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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Climate-induced hydrologic change in the source region of the Yellow River: a new assessment including varying permafrost" *by* Pan Wu et al.

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(a) For water storage change: The above Fig.1 is obtained from Wang et al., 2018. This figure shows the water storage change of the SRYR calculated by different methods. We draw a dark dashed line on it to indicate the zero ïĄĎS. As shown in this figure, ïĄĎS change fluctuates around the zero line but increases in 21st. These results are similarly with my results shown in first round submitted supplementary Figure 3. There is a larger deviation in 21st between recalculated w' and w caused by larger water storage change. Additionally, Figure 3 shows 11-year moving average method is efficient to remove water storage change. It is different form 5-year average value used by

Wang et al. 2018. And as shown in the Fig. 1, there is a deviation between water storage obtained from GRACE and the other two datasets. DS_GLEAM and DS_GBEHM show an increase of water storage change in 21st, however,DS_GRACE shows a decrease of water storage change. Wang et al., 2018 just use one landmass dataset CRS to analysis DS, but the ensemble mean (simple arithmetic mean of JPL, CSR, GFZ fields) was most effective in reducing the noise in these datasets (Sakumura et al., 2014). Different from Wang et al., 2018, the grace data we used are ensemble mean of JPL, GFZ and CRS landmass dataset. To further exam the efficiency of 11-year moving average mothed, ABCD model and Grace data are used to simulate and analyse water storage change. The results are show in supplementary 2. (b) Watershed property parameter (w) in the Fu's equation Reply: We agree that catchment properties are related to watershed slope, vegetation, soil properties and climate change. However, watershed slope is a constant value which won't change with time. In watershed underlain by frozen ground, frozen ground degradation will alter soil properties. Accordingly, our study considered climate change and frozen ground change impacts on catchment properties. A linear stepwise regression method was used to analyse potential factors impacts. And then land cover change impacts are calculated by using total discharge change (DQ) minus climatic-induced discharge change and permafrost degradation induced discharge change. Landcover change impacts are shown in Fig. 8. Following equation is used by Wang et al., 2018: Q=(P-ET_Budyko)+(-ET_dev-∆S)=Q_Budyko+Q_dev (1) Where Q_budyko is long-term average of the observed annual streamflow, Q_dev is the deviation of the observed annual Q from Qbudyko. As indicated by Eq.(1), Qdev corresponds to discharge change caused by catchment properties change and neglected water storage change. Wang et al., 2018 directly attributes Q_dev to frozen ground degradation and landscape change. However, catchment properties change is closely related to relative infiltration capacity, relative soil and water storage, and average slope. For the same watershed, considering precipitation intensity, temperature and potential evaporation impacts on catchment properties is more reasonable. I think without considering climate change impacts on the catchment properties are the main reason of Wang et. al., 2018 obtaining unreasonable results that permafrost degradation will decrease 70% streamflow in sub-basins above JM staion. It has been found that the permafrost degradation could enlarge baseflow in cold regions (Walvoord and Striegl, 2007; Jacques and Sauchyn, 2009; Bense et al., 2012; Evans et al., 2015; Duan et al.,2017). Decrease in MFD because of global warming was considered as a major factor for the increase in baseflow in the Qilian mountain, China (Qin et al. 2016). Additionally, the melt ice within permafrost and increasing hydrologic connectivity following permafrost degradation will increase the runoff discharge (Connon et al. 2014; Duan et al. 2017). (C) For vegetation/landcover change impacts Landcover change impacts on discharge change are analysed by Cuo et al., (2013) through VIC model. The results indicate landcover change is negligible above Tangnaihai station which is the outlet station of my study area. And in the Introduction Section, we already emphasized the low population density in the cathment above Tangnaihai hydrological station (about 6/km2, 2003 census data) and in the area above the Huangheyan station (0.34/km2) (Liang et al., 2010). From 1990 to 2000, the change in land use in the SRYR was generally less than 5% even a few of the sites exhibited 5-15% of the change (Wang et al., 2010). Accordingly, we neglected the landcover change in statistical analysis, but considered it as residual error of statistical analysis as shown in Figure 8. The results are consistent with the landcover change and low population intensity in the study area.

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Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-744/hess-2017-744-AC1-supplement.pdf

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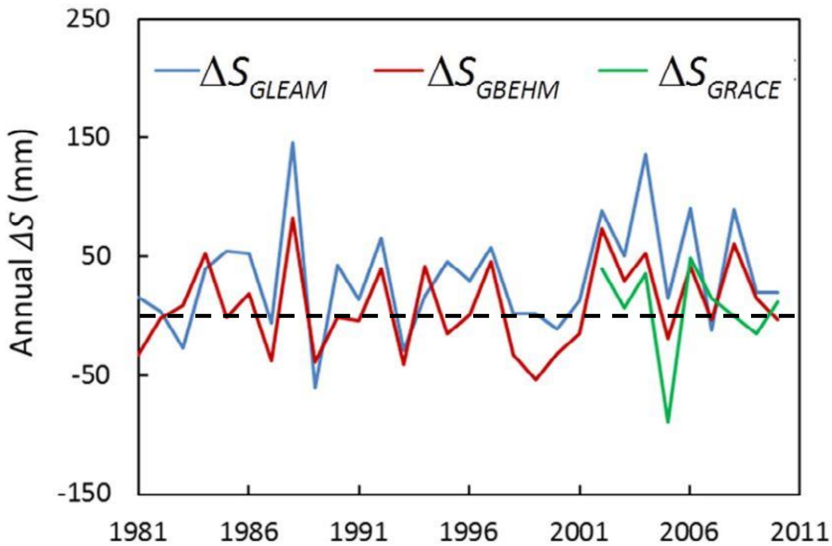

Fig. 1. Water storage change in the SRYR obtained from Wang et al.,2018