Geophysical Research Abstracts
Vol. 12, EGU2010-6573, 2010
EGU General Assembly 2010

Modeling Watershed-scale Distributions of Snow for Present-day and Future Climate in the Pacific Northwest, United States

Anne Nolin and Eric Sproles

Department of Geosciences, Oregon State University, Corvallis, United States (nolina@science.oregonstate.edu)

The snowmelt-dominated Cascade Mountains in the Pacific Northwest, United States provide critical water supply for agriculture, hydropower, ecosystems, and municipalities throughout the Pacific Northwest. Empirical analyses and models of projected climate change show rising temperatures in the region. This temperature trend is accompanied by a shift from snowfall to rainfall at lower elevations and earlier snowmelt. Climate change projections also suggest possible increases in winter precipitation in the region. In this study we model the spatial distribution of Snow Water Equivalent (SWE) in the McKenzie River Basin, Oregon (3200 km2). We use the physically-based SnowModel with a grid resolution of 100 m. Model inputs include meteorological data, a digital elevation model, and land cover information. We compute the ratio of SWE to total winter precipitation (SWE/PRE) for the period of 2000-2009. The model is evaluated using point-based measurements of SWE, precipitation, and temperature and spatially, using snow cover extent from the Moderate Resolution Imaging Spectroradiometer (MODIS) spaceborne sensor. SnowModel simulations are in very good agreement with measured SWE for most stations with Nash-Sutcliffe model efficiency values exceeding 0.9 in most cases. Agreement with MODIS snow covered area data show a total difference of 7.1% at the time of peak SWE with the largest difference in valley bottoms (where vegetation is dense and snow cover is difficult to view with the satellite data).

For the future climate scenarios, meteorological inputs are perturbed based upon downscaled Intergovernmental Panel on Climate Change model predictions. The temperature and precipitation forcing data for 2000-2009 were perturbed to represent projected climate changes based on a composite of nineteen IPCC climate models (scenario A1B) which has been downscaled to the Pacific Northwest region for the period 2030-2050. These perturbations were computed using the change from present-day climate to a projected future climate (delta value). The delta value was applied to the daily temperature and precipitation data using a prescribed monthly value and the model was then rerun using these perturbed values.

Our future climate simulations show substantial losses in SWE throughout the watershed, particularly at higher elevations in the watershed. There is a significant loss of snow covered area and volumetric water storage in the form of snow.