Geophysical Research Abstracts
Vol. 20, EGU2018-3451, 2018
EGU General Assembly 2018

Site specific adjustments in the hydrological unit of the mathematical model: HYPE version 4.10.7

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Mathematical models are widely used to solve complicated tasks as well as to understand particular processes in natural and anthropogenic environments. Model applied has to engage with available datasets and it has to be able to calculate required results at the appropriate level of confidence. Nevertheless, the model complexity and generalization should be in balance corresponding to the targets set. The model of Hydrological Predictions for the Environment (HYPE) as an open source software (Lindström et al. 2010) has been applied in this study to simulate hydrological processes and the effects of different agricultural practices on nitrogen and phosphorus losses in the Berze River basin. The contribution of total runoff components, i.e., surface runoff, groundwater runoff and runoff through drainage pipes, is not well represented in the modelling results. The model performance could be improved by modifications in the parameters related to total runoff generation under saturated and unsaturated conditions. Therefore, analysis of the HYPE code of version 4.10.7 and suggestions for adjustments of the hydrological unit are the subjects of this study. For unsaturated soil conditions the infiltration capacity and the threshold water content are a limiting parameters for the surface runoff and macropore flow calculations. For saturated soil conditions the runoff calculations can be generalized as shown in the following equation where each variable is a subject of change according to temporal and spatial conditions. This equation is our interpretation of the model description given by Swedish meteorological and hydrological institute (SMHI, 2017):

Runoff = *rc* × *WCEP*

WCEP – water content in effective porosity, mm;

rc- recession coefficient, fraction/time step.

According to this study it is suggested to adjust the following concepts: 1) apply the effective depth of subsurface drainage pipes (Krams and Ziverts, 1993) instead of the physical depth of pipes; 2) add a slope dependency for the recession coefficient to calculate the surface runoff under saturated conditions; 3) add a slope and land use dependency for the infiltration capacity to calculate the surface runoff under unsaturated soil conditions; 4) define the depth of subsurface drainage pipes at the bottom of particular soil layer. For Latvian conditions it could be the 2^{nd} layer. Furthermore, the thickness of particular soil layer and effective porosity should be adequate to ensure sufficient amount of water for more realistic calculations of the peak flow for groundwater runoff and runoff through drainage pipes.

Acknowledgements

This work resulted from the BONUS MIRACLE project was supported by BONUS (Art 185), funded jointly by the EU and the State Education Development Agency.

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