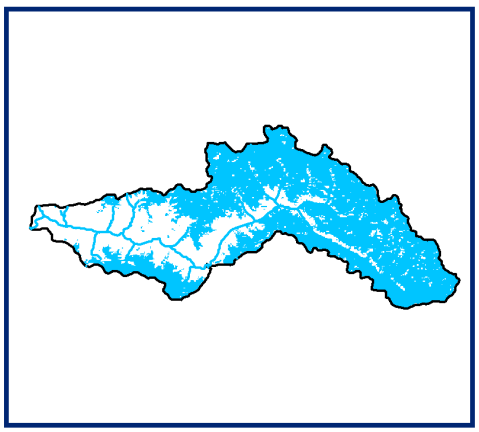

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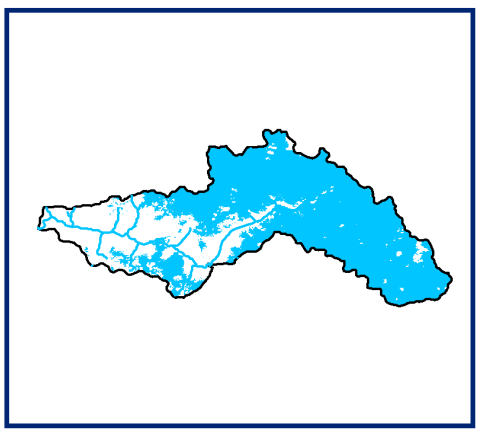

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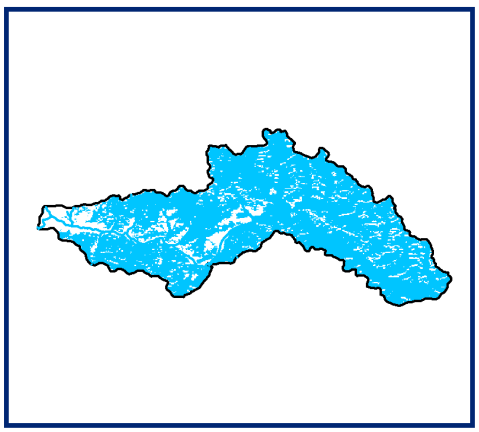

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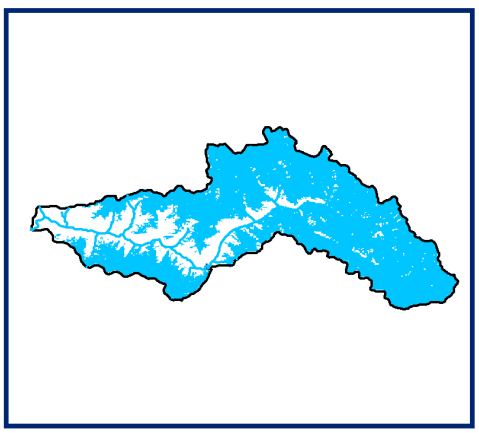


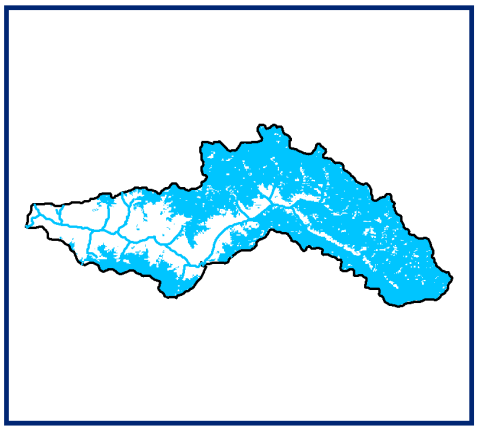
17 FEBRUARY 2016

SNOW

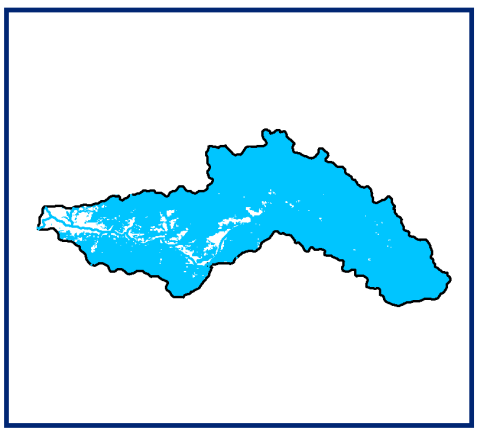
20 10 0 20 40 60

Kilometers

10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
01 FEBRUARY 2016
08 FEBRUARY 2016



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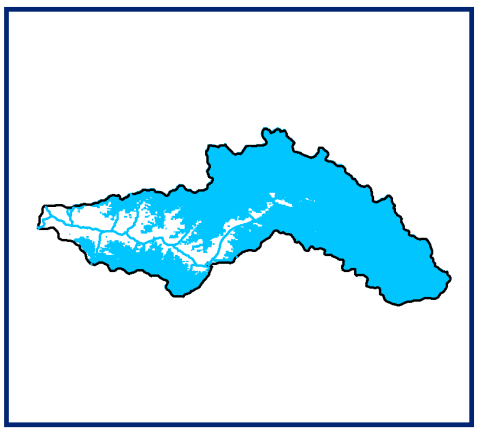
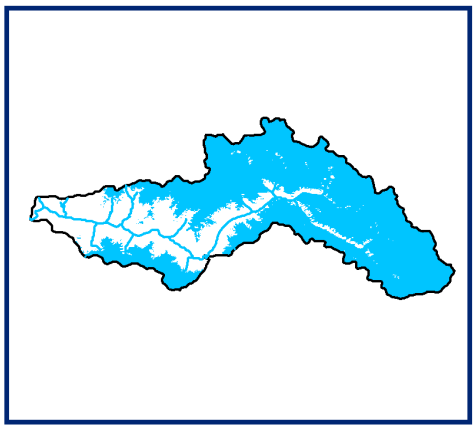


DATA USED
26 FEBRUARY 2016

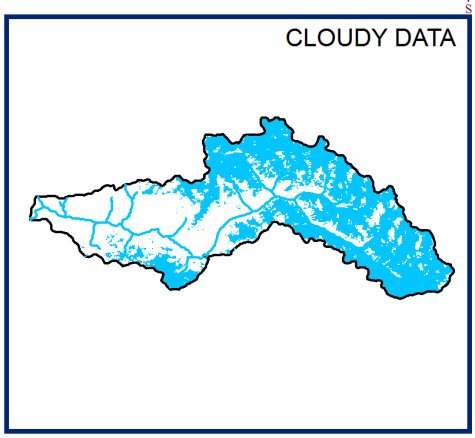
SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : BHUT SUB-BASIN



05 MARCH 2016



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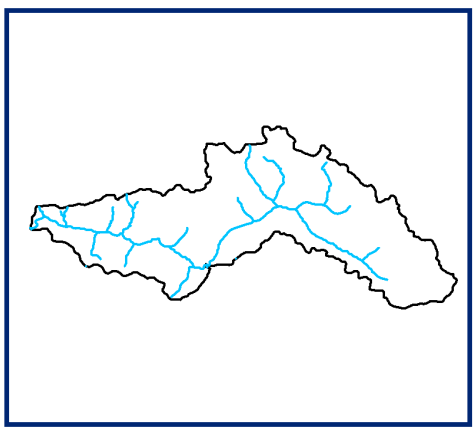

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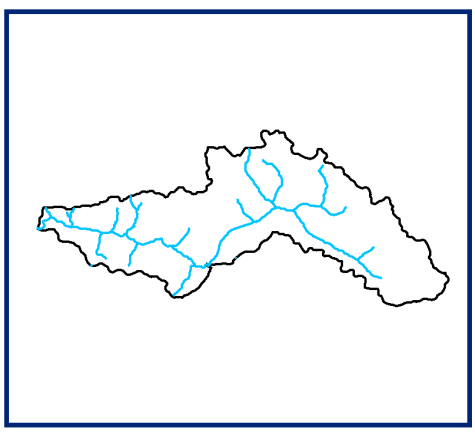

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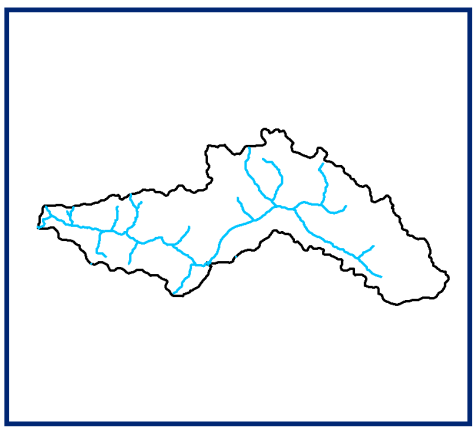

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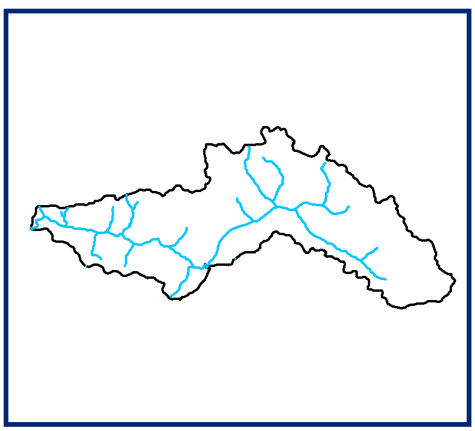


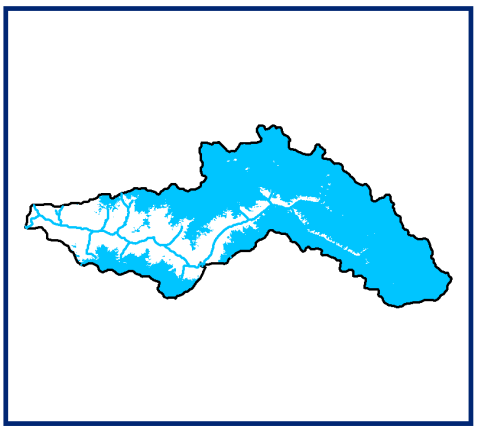
DATA NOT AVAILABLE

SNOW

20 10 0 20 40 60

Kilometers

10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
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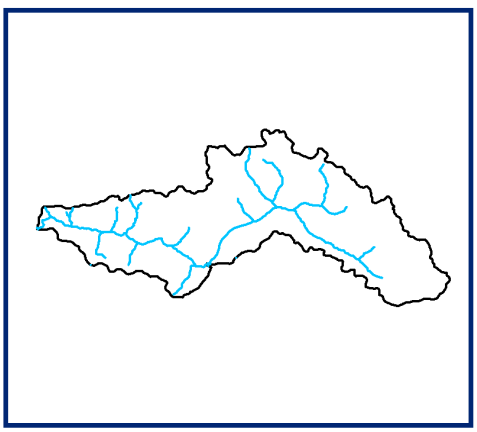

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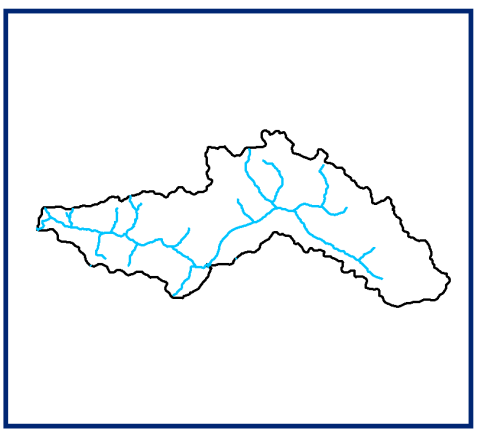

DATA NOT AVAILABLE

SNOW

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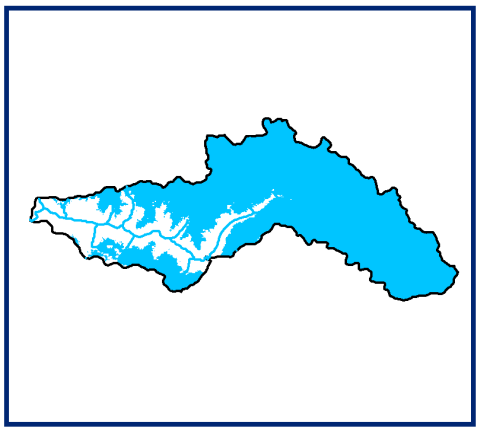
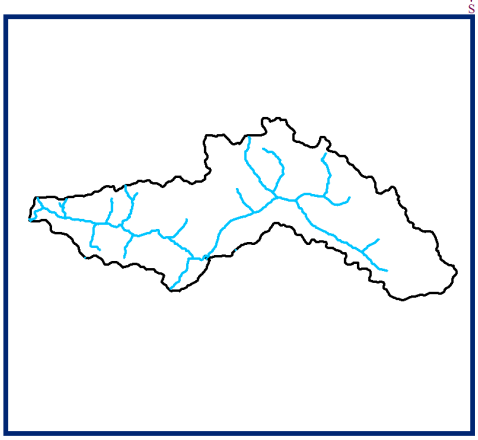
Kilometers

SNOW COVER MAP : BHUT SUB-BASIN



07 APRIL 2016



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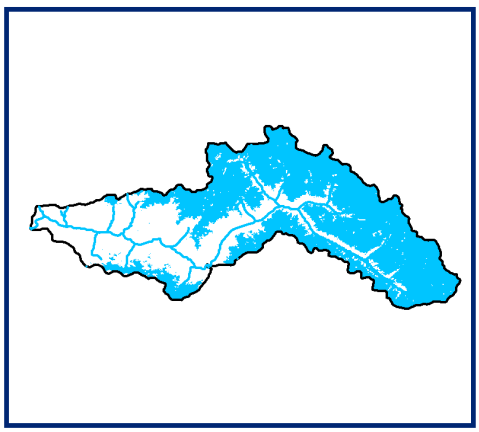
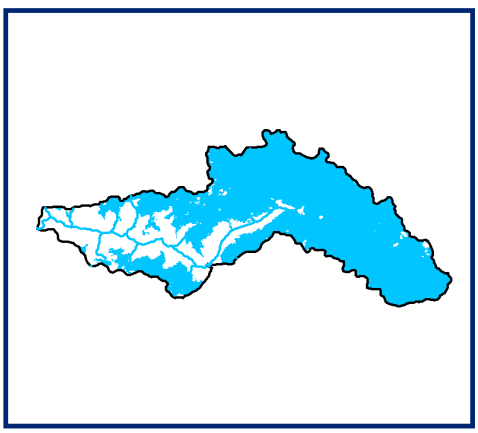


13 APRIL 2016



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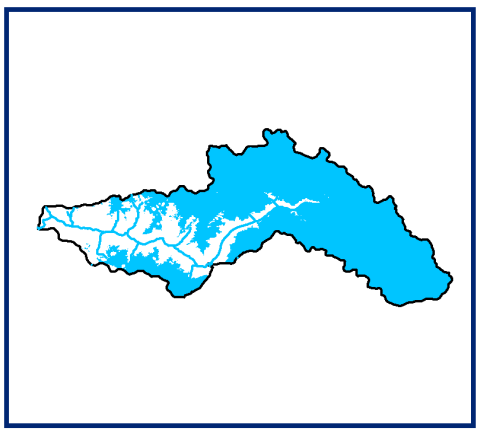
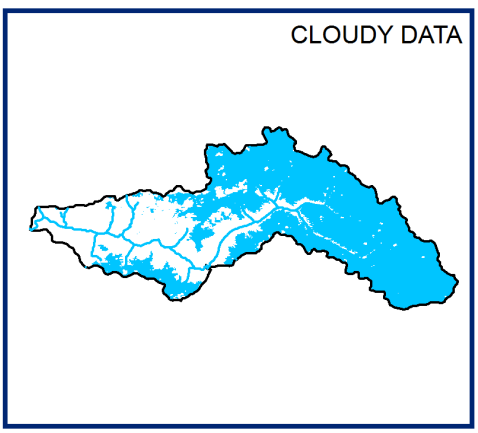


24 APRIL 2016



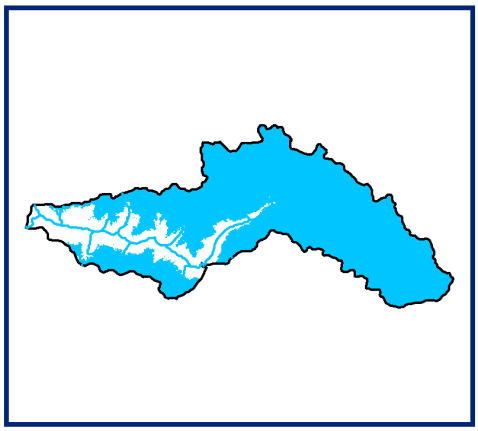
27 APRIL 2016

SNOW

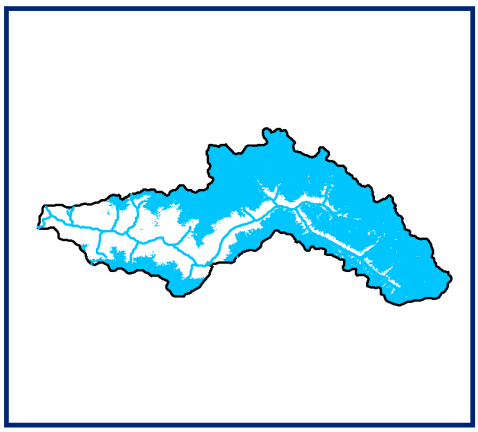
20 10 0 20 40 60

Kilometers

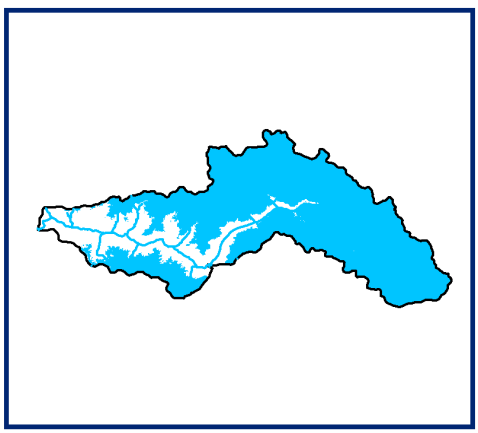
10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
07 APRIL 2016



DATA USED
13 APRIL 2016
20 APRIL 2016

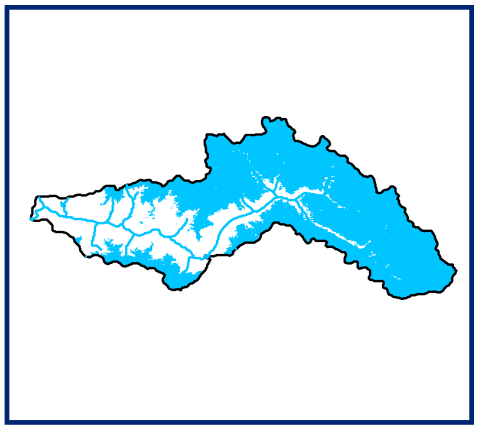


DATA USED
24 APRIL 2016
27 APRIL 2016

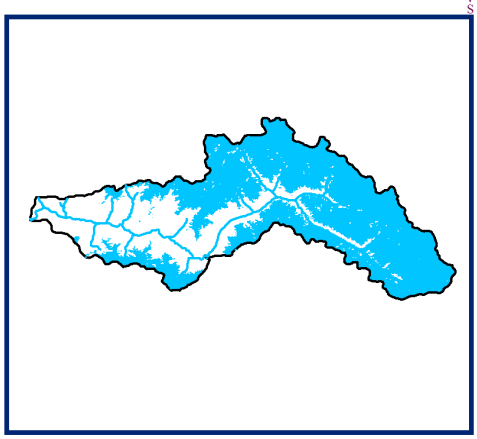
SNOW

20 10 0 20 40 60
Kilometers

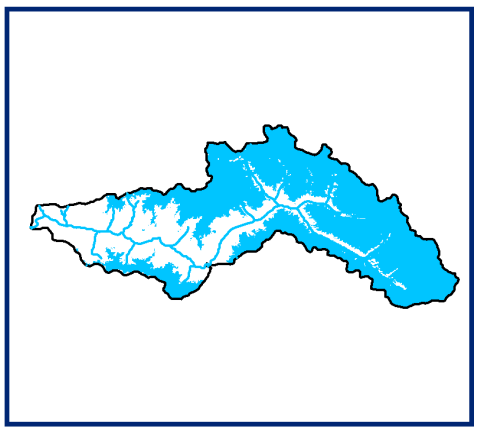
SNOW COVER MAP : BHUT SUB-BASIN



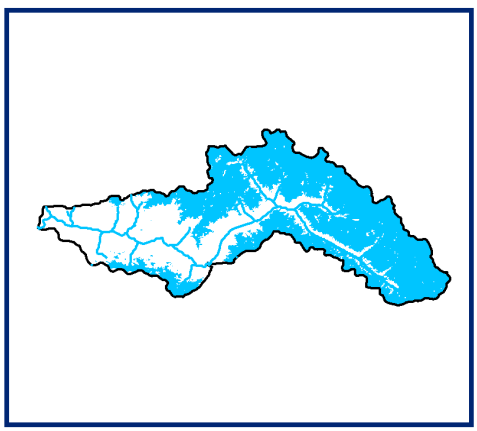
01 MAY 2016



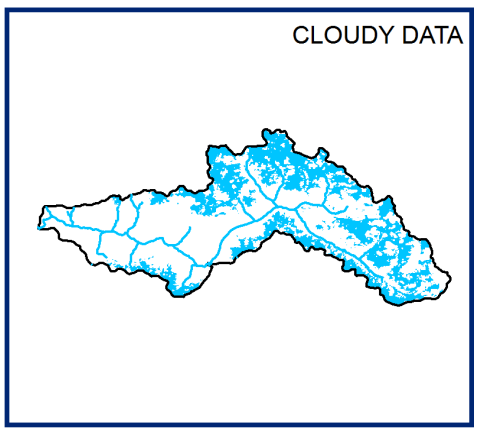
02 MAY 2016



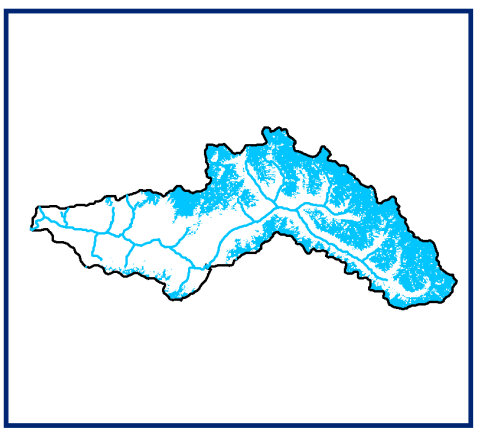
06 MAY 2016



07 MAY 2016



19 MAY 2016



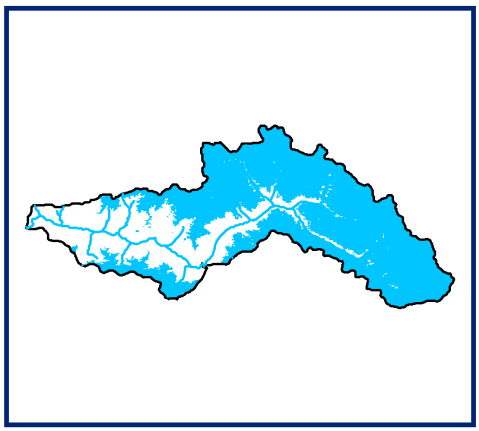
31 MAY 2016

SNOW

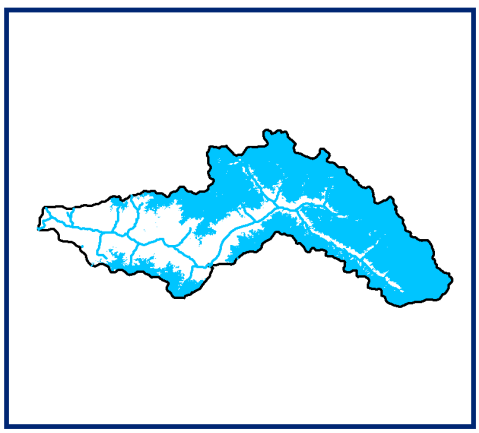
20 10 0 20 40 60

Kilometers

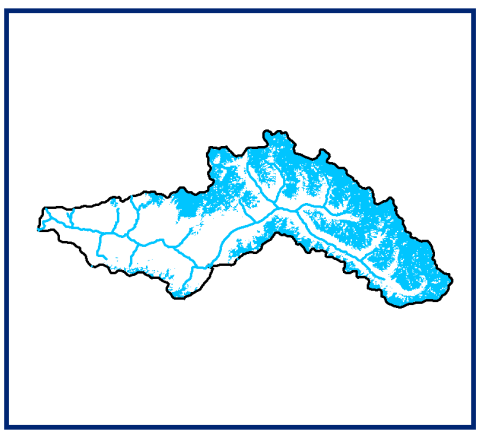
10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
01 MAY 2016
07 MAY 2016



DATA USED
19 MAY 2016

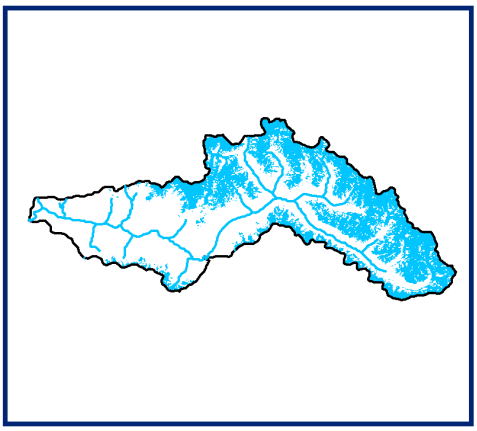


DATA USED
31MAY 2016

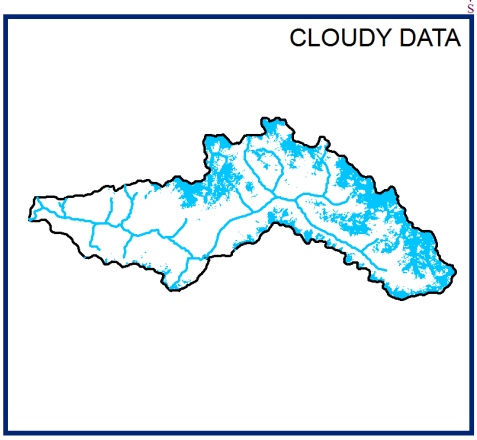
SNOW

20 10 0 20 40 60
Kilometers

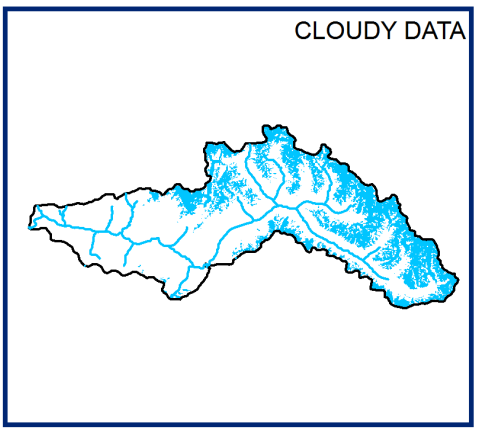
SNOW COVER MAP : BHUT SUB-BASIN



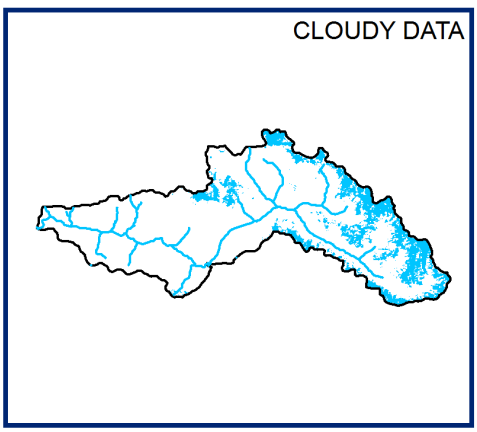
04 JUNE 2016



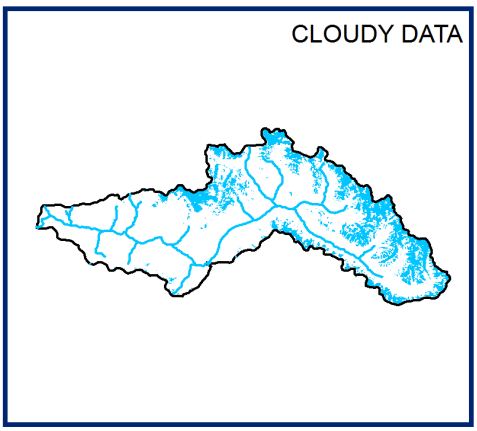
09 JUNE 2016



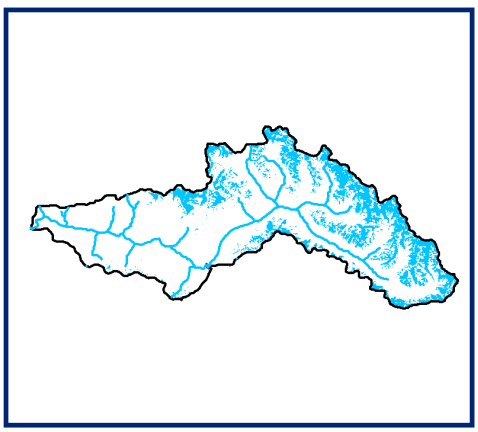
14 JUNE 2016



18 JUNE 2016



23 JUNE 2016



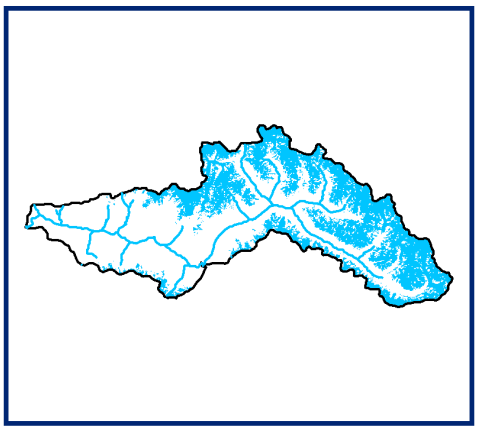
24 JUNE 2016

SNOW

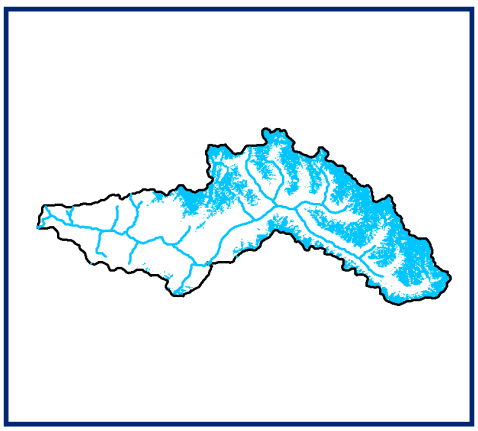
20 10 0 20 40 60

Kilometers

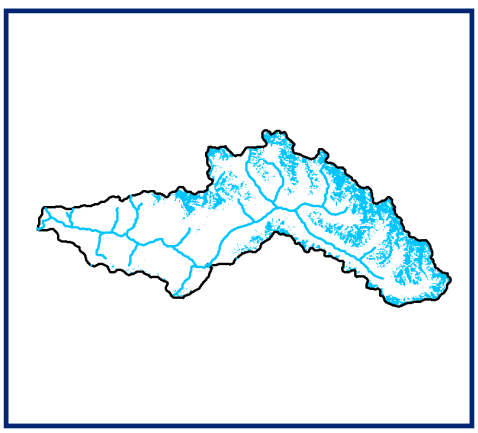
10 DAILY SNOW COVER MAP : BHUT SUB-BASIN



DATA USED
04 JUNE 2016
09 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
23 JUNE 2016
24 JUNE 2016

SNOW

20 10 0 20 40 60
Kilometers

WARWAN SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: WARWAN **BASIN AREA: 4670 sq km**

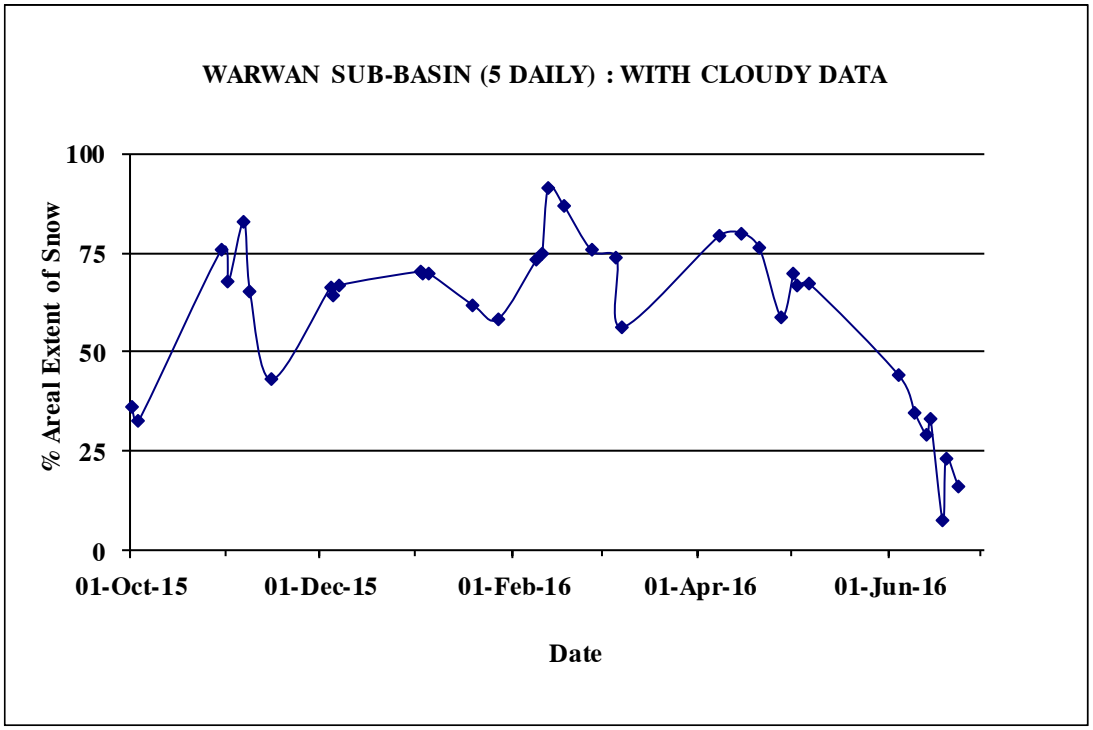
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	01/10/15	1681	36	3	30/10/15	3550	76
2	03/10/15	1521	33				
November 2013							
4	01/11/15	3162	68	6	08/11/15	3041(c)	65
5	06/11/15	3877	83	7	15/11/15	2013(c)	43
December 2013							
8	04/12/15	3102	66	10	07/12/15	3122	67
9	05/12/15	299464					
January 2014							
11	02/01/16	3286	70	14	19/01/16	2881(c)	62
12	03/01/16	3257	70	15	27/01/16	2730	58
13	05/01/16	3252(c)	70				
February 2014							
16	08/02/16	3412	73	19	17/02/16	4057	87
17	10/02/16	3496(c)	75	20	26/02/16	3529	76
18	12/02/16	4271	91				
March 2014							
21	05/03/16	3437	74	22	07/03/16	2630(c)	56
April 2014							
23	07/04/16	3701	79	25	20/04/16	3554	76
24	14/04/16	3739	80	26	27/04/16	2750(c)	59
May-2014							
27	01/05/16	3262	70	29	06/05/16	3140	67
28	02/05/16	3114	67				
June-2014							
30	04/06/16	2054	44	34	18/06/16	343(c)	7
31	09/06/16	1619	35	35	19/06/16	1085(c)	23
32	13/06/16	1353(c)	29	36	23/06/16	755(c)	16
33	14/06/16	1552	33				

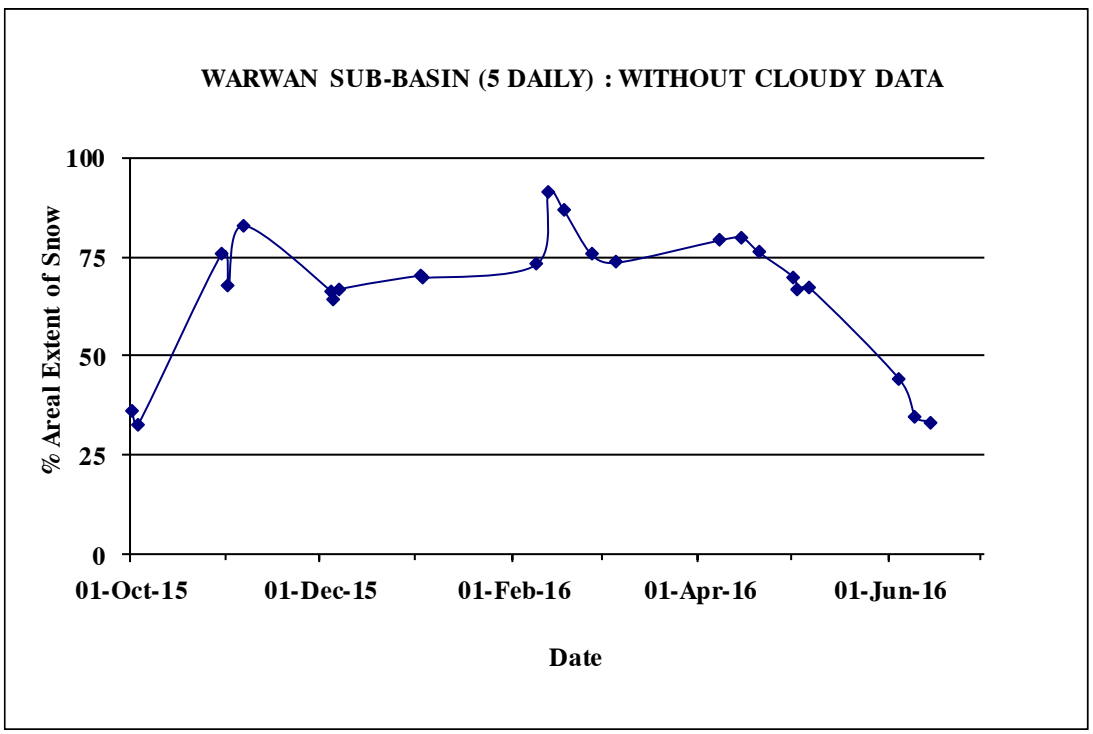
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: WARWAN **BASIN AREA: 4670 sq km**

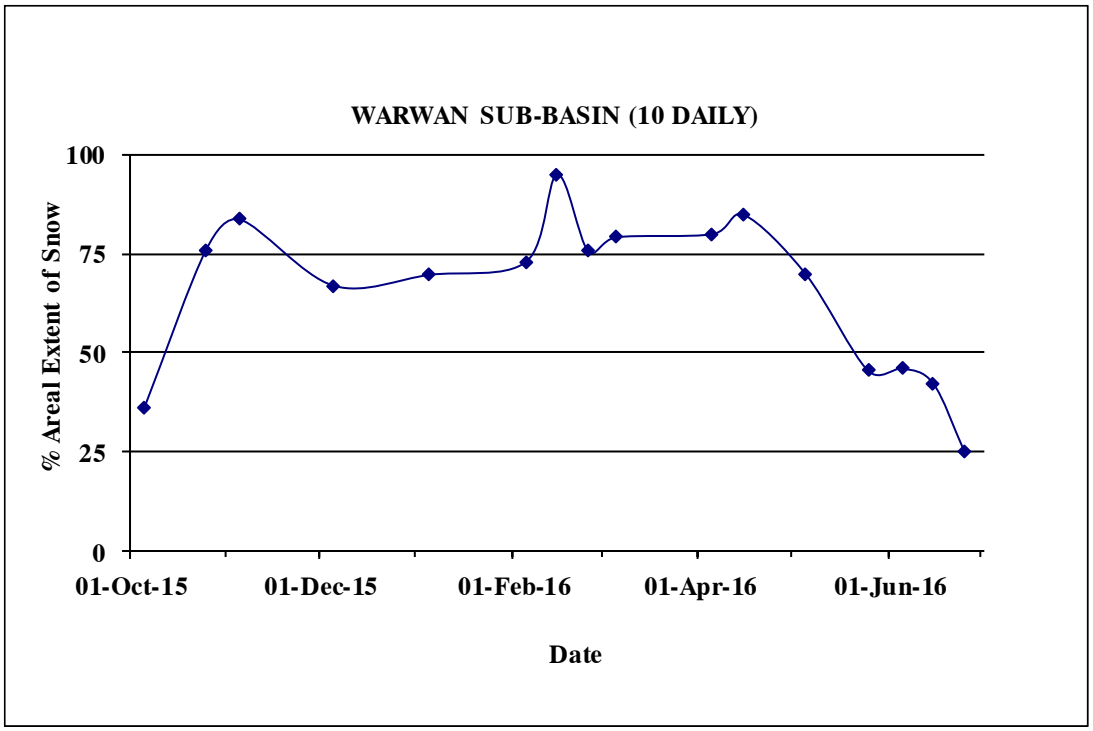
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2013							
1	05/10/15	1682	36	2	25/10/15	3551	76
November 2013							
3	05/11/15	3905	84	6			
December 2013							
4	05/12/15	3128	67				
January 2013							
5	05/01/16	3257	70				
February-2014							
6	05/02/16	3411	73	8	25/02/16	3530	76
7	15/02/16	4437	95				
March 2014							
9	05/03/16	3698	79				
April-2014							
10	05/04/16	3736	80	11	15/04/16	3963	85
May-2014							
12	05/05/16	3262	70	14	25-May-14	2129	46
13	15/05/16						
June-2014							
15	05/06/16	2155	46	17	25/06/16	1179	25
16	15/06/16	1977	42				

SNOW COVER DEPLETION CURVE



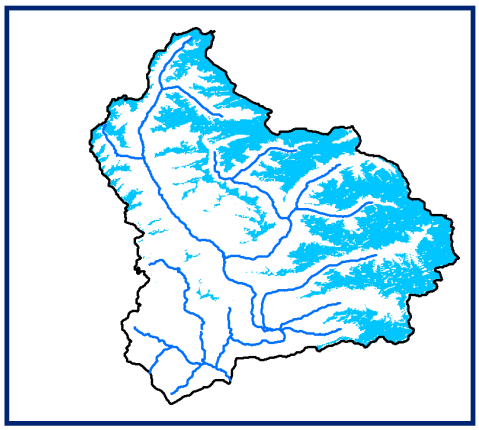


SNOW COVER DEPLETION CURVE

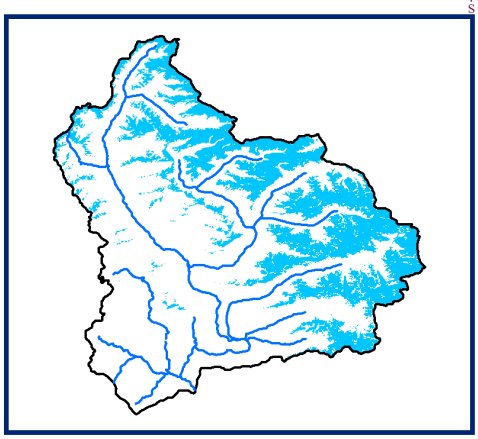


SNOW COVER MAP

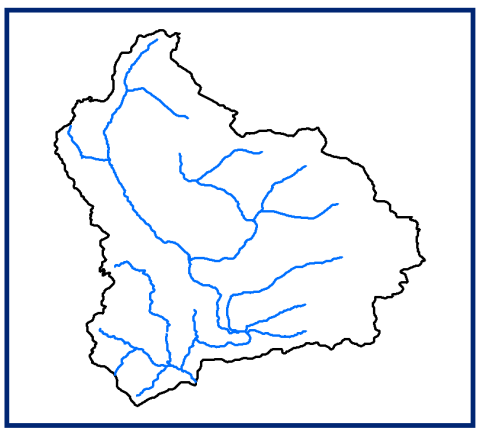
SNOW COVER MAP : WARWAN SUB-BASIN



01 OCTOBER 2015



03 OCTOBER 2015



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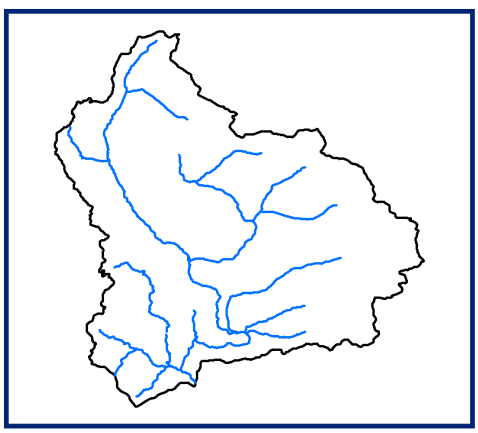

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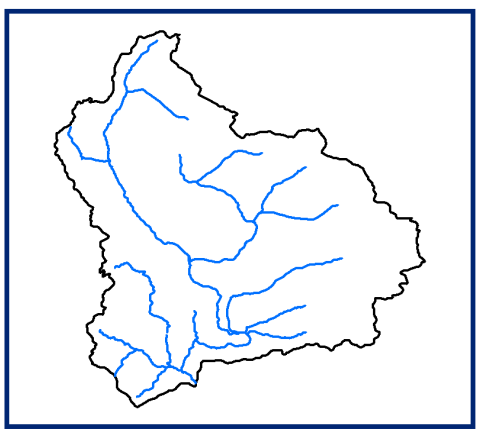

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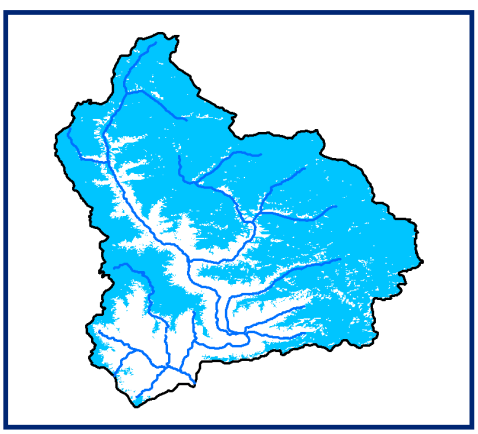


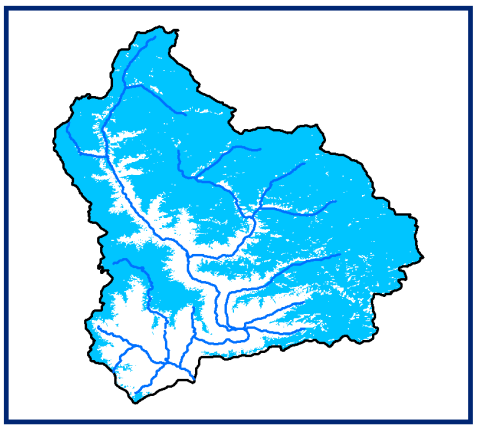
30 OCTOBER 2015

SNOW

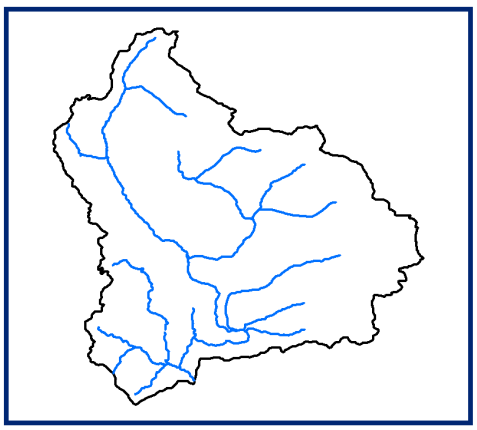
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
01 OCTOBER 2015
03 OCTOBER 2015



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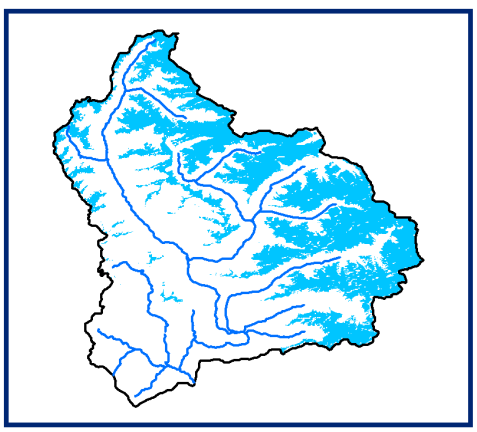
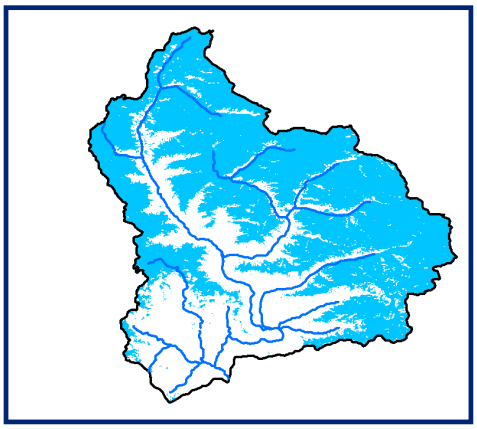


DATA USED
30 OCTOBER 2015

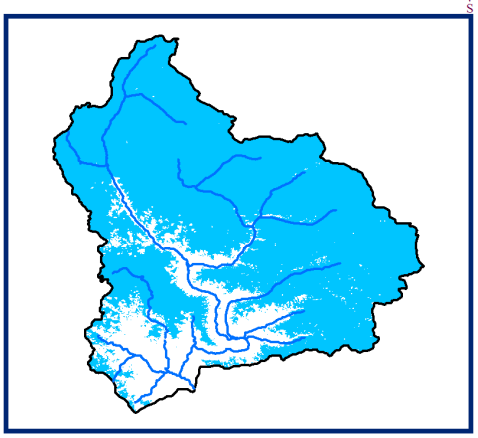
SNOW

20 10 0 20 40 60
Kilometers

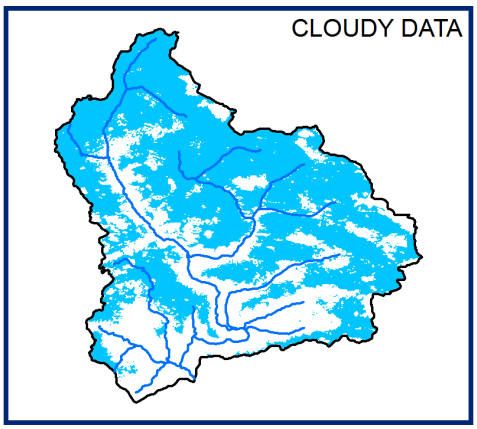
SNOW COVER MAP : WARWAN SUB-BASIN



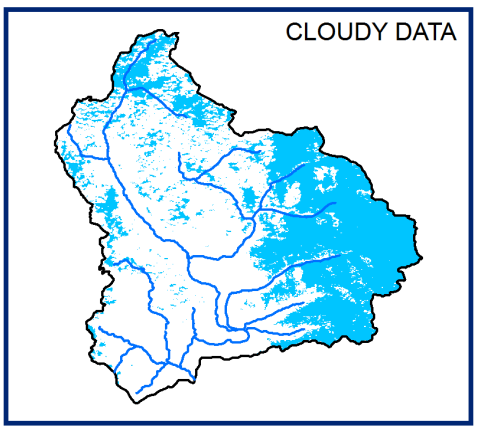
01 NOVEMBER 2015



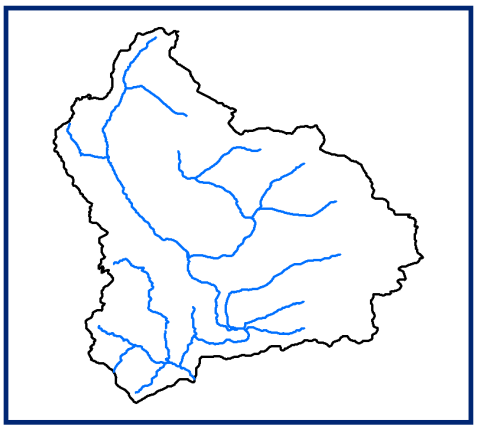
06 NOVEMBER 2015



08 NOVEMBER 2015



15 NOVEMBER 2015



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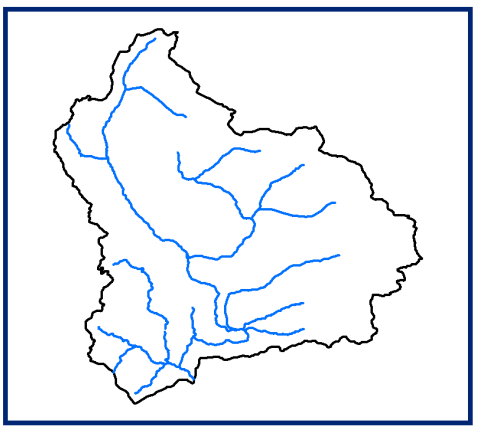


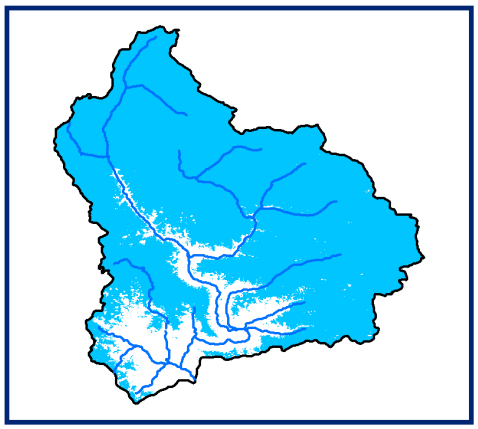
DATA NOT AVAILABLE

SNOW

30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN

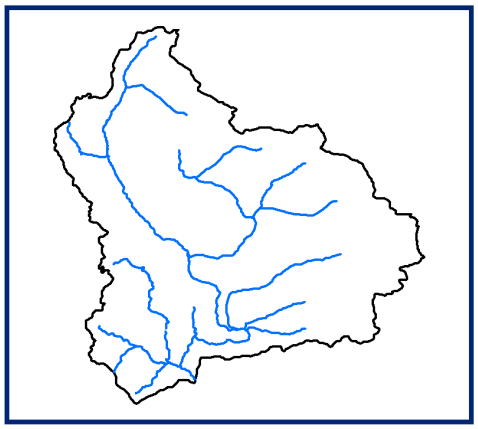


DATA USED

01 NOVEMBER 2015

06 NOVEMBER 2015

08 NOVEMBER 2015



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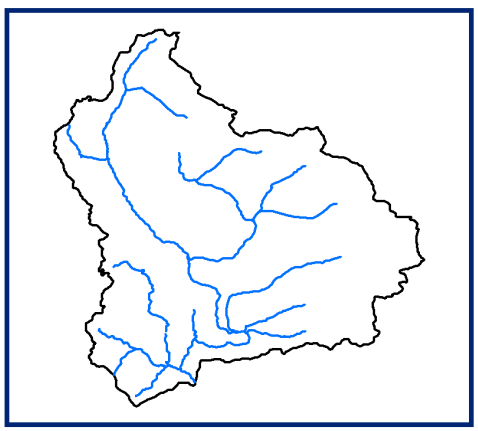


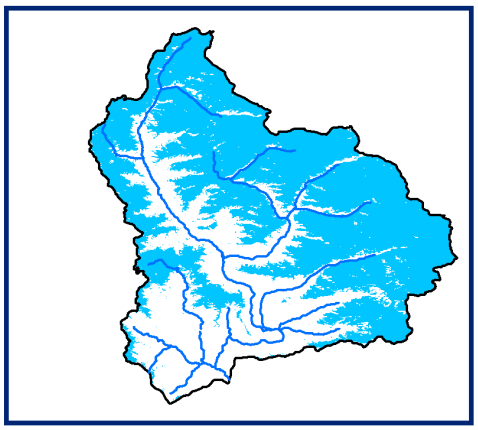
DATA NOT AVAILABLE

SNOW

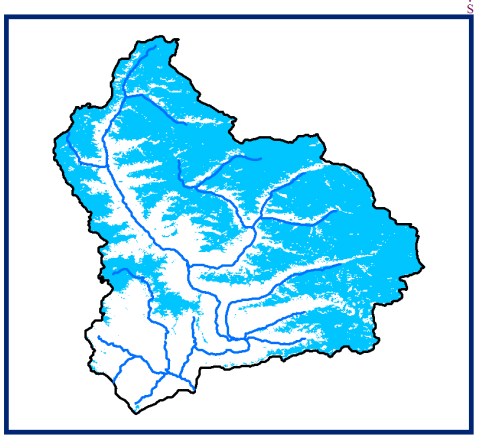
20 10 0 20 40 60

Kilometers

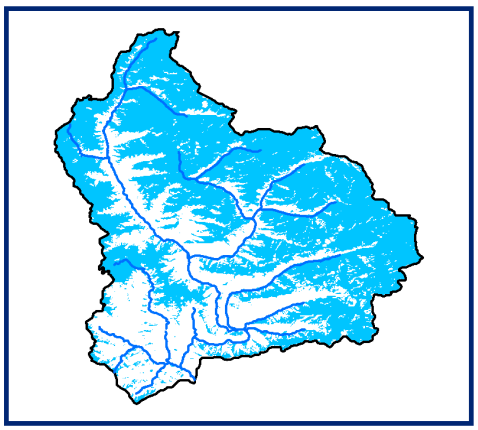
SNOW COVER MAP : WARWAN SUB-BASIN



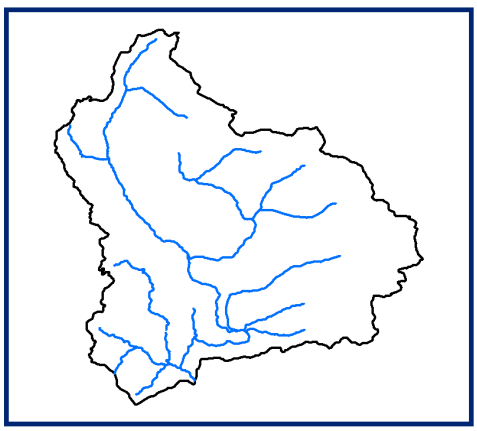
04 DECEMBER 2015



05 DECEMBER 2015



07 DECEMBER 2015



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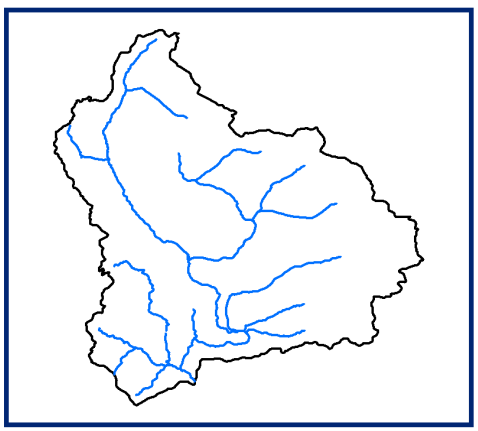

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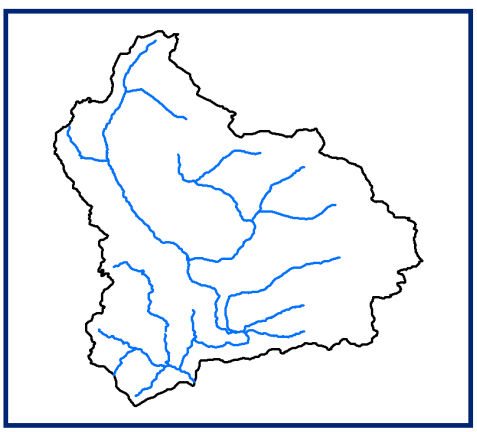


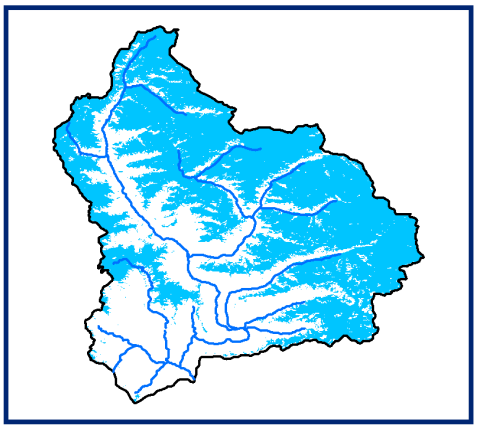
DATA NOT AVAILABLE

30 15 0 30 60 90

Kilometers

SNOW

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN

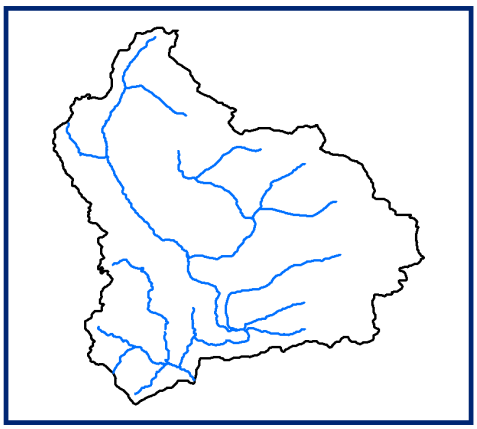


DATA USED

04 DECEMBER 2015

05 DECEMBER 2015

07 DECEMBER 2015



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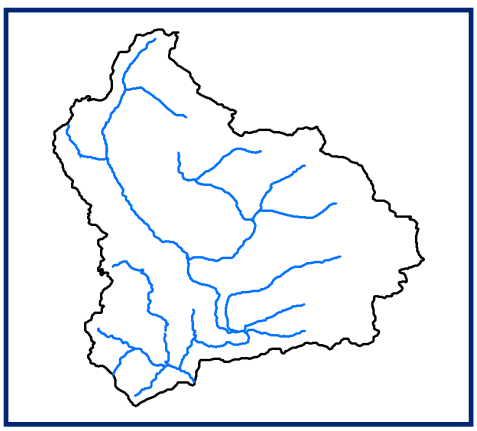


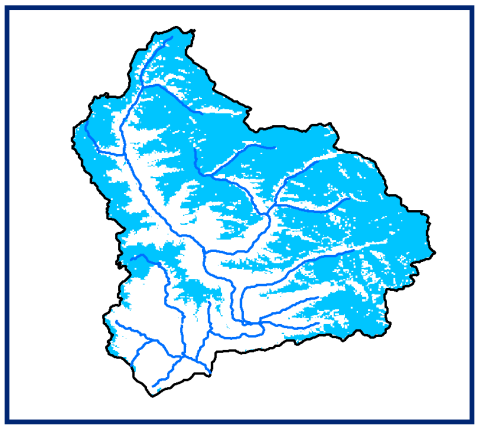
DATA NOT AVAILABLE

SNOW

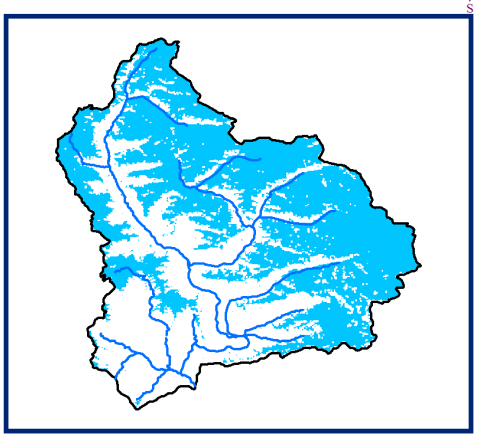
20 10 0 20 40 60

Kilometers

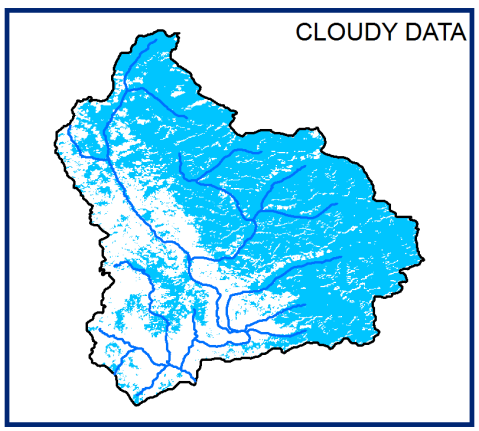
SNOW COVER MAP : WARWAN SUB-BASIN



02 JANUARY 2016



03 JANUARY 2016



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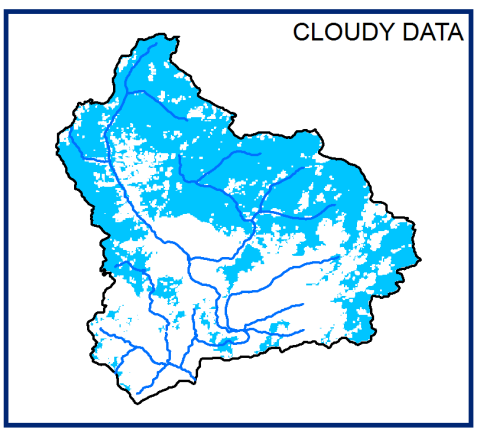
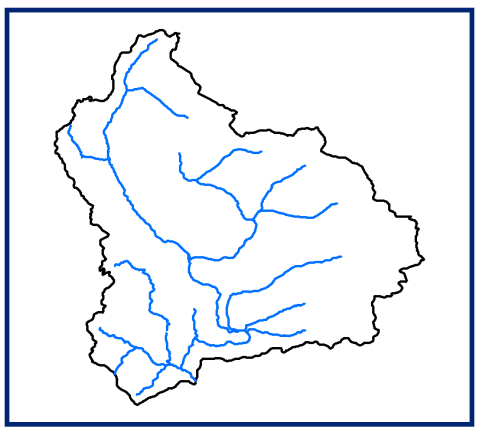


19 JANUARY 2016



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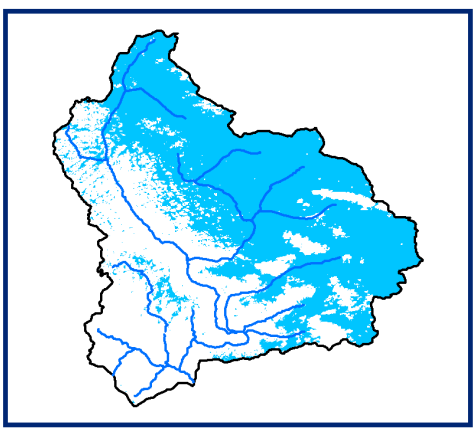
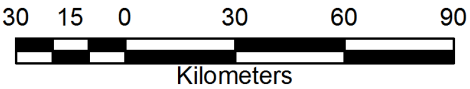
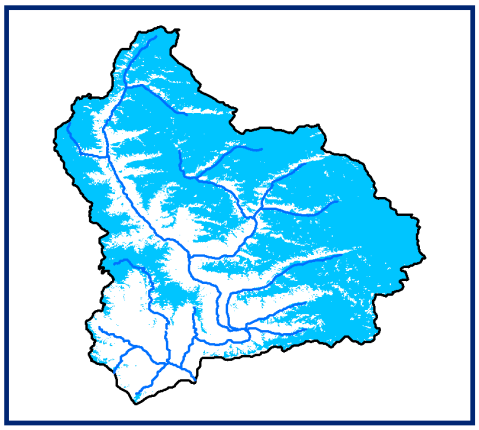


27 JANUARY 2016

SNOW



10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN

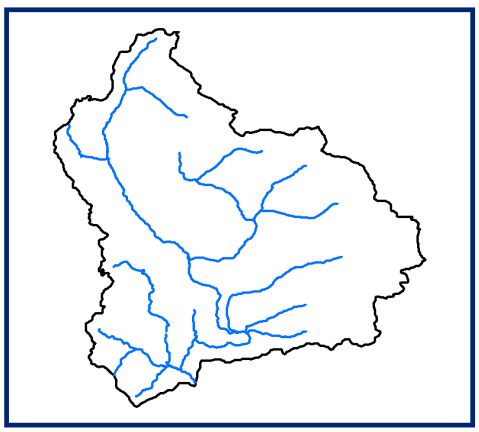


DATA USED

02 JANUARY 2016

03 JANUARY 2016

05 JANUARY 2016



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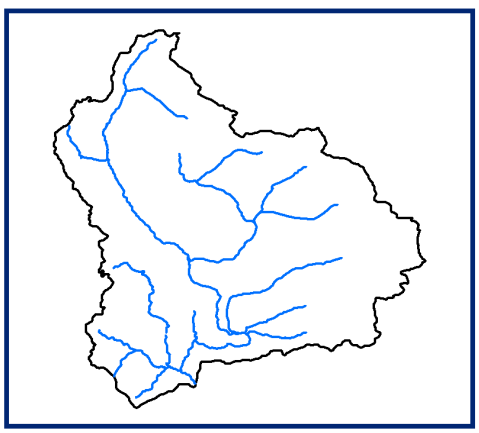


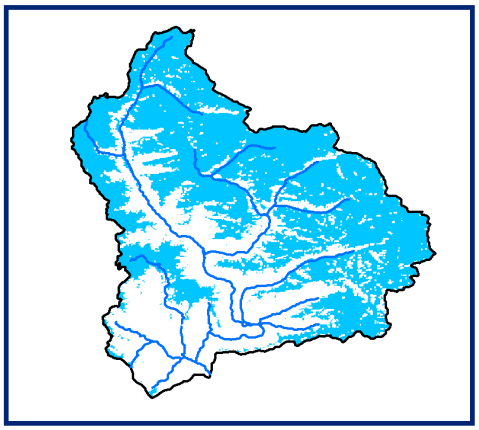
DATA NOT AVAILABLE

SNOW

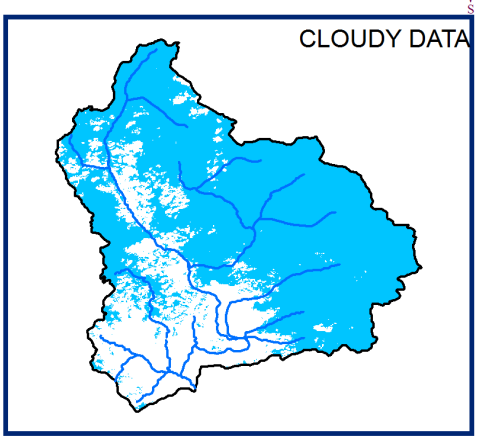
20 10 0 20 40 60

Kilometers

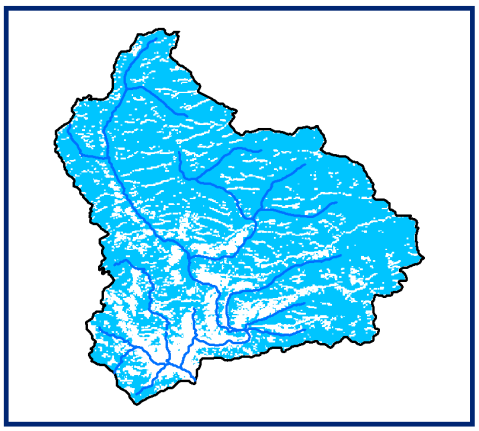
SNOW COVER MAP : WARWAN SUB-BASIN



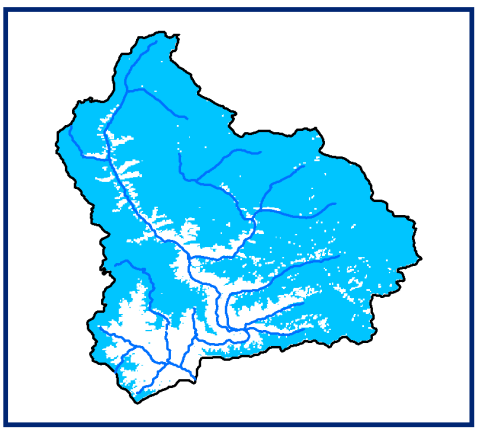
08 FEBRUARY 2016



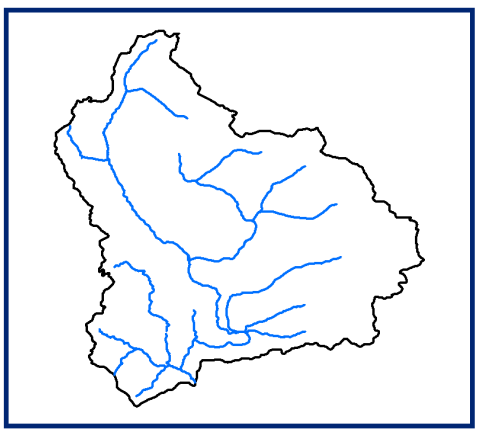
10 FEBRUARY 2016



12 FEBRUARY 2016



17 FEBRUARY 2016



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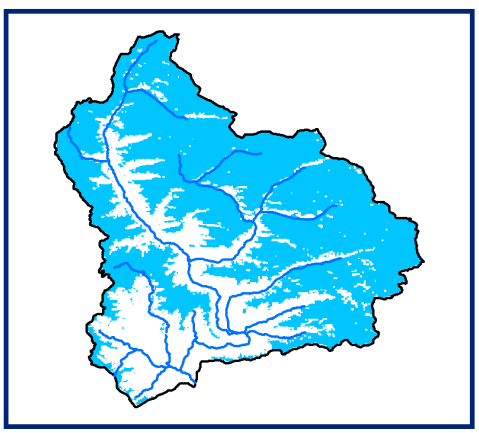


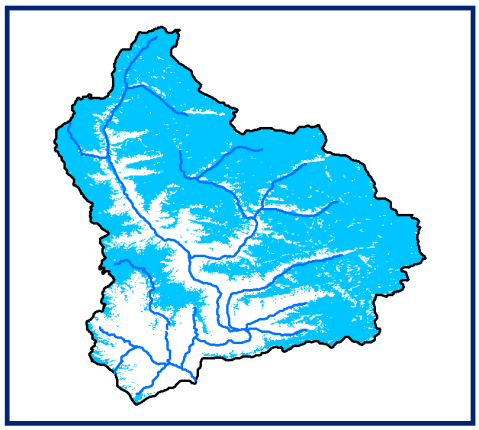
26 FEBRUARY 2016

SNOW

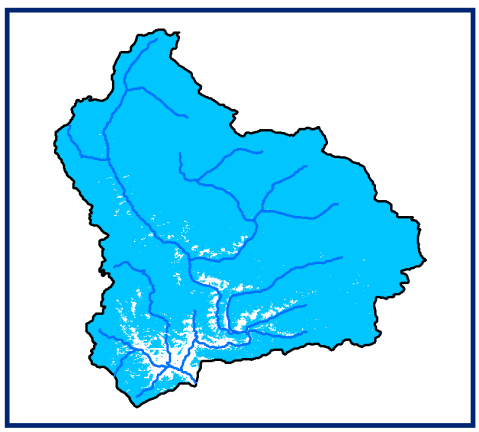
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
08 FEBRUARY 2016
10 FEBRUARY 2016



DATA USED
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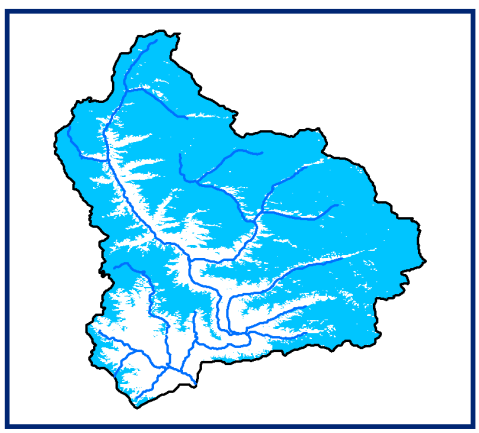
17 FEBRUARY 2016

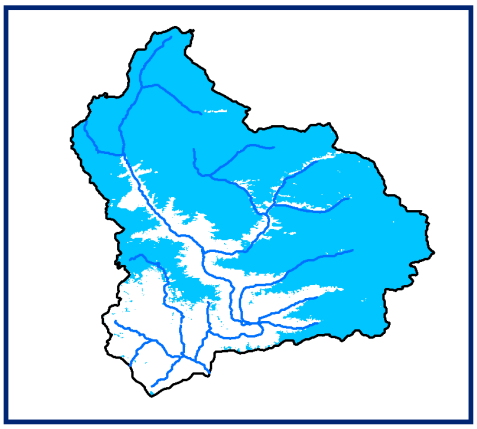


DATA USED
26 FEBRUARY 2016

SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : WARWAN SUB-BASIN



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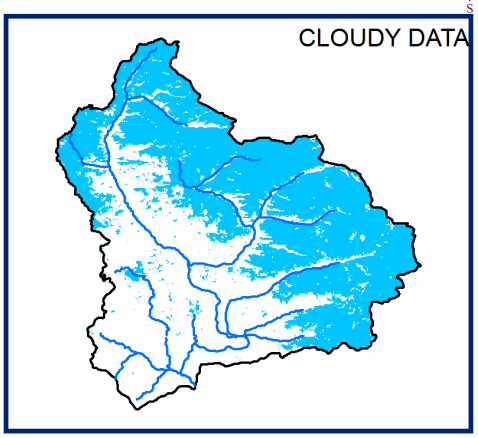
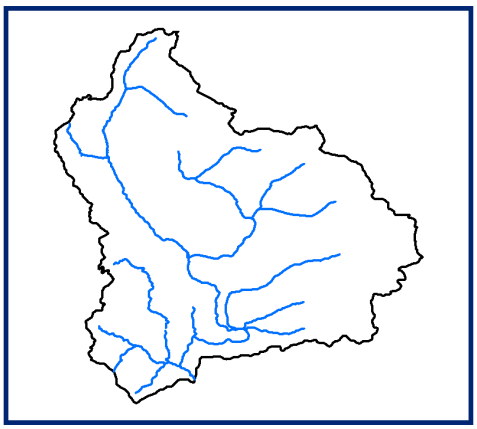


07 MARCH 2016



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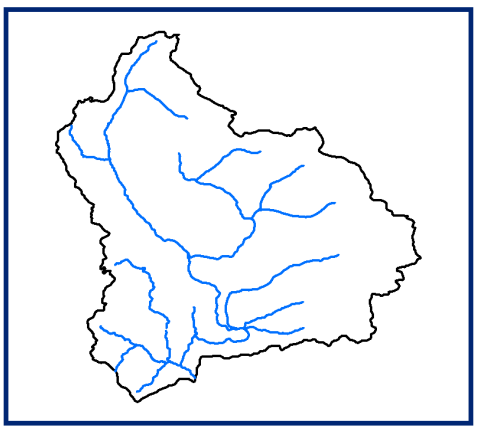

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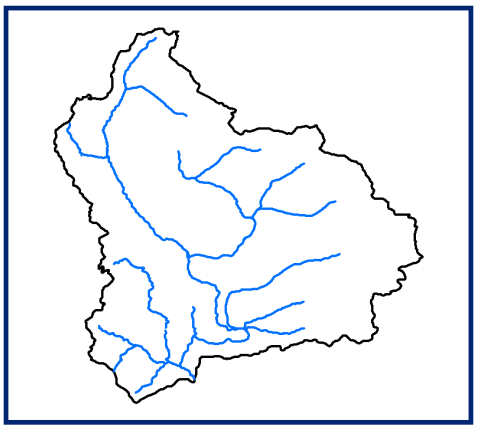

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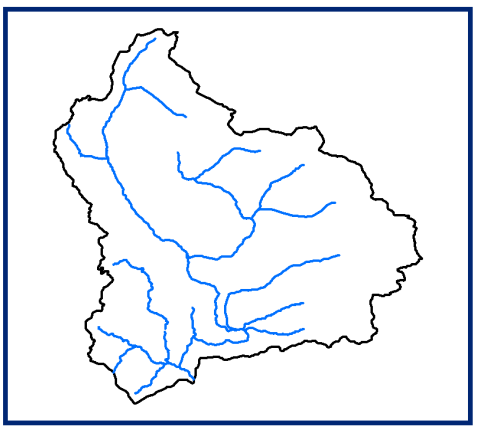


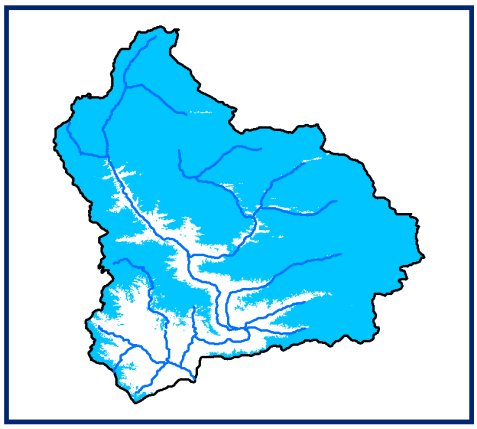
DATA NOT AVAILABLE

SNOW

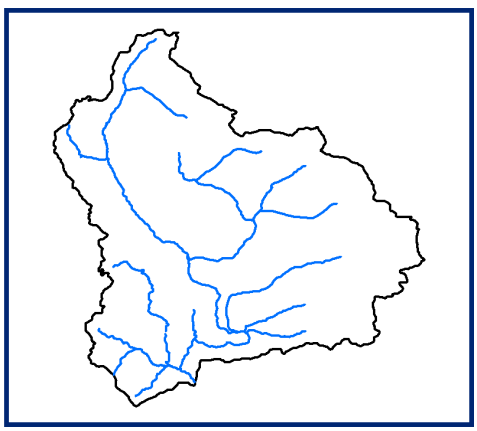
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
05 MARCH 2016
07 MARCH 2016



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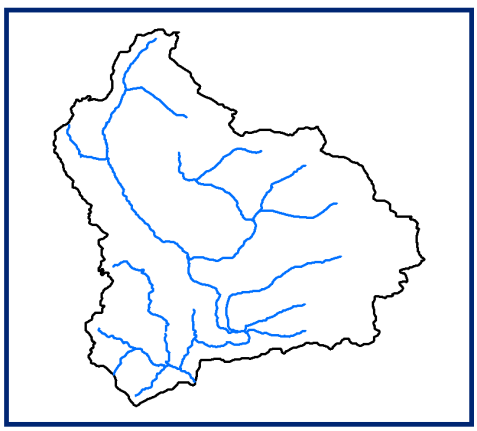
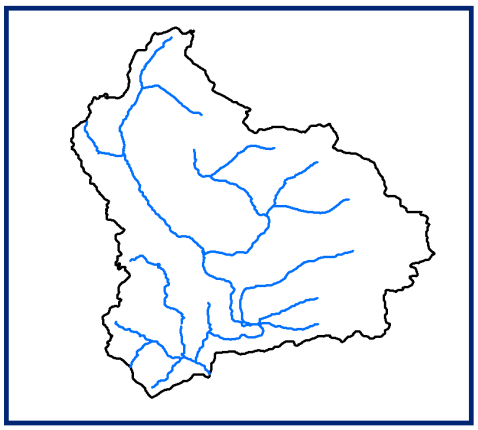


DATA NOT AVAILABLE

SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : WARWAN SUB-BASIN



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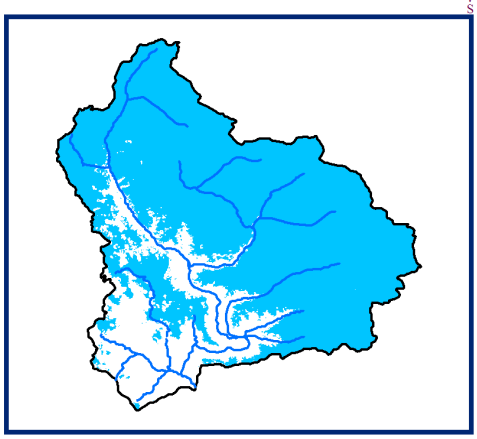
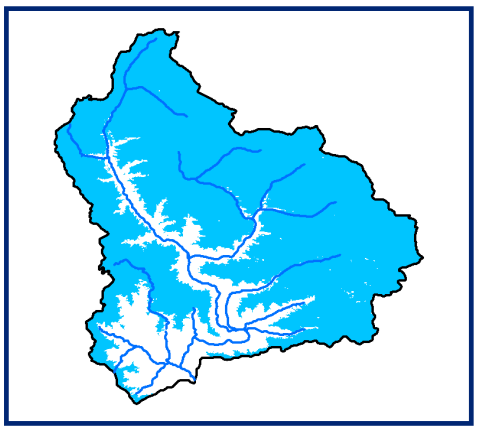
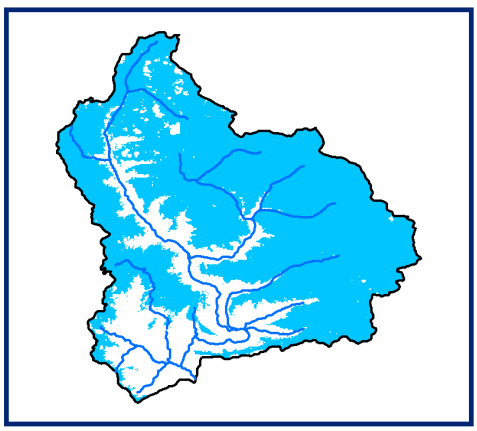


07 APRIL 2016



14 APRIL 2016



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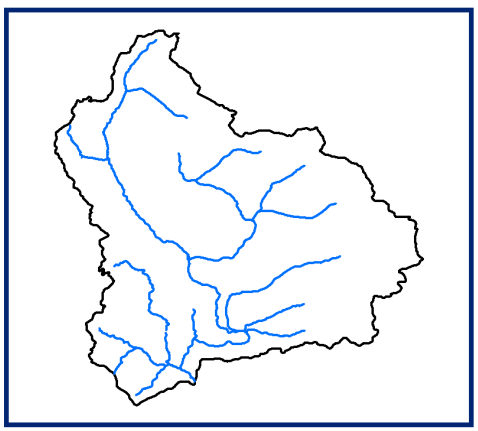

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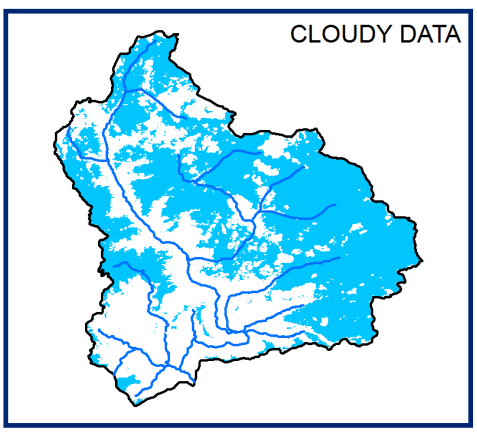


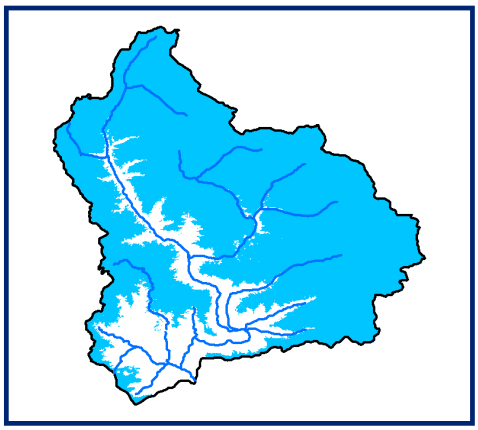
27 APRIL 2016

SNOW

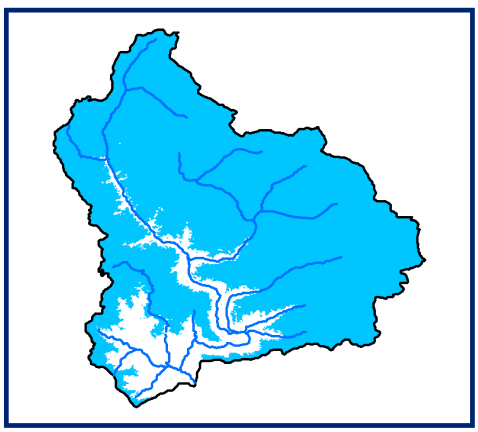
30 15 0 30 60 90

Kilometers

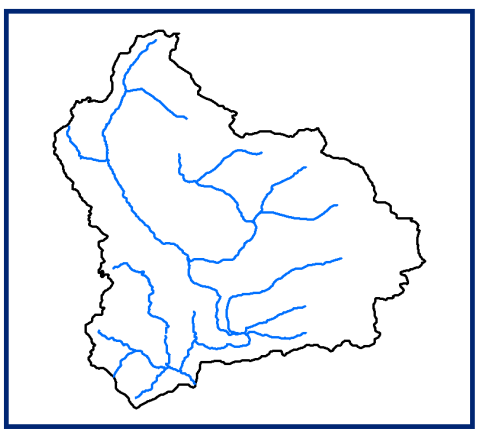
10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
07 APRIL 2016



DATA USED
14 APRIL 2016
20 APRIL 2016

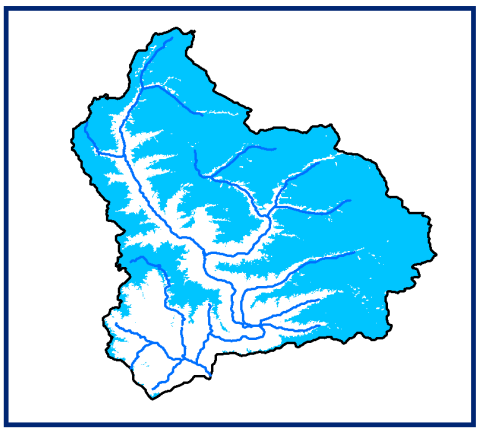


DATA NOT AVAILABLE

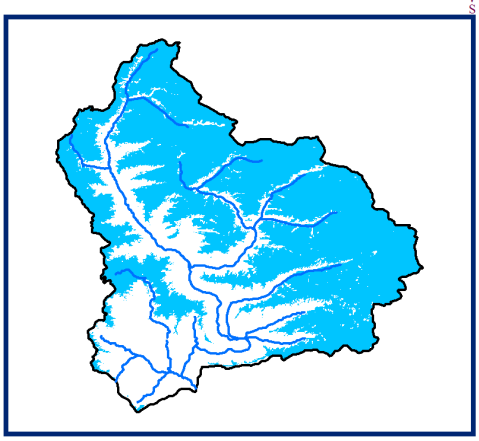
SNOW

20 10 0 20 40 60
Kilometers

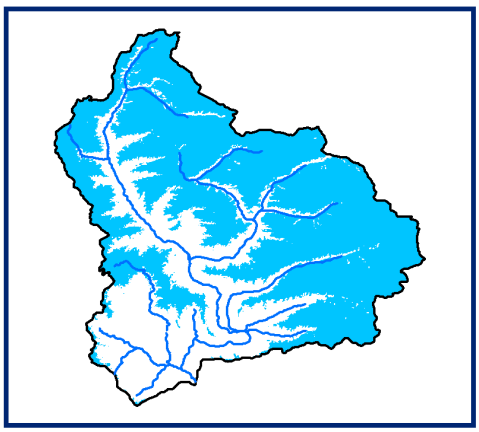
SNOW COVER MAP : WARWAN SUB-BASIN



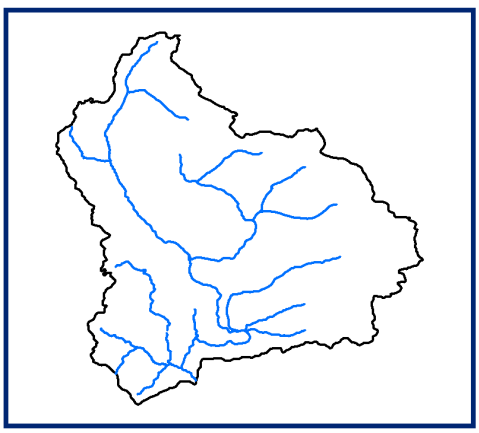
01 MAY 2016



02 MAY 2016



06 MAY 2016



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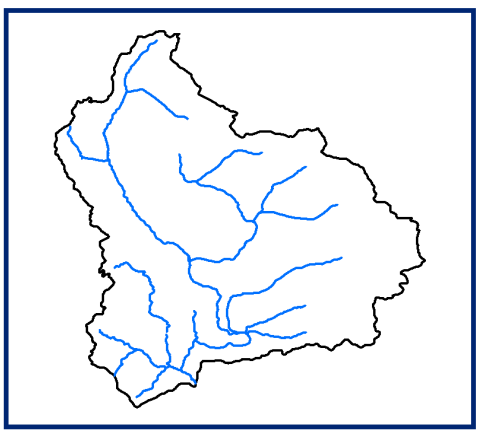

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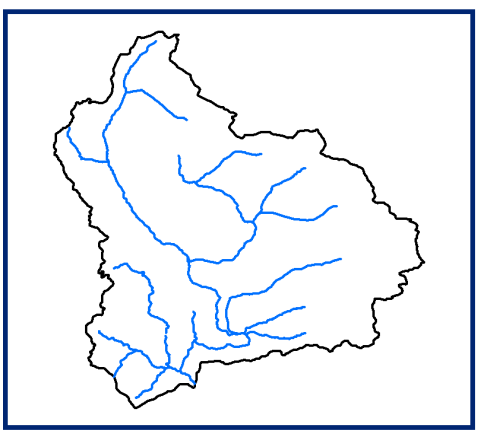


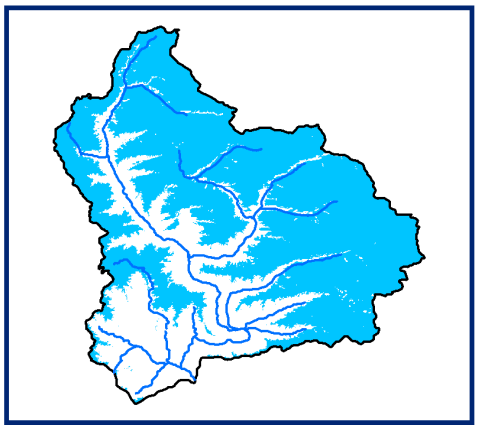
DATA NOT AVAILABLE

SNOW

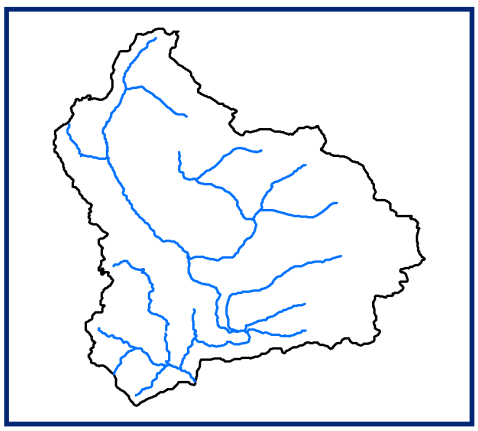
30 15 0 30 60 90

Kilometers

10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
01 MAY 2016
02 MAY 2016
06 MAY 2016



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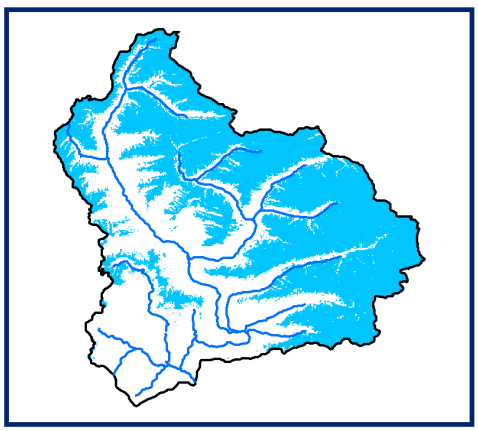
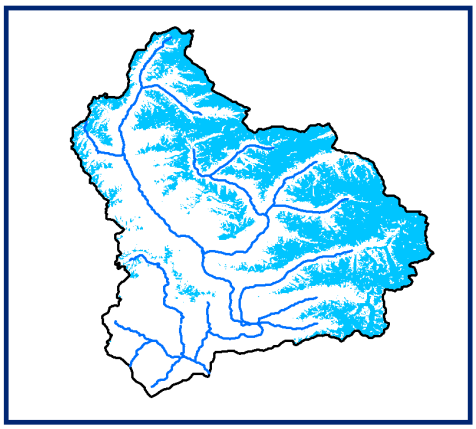


DATA USED
31 MAY 2016

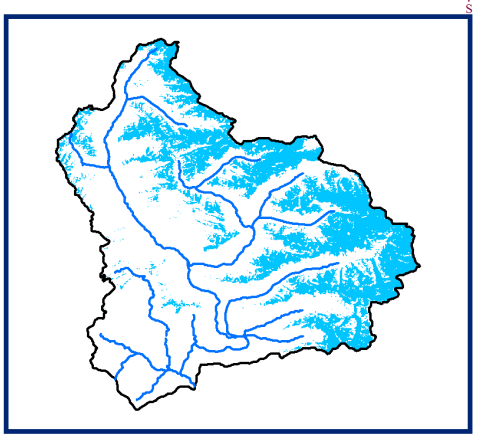
30 15 0 30 60 90
Kilometers

SNOW

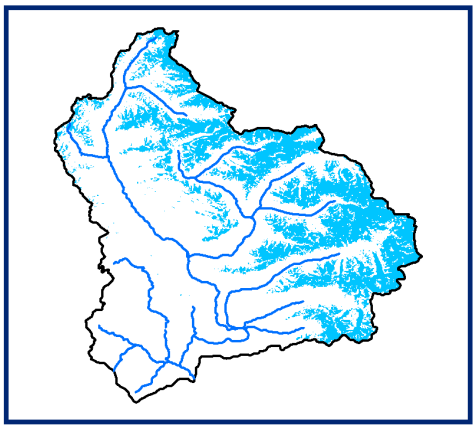
SNOW COVER MAP : WARWAN SUB-BASIN



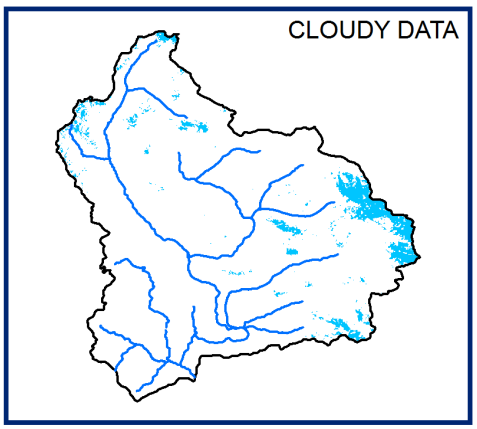
04 JUNE 2016



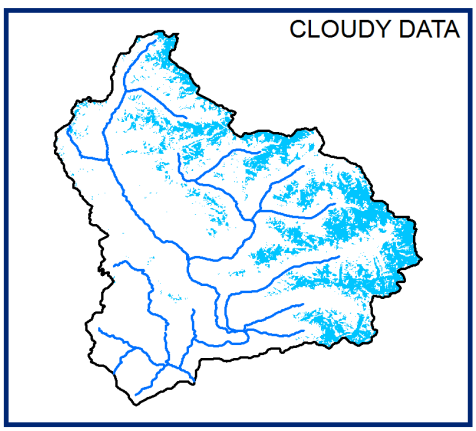
09 JUNE 2016



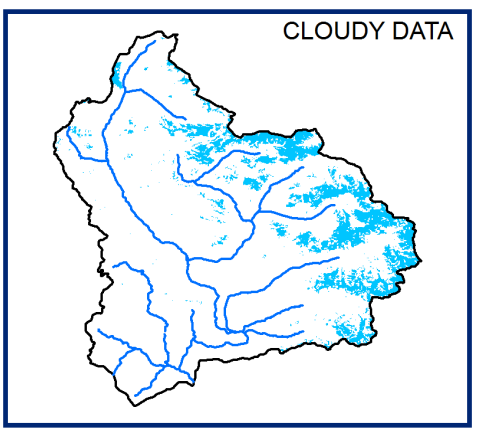
14 JUNE 2016



18 JUNE 2016



19 JUNE 2016



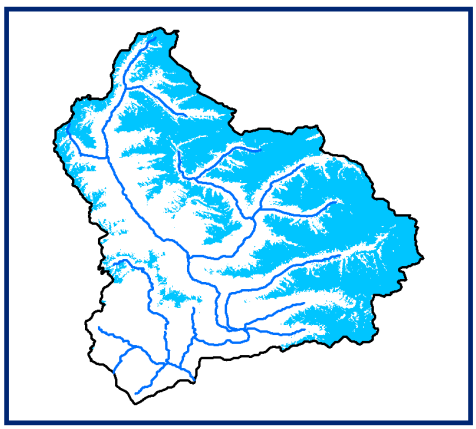
23 JUNE 2016

SNOW

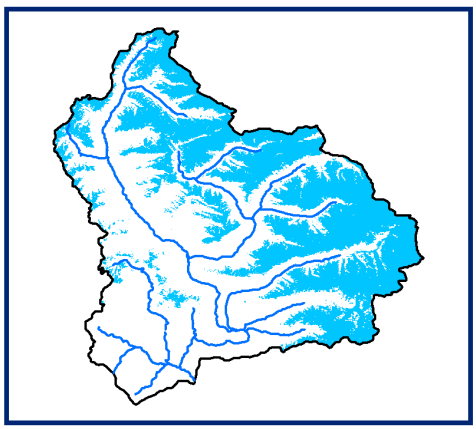
30 15 0 30 60 90

Kilometers

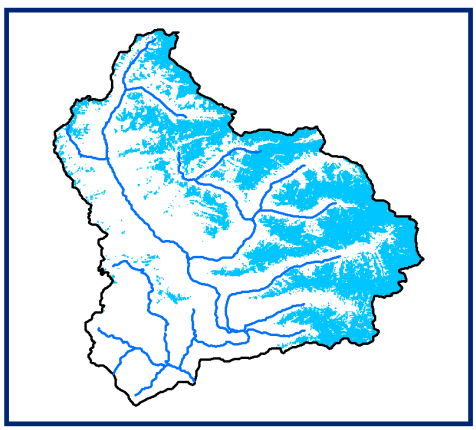
10 DAILY SNOW COVER MAP : WARWAN SUB-BASIN



DATA USED
04 JUNE 2016
09 JUNE 2016



DATA USED
13 JUNE 2016
14 JUNE 2016



DATA USED
23 JUNE 2016

30 15 0 30 60 90
Kilometers

SNOW