SIMULATION OF SNOW WATER EQUIVALENT BY MATHEMATICAL MODELS OF DIFFERENT COMPLEXITY

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Snow water equivalent (SWE) is the most important hydrological characteristic of the snow cover, because it provides the information on the amount of water which can eventually contribute to river runoff during the snowmelt. Basic principles of SWE simulation were elaborated almost 50 years ago. However, new models which profit from the progress in knowledge and technological development are developed permanently. Snow accumulation is generally simulated by all the models similarly using the threshold air temperature(s) to determine the portion of precipitation falling as snow. Algorithms of snow melting can be roughly divided into three big groups. The simplest ones (index methods) are based on the relationships between snow melt and easily available meteorological variables, e.g. air temperature (the degree-day method), wind speed, etc. These models attempt to describe the complex process of snow melt by means of simpler relationships. Algorithms of the second group strive to solve the complex energy balance of the snow cover (the energy-based models). They represent the physically-based approach to snowmelt modeling, although in some details they may usually also use empirical relationships due to computational complexity or unavailability of necessary input data. Algorithms of the third group use generalized equations to describe the relationship between snow melt and meteorological characteristics. They are not used so often as the algorithms of the first two groups. Our study will provide a brief overview of the development of snow accumulation and melt modeling and compare several models of varying complexity. The degree-day approach will be represented by the combined approach of Anderson modified by Braun. The energy based approach will be represented by the UEB model, the SPONSOR model and the SNOWPACK model. Except snow water equivalents, the last two models simulate also additional snow characteristics such as snow structure. The models will be tested with data from three sites in northern Slovakia which represent different conditions of snow evolution. The first site (570 m a.s.l.) represents the conditions of the mountain valley (shallow snow cover of shorter duration). Meteorological data are measured at the site. Two other sites (1420 m a.s.l., forested; 1500 m a.s.l., open area) represent mountainous conditions (thick snow cover of long duration). Meteorological data are measured at one of the two sites. Except SWE, additional characteristics of snow cover (snow temperature, snow structure) were measured occasionally at the three sites during two contrasting winters of 2006 and 2007. Winter 2006 was cold and long also at the lower elevations, although in mountains the SWE reached just the average maximum value. Winter 2007 was mild at lower elevations, but colder than average in the mountains. The objective of the study is to compare the ability of different models to simulate the snow cover characteristics in different climatic and site conditions.