Climate change scenarios in Emilia-Romagna

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Local Action Program to cope with drought and desertification

PAL in Emilia-Romagna

disclosure of the criteria for sustainable water management in condition of water scarcity, with the involvement of local administration, experts and stakeholders.

PAL ER focused on

the relationship between irrigation and water balance in a representative river basin
in current and future climate scenarios

to prevent the desertification in sensitive areas

understand dynamics of the critical factors

identifying the limits of the exploitation of the territory

following the principle

of sustainable management of water resources in agriculture.

Technical approach

identification of study area, crisis factors and possible solutions, establishment of a technical support group

Envolvement of stakeholders

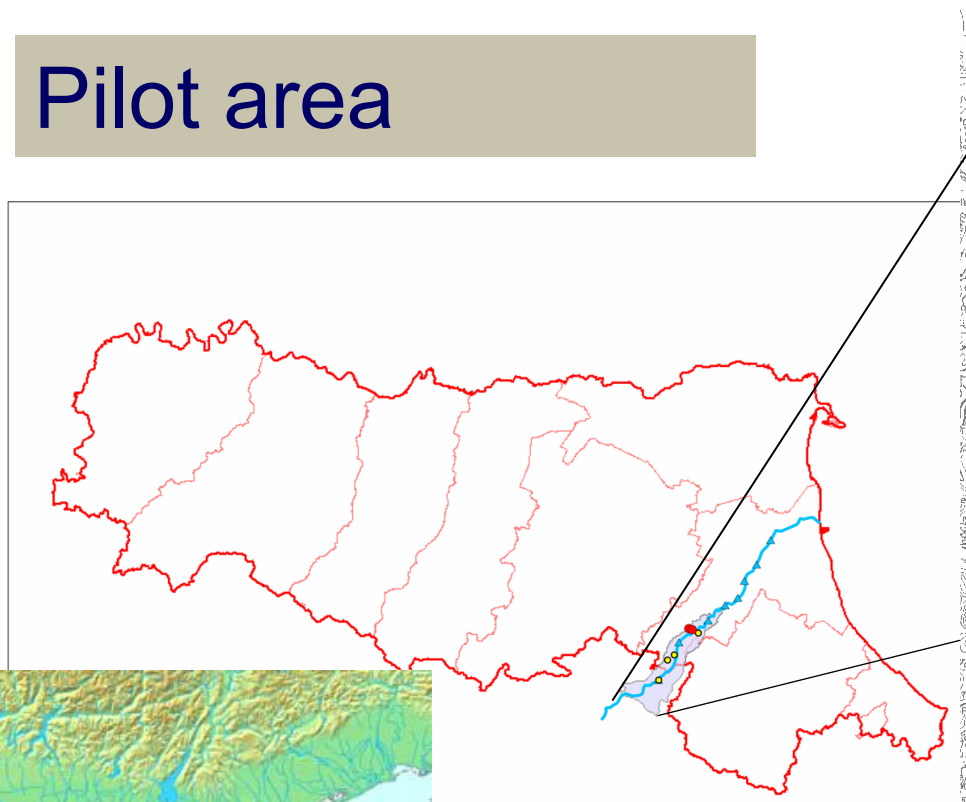
local administrations, associations, farmers, reclamation consortia, etc.

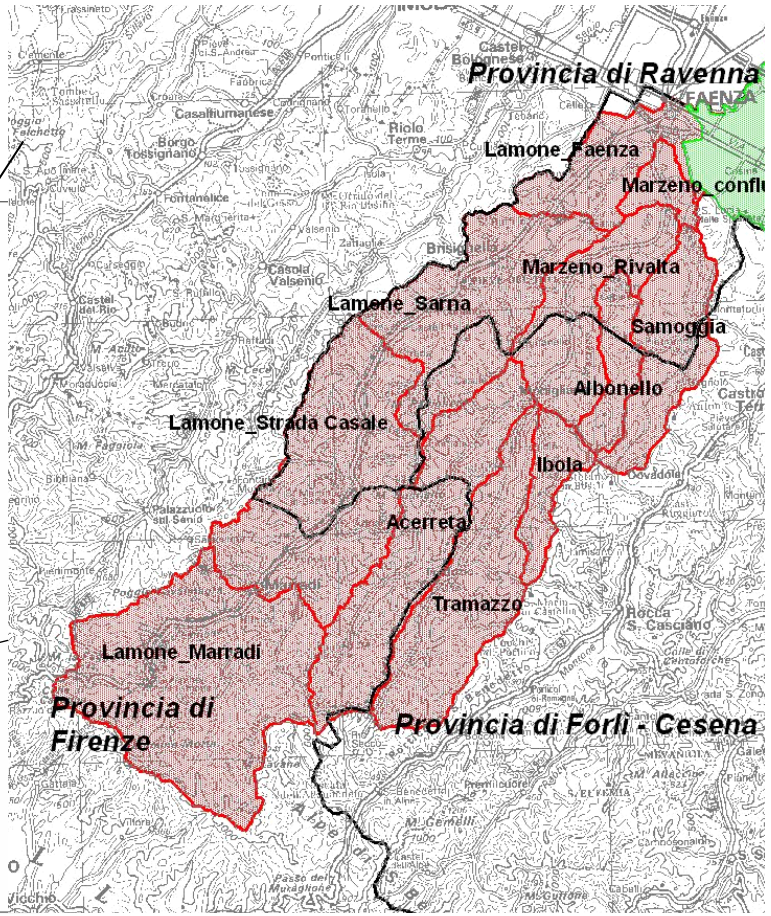
Dissemination and comunication

seminars, workshops, conferences

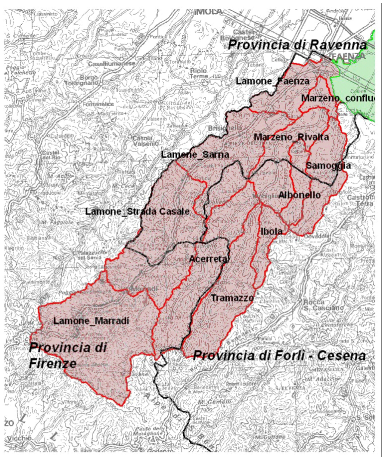
Case study

Pilot area





valley of river Lamone



the critical water balance in the basin have been long highlighted

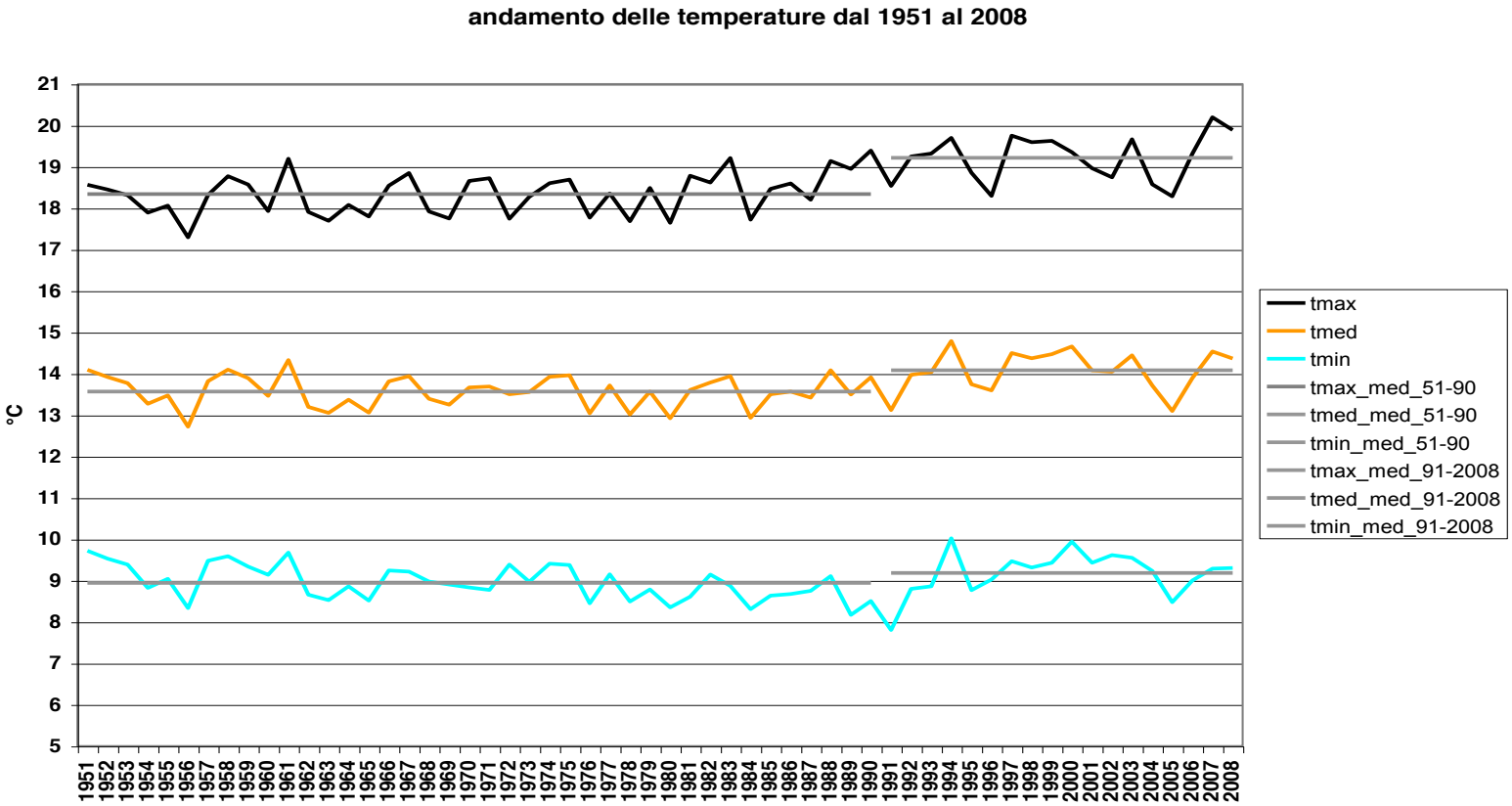
the **Regional Authority for Romagna Basins (ABRR)** have entered the Lamone valley

- in Annex "F" (areas threatened by drought, degradation soil and desertification processes - LGS 159/99) for the Regional Plan of water protection

- in the list of **vulnerable areas to desertification processes** (CIPE 229/1999)

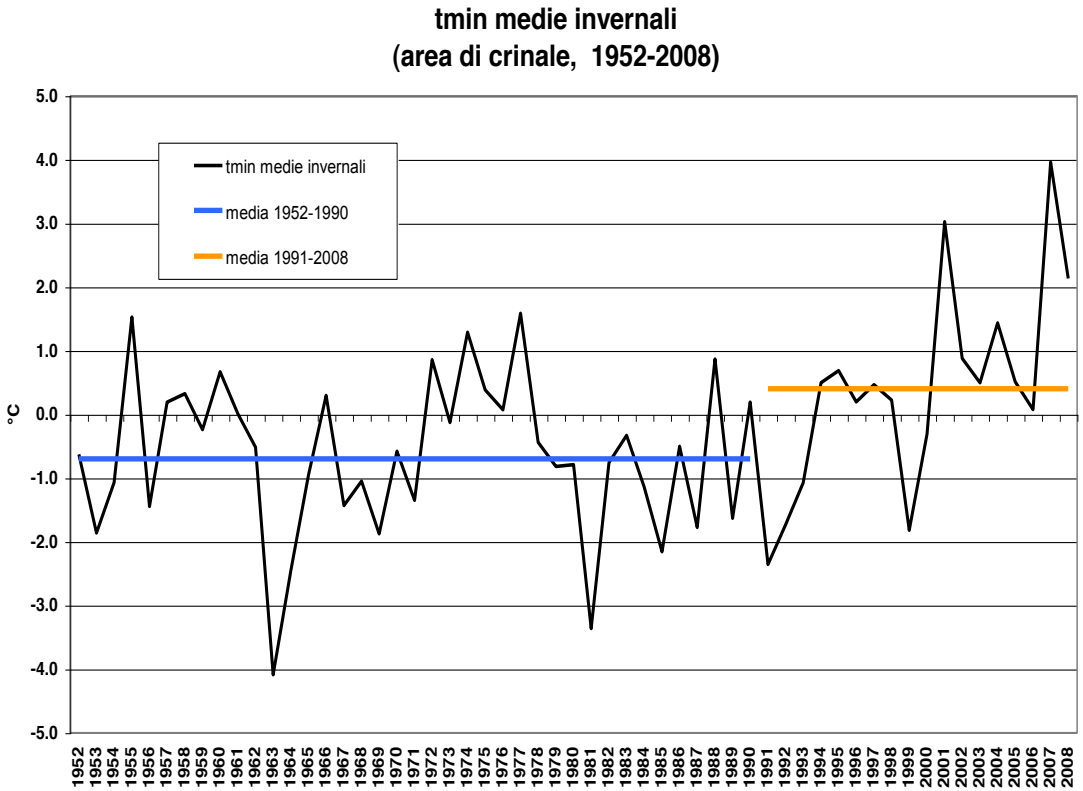
Climate change in the Lamone valley - discontinuity in the 90s

1°C increase in maximum temperatures

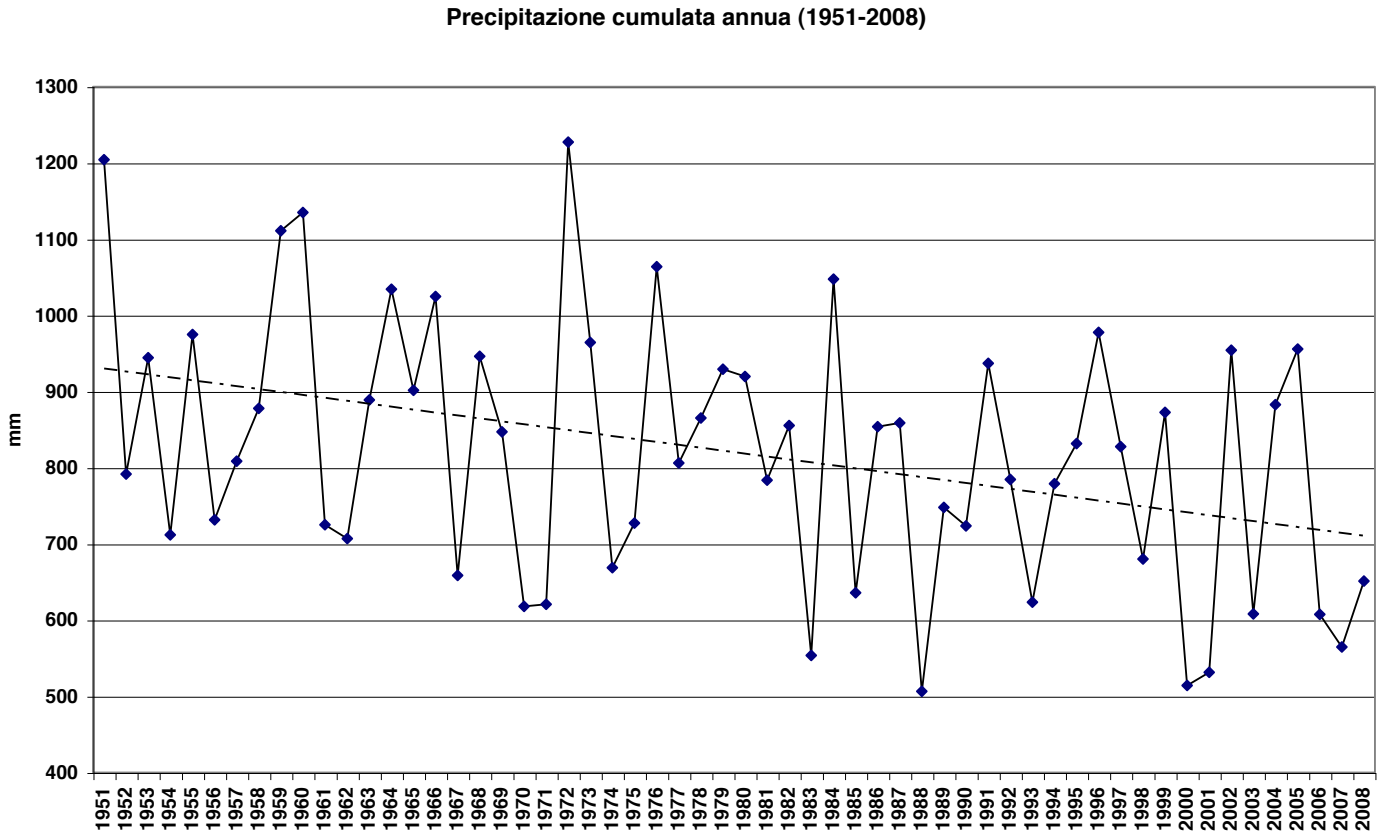


Climate change in the Lamone valley - discontinuity in the 90s

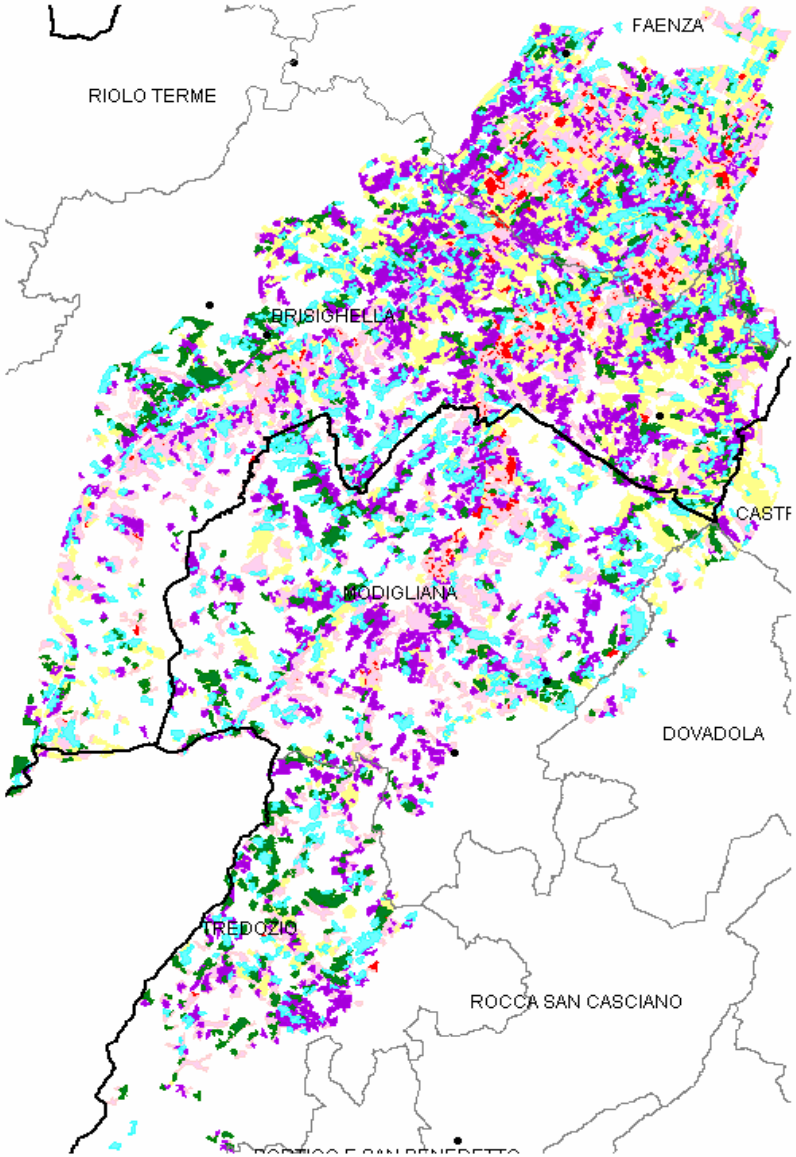
Winter minimum temperatures rose more than 1°C



Climate change in the Lamone valley
downward trend in rainfall of more than 2 mm per year



In the valleys of Romagna **specialized fruit farms** are increasing and the traditional vineyards and peach orchards are replaced with fruits with additional income, but high water consumption, like **kiwi (Actinidia chinensis e A. deliciosa)**



Wheat

Peach

Grape

Kiwi

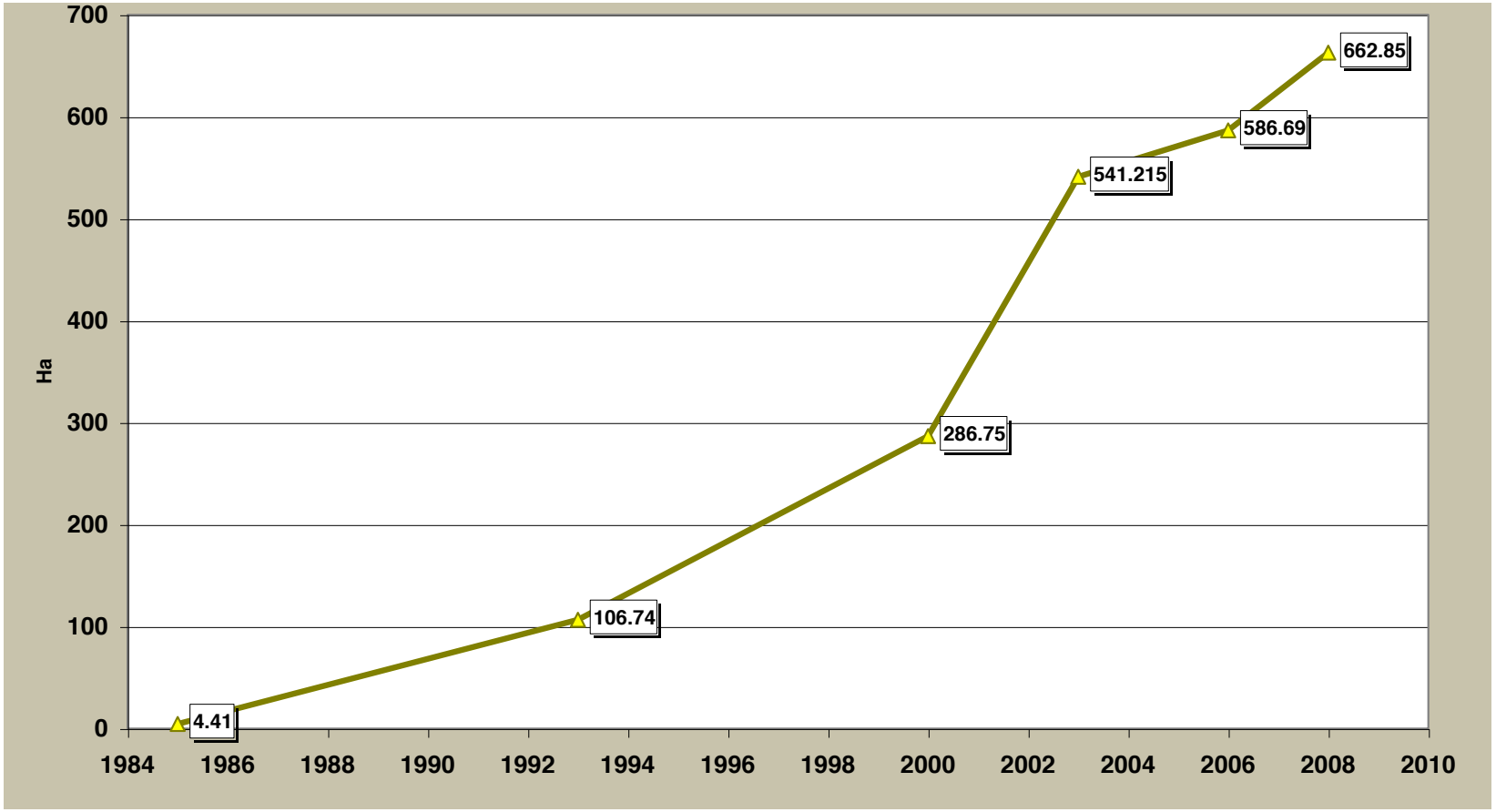
Alfalfa

Spring crops

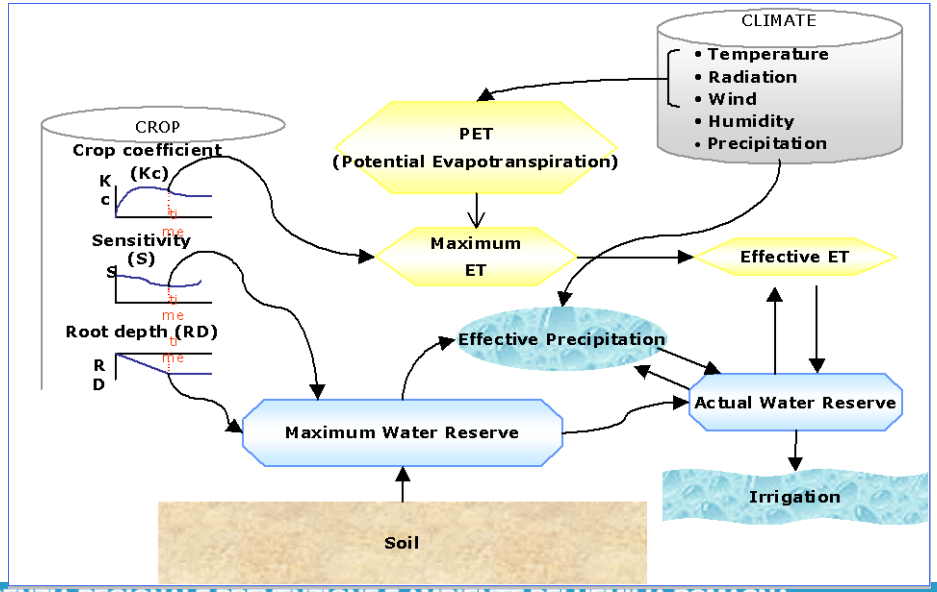
Map of land use from remote sensing (2008)

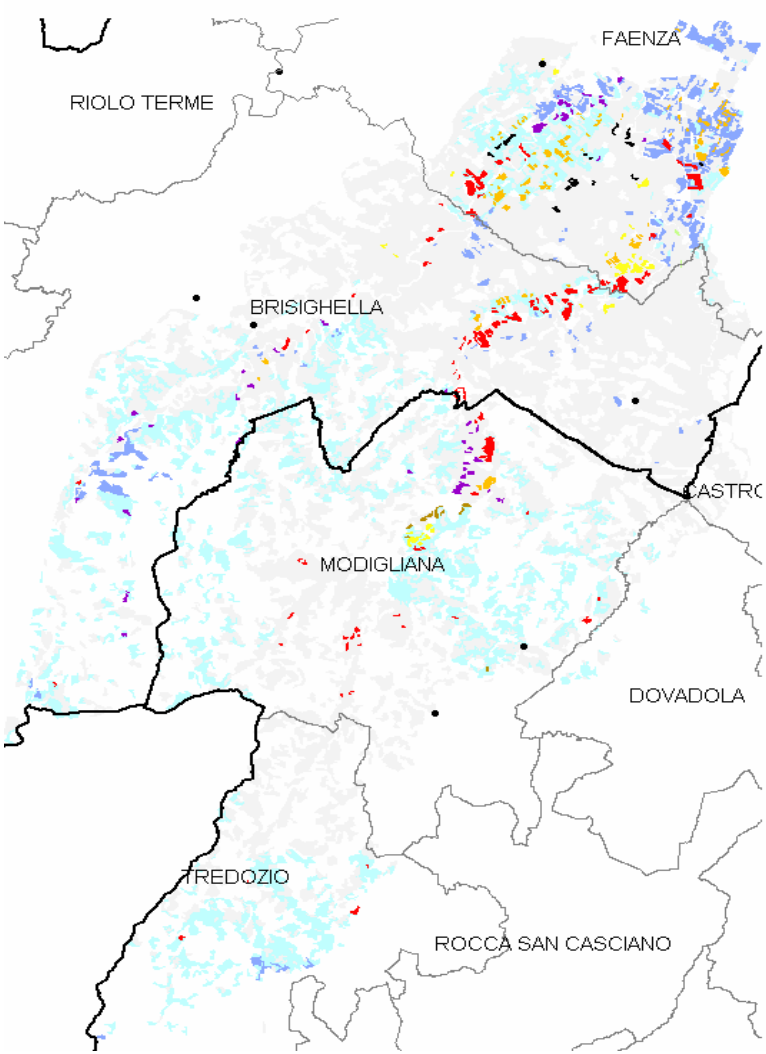
	ha	%
Cultivations total surface	**15.000**	**100.0**
Water demandig crops:		
Kiwifruit	**662**	**3.7**
Peach (and others)	**1.831**	**12.2**
Grape	**2.326**	**15.5**
Alfalfa	**3.790**	**8.2**

Trend of kiwi fruits (surface in hectars) from 1985 to 2008 (remote sensing)



- kiwifruit needs an average of 6700 m3 of water per hectar
- the rainfall during the growing season can supply around 50-60% of its water demand: **the result is a strong demand of water from irrigation**



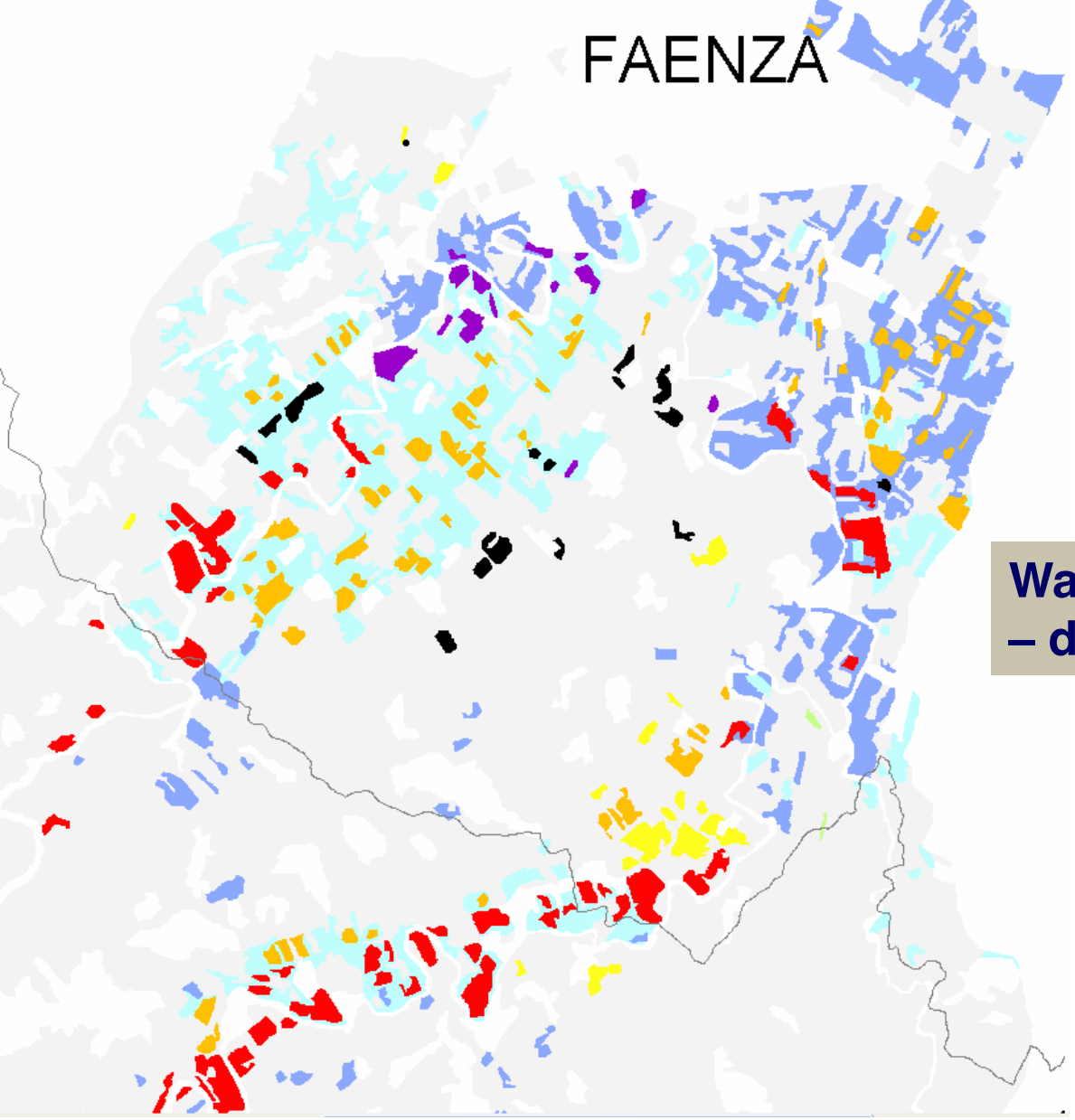


Water demand simulation (mm)

kiwifruit cultivations are mainly along the river Lamone and its tributary Marzeno

01/01/2008 - 20/09/2008

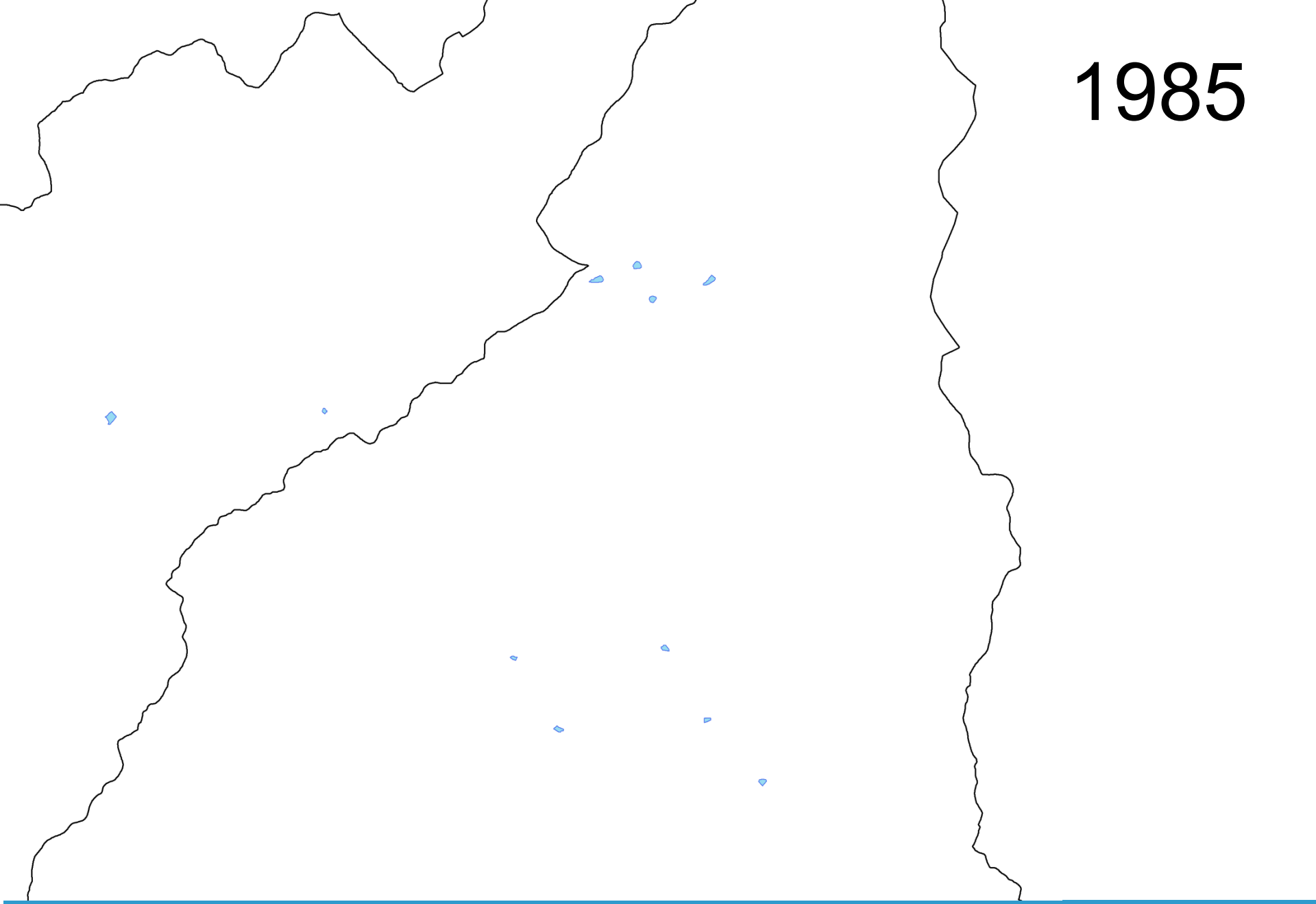
0 50 100 150 200 250 300 350 400 450 500

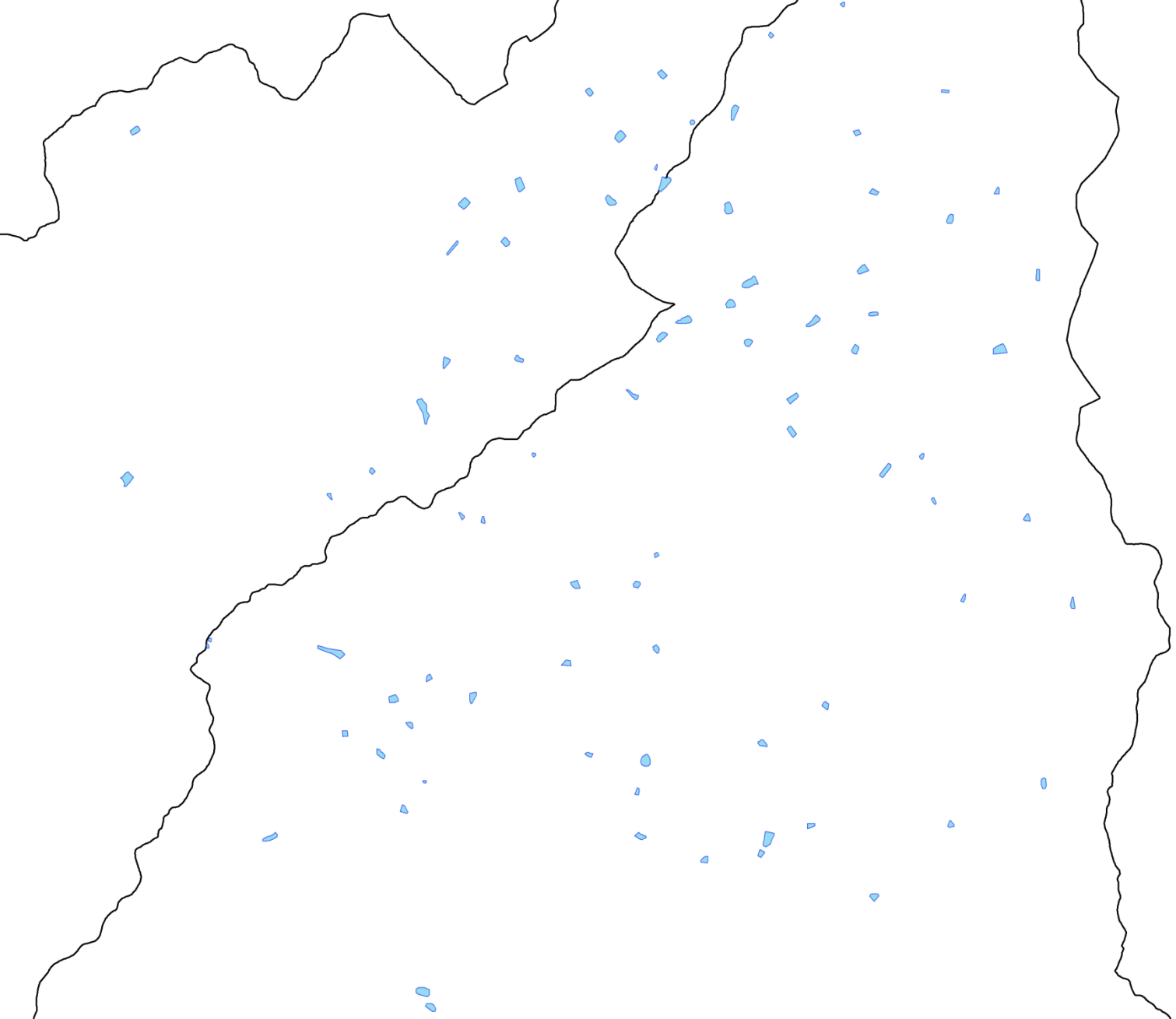


Water demand simulation – details (mm)

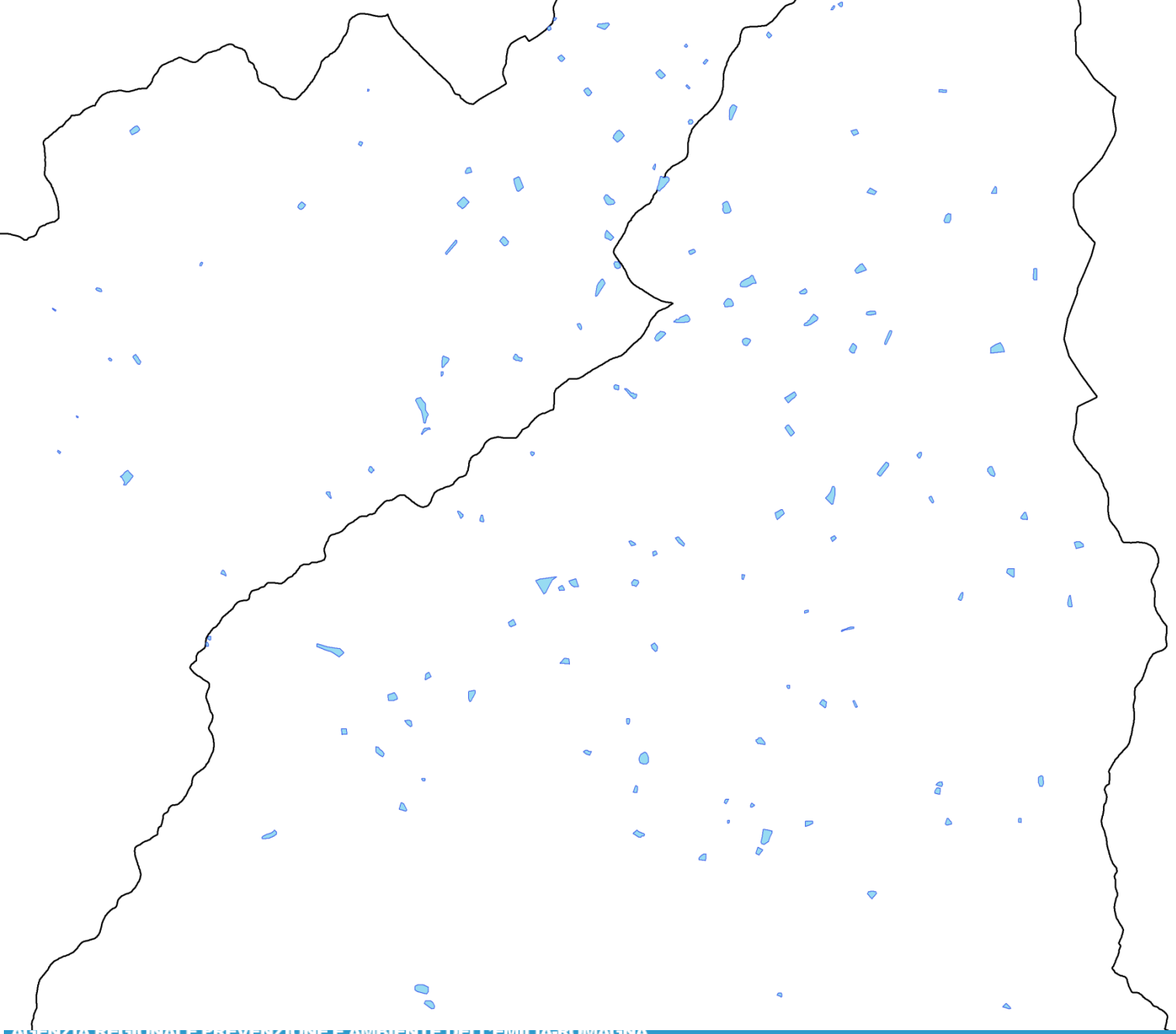
The Lamone River is the only **source of water supply** for irrigation both **directly** during the irrigation season and **indirectly** for storage water in reservoirs.

from 1985 to 2008 over **460 water storages** were dug.

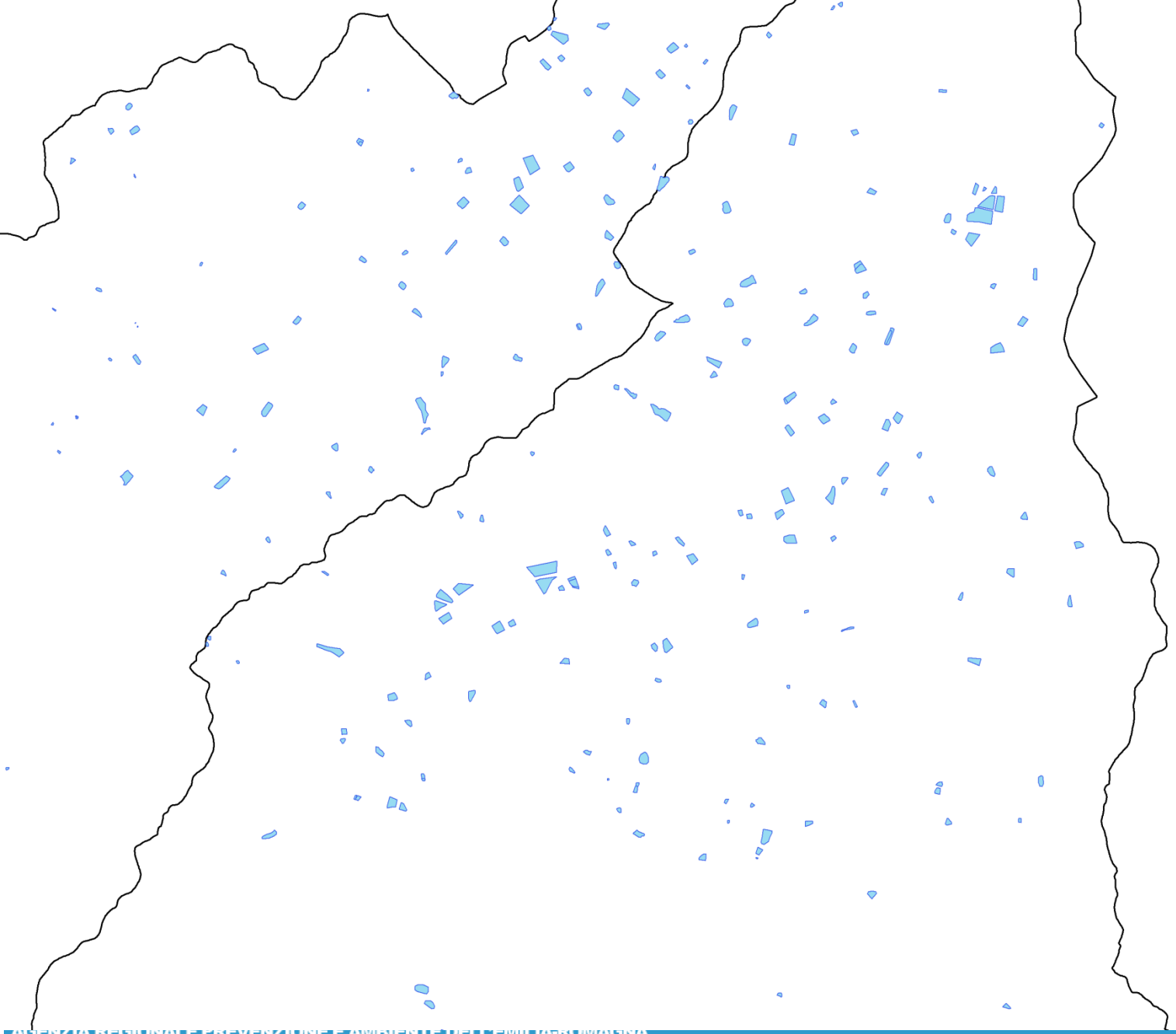

1985



1993



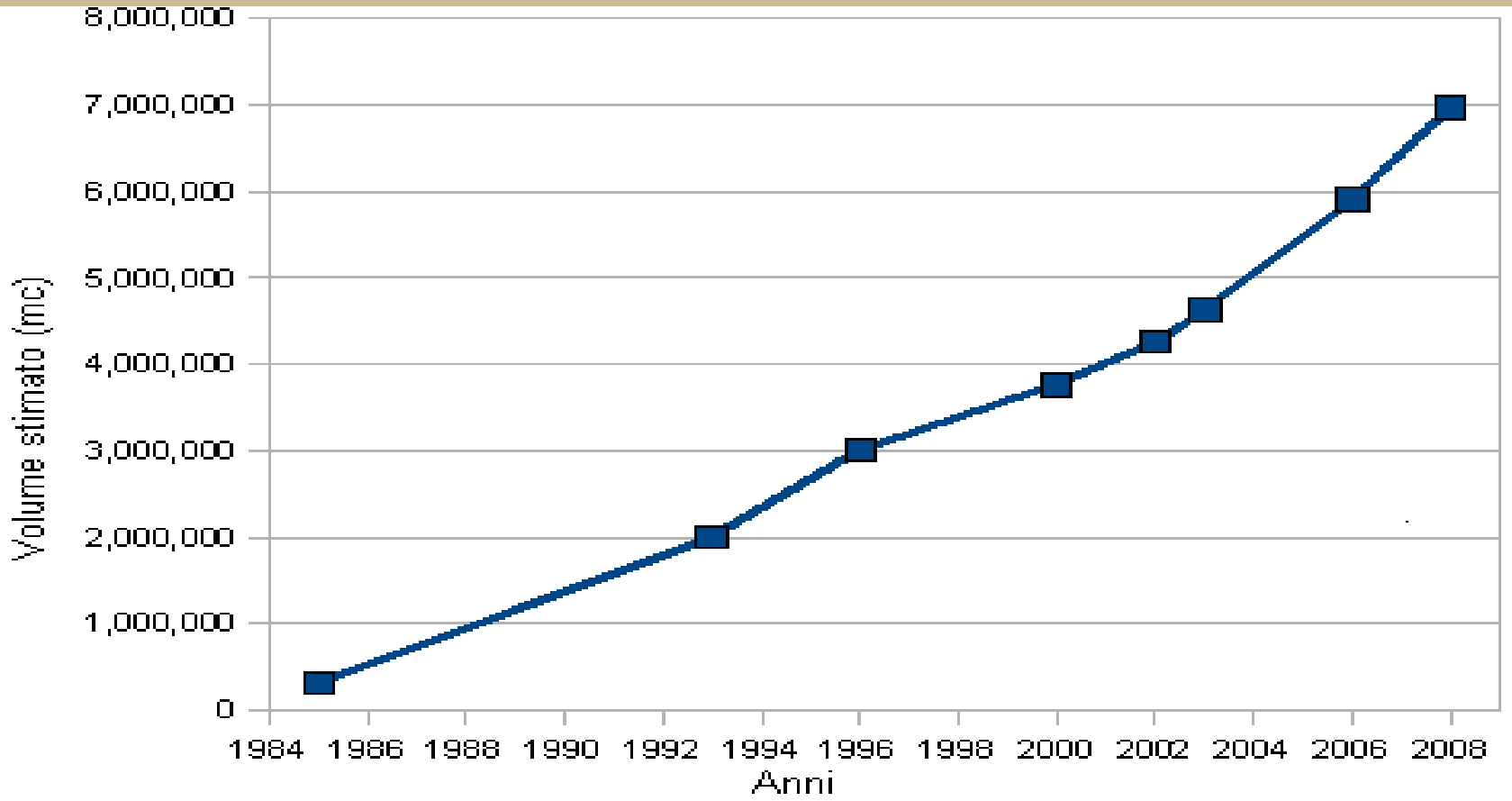
1996



2006

amounts of stored water from 1985 to 2008

(estimated from remote sensing)



Estimation of total water demand for the whole area

	ha	%	Avarage per hectare in m^3	total in m^3	%
waterfed crops surface tot.	8.609	100.0	699	6.017.011	100.0
composed by:					
kiwi	662	7.7	3263	2.160.106	35.9
peach (others)	1.831	21.3	1117	2.045.227	34.0
grape	2.326	27.0	453	1.053.678	17.5
Alfalfa	3790	44.0	200	758.000	12.6

In 2008 the river basin water balance, estimated computing water requirement for irrigation and reservoirs content, (structural and evaporative losses of the free surfaces considered) wasn't negative.

Despite this, partly because of the **non-uniform and unrational distribution** of the reservoirs, water pumping from the river continued, causing **non-compliance with safeguards rules** (minimum flow) during the summer.

Effects

worsening of chemical and biological water quality

alteration of the river ecosystem

loss of biodiversity

together with climate change, beginning of desertification

conflicts among potential users

Solutions

Pure adaptation model

due to drivers of the market, traditional fruits cultivations are replaced with kiwifruits, very water demanding.

The negative impact on the river is unchanged

the extent of adaptation (water storage) is insufficient because it does not limit water demand amount, which grows more quickly than the water storage itself. The negative impact on the river is unchanged

Mitigation and adaptation model

Computing the maximum resources available (subject to the minimum flow) and adopting measures to reduce demand.

Eg.: Use of proper water balance, less water demanding species and varieties, limit to withdrawals, pricing of water, limit of new kiwifruit planting).

The reservoirs are then sufficient to storage water, the minimum instream flow saved and emergency withdrawals allowed.

The applicable solutions include the integration of the following groups:

- structural solutions of pure adaptation
- solutions for the agro-environmental balance taking into account the mitigation
- solutions based on the environmental and social value of the resource

Structural solutions of pure adaptation :

- new storage basins, but larger and with public management to ensure protection of the minimum flow

- extention of the pressure irrigation network to part of the valley

Solutions for agri-environmental balance, taking into account the mitigation:

- the application of saving water techniques in irrigation
- adoption of agricultural practices limiting water consumption
- substitution of water demanding crops

Solutions based on the environmental and social value of the resource:

- internalization of the water cost (pricing consumptions)
- introduction of quotas for water demanding crops

Some of these proposals can be found in local planning instruments.

Partecipation and **comunication**

Technical support group

- Regional Authorities of the Romagna Rivers Basins
- APO-CONERPO Producers Organization
- Agrintesa Producers Cooperative
- Reclamation Consortium of the West Romagna
- Reclamation Consortium for the Emiliano-Romagnolo Channel
- National Research Board -Istitute of Biometeorology
- Regional Consortium for crops development
- UNIBO – Interdipartimental Research Centre for Environmental Sciences
- UNIBO - Dipartiment of Agricultural Economy and Engeneering

Local Administrations

- Province of Ravenna
- Province of Forlì
- Town of Faenza

Environmental education centres

• Centre for Environmental Education and Local Agenda 21 (Faenza CEA 21) of Faenza

• Atlantide - Cooperative for environmental education

The communication and informative actions, through seminars, meetings and conferences, have directly involve over 300 people.

• the results of the LAP E-R have been presented in two national scientific congresses (AIAM 2008 and AIAM 2009);

• the methodology and the project data have been published on regional and national reviews (*ARPA Rivista, Rivista Agricoltura*).

• awareness actions on drought and desertification have been held through the INFEA network, web channels and the environmental centres of Faenza CEA 21 and Coop Atlantide.

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Siccità e desertificazione in breve
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Rete Falda Ipodermica
Rete Piezometrica automatica

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Eventi

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Osservatorio regionale
Bollettini
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Desertificazione
Cambiamento climatico
Progetti

Utilità
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Programma di Azione Locale di Lotta alla siccità e alla desertificazione - Esperienze a confronto nel contesto nazionale

Bologna, 15 ottobre 2009

Il Programma di Azione Nazionale di lotta alla siccità e alla desertificazione (Delibera CIPE 21 dicembre 1999, n. 229), attribuì alle Regioni ed alle Autorità di Bacino la responsabilità di definire le azioni operative specifiche di lotta alla siccità e alla desertificazione e le loro modalità di attuazione a livello locale, indicando anche quattro settori prioritari di intervento: protezione del suolo, gestione sostenibile delle risorse idriche, riduzione d´impatto delle attività produttive e riequilibrio territoriale.

I Programmi di Azione Locale di Lotta alla Siccità e Desertificazione (PAL) sono progetti operativi e piani di azione specifici, relativi a comprensori omogenei dal punto di vista ambientale, volti alla prevenzione, alla mitigazione e all´adattamento dei fenomeni di siccità e desertificazione.

Nel 2005 il Ministero dell´Ambiente e della Tutela del Territorio e del Mare ha finanziato la predisposizione di PAL in sette Regioni italiane: Sicilia, Sardegna, Puglia, Basilicata, Calabria, Abruzzo e Piemonte.

Successivamente un secondo gruppo di regioni, composto da Campania, Emilia-Romagna, Liguria e Toscana, è stato interessato all´iniziativa.

La conferenza finale si è svolta a Bologna il 15 ottobre 2009. **Pieghevole** **Locandina**

Gli interventi dei relatori:

Il Programma di Azione Nazionale (Rosanna Bissoli, Servizio Tutela e Risanamento Risorsa Acqua, Regione Emilia-Romagna)

Il PAL in Emilia-Romagna (Lucio Botarelli, Servizio Idro-Meteo-Clima, ARPA ER)

Il PAL in Toscana (Franco Gallori, Regione Toscana - Luca Angeli, LaMMA CRES)

Il PAL in Liguria (Renzo Castello, Dip. Ambiente - Assetto Territorio, Regione Liguria)

Il PAL in Campania (Vera Corbelli - Maria Pagliaro, Aut. di Bacino fiumi Liri-Garigliano e Volturno, Regione Campania)

Gestione sostenibile delle risorse idriche (Lorenzo Canciani, Autorità di bacino fiume Reno, Regione Emilia-Romagna)

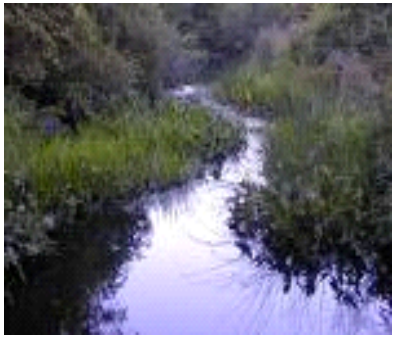
PAL Meetings and seminars

- **Conference of presentation of PAL to local administrations**. Forlì, 21 09 2008
- **Province Conference of Planning – PTCP Forlì-Cesena**. Forlì, 25 11 2008
- **Meeting "Valle del Lamone: territorio, risorse, ambiente**". Faenza (RA), 13 12 2008
- **Seminar "+CO2 -H2O"**. Faenza (RA), 27 01 2009
- **Seminar "Per fare il kiwi ci vuol....tanta acqua"**. Sant'Alberto (RA), 04 03 2009
- **Partecipatory conference "The case Lamone".** Faenza (RA), 28 09 2009
- **National conference on local programs to cope with drought and desertification.** Bologna 11 10 2009


Lamone







Climate change scenarios

AgroScenari project

Adaptation scenarios to climate change of Italian agriculture

Arpa Simc – Emilia-Romagna role

Line of research 1 - Acquire, calibrate and downscale future climate scenarios at local scale

Produce downscaled scenarios of climate change 2021-2050

Line of research 5 – Irrigation and climate change

Define adaptation strategies focused on irrigation for herbaceous, horticoltural and tree crops

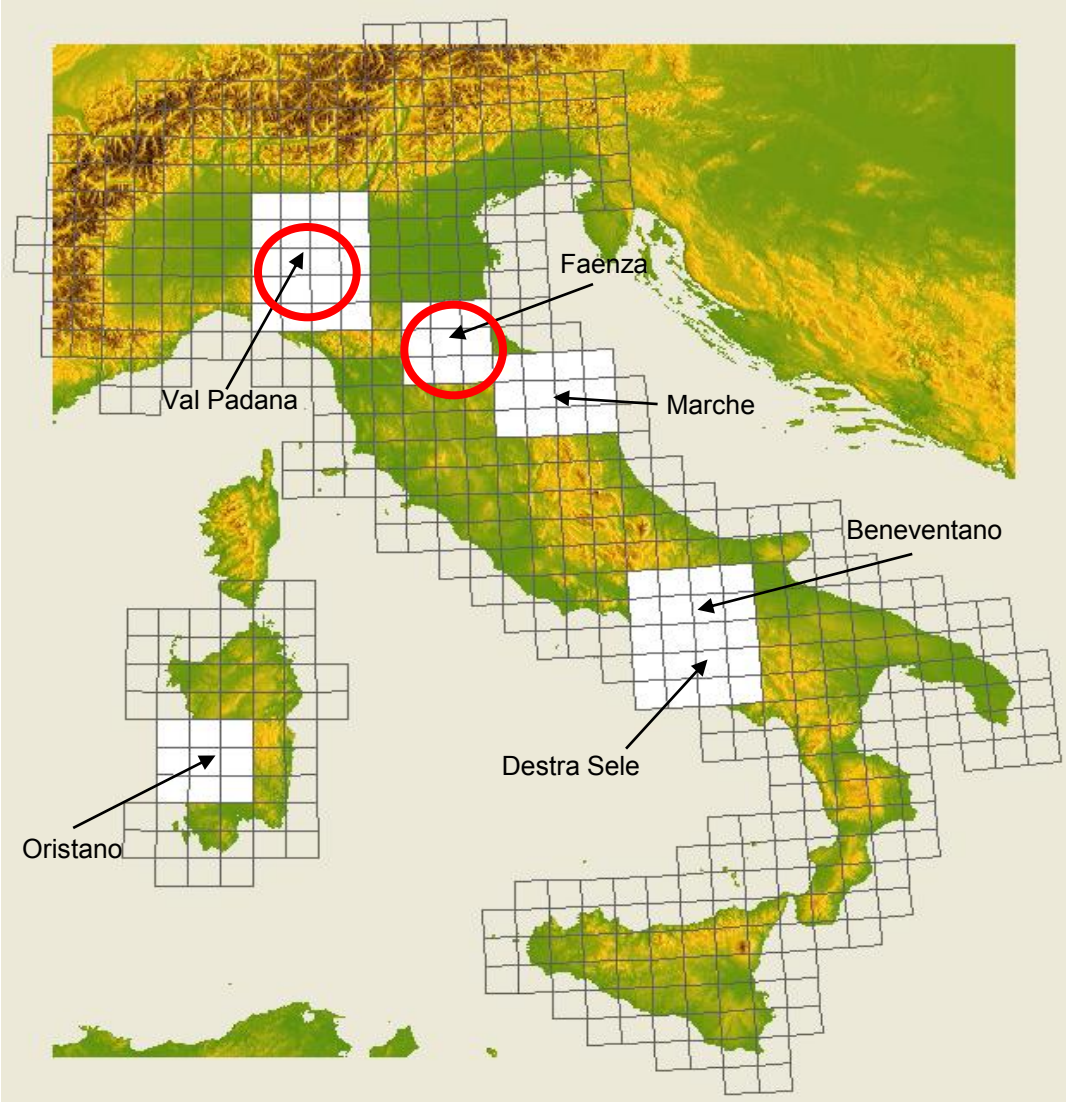
Crops studied

Kiwifruit vine in Romagna sub region (Faenza area)

Tomato in Val Padana area (Piacenza area)

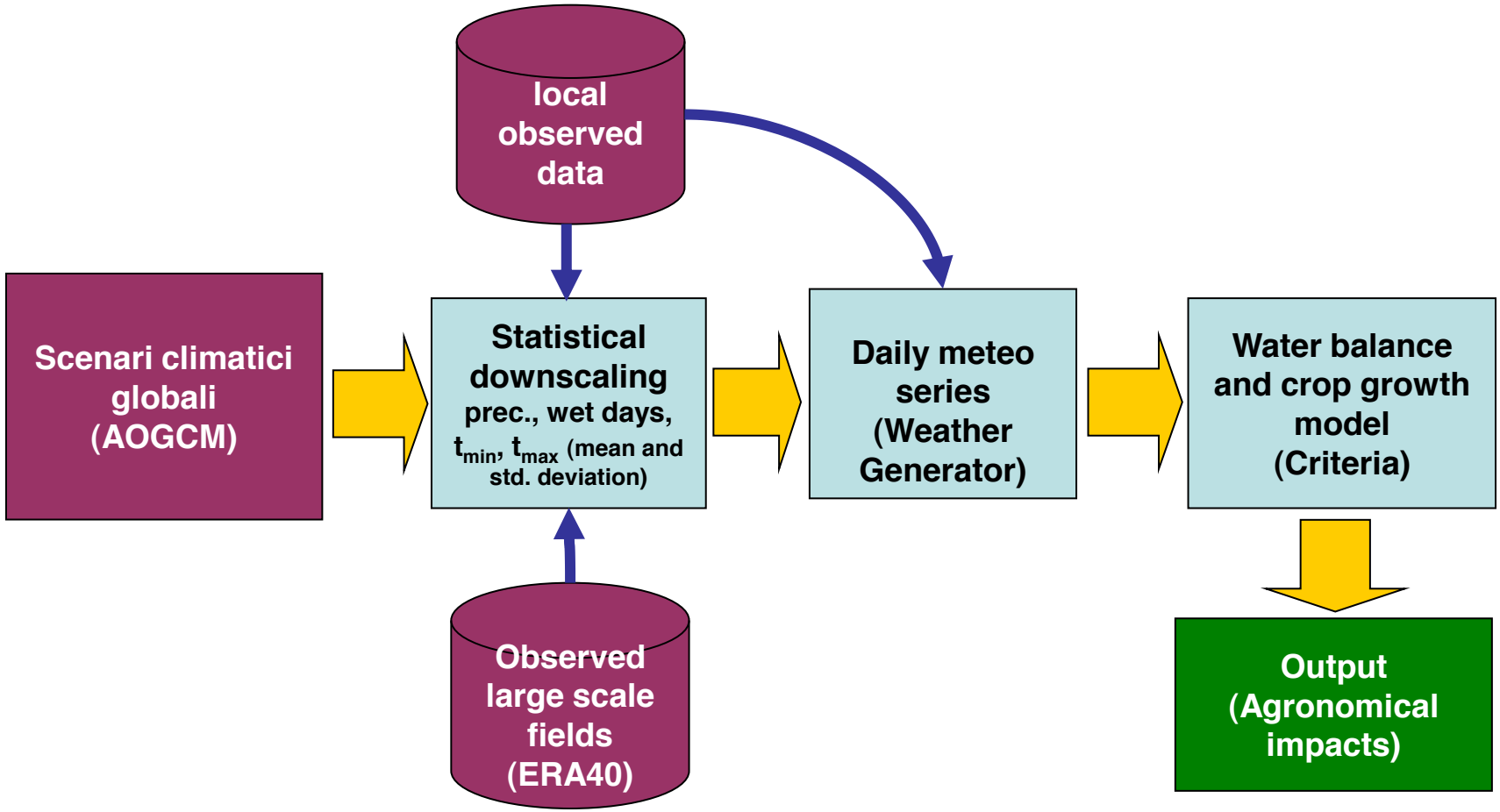
Faenza and Lamone Valley have been chosen as a national case study

Agroscenari project - study areas



Summary

Agronomical impacts simulations: modelling chain



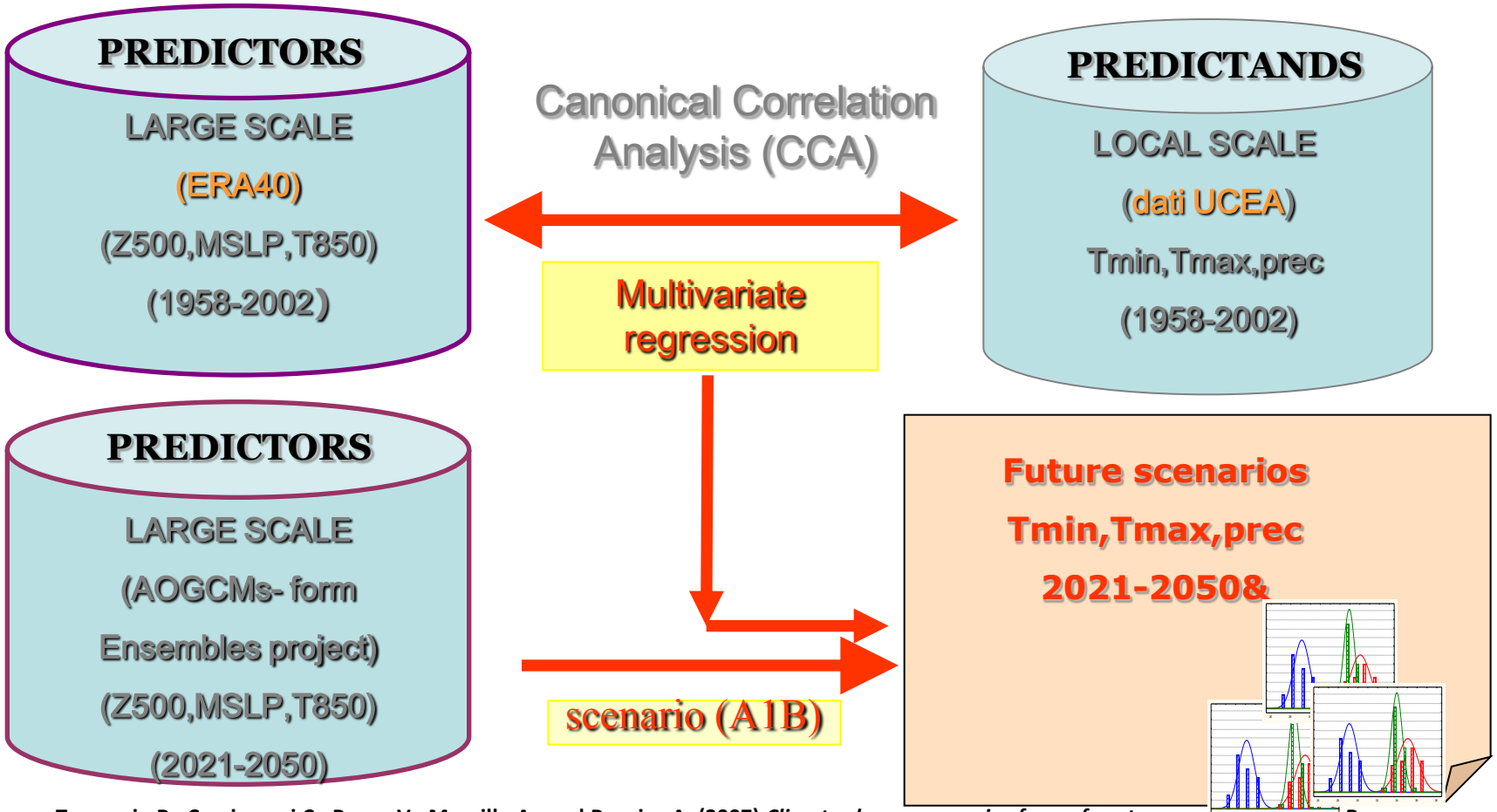
Agroscenari project

- Dataset: UCEA analysis, 1951-2009
- Reference climate: 1961-1990
- Scenario: 2021-2050

Global climate models (EU project ENSEMBLES):

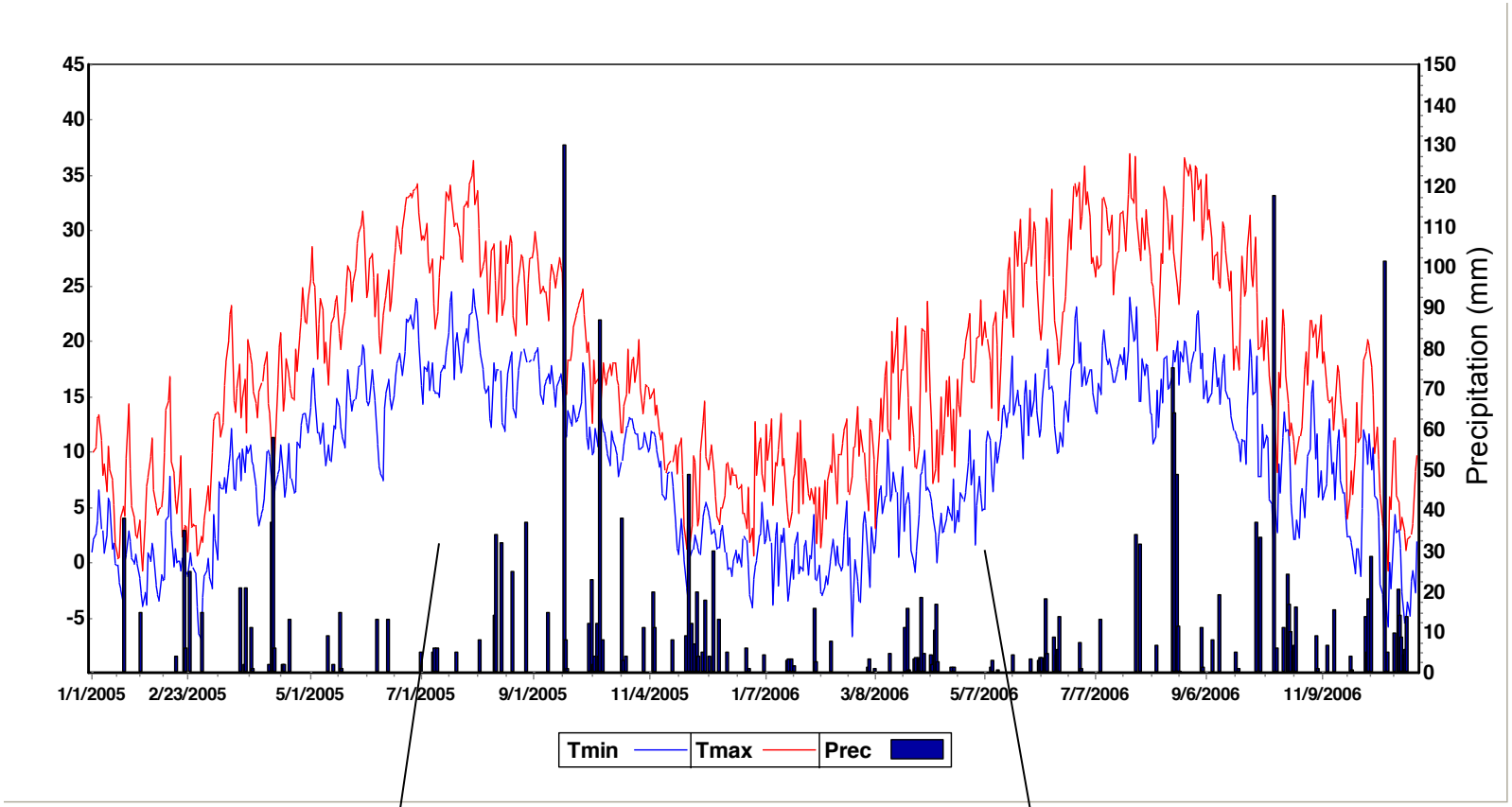
ERNSEMBLES–Model STREAM1	INSTITUTIONS	Resolution	AGCM	OGCM
INGV-SINTEX-G	INGV-Italy	1.125°×1.125°	ECHAM4 (T106L19)	OPA 8.2
FUB-EGMAM	Freie Universitaet Berlin(Germany)	3.75°×3.75°	ECHAM4 (T30L39)	HOPE-G (T42 with equatorial refinement, L20)
METO-HC (HADGEM1)	Met Office's Hadley Centre (UK)	1.875°×1.875°	HadGAM1(includes land and river routing components)	HadGOM1(includes sea ice components)
IPSL-CM4	Inst.Pierre Somon Laplace (France)	3.75°×3.75°	LMDZ (96x72x19)	OPA8.2
ECHAM5 MPI OM	Max-Planck Institute(Germany)	1.875°×1.875°	ECHAM5.2.02 (T63L31)	MPI-OM Vers. 1.0 (GR1.5L40)

Climate change
Statistical Downscaling (SD)



Tomozeiu R., Cacciamani C., Pavan V., Morgillo A., and Busuioc A. (2007) *Climate change scenarios for surface temperature in Emilia-Romagna (Italy) obtained using Statistical downscaling models*.Theoretical and Applied Climatology, 90, 25-47

Weather generator



Real year (2005)

Generated year on climate 1991-2008

Weather Generator input variables

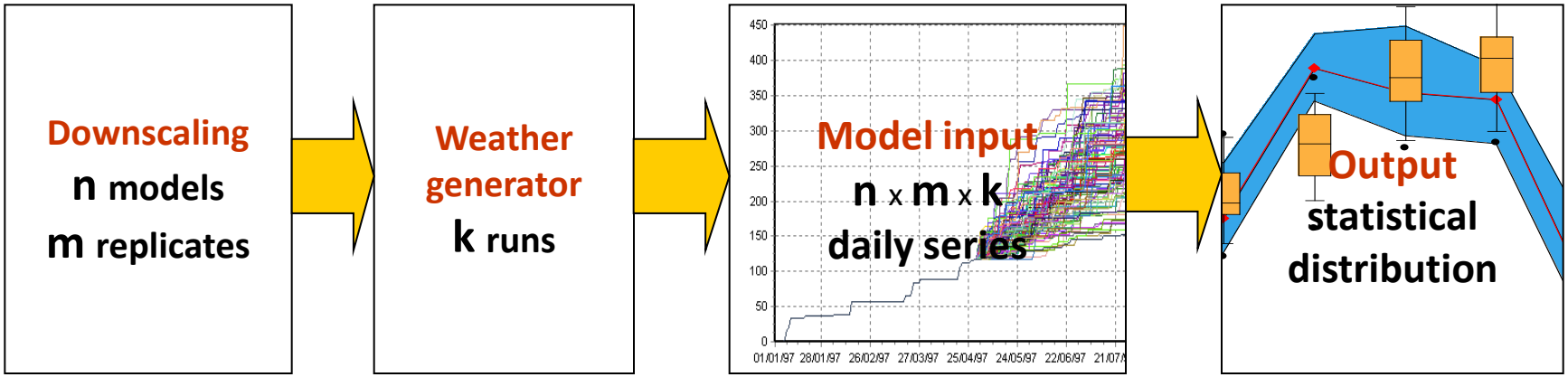
Variable code	Input data of WG	Unit
Tmax	mean of maximum temperature	°C
Tmin	mean of minimum temperature	°C
Txsd	standard deviation of maximum temperature	°C
Tnsd	standard deviation of minimum temperature	°C
Prcp	mean of total precipitation	mm
Fwet	fraction of wet days	-
Tdw	difference between maximum temperatures on dry and wet days	°C

Climate change scenario

Richardson, C. W., and Wright, D. A. (1984). *WGEN: A model for generating daily weather variables*. U.S. Department of Agriculture, Agricultural Research Service, ARS-8, 83 pp.

Stöckle, C.O., Campbell, G.S., and Nelson, R. (1999). *ClimGen manual*. Biological Systems Engineering Department, Washington State University, Pullman, WA. 28 pp.

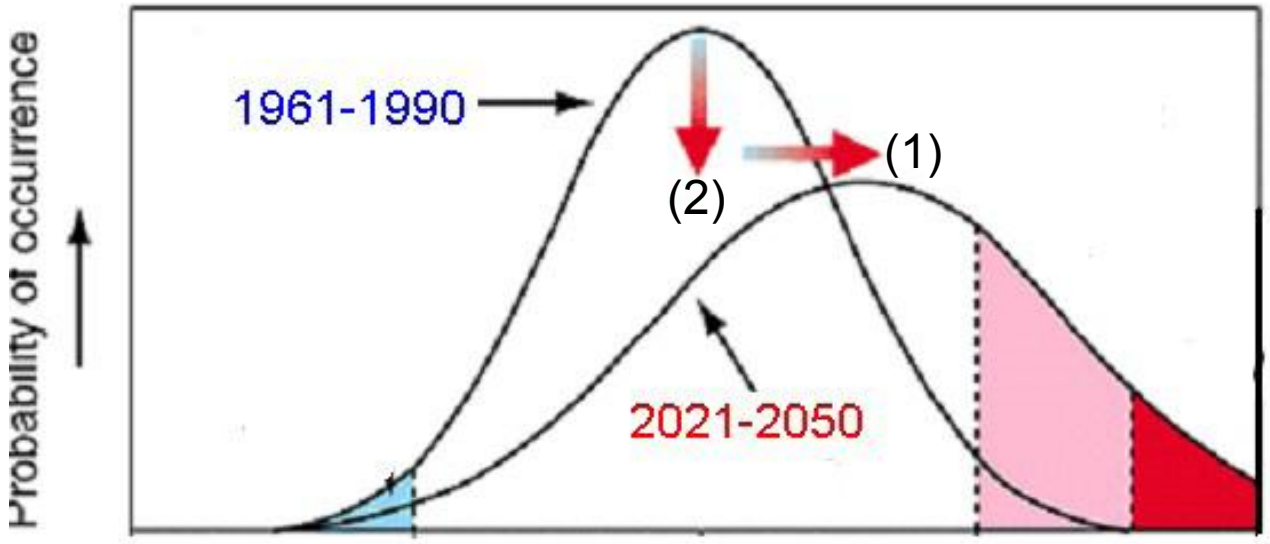
Uncertainty



Summary


• the applied technique and the model
• climatic projections of T and P

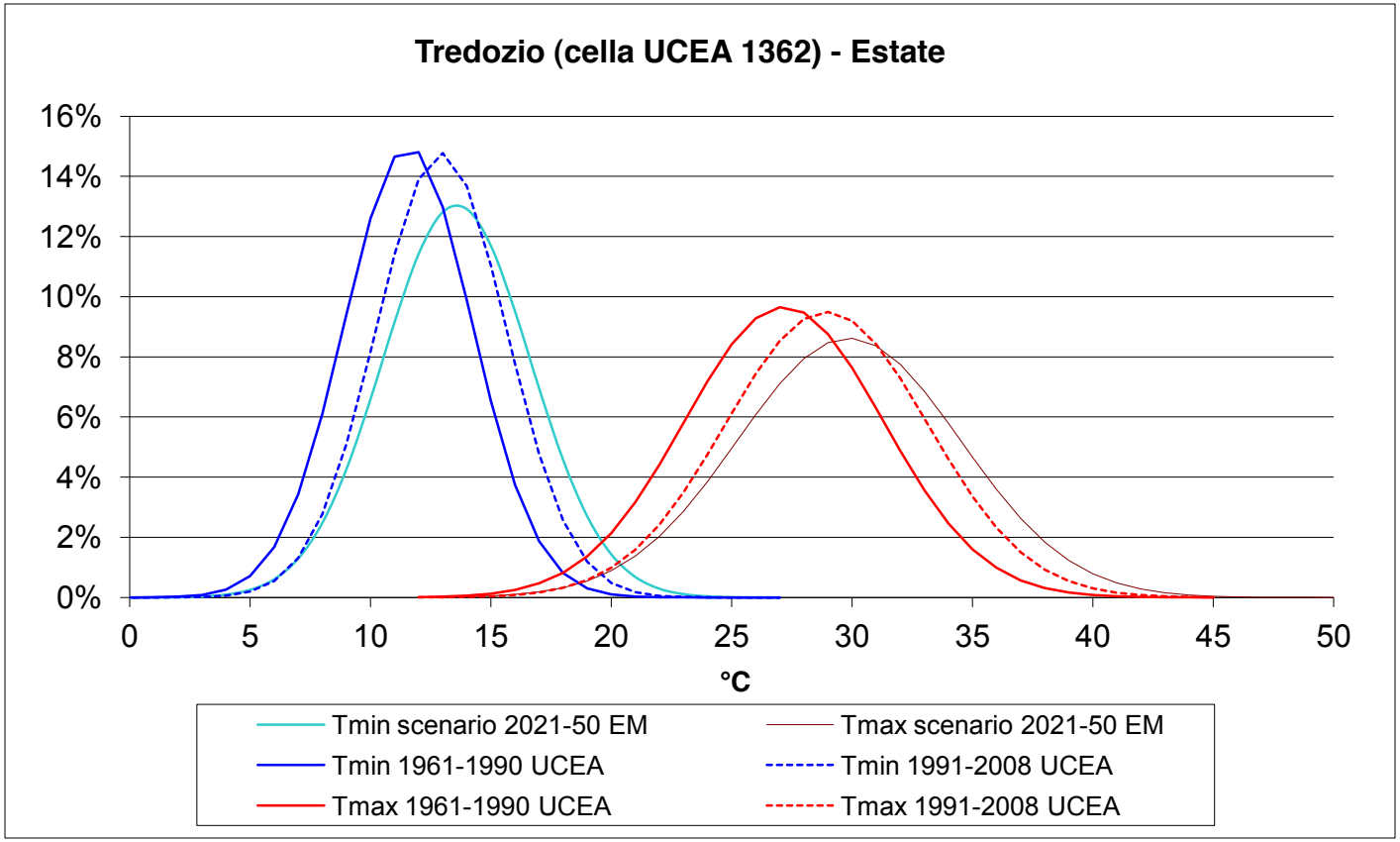
Climate change example



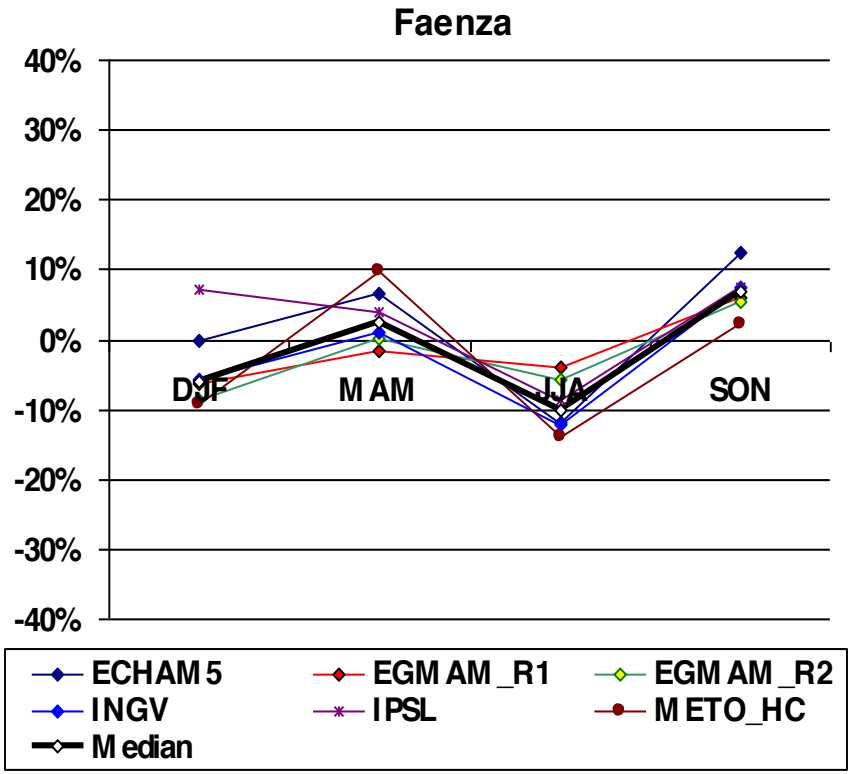
- mean value change (1)
- variance change (2)

The reference and scenario are typically 30-year periods.

Temperature



Precipitation

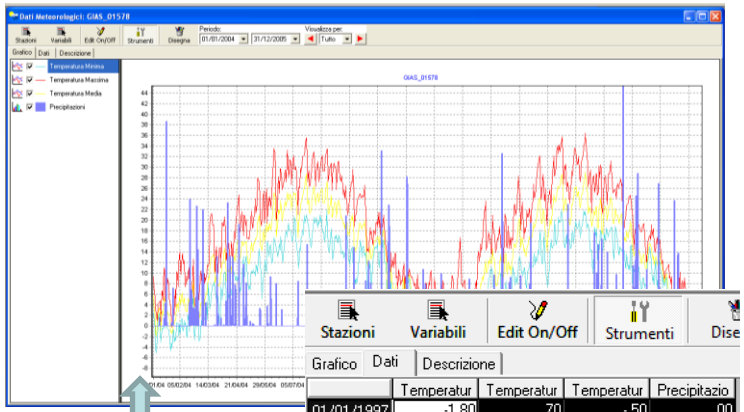


Summary

- the applied technique and the model
- climatic projections of T and P
- water balance Criteria and check

Criteria

Dati meteorologici giornalieri



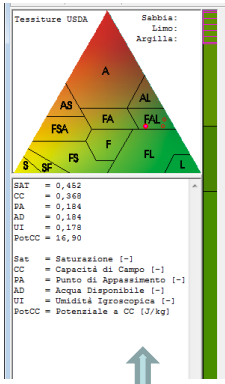
Temperature massime
Temperature minime
Precipitazioni

Stazioni | Variabili | Edit On/Off | Strumenti | Dise

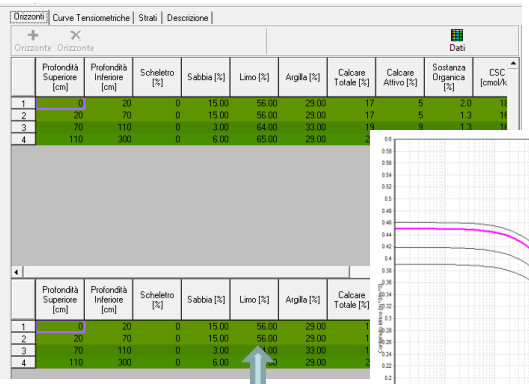
Grafico | Dati | Descrizione

	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

Dati pedologici

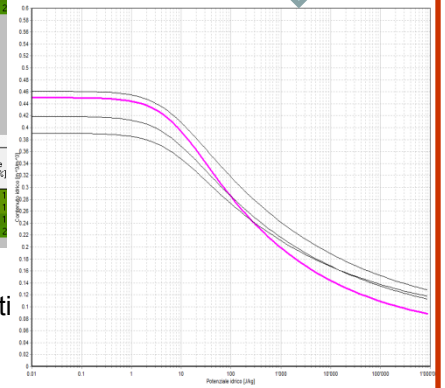


Tessitura

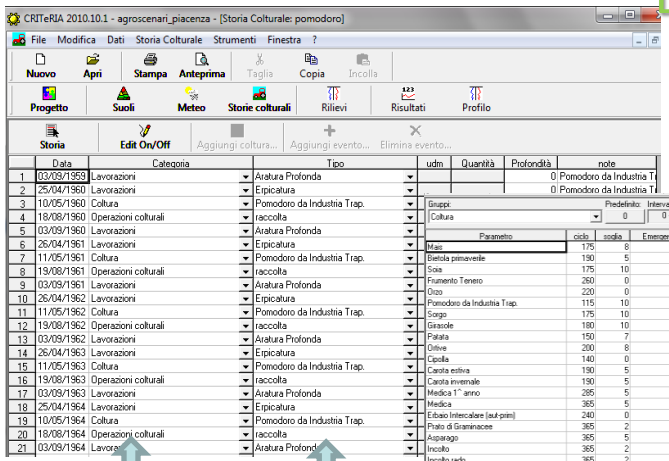


Descrizione degli strati

Curva di ritenzione dei suoli



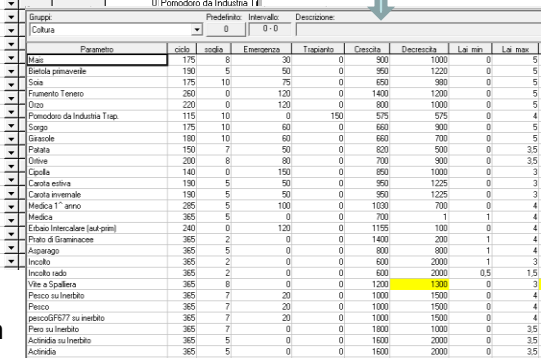
Dati colturali



Tillages

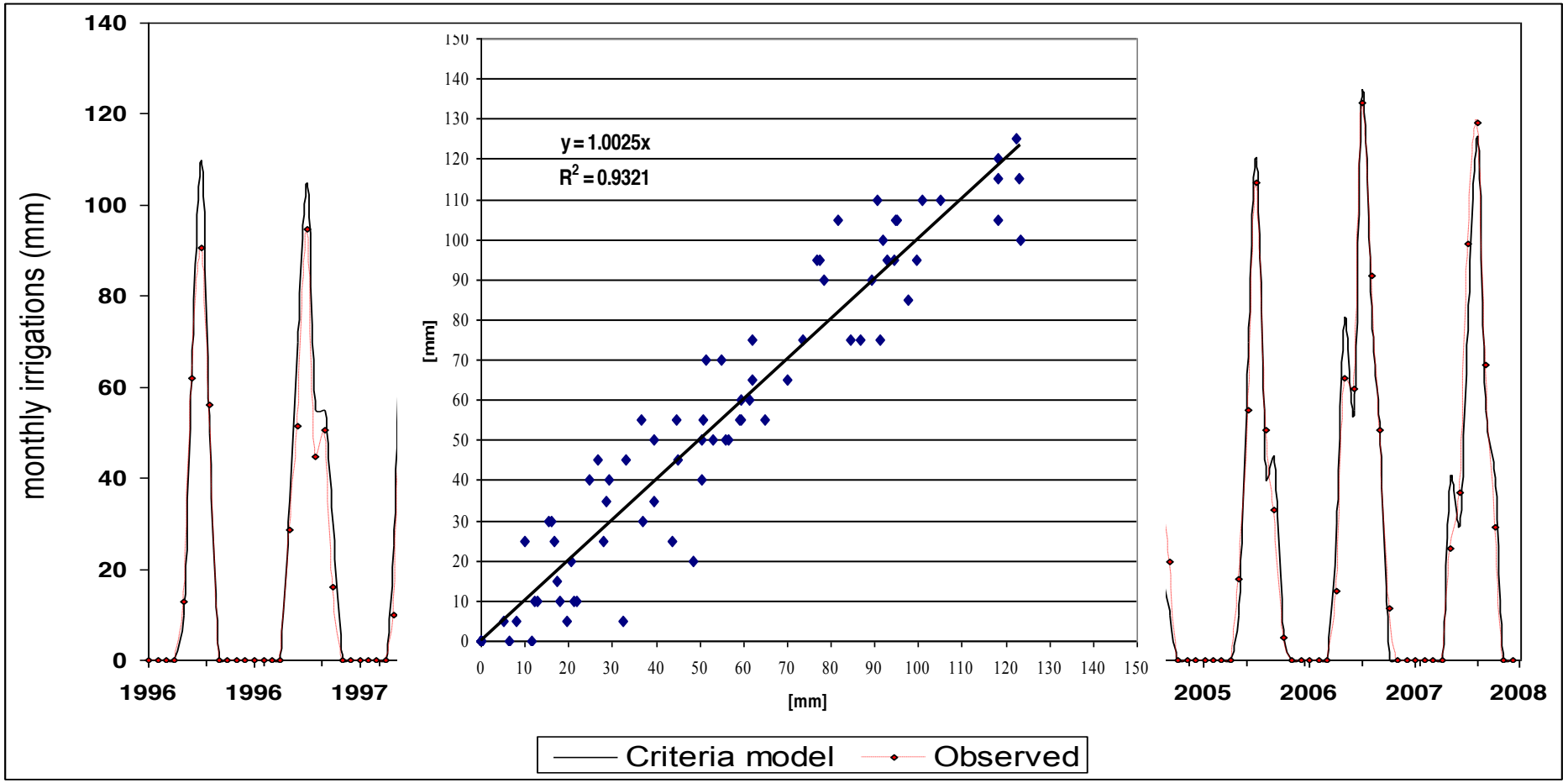
Crop rotation

Parametri colturali



Kiwifruit water need

calibration at Brisighella (Faentino)



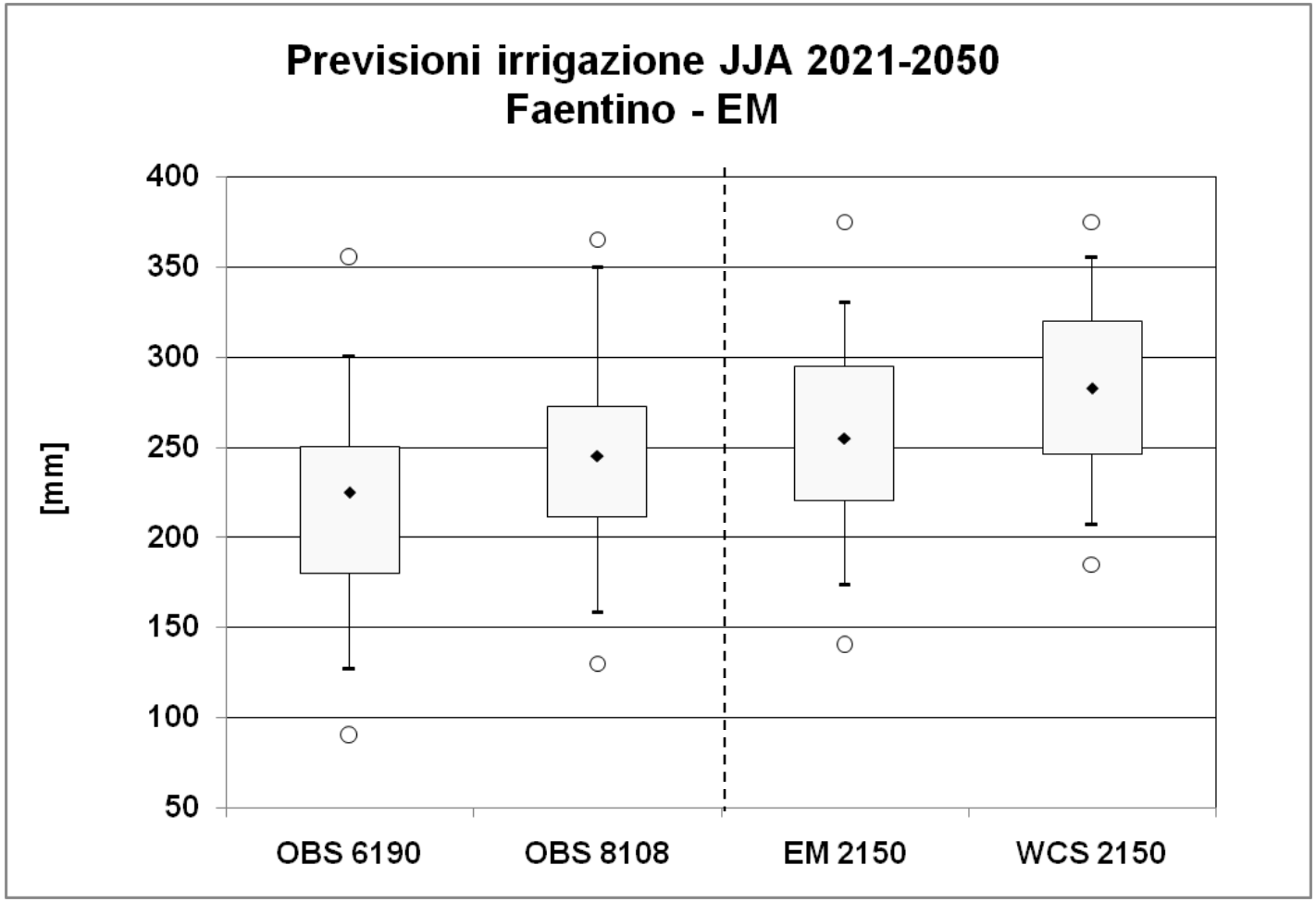
Comparison between monthly observed kiwifruit irrigation at Brisighella and CRITERIA simulations.

Summary

- the applied technique and the model
- climatic projections of T and P
- water balance Criteria and check
- **applications**

Irrigation water need

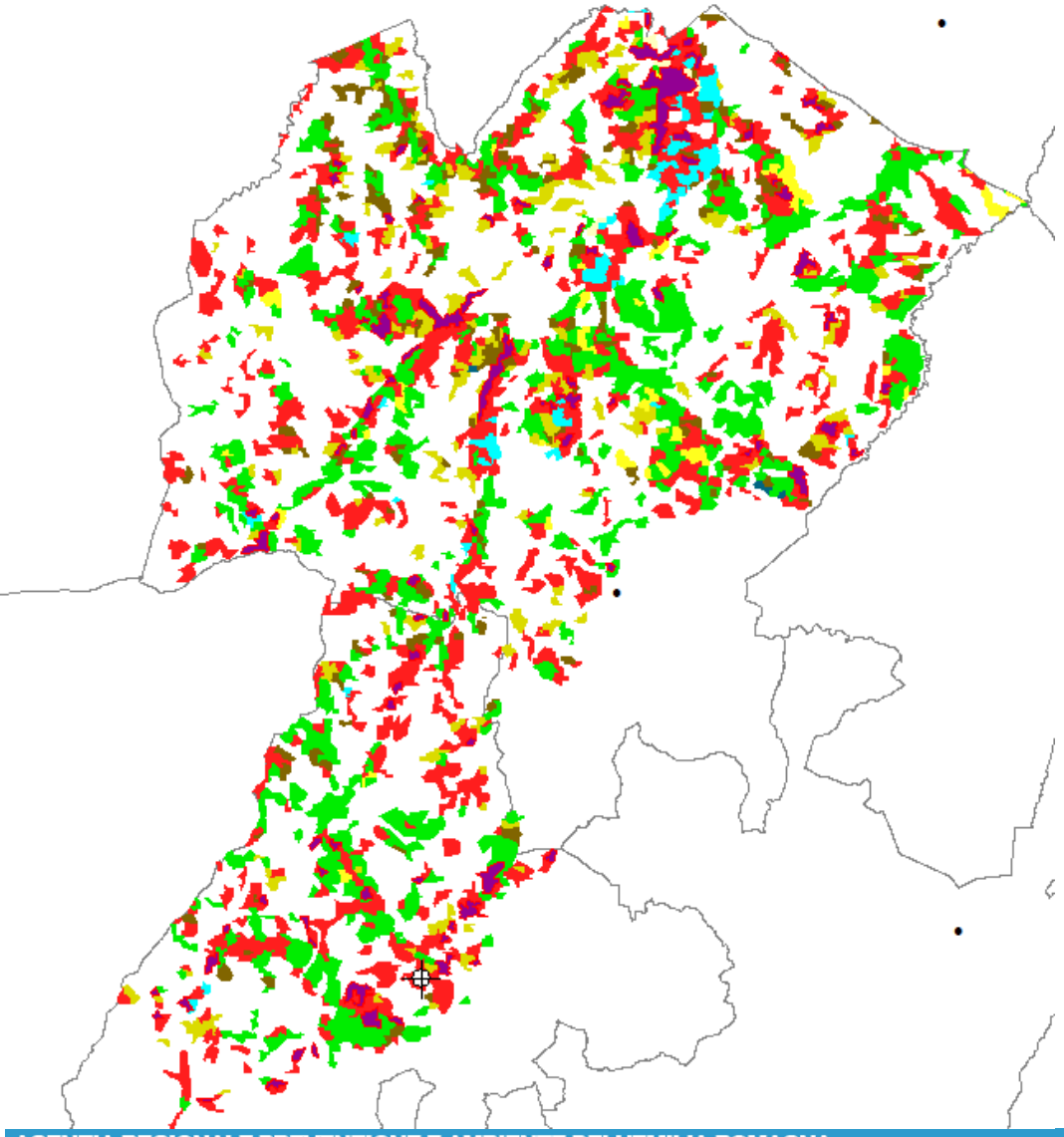
kiwi, 2021-2050, Faentino



Worst Case Scenario for Faenza

Stagioni	Grandezze	anomalie EM 2021-50	anomalie Eraclito 91-10	anomalie WCS
MAM	Tmin [°C]	1.5	0.7	1.5
	Tmax [°C]	1.7	1.2	1.7
	Prec [mm]	4.4%	-8.5%	-8.5%
JJA	Tmin [°C]	1.8	1.3	1.8
	Tmax [°C]	2.5	2.0	2.5
	Prec [mm]	-10.2%	-13.5%	-10.2%
SON	Tmin [°C]	1.8	0.8	1.8
	Tmax [°C]	1.1	0.3	1.1
	Prec [mm]	6.8%	10.8%	6.8%
DJF	Tmin [°C]	1.5	0.6	1.5
	Tmax [°C]	1.7	0.9	1.7
	Prec [mm]	-6.1%	-7.8%	-6.1%

Land use map 2008



Wheat

Peaches

Grapevyne

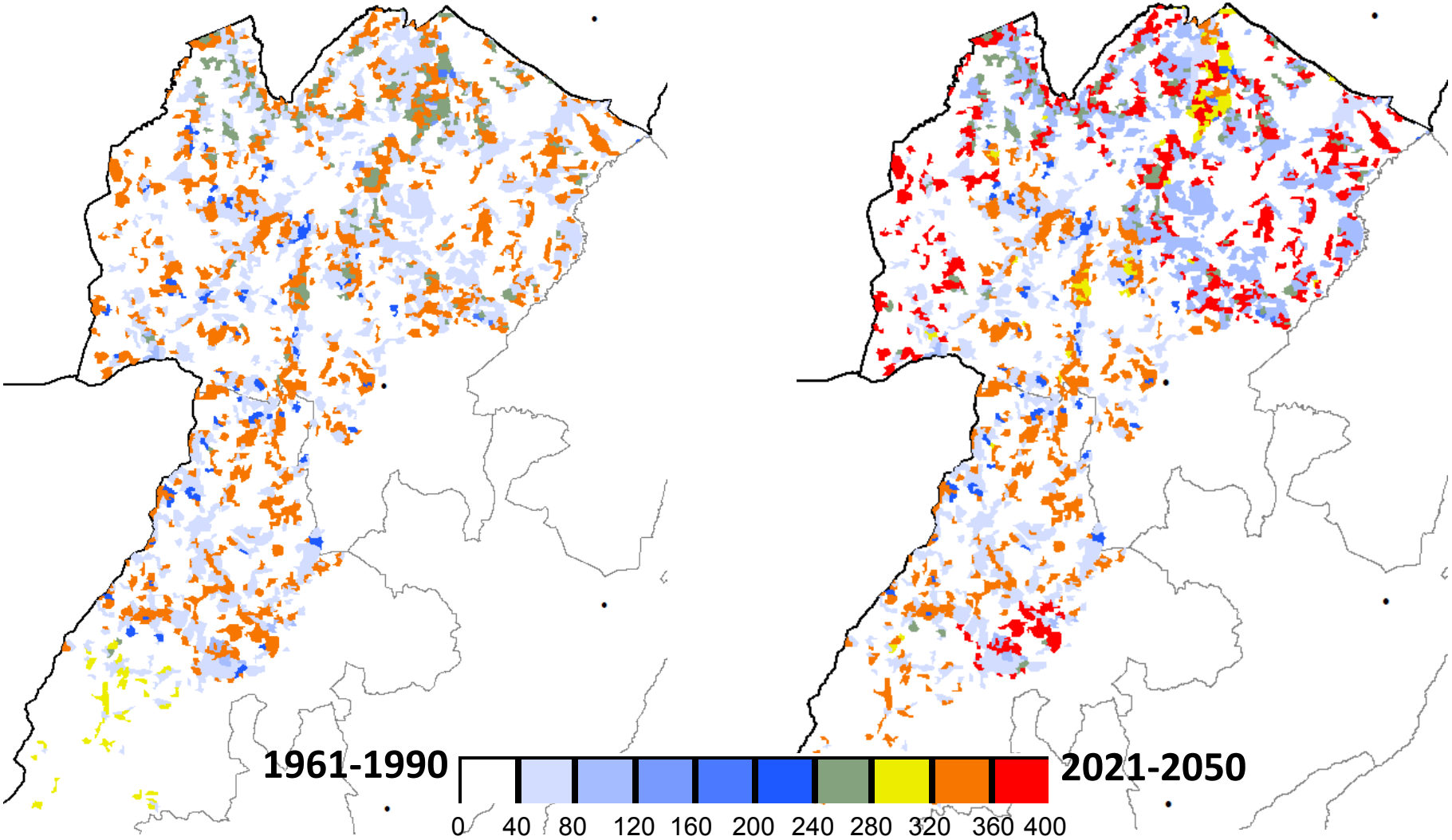
Horticultural crops

Meadows

Kiwifruit

Caso spazializzato: l'analisi territoriale dei fabbisogni irrigui delle colture nell'area di Faenza

Simulazione del fabbisogno irriguo (mm) delle colture per il periodo 1961-1990 e 2021-2050 su carta di uso del suolo agricolo del 2008



Summary

- the applied technique and the model
- climatic projections of T and P
- water balance Criteria and check
- applications
- **Conclusions and adaptation strategies**

Conclusions for Faenza

- In the scenario 2021-50, water needs for kiwifruit are increasing with respect to 1961-1990 because of the projected increase in temperature and ETP.
- In the WCS, a stronger increase of irrigation is forecasted, with the risk that “extreme” years can become usual.
- Part of the projected change is yet happened in the period 1981-2008.

Adaptation

- Previous studies in the past years stressed out a trend to water stress of the area, that needs specific actions (eg. water storages).
- Also a small increase fo irrigation demand could generate stress situations, thus the area needs monitoring also by means of geographical water balance.