

An approach to detect suitable marginal lands for industrial crops in Europe

MAGIC project

The potential of marginal lands as carbon sink in Europe 25th of November 2021

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Mapping marginal land in MAGIC

Biophysical factors have been identified for the classification of severe limitations; 18 single factors, grouped into 6 clustered factors:

1. Adverse climate
2. Excessive wetness
3. Low soil fertility
4. Adverse chemical conditions
5. Poor rooting conditions
6. Adverse terrain conditions



Correction for improvement to high productive lands

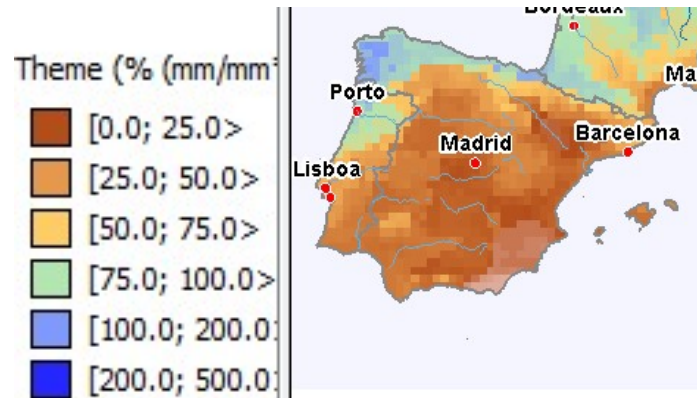
Focus on: agricultural mask
(Corine Land Cover agricultural 1990-2012)

Based on:

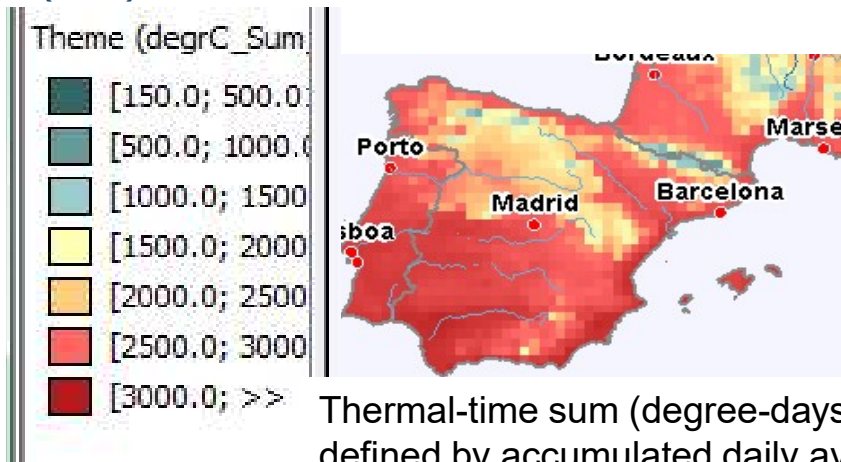
- JRC work on identifying **areas of natural constraints** (Van Oorschoven et al., 2014 and Terres et al., 2014) *CAP category*
- Several land evaluation systems for agronomic suitability (e.g. USDA-Land Capability Classification System (LCC) , Muencheberg classification by Mueller et al., 2010 and Soil Quality Rating by Shepherd, 2000)



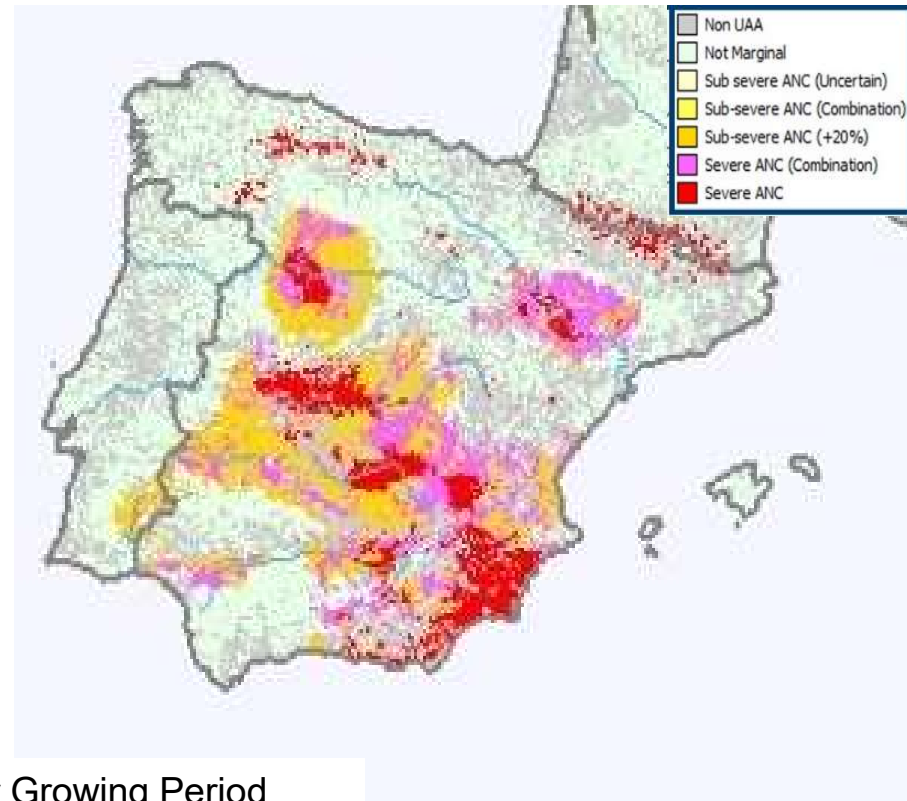
1. Adverse climate



Ratio of the annual precipitation (P) to the annual potential evapotranspiration (PET): $P/PET \leq 0.5$



Thermal-time sum (degree-days) for Growing Period defined by accumulated daily average temperature $> 5^{\circ}\text{C}$: $> 5^{\circ}\text{C} \leq 1500$ degree days (or 180 days)



2. Excessive wetness

Property	Criteria	Limits
Excess soil Moisture	Number of days at or above field capacity	> 230 days
Poor drainage		Soils with Gleyic qualifier and Gleysols Reference Soil Group (RSG)
Limited soil drainage	Areas which are water logged for significant duration of the year	Wet within 80cm from the surface for over 6 months, or wet within 40cm for over 11 months OR
		Poorly or very poorly drained soil
		Gleyic colour pattern within 40cm from the surface

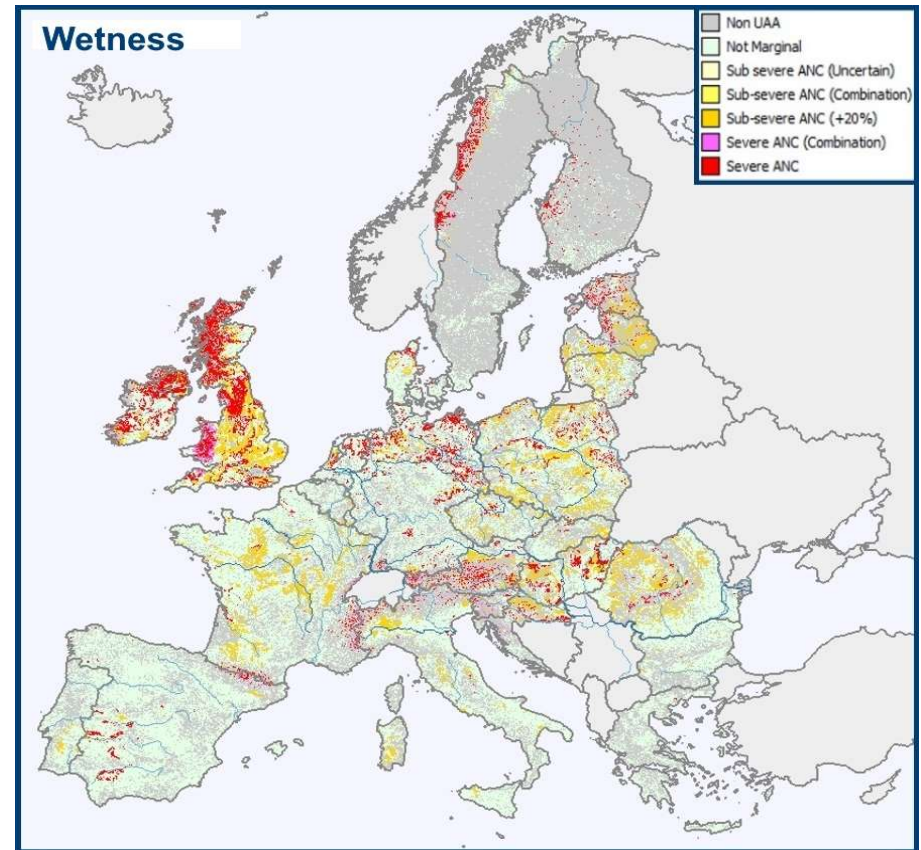
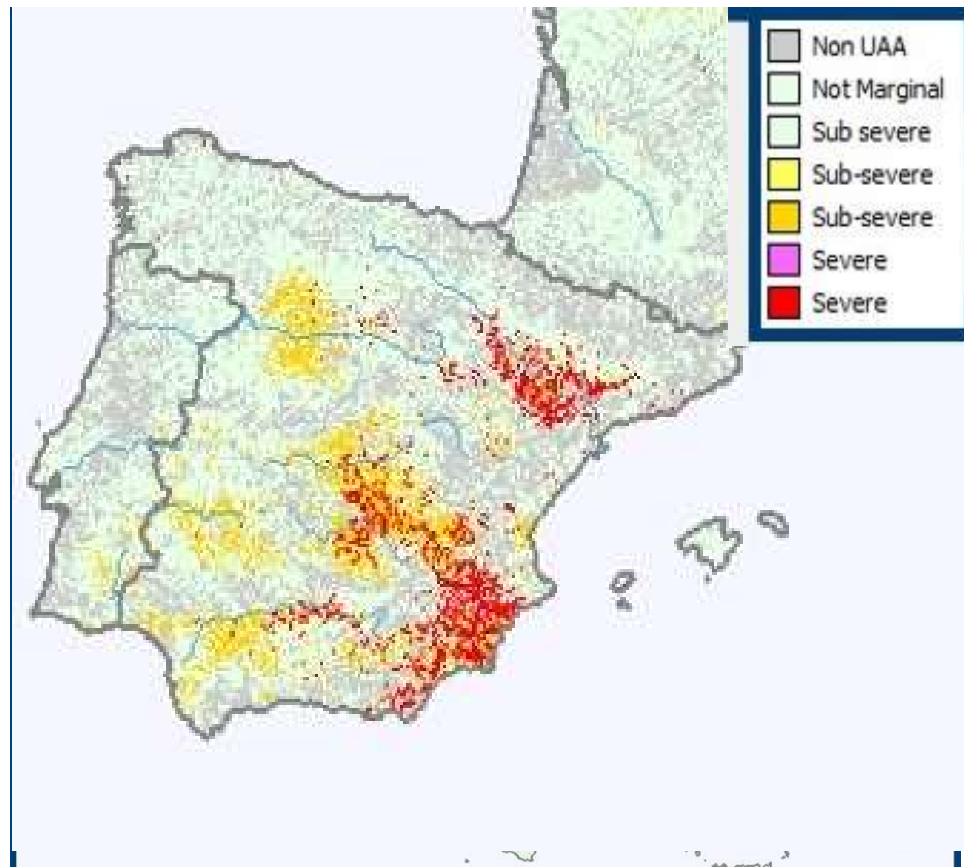


Figure 12: Spatial distribution of excess soil wetness (excess soil moisture and/or poor soil drainage) across Europe (adapted from Elbersen et al., 2018b).
Marginal lands for Growing Industrial Crops

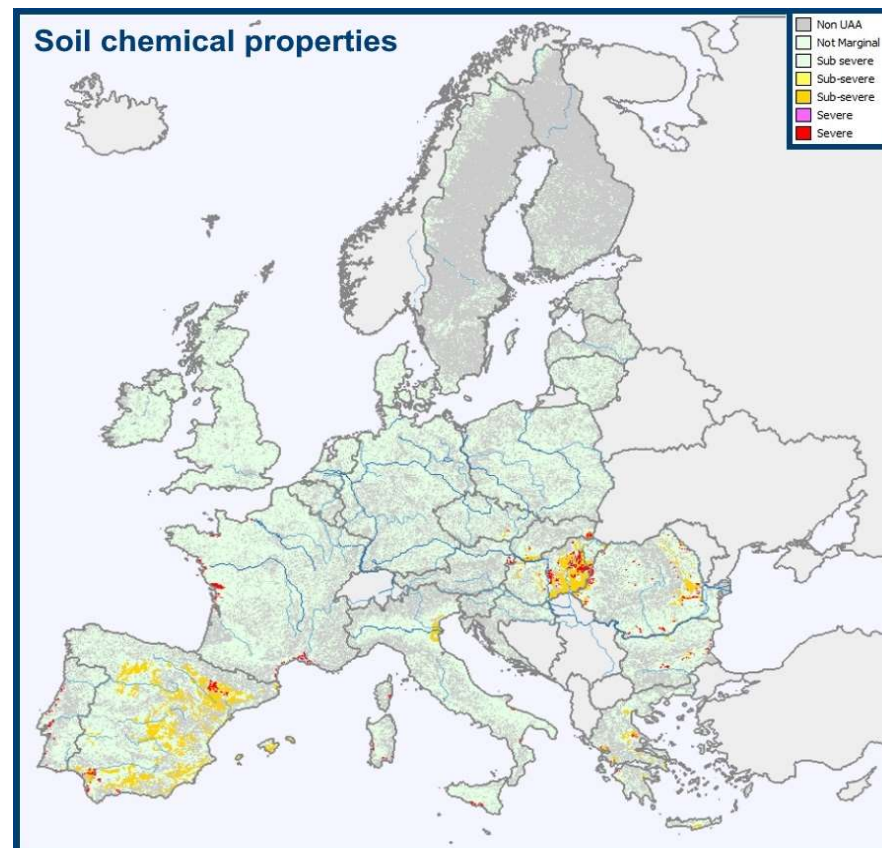
3. Low soil fertility

Property	Criteria	Limits
pH-H ₂ O	Acidity/ alkalinity	<4.5/>8
soc	Organic matter level	<1%



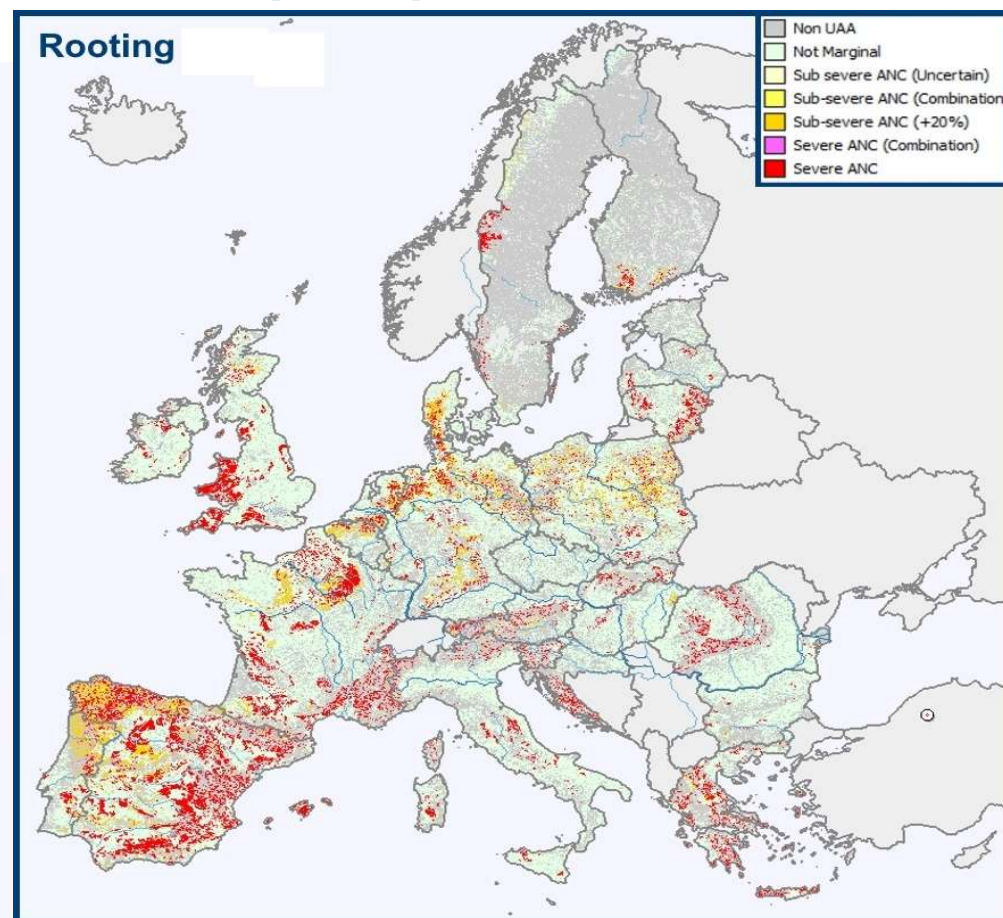
4. Adverse chemical conditions

Property	Criteria
Salinity (Ec)	>16
Sodicity (Na/ESP)	>25%
Toxicity natural	Soils with Thionic or Sulfidic qualifier
Toxicity pollutants	Soils with Toxic qualifier



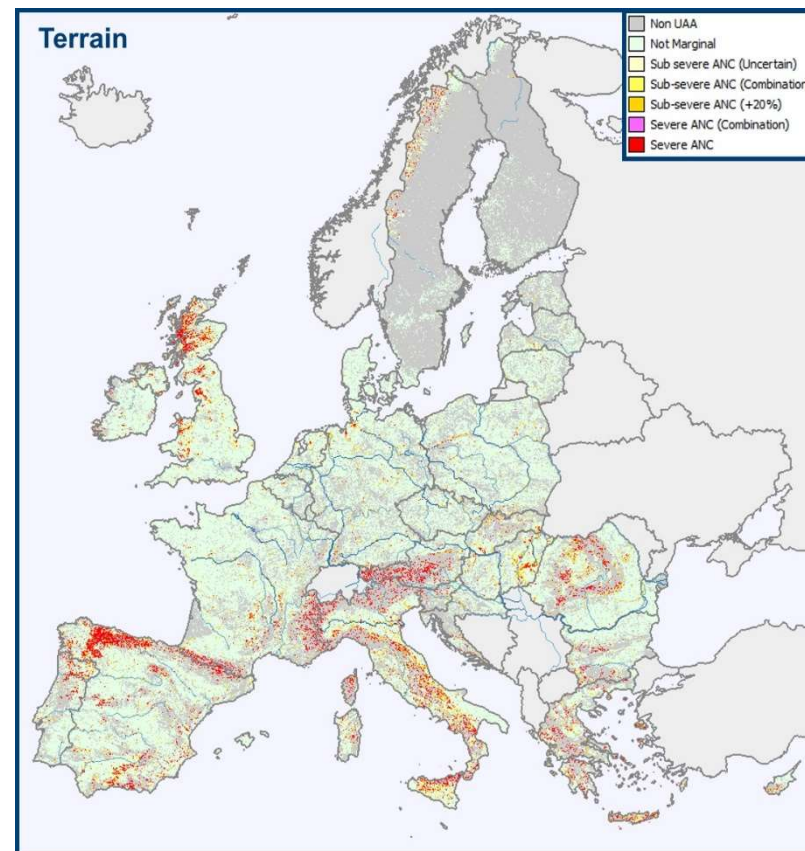
5. Poor rooting conditions (cntd)

Property	Criteria	Limits
Organic soils	Histosols	Relative abundance of clay, silt, sand, organic matter (weight %) and coarse material (volumetric %) fractions
Course texture/heavy clays	Arenosols, Vertisols	
Abrupt textural difference	Planosols	
Impeding soil layers	Fragipans, Soils with Leptic qualifier	Depth (cm) from soil surface to coherent hard rock or hard pan. <30 cm
Course fragments	Soils with skeletal qualifier	Suelos con profundidad de raíces <100 cm y fragmentos gruesos > 50%
Surface stones	> 15% surface cover	
Surface rocks	> 10% surface cover	

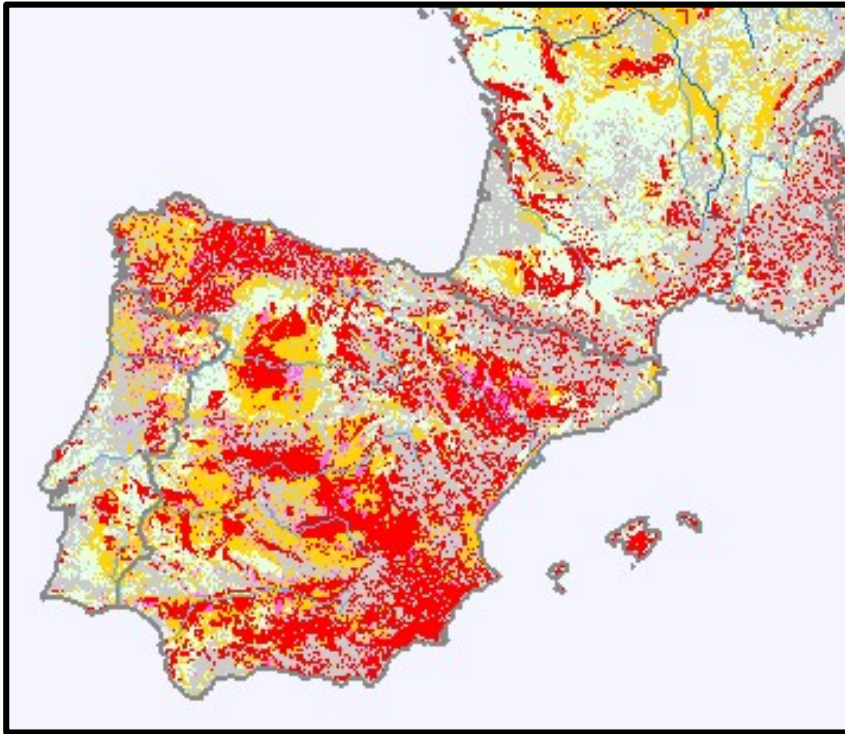


6. Adverse terrain conditions

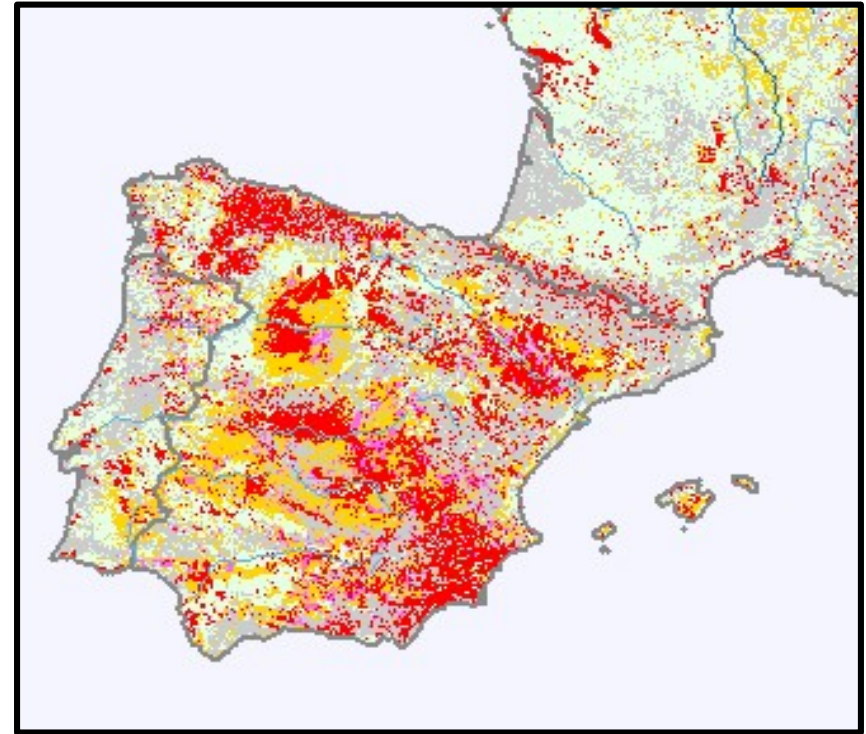
Property	Criteria
Steep slope	Change of elevation with respect to planimetric distance Slope > 15%
Flooding risk	Annually/ once 2-5 years Duración: > 15 días



Marginal zones in Spain



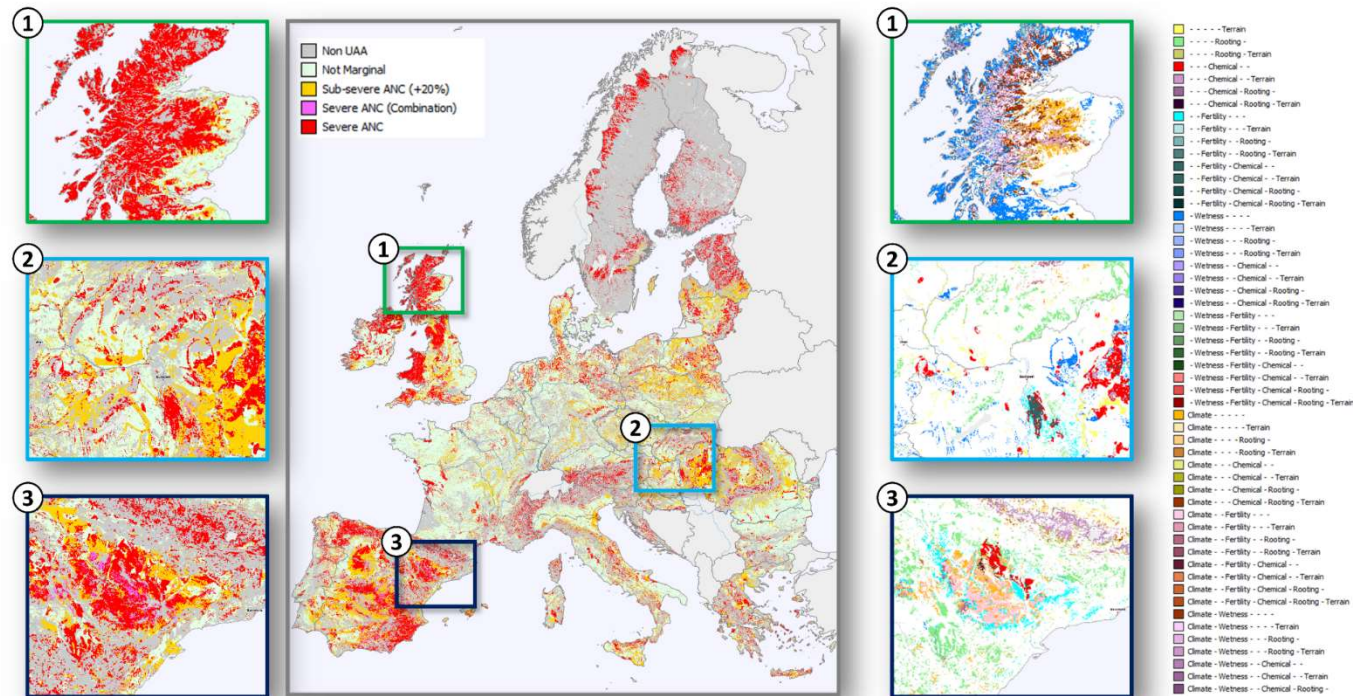
Without correction



After correction:

For improvements for irrigación y nutrient gift (in areas with high intensive agricultural production)

Final M-AEZ



- 1) Scotland; excessive wetness, climate, limitations in rooting.
- 2) Hungary: multiple limiting factors salinity, fertility, excessive wetness and rooting limitations.
- 3) Ebro Valley: large concentration of multiple overlapping limitations (all six factors).

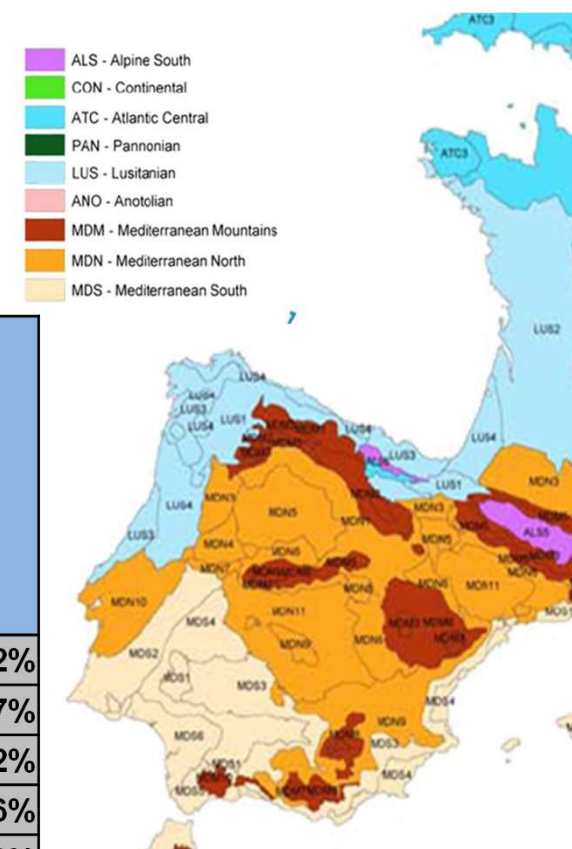
Final M-AEZ

- In total 29% of the agricultural area is marginal in EU-28.
- The most common are rooting limitations (12% of agricultural area after correction for improvement), adverse climate and excessive soil moisture (11% and 8% of the agricultural land).

	1. Adverse climate	2. Excessive soil moisture	3. Adverse chemical comp.	4. Low soil fertility	5. Adverse rooting cond.	6. Adverse terrain	Marginal	Not marginal
Alpine	40%	21%	0%	2%	45%	47%	61%	39%
Atlantic	4%	14%	1%	1%	12%	5%	26%	74%
Continental	1%	5%	2%	1%	5%	2%	14%	86%
Mediterranean	13%	1%	1%	6%	18%	9%	34%	66%
North	62%	14%	0%	3%	13%	3%	71%	29%
Grand Total	11%	8%	1%	2%	12%	6%	29%	71%

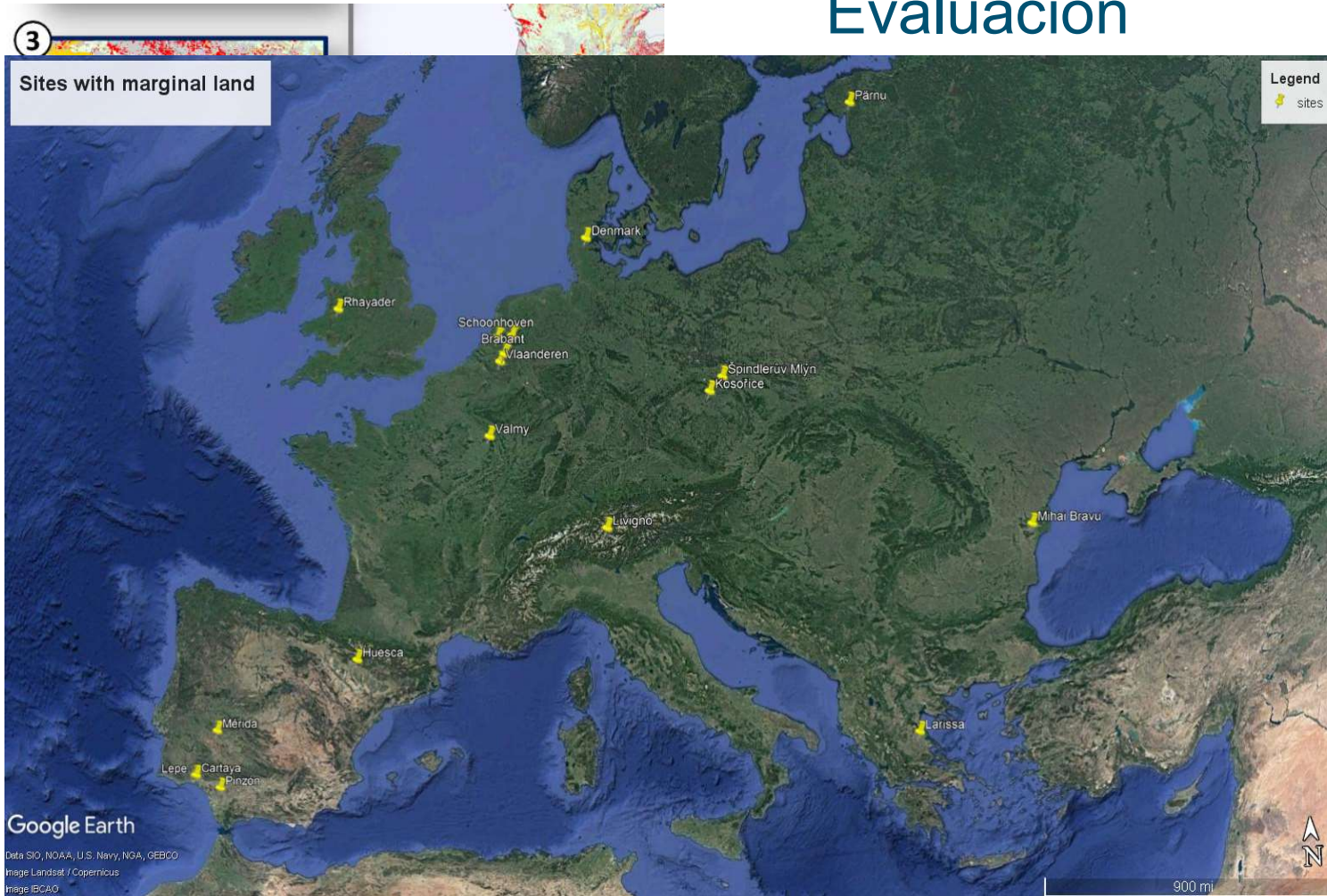
Zonas marginales en España

- In total 60% of the agricultural area is marginal in España
- Most dominant limiting factors are rooting limitations and adverse climate (dryness)
- Zona con mayor marginalidad se corresponde con clima Lusitano



Zona climatica	1. Clima adverso	2. Humedad excesiva	3. Condiciones químicas adversas	4. Baja fertilidad	5. Malas condiciones de enraizamiento	6. Condiciones adversas de terreno	Marginal	No marginal
Lusitano	0%	0%	0%	0%	43%	24%	68%	32%
Mediterráneo Montañas	7%	1%	0%	2%	40%	14%	63%	37%
Mediterráneo Norte	21%	0%	0%	8%	26%	3%	58%	42%
Mediterráneo Sur	24%	2%	2%	12%	11%	3%	54%	46%
Total	19%	1%	1%	8%	23%	8%	60%	40%

Evaluacion



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ains marginal with
ity, and rooting

neutralized by large
pivot irrigation

Selection of crops for marginal lands in three environmental zones



Growth-suitabilities of the pre-selected industrial crops across MAEZ per AEZ under consideration of both climatic and soil conditions. All values are colorized separately for each AEZ (adapted from deliverable D4.1). The crops are divided into four types (L= lignocellulosic crops, M= multipurpose crops, O= oil crops, W= woody species).

Mediterranean (AEZ 1)				Atlantic (AEZ 2)				Continental & Boreal (AEZ 3)			
Crop	Type	km²	%	Crop	Type	km²	%	Crop	Type	km²	%
Tall wheatgrass	L	211,255	96	Tall wheatgrass	L	151,166	79	Tall wheatgrass	L	172,355	86
Switchgrass	L	160,238	73	Reed canary grass	L	124,821	65	Reed canary grass	L	147,470	74
Miscanthus	L	130,634	60	Miscanthus	L	83,820	44	Miscanthus	L	88,010	44
Giant reed	L	129,501	59	Switchgrass	L	19,732	10	Switchgrass	L	26,628	13
Wild sugarcane	L	46,768	21	Giant reed	L	2,459	1	Giant reed	L	1,173	1
Reed canary grass	L	45,863	21	Wild sugarcane	L	252	0	Wild sugarcane	L	0	0
Lupin	M	201,888	92	Hemp	M	80,422	42	Cardoon	M	83,249	42
Biomass sorghum	M	193,118	88	Cardoon	M	71,822	37	Lupin	M	37,162	19
Cardoon	M	172,804	79	Lupin	M	36,790	19	Hemp	M	17,392	9
Hemp	M	162,794	74	Biomass sorghum	M	31,322	16	Biomass sorghum	M	6,323	3
Crambe	O	216,577	99	Camelina	O	186,018	97	Safflower	O	208,154	100
Camelina	O	209,761	96	Crambe	O	175,244	91	Camelina	O	183,667	92
Pennycress	O	208,388	95	Safflower	O	145,382	76	Crambe	O	130,959	66
Ethiopian mustard	O	184,988	84	Pennycress	O	64,812	34	Pennycress	O	76,465	38
Castor bean	O	160,990	74	Ethiopian mustard	O	43,177	23	Ethiopian mustard	O	10,111	5
Safflower	O	15,660	7	Castor bean	O	10,658	6	Castor bean	O	3,412	2
Siberian elm	W	179,148	82	Willow	W	164,191	86	Poplar	W	150,428	75
Willow	W	56,880	26	Poplar	W	159,930	83	Willow	W	119,536	60
Poplar	W	48,166	22	Siberian elm	W	20,611	11	Siberian elm	W	28,261	14

MAGIC marginal land databases online accessible

MAGIC databases (beta release):



MAGIC-MAPS

The MAGIC MAPS application characterises and analyses current and future marginal land in Europe facing natural constraints.

[Visit MAGIC MAPS](#)



MAGIC-CROPS

The MAGIC-CROPS database provides a description of 37 industrial crops suitable for growing on marginal land in Europe.

[Visit MAGIC CROPS](#)



MAGIC-DSS

The MAGIC decision Support System (DSS) provides users with guidelines for industrial crops growing under marginal conditions in Europe.

[Visit MAGIC DSS](#)



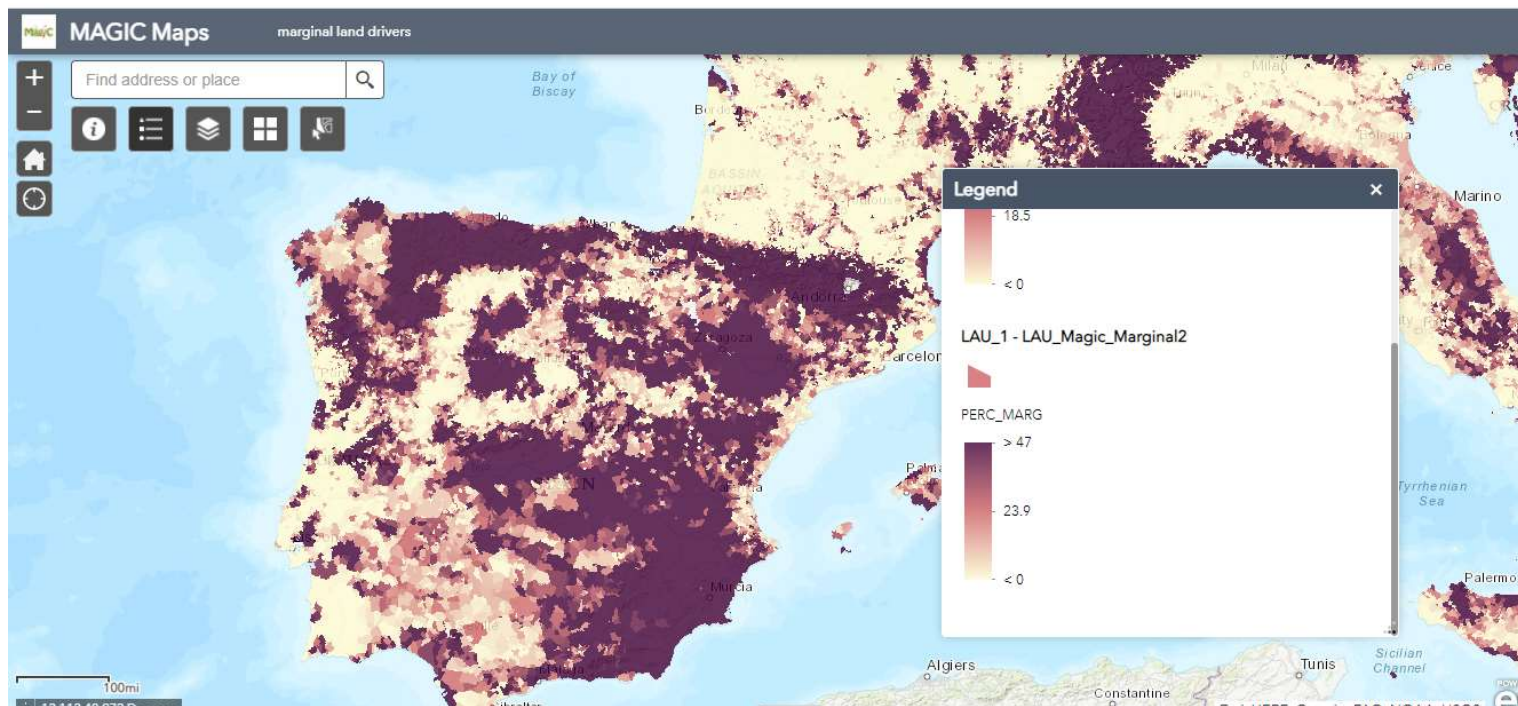
Bio2Match Tool

The Bio2Match tool collects information on conversion technologies for various biomass crops growing on marginal land in Europe.

[Visit Bio2Match Tool](#)

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

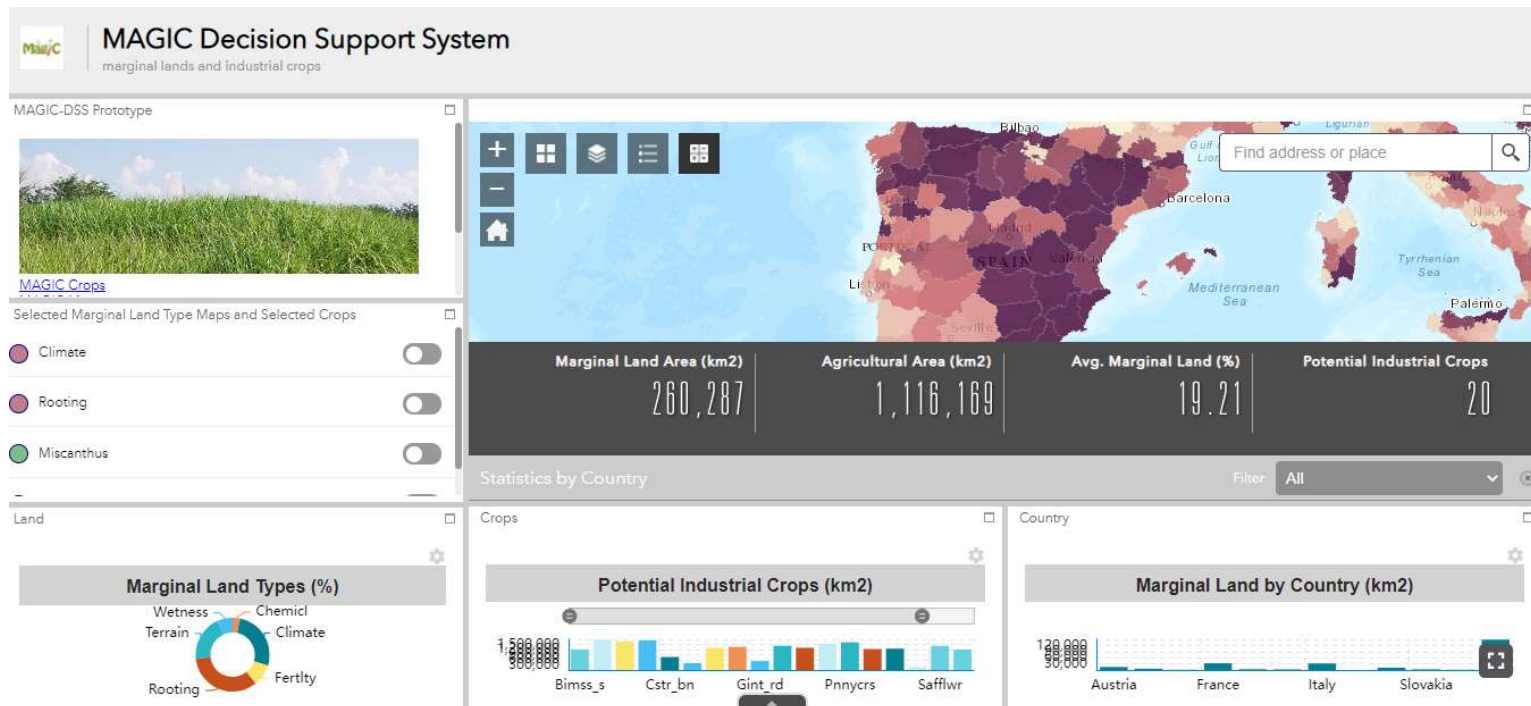
MAGIC MAPS (LAU level 1= municipality)



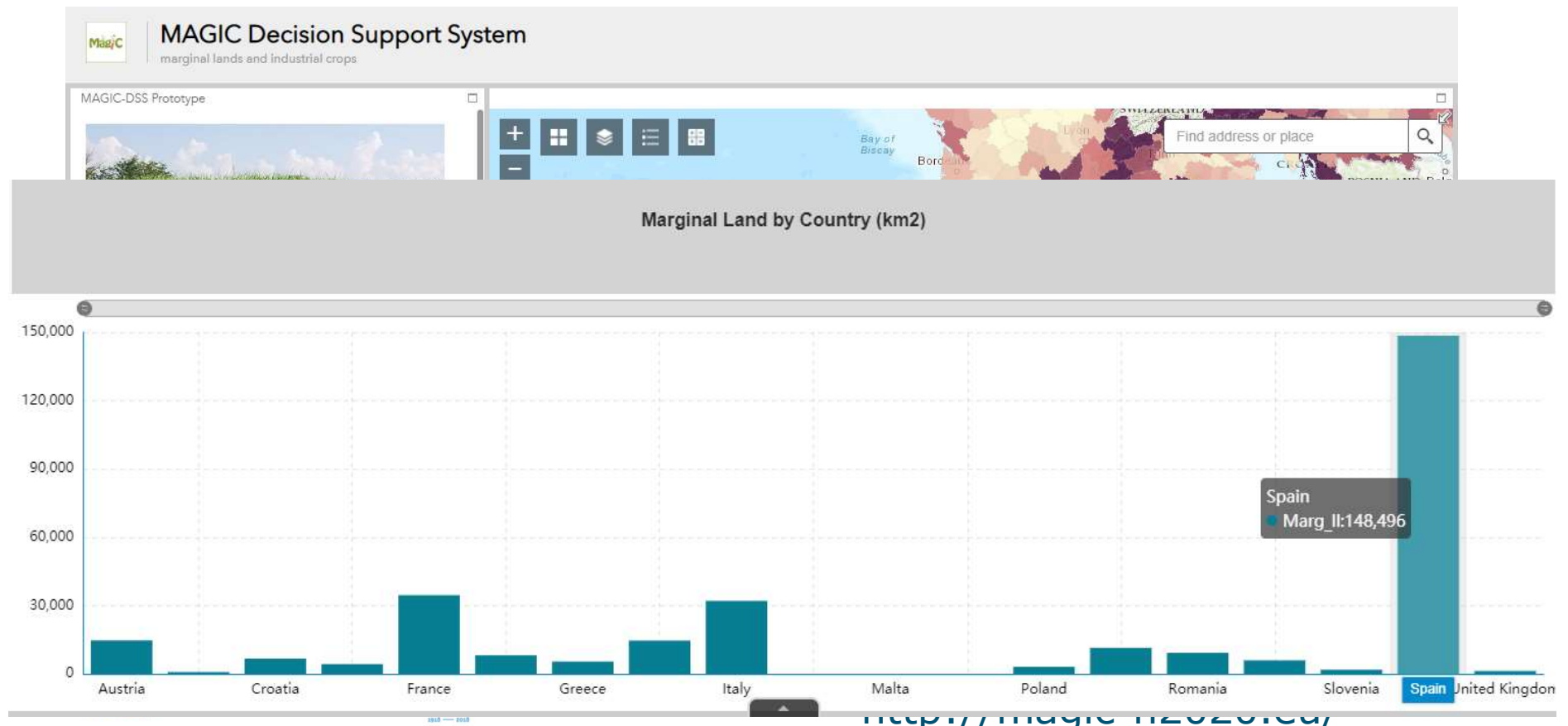
MAGIC MAPS



MAGIC DSS: marginal zones & Industrial cropping options



MAGIC DSS: marginal zones & Industrial cropping options



MAGIC DSS: zonas marginales y cultivos industriales



Conclusions

- Still to add characteristics on land abandonment likelihood
- Still to add yield reduction levels for MAGIC crops in different marginal locations
- End of project December 31st 2021
- Publications:
 - Book chapter on marginal land mapping
 - Paper on land abandonment detection with Radar SENTINEL data (in review)
 - Paper on marginal lands and likelihood for land abandonment (planned in February 2022)

¡Muchas gracias por su atención!

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To explore
the potential
of nature to
improve the
quality of life