5TH WORLD WATER FORUM, ISTAMBUL
SIDE EVENT
THE ROLE OF THE GROUNDWATER SILENT REVOLUTION:
"MORE CASH AND NATURE PER DROP
Re-thinking global water scarcity and security.

The role of Earth Observation and participatory GIS in groundwater management and monitoring

Alfonso Calera, Anna Osann
Regional Development Institute, Remote Sensing and GIS
University of Castilla La Mancha, Spain

UNIVERSIDAD DE CASTILLA-LA MANCHA

BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM ISTANBUL 2009

Water management in irrigated agriculture
faces a lot of multiple challenges and pressures

which increasing when groundwater is the water source

traditional management is not adequate in large areas

Remote Sensing,
Geographical Information System
Information Communication Technologies

<u>can provide new perspectives for monitoring irrigated areas</u>

Mapping Irrigated Crops
e-Space Irrigation Advisory Services
Irrigation Water Requirement

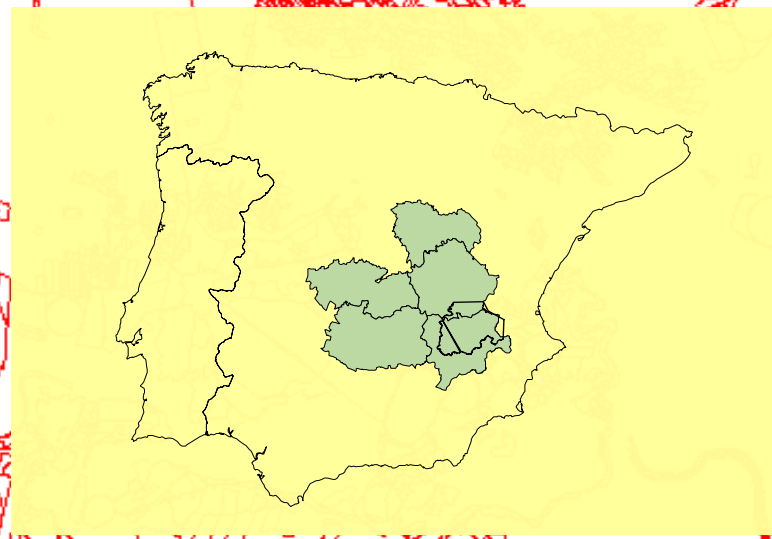
To enhance **cooperation** processes between stakeholders through Participation and Transparency

BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL 2009

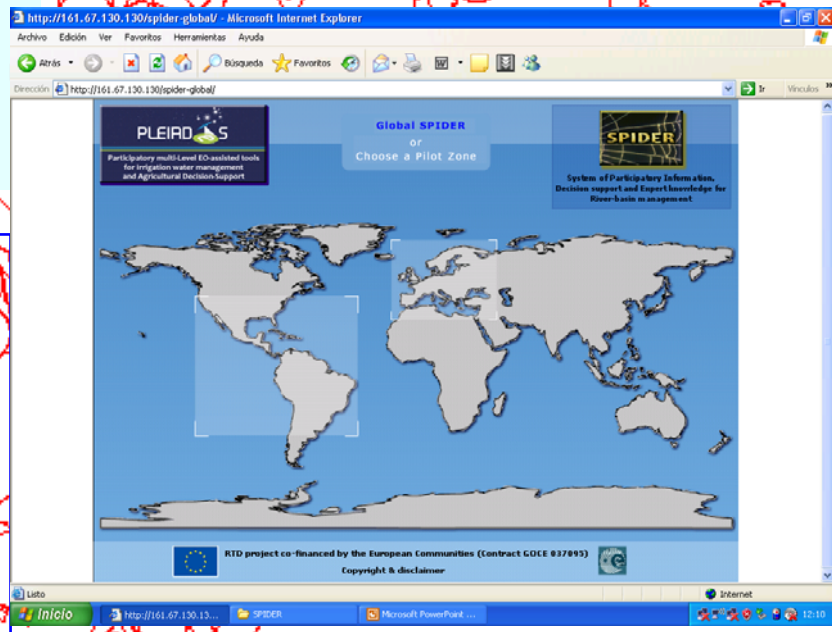
Operational application
in La Mancha Oriental aquifer,
Jucar river basin, SPAIN

100,000 ha of irrigated surface
from groundwater
2,500 Water Management Unit
12,000 farmers
275,000 inhabitants
1,000,000 ha

threatened by overexploitation

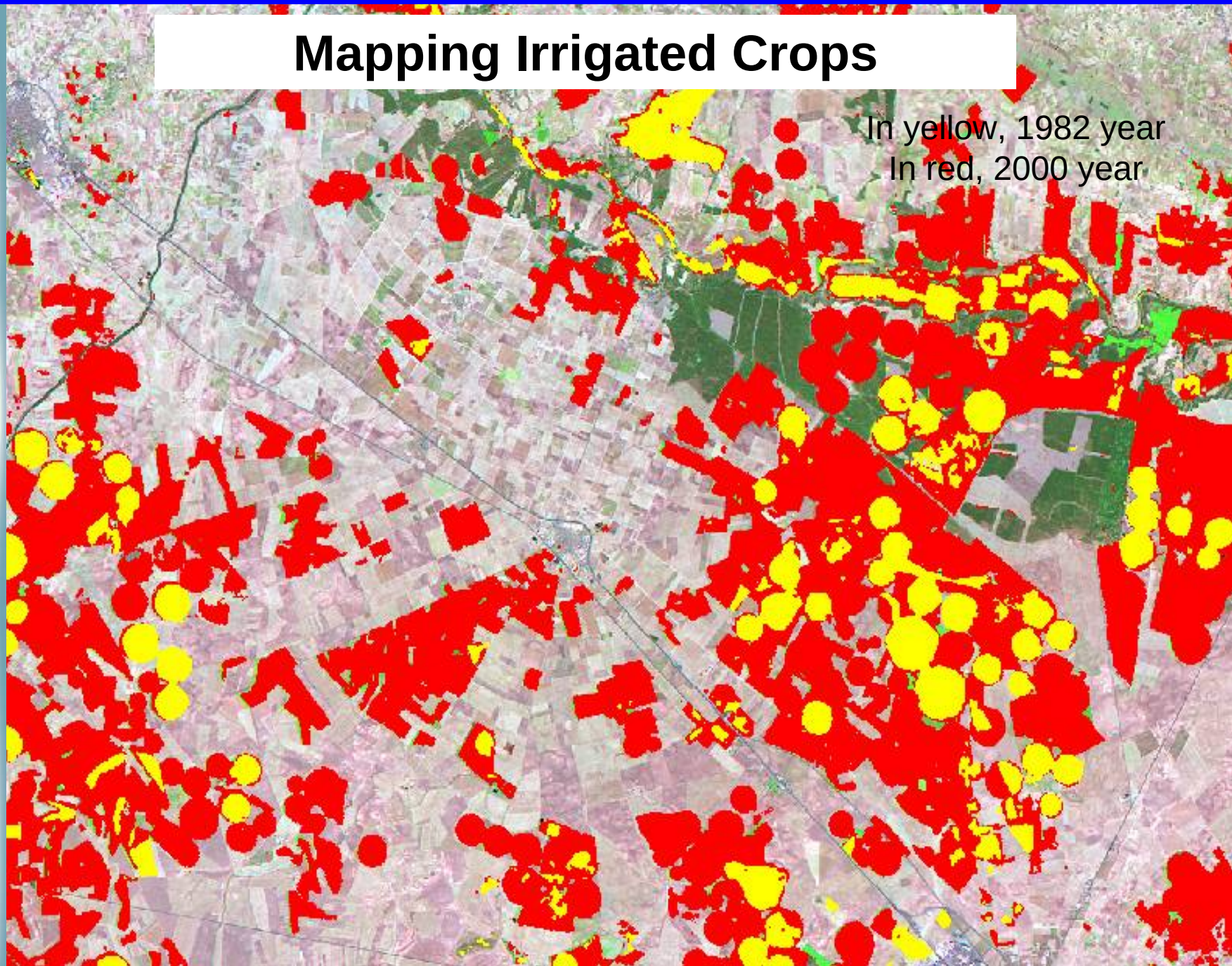


ERMOT
DEMETER
PLEIADeS
...
improving water efficiency



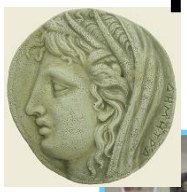
BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL 2009

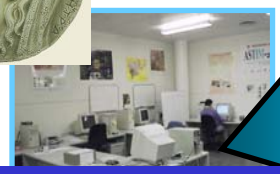
Mapping Irrigated Crops



BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM ISTANBUL 2009

e-Space Assisted Irrigation Advisory Service





EO Module
Basic Processing
Products

Field work

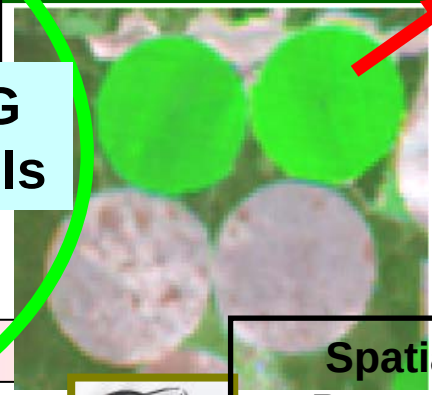
Satellite Data Assimilation

IAS

SIG Tools

Quality Control

Plot: 00722
Crop Water Requirement
6 mm/day

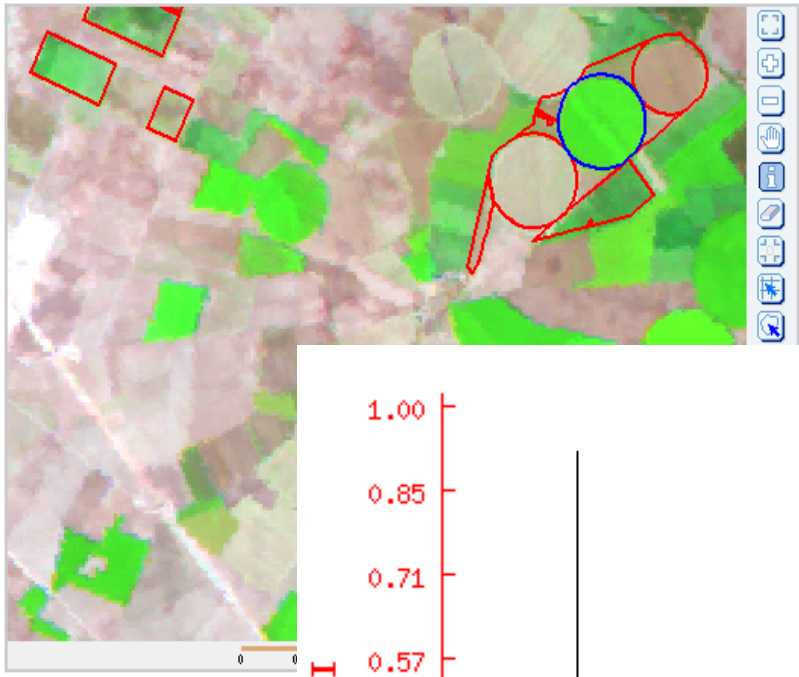


Spatialized, Personalized Information

running from 2005 year,…

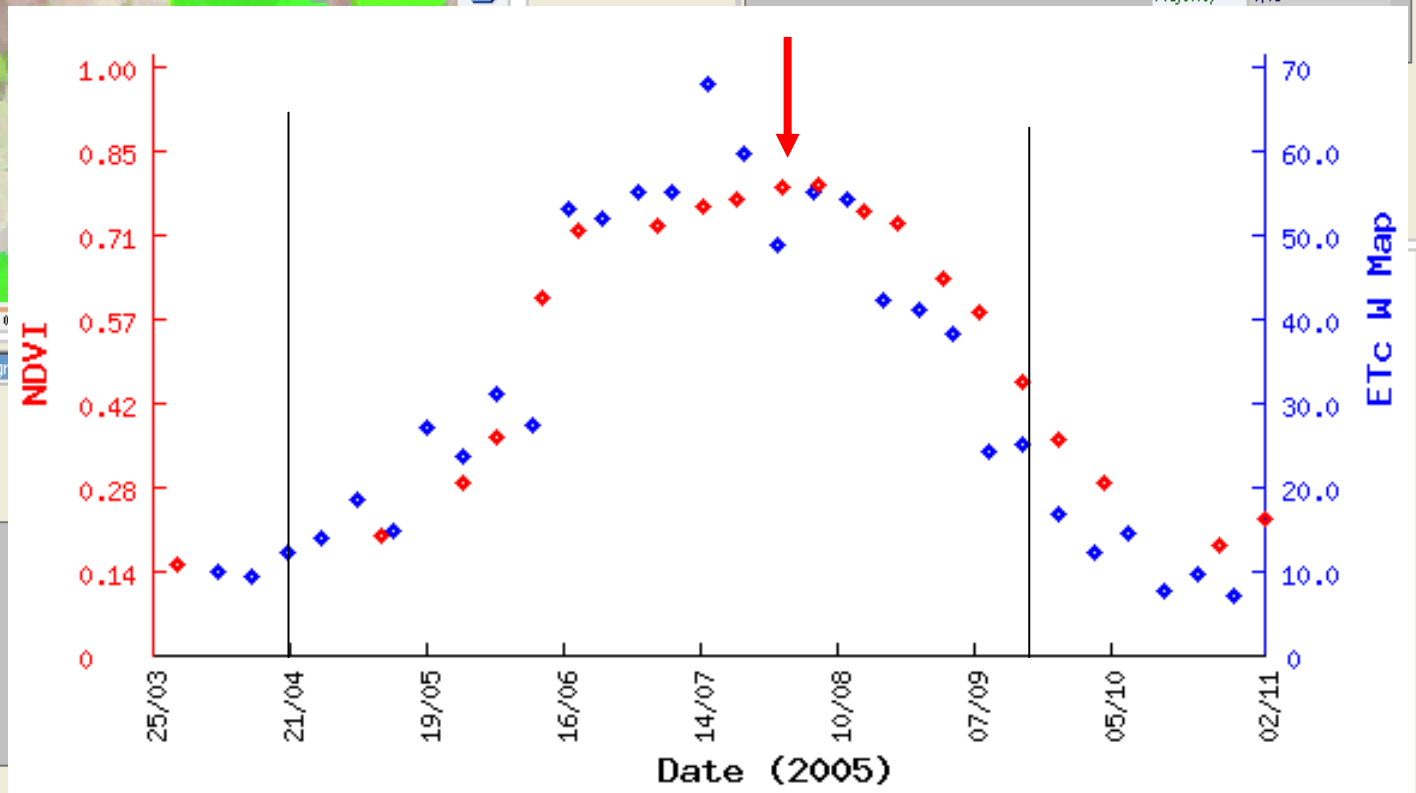
BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL 2009

Irrigation Water Requirements



Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

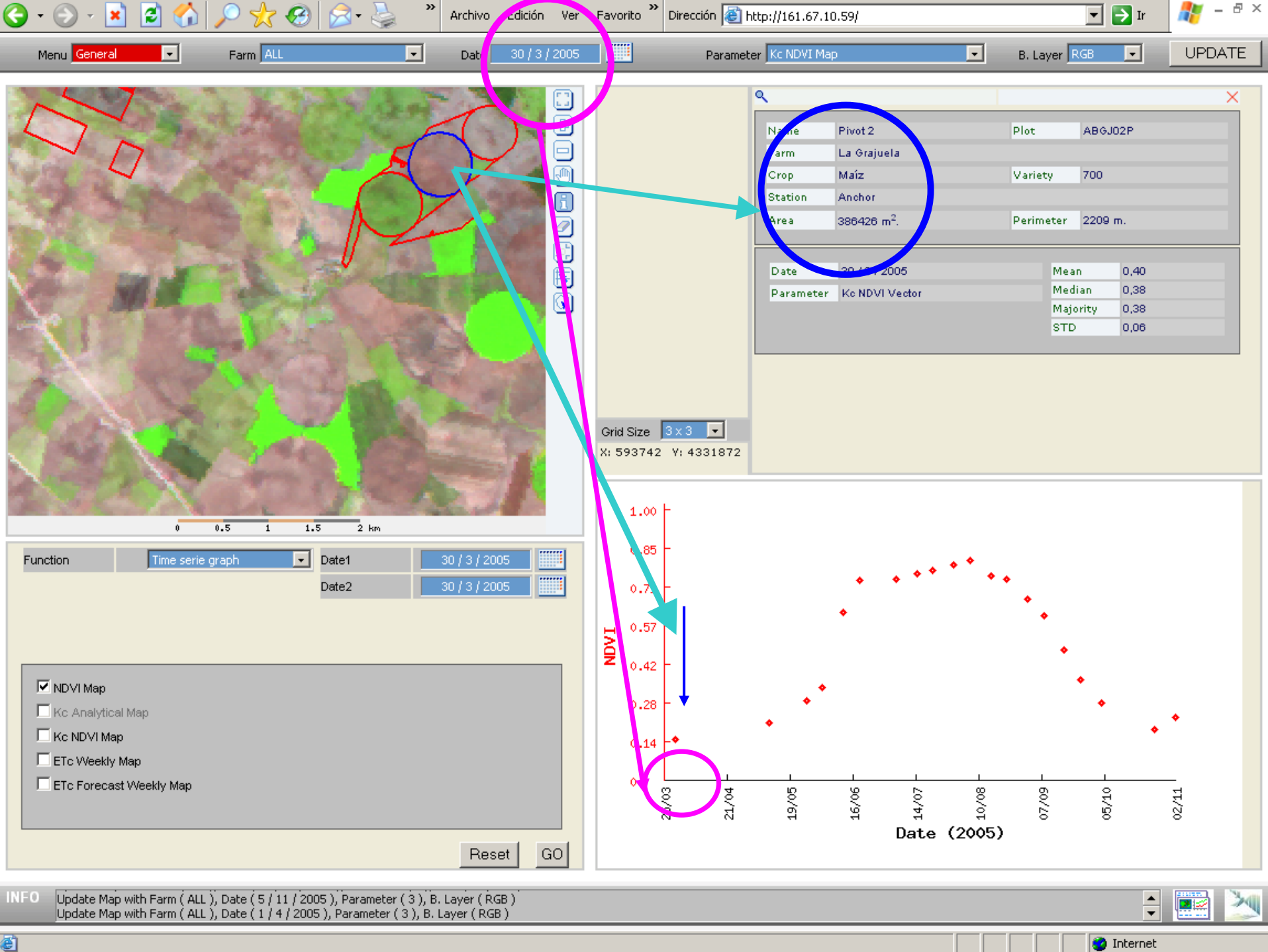
Date	29 / 7 / 2005	Mean	1,13
Parameter	Kc NDVI Vector	Median	1,14
		Majority	1,15



Function | Time serie gr

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

INFO Update Map with Farm (ALL), Date (21 / 6 / 2005), Parameter (3), B. Layer (RGB)


Archivo Edición Ver Favorito
Dirección http://161.67.10.59/
Ir
Menu General
Farm ALL
Dat 30 / 3 / 2005
Parameter Kc NDVI Map
B. Layer RGB
UPDATE
Name Pivot 2
Plot ABGJ02P
Farm La Grajuela
Crop Maíz
Variety 700
Station Anchor
Area 386426 m².
Perimeter 2209 m.
Date 30 / 3 / 2005
Parameter Kc NDVI Vector
Mean 0,40
Median 0,38
Majority 0,38
STD 0,06
Grid Size 3 x 3
X: 593742 Y: 4331872
0 0.5 1 1.5 2 km
Function Time serie graph
Date1 30 / 3 / 2005
Date2 30 / 3 / 2005
NDVI Map
Kc Analytical Map
Kc NDVI Map
ETc Weekly Map
ETc Forecast Weekly Map
Reset
GO
NDVI
1.00
0.85
0.71
0.57
0.42
0.28
0.14
0
21/03
21/04
19/05
16/06
14/07
10/08
07/09
05/10
02/11
Date (2005)
INFO
Update Map with Farm (ALL), Date (5 / 11 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (1 / 4 / 2005), Parameter (3), B. Layer (RGB)
Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 2 / 6 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE

Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	2 / 6 / 2005	Mean	0,68
Parameter	Kc NDVI Vector	Median	0,67
		Majority	0,67
		STD	0,09

Grid Size 3 x 3

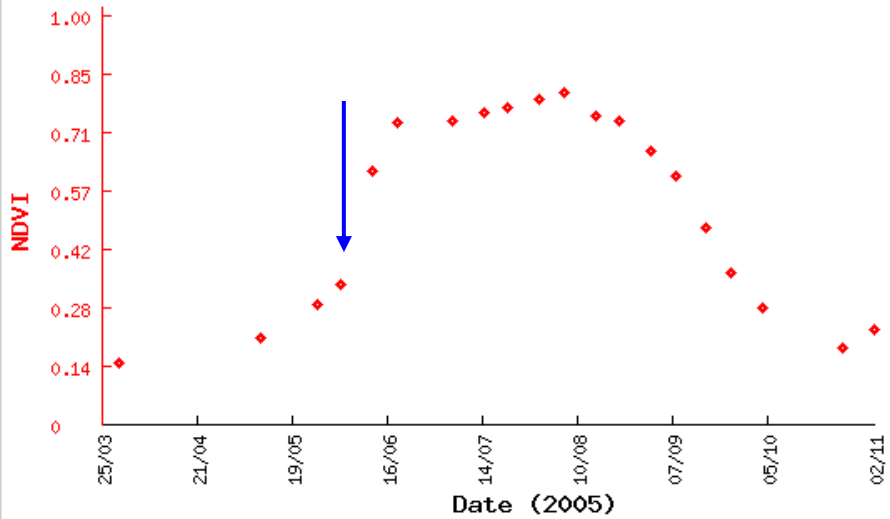
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1: 2 / 6 / 2005 | Date2: 2 / 6 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

Update Map with Farm (ALL), Date (1 / 6 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (10 / 6 / 2005), Parameter (3), B. Layer (RGB)

Alejar zona Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 11 / 6 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE

Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	11 / 6 / 2005	Mean	0,92
Parameter	Kc NDVI Vector	Median	0,93
		Majority	0,96
		STD	0,06

Grid Size 3 x 3

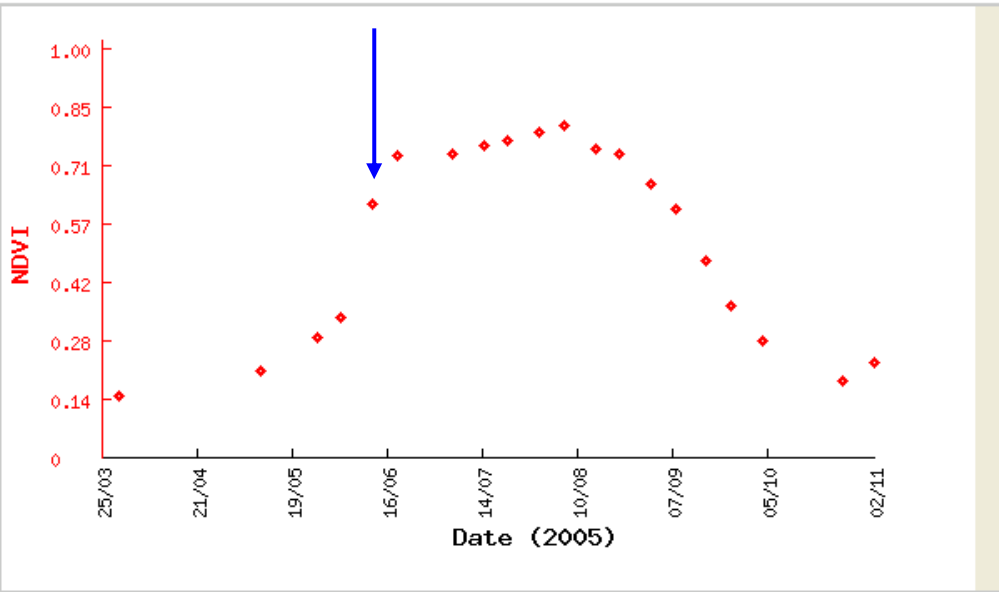
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1 11 / 6 / 2005 | Date2 11 / 6 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

Update Map with Farm (ALL), Date (9 / 6 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (16 / 6 / 2005), Parameter (3), B. Layer (RGB)

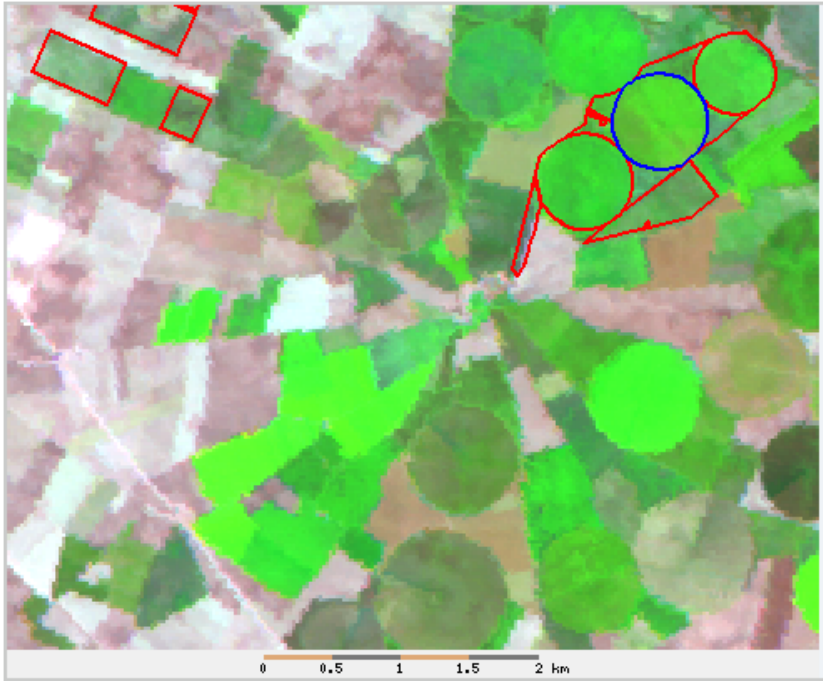
Coordenadas: 593608.751914 , 4332175.035984

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 18 / 6 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



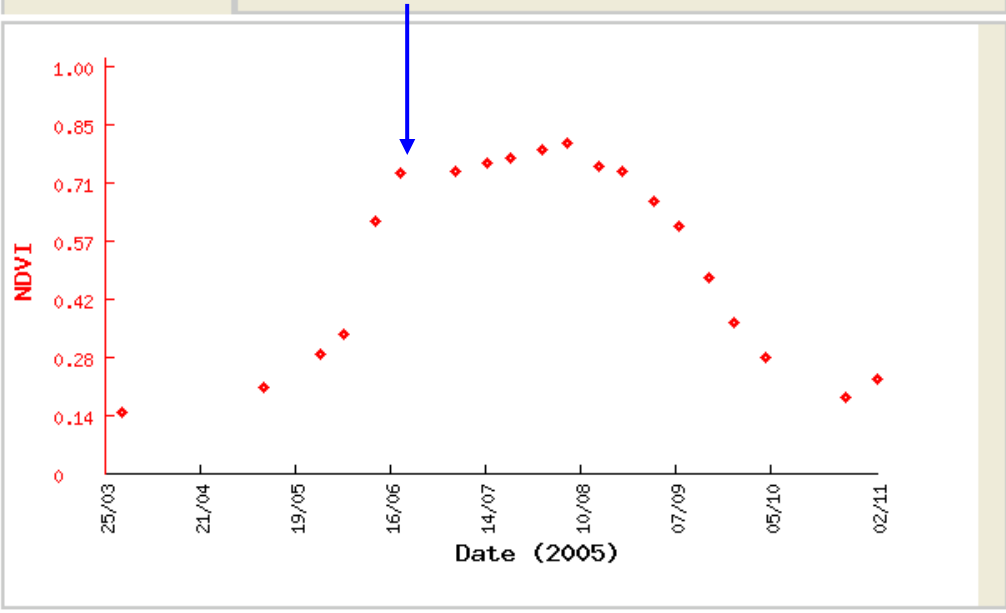
Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	18 / 6 / 2005	Mean	1,02
Parameter	Kc NDVI Vector	Median	1,06
		Majority	1,09
		STD	0,09

Grid Size 3 x 3

X: 593742 Y: 4331872

e-SARAS



Function: Time serie graph | Date1: 18 / 6 / 2005 | Date2: 18 / 6 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO

INFO

Update Map with Farm (ALL), Date (16 / 6 / 2005), Parameter (3), B. Layer (RGB)

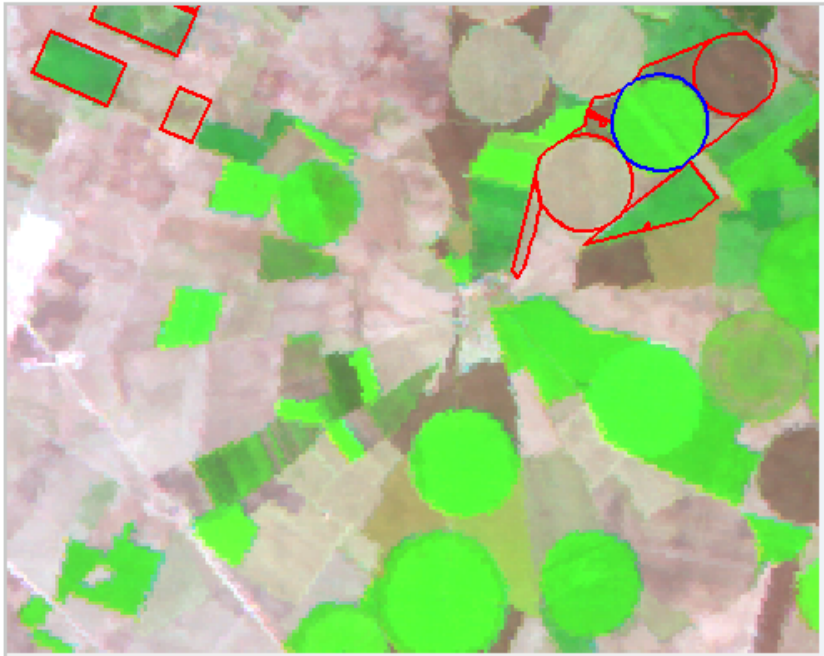
Update Map with Farm (ALL), Date (21 / 6 / 2005), Parameter (3), B. Layer (RGB)

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 20 / 7 / 2005 | Parameter Kc NDVI Map | B. Layer Raster | UPDATE



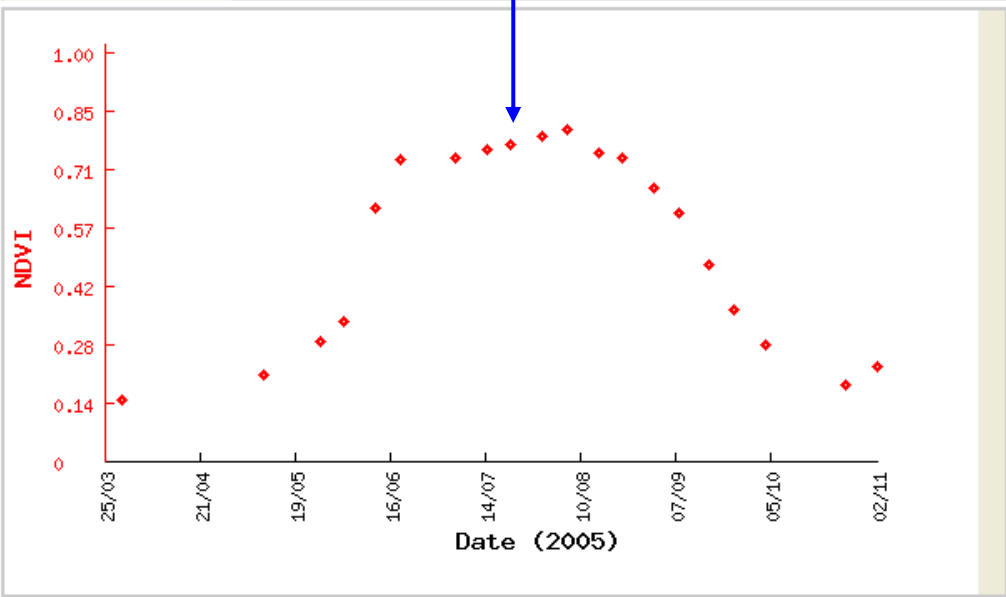
Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	20 / 7 / 2005	Mean	1,09
Parameter	Kc NDVI Vector	Median	1,12
		Majority	1,13
		STD	0,10

Grid Size 3 x 3

X: 593742 Y: 4331872

e-SARAS



Function: Time serie graph | Date1: 25 / 3 / 2005 | Date2: 2 / 11 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO

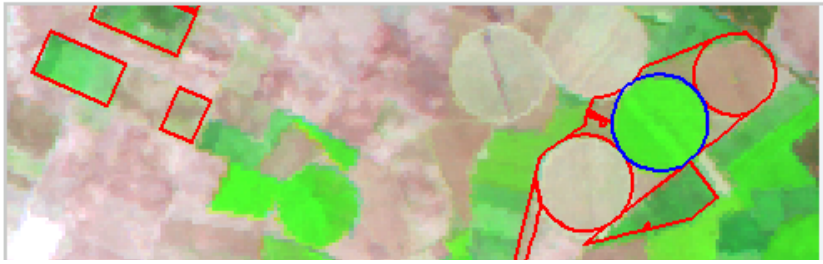
INFO Update Map with Farm (ALL), Date (20 / 7 / 2005), Parameter (1), B. Layer (RGB)

Coordenadas: 594240.015822 , 4332053.639079

Internet

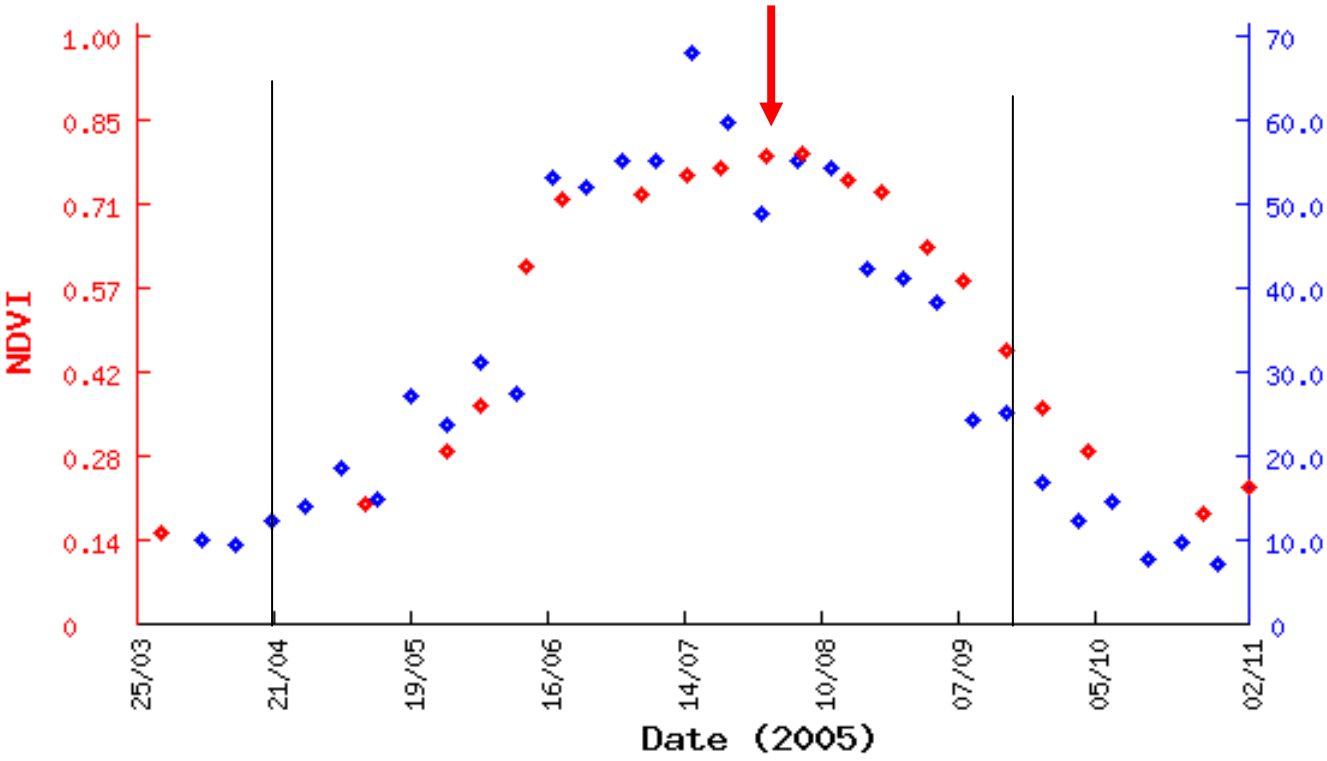
Archivo Edición Ver Favorito Dirección http://161.67.10.59/ Ir

Menu General Farm ALL Date 29 / 7 / 2005 Parameter Kc NDVI Map B. Layer RGB UPDATE

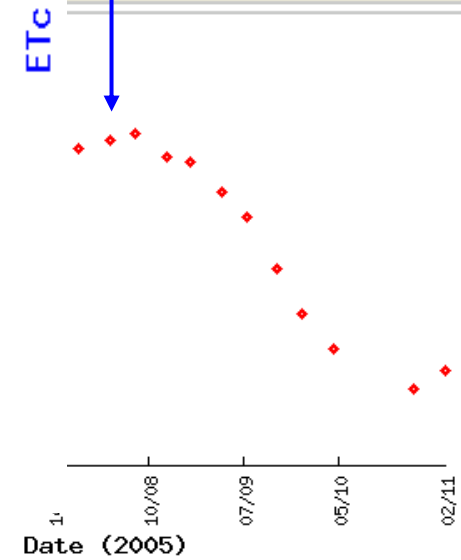


Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Mean	1,13
Median	1,14
Majority	1,15
STD	0,06



e-SARAS



Reset GO

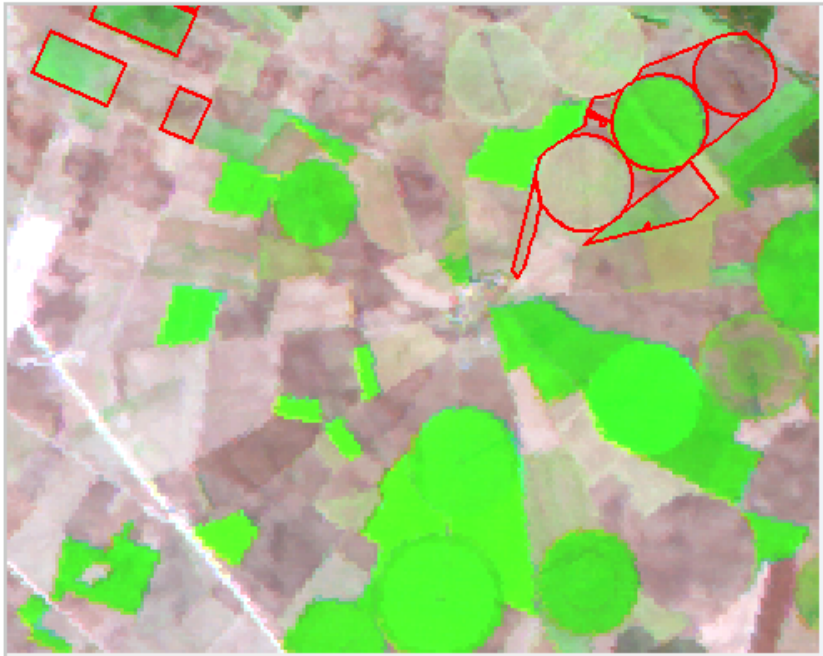
INFO
Update Map with Farm (ALL), Date (21 / 6 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (30 / 7 / 2005), Parameter (3), B. Layer (RGB)

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 21 / 8 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



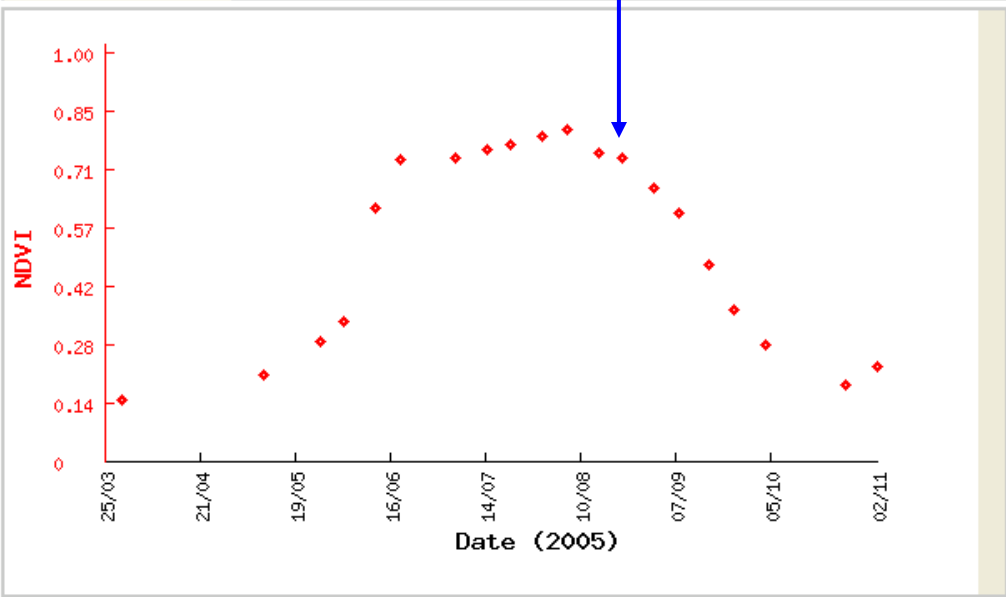
Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	21 / 8 / 2005	Mean	1,02
Parameter	Kc NDVI Vector	Median	1,06
		Majority	1,04
		STD	0,13

Grid Size 3 x 3

X: 593742 Y: 4331872

e-SARAS



Function: Time serie graph | Date1: 21 / 8 / 2005 | Date2: 21 / 8 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO

INFO

Update Map with Farm (ALL), Date (1 / 9 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (26 / 8 / 2005), Parameter (3), B. Layer (RGB)

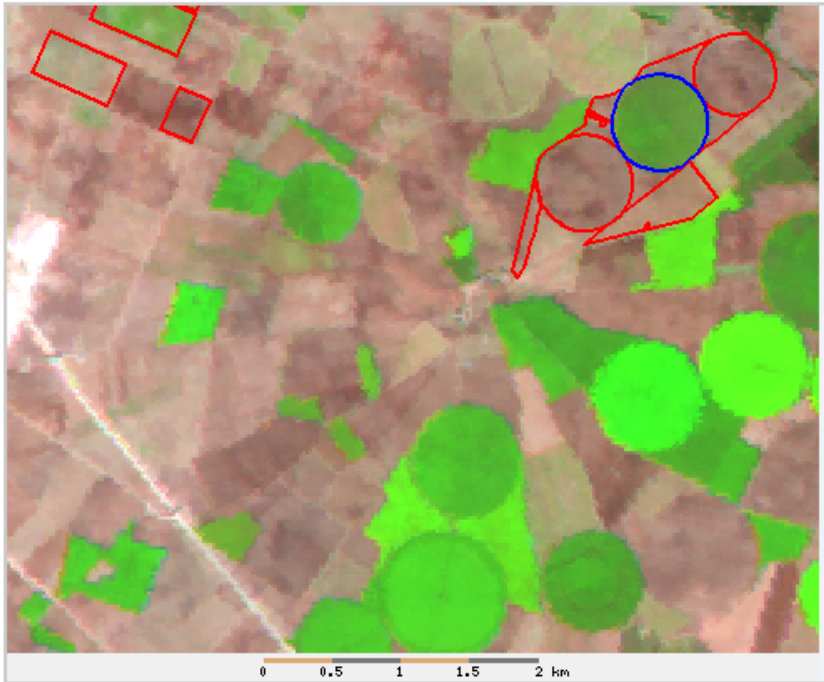
Coordenadas: 594324.993656 , 4331240.279813

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 6 / 9 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	6 / 9 / 2005	Mean	0,84
Parameter	Kc NDVI Vector	Median	0,85
		Majority	0,82
		STD	0,10

Grid Size 3 x 3

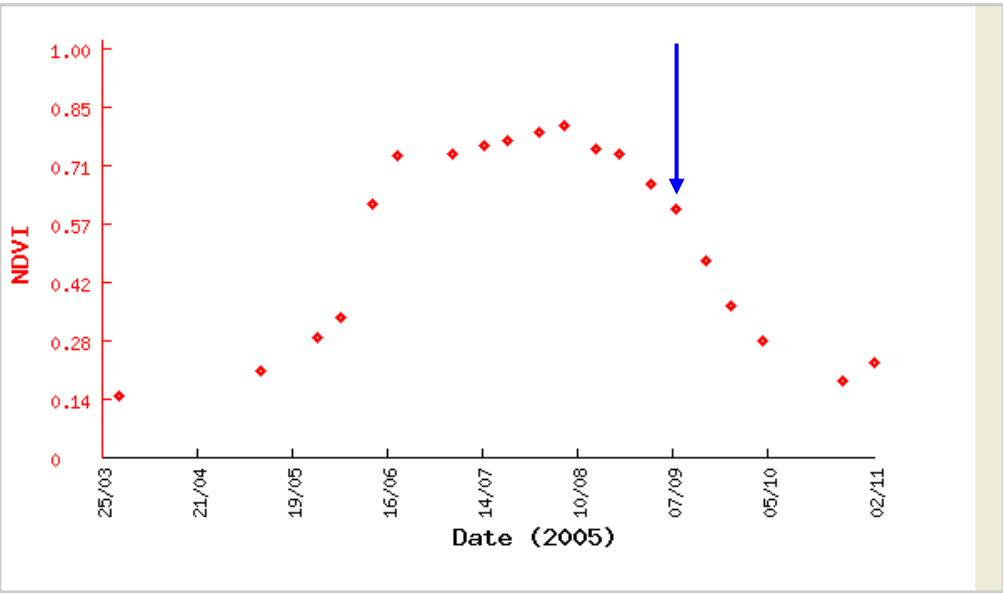
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1 6 / 9 / 2005 | Date2 6 / 9 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

Update Map with Farm (ALL), Date (5 / 9 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (8 / 9 / 2005), Parameter (3), B. Layer (RGB)

Coordenadas: 594082.199845 , 4332272.153508

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 22 / 9 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE

Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	22 / 9 / 2005	Mean	0,63
Parameter	Kc NDVI Vector	Median	0,62
		Majority	0,54
		STD	0,07

Grid Size 3 x 3

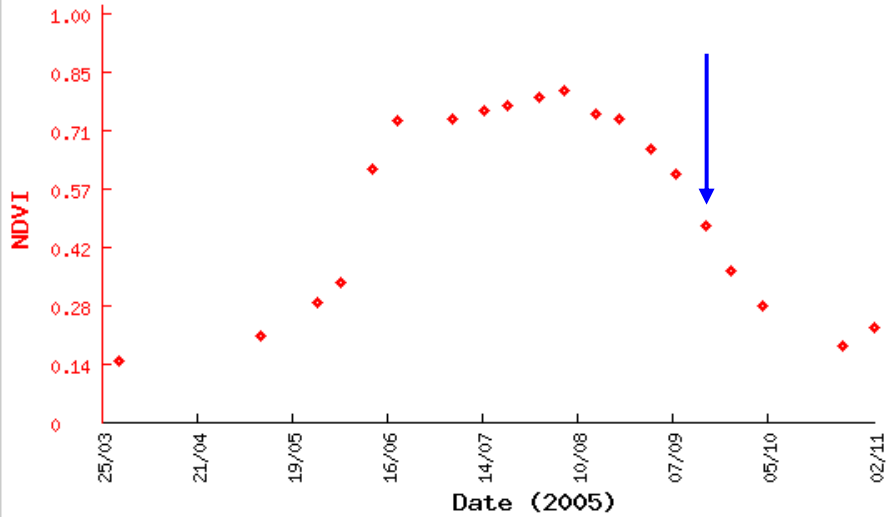
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1 22 / 9 / 2005 | Date2 22 / 9 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

Update Map with Farm (ALL), Date (16 / 9 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (24 / 9 / 2005), Parameter (3), B. Layer (RGB)

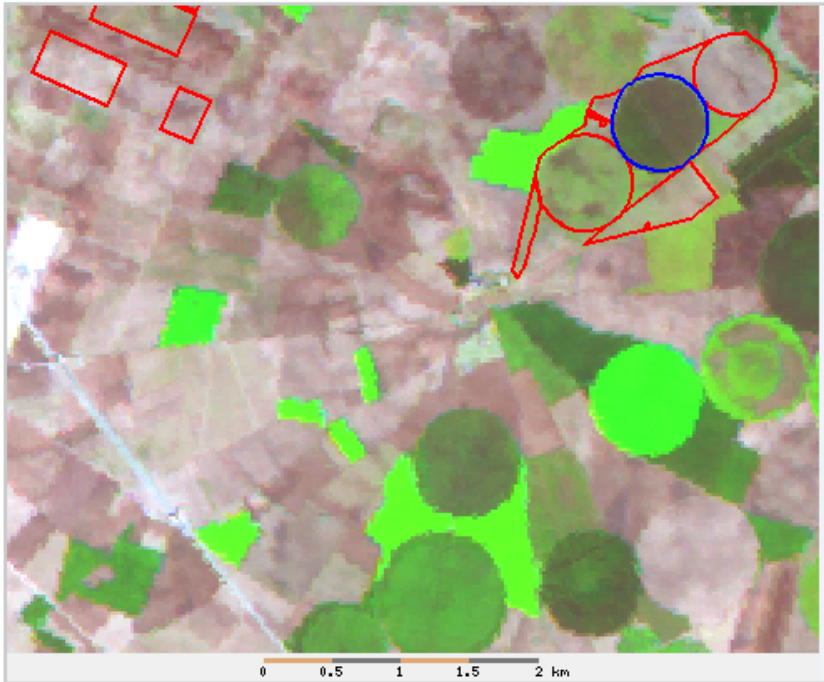
Coordenadas: 592030.592145 , 4332648.483915

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 1 / 10 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



Name	Pivot 2	Plot	ABGJ02P
Farm	La Grajuela		
Crop	Maíz	Variety	700
Station	Anchor		
Area	386426 m².	Perimeter	2209 m.

Date	1 / 10 / 2005	Mean	0,56
Parameter	Kc NDVI Vector	Median	0,55
		Majority	0,51
		STD	0,06

Grid Size 3 x 3

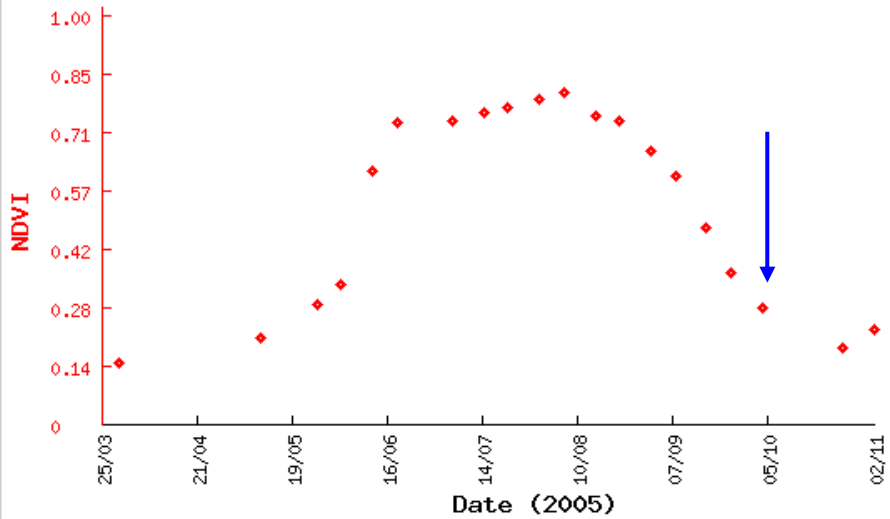
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1: 1 / 10 / 2005 | Date2: 1 / 10 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

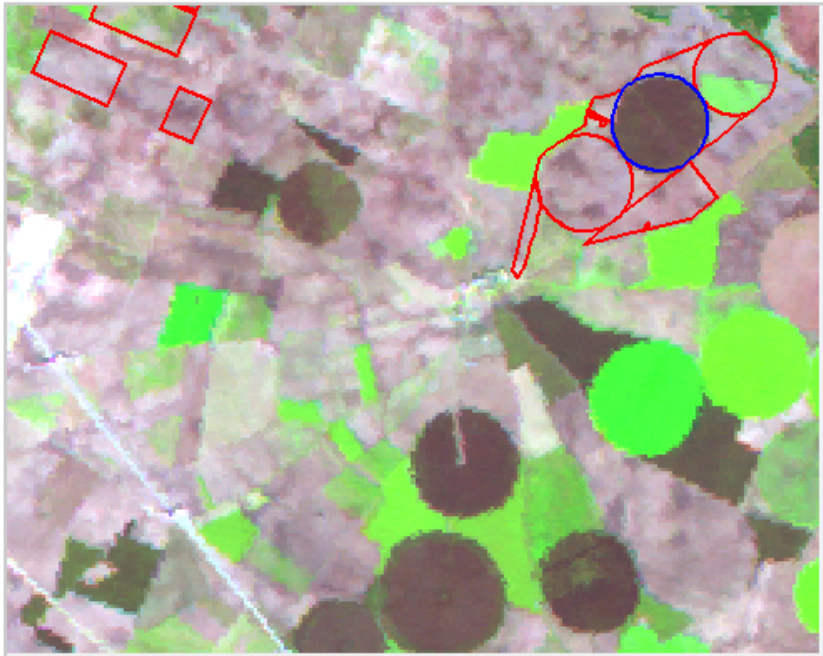
Update Map with Farm (ALL), Date (24 / 9 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (4 / 10 / 2005), Parameter (3), B. Layer (RGB)

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 24 / 10 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



Name	Pivot 2
Plot	ABGJ02P
Farm	La Grajuela
Crop	Maíz
Variety	700
Station	Anchor
Area	386426 m².
Perimeter	2209 m.

Date	24 / 10 / 2005
Parameter	Kc NDVI Vector
Mean	
Median	
Majority	
STD	

e-SARAS

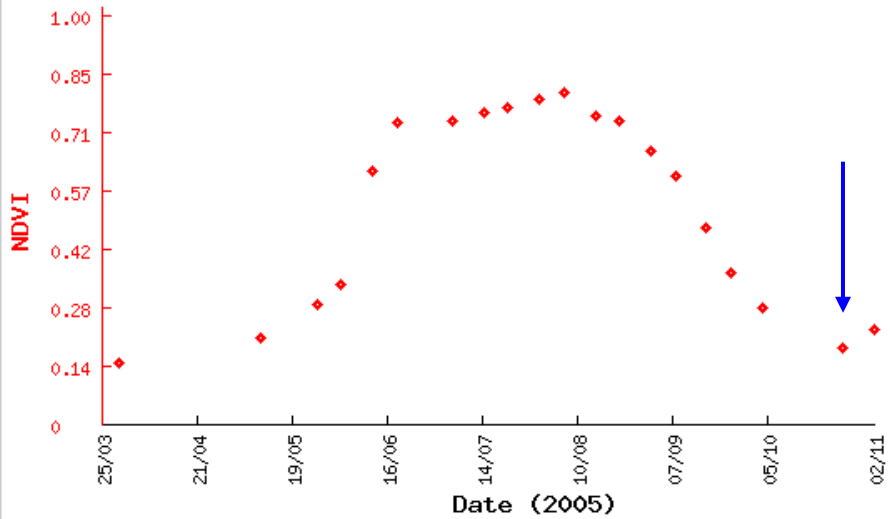
Grid Size 3 x 3

X: 593742 Y: 4331872

Function: Time serie graph | Date1: 1 / 10 / 2005 | Date2: 1 / 10 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



INFO

Update Map with Farm (ALL), Date (4 / 10 / 2005), Parameter (3), B. Layer (RGB)

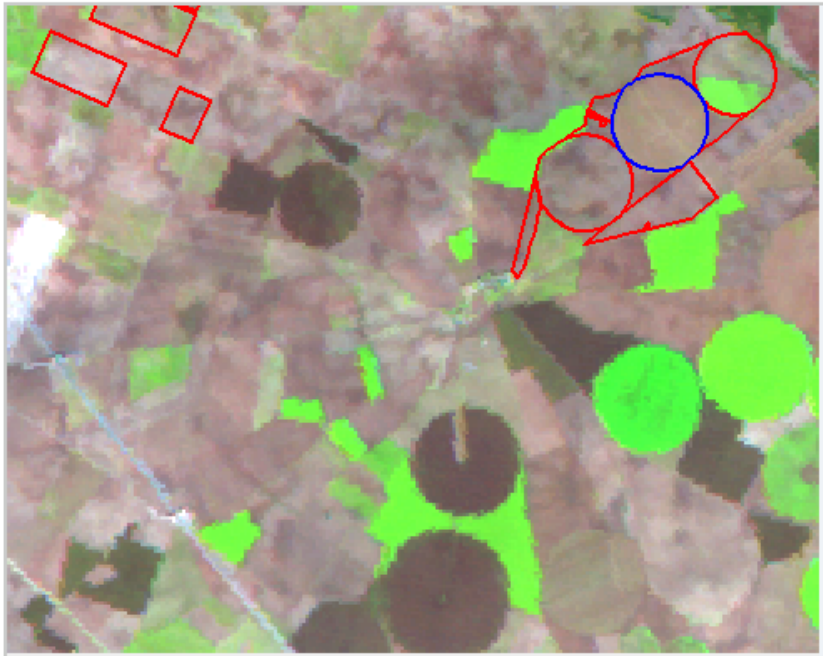
Update Map with Farm (ALL), Date (24 / 10 / 2005), Parameter (3), B. Layer (RGB)

Internet

Archivo Edición Ver Favorito

Dirección http://161.67.10.59/ Ir

Menu General | Farm ALL | Date 2 / 11 / 2005 | Parameter Kc NDVI Map | B. Layer RGB | UPDATE



Name	Pivot 2
Plot	ABGJ02P
Farm	La Grajuela
Crop	Maíz
Variety	700
Station	Anchor
Area	386426 m².
Perimeter	2209 m.

Date	2 / 11 / 2005
Parameter	Kc NDVI Vector

Mean
Median
Majority
STD

Grid Size 3 x 3

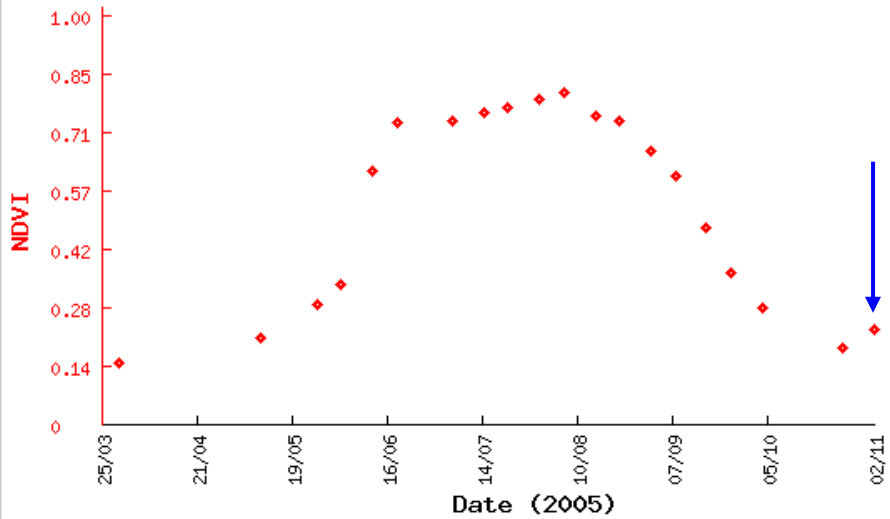
X: 593742 Y: 4331872

e-SARAS

Function: Time serie graph | Date1: 2 / 11 / 2005 | Date2: 2 / 11 / 2005

- [x] NDVI Map
- [ ] Kc Analytical Map
- [ ] Kc NDVI Map
- [ ] ETc Weekly Map
- [ ] ETc Forecast Weekly Map

Reset GO



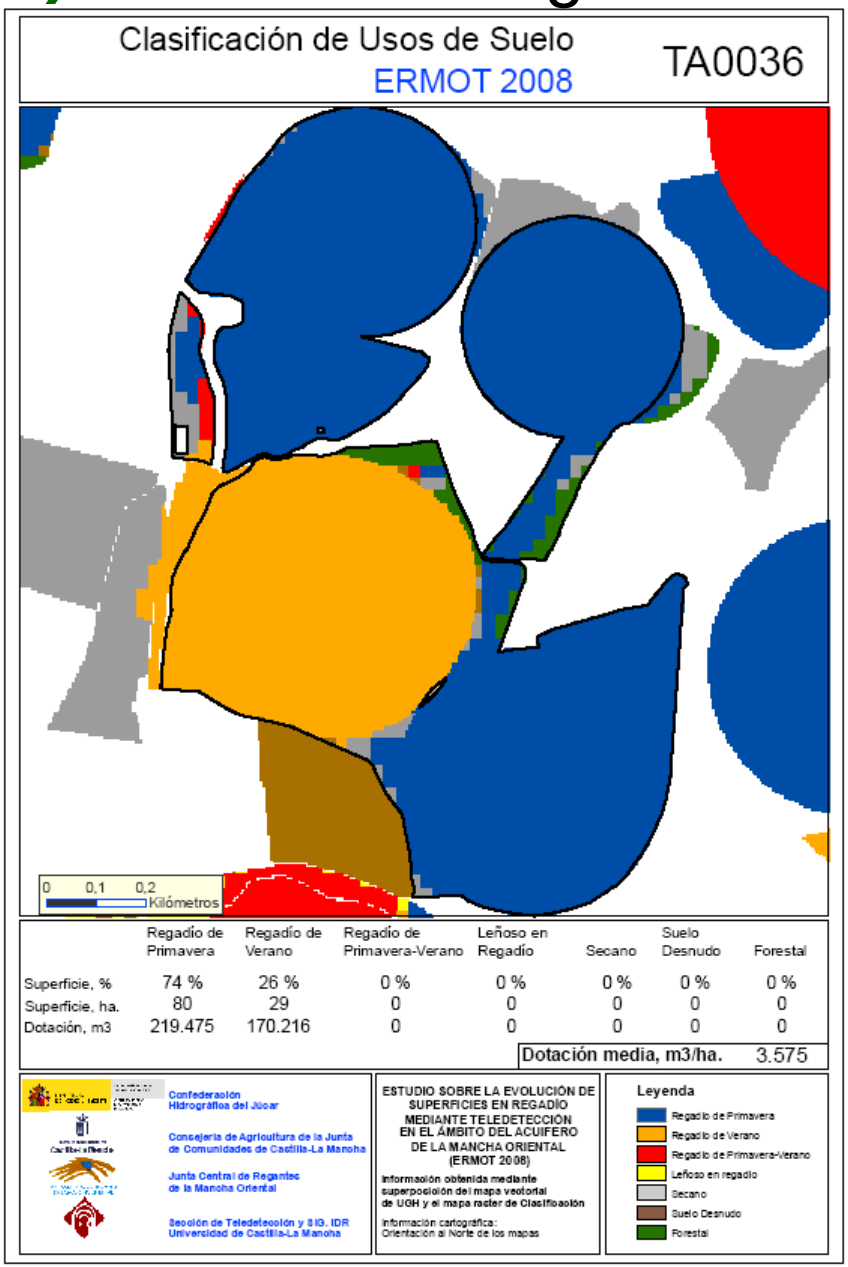
INFO

Update Map with Farm (ALL), Date (24 / 10 / 2005), Parameter (3), B. Layer (RGB)
Update Map with Farm (ALL), Date (5 / 11 / 2005), Parameter (3), B. Layer (RGB)

Pan Internet

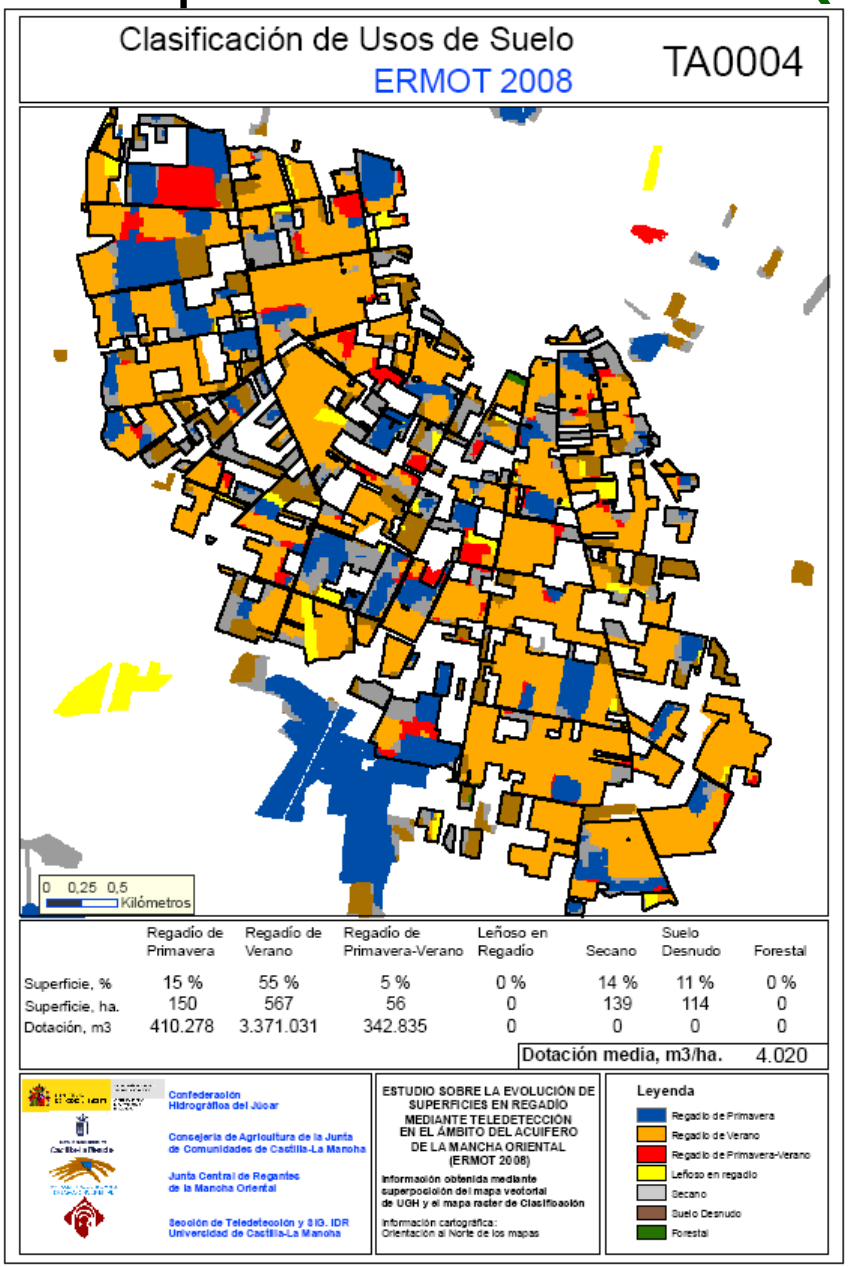
BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL 2009

Monitoring the Annual Exploitation Plan



	Regadío de Primavera	Regadío de Verano	Regadío de Primavera-Verano	Leñoso en Regadío	Secano	Suelo Desnudo	Forestal
Superficie, %	74 %	26 %	0 %	0 %	0 %	0 %	0 %
Superficie, ha.	80	29	0	0	0	0	0
Dotación, m3	219.475	170.216	0	0	0	0	0

Dotación media, m3/ha. 3.575



	Regadío de Primavera	Regadío de Verano	Regadío de Primavera-Verano	Leñoso en Regadío	Secano	Suelo Desnudo	Forestal
Superficie, %	15 %	55 %	5 %	0 %	14 %	11 %	0 %
Superficie, ha.	150	567	56	0	139	114	0
Dotación, m3	410.278	3.371.031	342.835	0	0	0	0

Dotación media, m3/ha. 4.020

BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL 2009

A success story…
enhancing **cooperation** processes
through Participation and Transparency

farmers, water managers, authorities in charge

share basic information space-assisted through GIS and ITC tools

Confederación Hidrográfica del Júcar	Junta Central de Regantes de la Mancha Oriental	Consejería de Agricultura y Medio Ambiente

Mapping Irrigated Crops. Irrigation Rights

e-Space Assisted Irrigation Advisory Service

Irrigation Water Requirements

IDR University of Castilla La Mancha
in charge of technical Remote Sensing products

BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM ISTANBUL 2009

Evaluation EO-based products: criteria

- → **precision/quality** "at least as good as current"
- → **added value** provides new and useful information and/or functionality
- → **confidence** at least as reliable as current
- → **cost** less than current, reasonable, brings more benefits
- → **benefits** save water, water productivity
- → **impact** environmental, social, economic

BRIDGING DIVIDES FOR WATER
16-22 MARCH 2009 • ISTANBUL TURKEY
5th WORLD WATER FORUM
ISTANBUL2009