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Using a dynamic vegetation model for future projections of crop yields: application to Belgium in the framework of the VOTES and MASC projects

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Dynamic vegetation models (DVM) were initially designed to describe the dynamics of natural ecosystems as a function of climate and soil, to study the role of the vegetation in the carbon cycle. These models are now directly coupled with climate models in order to evaluate feedbacks between vegetation and climate. But DVM characteristics allow numerous other applications, leading to amelioration of some of their modules (e.g., evaluating sensitivity of the hydrological module to land surface changes) and developments (e.g., coupling with other models like agent-based models), to be used in ecosystem management and land use planning studies. It is in this dynamic context about DVMs that we have adapted the CARAIB (CARbon Assimilation In the Biosphere) model.

One of the main improvements is the implementation of a crop module, allowing the assessment of climate change impacts on crop yields. We try to validate this module at different scales:
- from the plot level, with the use of eddy-covariance data from agricultural sites in the FLUXNET network, such as Lonzée (Belgium) or other Western European sites (Grignon, Dijkgraaf,...),
- to the country level, for which we compare the crop yield calculated by CARAIB to the crop yield statistics for Belgium and for different agricultural regions of the country.

Another challenge for the CARAIB DVM was to deal with the landscape dynamics, which is not directly possible due to the lack of consideration of anthropogenic factors in the system. In the framework of the VOTES and the MASC projects, CARAIB is coupled with an agent-based model (ABM), representing the societal component of the system. This coupled module allows the use of climate and socio-economic scenarios, particularly interesting for studies which aim at ensuring a sustainable approach. This module has particularly been exploited in the VOTES project, where the objective was to provide a social, biophysical and economic assessment of the ecosystem services in four municipalities under urban pressure in the center of Belgium. The biophysical valuation was carried out with the coupled module, allowing a quantitative evaluation of key ecosystem services as a function of three climatic and socio-economic scenarios.