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D01 CRC 1502 DETECT

DETAILED GLOBAL LAND USE AND LAND COVER PROJECTIONS UNDER THE SHARED SOCIO-ECONOMIC PATHWAYS

AN INTEGRATED CGE ANALYSIS WITH SUB-NATIONAL RESOLUTION FOR EUROPE

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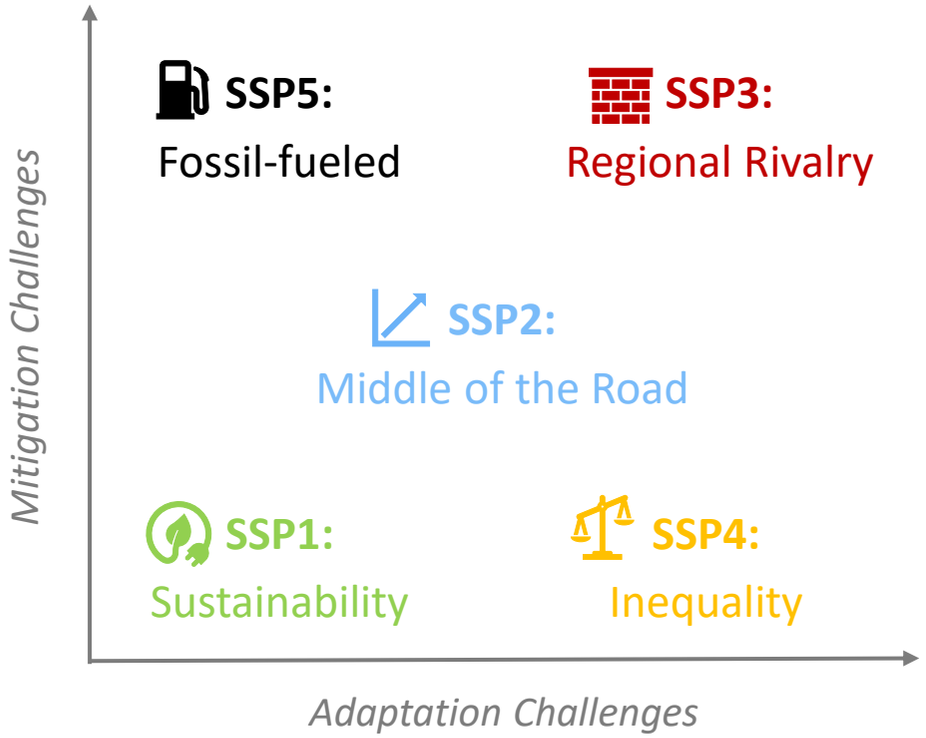
BACKGROUND: MOTIVATION AND APPROACH

- Land use and land cover (LULC) developments crucial for the future:
  - Food, feed, fibre, biomass, natural habitats, …
  - Climate change implications
- Driven by uncertain socio-economic developments
- Scenario Approach: Quantification of contrasting futures
  - Driver variation according to predefined narratives:
    Shared Socio-Economic Pathways (SSPs)

[1]-[4]

BACKGROUND: SHARED SOCIO-ECONOMIC PATHWAYS



- Futures resulting in different challenges to adaptation and mitigation
- Global economic developments:
  - Humanitarian conditions
  - Technological progress
  - Environmental awareness
  - …
- Country-specific projections:
  - Demographics
  - Gross Domestic Product (GDP)

[5]-[8]

BACKGROUND: RESEARCH AIM

- Existing SSP LULC quantifications:
  - Based on Integrated Assessment Models (IAMs)
  - Detailed biophysical representation
  - Highly aggregated

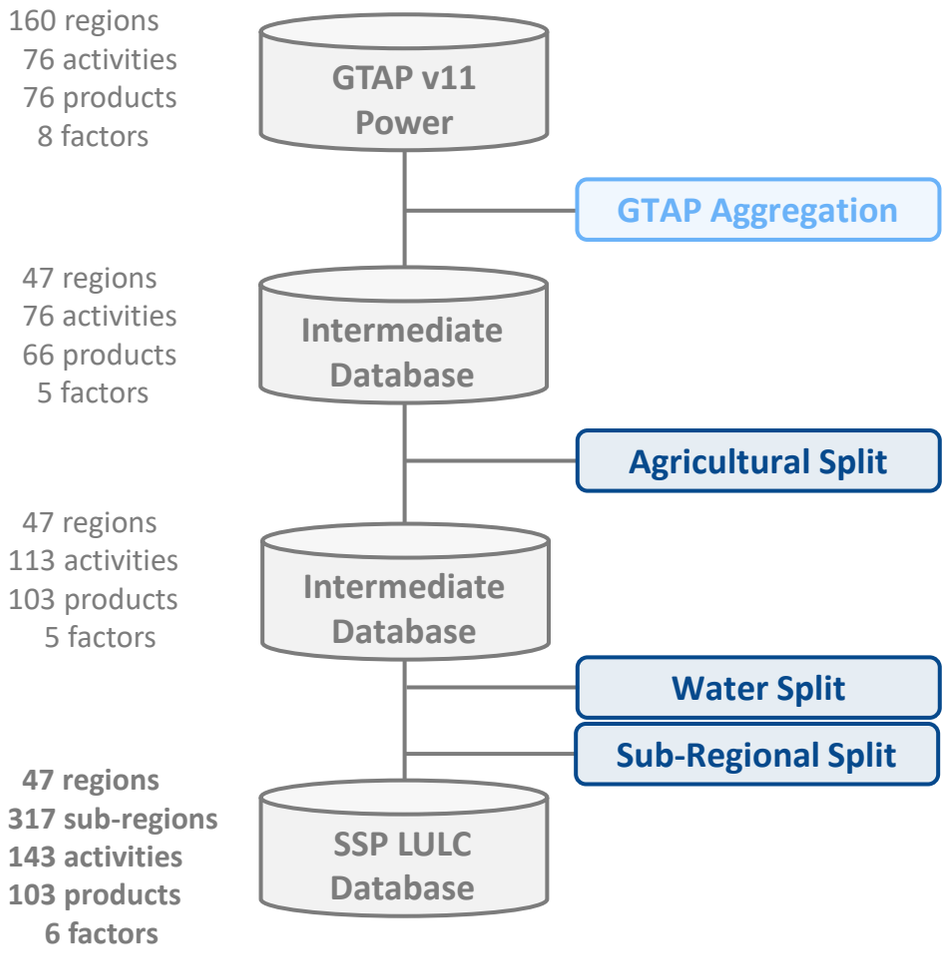
IAMs:
- AIM
- GCAM4
- IMAGE
- MESSAGE-GLOBIOM
- REMIND-MAgPIE
- WITCH-GLOBIOM

- Aim: New, globally consistent set of SSP LULC quantifications up to 2050

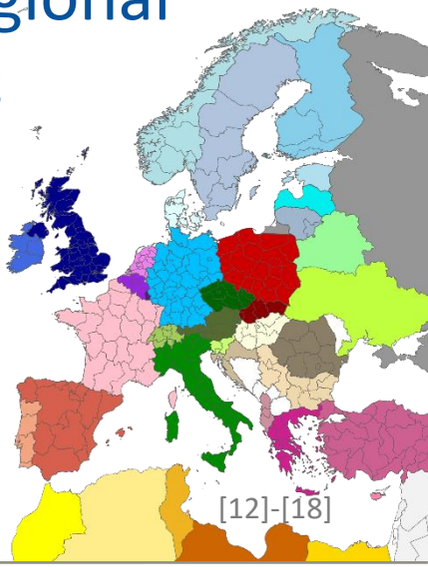
- Key advancements:
  1. High regional resolution
  2. Enhanced detail for land using production activities/ products
  3. Stand-alone economic model
  4. Key structural change drivers

[9]-[11]

MODEL SET-UP: DATABASE

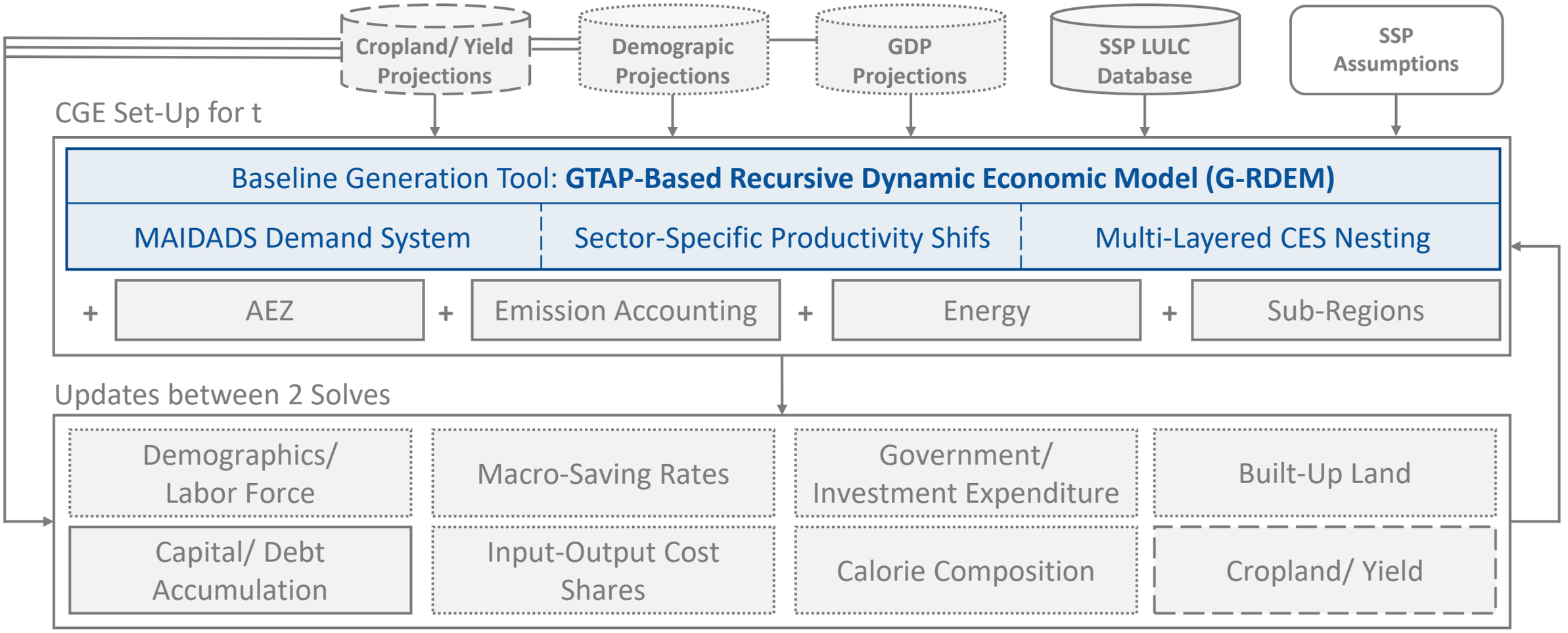


1. Aggregation according to study focus
2. Agricultural split based on FAOSTAT data
3. Water split based on FAOSTAT data
4. Sub-regional split based on regional statistics and satelite products



MODEL SET-UP: BASELINE GENERATION

CGEBox
Modular Extendable Flexible



[13]+[19]-[23]

SSP QUANTIFICATION: ASSUMPTIONS

(Exogenous) Socio-Economics

- GDP
- Demographics
- Calorie composition
- Built-up land
- Cropland
- Yield

Energy Policy

- Emissions price
- Resource extraction
- Renewable efficiency

Consumer Preferences

- Total calorie intake
- Animal calorie intake
- Food processing efficiency
- Food waste

Agriculture and Forestry

- Irrigation efficiency
- Livestock intensity
- Forest intensity
- Wood efficiency

Environmental Policy

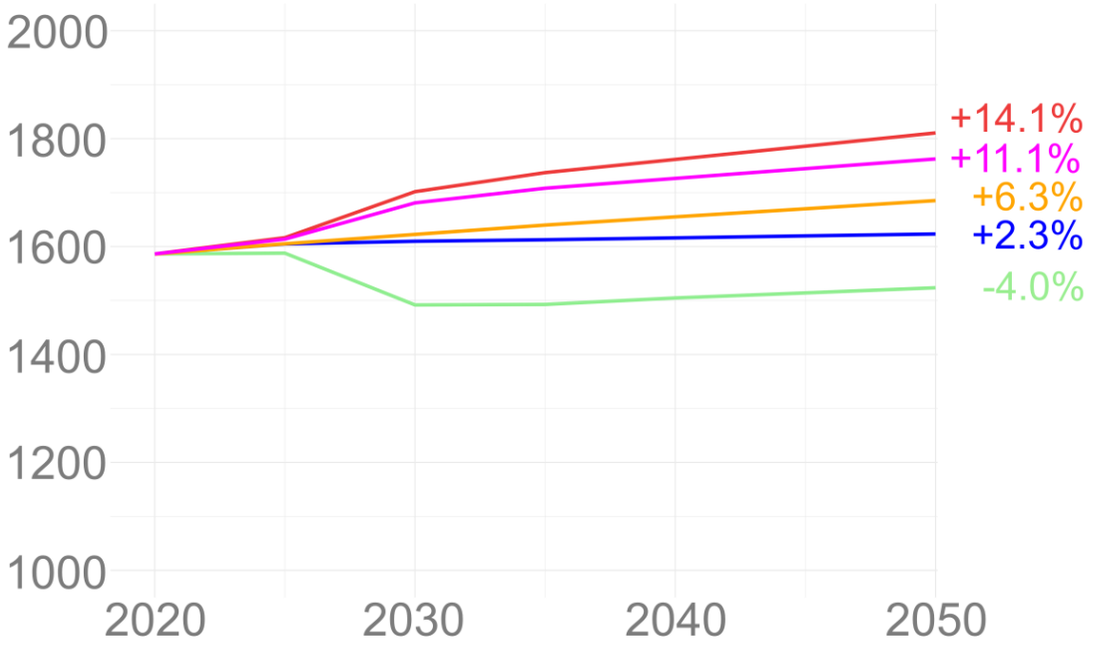
- Irrigation access
- Cropland subsidies
- Land conversion
- Meat tax

Trade/ Taxes

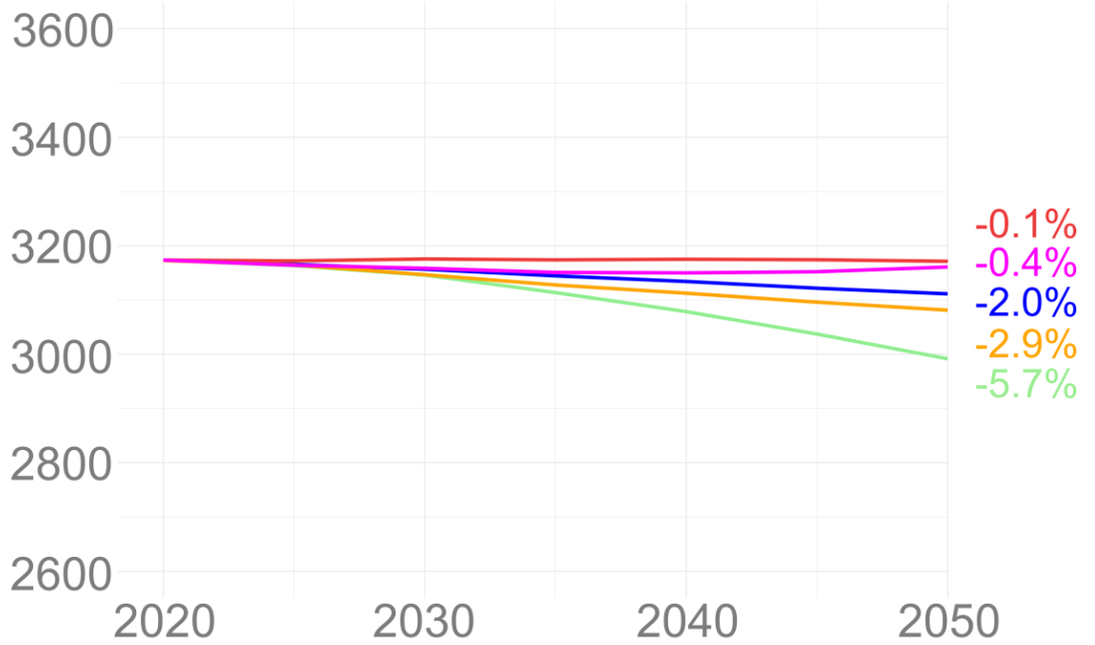
- Agricultural tariffs
- Other tariffs

RESULTS: GLOBAL LAND COVER

Cropland [in mio ha]



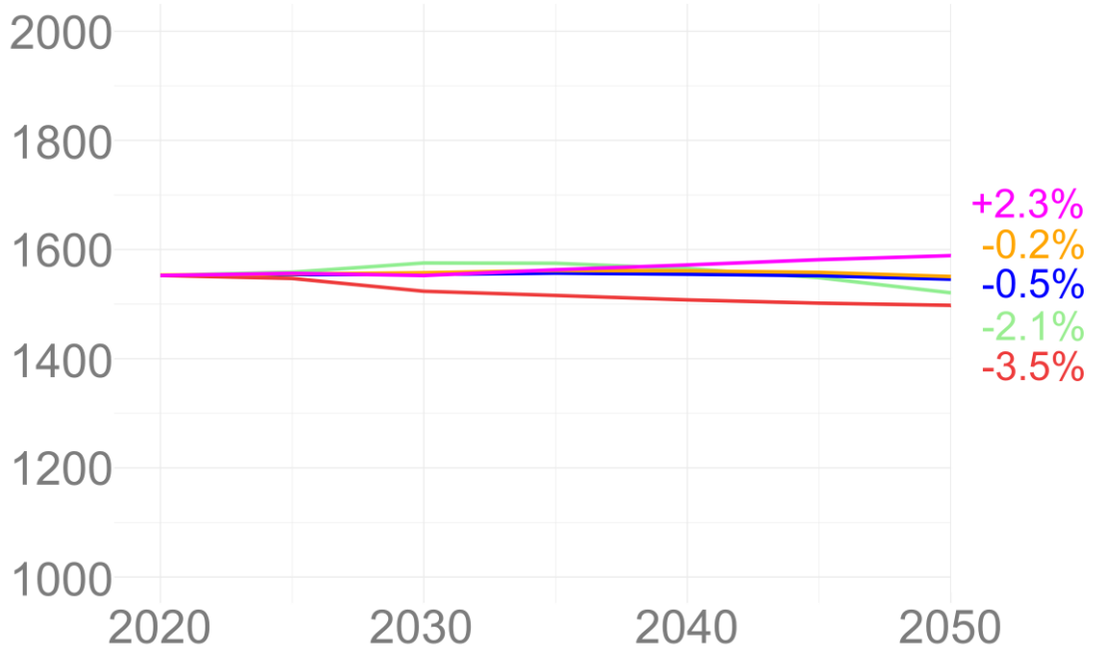
Pastureland [in mio ha]



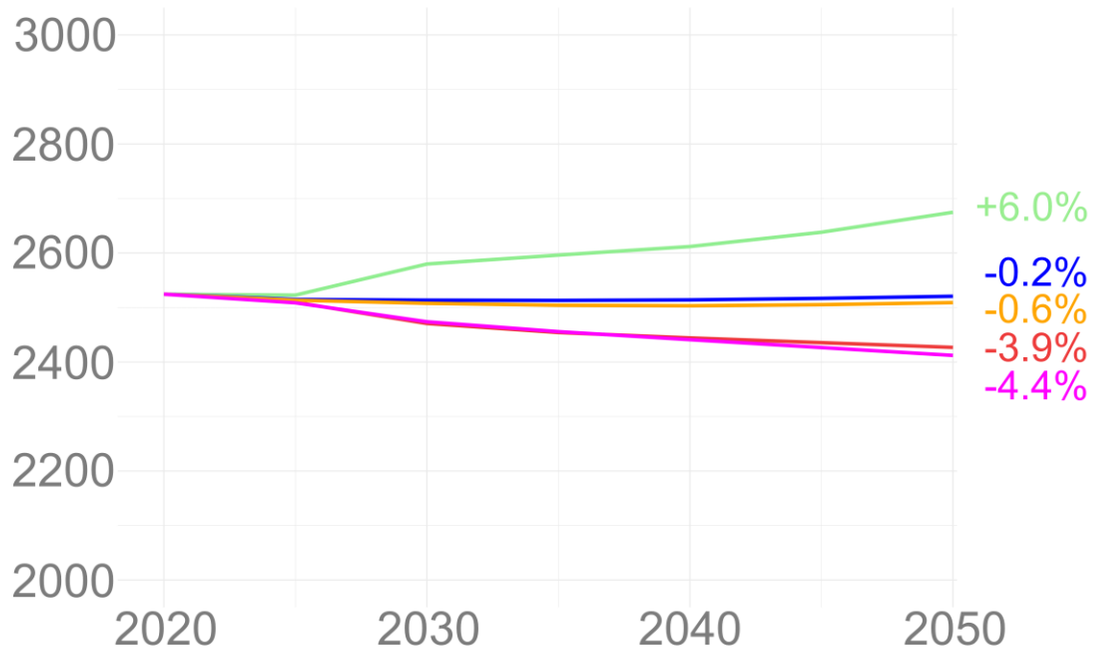
SSP1 SSP2 SSP3 SSP4 SSP5

RESULTS: GLOBAL LAND COVER

Managed Forest [in mio ha]

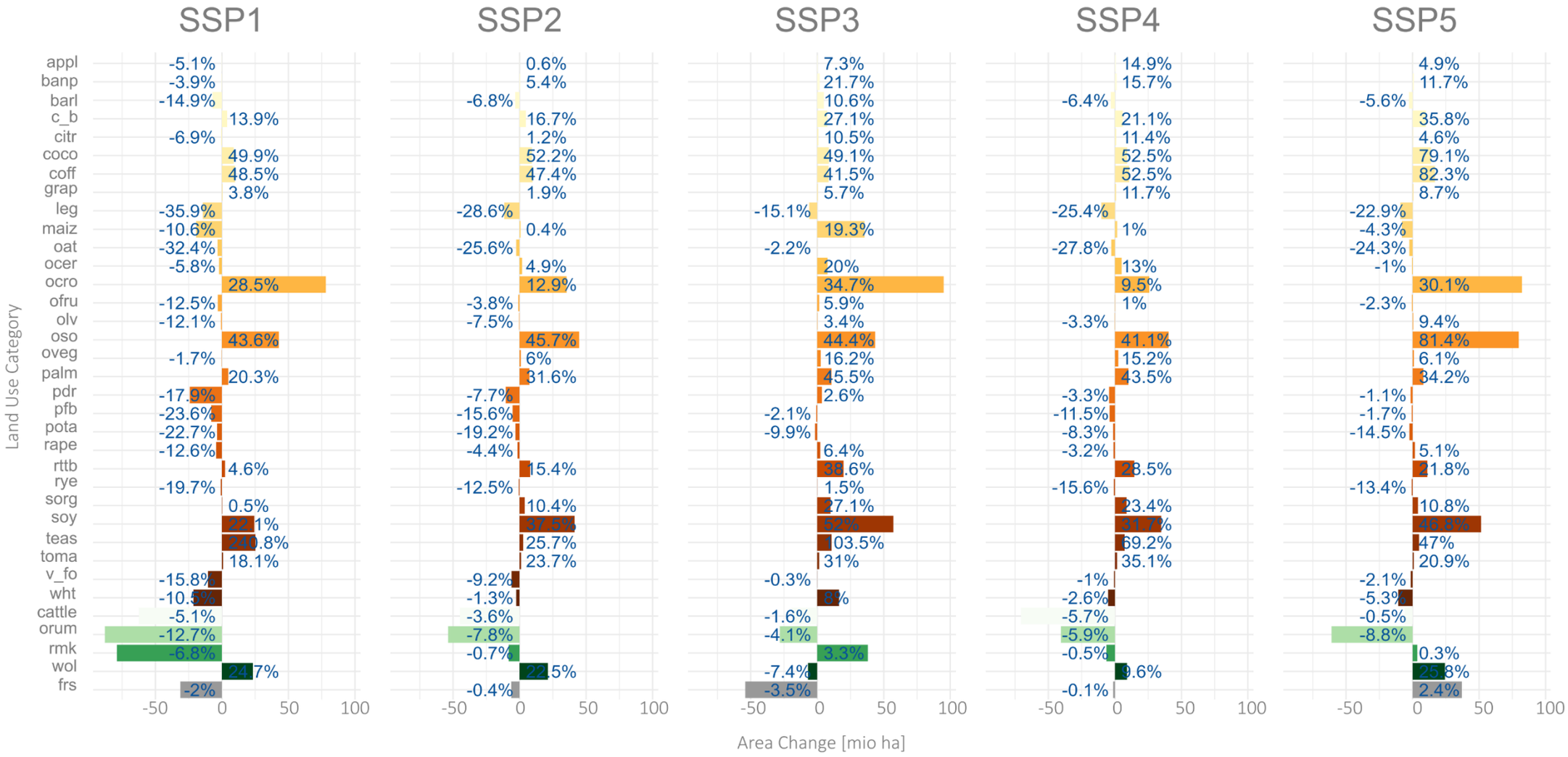


Natural Forest [in mio ha]



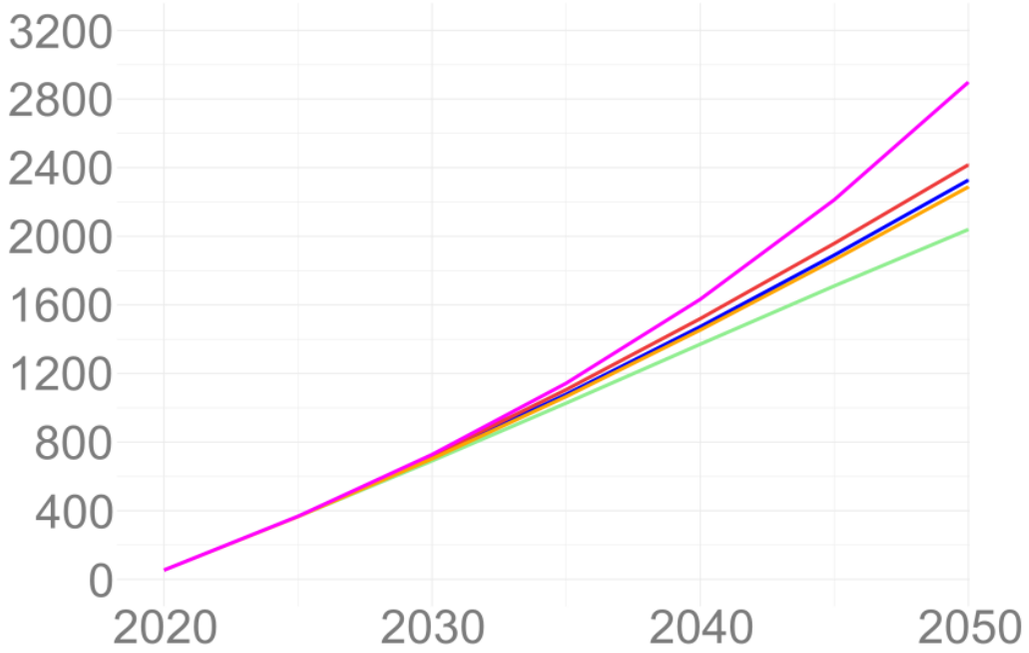
SSP1 SSP2 SSP3 SSP4 SSP5

RESULTS: GLOBAL LAND USE

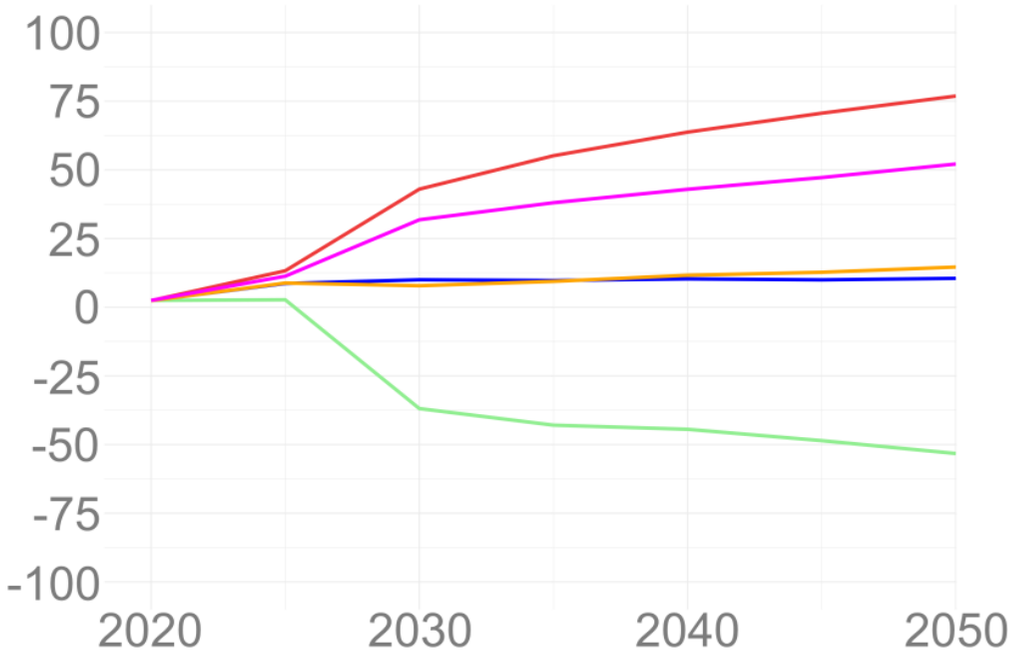


RESULTS: CUMULATIVE EMISSIONS

GHG Emissions [in GT CO_2eq]



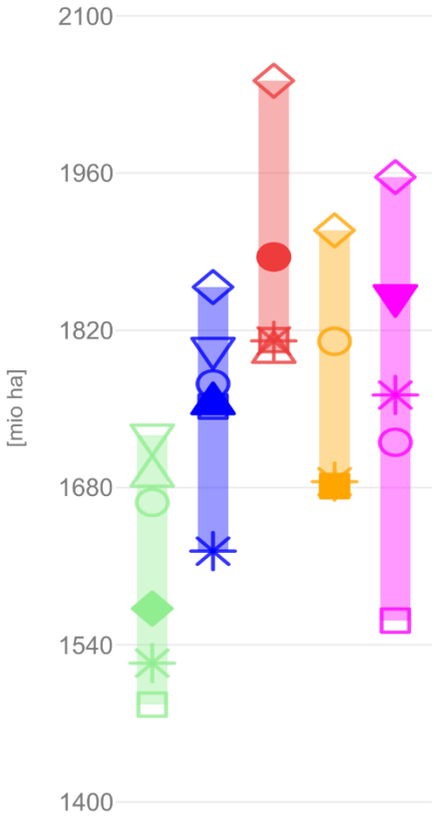
Carbon Stock Changes [in GT CO_2eq]



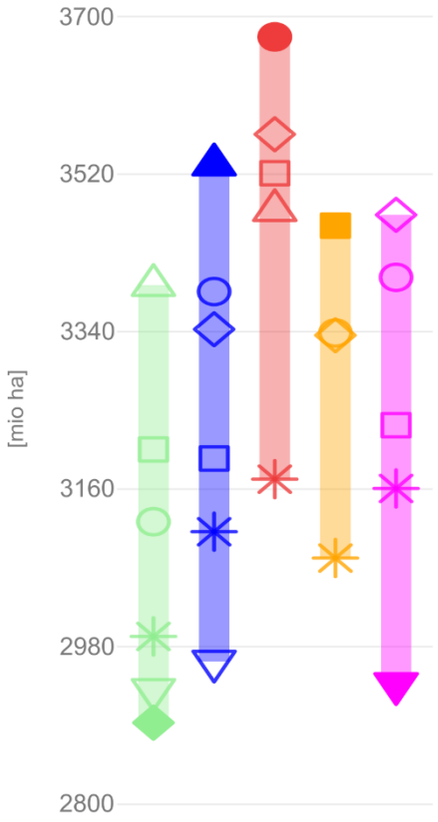
SSP1 SSP2 SSP3 SSP4 SSP5

IAM COMPARISON: 2050

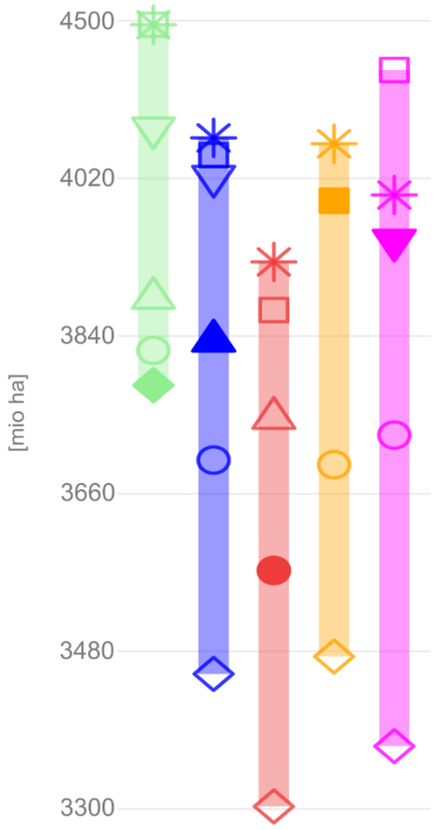
Cropland



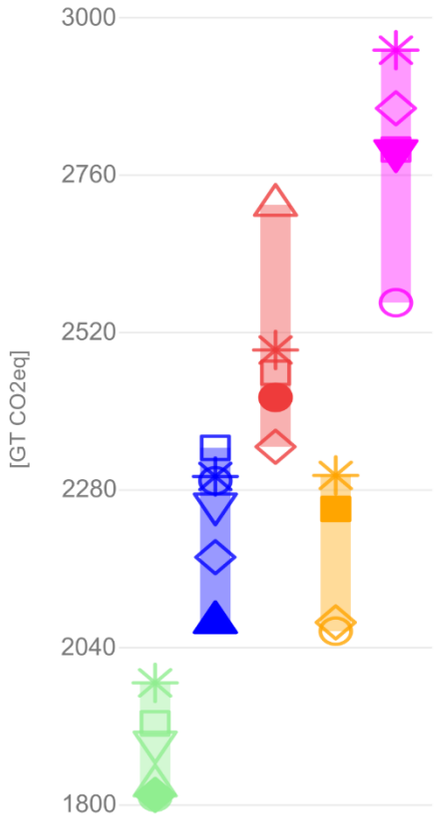
Pastureland

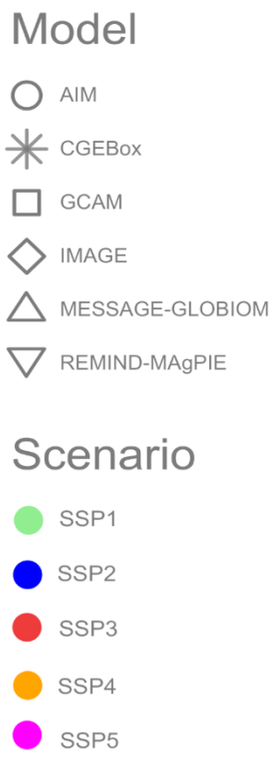


Forest



Emissions





[24]

SUMMARY AND CONCLUSION

- Novelty: Global LULC projections from stand-alone economic model
- No replacement of IAMs, but valuable complement
  - Alignment with IAM-based LULC and emissions trends
  - Results at high regional and sectoral resolution, freely accessible
  - Open-source application facilitating replication and development
  - Unified modelling architecture with relatively low computational requirements

➢ CGEBox well suited to support economic assessments of LULC change

➢ Especially where timely updates, distributional effects, or regional detail matter

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