EGU22-8893
https://doi.org/10.5194/egusphere-egu22-8893
EGU General Assembly 2022

Evaluating uncertainties in modelled surface mass balance components of a mountain glacier

Oleg Rybak[1,2,3] and Elena Rybak[2]
[1]Water Problems Institute of RAS, Laboratory of Global Hydrology, Moscow, Russian Federation (oleg.rybak@vub.be)
[2]FRC SSC RAS, Sochi, Russia
[3]Earth System Science and Department of Geography, Vrije Universiteit Brussel, Brussels, Belgium

The purpose of the research is to assess the influence of the random weather fluctuations on the estimates of the model-based surface mass balance (SMB) components of the mountain glacier. The common approach in the modeling studies is to use meteorological records (measured or modelled) – surface air temperature and precipitation rate – as weather forcing in numerical experiments. The results of the calculations are normally very sensitive to the parameter choice and the model should be carefully calibrated against measured SMB to obtain correct results. What is usually ignored within the frameworks of this approach is that forcing records at e.g. daily resolution contain internal weather variability which after being integrated by the model can yield in a random walk type trend of SMB.

To evaluate uncertainty in SMB calculations we force an energy balance model of Djankuat glacier in the Central Caucasus with surrogate series of surface air temperature and precipitation rate. The surrogate series of several model decades duration each are produced by a stochastic weather generator WGEN basing on the observed meteorological series at the weather stations located nearby. In WGEN, precipitation events are simulated by a first-order Markov chain, and the intensity of precipitation is represented using independent gamma distribution. Air temperature is calculated by fitting the appropriate distributions and harmonic functions separately for wet and dry days. Seasonality is reproduced by an estimate of individual sets of model parameters for different periods of the year.

Statistical analysis of the generated ensemble of SMB components revealed that relative standard deviation (RSD) of SMB components (accumulation rate, melting, evaporation, melt water retention) vary within the limits 3-6%, but RSD of the specific mass balance is several times higher.

Our approach enables to filter out reaction of the modeled glaciers induced by the weather noise from systematic reply on climate change.

The reported study was funded by the RFBR and RS grant 21-55-10003.