



Horizon 2020
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for Research & Innovation

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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

Moritz Von Cossel ^{1*}, Moritz Wagner ¹, Jan Lask ¹, Elena Magenau ¹, Andrea Bauerle ¹, Viktoria Von Cossel ², Kirsten Warrach-Sagi ², Berien Elbersen ³, Igor Staritsky ³, Michiel Van Eupen ³, Yasir Iqbal ⁴, Nicolai David Jablonowski ^{5,6}, Stefan Happe ⁷, Ana Luisa Fernando ⁸, Danilo Scordia ⁹, Salvatore Luciano Cosentino ⁹, Volker Wulfmeyer ², Iris Lewandowski ¹ and Bastian Winkler ¹

¹ Department of Biobased Resources in the Bioeconomy (340b), Institute of Crop Science, University of Hohenheim, Stuttgart, Germany

² Institute of Physics and Meteorology (120), University of Hohenheim, Stuttgart, Germany

³ Earth Informatics, Wageningen University and Research Centre, P.O. Box 47, 6700 AA Wageningen, The Netherlands

⁴ College of Bioscience and Biotechnology, Hunan Agricultural University, Changsha 410128, Hunan, China

⁵ IBG-2: Plant Sciences, Institute of Bio- and Geosciences, Forschungszentrum Jülich, 52425 Jülich, Germany

⁶ Bioeconomy Science Center (BioSC), c/o Forschungszentrum Jülich, 52425 Jülich, Germany

⁷ Institute of Animal Breeding and Husbandry, Kiel University, Kiel, Germany

⁸ METRICs, Departamento de Ciências e Tecnologia da Biomassa, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus de Caparica, 2829-516 Caparica, Portugal

⁹ Dipartimento di Agricoltura, Alimentazione e Ambiente (Di3A), University of Catania, 95123 Catania, Italy





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Internal area



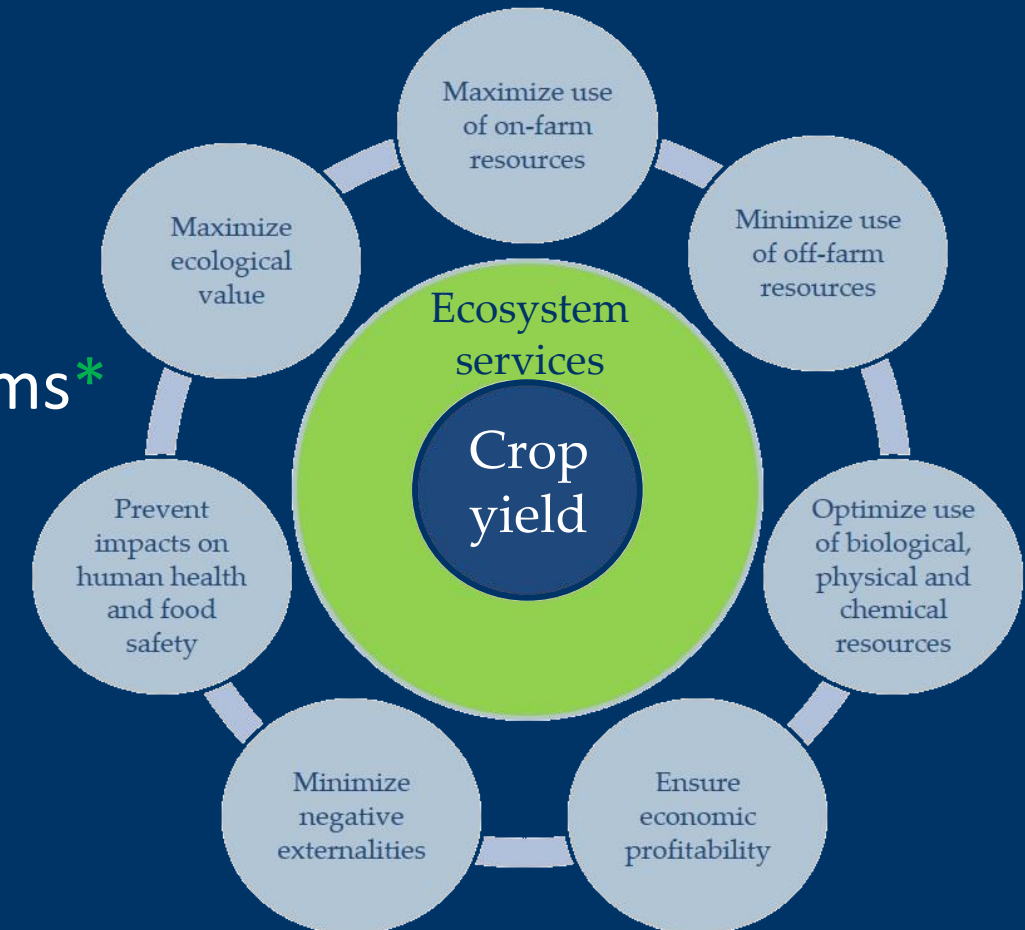
Marginal Lands for Growing Industrial Crops

Turning a burden into an opportunity

<http://magic-h2020.eu/>

Research objective

The development of long-term sustainable
Marginal Agricultural Land Low-Inter 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



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://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.)?*

A beneficial social-ecological contribution

Provision of food and s

Pollinator support (ne

No invasive potential,

Low toxicity, e.g. what



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

wild plant mixtures

foliatum L.) in Europe?

)?

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>

A beneficial social-ecological contribution



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

Provision of food and s

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wild plant mixtures

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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)*

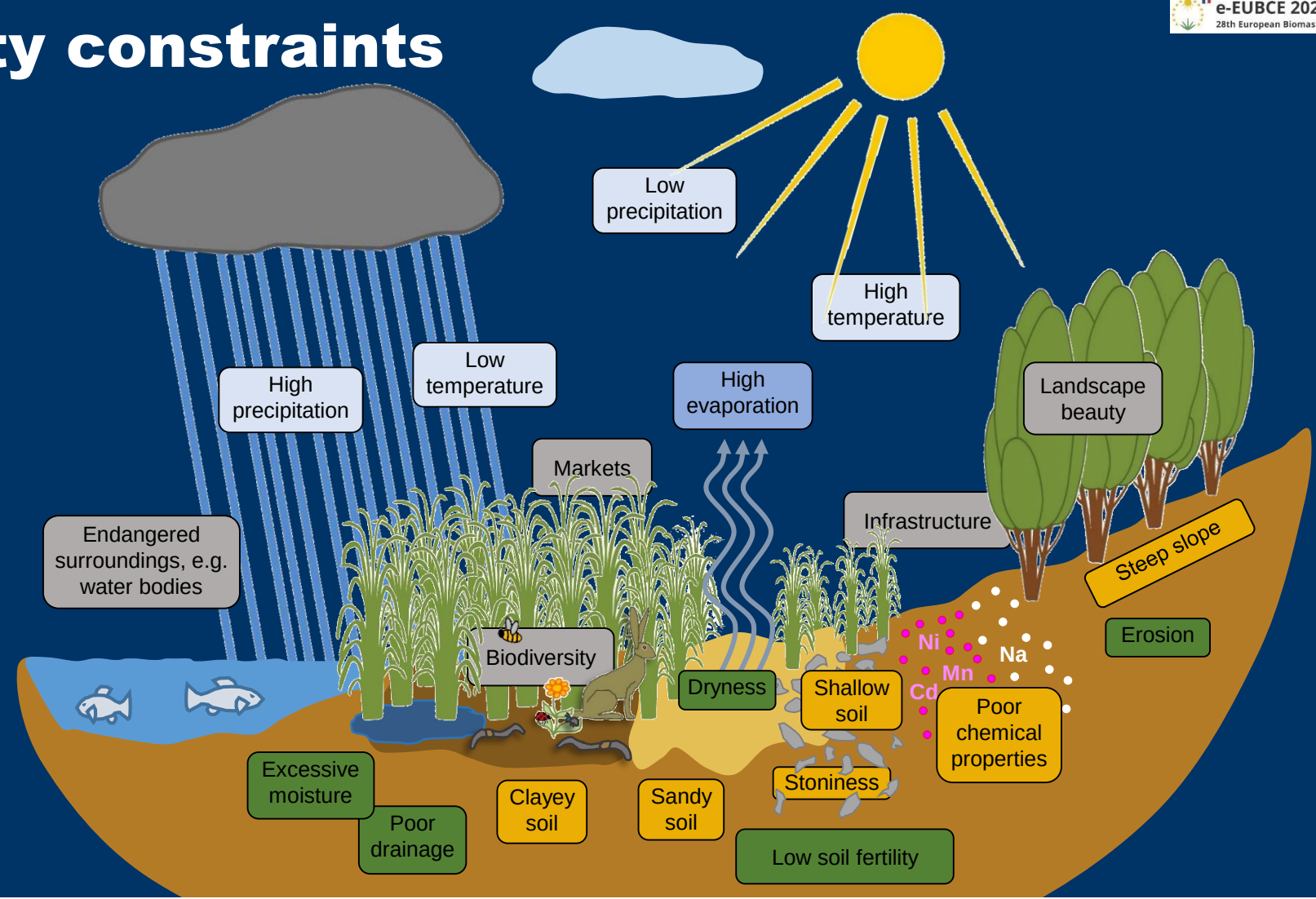
*<https://link.springer.com/article/10.1007/s12155-015-9690-2>

The use of marginal agricultural land



Source: Moritz Wagner

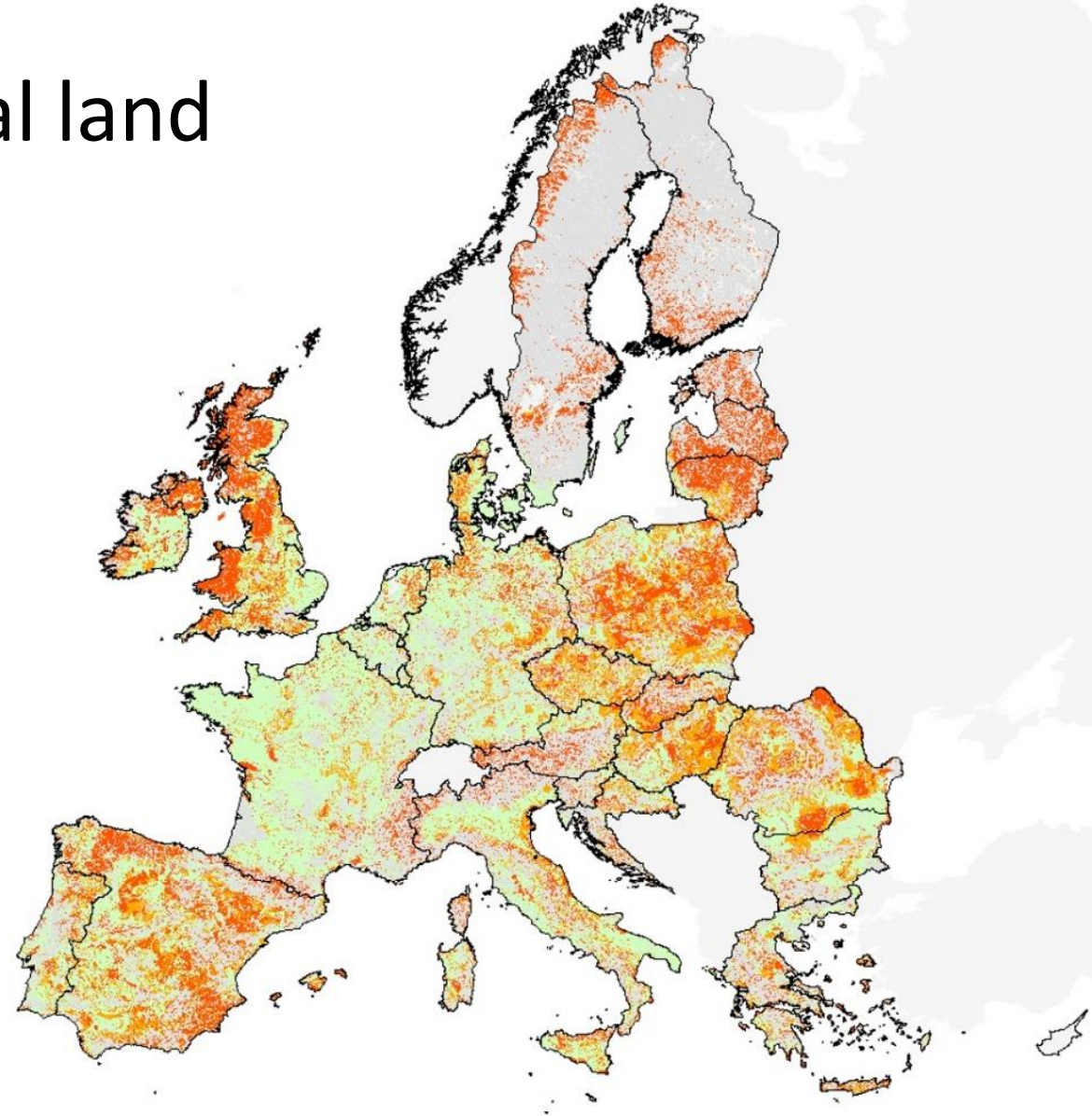
Marginality constraints



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

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>

Growth requirements of industrial crops

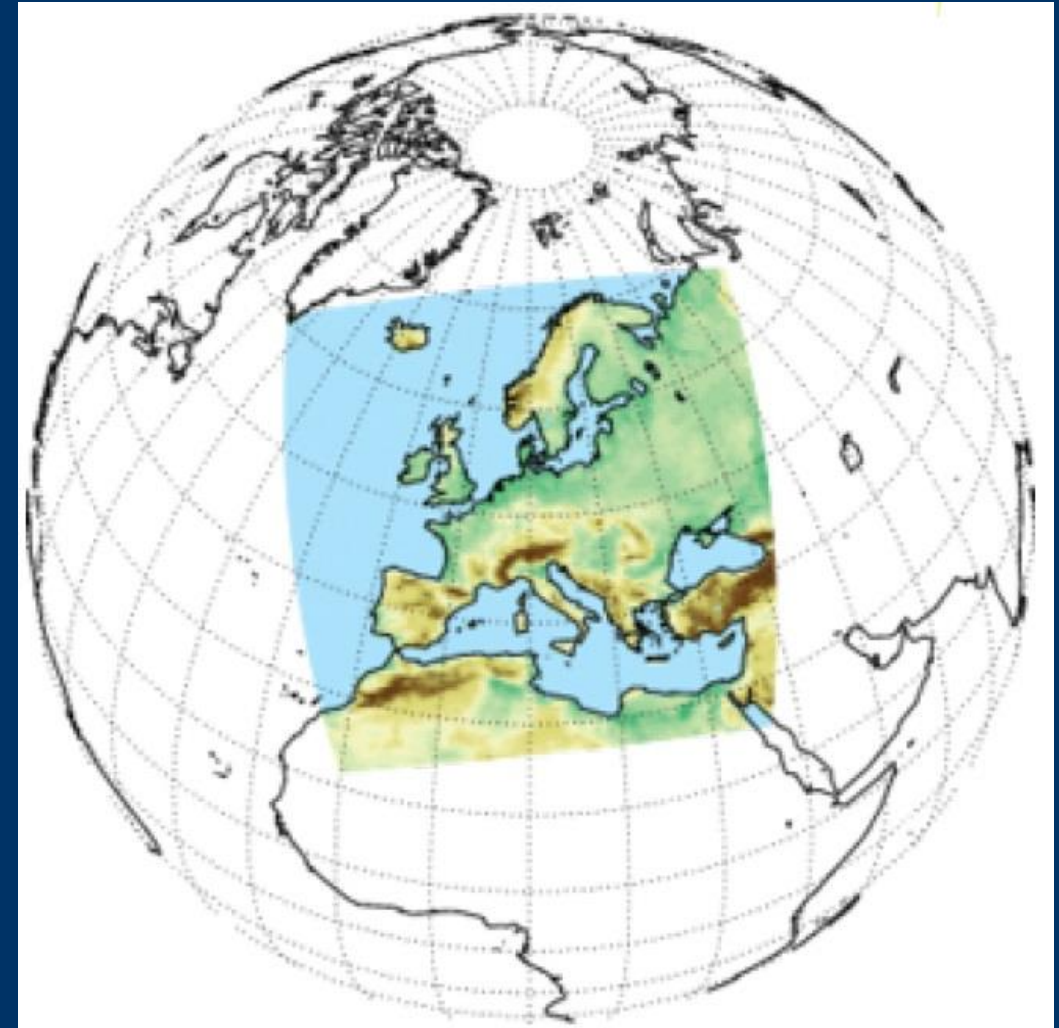
		<i>Amaranthus hypochondriacus</i> L.	<i>Robinia pseudoacacia</i> L.	<i>Calendula officinalis</i> L.	<i>Camelina sativa</i> (L.) Crantz
Factor	Classes (adapted from Ramirez-Almeyda et al., 2017)	Amaranth	Black locust	Calendula	Camelina (summer-annual)
Slope	< 4	4	4	4	4
	4-8	3	3	3	3
	8-12	1	3	2	2
	12-15	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	2
	Peat (no mineral texture)	3	1	0	1

Resilience in face of climate change-related issues



Climate change projections for Europe

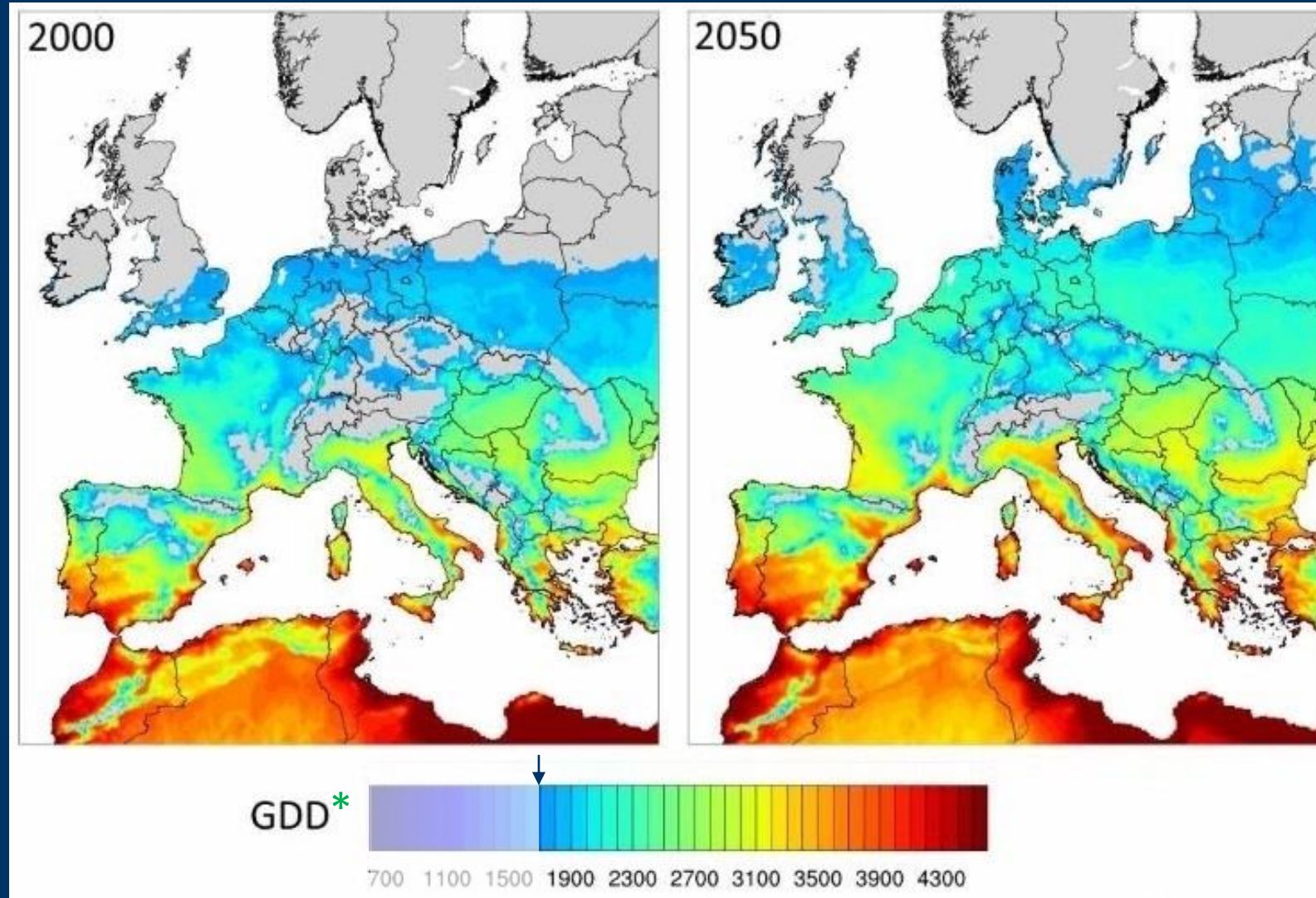
- EUROCORDEX model ensemble
- EC-Earth CCLM*
- RCP8.5 scenario
- Time periods:
 - 2016 – 2020
 - 2046 – 2050



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

*Two other projections were already re-processed.

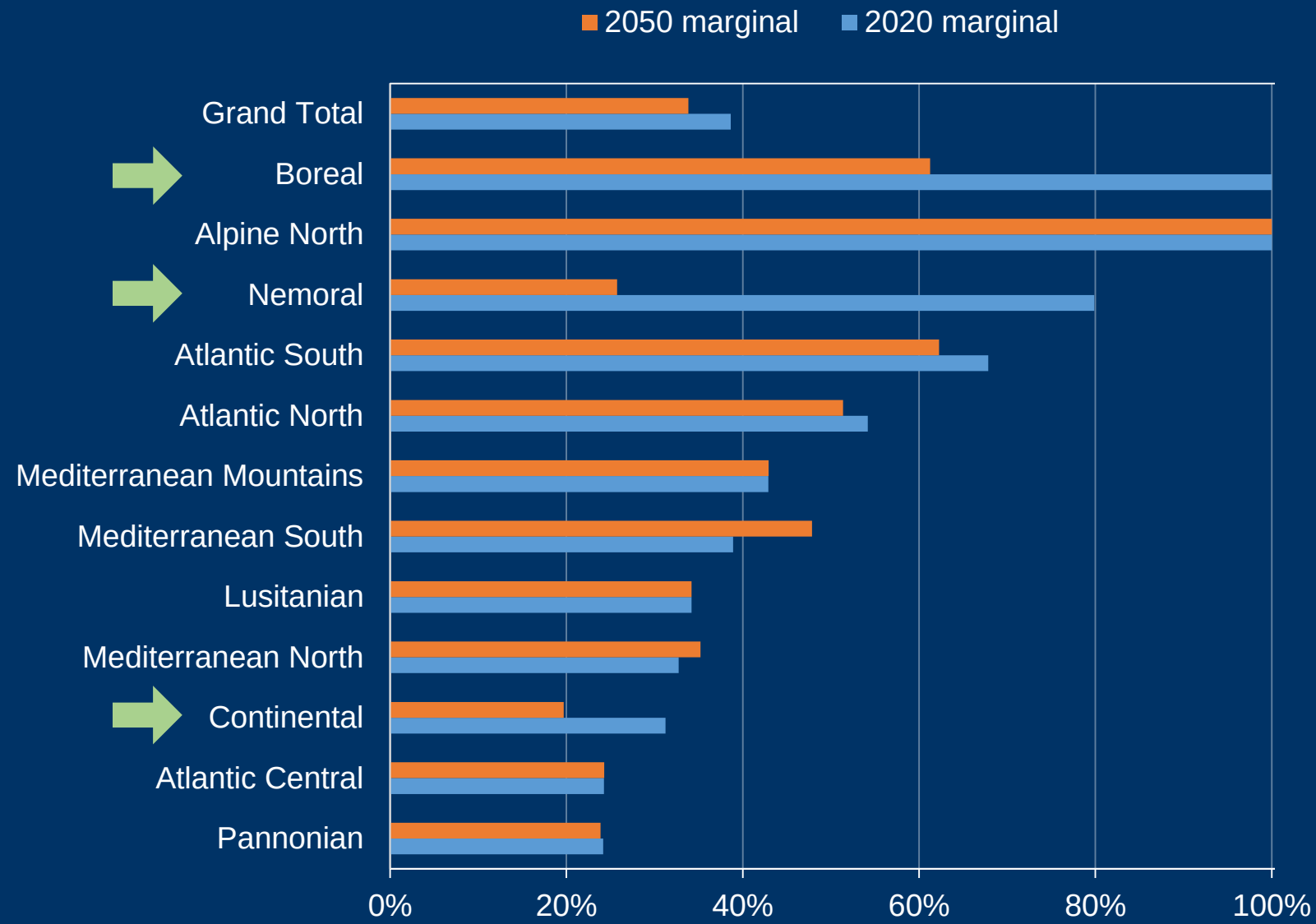
Global Warming → European Warming?



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

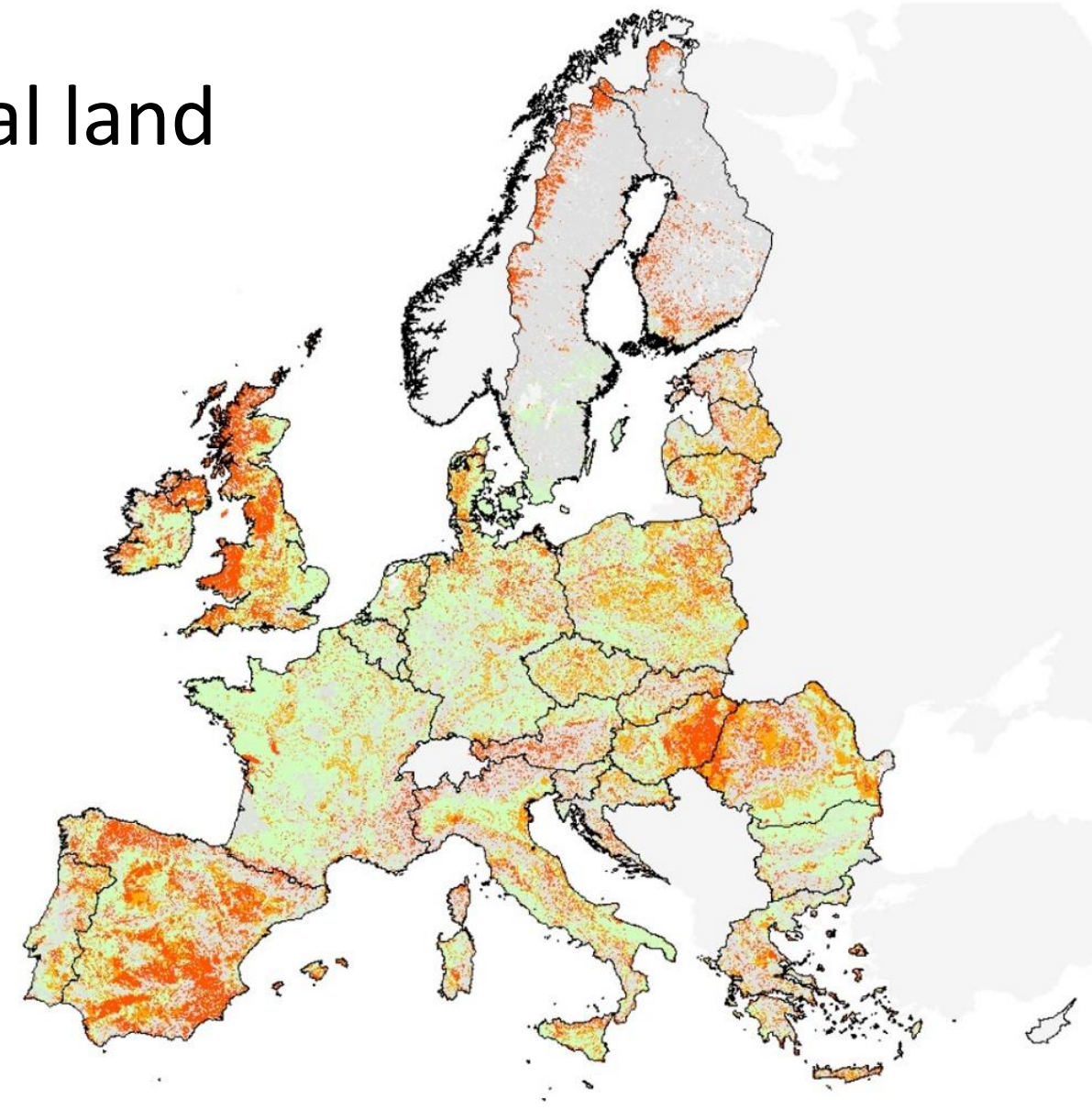
<https://www.mdpi.com/2073-4395/9/10/605>

Marginal areas (%) sorted by agro-ecological zone



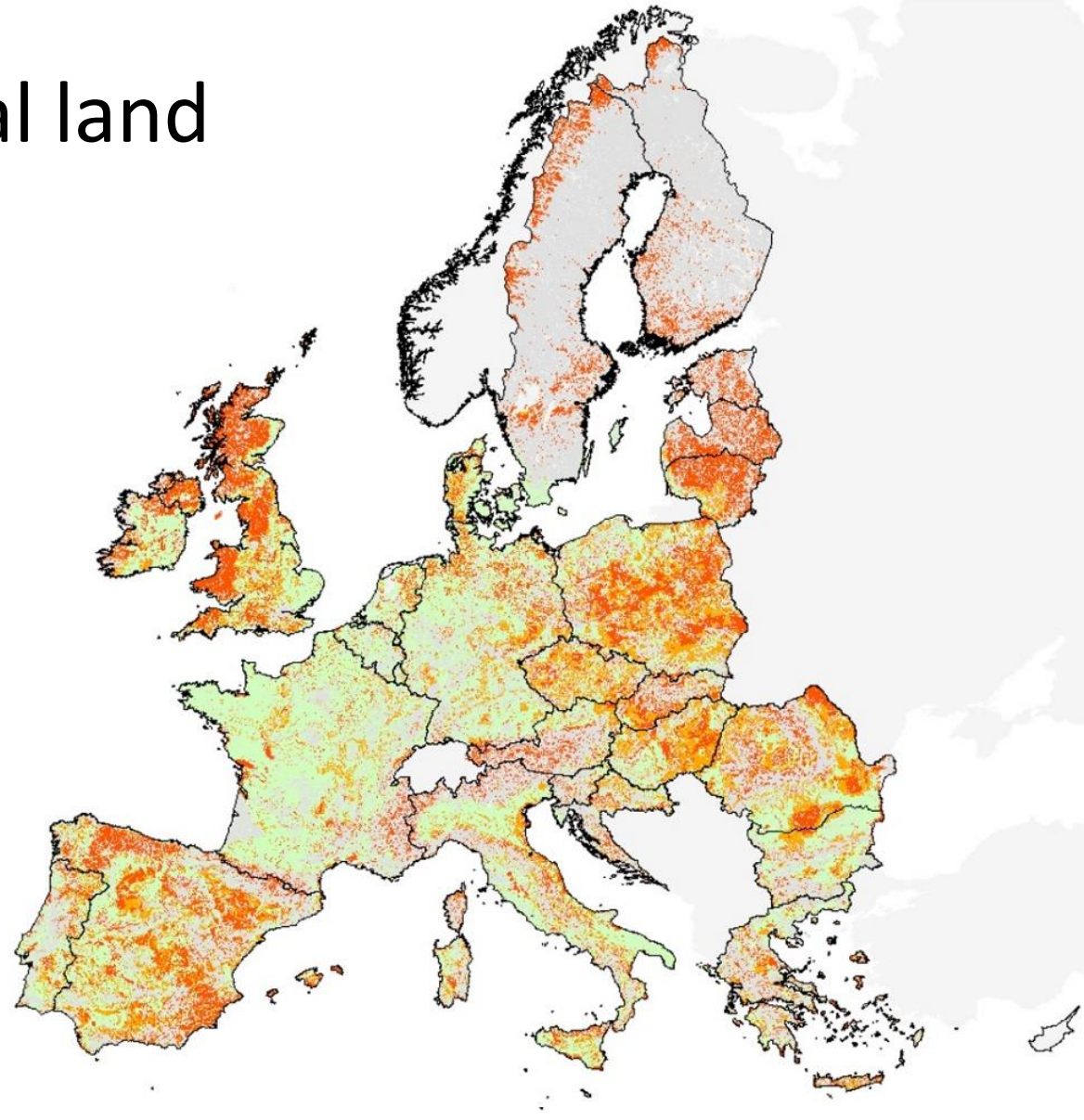
Marginal agricultural land 2050

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



Marginal agricultural land Current situation

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

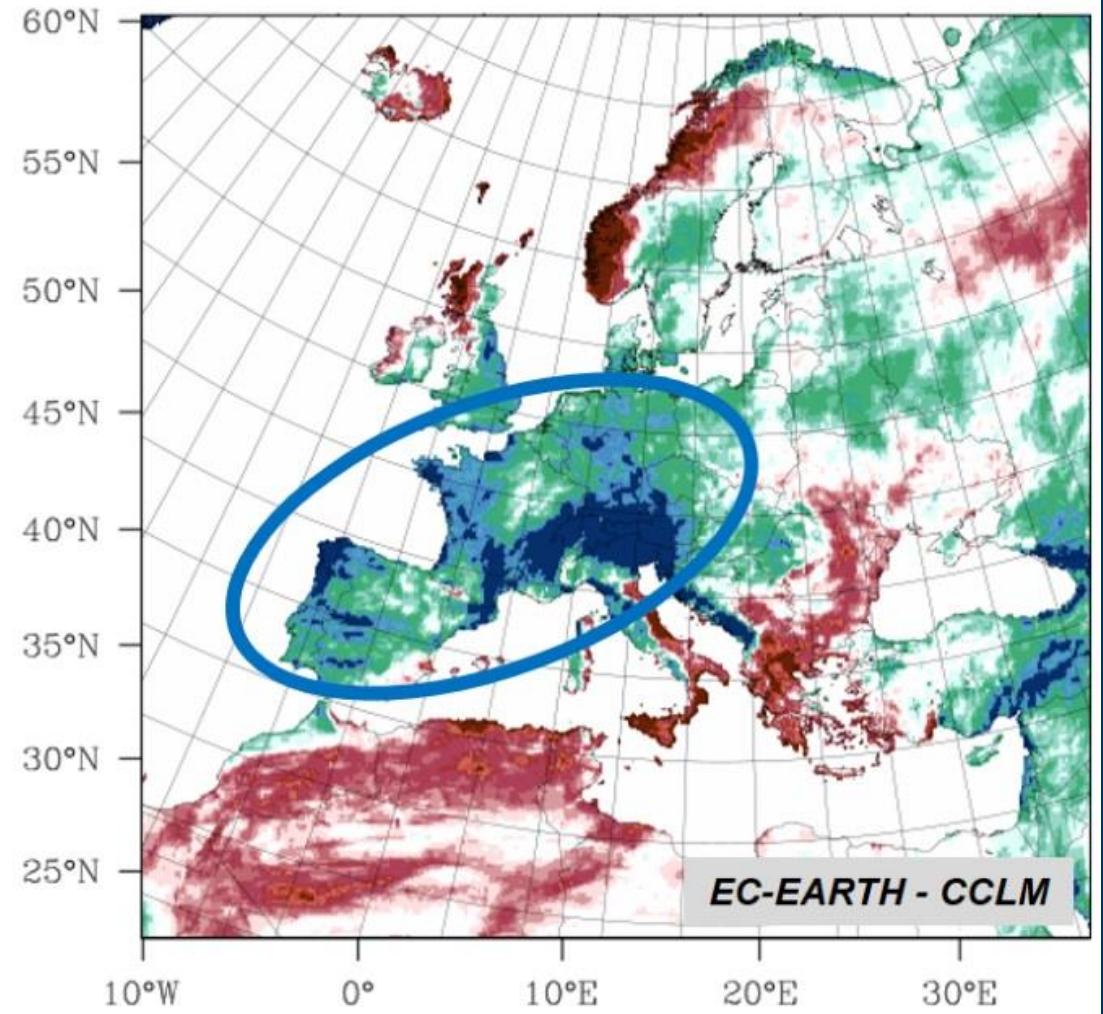
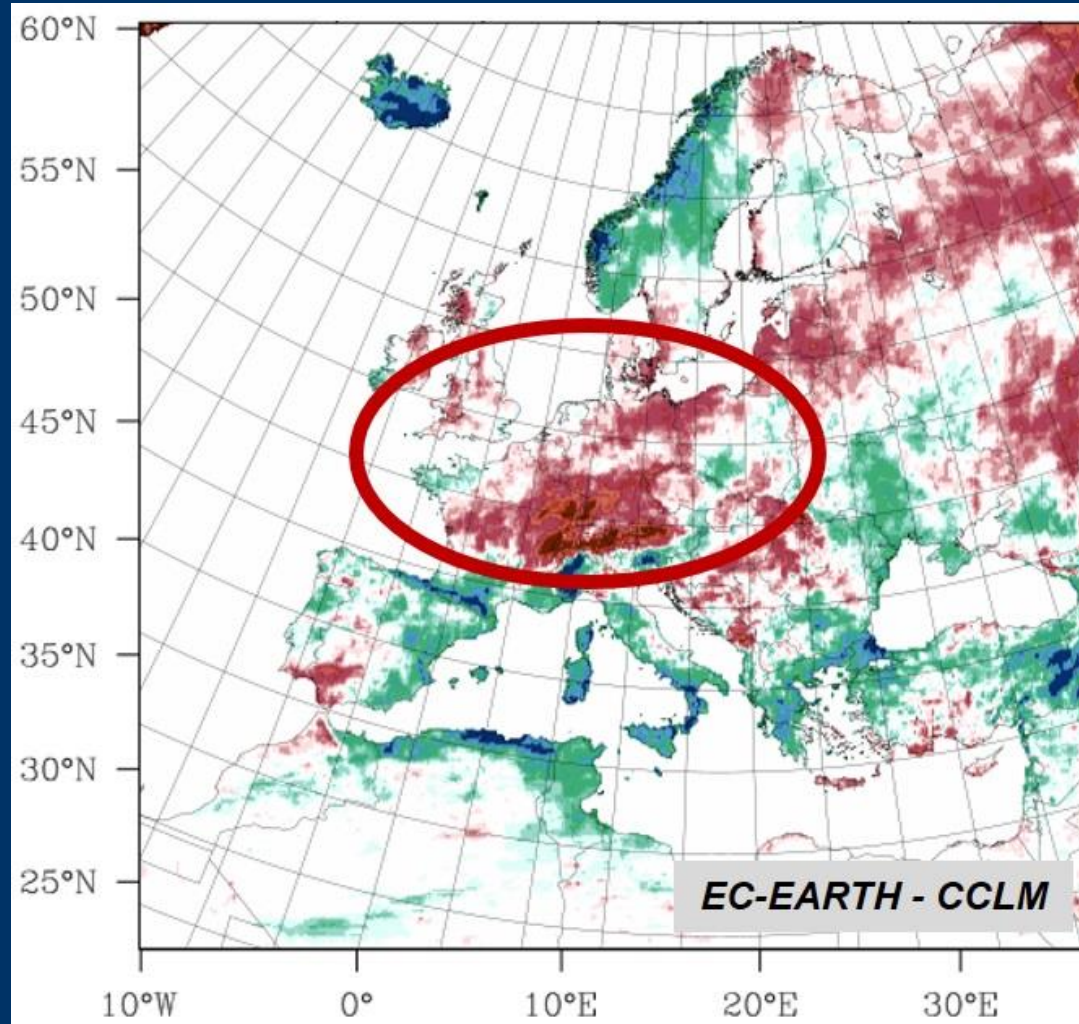


Difference in annual precipitation (mm) 2050 – 2020

23

March – May

September – November

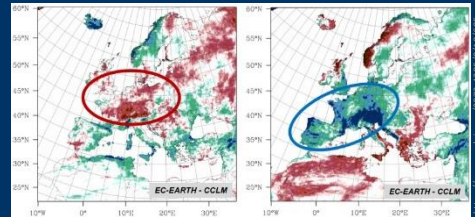


<https://www.mdpi.com/2073-4395/9/10/605>



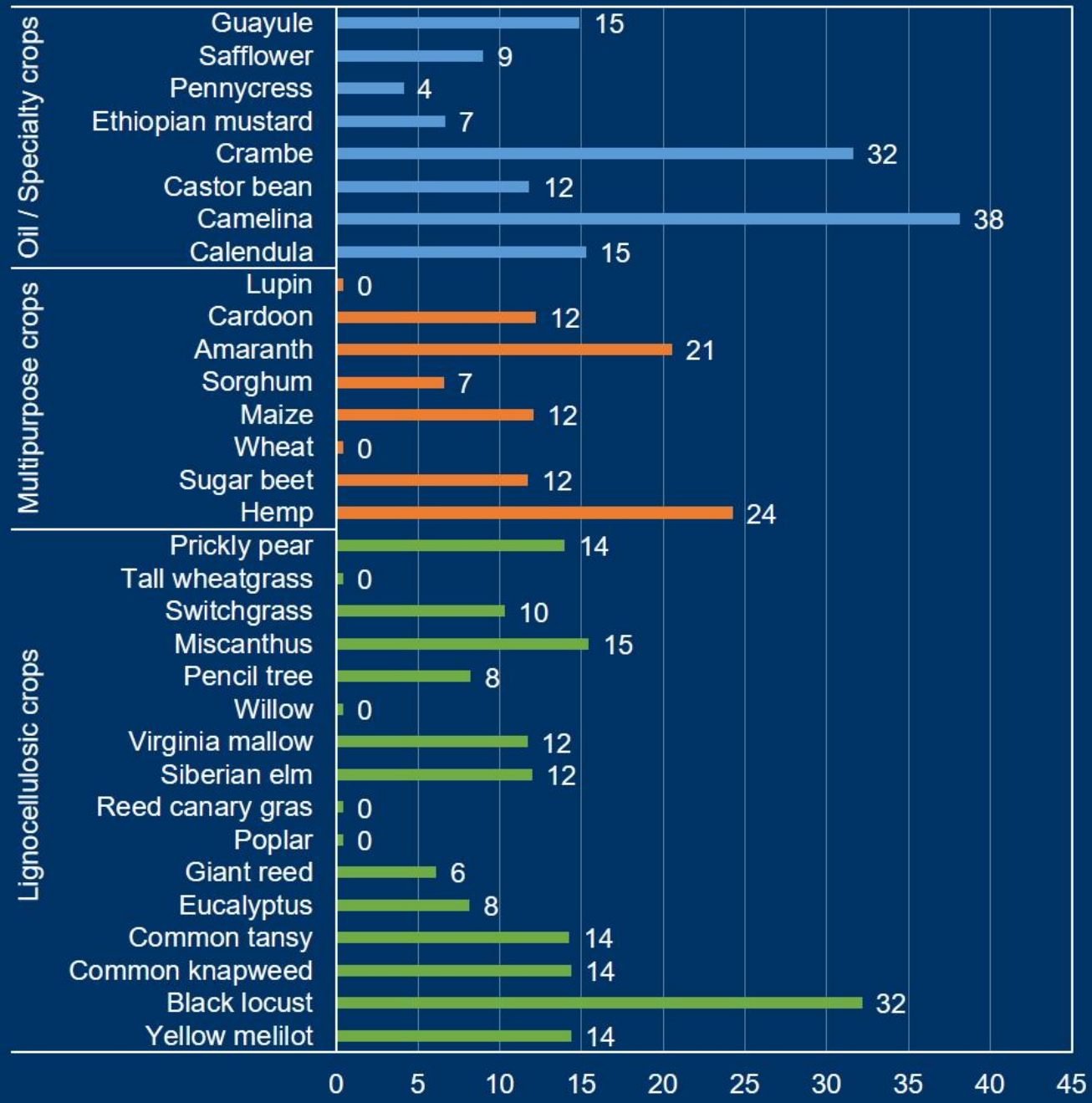
Most important limiting factors in Europe – Today and ‘tomorrow’

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

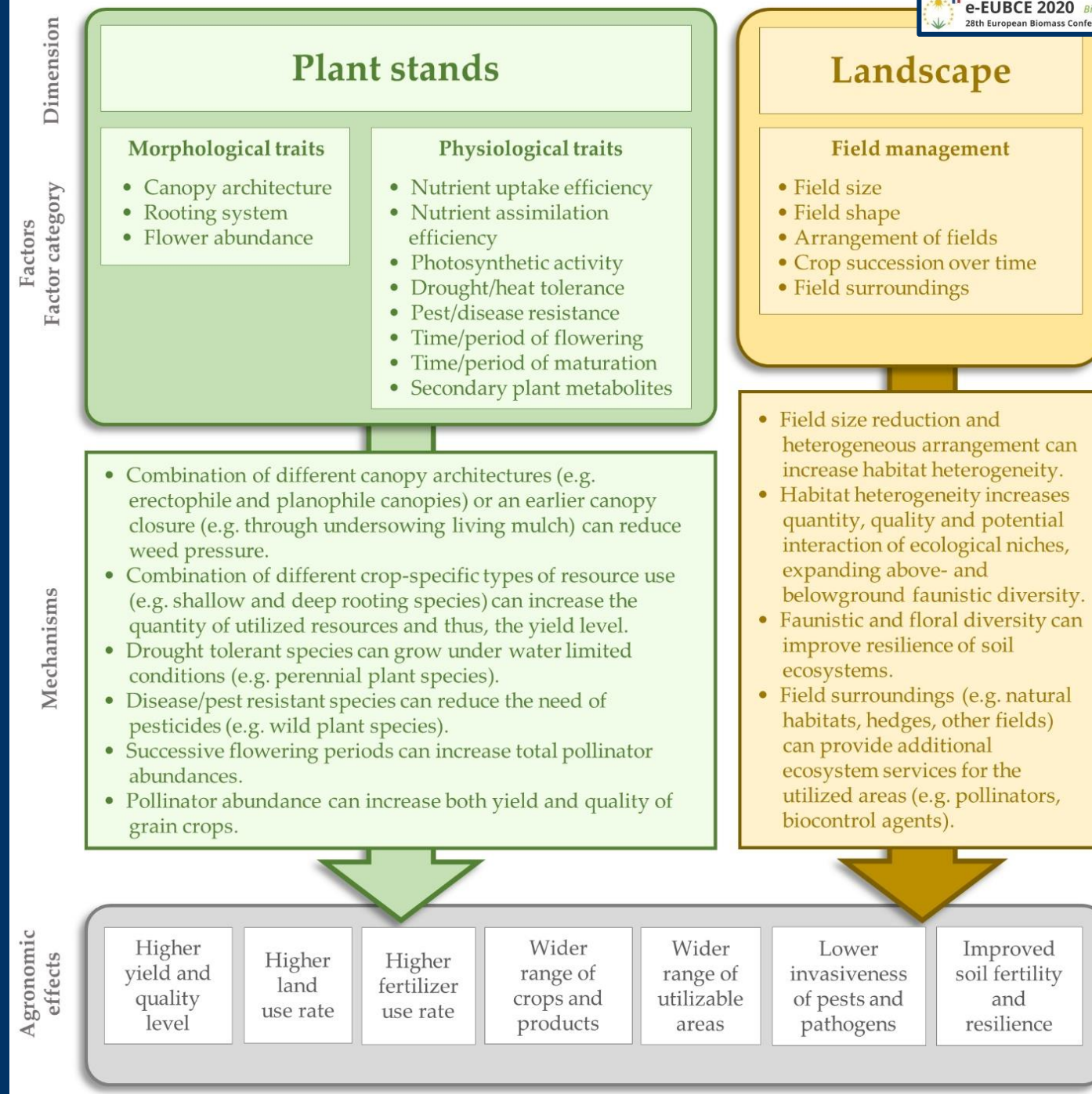


Increase in growth suitability on marginal European (EU-27) agricultural lands until 2050 (%)

Sorted by purpose / type of use



Holistic approaches for systematic implementations



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

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!



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