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Relationship between Agricultural Drought and Yields of Selected Crops at Regional Scale within the Czech Republic

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The main objective of submitted study was to assess whether an occurrence of a seasonal agricultural drought has any quantifiable influence over the production of selected crops which included spring barley, winter wheat, maize, potato, winter rape, oats, rye and hay from permanent meadows. Analysis was carried out in 77 districts of the Czech Republic (mean district area $\sim$ 1000 km^2) for the period from 1961 to 2000. In each crop specific analysis only districts with sowing area higher than 0.5% of total national acreage within at least 2/3 of evaluated years were considered. Based on the previous research and results of other authors we selected the Palmer's Z-index as the most appropriate indicator of agricultural drought. The Z-index is derived using a soil moisture/water balance algorithm that requires a time series of monthly air temperature and precipitation data and information on the maximum soil water holding capacity (MSWHC) in the rooting zone. The Z-index is a measure of the monthly moisture anomaly and reflects the departure of moisture conditions in a particular

month from normal (or climatically appropriate) moisture conditions and it could be used on monthly or seasonal basis. For each month the value of the Z-index was interpolated based on the network of 233 weather station (i.e. 1 station per 340 km^2) for the whole territory of the Czech Republic using a co-krigging interpolation technique (with altitude and MSWHC as additional co-variables). The monthly value of the Z-index for each individual district was then calculated as the spatial average (only for the grids of arable land). Data analysis proved that severe droughts (e.g. in 1981 and 2000) could be linked with significant reduction of yields of main cereals and most of other crops through the most drought prone regions. The study also shows that yields of spring barley (and spring crops in general) are more dependent on water stress than yields of winter wheat or perennials. We found a statistically significant correlation (at α= 0.05) between the Z-index value (summed from April to June) and the spring crop yield departures within majority of evaluated districts (over 80%). The results also indicated that severe drought spell during April-June do have quantifiable negative effect and clear pattern even within more humid regions. The presented results clearly demonstrate that, at least in some areas of the CR (and probably most of Central Europe), drought remains an important factor and that some form of continuous monitoring of this hydrometeorological extreme should be introduced. The large database and wide range of crops that was investigated also enabled us to develop critical thresholds below which negative drought impacts on the district/national yields are inevitable.

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