

"Bare soil" detection addressing agricultural production optimization throughout the year: case study in Emilia Romagna using Sentinel-2 images.

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Objectives

1

Identification and development of a methodology for bare soil (BS) mapping: case study Emilia Romagna Region (Italy)

How much BS is available?

When and for how many times?

Does exist a geographic distribution of BS?

How big are the BS plot?

2

Explore a scenario of agronomic valorization with dedicated non-food crops for energy production

How much energy is achievable from these BS?

QUESTIONS

What is BS?

Bare soil (BS): plot of land worked but not cultivated, left uncovered or with any plant residues from the previous crop in the period between sowing and the next crop and which does not give agricultural income.

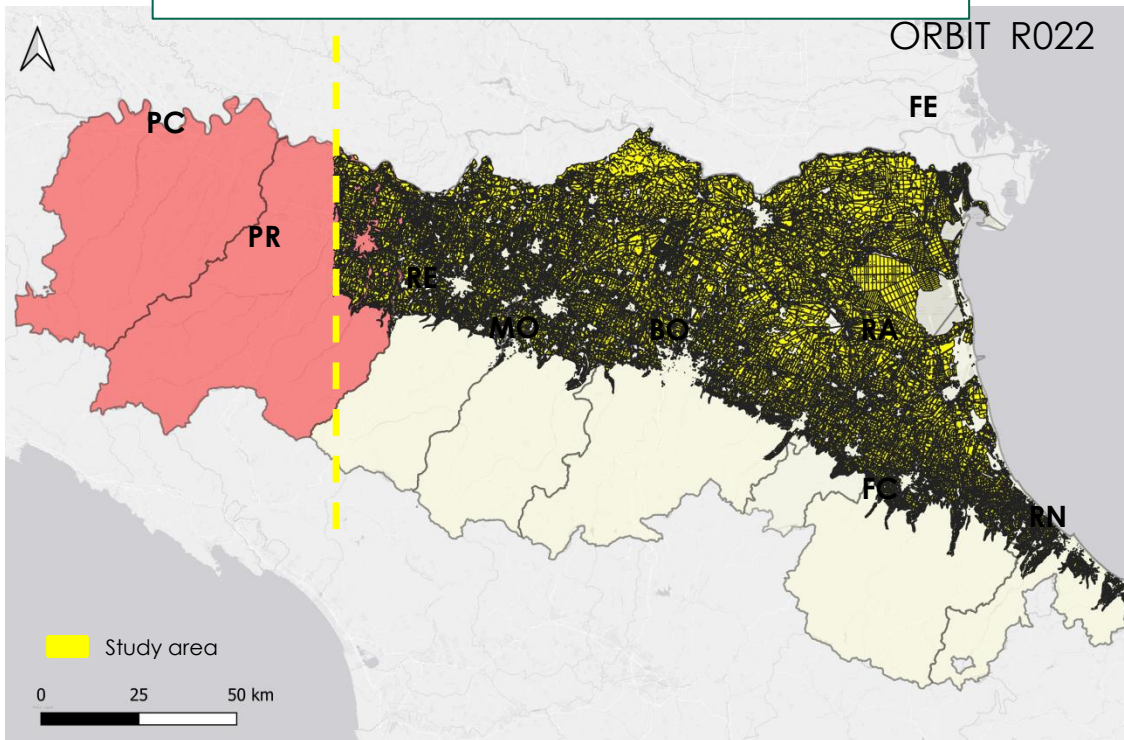
Why study BS?

- Optimize agricultural production
- Reduce nutrient leaching
- Investigate possible enhancement scenarios by knowing the available surfaces
- Addressing agricultural policies with positive effects on different stakeholders

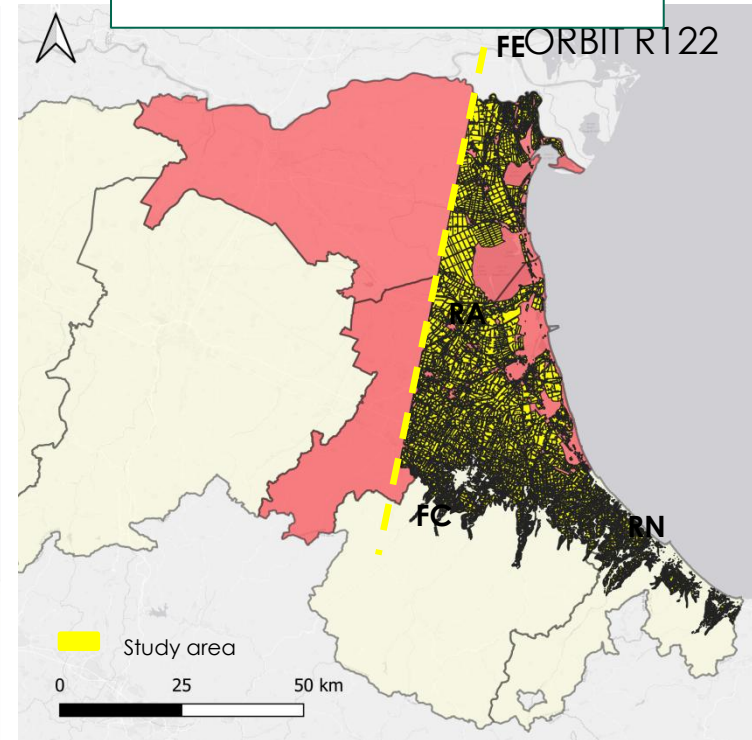
Study area

Emilia Romagna agricultural area corresponds to southern part of the Po Plain

ENTIRE REGION



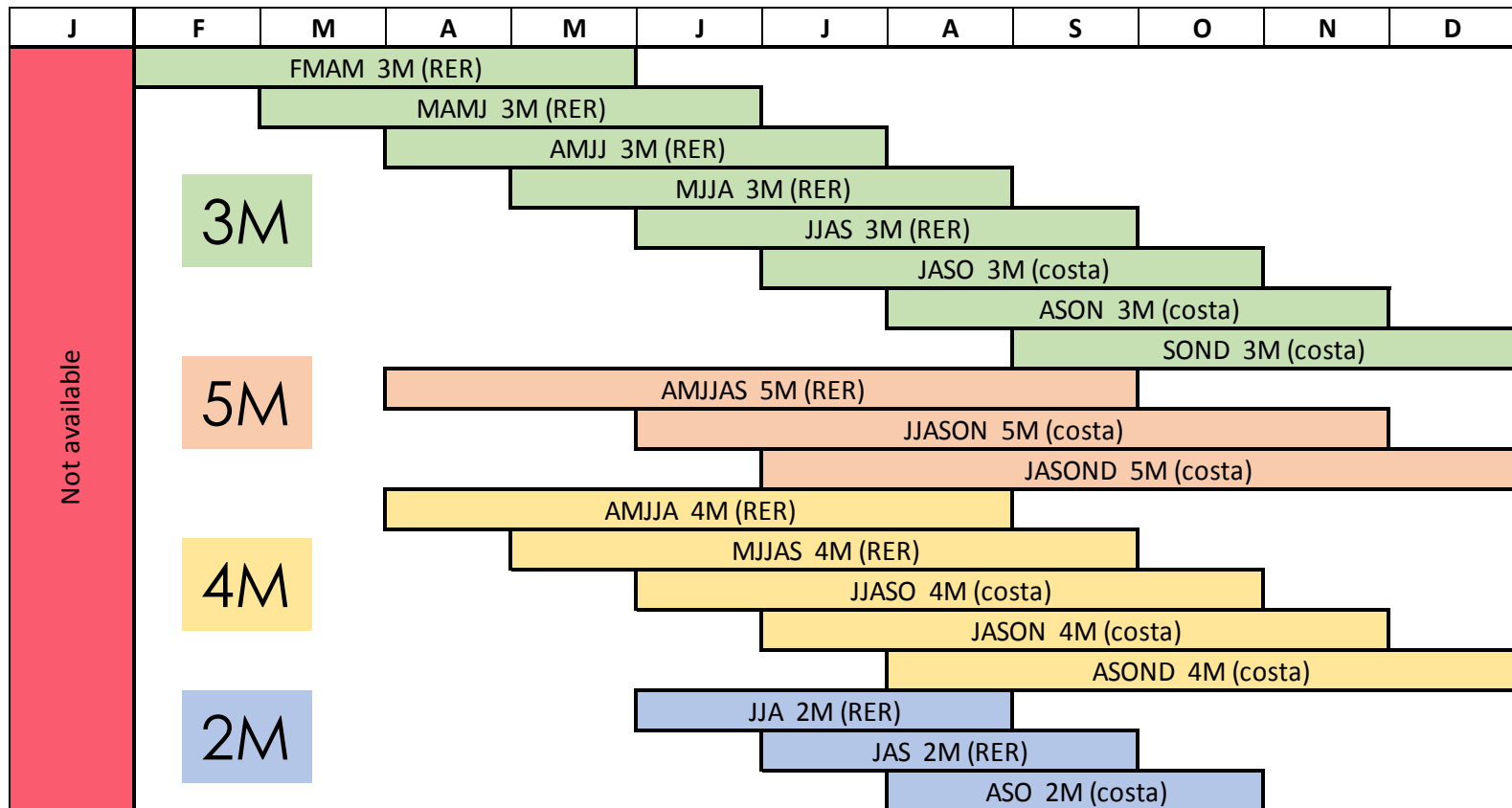
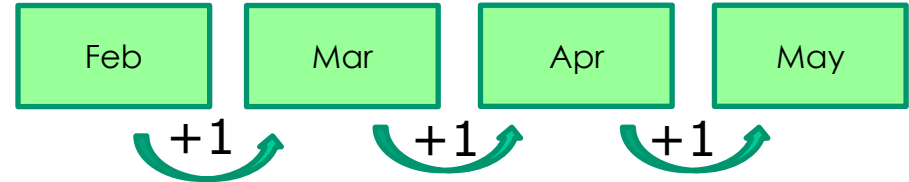
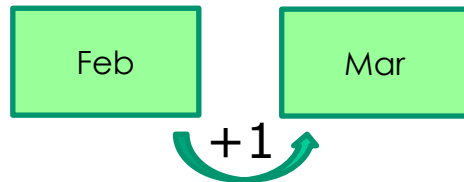
COASTAL



Investigated temporal sequences (2017)

Having two months "BS" means have at least one month "BS" (30 days)

3M → 4 consecutive images with detected BS



Operative procedure



Sentinel-2 images

- 20 m spatial resolution
- 3-5 days of revisiting time

arpae
emilia-romagna

<http://siam.andreabaraldi.com/>



Pre-processing

Color Name

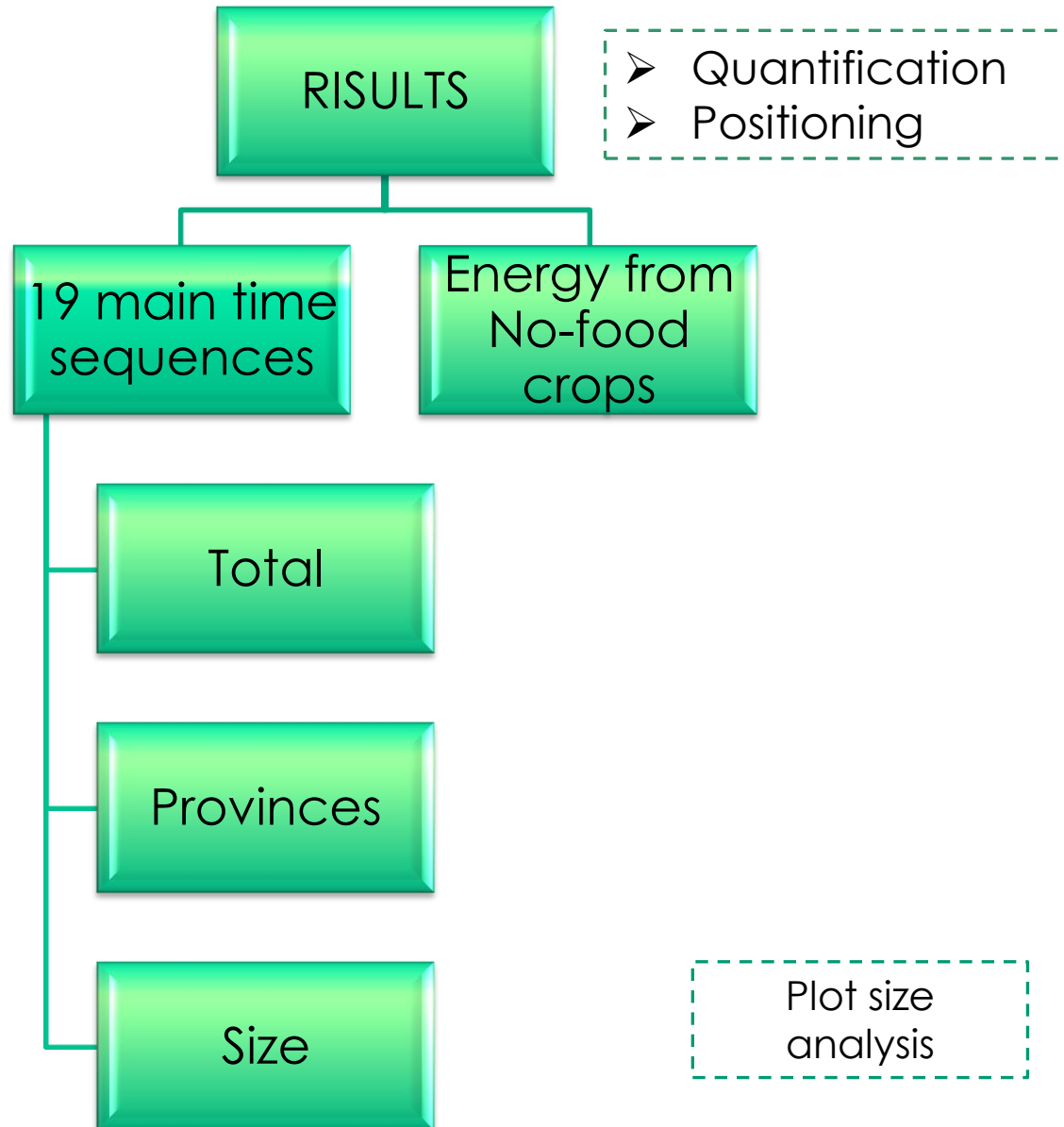
1	18
2	19
3	20
4	21
5	22
6	23
7	24
8	25
9	26
10	27
11	28
12	29
13	30
14	31
15	32
16	33
17	

- No clouds cover
Input: raster



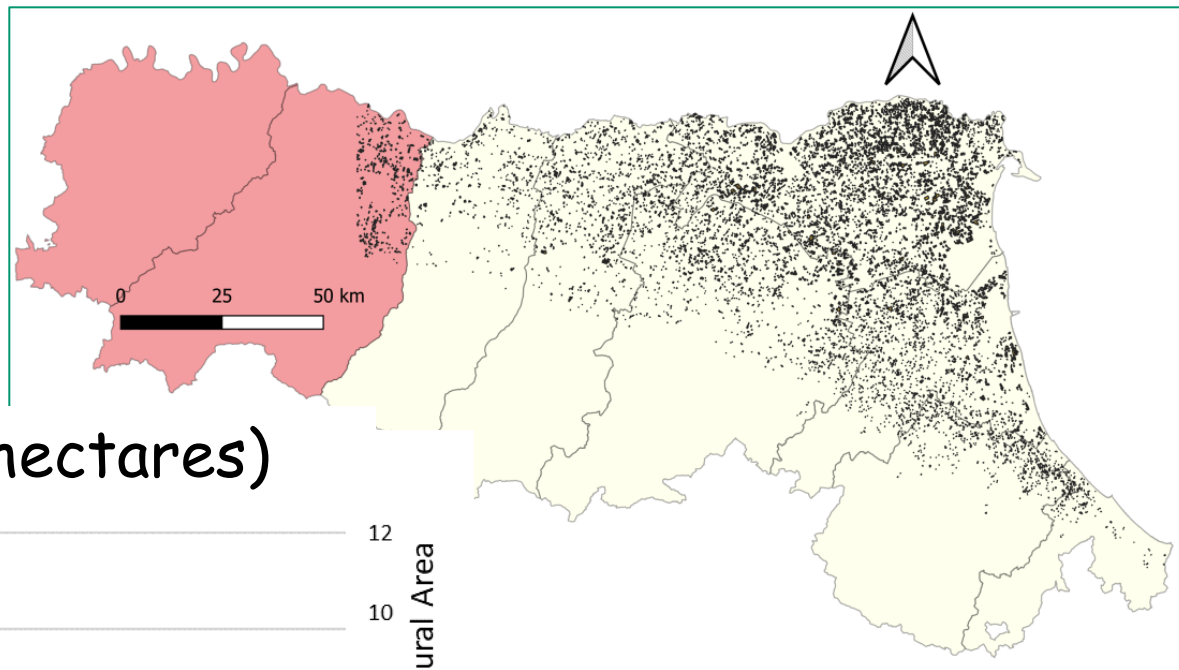
QGIS 3.4
Madeira

Results and Discussion

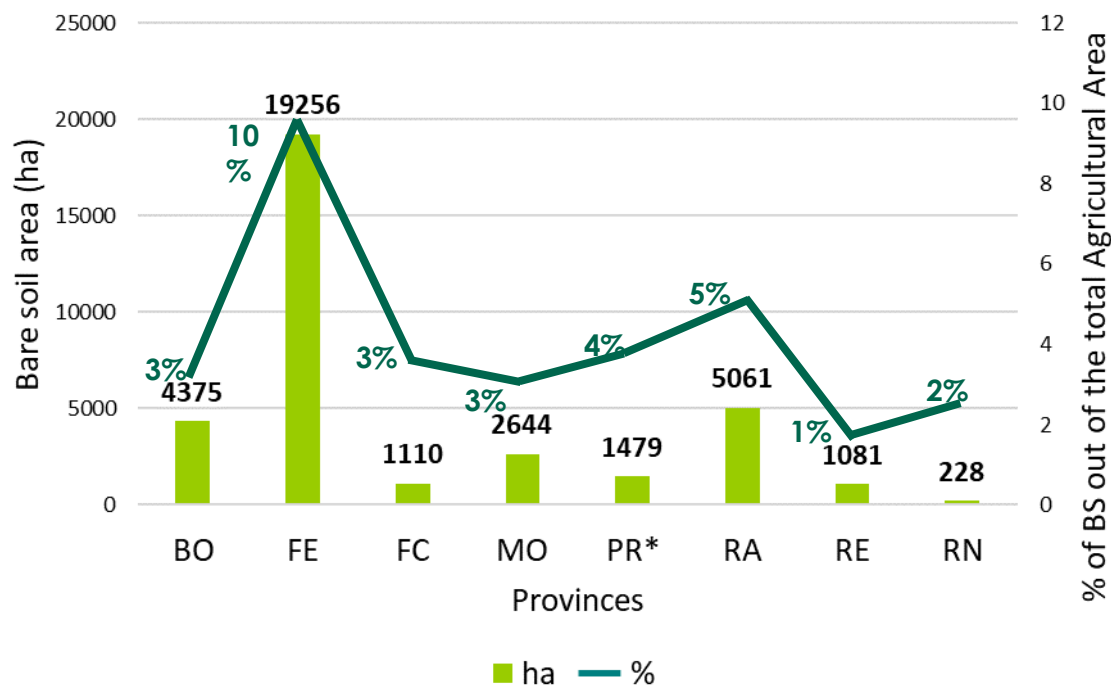


Example for March-April-May-June

MAMJ
Regional
extension

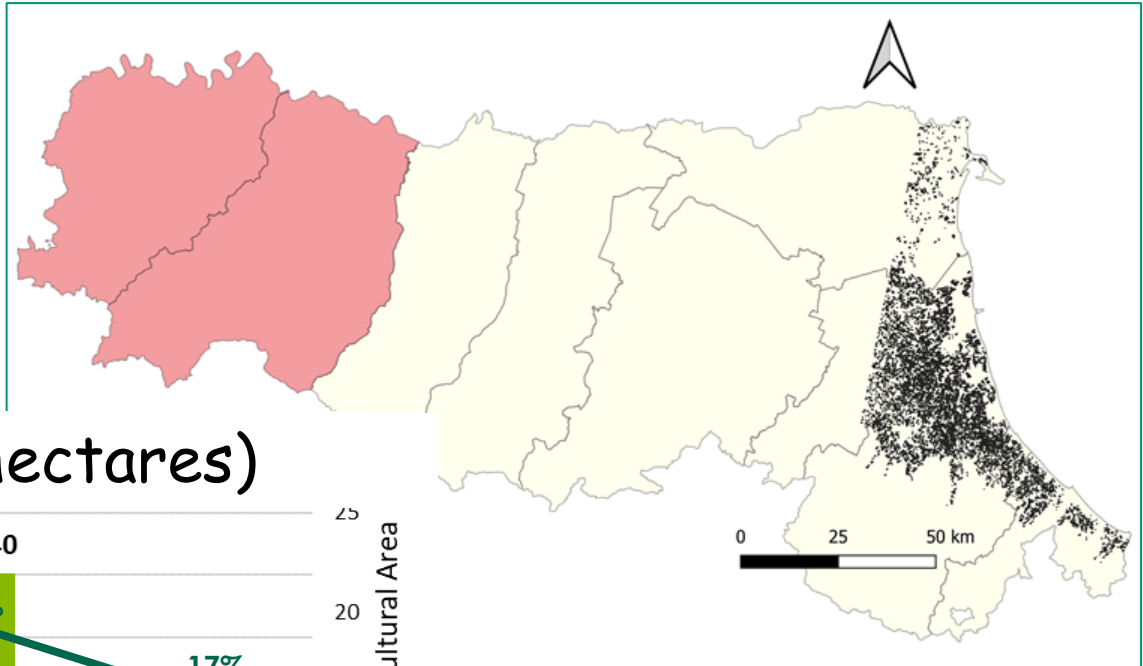


Extension of BS (hectares)

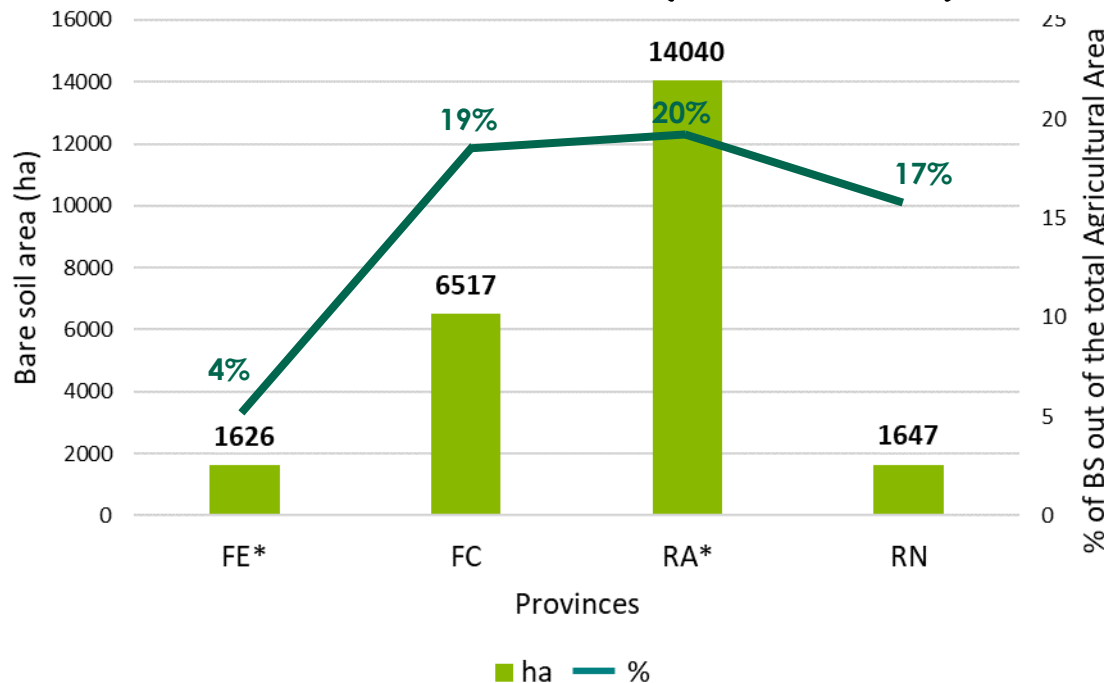


Example for July-August-Sept.-Oct.

JASO
Coastal
extension



Extension of BS (hectares)



Results for 19 main time sequences

% of BS for Provinces and total area

%	5 Months			4 Months					3 Months								2 Months		
	AMJJAS	JJASON	JASON	AMJJA	MJJAS	JJASO	JASON	ASOND	FMAM	MAMJ	AMJJ	MJJA	JJAS	JASO	ASON	SOND	JJA	JAS	ASO
RN	0.6	0.3	2.7	0.9	0.7	0.9	4.0	4.2	4.7	2.3	1.5	1.1	1.6	16.8	6.7	4.7	2.4	24.1	25.4
FC	0.7	0.7	5.4	1.2	0.9	1.3	8.6	9.1	6.6	3.2	1.7	1.5	1.8	19.1	14.6	10.7	2.8	22.6	31.0
RA	0.4	0.8	13.1	0.8	0.5	1.0	10.8	22.2	11.0	4.9	1.2	0.9	1.1	20.2	27.9	26.8	1.7	20.3	34.7
FE	0.2	0.2	1.9	0.3	0.2	0.3	0.5	4.0	21.6	9.8	0.6	0.4	0.7	4.0	5.0	8.2	1.1	16.4	8.8
BO	0.2			0.3	0.2				14.3	3.3	0.5	0.4	0.7				0.9	25.7	
MO	0.2			0.3	0.3				12.1	2.9	0.4	0.4	1.3				2.0	20.6	
RE	0.1			0.1	0.2				5.4	1.4	0.3	0.2	1.1				1.6	11.8	
PR	0.2			0.2	0.3				7.9	3.5	0.6	0.3	1.4				1.7	15.6	
Total BS (ha)	1599	901	12026	2667	2083	1323	15442	20673	93519	35234	4600	3503	6813	23829	27174	26143	10204	131130	40843
% of total BS out of total AA	0.2	0.6	7.8	0.4	0.3	0.9	10.0	13.4	13.7	4.7	0.7	0.5	1.0	15.4	17.6	16.9	1.5	19.2	26.4



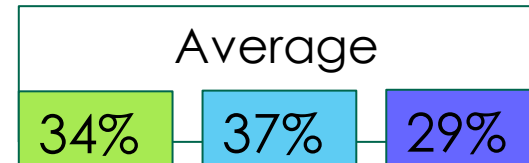
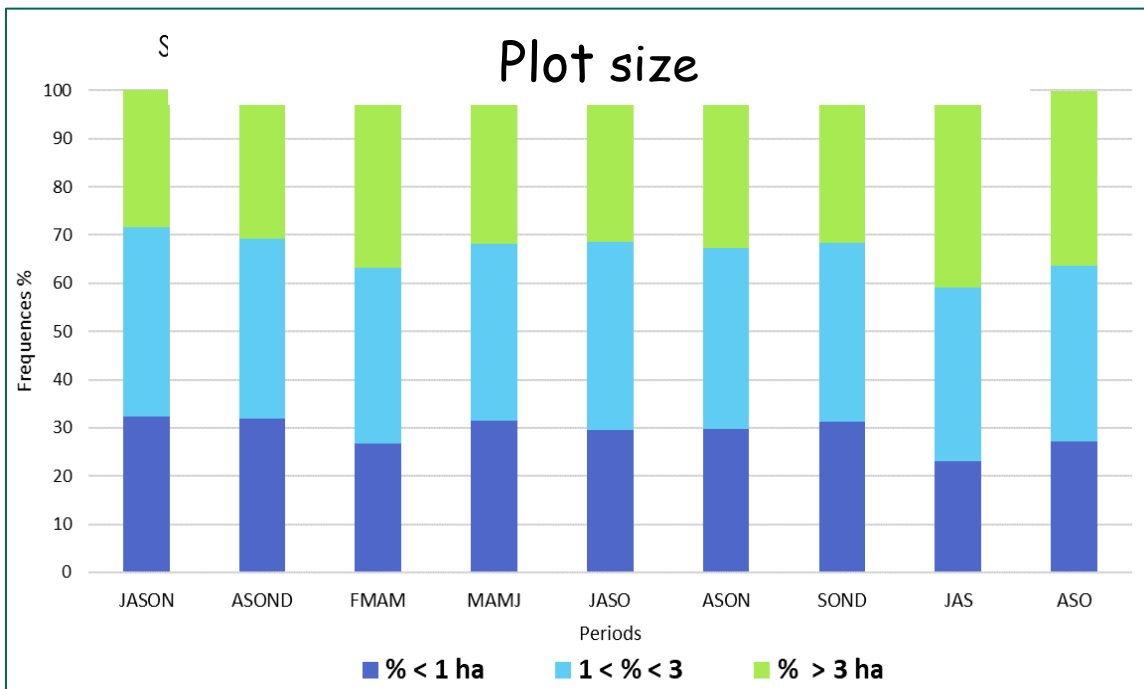
➤ % ↓

➤ % ↓
➤ Nov-Dec
Low solar radiation

➤ % ↑
➤ Optimal growing season

➤ Too short

Plot Size



JASO

Classes	BS number	%	BS ha	%
< 1 ha	1930	30	1481	6
1-3 ha	2540	39	4494	19
> 3	2048	31	17854	75
TOT	6518		23829	

High homogeneity among plots in every considered time sequence

BS energetic valorization

MAMJ e JASO

- Need for efficient solutions in terms of land use and agricultural input, low environmental impact
- New no-food energy crops
- Biogasdoneright® model based on the anaerobic digestion of double crops and by-products

- ❖ Rusticity
- ❖ Short crop cycle (<100 days)
- ❖ Low water demand
- ❖ Thermic requirement
- ❖ Good adaptability to the soil

*Crambe
abyssinica*

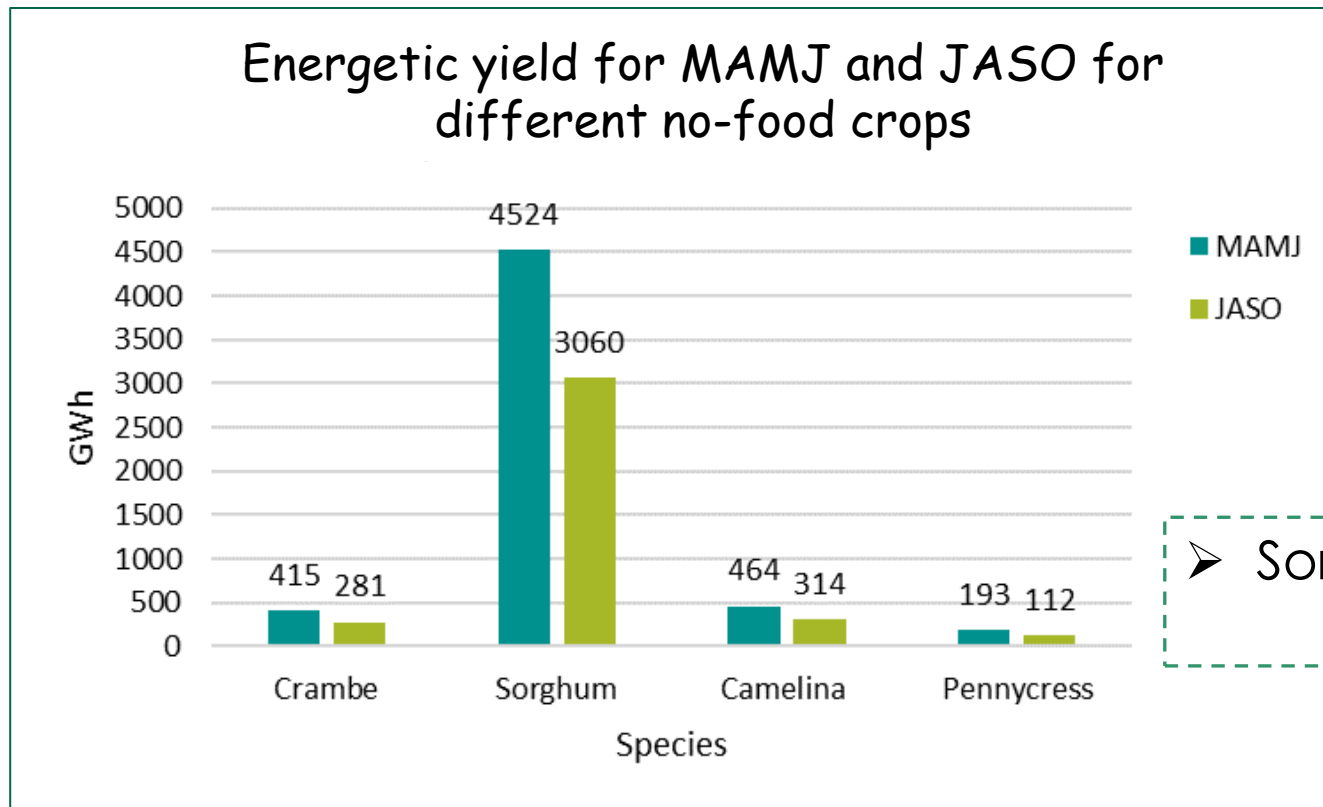
*Sorghum
Bicolor*

*Camelina
sativa*

Pennycress

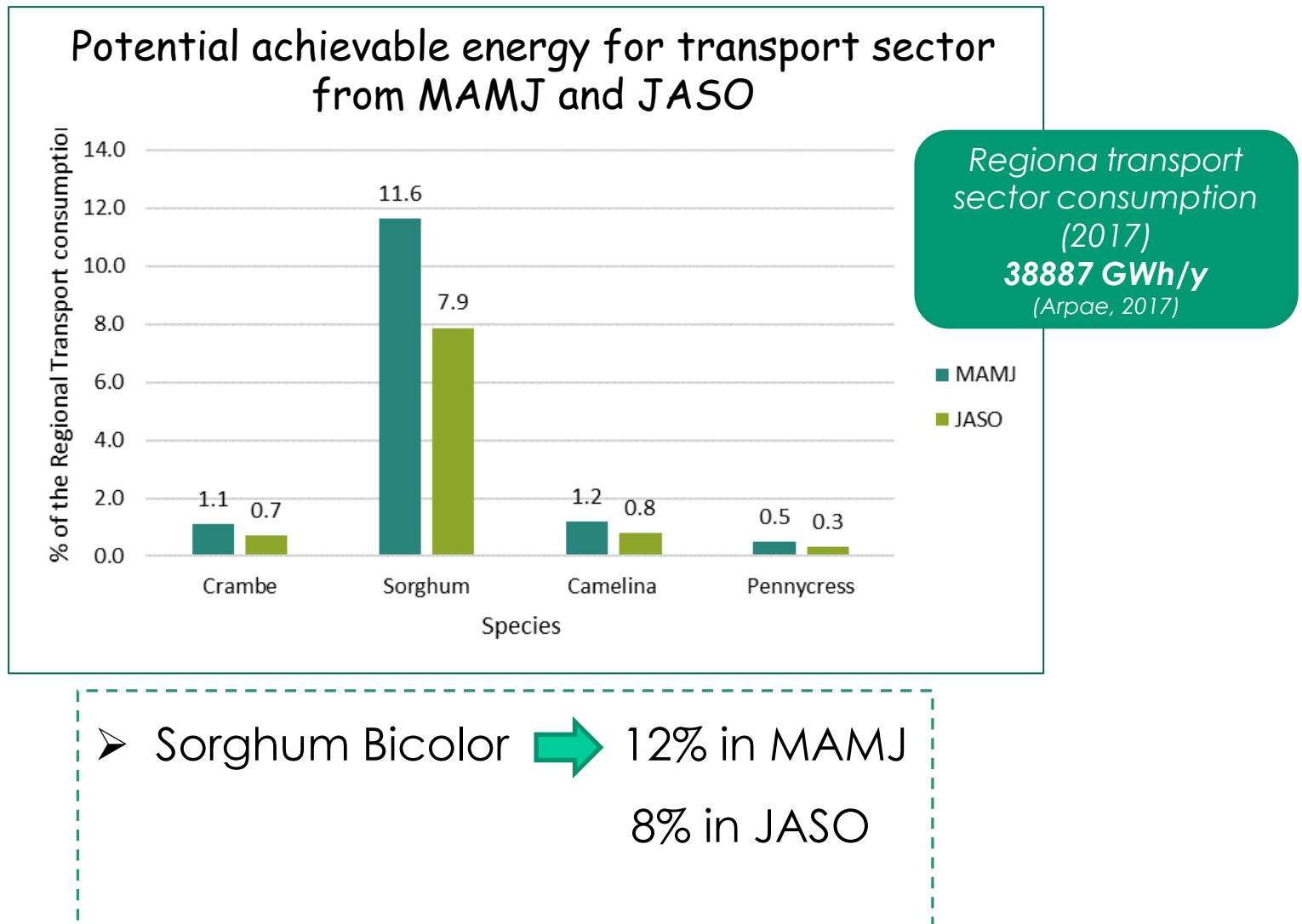


BS energetic valorization



➤ Sorghum Bicolor

BS energetic valorization



Conclusions

- Development of a methodology for BS spatial and temporal mapping
- Different spatial distribution of BS in the Region
- BS quantification identifies two highly performing periods: MAMJ and JASO
- Optimization of BS: a no-food crop generate 10% of the annual consumption of the transport sector in the Region, moreover keeping the soil covered prevents different environmental problems
- The methodology is satisfactory, replicable and automatable
- Need access to satellite data and updating of databases in real time