DKT Abstracts
DKT-10-8-1, 2015
10. Deutsche Klimatagung

Interactions of Generated Weather Raster and Soil Profiles in Simulating Adaptive Crop Management and Consequent Yields for Five Major Crops throughout a Region in Southern Germany

P. Parker (1,2), K. Warrach-Sagi (3), J. Ingwersen (4), P. Högy (5), C. Troost (6), H.D. Wizemann (7), E. Priesack (8), and J. Aurbacher (9)

(1) Institute of Farm Business and Management, Justus Liebig University Giessen, Giessen, Germany (phillip.s.parker@agrar.uni-giessen.de), (2) Institute of Landscape System Analysis, Liebniz Centre for Agricultural Research, Müncheberg, Germany (phillip.parker@zalf.de), (3) Institute of Physics and Meteorology, University of Hohenheim, Stuttgart, Germany (kirsten.warrach-sagi@uni-hohenheim.de), (4) Department of Soil Science and Land Evaluation, University of Hohenheim, Stuttgart, Germany (joachim.ingwersen@uni-hohenheim.de), (5) Institute of Landscape and Plant Ecology, University of Hohenheim, Stuttgart, Germany (petra.hoegy@uni-hohenheim.de), (6) Institute of Land Use Economics in the Tropics and Subtropics, University of Hohenheim, Stuttgart, Germany (christian.troost@uni-hohenheim.de), (7) Institute of Physics and Meteorology, University of Hohenheim, Stuttgart, Germany (hans-dieter.wizemann@uni-hohenheim.de), (8) Institute of Soil Ecology, Helmholtz Zentrum München, German Research Center for Environmental Health, Neuherberg, Germany (priesack@helmholtz-muenchen.de), (9) Institute of Farm Business and Management, Justus Liebig University Giessen, Giessen, Germany (joachim.aurbacher@agrar.uni-giessen.de)

The ability of bioeconomic simulation modelling to realistically predict agricultural adaptation is limited by the degree of detail in crucial model components. Model robustness must be tested before localized calibrations can be applied to regions of heterogenous environmental conditions.
The agent-based model FARMACTOR was used to simulate the timing of field management actions (planting, harvest etc.) in response to environmental conditions, and consequent yields of winter wheat, barley and rapeseed, spring barley and silage maize as the predominant crops in a distinct region of Germany, by linking weather data and the crop growth simulation model EXPERT-N. The integrated models were calibrated to observed experimental data and official phenological observations and then run from 1990 to 2009, forced with climate data from ERA-interim Reanalyses data which was downscaled with the Weather and Research Forecast (WRF) model to a 12 X 12 km^2 grid. Variability in regional soils was replicated with 10 different soil profiles mapped at 1/25,000 scale. The nature of the forcing climate data dictates temporal aggregation for analysis, so that validity is examined by comparing mean simulated planting and harvest dates and yields to official records in the area.
The mean predicted planting dates are very close to observations over the period, within a few days of observations, but show less variance. Harvest dates are accurately predicted as well, within one to two weeks, and the variances are closer to observations.
Predicted winter wheat yields are well simulated in comparison to observed data, but maize yields are underestimated, while winter and spring barley and winter rapeseed yields are greater than observed district ("Landkreis") yields. The degree of variance in simulated yields is acceptable in wheat, winter barley and maize, but excessive in spring barley and winter rapeseed. Cross-sectional examination of yields shows that the different soil profiles are responsible for more yield variance than simulated weather cells in all crops.
While the coupled models appear accurate in predicting crop management dates and physiological development, the inaccuracy in yields in all crops except winter wheat calls into question the reliability of the integrated models when applied, as is, outside of calibration conditions. That soil parameterization is responsible for more variance than generated weather is helpful in seeking to improve performance and encouraging in terms of the method of weather generation.
Reliable extension of the coupled models to include all soils in an area together with artificial spatial climatic variability may require regionalized calibration to increase crop model stability.