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Relationship between drought severity and observed regional yields in the Czech Republic

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Although the Czech Republic is not generally characterized as a drought prone region within European context, drought occurs and is one of the most important climatic extremes in terms of economic damages. Crop production is highly sensitive to soil water availability and the rainfed agriculture almost dominantly prevails in the Czech Republic. Generally we can observe trends towards drier conditions with more often and more severe drought episodes. Based on this, the impact analyzes are very important.
The relationship between drought episodes (with various timing and severity) and observed decrease of yields at district level (NUTS4) during the period from 2000 to 2014 was analyzed within submitted study. The observed yields of spring barley, winter wheat and oilseed winter rape from 14 districts were used (210 seasons are included). All districts are positioned within southeastern part of the Czech Republic and represent various agro-climatic conditions. The regressions between various drought indicators (as independent variables) and yields (dependent variable) were established. For this purpose the several drought indicators in monthly time step were derived as spatial average for arable land (each district separately). The difference between precipitation and reference evapotranspiration (ET0), average soil moisture content available for crops up to 40 cm and 100 cm depth, percent of time with soil moisture below 50 % and below 30 % of available soil moisture up to 100 cm depth were used. For reference evapotranspiration (ET0) and soil water estimates SoilClim model was used. This software is the main module used within Drought monitoring system in the Czech Republic (www.intersucho.cz). Within this study SoilClim was used in resolution 500 x 500 meters within grids of arable land. The soil water holding capacity as well as vegetation development was considered. By this way the yield losses due to various drought intensity was identified and compared. In case of extremely dry years (e.g. 2000, 2012, ...) yields declines (often devastating) were mostly explained by water balance. Moreover the differences among regions were analyzed in high detail. Based on achieved results could be concluded that SoilClim software is proper tool for quantification of drought impact within yields. The difference between precipitation and ET0 (from April to June) was identified as reasonably robust indicator but also soil water holding capacity consideration is very important.
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