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# Analysing data aggregation effects on large-scale yield simulations

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MACSUR and AgMIP jointly present the International Crop Modelling Symposium

# Crop Modelling for Agriculture and Food Security under Global Change

MACSUR

AgMIP

# ABSTRACTS

# Editors

**Frank Ewert**
**Kenneth J. Boote**
**Reimund P. Rötter**
**Peter Thorburn**
**Claas Nendel**

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**Abstracts of Oral Presentations**…… **17**

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## Welcome

It is with pleasure that we welcome the international crop and agro-ecosystem modelling community and scientists from related disciplines to the International Crop Modelling Symposium 2016, in Berlin.

The past decade has seen a number of research initiatives launched to advance crop modelling and related research. Among these initiatives, The European Knowledge Hub MACSUR (Modelling European Agriculture with Climate Change for Food Security, http://macsur.eu/) and the international AgMIP project (Agricultural Model Intercomparison and Improvement Project, http://www.agmip.org/) stand out in terms of the breadth of their research scope. A large and important part of the activities in both projects is comprised of the improvement, comparison and application of crop models for climate change impact and risk assessment for food security in Europe (MACSUR) and further (AgMIP). These projects have brought together a large number of scientists from around the world and produced a substantial body of novel results. The international MACSUR symposium on crop modelling in Oslo in 2014 and the annual Global Workshops of AgMIP have provided forums to exchange some of these results and have been initial and important events towards this symposium. The increasing interest from within and beyond the crop modelling community for a more comprehensive forum for the exchange of results ultimately motivated representatives of MACSUR and AgMIP to organise this symposium, reflecting the successful and joint work of both projects including successful interaction with other international networks.

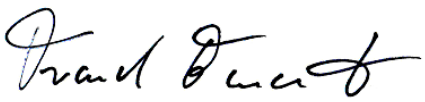
The overwhelming interest in participation in this symposium has exceeded original expectations. From the large number of submitted papers, it was possible to develop what we, the Symposium Chairs, hope is an exciting programme of oral and poster presentations combined with a range of internationally recognised keynote speakers. The workshop structure follows the main activities related to model improvement and model application, as well as anticipating improvements in genetics, and links between crop and related modelling fields such as grassland and vegetation modelling, and

functional structural plant modelling. Accordingly, four sessions have been organised:

- Session 1: Improvement of crop models and modelling approaches
- Session 2: Linking crop models and genetics
- Session 3: Crop modelling for risk/impact assessment
- Session 4: Expanding and supporting modelling activities

The organisation of this symposium was only possible due to the help of several people. Special thanks go to the Session Chairs and the Scientific Committee Members for supporting the development of the symposium programme. We are particularly grateful for the effort of the local host ZALF (Centre for Agricultural Landscape Research) for organising the venue, registration, website and logistics of the programme. The financial and in-kind support from the Research Council of Norway through MACSUR, CSIRO, AgMIP, University of Bonn, Luke and the University of Florida are likewise gratefully acknowledged.

We wish all participants a very fruitful and inspiring symposium and we look forward to the many interesting keynotes, oral and poster presentations. We also hope to have the chance to interact with many of you during the course of the symposium and that the symposium may help to support ongoing and initiate new collaborations to further advance research on crop modelling.



Frank Ewert

On behalf of the Symposium Chairs, Kenneth J Boote, Peter Thorburn and Reimund Rötter, and the local host at ZALF, Claas Nendel.

# Abstracts of Keynote Presentations

# Analysing data aggregation effects on large-scale yield simulations

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## Introduction

Large-scale yield simulations often use data of coarse spatial resolution as input for process-based models (Ewert et al., 2015; Zhao et al., 2015). However, using aggregated data as input for process-based models entails the risks of introducing errors linked to aggregation effects (AE) such as: i) data modification; ii) missing the valid range of the model; iii) data inconsistencies between data types. While the regional crop yield bias is usually <5 % on average over all years, it may increase to more than 10 % under specific conditions, e.g. in single years (Hoffmann et al., 2015), depending on the model. In order to assess these differences in detail, we present a model intercomparison on *AE* for a range of environmental conditions differing in climate and soil for two crops grown under three different production situations.

## Materials and Methods

Multi-model ensemble runs were conducted with soil and climate input data at resolutions from 1 to 100 km for the state of North Rhine-Westphalia, Germany. Climate data was spatially averaged. Soil data was aggregated by area majority. Winter wheat and silage maize yields of 1982-2011 were simulated with 11 models for potential, water-limited and water-nitrogen-limited production after calibration to average regional sowing date, harvest date and crop yield.

## Results and Discussion

Regional yields were reproduced by the models on average, regardless of input data type and resolution. However, *AE* were observed in dry years as well as due to soil aggregation. Large positive *AE* between coarser and 1 km resolutions were associated with low soil water holding capacity (SWHC) and low climatic water balance (CWB) at 1 km resolution in combination with increases in SWHC and CWB when aggregating to coarser resolutions. Consistently, the opposite was found for large negative *AE*. Large *AE* (larger/lower mean +/-2 standard deviations of *AE*) were due to changes in soil type. However, the lower 50 % of all *AE* also showed differences in the aggregation method: soil aggregation by majority led to about 20 % of grid cells with no *AE* at 100 km resolution whereas climate data aggregation by averaging always led to *AE*. Still, soil aggregation by majority led to a larger fraction of *AE* larger than 10 % as compared to climate averaging. Notably, this was further increased by the combined use of aggregated soil and climate data. Finally, models differed considerably in *AE*.

## Conclusions

The results highlight the interactions between model, data and aggregation method with *AE*, emphasizing the importance of models intercomparison analyses.

## Acknowledgements

The study was conducted in the frame of the FACCE JPI MACSUR and received funding from several national institutions. Please see Hoffmann et al., (2015) and Zhao et al., (2015) for further details on funding.

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