

Agricultural adaptation to climate change under different policy environments: an integrated assessment of impacts

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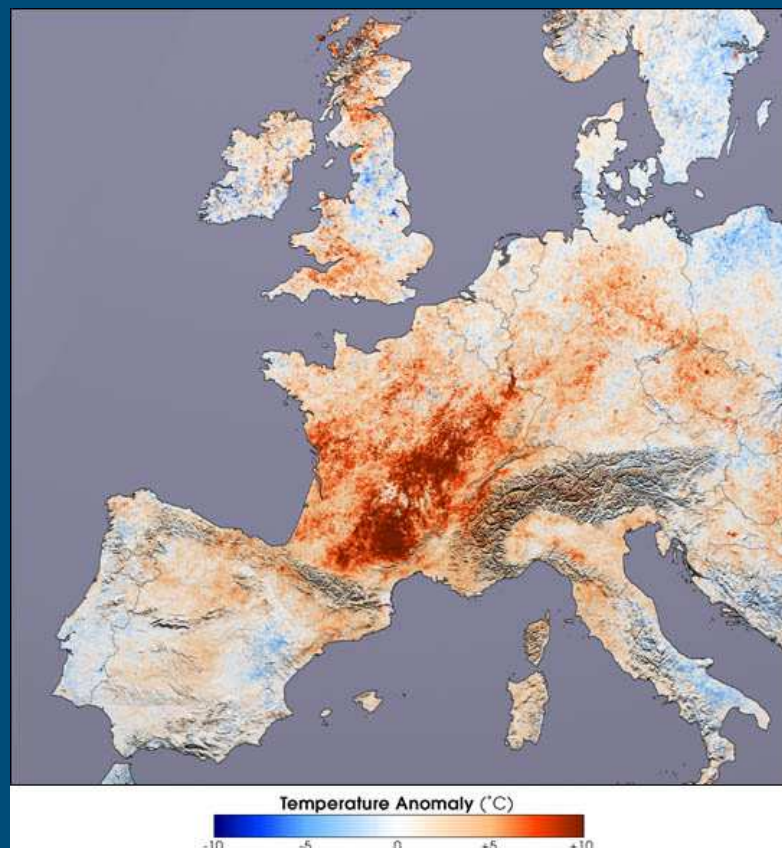
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Background

- Farmers are faced with (i) changes in Common Agricultural Policy (CAP) and markets and (ii) climate change, such as more frequent extreme weather events, that may result in lower yields and/or yield quality.
- Use an Integrated Assessment Model (IAM) approach to gain more insight in consequences of changes in climate, in interaction with changes in CAP and global markets, on agricultural income and environmental impacts.

Climate change impacts on agriculture in EU



2003: heat wave in Europe

Projections: mainly positive effects in Northern Europe, negative in South



lower crop yields

Climate change and other drivers of change in EU

Policy	Socioeconomics and Environment	
	Demand	Supply
CAP pillar I (single farm payment, safety net, cross compliance, greening ..)	Population, GDP growth (consumption)	Resource competition (e.g. urban)
CAP pillar II (LFA, agri-env. zones)	Consumer preferences (meat, organic)	Climate change (Temp, precip., CO ₂ , extreme events)
Environmental policy (NVZs, ESAs)	Bio-based economy	Technology & management
	Multi- and bi-lateral trade liberalization EU enlargement	

Aims of the study

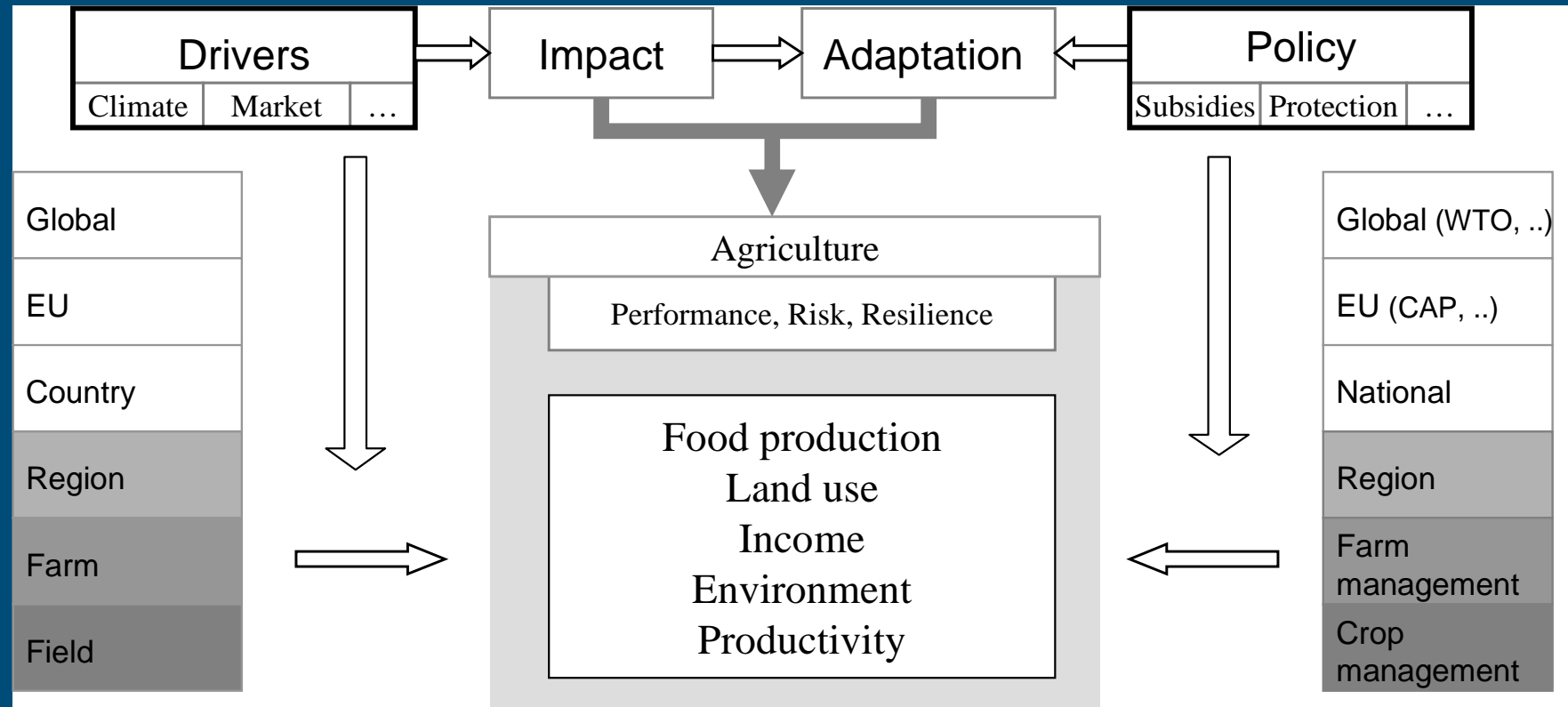
Aims derived in interaction with DG-Agriculture is to assess:

- the impacts of climate change and changing technology on *crop yields, crop patterns and farm net income*.
- the resulting consequences for the *environment (emissions of N, P and GHG to air and water)*.
- which adaptations at *farm level* to changed climate conditions are most effective.
- which are the most (CAP) effective *(inter)national* policy instruments to support adaptation.

for the year 2050, depending on farming structure, bio-physical conditions and region within EU27

Integrated assessment of adaptation strategies

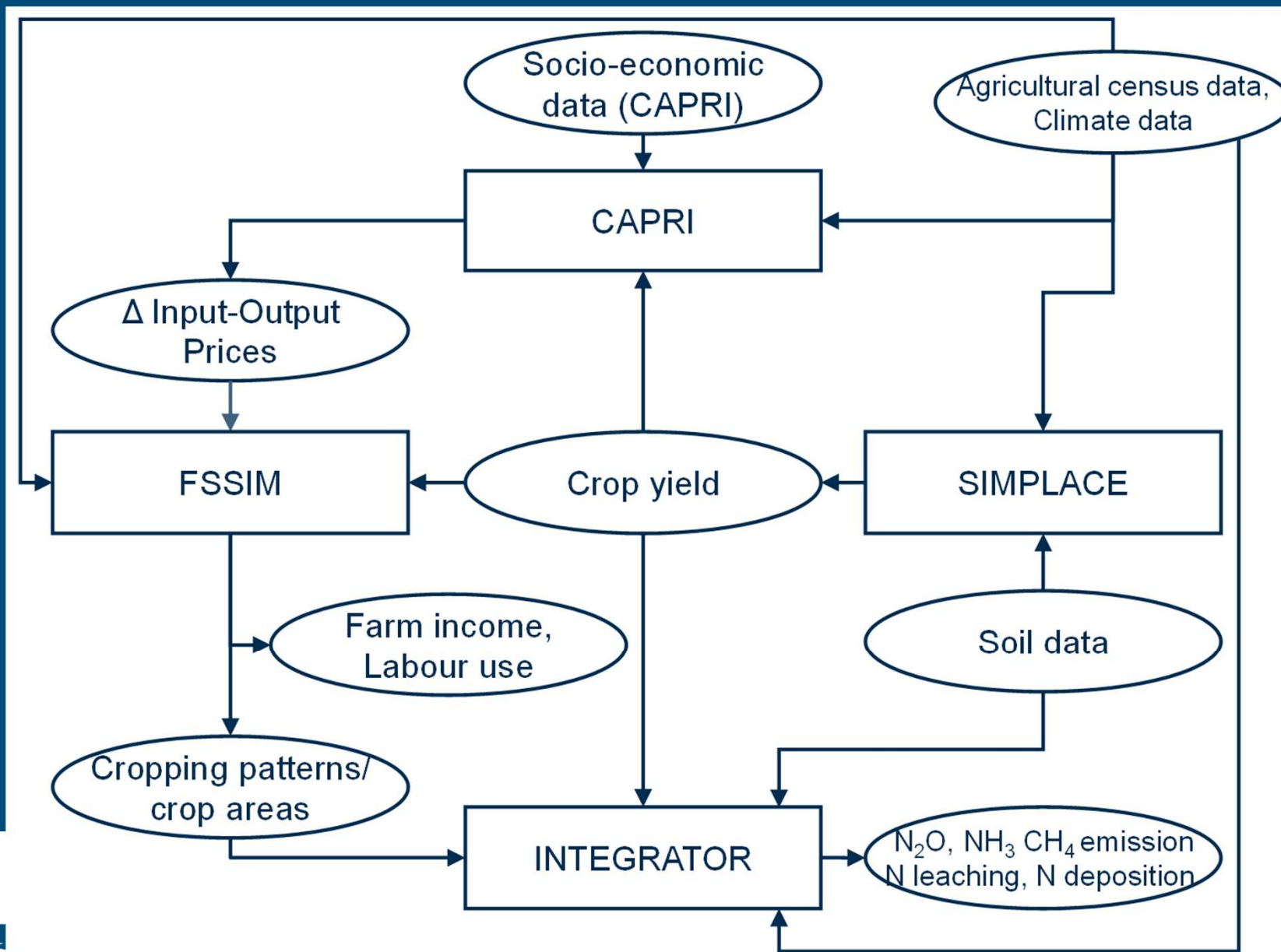
Scale dependent responses



Modelling approach

- Multi-scale assessment of climate change impacts, policy changes and adaptation strategies by linkage of:
 - **Crop growth model** (SIMPLACE): effects on **crop yield**, N-Demand, Water-Demand.
 - **Socio-economic model** (CAPRI): impacts of agricultural policies and CC on markets, **input and product prices**.
 - **Farm model** (FSSIM): effects on crop rotations, **farm income and labour demand** (incorporates farm management; specific regions).
 - **Environmental quality model** (INTEGRATOR): effects on the environment (**N emissions** to air and water).

Modelling approach



Scenarios

B1 is baseline scenario; A1-b1 is strong economic growth and B2 is weak economic growth : no policy changes are investigated, other than through different global scenarios

Overview of the applied scenarios and types of analysis (variations) for 2050

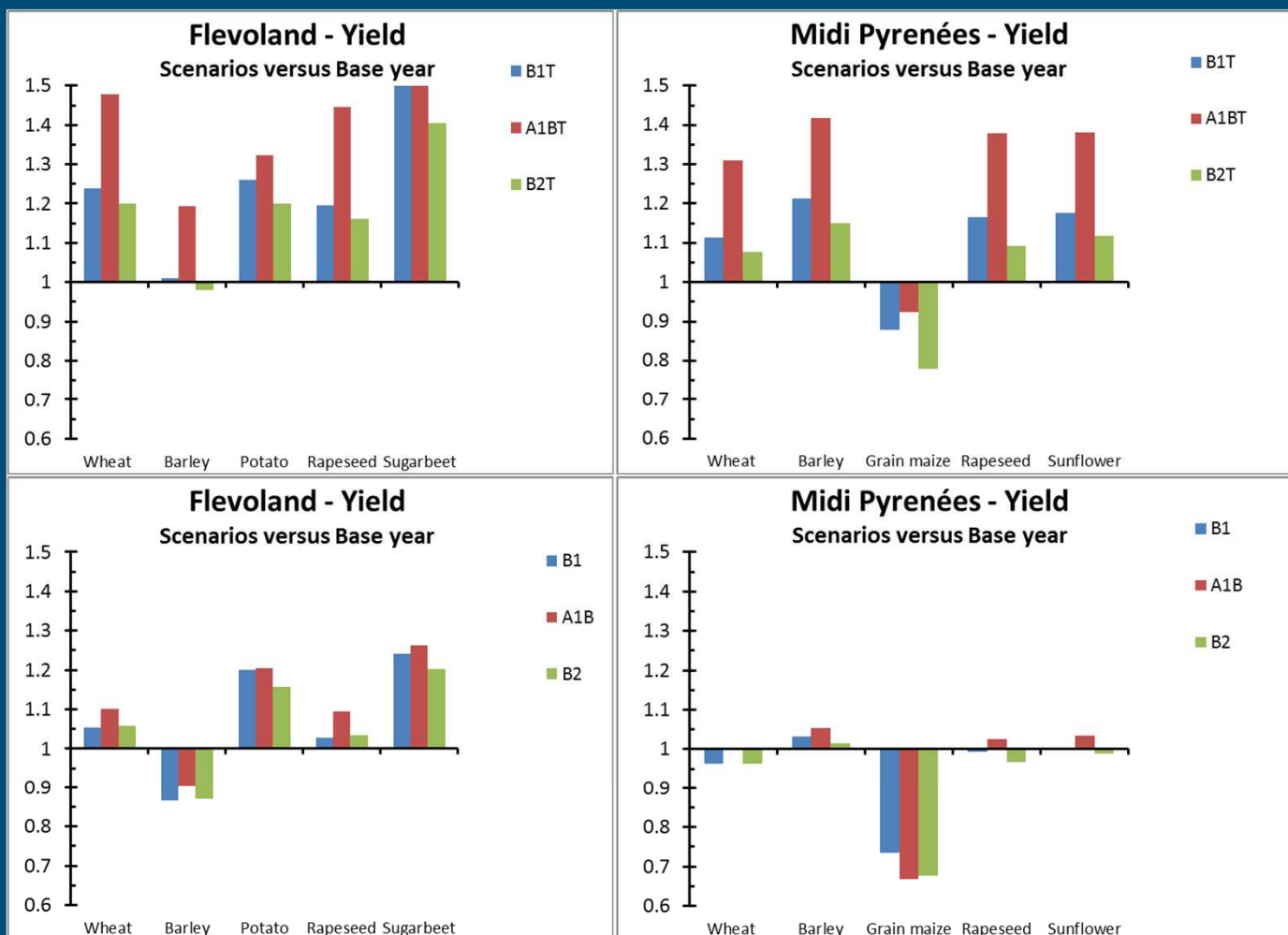
Scenarios IPCC	Variations	<i>Climate change</i> (change in CO ₂ and climatic parameters)	<i>Technological change</i> (e.g. improved cultivars)	<i>Price changes</i> for both inputs and products
B1, A1-b1, B2	CLIM	Yes	No	No
B1, A1-b1, B2	CLIMT	Yes	Yes	No
B1, A1-b1, B2	CLIMP	Yes	No	Yes
B1, A1-b1, B2	CLIMTP	Yes	Yes	Yes

Results

Ratio of selected model outcomes (crop yields, product prices, farm income, labour demand, N inputs and N emissions) in 2050 and in base year (2003-2005) for:

- two regions in Europe, i.e. Flevoland/The Netherlands and Midi Pyrenées/France.
- three IPCC scenarios (Base line B1, A1-b1 and B2)
- four variations (CLIM, CLIMT, CLIMP and CLIMTP)

Changes in crop yields : SIMPLACE results

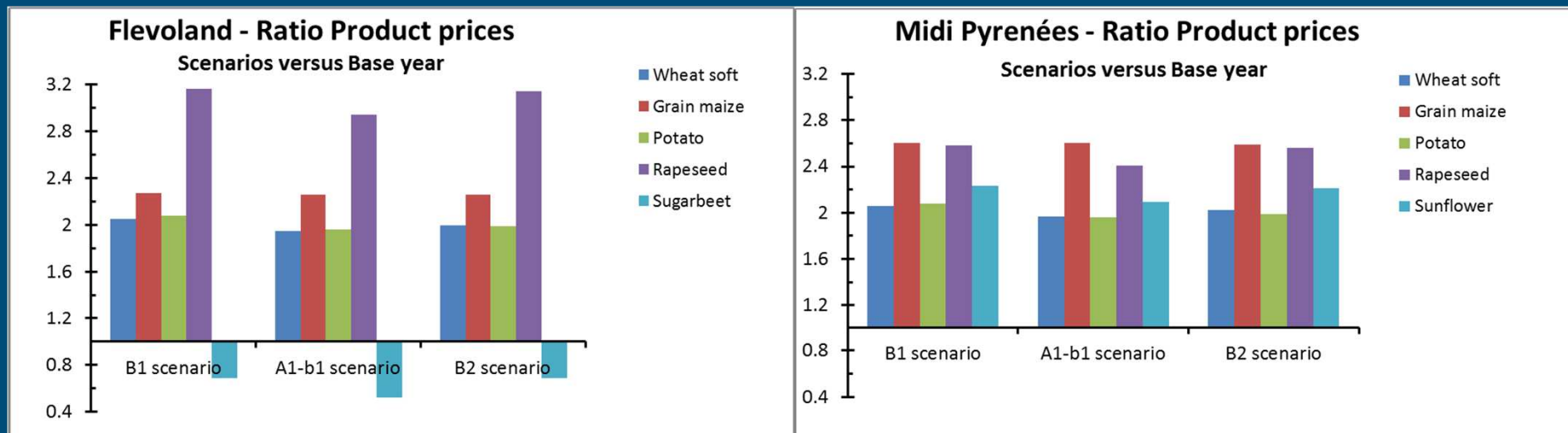


Relative changes in crop yield in Flevoland and Midi Pyrenées for B1, A1-b1 and B2 scenarios for 2050 compared to the Base year (i.e. 2003-2005) for both climate and technology change (CLIMT, top) and climate change only (CLIM, bottom).



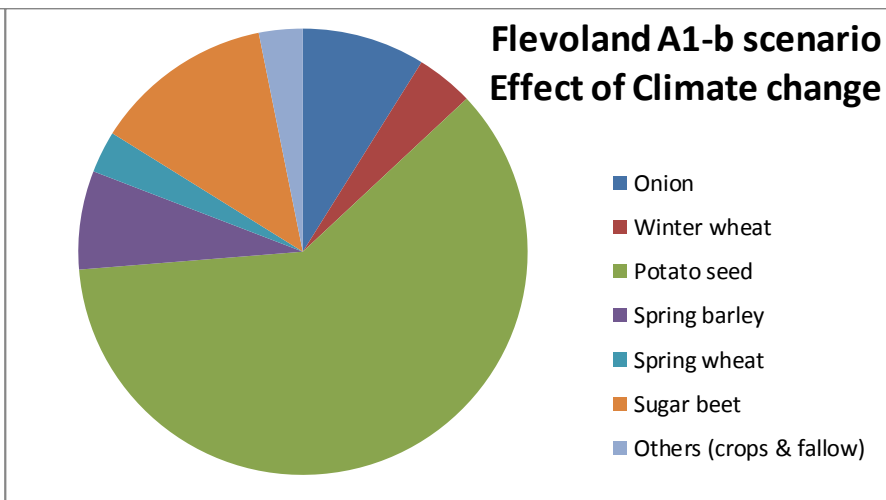
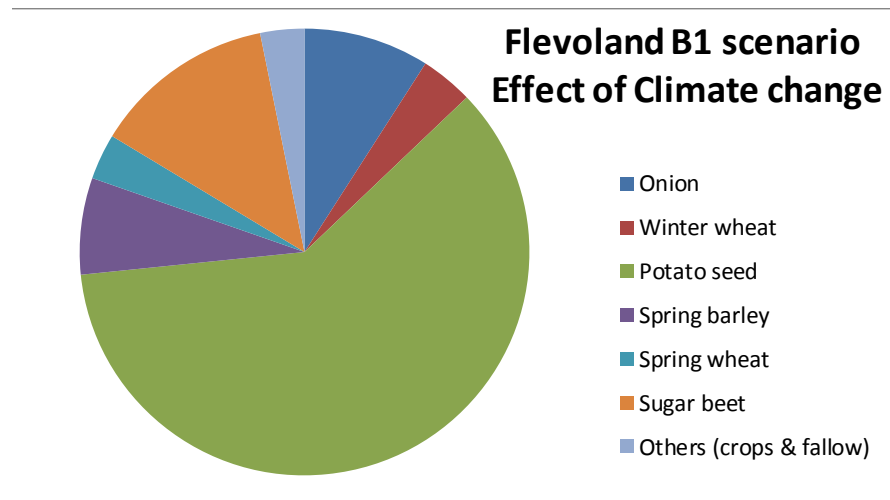
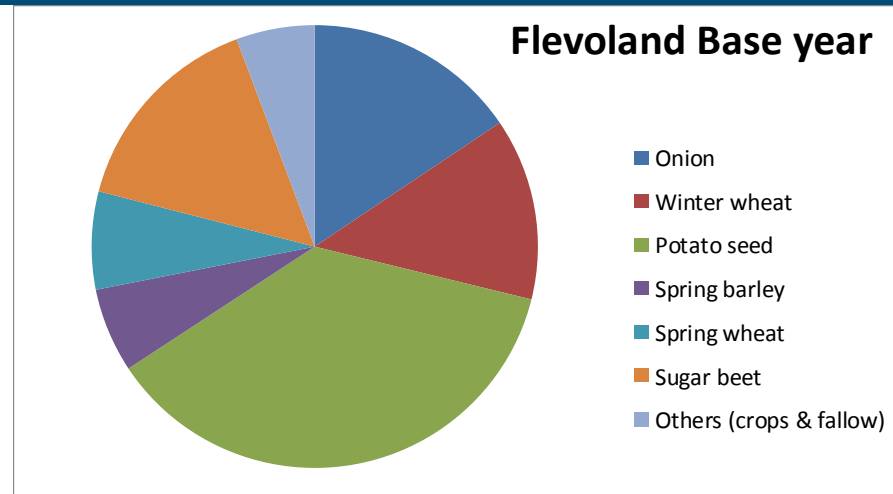
Changes in prices of products

CAPRI results



Relative changes in crop prices in Flevoland and Midi Pyrenées for B1, A1-b1 and B2 scenarios for 2050 compared to the Base year (i.e. 2003-2005).

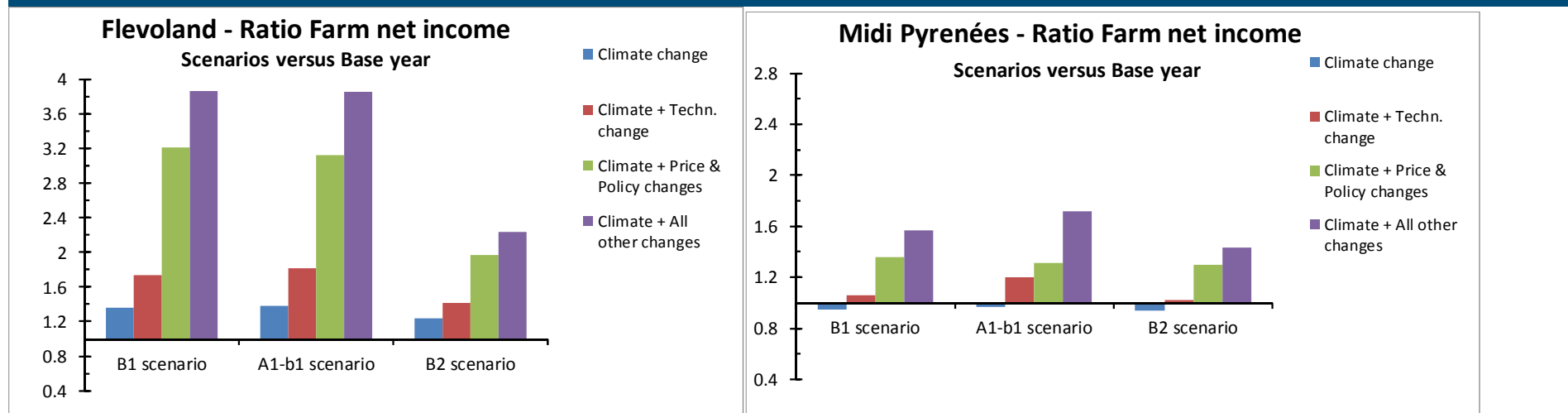
Example of current and future cropping patterns



Average Cropping patterns across all farm types in Flevoland for the B1 and A1-b1 scenarios in 2050

Changes in farm net income

FSSIM results

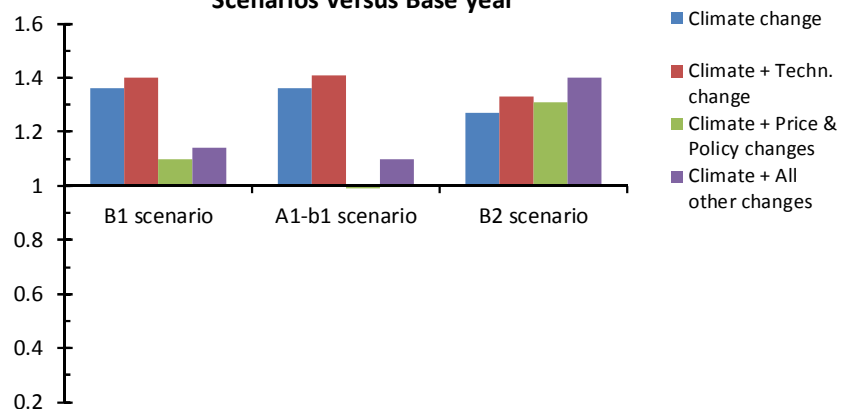


Relative changes in farm net income averaged across all farm types in Flevoland and Midi Pyrenées for the Base line (i.e. B1), A1-b1 and B2 scenarios for 2050 compared to the Base year (i.e. 2003-2005), for the variations CLIM, CLIMT, CLIMP and CLIMTP.

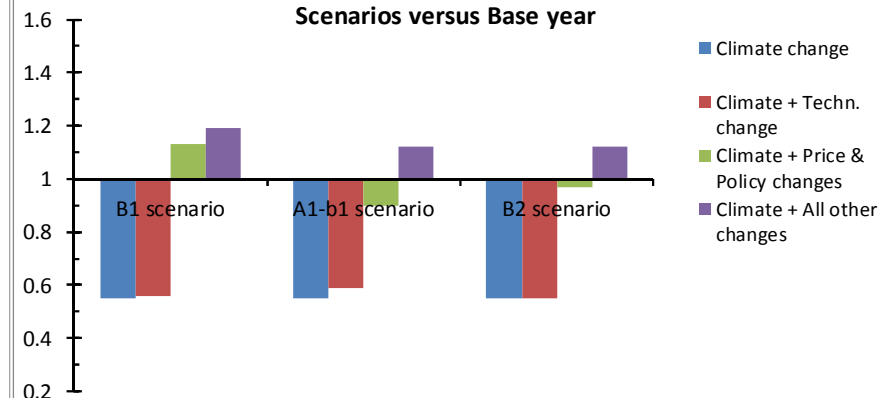
Changes in farm labour demand

FSSIM results

Flevoland - Ratio Farm labour demand
Scenarios versus Base year



Midi Pyrenées - Ratio Farm labour demand
Scenarios versus Base year



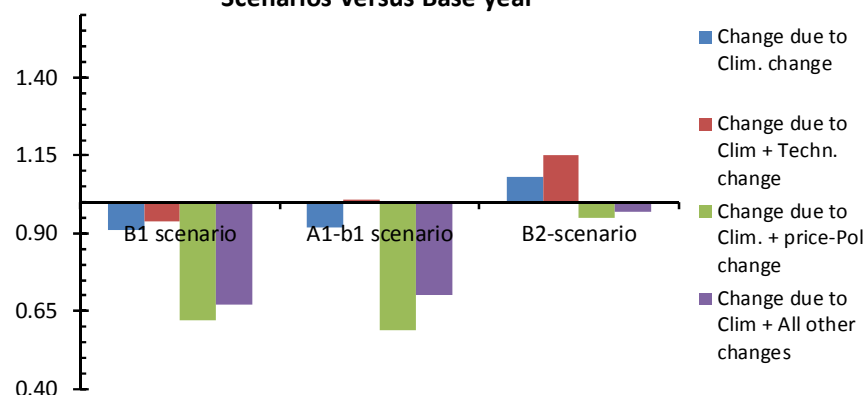
Relative changes in farm labour demand averaged across all farm types in Flevoland, and Midi Pyrenées for respectively the Base line (i.e. B1), A1-b1 and B2 scenarios for 2050 compared to the Base year (i.e. 2003-2005), considering the variations CLIM, CLIMT, CLIMP and CLIMTP.

Changes in total N leaching and runoff

INTEGRATOR results

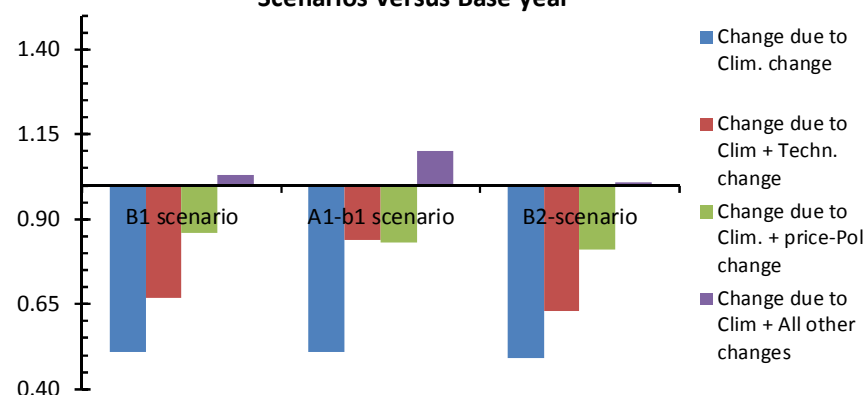
Flevoland Ratio N leaching

Scenarios versus Base year



Midi Pyrenées Ratio N leaching

Scenarios versus Base year



Relative changes in the sum of N leaching and runoff to ground water and surface water in Flevoland and Midi Pyrenées for respectively the Base line (i.e. B1), A1-b1 and B2 scenarios for 2050 compared to the Base year (i.e. 2003-2005), considering the variations CLIM, CLIMT, CLIMP and CLIMTP.

Conclusions

- **Farm income** strongly increases for both the B1 and A1-b scenarios and moderately for the B2 scenarios. This is mainly due to assumed product price changes over time and much less because of climate and technology changes.
- Changes in **farm labour demand** depend on region and are mainly caused by changes in cropping patterns.
- Changes in **N emissions and N leaching** are mainly caused by changes in N inputs and/or N uptake, which are determined by changes (mostly increase) in crop yields and cropping patterns.

Concluding remarks

- In next phase, most promising adaptation measures will be evaluated in view of expected changes. These adaptation measure then determine the needed policies to support them.
- Information is not directly useful at policy level (time scale up to 2020 and this study up to 2050), but tool is holistic and allows evaluation of CAP indicators:
 - Agricultural productivity; water abstraction: SIMPLACE
 - EU commodity price variability: CAPRI
 - Agricultural income: FSSIM/CAPRI
 - Agricultural GHG emissions and water quality indicators: INTEGRATOR

Thank you for the attention

