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Investigating the ability of a land surface model to simulate hydrological processes in cold and mountainous regions

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Abstract The aim of the present work is to investigate the ability of a physically-based land surface model (LSM) SWAP, which treats energy and water exchange at the land–atmosphere interface, to simulate snow and runoff formation processes in mountainous and high latitude regions. Two regions characterised by different climatic conditions were selected for this study: the French Alps and pan-Arctic river basins located in Russia. In the first case, the results of snow depth simulations by SWAP were compared with daily snow depth measured during three years at 24 mountainous sites (with the altitudes varying from 910 to 2590 m). In the second case, snow depth and river runoff simulated by SWAP for several northern river basins on a long-term basis were validated against daily observations conducted during 20–30 years. It was concluded that, in general, SWAP can capture evolution of snowpack depth and runoff hydrographs and performs fairly well statistically.

Key words land surface model SWAP; snowpack; river runoff; cold regions; parameter optimization