Relationship between agricultural drought and yields of selected crops at regional scale within the Czech Republic

Hlavinka P., Trnka M., Dubrovský M., Semerádová D., Žalud Z., Rischbeck P.

(1) Institute for Agrosystems and Biclimatology, Mendel University of Agriculture and Forestry Brno, Czech Republic, phlavinka@centrum.cz
(2) Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic
(3) Institute of Meteorology of the Department of Water, Atmosphere and Environment, University of Natural Resources and Applied Life Sciences (BOKU) Vienna, Austria

Introduction:

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 (spring barley, winter wheat, maize, potato, winter rape, oats, rye and hay from permanent meadows). Analysis was carried out in selected districts of Czech Republic (CR) for the period from 1961 to 2000. The criterion for district selection was sowing area (or acreage of meadows), which had to be significant on national scale (sowing area higher than 0.5% of total national acreage within at least 2/3 of evaluated years). Based on previous research and results (e.g. Quiring et al., 2003 or Trnka et al., 2007) we selected the Palmer’s ZCindex (Palmer, 1965) as the most appropriate indicator of agricultural drought. This Z-index is derived using a soil moisture/water balance algorithm that requires air temperature and precipitation data and information about the maximum soil water holding capacity (MSWHC) in the rooting zone (Figure 1). 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) conditions.

The climatological characteristics of individual regions of CR is partly apparent from Figure 2, which shows average difference between yearly sums of precipitation and reference evapotranspiration estimated by Penman-Monteith method (Allen et al., 1998).

Results:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Spring barley</th>
<th>Winter wheat</th>
<th>Maize</th>
<th>Rape</th>
<th>Aye</th>
<th>Oat</th>
<th>Potato</th>
<th>Hay</th>
</tr>
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<tbody>
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<td>Figure 1</td>
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<td>Figure 2</td>
<td>Mean yield departure of selected crop during the period 1961-2000 in analysed districts.</td>
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<td>Figure 4</td>
<td>The maps with spatial distribution of districts in which yield departures are statistically significantly correlated with the ZC index values.</td>
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Conclusions:

Submitted study proved that:

- in large areas of the Czech Republic (and also probably of Central Europe) drought is an important factor not only during extreme years
- 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,
- yields of spring barley (and spring crops in general) are more dependent on water stress than yields of winter wheat or perenneals,
- 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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REFERENCES:


