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ABSTRACT BOOK

INNOVATIVE CROPPING AND FARMING SYSTEMS FOR HIGH QUALITY FOOD PRODUCTION SYSTEMS

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3. PARALLEL SESSION 11.2 – CLIMATE CHANGE

PS-11.2-01

Greenhouse Gas Emissions Associated to Different Agricultural Intensification Scenarios of Maize Production in Sub-Saharan Africa

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Abstract: Agriculture is responsible for substantial emissions of greenhouse gasses (GHGs) through the use of fertilizers and through reclamation of land and associated carbon losses. Especially in sub-Saharan Africa (SSA) agricultural GHG emissions from both these processes might increase steeply in coming decades, through the increase of food production to match the steep growth of population and achieve food self-sufficiency. To raise food production, intensification of crop production by narrowing the gap between current farm yield and yield potential is needed, as this is considered more sustainable compared to agricultural land expansion (land use change, LUC). The objective of our study is therefore to assess the implications of different scenarios for intensification of maize production versus LUC, with different degrees of yield gap closure, on fertilizer demand and GHG emissions in SSA. Different future (2050) agricultural intensification scenarios were based on the yield gap analysis for ten countries in SSA, which uses a bottom-up approach with local agronomic data and a spatial upscaling methods. We conclude that intensification will require an enormous increase in nitrogen application of twenty times the current use in SSA, thereby reaching similar application levels as in Western Europe, which will come with an increase in GHG emissions. However, matching food demand through land use change, instead of intensification, will result in GHG emissions even four times larger. Moreover, the land area required for such expansion is not available in most SSA countries, and its reclamation would probably come at the cost of massive biodiversity and nature area loss.

Keywords: maize, yield gap, GHG emissions, sub-Saharan Africa, sustainable intensification, land use change, nitrogen, fertilizers

PS-11.2-02

The Challenges of Producing High-Resolution Simulations of Crop Yields for Large Areas

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Abstract: Regional and landscape-scale predictions of crop yields and related agro-ecosystem processes are typically produced by employing one-dimensional processed-based simulation models. Their mathematical nature allows a certain degree of freedom for scalability, but scaling to larger grid cell sizes requires adjustments in the model parameters to consider variability in model inputs and certain influencing factors that do not emerge at scales above or below. At the regional scale, model input requires data that reflect the main influencing factors, such as soil properties, meso-climate, groundwater levels, rooting depth, slope, land use and management. Here we demonstrate how we derived such information for modelling from existing data products and how consideration of these factors affects the quality of large-scale high-resolution simulations for crop yields at the national scale of Germany, using MONICA. Furthermore, we demonstrate how rule-based crop management can lead to more realistic representations of double cropping systems in Central Brazil in a simulation in the context of climate change adaptation. In this, much simpler set-up, we tested the use of rule-based sowing dates for soybean on the representation of sowing dates and phenology of maize and cotton that typically follow soybean of different maturity groups in rotation. Analysis of both experiments show, that phenology-related efforts to fine-tune the simulations have a larger impact on the quality of large-area simulations than improved soil information.

Keywords: Agro-ecosystem modelling, crop model, scaling, climate change impact, crop rotations

PS-11.2-03

Simulating the Potential Distribution and Abundance of the Brown Marmored Stink Bug (Halyomorpha halys) under Future Climate Scenarios in Switzerland

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Abstract: The climate in Switzerland is changing. Depending on the emission scenario and time period, the projected increase in temperature is 2.7-4.8°C and the projected decrease in precipitation is 18-28%. There is scientific evidence that climate change will increase economic damage by agricultural pests. The prevention and management options of alien species are cost and time intensive. Climate change will improve the long-term suitability of potential new areas and amplify the need for action. Therefore it is highly important to assess the risk of alien species under future climate conditions and to plan an efficient monitoring and to develop management strategies.

The brown marmorated stink bug (*Halyomorpha halys*) is an extremely polyphagous insect and has invaded North America and Europe around 2004. Especially in Italy it has become a relevant fruit pest. In Switzerland fruit damage have been reported from the canton Ticino and since 2017 also from the canton Zurich. Climate Impact studies are of great importance to develop adaptation strategies. In this work we used high-resolution, gridded climate change scenarios for Switzerland to simulate the distribution and abundance of *H. halys* under present and future climate conditions.

The simulations were performed with the software package CLIMEX (© CSIRO), a process-based bioclimatic niche model that simulates the mechanisms that limits species' geographical distributions and determine their seasonal phenology, and to some extend their relative abundance. A recently published CLIMEX model for *H. halys* (Kriticos et al. 2017, J Pest Sci) was validated and calibrated for Switzerland considering adult trap catch data. The potential distribution and abundance under present and future climates was compared by means of the number of generations per year and the annual growth index (suitability of the climate for the growth of insects).

Today *H. halys* is univoltine in Switzerland. Our results indicate that under future climate conditions a multivoltine behavior will be possible. Furthermore our simulations demonstrate an enhancement of the overall suitability for the growth of *H. halys*. Our results help to define regions and time periods at greatest risk and to design management strategies for *H. halys* under future climate conditions.

Keywords: Brown marmorated stink but, alien insect pests, climate change and Agriculture, Distribution and Abundance, Climex software