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1) Objectives

The overall objective of the MAPPY project is to study quantitatively feedback processes linking pollinators, plant diversity and crop yields in the context of climate and land use changes. A set of complementary models will be assembled, iteratively, to capture the dynamics of this complex system at regional level. Dynamic vegetation models and species distribution models will be used to assess the impacts of future climate change. Then, an agent-based model will be used to derive detailed land use and land cover change scenarios for the future at the scale of studied regions. The results of this combination of models will make it possible to assess the potential impacts on pollinators communities, which will make it possible to refine crop models. Finally, the socio-economic impacts of these forecasts will be assessed.
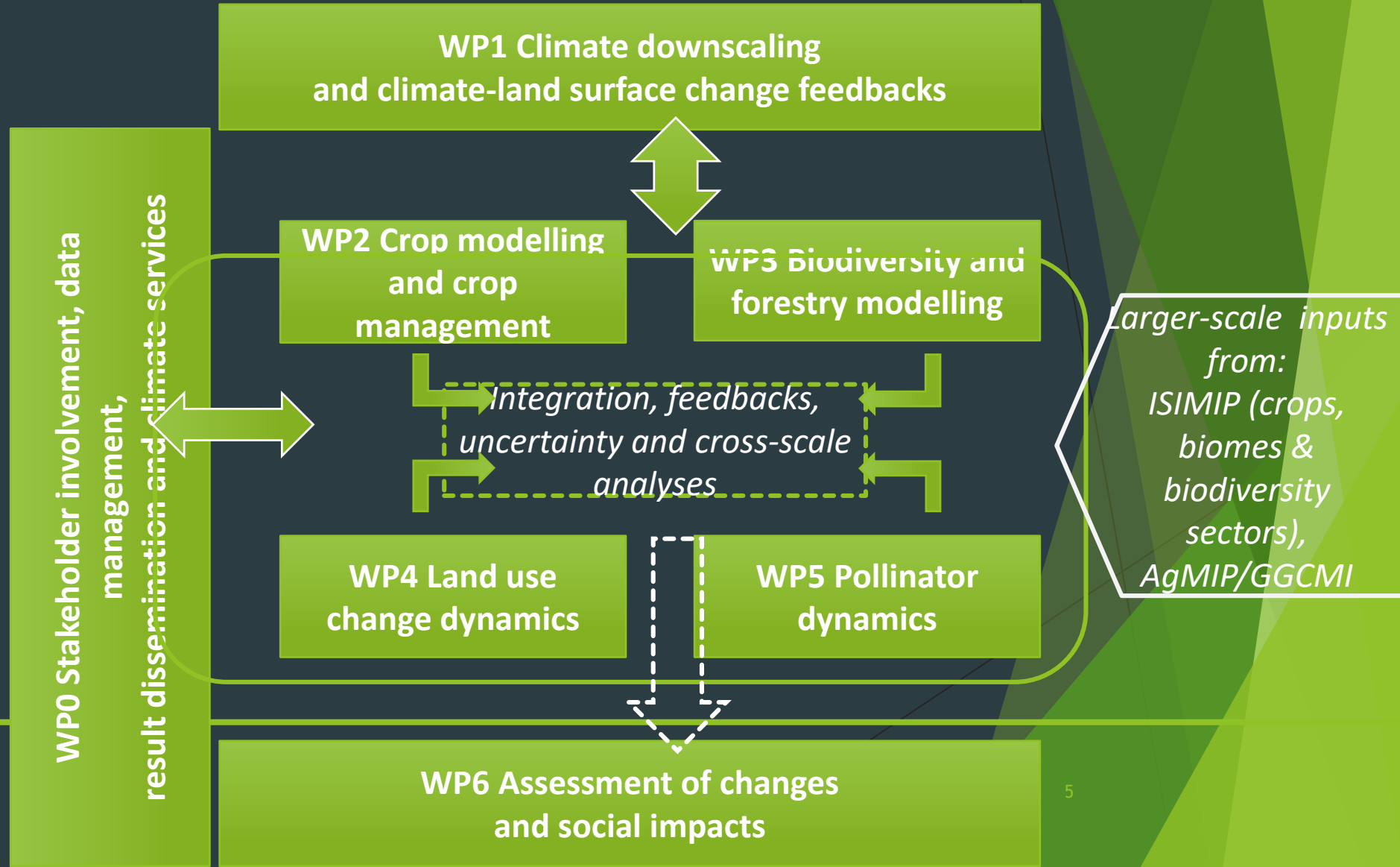
2) Methodology

In order to study quantitatively the feedback processes linking pollinators, plant diversity and crop yields accounting for climate and land use changes, at regional level, we will assemble a set of models using specific high resolution databases. We will run this suite of models for several case study regions, at least one for each country involved in the partnership of MAPPY (Figure 2 bellow), to explore these feedbacks and perform projections up to 2070. The case study regions will be selected in close consultation with stakeholders, according to their interests. To ensure the full participation of stakeholders, a subcontractor (EcoRes) will act as a link between scientists and the end users of the results.

2) Methodology - Workpackages

The project is subdivided in 7 work packages as presented here.

More details on each of the worpackages are given in the following slides.

WP1 Climate downscaling and climate-land surface change feedbacks

WP0 Stakeholder involvement, data management, result dissemination and climate services

WP2 Crop modelling and crop management

WP3 Biodiversity and forestry modelling

Integration, feedbacks, uncertainty and cross-scale analyses

WP4 Land use change dynamics

WP5 Pollinator dynamics

Larger-scale inputs from: ISIMIP (crops, biomes & biodiversity sectors), AgMIP/GGCMI

WP6 Assessment of changes and social impacts

2) Methodology - Workpackages

WP0 Stakeholder involvement, data management, result dissemination, climate services. Stakeholders will help the integration of disciplines and the translation of results in a way that corresponds to potential users by, for example, validating the choice of case study regions. A project web page will be created in order to advertise project objectives and expected results among stakeholders.

WP1 Climate downscaling and climate-land surface change feedbacks.
Novel downscaled projections will produce more accurate and reliable data that is important for the various project partners and stakeholders.

WP2 Crop modelling and crop management.
Crop models will be used to assess the impacts of climate change on agricultural yields. Crop species to be simulated include species that are dependent on insect pollination or not, but are key components of the landscape in the case study areas.

2) Methodology - Workpackages

WP3 Biodiversity and forestry modelling.
Dynamic vegetation models and niche-based models will be used to assess the impacts of climate change and management practices on the selected forest regions and their biodiversity.
WP4 Land use change dynamics.
An agent-based model will be used to derive high-resolution land use and land cover change scenarios for the future for the case study regions.
WP5 Pollinator dynamics
The potential impact of climate and land use change on pollinators communities and on their contribution to crop pollinisation will be studied. The WP2 crop models and the WP3 biodiversity models will be used as inputs into the pollinator's models.
**WP6 Assessment of changes and social impacts**
The projected changes in the studied regions under the different scenarios will be evaluated with the expected social impacts. This last part will be carried out in collaboration with local stakeholders, as well as with international projects such as ISMIP and AgMIP/GGCMI.

2) Methodology - Models

Here are the systems that will be studied during the project and how they will be linked together. The models that will be used in MAPPY are :

- CARAIB : Crop and forest model
- ADAM : Agent based model
- COSMO-CLM : Climate model
- LPJ-GUESS : Forest model
- LPJmL : Crop model
- FruitCan : Crop model
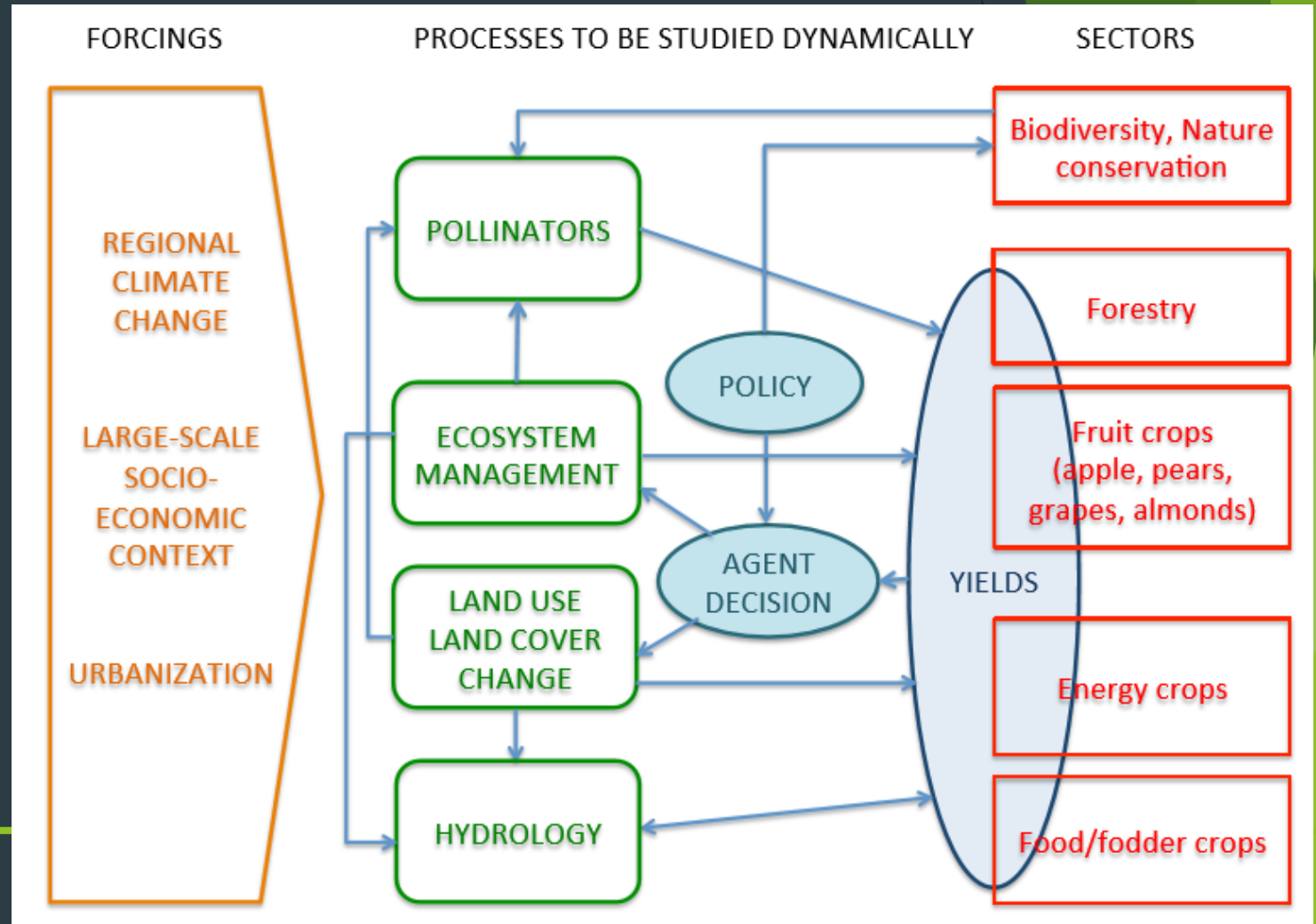
2) Methodology – Case study area

Simulations will be carried out on a regional scale. The following study regions have been selected for this project. Each partner (presented in the following slide) has chosen the region(s) of interest in its country, in accordance withother partners and stakeholders' expectations.

- AUSTRIA – Eisenwurzen : crops, rivers, mountain pastures.
- BELGIUM – Wallonia : arable agriulture and cattle breeding.
- GERMANY – Rhine-Main-area and Eifel/ lower Rhine valley : urbanisation, agriculture.
- NETHERLANDS – south western art : agriculture and nature interspersed.
- SPAIN – Cordoba province (Andalusia) : sierras and a main agricultural area.

2) Methodology - partners

- Pr. Louis FRANCOIS – Coordinator (University of Liège, Belgium) : Stakeholder involvement, data management, result dissemination, climate services. Biodiversity and forestry modelling

- Pr. Nicolas Dendoncker (University of Namur, Belgium) : Stakeholder involvement, data management, result dissemination, climate services. Land use change dynamics.

- Pr. Koos Biesmeijer (Naturalis Biodiversity Center, Netherlands) : Pollinator dynamics.

- Dr. Merja Tölle (Justus-Liebig University Giessen, Germany) : Climate downscaling and climate-land surface change feedbacks

- Pr. Thomas Hickler (Senckenberg, Germany) : Biodiversity and forestry modelling.

- Dr. Christoph Müller (Postdam Institute for Climate Impact Research (PIK), Germany) : Crop modelling and crop management.

- Dr. Lucas Testi (Consejo Superior de Investigaciones Cientificas (CSIC), Spain) : Crop modelling and crop management

- Dr. Veronika Gaube (University of Natural Resources and Life Sciences) : Assessment of changes and social impacts.

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2) Methodology - Stakeholders

The study will be driven by stakeholders' interests. Pollinator decline, fruit crop damage, and more generally, climate change impacts on crop yields are problems of increasing concern among stakeholders.

We will shape the project along the major problems identified in each studied region by local stakeholders. Many stakeholders are involved in the MAPPY project (see on right). They will also participate in the selection of results.

3) Deliverables

- Projections of climate scenarios for the future on **case study regions** :

  ➢ Yield projections for crops and optimal management.

  ➢ Forest development scenarios in two strates (herbaceous and canopy).

  ➢ Land use change scenarios linked to crops and forests development and socio-economic context.

  ➢ Evolution of pollinators communities and their impact on yields.

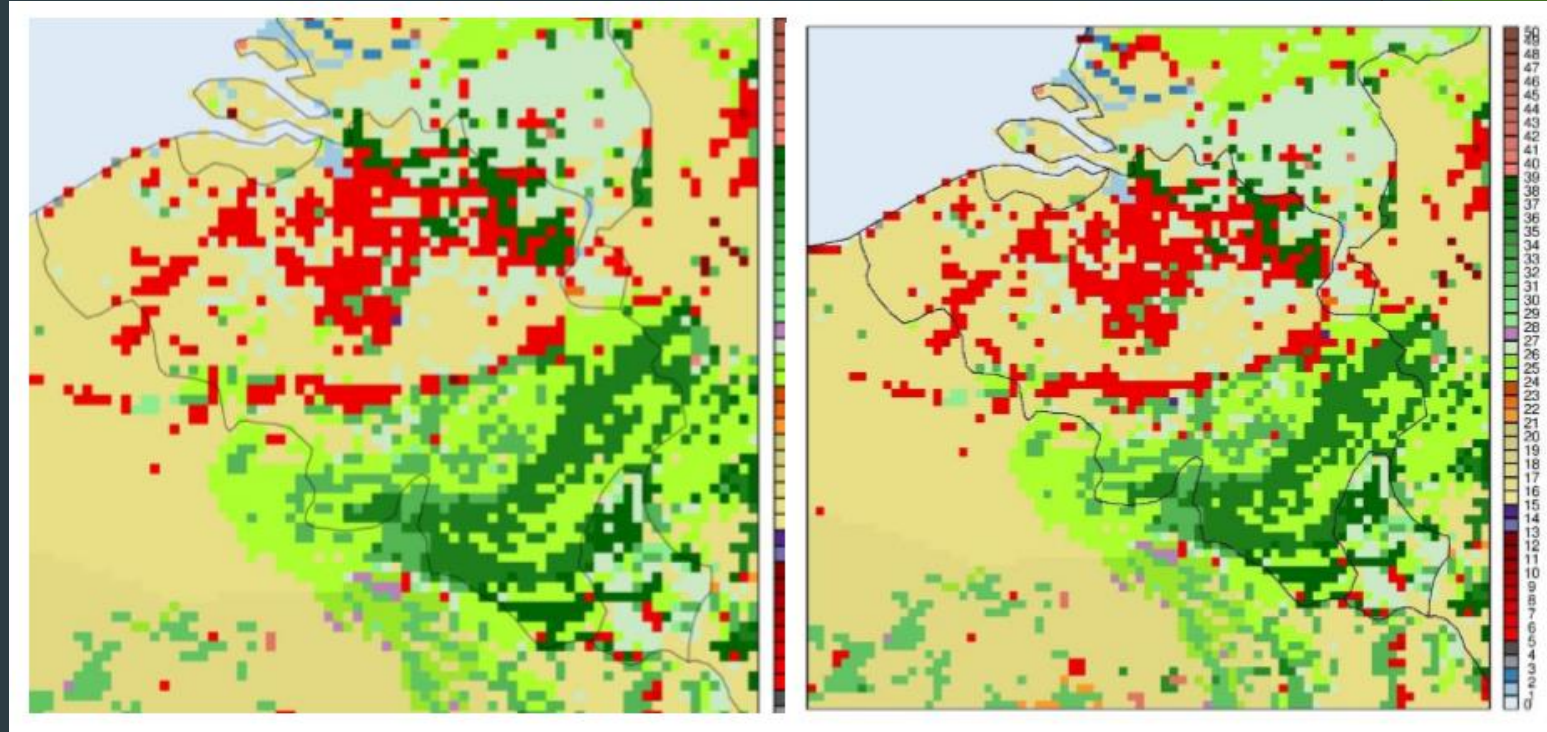Web-based communication tool designed for stakeholders

Report & scientific papers

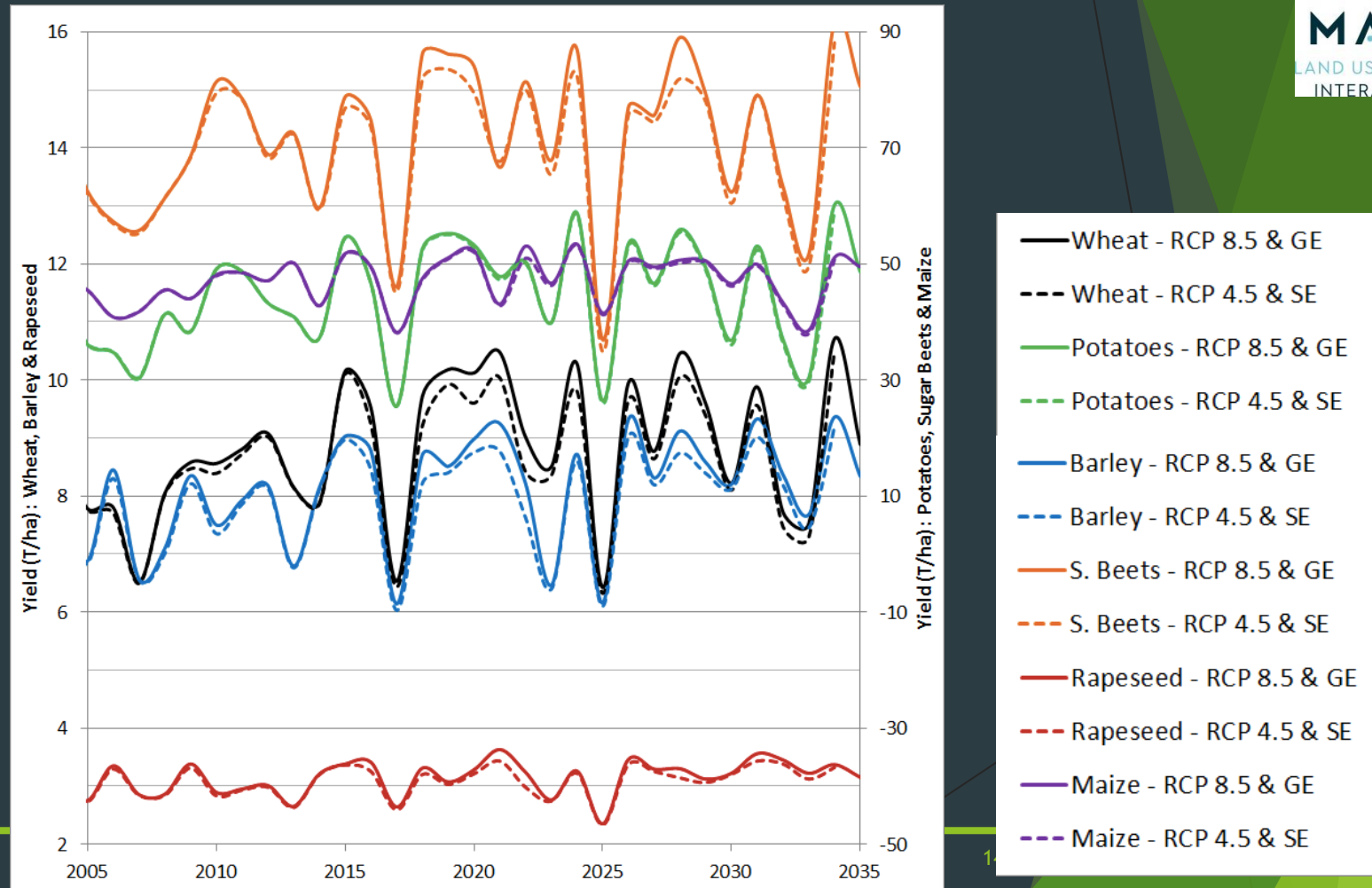## 4) Expected results, Belgium as exemple (MASC project)

Evolution of the land cover between 2005 and 2035, as a consequence of climate change and land-use change, which are in close interaction with socio-economic developments.

Blue colors = water surfaces, red colors = urban areas, yellow = crops, lightgreen = grassland, bluegreen = pasture, green = forest, brown = others.

5) Expected results, Belgium as exemple (MASC project)

Evolution of average crop yields in Belgium, between 2005 and 2035. Calculated by the CARAIB model with climate scenarios RCP 4.5 and 8.5.

Legend:
- Wheat - RCP 8.5 & GE
- Wheat - RCP 4.5 & SE
- Potatoes - RCP 8.5 & GE
- Potatoes - RCP 4.5 & SE
- Barley - RCP 8.5 & GE
- Barley - RCP 4.5 & SE
- S. Beets - RCP 8.5 & GE
- S. Beets - RCP 4.5 & SE
- Rapeseed - RCP 8.5 & GE
- Rapeseed - RCP 4.5 & SE
- Maize - RCP 8.5 & GE
- Maize - RCP 4.5 & SE

THANK YOU

For questions, come at the online meeting on
Friday 8th May, 8:30 to 10:15

www.sphere.uliege.be