



Snow and Ice melt contribution in a highly glacierized catchment of Chhota Shigri Glacier (India) over the last five decades

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Glacier-wide mass balances and runoffs are reconstructed over 1969-2016 for Chhota Shigri Glacier catchment (India) applying a glacio-hydrological model. The model is forced using in-situ daily air-temperature and precipitation records from the meteorological stations at Bhuntar city (1092 m a.s.l.), glacier base camp (3850 m a.s.l.) and glacier side moraine (4863 m a.s.l.). The modelled mean annual mass balance is -0.30 ± 0.36 m w.e. a⁻¹ (meter water equivalent year⁻¹), while the mean catchment-wide runoff is 1.56 ± 0.23 m w.e. a⁻¹ over 1969-2016. Three periods are distinguished in the reconstructed mass balance and runoff series. Periods I (1969–1985) and III (2001–2016) show glacier mass wastage at rates of -0.36 and -0.50 m w.e. a⁻¹, respectively, corresponding to catchment-wide runoffs of 1.51 and 1.65 m w.e. a⁻¹, respectively. Conversely, period II (1986–2000) exhibits steady-state conditions with average mass balances of -0.01 m w.e. a⁻¹, and corresponding runoff of 1.52 m w.e. a⁻¹. The reduced ice melt (0.20 m w.e. a⁻¹) over period II, in agreement with steady-state conditions, is compensated by the increased snow melt (1.03 m w.e. a⁻¹), providing almost similar catchment-wide runoffs for period I and II. The increased runoff after 2000 is mainly governed by increased ice melt (0.32 m w.e. a⁻¹) over period III. Snow accumulation in winter and summer seasons together control the glacier-wide mass balances as well as catchment-wide runoff. Snow melt contributes the maximum to the total mean annual runoff with 63% share while glacier melt and rain contribute 17% and 20% respectively over the whole period.