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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Reconciling high altitude precipitation in the upper Indus Basin with glacier mass balances and runoff" *by* W. W. Immerzeel et al.

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This interesting manuscript uses an impressive data collection to estimate the amount of precipitation in the upper Indus Basin, as a key for a better quantification of the available water resources. The authors conclude that currently used precipitation estimates yield a gross underestimation of actual precipitation. Given the virtual absence of ground-based precipitation estimates at high altitudes, this work is obviously of prime importance. I am not an expert for this region, but I get from the presented discussion that it is currently not even entirely clear whether runoff in this region is fed by positive net glacier melt or not.

What triggered the present comment on this paper was i) the overall impression that the used methods and results are presented in such a condensed way that I cannot entirely follow what has been done, ii) the absence of a summary of the order of magnitudes and of the uncertainties of the water balance terms, and iii) the fact that the paper does not mention groundwater.

Groundwater is absent from the water balance equation (eq. 2). This might of course be justified for the region / studied period but is nevertheless surprising.

The very condensed presentation of the methodology reads well but I would suggest to add some details (or supplementary material). I do for example not understand how the best precipitation field has been selected among all generated fields (there seems to be some form of optimization, on which criterion?). Also e.g. in the sentence ". By running a multiple regression analysis after optimizing the PGs we quantify the contribution of each parameter to the total uncertainty." I do not really know what has been done. What is the total uncertainty? Why do the degree-day factors explain the PGs ("We take into account uncertainty in the following key parameters (HREF, HMAX, DDFd, DDFdg, TS) for the PG")? On what are the PG-fields conditioned in "geostatistical conditional simulation"? What do you mean with a standardized semi-variogram.? The same functional type everywhere?

Finally: would it be possible to summarize the different estimates of the water balance terms for the different sub-regions, how they are estimated and the order of magnitude of their uncertainty? Are there areas where the uncertainty of precipitation and mass balance is in the order of magnitude of the uncertainty of evaporation, transpiration and groundwater storage change (which would make any inference impossible to my view)? A comment on the order of magnitude of the observed runoff uncertainty could perhaps complete the picture.

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