Geophysical Research Abstracts,
Vol. 11, EGU2009-6590, 2009
EGU General Assembly 2009

Impact of the snow cover estimation method on the Snowmelt Runoff Model performance in the moroccan High Atlas Mountains

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In the centre of Morocco, the High-Atlas range represents the most important water storage for the neighbouring arid plains through liquid but also solid precipitation. Snow in this mountain may represent an important source of water for downstream populations especially in spring and early summer. Therefore, monitoring efficiently the evolution of snow cover and snow depth is essential to properly managing the water resources of this region. In this context, five main tributary watersheds of the High-Atlas range were selected to evaluate the performance of the Snowmelt Runoff Modelling model using snow maps obtained from the SPOT-VGT satellite as input data. Before identifying the optimal parameters of the model in a systematic calibration procedure, a parameter sensitivity analysis and an investigation of the eventual equifinality problems are discussed. Calibration is performed in 2005 during the main snowfall/snowmelt season (from January 1 to May 31) and validation is carried out for the same season between 2002 and 2005. In order to quantify the added-value of remotely sensed snow cover extent, streamflow is simulated using SRM together with two Snow Cover Area (SCA) estimates: SCA estimated from remote sensing data, and SCA generated from scarce meteorological data, using a simple degree day method. Snow depletion curves developed from both methods were generally comparable in all watersheds, and satisfactory streamflow simulations were obtained at annual timescales using both snow-cover products. However, using snow cover information derived from remote sensing data can significantly improve streamflow prediction for individual interstorm periods were rainfall events are not observed by the network raingauges mostly located in the lower altitude, or when the temperature lapse rate is badly estimated. Finally, it was shown from the calibrated SRM model that roughly 25 % of streamflow arriving from the North sides of High Atlas is derived from snowmelt. In order to improve the long term predictive capacity of the model (e.g. for climate-change scenarios), SCA computation based on the degree-day method is developed on two research axis: first, since a large part of snow ablation is due to sublimation, around 20 to 30% according to energy balance models, current work is addressing snowmelt/sublimation partition in a simple modelling framework; second, time-series of LANDSAT_TM thermal images are used to interpolate air temperature between the few climate stations according to basic topographical features.