Validation in IMAGE

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@IMAGE_PBL

Validation activities in IMAGE

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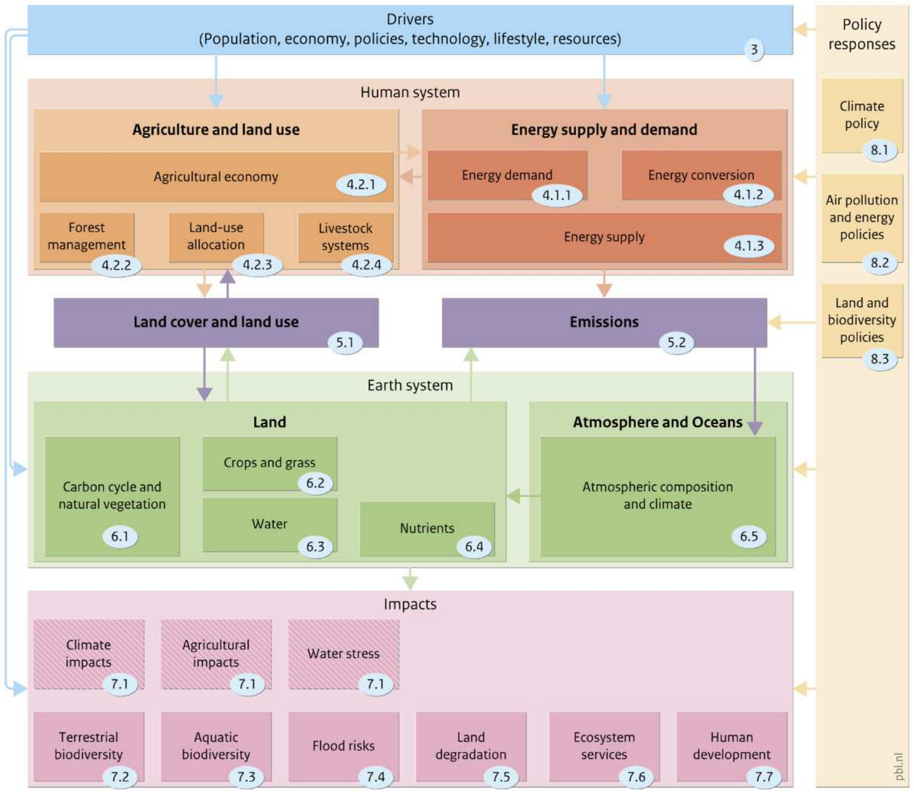
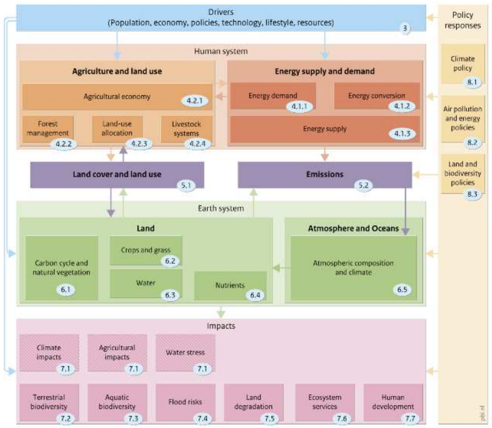
Co-lead WP4 (national scale mitigation scenarios)

Methods that have been used in IMAGE for validation

1. Validation & calibration over historical period (1970-2015/2020)
2. Model comparison
3. Model documentation
4. Uncertainty analysis
5. Use of scenarios
6. Comparison of future and historic rates of change
7. Discussion of model results with science communities



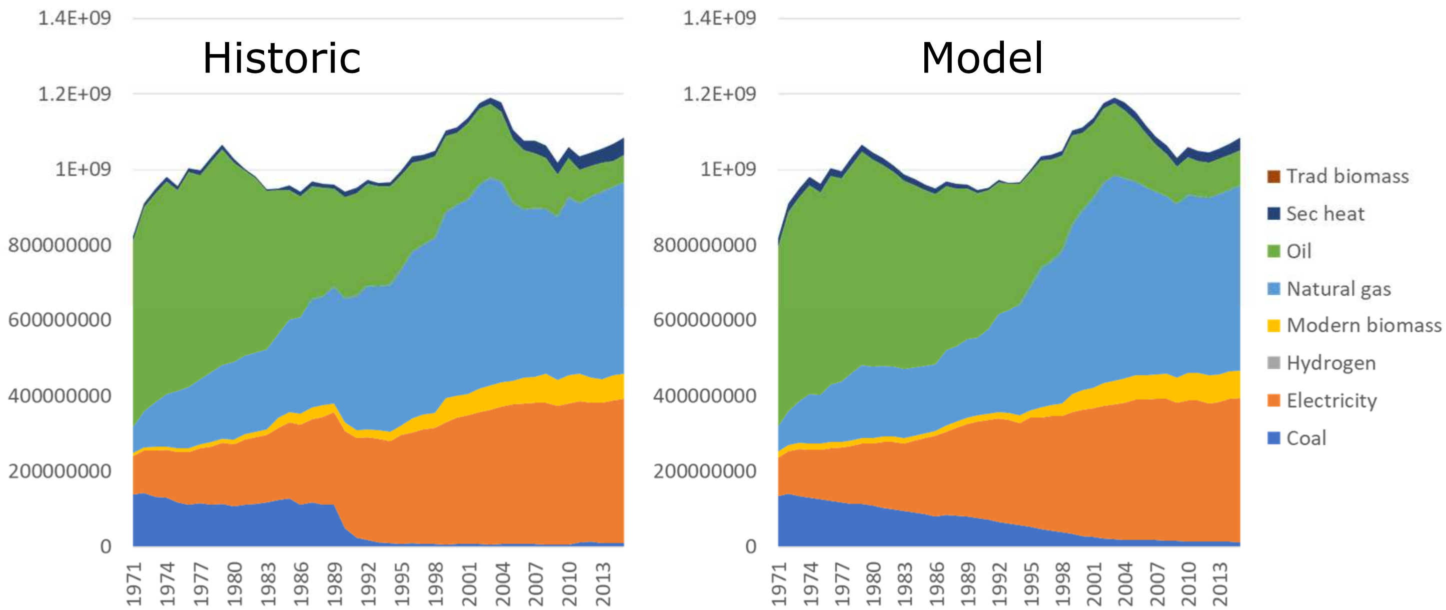


1.Calibration/validation over historical period (1970-2015/2020)

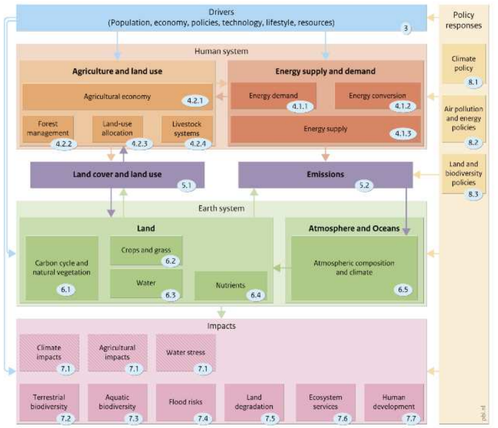
- Auto-calibration of the model to historical data over 1970-2015 period

An IMAGE model run starts in 1970 and over the period 1970-2015/2020 it is forced to follow the historical period, using exactly the same equations as for the future period (but with calibrated parameters)

Example food processing

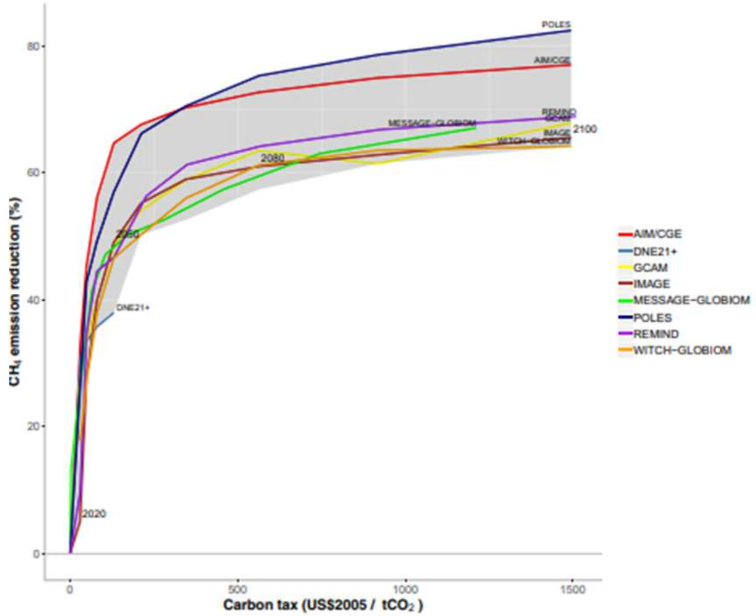


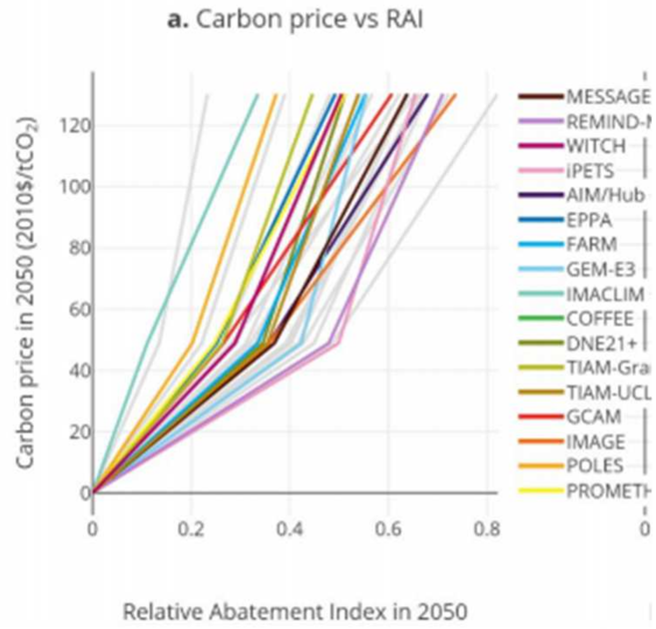
- Proves that model is able to reproduce past + forms spin-up



2. Model comparison (EMF, EUEMF, ENGAGE/NAVIGATE, AGMIP etc)

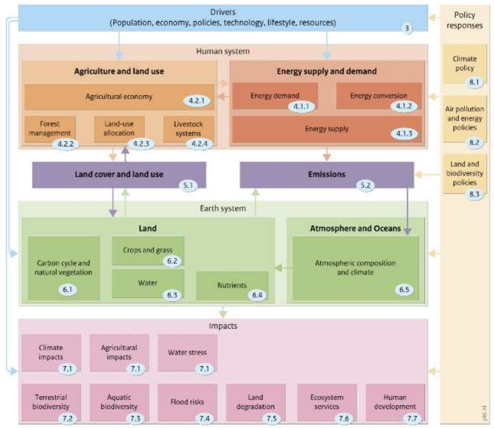
We participate in many model comparisons and learn how the model behaves compared to other models





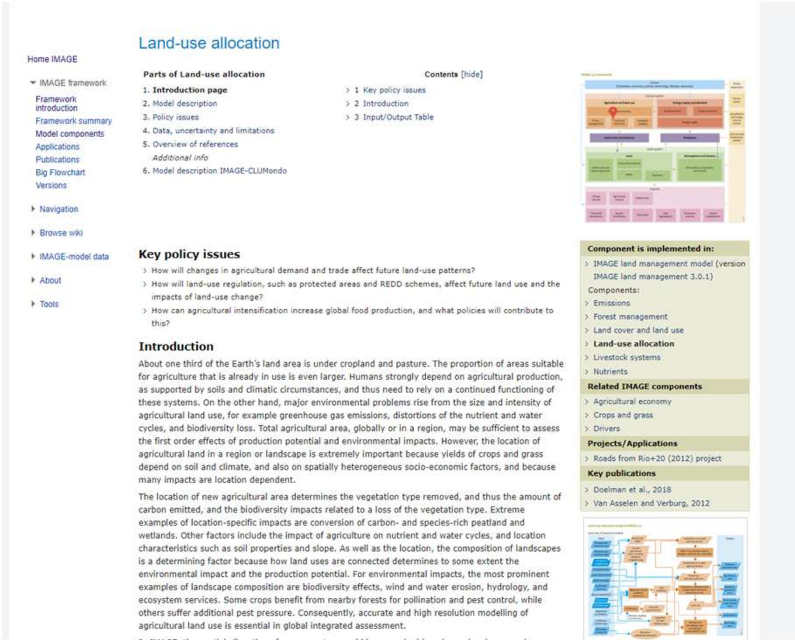
Provides confidence in model results by understanding differences with other models

3. Model documentation



All parts of IMAGE are documented at the IMAGE – wiki using exactly the same structure. The structure includes model rationale, structure, input/output data, examples of use and uncertainty.

We also publish our assumptions and data in the IIASA database and on our own website.



Land-use allocation

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Parts of Land-use allocation

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6. Model description IMAGE-CLUMondo

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Key policy issues

- How will changes in agricultural demand and trade affect future land-use patterns?
- How will land-use regulation, such as protected areas and REDD schemes, affect future land use and the impacts of land-use change?
- How can agricultural intensification increase global food production, and what policies will contribute to this?

Introduction

About one third of the Earth's land area is under cropland and pasture. The proportion of areas suitable for agriculture that is already in use is even larger. Humans strongly depend on agricultural production, as supported by soils and climatic circumstances, and thus need to rely on a continued functioning of these systems. On the other hand, major environmental problems rise from the size and intensity of agricultural land use, for example greenhouse gas emissions, distortions of the nutrient and water cycles, and biodiversity loss. Total agricultural area, globally or in a region, may be sufficient to assess the first order effects of production potential and environmental impacts. However, the location of agricultural land in a region or landscape is extremely important because yields of crops and grass depend on soil and climate, and also on spatially heterogeneous socio-economic factors, and because many impacts are location dependent.

The location of new agricultural area determines the vegetation type removed, and thus the amount of carbon emitted, and the biodiversity impacts related to a loss of the vegetation type. Extreme examples of location-specific impacts are conversion of carbon- and species-rich peatland and wetlands. Other factors include the impact of agriculture on nutrient and water cycles, and location characteristics such as soil properties and slope. As well as the location, the composition of landscapes is a determining factor because how land uses are connected determines to some extent the environmental impact and the production potential. For environmental impacts, the most prominent examples of landscape composition are biodiversity effects, wind and water erosion, hydrology, and ecosystem services. Some crops benefit from nearby forests for pollination and pest control, while others suffer additional pest pressure. Consequently, accurate and high resolution modelling of agricultural land use is essential in global integrated assessment.

Component is implemented in:
- IMAGE land management model (version IMAGE land management 3.0.1)

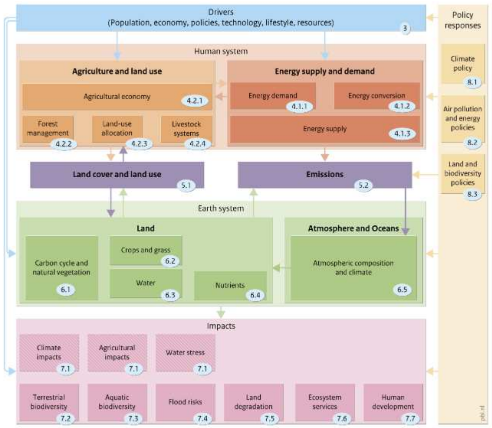
Components:
- Emissions
- Forest management
- Land cover and land use
- **Land-use allocation**
- Livestock systems
- Nutrients

Related IMAGE components
- Agricultural economy
- Crops and grass
- Drivers

Projects/Applications
- Roads from Rio+20 (2012) project

Key publications
- Doelman et al., 2018
- Van Asselen and Verburg, 2012

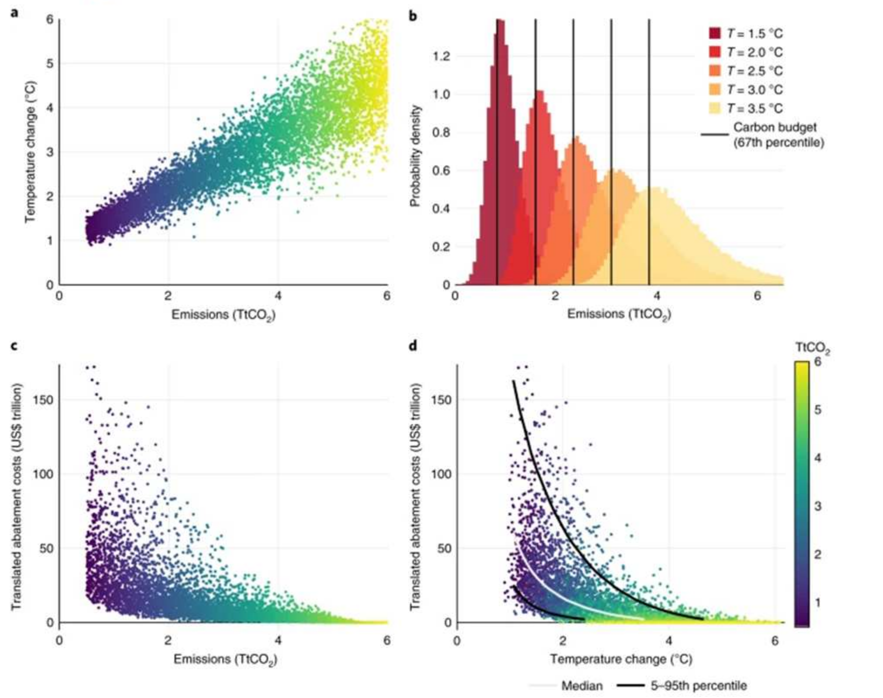
Transparency of underlying concepts



4. Uncertainty analysis

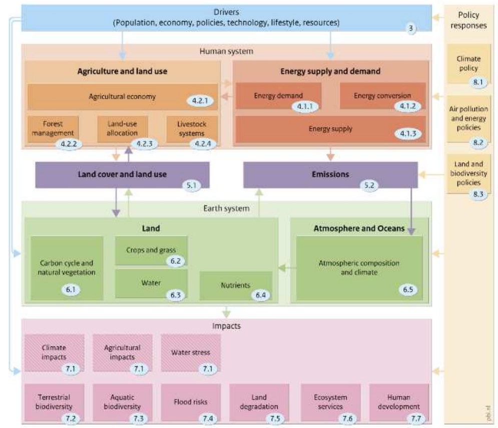
Most parts of the IMAGE model have been published in peer-reviewed journals. Typically, these publications also include an analysis of model uncertainty.

Fig. 2: Application of the metamodel.

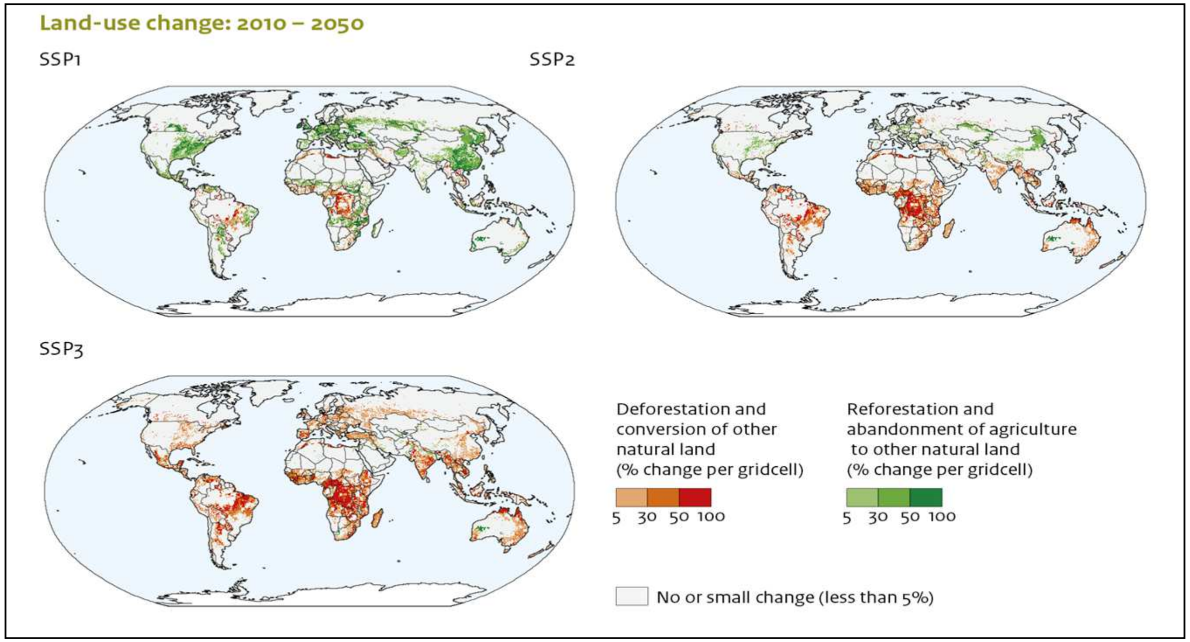


Insights in the range of model results (vis-à-vis expected range)

5. Use of scenarios

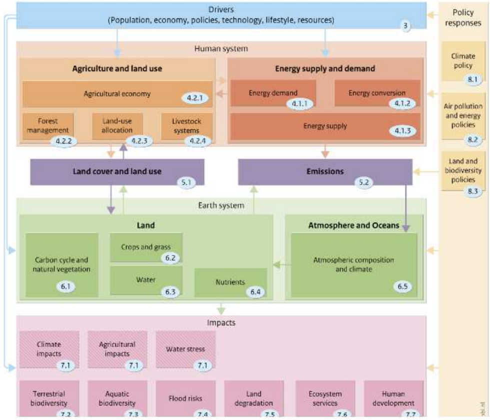


Scenario analysis is used to explore a wide range of possible futures.



Insights in the sensitivity of the models to fundamentally different scenario storylines (can the model provide insights into a range of outcomes)

6. Comparison of future and historic rates of change



We have compared the rates of change in the scenarios to those that occurred historically to 'validate' the feasibility of the rates of change in our projections

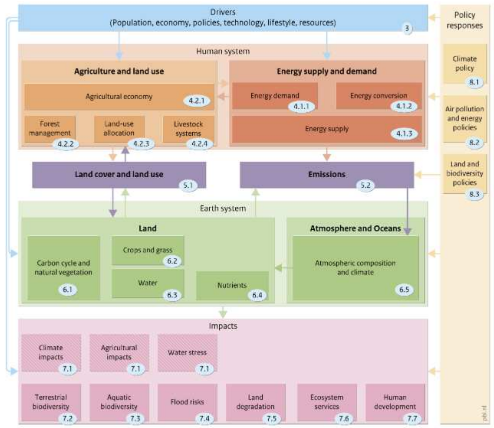
Table 6
Summary of comparisons between historical observations and three modeled scenarios using a diverse set of indicators. The fossil and non-fossil technologies are grouped—the table considers the highest rate of change in the group per scenario.

			Absolute growth			Normalized growth		
			Baseline	Reference	2 Degrees	Baseline	Reference	2 Degrees
2010-2030	Average annual capacity additions	Fossil						
		Non-Fossil						
	Average annual emission decline rates	System						
	Average annual supply-side investments	System						
2030-2050	Average annual capacity additions	Fossil						
		Non-Fossil						
	Average annual emission decline rates	System						
	Average annual supply-side investments	System						
	Technology diffusion	Tech-specific						

	Not applicable
	Below historical growth frontier for corresponding technology
	Below historical growth frontier for any technology
	Above historical growth frontier for any technology

Provides insights into the feasibility of the rates of change.

7. Discussion of model results with science communities



We do joint projects with other scientific communities to discuss our insights and learn from those in other communities.

- Socio-technical transition community (Geels et al.)
- Lifestyle community (Van den Berg et al.)
- Earth system science community (Van Vuuren et al)
- Land use community (Global Land Outlook

Confronts model outcomes and ideas with those of other science communities