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Abstract

During warm and dry weather events, meltwater from snow and glaciers can compensate for the lack of rainfall input and high evaporative demand in hydrological systems, thereby securing water availability. Previous studies have shown that the level of streamflow compensation mainly depends on the relative glacier cover in a catchment; the higher the glacier cover, the more streamflow is compensated. However, the streamflow responses to warm and dry (WD) events were also found to be highly variable, between the different summer months and between different years. Understanding this variability is important to assess when glaciers can compensate for a lack of rainfall-runoff and how this process is changing over time. Here, we examine this variability in observed streamflow responses of the last decades for a set of around 20 Swiss glacierized catchments with varying glacier cover. WD events were selected based on a precipitation, temperature and duration threshold (> 7 days) and the corresponding event streamflow was compared with the long-term mean. To explain the variability in event responses, we distinguish between catchment characteristics (spatial variability) and event characteristics (temporal variability). For the catchment characteristics, we determine besides relative glacier cover also other landcover types, such as rock, sediments and vegetation, to explore how catchment storage may influence the WD event responses. To explore the temporal variability, glacier cover changes, seasonal glacier mass balance anomalies, snowline elevations and antecedent meteorological conditions are considered. For each of these variables, hypotheses are formulated, which describe the effect on the streamflow response. These hypotheses are then tested by selecting specific WD events from the total sample of events. Overall, this study aims at providing detailed insights into the conditions in which glaciers compensate streamflow during WD periods, which will be important to assess the changing buffering role of mountain water towers under glacier retreat.