Geophysical Research Abstracts
Vol. 14, EGU2012-4948, 2012
EGU General Assembly 2012


# The impact of warming climate on late summer snow cover in northwestern Finland

S. Kivinen (1), E. Kaarlejärvi (2), K. Jylhä (3), and J. Räisänen (4)

(1) Department of Geography, University of Oulu, Oulu, Finland (sonja.kivinen@oulu.fi), (2) Department of Ecology and Environmental Science, Umeå University, Umeå, Sverige (elina.kaarlejarvi@emg.umu.se), (3) Finnish Meteorological Institute, Helsinki, Finland (kirsti.jylha@fmi.fi), (4) Department of Physics, University of Helsinki, Helsinki, Finland (jouni raisanen@helsinki.fi)

Snowbeds and snow patches are characteristic features of arctic and alpine regions and are classified as endangered habitats due to the warming climate. We studied interannual variation of late summer snow cover and the factors affecting it in sub-arctic Enontekiö Lapland, northwestern Finland in years 2000, 2004, 2006, and 2009. Snow cover at 30 m resolution was derived from Landsat TM and ETM+ images obtained between 27 July and 4 August using a normalized difference snow index (NDSI). A generalized linear model (GLM) was constructed for the number (0 – 4) of snow occurrence years in 1-km grid squares. Explanatory variables in the model were elevation, terrain ruggedness, insolation and aspect. Variation in climatic conditions in the study region was examined using temperature and precipitation data from 1995 to 2009 (Finnish Meteorological Institute) and climate scenarios derived from the ENSEMBLES and PRUDENCE simulations extending to the period of 2070-2099.

Late summer snow covered 23.0 km2 in 2000, 2.7 km2 in 2004, 1.5 km2 in 2006, and 5.0 km2 in 2009 of the 3176.5 km2 study area (mean altitude 727 m, maximum altitude 1310 m). The decline of snow cover was most prominent below 900 meters and on southern and western slopes. In year 2000, approximately a half of the snow cover was found above 900 meters (where 7% of the total study area is located) compared to circa 75% in 2004 and 2006, and 62% in 2009. Analyses at the 1-km resolution showed that in 19 % of the study squares there was late summer snow at least in one of the four years. Elevation and terrain ruggedness were the strongest explanatory variables for the number of snow occurrence year in a univariate GLM model. The GLM model including all variables explained 73% of the variation in the number of snow occurrence years.

The interannual variation in late summer snow cover reflects the climatic variation in the study region. The mean annual temperature increased on average by 0.16°C per year during 1995-2009. Warming was most noticeable in November-December (0.37°C/year) and April- May (0.33°C/year). The number of frost days and the proportion of the snow of the total precipitation amount generally decreased during the study period. A higher number of frost days and a snowfall peak in 2008 probably explain the observed slight increase in the summer snow cover in 2009. ENSEMBLES models predict the greatest warming to take place in winter, from late autumn to early spring (ca 5.5°C by 2070-2099). Snowfall is predicted to increase 7-26% in November-March and to decrease notably in April-October. Further, PRUDENCE models predict a significant decrease in the number of frost days from average of 240 in 1961-1990 to 185 in 2071-2100. These results suggest that future climatic conditions in the study area will not support the summer occurrence of snowbeds and snow patches, which leads to threat to the alpine species and communities associated with snow and moist soils.