Integrated Assessment of Climate Change Mitigation and Adaptation Impacts at Landscape level in the Austrian Mostviertel Region

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Global change at landscape level

drivers

climate change

CAP reforms & climate change policies

international market developments

3 weeks

-70%

land use & livestock management

response

impacts

farm welfare

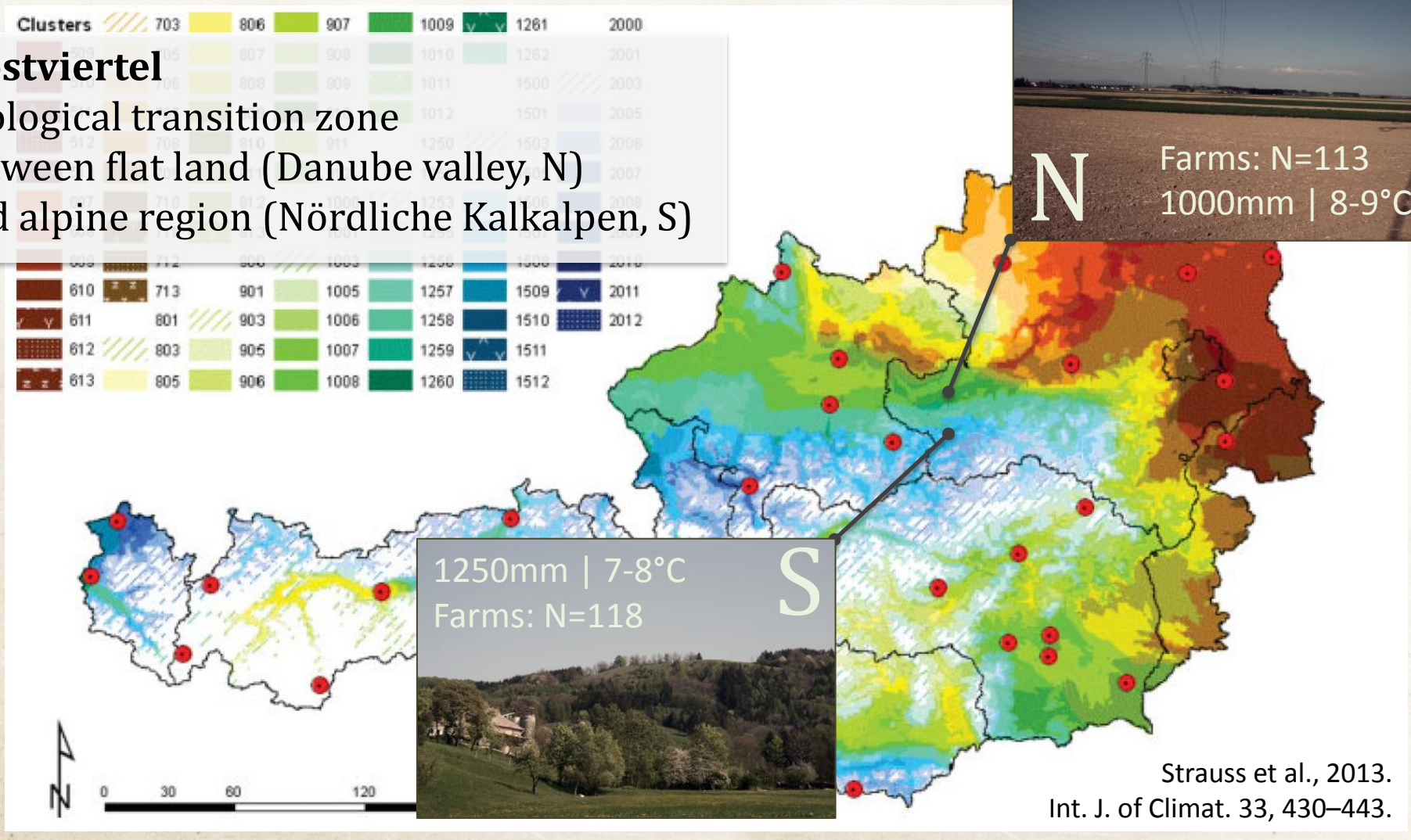
abiotic environmental impacts

biodiversity

landscape appearance

Case study landscape

Mostviertel
geological transition zone
between flat land (Danube valley, N)
and alpine region (Nördliche Kalkalpen, S)



Strauss et al., 2013.
Int. J. of Climat. 33, 430–443.

Methods and Data

Input

natural & socio-economic data

input and output prices
CAP
production functions
farm labor supply
livestock – herd sizes
observed land use
spatially explicit field data
landscape elements
climate scenarios
topography
soil characteristics

Models

CropRota[1]

EPIC[2]

CALDIS VÂTIS[4]

FAMOS[space][3]

Output

socio-economic & RD indicators

farm gross margin
public budget spending
farm labor demand
landscape diversity & appearance

agri-environmental indicators

agric. & forestry land use change
biodiversity
SOC
soil sediment loss
N & P nutrient balances
GHG emissions

food production indicators

crop & livestock production

[1]Schönhart et al. (2011). Eur J Agron 34, 263-277.
[2]e.g. Izaurralde et al. (2006). Ecol Modell 192, 362-384.
[3]Schönhart et al. (2011). J Environ Plann Manage 54, 115-143.
[4]Georg Kindermann, BFW (see Kirchner et al., 2014). Ecol Econ (in press).

Impact, mitigation & adaptation scenarios

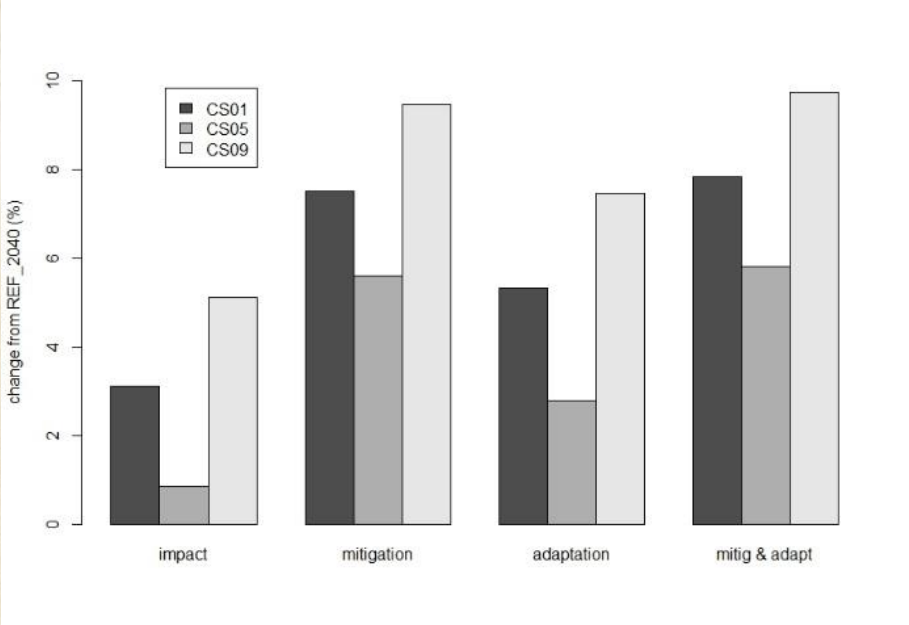
Name	CC*	AEP*	CAP reform	Mitigation policies	Adaptation policies
REF_2040	No	No	no dairy quota; no livestock premiums; regional farm payment; greening; LFA payments from 2008		
CS[CC]_i	Yes	No	like REF_2040		
CS[CC]_m	Yes	No	like REF_2040	energy crops on set aside; subsidies for: landsc. elements, SRF, afforestation, cover crops, min. tillage and extensive land use	
CS[CC]_a	Yes	No	like REF_2040		no greening, subsidies for maintenance of steep slope grass land and irrigation
CS[CC]_ma	Yes	No	like REF_2040	like CS[CC]_m	like CS[CC]_a

Climate Change [CC] Scenario Name	Climate change in 2040	
	Δ temperature (°C)	Δ precipitation (%)
CS01	+ 1.5	0%
CS05	+ 1.5	+20%
CS09	+ 1.5	-20%

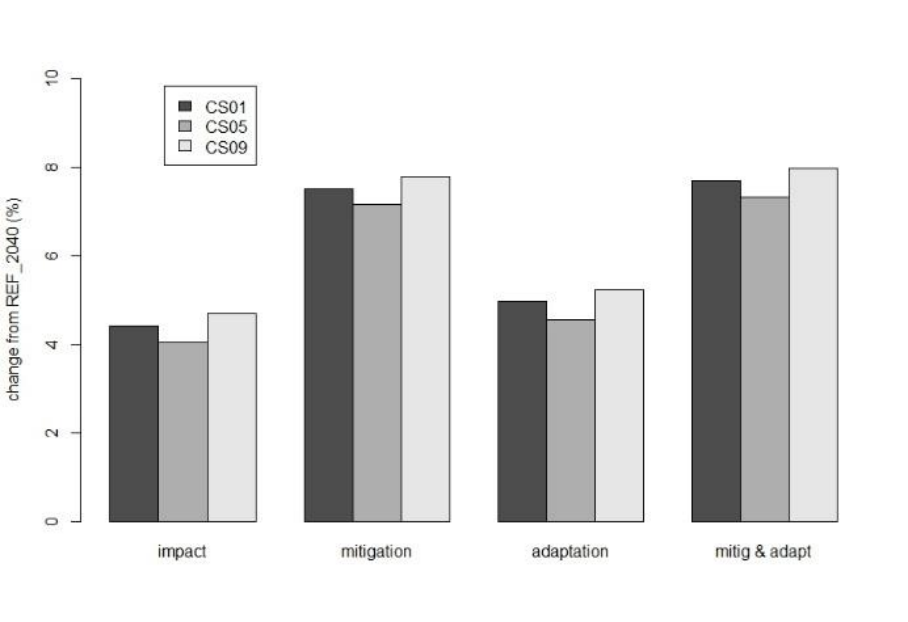
* CC…climate change, AEP…agri-environmental program

Results – changes in average aggregated farm gross margins from climate change and policies

Northern landscape



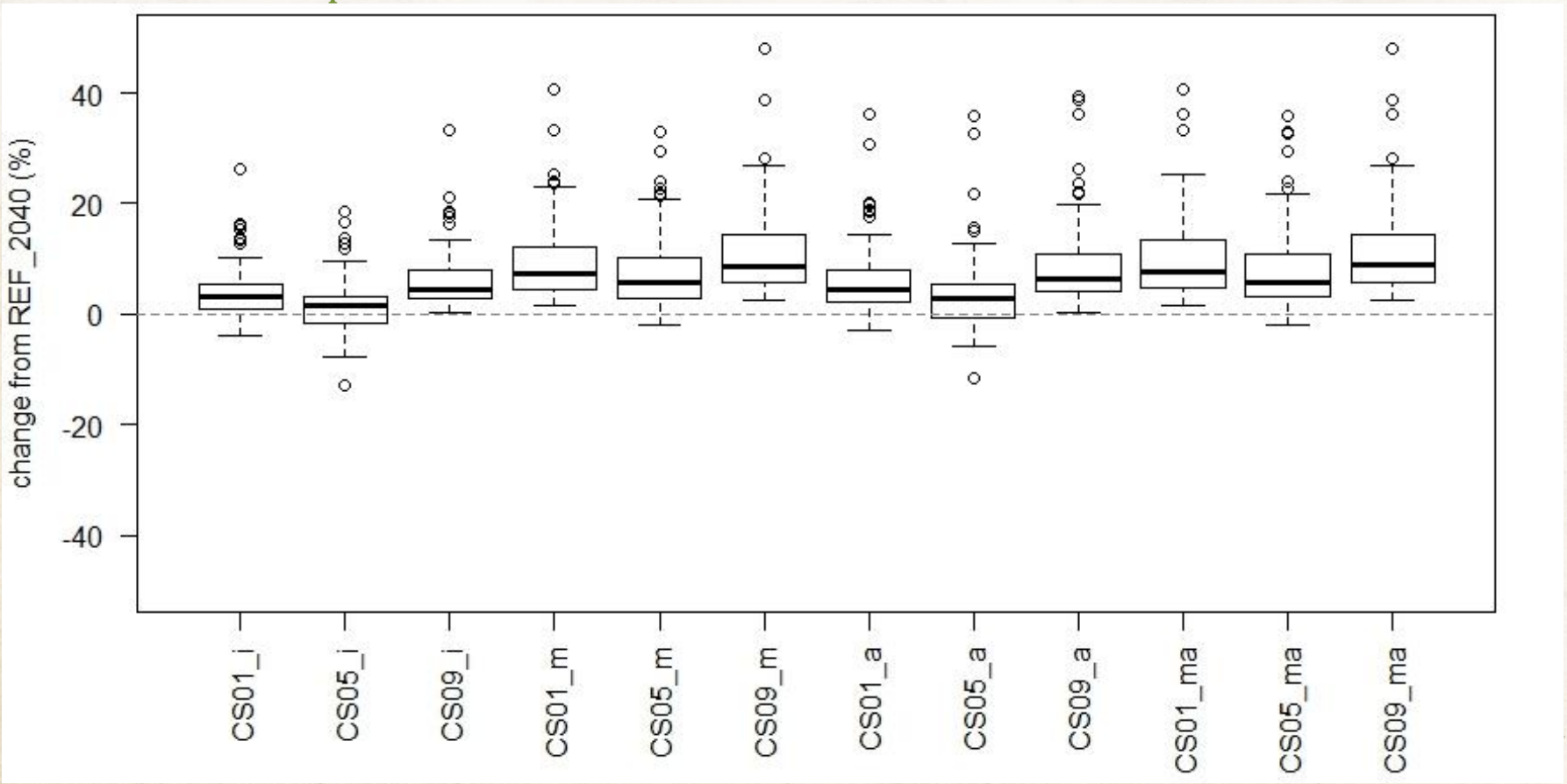
Southern landscape



Gross margin: + product sales (plant, livestock) + subsidies + annuities for long-term investment
- variable costs (machinery, inputs and services, off-farm labor)

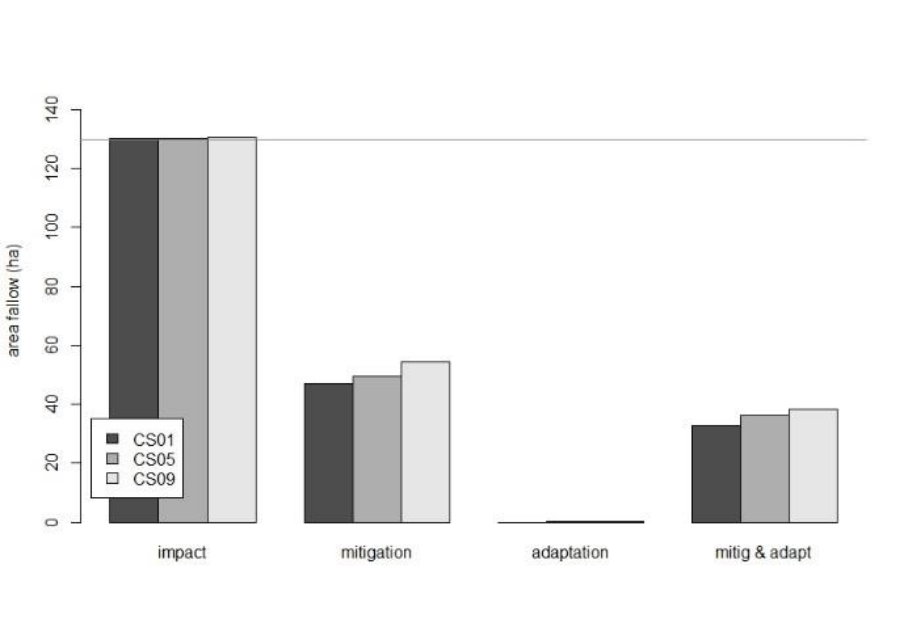
Results – changes in farm gross margins from climate change and policies

Northern landscape

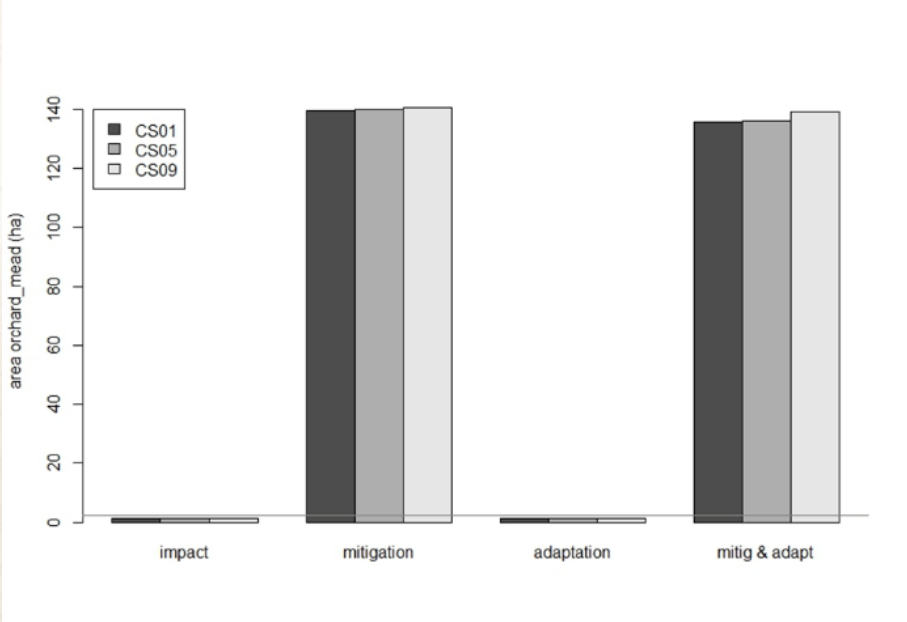


Results – land use change from climate change and policies

Northern landscape – fallow land

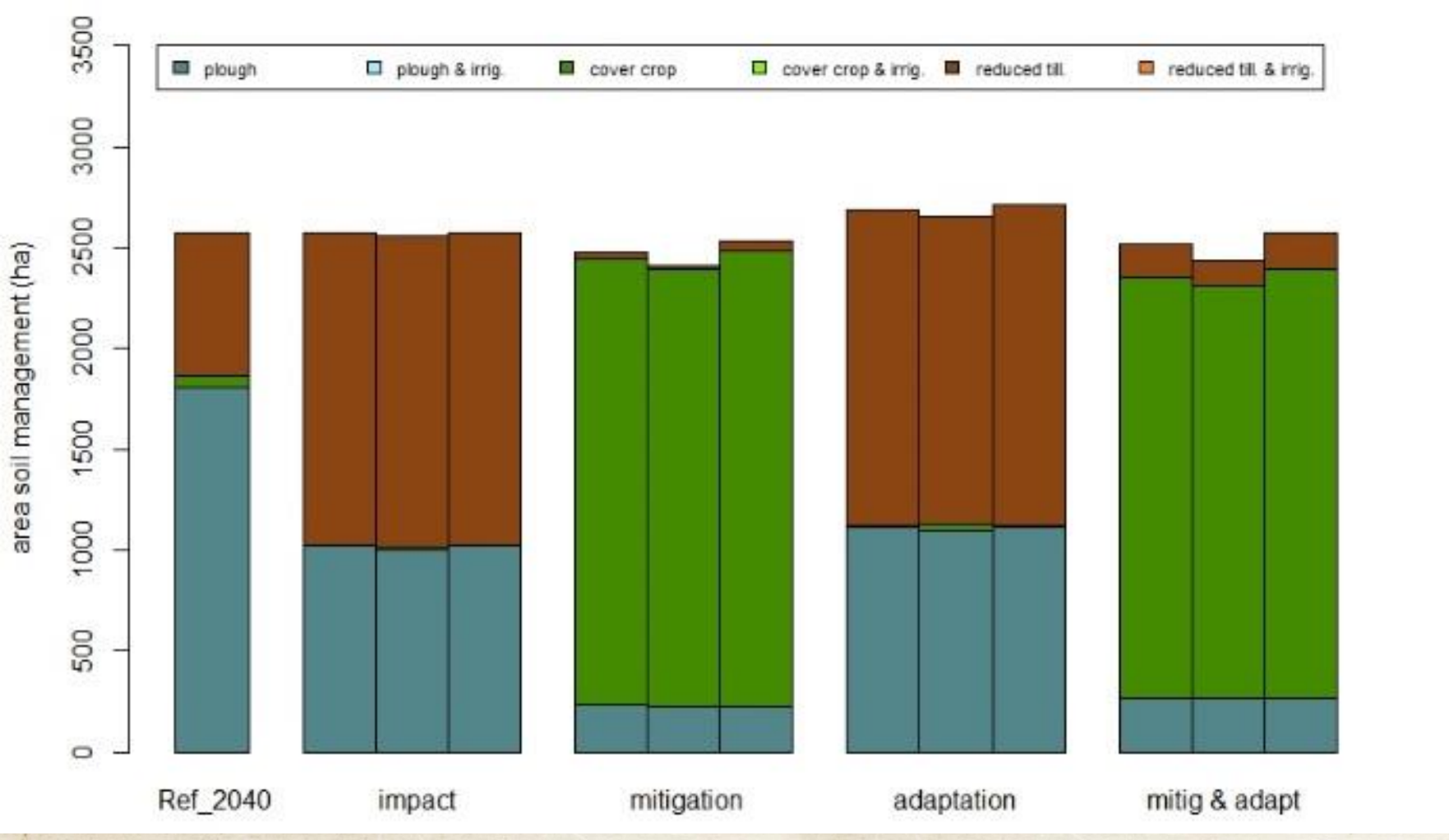


Southern landscape – orchard meadows



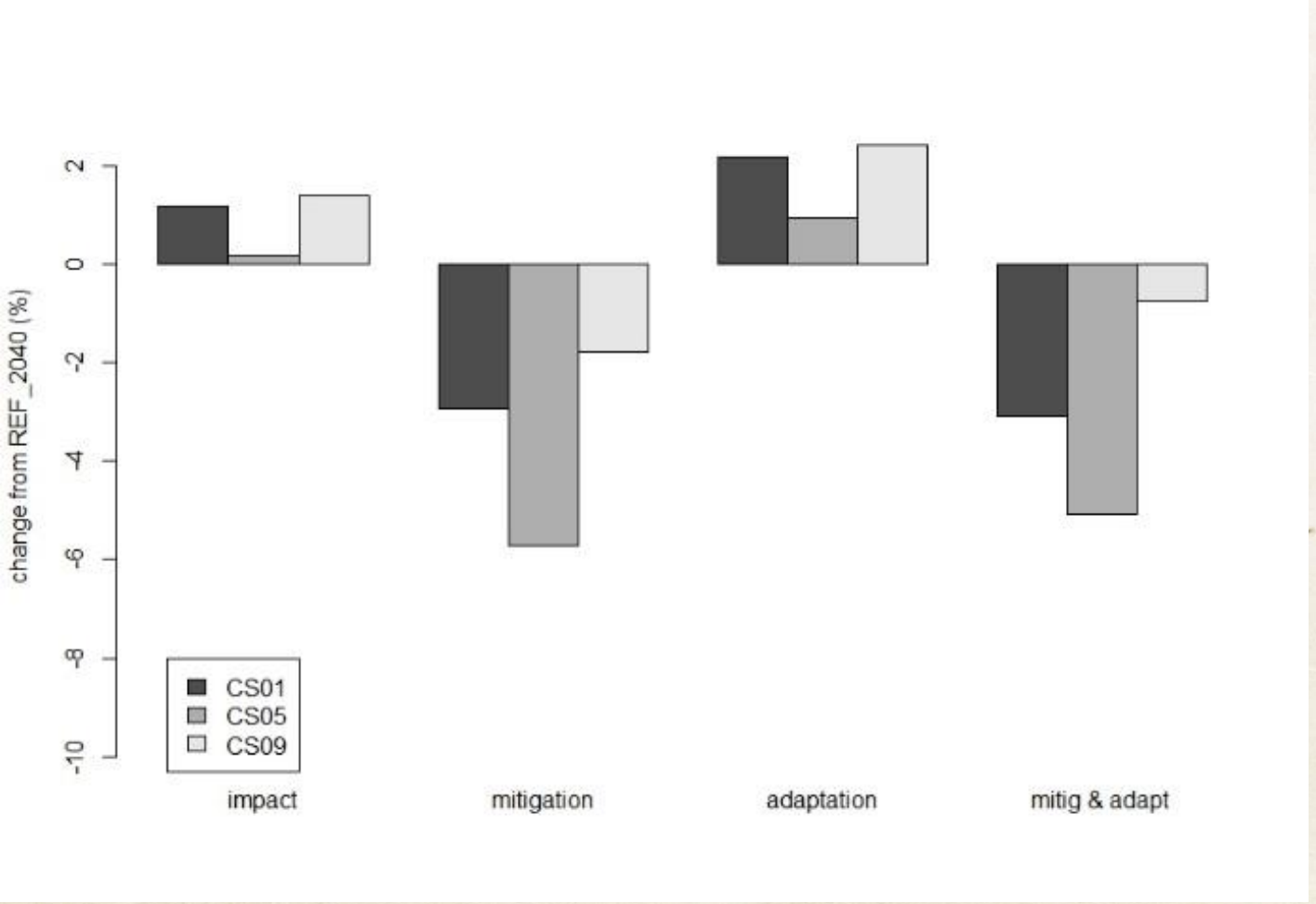
Results – soil management

Northern landscape



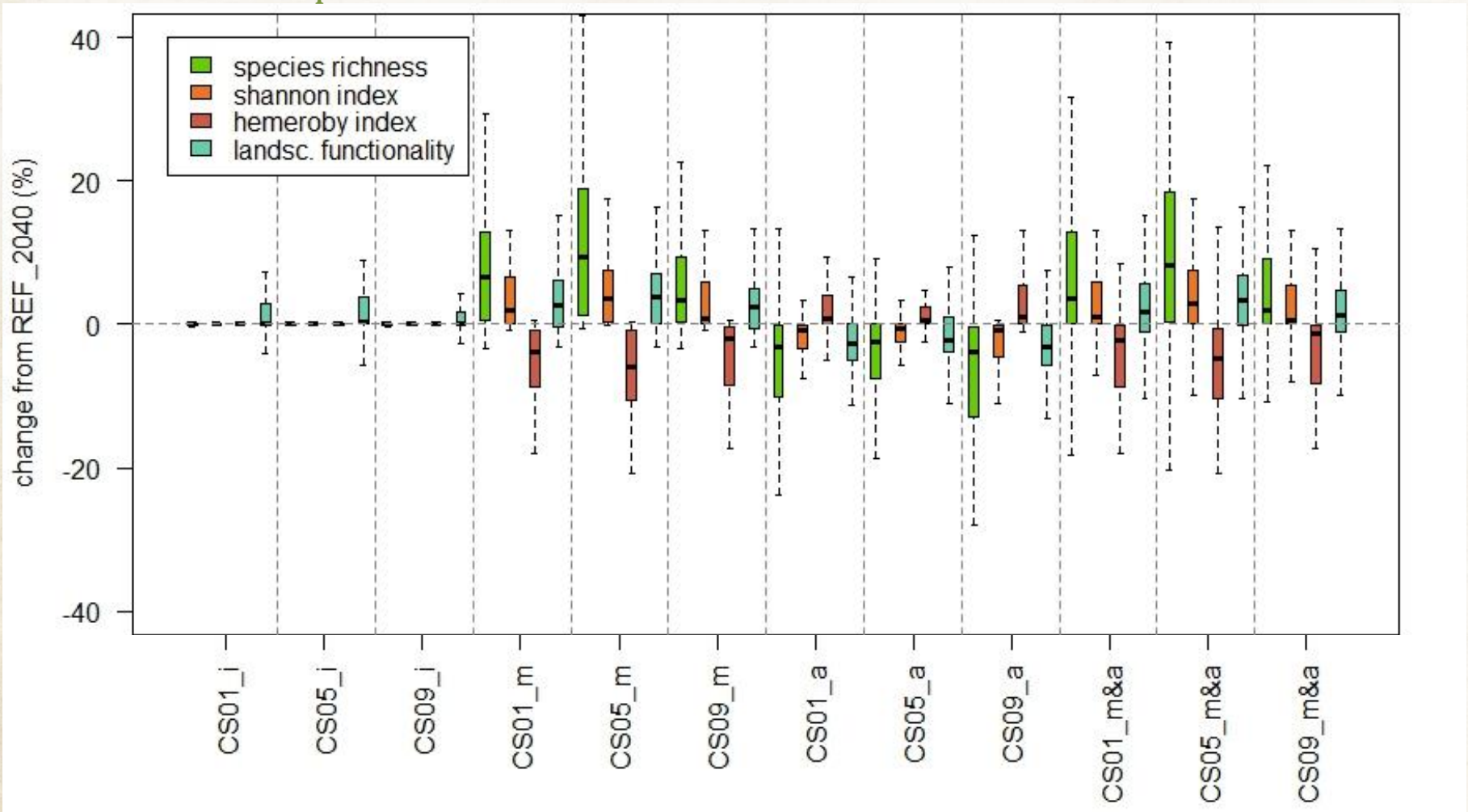
Results – changes in GHG emissions from climate change and policies

Northern landscape



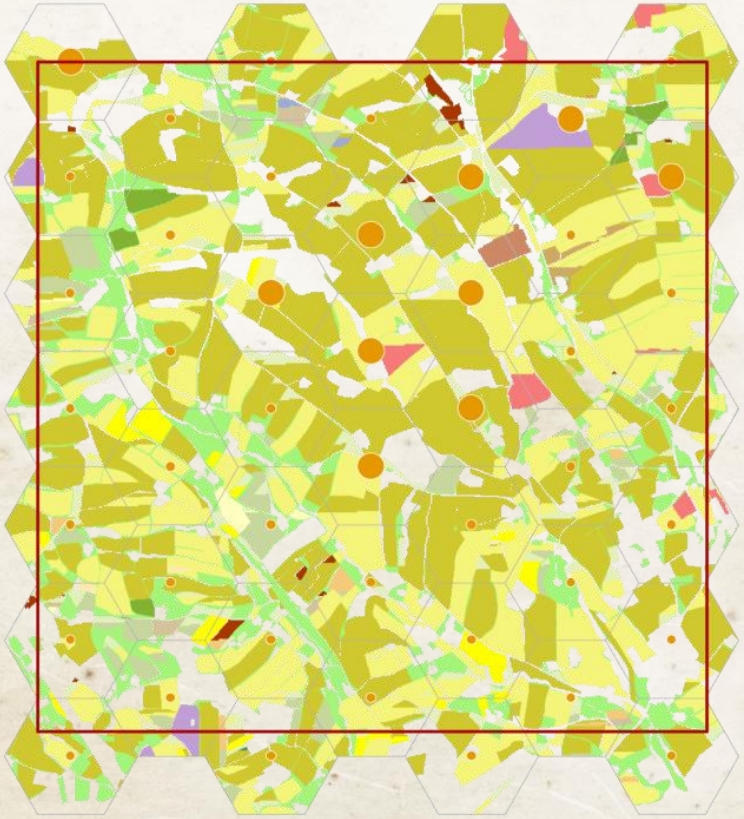
Results - farm land biodiversity indicators from climate change and policies

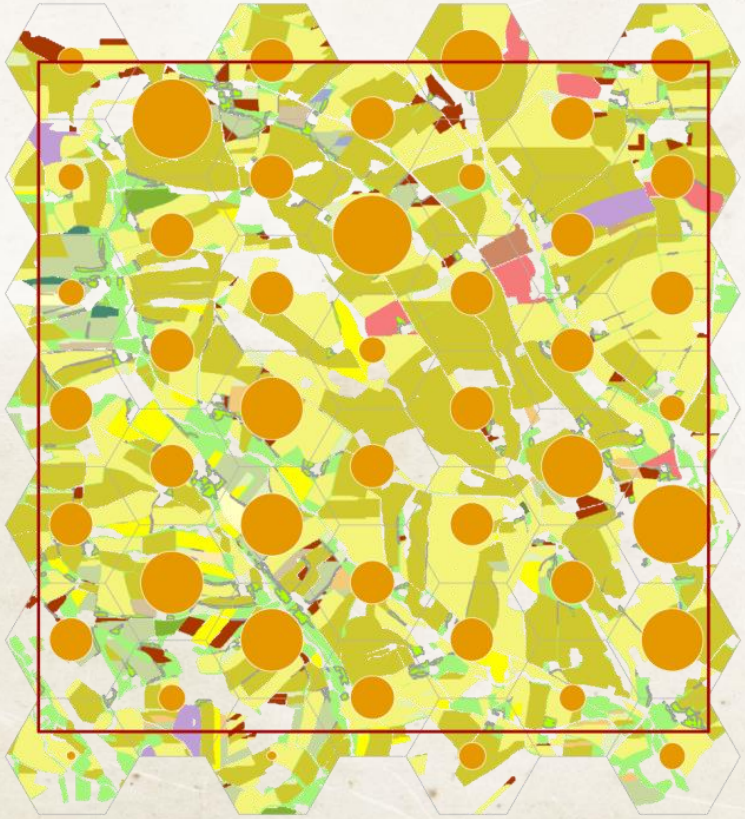
Northern landscape



Results – ACVV* indicator for landscape appearance

Northern landscape – REF_2040





Northern landscape – CS09_m

* Agricultural crops and vegetables value

Discussion

- Increasing productivity from climate change on average in both landscapes
  - In line with some of the literature, but not all
  - What about extreme weather events?
- Increasing farm incomes on average from assumed mitigation and adaptation policies
  - Mitigation policy increases environmental quality at the cost of public budgets and agricultural production
  - Flexibility from adaptation shows trade-offs between ag. production and env. protection
- Location determines impacts
  - Heterogeneous climate change impacts among regions and farms
  - Not only latitude but altitude to be considered as well in impact studies

Conclusions

- High spatial resolution creates interfaces to disciplinary models and indicators
  - Challenging data demand
- Increasing productivity can increase intensification pressures
  - Threatened permanent (extensive) grasslands and landscape elements, but
  - subject to resource constraints, costs and prices
  - Future RDP and environmental policy design (e.g. WFD) should take changing productivity into account
- Future research: analyze uncertainties
  - Ensembles of crop and grassland models
  - Sensitivity analysis on economic input parameters
  - Alternative model settings to test model uncertainty
  - Expert survey on observed and expected changes to complement modelling

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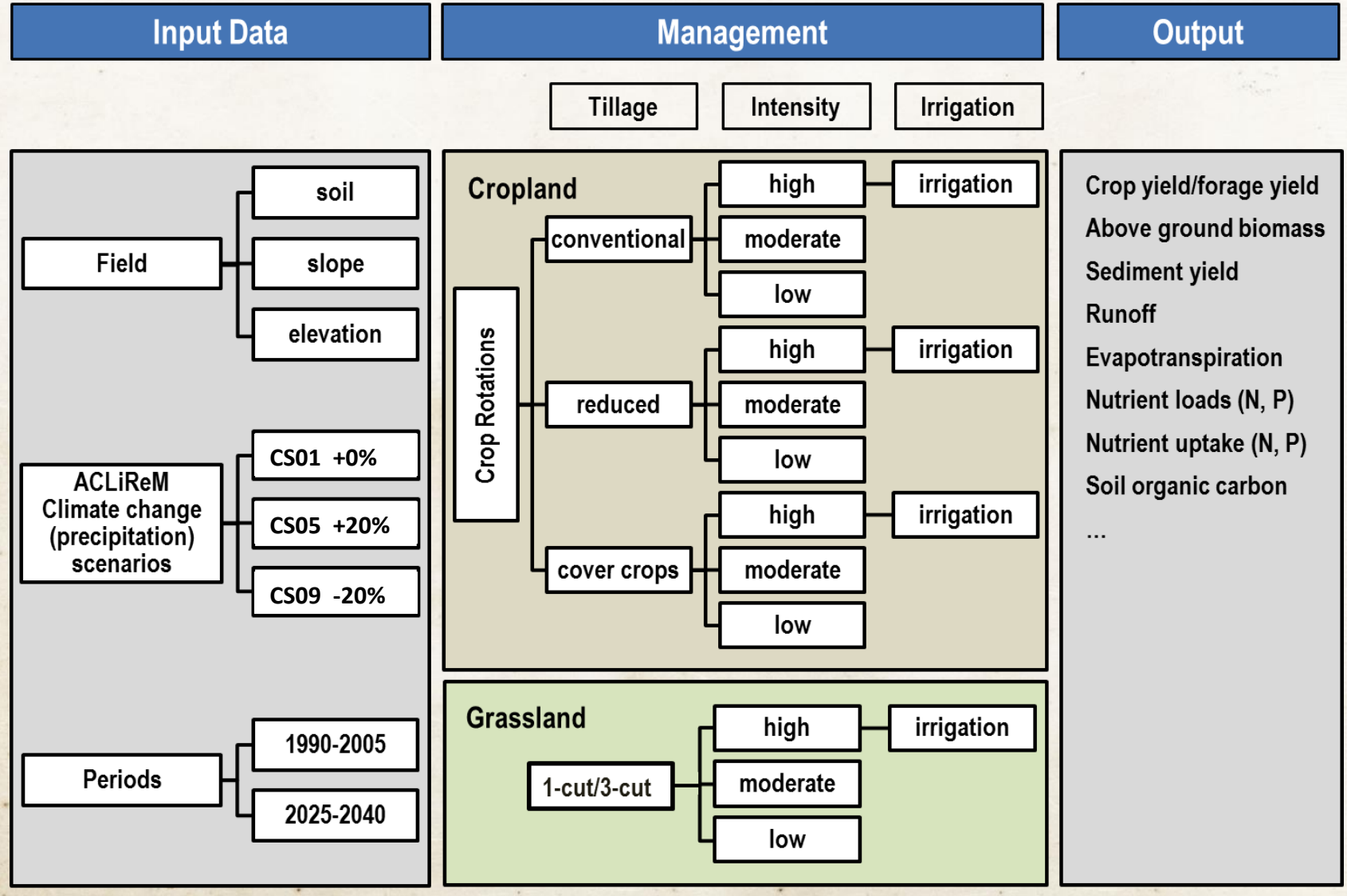
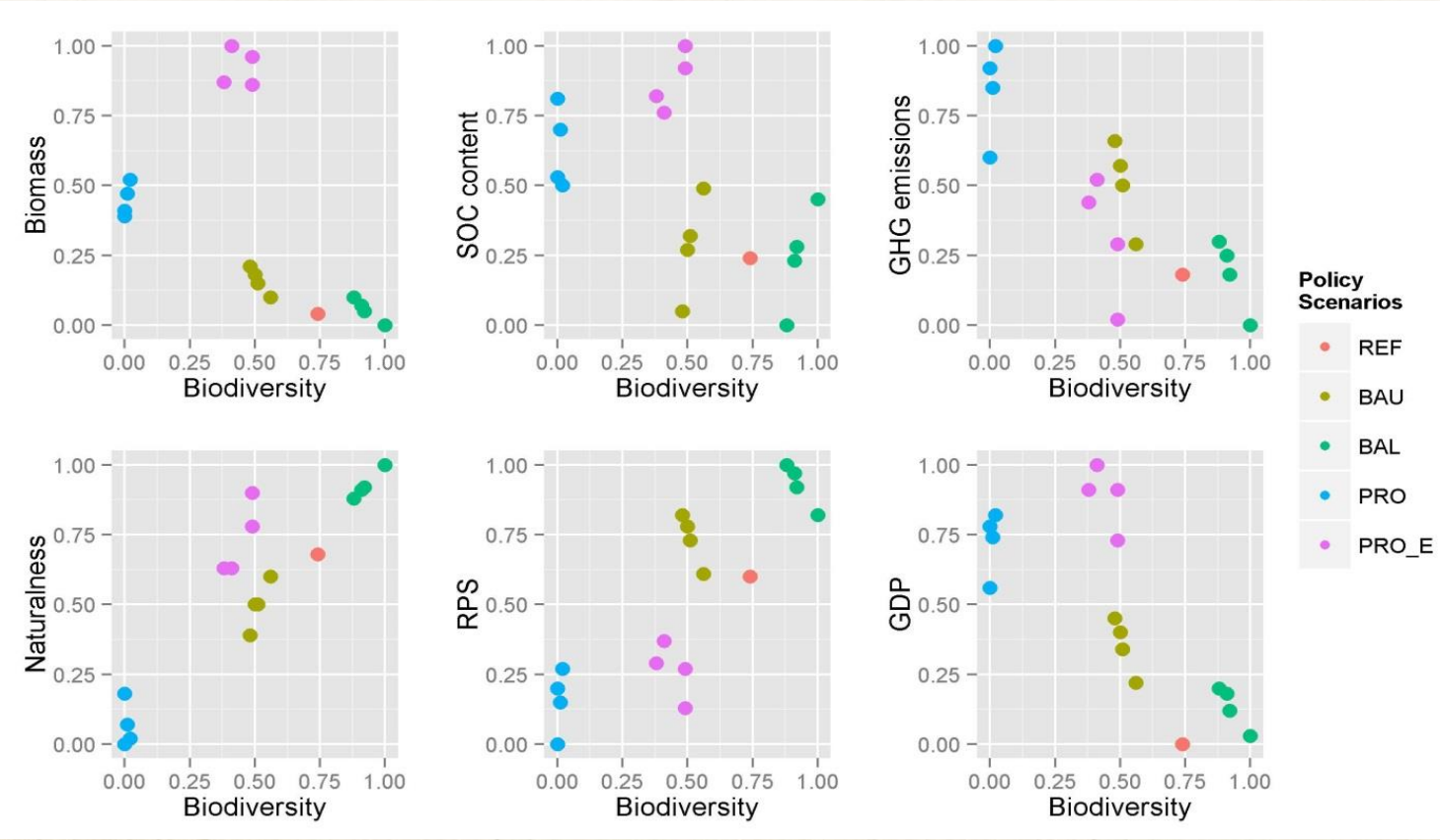
EPIC – model run settings



Outlook

Analysis of trade-offs and synergies



Kirchner et al., 2014. Ecological Economics (in press).

Outlook

Landscape visualization