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Responses of soil nitrous oxide emissions and nitrate leaching on climate, soil and management input data aggregation: a biogeochemistry model ensemble study

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15-17 March 2016, Berlin, Germany

iCROP M₂₀₁₆



MACSUR and AgMIP jointly present the International Crop Modelling Symposium
**Crop Modelling for Agriculture and Food Security
under Global Change**



ABSTRACTS

Editors

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

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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.

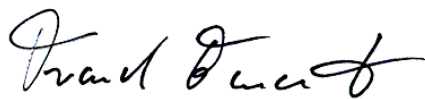
The overwhelming interest in participation in this symposium has exceeded original expectations. From the large number of submitted papers, it was possible to develop what we, the Symposium Chairs, hope is an exciting programme of oral and poster presentations combined with a range of internationally 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.

International Crop Modelling Symposium **iCROPM₂₀₁₆** 15-17 March 2016, Berlin

Abstracts of Keynote Presentations

**Responses of soil nitrous oxide emissions and nitrate leaching on
climate, soil and management input data aggregation: a
biogeochemistry model ensemble study**

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Introduction

Numerical simulation models are increasingly used to estimate greenhouse gas (GHG) emissions at site to regional scales and are outlined as the most advanced methodology (Tier 3) for national emission inventory in the framework of UNFCCC reporting. Low resolution simulations need less effort in computation and data management, but details could be lost during data aggregation associated with high uncertainties of the simulation results. This aggregation effect and its uncertainty will be propagated with the simulations. This paper aims to study the individual aggregation effects of climate, soil and management input data on soil N₂O emissions and nitrate leaching by an ensemble of different biogeochemistry models.

Materials and Methods

We simulated two 30-year cropping systems (winter wheat and maize monocultures) under nutrient-limited conditions. Climate and soil input data was based on a 1 km resolution, aggregated to resolutions of 10, 25, 50, and 100 km. Firstly, soil data was kept homogenous using representative soil properties while climate data was used on all different scales (see Hoffmann et al., 2015 and Zhao et al., 2015). In a second step, the climate data was kept homogeneous while soil initial data was used on all different scales. Finally, in a third step we have used spatially explicit climate and soil data on all different scales. We analyzed the N₂O emissions per unit of crop yield and the nitrate

leaching on the annual average as well as on daily resolution to study pulsing events for all scenarios and on all scales. The study was extended to assess the influence of management input data aggregation on the simulation results. The study presents an analysis of the influence of data aggregation on soil N₂O emissions and nitrate leaching for the state of North Rhine-Westphalia, Germany.

Results and Discussion

The study reveals the influence of input data aggregation on the nitrogen cycle and the losses of reactive nitrogen from managed ecosystems. While ensemble simulation results for micrometeorology and crop yield behave similar for the model ensemble, the response of the individual models for the prediction of soil N₂O emissions and nitrate leaching diverge significantly. This results from the structural differences of the biogeochemical process descriptions used within the model ensemble. The data aggregation effects on the nitrogen cycle across the scales were larger for the plain soil data aggregation compared to the plain climate input data aggregation. The aggregation effects across the scales on the nitrogen cycle for the model ensemble were more variable when using both climate and soil input data aggregation simultaneously. The variation between the wheat and the maize rotation was significant as the two crop rotations differ in nitrogen fertilizer input and plant nitrogen uptake which are the main drivers for the nitrogen cycle.

While the data aggregation of the agricultural management only addressed timings of individual management practices, their influence to the loss of reactive nitrogen were minor compared to the soil data aggregation.

Conclusions

The study gives an indication on adequate spatial aggregation schemes in dependence on the scope of regionalization studies addressing the quantification of losses of reactive nitrogen from managed arable systems.

Acknowledgements

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

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