

## ***Interactive comment on “Mass gain of glaciers in Lahaul and Spiti region (North India) during the nineties revealed by in-situ and satellite geodetic measurements” by C. Vincent et al.***

### **Anonymous Referee #1**

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### **General comments**

In this paper, authors addressed to evaluate mass balance of Chhota Sigri Glacier for recent 22 years by in-situ measurements and updated remote sensing based procedure (based on method of Gardelle et al. 2012a,b). The result **mass gain of glaciers in 1990s** is very impressive and interesting finding. However, I consider the assertion should weaken because mass balance error in 1990s ( $\pm 2.5$  m w.e.) is too large comparison with change itself (+ 1.0 m w.e.). Stable or balanced condition might be better than "mass gain".

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The main result of this paper are not so different with the story of Azam et al. (2012). And some main assertions (mass gain in 1990s, representativeness of Chhota Sigri Glacier in analyzed region) lack rational evidence. So, I consider this manuscript has not reached to publish level yet.

### Specific comments

*3739/24* : The two assumptions of extreme cases and one assumption of intermediate case are adequate for evaluating mass balance and maximum error. However, area of tributaries look like large in the glacier. Is same extrapolation method applicable to tributaries? You can check spatial distribution from remote sensing derived result.

*3743/3* : The velocities value in 1987/1988 and 2003/2004 should be shown here. Additionally, if you discuss about dynamic behavior, fluxes should also be shown here.

*3740/7* : Considering  $\pm 1$  m w.e. as uncertainty of all altitude range is too simplistic. You should examine altitudinal trend of uncertainty. Showing average and standard deviation of each altitude range in Fig.3 might be better as point with error bar.

*3741/2* : Resolution size should be shown. It is basic information for remote sensing study. I recommend to include subset closeup image of Chhota Sigri Glacier in Fig.4.

*3740/17* : Strictly, error estimation should be done considering altitude. Quadratical error summation above 5100, between 4900 and 5100, and lower 4900 m a.s.l. are 2.7 (error of elevation change: 2.5, error of density: 1), 1.8 (err. of elev. :1.5, err. of density: 1), and 1.5 (err. of elev. :1.5, err. of density: 0) respectively.

*3743/18* : Inconsistency between your space-borne measurements and previous glaciological measurements should be explained more rationally. The phrase **Probably biased** lacks evidence here. If you assume previous surveys were only carried out

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in their lower accessible part. You should compare between your space-borne measurements in lower part and previous result. Anyway spatial distribution of elevation change in Fig.4 should be examined more.

*3744/10* : How much area of glaciers covered by debris in the region? If there are so much debris-covered glacier in the region. Considering Chhota Shigri Glacier as representative glacier in the region would include negative bias. Actually MB of Chhota Shigri Glacier is negatively larger than regional MB.

*3745/5* : Author's results about **mass gain in 1990s** does not support previous studies (Gardelle et al., 2012a; Kääb et al., 2012). Because mass gain period in Gardelle et al. (2012a) and Kääb et al., (2012) are 1999–2008 and 2003–2008 respectively. The periods of them are almost after 2000s.

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Interactive comment on The Cryosphere Discuss., 6, 3733, 2012.

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