SNOW COVER CHANGE IN KULLU DISTRICT (HIMACHAL PRADESH) BETWEEN 2008 AND 2017

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Abstract: Snow plays a very important role in the mountain region. The seasonal snow and glacier melt coming from the Mountain Rivers is a dependable source of water for irrigation, hydroelectric power and drinking water supply. Snow cover is one of the most sensitive Landover over the earth`s surface that's why time to time monitoring, assessment as well as mapping of these is very important. In the present study an effort has been made to study the snow change of kullu district between 2008 and 2017 by taking Landsat images and using geoinformatic techniques like supervised classification and normalized difference snow index (NDSI) with the help of quantum GIS.

***Keywords*:** Snow cover, Geoinformatic techniques, Normalized difference snow index (NDSI), False colour composite (FCC).

I. INTRODUCTION

There is a large hue and cry everywhere the globe concerning warming and global climate change. Warming is that the century scale rise of the worldwide temperature. According to IPCC (Intergovernmental Panel on Climate Change) Fifth assessment report (AR5), the average temperature of earth's surface has increased to 0.85°C.Because of the rise in temperature of earth`s surface snow cover is decreasing. Snow and glaciers are very important source of freshwater because most of the earth`s fresh water is stored in it in the form of snow. But due to climate change and global warming most of the glaciers present on the earth`s surface are reduced during the time span of last 100 years. Presently 10% of the earth's landmass is covered with snow, out of which 13.9% in Greenland, 0.51% in North America, 0.77% in the Himalayas, 84.16% in the Antarctic, 0.37% in Africa, 0.15% in South America and 0.06% is in Europe. Snow cover is one of the most sensitive Landover over the earth`s surface that's why time to time monitoring, assessment as well as mapping of these is very important. The present study is an effort to find out the changes in snow cover in KULLU district (HIMACHAL PRADESH) using geoinformatic techniques like supervised classification and normalized difference snow index (NDSI) with the help of quantum GIS.

II. STUDY AREA

Kullu is a district of Himachal Pradesh; it is situated between 31.9579° N and 77.1095° E with the elevation of 1279 m above sea level. Kullu has an area of 5503 sq. Km with the population of 379865 (2001).

Fig 1 – Location of the Study Area

III. METHODOLOGY

The present work is getting started by downloading the satellite image of Landsat for year 2008 and 2017 from earthexplorer (USGS). Landsat 7 image is used for year 2008 and Landsat 8 images are used for 2017. For both years image of same date that is 24 February is selected because the month of February is quite cloudless and there is maximum snow cover in this month.

Then these downloaded images were resample and layerstacked in QGIS software. Now after layer stacking FCC were generated. Now NDSI technique is used to validate the snow cover.

NDSI = (Green –SWIR)/ (Green +SWIR)

Thus for Landsat 7 use formula:

NDSI= (BAND 2-BAND 5)/ (BAND 2+BAND 5)

And for Landsat 8:

NDSI= (BAND 3-BAND 6)/ (BAND 3+BAND 6)

NDSI algorithm itself is a quite simple and the subsequent steps are required to extract snow cover in a vector format. The NDSI algorithm will return results between -1 and 1 with the threshold for snow typically being values greater than 0.4. Snow cover absorbs sunlight and therefore appearance darker then clouds. This allows the effective discrimination between snow cover and clouds (https://www.qgis.org/en/site/about/case_studies/australia_snowyhydro.html).

IV. RESULTS

In mountains, snow cover plays an important in the land cover pattern. In the study over 200,000 glaciers since the mid 19th century in the world, it was found that 2/3 of the current glacier melting is due to human influence on the climate. This loss of mass from glaciers is caused primarily by warming over those glaciers and this warming is, in turns being caused primarily by the CO2 concentration in the atmosphere. (Burkhat et. al)

In present study it is found that the area under snow cover is declining in Kullu District. The point is validated by using geoinformatic techniques. Satellite images for the year 2008 and 2017 were downloaded from USGS website and then for the generation of FCC (False Color Combination) required bands were layerstacked. The generated FCC image is as shown in fig 2.To specify the area covered by snow the FCC images were classified using supervised classification technique, the maximum likelihood supervised classification algorithm was applied to classify the study area.

FCC image of 2008 (Landsat 7)

FCC image of 2017 (Landsat 8)

Figure 2 -FCC images of Kullu Disrtict

For getting some more information about the snow cover the NDSI technique is also used. NDSI is actually a ratio between visible band and SWIR band of Landsat image. The generated NDSI of Kullu District for year 2008 and 2017 is as show in fig 3.

(a). NDSI image of 2008

(b) NDSI image of 2017

Figure 3. NDSI images of 2008 and 2017 for Kullu District

In both these NDSI images we can find that the vegetation cover area of 2008 has receded quite a certain extend in 2017. That means the snow cover area of Kullu District is decreased from year 2008 to year 2017 and many of the snow covered area are found to have either converted to barren rocky of being placed by vegetation. In the post classification stage both the classified images were overlapped to find out the location change of this specific class

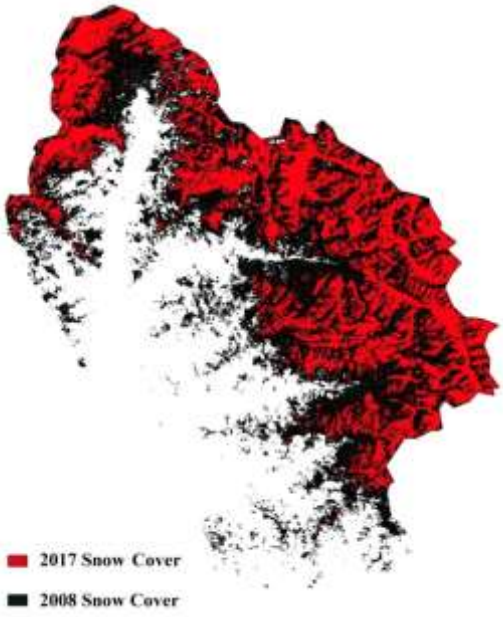

Figure 4. Snow cover change in Kullu between 2008 and 2017

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