International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr-2018 www.irjet.net p-ISSN: 2395-0072

MASS BALANCE AND WATER STORAGE OF HIMALAYAN GLACIER

Darshil Gameti[1], Darshit savani[2], B.P RATHORE[3], I.M Bahuguna[4]

M.E WRM, Ld College of Engineering
Head, EPSA/GHCAG/CSD,SAC-ISRO
Scientist/Engr, SAC, ISRO

Abstract - *Himalayas is the origin of many glaciers and important rivers of Asia. Glaciers are the fresh water source of India which are showing a continuous change in their area and volume. As per the past studies few of the Indian Himalayas are in retreating phase while some are in advancing phase due to climate change. Mountain glaciers comprise of small and widely distributed fraction of the world's terrestrial ice, yet their rapid losses presently drive a large percentage of the glacier's contribution to sea level rise. Hence, it is necessary to monitor the status or health of glaciers. The most viable and important parameter which show glacier health is the Mass balance. Mass balance refers to the total gain or loss of ice at the end of ablation season. Change in the mass balance easily tells that whether glacier are advancing or retreating depending the value of mass balance. AAR is the ratio of accumulated area to the total area.*

Area accumulation ratio of the Bhagirathi basin was determined based on the extraction of snow line at the end of ablation season. A correlation equation for finding the mass balance of Hamtah glacier has been found out by using data of year 2004, 2005, 2007 and 2011. A series of satellite images of AWiFS sensor were analysed for extraction of snowline on the glaciers of Bhagirathi basin for the period of 2014 and 2015. The snow line at the end of ablation season is used to compute accumulation area ratio (AAR = Accumulation area/Glacier area) for each glacier of basins. The AAR for the year 2014 and 2015 for Bhagirathi was found to be 0.3514 and 0.344.This indicates that the glacier is in retreating phase and the snow is melting continuously. The equation for calculating the mass balance of Hamtah glacier was derived by correlation between field mass balance and AAR which comes out to be y = 4.866x-3.4678 where the value of R^2*=0.95.*

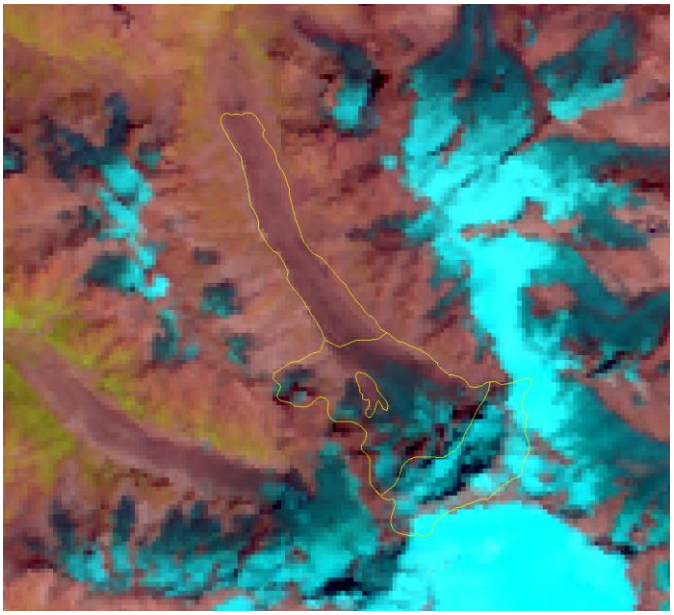
Key Words: Mass balance, AAR, Water Storage, Snow line

1. INTRODUCTION

Mass balance is considered as one of the important parameter which assesses the health of glacier. Mass balance in general term is the difference between amounts of accumulation and ablation of the glacier. It gives net change in volume of glacier over a specific period of time. Mass balance is considered to be quantitative entity. Annual mass balance is a hydrological budget which measure difference between accumulation and ablation of glacier during hydrologic year (Knight, 1999).

1.1 Study area

- Hamtah glacier is a north-west flowing glacier in the Chandra valley in the Chenab basin covering part of the Lahaul and Spiti district of Himachal Pradesh.
- Originating at an elevation of 5000 m asl,6.0 km long glacier having an average width of 0.50 km and covering an area of about 3.3 sq km, descends with a gentle gradient with its terminus at about 4000 m asl.
- The Hamtah glacier is located between 32°13'N and 77°24'E.
- It has a length of 6km and a mean width of 0.50 km covering the area of 3.24 sq km.



Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

1.2 Data used in the study

2004

Satellite	Sensors	Date of pass
IRS-R2	AW	7-Sep-04
IRS-R2	AW	12-Sep-04
IRS-R2	AW	19-Sep-04
IRS-R2	AW	26-Sep-04
IRS-R2	AW	4-Aug-04
IRS-R2	AW	21-Sep-04
IRS-R2	AW	2-Jul-04

2005

Satellite	Sensors	Date of pass
IRS-R2	AW	1-Sep-05
IRS-R2	AW	2-Sep-05
IRS-R2	AW	6-Sep-05
IRS-R2	AW	9-Aug-05
IRS-R2	AW	13-Aug-05
IRS-R2	AW	16-Sep-05
IRS-R2	AW	21-Sep-05
IRS-R2	AW	23-Aug-05
IRS-R2	AW	28-Aug-05
IRS-R2	AW	30-Aug-05

2007

Satellite	Sensors	Date of pass
IRS-R2	AW	10-Jul-07
IRS-R2	AW	30-Jul-07
IRS-R2	AW	27-Jul-07
IRS-R2	AW	18-Aug-07

2011

Satellite	Sensors	Date of pass
IRS-R2	AW	6-Aug-11
IRS-R2	AW	13-Jul-11
IRS-R2	AW	6-Aug-11
IRS-R2	AW	23-Sep-11
IRS-R2	AW	28-Sep-11
IRS-R2	AW	30-Aug-11

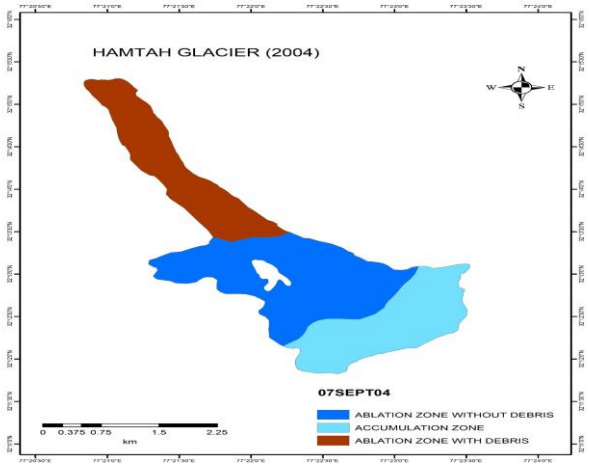
1.3 Methodology

Data from AWiFS sensor onboard Resourcesat-1 and 2 satellites is main source of delineate the snow line at the end of ablation season. AAR is estimated for the year 2004, 2005, 2007 and 2011 for the Hamtah glacier. Correlation equation is established between field mass balance and AAR.

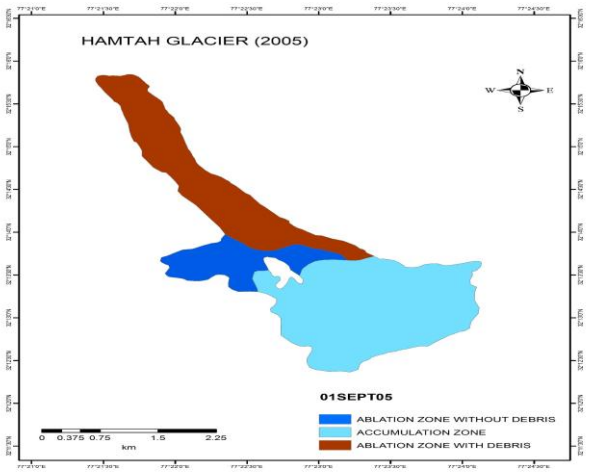
1) AWF files are converted into IMG format.
2) AWiFS images of period from July to October (ablation season) were geo-referenced with master images.
3) Basin boundaries were overlaid on the images. Image to map registration was carried out to match basin boundary.
4) All the glaciers boundaries were digitized on screen using AWiFS image to get area of glaciers.
5) The AWiFS scenes are used in order to ascertain the boundary of glaciers using higher resolution of the data. These boundaries are further confirmed using SOI maps.
6) To match the boundary of glaciers from maps and satellite data, part of accumulation zone is matched on the ridges based on the shadows observed.
7) Glacier boundaries are overlaid on all AWiFS scenes sequentially. Snowline of the respective date is created for individual glacier.
8) The accumulation area is the area of glacier above equilibrium line or snow line at end of ablation season. Thus AAR is derived for each glacier based on location of snow line at the end of ablation season.
9) A table is generated for AAR of each glacier corresponding to each scene. The least AAR is considered for estimation of mass balance.
10) The correlation is established between field mass balance and AAR in Excel.
11) An equation is generated by this correlation between Field Mass Balance and AAR.

1.3 Observations

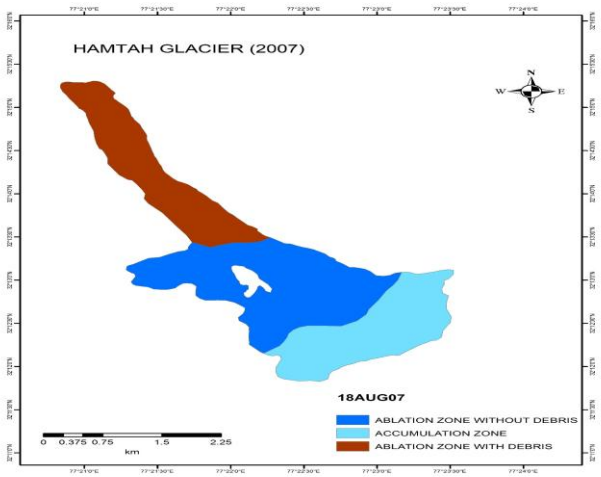
For the year 2004



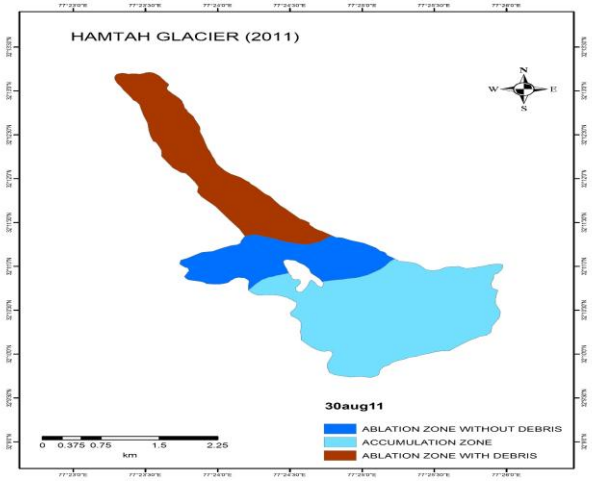
For the year 2005



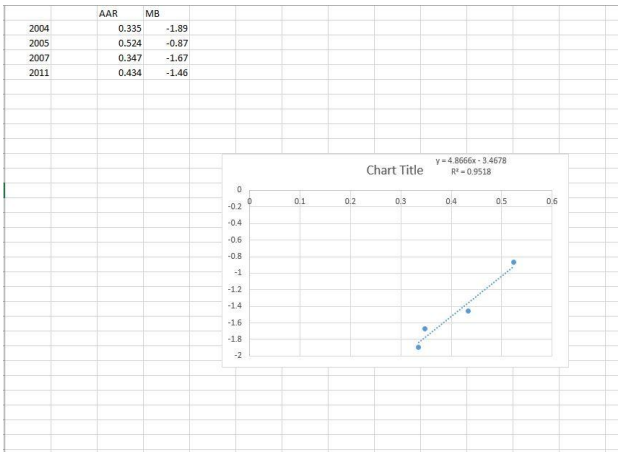
For the year 2007



For the year 2011



1.4 Generating the Equation for finding Mass balance of Hamtah glacier



From the above graph a regression relationship between AAR and Field Mass Balanced has been established. This analysis suggests a R^2=0.95 and yields an equation of calculating the mass balance of Hamtah glacier as

$$Y = 4.8666X - 3.4678$$

X = Area Accumulation Ratio

Y = Specific mass balance

2. RESULTS

Year	Field mass balance (m we)	Accumulation area (km^2)	Total area (km^2)	AAR	Debris (km^2)	Mean glacial depth (m)	Water storage (km^2)
2004	-1.89	2.59	7.722	0.335	2.07	59.60	1.5*10^4
2005	-0.87	4.04	7.722	0.524	2.48	69.72	2.7*10^4
2007	-1.69	2.67	7.722	0.347	2.23	60.25	1.6*10^4
2011	-1.46	3.35	7.722	0.434	2.35	65.29	2.1*10^4

3. CONCLUSIONS

- A correlation is established in between Field Mass Balance and AAR, a equation is generated by this correlation y=4.8666x-3.4678 and value of R^2=0.95.
- This equation can be used to find the Mass balance of following years.

ACKNOWLEDGEMENT

I am very much thankful to Dr. I.M Bahuguna(Head-EPSA/CHCAG/CSD-SAC-ISRO),B.P RATHORE(SCI/ENGR SAC-ISRO)Darshit Savani(JRF-M.G Science),Naveen Tripathi(SCI/ENGR SAC-ISRO)

REFERENCES

1. (Knight, 1999).