Submitted Abstract

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Abstract

Climate change in Central Asia causes degradation of mountain glaciers in the Tien Shan. Mountain glaciation is apparently the key factor of stable water supply in the hydrologic network of this arid region. Accelerated melting of glaciers in the warming climate is expected to cause additional risks for sustainable development, for regional energy and for food security. In Kyrgyzstan, meltwater comprises up to 50% of the total annual runoff and up to 70% in summer time. Meltwater is crucial not only for agriculture but also for hydropower, which in turn provides up to 90% of the state need in electricity. Further, gGlacial runoff determines to a great extent water level of Issyk-Kul lake.

Solar radiation is the most important factor determining the heat balance of the mountain glaciers. Therefore, accurate calculation of radiation is a key factor in surface mass balance modelling. Theoretical values of the direct solar radiation falling on the surface of any spatial orientation on the condition of absence of the atmosphere can be unequivocally calculated using trigonometric formulae. Shading effect from surrounding relief can be evaluated rather accurately. Nevertheless, to obtain correct results, one must consider several additional contributors: – atmospheric transmissivity, diffuse radiation and cloudiness.

The existing algorithms for long-wave radiation parameteriszation were developed mainly for flat areas and in many cases do not take into account various topographic effects. The influence of the latter on the thermal regime is more complicated than the influence of shortwave radiation: it includes relationships between temperature and emissivity, temperature in shaded areas, etc. It was shown that the sides of the valley, reflecting the emitted long-wave radiation, reduce the balance of long-wave energy in the valley by about 50% compared to the crest. The added energy at the glacier surface at the valley floor is equivalent to about 0.5 m[LVT1] of melt water when integrated over the entire snowmelt season.

In our study, we examine existing approaches and parameteriszation schemes for short- and longwave radiation fluxes and apply them for the Inner Tien Shan glaciation. A comparison of modelling results with the radiation observations ofn the automatic weather stations installed on several glaciers allowed to reveal best parameteriszation schemes for prognostic calculations of the radiation regime.

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[LVT1]w.e. or i.e.?