



Individual and regional glacier and ice cap surface mass balance and runoff modeling for the Northern Hemisphere

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Mass-balance and freshwater runoff observations from land-terminating glaciers and ice caps (GIC) are limited in high-latitude regions. Here, we present winter and summer mass-balances and runoff simulations for every GIC with surface areas greater than or equal to 1 km² in the Northern Hemisphere north of 25 deg. N latitude. The model development and setup permit relatively high-resolution (1-km horizontal grid; 3-h time step) GIC estimates for 1979 through present. Using MicroMet and SnowModel in conjunction with land cover (the Randolph glacier inventory), topography, and the NASA Modern-Era Retrospective Analysis for Research and Applications (MERRA) atmospheric reanalysis data, a spatially distributed and individual GIC dataset was created. Regional GIC mass-balance and runoff variability were analyzed to highlight the spatial and temporal variability using the regional demarcations defined by the IPCC (e.g., Alaska, Arctic Canada, Greenland, Svalbard, Himalaya, Central Europe, Caucasus, etc.). All regions faced, in average, increasing GIC mass-balance loss, with individual GIC within each region showing more local mass-balance and runoff variations.