Geophysical Research Abstracts
Vol. 18, EGU2016-9978, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

An energy-based model accounting for snow accumulation and snowmelt in a coniferous forest and in an open area

Ondřej Matějka and Michal Jeníček

Department of Physical Geography and Geoecology, Faculty of Science, Charles University, Prague, Czech Republic (matejkaon@gmail.com)

An energy balance approach was used to simulate snow water equivalent (SWE) evolution in an open area, forest clearing and coniferous forest during winter seasons 2011/12 and 2012/13 in the Bystřice River basin (Krušné Mountains, Czech Republic). The aim was to describe the impact of vegetation on snow accumulation and snowmelt under different forest canopy structure and trees density. Hemispherical photographs were used to describe the forest canopy structure.
Energy balance model of snow accumulation and melt was set up. The snow model was adjusted to account the effects of forest canopy on driving meteorological variables. Leaf area index derived from 32 hemispherical photographs of vegetation and sky was used to implement the forest influence in the snow model. The model was evaluated using snow depth and SWE data measured at 16 localities in winter seasons from 2011 to 2013. The model was able to reproduce the SWE evolution in both winter seasons beneath the forest canopy, forest clearing and open area. The SWE maximum in forest sites was by 18% lower than in open areas and forest clearings. The portion of shortwave radiation on snowmelt rate was by 50% lower in forest areas than in open areas due to shading effect. The importance of turbulent fluxes was by 30% lower in forest sites compared to openings because of wind speed reduction up to 10% of values at corresponding open areas. Indirect estimation of interception rates was derived. Between 14 and 60% of snowfall was intercept and sublimated in the forest canopy in both winter seasons. Based on model results, the underestimation of solid precipitation (heated precipitation gauge used for measurement) at the weather station Hřebečná was revealed. The snowfall was underestimated by 40% in winter season 2011/12 and by 13% in winter season 2012/13. Although, the model formulation appeared sufficient for both analysed winter seasons, canopy effects on the longwave radiation and ground heat flux were not included. This might cause inaccuracies, especially during clear sky conditions. This suggested the direction of further improvements of the model that will be of interest in further research.

Key words:
snow accumulation, snowmelt, runoff, leaf area index, forest, energy budget, mathematical model