Precision agriculture suitability to improve vineyard terroir management

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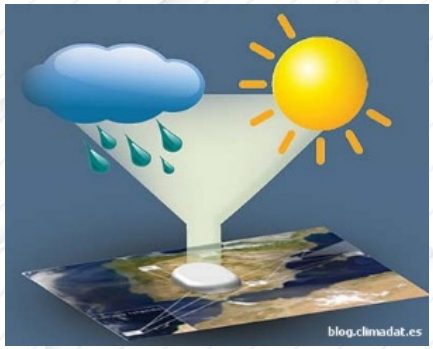
1. Terroir



apparent Electrical Conductivity (ECa)

Normalized Difference Vegetation Index (NDVI)

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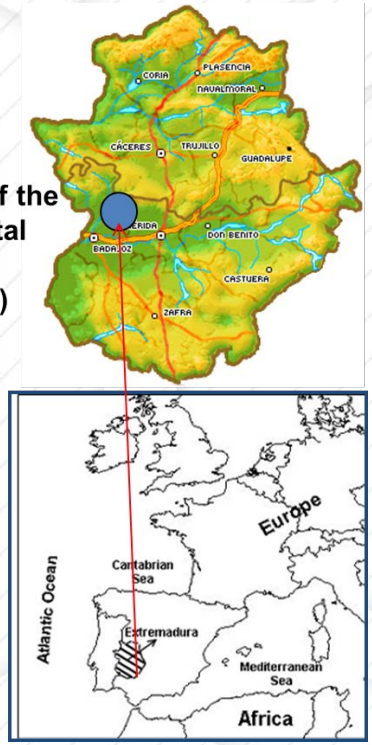
2. Material and methods

2.1. Study area and experimental design

Location of the experimental field (blue point)



Agrarian Research Institute “La Orden - Valdesequera”, in Extremadura (Spain)

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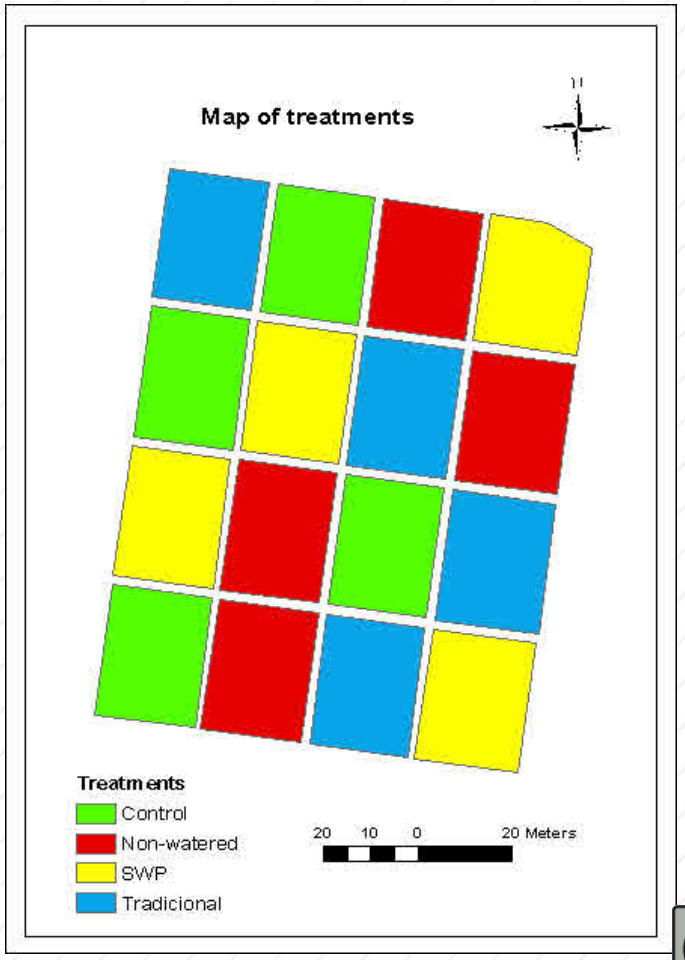
2. Material and methods

2.1. Study area and experimental design

- **Tempranillo**
  - **1,80 has.**
  - **1,20 m. x 2,50 m.**
- **Lisímeter**
- **216 vines in 12 lines of 18 plants by plot**
- **Treatments:**
  - **Control**: Irrigation for 100% ETc, during all season.
  - **Non-watered:** No irrigation.
  - **SWP:** Applying 75% of ETc in pre-veraison and maintain a stem water potential value of -1.1 MPa by CropSyst model simulation in post-veraison.
  - **Traditional:** Applying 75% of in pre-veraison and 25% of ETc in post-veraison



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2. Material and methods

2.2. Determination of vegetation index.

- ATV
- GPS – RTK
- Sensor:
  - Ag Leader ACS – 430
  - Cenital Position

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2. Material and methods

2.3. Determination of apparent electric conductivity.

VERIS 3150 Surveyor (CEa + pH)

VERIS Tecnologies, Inc.

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2. Material and methods

2.4. Data processing.

- Tools of ArcGIS v.10.1 software (ESRI, USA) used:
  - Ordinary kriging process "Geostatistical Analisys"
  - Principal component analysis (PCA).
  - Zonal Statistics as Table.
  - Identity.
  - Dissolve.
  - Geographycally Weighted Regression.

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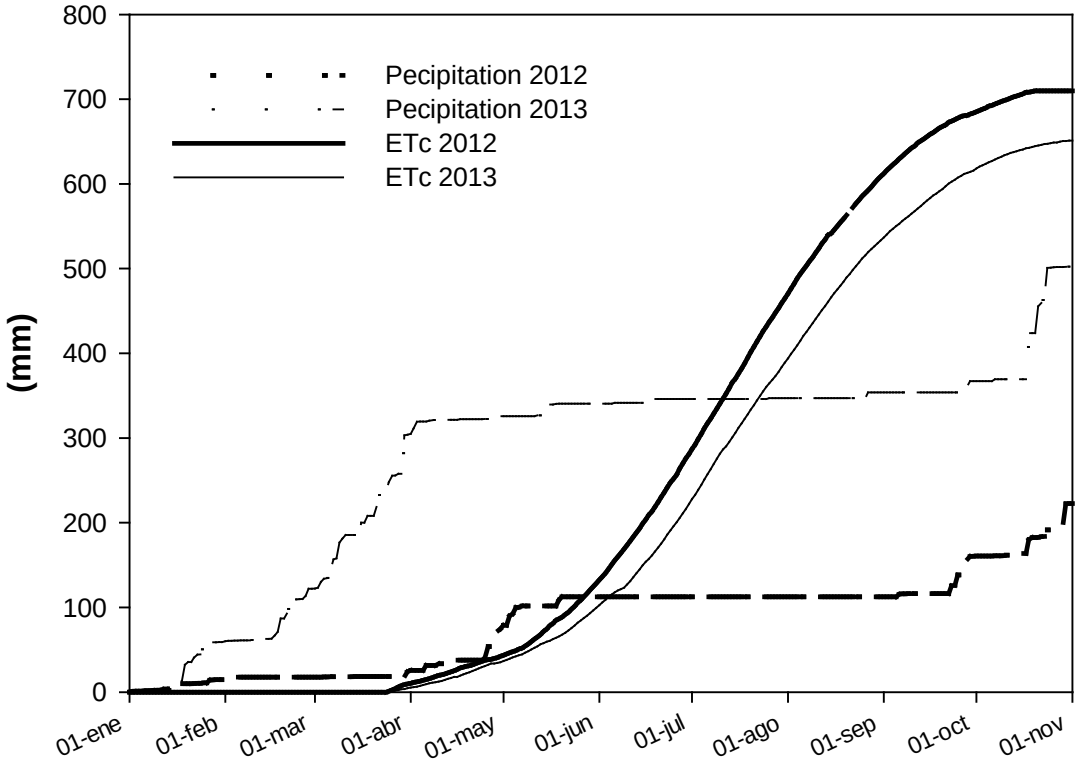
3. Results and discussion



Accumulation curve of rainfall and ETc in the 2012 and 2013 growing season

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3. Results and discussion

Descriptive statistics of shallow (0-30 cm) an deep (0-80 cm) soil apparent electrical conductivity data, ECa (mSxm-1), for sampling carried out on Feb 18, 2011.

	Mean	Median	SD	Max	Min	Skewness	Kurtosis	CV (%)
ECs	5.51	5.40	1.02	12.5	0.4	0.52	5.38	18.51
ECd	9.37	9.50	1.64	21.3	0.5	-0.34	5.88	17.50

SD = Standard Deviation, CV = Coefficient of variation

Descriptive statistics of NDVI, for different years.

Dates	Mean	Median	SD	Max	Min	Skewness	Kurtosis	CV (%)
May 29, 2012	0.61	0.62	0.11	0.81	0.20	-0.92	4.16	18.03
July 6, 2012	0.70	0.73	0.11	0.86	0.21	-1.52	5.55	15.71
July 24, 2012	0.71	0.75	0.11	0.86	0.21	-1.78	6.46	15.49
Aug. 24, 2012	0.69	0.72	0.11	0.85	0.21	-1.46	5.59	15.94
Sept. 6, 2012	0.66	0.68	0.09	0.82	0.24	-1.41	5.65	13.64
May 30, 2013	0.67	0.69	0.10	0.85	0.20	-1.25	5.31	14.93
July 8, 2013	0.77	0.79	0.09	0.87	0.24	-2.08	8.85	11.89
July 22, 2013	0.73	0.76	0.09	0.86	0.26	-1.92	7.63	12.33
Aug. 12, 2013	0.73	0.76	0.09	0.85	0.20	-2.14	9.23	12.33
Sept. 2, 2013	0.74	0.75	0.07	0.85	0.21	-2.52	13.32	9.46

SD = Standard Deviation, CV = Coefficient of variation.

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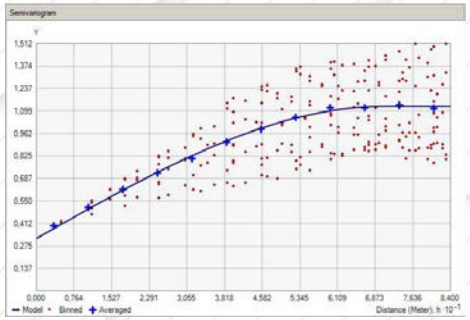
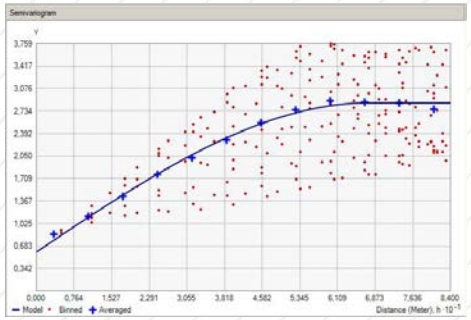
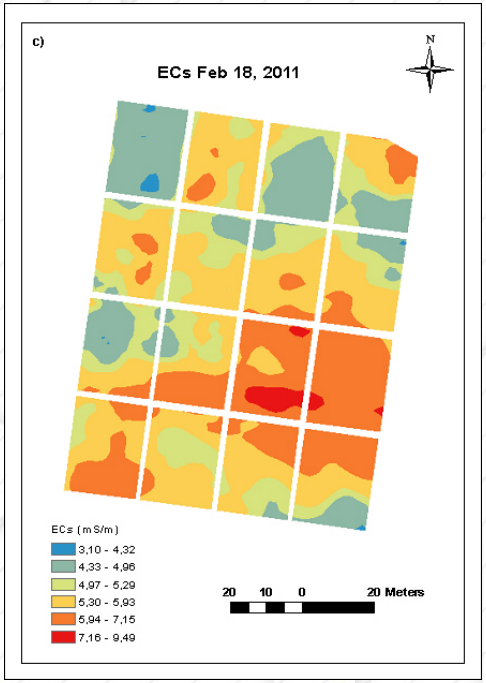
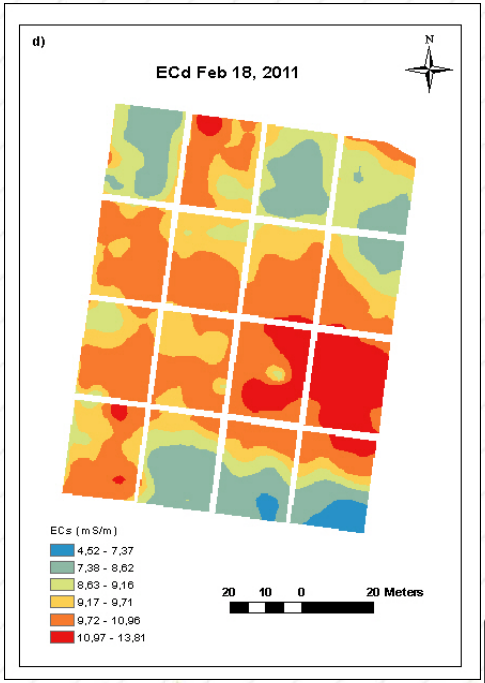
3. Results and discussion









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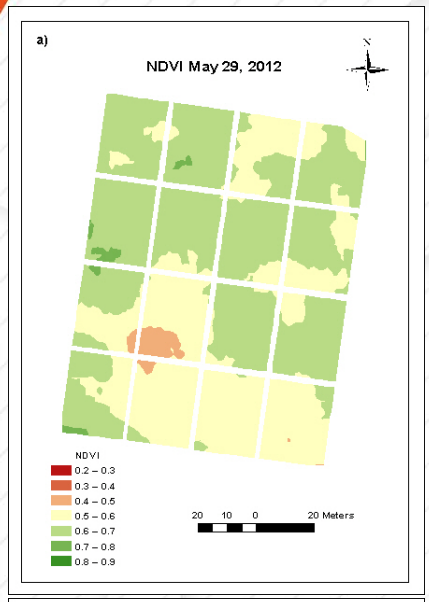
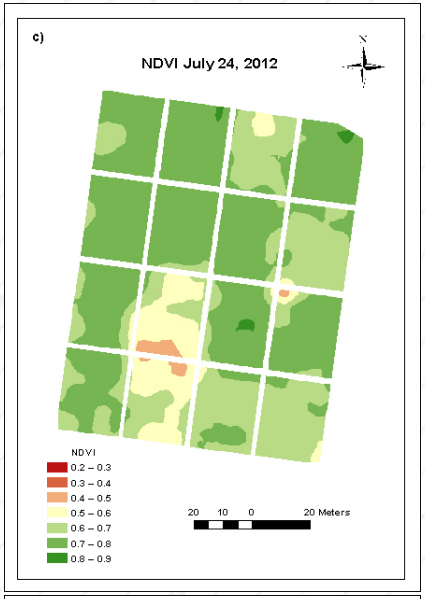
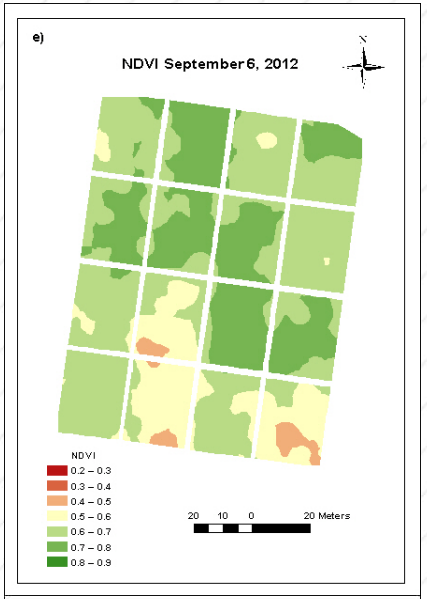
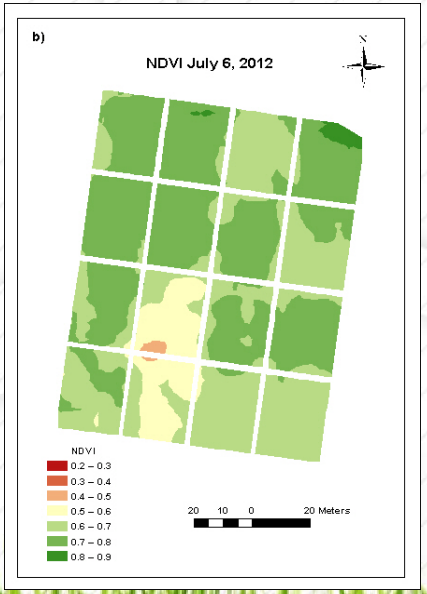
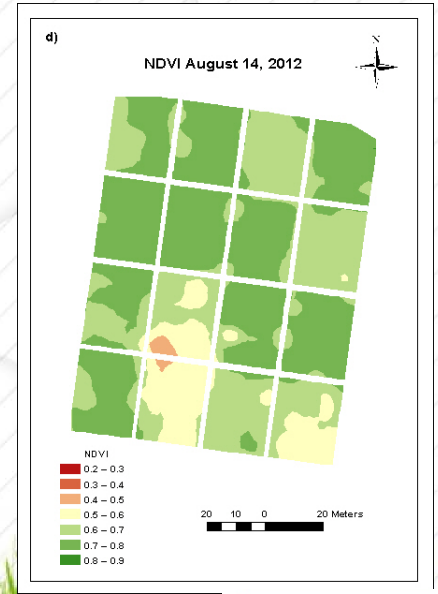
3. Results and discussion

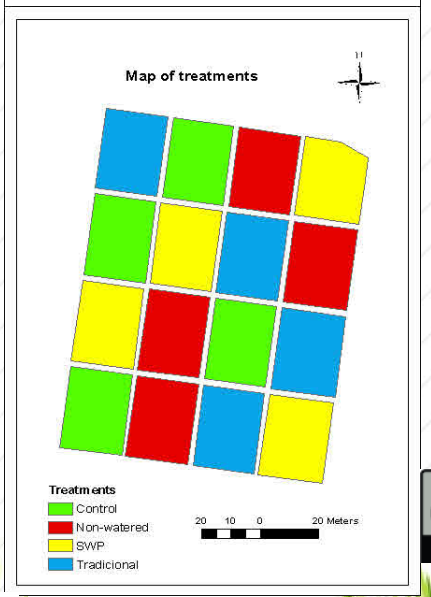












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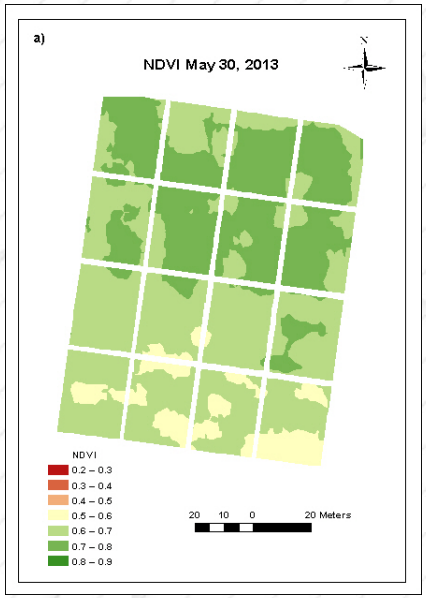
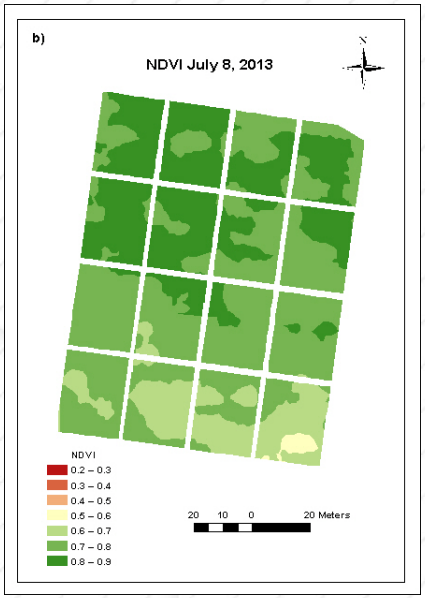
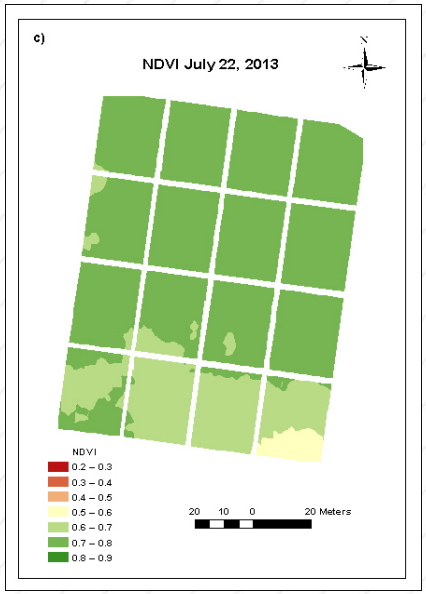
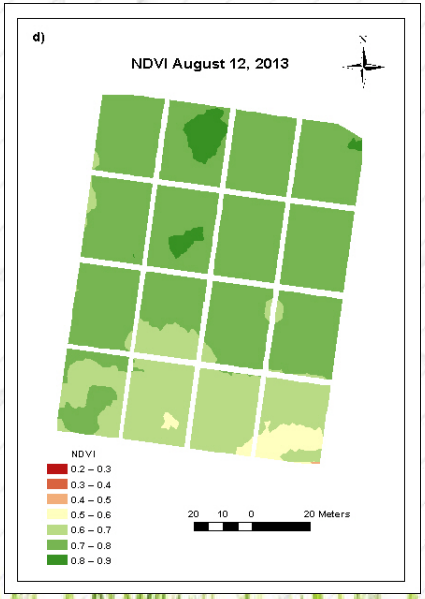
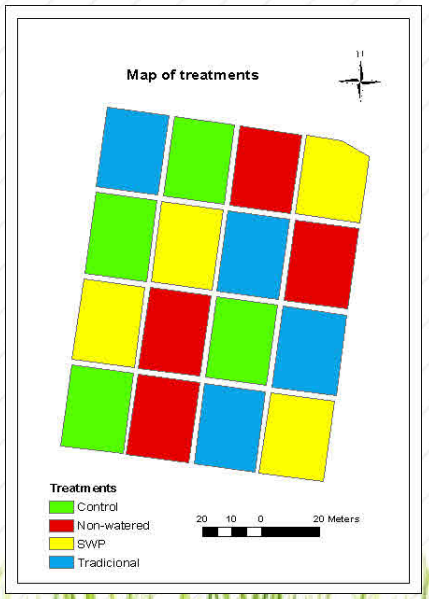
3. Results and discussion











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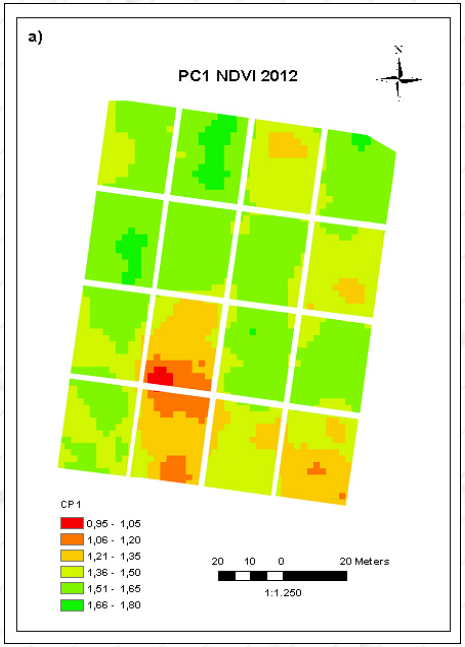
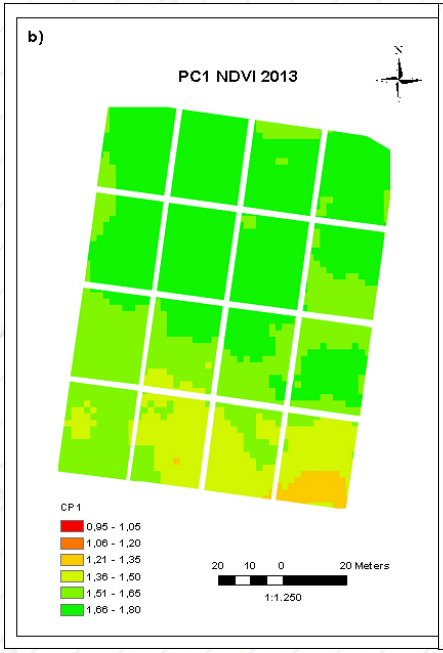
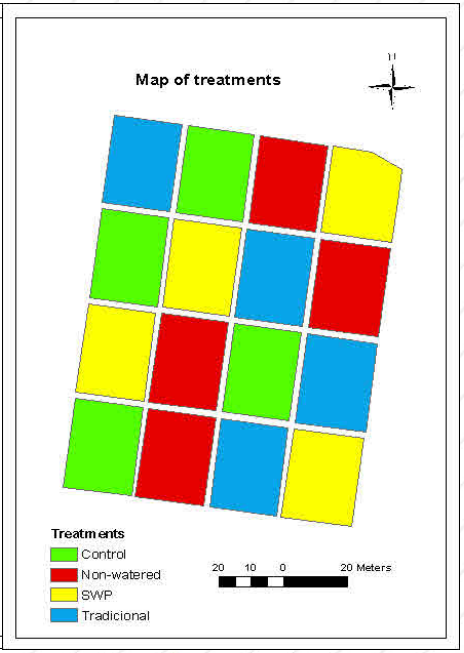
3. Results and discussion

Correlation matrix among NDVI maps for different dates Year 2012.					
	29-May	6-Jul	24-Jul	24-Aug	6-Sep
29-May	1				
6-Jul	0.50	1			
24-Jul	0.52	0.79	1		
24-Aug	0.65	0.81	0.82	1	
6-Sep	0.58	0.78	0.77	0.88	1

Correlation matrix among NDVI maps for different dates Year 2013.					
	29-May	6-Jul	24-Jul	24-Aug	6-Sep
30-May	1				
8-Jul	0.83	1			
22-Jul	0.83	0.79	1		
12-Aug	0.79	0.79	0.83	1	
2-Sep	0.84	0.85	0.85	0.81	1







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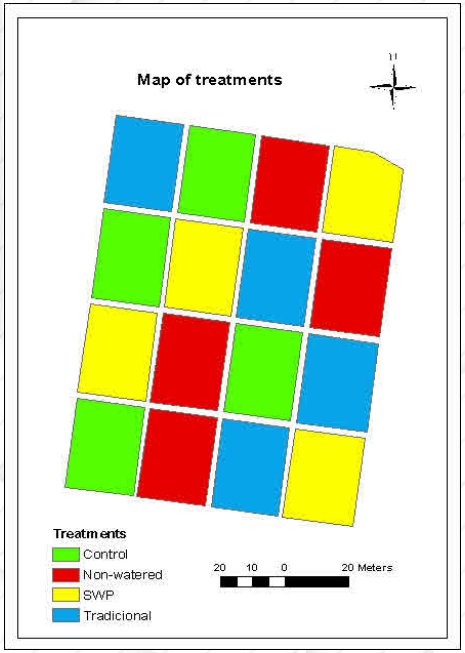
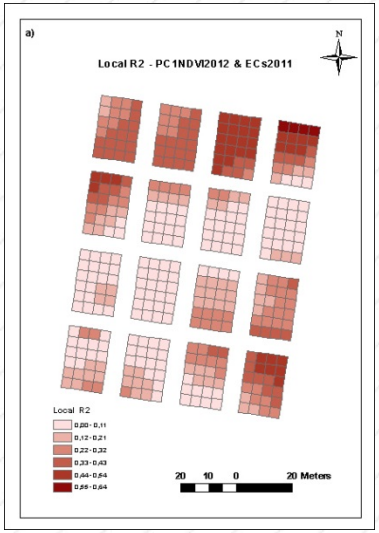
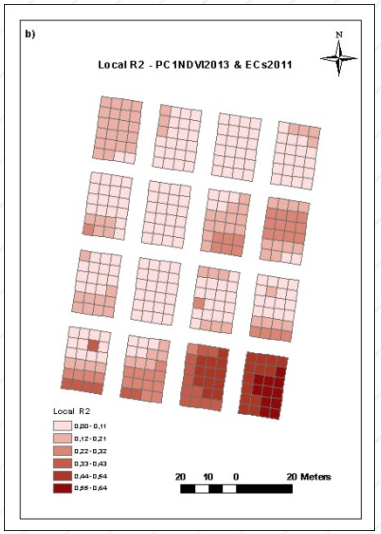
3. Results and discussion

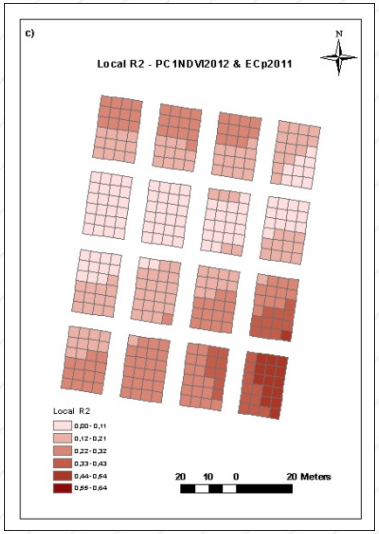
Correlation matrix between CP1 years 2012 and 2013 and ECs an ECd Year 2011.

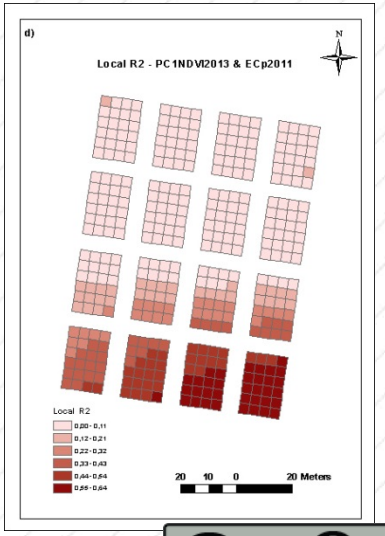
	PC1 NDVI 2012	PC1 NDVI 2013	ECs2011	ECd2011
PC1 NDVI 2012	1.00			
PC1 NDVI 2013	0.58	1.00		
ECs 2011	0.18	0.16	1.00	
ECd 2011	0.59	0.70	0.83	1.00











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4. Conclusions

- **Sampling of NDVI performed with multiespectral proximal sensors is a useful tool to manage a vineyard vegetative terroir and is capable of being used directly by farmers at low cost.**

- **ECa measured by electrical contact methods can be very useful in determining the soil spatial variability and the relationship of soil characteristics to vines vegetative growth and to irrigation management.**

- **The cumulative rainfall before season significantly influences the season plant vegetative behavior and may also influence the irrigation water plant relative response.**

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5. Acknowledgements

- This work was carried out with funding the RITECA Project, Transboundary Research Network Extremadura, Center and Alentejo, co-financed by the European Regional Development Fund (ERDF) by the Spain-Portugal Border Cooperation Operational Programme (POCTEP) 2007-2013.
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