Available soil water content calculation of watershed in drought impacted areas

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Summary

Globally due to climate change, droughts have a severe impact on the availability and quality of water, agricultural and energy production, and the health of the ecosystem. In many regions of Europe (inter alia in Hungary in Central Eastern Europe) agricultural production has been affected by droughts over the past decades. It is possible to define droughts in terms of meteorological, hydrological, agricultural, and socio-economic conditions. The effects of drought are dependent on both the physical nature of the hazard, and society's ability to manage the associated risks. Droughts have often been dealt with in a reactive manner rather than by applying a pre-emptive management approach that allows the effective use of all available information. Global Water Partnership (GWP) Central and Eastern Europe (CEE) want to initiate countries into and support them in the development of an early warning system, which consists of monitoring and prediction and national drought combating policies.

In order to use risk assessment – in which prevention of drought is emphasized - available water content calculation of watershed in drought impacted areas should be prepared. However, the soil maps can only be used for hydrologic calculations indirectly, such as for the forecast of damage caused by the drought. This is due to the fact that these maps are two-dimensional and represent point samples. Furthermore, in the soil maps of Central European countries, special taxonomical nomenclature is used (mostly based on the Russian school). This is an important limiting factor in building trans-border soil maps, which can describe soil water regime to analyse agricultural drought risk.

The aim of this study was to create a trans-border database with high-resolution and unified nomenclature, which provides information about the transpiration of plants and the amount of soil moisture content in root zones. Another goal of our study was to create a calculation map for the watershed of the river Tisza. To summarize our research, this paper describes a high-resolution, trans - border database which takes into account the most important water regime properties of soils and it can be uniformly used in different countries of the Tisza river watershed.

Material and Methods

Soil database

(soil water content in 2m layer depth of soil can be estimated in different horizons and soil types)

Digital soil maps of different counties in Tisza river watershed were adjusted to WRB (World Reference Base for Soil)

Calculation mapping was worked out for the total area of Tisza river watershed

Soil classifications are based on soil genesis and geography, we described our main soil types with the WRB2006 reference soil groups' names.

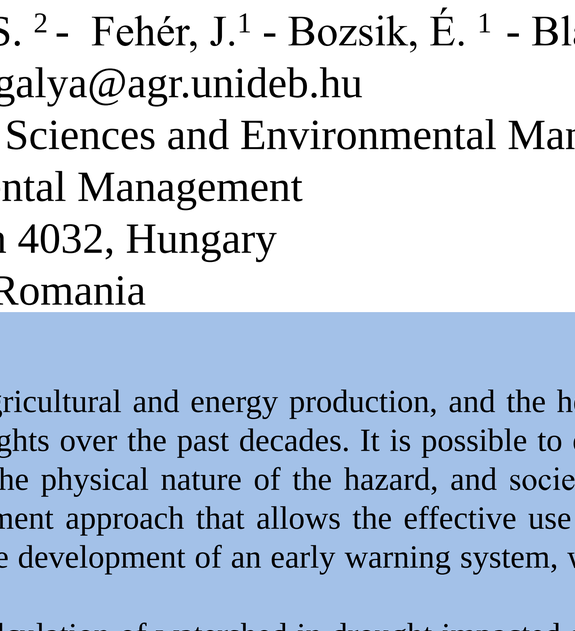
After allocations the soil layer, physical limit values of soils were estimated by using pedotransfer functions

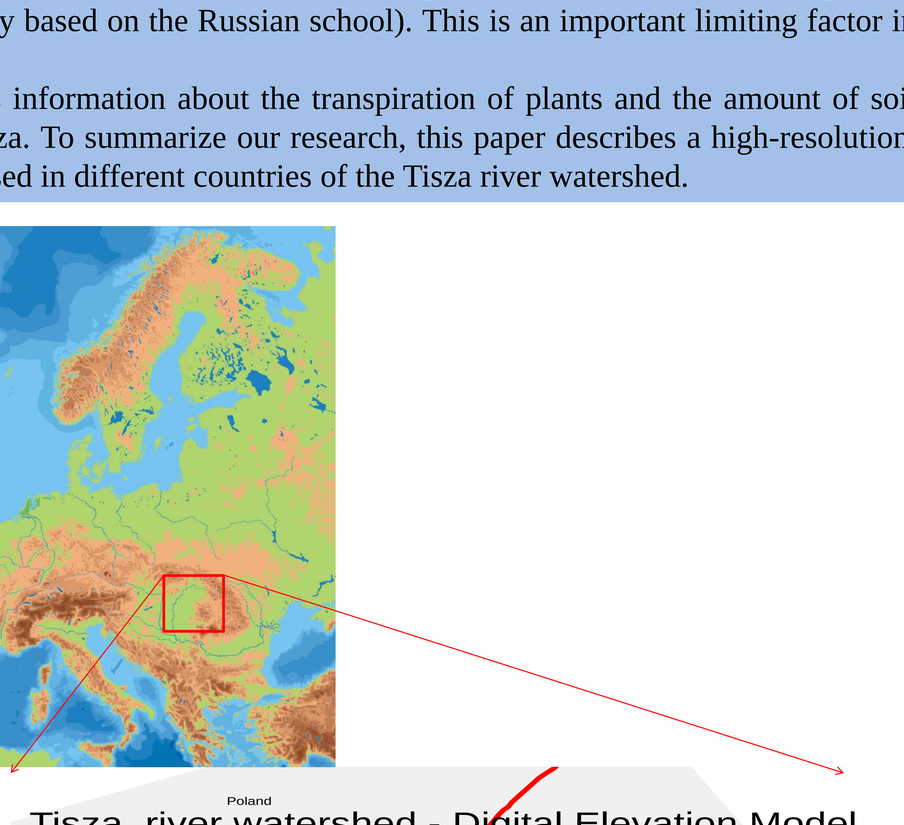
Water storage capacity and available water content were determined by the depth of the impermeable layer

Spatial queries are carried out in the Tisza river watershed

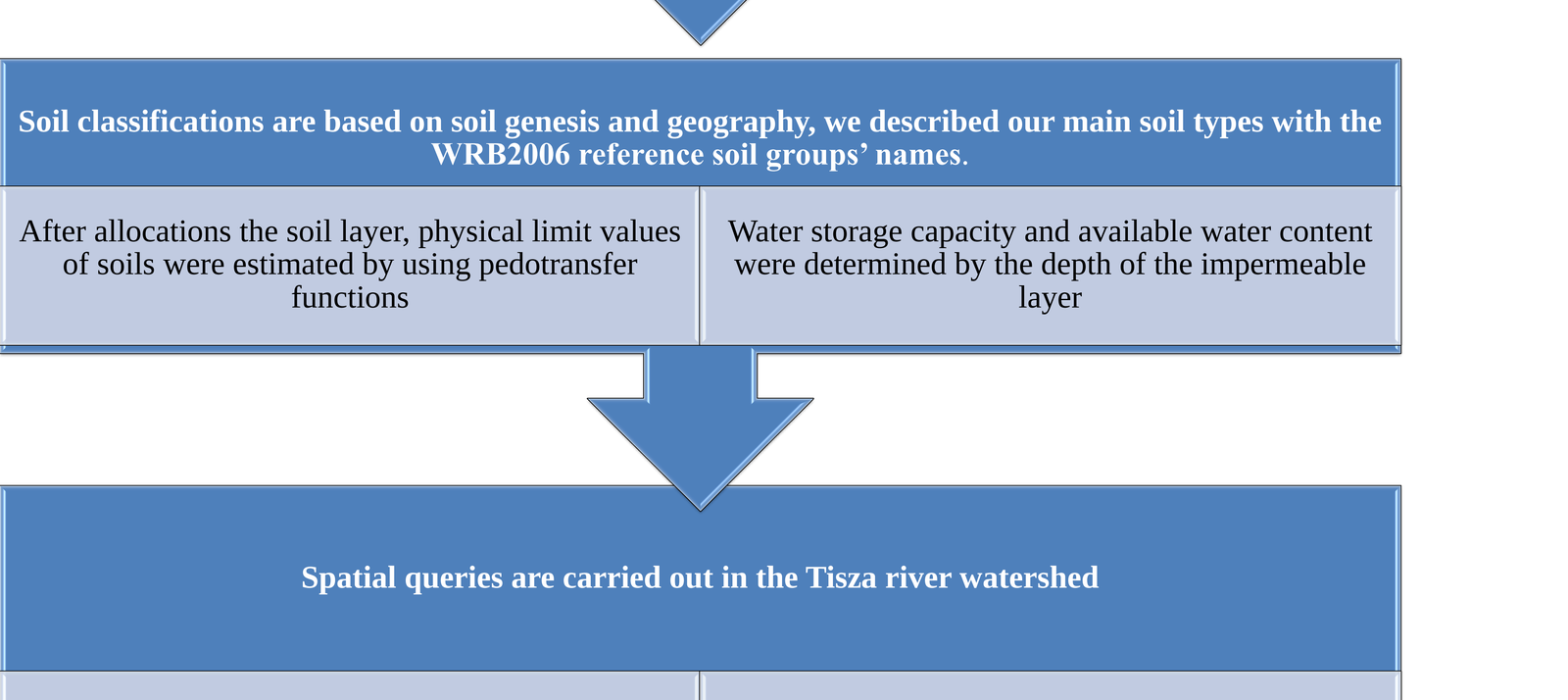
The cartographical characterizations and colour keys are added to these queries.

These data were fitted in a geographic information system





Results and discussion



Available soil water content in 2 m depth soil layer

The data clearly showed that the impact of drought were more severe in extreme water management soils (for example sandy soils which have low water capacity, extreme heat management; and clay, heavy clay soils which have low available water content and high swelling - shrinking capacity). However loamy soils (with good water management) have available water content for plants in case of moderate severity of meteorological drought, which can buffer the yield loss due to the drought.

Our calculations can not take into account local differences caused by flash floods, permanent water cover, high salt content and stagnant groundwater or nearly impermeable clay layers. In case of large-scale long-term droughts, local differences decreased the reliability of the calculations to a lesser degree. However, with further methodological development, the effect of these local differences can be reduced.

Finally, this paper describes a high-resolution, trans - border database which takes into account the most important water regime properties of soils and it can be uniformly used in different countries of the Tisza river watershed.

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