Introduction to CRITERIA model

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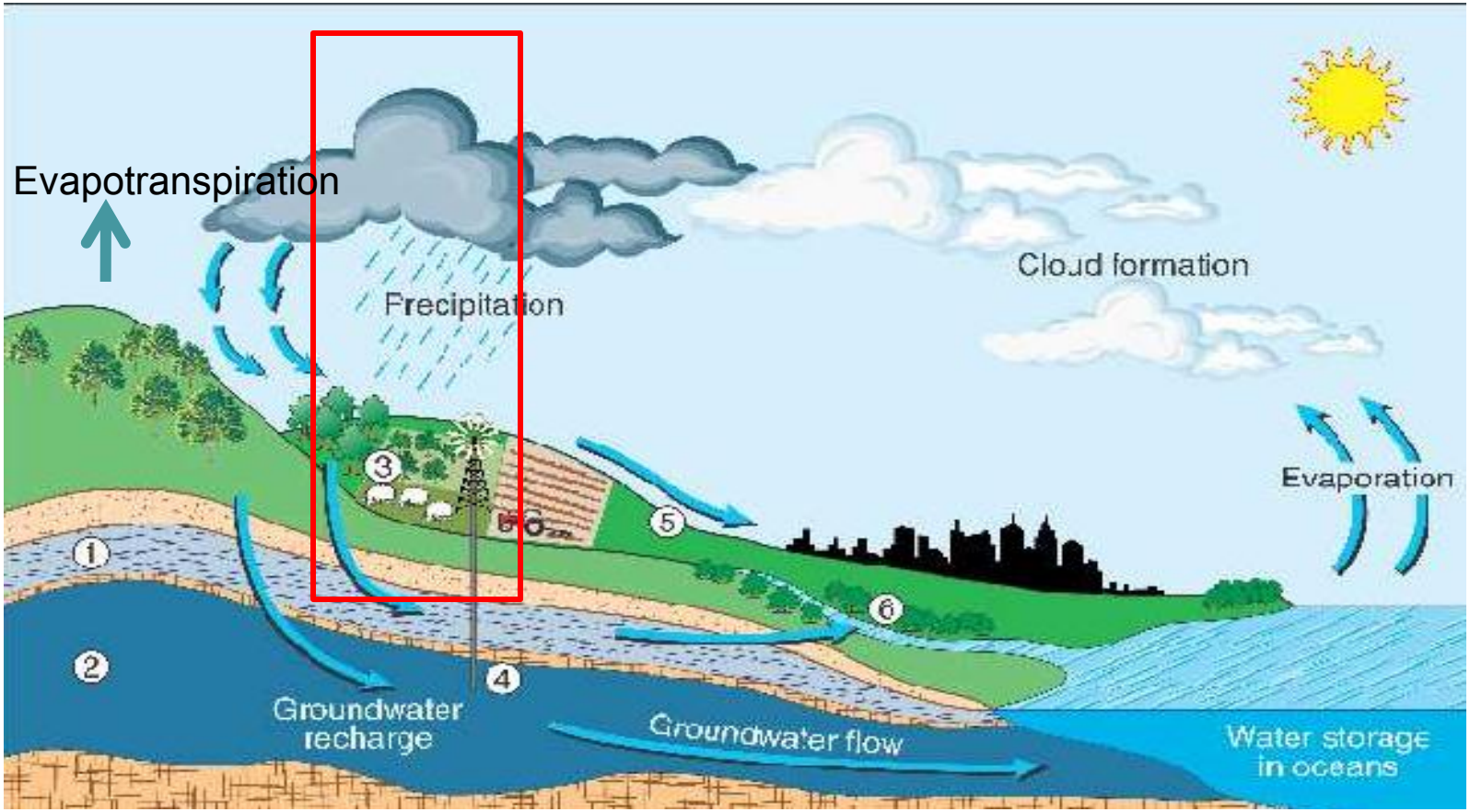
What is CRITERIA

- Modelling system aimed at the simulation of the agro-ecosystem
- Modular system:
  - Soil water balance: numerical model (based on Richard's equation) and empirical model
  - Crop and roots development model (phenology)
  - Evaluation functions (potential and actual ET, capillary rise…)
  - Water stress and irrigation
  - Crop growth model (Wofost 7.1)
  - Nitrogen and soil heat models
  - Modelling CO2 effects on assimilation
- Different versions for different applications

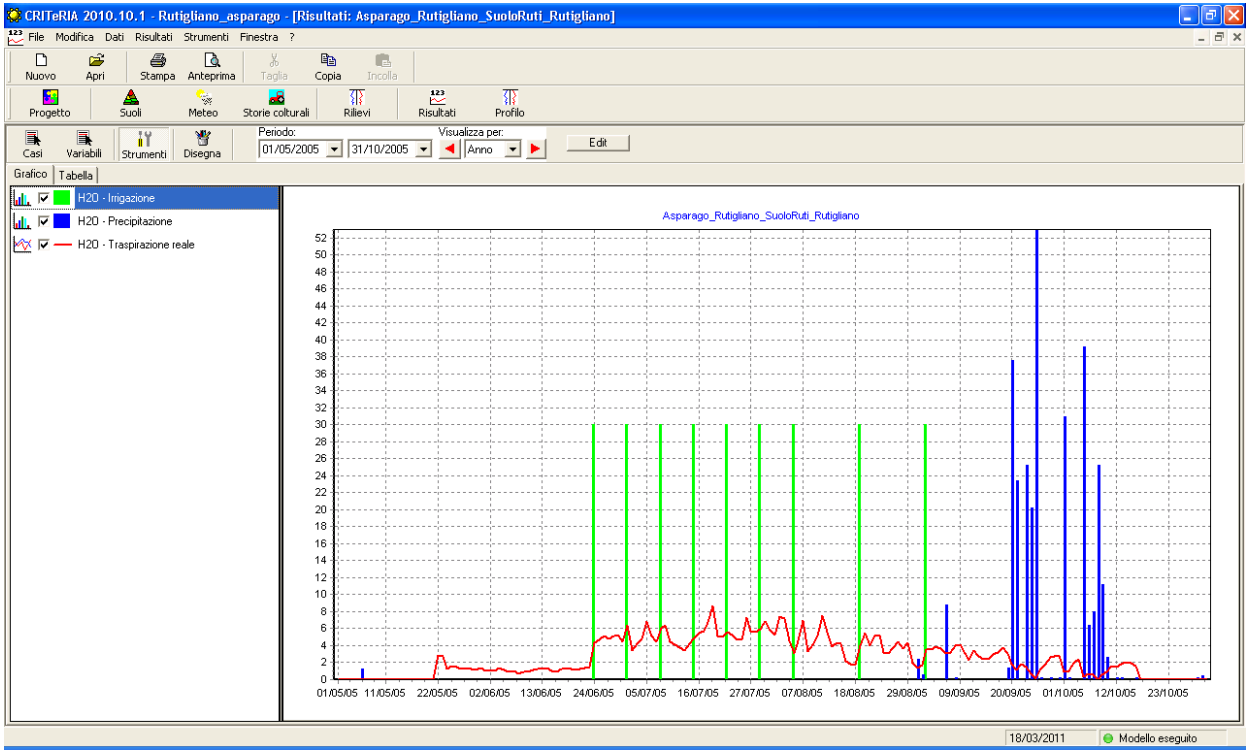
Available versions

- Version BdP (Benchmark) 1D downloadable from www.arpa.emr.it/sim
- Geographical version for spatial analysis

Water balance

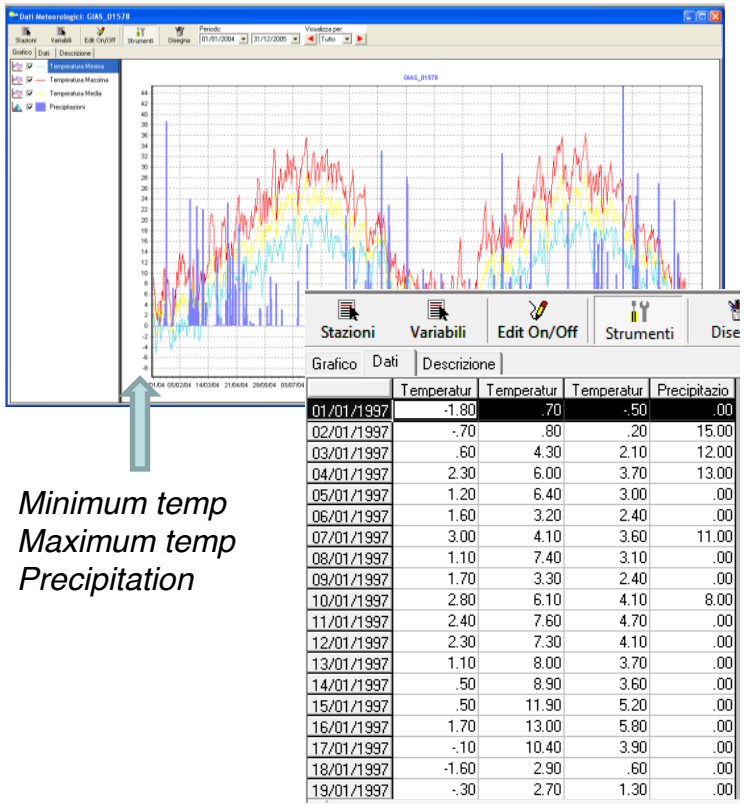


Water balance models give information on soil water content and crop water stress, so that irrigation practices can be managed and planned



CRITERIA INPUTS

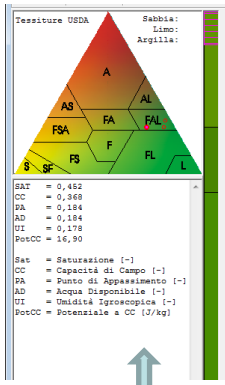
Daily meteorological data

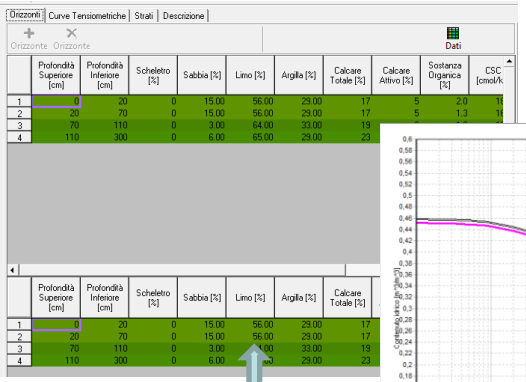


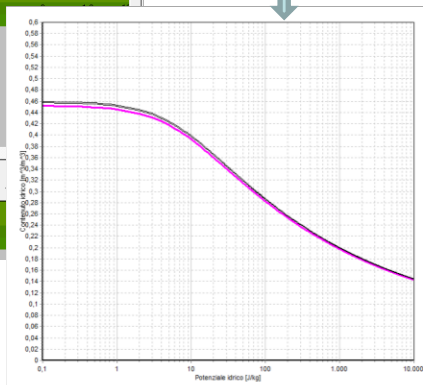
	Temperatur	Temperatur	Temperatur	Precipitazio
01/01/1997	-1.80	.70	-.50	.00
02/01/1997	-.70	.80	.20	15.00
03/01/1997	.60	4.30	2.10	12.00
04/01/1997	2.30	6.00	3.70	13.00
05/01/1997	1.20	6.40	3.00	.00
06/01/1997	1.60	3.20	2.40	.00
07/01/1997	3.00	4.10	3.60	11.00
08/01/1997	1.10	7.40	3.10	.00
09/01/1997	1.70	3.30	2.40	.00
10/01/1997	2.80	6.10	4.10	8.00
11/01/1997	2.40	7.60	4.70	.00
12/01/1997	2.30	7.30	4.10	.00
13/01/1997	1.10	8.00	3.70	.00
14/01/1997	.50	8.90	3.60	.00
15/01/1997	.50	11.90	5.20	.00
16/01/1997	1.70	13.00	5.80	.00
17/01/1997	-.10	10.40	3.90	.00
18/01/1997	-1.60	2.90	.60	.00
19/01/1997	-.30	2.70	1.30	.00

Minimum temp
Maximum temp
Precipitation

Soil data





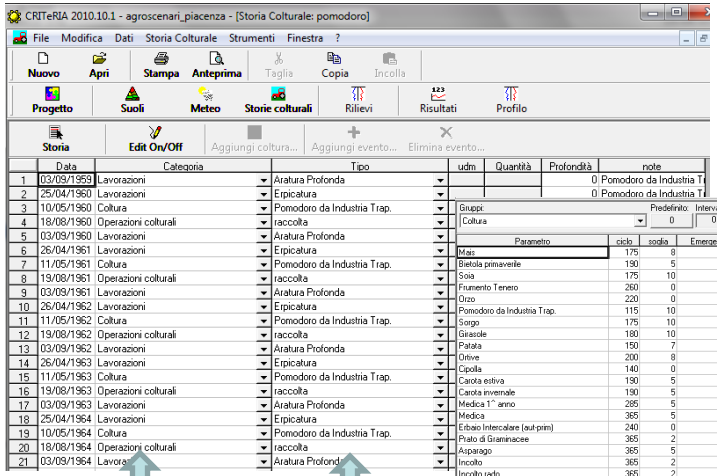


Soil retention curve

Texture

Layers description

Crop data



	Data	Categoria	Tipo	udm	Quantità	Profondità	note
1	03/09/1959	Lavorazioni	Aratura Profonda			0	Pomodoro da Industria T
2	25/04/1960	Lavorazioni	Erpicatura			0	Pomodoro da Industria T
3	10/05/1960	Coltura	Pomodoro da Industria Trap.				
4	18/08/1960	Operazioni colturali	raccolta				
5	03/09/1960	Lavorazioni	Aratura Profonda				
6	26/04/1961	Lavorazioni	Erpicatura				
7	11/05/1961	Coltura	Pomodoro da Industria Trap.				
8	19/08/1961	Operazioni colturali	raccolta				
9	03/09/1961	Lavorazioni	Aratura Profonda				
10	26/04/1962	Lavorazioni	Erpicatura				
11	11/05/1962	Coltura	Pomodoro da Industria Trap.				
12	19/08/1962	Operazioni colturali	raccolta				
13	03/09/1962	Lavorazioni	Aratura Profonda				
14	26/04/1963	Lavorazioni	Erpicatura				
15	11/05/1963	Coltura	Pomodoro da Industria Trap.				
16	19/08/1963	Operazioni colturali	raccolta				
17	03/09/1963	Lavorazioni	Aratura Profonda				
18	25/04/1964	Lavorazioni	Erpicatura				
19	10/05/1964	Coltura	Pomodoro da Industria Trap.				
20	18/08/1964	Operazioni colturali	raccolta				
21	03/09/1964	Lavorazioni	Aratura Profonda				

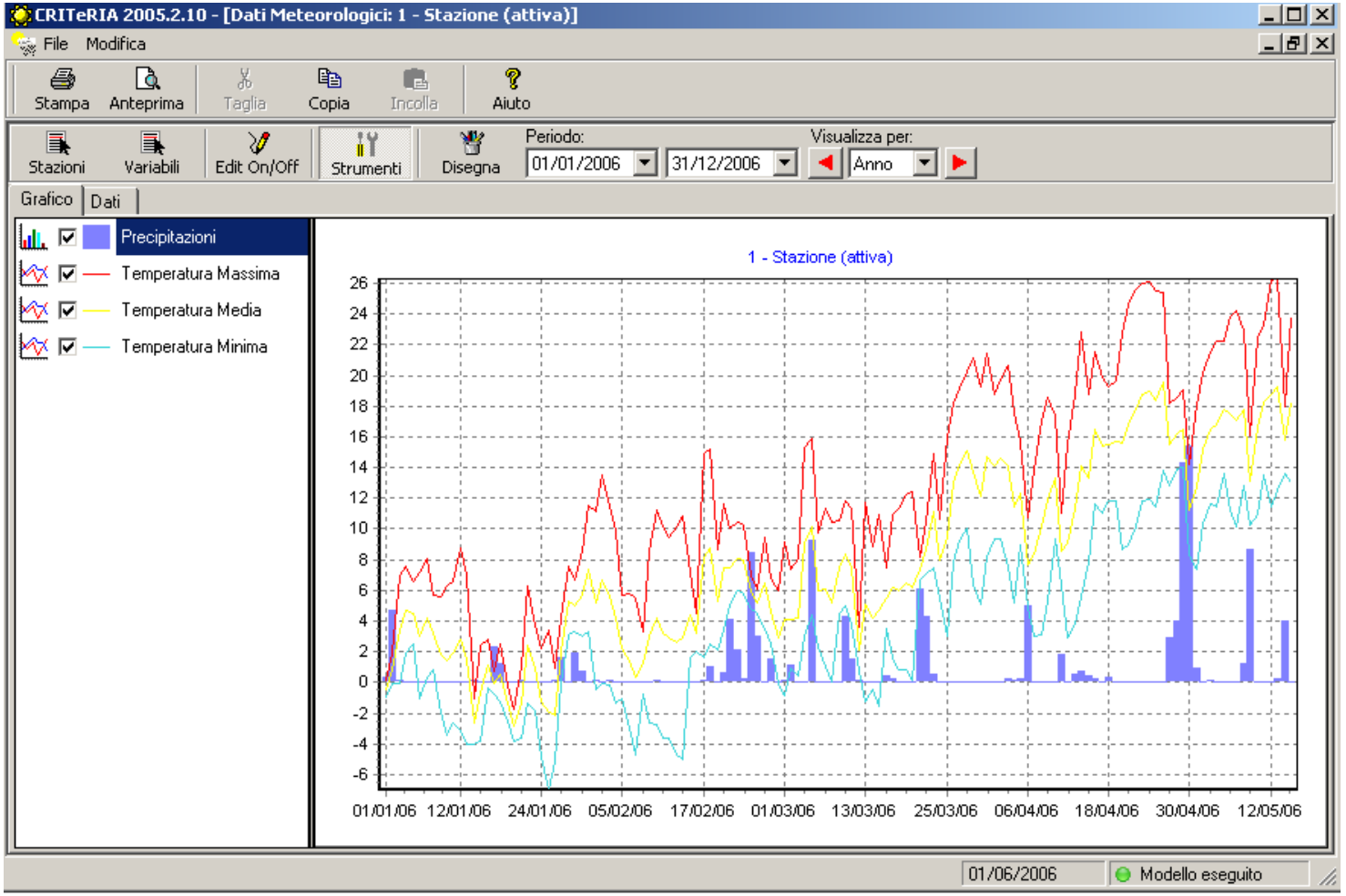
Crop parameters

Parametro	ciclo	soglia	Emergenza	Trapianto	Crescita	Decrescita	Lai min	Lai max
Mais	175	8	30	0	900	1000	0	5
Bietola primaverile	190	5	50	0	950	1220	0	5
Soia	175	10	75	0	650	980	0	5
Frumento Tenero	260	0	120	0	1400	1200	0	5
Orzo	220	0	120	0	800	1000	0	5
Pomodoro da Industria Trap.	115	10	0	150	575	575	0	4
Sorgo	175	10	60	0	660	900	0	5
Girasole	180	10	60	0	660	700	0	5
Patata	150	7	50	0	820	500	0	3,5
Ortive	200	8	80	0	700	900	0	3,5
Cipolla	140	0	150	0	850	1000	0	3
Carota estiva	190	5	50	0	950	1225	0	3
Carota invernale	190	5	50	0	950	1225	0	3
Medica 1^ anno	285	5	100	0	1030	700	0	4
Medica	365	5	0	0	700	1	1	4
Erbaio Intercalare (aut-prim)	240	0	120	0	1155	100	0	4
Prato di Graminacee	365	2	0	0	1400	200	1	4
Asparago	365	5	0	0	800	800	1	4
Incolto	365	2	0	0	600	2000	1	3
Incolto rado	365	2	0	0	600	2000	0,5	1,5
Vite a Spalliera	365	8	0	0	1200	1300	0	3
Pesco su Inerbito	365	7	20	0	1000	1500	0	4
Pesco	365	7	20	0	1000	1500	0	4
pescoGF677 su inerbito	365	7	20	0	1000	1500	0	4
Pero su Inerbito	365	7	0	0	1800	1000	0	3,5
Actinidia su Inerbito	365	5	0	0	1600	2000	0	3,5
Actinidia	365	5	0	0	1600	2000	0	3,5

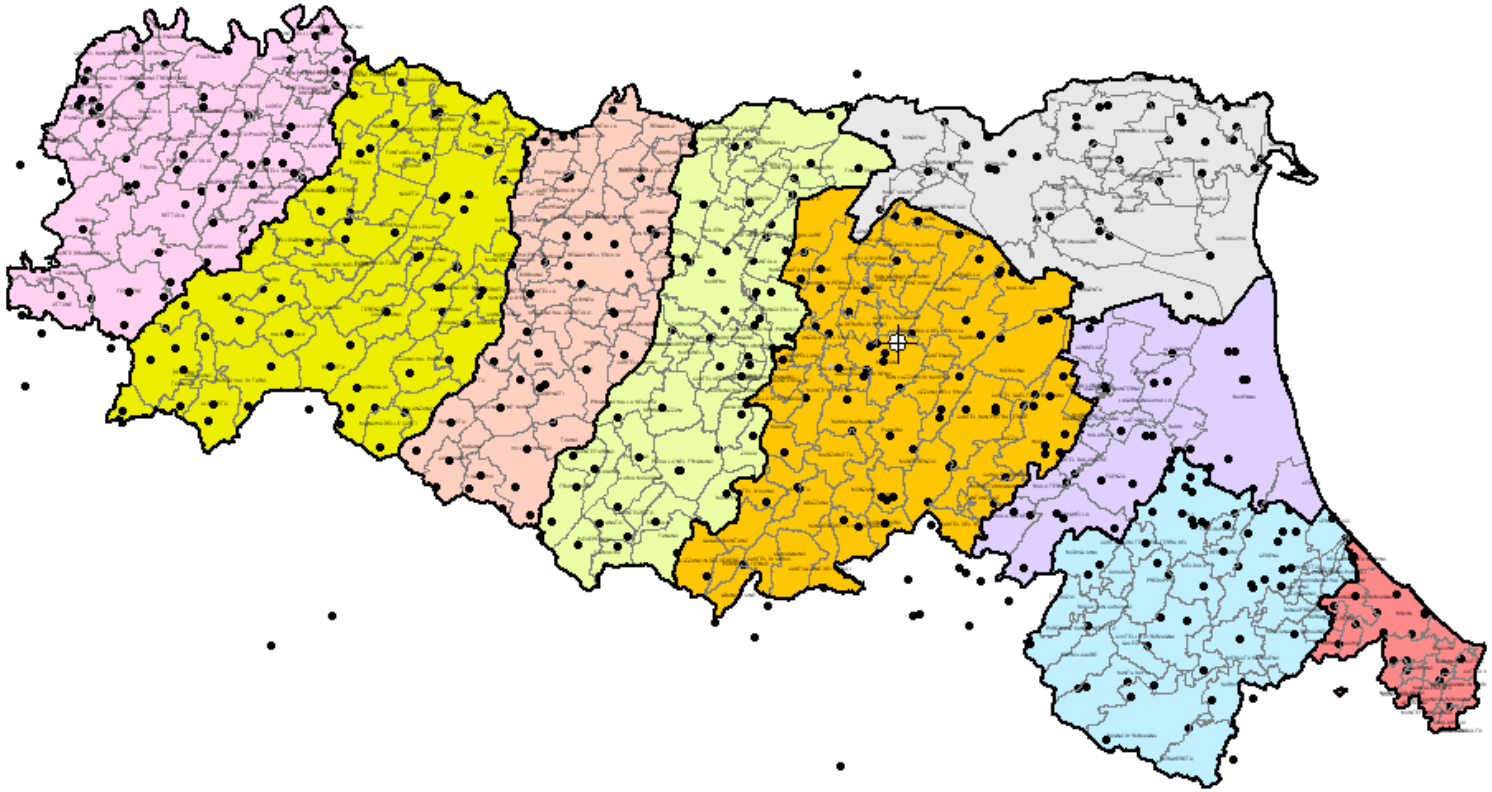
Tillages

Crop rotation

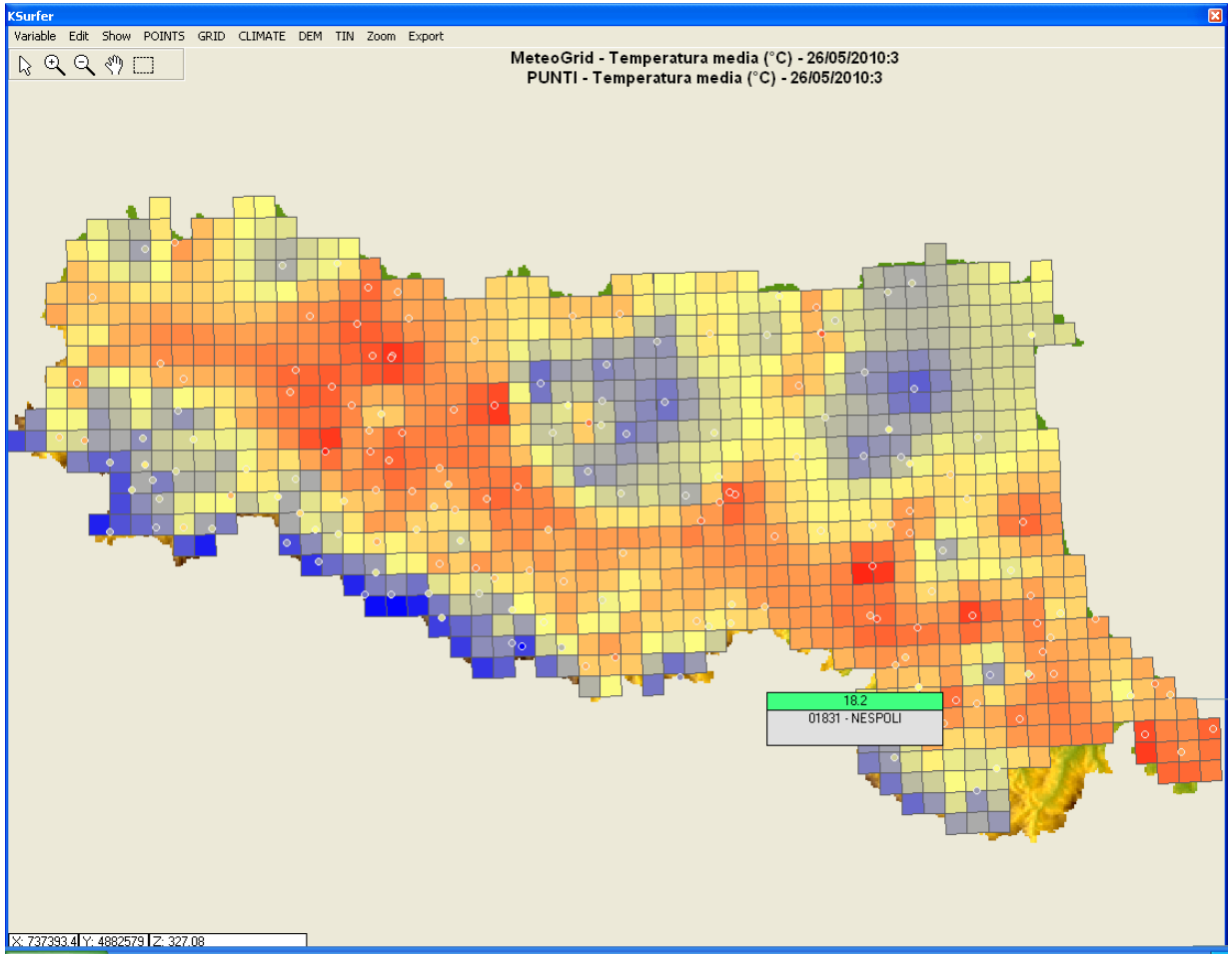
Meteorological data



Station network



ERG5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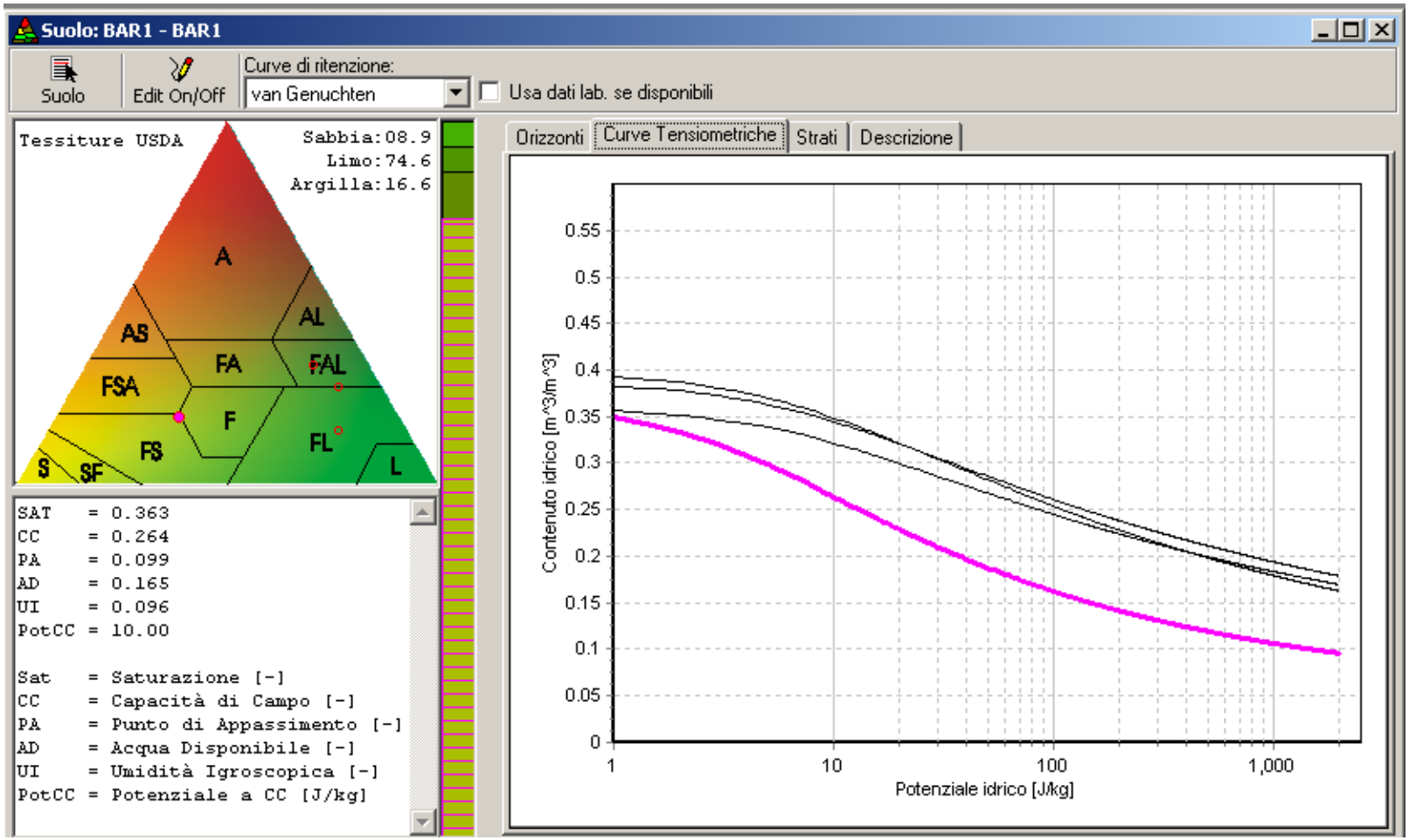
MeteoGrid - Temperatura media (°C) - 26/05/2010:3
PUNTI - Temperatura media (°C) - 26/05/2010:3
18.2
01831 - NESPOLI
X: 737393.4 Y: 4882579 Z: 327.08

Soil data


Suolo: BAR1 - BAR1
Suolo
Edit On/Off
Curve di ritenzione:
van Genuchten
Usa dati lab. se disponibili
Tessiture USDA
Sabbia:08.9
Limo:74.6
Argilla:16.6
A
AL
AS
FA
FAL
FSA
F
FL
FS
S
SF
L
SAT = 0.363
CC = 0.264
PA = 0.099
AD = 0.165
UI = 0.096
PotCC = 10.00
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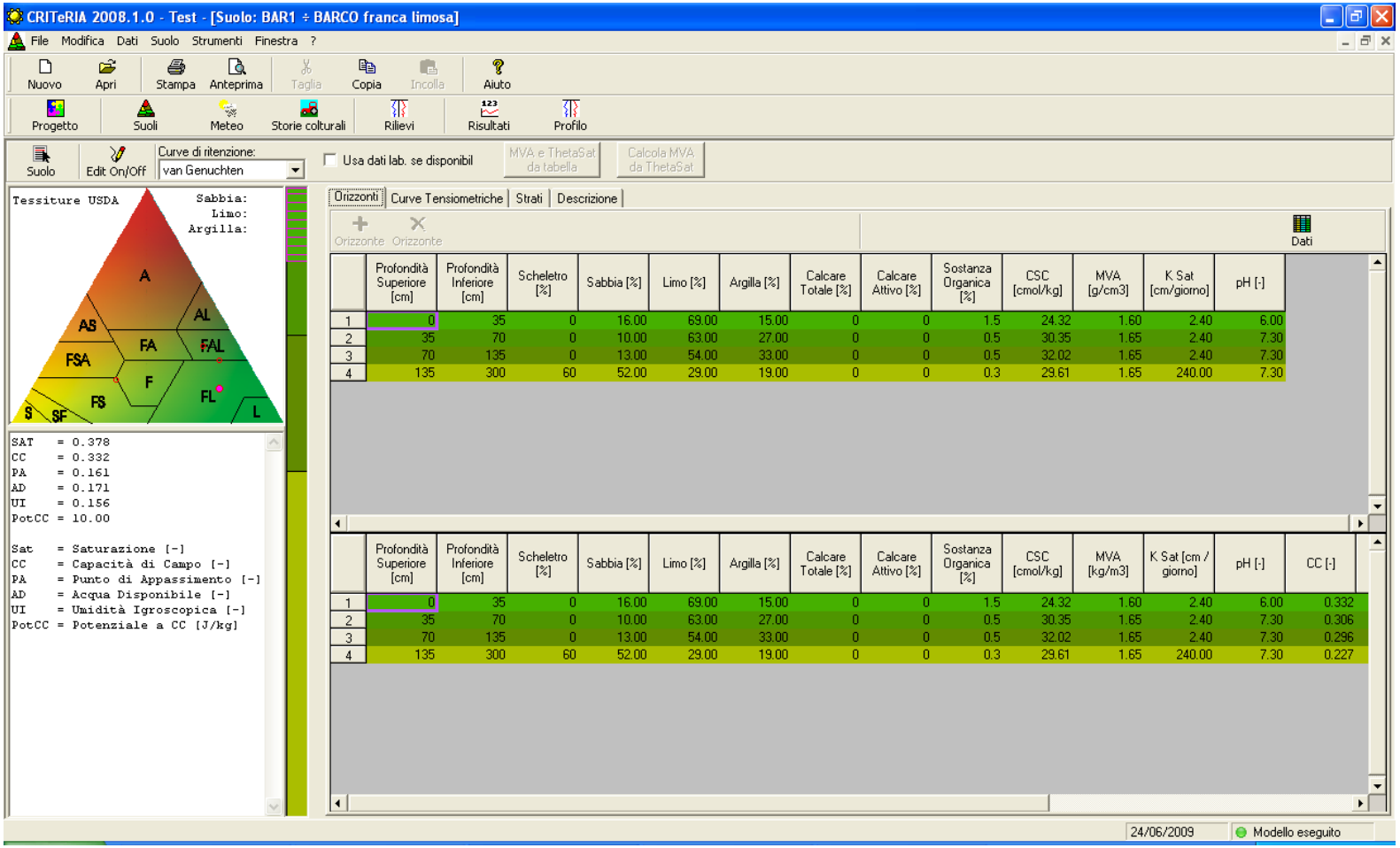
CC = Capacità di Campo [-]
PA = Punto di Appassimento [-]
AD = Acqua Disponibile [-]
UI = Umidità Igroscopica [-]
PotCC = Potenziale a CC [J/kg]
Orizzonti
Curve Tensiometriche
Strati
Descrizione
Contenuto idrico [m^3/m^3]
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1
10
100
1,000
Potenziale idrico [J/kg]

Soil data


CRITeRIA 2008.1.0 - Test - [Suolo: BAR1 ÷ BARCO franca limosa]
File Modifica Dati Suolo Strumenti Finestra ?
Nuovo Apri Stampa Anteprima Taglia Copia Incolla Aiuto
Progetto Suoli Meteo Storie colturali Rilievi Risultati Profilo
Suolo Edit On/Off Curve di ritenzione: van Genuchten Usa dati lab. se disponibil MVA e ThetaSat da tabella Calcola MVA da ThetaSat
Tessiture USDA
Sabbia:
Limo:
Argilla:
A AL AS FA FAL FSA F FL FS S SF L
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UI = 0.156
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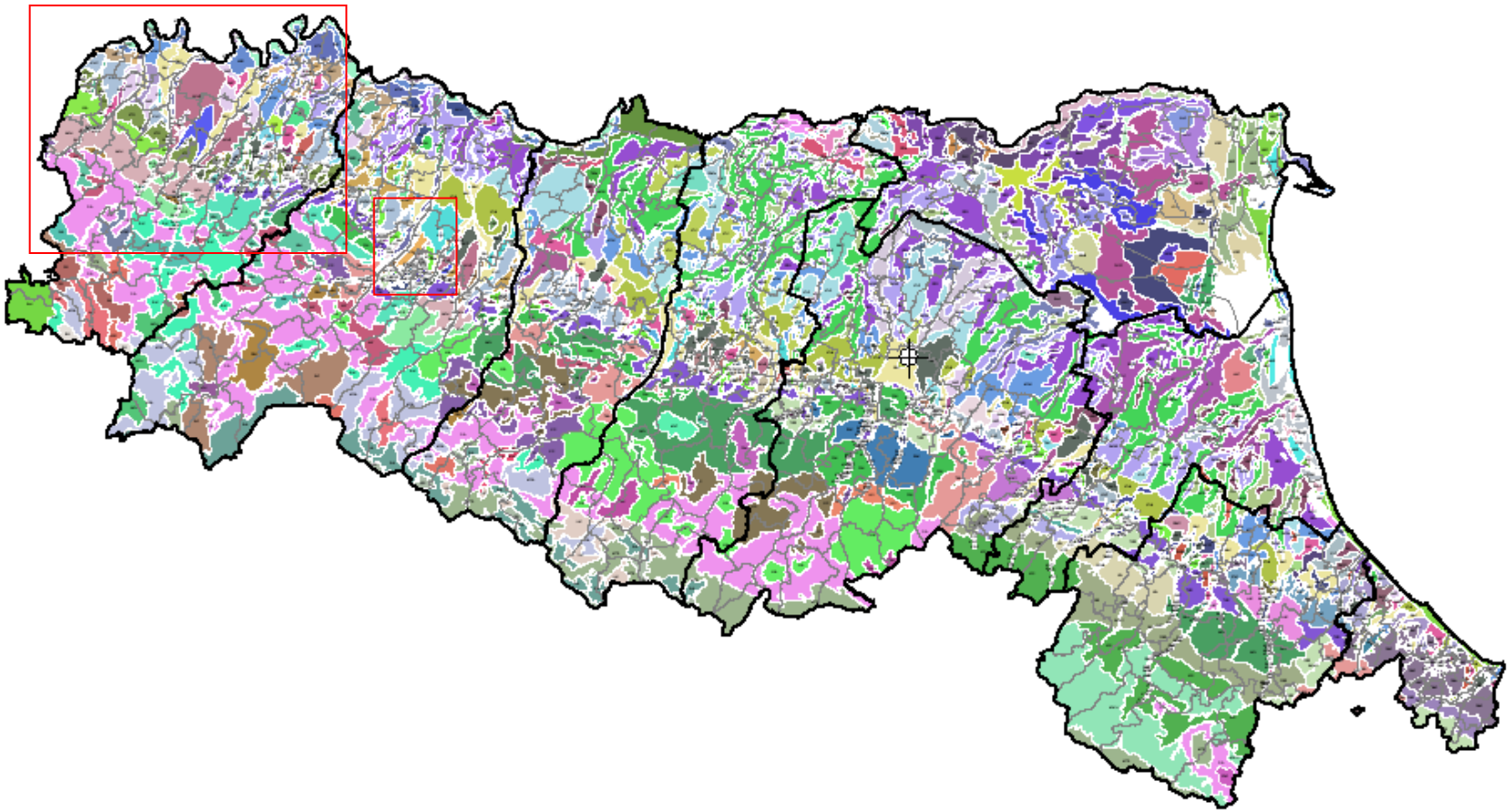
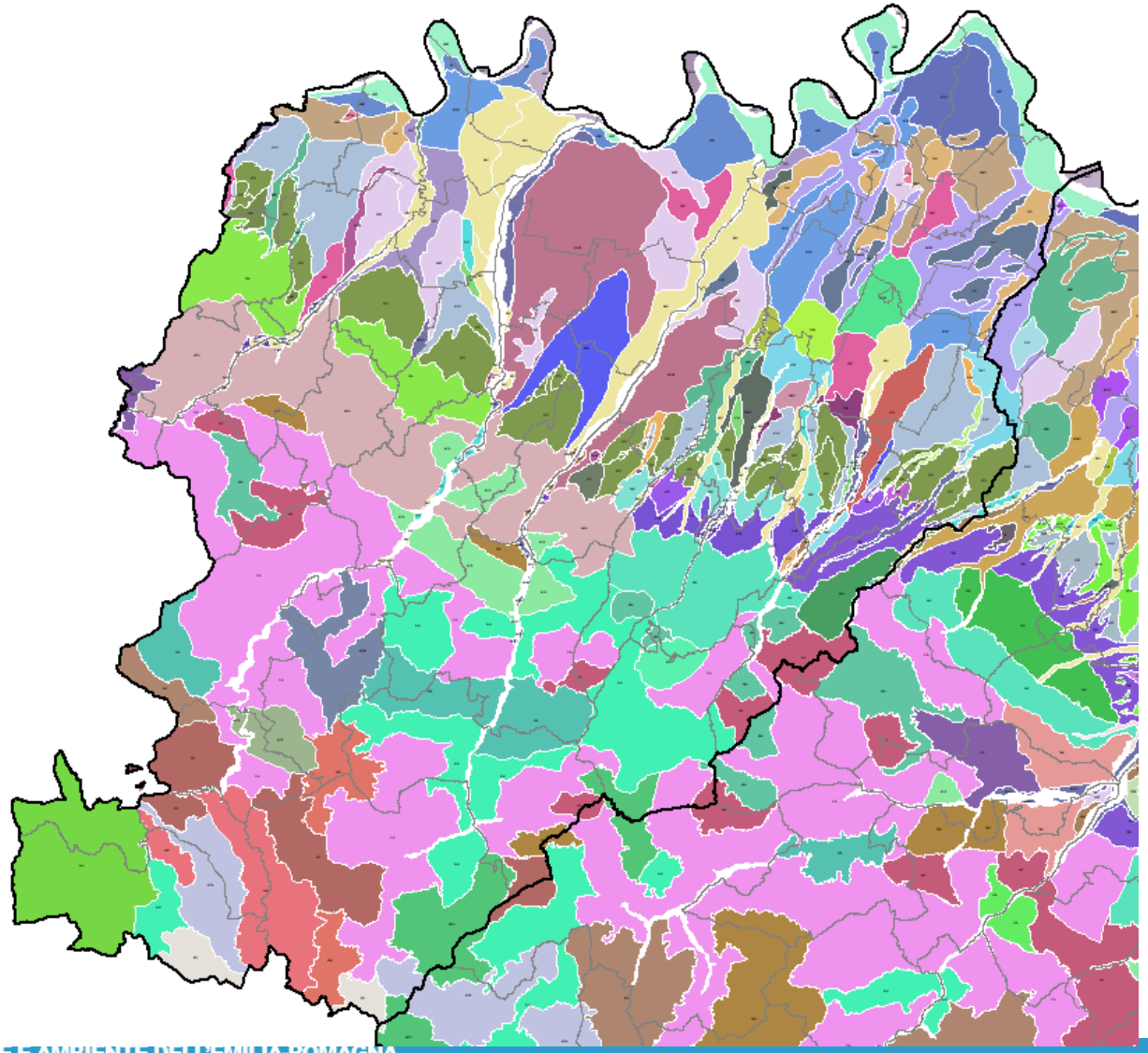
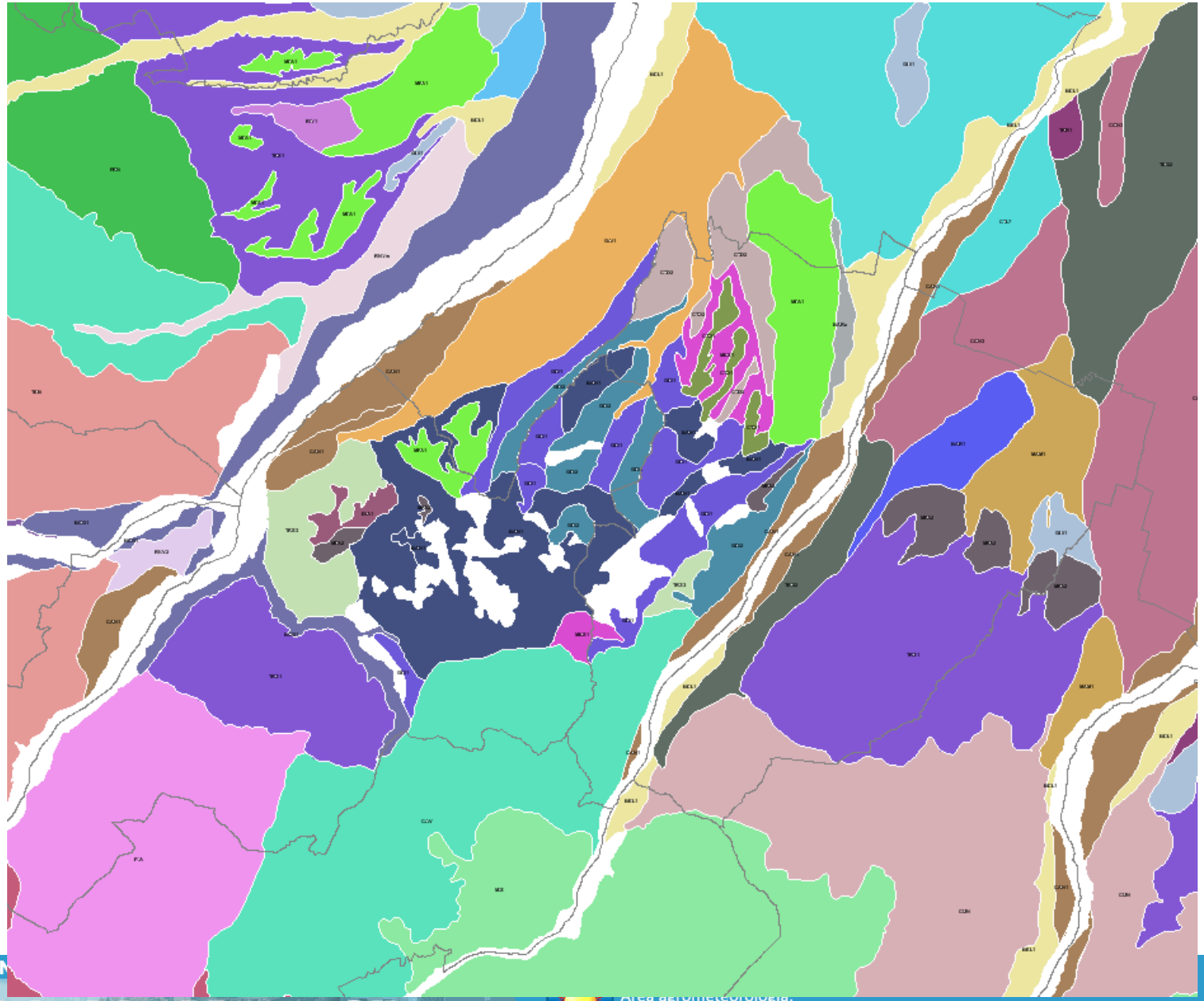
CC = Capacità di Campo [-]
PA = Punto di Appassimento [-]
AD = Acqua Disponibile [-]
UI = Umidità Igroscopica [-]
PotCC = Potenziale a CC [J/kg]
Orizzonti Curve Tensiometriche Strati Descrizione
Orizzonte Orizzonte Dati
Profondità Superiore [cm] | Profondità Inferiore [cm] | Scheletro [%] | Sabbia [%] | Limo [%] | Argilla [%] | Calcare Totale [%] | Calcare Attivo [%] | Sostanza Organica [%] | CSC [cmol/kg] | MVA [g/cm3] | K Sat [cm/giorno] | pH [-]
1 0 35 0 16.00 69.00 15.00 0 0 1.5 24.32 1.60 2.40 6.00
2 35 70 0 10.00 63.00 27.00 0 0 0.5 30.35 1.65 2.40 7.30
3 70 135 0 13.00 54.00 33.00 0 0 0.5 32.02 1.65 2.40 7.30
4 135 300 60 52.00 29.00 19.00 0 0 0.3 29.61 1.65 240.00 7.30
Profondità Superiore [cm] | Profondità Inferiore [cm] | Scheletro [%] | Sabbia [%] | Limo [%] | Argilla [%] | Calcare Totale [%] | Calcare Attivo [%] | Sostanza Organica [%] | CSC [cmol/kg] | MVA [kg/m3] | K Sat [cm / giorno] | pH [-] | CC [-]
1 0 35 0 16.00 69.00 15.00 0 0 1.5 24.32 1.60 2.40 6.00 0.332
2 35 70 0 10.00 63.00 27.00 0 0 0.5 30.35 1.65 2.40 7.30 0.306
3 70 135 0 13.00 54.00 33.00 0 0 0.5 32.02 1.65 2.40 7.30 0.296
4 135 300 60 52.00 29.00 19.00 0 0 0.3 29.61 1.65 240.00 7.30 0.227
24/06/2009
Modello eseguito

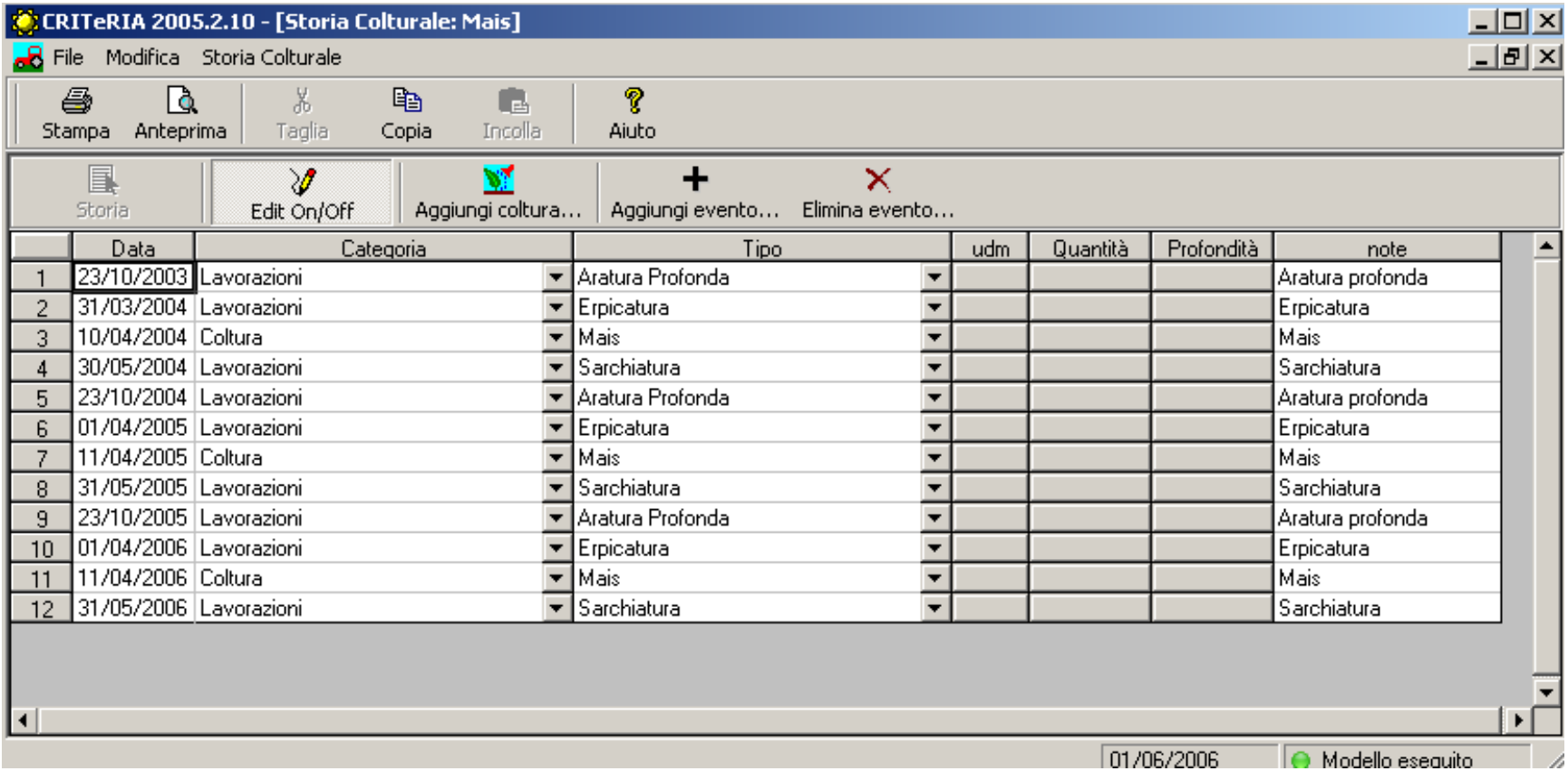
Soil map (1:250000 in mountain areas and 1:50.000 in plain areas)







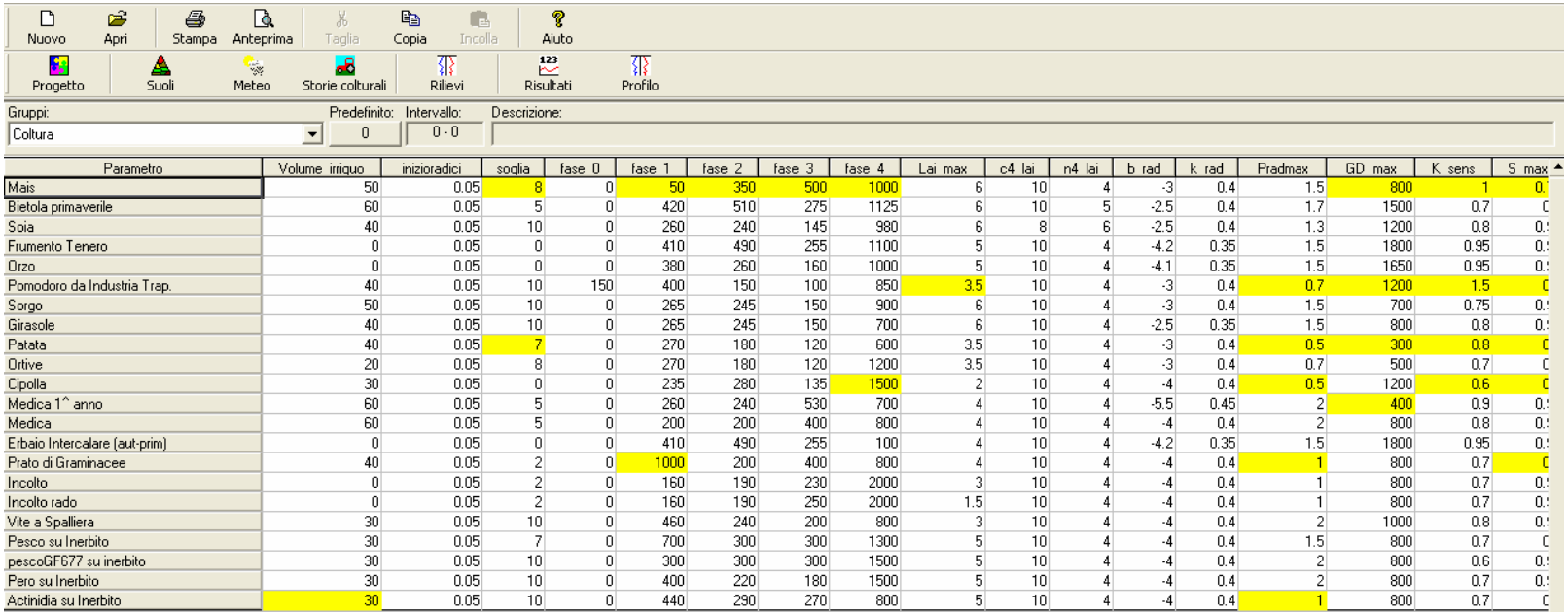
Agronomic data



	Data	Categoria	Tipo	udm	Quantità	Profondità	note
1	23/10/2003	Lavorazioni	Aratura Profonda				Aratura profonda
2	31/03/2004	Lavorazioni	Erpicatura				Erpicatura
3	10/04/2004	Coltura	Mais				Mais
4	30/05/2004	Lavorazioni	Sarchiatura				Sarchiatura
5	23/10/2004	Lavorazioni	Aratura Profonda				Aratura profonda
6	01/04/2005	Lavorazioni	Erpicatura				Erpicatura
7	11/04/2005	Coltura	Mais				Mais
8	31/05/2005	Lavorazioni	Sarchiatura				Sarchiatura
9	23/10/2005	Lavorazioni	Aratura Profonda				Aratura profonda
10	01/04/2006	Lavorazioni	Erpicatura				Erpicatura
11	11/04/2006	Coltura	Mais				Mais
12	31/05/2006	Lavorazioni	Sarchiatura				Sarchiatura

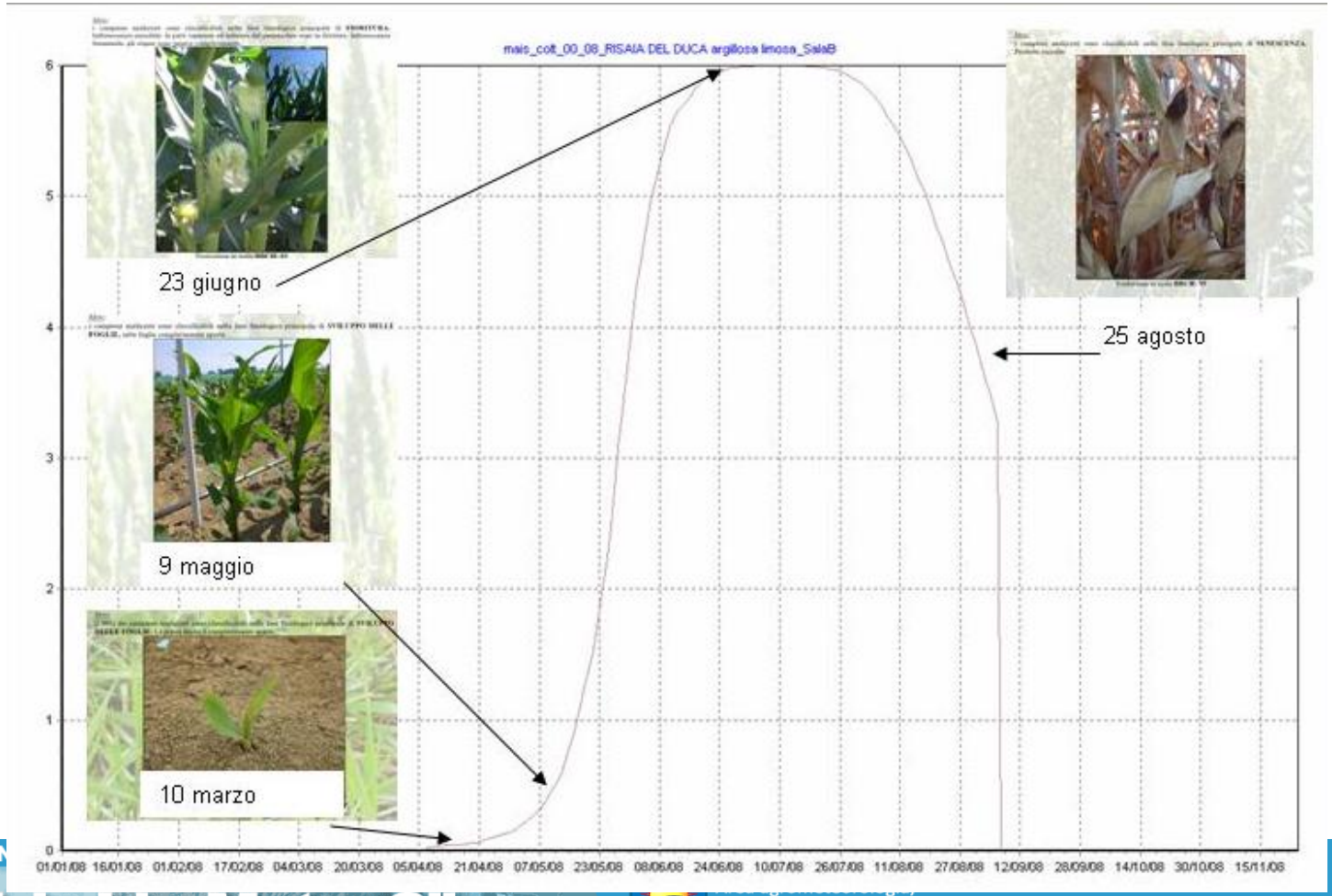
Crop parameters

Thermic threshold, GDD for phenological development, Lai max, Lai min, rooting depth, max sensibility to water stress, start and end of irrigation, irrigation shift, Kc max, ecc.

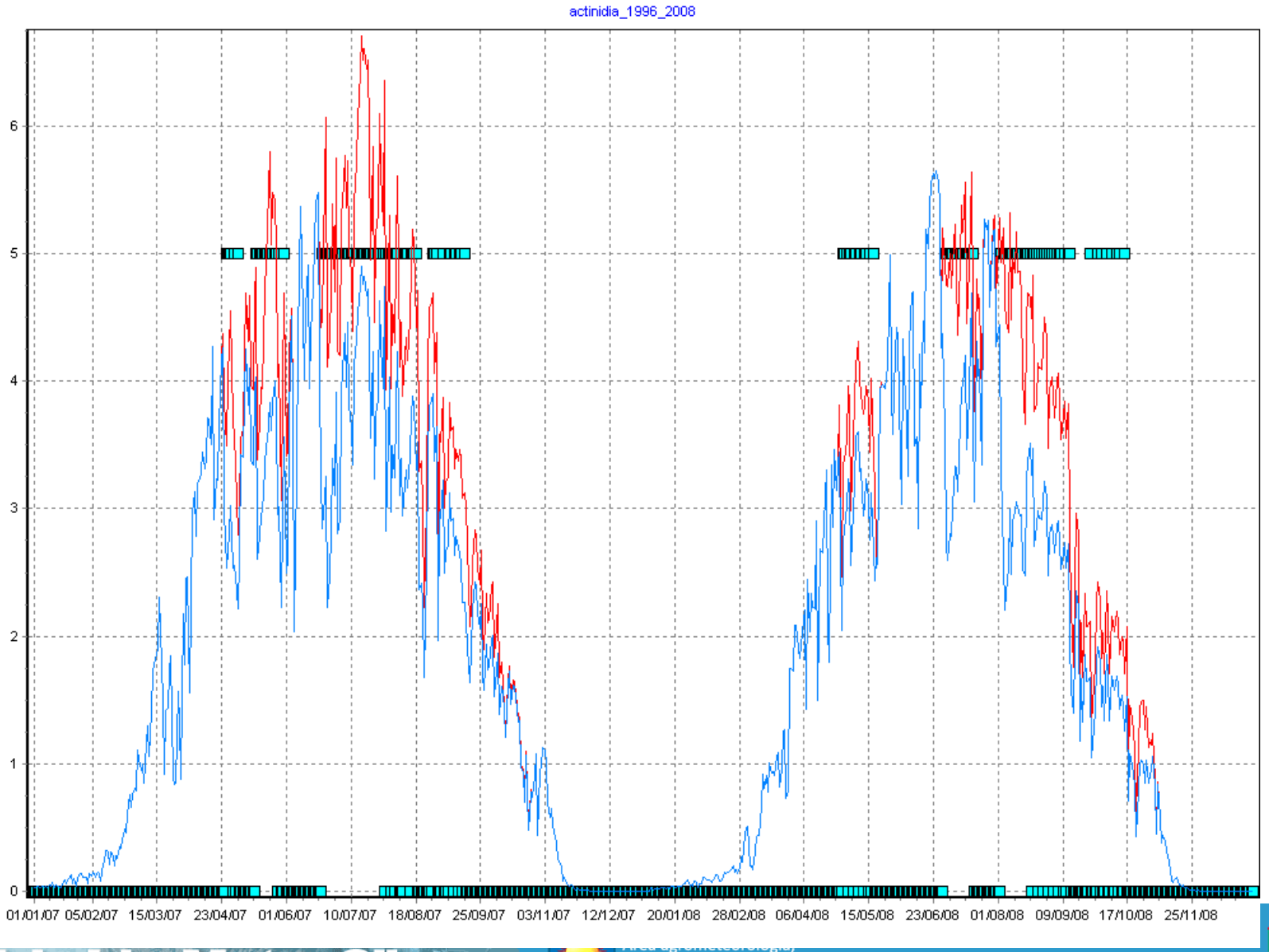


Parametro	Volume irriguo	inizioradici	soglia	fase 0	fase 1	fase 2	fase 3	fase 4	Lai max	c4 lai	n4 lai	b rad	k rad	Pradmax	GD max	K sens	S max
Mais	50	0.05	8	0	50	350	500	1000	6	10	4	-3	0.4	1.5	800	1	0.
Bietola primaverile	60	0.05	5	0	420	510	275	1125	6	10	5	-2.5	0.4	1.7	1500	0.7	0
Soia	40	0.05	10	0	260	240	145	980	6	8	6	-2.5	0.4	1.3	1200	0.8	0.
Frumento Tenero	0	0.05	0	0	410	490	255	1100	5	10	4	-4.2	0.35	1.5	1800	0.95	0.
Orzo	0	0.05	0	0	380	260	160	1000	5	10	4	-4.1	0.35	1.5	1650	0.95	0.
Pomodoro da Industria Trap.	40	0.05	10	150	400	150	100	850	3.5	10	4	-3	0.4	0.7	1200	1.5	0
Sorgo	50	0.05	10	0	265	245	150	900	6	10	4	-3	0.4	1.5	700	0.75	0.
Girasole	40	0.05	10	0	265	245	150	700	6	10	4	-2.5	0.35	1.5	800	0.8	0.
Patata	40	0.05	7	0	270	180	120	600	3.5	10	4	-3	0.4	0.5	300	0.8	0
Ortive	20	0.05	8	0	270	180	120	1200	3.5	10	4	-3	0.4	0.7	500	0.7	0
Cipolla	30	0.05	0	0	235	280	135	1500	2	10	4	-4	0.4	0.5	1200	0.6	0
Medica 1^ anno	60	0.05	5	0	260	240	530	700	4	10	4	-5.5	0.45	2	400	0.9	0.
Medica	60	0.05	5	0	200	200	400	800	4	10	4	-4	0.4	2	800	0.8	0.
Erbaio Intercalare (aut-prim)	0	0.05	0	0	410	490	255	100	4	10	4	-4.2	0.35	1.5	1800	0.95	0.
Prato di Graminacee	40	0.05	2	0	1000	200	400	800	4	10	4	-4	0.4	1	800	0.7	0
Incolto	0	0.05	2	0	160	190	230	2000	3	10	4	-4	0.4	1	800	0.7	0.
Incolto rado	0	0.05	2	0	160	190	250	2000	1.5	10	4	-4	0.4	1	800	0.7	0.
Vite a Spalliera	30	0.05	10	0	460	240	200	800	3	10	4	-4	0.4	2	1000	0.8	0.
Pesco su Inerbito	30	0.05	7	0	700	300	300	1300	5	10	4	-4	0.4	1.5	800	0.7	0
pescoGF677 su inerbito	30	0.05	10	0	300	300	300	1500	5	10	4	-4	0.4	2	800	0.6	0.
Pero su Inerbito	30	0.05	10	0	400	220	180	1500	5	10	4	-4	0.4	2	800	0.7	0.
Actinidia su Inerbito	30	0.05	10	0	440	290	270	800	5	10	4	-4	0.4	1	800	0.7	0

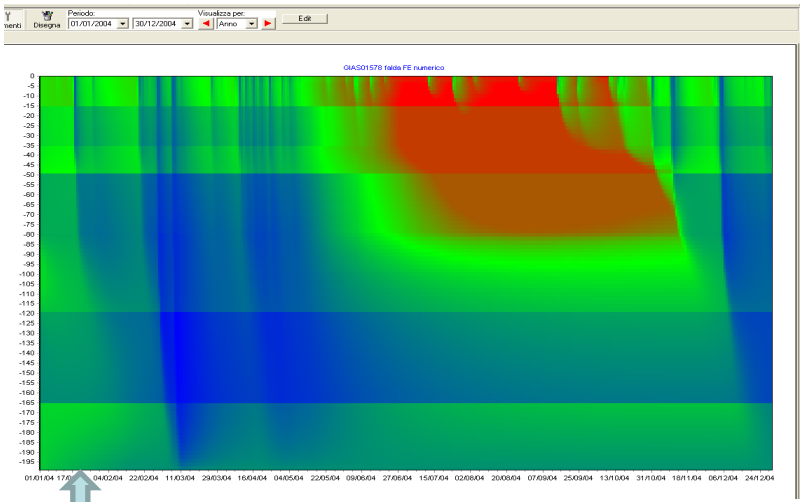
For each study case, Criteria simulates the trend of some important variables for the crop and the water balance:
-lai development,
-rooting depth.



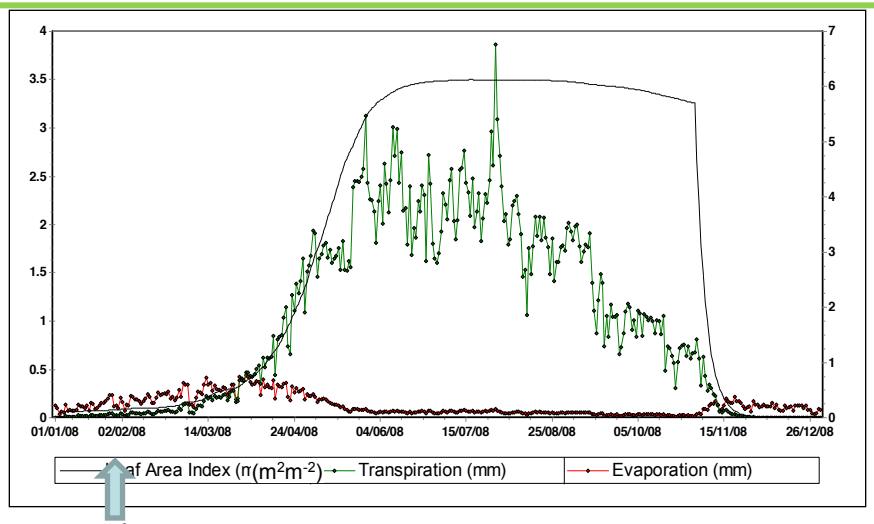
Trend of maximum and real transpiration



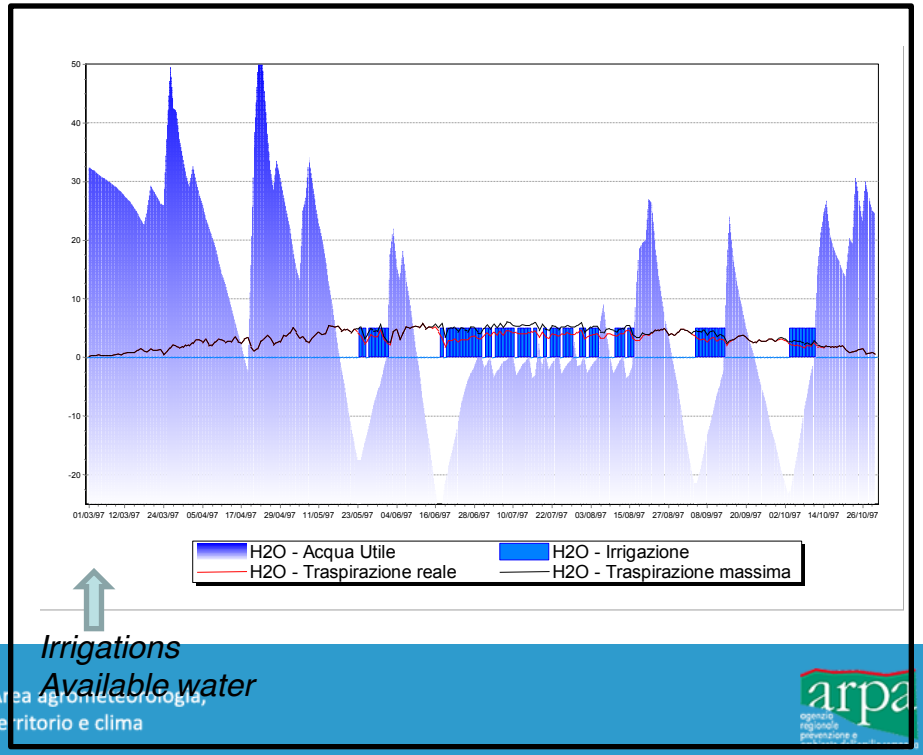
CRITERIA OUTPUTS



Soil moisture
on the soil profile

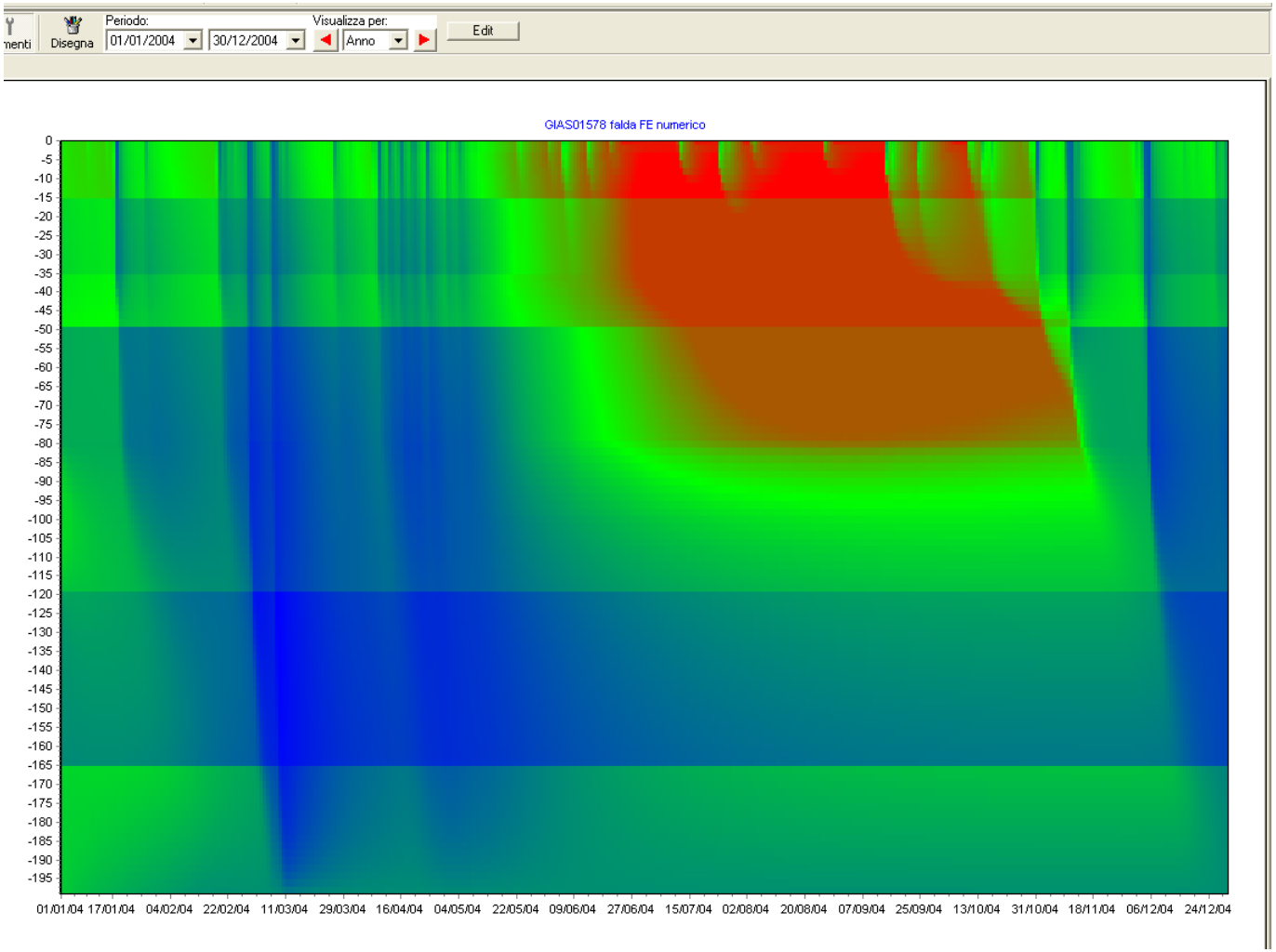


Leaf area index
Evapotranspiration

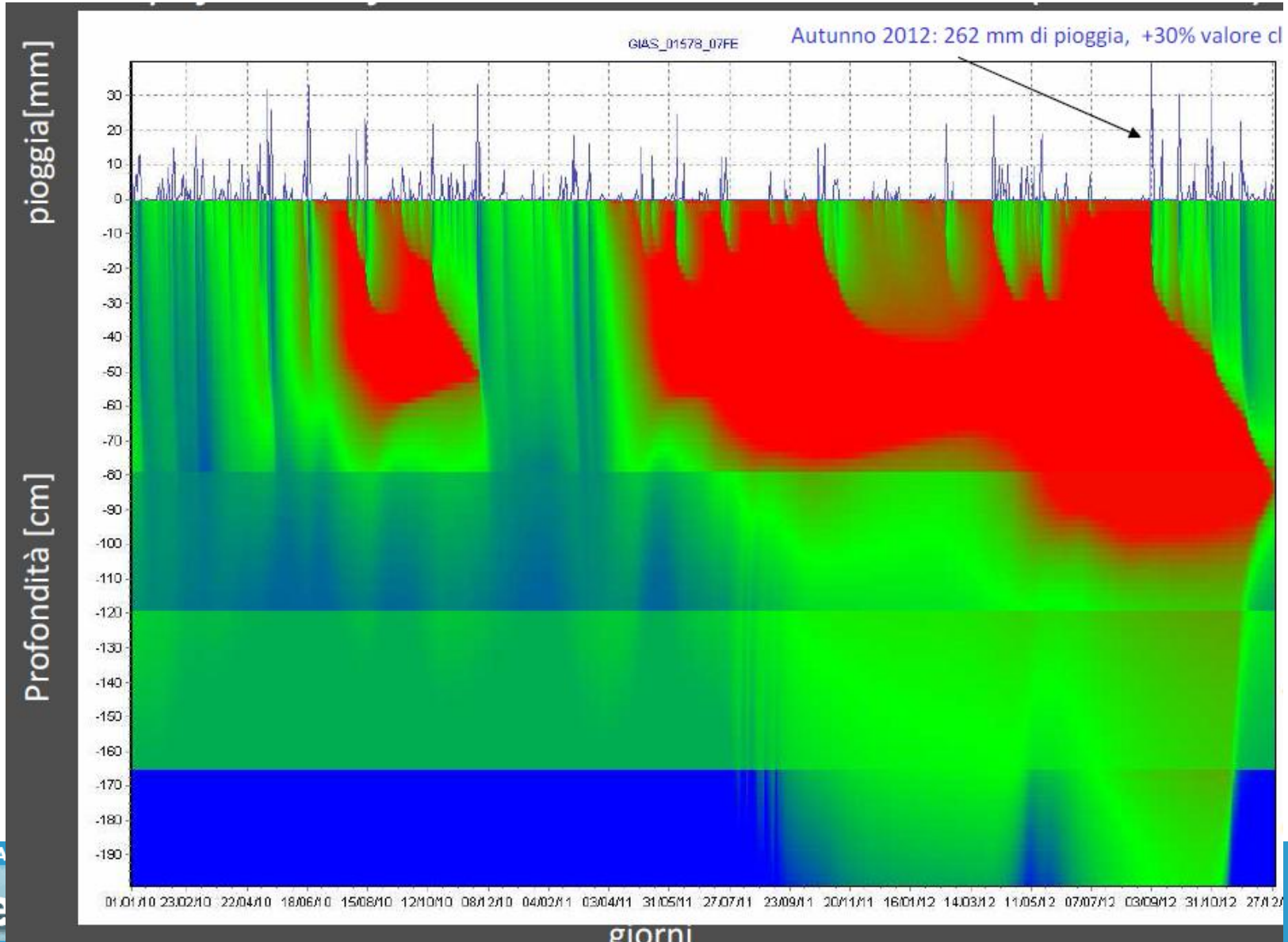


Irrigations
Available water

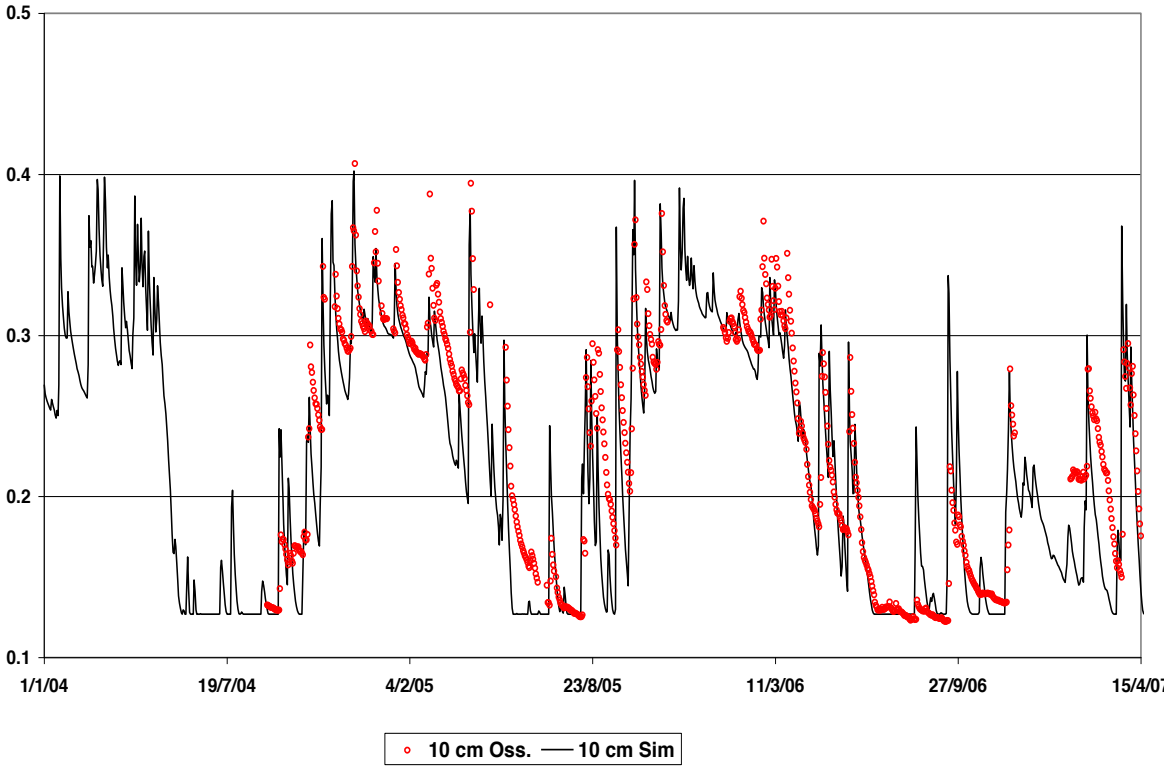
CRITERIA 1D (BdP)

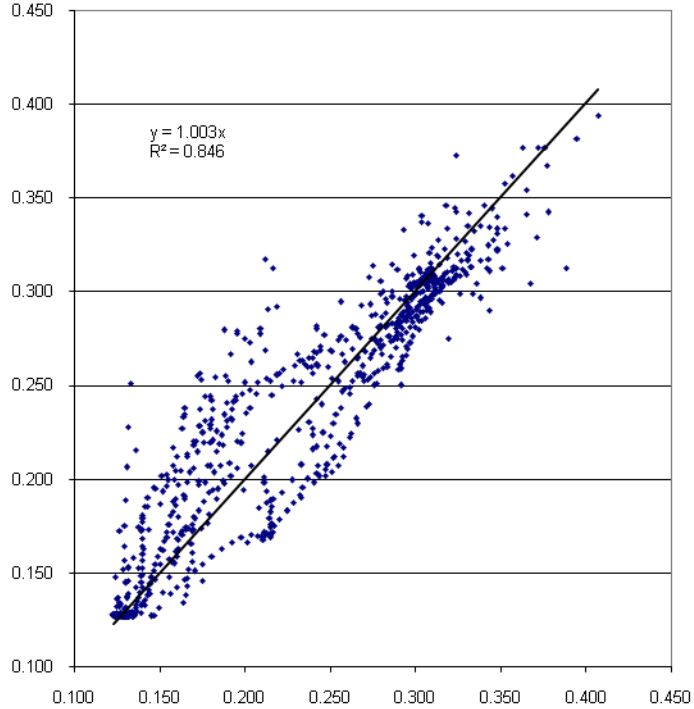


Simulation of years 2010-2012



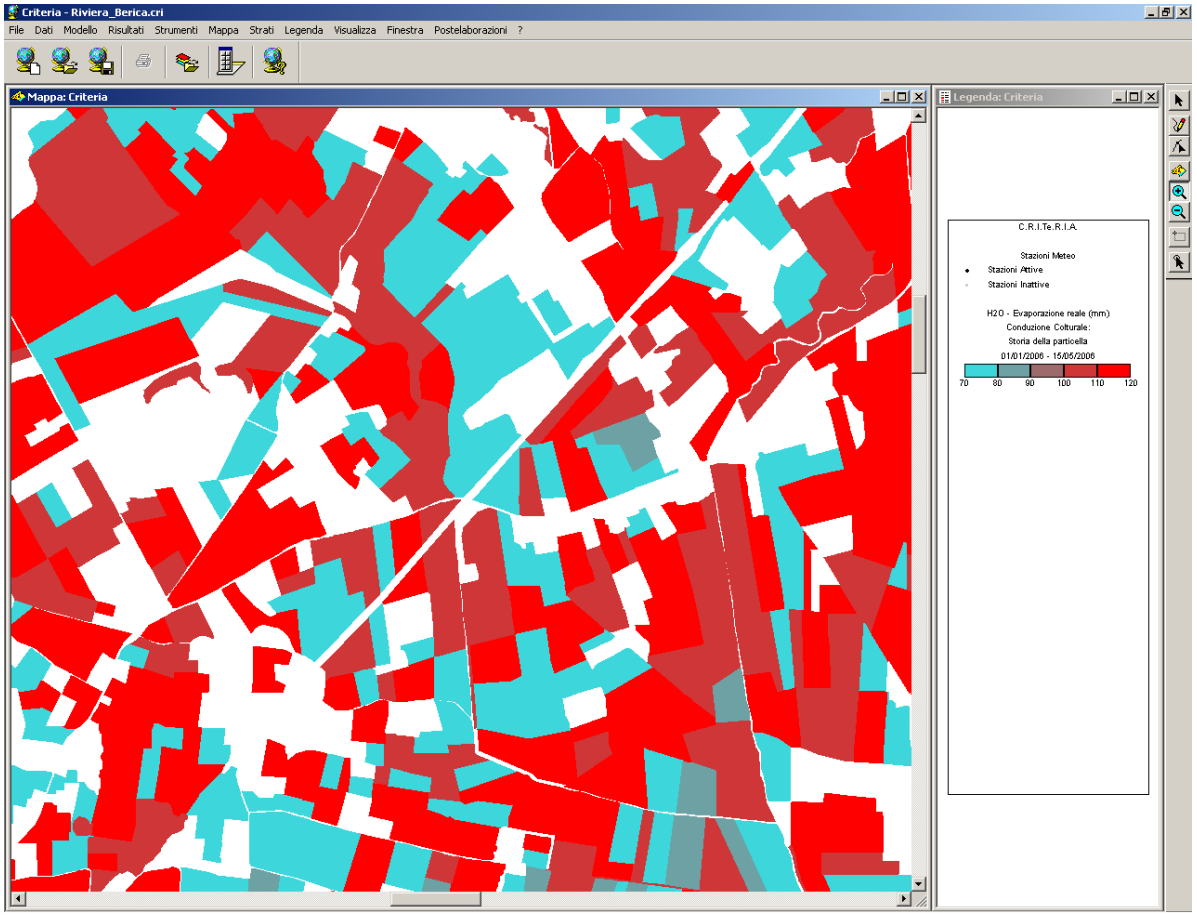
Validation

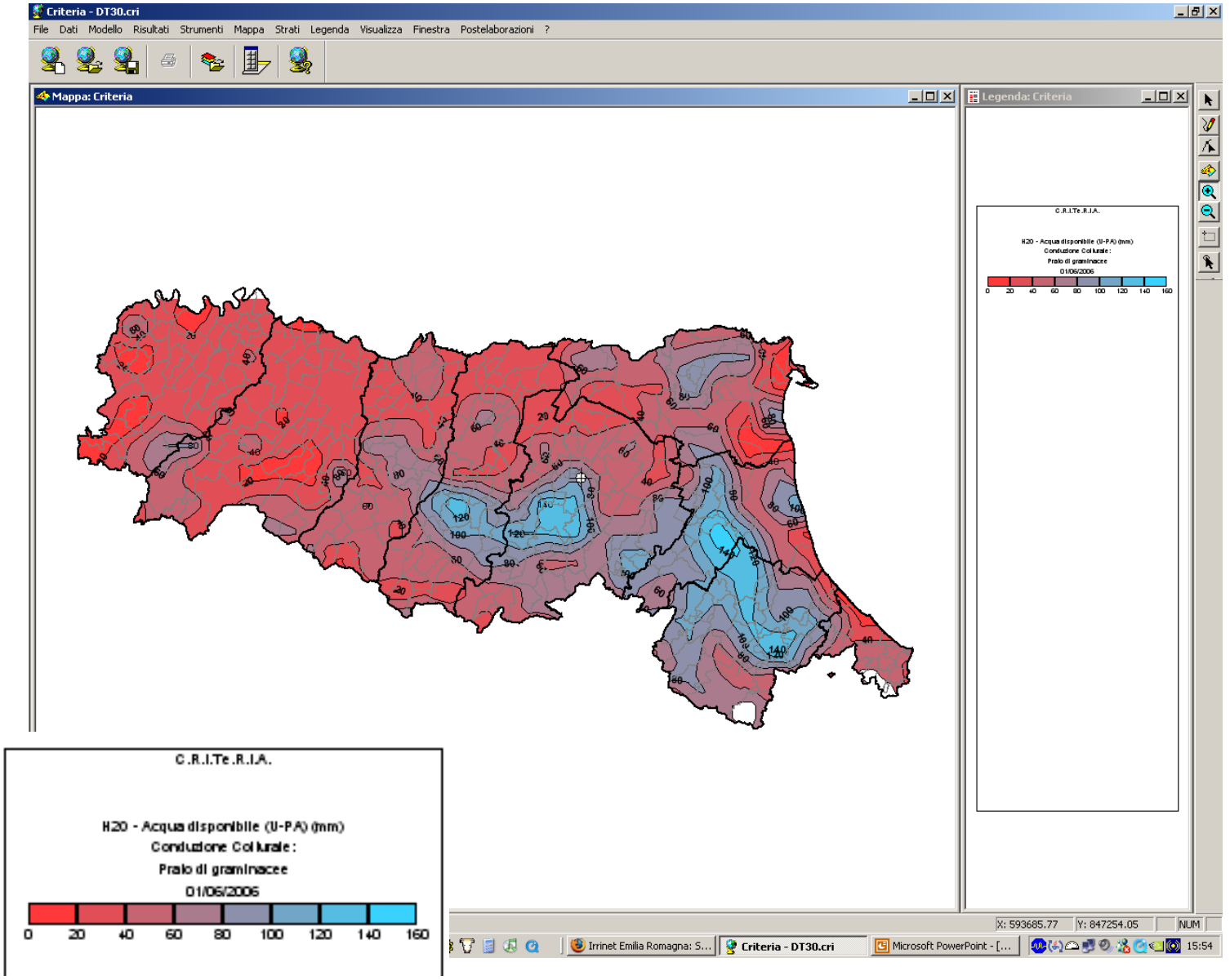




San Pietro Capofiume (2004-2007), confronto tra la simulazione di Criteria (modello numerico) e dati misurati (TDR), soil moisture a 10 cm

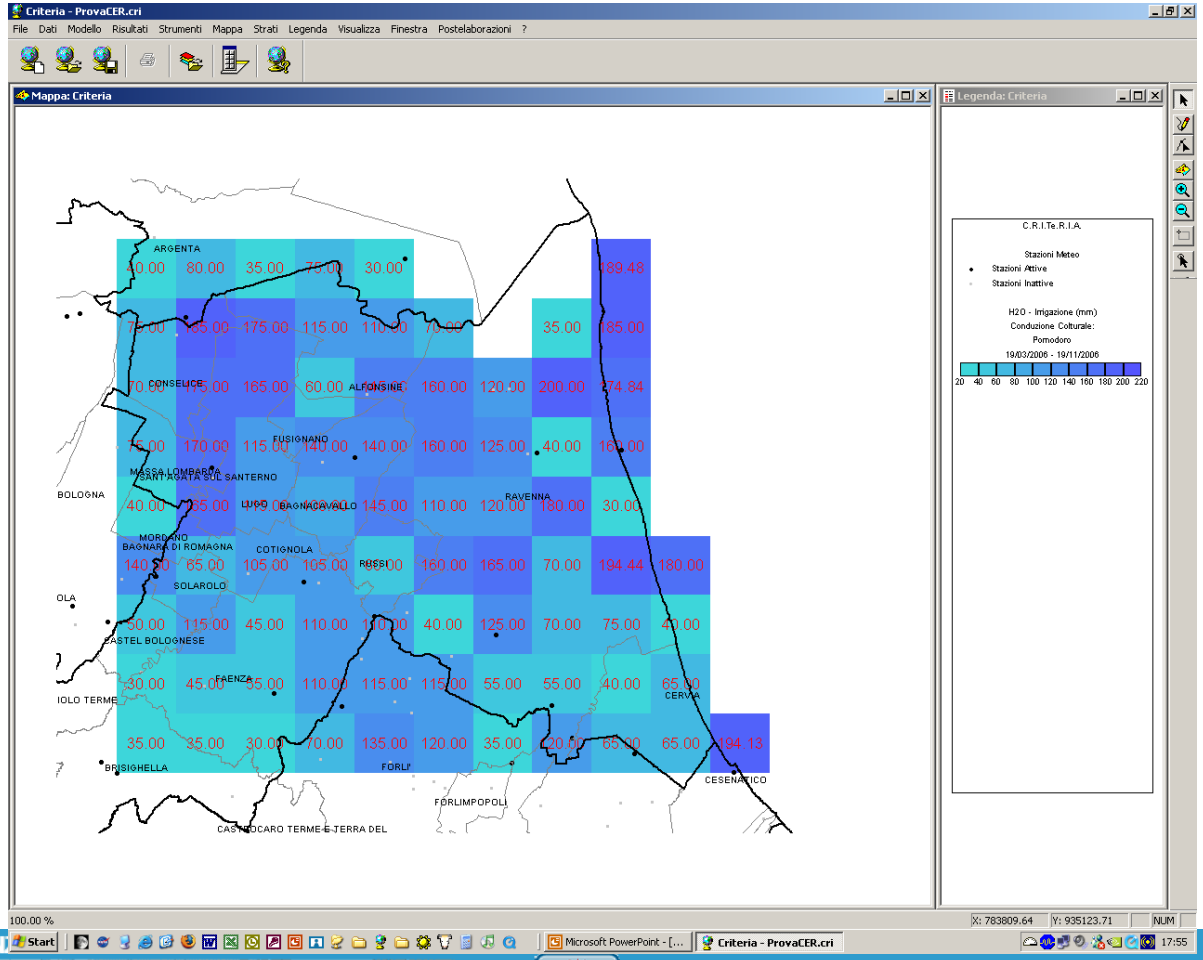
CRITERIA GEO




Criteria - DT30.cri
File Dati Modello Risultati Strumenti Mappa Strati Legenda Visualizza Finestra Postelaborazioni ?
Mappa: Criteria
Legenda: Criteria
C.R.I.Te.R.I.A.
H20 - Acqua disponibile (U-PA) (mm)
Conduzione Colturale :
Prato di graminacee
01/06/2006
0 20 40 60 80 100 120 140 160
X: 593685.77 Y: 847254.05 NUM
Irrinet Emilia Romagna: S...
Criteria - DT30.cri
Microsoft PowerPoint - [...
15:54

C.R.I.Te.R.I.A.
H20 - Acqua disponibile (U-PA) (mm)
Conduzione Colturale :
Prato di graminacee
01/06/2006
0 20 40 60 80 100 120 140 160

Irrigation 2006 (mm)



Result map (irrigation)

Criteria: application

- Agrometeorological bullettins
- Reclamation consortia support
- Yield forecasts
- Pollution from agriculture
- Agricultural drought index
- Landslide risks
- Fire risks