Role of glaciers in watershed hydrology: ''Himalayan catchment'' perspective

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Review, Nils Roar Sælthun

General:

This is an important contribution on a topic that is very much in focus. It adresses relevant scientific questions, clearly within the scope of the journal. The high altitude rivers of the region have scarce observational data, and all data and analyses that are brought into the public domain are most welcome contributions. The methods of analysis are not novel per se, but the sharp focus on glacial melt contribution to runoff is an original contribution in this case. The conclusions are clearly stated, but I suggest minor alteration to the following:

Relationship between glacier degraded runoff and discharge variations from Din Gad catchment suggests that the increased glacier degradation need not necessarily translate into higher glacier discharge and river flow in a Himalayan catchment as suggested by the IPCC reports. (455/24).

Reason: Negative mass balance will necessarily translate into higher glacier runoff – all other elements remaining unchanged. The important point illustrated by the paper is however that under climate change this is likely to be a minor effect compared to other impacts, especially as one moves away from the glacier outlet.

In this context I miss refererence to the paper Hasnain S.I.: Himalayan glaciers meltdown: impact on south Asian rivers. IAHS Publication no 274: FRIEND 2002 – Regional Hydrology, eds H.A.J van Lanen & S. Demuth, pp 417-423. This paper is based on analysis of data from the same glacier (1994 to 2000), and concludes: *It is evident from Fig 2. that anomalously high rates of glacier shrinkage due to climate warming have resulted in high runoff.* A discussion is called for.

For completeness, a reference to the paper Hasnain S.I. 1999: Runoff characteristics of a glacierized catchment, Garhwal Himalaya, India. HSJ 44(6) 847-854. may also be in pertinent, as it analyses data from the same glacier. It does not address the central topics of the present paper, but stresses the importance of the monsoon regime in these areas.

My evaluation of the paper is as follows: Good(2) on all criteria (Scientific Significance, Scientific Quality, Presentation Quality.

Minor comments:

1. The abstract has in parts shorthand style: ”Other two major glacio-hydrological regimes …” > Two other or The two other, ”Study shows” > ”The study shows” (several othes like this). Should be corrected.

2. The term ”Himalayan catchment” for the monsoon dominated region is used in the title and throughout the paper. It is defined in the paper and thus acceptable, but could easily be misunderstood when read outside the context. I’d suggest a more descriptive term is used.

3. The term ”degraded runoff”/”glacial degraded runoff” used in line 444/19, 448/19, 452/8 etc for the runoff component stemming from negative mass balance does not ring well, is not selfexplanatory and is not defined.

4. Error in reference list Thayyen et al 2005 – volume should be 306, not 36.

5. Line 447/7: Thayyen et al 2007 should be Thayyen et al 2007a (probably). In the reference list The two Thayyen et al 2007 should be marked 2007a and 2007b.

6. Reference list: Rai, S.C. and Grung, A. > Gurung A.

7. Line 458/10: Barnet et al 2005 > Barnett et al

Minor orthographical errors:

1. 446/12: The Din Gad catchment covers an area of 77.8km2, extends from 2360 to 6000 ma.s.l. and has 9.6% glacierisation.
2. 451/5: The monsoon systems operate around 850 hPa level (Goswami et al., 2003). They encounter Himalayas at lower elevations and undergo orographic uplift.
3. 452/26: July and August are the warmest months ..
4. 453/12: While the discharge at Tela and Gujjar Hut stations was reduced by 58 and 50 percentage respectively from 1998 to 2004, discharge from the glacier catchment showed comparatively steadied response. Analysis of specific runoff from each sub-catchment showed that the contributions from Tela catchment (41.8km2) were reduced from 25 mm/day in 1998 to 9 mm/day in 2004 (Table 1). Similarly, runoff contributions from the Gujjar Hut sub-catchment (20.3 km2) were reduced from 18 mm/day to 4 mm/day during the same period, whereas runoff from the glacier catchment (15.7km2) varied from 29 to 15 mm/day. The variations …
5. 454/6: Monthly discharge and percentage runoff contribution from the glacier catchment to Tela and Gujjar hut stations are shown in the Fig. 8a and b
6. 454/21: Two important conclusions emerge from the discussion above: 1) The highest runoff in a glacier fed stream of a “Himalayan catchment” always occurs as a result of high precipitation.
7. 456/21: were precipitation dependent rather than glacier degradation dependent, as we have observed in the Din Gad catchment.
8. 459/5: The other two are the winter snow dominated Alpine catchment and the cold-arid region of the Ladakh. This study suggests that the hydrological characteristics of the Alpine and the Himalayan catchment are significantly different.

My evaluation of the paper is as follows: Good(2) on all criteria (Scientific Significance, Scientific Quality, Presentation Quality. Given the importance of the topic, Scientific Significance verges on Excellent.