THE EFFICIENCY IN NITROGEN REMOVAL OF AN IRRIGATED BUFFER AREA

CONSORZIO DI BONIFICA ACQUE RISORGIVE

REGIONE DEL VENETO

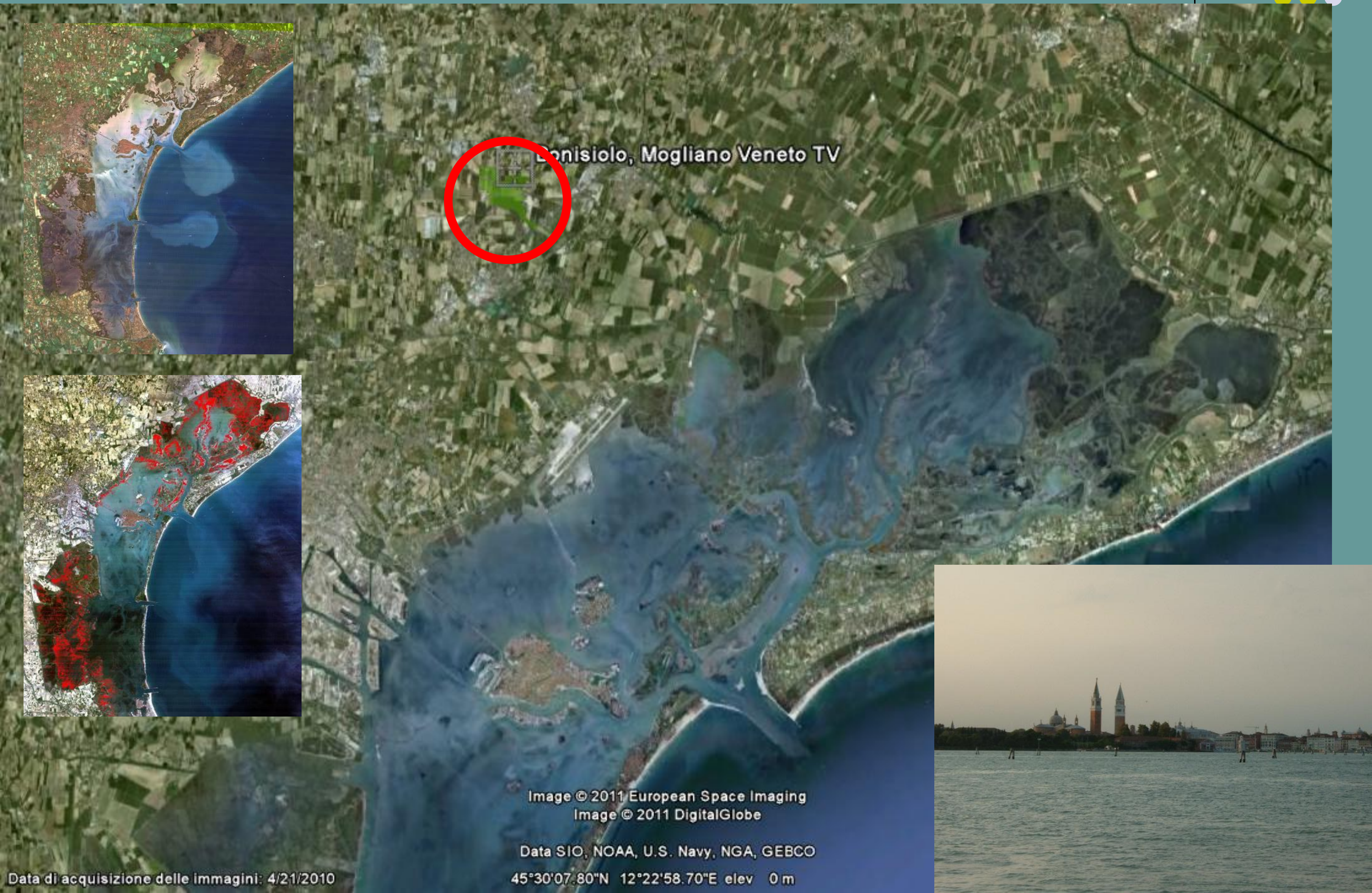
Bruna Gumiero
University of Bologna

Bruno Boz
University of Padova

Paolo Cornelio
Consorzio Acque Risorgive

HydroEco´2011

LOCATION:


Bonisiolo, Mogliano Veneto TV
Image © 2011 European Space Imaging
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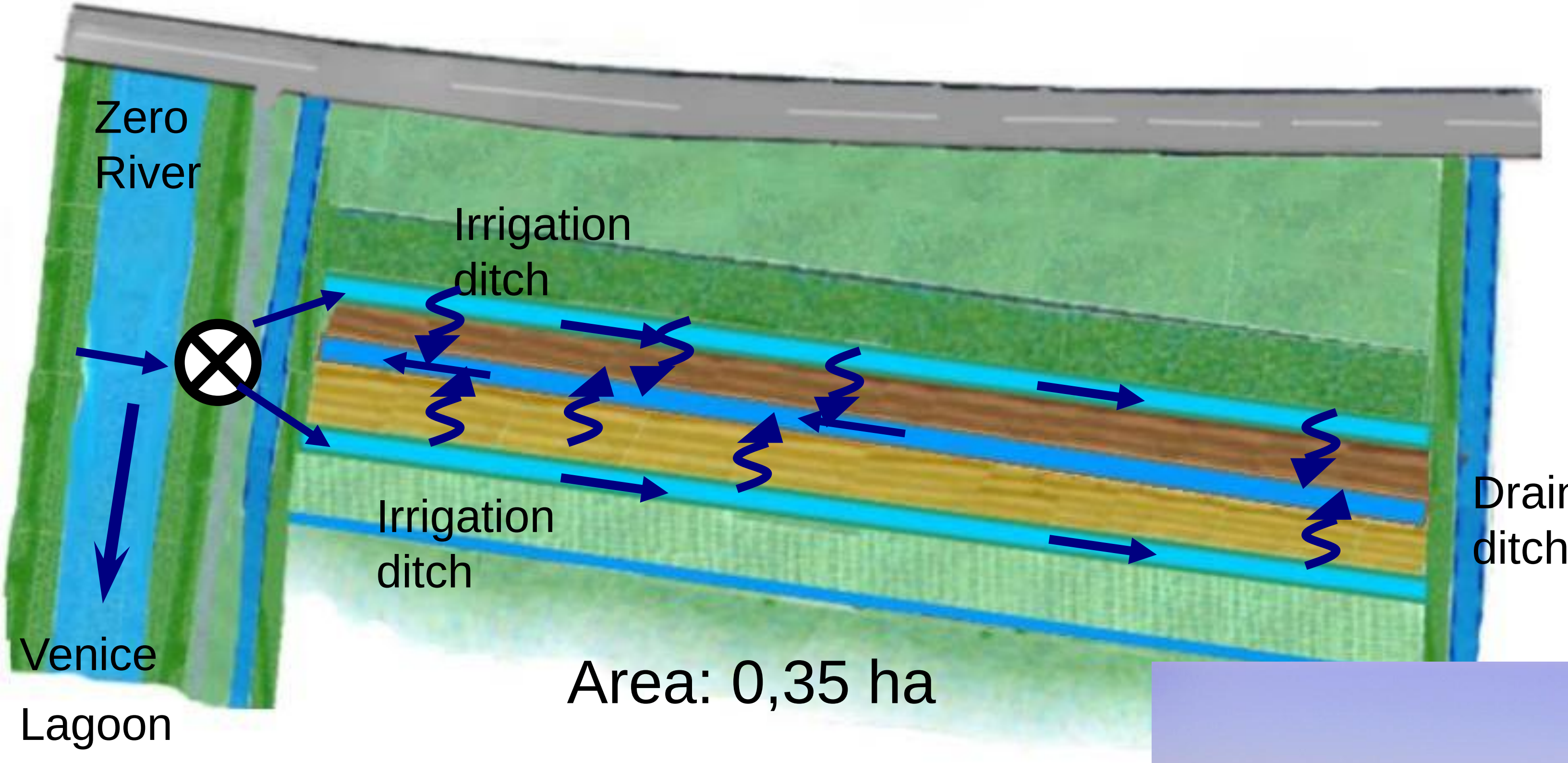
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
45°30'07.80"N 12°22'58.70"E elev 0 m
Data di acquisizione delle immagini: 4/21/2010

WOODED BUFFER AREA

Subcontinental
T. from 1 to 23 °C
900 mm rainfall
Silty clay loam

In 1999 a cultivated area of about 30 ha was converted in a afforesterd buffer area irrigated with fresh water from the Zero river, so the wet woodland could oparate similarly to a natural riparian woodland

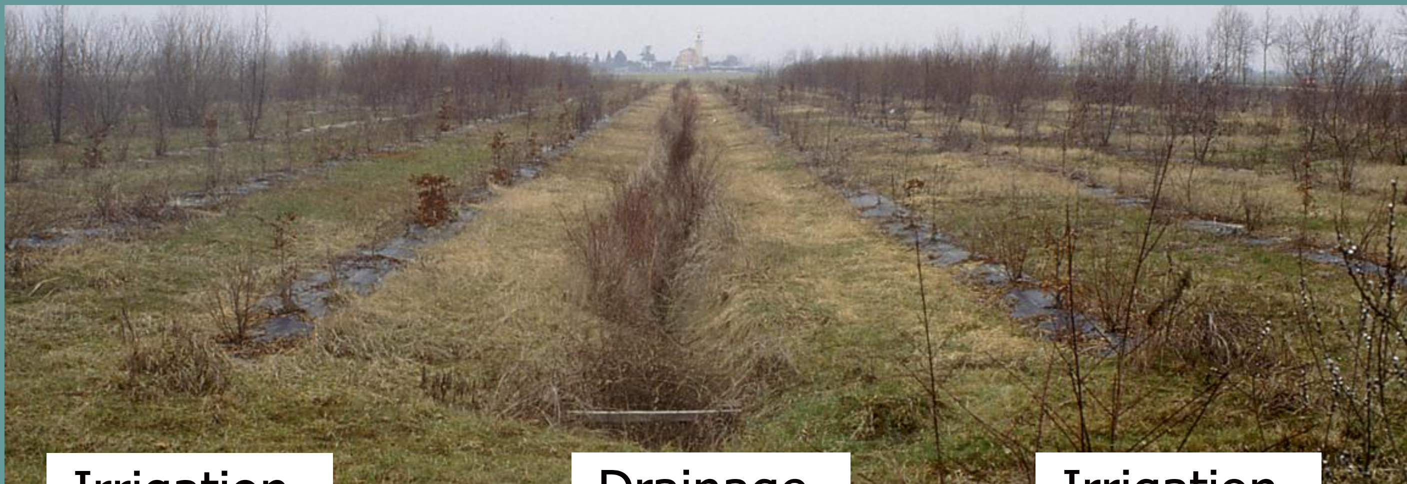
RIPARIAN WOODLAND: EXPERIMENTAL SITE



Monitoring of the buffering efficiency of a wooded areas on non-point pollution sources of nitrogen.

EXPERIMENTAL SITE

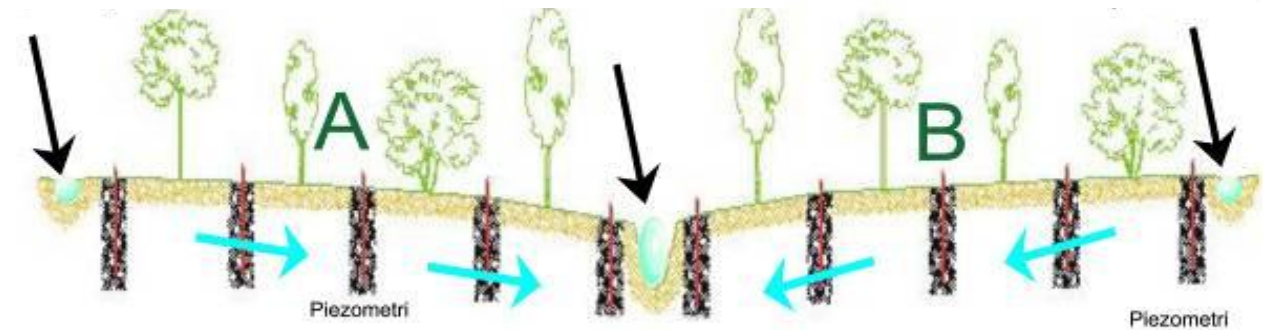
4% slope



Irrigation ditch

Drainage ditch

Irrigation ditch



Ridges and furrows facilitate sub-superficial water flow throughout the field from the inlet point, represented by irrigation ditches, to the parallel drainage ditches localized at lower elevation

TREES and SHRUBS

Salix alba L
Salix triandra
Alnus glutinosa
Quercus robur
Acer campestre
Corylus avellana
Crat. monogyna
Fraxinus ornus
Frangula alnus

MONITORING PLANE

Nitrogen Control by Landscape Structures in Agricultural Environments
Research Project 1997 – 2000 European Commission DGXII

Monitoring activity started in October 1999, two phases: 2000-2002 (2 plots) and 2008-2010 (only plot A)

-**hydrological and meteorological** daily parameters

-**water** samples from piezometers and river

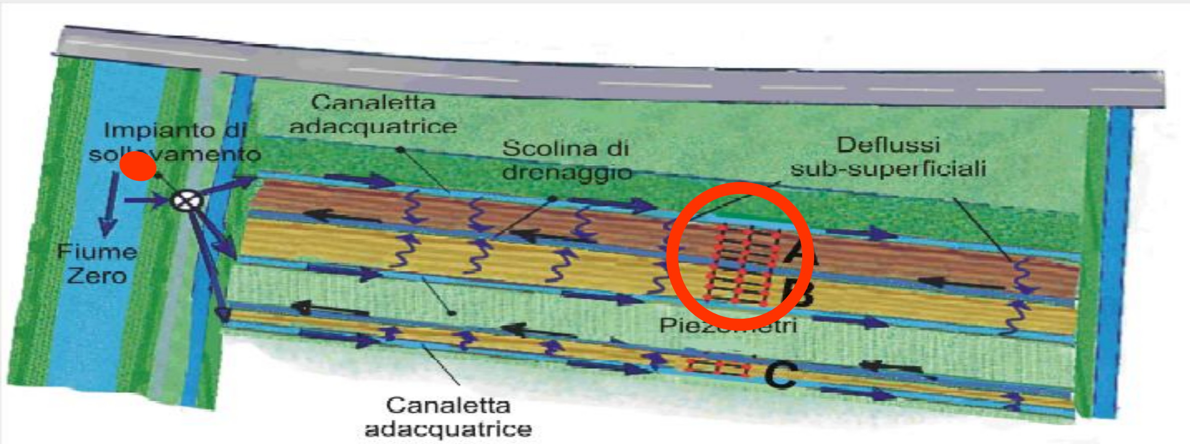
- seasonal **soil** samples collection in different zones and different layers

- **vegetation and litter** : biomass, N and C content

- **Wood**: biomass, N, P and C content

- **microbial communities** by DNA extraction

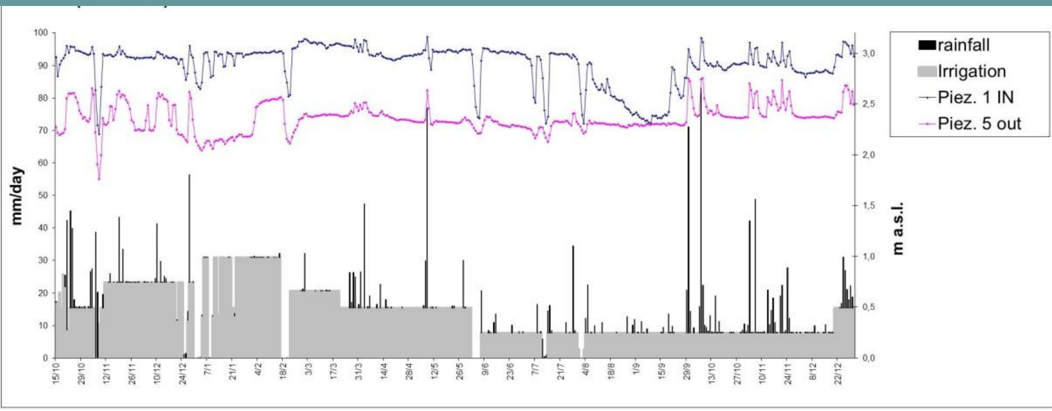
HYDROLOGY and WATER MONITORING

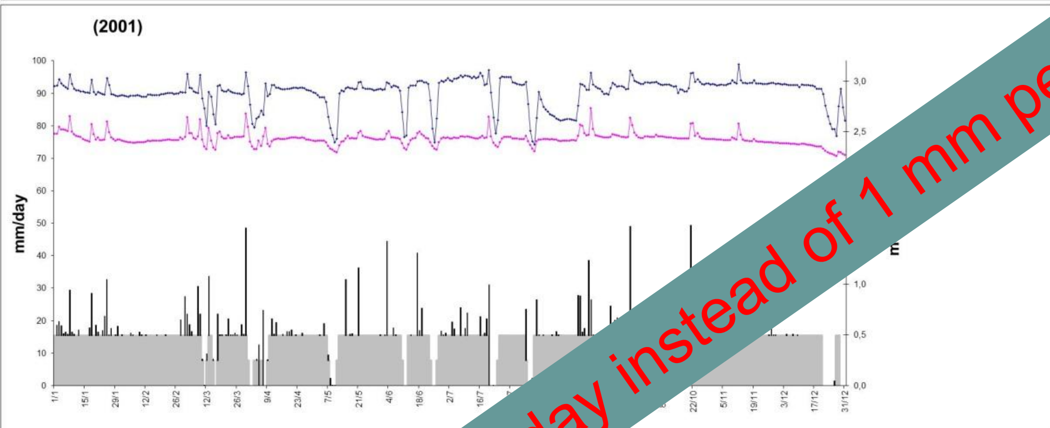


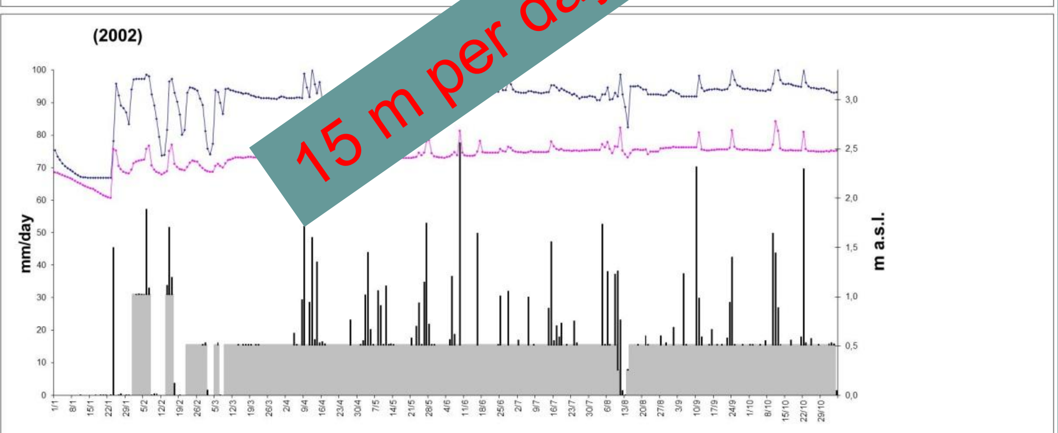
Year	I Irrigation (m-cu/ha/year)
1999 - 2000	51.917
2000 - 2001	48.060
2001 - 2002	48.600
2007 - 2008	61.389
2009	55.046
2010	51.431

The total pumped volumes were not changed to compensate for different season water demand, except for two months in winter.

SOIL HYDROLOGY

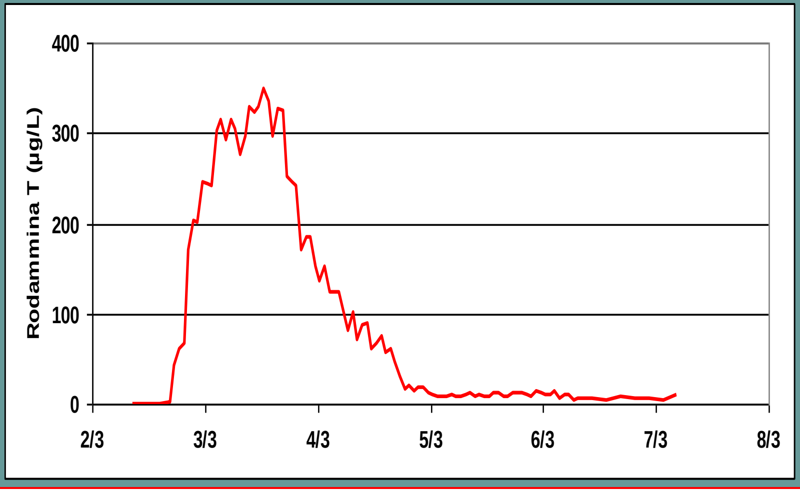






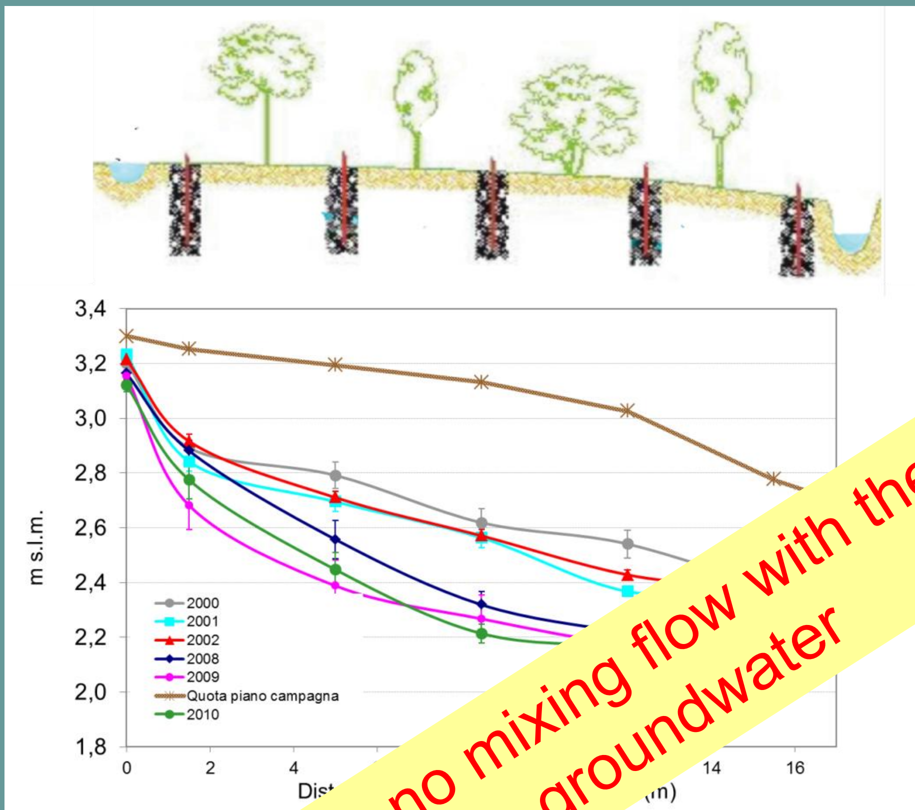
15 m per day instead of 1 mm per hour

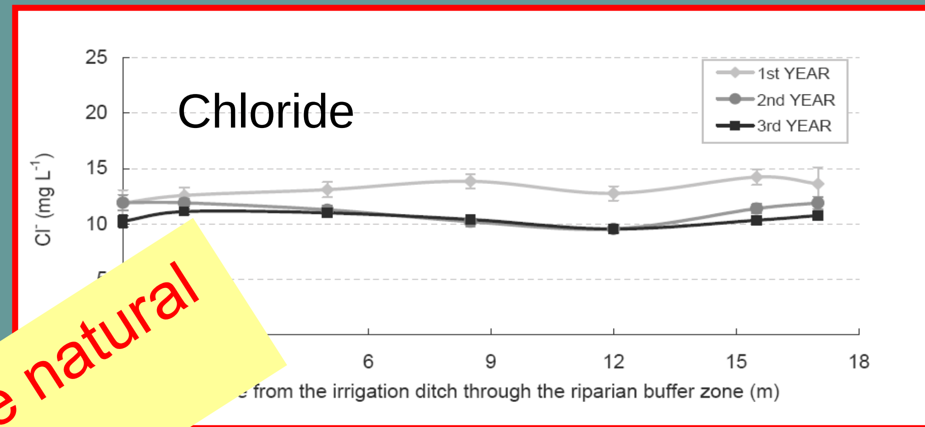
Two additional piezometers connected to a data-logger were installed for continuous measurement



The residence time of water, measured in 2008 within the plot A by RWT tracer, was 24.7 hours.

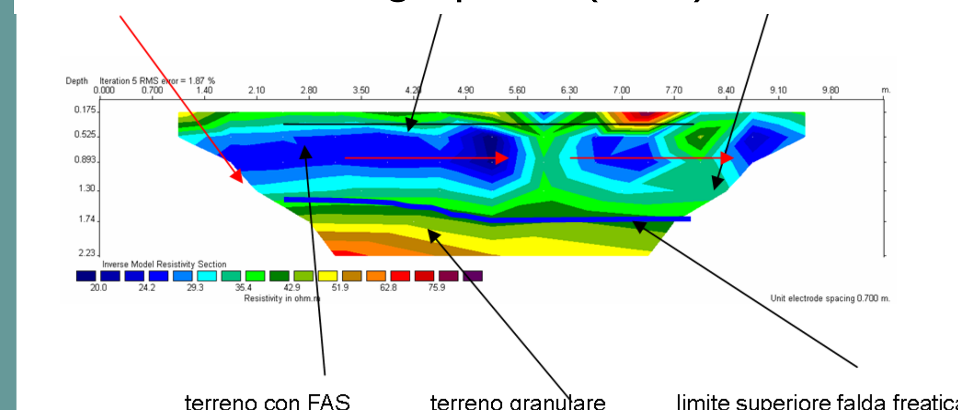
SOIL HYDROLOGY





There is no mixing flow with the natural groundwater

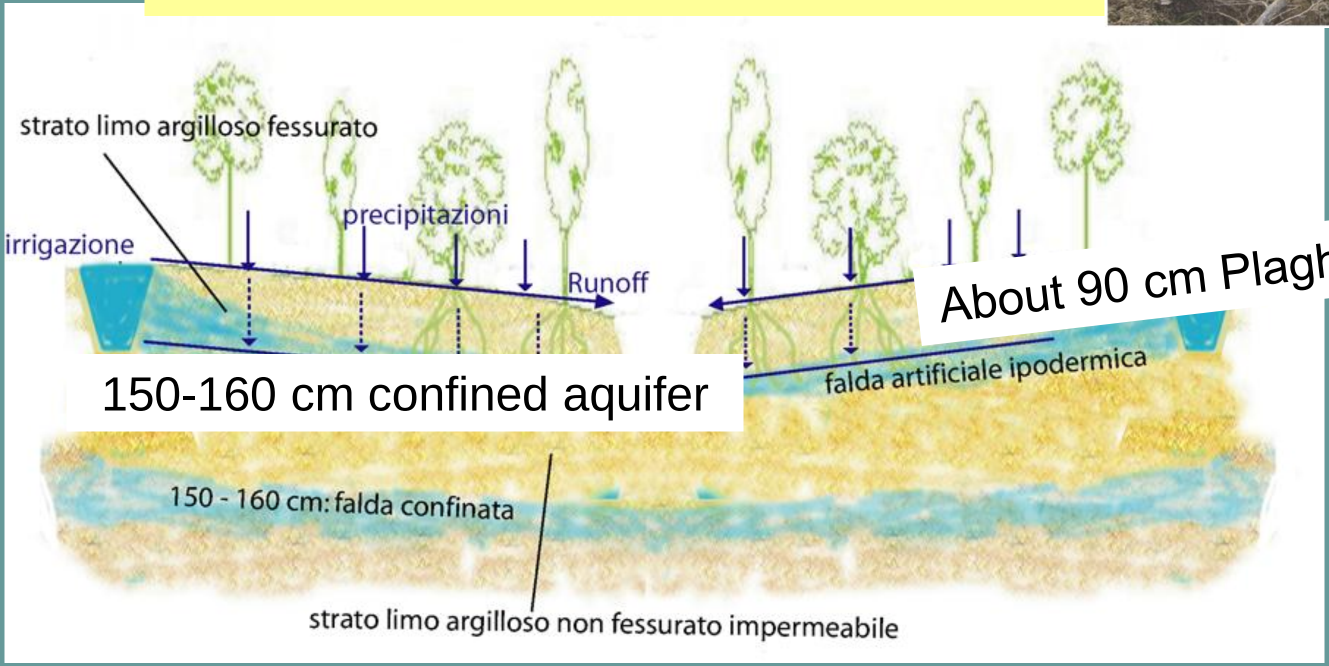
Geoelectrical survey with resistivity tomographies (ERT)



SOIL HYDROLOGY

$$I + P - ET = D$$

In the discarge ditch we have the result of the dual flows and runoff



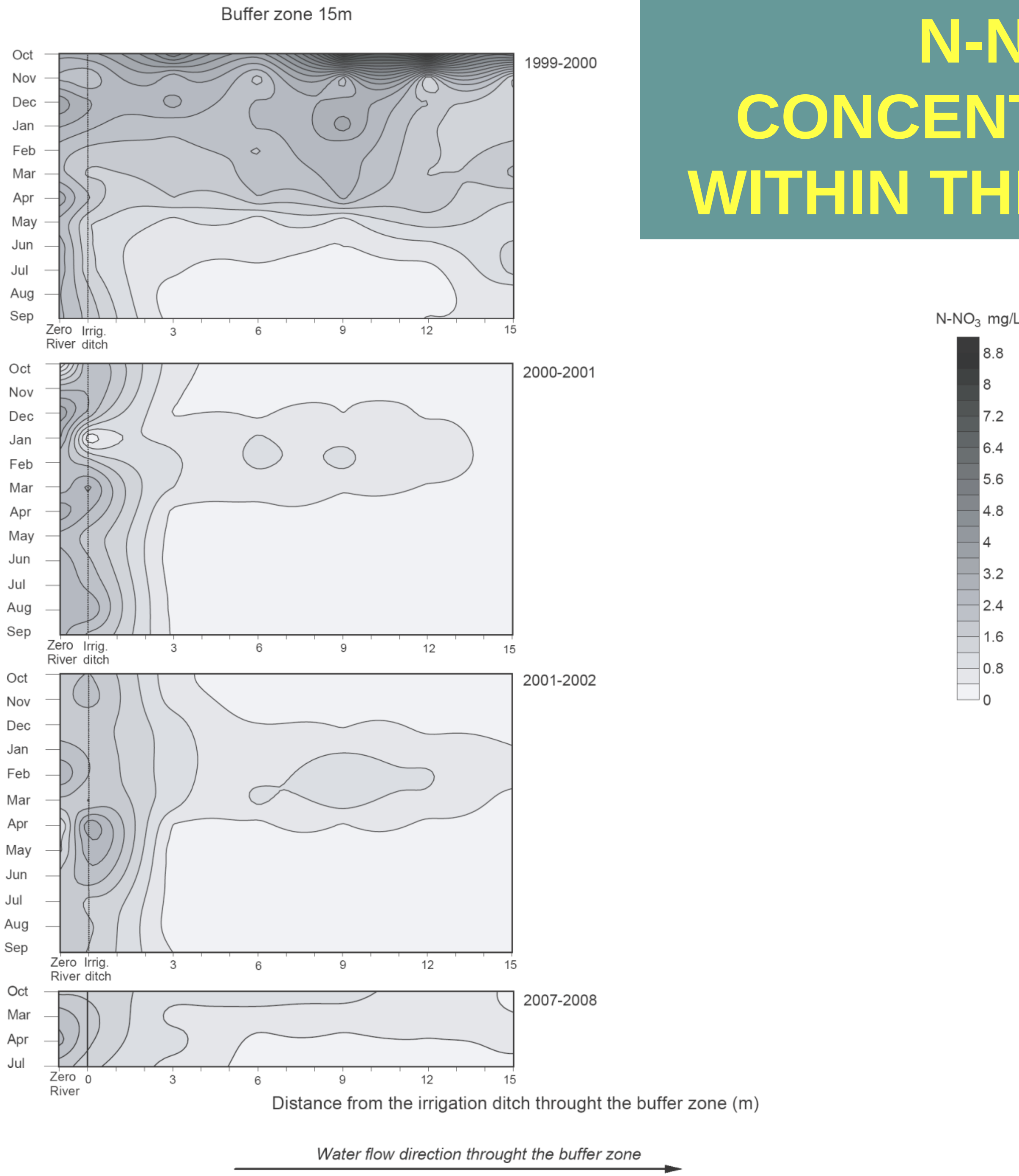
About 90 cm Plagh pan

150-160 cm confined aquifer

Seepage can be considered negligibile

As a consequence of the irrigation, a suspended superficial aquifer (with a depth between 25-80 cm) was created on a
While the upper soil layer was subjected to the normal seasonal cycle.

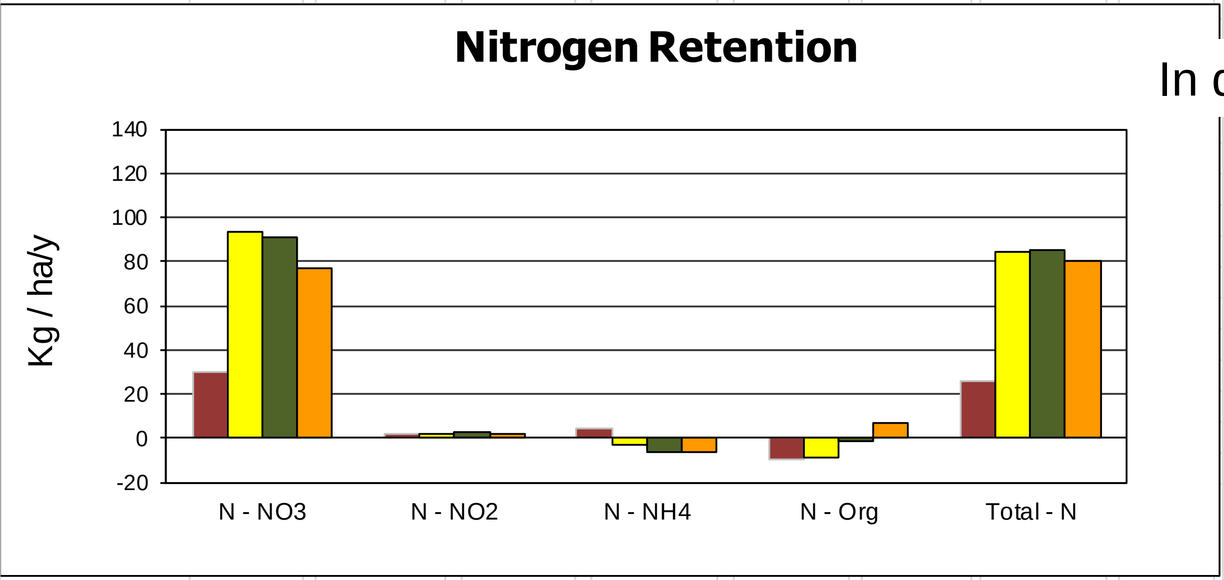
N-NO$_3$ CONCENTRATION WITHIN THE SYSTEM



Considerable removal already at 3-4 m from the irrigation ditch.
More evident during the warm season.

(Gumiero et al. 2011)

NITROGEN REMOVAL



In discharge ditch

Remotion Kg/ha/y	2000		2001		2002		2008	
N - NO_3	30	30%	93	88%	91	87%	77	78%
N - NO_2	2	77%	2	86%	3	89%	2	67%
N - NH_4	4	25%	-3	-17%	-6	-42%	-6	-72%
N - Org	-10	-78%	-9	-102%	-2	-19%	7	18%
Total - N	26	20%	84	62%	85	65%	80	56%
Irrigation Volume	77 mc / Ha giorno		154 mc / Ha giorno		154 mc / Ha giorno		205 mc / Ha giorn	

The removal capacity increased strongly from 1° to 3° year

Removal of the organic nitrogen

In piezometers

2000		2002		2008	
30,0	46%	73,2	83%	116,5	83%
1,8	86%	2,4	84%	2,6	76%
6,9	35%	0,0	-7%	-0,3	-3%
-15,9	-177%	-1,5	-13%	10,2	24%
22,8	33%	74,1	55%	129,1	65%

(Gumiero et al. 2011)

NEW EXPERIMENTS

2010
Partial wood cutting

row	1	2	3	4	total
Kg of wood	8795	3542	2852	2439	17628

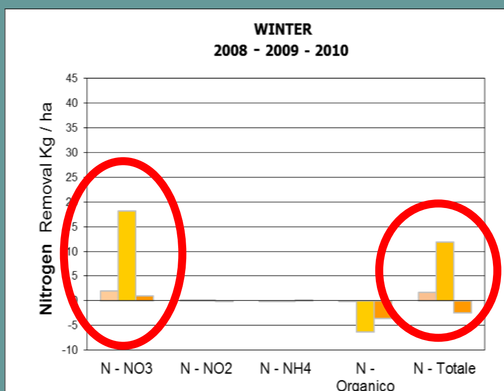
2009 and 2010
10 X of N-NO_3
(from 3 to 30 mg/l)

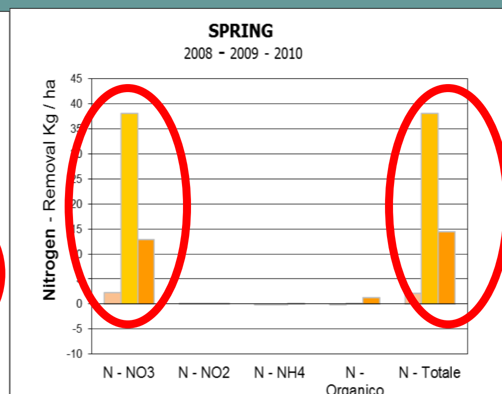
NITROGEN REMOVAL

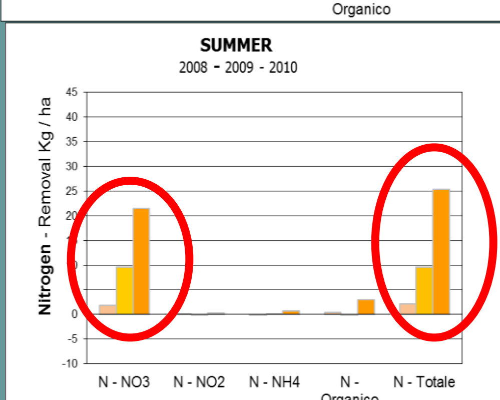
Adding ten times of N-NO3 for 8 days, ones per season

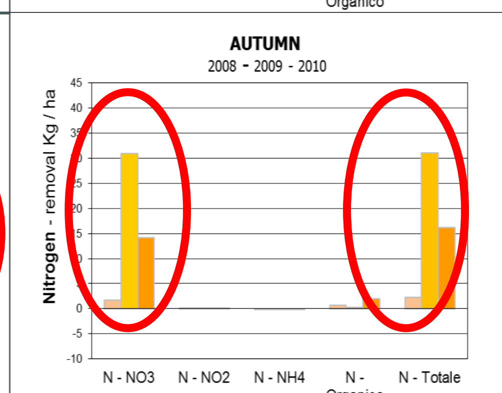
N-NO3	2008 1.7mg/L N-NO3		2009 19mg/L N-NO3)		2010 23mg/L N-NO3	
Winter	2,0	**70%**	18,2	**54%**	1,0	**2%**
Spring	2,3	**81%**	38,0	**79%**	12,9	**34%**
Summer	1,9	**80%**	9,6	**75%**	21,4	**46%**
Autumn	1,7	**78%**	30,9	**71%**	14,2	**37%**

N tot	2008 1.7mg/L N-NO3		2009 19mg/L N-NO3)		2010 23mg/L N-NO3	
Winter	1,8	51%	11,8	33%	-2,5	-6%
Spring	2,1	52%	38,1	74%	14,5	36%
Summer	2,1	61%	9,5	69%	25,4	49%
Autumn	2,2	56%	31,0	69%	16,2	39%









The system keep almost the same performances but if you cut 50% of the trees/shrub biomass in the active zone the buffering capacity is going to reduce drastically.

CONCLUSIONS

1. 60-65% of nitrate removal already after one year from conversion
2. After 8 years the buffering capacity remains
3. Buffering activity occurs mainly within the first few meters
4. 10 time increase of nitrate input can still be removed in the buffer zone
5. 50% of tree removal decreases significantly nitrate removal

Thanks for lissening