SUMMARY AND CONCLUSION
SUMMARY AND CONCLUSION

The world wide collection of information about ongoing glacier changes was initiated in 1894 with the foundation of International Glacier Commission (IGC) now popularly known as World Glacier Monitoring Service (WGMS). It was hoped that long term glacier observations would give insight into processes of climatic change. Today, the WGMS collects data throughout the world. But, according to the IPCC report 2007, very few long term data are available for the Indian glaciers. In 2002 Chhota Shigri glacier was chosen as a bench mark glacier by the International Commission on Snow and Ice (ICSI) in the whole Himalaya, for the mass balance studies. The present work is based on the mass balance studies done on this bench mark glacier since 2002 – 2007.

The present study shows the annual mass balance measurements on the bench mark Chhota Shigri Glacier obtained using the direct glaciological method (ablation stakes, drillings and pits). Mass balance study conducted on this glacier shows that the mass balance is strongly dependent on debris cover (which significantly protects the lowest part of the glacier from melting), on amount of exposure and on the shading effect of surrounding steep slopes. This suggests that melting is likely to be predominantly driven by incoming solar radiation which is irregularly absorbed by the glacier according to surface albedo (snow or ice, presence or absence or debris cover). These facts are needed to be compared with the energy balance measurements at various elevations.

Results of surface velocity show that the glacier moves faster in the upper ablation zone with velocities greater than 45m/year and slows down to 25 m/year at an altitude of around 4400 m. The present study shows that there is a limited sensitivity of glacier velocity to changes in mass balance at the annual scale, but repeated long term measurements of thickness changes at various elevations are still needed in order to understand the dynamics of this glacier.

This studied glacier from the arid zone of the western Himalaya, exhibits the similar characteristics as compared to the mid – latitude glacier. If the mass balance data is compared, they have the same vertical gradient of mass balance in the ablation area (excluding the debris covered part) of approximately 0.7 m w.e. (100 m)\(^{-1}\) and their ablation season is restricted to the summer months. But this statement can’t be
generalised. More studies should be conducted in support of this statement, including the winter balance studies and the accumulation pattern throughout the year. Western Himalaya are alternately exposed to mid-latitude westerlies bringing precipitation in winter and to the Asian summer monsoon. As a consequence, the cold winter is the main accumulation season but the glacier may receive further snow in summer, at least at high elevations. In the future winter balance studies along with the summer balance studies must be considered in order to understand the accumulation regime prevailing on western Himalayan glaciers. This may be very different from the glacier of mid-latitude.

During this 5 years of studied period, the annual specific mass balance of Chhota Shigri glacier was sharply negative, with \(-1.4, -1.2, +0.1, -1.4\) and \(-1.3\) w.e. in 2002/2003, 2003/2004, 2004/2005, 2005/2006 and 2006/2007, respectively. The values obtained so far do not follow any specific trend, thus at this stage no concrete conclusion can be drawn. Some of the recent remote sensing studies carried out in this region report an overall deglaciation of about 21% between 1962 and 2007 (Kulkarni and others, 2007). Another study shows thinning of glaciers in the western Himalaya between 1999 and 2004, supported by field investigations (Berthier and others, 2007; overall specific mass balance of \(-0.7\) to \(-0.85\) m w.e a\(^{-1}\) obtained over a 915 km\(^2\) ice covered area including Chhota Shigri Glacier).

An estimate of the accumulation area ratio through the remote sensing method has been attempted to compare its variation with the field data. The satellite image of IRS LISS III with a spatial resolution of 23.5 metres is taken and the glacier boundary of Chhota Shigri glacier has been delineated. Accordingly, the subsequent accumulation areas have been delineated by manual digitization. Based on the above hypothesis, the AAR for the Chhota Shigri glacier has been estimated at 0.16 and the glacier adjacent to the Chhota Shigri at coordinate 77° 28'06" E 32° 14' 33" N this shows that the glacier is showing a negative mass balance.

During the course of retreat, the glacier leaves behind the material, which it carries as a load, in form of well defined depositional structures, moraines, these were traced in the geomorphological study. In the Chhota Shigri glacier valley, four stages of glaciation
can be inferred by the morainic deposits near the Chandra river. The first terminal morainic loop lies 150 m south of the Chandra river which is partly eroded by the Chhota Shigri stream, second one lies about 100 m south of the previous one, third one lies 2 km south of the second morainic deposit and the fourth loop lies about 100 m south of the third loop and is about 50 m from the snout.

In this work, mass balance studies supported by remote sensing and geomorphological studies show increased rate of glacier wastage in the western Himalaya, probably related to global warming, but long term monitoring of Chhota Shigri Glacier is needed to study the evolution of glaciers and their relation to climate.