Assessment of climate change impact on wheat production in Germany using a multi-model-ensemble

Christian Jorzig[1], Ashifur Rahman Shawon[1], Emir Memic[2], Anto Raja Dominic[1], Arno de Kock[1], Jörn Strassemeyer[1], Burkhard Golla[1] and Til Feike[1]

[1]Julius Kühn Institute (JKI) – Federal Research Centre for Cultivated Plants, Institute for Strategies and Technology Assessment, Kleinmachnow

[2]Working Group Cropping Systems and Modelling (340), University of Hohenheim, Hohenheim

E-mail of corresponding author: christian.jorzig@julius-kuehn.de

Process-based crop simulation models provide valuable information on potential crop production under future climate conditions. They further allow the development and evaluation of suitable adaptation strategies in crop management to address future risk factors like increased temperature and altered precipitation patterns. Thereby the use of a multi-model-ensemble approach in crop modelling can increase simulation robustness compared to single model outputs. The objective of this study is to simulate mid-century mean yield development and yield stability of winter wheat (*Triticum aestivum*) under different climate scenarios of RCP 2.6, RCP 4.5 and RCP 8.5 for important wheat production regions in Germany. We use the three wheat crop models CERES, CROPSIM and NWHEAT embedded in the Decision Support System for Agrotechnology Transfer (DSSAT). This enables depiction of the model-specific uncertainties in addition to the climate-related uncertainties allowing a more robust evaluation of potential future wheat yields.

In the first step, we conduct a cultivar specific calibration and validation of the three models building on a vast experimental data set of around 100 site-years, with 75 % of the data being used for model calibration and 25 % for model validation. Model calibration is executed to a similar extend for all models adjusting comparable types and number of coefficients to fitting observed and simulated phenology, growth and yield parameters. We then compare simulated yields in 2031-2061 with simulated yields in 1971-2000. We find significant differences between climate scenarios and between the three crop models. While for some scenarios all models show comparative yield trends, for some scenarios results differ between models. We demonstrate the potential and necessity of using multi-model ensembles both, with regard to climate change scenarios and crop models, especially when intended for policy advice.