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Earth Surface Dynamics Discussions

Interactive comment on "The hydrological cycle in the high Pamir Mountains: how temperature and seasonal precipitation distribution influence stream flow in the Gunt catchment, Tajikistan" *by* E. Pohl et al.

Anonymous Referee #1

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Authors used remotely sensed precipitation product TRMM3B42 V7,interpolated precipitation data, APHRODITE and climate model data, HAR10 in combination with MOD11C1 V5 LST to evaluate the various components of the hydrological cycle of the Gunt catchment in the south of the Gorno-Badakhshan Autonomous Oblast in south-eastern Tajikistan. They have achieved this by implementing J2000g hydrological model. The results presented shows 80% of the annual precipitation is in the form of winter snow. An interesting result is the significant groundwater contribution up to 40% in the catchment. Authors suggests a shallow and a deep aquifer system con-

tributing to the bulk flow at Khorong. They also suggests 30% glacier melt component in the runoff.

Study is interesting, and highly relevant, especially to the HKH region. However, the results presented are mainly focused on the limitations of various precipitation products in a complex mountain terrain, importance of groundwater contribution in the hydrology of high Pamir mountain and significantly high glacier contribution. Authors failed to sketch a clear picture of the hydrological cycle of the high Pamir Mountains as suggested in the title. A section on final synthesis of precipitation/temperature and its elevation dependency across 14000 km2 study area is missing. What is the mean annual precipitation arrived through the modelling exercise?. A section on general climate and hydrology of the basin, based on the 5 met. station and one discharge station data is also missing. Methodology section talks about calculation of potential evaporation and actual evapotranspiration. However, there is no discussion on these parameters presented in the paper. It may be appropriate to discuss all these results to justify the title of the paper. Authors mentioned 30% glacier contribution in the catchment just as a remark without any discussion and also highlighted this aspect in the abstract. This is an important finding and need to discuss in detail. What does this glacier contribution means? Whether it corresponds to annual glacier mass exchange or net mass balance? Whether it covers whole 7.5% permanent snow cover or just glaciers?. In the end reader is left with many such questions. Please see the specific comments below. The issues discussed are important and this paper merit publication.

Specific comments Section 2 Study area should be strengthened by giving information on 1. percentage glacier cover, number of glaciers, mean size of the glaciers and also volume of glaciers, if available, especially when authors present a 30% glacier contribution in the catchment .Please give altitude of the meteorological stations in the catchment.

Section -4.1.3 p1167- Snow cover duration in the catchment is also very critical for ground water generation. It is stated that 7.5% is the permanent snow cover in the

catchment. However no information on seasonal snow cover is provided. With significant (40%) groundwater contribution in the basin, altitude wise average snow cover depletion curves will provide greater insight to these processes.

4.2.1/4.2.2 The paper is discussing hydrological cycle in the high Pamir Mountains and not enough insight on orographic influence of precipitation/temperature distribution is not provided. Mean monthly precipitation and temperature data from five meteorological stations in the catchment may be presented and elaborated. Figure 3 & 4 is well appreciated. But presentation of measured monthly mean temperature and precipitation at different altitude in comparison with the best of the model result will help in better understanding of the climate of the region and its temporal and spatial controls on hydrological cycle.

A discussion on measured discharge at Khorog, its monthly distribution, high and low discharges, inter-annual variations etc.is missing. This will improve the understanding of the hydrological setting of the catchment and will help the reader to appreciate the model results better. Section 5 p1175 L 5-7 Please mark the hydropower station and Lake regulation site on Fig. 1

P1175 L9-10 It is stated that the "records from the 1960s show similar winter discharge as in 2000s". What is the percentage contribution of this winter discharge from the lake in the bulk winter flow at the outlet. Is this winter out flow from lake is treated as groundwater component? Section 6 L 25-26 It is stated that "characteristic transition from snow to glacier melt in summer". What does this mean? Please elaborate on this aspect. Glacier discharge at the snout always have a significant contribution of snowmelt over the glacier. Are you distinguishing between glacier ice melt and snowmelt over the glacier?. It is mentioned earlier that the catchment have 7.5% permanent snow cover. Are you considering the melt from permanent snow cover as glacier melt? Is major glacier discharge comes from few big glaciers? Please see the comment on section 2 earlier.

P 1176 L 1-2 Authors mention " Strong constraint on the parameterization of ground water aquifer". What is the winter temperature range of the higher altitude regions?. Significant area of the catchment may be experiencing seasonal ground freeze. Can you give brief description of stream characteristics in the basin? Is all the glacial streams are perennial? Or interrupted streams?. What about non-glacial streams. This will give a clear picture on area experiencing seasonal freezing. Overall hydrology of the basin need to be explained for better understanding of the hydrological cycle response over the area.

Section 6.1 L 14-20 . Authors stated that at the end of the summer, there is no snow cover left and meltwater only originate from glacier melt... This gives an impression that the glacier melt sustains the runoff during the late summer period, which is not true. Interestingly, the groundwater component in the stream flow dominates the glacier component throughout the glacier ablation season. The sentence may be modified to convey this finding.

P1178 Section 6.2 Data set characteristics. It is stated that the average annual discharge volume 3.48 km3 /yr. What is the monthly/seasonal runoff distribution?. 30% glacier discharge means around 1.04 km3/yr glacier contribution. Is this 30% of the summer months or annual total. What is the estimated glacier storage volume in the catchment?. Again there is a section 7.2 discussing the data set characteristics (P 1184). Please combine these sections and could be present it under section 4.

P1179 L 22-23 Degree Day factor of glacier ice TMFgi is shown as 1mm/oC/d. Is any supporting data from mass balance studies in the area available for such a low value?

P 1181 L8-9 Effective precipitation is defined as all liquid stream water contribution from rainfall, snowmelt and glacier melt. Is it prudent to incorporated glacier ice melt to as effective precipitation? In section 7.1 hydrological cycle, one expect a detailed discussion on various components of the hydrological cycle of the catchment including basin average precipitation synthesised through the modelling effort, discussion

on 30% glacier contribution as mentioned in the abstract and conclusion and actual evapotranspiration and runoff etc.

P1185 section 7.3 Sensitivity analysis is discussed under section 6.3. Why section 7.3 cannot be discussed along with section 6.3.? Sections 7.1 could be strengthened by combining pertinent issues discussed under section 7.3.

P1186 L25-30 &1187, L 1-15 Discussion on hill slope processes and erosion discussed here can be avoided as it is not the focus of present paper.

P1187 L 13-14 Only discharge part of the hydrological cycle is being discussed no precipitation amount is discussed

P1188 L 17-30 & P1189 L 1-5. This issues are not evaluated in the paper and it is only conjecture and should be avoided.

Interactive comment on Earth Surf. Dynam. Discuss., 2, 1155, 2014.