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THIRD AFRICA CONGRESS ON CONSERVATION AGRICULTURE
5-8 June 2023 | Rabat, Morocco

Application of electromagnetic induction (EM38) to evaluate compaction of tilled and no-tilled vertisols

Theme:
Building a Resilient Future in Africa
through Conservation Agriculture and Sustainable Mechanization

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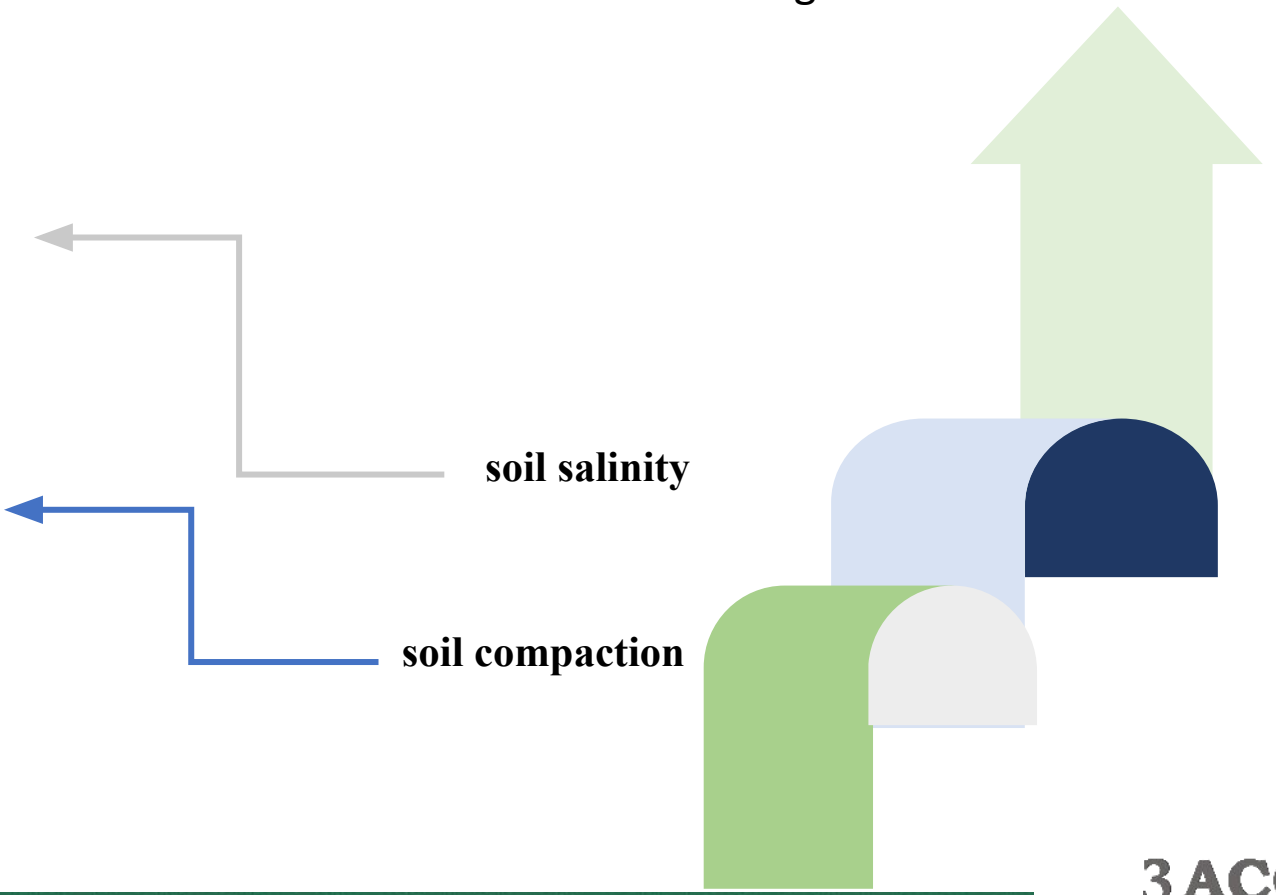
Introduction

Monitoring of its spatio-temporal distribution is essential to ensure integrated crop management and achieve the goal of a sustainable agriculture.

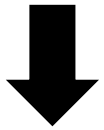
Limiting factors for plant production

Limitation of root system development



Introduction

Direct methods are laborious, time consuming and not highly representative for large-scale studies



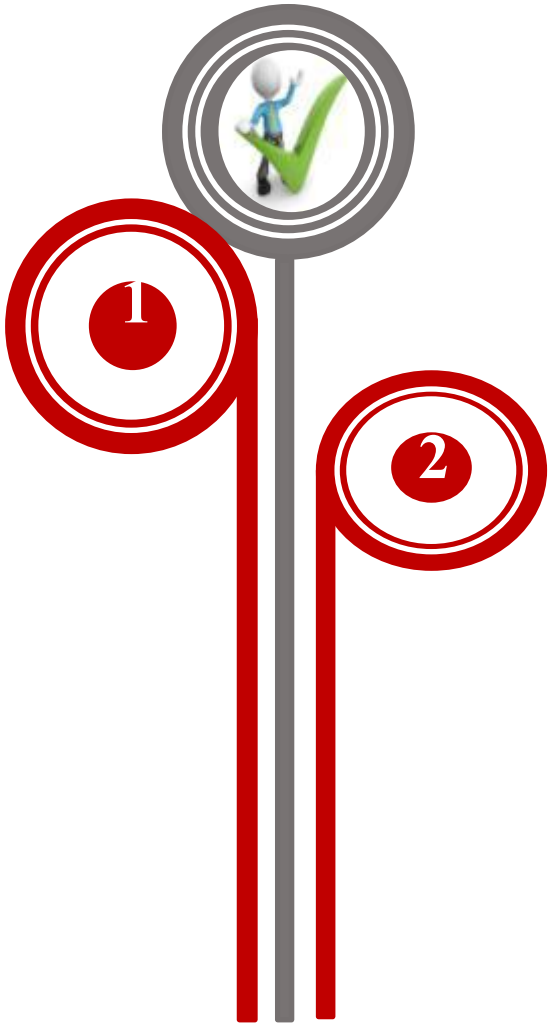
Fast, effective, and non-destructive methods

Electromagnetic induction (EMI)

Measure apparent electrical conductivity to evaluate soil properties

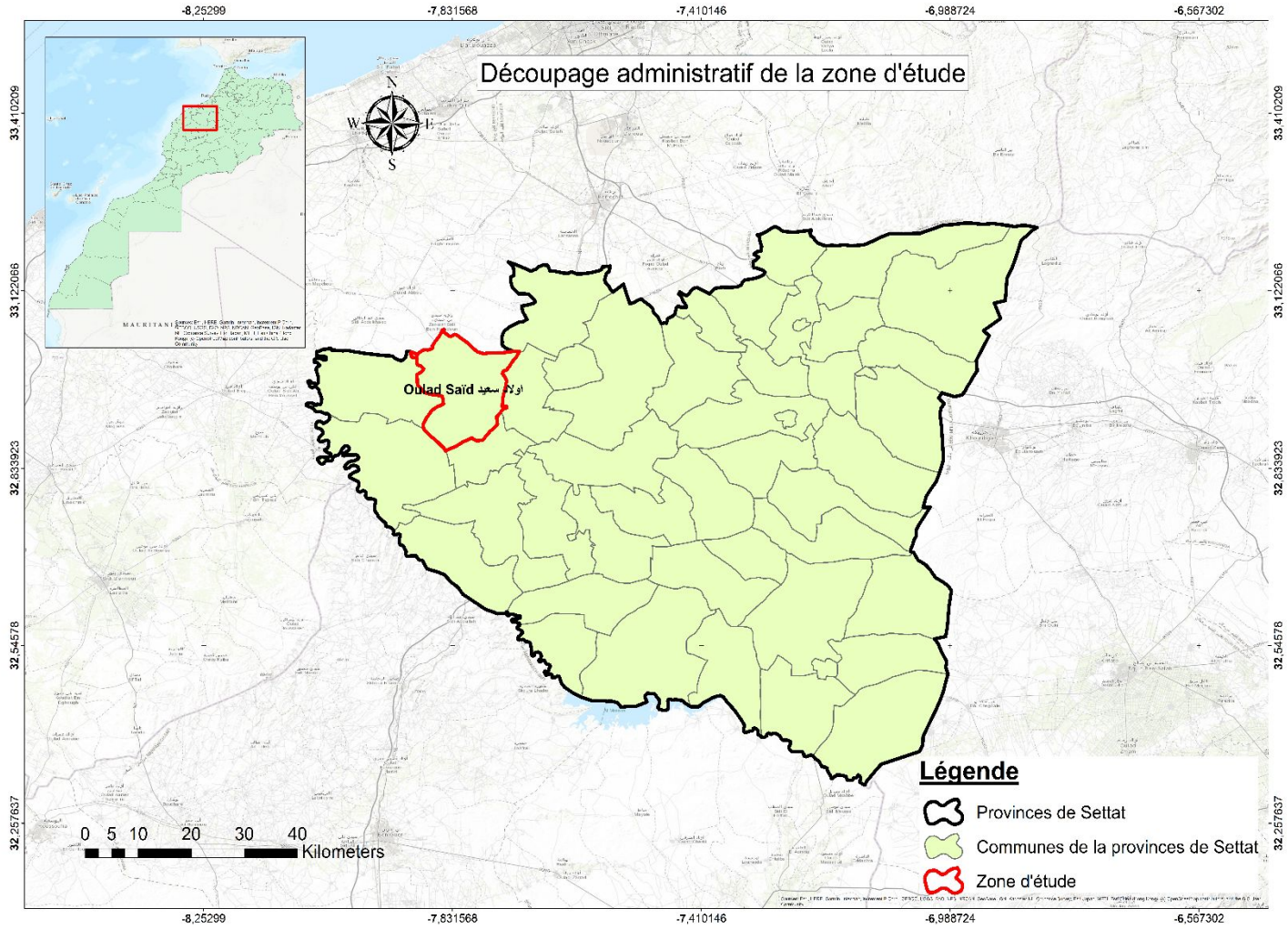
The objective of this paper

The study of the possibility of finding correlations between soil compaction and salinity of a vertisol with ECa using the Geonics EM38 tool based on EMI



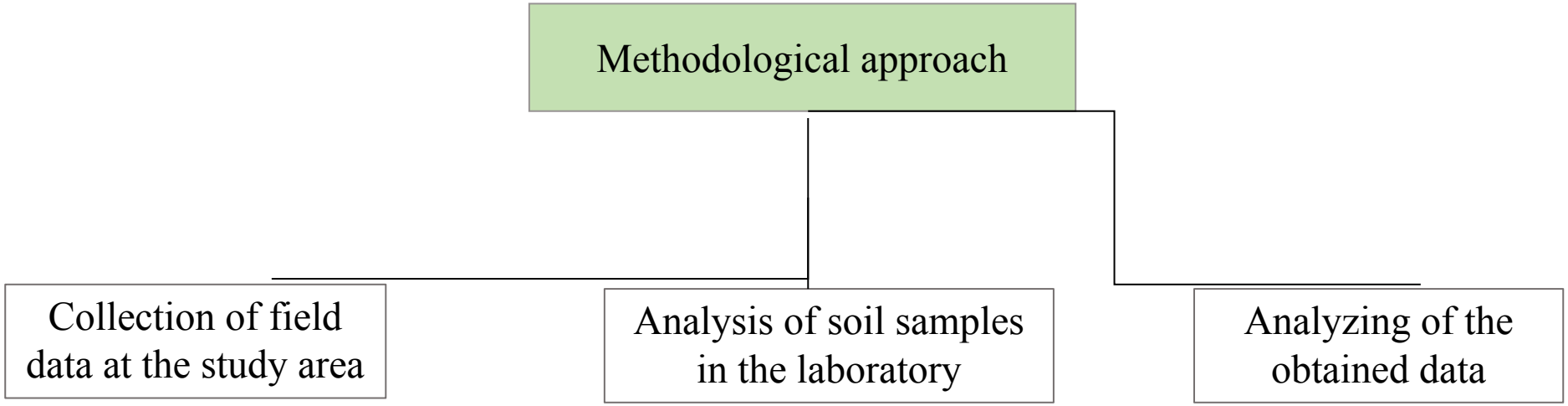
This study highlights the role that this tool can play in characterizing, analyzing and mapping soil related factors using EMI responses in the Chaouia region

Materials and methods



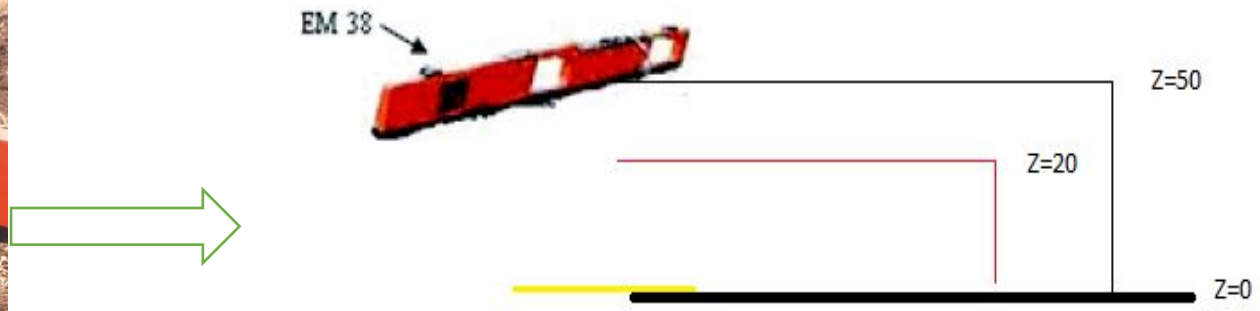
- Oulad Said region of Morocco (X=32580, Y=7490)
- Semi-arid climate

Materials and methods



Collection of field data

ECa measurements

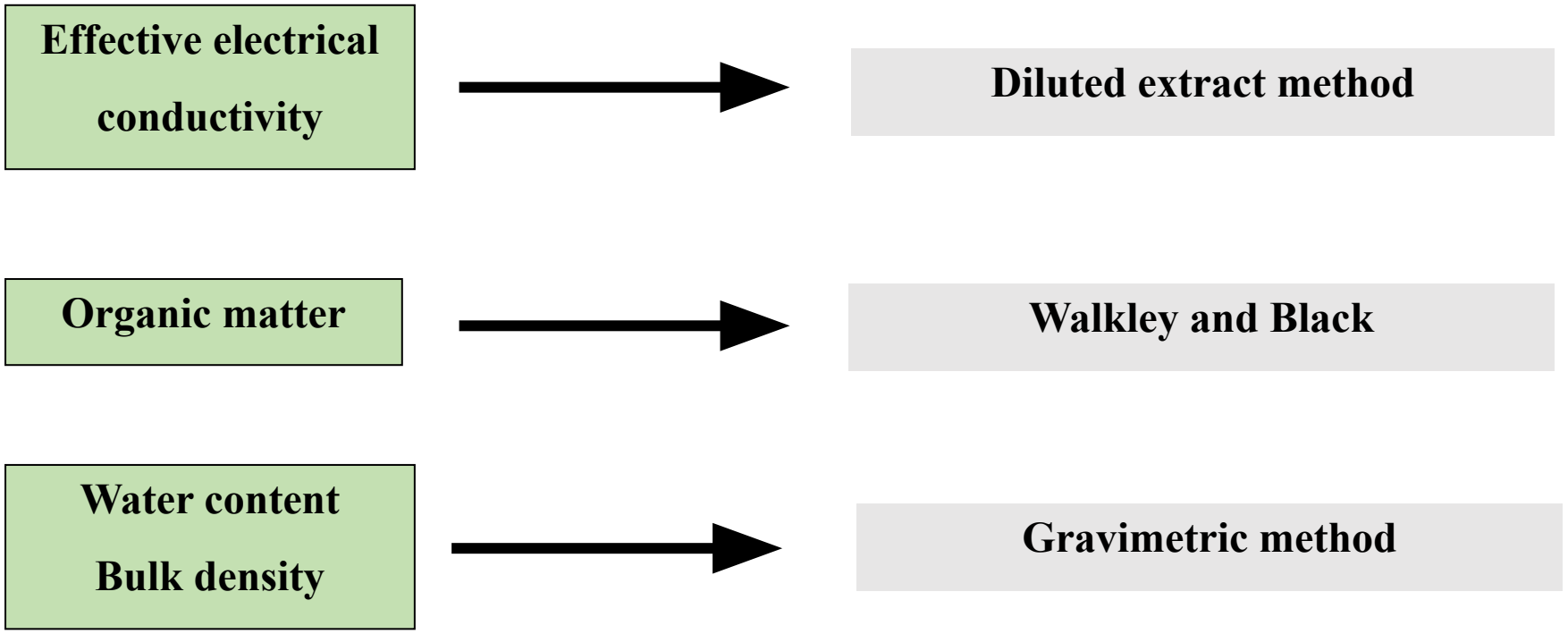


Collection of field data

Soil compaction measurements

Soil sampling

Analysis of soil samples in the laboratory



Data analysis

- We have used several statistical analysis methods to process and analyze our data such as: SPSS software to excute statistical analysis, including descriptive statistics, bivariate correlation matrix to evaluate the relation between variables ECa/ECe and ECa/RP, and multiple linear regression to predict soil salinity by ECa.
- Then, we used ArcMap software to map penetration resistance with the inverse distance weighting (IDW) technique and predicted electrical conductivity using controlled kriging.

Results and discussions

Relation ECe/ECa

To evaluate the reliability of the electromagnetic method using the measurements ECa to assess soil compaction and salinity, we established a correlation matrix between ECe and ECa. A strong correlation between the different measurement modes by EM38 for most levels was observed (R^2=0.78).

Results and discussions

Relation ECa/RP

A correlation matrix was realized to test the ECa-RP correlation in order to assess the dependence between these two variables.

No-till plot

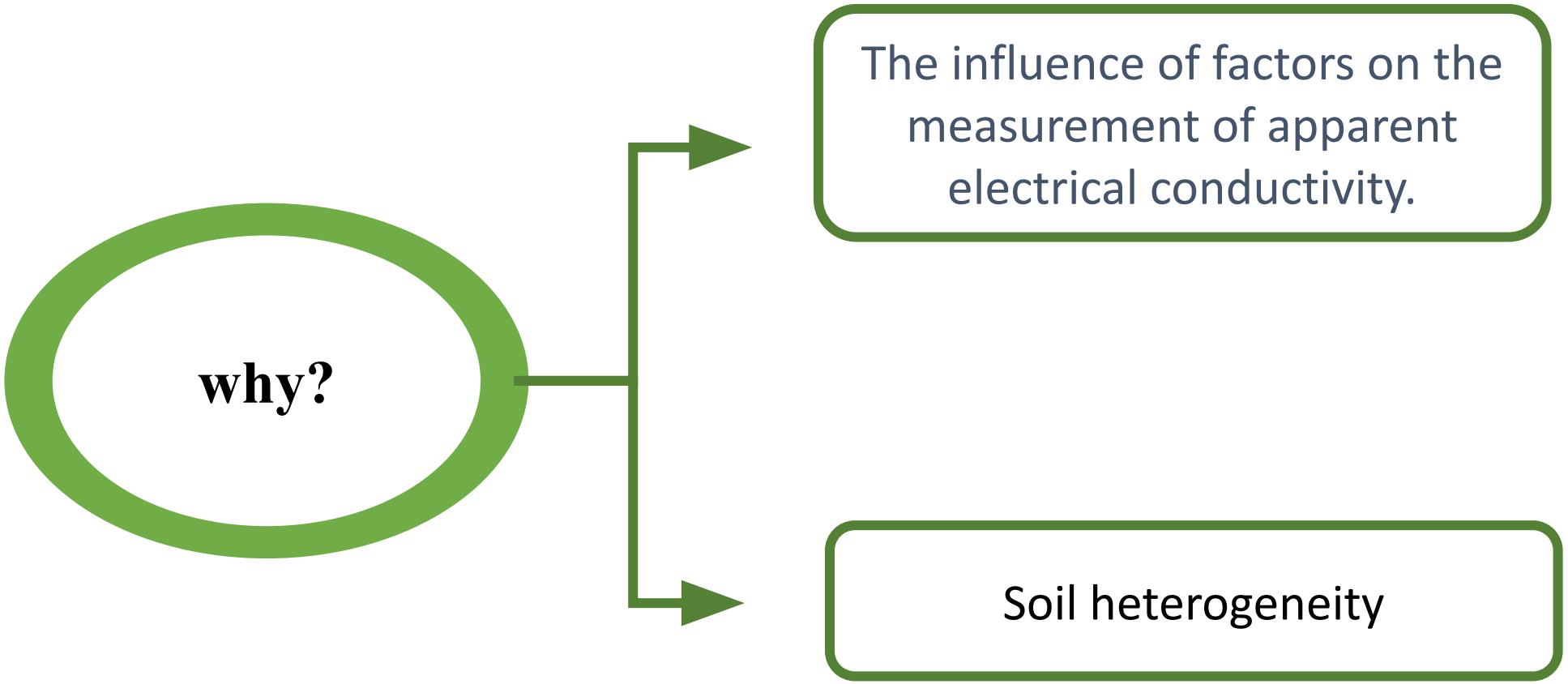
	RPmax (0-10)	RPmax (10-20)	RPmax (20-30)	H.M(0)	V.M(0)	H.M(20)	V.M(20)	H.M(50)	V.M(50)
RPmax (0-10)	1								
RPmax (10-20)	0,47	1							
RPmax (20-30)	0,37	0,74	1						
H.M(0)	-0,34	-0,29	-0,36	1					
V.M(0)	-0,14	0,20	0,14	0,13	1				
[illegible]	-0,17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
V.M(20)	-0,24	0,03	-0,10	0,53	0,87	0,73	1		
H.M(50)	-0,25	-0,02	-0,15	0,67	0,73	0,86	0,93	1	
V.M(50)	-0,23	-0,01	-0,13	0,61	0,81	0,81	0,97	0,96	1

No significant correlation was found

Full-tillage plot

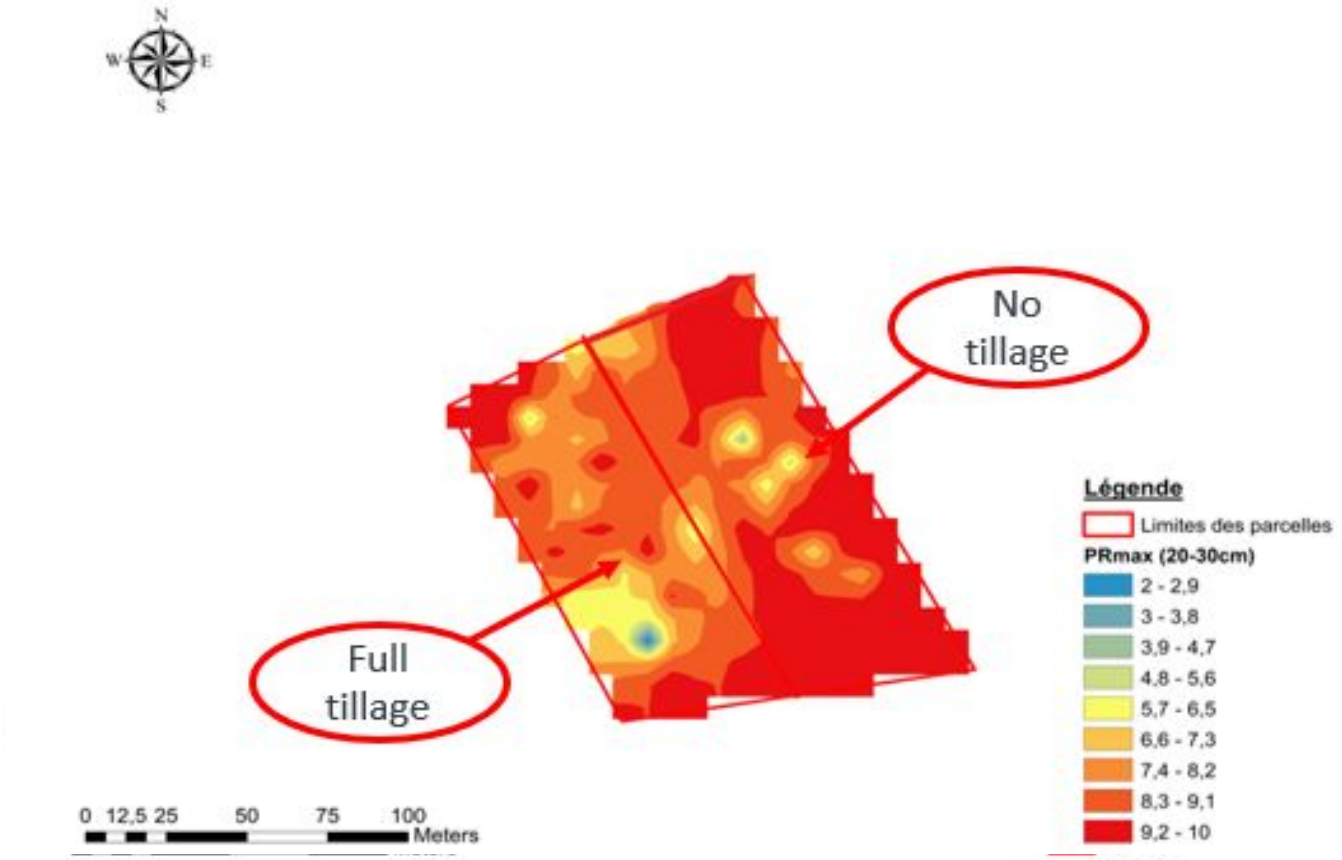
	RPmax (0-10)	RPmax (10-20)	RPmax (20-30)	H.M(0)	V.M(0)	H.M(20)	V.M(20)	H.M(50)	V.M(50)
RPmax (0-10)	1								
RPmax (10-20)	0,46	1							
RPmax (20-30)	0,33	0,75	1						
H.M(0)	-0,26	-0,15	-0,18	1					
V.M(0)	-0,17	-0,17	-0,13	0,69	1				
H.M(20)	-0,26	-0,14	-0,18	0,94	0,81	1			
V.M(20)	-0,27	-0,14	-0,10	0,81	0,92	0,90	1		
H.M(50)	-0,25	-0,12	-0,13	0,84	0,89	0,95	0,95	1	
V.M(50)	-0,26	-0,16	-0,15	0,87	0,92	0,95	0,97	0,99	1

Results and discussions



Results and discussions

Soil compaction degree



Conclusions

- The use of EM38 as a non-destructive tool can potentially be promoted on a large scale for charactering physical and chemical states of soils under both no-tillage and conventional farming systems.
- Soil compaction was present, its correlation with ECa was not significant according to potential influence of soil moisture content on ECa measurement. The optimal soil moisture content should be around 15%.
- Higher levels of compaction were not only observed in the subsoil layer but also in the plot under no-tillage farming system. Correction of the soil compaction can be achieved by implementing appropriate soil management techniques.

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