XXII Congresso dell'Associazione Italiana di Oceanologia e Limnologia

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Centro Congressi dell'Hotel Majestic, Verbania Pallanza

Le alterazioni del ciclo dell'acqua

Interazioni tra acque continentali e oceani in un pianeta in rapido cambiamento

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BOOK OF ABSTRACTS

Il presente volume raccoglie i riassunti dei contributi presentati al XXII Congresso Nazionale dell'Associazione Italiana di Oceanologia e Limnologia. I contributi sono riportati in ordine alfabetico, in base al cognome del primo autore.

This volume is a collection of the abstracts of the scientific contributions presented at the XXII Congress of the Italian Association of Oceanology and Limnology (A.I.O.L.). Abstracts are reported following the alphabetical order, according to the first author's surname.

RELAZIONI AD INVITO

INVITED LECTURES

Hydrological alterations on aquatic ecosystems of the Western Mediterranean region and its influence on its ecological integrity and ecosystem services

ANTONIO CAMACHO

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In the Mediterranean region intensive water usage usually drives to unbalanced distribution of water resources, and the ecological health of aquatic ecosystems is not always guaranteed when water needs for humans are high. Hydrological alterations often affect the ecological functioning of these ecosystems, and impact its physical structure, biogeochemical cycles, and the composition of the biological communities, among others. This also have repercussions on the services these ecosystems offer, this is, the benefits that we, as humans, obtain from nature. Here we offer a series of scientifically supported case studies in which the ecological health of specific aquatic epicontinental ecosystems located in the Mediterranean region have been impacted by hydrological alterations, and how this modifies its ecological functioning by acting on its morphology, biogeochemistry, and/or its biota, thus affecting ecosystem services. Water regulatory frameworks, such as the Water Framework Directive in Europe, try to face anthropogenic disturbances affecting water bodies. Though, a Mediterranean perspective would likely need to strengthen the attention on hydrological alterations as main impacts, but also when evaluating the ecological status of these ecosystems. Specific tools, such as the use of water plants as indicators of hydrological stress in lakes and wetlands, would here be proposed for these evaluation procedures. On the other hand climate prognoses, synthesized by the IPCC, predict huge changes in the rainfall patterns on the region, especially in the Western Mediterranean, where precipitations would likely be lower and more irregularly distributed. How these changes could affect the ecological functioning of particular types of aquatic ecosystems in the Western Mediterranean would also be addressed in this talk, stressing the need for more focus on the alteration of the hydrological patterns to maintain the ecosystem processes and to increase its resilience towards climate change, both in adaptation and mitigation.

Putting ecology into ecosystem services: the challenges ahead for limnology

LAURENCE CARVALHO

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Since the Millennium Assessment in 2005, the concept of ecosystem services has become rapidly adopted in environmental policies across the globe. Great efforts are now being made to model and map these services and value the benefits they provide, yet the ecological processes underpinning the delivery of ecosystem services is rarely considered in any depth.

Freshwater lakes provide many ecosystem goods and services, including water supply, fish production, tourism and recreation, as well as a host of regulatory services, such as water purification and climate regulation. To manage all these services in a sustainable way requires ecological understanding. This raises a number of challenges for ecological science: What are the relationships between water quality, freshwater biodiversity and the delivery of ecosystem services? Can we incorporate this understanding into models of ecosystem services? How do we manage lakes to minimise conflicts and maximise benefits whilst sustaining environmental quality?

The talk will highlight some of the difficulties addressing these challenges and some solutions to help put ecological science back into ecosystem services. The development and application of functional trait-based classifications is one such approach. At a local scale, a case-study of Loch Leven, a large, shallow lake in Scotland, will highlight that the relationships between freshwater biodiversity and the services provided by freshwaters are complex and that thresholds in ecosystem services are not just driven by ecology. Demonstrating at least some linkage, is however, critical to develop stronger public and policy support for maintaining and restoring the ecological quality of our lakes.

Microbial diversity and ecosystem functioning in a changing ocean: a plunge into the deep sea

ANTONIO DELL'ANNO

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Deep-sea ecosystems represent the largest and most remote biome of the biosphere. They play a key role in biogeochemical cycles and ecological processes that regulate the functioning of the biosphere, and provide the basis for a sustainable provision of ecosystem goods and services. In the last 20 years enormous progress has been made in the investigation of deep-sea microbes, but the knowledge of the microbial ecology of surface deep-sea sediments is still limited. Deep-sea sediments host the largest fractions of Bacteria, Archaea and viruses on Earth, and available results suggest that a large fraction of microbial diversity is completely unknown to science. Assessing the diversity of benthic deep-sea microbes, their distribution and interactions across and within oceanic sectors are key priorities for a better understanding of the functioning of the global biosphere and for planning efficient management strategies at regional scale able to mitigate the forecasted impacts of global climate changes.

In this talk I will present new insights on virus-host interactions in surface deep-sea sediments with a special emphasis on the potential impact of present climate changes on benthic deep-sea ecosystem functioning.

Long-term research to understand impact of perturbations on lakes: the example of Lake Maggiore

MARINA MANCA

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Contribution by:

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Perturbations linked to the direct and indirect impacts of human activities during the so-called Anthropocene, affect the structure and functioning of lake ecosystems to varying degrees. To understand the patterns and mechanisms of these anthropogenic effects and the extent to which they may drive irreversible changes in ecosystem services, long-term research is required. Studies on the long-term dynamics of plankton may be particularly useful for large and deep lakes whose overall productivity is dominated by pelagic processes. In the open-waters of such lakes, planktonic organisms link and interact with both abiotic and biotic compartments. Here we will analyse 60 years of data on the plankton of the large, deep, subalpine, Lake Maggiore, tracing changes in the pelagic food web which occurred during different phases of the lake's recent evolution. We will document short- to- medium response times by different trophic levels, from microbes, to primary producers and secondary consumers. We will revisit results of past studies based on contemporary and paleolimnological studies and present new analyses to: i) identify any tipping points of the lake trophic evolution, ii) discern effects of recent climatic change, iii) quantify whether inter-annual variability has changed perhaps in responses to changes in thermal stratification regime and warming. By supplementing structural with functional descriptions of long term changes in phyto- and zooplankton communities, we aim to test competing mechanisms underpinning the decade-scale changes we observed.

Impact of catastrophic events on small mountainous river discharge

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Small mountainous rivers (<10,000 km^2 in area) account for only about 10% of the land area draining into the global ocean, but collectively they discharge nearly 40% of the world's sediment load. One reason for these very high yields are catastrophic events, particularly earthquakes and floods, as seen in the very high sediment yields of small rivers in such diverse areas as in Taiwan rivers and rivers draining into the Adriatic Sea. The effects of such events is perhaps best illustrated by the Choshui River (3100 km^2) in western Taiwan), which between 1990 and 2009 was impacted by 26 significant floods as well as the M_w 7.6 Chichi earthquake (September 1999). In the 10 years prior to the earthquake, during which there were 7 significant floods, the Choshui discharged ~330 million tons (Mt) of sediment past the Jangun Bridge gauging station (seaward-most station on the river), nearly half of which was discharged during two floods (1994, 1996). In the 10 years after the Chichi earthquake, the Choshui discharged 1450 Mt, 1250 Mt of which were discharged during 11 major floods and 2 super floods. The decadal average sediment yield of ~45,000 $t/km^2/yr$ (compared to the average global yield of 190 Mt/yr) was roughly an order of magnitude greater than it would have been without the earthquake or the typhoon-generated floods. To document the impacts of such events in other rivers necessitates careful long-term monitoring, which, unfortunately, few rivers presently have.

Submarine Groundwater Discharge: a relevant but overlooked process in the Mediterranean Sea

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Submarine Groundwater Discharge (SGD), encompassing fresh groundwater and seawater recirculating through the coastal aquifer, has been recognized as an important component of the hydrological cycle and a dominant pathway for terrestrial chemical constituents to reach the coastal sea. Inputs of nutrients supplied by SGD may be particularly relevant for the biogeochemical cycles of the Mediterranean Sea, which is considered one of the most oligotrophic seas in the world. However, the role of SGD as a source of dissolved compounds to this basin has been largely ignored. In this study, we used a comprehensive mass balance of radium-228 (^{228}Ra) to estimate the magnitude of SGD to the Mediterranean Sea, as well as its associated nutrient inputs. Radium isotopes have been widely applied as tracers of SGD, mainly because they are highly enriched in SGD relative to seawater and they behave conservatively once released into the sea. By using this radionuclide, we estimated that the total SGD contributes up to $(0.3–4.8)\cdot10^{12}$ $m^3\cdot yr^{-1}$ to the Mediterranean basin, which appears to be 1-16 times higher than the riverine discharge. SGD represents also a major source of dissolved inorganic nutrients (Nitrogen (DIN), Phosphorous (DIP) and Silica (DSi)) to the Mediterranean Sea, with median annual fluxes of $190\cdot10^9$, $0.7\cdot10^9$ and $110\cdot10^9$ mol for DIN, DIP and DSi, respectively, which are comparable to riverine and atmospheric inputs. These results demonstrate the profound implications that SGD may pose in the biogeochemical cycles of the Mediterranean Sea and emphasize the need for its consideration in coastal and basin-wide studies.

COMUNICAZIONI ORALI

ORAL PRESENTATIONS

The LTER site Gulf of Venice and the project RITMARE: a case study for the recovery, search, view and sharing of long term ecological marine research data

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The need for ecological knowledge synthesis and availability, with an open science perspective, requires the application of good information management approaches, providing the capacity to discover, access, interpret, process and distribute data. Access to information both reliable and interoperable among different providers is essential to address key environmental challenges, most of them requiring analyses of long-term trends, identification of drivers and provision of options for mitigation and adaptation. To this purpose, a collective effort among producers of ecological data, information managers and users (in science, policy and business) is needed. Within this general and relevant context, that is driving many processes, initiatives and projects at the European and global level, practical examples of collaboration are needed.

In this work we present a case study, resulting from the cooperation between marine LTER (Long Term Ecological Research) ecologists working in one of the LTER-Italy sites (the Gulf of Venice), extended from the northern Adriatic areas to the south of the Po delta river, and the data manager group working in the national flagship project RITMARE. The process of data mining and harmonization concerned 50 years (1965-2015) of observations on pelagic abiotic factors and phytoplankton in the Gulf of Venice. The information on this database is made available, for discovery and access, by the suite software Get-It StarterKit, developed by CNR within the project RITMARE specifically for the marine community. The relevant results, opportunities and weaknesses of this cooperation as well as the main implications for the wider LTER and marine community are illustrated, together with some examples of the management of this long-term dataset developed within the RITMARE SP7.

Use of an Autonomous Underwater Vehicle to map frontal coastal zones

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From January to February 2014, the Institute of Marine Sciences of the Italian National Research Council (CNR-ISMAR, Venice) coordinated an ad-hoc international oceanographic campaign (named CARPET, Characterizing Adriatic Region Preconditioning EvenTs) with the aim of tracking seawater conditions in the Northern Adriatic Sea region, in both Italian and Slovenian waters. The R/V *Urania* was equipped with state-of-the-art oceanographic instrumentation, turbulence free-falling profilers and, for the first time, an Autonomous Underwater Vehicle (AUV) from the Remote Environmental Measuring UnitS (REMUS) family, more specifically the REMUS 100.

One aim of CARPET was to track the river plume frontal zones that characterize the basin and represent very important injections of fresh water and sediments. Among the REMUS 100 missions during CARPET, the operation planned in the Gulf of Trieste, was particularly relevant. During this mission, the REMUS 100 AUV was operated to move across the Isonzo river plume, a relatively short river (140 km) that is known for its highly variable outflow during flood periods. With the REMUS 100 sensors (particularly Conductivity, Temperature, and Turbidity Sensor), relationship between the sea surface turbidity front and the dilution of freshwater delivered to the basin was investigated.

Data showed that sediment and salinity patches, once delivered by the rivers, mix differently with the ambient sea waters, a fact that can lead to strong implications when using optical data for tracking river plumes. This is particularly important when dealing with integrated approaches consisting of in-situ measurements, earth observation and numerical model results for describing coastal dynamics. The adoption of so-called triple-collocation algorithms will allow the intercalibration of properties retrieved from the different sources, while the use of independent data sets will enable the identification of correct time and space scales for the observed phenomena.

Morphological traits of phytoplankton in the Lagoon of Venice

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The Venice Lagoon, the largest Italian lagoon, is one of the research sites of the Italian Long Term Ecosystem Research network (LTER-Italy). Consistent monthly observations on phytoplankton and related abiotic factors started in 1998 and are still regularly ongoing. Based on the available time series, we analyzed the phytoplankton community by focusing on the morphological traits and on the related size. Phytoplankton taxa were classified in terms of geometric shape, biovolume, great axial linear dimension, and surface-to volume ratio. The main targets of the study were to: 1) examine the shape variability of the phytoplankton in the lagoon, 2) assess the links between shapes and taxonomic biodiversity, in terms of redundancy, 3) analyze the relations between shape and other morphological traits, 4) evaluate whether shapes are dependent on the environmental factors.

With this work we aim at giving a contribution to the debate about phytoplankton community structure emergence under different environmental scenarios and ecological interactions. To elaborate data about phytoplankton morphology we used some online tools made available by the virtual Research Infrastructure Lifewatch, thus contributing to the design of a virtual lab about phytoplankton traits.

La forma dell'acqua – The shape of water

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Secondo Camilleri, dal quale ho preso a prestito il titolo, l'acqua "Piglia la forma che le viene data". Le caratteristiche del contenitore, però, condizionano quelle del contenuto: per esempio, la radiazione termica influenza le acque di un lago in modo diverso a seconda della sua profondità. Per questo fin dall'inizio della limnologia i limnologi si sono interessati alla morfologia della conca lacustre ed hanno usato strumenti, spesso presi a prestito dalla geografia e dall'oceanografia, per darne una descrizione quantitativa. Molti di quegli strumenti sono ormai obsoleti e superati dall'introduzione di tecniche più moderne. Oggetti come il limnigrafo a corda, lo scandaglio a filo, il circolo di Amici, lo staziografo, ecc. sono oggi pezzi da museo. Parlare di quegli strumenti è come obbligare l'ascoltatore a visitare un museo di oggetti che non ha più senso utilizzare, che sono ormai inutili nella pratica quotidiana della ricerca scientifica. Però la salvaguardia del patrimonio strumentale del passato e lo studio dei suoi fallimenti o successi hanno un valore e un senso che va oltre la semplice conservazione documentaria di un oggetto. Possono, infatti, servire a gestire meglio le tecnologie emergenti, fatte di informatica, di reti di sensori, di applicazioni mobili, ecc. Per la loro elevata diffusione ed accessibilità queste tecnologie influenzeranno l'alfabetizzazione scientifica e la partecipazione dei cittadini assai più di quanto fecero gli strumenti storici. La forma dell'acqua è oggi disponibile su ogni cellulare: mappe, livelli e dati ambientali sono online, ma la giusta chiave di lettura ha radici anche nel passato.

Stati alternativi di ecosistemi marini in Mediterraneo: effetti sulla meiofauna

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Nell'infralitorale roccioso del Mediterraneo, la pesca eccessiva, favorendo in alcuni casi l'esplosione demografica dei ricci di mare, può provocare la transizione repentina da ecosistemi complessi dominati da macroalghe a tallo eretto (EMA) ad ecosistemi più semplici dominati da alghe incrostanti (ECA). La meiofauna riveste un ruolo ecologico importante nella maggior parte degli ecosistemi marini bentonici di fondo mobile. Al contrario, le informazioni circa abbondanza e biodiversità della meiofauna nell'infralitorale roccioso, sia esso dominato da alghe a tallo eretto o da alghe incrostanti, sono assai ridotte. Abbiamo ipotizzato che, come già osservato per le componenti bentoniche più grandi, la transizione repentina da sistemi EMA a sistemi ECA possa avere effetti significativi anche sulla meiofauna. In particolare, abbiamo analizzato le differenze nella densità e composizione delle comunità meiobentoniche, con particolare riferimento alla biodiversità dei nematodi, tra sistemi EMA ed ECA in sei differenti aree (Minorca, Sardegna, Capraia, Sicilia, Croazia e Montenegro), sparse nei bacini del Mediterraneo N Occidentale, Tirreno meridionale, e Adriatico. In tutte le aree oggetto di studio l'abbondanza e la biomassa della meiofauna, così come la ricchezza specifica dei nematodi nei sistemi ECA sono risultate significativamente inferiori a quelli osservati nei sistemi EMA. Anche la composizione delle comunità di meiofauna e di nematodi differiva tra i due tipi di ecosistemi, con valori di β-diversità tra ecosistemi in ciascuna area di campionamento sempre maggiori di quelli tra aree di campionamento per ciascun tipo di ecosistema. I risultati di questo studio comparativo indicano che la transizione da ecosistemi EMA ad ecosistemi ECA può avere effetti notevoli anche sulla meiofauna e in particolare sui nematodi, senza significative differenze tra differenti aree del Mediterraneo. Questi risultati evidenziano la necessità di aumentare la sorveglianza delle coste vulnerabili a questa sempre più ricorrente transizione tra i due tipi di ecosistemi considerati.

A macro-ecological approach to the study of the vulnerability of aquatic environments to non-indigenous species: a case study by the Virtual Research Infrastructure LifeWatch Italy

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LifeWatch, the European Virtual Biodiversity Research Infrastructure, is a reference point for researchers, policy makers, public authorities and enterprises operating in the field of protection, management and the sustainable use of biodiversity and ecosystems.

LifeWatch Italy has proposed a European-level case study designed to assess the vulnerability of aquatic and terrestrial ecosystems to the arrival of non-indigenous species (NIS), in order to demonstrate the functionality of the e-infrastructure and its potential. Here we present the results of a first analysis conducted, on a national scale, on NIS presence in various typologies of aquatic environments (freshwater, transitional and marine), aimed at verifying the link between vulnerability to NIS and human activities.

Each of these environments is diversely affected by the NIS problem, which is of great interest both at national and international level, showing different rates of biodiversity alteration. To understand the mechanisms that cause the NIS success and to find adequate means of prevention, the LifeWatch community proposes a macro-ecological approach. It analyzes the drivers of NIS occurrence and the role played by climate change in facilitating their spread, so as to provide solutions that will lead to their reduction by applying effective measures for biodiversity conservation. The data used refer to a 30-year time span and include several taxonomic groups. All analyses were performed using dedicated R packages, which are one of the services provided by LifeWatch on the web.

Relations between flow regime and benthic macroinvertebrate communities in the lower section of the Trebbia River

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Climate changes and local pressures, e.g. water abstraction, damming sand and gravel dredging have greatly altered the river flow, especially at mid latitudes and in Mediterranean regions. Here, the shift from permanent to intermittent flow conditions is becoming more frequent, which are serious threats especially for macrozoobenthic communities. There are evidences that the benthic fauna of naturally intermittent environments has developed adaptations to changes and variability in terms either of resistance and resilience. By contrast, benthic communities of perennial sites are not prepared to face this regime shift.

This study aims at evaluating the consequences of flow reduction on invertebrate community in the Trebbia River (Po River Basin, Northern Italy), which is becoming more intermittent. We assessed the variations of species richness and abundance and changes in community structure with a focus on the partitioning of ß-diversity (nestedness and turnover) and variations of biological and ecological traits. We worked at two stations in the Trebbia River, upstream and downstream a cross barrier for water withdrawal.

We observed a significant difference between stations, both in terms of richness and abundance and community structure, but similar temporal trends. This means that the interaction between discharge and species richness and abundance was not statistically significant. These two findings could be due to i) intrinsic differences between the stations in terms of microhabitat; ii) an adaptation to disturbance of the downstream community; iii) a failure to reach the threshold of disturbance; iv) disturbance threshold reached for a too short period.

Further studies will investigate the effect of summer drought on benthic communities, throughout the comparison of the same order rivers and river reaches.

Single culture and co-culture of two *Synechococcus* phylotypes respond differently to nanoflagellate grazing

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Cyanobacteria belonging to the genus *Synechococcus* are found in lake waters typically as planktonic single cells and monospecific microcolonies. In oligotrophic lakes, single cells dominate in spring, while microcolonies are mostly found in late summer-autumn when the large colonial cyanobacteria increase in number. Since grazing activity is known as one of the major factors inducing microbial phenotypical changes, the formation of *Synechococcus* microcolonies was proposed as an efficient defence strategy against size-selective predators. To better understand this ecological interaction, we explored the effect of grazing by the mixotrophic nanoflagellate *Poteriochromonas* sp. on the aggregation of two freshwater *Synechococcus* strains belonging to different phylogenetic clades (phycoerythrin-rich cells, PE, Group A; phycocyanin-rich cells, PC, Group I). During four days of incubation, we followed the dynamics of single-cells, microcolonies, and flagellates in semi-continuous cultures under different treatments (single culture and co-culture, with and without predators) by flow cytometry, epifluorescence microscopy and PhytoPAM. In single culture with the addition of *Poteriochromonas*, we observed the formation of grazing-induced monoclonal PE microcolonies, conversely limited in PC. In co-culture, there was an interaction between PE and PC, with an active microcolony formation by both PE and PC, and an increase of PC photosynthetic fitness (Fv/Fm). In co-culture, the microenvironment, generated by the formation of PE microcolonies, PC cells, bacteria and *Poteriochromonas*, can be the site of a beneficial "communication signalling" among *Synechococcus* cells for attaining the best spatial distribution for the fitness of the group.

Distribution patterns and toxic potential of *Dolichospermum lemmermannii* (Cyanobacteria) in European water bodies

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The presence of *Dolichospermum lemmermannii* (Nostocales) in Central and Northern Europe is well documented. Albeit this species is typical of cold environments, it is characterised by high variability to temperature adaptation as well. Some populations of *D. lemmermannii* show high temperature optima (i.e. between 19°C and 26°C) and have the capability to form huge water blooms in summer stratified conditions and during calm weather. In Southern Europe, a case of recent colonisation is represented by the spread of this species to the large and deep lakes south of the Alps (namely, lakes Garda, Iseo, Como and Maggiore). *Dolichospermum* appeared for the first time in Lake Garda at the beginning of the 1990s with extended blooms between July and September. Afterwards it appeared in lakes Iseo (second half of the 1990s), Maggiore (2005), and Como (2006). The spread highlighted the ecological heterogeneity of *D. lemmermannii*, possibly suggesting the existence of different ecotypes adapted to different European climatic regions. In this work, we report the preliminary results of a wide research carried out on populations isolated from different European waterbodies. The analyses are based on taxonomical, genetic and metabolomic determinations carried out on isolated strain cultures. A phylogenetic study on the 16S rRNA and housekeeping genes (e.g. *rpoB*,) was integrated by the assessment of the toxic potential, evaluating the presence of cyanotoxins (*i.e.* microcystins, nodularins, anatoxins, cylindrospermopsins) and cyanotoxins encoding genes. Further studies will allow gaining insight about the phylogeography of this fast spreading species at a continental level, along climatic and trophic gradients.

Partecipa al concorso per la miglior presentazione orale/miglior poster

Prokaryotic diversity and metabolism in deep Arctic waters

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The dark portion of the ocean represents the largest set of ecosystems in the planet. However, our comprehension of the processes occurring in the water column below the photic zone is still controversial, since estimated vertical fluxes of organic matter are not sufficient to meet the energy demand of microbes. Such discrepancy has been partially resolved by the discovery of non sinking particulate matter loads, and of relatively fast dissolved inorganic carbon (DIC) fixation rates by prokaryotes. In order to understand the ecosystem functioning in the deep Barents Sea, a set of ten incubation experiments was performed in two coast-offshore transects off Svalbard Islands in the boreal summer 2014. Five experiments were carried out collecting samples from the mesopelagic in Atlantic Waters (AW) and five from the bathypelagic in Norwegian Sea Deep Waters (NSDW). During each experiment we measured community respiration, heterotrophic carbon production (HCP), primary production (DIC uptake – measured in the particulate and in the dissolved fractions) together with the abundance and diversity of planktonic prokaryotes (estimated by next generation sequencing of the 16S rRNA gene). Heterotrophic processes (respiration and HCP) were significantly faster in AW than in NSDW. On the contrary, particulate primary production did not show different rates in the two water masses. Dissolved primary production was not detectable in most experiments. In 9 experiments out of 10, the uptake of organic carbon was higher than its inorganic counterpart, suggesting a general reliance on heterotrophic metabolism. Prokaryotic community structure was generally water-mass specific. The only station located in the continental shelf (200m) showed a unique type of assemblage. No correlation between the relative abundance of *Thaumarchaeota* and DIC fixation was found.

Phytoplankton response to reduced river inputs and anomalous physical conditions at a costal site in the Gulf of Trieste (northern Adriatic Sea)

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Phytoplankton community composition and production (PP) were studied from March 2006 to March 2007 and related to the discharge of the River Isonzo, the main freshwater input in the Gulf of Trieste. Water samples were collected at four depths in a coastal site to determine the nanoplankton abundance and microphytoplankton diversity and abundance. Concomitantly, inorganic C assimilation of the total phytoplankton was estimated in situ using the 14C method and, from June to November 2006, the contribution of the nanoplanktonic fraction (2-20 µm) was also estimated. Monthly mean Isonzo inputs were much lower than the climatological (1998-2005) mean data and the typical autumn peak did not occur with consequent high salinity from May to November (up to +1.26 than the climatological data). Monthly mean temperatures were lower than the climatological values (-2.95 °C at the surface) from March to August 2006 and higher (+2.15 °C at the surface) from September to February 2007. Phytoplankton community was dominated by the nanophytoplanktonic fraction (on average about 2.0 x 10^6 cells L^{-1}), with higher abundance in spring and late summer. Microphytoplankton was dominated by diatoms (81% of the total microphytoplankton) and showed a mean abundance of 2.0 x 10^5 cells L^{-1} with a peak in May mainly due to species belonging to *Chaetoceros* genus and *Pseudo-nitzschia delicatissima* group. PP reached 7.11 ± 1.01 µgC L^{-1} h^{-1} in November at the surface and showed relative maxima in June and July with 5.28 ± 0.43 and 5.80 ± 0.64 µg L-1 h-1, respectively. The nanophytoplankton was responsible for about one third of the total PP. Interestingly, the maximum PP rate estimated in November did not correspond to either a bloom of microphytoplankton or nanophytoplankton, but was likely due to the high abundance of Cyanobacteria (> 1.0 x 10^7 cells L^{-1}) measured in that month.

Distribution and origin of *Thaumarchaea* in the deep hypolimnion of Lake Maggiore

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Thaumarchaea represents one of the most abundant groups of Archaea on Earth, being found in a variety of environments including soils, oceans, and freshwaters. Ammonia-oxidizing *Thaumarchaea* (AOA) significantly contribute to the global nitrogen and carbon cycle through chemolithoautotrophic oxidation of reduced nitrogen compounds. Their distribution of in freshwaters is still far less known than in marine and terrestrial environments. In this study, we analyzed the diversity and relative abundance of AOA in the deepest layers of the oligotrophic Lake Maggiore, confirming previous published results of AOA presence and showing spatial but no seasonal trends with respect to Bacteria. A high resolution at the *Thaumarchaea* community level was reached with the probe MGI-535 specifically designed in this study and applied for CARD-FISH analysis. Furthermore, phylogenetic analysis of AOA clone libraries from deep lake water and from the lake tributary, River Maggia, suggested the riverine origin of AOA of the deep hypolimnion of the lake.

Food web structure of swimmers collected in sediment traps in the Bari canyon and the adjacent slope: possible effects of dense shelf water cascading

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Food web structure of the swimmer fauna collected in sediment traps in the Bari canyon and the adjacent slope of the Southern Adriatic Sea was investigated using carbon and nitrogen stable isotope tracers on a total of 20 taxa. Overall, samples were collected from three sites within the Bari canyon and on the adjacent slope between 600 and 1200 m depth, from March to November 2012. Mean δ13C values ranged from –22.3‰ (the copepod Euchaeta sp.) to –17.5‰ in hyperiids. Values of δ15N ranged from 2.6‰ in hyperiids to 9.9‰ (the copepod Heterorabdus sp.). The stable isotope ratios of this fauna displayed a continuum of values over the δ15N range of 7‰, confirming a wide spectrum of feeding strategies (from filter feeders to predators). Seasonal variations were found possibly attributed to the cascading event, which occurred in the area in February-March with strong inter-annual variations. A clear delay between the occurrence of the cascading event and the incorporation in the isotopic composition of swimmer fauna was evident. Indeed, correlation between δ13C–δ15N was quite strong and significant during the cascading event indicating that the community relied on a principal food source (i.e. the marine snow). Conversely, δ13C–δ15N correlation was weak and not significant just after the cascading event, likely attributable to consumption of different kinds of sinking particles of different origin (marine vs. terrestrial). Multivariate linear models with available environmental variables and possible food inputs helped in explaining the observed patterns.

Foam formation in lakes: a long term analysis conducted on Lake Maggiore (northern Italy)

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The causes and origin of foams in lakes have been rarely object of studies, although this phenomenon may cause problems to touristic or fisheries activities and imply a possible risk to human health. The formation of foams in the aquatic environment is due to the accumulation of surface-active compounds (surfactants) at the air-water interface joined with the mechanic action of a forcing (such as wind or waves) able to inject gas bubbles in the upper water layer. Surfactants can be either of natural or synthetic origin. Fulvic or humic acids, lipidic, proteic or colloidal substances are examples of natural surfactants that can promote foam formation, while man-made foams are generally due to the release of phosphates from agriculture and/or to the presence of organic and inorganic detergents. A comprehensive analysis of three foam episodes in Lake Maggiore (2007, 2008 and 2010) has been undertaken to identify their origin, causes and to unravel most likely factors triggering foam formation. At this scope, a long term (2000-2013) analysis of phytoplankton biovolumes and meteorological and hydrological anomalies has been performed together with the chemical characterization of foams. Foam resulted of endogenous origin, related to phytoplankton biomass degradation. The long term analysis highlighted atypical warm temperatures and residual lake stratification in winter in two of the years of foam events, coupled with exceptional Bacillariophyceae blooms in spring. *Tabellaria flocculosa* mostly contributed in terms of biomass in 2007 and 2008, but not in 2010, and overall total algal biomass seemed a better predictor of the risk of foam formation. Foam events occurred from July to December, driven by atypically high windy conditions, and congruently with the time needed to degrade biomass into surfactant compounds. A co-occurrence of different factors resulted essential to generate foams, and climate changes likely contributed to enhance their occurrence in Lake Maggiore.

Antibiotics and pathogens, when the natural bacterial community resists!

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The spread and persistence of antibiotic resistances (AR) in waters is a major threat for the environmental management, with direct risks for human health. Although antibiotic resistant bacteria (ARB) are found everywhere, their ecological success is related to anthropic impact, and to disturbed natural communities. In the same waters where AR can be a problem, other disturbances promoted by human activities can interfere with natural communities, e.g. the input of allochthonous (and potentially pathogenic) bacteria. The concomitant impact of those disturbances can have dramatic effects on the persistence and resistance of natural communities. With an experimental system on continuous cultures, we tested the impact on the microbial community from anthropized Lake Maggiore of enhanced tetracycline concentrations and of a subsequent invasion by a mixed population of *E. coli*. We measured the response in terms of bacterial and eukaryotic abundances, phenotypical distribution, bacterial community composition, spread and persistence of tetracycline resistance genes, and the fate of *E. coli* strains, by applying a number of techniques including flow-cytometry, microscopy, qPCR, and Illumina sequencing. We observed the preservation of AR genes, even when antibiotics were not in the system, suggesting a relatively small cost of maintenance of these genes, or their involvement in other genetic pathways. However, we did not see a general increase of e.g. *tet*A resistance genes, following the addition of antibiotics. In fact, it rather seemed that resistance to tetracycline was rather acquired by morphological changes and species interactions; we observed many more aggregated cells when the antibiotic was added. On the other hand, the invasion with *E.coli* seemed to generally promote the overall productivity of the systems without and with little antibiotic. Our results demonstrate that despite the heavy disturbance the natural microbial communities can develop a number of mechanisms of resistance in order to reduce the impact (e.g. aggregation), complicating the system modelling, thus reducing our forecasting possibilities.

Zooming in the small world: quantifying food-web interactions unveils the link between biological diversity and functioning in plankton communities

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Plankton is a small world, whose microscopic players draw hidden plots, following elusive rules. Plankton is a hugely (functionally) diverse community deeply entangled in food-webs and biogeochemical cycles. Trampled between the availability of inorganic nutrients boosting up primary production and the predation exerted by nekton (i.e. 'bottom-up' and 'top-down' controls), plankton has historically been considered a 'passive' transducer of organic matter to higher trophic levels (e.g. fishes). As a consequence, the plethora of trophic processes reported among plankton organisms (i.e. the real plankton food-web) attracted a very small attention from both biogeochemical and fishery modelers. Herein, we describe the role of species and functional diversity in driving the functioning of a plankton community (e.g. the amount and the pathways of biomass transfer to higher trophic levels) by analysing the modifications induced in the food-web structure by significant biogeochemical processes, e.g., the occurrence of phytoplankton blooms. To this aim, based on real biomass data and experimentally-derived trophic relations, we constructed a model reproducing a virtually complete plankton community (from bacteria to chaetognats). We demonstrated that the all food-web is not 'passive' but re-organizes based on the shift in primary producers' biomass by adopting distinct biomass-flux patterns at bloom and non-bloom states of the system. Such a 'collective behaviour', stemming from species' trophic plasticity and played at community level, enabled the system to gain a comparable energetic sustainability, despite changes in primary producers. In synthesis, plankton food-web showed a configuration typical for 'small-world' networks - i.e. highly clustered networks with small path lengths linking nodes in a non-casual manner. In such networks, few nodes play as 'hubs of connection' and can promote the shift in organization of the network itself. Herein, we show that plankton is not only a small world, but indeed a 'small-world' that follows causative rules.

Temporal variability of total mass fluxes in Kongfjorden (Svalbard) as driven by glacier melting and enhanced coastal erosion

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Over the last 2-3 decades, the Arctic area has experienced more warming than any other region on Earth. This Arctic amplification may be due to feedback mechanisms from loss of sea ice or changes in atmospheric and oceanic circulation. Kongsfjorden is a small fiord at 79° N; 26 km long, 6-14 km wide, extended in SE-NW direction in the western part of Svalbard Islands. All glaciers reaching the Kongsfjorden are rapidly retreating. For example over the last 60 years the glacier front of the glaciers Kronebreen, Kongsvegen and Kongsbreen deceded ~6 km. There is ample evidence that land-to-ocean fluxes of particulate material along the Arctic coasts are changing, too. Recent studies suggest that the increase of the hydrologic regime observed in the last decades is mainly the consequence of recent climate warming and closely related to changes in permafrost conditions. To verify the temporal variability of particle fluxes and composition on long time-scale and monitoring variations of thermohaline characteristics, an instrumented mooring, equipped with an automatic sediment trap, a temperature and salinity recorder and two current meters, was deployed in September 2010 in the inner fjord at ~100m water depth. The first 4 years of the total mass fluxes are here presented and the mass flux trend is discussed. The mass amount varied from year to year by a factor 5 according to the seasons. The highest peaks were recorded in summer months (in particular during the summer 2013 it reached ~330 g m^{-2} day^{-1}), followed by reduced fluxes during winters. The temporal variability of mooring data will be discussed concurrently with sea ice cover, rain precipitation (as a runoff proxy) and chlorophyll-a concentration data (as a proxy of autochthonous marine organic matter contribution) in order to elucidate the main processes involved in the particle sedimentation in the inner Kongsfjorden.

Lake water as reservoir of antibiotic resistance genes constitutively present within the natural microbial community

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The fate of antibiotic resistance genes (ARGs) in environmental microbial community is largely unknown although ARGs can constitute a threat for human health. In order to understand the dynamics and the relations of ARGs with biotic and abiotic factors in aquatic environment, we sampled water for 1.5 year in four stations of Lake Maggiore; for one of them (Ghiffa), we also sampled water from the whole water column. Moreover, for Ghiffa station, limnological parameters and prokaryotic cell abundance were determined. Each water sample was filtered and processed for the presence of twelve ARGs by PCR and, for the positive ARGs, qPCR protocols were developed. In order to investigate the relations between ARGs profiles and microbial community composition, we also sampled water every day for one week in Pallanza station. The DNA recovered during both the 18 months' (long term) and the week (short term) monitoring were analyzed for the presence and abundance of ARGs and for the microbial community composition by 16SrDNA Illumina sequencing. Four ARGs were detectable in all stations during the whole sampling campaign, for instance tet(A) and sulII genes resulted quantifiable in more than half of the samples, and their abundance was positively correlated to oxygen and negatively to chlorophyll a, while str(B) and blaCTXM were present but rarely quantifiable. The composition of the microbial community was stable during the week while a seasonality was observed during 1.5 year of analysis. Moreover a potential relation between the presence of blaCTXM and the abundance of Flavobacteria was observed. All together, these results suggest the Lake as reservoir of ARGs fixed within the natural microbial community, thus it can constitute a hazardous hotspot for the transmission of antibiotic resistance to human pathogens.

Zooplankton as refuge for invading bacteria

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It has long been known that zooplankton species, such as daphnids and rotifers, are populated with bacterial epibionts. Nonetheless, studies on the impact of non-parasitic bacteria are still scarce. In this study we analysed the consequences of this colonisation on the distribution of potentially pathogenic and antibiotic resistant bacteria in freshwater systems. This is based on the hypothesis that potential pathogens have a selective advantage when growing in biofilms, as has been shown in clinical settings. Thus we postulate that attaching to animals might allow potential pathogens, e.g. deriving from the efflux of a waste water treatment plant (WWTP), to survive in freshwaters. Additionally the movement of the animal transports the bacteria away from the point-contamination to more pristine waters.

We experimentally show that, if added to a natural bacterial community, *Escherichia coli* attaches to daphnids and derives particularly well in the gut of the animals, where they naturally do not form part of their microflora, whilst decreasing in abundance in the surrounding water. Moreover, the presence of daphnids decreased the abundance of a tetracycline resistance gene (*tet*A) in the surrounding water, whilst a higher number of *tet*A gene copies were detected in the animals. In addition we tested whether zooplankton species form a surface for the horizontal gene transfer, of e.g. antibiotic resistant genes, from one *E. coli* strain to another. In order to expand our hypothesis to natural environment we sampled Lake Maggiore at three points with increasing distance to an inflow of a WWTP and compared the microbial community on various zooplankton species as well as on stones and in the sediment. Whereas similar relationships have been described in marine systems, e.g. *Vibrio cholera* and Copepods, this is the first study that confronts the potential role of zooplankton in the spread of potential pathogens in freshwater systems.

Cryptic species in the zooplankton hindering our understanding of ecological processes

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Species identification for most ecological and applied purposes (e.g. biological monitoring, environmental assessment, etc.) is performed through the analysis of morphological features of the organisms collected in the wild and sorted individually. There are growing evidences that several complexes of cryptic species (i.e. species that cannot be identified from morphology) exist in the zooplankton, and that different cryptic species within a single morphological species may respond differently to environmental drivers, because they represent different evolutionary entities with different ecological adaptations. Such differences can represent serious hindrances to our understanding of biological drivers and correlates of biodiversity if the species complexes are not solved. I will report few examples from on-going analyses on aquatic and limno-terrestrial rotifers to support such scenario and provide suggestions on how molecular tools could provide useful avenues to get pass such impasse.

Detecting natural and anthropogenic trends of Po River loads in the North Adriatic: the importance of data mining and time series analysis

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The load of freshwater and chemical compounds by the rivers have a pivotal role on most of physical, chemical, biological and geological characteristics of N Adriatic ecosystem, being this area a shallow continental shelf receiving one of the largest runoff of Mediterranean. In particular, Po River constitutes the most important source of freshwater, organic and suspended matter and nutrients in this region, with averaged discharges of 45 km^3/y of freshwater, 164 kt-N/y of TN, 8 kt-P/y of TP, 140 kt-Si/y of SiO_2, 205 kt-C/y of TOC and 3920 kt/y of TSM, during the recent period 1995-2012.

During the last decade, a growing number of scientific studies has pointed out the importance of the oscillations of river loads as a factor regulating the long term evolution of productivity and of eutrophication problems and dystrophic events in this marine region. This finding has made outdated the view of river inputs as a stationary (i.e. climatological) component of this marine ecosystem. These oscillations originate by a complex interaction between natural trends, mainly induced by the climate, and development of human activities and they act over temporal scales from seasons to millennia. However, the oscillations of river loads in the Adriatic are not yet adequately analyzed, even in the last century, due to the difficulty of data mining, the incompleteness of time series and the dispersion of the competences on monitoring activities among different institutions.

The aim of this study is to provide an updated analysis of Po river load in the Adriatic, in order to better highlight its oscillations and effects in the marine ecosystem. River water flows in 1917-2012 and nutrient concentration in freshwater in 1988-2012 were reanalyzed, paying a special attention on the past and present problems that affect these data series and limit their utilization for the environmental research.

Dense water evolution in the Adriatic pits during 2013-14: physical and biogeochemical properties

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Three oceanographic cruises were conducted in the framework of the Perseus Project (Mar. 2013, Feb. and Oct. 2014). They testify the time-space evolution of the hydrographic and biogeochemical properties in the Middle (MAP) and Southern Adriatic Pit (SAP) after 2012, when extremely dense waters were formed in the northern Adriatic Sea. After that cold outbreak, the deepest MAP (220-260 m) was filled with dense, cold, and fresh waters (29.79 kg/m^3, 10.00 °C and 38.63). Observations conducted in 2013 showed a significant warming and salinification of the deepest waters. Simultaneously, density and dissolved oxygen decreased. Moreover, nutrients markedly increased during 2013 and 2014. We consider that both, partial mixing with the overlaying intermediate waters and remineralization, were acting in the MAP. The deepest SAP (1000-1200 m), topographically isolated from the MAP (by the Palagruža sill at 160 m) and from the Northern Ionian (by the Otranto Sill at 800 m), was filled with waters of ~29.30 kg/m3 in 2012. In March 2013, salinity was minimal (38.71), while the slight warming induced the small density decrease. Measurements conducted in 2014 indicate that the thermohaline properties fluctuated within 13.07-13.13 °C and 38.72-38.73, almost as those in 2013. An increase of nutrients (nitrate and silicates) has also been observed between the winters 2013 and 2014.

Both AOU (Apparent Oxygen Utilization) and nutrients of dense waters were higher in the MAP than in the SAP. Therefore, we assume that remineralization, but also mixing are more efficient in the MAP than in the SAP. The intermediate layers, instead, were more oxygenated than the deepest ones in both areas. Considering that since 2012 there was no ample recent dense water formed/advected to ventilate the deep troughs of the MAP and SAP, the remineralization and mixing rates of the deep waters will be assessed for the two areas.

Effects of CO_2 leakage on chemical species mobilization from marine sediments

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The injection and storage of CO_2 into marine geological formations has been suggested to meet carbon emission reduction targets. However, storage leaks could be possible resulting in several effects in the ecosystem. Laboratory experiments were conducted to study the possible mobilization of chemical species (nutrients, trace metals) from marine sediments due to a CO_2 leak. About 10 cm of surface sediments were placed in nine separate aquarium (≅ 200 L) and covered with 40 cm of sea water. Three were used for control, in three the neutral gas helium was bubbled through the sediments to determine any physical effects, and in three CO_2 was bubbled to look at acidification effects. The experiments were conducted over a three week injection period with 12 hours light and 12 hours dark each day. Results clearly show the impact of the leaking CO_2 gas on the chemistry of the overlying seawater in comparison to the almost identical behaviour of the control and He gas results. The lack of difference between these latter two indicates that the mechanical mixing or oxygen stripping induced by bubbling had little or no influence on the results, and that changes observed in the CO_2 tanks are strictly due to acidification. In terms of nutrients, silica rose during the entire injection phase due to mineral dissolution. Both major and trace elements can be divided into two main groups. The first shows an initial increase after the start of injection followed a few days later by a decrease. The second shows a relative steady increase during the entire CO_2 injection period. The increase of Mn is particularly strong due likely to the solubilisation of phases as manganite and rhodochrosite to Mn^{2+} under acidic conditions followed by re-precipitation and return to low background dissolved concentrations three weeks after injection was stopped.

Partecipa al concorso per la miglior presentazione orale/miglior poster

The history of Lake Maggiore industrial pollution traced through lake sediment and long term monitoring of the biota

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In Lake Maggiore large watershed (*ca.* 6,600 sq. km), industrial activities along the XX century led to the discharge into the lake or its tributaries of several pollutants, such as DDT, PCBs and mercury.

Other pollutants, such as PAHs and flame retardants (such as PBDEs) are still reaching the lake.

Analyses of some of these pollutants in lake biota were performed continuously since 1998 and form a unique time series.

We used in parallel lake sediment cores to infer the history of lake contamination, and analyses of biological samples to describe the distribution of these pollutants in the lake food web and its year-to-year variability.

Furthermore, analysis of the sediment of the main rivers flowing towards Lake Maggiore was used to get information on present sources of pollution.

Results also show that legacy pollutants, which are no more used nor produced, still reach the lake from polluted soils located around the industrial sites, in particular during heavy rainfall. In particular, we paid special attention to Hg and to DDT and its metabolites, because of the presence of a large pollution source close to the River Toce, one of the main inlets of Lake Maggiore.

Although DDT production ended in 1996, p,p'-DDT is still found in river sediment and in molluscs collected in Lake Maggiore, deriving probably from polluted soils. On the contrary, p,p'-DDE prevails in fish tissues, zooplankton and molluscs.

Finally, high values of the concentration of some pollutants in the sediment of Lake Maggiore outlet (River Ticino) show that the lake does not act as a perfect sink for these compounds.

Considering present day pollution, PAHs derive from diffuse sources and are found in the sediment of all tributaries, while PBDEs where found only in the sediment of two inlets, revealing the presence of active point sources.

Rise and fall of modern deltas

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Understanding the life cycle of delta systems is crucial for disentangling the role of natural processes and anthropic forcing in building modern coastal zones, an open issue that bears substantial implications on our full awareness on the management of the entire coastal zone. The review of geochronological and historical data documents that the bulk of the four largest northern Mediterranean and Black Sea deltas (Ebro, Rhone, Po and Danube), as other smaller systems (Ombrone, Arno), formed during two short and synchronous intervals of enhanced, human-driven, sediment supply. The first progradational phase reflected the rise of the Roman Empire, when the spread of agricultural activities and forest clearance led to a substantial increase in soil erosion and, consequently, sediment discharge from rivers. Since the Barbarian invasions, the fall of the Roman Empire favoured a new afforestation phase that reduced soil erosion and the outbuilding of Mediterranean deltas. Since the 1650 yr AD, a combination of human population growth and climatic instability led to important land-use change that triggered a fast increase in sediment production, sustaining the last, and major, progradational phase of all southern European deltas.

Since the industrial revolution, and particularly during the last 50 years, the engineering of river channels through river dams, channel diversions and artificial levees, overkilled the still increasing sediment production in catchment basins, leading to a dramatic decrease in the supply of coarse-grained material to the coasts; delta systems become, therefore, more vulnerable to the action of marine processes, as reflected by a generalized phase of delta erosion and retreat.

Diatoms and Cladocera reponses to secular environmental changes in Lake Garda.

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Lake Garda (368 km^2) represents a key environment resource in northern Italy for biodiversity, tourism, drinking water supply and irrigation. The evaluation of the lake vulnerability to human stressors within the current climate change emerges as a stringent necessity Paleoecological methods were used to understand ecosystem changes in Lake Garda at secular scale. Two short sediment cores were collected from the deepest point of the main (350 m) and shallower (81 m) basins. Radiometric dating indicates an age of ~700 years for both the cores. Analysis of the diatom assemblage indicated very stable oligotrophic conditions until the 1960's, followed by a rapid inccrease in mesotrophic pennate colony–forming Fragilariaceae at the expense of *Cyclotella comensis*, essentially as a result of moderate nutrient enrichment. In order to integrate diatom results and compare long term changes in the pelagic and in the littoral zone of Lake Garda, the two deep cores and an additional littoral core (30 m depth) of the shallower basin were analysed for cladocera remains. The three cores showed comparable temporal trends. Until the 1960s, in the lower core sections they presented a great variety of species and the dominance of *Alona* sp. and *Acroperus harpae* , while *Daphnia* sp. and *Bosmina* sp. were the most abundant taxa in the upper sections. A non-metric multidimensional scaling (NMDS) was performed for each core to identify patterns in the temporal evolution of sub-fossil diatom assemblages and cladocera remains, separately. To investigate the influence of different limnological and sediment-inferred factors on the cladocera community composition, a vector fitting analysis was applied to the sample scores on the NMDS configuration. The study confirms the strength of the multi-proxy paleoecological approach in complementing and interpreting limnological investigations and ecological changes at secular scale.

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An Introduction to the Project BLASCO - Blending LAboratory and Satellite techniques for detecting CyanObacteria

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Algal blooms can have an impact on health care costs, on the costs associated with the treatment of water intended for human consumption and on the tourism industry. The implementation of early warning systems would reduce these costs and the efforts needed to face and control the harmful effects of an algal bloom. A system for monitoring the quality of the waters, which operates on a large scale and at high frequency, would allow to keep under control the evolution of a bloom. The observation by satellite allows such a monitoring: in particular, the project is focused on the development of techniques for the analysis of satellite images, in order to detect the specific phytoplankton species potentially responsible for bloom formation in lakes. To reach this goal, it is necessary to analyse the spectral response characteristic of cyanobacteria and to develop algorithms to be applied to the analysis of satellite images. New calibration algorithms for the interpretation of satellite images will be obtained in lab experiments, using algal cultures. The developed algorithms will be tested through the analysis of remote sensing images, with particular attention to the bloom events occurring in the lakes of Lombardy and Piedmont. Field data on water optical properties and phytoplankton samples will be also collected. Moreover, different approaches will be applied and compared to quantify the amount of cyanobacteria (HPLC, counting, in vivo fluorimetry, spectroradiometry). Among the main results there will be the creation of a dataset of spectral signatures of some cyanobacteria taxa, as well as the development of calibration curves for the qualitative and quantitative estimation of the blooms. In general, we expect that it will be possible to distinguish, in natural conditions, the spectral signatures of cyanobacteria, even at low concentrations and within mixed populations of phytoplankton.

A century of limnological research in the Historical Archive of the CNR ISE

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Since 2010, the Historical Archive of the Italian Institute of Ecosystem Studies has been subject to an extensive re-arrangement and improvement program. The Archive contains original documents (such as letters, administrative documents, notarial deeds, drawings and prints, photographic plates, photographs) recording the scientific and administrative activities from the foundation of the Institute (1938) till its annexation to the Italian National Research Council (1977). Furthermore, it hosts some material documenting studies that were conducted in the first decades of the XIX Century, mainly by Marco De Marchi (1872-1936), a pioneer of limnology in Italy, and Edgardo Baldi (1899-1951), the first director of the Institute. This collection is a cornerstone of more than a century of scientific research in limnology, which also benefitted from frequent international contacts with scientists and ecological associations. The reorganization of the material in the Historical Archive was planned in consultation with the Soprintendenza Archivistica of the Piedmont Region, which is the legal authority responsible for the public archives in the Piedmont Region. Beginning in 2012, the information contained in the Archive has been digitized using the software xDams, an open version software source of Regesta©. In 2014, part of the digitized material was made available on the web site: http://www.ise.cnr.it/archivio.

These activities were conducted thanks to the contribution of the Fondazione Cassa Risparmio di Torino and Fondazione Comunitaria VCO, which funded two temporary staff for the reorganisation of the Historical Archive, including the physical preservation and digitalisation of the documents. These activities are part of the CNR mission within the European Digital Agenda, and the CNR contribution to the development of scientific thought.

It's Our Choices: An educational project for promoting citizens' environmental awareness

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The speed at which we impact our Planet by overexploiting its resources is not sufficiently balanced by increased awareness among citizenship for the real extent of such impacts. Although scientific knowledge is progressively developing, it hardly reaches civil society playing influential roles in education and effectively addressing eco-friendly behaviors. However, to reach the global goal of sustainable use, well balanced distribution, and successful management of our resources, it is crucial that every generation and stakeholder take "greener" actions in their daily choices. This importance in particular should be addressed to women, who generally are more concerned about resource management in households, and young generations, who will have to carry the future of this Planet. Therefore, to disseminate the scientific facts about environmental issues in simple and catchy ways for anyone can enhance the involvement of bigger portion of citizens in making responsible choices for sustainable use of our resources.

With this aim in mind, we created and launched a website, "It's Our Choices" (www.itsourchoices.org), in order to inform the public about some urgent environmental risks and to encourage them to take actions. The website is mainly centered on Water issues, which is an essential resource for all the lives on this Planet, with five deriving themes represented in the corolla of a flower portrayed as the project's symbolic image; Food, Energy, Chemicals, Clothes & Goods, and Soap & Cosmetics. The website is also supposed to serve as an open arena to share arising suggestions and ideas to potentially be contributed by visitors, in parallel with its Facebook page (www.facebook.com/itsourchoices) where more open and immediate discussion are expected to take place.

Lead-resistant bacterial strains isolated from polluted sediments of Sarno River, Campania, Italy, perform lead absorbance/uptake by biofilm entrapment or nanoparticles production

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Lead (Pb) is one of the most diffused pollutants in the environment originating from industrial production or also natural sources. Pb is toxic at very low concentrations and is not known to be of any biological importance. Pb(II) toxicity arises as a result of changes in the conformation of nucleic acids and proteins, inhibition of enzyme activity, disruption of membrane functions and oxidative phosphorylation, as well as alterations of the osmotic balance. Despite its high toxicity, many microorganisms have evolved mechanisms to survive Pb exposure, including its export through different efflux systems, extra- and intracellular precipitation, adsorption on eso-polysaccharides, or binding to the cell wall. Two Pb(II)-resistant bacterial strains were isolated from the polluted sediments of the Sarno River, Italy, from enrichment cultures in the presence of 100 µg ml^{-1} Pb(II) added as $Pb(NO_3)_2$. The isolates (i.e. Pb15 and PbVIc) were able to grow in the presence of 500 and 800 µg ml^{-1} of Pb(II), respectively. Sequencing of the 16S rRNA gene assigned isolate Pb15 to the genus Bacillus, while taxonomical identification of the strain PbVIc is in progress. Pb presence was confirmed by chemical characterization by digesting pellets of the two strains at 60 °C in the presence of concentrated HNO3, and analyzing in order to quantify Pb concentration. Image study, carried out by SEM and TEM analyses pointed for strain Pb15 biofilm increased compactness at Pb concentrations up to 250 µg ml^{-1}, while a loss of compactness was induced by higher concentrations. Strain PbVIc images evidenced esocellular material entrapping Pb as nanoparticles of about 20 nm, transported into the cells and accumulating in the periplasmic area. These modes of Pb uptake point to different mechanisms of Pb uptake and suggest a potential use of the isolated strains for bioremediation of polluted coastal areas.

Distribution of *Escherichia coli* in a coastal lagoon (Venice, Italy): temporal patterns, genetic diversity and the role of tidal forcing

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Despite its worldwide importance as fecal indicator in aquatic systems, little is known about the spatio-temporal patterns and genetic diversity of *E. coli*, and the environmental factors driving its distribution. The city of Venice (Italy), lying at the forefront of a large European lagoon, is an ideal site to study the mechanisms driving the fate of fecal bacteria, due to the huge fluxes of tourists, the city's unique architecture (causing poor efficiency of sewages treatment), and the long branching network of canals crossing the city. We summarize the results of a multi-year investigation to study the temporal dynamics of *E. coli* around the city, describe the population structure (by assigning isolates to their phylogenetic group) and the genotypic diversity, and explore the role of environmental factors in determining its variability. *E. coli* abundance in water was highly variable, ranging from being undetectable up to 104 colony forming units (CFU) per 100 ml. Abundance did not display significant relationships with the water physico-chemical variables. The analysis of the population structure showed the presence of all known phylogroups, including extra-intestinal and potentially pathogenic ones. The genotypic diversity was very high, as likely consequence of the heterogeneous input of fecal bacteria from the city, and showed site-specific patterns. Intensive sampling during the tidal fluctuations highlighted the prominent role of tides, rather than environmental variables, as source of spatial variation, with more evident influence in water than sediments. These results, the first providing information on the genetic properties, spatial heterogeneity and influence of tides on *E. coli* populations around Venice, have implications to understand and manage the fecal pollution, and the associated waterborne disease risks, in this city, as well as in other cities similarly lying in front of coastal lagoons and semi-enclosed basins.

Mechanisms underlying recovery of zooplankton in Lake Orta after liming

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The goal of this study was to improve the understanding of the large-scale mechanisms underlying the recovery of the zooplankton of Lake Orta from historical contamination following the liming intervention (1989/90).). The pollution has been severe and long-lasting (1929-1990). Previous analysis of subfossil Cladocera remains and rotifer resting stages in sedimentary archives, coupled with long-term monitoring data of planktonic pelagic population has indicated both the extinction of many taxa than the attempt of recolonization by rotifers.

Our results highlighted that the most number of new taxa recorded by countings belonged to Rotifers, and that, Calanoids and big Cladocera predators (*Bythotrephes* and *Leptodora*) living in the nearby Lake Maggiore, 17 years after liming, were still absent. We assessed, also, the annual persistence of Crustacea and Rotifer taxa (P) as an estimator of whether introduced propagules that survived, also thrived. We found that the rate of introduction of zooplankton colonists and their persistence in the water column of Lake Orta have changed over time (1971-2007). New rotifers taxa attempted to colonize the lake after middle '80, when the discharge of toxic substances decreased, but their persistence was low ($P < 0.5$) until the beginning of 2000s. The unexpected high values of Crustacea persistence recorded in Lake Orta in 2001 and 2007, in comparison to other environments (Sudbury lakes), could be related to the lack of zooplanktivorous fish in the pelagic waters.

Unravelling short-term responses of deep continental margin ecosystems to episodic events

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Continental margins are sites of intense exchange of energy and material between the continental shelves and the deep basins, and, as such play a key role in global biogeochemical cycles. Information on temporal changes of the biodiversity and functioning of deep continental margins are still scarce. To provide insights about the scale of temporal variations and resilience of deep continental margins after episodic climate events at the sea surface, we have analysed comparatively the trajectories and timing of ecosystem change in the Cretan, Catalan and Arctic margins, after episodes of dense shelf water cascading (Cretan and Catalan margins) or current anomalies over the continental shelf (Arctic margin). In all areas, irrespectively of the type of anomaly at the sea surface, we observed significant changes in the quantity, biochemical composition and bioavailability of sedimentary organic matter, whereas the effects of episodic events on the benthic (meiofauna) biodiversity varied among areas depending on the oceanographic mechanism involved and the strength and duration of resulting deep-sea environmental conditions. As current climate change is increasingly influencing the strength and intensity of anomalies at the oceans' surface we can anticipate that these will most likely have large consequences on the deep ocean interior, the largest biome on Earth.

Patterns of benthic bacterial diversity in coastal areas contaminated by heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Polychlorinated Biphenyls (PCBs)

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Prokaryotes in coastal sediments are fundamental players in the ecosystem functioning and regulate processes relevant in the global biogeochemical cycles. Nevertheless, knowledge on benthic microbial diversity, its patterns and community changes across spatial scales, or as function to anthropogenic influence, is still limited. We investigated the microbial diversity in two of the most chemically polluted sites along the coast of Italy. One site is the Po River Prodelta (Northern Adriatic Sea), which receives significant contaminant discharge from one of the largest rivers in Europe. The other site, the Mar Piccolo of Taranto (Ionian Sea), is a chronically-polluted area due to steel production plants, oil refineries, and intense maritime traffic. We collected sediments from 30 stations along gradients of contamination, and studied prokaryotic diversity using Illumina sequencing of the 16S rDNA gene. The main sediment variables and the concentration of 11 metals, PCBs and PAHs were measured. Chemical analyses confirmed the high contamination, with concentrations of PCBs particularly high (up to 28.1 and 1045.1 ng g^{-1} of sediment, respectively). The analysis of about 3 millions of 16S rDNA sequences showed that bacterial richness typically decreased with higher contamination levels. Multivariate analyses showed that chemical contaminants significantly shaped community composition. Assemblages differed significantly between the two sites, but also showed wide within-site variation related with spatial gradients in the chemical contamination. An overall larger importance of PCB-degrading taxa was observed in the Mar Piccolo, suggesting potential selection of these taxa in this historically-polluted site. Our results indicate that sediment contamination by multiple contaminants significantly alter benthic bacterial diversity in coastal areas, and suggests considering the potential contribution of the resident microbes to contaminant bioremediation actions.

The role of social networks and citizen science in environmental research: the unexpected revival of freshwater mussels in Lake Orta

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Social networks are increasingly used for many conservation and environmental educational purposes. The usefulness for ecological studies is exemplified by the casual discovery of the recovery of freshwater mussels in Lake Orta. Mussels were extirpated by severe industrial pollution soon after 1926 and over the following decades their recovery was prevented by acidification and increase of metal concentrations. Even after the improvement of water conditions obtained by limning, the lack of mussels was taken for granted based on the legacy effects of accumulated toxins in the sediments, and on the limited potential for most extirpated species of mussels to naturally recolonize. The probability of mussel's recovery in Lake Orta was considered poor also for the apparent lack of access to restocking populations, which is essential to start the natural recolonization of an area. Because of the assumption that mussels were absent and of the difficulties of locating mussels their recolonization went unnoticed for about 15 years. Only in 2014 the casual discovery of mussels in Lake Orta was made possible thanks to an amateur video posted on YouTube and delivered to one of us through Facebook: this highlights once more the potential role of social networks for conservation and environmental issues. Freshwater mussels are challenging to locate because they are often rare, spatially clustered, and difficult to detect. The recolonization of Lake Orta went unnoticed probably due to the limited extent of the colonized area, low density and, at least initially, the small size of individuals. In such cases the contribution of citizen science can be crucial to provide the reporting even of small populations present in restricted areas and/or not easily accessible. An extensive search along the lake perimeter is being performed through the volunteer collaboration of local SCUBA divers and an online survey through social networks.

Is dissolved iron distribution in the Ross Sea surface water affected by mesoscale physical structures?

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The Ross Sea shelf waters are the most productive waters in the Southern Ocean and may represent a significant contribution to the oceanic CO_2 sink. During summer, the observed abundance of macronutrients and scarcity of dissolved iron (Fe_d) are consistent with a limitation in phytoplankton growth due to Fe lack in the offshore waters. Anyway, evidences suggest that Fe limitation as well as Fe_d speciation is important in the highly productive coastal areas too. The circulation of the Antarctic Surface Waters (AASW) in the Ross Sea is largely affected by the presence of small-scale structures (eddies, fronts or filaments), which can penetrate deep below the ocean surface layer influencing the intensity of the bloom by supplying to the surface waters nutrients and trace elements, such as iron.

In this study we exploit the link between iron supply and physical features of the water column, to qualitatively infer whether Fe_d distribution and availability could be affected by mesoscale structures. Surface and sub surface sea water samples were collected in three different areas in the Ross Sea during the austral summer 2013-14, with the aim of evaluating. The position of the stations was chosen accordingly to the MODIS (Moderate Resolution Imaging Spectroradiometer) Aqua and Terra satellites level-2 products relative to the previous 12/24 hours. Sea surface temperature (SST) and surface chlorophyll-a concentration (Chl-a) maps at 1 km resolution were generated in order to sample the casts in correspondence of both high and low chlorophyll signals. Total Fe_d varied between the areas (1.48, 1.77 and 2.13 nM as mean value, respectively), but in all of the samples more than 99% of the Fe_d resulted bound to dissolved organic ligands, which could influence significantly the availability of Fe for phytoplankton species.

An approach to high frequency monitoring of lakes: the SAILING and PITAGORA projects

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Recent developments in sensor technology allow high-resolution monitoring of lakes and reservoirs from sensor based systems such as buoys and platforms. The data collected by these systems may be provided to end-users by web-based technology and in this way be readily available for both advanced users (e.g. researchers) and citizens. With respect to traditional monitoring, based on discrete samples, high frequency data may resolve diel or short-term events and detect horizontal and vertical patterns in large deep lakes. Starting in 2014, we assembled a multi-parameter measuring system, adaptable to specific needs and implementable with different type of sensors. This system was initially tested on a sailing boat, in the framework of the SAILING project (Sensor-based Assessment on In Lake processes and water quality - Scientific INvestigation and Growing environmental awareness): two monitoring campaigns were performed, on Lake Maggiore (during 2014) and Orta (during 2015), with the aim of measuring basic limnological parameters (water temperature, pH, conductivity, dissolved oxygen) in surface water with high temporal and spatial frequency. Successively, through the PITAGORA project (Platform of interoperable technology for the acquisition, management and organization of environmental data), a similar measuring system was installed on a couple of buoys, deployed in both the two lakes. In this paper we describe the approach we used in the development of these sensor based systems and present some preliminary results obtained from the analysis of high frequency data. Results highlight the usefulness of these data in detecting processes that occur on very short time scales, such as those driven by rapid changes in meteorological condition. These activities have been performed in the framework of the EU COST Action NETLAKE (Networking Lake Observatories in Europe), aiming to build a network of sites and individuals to support the development and deployment of sensor-based systems in lakes and reservoirs.

La comunità fitoplanctonica del Lago d'Idro con particolare riferimento alle popolazioni cianobatteriche tossigeniche

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Rispetto ai laghi sudalpini più estesi e profondi (Garda, Como e Maggiore), e analogamente ai laghi di Lugano e Iseo, il Lago d'Idro è spiccatamente meromittico. Oltre i 40 m, le acque sono anossiche, presentando concentrazioni elevate di composti ridotti e nutrienti. Nel corso delle ricerche svolte tra novembre 2013 e novembre 2014, le concentrazioni mediane annuali del fosforo totale ipolimnetico (>200 µg P L^{-1}) sono state un ordine di grandezza maggiori di quelle rilevate nel mixolimnio (15 µg P L^{-1}). Nello strato trofogenico, queste condizioni pongono il lago in uno stato di vulnerabilità a causa dei picchi di nutrienti originati in occasione di episodi di parziale rimescolamento (per esempio in primavera) e del conseguente potenziale sviluppo di cianobatteri. Nel periodo analizzato, *Planktothrix rubescens* è stata rilevata solo in due occasioni e con abbondanze estremamente basse (< 2 mm^3 m^{-3}). Ciò contrasta nettamente con quanto rilevato nei grandi laghi del distretto lacustre sudalpino, dove questa specie è presente con popolazioni tossiche spesso dominanti. La specie più abbondante tra i cianobatteri è stata *Aphanizomenon flos-aquae*, una Nostocales potenzialmente tossigenica. L'identità tassonomica di questo *taxon* è stata verificata anche con analisi filogenetiche, confrontando le sequenze 16S rRNA (> 1500 bp) con quelle di altri ceppi europei. Un'altra Nostocales che ha presentato picchi isolati è *Dolichospermum lemmermannii*. Nonostante lo sviluppo di specie potenzialmente tossiche, le analisi delle cianotossine effettuate sui campioni ambientali del Lago d'Idro non hanno mai evidenziato la presenza di MC, ATX, NOD e CYN. Relativamente a MC e ATX, anche questi risultati sono del tutto in controtendenza rispetto a quanto osservato negli altri grandi laghi sudalpini. Le ragioni sono dovute alla diminuita presenza di Oscillatoriales (inclusa *Planktothrix*) e allo sviluppo di Nostocales che, a differenza dei paesi nord europei, nelle regioni mediterranee sono state spesso rilevate con ceppi non tossici.

Forty years of contribution by Water Research Institute in the study of Italian lakes: survey, processes and normative

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Since its establishment in the late sixties (1968) the Water Research Institute (Istituto di Ricerca Sulle Acque, IRSA) is an interdisciplinary organism covering several water research topics: waste waters treatment, water management, water quantity and quality. Although the study of lakes has always covered a limited portion of the IRSA's activities in the seventies a small group of researchers in the headquarters of Brugherio carried out a series of studies, that still constitute a reference point for the study of lake in Italy. The survey on the lakes of Brianza and the first collection of hydro-morphological and chemical data of the main Italian lakes allow the IRSA group to provide a significant contribution to limnology. The work on the lakes of Brianza (1971-73) in particular is one of the first lake-catchment integrated study, covering a range of disciplines: geology, climate, hydrology, hydrochemistry, hydrobiology until the evaluation of anthropogenic pressures to estimate the nutrient loads. This integrated approach characterized the first two decades of the Institute's activities, with the mission to transfer scientific knowledge on mechanisms and processes in regulations to protect the aquatic ecosystems, with particular respect to eutrophication control. Since the nineties the limnological studies at IRSA become more targeted to specific issues, such as: the formulation of simulation models of nutrient loads from the catchment, completed in recent years with the application of deterministic geo-referenced models; the hydrodynamic and ecological modeling of large (Como) and medium (Pusiano) lakes; the study of circulation of organic micro-pollutants in Southern Alpine great lakes (in particular Lake Maggiore) and remote areas.

Evidence of rock glacier melt impacts on chemistry and diatoms in Alpine headwater streams and lakes

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Active rock glaciers are highly sensitive to increasing air temperature in high mountain areas due to their location near the lower altitudinal boundary of alpine permafrost. Though still sparse, there is first evidence about a climate-related impact by rock glaciers on alpine headwater chemistry. A first study on the potential effects of rock glacier thawing on the ecological quality of headwater streams was recently conducted in the Oetztal Alps (Tyrol, Austria). The streams impacted by active rock glaciers showed high electrical conductivity, but differed in acidity, heavy metal concentrations and by the proportion of acidophilous diatoms. On the contrary, all reference streams exhibited low conductivity and circumneutral to slightly acidic pH values (characteristic for surface waters on crystalline bedrock), with no detectable heavy metals and a diatom composition typical for high altitude softwater streams. Within the project Interreg IV Italy-Austria Permaqua (ID5302) the study was extended to permafrost impacted running waters, springs and lakes located in different siliceous mountain districts of South and North Tyrol, in order to better understand diatom responses to melting permafrost. Due to their remoteness these headwaters are not affected by direct anthropogenic impacts. Both permafrost and reference waters were investigated in late summer for water chemistry and periphytic diatoms. The study confirmed a clear response of diatom species composition to permafrost driven changes in water mineralization level and acidity. In order to obtain a first long term temporal perspective of the potential response of headwater ecosystems to permafrost degradation, deep sediment cores were collected from five Permaqua lakes, radiometrically dated, and analyzed for lithological, geochemical, and biological proxies. Sediment records indicated an ecological transition common to all lakes after the end of the Little Ice Age, while diatom-inferred water pH revealed a slight, possibly permafrost related, acidification in some lakes.

A 13000 year environmental history of Lake Colbricon Inferiore (Trentino, Italia)

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Lake sediments have long been used as an archive for paleoclimatic-paleoenvironmental reconstructions, with more and more refined techniques developed in the late 40 years. This work is an attempt to reconstruct with a multiproxy paleolimnological technique the ecosystem response in Colbricon Inferiore, a small high-mountain lakes located in the Paneveggio-Pale di S. Martino Natural Park(Trento, Italy). A ca. 360cm long core was retrieved with a piston core; a gravity corer was used for the most recent sediment. Chronology was established by a combination of ^{210}Pb and ^{14}C isotopes. Diatom assemblages show changes in species composition that could be associated to an initial warm phase (Allerod), a following colder one (YD) and a progressive amelioration of climate until the optimum (8500-3500). During the transition period (10000-8000) carotenoids point out to an increase of cyanobacteria (Echinenone and myxoxanthophyll) associated with an increase of fire frequency and the first settlement around Lake Colbricon.

Along the climatic optimum, algal pigment are rather stable and Chryptophytes (alloxanthin) are well represented pointing to a high and stable water level. Diatom assemblages are dominated by the planktonic *Discostella stelligeroides*. At ca. 3500 yrs. B.P., a new phase begins with a decrease of *D. stelligeroides* and an increase of the small benthic fragilariaceae (*Staurosira* and *Pseudostaurosira* species) typical of cold-water conditions. At this level, there is a general increase of carotenoids and a shift in the ratio CD:TC. This suggest, rather than an increase in productivity, a change in the preservation conditions associated with the worsening of climate. After 2000 cal yr BP the lake seems quite stable: diatom assemblages are dominated by *Staurosira* and *Pasudostaurosira* species. Algal pigment are also quite stable apart myxoxanthophyll that increase in the more recent phase.

Degenerative processes in Lake Idro: anoxia, reducing conditions and internal loadings

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Ecological studies in Lake Idro, performed in the last five years (May 2010 - April 2012 and September 2013 - November 2014), evidenced a progressive deterioration of water quality and ecosystem status. The water column is permanently stratified and the chemocline is presently at about 40-50 m depth, out of 120 m maximum depth. The monimolimnion, which is ~50% of the water volume, is devoid of oxygen, with a concurrent accumulation of Fe^{2+} and Mn^{2+}, methane, dissolved sulphides, ammonium (NH_4^+), soluble reactive phosphorus (SRP) and dissolved reactive silica. Conversely, in surface waters NH_4^+ , SRP and trace metals are almost completely depleted, whilst nitrate is the main nitrogen species. The littoral zone (<10 m depth) is colonized by a wide macrophyte belt, with the dominance of invasive elodeids. The high primary productivity of both phytoplankton and macrophytes is sustained by external nutrient loads and by internal nutrient regeneration, especially SRP.

Critical issues and threats for lake management and recovery have been also identified. The monimolimnion and the surface sediment horizon have accumulated a bulk of phosphorus. Moreover, the strong reducing conditions of the monimolimnion favour the SRP release from sediments which greatly exceeds the external P loading and will bias the effects of reducing external loadings. Conversely, a net inorganic nitrogen loss occurs, due to denitrification processes in the chemocline. The concurrent inorganic N to P ratio imbalance has to be studied as a possible trigger of the development of toxigenic cyanobacteria. Finally, the reducing compounds bulk in the monimolimnion can potentially account for an oxygen demand which is nearly two- threefold the actual oxygen availability. Hence, in case of complete water overturn, oxygen dilution and consumption, might lead to a critical oxygen shortage with a possible collapse of the aquatic food web.

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Influence of riverine, oceanographic and meteorological forcings on coastal hypoxia in the NW Adriatic, Italy

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Long-term series of riverine, oceanographic and meteorological data in the Emilia Romagna Coastal Zone were analyzed with respect to the records of hypoxic events that were collected during the environmental monitoring of ARPA in 1977-2008, in order to highlight seasonal and interannual mechanisms of formation of this phenomenon. On a seasonal scale, hypoxia was found to be largely modulated by the pronounced annual cycle of environmental conditions typical of this area. During winter, its appearance was matched to air and surface seawater temperatures higher than average (difference between monthly medians up to +3.6 °C). In spring and autumn, a greatest importance of large phytoplankton blooms induced by river nutrient loads was observed. In August-October, hypoxia was correlated to stable weather conditions (wind velocity < 2 m s^{-1}, precipitation < 2 dm^3 m^2 d^{-1}) suggesting a major role played by the persistent stratification of the water column as forcing factor. During all the seasons, wind direction resulted to be a factor enhancing hypoxia when it contributed to the reduction of water flushing along the coast, or to the spreading of hypoxic bottom waters. On an interannual scale, a shift from large, persistent summer hypoxia to short, recurrent, irregular events distributed across all seasons occurred after the end of the 1980s. This change was concomitant to significant decadal trends for air warming (+0.14 C yr^{-1}), wind speed (+0.03 m s^{-1} yr^{-1}), Po River flow (-0.54 km^3 yr^{-1}) and salinity (+0.09 yr^{-1}), oxygen saturation (-0.2 % yr^{-1}), PO_4^{3-} (-0.004 µmol-P L^{-1} yr^{-1}) and NH_4^+ (-0.04 µmol-N L^{-1} yr^{-1}) concentrations in surface seawater. These results suggest that ongoing and future climate changes occurring in this region might significantly alter the dynamics of coastal hypoxia.

Abundance, diversity and activity of microbial community in the Gulf of Naples, Southern Tyrrhenian: an integrated approach

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Heterotrophic bacteria and picophytoplankton abundance, bacterial community composition and bacterial metabolic activity in the Gulf of Naples were investigated using multiple approaches. Cell concentrations were estimated by flow cytometry for three main groups of autotrophs (*Synechococcus*, *Prochlorococcus* and picoeukaryotes) as well as for the heterotrophic bacteria. Bacterial community composition and activity were estimated by CARD-FISH and MAR-CARD-FISH, respectively. Total environmental DNA and RNA samples were also sequenced with Illumina MiSeq so to obtain a high-resolution estimate of biodiversity and functional diversity in terms of transcripts as a proxy of potential activity of heterotrophic bacteria. Both *Prochlorococcus* and *Synechococcus* increased towards marine waters so as picoeukaryotes, while heterotrophic bacteria were more abundant in the river-influenced waters, confirming their role as remineralizers of organic matter and as nutrient recyclers. Heterotrophic bacteria community composition was analysed by CARD-FISH and the metabolic activity by MAR-CARD-FISH. The most abundant group was Alphaproteobacteria his abundance decrease near the coast and in particular near the the Sarno River suggesting a negative effect of the river. Within the Alphaproteobacteria, SAR 11 and Roseobacter showed an opposite trend with Roseobacter more active and abundant near the coast and less abundant and active at all the other stations. Abundance and activity of Gammaproteobacteria and Cytophaga-Flavobacterium-Bacteroides increased from the offshore station to the coastal one confirming their ability to degrade organic matter from land or river inputs. Taxonomic diversity comparison between the offshore and the coastal stations showed that cyanobacteria, both *Synechococcus* and *Prochlorococcus* species are dominant at the offshore station, while heterotrophs such as Betaproteobacteria and Alphaproteobacteria (mostly Rodhobacteraceae) dominated at the coastal station. Results of the analyses of the entire dataset on the community composition, the metabolic activity, and the metagenomics comparative analysis from the two sites will be discussed in order to assess the functional diversity of the pico-fraction of microbes in different coastal areas.

Short term scale variations of a summer microbial community in the Gulf of Naples

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Diel variability is an important time scale to consider when investigating the physiology and ecology of microbial communities. The picoplankton community (autotrophic and heterotrophic) of the Gulf of Naples was investigated in July 2012 during a Lagrangian experiment (Tosca Diel, TD) by sampling surface water every 2 h while following a floating device. The sampling strategy consisted in releasing a floating buoy and following its path for 28 h, with the aim of analysing the same water body and its associated picoplankton community. Picoplankton abundances, both autotrophs (Synechococcus and Picoeukaryotes) and heterotrophic bacteria, were estimated by flow cytometry, and the heterotrophic bacterial composition was estimated by CARD-FISH every 6 h. Although the water masses characteristics should have stayed constant, when the floating device encountered a flowing coastal current, an unexpected evolution was observed. This was represented by a shift from more oligotrophic to rather eutrophic seawater, in terms of nutrients and also chlorophyll content. Also, higher picoplankton concentrations were observed and also a lower contribution of Alphaproteobacteria (56%±3%) suggesting this clade as a marker of river-influenced seawater. In fact, the Sarno river plume shows a northbound flow, carrying along nutrients and biomass. 66% (±4%) of heterotrophic bacteria were detected using the Eubacteria probe by CARD-FISH. Among these, the most abundant group was Alphaproteobacteria (56%±3%) and within them, SAR11 (32%±5%) was the most abundant group and showed an opposite trend to Roseobacter (16%±7%). Gammaproteobacteria (26%±4%) and Cytophaga/Flavobacterium/Bacteroides clade (28%±4%) showed no variations during the 28 h sampling. Altogether, these data point to a complex dynamics of the bacterial community which even in the summer, when circulation is reduced, depends upon the hydrological factors and water mass characteristics which can vary at very short time and space scales.

PALOMA: an automated observatory in the Gulf of Trieste participating in the ICOS ITALY network

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The Northern Adriatic is a shallow, semi-enclosed industrialized sub-basin in the northernmost part of the Mediterranean Sea affected by intense air sea fluxes (gas and heat) and ecosystem changes. Dense water formation may occur during winter. For these reasons the site appears interesting to the ICOS targets and has been included in the ICOS Italy network. The site has been regularly visiting (once per month) for the last eight years, a better understanding of processes driving air-sea CO_2 fluxes and inorganic carbon chemistry changes has been inferred by the combination of automated in situ measurements, monthly samplings and local scale oceanographic surveys.

Recently the platform has been implemented with temperature and salinity sensors, continuous pCO_2 measurements at 3 m depth and atmospheric pCO_2 measurements. The equipped observatory and first results of automated instruments are here presented.

Heavy metal contamination and heavy metal tolerant bacterial communities in sediment along the Pasvik River (Arctic Norway)

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Anthropogenic impact over the Pasvik River is mainly caused by emissions from runoff from smelter and mine wastes, as well as domestic sewage from the Russian, Norwegian and Finnish settlements situated on its catchment area. The river flow could have a pollutant effect also on the fjord system up to the larger Varanger fjord. A localized contamination by HMs probably exists in sites where materials (e.g. bombs, ammunition, bullets) of the Second World War were discharged.

Within the multidisciplinary project SpongePOP (EU INTERACT), this study aimed at describing the HM-tolerant bacterial communities along the River, in relation to HM contamination. Sediment samples were collected from 11 stations during two seasonal surveys in 2014. The concentration of eighteen HM in samples were determined by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after pyrohydrolysis with HNO_3 and H_2O_2. Higher levels of HM were generally recorded in July than in May (except for the inner stations 8 and 9), with stations 1 and 5 that became particularly enriched in Cr, Ni, Cu and Zn. For bacterial isolation, samples were opportunely diluted and plated on agar plates amended with HM. Overall, tolerance was in the order Pb>Zn>Co>Ni>Cu>Cd>Hg. A total of 400 bacterial colonies (mainly from Cu-, Ni-, Zn- and Co-amended agar plates) were isolated and cross-tested on all heavy metals whose concentrations were in the range 50-10000 ppm. Cu and Cd were generally tolerated up to 3500 ppm, while Zn, Ni and Co up to 7500 ppm. As it was expected, Pb was better tolerated than other tested metals (up to 10000 ppm), whereas no bacterial isolates grew in the presence of high concentration of Hg. Isolates tolerant to higher concentration of HM and showing multiple tolerance were identified by the 16S rRNA gene sequencing.

Cross-border marine environmental monitoring in the framework of the European ENPI-CBC S&T Med strategic project

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The objective of the European S&T Med strategic project is to promote the sustainable and harmonious cooperation process at the Mediterranean Basin level by dealing with the promotion of sustainable tourism and the spreading of good social and environmental practices. The main role of the Stazione Zoologica Anton Dohrn in the S&T Med project is to participate in providing technical, scientific and organizational support to the local partners of the project. The aim of these activities is to involve small and medium-sized enterprises, local communities, tourists and local touristic operators in the spreading of good environmental practices, in the implementation of environmental protection strategies and in the creation of high-quality networks of environmental monitoring, through sensibilization and valorization initiatives. These include the design of a trans-national environmental monitoring system based on the setup of high-tech local marine observatories, aimed at involving local operators and local enterprises in new touristic and business activities focused on the concept of environmental quality and sustainability. Linking tourism to scientific knowledge through monitoring and data collection and analysis at three sites of Mahdia (Tunisia), Gulf of Oristano (Italy) and Aqaba (Jordan) is one of the most relevant features of the S&T Med project. Beyond its importance for scientific purposes and decision-making, these activities will allow tourists to engage in environmental monitoring and protection activities, increasing their awareness of the values of the good environmental status of coastal ecosystems. The environmental monitoring system operated by the Stazione Zoologica in collaboration with the other scientific partners of the project is intended to feed a trans-national Observatory on Sustainable Tourism as well as a worldwide database of Long Term Monitoring Stations, a key tool for understanding global trends in environmental changes. This will allow the three sites to enter a cross-boundary network of sites adopting best environmental practices through the use of water quality indicators. The monitoring system will be based on one monitoring system to be placed at each Project's coastal sites, equipped with sensors and modules acquiring local environmental data, as well as underwater cameras for visualization of specific features of the sites.

Influence of physical and biological factors on seasonal variability of North Adriatic's carbonate system

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The considerable amount of anthropogenic carbon dioxide absorbed by oceans since the Industrial Revolution, brought to acidification of the sea on a global scale and it represents one of the worst danger of this century for marine ecosystems. The negative impact of this phenomenon could be greater especially in coastal ecosystems, characterized by a higher variability, like the North Adriatic Sea. The main physical and biological factors characterizing temporal and spatial variability of the carbonate system have been studied, on a seasonal scale, focusing on a representative area of the North Adriatic, composed by a transect from Po delta to Istria. Samplings have been performed on a monthly basis in 6 sampling stations arranged along the transect, at 4 depths. Alkalinity, pH and the major physico-chemical descriptors, like salinity, temperature and dissolved oxygen, have been considered. The preliminary data show a strong influence of riverine waters on the majority of the parameters, indeed, smaller variations of temperature, pH_T (25°C), total alkalinity (A_T), dissolved inorganic carbonate (DIC) and oxygen concentration have been observed in the oriental sector of the basin (oligotrophic) rather than in the occidental sector (mesotrophic). During spring, with the beginning of stratification, superficial waters were characterized by negative values of apparent oxygen utilization (AOU) and by high values of pH in situ; index of the prevailing of primary production processes. In the months in which a greater contribution of riverine waters have been found, both alkalinity and DIC were increasing in correspondence with higher nutrients concentration (NO_3, PO_4 e SiO_4). Alkalinity showed a significant negative correlation with salinity ($p<0.0001$) for depths between 0 and 10m. Beyond the thermal effect on the balances which govern pH, an inverse linear regression between AOU and pH_T(25°C) was indicating a crucial influence of primary production and respiration processes in determining pH

Viable planktonic organisms transferred via ships' ballast water into the Gulf of Trieste (NE Adriatic Sea)

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The worldwide transfer and introduction of non-indigenous or harmful species by human activities has increased dramatically over the past century, resulting in a broad array of unwanted ecological, economic and human-health effects. Today, the global movement of ships' ballast water is considered the largest transfer mechanism for aquatic organisms. The International Maritime Organization (IMO) has defined biological standards, concerning ballast water quality, to regulate possible transport of Harmful Aquatic Organisms and Pathogens (HAOP). Microbiological limits accepted by IMO consider only the abundances of indicators of faecal pollution and the presence of Vibrio cholerae; proposed biological standards regarding phyto- and zooplankton are based on the amount of viable organisms related to their dimension excluding taxonomic identification.

In the framework of the BALMAS (Ballast water Management for Adriatic Sea protection) project, 10 ship' ballast tanks, coming in the Port of Trieste (NE Adriatic Sea), were sampled in order to estimate and identify viable phyto- and zooplankton organisms and to assess the occurrence of potential pathogenic bacteria. Facultative thermophile bacteria were selected, phenotypically characterized through miniaturized diagnostic systems (API 20E and API 20NE) and identified by molecular assays (PCR amplification of 16S RNA gene fragments). Phytoplankton viability was checked using epifluorescence microscopy with Fluorescein Diacetate (FDA) stain that discerns metabolically active cells. Lugol fixed samples were also observed at an inverted microscope to characterize the phytoplankton community. Zooplankton viability (above 50 µm) was detected by stereo microscope and the taxonomic identification was performed.

In all collected samples, viable phyto- and zooplankton cells were detected. Microbial characterizations revealed the presence of potential pathogenic species belonging to genus Vibrio, Aeromonas, Pseudomonas and Bacillus in the ballast waters.

Posidonia oceanica (L.) Delile as bioindicator of marine water healthiness: analysis of biomarkers related to oxidative stress and critical light condition in *Posidonia oceanica* (L.) Delile

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In the Mediterranean coastal ecosystem, the endemic seagrass P. oceanica (L.) Delile plays a relevant ecological role and sensitivity of seagrass meadows to disturbance makes them a benchmark for monitoring the environmental health of aquatic systems. In this work is proposed a fast and reproducible technique to value Posidonia meadows healthiness based on the detection of molecular markers responsive to heavy metal contamination and altered light perception. The study area included four meadows of the Tyrrhenian coastline: "Punta Murelle", “Chiarone", "Giannutri" and "Tor Paterno". Antioxidant enzymes, such as catalase, glutathione-S-transferase, peroxidase and superoxide dismutase, were chosen as biomarkers of oxidative stress, whereas 2b-metallothionein (MT-2b) and Chromomethylase (CMT) as biomarkers responsive to heavy metal accumulation. Furthermore geranylgeranyl reductase, Cytochrome-c-oxidase, putative peptidase and RuBisCO were chosen as biomarkers related to light availability. The trend of the selected biomarkers was analyzed by both enzymatic assays and qPCR and the up-regulation of genes involved in photoacclimation and photoprotection (antioxidant enzymes, tocopherol biosynthesis) was highlighted in the Murelle site indicating that plants are under stressful light conditions. Moreover, also antioxidant enzymes, MT-2b and CMT reached their higher level in the Murelle site which showed active responsiveness to stress. Interestingly, the heavy metal accumulation analysis in the leaves of Posidonia specimens inhabiting the four sampling sites revealed that they were less concentrated in Murelle and Chiarone plants, with Murelle showing the lowest level of Cu contamination. Since high doses of Cu are known to have inhibitory effects on vascular plants defense responses, it is suggested that only Murelle specimens retain the ability to react to heavy metal contamination activating ROS scavenging enzymes and heavy metal chelating proteins. Hence, the use of biomarkers of environmental stress provides an important tool for rapid and reproducible detection of healthy status changes in seagrasses.

Seasonal study on the microbial community inhabiting the Pasvik River (Arctic Norway) -Part I: Water

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The spatial and temporal distribution of microbial biomass and metabolic rates were investigated in water samples collected from 9 stations [outer zone: stations 3, 6, 7 and 4; inner: stations 1, 2, 5, 8 and 9] during two sampling campaigns (May and July 2014) within the EU INTERACT SpongePOP Project. Samples were analyzed for: bacterial abundances by viable counts (VC), and total prokaryotic counts by DAPI-staining (TC); microbial enzymatic activities (leucine aminopeptidase, LAP, beta-glucosidase, GLU, alkaline phosphatase, AP); respiratory activity (R). Water temperatures ranged from 2.7 to 5.5°C in May and from 10.4 to 20.6°C in July. Salinity was between 2.0 (in the inner part of the river) and 15.0 in May, between 0 and 30 in July. Higher values of conductivity and redox potential were recorded in May, whereas dissolved solids and oxygen were higher in July. VC were generally of the same order of magnitude in May and July (range 0.4-30.0x102 CFU/ml and 0.8-30.0x102 CFU/ml, respectively); TC slightly decreased in July (2.1-12.3x105 cell/ml) compared with May (0.7-2.9x106 cell/ml). Results highlighted different gradients of microbial activities, with different pathways of carbon in different sampling sites. Higher values of GLU and AP were generally recorded in May, whereas LAP activities were higher in July. In May lowest LAP rates were measured at inner stations; GLU and AP rates were highest at stations 5-7, and lowest at stations 1-3. In July the lowest LAP rates were recorded at station 8; the maximum value of both GLU and AP was measured at the outer station 4, the minimum at station 2. Microbial respiration was higher in July than in May, with the lowest and highest values recorded in May at stations 2-9 and in July at stations 6-5, respectively.

Seasonal study on the microbial community inhabiting the Pasvik River (Arctic Norway) - Part II: Sediments

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Within the multidisciplinary project SpongePOP funded by the EU INTERACT Programme, a study focused on the microbiological features of the Pasvik River, one of the largest river in the Northern Fennoscandia. Sediment samples were collected from 9 stations during two seasonal surveys (May and July 2014). The river is typically a freshwater environment at its inner zone and brackish at its outer zone. Samples were treated at Bioforsk Station laboratory and analyzed for viable heterotrophic bacteria (viable counts, VC) on Marine Agar (MA) and Plate Count Agar (PCA), total prokaryotic abundance by DAPI-staining (total counts, TC), microbial enzymatic activity rates (leucin aminopeptidase, LAP, beta-glucosidase, GLU, alkaline phosphatase, AP), community respiration (R), phylogenetic composition **of the bacterial community.** Physical and chemical parameters are reported in the "Part I: water" of the same study. VC were generally higher in July than in May, with ranges of 1.2-1515.0 x 10^5 CFU/g and 0.1-16.5 x 10^5 CFU/g, respectively. TC were generally two orders of magnitude higher than VC. LAP rates ranged between 0.02 and 9.73 mmol/g/h in May, and between 1.70 and 36.23 mmol/g/h in July. Conversely, both GLU and AP were generally higher in May than in July, with highest values at the outer station 4. Particularly, GLU rates ranged from 0.22 to 15.98 mmol/g/h in May and from 0.05 to 2.34 mmol/g/h in July; AP from 0.29 to 53.39 mmol/g/h in May and from 0.47 to 19.33 mmol/g/h in July. Respiration rates were higher than in waters, and in July compared with May. The bacterial community was mainly composed by Proteobacteria (55.3 and 51.1% in May and July, respectively), Actinobacteria (15.6 and 11.20%) and Bacteroidetes (12.7 and 9.7%) whose relative percentages were almost similar between the two periods. Conversely, the remaining detected phyla were generally more abundant in July than in May.

Variability of PAHs in the sediments in relation to environmental characteristics of the bottom layer in the middle Adriatic Sea

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In the framework of the project PERSEUS (FP7-OCEAN-2011-3), two interdisciplinary surveys were carried out in April 2013 and April 2014 in the middle Adriatic Sea along the Pescara-Sibenik transect (Jabuka Pits area) and Vieste-Split transect (Palagruza Sill area). The main objective of these research cruises was the implementation of the MSFD in the Adriatic region for collecting physical, chemical and biological data in order to get a better understanding of whole Adriatic ecosystem.

The two transects are already recognised as a key areas for the interception and the study of dense water modification and they are characterized by high temporal variability of the thermohaline structure and other oceanographic parameters. Several oceanographic parameters relevant and useful for the ecosystem assessment of the two areas (temperature, salinity, density, fluorescence, oxygen and nutrients) were collected and Polycyclic Aromatic Hydrocarbons (PAHs) were examined in surface sediments.

During the first survey (April 2013), PAHs concentrations ranged from 5 ng/g dry weight (d.w.) to 36 ng/g d.w. (21 ± 11 ng/g, mean ± SD). While, in the second survey (April 2014), PAHs concentrations ranged from 8 ng/g d.w. to 146 ng/g d.w. (53 ± 43 ng/g, mean ± SD). The total PAHs concentrations were observed in relation to the physical and chemical characteristics of the bottom layer. Among the examined correlations, density and depth showed a significant positive relationship ($p < 0.05$) with PAHs. While, salinity and temperature showed a significant negative relationship ($p < 0.05$) with PAHs. Conversely, a significant correlation between total PAHs and nutrients in the bottom layer was not found. In both survey, the mean values of PAHs in Jabuka Pits area were higher than Palagruza Sill area ones. Therefore, the pits act as areas of PAHs accumulation due to sedimentation processes that occur within them.

ICOS Italy: the Italian Network of platforms for high quality monitoring of the marine CO_2 variables

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The Integrated Carbon Observing System Research Infrastructure (ICOS RI) is a European Research Infrastructure which aims to provide harmonized and high precision scientific data on carbon cycle and greenhouse gas budget and perturbations. The backbones of ICOS RI are the national networks consisting of atmospheric and ecosystem stations across Europe and marine stations covering North Atlantic and European marginal seas. The structure includes the ERIC and the Central Facilities (Thematic Centres and Calibration Centre), here the Ocean Thematic Centre (OTC) supporting ICOS network of observations in the North Atlantic, Nordic Seas, Baltic and the Mediterranean is presented. In particular the contribute is going to focus on the ICOS-Italy marine network, measuring CO_2 fluxes over the seas surrounding Italy. The ICOS Italy network relies on a few, open sea and coastal, fixed observatories monitoring air-sea CO_2 exchanges and the variability of marine CO_2 system. The fixed stations are equipped with autonomous sensors measuring physical and biogeochemical properties of seawater, and atmospheric parameters close to the ocean interface.

The network includes the W1-M3A observatory, moored at the centre of the Ligurian basin on a deep sea bed of about 1200 m; the Lampedusa station, not yet equipped, in the Sicily Channel; the EM23A buy in the Southern Adriatic sea, on deep sea bed of 1200 m; the PALOMA fixed platform, positioned in the Gulf of Trieste (North Adriatic shelf) at about 8 nautical miles far from the coast, and the Mambo buy very close to the coast in the protected area of the Riserva Marina Miramare.

Characterization of transgressive deposits in the Northern Adriatic Sea

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The Adriatic Sea is an epicontinental semi-enclosed basin characterized by a low axial gradient shelf in the northern and central part and by a steeper gradient in the southern sector. During the Last Glacial Maximum the sea-level was about 120 m lower than today and the northern continental shelf was in subaerial conditions. Afterwards, during the late-glacial to early-Holocene the relative sea-level rise favoured the deposition of different generations of transgressive deposit. Nowadays from Trieste to Ravenna, these deposits are located between -10 and -35 m w.d., showing a longshore trend similar to the modern high-stand deposits. The characterization of these bodies is based on a large dataset of CHIRP-sonar profiles, bathymetric and isopach maps, stratigraphic studies, compositional analysis of sand samples from sediment cores and radiocarbon data from peat and organic-rich layers. Deposits located north of the Po delta have been mainly characterized in order to understand their provenance. Petrographic results show a compositional variation depending on the areal position of the deposits. Three different petrographic provinces were distinguished: 1) deposits located offshore Lignano show an eastern Alpine signature; 2) deposits located close to the Po mouths are characterized by a quartzolithic Po drainage basin signature; 3) deposits situated off-shore the Venice lagoon show a mixed composition between carbonate Alpine supply and quartzolithic components. On the other hand, one deposit situated south of the Po delta has been investigated in order to define the stratigraphic evolution during its formation. Different environment of sedimentation have been identified within the deposit, the basal portion correspond to delta plain setting with distributary channels and brackish lagoons, while the upper portion represents a barrier-lagoon system. The detailed study of these deposits allows the paleo-geographic reconstruction during the last transgressive cycle, and could give solid framework of the past relative position of the sea-level.

Not only Cladocera: what we can learn from RRE analysis in deep lake sediment cores

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Since early palaeolimnological studies, Cladocera have been largely investigated in lakes of different typologies and from a large variety of sites. Analyses of their subfossil remains provide evidence for changes in trophodynamics, habitat and water level fluctuations and of impact of drivers such as climate change on lake ecosystem functioning. Rotifers are an important component of lacustrine food webs. They are responsible for the largest part of zooplankton diversity. Because of short developmental times and intrinsic rate of increase, they promptly respond to different impacts, such as changes in trophy, pollution and recovery as well as climate-driven changes. Rotifers have been overlooked in palaeolimnological studies because they do not leave subfossil remains. They do produce, however, resting eggs of a variety of morphotypes (MTs), which preserve well in sediments. We report here results of a study in which we applied RRE MTs (**R**otifer **R**esting **E**ggs **M**orpho**T**ype**s**) analyses to a sediment core of Lake Orta on which cladocera and diatoms were analysed along with lake chronic, heavy metal pollution and acidification as well as recovery. We found that RRE abundance increased during pollution. RRE MTs differed substantially before vs. during pollution and along with the different recovery phases. The restored RRE community differed substantially from the pre-pollution one. Unexpectedly, RREs persisted over the full pollution phase, when copper concentration in the water column was as high as 108 µg/L (in the late fifties) and when lake pH (value at the winter mixing) was of 3.8 (in the middle eighties). The presence of open egg cases also proves attempts of e.g. *Brachionus calyciflorus* to establish also during pollution phase. Extending RREMTs analyse to other deep subalpine lakes (i.e. Léman, Annecy and Bourget) encourage to further develop this approach to contribute to understanding impact of local vs. global drivers affecting lake ecosystem functioning.

First detection of the bloom forming *Peridiniopsis penardii* from a Sardinian reservoir (NW Mediterraean Sea)

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In the Mediterranean region, reservoirs represent the main sources of water supply for various human demands. The main issues in these ecosystems are linked to eutrophication and, consequently, to the development of Cyanobacteria blooms. However, freshwater red tides caused by dinoflagellates are becoming a new emergent problem for water treatments. In Sardinian reservoirs, dinoflagellate blooms have been detected since the seventies and were mainly caused by *Ceratium hirundinella*. Recently, other dinoflagellates have given rise to similar events. One of the most intense was recorded in Cedrino Lake in February 2012. The causative dinoflagellates were firstly recognized as *Peridinium* species. In this study, fixed samples collected during this event were analyzed in more detail with optical and scanning electron microscopy. Surface sediment samples were taken and analyzed for the presence of resting cysts. Genetic analyses were conducted on alive and fixed vegetative cells. Furthermore, ecological data were analysed. The plate formula of the recovered cells was po, x, 4', 6", 5C, 4S, 5"' and 2''''. Scattered pores ornamented the theca and numerous spines the hypotheca, but cells without spines have been observed. The cysts were slightly irregular in shape, and most of them maintained the external theca. The cyst content was grainy with yellowish to reddish accumulation bodies. Based on the tabulation features, this dinoflagellate was assigned to the *Peridiniopsis* genus, 'penardii' section. The genetic results showed a very high similarity of the Sardinian sequences with *Peridiniopsis penardii* sequences from China. The species was recorded in Cedrino Lake in a wide time frame (September to June), but the two bloom events showed a well-defined seasonality (February-March). The species abundances were significantly correlated with a number of environmental parameters (e.g. temperature and nutrients).

High biomass blooms in beaches: are resting cysts maintained in situ?

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Data derived from an extensive sampling campaign along the Sardinian coasts have allowed the identification of *Alexandrium taylorii*, *Levanderina fissa* and *Barrufeta bravensis* as the most widely distributed cyst-forming harmful species in the 74 beaches investigated in summer 2012. They are high-biomass forming species and their blooms can impact negatively on tourism. Statistical analyses indicated that the distribution of harmful algal species was correlated with gravel and medium-fine sand substrata. This relationship suggested that vegetative cells might be recruited from cyst beds in beach sediments. Therefore, the objective of this study was to verify the presence of resting cysts in the near shore beach sediments. Sediment cores (40-50 cm long) were collected in May 2013 from three target beaches. Cores were sampled at three stations (foreshore, trough, bars) along a perpendicular transect at each beach. Cores were sectioned every 5 cm. *Alexandrium taylorii* cysts were observed in the three beaches, always below a depth of 15 cm. Cyst presence was assessed at the trough and bar stations in Platamona and Villasimius, whereas at the foreshore station in Bosa. *Levanderina fissa* cysts were detected only in Bosa at the bar station, at a depth below 20 cm. Naked-like dinoflagellate cysts, probably belonging to *Barrufeta bravensis*, were observed at the same station and depth. The found cyst distributions reflected the different morphodynamic features of the beaches. The discovery of resting cysts in the near shore sediments supports the hypothesis of a potential '*in situ*' source of vegetative cell inoculum.

An acoustic approach to evaluate presence and ecological status of cetaceans in the Ionian Sea

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Cetaceans are among the biggest top-predator species and their presence is therefore a useful indicator of the health status of marine environment. Variations in their presence and distribution in a given area, such as the Mediterranean Sea, potentially highlight environmental alterations driven by either biological, chemical, physical or anthropogenic factors. Hence, the development of new cetaceans monitoring techniques actively contributes to promote good management practices of water resources. Since 2005, the INFN (Istituto Nazionale di Fisica Nucleare) has promoted, within the framework of the EMSO and KM3NeT projects, the installation and operation of two cabled deep-sea infrastructures offshore Eastern Sicily, Ionian Sea: the Catania node, at a depth of 2,100 m, 25 km offshore the harbour of Catania and the Capo Passero node, at a depth of 3500 m, 100 km offshore Portopalo di Capo Passero. The two submarine infrastructures are equipped with acoustic arrays for the real time monitoring of the underwater noise. The acoustic signals acquired at the two deep-sea sites have been analysed by means of new software tools, developed on purpose for the automatic detection and classification of the sounds emitted by different cetacean species. The newly-developed software tools brought for the first time to the long-term monitoring of cetaceans presence and vocal behaviour, offshore Eastern Sicily. The acoustic presence of the Mediterranean Sperm whale (*Physeter macrocephalus*) and Fin whale (*Balaenoptera physalus*) has been studied over different recording years. In addition, the automatic analysis of the sperm whale “clicks” allowed to reveal the size distribution of the animals occurring in the area. Within the observation areas, the acoustic tracking of biological and anthropogenic noise sources was also possible. Evolving passive acoustic monitoring strategies represents an actual-technological challenge for the protection and management of the marine environment, which asks for increasingly advanced multidisciplinary partnerships.