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Projection of Uncertainties of the Climate Change Scenarios into the Estimates of Future Agrometeorological Conditions and Crop Yields.

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Central Europe is located between East and South European climate change hot-spots where its impact is thought to become visible sooner or will be more pronounced (or both). Despite the fact that agriculture is by no means a dominant activity in the region it remains an essential part of economy (and landscape) and in most cases it is based on the performance of few crops as it is case of spring barley and winter wheat within the Central Europe. It is obvious that production stability and quality would be influenced under changed climatic conditions and that these changes will differ between regions. However the magnitude of the change in the agrometeorological conditions and crop productivity (both positive and negative) is not fully known due to the large differences between individual global circulation models (GCM) and SRES scenarios. In order to assess trends and magnitude of crop yields and key agrometeorological indicators we applied dynamic crop models CERES-Barley and CERES-Wheat in combination with newly developed tool AgriClim. The AgriClim allowed us to inves-

tigate effect of climate change on the selected agrometeorological characteristics with a pronounced influence on the overall site suitability for crop production including **i)** length of growing season and interannual variability of this parameter; **ii)** probability of occurrence of late/early frosts; **iii)** number days suitable for sowing during spring/autumn sowing windows ; **iv)** number of days suitable for harvesting during harvest period; **v)** snow cover presence/absence during days with Tmin $<$ -5˚C and -15˚C and **vi)** number of days during anthesis with daily maximum temperature over 32 and 35˚C. On top of that the crop models provided us with the opportunity to explore climate change impacts using sophisticated and well validated system as both models were evaluated using data from 17 (7) experimental sites with 230 (87) experimental years. The models were run for the area of the Czech Republic and north-east part o Austria to cover wide range of climate conditions in the Central European region. When necessary the results were then interpolated into a 1x1 km grid matrix using ArcInfo GIS software and only grids covered by arable land were analyzed further. The selection of the methods and crops made possible to distinguish between climate change impact on the winter and summer crops and to take into account changes in the key agrometeorological indicators.

In order to estimate the uncertainty in the future crop production the number of GCMs provided for the Fourth Assessment Report (4AR) was used (ECHAM, HadCM, NCAR-PCM, CSIRO and GFDL) applying pattern-scaling technique. The method enabled us to take into account wide range of SRES scenarios (i.e. A2, A1B and B1) and account for different climate system sensitivity (CS). The scenario values were used to set up boundary parameters of the future climate over the Central Europe (including CO_2 levels required as an input for the crop model). In the next step synthetic weather series of 99 years were generated using stochastic weather generator (M&rwin) for the set of weather stations and centered for time periods centered on years 2020, 2030, 2040, 2050 and 2100. In order to estimate future yields more realistically both long-term trends in grain production yields between 1918-2005 (accredited to technological advance) and effects of simple adaptation strategies were taken into account. The latter included optimization of fertilization and sowing dates, changing basic parameters of the cultivar and finally measures to increase soil water accumulation during winter that precede to sowing.

Results: The result confirmed that both CERES-Barley and CERES-Wheat depicts well interannual variability of Central European spring barley and winter wheat production as e.g. the coefficient of determination between the simulated and experimental grain yields was higher than 0.70 at most sites and the systematic bias was acceptable. The range of uncertainty caused by the different projections within the set of used GCM is relatively large and is most pronounced in case of A2 SRES scenario in combination with the high climate system sensitivity. Overall uncertainty of the future crop productivity is rather high (larger than 20% between individual GCM for 2030) and becomes even higher in case of spring cereals (compared to winter cereals). The results suggest that the effect of GCM driven boundary conditions are dominant on the national level, whereas the future regional productivity is significantly influenced by relatively subtle differences in the abiotic conditions (e.g. present climate or soil conditions). However the effect of uncertainty within the available set of GCM-SRES-CS on the future national production levels is one order higher than then the effect of sub-regional differences. The sensitivity of agrometeorological indicators to SRES-GCM-CS used showed similar patterns as crop yields and changes in some parameters (e.g. snow cover absence) are cause for concern. Overall the higher altitudes (between 400-700 m a.s.l) of the region seem to benefit more from the changing agrometeorological conditions whilst in the lowlands the new type of stress factors (e.g. high temperature during anthesis or absent snow cover during winter) are emerging.

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