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A. Holzkämper
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern, annelie.holzkaemper@agroscope.admin.ch

T. Klein
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern

R. Seppelt
Helmholtz-Centre for Environmental Research – UFZ

J. Fuhrer
Agroscope, Institute for Sustainability Sciences, Oeschger Centre for Climate Change Research, University of Bern

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Agro-ecosystem adaptation to climate change – How does crop model uncertainty affect the choice of optimum adaptation responses?

A. Holzkämper[a, b], T. Klein[a, b], R. Seppelt[c], J. Fuhrer[a, b]
[a]*Agroscope, Institute for Sustainability Sciences, Reckenholzstrasse 191, 8046 Zürich, Switzerland*
[b]*Oeschger Centre for Climate Change Research, University of Bern, Hochschulstrasse 4 3012 Bern, Switzerland*
[c]*Helmholtz-Centre for Environmental Research – UFZ, Permoserstr. 15 04318 Leipzig, Germany*
Corresponding author E-mail: annelie.holzkaemper@agroscope.admin.ch

Abstract: Amongst the crop modelling community, it is now widely acknowledged that model uncertainties can have huge implications on the results from climate impact studies. While uncertainties in climate impact assessments are increasingly being considered, studies investigating the implications of model uncertainties on recommendations for adaptation responses are still very rare. To address this gap, this study investigates how crop model uncertainty can affect the selection of suitable adaptation responses. The agroecosystem model CropSyst is applied in connection with an optimization routine to select optimum adaptation options with regard to different adaptation goals (i.e. maximum productivity, minimum erosion, minimum leaching). By integrating different climate model projections and different crop model parameterizations, we account for two potential sources of uncertainty.
Results from a case study application in Western Switzerland show that for climate impact estimates, the effects of climate model uncertainty dominate over the effects of parameter uncertainty. For selected optimum adaptation responses, however, it was found that the influences of climate model and parameter uncertainties can differ substantially depending on the prioritization of objectives and depending on local conditions. The optimum choice of irrigation level was found to be the decision variable subject to greatest uncertainty particularly on coarser soil. This finding suggests that for the long-term planning of irrigation infrastructure and management, a robust adaptation approach is required for approaching unavoidable uncertainty from a risk management perspective.

Keywords: climate change adaptation; multifunctional agroecosystem; robust decision-making; simulation-optimization; uncertainty