XXXVIII IAH Congress

Groundwater Quality Sustainability

Krakow, 12–17 September 2010

Extended Abstracts

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University
of Silesia
Press 2010

abstract id: **511**

topic: **1**
Groundwater quality sustainability

1.6
Groundwater monitoring

title: **Monitoring of the impact of agriculture on groundwater in Latvia**

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keywords: groundwater, monitoring, agriculture

ABSTRACT

The objective of the study is to investigate the overall status of groundwater table fluctuations and quality to evaluate possibility to use groundwater monitoring results for evaluation of the efficiency of good agricultural practice.

Groundwater monitoring is a part of state water monitoring program in Latvia. For agriculture, the risk is related to leaching of nutrients and pollutants to the shallow groundwater. Groundwater regime and balance plays significant rule in agricultural lands as part of water cycle and surface and subsurface interaction.

INTRODUCTION

Groundwater resources, especially shallow ones are sensitive to contamination and other anthropogenic factors. Most intensive farming is developed in Zemgale region where area of agricultural land reached up to 80% of total land use.

Fluctuations of groundwater level in an unconfined aquifer in agricultural land depend on many factors: subsurface drainage, physical and chemical soil properties, soil water balance, slopes and, infiltration and percolation processes. At present groundwater monitoring (quantity and quality) in agricultural land has been carried out by Latvian Environment, Geology and Meteorology Centre (LEGMC) and Latvia University of Agriculture (LUA). LUA have three monitoring stations, which are located in different types of soil and intensity of farming. Monitoring of groundwater level in Latvia at three agricultural run-off monitoring stations in 10 observation wells started in year 2006.

GROUNDWATER LEVEL MODELLING

Conceptual groundwater level model METUL by Krams and Ziverts (1993) was calibrated using measurements of the daily groundwater level fluctuations for the period 2006–2009. This model is site oriented two-dimensional mathematical model based on daily weather data (temperature, precipitation, and relative humidity).

Water balance for model calibration is from three parts: estimation of snow cover, estimation of active soil zone of moisture balance and estimation of groundwater balance together with capillary fringe. Necessary parameters in each part for groundwater balance calculations are required. For snow cover estimation parameters are air temperature of daily average below which snow accumulation begins, air temperature of daily average above which snow ablation begins, evaporation coefficient from snow and two empirical coefficients, which characterize the intensity of the snowmelt and the water contribution from the snow.

For active soil zone moisture balance estimation parameters are water storage of the active soil zone at the beginning and the end of the day (mm), rain and snow melt water (mm/day), evaporation from active soil zone (mm/day), evaporation from groundwater surface (mm/day).

For groundwater and capillary water zone parameters are capacity of empty ground pores at the beginning and the end of the day (mm), recharge of groundwater (mm/day), evaporation from groundwater surface (mm/day), three runoff components: surface, drainage, groundwater (mm/day) (Krams and Ziverts, 1993).

GROUNDWATER QUALITY

The groundwater quality in the agricultural run-off monitoring stations has been measured during 2006 – 2009. In the climatic conditions of Latvia the pollutant threshold values for groundwater bodies (50 mg l^{-1} of nitrate) was not observed today. Observed data shows water quality in three parts of soil profile: small catchment area (surface water bodies) drainage field and groundwater aquifer level (Figure 1). One of the important future tasks is to organize comprehensive national groundwater monitoring network covering both confined and unconfined aquifers.

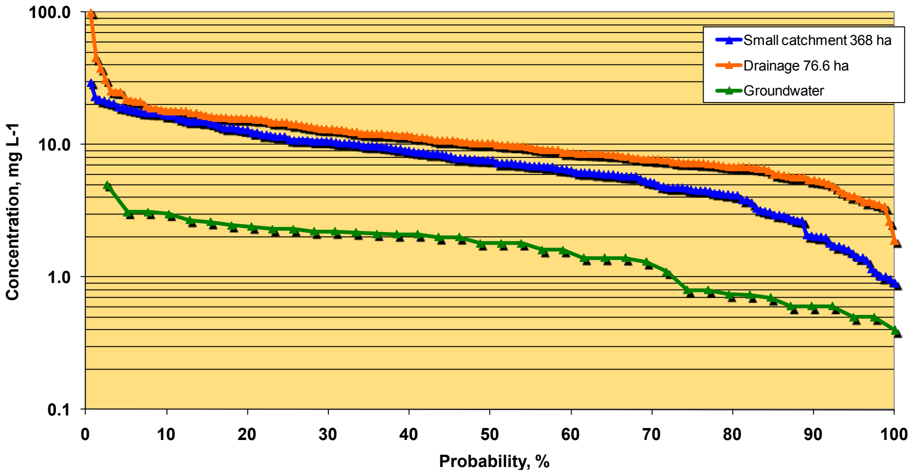

Figure 1. Cumulative probability distribution for Ntot concentration in monitoring station Berze.

DISCUSSION

In each territory, groundwater development conditions are different and depended on following regularities: soil type, geological structure of ground layers, hydrophysical conditions etc. All mentioned parameters for groundwater level modelling are taking into account. Observed data are required to transform as model recognize them and all parameters must known before modelling.

However, the impact on the groundwater watertable in Latvia mostly depends on precipitation amount. Characteristic seasonal fluctuations in groundwater level in mentioned monitoring stations from 2006 – 2009 were observed (Figure 2). High groundwater level in autumn, spring and lowering of the groundwater levels in summer time is typical for soils in Latvia.

Modeling results shows correlation between modeled and observed data. To be able to compare mentioned data curves use determination coefficient R^2. The coefficient of determination, R^2, is useful because gives the proportion of the fluctuation of one variable that is predictable from the other variable (Steel and Torrie, 1960). Three and two year period is not enough for determination of hydrological processes but it is sufficient for trend analyses in mentioned monitoring stations and prediction of future purposes. Further research will be based on groundwater modeling results from three monitoring stations (case study area). Groundwater level simulations using METUL for prediction of groundwater levels in future are expecting. All determine parameters and compliances will be applied to another territory and soil type in future. If soil type or hydrogeological conditions are different necessary to take into account new parameters.

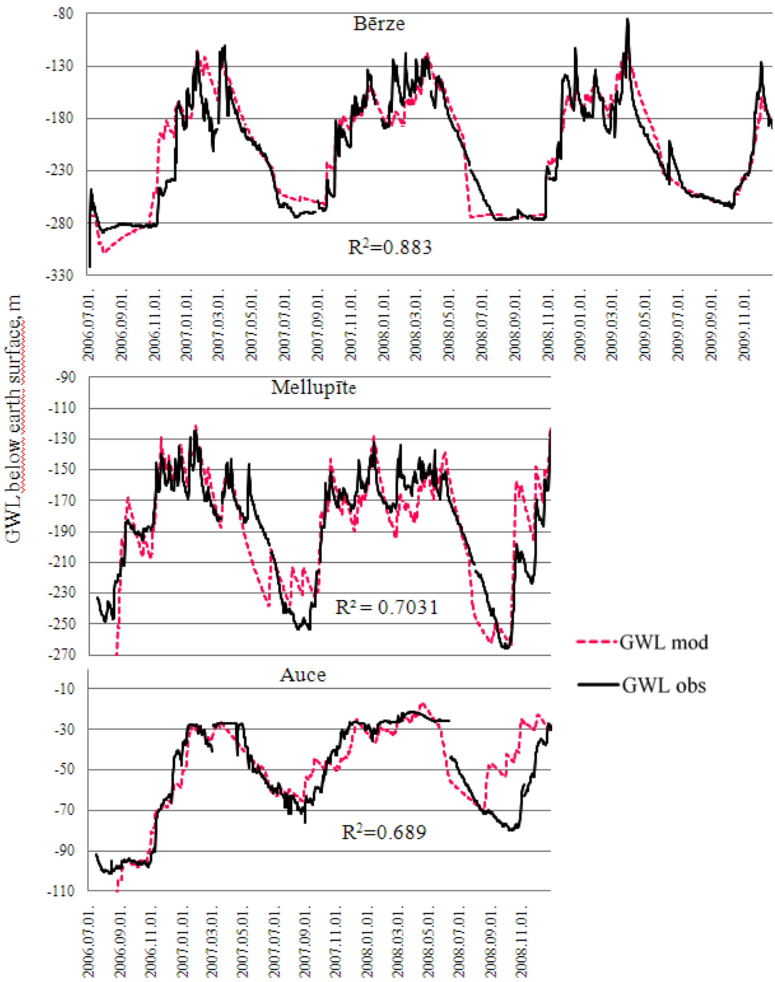

Figure 2. Observed and modeled groundwater level fluctuations 2006 – 2009 in LUA monitoring stations.

CONCLUSIONS

Determination of soil properties and meteorological conditions are the key purpose for groundwater level simulations based on METUL model. A result shows good determination correlation between observed and modeled data in Berze and Mellupite stations (Figure 2). In Auce monitoring station compliance between observed and modelled data are lower. For best compliance in Auce monitoring station are necessary to reconsider used parameters and add new ones depending on hydrogeological, hydrological and soil type conditions in mentioned area. Introduce in groundwater model METUL new calibrated parameters depending on groundwater aquifer conditions. Risk for groundwater quality conditions in mentioned monitoring sites are depending mostly on drainage water contamination. Drainage runoffs in agricultural areas are contaminated by biogenic elements from agricultural production.

ACKNOWLEDGEMENTS

This work has been supported by the European Social Fund within the project „Establishment of interdisciplinary scientist group and modelling system for groundwater research".

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International Association of Hydrogeologists

AGH University of Science and Technology

2-vol. set + CD
ISSN 0208-6336
ISBN 978-83-226-1979-0