Diffusion of the Chemical contaminants and quality of fish products

Mauro Marini

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https://www.researchgate.net/profile/Mauro_Marini2

FISHMED-PhD

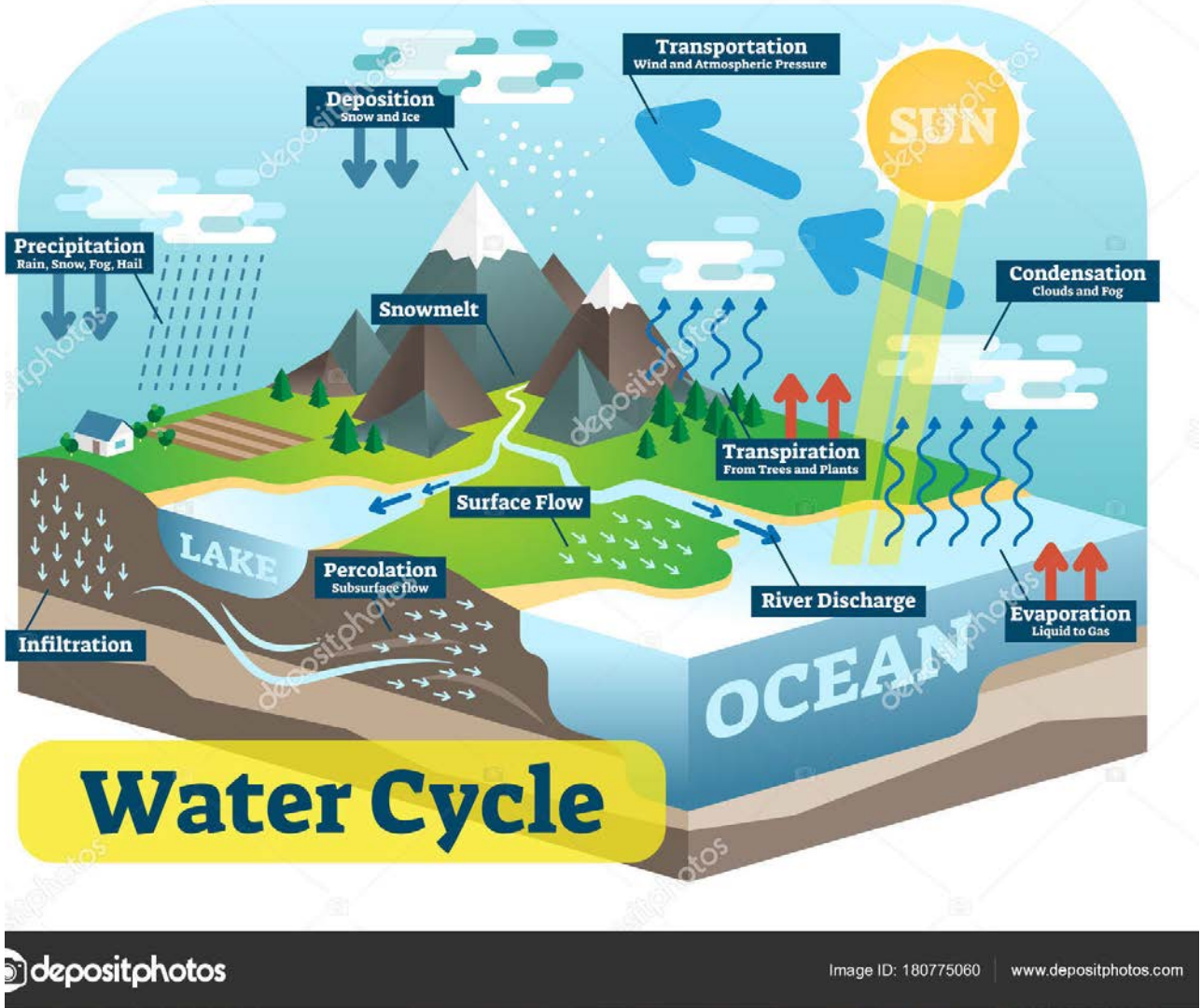
Fano, 02-03-2023

FishMed-PhD

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Consiglio Nazionale delle Ricerche

CNR IRBIM
ISTITUTO PER LE RISORSE BIOLOGICHE E LE BIOTECNOLOGIE MARINE



Topics in this lesson:

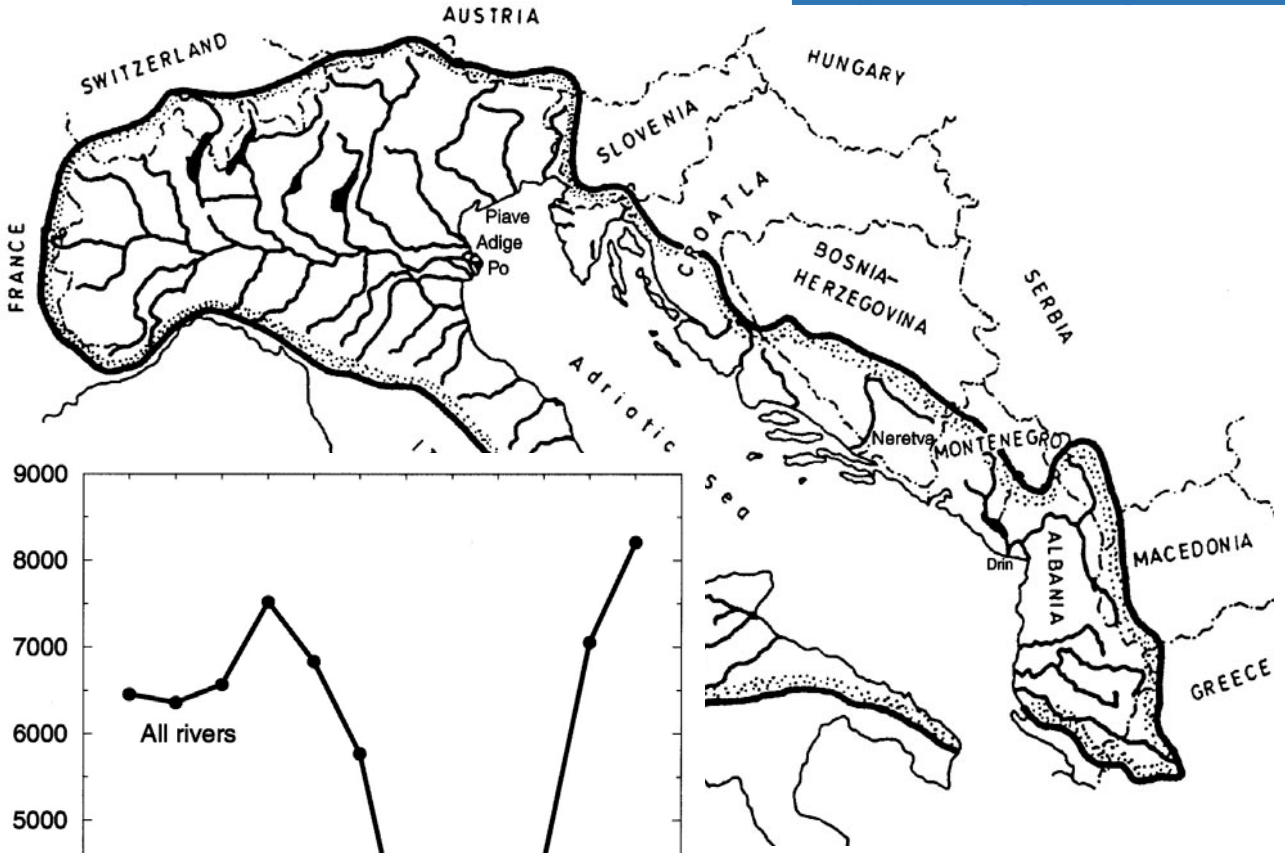
1. Description of the Adriatic basin, main oceanographic processes.

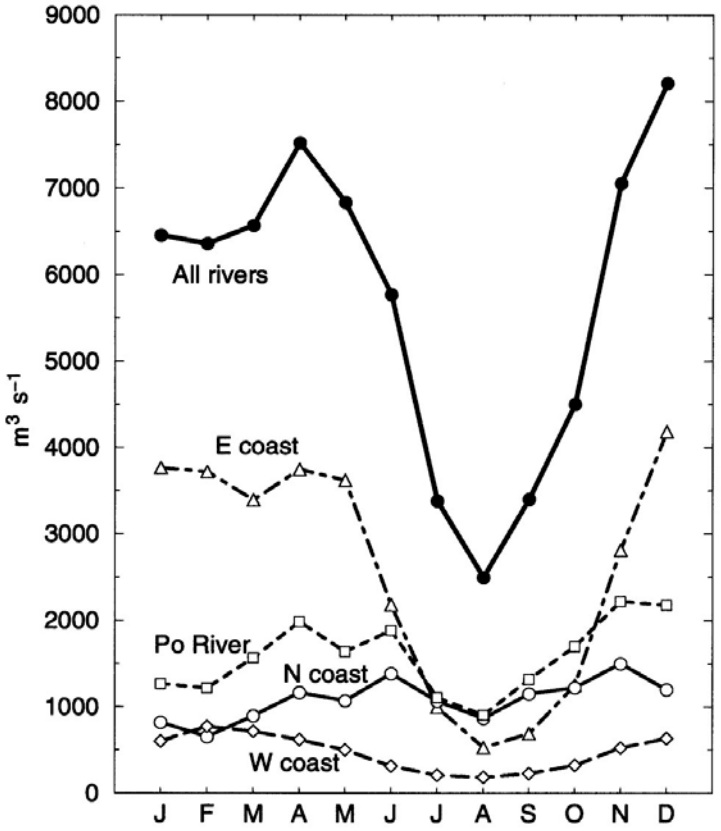
2. Nutrients that reach the sea via rivers.

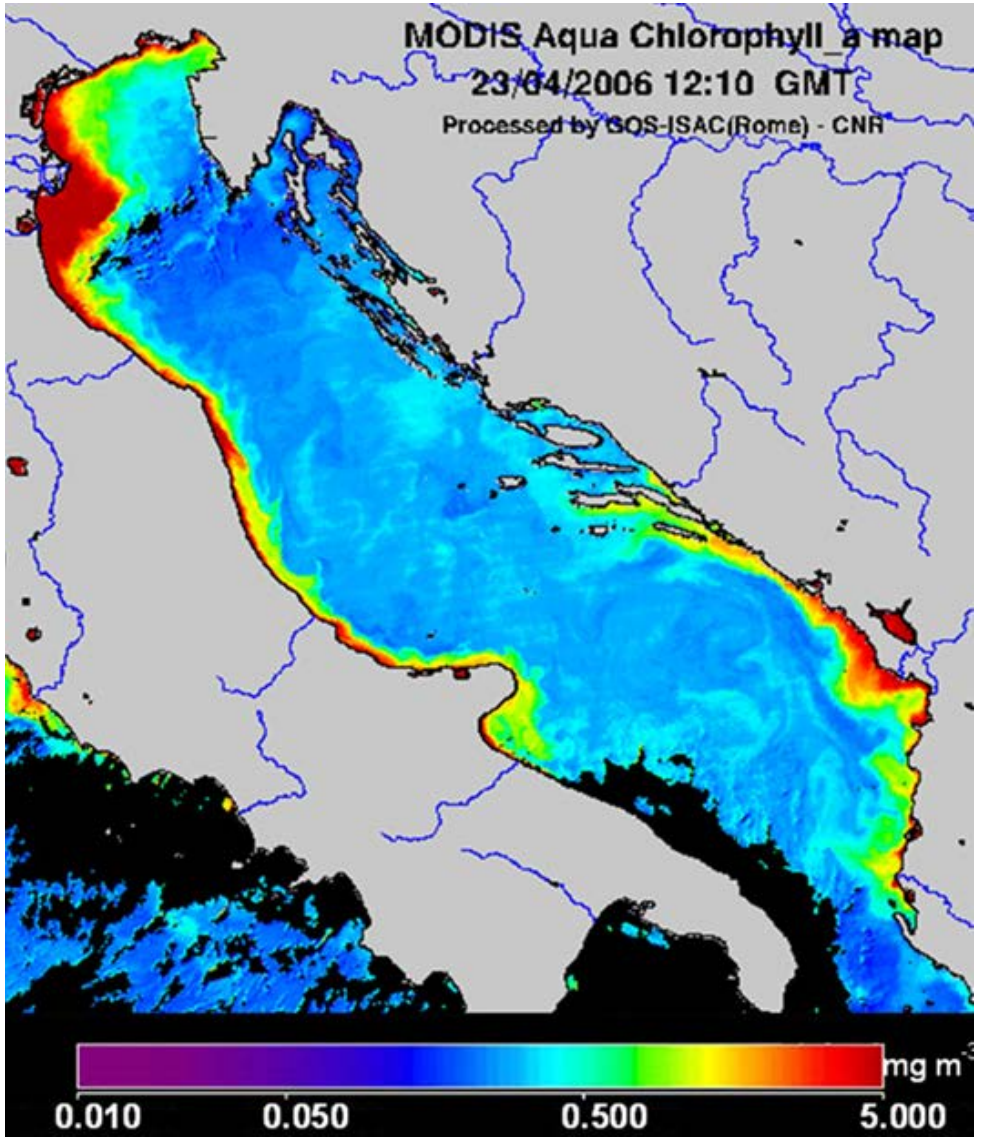
3. Organic contaminants that are dispersed in the sea, for example: polycyclic aromatic hydrocarbons, pesticides …..

4. Fate and accumulation of chemical contaminants in marine organisms.

Hydrographic basin of the Adriatic

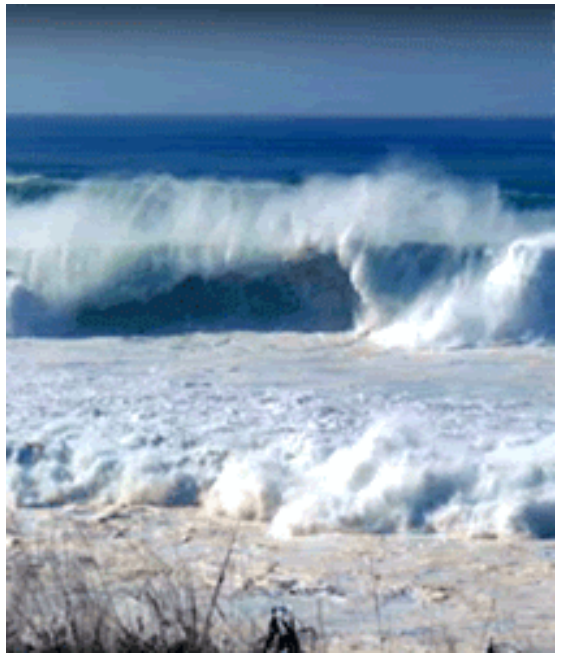


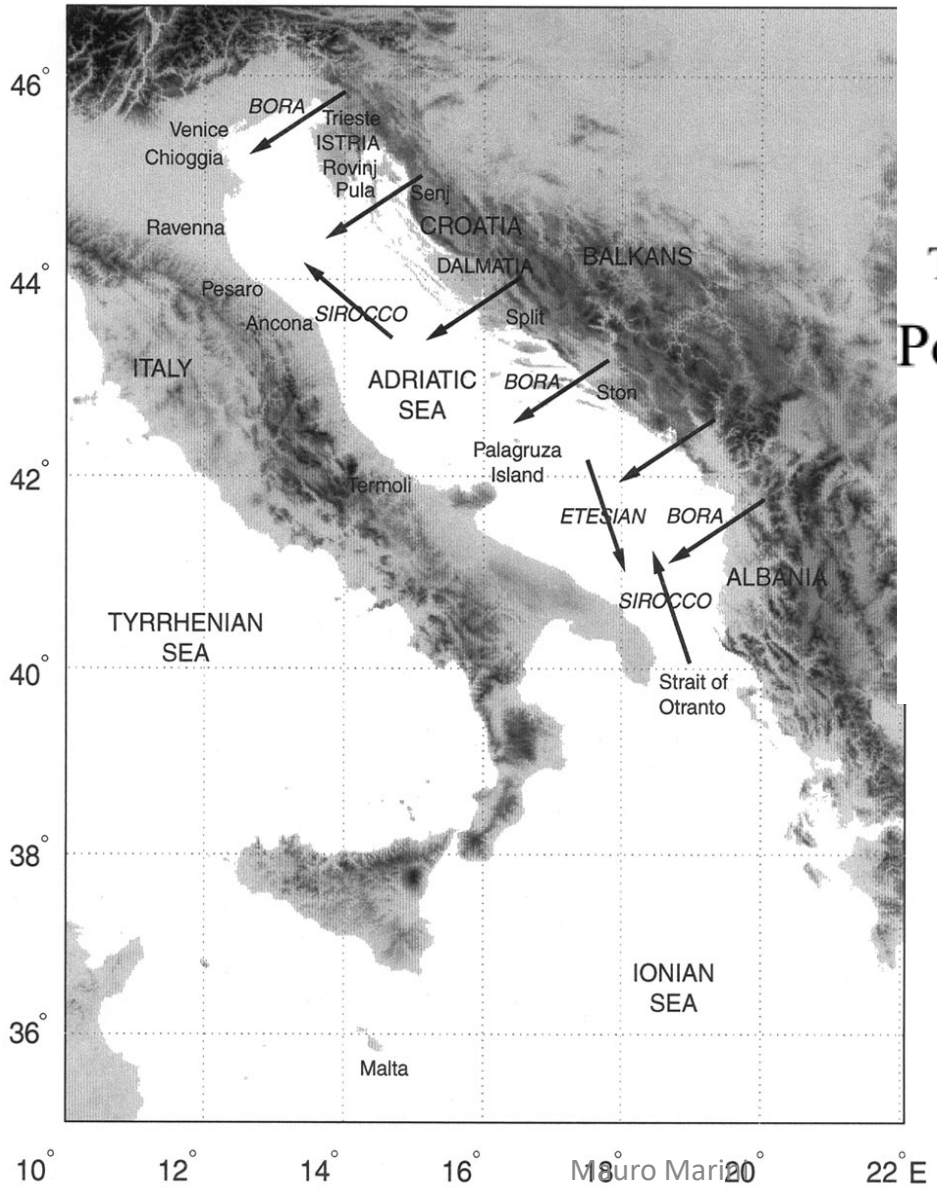


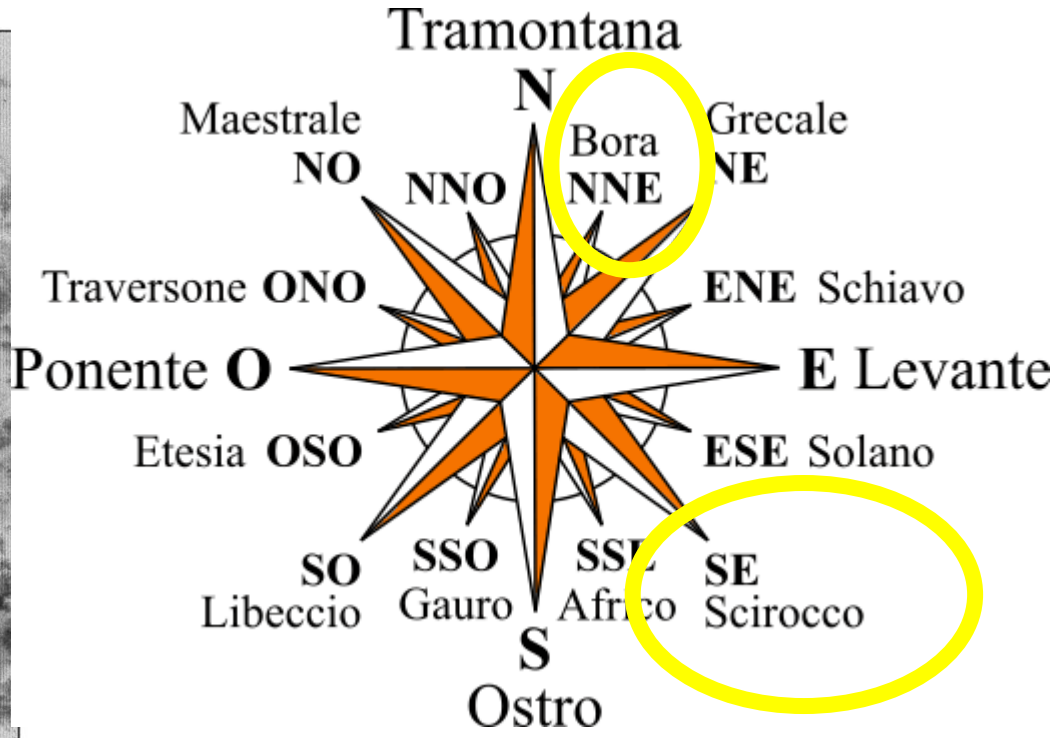


Cushman-Roisin, et al., Physical Oceanography of the Adriatic Sea: Past, Present and Future, 2001

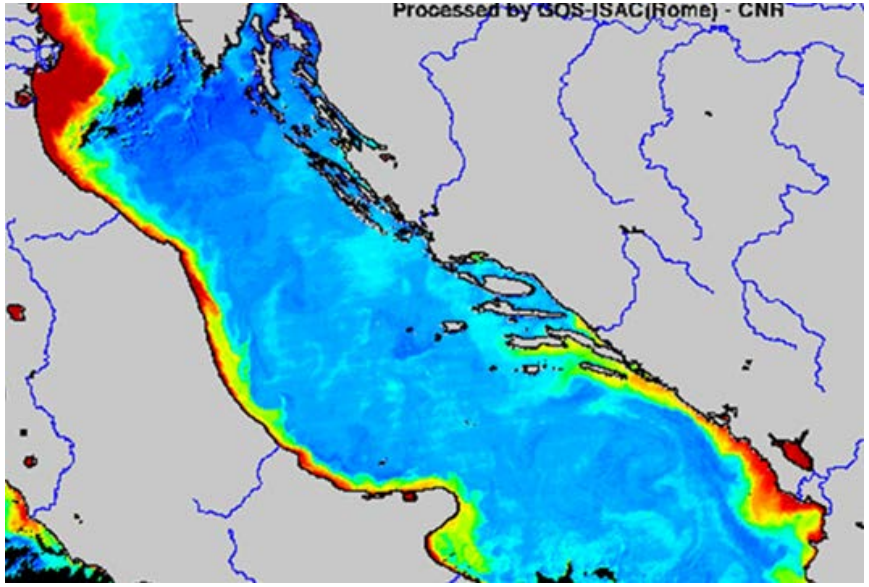
Effect of winds on the catchment area

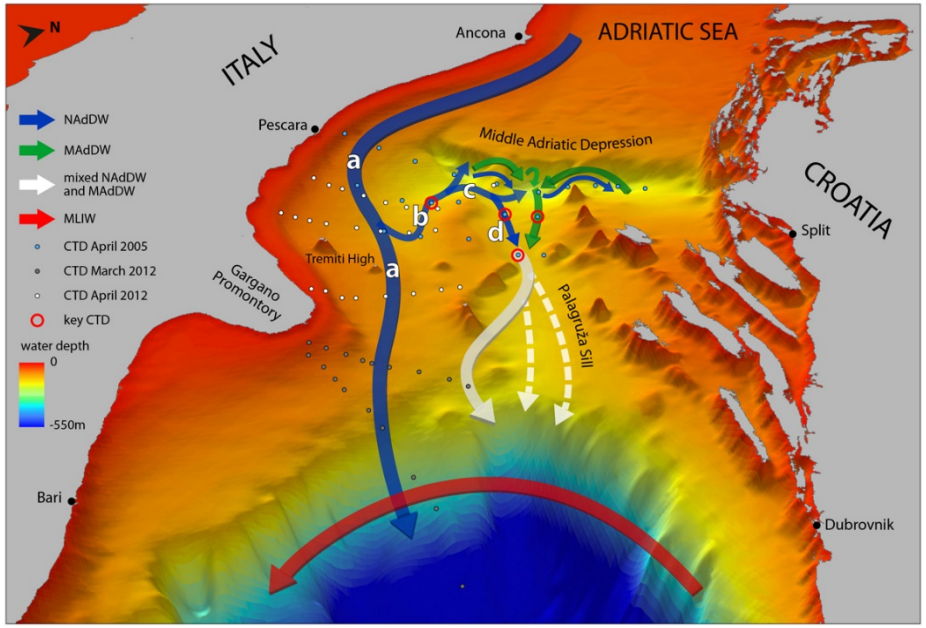




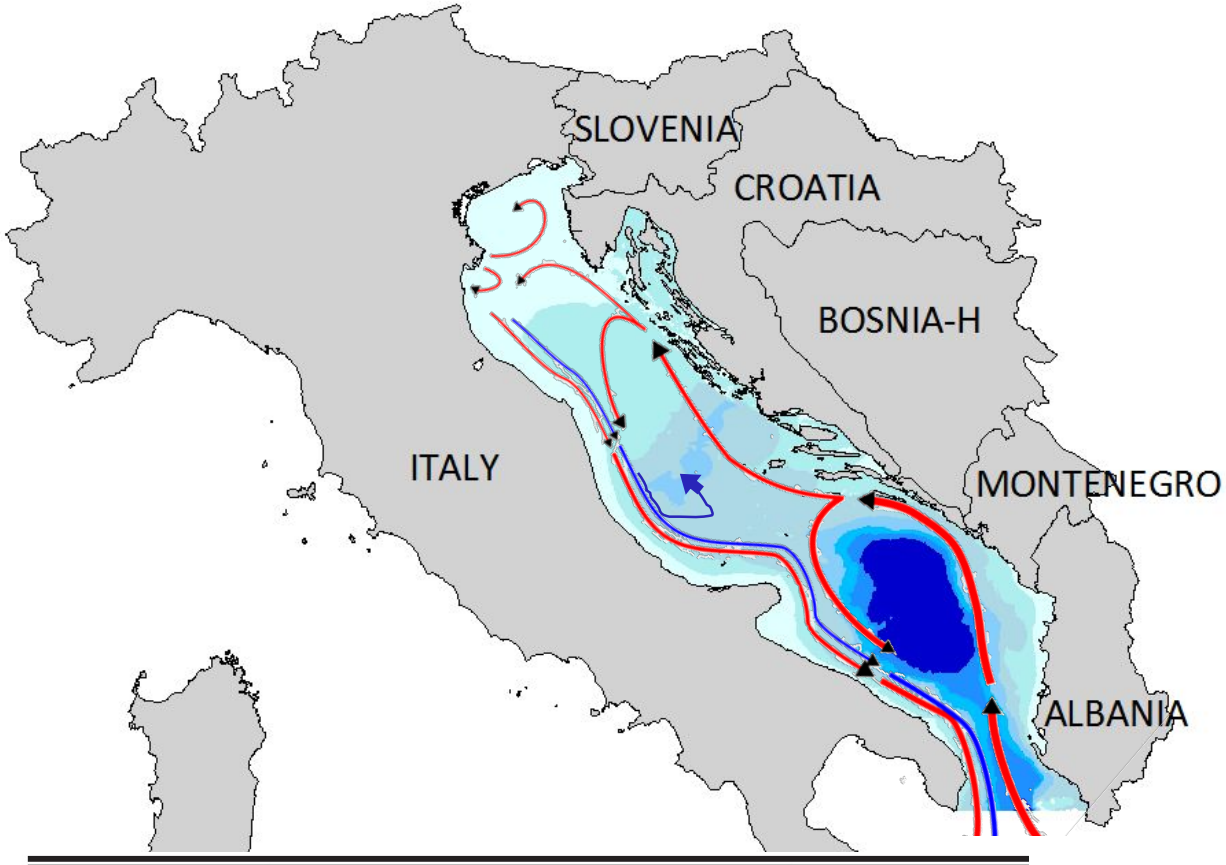


Circulation of the Adriatic Sea





Marini et al., Marine Geology, 2016



Vol. 31: 227–237, 2006 | CLIMATE RESEARCH Clim Res | Published July 27

Short-term physical and chemical variations in the bottom water of middle Adriatic depressions

M. Marini[1,*], A. Russo[2], E. Paschini[1], F. Grilli[1], A. Campanelli[1]

Dense water evolution in Mid Adriatic depression

Marine Geology 375 (2016) 5–14

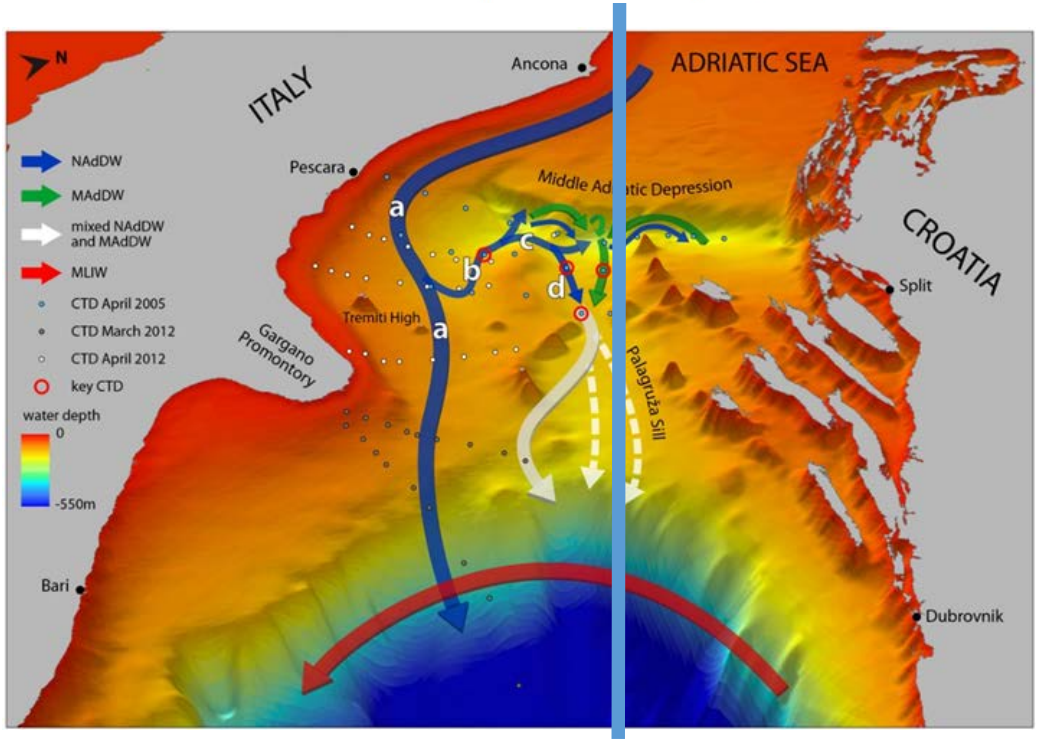
Contents lists available at ScienceDirect

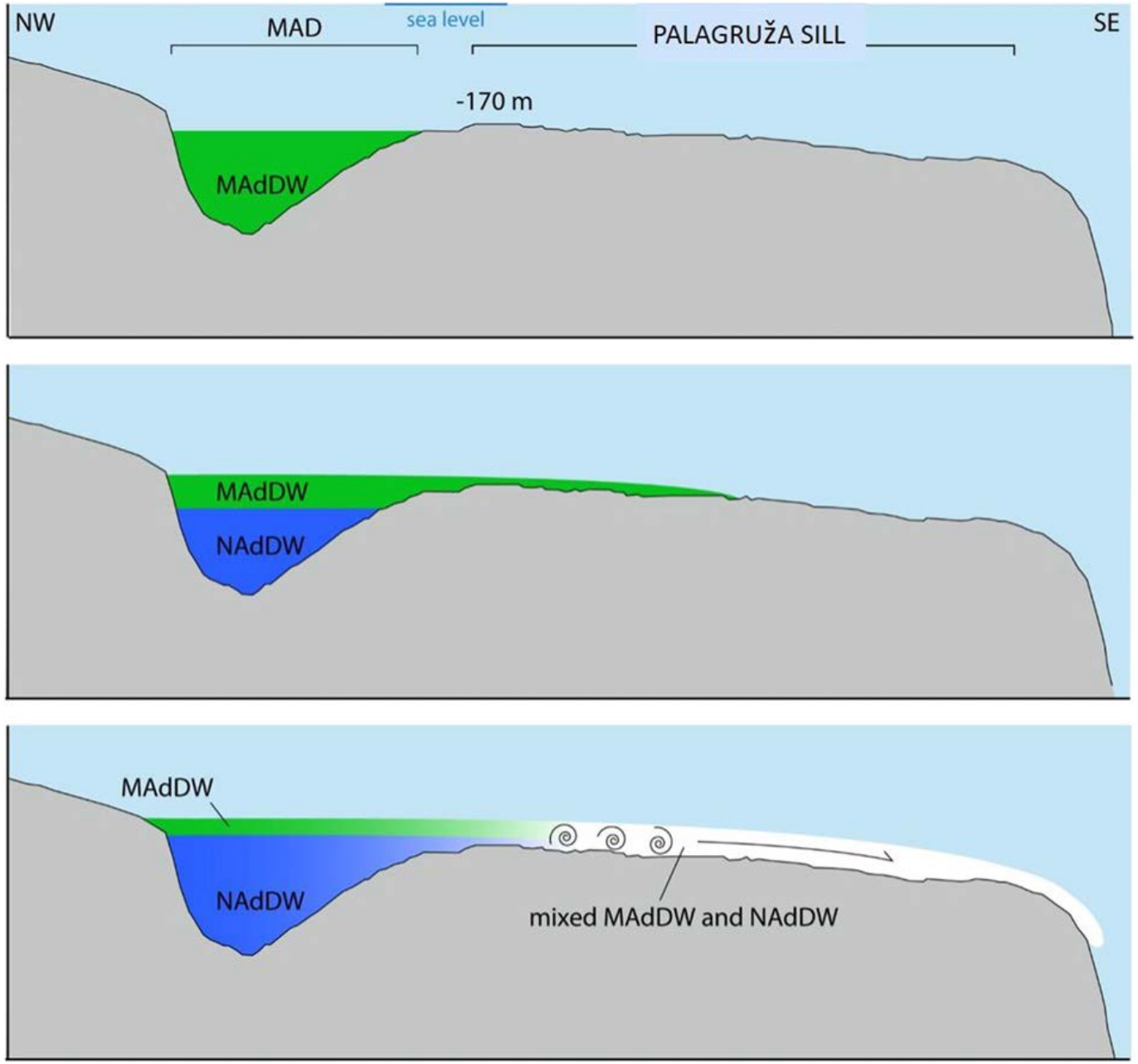
Marine Geology

journal homepage: www.elsevier.com/ locate/margo

Role of the Mid-Adriatic deep in dense water interception and modification

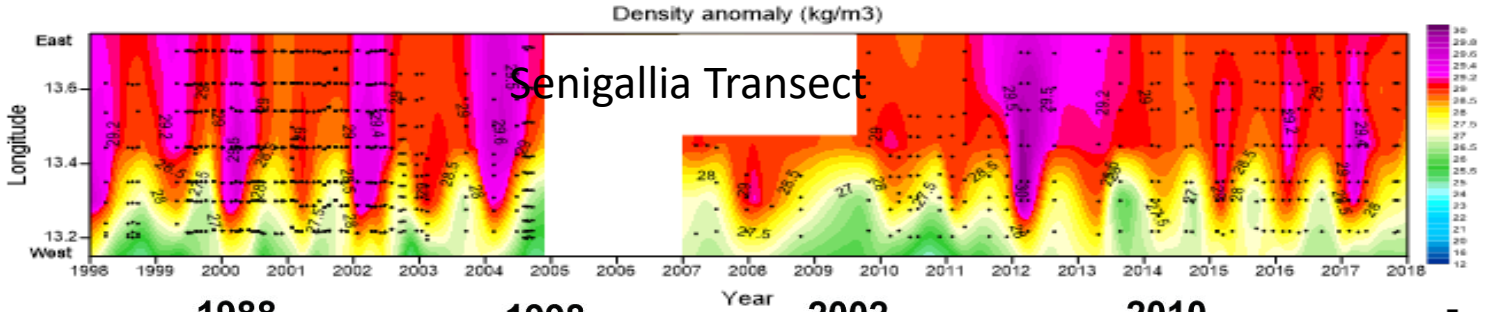
Mauro Marini [a,*], Vittorio Maselli [b], Alessandra Campanelli [a], Federica Foglini [b], Federica Grilli [a]



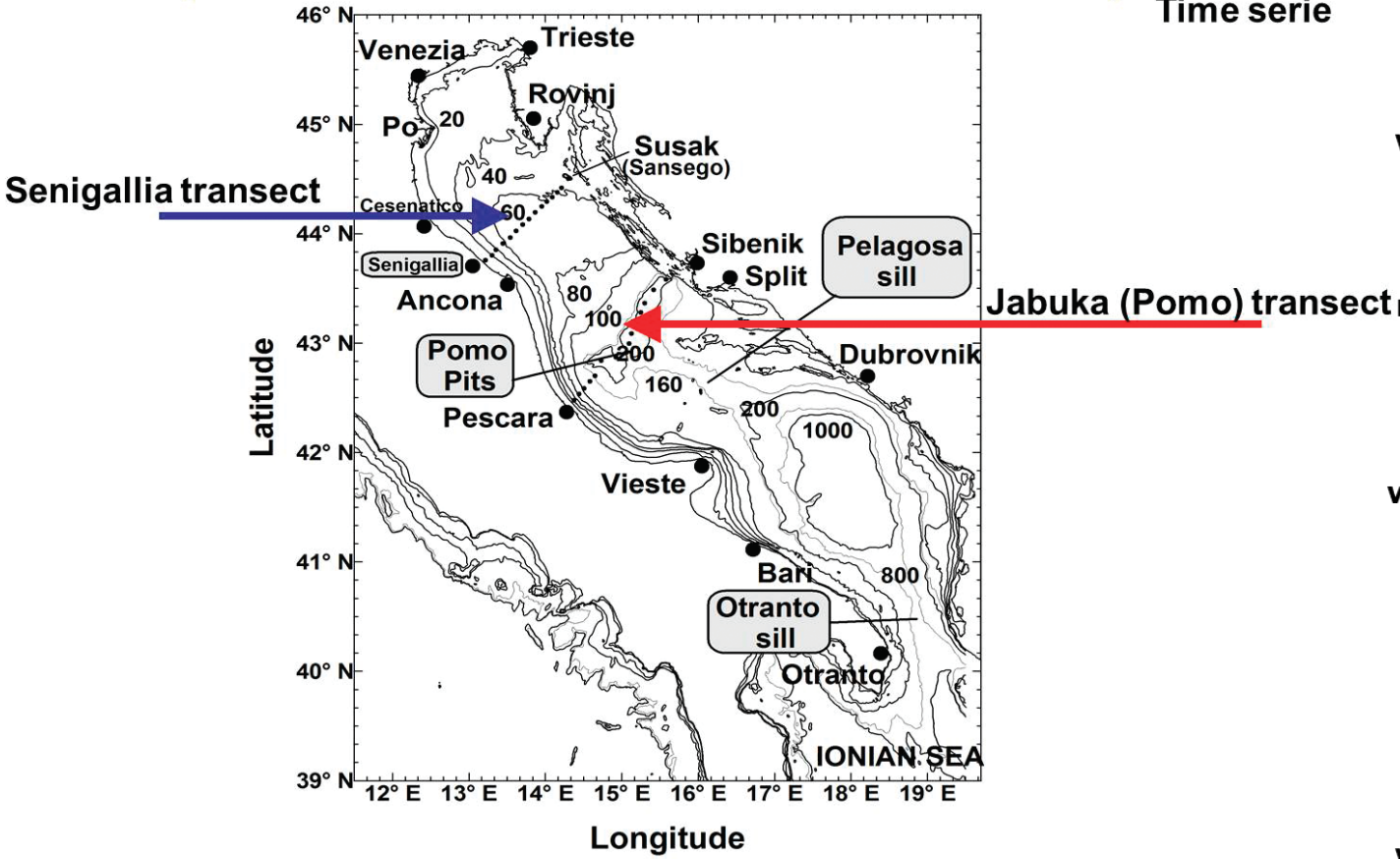


Mauro Marini

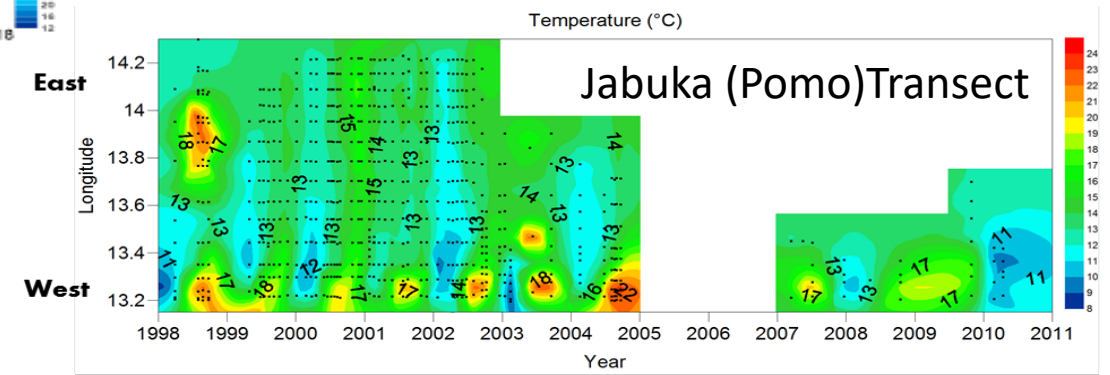
Example of the time series

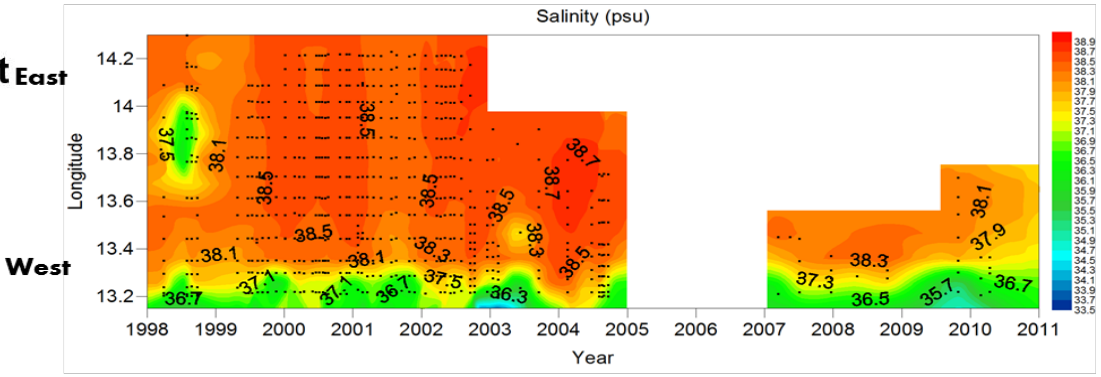


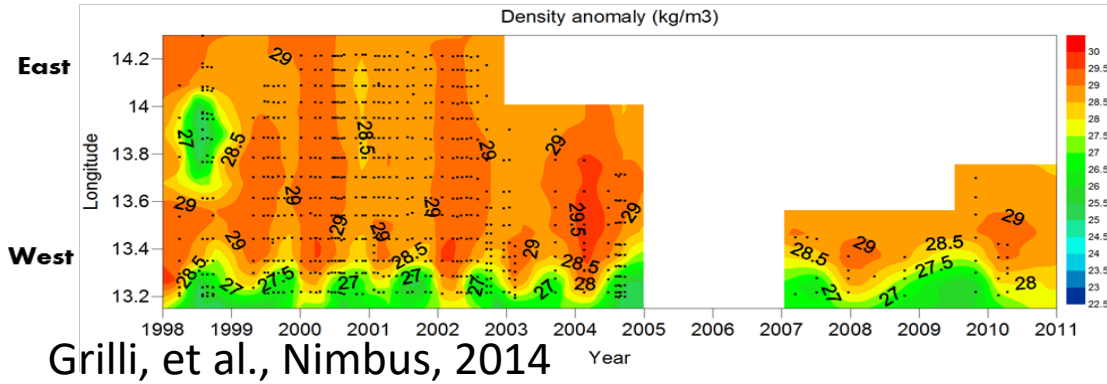
1988 half transect 1998 full transect 2002 half transect 2010 Senigallia Time serie



1980 West Pit 1998 full transect 2010 Pomo Time serie

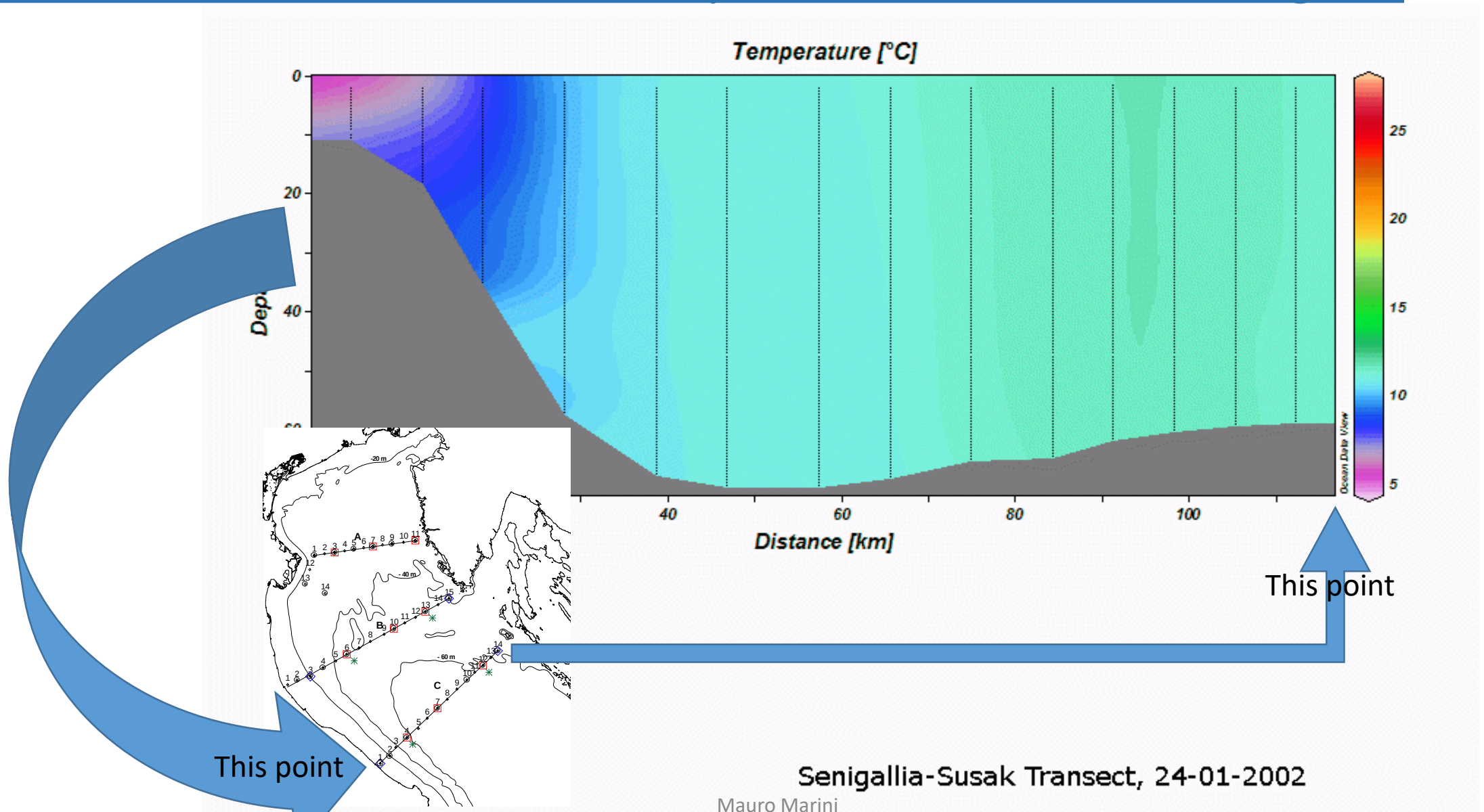






Grilli, et al., Nimbus, 2014

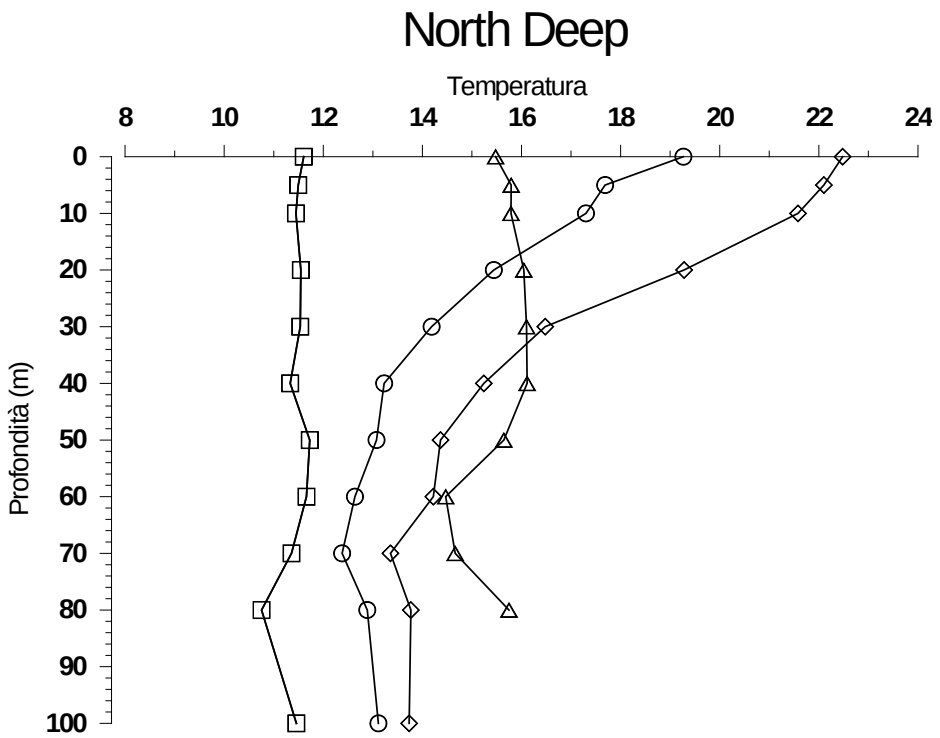
Thermocline or double thermal layer in the transect of Senigallia



Grilli et al., Science of the Total Environment, 2005

Oceanographic seasons

Two databases were used to describe the thermal, saline and dynamic characteristics. For the Northern and Central basin, the ***data base* ATOS** (Adriatic Temperature, Oxygen and Salinity) made up of 5543 stations performed throughout the year from 1911 to 1983, while for the southern basin the ***data base* MATER** (Mass Transfer and Ecosystem Response) consisting of oceanographic data (from 1996 to 1999) relating to the measurements of physical and bio-chemical parameters in the water column. Spatial and seasonal averages were made for both.



To define the **oceanographic seasons**, we based ourselves on the trend of the average monthly heat flux at the sea surface. It turned out that the period during which **the sea loses heat**, i.e. **winter, runs from January to April**, while the period during which **the sea receives heat**, i.e. the **summer period, runs from July to October**. The transition period between winter and summer, i.e. **spring, are the months of May and June** the transition period between summer and winter, i.e. **autumn, are the months of November and December**.

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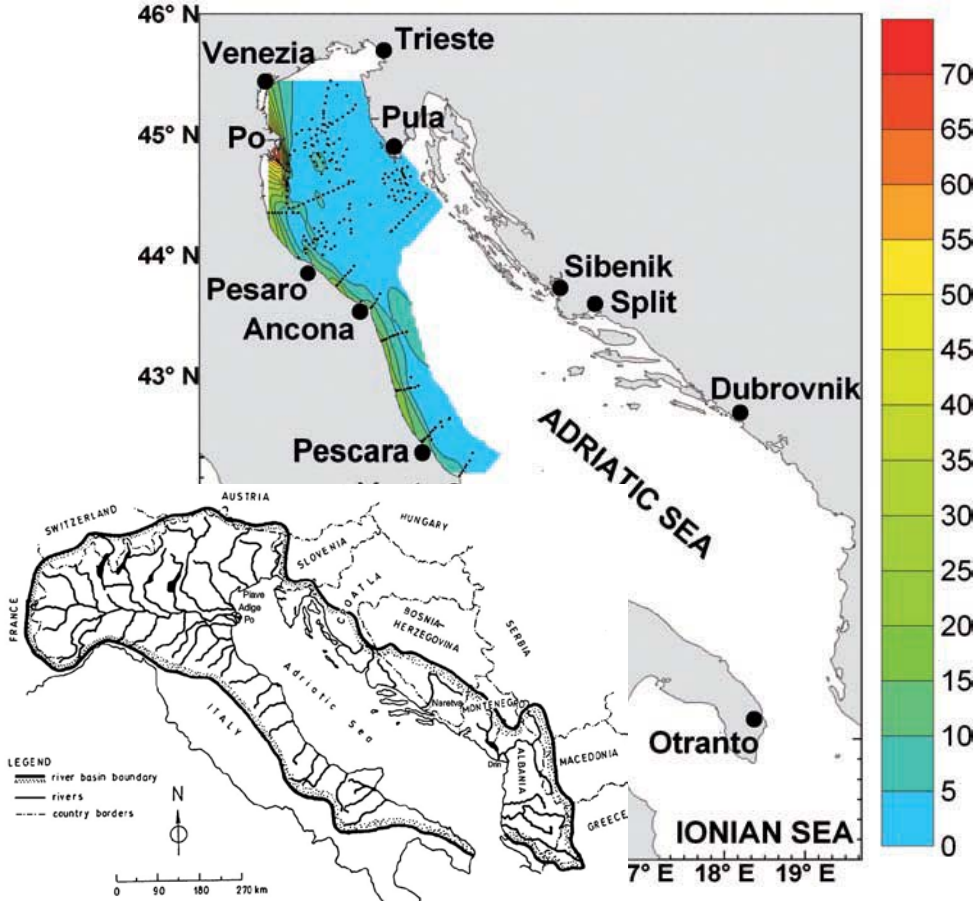
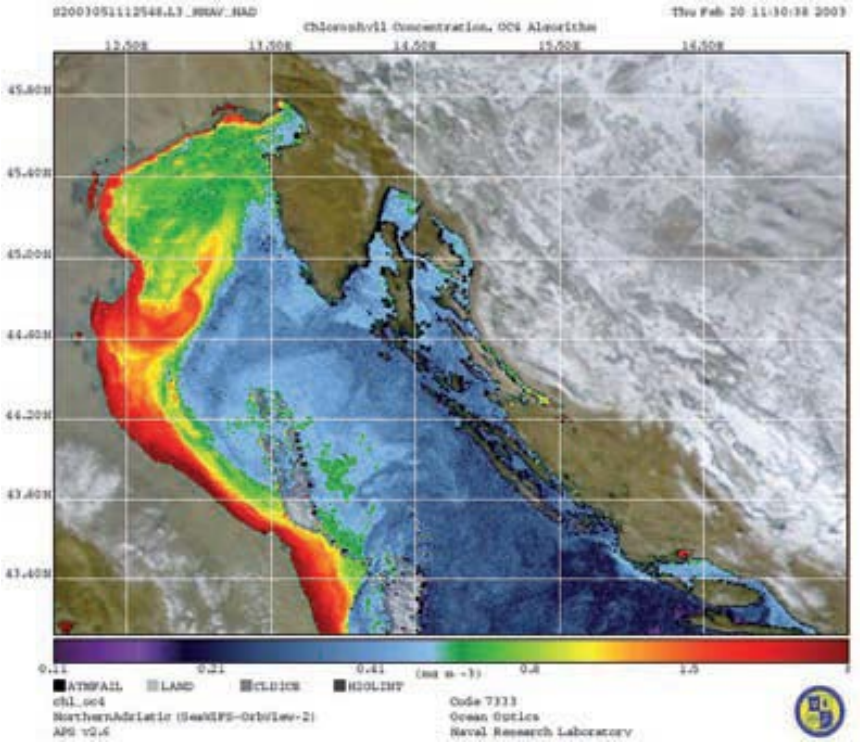
Winter surface distribution of dissolved inorganic nitrogen



*Spatial distribution of the concentration of **dissolved inorganic nitrogen** (µM) on the surface in **February** 2003, the black dots represent the location of the measuring stations*



*Satellite image of surface distribution of chlorophyll concentration (mg/m^2) dated **February** 20, 2003*

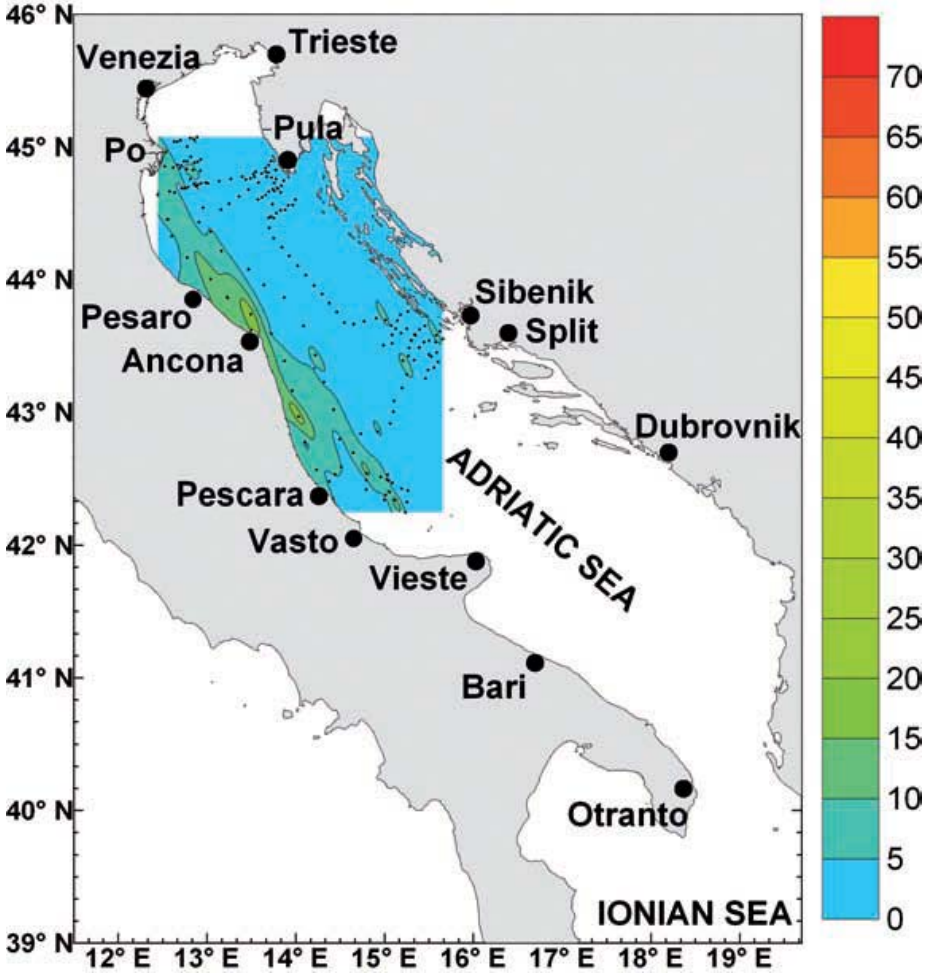
JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 113, C05S90, doi:10.1029/2007JC004370, 2008

Click Here for Full Article

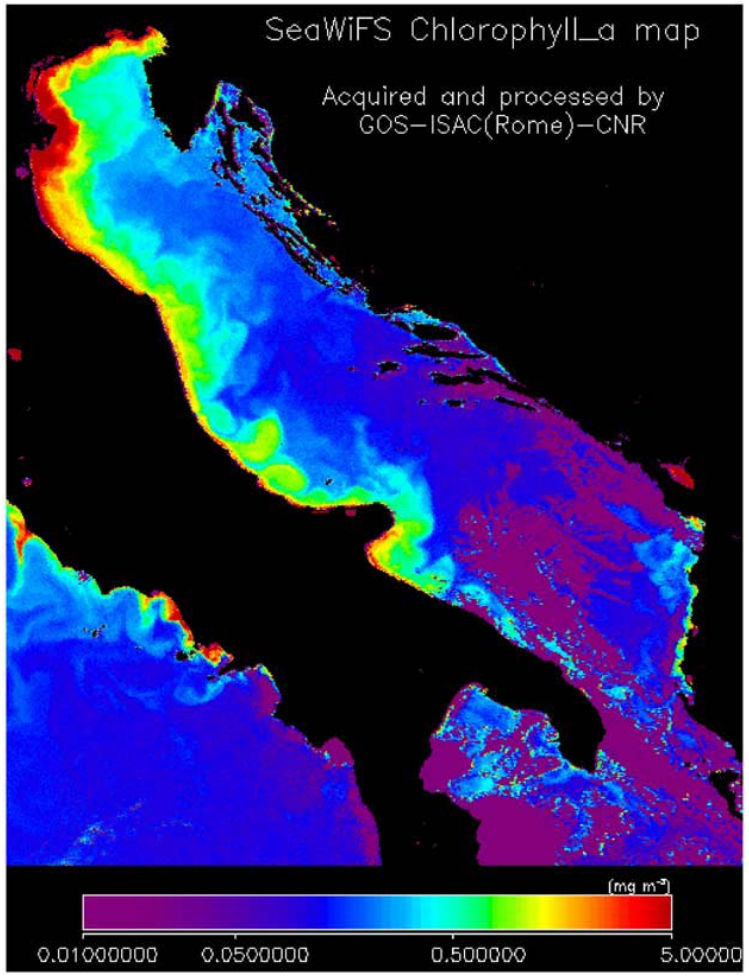
Seasonal variability and Po River plume influence on biochemical properties along western Adriatic coast

Mauro Marini,[1] Burt H. Jones,[2] Alessandra Campanelli,[1] Federica Grilli,[1] and Craig M. Lee[3]

Summer surface distribution of dissolved inorganic nitrogen

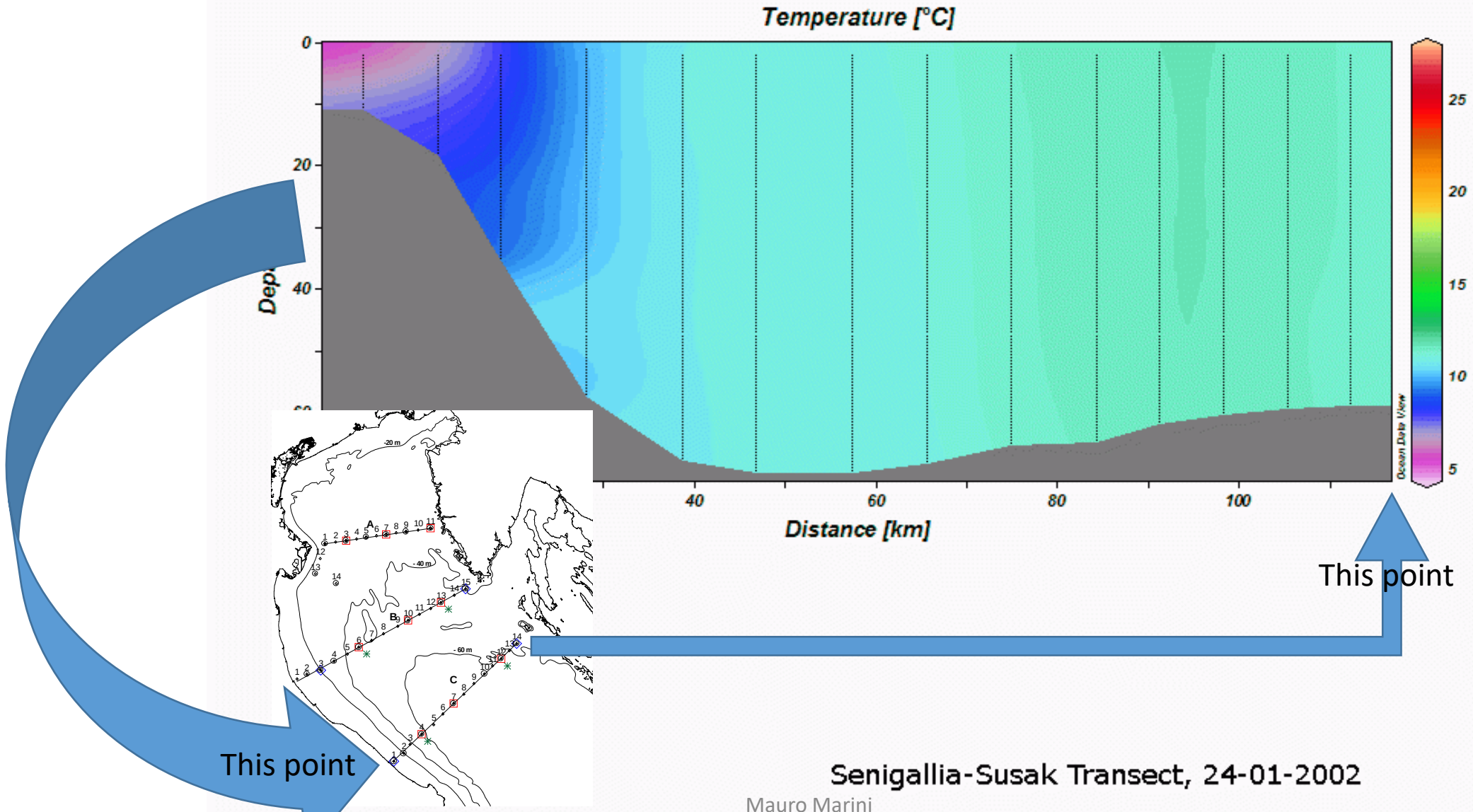


*Spatial distribution of **dissolved inorganic nitrogen** concentration (µM) on the surface in the month of **May-June** 2003, the black dots represent thelocation of measuring stations.*



*Satellite image of the surface distribution of **chlorophyll** concentration (mg/m²) from **June** 4, 2003*

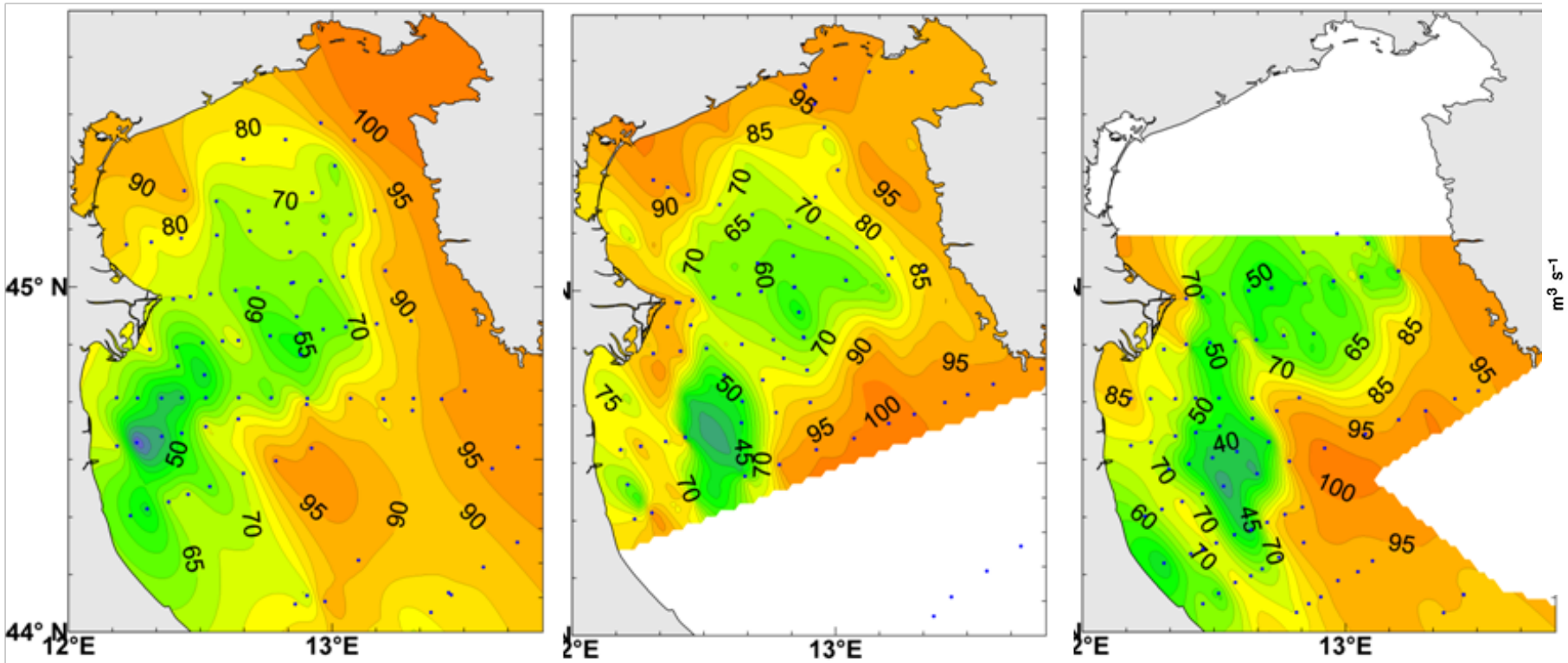
Thermocline or double thermal layer in the transect of Senigallia

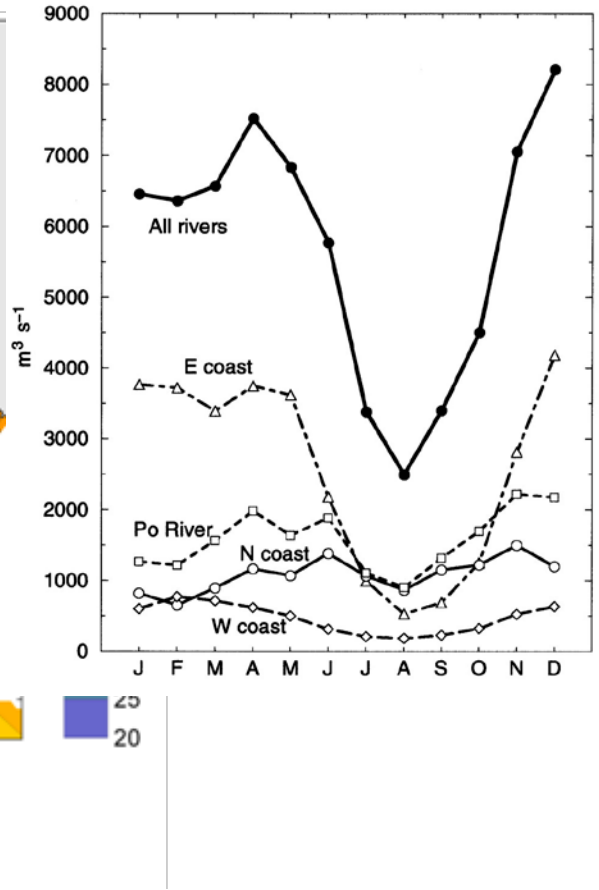


Mauro Marini

Grilli et al., Science of the Total Environment, 2005

Effect of the thermocline on coastal inputs. Hypoxia (% of oxygen saturation) on the waters of the bottom layer of the northern Adriatic.





Boldrin et al., Journal of Geophysical Research: Oceans, 2009

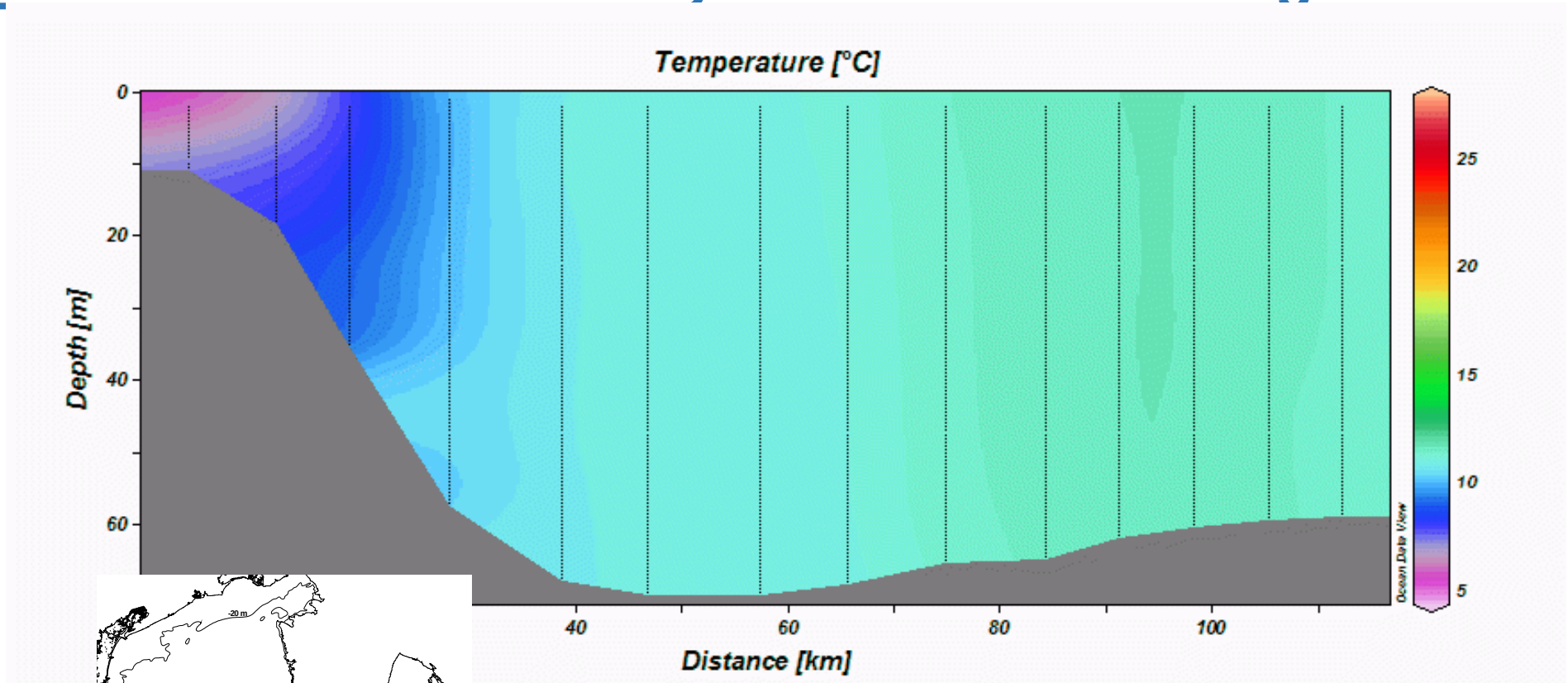
JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 114, C08S92, doi:10.1029/2008JC004837, 2009

Click Here for Full Article

Effects of bora wind on physical and biogeochemical properties of stratified waters in the northern Adriatic

A. Boldrin,[1] S. Carniel,[1] M. Giani,[2] M. Marini,[3] F. Bernardi Aubry,[1] A. Campanelli,[3] F. Grilli,[3] and A. Russo[4]

Thermocline or double thermal layer transect of Senigallia



Senigallia-Susak Transect, 24-01-2002

Mauro Marini

Grilli et al., Science of the Total Environment, 2005

Example of seasonal maps obtained from historical series

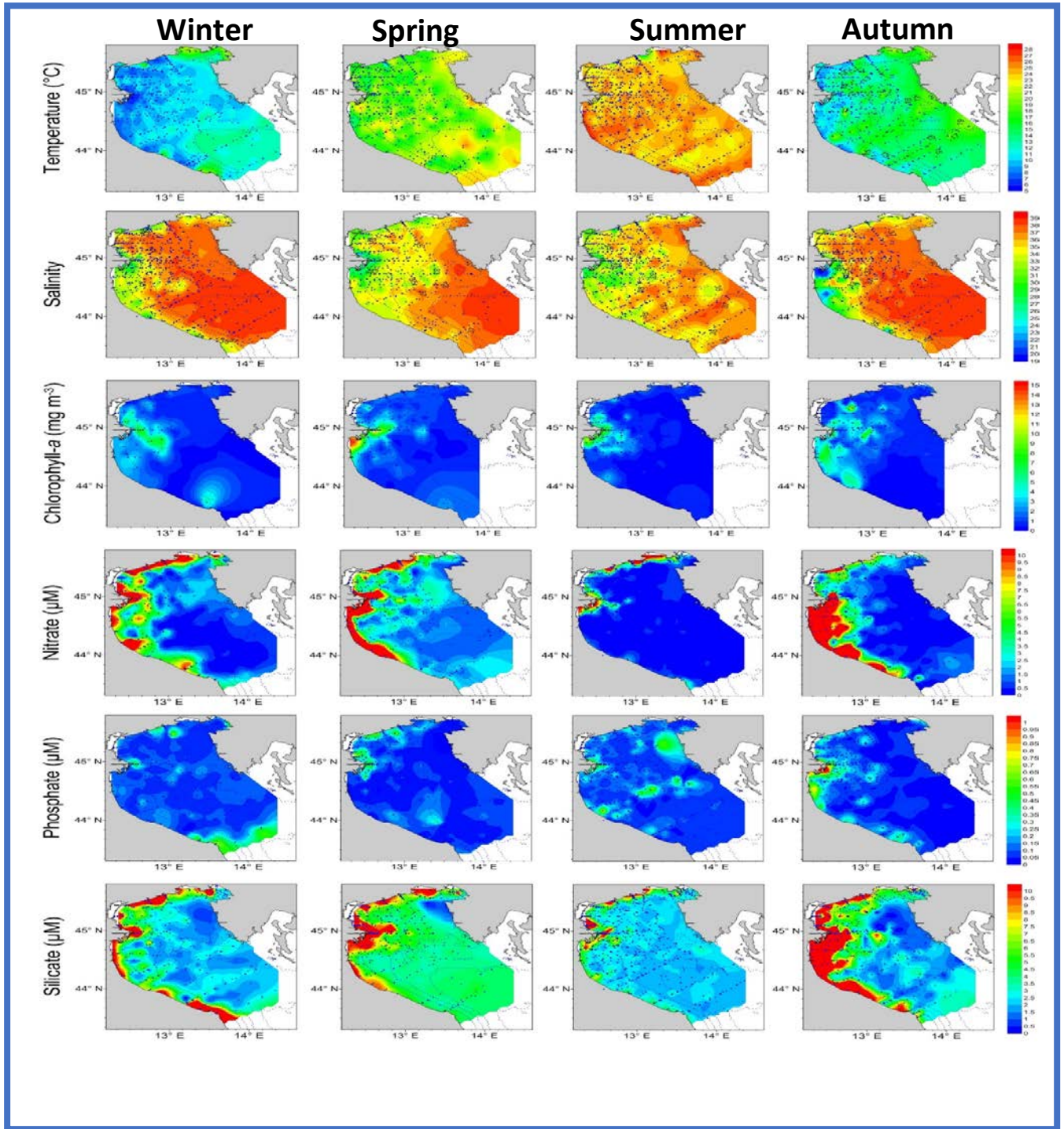
water

MDPI

Article

Seasonal and Interannual Trends of Oceanographic Parameters over 40 Years in the Northern Adriatic Sea in Relation to Nutrient Loadings Using the EMODnet Chemistry Data Portal

Federica Grilli [1,*], Stefano Accoroni [2,3], Francesco Acri [4], Fabrizio Bernardi Aubry [4], Caterina Bergami [5], Marina Cabrini [6], Alessandra Campanelli [1], Michele Giani [6], Stefano Guicciardi [1], Mauro Marini [1,3], Francesca Neri [2], Antonella Penna [3,7], Pierluigi Penna [1], Alessandra Pugnetti [4], Mariangela Ravaioli [5], Francesco Riminucci [5,8], Fabio Ricci [3,7], Cecilia Totti [2], Pierluigi Viaroli [9] and Stefano Cozzi [10]



Italian oceanographic vessels used for these research

Topics in this lesson:

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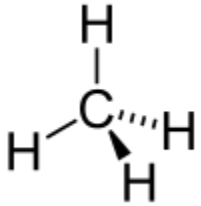
What are hydrocarbons?

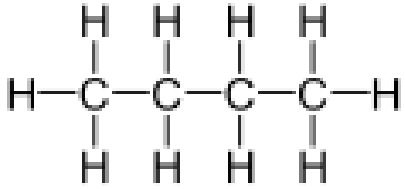
Wide range of organic compounds **containing only C and H atoms.**

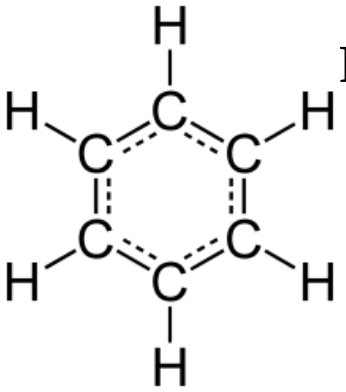
They are divided into two main categories:



Methane

Alifatic, linear chains **e.g. Butane C_4H_{10}**

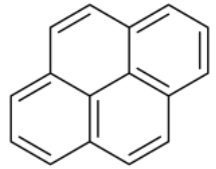




Benzene

Polycyclic Aromatic Hydrocarbons (PAH), multiple aromatic rings linked together

e.g. Pirene $C_{16}H_{10}$



- Light low molecular weight PAHs (2-3 rings condensed)
- Medium Molecular Weight IPA (4 rings condensed)
- Heavy high molecular weight PAHs (5-6 rings condensed)

STRONGLY LIPOPHILIC

Naftalene	Acenaftilene	Acenaftene	Fluorene
Fenantrene	Antracene	Fluoranthene	Pirene
Crisene	Benzo(a)antracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene
Benzo(a)pirene	Dibenzo(a,h)antracene	Benzo(g,h,i)perilene	Indeno(1,2,3,c,d)pirene

Polycyclic aromatic hydrocarbons are organic compounds (consisting of C and H atoms) belonging to a class of hydrocarbons characterized by the presence in their chemical structure of at least two condensed aromatic rings.

In the background are examples of molecular structures.

SOURCES OF HYDROCARBONS

NATURAL

- Volcanic eruptions
- Forest fires
- Synthesized by plant organisms
- …

ANTROPOGENIC

- Industries
- Oil processing
- Motor vehicle emissions
- …

Idrocarburi Policiclici Aromatici

WHY SCIENTIFIC INTERESTAND THE IMPORTANCE FOR THE ENVIRONMENT → **HIGH TOXICITY**

LIPOPHILIC COMPOUNDS easily cross cell membranes

PRESENCE OF AROMATIC RINGS formation of highly reactive compound epoxides

LOW SOLUBILITY tend to break down into the solid fraction

POOR BIOAVAILABILITY for the involved microorganisms to degradation

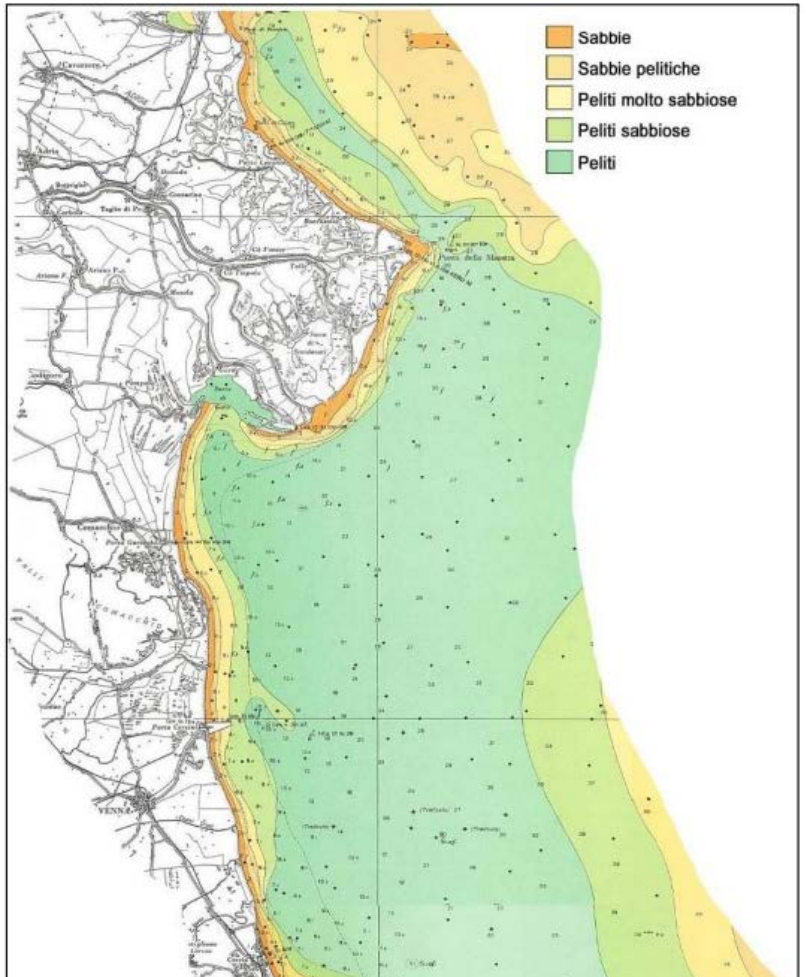
16 PAHs have been classified as PRIORITY POLLUTANTS by international environmental agencies

DISPERSION Polycyclic Aromatic Hydrocarbons

ROLE OF RIVERS

The deposition of suspended particulate increases the phenomena of accumulation of PAHs in the sediment

GRANULOMETRY OF THE SEDIMENT

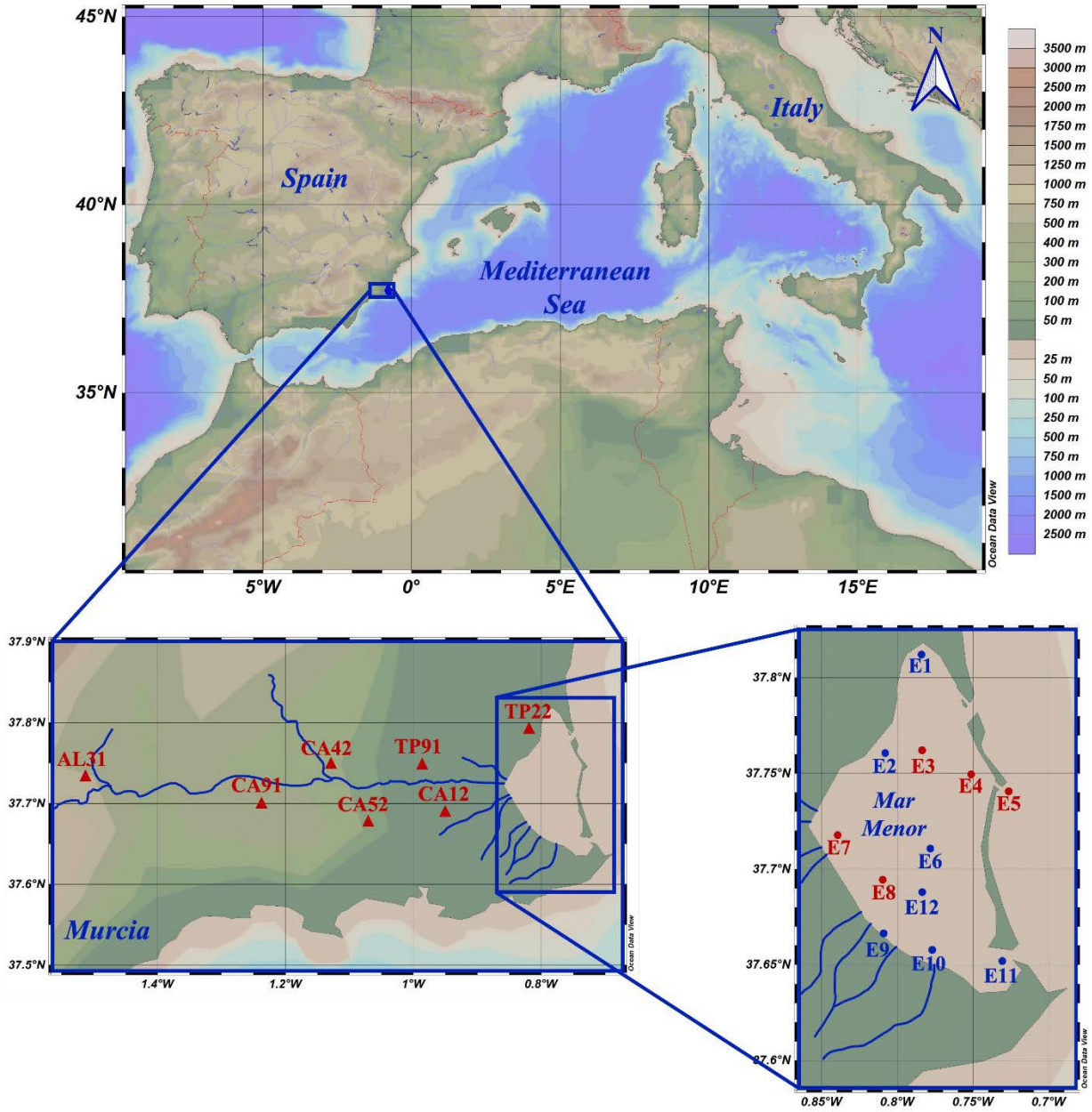


PAHs are found in highest concentration in fine sediment (< 2 µm). Fine particles adsorb more as they have a larger specific surface area

• The PAHs that we find in the Adriatic come mainly from anthropic sources and have a pyrolytic origin (combustion of organic material). Low PM/High PM < 1 .

• The mainly polluted areas are the Po Delta (333.9 ng/g d.w.); the Gulf of Trieste (> 500 ng/g d.w.). The Ancona area is less polluted (184.6 ng/g d.w.). The quantification of PAHs contained in marine sediments is of the order of ppb, these values can be considered moderately low.

• The presence of PAHs decreases going from the western to the eastern Adriatic and from the coast to the open sea


45°N
40°N
35°N
5°W
0°
5°E
10°E
15°E
N
Spain
Italy
Mediterranean Sea
3500 m
3000 m
2500 m
2000 m
1750 m
1500 m
1250 m
1000 m
750 m
500 m
400 m
300 m
200 m
100 m
50 m
25 m
50 m
100 m
250 m
500 m
750 m
1000 m
1500 m
2000 m
2500 m
Ocean Data View
37.9°N
37.8°N
37.7°N
37.6°N
37.5°N
1.4°W
1.2°W
1°W
0.8°W
AL31
CA91
CA42
CA52
TP91
CA12
TP22
Murcia
37.8°N
37.75°N
37.7°N
37.65°N
37.6°N
0.85°W
0.8°W
0.75°W
0.7°W
E1
E2
E3
E4
E5
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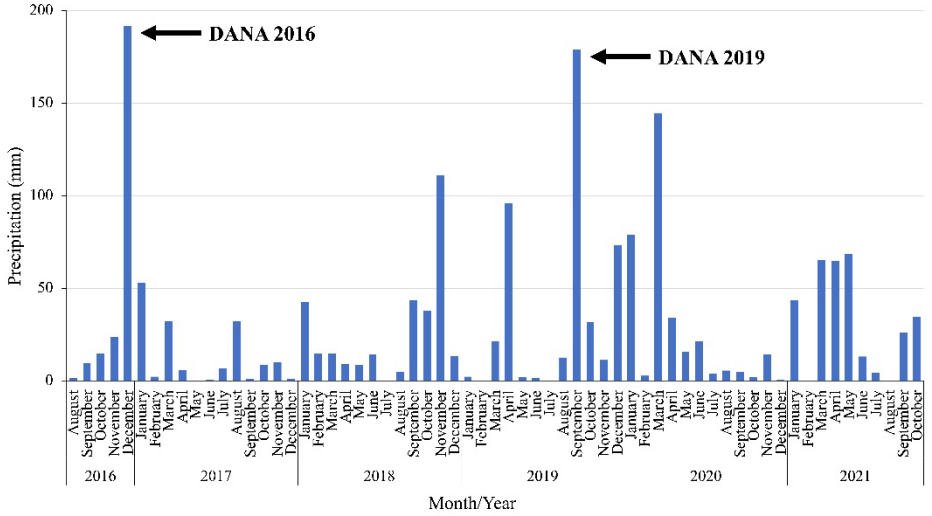
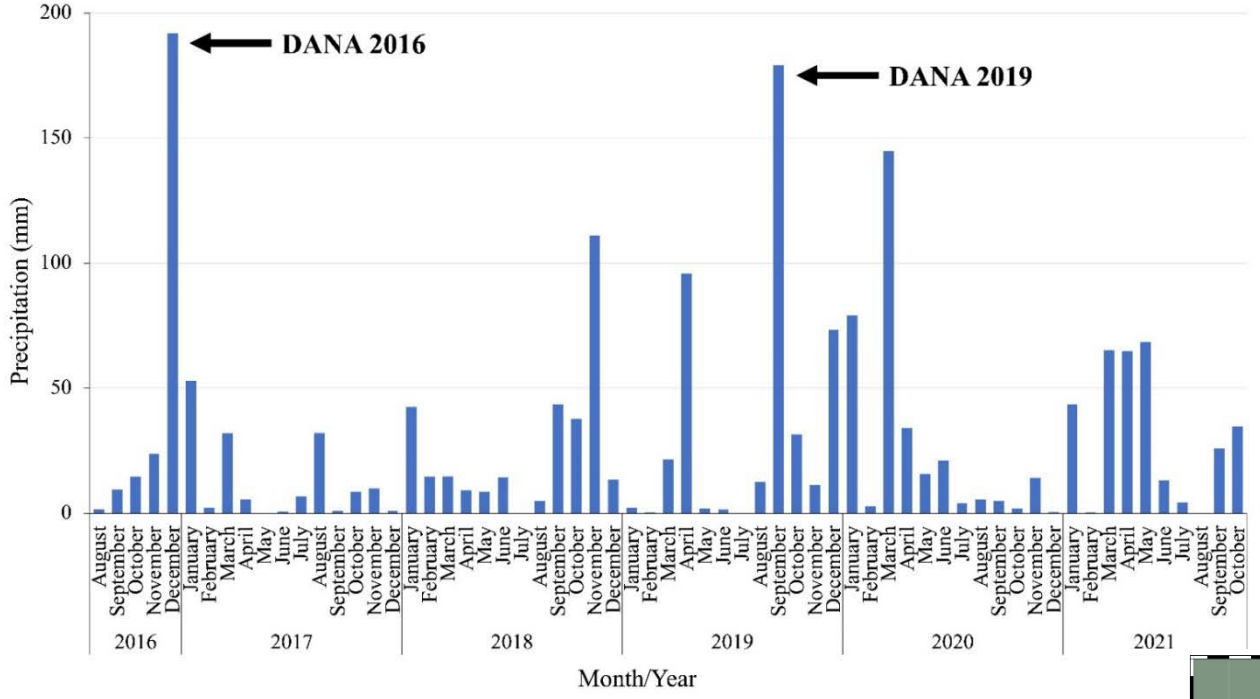
E7
E8
E9
E10
E11
E12
Mar Menor


DANA 2016
DANA 2019
Precipitation (mm)
200
150
100
50
0
August September October November December January February March April May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October
2016
2017
2018
2019
2020
2021
Month/Year

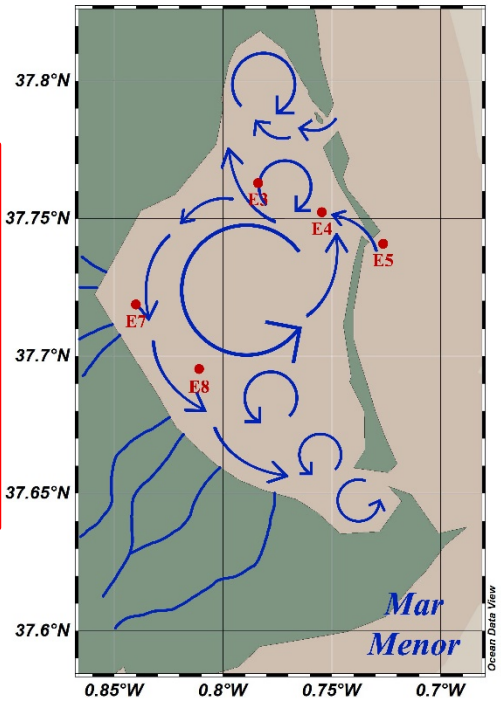

Sentinel-2 L1C, True color on 2019-09-13
5 km
Copernicus
SENTINEL Hub

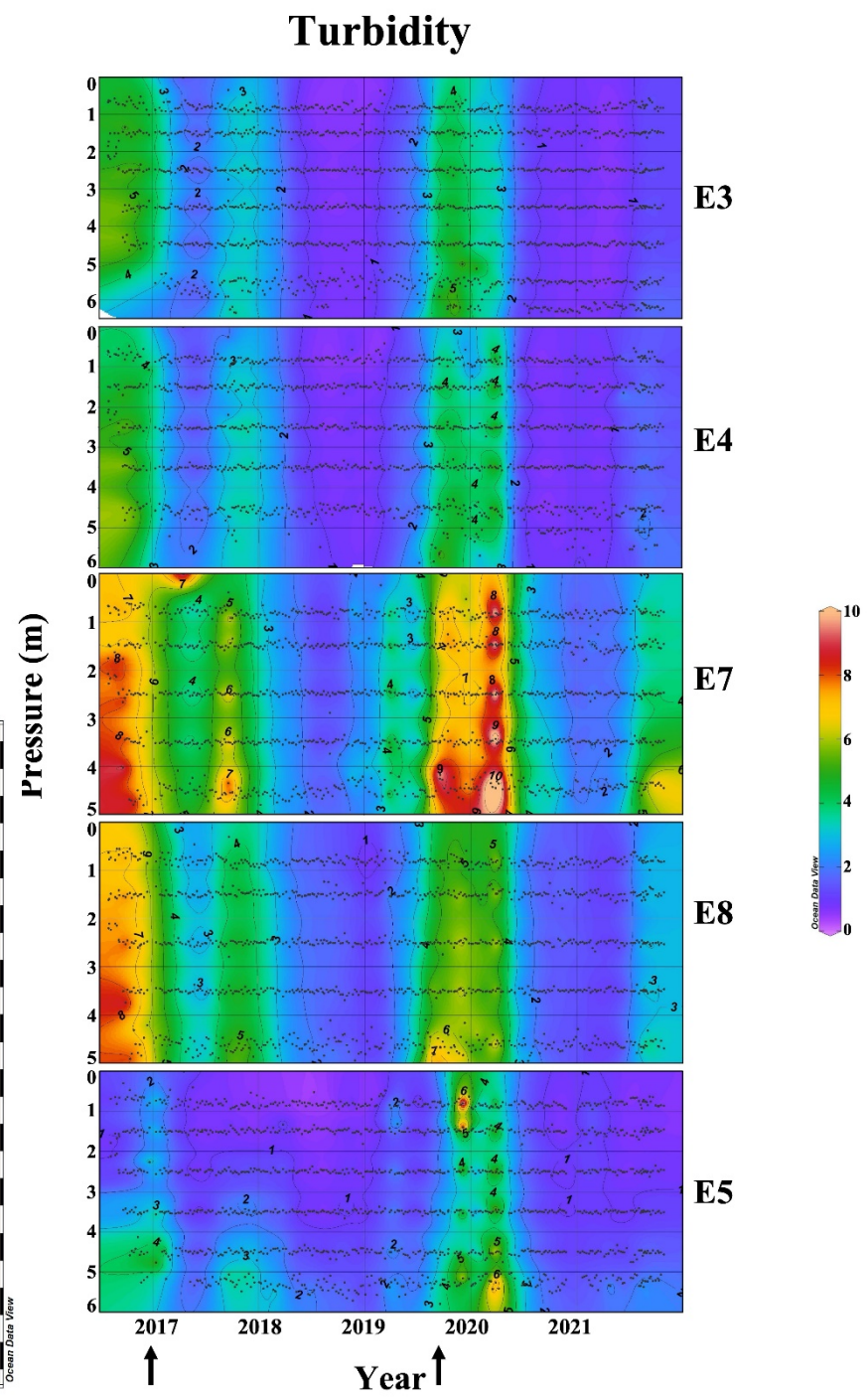


Journal of Marine Science and Engineering
MDPI
Article

Extreme Flooding Events in Coastal Lagoons: Seawater Parameters and Rainfall over A Six-Year Period in the Mar Menor (SE Spain)

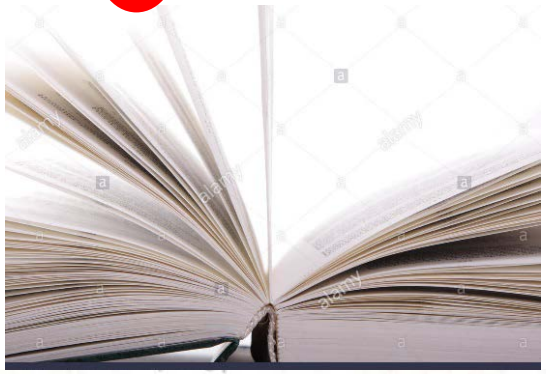
Mariana Machado Toffolo [1,2,†], Federica Grilli [3,†], Catia Prandi [4,5], Stefano Goffredo [1,2] and Mauro Marini [2,3,*]

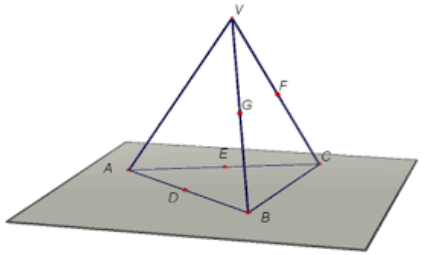




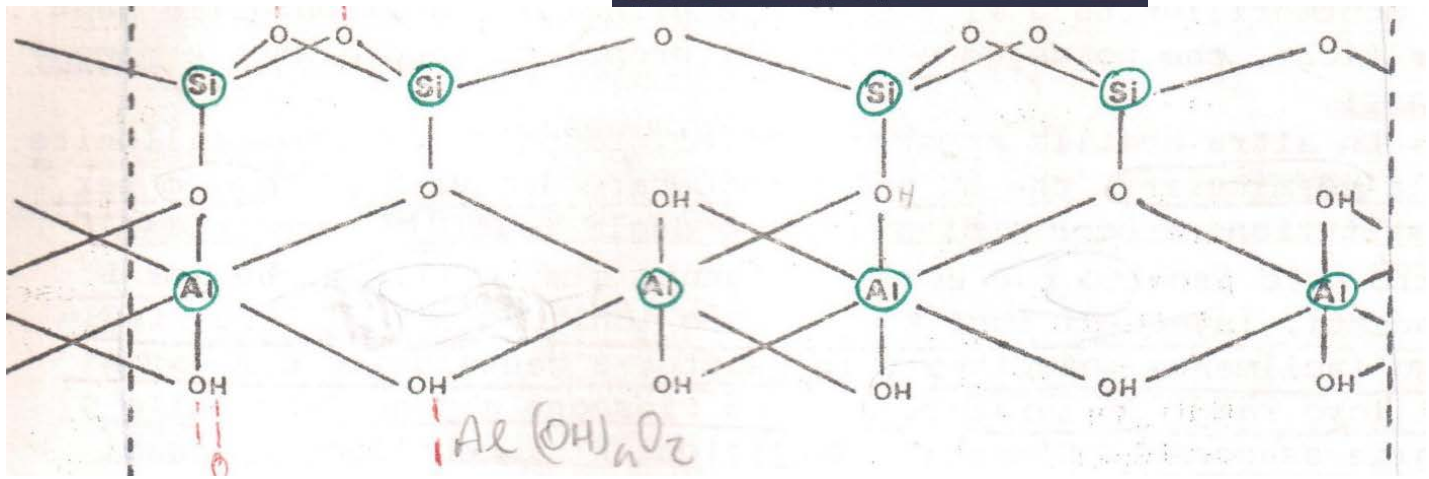
Soil: Clay! Particle size < 2µm

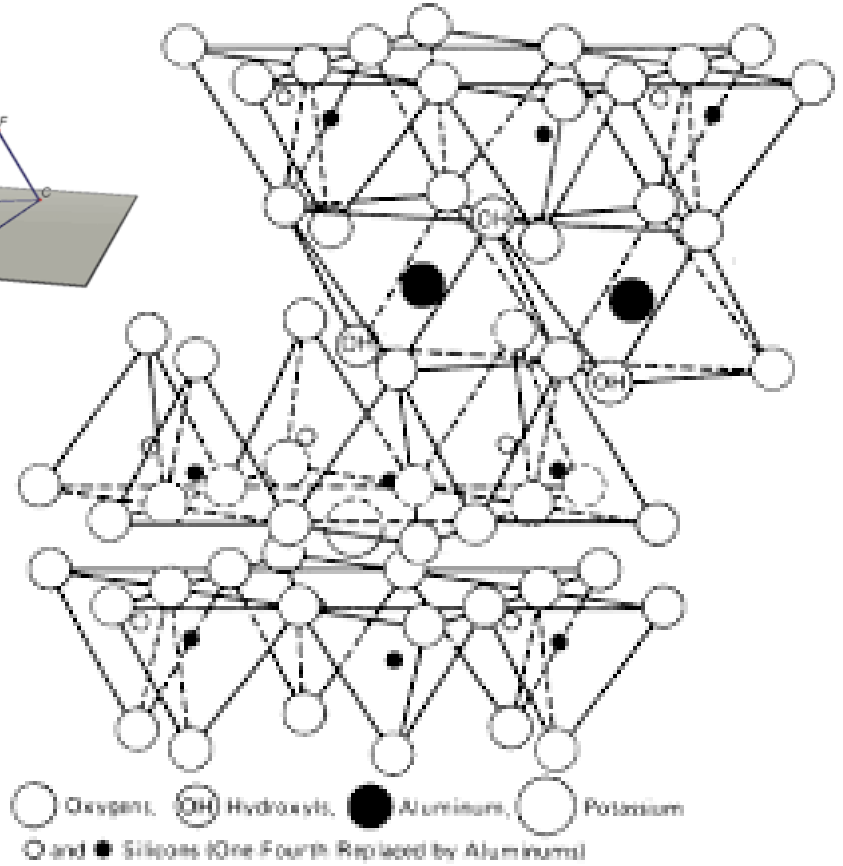
- lamellar structure consisting of **silica hydrogel (SiO_2) and allumina (Al_2O_3), related to nH_2O**

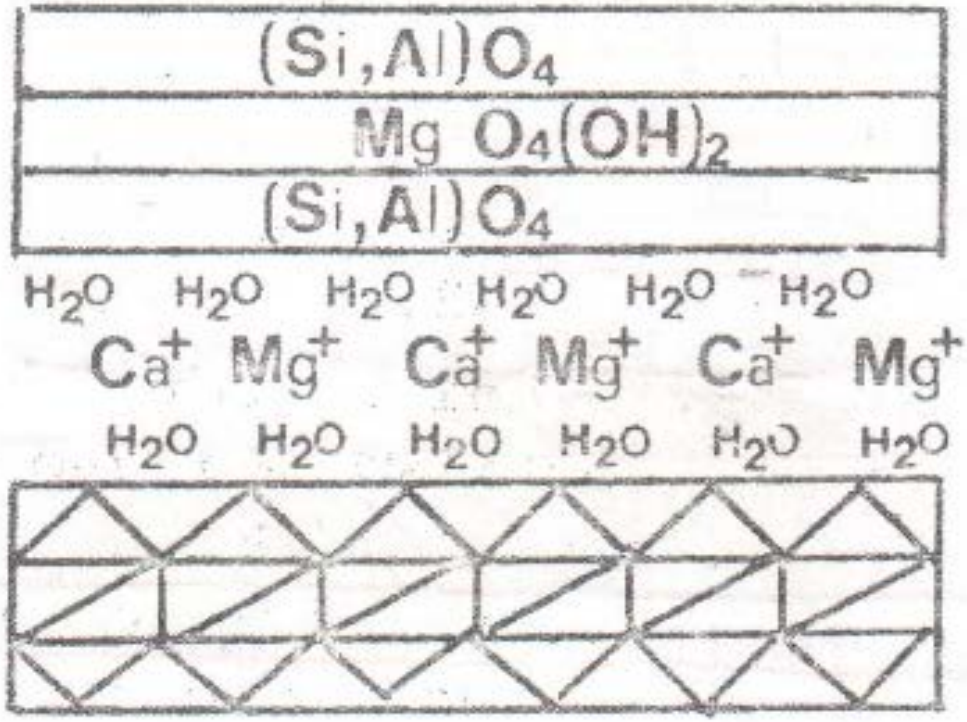




- Caolinite - $Al_2Si_2O_5(OH)_4$
- Pirofillite - $Al_2Si_4O_{10}(OH)_2$







10 – 15 A°

Periodo d'Identità A°

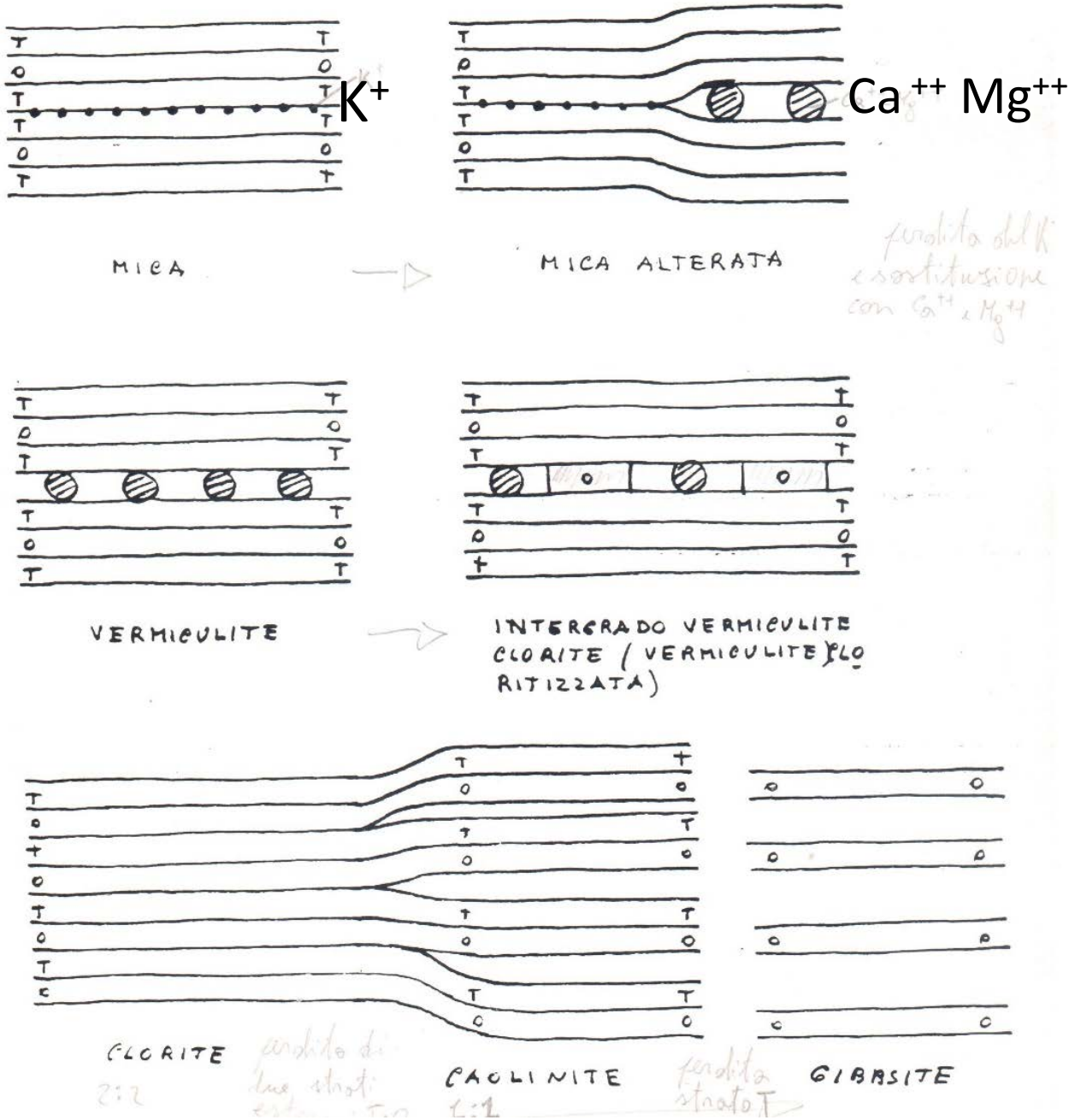
Superficie Specifica = m^2/g

SS. = 600 / 800 m^2/g

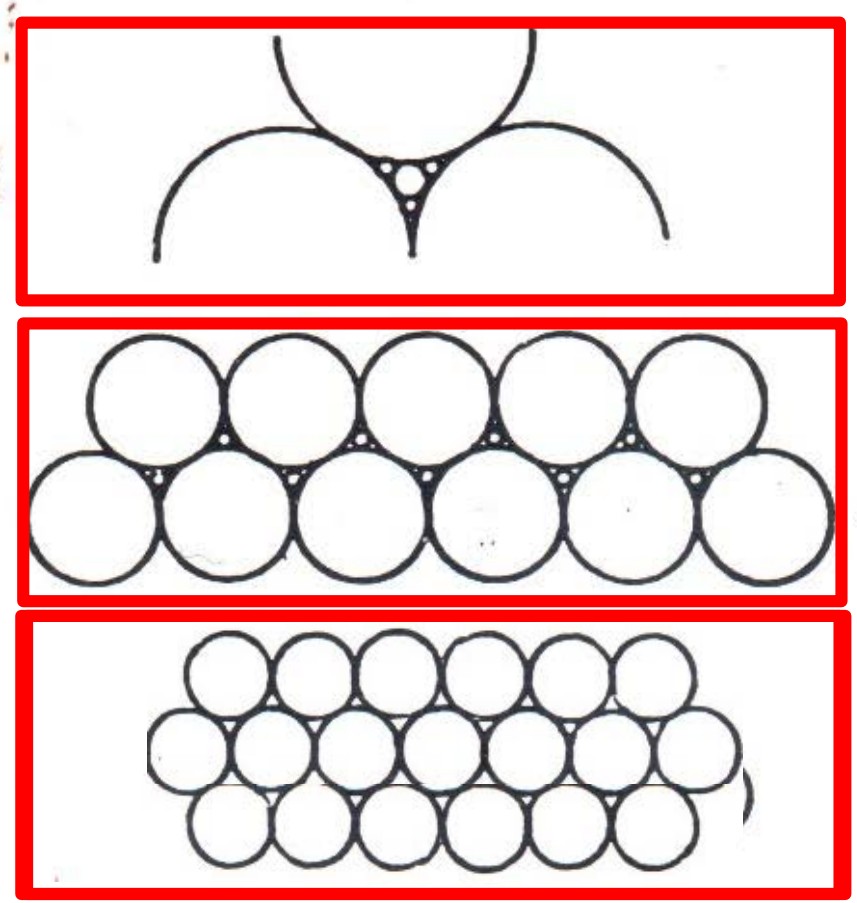
n = 0,6 - 9 8

VERMICULITE

Gruppo della Caolinitie,
Processo di trasformazione
Rapporto Si:Al = 1:1
$Si_4O_{10} : Al_4(OH)_8$



Specific surface = m^2/g



Porosity %
(empty spaces)

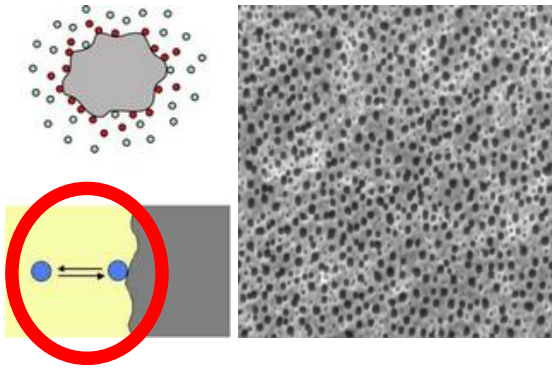
2%

7%

26%

WHAT IS ADSORPTION?

Adsorption is a chemical-physical phenomenon involving two parts: the **adsorbed molecule** and the **adsorbent matrix**, in which the interactions (chemical bonds) between them occur only on the external surface of the adsorbent, in the wall directly exposed to the aqueous phase and in the porous walls present within the matrix



Contaminant ⟷ Sediment

- Molecular shape
- Chemical structure
- Dimensions
- Solubility
- Polarity

- Chemical-physical properties
- Qualitative and quantitative composition
- Humidity
- Temperature
- pH

PAH adsorption process in marine sediments

WHAT HAPPENS IN THE ADSORPTION PROCESS?

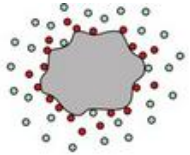
Contaminant

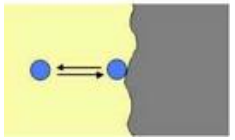
PAH (*X*)

Adsorbent

SEDIMENT

Achieving an **equilibrium** between the PAH concentration adsorbed to the adsorbent matrix and the PAH concentration in the liquid phase.





$$K_D = \frac{X/m}{C_{eq}}$$

The K_D DISTRIBUTION COEFFICIENT indicates the tendency of the PAH compound to be adsorbed to the sediment. It is the ratio between the concentration of PAH adsorbed to the sediment and the concentration of PAH present in the aqueous solution at equilibrium.

The higher the K_D value the higher the trend of molecule to be retained in the adsorbent matrix

Chemosphere 90 (2013) 1839–1846

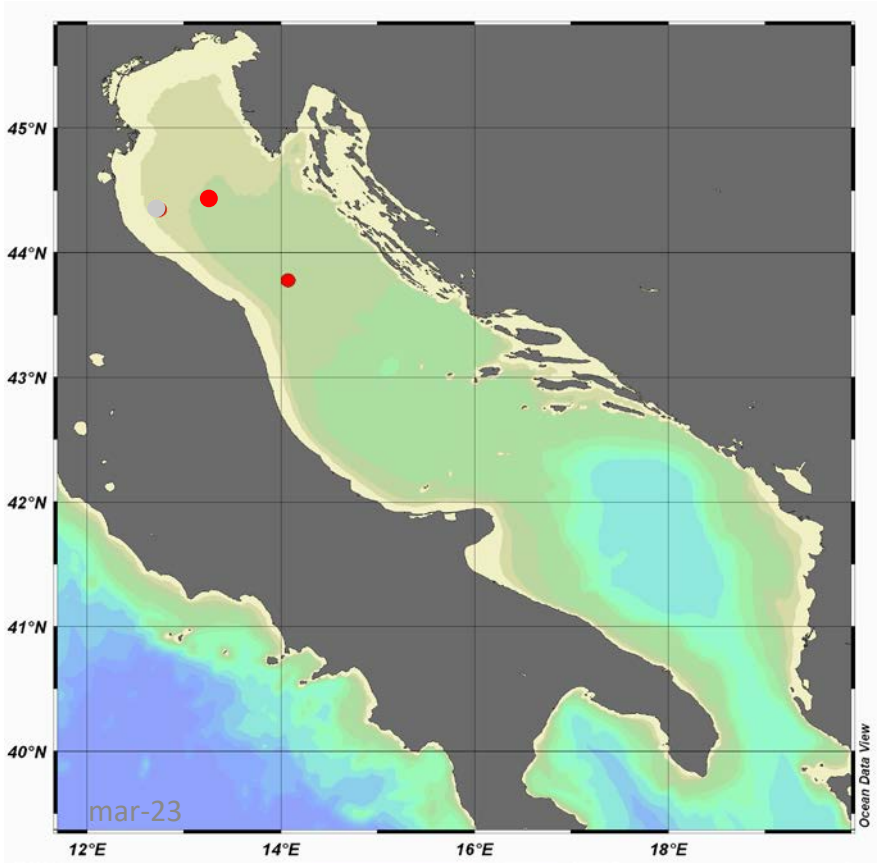
Contents lists available at SciVerse ScienceDirect

Chemosphere

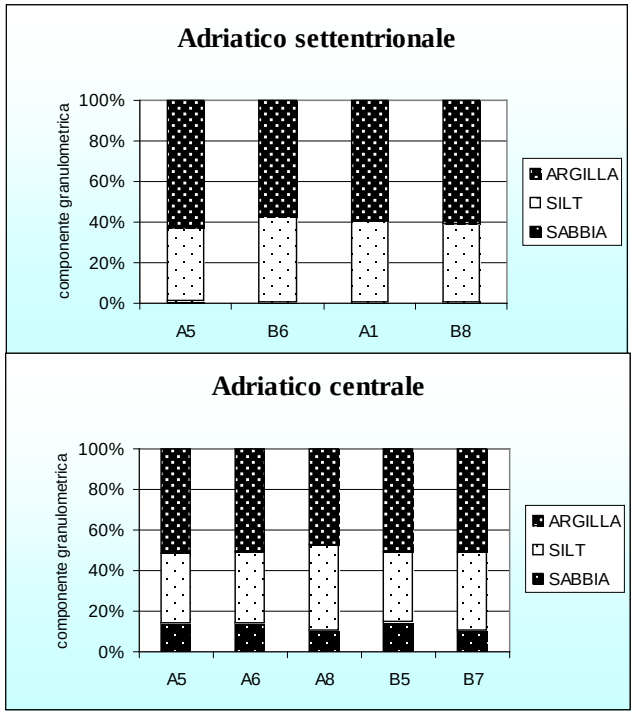
journal homepage: www.elsevier.com/locate/chemosphere

Persistence of polycyclic aromatic hydrocarbons in sediments in the deeper area of the Northern Adriatic Sea (Mediterranean Sea)

Mauro Marini *, Emanuela Frapiccini



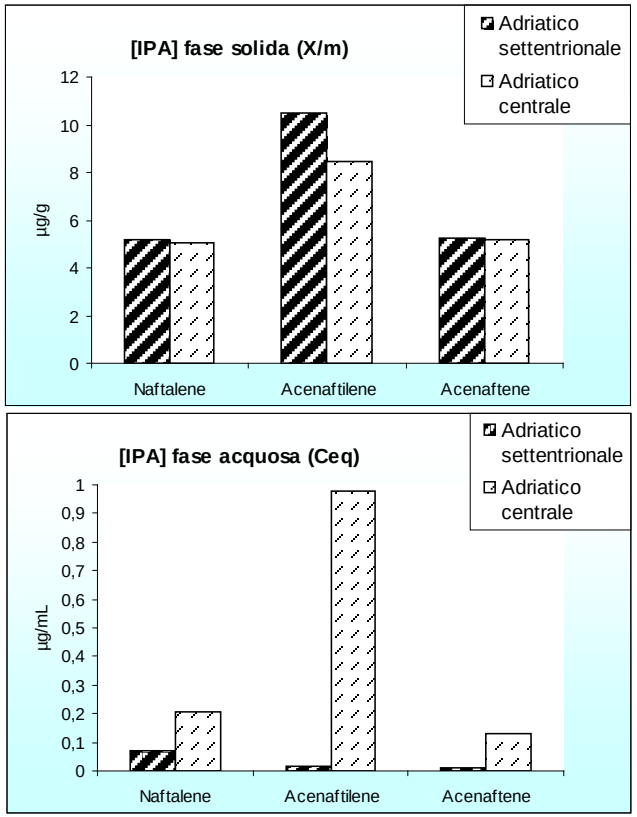
Granulometric characteristics



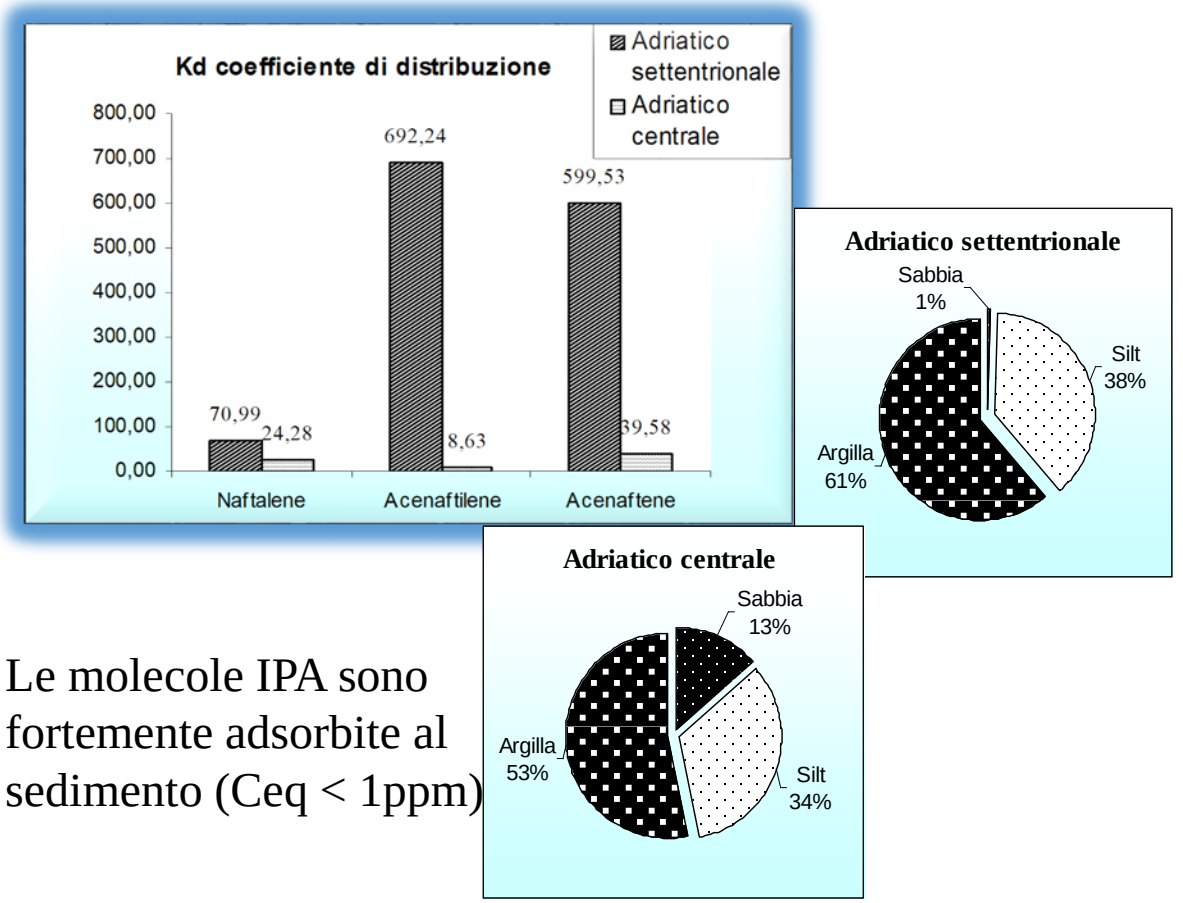
This study describes the persistence of PAHs in the deep and coastal sediments of the Northern Adriatic. Different environmental conditions were studied: salinity, temperature, sunlight, sediment particle size and organic matter in sediment. The average **conditions in the deep areas of the Northern Adriatic are: salinity higher than 37, temperature lower than 11 °C, darkness and clayey sediments with a high organic matter content. These conditions increase the persistence of the PAHs in the deep area of the Northern Adriatic.**

Adsorption process of PAHs in marine sediments of the Adriatic

Frapiccini & Marini, Water, Air, & Soil Pollution 2015



ADSORPTION VS SEDIMENT GRANULOMETRY



Le molecole IPA sono fortemente adsorbite al sedimento (Ceq < 1ppm)

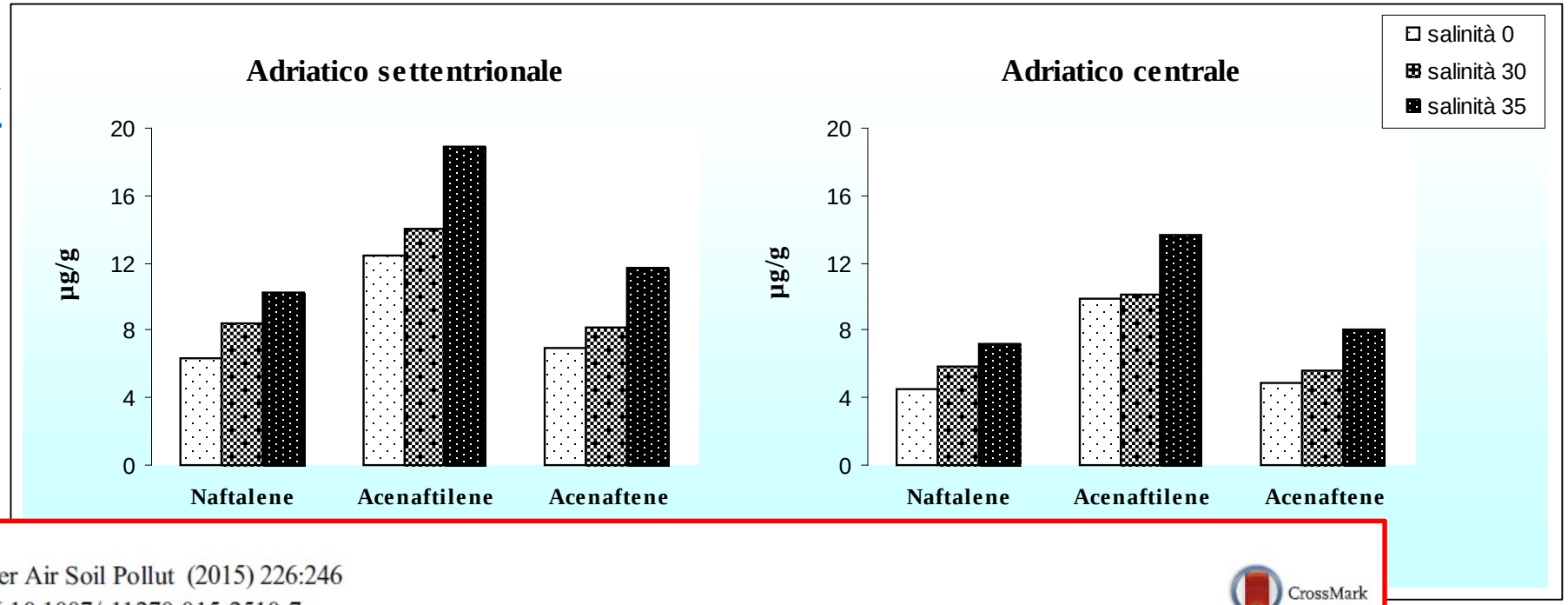
The finer textured sediment (northern Adriatic) shows higher K_D values.

Adsorption process of PAHs in marine sediments of the Adriatic

ADSORPTION VS SALINITY

The presence of ionic solutes in water causes a decrease in the solubility of the contaminant

As the salt concentration increases, the PAH molecules are more adsorbed to the sediment



Water Air Soil Pollut (2015) 226:246
DOI 10.1007/s11270-015-2510-7

CrossMark

Polycyclic Aromatic Hydrocarbon Degradation and Sorption Parameters in Coastal and Open-Sea Sediment

Emanuela Frapiccini · Mauro Marini

Degradation kinetics of PAHs in marine sediments of the Adriatic

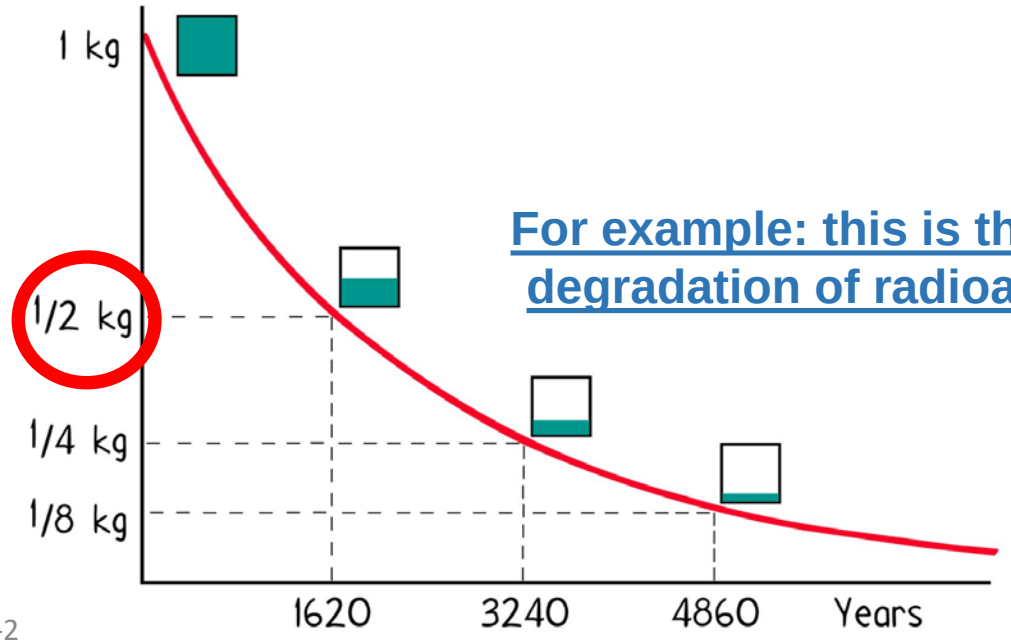
WHAT IS A DEGRADATION KINETIC?

Degradation is a set of phenomena that transform the contaminant into substances of lower atomic weight and into inorganic substances

DEGRADAZIONE → REAZIONE DI TRASFORMAZIONE

↓

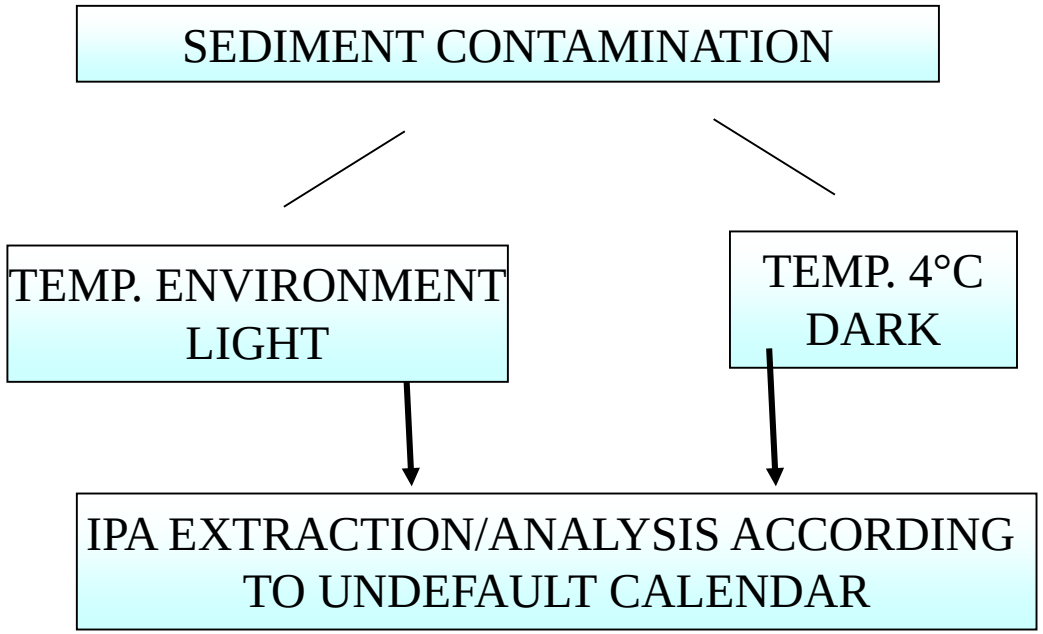
CINETICA DI DEGRADAZIONE



For example: this is the trend line of the degradation of radioactive substances

The kinetics of a reaction studies the *speed* with which this reaction takes place

HOW TO STUDY DEGRADATION KINETICS?



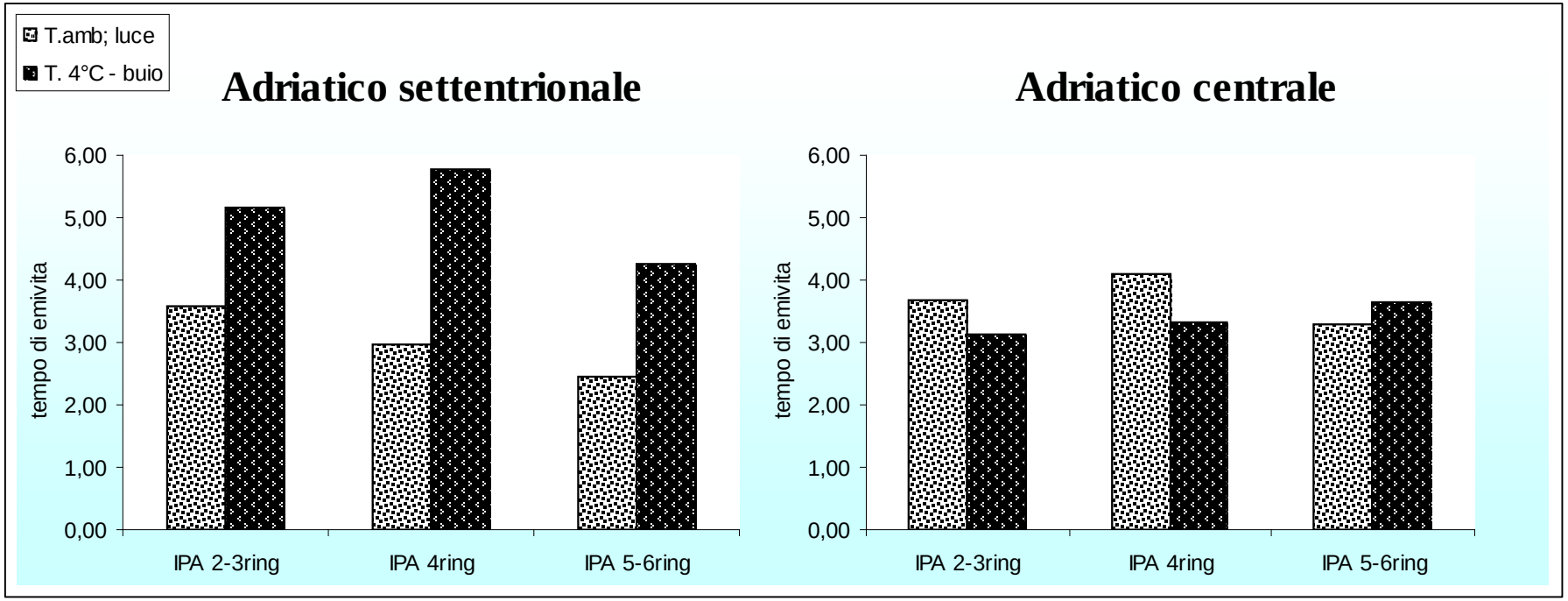
Water Air Soil Pollut (2015) 226:246
DOI 10.1007/s11270-015-2510-7

Polycyclic Aromatic Hydrocarbon Degradation and Sorption Parameters in Coastal and Open-Sea Sediment

Emanuela Frapiccini · Mauro Marini

Example of PAH degradation kinetics in marine sediments of the Adriatic

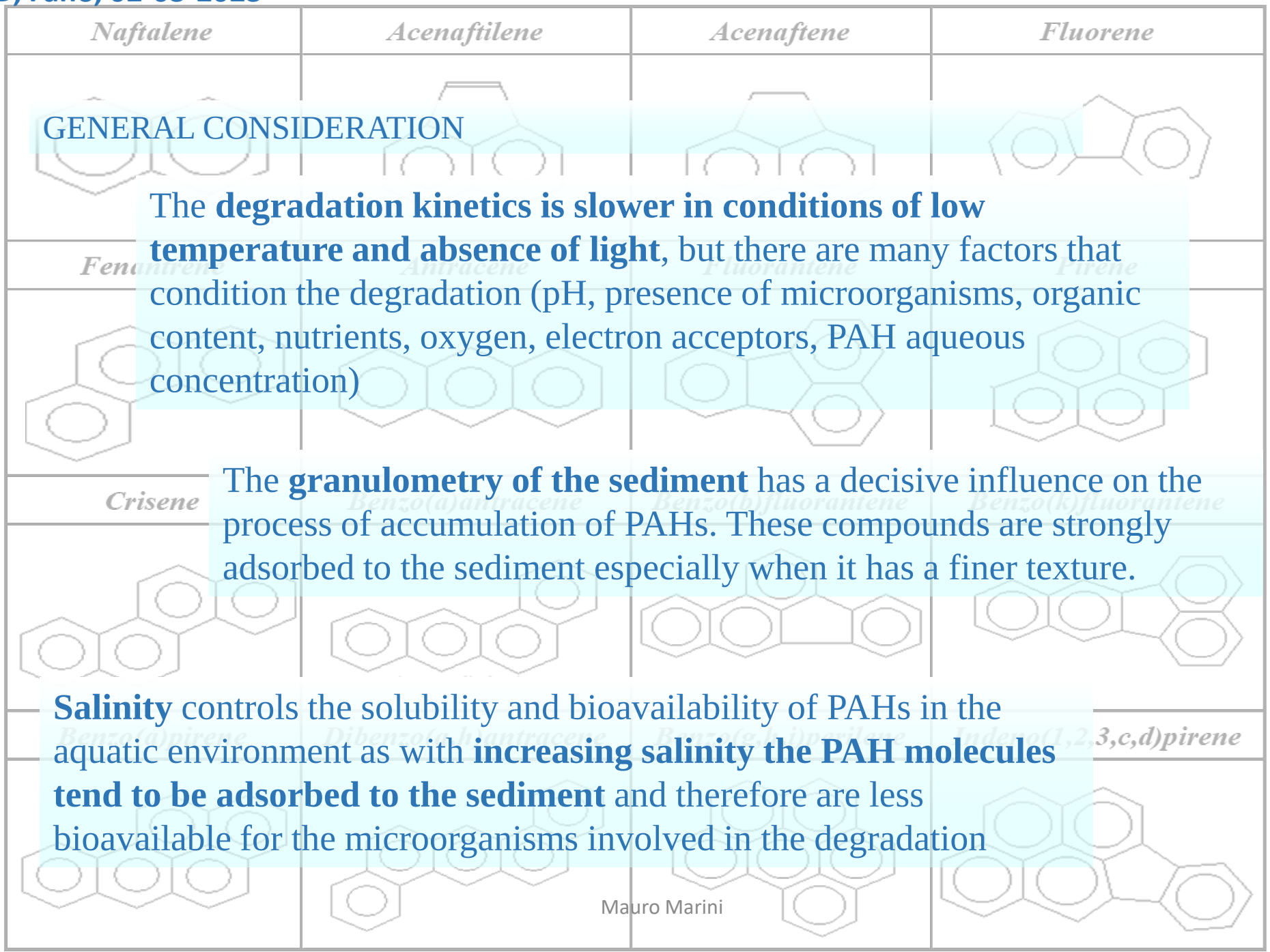
Marini & Frapiccini, Chemosphere 2013



⇒ La cinetica di degradazione delle molecole IPA esaminate è veloce. Il tempo di emivita lo si raggiunge mediamente entro i primi tre giorni.

⇒ **The degradation kinetics is slower in conditions of low temperature and in the absence of light.**

⇒ Non vi è una chiara relazione tra diverso numero di anelli aromatici e velocità di degradazione.



GENERAL CONSIDERATION

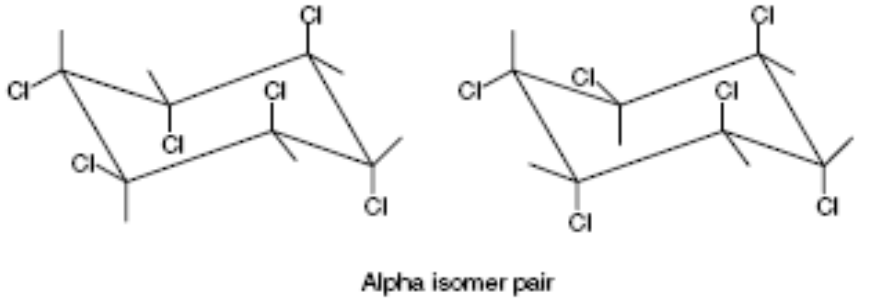
The **degradation kinetics is slower in conditions of low temperature and absence of light**, but there are many factors that condition the degradation (pH, presence of microorganisms, organic content, nutrients, oxygen, electron acceptors, PAH aqueous concentration)

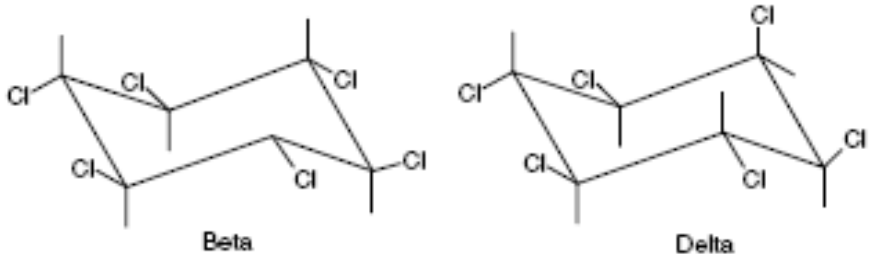
The **granulometry of the sediment** has a decisive influence on the process of accumulation of PAHs. These compounds are strongly adsorbed to the sediment especially when it has a finer texture.

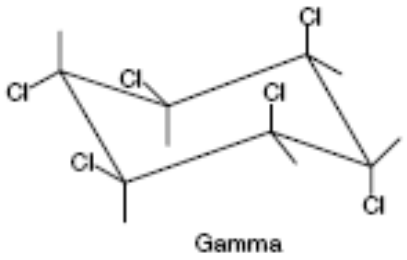
Salinity controls the solubility and bioavailability of PAHs in the aquatic environment as with **increasing salinity the PAH molecules tend to be adsorbed to the sediment** and therefore are less bioavailable for the microorganisms involved in the degradation

Organic substances used in agriculture/industry: **pesticides**

Example of Lindane (hexachlorocyclohexane) its various isomers





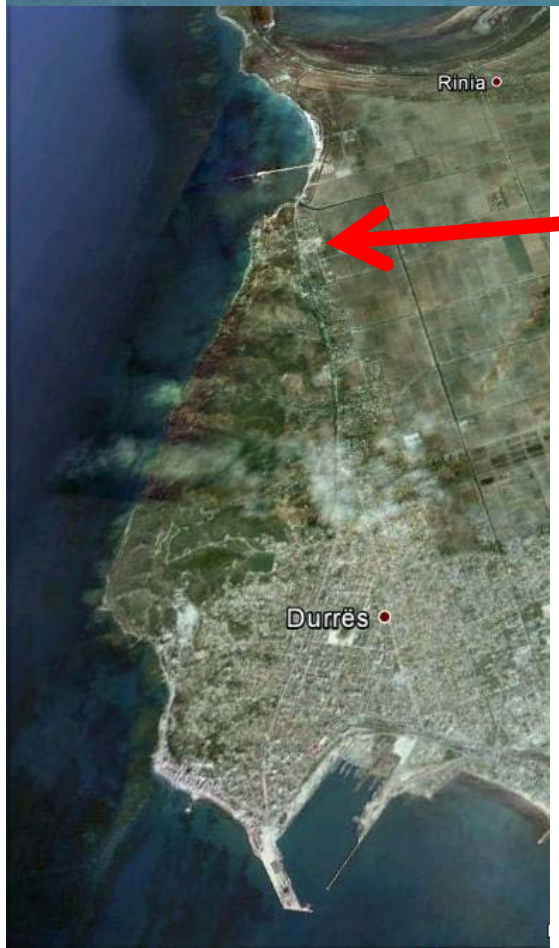


Organo-chlorinated insecticides such as, for example, hexachlorocyclohexane (lindane) and dichlorodiphenyltrichloroethane (DDT), have been extensively studied in the last 30-40 years: for their widespread diffusion, for their impact on non-target organisms, **for their bioaccumulation and for toxicity in humans.** Little is known about the accumulation in marine fish. Survey made 7 km north of the city of Durres (Albania).

About 0.7 km from the coast there was a pesticide factory. The production activity of the factory was stopped in 1991 and the sludge and processing residues containing lindane were buried in the production site. The whole area is below sea level and the surface waters reach the sea through a dewatering pump.

Symbols used according to the law for toxic substances

Old piston pump for DDT Used in the 60s



Durazzo, Albania

Marini et al., Marine Pollution Bulletin, 2012

Concentrations of Lindane in the sediments at the mouth of the channel are in the range of 46 - 80 ng/g

Marini et al., Marine Pollution Bulletin, 2012

Ex pesticide factory

Porto Romano area

Durres city

Lindane concentrations in ng/g in marine sediments sampled inshore and offshore along the 100 m bathymetry

Marine Pollution Bulletin 64 (2012) 472–478

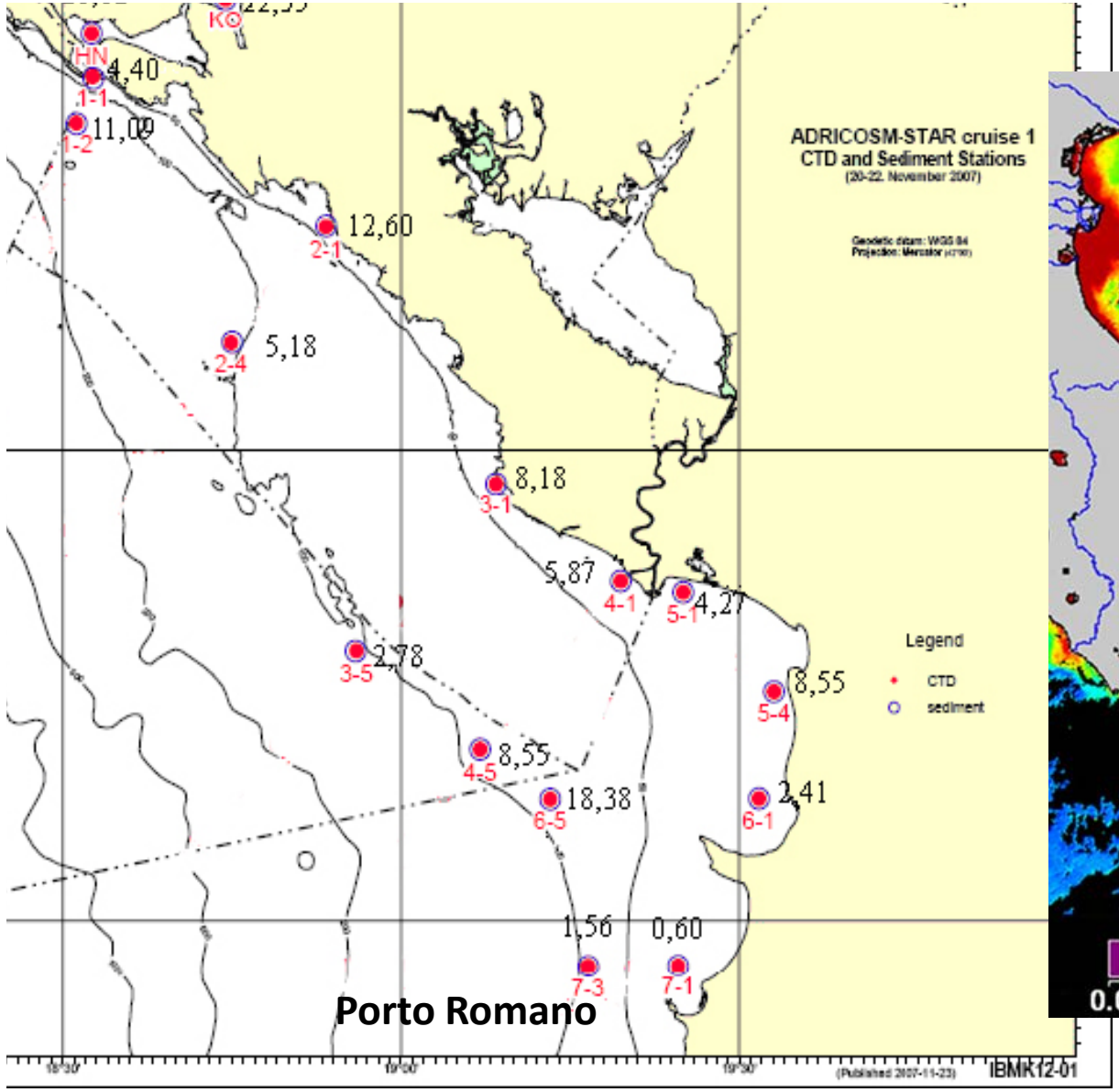
Contents lists available at SciVerse ScienceDirect

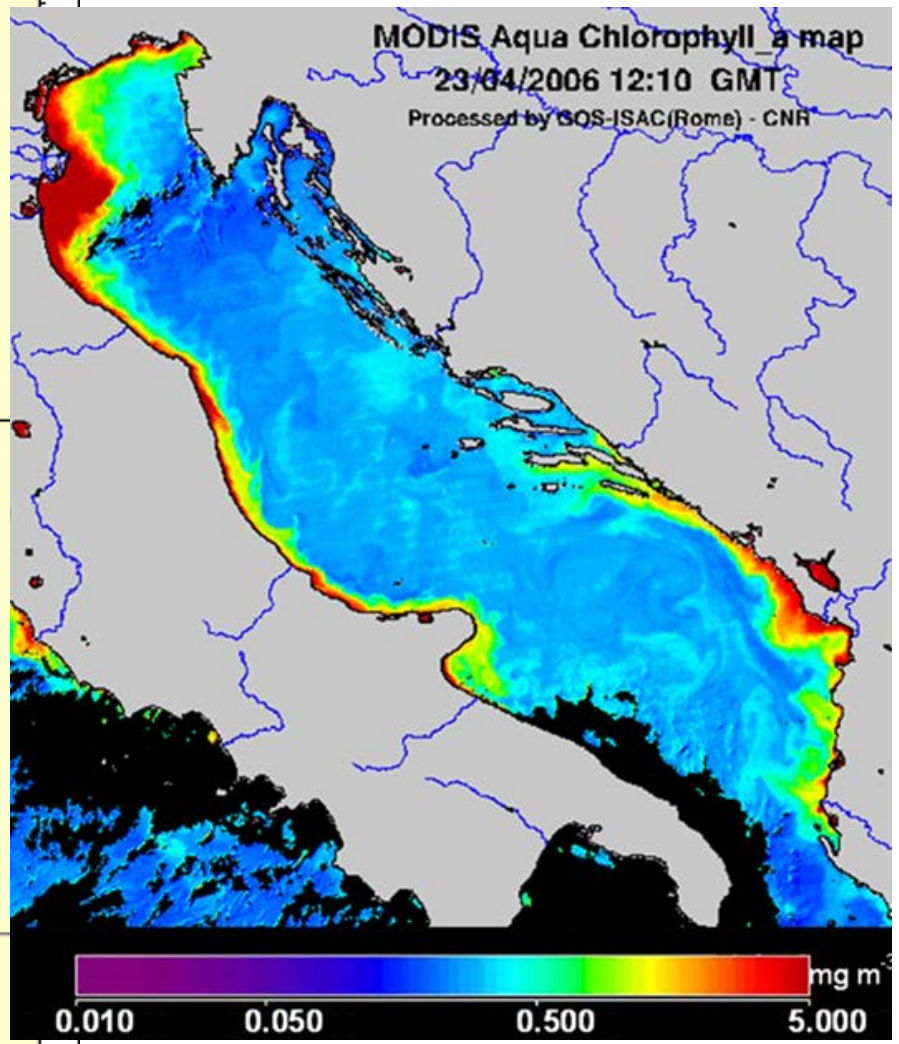
Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Evaluation of lindane diffusion along the southeastern Adriatic coastal strip (Mediterranean Sea): A case study in an Albanian industrial area

Mauro Marini [a,*], Mattia Betti [a], Fabio Grati [a], Valerio Marconi [b], Anna Rita Mastrogiacomo [b], Piero Polidori [a], Mitat Sanxhaku [c]





Topics in this lesson:

1. Description of the Adriatic basin, main oceanographic processes.

2. Nutrients that reach the sea via rivers.

3. Organic contaminants that are dispersed in the sea, for example: polycyclic aromatic hydrocarbons, pesticides …..

4. Fate and accumulation of chemical contaminants in marine organisms.

Bull Environ Contam Toxicol (2017) 98:656–661
DOI 10.1007/s00128-017-2056-z

CrossMark

Comparison of Lindane and Carbaryl Pesticide Bioaccumulation in the Common Sole (*Solea solea*)

Frapiccini Emanuela[1] · Scarcella Giuseppe[1] · Guicciardi Stefano[1] · Betti Mattia[1] · Marini Mauro[1]

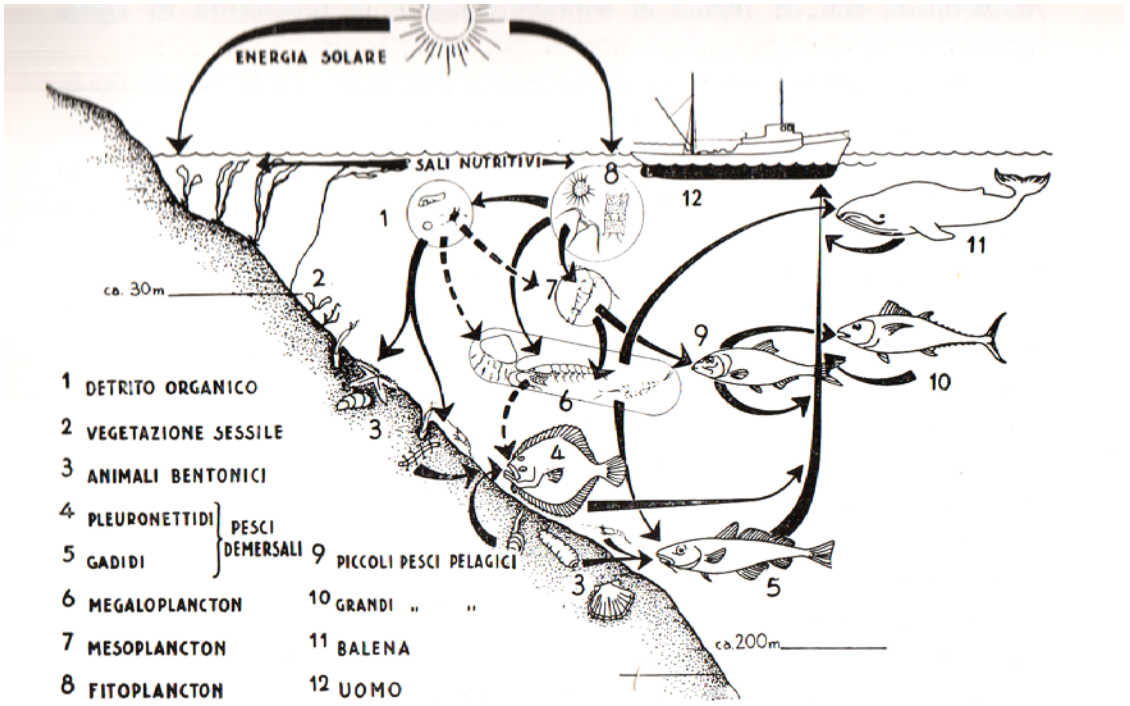


Fig. 17. Schema delle catene alimentari o di nutrizione nel mare (da Maldura in « Enciclopedia della Natura »).

Organochlorines and carbamates are common pesticides predominantly employed in agriculture. Large amounts of pesticides make their way into rivers and marine habitats. They accumulate in aquatic organisms through different exposure routes and gradually move up the food chain. Since contaminant bioaccumulation in animals is affected by several factors, this work harnessed several different approaches to explore the persistence of lindane, a long banned organochlorine pesticide, and carbaryl, a newer generation pesticide, in common sole (*Solea solea*), a major commercial species in Adriatic fisheries.

Lindane was not only more accumulated than carbaryl in sole liver, but it was also detected in greater amount in muscle tissue, the edible part (lindane, 7 ng/g; carbaryl, <0.004 ng/g w/w). Additional assays documented a greater accumulation of lindane in adults compared with juveniles and in specimens caught offshore than in those collected close to the coast. **The present findings demonstrate the different accumulation dynamics of the two pesticides to confirm the benefits derived from the replacement of organochlorine pesticides with carbamate compounds.**

Marine Pollution Bulletin 137 (2018) 61–68

Contents lists available at ScienceDirect

Marine Pollution Bulletin

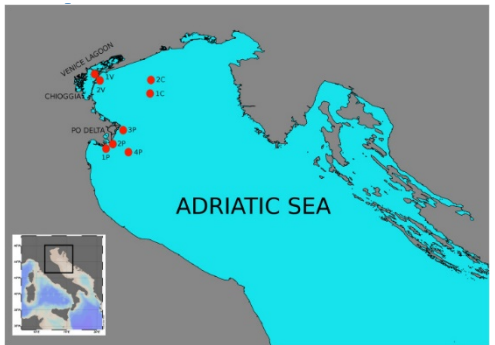
journal homepage: www.elsevier.com/locate/marpolbul

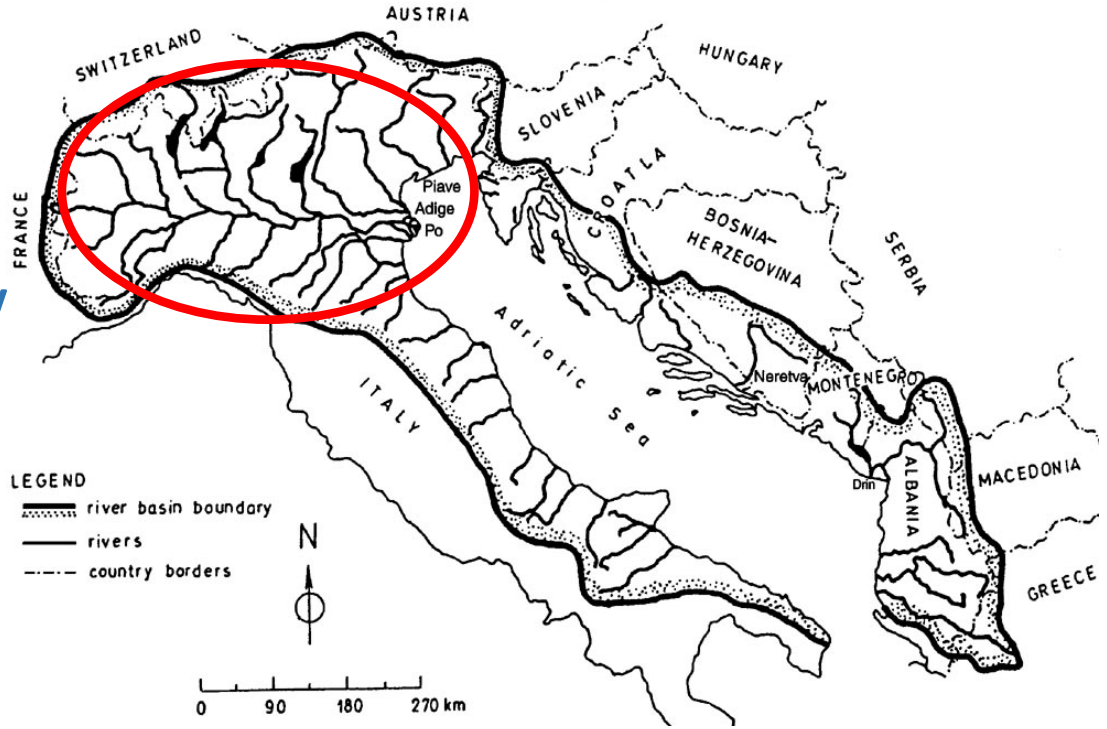
Baseline

Polycyclic aromatic hydrocarbon (PAH) accumulation in different common sole (*Solea solea*) tissues from the North Adriatic Sea peculiar impacted area

Frapiccini Emanuela[a], Annibaldi Anna[b], Betti Mattia[a], Polidori Piero[a], Truzzi Cristina[b], Marini Mauro[a,*]

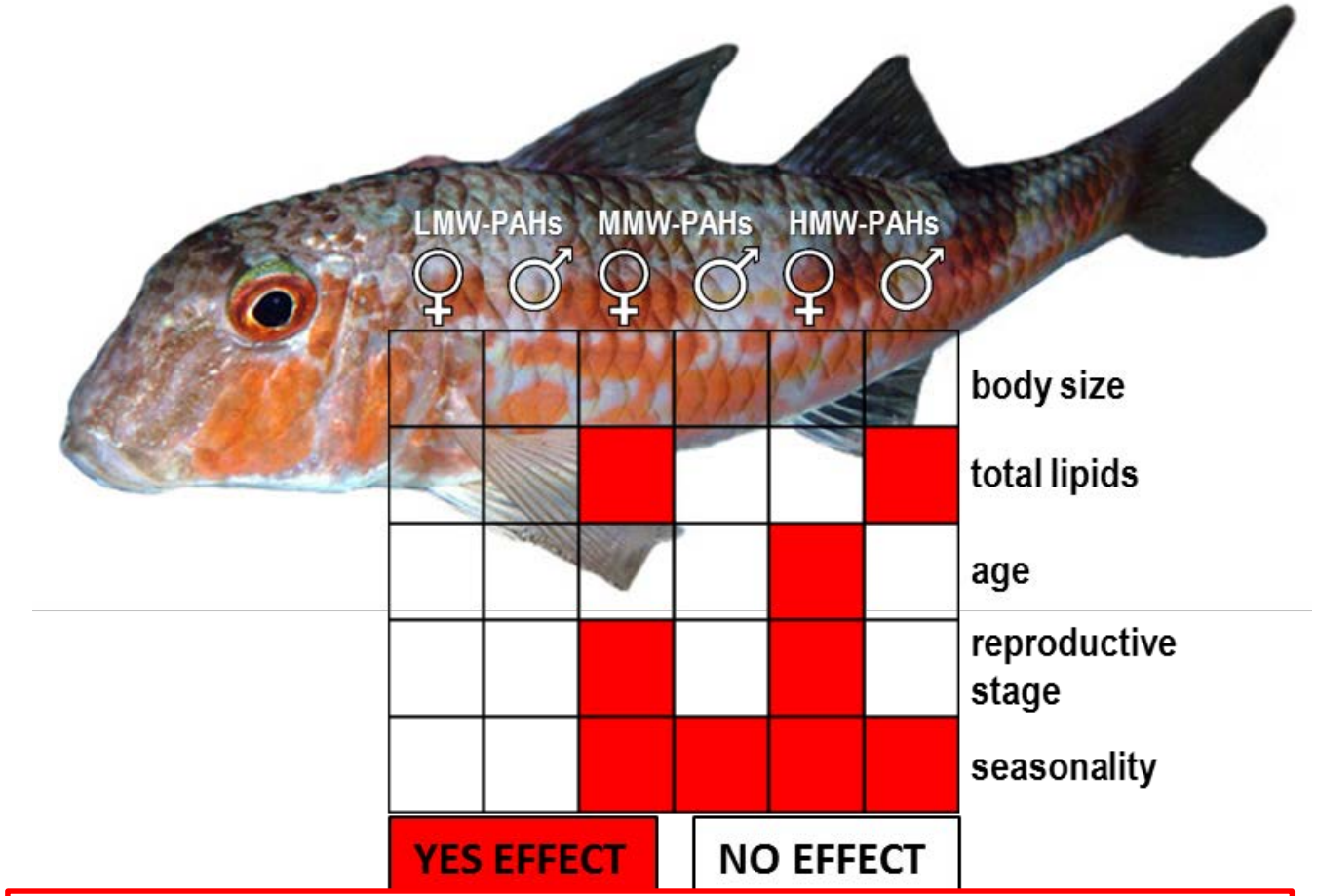
Po Valley, a very important agricultural region, the industrial heart of northern Italy and intensity





This study extends our knowledge of the bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) in marine organisms and investigates its possible determinants. PAH levels were measured in Solea solea tissue and in marine sediments collected from three areas of the northern Adriatic Sea characterized by different anthropic impacts (Venetian Lagoon, Po Delta, and fishing grounds off Chioggia). The possibility of differential PAH bioaccumulation in different tissues (**muscle, liver and gills**) was investigated by seeking relationships between mean individual and total PAH concentrations in tissue and sediment samples, the physicochemical properties of PAHs (rings and Kow), and some key biological variables (lipid content of tissues, body size, habitat). The present study demonstrated that the lipid content might not be the only determinant of PAH bioaccumulation in common sole tissues. **The habitat characteristics, the tissue types and some physicochemical properties of compounds were closely related to PAH bioaccumulation.**

This study evaluates the effects of biological factors of fish and seasonality on Polycyclic Aromatic Hydrocarbon (PAH) accumulation in red mullet (Mullus barbatus) tissue. Specimens were collected monthly with a bottom trawl net in an offshore fishing ground in the Northern and Central Adriatic Sea (Geographical Sub Area 17) throughout 2016.
The edible fillets of 380 individuals were analyzed for the concentrations of individual PAH, total PAH, and low, medium and high molecular weight (MW) PAHs. PAH bioaccumulation was related to their physicochemical characteristics (MW, and logarithm of the octanol-water partition coefficient, log Kow), some biological parameters of fish (body size, age, sex, reproductive stage and total lipid content), and catch season.
The PAH bioaccumulation pattern and the effects of the different factors varied according to PAH MW.
The heavier (medium and high MW) PAHs showed higher levels in winter-autumn and in pre-spawners compared with spawners and post-spawners. Our findings suggest that an important detoxification mechanism, albeit limited to the heavier PAHs, acts in the spawning and post-spawning stage. Low MW PAHs appeared to be unaffected by reproductive stage, lipid content and seasonality. **Reproductive stage and seasonality seem to play an important role in the accumulation of heavier PAH, whereas total lipid content and age seem to exert a limited influence, and body size no effect at all.**



Environmental Pollution 258 (2020) 113742

Contents lists available at ScienceDirect

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol

Effects of biological factors and seasonality on the level of polycyclic aromatic hydrocarbons in red mullet (*Mullus barbatus*)☆

E. Frapiccini [a, 1, *], M. Panfili [a, 1], S. Guicciardi [a], A. Santojanni [a], M. Marini [a], C. Truzzi [b], A. Annibaldi [b]

Marine Pollution Bulletin 176 (2022) 113461

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Mercury levels in *Merluccius merluccius* muscle tissue in the central Mediterranean Sea: Seasonal variation and human health risk

Federico Girolametti [a], Monica Panfili [b], Sabrina Colella [b], Emanuela Frapiccini [b,*], Anna Annibaldi [a,c], Silvia Illuminati [a], Mauro Marini [b,c], Cristina Truzzi [a]

Is the first study evaluating THg levels in hake fillets in relation to ecological (season) and biological (body size, sex, sexual maturity, lipid content) parameters. THg levels in muscle showed no sex-related differences; in contrast, significant season-related differences were found in females, with higher levels in spring-summer compared with autumn-winter. No season-related differences were seen in males. A significant sex effect was found for body size and sexual maturity. Females showed a correlation between THg level and length, THg being significantly higher in mature compared with immature specimens. No significant sex effect was found for muscle lipid content, because a correlation between THg concentration and tissue lipids was found in both sexes.

This study demonstrates that European hake caught in the northern and central Adriatic is safe for human consumption.

applied sciences

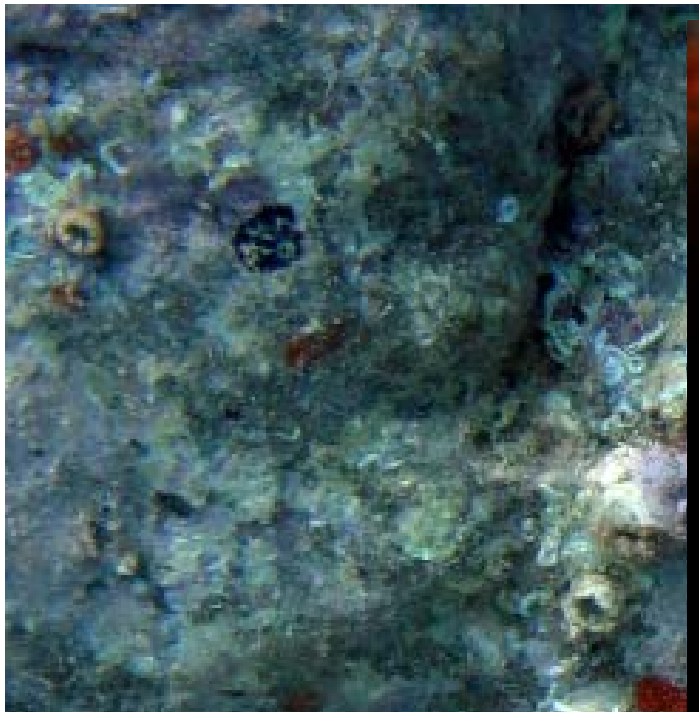
MDPI

Review

Methylmercury and Polycyclic Aromatic Hydrocarbons in Mediterranean Seafood: A Molecular Anthropological Perspective

Andrea De Giovanni [1,2,*], Cristina Giuliani [3], Mauro Marini [2,4] and Donata Luiselli [1,2]

In the present review, we summarize the results of epidemiological investigations on the genetic component of individual susceptibility to methylmercury and polycyclic aromatic hydrocarbons exposure in humans, and on the effects that these two pollutants have on human epigenetic profiles (DNA methylation). Then, we provide evidence that Mediterranean coastal communities represent an informative case study to investigate the potential impact of methylmercury and polycyclic aromatic hydrocarbons on the human genome and epigenome, since they are characterized by a traditionally high local seafood consumption, and given the characteristics that render the Mediterranean Sea particularly polluted.



Marine Pollution Bulletin 184 (2022) 114109

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Peculiar polycyclic aromatic hydrocarbons accumulation patterns in a non-zooxanthellate scleractinian coral

Frapiccini Emanuela [a,d,1], Caroselli Erik [b,d,1], Franzellitti Silvia [c,d], Prada Fiorella [a,d,2], Marini Mauro [a,d,*], Goffredo Stefano [a,d]

Science of the Total Environment 743 (2020) 140781

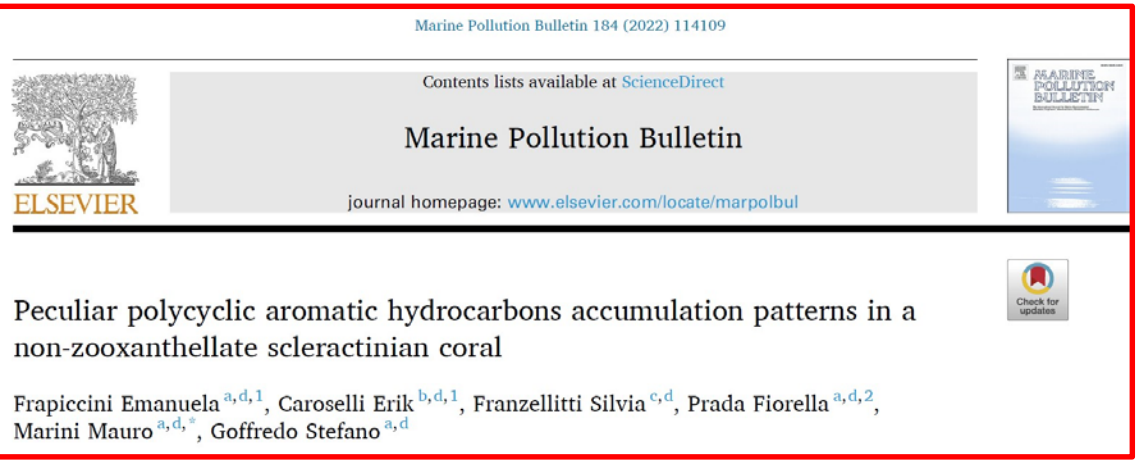
Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Accumulation of PAHs in the tissues and algal symbionts of a common Mediterranean coral: Skeletal storage relates to population age structure

Erik Caroselli [a,e,1], Emanuela Frapiccini [b,e,1], Silvia Franzellitti [c,e], Quinzia Palazzo [d,e], Fiorella Prada [a,e], Mattia Betti [b,e], Stefano Goffredo [a,e,*], Mauro Marini [b,e,*]


Marine Pollution Bulletin 184 (2022) 114109

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Peculiar polycyclic aromatic hydrocarbons accumulation patterns in a non-zooxanthellate scleractinian coral

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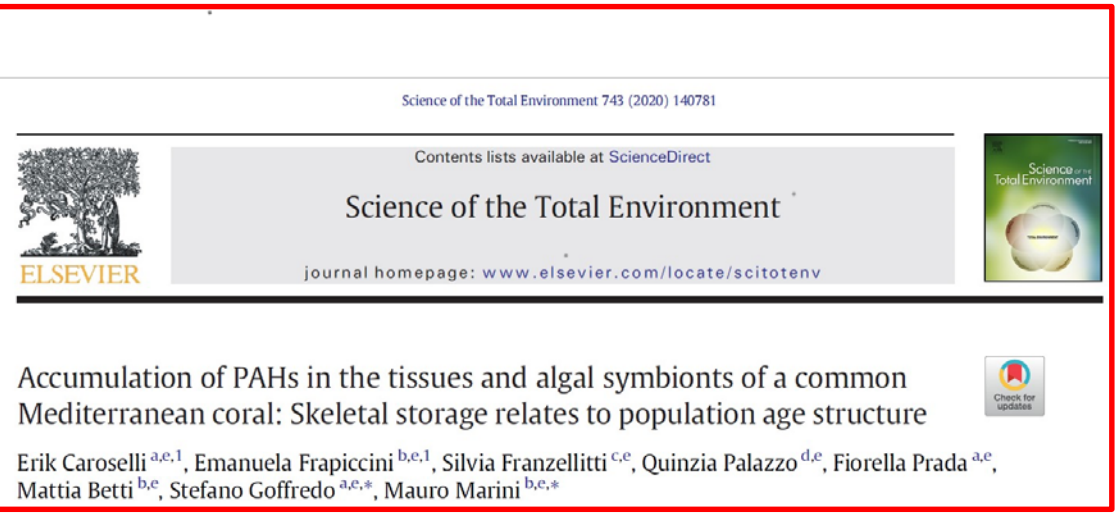
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Accumulation of PAHs in the tissues and algal symbionts of a common Mediterranean coral: Skeletal storage relates to population age structure

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In conclusions.

Assessing the sources and accumulation patterns of polycyclic aromatic hydrocarbons (PAHs) in corals is critical, as they threaten coral ecosystem resilience in addition to other anthropogenic pressures. We determined acenaphthene, fluorene, fluoranthene, and pyrene concentration in the skeleton and soft tissue of 7 adult and 29 old specimens of the non-zooxanthellate coral Leptopsammia pruvoti from the Mediterranean Sea.

Leptopsammia pruvoti accumulated 2–72 times higher PAH concentrations than the previously investigated zooxanthellate Balanophyllia europaea living at the same site at shallower depth, likely in relation to the different trophic strategy. Low molecular weight PAHs were preferentially accumulated compared to high molecular weight PAHs.

Detected PAHs were mainly petrogenic, consistently with local pollution sources. **Populations of L. pruvoti immobilized PAHs in the skeleton 3–4 orders of magnitude more efficiently than B. europaea.** This highlights the need to investigate other non-zooxanthellate species, which represent the majority of Mediterranean scleractinians, but are widely overlooked with respect to the few zooxanthellate species.

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Conclusions:

Contaminants spread easily into the sea mainly through **rivers**;

In fish, the contaminants are found accumulated in the various organs: **gills, liver and muscle**;

The contaminants are also **present in other marine organisms and sediments** in non-negligible concentrations;

The results of research on edible marine products do **not show dangerous concentrations** for human health **but** we must always bear in mind that they **accumulate**.

Human toxicity may develop in human tissue over time.

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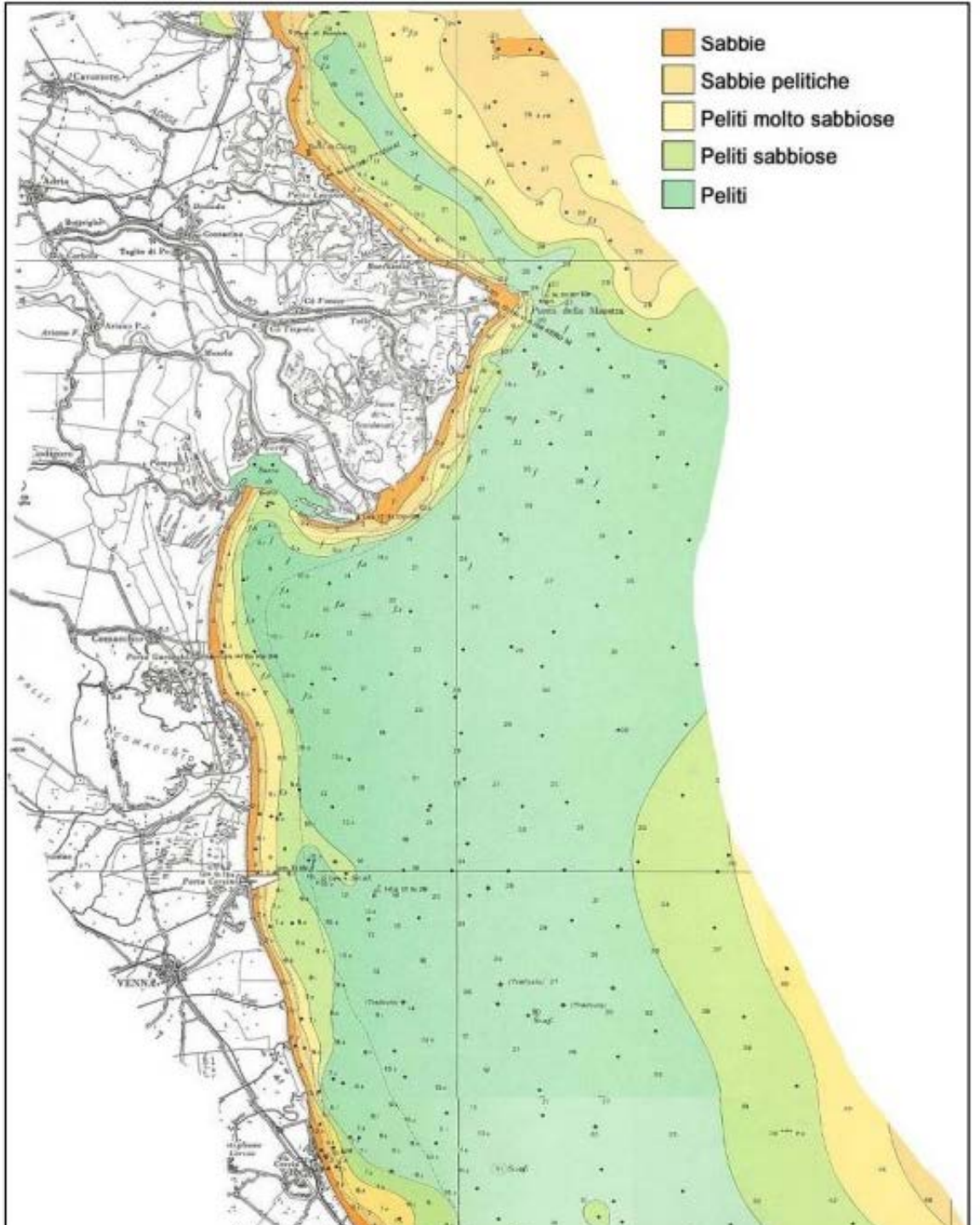

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