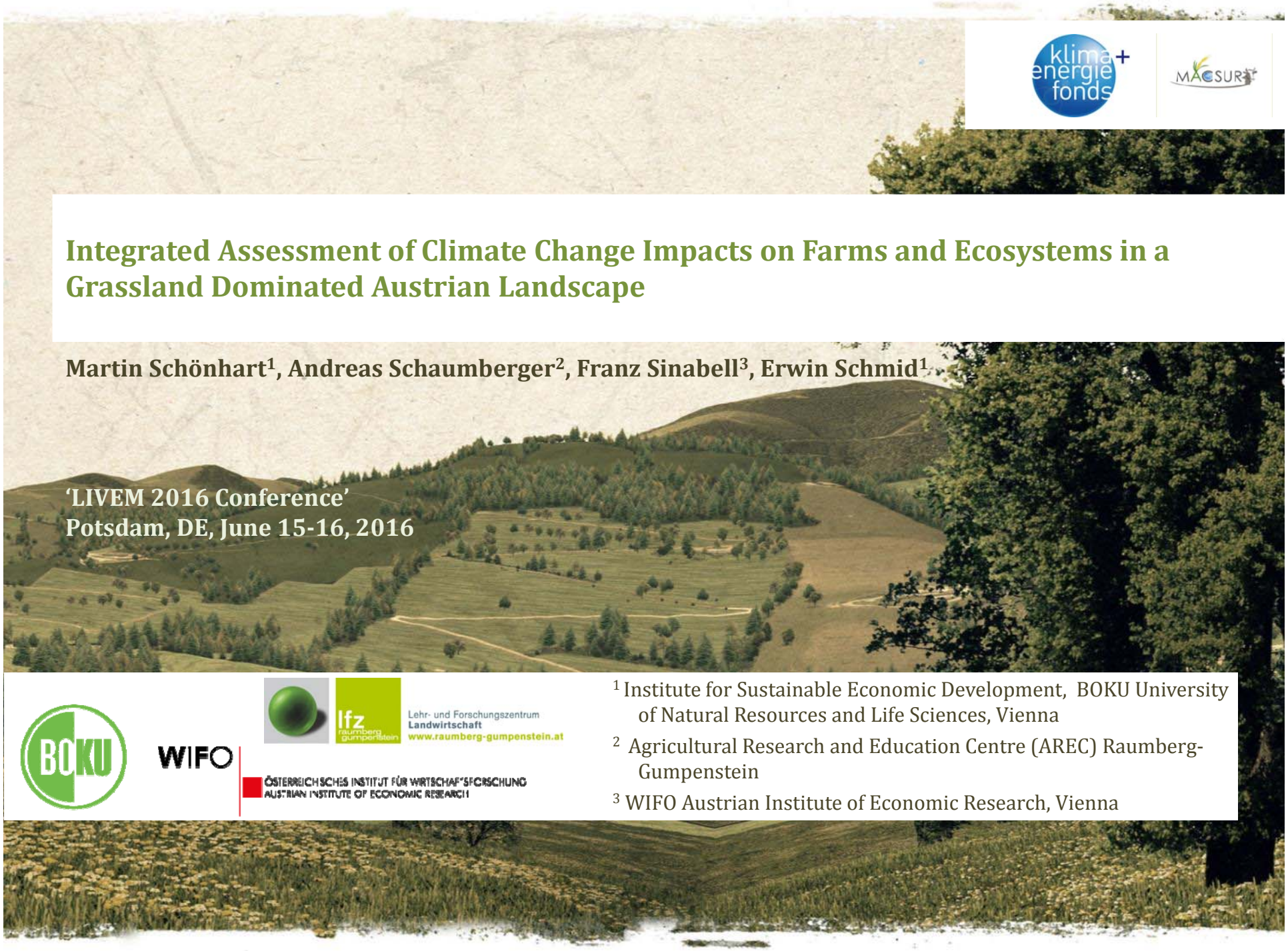


Integrated Assessment of Climate Change Impacts on Farms and Ecosystems in a Grassland Dominated Austrian Landscape

Martin Schönhart[1], Andreas Schaumberger[2], Franz Sinabell[3], Erwin Schmid[1]

'LIVEM 2016 Conference'
Potsdam, DE, June 15-16, 2016

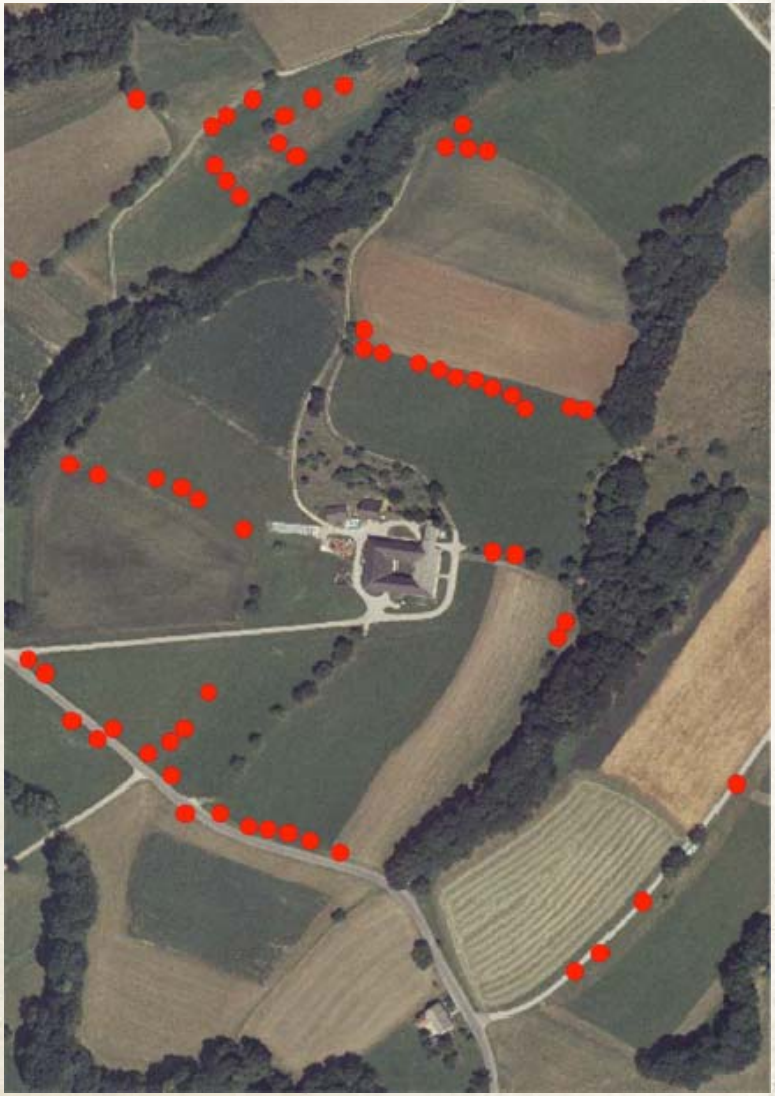
[1] Institute for Sustainable Economic Development, BOKU University of Natural Resources and Life Sciences, Vienna

[2] Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein

[3] WIFO Austrian Institute of Economic Research, Vienna

History of orchard meadows

(Streuobstwiesen)



Up to the 1950ies

Wide spread of orchard meadows around farms, on grassland and along field borders

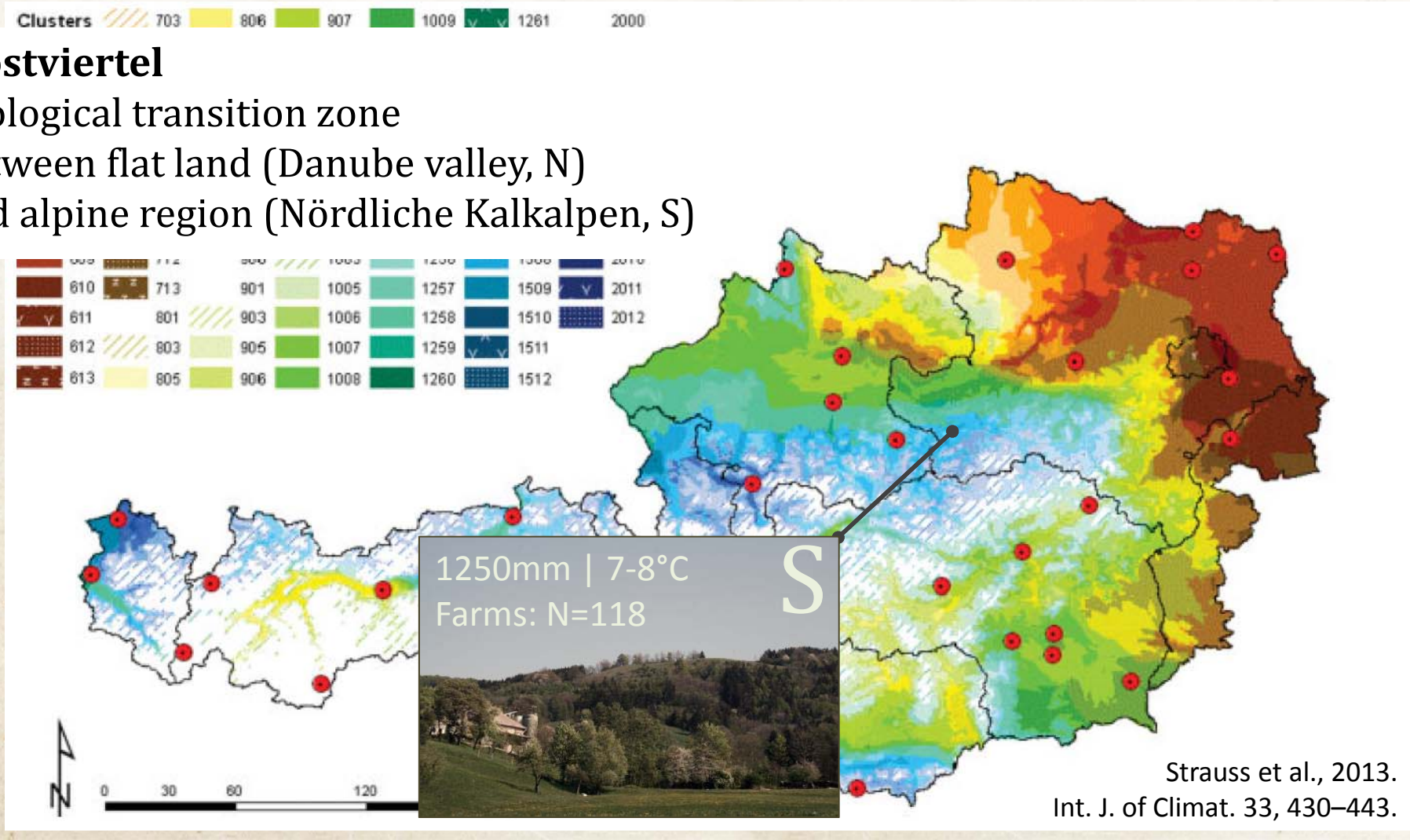
Since then...

Permanent decrease of fruit trees and orchard meadows

Schauppenlehner und Amon, 2012. Angewandte Geoinformatik 2012. Herbert Wichmann Verlag, Berlin/Offenbach. p. 652–661.

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

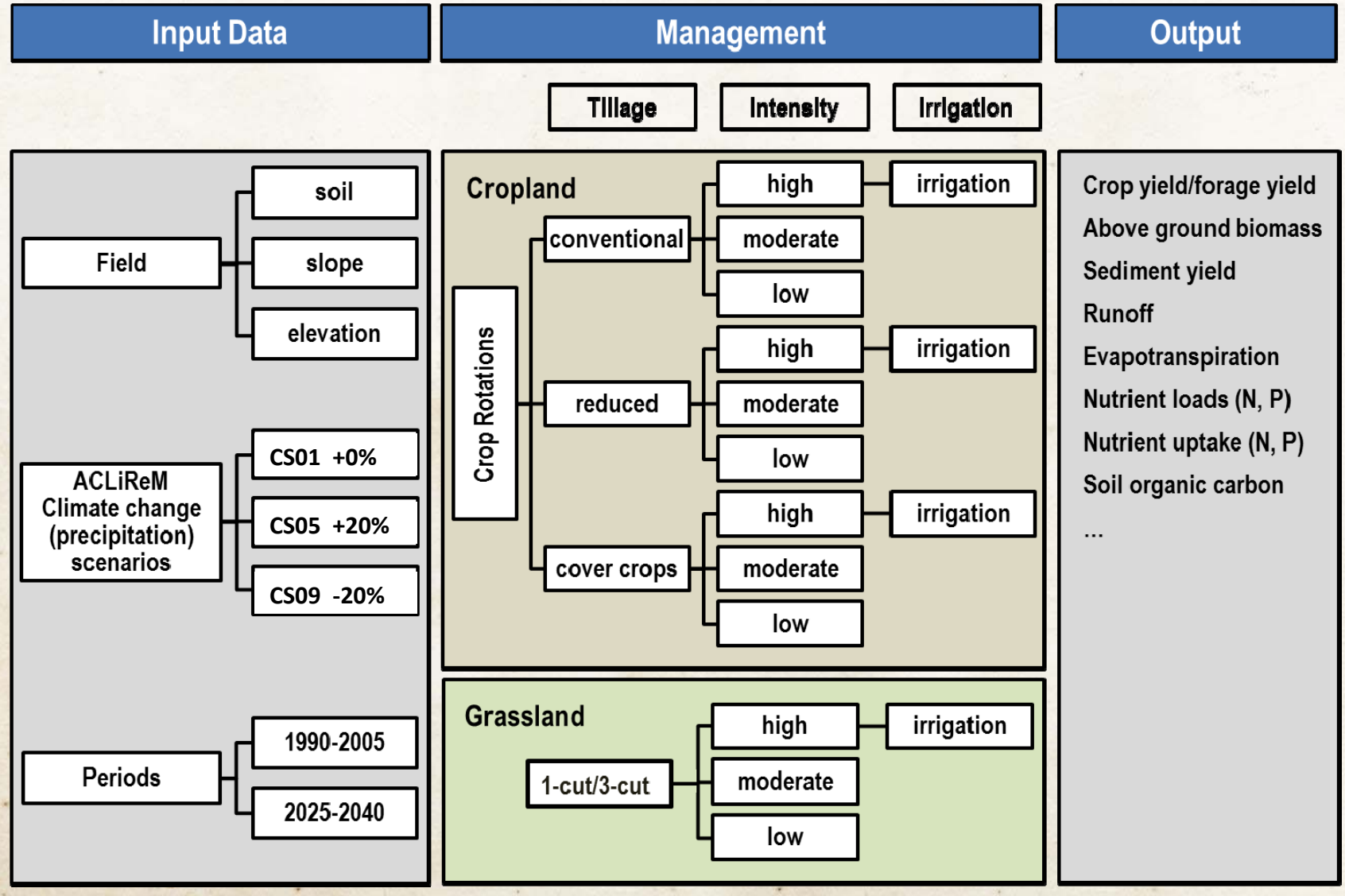
food production indicators

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., (2015). Ecol Econ 109, 161-174).

Schönhart et al., 2016. Agric. Syst. 145, 39-50

EPIC – model run settings



Impact, mitigation & adaptation scenarios

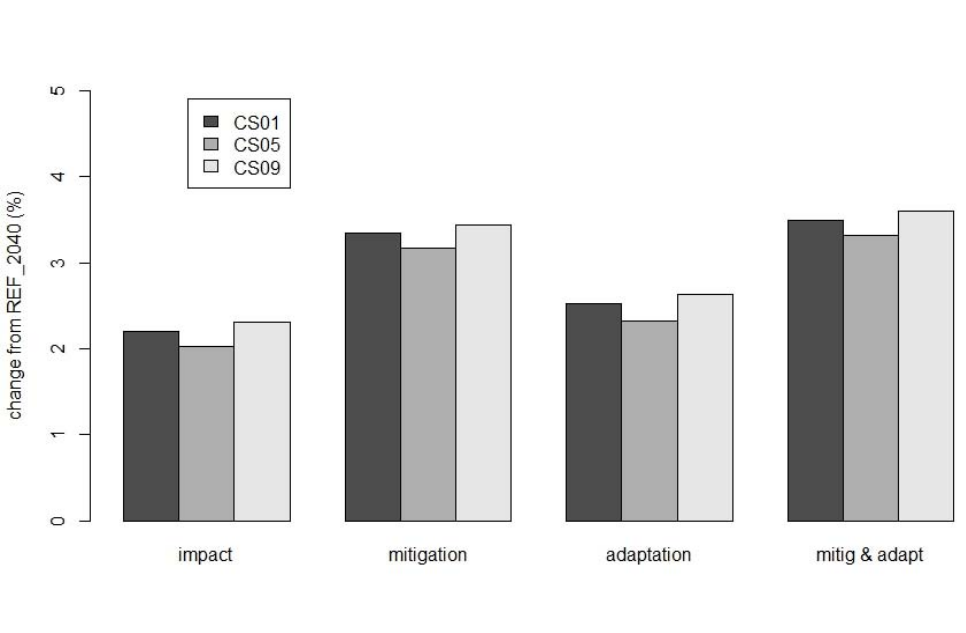
Name	CC*	AEP*	CAP reform	Mitigation policies	Adaptation policies
REF_2040	No	No	no dairy quota; no livestock premiums; regional farm payment; greening; LFA payments from 2008		
CS[CC]_i	Yes	No	like REF_2040		
CS[CC]_m	Yes	No	like REF_2040	energy crops on set aside; subsidies for: landsc. elements, SRF, 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

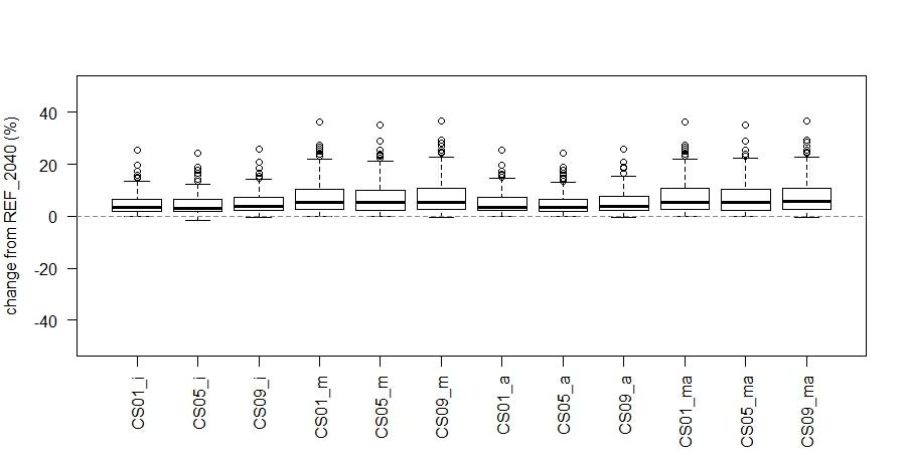
Climate Change [CC] Scenario Name	Climate change in 2040	
	Δ temperature (°C)	Δ precipitation (%)
CS01	+ 1.5	0%
CS05	+ 1.5	+20%
CS09	+ 1.5	-20%

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

Prelim. Results – changes in farm gross margins

from climate change and policies



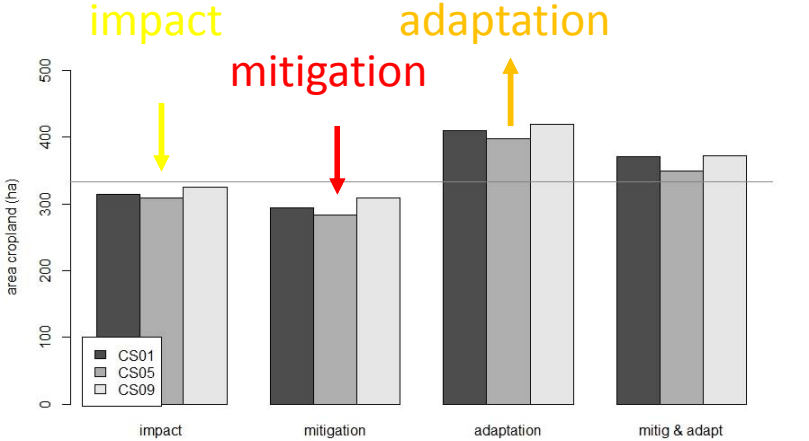


Gross margin: + product sales (plant, livestock) + subsidies + annuities for long-term investment
- variable costs (machinery, inputs and services, off-farm labor)

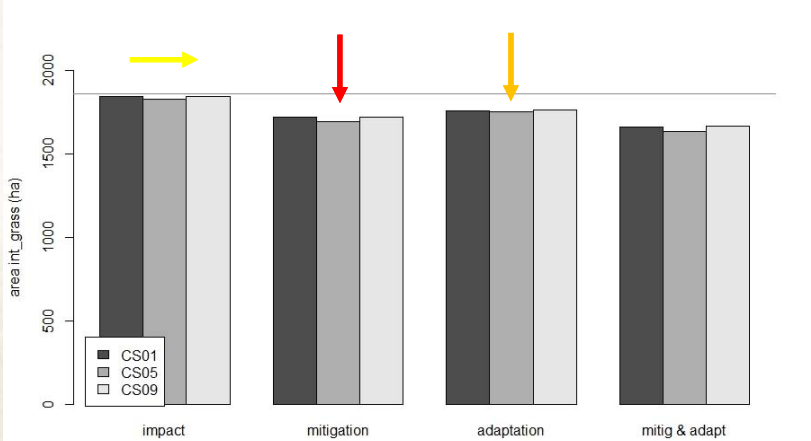
Prelim. Results – land use impacts (ha)

from climate change and policies

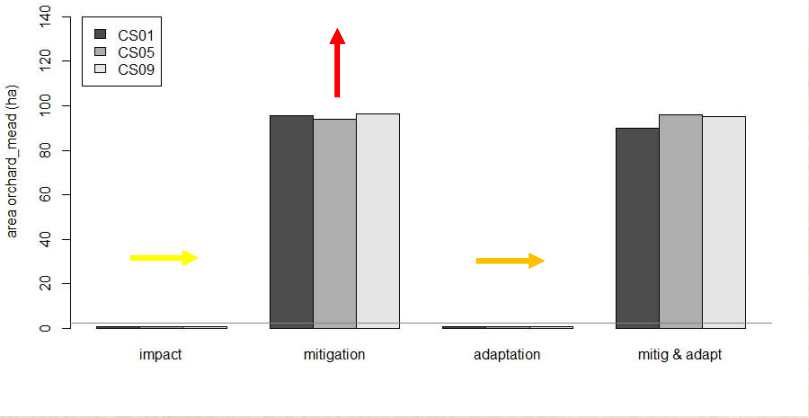
Cropland



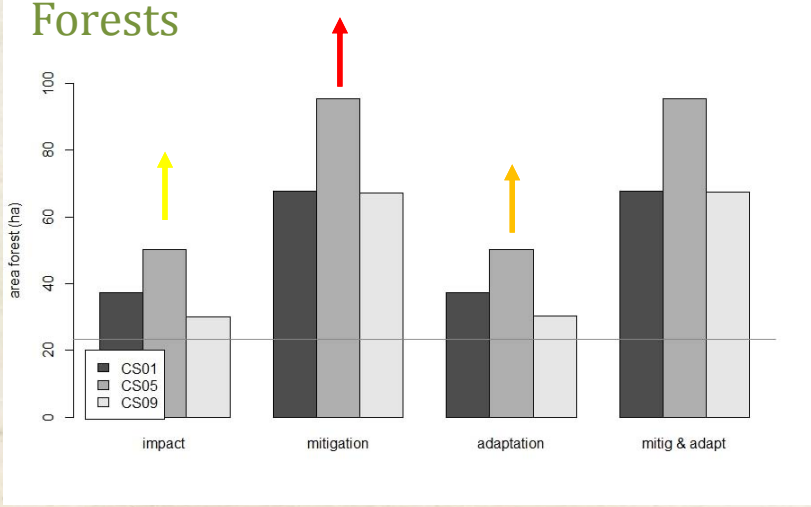
Intensively managed permanent grassland



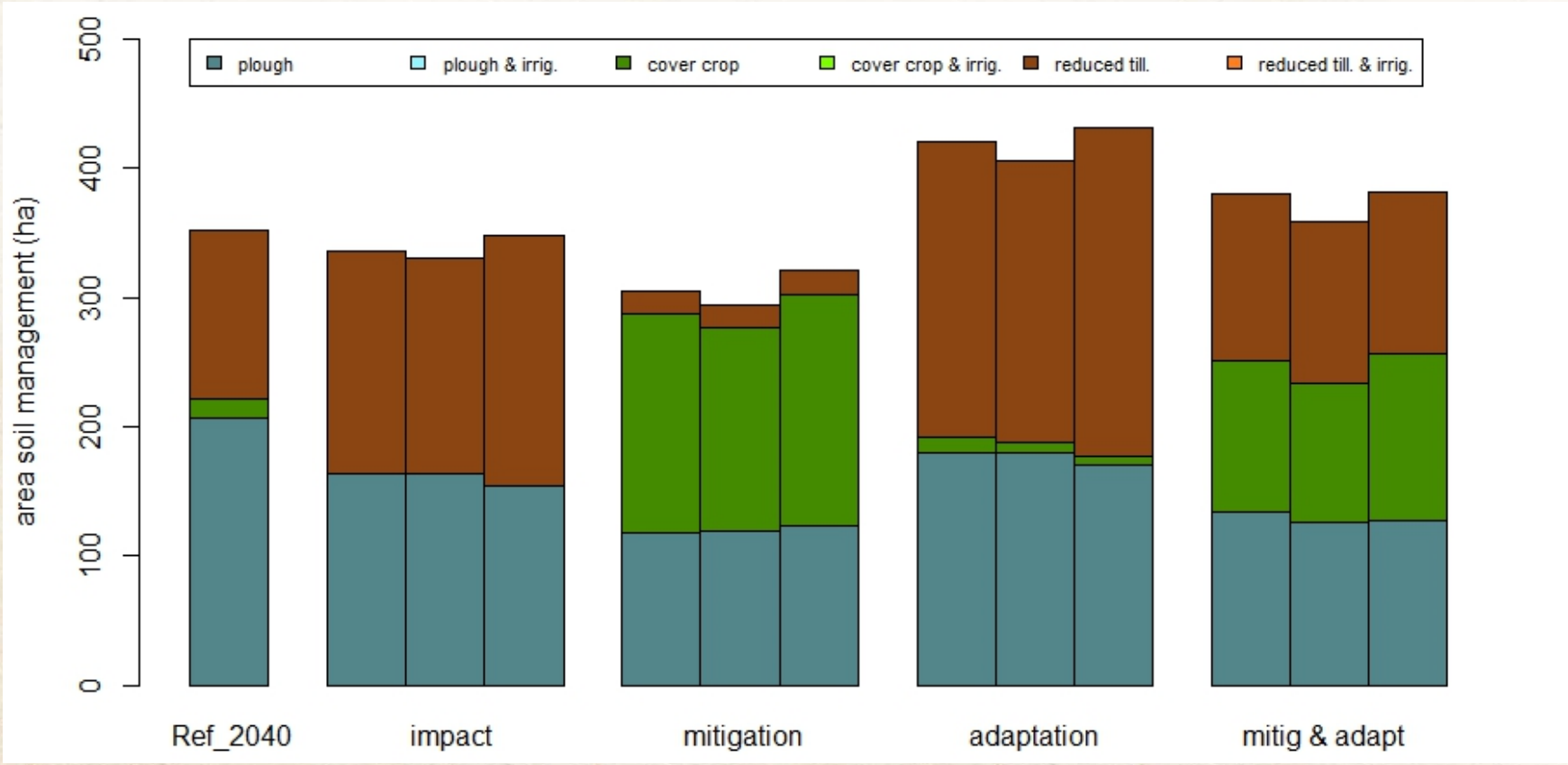
Orchard meadows



Forests



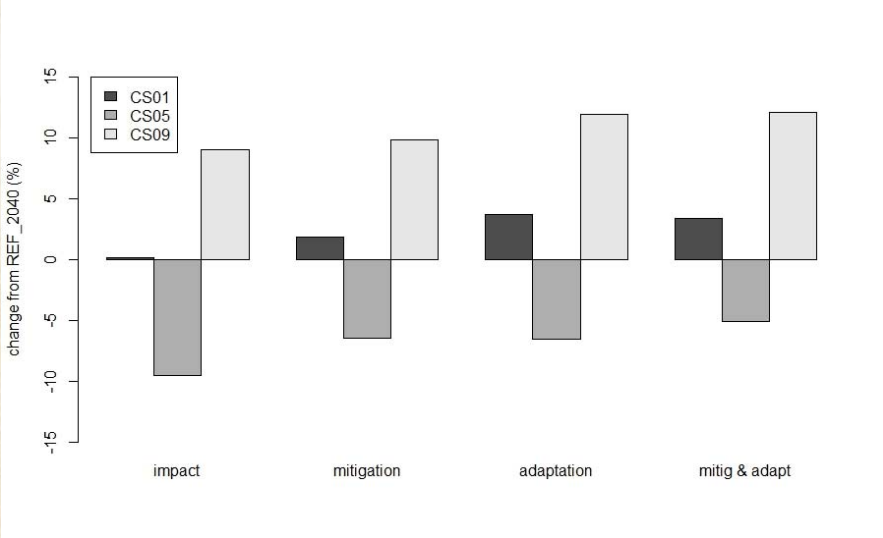
Prelim. Results – soil management (ha)



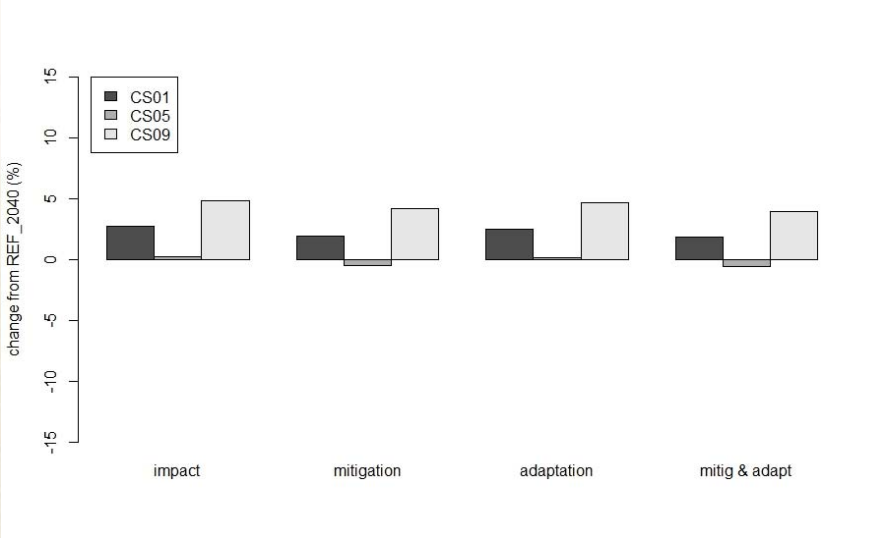
Prelim. Results – changes in soil organic carbon

from climate change and policies

Cropland



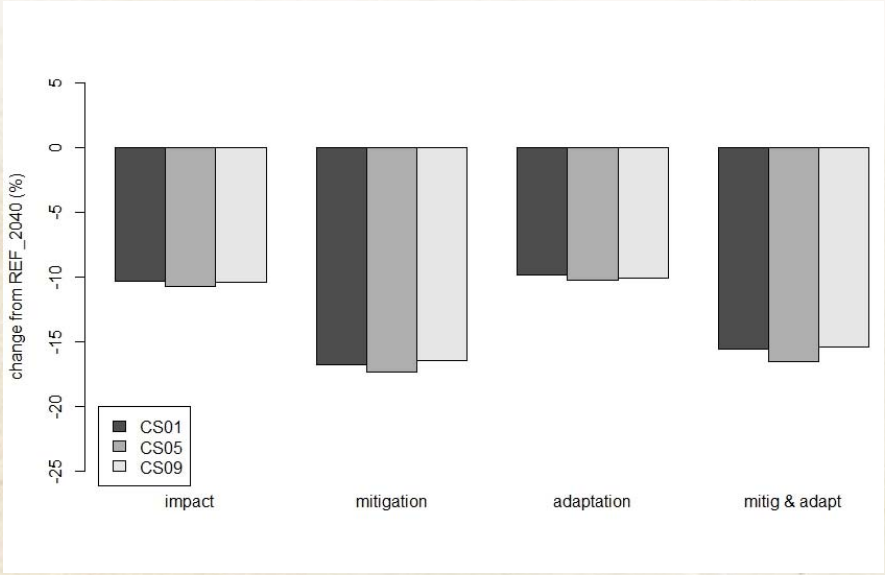
Permanent grassland



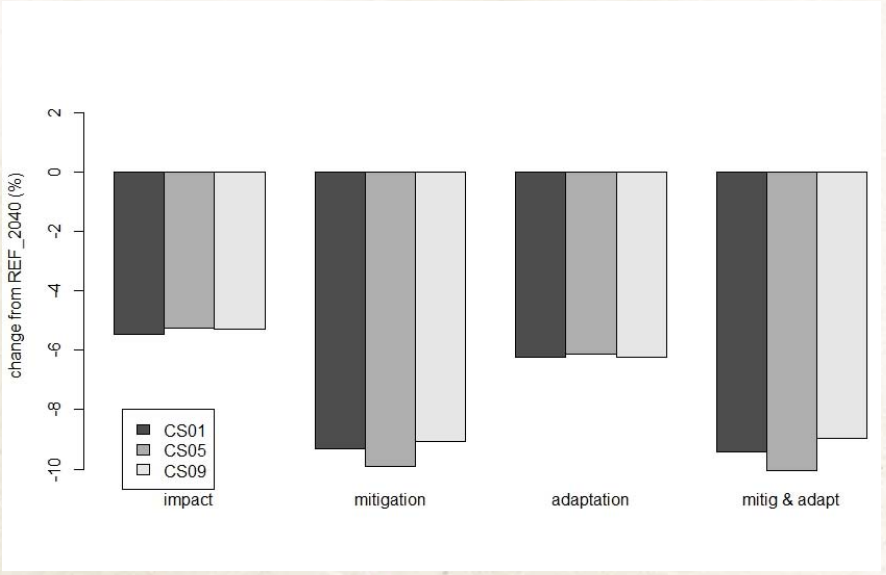
Prelim. Results – changes in nitrogen fertilization and GHG emissions

from climate change and policies

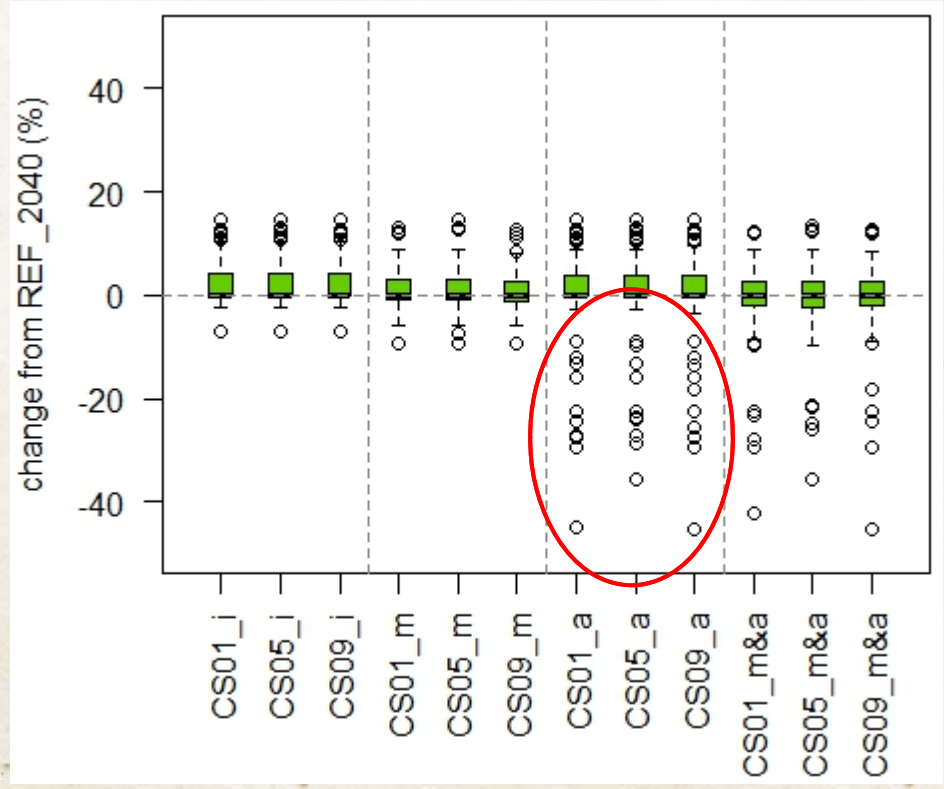
Nitrogen fertilization



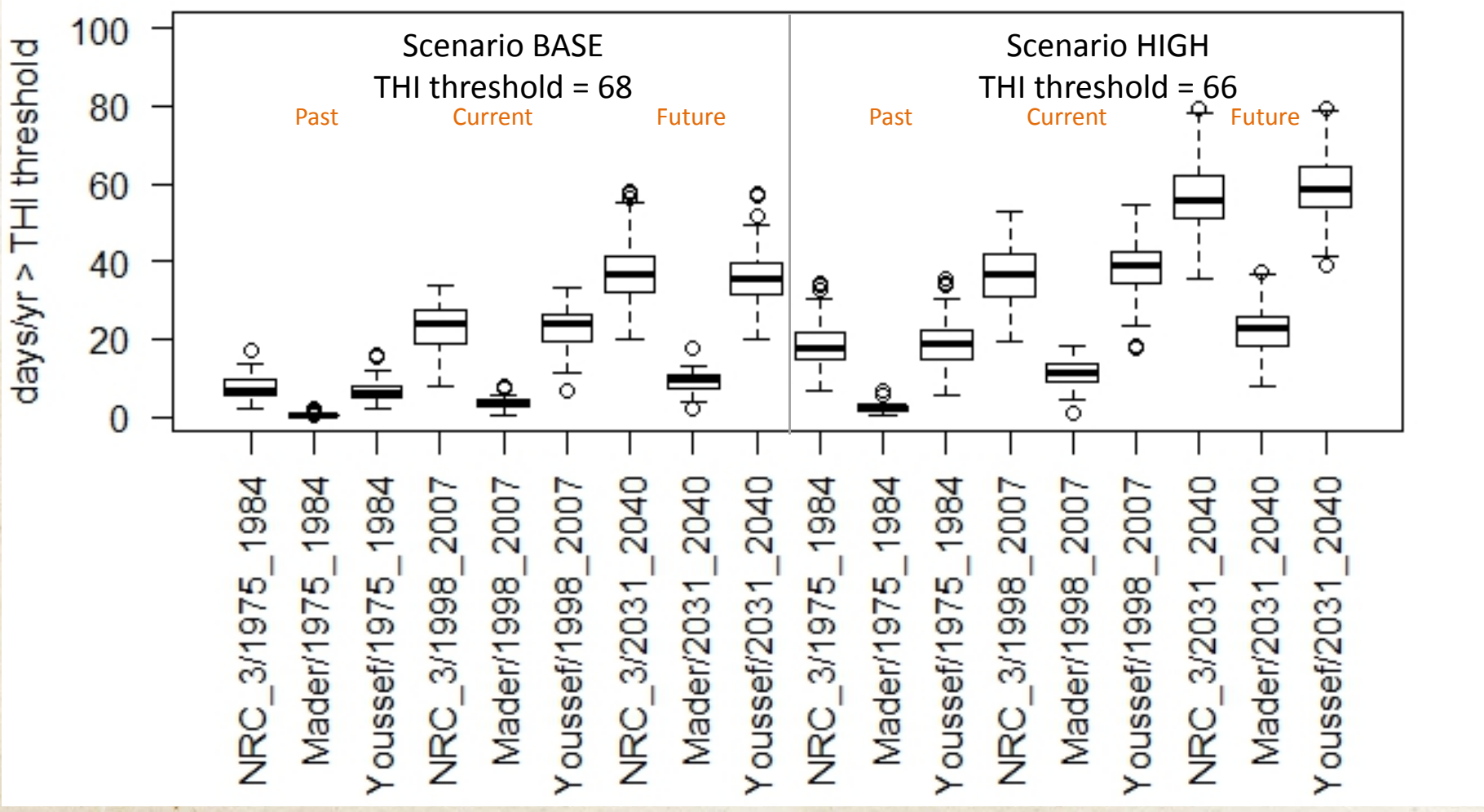
GHG emissions



Prelim. Results –
changes in vascular plant species richness on farms
from climate change and policies



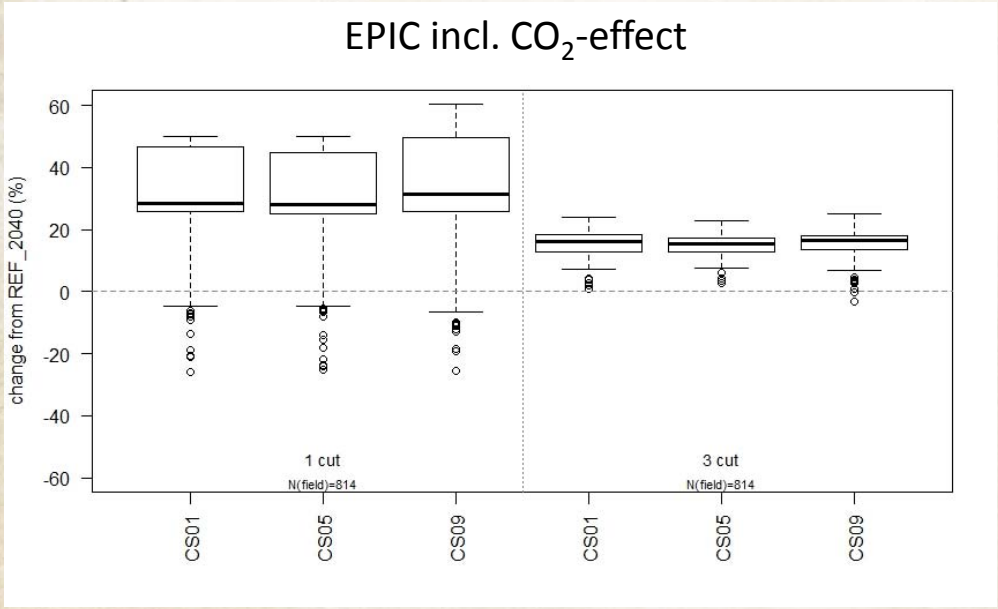
Days of THI values > threshold



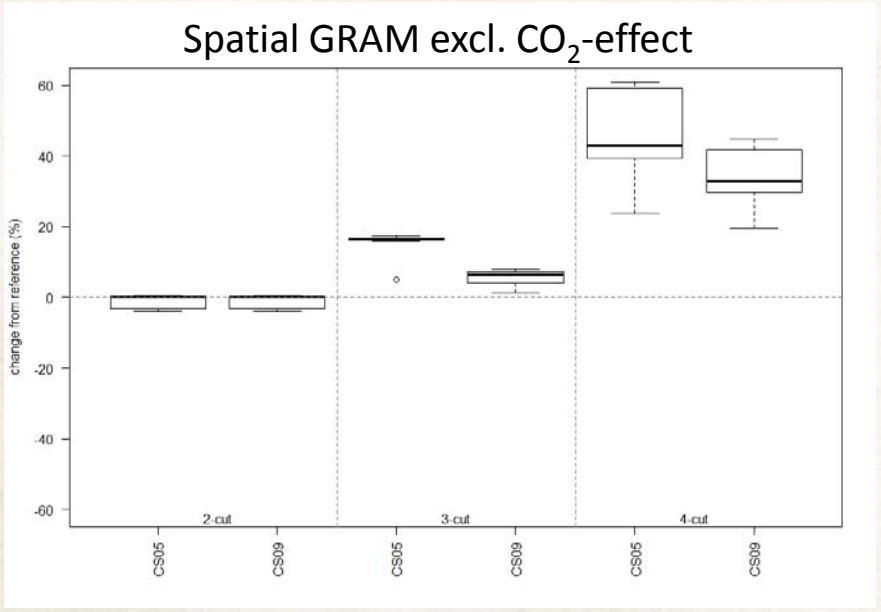
THI-models and scenario defintions based on Schönhart and Nadeem, 2015. Adv. in An. Biosci. 6, 17–20.

Model outputs on grassland yields

EPIC incl. CO_2-effect



Spatial GRAM excl. CO_2-effect



Discussion & Conclusions

- Increasing productivity from climate change on average
  - Consistent with literature
  - Some extremes not considered
  - Decreasing intensity on grassland counter-intuitive: model rigidity?
- Increasing farm incomes from policies on average
  - Mitigation: environmental quality, public cost, less production
  - Flexibility from adaptation: environmental trade-offs
- Heat stress: likely no issue in this region
- Location determines impacts
  - Heterogeneity among regions and farms
  - Not only latitude but altitude to be considered
- High spatial and system resolution offers interfaces

Lehr- und Forschungszentrum Landwirtschaft
www.raumberg-gumpenstein.at

WIFO
ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG
AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH

BOKU
Universität für Bodenkultur Wien

Martin Schönhart| martin.schoenhart@boku.ac.at

This presentation was prepared within the project CATMILK funded by the Austrian Klima & Energie Fonds as well as within the FACCE-JPI MACSUR project supported by BMLFUW.