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Modelling of the Soil Moisture and Temperature Regimes in central Europe and Central US

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The new version of a Newhall Simulation Model (NSM 3.0) was developed, tested and applied in this study in order to determine soil moisture regime and drought probability over a range of climatic and soil conditions. The NSM 3.0 is based on a newly enhanced daily water balance model and incorporates realistically modelled interactions between soil and atmosphere through a dynamical module of vegetation cover. In addition the snow cover effect on the water balance (through freezing and thawing) as well as on the soil temperatures are taken into account through incorporation of a snow cover simulator. In order to thoroughly test performance of NSM 3.0 the model was tested on several levels: i) Daily values of estimated soil moisture content in both model layers were compared in detail with the observed soil moisture on three most productive and in agricultural landscapes frequently apperaring soil types: deep grounded chernosem, sandy chernosem and fluvisoil during period 1998-2005 (Evaluation dataset was provided by lysimeters of Federal Office and Research Centre for

Agriculture in Vienna, Austria). ii) In addition the agreement of simulated soil water dynamics was compared with observations at 5 stations in the Czech Republic and 5 in Nebraska (US); iii) Soil temperature model was evaluated using soil temperature series from Doksany (1971-2000) and iv) Soil moisture regime was estimated for number of sites where soil pits were collected and compared with the expert assessment.

In the next step the NSM 3.0 was run for sample of 10 sites in the Czech Republic and Nebraska to verify the overall model response within various climate and soil conditions and compared with the outputs of preceding studies.

The spatial assessment of the soil moisture regime within the Czech Republic was carried out using 125 weather stations where 99 year-long synthetic series resembling 1961-2000 climate of daily temperature, wind, relative humidity, global solar radiation and precipitation sums were available. . In order to carry out spatial analysis, the model was run for all combinations of 125 weather stations using 400 different soil units (representing over 1600 individual soil polygons) with the help of a special software package: Marwin. The results were then interpolated into a 1x1 km grid matrix through locally weighted regression. The procedure was repeated for each type of landuse analyzed and included i) evergreen forest stand (representing forested area); ii) winter wheat crop (representing arable land) and iii) extensive permanent grassland (representing non forested and non arable land).

The NSM 3.0 was found to mimic seasonal variations of the soil moisture and soil temperature reasonably well both in Central Europe and in Nebraska. The estimated soil moisture regimes also corresponded rather well with the results of field observations and the spatial estimates were found to be qualitatively in accordance with reality. As the soil climate regimes are closely linked with key soil processes and also eventual drought impacts such as decrease of crop yields, damage to forest stands or low stream the tool of this kind has a promising potential for a climate change impact studies as well as drought risk assessments.

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