Introduction

An increased demand for biofuel feedstocks can lead to direct land use change (dLUC): land use is changed from some previous use to the biofuel feedstock. This, in turn, can lead to indirect land use change (iLUC): a change of land use elsewhere, induced by a change in use or production quantity of that biofuel feedstock (Figure 1). It is commonly recognized that there are large uncertainties in modelled biofuel induced dLUC and iLUC, but until now, quantification of such uncertainties has never been performed.

Methods

The projection of dLUC and iLUC in Brazil caused by an increasing demand for biofuels and the uncertainty herein is performed using MAGNET, a global Computable General Equilibrium (CGE) model, connected to the PCRaster Land Use Change model (PLUC) (Figure 2).

Results

Uncertainty quantification is critical to evaluate whether or not dLUC and iLUC indicators are reliable enough to be included in legislation, to identify which parts of the modelling chain have the highest priority for improvement, and to assess how this uncertainty propagates to the impacts of iLUC, like greenhouse gas (GHG) emissions. Therefore, we aim 1) to project dLUC and iLUC for Brazil, cause by sugar cane expansion as a result of an increased demand for biofuels, up to 2030 in a spatially explicit way, and 2) to quantify the uncertainty herein.

Discussion and conclusions

The uncertainty in iLUC area and location is generally higher than in dLUC (Figure 3), because iLUC is caused by the interplay of various land use types that each have their uncertain model parameters, while dLUC is mainly affected by the parameters for sugar cane. Estimated iLUC areas, even at country level, might as well be 2.4 times as high or as low, given the 95% confidence interval.

Based on our case study, our opinion is that iLUC indicators are not reliable enough to be included in legislation. Strict thresholds in legislation have no use when the model, used to check whether an indicator for a specific case is above or below this threshold, gives an output confidence interval that straddles this threshold. This is likely to happen considering the high uncertainties found in our study.

Reference

Verstegen, J.A., van der Hilst, F., Wolfer, G., Karsensberg, D., Fissel, APC (in review) What can and can’t we say about indirect land use change in Brazil using an integrated economic - land use change model?