Geophysical Research Abstracts
Vol. 14, EGU2012-5556, 2012
EGU General Assembly 2012

Modelling snow distribution and snowmelt energetics in shrub tundra

C. B. Ménard (1), R. Essery (1), and J. Pomeroy (2)

(1) University of Edinburgh, School of Geosciences, Edinburgh, United Kingdom , (2) Centre for Hydrology, University of Saskatchewan, Saskatoon, Canada

Shrubs currently cover approximately 25% of the pan-Arctic. Increasing evidence from field observations, remotely sensed data and models suggests that the recent climate warming is leading to a "greening" of the Arctic that can mainly be attributed to the densification and expansion of shrub patches at high latitude. The relationship between shrubs and snow are at the core of feedback loops affecting the biochemistry, ecology, hydrology and energy balance of the Arctic. As a consequence, there is a need to improve the representation of snow-vegetation interactions in climate models. Land surface models generally define the characteristics of different vegetation types with plant functional type-specific parameters, many of which were developed for dense and tall rather than sparse vegetation. In addition, the lack of horizontal interaction within or between model gridboxes precludes the representation of processes that are critical in sparse canopies such as the advection of heat from snow-free patches and shrubs to the snowpack or wind-borne snow transport from open to closed shrub canopies. A distributed surface energy balance model which includes three energy sources within each gridbox (snow – shrub – ground) was specifically developed to investigate the energy balance and snow distribution of shrub tundra. The model is coupled to a blowing snow model which allows snow transport between gridboxes and provides initial snow conditions. Modelled turbulent fluxes were evaluated against point latent and sensible heat flux measurements. Snow spatial variability and the snow cover fraction during the snowmelt period were evaluated against manual snow depth and swe surveys along 3 transects and georeferenced slope photographs. The model was found to be an efficient tool to calculate snowmelt energetics and snow distribution in shrub tundra environments and is now the surface energy balance model in the JULES Investigation Model, a structurally simpler version of the land surface JULES which was adapted for investigating the impact of Arctic greening on the radiation and energy balances of the region.