

Interactive comment on “Trends in timing and magnitude of flow in the Upper Indus Basin” by M. Sharif et al.

M. Sharif et al.

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Received and published: 8 November 2012

We again appreciate the positive comment and respond here to substantive comments and will respond to the detailed points of clarification in a revised version of the paper.

Comment (1) p9938: Discussion of changes in precipitation are very brief, and no comment is provided on the implications for streamflow (e.g. which sites showed an increase in winter precipitation? which types of flow regimes would be most affected and how?). A figure on spatial distribution of precipitation changes would be useful in assisting interpretation of Fig 4.

Response: We accept that the description of changes in precipitation is quite brief,

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but we do refer the reader to the fuller discussion of precipitation in Archer and Fowler (2004) where spatial variation and annual and seasonal trends were investigated. We will expand this section.

With respect to sites showing and increase in winter precipitation we add the following:

‘Annual and seasonal trends in precipitation at 10 stations in the UIB from 1961 to 1999 were investigated in Archer and Fowler (2004). All ten winter (October to March) trends were positive with three significant at $p < 0.05$; winter precipitation shows strong spatial correlation throughout the region both north and south of the Himalayan divide. Positive trends were identified at eight of ten stations in summer (April to September), but all were non-significant; summer precipitation shows poor spatial correlation.

With respect to implications for streamflow in different flow regimes:

‘Since runoff on catchments predominantly fed by melt of winter snow, show strong correlation between winter precipitation and subsequent summer runoff (Archer 2003; Archer and Fowler 2008), an upward trend in runoff in these catchments is also expected. Glacier-fed catchments are expected to be unaffected by preceding snowfall. These hypotheses are tested in this analysis.’

These issues are already addressed in the Discussion p9948 lines 15-23 and 9949 lines 11-17. We will strengthen the link with the above stated hypothesis.

Given the limited number of climate stations in a large and varied environment, we do not think that a figure showing precipitation trends would further assist interpretation.

Comment (2) p9939 "During the recent decade the Indus has experienced ..." Perhaps some references could be cited for the events listed here.

Response: References inserted as follows:

With respect to the drought 2000:

Ahmad, S., Hussain, Z., Sarwar, A., Qureshi, Majeed, R. and Saleem, M. (2004)

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Drought Mitigation in Pakistan: Current Status and Options for Future Strategies , International Water Management Institute, Working Paper 85, Drought Series. Paper 3, 56pp.

With respect to the 2010 flood:

Houze R.A., Rasmussen, K.L., Medina, S., S. R. Brodzik, S.R. and Romatschke, U. (2011) Anomalous Atmospheric Events Leading to the Summer 2010 Floods in Pakistan, Bull. Amer. Meteor. Soc., 92 (3), 291-298, DOI:10.1175/2010BAMS3173.1.

Webster, P. J., V. E. Toma, and H.-M. Kim, 2011: Were the 2010 Pakistan floods predictable? Geophys. Res. Lett., 38, L04806, doi:10.1029/2010GL046346.

No published references were found to the winter precipitation of 2009 and this has now been omitted.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 9931, 2012.

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