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Assessment of the impact of contour ridge benches on the soil water content in the watershed of wadi Siliana (Medjerda basin, Northern Tunisia)

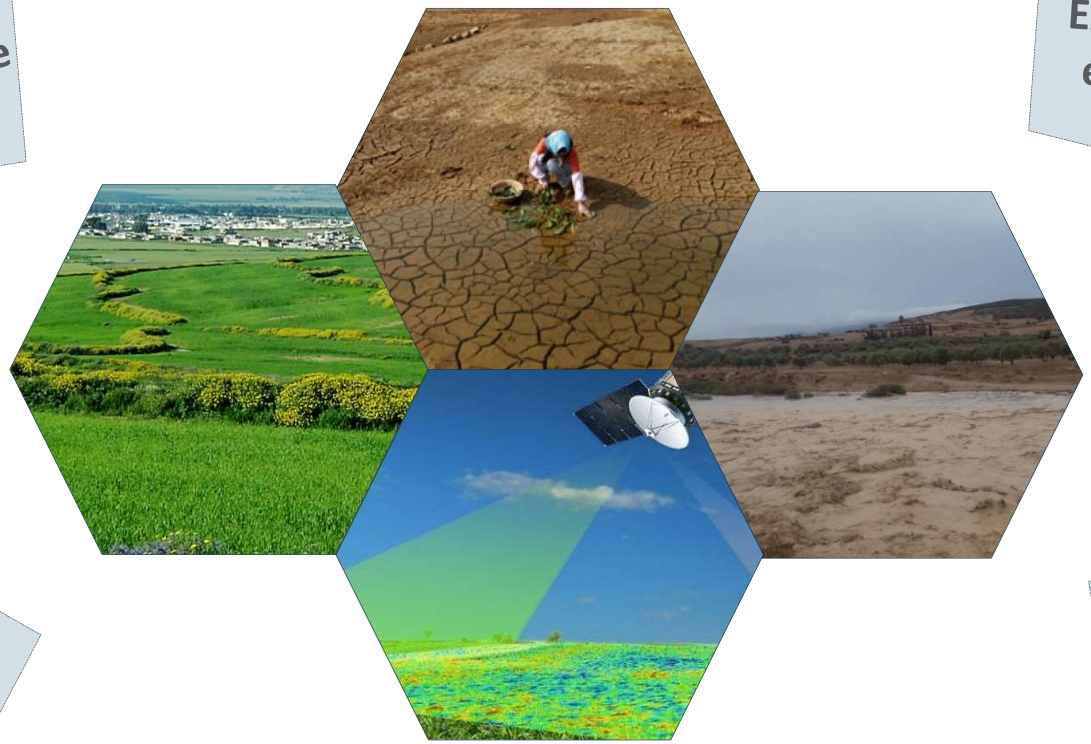


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1. Background / Opening

82 % agriculture



Extreme events

Contour Ridge bench

Rarely quantified

1. Motivation and objective of the study



+ **Water stress** exceeds 100 % in the Medjerda catchment since 2013.

+ Water scarcity exerts **a high pressure on crop production**.

+ Water reservoirs of the catchment are severely **affected by sedimentation** / **overexploitation of the groundwater.**

+ Watershed is subjected to extreme weather and climate events.

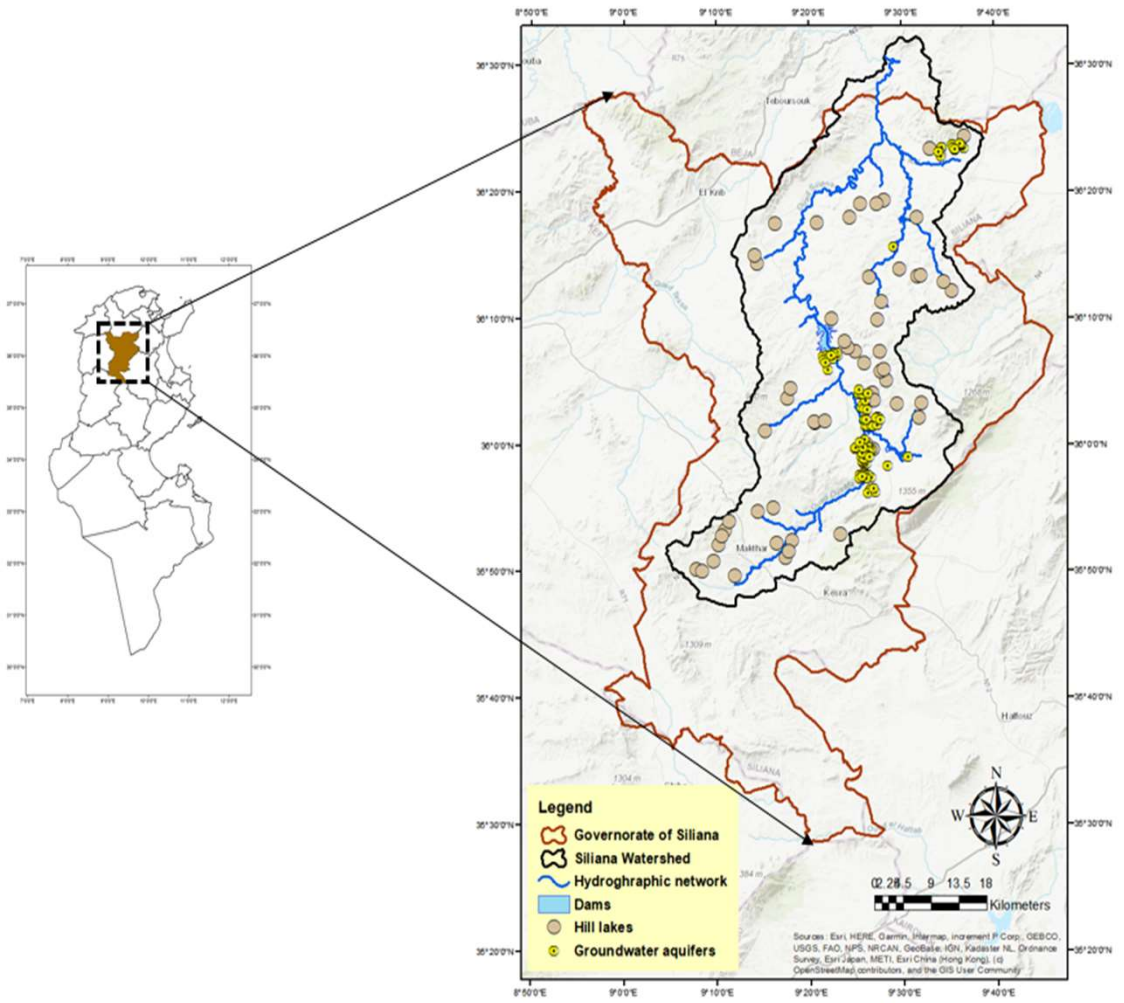
Goal : To evaluate the effect of soil and water conservation practice, especially Contour Ridge Benching (CRB) on Soil Water Content (SWC).

2. Study area

Study area (km^2)	Precipitation (mm)	Temperature (°C)
2124	400	19

Water Resources

-Dams
-Hill and small hill dams
-Ground water aquifers.



2.Study Area

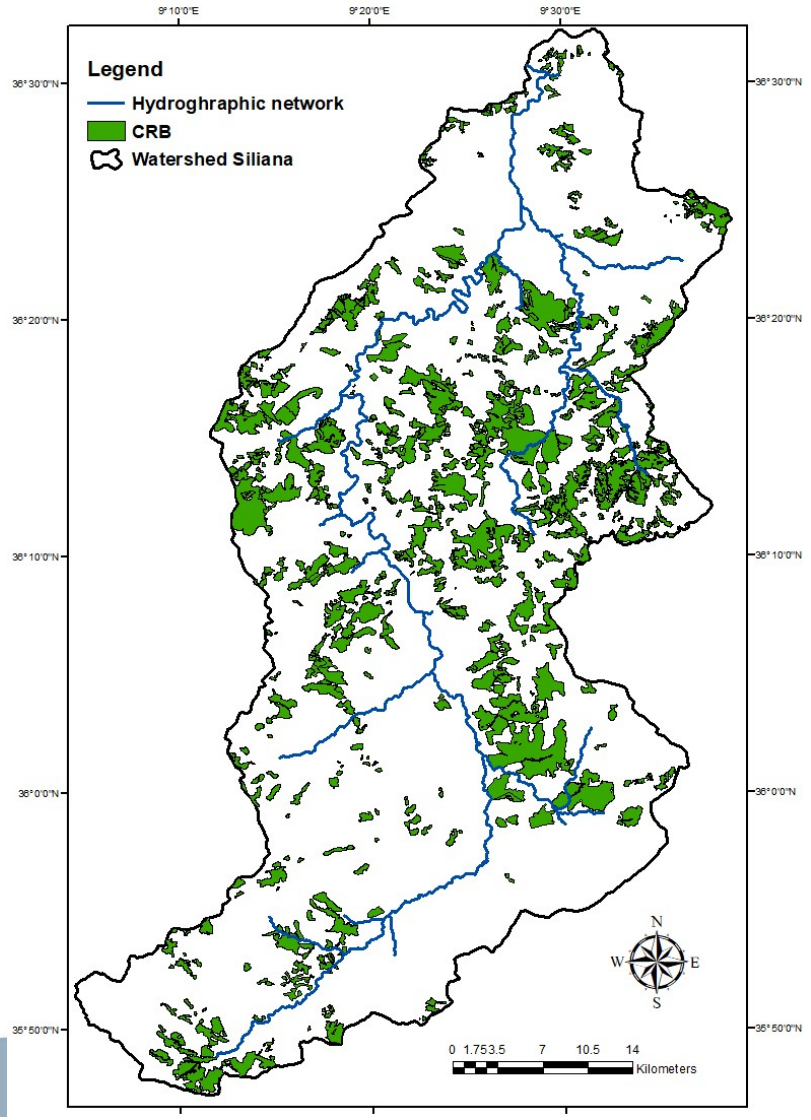
CRB in the study area

- CRB is a soil conservation technique consisting of earth embankments constructed across cropped slopes, at regular intervals.
- CRB techniques are implemented on 380 km² of the total area.

CRB aims to :

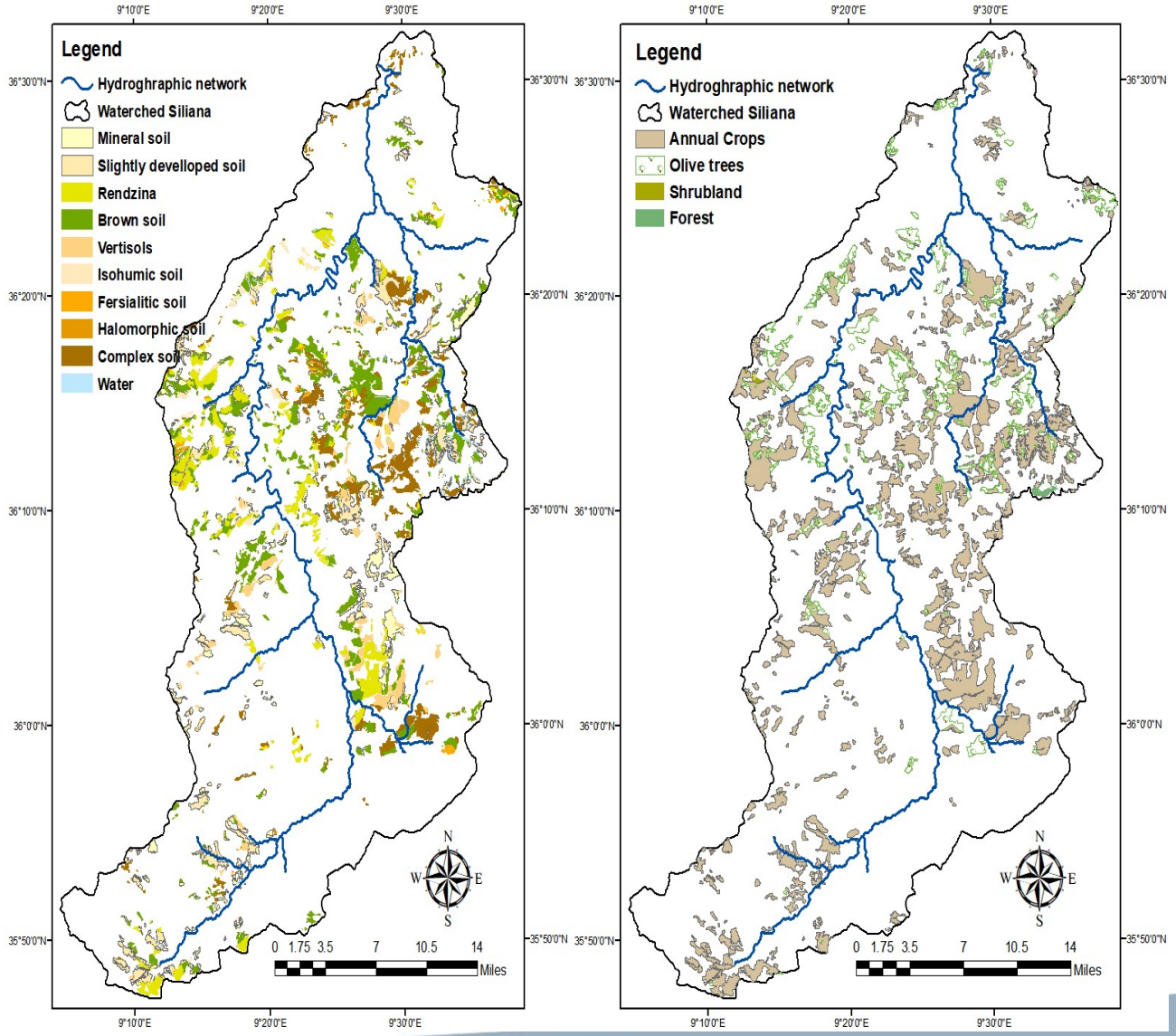
- ✓ Reduce soil losses from soil erosion;
- ✓ Intercept runoff ;
- ✓ Harvest water;
- ✓ Maintain and preserve soil fertility; and
- ✓ Improve crop yield.





2.Study Area

Soil types and Land Cover (LC) in perimeter with CRB



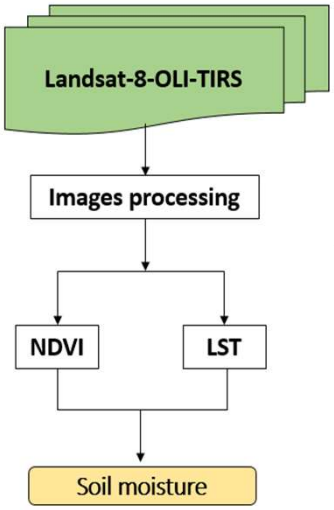
Soil types in the CRB area

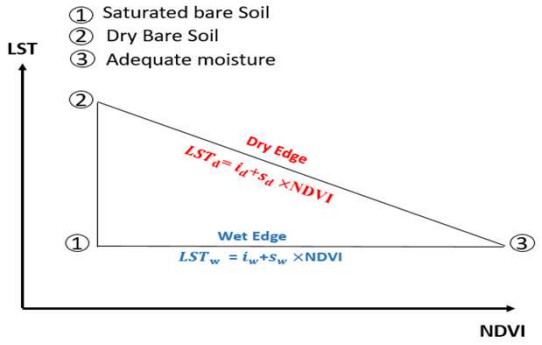
Type of soil (CRB)	Area (%)
Regosois	8.9
Lethosols	17.4
Rendzina	16.0
Brown soil	26.5
Vertisols	8.0
Complex unit of soils	18.1
Water ways	1.5
Others soils	3.6
Total	100

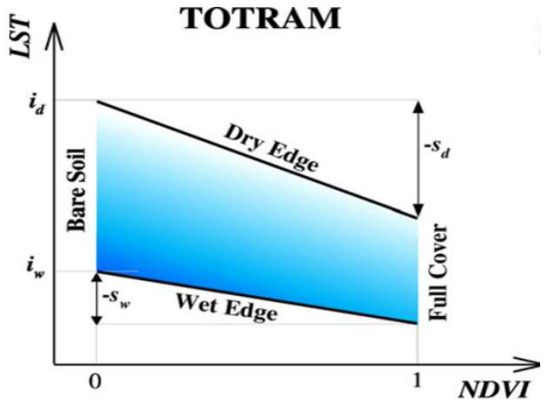
Land Cover in the CRB area

Land Cover	Area (%)
Forest and Shrubland	0.5
Olive trees	18.7
Field crops	80.8
Total	100.0

3. Materials and methods







According to Sadeghi et al, 2017

Eq1

$$LST_{max} = i_d + s_d \times NDVI$$

$$LST_{min} = i_w + s_w \times NDVI$$

2Eq

$$\frac{\theta - \theta_d}{\theta_w - \theta_d} = \frac{LST - LST_d}{LST_w - LST_d}$$

Eq3

$$SWC = \frac{(i_d + s_d)NDVI - LST}{(i_d - i_w) + (s_d - s_w)NDVI}$$

$(i_d + s_d)$: dry Edge

$(i_w + s_w)$: wet Edge

θ : soil moisture measured
θ_d : dry soil moisture
θ_w : wet soil moisture

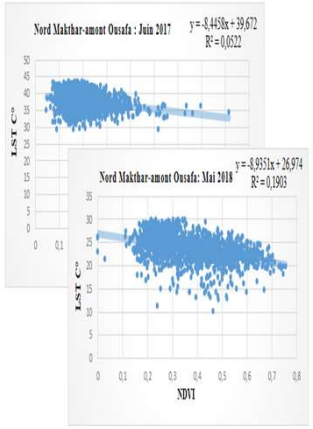
LST : land surface temperature
LST_d : dry soil temperature
LST_w : wet soil temperature

3. Materials and methods

- Download and preprocess **rasters images : LST/NDVI**

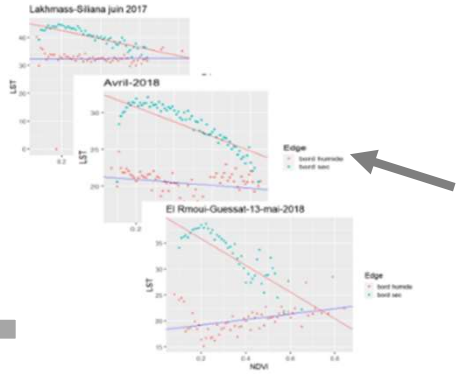
- Breakdown of information between sites (with CRB, without CRB).
- Conversion of data (LST, NDVI) **into point.**

- Import the data to be processed in Excel.



- Application of the algorithm

R Studio®



(id,sd,iw and sw)

TOTRAM

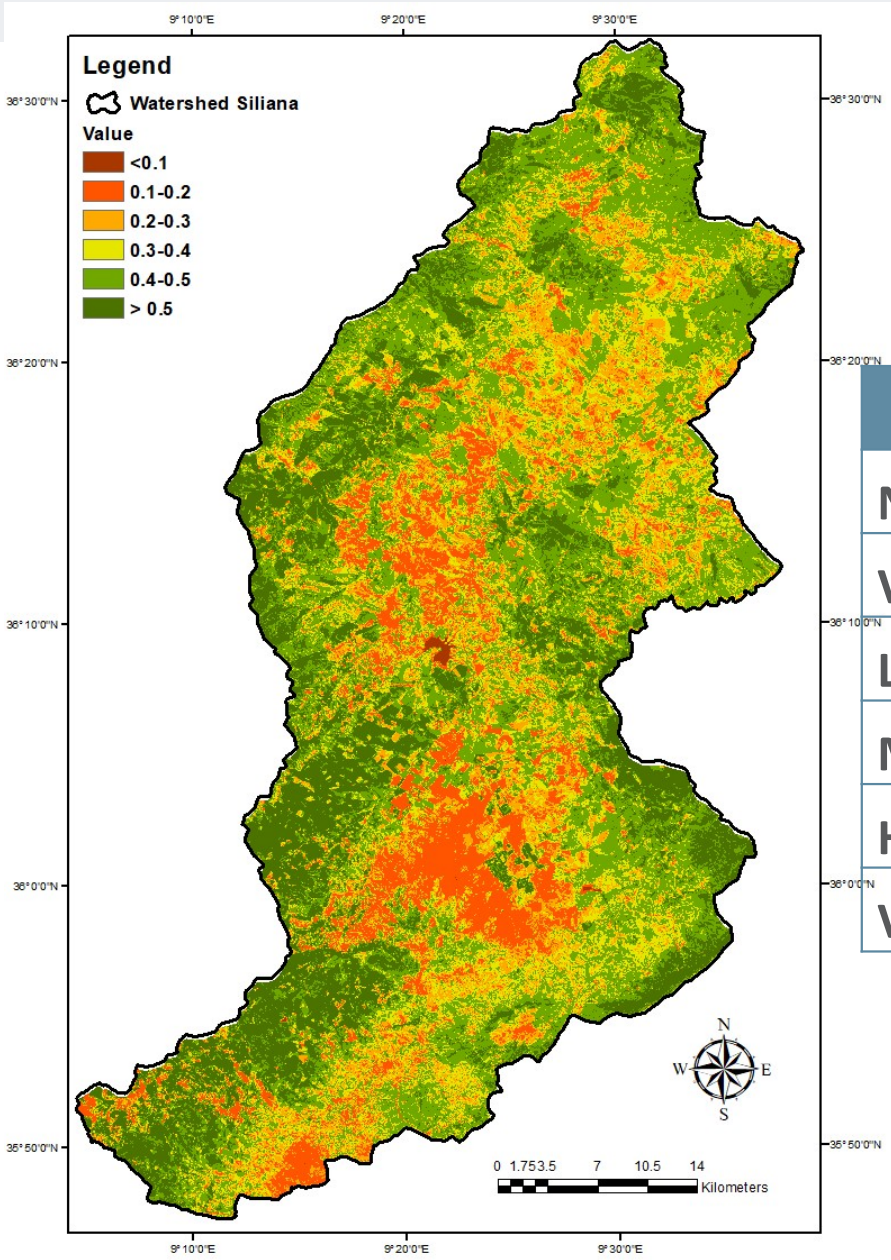
Determination of the average of SWC between the sites

Assessing of the effects of the CRB (**TEST- ANOVA)**

3. Materials and methods

$$NDVI = \frac{(B4-B5)}{(B4+B5)}$$

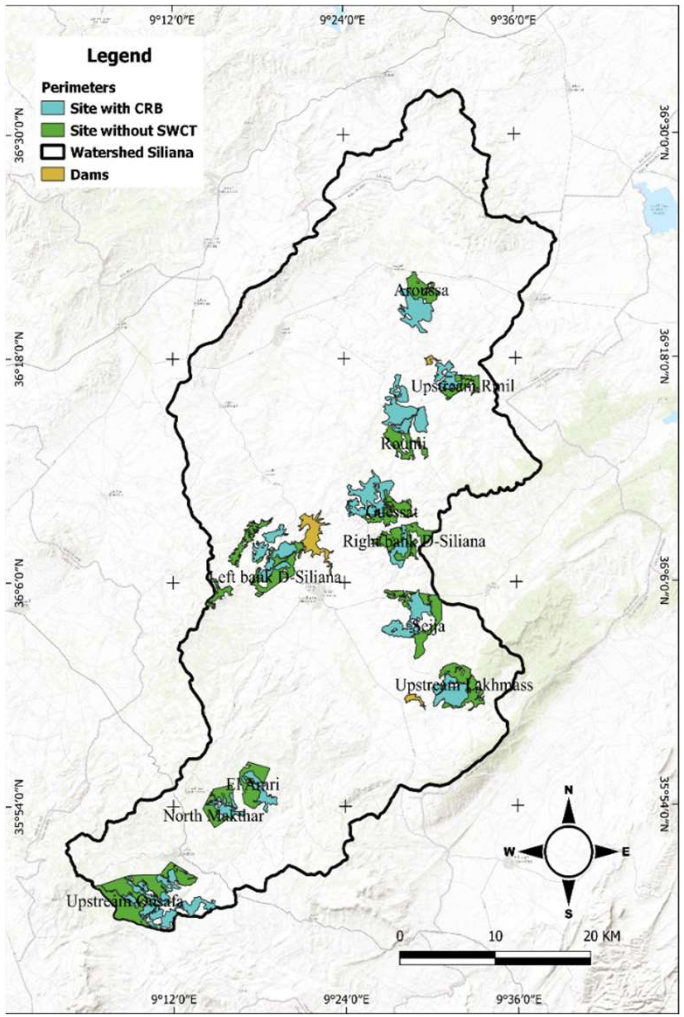
Masked the negatives values



NDVI Classes

Class	Value
Negative	NDVI<0 or NDVI<0.1
Very low	0.1<NDVI<0.2
Low	0.2<NDVI<0.3
Moderate	0.3<NDVI<0.4
High	0.4<NDVI<0.5
Very high	NDVI > = 0.5

4. Results



Investigations within CRB

Site	Area (ha)	
	CRB	Without CRB
Lakhmass	729.1	785.4
Ousafa	1496.2	1985.6
Rmil	425.7	396.1
Aroussa	774.6	518.9
El Amri	400.3	688.8
Guessat	1107.7	607.8
Makthar	346.9	548.0
RB-Siliana	358.7	879.6
LB-Siliana	932.4	1419.9
Roumi	1240.0	545.0
Sejja	806.8	850.3

22 sites were selected with two treatments: one half with CRB and one another without CRB, they are represented respectively on a total area of nearly 8600 ha and 9200 ha, correspond to annual crops.

4. Results

Analysis of the variance of the effect of CRB and study sites on the SWC

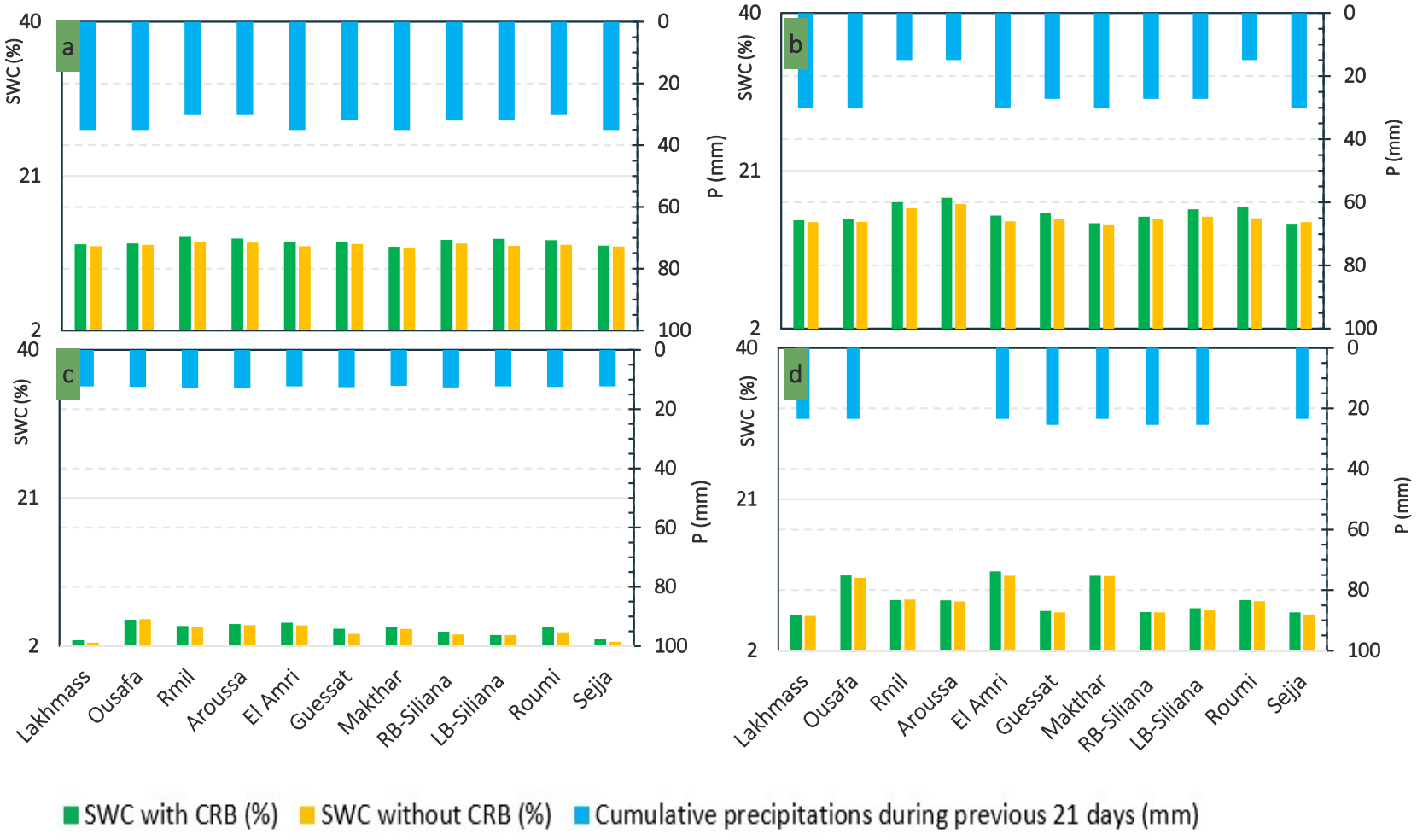
Date	Site with CRB		All Sites	
	F	Prob	F	Prob
04-08-2017	29.869	0.000	5.132	0.008
04-24-2017	17.254	0.002	15.738	0.000
05-03-2017	0.218	0.651	2.768	0.062
06-11-2017	0.417	0.533	5.847	0.005
04-11-2018	133.203	0.000	50.676	0.000
04-27-2018	65.973	0.000	29.053	0.000
05-13-2018	8.027	0.018	61.948	0.000
06-14-2018	4.548	0.059	41.487	0.000

The coefficient of variation (CV) and determination (R^2) of the site effect on SWC.

R^2	CV (%)
0.890	2.9
0.946	5.9
0.736	7.3
0.855	12.9
0.985	8.6
0.973	6.9
0.984	40.5
0.977	13.7

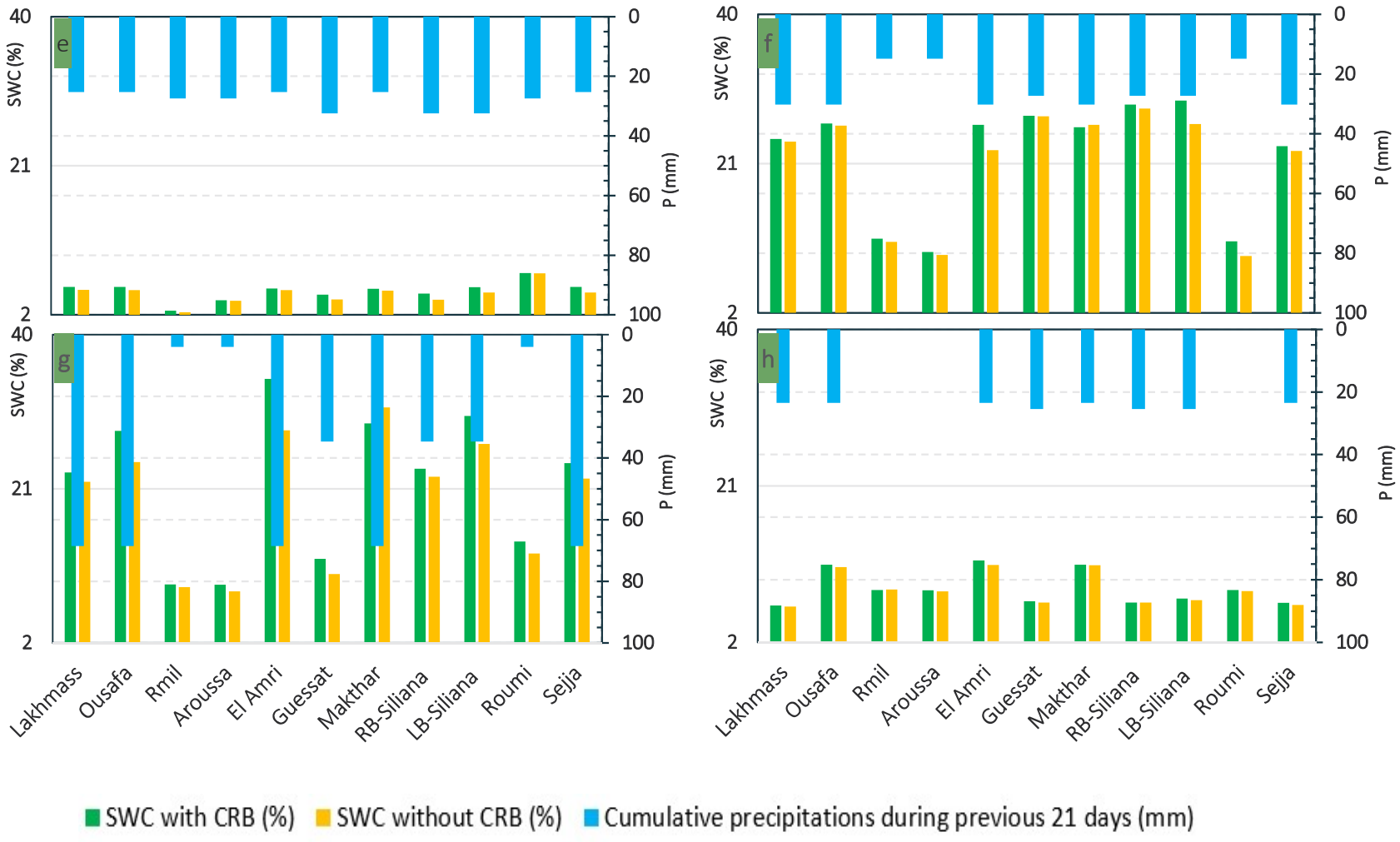
4. Results

SWC in 2017



4. Results

SWC in 2018



5. Discussion

1. Results show that the SWC was explained by the presence of CRB, precipitations, and sites.

2. Since SWC was improved at the end of the growing season of crops, CRB can be considered as a suitable practice to mitigate climate change effects.

3. The beneficial effects of CRB on SWC seems to be affected by site characteristics such as soil class, slope, landuse…

6. Conclusions

This study aimed to quantify the impact of CRB on SWC.

SWCs are significantly affected by the presence of the CRB.

CRB effects on soil moisture depend on site proprieties and antecedent precipitations.

The effects of CRB on runoff, dam's flow, and dam's siltation rates will be considered .



Thank you!

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