



Planbureau voor de Leefomgeving

IMAGE 3.0

overview

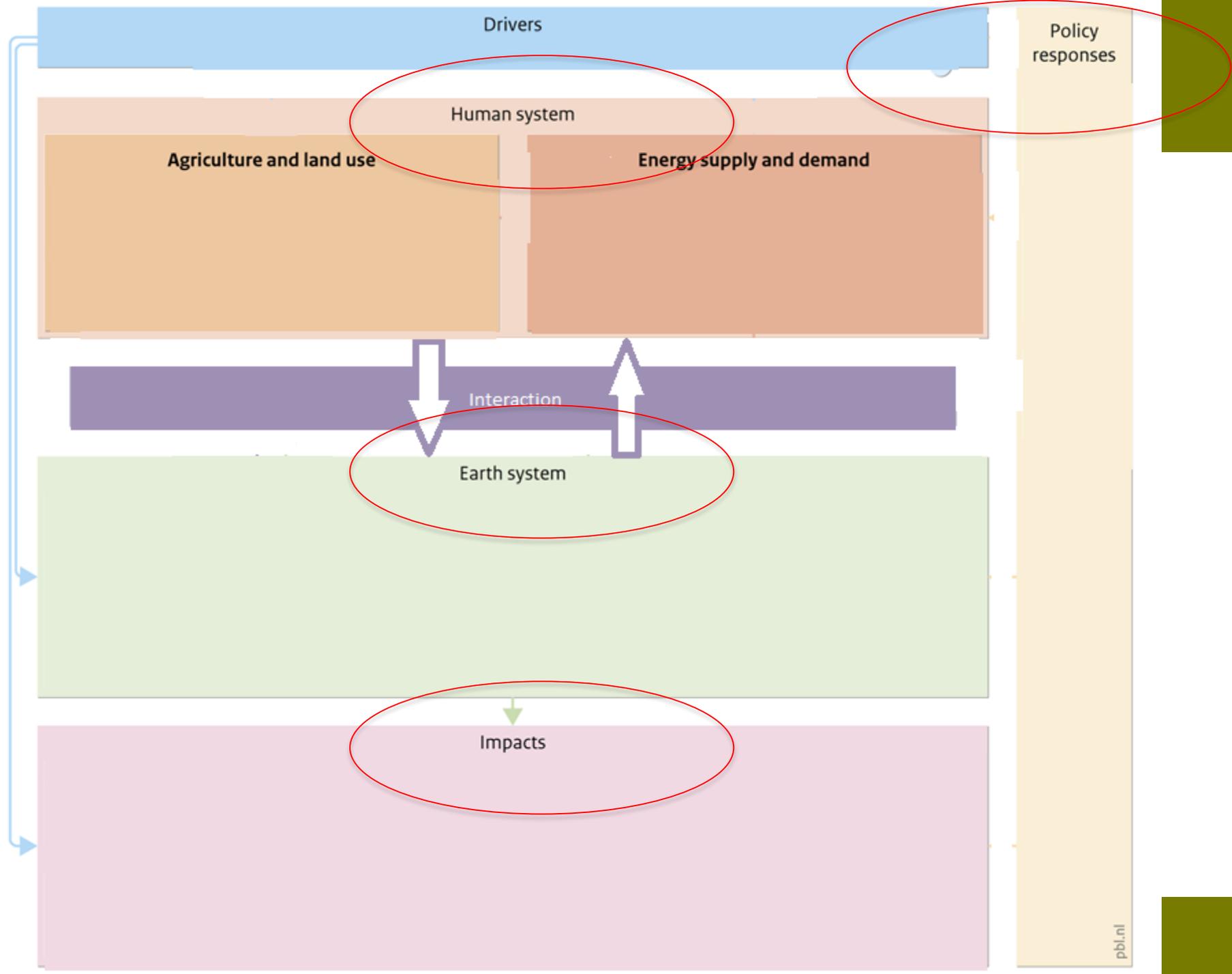
Detlef van Vuuren, Elke Stehfest,
Tom Kram, Lex Bouwman

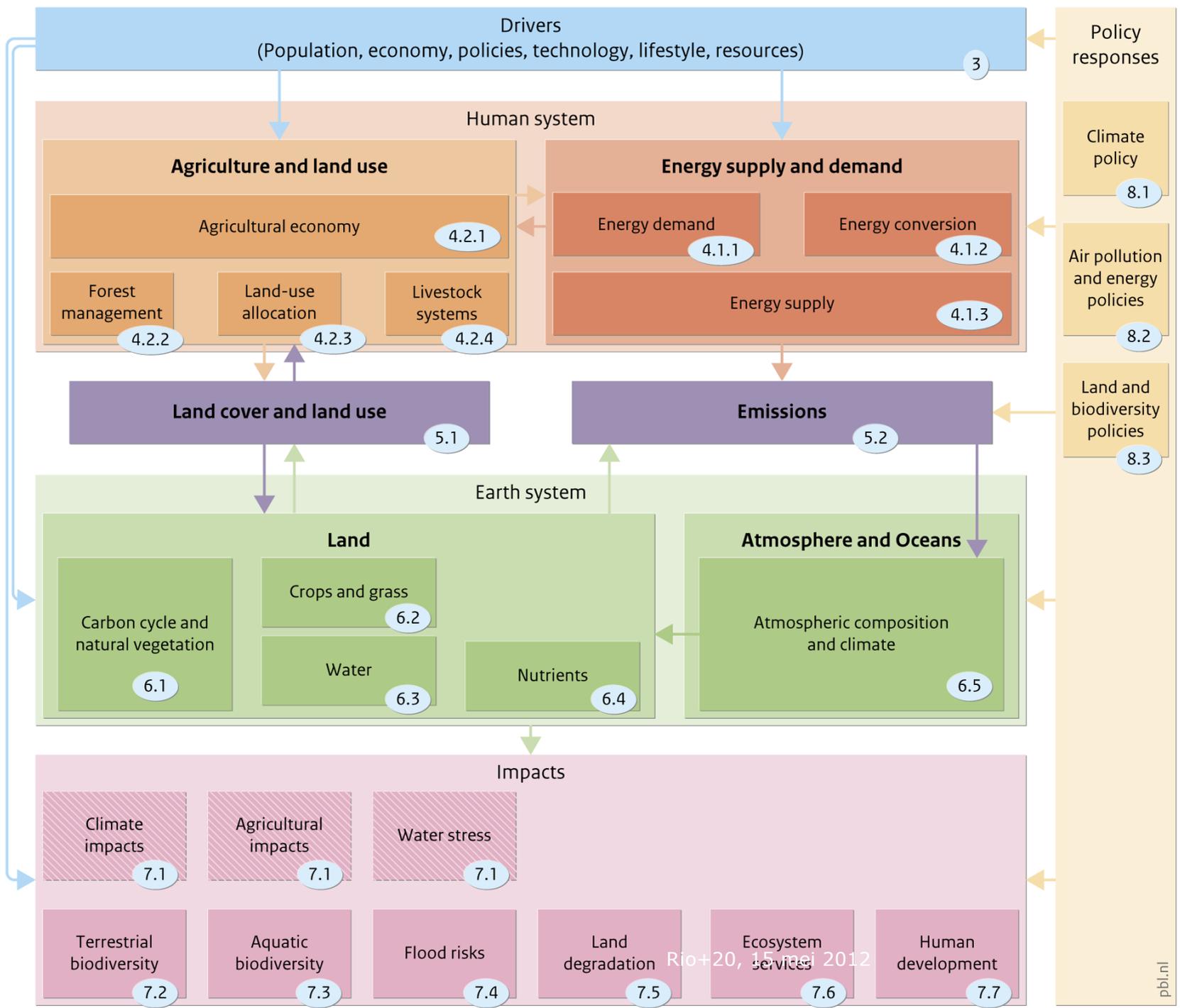




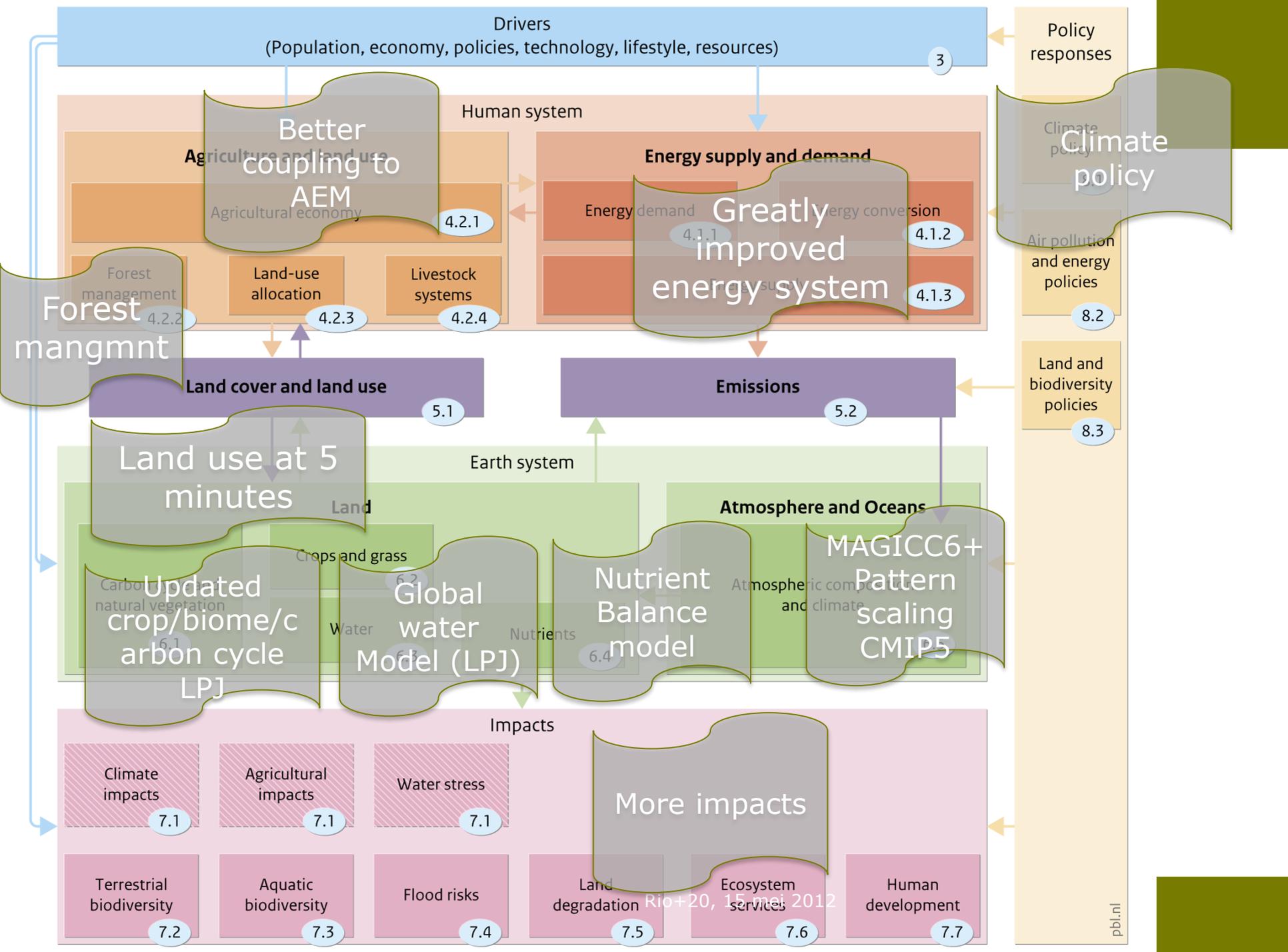
New model version IMAGE 3.0

- Long history, from IMAGE 1.0 (1990, 1 world global model for climate), via IMAGE 2.0 (1994, gridded system), IMAGE 2.1 (1998, global environmental change focus), IMAGE 2.4 (more policy relevant) to IMAGE 3.0)
- IMAGE 3.0 partly more a model framework than a single model.
- Objectives:
 - large-scale and long-term interactions between human development and the natural environment to understand global environmental change
 - To identify response strategies to global environmental change based on assessment of options for mitigation and adaptation;
 - To indicate key interlinkages and associated levels of uncertainty in processes of GEC.



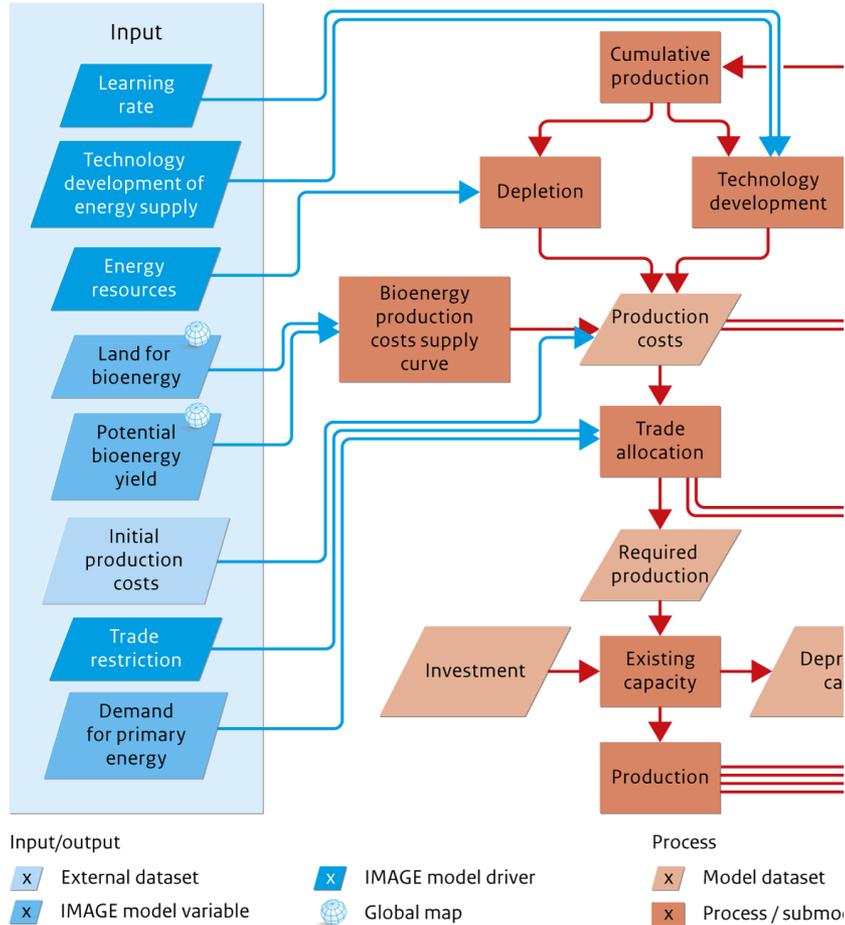


Rio+20, 15 mei 2012



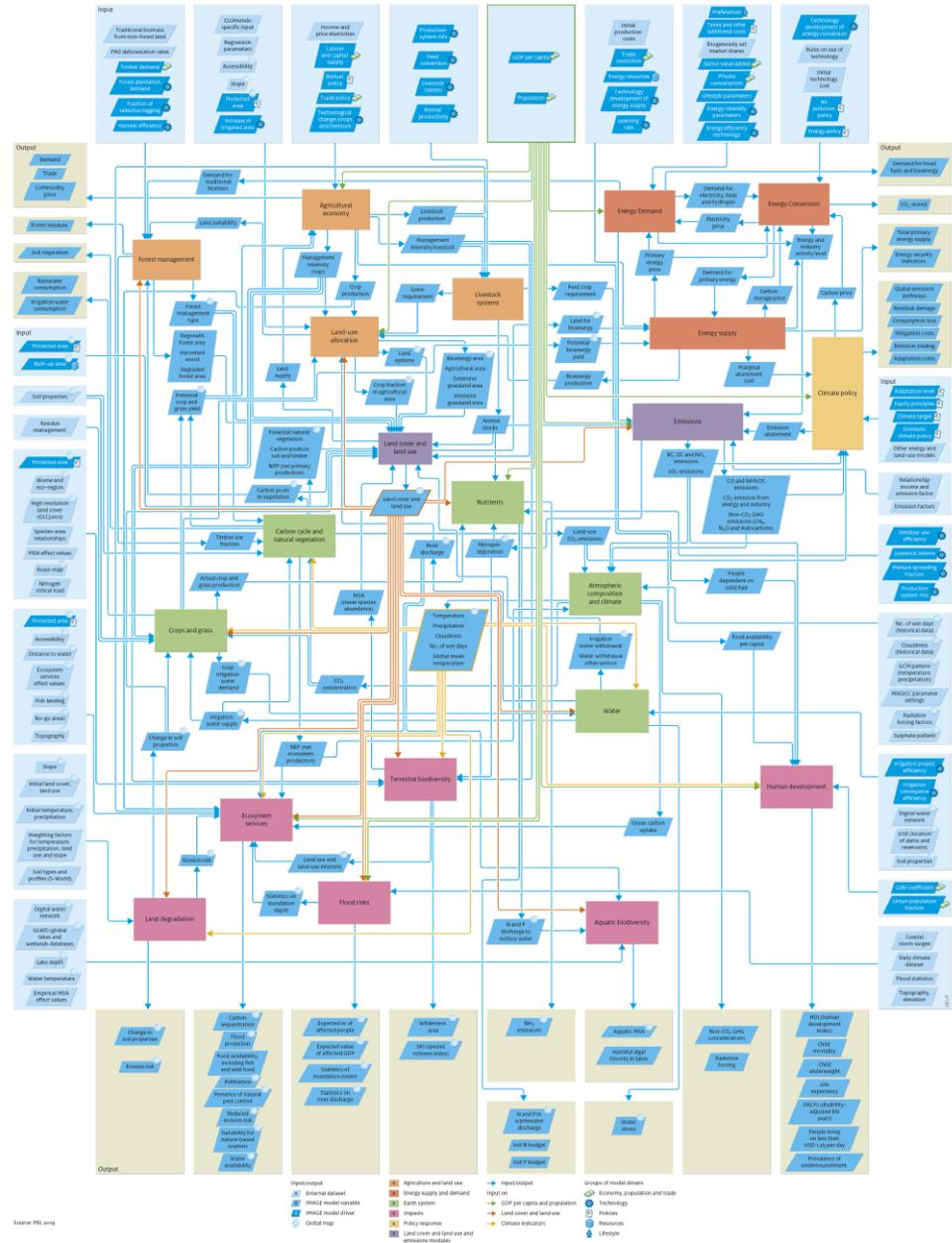
Website links all components

TIMER model, energy supply module

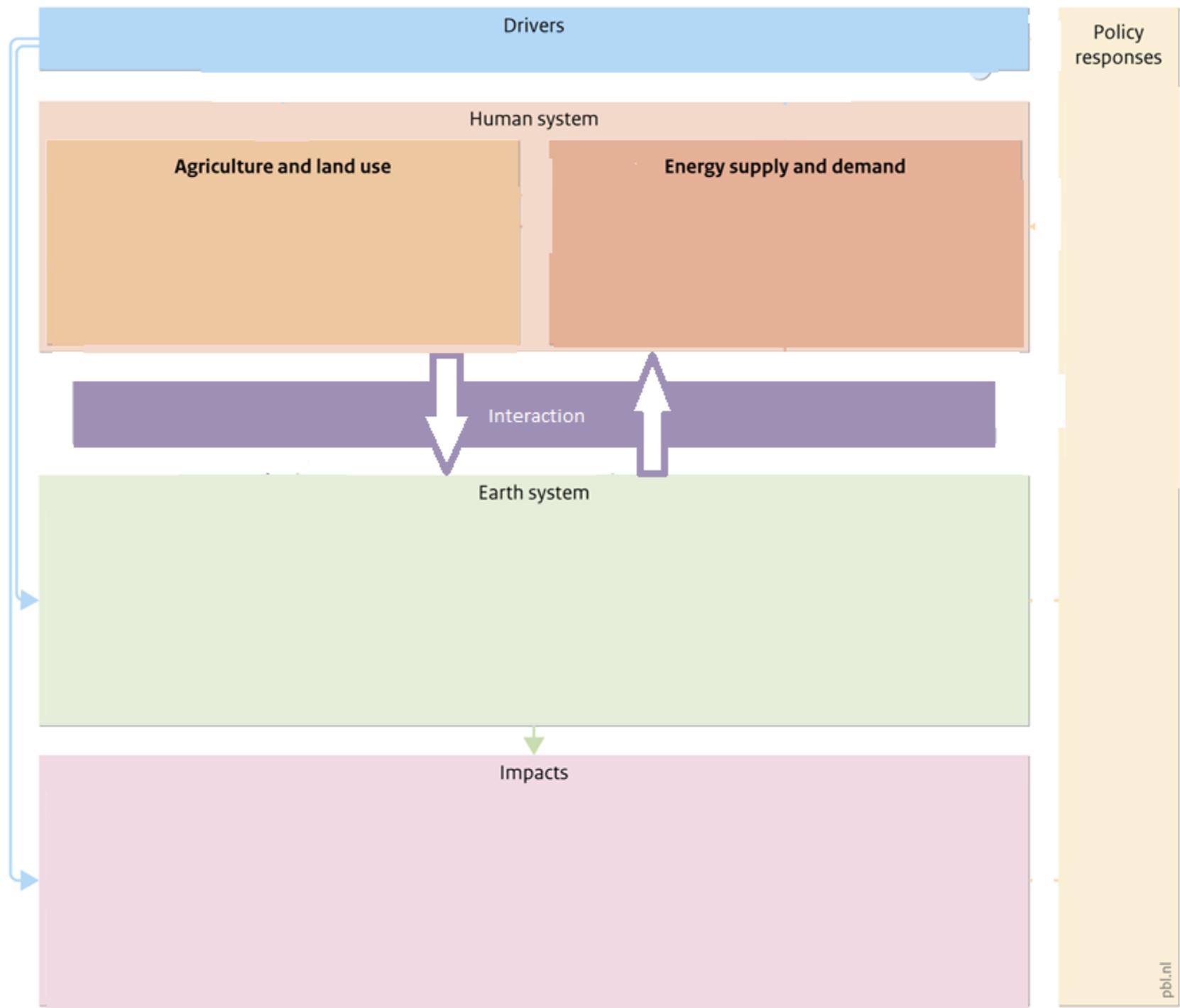


Source: PBL 2014

Image 3.0 in detail



Source: PBL 2014



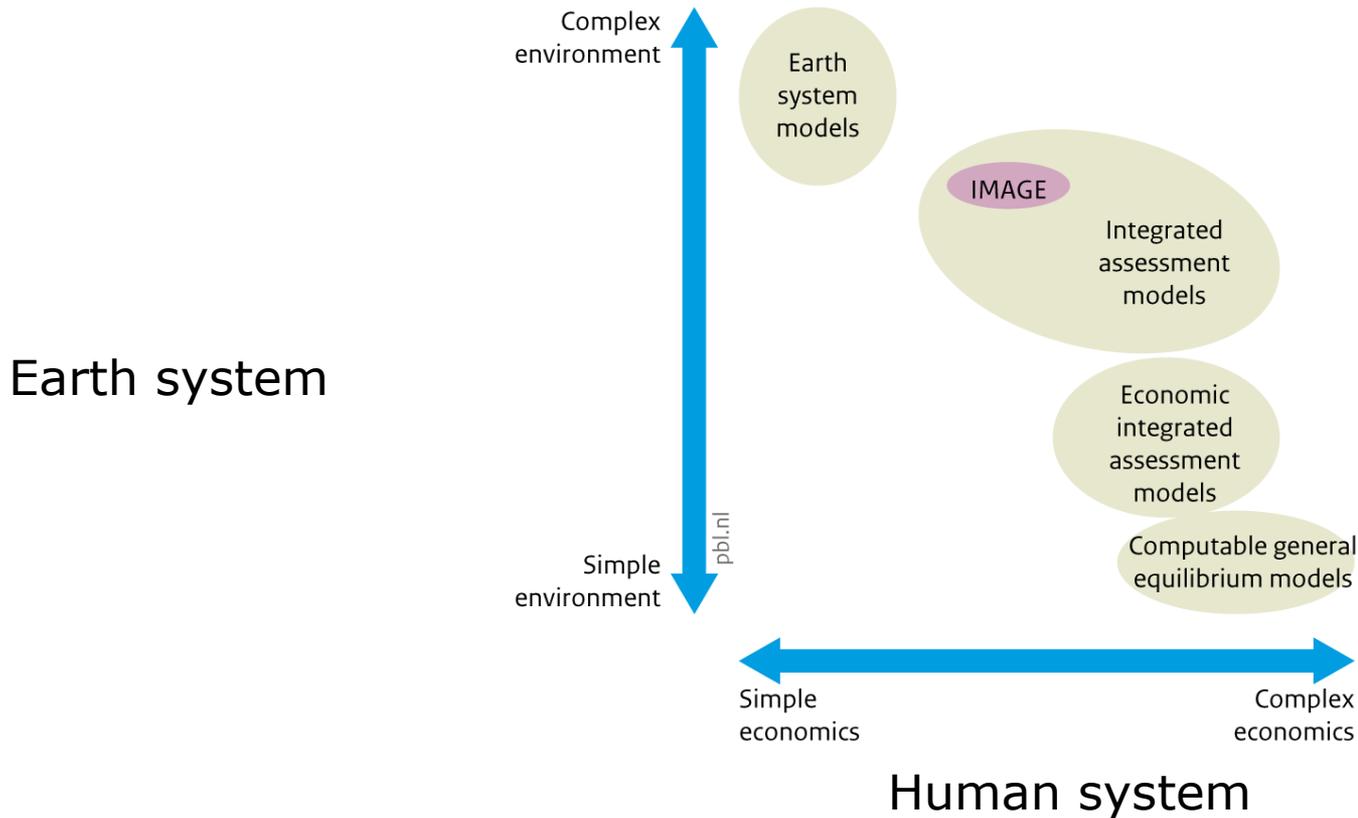
Human system



Earth system

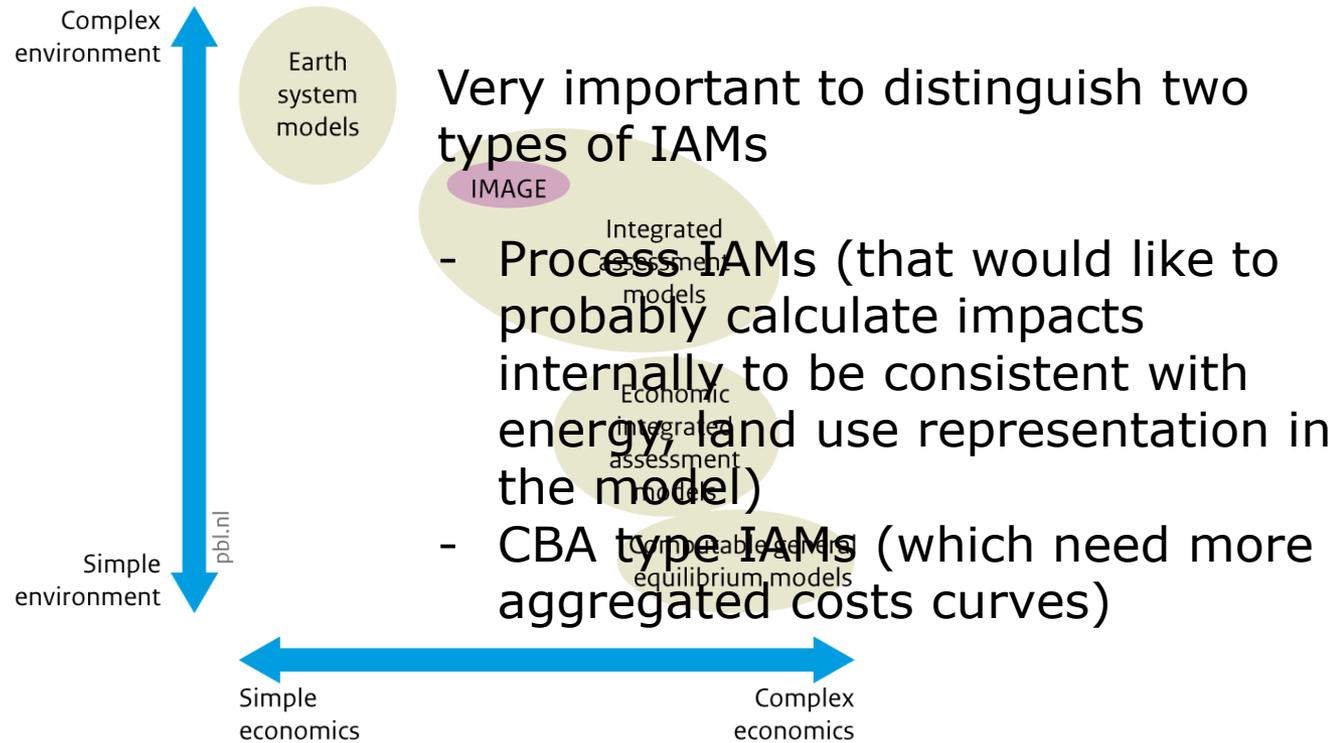
IMAGE compared to other global models

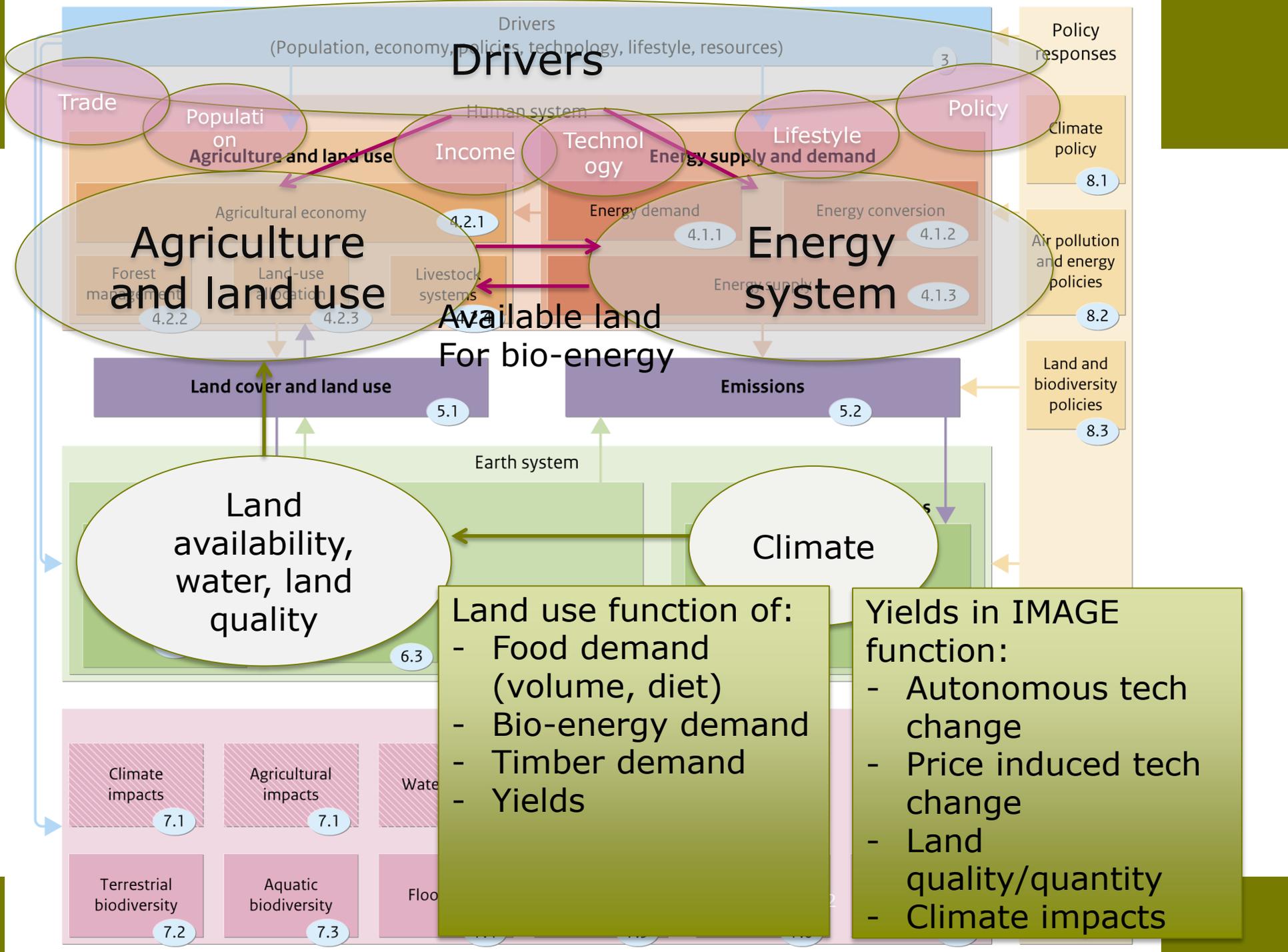
Different types of global models distinguished according to level of detail



Different IAMs → different impact representation.

Different types of global models distinguished according to level of detail



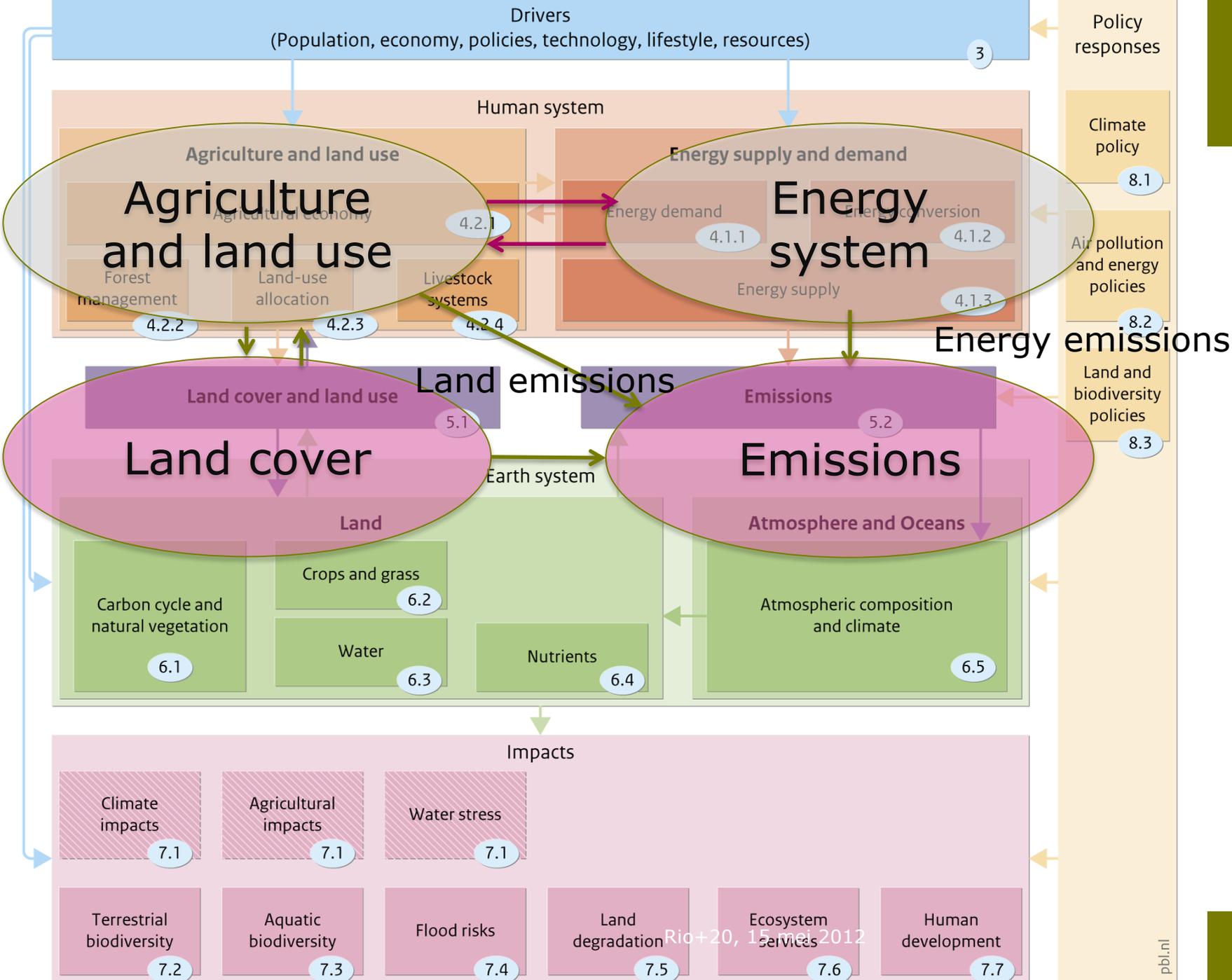


Land use function of:

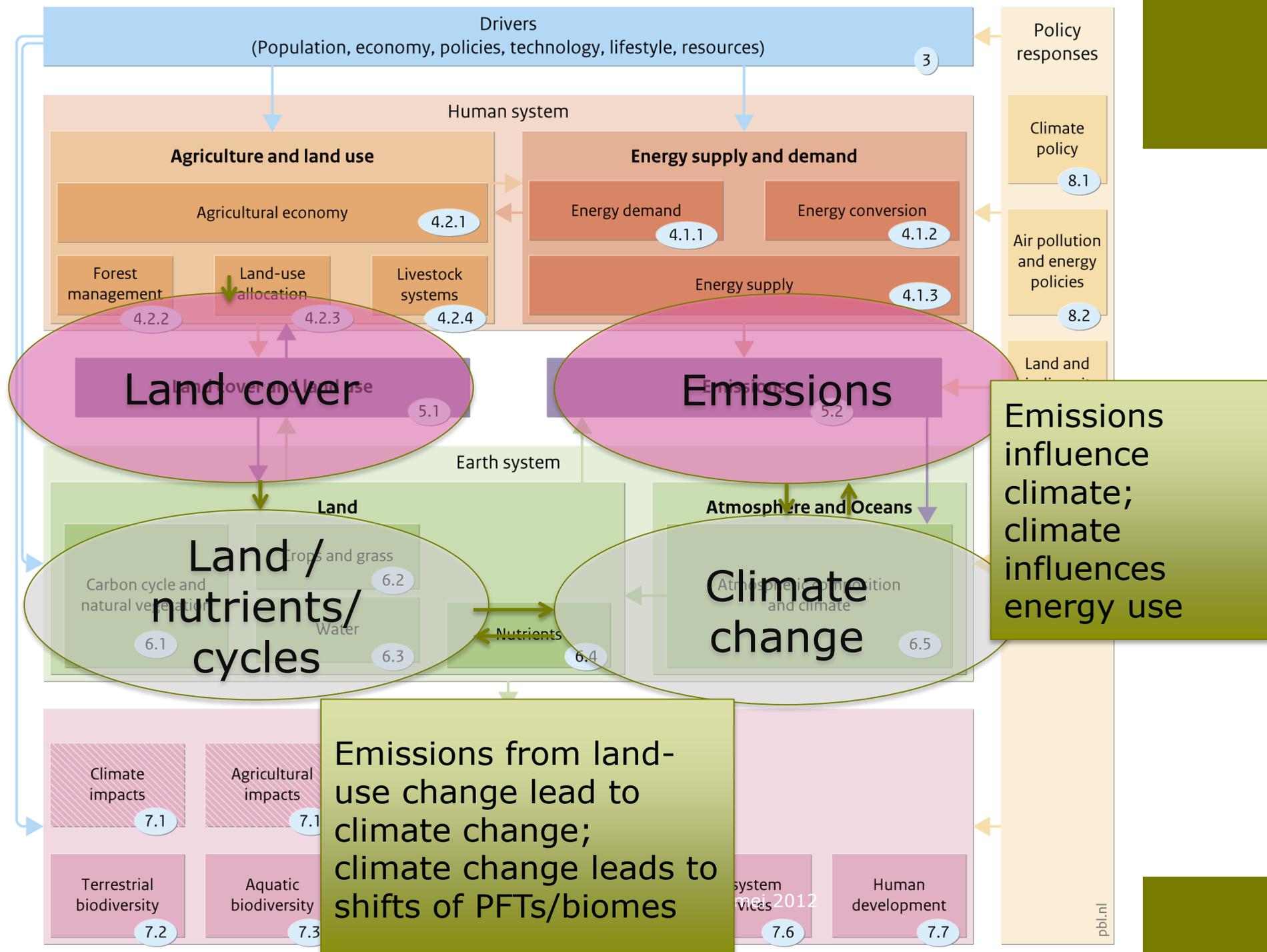
- Food demand (volume, diet)
- Bio-energy demand
- Timber demand
- Yields

Yields in IMAGE function:

- Autonomous tech change
- Price induced tech change
- Land quality/quantity
- Climate impacts

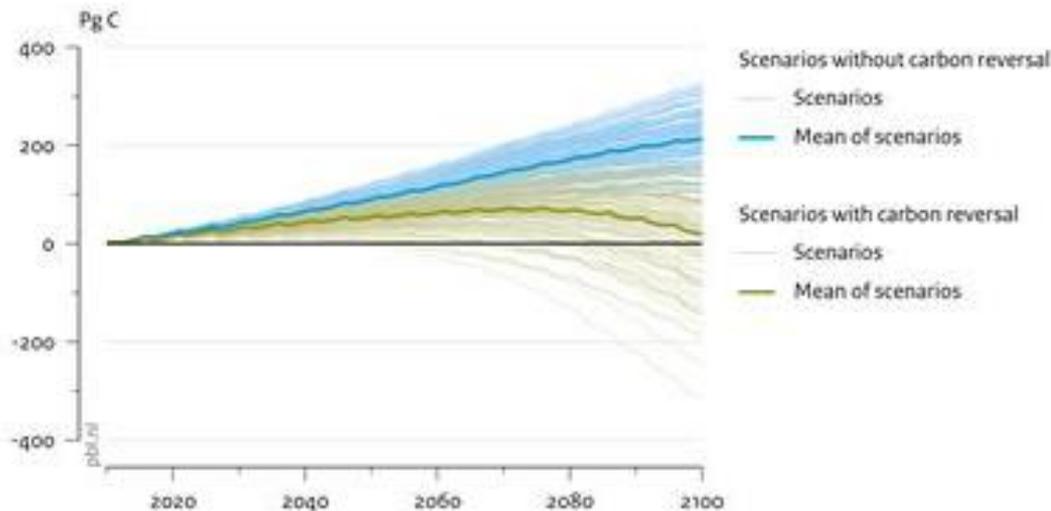


Rio+20, 15 June 2012



Description of earth system – LPJ as core

Cumulative terrestrial carbon flux of long-term climate scenarios



Source: Müller et al, in preparation

Terrestrial ecosystems currently form net sink – but could become a net release of carbon (depending on climate and other uncertainties)

→ Also land use scenario play a major role.

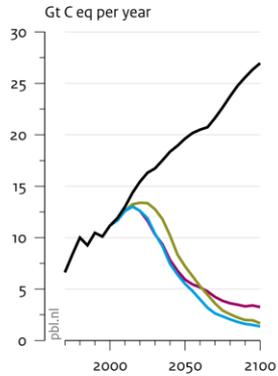
Climate: MAGICC + pattern scaling



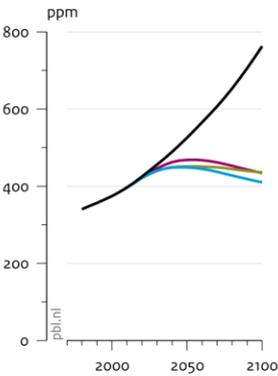
Planbureau voor de Leefomgeving

Greenhouse gas emissions, CO₂ concentration, temperature increase and radiative forcing under baseline and climate policy scenarios

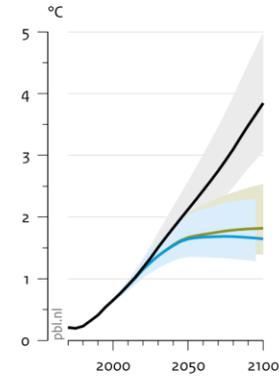
Greenhouse gas emissions



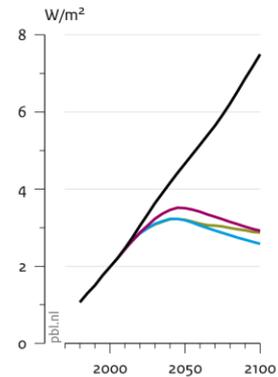
CO₂ concentration



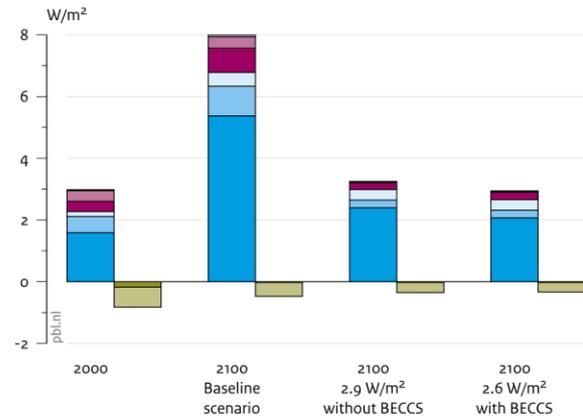
Temperature increase



Radiative forcing

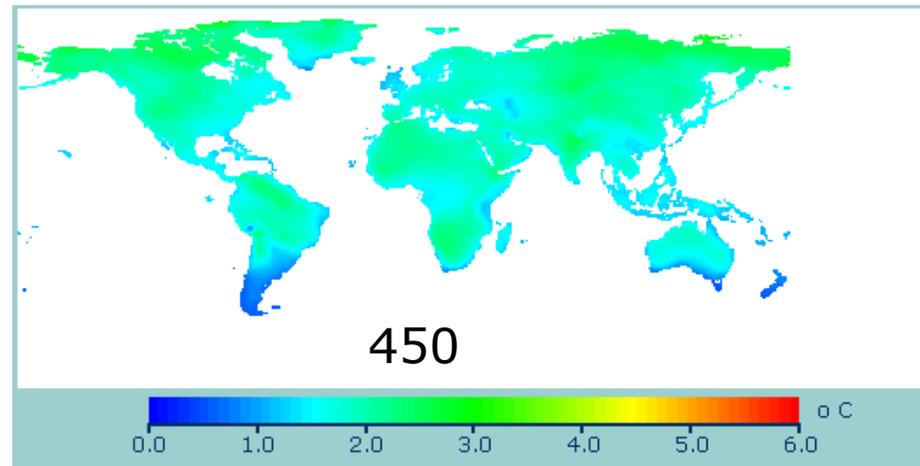
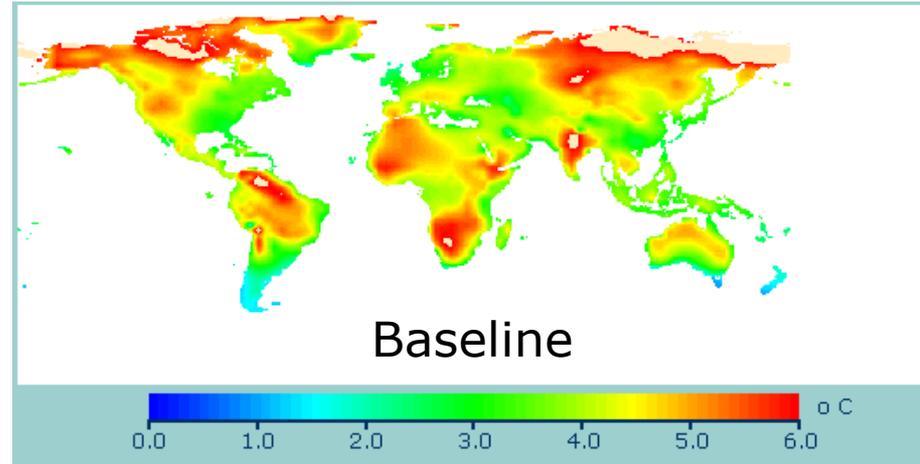


Radiative forcing by component



- Baseline scenario
- 2.9 W/m² without BECCS
- 2.9 W/m² with BECCS
- 2.6 W/m² with BECCS
- Range baseline scenario
- Range 2.9 W/m² with BECCS
- Range 2.6 W/m² with BECCS
- Stratospheric water vapour
- Tropospheric ozone
- Halogenated gases
- N₂O
- CH₄
- CO₂
- Stratospheric ozone
- Aerosols

Source: Van Vuuren et al. 2010



Rio+20, 15 mei 2012

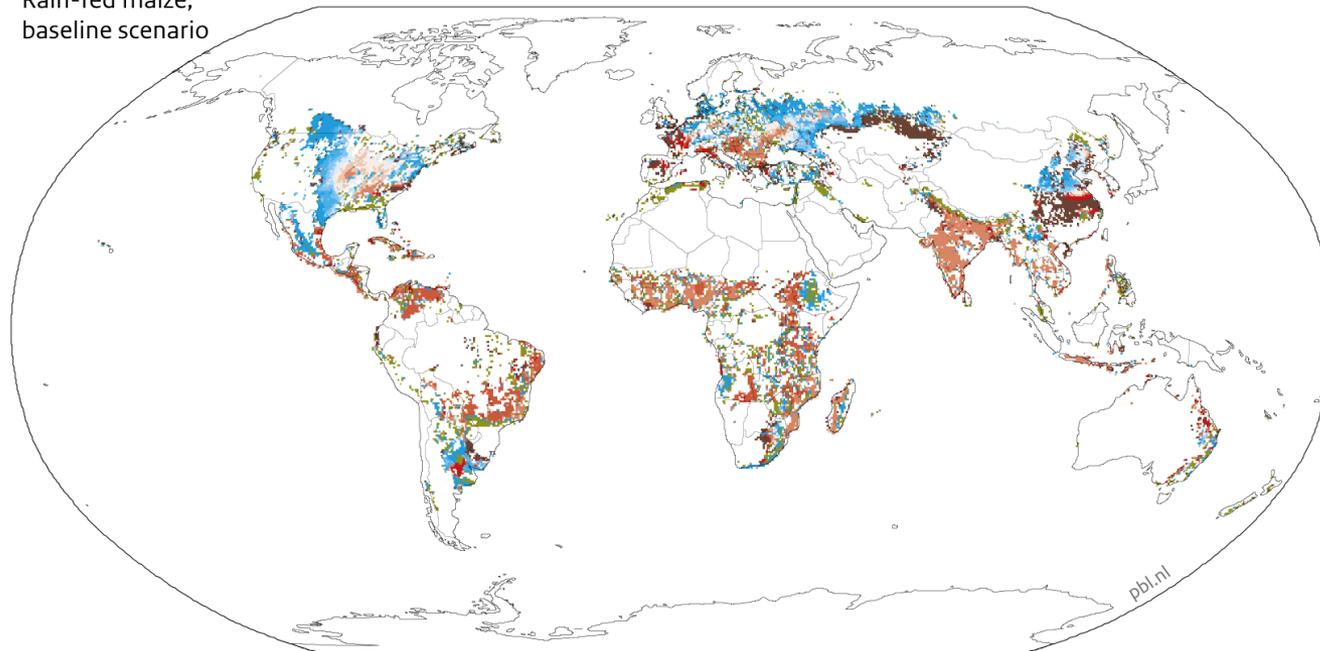
Climate impacts on crops



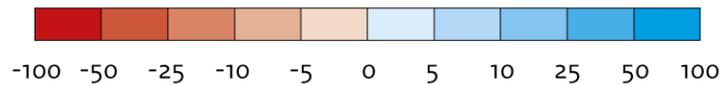
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Climate change impacts on crop yields from 1981 – 2010 to 2070 – 2099

Rain-fed maize,
baseline scenario



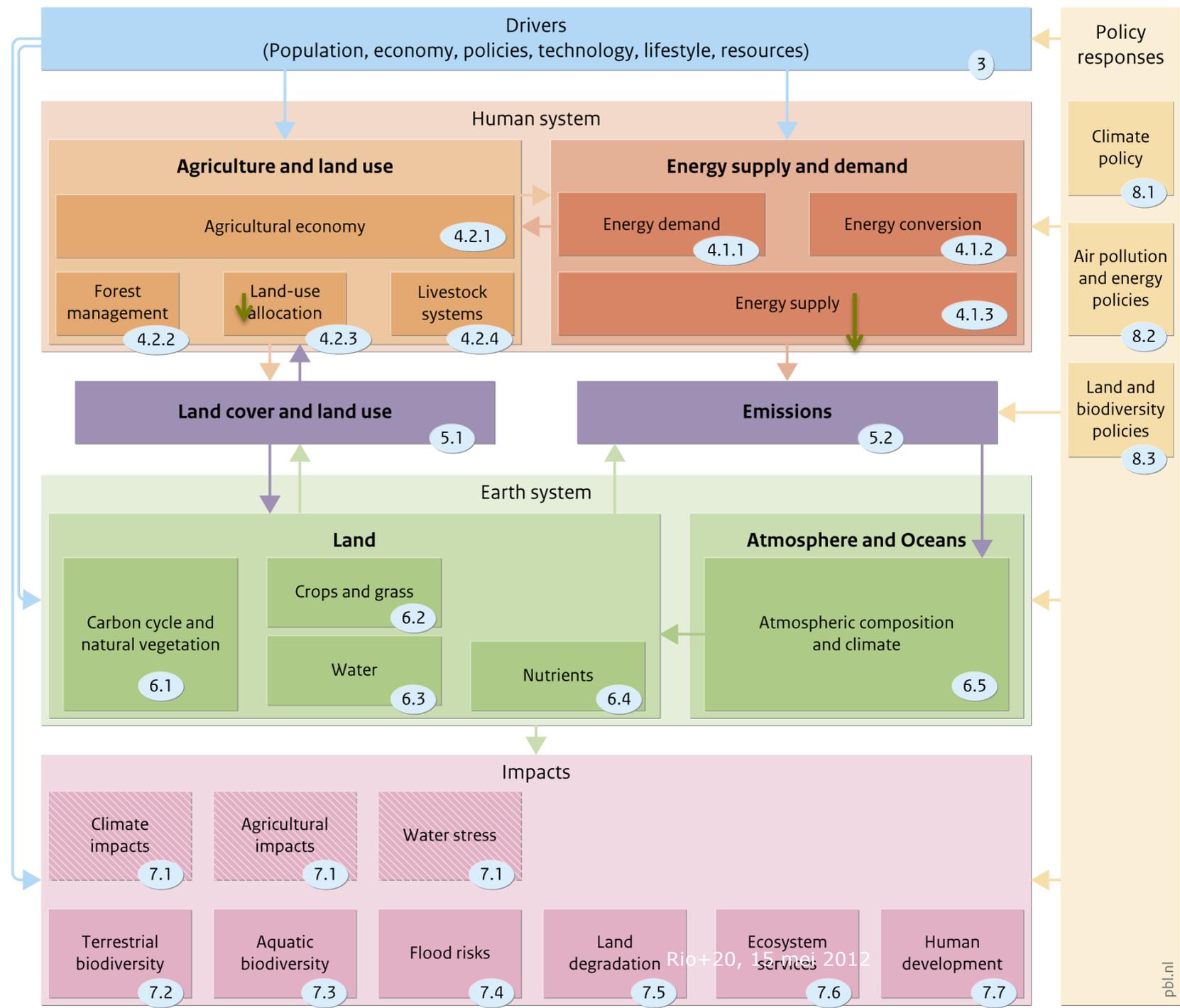
Change in crop yields in %



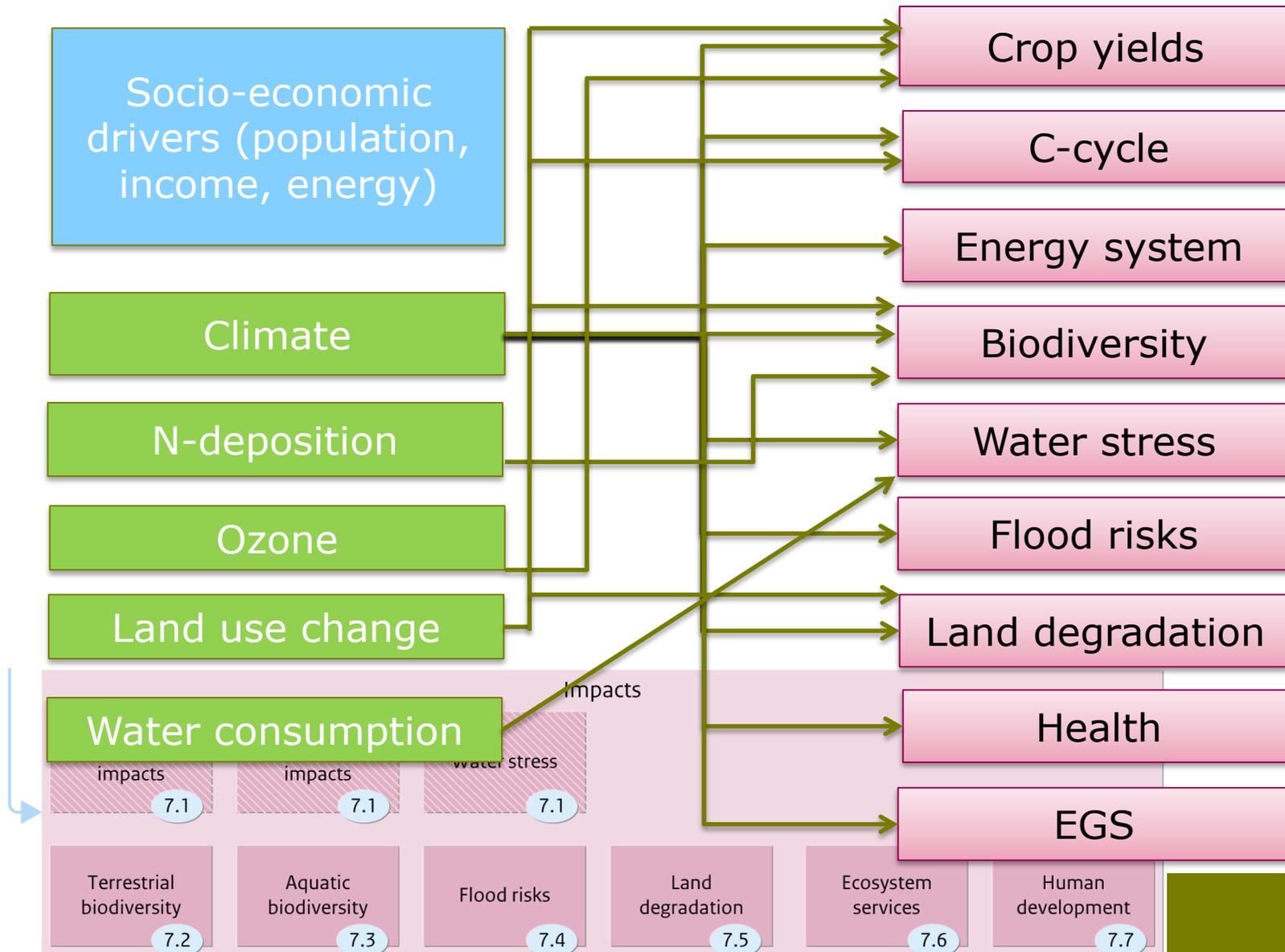
Abandonment

Expansion

Source: PBL 2014



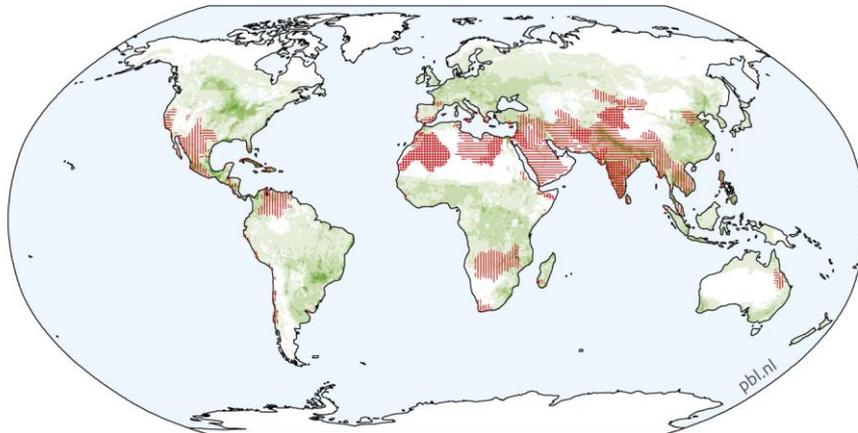
Rio+20, 15 mai 2012



Water scarcity

- Water modelled in IMAGE by LPJml: water modelling in river basins; interaction with land use on grid scale. Water demand and agriculture economic response energy at 26 regions.

Regions vulnerable to crop production losses due to irrigation water shortage



Basins with irrigated crop production

Reduction more than 20% due to water shortage

More than 20% depending on groundwater

Crop production (t / grid cell)

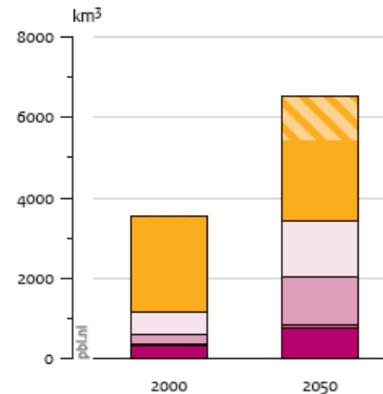
Low High

Source: Biemans et al. 2012

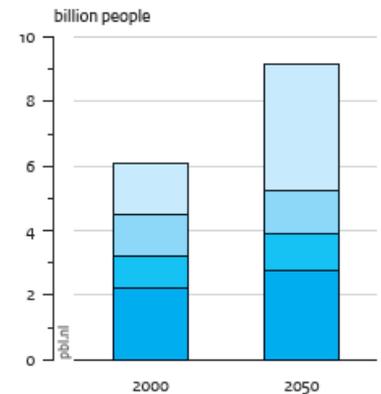
Figure 6.3.2

Global water demand and water stress under a baseline scenario

Global water demand



Population in water-stressed basins



Uncertainty due to water stress

Irrigation

Electricity

Manufacturing

Livestock

Domestic

Severe water stress

Medium water stress

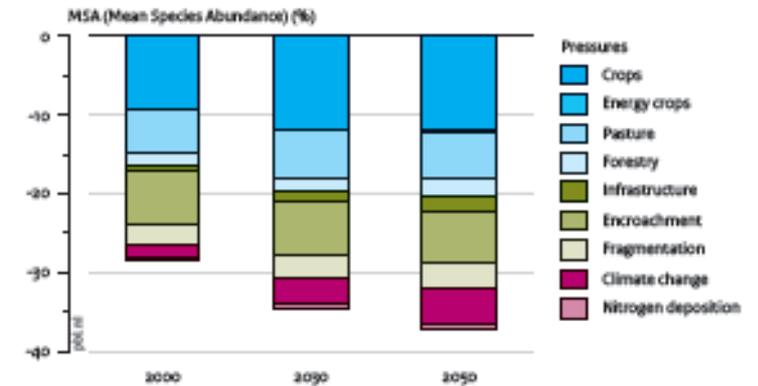
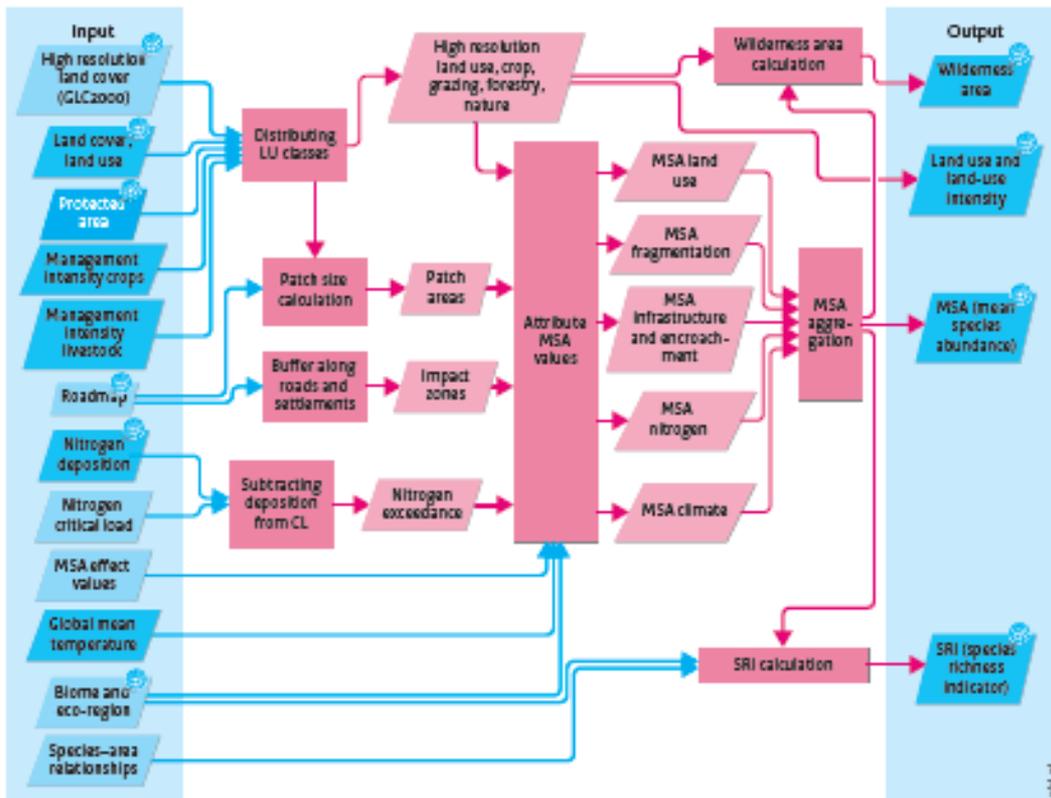
Low water stress

No water stress

Water scarcity influenced by water demand (agriculture, energy, industry, population) and climate change; Water scarcity impacts irrigation availability



Biodiversity

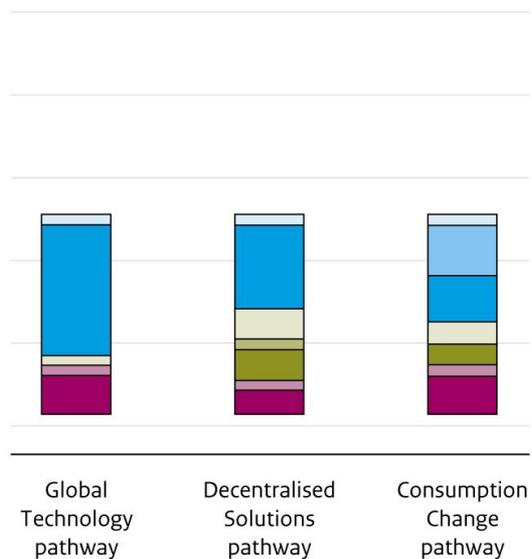
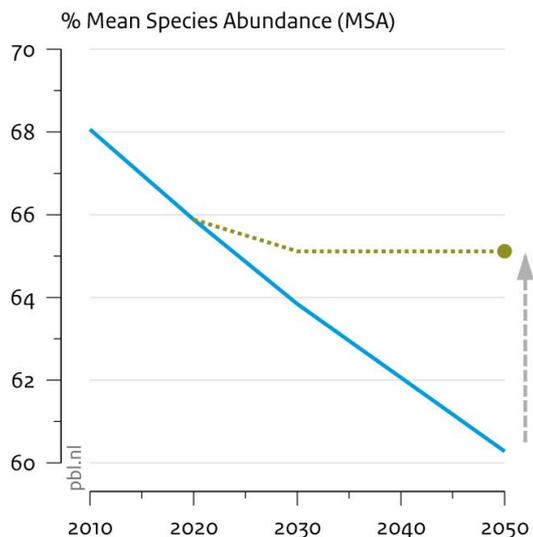




Global biodiversity and options to prevent biodiversity loss

Global biodiversity

Contribution of options to prevent biodiversity loss, 2050



— Trend scenario

● Goal

..... Derivation of 2050 goal

↑ Policy gap

Restore abandoned agricultural lands

Reduce consumption and waste

Increase agricultural productivity

Expand protected areas

Reduce nature fragmentation

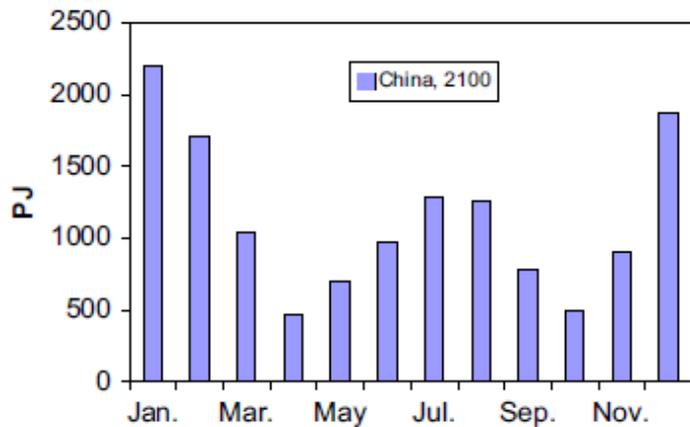
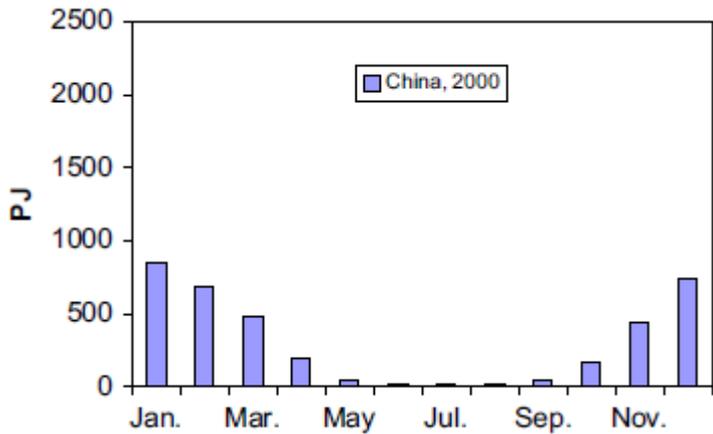
Reduce infrastructure expansion

Reduce nitrogen emissions

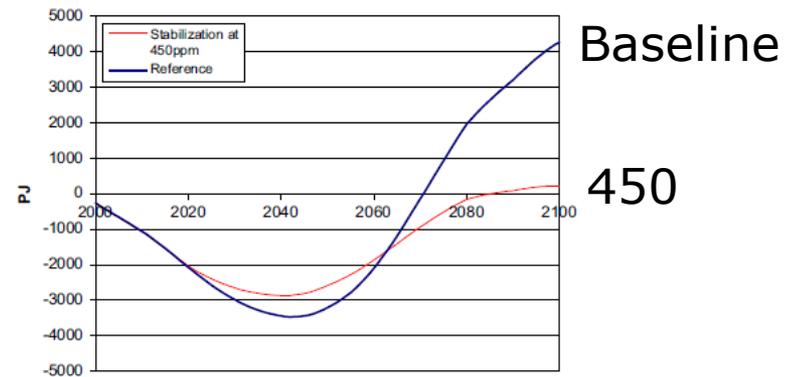
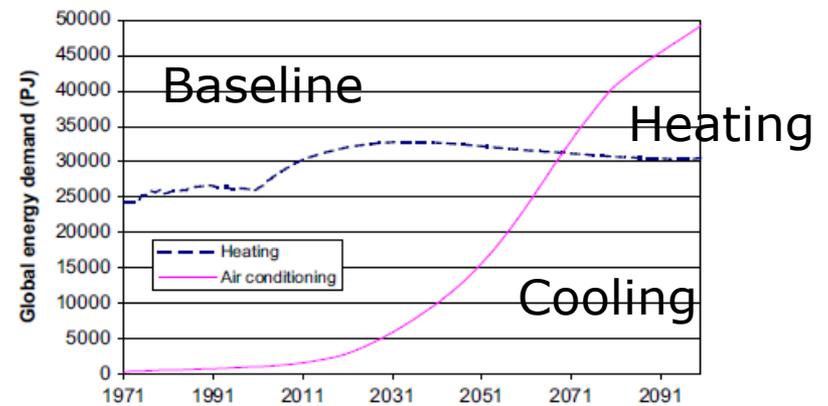
Mitigate climate change



Energy



Century pattern





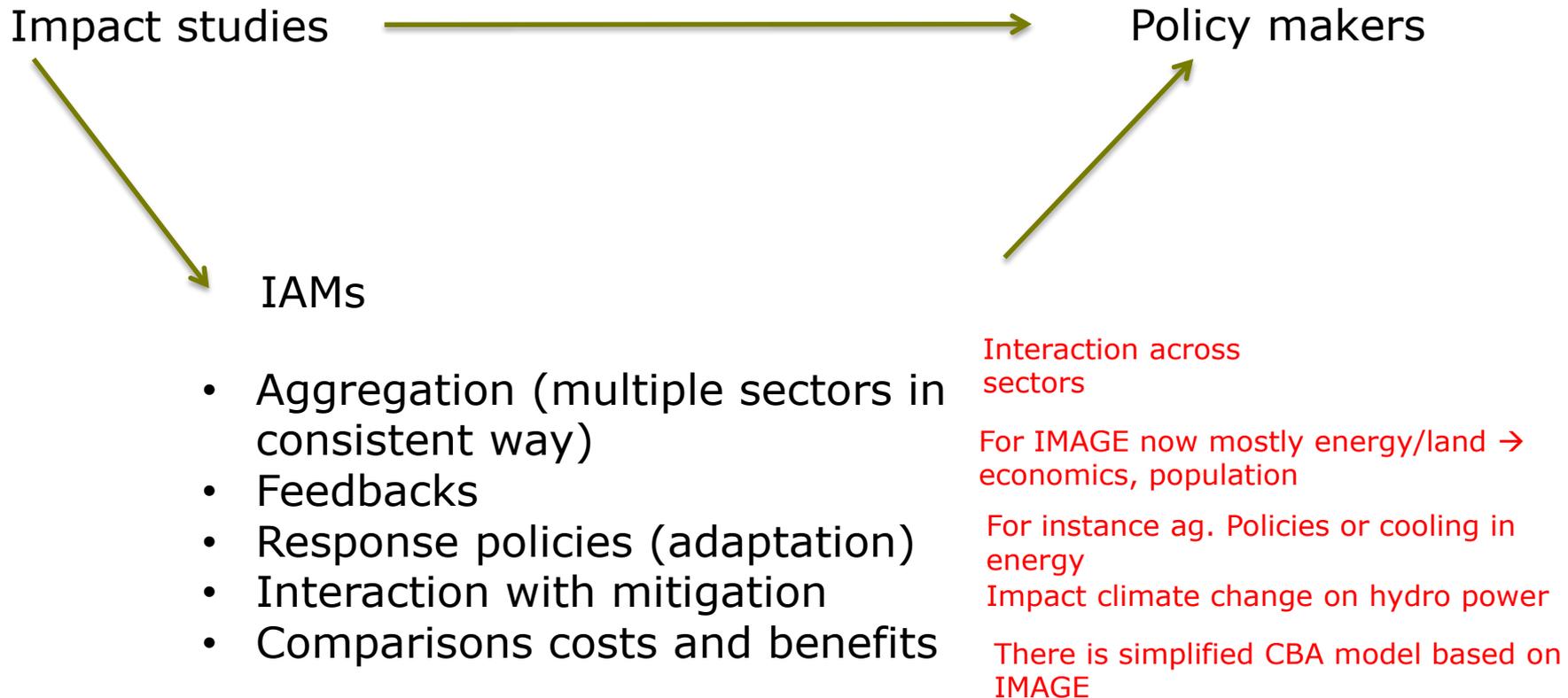
So relationships between IAM and impact research

- Depends strongly on the type of IAMs, information needs for DICE very different from IMAGE – information need strongly depend on the model
 - DICE: Interested in aggregated equation on damage and delta T
 - IMAGE: Interested in relationships between climate parameters and the processes represented in IMAGE

For IMAGE, we actually would like to test our future strategy slightly better against this.

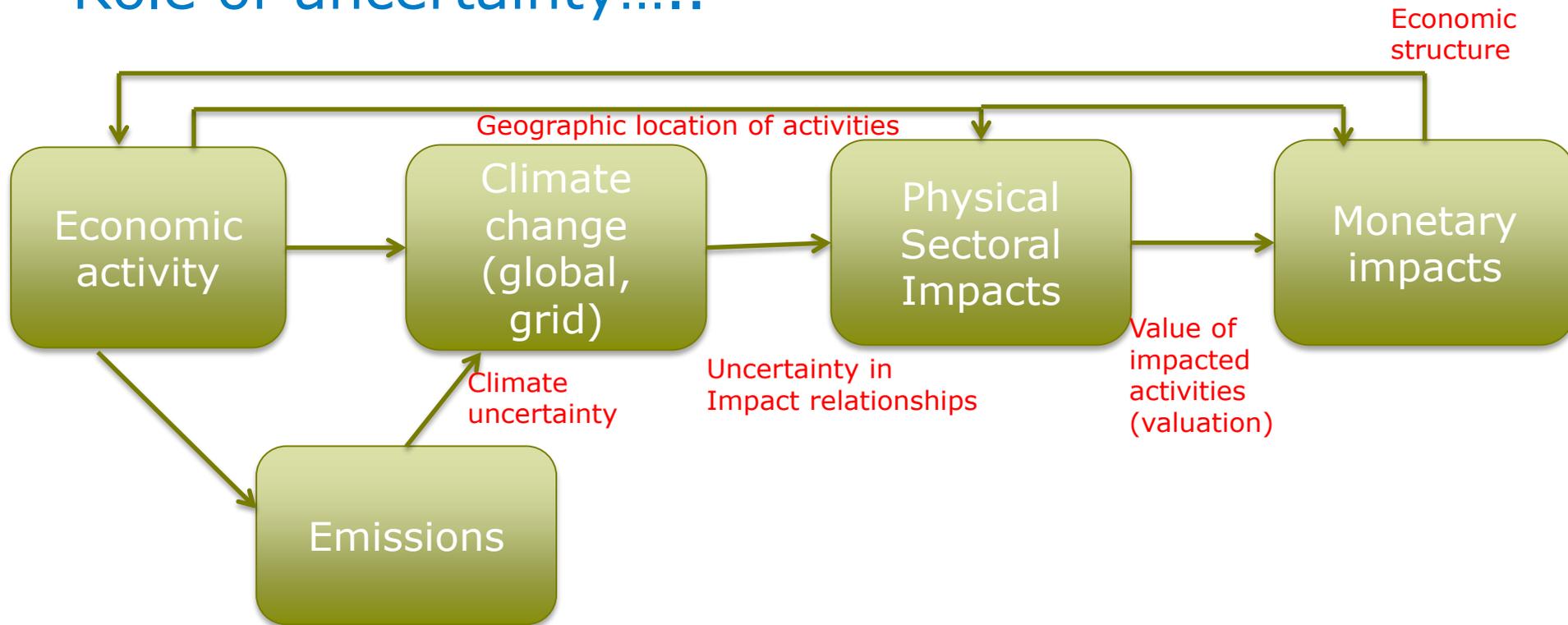


How can IAMs add to sectoral impact studies?





Role of uncertainty.....



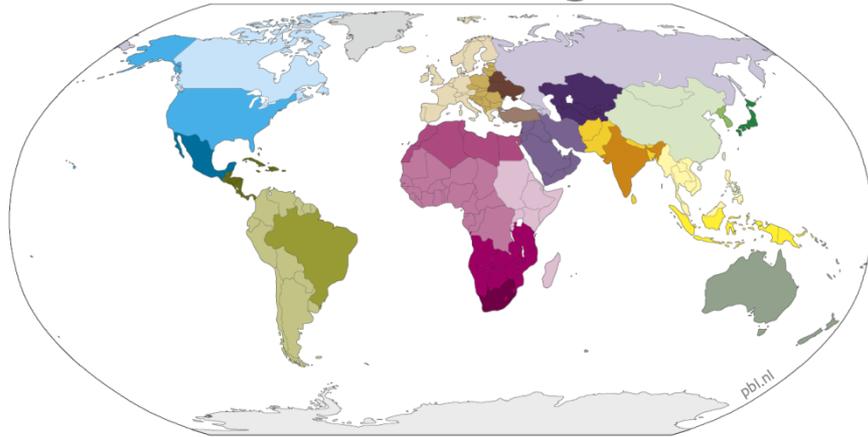
Somehow we need a process that is able to do this in a transparent way, that can be updated in time and on individual insights and still represents uncertainty

Role of scale.....

Socio-economic processes

IMAGE regional breakdown

26 regions

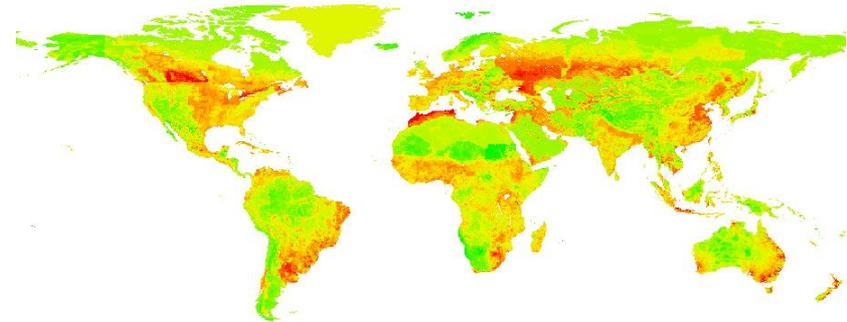


- | | | | |
|-----------------------|-------------------------|--------------------|--------------|
| Canada | Western Europe | Russia region | China region |
| USA | Central Europe | Central Asia | Korea region |
| Mexico | Ukraine region | Middle East | Japan |
| Central America | Turkey | Southeastern Asia | Oceania |
| Brazil | Northern Africa | Indonesia region | Greenland |
| Rest of South America | Western Africa | India* | Antarctica |
| | Eastern Africa | Rest of South Asia | |
| | South Africa* | | |
| | Rest of Southern Africa | | |

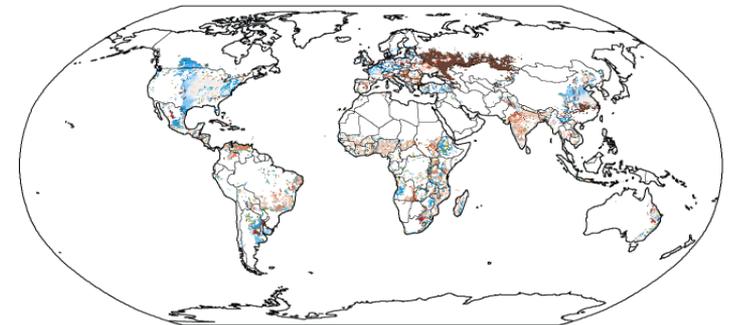
*) In the land-use modelling of IMAGE and MAGNET India is merged with the Rest of South Asia ('India region') and South Africa with the Rest of Southern Africa ('Southern Africa').

Bron: PBL 2014

Environmental factors



5 min: land use, land cover



30 min, fractional land use: LPJmL



Should we organise interaction better?

- E.g. SSP-process designed to help this process – is it designed best for this?
- E.g. ISI-MIP and use of scenarios in ISI-MIP – more interaction?
- Compare the IAM model outcomes to the MIP outcomes and see where they are.