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This study (i) presents a coupled vegetation-soil model adapted to perennial C4 seasonally flooded semi-arid grasslands; and (ii) applies the model to evaluate changes in the annual productivity of the grasslands of the Tana River Delta, Kenya, under changing flooding conditions. Main plant growth processes are modelled within coupled plant carbon balance and soil water budget modules: photosynthesis, allocation of photosynthates, respiration, translocation of root phytomass to aerial phytomass, senescence and litter production. Aerial phytomass can also be subtracted from the system, to simulate grazing or cutting. New features concern the inclusion of effects of floods on energy conversion efficiency, photosynthate allocation, senescence and litter production. The vegetation model, composed of four phytomass compartments (leaves, stems, roots, aerial dead matter), simulates three main growth phases related to flooding: floods, a post-flood phase and a non-flooded phase. It was designed to be used with limited climatic data. Data collected during a 14-month experiment (2010–2012) in the Tana River Delta, Kenya, in which different irrigation and cutting treatments and flood events were recorded, were used for calibration and validation purposes. Fourteen parameters, selected through a sensitivity analysis, were calibrated on half of these treatments. Uncertainty in parameter estimation was expressed through a stochastic ensemble of simulations. The remaining independent data were used for model validation. Overall, the model predictions are in good agreement with the experimental data. This model can be used to assess the impact of rain variability, grazing or flooding patterns on the annual primary productivity of Sub-Saharan floodplain grasslands composed mainly of *Echinochloa stagnina* (Retz) P. Beauv. In particular, simulations for the Tana River Delta suggest that past changes in the hydrological regime of the river, as well as future changes due to the construction of hydroelectric infrastructure, have led and will certainly lead to an important decrease of the floodplain grassland productivity. As local and regional livestock keeping activities rely heavily on the dry seasons' grazing resources available within the wetland, future development plans should seriously consider the negative effects of these changes on local activities and livelihoods. This presentation results from a publication in Ecological Modelling: https://doi.org/10.1016/j.ecolmodel.2018.09.015

Keywords: Echinochloa stagnina (Retz) P. Beauv., plant growth model, floodplains, Tana River Delta, Kenya.

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Modelling of drought stress in field crops by crop growth model DAISY

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The field experiment with rain-out shelters for precipitation reduction was established in Bohemian-Moravian highlands (Domanínek experimental station, 49°31’42»N, 16°14’13»E, altitude 560 m) in 2014. The purpose of this field experiment is to gather sufficient data for modelling the crop’s response to the climatic conditions expected in the future, in this case drought stress. Winter wheat and spring barley are the most widely grown cereals in the Czech Republic. The main aim of this study was evaluate a drought stress effect on winter wheat (cultivar Bohemia) and spring barley (cultivar Bojos). At the same time the ability of crop model DAISY to simulate drought stress response was tested. The monitored parameters were development, grain yield and soil moisture on two growth seasons (2017/2018 and 2018/2019) for two experimental variants with three repetitions in each crops (the first variant = natural climatic conditions; the second variant = drought stress is induced using the mobile rain-out shelters made of corrugated clear polycarbonate material and installed in the crop canopy). In each variant were sensors TDR (time domain reflectometry, CS 616, Campbell Scientifi c Inc., Shepshed, UK) to measure the soil water content placed vertically to monitor the soil water content from the surface to a depth of 30 cm. Observed and measured parameters such as terms of phenological phases, soil moisture and grain yields were compared with modelled data. The simulation results with respect to the phenological phase of flowering/maturity showed a slight deviation from the observations, from +3/-1 to -3/+1 days for winter wheat and -6/-2 to +5/+1 days for spring barley. The precipitation was reduced during the growth season. A reduction of precipitation by 138,2 mm and 203,8 mm for winter wheat 2018 and 2019 and a reduction of precipitation by 87,6 mm and 102,2 mm for spring barley 2018 and 2019, led to decrease in grain yields. Grain yield for winter wheat/spring barley decreased from 7.43 /4.97 t/ha (natural climatic conditions) to 4.19/3.70 t/ha (drought stress was induced using the rain-out shelters) in 2018 and from 6.72/6.12 t/ha to 4.99/4.44 t/ha in 2019. The results of this study showed that the crop model DAISY relatively satisfactorily simulates the main feature soil water content dynamics as measured by TRD sensors in 2018 and 2019 and reproduce the drought stress for crop yields of winter wheat and spring barley to a certain extent. The crop model DAISY simulated the movement of soil water based on the numerical solution of Richards‘ equation. The decrease in the simulated grain yield after precipitation reduction is obvious. The simulation results for winter wheat/spring barley grain yield in natural climatic conditions were 8.04/3.98 t / ha in 2018 and 8.01/6.12 t/ha in 2019. The simulation results for winter wheat/spring barley grain yield in drought stress were 4.42/2.54 t/ha in 2018 and 4.40/4.20 t/ha in 2019. When rain-out shelters were used, real winter wheat/spring barley grain yields were reduced by 3.24/1.27 t/ha in 2018 and by 1.73/1.68 t/ha in 2019. The model underestimated the yields of winter wheat/spring barley for the sheltered variant by 3.62/1.44 t/ha in 2018 and by 3.61/1.92 t/ha in 2019. The study and contribution was funded through SustES - Adaptation strategies for sustainable ecosystem services and food security under adverse environmental conditions“ project no. CZ.02.1.01/0.0/0.0/16_019/0000797.

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