University of Natural Resources and Life Sciences, Vienna
Department of Economics and Social Sciences

Modelling the risk of Western Corn Rootworm infestation on Austrian cropland

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Overview

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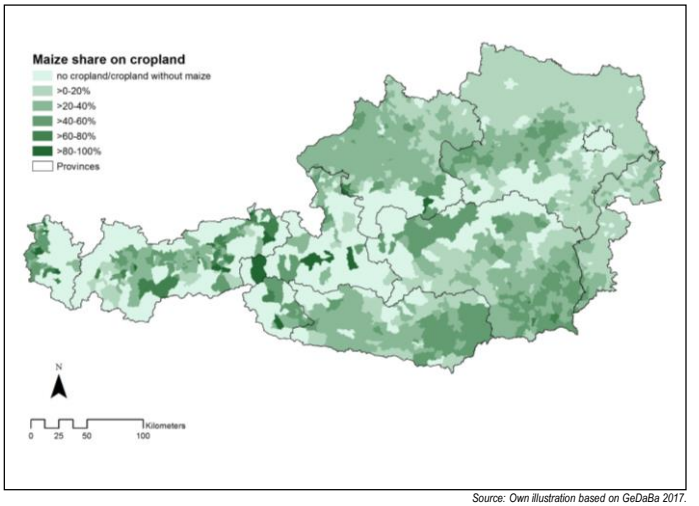
- Research background
- Research objectives
- Material & Methods
  - Integrated modelling framework
  - Assumptions and scenarios
- Results
  - Economic effects
  - Western Corn Rootworm (WCR) abundance
- Conclusions

Research background



Source: Own illustration based on GeDaBa 2017.

Research background

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- 2002: 1st WCR detection in Austria
- Hotspots of maize production = hotspots for WCR infestation
  → Economic losses
- WCR monitoring with pheromone traps
- Factors influencing WCR infestation
  - Maize cultivation intensity (monocultures)
  - Climatic conditons (life cycle development)

Research objectives

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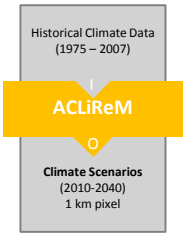
- We aim at
  a) analyzing the **effect of crop rotation** regulations with upper limits for maize shares and the **effect of climate change** on WCR infestation.
  b) identify effective and efficient management strategies to control WCR spreading.

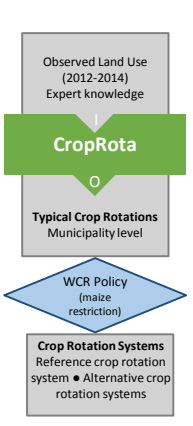
- Model design
  – Development and calibration of a WCR abundance model.
  – Application of the WCR model within an integrated land use modelling framework.

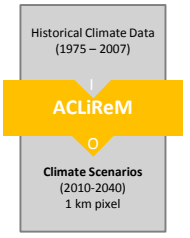
Integrated modelling framework

Integrated modelling framework



Integrated modelling framework





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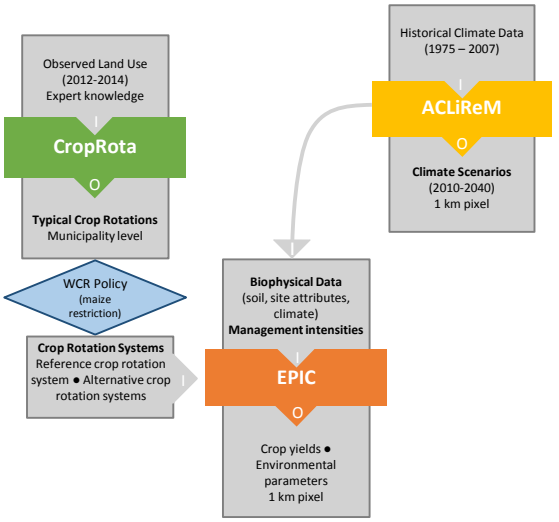

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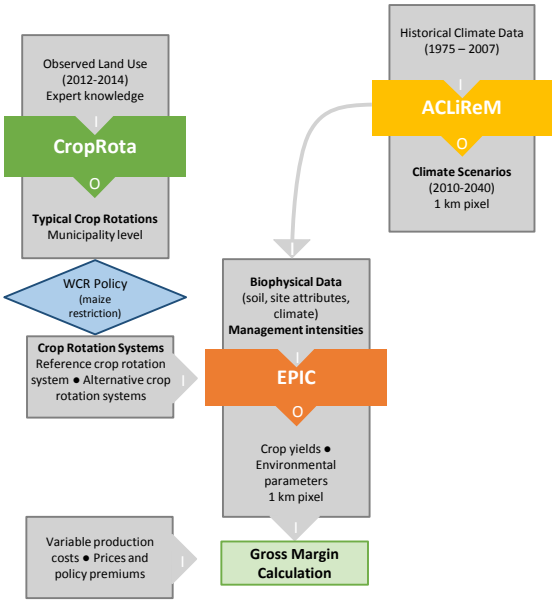
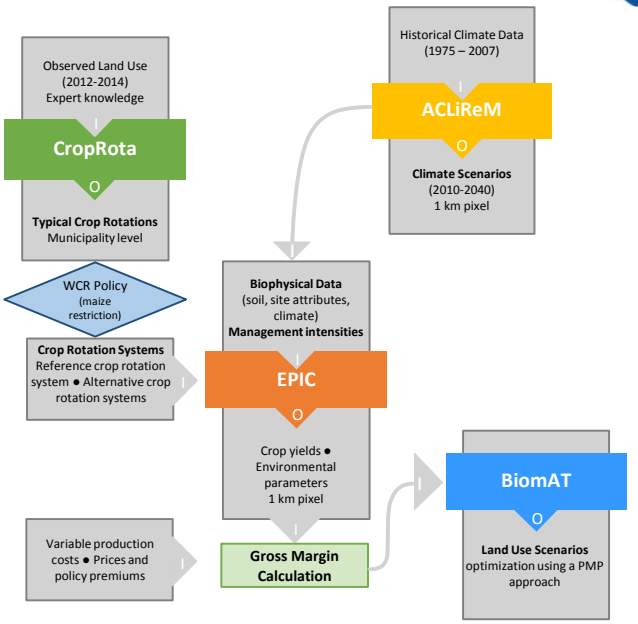


Integrated modelling framework



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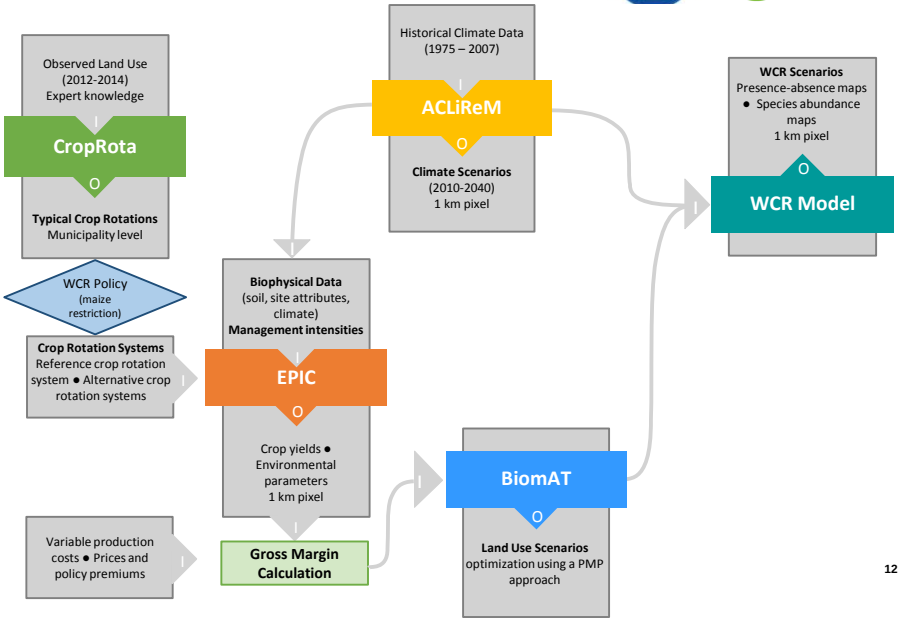
Integrated modelling framework



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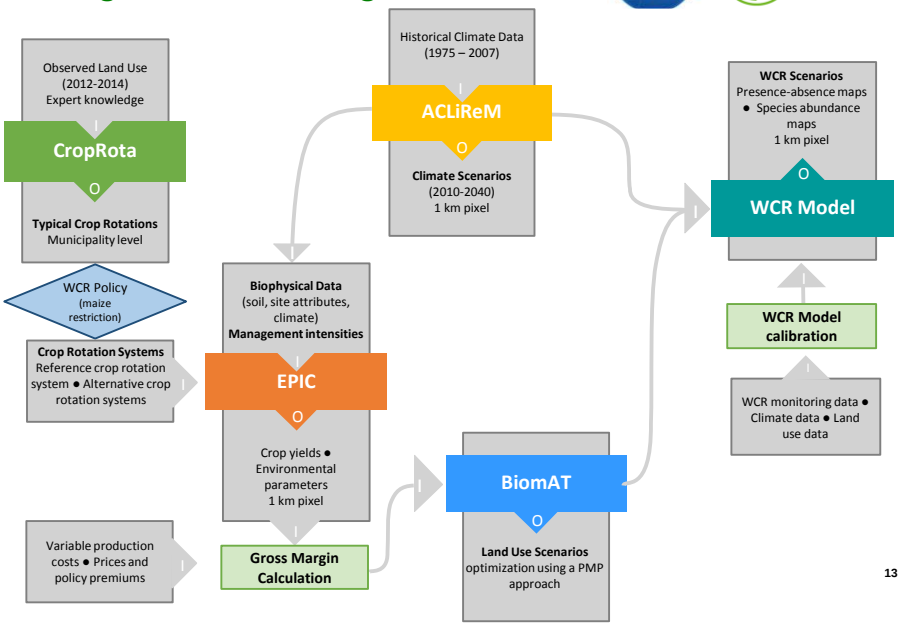
Integrated modelling framework



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Assumptions and scenarios

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- Crop rotation systems

Scenario	Upper limit for maize in crop rotations
REF	unrestricted
MS50	50%
MS25	25%
MS10	10%

- Climate change scenarios

Scenario	Temperature trend	Precipitation sums
SIMILAR	+ 0.05°C/year	resemble the past
WET	+ 0.05°C/year	increase (+20%)
DRY	+ 0.05°C/year	decrease (-20%)

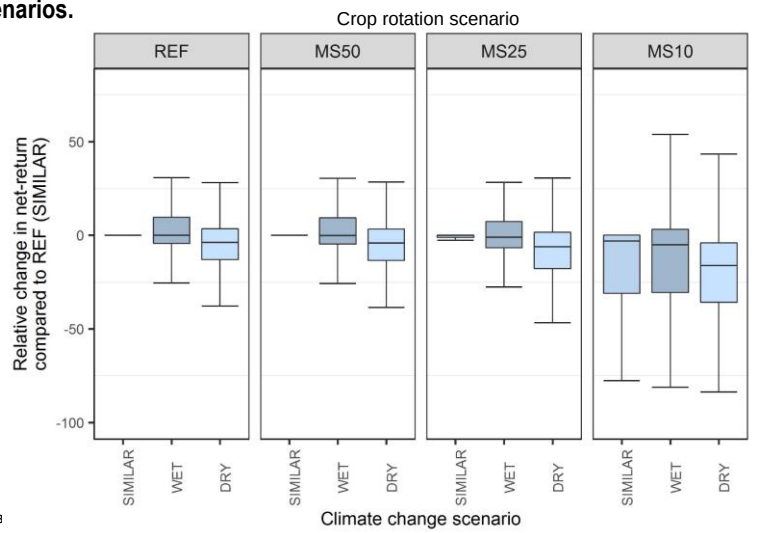
Results

Economic effects of maize restrictions

Source: Own illustration based on model results. Note: outliers not shown.

Results

Changes in net-returns by maize restriction and climate change scenarios.



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Results

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Economic effects of maize restrictions:

Compared to the REF, net-returns

- show a decreasing trend if we limit maize production to MS50, MS25 or MS10.
- are highest under WET and lowest under DRY climatic conditions.
- decrease most under most restrictive maize limits in crop rotations.
- show a higher variability.

Results

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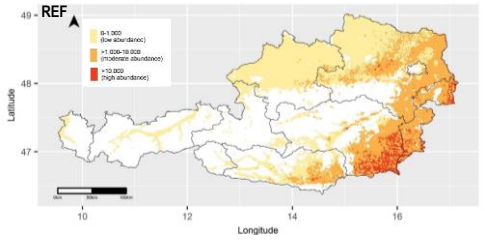
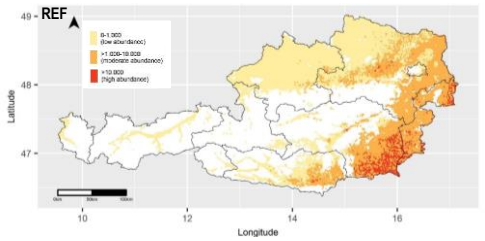
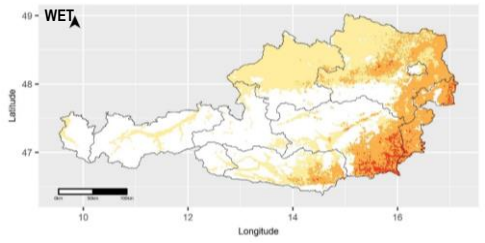
WCR abundance

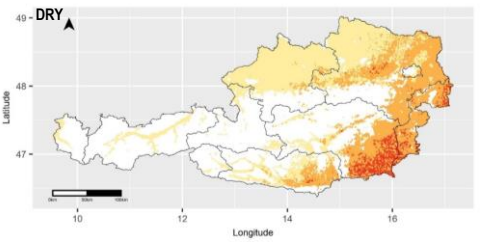


	SIMILAR		WET		DRY	
Crop rotation system	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]
REF	**88,406**					
MS50						
MS25						
MS10						

Source: Own illustration and calculation based on model results.

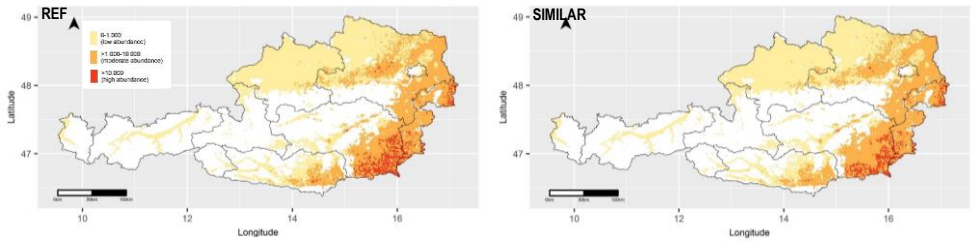






	SIMILAR		WET		DRY	
Crop rotation system	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]
REF	**88,406**		**100,401**	**+13.6%**	**69,389**	**-21.5%**
MS50						
MS25						
MS10						

Source: Own illustration and calculation based on model results.



	SIMILAR		WET		DRY	
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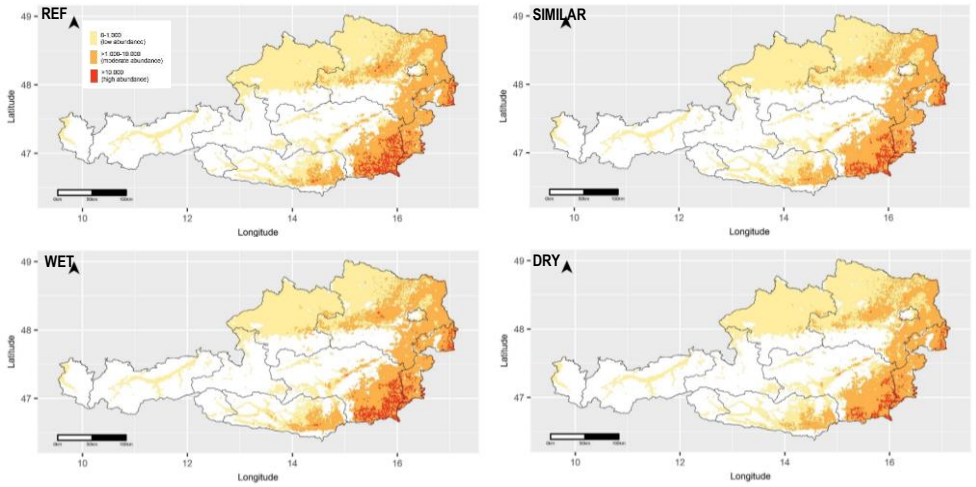
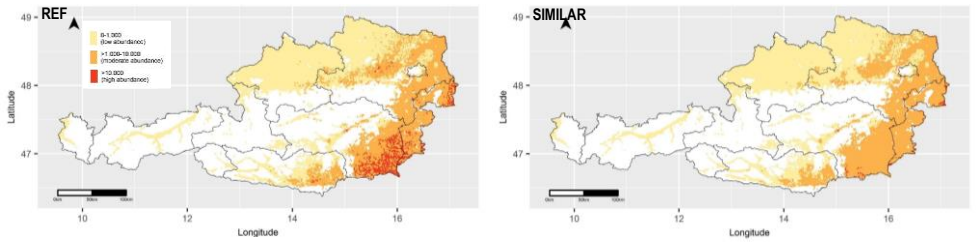
REF	88,406		100,401	+13.6%	69,389	-21.5%
MS50	**68,092**	**-23.0%**				
MS25						
MS10						

Source: Own illustration and calculation based on model results.



	SIMILAR		WET		DRY	
Crop rotation system	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]
REF	88,406		100,401	+13.6%	69,389	-21.5%
MS50	**68,092**	**-23.0%**	**85,514**	**+/-0.0%**	**49,279**	**-44.3%**
MS25						
MS10						

Source: Own illustration and calculation based on model results.



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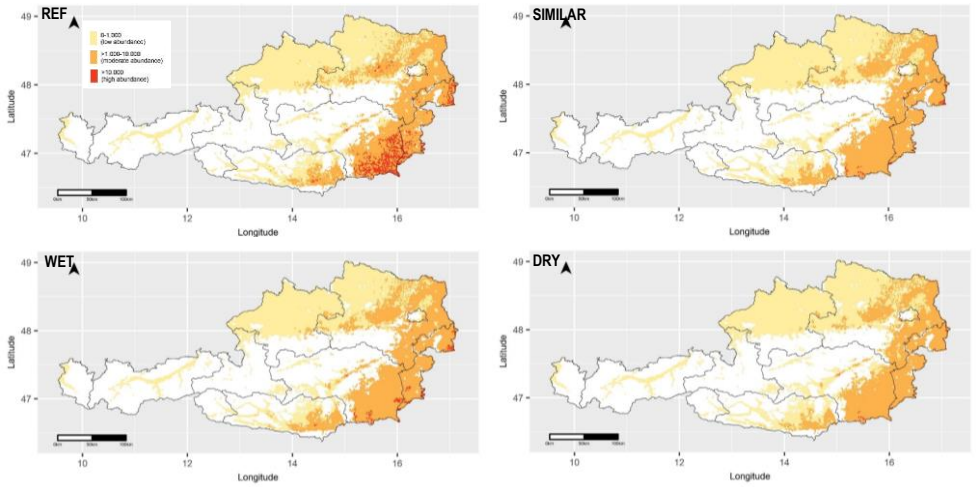
MS25	**5,286**	**-94.0%**				
MS10						

Source: Own illustration and calculation based on model results.



	SIMILAR		WET		DRY	
Crop rotation system	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]	**High abundance** [ha cropland]	**Change in high abundance** [%]
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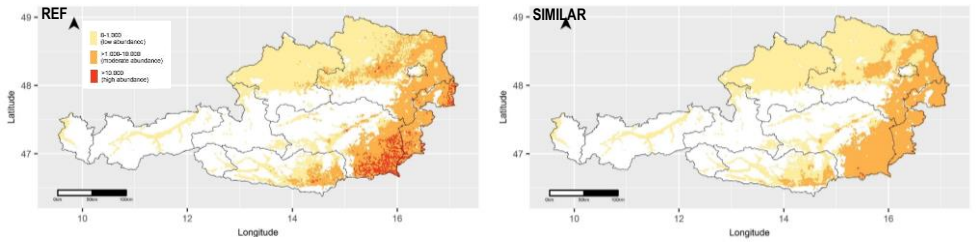
MS25	**5,286**	**-94.0%**	**13,053**	**-85.2%**	**812**	**-99.1%**
MS10						

Source: Own illustration and calculation based on model results.



Crop rotation system	SIMILAR High abundance [ha cropland]	SIMILAR Change in high abundance [%]	WET High abundance [ha cropland]	WET Change in high abundance [%]	DRY High abundance [ha cropland]	DRY Change in high abundance [%]
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MS25	5,286	-94.0%	13,053	-85.2%	812	-99.1%
MS10	**111**	**-99.9%**				

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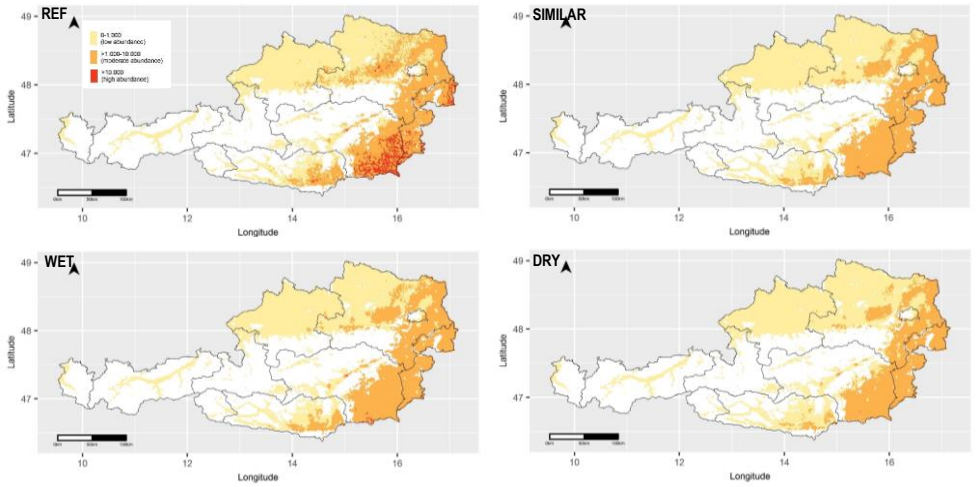

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MS10	**111**	**-99.9%**	**213**	**-99.8%**	**2**	**-100%**

Source: Own illustration and calculation based on model results.

Conclusions

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- Farmers are increasingly aware of risks resulting from pests and climate change.
  → Important to develop robust cropping systems and adequate policies to slow down pest dispersal rates.

- Analysis allows us to analyze the effect of
  I. management strategies (i.e. crop rotation decisions) and
  II. climate change

  on the risk of WCR infestation.

- Crop rotation regulations with upper limits for maize can help to reduce WCR pressure.

Conclusions

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- Net-returns of crop production with maize restrictions.

- WCR regulations should consider regional production characteristics.

- Farm and regional specific analysis of the effects are important.

- Livestock farms and biogas plants highly dependent on maize.

→ Evaluating the trade-offs between crop rotation regulations, economic effects and the risk of WCR infestation.

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Thank you for your attention!

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