

CRA
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CIHEAM
MEDITERRANEA

AN APPROACH FOR DELINEATING HOMOGENEOUS ZONES BY USING PROXIMAL AND REMOTE SENSING

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Proximal Soil Sensing

SPATIAL VARIABILITY

FIELD

→

Growth
Yield
Quality

PRECISION FARMING COST-EFFECTIVE APPROACH

MANAGEMENT ZONES (MZ): homogeneous subfield regions with similar attributes affecting yield (Doerge, 1999)

REMOTE & PROXIMAL SENSING

- WorldView2
- Field Spec
- Ground Penetrating Radar
- DGPS
- Electromagnetic Induction

FOCUS ON JOINT ANALYSIS

Statistics & Geostatistics

STUDY AREA

- 1 ha (300m x 30m) located in Capitanata plain in Southern Italy
- The climate is "accentuated thermo-Mediterranean" with minimum temperatures below 0 °C in winter and maximum temperatures above 40 °C in summer.
- The soil is silty

The field was split in two blocks (150 x 30m)

Deficit irrigation (DE)

Optimal irrigation (OP)

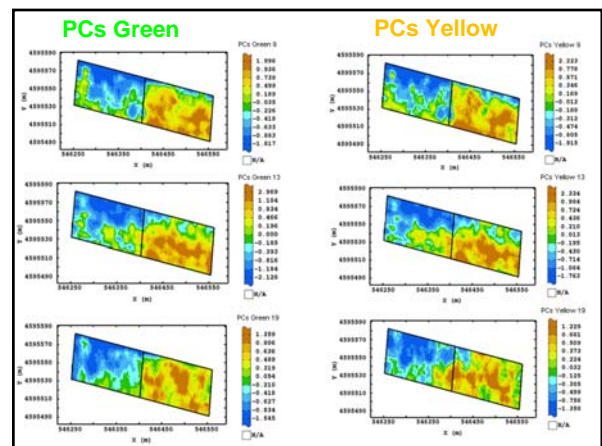
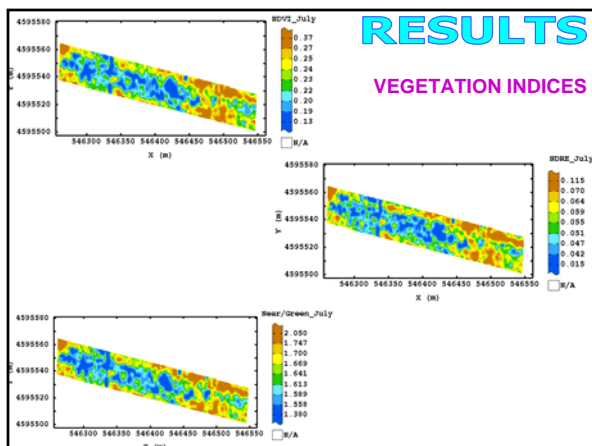
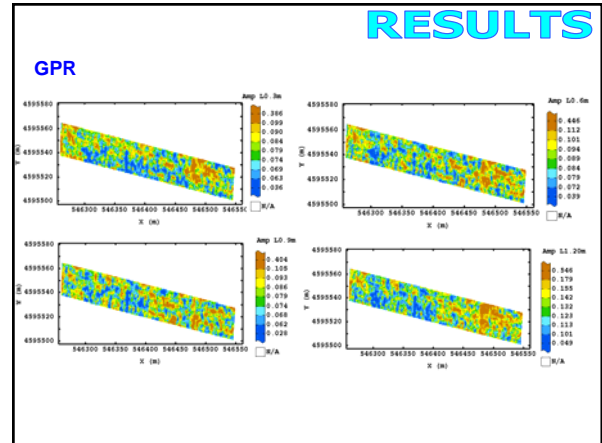
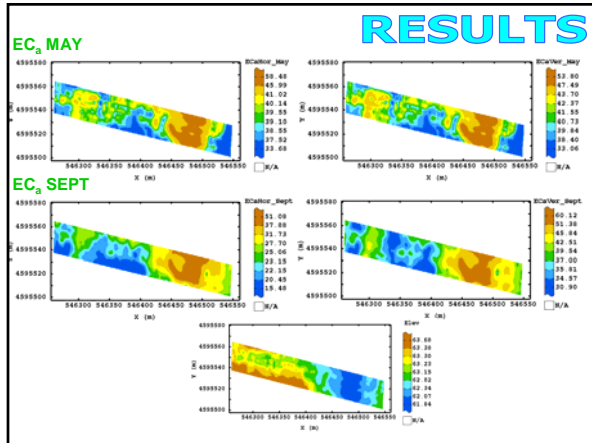
SURVEYING PROTOCOL AND DATA PROCESSING

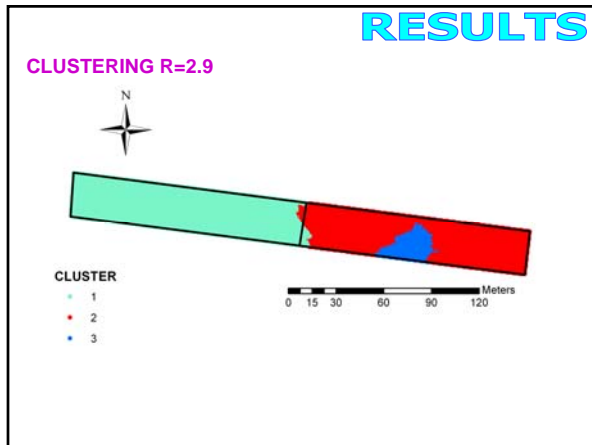
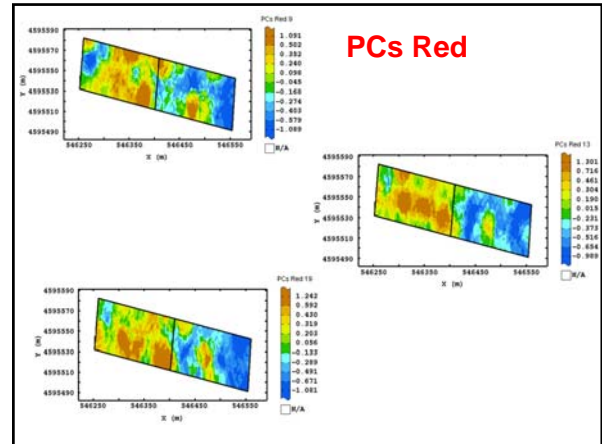
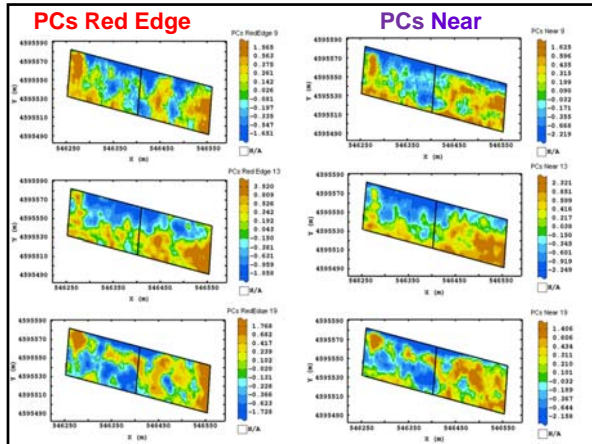
Sensor	Time	Crop	Measured or calculated variables	Statistical or geostatistical analysis
EM38DD Both polarization	✓ May 12 th 2010 ✓ September 20 th 2010	Rare soil after cabbage harvesting Rare soil after tomato harvesting	Bulk electrical conductivity (EC _e mS/m)	Gaussian anamorphosis + cokriging Gaussian anamorphosis + cokriging
GPR Frequency 600MHz	✓ September 24 th 2010	Rare soil after tomato harvesting	Signal Amplitude (Volt)	Gaussian anamorphosis Block kriging
WorldView2 8 bands: coastal, blue, yellow, red, red edge band and two near infrared	✓ July 2010	Tomato before water treatment differentiation	Vegetation index: $NDVI = \frac{R_{NIR} - R_{red}}{R_{NIR} + R_{red}}$ $NDRE = \frac{R_{NIR} - R_{rededge}}{R_{NIR} + R_{rededge}}$	Variogram modelling + kriging
Fieldspec (400-1000nm) 5 bands: Green (510-580 nm) Yellow (580-630 nm) Red (630-690 nm) Red-Edge (705-770 nm) NIR (770-1000 nm)	✓ August 9 th 2010 ✓ August 13 th 2010 ✓ August 19 th 2010	Tomato during water treatment differentiation	Reflectance	PCA Anisotropic LMC + cokriging of PC ₁ in Green, Yellow, Rededge and NIR band per each data Isotropic variogram + kriging in Red band

NON PARAMETRIC DENSITY ESTIMATION (Silverman, 1986; Scott, 1992)

DEFINITION

CLUSTER = LOCAL MAXIMUM OF PROBABILITY DENSITY FUNCTION





Variables	Cluster 1		Cluster 2		Cluster 3	
	Medie	Dev std	Medie	Dev std	Medie	Dev std
EcaHor May	36.106	1.198	41.106	4.157	47.708	1.654
EcaVer May	41.026	1.913	42.502	4.765	49.755	2.131
EcaHor Sept	71.991	2.522	31.909	5.858	39.512	4.343
EcaVer Sept	35.331	2.352	49.856	5.241	55.250	3.067
Elevation	61.114	0.124	62.488	0.385	62.311	0.119
GPR L0.30m	0.060	0.018	0.081	0.017	0.089	0.022
GPR L0.60m	0.068	0.019	0.094	0.020	0.105	0.023
GPR L0.90m	0.171	0.020	0.096	0.021	0.091	0.023
GPR L1.20m	0.131	0.031	0.148	0.037	0.169	0.041
GPR L1.50m	0.118	0.026	0.134	0.034	0.160	0.040
GPR L1.80m	0.307	0.022	0.112	0.028	0.130	0.034
GPR L2.10m	0.217	0.015	0.081	0.018	0.194	0.022
GPR L2.40m	0.296	0.012	0.072	0.015	0.079	0.017
GPR L2.70m	0.061	0.012	0.069	0.014	0.075	0.014
GPR L3m	0.060	0.010	0.067	0.013	0.071	0.011
NDRE	0.060	0.011	0.059	0.013	0.064	0.010
NDVI	0.321	0.031	0.242	0.036	0.261	0.038
NearGreen	1.021	0.078	1.674	0.084	1.688	0.077
PCs Green 9Aug	-0.377	0.296	0.759	0.312	0.468	0.173
PCs Green 13Aug	-0.318	0.494	0.831	0.433	1.047	0.234
PCs Green 19Aug	-0.489	0.322	0.544	0.298	0.538	0.203
PCs Near 9Aug	-0.016	0.536	0.331	0.283	0.068	0.171
PCs Near 13Aug	-0.117	0.382	0.508	0.458	0.329	0.162
PCs Near 19Aug	-0.248	0.370	0.307	0.291	0.145	0.324
PCs Red 9Aug	0.198	0.269	0.268	0.269	0.333	0.301
PCs Red 13Aug	0.553	0.314	0.666	0.265	0.108	0.242
PCs Red 19Aug	0.407	0.295	0.401	0.329	0.254	0.326
PCs RedEdge 9Aug	0.032	0.332	0.200	0.336	0.221	0.221
PCs RedEdge 13Aug	0.017	0.403	0.410	0.552	0.190	0.305
PCs RedEdge 19Aug	-0.288	0.362	0.211	0.317	-0.114	0.258
PCs Yellow 13Aug	-0.101	0.504	0.696	0.448	1.050	0.308
PCs Yellow 19Aug	-0.236	0.460	0.520	0.292	0.421	0.324
PCs Yellow 9Aug	-0.251	0.241	0.697	0.318	0.314	0.187

