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Evolution of Sary-Tor Glacier, Inner Tien Shan, under climate change

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Current and future shrinking of mountain glaciation in High-mountain Asia has been in the focus of research activities during the last several decades. Rivers originating in the Inner Tien Shan in Kyrgyz Republic are highly important for several developing countries with economies and population, and, therefore, water consumption. Mountain glaciation is one of the main sources of fresh water in the region, contributing essentially to the total river run off especially in dry years.
We employ a 3-d higher-order mathematical model coupled to a surface mass balance model to reproduce evolution of Sary-Tor Glacier located in Ak-Shiyrak Massif, Inner Tien Shan under changing climatic conditions. Structure of the model and experimental set-up are described in necessary details. For calibration and validation of the model we use results of measurements in snow pits and on ablation stakes in 2014-2016. A series of ten prognostic numerical experiments of 90 model years duration was performed. As a climatic forcing, we used air temperature and precipitation records on the weather station Tien-Shan-Kumtor located in the vicinity of the glacier. In the schematic scenarios, average daily surface air temperature grows with gradients 0-4[U+F0B0] / 100 years. Present-day glacier configuration is in imbalance with the climate of 2014-2016. As a result, its area and volume proceed to decrease until equilibrium is achieved after several tens of model years. Under extreme rates of temperature increase (+4[U+F0B0] / 100 years) Sary-Tor almost diminishes by the end of experiments. Glacial run-off rapidly decreases after initial growth in the first half of the experiments. Mathematical model inevitably contains simplifications of the real natural conditions. Nevertheless, obtained results will be useful in prognostic water balance alculations in the key region for the country's water supply.