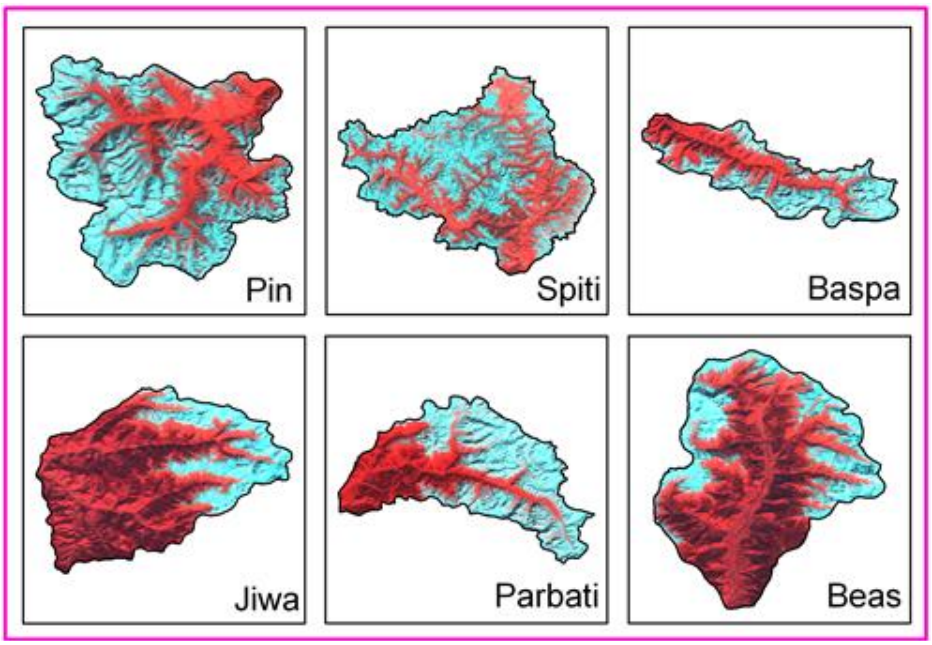
SNOW COVER ATLAS OF SATLUJ BASIN

Sub basins: Pin, Spiti, Baspa, Jiwa, Parbati and Beas

(Integrated *Studies of Himalayan Cryosphere*
A Project of Indian Space Research Organisation)

YEAR: 2015-16



Space Applications Centre (ISRO)

Ahmedabad – 380015

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DOCUMENT CONTROL AND DATA SHEET

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Abstract	This atlas gives sub-basin-wise distribution of snow cover in the Satluj basin from October 2015 to June 2016. The sub-basins included in this report are Pin, Spiti, Baspa, Jiwa, Parbati and Beas. 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 curves. It is expected that this data will be useful for hydrological and climatological applications.
Key words	Snow cover, NDSI, AWiFS, depletion curve, Pin, Spiti, Baspa, Jiwa, Parbati and Beas basins.
Security Classification	Unrestricted
Distribution	As per list

CONTENTS

1. **Introduction**

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

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

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

2. Study Area:

The study area comprises of distribution of snow cover in Pin, Spiti, Baspa, Jiwa, Baspa, Parbati and Beas sub basins of Satluj basin. The location map of these sub basins is as per Figure 1.

3. Data used:

AWiFS data from October 2015 to June 2016 was 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 curve is given from October 2015 to June 2016. Snow ablation pattern varies from basin to basin, depending on area altitude distribution in the basins. For example, in the Jiwa and Beas river basin, which is located in lower altitude zone and contains few glaciers has shown and ablation of snow through out the winter season. However, in case of Pin & Parbati basins, located in high altitude region and large area is covered by glaciers has shown little or no ablation from January to April. For a period between October to December, snow ablation was observed in all basins.

Acknowledgements

This investigation was carried out under Integrated studies of Himalayan Cryosphere, at Space Applications Centre (ISRO), Ahmedabad. The authors are grateful to Shri Tapan Misra, Director, Space Applications Centre, Ahmedabad for continuous guidance and encouragement during the investigation. Authors would like to thank Dr. Rajkumar Deputy Director, EPSA, SAC for their suggestions and comments on the manuscript.

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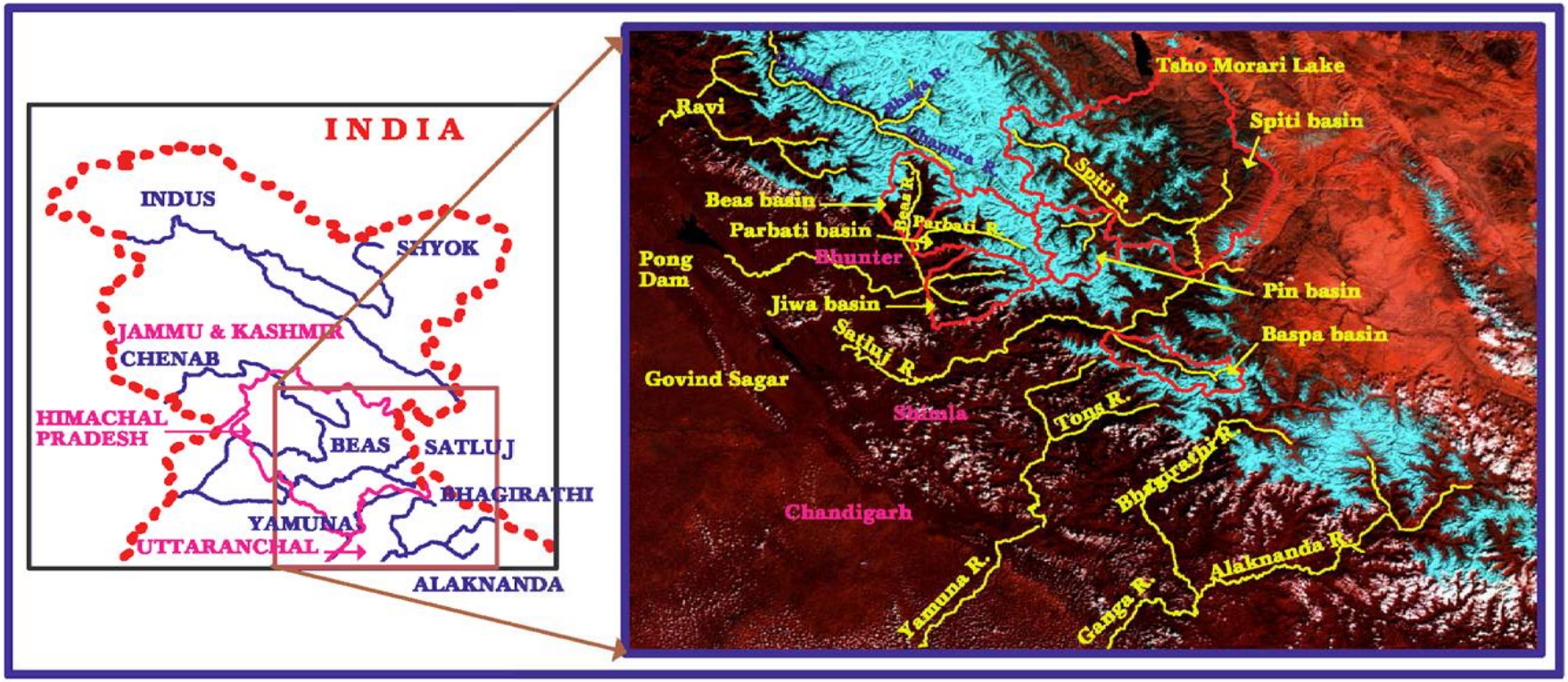


Figure 1: Location map of Pin, Spiti, Baspa, Jiwa, Parbati and Beas sub-basins (Part of Satluj basin)

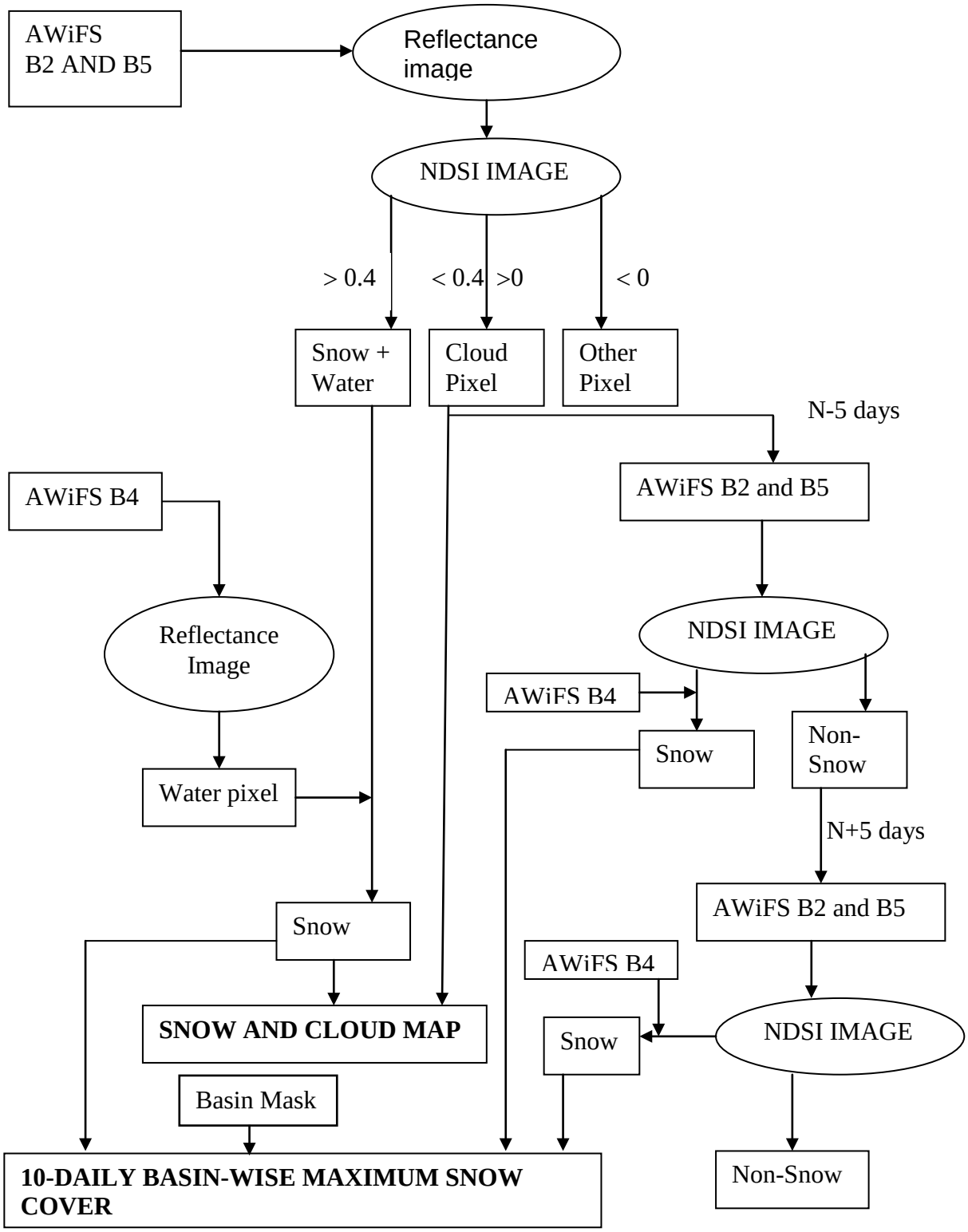


Figure 2: Algorithm for snow cover mapping using AWiFS data

PIN SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: PIN **BASIN AREA: 1266 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	01-Oct-15	590	47	**3**	28-Oct-15	830	66
2	04-Oct-15	549	43		30-Oct-15	635	50
November 2015							
4	01-Nov-15	550	43	**6**	06-Nov-15	982	78
5	02-Nov-15	523	41	**7**	07-Nov-15	890	70
December 2015							
8	01-Dec-15	923	73	**11**	10-Dec-15	678	54 (c)
9	05-Dec-15	800	63	**12**	13-Dec-15	1218	96
10	07-Dec-15	619	49 (c)	**13**	20-Dec-15	1167	92
January 2016							
14	03-Jan-16	1026	81	**16**	13-Jan-16	1061	84
15	05-Jan-16	1100	87	**17**	27-Jan-16	1055	83
	06-Jan-16	1105	87				
February 2016							
18	01-Feb-16	1264	100	**21**	10-Feb-16	1221	96
19	03-Feb-16	1194	94	**22**	17-Feb-16	1208	95
20	05-Feb-16	707	56 (c)	**23**	27-Feb-16	1223	97
	08-Feb-16	1266	100				
March 2016							
24	01-Mar-16	1210	96	**26**	05-Mar-16	1162	92 (c)
25	03-Mar-16	1219	96		22-Mar-16	1264	100
April 2016							
27	03-Apr-16	1209	95	**30**	23-Apr-16	1219	96
28	13-Apr-16	1221	96	**31**	27-Apr-16	1139	90
29	20-Apr-16	1202	95	**32**	30-Apr-16	1108	88
May 2016							
33	02-May-16	1101	87	**35**	19-May-16	829	65
34	17-May-16	860	68	**36**	31-May-16	677	53

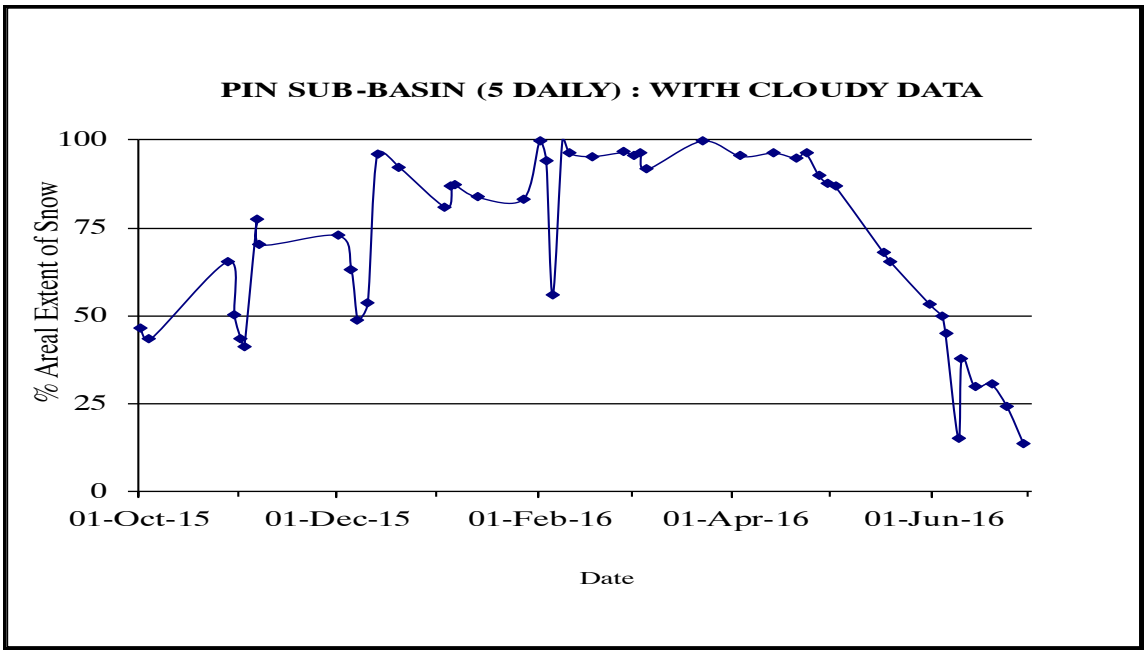
June 2016							
37	04-Jun-16	631	50	**41**	14-Jun-16	379	30
38	05-Jun-16	568	45	**42**	19-Jun-16	388	31
39	09-Jun-16	191	15 (c)	**43**	24-Jun-16	305	24
40	10-Jun-16	481	38	**44**	29-Jun-16	174	14 (c)

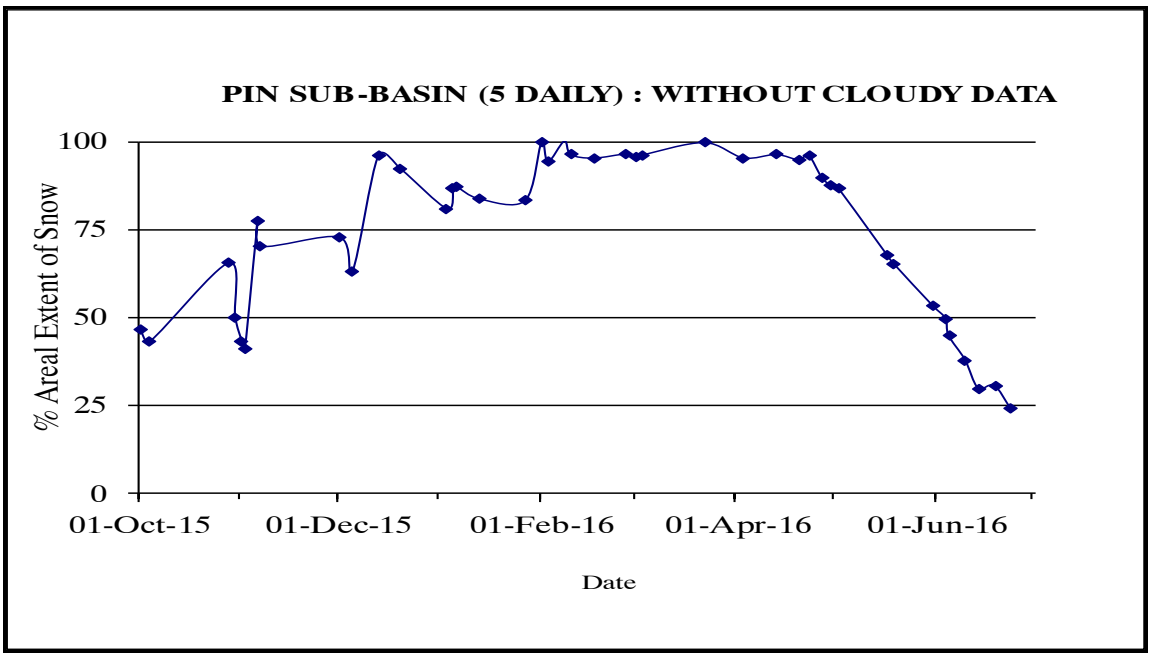
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: PIN **BASIN AREA: 1266 sq km**

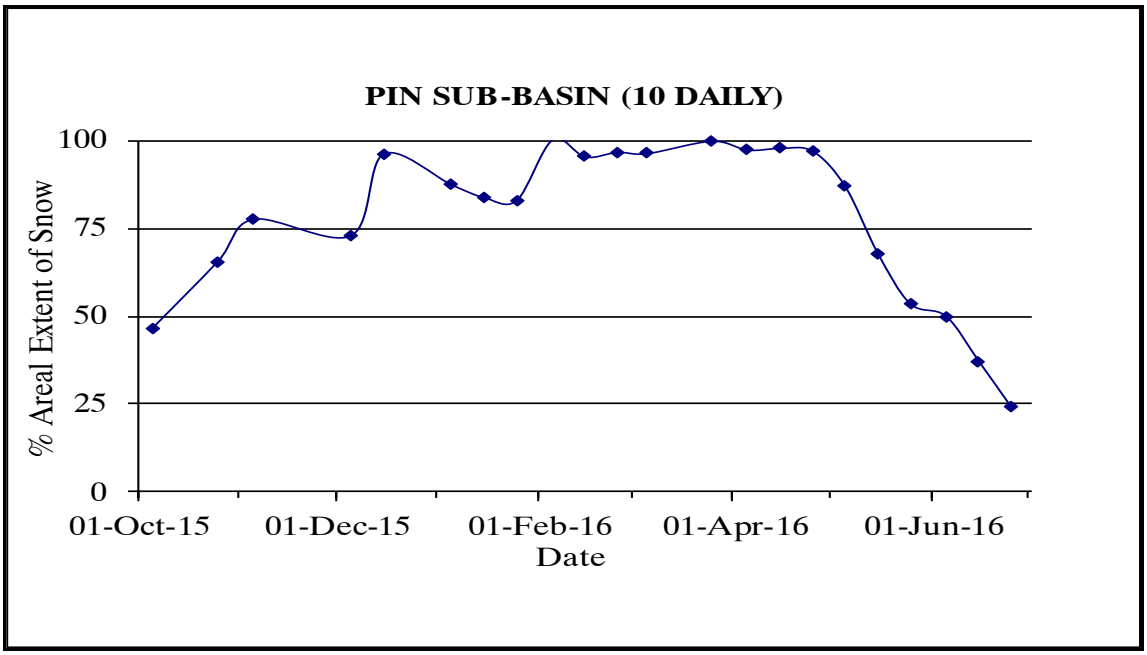
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	590	47	**3**	05-Nov-15	982	78
2	25-Oct-15	830	66				
December 2015				**January 2016**			
4	05-Dec-15	923	73	**6**	05-Jan-16	1106	87
5	15-Dec-15	1218	96	**7**	15-Jan-16	1060	84
				8	25-Jan-16	1055	83
February 2016				**March 2016**			
9	05-Feb-16	1269	100	**12**	05-Mar-16	1219	96
10	15-Feb-16	1207	95	**13**	25-Mar-16	1264	100
11	25-Feb-16	1224	97				
April 2016				**May 2016**			
14	05-Apr-16	1232	97	**17**	05-May-16	1101	87
15	15-Apr-16	1238	98	**18**	15-May-16	860	68
16	25-Apr-16	1228	97	**19**	25-May-16	677	53
June 2016							
20	05-Jun-2016	632	50				
21	15-Jun-2016	471	37				
22	25-Jun-2016	305	24				

SNOW COVER DEPLETION CURVE

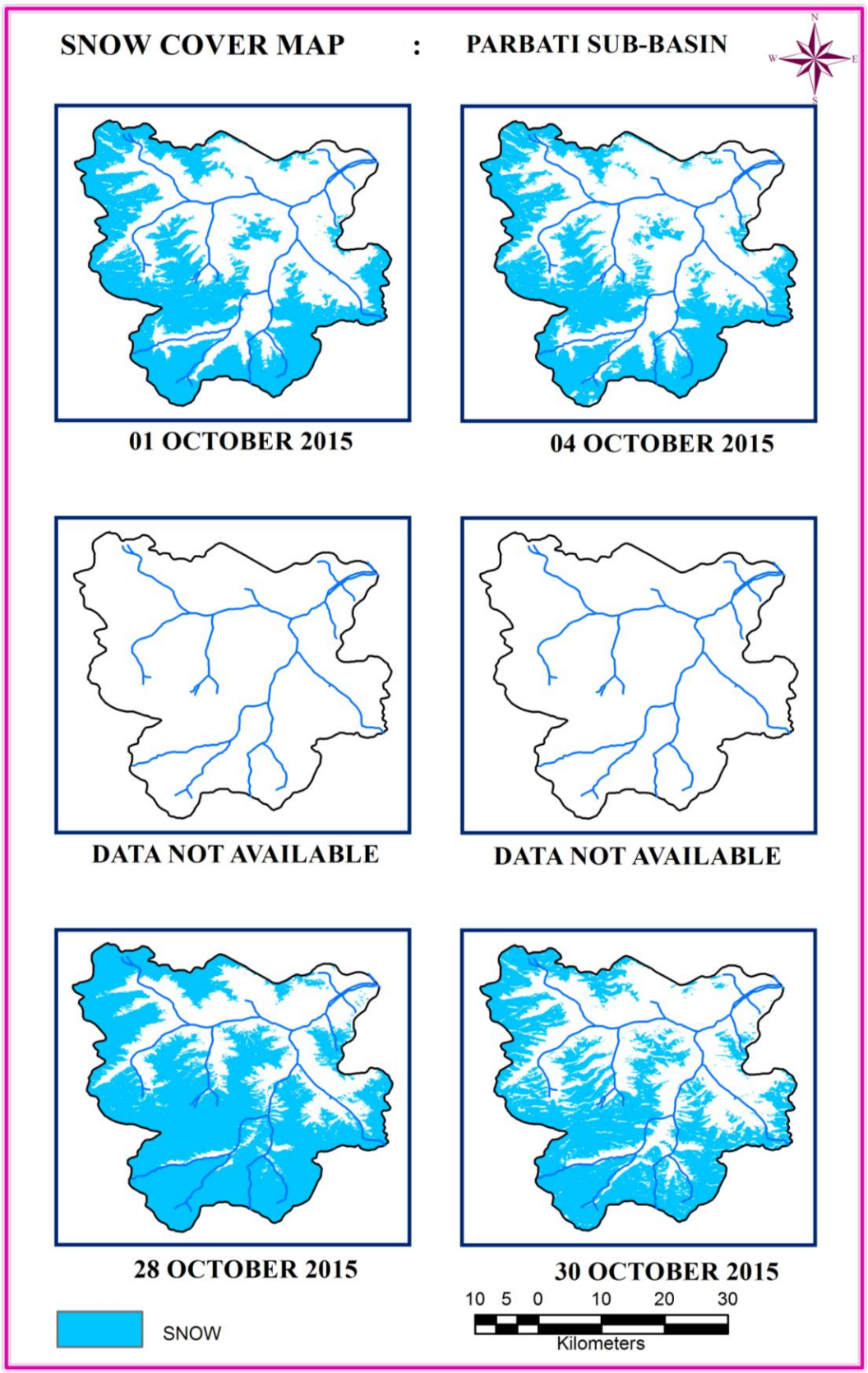




SNOW COVER DEPLETION CURVE



SNOW COVER MAP


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
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01 OCTOBER 2015
04 OCTOBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
28 OCTOBER 2015
30 OCTOBER 2015
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN

DATA USED
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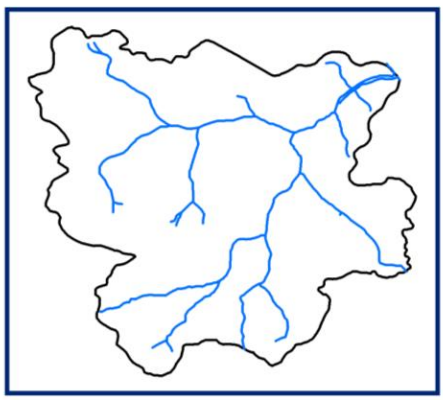
04 OCTOBER 2015



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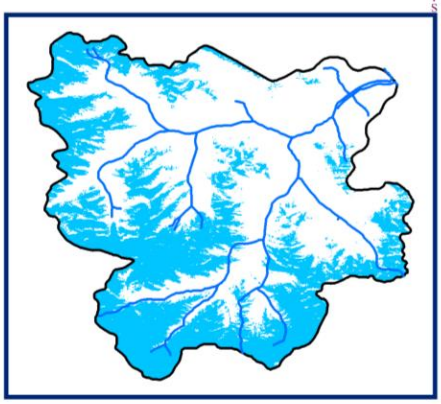
DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

10 5 0 10 20 30 40
Kilometers

SNOW COVER MAP : PARBATI SUB-BASIN

01 NOVEMBER 2015



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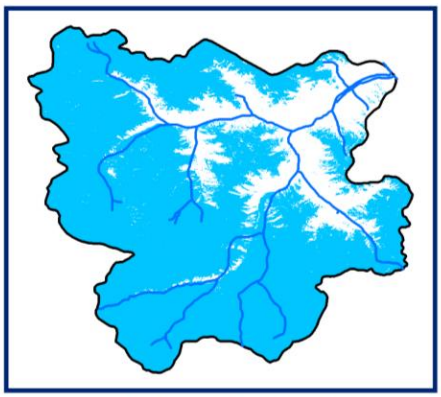

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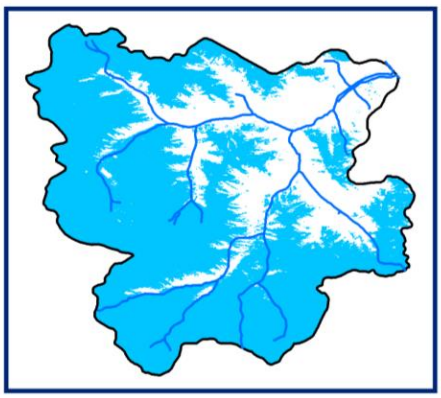

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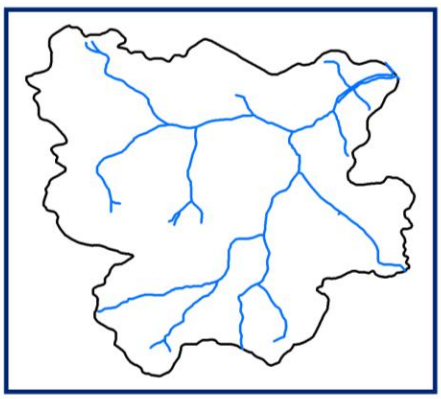

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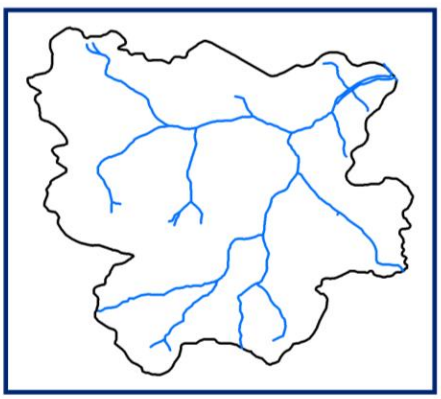

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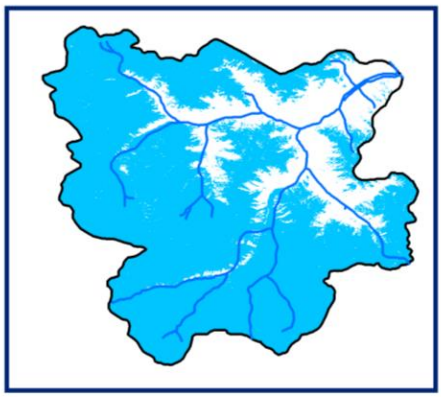
SNOW

10 5 0 10 20 30

Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN



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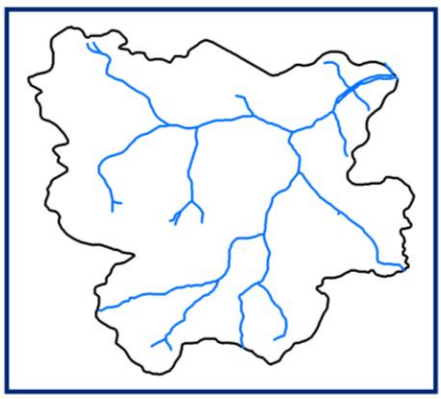

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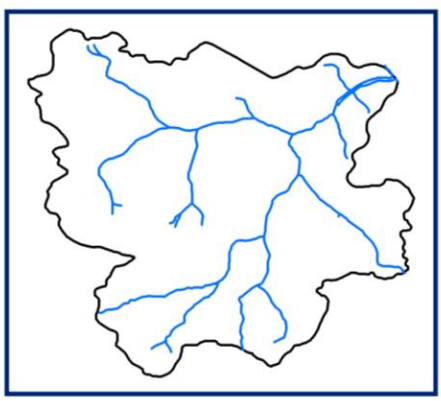

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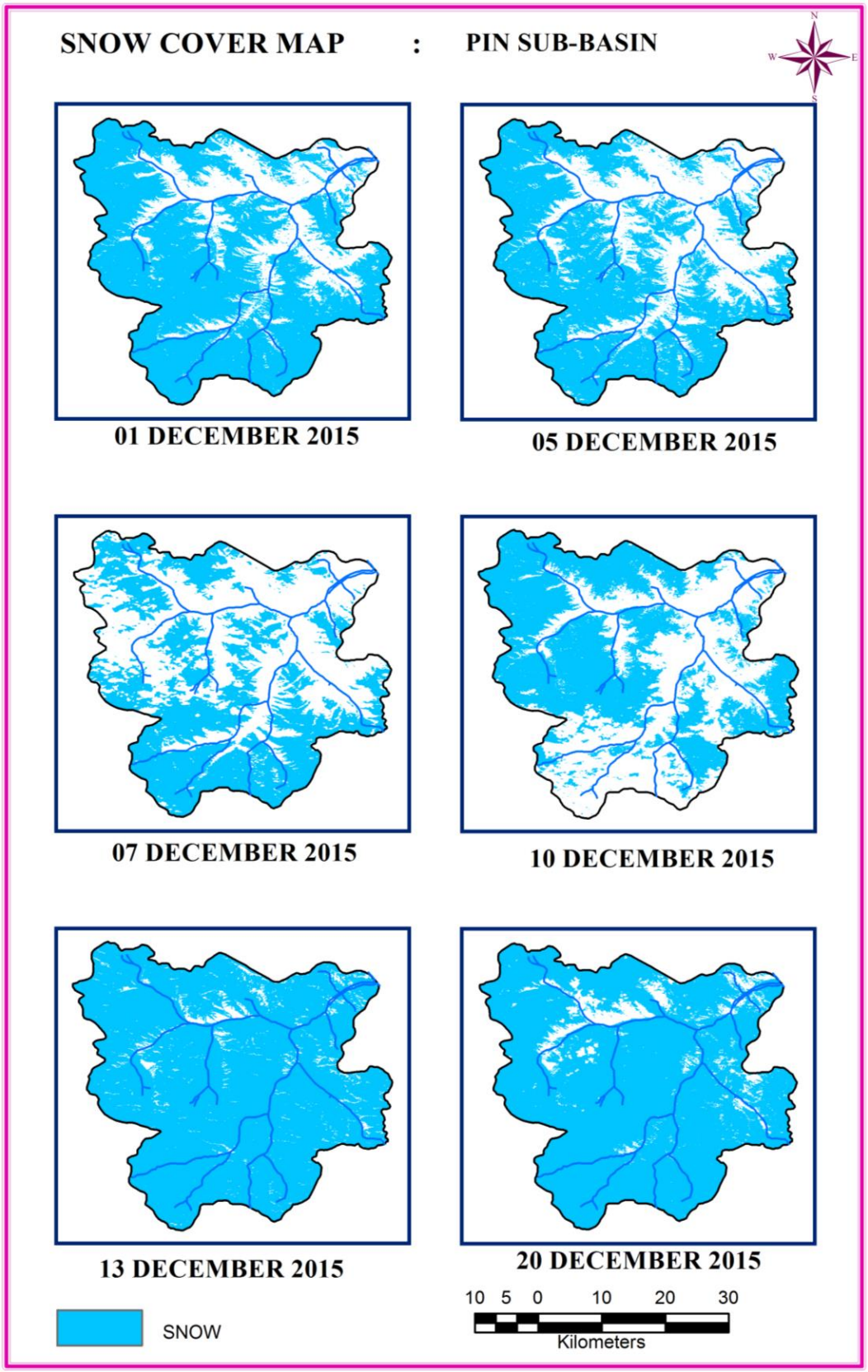
SNOW

10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PIN SUB-BASIN
N
W
E
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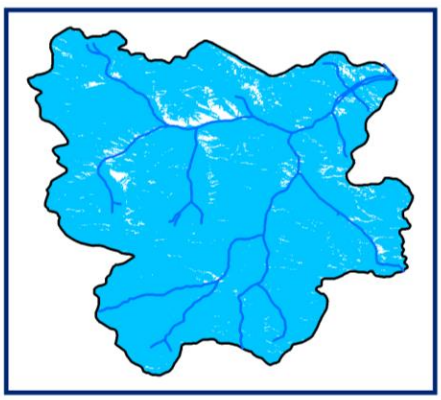
01 DECEMBER 2015
05 DECEMBER 2015
07 DECEMBER 2015
10 DECEMBER 2015
13 DECEMBER 2015
20 DECEMBER 2015
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN

DATA USED
01 DECEMBER 2015
05 DECEMBER 2015
10 DECEMBER 2015



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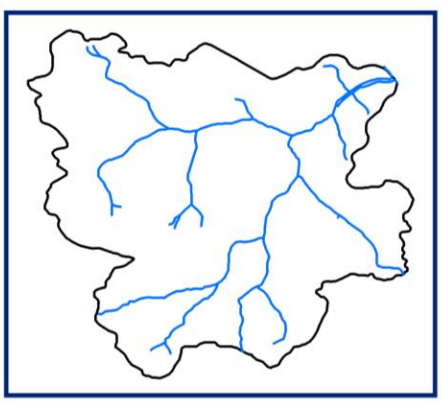

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SNOW

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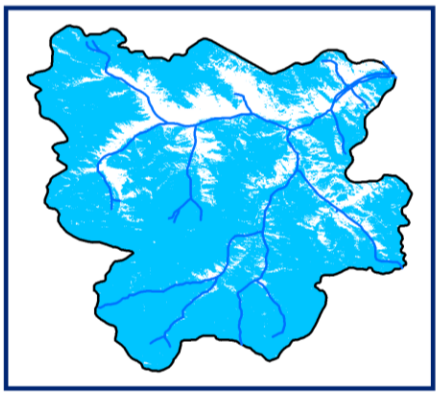
Kilometers

SNOW COVER MAP : PIN SUB-BASIN



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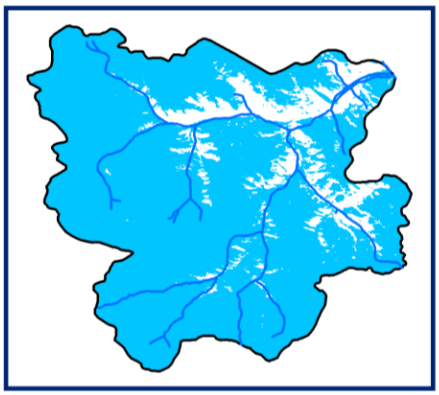

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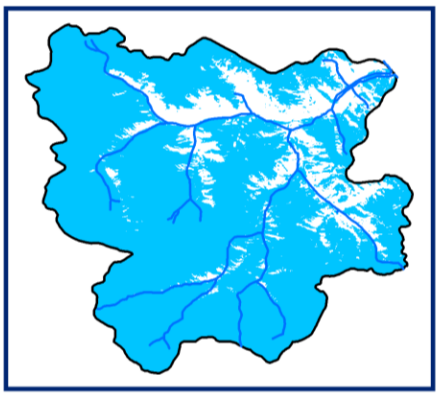

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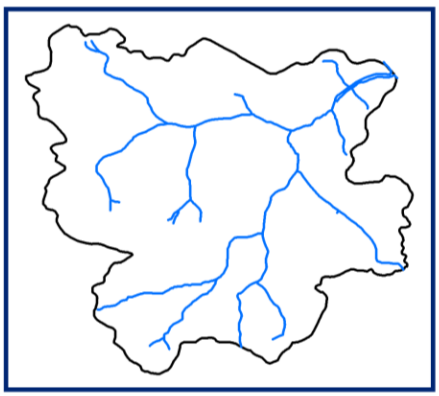

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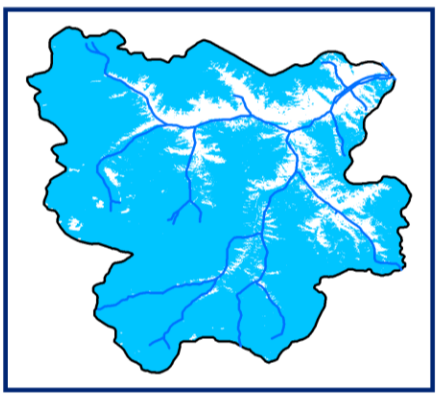

27 JANUARY 2016

SNOW

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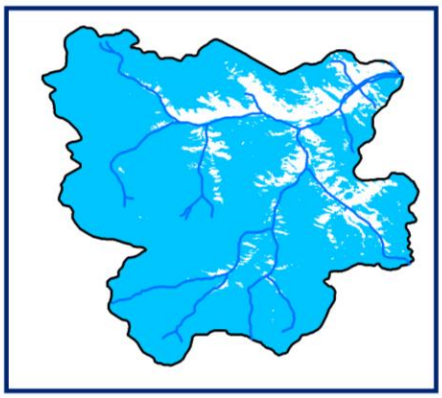
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN



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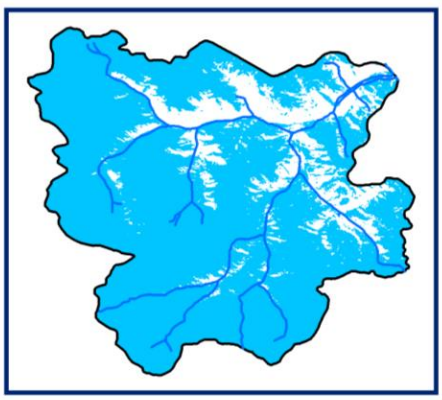
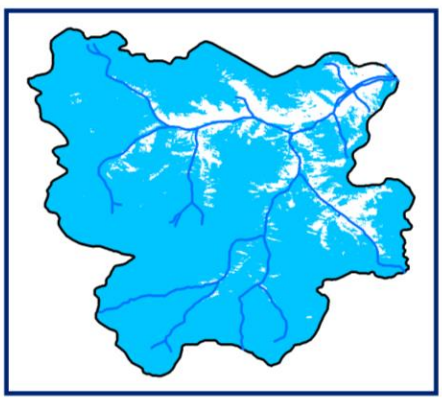
05 JANUARY 2016
06 JANUARY 2016



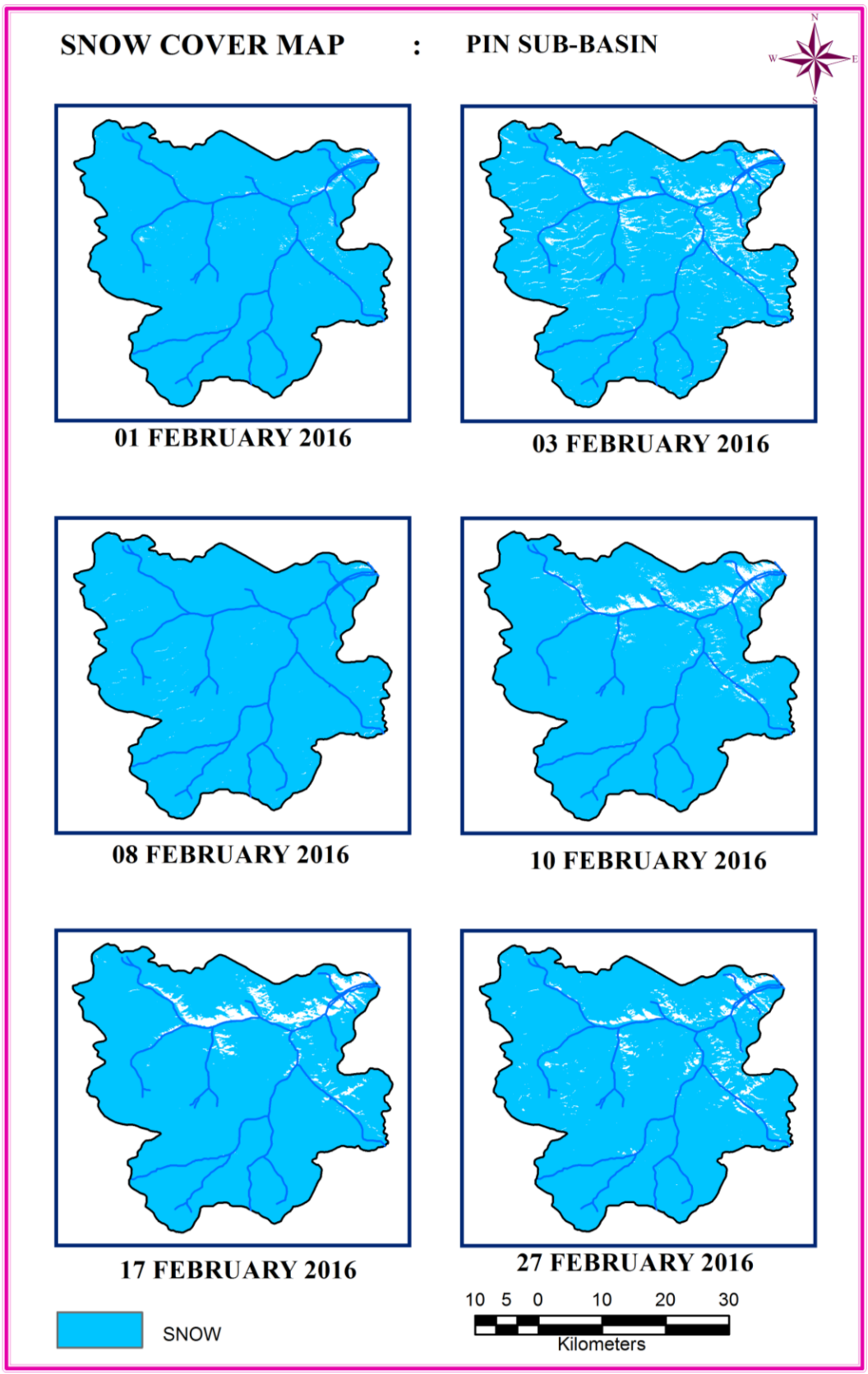
DATA USED
15 JANUARY 2016



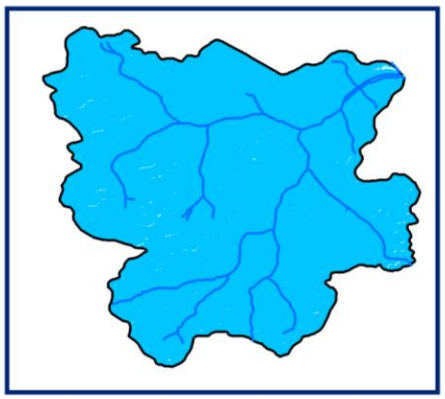
DATA USED
25 JANUARY 2016

SNOW

10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PIN SUB-BASIN
N
W
E
S
01 FEBRUARY 2016
03 FEBRUARY 2016
08 FEBRUARY 2016
10 FEBRUARY 2016
17 FEBRUARY 2016
27 FEBRUARY 2016
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN



DATA USED
01 FEBRUARY 2016
08 FEBRUARY 2016
10 FEBRUARY 2016

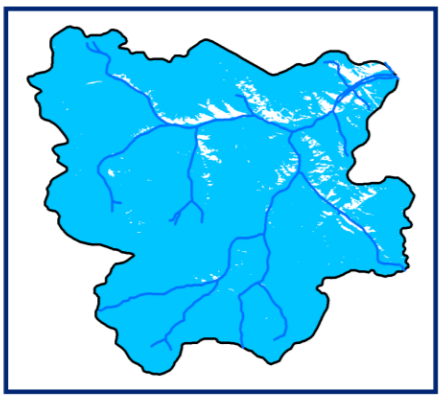
DATA USED
15 FEBRUARY 2016
08 FEBRUARY 2016

DATA USED
25 FEBRUARY 2016

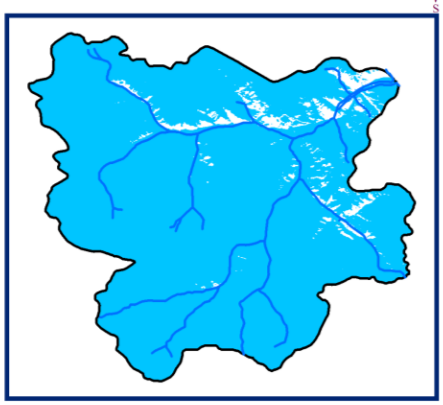
SNOW

10 5 0 10 20 30 40
Kilometers

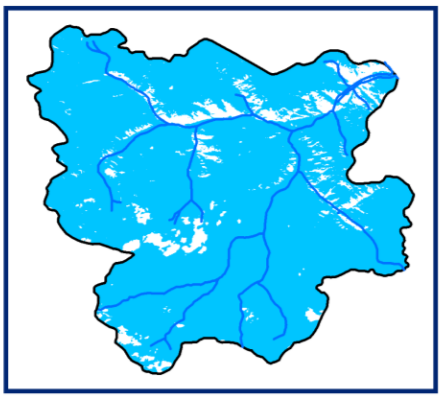
SNOW COVER MAP : PIN SUB-BASIN



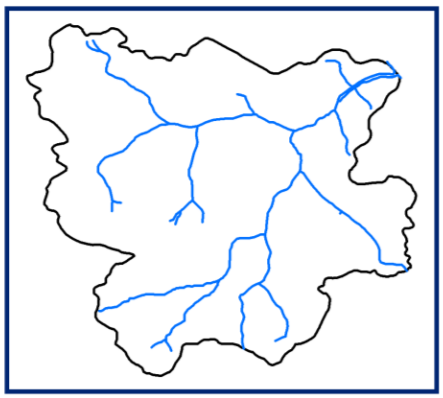
01 MARCH 2016



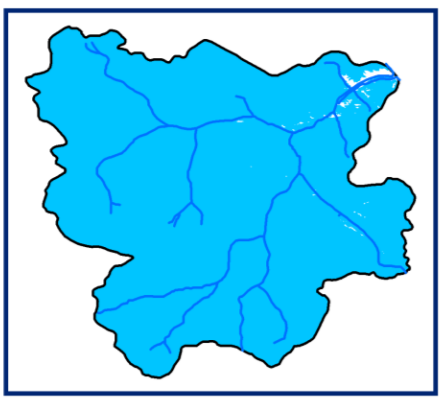
03 MARCH 2016



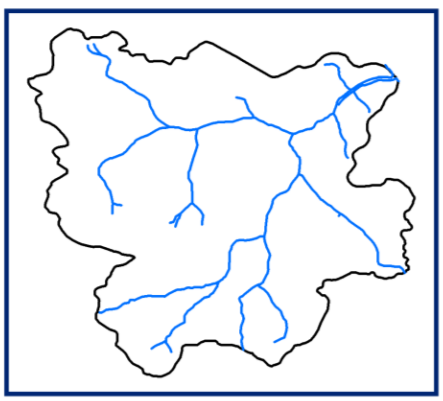
05 MARCH 2016



DATA NOT AVAILABLE



22 MARCH 2016



DATA NOT AVAILABLE

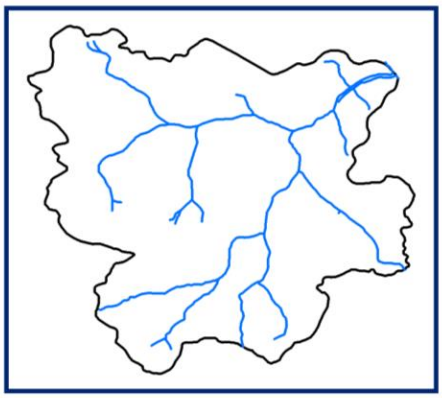
SNOW

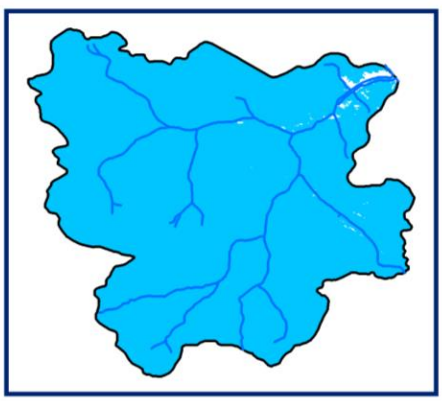
10 5 0 10 20 30

Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN

DATA USED
01 MARCH 2016
03 MARCH 2016
05 MARCH 2016

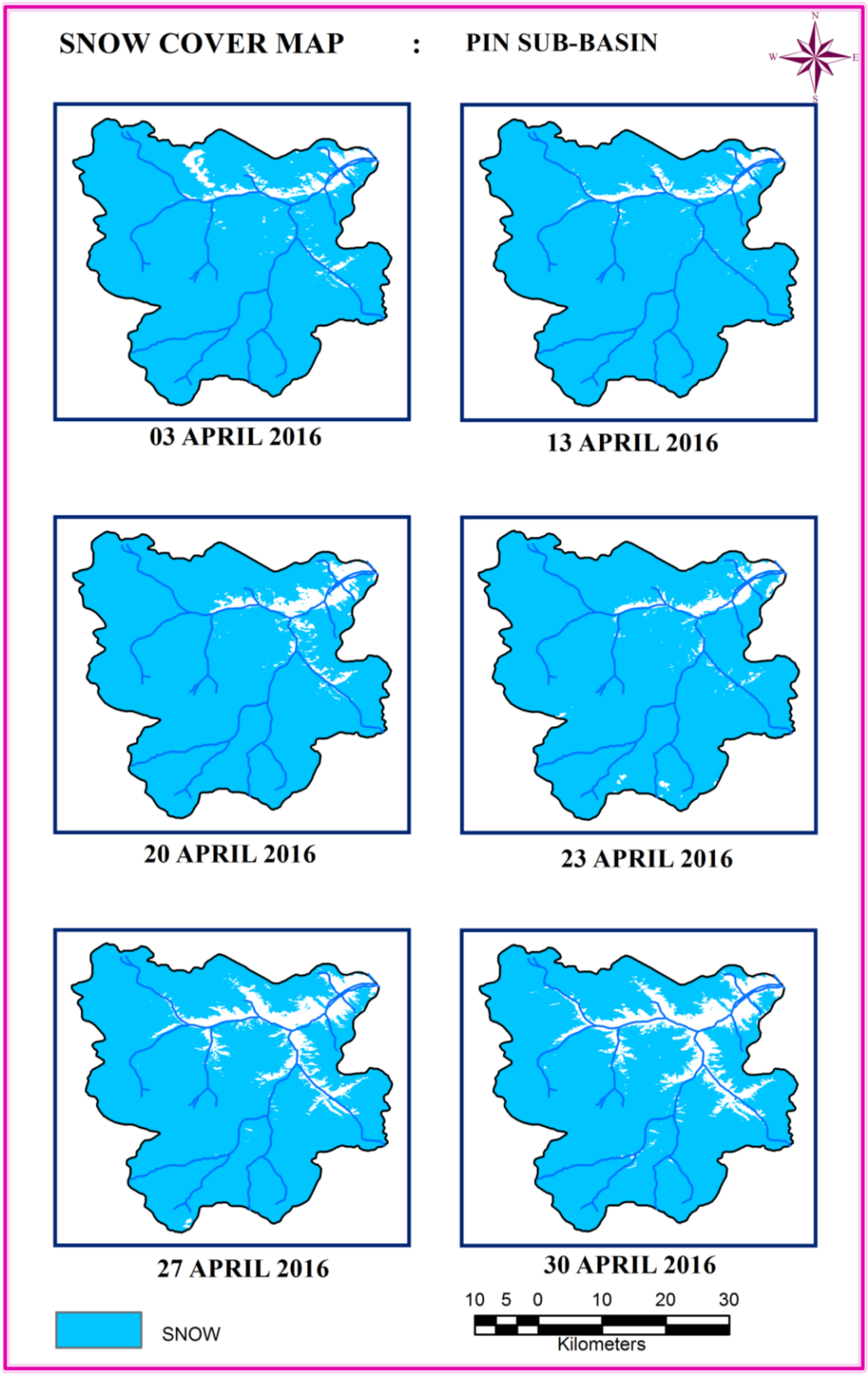




DATA USED
25 MARCH 2016

SNOW

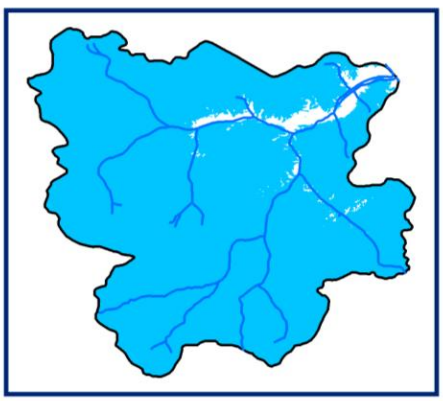
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PIN SUB-BASIN
N
W
E
S
03 APRIL 2016
13 APRIL 2016
20 APRIL 2016
23 APRIL 2016
27 APRIL 2016
30 APRIL 2016
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN

DATA USED
05 APRIL 2016

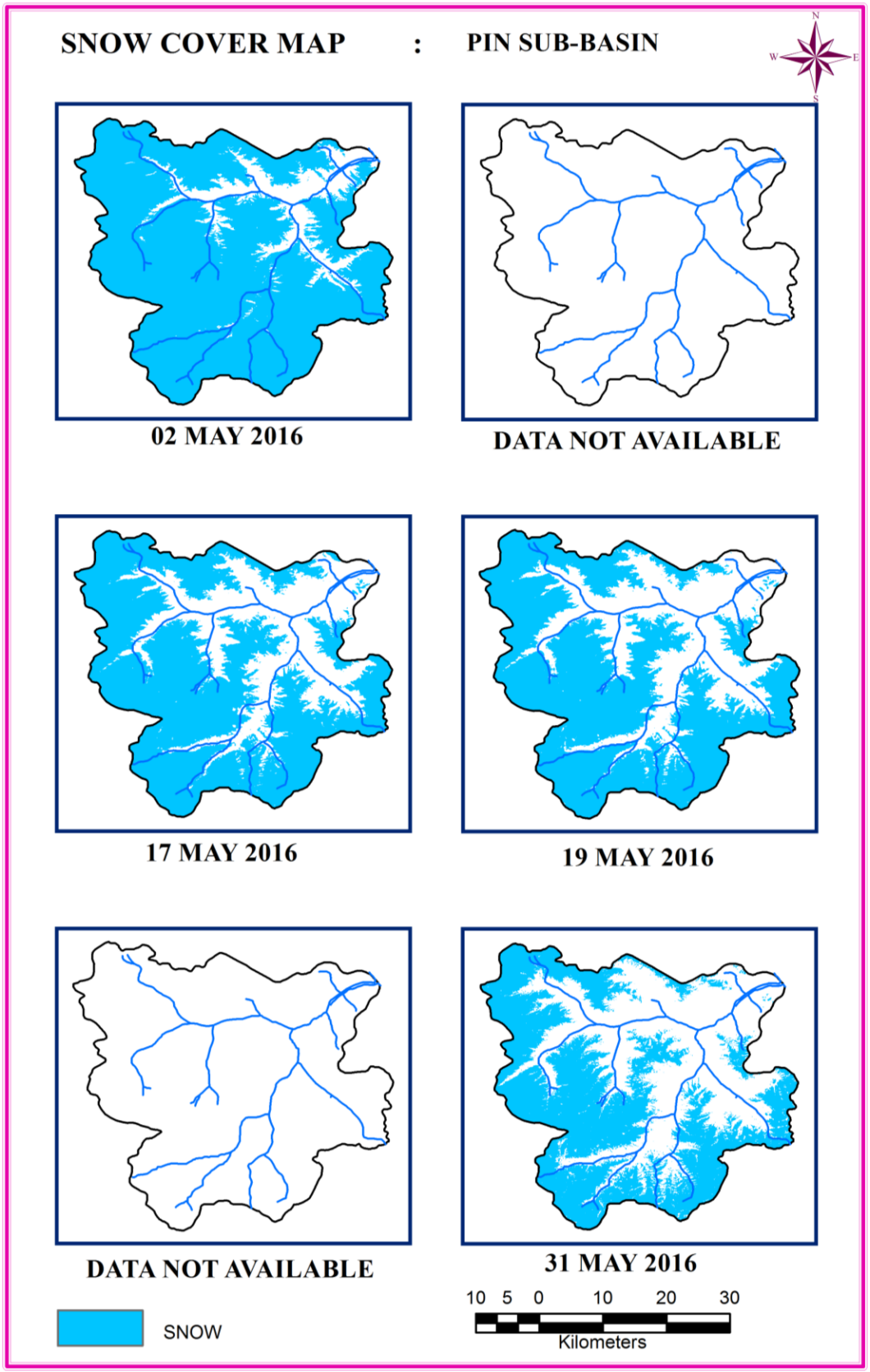
DATA USED
13 APRIL 2016
20 APRIL 2016



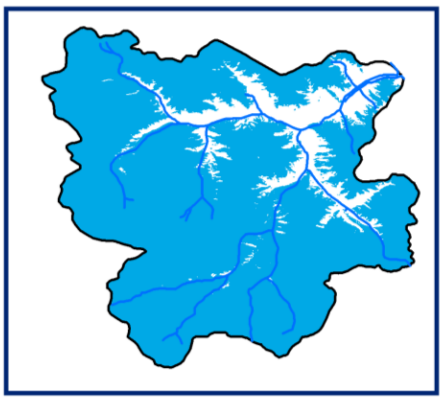
DATA USED
23 APRIL 2016
27 APRIL 2016
30 APRIL 2016

SNOW

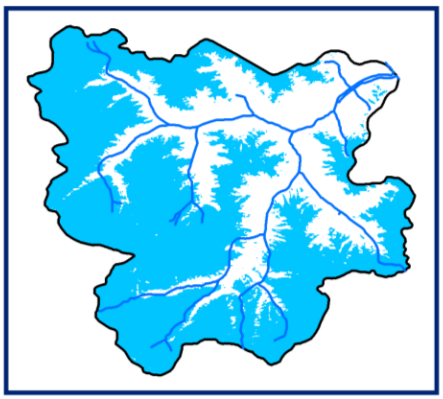
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PIN SUB-BASIN
N
W
E
S
02 MAY 2016
DATA NOT AVAILABLE
17 MAY 2016
19 MAY 2016
DATA NOT AVAILABLE
31 MAY 2016
SNOW
10 5 0 10 20 30
Kilometers

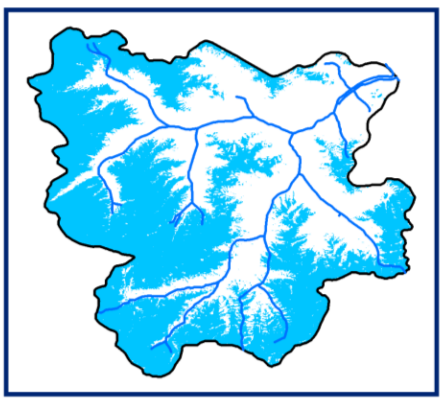
10 DAILY SNOW COVER MAP : PIN SUB-BASIN



DATA USED
05 MAY 2016



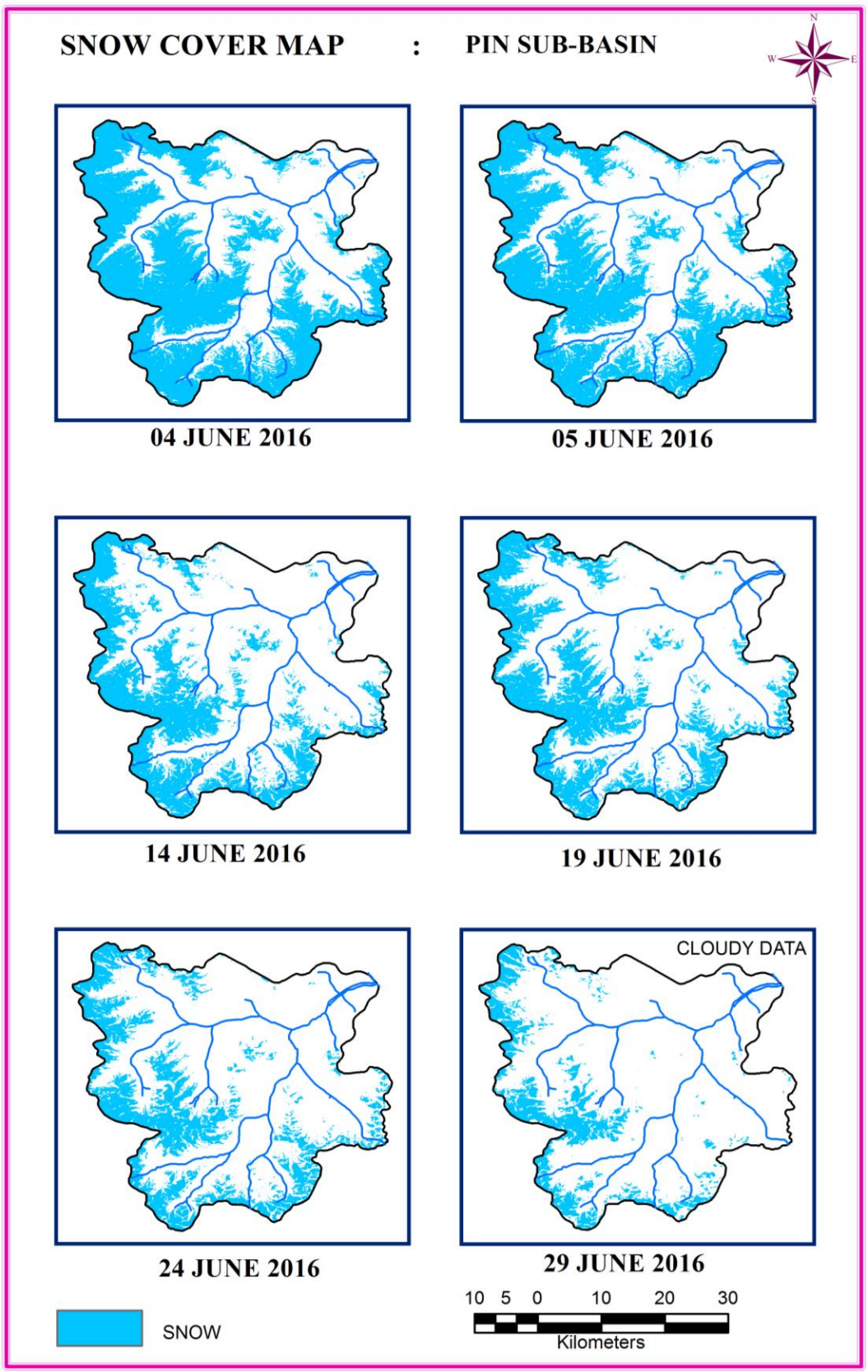
DATA USED
17 MAY 2016
19 MAY 2016



DATA USED
31 MAY 2016

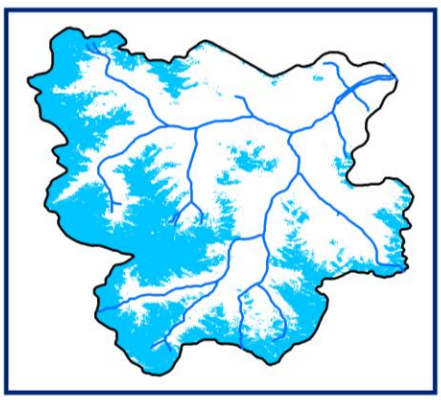
SNOW

10 5 0 10 20 30 40
Kilometers

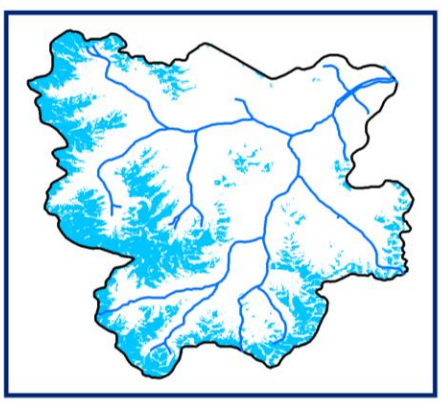

SNOW COVER MAP : PIN SUB-BASIN
N
W
E
S
04 JUNE 2016
05 JUNE 2016
14 JUNE 2016
19 JUNE 2016
24 JUNE 2016
CLOUDY DATA
29 JUNE 2016
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : PIN SUB-BASIN

DATA USED
04 JUNE 2016
05 JUNE 2016
10 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
24 JUNE 2016
29 JUNE 2016

SNOW

10 5 0 10 20 30 40
Kilometers

SPITI SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: SPITI **BASIN AREA: 8871 sq km**

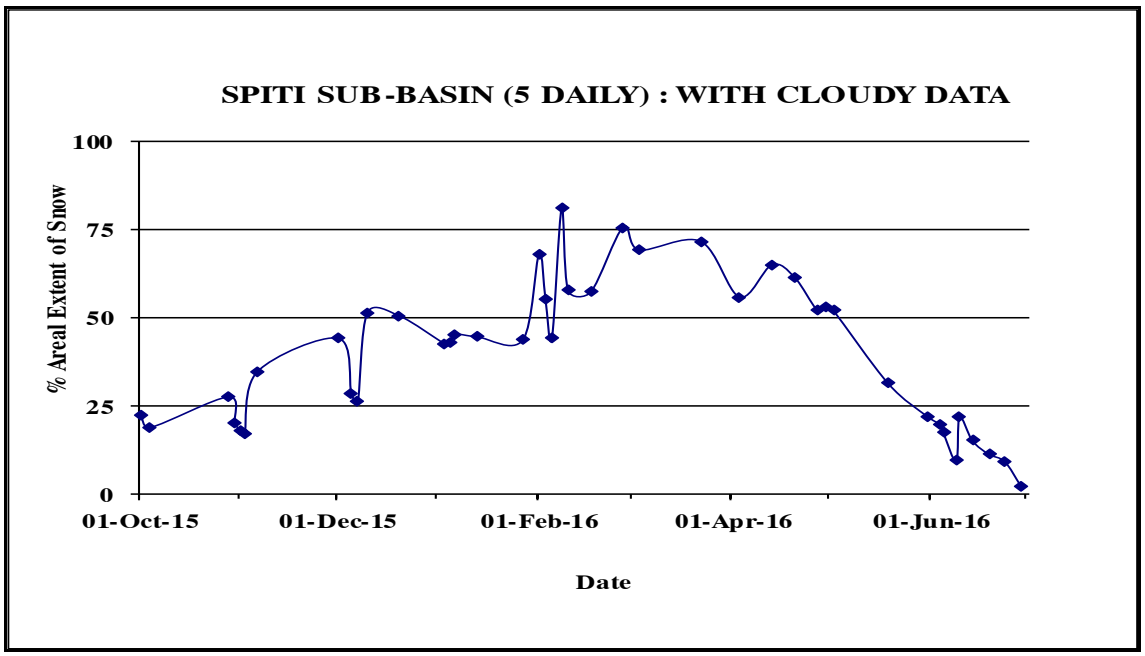
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	01-Oct-15	1985	22	**3**	28-Oct-15	2446	28
2	04-Oct-15	1683	19 (c)		30-Oct-15	1779	20
November 2015							
4	01-Nov-15	1599	18	**6**	06-Nov-15	3086	35
5	02-Nov-15	1500	17				
December 2015							
7	01-Dec-15	3921	44	**10**	10-Dec-15	4569	52
8	05-Dec-15	2526	28	**11**	20-Dec-15	4477	50
9	07-Dec-15	2317	26				
January 2016							
12	03-Jan-16	3778	43	**15**	13-Jan-16	3955	45
13	05-Jan-16	3827	43 (c)	**16**	27-Jan-16	3880	44
14	06-Jan-16	4024	45				
February 2016							
17	01-Feb-16	6041	68	**21**	10-Feb-16	5121	58
18	03-Feb-16	4909	55	**22**	17-Feb-16	5083	57
19	05-Feb-16	3919	44 (c)	**23**	27-Feb-16	6715	76
20	08-Feb-16	7195	81				
March 2016							
24	03-Mar-16	6143	69	**25**	22-Mar-16	6358	72
April 2016							
27	03-Apr-16	4960	56	**30**	27-Apr-16	4632	52 (c)
28	13-Apr-16	5769	65	**31**	30-Apr-16	4726	53
29	20-Apr-16	5455	61				
May 2016							
33	02-May-16	4621	52	**35**	31-May-16	1956	22
34	19-May-16	2778	31				
June 2016							
37	04-Jun-16	1750	20	**41**	14-Jun-16	1341	15 (c)
38	05-Jun-16	1544	17	**42**	19-Jun-16	1006	11
39	09-Jun-16	827	9 (c)	**43**	24-Jun-16	817	9
40	10-Jun-16	1938	22 (c)	**44**	29-Jun-16	198	2 (c)

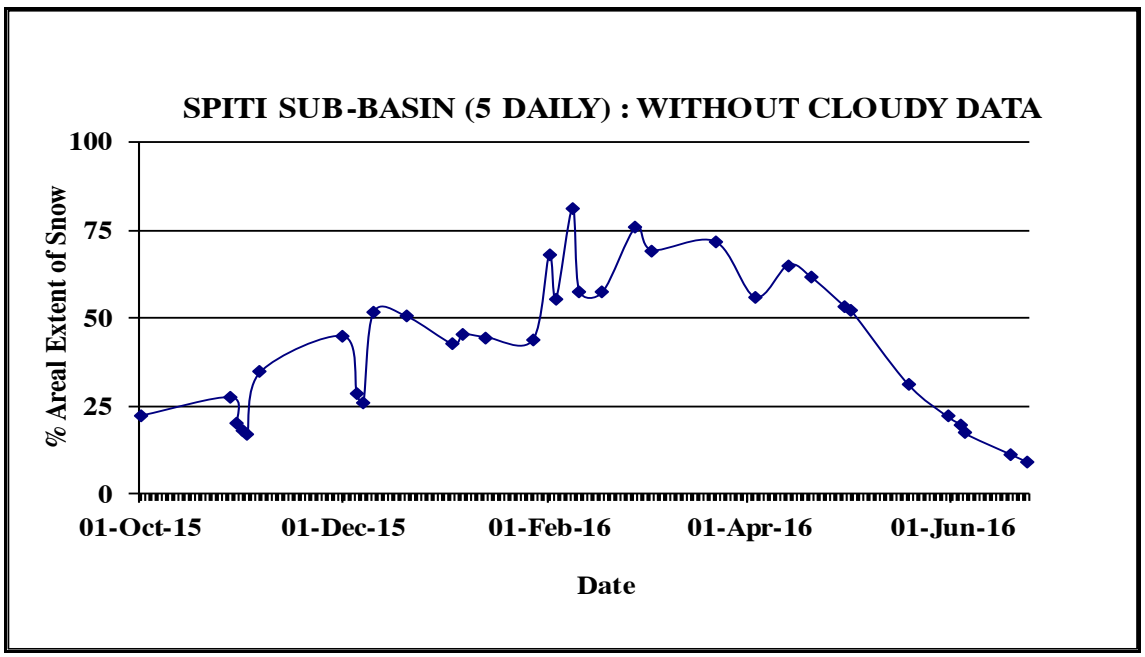
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: SPITI **BASIN AREA: 8871 sq km**

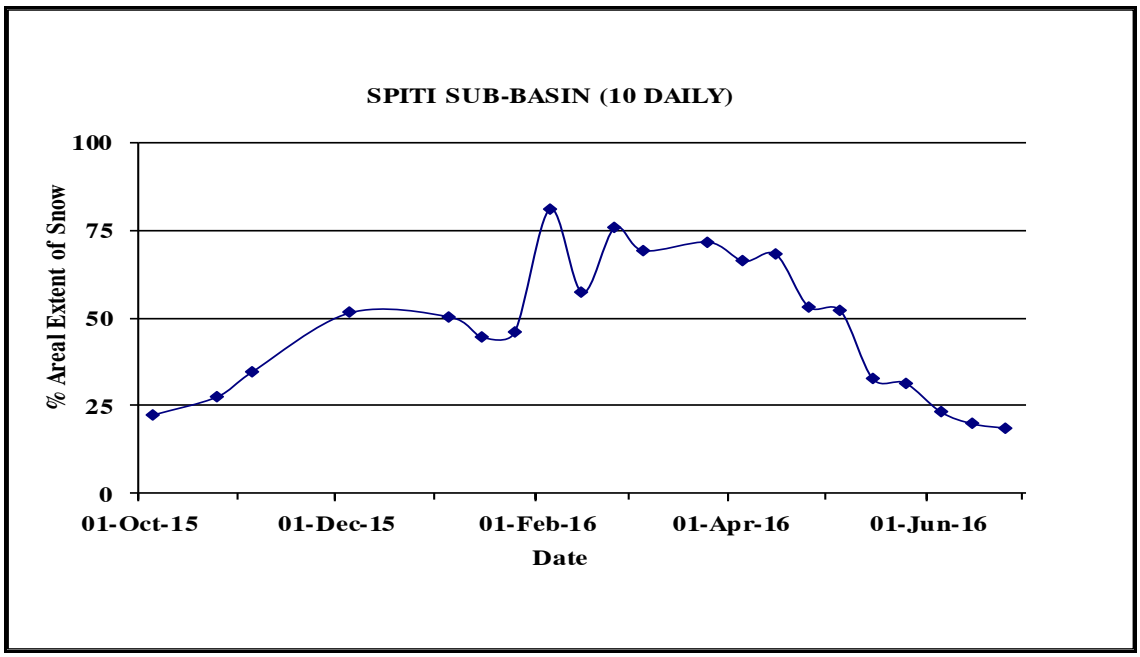
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	1983	22	**3**	05-Nov-15	3085	35
2	25-Oct-15	2446	28				
December 2015				**January 2016**			
4	05-Dec-15	4569		**6**	05-Jan-16	4464	50
				7	15-Jan-16	3954	45
				8	25-Jan-16	4069	46
February 2016				**March 2016**			
9	05-Feb-16	7194	81	**12**	05-Mar-16	6143	69
10	15-Feb-16	5083	57	**13**	25-Mar-16	6360	72
11	25-Feb-16	6715	76				
April 2016				**May 2016**			
14	05-Apr-16	5877	66	**17**	05-May-16	4619	52
15	15-Apr-16	6045	68	**18**	15-May-16	2899	33
16	25-Apr-16	4727	53	**19**	25-May-16	2798	32
June 2016							
20	05-Jun-2016	2064	23				
21	15-Jun-2016	1760	20				
22	25-Jun-2016	1653	19				

SNOW COVER DEPLETION CURVE

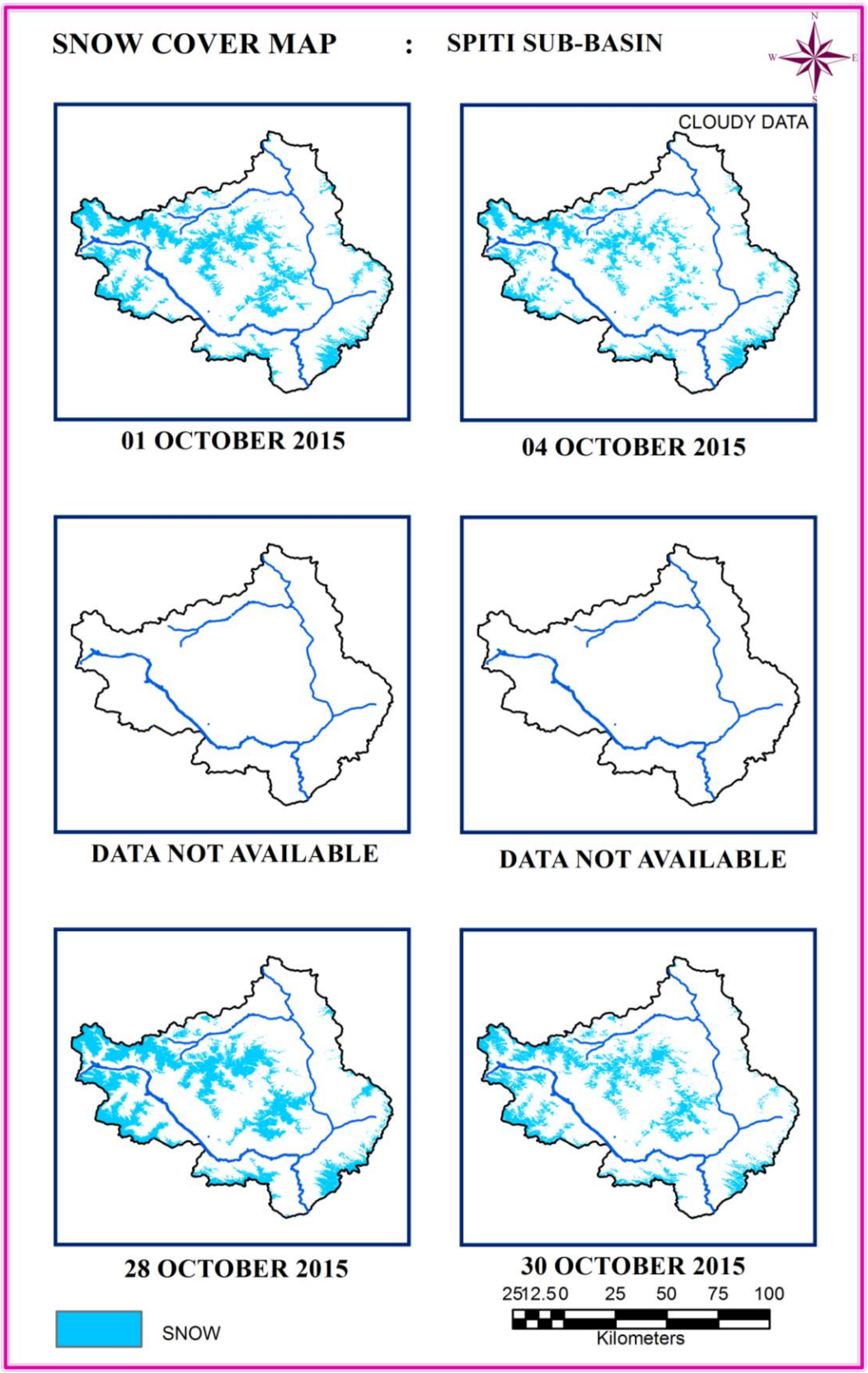




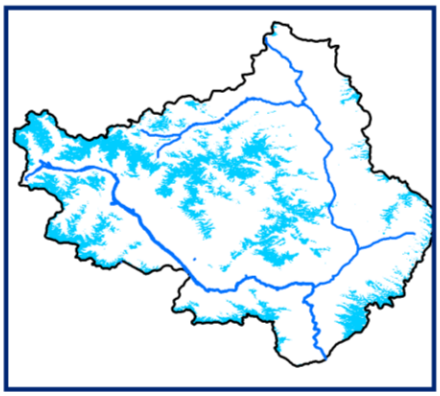
SNOW COVER DEPLETION CURVE



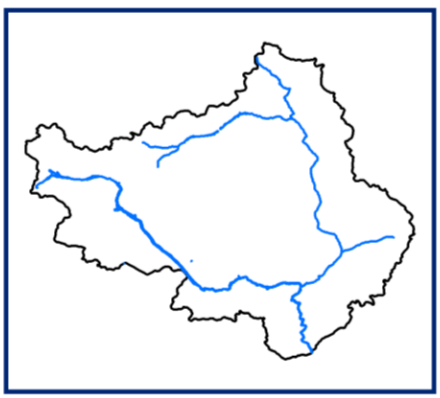
SNOW COVER MAP


SNOW COVER MAP : SPITI SUB-BASIN
N
W
E
S
CLOUDY DATA
01 OCTOBER 2015
04 OCTOBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
28 OCTOBER 2015
30 OCTOBER 2015
2512.50 25 50 75 100
Kilometers
SNOW

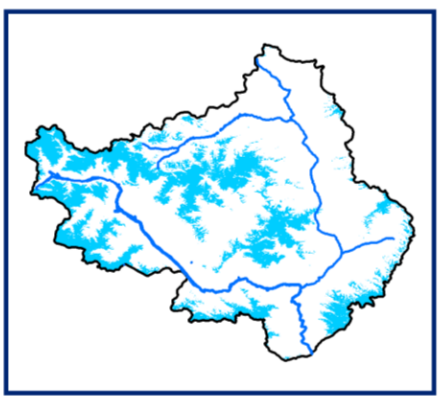
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
01 OCTOBER 2015
04 OCTOBER 2015



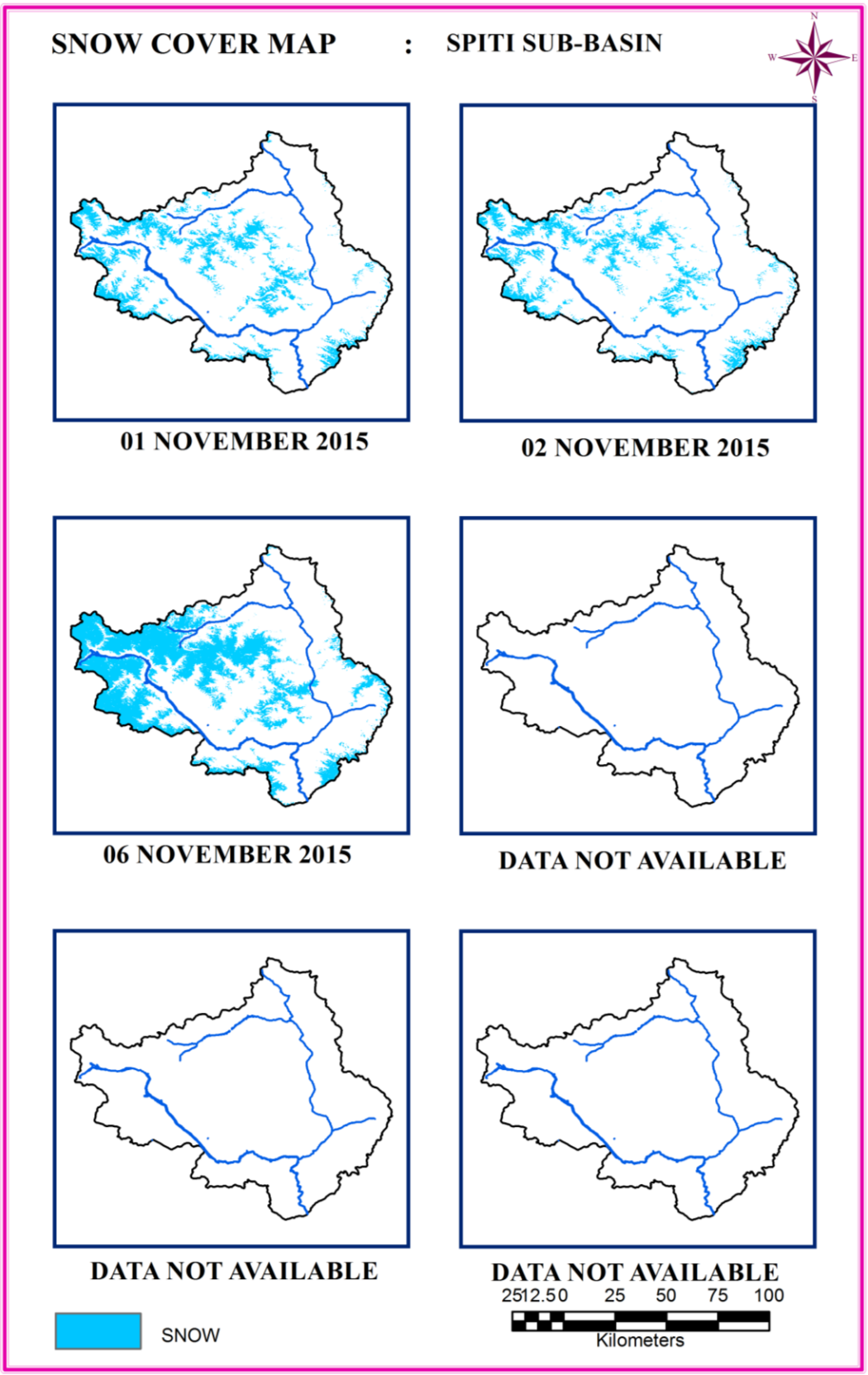
DATA NOT AVAILABLE



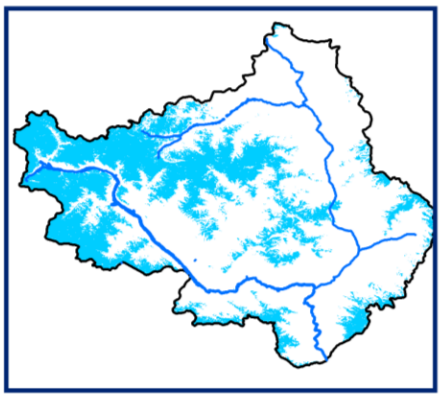
DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

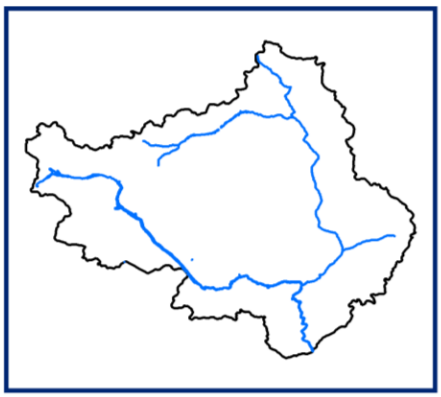
2010 0 20 40 60
Kilometers


SNOW COVER MAP : SPITI SUB-BASIN
N
W
E
S
01 NOVEMBER 2015
02 NOVEMBER 2015
06 NOVEMBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
DATA NOT AVAILABLE
SNOW
2512.50 25 50 75 100
Kilometers

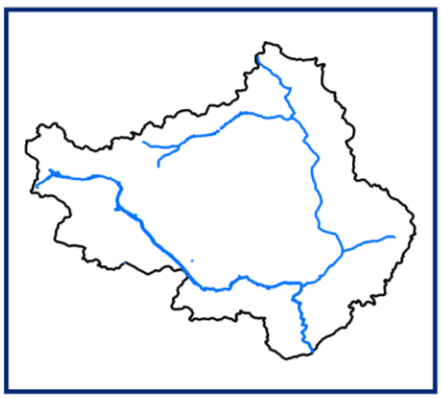
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
01 NOVEMBER 2015
02 NOVEMBER 2015
06 NOVEMBER 2015



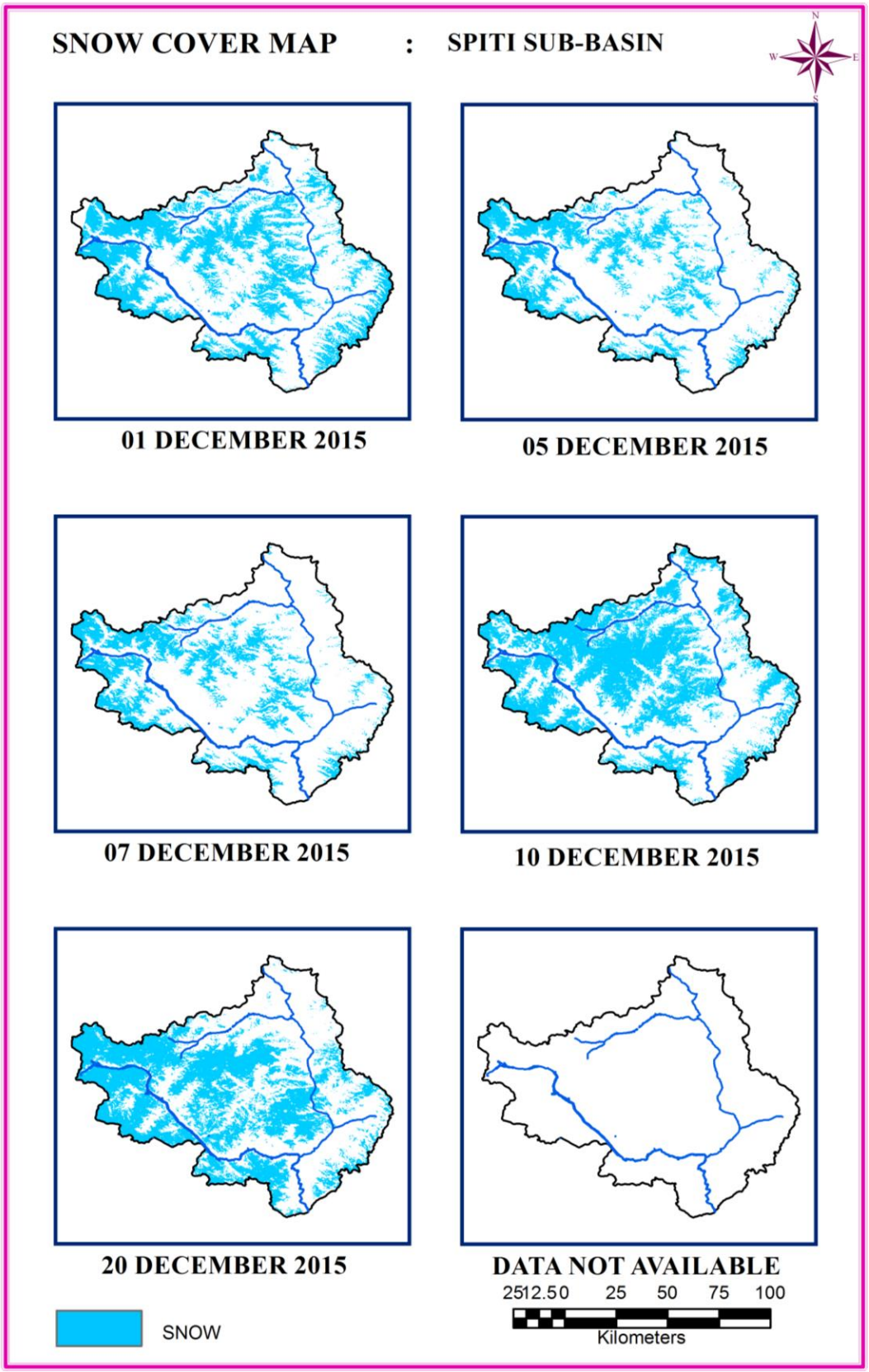
DATA NOT AVAILABLE



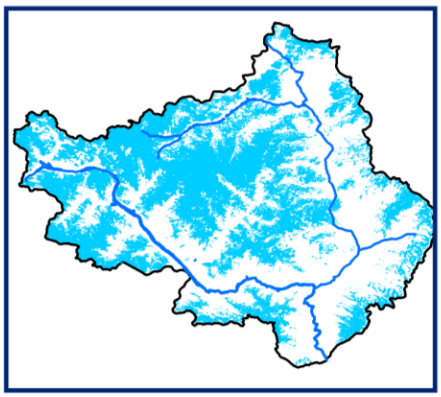
DATA NOT AVAILABLE

SNOW

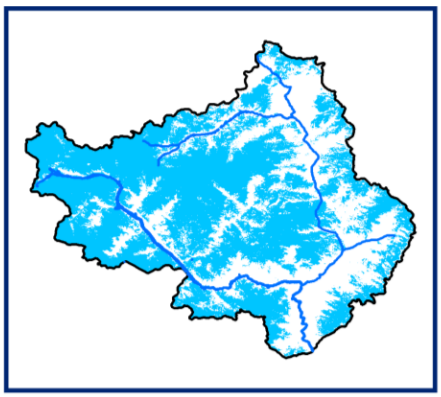
20 10 0 20 40 60
Kilometers


SNOW COVER MAP : SPITI SUB-BASIN
N
W
E
S
01 DECEMBER 2015
05 DECEMBER 2015
07 DECEMBER 2015
10 DECEMBER 2015
20 DECEMBER 2015
DATA NOT AVAILABLE
2512.50 25 50 75 100
Kilometers
SNOW

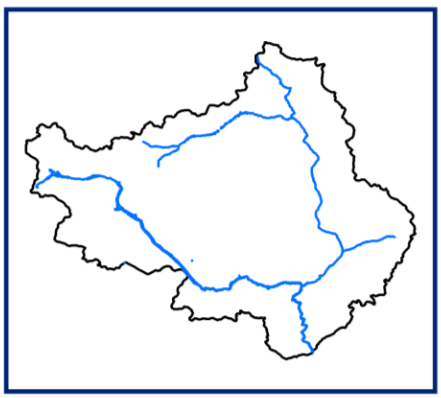
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
01 DECEMBER 2015
05 DECEMBER 2015
10 DECEMBER 2015



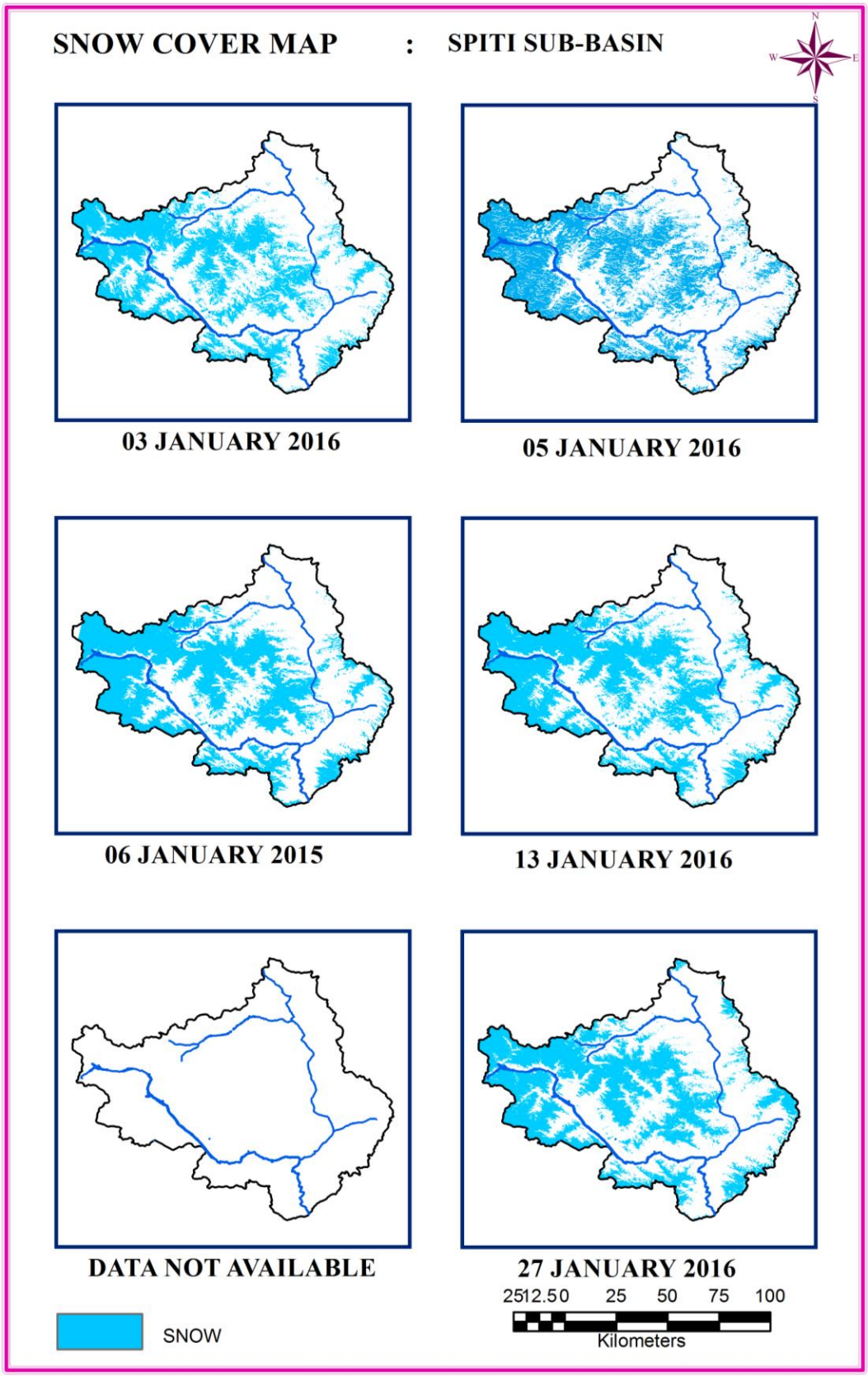
DATA USED
20 DECEMBER 2015



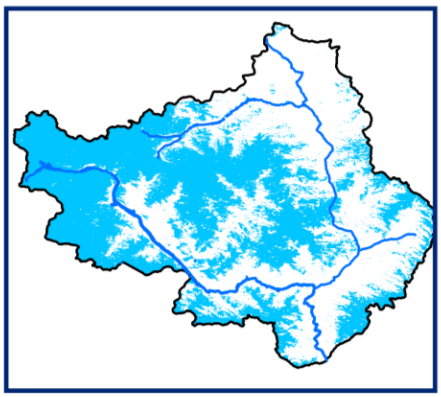
DATA NOT AVAILABLE

SNOW

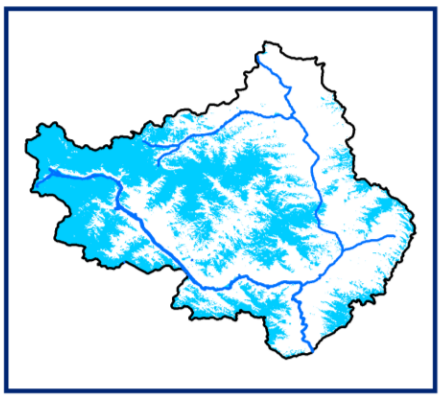
20 10 0 20 40 60
Kilometers


SNOW COVER MAP : SPITI SUB-BASIN
N
W
E
S
03 JANUARY 2016
05 JANUARY 2016
06 JANUARY 2015
13 JANUARY 2016
DATA NOT AVAILABLE
27 JANUARY 2016
SNOW
2512.50 25 50 75 100
Kilometers

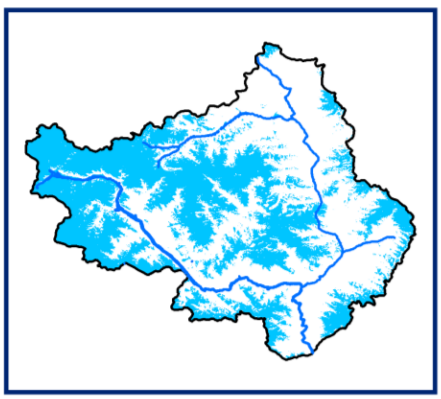
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
03 JANUARY 2016
05 JANUARY 2016
06 JANUARY 2016



DATA USED
15 JANUARY 2016

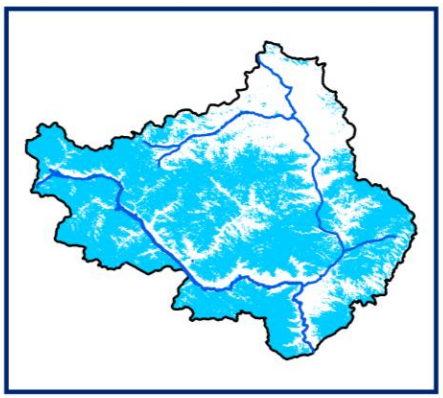


DATA USED
25 JANUARY 2016

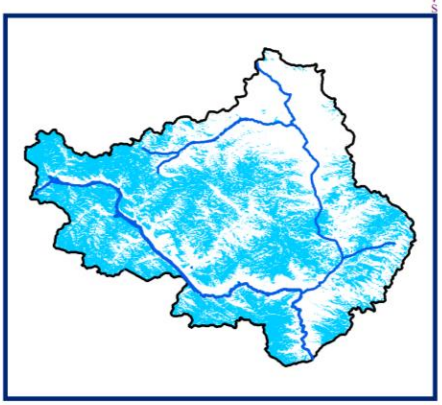
SNOW

20 10 0 20 40 60
Kilometers

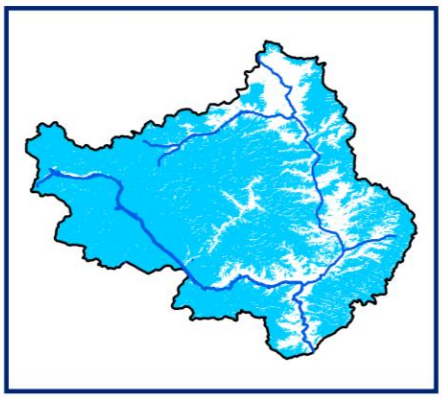
SNOW COVER MAP : SPITI SUB-BASIN



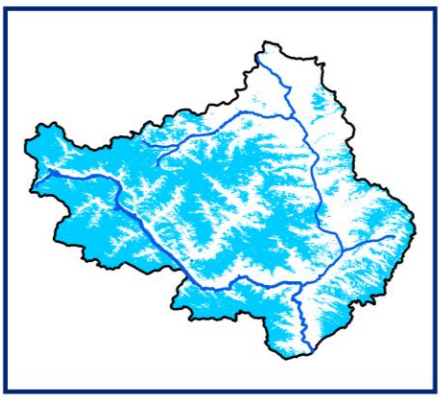
01 FEBRUARY 2016



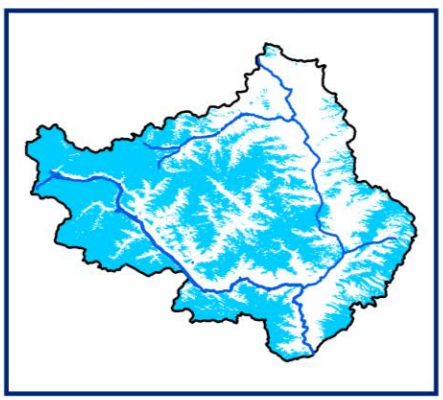
03 FEBRUARY 2016



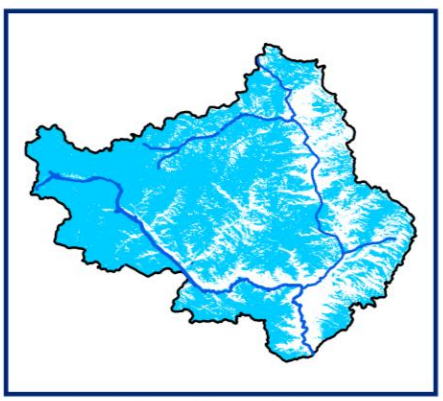
08 FEBRUARY 2016



10 FEBRUARY 2016



17 FEBRUARY 2016



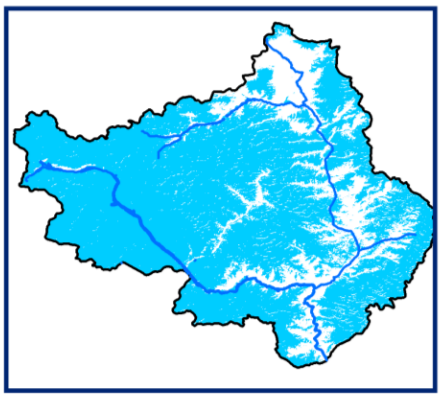
27 FEBRUARY 2016

SNOW

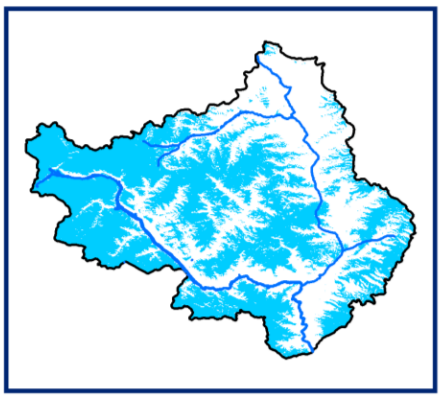
2512.50 25 50 75 100

Kilometers

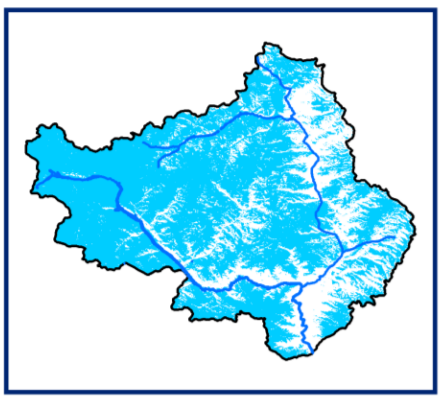
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
01 FEBRUARY 2016
08 FEBRUARY 2016
10 FEBRUARY 2016



DATA USED
15 FEBRUARY 2016

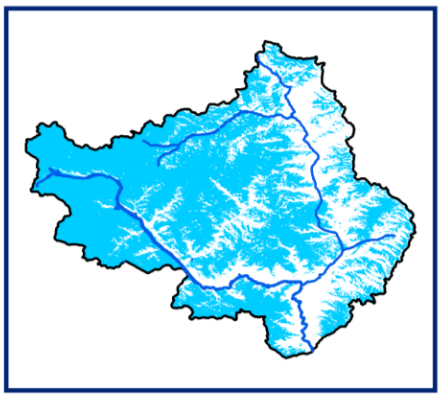


DATA USED
25 FEBRUARY 2016

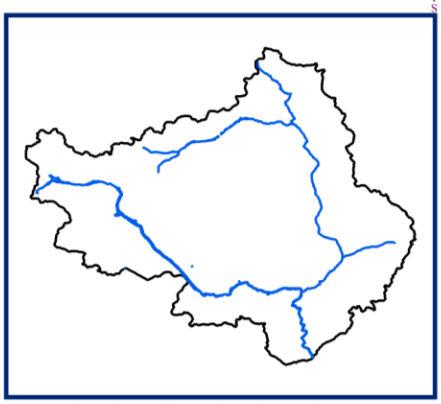
SNOW

20 10 0 20 40 60
Kilometers

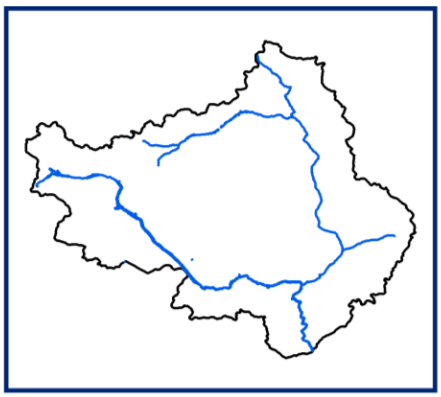
SNOW COVER MAP : SPITI SUB-BASIN



03 MARCH 2016



DATA NOT AVAILABLE



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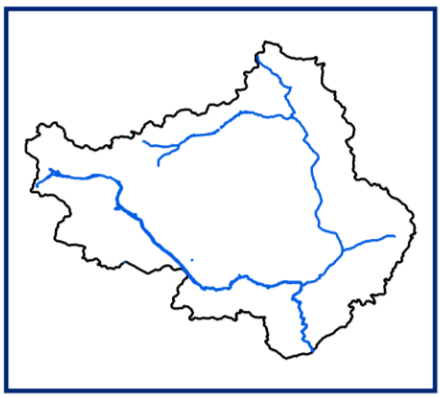

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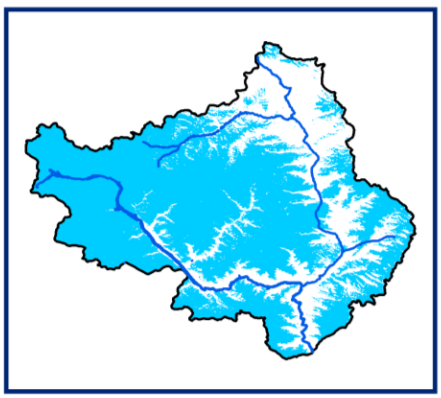
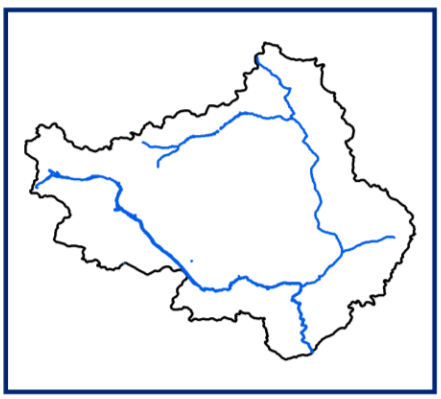


22 MARCH 2016



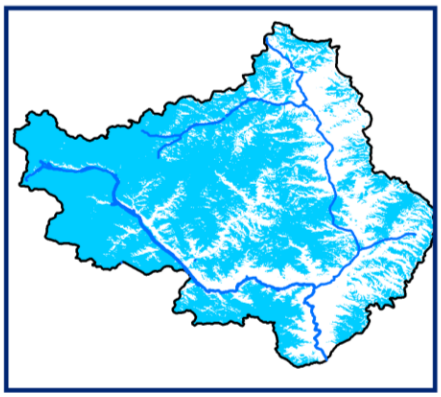
DATA NOT AVAILABLE

SNOW

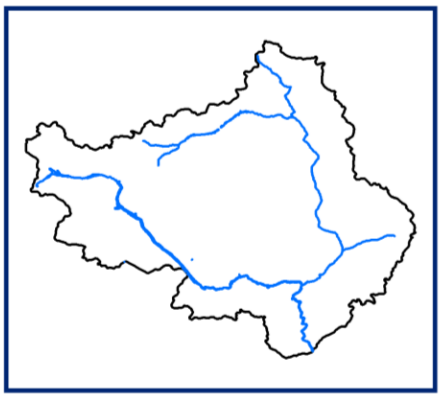
2512.50 25 50 75 100

Kilometers

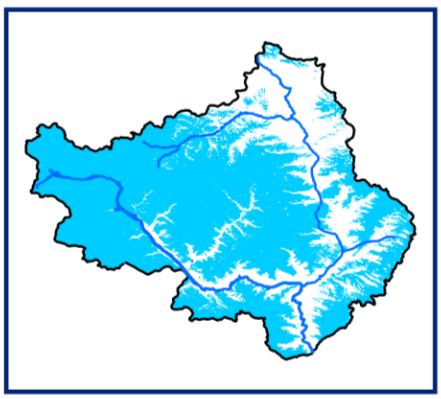
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
05 MARCH 2016



DATA NOT AVAILABLE

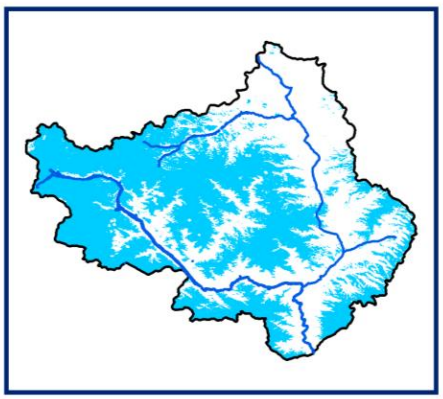


DATA USED
25 MARCH 2016

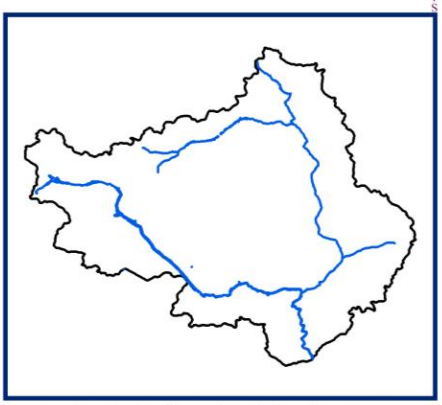
SNOW

20 10 0 20 40 60
Kilometers

SNOW COVER MAP : SPITI SUB-BASIN



03 APRIL 2016



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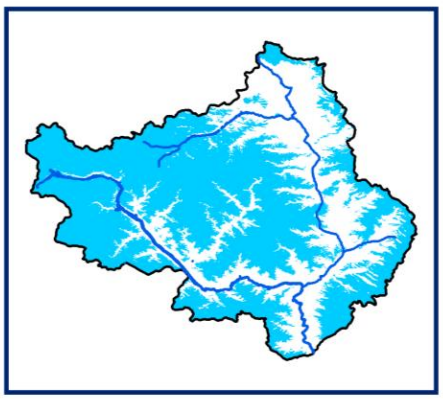
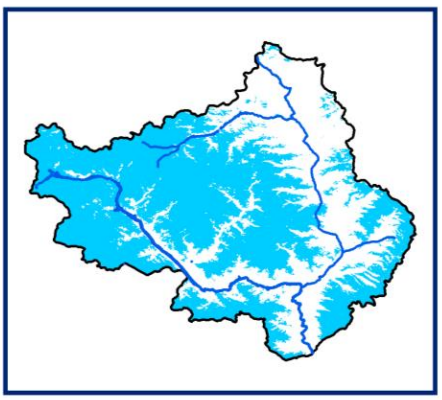
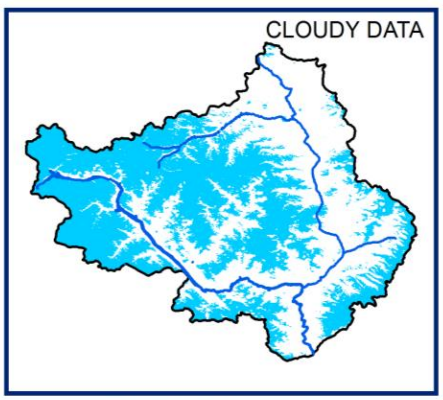


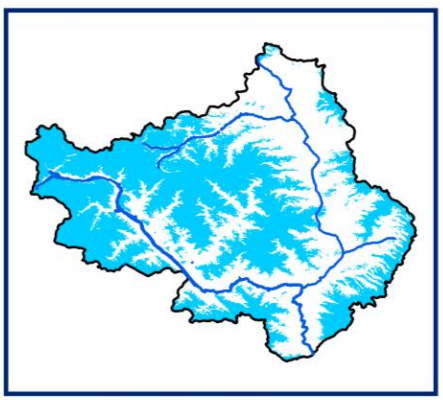
13 APRIL 2016



20 APRIL 2016



27 APRIL 2016



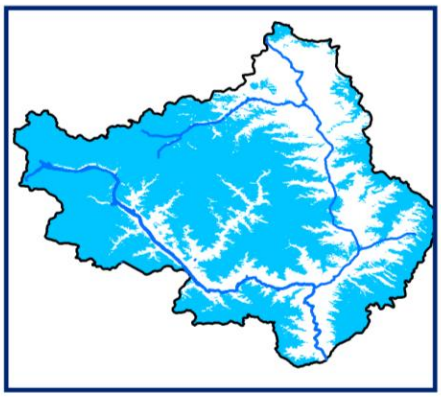
30 APRIL 2016

SNOW

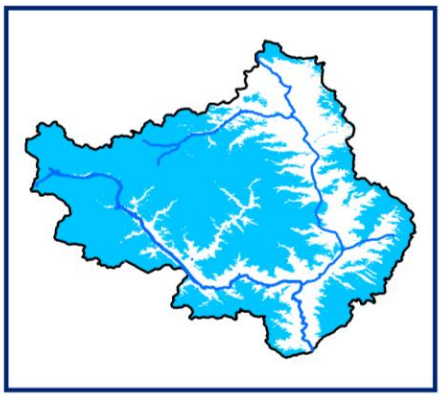
2512.50 25 50 75 100

Kilometers

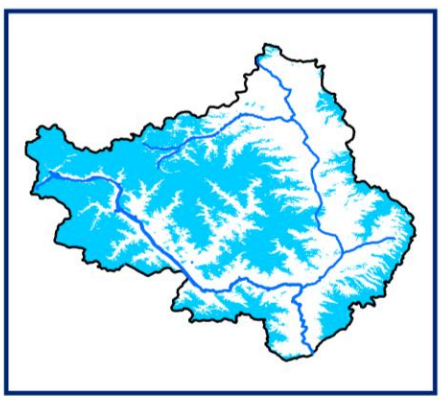
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
05 APRIL 2016



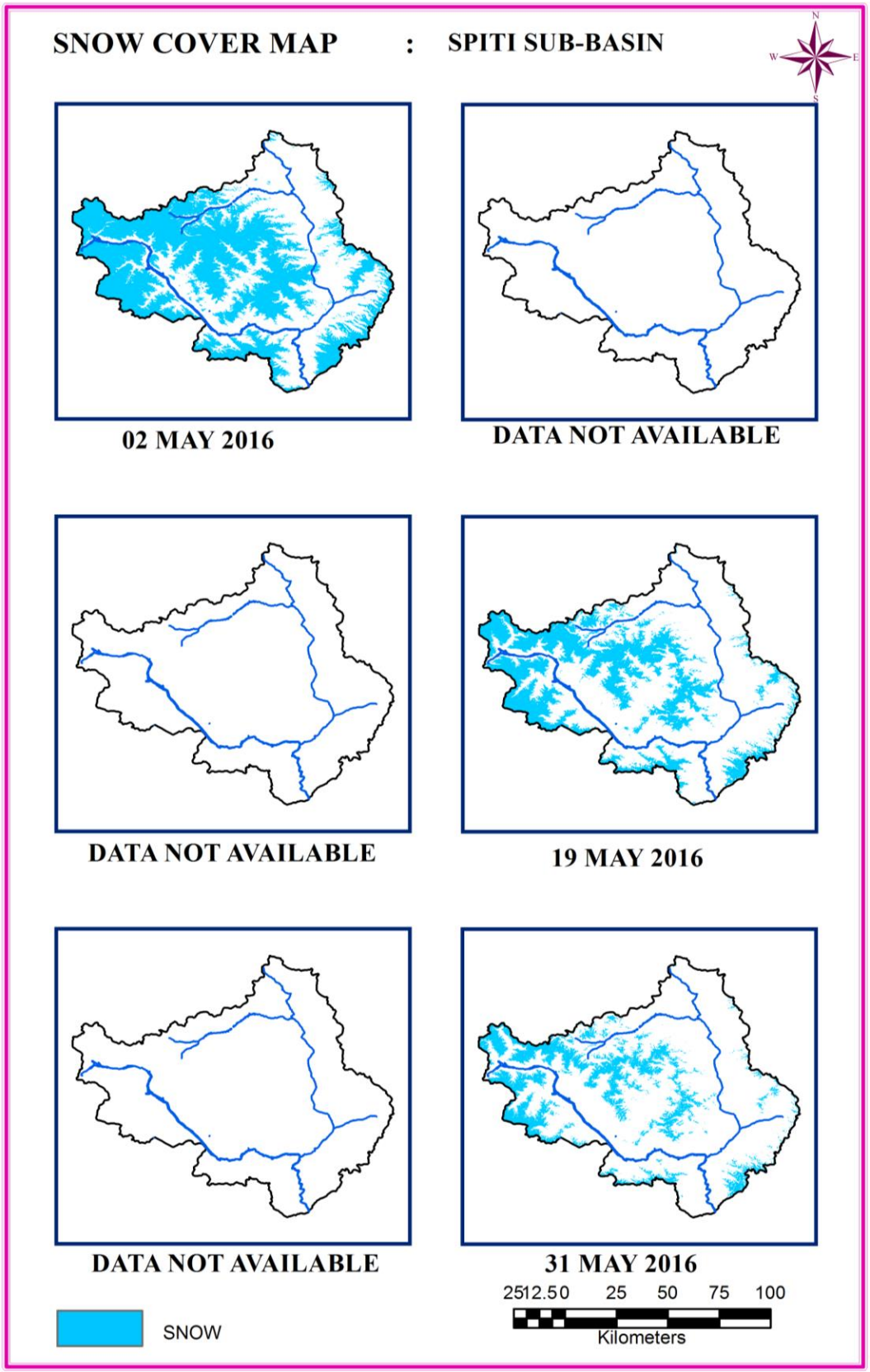
DATA USED
13 APRIL 2016
20 APRIL 2016



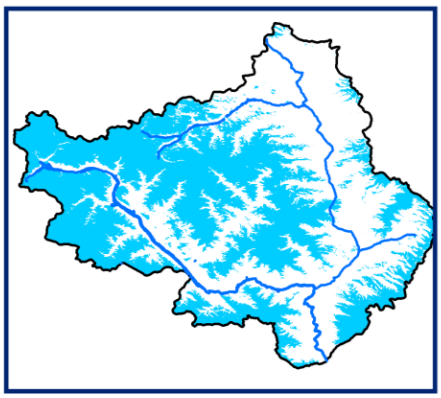
DATA USED
27 APRIL 2016
30 APRIL 2016

SNOW

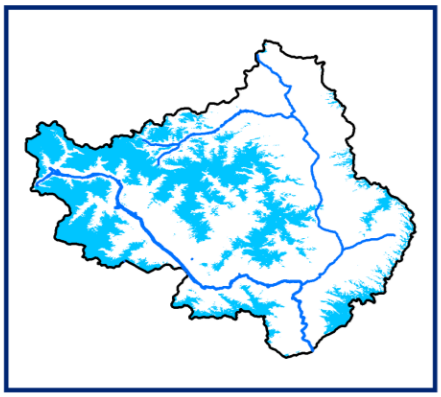
20 10 0 20 40 60
Kilometers


SNOW COVER MAP : SPITI SUB-BASIN
N
W
E
S
02 MAY 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
19 MAY 2016
DATA NOT AVAILABLE
31 MAY 2016
SNOW
2512.50 25 50 75 100
Kilometers

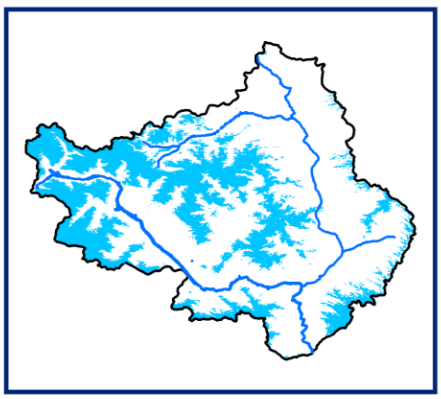
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
05 MAY 2016



DATA USED
15 MAY 2016

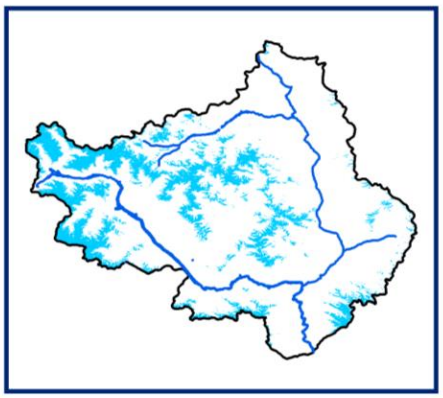


DATA USED
25 MAY 2016

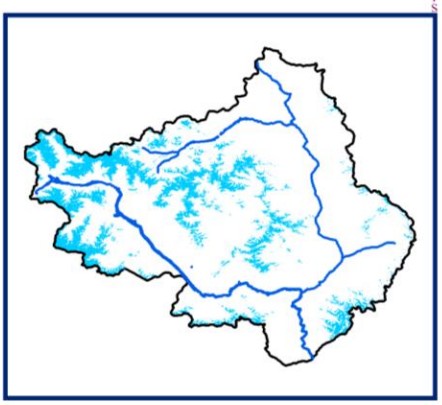
SNOW

20 10 0 20 40 60
Kilometers

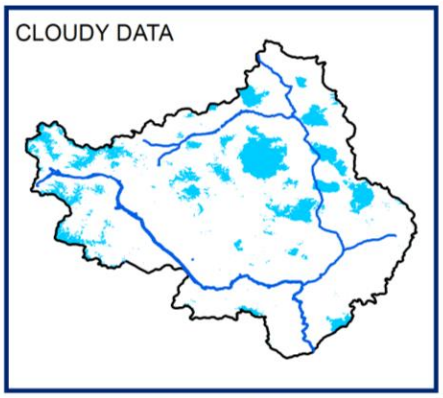
SNOW COVER MAP : SPITI SUB-BASIN



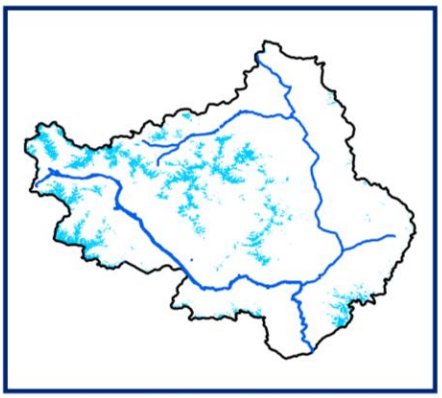
04 JUNE 2016



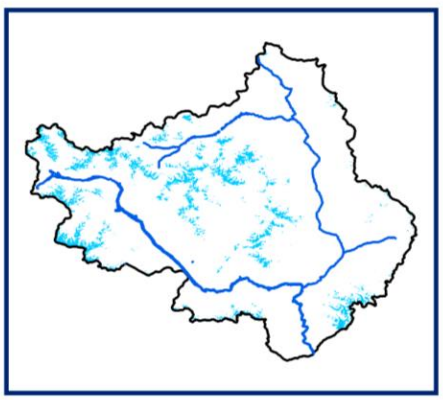
05 JUNE 2016



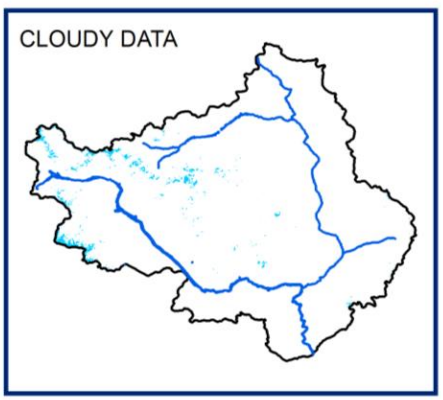
14 JUNE 2016



19 JUNE 2016



24 JUNE 2016



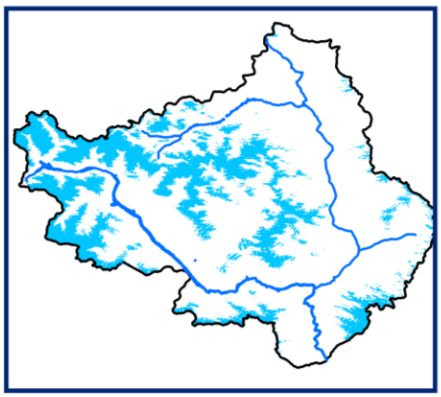
29 JUNE 2016

SNOW

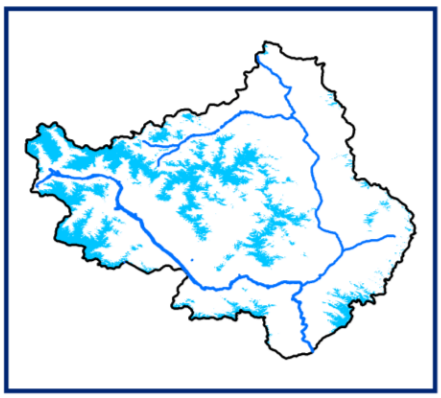
2512.50 25 50 75 100

Kilometers

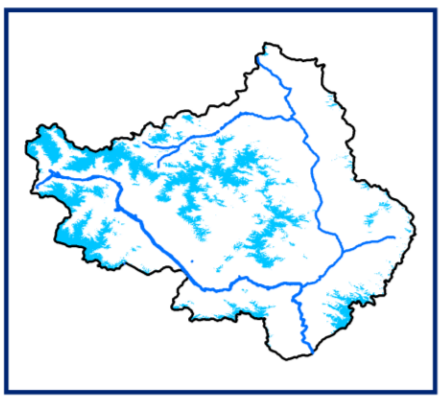
10 DAILY SNOW COVER MAP : SPITI SUB-BASIN



DATA USED
04 JUNE 2016
05 JUNE 2016
10 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
24 JUNE 2016
29 JUNE 2016

SNOW

20 10 0 20 40 60
Kilometers

BASPA SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: BASPA **BASIN AREA: 1096 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	04-Oct-15	396	36	**3**	30-Oct-15	340	31
2	28-Oct-15	408	37				
November 2015							
4	01-Nov-15	334	30	**6**	06-Nov-15	768	70
5	02-Nov-15	313	29	**7**	07-Nov-15	615	56
December 2015							
8	01-Dec-15	534	49	**11**	10-Dec-15	486 (C)	44
9	05-Dec-15	405	37	**12**	13-Dec-15	939	86
10	07-Dec-15	429	39	**13**	20-Dec-15	812	74
January 2016							
14	03-Jan-16	661	60	**16**	13-Jan-16	706	64
15	06-Jan-16	784	72	**17**	27-Jan-16	781	71
February 2016							
18	01-Feb-16	890	81	**21**	10-Feb-16	948	86
19	03-Feb-16	781	71	**22**	17-Feb-16	926	84
20	08-Feb-16	1079	98	**23**	27-Feb-16	870	79
March 2016							
24	01-Mar-16	858	78	**26**	22-Mar-16	1000	91
25	03-Mar-16	816	74				
April 2016							
27	03-Apr-16	866	79	**30**	23-Apr-16	941 (c)	86
28	13-Apr-16	912	83	**31**	27-Apr-16	803	73
29	20-Apr-16	950	87	**32**	30-Apr-16	798	73
May 2016							
33	02-May-16	793	72	**35**	19-May-16	576	53
34	17-May-16	603	55	**36**	31-May-16	471	43

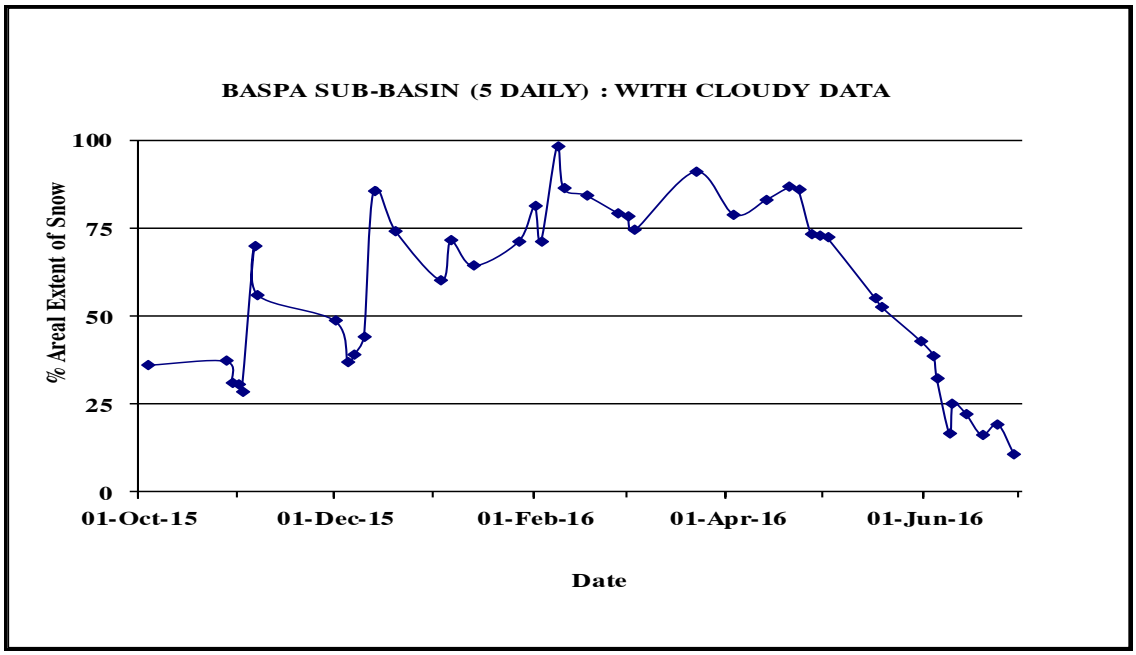
June 2016							
37	04-Jun-16	424	39	**41**	14-Jun-16	245	22
38	05-Jun-16	355	32	**42**	19-Jun-16	178 (c)	16
39	09-Jun-16	181 (c)	17	**43**	24-Jun-16	211	19
40	10-Jun-16	276 (c)	25	**44**	29-Jun-16	118 (c)	11

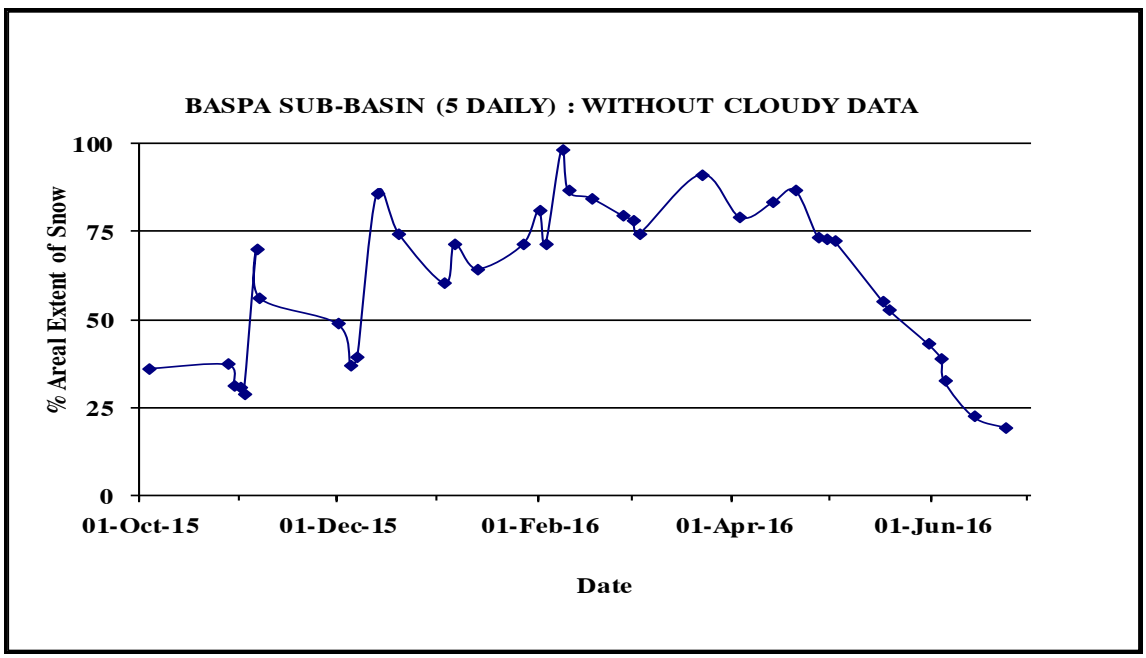
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: BASPA **BASIN AREA: 1096 sq km**

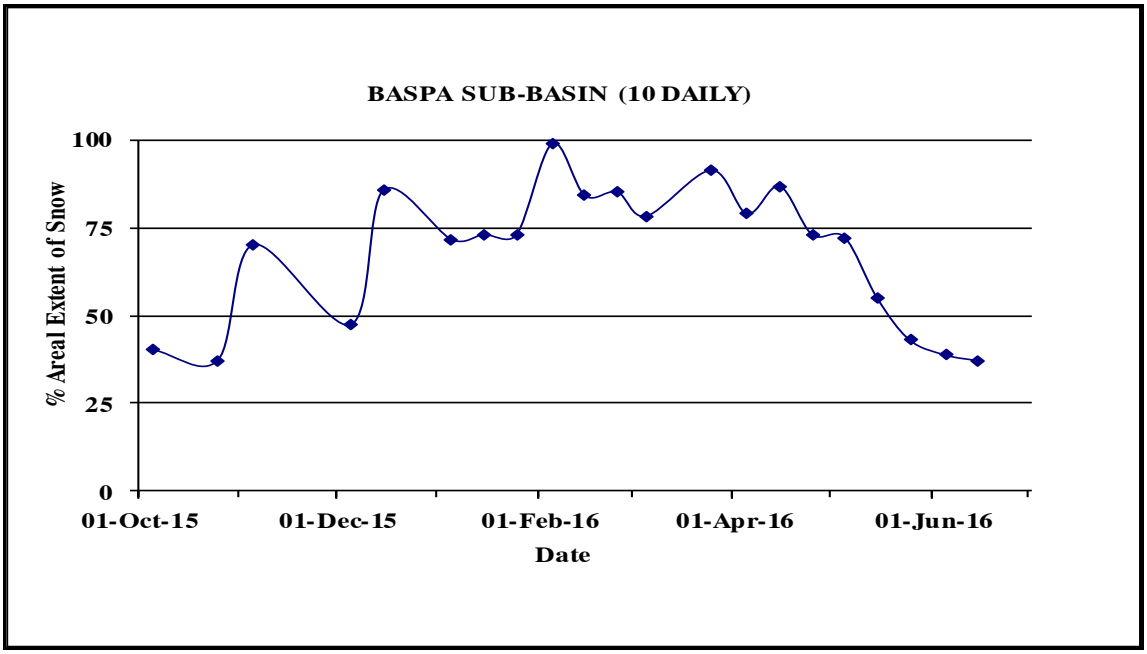
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	440	40	**3**	05-Nov-15	768	70
2	25-Oct-15	408	37				
December 2015				**January 2016**			
4	05-Dec-15	519	47	**6**	05-Jan-16	784	72
5	15-Dec-15	938	86	**7**	15-Jan-16	798	73
				8	25-Jan-16	799	73
February 2016				**March 2016**			
9	05-Feb-16	1083	99	**12**	05-Mar-16	857	78
10	15-Feb-16	921	84	**13**	25-Mar-16	1000	91
11	25-Feb-16	932	85				
April 2016				**May 2016**			
14	05-Apr-16	864	79	**17**	05-May-16	791	72
15	15-Apr-16	950	87	**18**	15-May-16	602	55
16	25-Apr-16	799	73	**19**	25-May-16	471	43
June 2016							
20	05-Jun-2016	424	39				
21	15-Jun-2016	406	37				
22	25-Jun-2016	212	19				

SNOW COVER DEPLETION CURVE

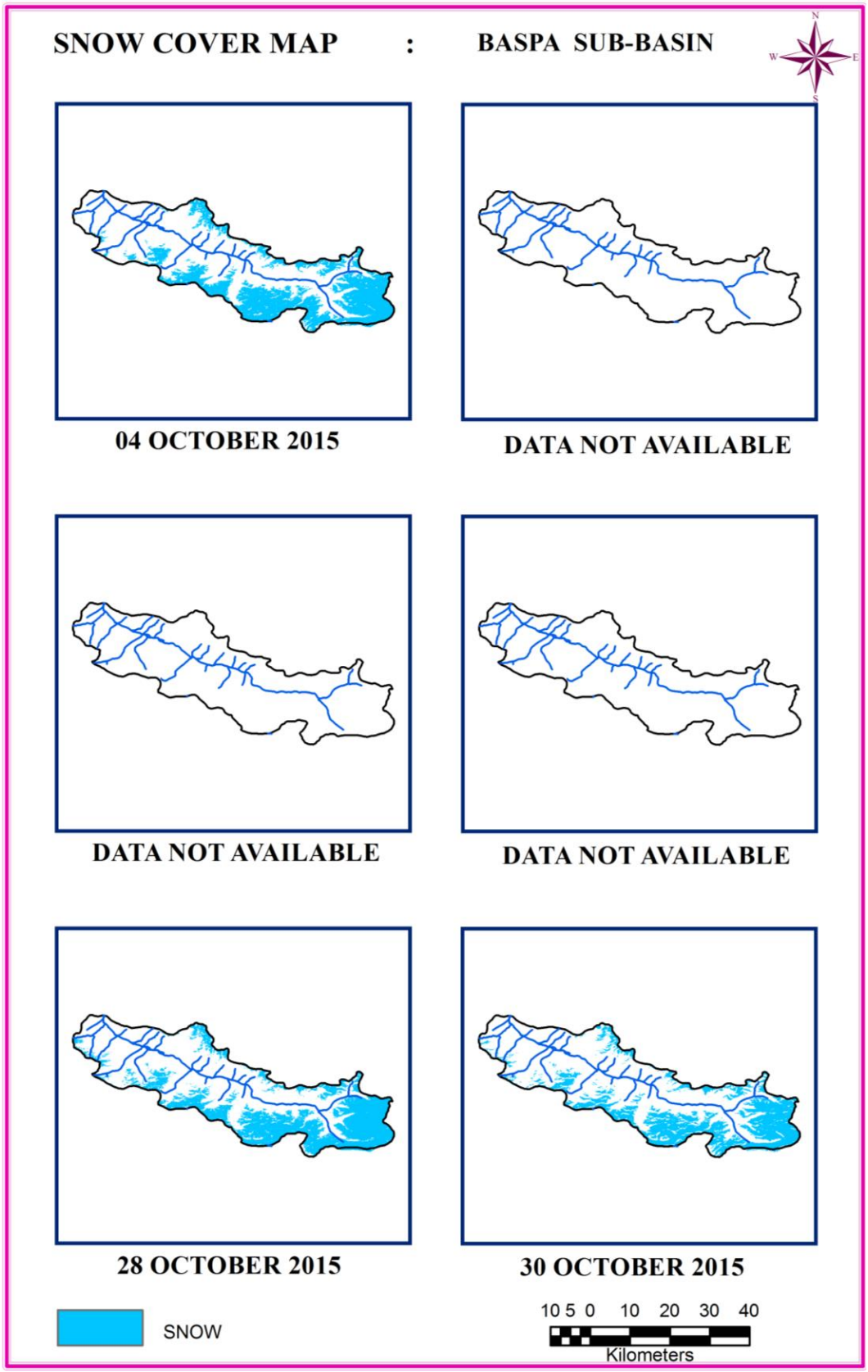




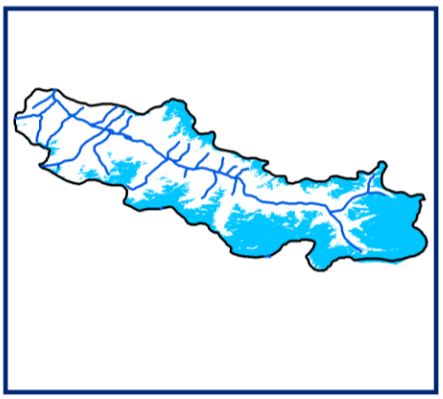
SNOW COVER DEPLETION CURVE



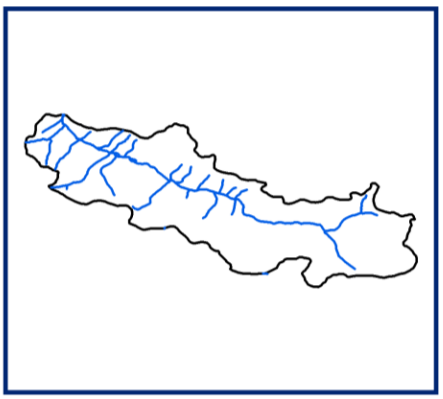
SNOW COVER MAP


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
04 OCTOBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
DATA NOT AVAILABLE
28 OCTOBER 2015
30 OCTOBER 2015
SNOW
10 5 0 10 20 30 40
Kilometers

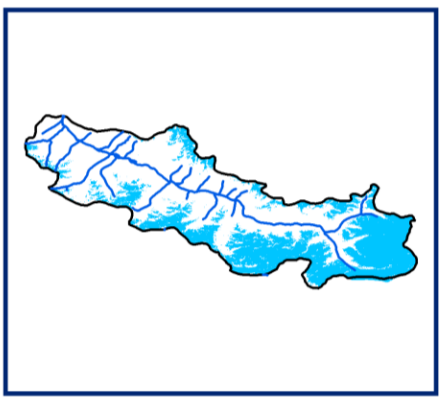
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
05 OCTOBER 2015



DATA NOT AVAILABLE

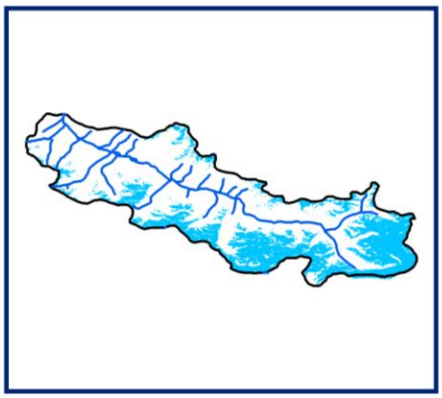


DATA USED
28 OCTOBER 2016
30 OCTOBER 2016

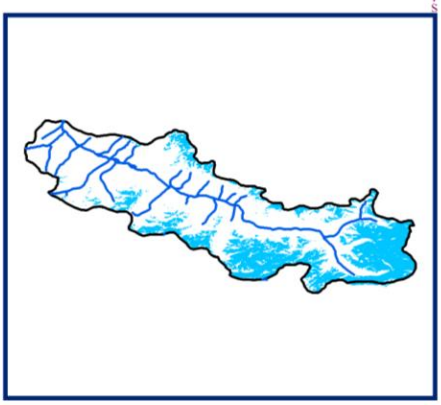
SNOW

10 5 0 10 20 30
Kilometers

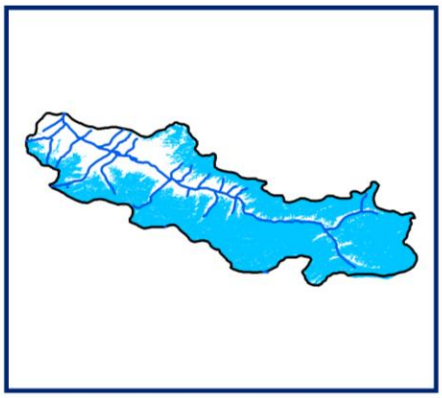
SNOW COVER MAP : BASPA SUB-BASIN



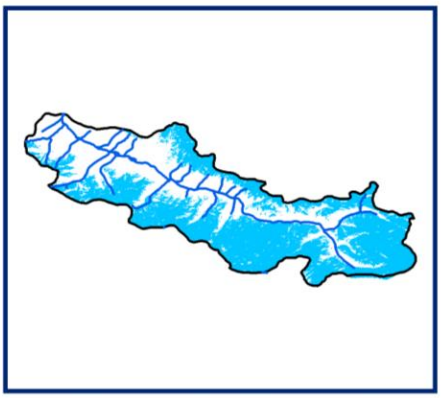
01 NOVEMBER 2015



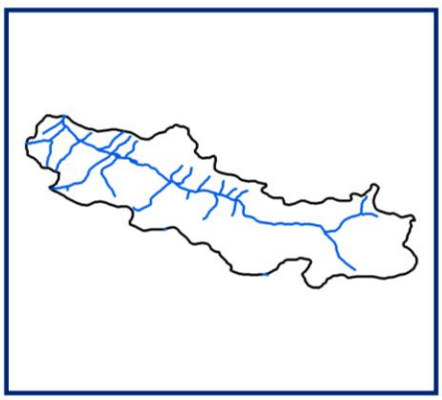
02 NOVEMBER 2015



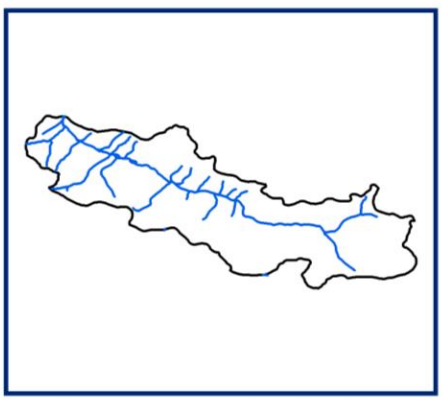
06 NOVEMBER 2015



07 NOVEMBER 2015



DATA NOT AVAILABLE



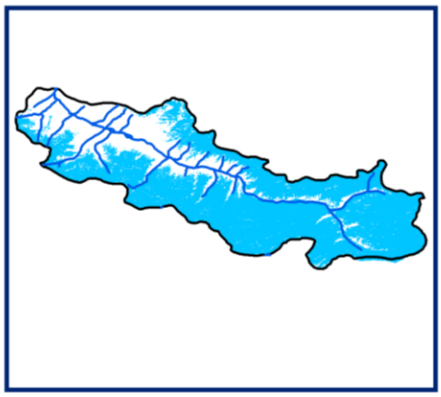
DATA NOT AVAILABLE

SNOW

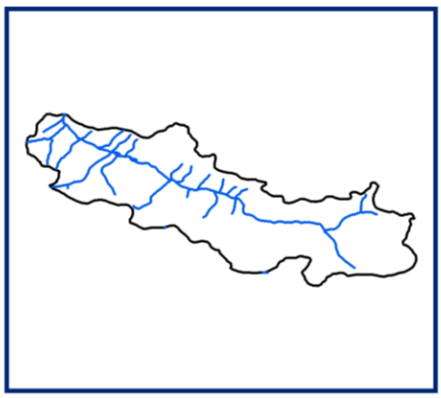
10 5 0 10 20 30 40

Kilometers

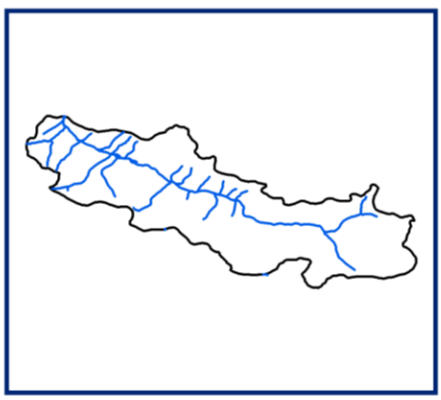
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
01 NOVEMBER 2015
02 NOVEMBER 2015
06 NOVEMBER 2015



DATA NOT AVAILABLE

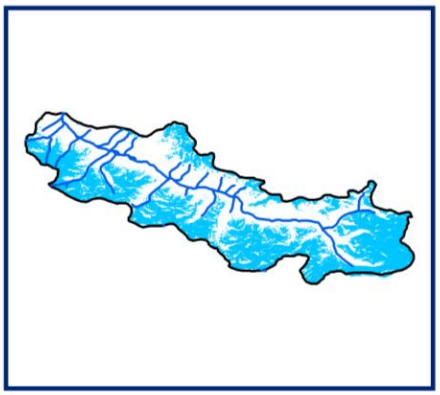


DATA NOT AVAILABLE

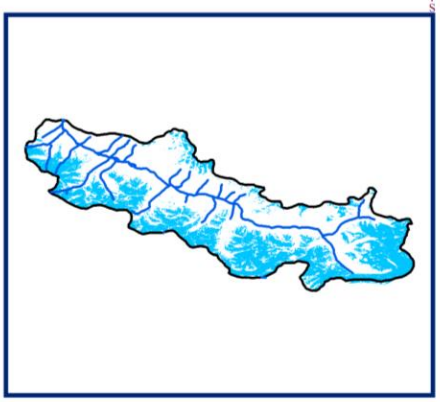
SNOW

10 5 0 10 20 30
Kilometers

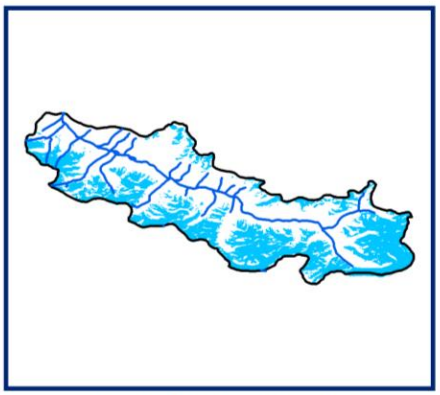
SNOW COVER MAP : BASPA SUB-BASIN



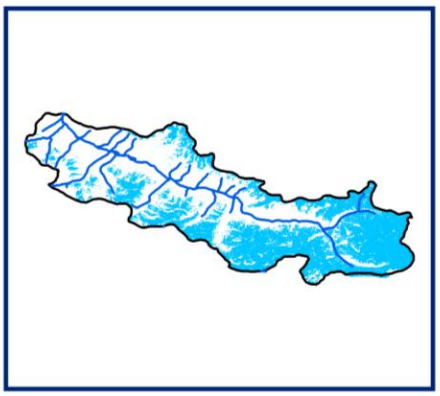
01 DECEMBER 2015



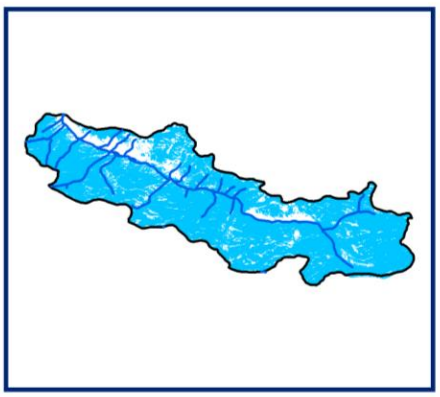
05 DECEMBER 2015



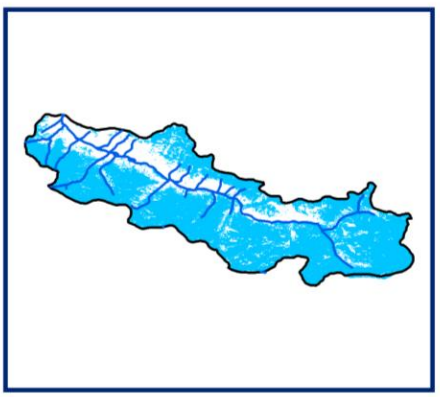
07 DECEMBER 2015



10 DECEMBER 2015



13 DECEMBER 2015



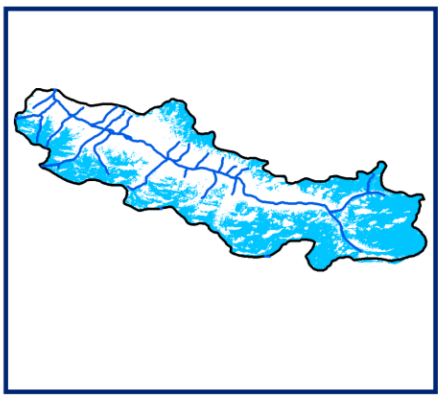
20 DECEMBER 2015

SNOW

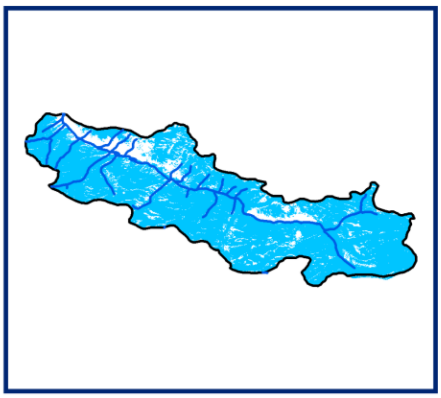
10 5 0 10 20 30 40

Kilometers

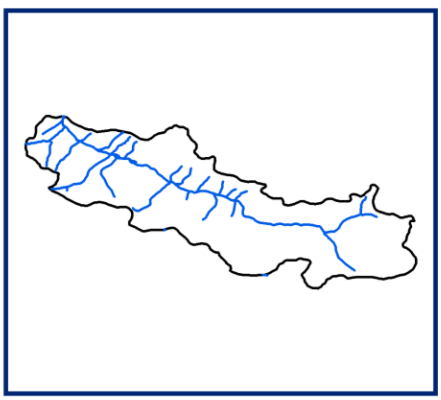
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
01 DECEMBER 2015
05 DECEMBER 2015
07 DECEMBER 2015



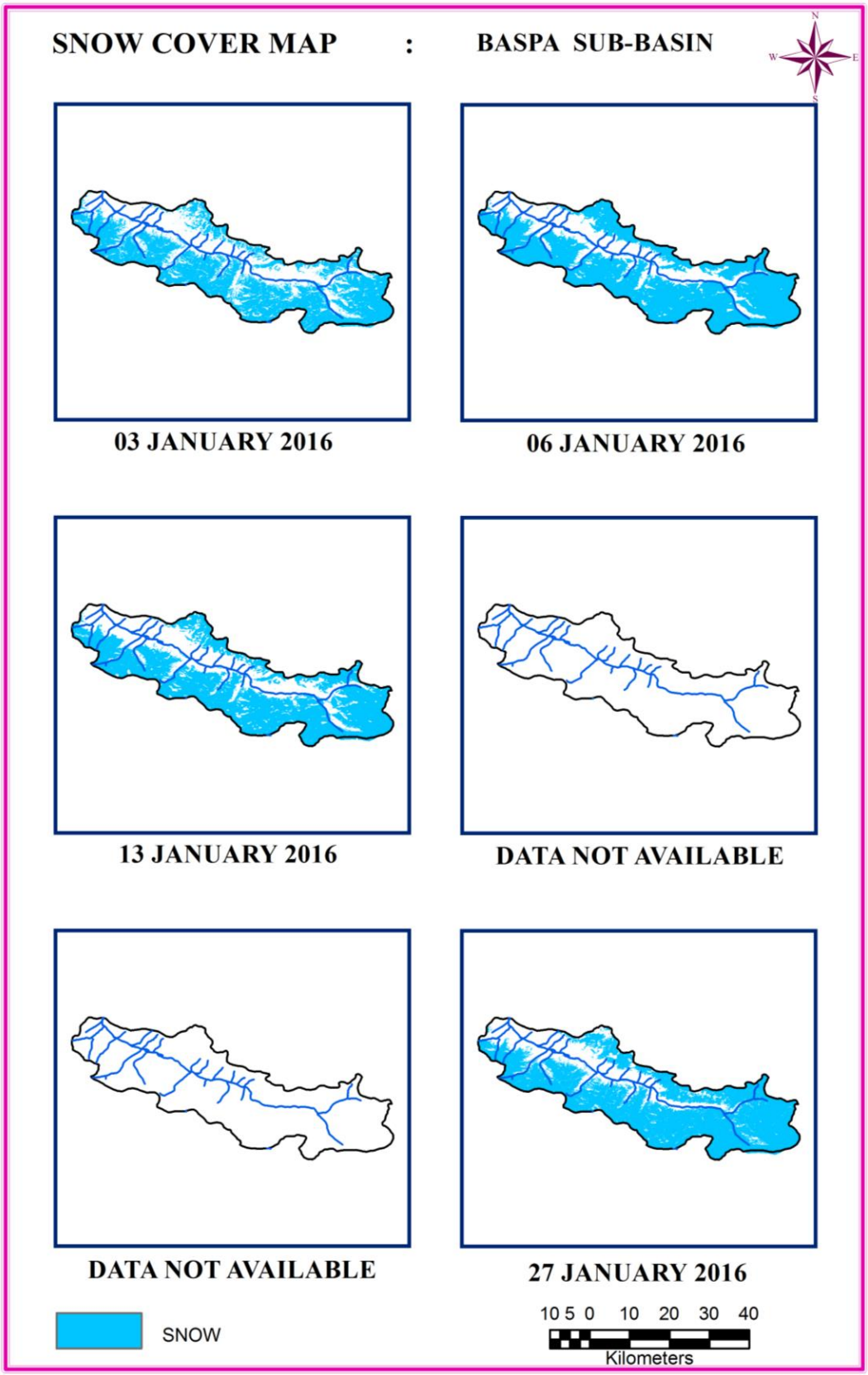
DATA USED
13 DECEMBER 2015
20 DECEMBER 2015



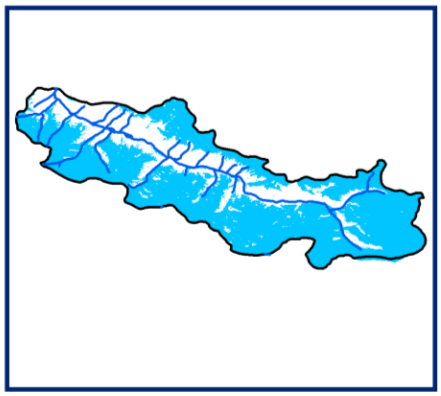
DATA NOT AVAILABLE

SNOW

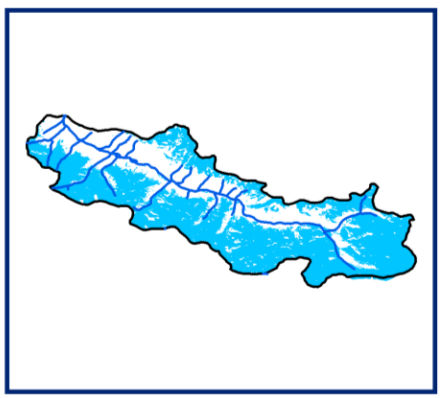
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
03 JANUARY 2016
06 JANUARY 2016
13 JANUARY 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
27 JANUARY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

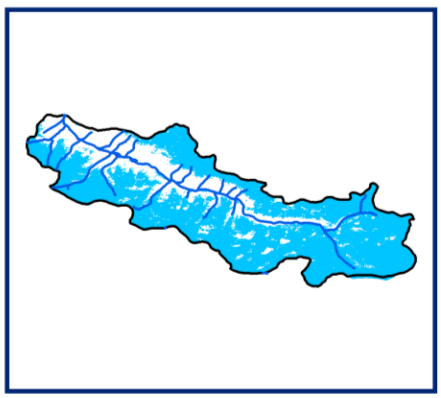
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
03 JANUARY 2016
06 JANUARY 2016



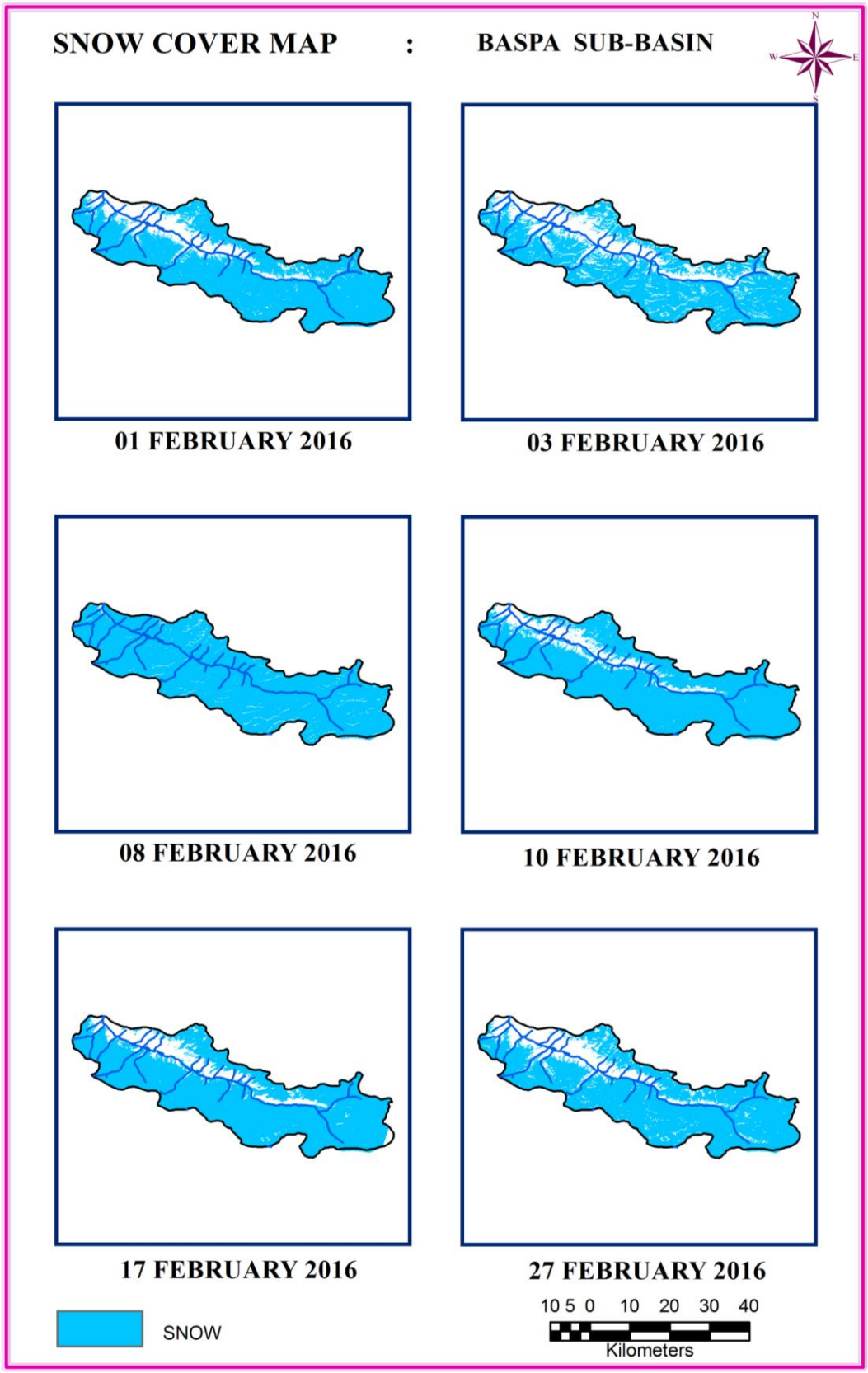
DATA USED
15 JANUARY 2016



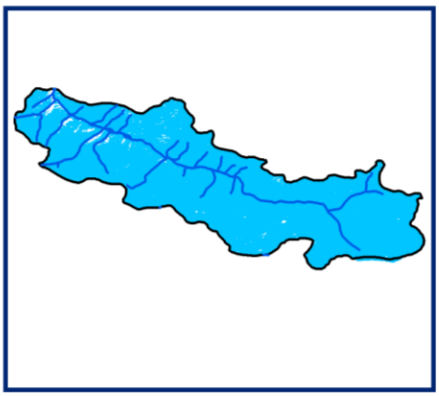
DATA USED
25 JANUARY 2016

SNOW

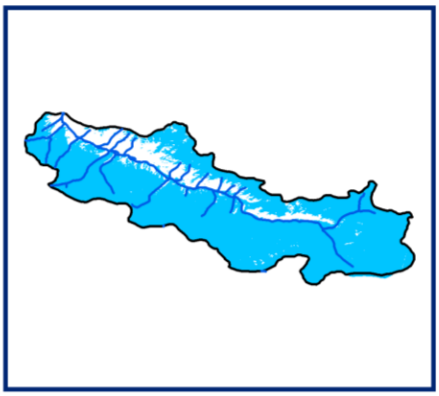
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
01 FEBRUARY 2016
03 FEBRUARY 2016
08 FEBRUARY 2016
10 FEBRUARY 2016
17 FEBRUARY 2016
27 FEBRUARY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

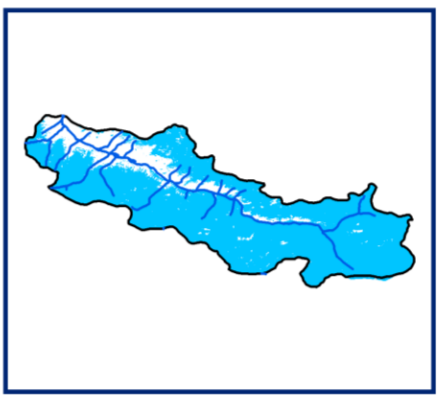
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
01 FEBRUARY 2016
03 FEBRUARY 2016
08 FEBRUARY 2016



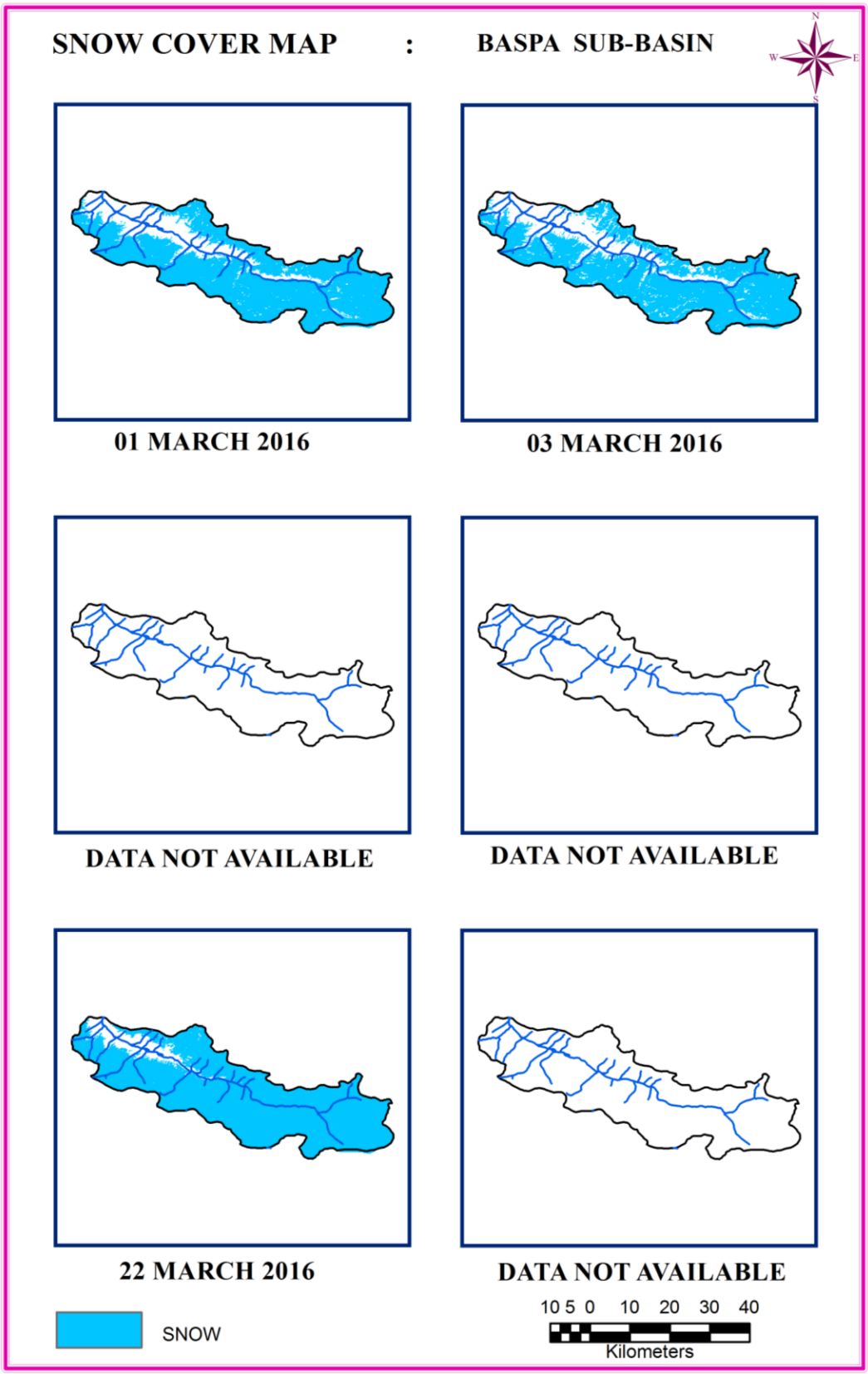
DATA USED
10 FEBRUARY 2016
17 FEBRUARY 2016



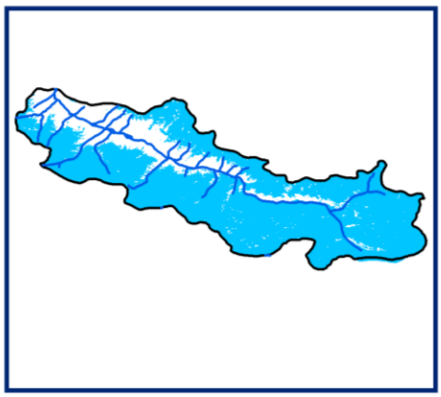
DATA USED
25 FEBRUARY 2016

SNOW

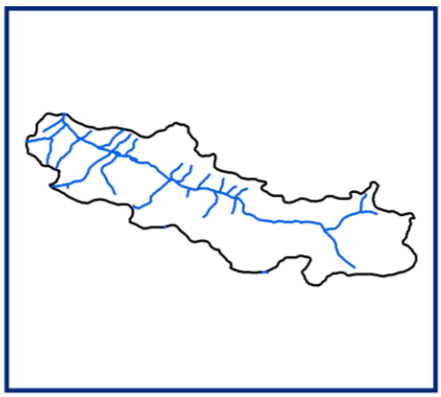
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
01 MARCH 2016
03 MARCH 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
22 MARCH 2016
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30 40
Kilometers

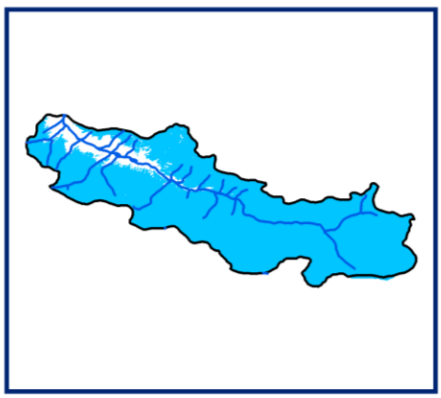
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
01 MARCH 2016
03 MARCH 2016



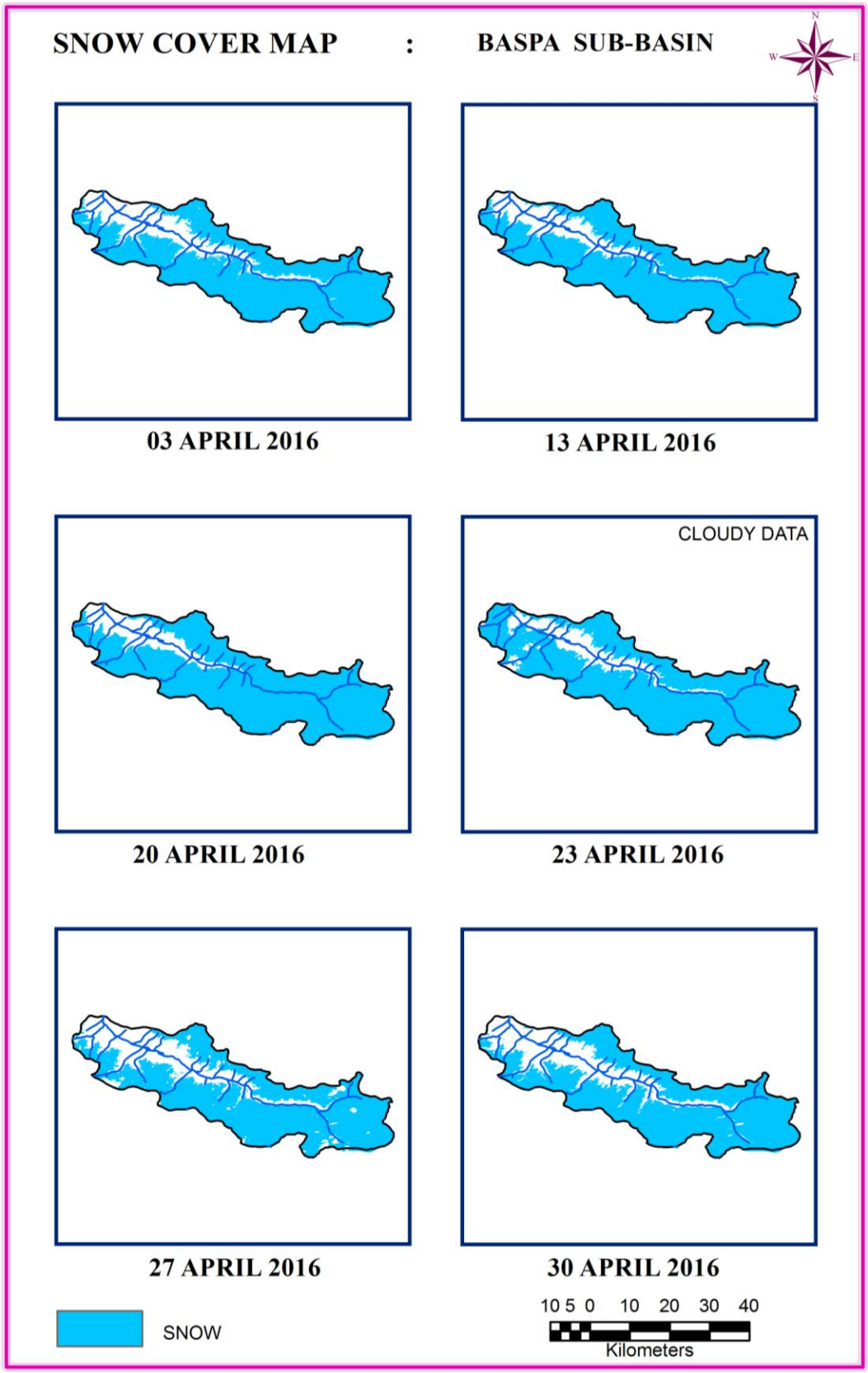
DATA NOT AVAILABLE



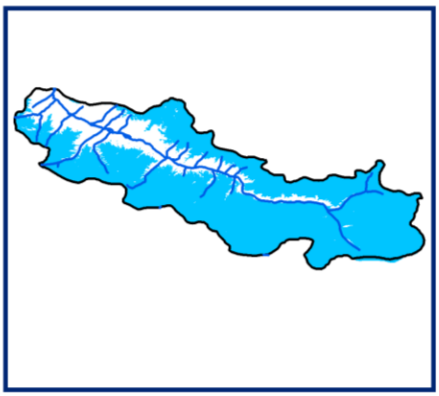
DATA USED
25 MARCH 2016

SNOW

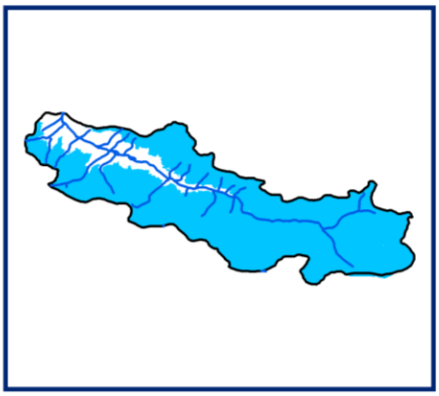
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
03 APRIL 2016
13 APRIL 2016
20 APRIL 2016
CLOUDY DATA
23 APRIL 2016
27 APRIL 2016
30 APRIL 2016
SNOW
10 5 0 10 20 30 40
Kilometers

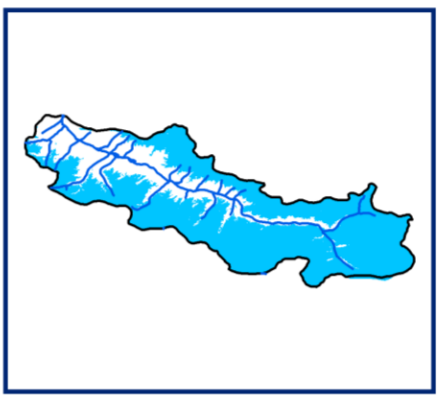
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
05 APRIL 2016



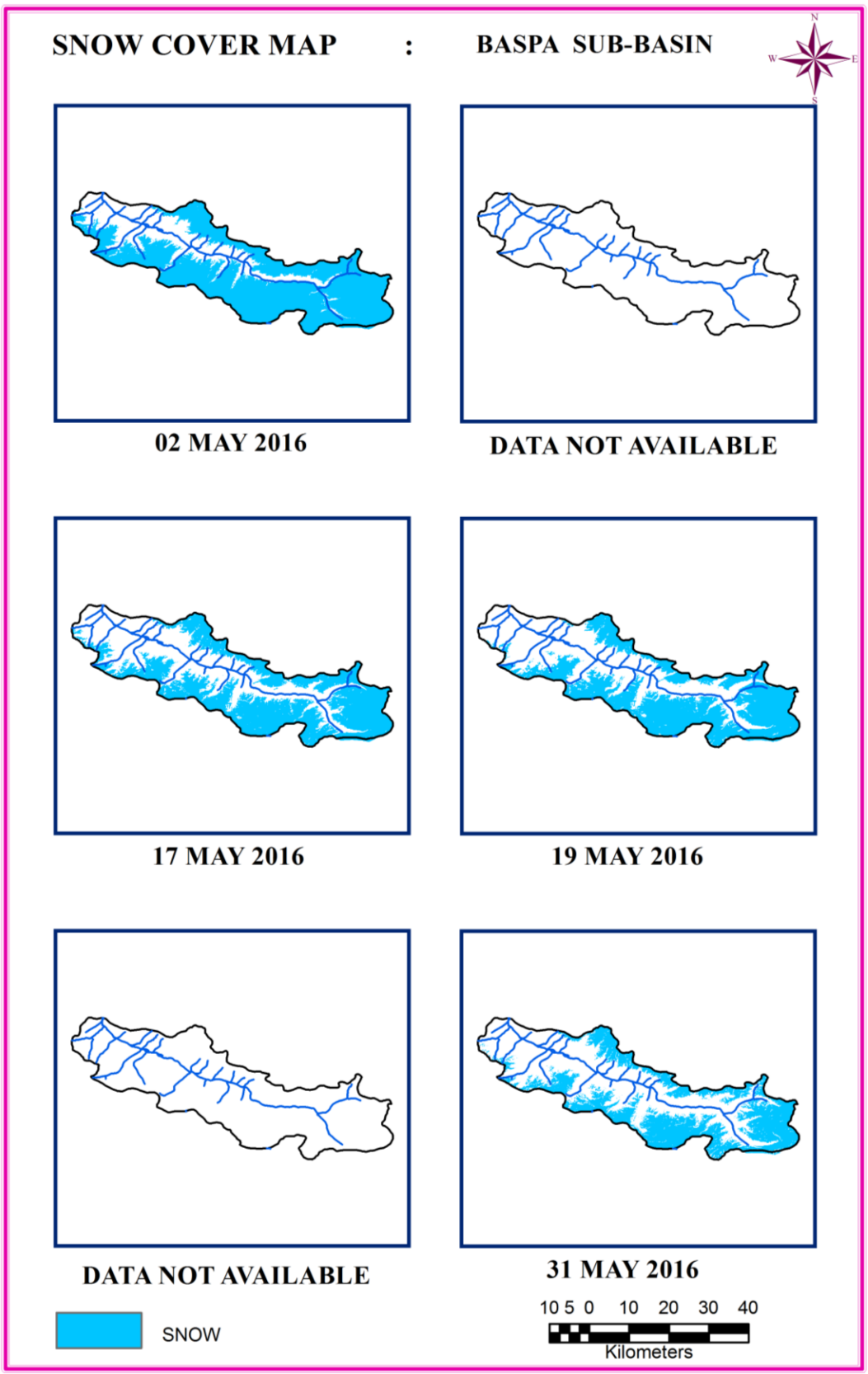
DATA USED
13 APRIL 2016
20 APRIL 2016



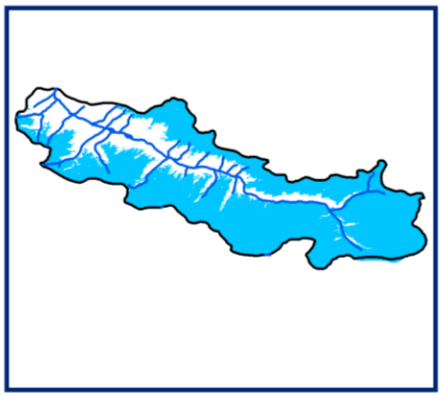
DATA USED
23 APRIL 2016
27 APRIL 2016
30 APRIL 2016

SNOW

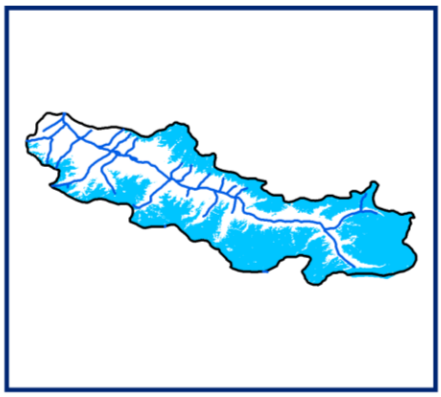
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
02 MAY 2016
DATA NOT AVAILABLE
17 MAY 2016
19 MAY 2016
DATA NOT AVAILABLE
31 MAY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

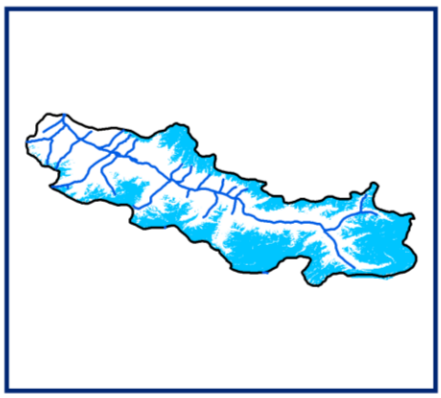
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
05 MAY 2016



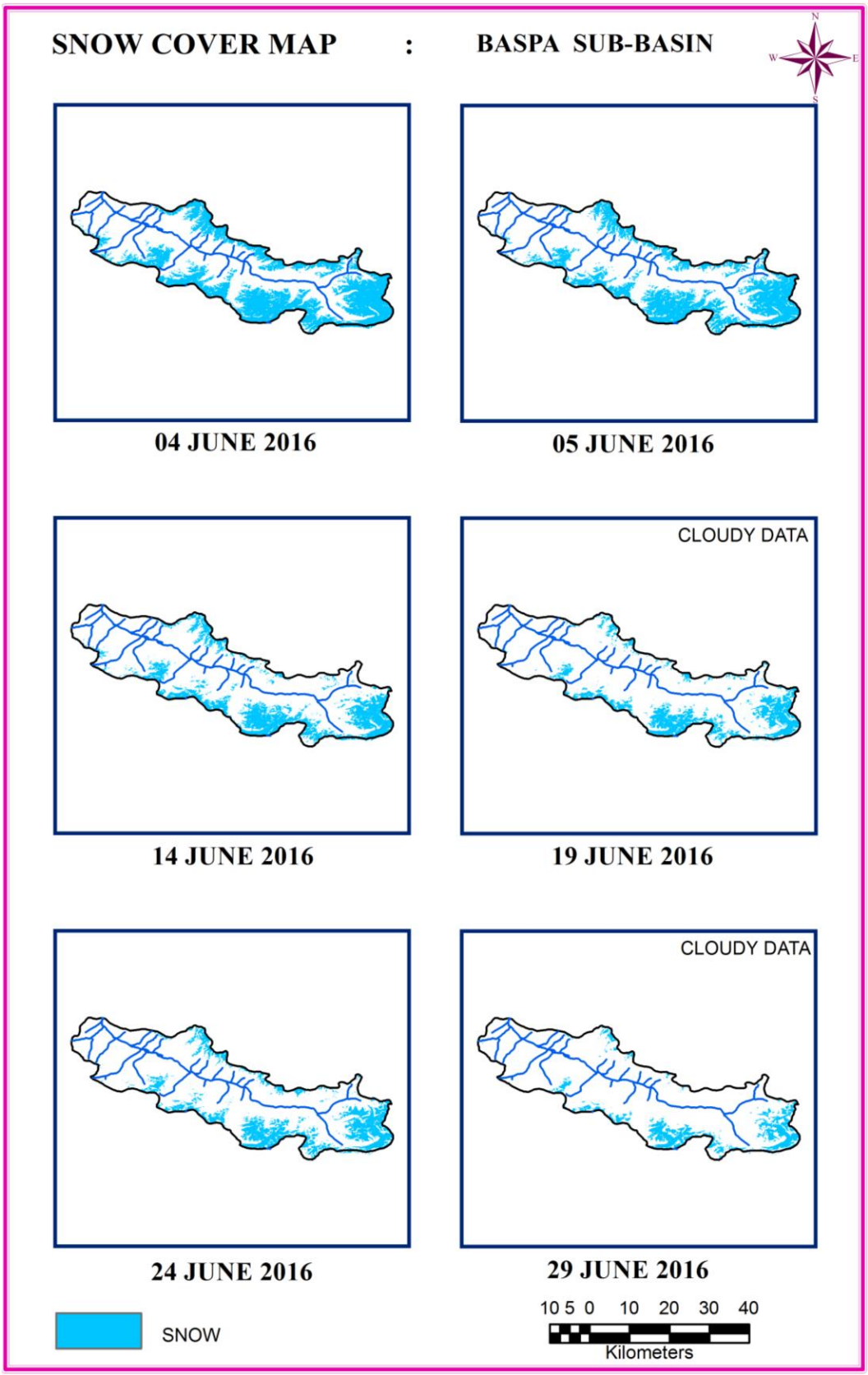
DATA USED
17 MAY 2016
19 MAY 2016



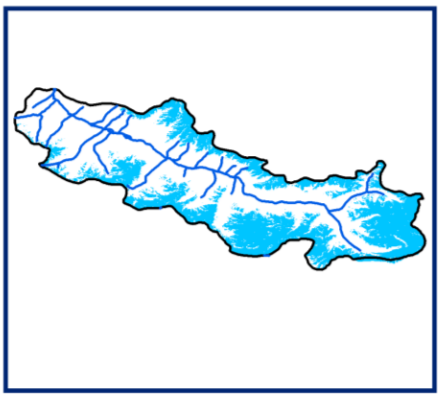
DATA USED
31 MAY 2016

SNOW

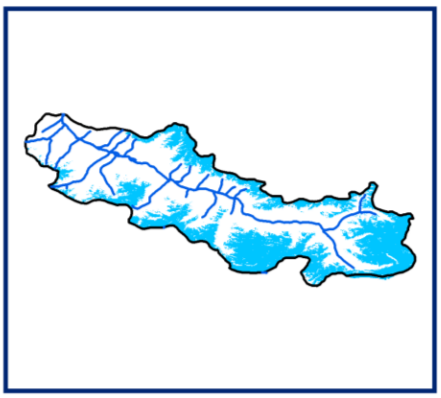
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BASPA SUB-BASIN
N
W
E
S
04 JUNE 2016
05 JUNE 2016
CLOUDY DATA
14 JUNE 2016
19 JUNE 2016
CLOUDY DATA
24 JUNE 2016
29 JUNE 2016
SNOW
10 5 0 10 20 30 40
Kilometers

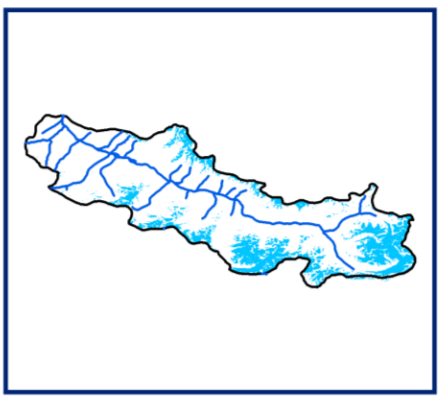
10 DAILY SNOW COVER MAP : BASPA SUB-BASIN



DATA USED
04 JUNE 2016
05 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
24 JUNE 2016
29 JUNE 2016

SNOW

10 5 0 10 20 30
Kilometers

JIWA SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: JIWA **BASIN AREA: 1445 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	03-Oct-15	165	11	**3**	28-Oct-15	195	13
2	04-Oct-15	130	9 (c)		30-Oct-15	155	11
November 2015							
4	01-Nov-15	110	8 (c)	**6**	06-Nov-15	423	29
5	02-Nov-15	185	13	**7**	08-Nov-15	151	10 (c)
December 2015							
8	05-Dec-15	130	9	**11**	20-Dec-15	459	32
9	07-Dec-15	137	9 (c)				
January 2016							
14	03-Jan-16	388	27	**16**	27-Jan-16	398	28 (c)
15	13-Jan-16	491	34				
February 2016							
18	01-Feb-16	637	44	**21**	12-Feb-16	610	42
19	03-Feb-16	663	46	**22**	17-Feb-16	543	38
20	08-Feb-16	1179	82	**23**	27-Feb-16	507	35
	10-Feb-16	523	36				
March 2016							
24	01-Mar-16	499	35	**26**	22-Mar-16	660	46
April 2016							
27	03-Apr-16	498	34	**30**	24-Apr-16	552	38
28	13-Apr-16	491	34	**31**	27-Apr-16	377	26 (c)
29	20-Apr-16	425	29	**32**	30-Apr-16	404	28
May 2016							
33	02-May-16	379	26	**35**	31-May-16	261	18
34	06-May-16	900	62 (c)				

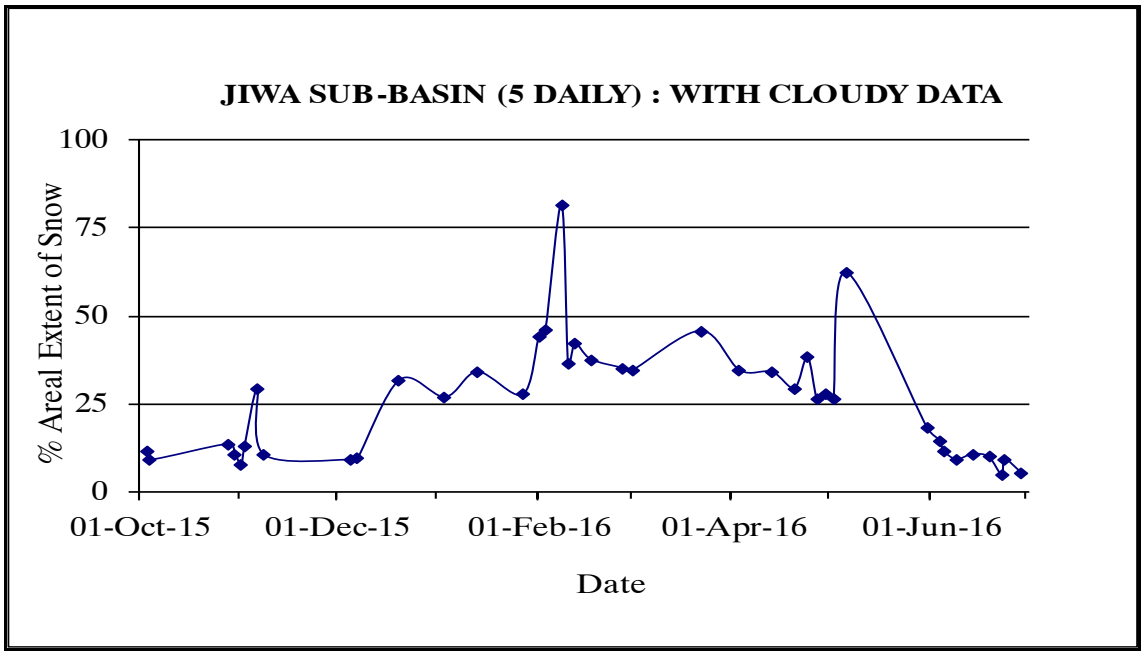
June 2016							
37	04-Jun-16	209	14	**41**	19-Jun-16	142	10 (c)
38	05-Jun-16	167	12 (c)	**42**	23-Jun-16	68	5 (c)
39	09-Jun-16	132	9 (c)	**43**	24-Jun-16	131	9
40	14-Jun-16	153	11 (c)	**44**	29-Jun-16	78	5 (c)

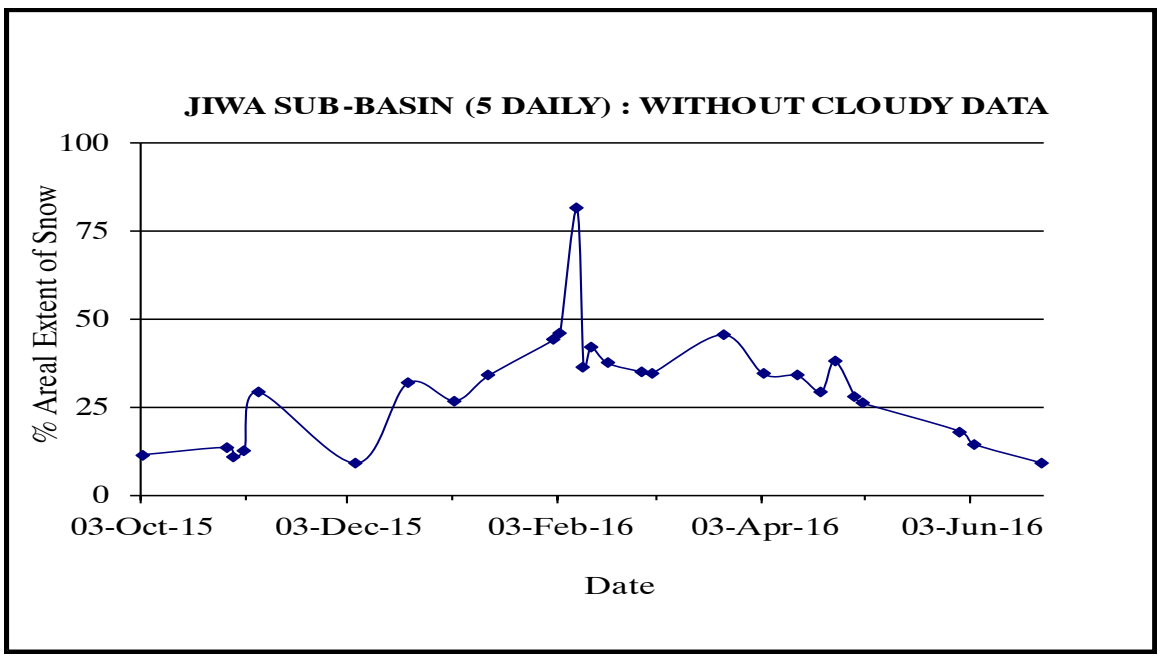
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: JIWA **BASIN AREA: 1445 sq km**

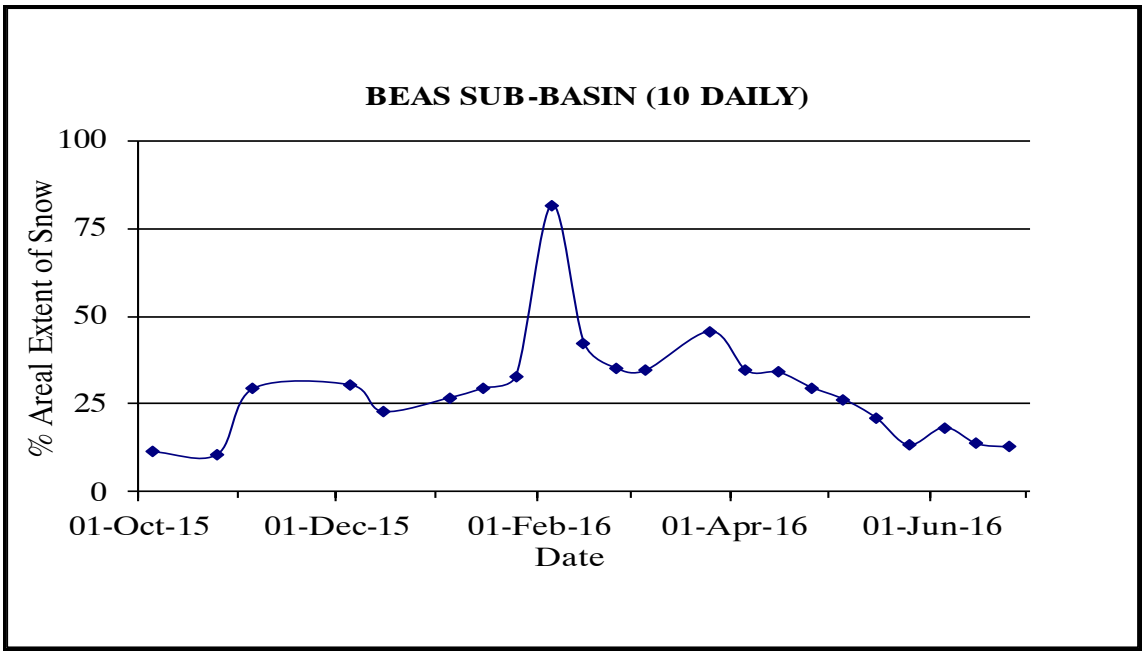
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	165	11	**3**	05-Nov-15	424	29
2	25-Oct-15	155	11				
December 2015				**January 2016**			
4	05-Dec-15	439	30	**6**	05-Jan-16	388	27
5	15-Dec-15	330	23	**7**	15-Jan-16	427	30
				8	25-Jan-16	477	33
February 2016				**March 2016**			
9	05-Feb-16	1178	82	**12**	05-Mar-16	499	35
10	15-Feb-16	610	42	**13**	25-Mar-16	659	46
11	25-Feb-16	507	35				
April 2016				**May 2016**			
14	05-Apr-16	498	34	**17**	05-May-16	380	26
15	15-Apr-16	491	34	**18**	15-May-16	304	21
16	25-Apr-16	429	30	**19**	25-May-16	193	13
June 2016							
20	05-Jun-2016	265	18				
21	15-Jun-2016	198	14				
22	25-Jun-2016	184	13				

SNOW COVER DEPLETION CURVE

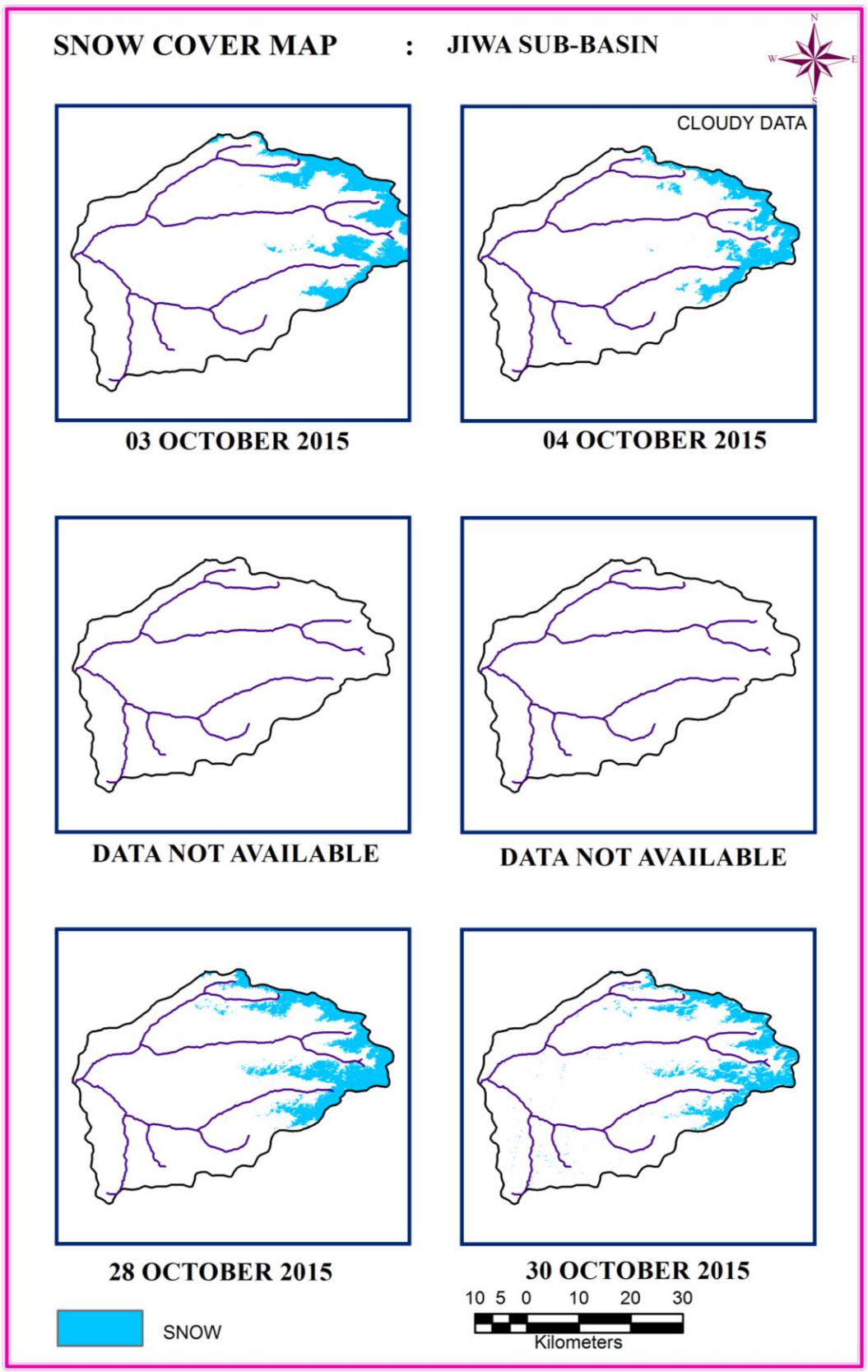




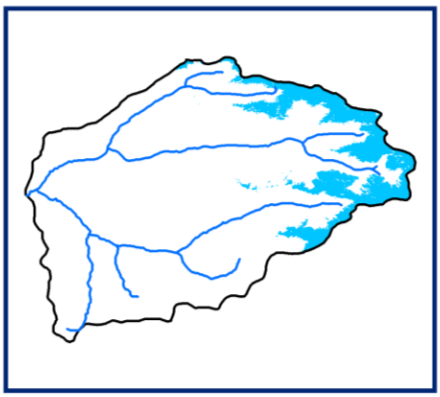
SNOW COVER DEPLETION CURVE



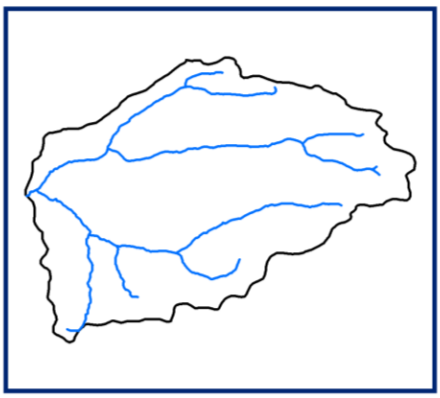
SNOW COVER MAP


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
CLOUDY DATA
03 OCTOBER 2015
04 OCTOBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
28 OCTOBER 2015
30 OCTOBER 2015
10 5 0 10 20 30
Kilometers
SNOW

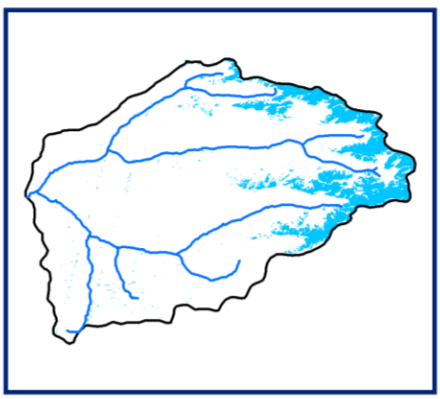
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
03 OCTOBER 2015
04 OCTOBER 2015



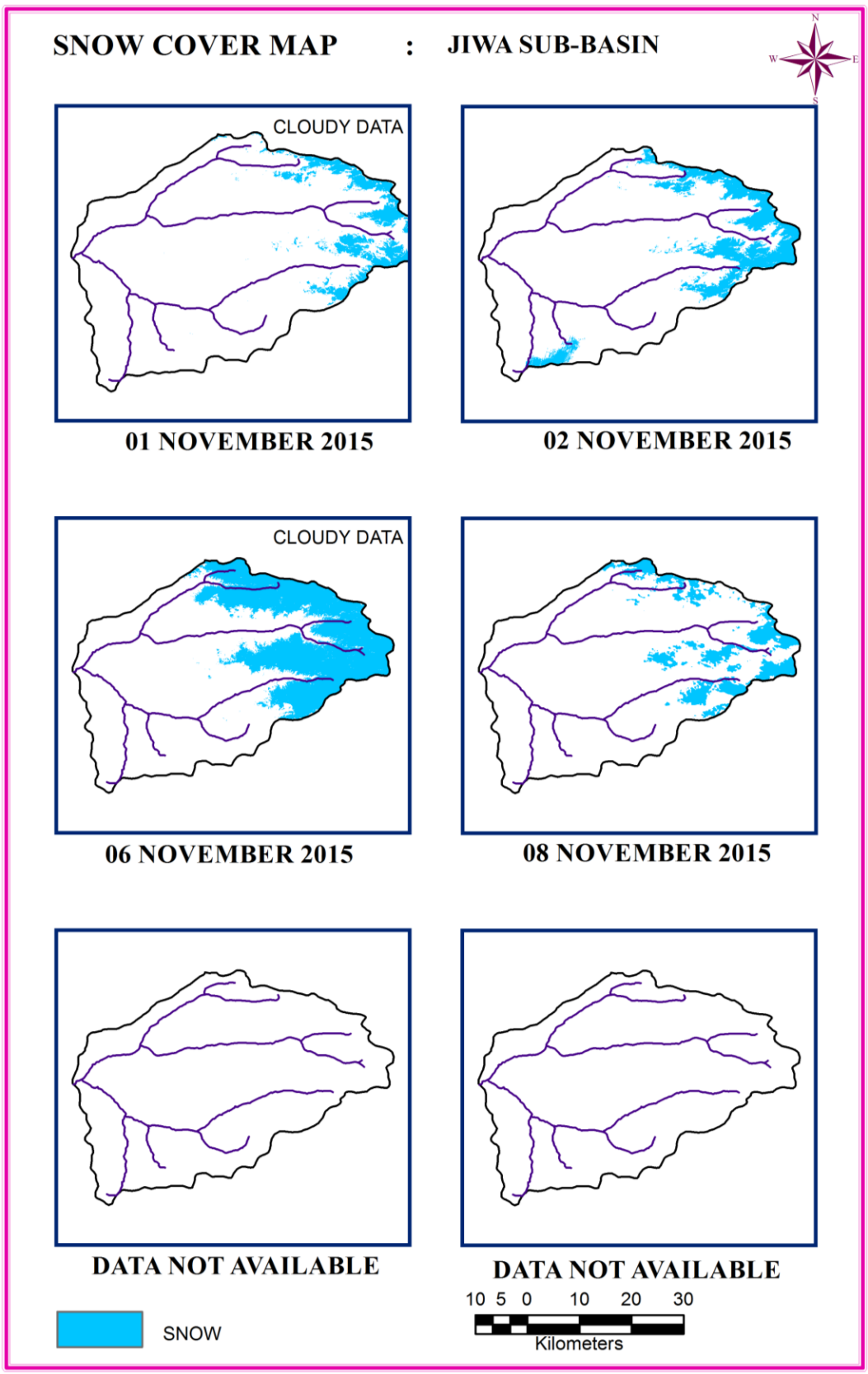
DATA NOT AVAILABLE



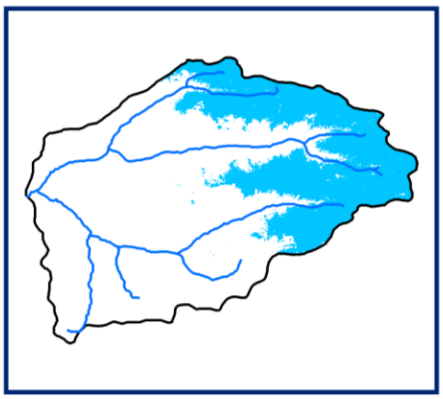
DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

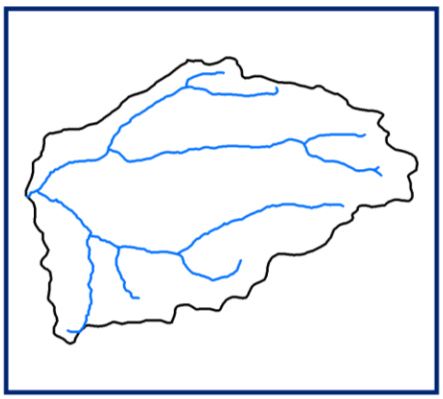
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
CLOUDY DATA
01 NOVEMBER 2015
02 NOVEMBER 2015
CLOUDY DATA
06 NOVEMBER 2015
08 NOVEMBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30
Kilometers

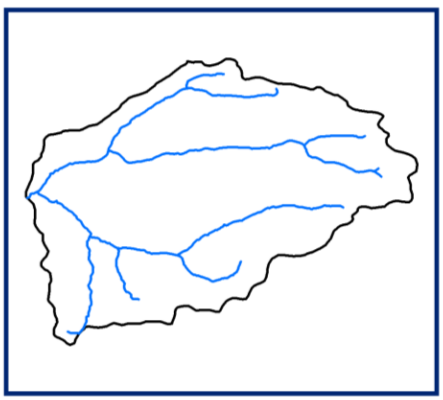
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
01 NOVEMBER 2015
02 NOVEMBER 2015
06 NOVEMBER 2015



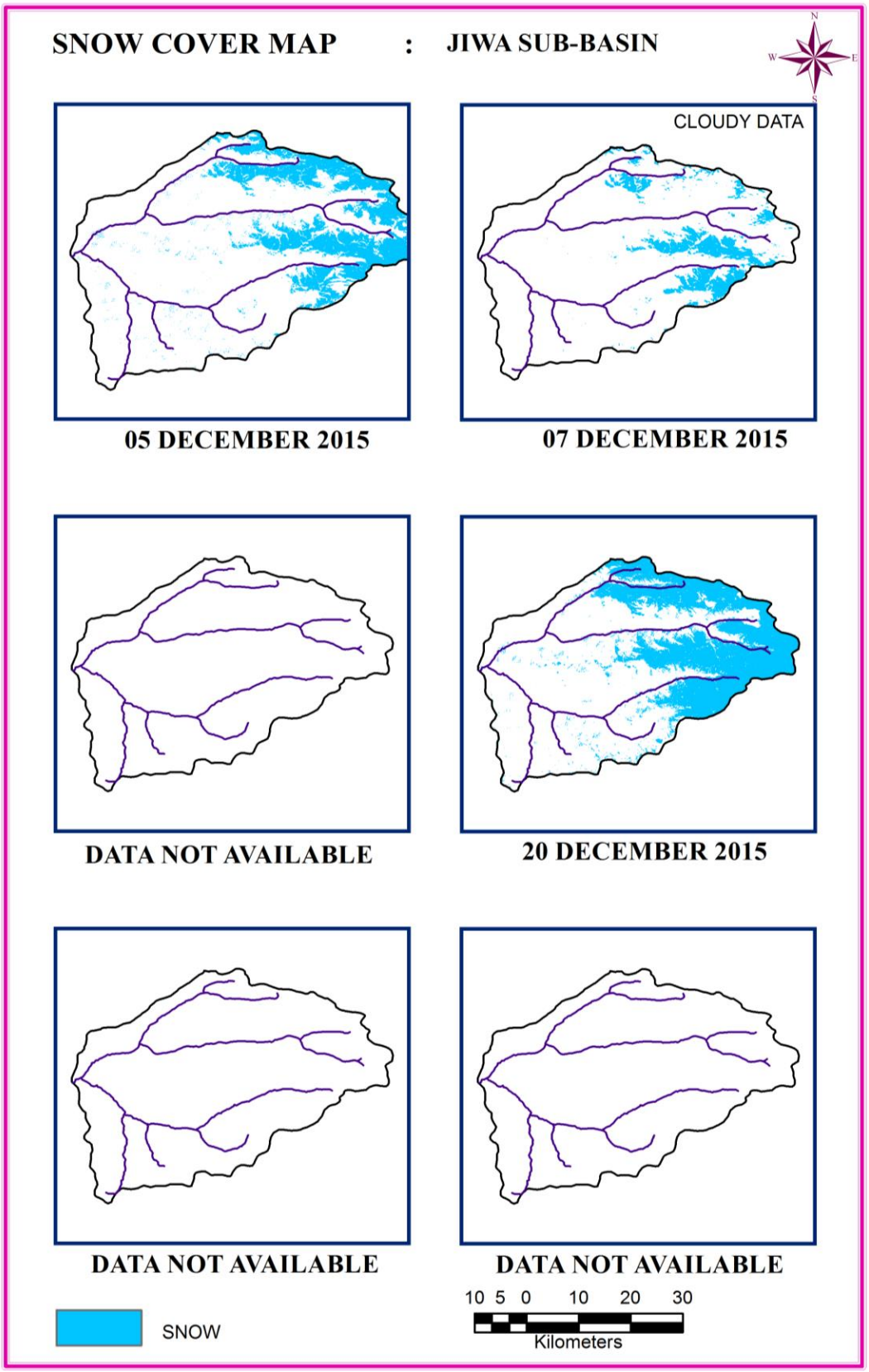
DATA NOT AVAILABLE



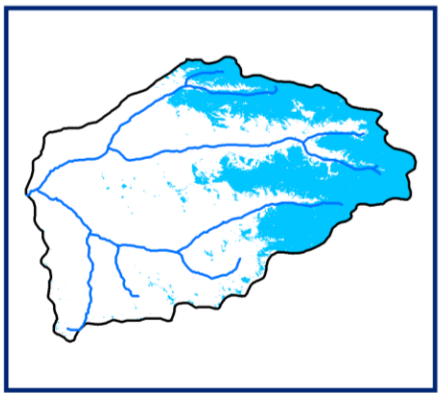
DATA NOT AVAILABLE

SNOW

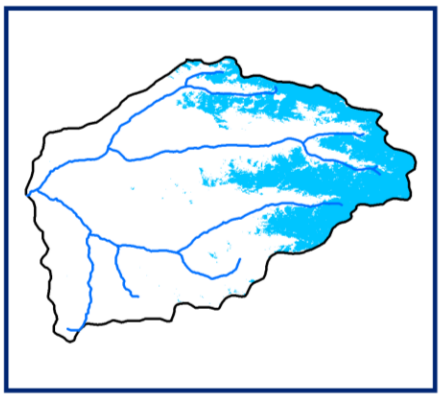
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
CLOUDY DATA
05 DECEMBER 2015
07 DECEMBER 2015
DATA NOT AVAILABLE
20 DECEMBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30
Kilometers

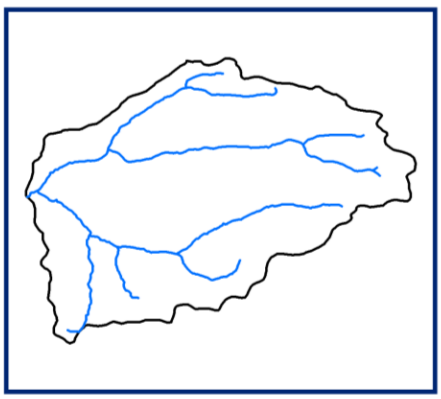
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
05 DECEMBER 2015
07 DECEMBER 2015



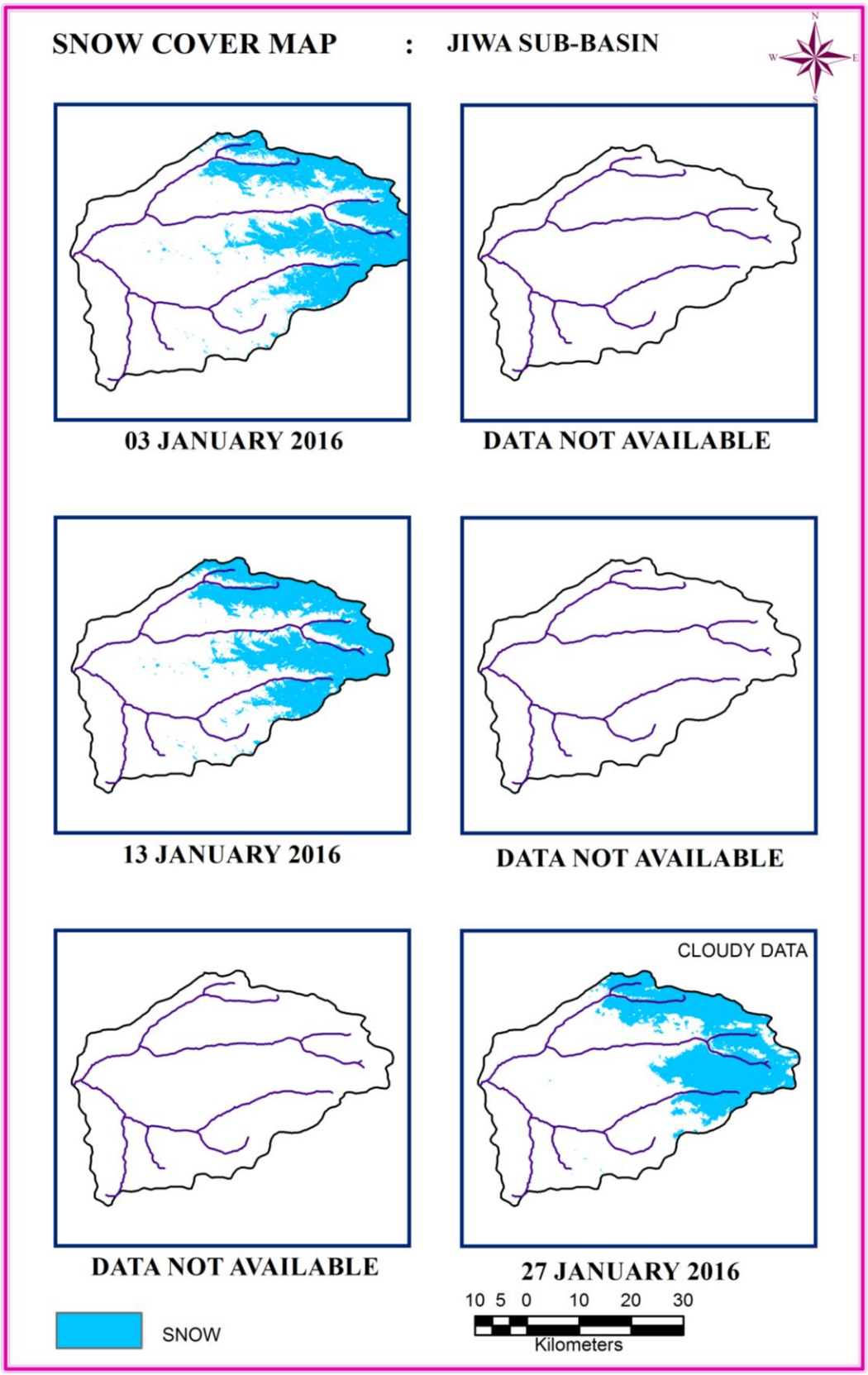
DATA USED
15 DECEMBER 2015



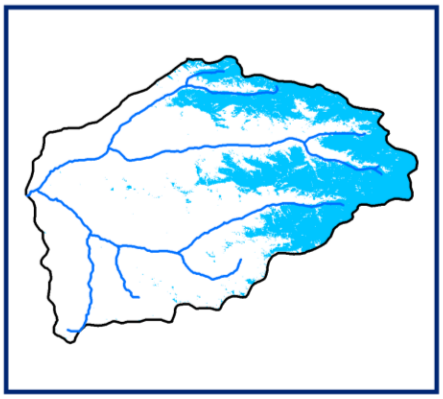
DATA NOT AVAILABLE

SNOW

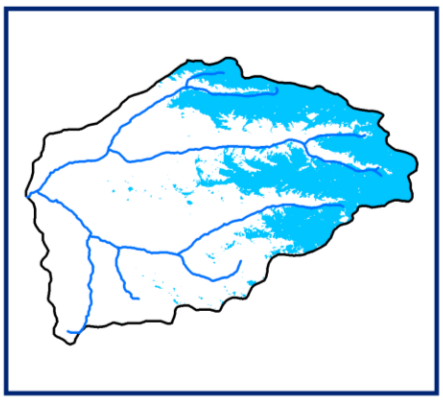
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
03 JANUARY 2016
DATA NOT AVAILABLE
13 JANUARY 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
CLOUDY DATA
27 JANUARY 2016
10 5 0 10 20 30
Kilometers
SNOW

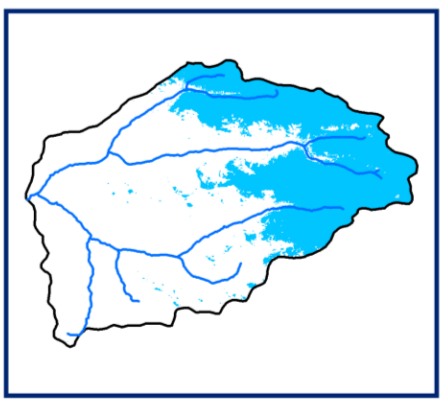
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
05 JANUARY 2016



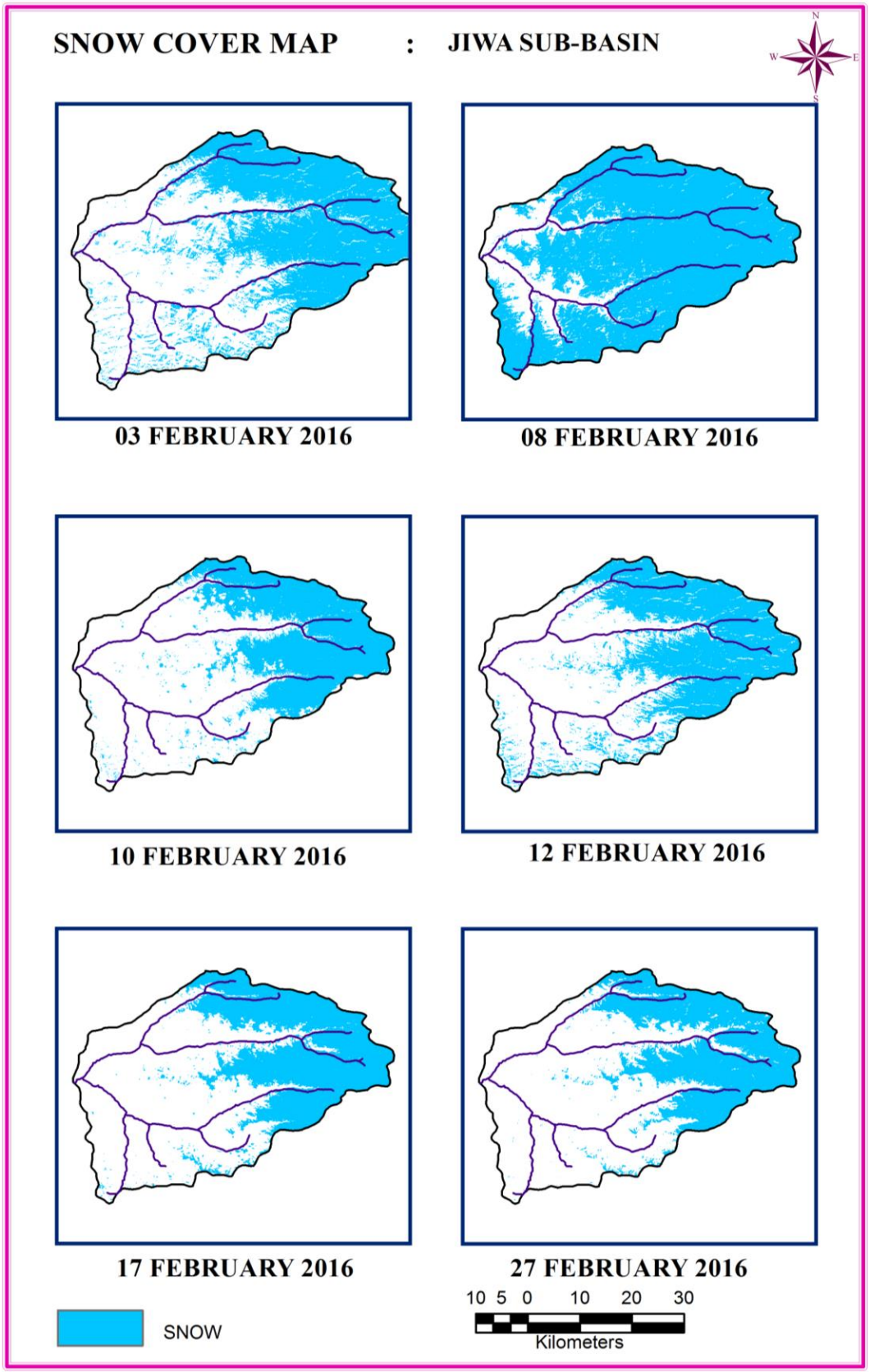
DATA USED
15 JANUARY 2015



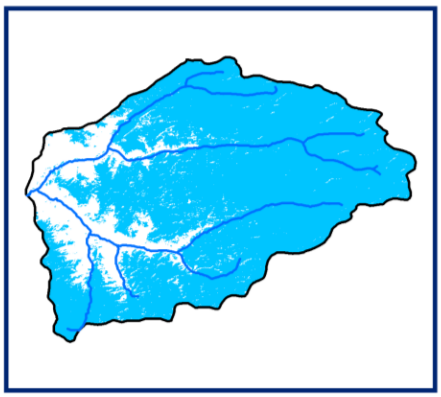
DATA USED
25 JANUARY 2015

SNOW

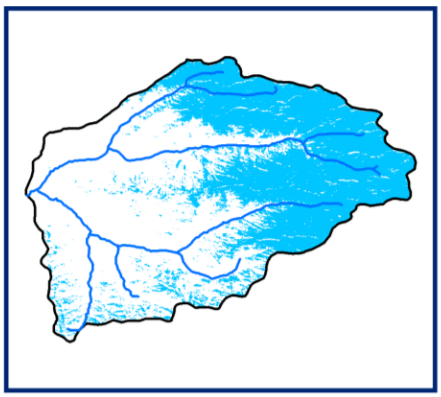
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
03 FEBRUARY 2016
08 FEBRUARY 2016
10 FEBRUARY 2016
12 FEBRUARY 2016
17 FEBRUARY 2016
27 FEBRUARY 2016
SNOW
10 5 0 10 20 30
Kilometers

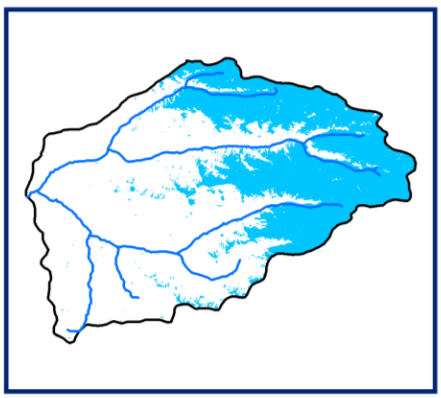
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
01 FEBRUARY 2016
03 FEBRUARY 2016
08 FEBRUARY 2016



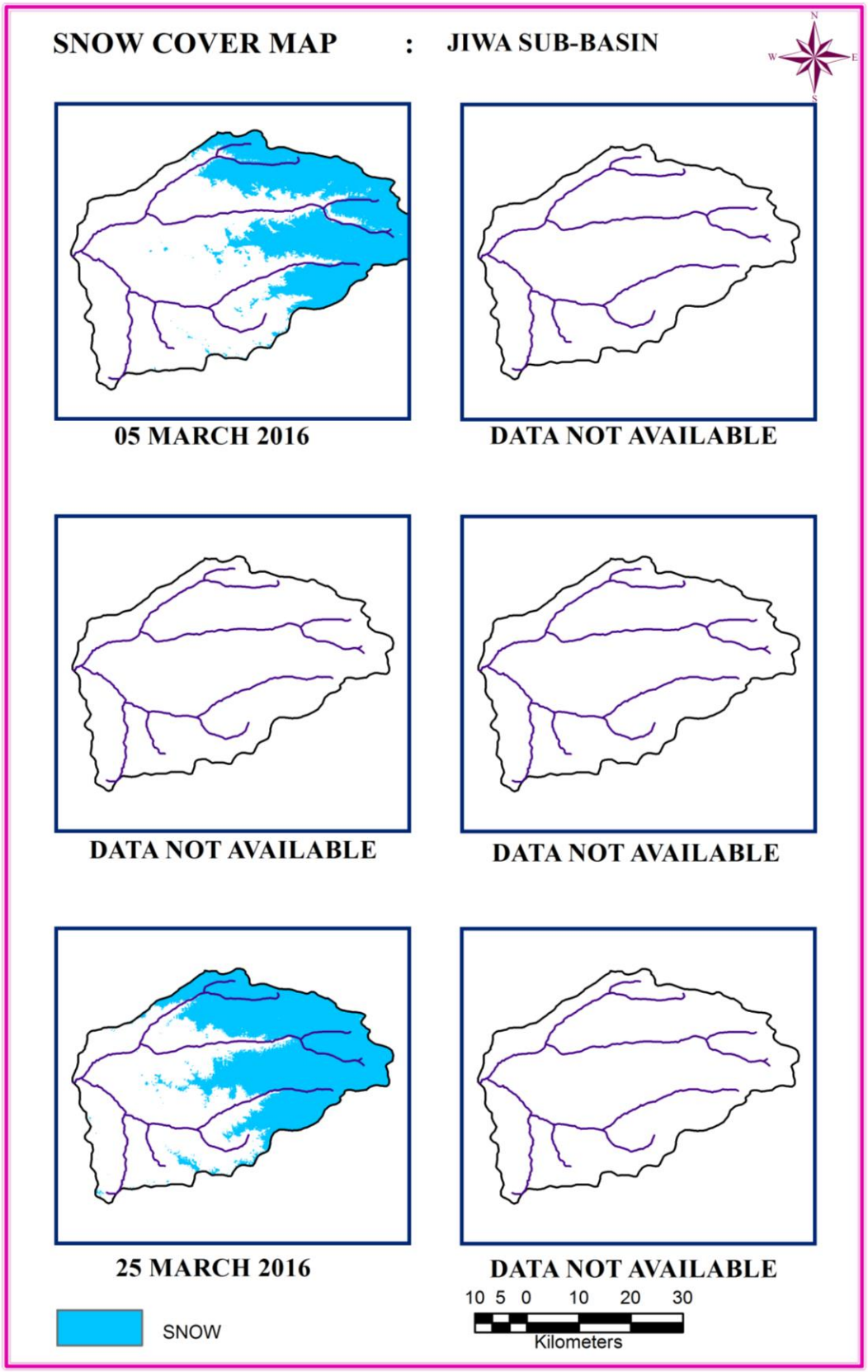
DATA USED
12 FEBRUARY 2016
17 FEBRUARY 2016



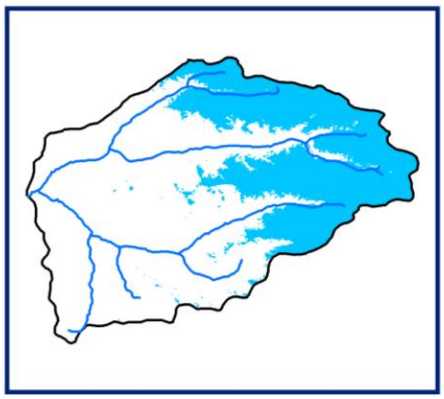
DATA USED
25 FEBRUARY 2015

10 5 0 10 20 30
Kilometers

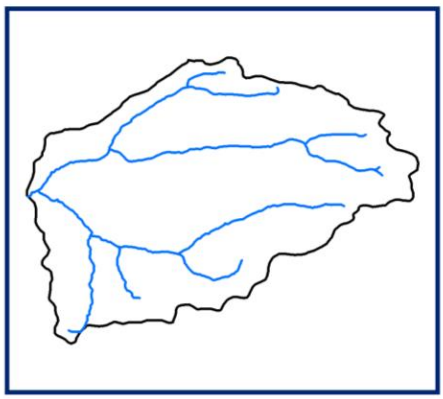
SNOW


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
05 MARCH 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
DATA NOT AVAILABLE
25 MARCH 2016
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30
Kilometers

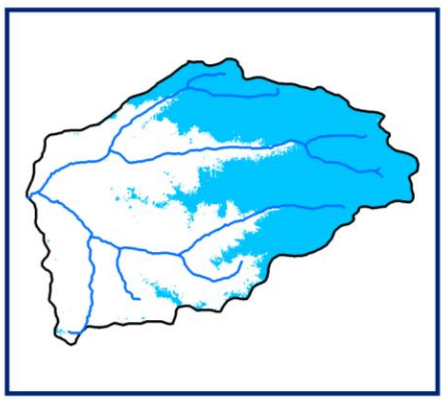
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
05 MARCH 2016



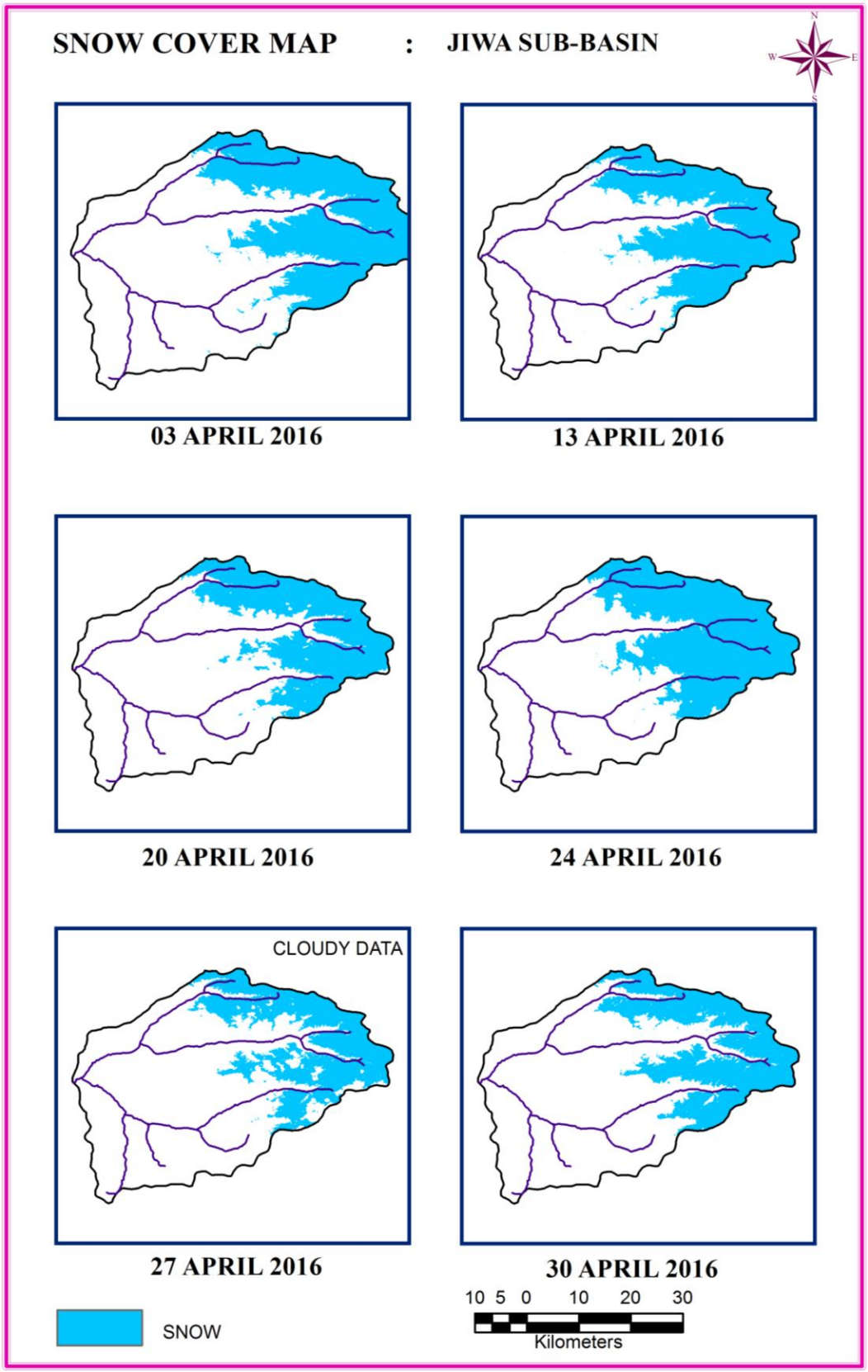
DATA NOT AVAILABLE



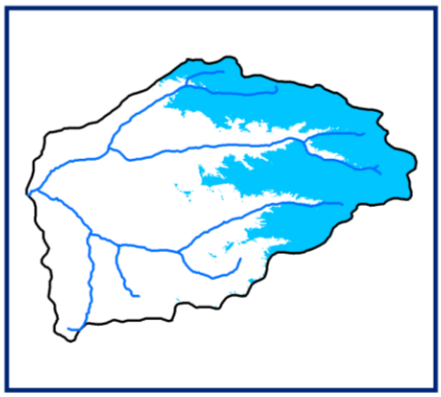
DATA USED
25 MARCH 2016

SNOW

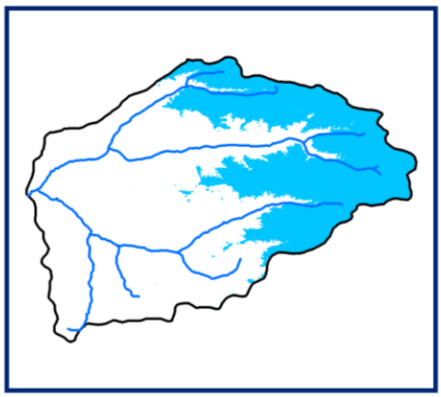
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
03 APRIL 2016
13 APRIL 2016
20 APRIL 2016
24 APRIL 2016
CLOUDY DATA
27 APRIL 2016
30 APRIL 2016
SNOW
10 5 0 10 20 30
Kilometers

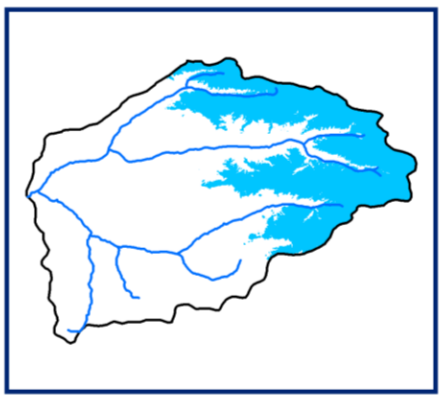
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
05 APRIL 2016



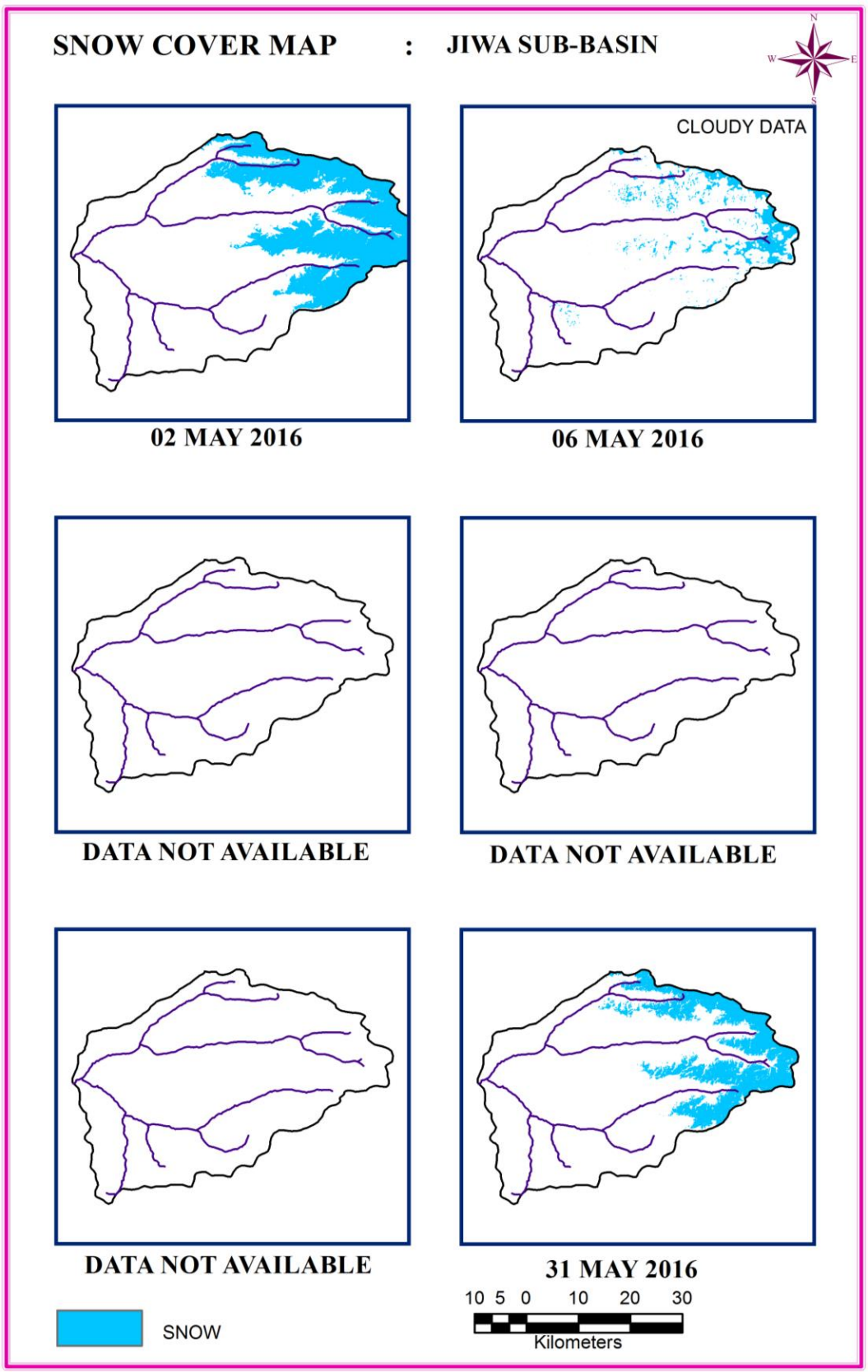
DATA USED
13 APRIL 2016
20 APRIL 2016



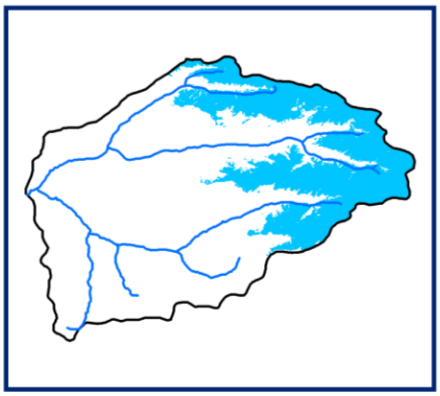
DATA USED
24 APRIL 2016
27 APRIL 2016
30 APRIL 2016

SNOW

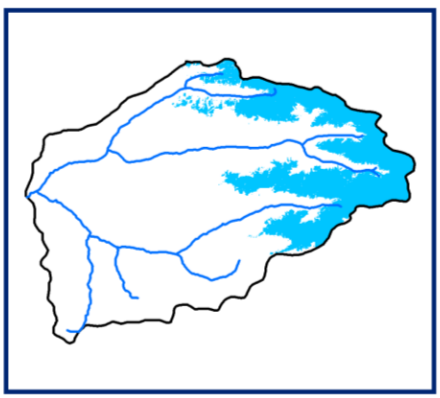
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
CLOUDY DATA
02 MAY 2016
06 MAY 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
DATA NOT AVAILABLE
31 MAY 2016
10 5 0 10 20 30
Kilometers
SNOW

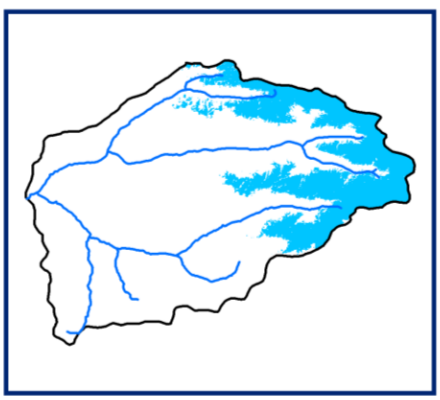
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
05 MAY 2016



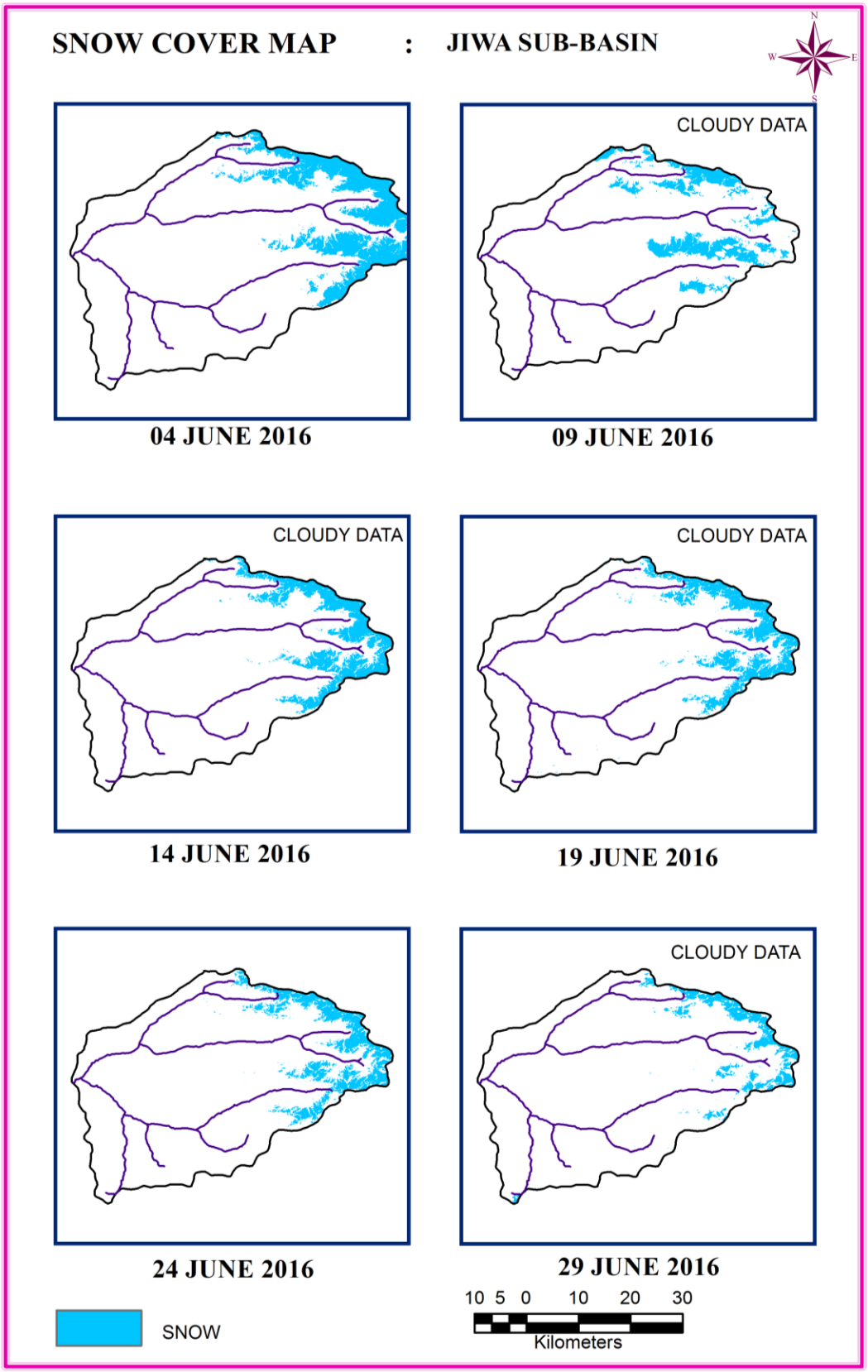
DATA USED
15 MAY 2016



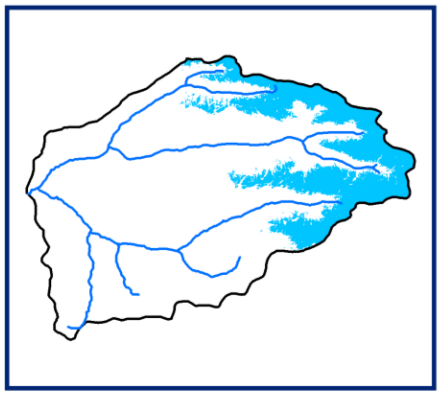
DATA USED
25 MAY 2016

SNOW

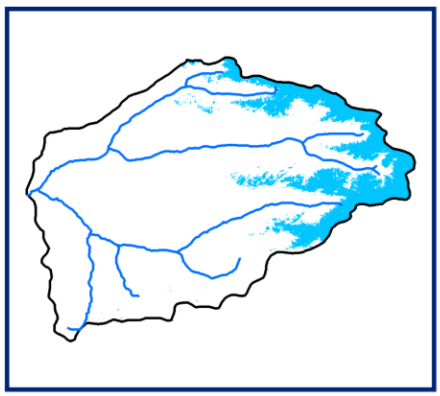
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : JIWA SUB-BASIN
N
W
E
S
CLOUDY DATA
04 JUNE 2016
09 JUNE 2016
CLOUDY DATA
CLOUDY DATA
14 JUNE 2016
19 JUNE 2016
CLOUDY DATA
24 JUNE 2016
29 JUNE 2016
SNOW
10 5 0 10 20 30
Kilometers

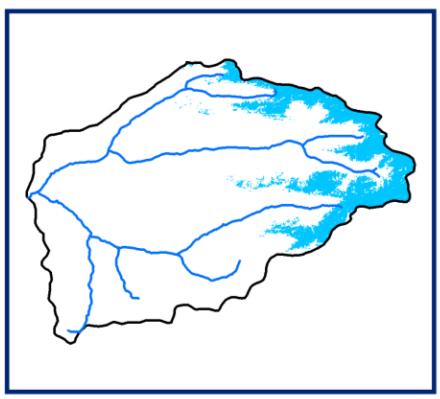
10 DAILY SNOW COVER MAP : JIWA SUB-BASIN



DATA USED
04 JUNE 2016
05 JUNE 2016
09 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
23 JUNE 2016
24 JUNE 2016
29 JUNE 2016

10 5 0 10 20 30
Kilometers

SNOW

PARBATI SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: PARBATI **BASIN AREA: 1773 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	01-Oct-15	735	41	**3**	28-Oct-15	912	51
2	03-Oct-15	728	41		30-Oct-15	722	41
	04-Oct-15	599	34 (C)				
November 2015							
4	01-Nov-15	630	36 (C)	**6**	06-Nov-15	1229	69
5	02-Nov-15	671	38	**7**	07-Nov-15	881	50 (C)
December 2015							
8	05-Dec-15	1031	58	**11**	20-Dec-15	1261	71
9	07-Dec-15	643	36 (C)	**12**			
January 2016							
14	03-Jan-16	1180	67	**16**	19-Jan-16	641	36 (C)
15	05-Jan-16	1376	78	**17**	27-Jan-16	1267	71
	13-Jan-16	1291	73				
February 2016							
18	01-Feb-16	1431	81	**21**	10-Feb-16	1301	73
19	03-Feb-16	1353	76	**22**	12-Feb-16	1420	80
20	05-Feb-16	1190	67 (C)	**23**	17-Feb-16	1361	77
	08-Feb-16	1622	91		27-Feb-16	1313	74
March 2016							
24	01-Mar-16	1292	73	**26**	22-Mar-16	1462	82
25	05-Mar-16	1405	79 (C)				
April 2016							
27	03-Apr-16	1385	78	**30**	24-Apr-16	1340	76
28	13-Apr-16	1287	73	**31**	27-Apr-16	1211	68
29	20-Apr-16	1312	74	**32**	30-Apr-16	1191	67
May 2016							
33	02-May-16	1168	66	**35**	19-May-16	889	50 (C)
34	06-May-16	778	44 (C)	**36**	31-May-16	942	53

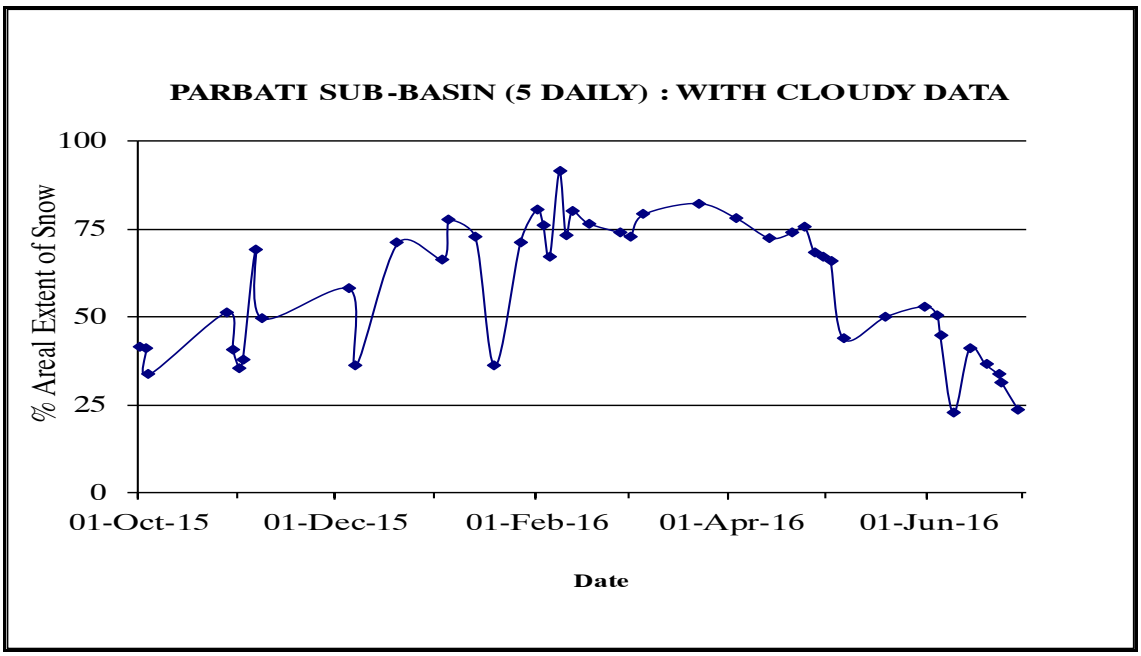
June 2016							
37	04-Jun-16	895	50	**41**	19-Jun-16	650	37 (C)
38	05-Jun-16	792	45	**42**	23-Jun-16	598	34 (C)
39	09-Jun-16	404	23 (C)	**43**	24-Jun-16	558	31
40	14-Jun-16	729	41 (C)	**44**	29-Jun-16	423	24 (C)

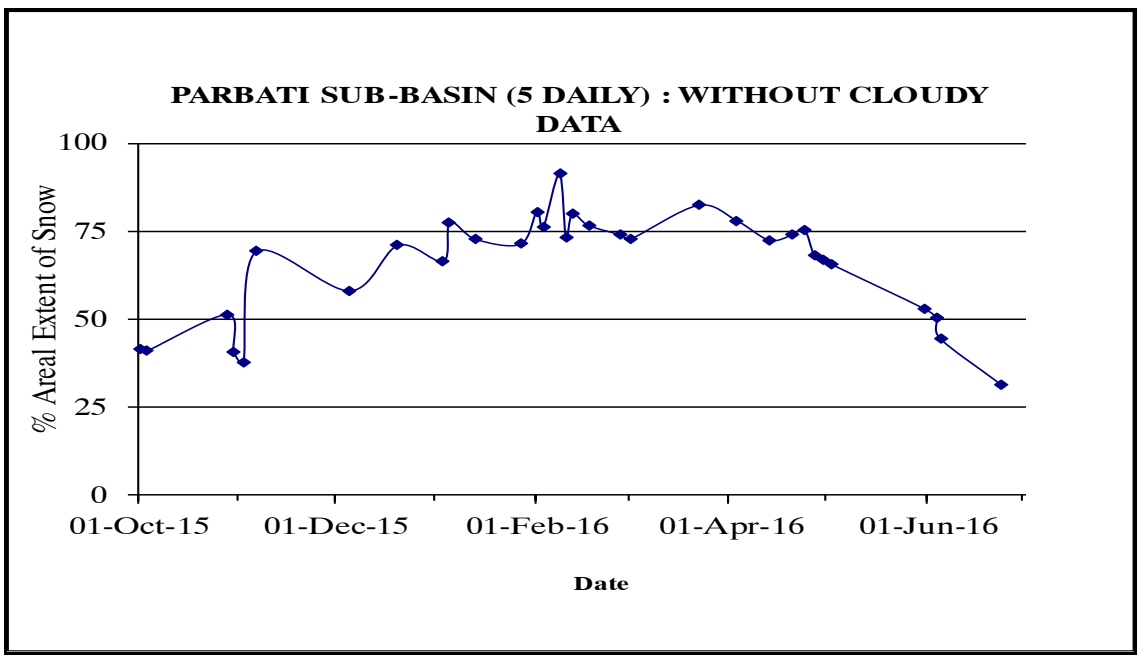
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: PARBATI **BASIN AREA: 1773 sq km**

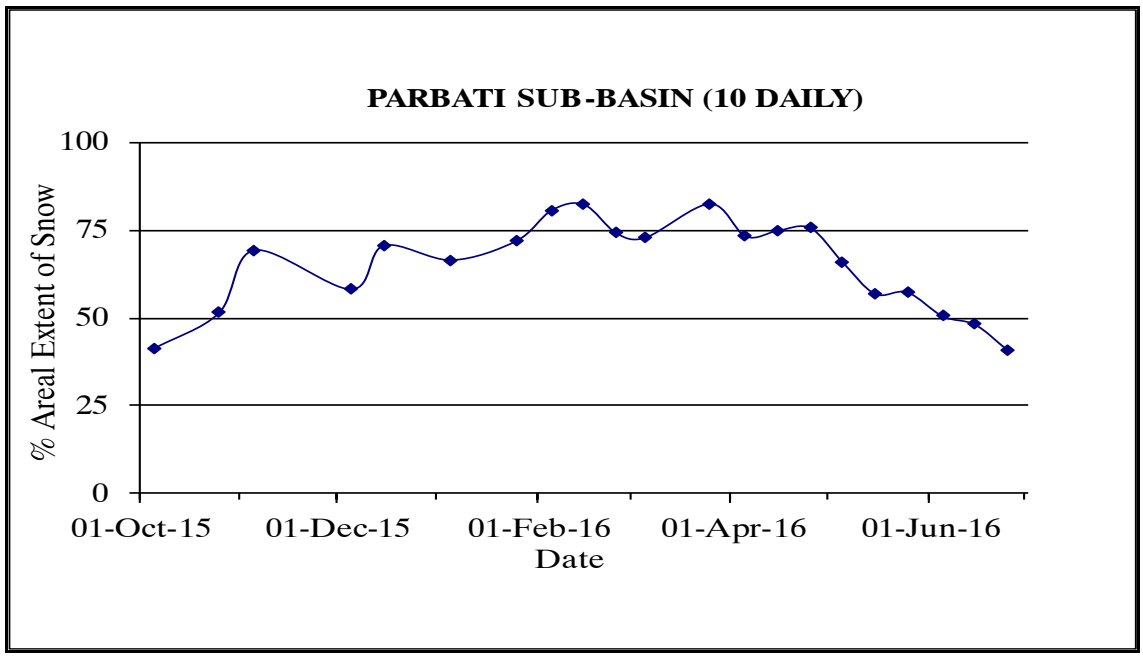
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	735	41	**3**	05-Nov-15	1229	69
2	25-Oct-15	913	51				
December 2015				**January 2016**			
4	05-Dec-15	1032	58	**6**	05-Jan-16	1179	66
5	15-Dec-15	1252	71	**7**	25-Jan-16	1275	72
February 2016				**March 2016**			
9	05-Feb-16	1430	81	**12**	05-Mar-16	1292	73
10	15-Feb-16	1458	82	**13**	25-Mar-16	1462	82
11	25-Feb-16	1314	74				
April 2016				**May 2016**			
14	05-Apr-16	1298	73	**17**	05-May-16	1168	66
15	15-Apr-16	1327	75	**18**	15-May-16	1009	57
16	25-Apr-16	1340	76	**19**	25-May-16	1017	57
June 2016							
20	05-Jun-2016	896	51				
21	15-Jun-2016	854	48				
22	25-Jun-2016	726	41				

SNOW COVER DEPLETION CURVE



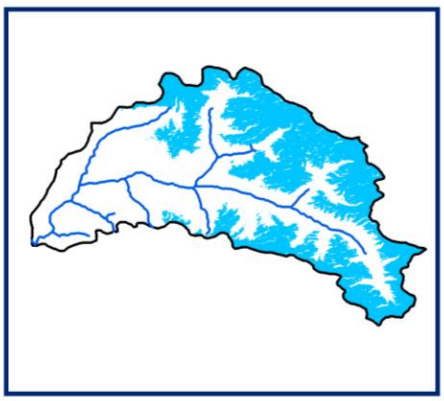


SNOW COVER DEPLETION CURVE

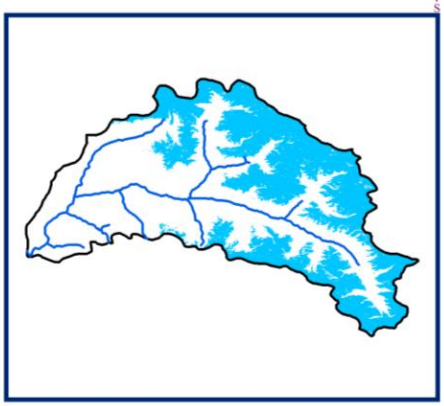


SNOW COVER MAP

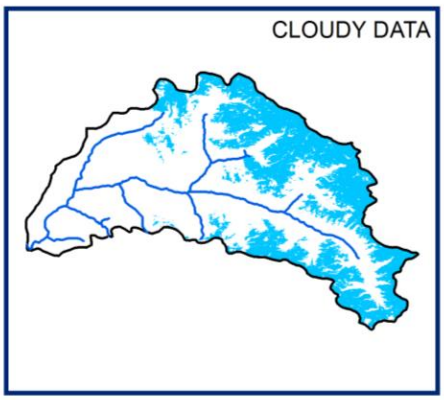
SNOW COVER MAP : PARBATI SUB-BASIN



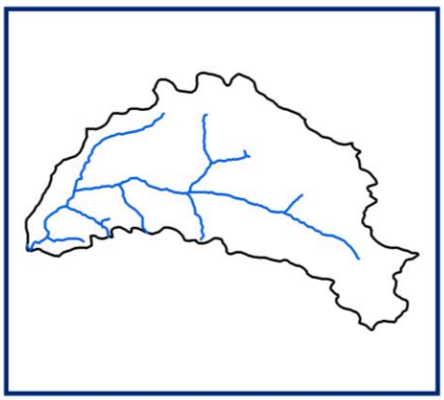
01 OCTOBER 2015



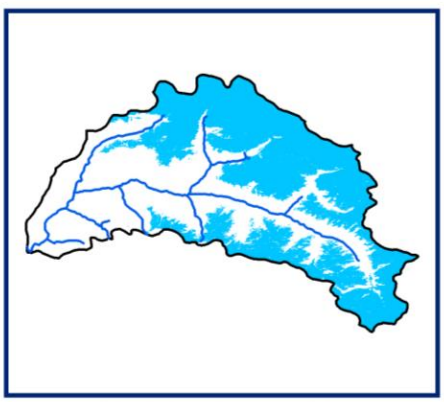
03 OCTOBER 2015



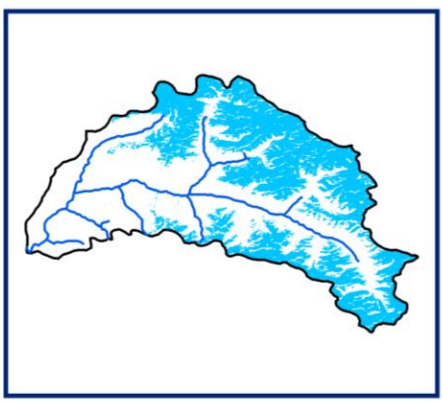
04 OCTOBER 2015



DATA NOT AVAILABLE



28 OCTOBER 2015



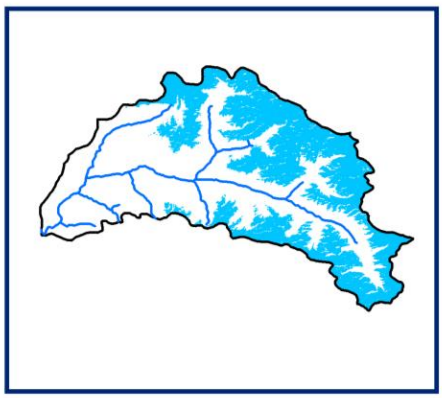
30 OCTOBER 2015

SNOW

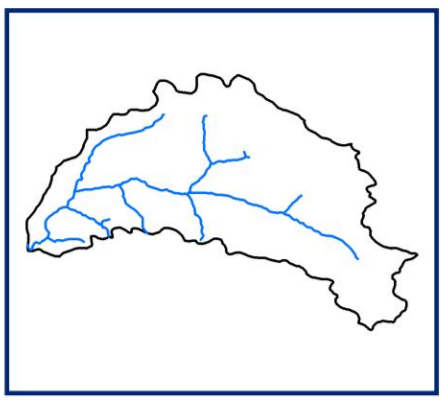
10 5 0 10 20 30 40

Kilometers

10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
01 OCTOBER 2015
03 OCTOBER 2015
04 OCTOBER 2015



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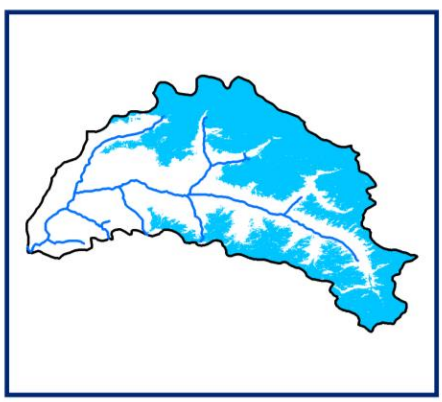
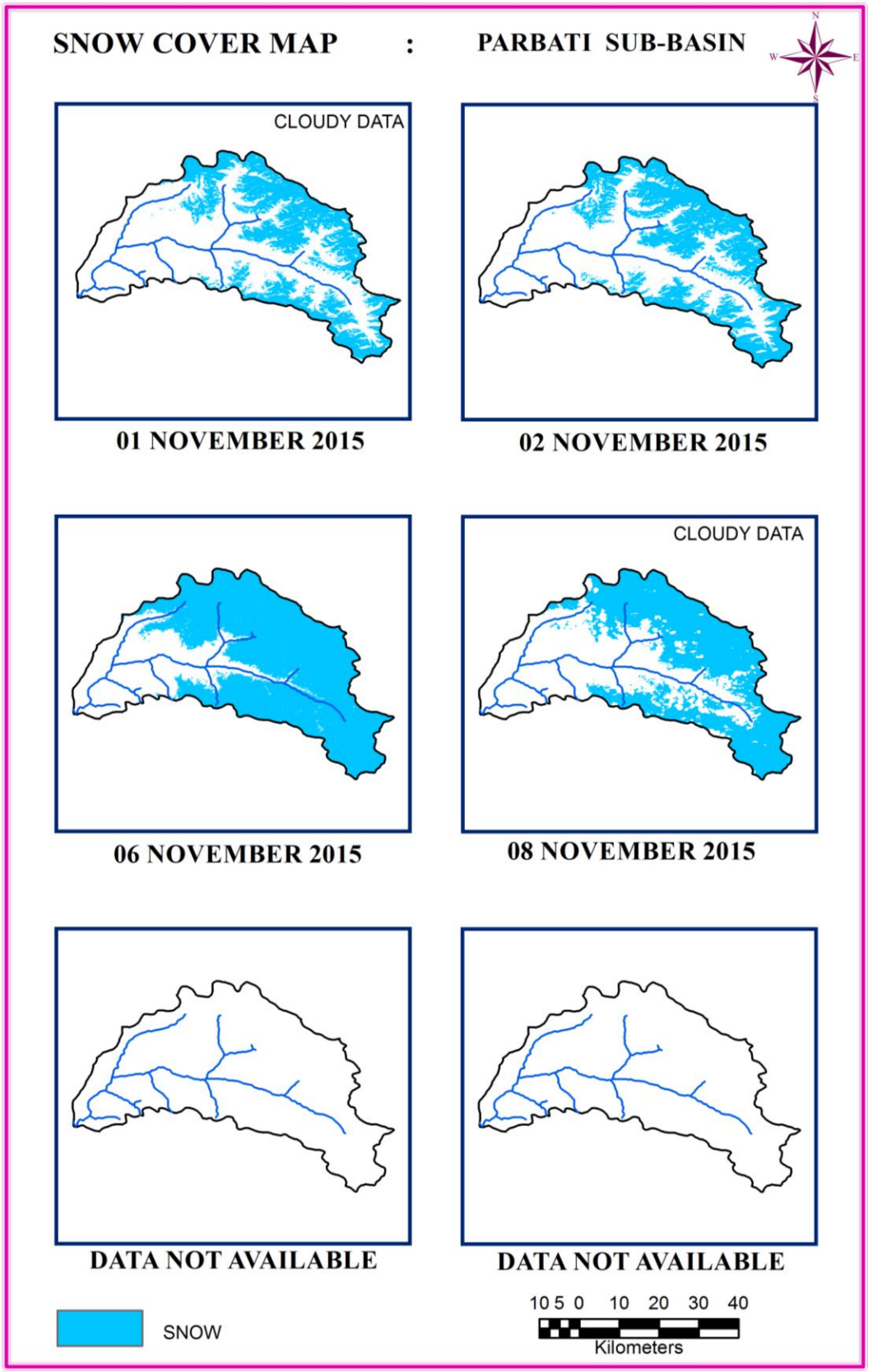


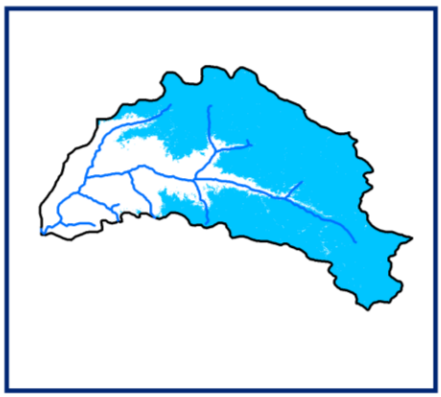
DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

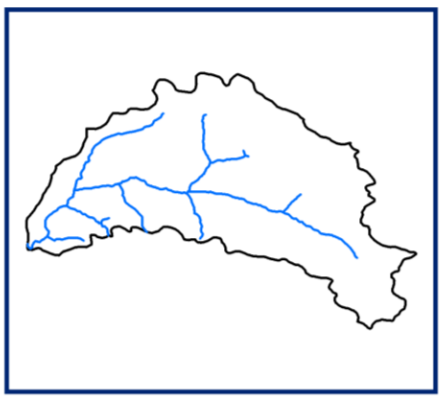
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
CLOUDY DATA
01 NOVEMBER 2015
02 NOVEMBER 2015
06 NOVEMBER 2015
CLOUDY DATA
08 NOVEMBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30 40
Kilometers

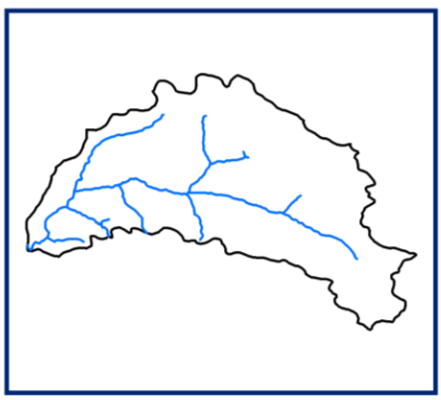
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
02 NOVEMBER 2015
06 NOVEMBER 2015
08 NOVEMBER 2015



DATA NOT AVAILABLE

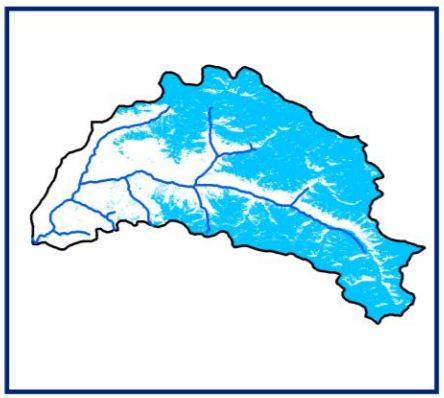


DATA NOT AVAILABLE

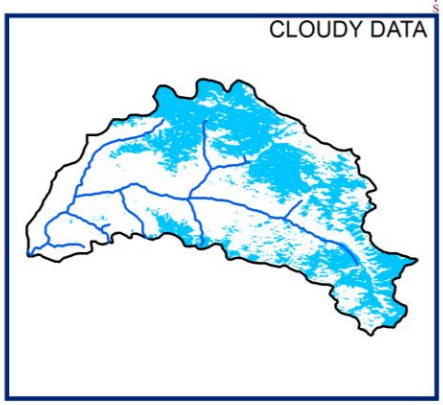
SNOW

10 5 0 10 20 30 40
Kilometers

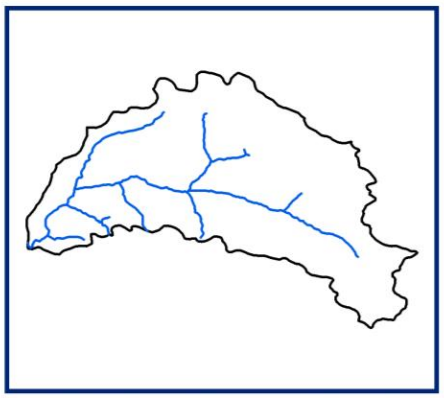
SNOW COVER MAP : PARBATI SUB-BASIN



05 DECEMBER 2015



07 DECEMBER 2015



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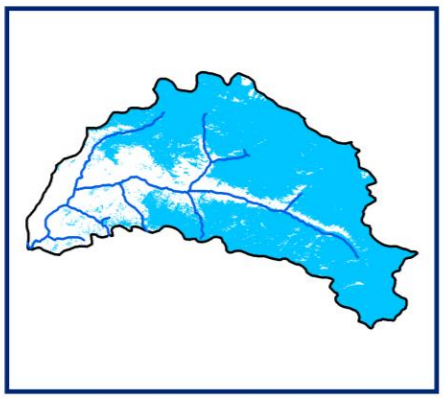
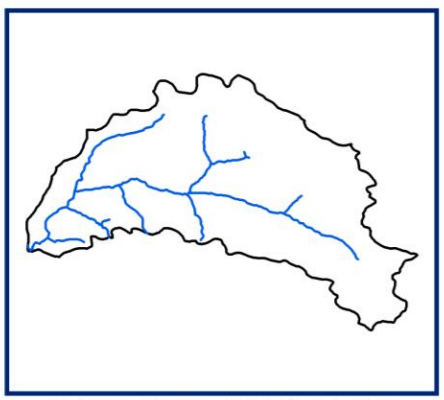
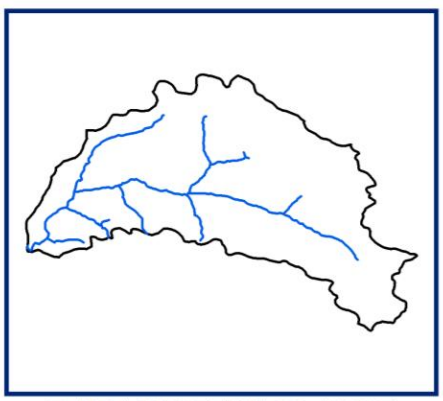


20 DECEMBER 2015



DATA NOT AVAILABLE



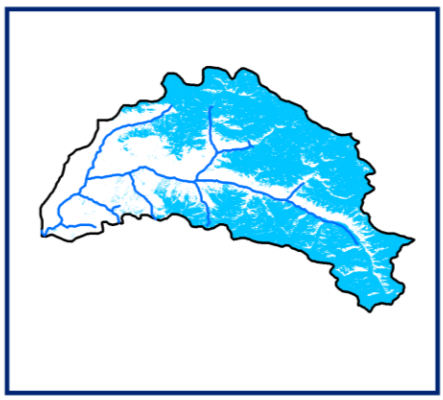
DATA NOT AVAILABLE

SNOW

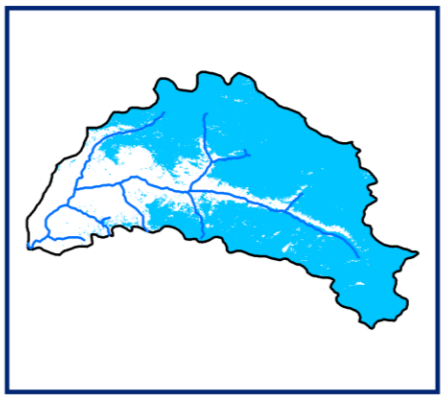
10 5 0 10 20 30 40

Kilometers

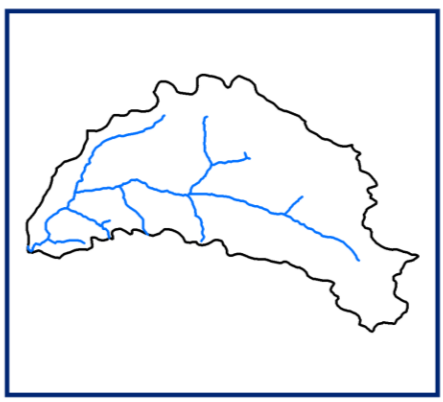
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
05 DECEMBER 2015
07 DECEMBER 2015



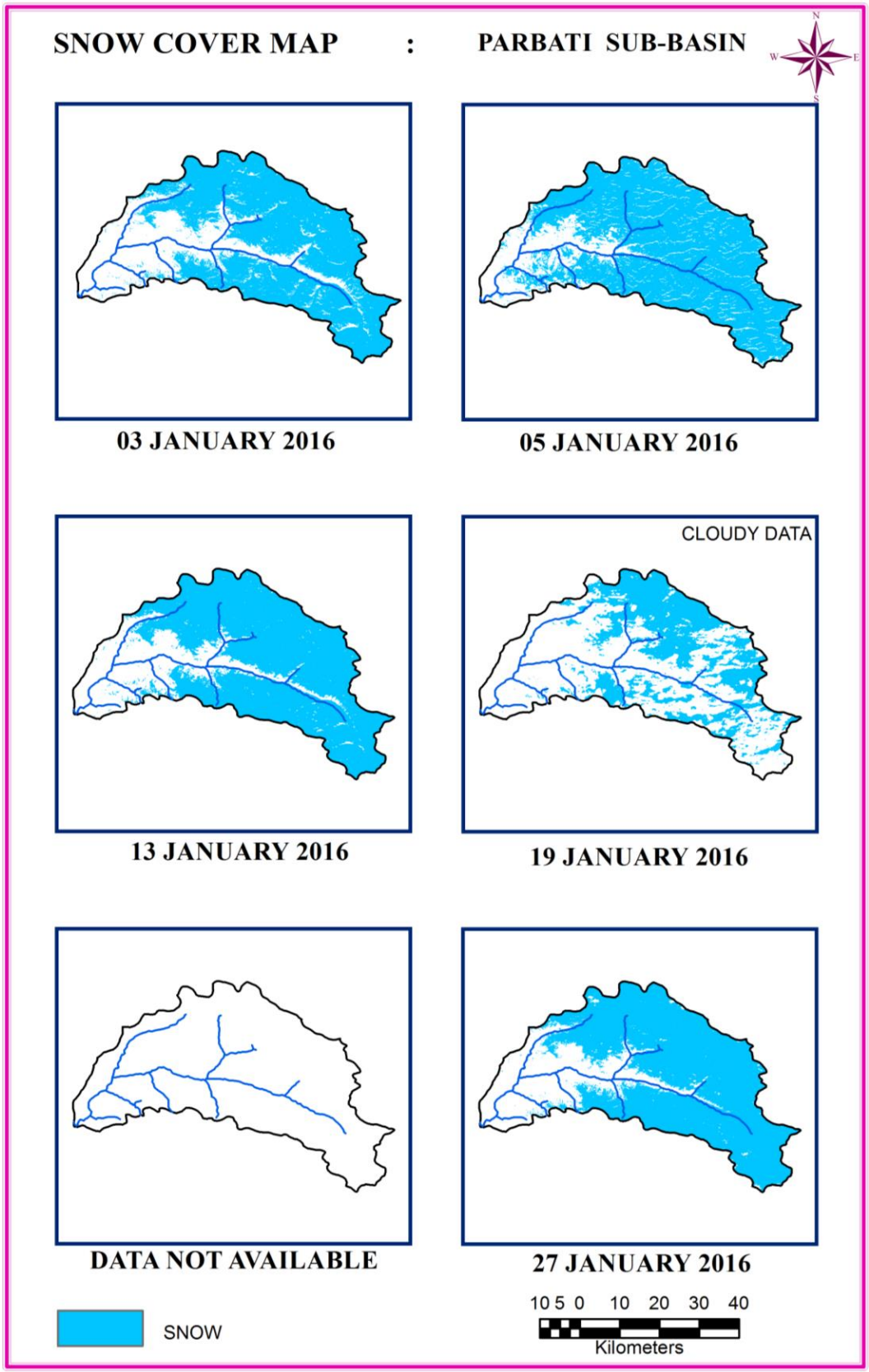
DATA USED
07 DECEMBER 2015



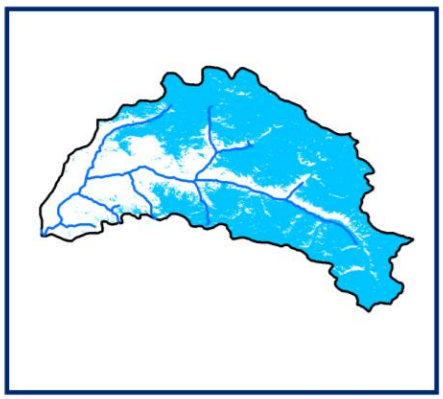
DATA NOT AVAILABLE

SNOW

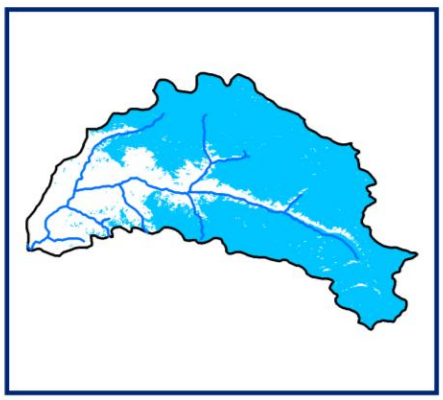
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
03 JANUARY 2016
05 JANUARY 2016
13 JANUARY 2016
CLOUDY DATA
19 JANUARY 2016
DATA NOT AVAILABLE
27 JANUARY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

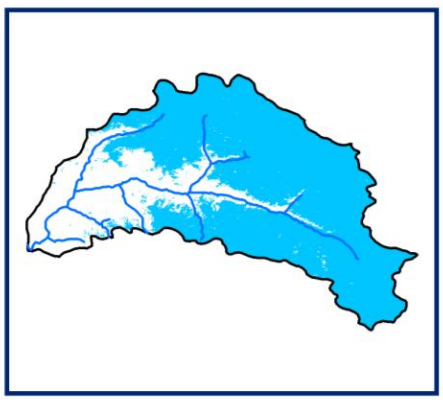
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
03 JANUARY 2016
05 JANUARY 2016



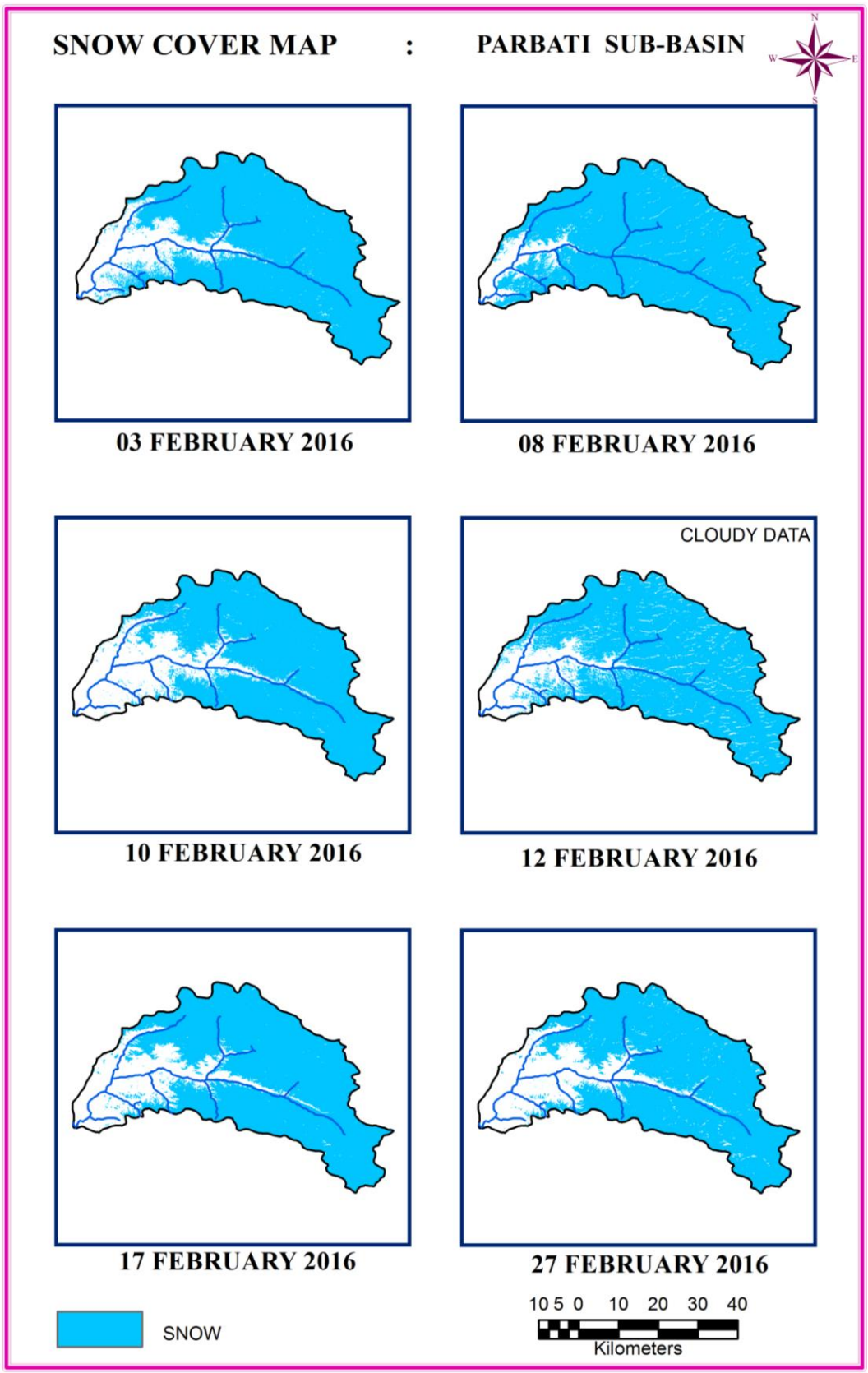
DATA USED
13 JANUARY 2016
19 JANUARY 2016



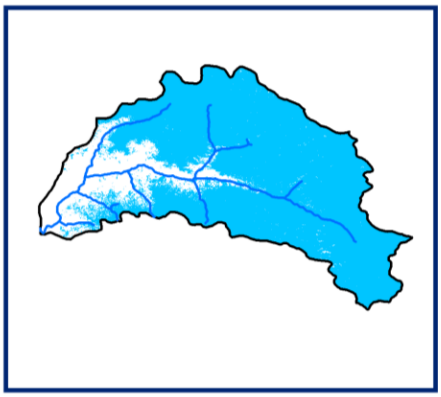
DATA USED
25 JANUARY 2016

SNOW

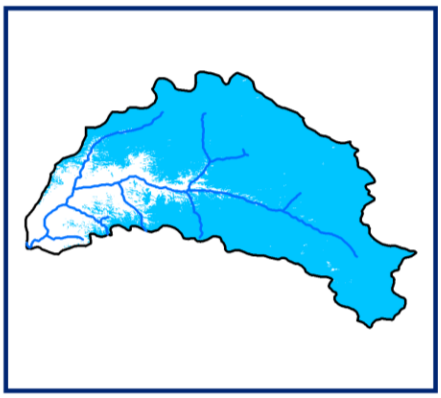
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
03 FEBRUARY 2016
08 FEBRUARY 2016
CLOUDY DATA
10 FEBRUARY 2016
12 FEBRUARY 2016
17 FEBRUARY 2016
27 FEBRUARY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

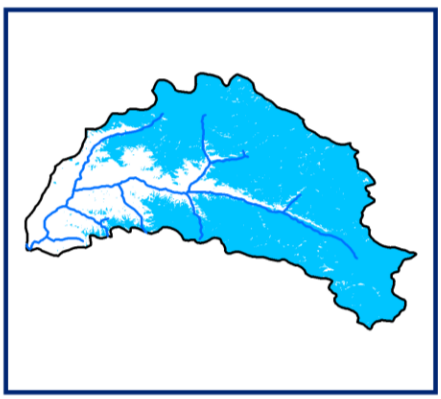
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
01 FEBRUARY 2016
03 FEBRUARY 2016
08 FEBRUARY 2016



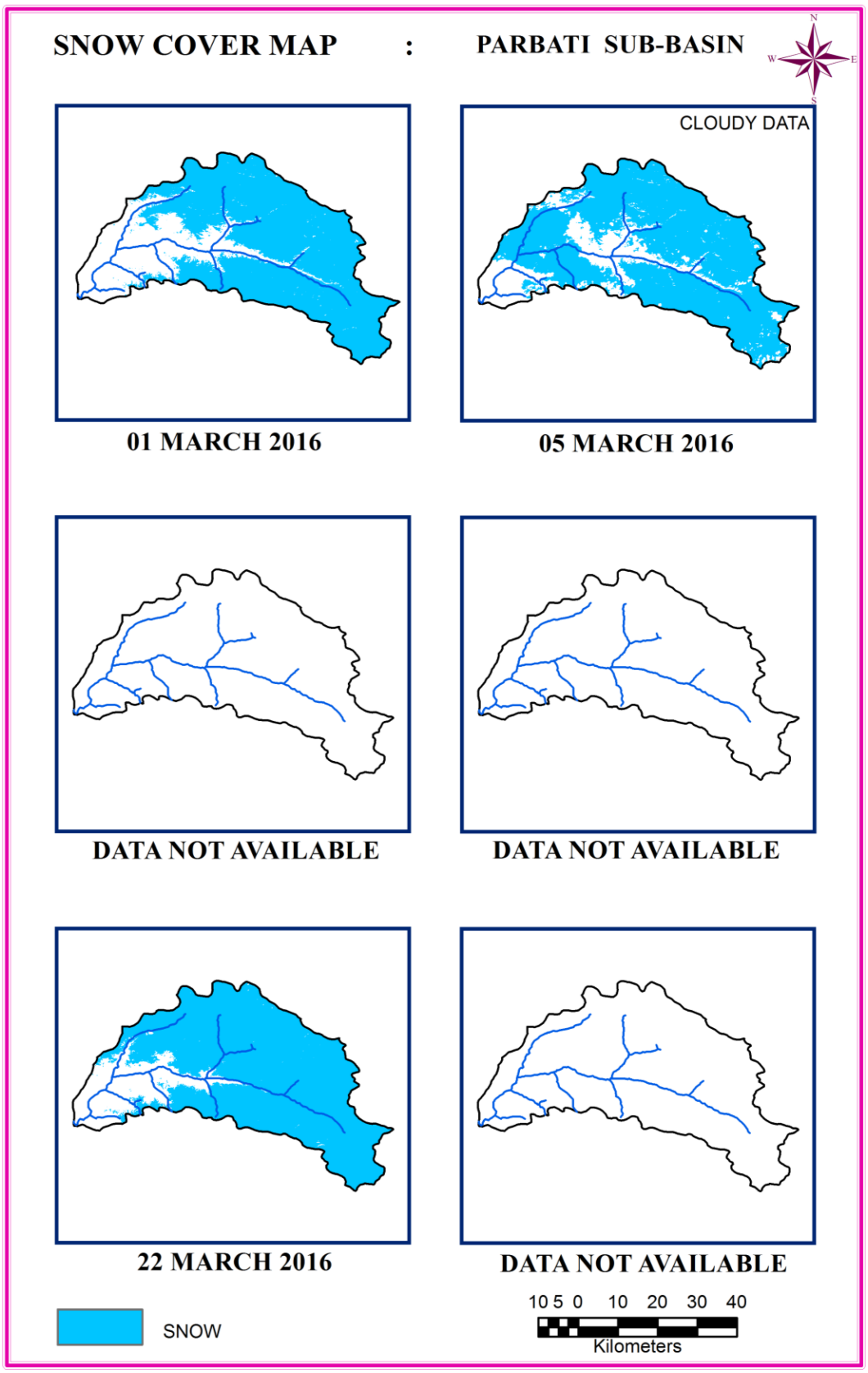
DATA USED
12 FEBRUARY 2016
17 FEBRUARY 2016



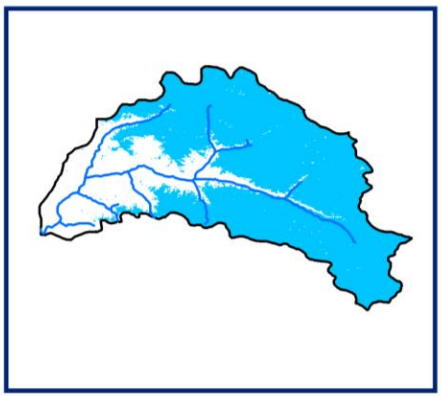
DATA USED
27 FEBRUARY 2016

SNOW

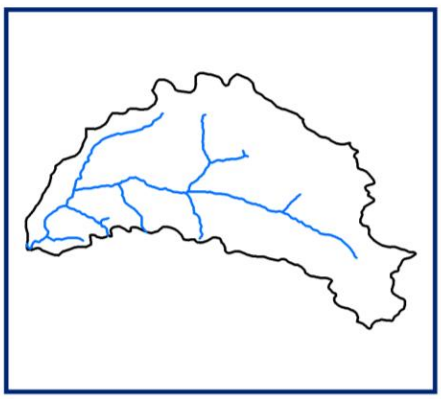
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
CLOUDY DATA
01 MARCH 2016
05 MARCH 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
22 MARCH 2016
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30 40
Kilometers

10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
01 MARCH 2016
05 MARCH 2016



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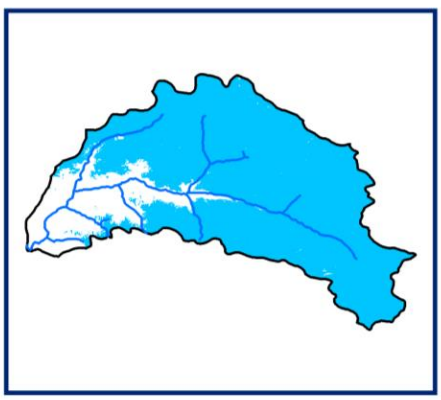
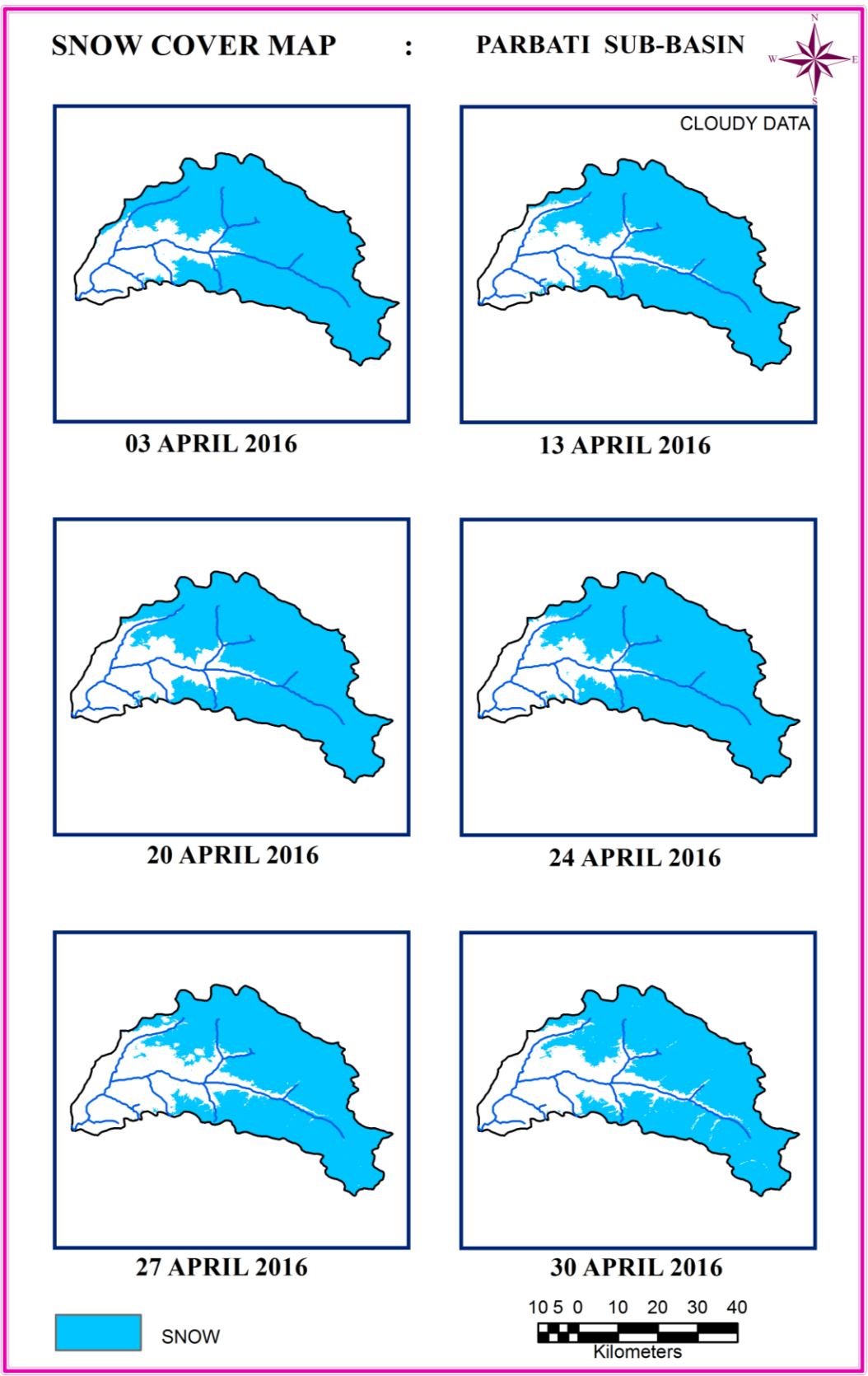


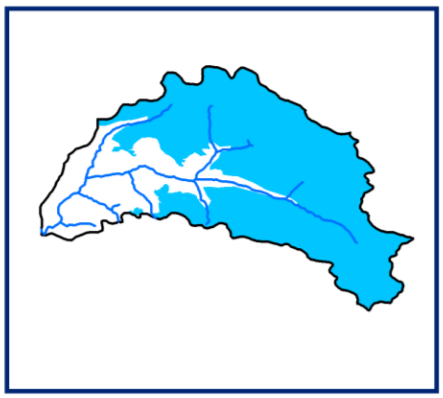
DATA USED
01 MARCH 2016

SNOW

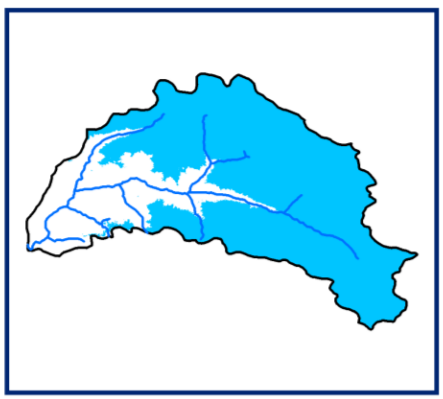
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
CLOUDY DATA
03 APRIL 2016
13 APRIL 2016
20 APRIL 2016
24 APRIL 2016
27 APRIL 2016
30 APRIL 2016
SNOW
10 5 0 10 20 30 40
Kilometers

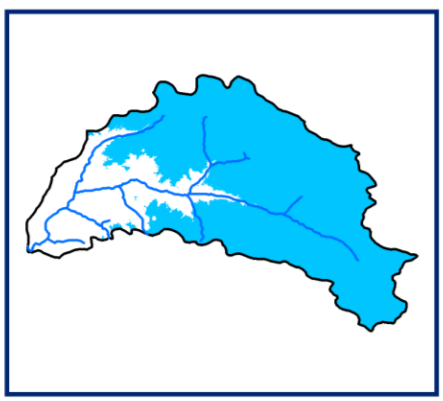
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
05 APRIL 2016



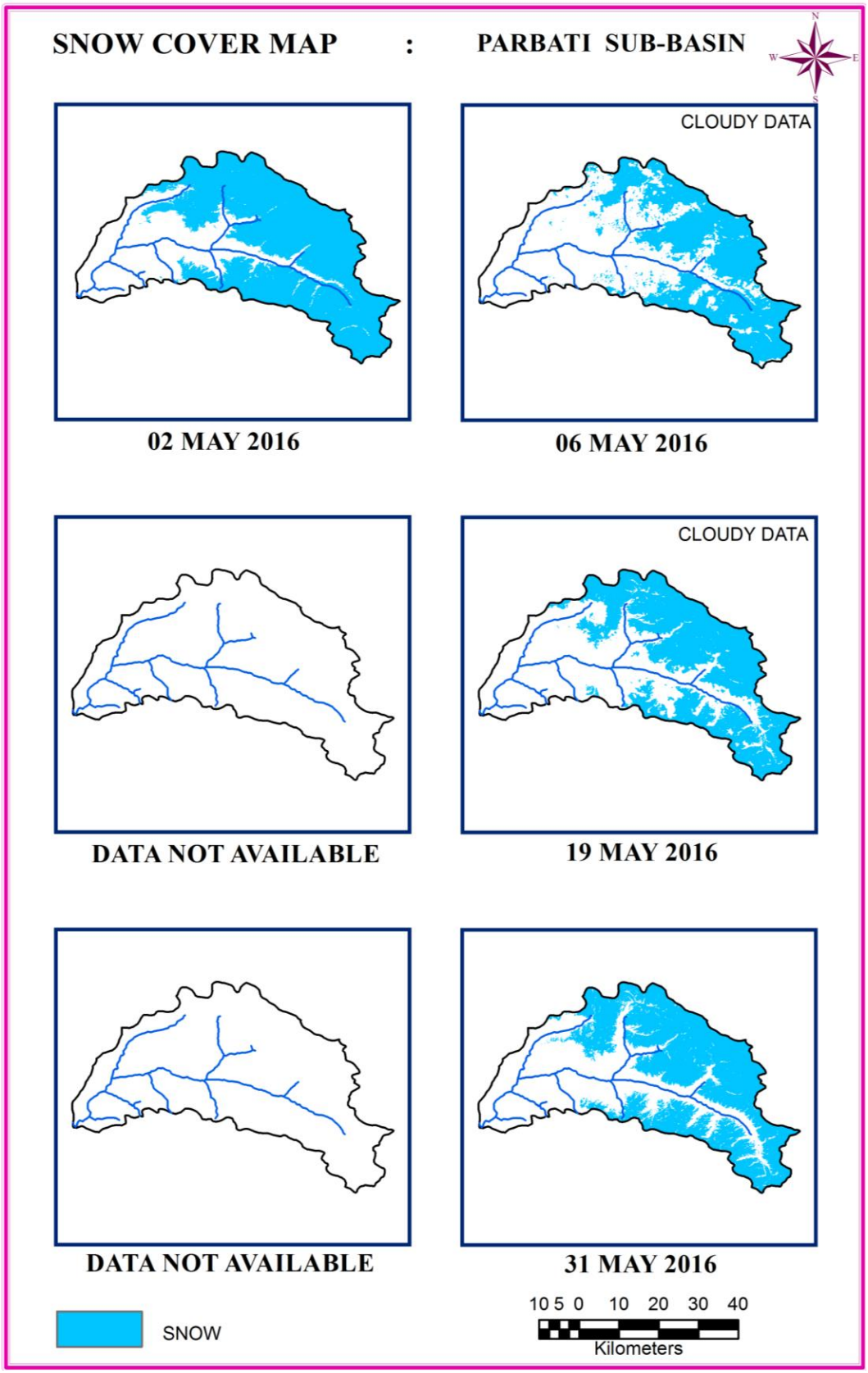
DATA USED
13 APRIL 2016
20 APRIL 2016



DATA USED
24 APRIL 2016
27 APRIL 2016
30 APRIL 2016

SNOW

10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
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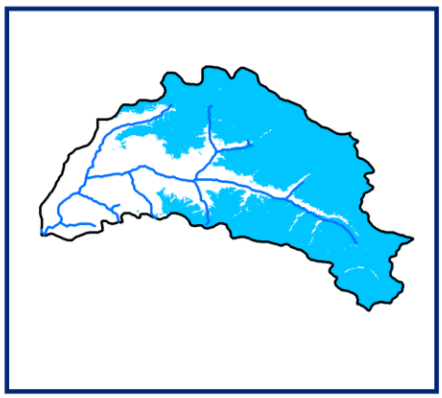
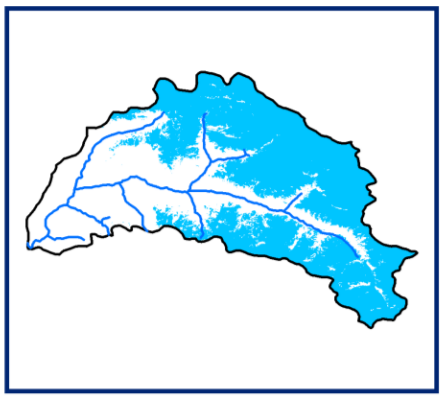
S
CLOUDY DATA
02 MAY 2016
06 MAY 2016
CLOUDY DATA
DATA NOT AVAILABLE
19 MAY 2016
DATA NOT AVAILABLE
31 MAY 2016
SNOW
10 5 0 10 20 30 40
Kilometers

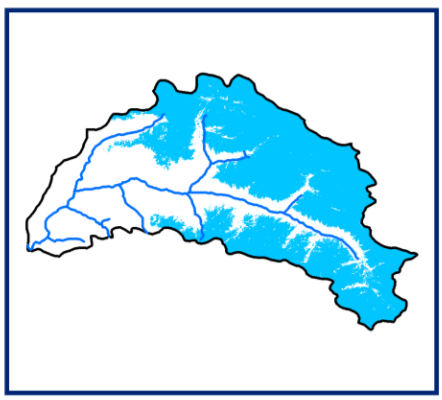
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
02 MAY 2016
06 MAY 2016



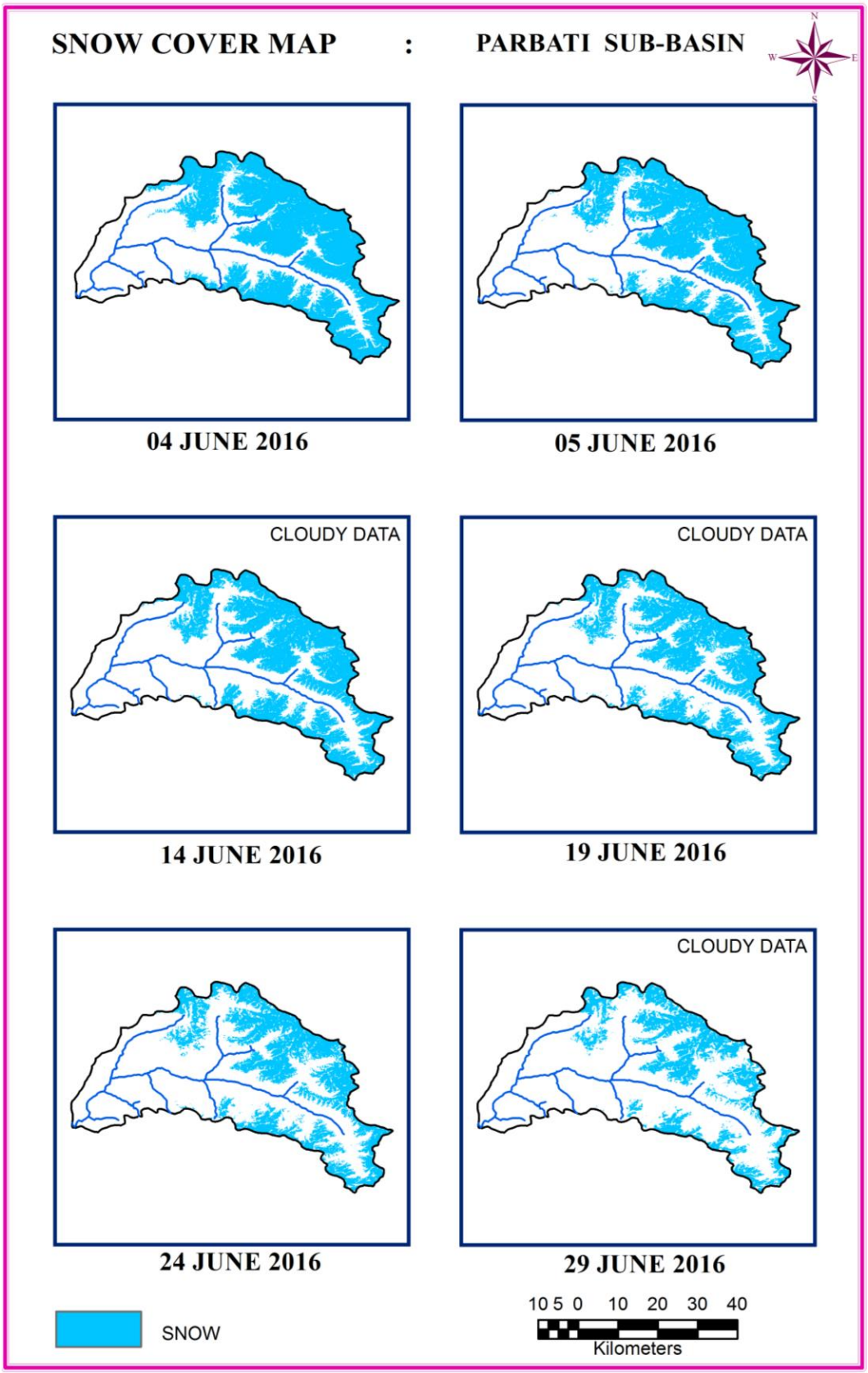
DATA USED
15 MAY 2016



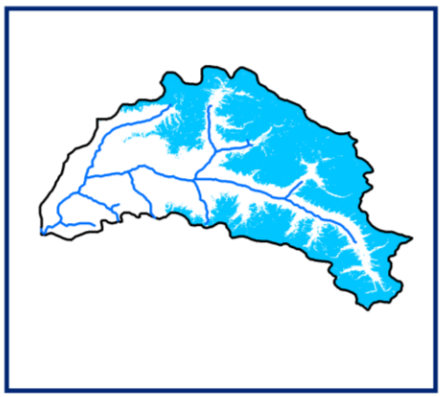
DATA USED
25 MAY 2016

SNOW

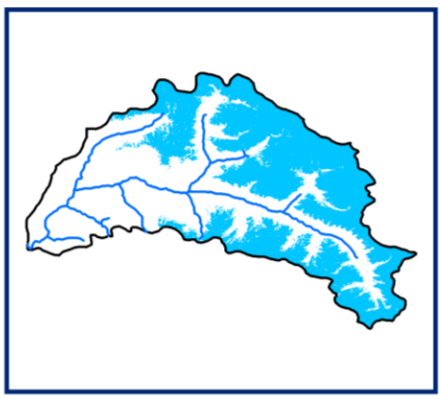
10 5 0 10 20 30 40
Kilometers


SNOW COVER MAP : PARBATI SUB-BASIN
N
W
E
S
04 JUNE 2016
05 JUNE 2016
CLOUDY DATA
14 JUNE 2016
CLOUDY DATA
19 JUNE 2016
24 JUNE 2016
CLOUDY DATA
29 JUNE 2016
SNOW
10 5 0 10 20 30 40
Kilometers

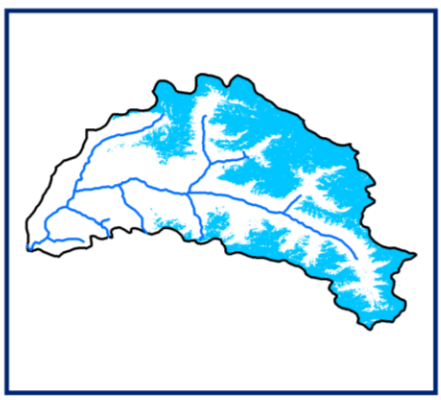
10 DAILY SNOW COVER MAP : PARBATI SUB-BASIN



DATA USED
04 JUNE 2016
05 JUNE 2016
09 JUNE 2016



DATA USED
14 JUNE 2016
19 JUNE 2016



DATA USED
23 JUNE 2016
24 JUNE 2016
29 JUNE 2016

SNOW

10 5 0 10 20 30 40
Kilometers

BASPA SUB-BASIN

AREAL EXTENT OF SNOW (5 DAILY)

BASIN NAME: BEAS **BASIN AREA: 1132 sq km**

S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015							
1	01-Oct-15	141	12	**3**	28-Oct-15	452	40
2	03-Oct-15	134	12		30-Oct-15	305	27
November 2015							
4	01-Nov-15	152	13 (C)	**6**	06-Nov-15	496	44
5	02-Nov-15	143	13 (C)	**7**	08-Nov-15	410	36(C)
December 2015							
8	05-Dec-15	311	27	**10**	20-Dec-15	622	55
9	07-Dec-15	296	26				
January 2016							
11	03-Jan-16	544		**14**	19-Jan-16		
12	05-Jan-16	668		**15**	27-Jan-16		
13	13-Jan-16	565					
February 2016							
16	01-Feb-16	632	56	**19**	10-Feb-16	384	34 (c)
17	03-Feb-16	608	54	**20**	12-Feb-16	837	74
18	05-Feb-16	568	50(c)	**21**	17-Feb-16	694	61
	08-Feb-16	910	80		27-Feb-16	578	51
March 2016							
22	01-Mar-16	528	47	**24**	22-Mar-16	773	68
23	03-Mar-16	540	48				
April 2016							
25	13-Apr-16	553	49	**28**	24-Apr-16	508	45 (c)
26	18-Apr-16	453	40 (c)	**29**	27-Apr-16	314	28 (c)
27	20-Apr-16	427	38 (c)	**30**	30-Apr-16	407	36
May 2016							
31	02-May-16	390	34	**33**	19-May-16	192	17 (c)
32	06-May-16	126	11 (c)	**34**	31-May-16	211	19

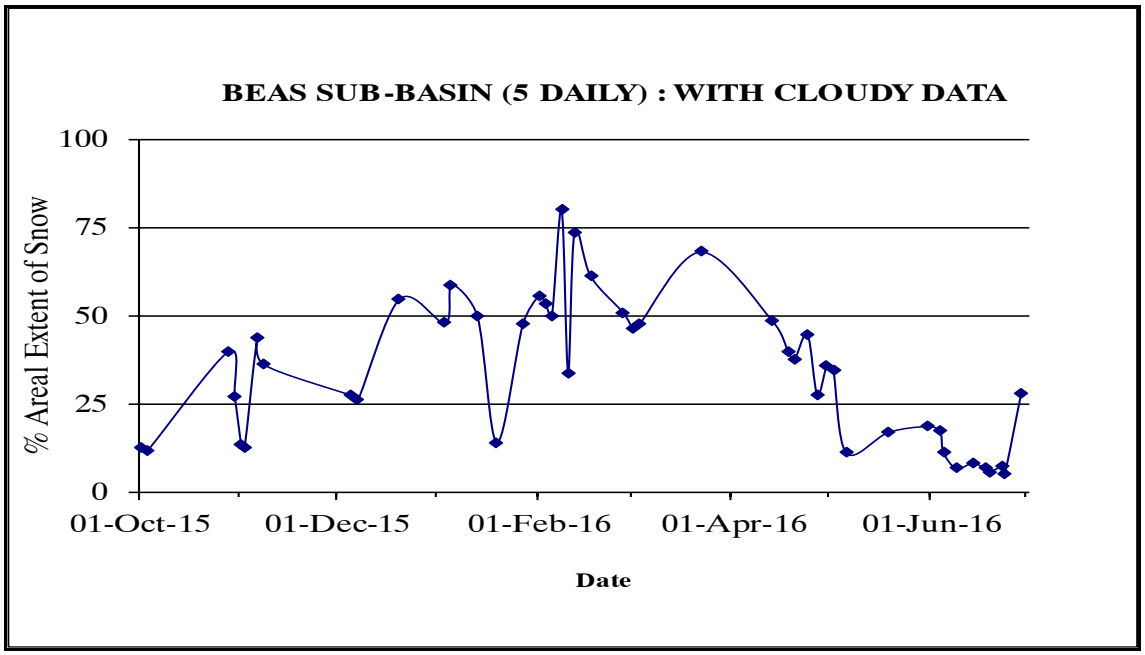
June 2016							
35	04-Jun-16	195	17	**40**	19-Jun-16	63	6 (c)
36	05-Jun-16	128	11 (c)	**41**	23-Jun-16	81	7 (c)
37	09-Jun-16	76	7 (c)	**42**	24-Jun-16	60	5 (c)
38	14-Jun-16	92	8 (c)	**43**	29-Jun-16	315	28 (c)
39	18-Jun-16	76	7 (c)				

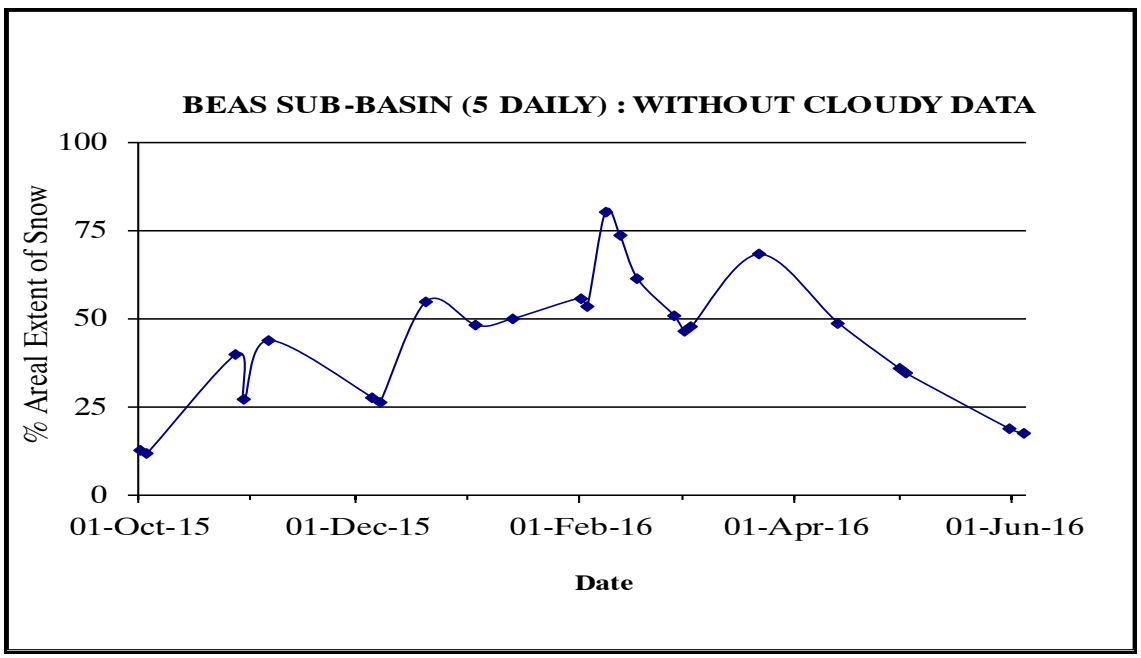
AREAL EXTENT OF SNOW (10 DAILY)

BASIN NAME: BEAS **BASIN AREA: 1132 sq km**

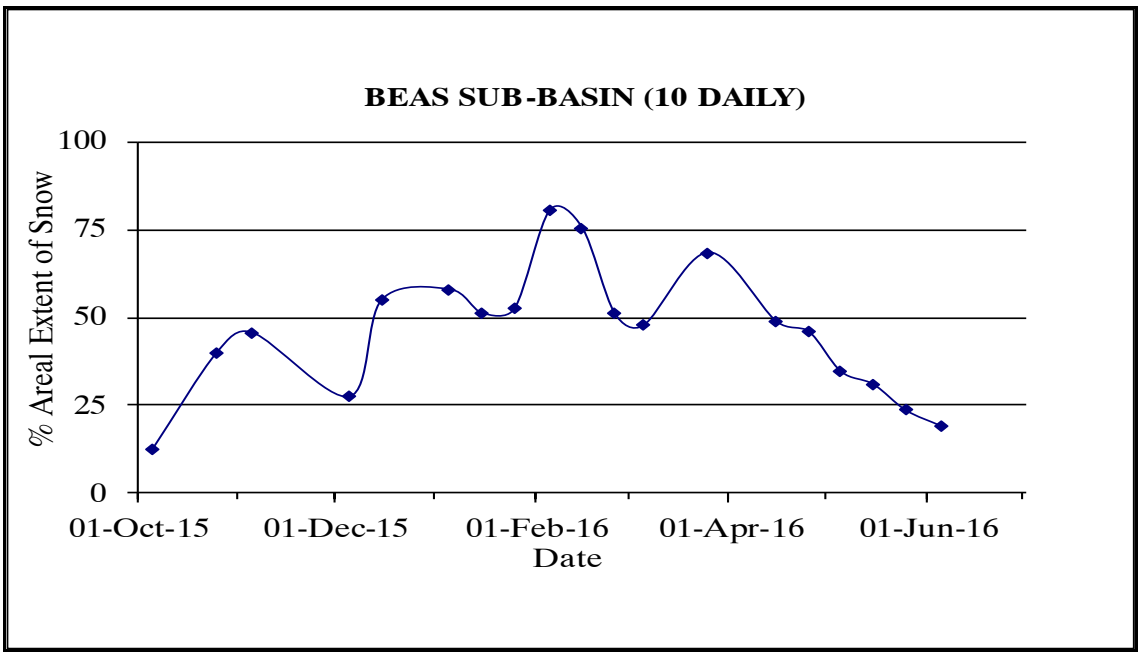
S No	Date	Snow cover (sq km)	Snow cover (%)	S No	Date	Snow cover (sq km)	Snow cover (%)
October 2015				**November 2015**			
1	05-Oct-15	141	12	**3**	05-Nov-15	516	46
2	25-Oct-15	305	27				
December 2015				**January 2016**			
4	05-Dec-15	311	27	**6**	05-Jan-16	655	58
5	15-Dec-15	622	55	**7**	15-Jan-16	579	51
				8	25-Jan-16	593	52
February 2016				**March 2016**			
9	05-Feb-16	910	80	**12**	05-Mar-16	540	48
10	15-Feb-16	852	75	**13**	25-Mar-16	774	68
11	25-Feb-16	578	51				
April 2016				**May 2016**			
15	15-Apr-16	552	49	**17**	05-May-16	391	35
16	25-Apr-16	520	46	**18**	15-May-16	350	31
				19	25-May-16	267	24
June 2016							
20	05-Jun-2016	216	19				

SNOW COVER DEPLETION CURVE

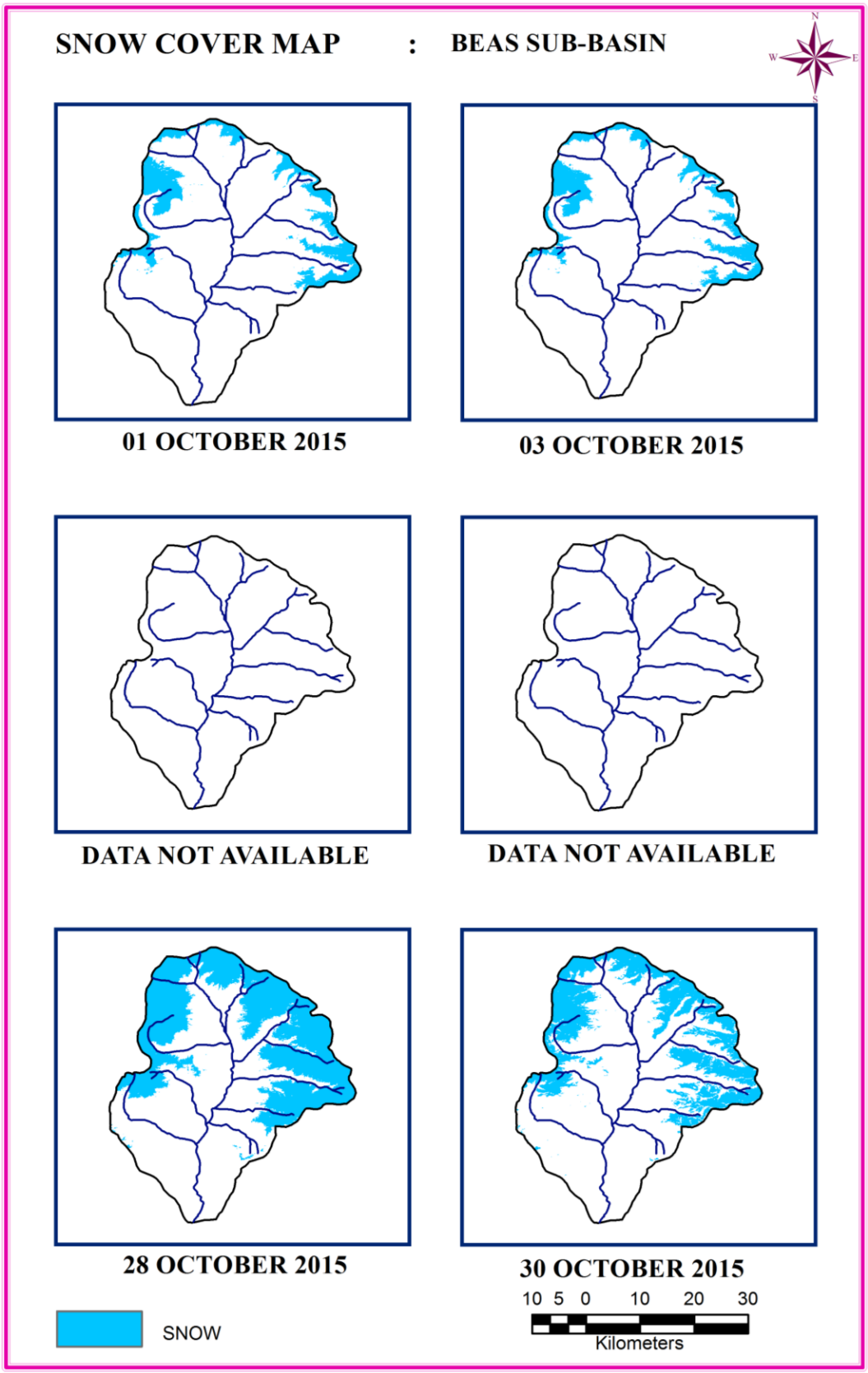




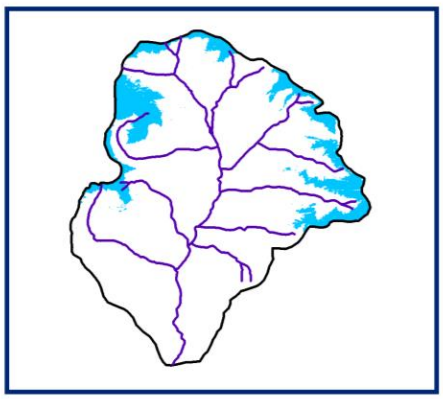
SNOW COVER DEPLETION CURVE



SNOW COVER MAP


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
01 OCTOBER 2015
03 OCTOBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
28 OCTOBER 2015
30 OCTOBER 2015
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
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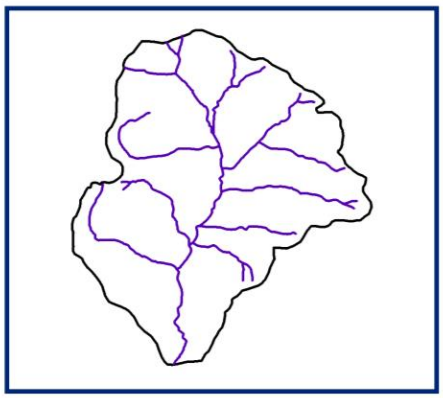
03 OCTOBER 2015



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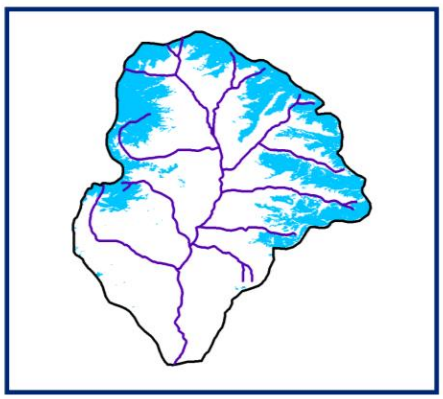
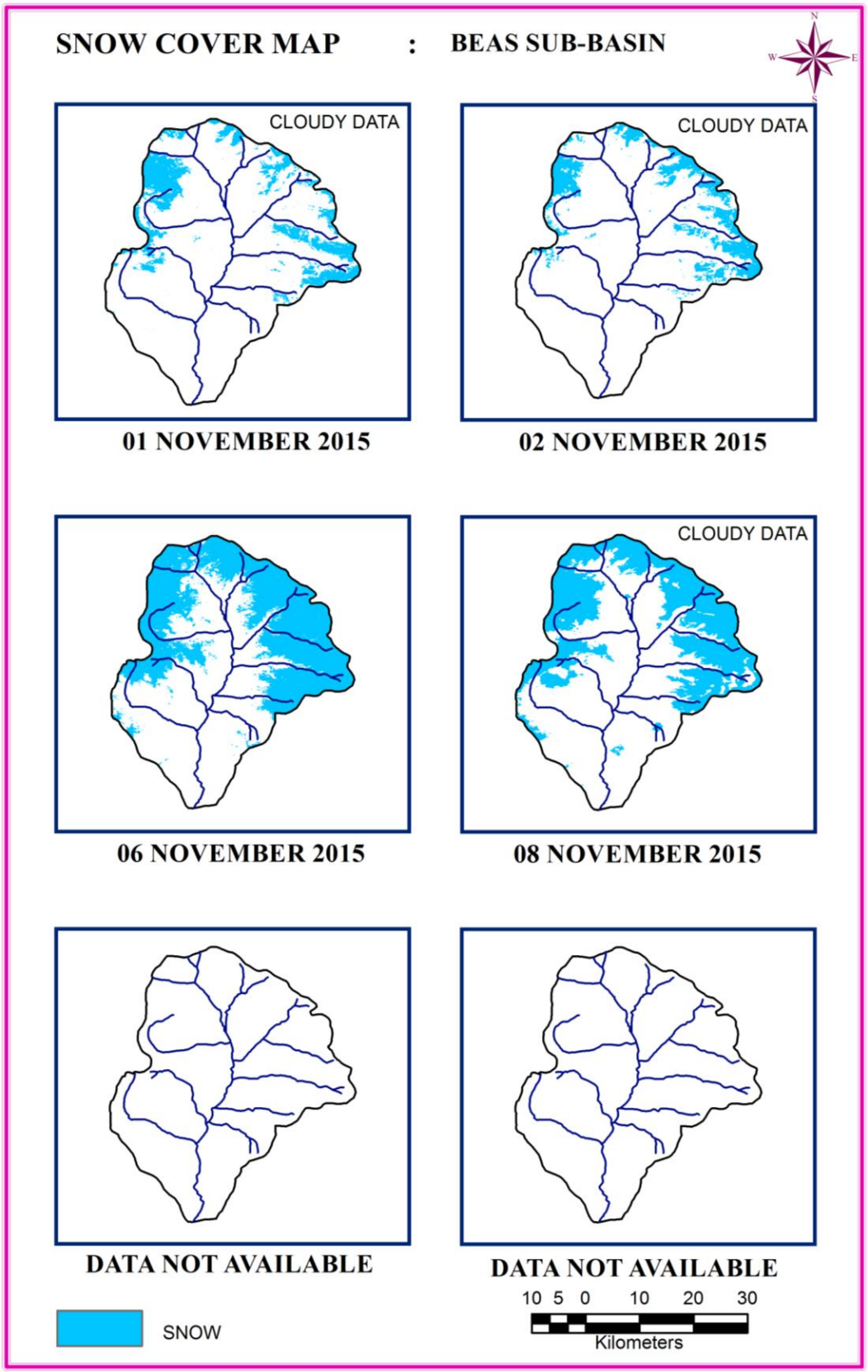


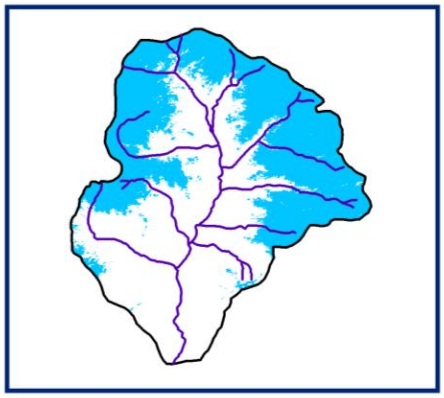
DATA USED
28 OCTOBER 2015
30 OCTOBER 2015

SNOW

10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
CLOUDY DATA
01 NOVEMBER 2015
CLOUDY DATA
02 NOVEMBER 2015
06 NOVEMBER 2015
CLOUDY DATA
08 NOVEMBER 2015
DATA NOT AVAILABLE
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



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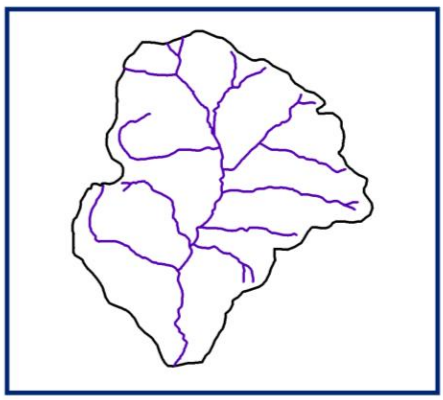
02 NOVEMBER 2015

06 NOVEMBER 2015

08 NOVEMBER 2015



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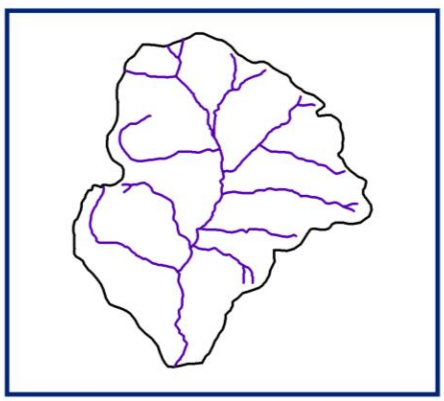


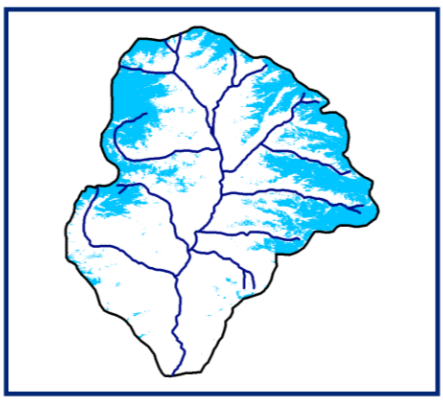
DATA NOT AVAILABLE

SNOW

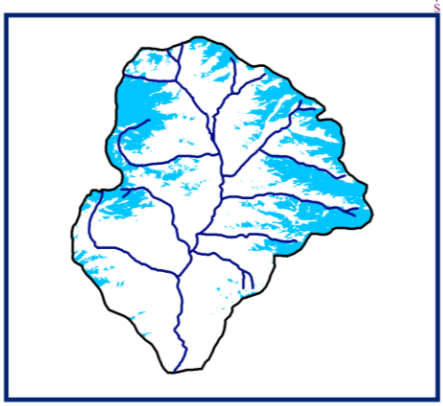
10 5 0 10 20 30

Kilometers

SNOW COVER MAP : BEAS SUB-BASIN



05 DECEMBER 2015



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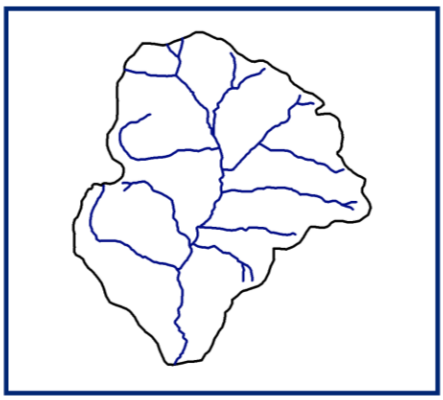

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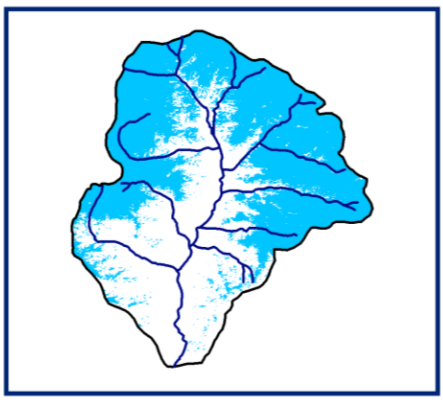

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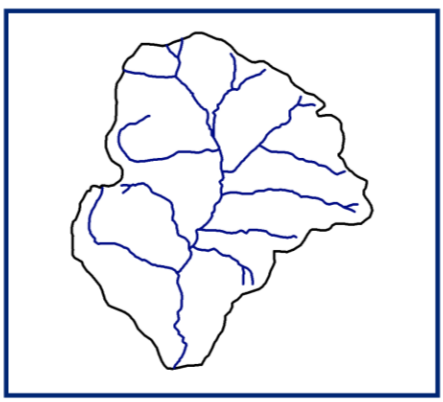

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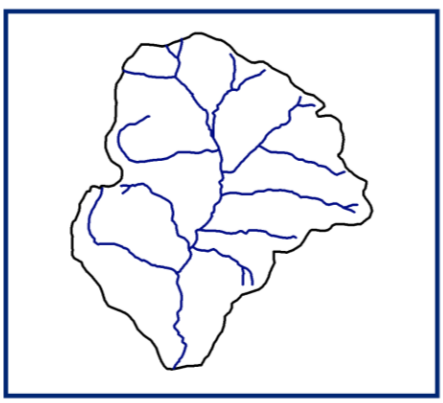


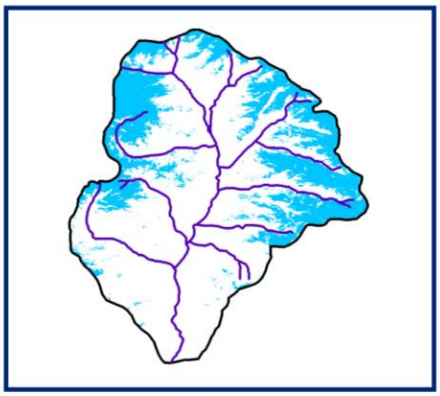
DATA NOT AVAILABLE

SNOW

10 5 0 10 20 30

Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



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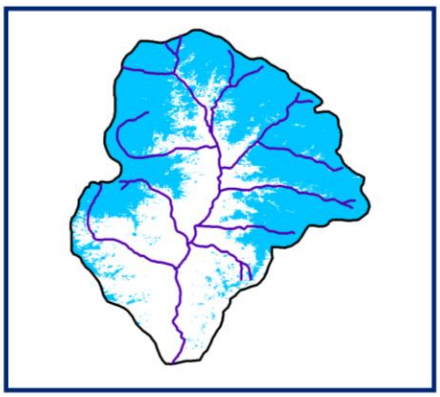

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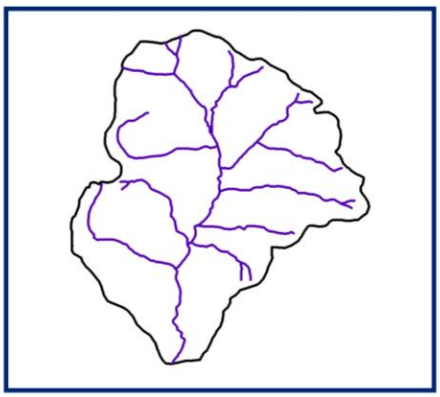
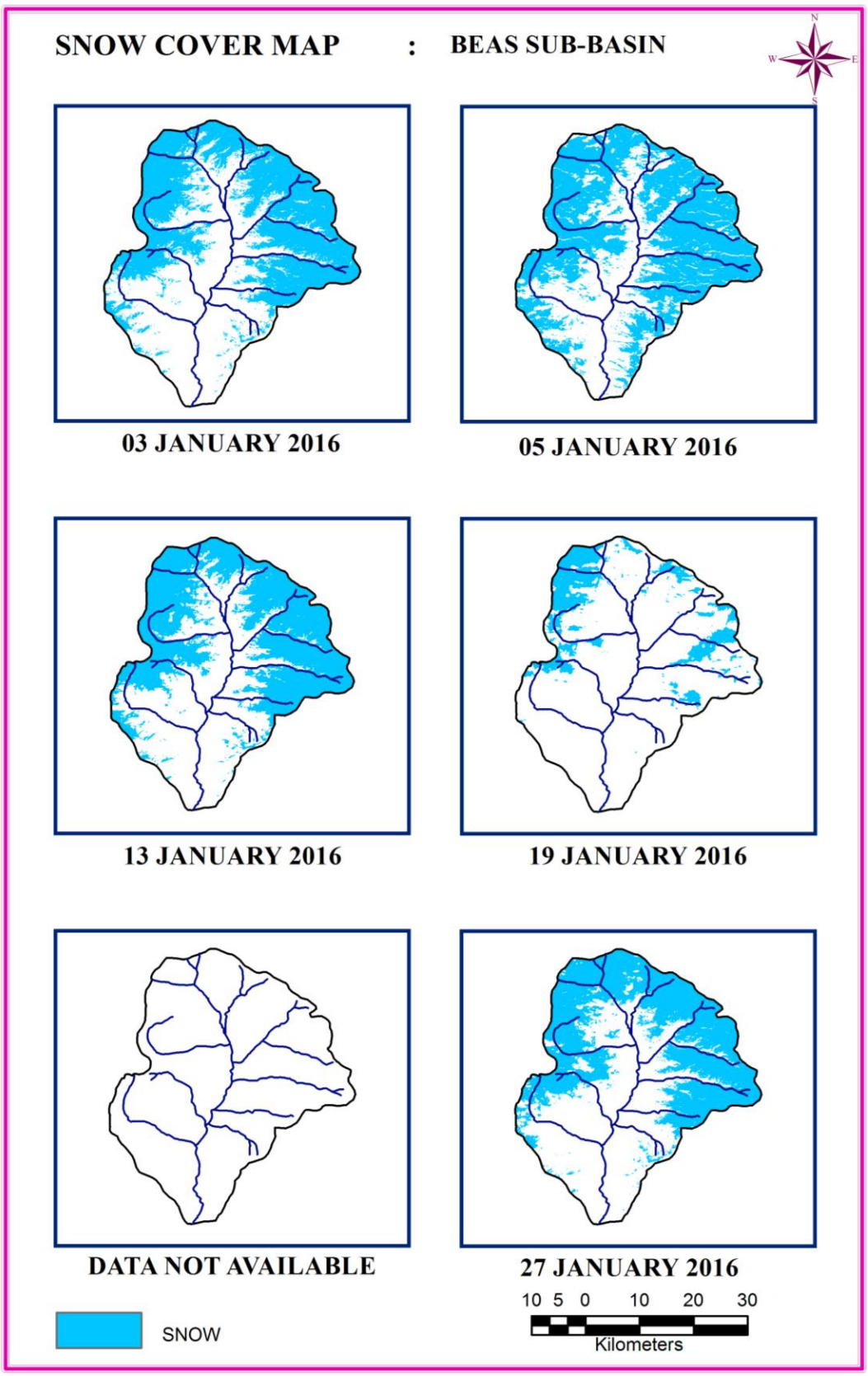


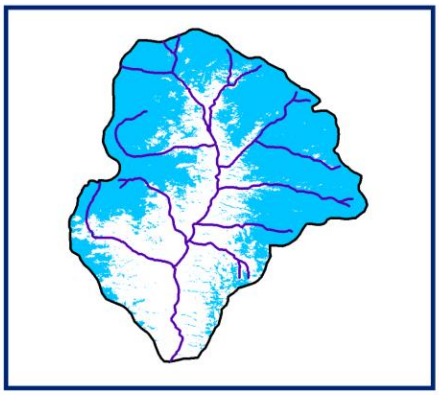
DATA NOT AVAILABLE

SNOW

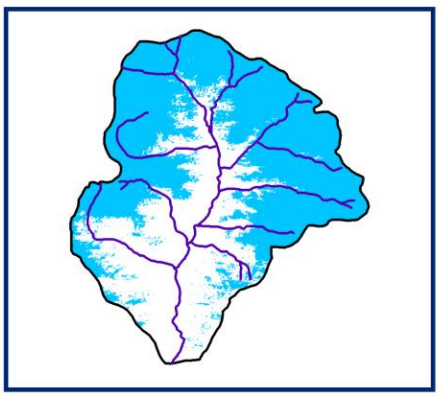
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
03 JANUARY 2016
05 JANUARY 2016
13 JANUARY 2016
19 JANUARY 2016
DATA NOT AVAILABLE
27 JANUARY 2016
10 5 0 10 20 30
Kilometers
SNOW

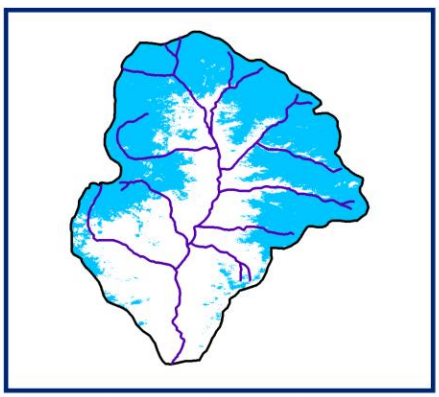
10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
03 JANUARY 2016
05 JANUARY 2016



DATA USED
13 JANUARY 2016
19 JANUARY 2016

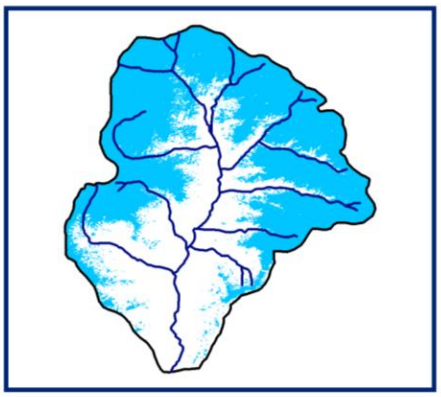


DATA USED
27 JANUARY 2016

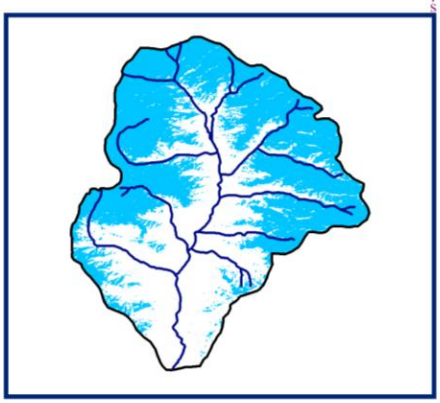
SNOW

10 5 0 10 20 30
Kilometers

SNOW COVER MAP : BEAS SUB-BASIN



01 FEBRUARY 2016



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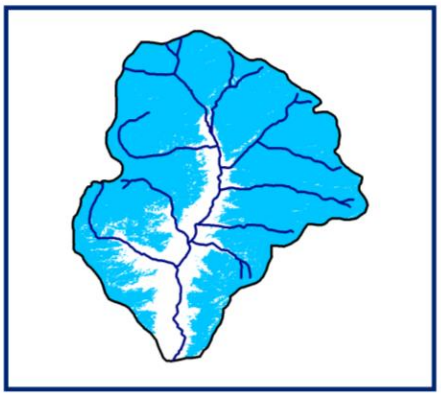
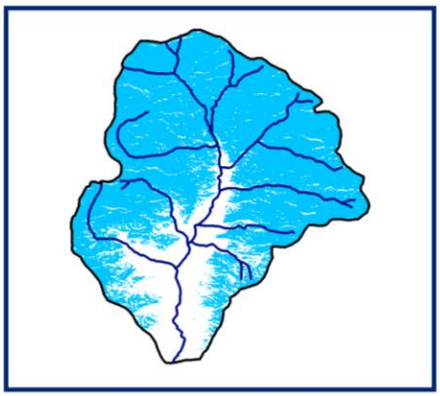
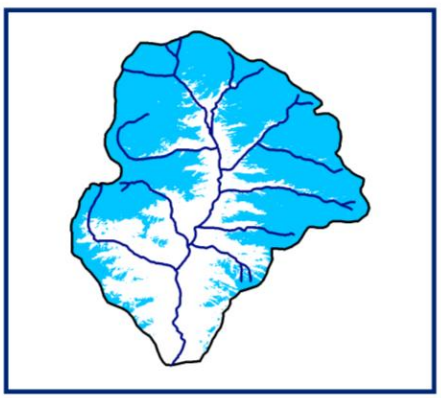


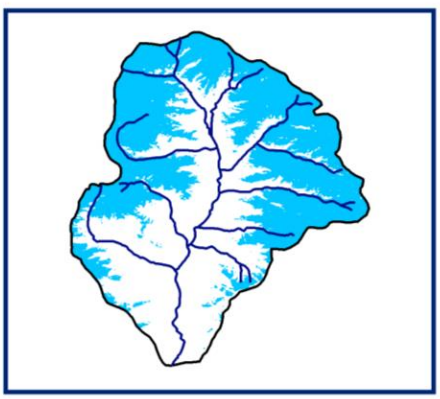
08 FEBRUARY 2016



12 FEBRUARY 2016



17 FEBRUARY 2016



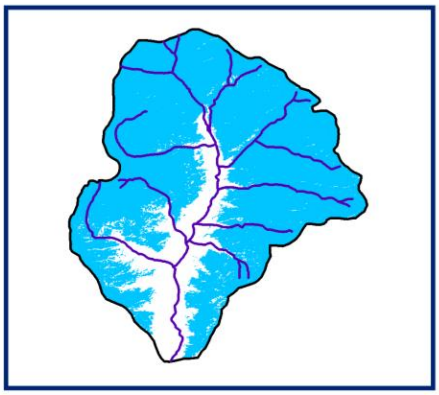
27 FEBRUARY 2016

SNOW

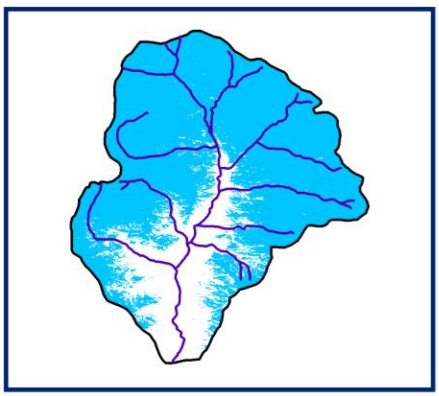
10 5 0 10 20 30

Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
01 FEBRUARY 2016
05 FEBRUARY 2016
08 FEBRUARY 2016



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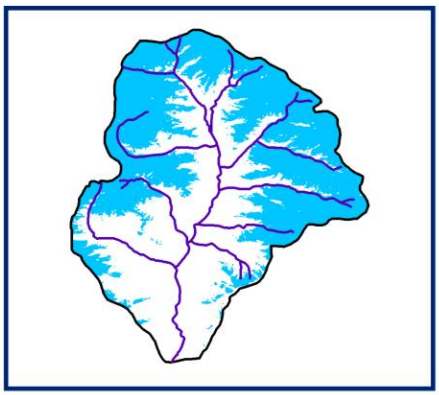
17 FEBRUARY 2016



DATA USED
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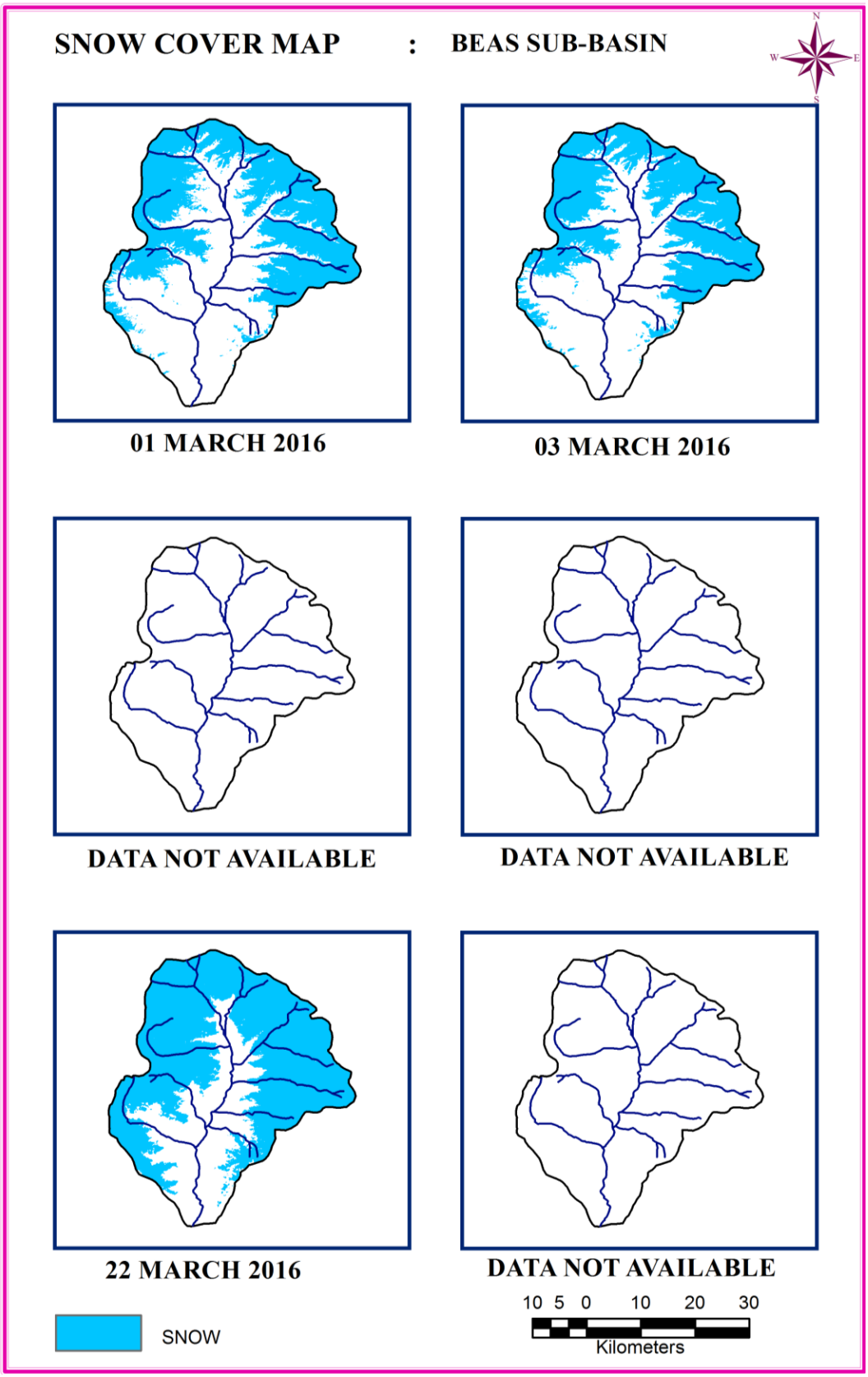
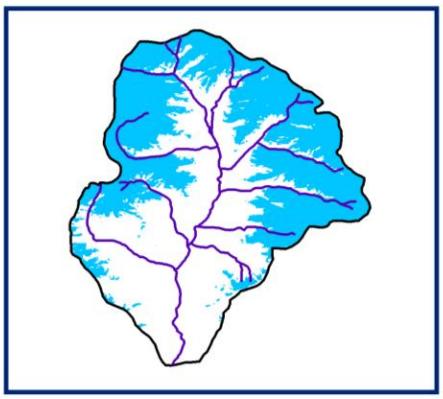
SNOW

10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
01 MARCH 2016
03 MARCH 2016
DATA NOT AVAILABLE
DATA NOT AVAILABLE
22 MARCH 2016
DATA NOT AVAILABLE
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
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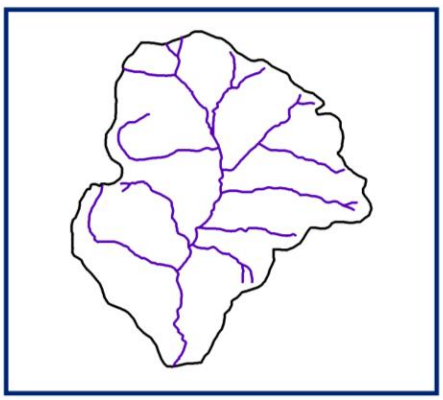
03 MARCH 2016



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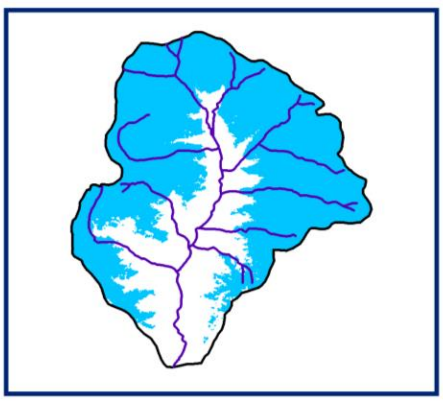
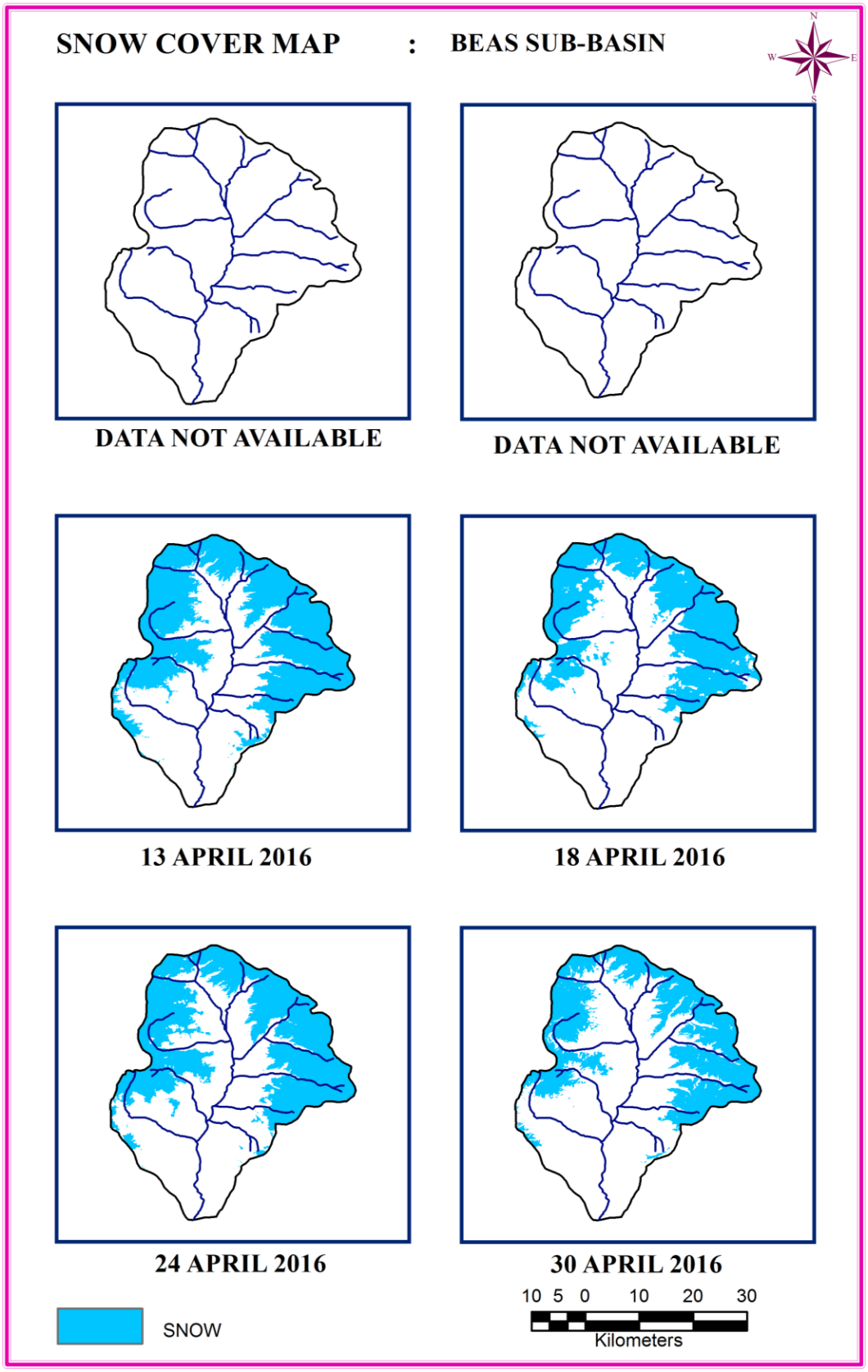


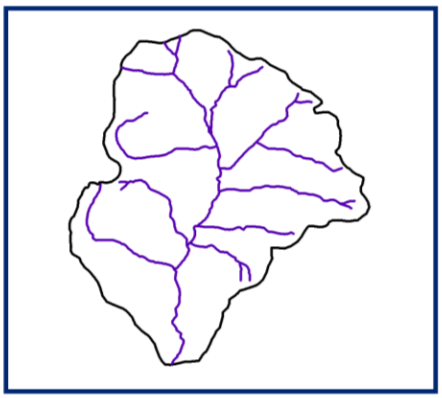
DATA USED
22 MARCH 2016

SNOW

10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
DATA NOT AVAILABLE
DATA NOT AVAILABLE
13 APRIL 2016
18 APRIL 2016
24 APRIL 2016
30 APRIL 2016
SNOW
10 5 0 10 20 30
Kilometers

10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



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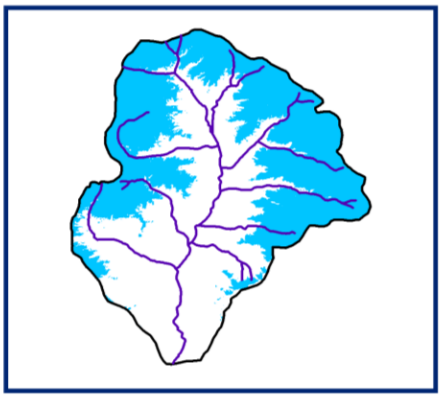
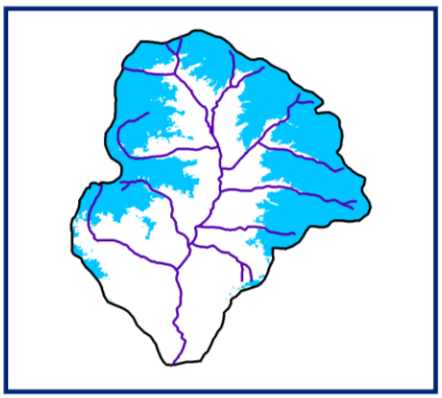


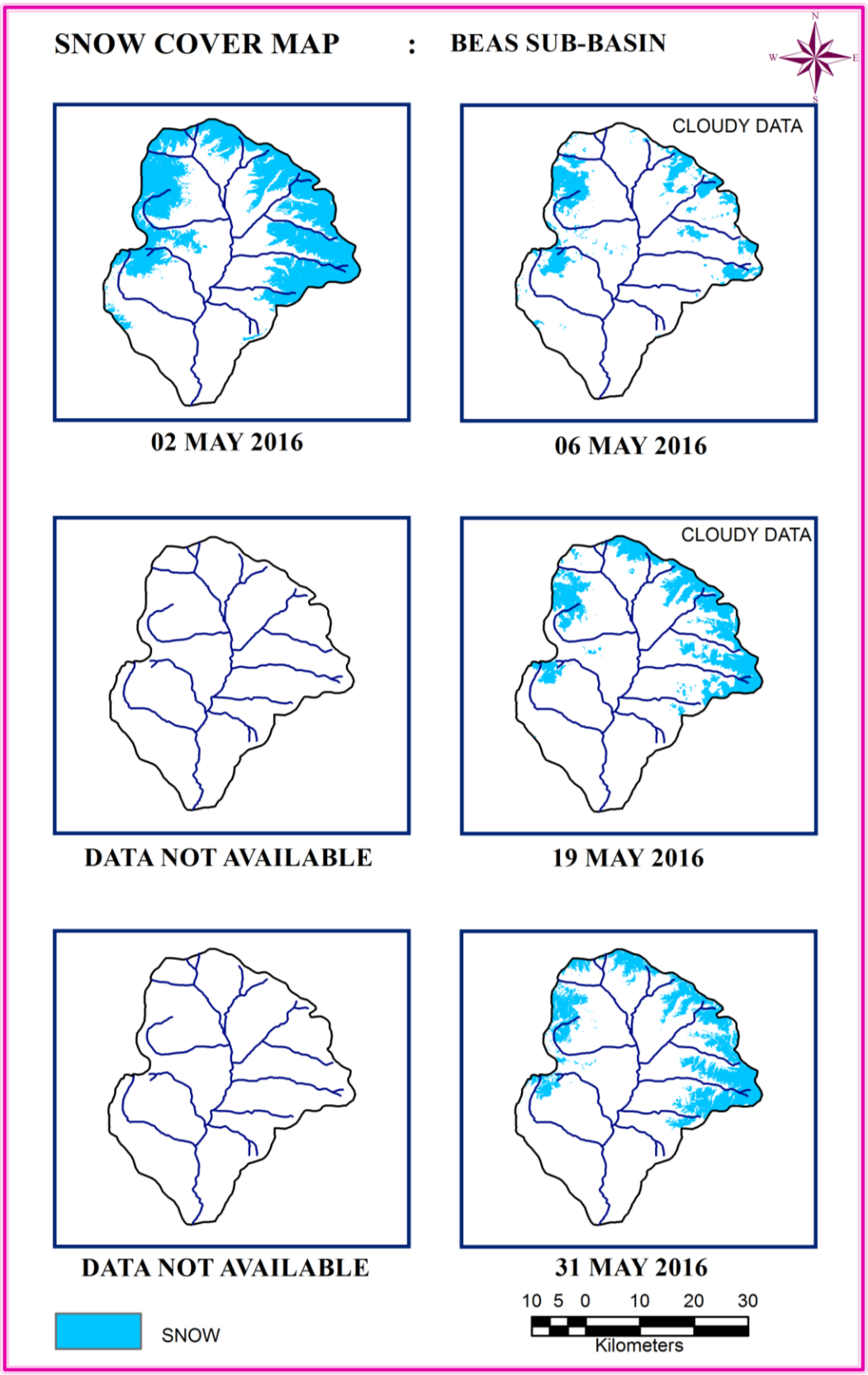
DATA USED
13 APRIL 2016
18 APRIL 2016



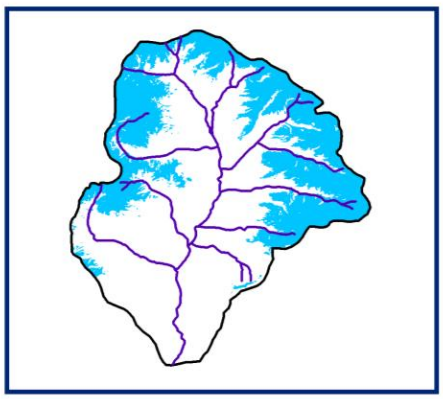
DATA USED
24 APRIL 2016
30 APRIL 2016

SNOW

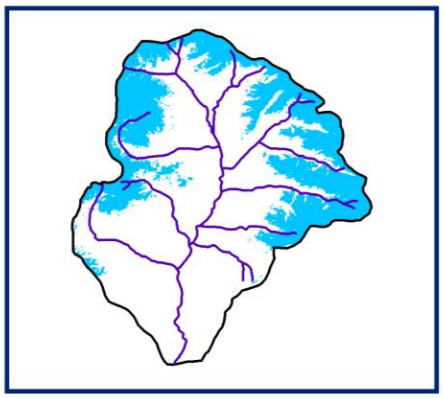
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
CLOUDY DATA
02 MAY 2016
06 MAY 2016
CLOUDY DATA
DATA NOT AVAILABLE
19 MAY 2016
DATA NOT AVAILABLE
31 MAY 2016
10 5 0 10 20 30
Kilometers
SNOW

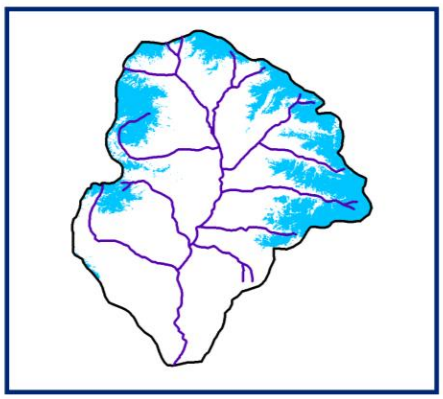
10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
02 MAY 2016
06 MAY 2016



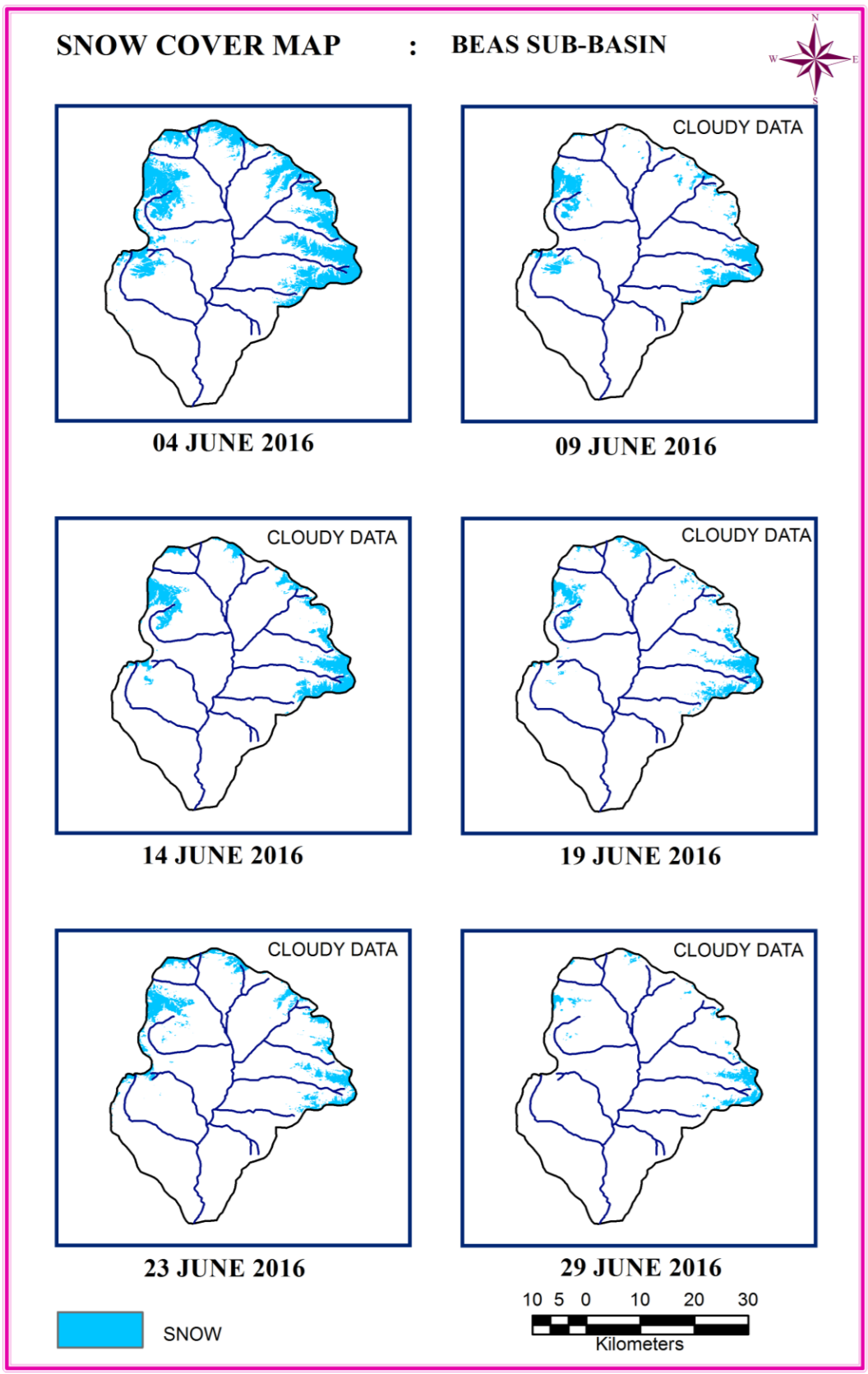
DATA USED
19 MAY 2016



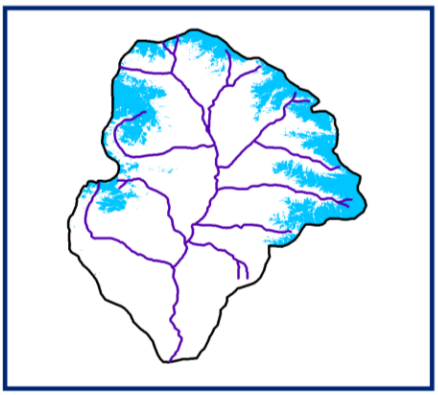
DATA USED
31 MAY 2016

SNOW

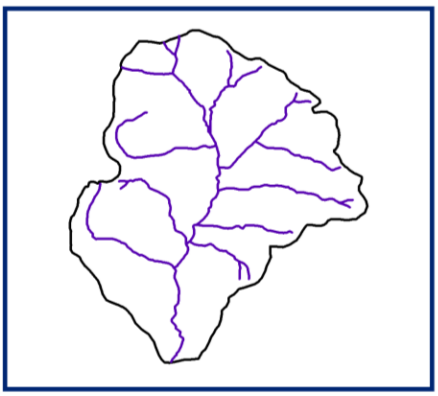
10 5 0 10 20 30
Kilometers


SNOW COVER MAP : BEAS SUB-BASIN
N
W
E
S
CLOUDY DATA
04 JUNE 2016
CLOUDY DATA
09 JUNE 2016
CLOUDY DATA
14 JUNE 2016
CLOUDY DATA
19 JUNE 2016
CLOUDY DATA
23 JUNE 2016
CLOUDY DATA
29 JUNE 2016
SNOW
10 5 0 10 20 30
Kilometers

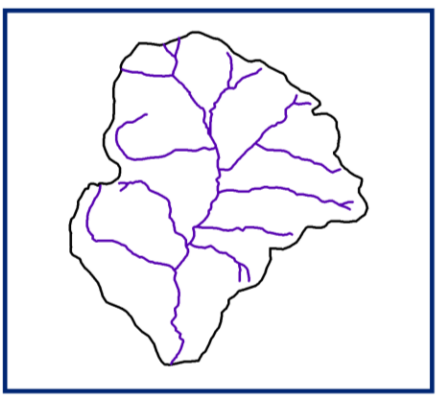
10 DAILY SNOW COVER MAP : BEAS SUB-BASIN



DATA USED
04 JUNE 2016
09 JUNE 2016



DATA NOT AVAILABLE



DATA NOT AVAILABLE

SNOW

10 5 0 10 20 30
Kilometers