

## **Abstract**

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

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). The aim was to describe the impact of vegetation on snow accumulation and snowmelt under different forest canopy structure and density of trees. Hemispherical photographs were used to describe the forest canopy structure. Energy balance model of snow accumulation and melt was set up. For forest sites the snow model was altered for accounting the effects of the forest canopy on the driving meteorological variables of the snow model. Leaf area index derived from 32 hemispherical photographs of the vegetation and sky was used for forest influence implementation in the snow model. The model was evaluated using snow depth and SWE field 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 with correlations to observations ranging from 0.16 to 0.99. The SWE maximum in forest sites is by 18% lower than in open areas and forest clearings. The portion of shortwave radiation on snowmelt is by 50% lower in forest areas than in open areas due to shading effect. The importance of turbulent fluxes is by 30% lower in forest sites because of wind speed reduction up to 10% of the value at the open areas. Indirect estimation of interception rates was derived. Between 14 and 60% of snowfall is intercepted and sublimated in the forest canopy in both winter seasons. Based on model results, the underestimation of solid precipitation by the precipitation gauge at the weather station Hřebečná was revealed. The snowfall was underestimated by 40% in winter season 2011/12 and by 13% in winter 2012/13. Although the model formulation appeared sufficient for both winter seasons, canopy effects on the longwave radiation and ground heat flux were not included. This might cause inaccuracies, especially during clear sky condition. This suggested the direction of further improvements of the model that might be achieved in further research.

#### **Key words:**

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