

***Interactive comment on “***

**Snow cover dynamics and hydrological regime of  
the Hunza River basin, Karakoram Range,  
Northern Pakistan” by A. A. Tahir et al.**

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The topic under discussion is in line with a number of recent studies on the hydro-climatic conditions and processes in the Upper Indus River Basin. The methodological tools chosen are focused on the investigation of the high altitude regions in the Hunza Karakoram. The lack of reliable ground data (especially at higher elevations) requires the combination of ground observations, remotely sensed data and runoff measurements. Statistical analysis of time series of different length and origin are applied in

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order to extend our existing knowledge on altitudinal characteristics of the seasonal water balance and temporal trends. Conclusions derived from the analysis suggest an expansion of snow cover at high altitudes due to changes in atmospheric circulation patterns. Atmospheric warming trends seem not to be as significant compared to other regions of South Asian mountains.

The study is interesting, methodological approaches are carefully chosen and statistical analysis follow well tested procedures. Nevertheless, several fundamental aspects should eventually more carefully be discussed, investigated or questioned. In addition to comments provided by other referees I would like to add the following points:

1. The theoretical hydro-climatic model of mountain systems suggests, that run-off is determined by more variables than considered in this study. It should be made clear that evaporation, sublimation, melting permafrost, different ablation procedures on debris covered or debris free glaciers have not been taken into consideration or only indirectly.
2. The quality of meteorological data depends on the parameter chosen. In accordance with the authors statements temperature data are rather consistent. On the other hand precipitation data are useful (although not very accurate) for liquid rainfall, e.g. in summer. They become almost totally random for snowfall (the authors mention the reasons) and therefore with increasing altitude. In this case the combination of satellite data (providing a yes/no-information on existing snow coverage) and ground data (e.g. snow-pits) or information based on snow-cover/runoff models is an appropriate approach and might overcome to a great extent this bottleneck. Several studies come to similar conclusions: the maximum snowmelt input to runoff in the area under discussion originates from the altitudinal range between 4000-5500 m. This interval combines hypsometric characteristics and approximate values of vertical rainfall gradients (e.g. Winiger et al, 2005).
3. The quality of run-off data at Dainyor-Bridge should be discussed under the per-

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spective of long-term trends.

4. The obviously different characteristics of glaciers in the Karakoram compared to other mountain areas (incl. Himalaya) should differentiate between retreating, stagnating and advancing (especially surging) glaciers. In the Karakoram the percentage of surging glaciers seems to be rather high (as Hewitt has shown in several case studies). An overall increase of snow-cover at high elevations is suggested, but has to be verified.

5. The analysis of time-series for the basin based on only 10-years of data should be discussed with more reserve.

#### Conclusion:

The paper deals with a fundamental question. It is a valuable contribution to high-altitude hydro-climatology in the Karakoram. It uses innovative methodological approaches. Several aspects should be discussed with more precaution. In some cases (as outlined above) conclusions should eventually be considered to be an assumption or a hypothesis.

#### Recommendation:

It is worth to publish the paper. But comments made by the referees should – if possible – be taken into account.

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