Alcune evidenze sperimentali sul ruolo della denitrificazione nei suoli e nelle acque superficiali

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In un programma quadriennale (2009-12) in provincia di Ferrara sono state studiate:

1) caratteristiche idrologiche del bacino,

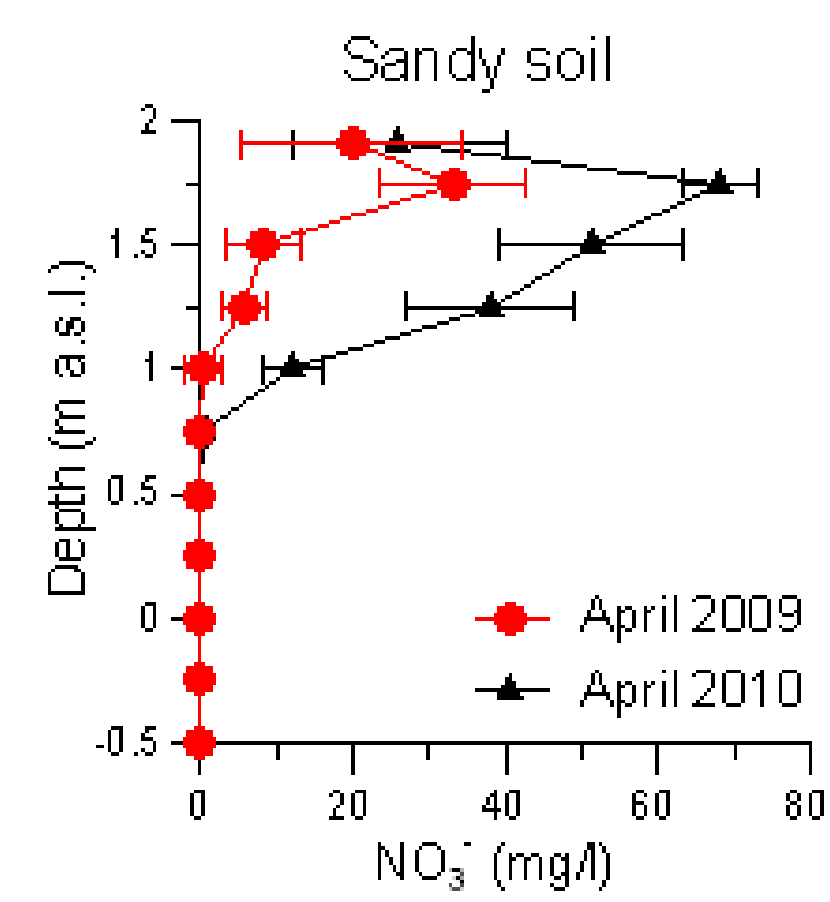
2) la percolazione e l'accumulo dell'azoto in falda,

3) i carichi di azoto della rete idrica,

5) la nitrificazione e il bilancio dell'azoto nel suolo,

6) la denitrificazione nel suolo e

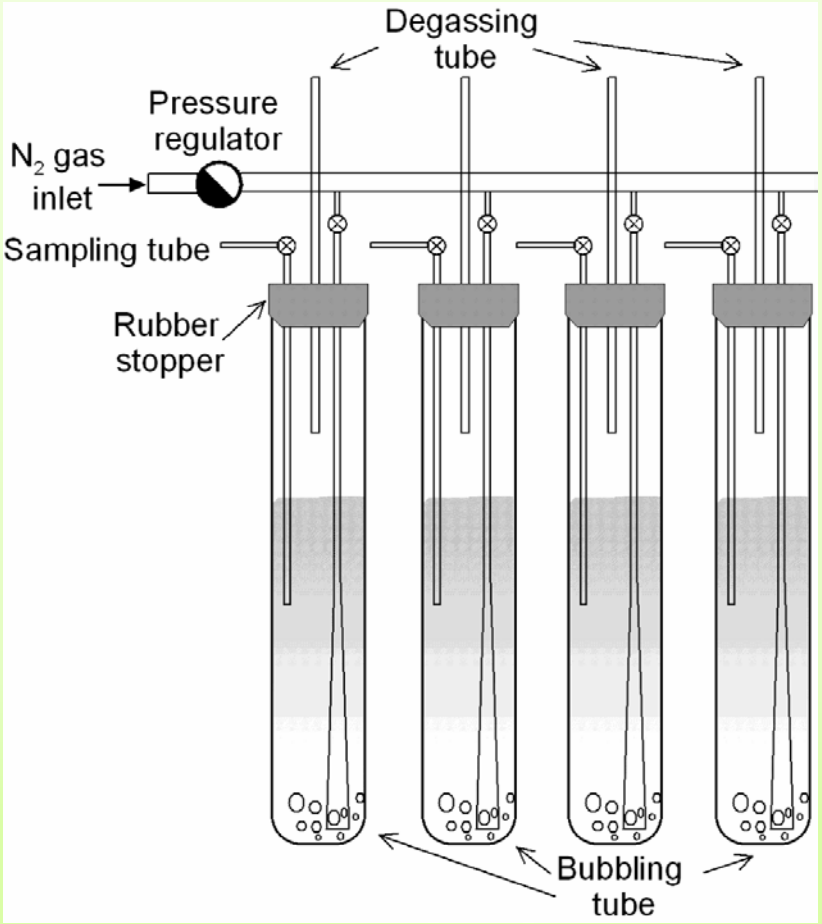
7) la denitrificazione nella rete idrica.

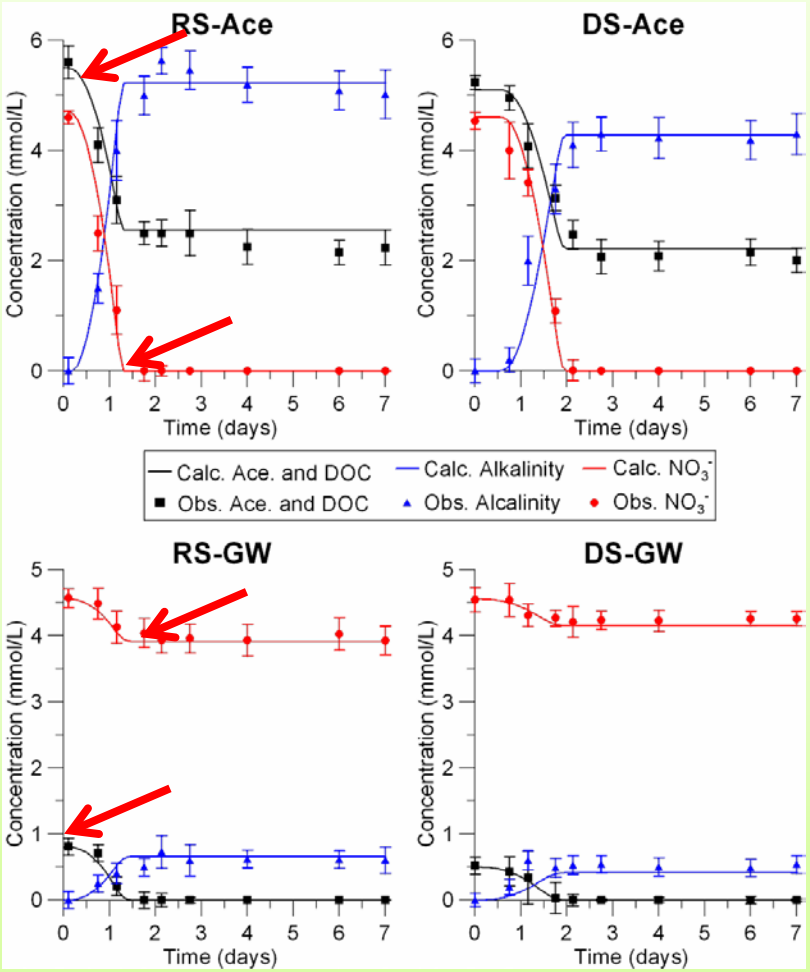


Profili verticali di NO_3^- nel sito sperimentale di Monticelli (sabbioso)

The role of permeability distribution on nitrate fate and transport, in different scales experiments under saturated condition (*2011*) M. Mastrocicco, N. Colombani, G. Castaldelli; In GQ10: Groundwater Quality Management in a Rapidly Changing World Edited by *M. Schirmer, E. Hoehn & T. Vogt;* IAHS Publ. 342 ISBN 978-1-907161-16-2.

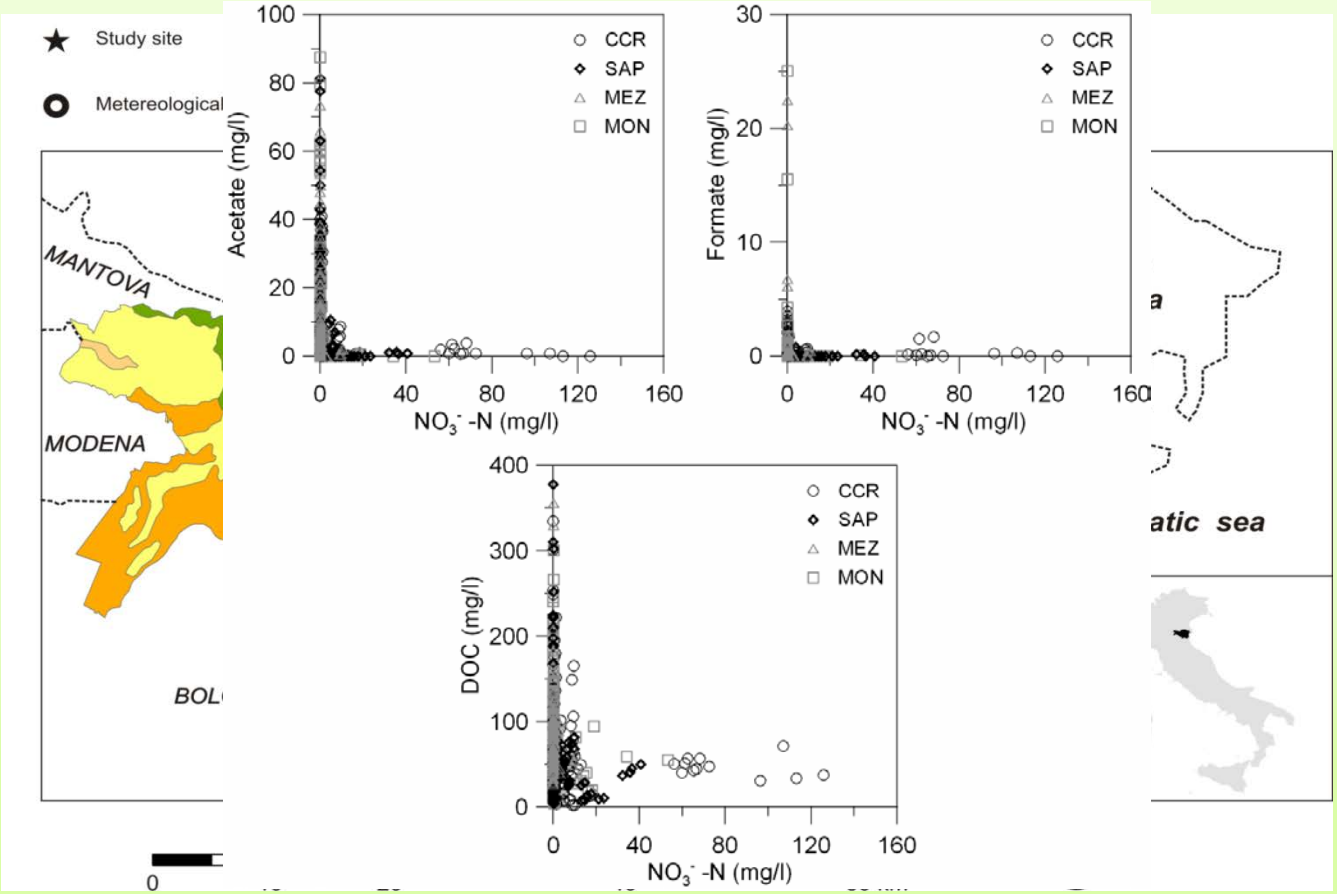
Esperimenti di laboratorio per determinare il tasso di denitrificazione con e senza materia organica labile





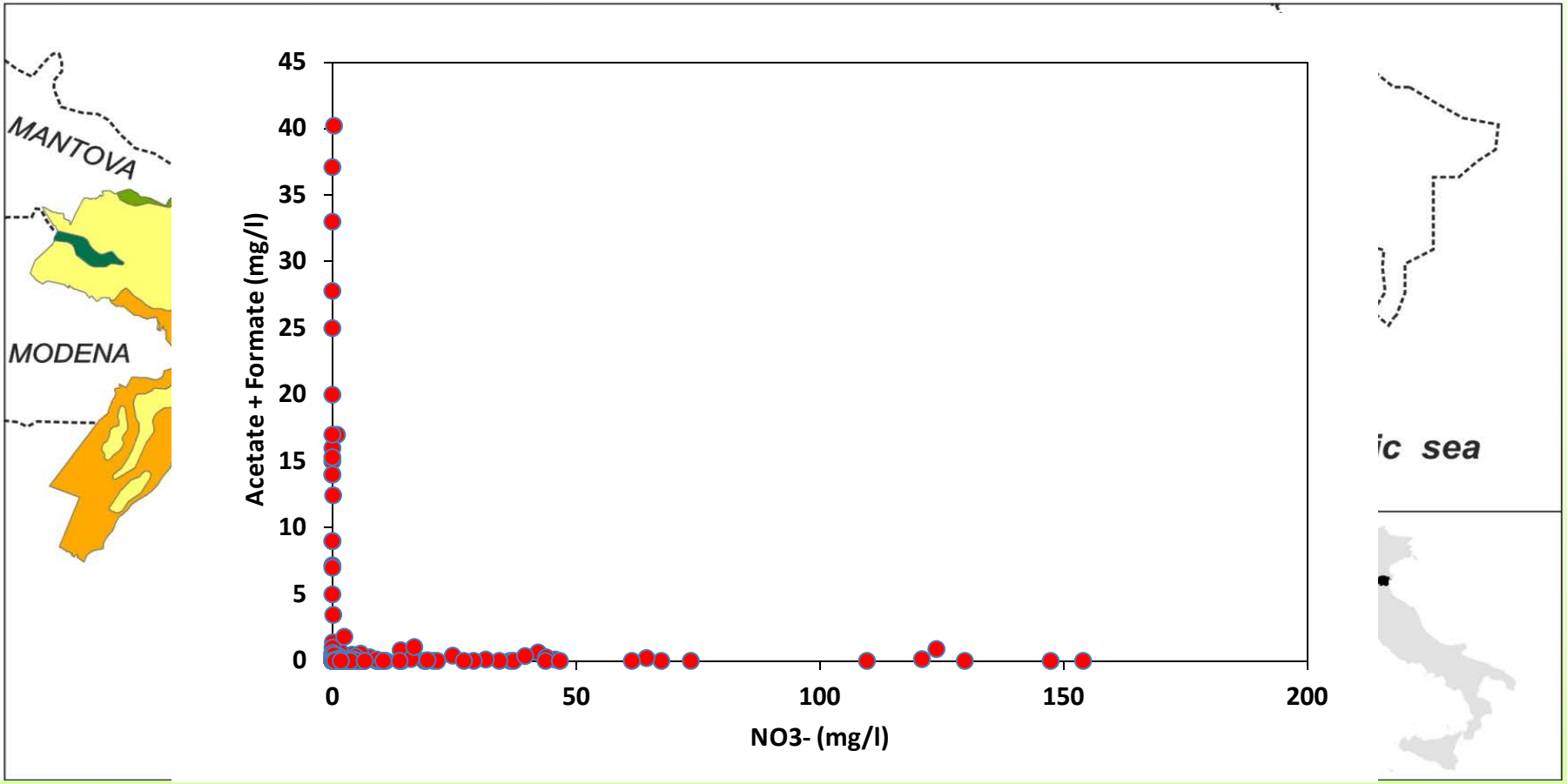
Reactive modelling of denitrification in soils with natural and depleted organic matter (2011) Mastrocicco M., N. Colombani, E. Salemi, G. Castaldelli (2011) *Water Air and Soil Pollution*, 222(1-4): 205-215.

Relazioni fra acetato, formiato, carbonio organico disciolto (DOC) e nitrato, nel suolo insaturo (lisimetri)

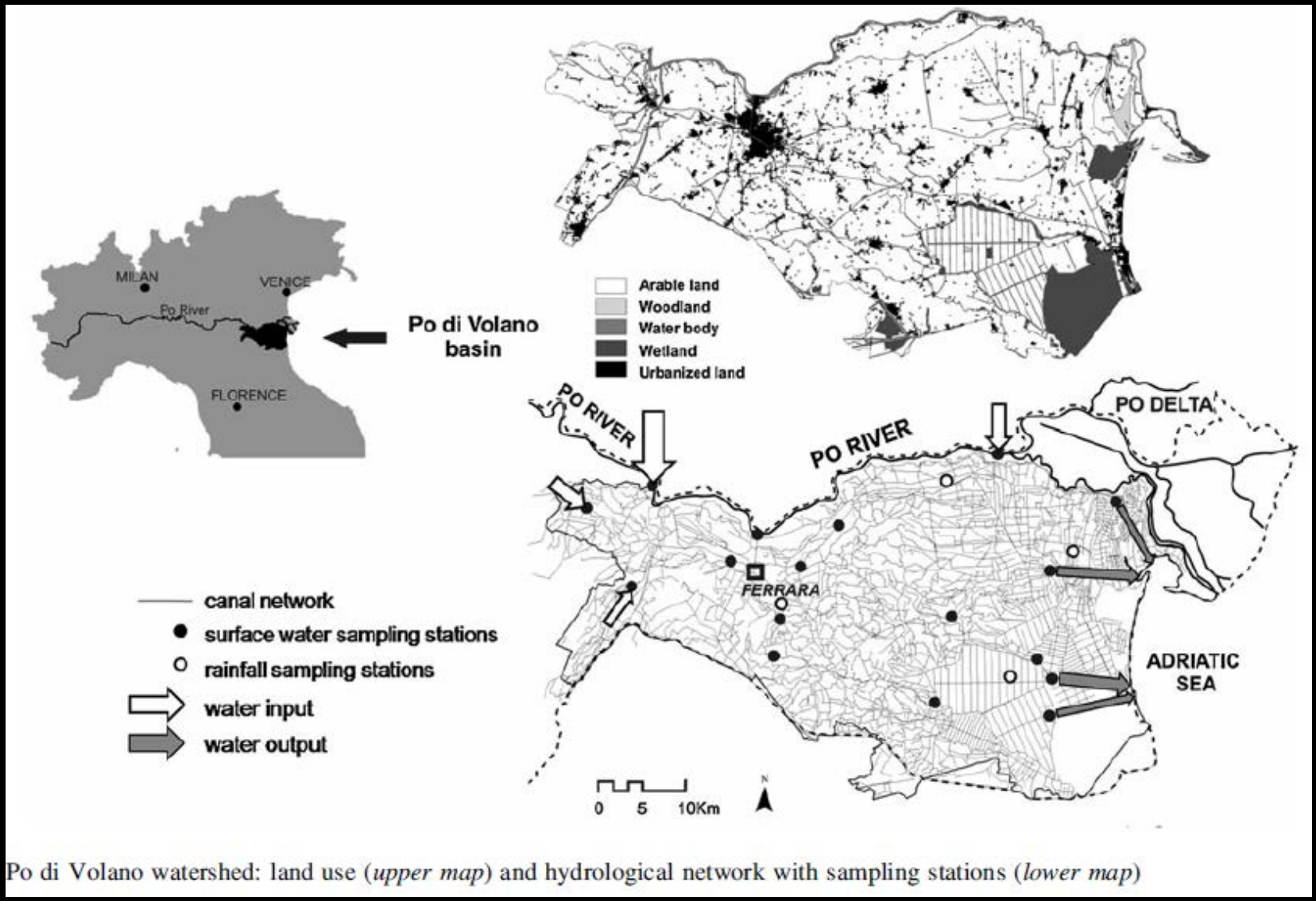


Linking dissolved organic carbon, acetate and denitrification in agricultural soils (2012) Castaldelli G., Colombani N., Vincenzi F., Mastrocicco M. Environmental Earth Sciences, 1-7. Article in Press. DOI: 10.1007/s12665-012-1796-7.

Relazione fra acetato, formiato e nitrato nella falda freatica



Nitrogen speciation and denitrification in a low land territory receiving synthetic fertilizers (Province of Ferrara, Northern Italy). Colombani N., Mastrocicco M., Vincenzi F., Castaldelli G., BALWOIS, North America, feb. 2012. Available at:
http://ocs.balwois.com/index.php?conference=BALWOIS&schedConf=BW2012&page=paper&op=view&path%5B%5D=347&path%5B%5D=71.



Po di Volano watershed: land use (*upper map*) and hydrological network with sampling stations (*lower map*)

Environmental Management
DOI 10.1007/s00267-013-0052-6

Nitrogen Budget in a Lowland Coastal Area Within the Po River Basin (Northern Italy): Multiple Evidences of Equilibrium Between Sources and Internal Sinks

Giuseppe Castaldelli · Elisa Soana · Erica Racchetti · Enrica Pierobon · Micol Mastrocicco · Enrico Tesini · Elisa Anna Fano · Marco Bartoli

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considered 3-year period (from 2006 to 2008), as monthly and in some cases, as daily volumes. Nitrogen species concentrations were measured monthly to fortnightly in the same period at 17 stations (Fig. 1), by the Regional Environmental Protection Agency (ARPA, Emilia Romagna Region, Provincial Department of Ferrara). N loads were calculated by means of the interpolation method according to Kronvang and Bruhn (1996) and Letcher and others (2002) which appeared to be the most sensitive one for small lowland streams with sudden changes in hydrological regime. Nitrogen loads were estimated by interpolating linearly the N compound concentration between subsequent measurements (Eq. 2):

$$L = \sum_{i=1}^{n} \sum_{t_i < t < t_{i+1}} q_t \frac{C_{ti}(t_{i+1} - t) + C_{ti+1}(t - t_i)}{t_{i+1} - t_i} \qquad (2)$$

where q_t is the flow at time t, t_i, $i = 1,\ldots, n$ are the times at which concentration measurements were taken, and C_{ti} is the measured concentration at time t_i.

Table 2 Annual inputs and outputs of water, nitrate ($N\text{-}NO_3^-$), dissolved inorganic nitrogen (DIN) and total nitrogen (TN) through the hydrological network of the Po di Volano watershed (average ± standard deviation for the 3-year period 2006–2008)

	Input	Output	Delta
Water (10^6 m^3)	725 (77)	654 (54)	
$N\text{-}NO_3^-$ (t N $year^{-1}$)	1,213 (449)	1,020 (251)	−192 (199)
DIN (t N $year^{-1}$)	1,825 (321)	1,584 (300)	−241 (22)
TN (t N $year^{-1}$)	3,332 (378)	2,707 (256)	−625 (122)

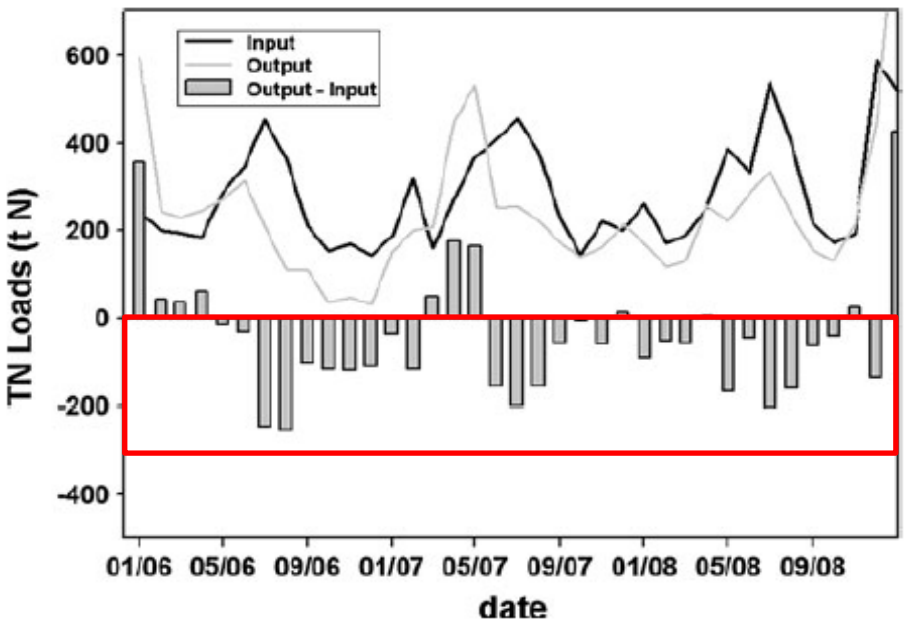
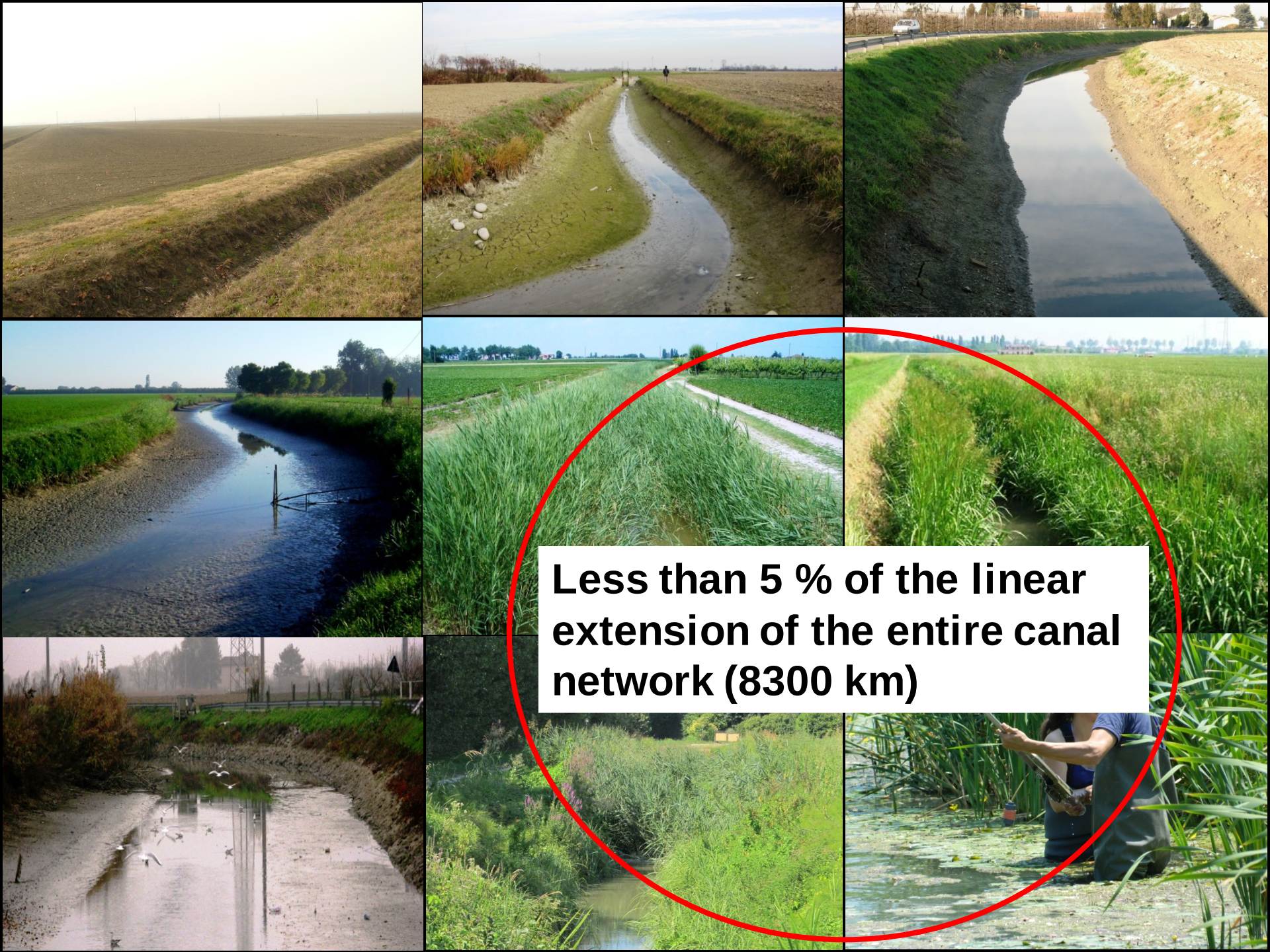
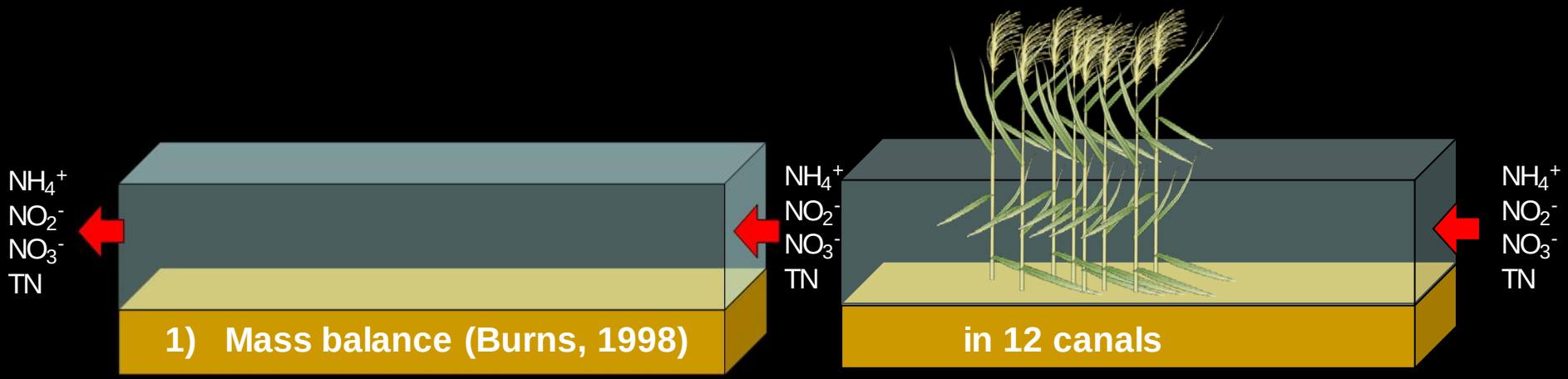


Fig. 4 Temporal pattern of total N loads, reported as input, output and their monthly difference in the hydrological network along the 3-year period 2006–2008


Less than 5 % of the linear extension of the entire canal network (8300 km)

2) Vegetated VS unvegetated canals

- Hypothesis: Ecosystem services provided by canals are largely supported by macrophytes



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CLEAN
Soil Air Water

Enrica Pierobon
Giuseppe Castaldelli
Sara Mantovani
Fabio Vincenzi
Elisa Anna Fano

Department of Biology and Evolution,

Research Article

Nitrogen Removal in Vegetated and Unvegetated Drainage Ditches Impacted by Diffuse and Point Sources of Pollution

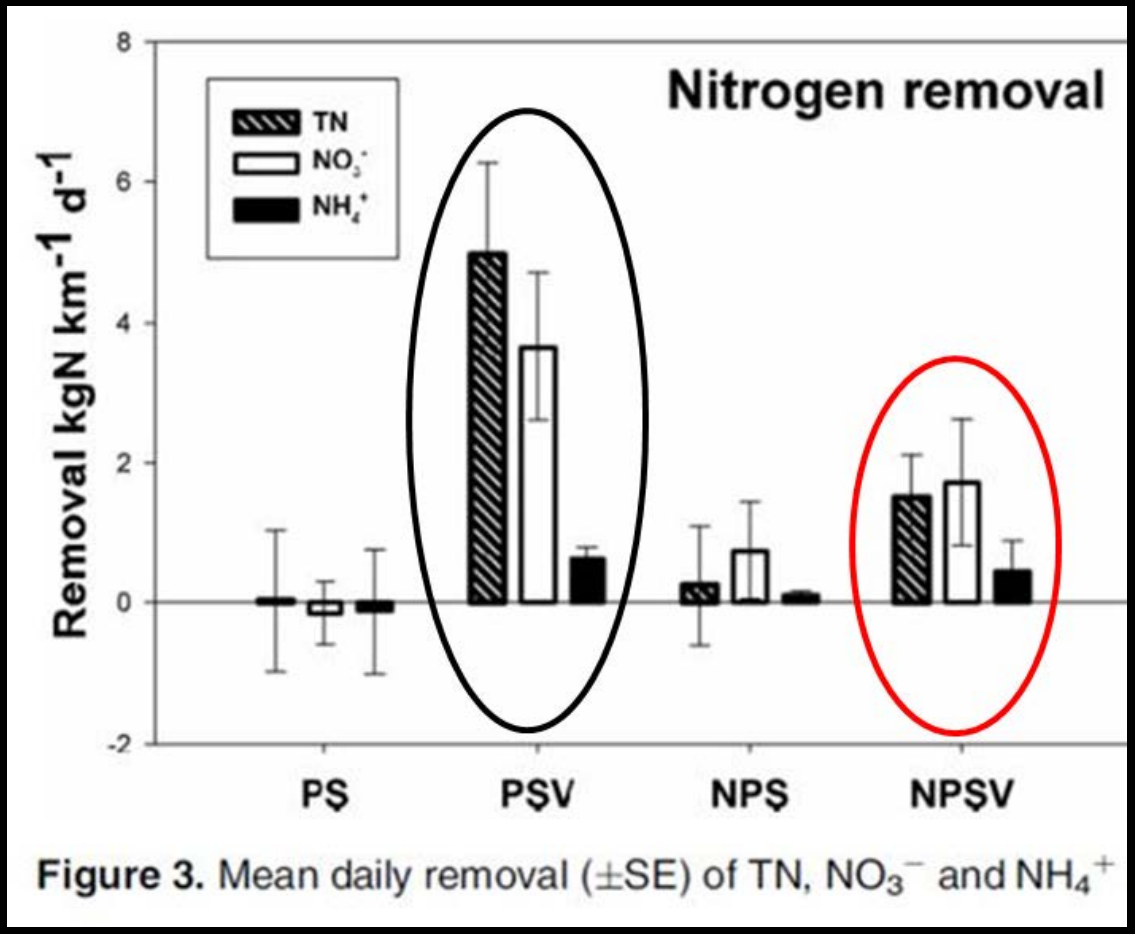

Figure 3. Mean daily removal (±SE) of TN, NO_3^- and NH_4^+

PS: point source pollution

PSV: point source – vegetated

NPS: non-point source

NPSV: non-point source - vegetated

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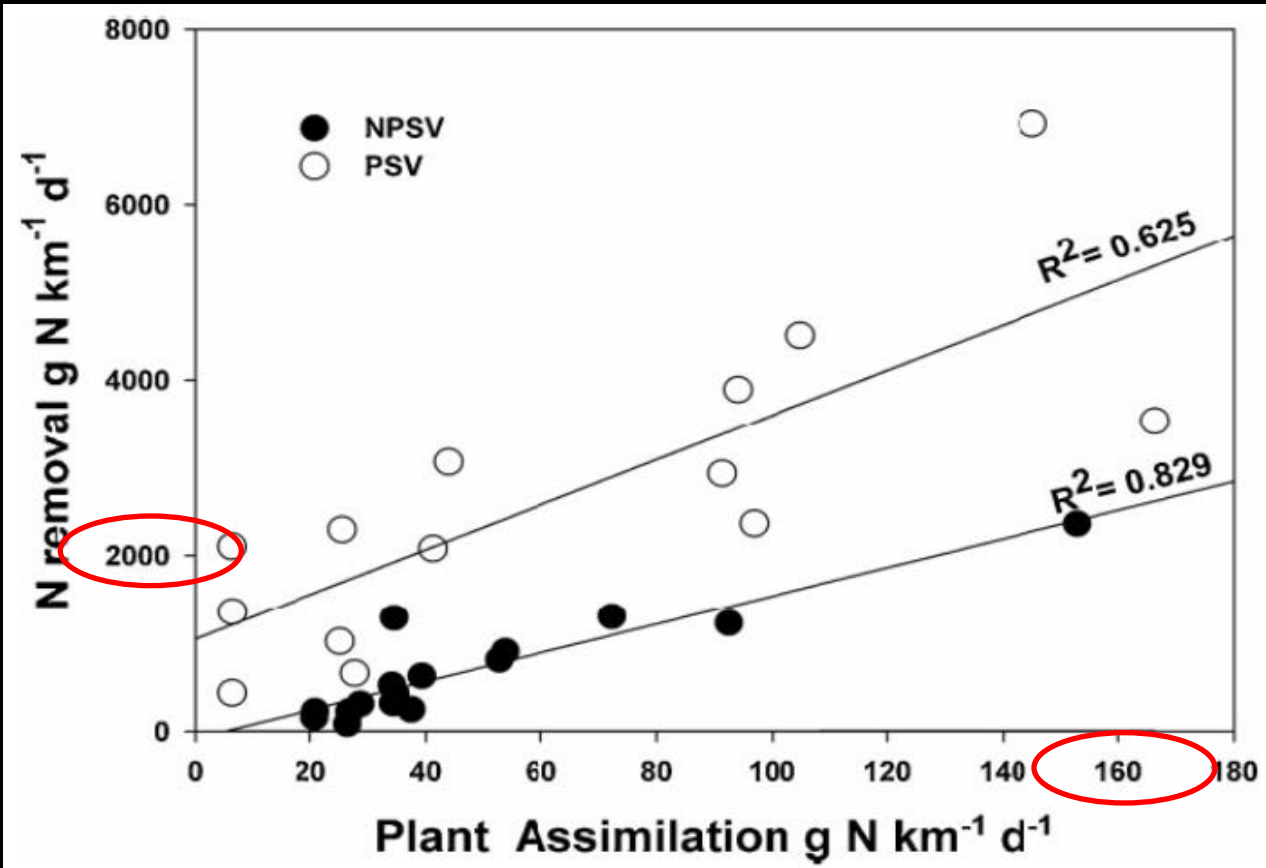


Figure 5. Plant net N daily uptake (g N km^{-1} d^{-1}) versus TN removal in the water column.

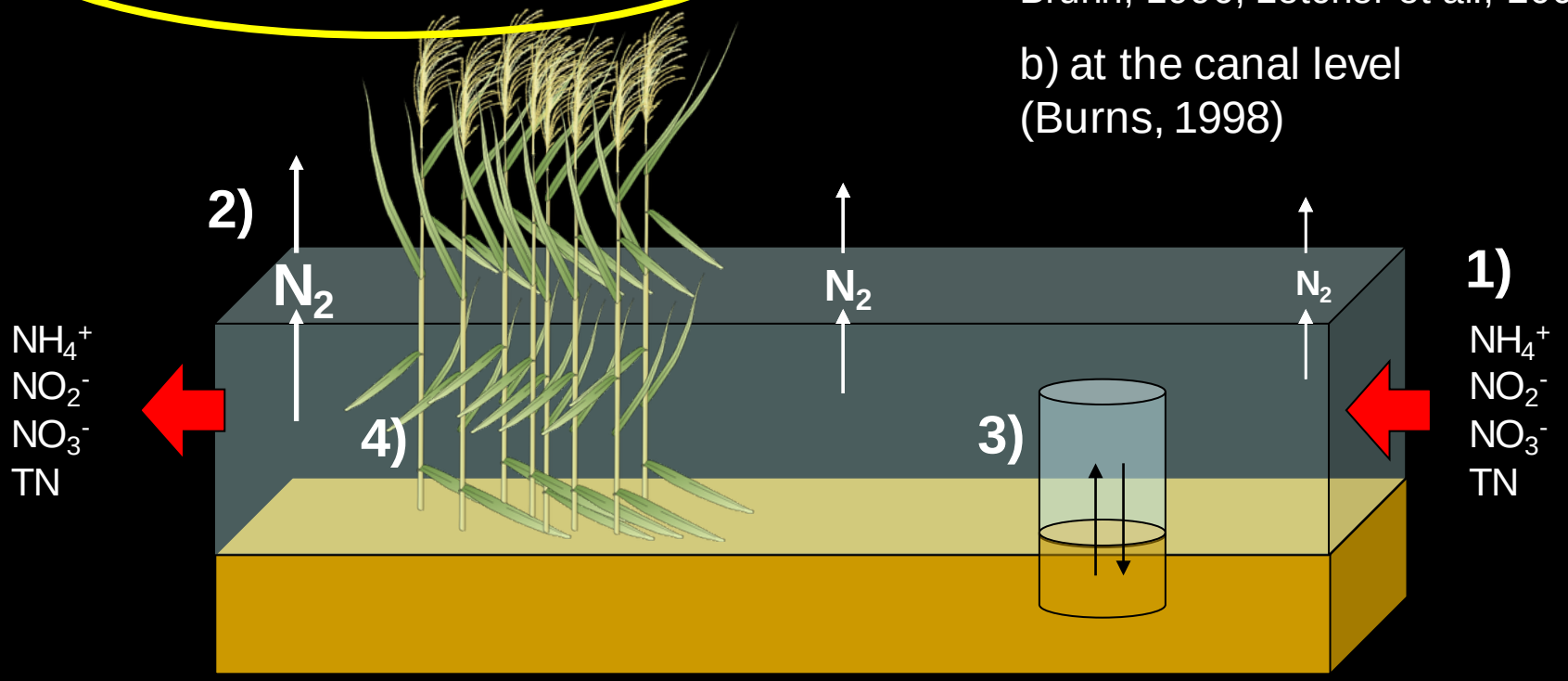
… new insights

2) Whole reach denitrification (N_2/Ar) (Laursen and Seitzinger, 2004)

1) Mass balance (Δ=out-in)

a) at the basin level (Kronvang and Bruhn, 1996; Letcher et al., 2002)

b) at the canal level (Burns, 1998)



4) Vegetation N uptake : random sampling for plant density, biomass and N content of the species found

3) Intact core incubation: DIN & N_2 net flux (Dalsgaard et al. 2000)

Estimating denitrification in rivers at the whole-reach scale – a modeling approach based on high precision measurement of dissolved gases

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Ryerson University
Toronto, Ontario

Sybil Seitzinger
Institute of Marine and Coastal Sciences
Rutgers University
New Brunswick, NJ

National Science Foundation
Denitrification Research Coordination Network
Training Module

The use of membrane inlet mass spectrometry (MIMS) for the measurement of high precision N_2/Ar ratios.

Dr. Todd M. Kana
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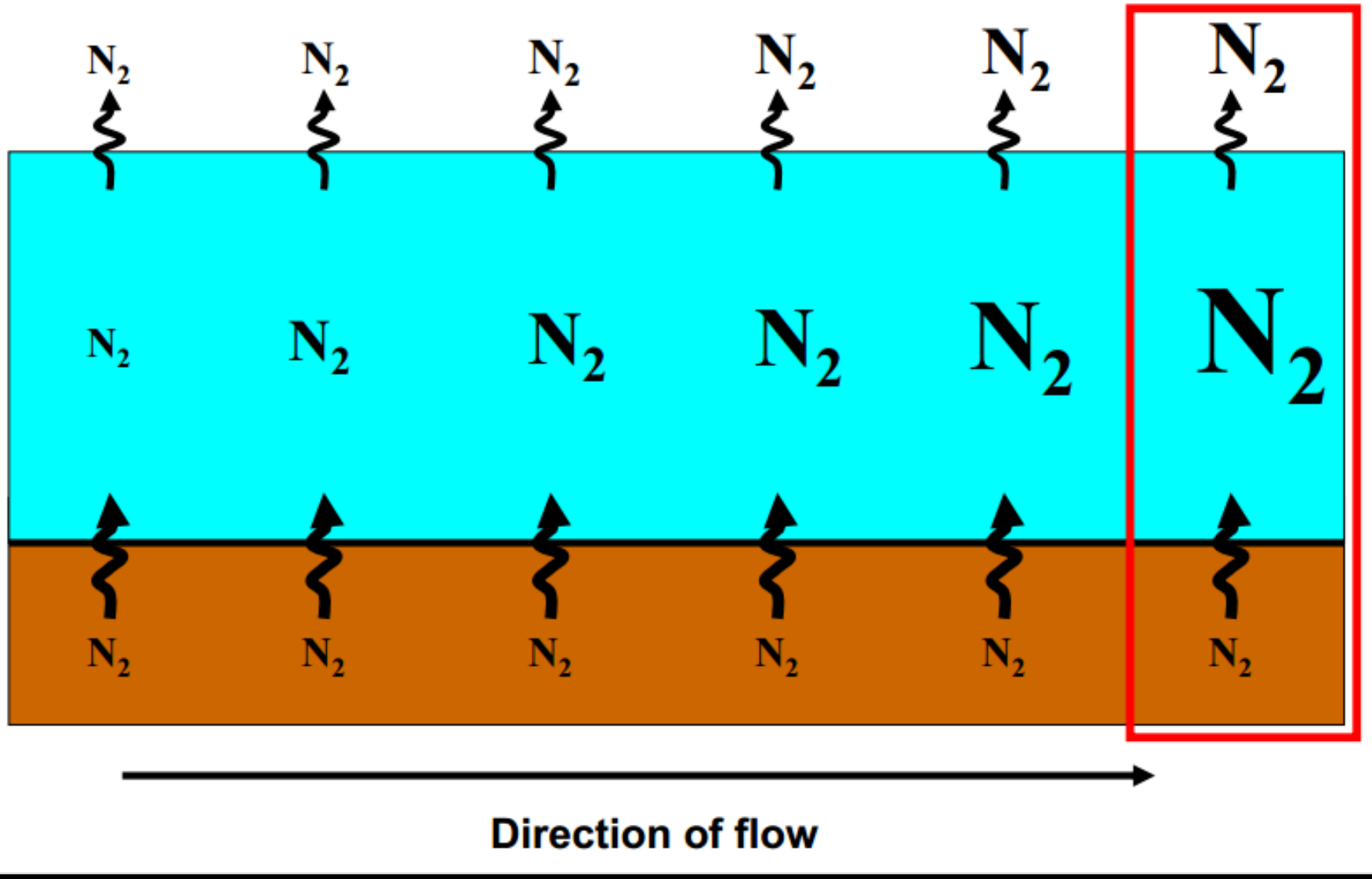
Horn Point Laboratory
University of Maryland
Center for Environmental Science

ADVANTAGES:
- High precision
- Direct dissolved gas interface

RESULT:
- Detection of ≤ 0.03% dissolved N_2 in < 2 minutes

I. Lagrangian Sampling: N_2 increases during downstream transport



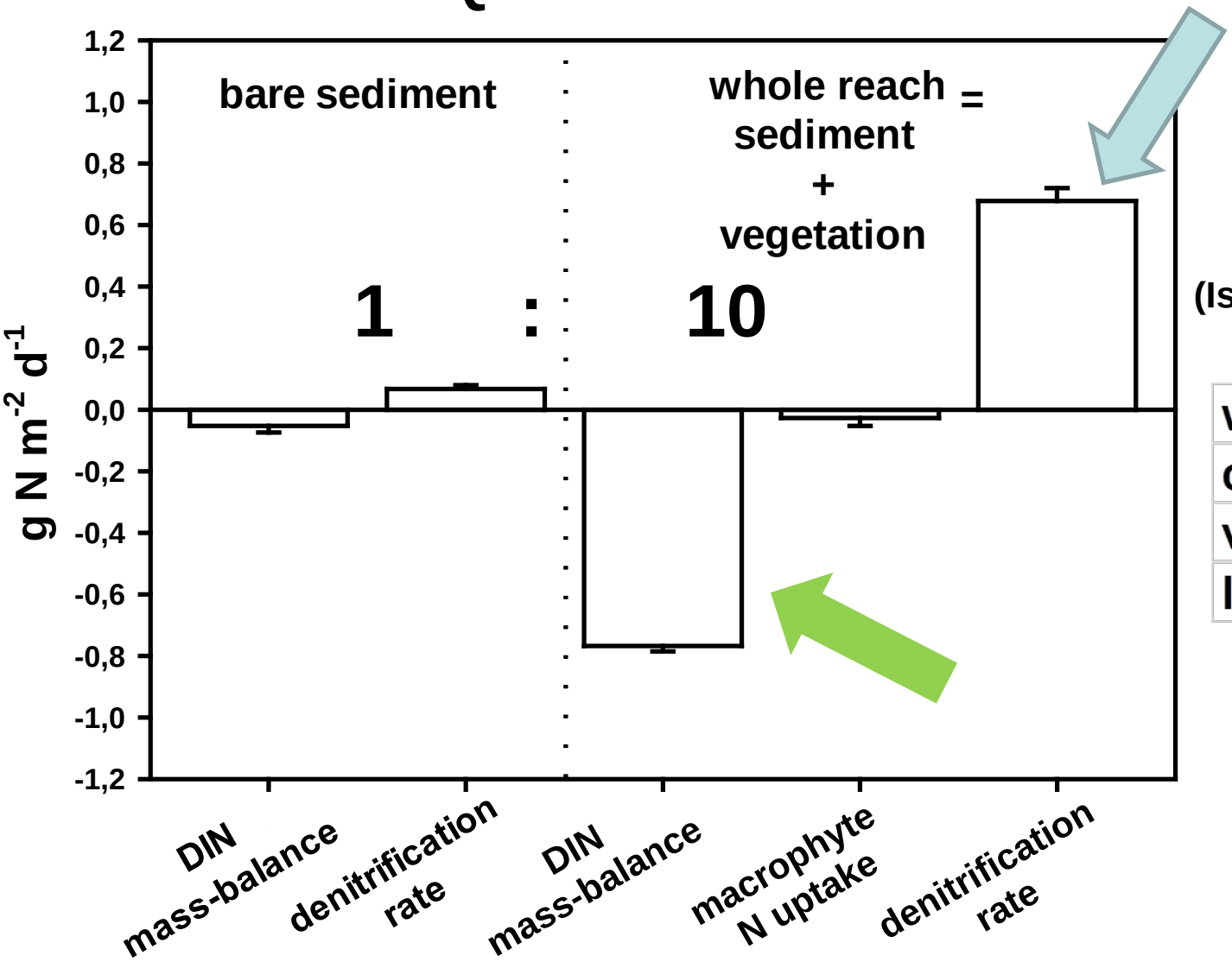








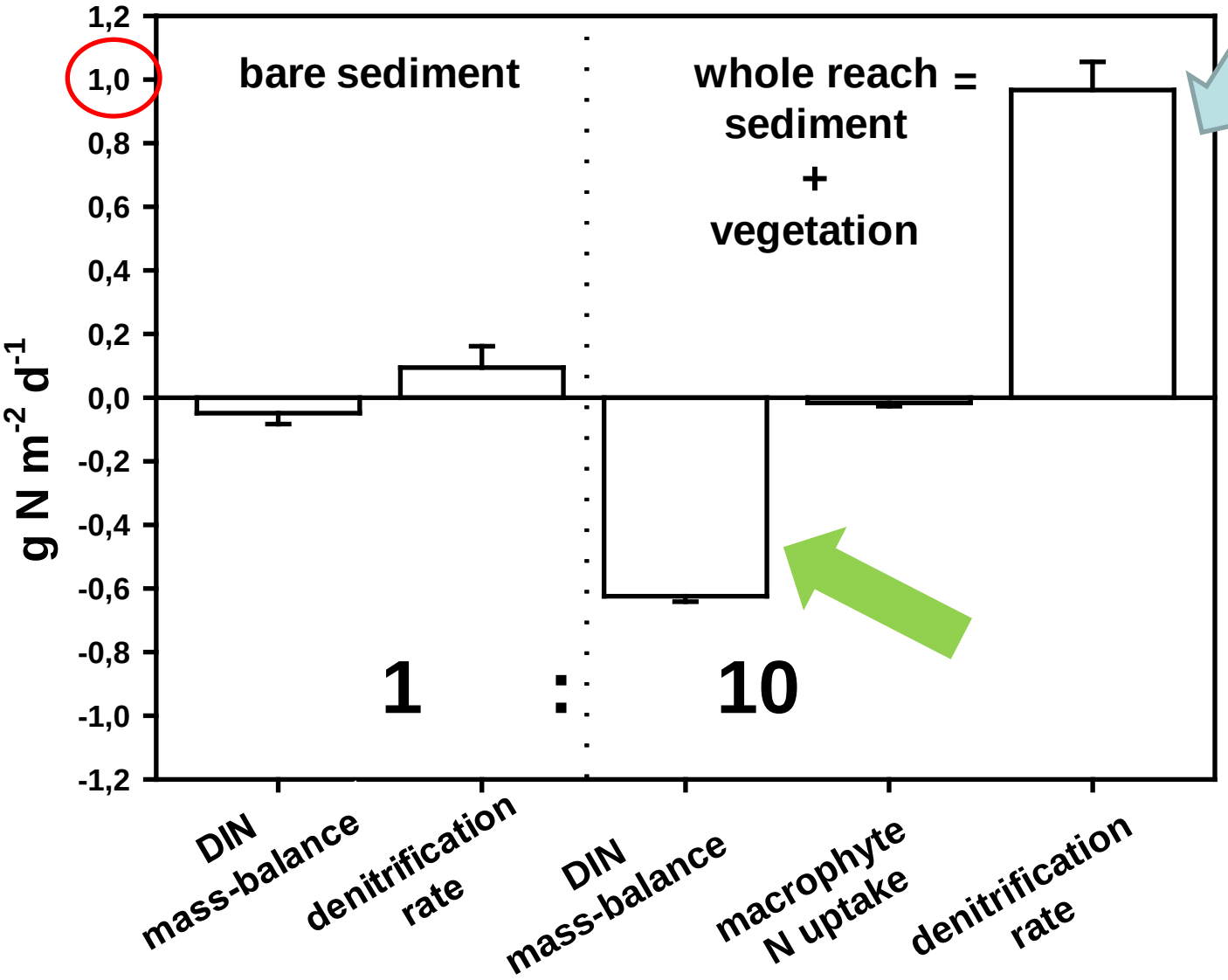
QUARTESANE



k=0.71
(Isaacs & Gaudy, 1968)

width (m)	4.8
depth (m)	0.6
vel. (cm/s)	6.6
load (l/s)	93

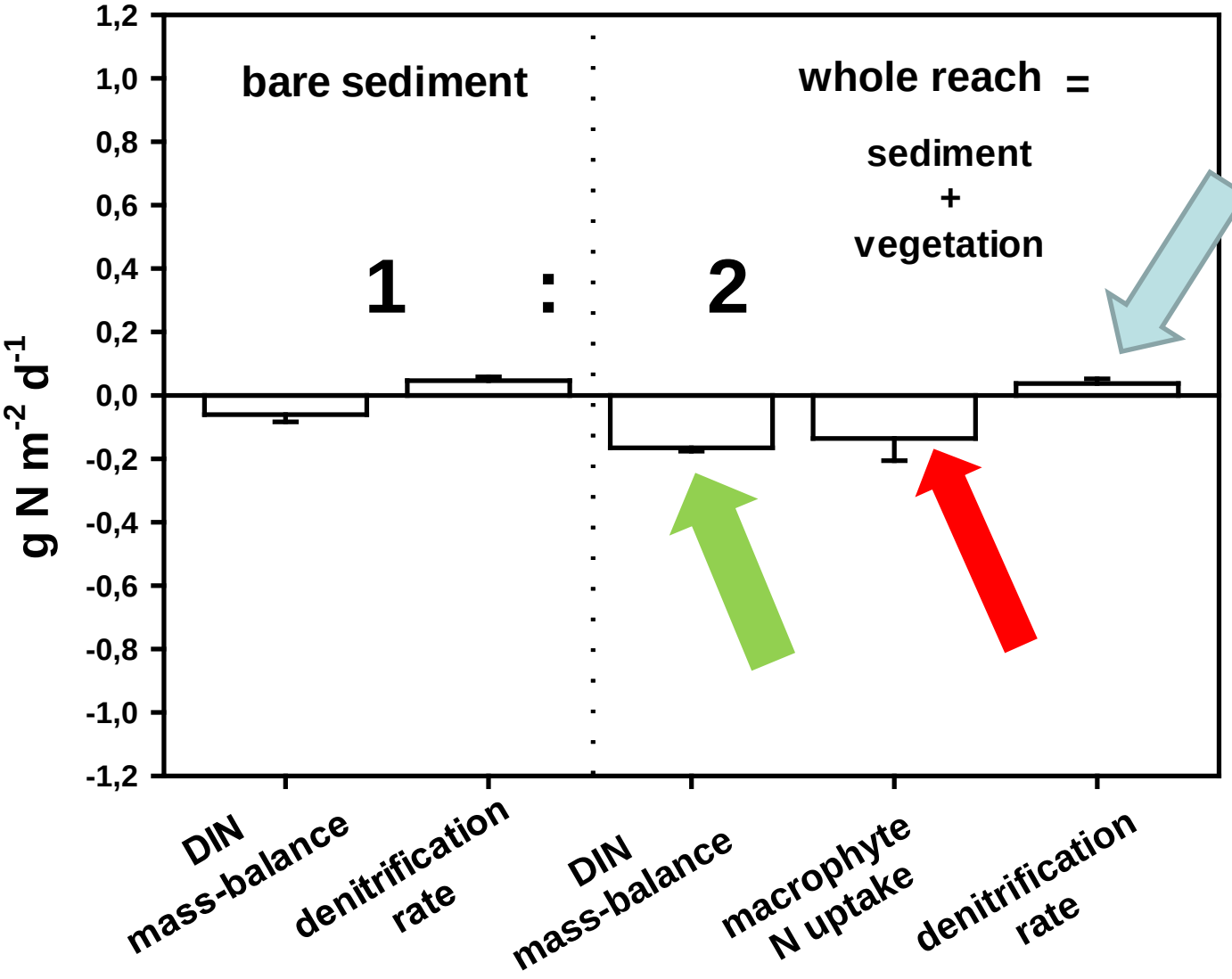
FORNARO



k=2.56
(Isaacs & Gaudy, 1968)

width (m)	2.80
depth (m)	0.3
vel. (cm/s)	8.7
load (l/s)	53

CODREA



k=0.15
(Isaacs & Gaudy, 1968)

width (m)	4
depth (m)	0.5
vel. (cm/s)	1.1
load (l/s)	21

From May to September,

8300 km of canals,

kept mowed,

remove 352 ± 355 t N,

while,

if they were left vegetated

N removal would go up to

3168 ± 502 t N.

Pubblicazioni più significative

Aschonitis, V.G., Mastrocicco, M., Colombani, N., Salemi, E., Castaldelli, G. Assessment of the intrinsic vulnerability of agricultural land to water and nitrogen losses: Case studies in Italy and Greece(2014) IAHS-AISH Proceedings and Reports, 364, pp. 14-19.

Castaldelli, G., Soana, E., Racchetti, E., Pierobon, E., Mastrocicco, M., Tesini, E., Fano, E.A., Bartoli, M. Nitrogen budget in a lowland coastal area within the Po River Basin (Northern Italy): Multiple evidences of equilibrium between sources and internal sinks (2013) Environmental Management, 52 (3), pp. 567-580.

Aschonitis, V.G., Salemi, E., Colombani, N., Castaldelli, G., Mastrocicco, M. Formulation of indices to describe intrinsic nitrogen transformation rates for the implementation of best management practices in agricultural lands (2013) Water, Air, and Soil Pollution, 224 (3), 1489.

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Viaroli, P., Bartoli, M., Castaldelli, G., Naldi, M., Nizzoli, D., Rossetti, G. Recent evolution and expected changes of nutrient loads in a heavily exploited watershed: The Po River, Italy (2013) IAHS-AISH Proceedings and Reports, 361, pp. 175-182.

Pierobon, E., Castaldelli, G., Mantovani, S., Vincenzi, F., Fano, E.A. Nitrogen Removal in Vegetated and Unvegetated Drainage Ditches Impacted by Diffuse and Point Sources of Pollution (2013) Clean - Soil, Air, Water, 41 (1), pp. 24-31.

Aschonitis, V.G., Mastrocicco, M., Colombani, N., SalemiE., Kazakis, N., Voudouris, K., Castaldelli, G. Assessment of the intrinsic vulnerability of agricultural land to water and nitrogen losses via deterministic approach and regression analysis (2012) Water, Air, and Soil Pollution, 223 (4), pp. 1605-1614.

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Mastrocicco, M., Colombani, N., Palpacelli, S., Castaldelli, G. Large tank experiment on nitrate fate and transport: The role of permeability distribution (2011) Environmental Earth Sciences, 63 (5), pp. 903-914.

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Mastrocicco, M., Colombani, N., Salemi, E., Castaldelli, G. Numerical assessment of effective evapotranspiration from maize plots to estimate groundwater recharge in lowlands (2010) Agricultural Water Management, 97 (9), pp. 1389-1398.

Capitoli di libri

The role of the unsaturated zone in determining nitrate leaching to groundwater; In “Groundwater Quality Sustainability” - IAH Series: Selected Papers on hydrogeology (2011); edited by P. Maloszewski, S. Witczak and G. Malina – CRC Press, Taylor & Francis Books (UK). ISBN: 9780415698412

A step-wise approach to assess the fate of nitrogen species in agricultural lowlands; in "Wastewater reuse and management" (2013); Sharma, Sanjay K. and Sanghi, Rashmi (Eds.) Springer-Verlag New York, LLC; ISBN 978-94-007-4941-2; 474 p.

EU.Water - Un’agricoltura sostenibile e di qualità Elementi a supporto dell’applicazione della Direttiva Nitrati nelle Province di Ferrara e Rovigo (2012). A cura di Meggiolaro M., Castaldelli G., Provincia di Ferrara Ed., Sate srl, Ferrara, 120 pp.
http://www.eu-water.eu/images/EU.WATER_italian%20final%20publication.pdf

Grazie per l’attenzione