Addressing the uncertainty of the Managed Land module in LPJ-GUESS

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Modelling agriculture
At present, cultivated arable land covers 12% of the Earth’s land surface, making it crucial to include managed ecosystems in simulations of the carbon cycle on a global scale. However, the inclusion of managed land in global ecosystem models, such as Dynamic Global Vegetation Models (DGVMs), is only a part in a handful of models [1, 2]. This is despite the acknowledged effects of past and present-day land use/land cover change for carbon cycle and biophysical exchanges, and potentially large importance of future land use change for projections of climate, atmospheric chemistry and air pollution.

The detailed regionally oriented DGVM LPJ-GUESS [3] with individual-based vegetation dynamics has been expanded with a module for Managed Land (ML) phenology and biogeochemistry of growth and land conversion. The ML module builds further on the implementation in the LPJ-mL DGVM [1]. The ML module introduces new crop functional types, representing the globally most important crops e.g. Maize, Wheat and Rice, and also distinguishes between rain-fed and irrigated crops.

A sowing algorithm that emulates farmer decisions based on climate variability [5] is expected to increase robustness when the model is applied under future scenarios of climate and atmospheric change.

Model uncertainty
While the inclusion of ML is considered an important development in global ecosystem models, the associated increase in model complexity risks amplifying uncertainty in the output of the model.

Uncertainty analysis
I will assess the uncertainty associated with the introduction of new parameters in the Managed Land module of LPJ-GUESS with a Metropolitan Hasting Monte Carlo (MHMC) algorithm [4]. The results will provide insight on the overall robustness of the model and its sensitivity to uncertainty propagating from an incomplete knowledge of the introduced management and biological processes, and their scaling in space and time [6].

A selected set of parameters that have shown to have a significant effect on the model in a sensitivity analysis [6] will be analysed using the MHMC.

Outcomes
The expected outcomes from this analysis are:

- quantification of the uncertainty in the model
- deeper understanding of the distribution of the model parameters

References