

Contribution of high resolution remote sensing data to the modeling of the snow cover the in Atlas Mountains

Mohamed Wassim Baba (1), Simon Gascoin(1), Lahoucine Hanich(2)

(1) CESBIO, Toulouse, France (2) Université Cadi Ayyad, Marrakech, Morocco

Snow melt from the Atlas Mountains watersheds represent an important water resource for the semi-arid, cultivated, lowlands. Due to the high incoming solar radiation and low precipitation, the spatial-temporal variability of the snowpack is expected to be strongly influenced by the topography. We explore this hypothesis using a distributed energy balance snow model (SnowModel) in the experimental watershed of the Rheraya River in Morocco (225 km²). The digital elevation model (DEM) in SnowModel is used for the computation of the gridded meteorological forcing from the automatic weather stations data. We acquired three Pléiades stereo pairs in to produce an accurate, high resolution DEM of the Rheraya watershed at 4 m posting. Then, we ran Snowmodel after resampling the input DEM at different spatial resolutions (8 m, 90 m and 500 m) to simulate the snow water equivalent (SWE) and snow depth (SD) over a snow season. The results show low differences between simulations at 90 m and 8 m. The differences are only evident in very high elevation (> 2700 m), with an absolute difference between 8m SWE and 90m SWE exceeding 25 mm we. The difference between the 8 m and 500 m simulations are much more significant, with a root mean square error between both simulated SWE of 7 mm we. We further used 15 Formosat-2 images of the Rheraya watershed that were acquired during the same snow season to retrieve the snow cover area (SCA) at 8 m resolution. From February to April, a good agreement was observed between the simulated SCA and the Formosat-2 SCA at 8 m and 90 m. Before melting season, true positive (TP) column of confusion matrix is close to 1, but it drops during melting season. Heidke Skill Score (HSS) is higher than 0.7 for the most of the time and with 0.8 as a mean. On the contrary, 500 m simulation underestimates the SCA throughout the snow season: TP score is always inferior to the one obtained at 8 m and 90 m. We finally show that both 8 m and 90 m simulations can be improved by optimizing the precipitation lapse rates using the Formosat-2 snow maps as a target optimization variable.