Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09575, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09575
EGU General Assembly 2008

Climate and runoff modelling in the Caucasus mountains

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To quantify recent and future regional climate, the PRECIS modelling system based on HadRM3 regional climate model developed by the UK MetOffice was employed in the Caucasus mountains. PRECIS has a 25 km horizontal resolution and uses a fractional grid cover which allows to incorporate glacier ice as a surface class. Three integrations were externally forced to produce regional baseline climate (1961-1990) and future climate (2071-2100) projections for A2 and B2 emission scenarios. The model outputs have been validated against observations from individual weather stations, where the performance is good with regard to air temperature. For the central region of the Greater Caucasus, the highest domain bias of +22% occurred in July-August with much lower errors in all other months. More significant errors characterise the precipitation output, with winter means being overestimated and summer values being underestimated by the model.

A daily timestep runoff model (HBV-ETH) was used to simulate the water balance of Baksan river basin (Mt. Elbrus region) for the current climate and for future conditions. The model uses a temperature divider to distinguish rain from snow and a temperature index approach with a seasonable variable degree day factor for the calculation of melt. Slope and aspect as well as albedo differences between snow and ice are also taken into account by freely optimised melt parameters. Model calibration

was conducted in years with observational data by comparing measured and simulated runoff. An additional quality check was performed by comparing measured glacier mass balance of Djankuat glacier with simulated values. Model validation yielded fairly good results, indicated by Nash-Sutcliffe criterions of model efficiency around 0.8. Future scenarios for the 2071-2100 period are based on the output of the PRECIS modelling system and on assumed steps of deglaciation. A severe loss of glaciated area by the end of this century will go along with an unfavourable redistribution of seasonal water resources, resulting in spring floods and summer droughts that will affect high- and lowland population.