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Modelling mass changes of Dokriani (Central Himalaya) and Chhota Shigri (Western Himalaya) glaciers, India using energy balance approach

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Processes controlling the glacier wastage in the Himalaya are still poorly understood. In the present study, a surface energy-mass balance model is applied to reconstruct the long-term mass balances over 1979-2020 on two benchmark glaciers, Dokriani and Chhota Shigri, located in different climatic regimes. The model is forced with ERA5 reanalysis data and calibrated using field-observed point mass balances. The model is validated against available glacier-wide mass balances. Dokriani and Chhota Shigri glaciers show moderate wastage with a mean value of –0.28 and –0.34 m w.e. a^{-1}, respectively over 1979-2020. The mean winter and summer glacier-wide mass balances are 0.44 and –0.72 m w.e. a^{-1} for Dokriani Glacier and 0.53 and –0.85 m w.e. a^{-1} for Chhota Shigri Glacier, respectively, showing a higher mass turn over on Chhota Shigri Glacier. Net radiation flux is the major component of surface energy balance followed by sensible and latent heat fluxes on both the glaciers. The losses through sublimation is around 10% to the total ablation. Surface albedo is one of the most important drivers controlling the annual mass balance of both Dokriani and Chhota Shigri glacier. Summer mass balance (0.76, $p<0.05$) mainly controls the annual glacier-wide mass balance on Dokriani Glacier whereas the summer (0.91, $p<0.05$) and winter (0.78, $p<0.05$) mass balances together control the annual glacier-wide mass balance on Chhota Shigri Glacier.