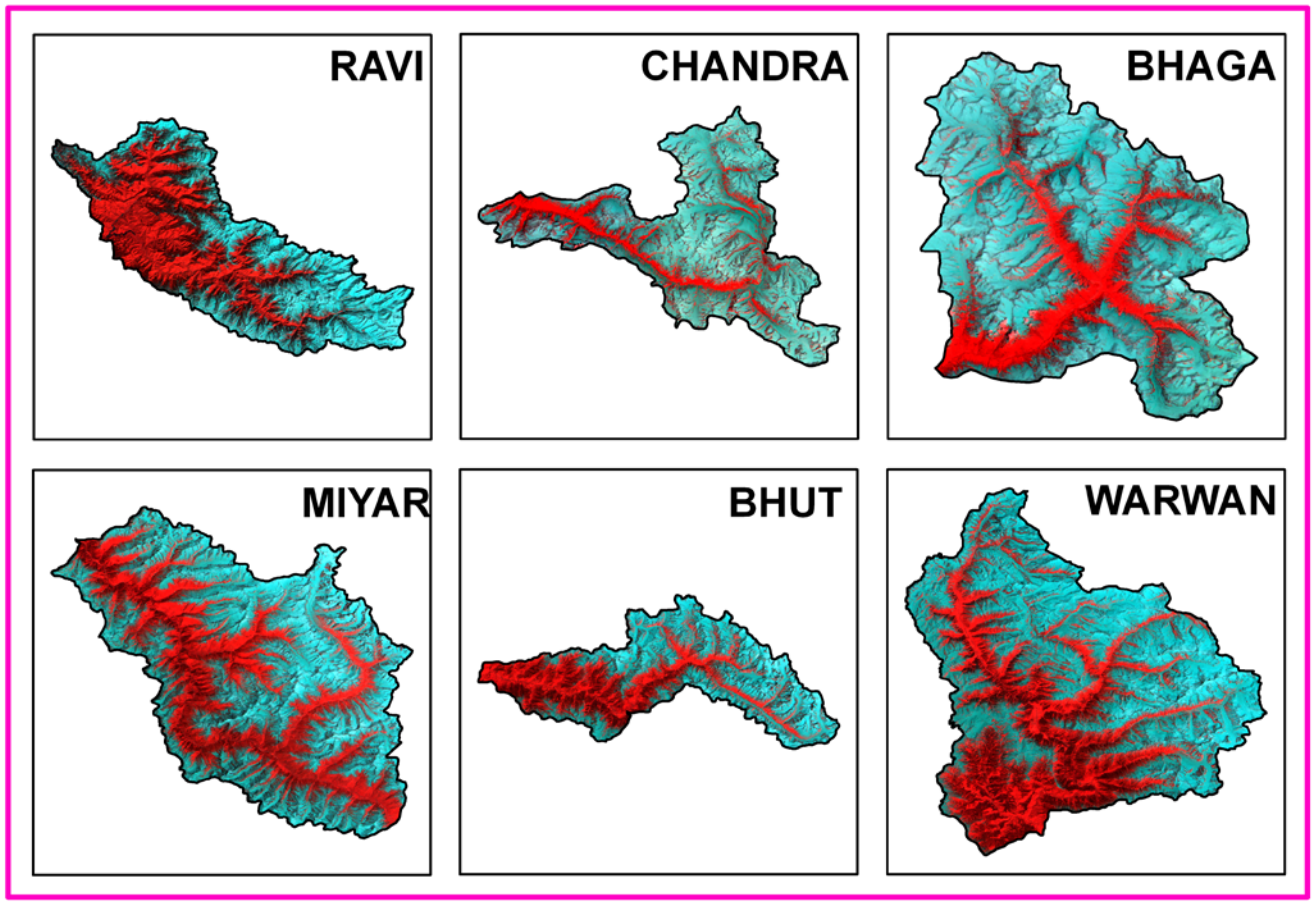
SNOW COVER ATLAS OF CHENAB BASIN

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

(A Joint Project of Indian Space Research Organisation and Ministry of Environment and Forests, Govt. of India)

Year : 2010-11



Faculty of Geomatics and Space Applications
CEPT University- Ahmedabad - 380009

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Space Applications Centre (ISRO)
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Abstract	This atlas gives subbasin-wise distribution of snow cover in the Chenab basin from October 2010 to June 2011. The subbasins 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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CONTENTS

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 2010 to June 2011 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 2010 to June 2011. 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 mid of April almost entire basin is covered by snow for Chandra, Bhaga and ablation starts from the end of April. In the Bhut, Warwan and the Miyar sub-basins accumulation starts from mid of November and ablation starts from mid of March. In case of Ravi sub-basin no accumulation is found till mid of December then in the month of January, maximum snow was observed 97% and it reduces up to 59% in the beginning of February and ablation continuous till june.

Acknowledgements

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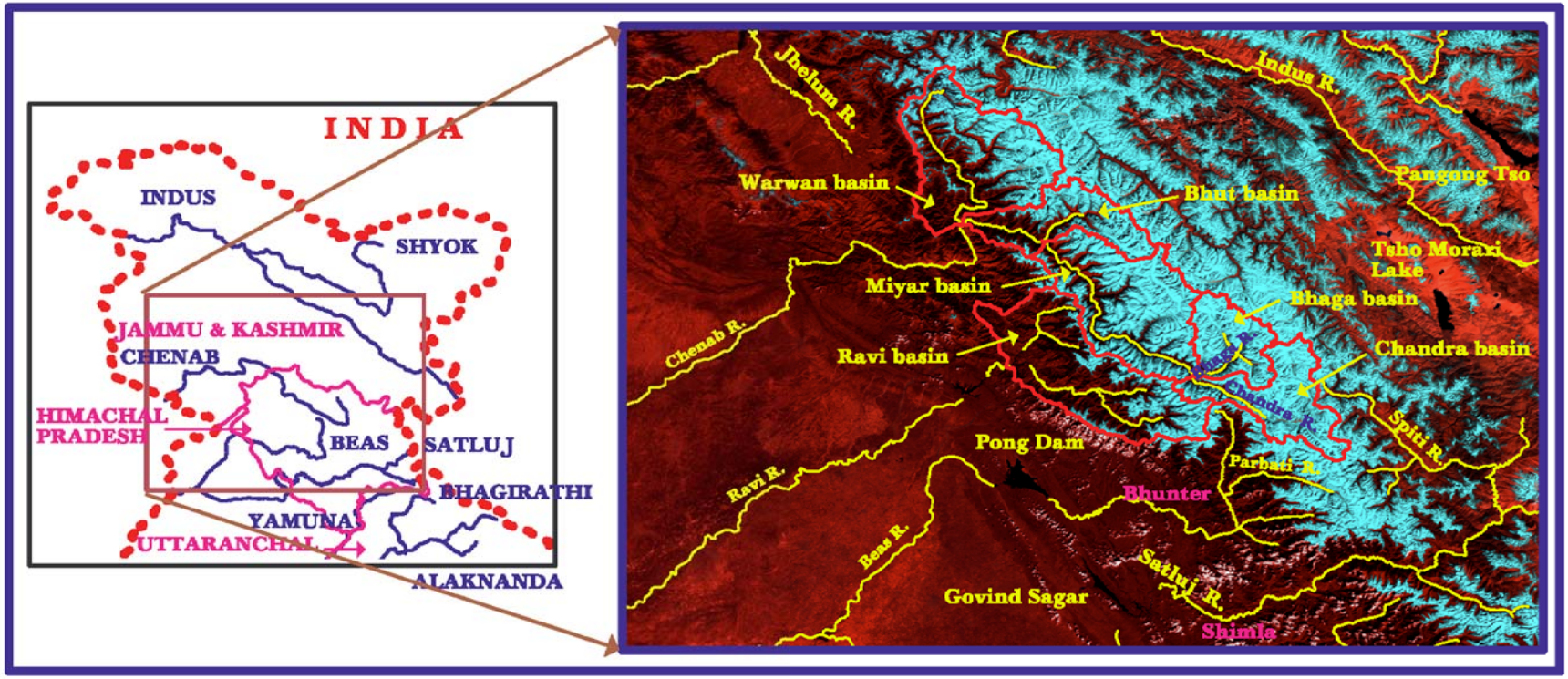


Figure 1: Location map of Ravi, Chandra, Bhaga, Miyar, Bhut and Warwan sub-basins (Part of Chenab basin)

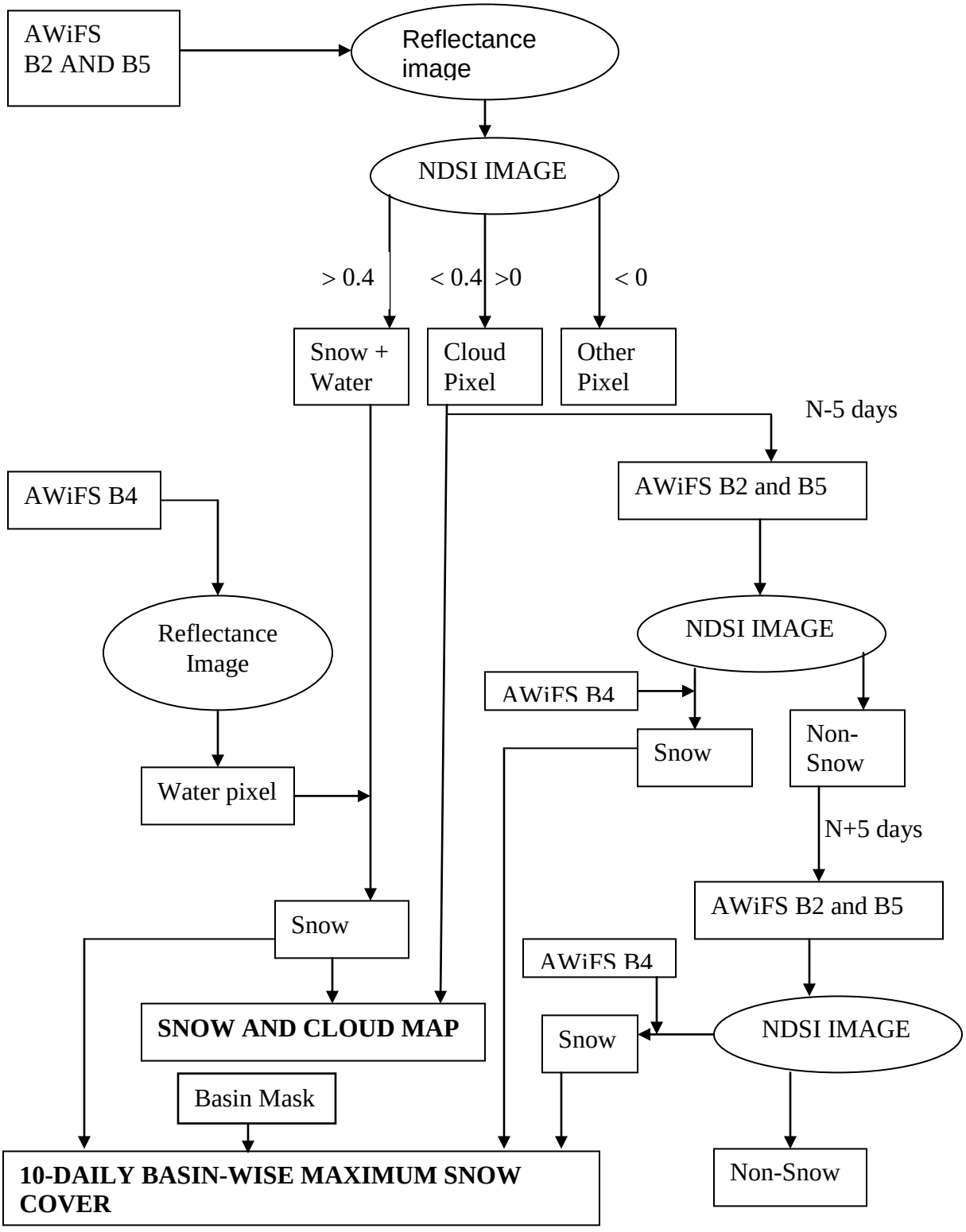


Figure 2: Algorithm for snow cover mapping using AWiFS data

BHUT BASIN

AREAL EXTENT OF SNOW (5 DAILY)

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

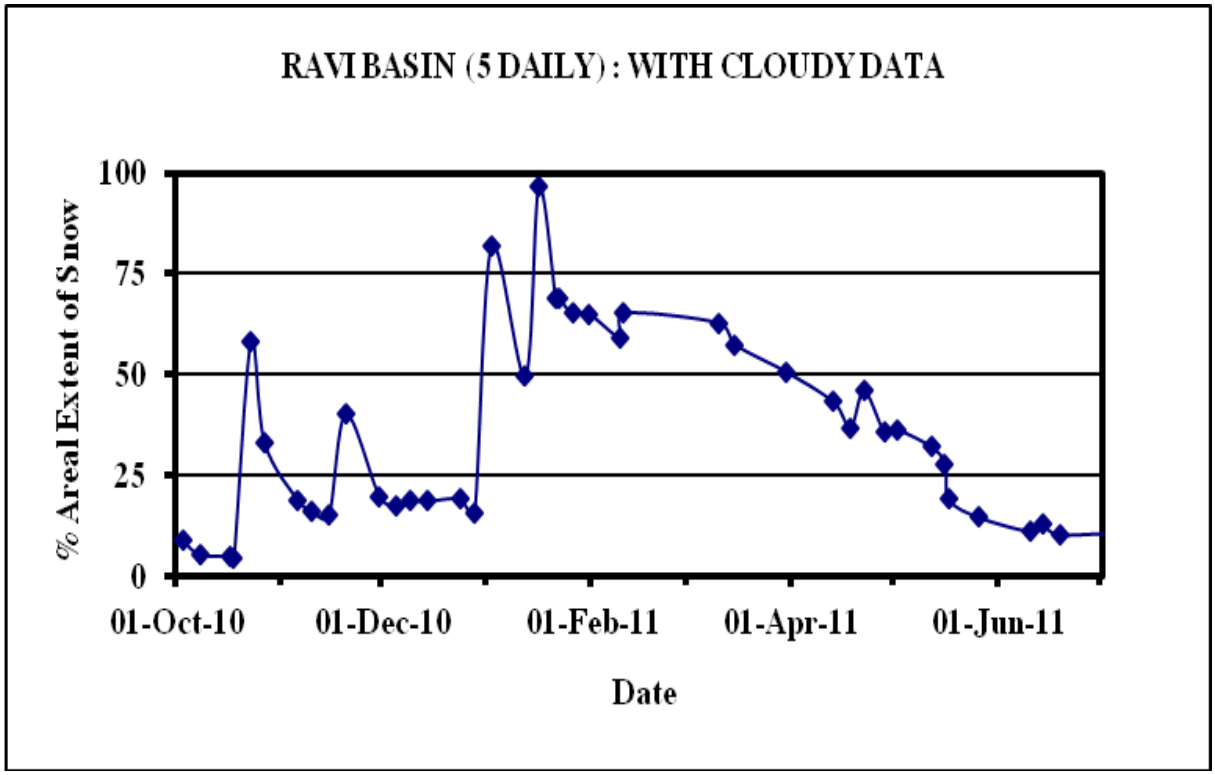
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	3-Oct-10	436.75	9	4	18-Oct-10	233.82	5
2	8-Oct-10	271.70	5	5	23-Oct-10	2858.54	58
3	17-Oct-10	254.01	5	6	27-Oct-10	1633.01	33
November 2010							
7	6-Nov-10	928.14	19	10	20-Nov-10	1980.96	40
8	10-Nov-10	796.63	16	11	30-Nov-10	972.51	20
9	15-Nov-10	743.55	15				
December 2010							
12	4-Dec-10	883.35	18	16	19-Dec-10	792.83	16
13	5-Dec-10	857.91	17	17	24-Dec-10	952.31	19
14	9-Dec-10	924.47	19	18	28-Dec-10	780.67	16
15	14-Dec-10	920.72	19				
January 2011							
19	2-Jan-11	4011.17	82	23	22-Jan-11	3380.68	69
20	12-Jan-11	2438.64	50	24	26-Jan-11	3200.77	65
21	16-Jan-11	4740.78	97	25	31-Jan-11	3189.71	65
22	21-Jan-11	3375.55	69				
February 2011							
26	9-Feb-11	2909.82	59	27	10-Feb-11	3205.41	65
March 2011							
28	10-Mar-11	3086.61	63	30	30-Mar-11	2493.04	51
29	15-Mar-11	2821.55	58				
April 2011							
31	13-Apr-11	2126.36	43	33	22-Apr-11	2263.42	47
32	18-Apr-11	1810.88	37	34	28-Apr-11	1764.96	36
May 2011							
35	2-May-11	1785.95	36	38	17-May-11	942.25	19
36	12-May-11	1578.29	32	39	26-May-11	723.49	15
37	16-May-11	1361.67	28				
June 2011							
40	10-June-11	554.49	11	42	19-June-11	505.37	10
41	14-June-11	639.2	13				

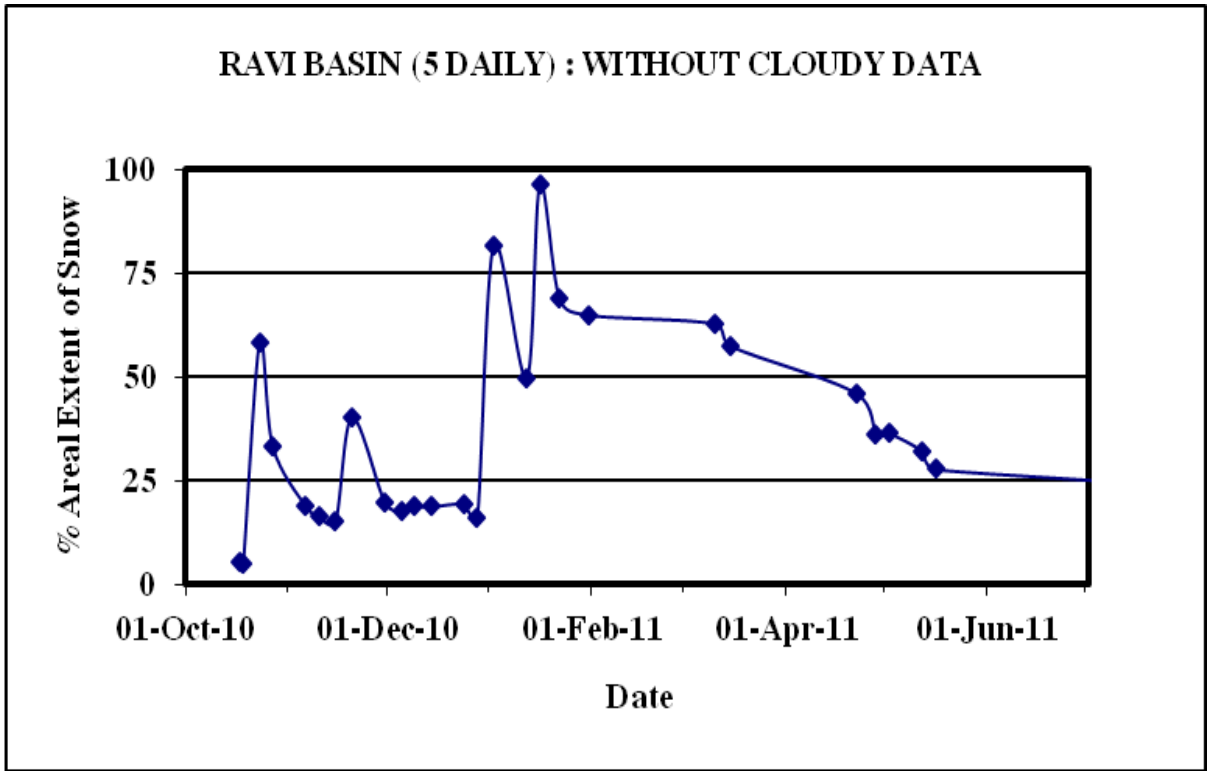
AREAL EXTENT OF SNOW (10 DAILY)

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

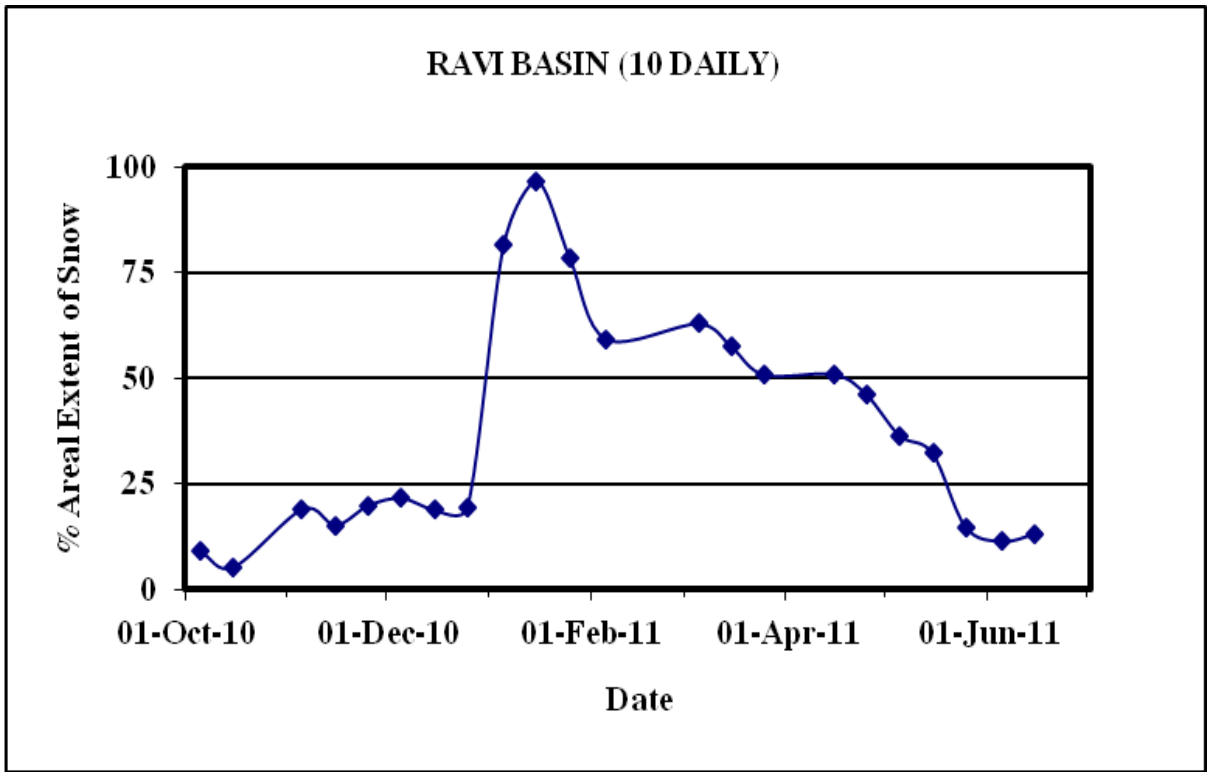
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	436.75	9	2	15-Oct-10	254.04	5
November 2010							
3	5-Nov-10	930.44	19	4	15-Nov-10	743.55	15
5	25-Nov-10	972.52	20				
December 2010							
6	5-Dec-10	1057.3	22	7	15-Dec-10	920.72	19
8	25-Dec-10	952.91	19				
January 2011							
9	5-Jan-11	4011.17	82	10	15-Jan-11	4747.41	97
11	25-Jan-11	3855.7	79				
February 2011							
12	5-Feb-11	2909.87	59				
March 2011							
13	5-Mar-11	3086.61	63	14	15-Mar-11	2821.55	58
15	25-Mar-11	2493.04	51				
April 2011							
16	15-Apr-11	2498.28	51	17	25-Apr-11	2262.45	46
May 2011							
18	5-May-11	1785.95	36	19	15-May-11	1580.76	32
20	25-May-11	723.49	15				
June 2011							
21	5-June-11	554.49	11	22	15-June-11	638.91	13

SNOW COVER DEPLETION CURVE



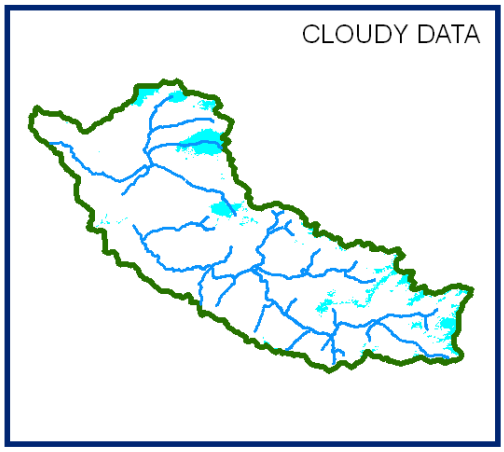


SNOW COVER DEPLETION CURVE



SNOW COVER MAP

SNOW COVER MAP : RAVI BASIN



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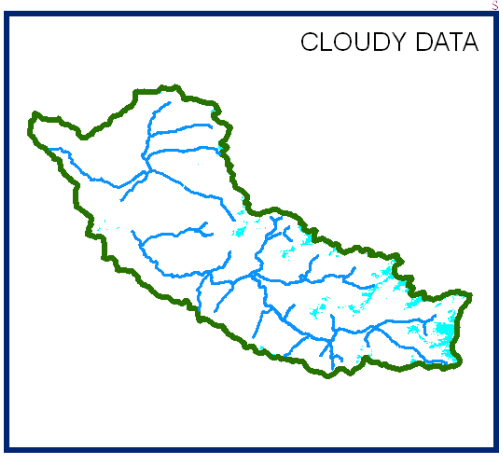

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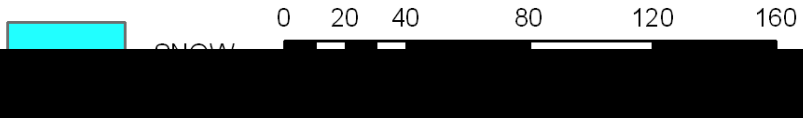

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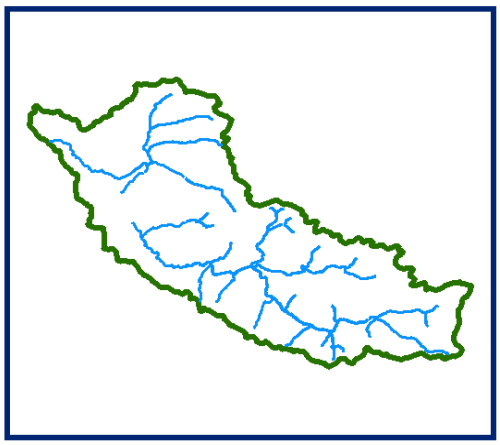

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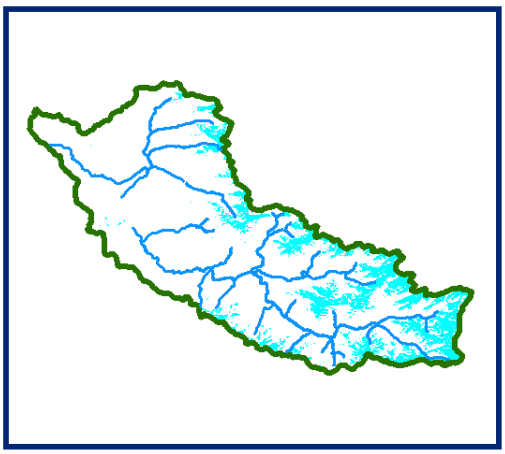

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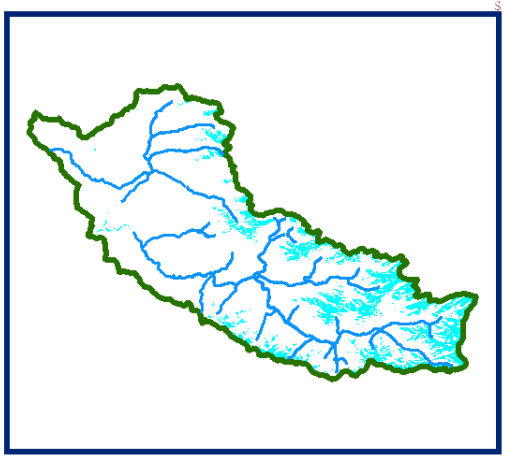

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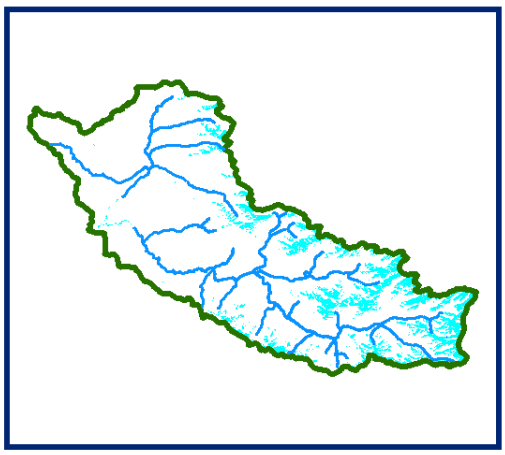

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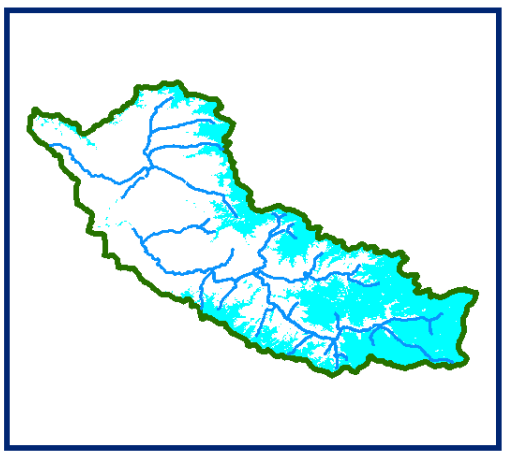

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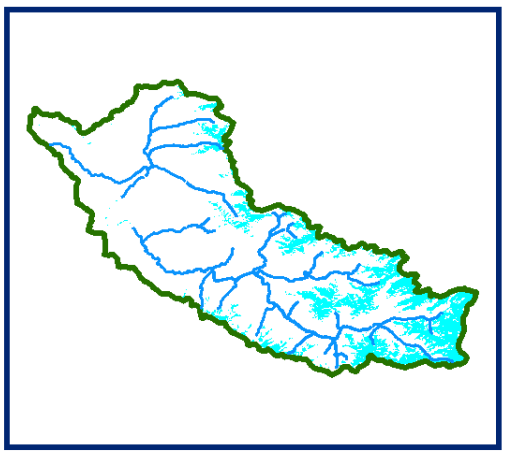

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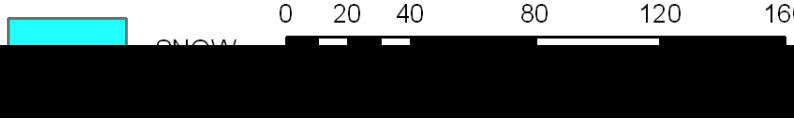

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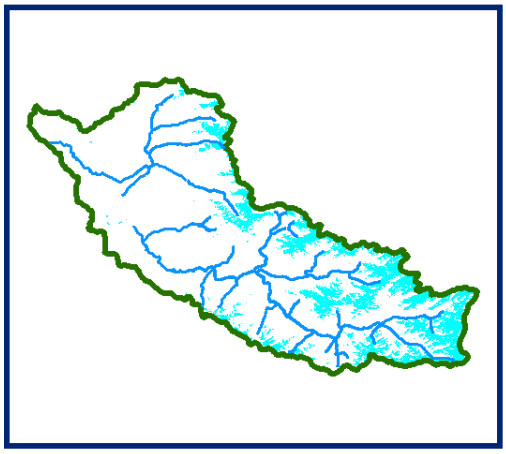

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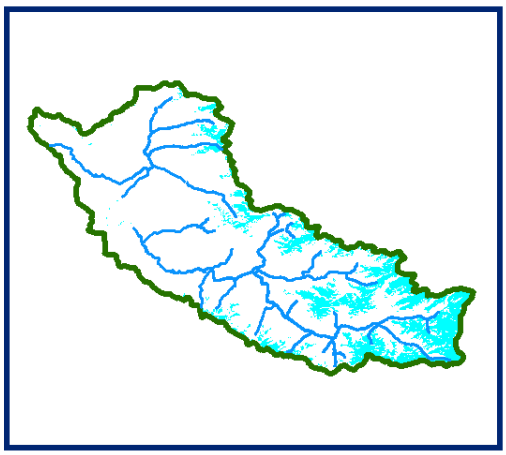

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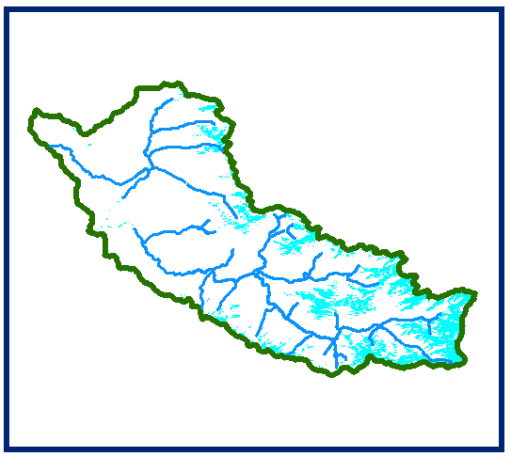
SNOW COVER MAP : RAVI BASIN



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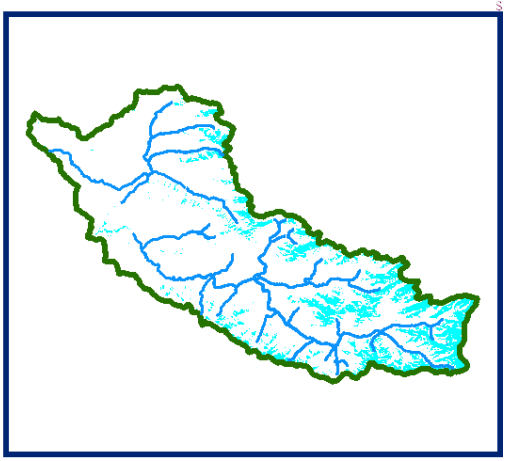

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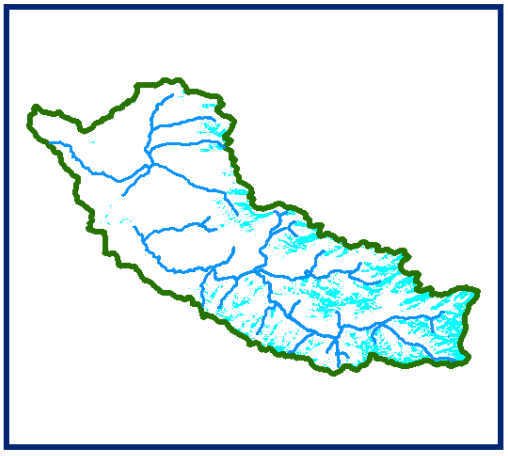

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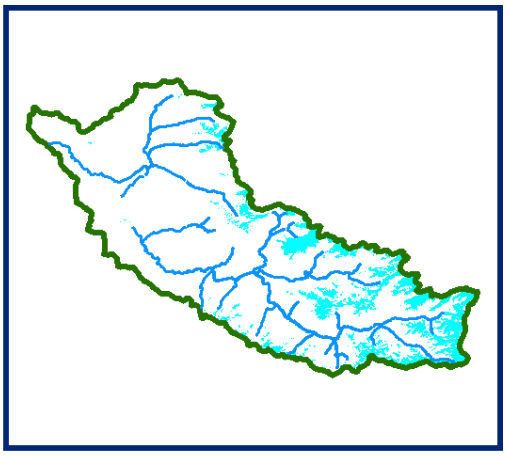

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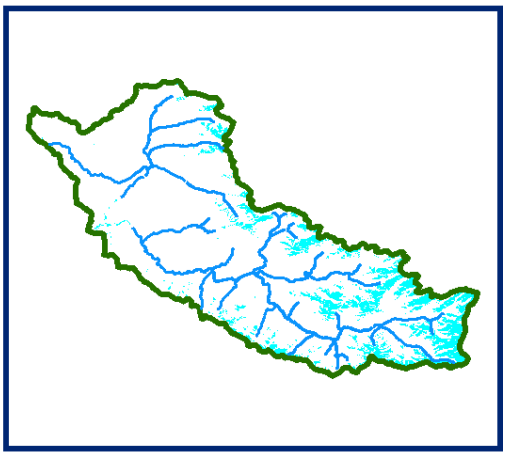

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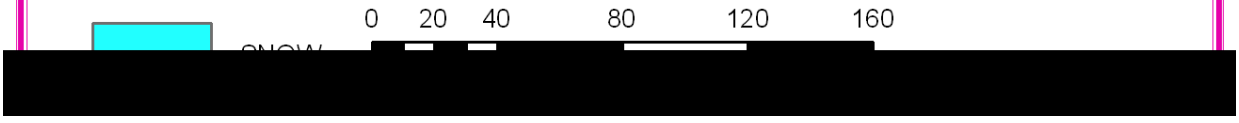
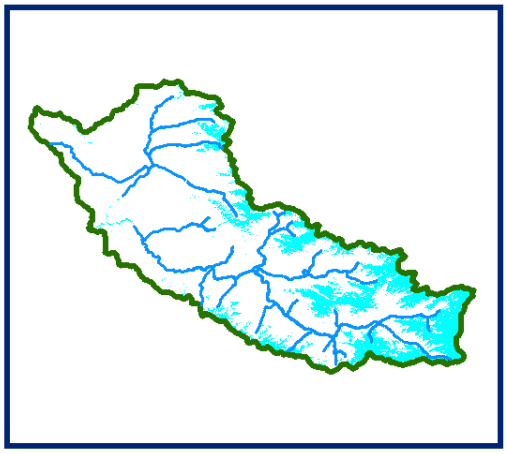


10 DAILY SNOW COVER MAP : RAVI BASIN



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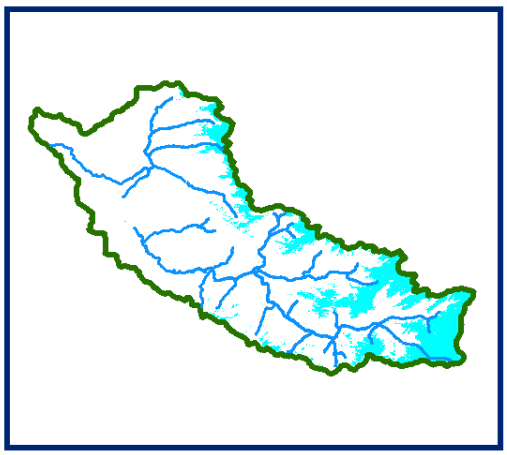

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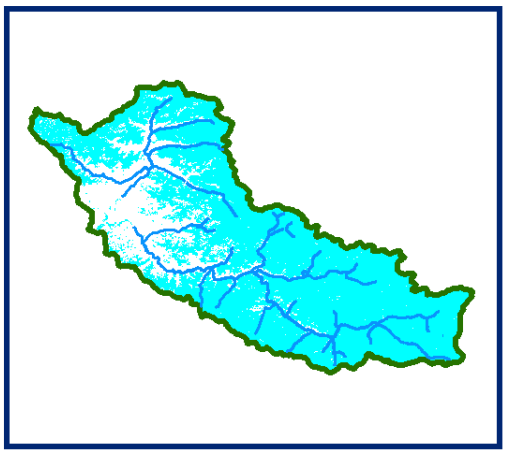
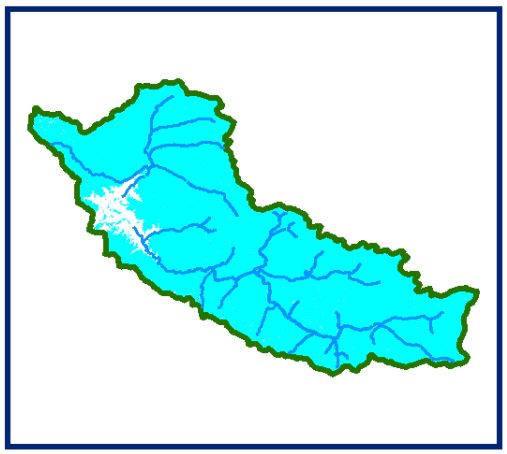
SNOW COVER MAP : RAVI BASIN



02 JANUARY 2011

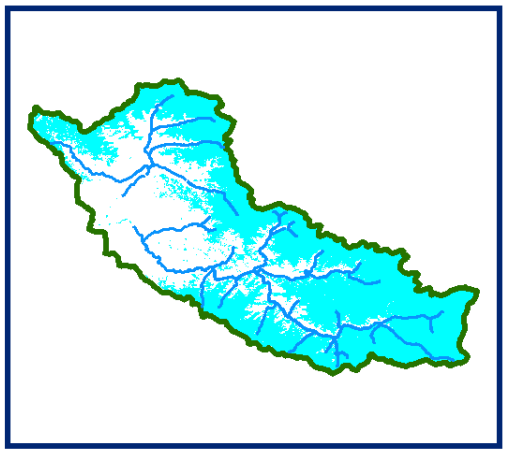
DATA NOT AVAILABLE

12 JANUARY 2011

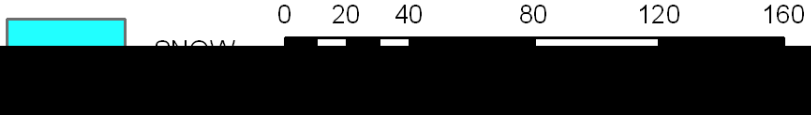


16 JANUARY 2011

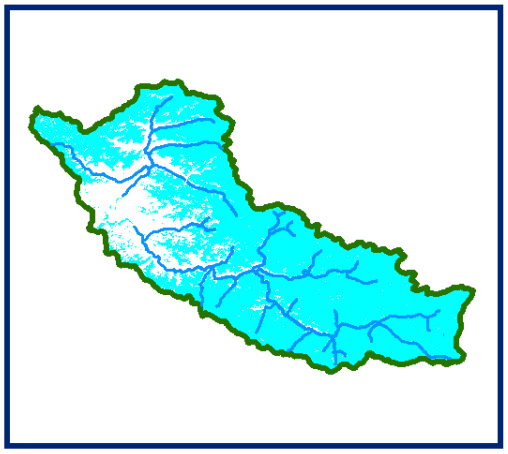
22 JANUARY 2011



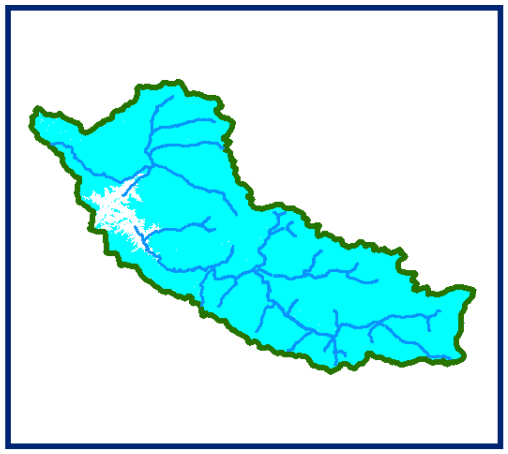
31 JANUARY 2011



10 DAILY SNOW COVER MAP : RAVI BASIN



DATA USED
02 JANUARY 2011



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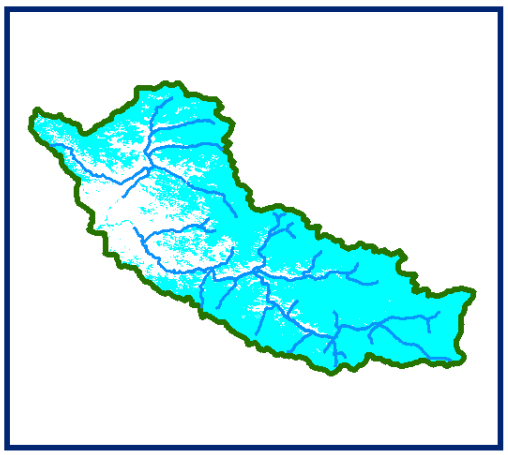
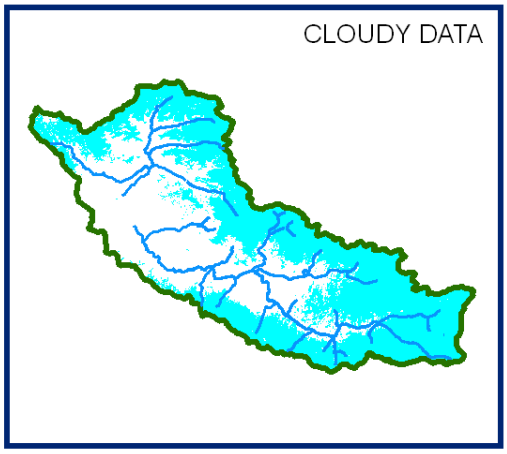
16 JANUARY 2011



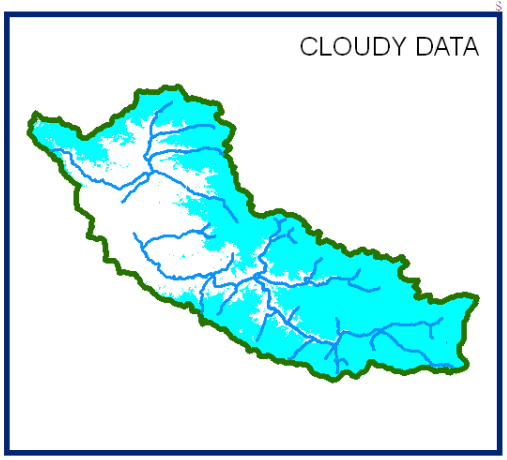
DATA USED
21 JANUARY 2011
22 JANUARY 2011
31 JANUARY 2011

0 10 20 40 60 80

SNOW COVER MAP : RAVI BASIN



09 FEBRUARY 2011



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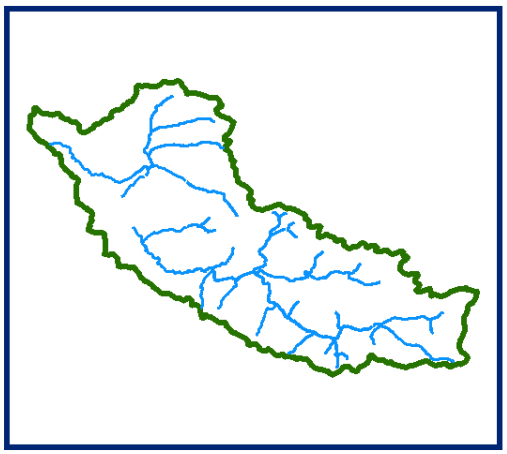

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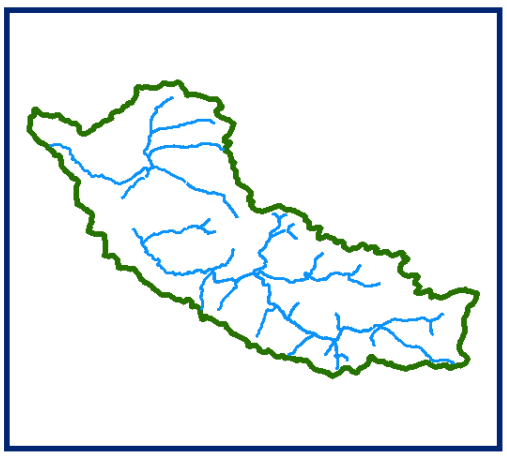

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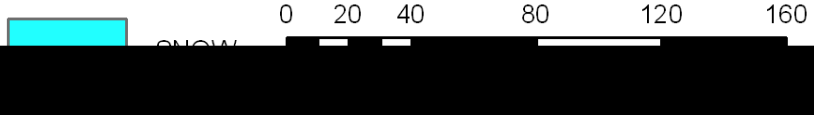


10 DAILY SNOW COVER MAP : RAVI BASIN

DATA USED
09 FEBRUARY 2011
10 FEBRUARY 2011

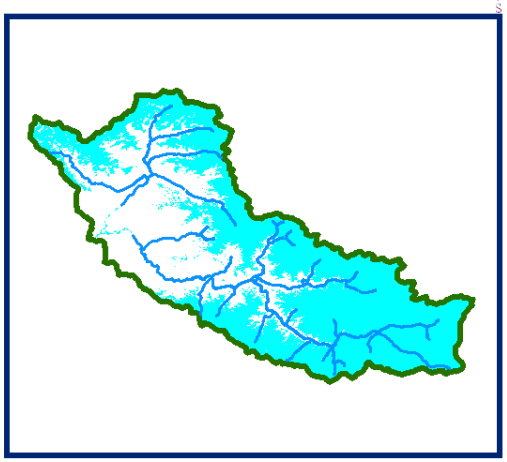
DATA NOT AVAILABLE

DATA NOT AVAILABLE

0 10 20 40 60 80

SNOW COVER MAP : RAVI BASIN

DATA NOT AVAILABLE



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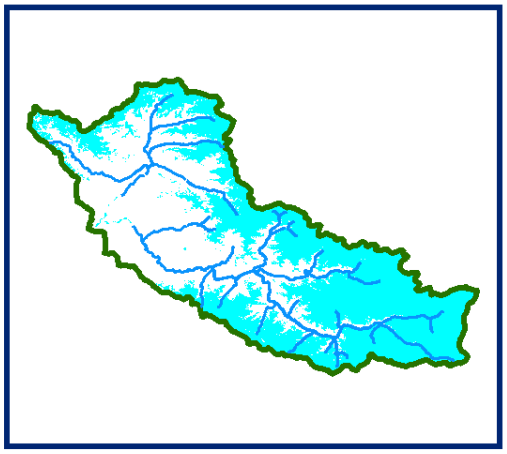

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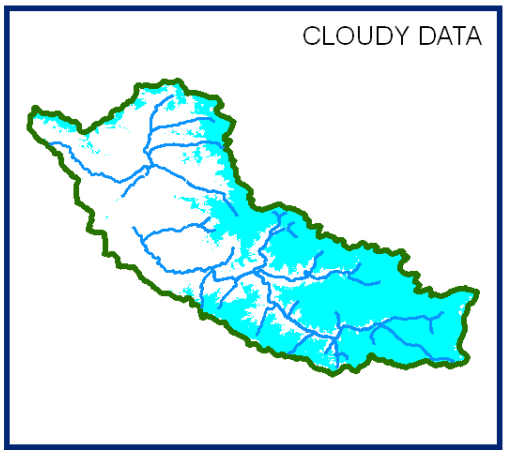

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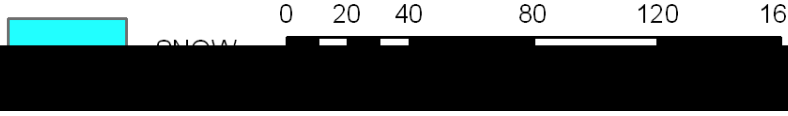


10 DAILY SNOW COVER MAP : RAVI BASIN

DATA USED
10 MARCH 2011

DATA USED
15 MARCH 2011

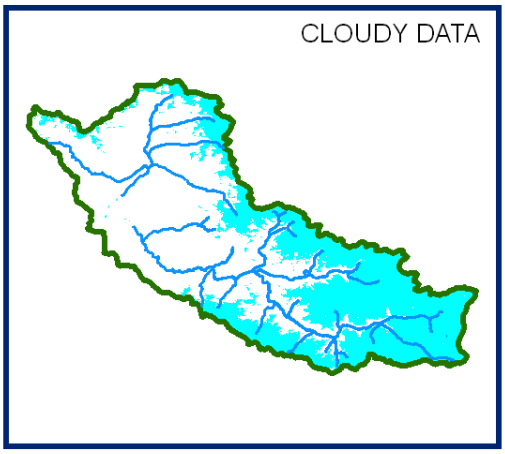
DATA USED
30 MARCH 2011

0 10 20 40 60 80

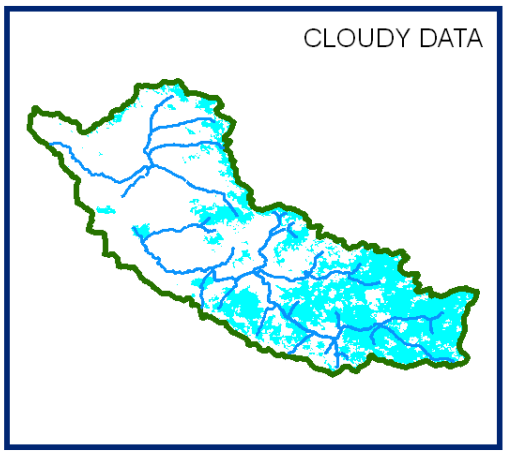
SNOW COVER MAP : RAVI BASIN

DATA NOT AVAILABLE

DATA NOT AVAILABLE



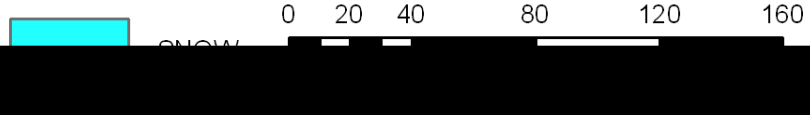
13 APRIL 2011



18 APRIL 2011

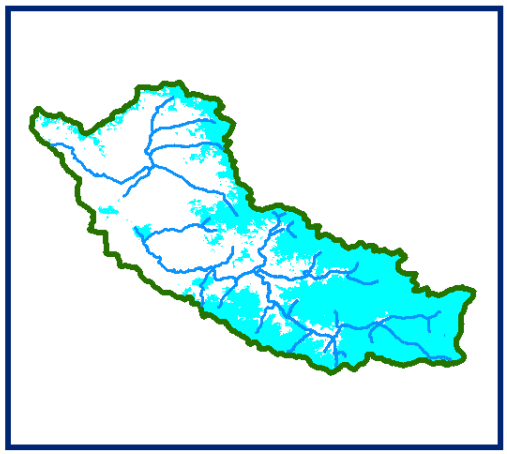
22 APRIL 2011

28 APRIL 2011



10 DAILY SNOW COVER MAP : RAVI BASIN

DATA NOT AVAILABLE



DATA USED

13 APRIL 2011
18 APRIL 2011

DATA USED

22 APRIL 2011
28 APRIL 2011

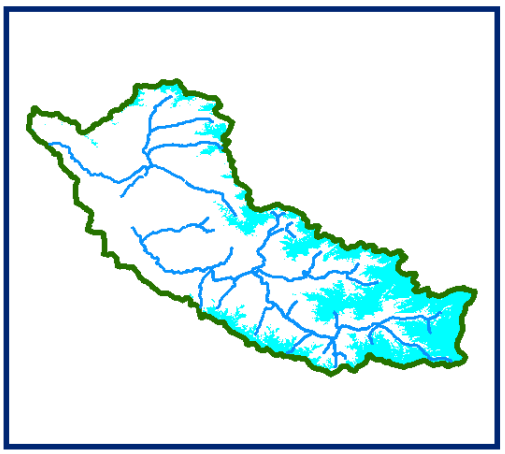
0 10 20 40 60 80

SNOW COVER MAP : RAVI BASIN

02 MAY 2011

DATA NOT AVAILABLE

12 MAY 2011



16 MAY 2011

26 MAY 2011

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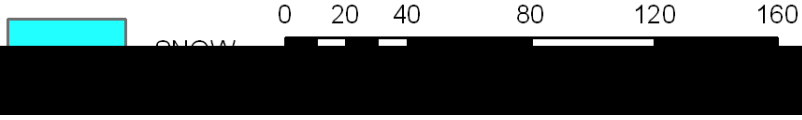

10 DAILY SNOW COVER MAP : RAVI BASIN

DATA USED
02 MAY 2011

DATA USED
12 MAY 2011
16 MAY 2011
17 MAY 2011

DATA USED
26 MAY 2011

0 10 20 40 60 80

SNOW COVER MAP : RAVI BASIN

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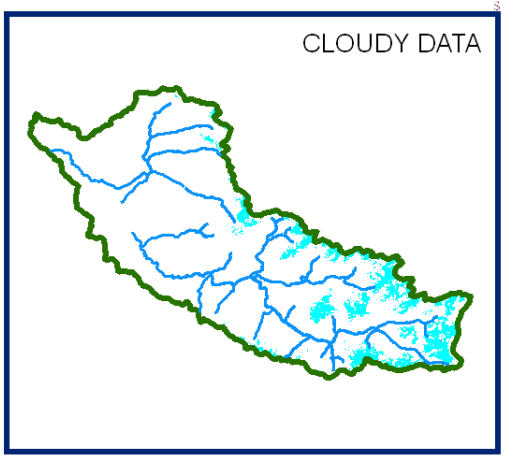
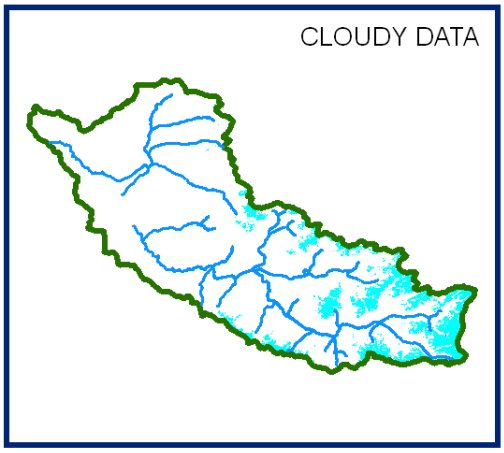
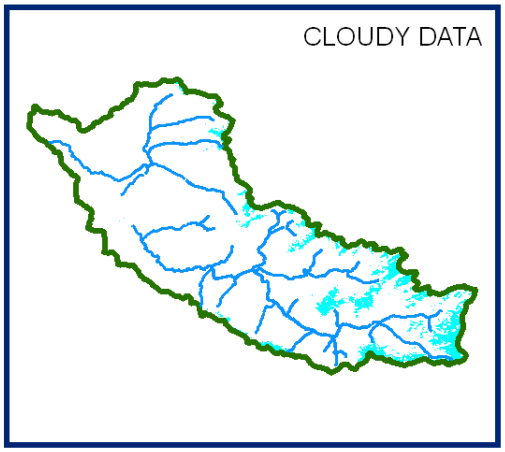


10 JUNE 2011



14 JUNE 2011



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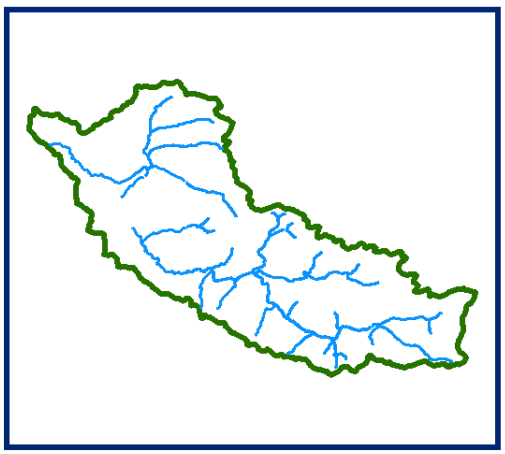

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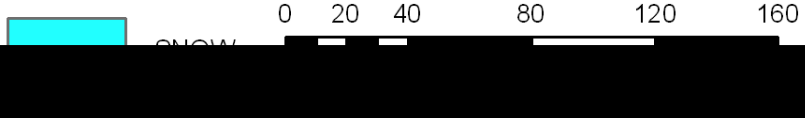
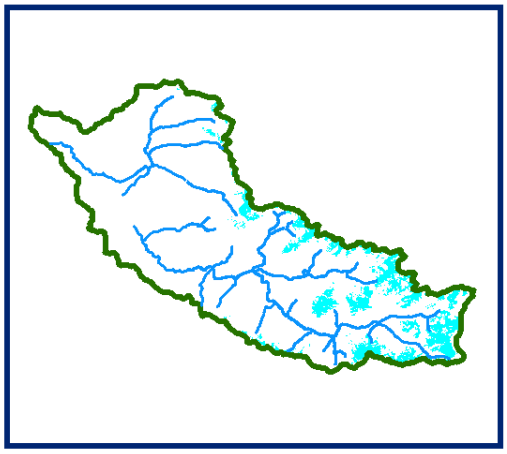
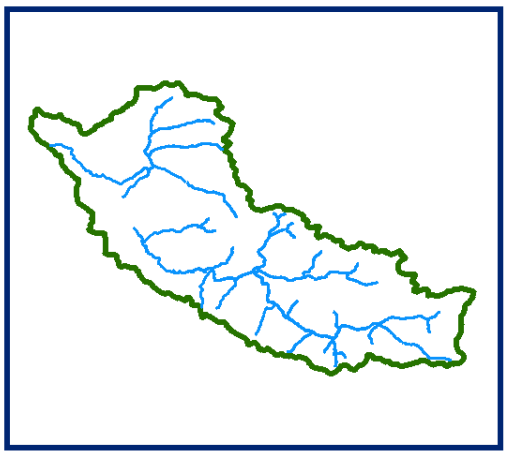


10 DAILY SNOW COVER MAP : RAVI BASIN



DATA USED
10 JUNE 2011

DATA USED
14 JUNE 2011
19 JUNE 2011



DATA NOT AVAILABLE

0 10 20 40 60 80

CHANDRA BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: CHANDRA **BASIN AREA: 2433 Sq km**

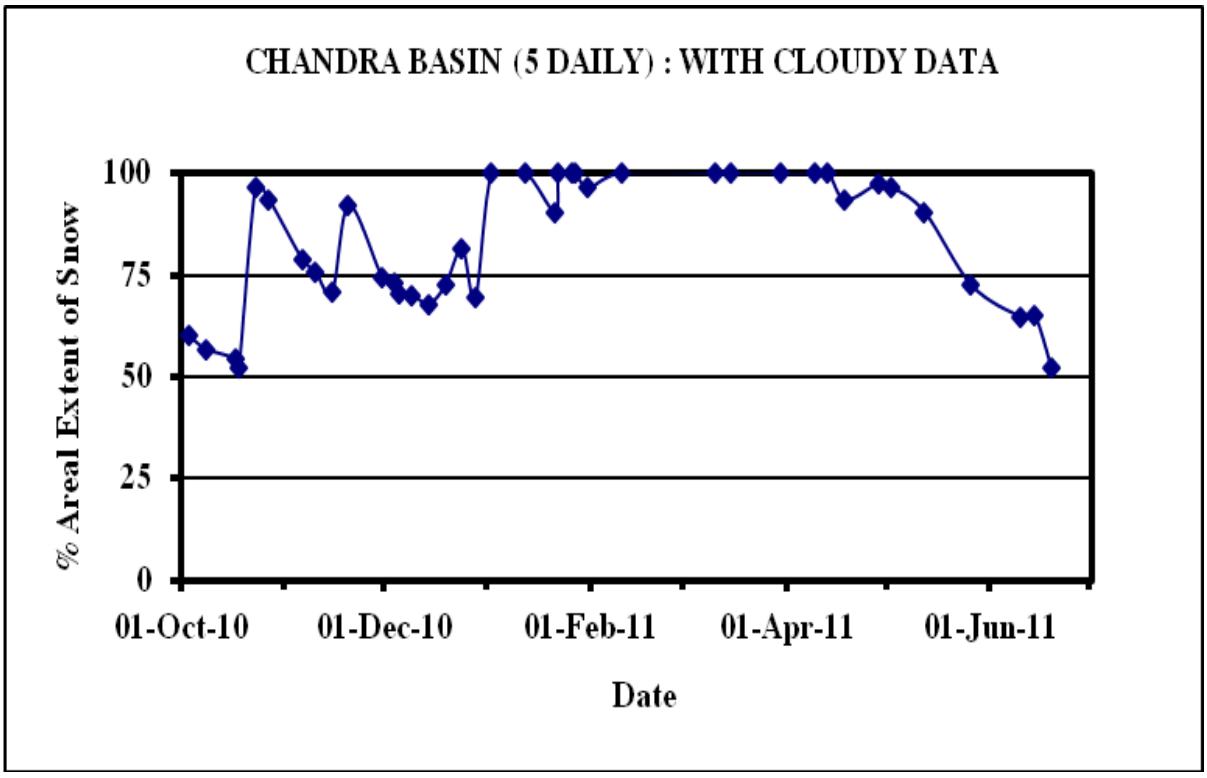
S No	Date	Snow Cover (sq km)	Snow Cover (%)	S No	Date	Snow Cover (sq km)	Snow Cover (%)
October 2010							
1	3-Oct-10	1461.21	60	4	18-Oct-10	1266.58	52
2	8-Oct-10	1382.51	57	5	23-Oct-10	2351.35	97
3	17-Oct-10	1324.13	54	6	27-Oct-10	2274.48	94
November 2010							
7	6-Nov-10	1917.17	79	10	20-Nov-10	2237.79	92
8	10-Nov-10	1842.87	76	11	30-Nov-10	1812.62	75
9	15-Nov-10	1720.85	71				
December 2010							
12	4-Dec-10	1782	73	16	19-Dec-10	1762.17	72
13	5-Dec-10	1713.37	70	17	24-Dec-10	1979.84	81
14	9-Dec-10	1704.06	70	18	28-Dec-10	1686.06	69
15	14-Dec-10	1651.63	68				
January 2011							
19	2-Jan-11	2441.17	100	23	26-Jan-11	2439.64	100
20	12-Jan-11	2434.77	100	24	27-Jan-11	2437.07	100
21	21-Jan-11	2195.16	91	25	31-Jan-11	2343.97	96
22	22-Jan-11	2438.48	100				
February 2011							
26	10-Feb-11	2441.03	100				
March 2011							
27	10-Mar-11	2443.28	100	29	30-Mar-11	2434.38	100
28	15-Mar-11	2441.06	100				
April 2011							
30	9-Apr-11	2437.18	100	32	18-Apr-11	2269.71	93
31	13-Apr-11	2429.84	99	33	28-Apr-11	2367.52	98
May-2011							
34	2-May-11	2347.27	96	36	26-May-11	1760.95	72
35	12-May-11	2195.88	90				
June-2011							
37	10-June-11	1581.16	65	39	19-June-11	1270.07	52
38	14-June-11	1581.16	65				

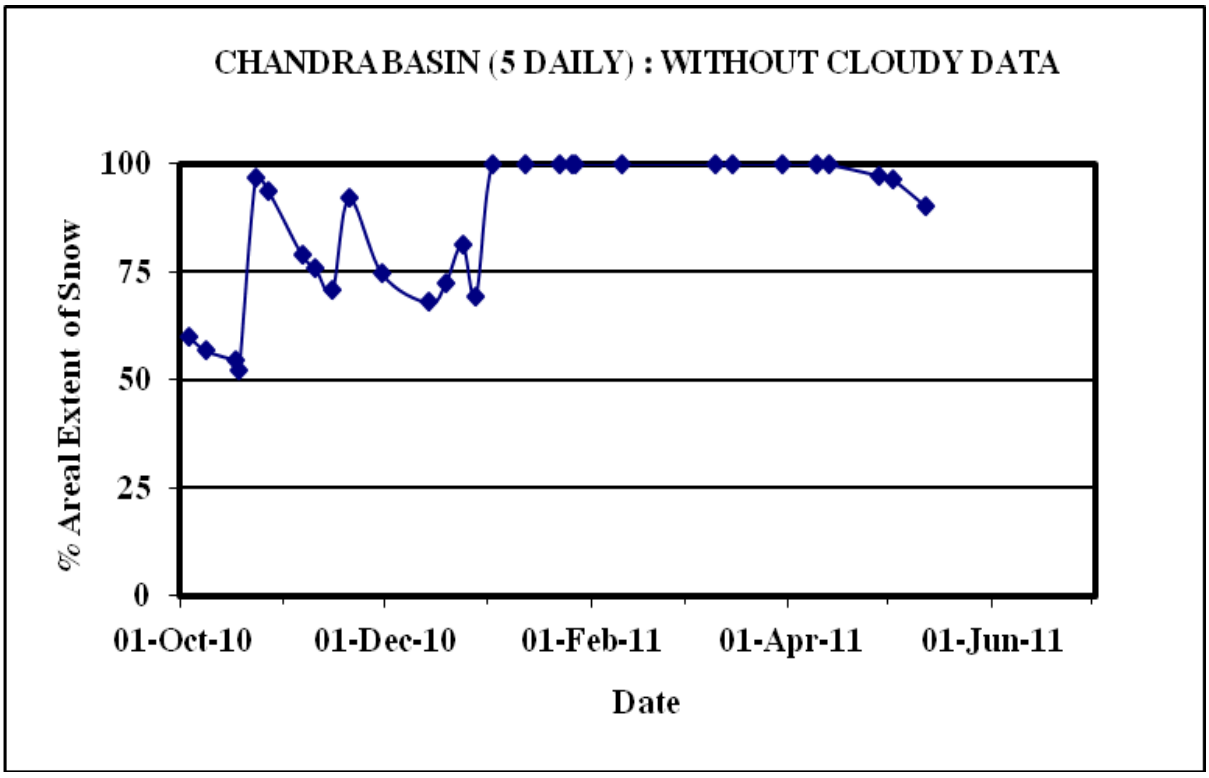
AREAL EXTENT OF SNOW (10 DAILY)

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

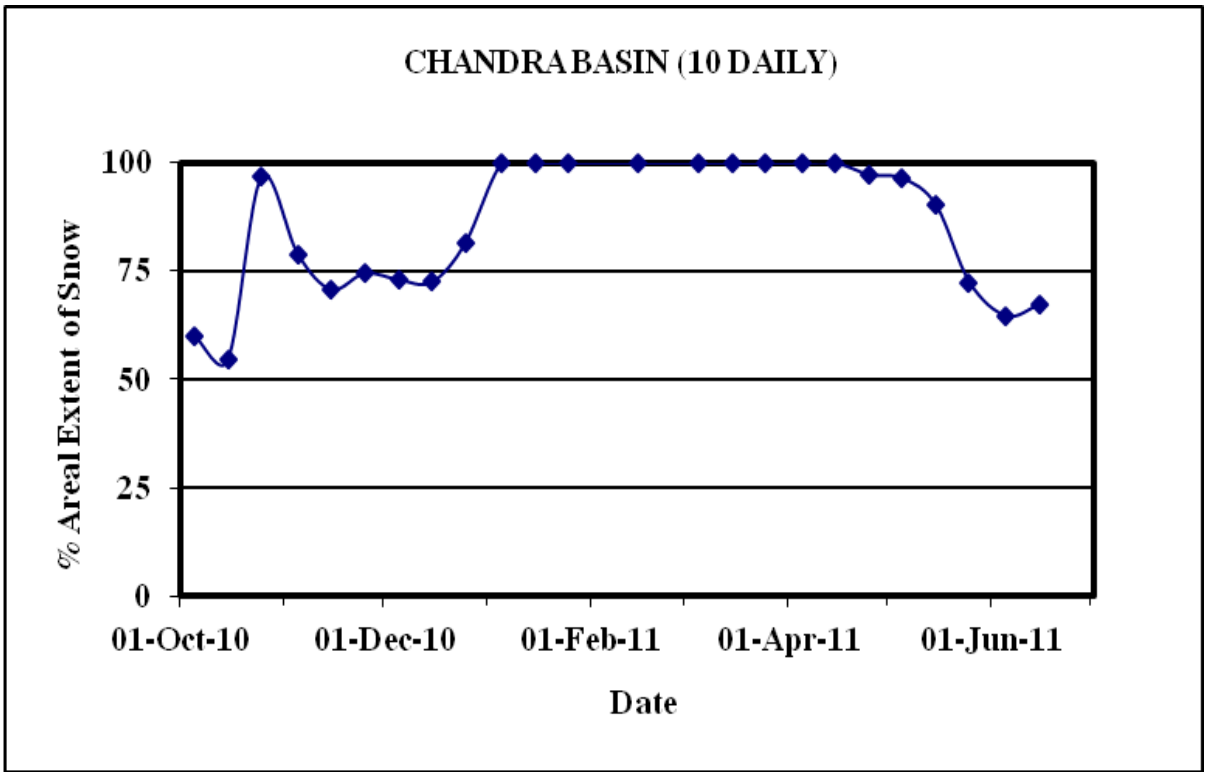
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	1461.28	60	2	15-Oct-10	1323.93	54
3	25-Oct-10	2351.96	97				
November 2010							
4	5-Nov-10	1917.13	79	5	15-Nov-10	1720.37	71
6	25-Nov-10	1812.62	75				
December 2010							
7	5-Dec-10	1955.14	80	8	15-Dec-10	1651.53	68
9	25-Dec-10	1979.54	81				
January 2011							
10	5-Jan-11	2441.17	100	11	15-Jan-11	2434.77	100
12	25-Jan-11	2442.16	100				
February 2011							
13	15-Feb-11	2441.03	100				
March 2011							
14	5-Mar-11	2443.28	100	15	15-Mar-11	2441.06	100
16	25-Mar-11	2434.38	100				
April 2011							
17	5-Apr-11	2437.18	100	18	15-Apr-11	2443.17	100
19	25-Apr-11	2367.52	97				
May 2011							
20	5-May-11	2347.27	96	21	15-May-11	2195.88	90
22	25-May-11	1760.95	72				
June 2011							
23	5-June-11	1572.48	65	24	15-June-11	1636.58	67

SNOW COVER DEPLETION CURVE



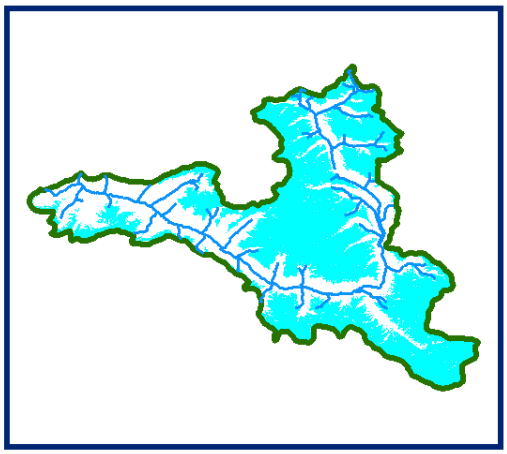


SNOW COVER DEPLETION CURVE

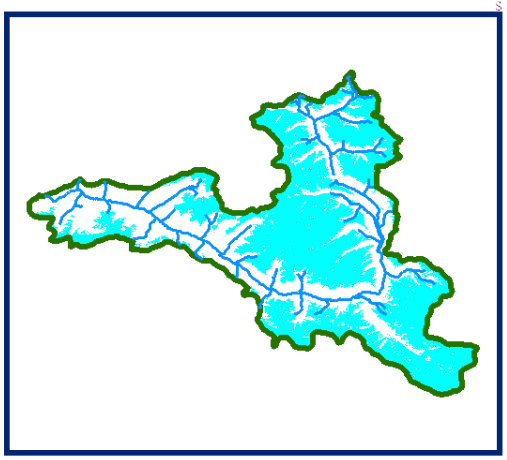


SNOW COVER MAP

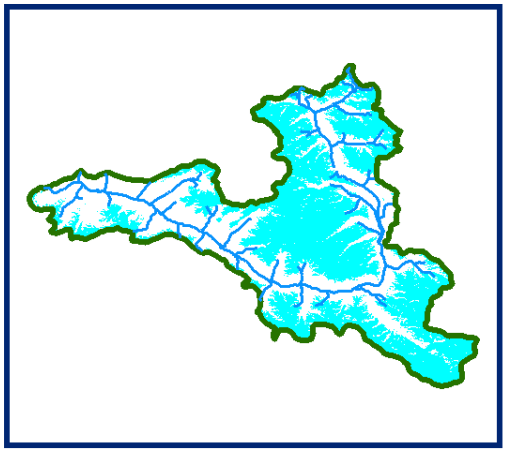
SNOW COVER MAP : CHANDRA BASIN



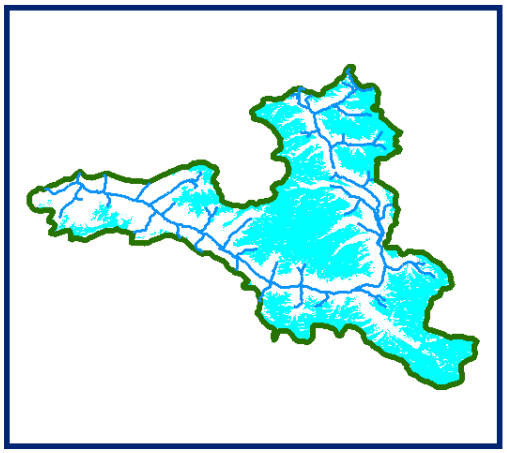
03 OCTOBER 2010



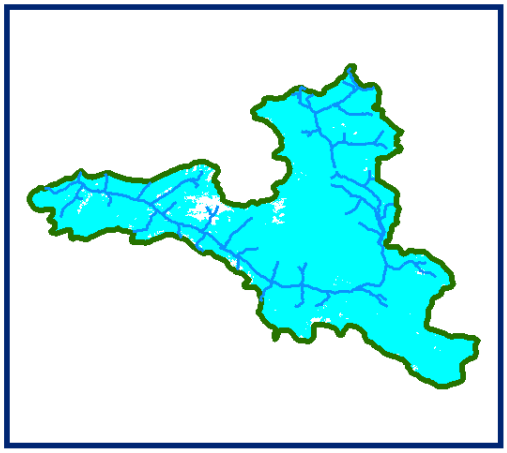
08 OCTOBER 2010



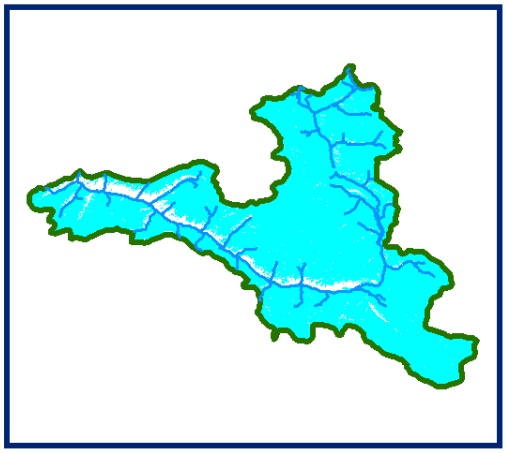
17 OCTOBER 2010



18 OCTOBER 2010



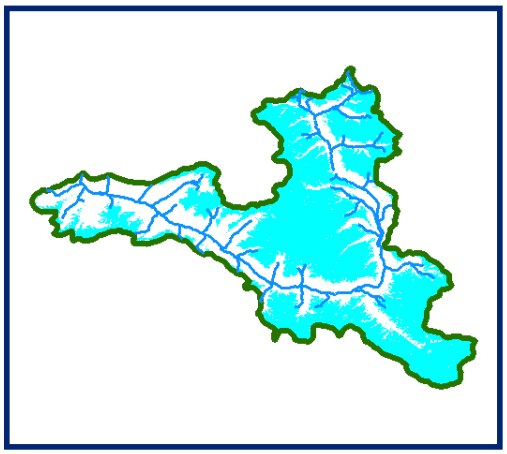
23 OCTOBER 2010



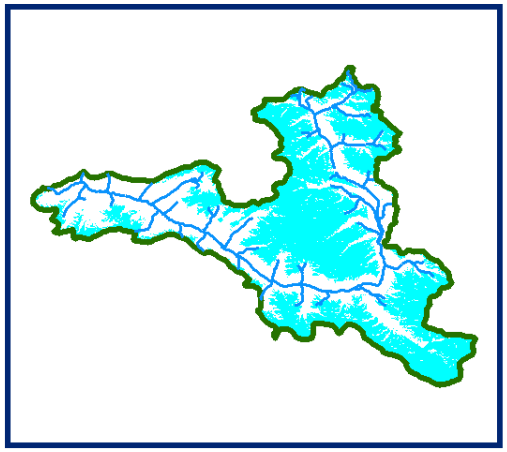
27 OCTOBER 2010

0 15 30 60 90 120

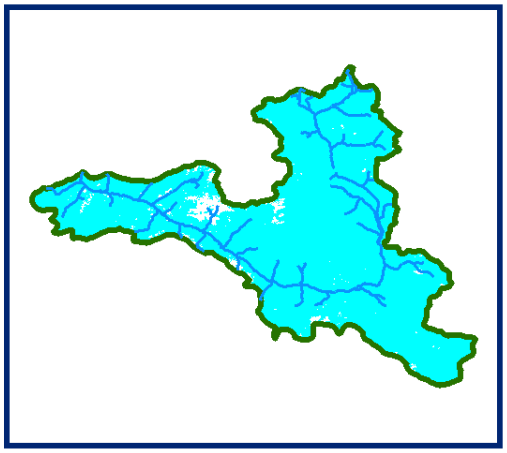
10 DAILY SNOW COVER MAP : CHANDRA BASIN



DATA USED
03 OCTOBER 2010
08 OCTOBER 2010



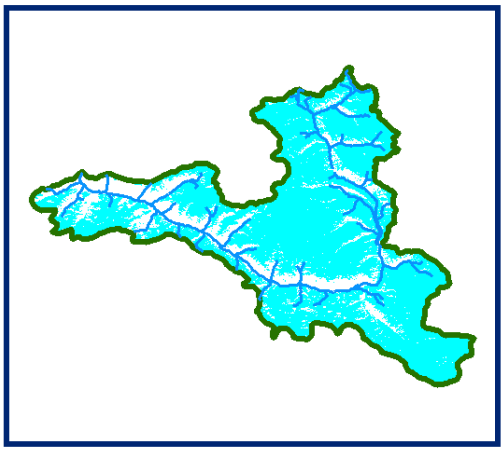
DATA USED
17 OCTOBER 2010
18 OCTOBER 2010



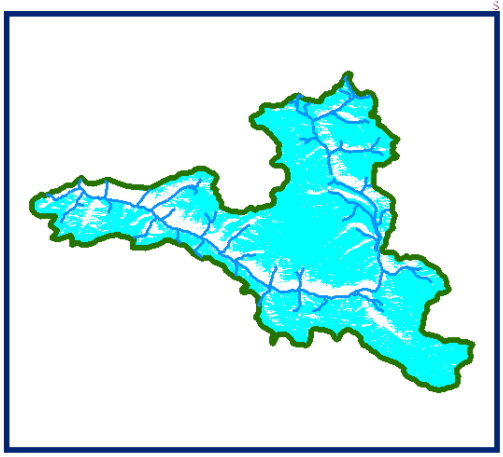
DATA USED
23 OCTOBER 2010
27 OCTOBER 2010

0 510 20 30 40

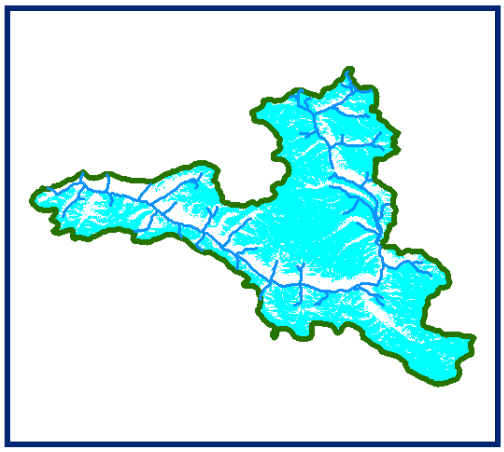
SNOW COVER MAP : CHANDRA BASIN



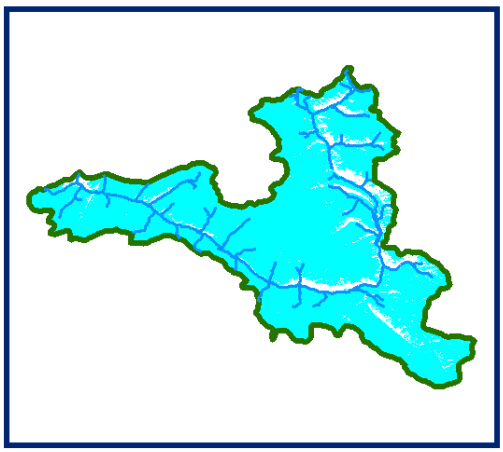
06 NOVEMBER 2010



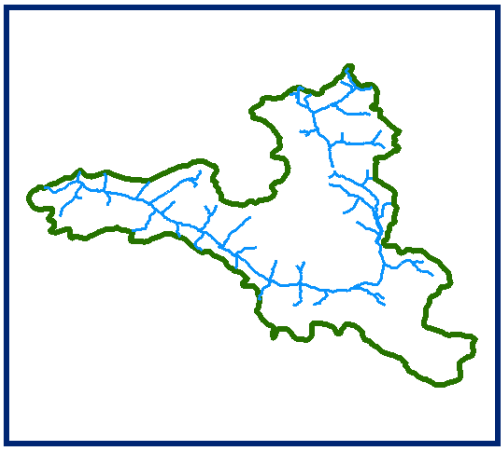
10 NOVEMBER 2010



15 NOVEMBER 2010



20 NOVEMBER 2010



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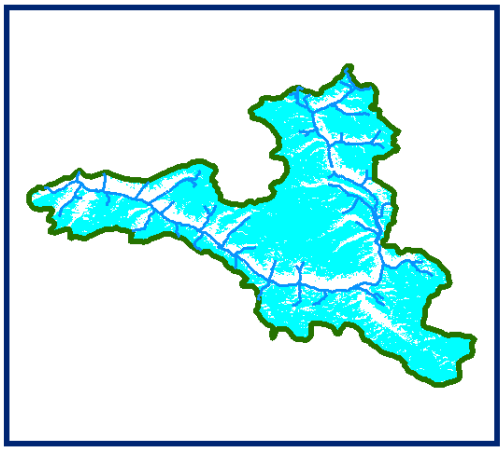
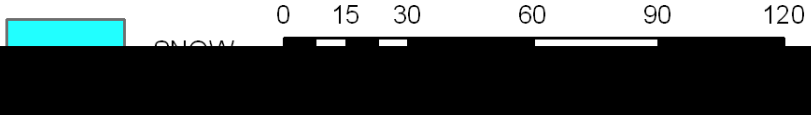
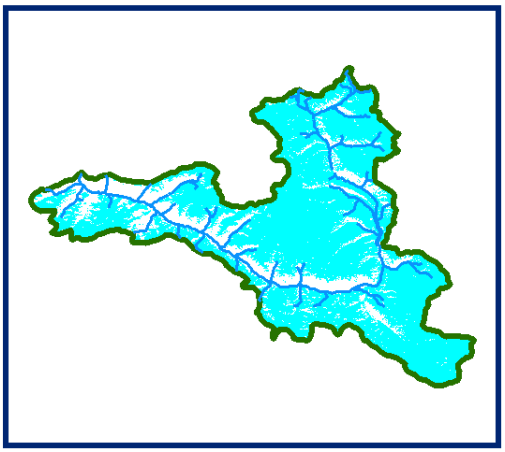


30 NOVEMBER 2010

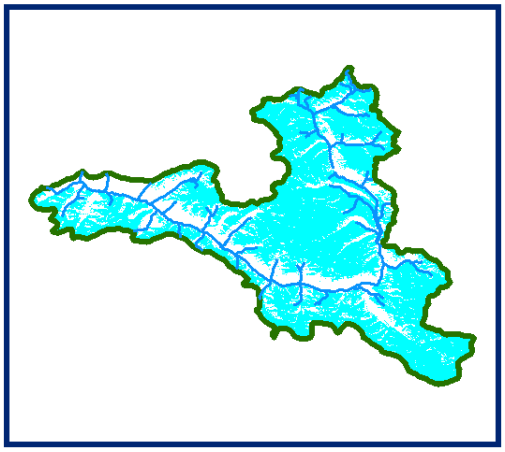


10 DAILY SNOW COVER MAP : CHANDRA BASIN



DATA USED

06 NOVEMBER 2010
10 NOVEMBER 2010



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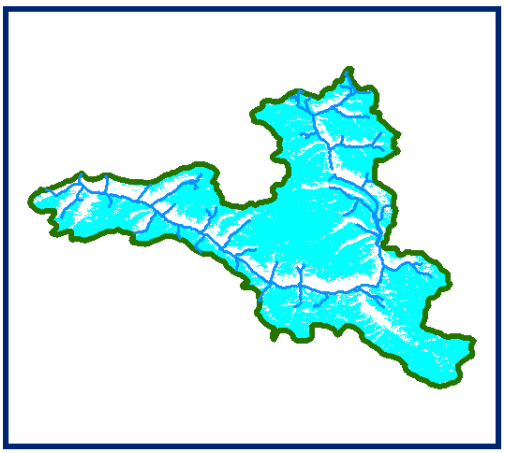
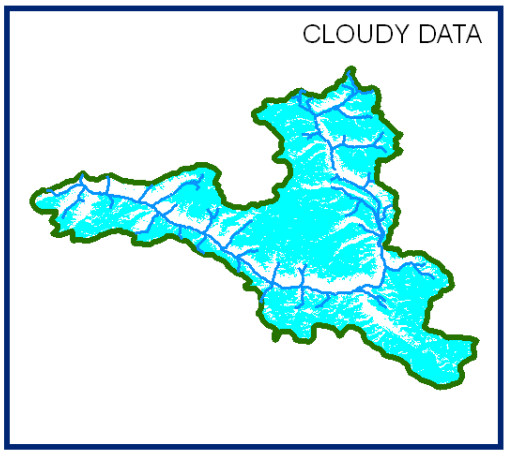


DATA USED

30 NOVEMBER 2010

0 5 10 20 30 40

SNOW COVER MAP : CHANDRA BASIN



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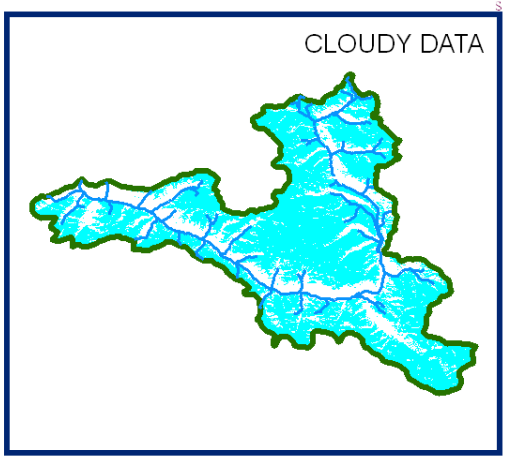
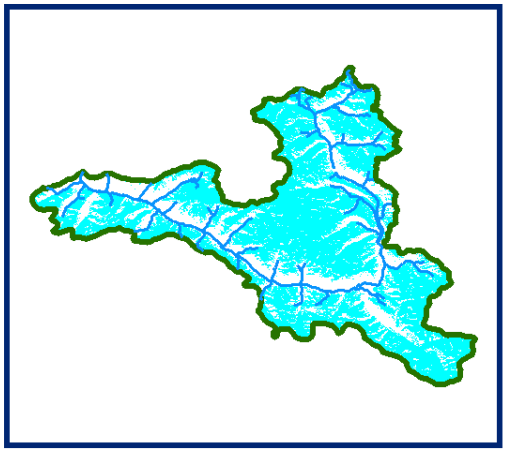
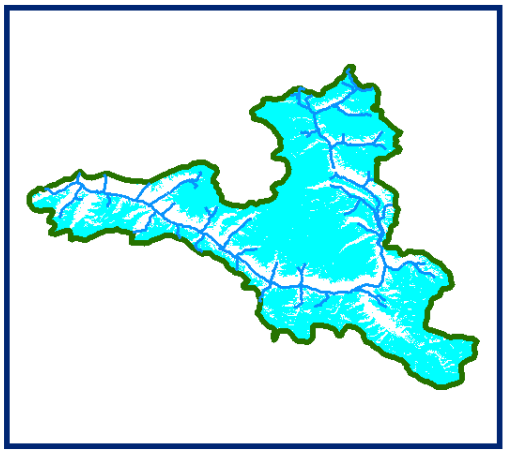


09 DECEMBER 2010



14 DECEMBER 2010



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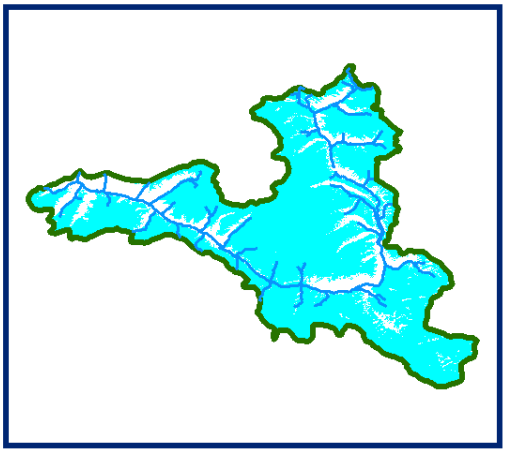

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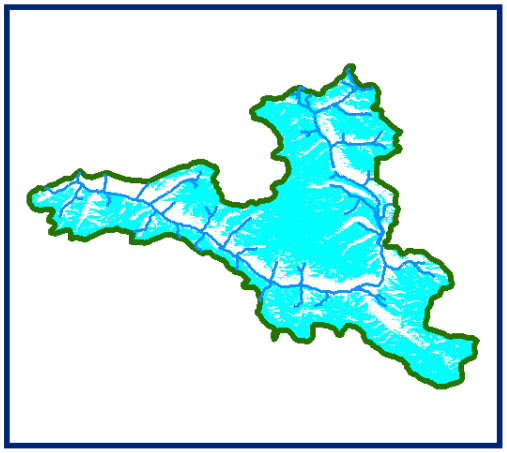

28 DECEMBER 2010

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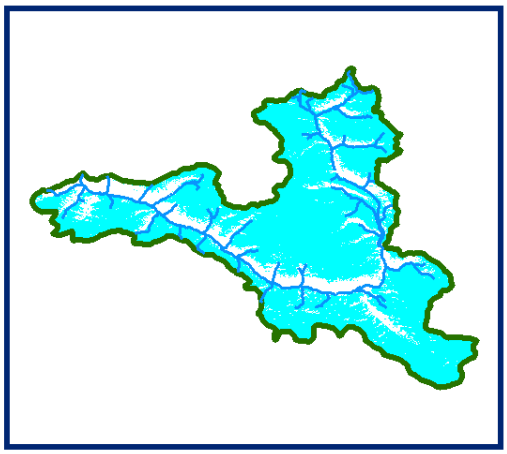
10 DAILY SNOW COVER MAP : CHANDRA BASIN



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04 DECEMBER 2010
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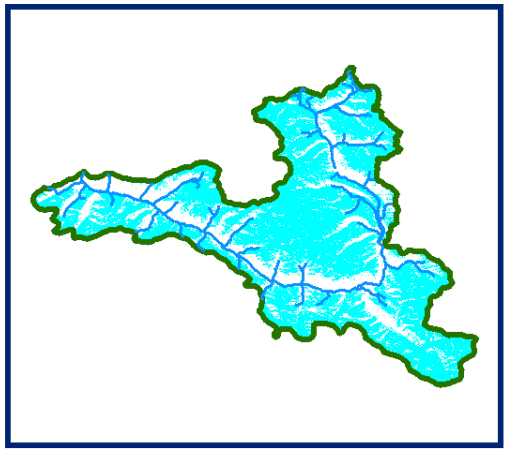

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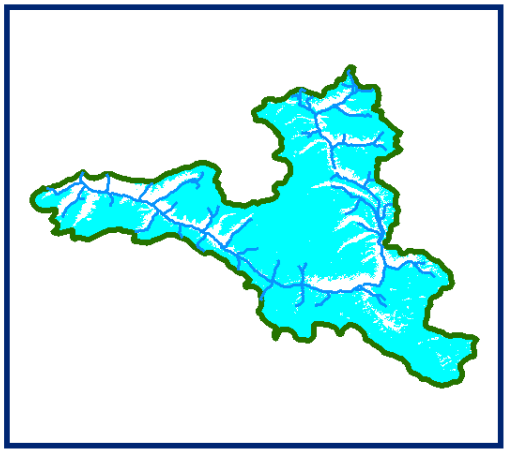

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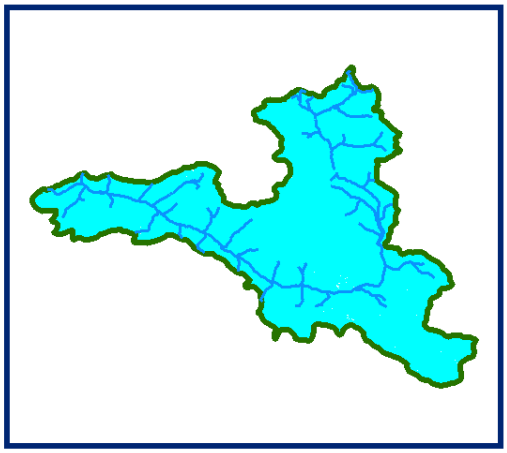
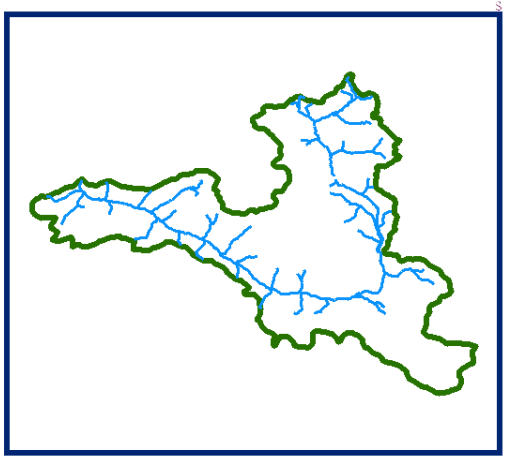
SNOW COVER MAP : CHANDRA BASIN



02 JANUARY 2011



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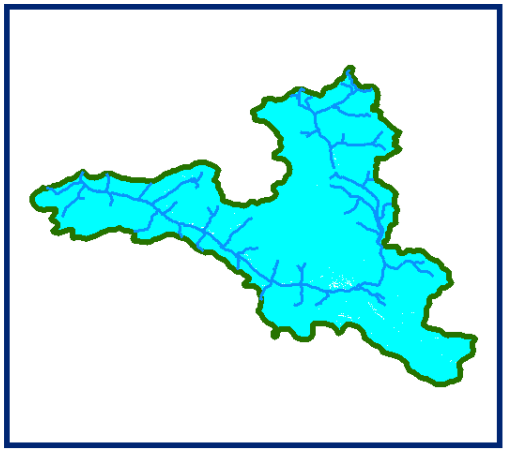
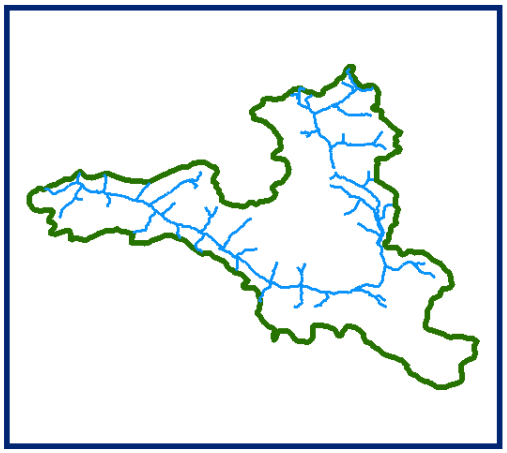


12 JANUARY 2011



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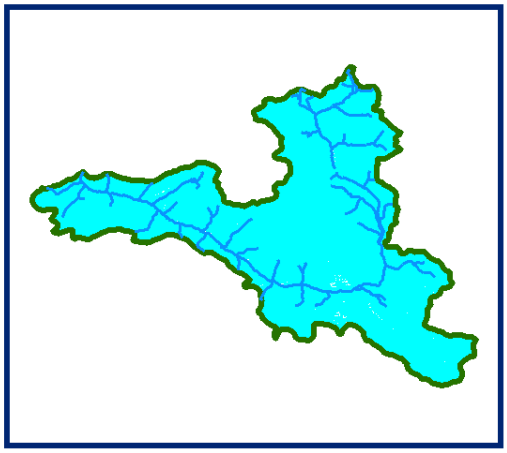

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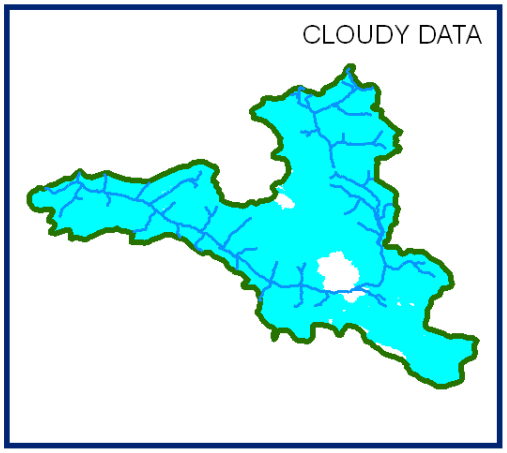

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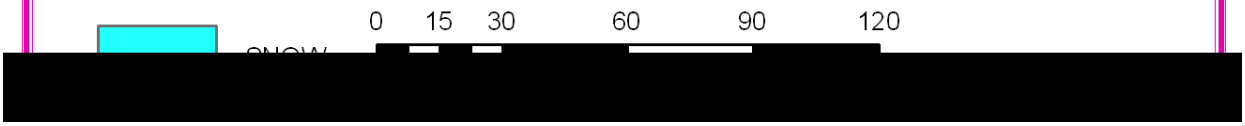
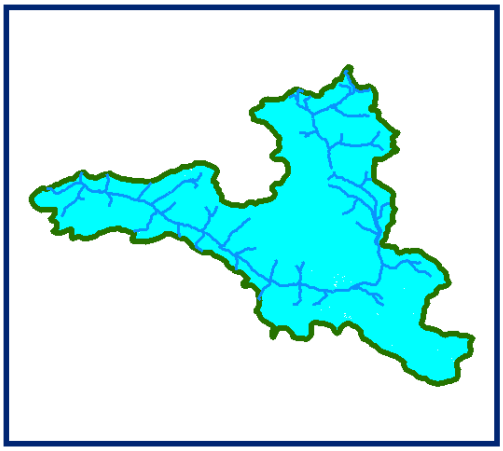


10 DAILY SNOW COVER MAP : CHANDRA BASIN



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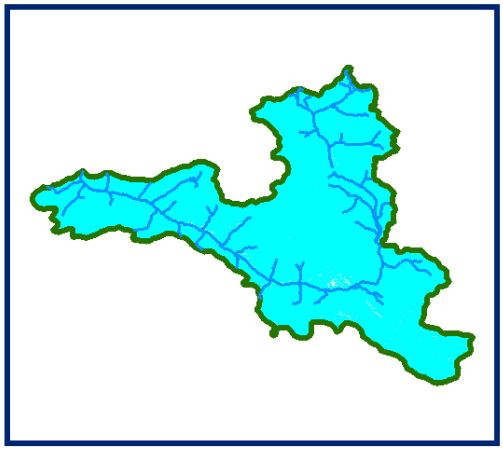

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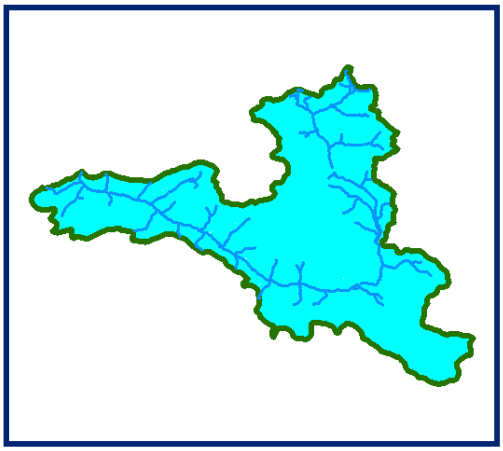

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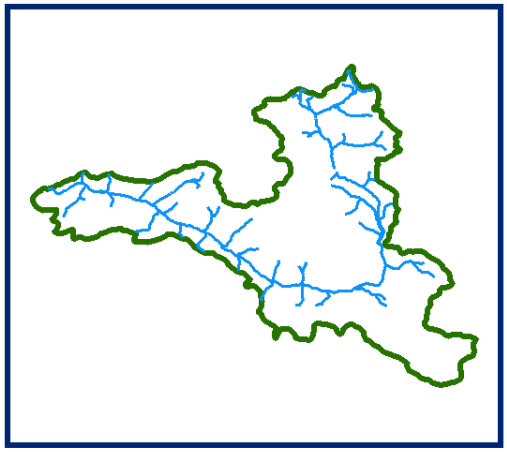
22 JANUARY 2011
27 JANUARY 2011

0 5 10 20 30 40

SNOW COVER MAP : CHANDRA BASIN



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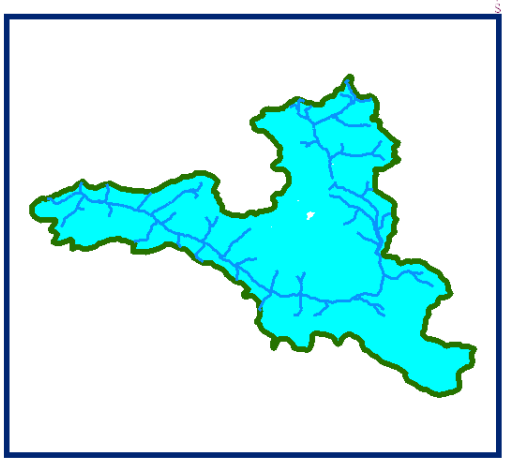

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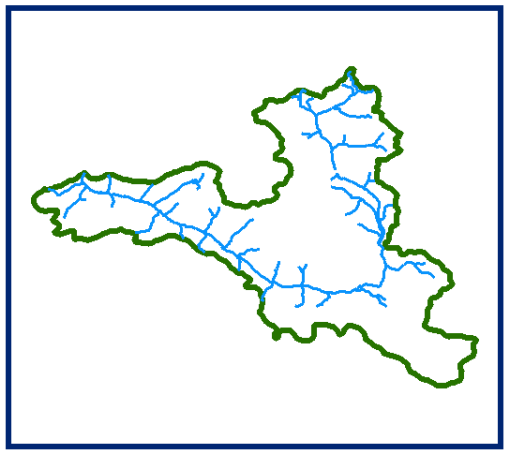

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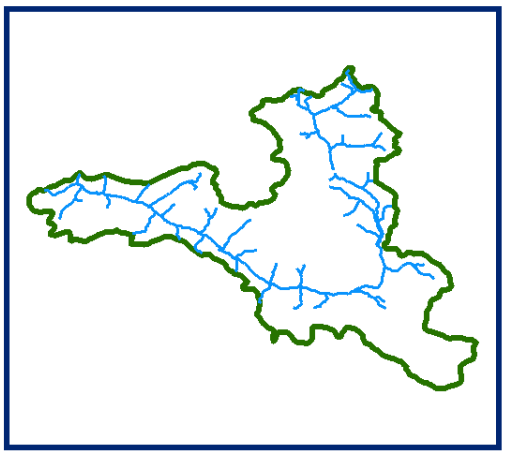

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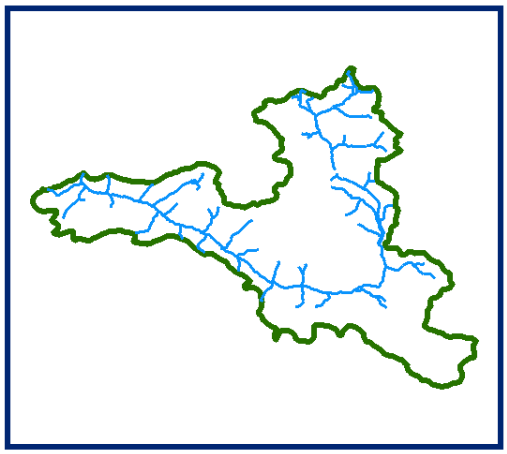

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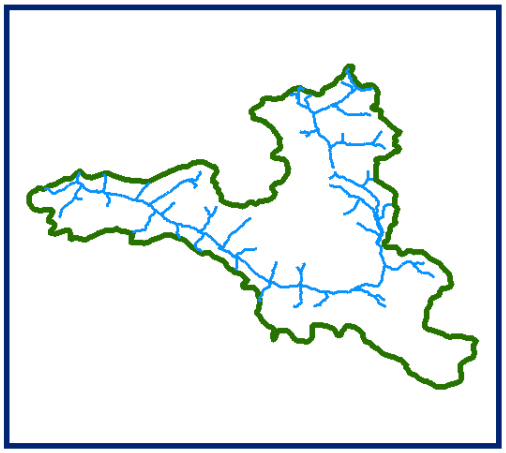

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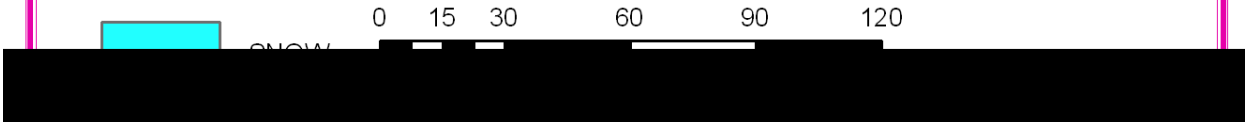
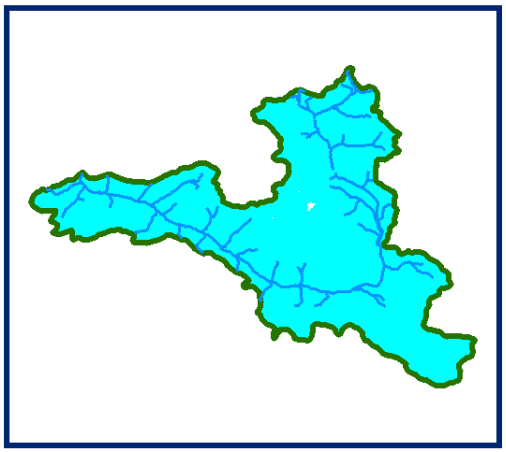


10 DAILY SNOW COVER MAP : CHANDRA BASIN



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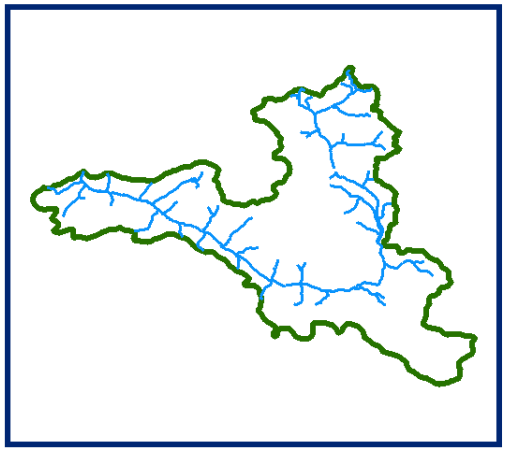

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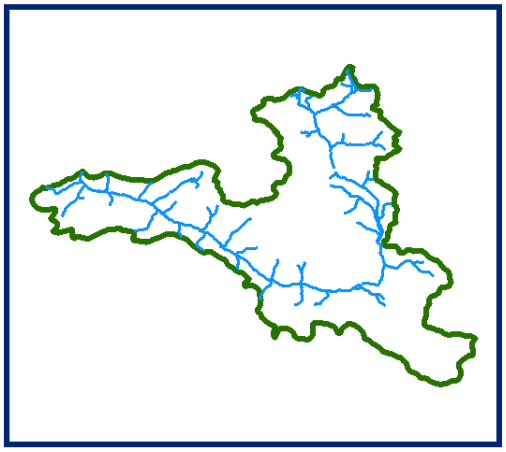

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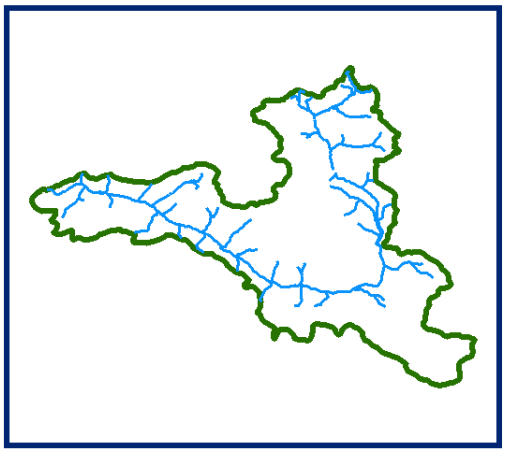
SNOW COVER MAP : CHANDRA BASIN



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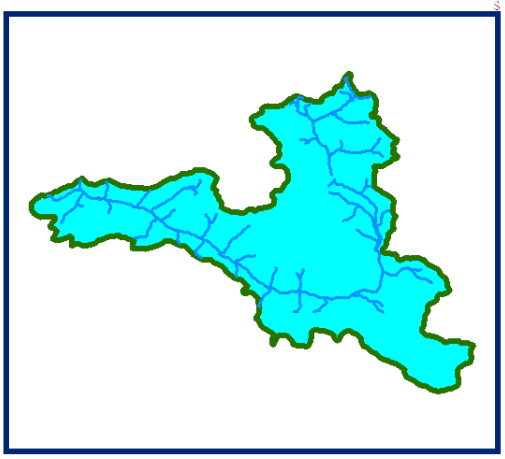

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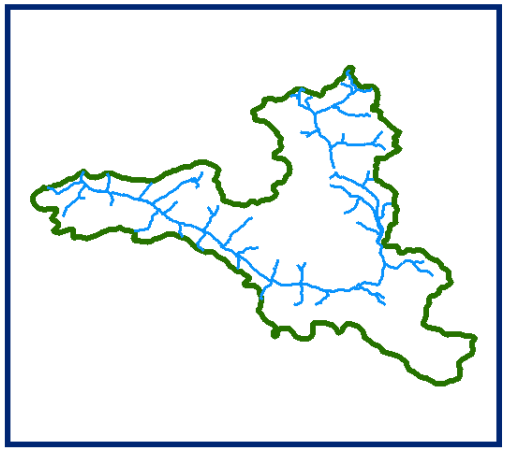

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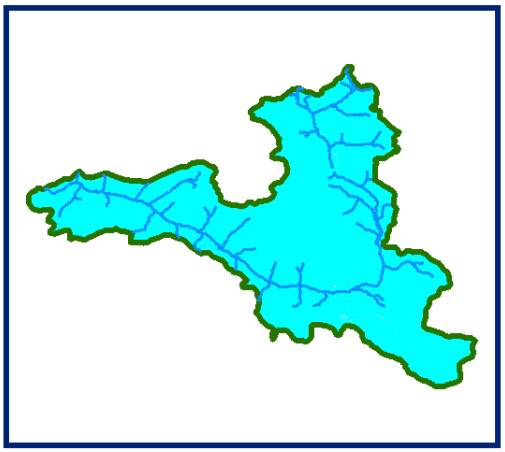

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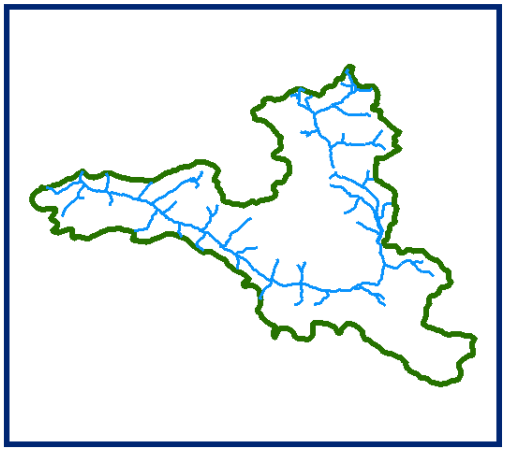

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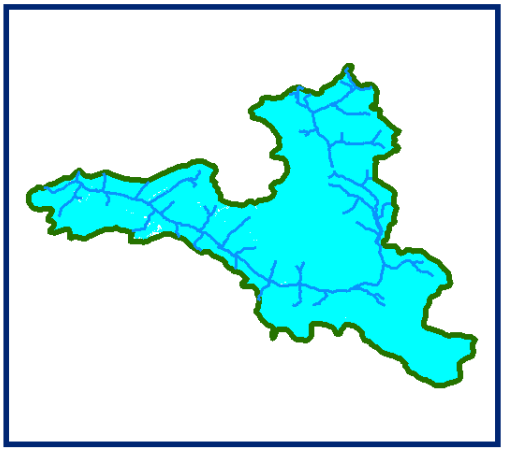

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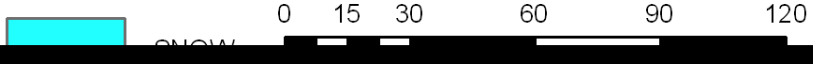
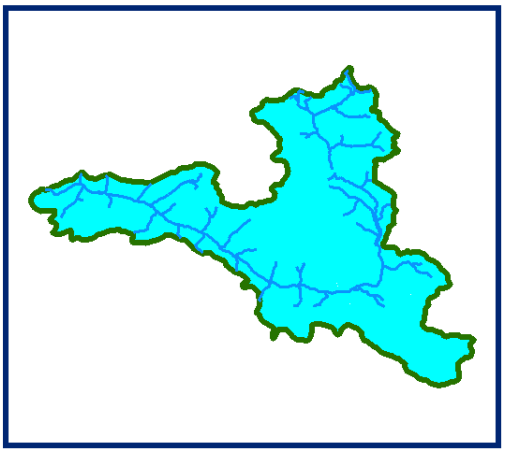


10 DAILY SNOW COVER MAP : CHANDRA BASIN



DATA USED
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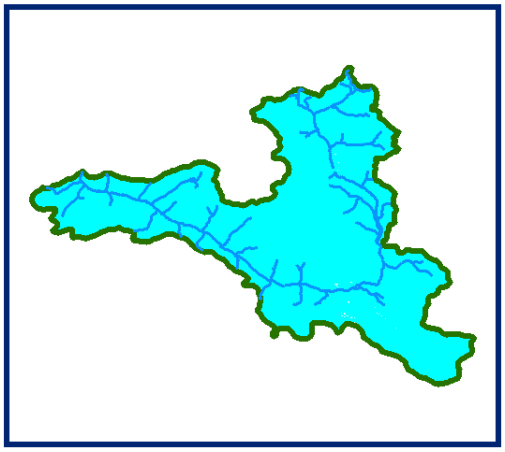

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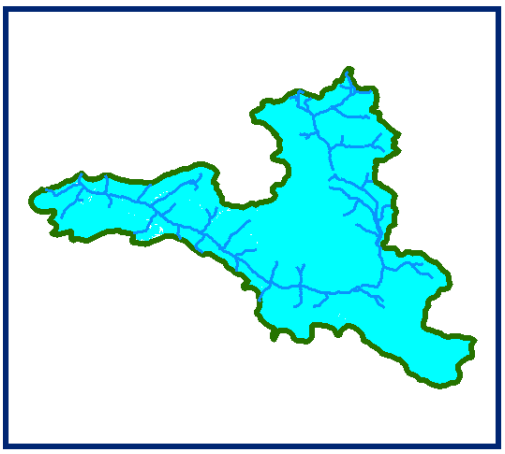

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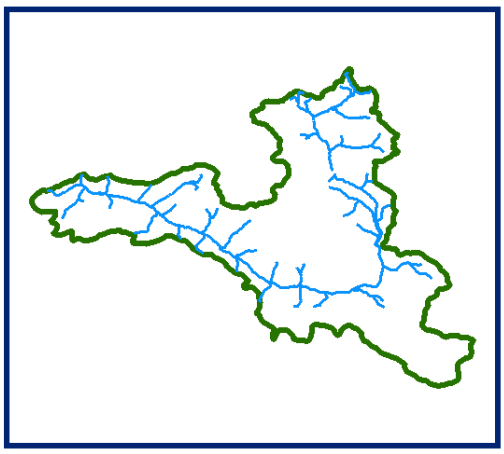
SNOW COVER MAP : CHANDRA BASIN



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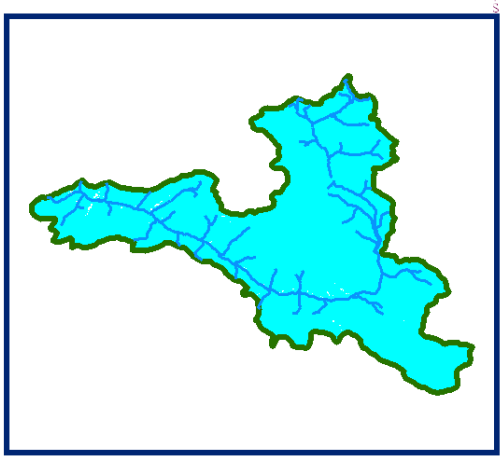
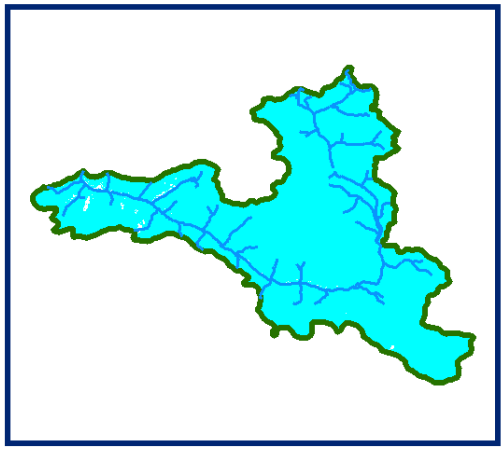
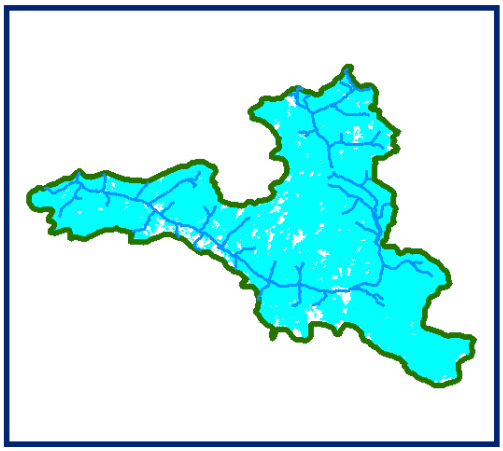


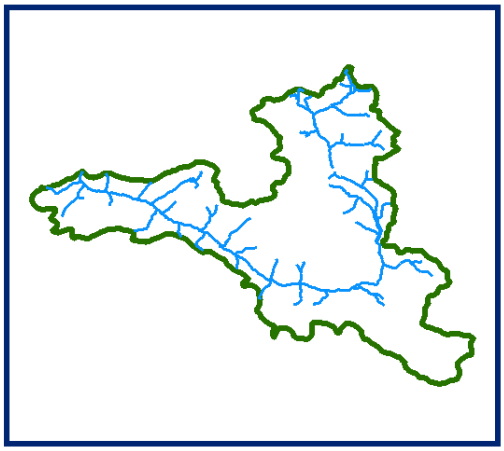
09 APRIL 2011



13 APRIL 2011



18 APRIL 2011



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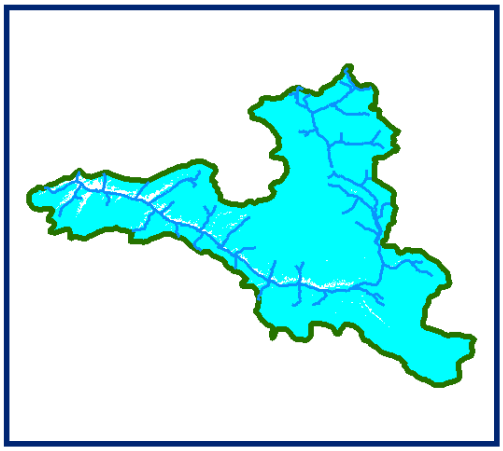
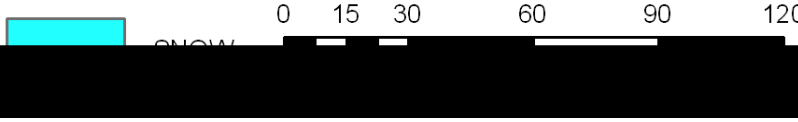
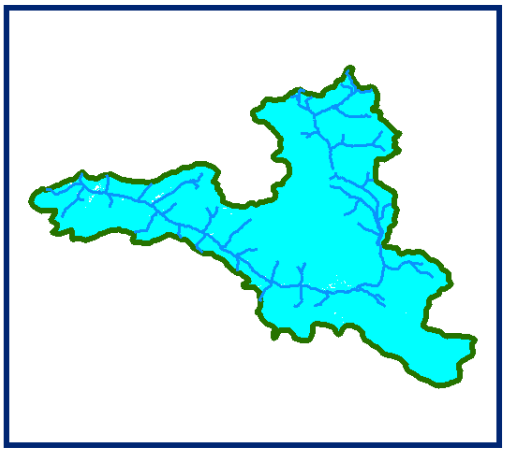


28 APRIL 2011



10 DAILY SNOW COVER MAP : CHANDRA BASIN



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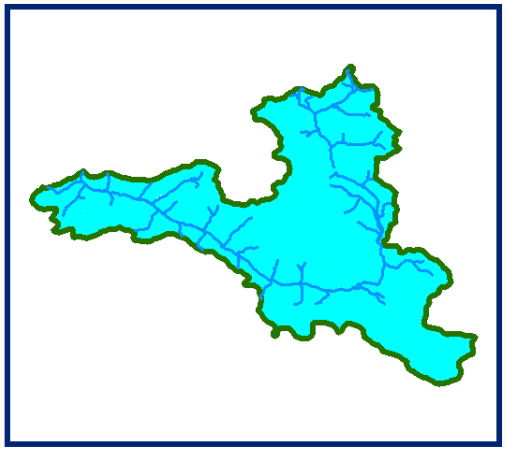

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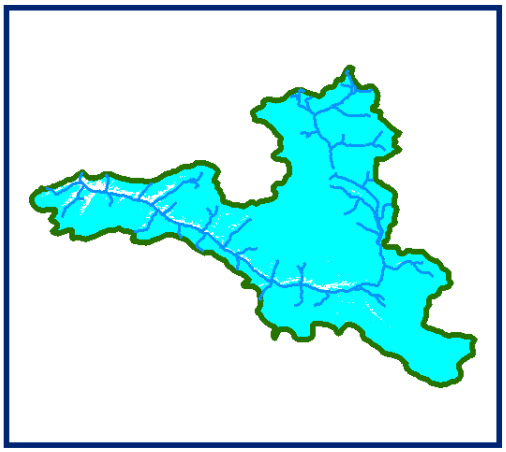
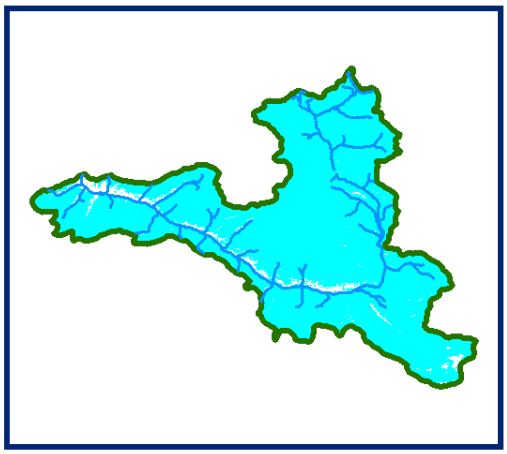


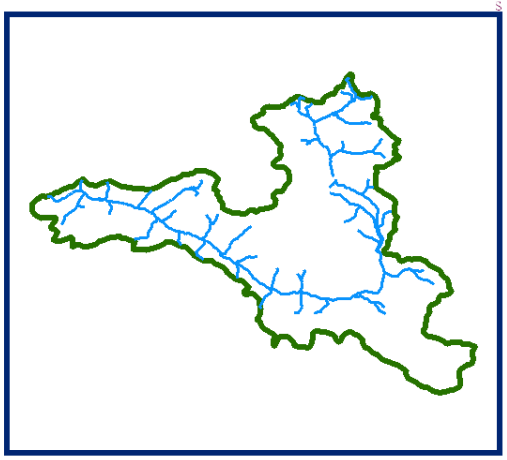
DATA USED
28 APRIL 2011

0 5 10 20 30 40

SNOW COVER MAP : CHANDRA BASIN



02 MAY 2011



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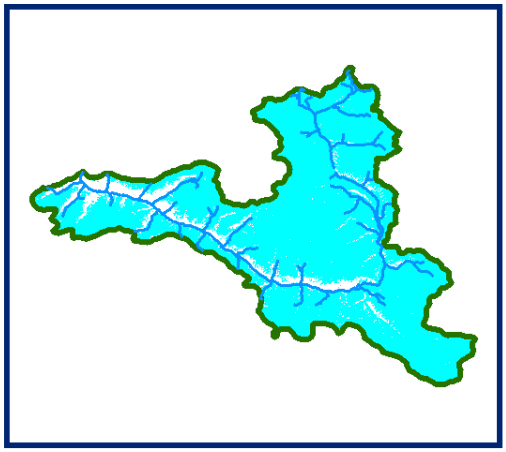
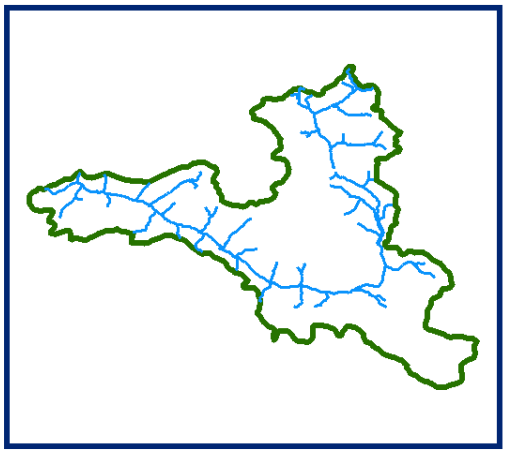


12 MAY 2011



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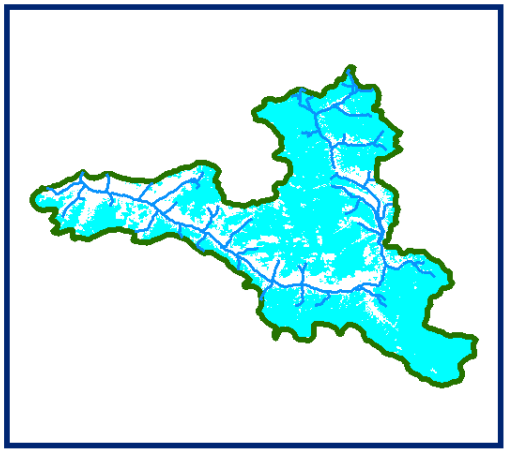
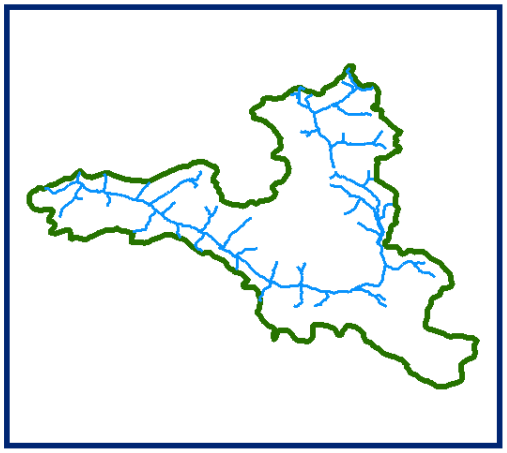


26 MAY 2011



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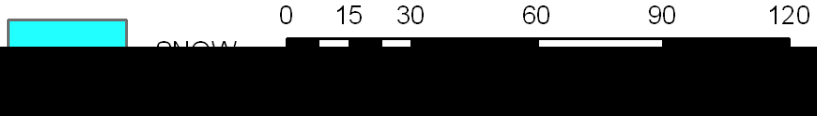
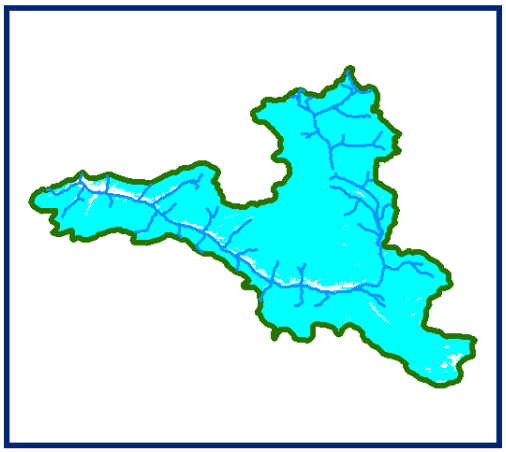
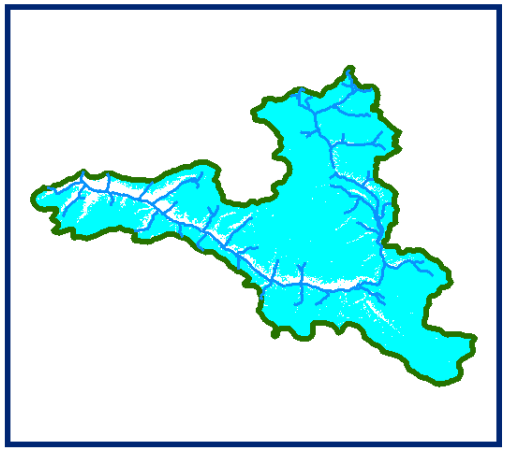


10 DAILY SNOW COVER MAP : CHANDRA BASIN



DATA USED
02 MAY 2011



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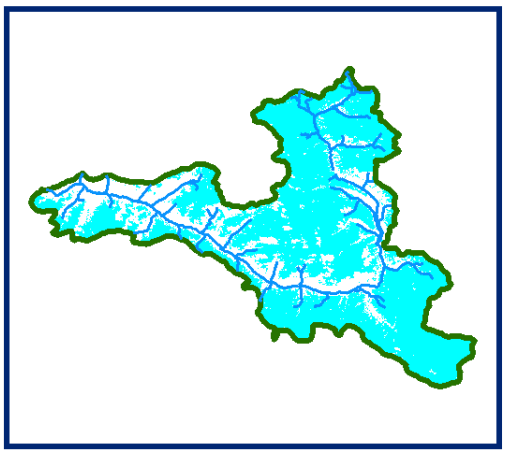
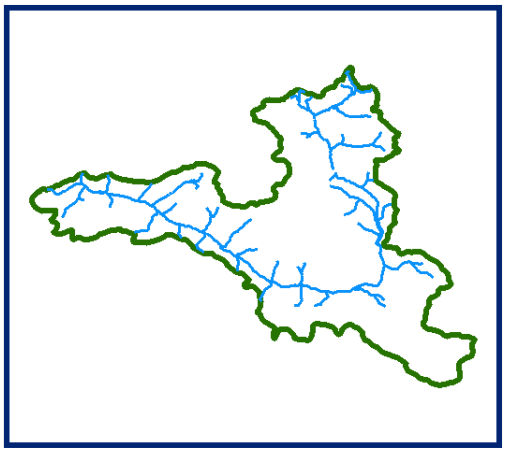


DATA USED
26 MAY 2011

0 5 10 20 30 40

SNOW COVER MAP : CHANDRA BASIN



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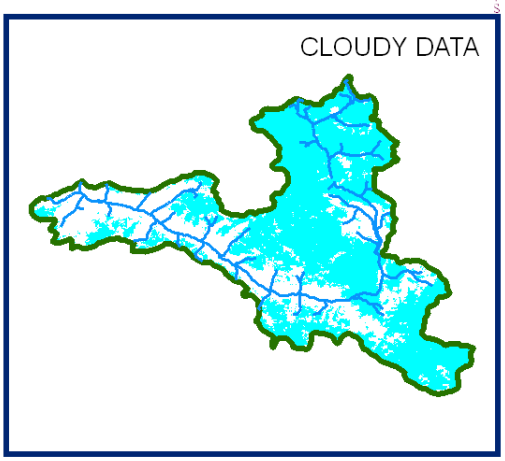
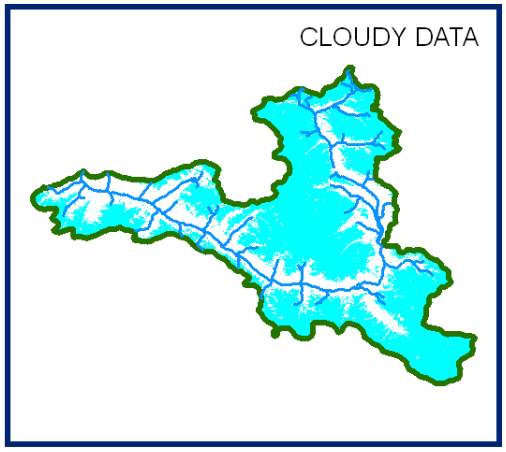


10 JUNE 2011



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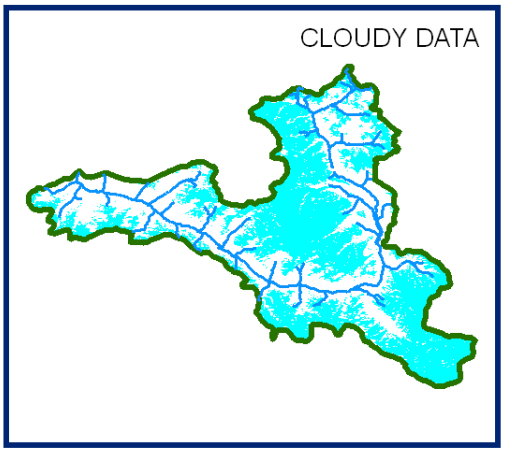

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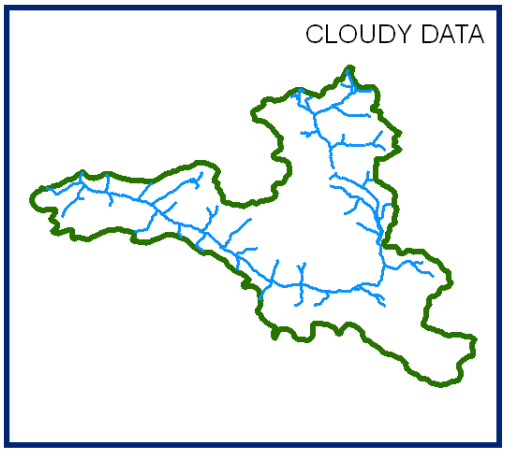

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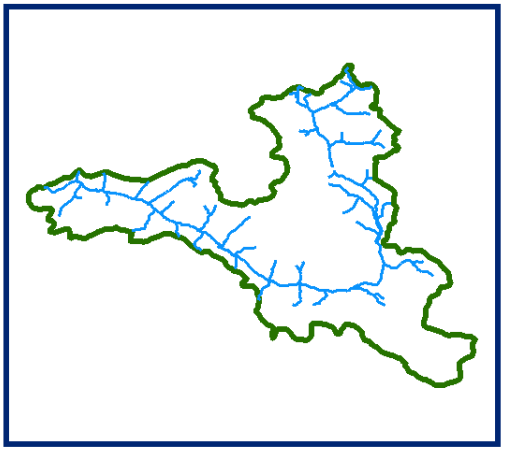

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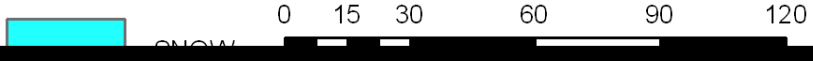
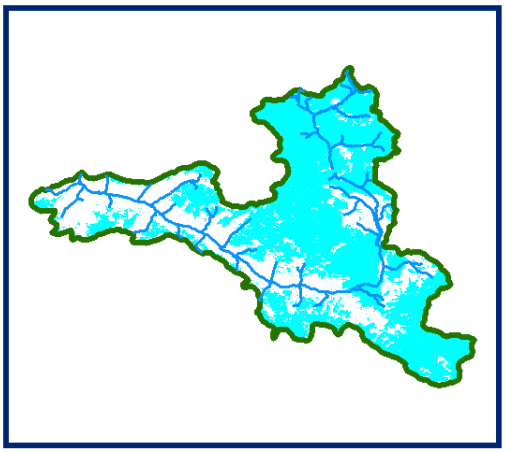


10 DAILY SNOW COVER MAP : CHANDRA BASIN



DATA USED
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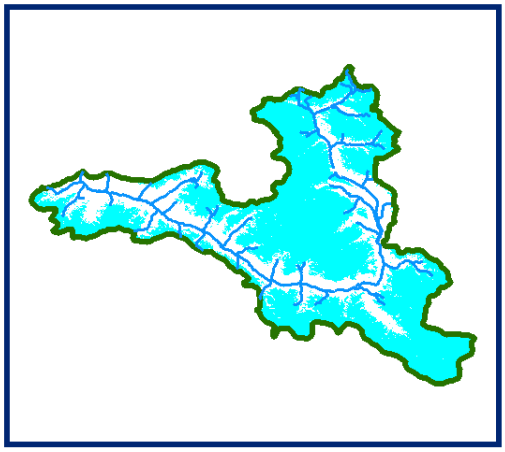
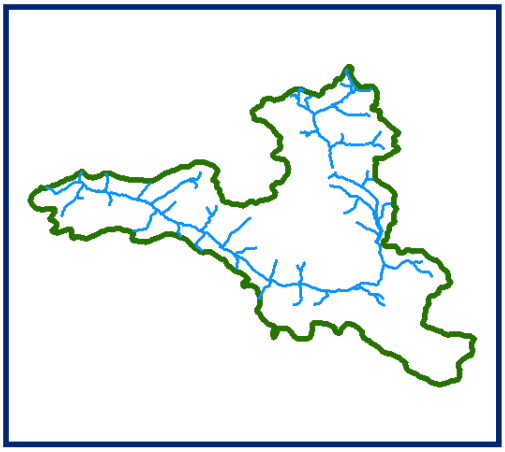


DATA USED
14 JUNE 2011
19 JUNE 2011



DATA NOT AVAILABLE

0 5 10 20 30 40

BHAGA BASIN

AREAL EXTENT OF SNOW (5 DAILY)

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

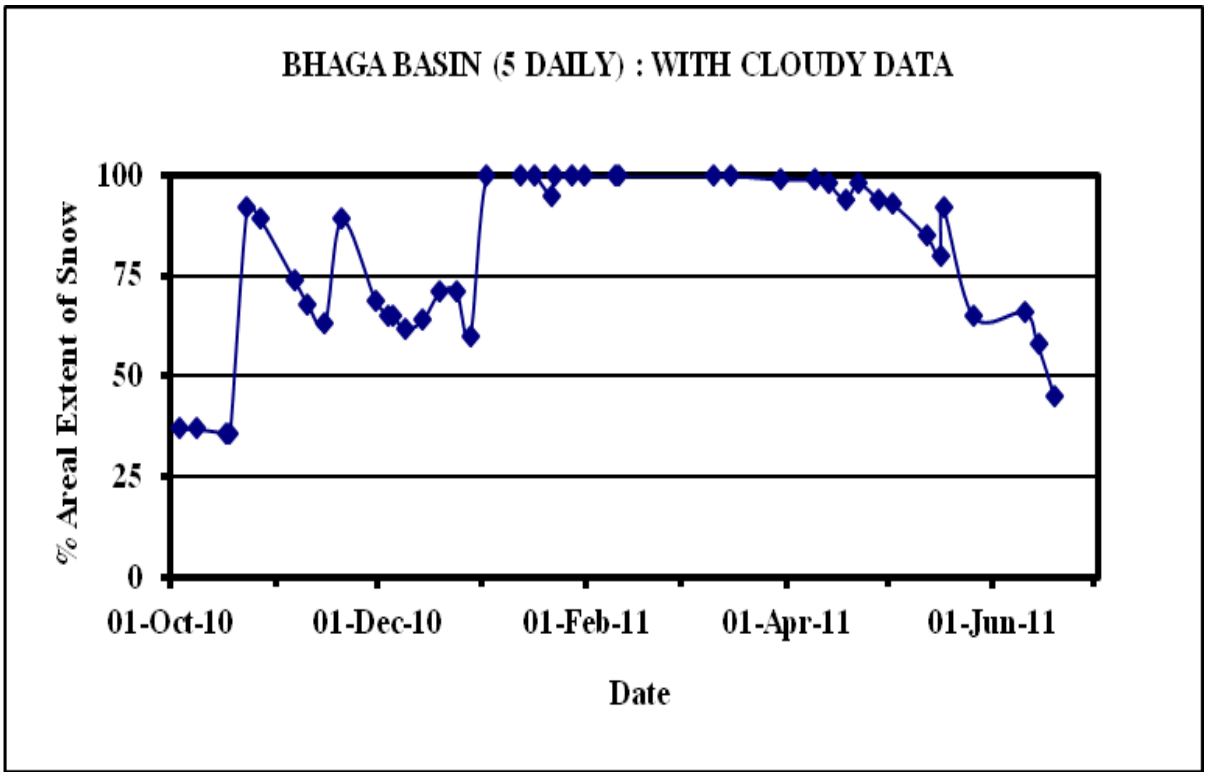
S. No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq. km)	Snow cover (%)
October 2010							
1	3-Oct-10	626.61	37	4	18-Oct-10	611.94	36
2	8-Oct-10	627.36	37	5	23-Oct-10	1548.07	92
3	17-Oct-10	619.33	37	6	27-Oct-10	1496.28	89
November 2010							
7	6-Nov-10	1237.70	74	10	20-Nov-10	1493.76	89
8	10-Nov-10	1148.12	68	11	30-Nov-10	1161.27	69
9	15-Nov-10	1068.08	64				
December 2010							
12	4-Dec-10	1091.98	65	16	19-Dec-10	1200.73	71
13	5-Dec-10	1087.19	65	17	24-Dec-10	1196.43	71
14	9-Dec-10	1051.03	63	18	28-Dec-10	1016.47	61
15	14-Dec-10	1076.52	64				
January 2011							
19	2-Jan-11	1695.92	100	23	22-Jan-11	1696.46	100
20	12-Jan-11	1695.92	100	24	27-Jan-11	1695.86	100
21	16-Jan-11	1695.48	100	25	31-Jan-11	1689.15	100
22	21-Jan-11	1606.1	96				
February 2011							
26	9-Feb-11	1695.48	100	27	10-Feb-11	1696.43	100
March 2011							
28	10-Mar-11	1696.62	100	29	15-Mar-11	1695.48	100
30	30-Mar-11	1678.1	99				
April 2011							
31	9-Apr-11	1667.93	99	34	22-Apr-11	1649	98
32	13-Apr-11	1658.94	99	35	28-Apr-11	1583.99	94
33	18-Apr-11	1591	95				
May-2011							
36	2-May-11	1576.77	94	39	17-May-11	1548.54	92
37	12-May-11	1444.2	86	40	26-May-11	1093.66	66
38	16-May-11	1345.86	80				
June-2011							
41	10-June-11	1113.41	66	43	19-June-11	7581.71	45
42	14-June-11	9812.59	58				

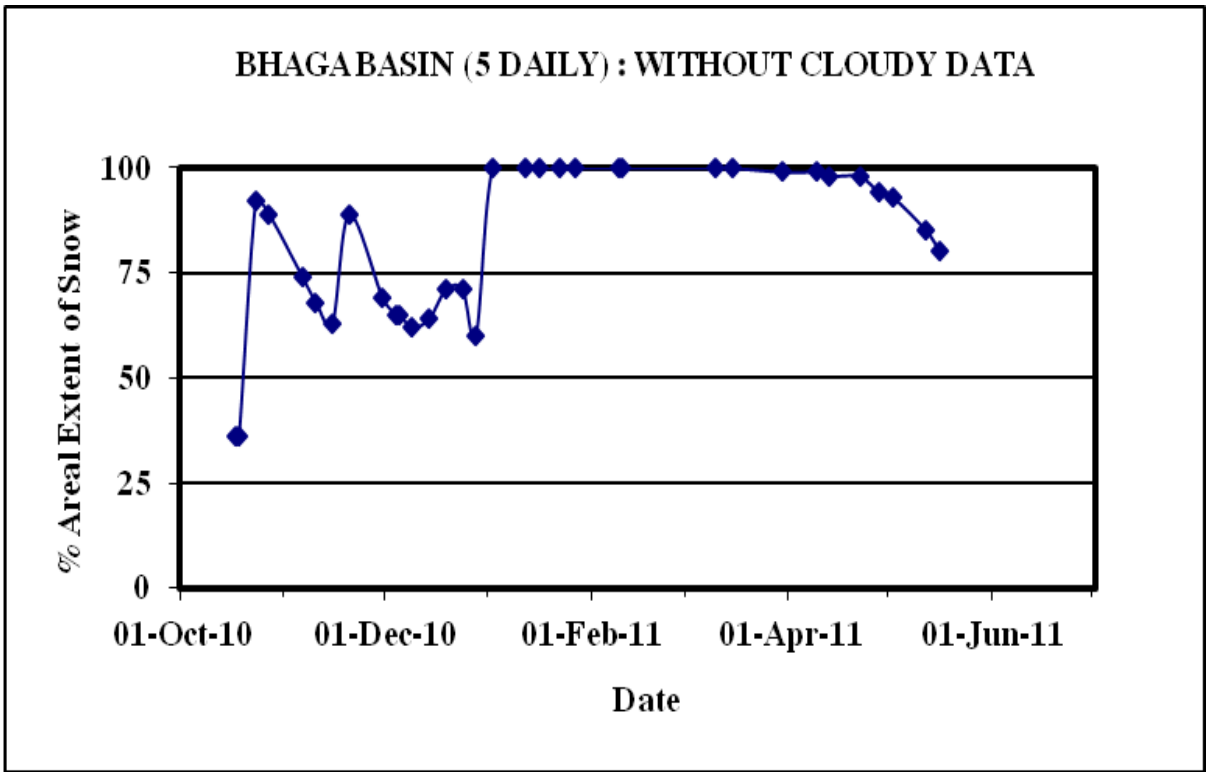
AREAL EXTENT OF SNOW (10 DAILY)

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

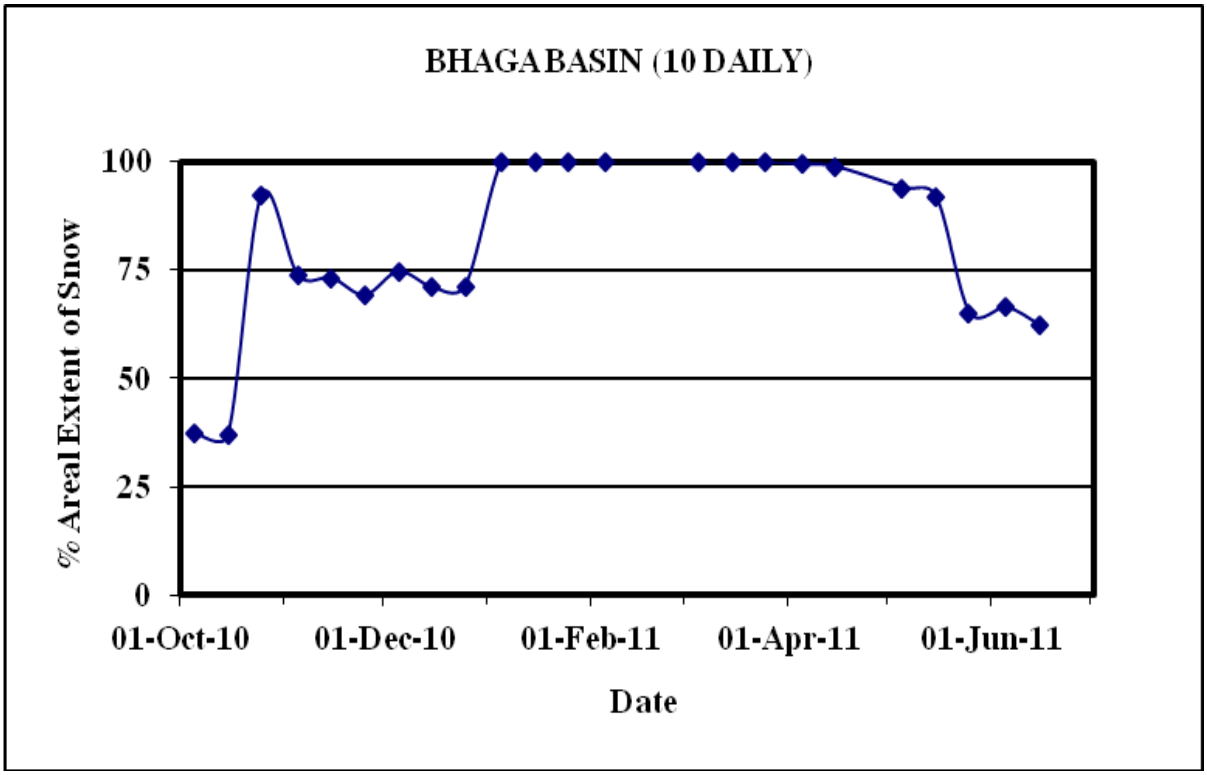
S. No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	626.55	37	2	15-Oct-10	619.08	37
3	25-Oct-10	1546.5	92				
November 2010							
4	5-Nov-10	1237.56	74	5	15-Nov-10	1227.24	73
6	25-Nov-10	1161.27	69				
December 2010							
7	5-Dec-10	1252.07	75	8	15-Dec-10	1076.52	64
9	25-Dec-10	1196.43	71				
January 2011							
10	5-Jan-11	1695.92	100	11	15-Jan-11	1695.86	100
12	25-Jan-11	1699.3	100				
February 2011							
13	5-Feb-11	1695.86	100				
March 2011							
15	5-Mar-11	1696.62	100	16	15-Mar-11	1695.48	100
17	25-Mar-11	1678.1	99				
April 2011							
18	5-Apr-11	1667.93	99	19	15-Apr-11	1659.05	99
May 2011							
21	5-May-11	1576.77	94	22	15-May-11	1542.36	92
23	25-May-11	1093.66	65				
June 2011							
24	5-June-11	1113.41	66	25	15-June-11	1046.02	62

SNOW COVER DEPLETION CURVE



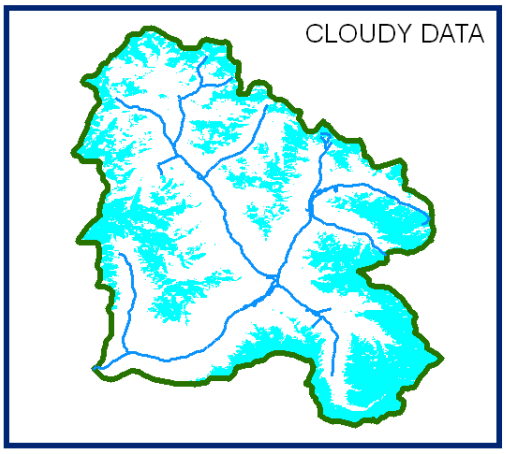


SNOW COVER DEPLETION CURVE

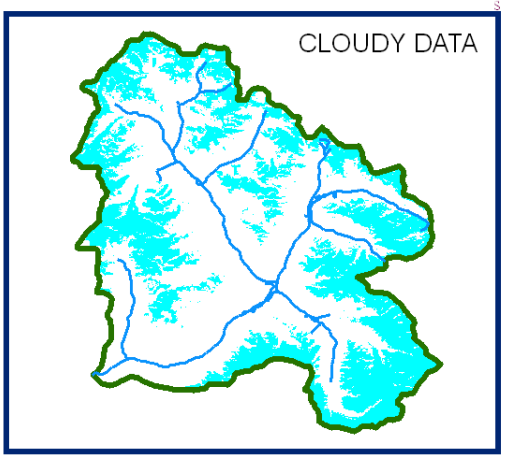


SNOW COVER MAP

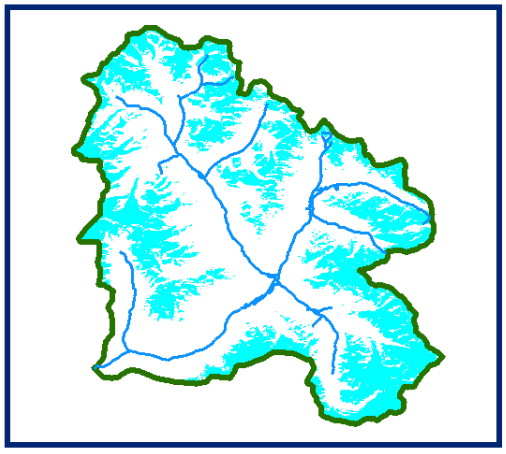
SNOW COVER MAP : BHAGA BASIN



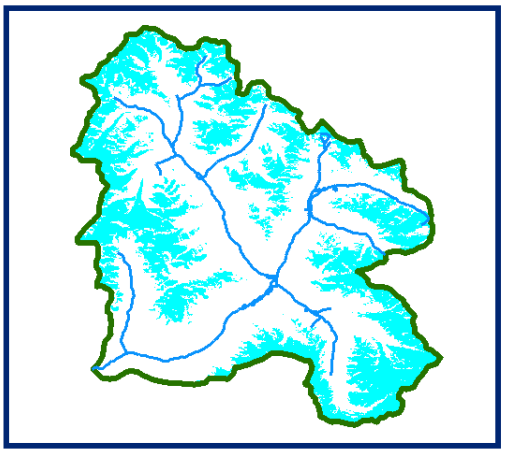
03 OCTOBER 2010



08 OCTOBER 2010



18 OCTOBER 2010



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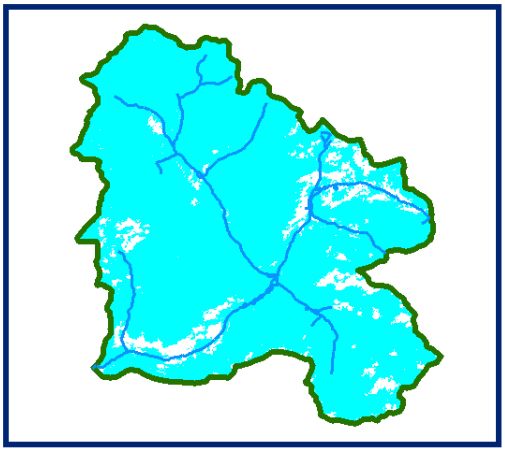
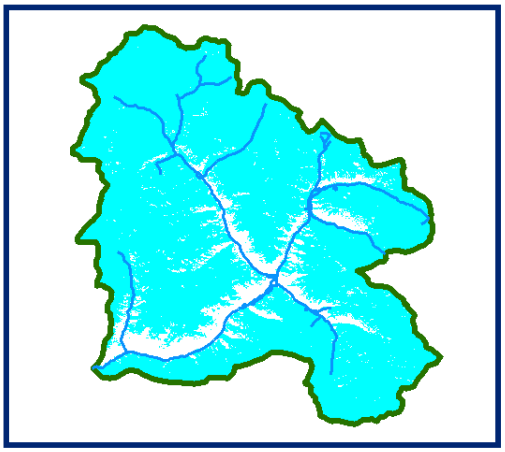


23 OCTOBER 2010



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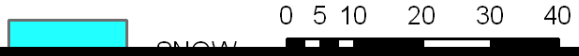
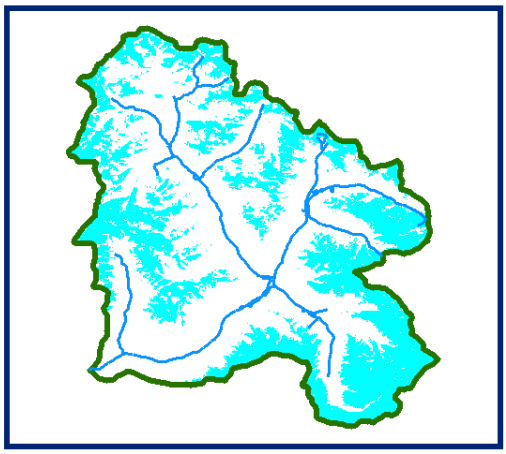


10 DAILY SNOW COVER MAP : BHAGA BASIN



DATA USED
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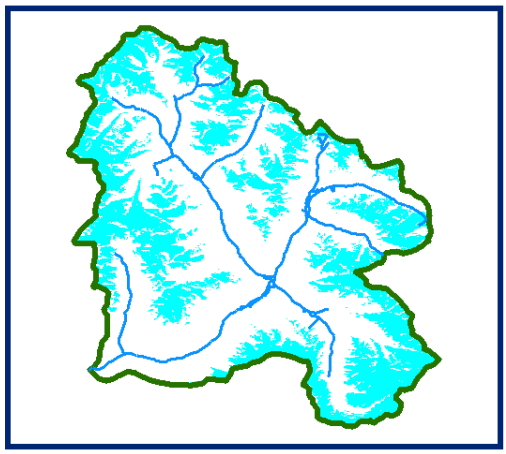
08 OCTOBER 2010



DATA USED
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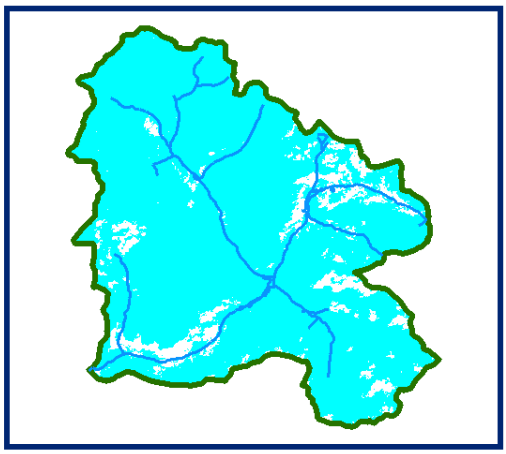
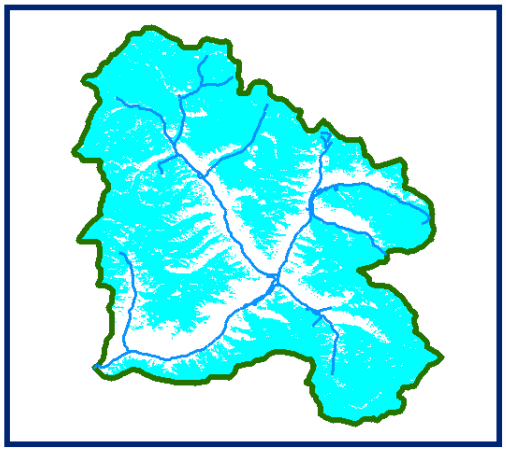


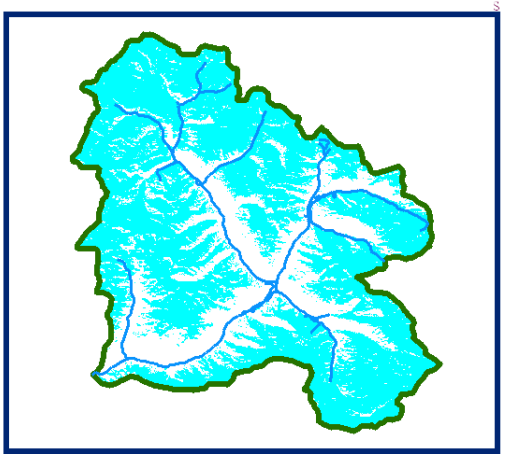
DATA USED
23 OCTOBER 2010
27 OCTOBER 2010

0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



06 NOVEMBER 2010



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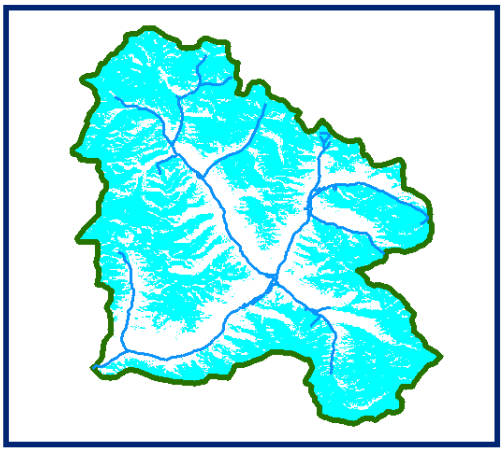

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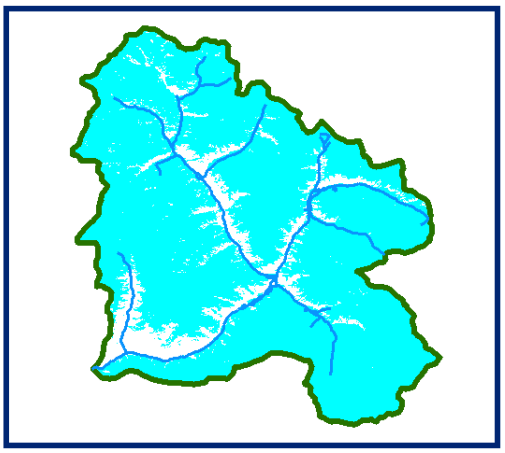
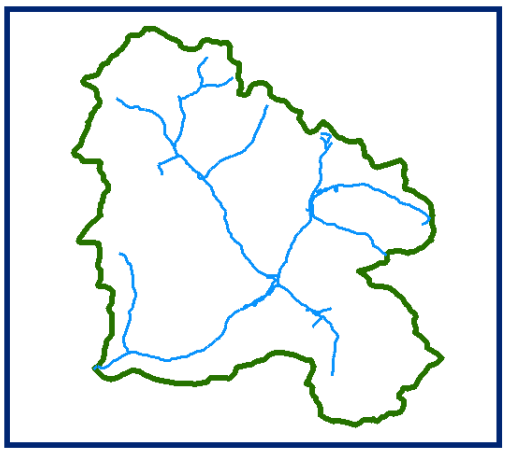


20 NOVEMBER 2010



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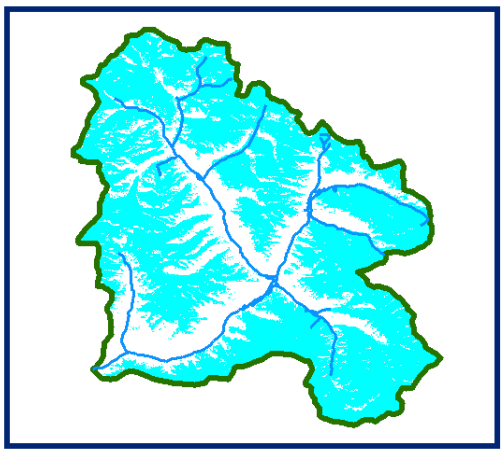
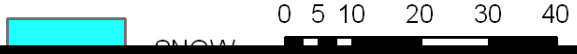
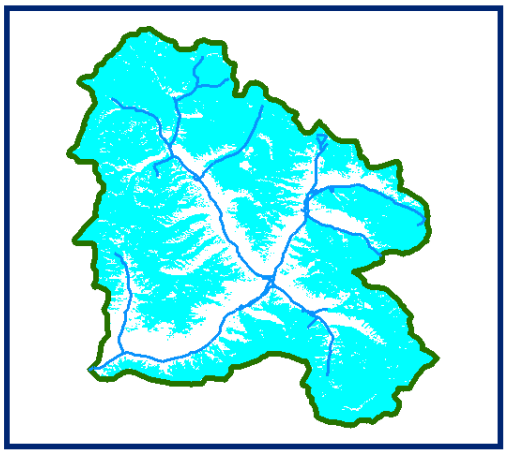


30 NOVEMBER 2010



10 DAILY SNOW COVER MAP : BHAGA BASIN



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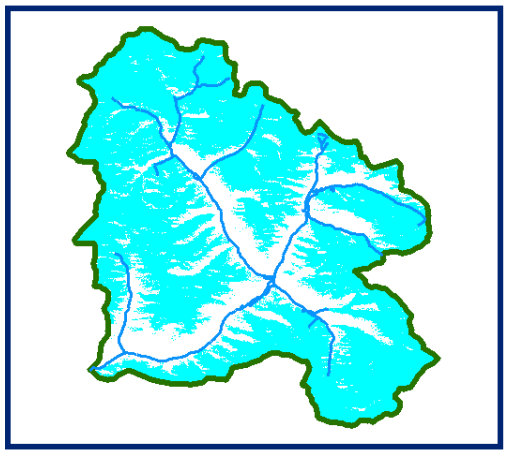
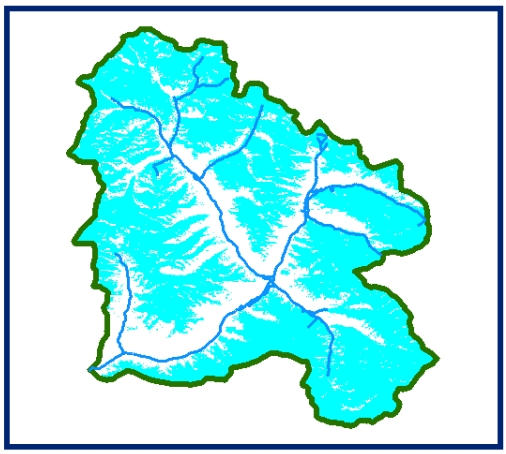
06 NOVEMBER 2010
10 NOVEMBER 2010



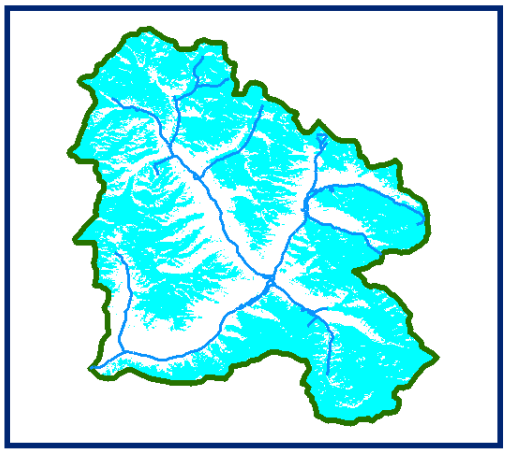
DATA USED
15 NOVEMBER 2010
20 NOVEMBER 2010



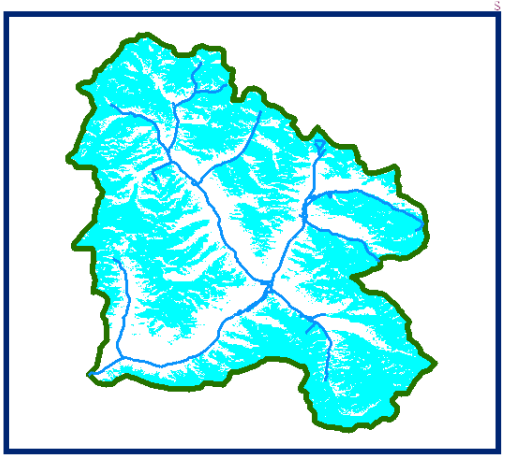
DATA USED
30 NOVEMBER 2010

0 5 10 20 30 40

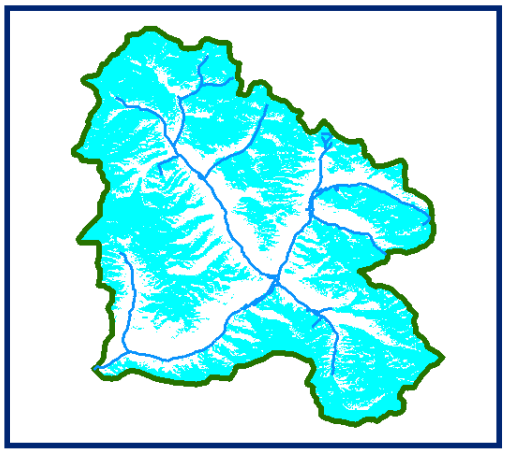
SNOW COVER MAP : BHAGA BASIN



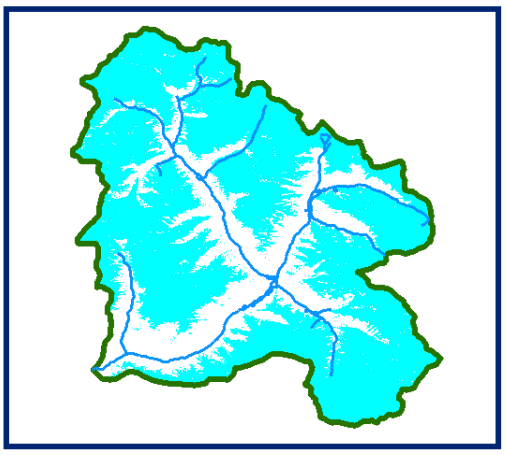
05 DECEMBER 2010



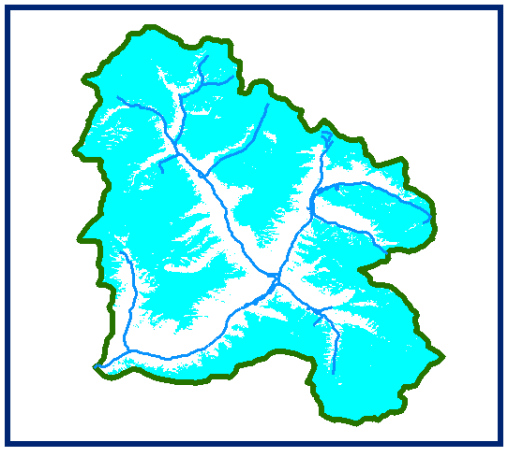
09 DECEMBER 2010



14 DECEMBER 2010



19 DECEMBER 2010



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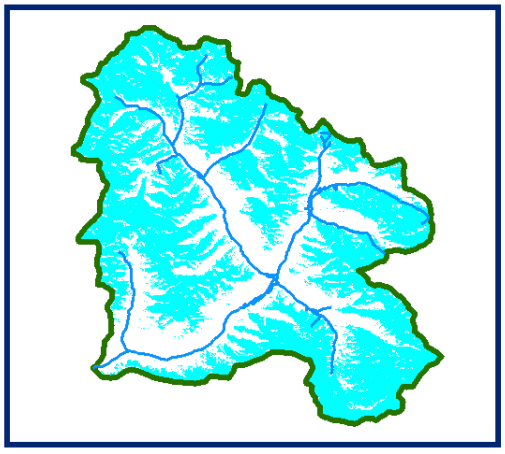

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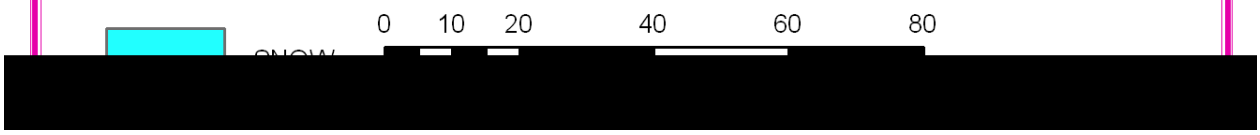
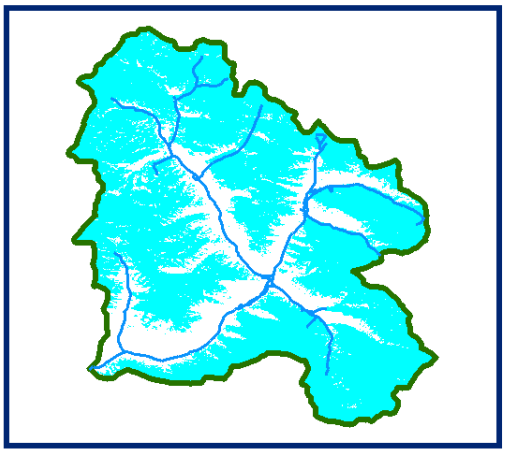


10 DAILY SNOW COVER MAP : BHAGA BASIN



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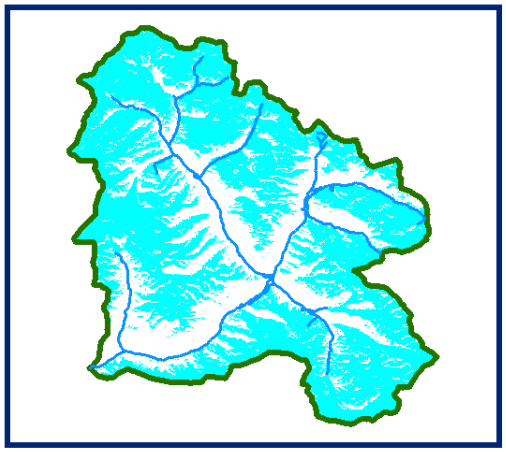
04 DECEMBER 2010
05 DECEMBER 2010
09 DECEMBER 2010



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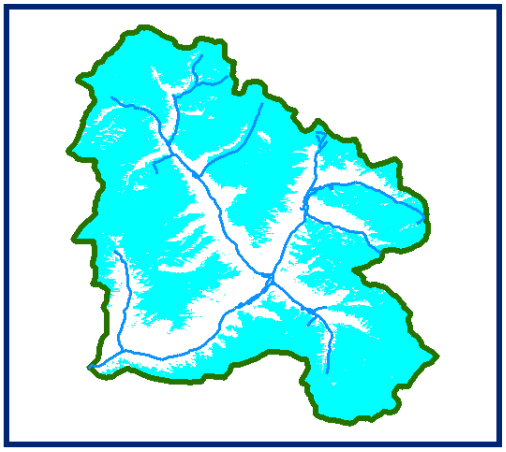

DATA USED
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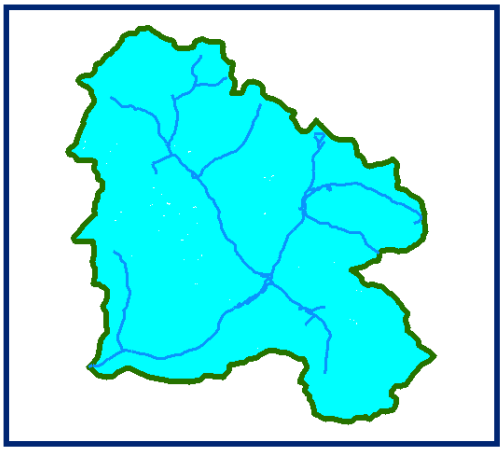
0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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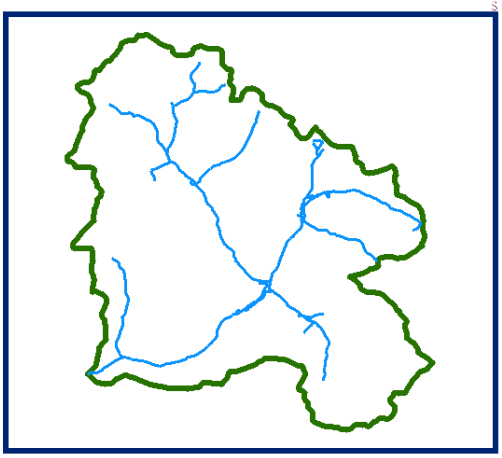

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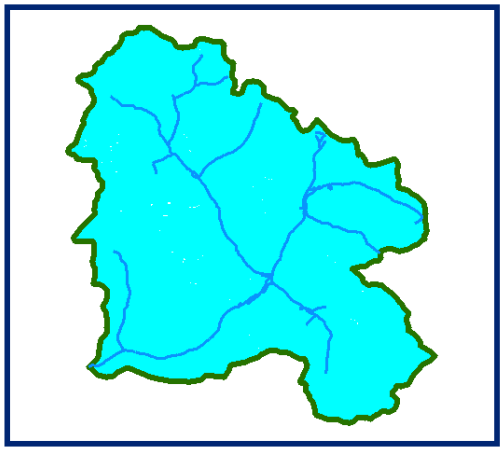

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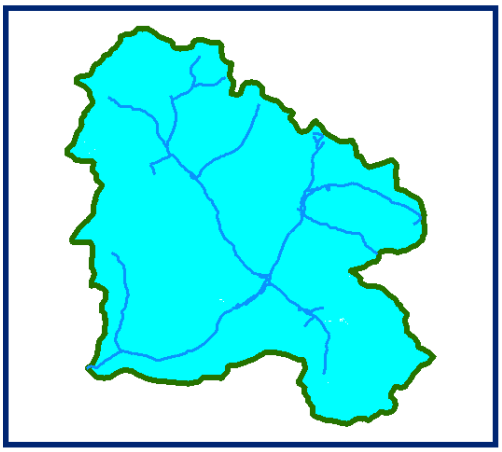

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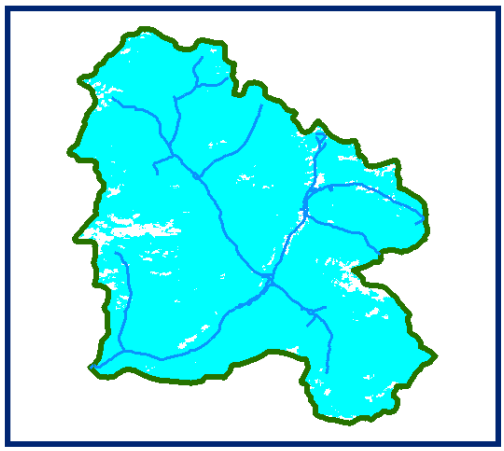

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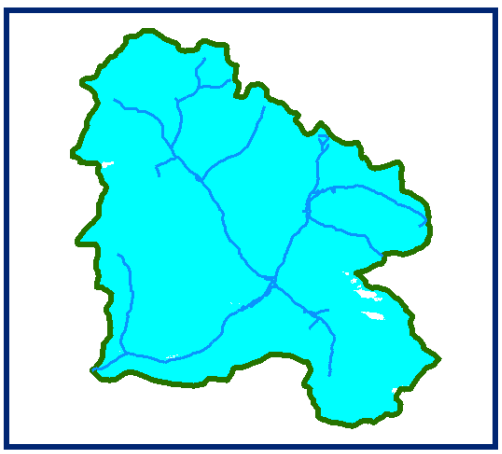

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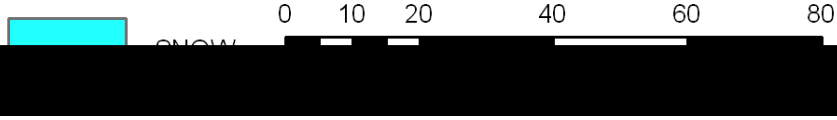
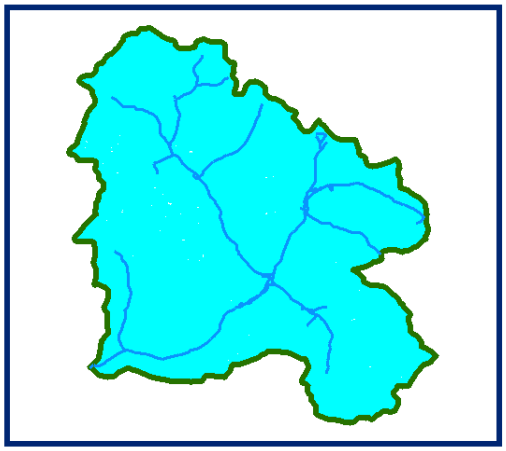


10 DAILY SNOW COVER MAP : BHAGA BASIN



DATA USED
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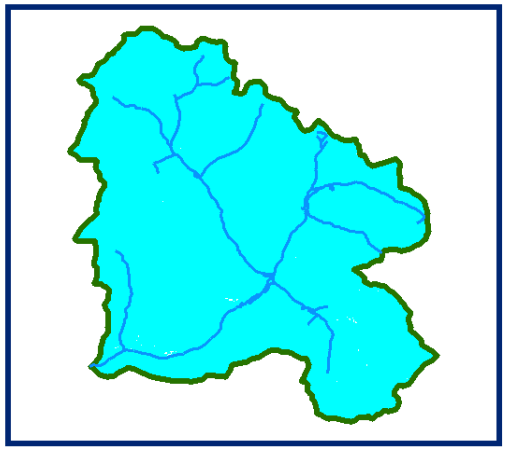

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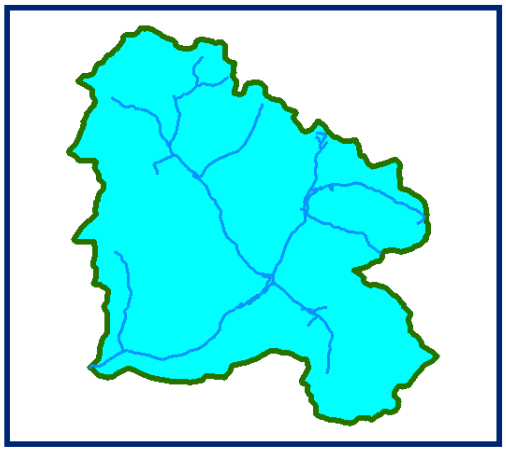
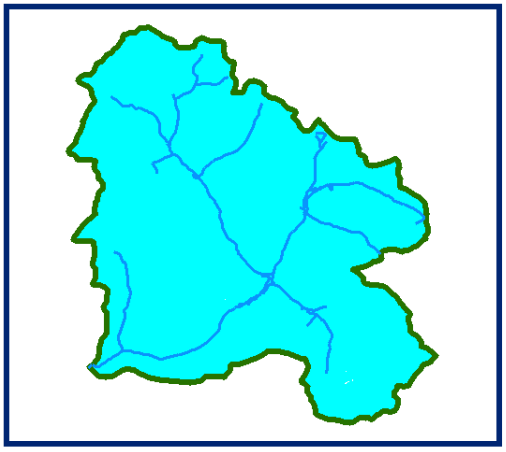


DATA USED
22 JANUARY 2011
26 JANUARY 2011
31 JANUARY 2011

0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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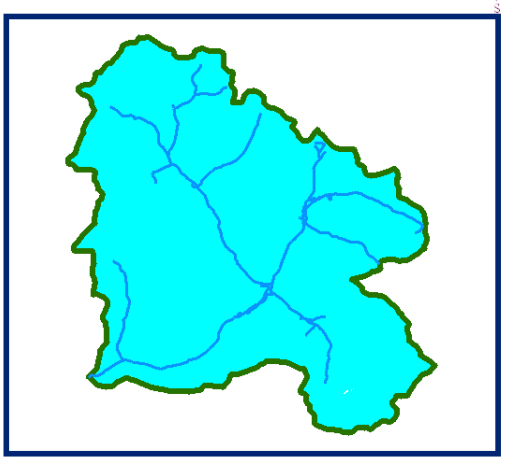

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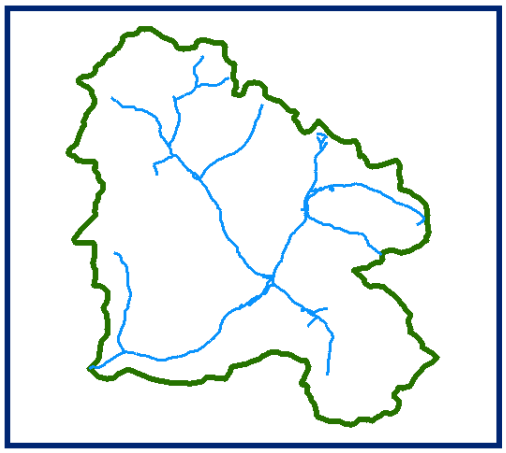

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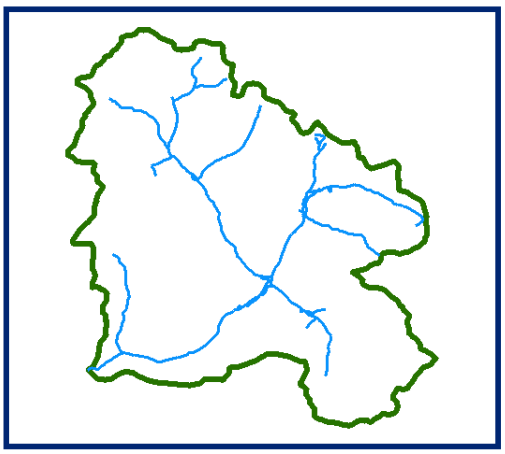

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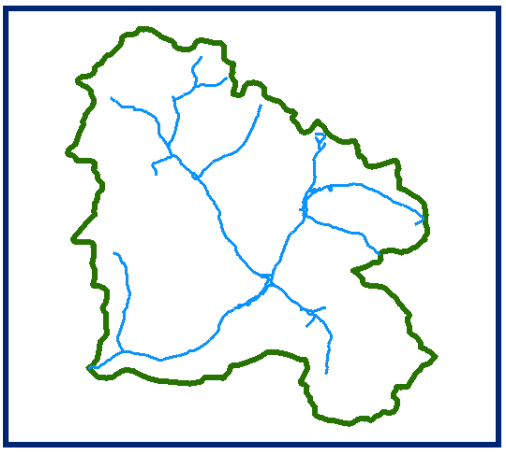

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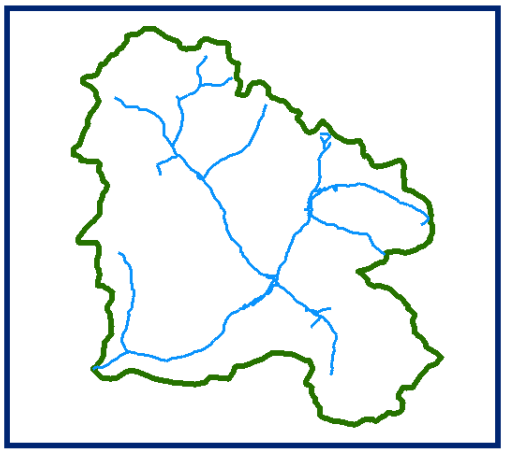

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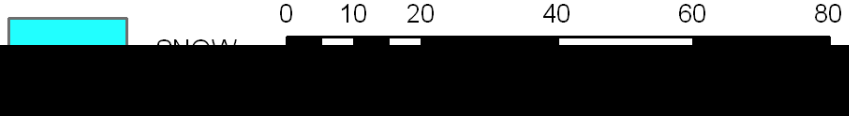
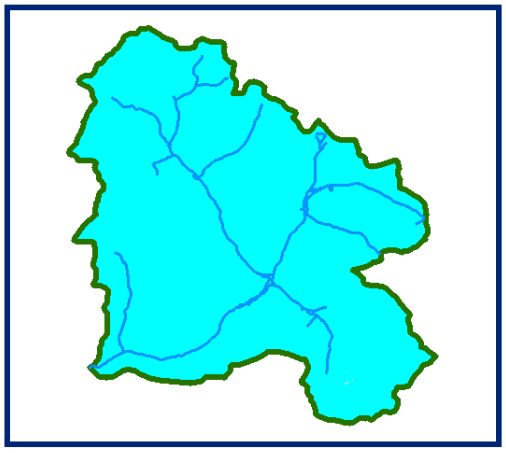


10 DAILY SNOW COVER MAP : BHAGA BASIN



DATA USED
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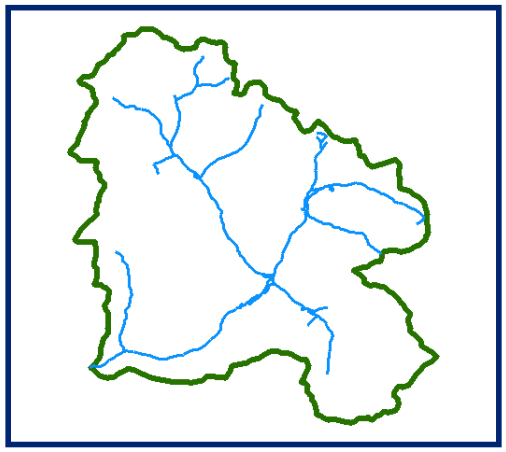

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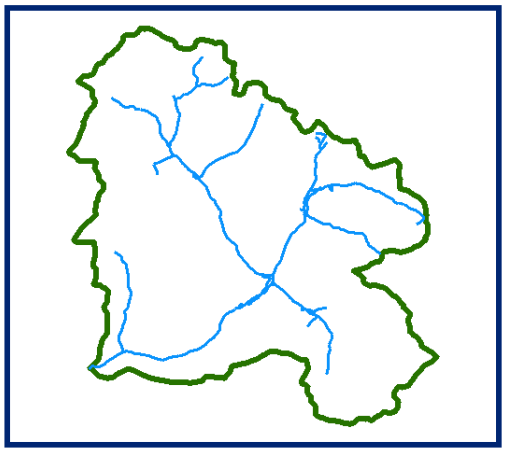

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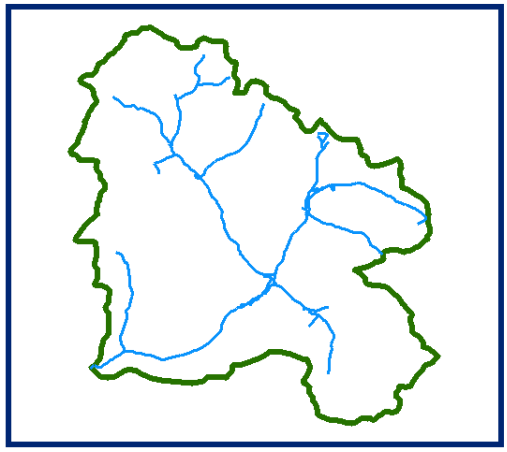
0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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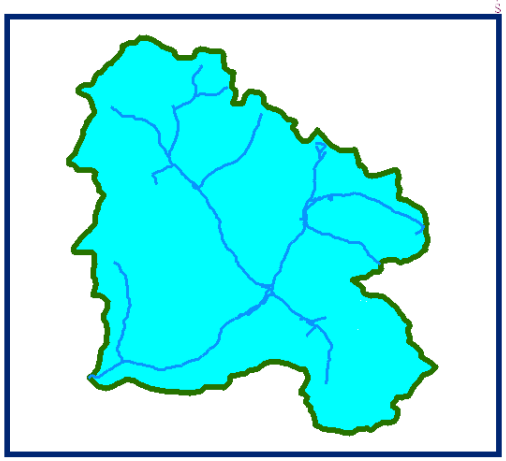

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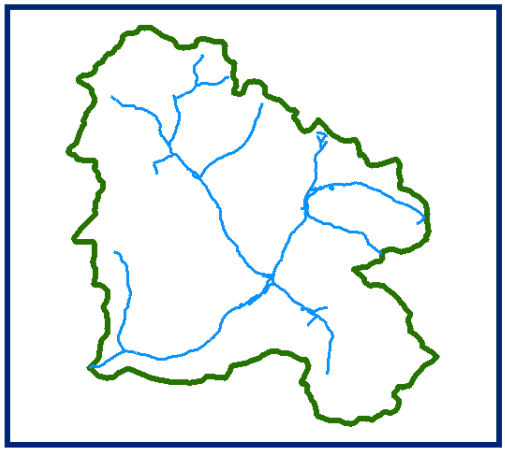

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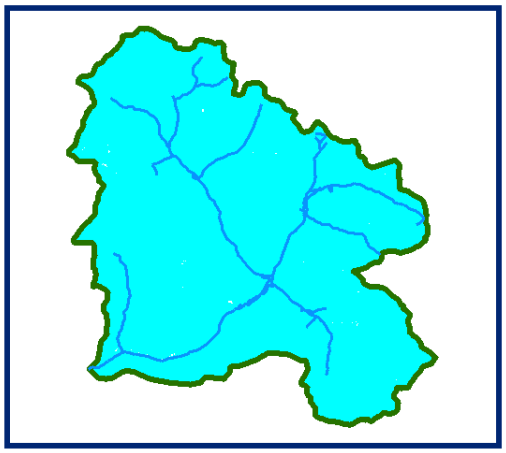

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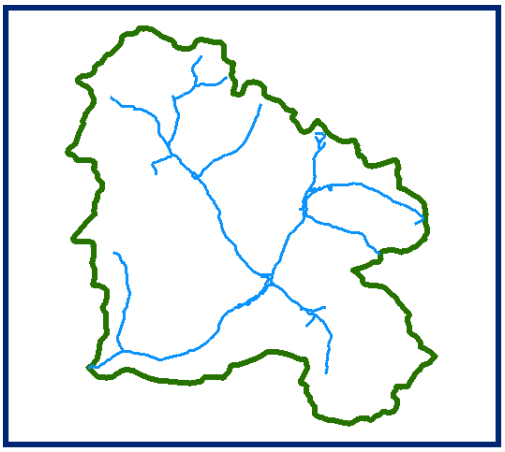

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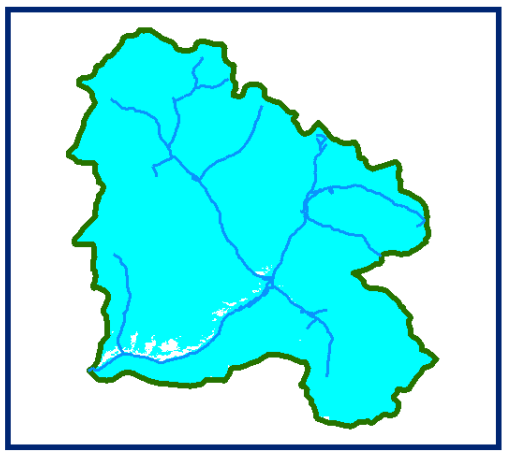

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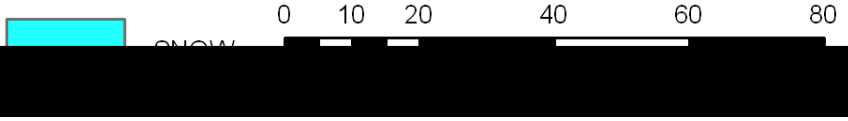
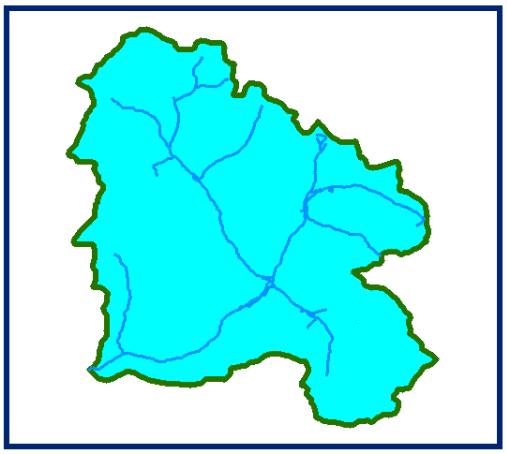


10 DAILY SNOW COVER MAP : BHAGA BASIN



DATA USED
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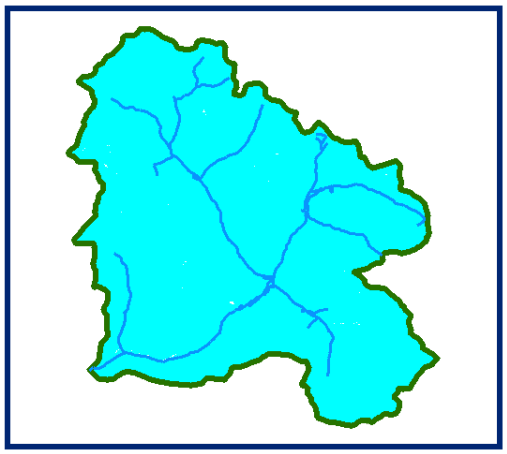

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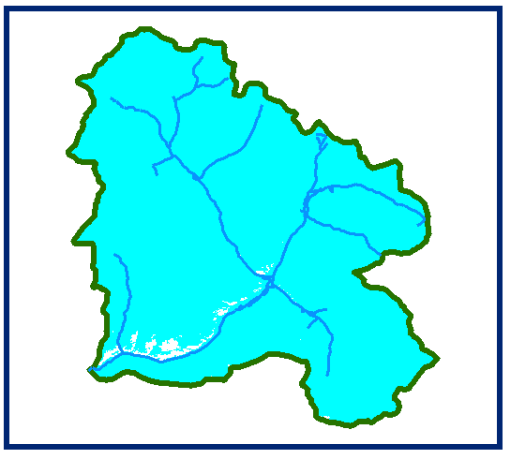
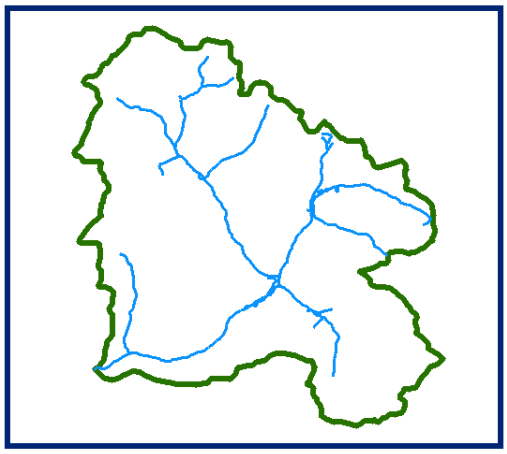


DATA USED
30 MARCH 2011

0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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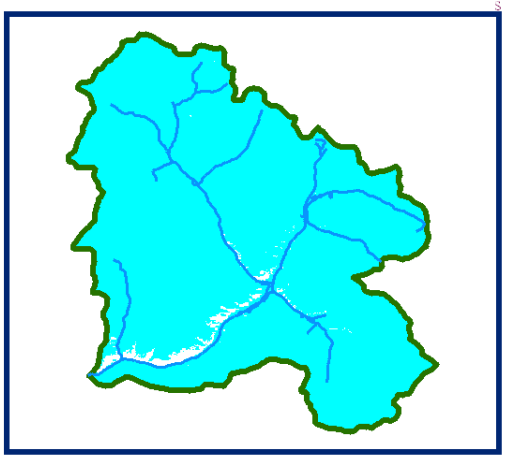

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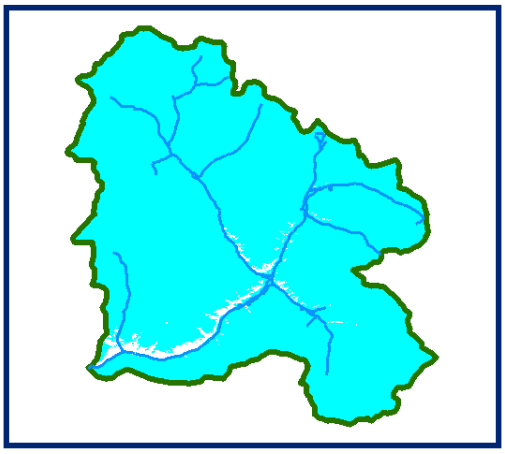
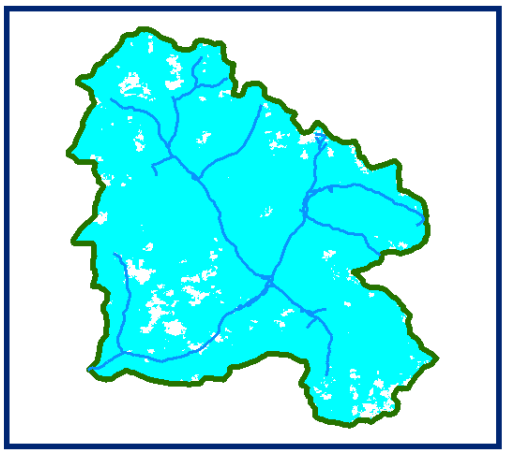


13 APRIL 2011



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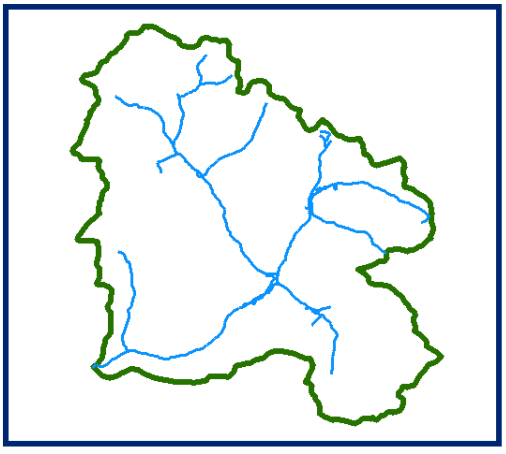

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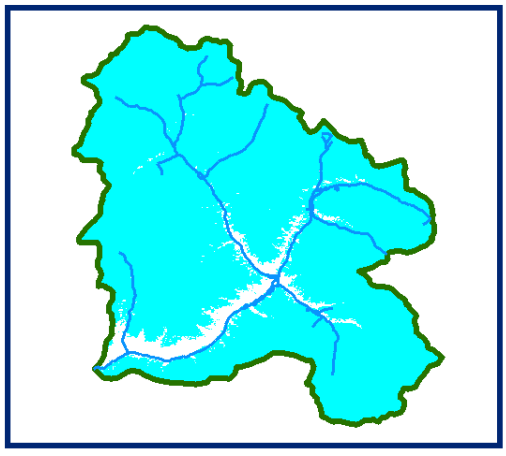

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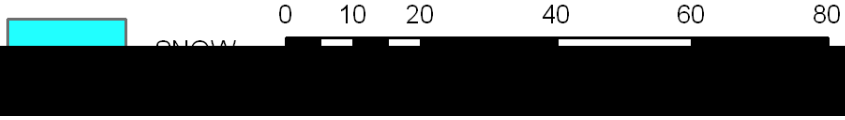
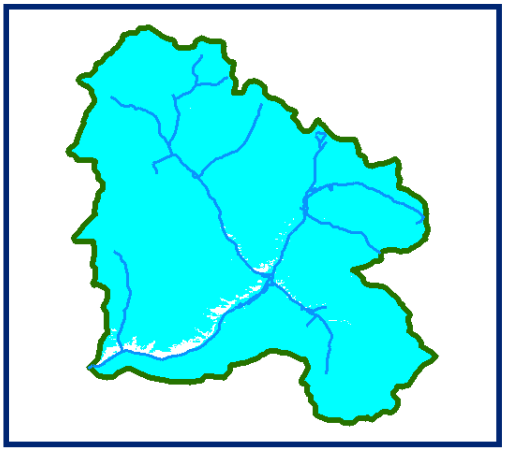


10 DAILY SNOW COVER MAP : BHAGA BASIN



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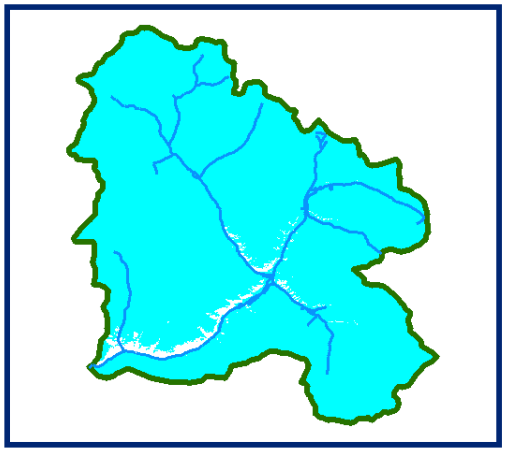

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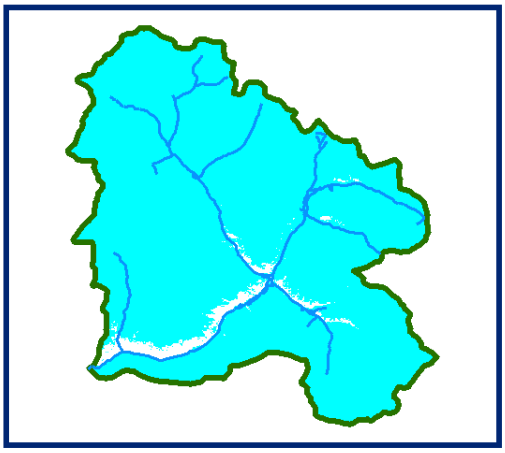
18 APRIL 2011



DATA USED
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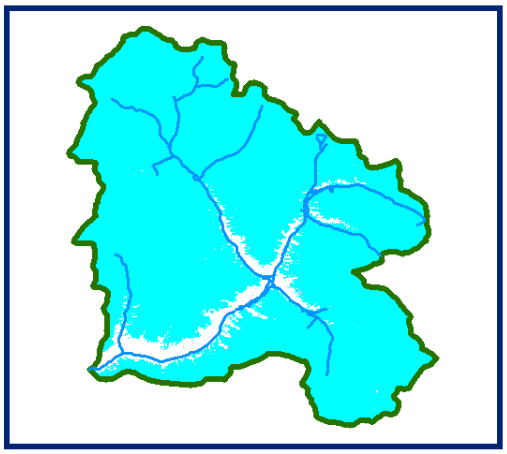
28 APRIL 2011

0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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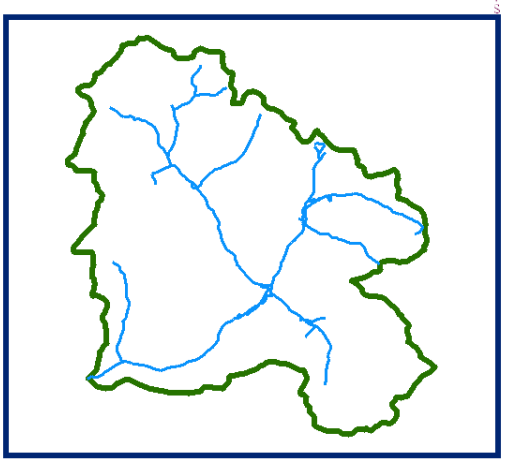

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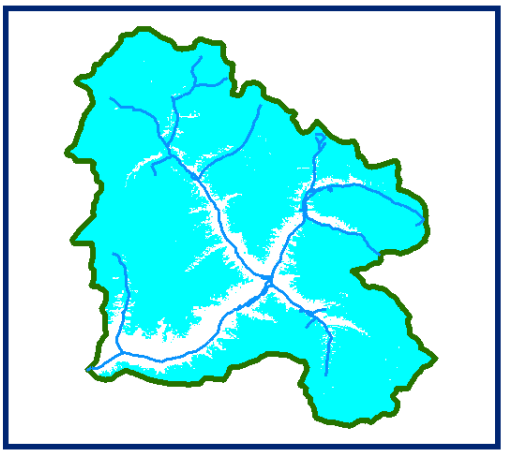

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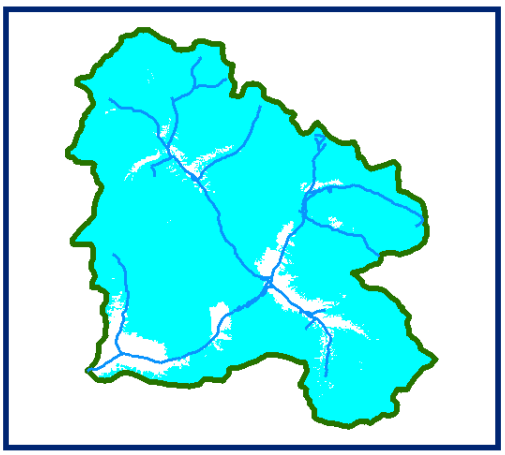

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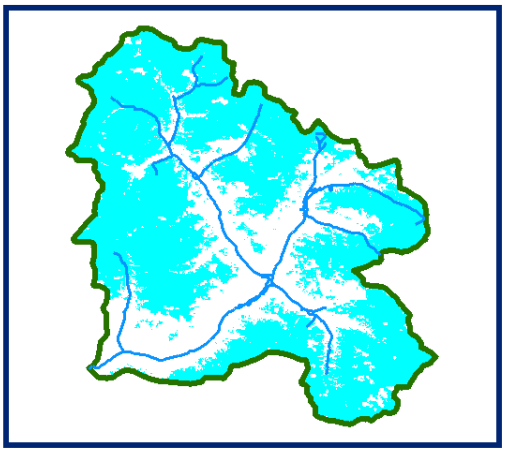

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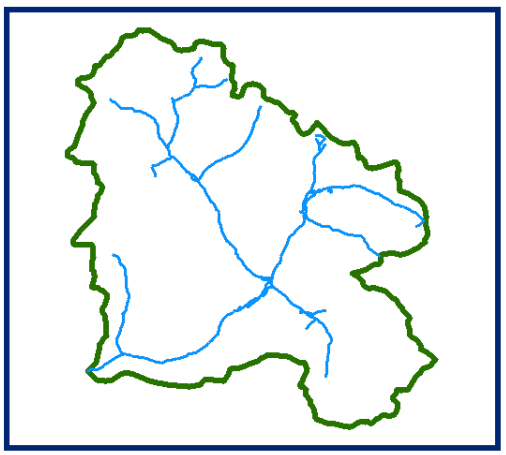

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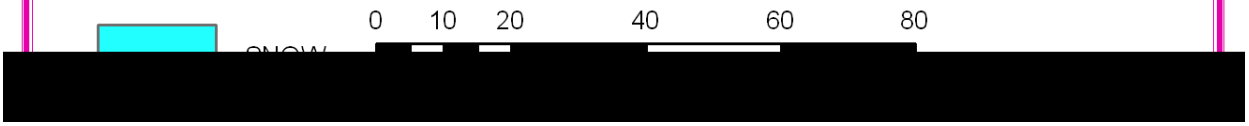
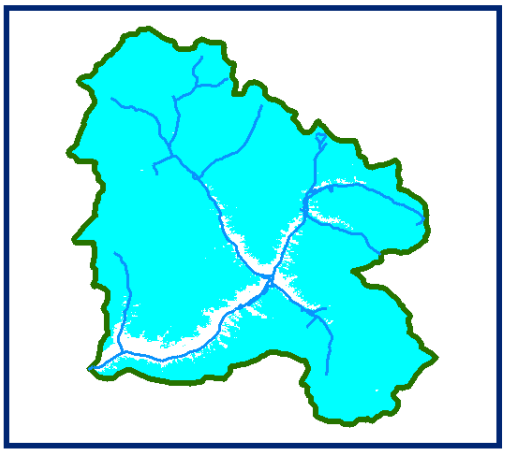


10 DAILY SNOW COVER MAP : BHAGA BASIN



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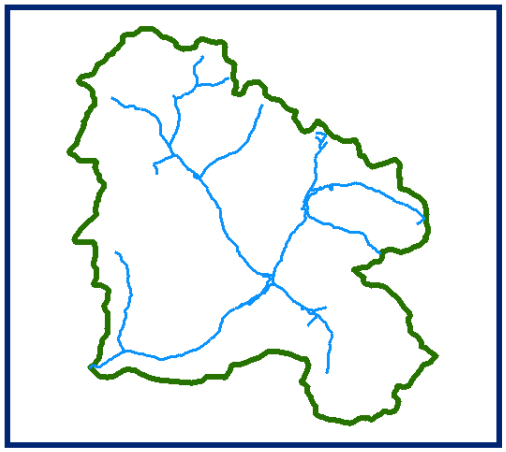

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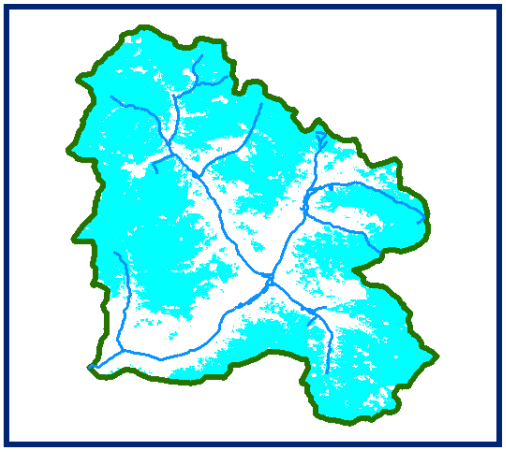
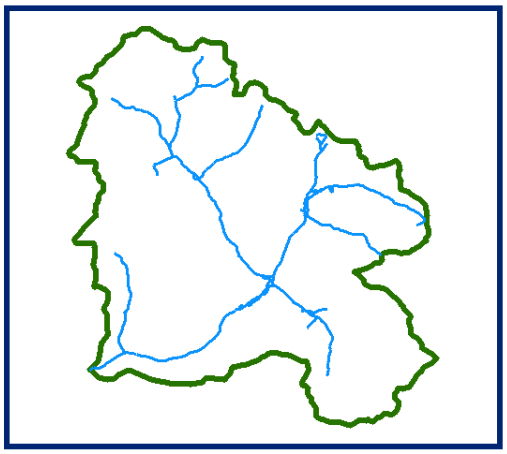


DATA USED
26 MAY 2011

0 5 10 20 30 40

SNOW COVER MAP : BHAGA BASIN



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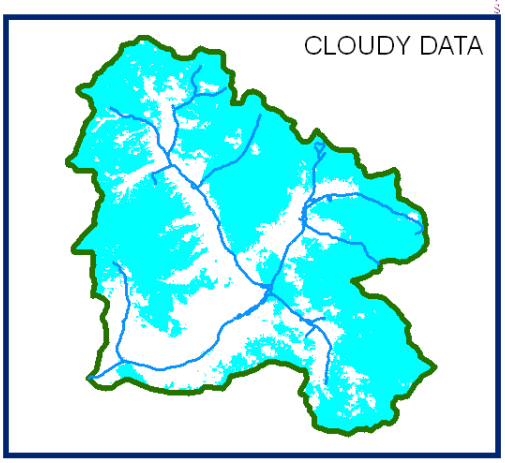
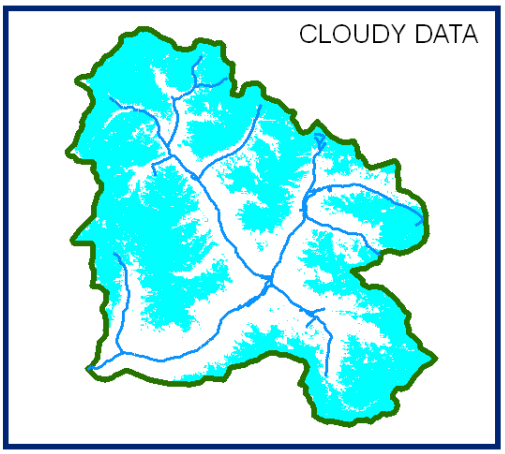
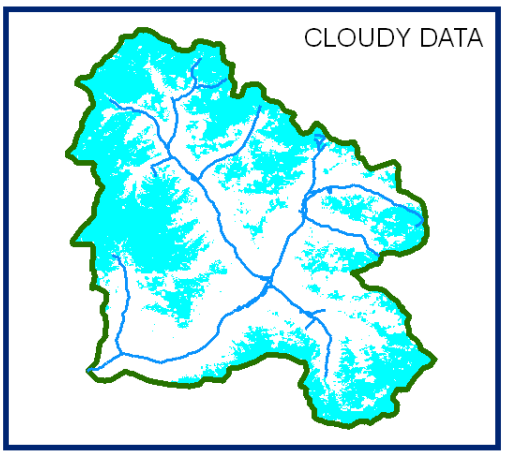


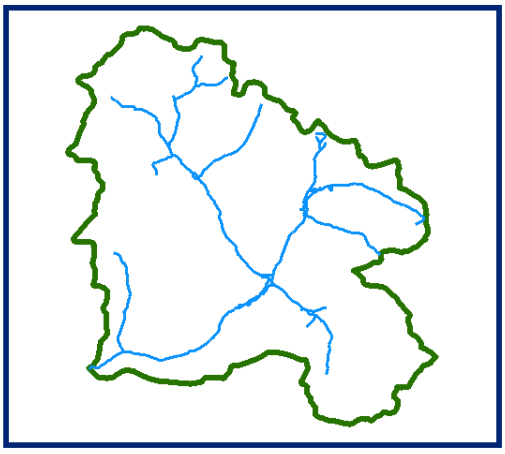
10 JUNE 2011



14 JUNE 2011



19 JUNE 2011



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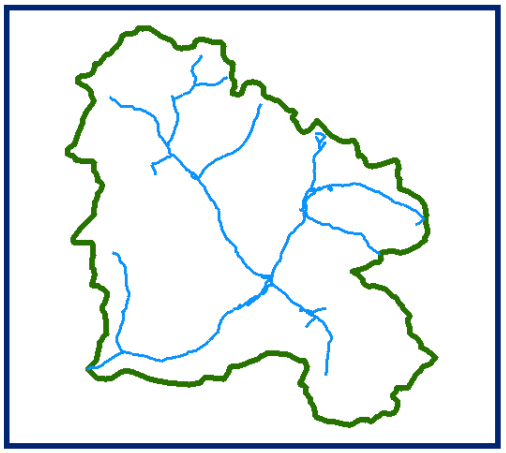

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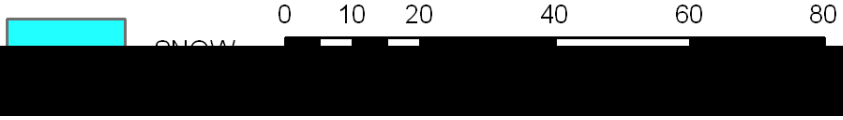
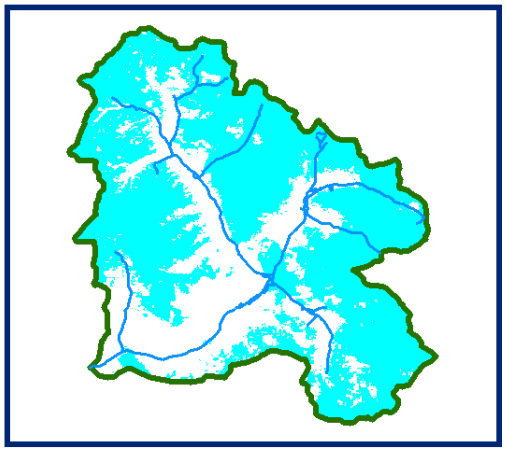
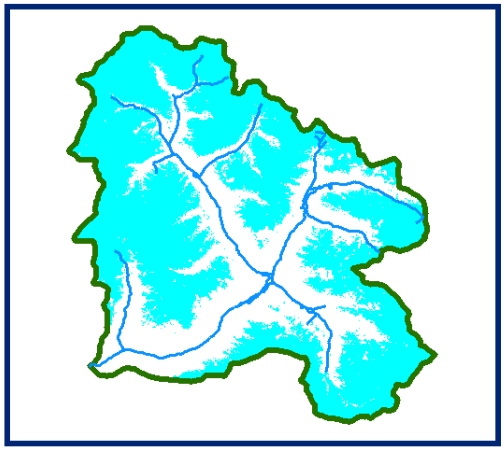


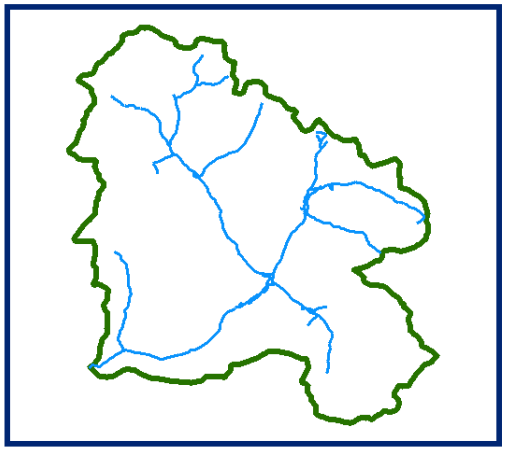
10 DAILY SNOW COVER MAP : BHAGA BASIN



DATA USED
10 JUNE 2011



DATA USED
14 JUNE 2011
19 JUNE 2011



DATA NOT AVAILABLE

0 5 10 20 30 40

MIYAR BASIN

AREAL EXTENT OF SNOW (5 DAILY)

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

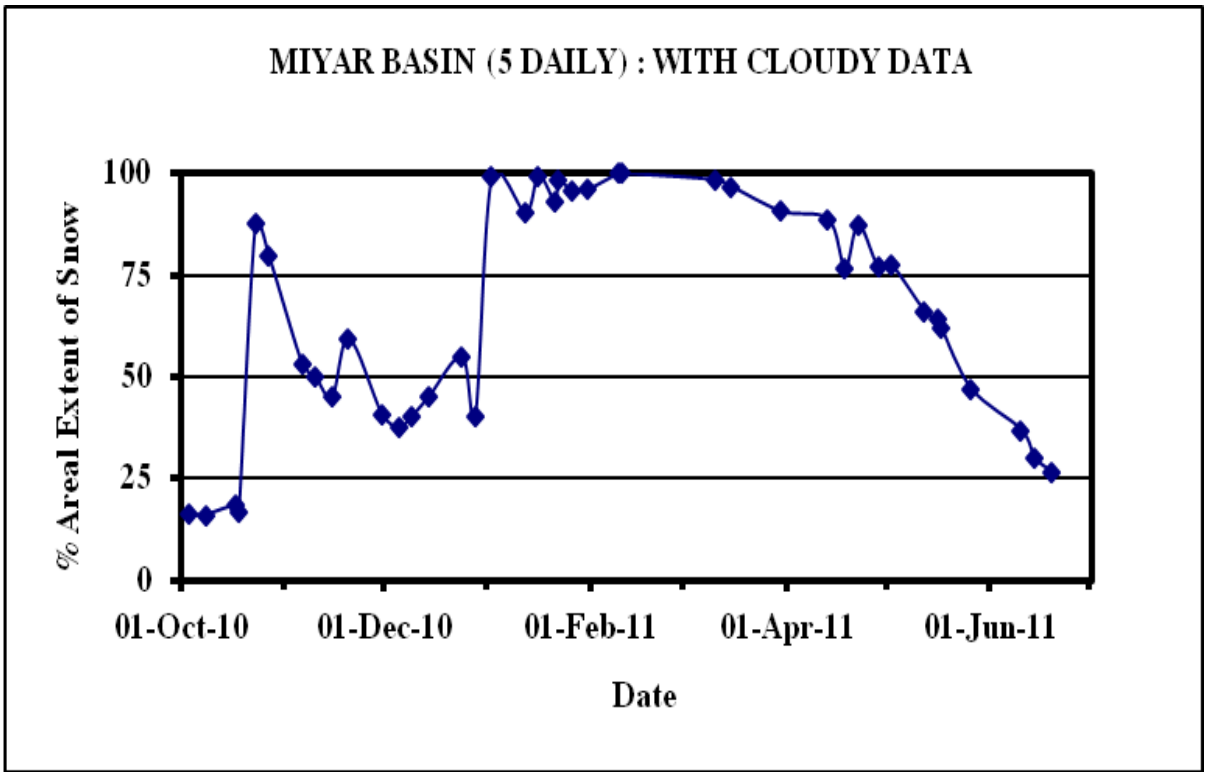
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	3-Oct-10	716.36	16	4	18-Oct-10	749.70	17
2	8-Oct-10	714.26	16	5	23-Oct-10	3897.56	88
3	17-Oct-10	822.03	18	6	27-Oct-10	3544.05	80
November 2010							
7	6-Nov-0	2365.95	53	10	20-Nov-10	2641.53	59
8	10-Nov-0	2218.38	50	11	30-Nov-10	1810.43	41
9	15-Nov-10	2001.99	45				
December 2010							
13	5-Dec-10	1663.52	37	16	24-Dec-10	2446.65	55
14	9-Dec-10	1792.80	40	17	28-Dec-10	1799.84	40
15	14-Dec-10	2001.07	45				
January 2011							
18	2-Jan-11	4406.22	99	22	22-Jan-11	4376.34	98
19	12-Jan-11	4010.74	90	23	26-Jan-11	4250.59	96
20	16-Jan-11	4421.29	99	24	2431-Jan-11	4274.55	96
21	21-Jan-11	4127.58	93				
February 2011							
25	9-Feb-11	4446.91	96	26	10-Feb-11	4448.37	99
March 2011							
27	10-Mar-11	4376.38	98	29	30-Mar-11	4029.84	91
28	15-Mar-11	4299.68	97				
April 2011							
30	13-Apr-11	3943.73	89	32	22-Apr-11	3887.98	87
31	18-Apr-11	3414.61	77	33	28-Apr-11	3417.78	77
May 2011							
34	2-May-11	3445.17	77	37	17-May-11	2754.67	62
35	12-May-11	2935.05	66	38	26-May-11	2087.86	47
36	16-May-11	2845.49	64				
June 2011							
39	10-June-11	1335.6	37	41	19-June-11	1186.53	27
40	14-June-11	1335.6	30				

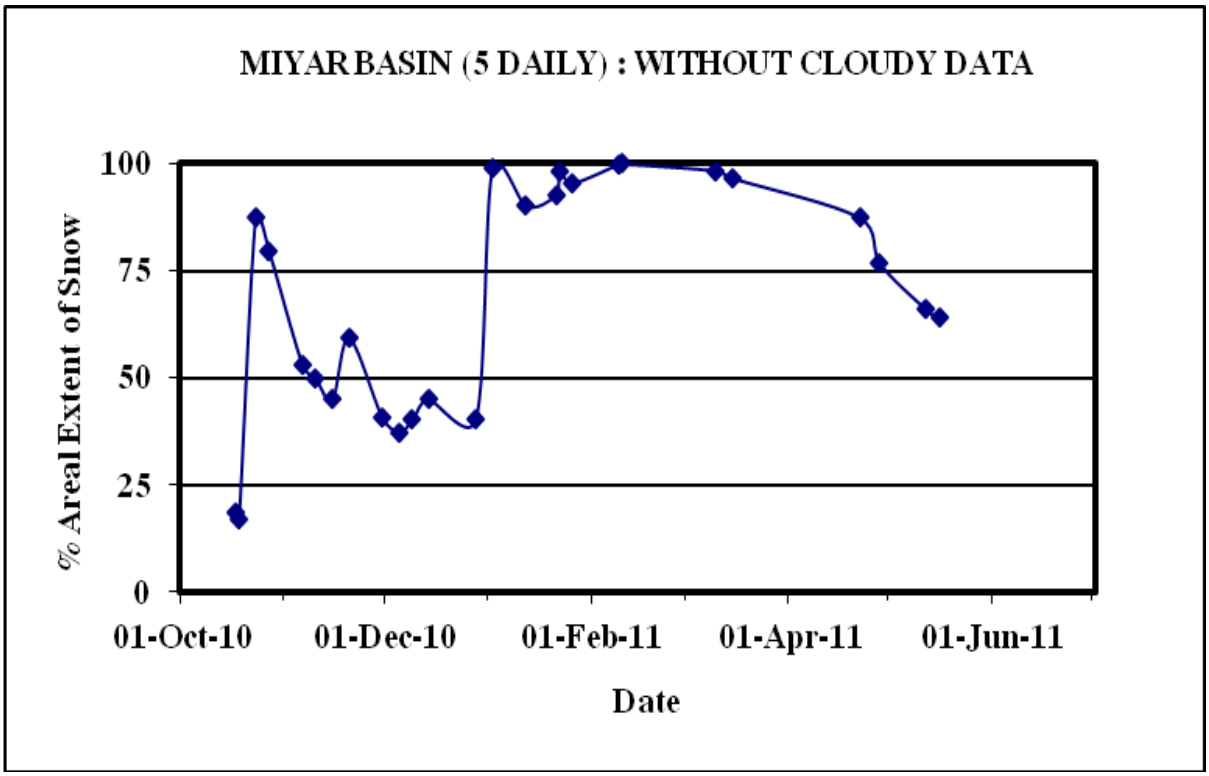
AREAL EXTENT OF SNOW (10 DAILY)

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

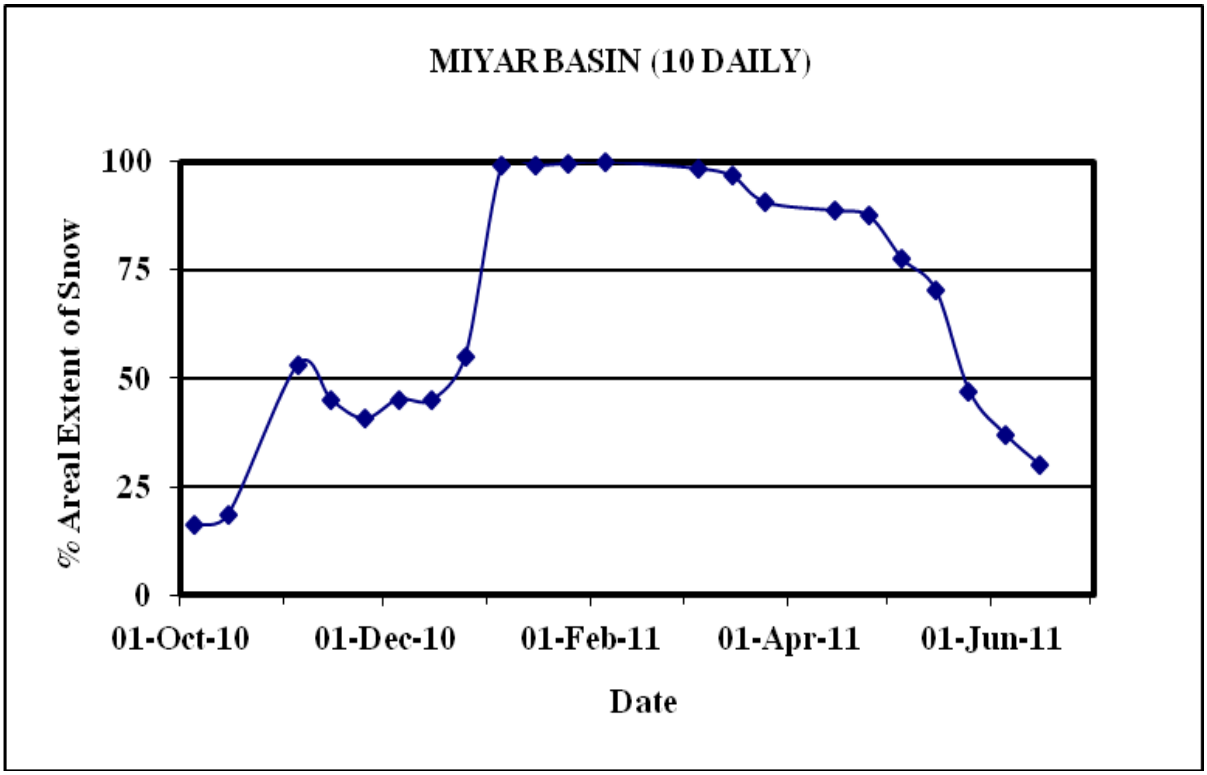
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	716.02	16	2	15-Oct-10	822.21	18
November 2010							
3	5-Nov-10	2365.95	53	4	15-Nov-10	2001.32	45
5	25-Nov-10	1810.53	41				
December 2010							
6	5-Dec-10	2007.69	45	7	15-Dec-10	2001.14	45
8	25-Dec-10	2446.13	55				
January 2011							
9	5-Jan-11	4406.22	99	10	15-Jan-11	4010.94	90
11	25-Jan-11	4431.93	99				
February 2011							
12	5-Feb-11	4446.92	99				
March 2011							
13	5-Mar-11	4376.38	98	14	15-Mar-11	4299.68	97
15	25-Mar-11	4029.84	91				
April 2011							
16	15-Apr-11	3943.71	89	17	25-Apr-11	3887.1	87
May 2011							
18	5-May-11	3445.17	77	19	15-May-11	3125.01	70
20	25-May-11	2087.86	47				
June 2011							
21	5-June-11	1639.54	37	22	15-June-11	1335.93	30

SNOW COVER DEPLETION CURVE



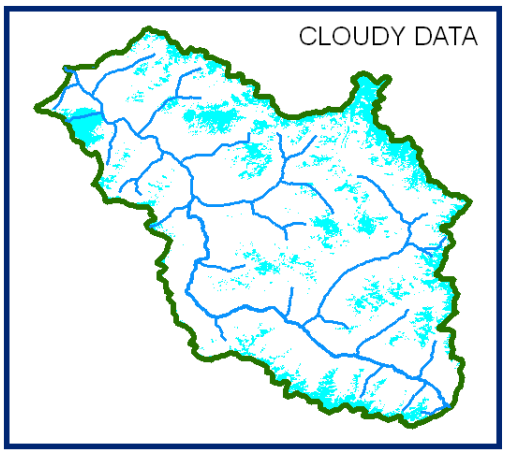


SNOW COVER DEPLETION CURVE

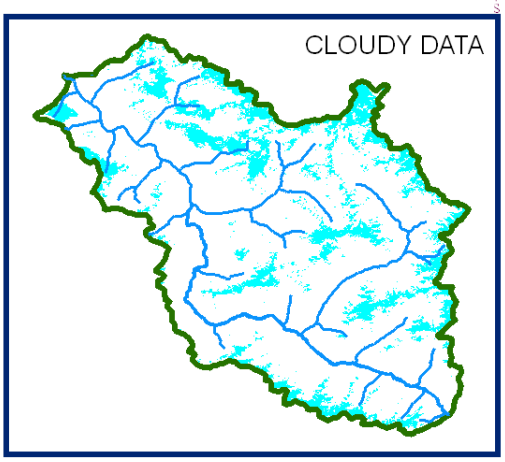


SNOW COVER MAP

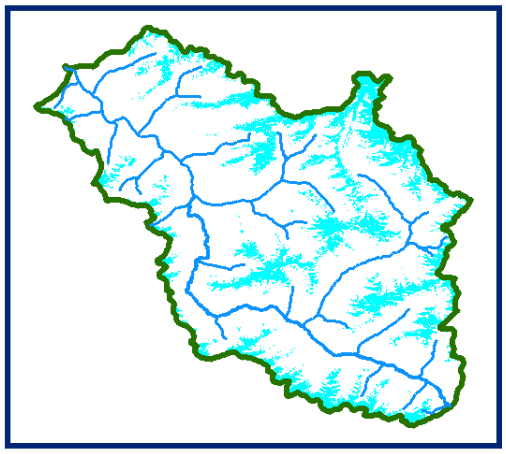
SNOW COVER MAP : MIYAR BASIN



03 OCTOBER 2010



08 OCTOBER 2010



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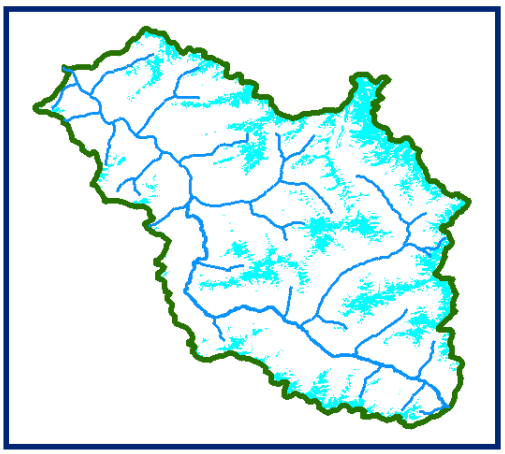

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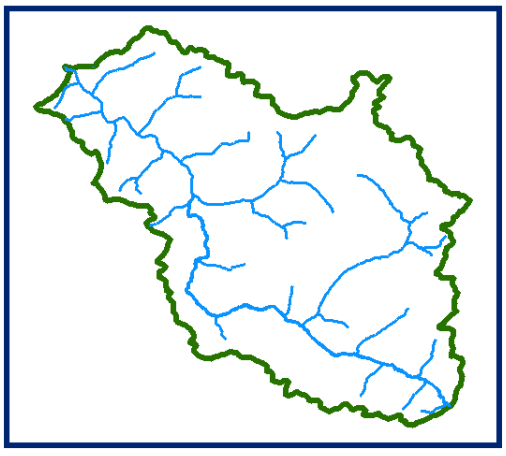

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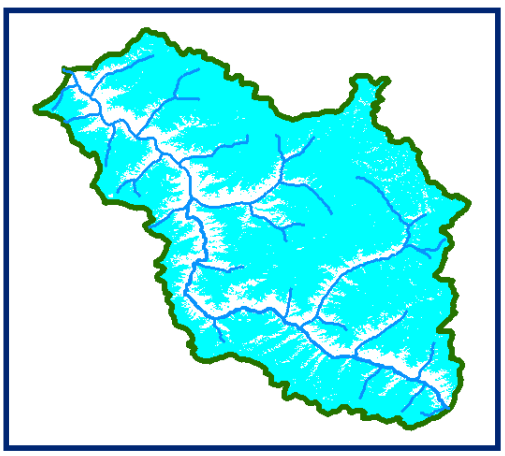
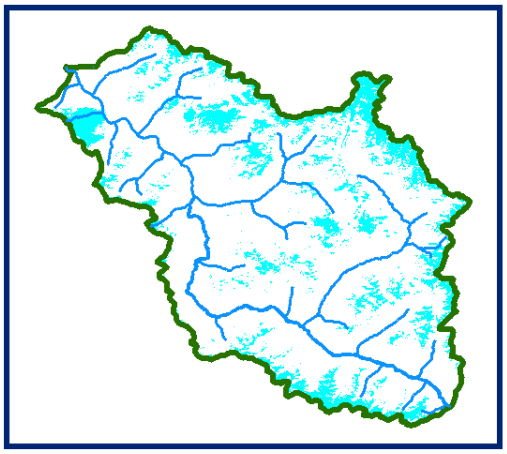
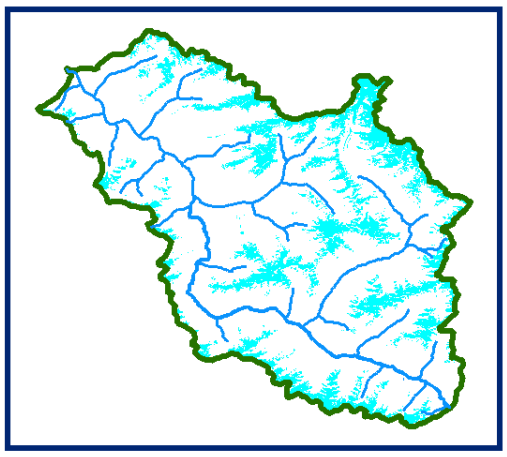


27 OCTOBER 2010

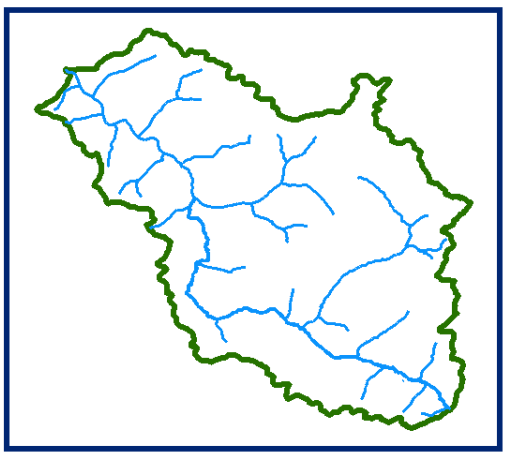
10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
03 OCTOBER 2010
08 OCTOBER 2010



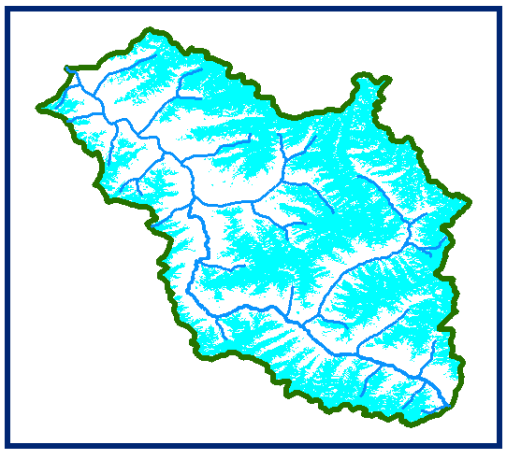
DATA USED
17 OCTOBER 2010
18 OCTOBER 2010



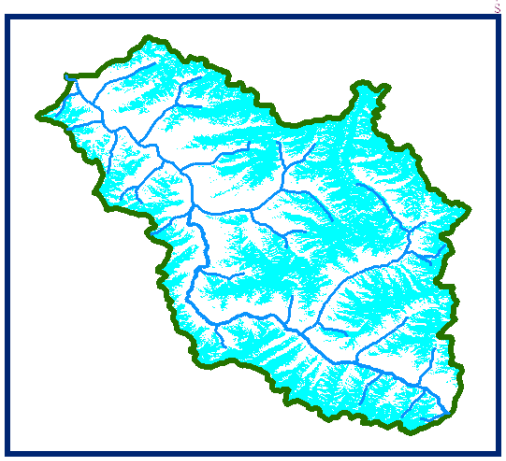
DATA NOT AVAILABLE

0 5 10 20 30 40

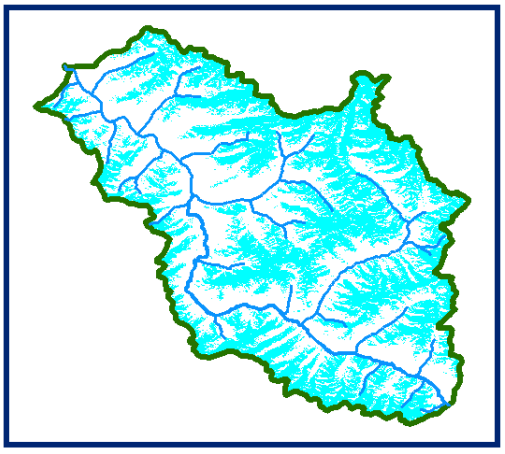
SNOW COVER MAP : MIYAR BASIN



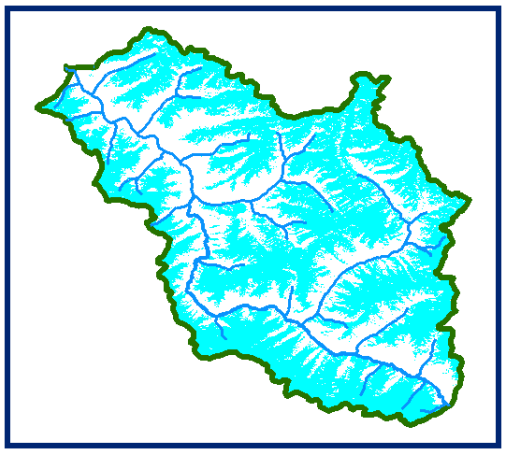
06 NOVEMBER 2010



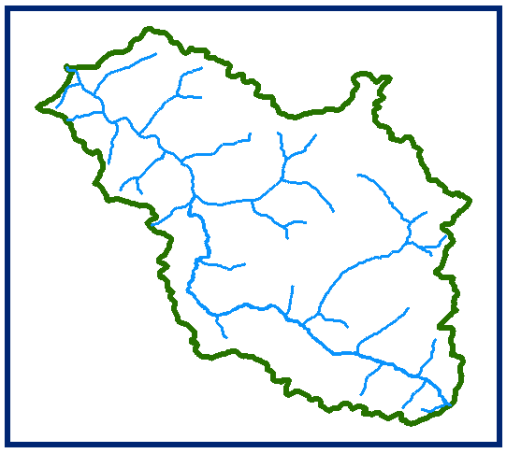
10 NOVEMBER 2010



15 NOVEMBER 2010



20 NOVEMBER 2010



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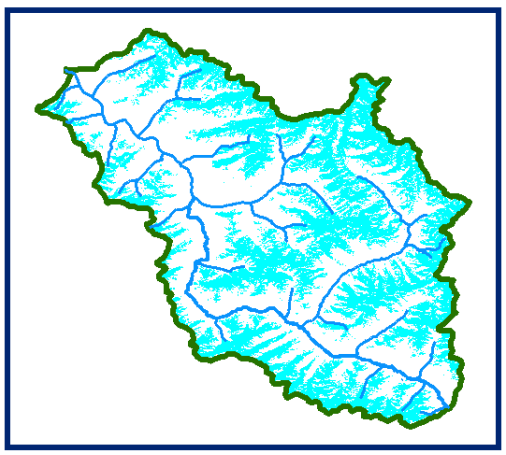
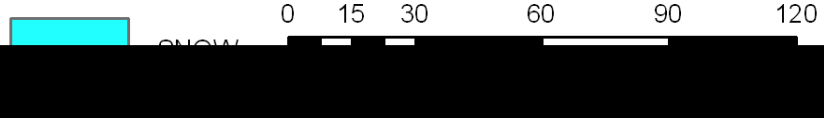
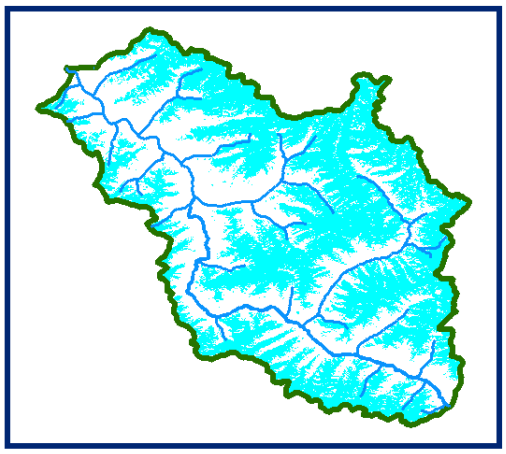


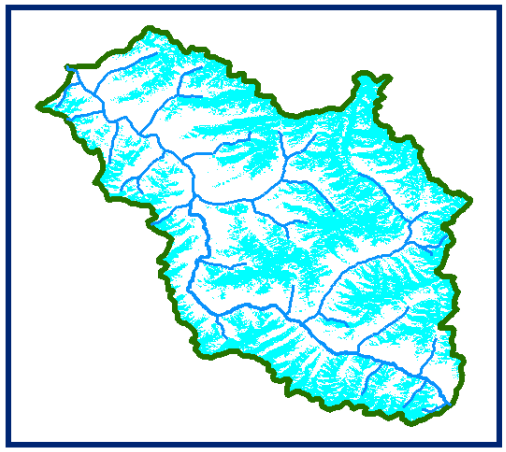
30 NOVEMBER 2010



10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
06 NOVEMBER 2010
10 NOVEMBER 2010



DATA USED
15 NOVEMBER 2010
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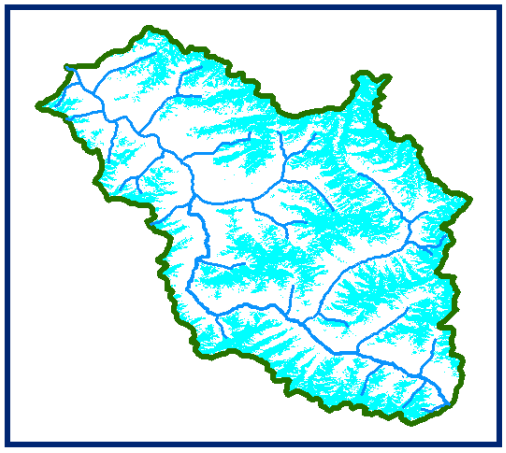
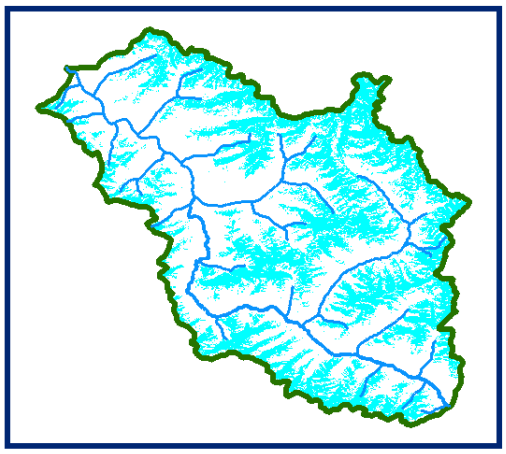


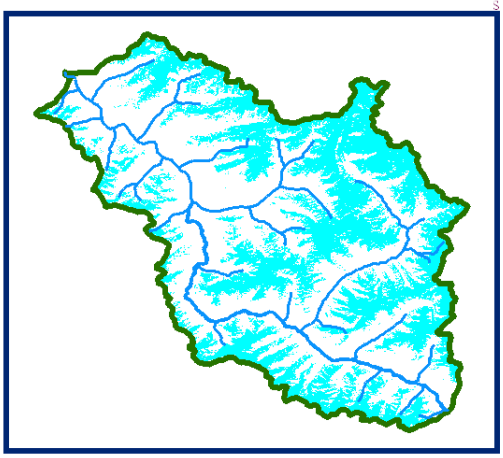
DATA USED
30 NOVEMBER 2010

0 5 10 20 30 40

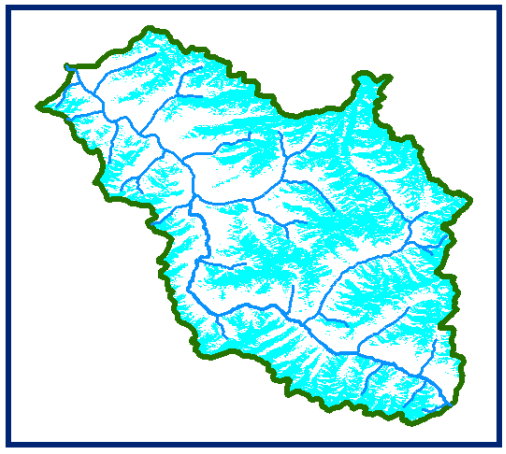
SNOW COVER MAP : MIYAR BASIN



05 DECEMBER 2010



09 DECEMBER 2010



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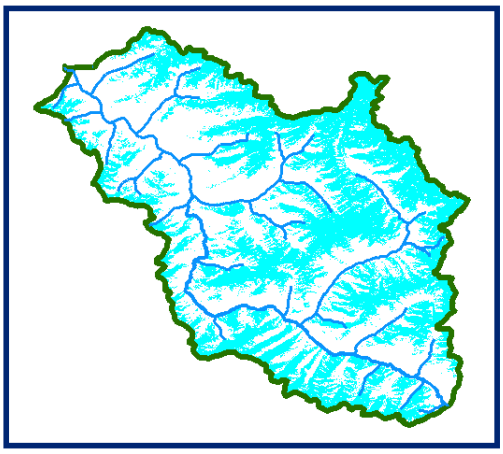
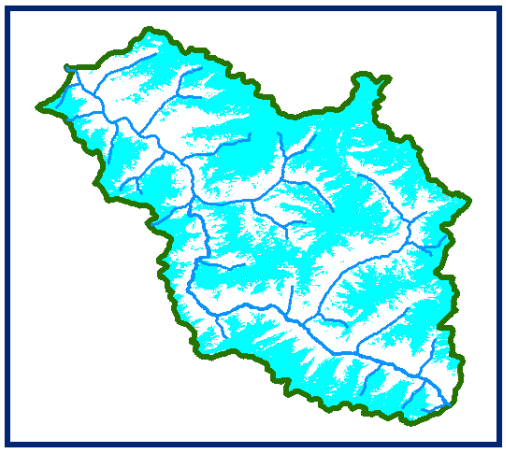
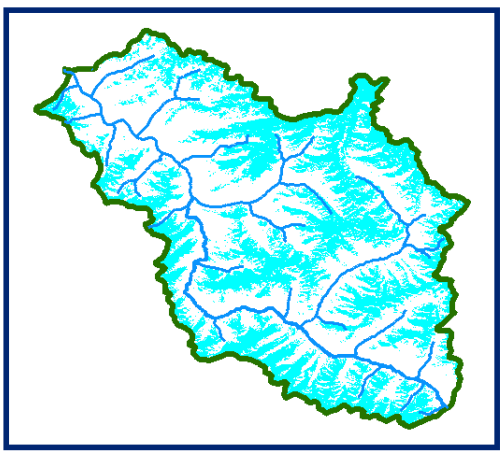


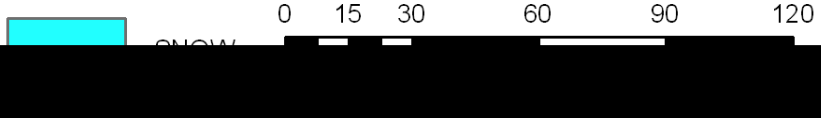
14 DECEMBER 2010



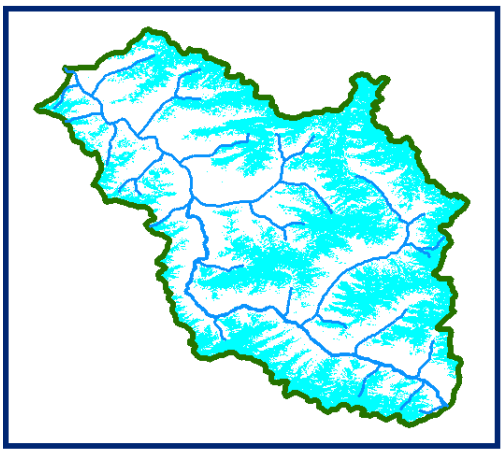
24 DECEMBER 2010



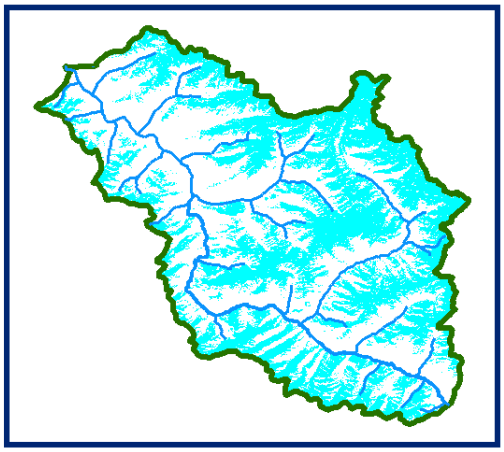
28 DECEMBER 2010



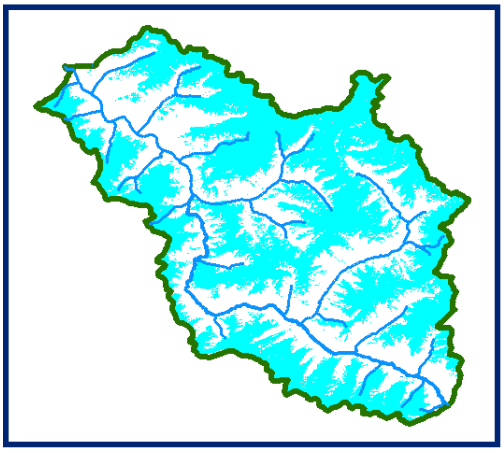
10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
04 DECEMBER 2010
05 DECEMBER 2010
09 DECEMBER 2010



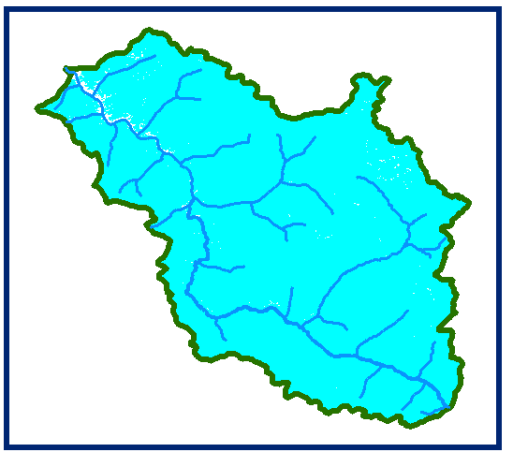
DATA USED
14 DECEMBER 2010
19 DECEMBER 2010



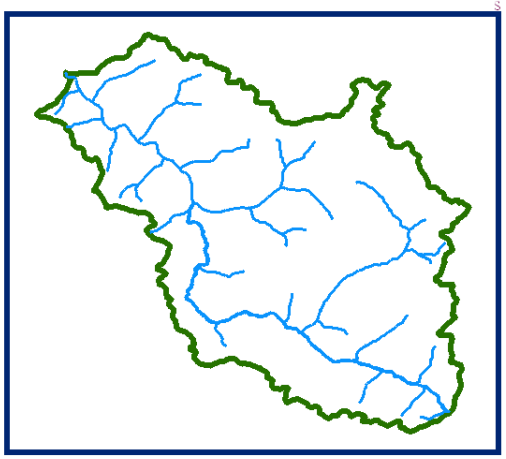
DATA USED
24 DECEMBER 2010
28 DECEMBER 2010

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



02 JANUARY 2011



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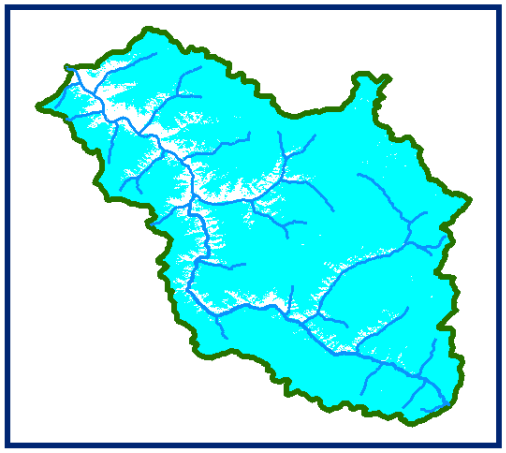
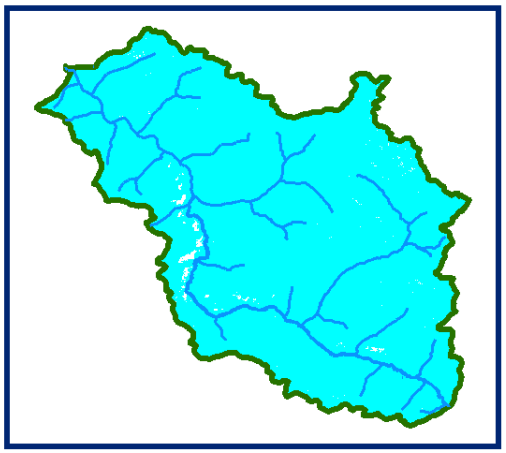
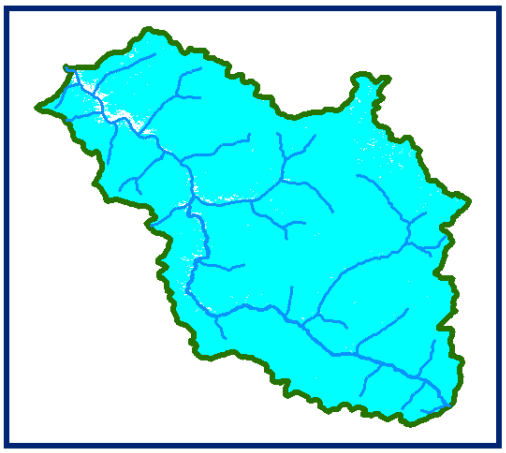


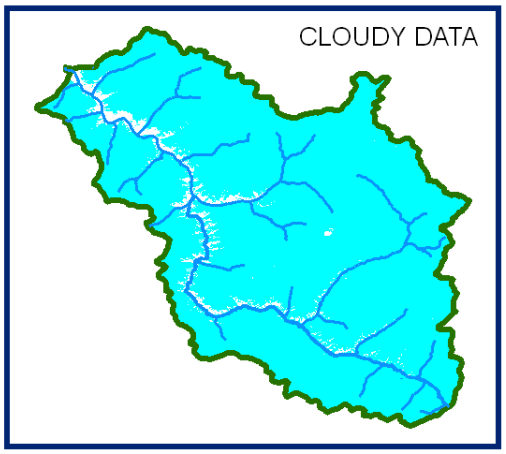
12 JANUARY 2011



16 JANUARY 2011

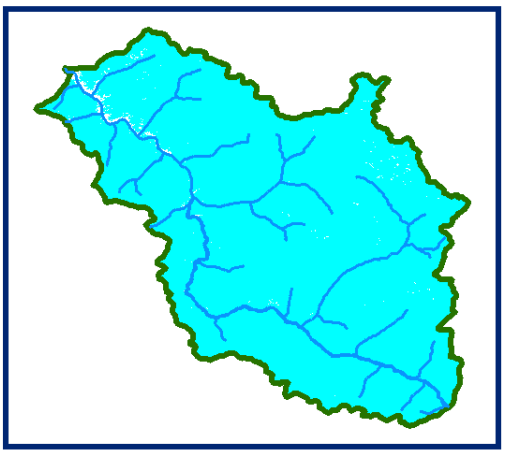


22 JANUARY 2011

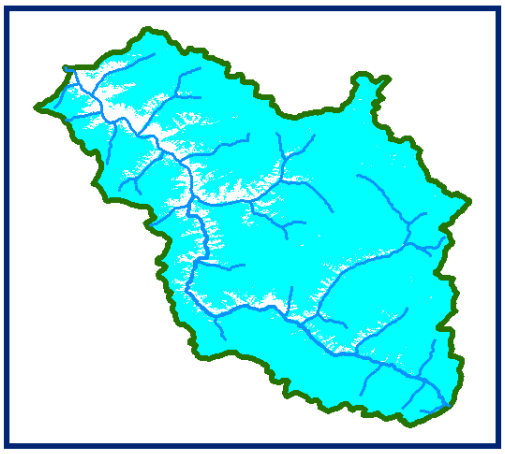


31 JANUARY 2011

10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
02 JANUARY 2011



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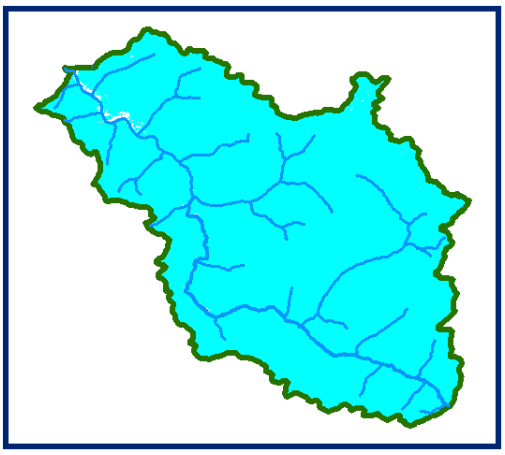
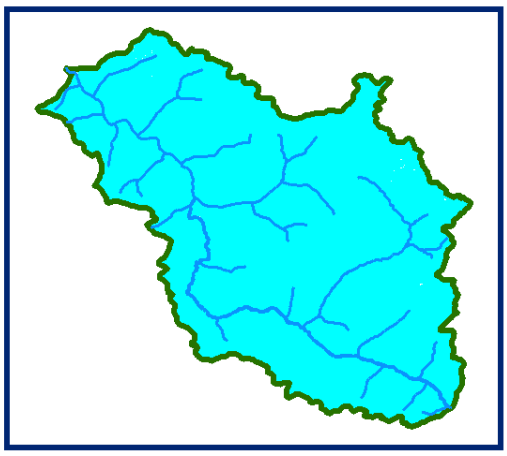


DATA USED
21 JANUARY 2011
22 JANUARY 2011
31 JANUARY 2011

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



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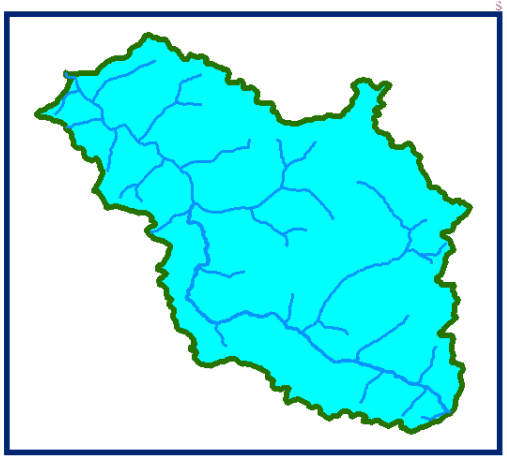
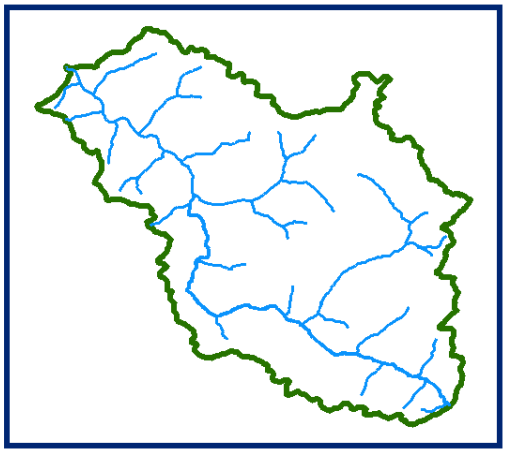


10 FEBRUARY 2011



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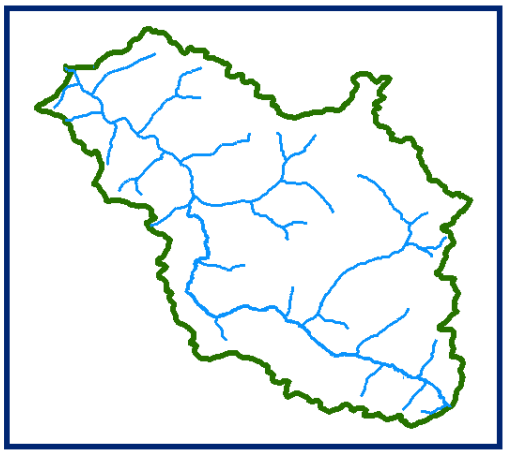

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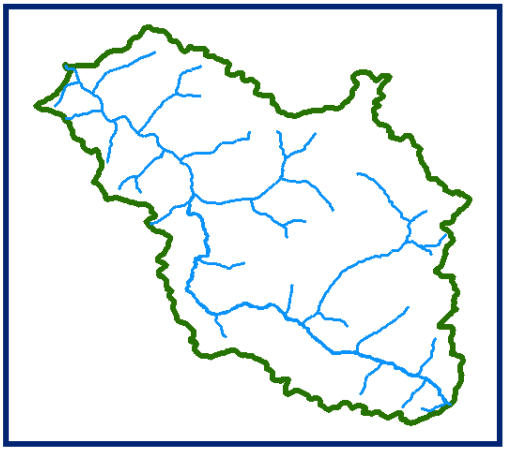

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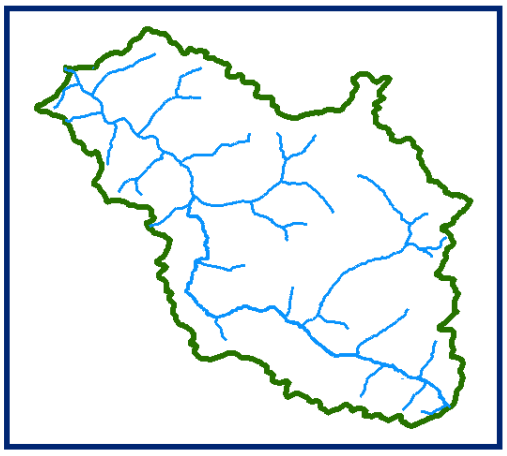

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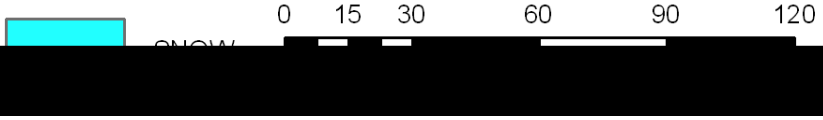
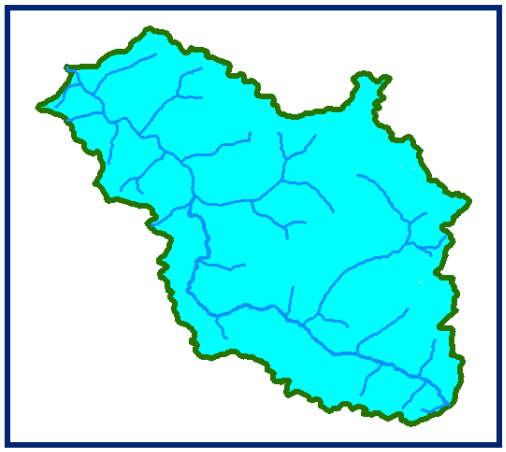
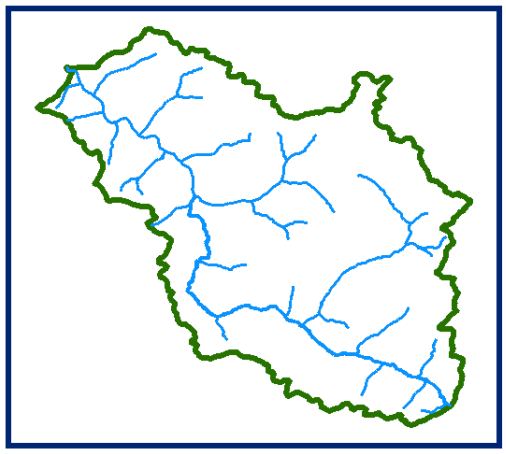


10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED

09 FEBRUARY 2011
10 FEBRUARY 2011



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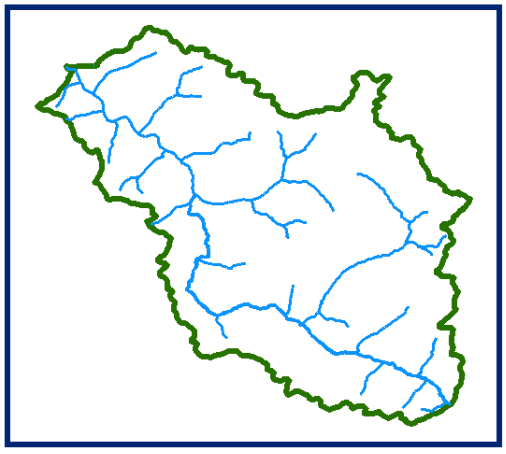
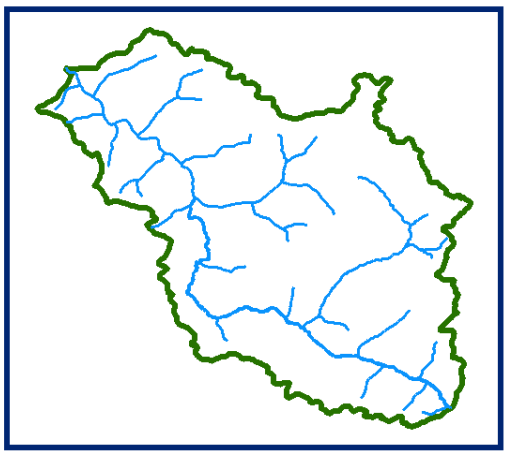


DATA NOT AVAILABLE

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



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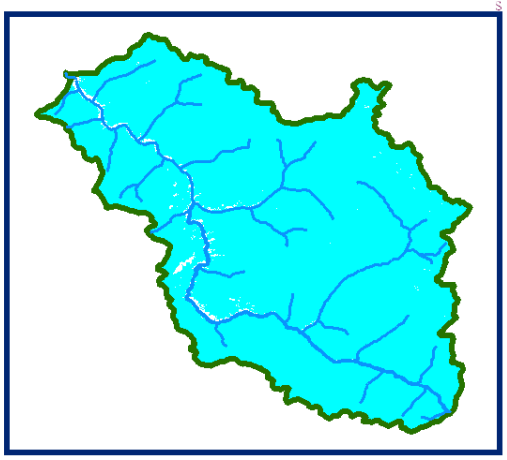
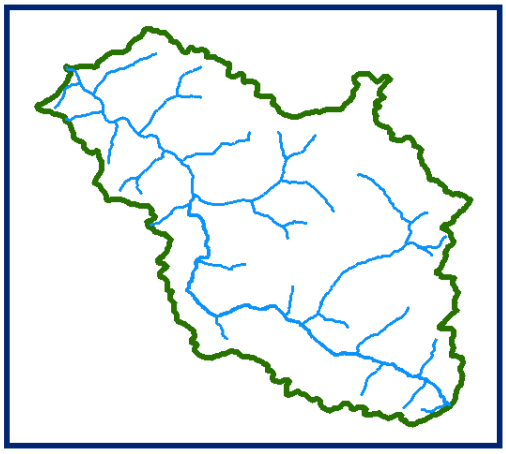


10 MARCH 2011



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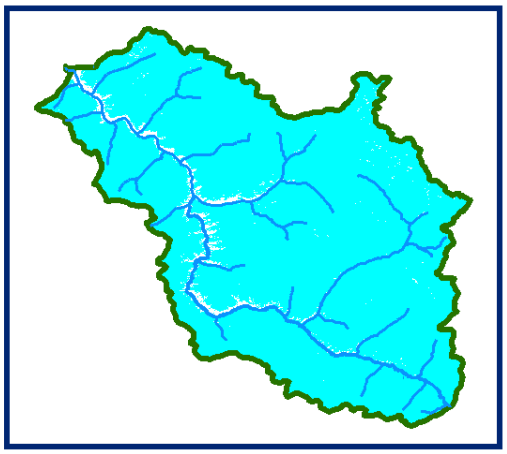

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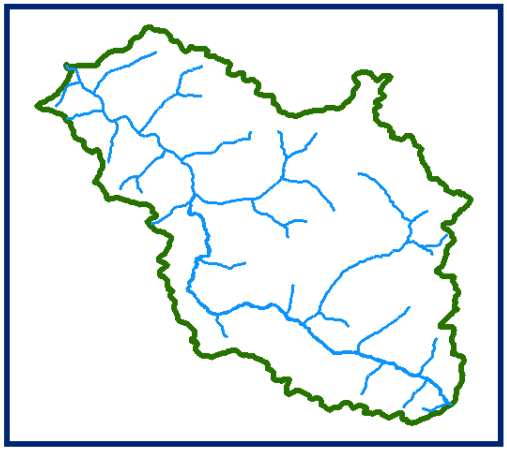

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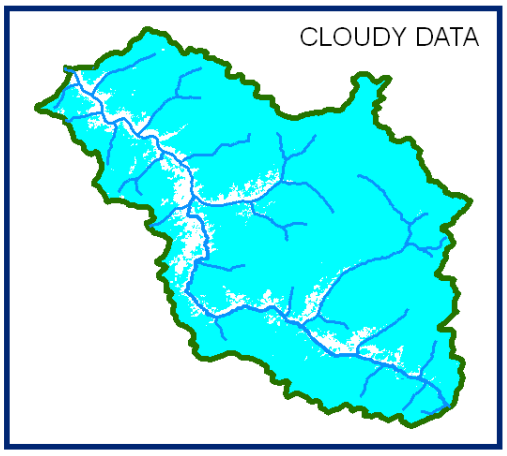
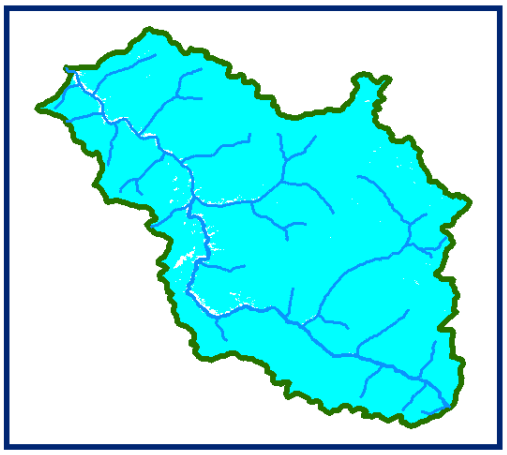
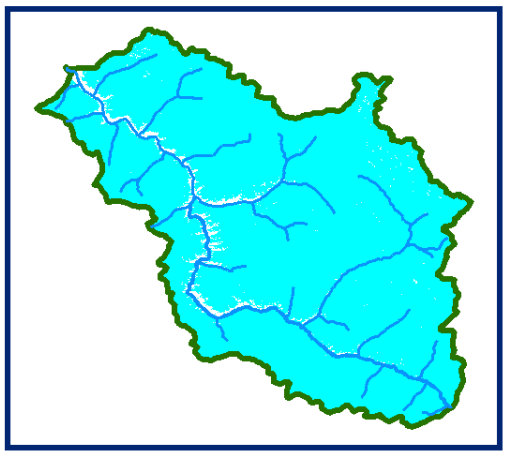


30 MARCH 2011

10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
10 MARCH 2011



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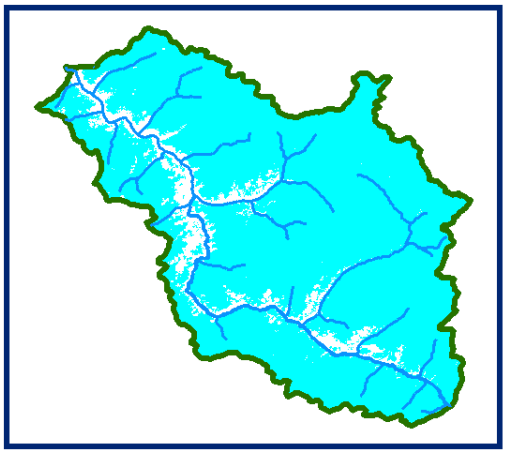
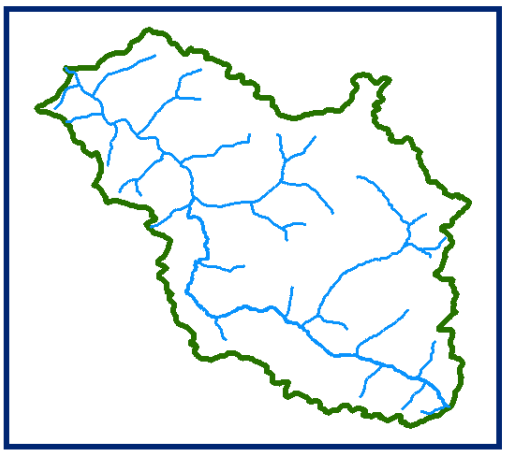


DATA USED
30 MARCH 2011

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



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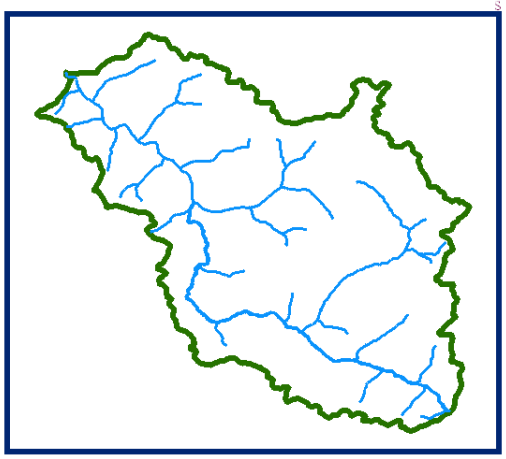

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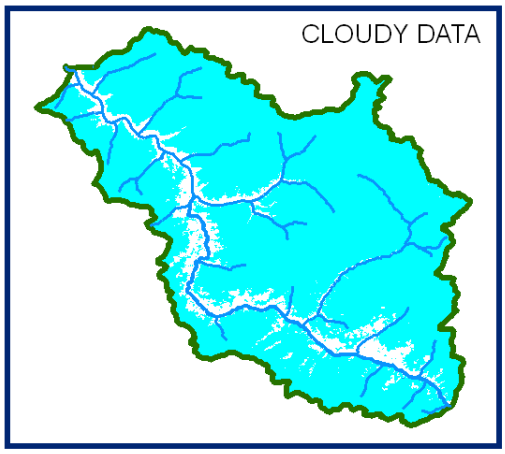
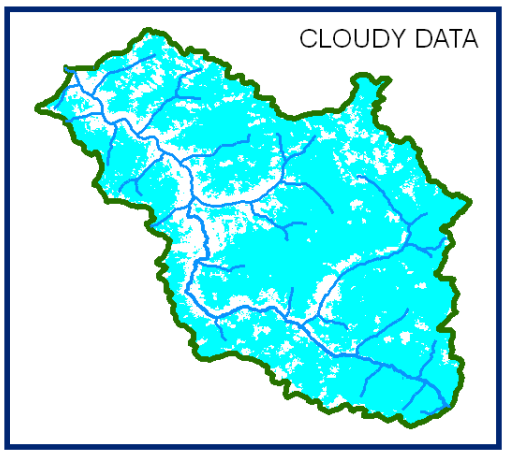
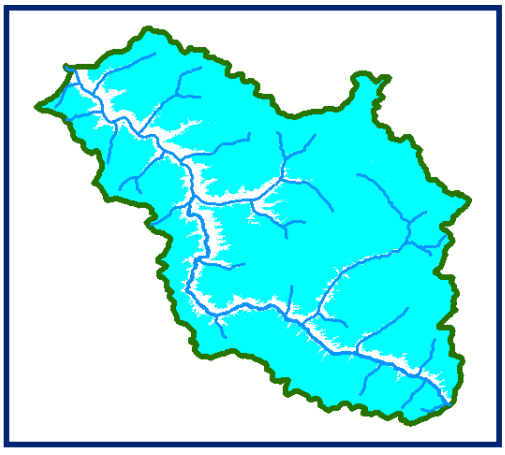


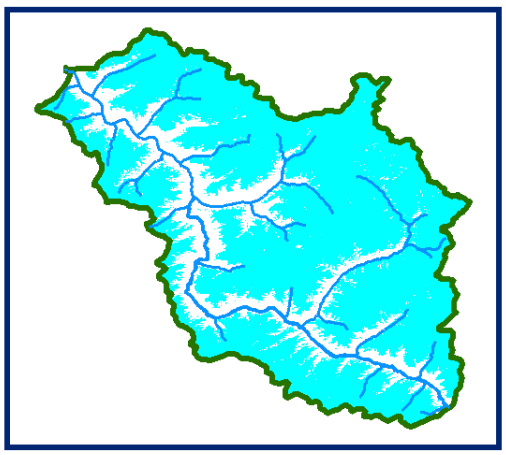
13 APRIL 2011



18 APRIL 2011

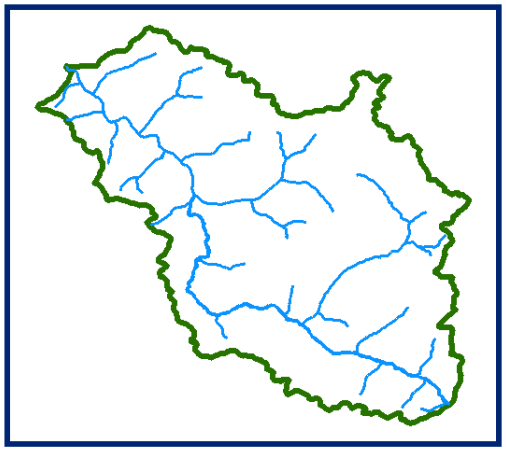


22 APRIL 2011



28 APRIL 2011

10 DAILY SNOW COVER MAP : MIYAR BASIN



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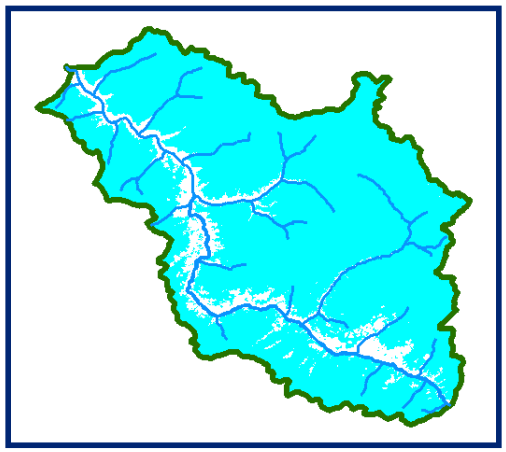
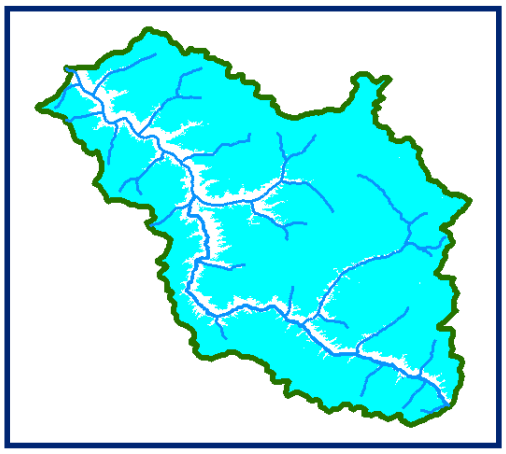


DATA USED

13 APRIL 2011
18 APRIL 2011

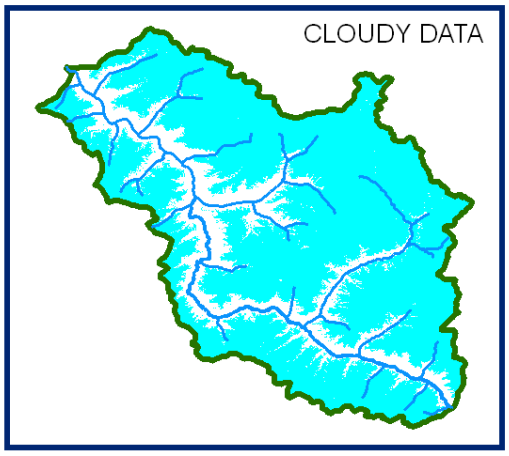


DATA USED

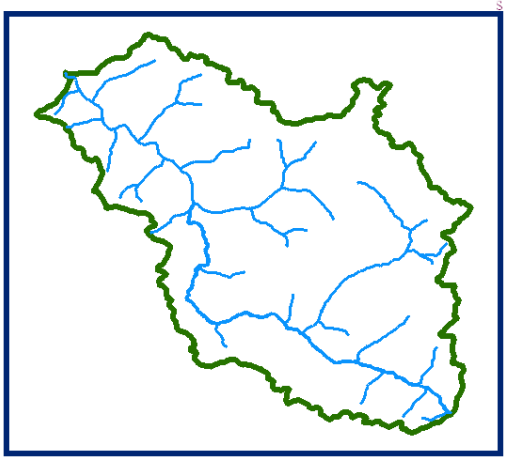
22 APRIL 2011
28 APRIL 2011

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



02 MAY 2011



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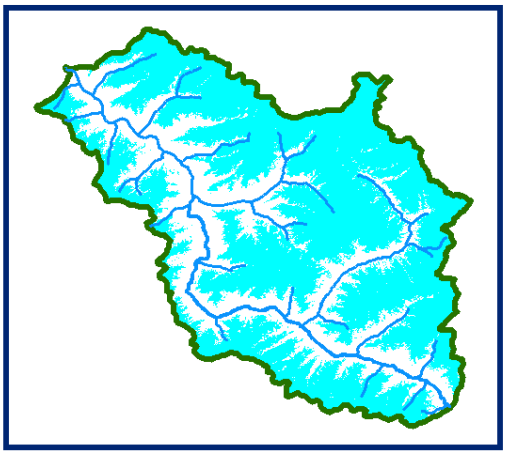

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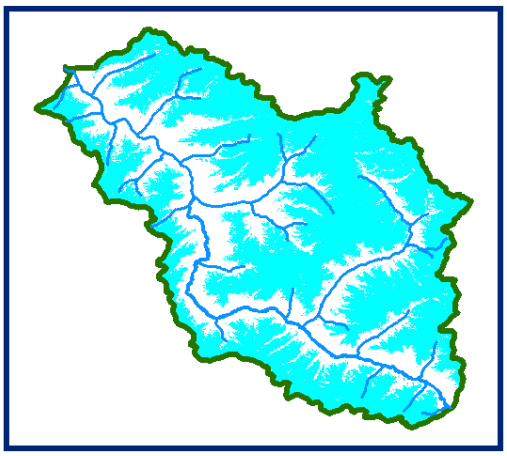
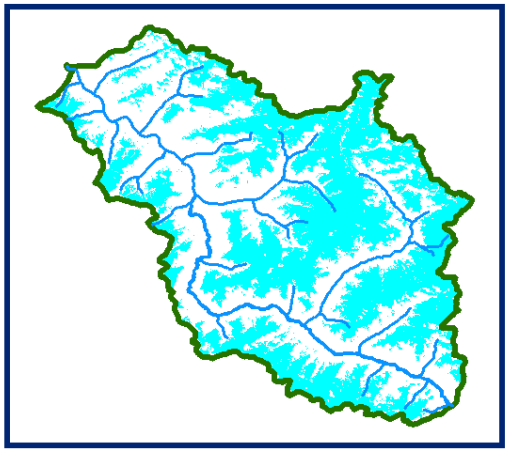
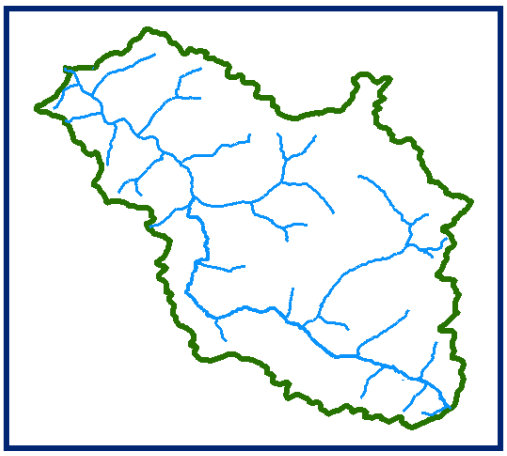


16 MAY 2011



26 MAY 2011



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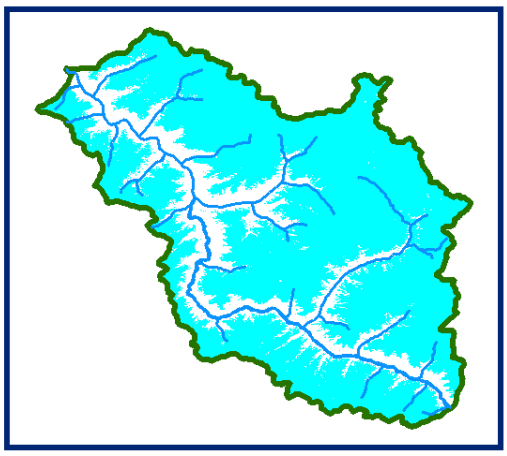
10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
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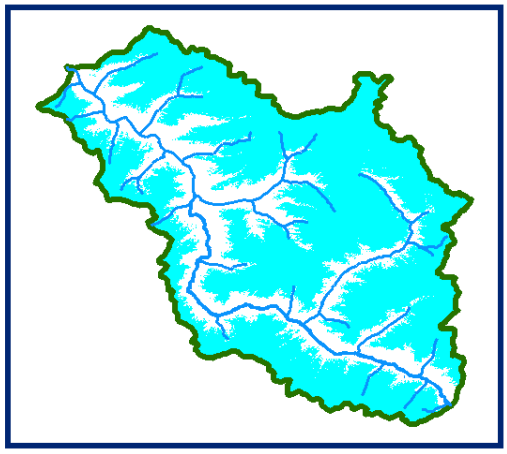
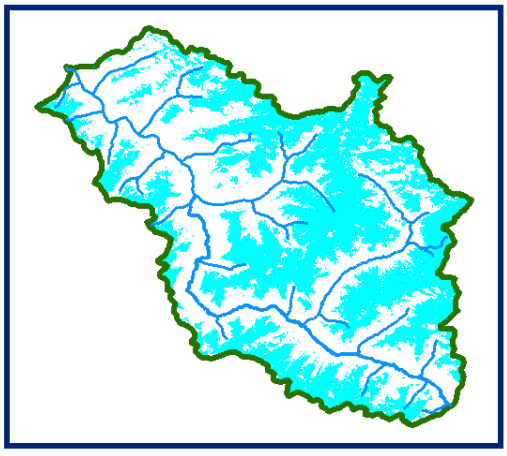


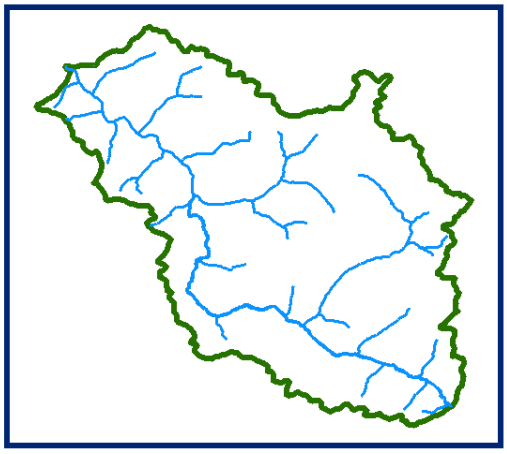
DATA USED
12 MAY 2011
16 MAY 2011
17 MAY 2011



DATA USED
26 MAY 2011

0 5 10 20 30 40

SNOW COVER MAP : MIYAR BASIN



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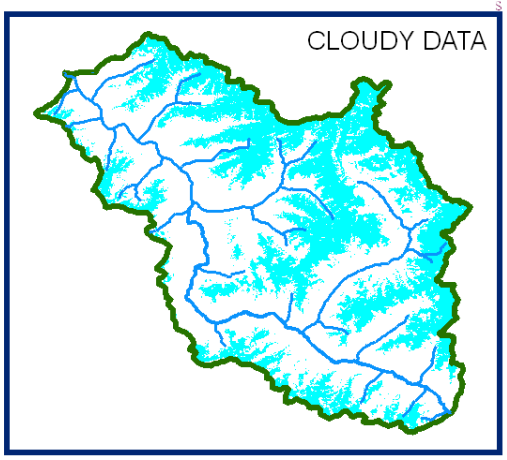
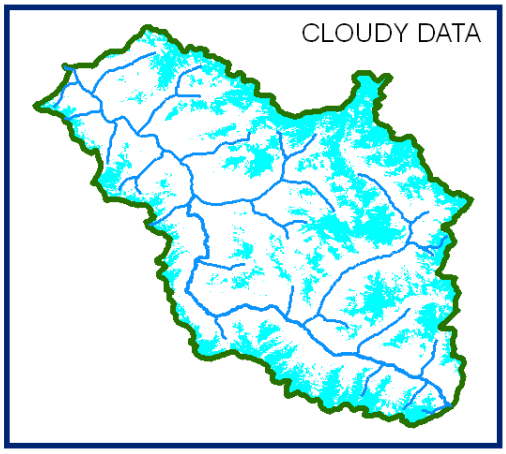
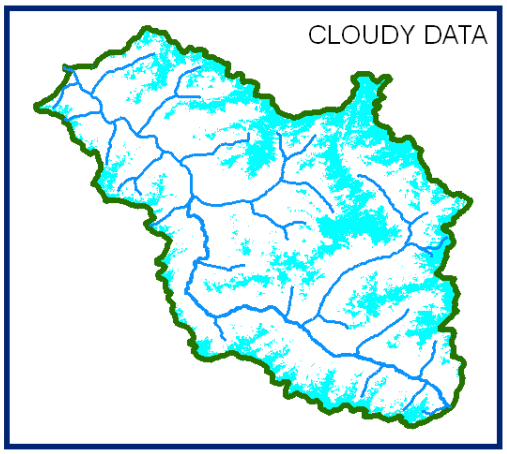


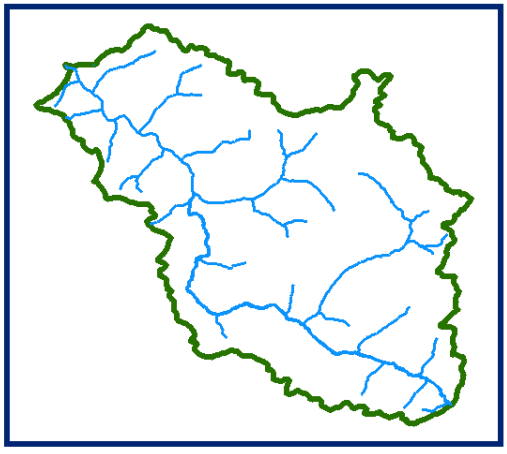
10 JUNE 2011



14 JUNE 2011



19 JUNE 2011



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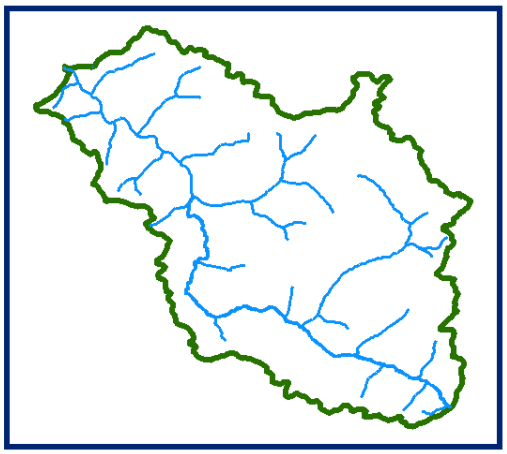

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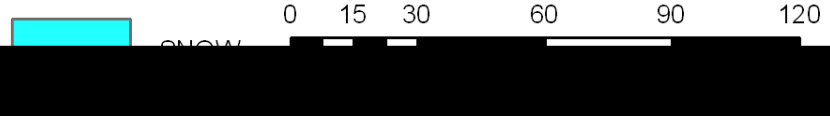
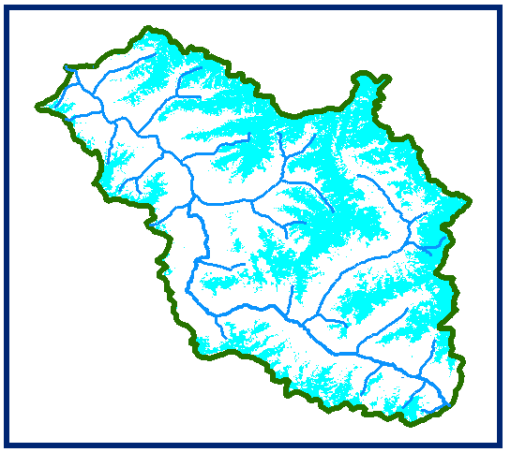
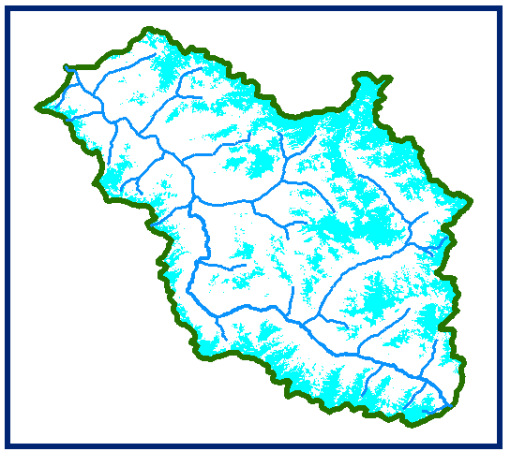


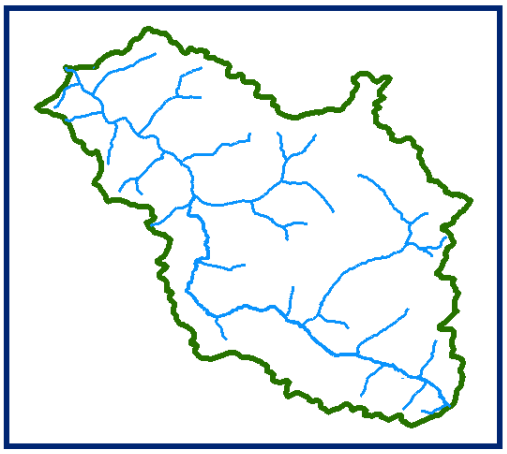
10 DAILY SNOW COVER MAP : MIYAR BASIN



DATA USED
10 JUNE 2011



DATA USED
14 JUNE 2011
19 JUNE 2011



DATA NOT AVAILABLE

0 5 10 20 30 40

BHUT BASIN

AREAL EXTENT OF SNOW (5 DAILY)

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

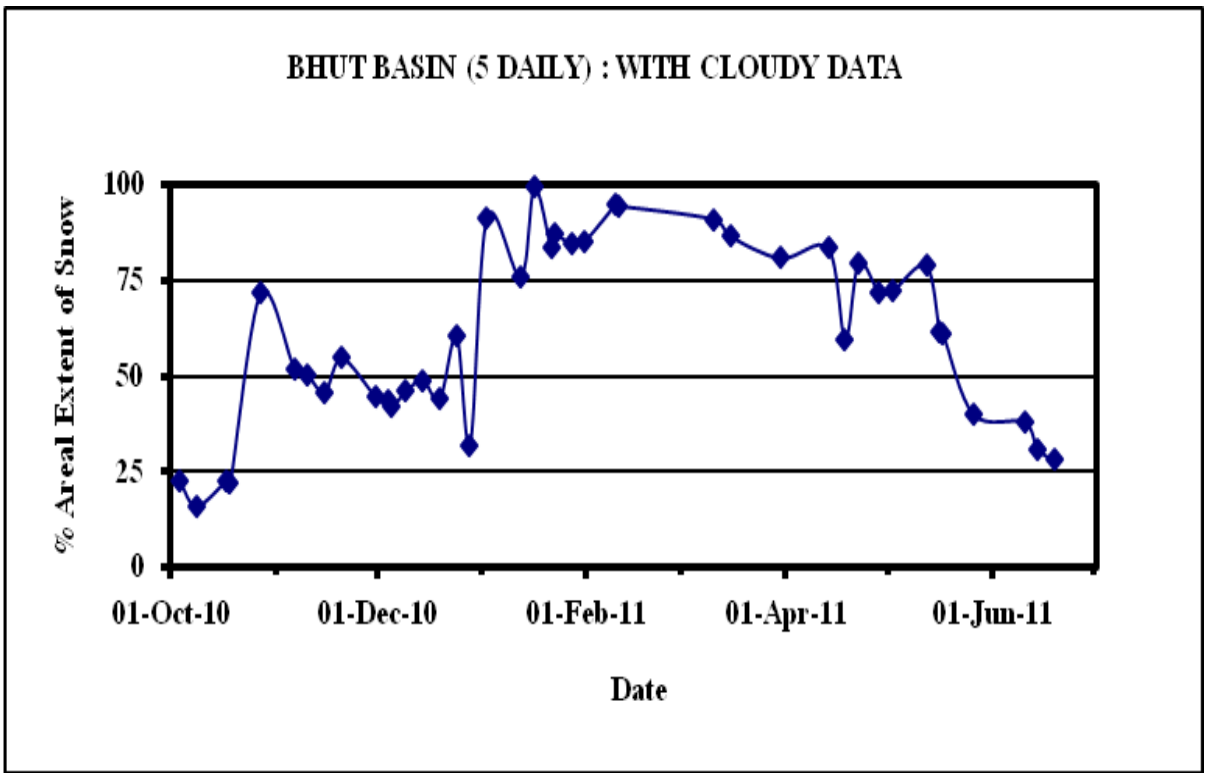
S No	Date	Snow cover (sq km.)	Snow cover (%)	S No	Date	Snow cover (sq km.)	Snow cover (%)
October 2010							
1	3-Oct-10	501.23	23	4	18-Oct-10	485.18	22
2	8-Oct-10	353.35	16	5	27-Oct-10	1589.74	72
3	17-Oct-10	502.52	23				
November 2010							
6	6-Nov-10	1154.32	52	9	20-Nov-10	1211.46	55
7	10-Nov-10	1109.97	50	10	30-Nov-10	991.21	45
8	15-Nov-10	1016.79	46				
December 2010							
11	4-Dec-10	966.25	44	15	19-Dec-10	973.96	44
12	5-Dec-10	930.20	42	16	24-Dec-10	1341.76	61
13	9-Dec-10	1020.04	46	17	28-Dec-10	708.84	32
14	14-Dec-10	1084.78	49				
January 2011							
18	2-Jan-11	2030.07	92	22	22-Jan-11	1932.6	87
19	12-Jan-11	1682.79	76	23	26-Jan-11	1873.35	84
20	16-Jan-11	2202.19	99	24	31-Jan-11	1893.34	85
21	21-Jan-11	1852.78	83				
February 2011							
25	9-Feb-11	2100.37	95	26	10-Feb-11	2095.75	94
March 2011							
27	10-Mar-11	2018.25	91	29	30-Mar-11	1791.85	81
28	15-Mar-11	1919.59	87				
April-2011							
30	13-Apr-11	1848.4	83	32	22-Apr-11	1765.32	80
31	18-Apr-11	1322.55	60	33	28-Apr-11	1595.99	72
May-2011							
34	2-May-11	1602.11	72	37	17-May-11	1349.53	61
35	12-May-11	1750.84	79	38	26-May-11	885.3	40
36	16-May-11	1359.68	61				
June-2011							
39	10-June-11	840.19	38	41	19-June-11	620.29	28
40	14-June-11	682.94	31				

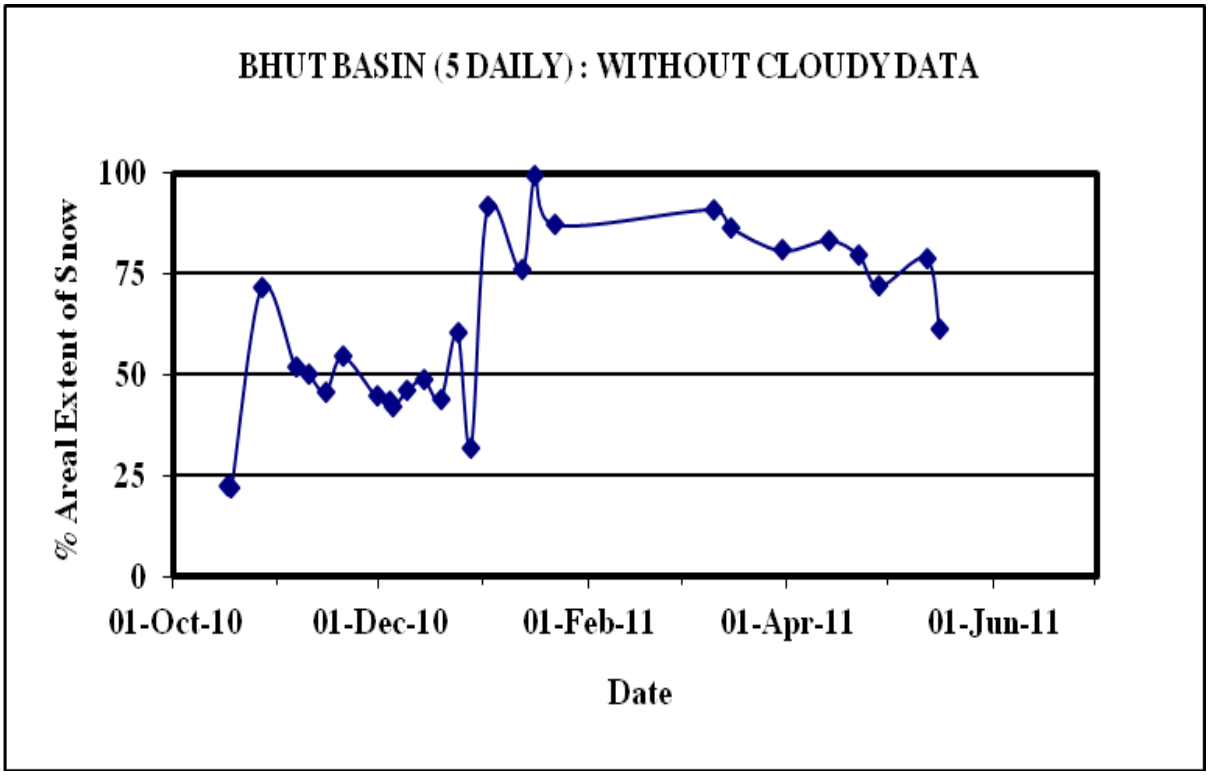
AREAL EXTENT OF SNOW (10 DAILY)

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

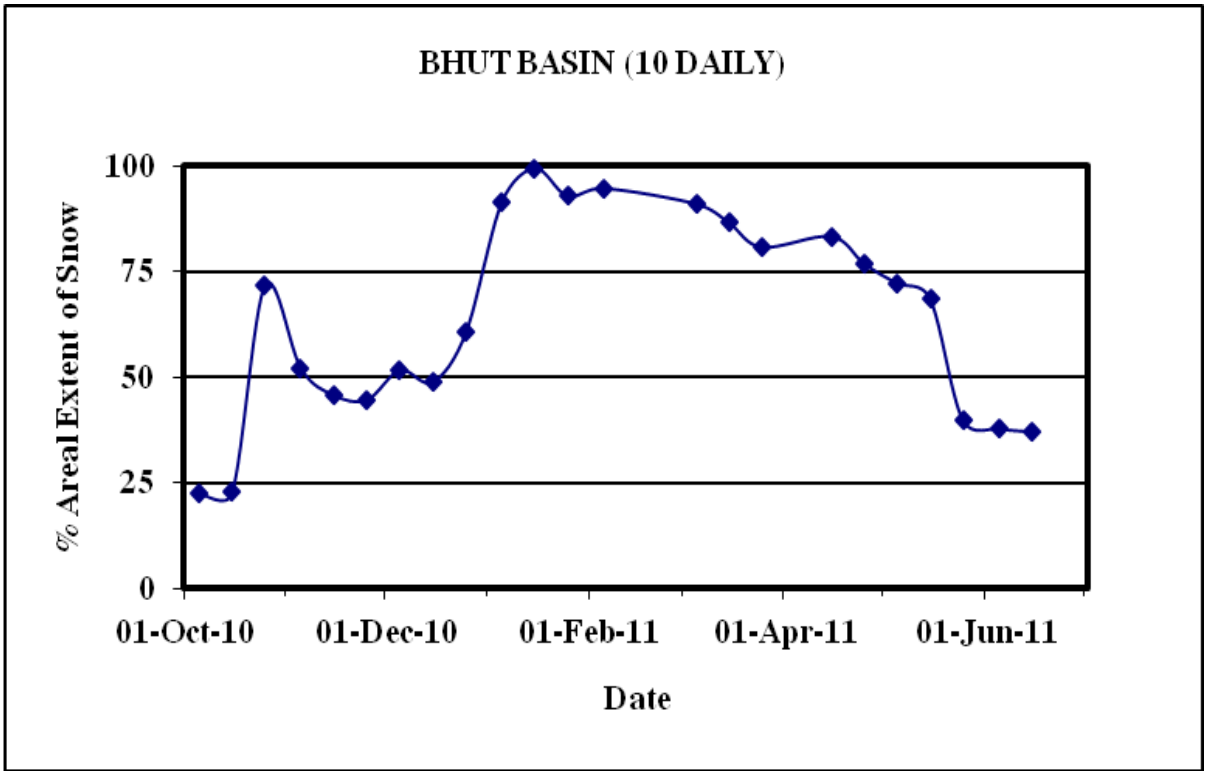
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	500.67	23	2	15-Oct-10	502.7	23
3	25-Oct-10	1589.74	72				
November 2010							
4	5-Nov-10	1154.4	52	5	15-Nov-10	1015.48	46
6	25-Nov-10	991.21	45				
December 2010							
7	5-Dec-10	1147.31	52	8	15-Dec-10	1084.78	49
9	25-Dec-10	1341.73	61				
January 2011							
10	5-Jan-11	2030.07	92	11	15-Jan-11	2206.36	99
12	25-Jan-11	2058.51	93				
February 2011							
13	5-Feb-11	2100.32	95				
March 2011							
14	5-Mar-11	2018.25	91	15	15-Mar-11	1919.59	87
16	25-Mar-11	1791.85	81				
April 2011							
17	15-Apr-11	1848.38	83	18	25-Apr-11	1705.96	77
May 2011							
19	5-May-11	1602.11	72	20	15-May-11	1523.29	69
21	25-May-11	885.3	40				
June 2011							
22	5-June-11	840.19	38	23	15-June-11	824.2	37

SNOW COVER DEPLETION CURVE



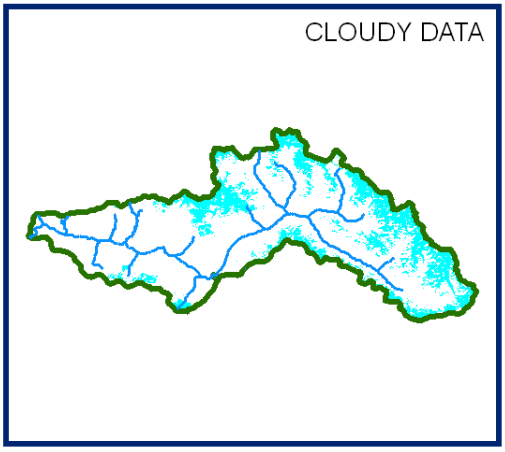


SNOW COVER DEPLETION CURVE

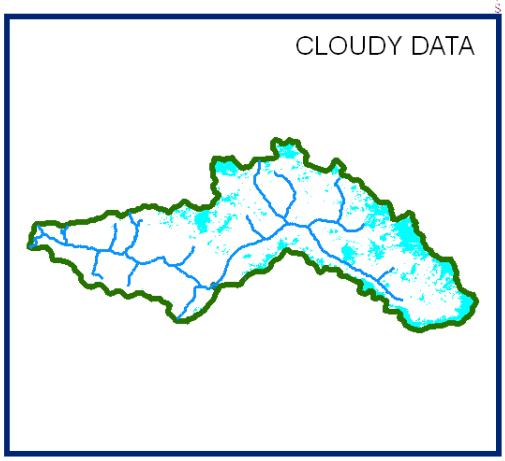


SNOW COVER MAP

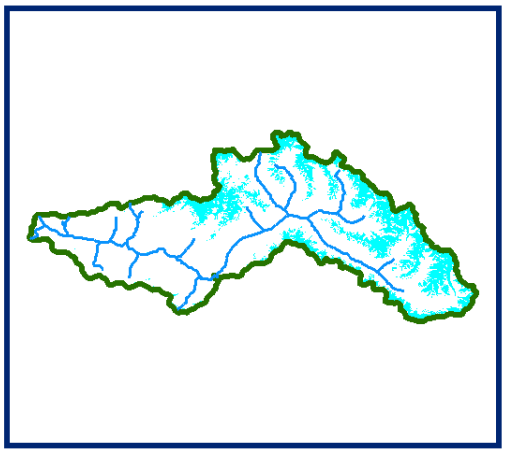
SNOW COVER MAP : BHUT BASIN



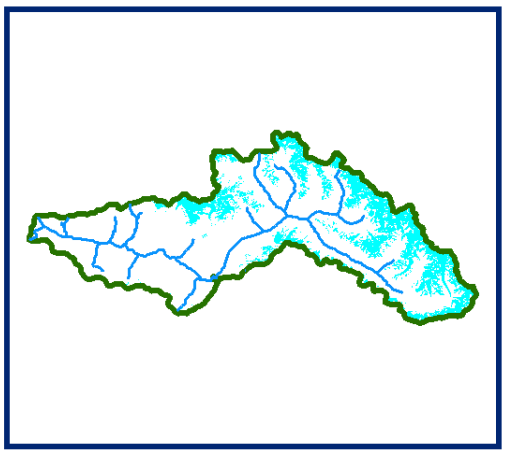
03 OCTOBER 2010



08 OCTOBER 2010



17 OCTOBER 2010



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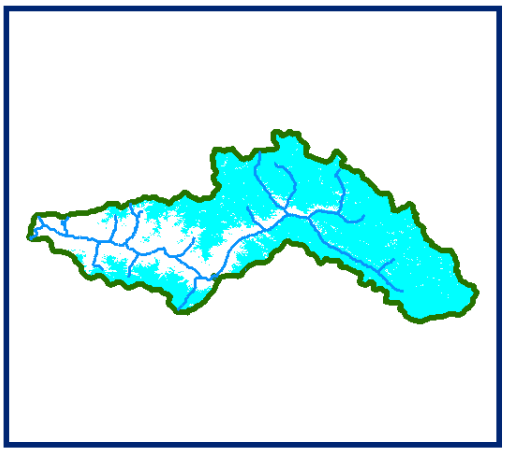

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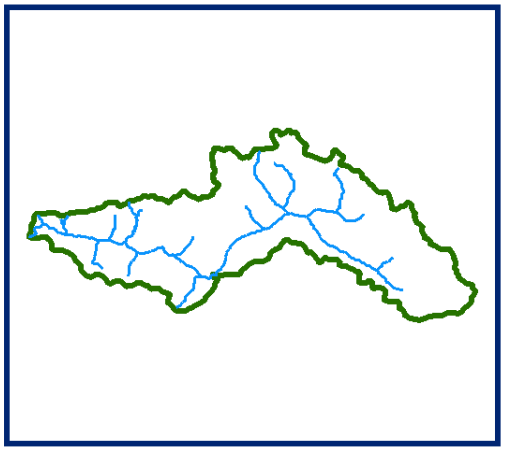

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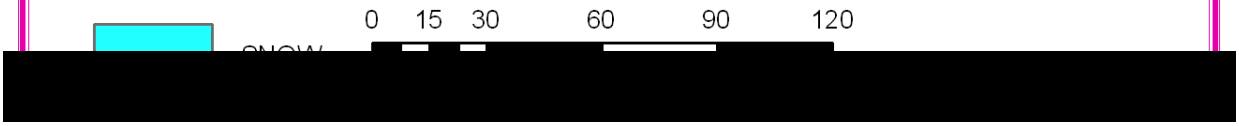
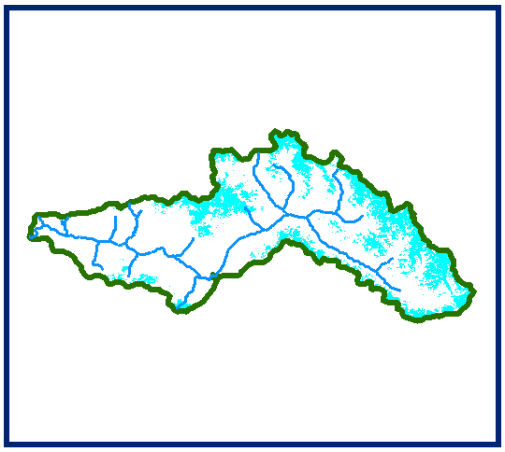
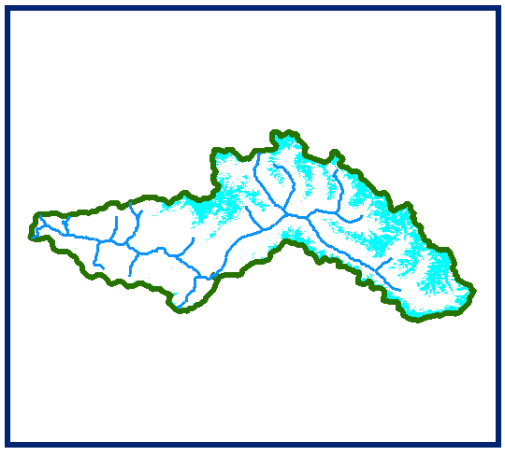


10 DAILY SNOW COVER MAP : BHUT BASIN



DATA USED
03 OCTOBER 2010
08 OCTOBER 2010



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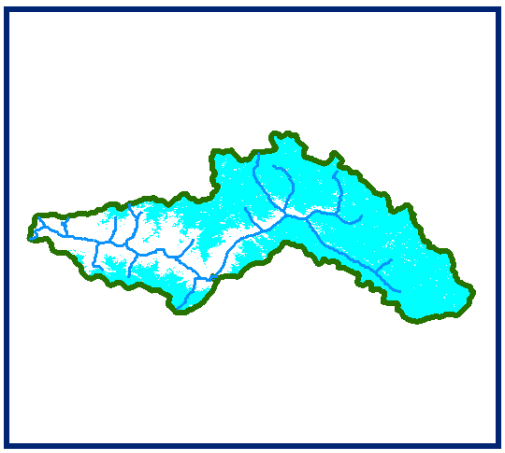
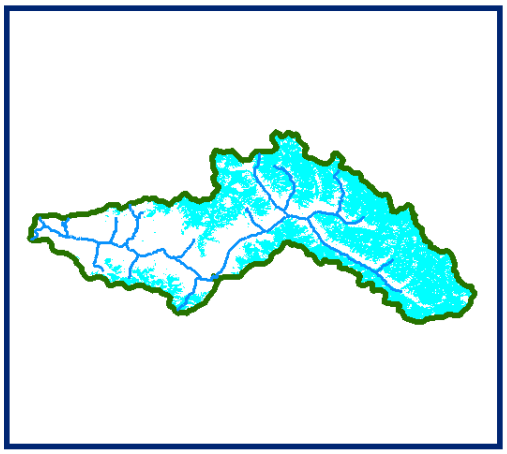


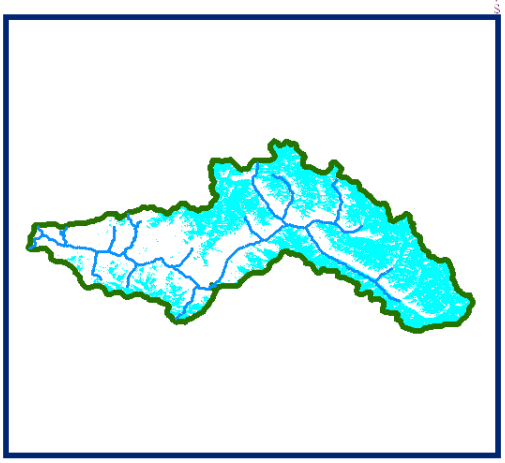
DATA USED
27 OCTOBER 2010

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



06 NOVEMBER 2010



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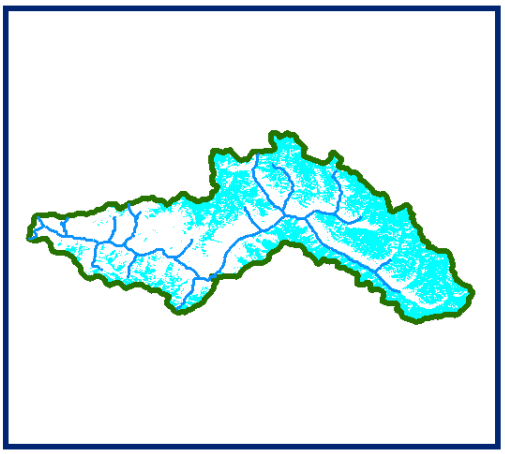

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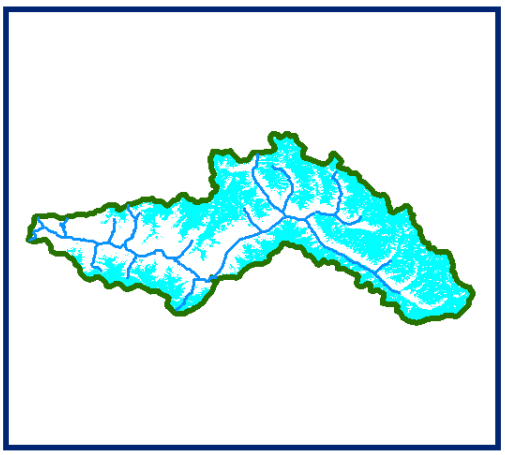

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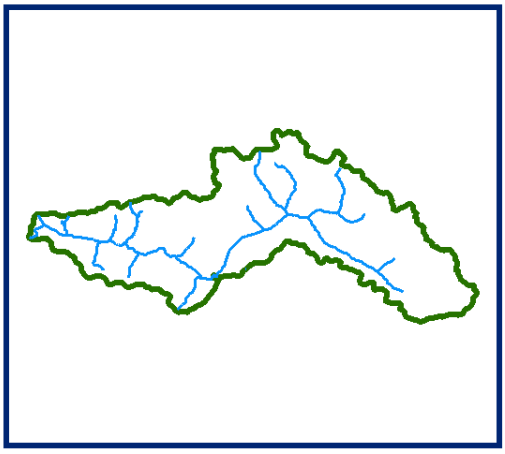

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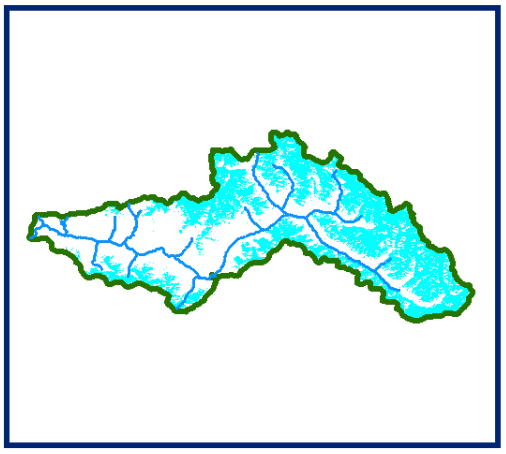
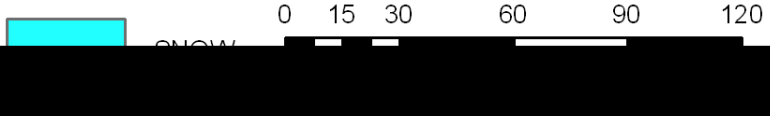
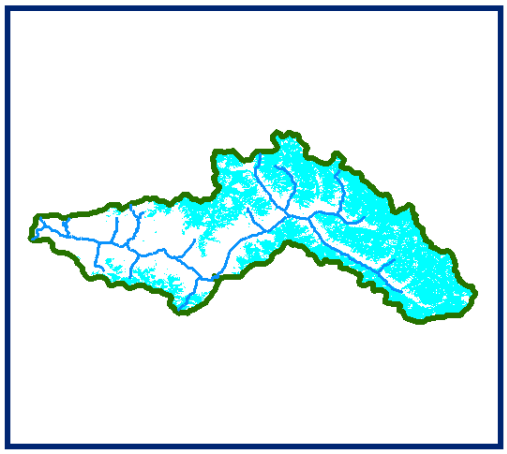


30 NOVEMBER 2010



10 DAILY SNOW COVER MAP : BHUT BASIN



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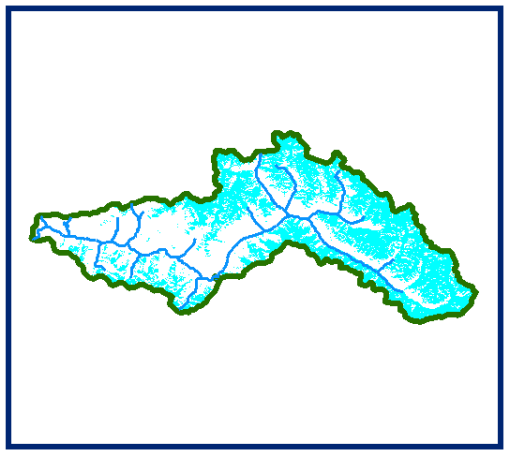
10 NOVEMBER 2010



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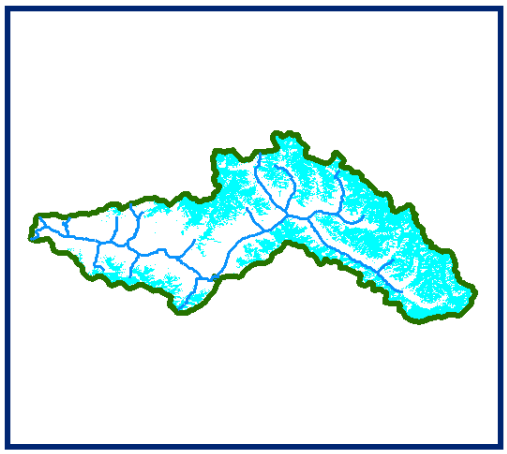
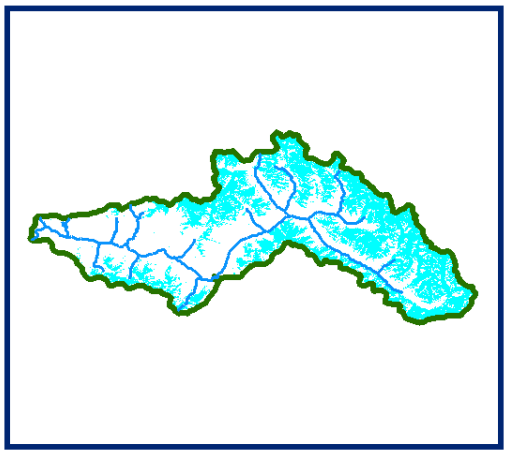


DATA USED
30 NOVEMBER 2010

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



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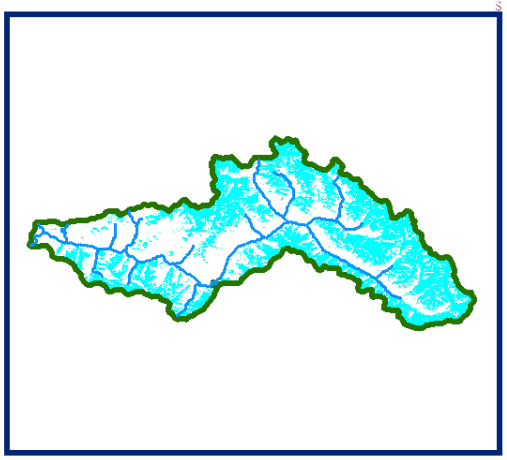

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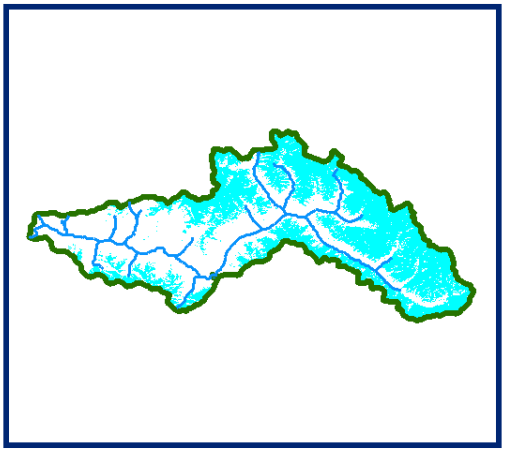

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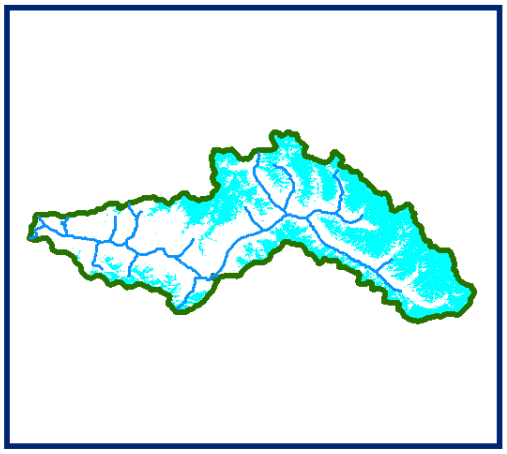

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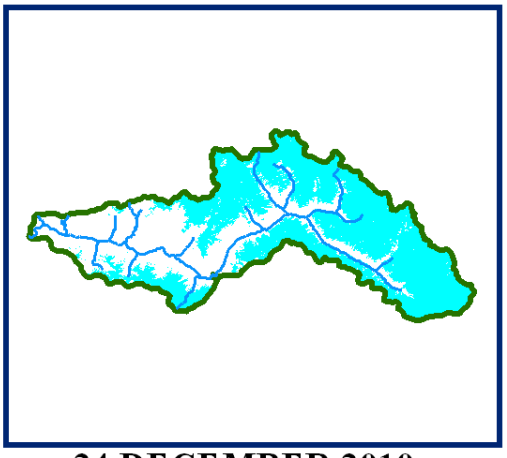

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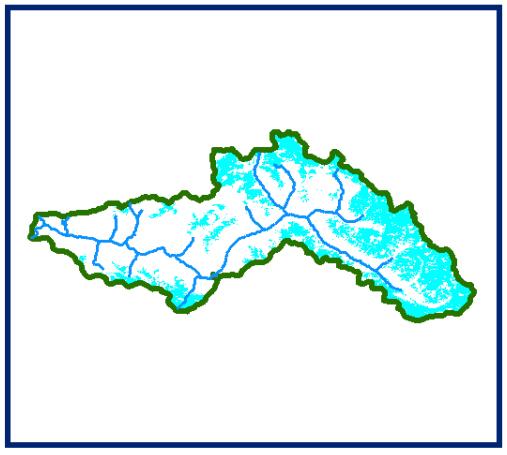

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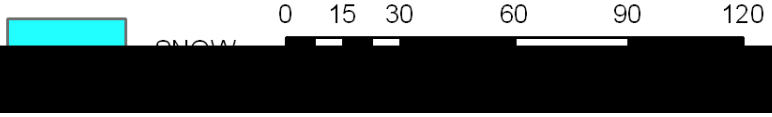
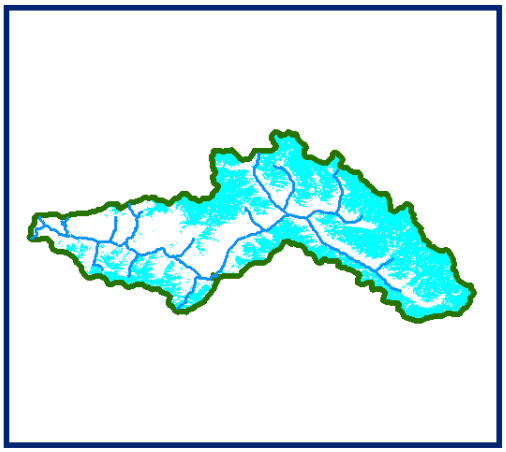


10 DAILY SNOW COVER MAP : BHUT BASIN



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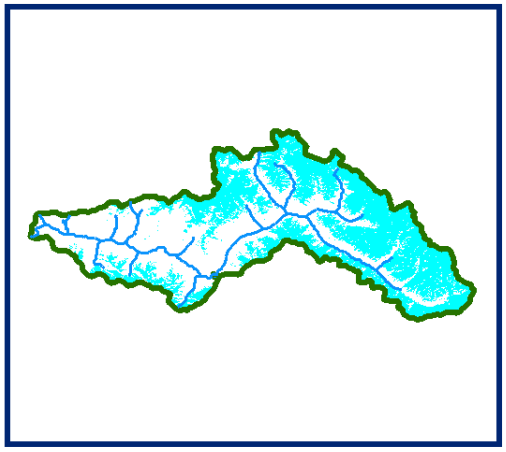
04 DECEMBER 2010
05 DECEMBER 2010
09 DECEMBER 2010



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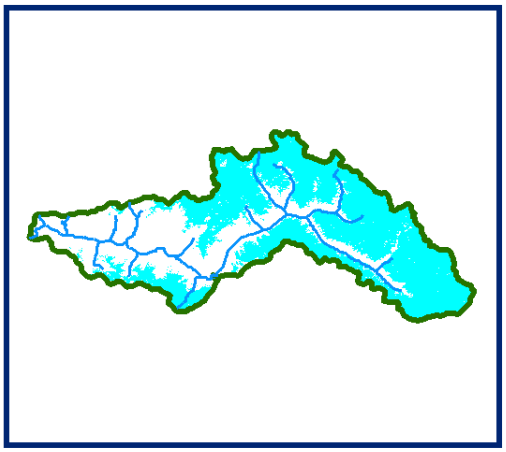

DATA USED
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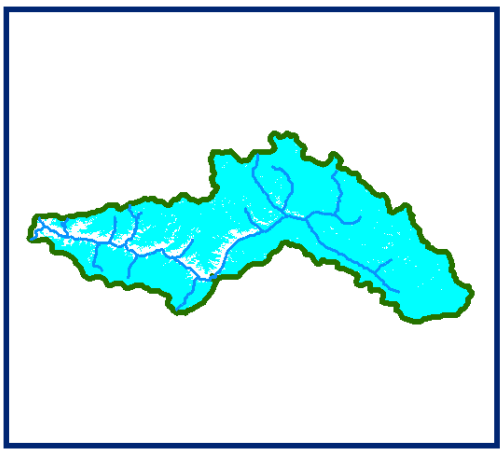
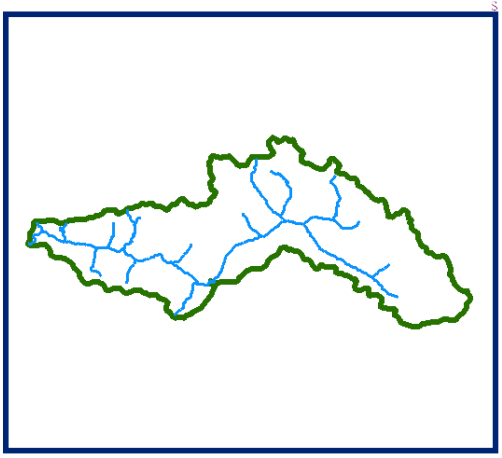
28 DECEMBER 2010

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



02 JANUARY 2011



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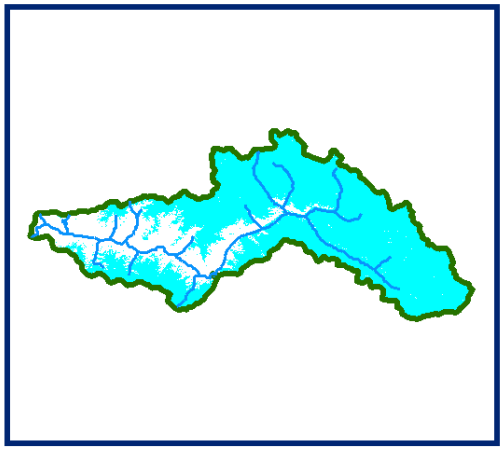

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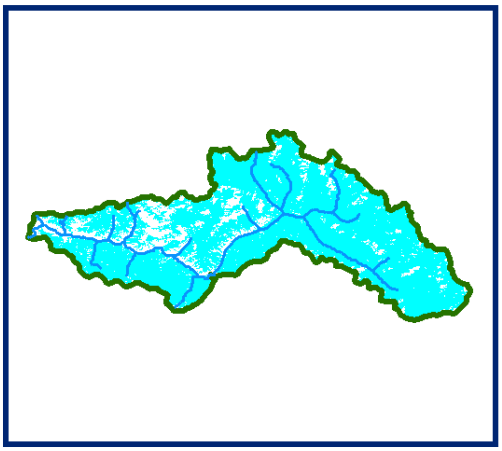

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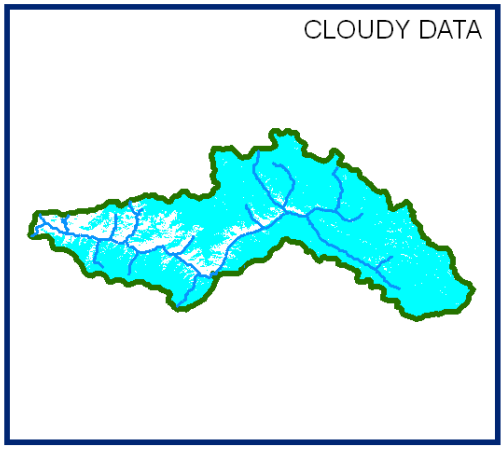
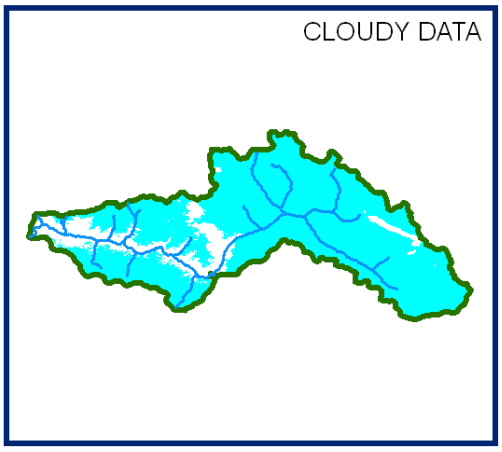
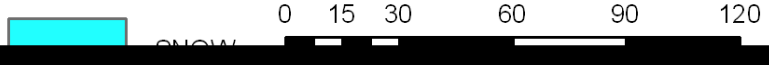


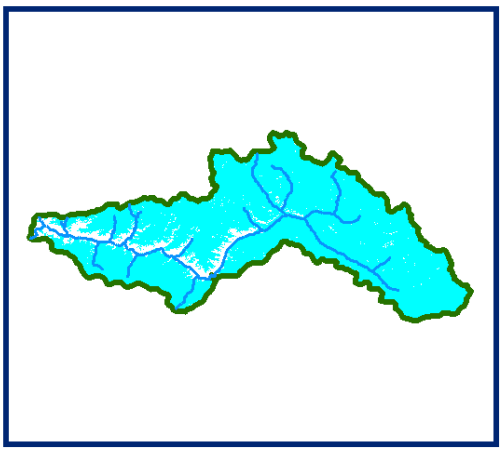
26 JANUARY 2011



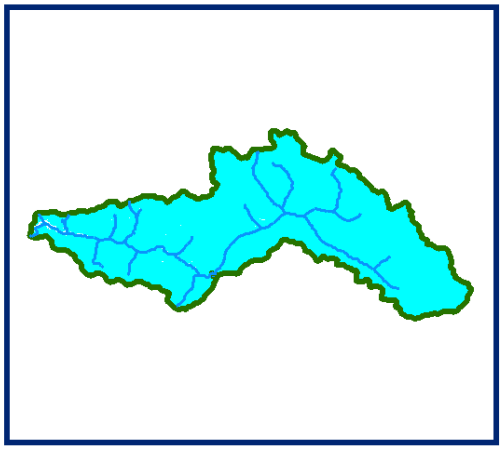
31 JANUARY 2011



10 DAILY SNOW COVER MAP : BHUT BASIN



DATA USED
02 JANUARY 2011



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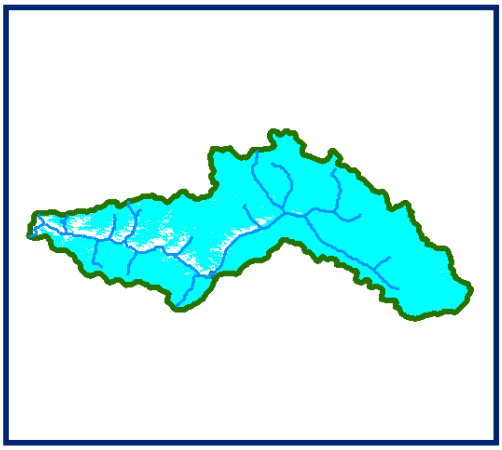

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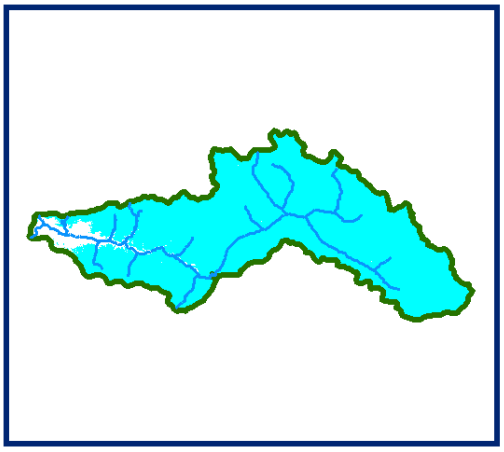
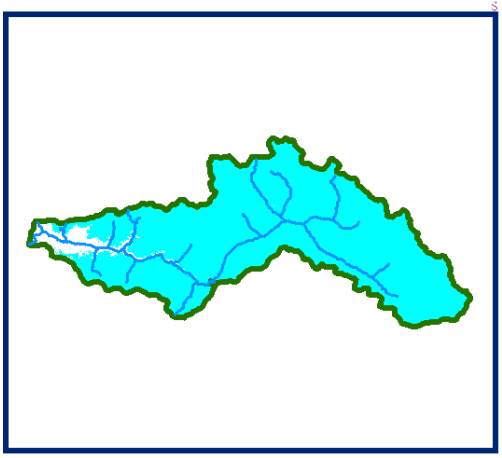
22 JANUARY 2011
31 JANUARY 2011

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



09 FEBRUARY 2011



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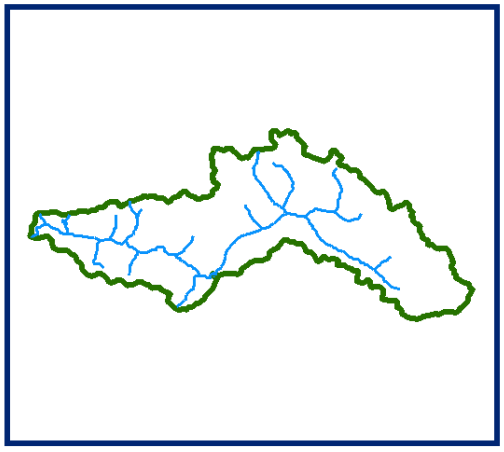

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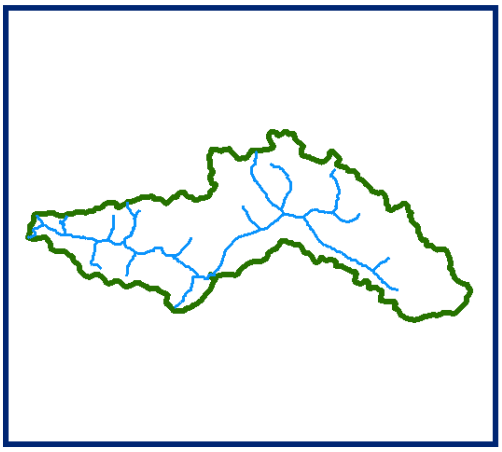

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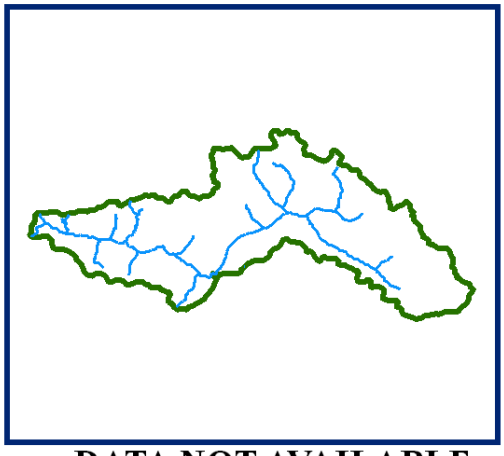

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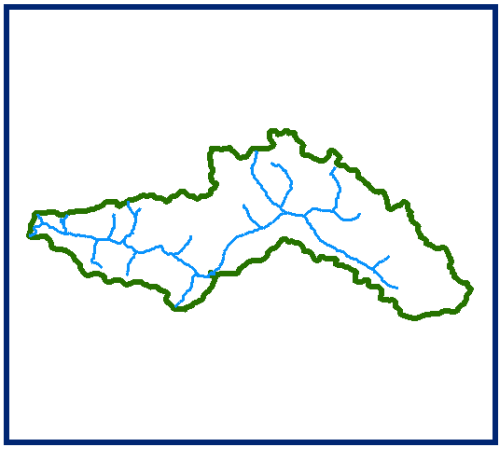

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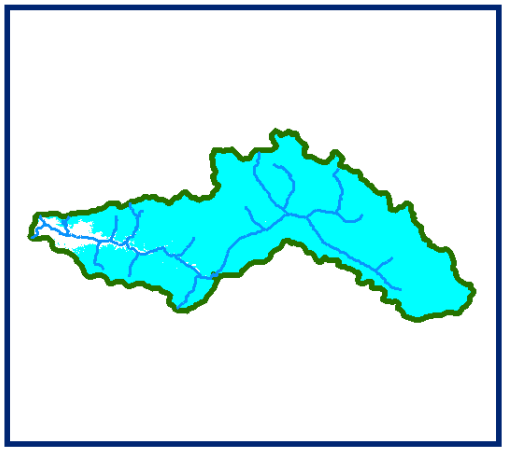
0 15 30 60 90 120

10 DAILY SNOW COVER MAP : BHUT BASIN



DATA USED
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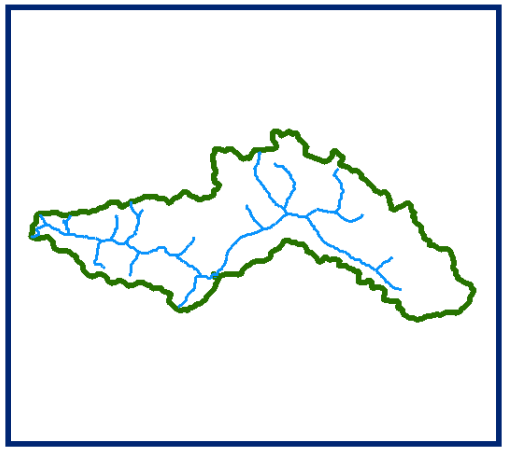
10 FEBRUARY 2011



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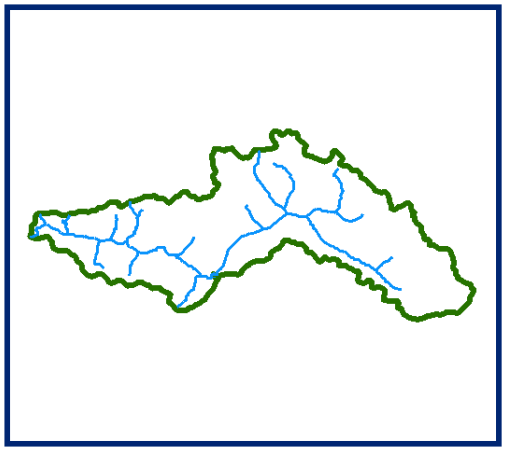

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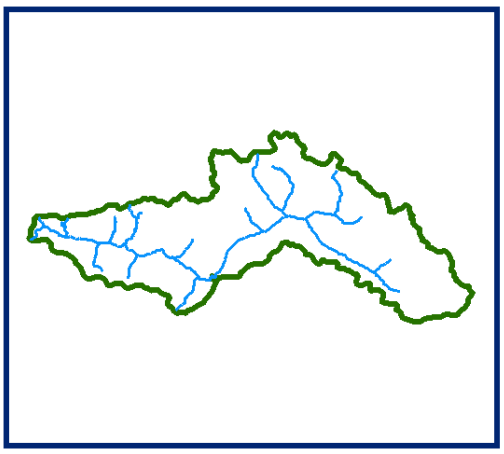
0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



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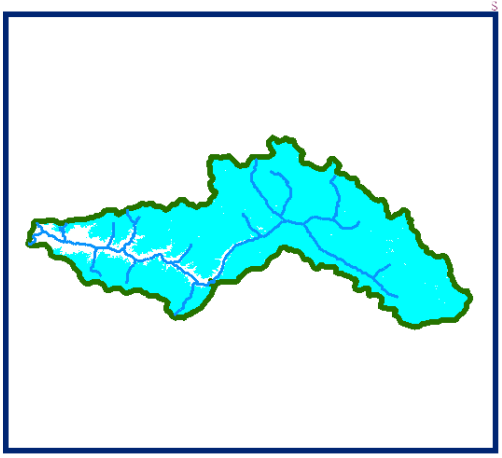
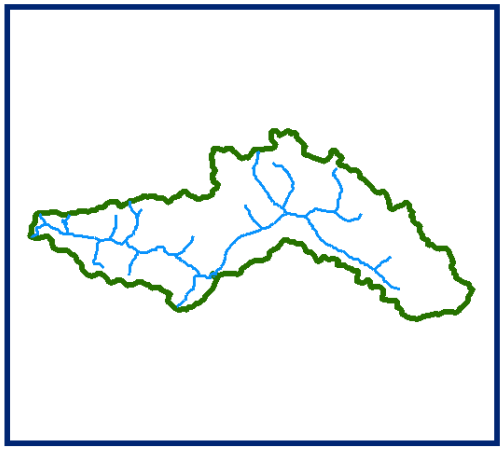


10 MARCH 2011



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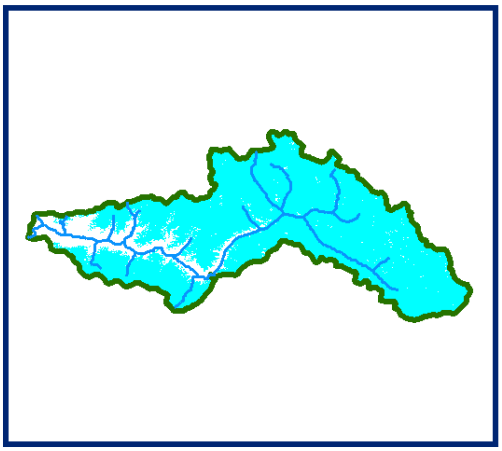

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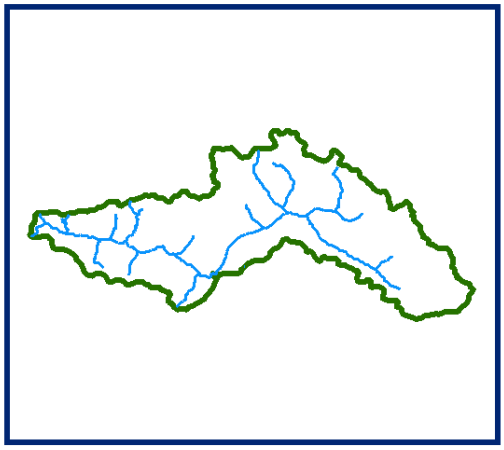

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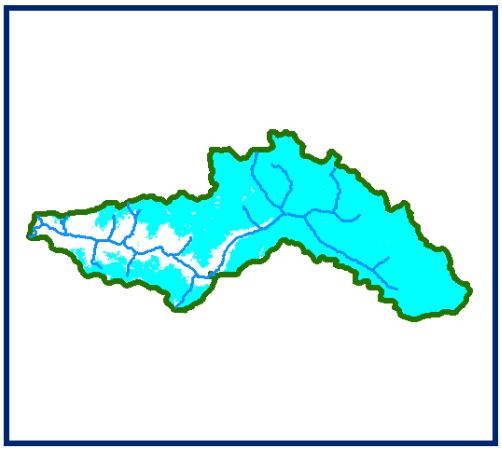
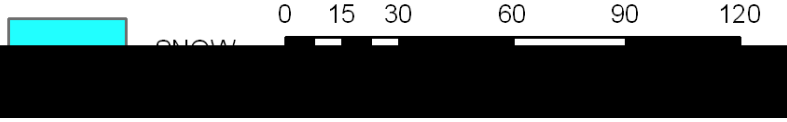
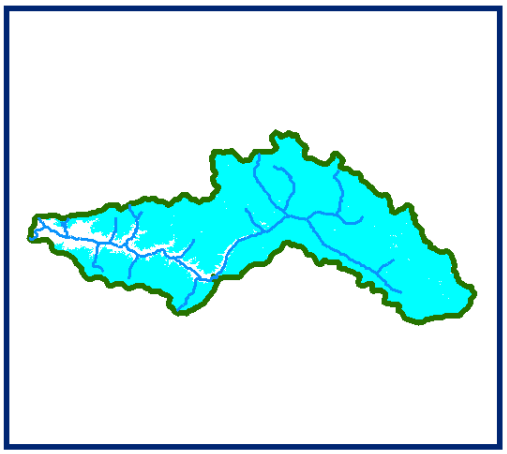


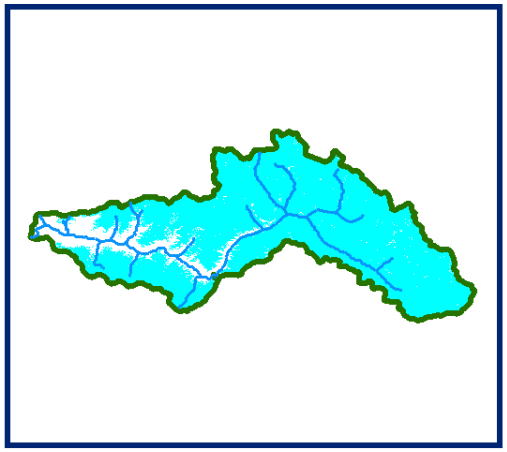
30 MARCH 2011



10 DAILY SNOW COVER MAP : BHUT BASIN



DATA USED
10 MARCH 2011



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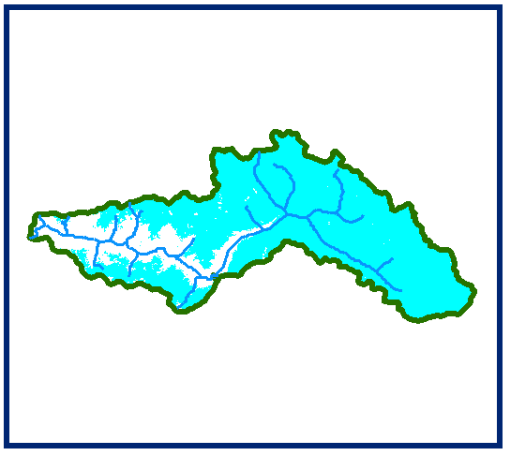
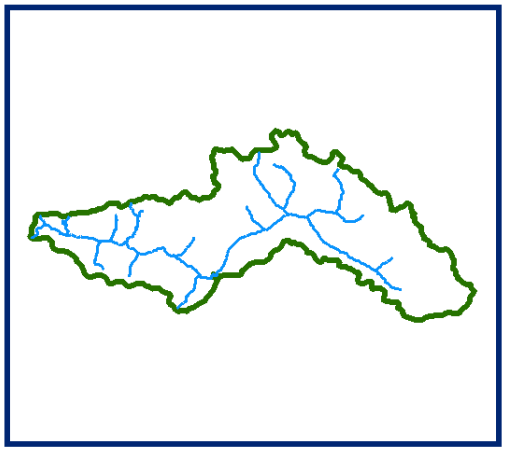


DATA USED
30 MARCH 2011

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



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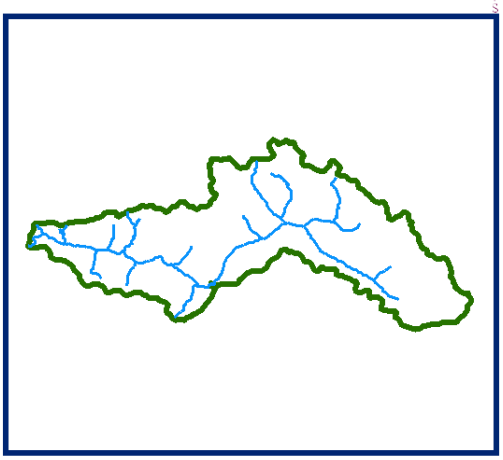

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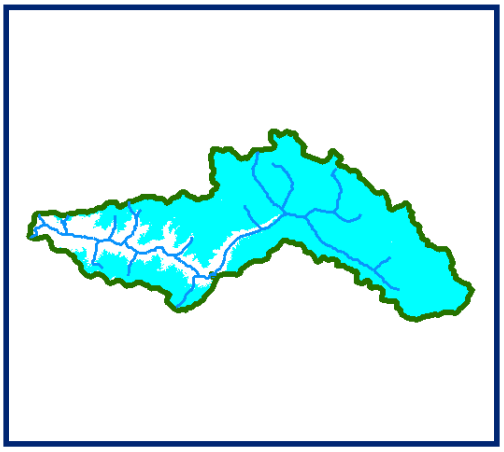
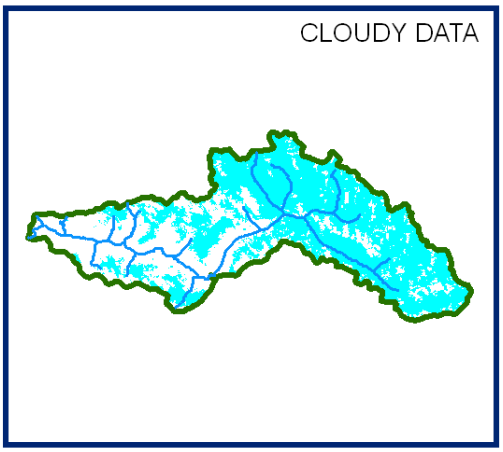


13 APRIL 2011



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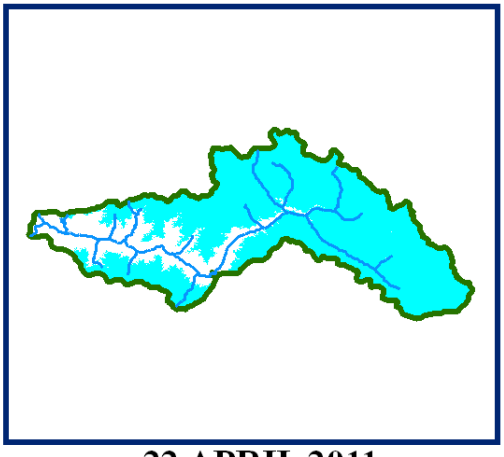

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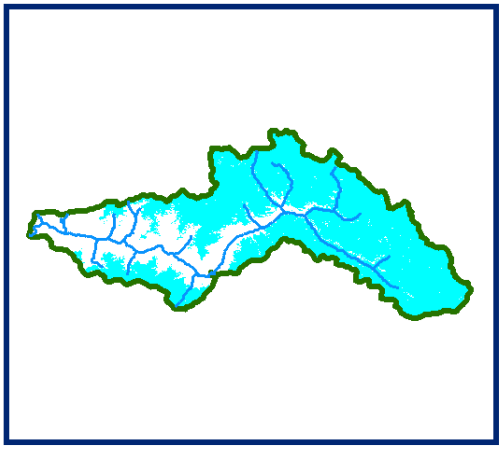
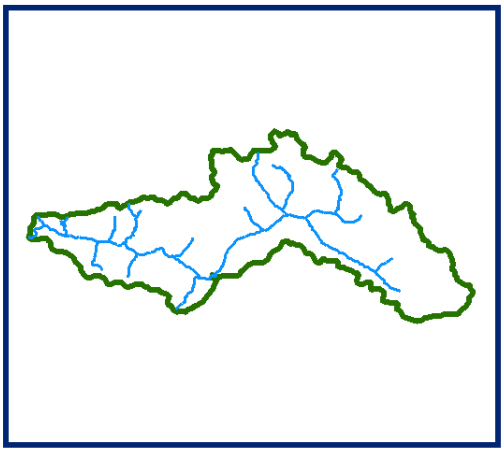


28 APRIL 2011

10 DAILY SNOW COVER MAP : BHUT BASIN



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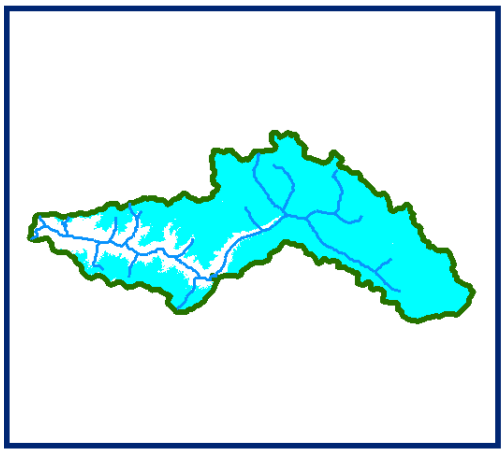
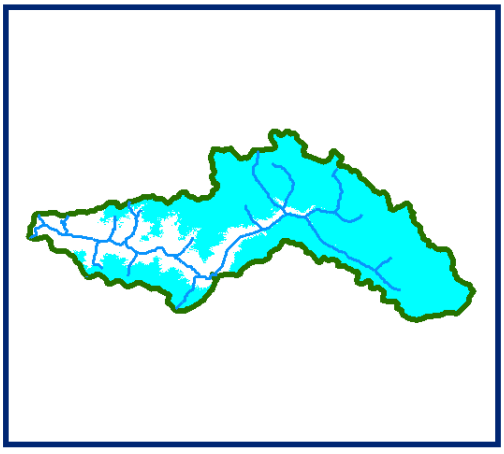


DATA USED

13 APRIL 2011
18 APRIL 2011

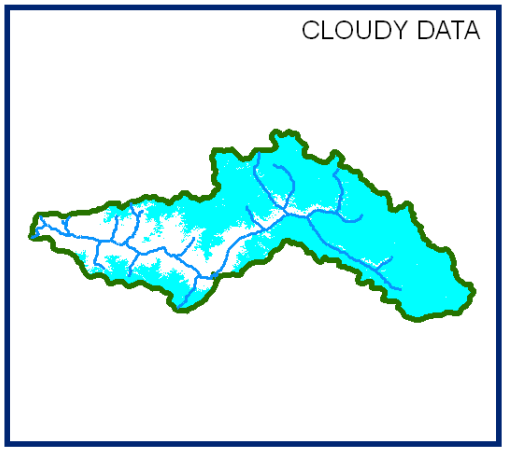


DATA USED

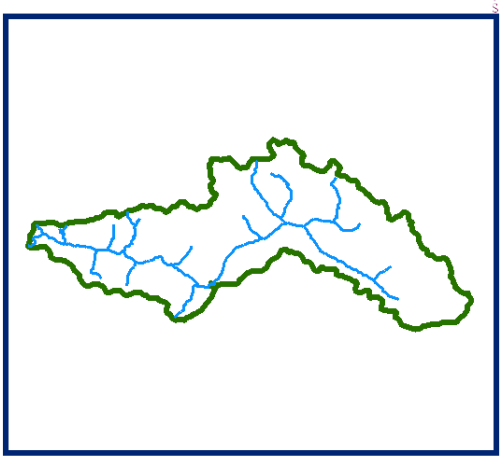
22 APRIL 2011
28 APRIL 2011

0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



02 MAY 2011



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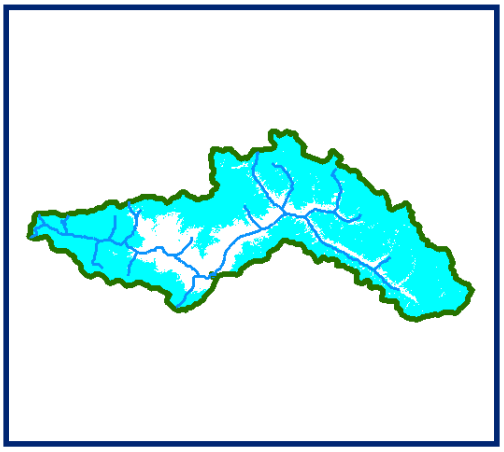

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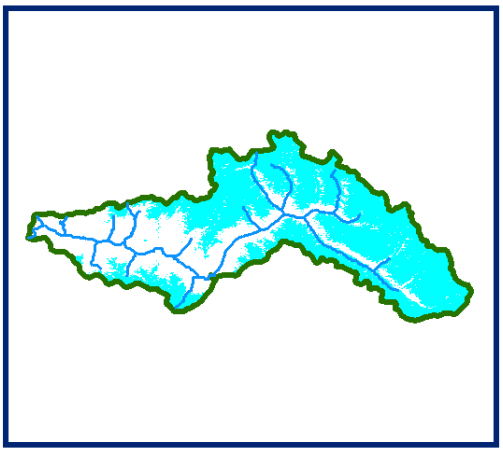

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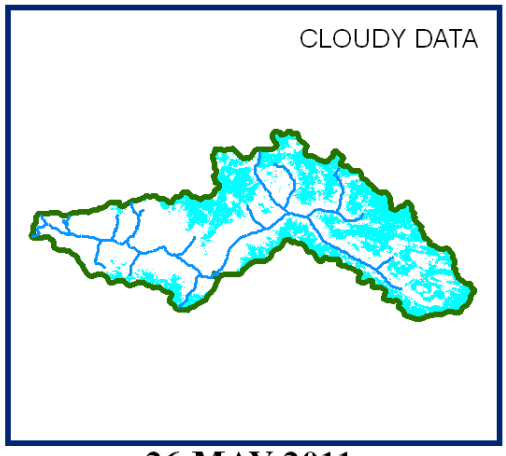

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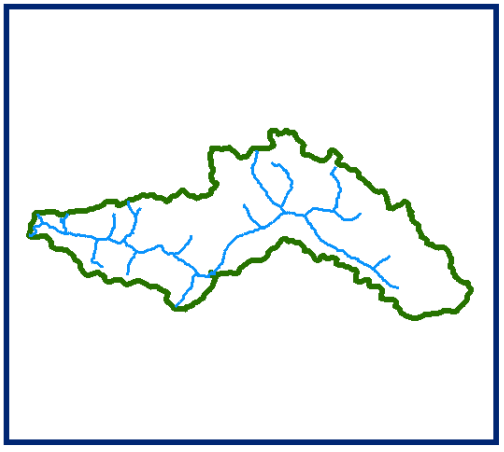
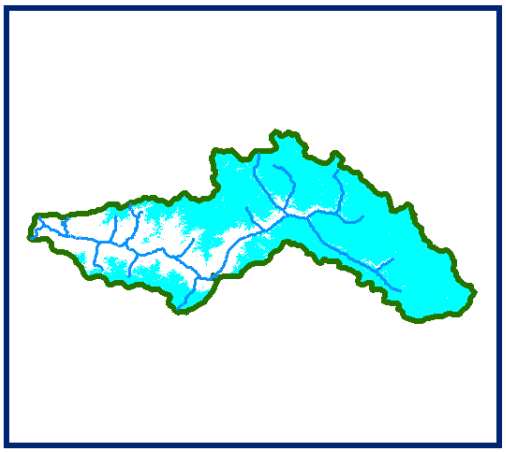


DATA NOT AVAILABLE

10 DAILY SNOW COVER MAP : BHUT BASIN



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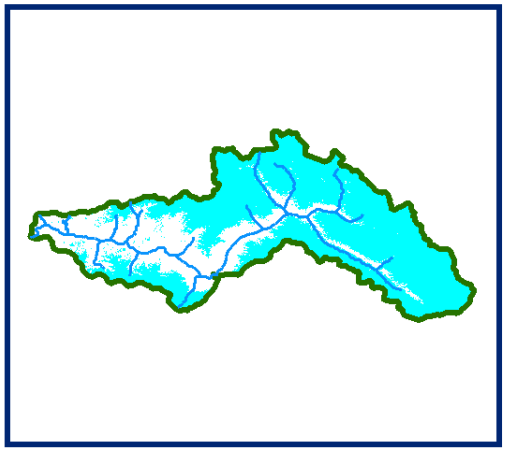

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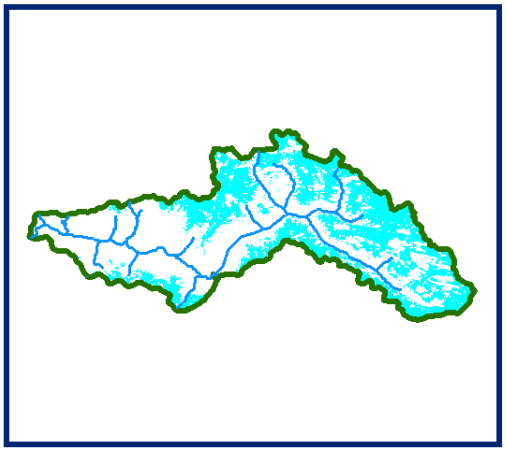

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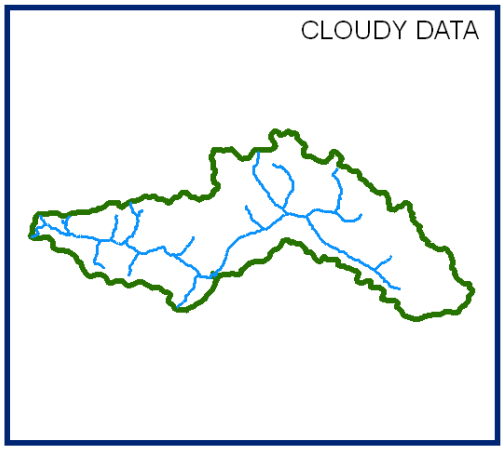
0 5 10 20 30 40

SNOW COVER MAP : BHUT BASIN



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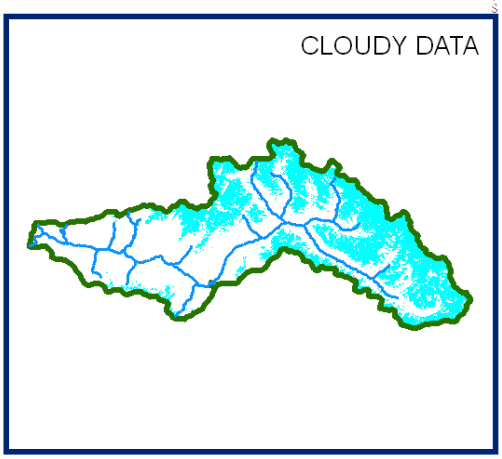
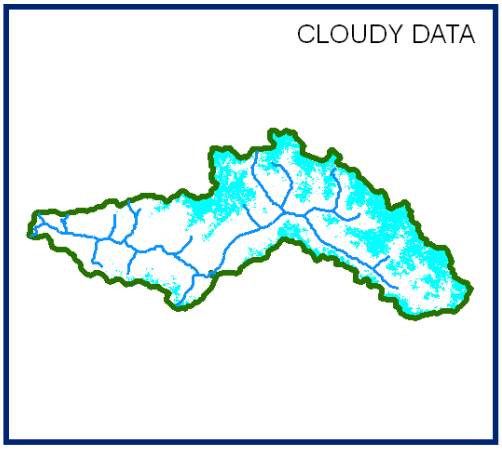
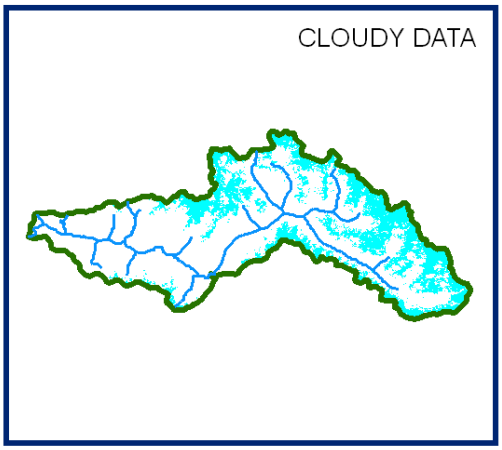


10 JUNE 2011



14 JUNE 2011



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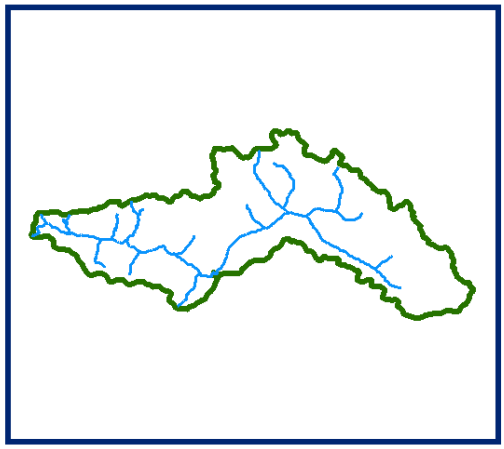

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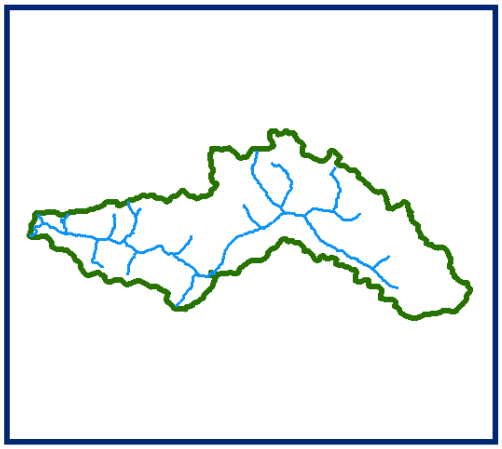

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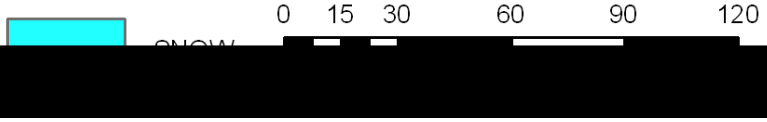
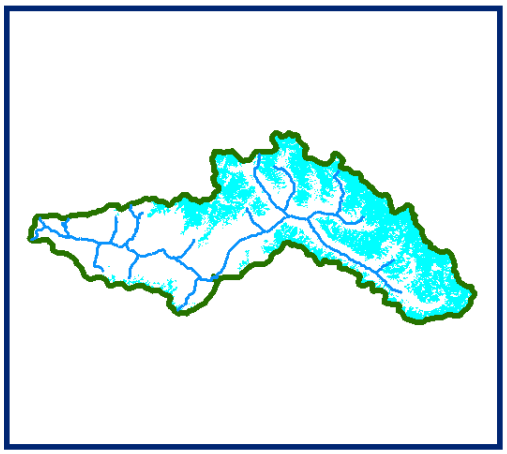


10 DAILY SNOW COVER MAP : BHUT BASIN



DATA USED
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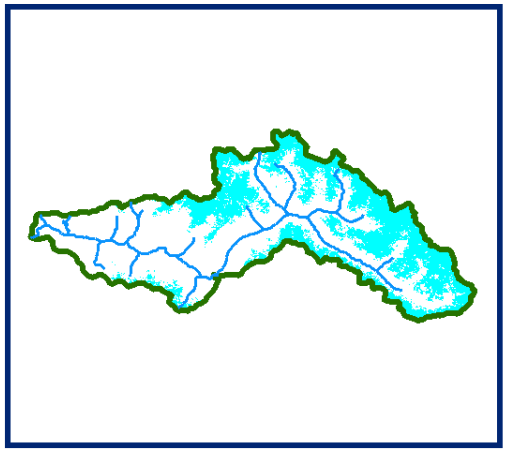

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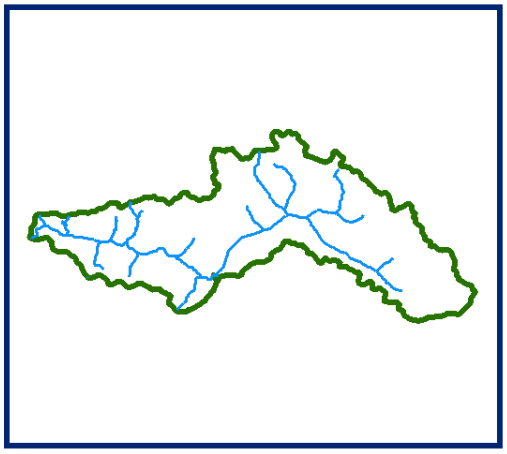
14 JUNE 2011
19 JUNE 2011



DATA NOT AVAILABLE

0 5 10 20 30 40

WARWAN BASIN

AREAL EXTENT OF SNOW (5 DAILY)

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

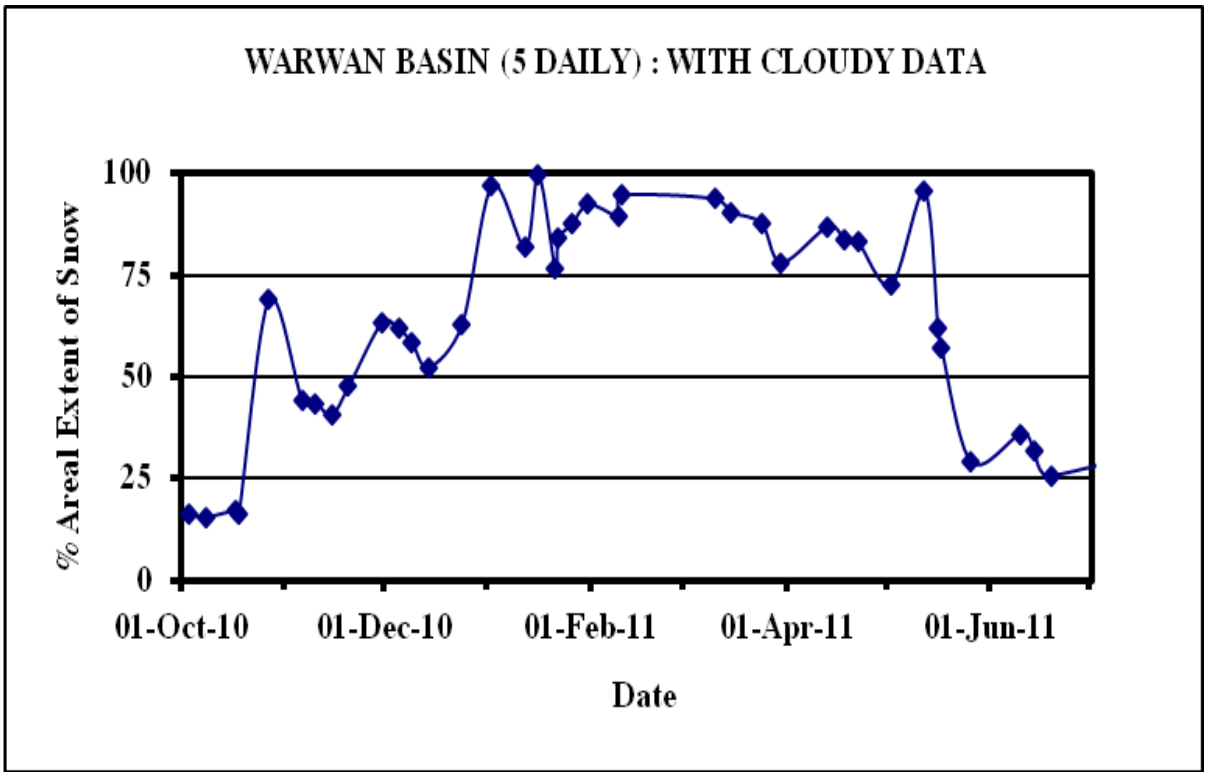
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	3-Oct-10	760.32	16	3	17-Oct-10	800.77	17
2	8-Oct-10	722.73	15	4	18-Oct-10	756.24	16
5	27-Oct-10	3216.10	69				
November 2010							
6	6-Nov-10	2063.85	44	7	20-Nov-10	2225	48
8	10-Nov-10	2034.55	44	9	30-Nov-10	2958.66	63
10	15-Nov-10	1897.45	40				
December 2010							
11	4-Dec-10	2837.37	61	12	9-Dec-10	2724.51	58
13	5-Dec-10	2887.63	62	14	14-Dec-10	2441.49	52
15	19-Dec-10	2335.51	50	16	24-Dec-10	2930.48	63
January 2011							
17	2-Jan-11	4522.07	97	18	22-Jan-11	3922.56	84
19	12-Jan-11	3823.75	82	20	26-Jan-11	4086.71	87
21	16-Jan-11	4654.53	99	22	31-Jan-11	4313.61	92
23	21-Jan-11	3585.78	77				
February 2011							
24	9-Feb-11	4184.32	90	25	10-Feb-11	4416.7	94
March 2011							
26	10-Mar-11	4378.51	94	27	24-Mar-11	4095.57	88
28	15-Mar-11	4223.31	90	29	30-Mar-11	3645.87	78
April 2011							
30	13-Apr-11	4060.76	87	31	22-Apr-11	3881.04	83
32	18-Apr-11	3912.02	84				
May 2011							
33	2-May-11	3390.08	73	34	17-May-11	2671.79	57
35	12-May-11	4456.65	95	36	26-May-11	1356.4	29
37	16-May-11	2902.81	62				
June 2011							
38	10-June-11	1680.04	36	39	19-June-11	1192.32	26
40	14-June-11	1482.15	32				

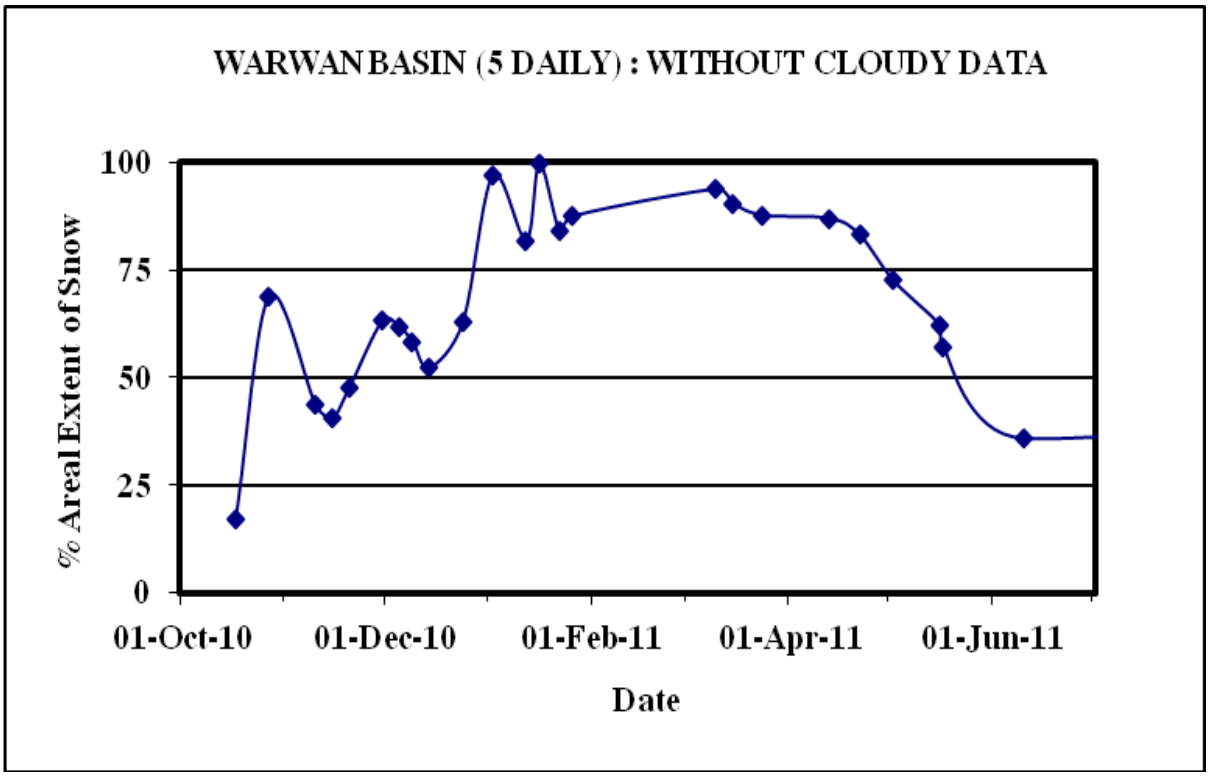
AREAL EXTENT OF SNOW (10 DAILY)

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

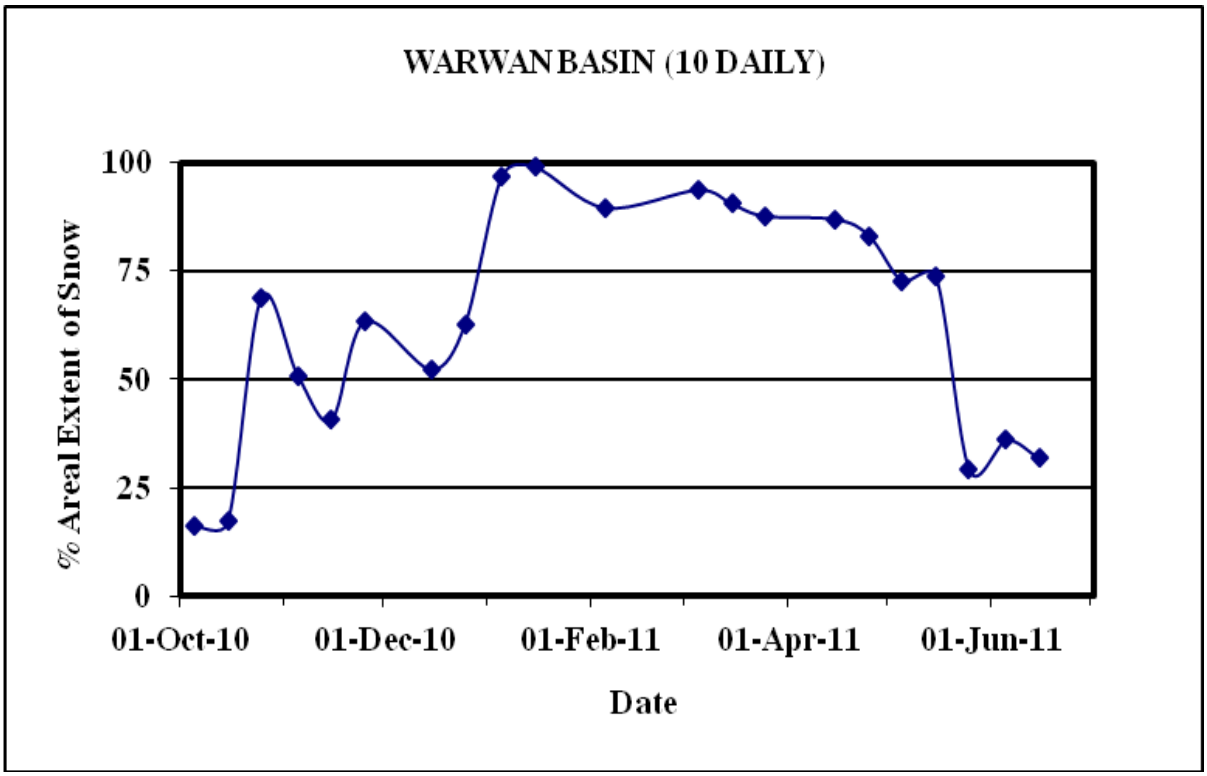
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2010							
1	5-Oct-10	760.32	16	2	15-Oct-10	801.1	17
3	25-Oct-10	3216.1	69				
November 2010							
4	5-Nov-10	2374.81	51	5	15-Nov-10	1900.53	41
6	25-Nov-10	2958.66	63				
December 2010							
7	15-Dec-10	2442.27	52	8	25-Dec-10	2930.42	63
January 2011							
9	5-Jan-11	4522.07	97	10	15-Jan-11	3823.67	82
February 2011							
11	5-Feb-11	4184.32	90				
March 2011							
12	5-Mar-11	4378.51	94	13	15-Mar-11	4223.31	90
14	25-Mar-11	4094.59	88				
April 2011							
15	15-Apr-11	4060.86	87	16	25-Apr-11	3881.04	83
May 2011							
17	5-May-11	3390.08	73	18	15-May-11	3437.43	74
19	25-May-11	1356.4	29				
June 2011							
20	5-June-11	1680.04	36	21	15-June-11	1482.45	32

SNOW COVER DEPLETION CURVE



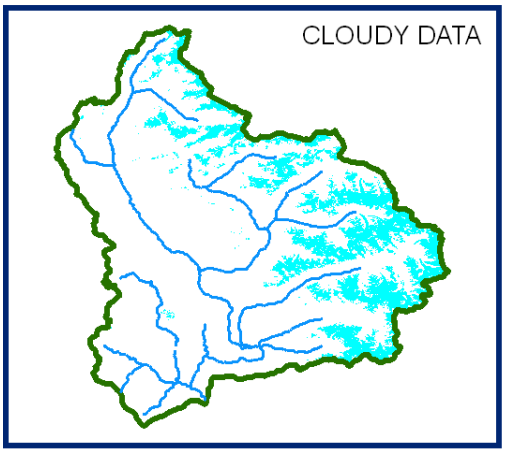


SNOW COVER DEPLETION CURVE

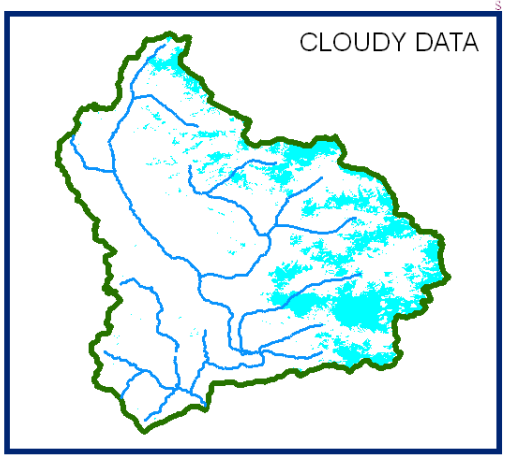


SNOW COVER MAP

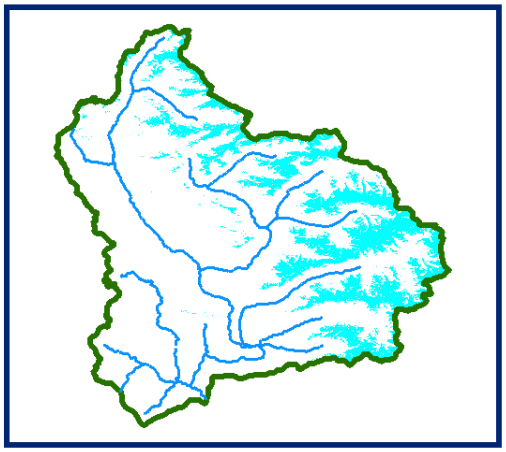
SNOW COVER MAP : WARWAN BASIN



03 OCTOBER 2010



08 OCTOBER 2010



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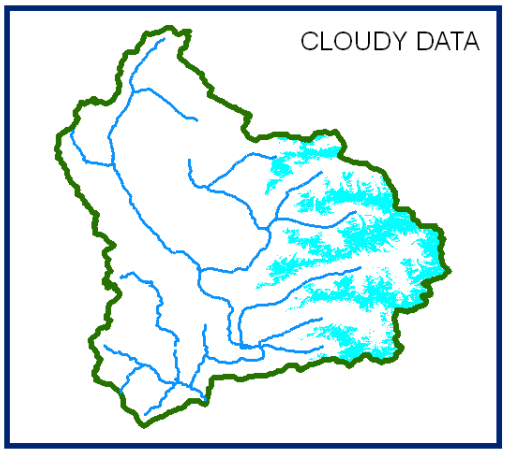
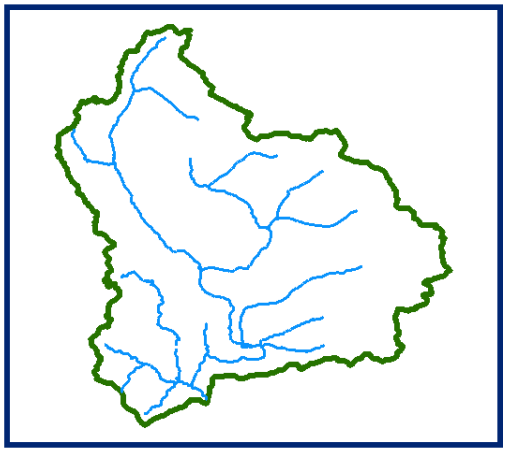


18 OCTOBER 2010



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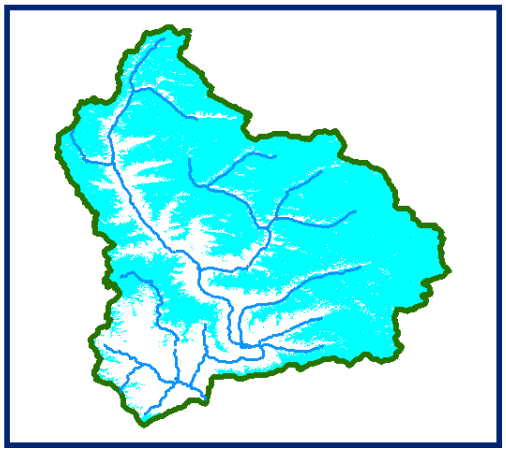
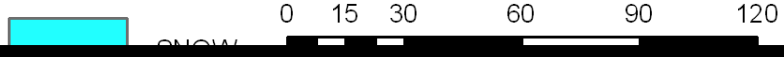
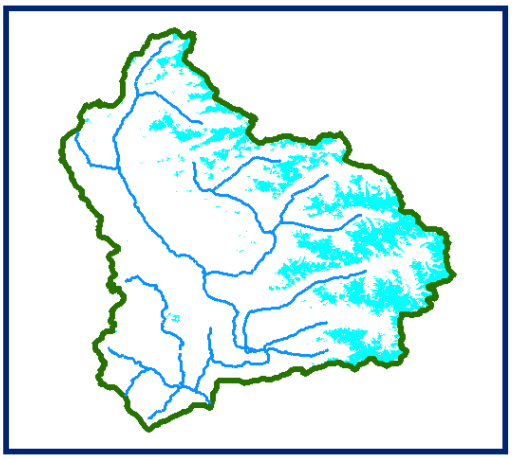


27 OCTOBER 2010



10 DAILY SNOW COVER MAP : WARWAN BASIN



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03 OCTOBER 2010
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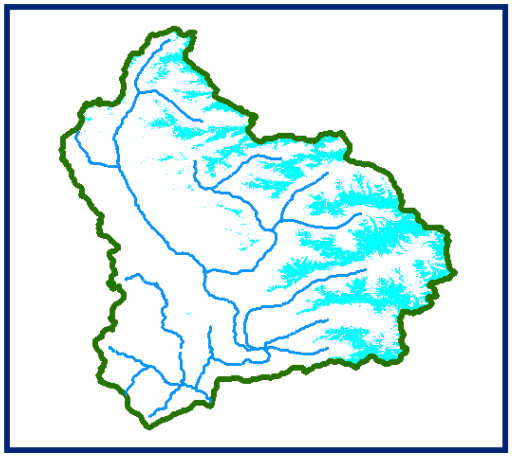

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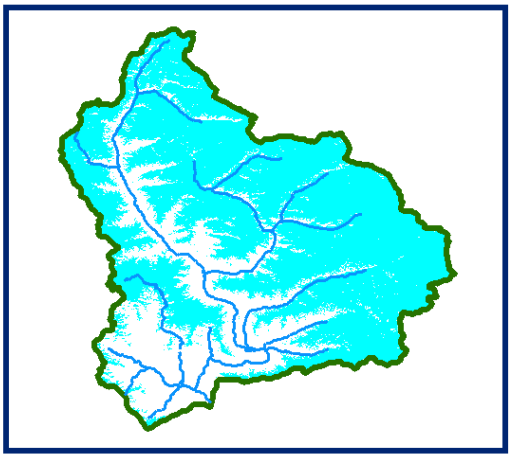
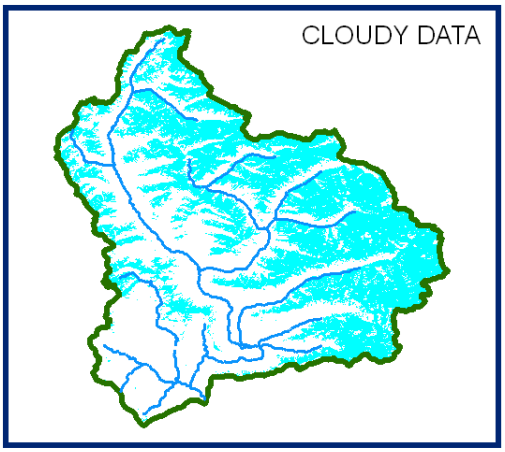


DATA USED

27 OCTOBER 2010

0 5 10 20 30 40

SNOW COVER MAP : WARWAN BASIN



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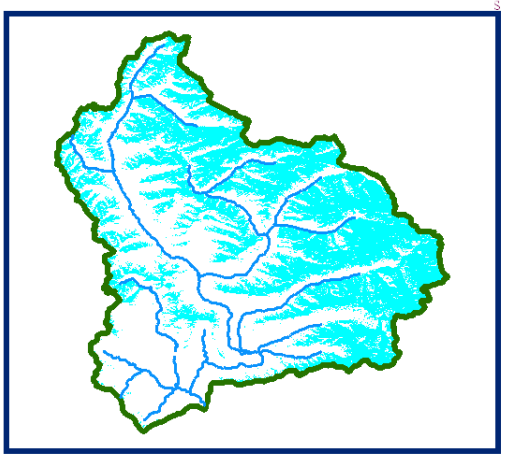

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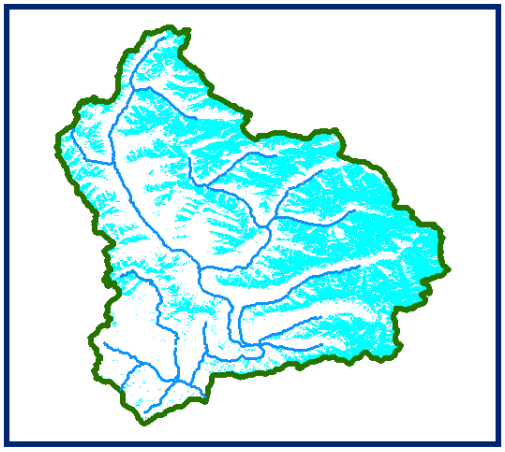

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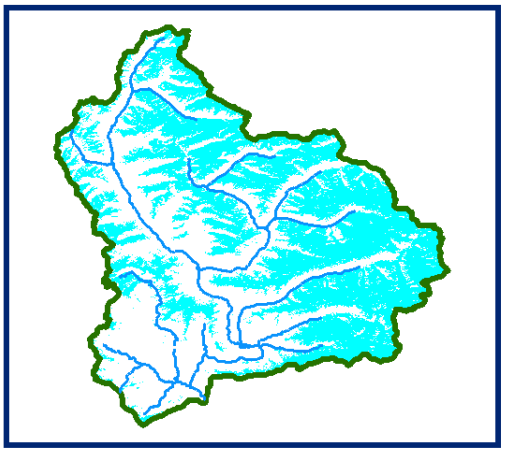

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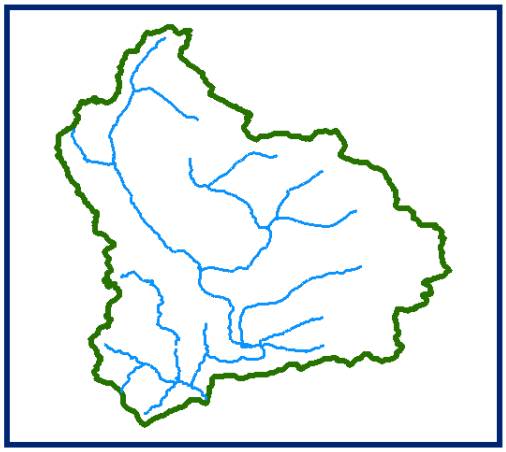

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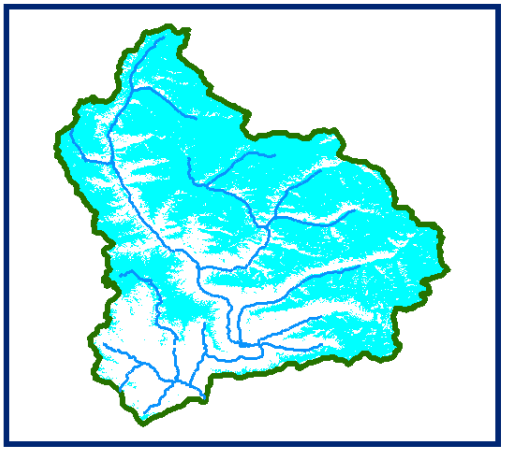

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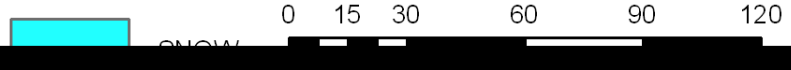
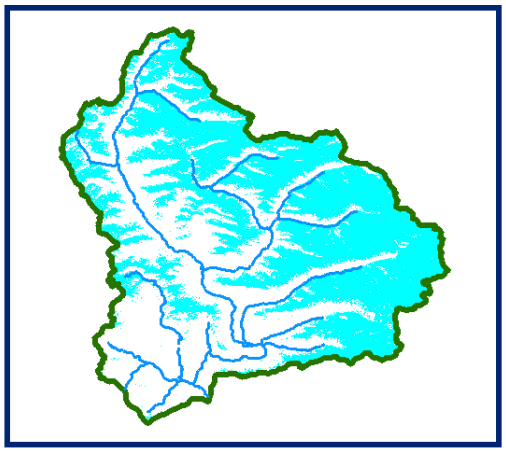


10 DAILY SNOW COVER MAP : WARWAN BASIN



DATA USED

06 NOVEMBER 2010
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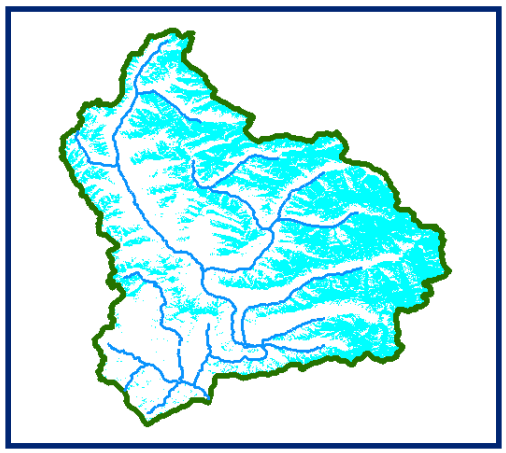

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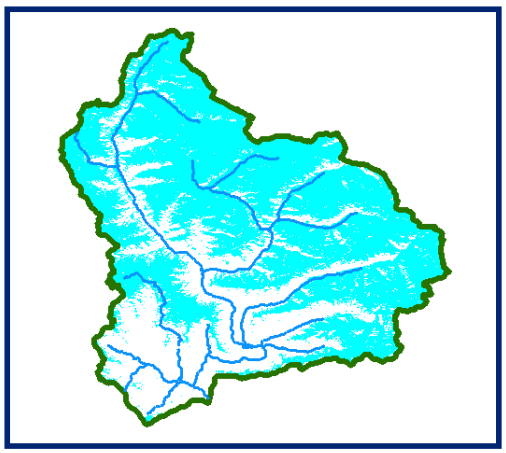
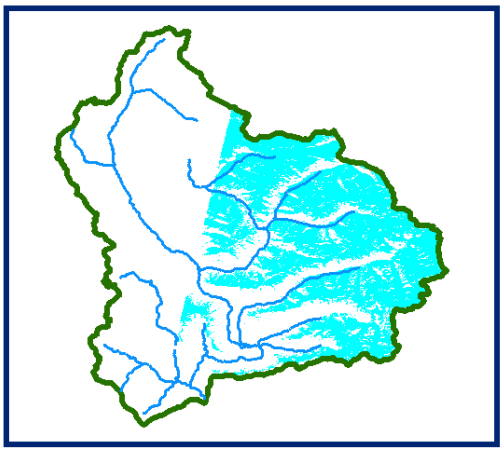


DATA USED

30 NOVEMBER 2010

0 5 10 20 30 40

SNOW COVER MAP : WARWAN BASIN



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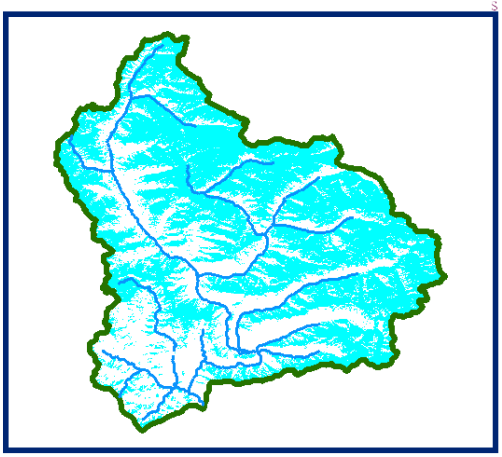

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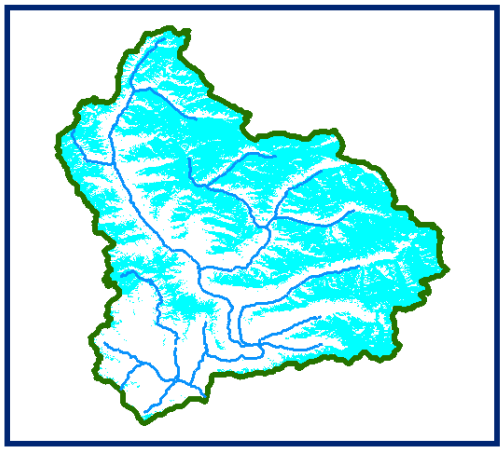
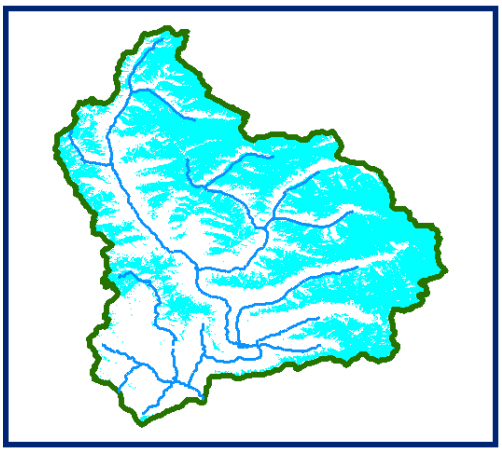


14 DECEMBER 2010



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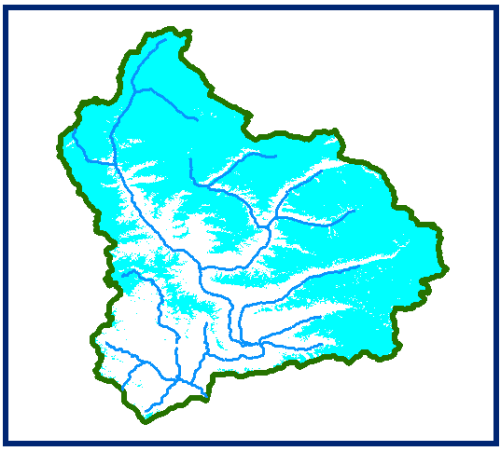

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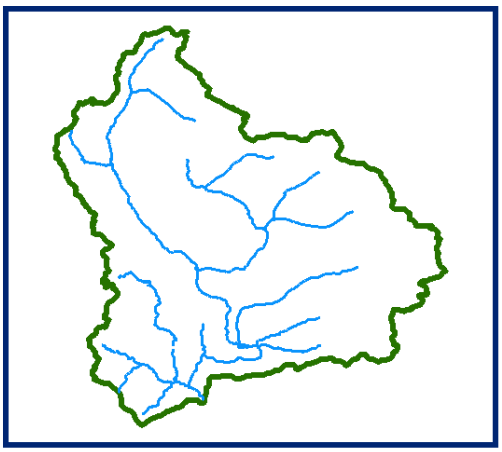

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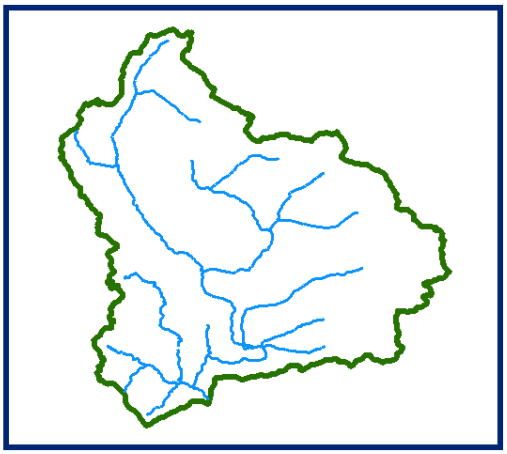
10 DAILY SNOW COVER MAP : WARWAN BASIN



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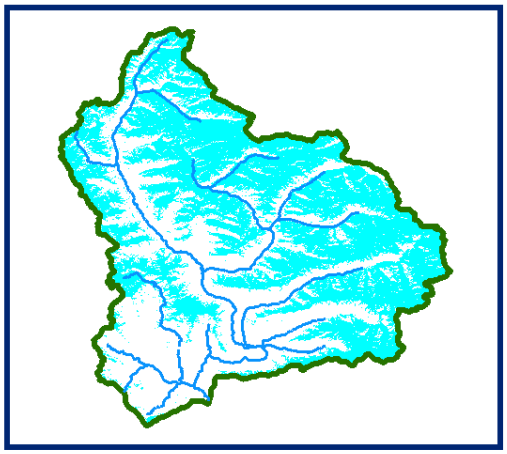

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14 DECEMBER 2010
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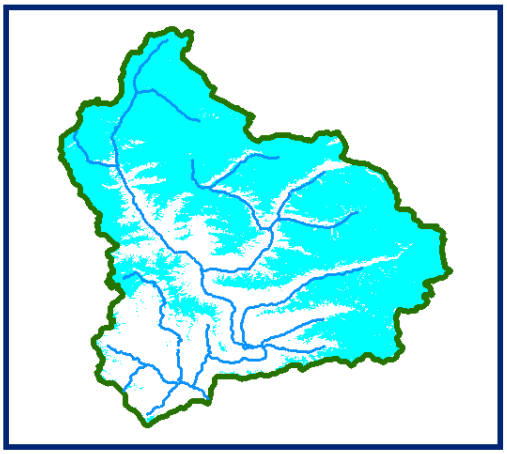

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24 DECEMBER 2010

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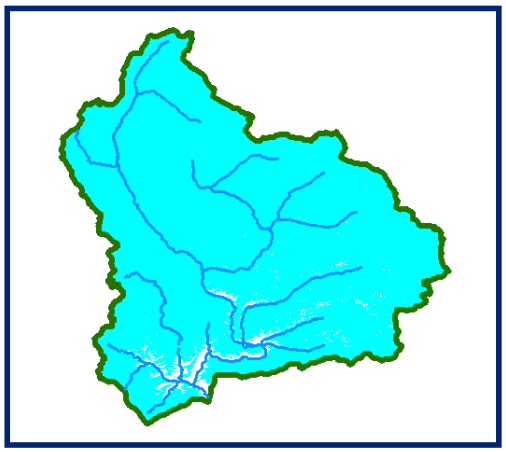
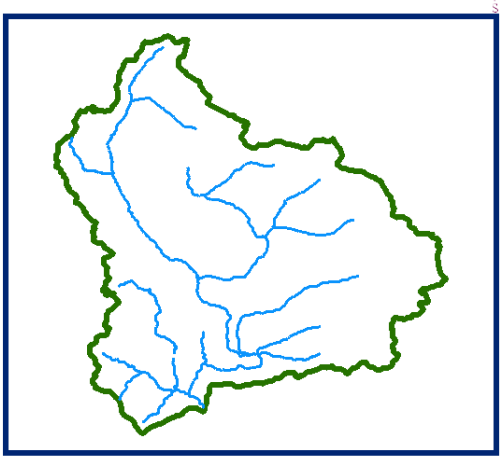
SNOW COVER MAP : WARWAN BASIN



02 JANUARY 2011



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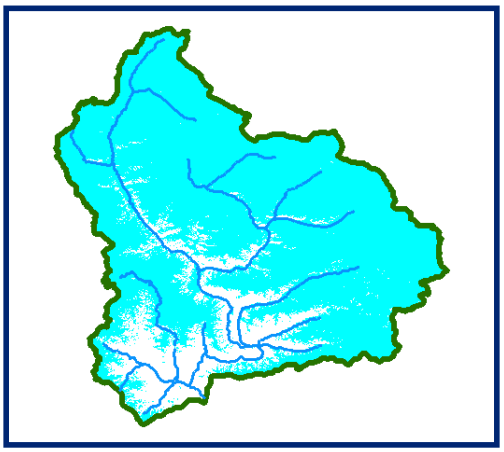
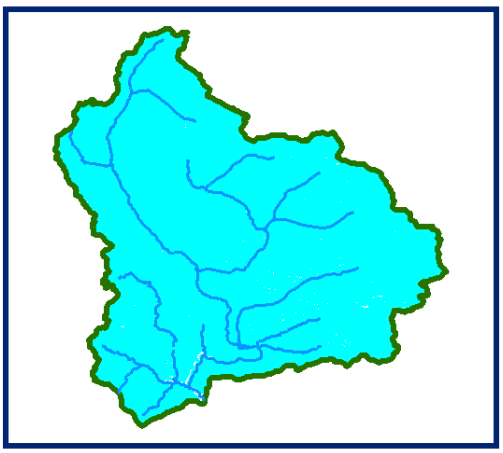


12 JANUARY 2011



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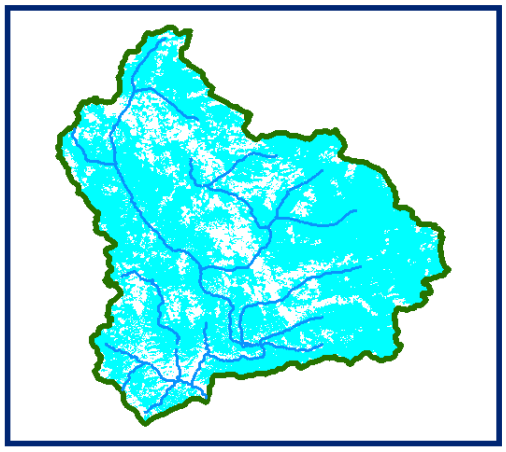

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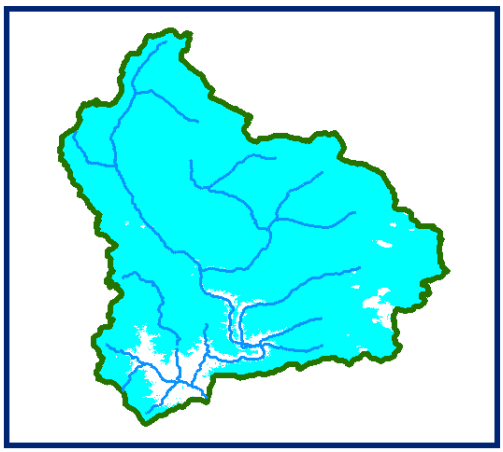
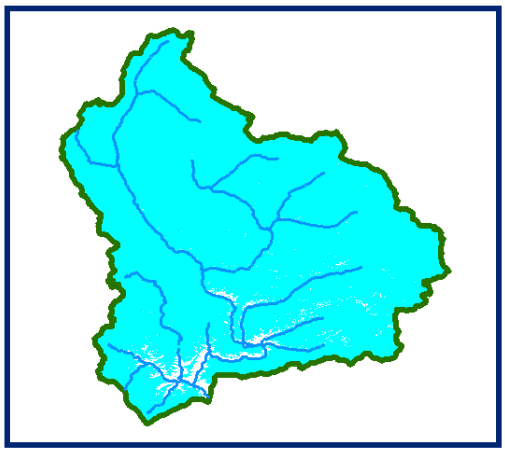


31 JANUARY 2011

10 DAILY SNOW COVER MAP : WARWAN BASIN



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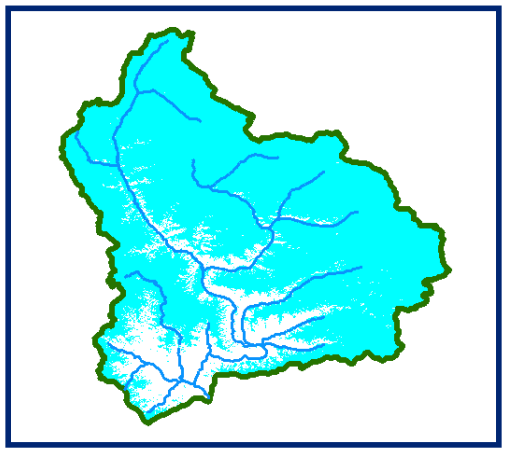

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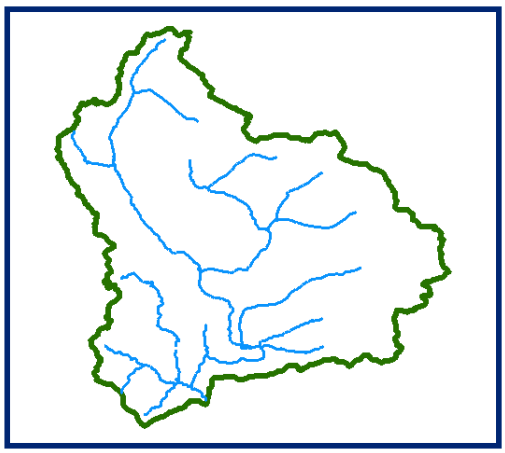
16 JANUARY 2011



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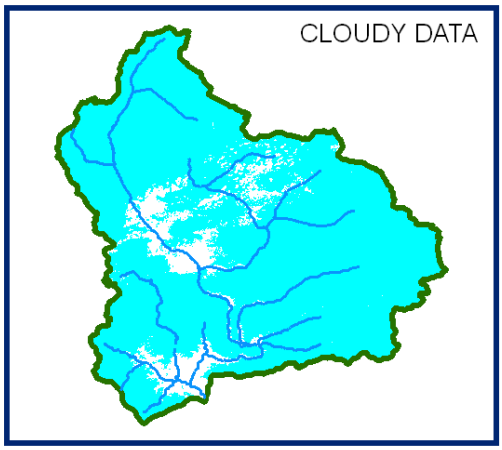
SNOW COVER MAP : WARWAN BASIN



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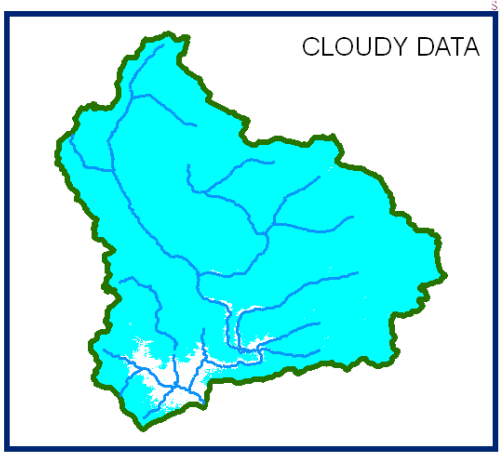

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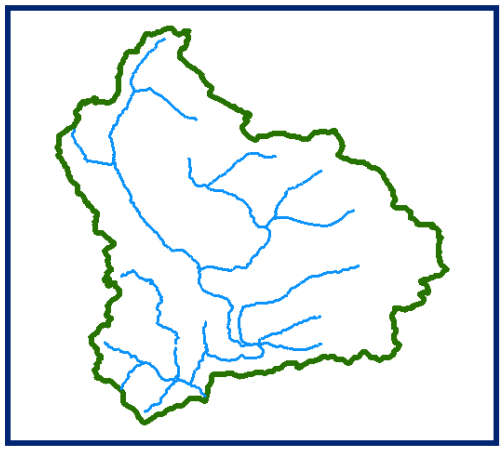

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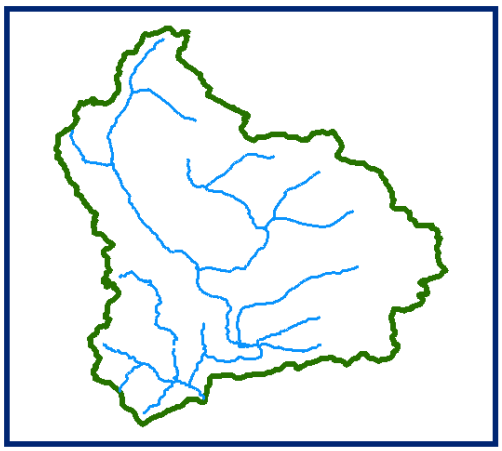

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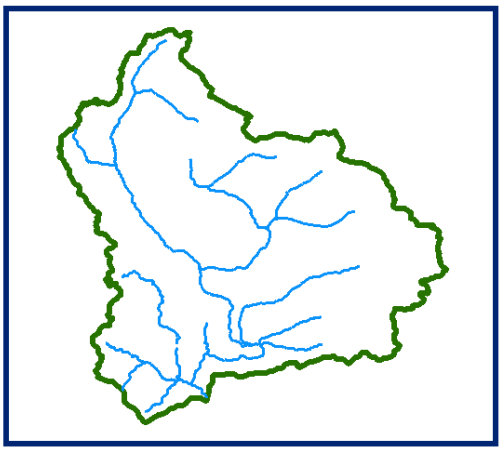

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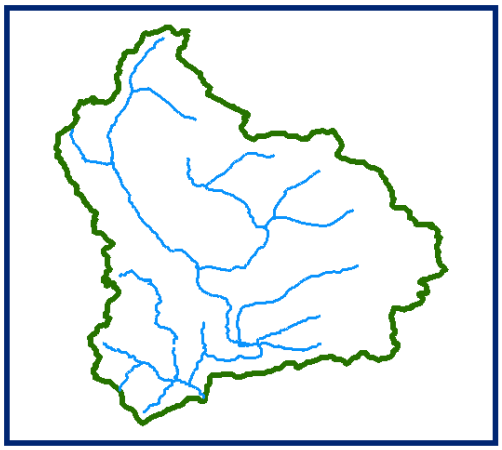

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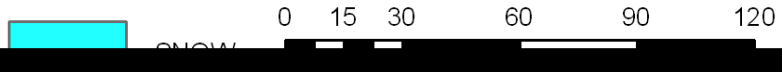
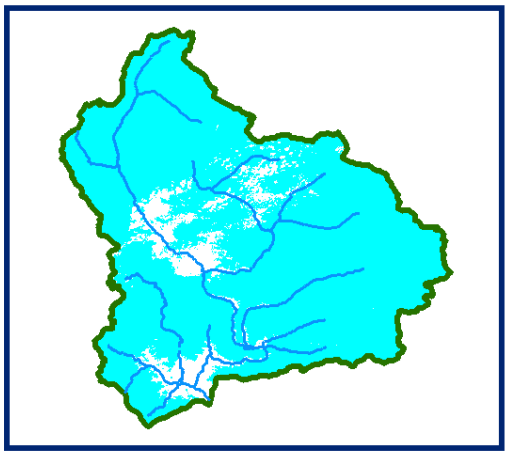


10 DAILY SNOW COVER MAP : WARWAN BASIN



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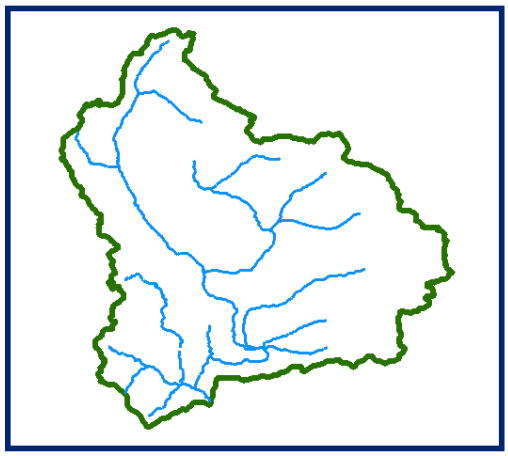

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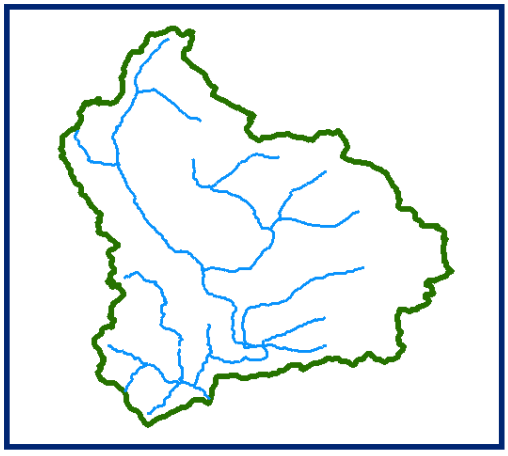

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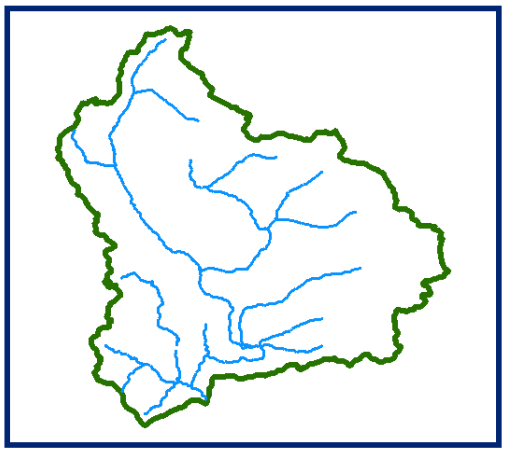
0 5 10 20 30 40

SNOW COVER MAP : WARWAN BASIN



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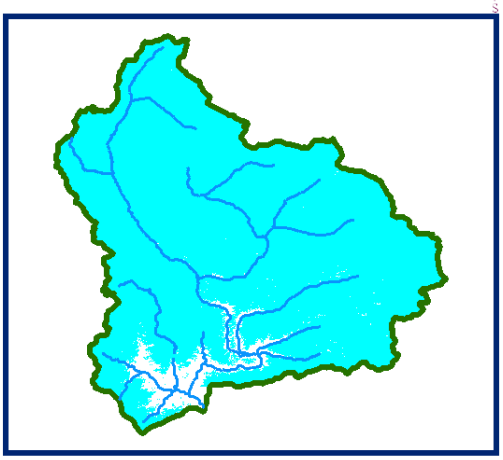

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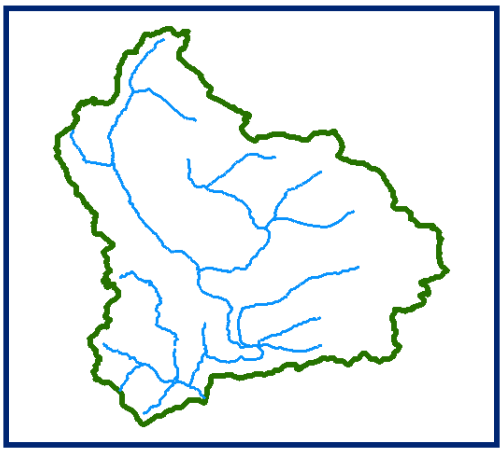

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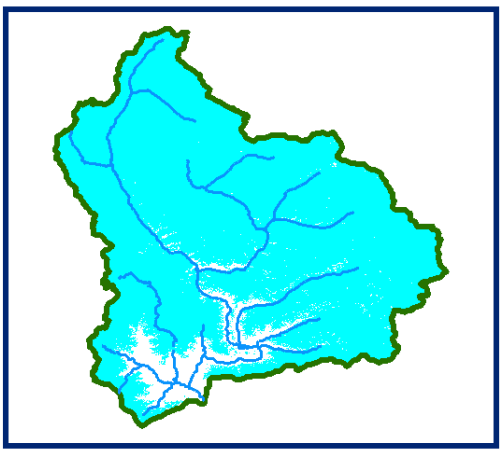

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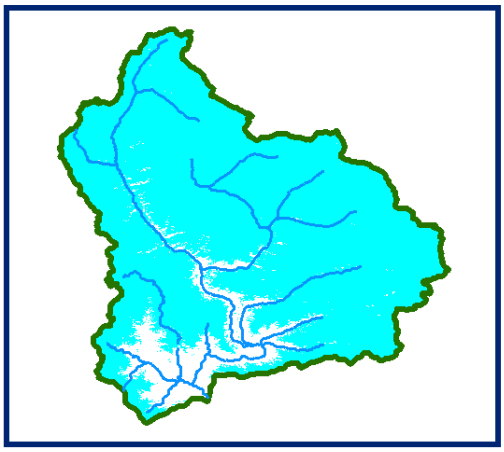

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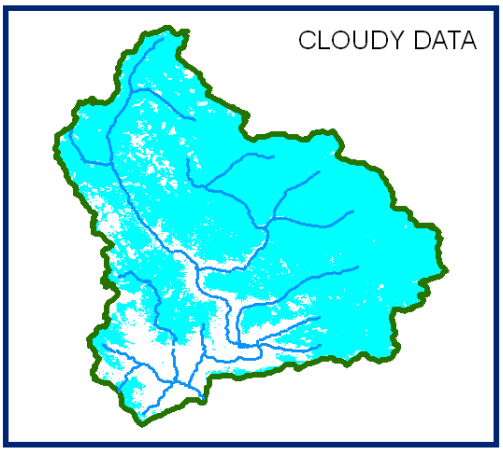

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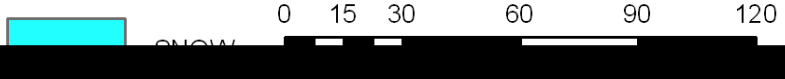
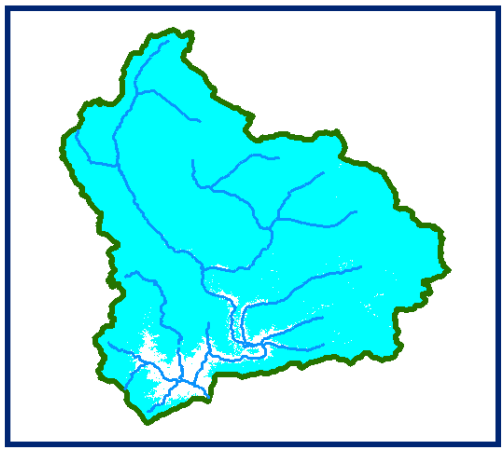


10 DAILY SNOW COVER MAP : WARWAN BASIN



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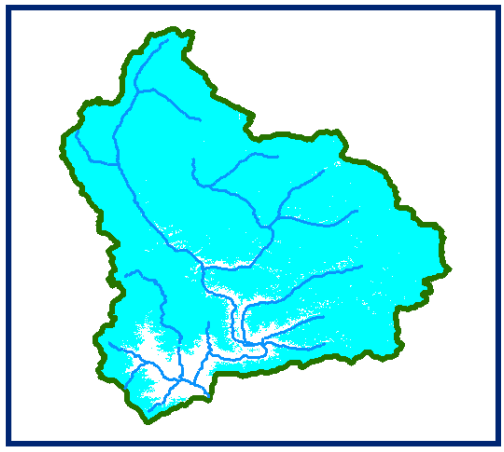

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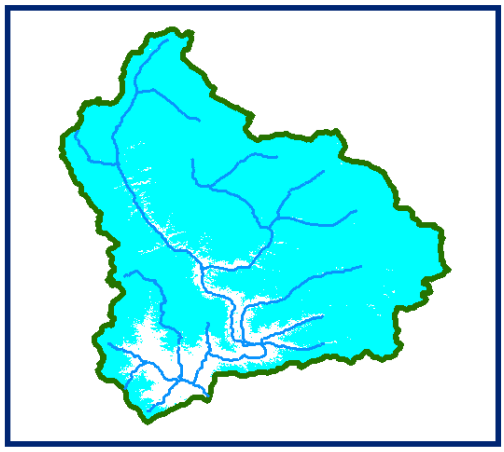

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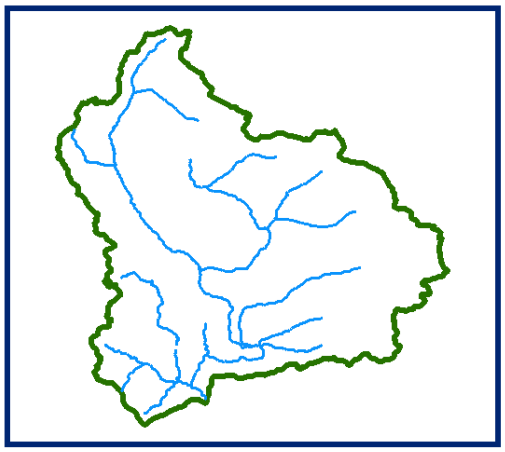
30 MARCH 2011

0 5 10 20 30 40

SNOW COVER MAP : WARWAN BASIN



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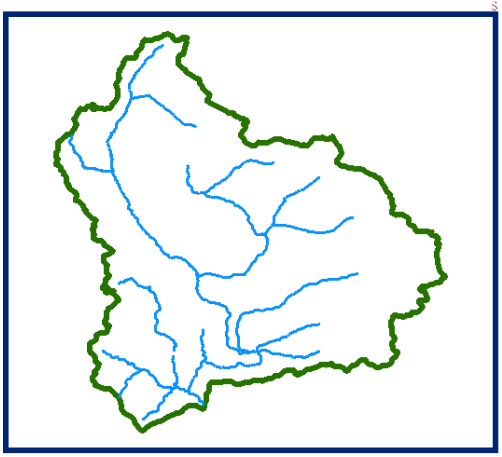

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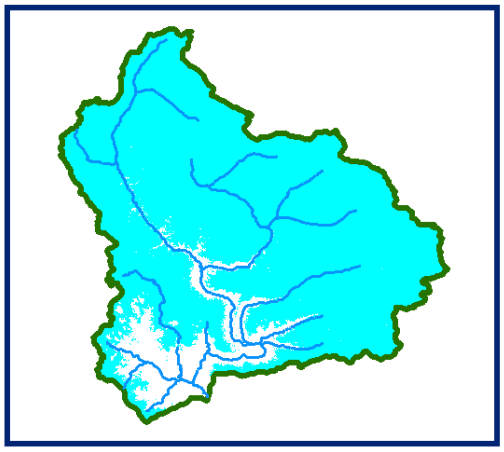
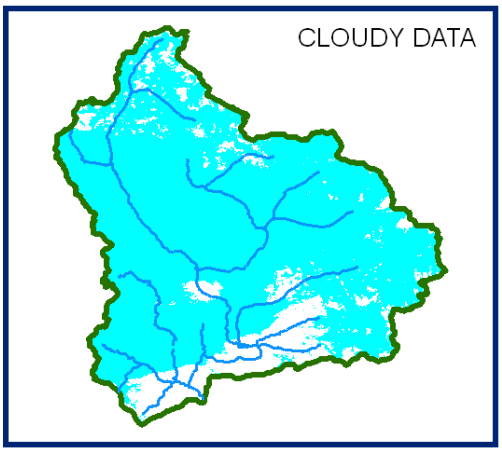


13 APRIL 2011



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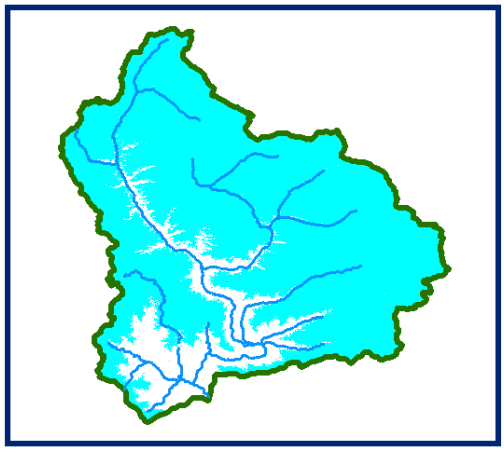

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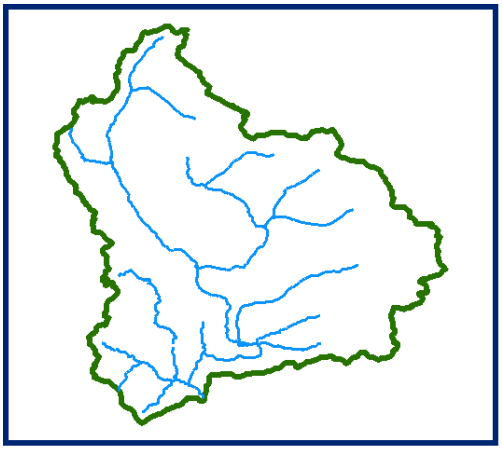

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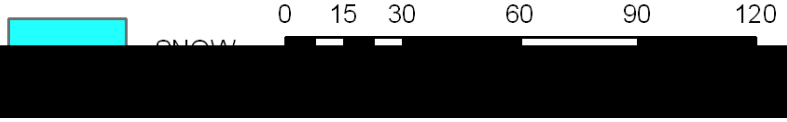
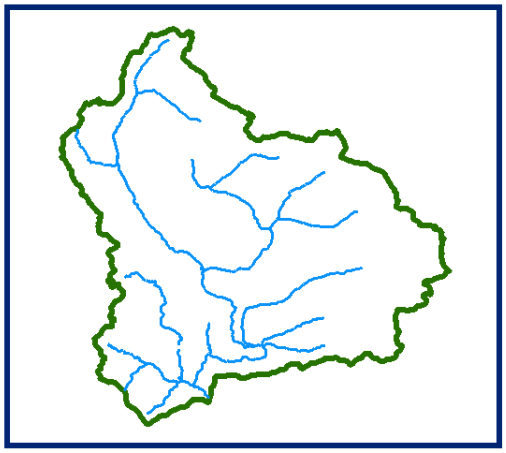


10 DAILY SNOW COVER MAP : WARWAN BASIN



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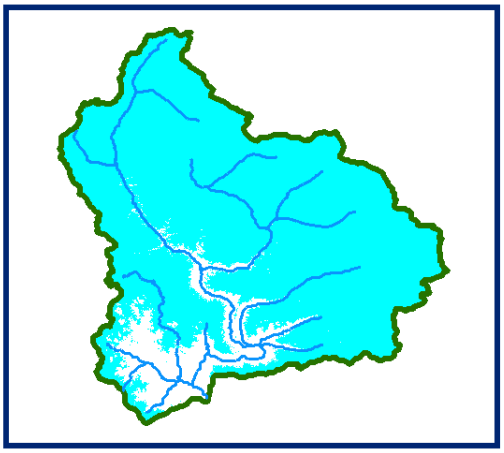

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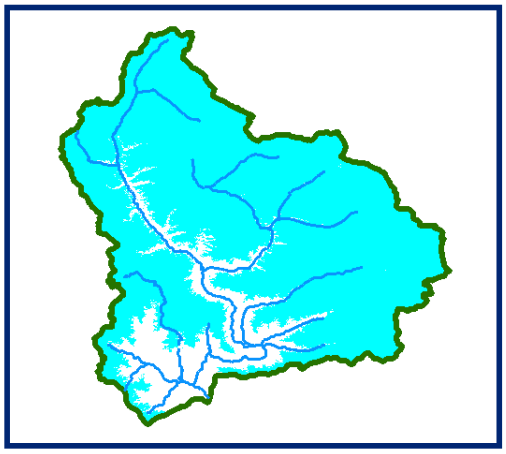

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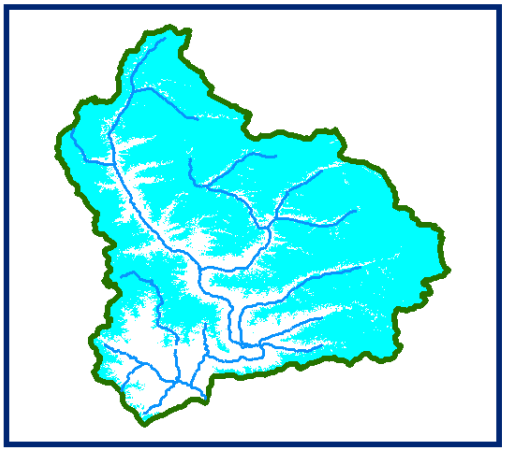
SNOW COVER MAP : WARWAN BASIN



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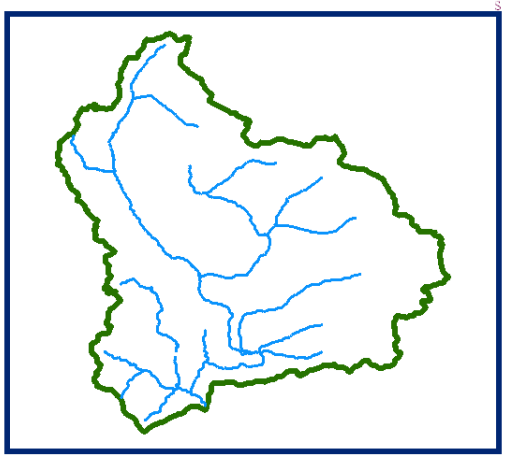

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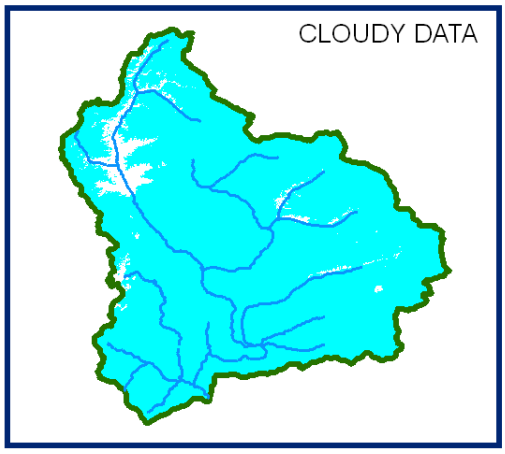

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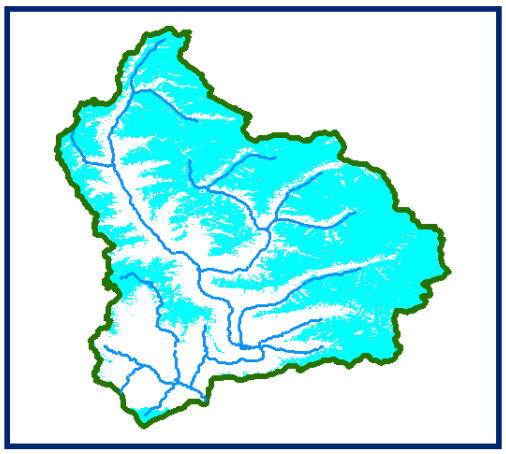

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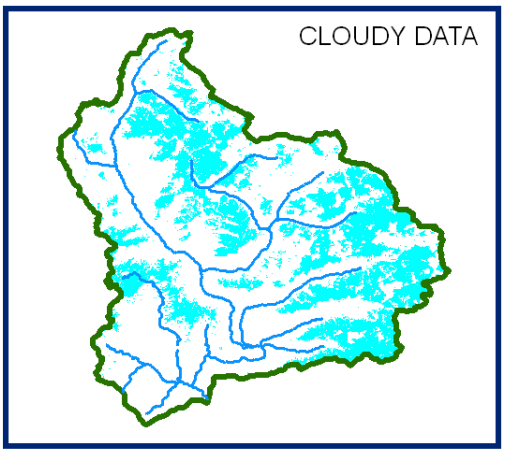

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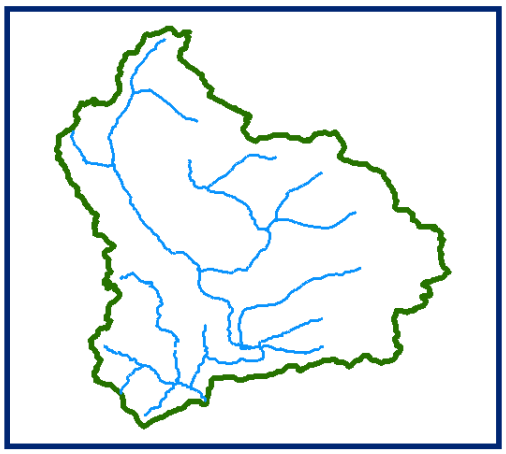

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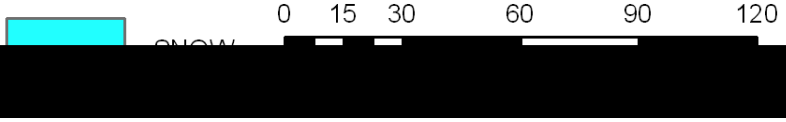
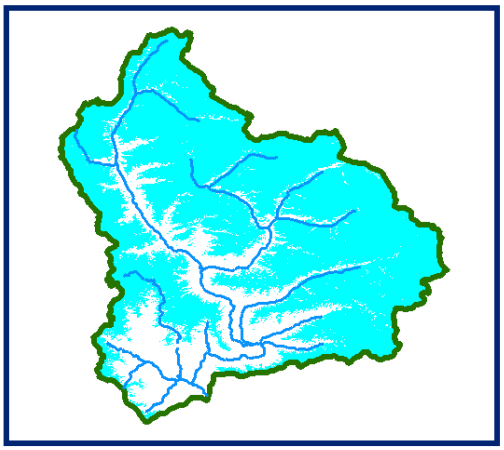


10 DAILY SNOW COVER MAP : WARWAN BASIN



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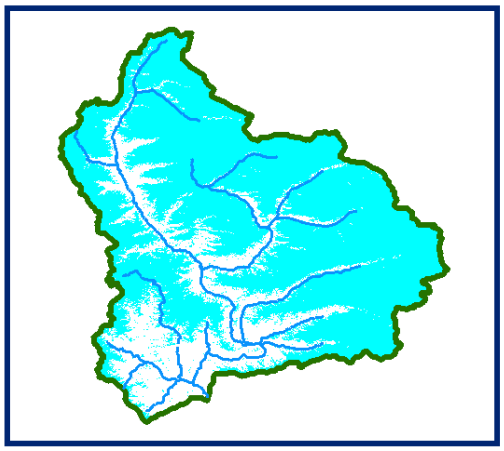

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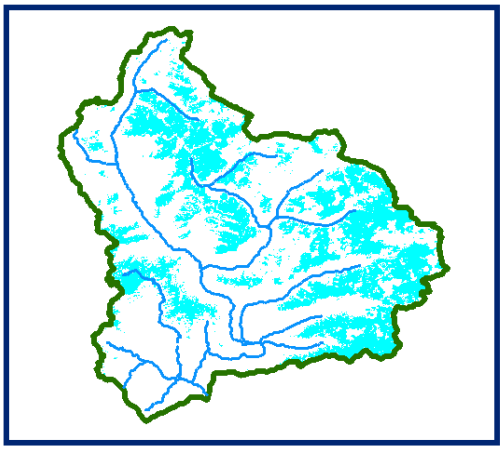

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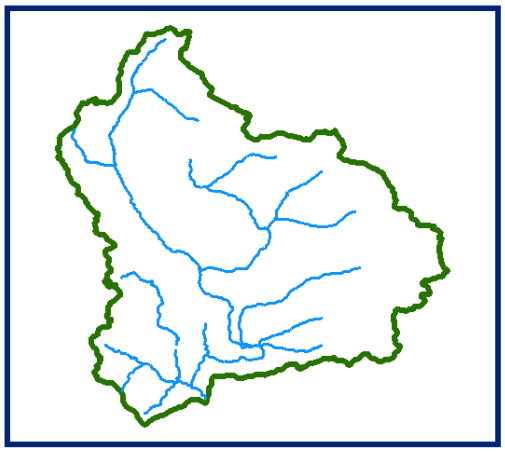
SNOW COVER MAP : WARWAN BASIN



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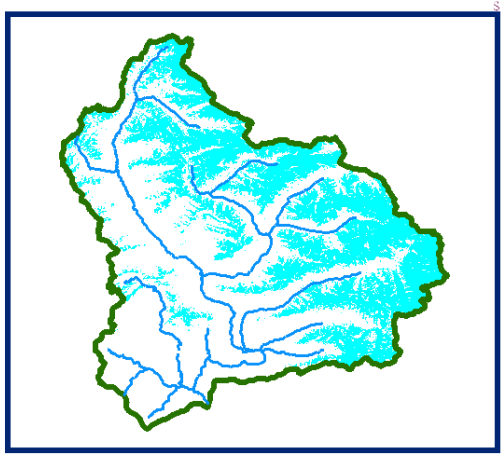
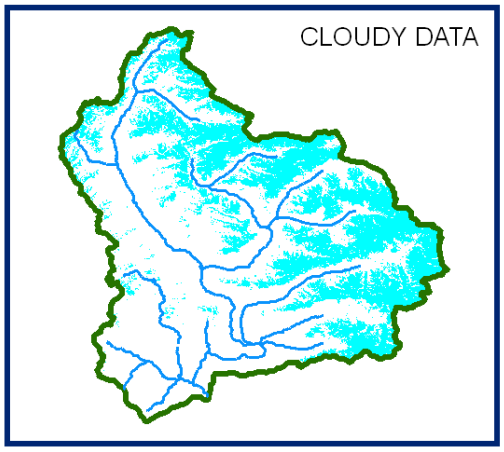


10 JUNE 2011



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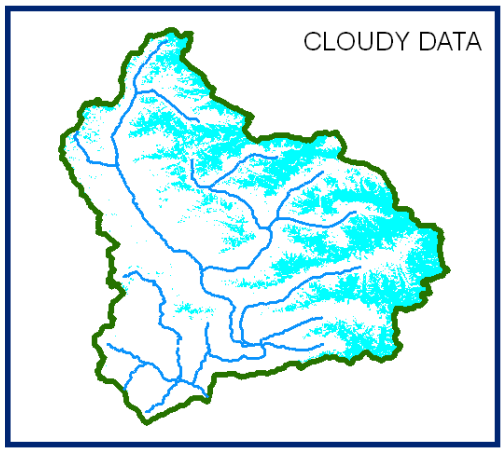

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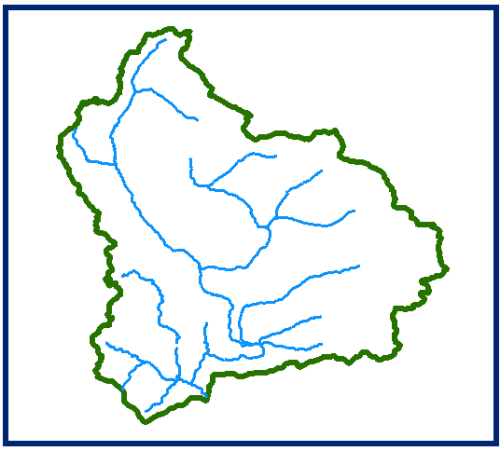

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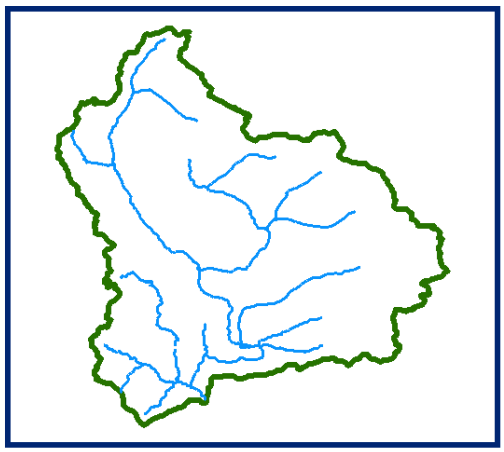

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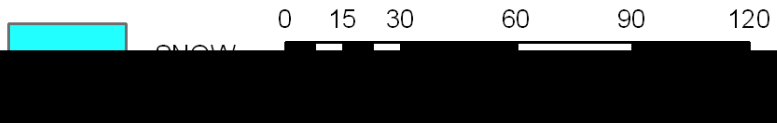
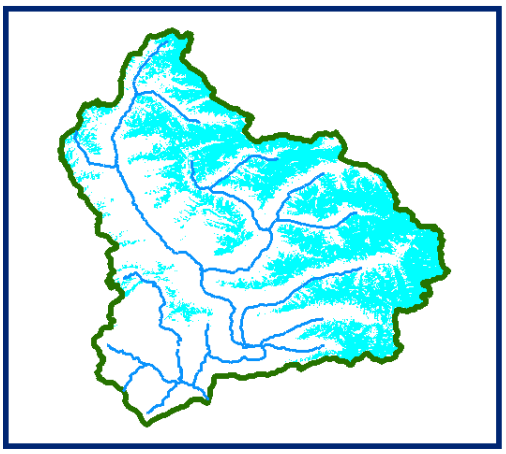


10 DAILY SNOW COVER MAP : WARWAN BASIN



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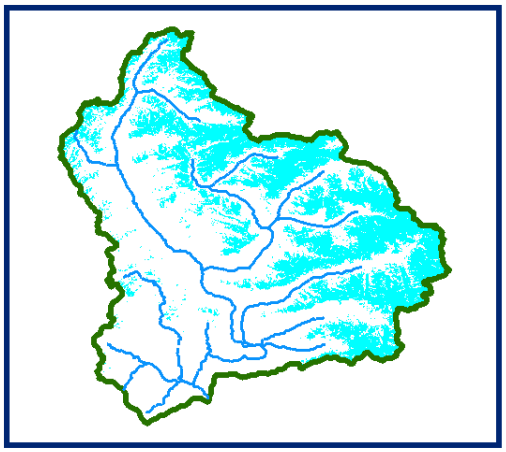

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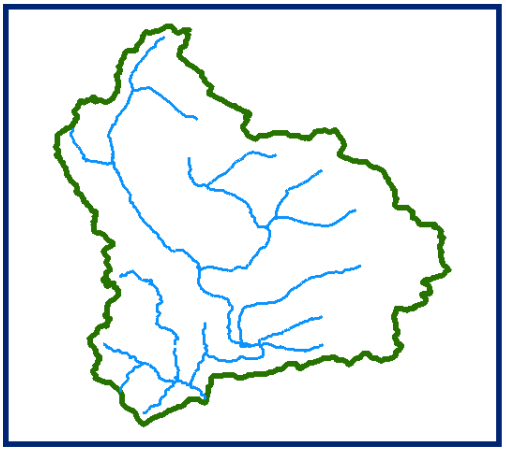

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