Recent Trends in Agroclimatic Characteristics and Consequences for Adaptation Options in Cereal Production – *Adaption in Agriculture, but to what?*

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The studies on anthropogenic climate change performed in the last decade over Europe indicate consistent increases in projected temperature and different patterns of precipitation with widespread increases in Northern Europe and rather small decreases over Central Europe. These changes in climate patterns are expected to greatly affect all components of the European agricultural ecosystems (e.g. crop suitability, yield and production, livestock, etc.).

The development in national grain yields for wheat in the period 1961 to 2006 for countries in Europe shows that yields in Northern Europe are limited by cold temperatures, whereas relationship between yields and weather conditions in Central Europe is more complex being affected by both high or low temperatures and/or rainfall. Yields increased considerably during the period 1970 to 1990 in all countries with the highest absolute increases in Western and Central Europe. The yield increases have
levelled off considerably during the past 10-20 years. There is in recent years a tendency in many countries to lower yields and increased yield variability that could not be explained by socio-economic changes alone.

The presented study tries to validate reliability of warming and drying trends and their relationship to winter wheat, spring barley and grain maize yields in selected regions and sites in Austria, Czech Republic and Denmark during period 1961-2007. In the analysis of the warming trend we focused on the relationship between the increasing temperature, which leads to the shortening of key developmental stage and thus causing lower wheat and barley yields. In the same time we employed daily soil moisture model SoilClim to investigate existing drying trends (and their drivers) in relation with the interseasonal yield variability. A preliminary analysis showed that the yields of winter wheat and spring barley in the analyzed countries are correlated (at least during 1997-2007 period) with the mean (and maximum) temperature during the main part of growing season. During this period we observed yield reduction in warmer years and the yield decreases in some unusually warm seasons (e.g. 2000 and 2003 in Austria and Czech Republic) were exacerbated by drought.

The analysis of the agroclimatic conditions in Central Europe during 1961-2007 period show tendency to higher spring temperatures and higher drought intensity which in turn leads to increasing yield variability particularly in the past decade. On the other hand the analyses based on the crop models indicated that yield should increase thanks to the combination of higher $\text{CO}_2$ concentration and earlier sowing dates. Therefore the observed tendencies seem to contradict these findings that are generally used to plan adaptation of agriculture sector. Similar situation was found in Denmark where the yield decreases seemed to be related only with the temperature increase as drought intensity during spring seems to show no significant change. Reconciling the differences between the observed trends in agroclimatic conditions and response of the crop models is crucial for the proposing sensible adaptation options. In the same time the close relationship between the observed trends of climate variables and yields illustrate the need to quantify the climate trends better in order to understand possible impacts in the future.

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