Evaluation of riparian forest water supply with groundwater monitoring and numerical modelling

Gribovszki Zoltán¹, Cseke Csaba¹, Csáki Péter¹, Horváth László², Kalicz Péter³, Nagy László³, Szőke Előd³, Zaggyváine Kiss Katalin¹

¹ University of Sopron, 9400 Sopron, Bajcsy-Zs. u. 4., Hungary (E-mail: elod0324@gmail.com)
² National Agricultural Research and Innovation Centre, Forest Research Institute, H-9000 Szécsény, Vákruterút 30/a
³ KASZÓ Forestry Stock Company, H-7564 Kaszó, Kaszópuszta 1., Hungary

INTRODUCTION

Riparian zone forests (as a special type of agro-forestry systems) are very vulnerable in changing climate because they strongly depend on additional water. The effect of an artificial water supply (new lakes and bottom thresholds) was evaluated in Kaszó Forest (South West Hungary). An eco-hydrological monitoring (with groundwater well settling) was conducted on 14 regular (under the effect of water supply interventions) and 4 control plots (Fig. 1).

NUMERICAL MODELLING

1-D Hydrus model (using complex field monitoring data) was calibrated for an elder and two common oak forest plots (7., 8. and 9. on Fig. 1.). Diurnal signal of groundwater levels was used for evapotranspiration (ET) estimation in the model (Fig. 4.). Model results showed that groundwater uptake of forest vegetation was significantly increased (30%) regarding water supply interventions.

HYDRUS 1-D SETUP:

Upper boundary conditions (atmospheric constrains)
- precipitation (P) reduced by interception (INT)
- potential transpiration (PT) = potential ET (PET) reduced by interception (INT)

Lower boundary conditions:
- variable pressure head
- Initial condition: pressure head -80 (0.0 m), +320 (4.0 m deep)
- Vertical root distribution: to 1.2 m depth, uniform

Between 380-392 cm a silty clay layer for dampening the effect of bottom pressure head

Soil profile:
- sandy loam
- sandy loam
- sand
- silty clay

MODELLING FRAMEWORK:
- meteorological data (2014-2018)
- soil informations (layering and texture)
- PET calibration by ETgw (Fig. 4.)

GROUNDWATER MONITORING EVALUATION

The impact of water supply interventions was interpreted using spatio-temporal groundwater level difference analysis (Fig. 2.) and found that lake settling and renewal had positive impact on the riparian zone water table (40-50 cm rise in the neighbourhood of new lakes) while the effects of bottom thresholds are hardly detectable (Fig. 3.).

Figure 1. Research area

Figure 2. Principle of treatment-control space and time deviation analysis

Figure 3. Water-table change related to control

Figure 4. PET calibration using ETgw data for representative dry periods

Acknowledgements: The research was supported by EFOP-3.6.2-16-2017-00018 in University of Sopron project.
https://doi.org/10.5194/egusphere-egu2020-13934