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Evaluation and Agrometeorological Application of a Snow Cover Model

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Seasonal snow cover occurrence is one of the most pronounced characteristics of the climate in Central Europe and constitutes significant portion of the annual precipitation. Most of the agricultural lands in this region are influenced by its presence and success of key cropping schemes (e.g. production of winter cereals) depends on its character and depth. Snow cover affects temperature of the adjacent air and of the soil and the energy budgets. In the same time it represents an important source of moisture for agricultural crops while in the same time it regulates soil freezing and influences soil hydraulic properties and the over-winter survival of crops but also of weeds and pests. The snow presence/absence is particularly important during periods when the minimum temperature drops below the critical thresholds for survival, which could lead to large scale losses even in case of winter hardy crops (e.g. winter wheat). Also the presence of the snow cover influences the soil water fluxes and runoff as well it reduces the soil moisture recharge or delays it by number of days.

As the snow cover data are not always readily available especially for a spatial assessment a simple but sufficiently accurate daily snow cover model originally introduced by Thornton and Running, 1988[1]was calibrated and verified across the wide range environmental conditions in the Central Europe. The model requires only daily maximum and minimum temperatures and daily precipitation sum as the inputs and

provides information about the presence/absence of snow cover, the water equivalent of the snow cover as well as the daily water fluxes. The model was tested within the agricultural areas of Central Europe at 25 Austrian stations (1948-2002) and 5 Czech stations (1961-2005) over large altitudinal gradient (151-1800 m a.s.l.). The results indicated acceptable level of model precision with less than 7-16% of days from November to April being misclassified (kappa coeficient ranged between 0.63-0.81). However in case of days with Tmin$<$ -15˚C the proportion of days with incorrect simulation of snow cover presence/absence was in most cases below 7%.

The benefit of the snow cover model inclusion into the agrometeorological applications is demonstrated on the example of STICS crop growth model results for overwintering of winter wheat in the Czech Republic during critical winter 2002/2003. The absence of the snow cover module in the STICS model have led to extremely large bias of up to 100% in the yield estimates as during this particular winter, large area of Central Europe was affected by temperature below -25˚C without the snow cover presence. The introduction of the snow cover model significantly reduced this bias to 5-15% when the same model set up was used.

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