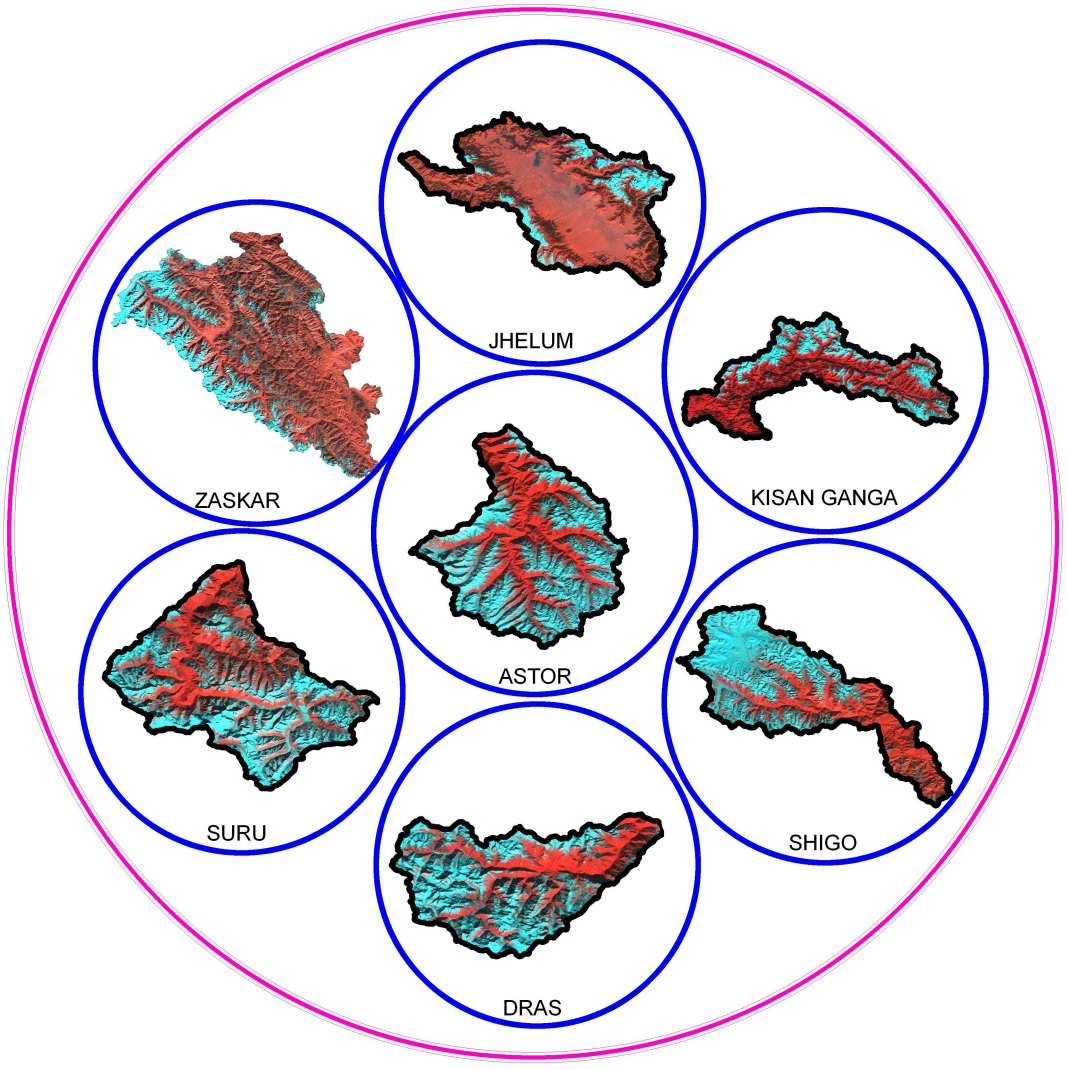
SNOW COVER ATLAS OF THE INDUS BASIN

Sub basins

Jhelum, Kisan Ganga, Astor, Shigo, Dras, Suru and Zaskar.

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

Year 2008 - 09



Space Applications Centre (ISRO)
Ahmedabad - 380015

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Abstract	This atlas gives subbasin-wise distribution of snow cover in the Indus basin from October 2008 to June 2009. The subbasins included in this report are Jhelum, Kisan ganga, Astor, Shigo, Dras, Suru and Zaskar. 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, Jhelum, Kisan ganga, Astor, Shigo, Dras, Suru and Zaskar basins.
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1. **Introduction**

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

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

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

2. Study Area:

This Atlas gives distribution of snow cover in seven subbasins of the Indus basin. These are Jhelum, Kisan ganga , Astor, Shigo, Dras, Suru and Zaskar sub basins. Locations of these basins are shown in Figure 1.

3. Data used:

AWiFS data from October 2008 to June 2009 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 2008 to June 2009. Snow ablation pattern varies from basin to basin, depending on area altitude distribution in the basins. Accumulation and ablation pattern in Dras, Shigo and Suru river sub-basin and Zaskar, Astor & Kisanganga river sub-basin is almost same and significant amount of melting was observed in early part of winter. From February to mid of April almost entire basin is covered by snow and ablation starts from the end of April. In case of Jhelum sub-basin continuous accumulation and ablation was observed throughout the season.

Acknowledgements

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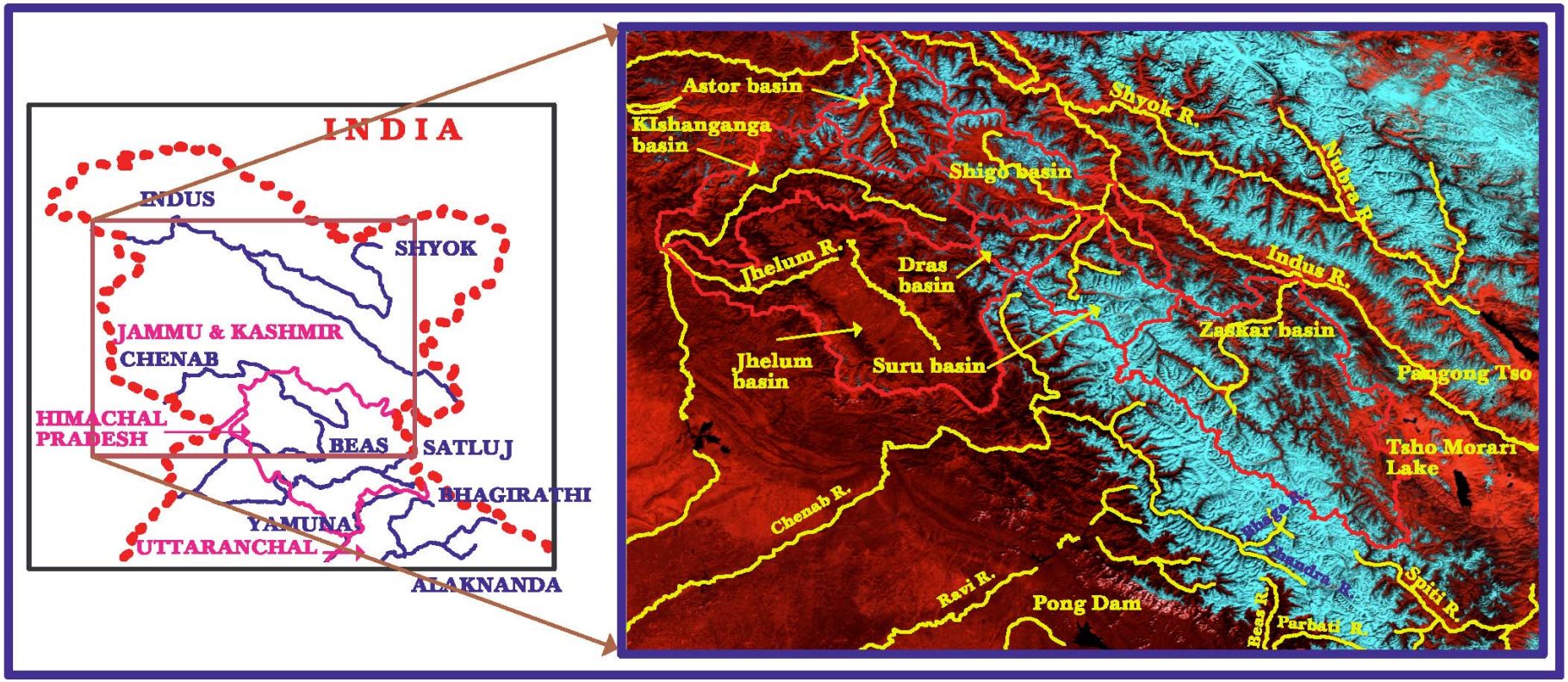


Figure 1: Location map of Jhelum, Kisan ganga, Astor, Shigo, Dras, Suru and Zaskar sub-basins (Part of Indus basin)

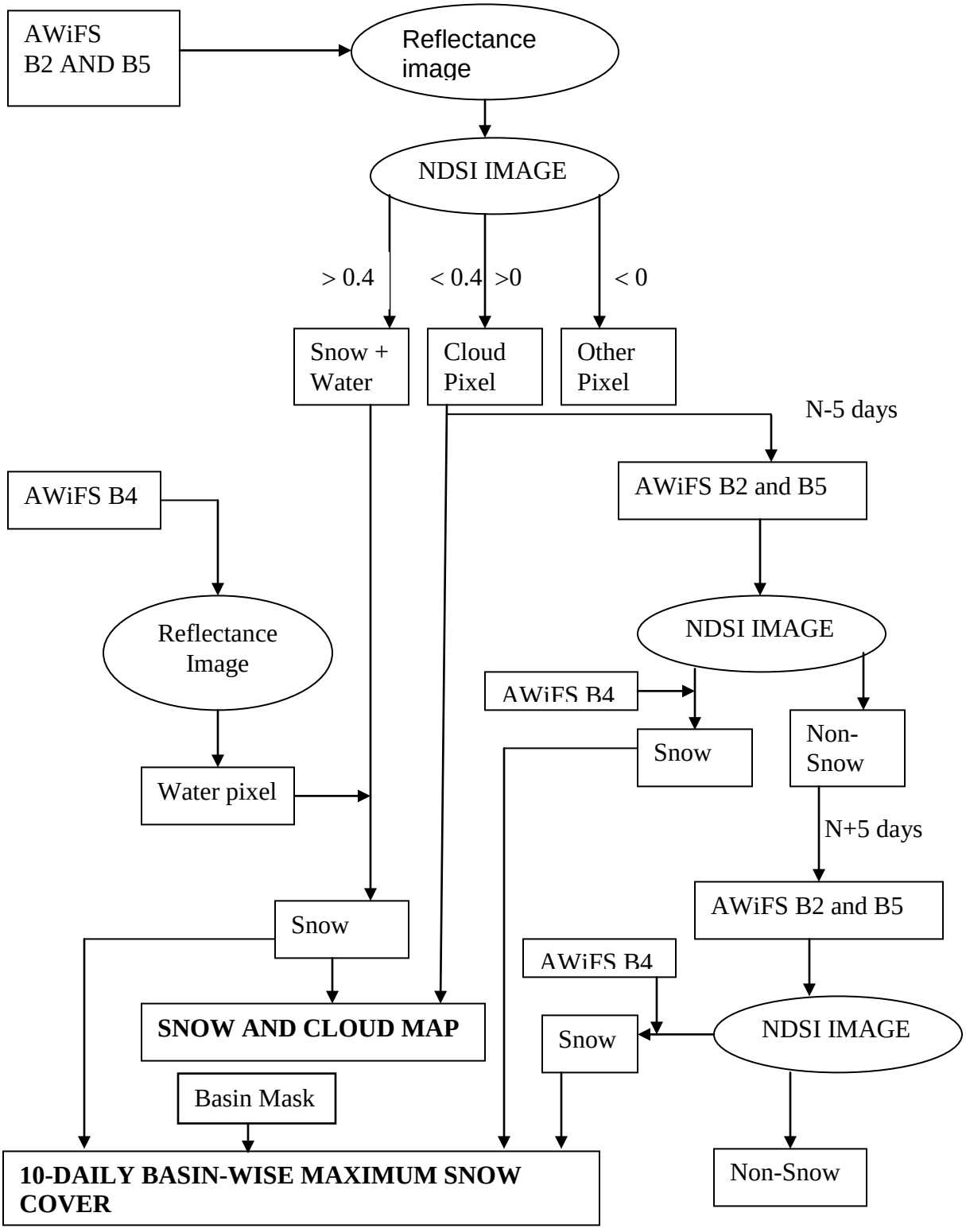


Figure 2: Algorithm for snow cover mapping using AWiFS data

JHELUM BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: JHELUM **BASIN AREA: 14472 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	12-Oct-08	457	3				
November 2008							
2	20-Nov-08	4287	30	3	25-Nov-08	3637	25
December 2008							
4	23-Dec-08	5872	41				
January 2009							
5	7-Jan-09	8848	61	6	12-Jan-09	6531	45
February 2009							
7	5-Feb-09	14362	99				
March 2009							
8	11-Mar-09	4934	34				
April 2009							
9	13-Apr-09	3911	27	10	22-Apr-09	3124	22
11	23-Apr-09	3257	23	12	27-Apr-09	4673	32
13	28-Apr-09	1164	8				
May 2009							
14	7-May-09	3212	22	15	12-May-09	2940	20
16	16-May-09	2393	17	17	17-May-09	2444	17
18	22-May-09	2498	17	19	26-May-09	2008	14
20	31-May-09	1623	11				

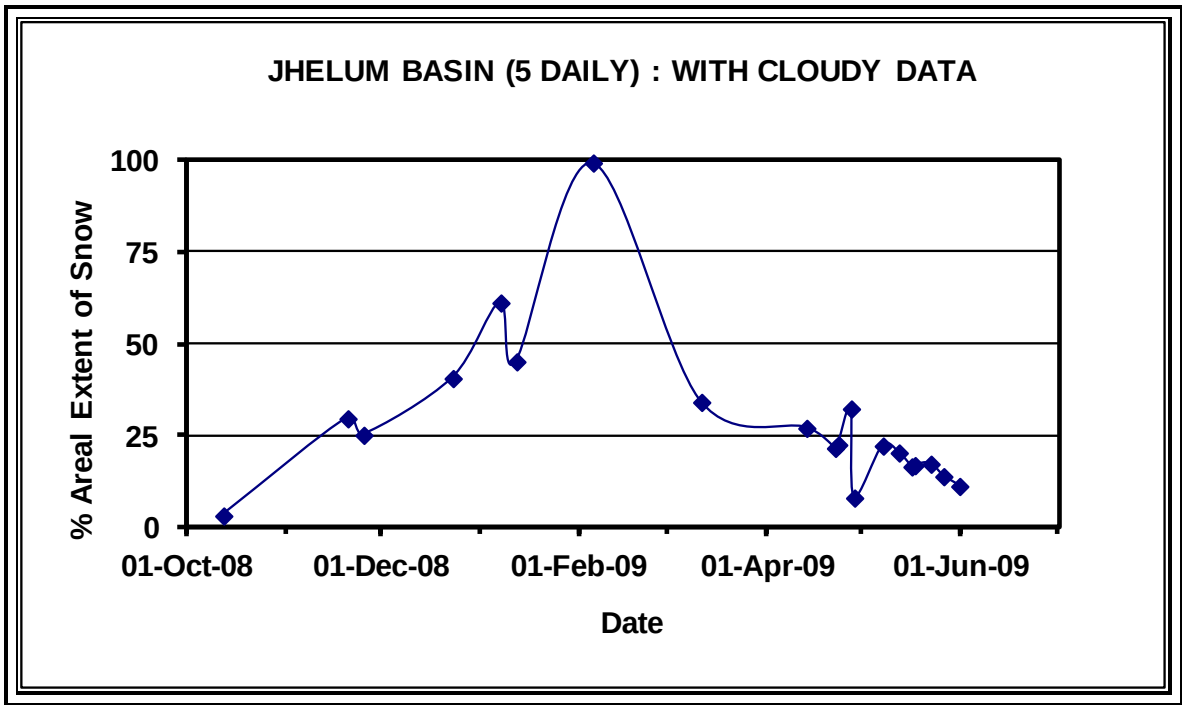
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
June 2009							
July 2009							
21	9-Jul-09	457	3				

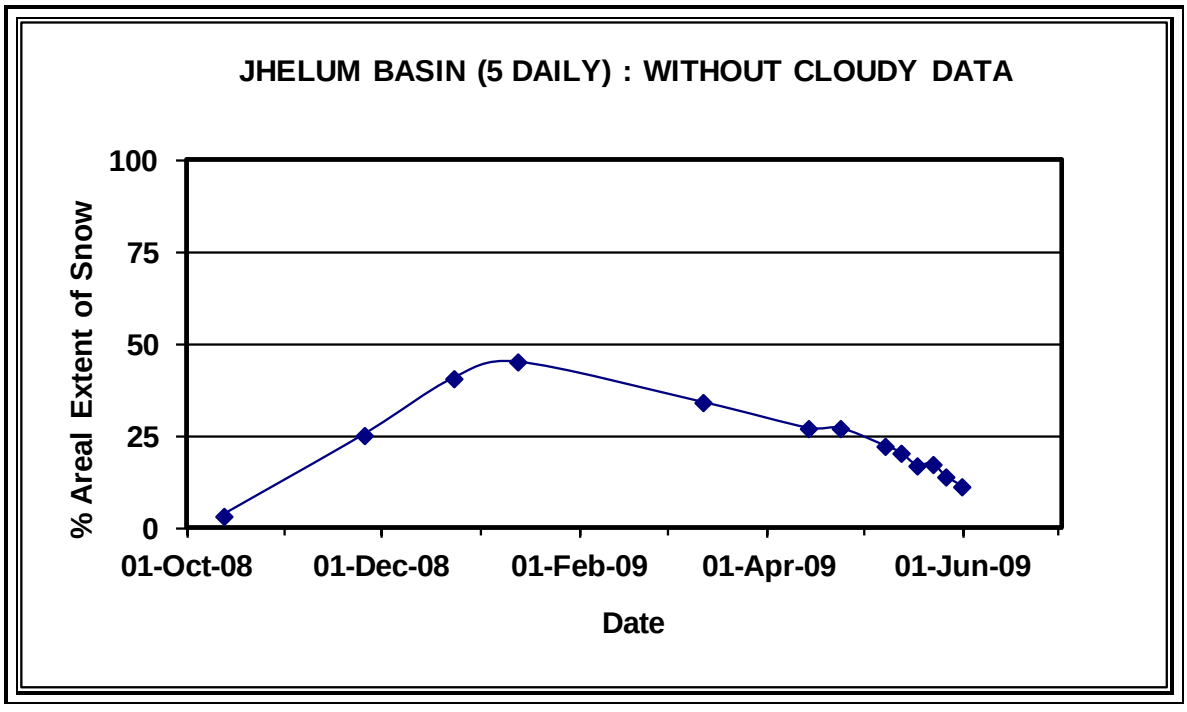
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: JHELUM **BASIN AREA: 14472 Sq km**

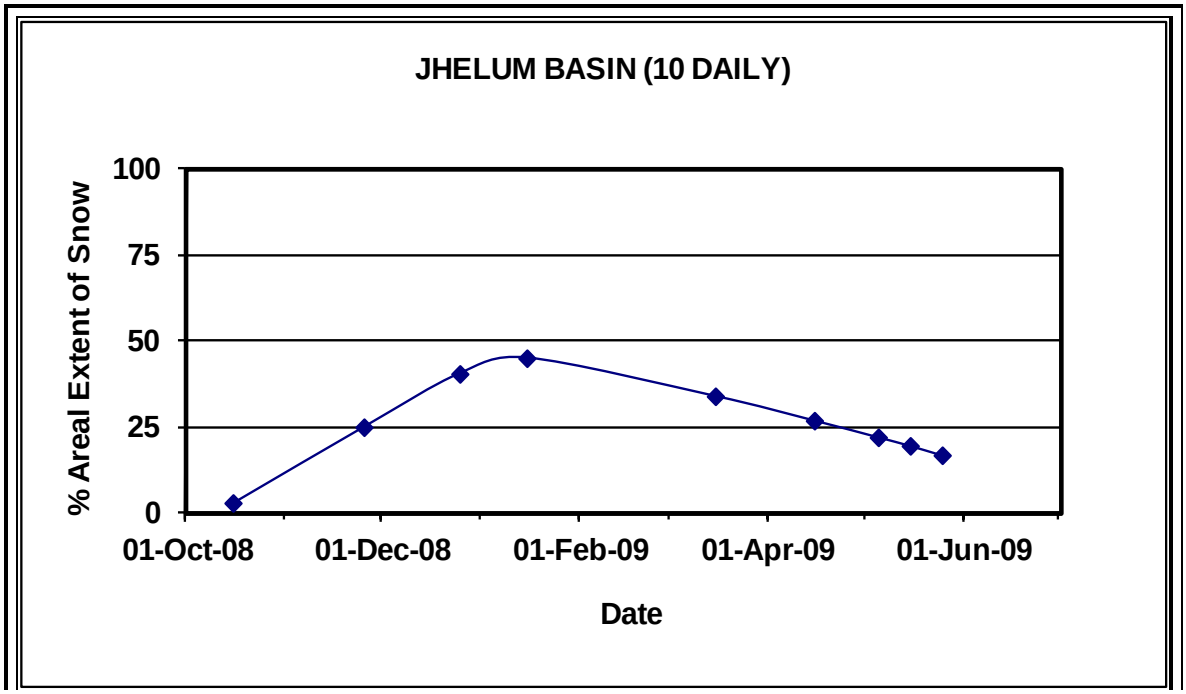
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	12-Oct-08	457	3	2	25-Nov-08	3637	25
December 2008				**January 2009**			
3	23-Dec-08	5872	41	4	15-Jan-09	6531	45
February 2009				**March 2009**			
				5	11-Mar-09	4934	34
April 2009				**May 2009**			
6	15-Apr-09	3911	27	7	7-May-09	3212	22
				8	12-May-09	2854	20
				9	26-May-09	2035	17
June 2009				**July 2009**			
				10	9-Jul-09	457	3

Snow cover depletion curve



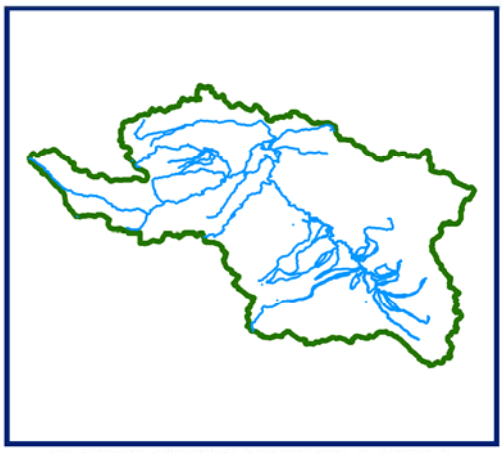


Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : JHELUM BASIN



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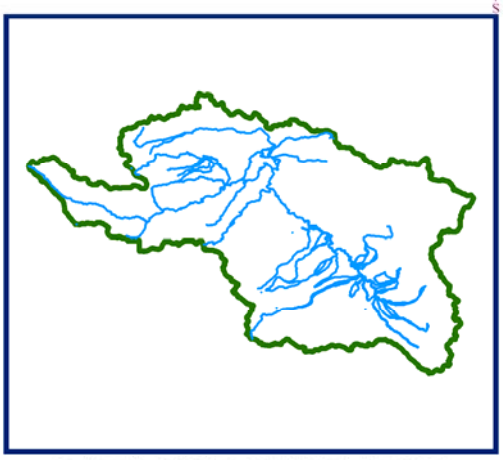

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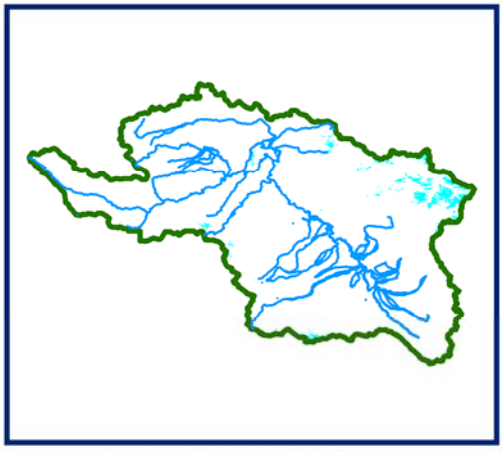

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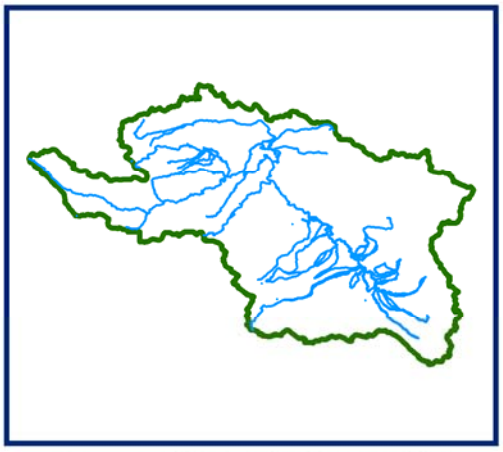

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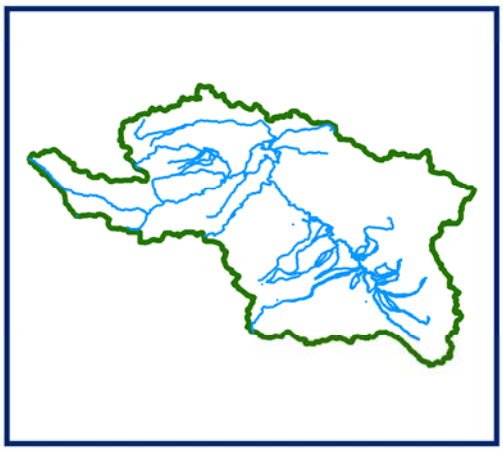

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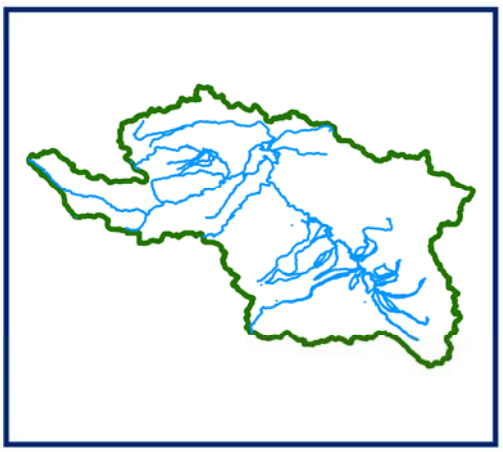

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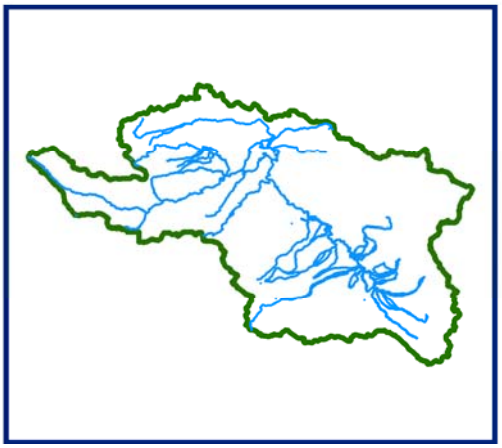
SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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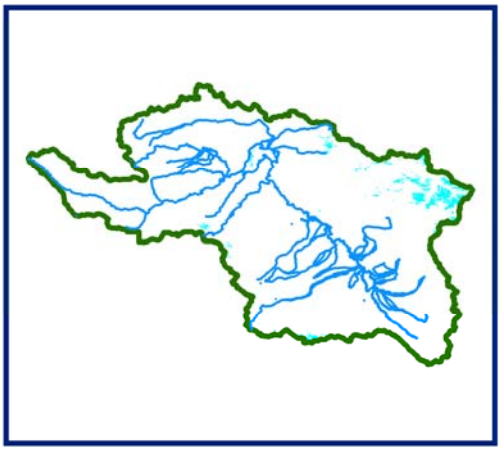

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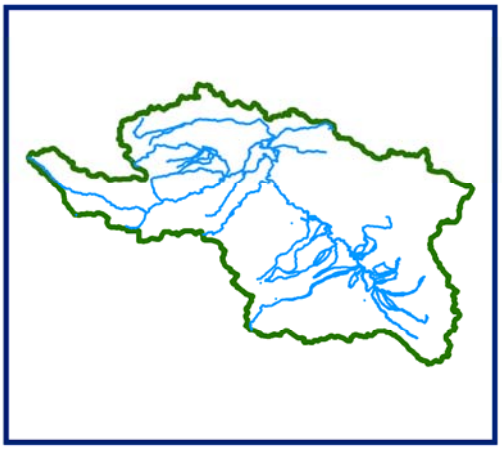

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SNOW

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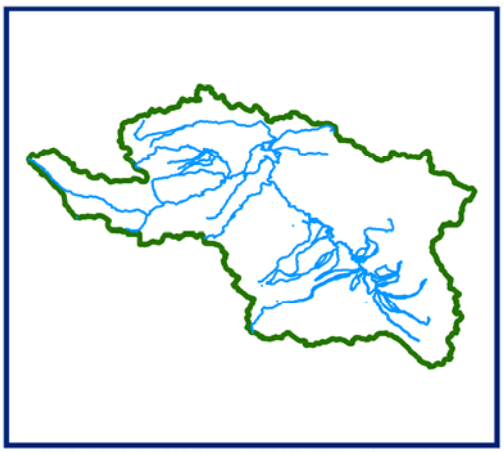
SNOW COVER MAP : JHELUM BASIN



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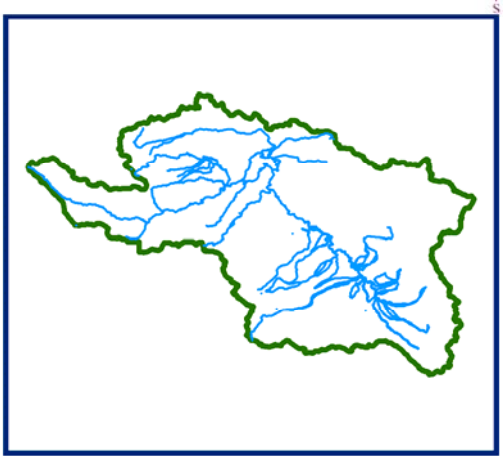

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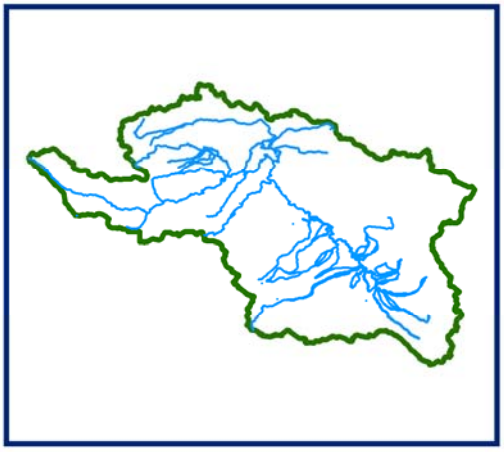

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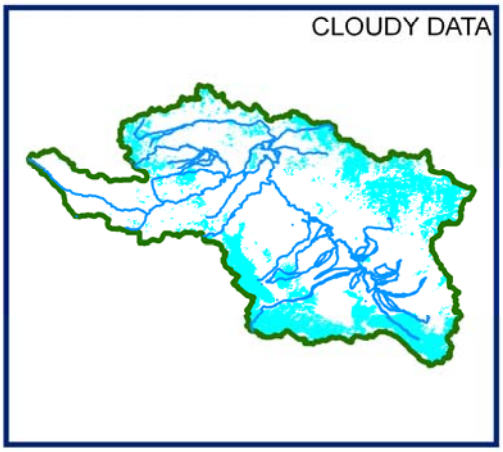

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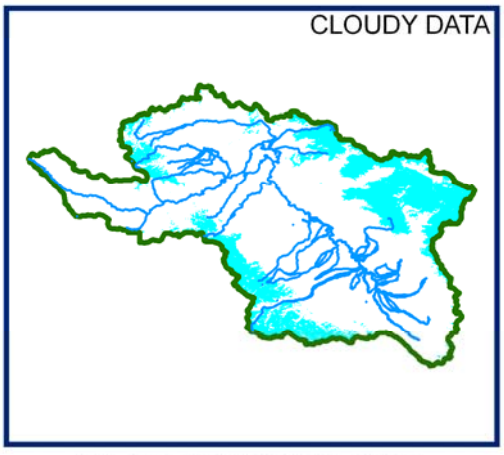

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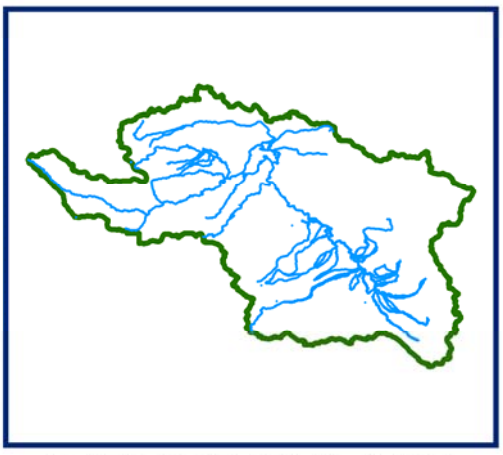

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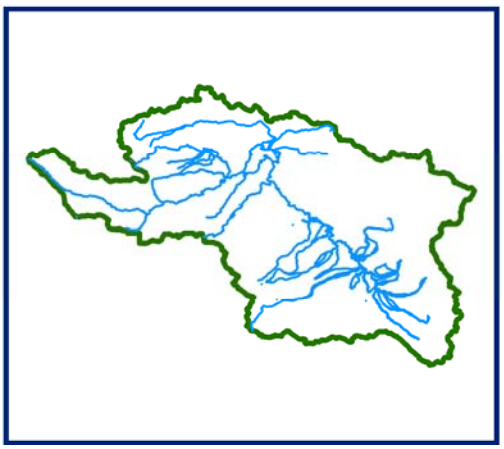
10 DAILY SNOW COVER MAP: JHELUM BASIN



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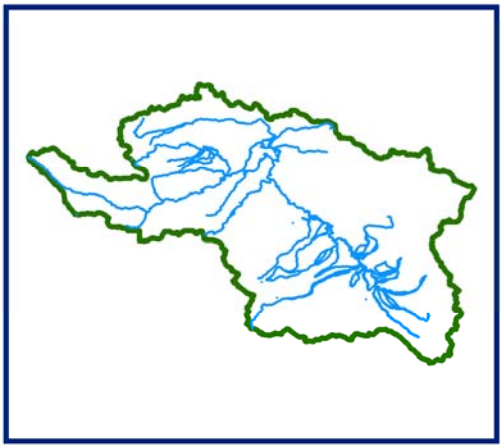

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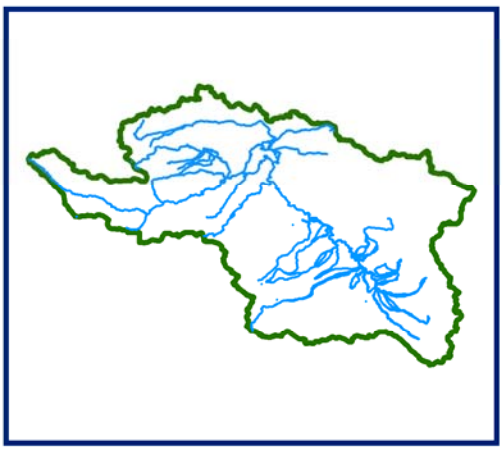

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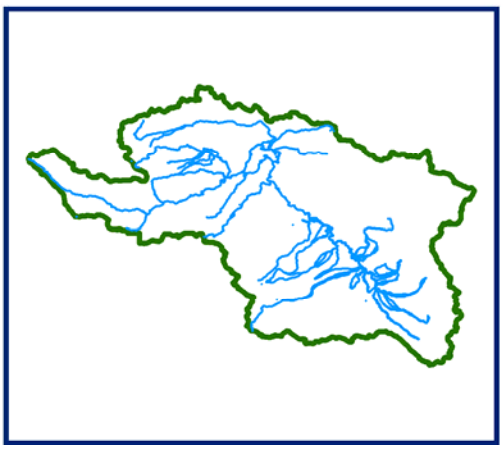

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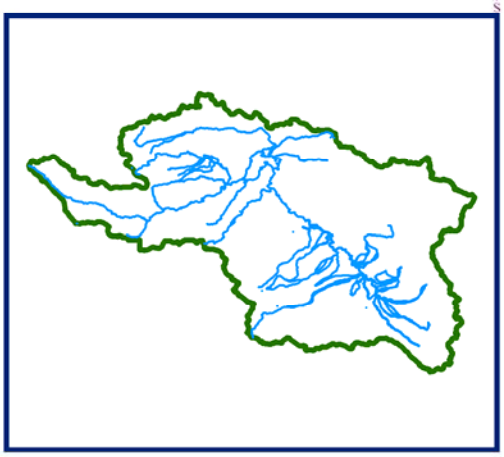

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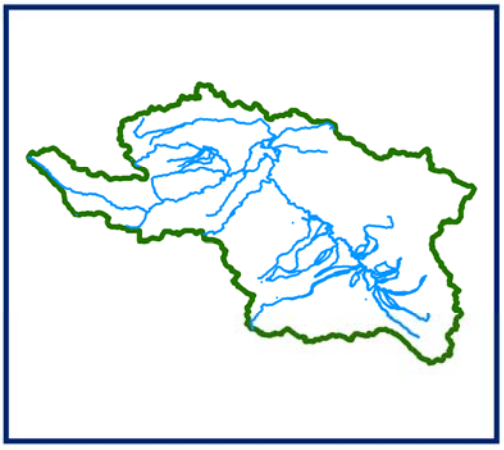

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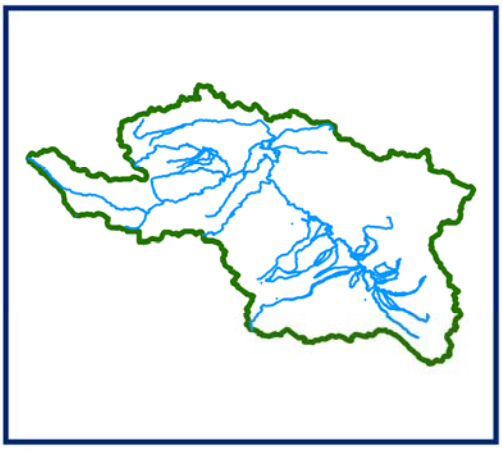

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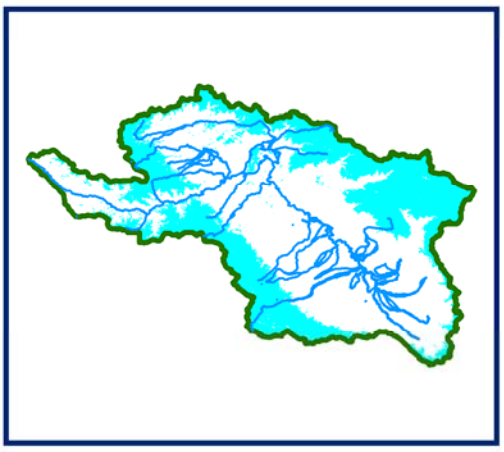

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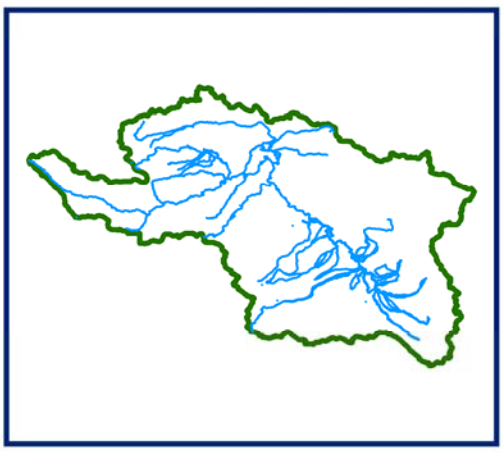

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SNOW

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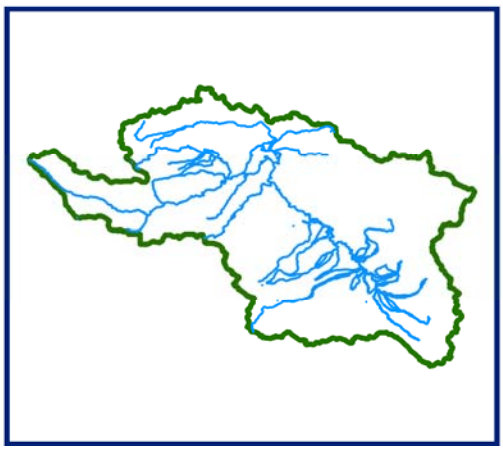
Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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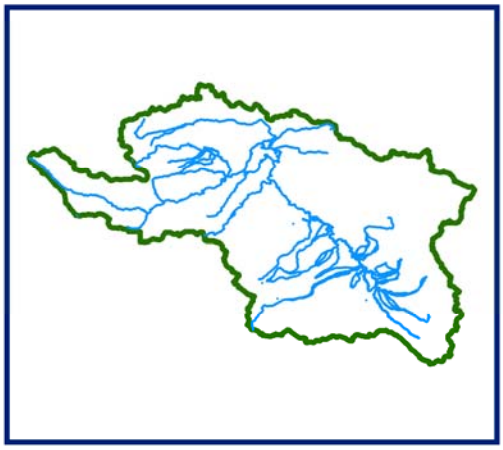

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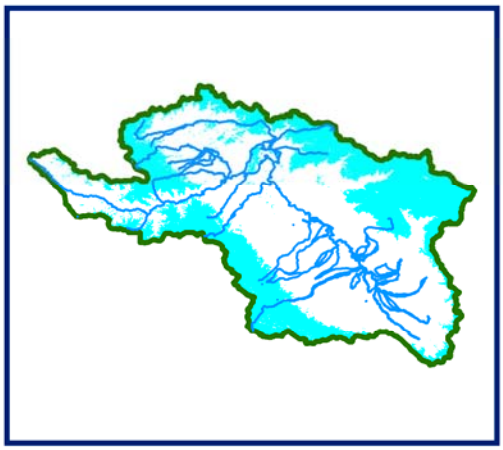


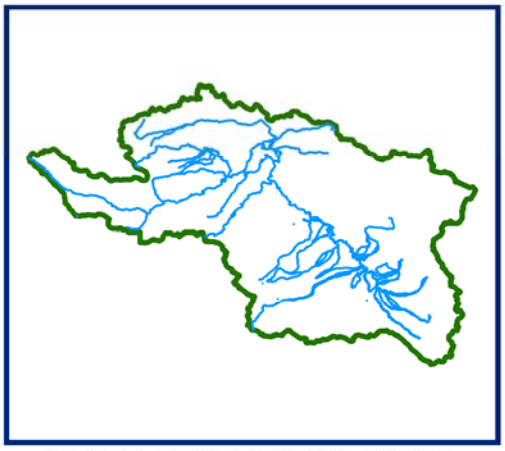
DATA USED
23 DECEMBER 2009

SNOW

0 35 70 140 210 280

Kilometers

SNOW COVER MAP : JHELUM BASIN



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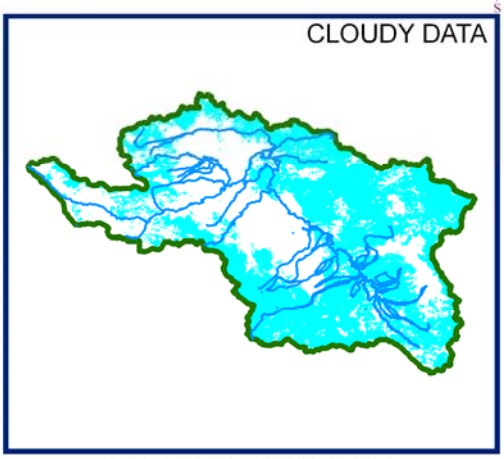
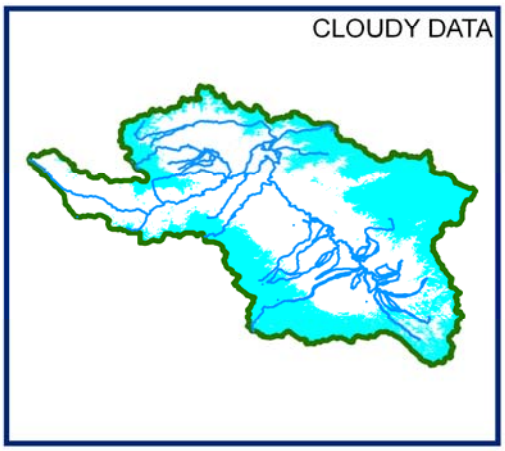
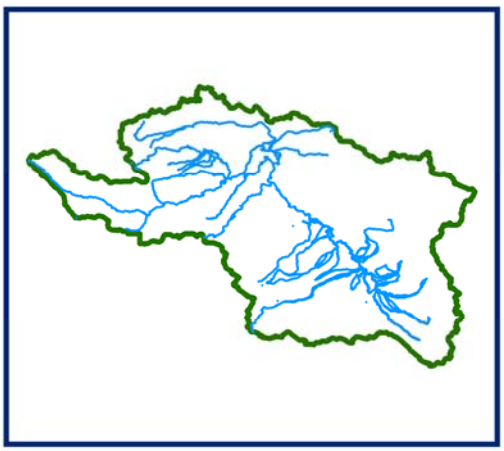


7 JANUARY 2009



12 JANUARY 2009



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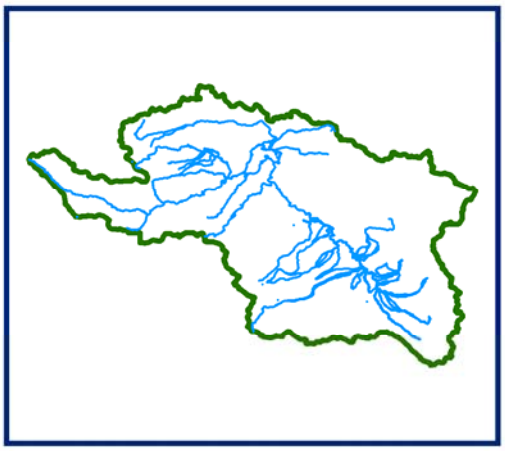

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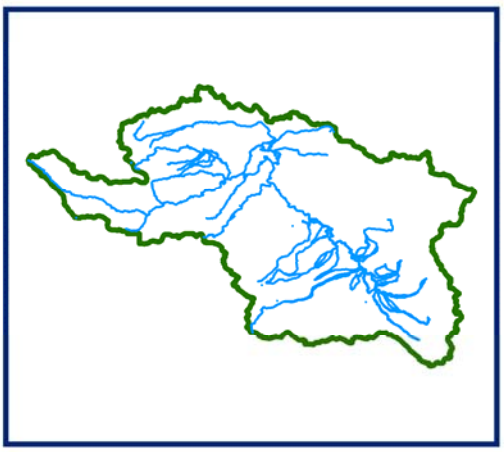


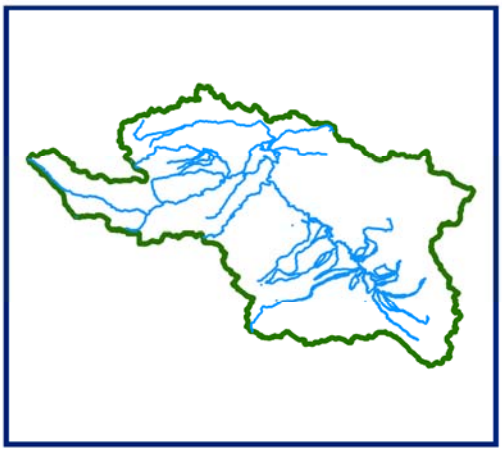
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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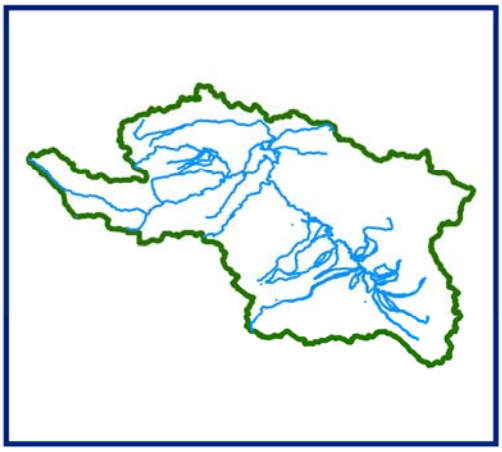

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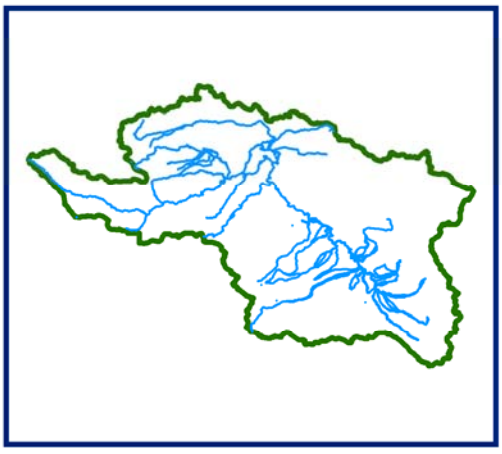

DATA USED
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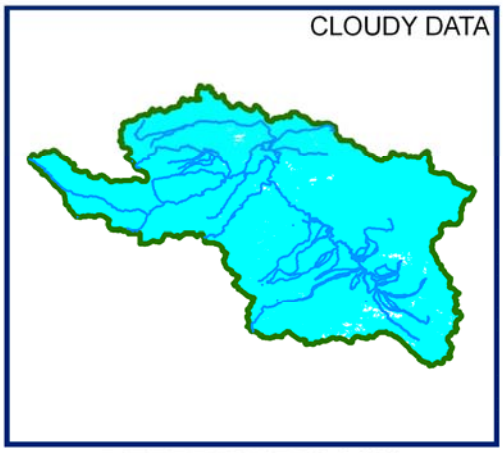
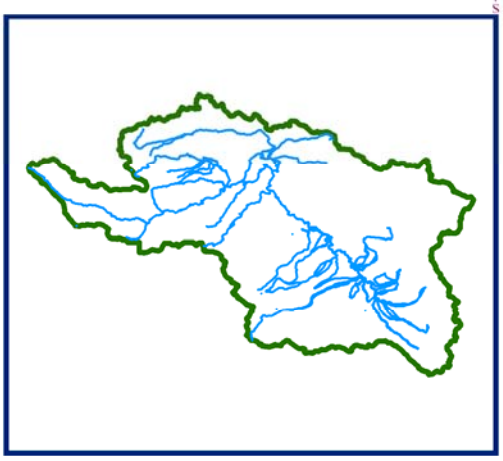
SNOW

0 35 70 140 210 280
Kilometers

SNOW COVER MAP : JHELUM BASIN



5 FEBRUARY 2009



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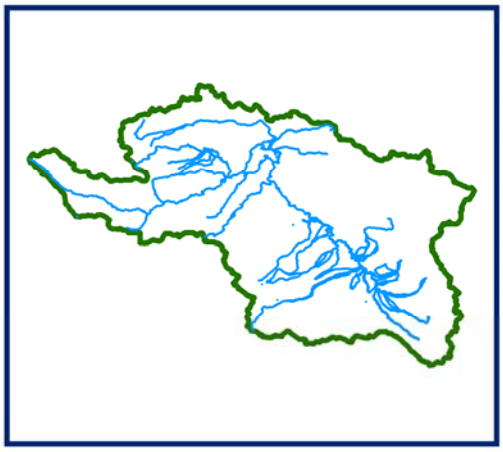

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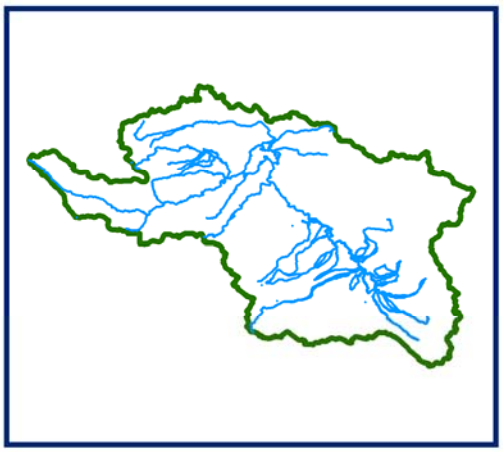

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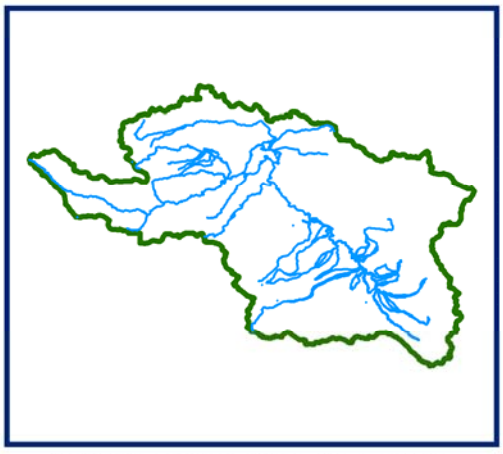

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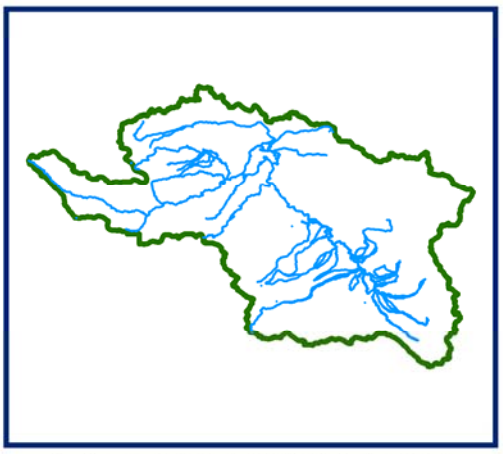


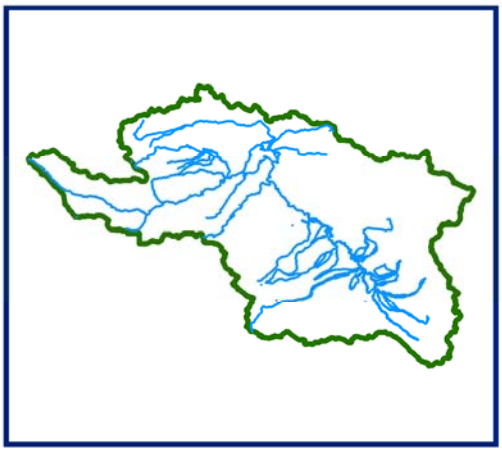
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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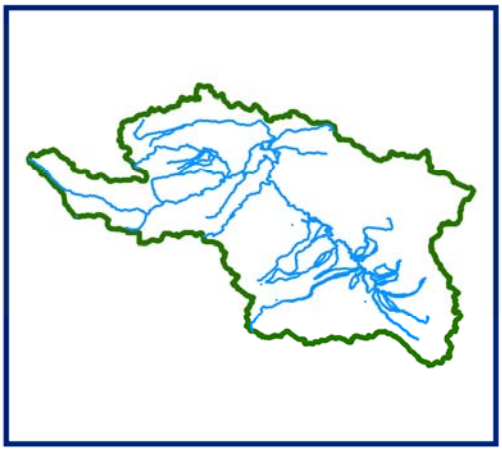

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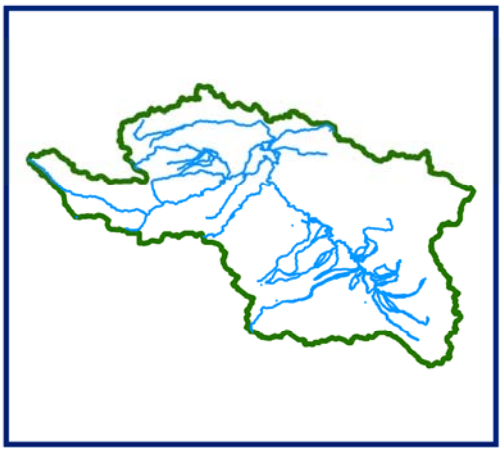

DATA USED
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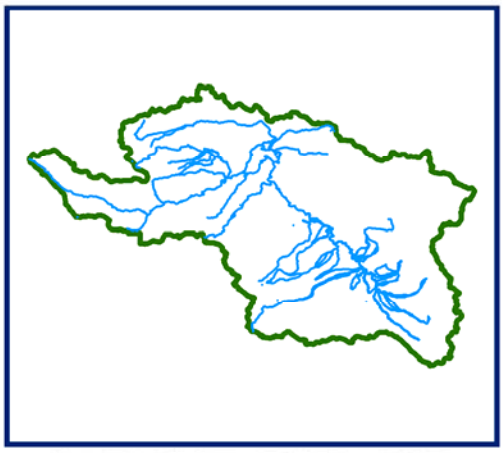
SNOW

0 35 70 140 210 280
Kilometers

SNOW COVER MAP : JHELUM BASIN



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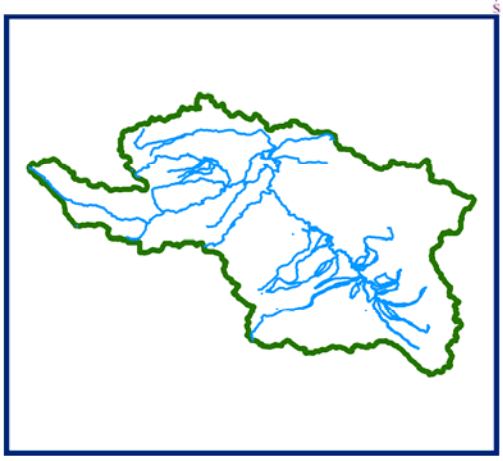

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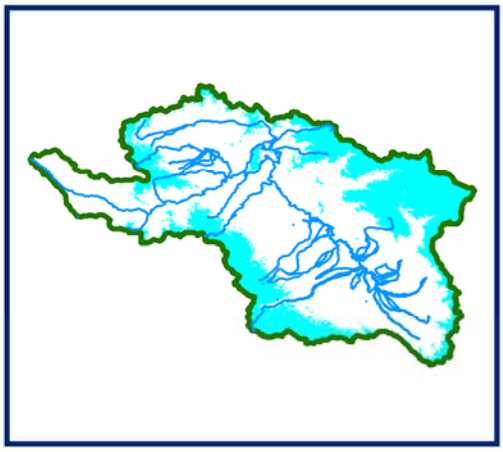
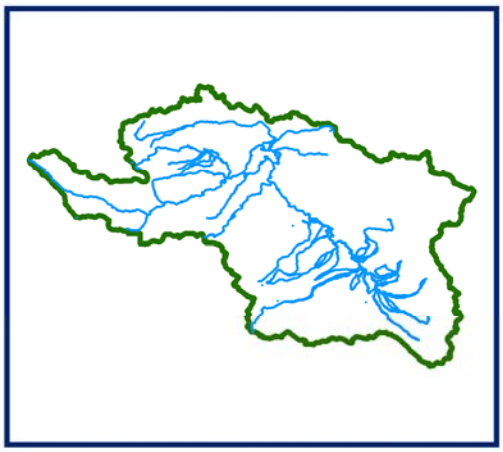


11 MAR 2009



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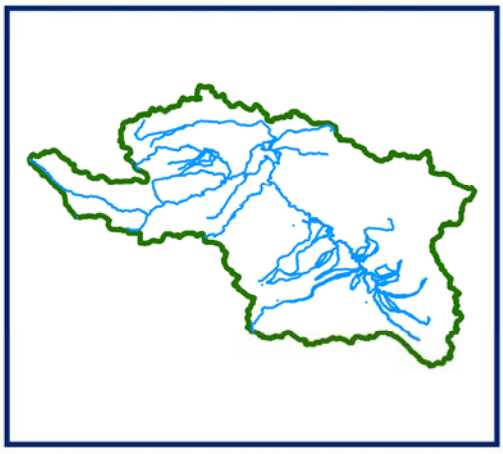

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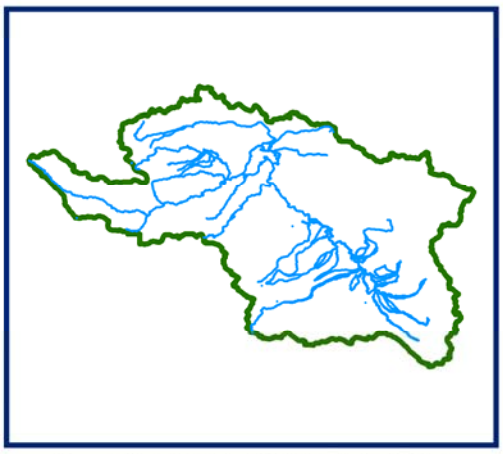


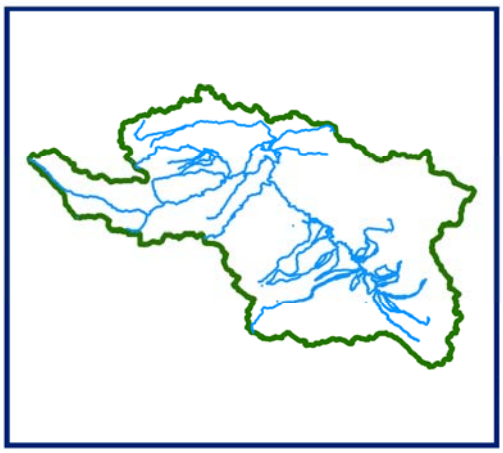
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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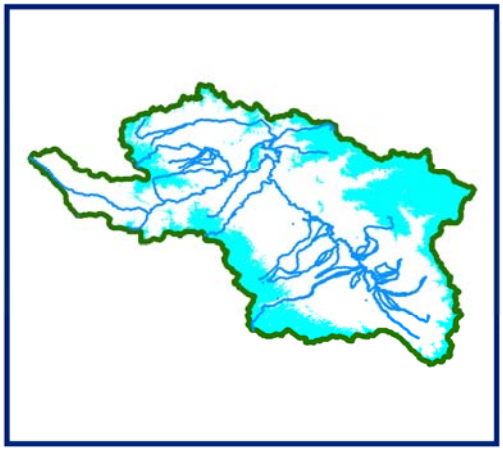

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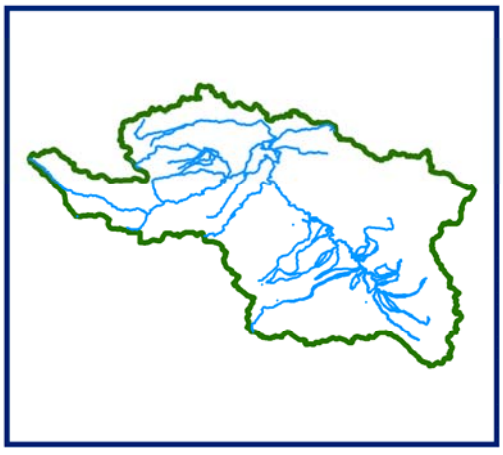
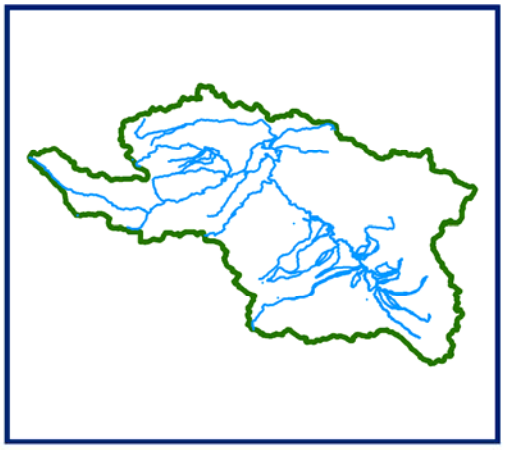


DATA USED
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280
Kilometers

SNOW COVER MAP : JHELUM BASIN



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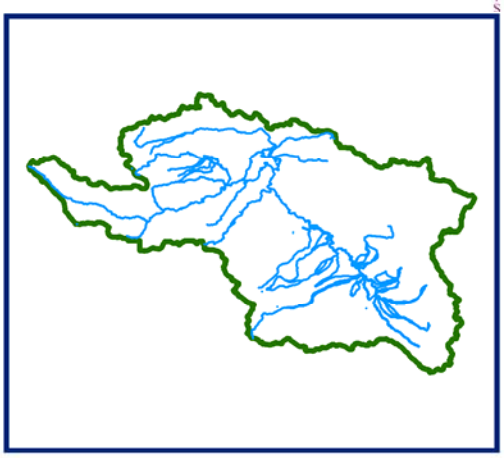

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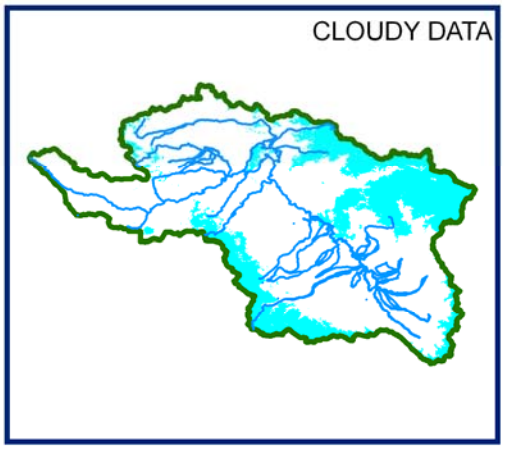
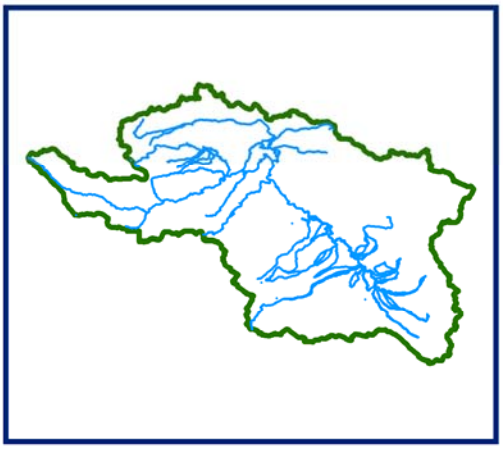


13 APRIL 2009



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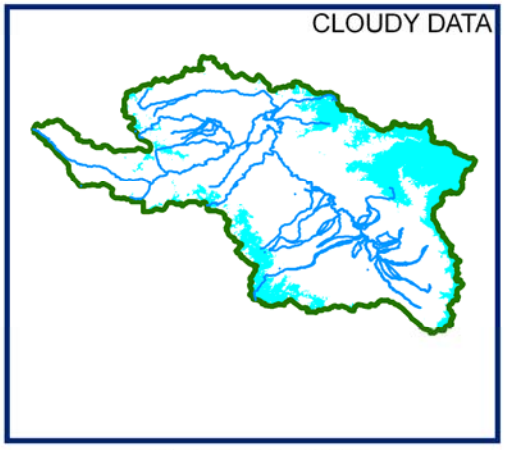
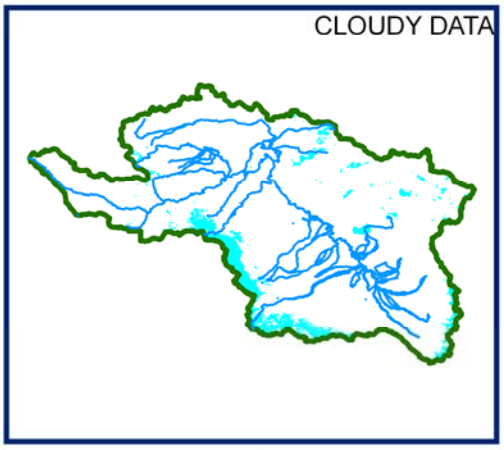


22 APRIL 2009



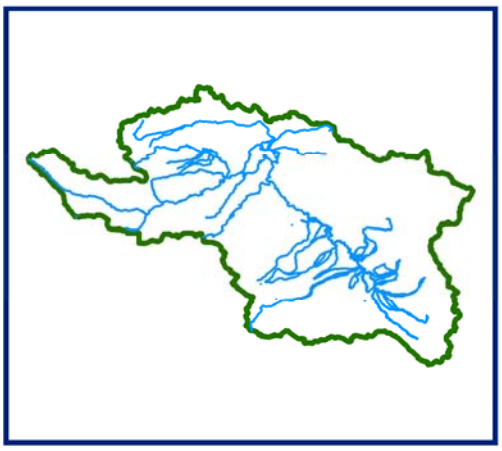
28 APRIL 2009

SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



DATA USED
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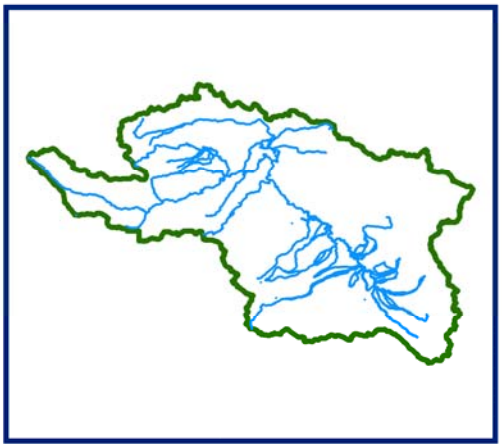

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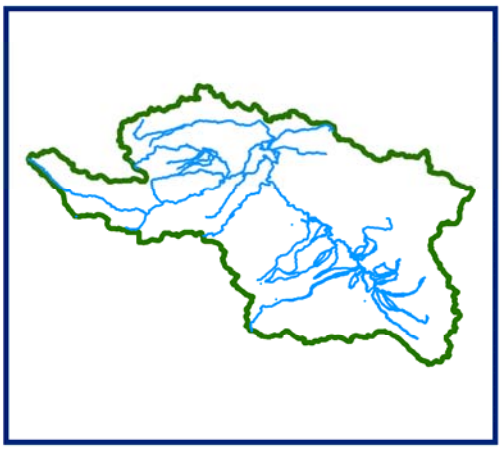
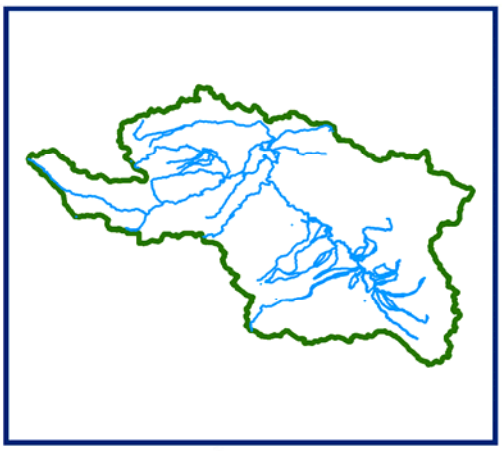


DATA USED
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280
Kilometers

SNOW COVER MAP : JHELUM BASIN



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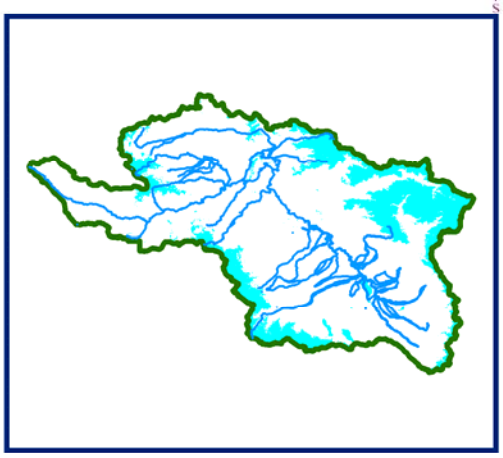
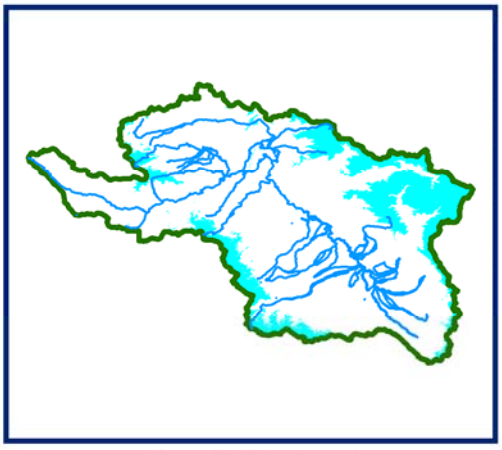
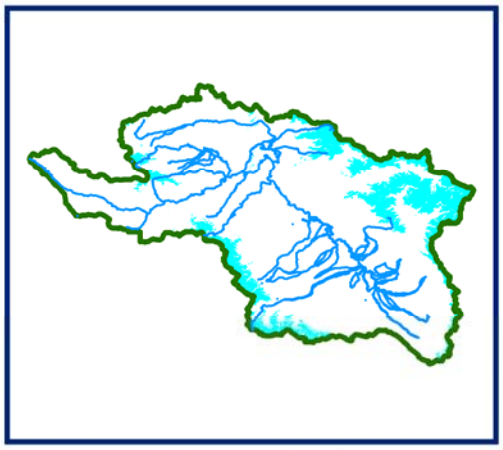


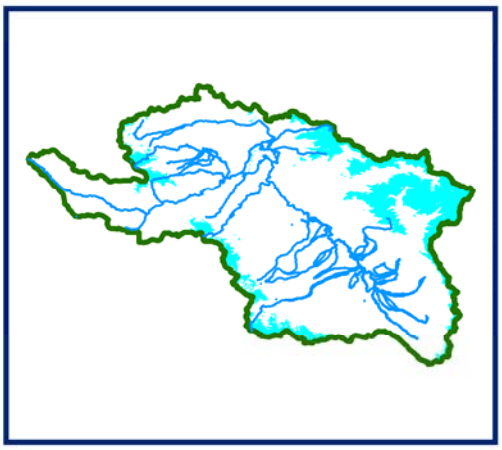
7 MAY 2009



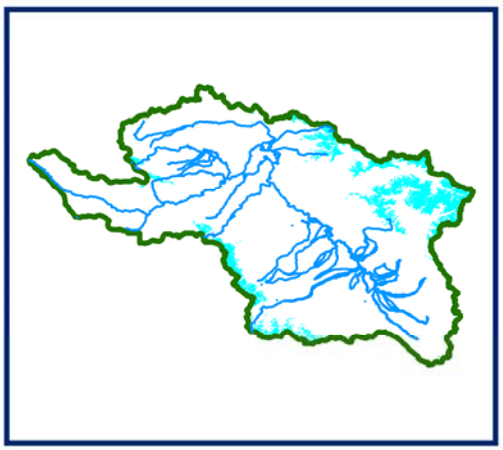
12 MAY 2009



17 MAY 2009



22 MAY 2009



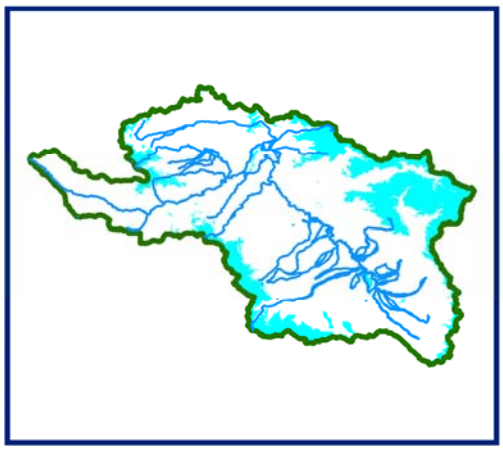
31 MAY 2009

SNOW

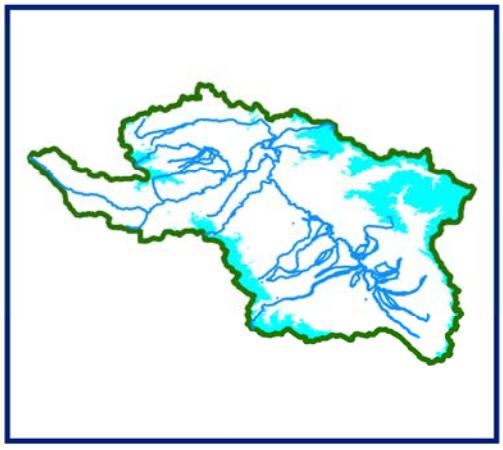
0 35 70 140 210 280

Kilometers

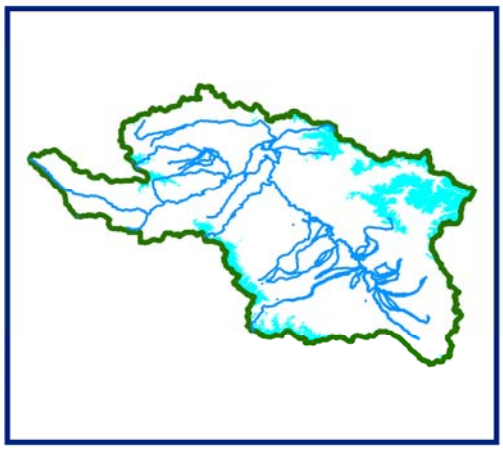
10 DAILY SNOW COVER MAP: JHELUM BASIN



DATA USED
7 MAY 2009



DATA USED
12 MAY 2009
17 MAY 2009

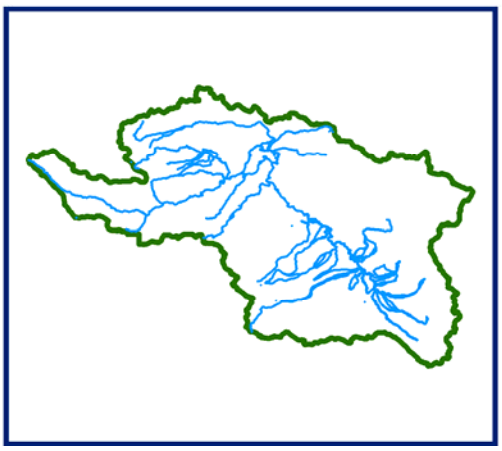


DATA USED
22 MAY 2009
26 MAY 2009
31 MAY 2009

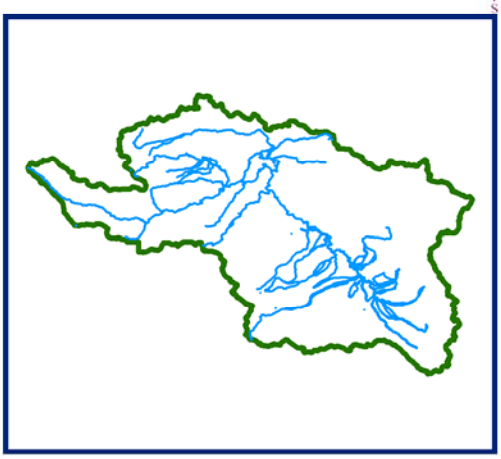
SNOW

0 35 70 140 210 280
Kilometers

SNOW COVER MAP : JHELUM BASIN



DATA NOT AVAILABLE



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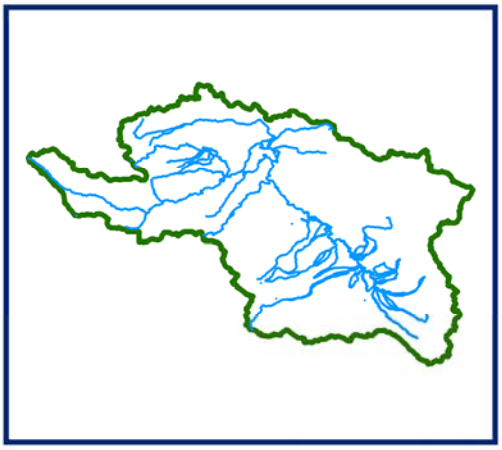

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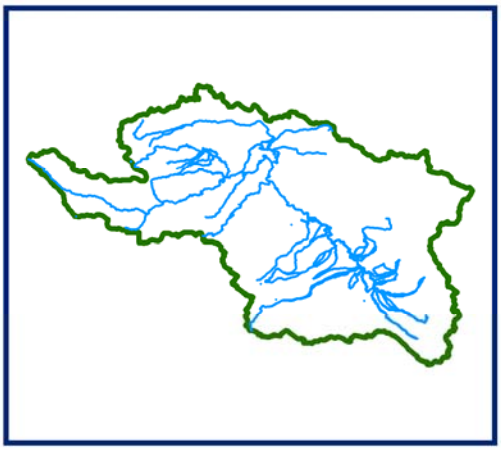

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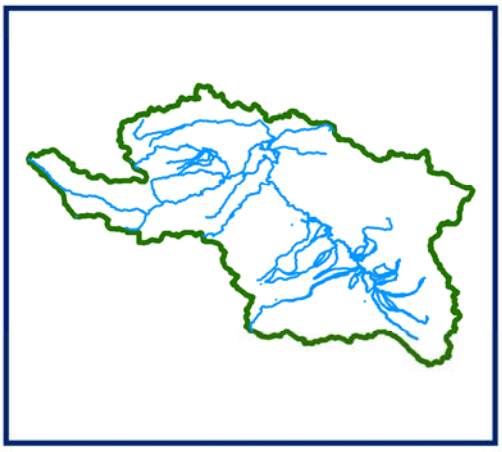

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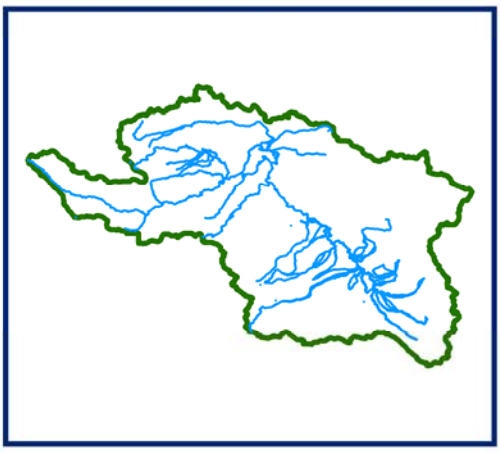


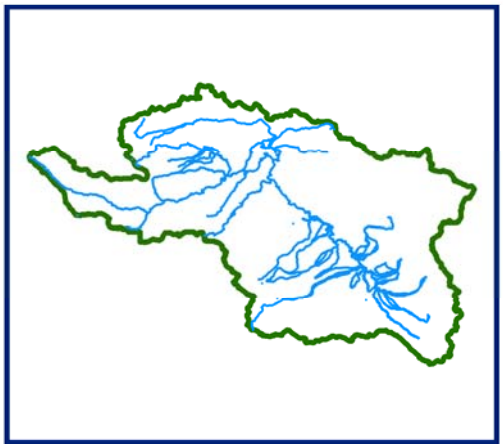
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280

Kilometers

10 DAILY SNOW COVER MAP: JHELUM BASIN



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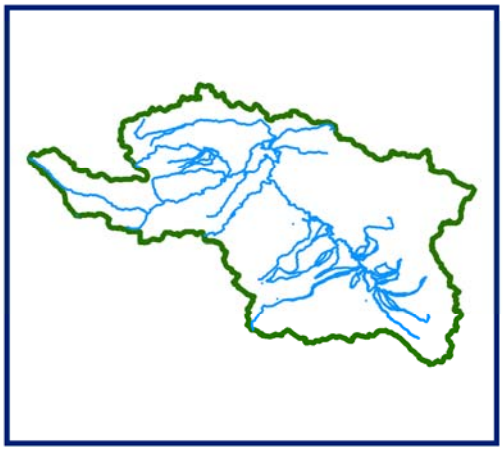

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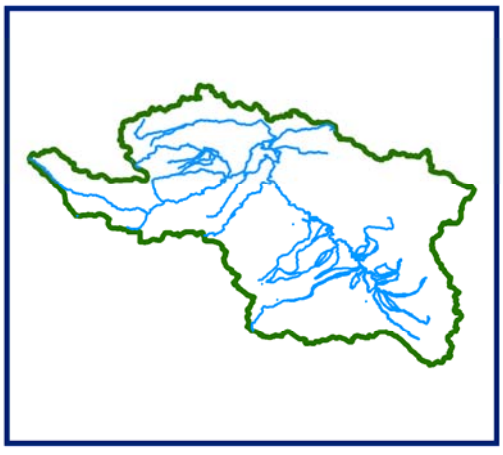
DATA NOT AVAILABLE



DATA USED
DATA NOT AVAILABLE

SNOW

0 35 70 140 210 280
Kilometers

KISAN GANGA BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: KISHAN GANGA **BASIN AREA: 7451sq km**

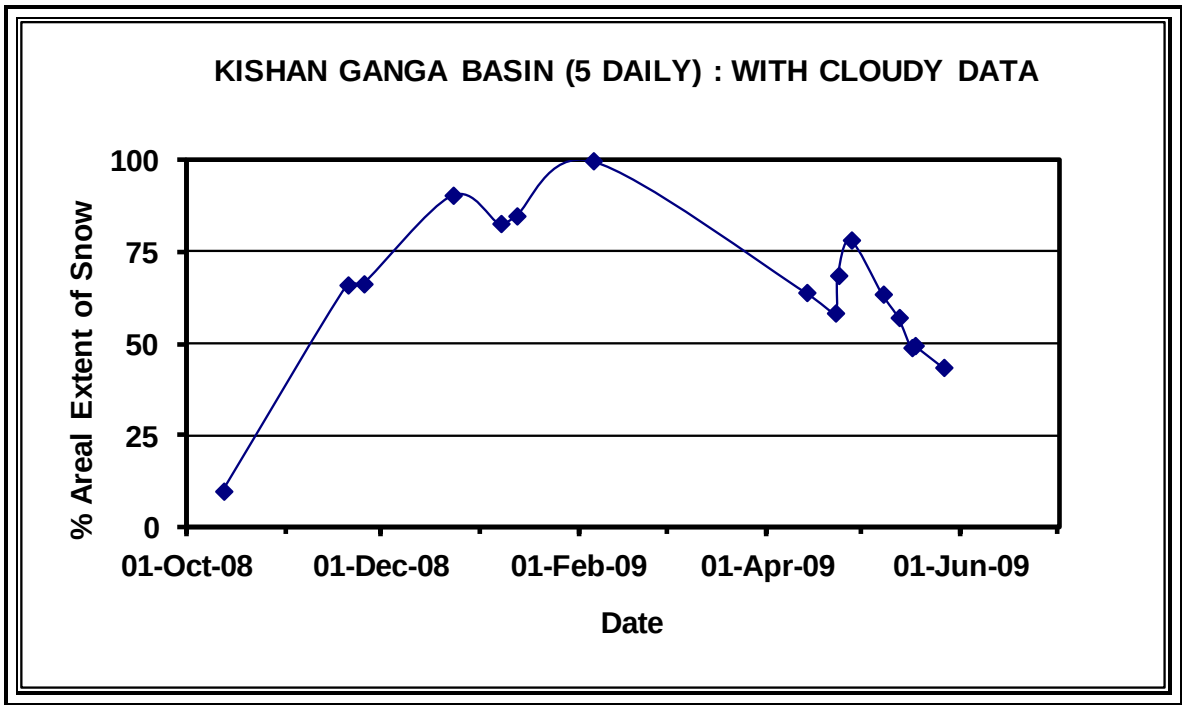
S. No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	12-Oct-08	740	10				
November 2008							
2	20-Nov-08	4922	66	3	25-Nov-08	4945	66
December 2008							
4	23-Dec-08	6741	90				
January 2009							
5	7-Jan-09	6169	83	6	12-Jan-09	6323	85
February 2009							
7	5-Feb-09	7441	100				
March 2009							
8	13-Apr-09	4769	64	9	22-Apr-09	4353	58
April 2009							
10	23-Apr-09	5115	69	11	27-Apr-09	5834	78
May 2009							
12	7-May-09	4736	64	13	12-May-09	4262	57
14	16-May-09	3652	49	15	17-May-09	3693	50
16	26-May-09	3250	44				
June 2009							

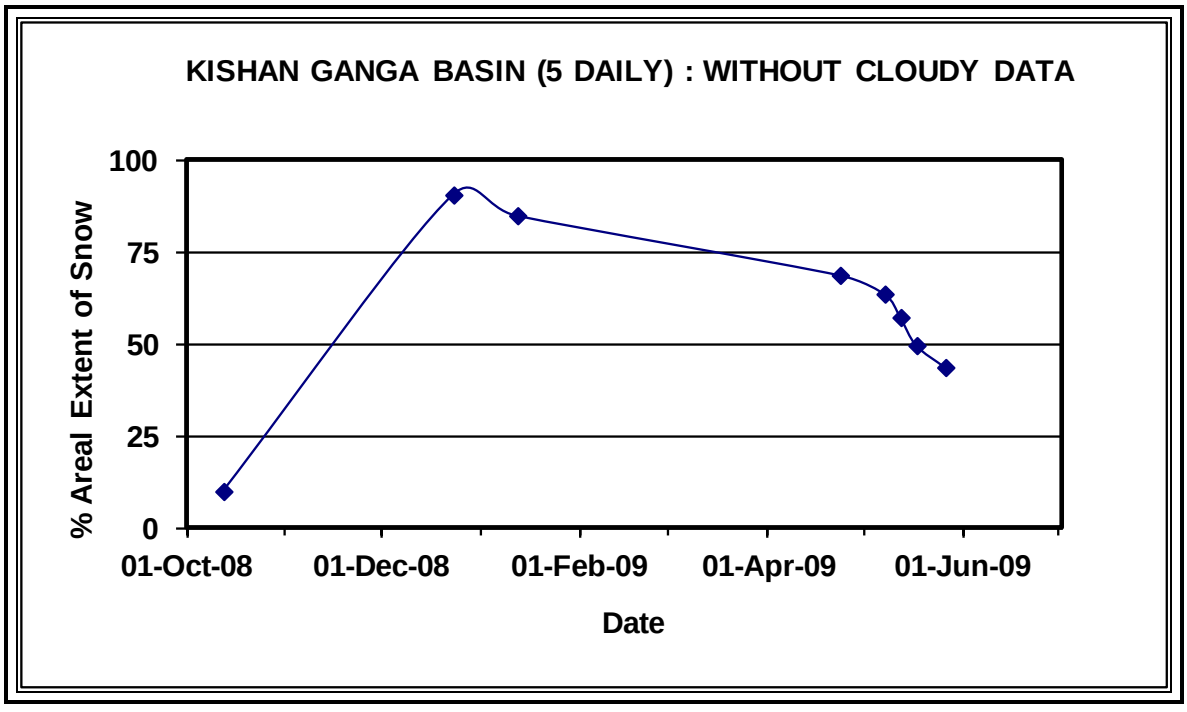
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: KISHAN GANGA **BASIN AREA: 7451 Sq km**

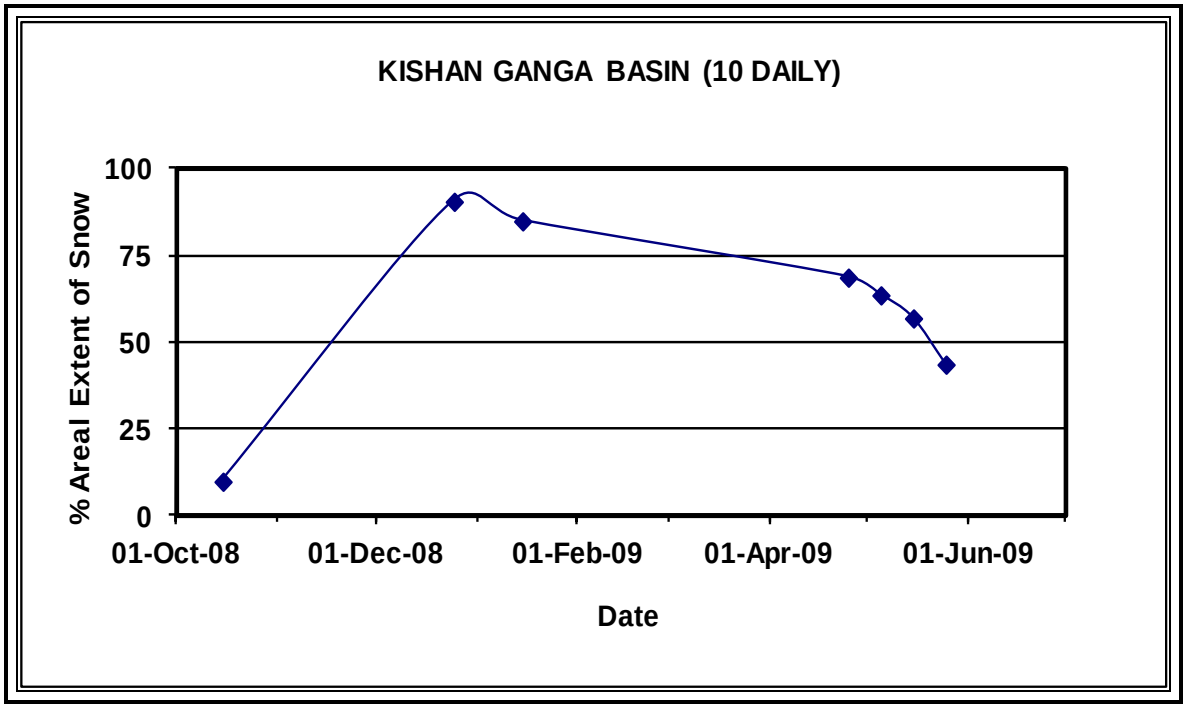
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	12-Oct-08	740	10				
December 2008				**January 2009**			
2	23-Dec-08	6741	90	3	15-Jan-09		85
February 2009				**March 2009**			
April 2009				**May 2009**			
4	23-Apr-09	5115	69	5	7-May-09	4736	64
				6	12-May-09	4241	57
				7	26-May-09	3250	44
June 2009				**July 2009**			

Snow cover depletion curve



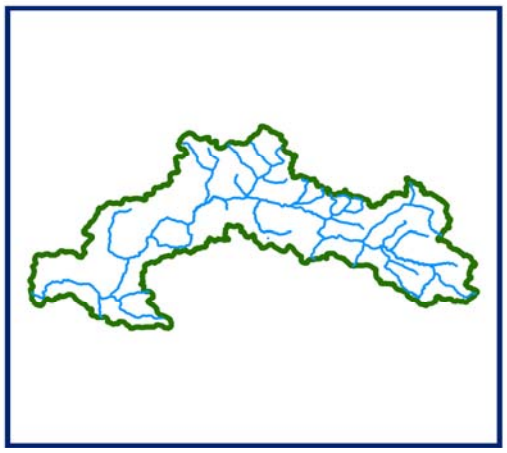


Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : KISHAN GANGA BASIN



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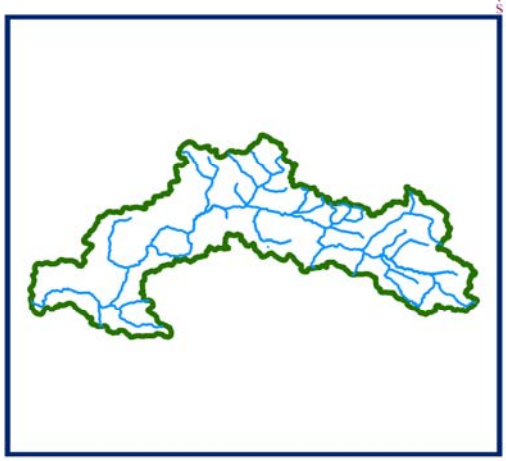

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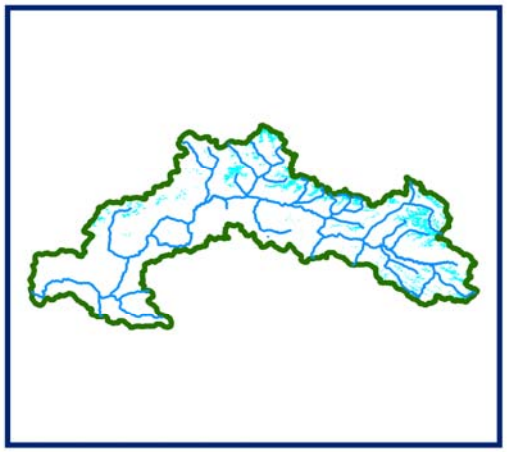
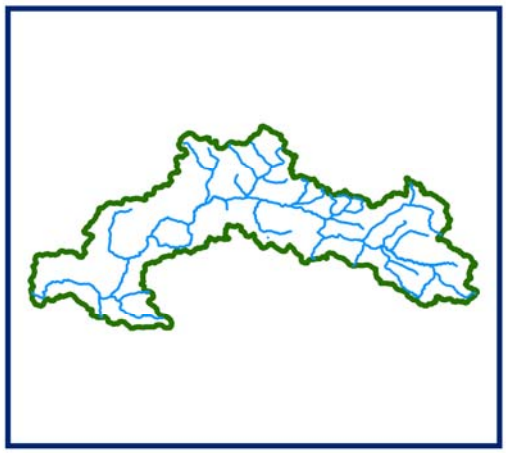


12 OCTOBER 2008



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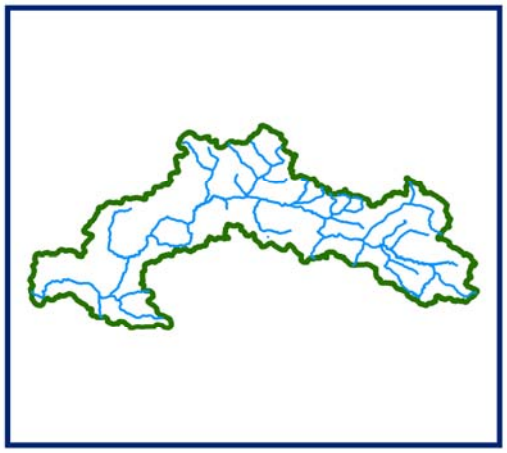

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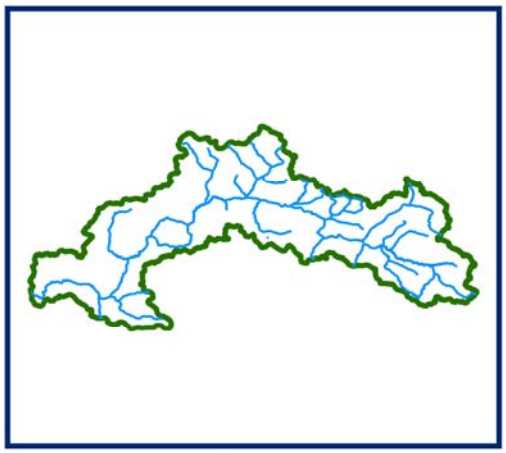

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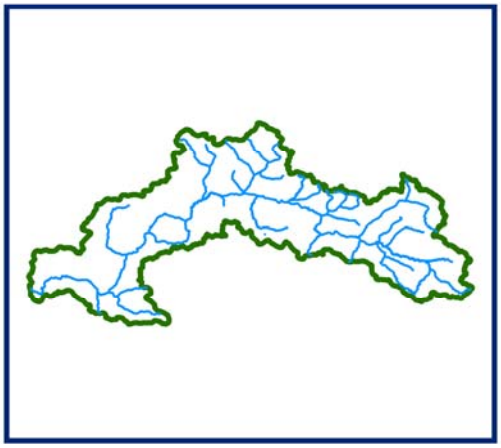
SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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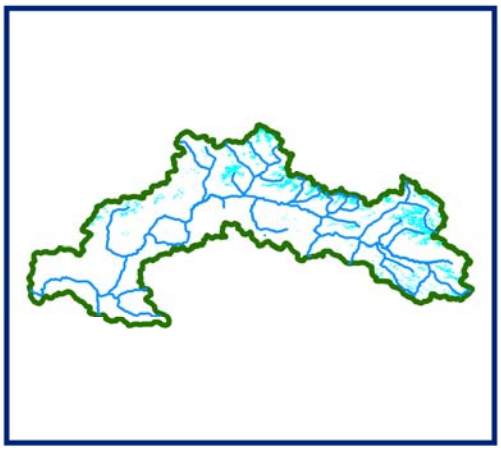

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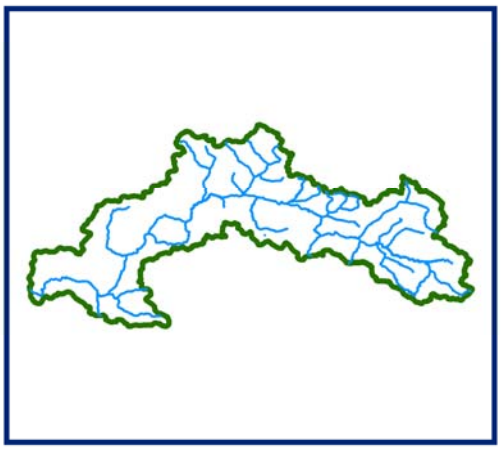

DATA USED
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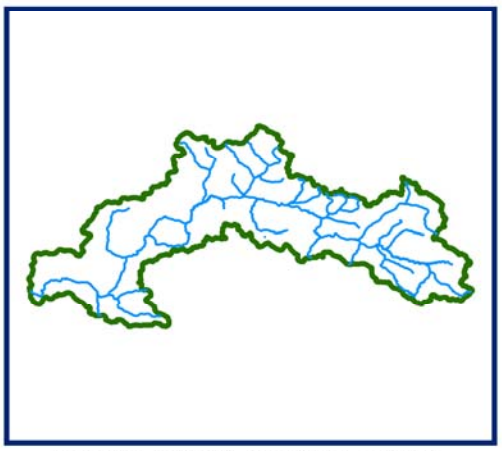
SNOW

0 30 60 120 180 240

Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



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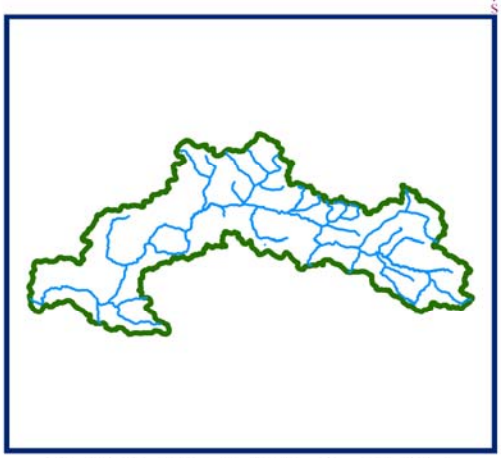

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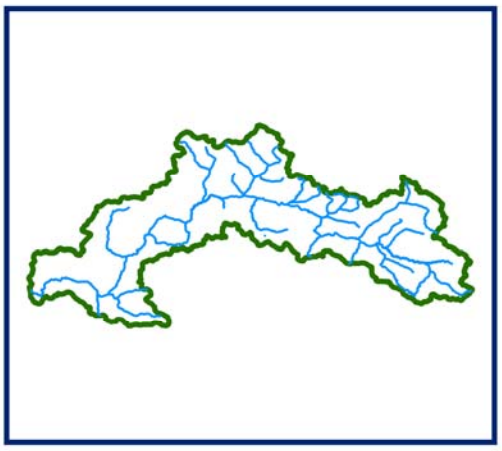

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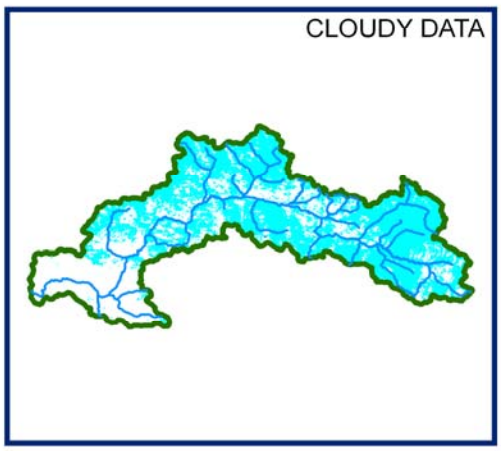
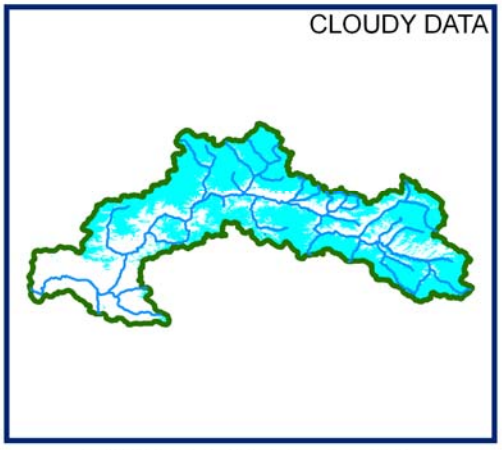
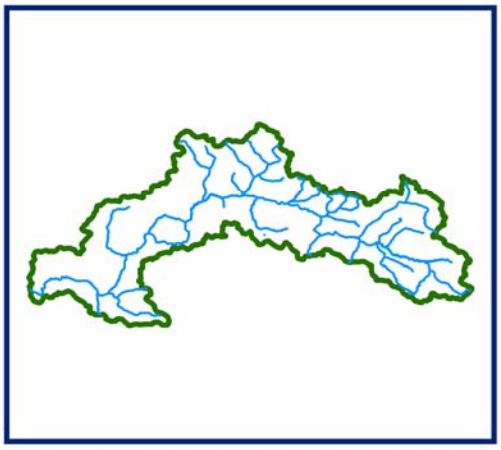


20 NOVEMBER 2008



25 NOVEMBER 2008



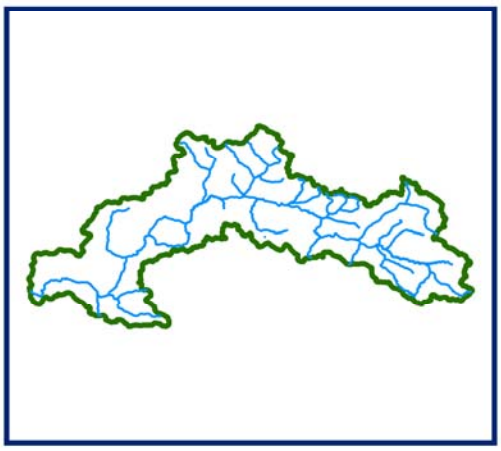
DATA NOT AVAILABLE

SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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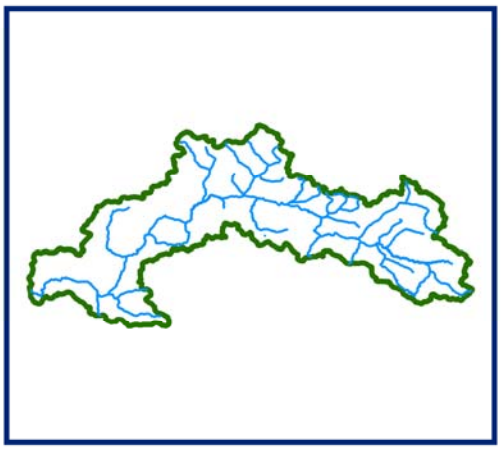

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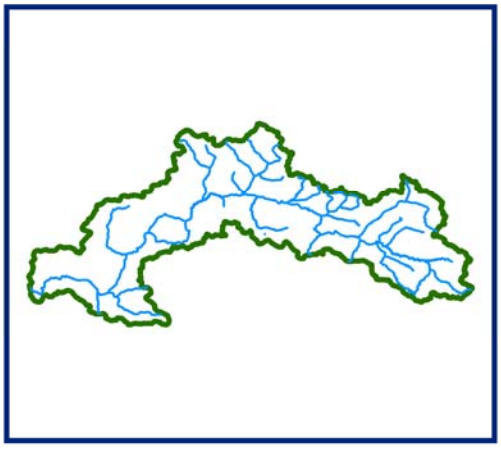

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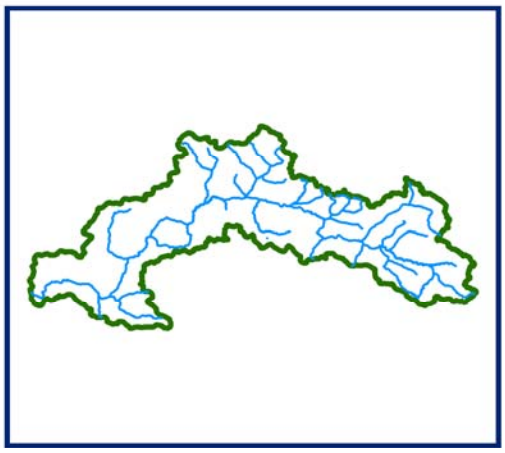
SNOW

0 30 60 120 180 240
Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



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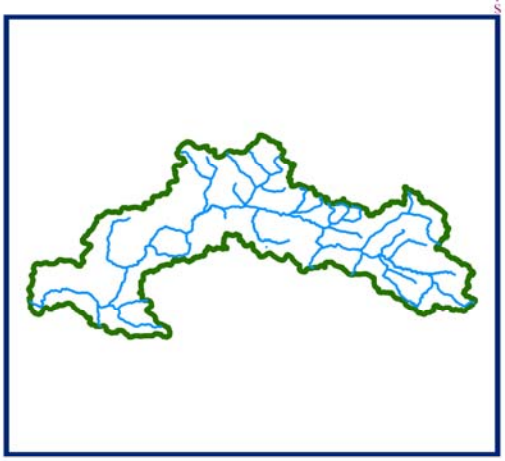

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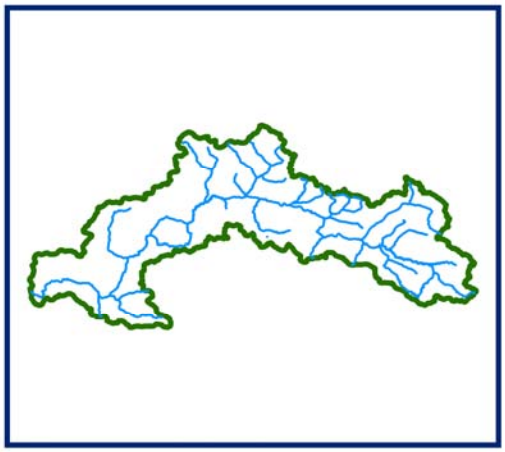

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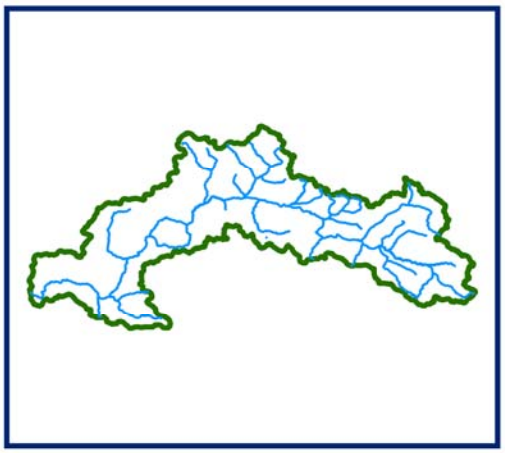

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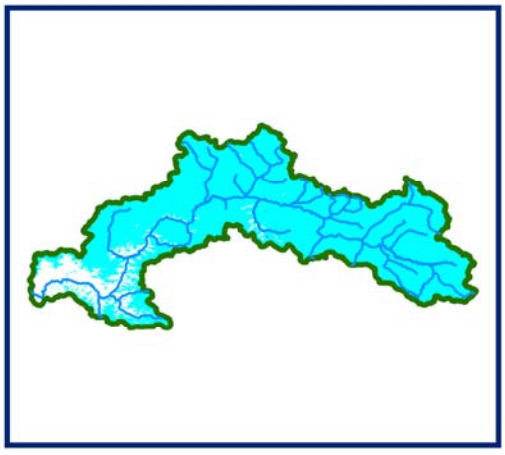
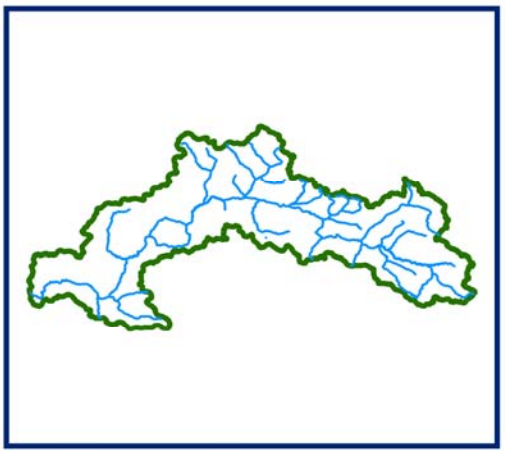


23 DECEMBER 2008



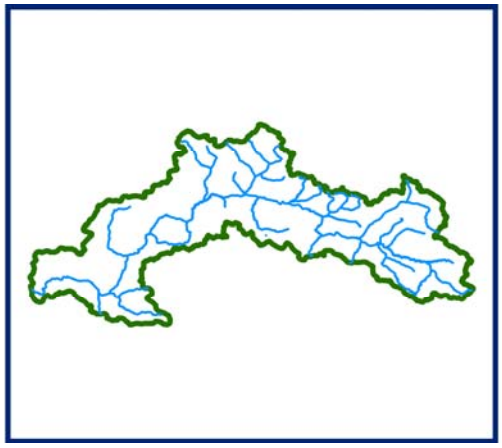
DATA NOT AVAILABLE

SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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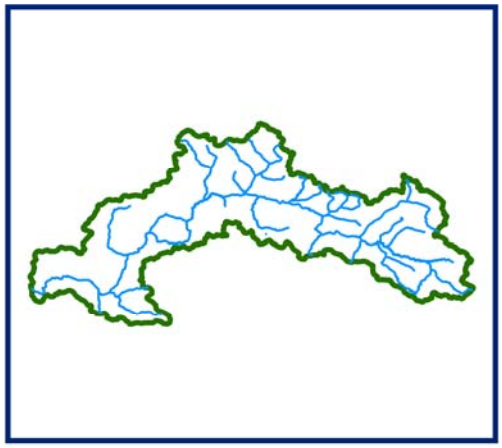

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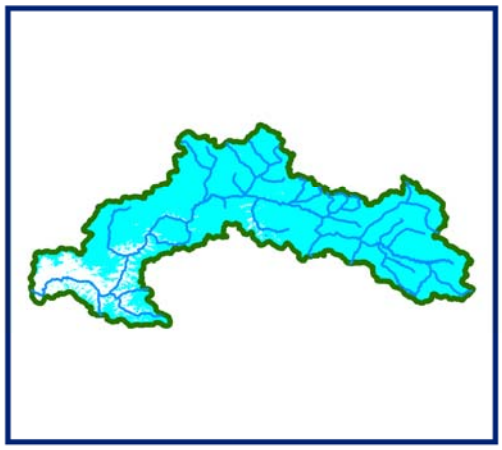
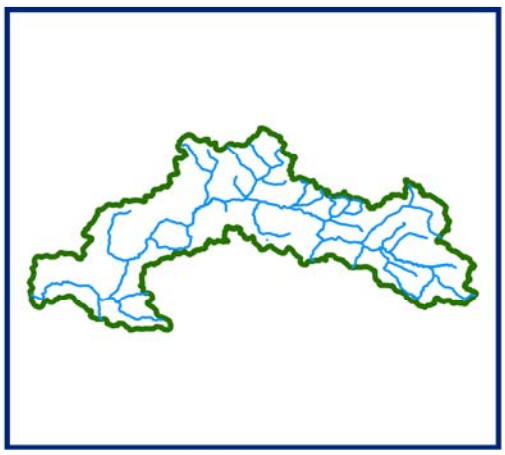


DATA USED
23 DECEMBER 2008

SNOW

0 30 60 120 180 240
Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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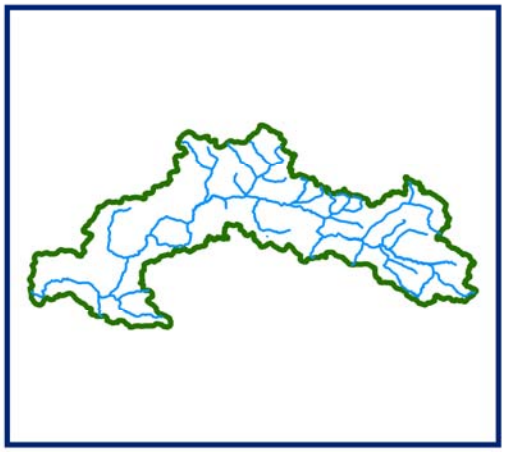

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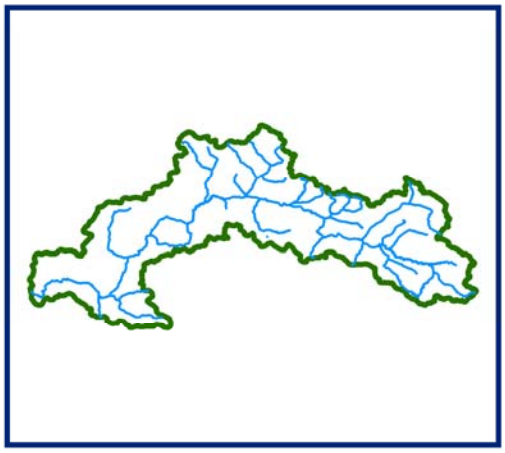

DATA USED
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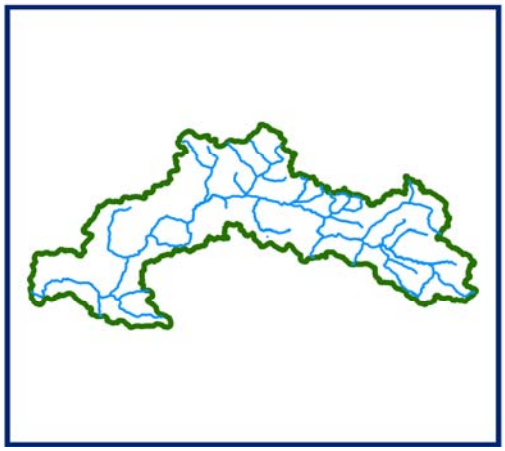
SNOW

0 30 60 120 180 240
Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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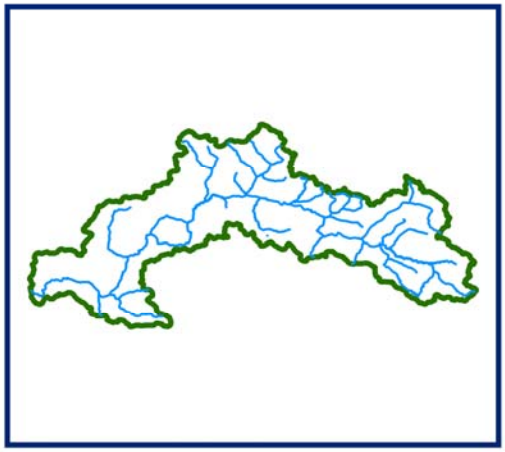

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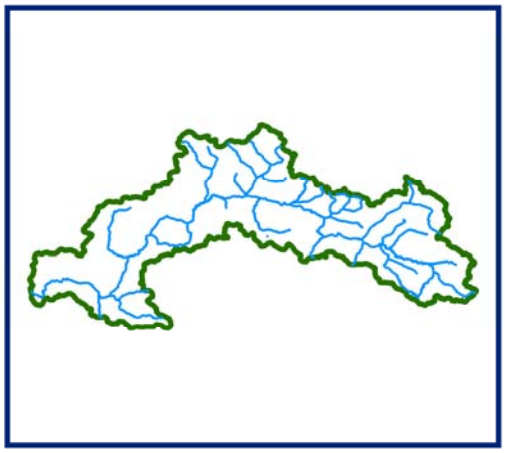

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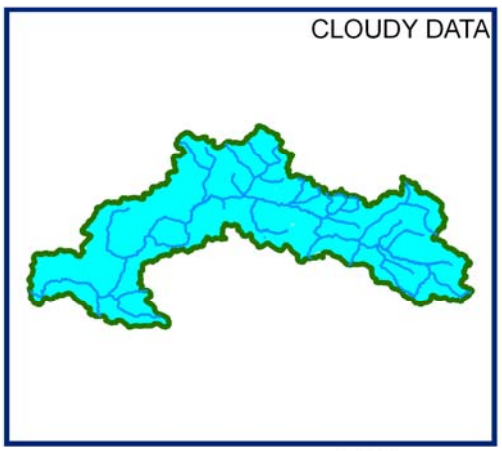
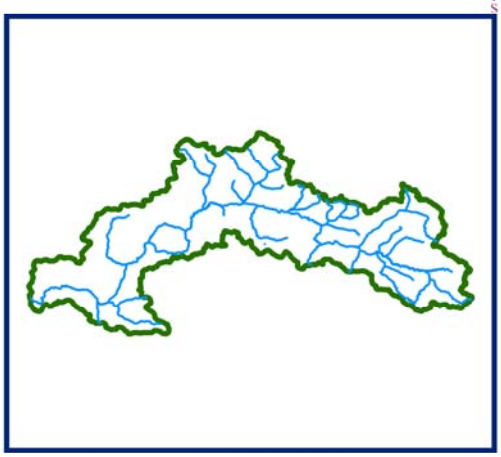
SNOW

0 30 60 120 180 240
Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



5 FEBRUARY 2009



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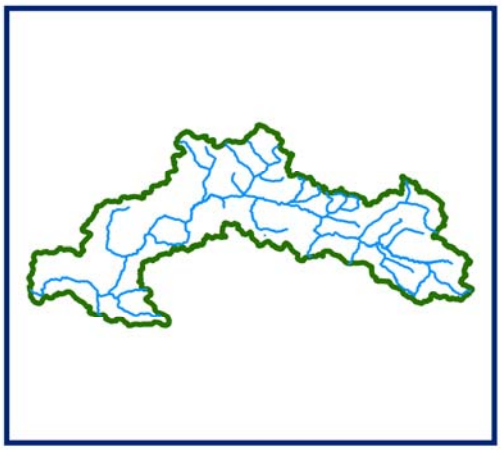

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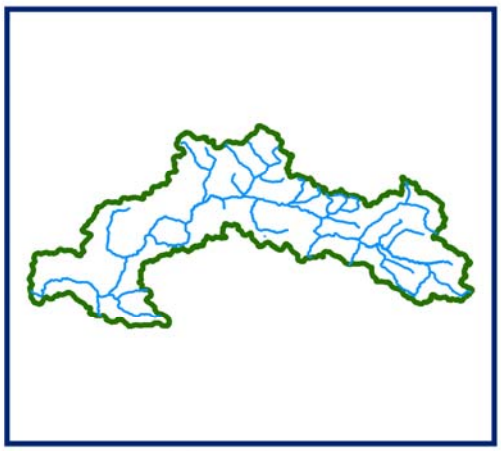

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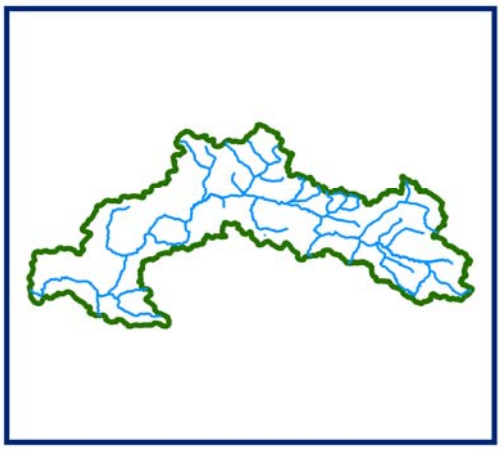

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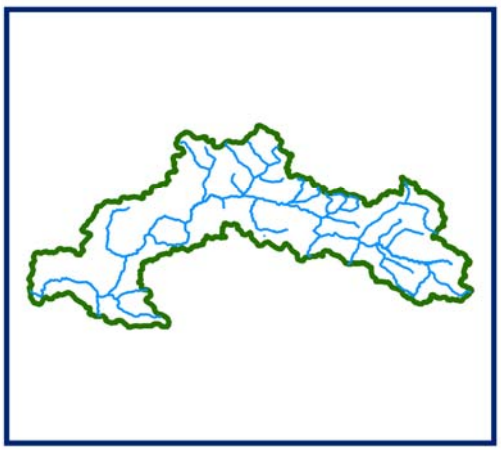

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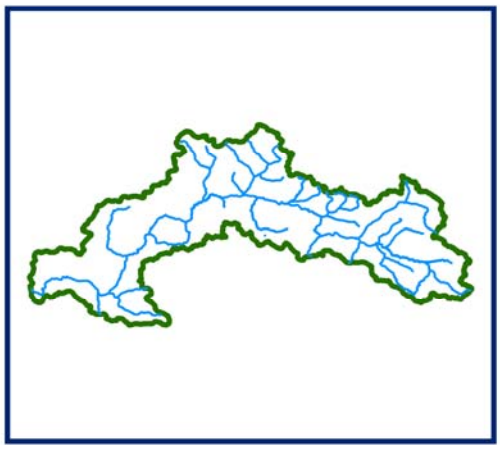
SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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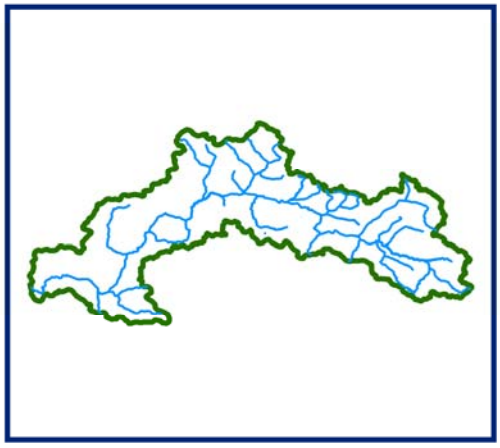

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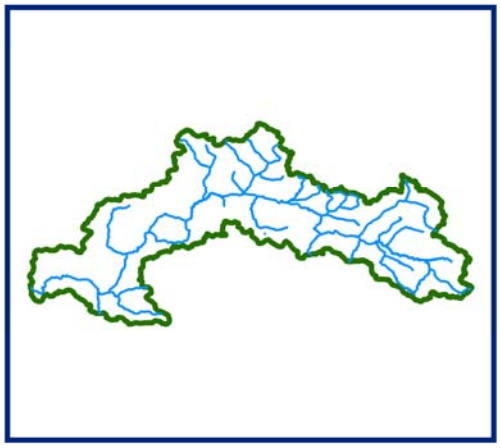

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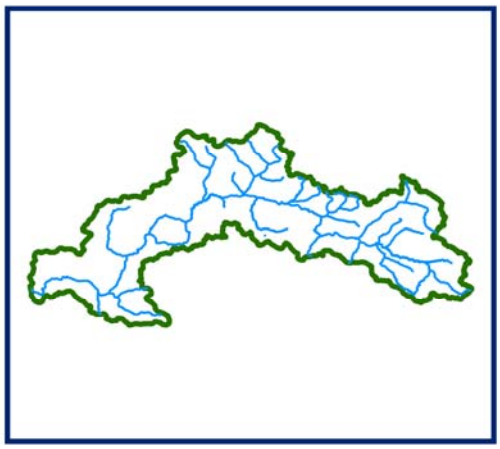
SNOW

0 30 60 120 180 240
Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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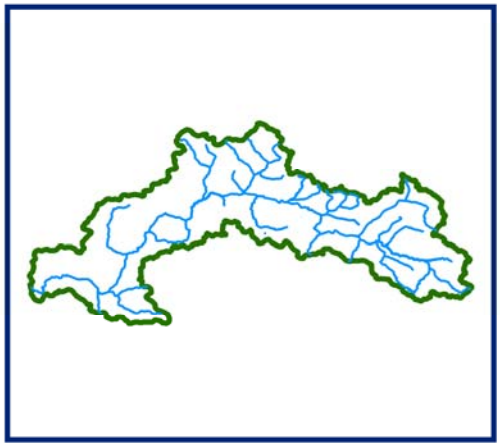

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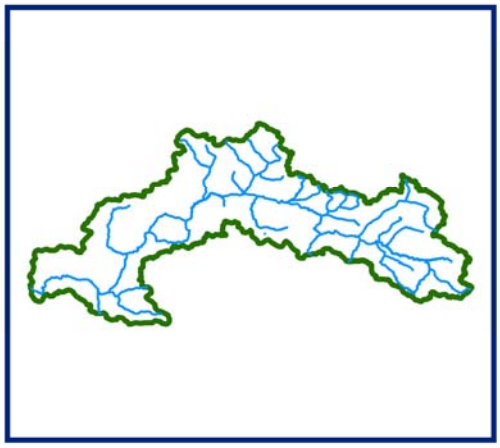

DATA USED
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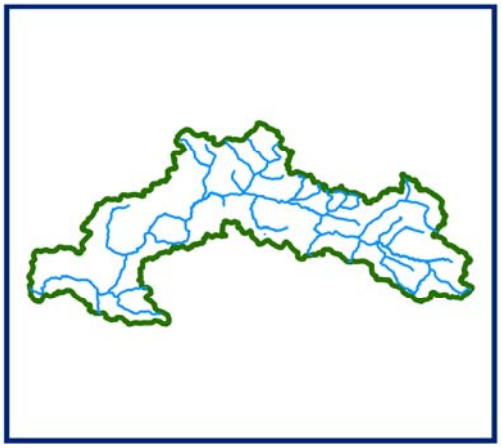
SNOW

0 30 60 120 180 240
Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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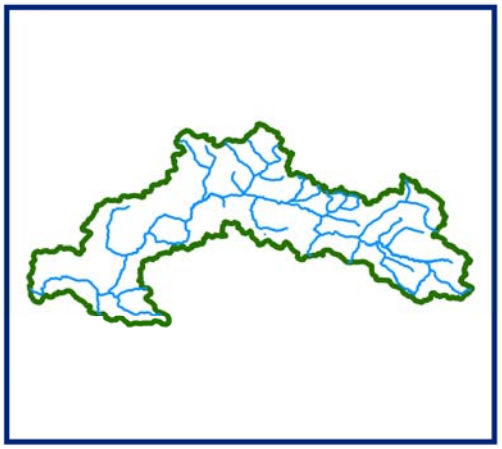

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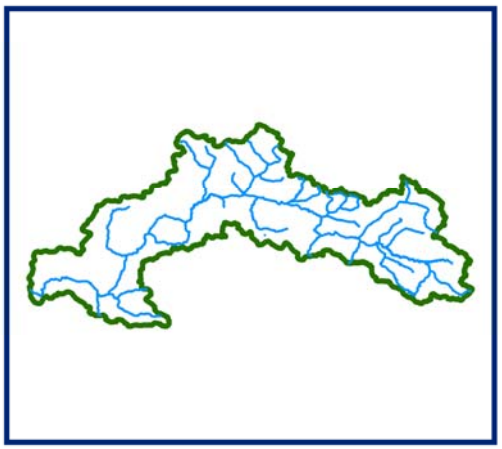
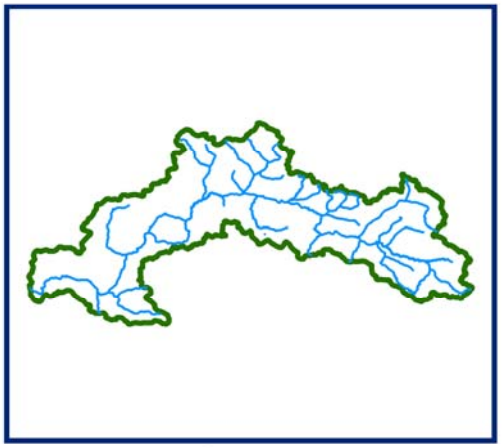


DATA USED
DATA NOT AVAILABLE

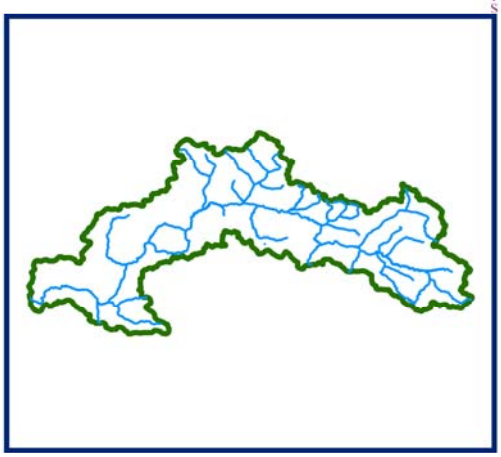
SNOW

0 30 60 120 180 240
Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



DATA NOT AVAILABLE



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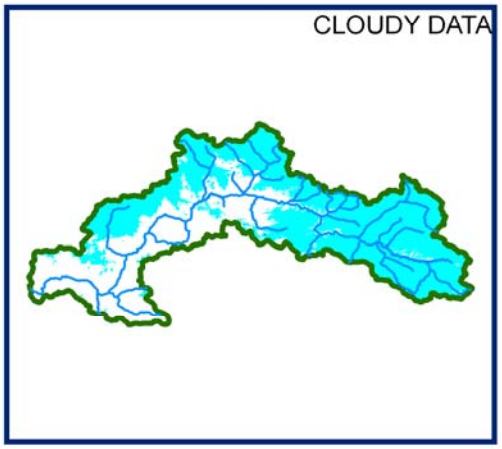
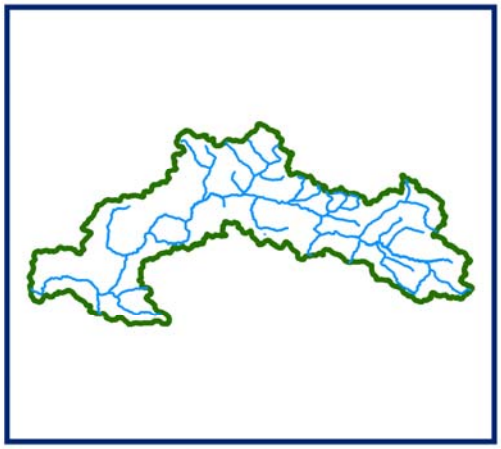


13 APRIL 2009



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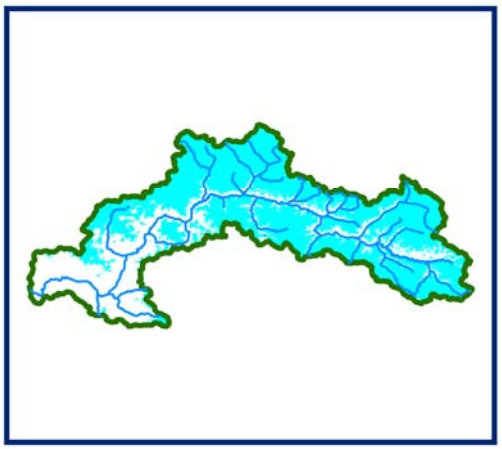
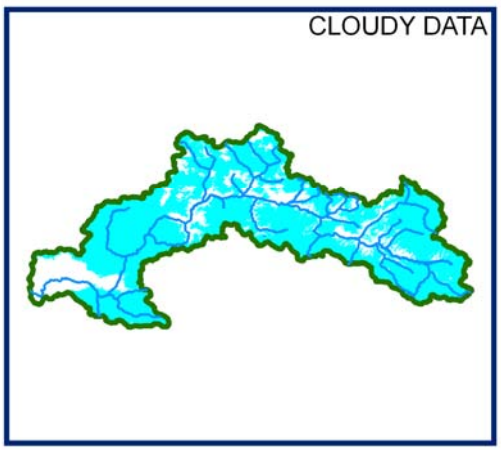


23 APRIL 2009



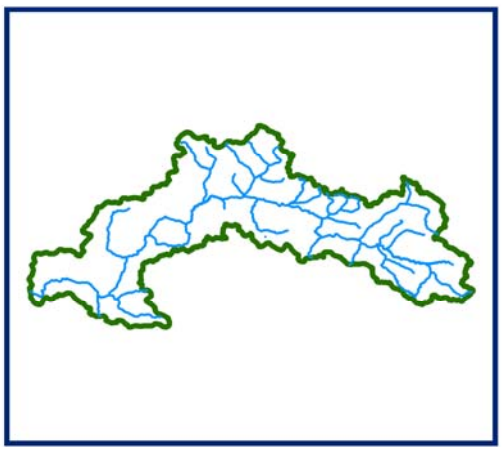
27 APRIL 2009

SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



DATA USED
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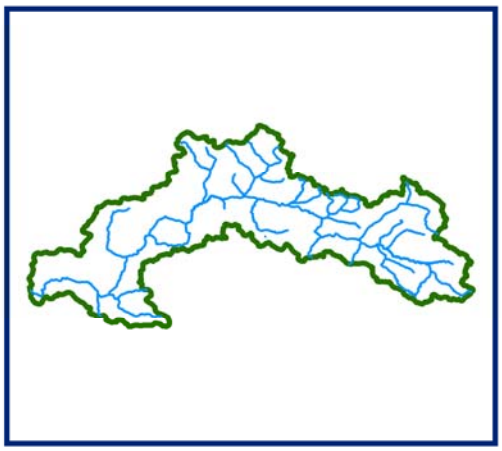

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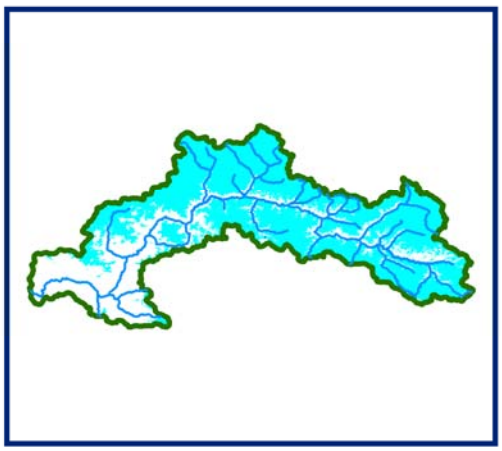
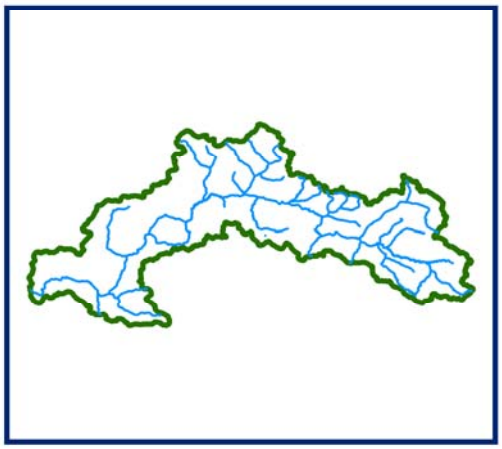


DATA USED
23 APRIL 2009

SNOW

0 30 60 120 180 240
Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



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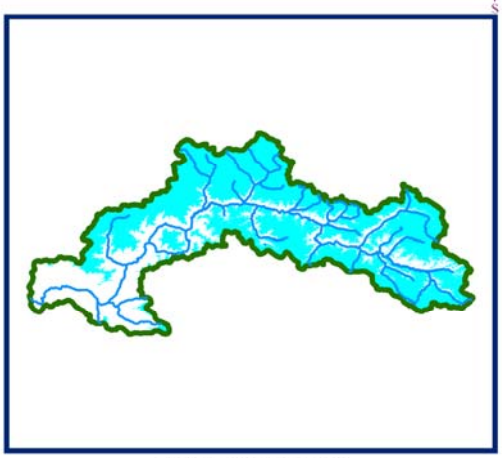
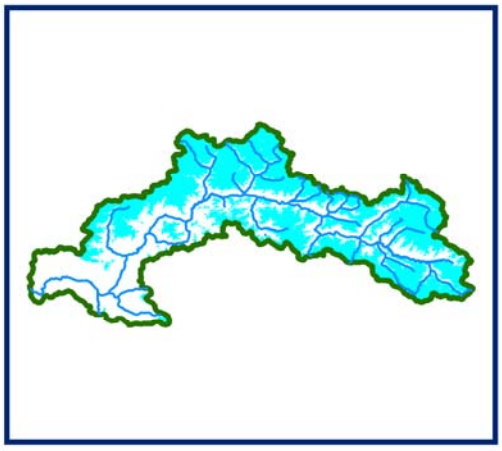
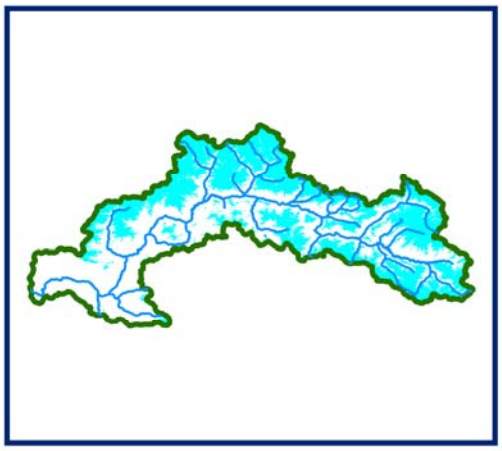


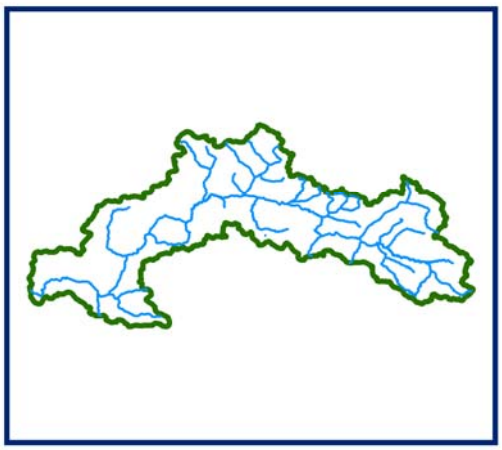
7 MAY 2009



12 MAY 2009



17 MAY 2009



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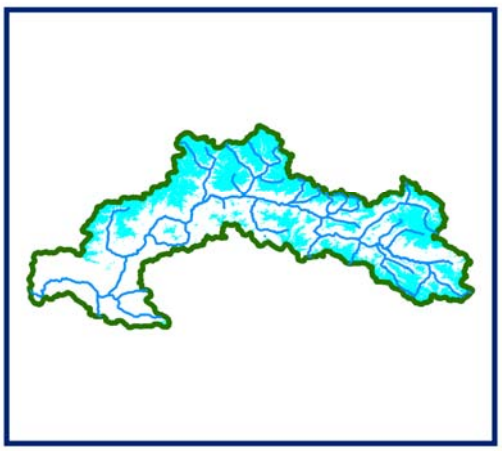


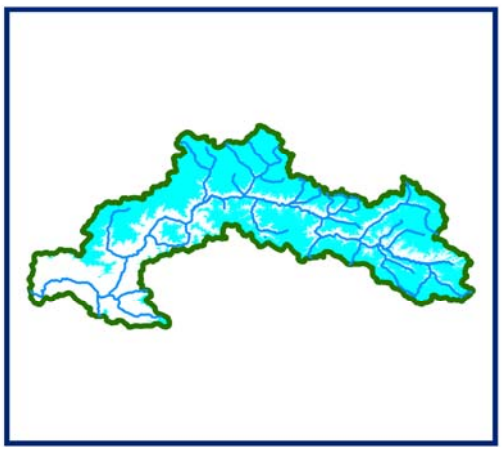
26 MAY 2009

SNOW

0 30 60 120 180 240

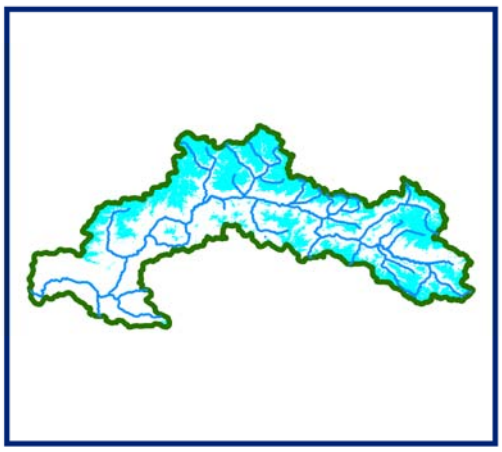
Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



DATA USED
7 MAY 2009

DATA USED
12 MAY 2009
17 MAY 2009

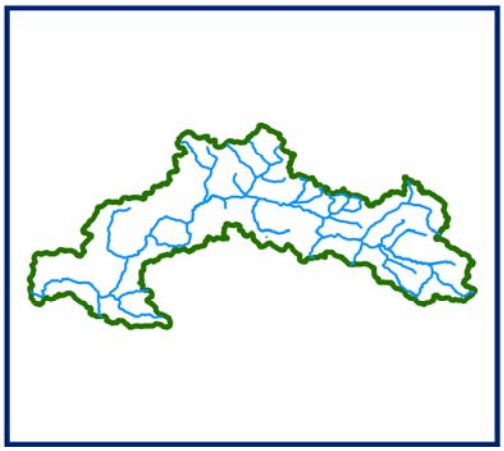


DATA USED
26 MAY 2009

SNOW

0 30 60 120 180 240
Kilometers

SNOW COVER MAP : KISHAN GANGA BASIN



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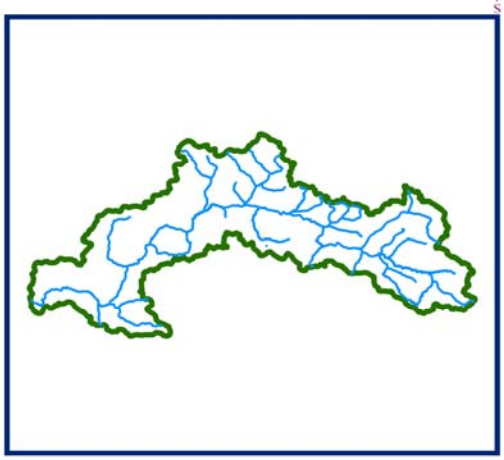

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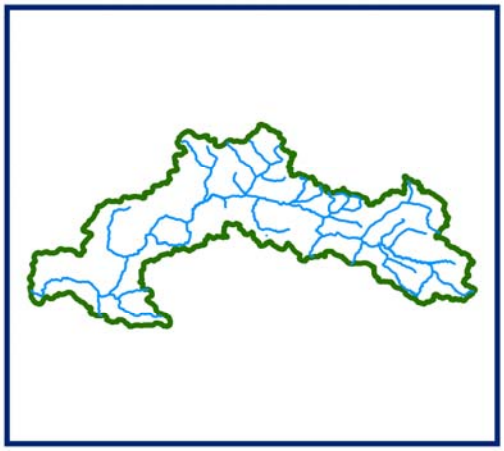

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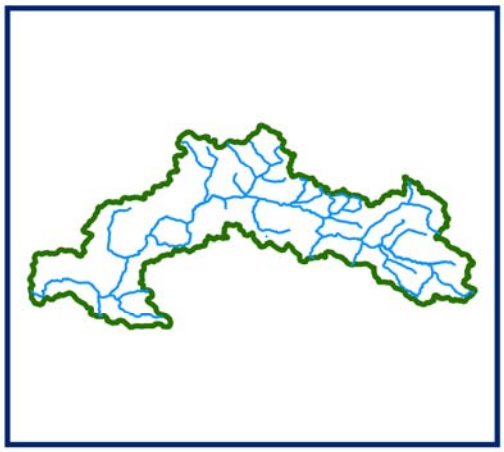

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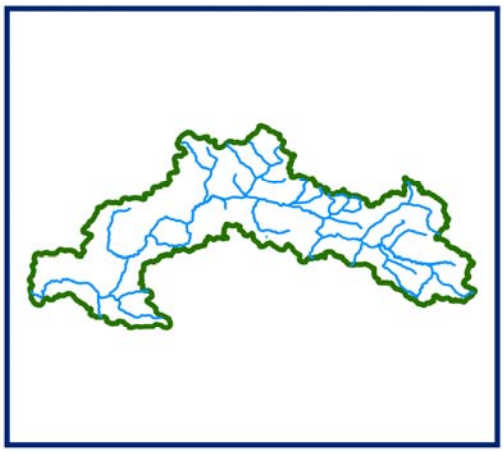

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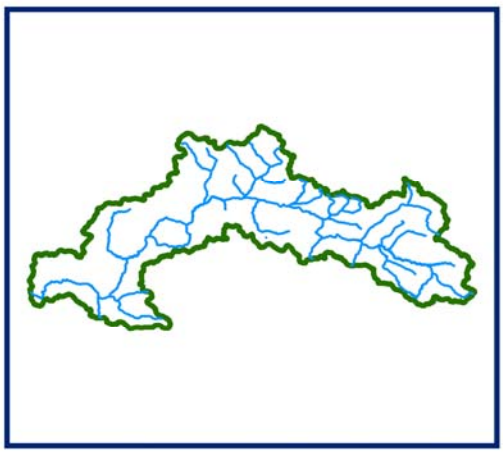


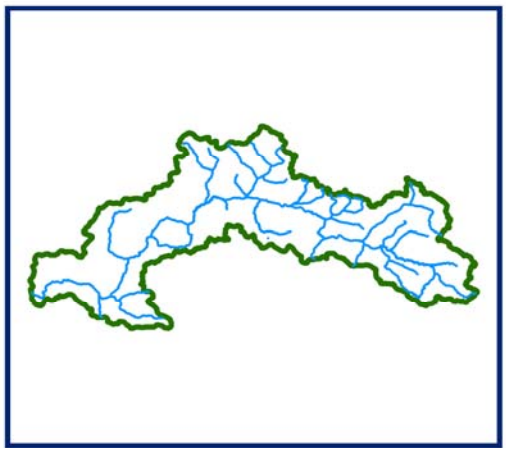
DATA NOT AVAILABLE

SNOW

0 30 60 120 180 240

Kilometers

10 DAILY SNOW COVER MAP : KISHAN GANGA BASIN



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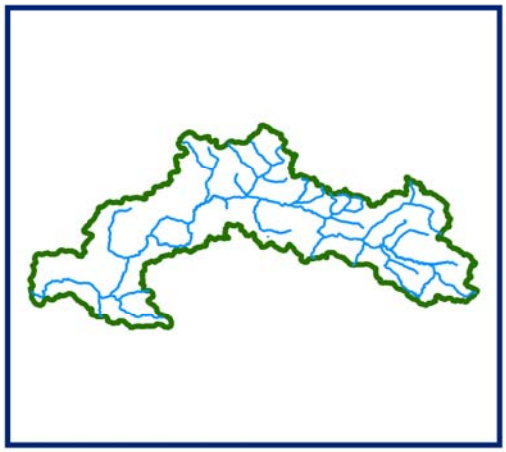

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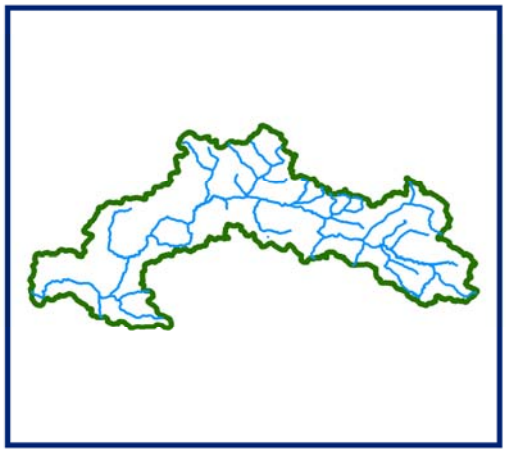


DATA USED
DATA NOT AVAILABLE

SNOW

0 30 60 120 180 240
Kilometers

ASTOR BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: ASTOR **BASIN AREA: 4008 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	12-Oct-08	1012	25				
November 2008							
2	11-Nov-08	1821	45	3	20-Nov-08	3185	79
4	25-Nov-08	3175	79				
December 2008							
5	5-Dec-08	2599	65	6	23-Dec-08	3958	99
January 2009							
7	7-Jan-09	3951	99	8	12-Jan-09	3917	98
February 2009							
9	5-Feb-09	4008	100	10	15-Feb-09	3821	95
March 2009							
11	11-Mar-09	3879	97				
April 2009							
12	4-Apr-09	3706	92	13	22-Apr-09	3069	77
14	23-Apr-09	3594	90	15	27-Apr-09	2770	69
16	28-Apr-09	993	25				

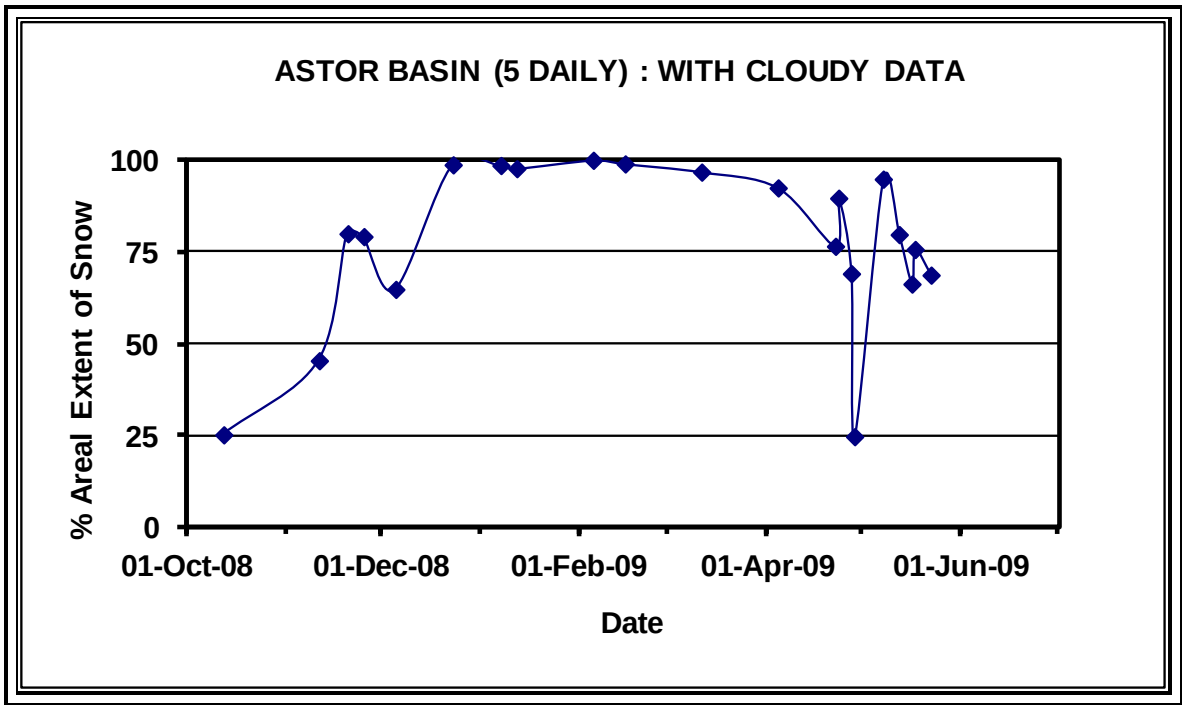
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May 2009							
17	7-May-09	3802	95	18	12-May-09	3197	80
19	16-May-09	2657	66	20	17-May-09	3035	76
21	22-May-09	2755	69				
June 2009							
July 2009							
22	9-Jul-09	1349	34				

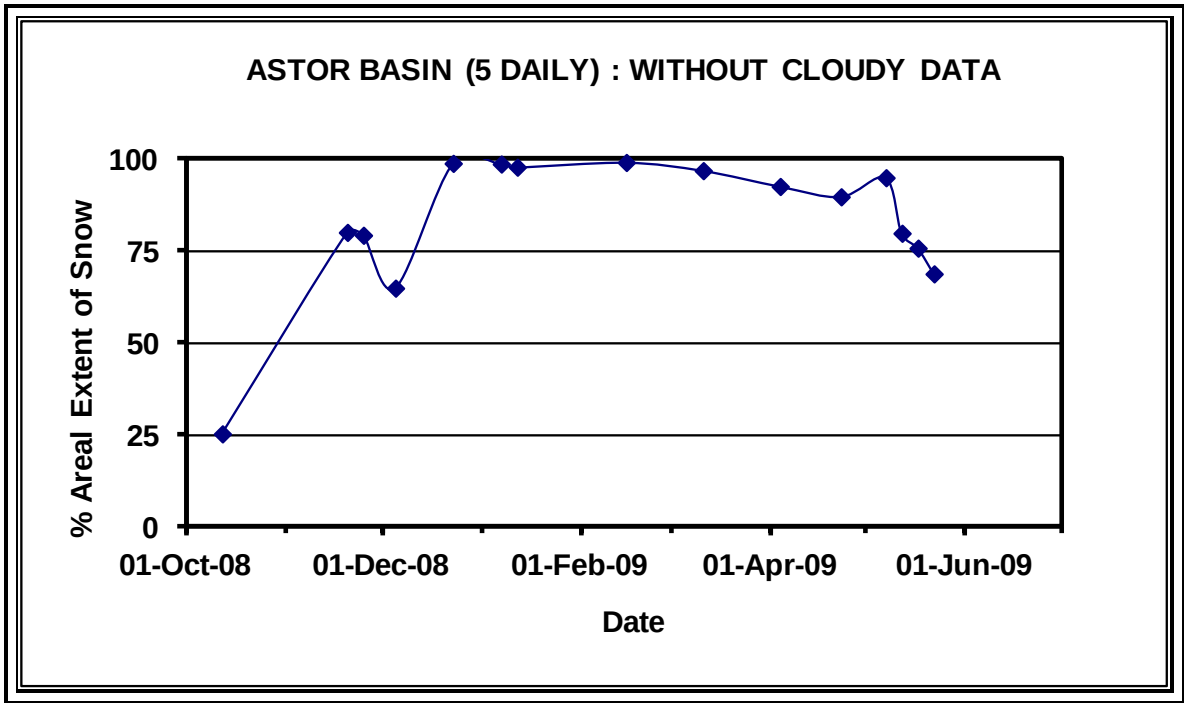
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: ASTOR **BASIN AREA: 4008 sq km**

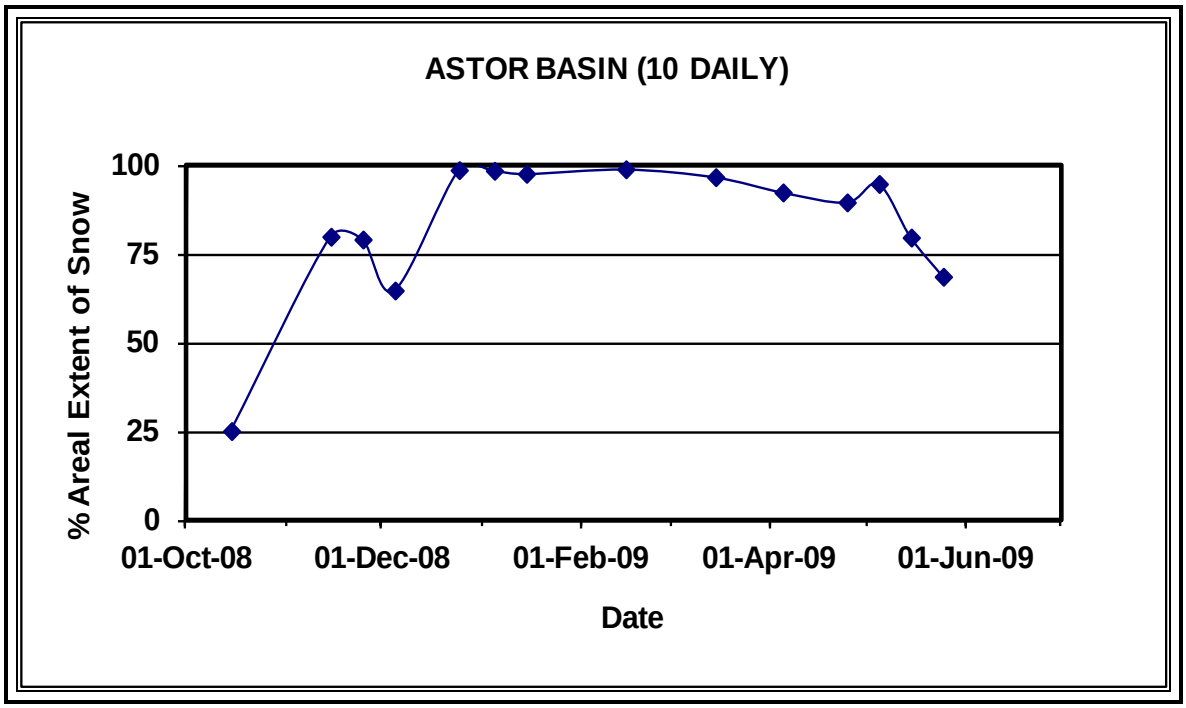
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	15-Oct-08	1012	25	2	15-Nov-08	3206	80
				3	25-Nov-08	3175	79
December 2008				**January 2009**			
4	5-Dec-08	2599	65	6	5-Jan-09	3951	99
5	23-Dec-08	3958	99	7	15-Jan-09	3917	98
February 2009				**March 2009**			
8	15-Feb-09	3968	99	9	11-Mar-09	3879	97
April 2009				**May 2009**			
10	4-Apr-09	3706	92	12	7-May-09	3802	95
11	23-Apr-09	3594	90	13	7-May-09	3197	80
					7-May-09	2755	69
June 2009				**July 2009**			

Snow cover depletion curve



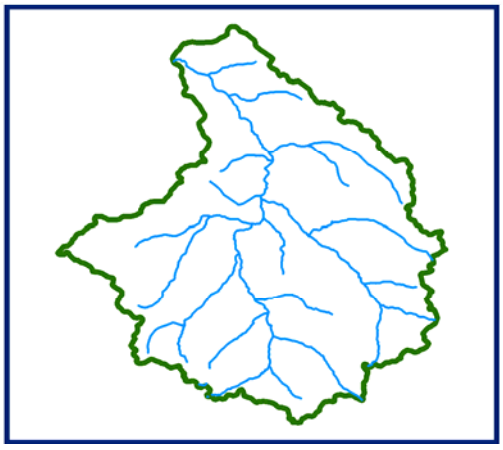


Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : ASTOR BASIN



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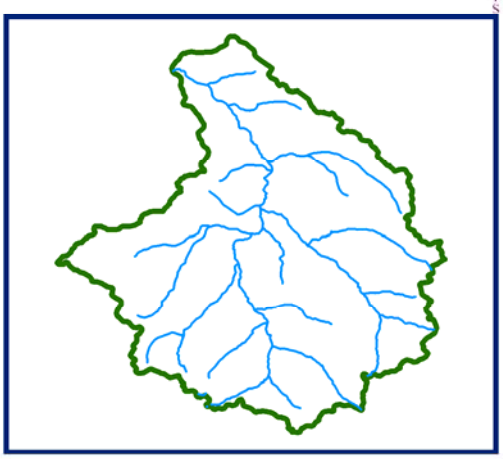

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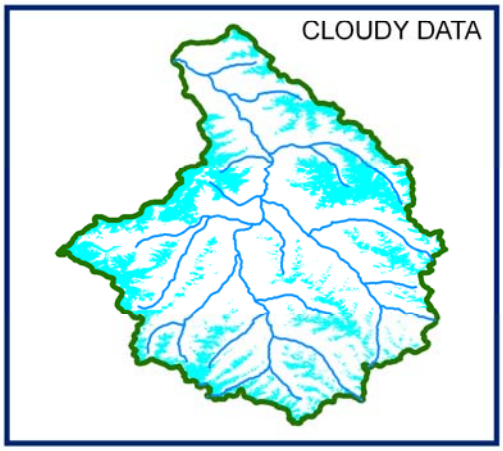
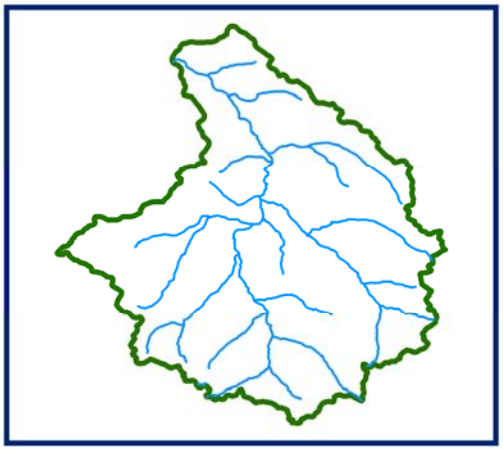


12 OCTOBER 2008



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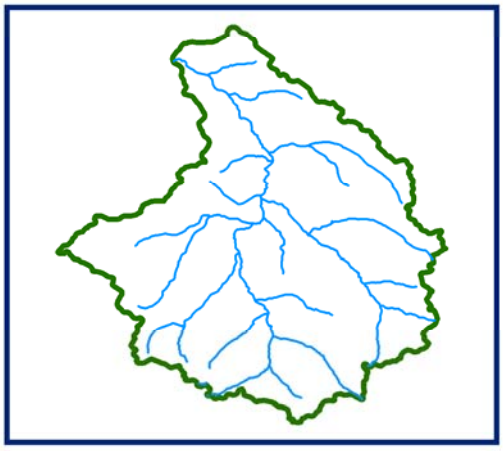

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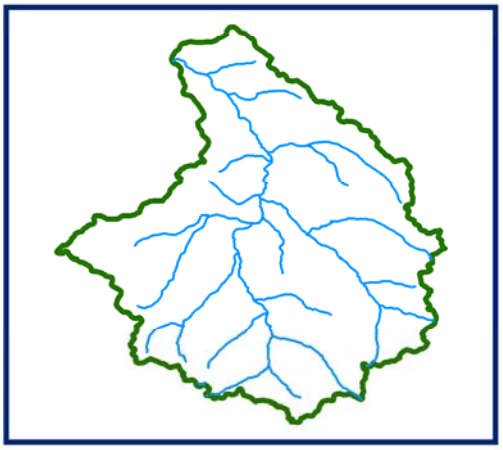

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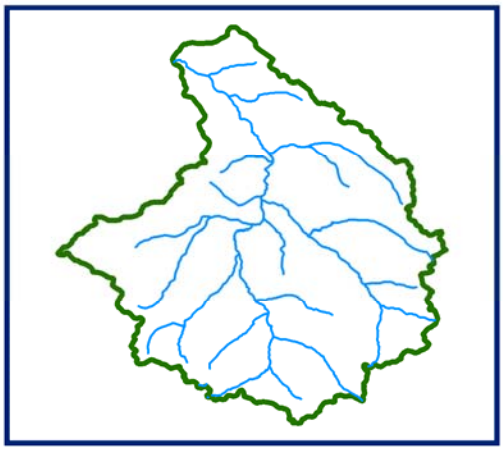
10 DAILY SNOW COVER MAP: ASTOR BASIN



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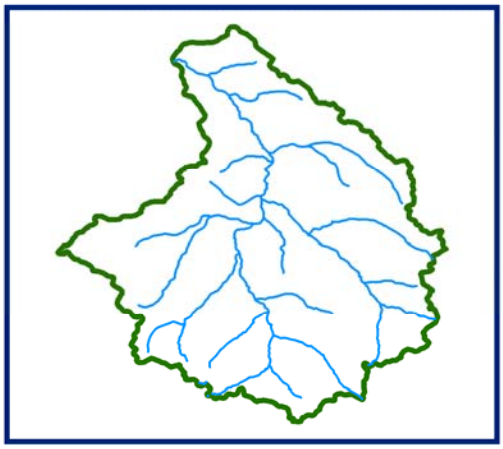

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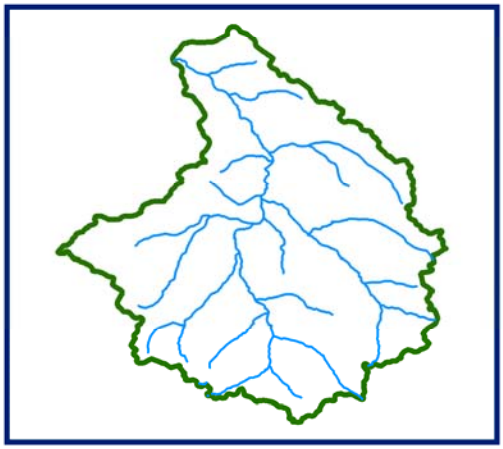

DATA USED
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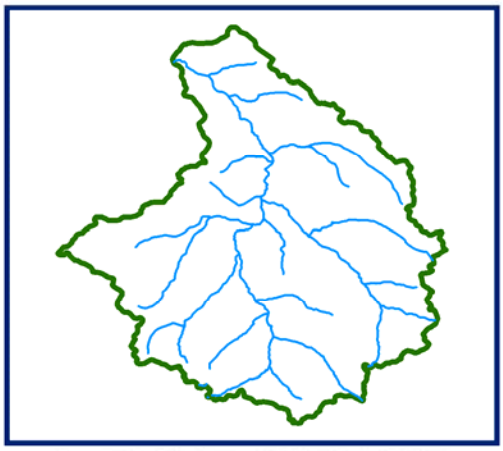
SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



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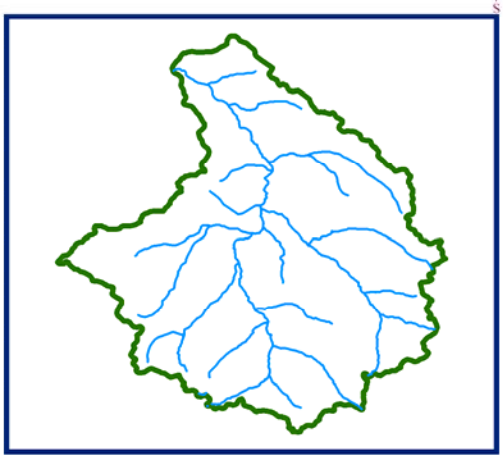

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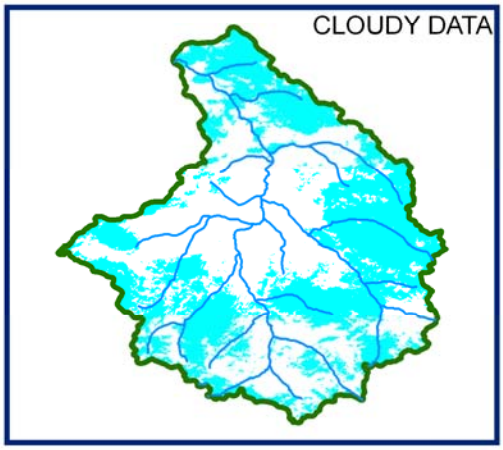
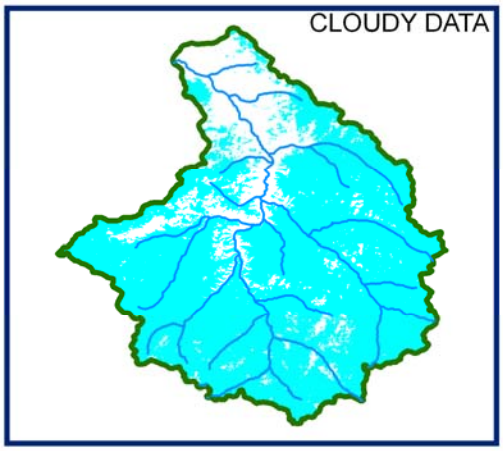
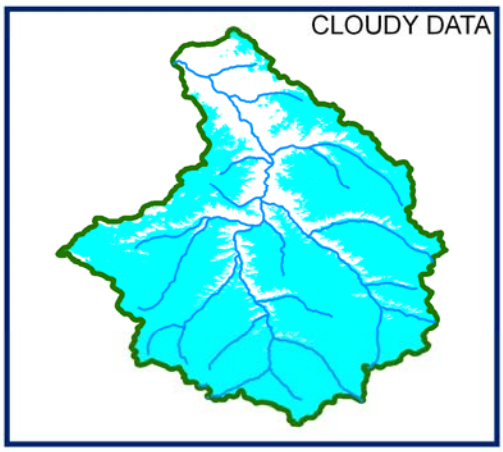


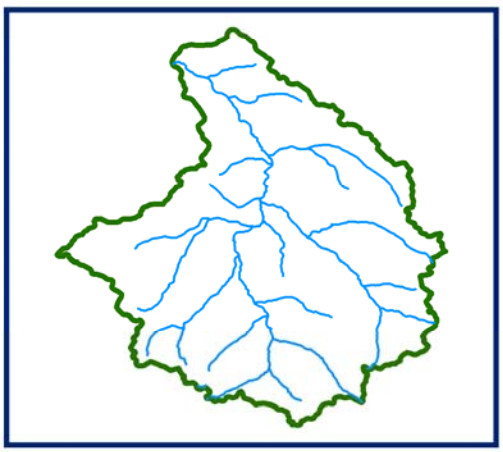
11 NOVEMBER 2008



20 NOVEMBER 2008



25 NOVEMBER 2008



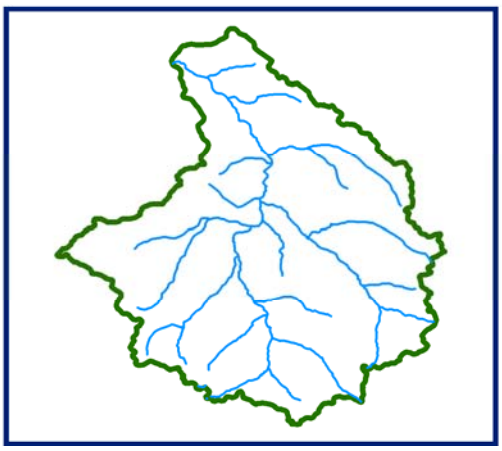
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



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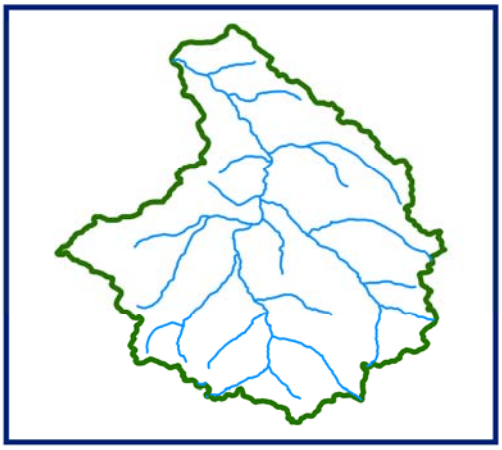

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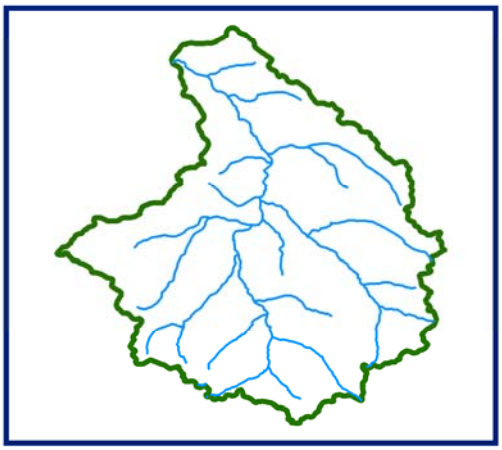

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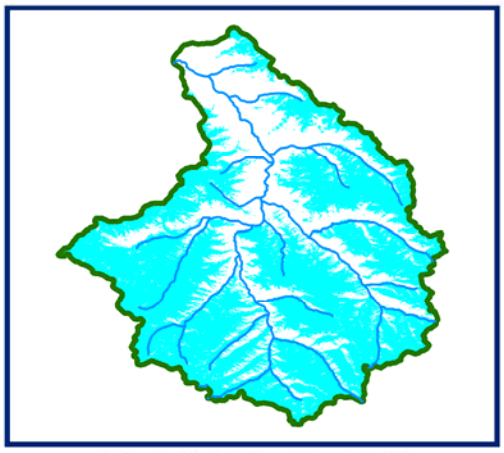
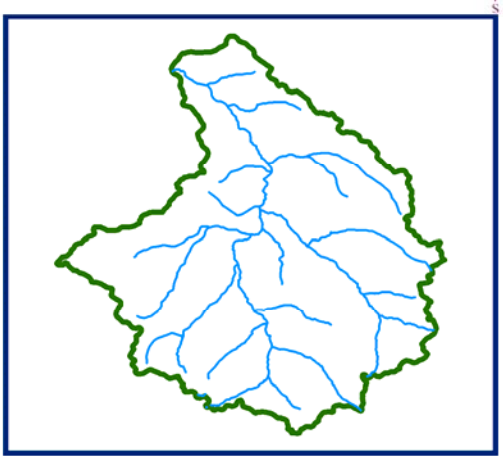
SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



5 DECEMBER 2008



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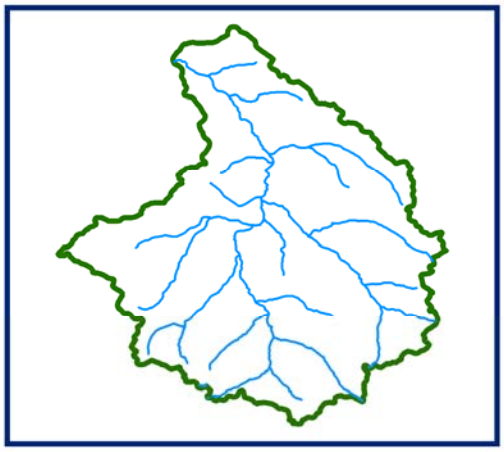

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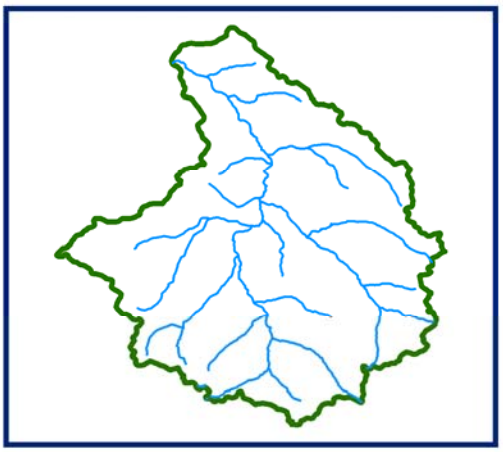

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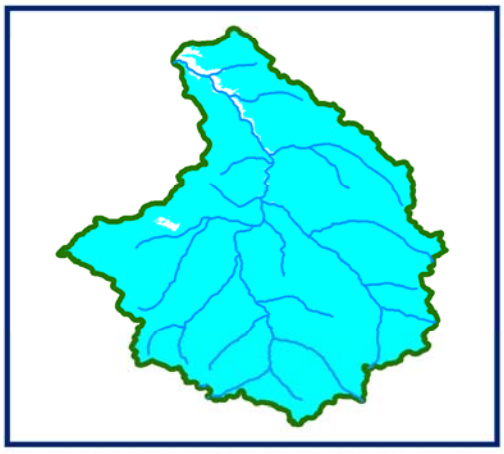
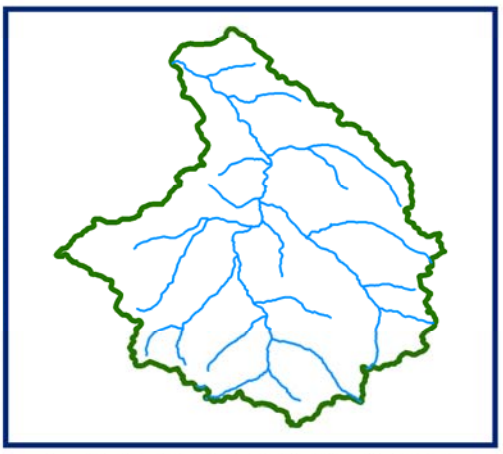


23 DECEMBER 2008



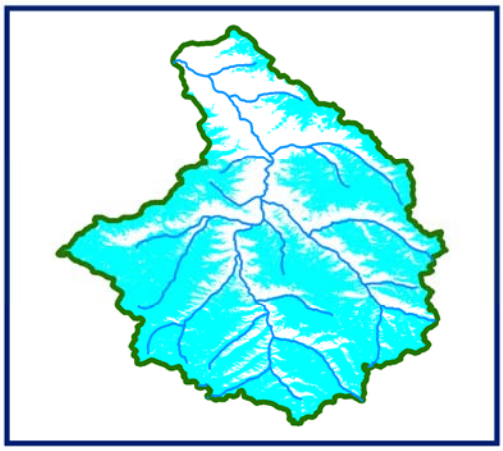
DATA NOT AVAILABLE

SNOW

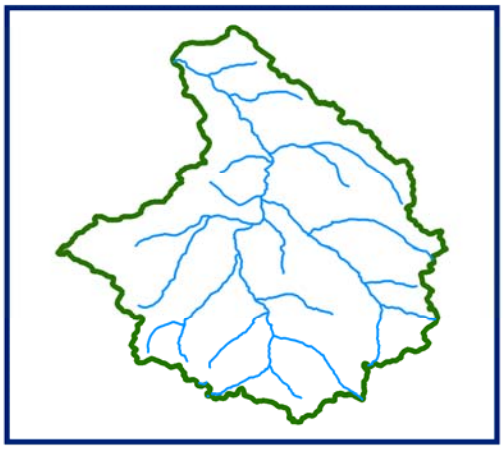
0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



DATA USED
5 DECEMBER 2008



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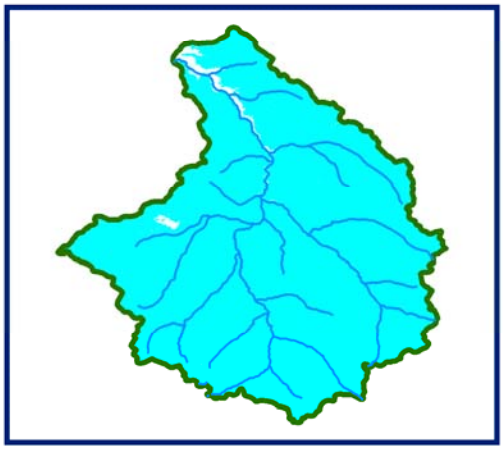
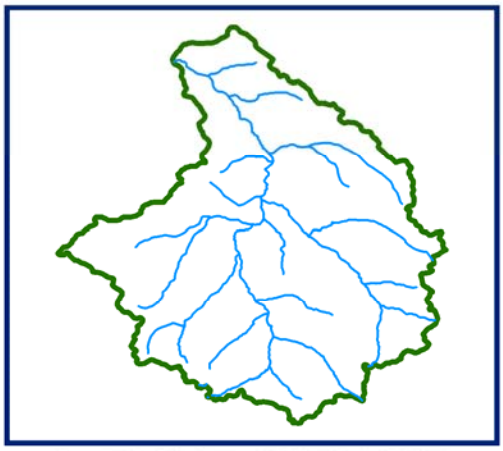


DATA USED
23 DECEMBER 2008

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



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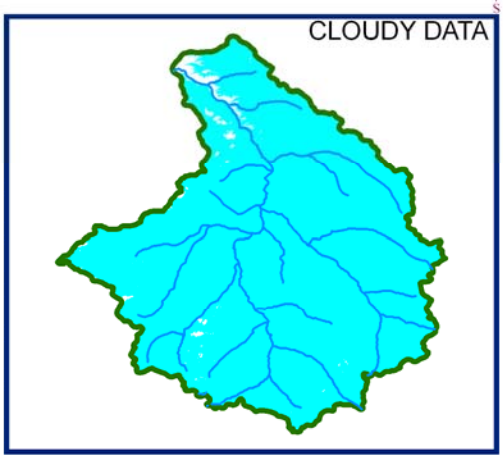
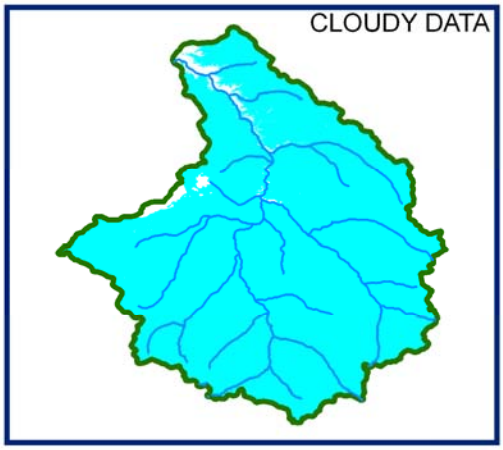
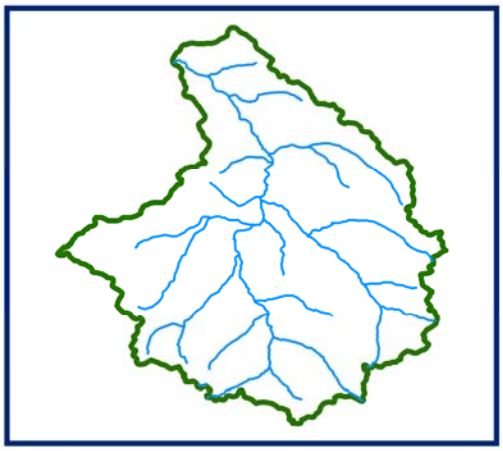


7 JANUARY 2009



12 JANUARY 2009



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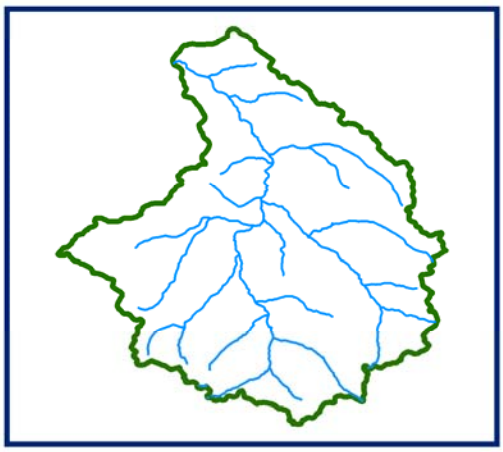

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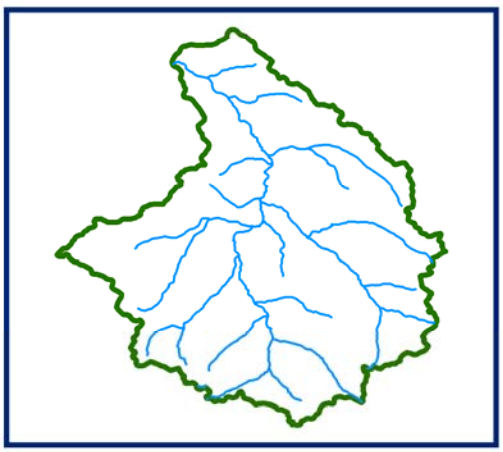


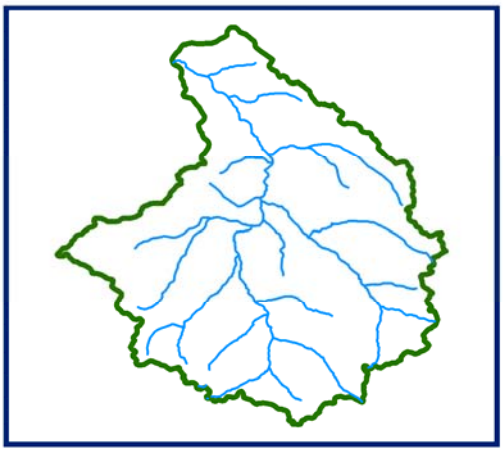
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



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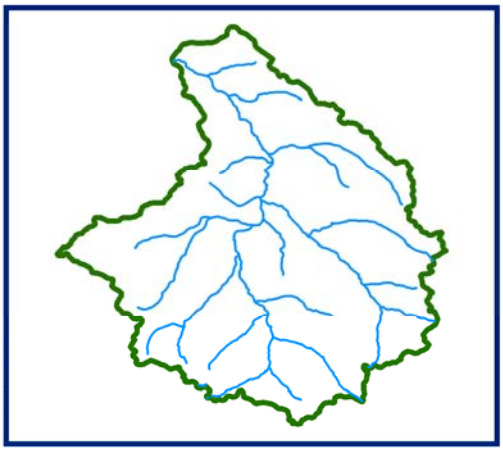

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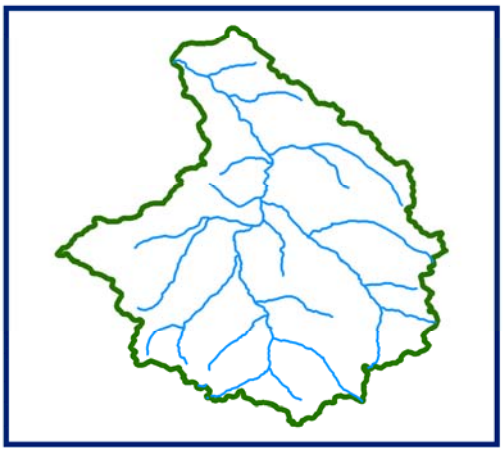

DATA USED
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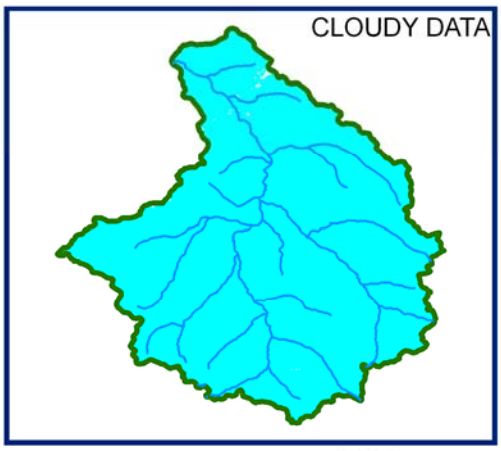
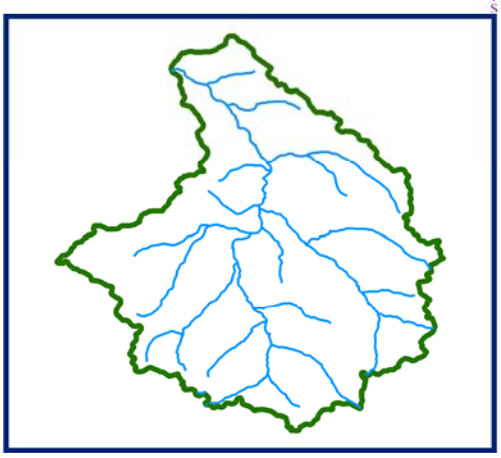
SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



5 FEBRUARY 2009



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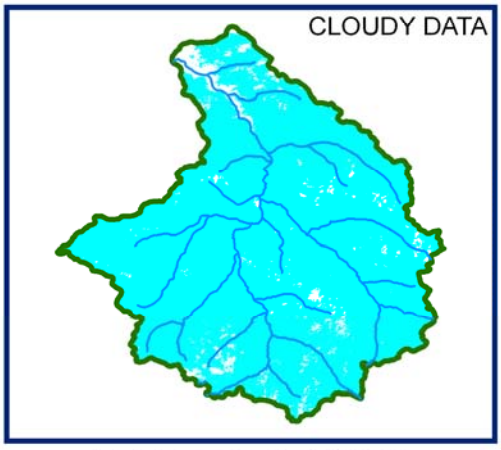
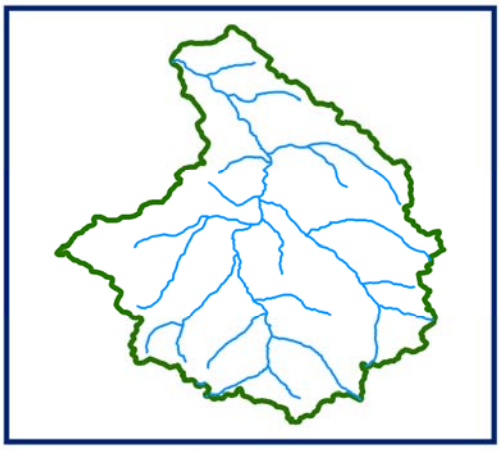


15 FEBRUARY 2009



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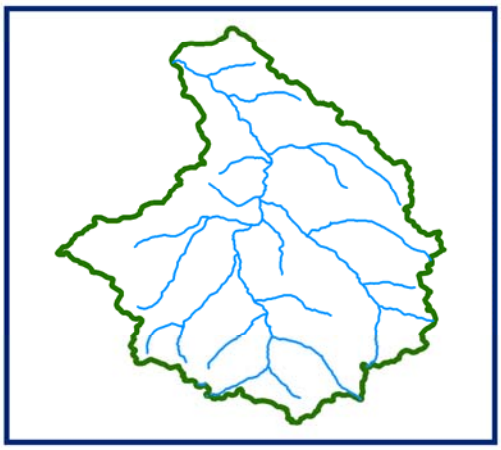

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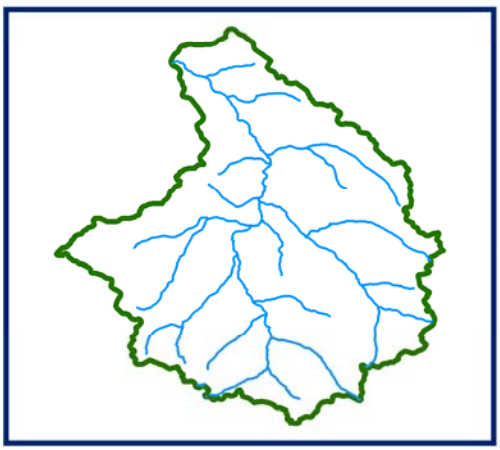


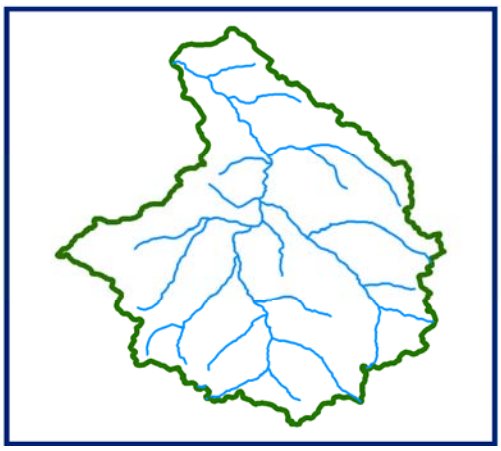
DATA NOT AVAILABLE

SNOW

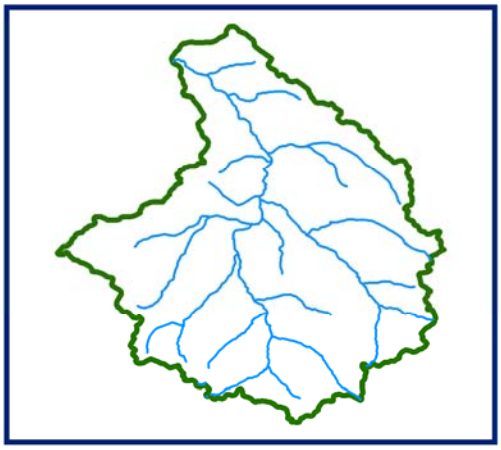
0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



DATA USED
DATA NOT AVAILABLE



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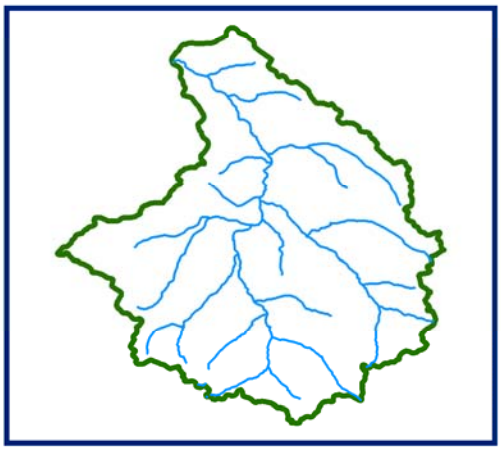
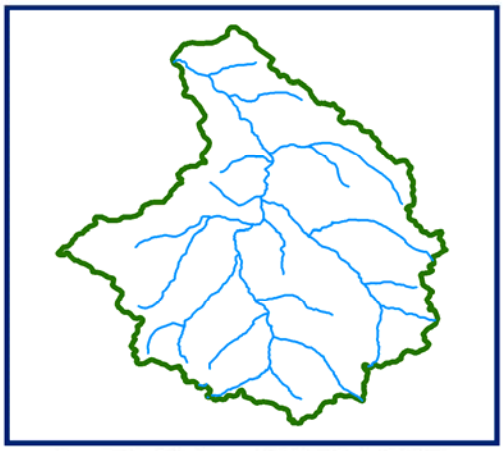


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



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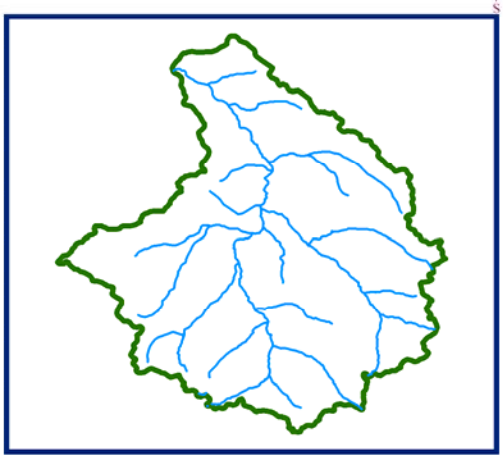

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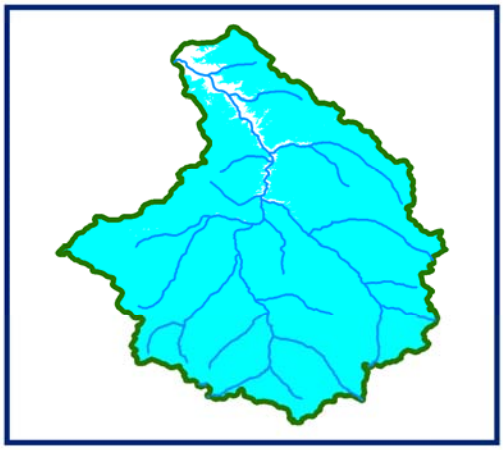
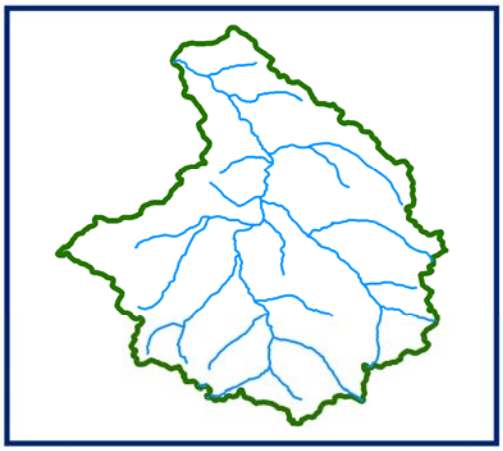


11 MARCH 2009



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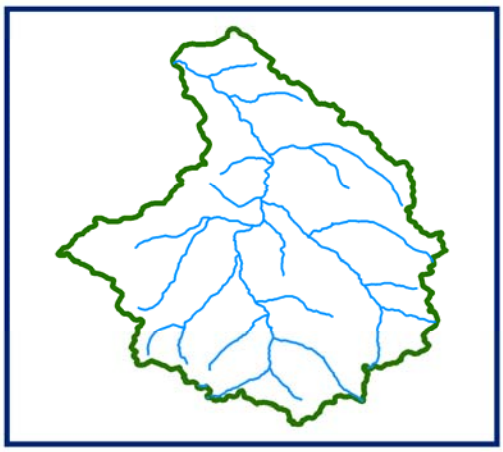

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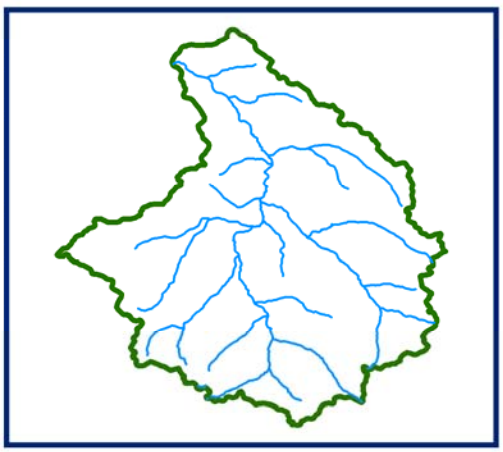


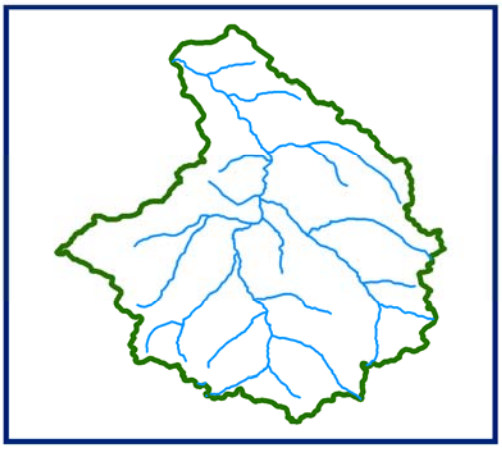
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



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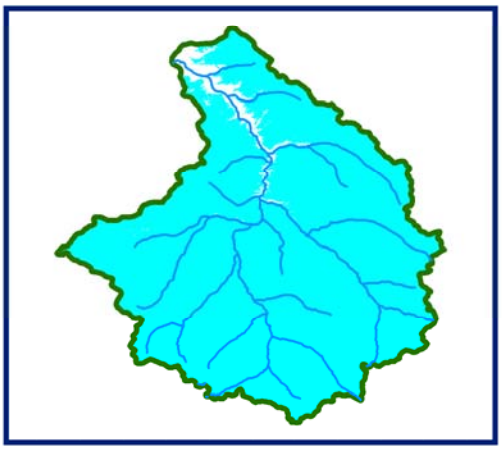

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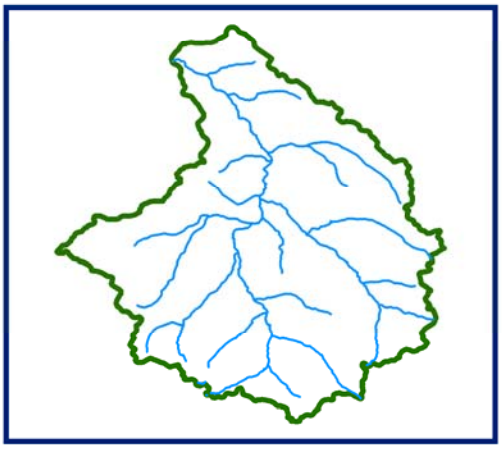
11 MARCH 2009



DATA USED
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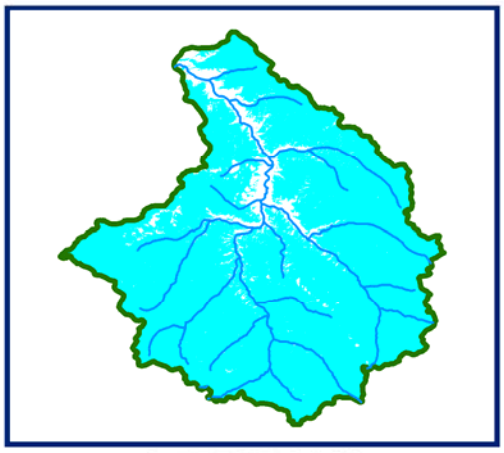
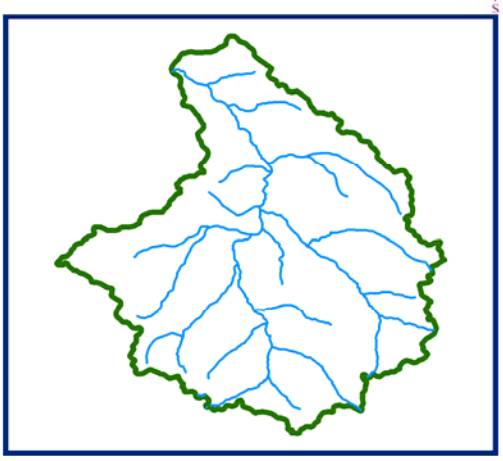
SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



4 APRIL 2009



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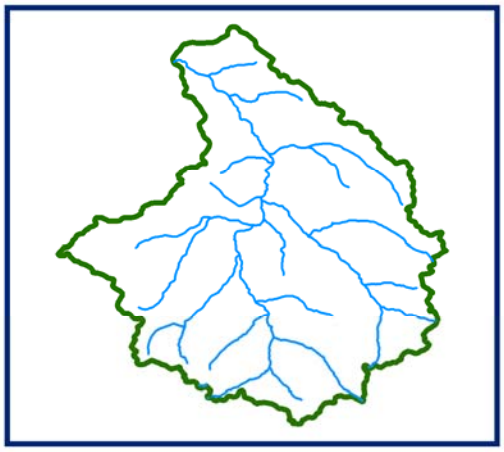

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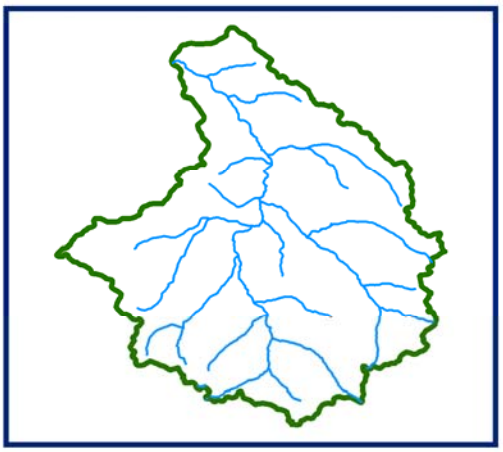

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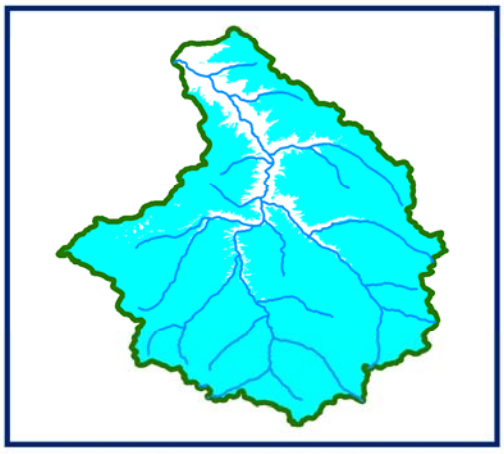
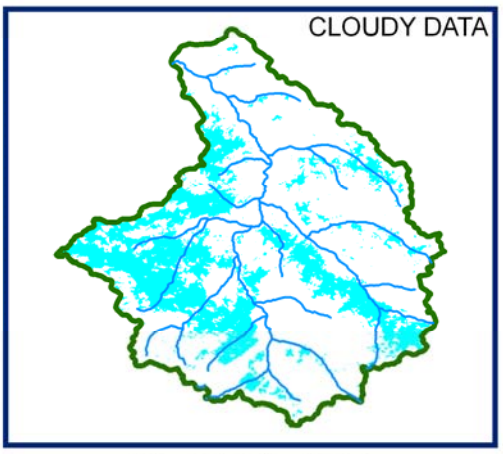


23 APRIL 2009



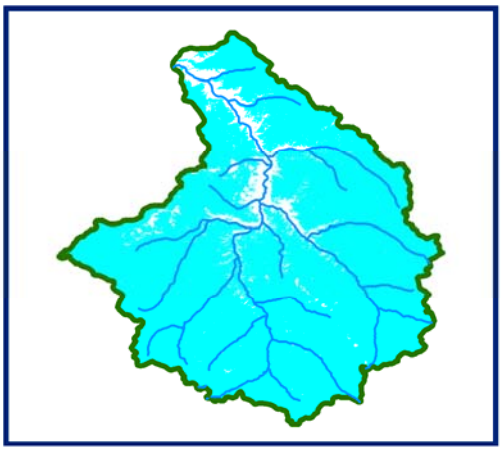
28 APRIL 2009

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



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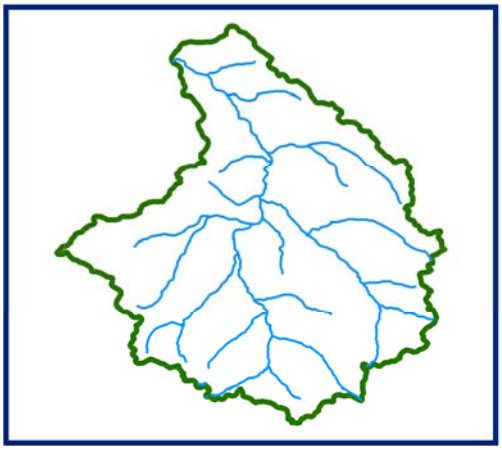
4 APRIL 2009



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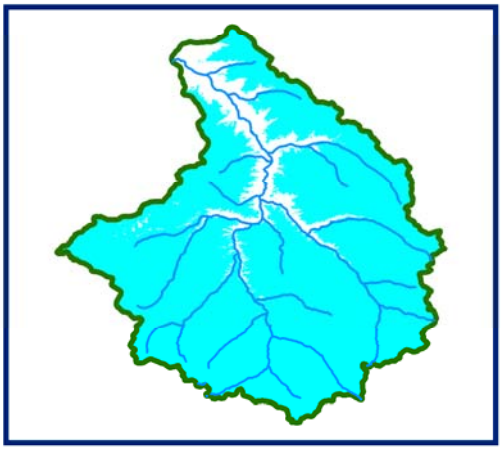
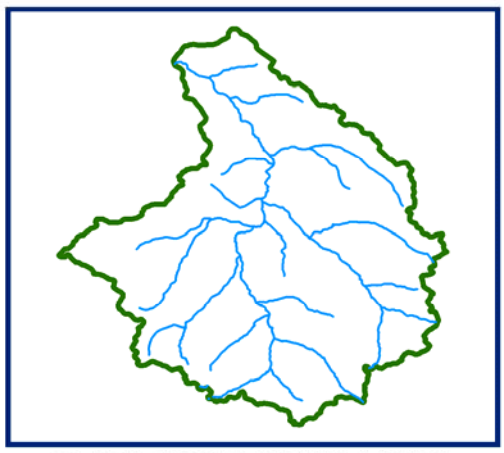


DATA USED
23 APRIL 2009

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



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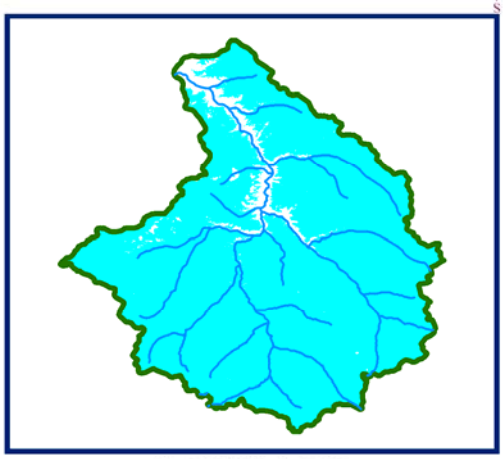
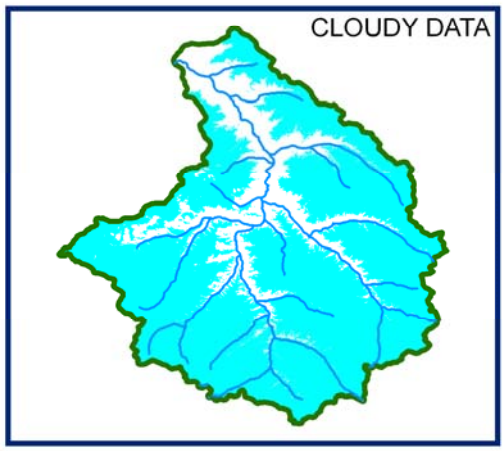
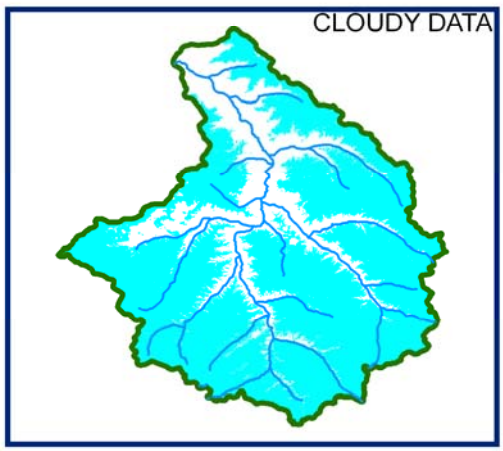


7 MAY 2008



12 MAY 2008



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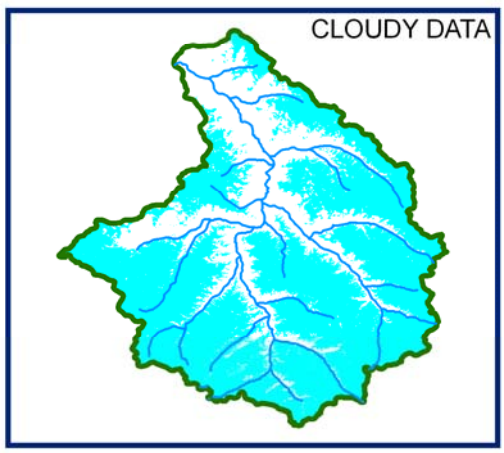
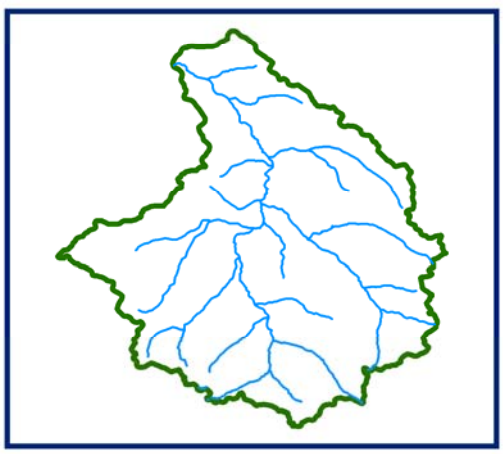


22 MAY 2008



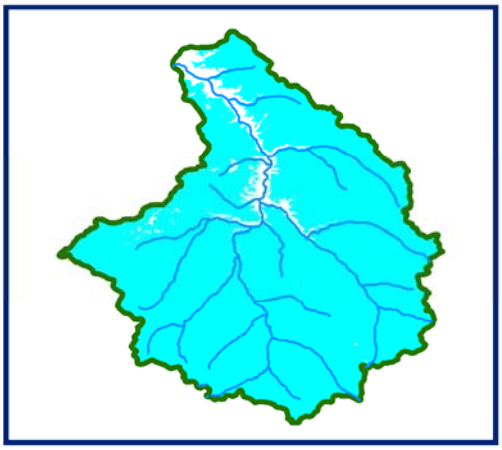
DATA NOT AVAILABLE

SNOW

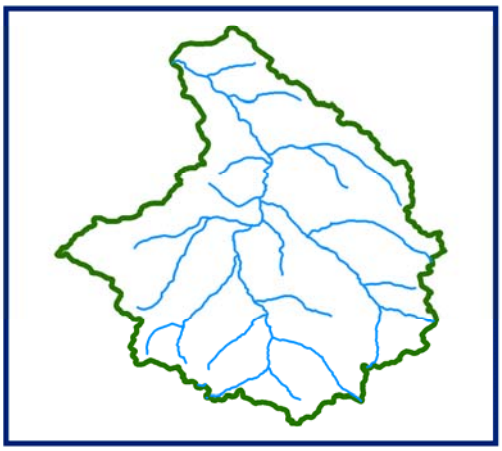
0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



DATA USED
07 MAY 2009



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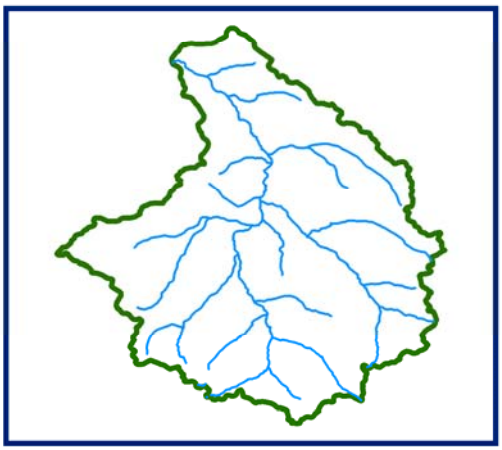
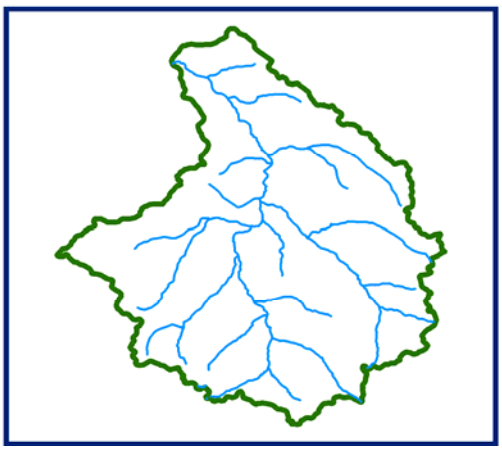


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : ASTOR BASIN



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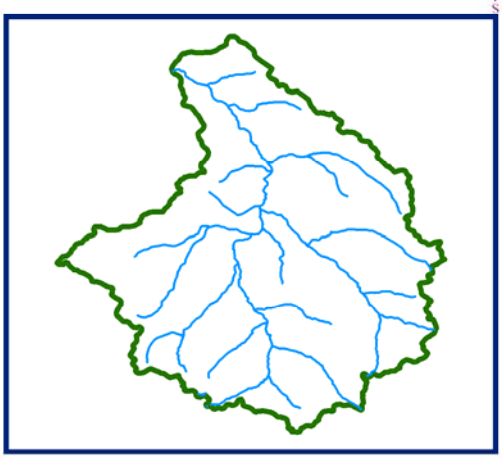

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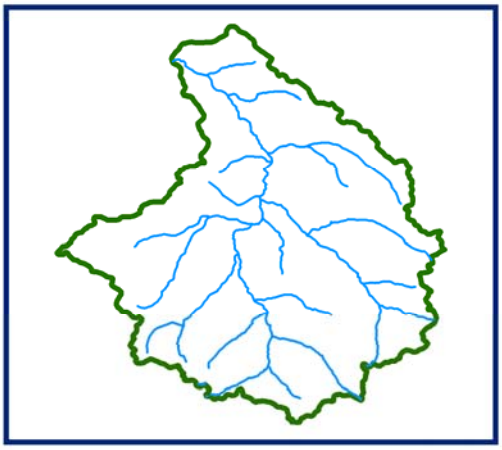

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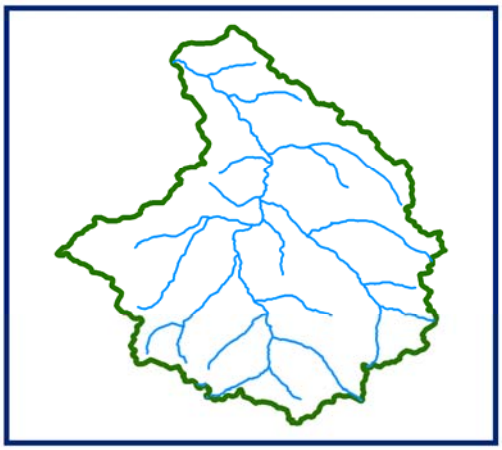

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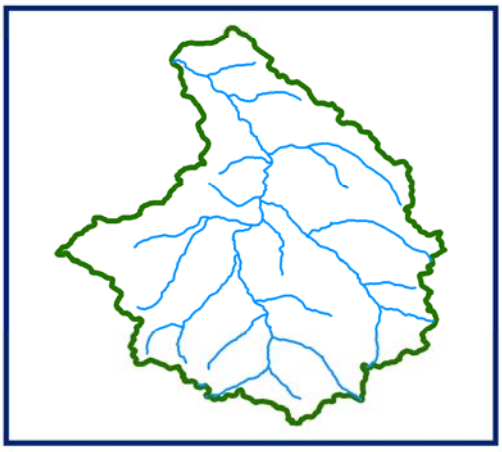

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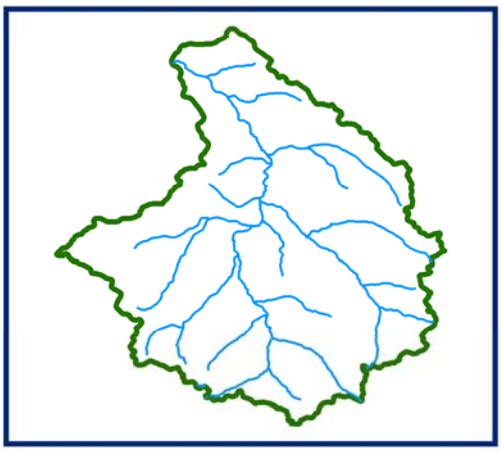


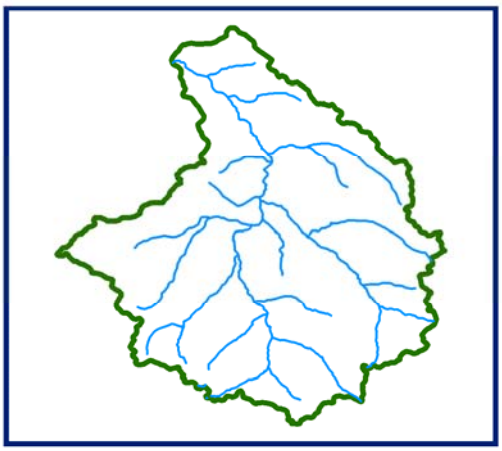
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: ASTOR BASIN



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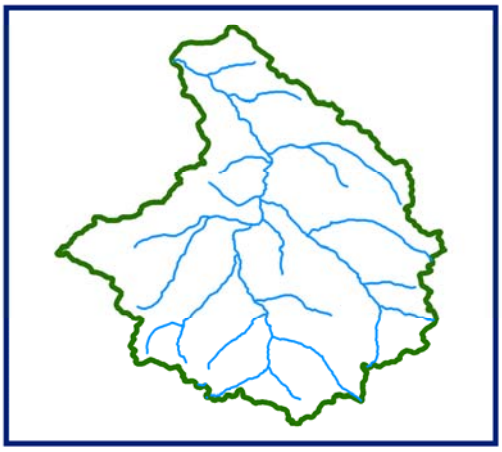

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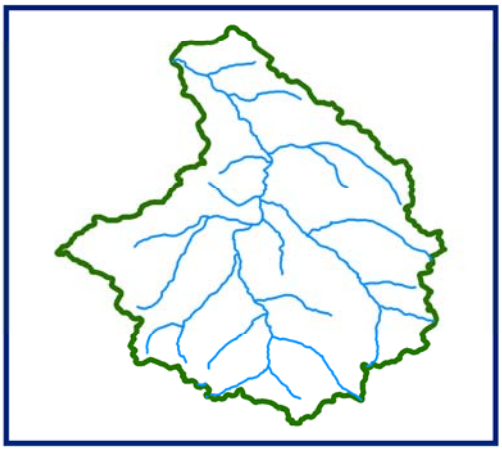


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SHIGO BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: SHIGO **BASIN AREA: 5539 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	23-Oct-08	1262	23				
November 2008							
2	11-Nov-08	1907	34	3	16-Nov-08	3018	54
4	20-Nov-08	3423	62	5	25-Nov-08	2768	50
December 2008							
6	5-Dec-08	1961	35				
January 2009							
7	7-Jan-09	5461	99	8	12-Jan-09	5224	94
9	27-Jan-09	5487	99				
February 2009							
10	5-Feb-09	5519	100	11	15-Feb-09	5517	100
March 2009							
12	11-Mar-09	5451	98				
April 2009							
13	4-Apr-09	4885	88	14	13-Apr-09	4758	86
15	23-Apr-09	4541	82	16	27-Apr-09	3922	71
17	28-Apr-09	1295	23				

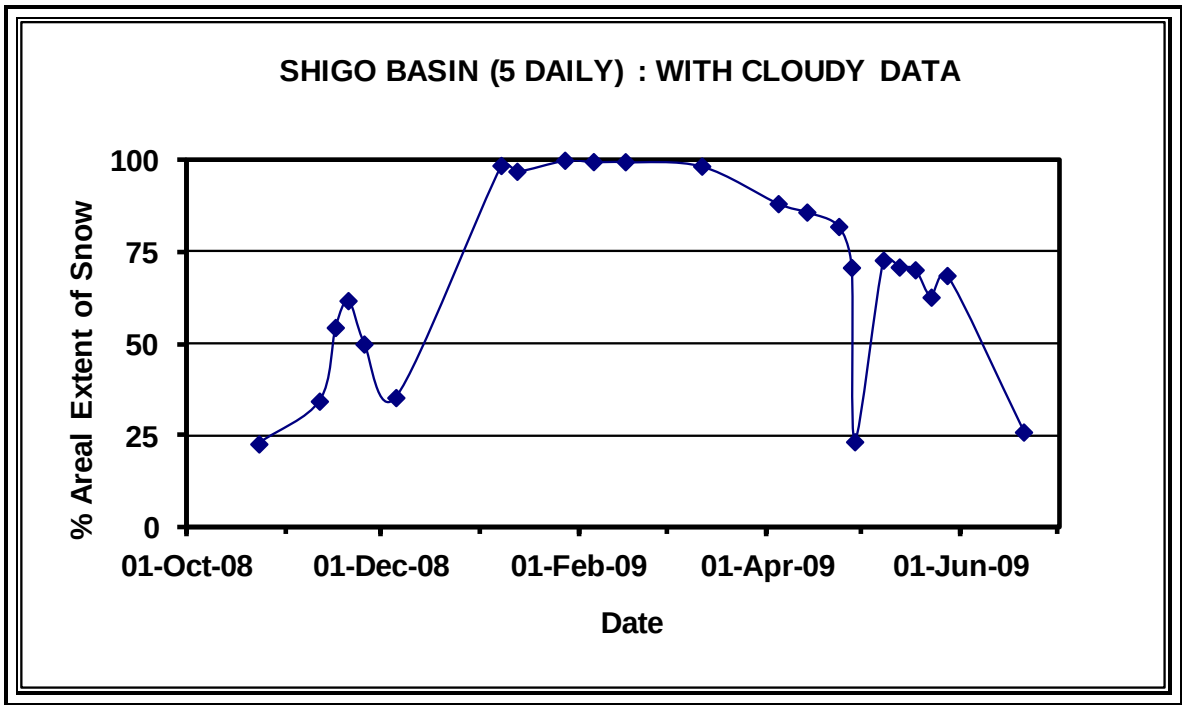
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May 2009							
18	7-May-09	4033	73	19	12-May-09	3929	71
20	17-May-09	3887	70	21	22-May-09	3475	63
22	27-May-09	3802	69				
June 2009							
23	20-Jun-09	1441	26				
July 2009							

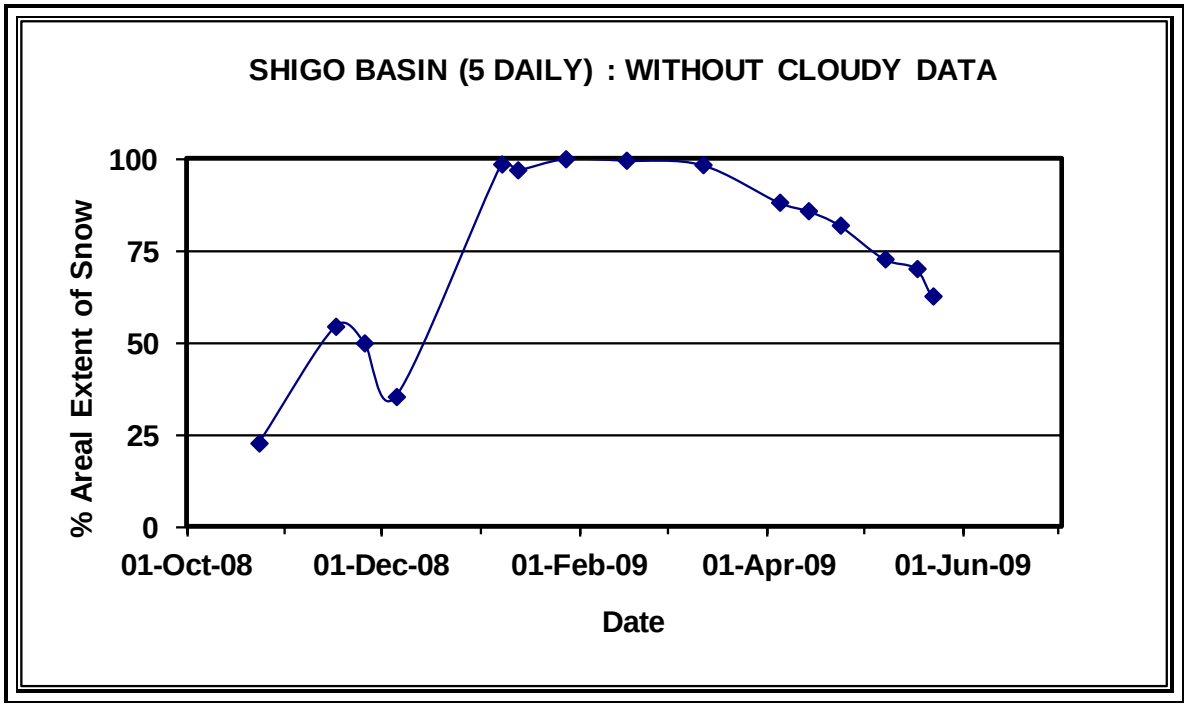
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: SHIGO **BASIN AREA: 5539 Sq km**

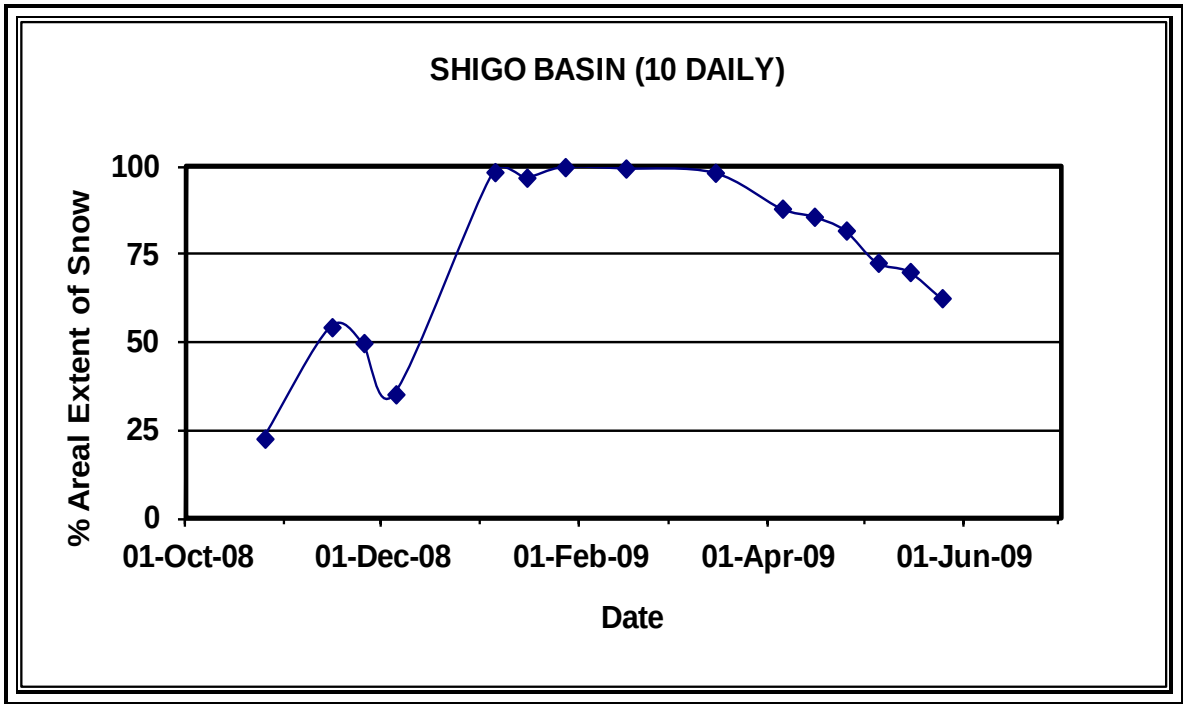
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	23-Oct-08	1262	23	2	16-Nov-08	3018	54
December 2008				**January 2009**			
3	5-Dec-08	1961	35	4	5-Jan-09		99
				5	15-Jan-09		99
February 2009				**March 2009**			
6	15-Feb-09	5517	100	7	11-Mar-09	5451	98
April 2009				**May 2009**			
8	4-Apr-09	4885	88	11	7-May-09	4033	73
9	15-Apr-09		86	12	17-May-09	3887	70
10	25-Apr-09		82	13	22-May-09	3475	63
June 2009				**July 2009**			

Snow cover depletion curve



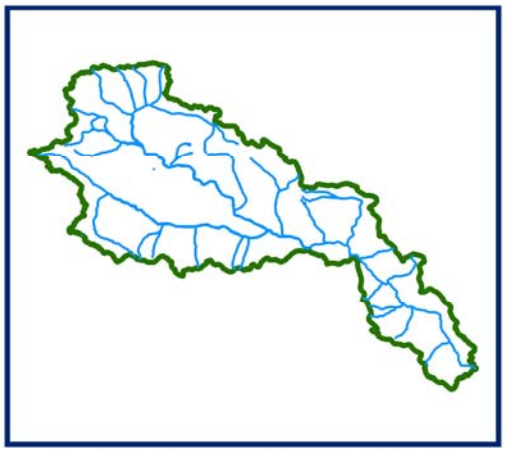


Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : SHIGO BASIN



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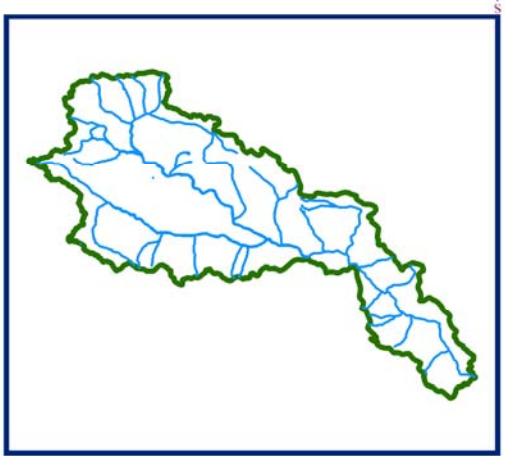

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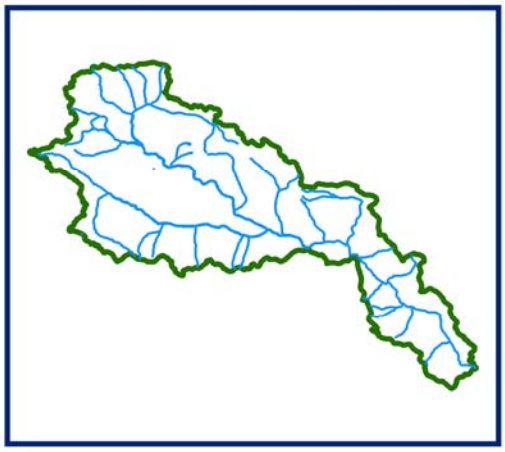

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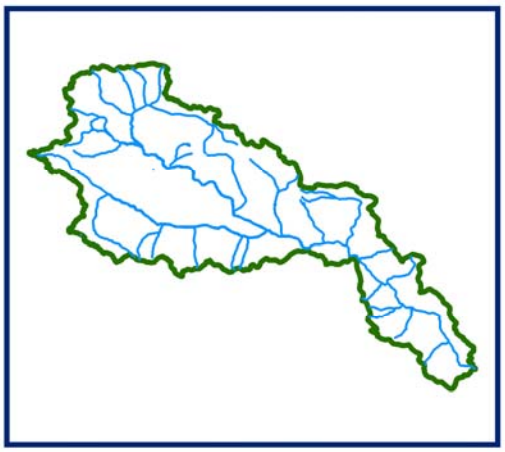

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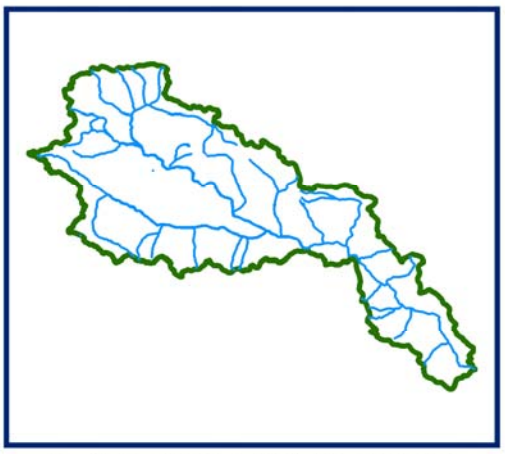
23 OCTOBER 2008



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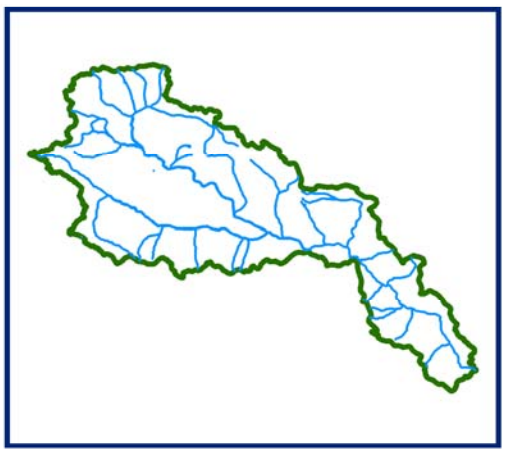
SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN



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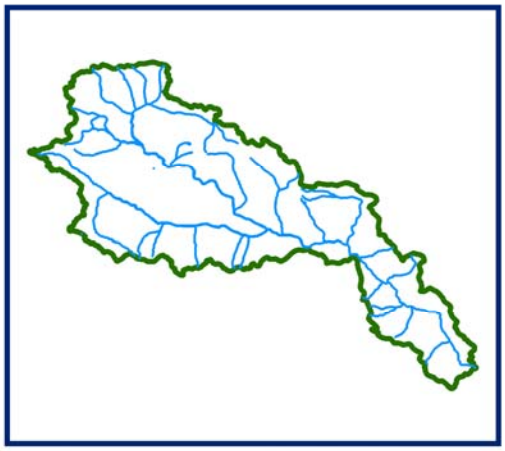

DATA USED
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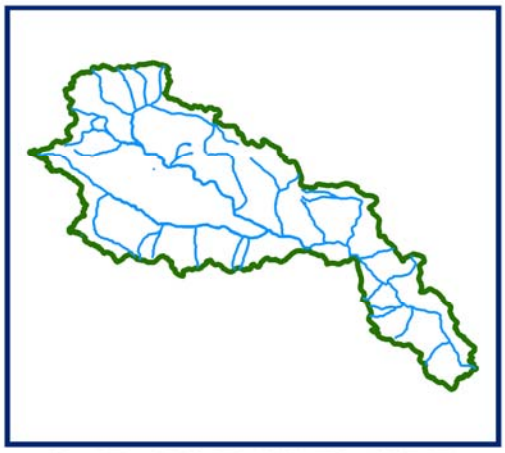
DATA USED
23 OCTOBER 2008

SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : SHIGO BASIN



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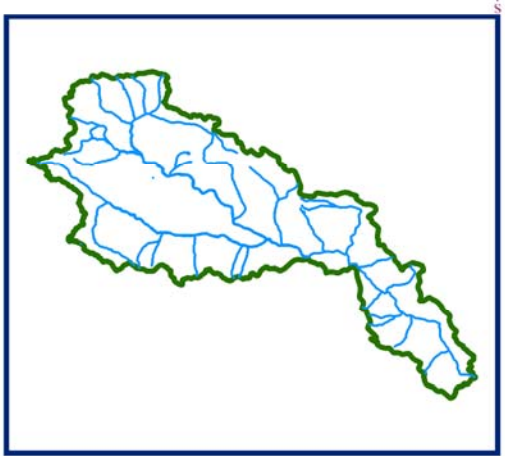

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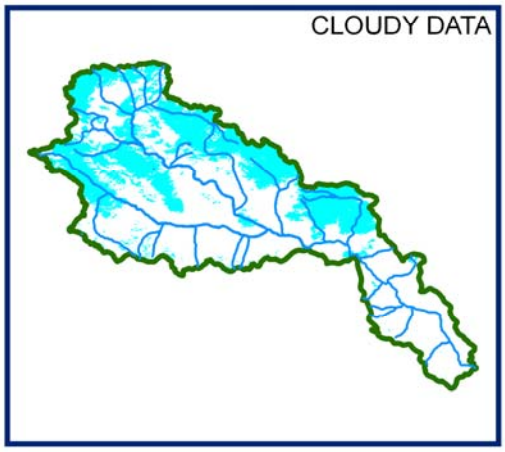
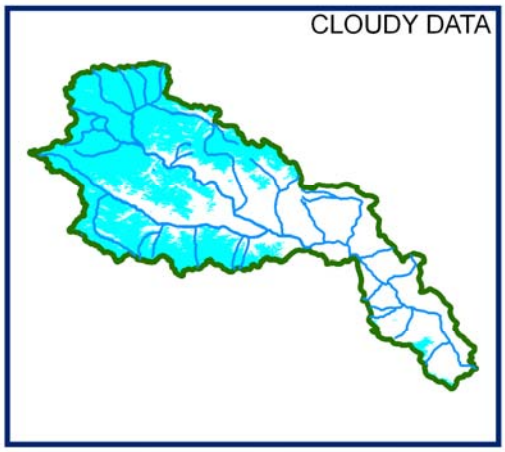


11 NOVEMBER 2008

16 NOVEMBER 2008



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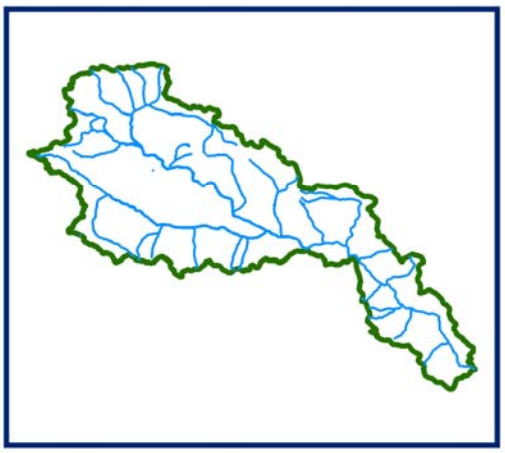

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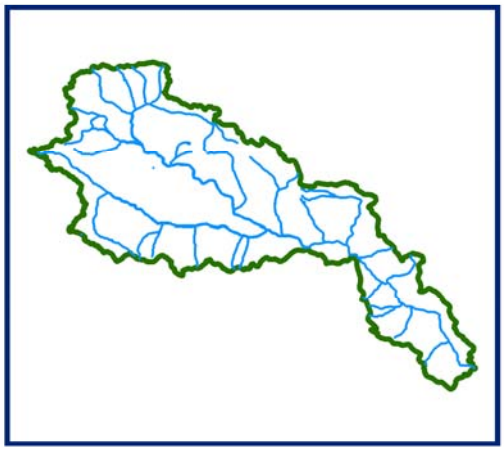
SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN



DATA USED
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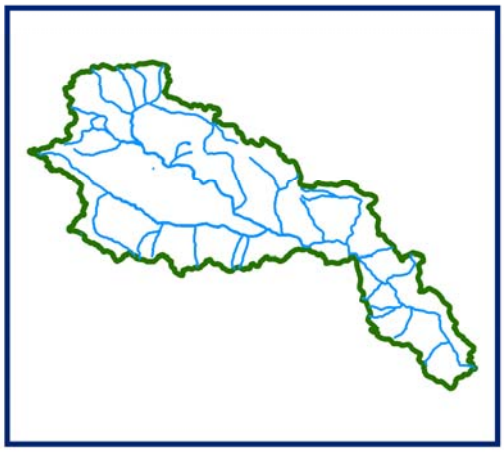
DATA USED
16 NOVEMBER 2008



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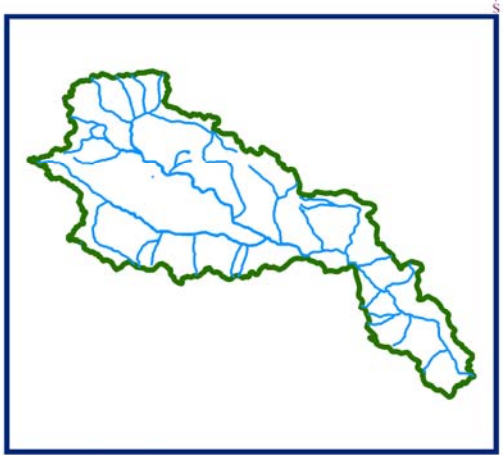
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : SHIGO BASIN

5 DECEMBER 2008



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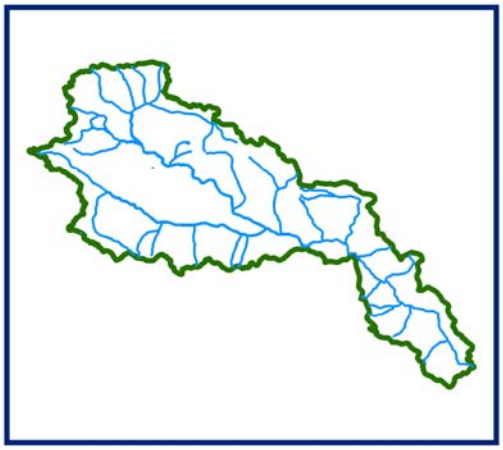

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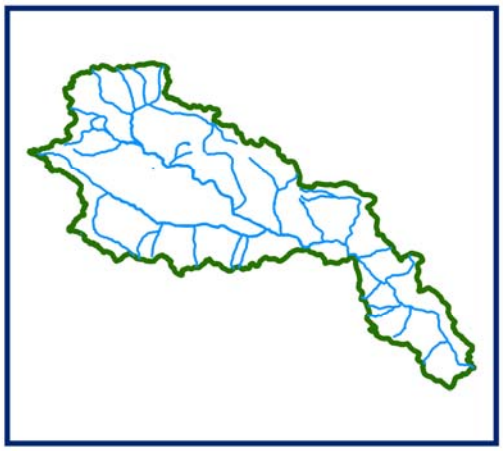

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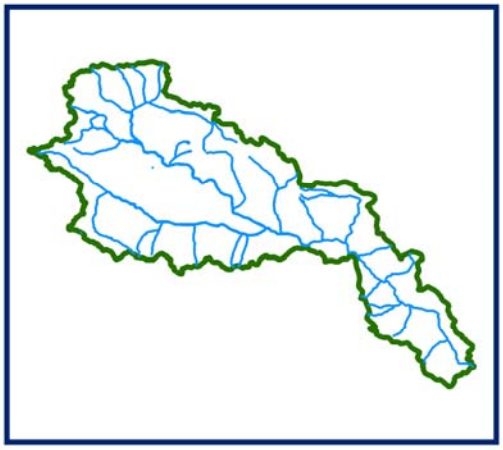

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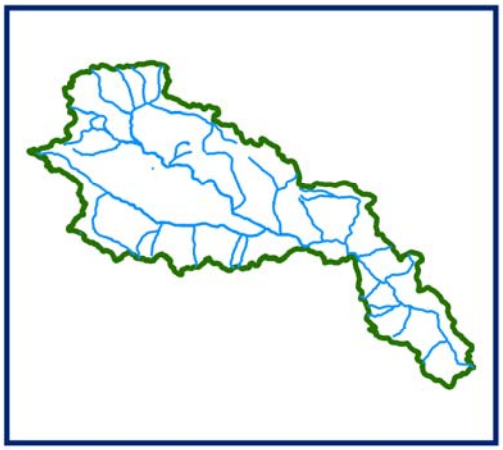

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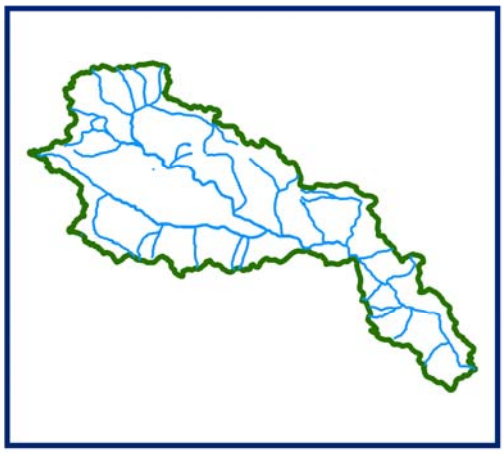
SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN

DATA USED
5 DECEMBER 2008



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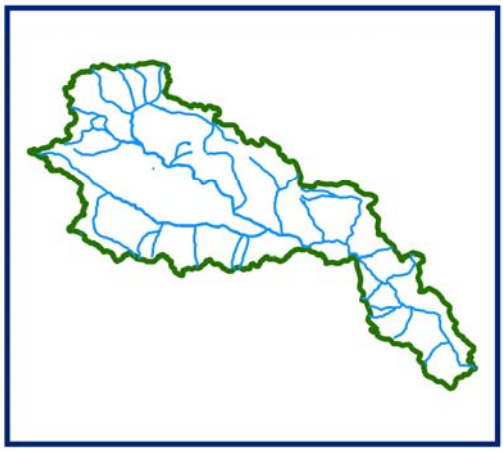

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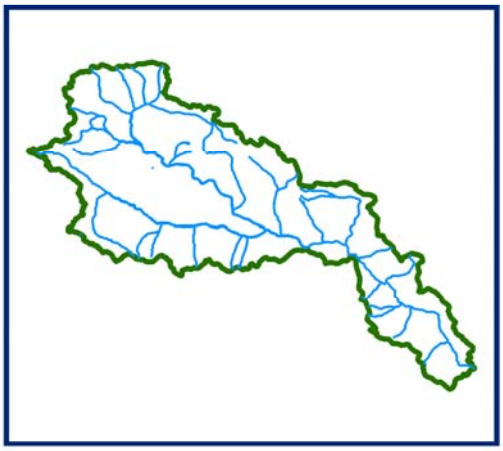
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : SHIGO BASIN



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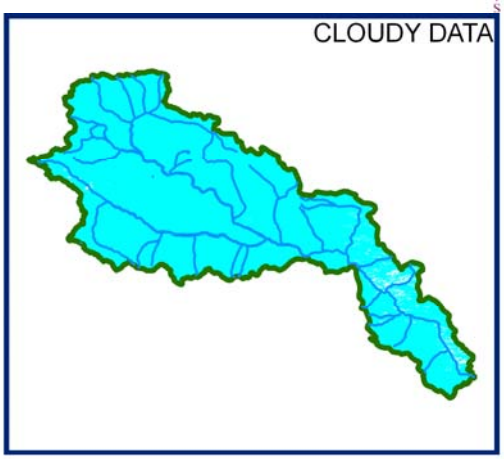
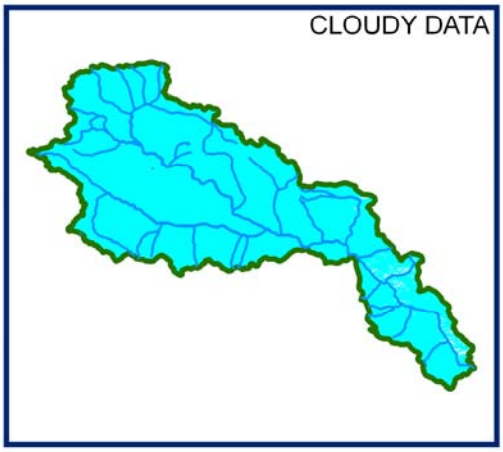
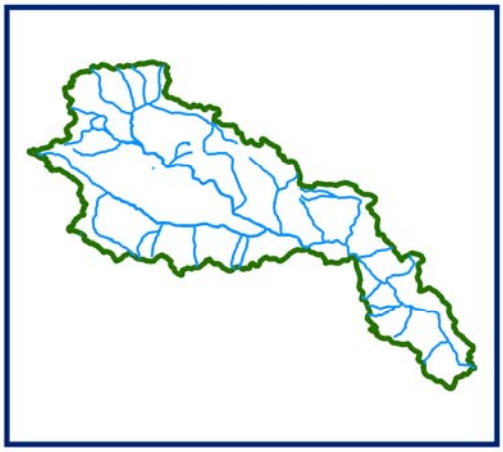


7 JANUARY 2009



12 JANUARY 2009



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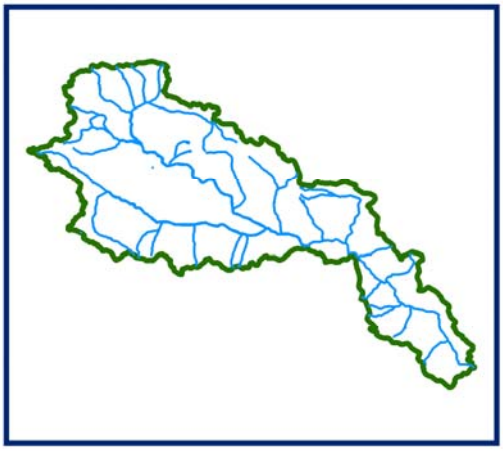

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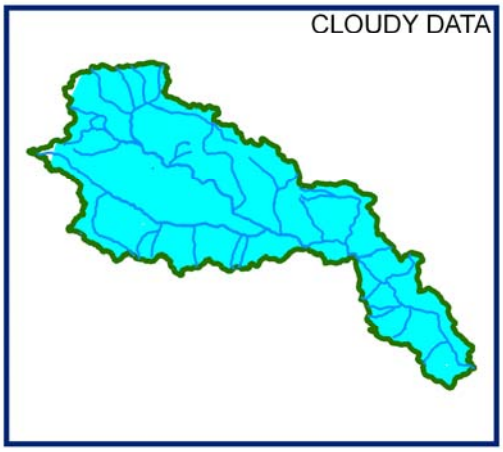
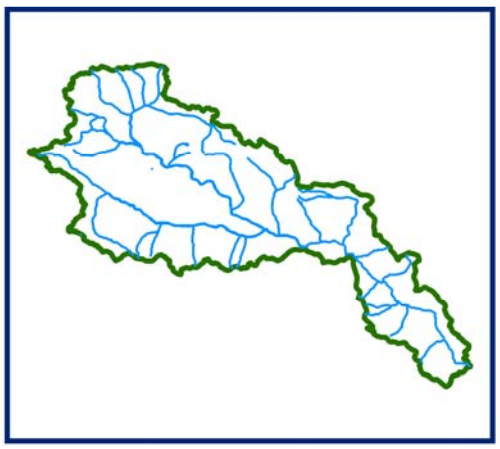


27 JANUARY 2009

10 DAILY SNOW COVER MAP: SHIGO BASIN



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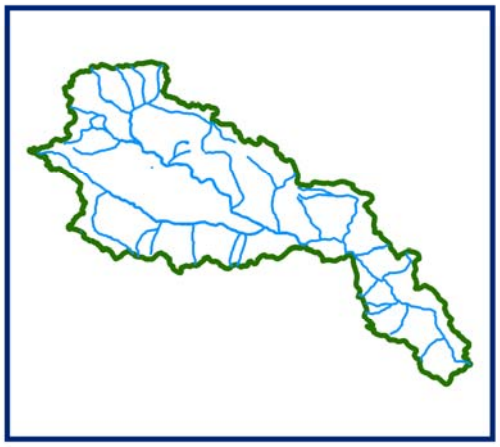

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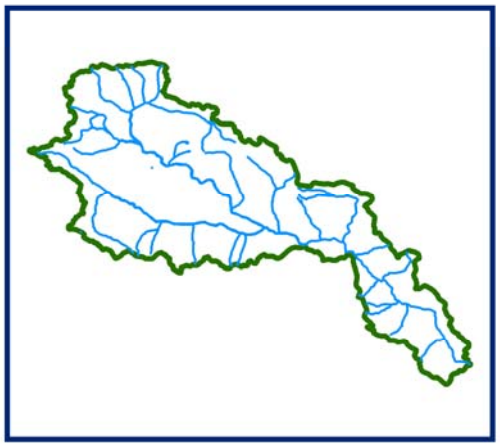

DATA USED
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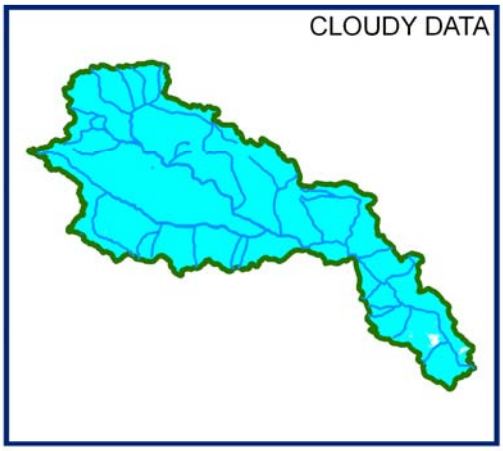
SNOW

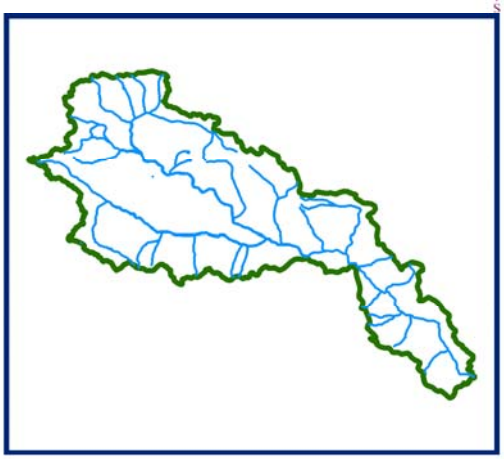
0 25 50 100 150 200

Kilometers

SNOW COVER MAP : SHIGO BASIN



5 FEBRUARY 2009



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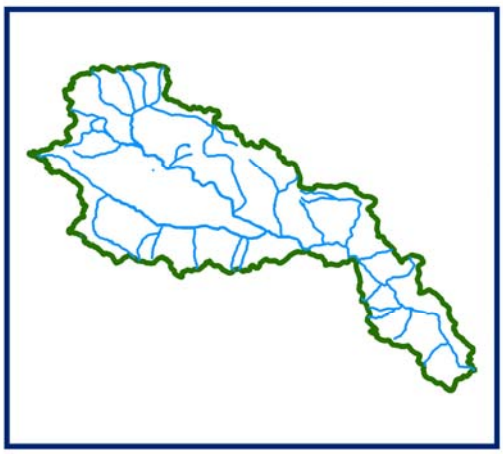

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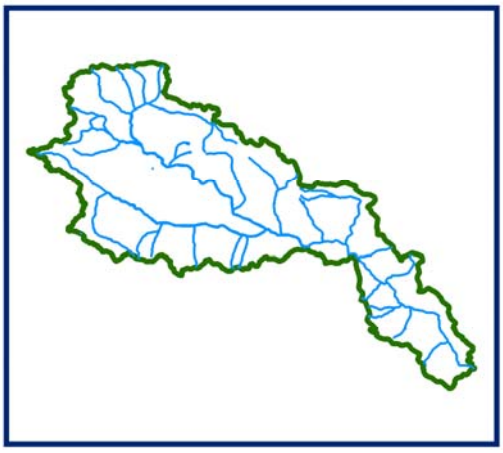

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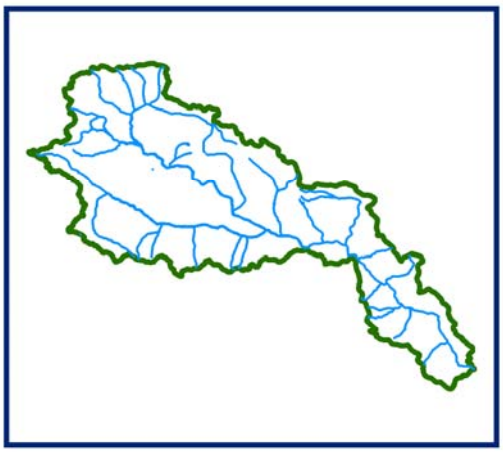

DATA NOT AVAILABLE

SNOW

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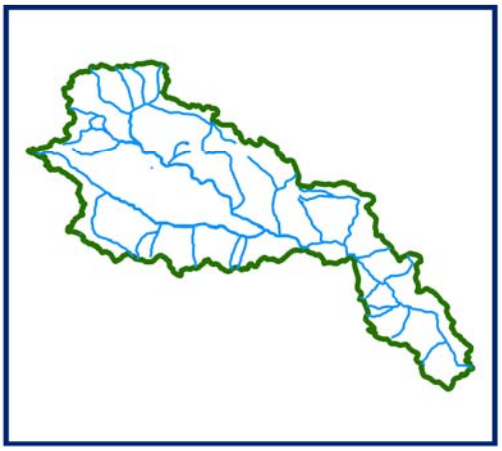
Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN



DATA USED
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DATA USED
15 FEBRUARY 2009

DATA USED
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SNOW

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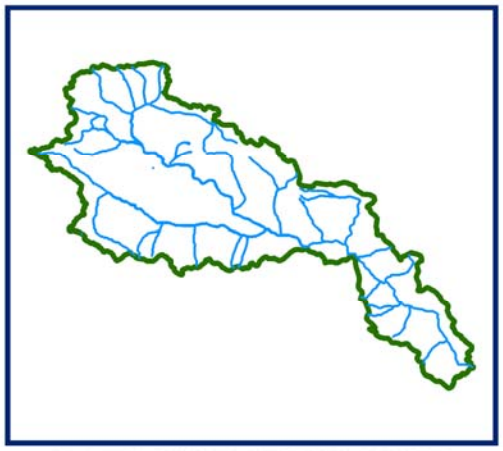
Kilometers

SNOW COVER MAP : SHIGO BASIN



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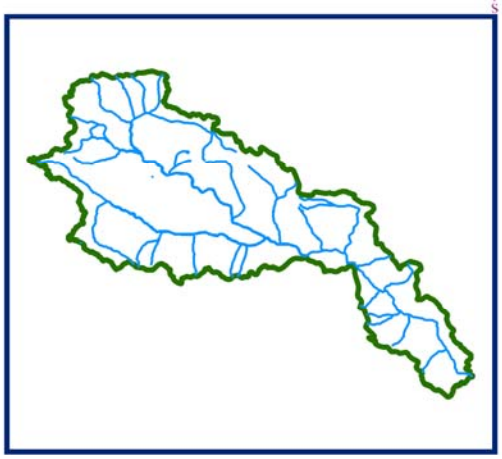

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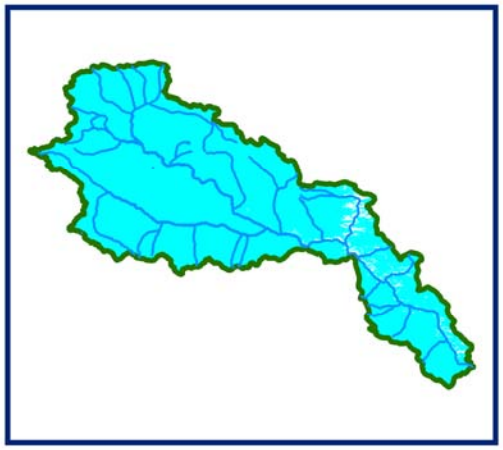
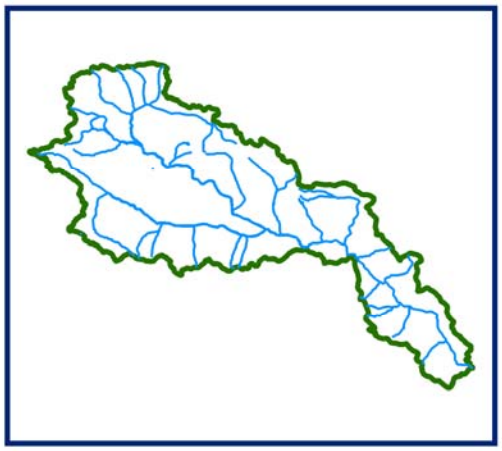


11 MARCH 2009



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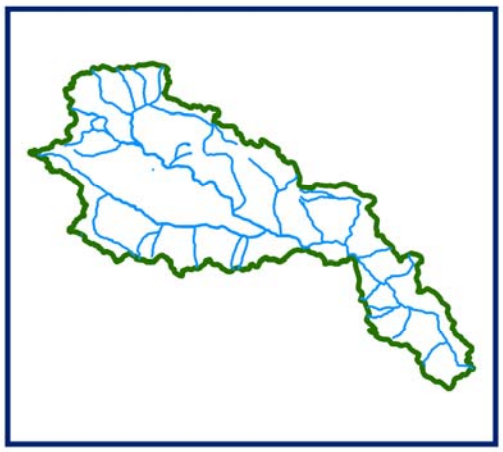

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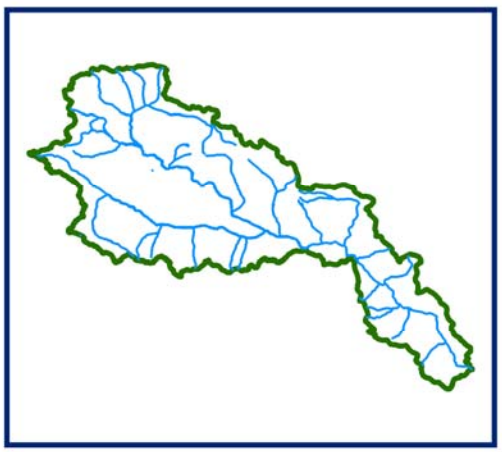


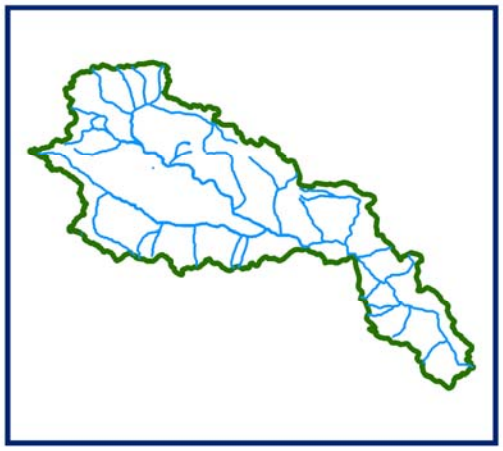
DATA NOT AVAILABLE

SNOW

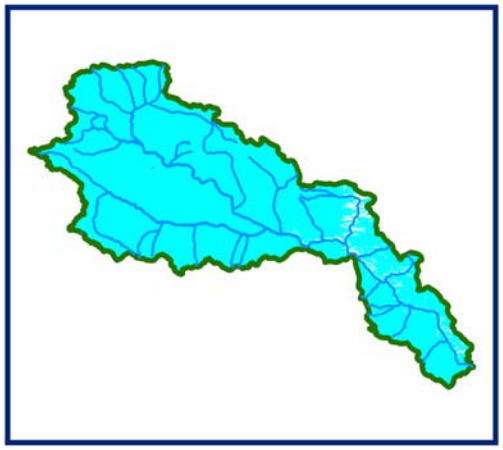
0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN



DATA USED
DATA NOT AVAILABLE



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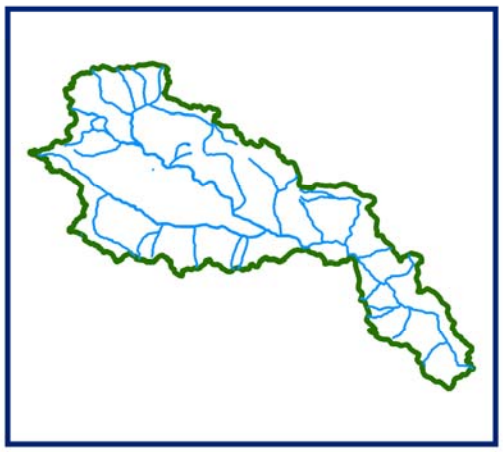
11 MARCH 2009

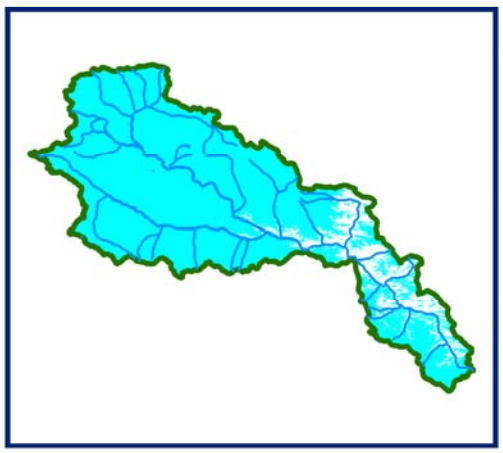


DATA USED
DATA NOT AVAILABLE

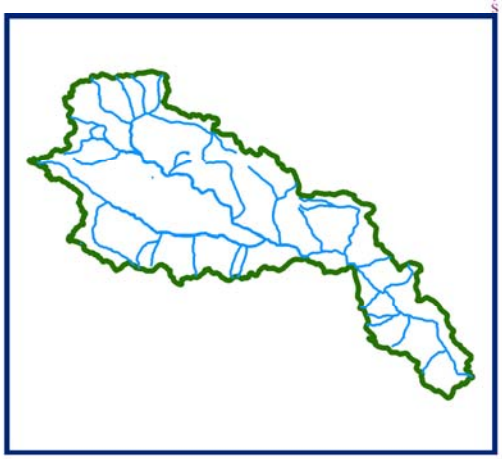
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : SHIGO BASIN



4 APRIL 2009



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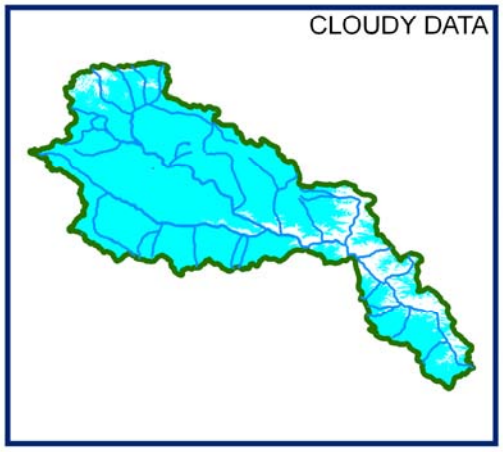
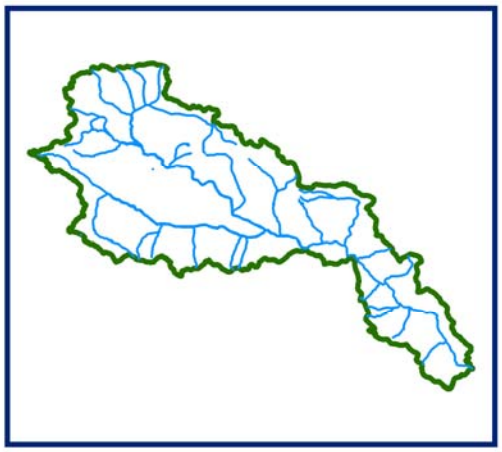


13 APRIL 2009



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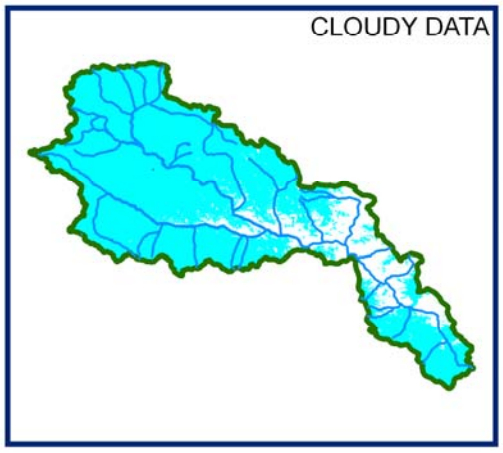
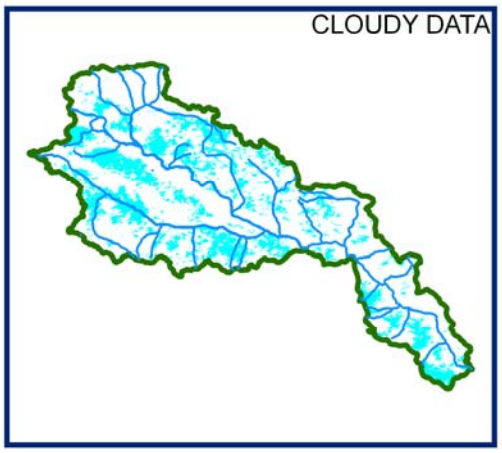


23 APRIL 2009



28 APRIL 2009

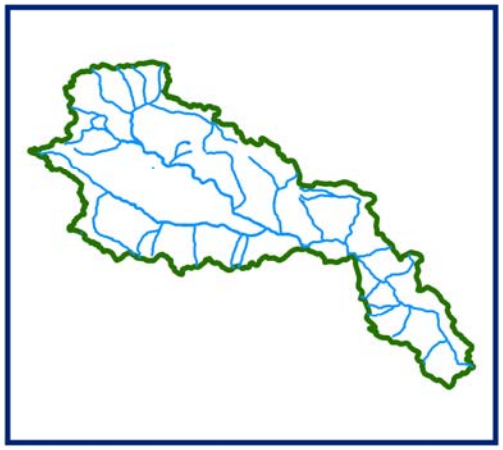
SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN

DATA USED
4 APRIL 2009



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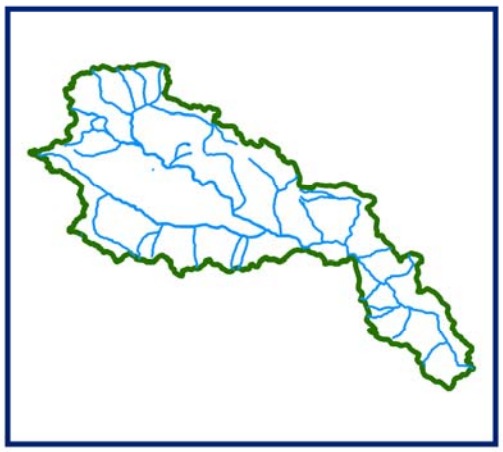

DATA USED
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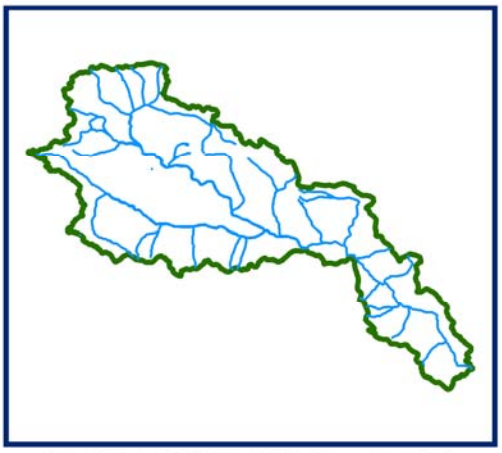
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : SHIGO BASIN



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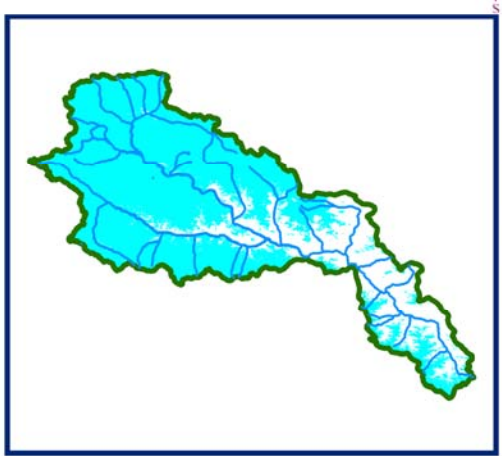
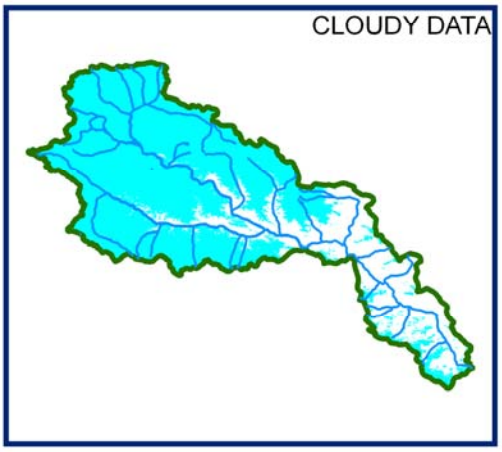


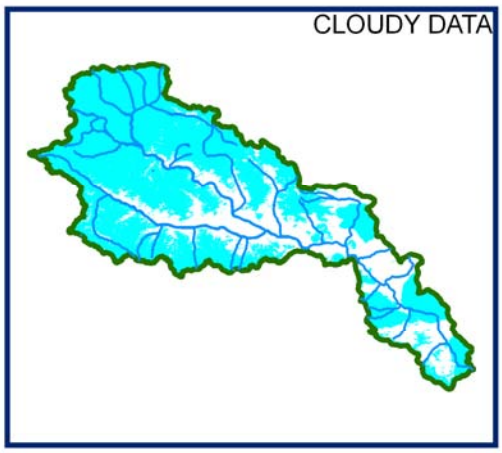
7 MAY 2009



12 MAY 2009

17 MAY 2009

22 MAY 2009



27 MAY 2009

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN

DATA USED
7 MAY 2009

DATA USED
17 MAY 2009

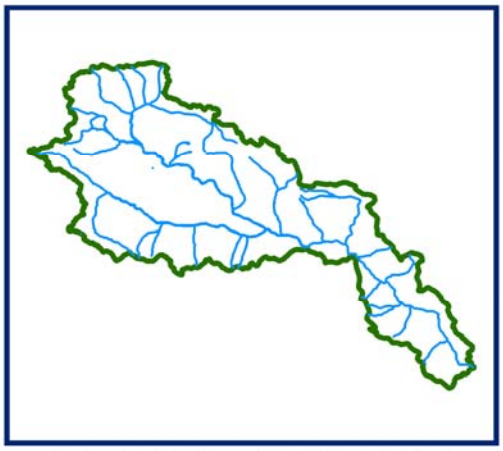
DATA USED
22 MAY 2009

SNOW

0 25 50 100 150 200

Kilometers

SNOW COVER MAP : SHIGO BASIN



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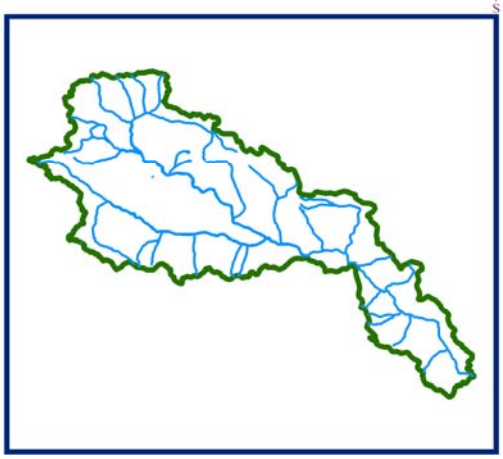

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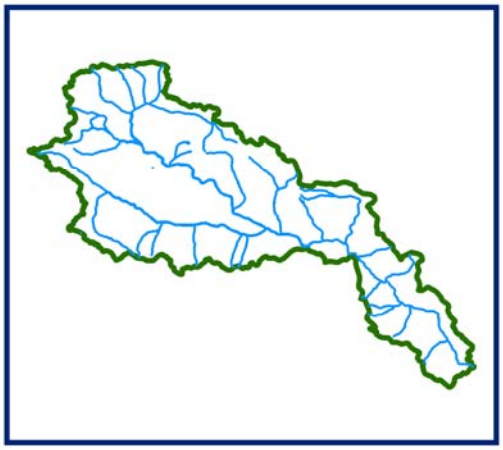

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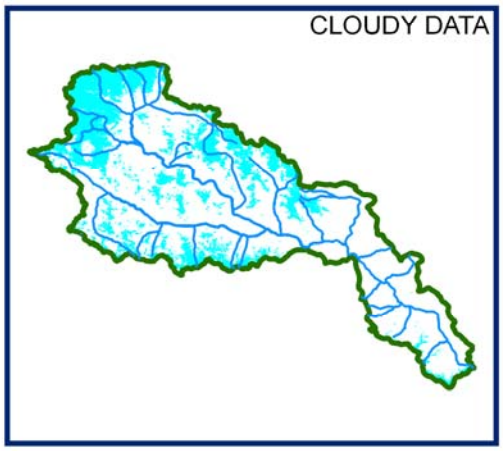
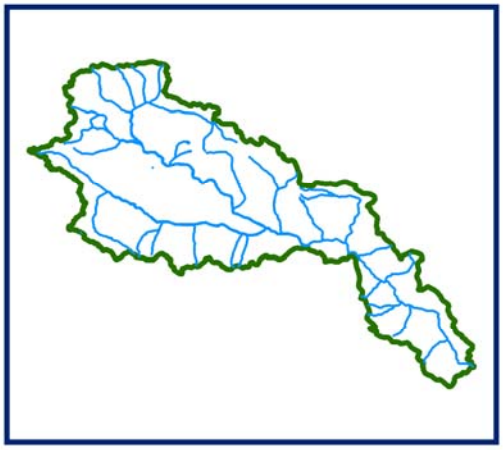


20 JUNE 2009



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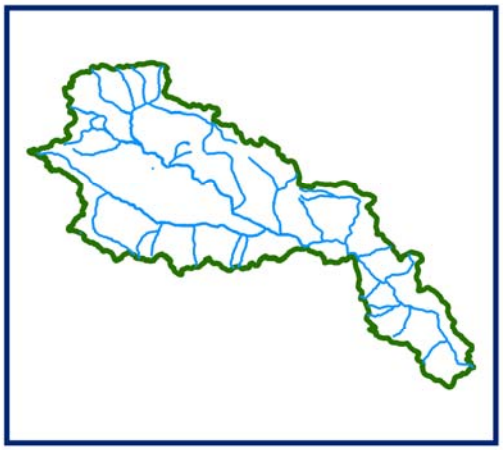


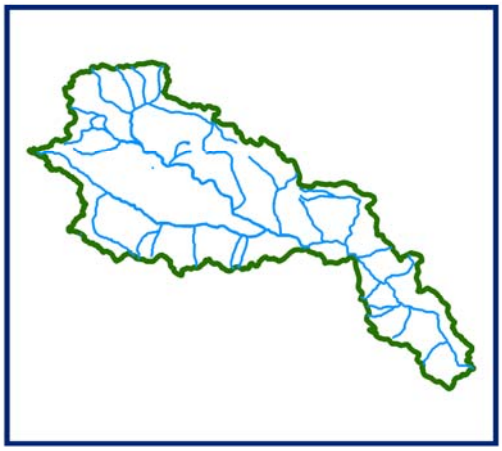
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: SHIGO BASIN



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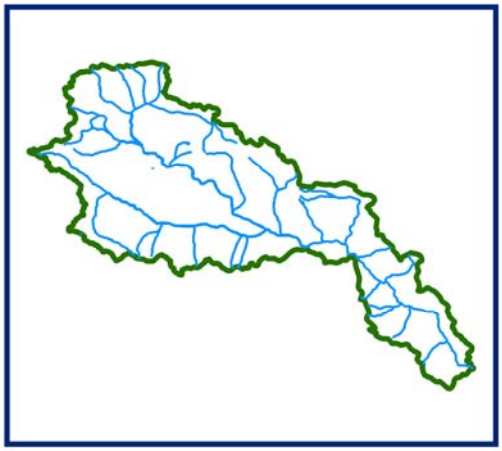

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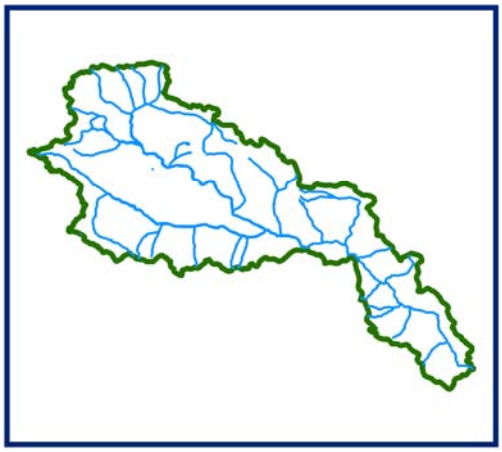


DATA USED
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200
Kilometers

DRAS BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: DRAS **BASIN AREA: 1683 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	23-Oct-08	550	33				
November 2008							
2	11-Nov-08	291	17	3	16-Nov-08	1190	71
4	20-Nov-08	1251	74	5	25-Nov-08	1197	71
December 2008							
6	5-Dec-08	701	42	7	10-Dec-08	1474	88
January 2009							
8	7-Jan-09	1638	97	9	12-Jan-09	1658	98
10	27-Jan-09	1642	98				
February 2009							
11	5-Feb-09	1656	98	12	15-Feb-09	1643	98
March 2009							
13	11-Mar-09	1656	98				
April 2009							
14	4-Apr-09	1625	97	15	13-Apr-09	1622	96
16	23-Apr-09	1490	89	17	27-Apr-09	1434	85
18	28-Apr-09	483	29				

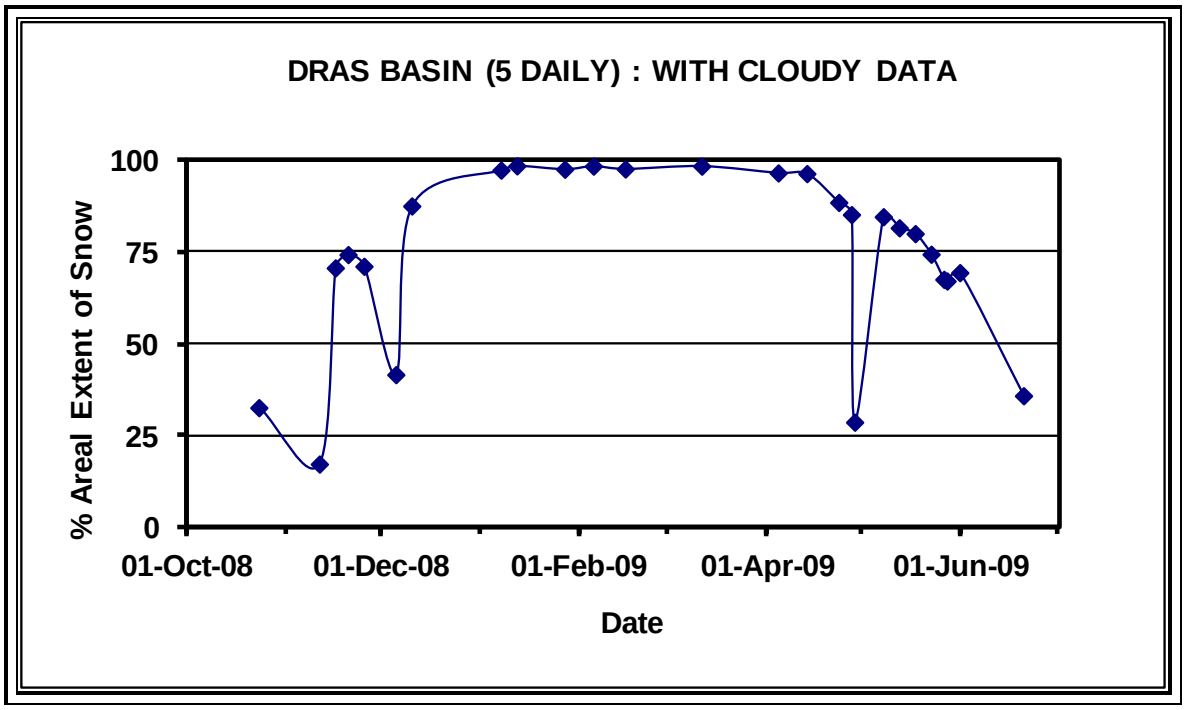
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May 2009							
19	7-May-09	1425	85	20	12-May-09	1374	82
21	17-May-09	1347	80	22	22-May-09	1253	74
23	26-May-09	1138	68	24	27-May-09	1130	67
25	31-May-09	1168	69				
June 2009							
26	20-Jun-00	604	36				
July 2009							
27	9-Jul-09	542	32				

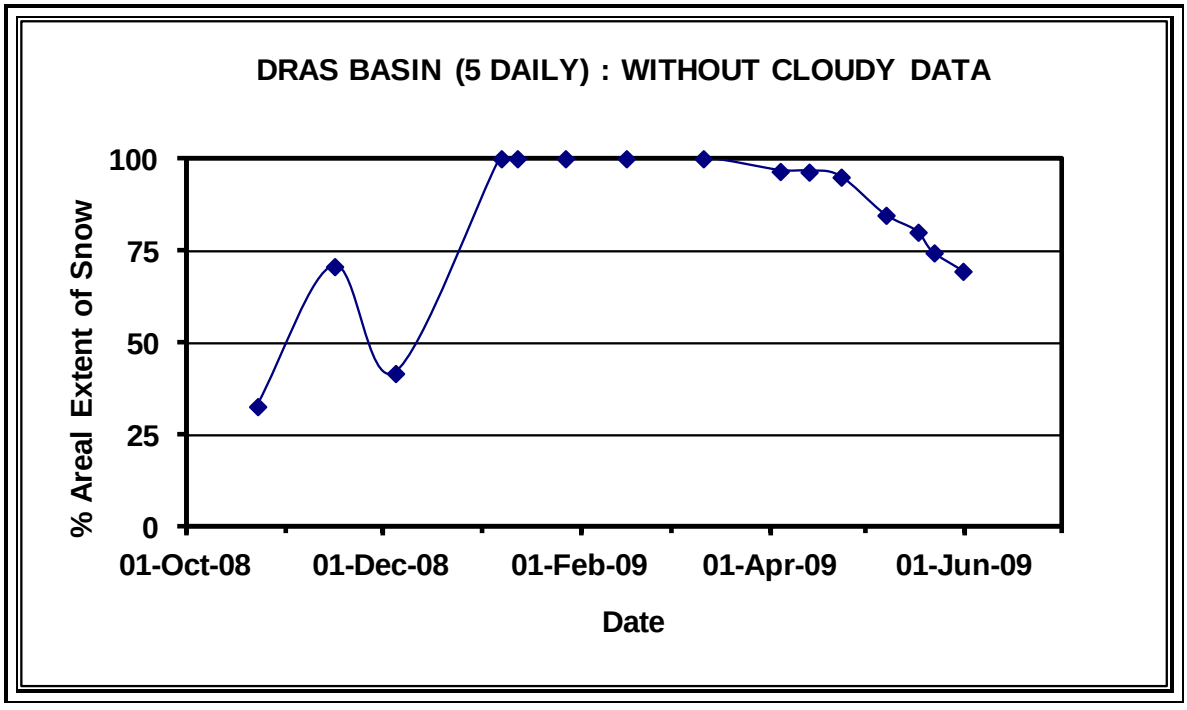
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: DRAS **BASIN AREA: 1683 sq km**

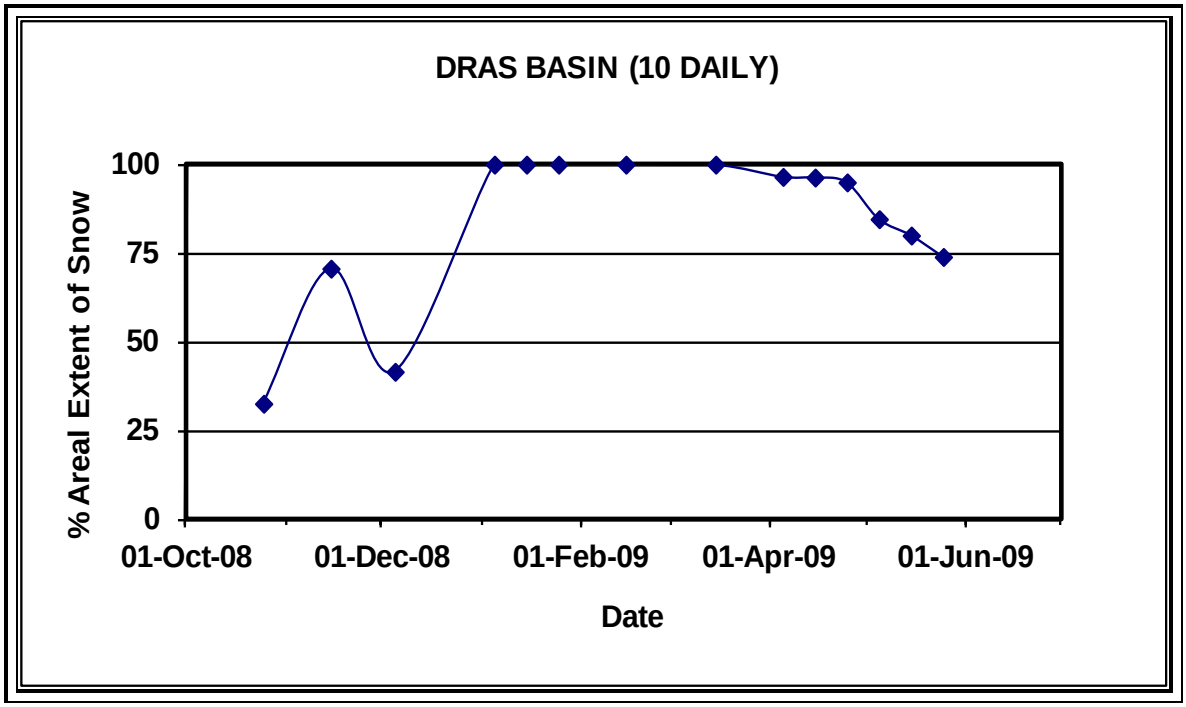
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	25-Oct-08		33	2	16-Nov-08	1190	71
December 2008				**January 2009**			
3	5-Dec-08	701	42	4	5-Jan-09	1683	100
				5	15-Jan-09	1683	100
				6	25-Jan-09	1683	100
February 2009				**March 2009**			
7	15-Feb-09	1683	100	8	11-Mar-09	1683	100
April 2009				**May 2009**			
9	4-Apr-09	1625	97	12	7-May-09	1425	85
10	15-Apr-09	1615	96	13	17-May-09	1347	80
11	25-Apr-09	1599	95	14	22-May-09	1283	74
June 2009				**July 2009**			

Snow cover depletion curve



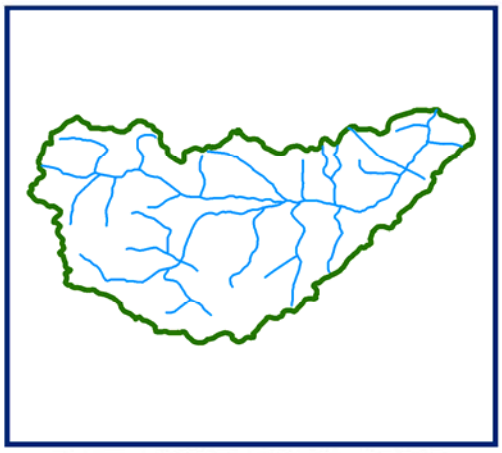


Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : DRAS BASIN



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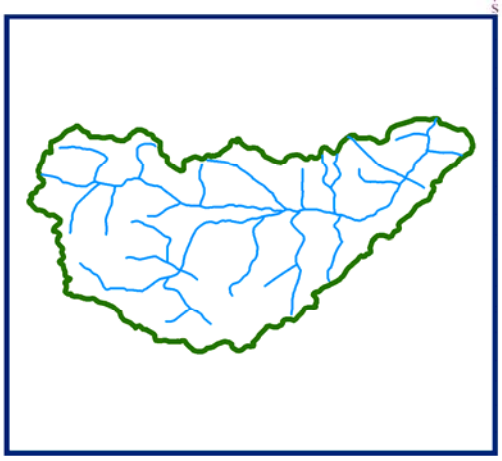

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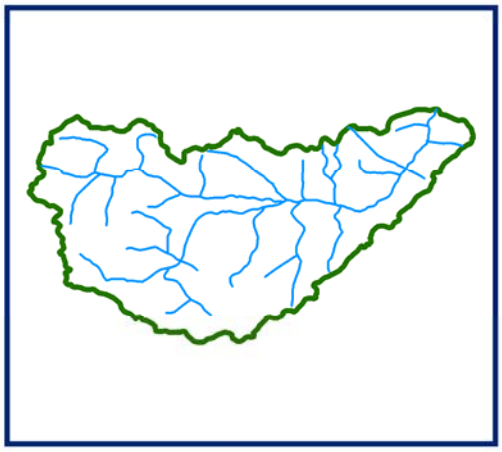

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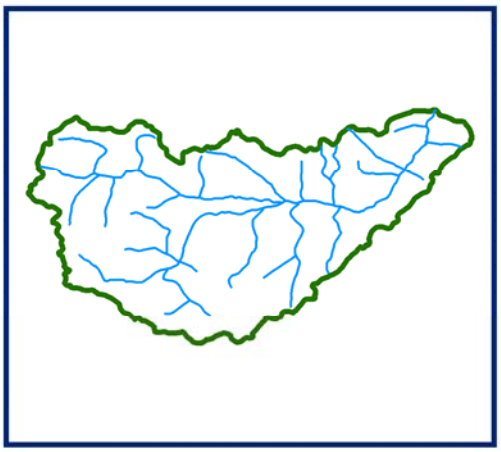

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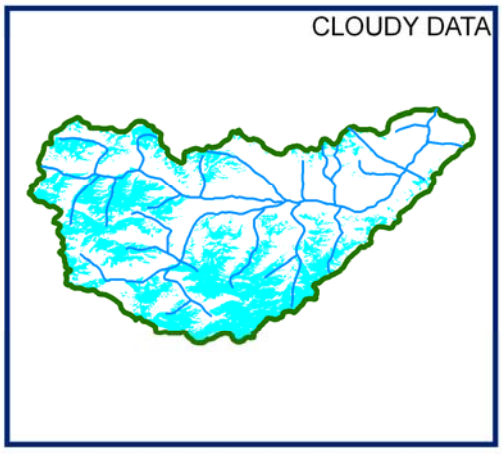
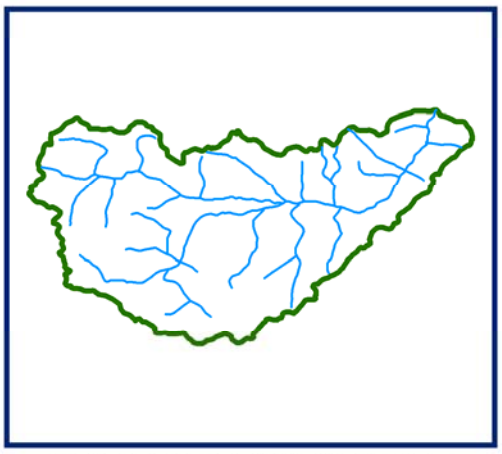


23 OCTOBER 2008



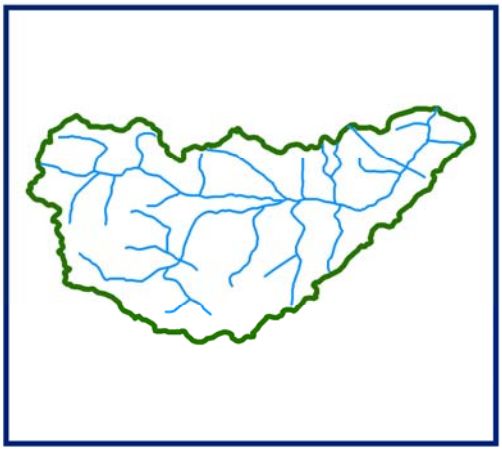
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



DATA USED
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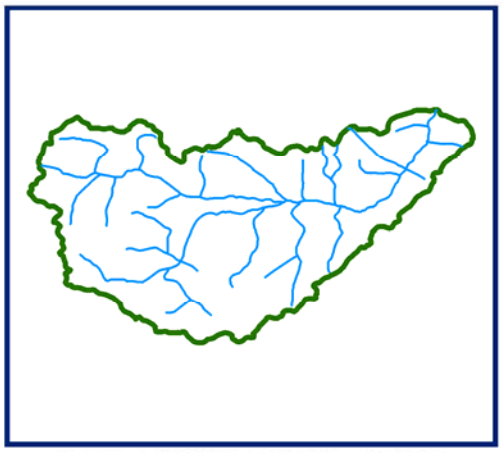
DATA USED
DATA NOT AVAILABLE

DATA USED
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



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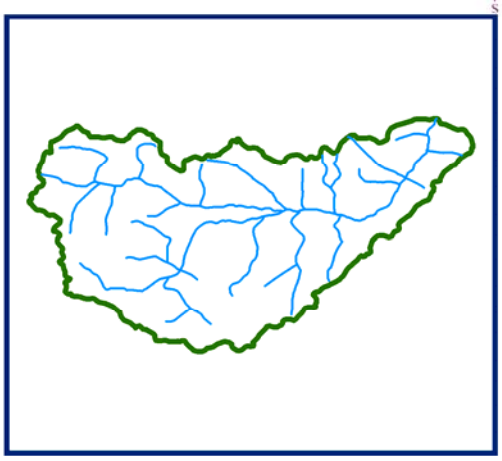

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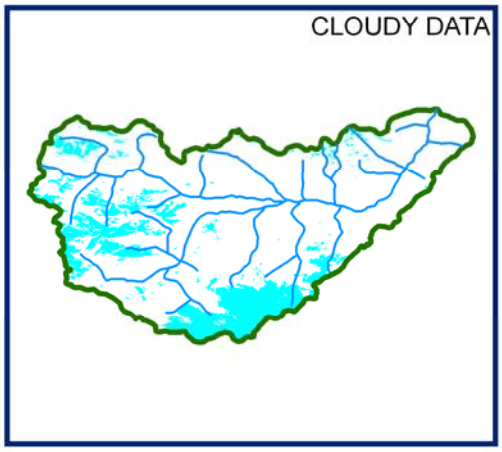
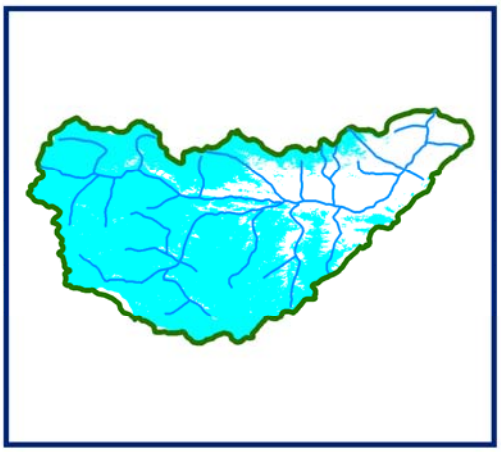
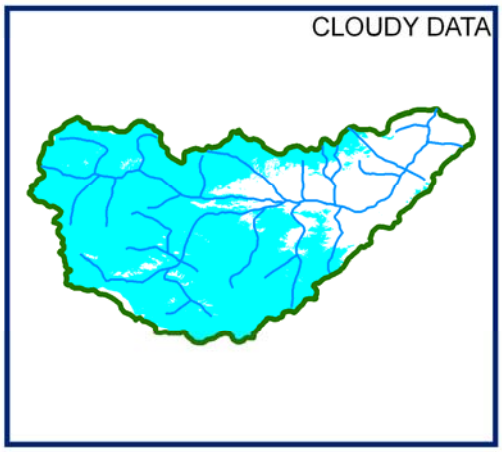


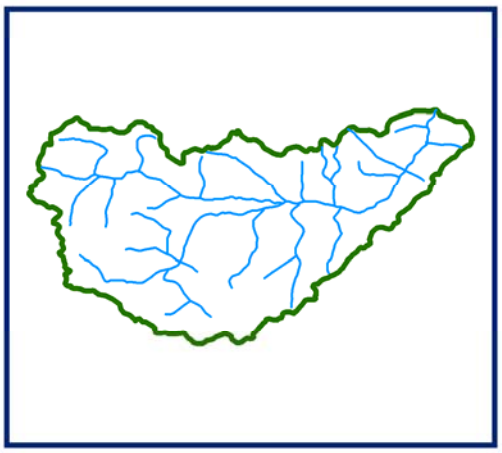
11 NOVEMBER 2008



16 NOVEMBER 2008



25 NOVEMBER 2008



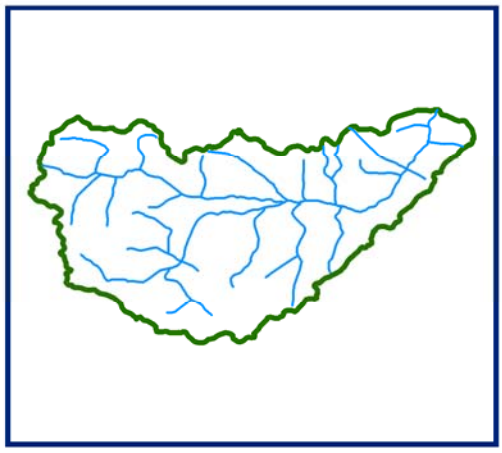
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



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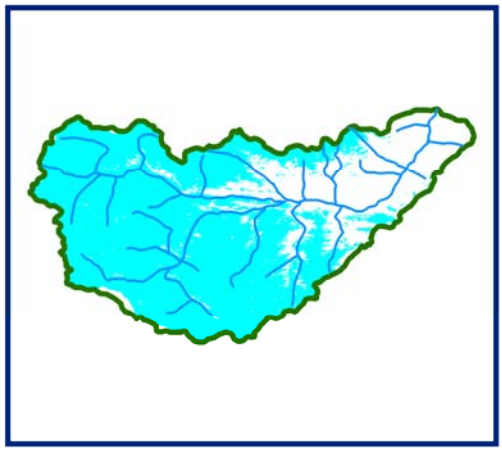

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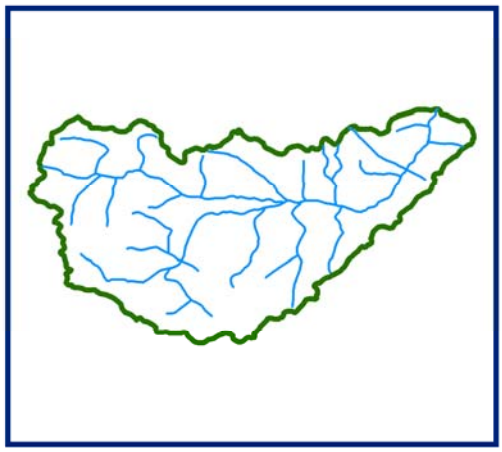
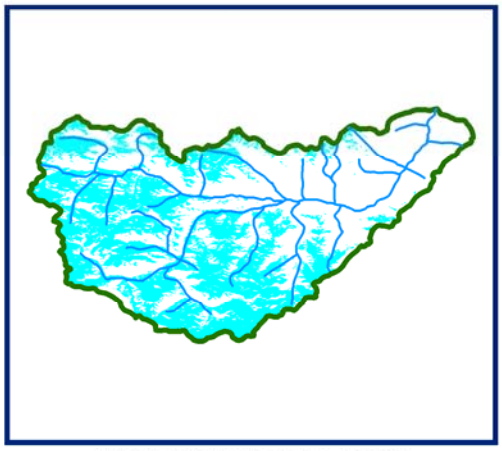


DATA USED
DATA NOT AVAILABLE

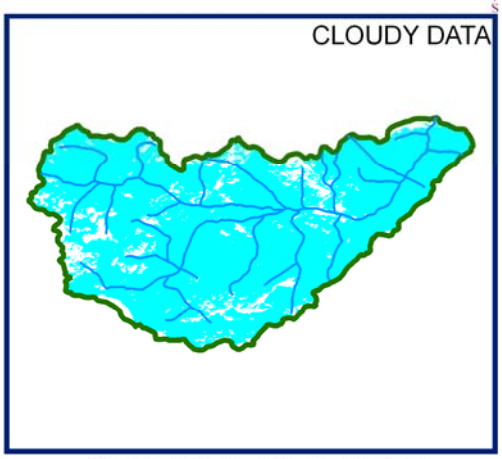
SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



5 DECEMBER 2008



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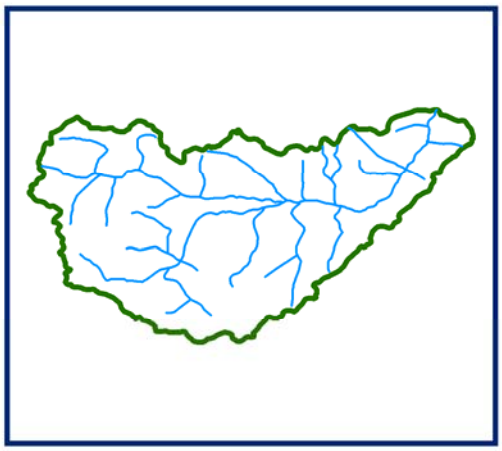

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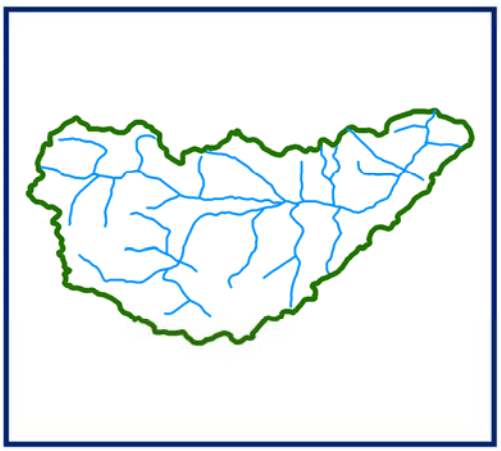

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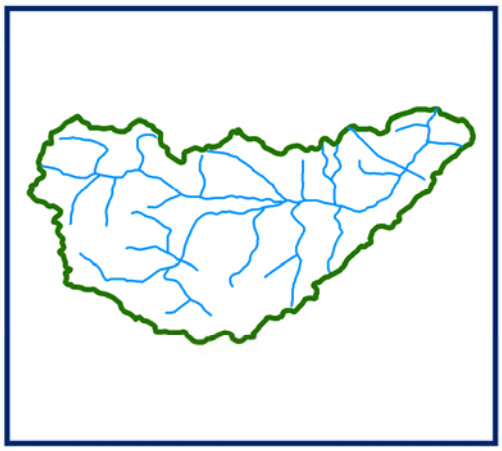

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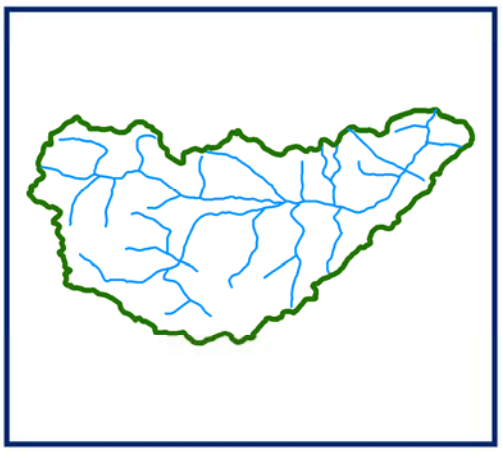


DATA NOT AVAILABLE

SNOW

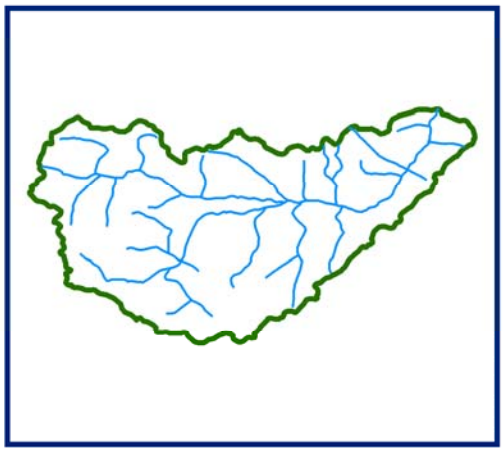
0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN

DATA USED
5 DECEMBER 2008

DATA USED
DATA NOT AVAILABLE



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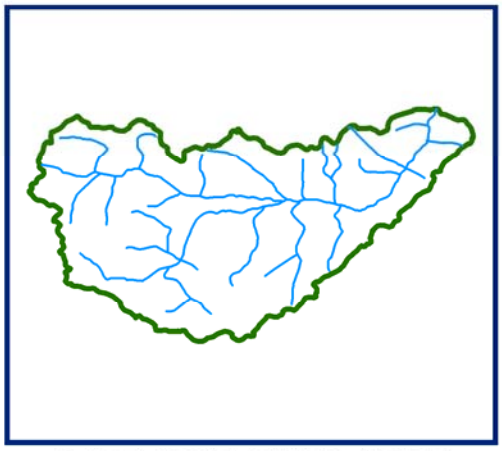
SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



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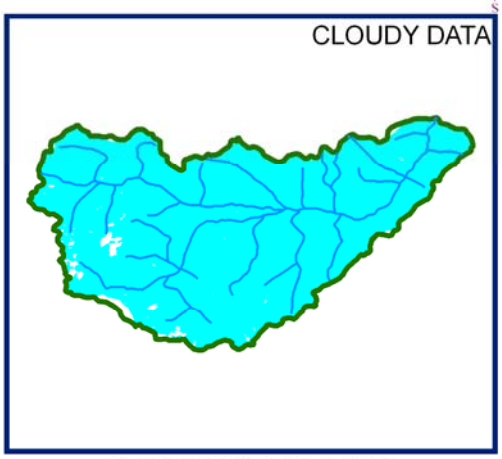
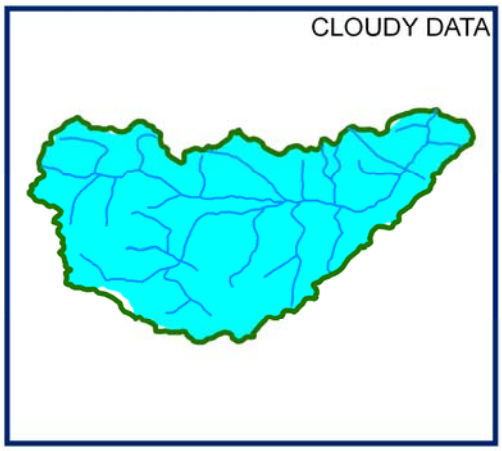
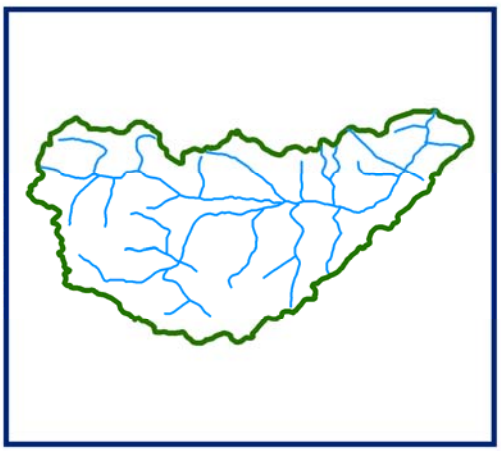


7 JANUARY 2009



12 JANUARY 2009



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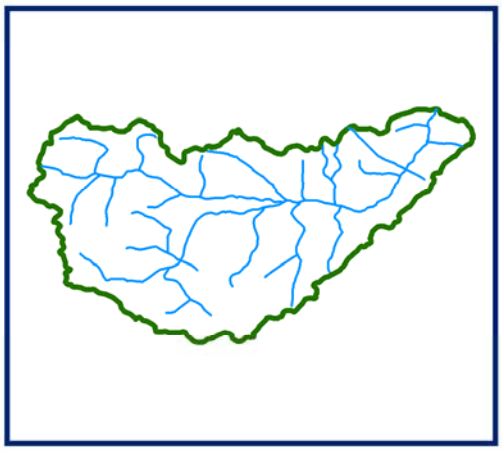

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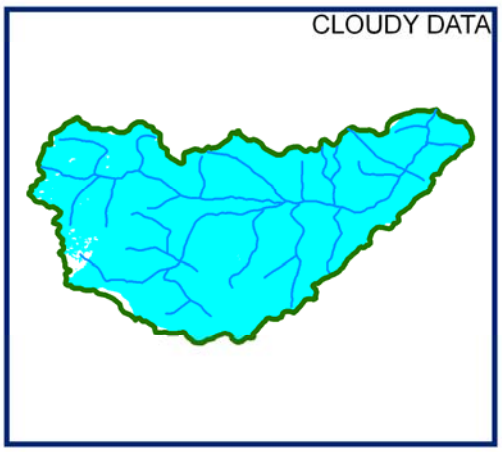


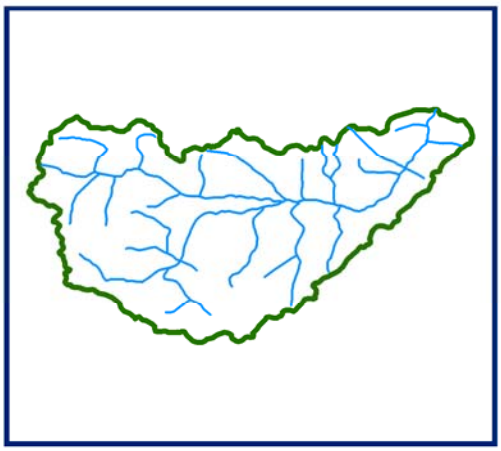
27 JANUARY 2009

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



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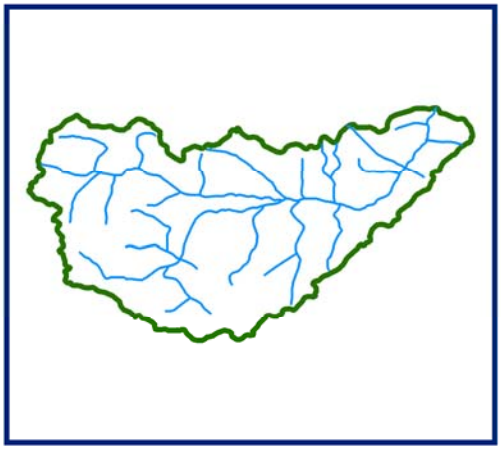

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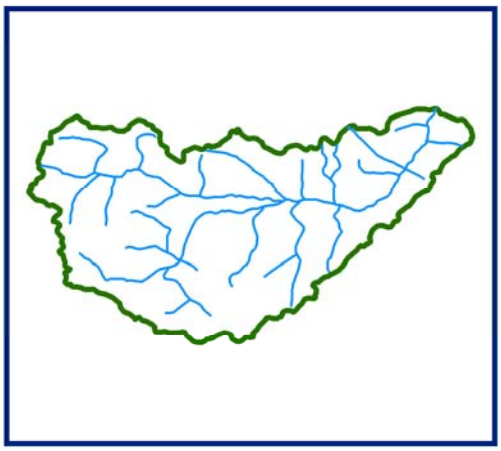

DATA USED
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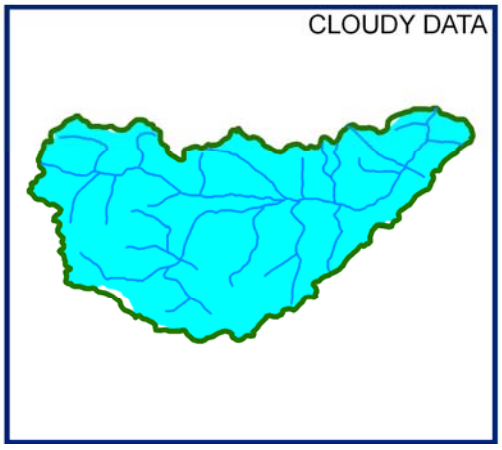
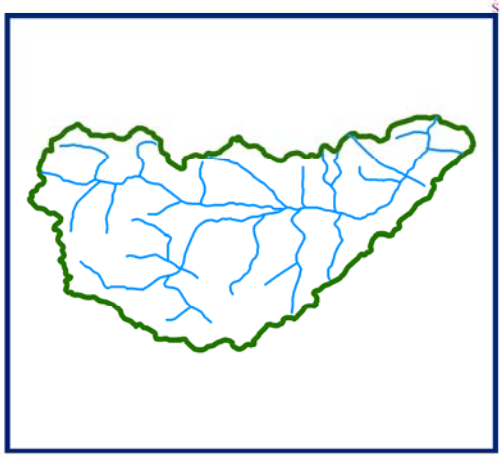
SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



5 FEBRUARY 2009



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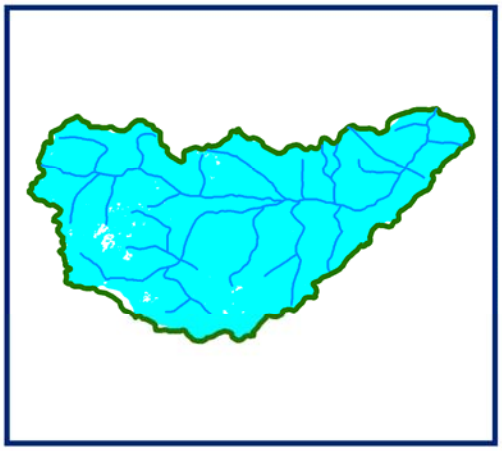
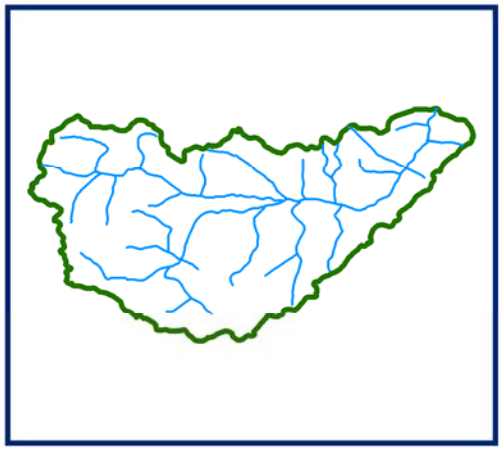


15 FEBRUARY 2009



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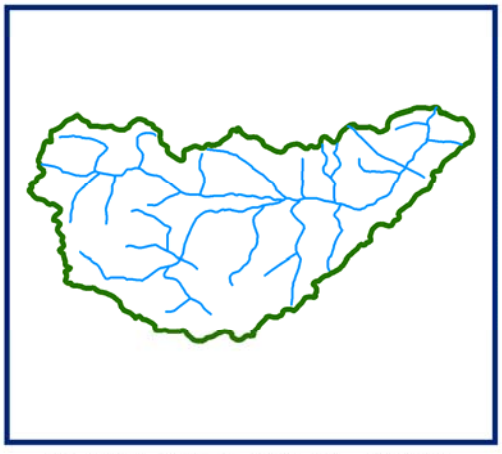

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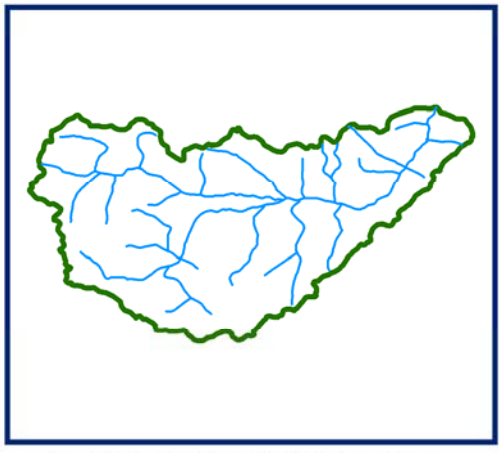


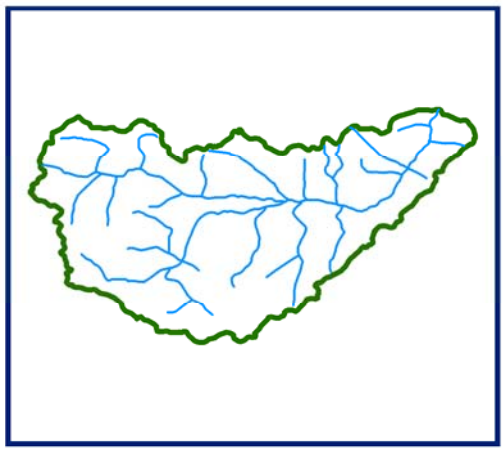
DATA NOT AVAILABLE

SNOW

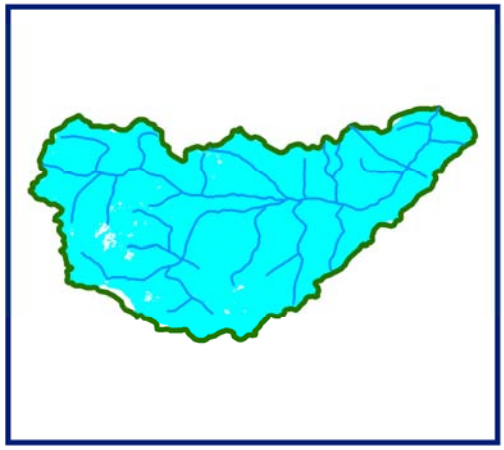
0 10 20 40 60 80

Kilometers

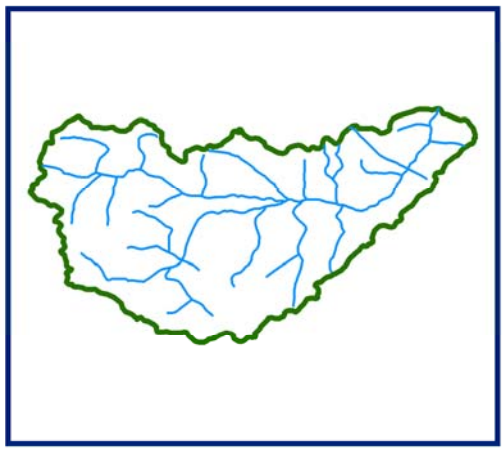
10 DAILY SNOW COVER MAP: DRAS BASIN



DATA USED
DATA NOT AVAILABLE



DATA USED
15 FEBRUARY 2009

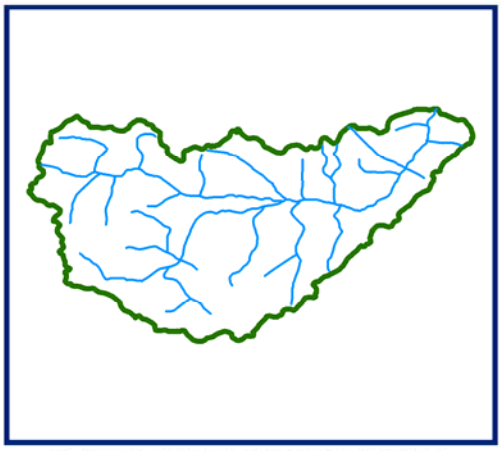


DATA USED
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



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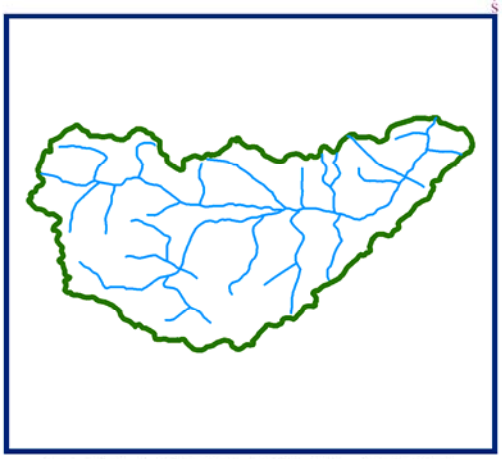

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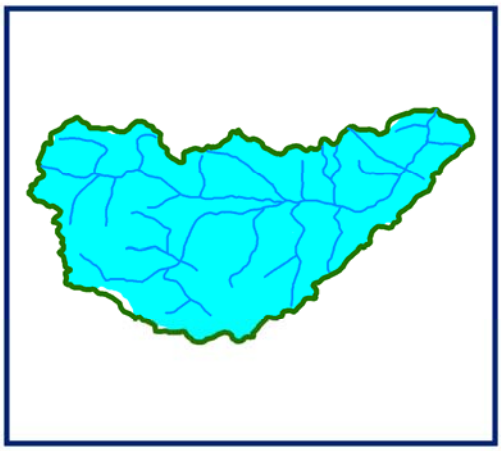
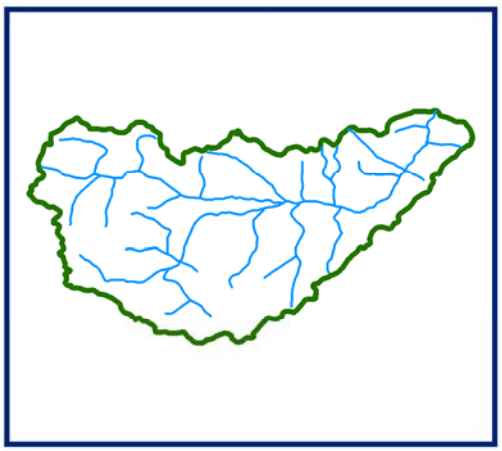


11 MARCH 2009



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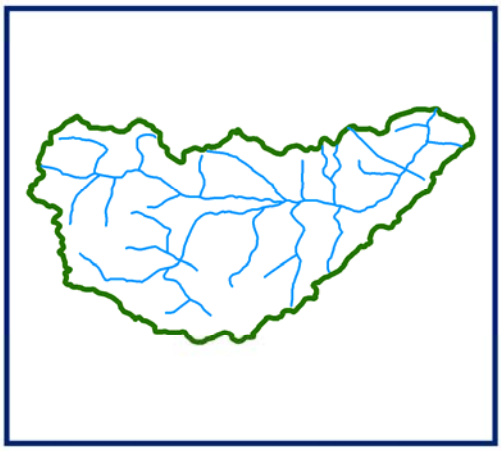

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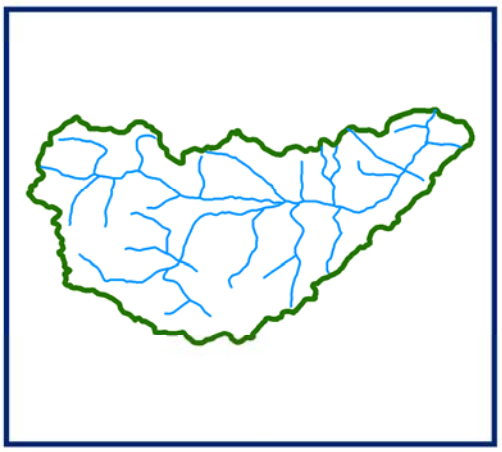


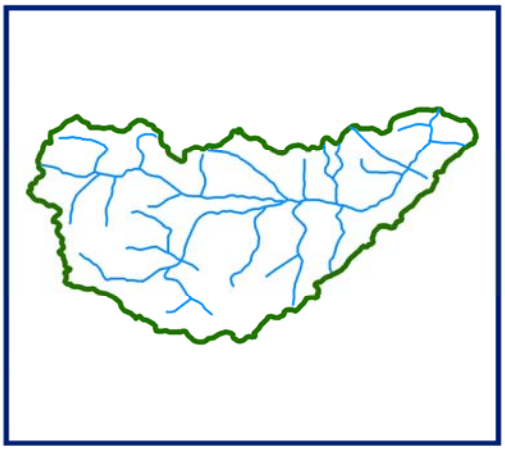
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



DATA USED
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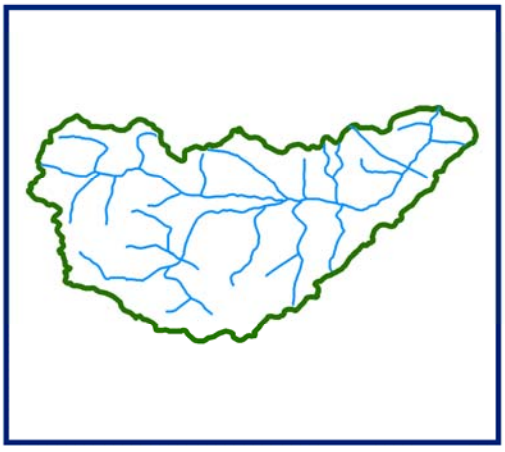
DATA USED
11 MARCH 2009



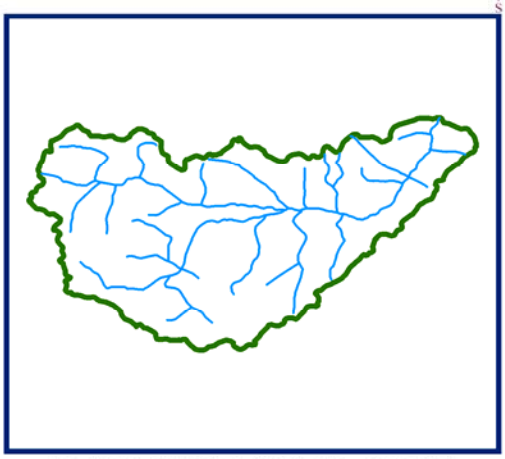
DATA USED
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN

4 APRIL 2009



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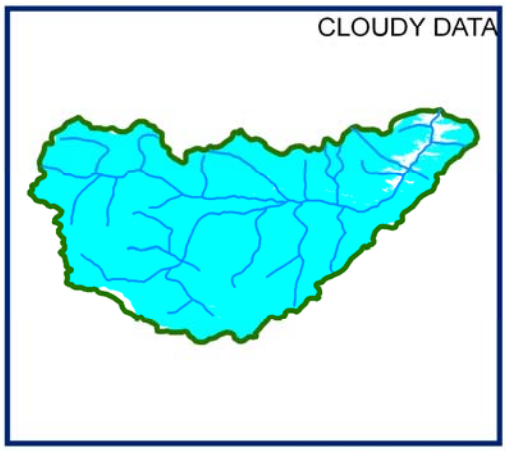
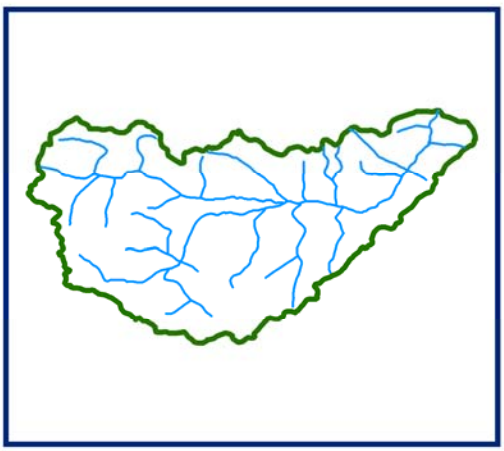


13 APRIL 2009



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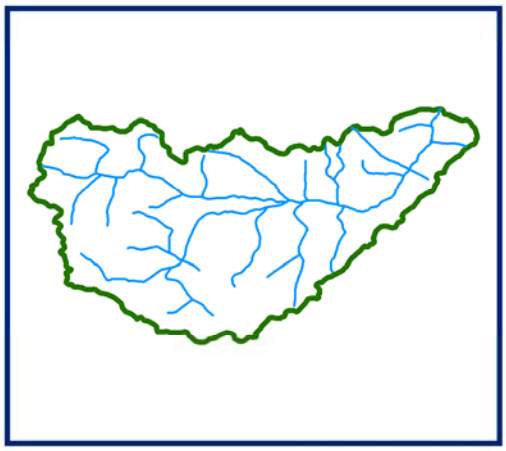

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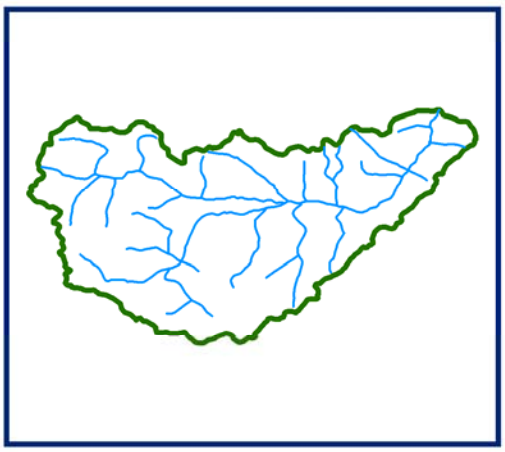


DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN

DATA USED
4 APRIL 2009

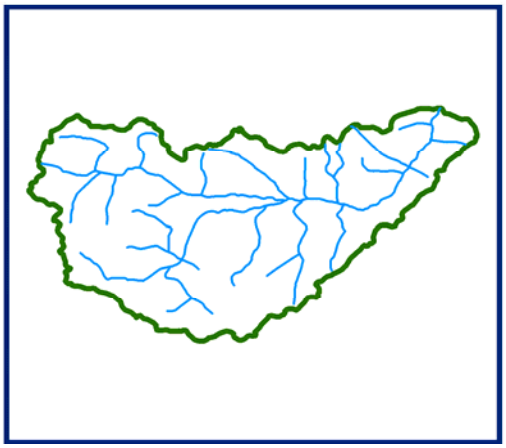
DATA USED
DATA NOT AVAILABLE

DATA USED
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



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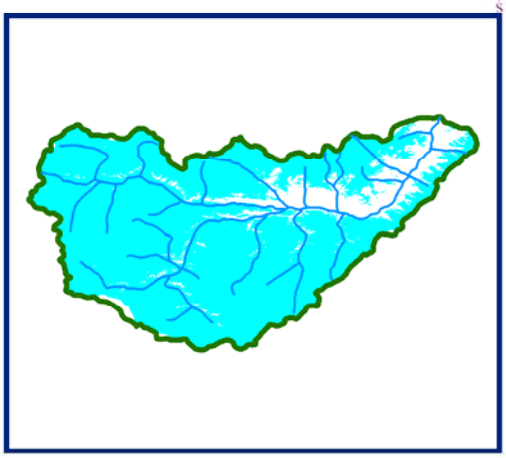
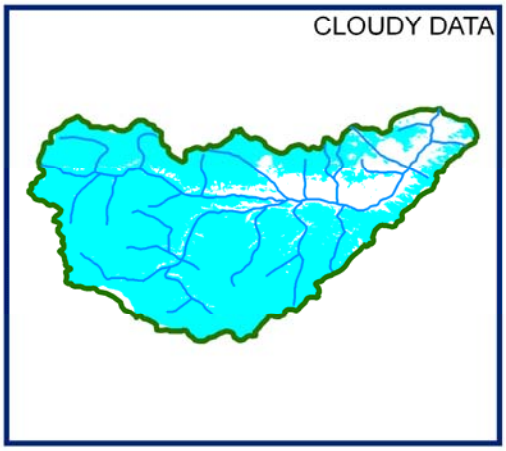
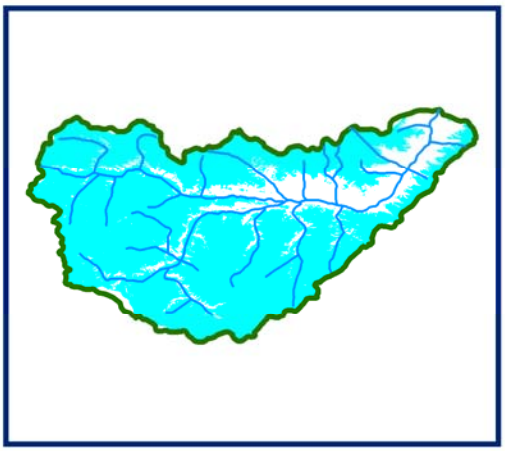


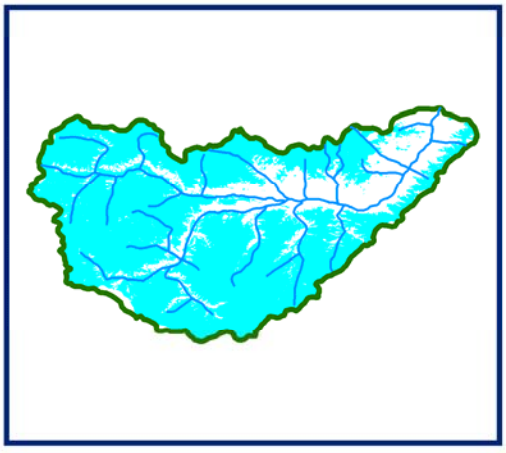
7 MAY 2009



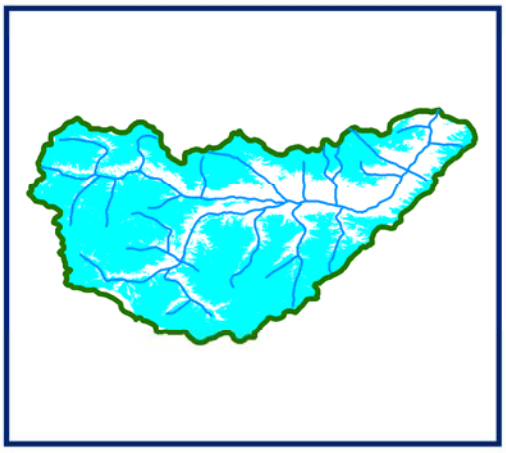
12 MAY 2009



17 MAY 2009



22 MAY 2009



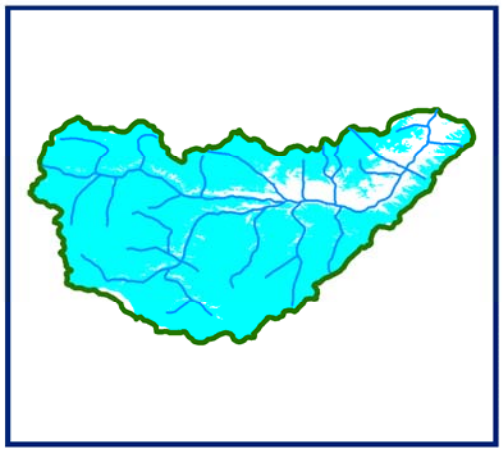
31 MAY 2009

SNOW

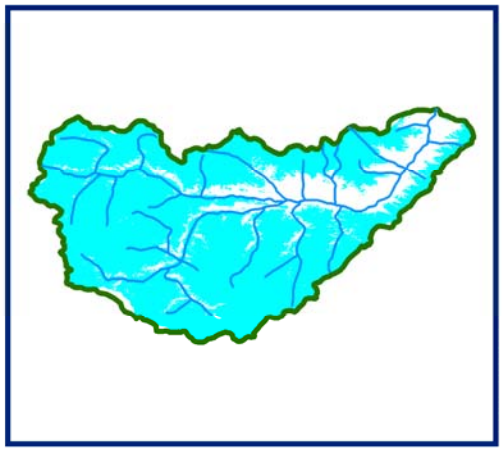
0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



DATA USED
7 MAY 2009



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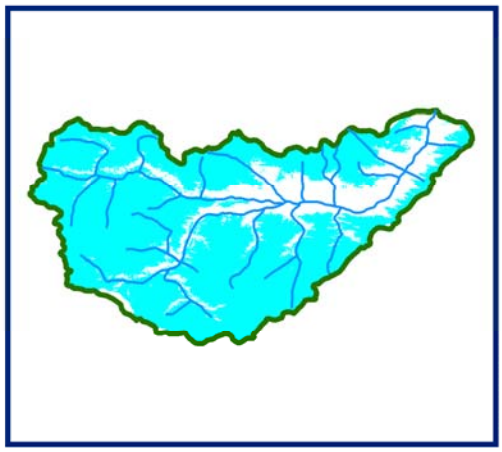
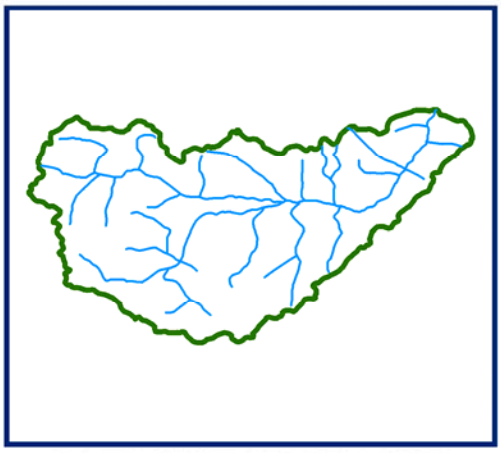


DATA USED
22 MAY 2009
31 MAY 2009

SNOW

0 10 20 40 60 80
Kilometers

SNOW COVER MAP : DRAS BASIN



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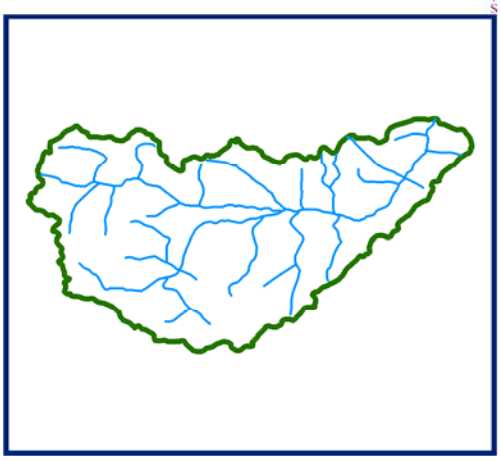

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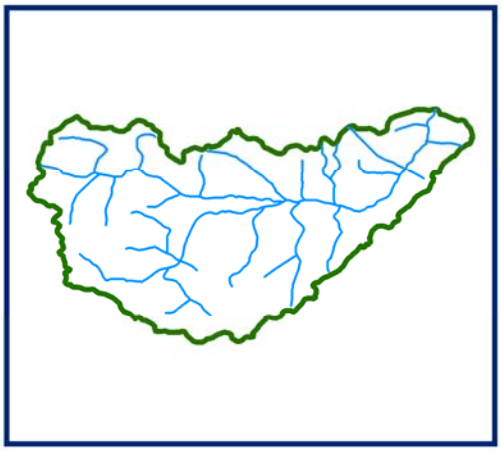

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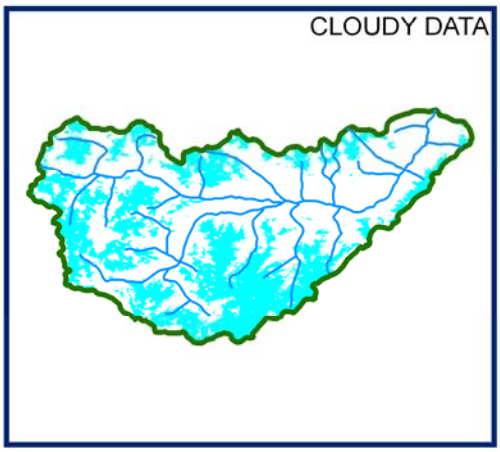
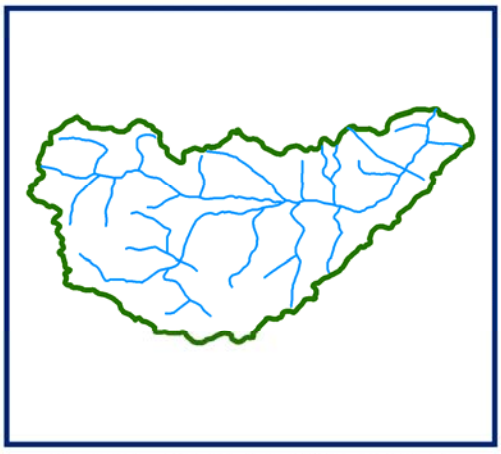


20 JUNE 2009



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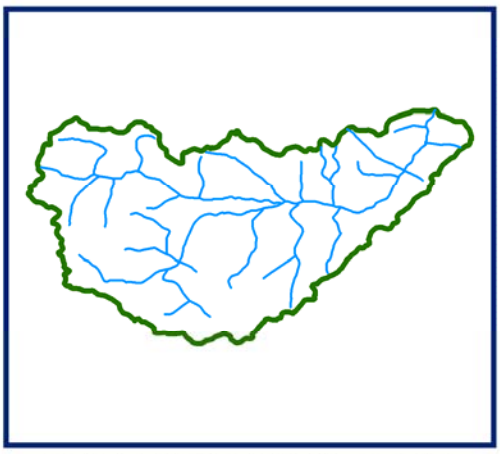


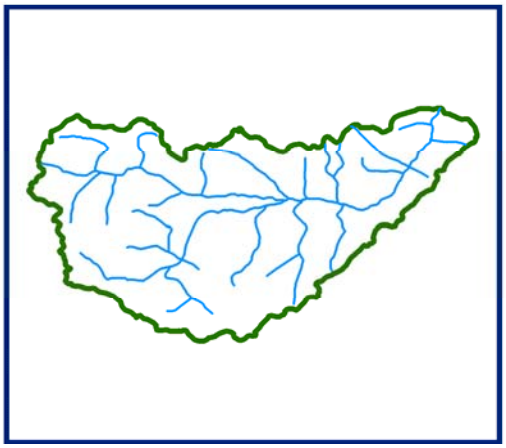
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80

Kilometers

10 DAILY SNOW COVER MAP: DRAS BASIN



DATA USED
DATA NOT AVAILABLE

DATA USED
DATA NOT AVAILABLE

DATA USED
DATA NOT AVAILABLE

SNOW

0 10 20 40 60 80
Kilometers

SURU BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: SURU **BASIN AREA: 3575 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	23-Oct-08	1389	39	2	27-Oct-08	1389	39
November 2008							
3	11-Nov-08	994	28	4	16-Nov-08	1049	29
5	20-Nov-08	2689	75	6	25-Nov-08	1590	44
December 2008							
7	5-Dec-08	996	28	8	10-Dec-08	3394	95
January 2009							
9	7-Jan-09	3575	100	10	12-Jan-09	3575	100
11	27-Jan-09	3575	100				
February 2009							
12	5-Feb-09	3551	99	13	15-Feb-09	3575	100
March 2009							
14	11-Mar-09	3551	99	15	21-Mar-09	3551	99
April 2009							
16	4-Apr-09	3302	94	17	13-Apr-09	3361	94
18	23-Apr-09	3181	89	19	27-Apr-09	3066	86
20	28-Apr-09	2117	59				

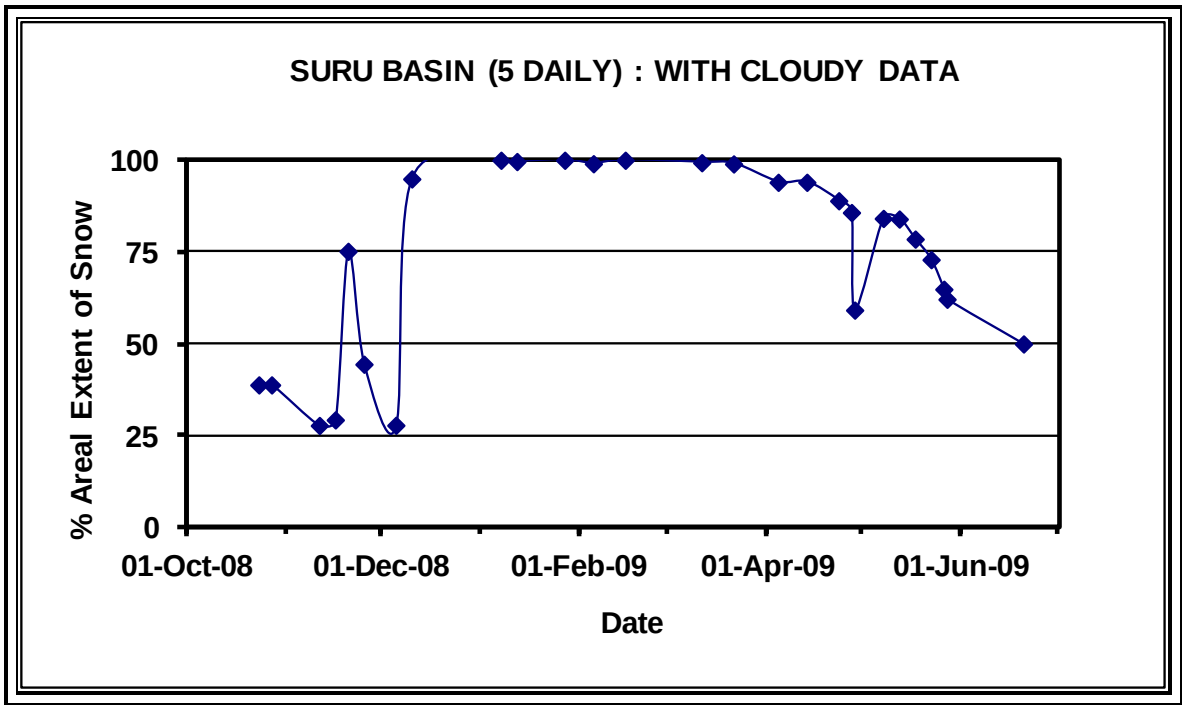
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
May 2009							
21	7-May-09	3009	84	22	12-May-09	3003	84
23	17-May-09	2808	79	24	22-May-09	2608	73
25	26-May-09	2320	65	26	27-May-09	2222	62
June 2009							
27	20-Jun-09	1788	50				
July 2009							

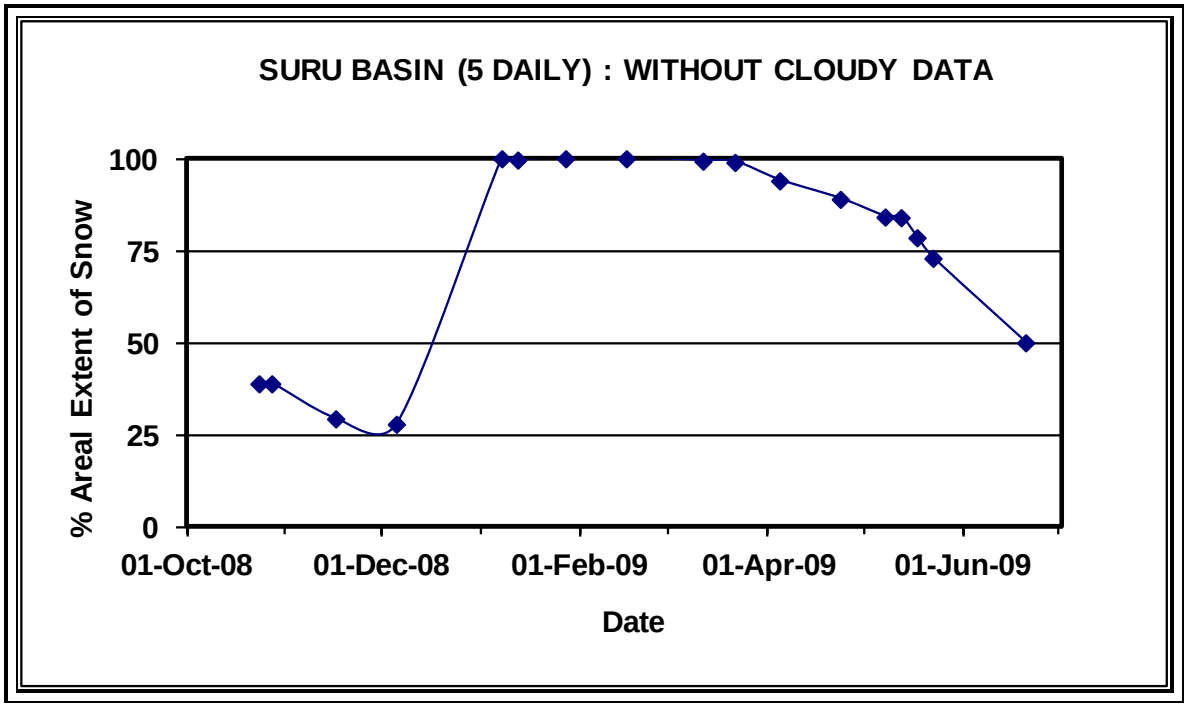
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: SURU **BASIN AREA: 3575 sq km**

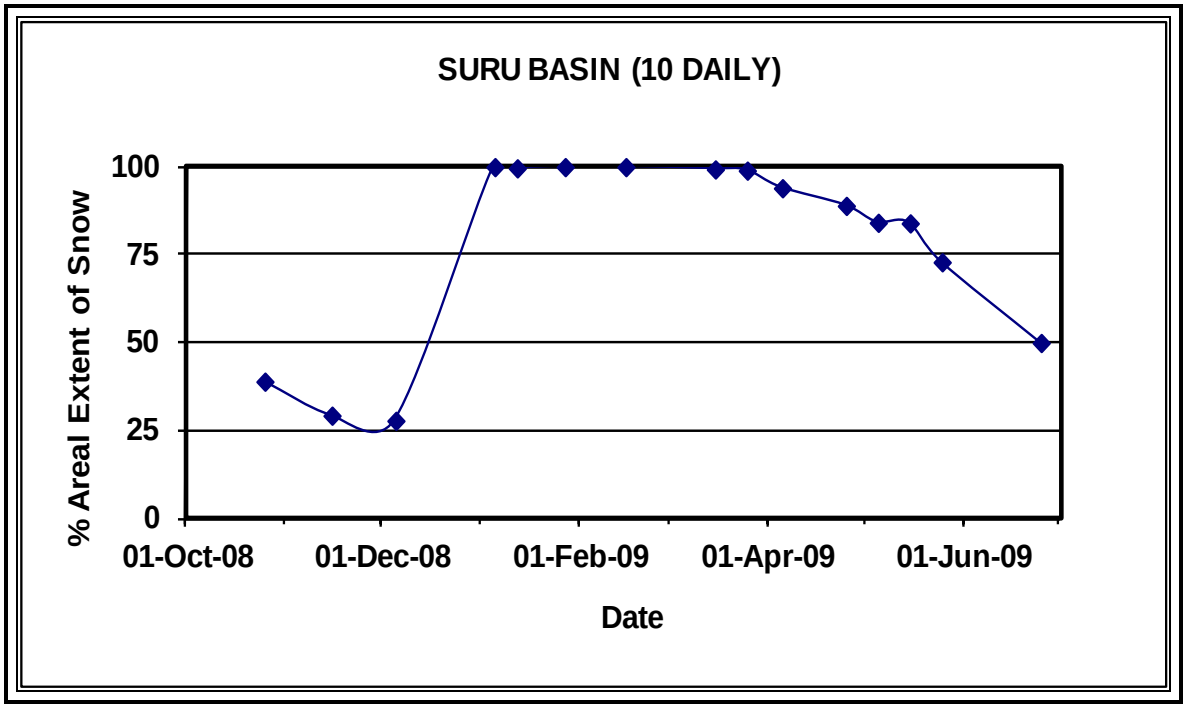
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	23-Oct-08	1394	39	2	16-Nov-08	1049	29
December 2008				**January 2009**			
3	5-Dec-08	996	28	4	5-Jan-09	3575	100
				5	15-Jan-09	3575	100
				6	25-Jan-09	3575	100
February 2009				**March 2009**			
7	15-Feb-09	3575	100	8	11-Mar-09	3551	99
				9	21-Mar-09	3539	99
April 2009				**May 2009**			
10	5-Apr-09	3361	94	12	7-May-09	3009	84
11	25-Apr-09	3181	89	13	17-May-09	3009	84
				14	22-May-09	2608	73
June 2009				**July 2009**			
15	25-June-09	1788	50				

Snow cover depletion curve



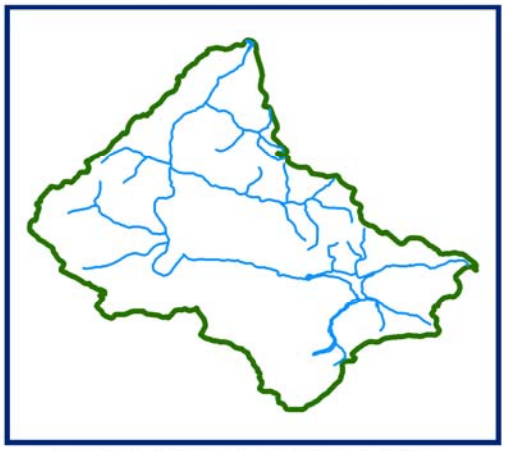


Snow cover depletion curve

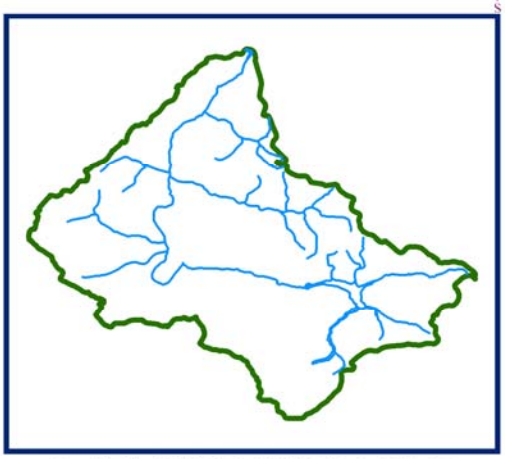


SNOW COVER MAP

SNOW COVER MAP : SURU BASIN



DATA NOT AVAILABLE



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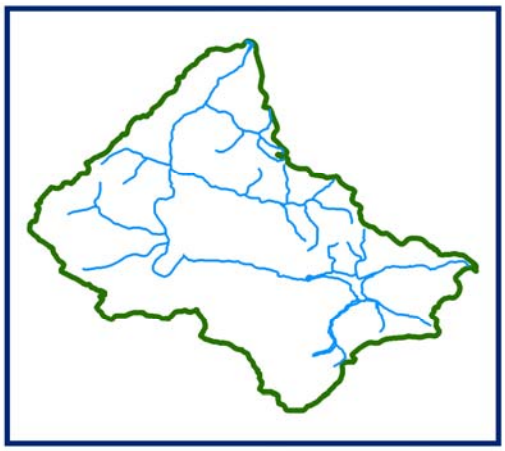

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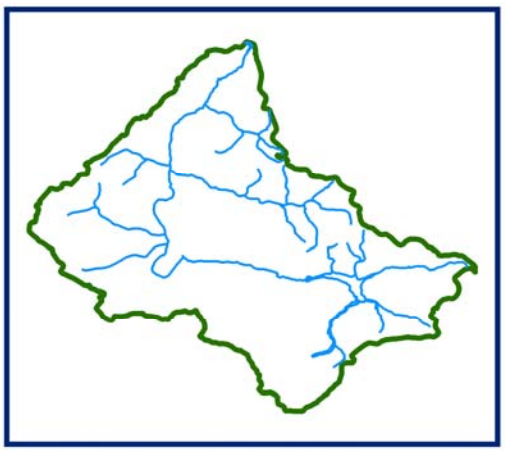

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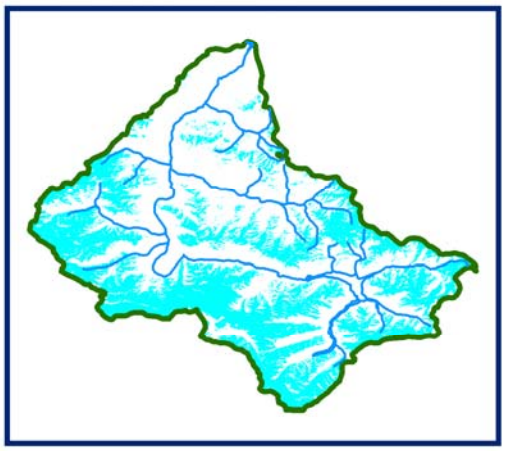
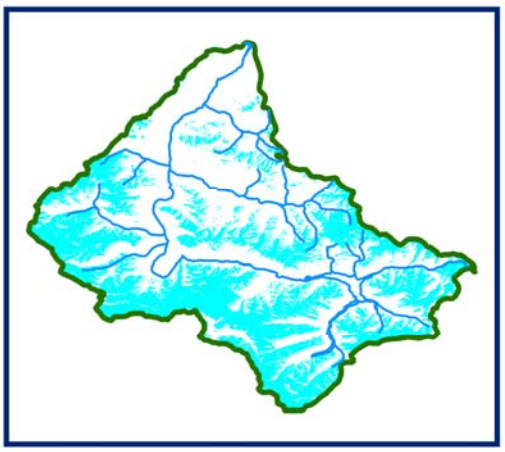


23 OCTOBER 2008



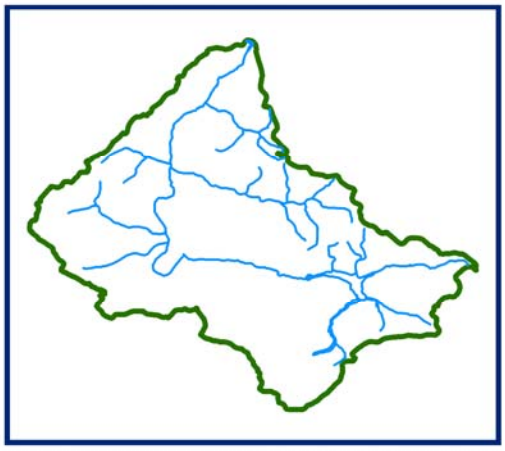
27 OCTOBER 2008

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



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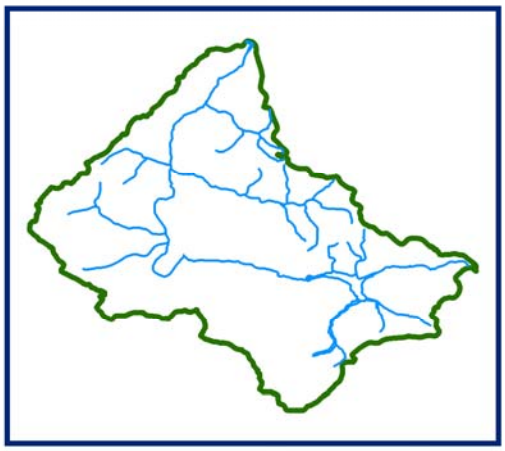

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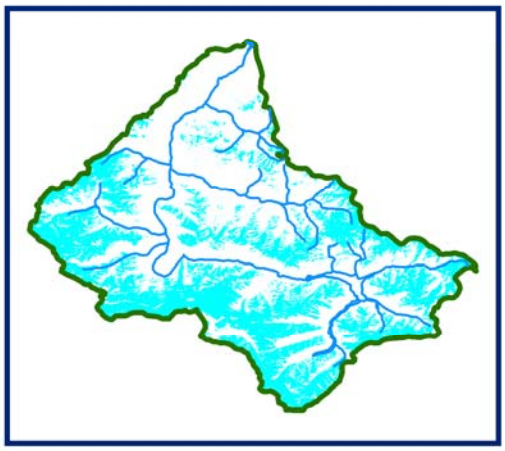
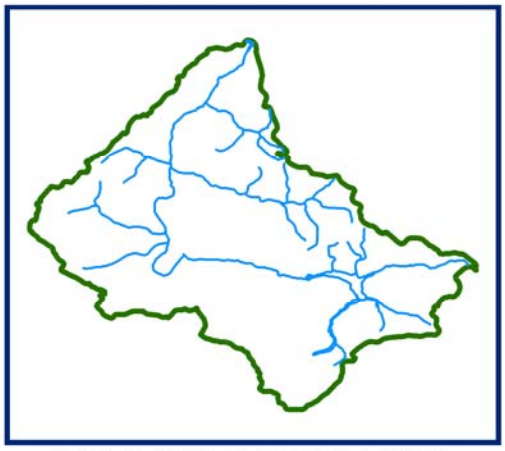


DATA USED
23 OCTOBER 2008
27 OCTOBER 2008

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



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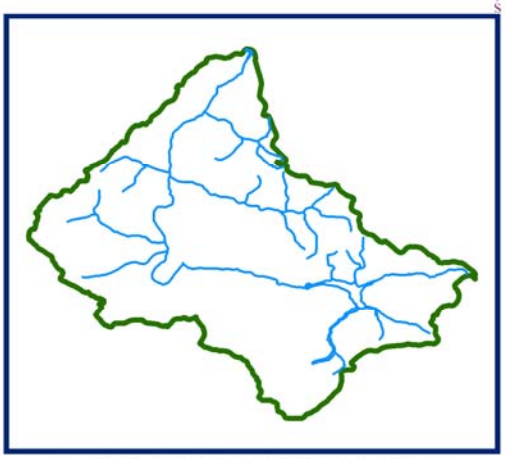

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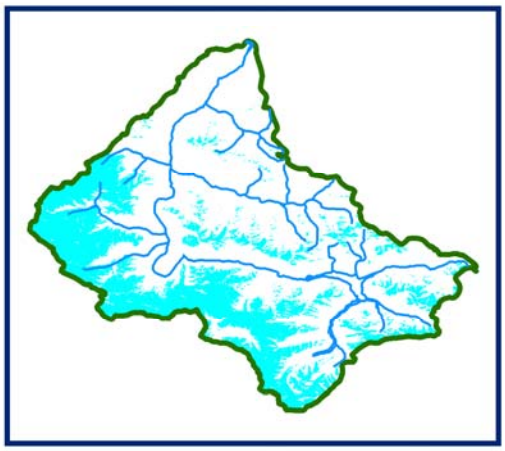
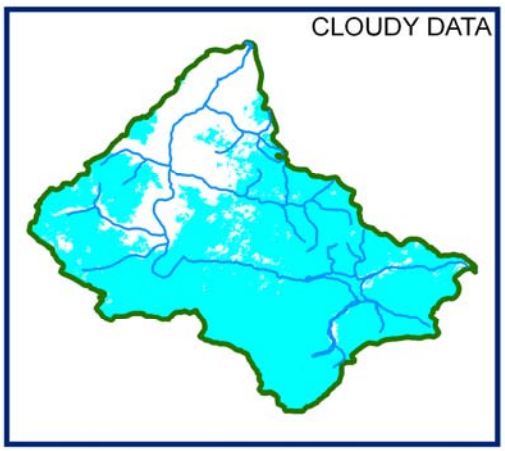
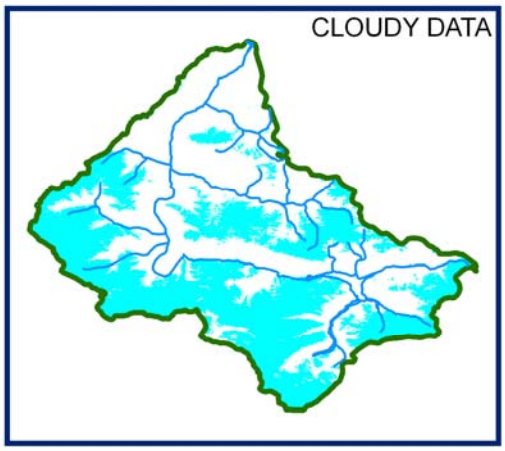


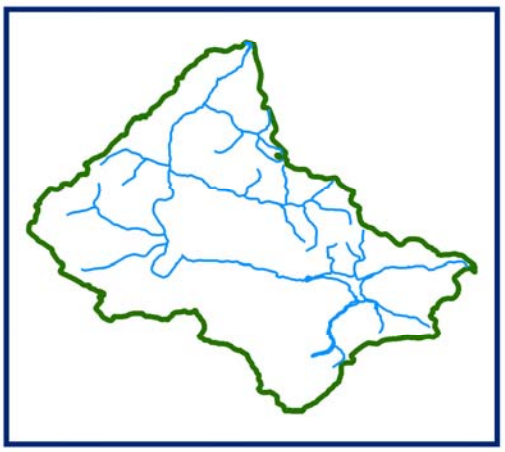
16 NOVEMBER 2008



20 NOVEMBER 2008



25 NOVEMBER 2008



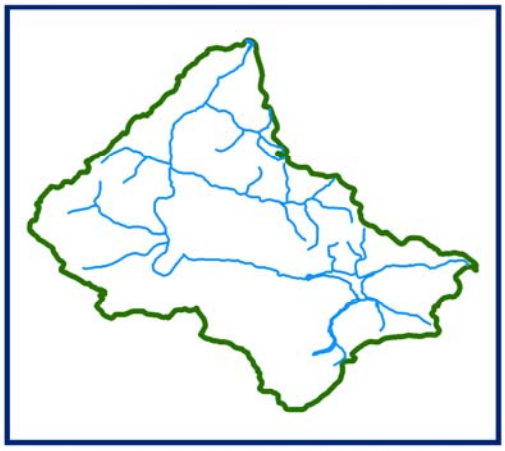
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



DATA USED
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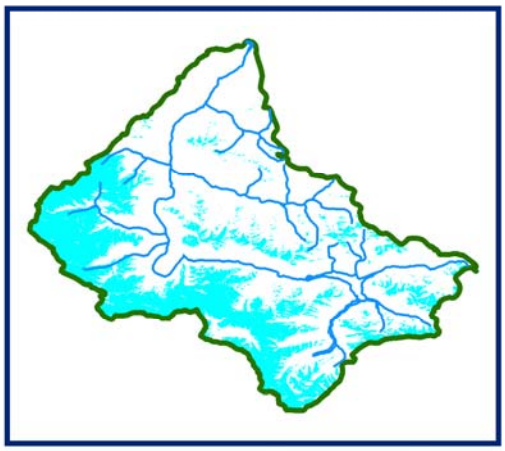
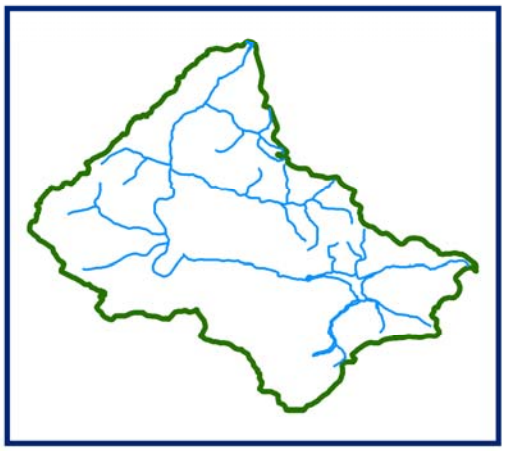


DATA USED
16 NOVEMBER 2008

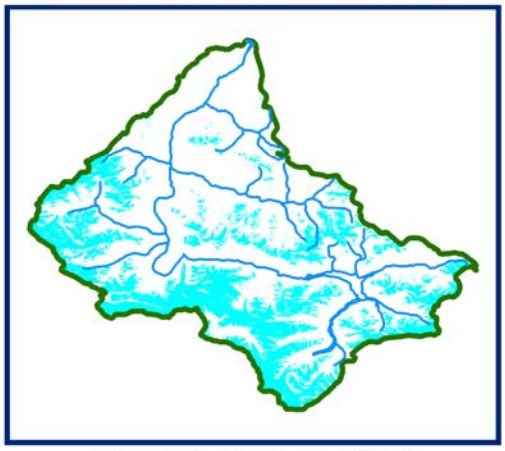


DATA USED
DATA NOT AVAILABLE

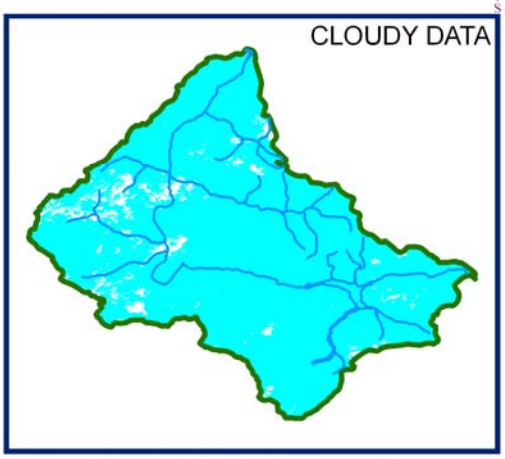
SNOW

0 15 30 60 90 120
Kilometers

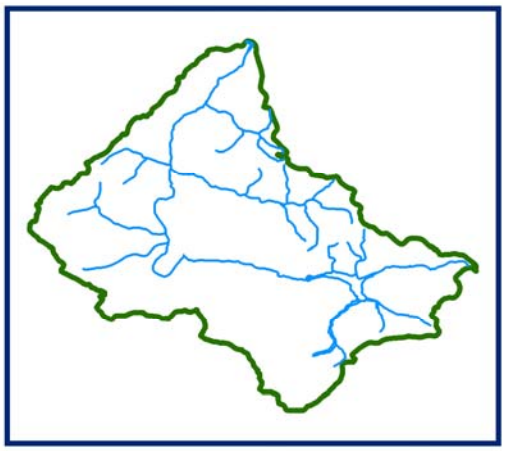
SNOW COVER MAP : SURU BASIN



5 DECEMBER 2008



10 DECEMBER 2008



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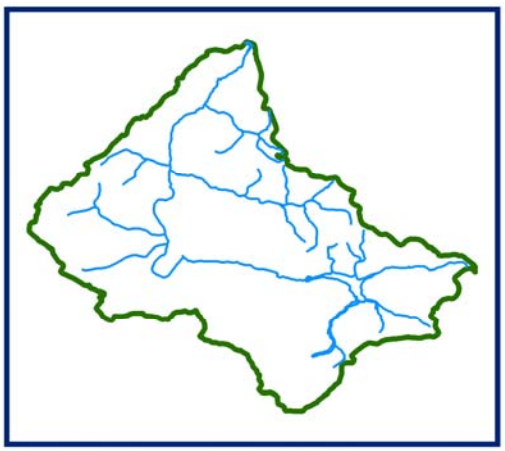

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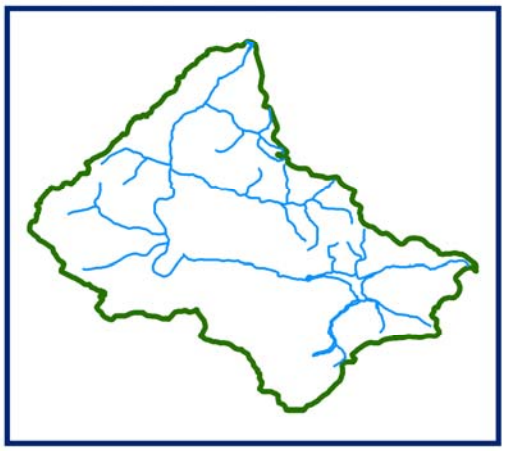

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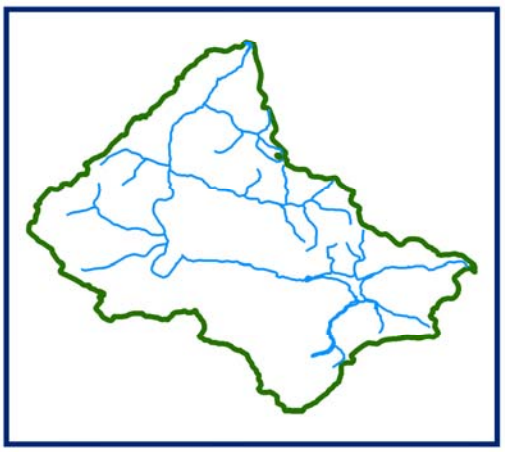


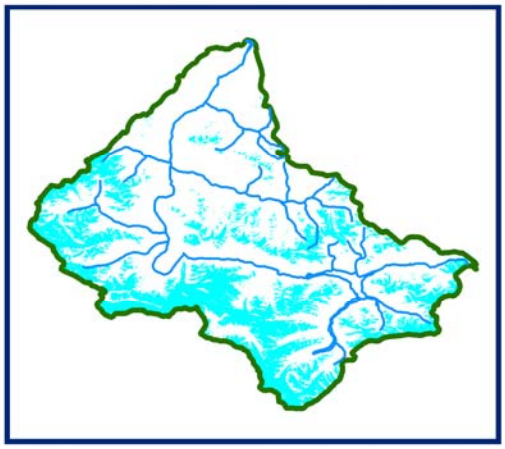
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



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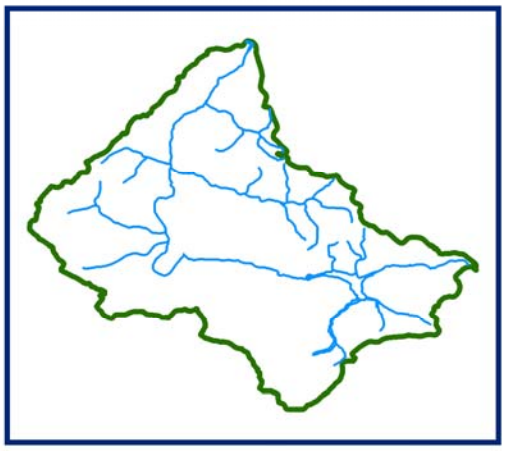

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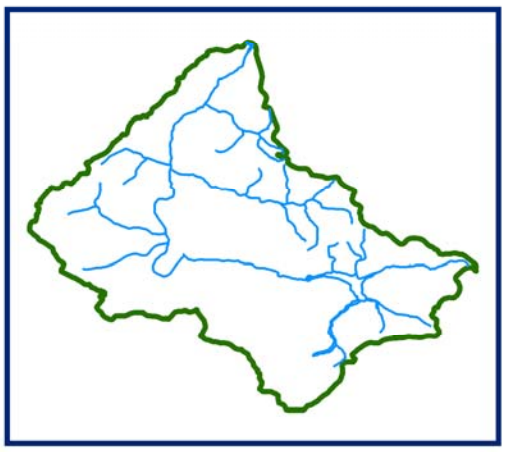
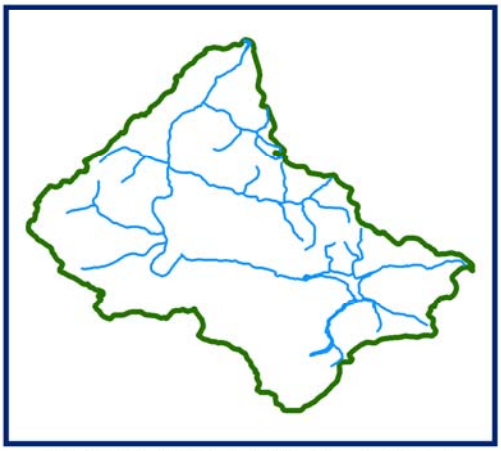


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



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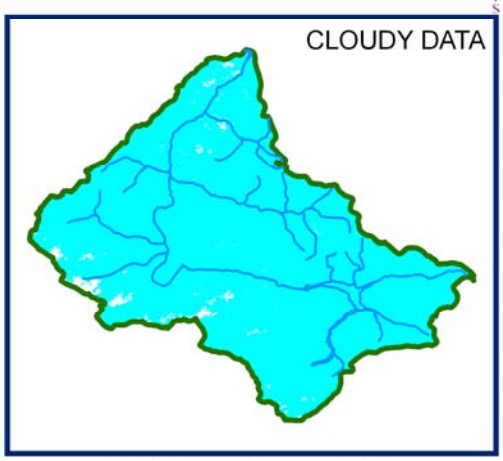
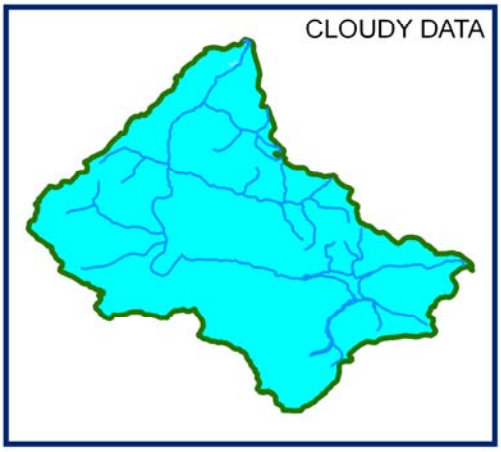
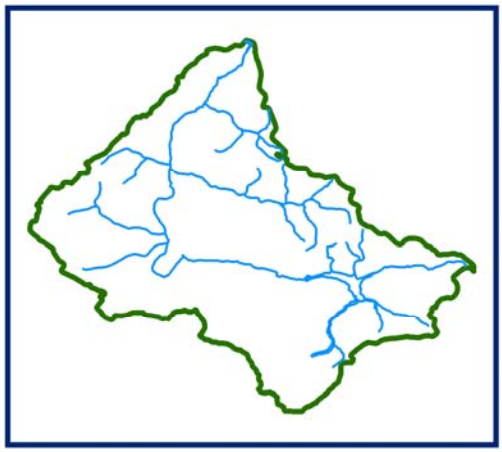


7 JANUARY 2009



12 JANUARY 2009



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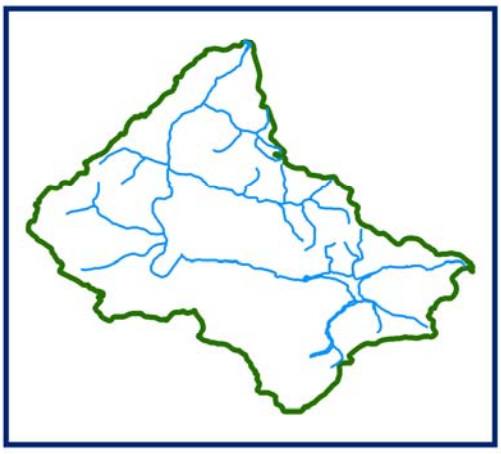

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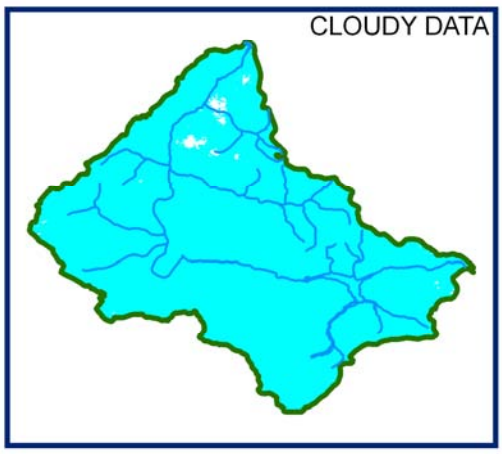
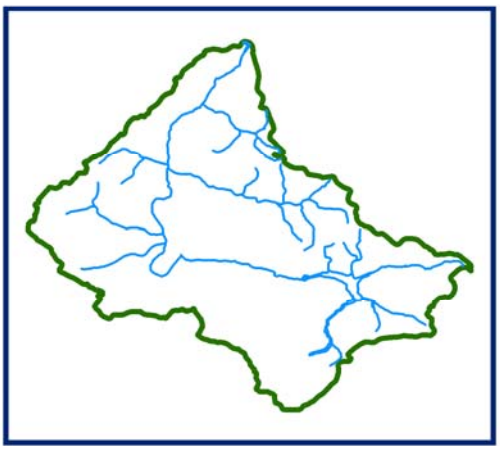


27 JANUARY 2009

10 DAILY SNOW COVER MAP: SURU BASIN



DATA USED
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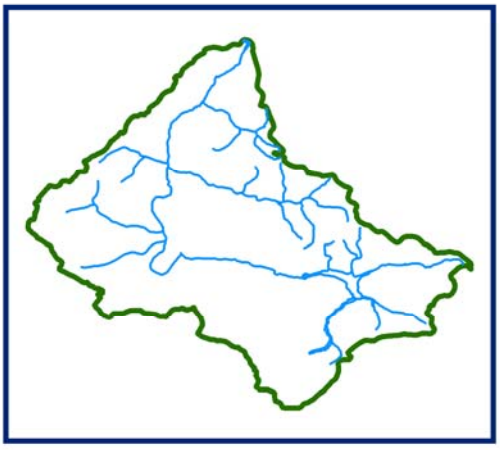

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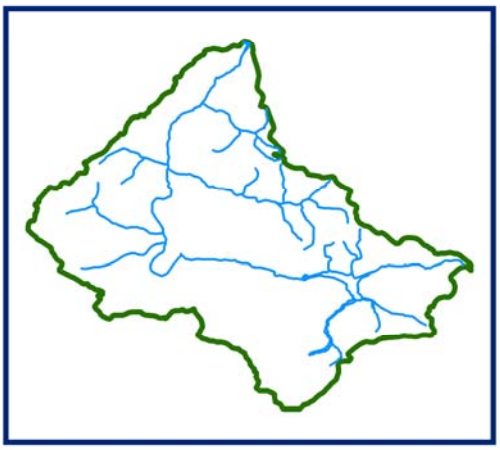

DATA USED
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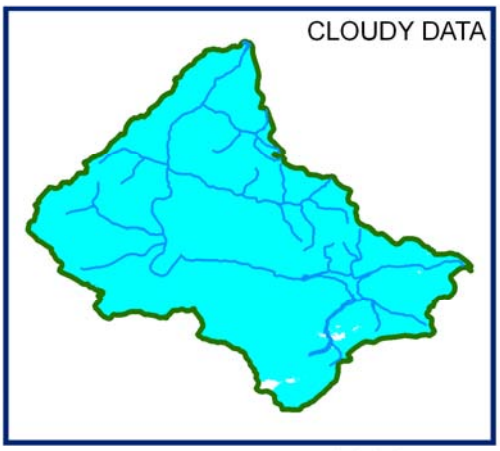
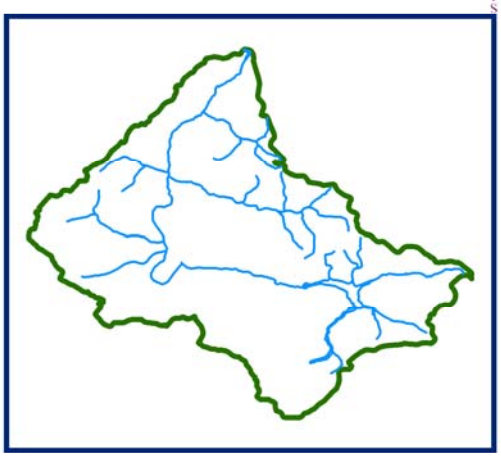
SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



5 FEBRUARY 2009



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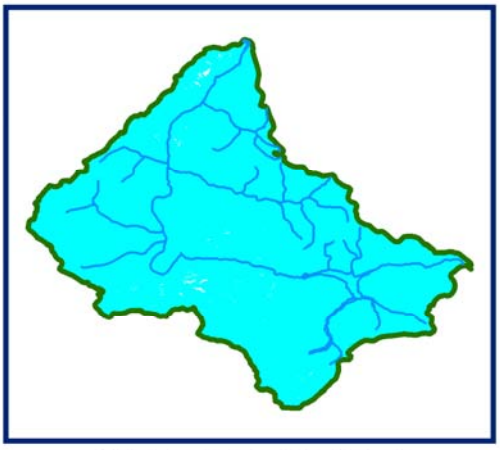
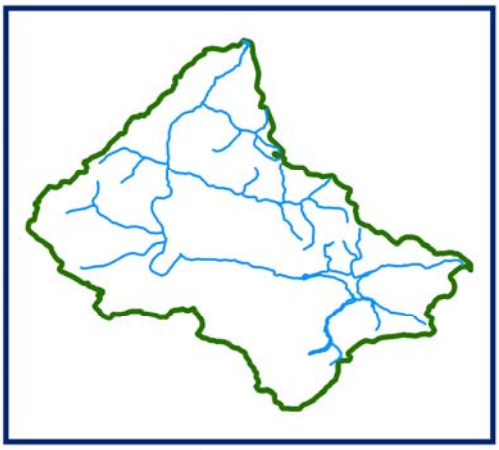


15 FEBRUARY 2009



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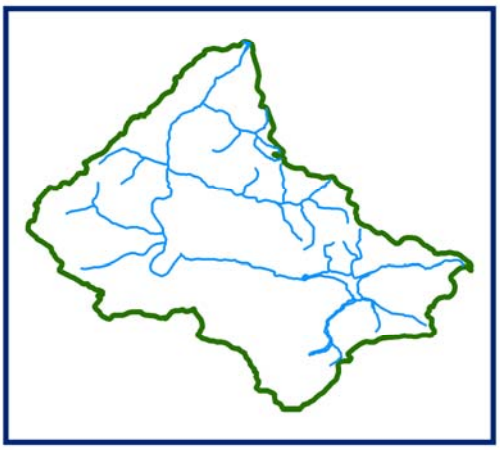

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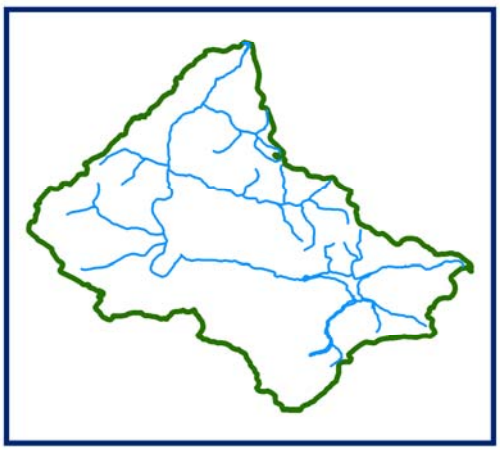


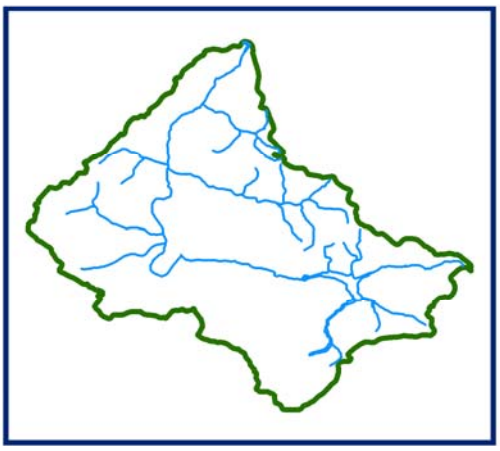
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



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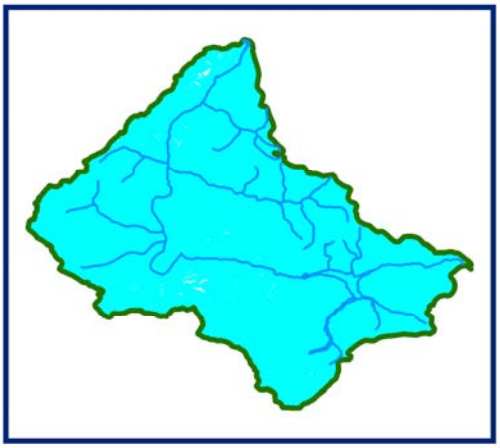

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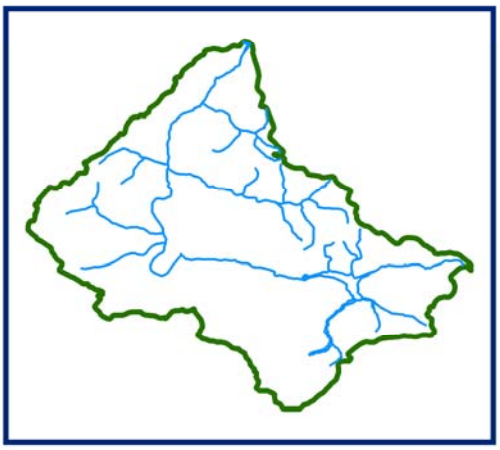
15 FEBRUARY 2009

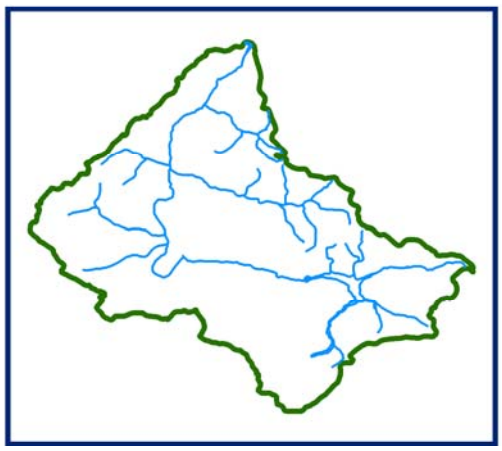


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



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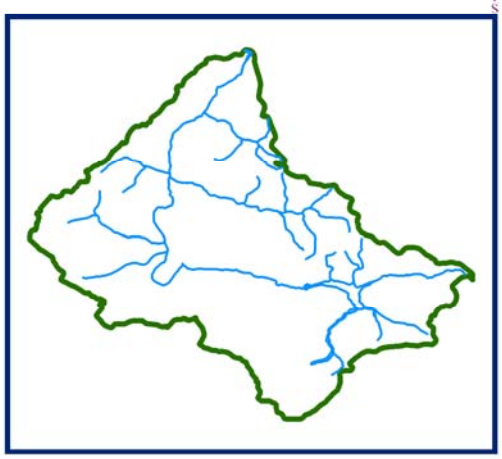

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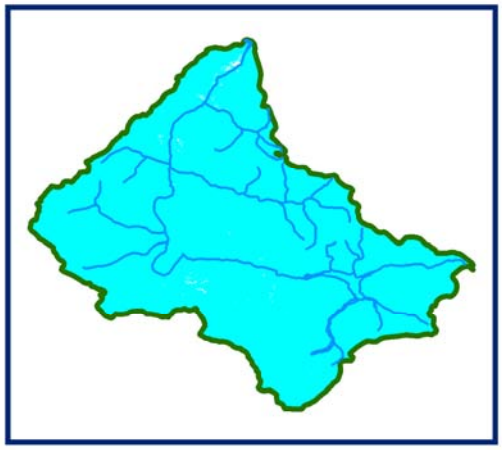
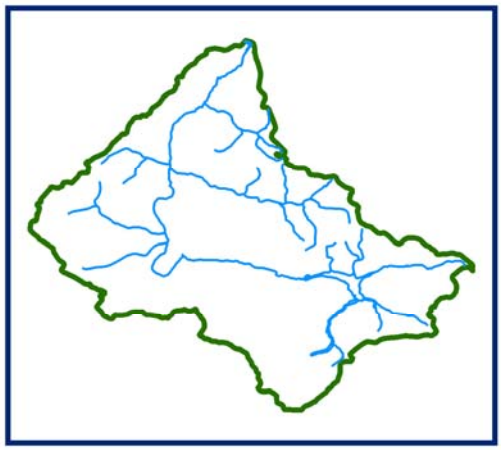


11 MARCH 2009



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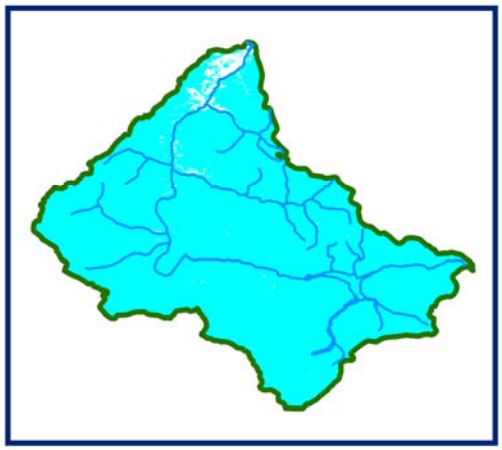
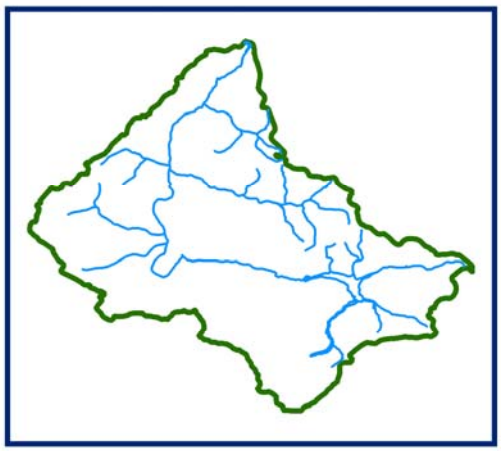


21 MARCH 2009



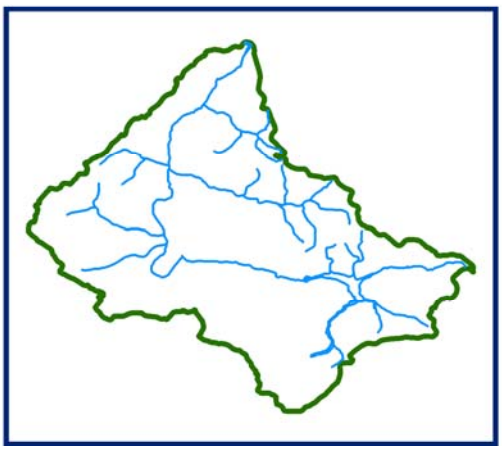
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



DATA USED
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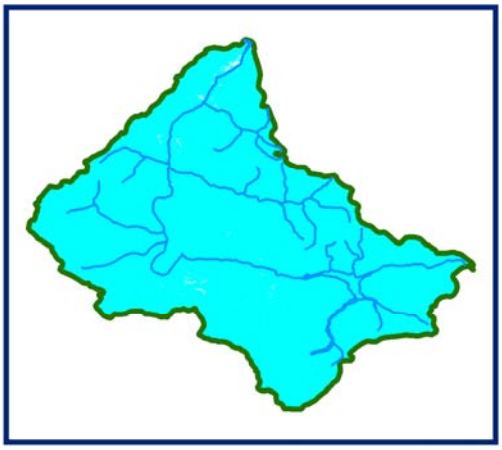

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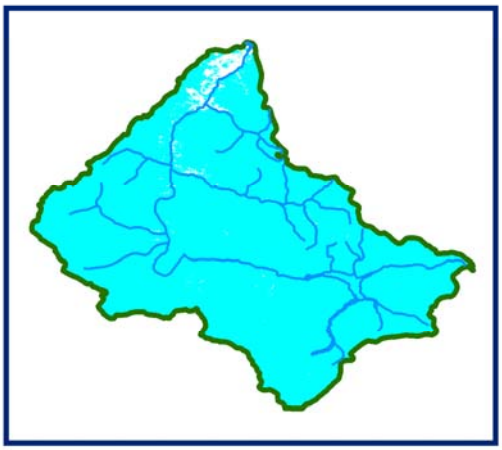
11 MARCH 2009

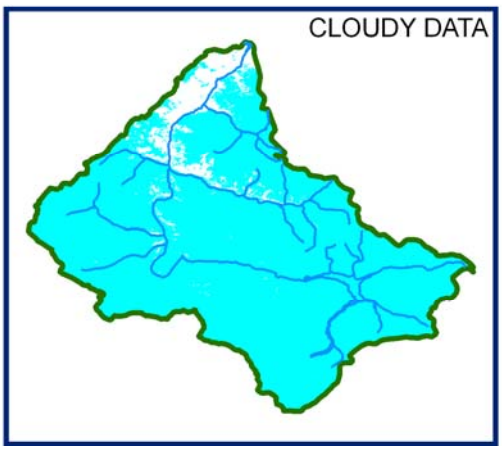


DATA USED
21 MARCH 2009

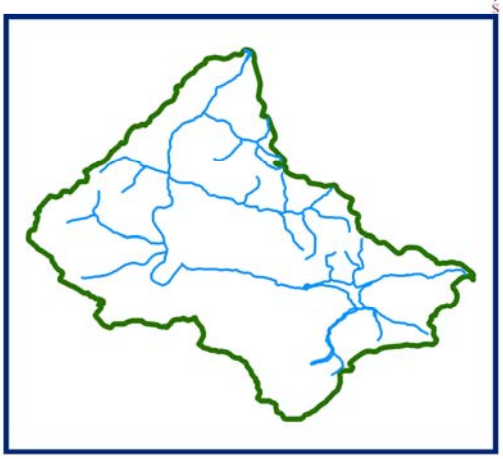
SNOW

0 15 30 60 90 120
Kilometers

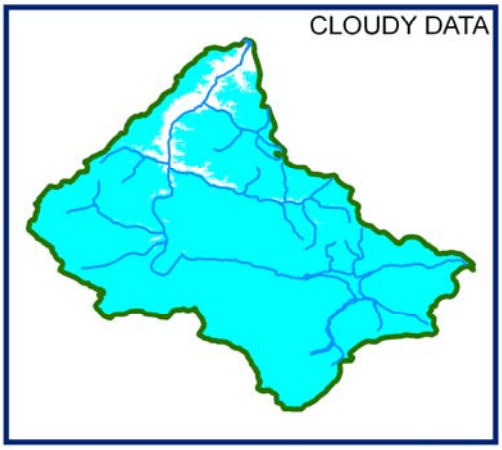
SNOW COVER MAP : SURU BASIN



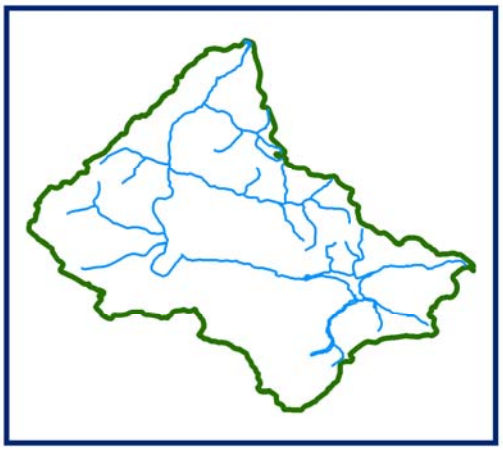
4 APRIL 2009



DATA NOT AVAILABLE



13 APRIL 2009



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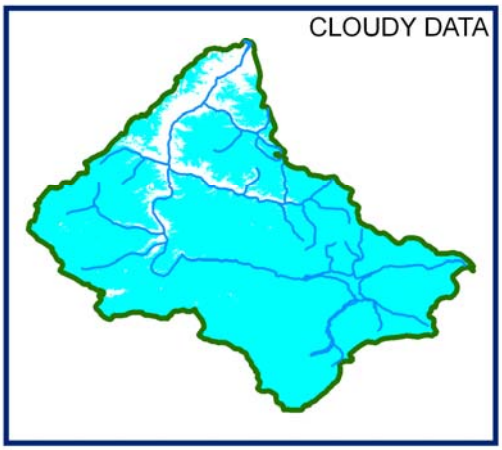
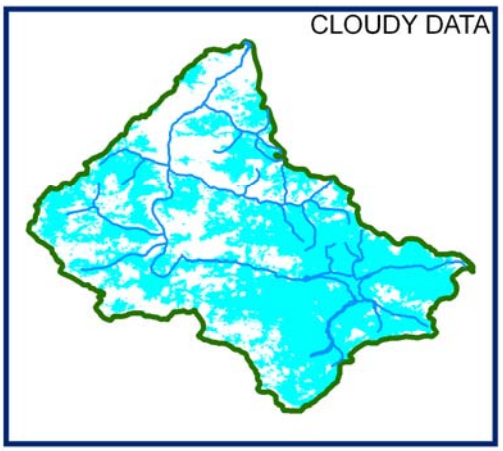
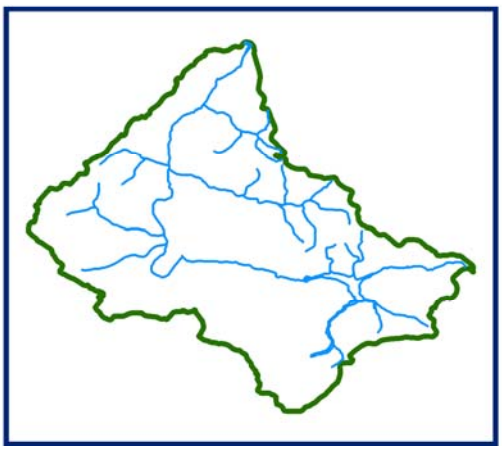


23 APRIL 2009

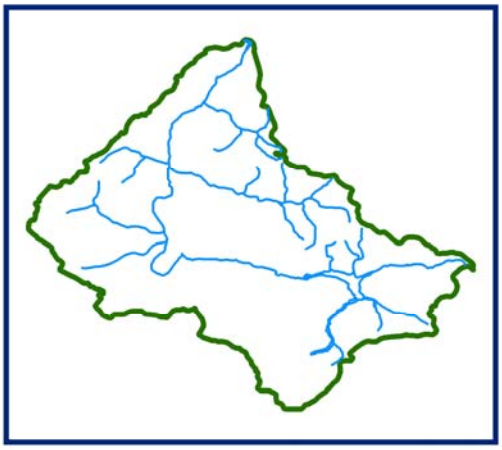


28 APRIL 2009

10 DAILY SNOW COVER MAP: SURU BASIN



DATA USED
DATA NOT AVAILABLE



DATA USED
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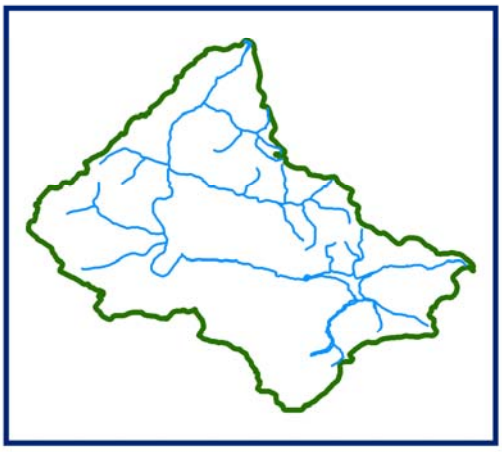
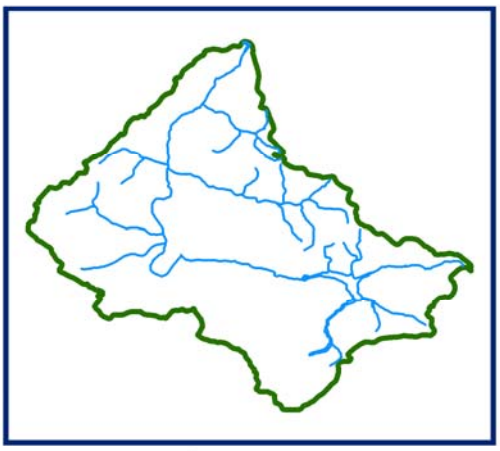


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



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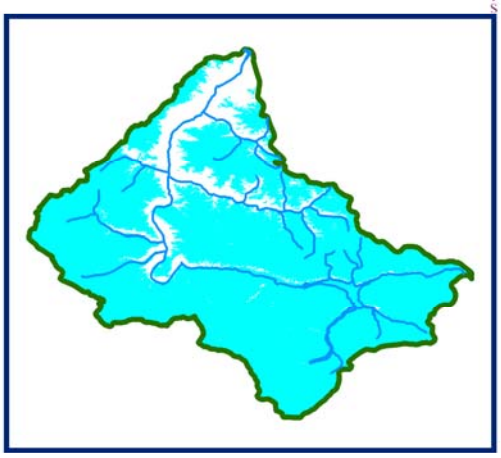
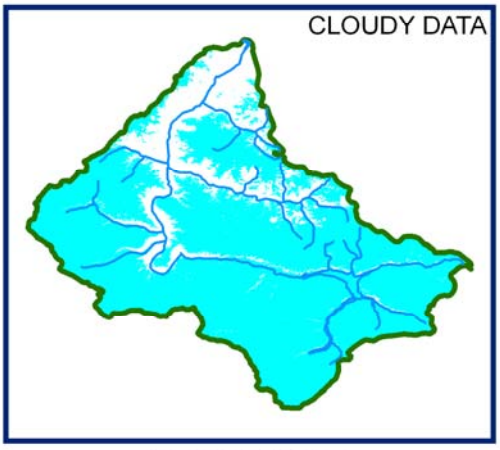
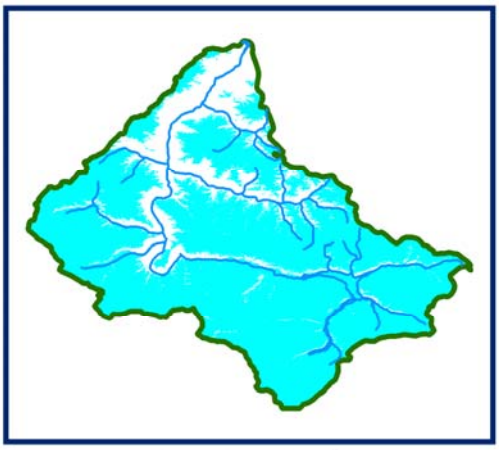


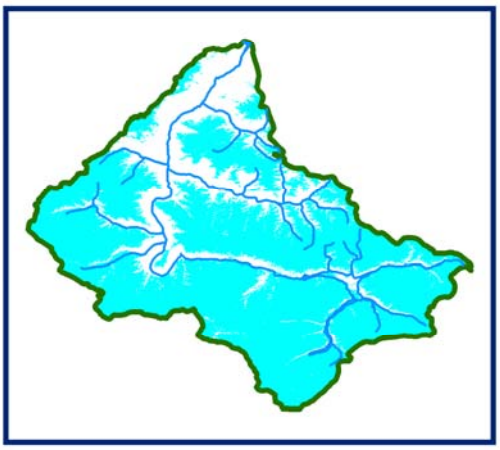
7 MAY 2009



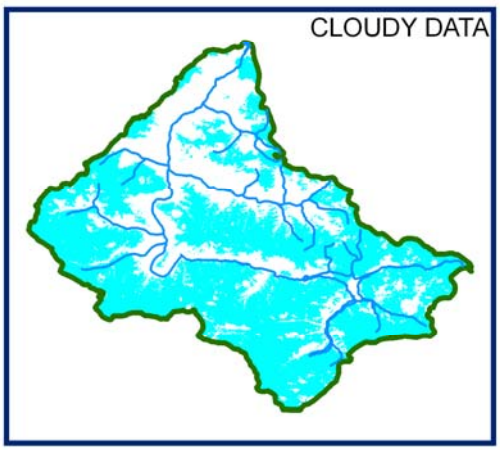
12 MAY 2009



17 MAY 2009



22 MAY 2009



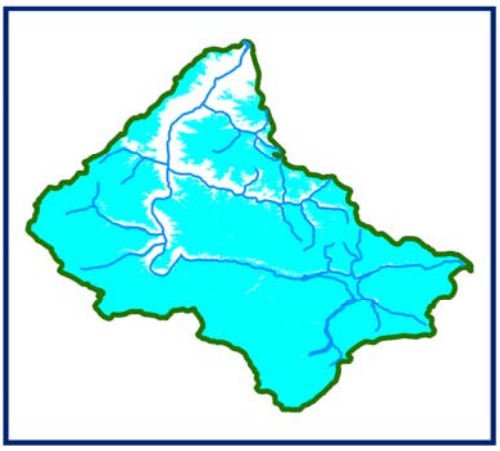
27 MAY 2009

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



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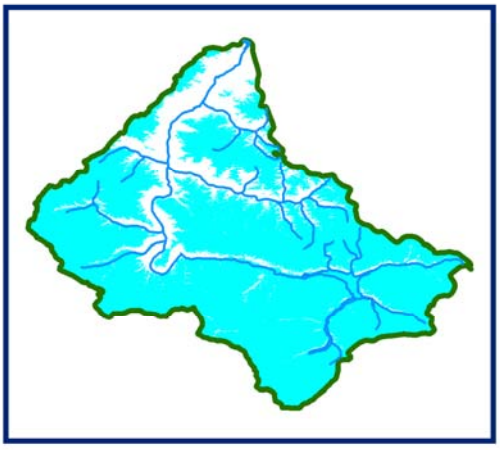

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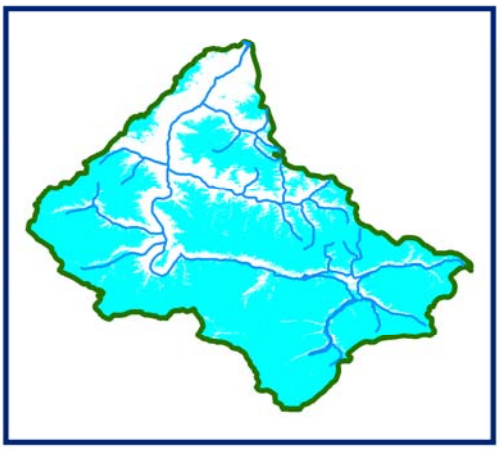
17 MAY 2009

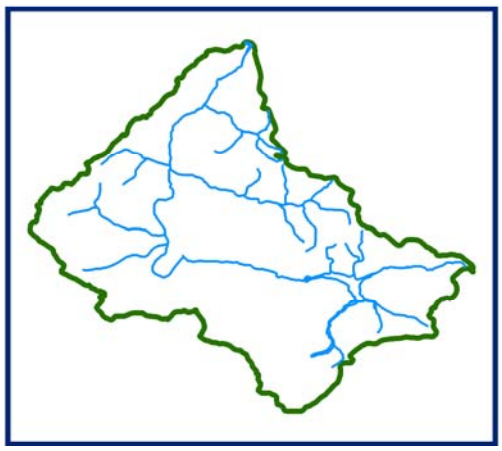


DATA USED
22 MAY 2009

SNOW

0 15 30 60 90 120
Kilometers

SNOW COVER MAP : SURU BASIN



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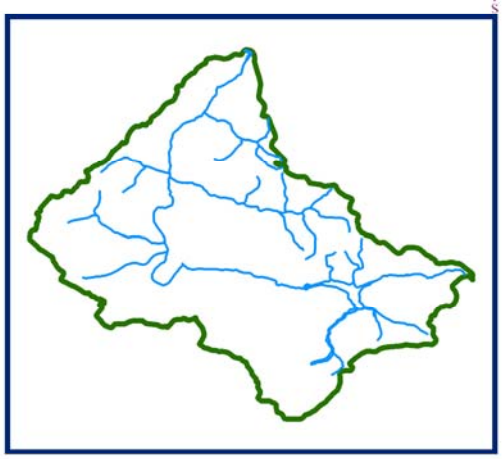

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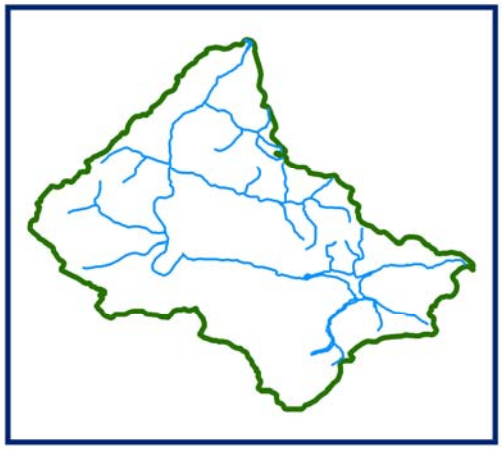

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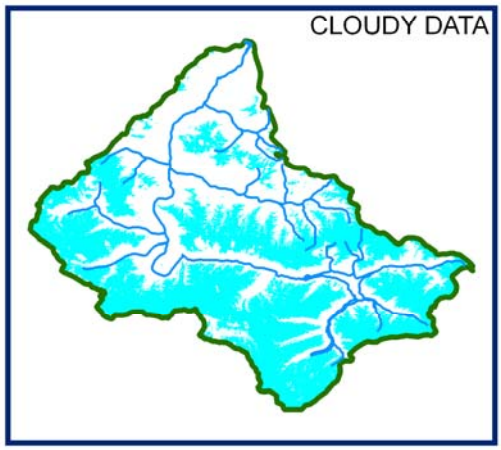
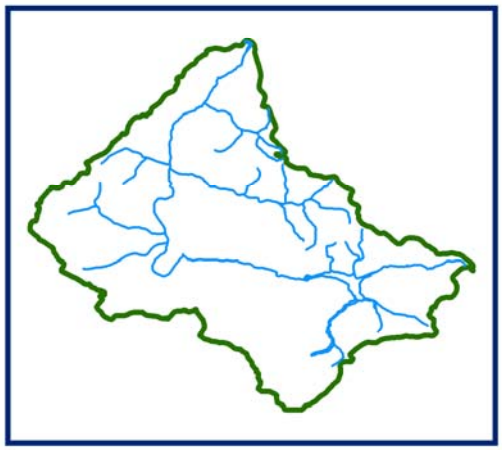


20 JUNE 2009



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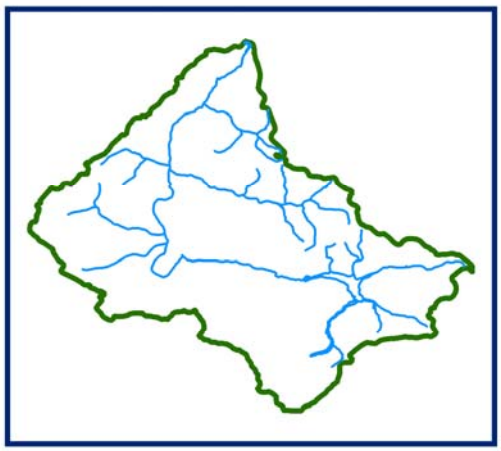


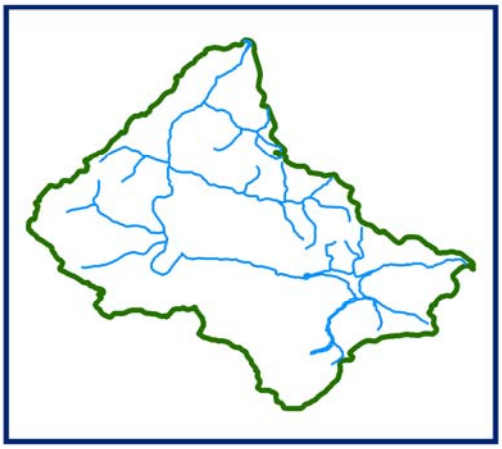
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120

Kilometers

10 DAILY SNOW COVER MAP: SURU BASIN



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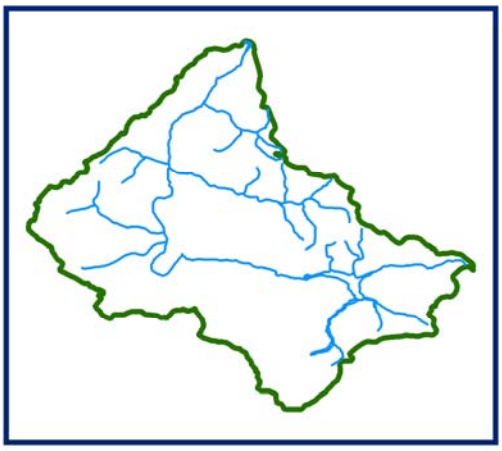

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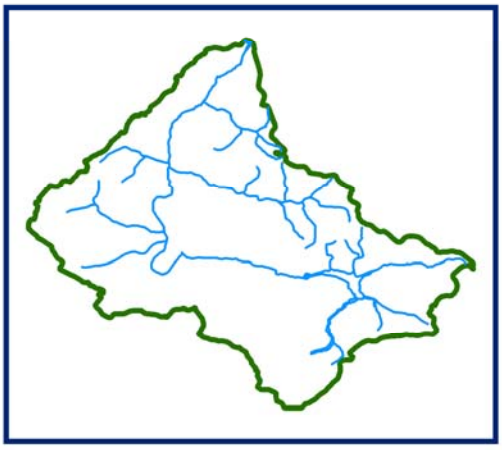


DATA USED
DATA NOT AVAILABLE

SNOW

0 15 30 60 90 120
Kilometers

ZASKAR BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: ZASKER **BASIN AREA: 14914 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008							
1	4-Oct-08	5133	34	2	13-Oct-08	5019	34
3	23-Oct-08	5319	36	4	27-Oct-08	5319	36
November 2008							
5	11-Nov-08	4047	27	6	16-Nov-08	3841	26
7	20-Nov-08	6862	46	8	21-Nov-08	7772	52
9	25-Nov-08	4154	28	10	26-Nov-08	4176	28
December 2008							
11	5-Dec-08	3778	25	12	10-Dec-08	10100	68
13	15-Dec-08	7286	49	14	24-Dec-08	7176	48
January 2009							
15	7-Jan-09	13922	93	16	8-Jan-09	13845	93
17	12-Jan-09	13856	93	18	27-Jan-09	14504	97
19	31-Jan-09	14428	97				
February 2009							
20	1-Feb-09	14370	96	21	5-Feb-09	9154	61
22	15-Feb-09	14319	96	23	25-Feb-09	14295	96
March 2009							
24	11-Mar-09	13801	93	25	21-Mar-09	13082	90
April 2009							
26	4-Apr-09	13051	88	27	13-Apr-09	11767	79
28	14-Apr-09	11353	76	29	18-Apr-09	11422	77
30	23-Apr-09	11370	76	31	28-Apr-09	9599	64
32	29-Apr-09	4354	29				
May 2009							
33	7-May-09	9850	66	34	12-May-09	8784	59
35	17-May-09	8620	58	36	22-May-09	6855	46
37	27-May-09	8116	54	38	31-May-09	7275	49

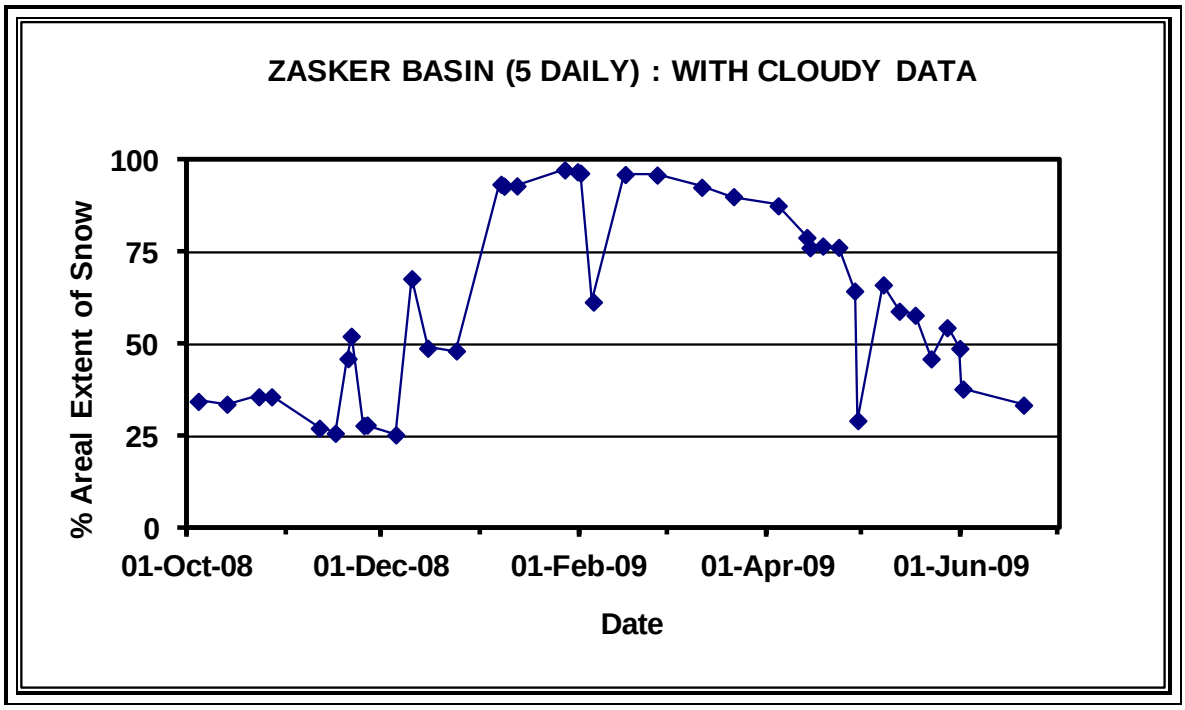
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
June 2009							
39	1-Jun-09	5634	38	40	20-Jun-09	4982	33
July 2009							
41	9-Jul-09	2153	14				

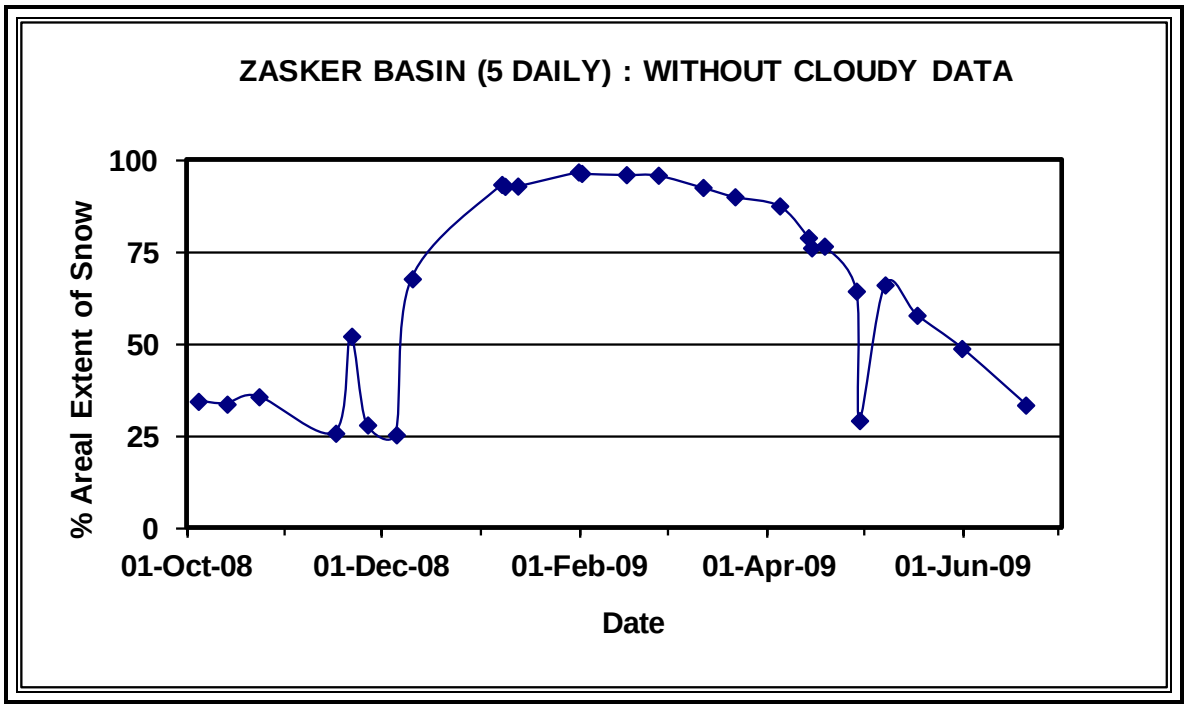
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: ZASKER **BASIN AREA: 14914 sq km**

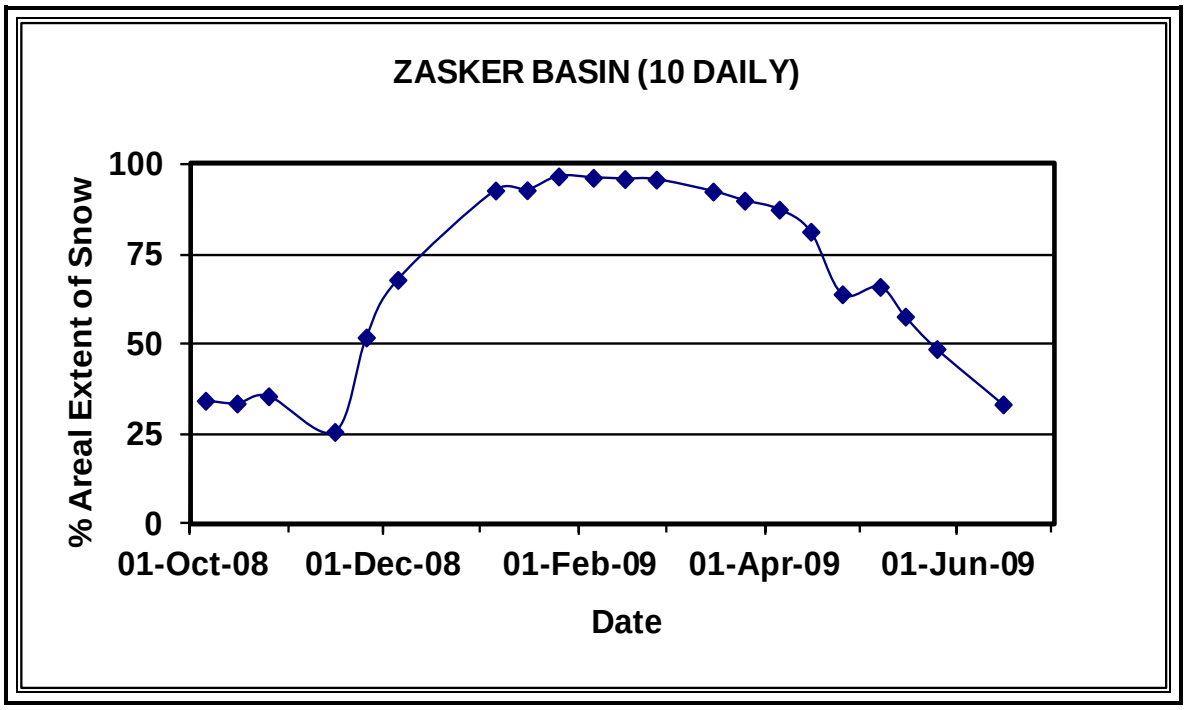
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2008				**November 2008**			
1	5-Oct-08	5133	34	4	15-Nov-08	3841	26
2	15-Oct-08	5019	34	5	25-Nov-08	7755	52
3	25-Oct-08	5369	36				
December 2008				**January 2009**			
6	5-Dec-08	10142	68	7	5-Jan-09	13845	93
				8	15-Jan-09	13856	93
				9	25-Jan-09	14428	97
February 2009				**March 2009**			
10	5-Feb-09	14370	96	13	15-Mar-09	13801	93
11	15-Feb-09	14319	96	14	25-Mar-09	13423	90
12	25-Feb-09	14295	96				
April 2009				**May 2009**			
15	5-Apr-09	13051	88	18	5-May-09	9850	66
16	15-Apr-09	12136	81	18	15-May-09	8620	58
17	25-Apr-09	9545	64	19	25-May-09	7275	49
June 2009				**July 2009**			
20	15-Jun-09	4982	33				

Snow cover depletion curve





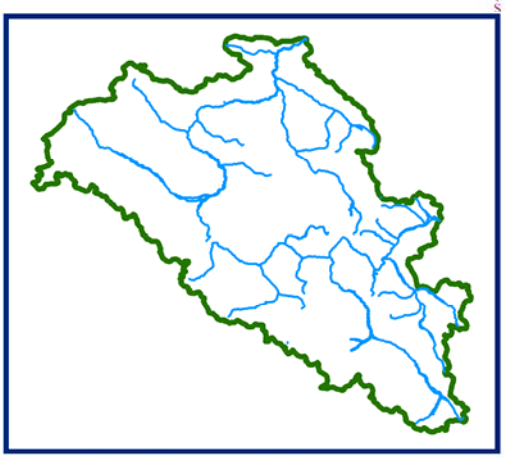
Snow cover depletion curve



SNOW COVER MAP

SNOW COVER MAP : ZASKER BASIN

4 OCTOBER 2008



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13 OCTOBER 2008

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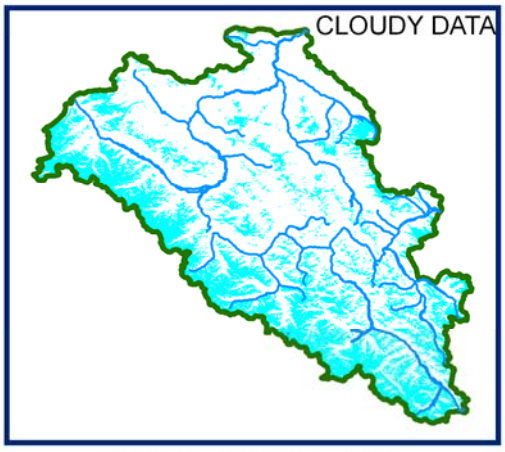
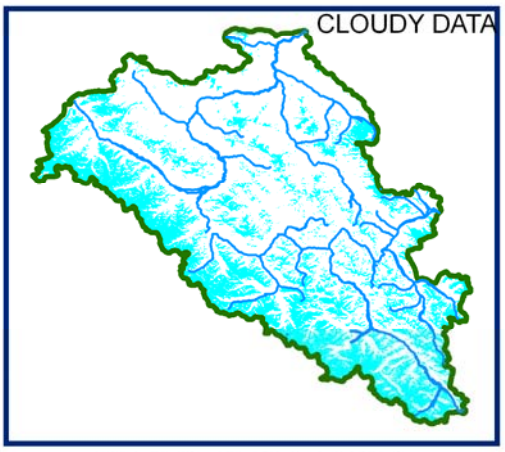


23 OCTOBER 2008



27 OCTOBER 2008

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
4 OCTOBER 2008

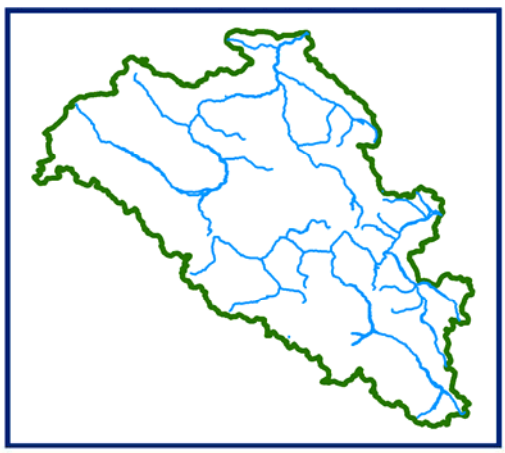
DATA USED
13 OCTOBER 2008

DATA USED
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN



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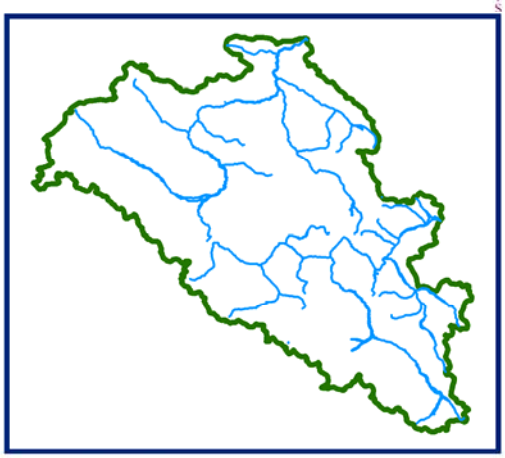

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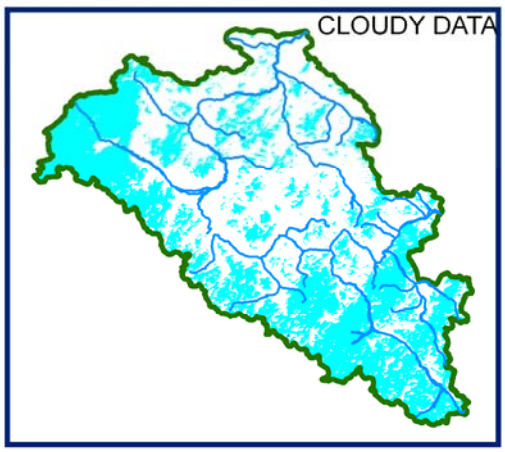
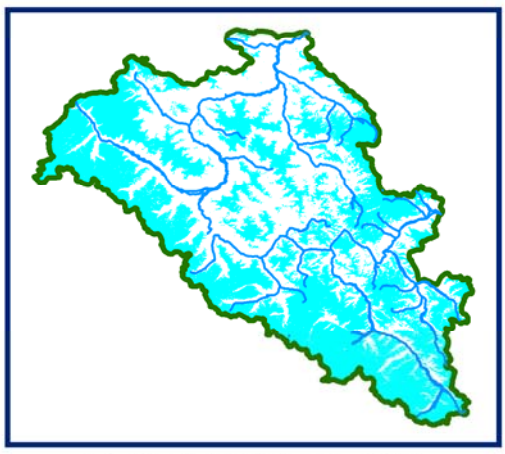
16 NOVEMBER 2008



20 NOVEMBER 2008



21 NOVEMBER 2008

26 NOVEMBER 2008

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
DATA NOT AVAILABLE

DATA USED
16 NOVEMBER 2008

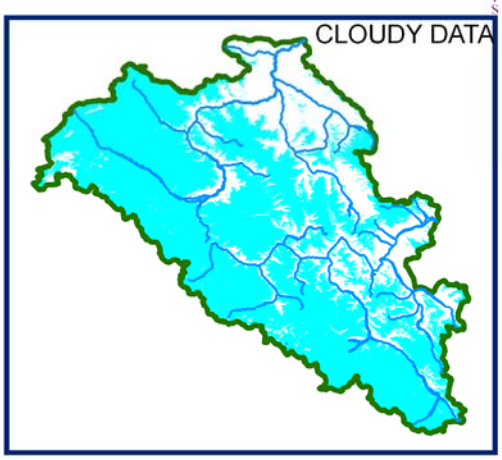
DATA USED
21 NOVEMBER 2008
26 NOVEMBER 2008

SNOW

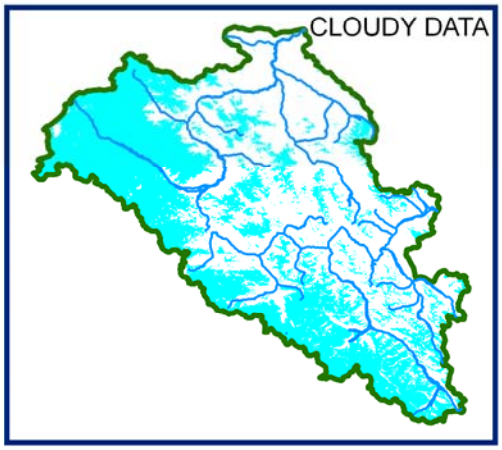
0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN

5 DECEMBER 2008

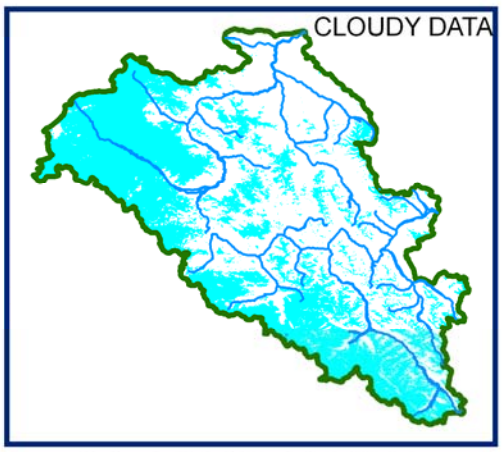


10 DECEMBER 2008



15 DECEMBER 2008

DATA NOT AVAILABLE



24 DECEMBER 2008

DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
5 DECEMBER 2008

DATA USED
DATA NOT AVAILABLE

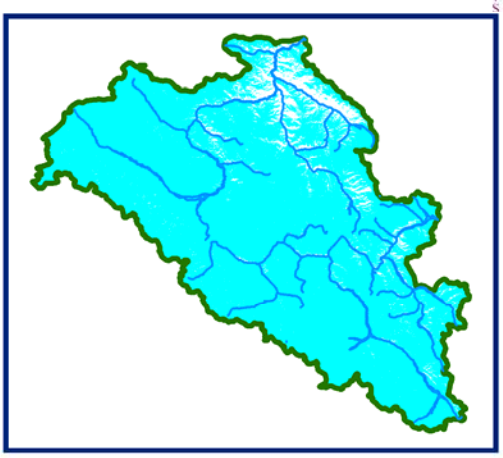
DATA USED
DATA NOT AVAILABLE

SNOW

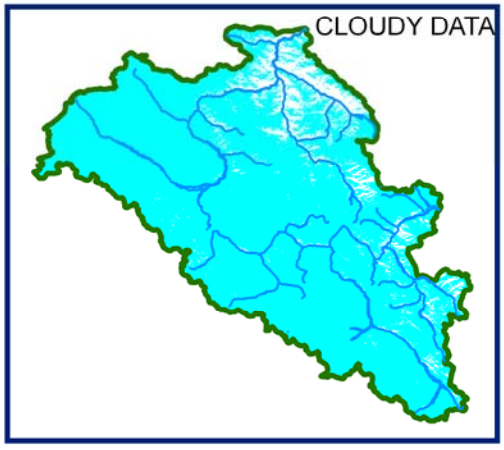
0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN

DATA NOT AVAILABLE



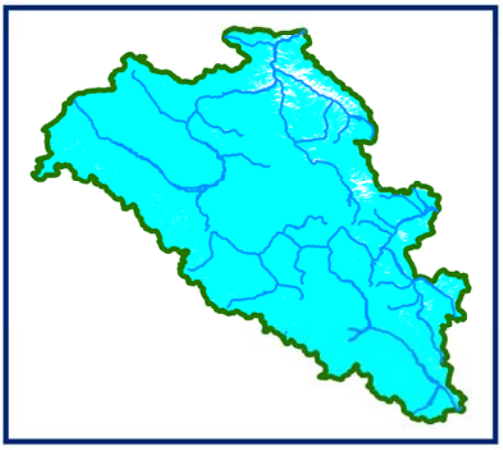
8 JANUARY 2009



12 JANUARY 2009

DATA NOT AVAILABLE

DATA NOT AVAILABLE



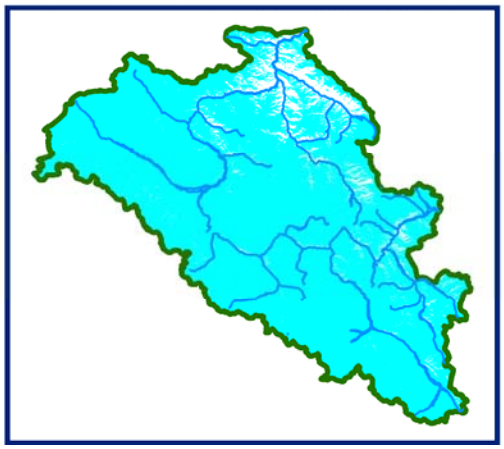
31 JANUARY 2009

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN



DATA USED
8 JANUARY 2009

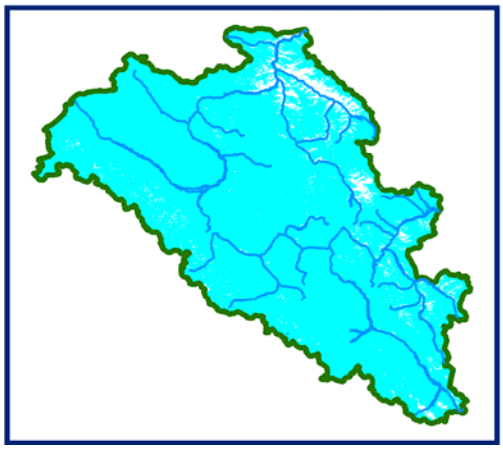
DATA USED
DATA NOT AVAILABLE

DATA USED
31 JANUARY 2009

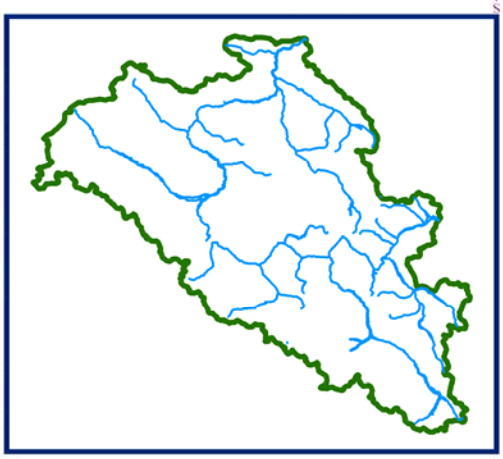
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN



1 FEBRUARY 2009



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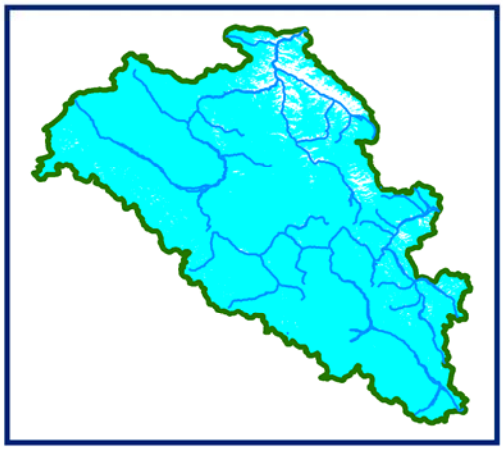
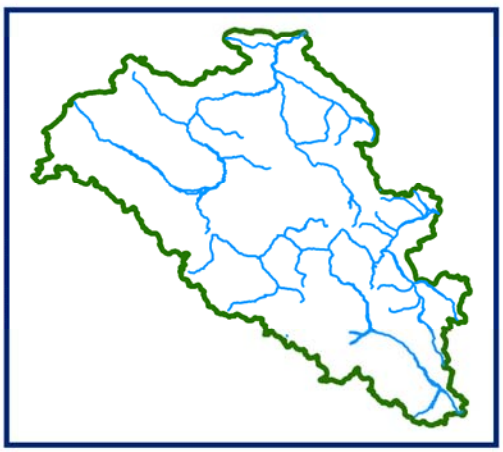


15 FEBRUARY 2009

DATA NOT AVAILABLE

25 FEBRUARY 2009



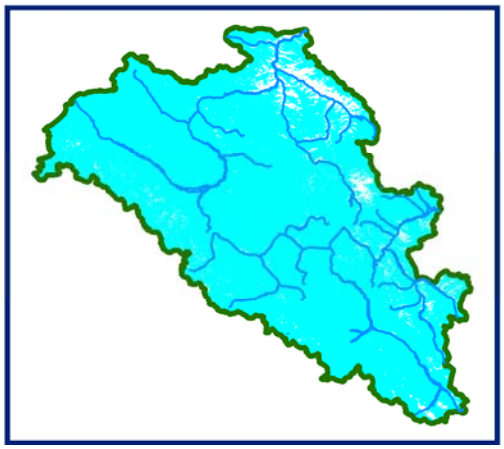
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN



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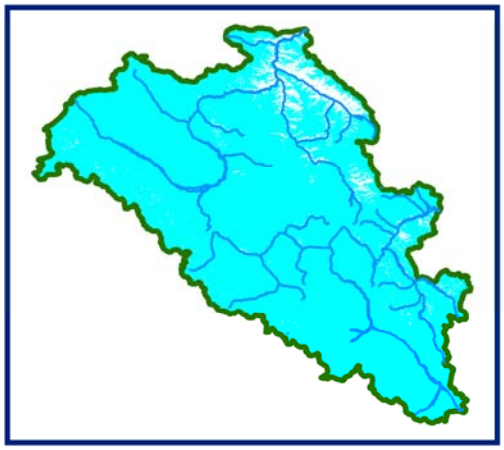
1 FEBRUARY 2009



DATA USED
15 FEBRUARY 2009

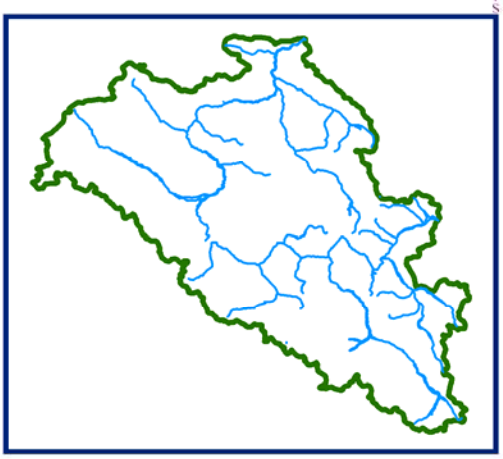
DATA USED
25 FEBRUARY 2009

SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN

DATA NOT AVAILABLE



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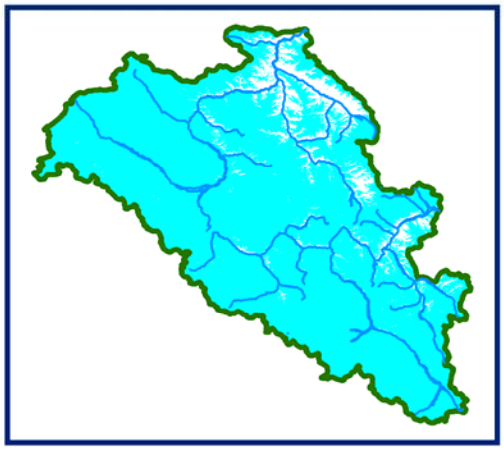
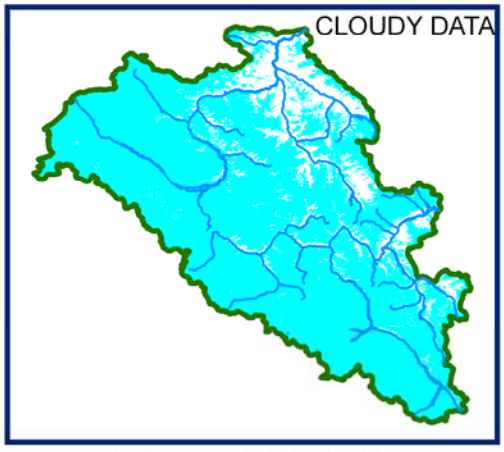


11 MARCH 2009

DATA NOT AVAILABLE



21 MARCH 2009

DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
DATA NOT AVAILABLE

DATA USED
10 MARCH 2009

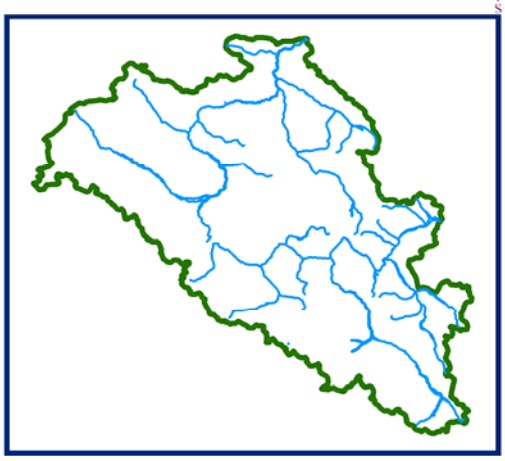
DATA USED
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200
Kilometers

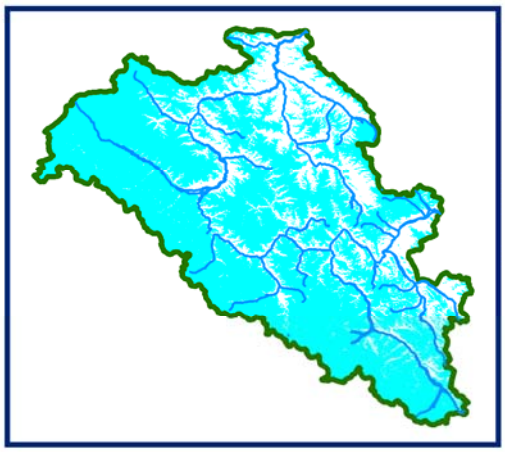
SNOW COVER MAP : ZASKER BASIN

4 APRIL 2009

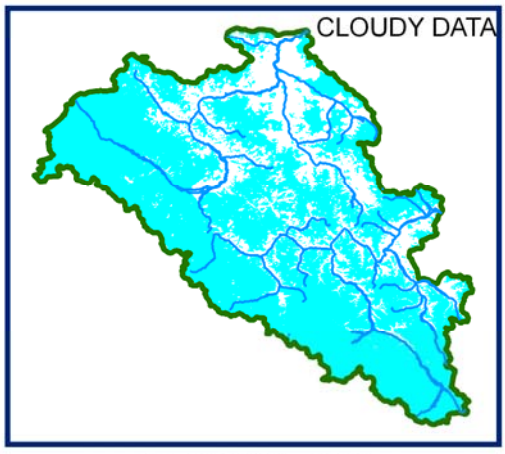


DATA NOT AVAILABLE

13 APRIL 2009



18 APRIL 2009



23 APRIL 2009

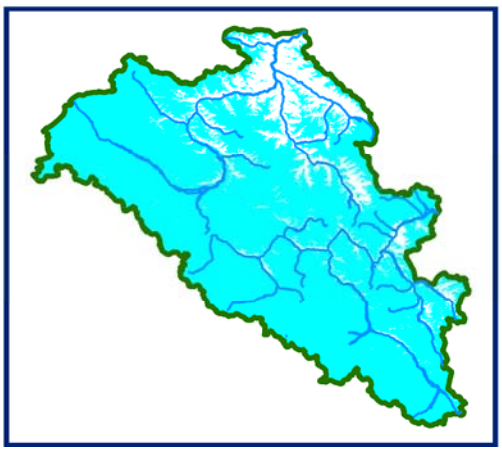
29 APRIL 2009

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN



DATA USED
4 APRIL 2009

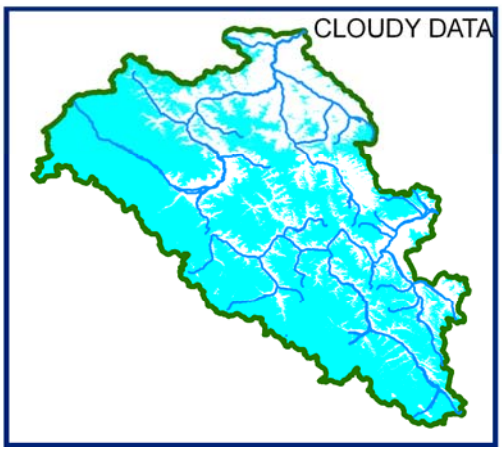
DATA USED
13 APRIL 2009
14 APRIL 2009
18 APRIL 2009

DATA USED
29 APRIL 2009

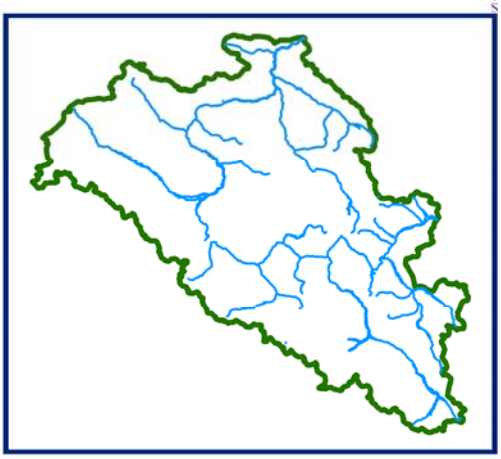
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN



7 APRIL 2006



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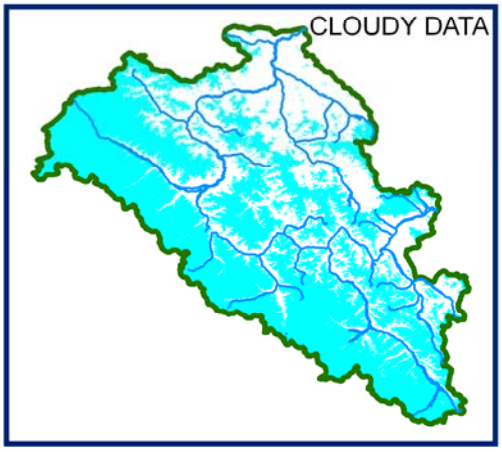
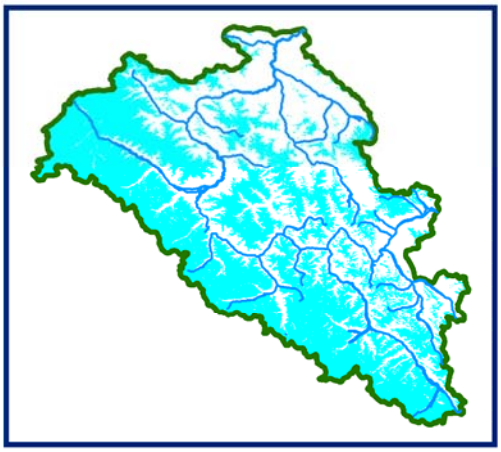


12 MAY 2009



17 MAY 2009

DATA NOT AVAILABLE

31 MAY 2009

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
DATA NOT AVAILABLE

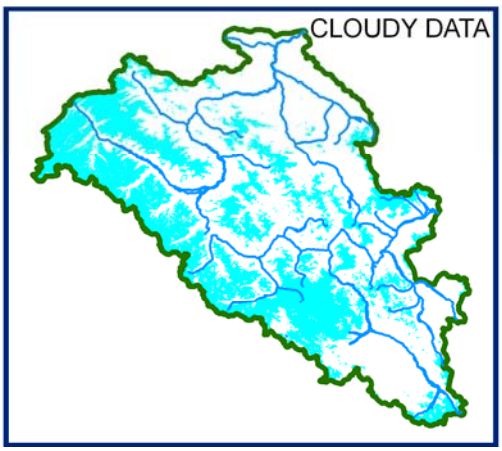
DATA USED
17 MAY 2009

DATA USED
31 MAY 2009

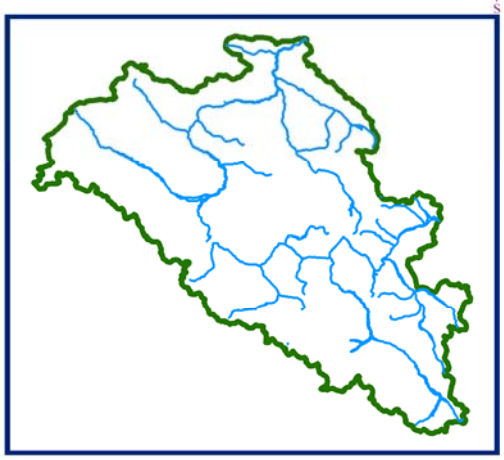
SNOW

0 25 50 100 150 200
Kilometers

SNOW COVER MAP : ZASKER BASIN



1 JUNE 2009

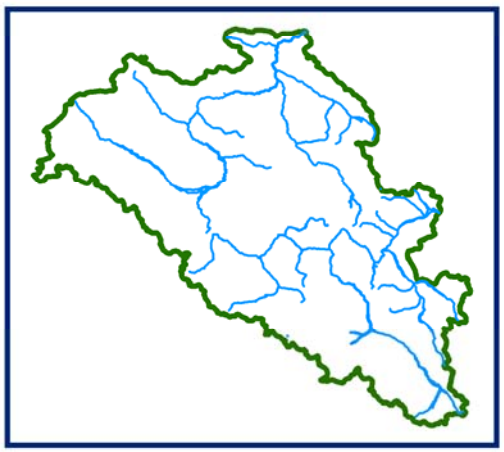


DATA NOT AVAILABLE

DATA NOT AVAILABLE

20 JUNE 2009

DATA NOT AVAILABLE



DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200

Kilometers

10 DAILY SNOW COVER MAP: ZASKER BASIN

DATA USED
DATA NOT AVAILABLE

DATA USED
20 JUNE 2009

DATA USED
DATA NOT AVAILABLE

SNOW

0 25 50 100 150 200
Kilometers