



Modelling European Agriculture with Climate Change for Food Security



## Agriculture, food security and climate change - relevance and perspectives for a small open economy exemplified by Austria

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## Outline

- Problem framing i.e. global phenomena with local/regional significance
- Relevance and perspectives
  - Scientific model analysis
  - Austrian agriculture - some scientific evidence
- Conclusions
- Outlook



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## Some global phenomena with local/regional significance

- Carbon leakage
- Indirect land use change (iLUC)
- Rebound effect
- „Ending“ of the *treadmill* effect
- Land grabbing
- etc.

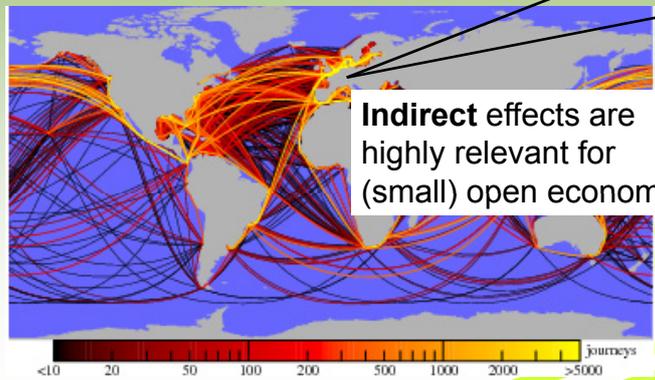
→ **interconnectedness of responses and effects**



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## Global climate change impacts influence effectiveness of national adaptation and food security measures and vice versa



**Indirect effects are highly relevant for (small) open economies**

Source: Network of cargo ships; <http://wwwf.imperial.ac.uk/~mgastner/networks/networks.html>



## Example: Austrian crop supply balance sheets

	SSR	balance	
	2008-2010		
	%	1000 t	
barley	94	-64	
maize	89	-272	
durum wheat <sup>1</sup>	103	-2.0	
oats	95	-5.2	
potatoes	92	-64.9	
soybeans	58	-51.6	
sunflower	65	-44.7	
triticale	99	-3.1	
winter rape	45	-201	
rye	85	-35.5	
winter wheat	107	+95.6	

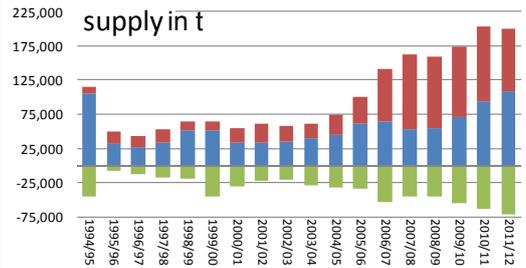
**SSR = self-sufficiency rate**

Note: A positive balance implies a surplus of exports. <sup>1</sup>Negative trade balance and SSR greater 100% are due to storage. Source: own results based on Statistics Austria, various years.



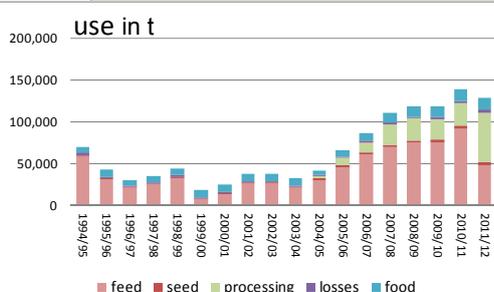
## Example: Soybean supply and use in Austria

### supply in t



■ domestic production ■ imports ■ exports

### use in t



■ feed ■ seed ■ processing ■ losses ■ food

## Increasing soybean trade and use in Austria



**Relevance for scientific analysis:  
agecon-modelling typically at 3 scales**

1. Farm and regional production models - price exogenous e.g. using OECD/FAO price projections.
2. (Supra)national partial equilibrium models - price endogenous e.g. using rest of world (ROW) excess supply/demand representation.
3. Global partial equilibrium models - price endogenous e.g. using world regional representation of supply, demand and trade.

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Trade-offs between detailed depiction of farm production and policy measures and accounting of international feedbacks such as iLUC & carbon leaching.

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## Relevance for scientific analysis: some issues

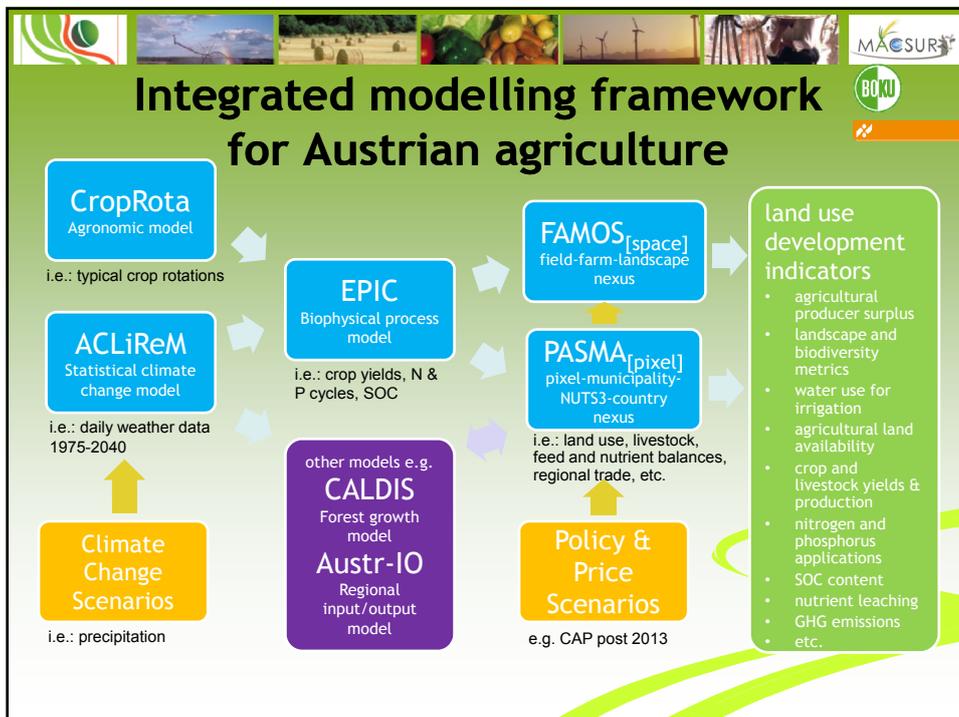
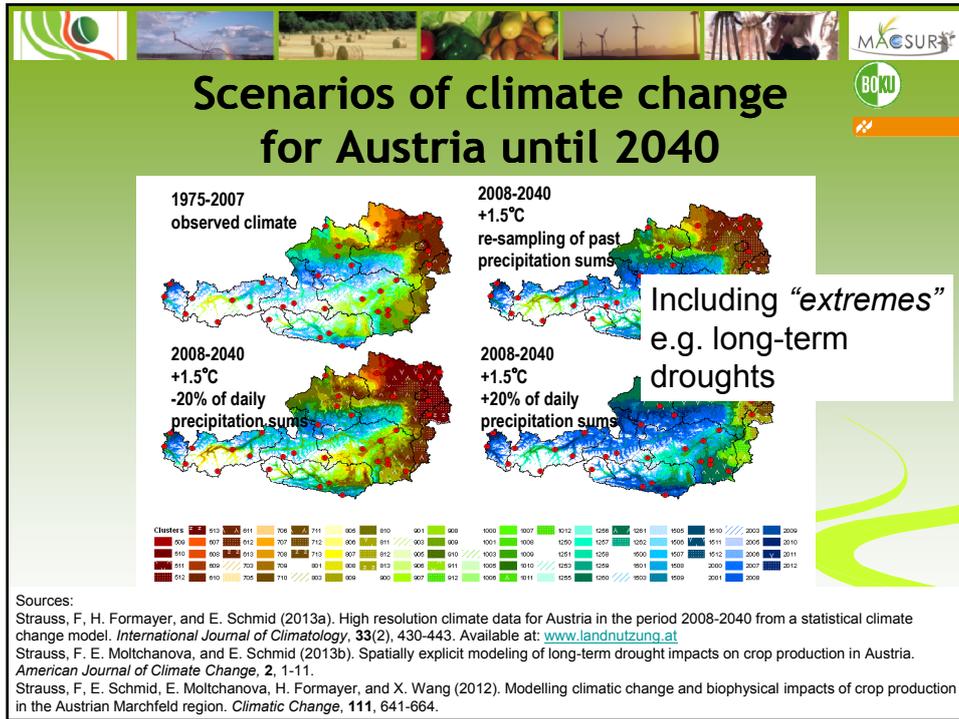
Modelling, tracking and disentangling of inter-connected responses and effects (direct & indirect) across scales (farm ↔ global) puts methodological challenges to the scientific community → workshop.

- Linking of disciplinary models (e.g. crop and farm models) and agecon-models at different scales (e.g. farm and global market models) requires developing of consistent dis/aggregation procedures.
- “Sufficient” and “detailed” depiction of production processes, management measures (adaptation and mitigation), and commodities (i.e. representation of opportunity costs).
- Representation of supply and demand (vertical vs. horizontal) and trade.



## Some scientific evidence for Austrian agriculture

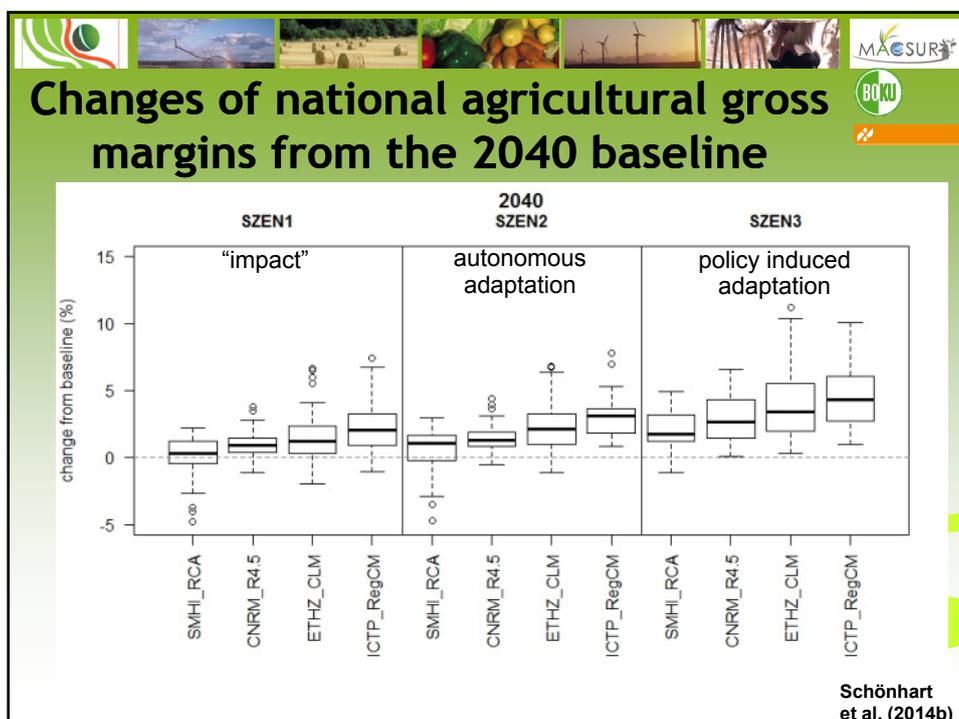
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- Mitter, H., M. Kirchner, E. Schmid, and M. Schönhart (2014a). The participation of agricultural stakeholders in assessing regional vulnerability of cropland to soil water erosion in Austria. *Regional Environmental Change*, 14(1), 385-400.
- Mitter, H., C. Heumesser, and E. Schmid (2014b). Spatial modelling of robust crop production portfolios in assessing agricultural vulnerability and adaptation to climate change. [*Land Use Policy*].
- Mitter, H., E. Schmid, and F. Sinabell (2014c). Climate change and policy impacts on Austrian protein crop supply balances. [*Jahrbuch der ÖGA*].
- Schönhart, M., T. Schauppenlehner, and E. Schmid (2014a). Integrated land use modelling of climate change impacts in two Austrian case study landscapes at field level (2014). Paper presented at 14<sup>th</sup> EAAE Congress 'Agri-food and rural innovations for healthier societies', Ljubljana, 26-29<sup>th</sup> August, 2014.
- Schönhart, M., H. Mitter, E. Schmid, G. Heinrich, and A. Gobiet (2014b). Integrated analysis of climate change impacts and adaptation measures in Austrian agriculture. *German Journal of Agricultural Economics*, 63(3), 156-176.
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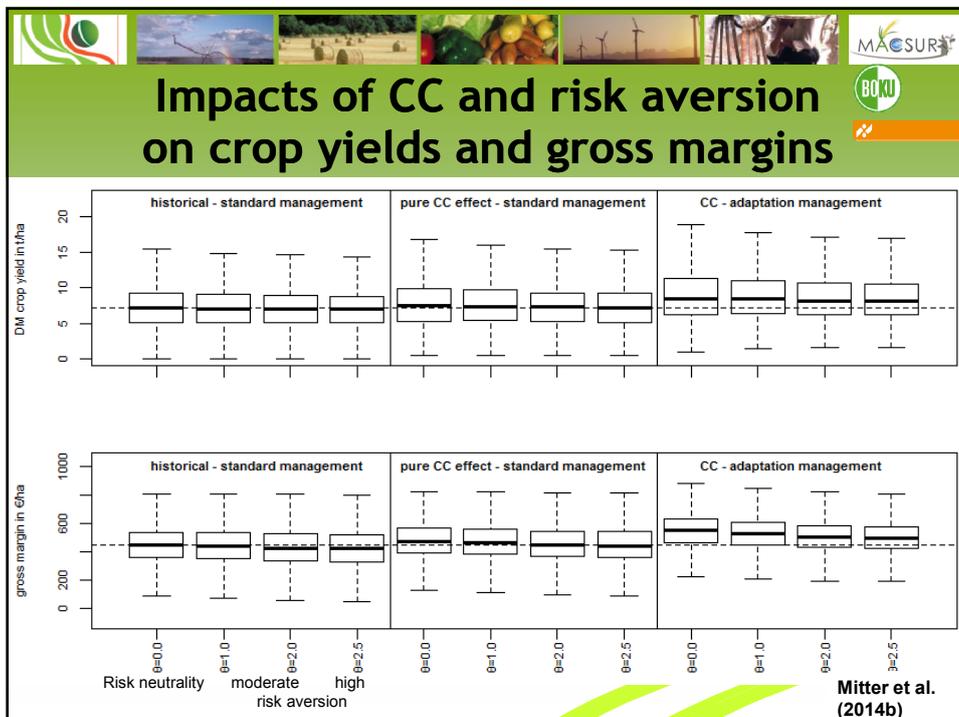
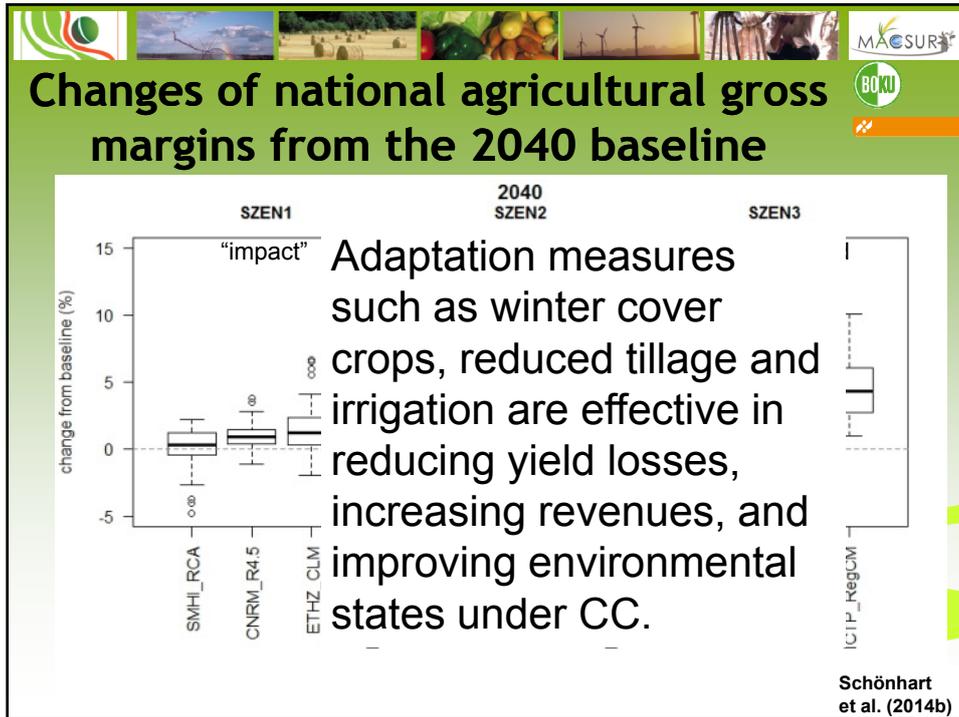


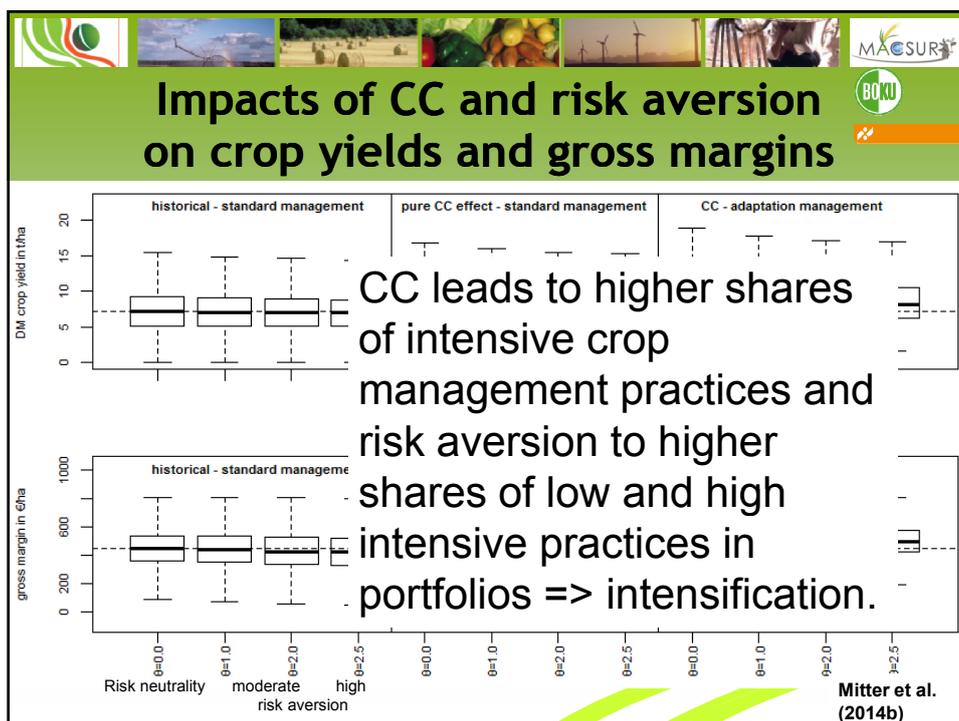


## Relevance and perspectives for Austrian agriculture I

- Climate change impacts are both adverse and beneficial (i.e. next few decades)
  - semi-arid eastern cropland regions
  - + humid, western/alpine grassland regions
- Leads to “winners” and “losers” of CC within the ag-sector i.e. may in/decrease disparities.
- Effective adaptation allows alleviating of adverse and utilizing of beneficial CC effects.

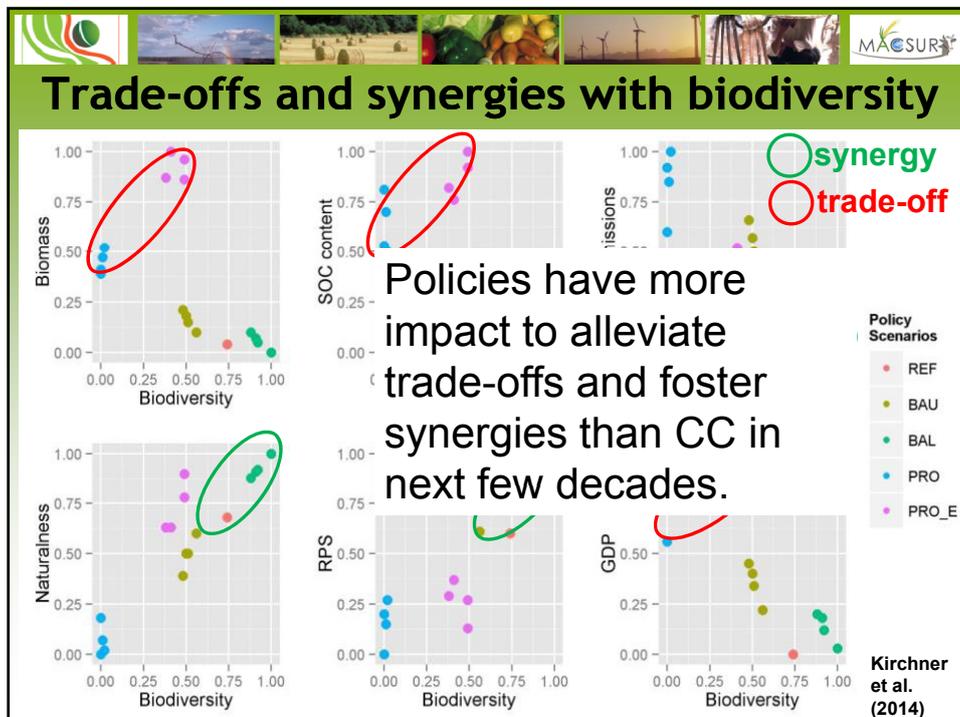
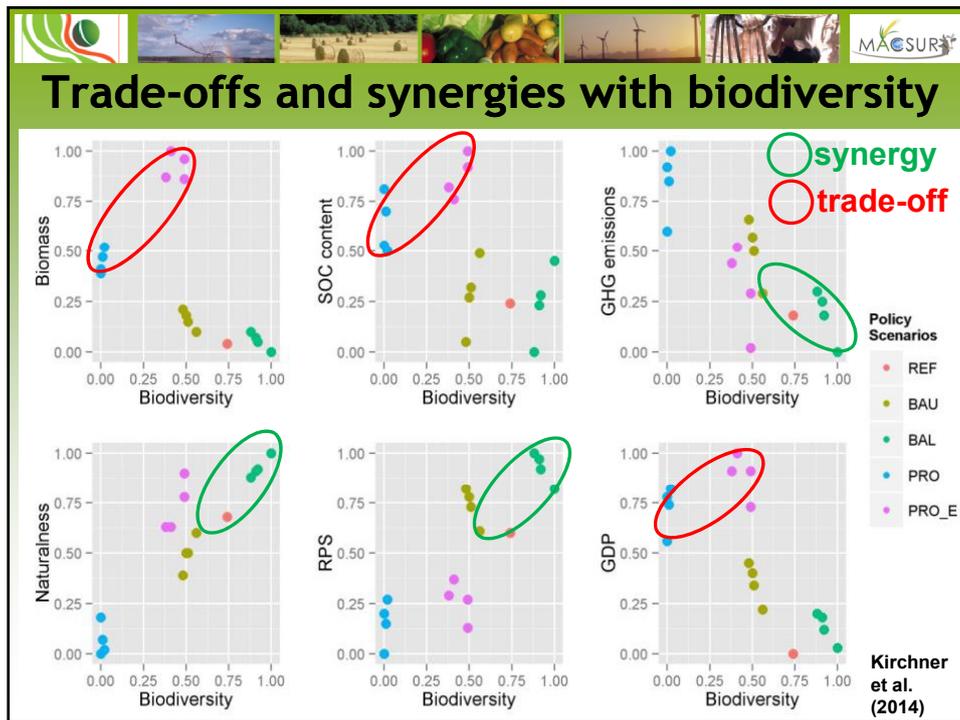






**Relevance and perspectives for Austrian agriculture II**

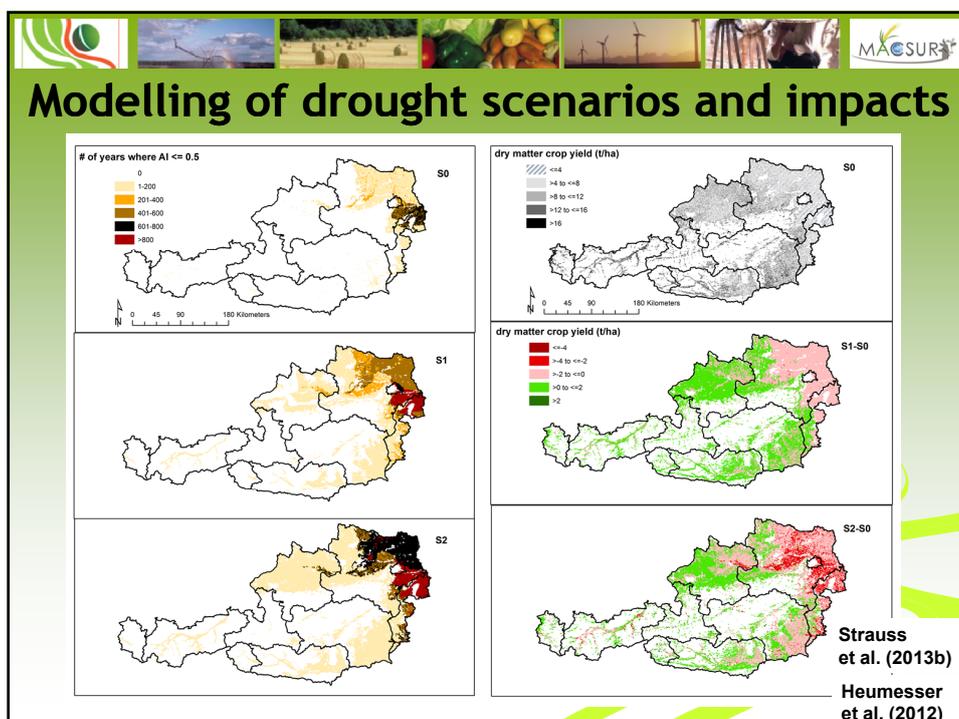
- CC accelerates intensification on favourable and extensification on unfavourable sites
  - intensification dominates at national level.
  - trade-offs and synergies between different landuse development indicators.
- Increasing crop productivity by CC puts pressure on conservation (e.g. orchard meadows, bio-diversity) and extensification policies (e.g. AEPs)

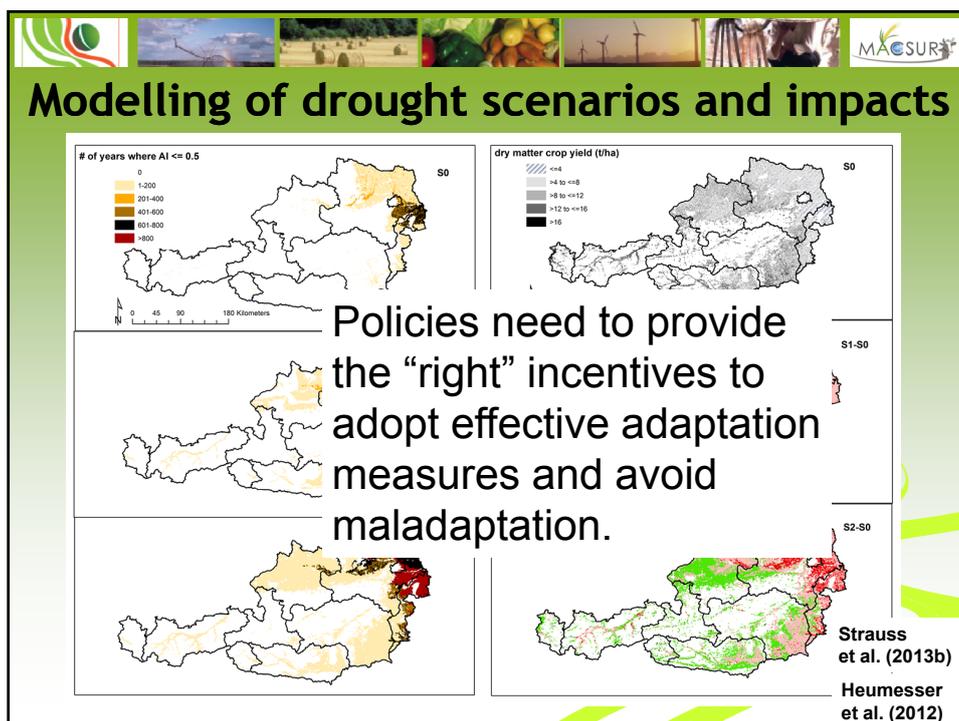




## Relevance and perspective for Austrian agriculture III

- Price volatility, policy reforms and trade liberalisation have higher impact on ag-sector development than CC (i.e. next few decades).
- Climate extremes (e.g. droughts) can put additional pressures on already scarce resources (e.g. groundwater), trigger migration in regions with already insecure food supply, or can lead to irreversible outcomes (e.g. loss of biodiversity).
- Uncertainty requires flexibility in response and policies should incentivize “right” responses.





**Conclusions**

- Open economies are sensitive to indirect CC impacts, which have the potential to enhance, mitigate or even reverse *price sensitive* responses, e.g. fertilization & irrigation, imports and exports, choice of cultivar.
- Tools to model, track and disentangle direct & indirect effects across scales are of high relevance.
- Knowledge integration i.e. among researchers from different disciplines (e.g. MACSUR network) and stakeholders' expertise is paramount for capacity building in the field of global climate change and food security.

