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Modeling of soil water content and soil temperature at selected U.S. and central European stations using SoilClim model

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Within the presented study the SoilClim model was tested through various climatic and soil conditions. SoilClim model enables to estimate reference and actual evapotranspiration from defined vegetation cover and consequently the soil water content within two defined layers (named as Moisture control section I and II) could be deduced. The soil temperature in 0.5 m depth is also estimated (on the basis of simple empirical model). Mentioned outputs could be additionally used for identification of soil climate regimes (both Hydric and Thermic) within selected location. The SoilClim works in daily step and needs daily maximum and minimum air temperature, global radiation, precipitation, air humidity and wind speed as input. The brief information about soil layers (field capacity, wilting point, depth) and vegetation cover is necessary. The algorithm for reference evapotranspiration is based on Penman-Monteith method.

The main aim of the study was to assess accuracy and suitability of the SoilClim for simulation of soil water content in the two defined layers and temperature in 0.50 m depth. For this purpose the seven stations through central U.S. were selected (by twos from Nebraska, Iowa and Kansas and one from South Dakota). Used measurements were observed from 2004 to 2008. The central European region was represented by Austrian Lysimetric station Gross-Enzersdorf. The data within three different soil profiles and for various crop covers (spring barley, winter wheat, maize and potato) from 1999 to 2004 were used.

During introduced reserch SoilClim provided reasonable results of soil moisture for both layers against lysimetric measurements. Agreement between measured and estimated water content (30 days averages) could be described by coefficient of determination (R^2) which varied from 0.45 to 0.75. The Mean Bias Error (MBE) for values in daily step was from -12.87 % to 20.66 % and Root Mean Square Error (RMSE) varied from 14.49 % to 34.76 %. The modeling efficiency index (MEI) was from 0 to 0.67 through the all lysimetric experiments. The estimates for U.S. stations showed higher inaccuracy during the winter months. It was caused by using automatic non heated rain gauge which distort information about time of solid precipitation. Consequently SoilClim produced some deviation in estimated snow cover occurence. On the other hand the variability and trends of soil water content during vegetation seasons were sufficiently explained by the SoilClim.

The satisfactory results were achieved within soil temperature (in 0.5 m depth) simulation within U.S. stations while R^2 varied from 0.69 to 0.93. Certain deviations were apparent within winter months due to input data from non heated rain gauge.

It was concluded that tested model gives reasonable idea about soil water content and soil temperature. The SoilClim could be successfully used for water balance analysis, drought occurrence and soil climate assessment as well.

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