Horizon 2020
European Union Funding
for Research & Innovation

This study is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme *under grant agreement No 727698*.

Magic
Marginal lands for Growing Industrial Crops

e-EUBCE 2020 Bioeconomy's role in the post-pandemic economic recovery
28th European Biomass Conference & Exhibition VIRTUAL | 6 - 9 July

Bioenergy cropping systems of tomorrow

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Background


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Project overview
Partners
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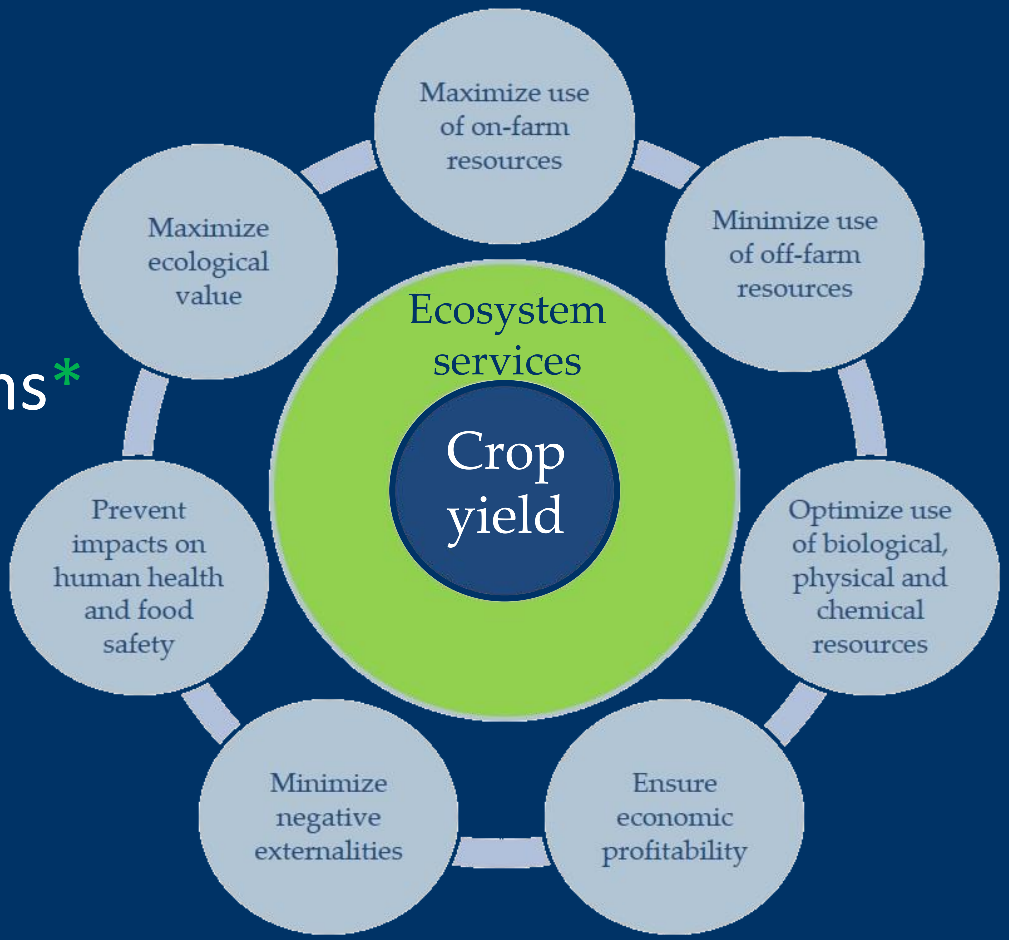
Internal area
Magic
Marginal lands for Growing Industrial Crops
Marginal Lands for Growing Industrial Crops
Turning a burden into an opportunity
http://magic-h2020.eu/

Research objective

The development of long-term sustainable Marginal Agricultural Land Low-Input Systems* (MALLIS) for industrial crop cultivation

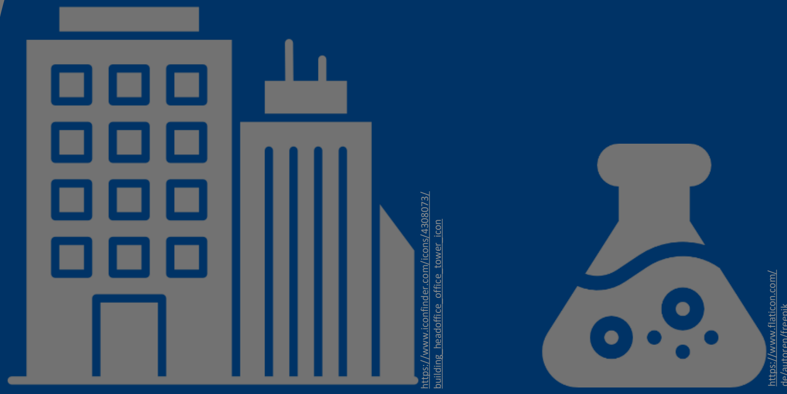


* https://www.mdpi.com/1996-1073/12/16/3123

Scope

Cropping systems providing biomass for…

Bioenergy



(Biobased products)

Research question

How can bioenergy cropping systems of tomorrow be made more sustainable under social-ecological aspects?

Methods

Literature review*

Expert opinions

*https://www.mdpi.com/2073-4395/9/10/605

Results

Main requirements for social-ecologically more sustainable BCSs

(i) A beneficial social-ecological contribution

(ii) The use of marginal agricultural land

(iii) Resilience in face of climate change-related issues

(iv) The use of holistic approaches for systematic implementations of BCSs

A beneficial social-ecological contribution

Provision of food and shelter for open land vertebrates

Pollinator support (nectar, pollen and habitat functions), e.g. wild plant mixtures *

https://www.mdpi.com/2073-4395/9/10/605

* https://onlinelibrary.wiley.com/doi/10.1002/adsu.202000037

A beneficial social-ecological contribution

Provision of food and shelter for open land vertebrates

Pollinator support (nectar, pollen and habitat functions), e.g. wild plant mixtures

No invasive potential, e.g. what about cup plant (*Silphium perfoliatum* L.) in Europe?*

Source: Viktor Koch

*https://www.kohlhammer.de/wms/instances/KOB/appDE/Neuerscheinungen-E-Produkte/Spontanvorkommen-der-Silphie-im-Bayreuther-Raum-birgt-diese-neue-Bioenergiepflanze-ein-Invasionspotenzial

A beneficial social-ecological contribution

University of Bologna, Italy, taken from: http://www.panacea-h2020.eu/wp-content/uploads/2019/05/D4.1-Training-manual-for-agronomists-and-students_INI-format-review_as.pdf

http://www.panacea-h2020.eu/wp-content/uploads/2019/06/alexopoulou_Promising-oilseed-crops-for-Europe-which-could-be-grown-on-marginal-lands.pdf

Low toxicity, e.g. what about castor bean (*Ricinus communis* L.)?*

*https://pubs.rsc.org/en/content/chapter/9781849737913-00186/978-1-84973-791-3

A beneficial social-ecological contribution

Provision of food and s

Pollinator support (nec … wild plant mixtures

No invasive potential, … *foliatum* L.) in Europe?

Low toxicity, e.g. what …)?

https://www.mdpi.com/1996-1073/12/16/3123

Groundwater protection, e.g. miscanthus (*Miscanthus* x *giganteus* Greef et Deuter)*

*https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-2743.1998.tb00136.x

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Groundwater protection, e.g. miscanthus (*Miscanthus* x *giganteus* Greef et Deuter)

Erosion mitigation, e.g. miscanthus (*Miscanthus* x *giganteus* Greef et Deuter)*

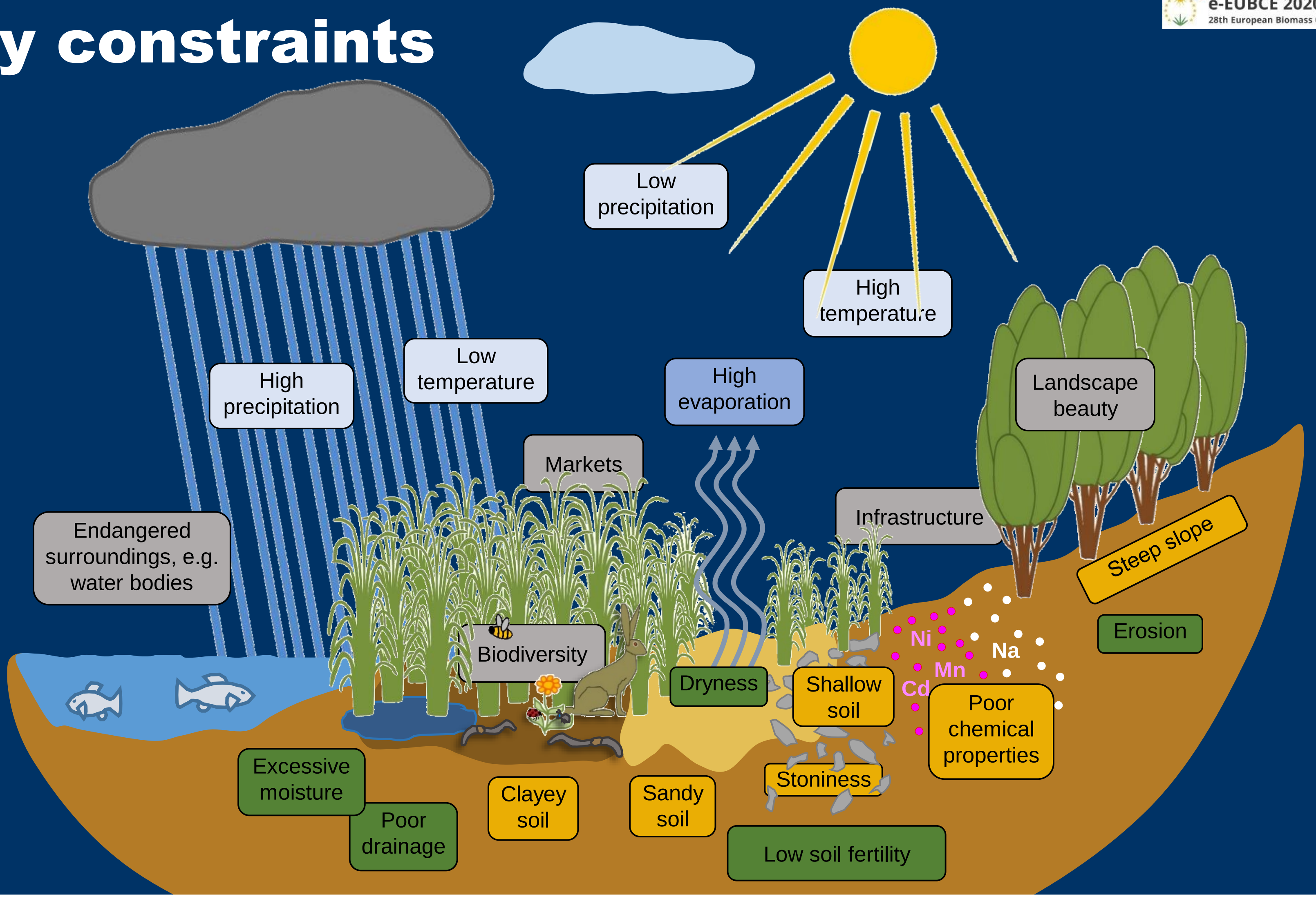
*https://link.springer.com/article/10.1007/s12155-015-9690-2

The use of marginal agricultural land

Source: Moritz Wagner

https://zenodo.org/record/3539369#.XwG_Z-fgrV8

Marginality constraints

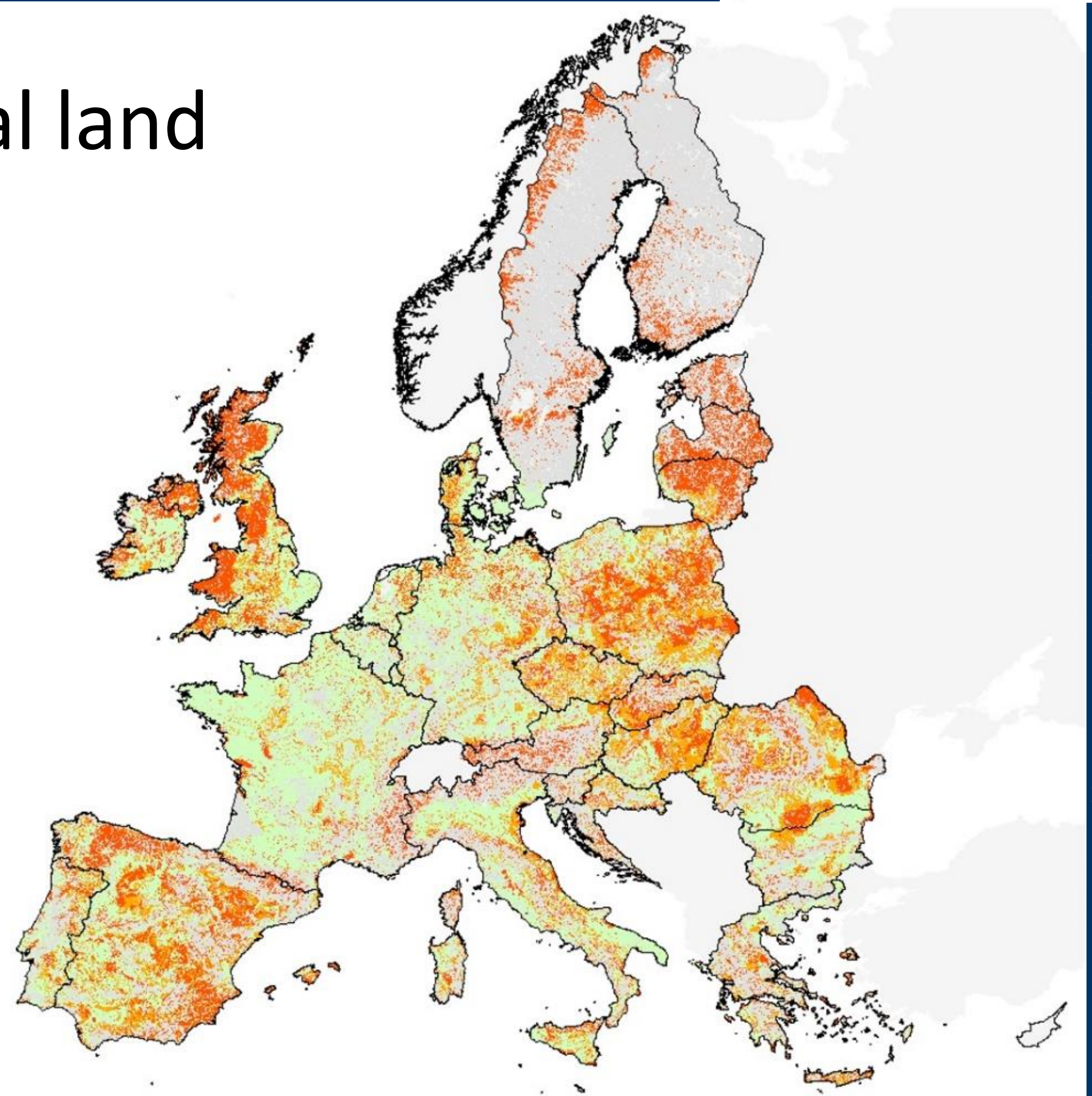


Main climatical constraints
Combined climatical constraints
Socio-economic challenges
Main geophysical constraints
Combined geophysical constraints

https://www.mdpi.com/1996-1073/12/16/3123

Marginal agricultural land
Current situation

- No UAA
- Not Marginal
- Sub-severe ANC (+20%)
- Severe ANC



Adapted from: https://www.mdpi.com/1996-1073/12/16/3123

UAA = utilized agricultural area; ANC = agricultural natural constraint; Sub-severe ANC (+20%) = within the 20% margin of the threshold value of severity.

Growth requirements of industrial crops

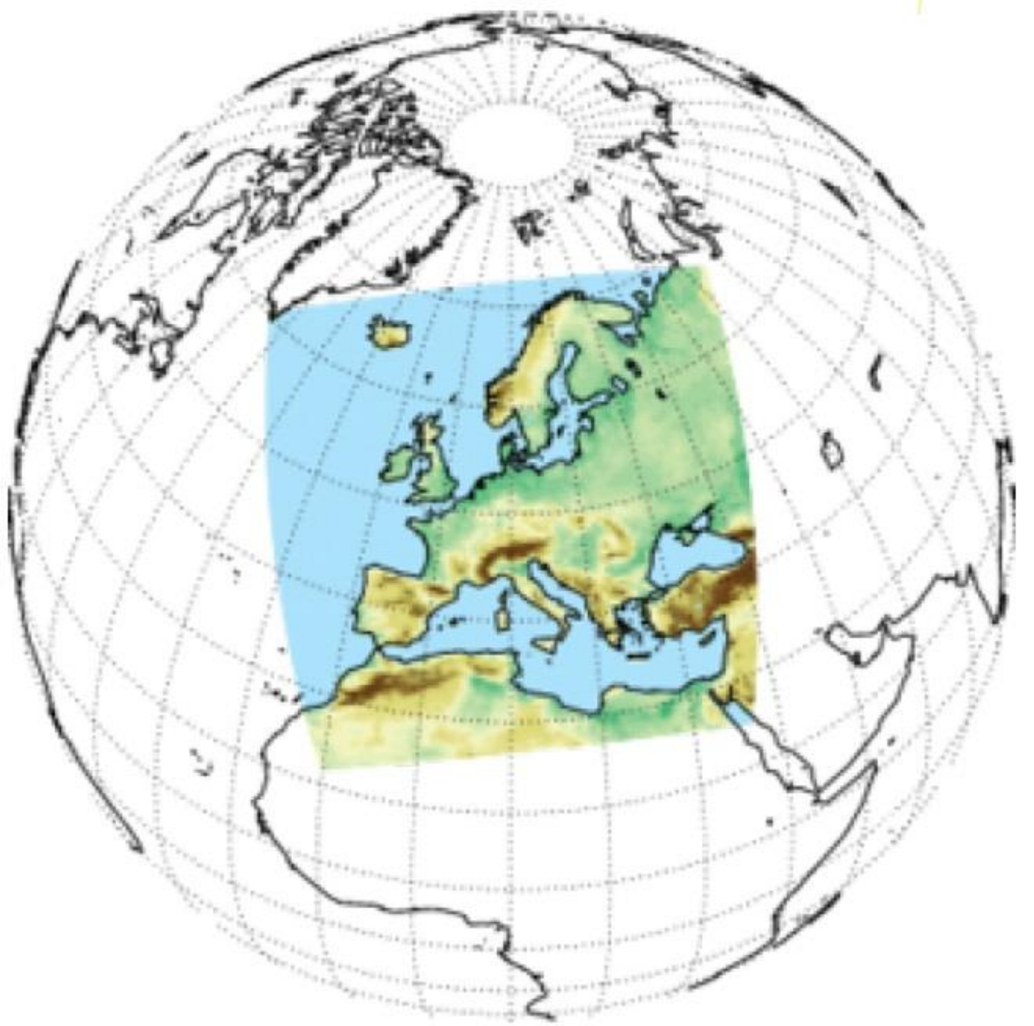
Factor	Classes (adapted from Ramirez-Almeyda et al., 2017)	Amaranth (*Amaranthus hypochondriacus* L.)	Black locust (*Robinia pseudoacacia* L.)	Calendula (*Calendula officinalis* L.)	Camelina (summer-annual) (*Camelina sativa* (L.) Crantz)
Slope	< 4	4	4	4	4
	4-8	3	3	3	3
	8-12	1	3	2	2
	12-15	0	2	2	2
	15-25	0	2	1	1
	> 25	0	1	1	1
Soil Depth	Shallow (<35)	2	1	2	2
	Moderate (35-80)	4	2	4	4
	Deep (80-120)	4	3	4	4
	Very deep (> 120)	3	4	4	4
Texture	Sand (coarse)	3	3	3	4
	Loam (medium-medium fine)	4	4	4	4
	Clay (fine)	4	2	2	3
	Heavy clay (very fine)	3	2	1	1
	Peat (no mineral textu	3	1	0	1

Resilience in face of climate change-related issues

https://onlinelibrary.wiley.com/doi/10.1002/adsu.202000037

Climate change projections for Europe

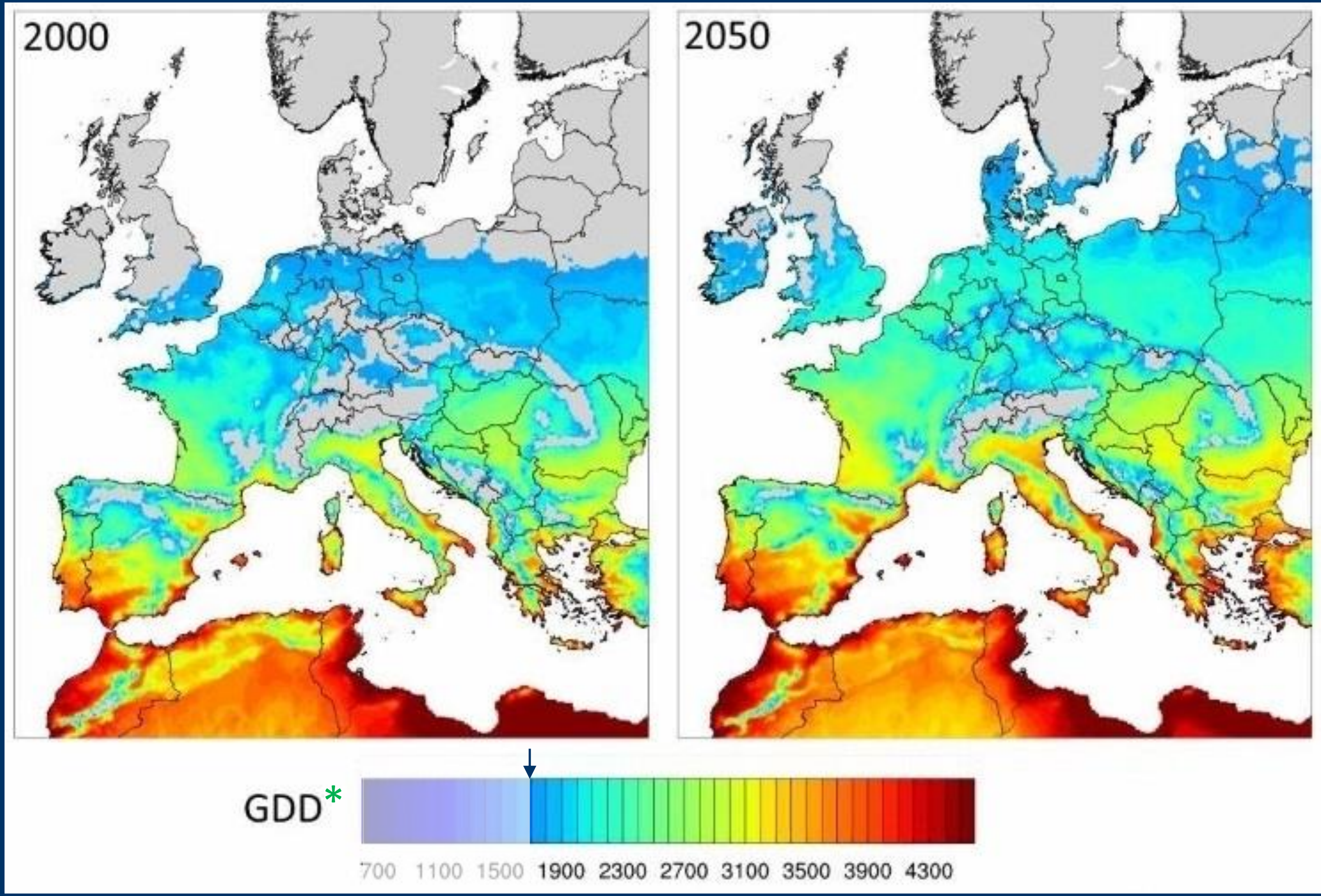
- EUROCORDEX model ensemble
- EC-Earth CCLM*
- RCP8.5 scenario
- Time periods:
  - 2016 – 2020
  - 2046 – 2050



https://link.springer.com/article/10.1007/s10113-020-01606-9

*Two other projections were already re-processed.

Global Warming → European Warming?



*GDD = growth degree days, basic temperature of 10°C

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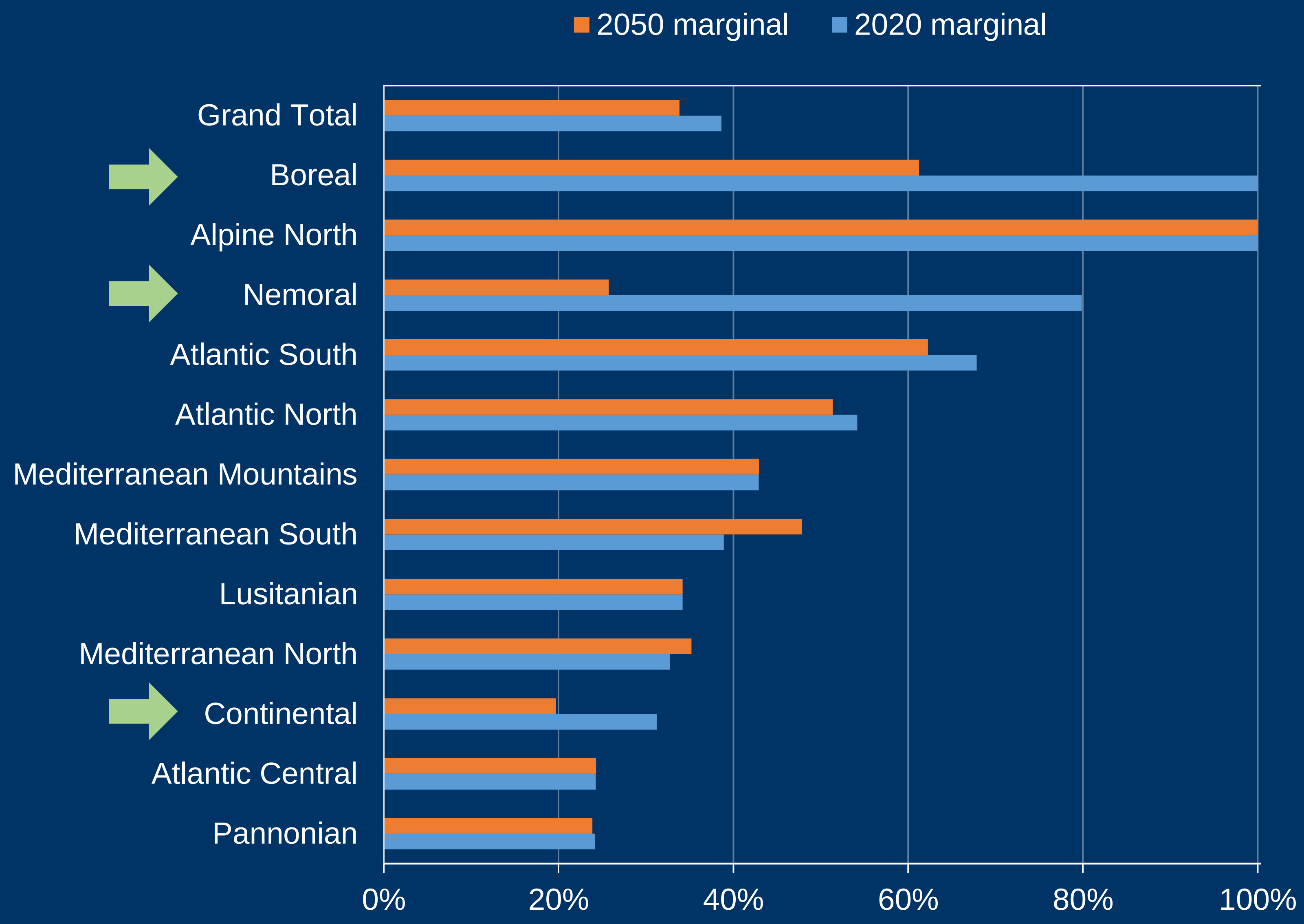
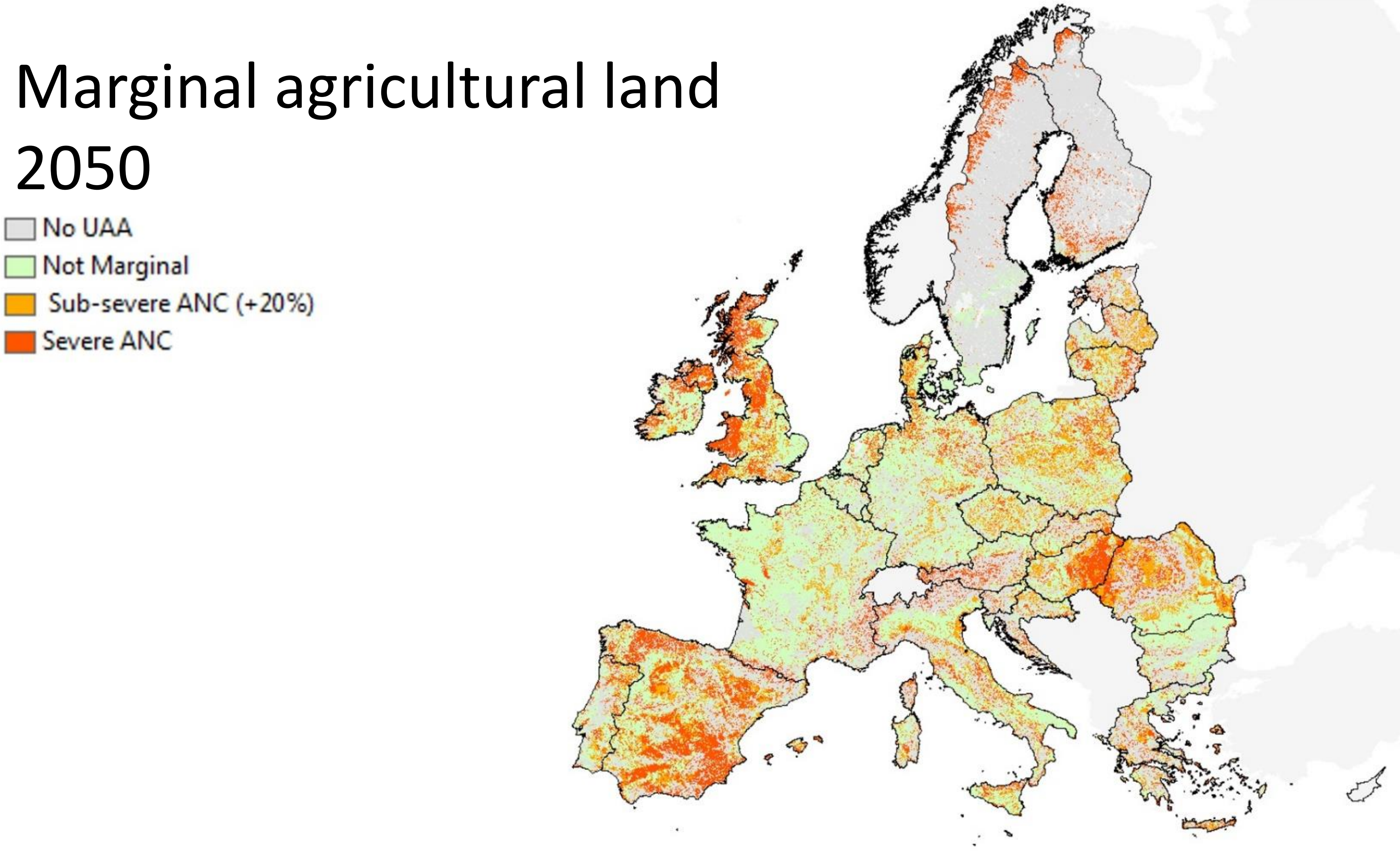
Marginal areas (%) sorted by agro-ecological zone



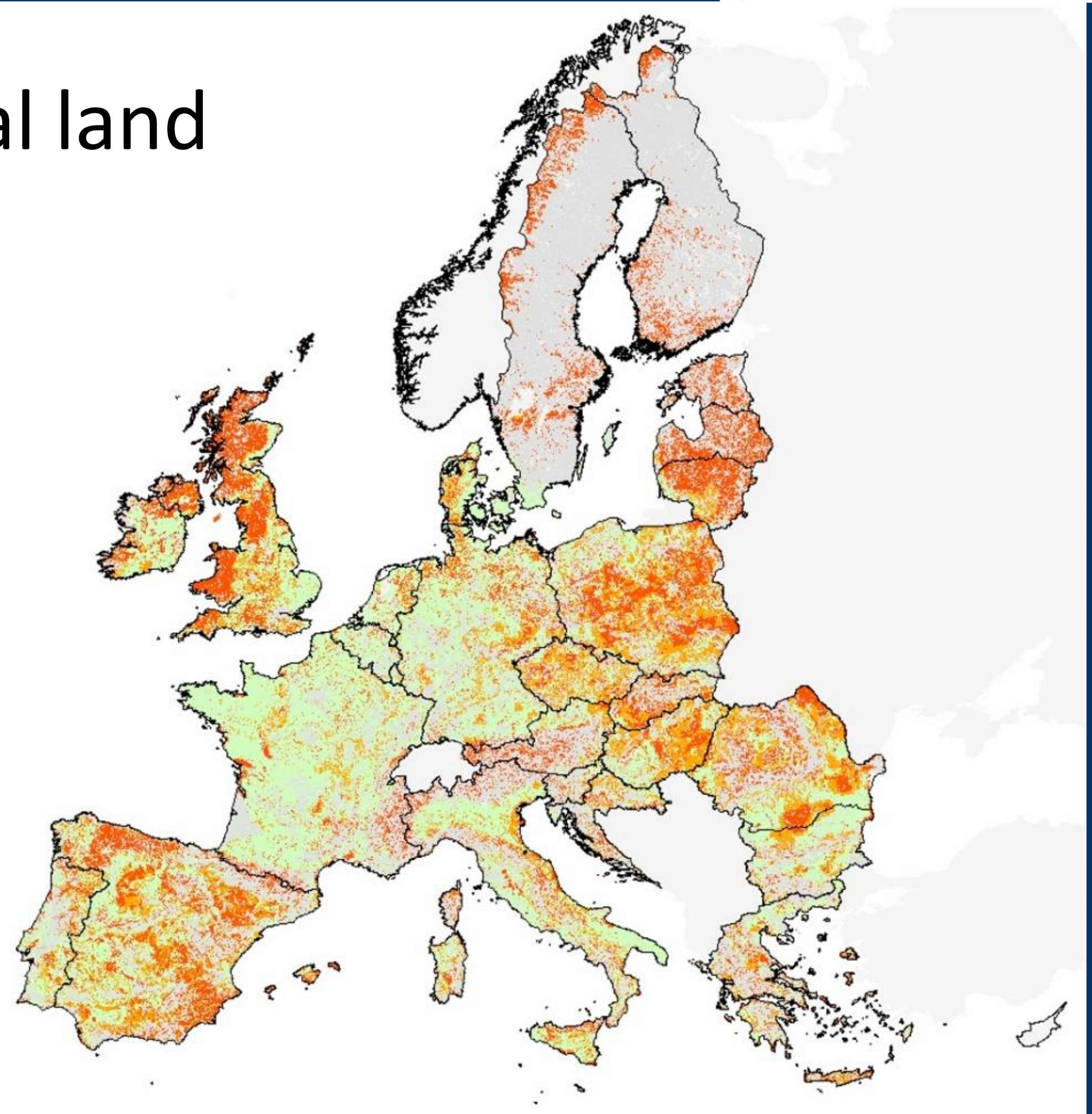
Marginal agricultural land 2050



UAA = utilized agricultural area; ANC = agricultural natural constraint; Sub-severe ANC (+20%) = within the 20% margin of the threshold value of severity.

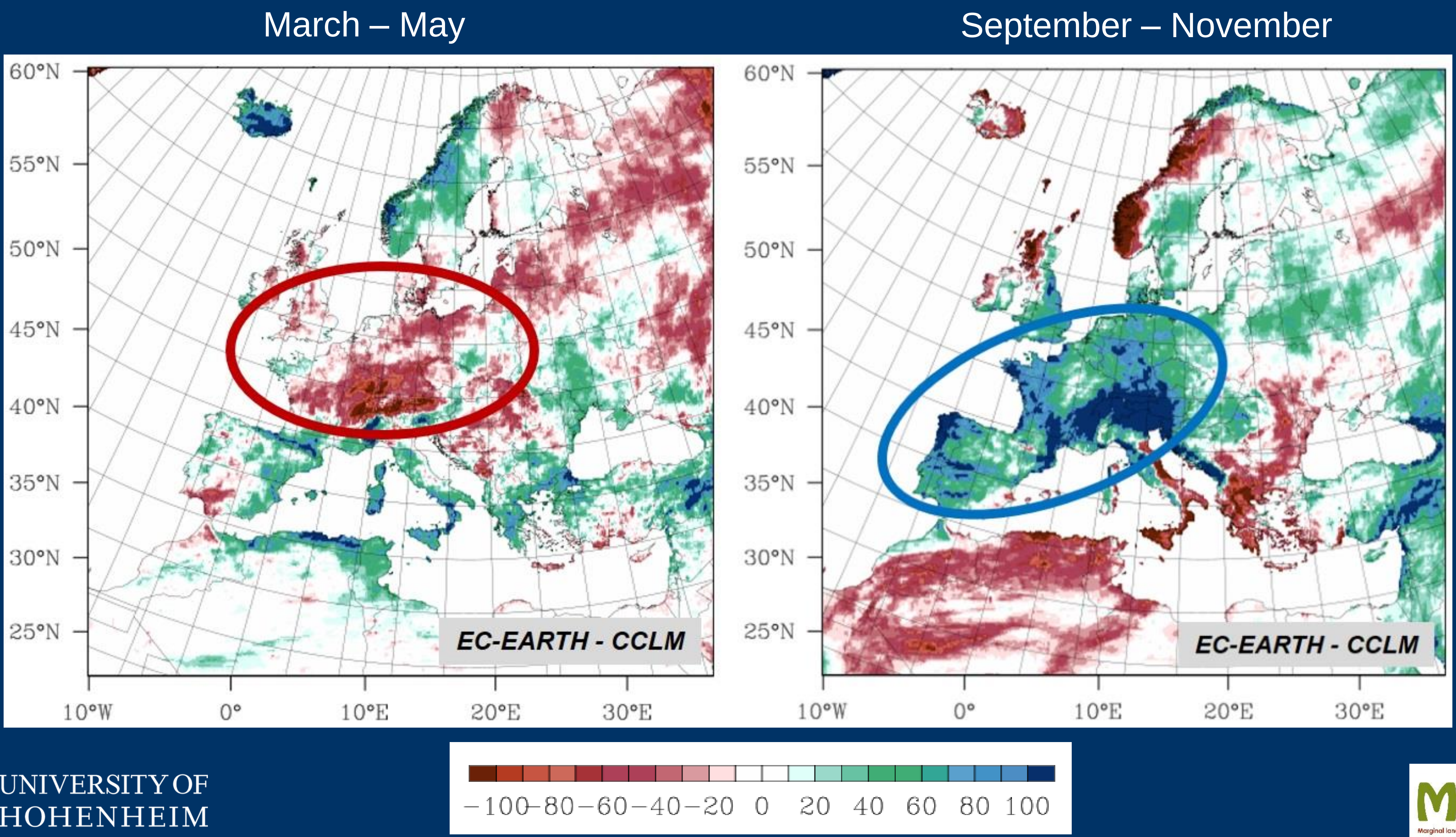
Marginal agricultural land
Current situation

No UAA
Not Marginal
Sub-severe ANC (+20%)
Severe ANC



UAA = utilized agricultural area; ANC = agricultural natural constraint; Sub-severe ANC (+20%) = within the 20% margin of the threshold value of severity.

Difference in annual precipitation (mm) 2050 – 2020



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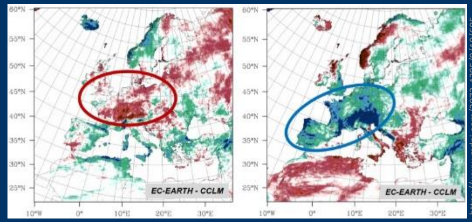
Most important limiting factors in Europe – Today and 'tomorrow'

	2020	2050
Growing degree days	23%	20%
Precipitation	53%	57%



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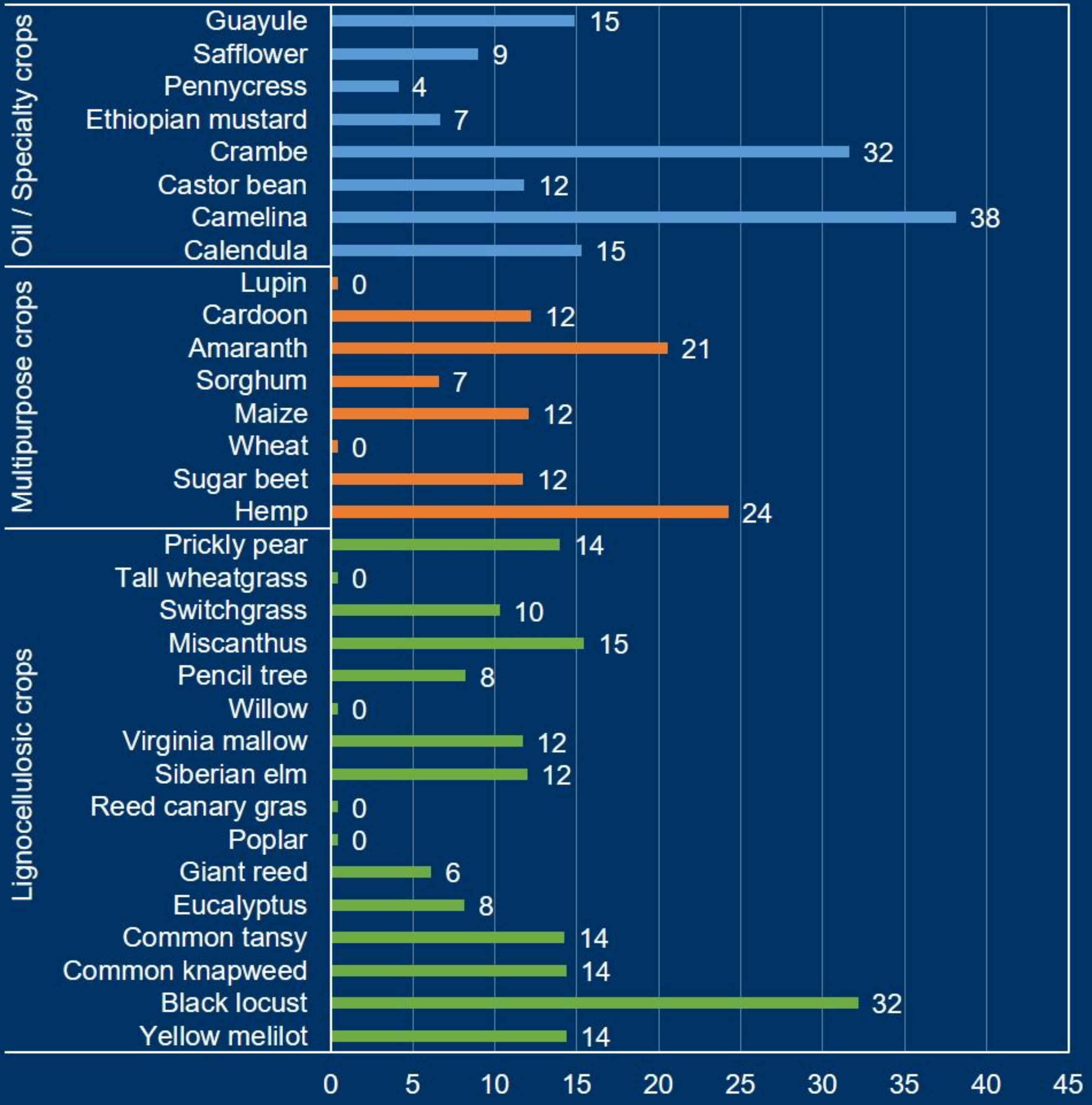
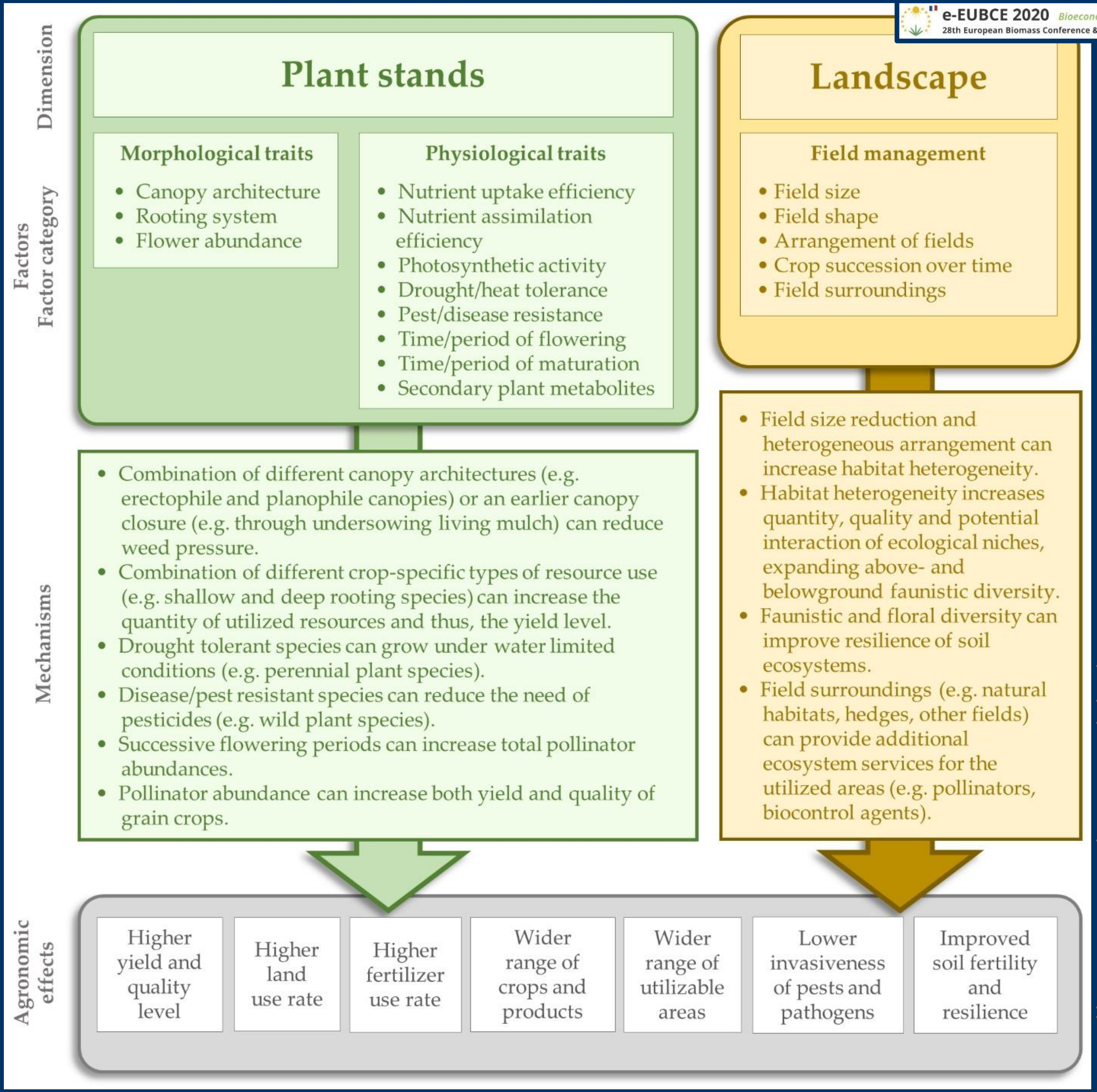
Increase in growth suitability on marginal European (EU-27) agricultural lands until 2050 (%)

Sorted by
purpose / type of use



Holistic approaches for systematic implementations



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Outlook / Next steps

Continuously improve social-ecological sustainability of BCS

- Intensify research on social-ecological impacts & performances of BCSs
  - e.g. characterization matrixes
- Development of decision matrixes for site-specific optimization of BCSs

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Thank you for your attention!