POSTER SESSION 1: TOPIC 2
Physical forcing on biogeochemical cycling and marine food webs

Massive Corals, revisited Paleoclimate Archives

D. Allemand[1], D. Blamart[2], J.P. Cuif[3], T. Corrège[4], Y. Dauphin[3], A. Denis[3], C. Ferrier-Pagès[1], P. Gautret[3] A. Juillet-Leclerc[2], F. Le Cornec[5], S. Reynaud[1], C. Rollion-Bard[5]
[1] CSM Avenue Saint-Martin MC-98000 Monaco, Principality of Monaco
[2] LSCE Domaine du CNRS, 91198 Gif sur Yvette, France
[3] Laboratoire de biominéralisation, Bat 504, Université Paris XI, 91405 Orsay, France
[4] IRD, BPA5, Nouméa, New Caledonia
[5] CRPG, B.P. 20 54501 Vandoeuvre-Les-Nancy Cedex, France
Email: Anne.Juillet@lsce.cnrs-gif.fr

Tropical ocean-atmosphere interaction plays a key-role for worldwide climate variability. Instrumental observations are available only for the last decades and paleoclimatic reconstruction becomes necessary to recognize decadal and longer changes of the tropical system. Long-live massive corals, developped all around tropical belt, are unique archives offering both annual resolution and multicentury record lenght needed for reconstructing saesonal to centennial variations of tropical surface ocean variations. However the deposition of the coral skeleton is much more compex than we could expect and, up to now, the geochemical records, isotopic ratio and trace elements as well, did not provide the promised climatic indications. The multi-proxies approach that we propose, will improve our understanding of the consequences of the oceanic and climatic changes on the aragonite chemistry and will allow these effects to be quantifed. This approach is based on three evidences:
- the geochemical analyses of the aragonite deposited by cultured corals developed over controlled conditions is the only way to provide the quantified geochemical response to a unique factor.
- ion microprobe measurements permit the analysis at a micrometer scale, showing the complexity of the skeleton structure and revealing the intimate mechanisms of the mineral deposition.
- the statistical treatments of both meteorological data and proxy records, well suited to each time scale, are able: first to reveal the factors prevailing on climate variability and on mineral deposition mechanisms and also to establish the relationships linking them.
Preliminary studies conducted following these principles furnished first results.

Biogeochemical Transport Balance, Phytoplankton and Bacterial Coupling in a Sub-tropical Estuary, Brazil.

J.J. Barrera-Alba, Gianesella, S.M.F.; Moser, G.A.O.; Saldanha-Corrêa, F.M.P.; Nishihara, L.; Jakovac, A.C.C.; Ricci, F.P.; Picarelli, S.S.; Miranda, L.B.de & Harari, J.
Instituto Oceanográfico. Praça do Oceanográfico, 191. CEP 05508-900. 55-11-30916551. São Paulo, SP.Brazil.
Email: juanalba@usp.br

The estuarine-lagoon system of Cananéia-Iguape, at the southern Brazilian coast, is a well preserved area which main economic and social activity is the artesian fishery. This system is 110 km long, consisting of several channels behind a 70 km barrier island connected to the sea by two narrow inlets at the southern and northern ends. The circulation pattern is intricate, with higher freshwater discharge in the north portion of the system.This system is one of the most important Brazilian naturally eutrophicated areas with values of primary productivity higher than 80 mg C m-3 h-1. Thus, studies that actually integrate physical, geochemical and biological aspects are of extreme importance in this area. The goal of the present study is correlate the dynamics of phytoplankton and bacterial communities to physical and geochemical transport balances. On July 2001 (dry season) and January 2002 (raining season) three stations were sampled along the system in complete tidal cycles (semi-diurnal tide), in both spring and neap tides.In each station current and physical properties were sampled hourly; concentrations of inorganic dissolved nutrients, bacterial and phytoplankton biomass, and Transparent Exopolymeric Particles (TEP) concentrations were sampled each two hours; CNH determination and phytoplankton and bacterial productivity experiments were conducted during flood and ebb tides. Properties transport and productivity rates were higher during ebb tides, suggesting an outwelling to the adjacent coastal area. Higher TEP concentrations were also found in the north portion of the system, associated to phytoplanktonic biomass.

Variability of air-sea CO_2 fluxes in the Southern Ocean inferred from CARIOCA drifters, ships and remotely sensed measurements

J. Boutin[1], Y. Rangama[1], J. Etcheto[1] , L. Merlivat [1], T. Takahashi[2], M. Frankignoulle[3] and B. Delille[3]
[1] Laboratoire d\'Océanographie Dynamique et de Climatologie, Paris, France
[2] Lamont Doherty Earth Observatory of Columbia University, Palisades, USA
[3] Université de Liège, Liège, Belgium
Email: jb@lodyc.jussieu.fr

We combine CARIOCA drifter, ship and satellite measurements to derive air-sea CO_2 fluxes and analyse their variability relative to the physical parameters in the Southern Ocean. Using ship measurements conducted during JGOFS campaigns south of Tasmania and New Zealand, we establish 1) weak pCO_2-SST correlations in regions where the chlorophyll content, Chl is low, and 2) negative pCO_2-Chl correlations in high Chl regions. Seasonal correlations are established and applied in provinces monitored using threshold on SEAWIFS Chl. Using pCO_2 fields interpolated for one year, we estimate an absorbing flux of -0.09 GtC/yr in the region 125E-155E; 60S-45S whereas the flux derived in the same way from Takahashi(2001) pCO_2 maps is -0.13GtC/yr. Part of the discrepancy may come from different weights in the interpolation method given to data taken in high Chl regions. The variability of pCO_2 was measured by two CARIOCA drifters deployed in the central Indian Ocean near 45°S-72°E in January 2001. The buoys drifted eastward in the subantarctic zone for 3 and 7 months respectively. One of them reached 52°S-145°E, south of Tasmania in July 2002. pCO_2 are always under saturated by 0 to 30 µatm with respect to the atmosphere. Large pCO_2 variations appear at day to week time scale. We analyse their origin by looking at measured physical (surface temperature and salinity) and biological (fluorescence) parameters. The total carbon content, Ct, is derived from pCO_2 and alkalinity estimated from salinity. Similarities between SST-SSS and Ct-SSS diagrams suggest that most of the Ct variations are related to mixing of different water masses.

Chlorophyll patterns in anticyclonic vortex and distribution of DOC and Nutrients in Sardinia Sea : preliminary results.

Laura Carlini[1], Antonia Di Maio[2], Marco Marcelli[1], Angelo Perilli[3]
[1] University of Tuscia, Department of Environmental Sciences, Largo dell'Università snc Viterbo
[2] AQSmare sr.l. Via del Molo di Levante 1, Fiumicino, Rome
[3]CNR-AMC Sez. S2AM di Oristano Loc. Sa Mardini Torregrande Oristano c/o IMC.
Email: lauracarlini@virgilio.it

The general oligotrophic regime of the Mediterranean sea is typically modulated by the sub-basin gyre, meso-scale features and coastal upwelling. The Sardinian Sea is located in the Algerian-Provençal basin, an area characterised by intense meso-scale activity. Despite the geographical importance of the Sardinian Sea, biogeochemical and hydrological observations are few and sparse, both in time and space. Four oceanographic cruises were conducted in the Sardinian Sea and the Sardinian Channel by N/V Urania (MedGOOS1 May-June 2000, MedGOOS2 March 2001, MedGOOS3 September 2001, MedGOOS4 May 2002). The Primary productivity has been evaluated by means a pump and probe fluorometer coupled with a single dimensional model, based on light, biomass and photosynthetic efficiency. For the purpose of this activity we have developed and tested new instrumentation to study biological-physical interaction in the water column. The preliminary results permitted to describe the distribution of primary producers in relationship to the meso-scale processes and to recognize surface meso-scale patterns according with Milliot (1990). The area is dominated by large meso-scale anti-cyclonic structures. The DCM is driven by these meso-scale structures and it is stronger in the border zones of the anti-cyclonic vortex. The LIW flows along the west Sardinian platform, particularly packed in the north area. The biogeochemical variables, DOC values are in accordance with the Mediterranean means. Low variability of DOC concentrations is detected from coast to off shore water suggesting a low terrigenous influence in the area. Further analysis will also include a combined evaluation of nitrate and phosphate concentrations in relation to the physical-chemical characteristics of this water masses.

Comparison of the pelagic ecosystems interannual variability in the Canary and Benguela upwelling systems.

P. P. Chernyshkov, A.M. Sirota, G.N. Andrianov, Gleza I.L.
AtlantNIRO, 5, Dm.Donskoy Str., Kaliningrad, 236000, Russia
Email: sea@atlant.baltnet.ru

Biohydrochemical parameters of pelagic ecosystems as well as small pelagic fish biomass (sardine, horse mackerel, sardinella) in the coastal upwelling regions undergo significant interannual variations caused by environmental influence. The main purpose of this study is to define and describe the scales and nature of interannual variability of primary production, chlorofyll a, phyto- and zooplankton distributions as well as to reveal peculiarities of pelagic fish biomass redistribution under the influence of structure and dynamics of water masses in the NE Atlantantic (Canary upwelling region) and SE Atlantic (Benguela upwelling region). Furthermore, the interrelations of these regions' processes have been investigated. Data of oceanographic surveys, surface temperature and surface atmospheric pressure fields as well as altimeter surface height field were used to examine the water circulation in the regions. Empirical orthogonal function analysis was performed to compare the processes under investigation. It is shown that pelagic ecosystem parameters in upwelling regions essentially depend on waters structure and dynamics, which in turn depend on atmospheric circulation. Interrelation between interannual variations of biooceanographic processes in the Canary and Benguela upwelling systems is revealed.

Mesoscale physical forcing of pulsed export of labile biogenic material to the deep Sargasso Sea

M. H. Conte[1], T. M. Dickey[2], J. C. Weber, R. J. Johnson and A. H. Knap[3]
[1] Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA
[2] University of California Santa Barbara
[3] Bermuda Biological Station for Research
Email: mconte@whoi.edu

Considerable attention has focused on the role of mesoscale features in affecting biogeochemical fluxes in the Sargasso Sea. In late fall 1996, the Bermuda Testbed Mooring (BTM) and Bermuda Atlantic Time Series (BATS) shipboard sampling evidenced a large phytoplankton bloom at the Bermuda time-series site. This bloom was strongly forced by the interplay between seasonal mixed layer destratification and perturbation of mixed layer dynamics due to passage of a warm mesoscale feature, possibly an eddy remnant, having a thick warm, low salinity thermostad >180m in depth. Nutrient, chlorophyll and pigment profiles indicated entrainment of nutrients and stimulation of phytoplankton growth by intermittent deep mixing to the base of the thermostad. Integrated 0-200 m zooplankton biomass was also several-fold greater inside the feature, and drifting sediment traps at 200 m depth recorded greatly increased export flux. Nearly coincident with the arrival of this mesoscale feature in surface waters at the time-series site, the Oceanic Flux Program (OFP) sediment trap at 3200 m depth recorded an abrupt, factor of 2.5 increase in mass flux. Even more dramatic was the observed increases in fluxes of labile organic biomarkers of phytoplankton and bacterial origins, which increased by factors of 5-30. Differences in temporal phasing of flux components suggested significant modifications of the sinking bloom materials by mesopelagic grazers. These results show that transient, physical forcing by warm mesoscale features - which include but are not limited to eddies - can have an enormous effect on the export flux of labile biogenic material. The occurrence of episodic, high flux events throughout the OFP time-series record suggests that flux events associated with transient, mesoscale physical forcing may exert a major control on the total export of bioreactive carbon and associated elements to the deep oligotrophic ocean.

Ten years of numerical studies on the pelagic Mediterranean ecosystem.

A.Crise, G. Crispi, D. Melaku Canu, V. Mosetti, C. Solidoro, I. Tomini
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS.
Email: acrise@ogs.trieste.it

Mediterranean Sea is characterized by its peculiar dynamics and trophic conditions, and it is governed by an external forcing subjected to a prominent seasonal cycle with superimposed an interannual variability. The aim of this presentation is to gain deeper insight on the processes that convey such variability to the Mediterranean pelagic community by means of the response of the upper ocean food web. The results obtained through the implementation of three-dimensional eco-hydrodynamical models of increasing detail for the biotic component starting from a classical NPZD-like scheme to multi-nutrient two-compartment primary producers biomass models. Major achievements in explaining the Mediterranean behaviour have been derived from model results, corroborated by *in situ* and remotely sensed data. These achievements can briefly summarized:
1) East-West trophic gradient can be explained only if, in addition to the estuarine inverse circulation, the biological pump is added to the nutrient advection in the main thermohaline cell.
2) The seasonal cycle of primary producers is always conditioned at basin scale by nutrients availability, while PAR and temperature are less involved in limitation of primary production.
3) A scenario analysis on the Mediterranean resiliency even in case of strong atmospheric input is proof of the \'self-purification\' capability of the upper layer.
4) The buoyancy content, being a potential energy, acts as an integrator of the atmospheric forcing and permits to decouple in time the biotic response from the atmospheric seasonal and interannual variability.

Sea surface ecosystem and oceanic waves

Dandonneau Yves, Andrès Vega, Christophe Menkes, Hubert Loisel, Gisèle Champalbert and Yves Dupenhoat
LODYC, Tour 15, Case 100, Université Pierre et Marie Curie, 4 place Jussieu, 75252 Paris Cedex 05, France
Email: yd@lodyc.jussieu.fr

The bottom of the sea is a boundary on which carbon containing particles concentrate after sinking. The study of downward carbon flux is an important issue for JGOFS. Similarly, buoyant biogenic material can accumulate at the sea surface and should concentrate in current convergences. There have already been indications of such processes. For instances, a "line in the sea" of extremely dense diatom mats was observed at a subduction front of a tropical instability wave. It could not be explained by the supply of nutrients and phytoplankton growth. Rather, strong current convergence at the front provoked the positively buoyant diatom accumulation. Such phenomenon may not be episodic since the tropical instabilities are often associated with such convergent areas. Other observations, such as the SeaWiFS chlorophyll anomalies propagating with Rossby waves in the south Pacific subtropical gyre also suggest of such surface accumulations. So far, mechanisms underlying such co-propagations have mainly focused on vertical processes. However, we show that the chlorophyll-rich areas within the waves are found in the convergence (downwelling) areas. As such, they can hardly be explained by inputs of nutrients from below. Rather we suggest that it is the concentration of buoyant biogenic material in the convergence areas that create the apparent chlorophyll concentration. The use of a radiative transfer model indeed shows that even small amounts of particles accumulated at the surface of oligotrophic areas will change the oceanic reflectance in the same way as an increase in chlorophyll concentration.

Distribution of nutrients, chl-a, POM and primary production in relation to the prevailing hydrographic features of the NE Mediterranean

D. Ediger, S. Tuğrul, and A. Yılmaz
Middle East Technical University, Institute of Marine Sciences, P.O.Box 28, 33731, Erdemli, Turkey
Email: dilek@ims.metu.edu.tr

Nutrients, particulate organic matter, chlorophyll-a and primary production measurements were performed at three different regions (cyclonic, frontal and anticyclonic) in the northeastern Mediterranean during 1991-1994 period. Particulate organic matter profiles showed subsurface maxima in the cyclonic region and its peripheries where the nutricline was situated near the 1% light penetration depth. These peaks coincided with the chlorophyll maximum. The particulate organic matter peaks for early spring were broader and also appeared at shallower depths than those in the summer-autumn period. However, under prolonged winter conditions, as experienced in 1992, the surface layer of the Rhodes cyclonic region was composed completely of the relatively nutrient-rich deep waters, where vertically uniform profiles yielded average concentrations of 0.50 μgL-1 for chlorophyll-a and 2.45, 0.16, 0.02 μM for particulate organic carbon, nitrogen, and phosphorus, respectively. Total production rate for the water column ranged between 38.5 and 457 mgCm-2d-1 for oligotrophic summer conditions and moderately mesotrophic cool winter conditions respectively. The main goal of this study was to improve understanding of the dynamics governing the structure and function of ecosystem of the NE Mediterranean.

The 1997/98 El Niño in the Humboldt Current System: a synthesis.

R. Escribano, G. Daneri, L. Farías, V. A. Gallardo, H. González, C. B. Lange, C. E. Morales, S. Pantoja, O. Pizarro, R. Quiñones, W. Schneider, and O. Ulloa.
Center for Oceanographic Research in the Eastern South Pacific (COPAS), Universidad de Concepción, P.O. Box 160C, Concepción, Chile.
Email: hgonzale@uach.cl

The Humboldt Current System (HCS) sustains its high biological productivity upon wind-driven upwelling. This system however is subjected to major interannual variability caused by the ENSO cycle. The general view supports the idea that drastic changes may occur in the community structure and biological production as a consequence of alternating El Niño/La Niña periods. The recent 1997/98 El Niño (EN) provided an opportunity to carry out multidisciplinary studies in different regions along the Chilean coast. This contribution is an attempt to synthesize information on the major changes associated with this event. The oceanographic changes associated with the 1997/98 EN in the central and southern regions included intrusions of oceanic, low-nutrient, warmer, and more oxygenated waters into the coastal areas. These changes were responsible for the following effects: a)Reduction in the extension of the productive zone; b)Changes in the "normal" seasonal regime of benthic hypoxia and macrofaunal biomass in inshore sediments; c) Disappearance of the filamentous bacteria Thioploca; d) Benthic bioturbation enhancement; e) Alteration of nursery and feeding habitats of jack mackerel. Abnormally high temperatures prevailed for nearly one year and thermocline and oxycline deepening occurred down to 200 m. It is revealing however that despite the clearly altered oceanographic conditions for one, or even more than one year, there were no collapses of major fisheries and the production capacity in all trophic levels of the upwelling regions considered seemed to have rapidly recovered for the subsequent seasons after the EN retreat.

The key role of thermal speciation in marine organisms

Wulf Greve
German Centre for Marine Biodiversity Research (FIS) and c/o DESY Geb. 3, Notkestr. 85, D-22607 Hamburg, Germany
Email: wgreve@meeresforschung.de

The speed of physiological processes is temperature controlled. The functional relationships determining these processes are the Q10 rule and the species specific temperature-tolerance and temperature-preference responses. The later determine the local temporal and general latitudinal distribution of populations. Global temperature changes alter this distribution in a species-specific way with possibly severe consequences also on the marine ecosystems. Marine research has documented such responses in algae, in holo- and in merozooplankton though this aspect is not integrated into general research strategies. The determination of the species specific temperature responses should be studied on the bases of time-series analysis, biogeography, physiological laboratory studies and advanced computer simulations to integrate physiological and ecological demand and environmental offer. Phenology and biometeorology are disciplines of growing importance in marine ecology. A strategy of implementation to be put forward at the next ICES assembly will be presented.

The Bermuda Atlantic Time-series Study (BATS): A time-series Window on Climate forcing of ocean variability

Anthony Knap, Nicholas Bates, Michael Lomas, Rod Johnson
Bermuda Biological Station for Research, Inc., St. Georges, GE 01, Bermuda
Email: knap@bbsr.edu

The Bermuda Atlantic Time-series Study (BATS) located in the Northwestern Sargasso Sea, was started over 14 years ago as part of the Joint Global Ocean Flux Study. The BATS sampling region lies ~82km southeast of Bermuda in about 4600m of water near the Ocean Flux Program site and the Bermuda Testbed Mooring. Over this 14-year period, a suite of core measurements has been made monthly or bi-weekly during the winter/spring bloom period (January to April). These measurements cover a wide range of physical, chemical and biological stock measurements. In conjunction with these stock measurements, a number of BATS core rate process measurements are made such as primary and bacterial production, and particle mass flux. Over the record of this program, numerous ancillary projects have greatly enhanced the significance and interpretability of the core measurement. More importantly, this 14-year time-series data set has provided information that allows us to re-examine some of the dominant paradigms in biological oceanography, name that the open ocean is an unchanging biological "desert" as well as the role of climate forcing on the biogeochemistry at the site. The past decade has seen a shift in fate of the carbon fixed during primary production. This change in the partitioning of primary production appears to be associated with significant changes in phytoplankton community structure and climatic forcing. The interannual anomalies of hydrography and ocean biology and biogeochemistry are partially linked to large-scale climate variability such as North Atlantic Oscillation (NAO) and El Niño Southern Oscillation (ENSO). Temperature, mixed layer depth, primary production, phytoplankton community structure and TCO_2 anomalies are correlated with NAO variability, with cold anomalies at BATS generally coinciding with NAO positive states. Salinity, alkalinity and $nTCO_2$ anomalies were correlated with the Southern Oscillation Index (SOI), lagging ENSO events by 6-12 months.

Estimation of the impact of submarine groundwater discharge on the bio-geochemical parameters of coastal waters

Evgeny Kontar, G.I. Shapiro, and L.I. Lobkovsky
P.P. Shirshov Institute of Oceanology Russian Academy of Sciences, 36, Nakhimovsky prospect, Moscow 117851, Russia
Email: e_kontar@hotmail.com

We are working on the estimation of the impact of submarine groundwater discharge (SGD) on the biogeochemical parameters of coastal waters. It is important to obtain reliable quantitative estimates of both in coming and outgoing fluxes of fresh cold waters. In situation that incoming groundwater is cold enough to occupy the lower part of the stratified water column on the shelf, transport processes in the bottom boundary layer dominate the removal of discharged water from the coastal zone. Physical mechanisms of such removal seem to be similar to the mechanisms of dense water cascades off the continental shelf over the shelf break. Cascading is a specific type of thermohaline circulation, in which dense water formed over the continental shelf descends down the continental slope to a greater depth. This process is a major component of ventilation of intermediate and abyssal waters, hence affecting thermohaline circulation and global climate. The resulting flows produce an irreversible exchange of oceanic and shelf waters and take an important role in biogeochemical cycles by removal of phytoplankton, carbon and chlorophyll from productive areas. Because it can take decades or more for the subducted water to re-surface, water cascades contribute to long term climatic variability. It is common to consider formation of dense water by cooling, evaporation or freezing in the surface layer. SGD can provide an alternative mechanism of dense water formation also responsible for physical forcing of biogeochemical cycling on the shelf.

Gaining insight into the interannual variability of air-sea CO_2 fluxes using satellite observations

Corinne Le Quere[1] and Nicolas Gruber[2]

[1] Max-Planck-Institut for Biogeochemistry, Postfach 100164, D07701 Jena, Germany
[2] IGPP & Dept. of Atmospheric Sciences, 5853 Slichter Hall , University of California, Los Angeles, Los Angeles, CA 90095-4996, USA
Email: lequere@bgc-jena.mpg.de

While estimates of interannual air-sea CO_2 flux variability in the tropics tend to converge, the role of the mid and high-latitude oceans is poorly understood. Most of the interannual variability in air-sea CO_2 flux at these latitudes is caused by variations in surface ocean mixing and associated entrainment, in biological export production, in warming or cooling of surface waters, and in gas exchange velocity. Each of these processes leaves a signature that has been observed by satellite for at least five years. Here we present a first attempt to quantify these processes and their contribution to air-sea CO_2 flux variability in the extra-tropics: we use sea surface height (SSH) to estimate variations in entrained DIC, chlorophyll a for export production, sea surface temperature for the solubility, and wind speed for the gas exchange coefficient. The reconstructed interannual variations in air-sea CO_2 flux are the order of +/-0.5 PgC/yr when integrated over an entire basin. These estimates are larger than those deduced from ocean model simulations, but the satellite inferred estimates are also associated with large ncertainties. Although our estimates are highly dependent on the selected data and algorithms, they present the advantage of being based on observations and not on ocean models, which are known to vary too little at high latitudes, or on atmospheric inversions, which have difficulty to separate the land from the ocean.

The role micro-phytoplankton in bio-elemental cycling in stratified oligotrophic waters of the North Pacific Subtropical Gyre

R.M. Letelier[1], D.M. Karl[2], M.R. Abbott[1], R. Bidigare[2], A. White[1]
[1] COAS-Oregon State University
[2] SOEST-University of Hawaii
Email: letelier@coas.oregonstate.edu

Under stratified conditions oligotrophic pelagic environments are thought to be dominated by pico-phytoplankton assemblages whose growth are fueled by regenerated nutrients. Implicit in this conceptual model is the tight coupling between rates of photosynthesis and community respiration in the upper water-column. Only the aperiodic supply of nutrients to the euphotic zone due to short lived physical perturbations (e.g., deep-mixing events, cyclonic eddies, and the breaking of internal waves) may allow a temporal or spatial imbalance between these metabolic processes, leading to increased algal biomass and the subsequent export of organic matter. Over the past 15 years, field and satellite observations in the vicinity of Station ALOHA (22.75° N, 158°W) have documented extensive blooms of micro-phytoplankton during extended periods of well stratified that appears to contradict the predictions of this conceptual model. These blooms are characterized by the dominance of large cell size phytoplankton, especially diatoms and colony-forming cyanobacteria (e.g., Trichodesmium). To date, all identified algal species responsible for these blooms have been shown to regulate their buoyancy and fix di-nitrogen or host symbiotic di-nitrogen fixing bacteria. These characteristics allow the potential use of nutrient sources that are not available to other phytoplankton taxa. The Hawaii Ocean Time-series scientists have sampled repeatedly these summer blooms and recorded an increase in elemental fluxes during them. In the present study we summarize the significance that these distinct events have in bio-elemental cycles in the NPSG.

Interannual variability in the Agulhas Current System : a comparative study between a coupled physical-biological model and multi-remote sensing data sets.

Jerome Llido[1] , Eric Machu[2], Isabelle Dadou[1], Veronique Garcon[1]
[1] LEGOS, 14 Avenue Edouard Belin, 31400 Toulouse Cedex 4, FRANCE
[2] CERFACS, 42 Avenue Gaspard Coriolis, 31057 Toulouse Cedex 1, FRANCE
Email: llido@notos.cst.cnes.fr

A 1D wavelet analysis is performed on 4 years (October 1997-September 2001) time series of different satellite data sets: SeaWiFS chlorophyll a, Topex/ERS mapped sea level anomaly (MSLA) and sea surface temperature (SST), in the Agulhas Current system south of south Africa. Concurrently, a three dimensional coupled physical/biological model is used with an eddy-permitting resolution (1/3 of degree) in the Agulhas region. Two different conditions of forcing are examined: an ECMWF monthly climatology and monthly means over the 1995-2001 period of the NCEP reanalysis. A similar wavelet analysis is carried out on modelled SST, chlorophyll a and sea surface heights. The range of dominant wavelengths of the Rossby wave associated to the meanders of the Agulhas Return Current and Subtropical Convergence in the longitude band 15-45E, varies between 380 and 760 km. We examine the time and space variability of this frontal system comparing phytoplankton distribution with the dynamical fronts, using both satellite data sets and modelled distributions. The variance of each signal, provided by the meridional average of the power Hovmoller, and model outputs are used to quantify precisely the observed interannual variability associated to the ARC Rossby wave in this dynamic region.

C-N-P flux from Brahmaputra-Ganges system to the Bay of Bengal: Potential Impact on the Biogeochemistry of the Indian Ocean

C. Mahanta and R.K. Goswami
Department of Civil Engineering, Indian Institute of Technology - Guwahati
Email: mahanta_iit@yahoo.com

Early signs of global change would appear earlier in the places of most sensitive nature; biogeochemical hot spots like the Brahmaputra basin, which is located at the transitional zones between different climatic regions and different distinct ecosystems, that of the cold dry climate of the Tibetan plateau and the warm tropical climate of the Assam-Bangladesh plains, where temperature contrast will occur earlier than other regions. The thermal and dynamic influence of the Tibetan Plateau not only plays a significant role in the evolution and formation of the Asian monsoon circulation; it affects climatic modulation of organic matter fluxes through the Ganges-Brahmaputra as well.
In the light of the Brahmaputra-Ganges system carrying almost 5% of the global dissolved and particulate C-N-P input (due to its highest sediment load) to the Bay of Bengal, current uncertainty about its future effect on the ecological and biogeochemical processes of the Indian ocean is increasing which may have critical implications for the marine food webs. The magnitude and direction of the change could be significant both in relative and absolute terms and continental shelf areas including Indian coastal ecosystems could experience diverse impacts due to modified coupled C-N-P cycles. The future of biogeochemistry of the Indian Ocean may be impacted significantly by the nutrient flux of the Brahmaputra-Ganges and its role in the evolution of marine ecosystem of the Indian Ocean could be vital.

Links between trophic interactions and biogeochemical fluxes mediated through small-scale hydrodynamics: First efforts of the NTAP project.

C. Marrase[1], J. Dolan[2], J. Egge[3], H. Havskum[4], A. Metcalfe[5], T. Pedley[5], F. Peters[1], F. Thingstad[3], M. Vidal[1].
[1] Institut de Ciencies del Mar (CSIC), Barcelona, Spain
[2] Laboratoire d'Oceanographie de Villefranche (CNRS), Villefranche sur-Mer, France
[3] University of Bergen, Bergen, Norway
[4] Marine Biological Laboratory, Helsingoer, Denmark
[5] University of Cambridge,UK
Email: celia@icm.csic.es

The effects of turbulence on plankton modulate the flux of nutrients and carbon. However, models of biogeochemical fluxes usually do not consider turbulence as a factor affecting biological processes at small scales. This is due to the scarcity of data available and to some apparent contradictory results. Turbulence increases the flux of nutrients to cells. This increase varies from negligible to significant as cell size increases, and depends also on cell motility. Thus turbulence induces changes in processes (nutrient uptake) and structure (size and species distribution) of planktonic organisms. We hypothesize that these changes should be reflected in the quality of particulate organic matter. Within the NTAP project, we did experiments to test effects of turbulence on plankton structure for a range of different initial conditions. We found turbulence altering the size and species distribution. While at low nutrient concentrations turbulence induced no changes in size distribution, at high nutrient concentrations we found turbulence favoring larger cells. Turbulence also affected the stoichiometry of organic matter. The proportion of carbon to phosphorus in particulate organic matter was higher under turbulence treatments. The importance of this effect varied depending on the inorganic nutrient conditions. Our results show that multifactorial approaches should be considered when studying the effect of turbulence on plankton dynamics, as the hydrodynamics of the system affect different processes simultaneously. A conceptual framework of possible scenarios is presented based on the results obtained so far.

Validation of Ocean Color Sensors in Case 2 waters: The biogeochemical processes in the Gulf of Cadiz (SW, Spain)

Mata, A.J.[1]; Ch. Ponsard[2]; C. Jiménez[1]; J. Morales[1]; A. Mangin[2]
[1] CICEM Agua del Pino. PO Box 104, 21071 Huelva (Spain)
[2] ACRI SA, Route Du Pin Montard 260, 06904 Sophia Antipolis, CEDEX (France)
Email: ajmata@cica.es

It is a common trend in the current oceanography research the assimilation of satellite data and *in situ* measurements. For this study chlorophyll concentrations derived from the ocean color sensors SeaWIFS (ocv4 obtained at the ACRI receiving station in Southern France) and MODIS Terra (MODO CL2B product from NASA-DAAC) were validated against laboratory measurements of chlorophyll *a* concentrations obtained from four subsurface (1 metre underwater) water samples, taken within a weekly monitoring program developed along the Case 2 waters of the Huelva coastal region (Gulf of Cadiz, SW-Spain) for one year. The biological information derived from the images was complemented with SST image data from NOAA satellites for an analysis in which both parameters were used together in the study of the coupled physical-biological processes in this region. Correlation between spectrophotometry and HPLC chlorophyll *a* determinations was calculated, resulting in a coefficient of 0.946 (significance level = 0.01). Laboratory measurements were then correlated with the chlorophyll *a* values derived from SeaWifs and MODIS-Terra. Preliminary results show a weak correlation ($R^2 < 0.60$) between both satellite data and HPLC measurements, which would stress the relevance of further adjustments in the global ocean color algorithms or the need for specifically tailored regional algorithms. However, the combined use of chlorophyll and SST imagery provide a better understanding of the physical-biological processes that any single analysis.

Tropical Instability vortices: a major control of the ecosystem in the tropical Pacific and Atlantic oceans

Menkes Christophe, Dandonneau Yves, Marchal Emile, Landry Michael, Kennan Sean, Vialard Jérome, Flament Pierre, Champalbert Gisèle, Radenac Marie-Hélène.
Author_affiliations: LODYC, Tour 26, case 100, Université Pierre et Marie Curie, 4 Place Jussieu, 75252 Paris Cedex 05, France
Email: menkes@lodyc.jussieu.fr

Tropical Instability Waves and their associated tropical instability vortices have been suggested to exert major controls on the ocean and atmosphere dynamics, thermodynamics and marine biology in the equatorial Atlantic and Pacific oceans. These controls range from sub-mesoscale processes (sharp frontal areas <(1 km) involving vertical ocean velocity >(1 m/s)) to meso-scale vortex processes ~500 km with horizontal velocities >(1m/s) and vertical velocities ~50 m/day. These phenomena are prominent during the upwelling seasons when the equatorial upwelling is transformed into a succession of striking north-south undulations of SST and chlorophyll fronts detected in remotely-sensed data. Such undulations are clearly under the control of the complex 3-D flow associated to the vortices. These very energetic ocean vortices has also been suggested to shape the marine ecosystem (phytoplankton, zooplankton, micronekton) up to the highest trophic levels and to constitute, in the equatorial Pacific ocean, a natural analog of an iron enrichment experiment in a region that is HNLC (High Nutrient Low chlorophyll). In this study, we review the present stage of observational and modeling backgrounds, present the major questions about the control of the vortices onto the marine ecosystem and present observational plans to better understand the dynamical and biological coupling on these scales.

Climate change in the North Pacific region over the last three centuries

G.W.K. Moore, G. Holdsworth, K. Alverson
University of Toronto, University of Calgary, PAGES International Project Office
Email: alverson@pages.unibe.ch

The relatively short length of most instrumental climate datasets restricts the study of variability that exists in the climate system. This is particularly true regarding the atmosphere where high quality spatially dense data exists only since the late 1940's3. With this data, the Pacific North America pattern (PNA) has been identified as one of the dominant modes of variability in the atmosphere. The PNA is related to an inter-decadal mode of climate variability known as the Pacific Decadal Oscillation (PDO). The PDO has been shown, over the past 50 years, to influence marine productivity in the North Pacific as well as modulating the impact of the El Niño-Southern Oscillation in North America and Australia. Here we present an updated 301-year ice core record from Mount Logan in northwestern North America that shows a statistically significant and accelerating positive trend in snow accumulation from the middle of the 19th century that appears to be associated with secular changes in the PNA. A manifestation of this trend has been a warming over northwestern North America both at the surface and throughout the lower atmosphere. The implication of this, and other multi-century long paleo-records for the correlation between north pacific climate and salmon fisheries will be discussed.

Primary productivity and instantaneous transport of salt, chlorophyll-a, seston and dissolved nutrients in a polluted tropical estuarine system.

Moser, G. A. O.; Gianesella, S. M. F.; Barrera-Alba, J. J.; Catenna, C. de O.; Saldanha-Corrêa, F. M. P.; David, C. J.; Luvison, A. B. L.; Miranda, L. B. de & Harari, J.
Instituto Oceanográfico. Praça do Oceanográfico, 191. CEP 05508-900. 55-11-30916551. São Paulo, SP.Brazil.
Email: gleyci_moser@terra.com.br

Santos Estuarine System at the Southern Brazilian coast comprises two main estuarine channels directly connected to Santos Bay. The area experiences heavy urban, industrial and portuary activities which lead to sewage disposal along the whole system. The domestic effluents of Santos City are disposed through a submarine outfall in Santos Bay since 1979.The present study is the first effort to determine the contribution of the estuaries to the eutrophication of Santos Bay, quantifying the transport of several non conservative properties: dissolved inorganic nitrogen, phosphate, seston and chlorophyll-a, besides a conservative one, salt, during dry and rainy seasons. Moreover phytoplanktonic primary productivity, bioassays with *Phaeodactylum tricornutum* and nutrients concentrations were used to achieve the currently eutrophication level of the estuarine system. Three cruises took place in August/1999 (dry season) January/2000 (rainy season) and March/2000 (end of the rainy season). In each survey the sampling activities were carried out during spring and neap tides, in two transects in the estuaries mouths and in 6 stations in the inner zone of the system and Santos Bay. Considering the submarine outfall sporadic discharge of 7 m3/s and the estuarine mean discharge of 102 to 103 m3/s, instantaneous transport balance pointed out the estuaries as the major sources of nutrients, seston and phytoplanktonic biomass to the bay, particularly during periods of higher freshwater discharge. Comparing the present data to previous studies of 20 years ago, evidences suggest that the eutrophication level of this estuarine system is still critical.

May prey genes be used to determine zooplankton feeding *in situ*?

Jens C. Nejstgaard[1], Marc E. Frischer[2,3], Rita Gruebel[2], Peter G. Verity[2]
[1] University of Bergen, Norway
[2] Skidaway Institute of Oceanography, Savannah, Georgia, USA
Email: jens.nejstgaard@ifm.uib.no

The ability to determine trophic interactions is vital for understanding mechanisms that structure complex aquatic ecosystems. However, despite decades of research, methods to quantify selective feeding of the entire prey range by non-manipulated zooplankton *in situ* have been lacking. Molecular methods based on the polymerase chain-reaction (PCR) have been successfully applied to detect ingested prey in insects and recently we have applied them to marine copepods. In these studies we demonstrated the successful extraction and PCR amplification of algal 18S ribosomal DNA from prey inside calanoid copepods and freshly produced faecal pellets. The PCR-products from closely related prey algae species and pure copepod extracts were unambiguously differentiated from the target prey. The results also suggest that the prey DNA may be quantified for determination of prey specific zooplankton feeding rates. Therefore, we argue that this should be an excellent tool for zooplankton studies, with a potential to quantify undisturbed trophic interactions between individual predators and all their prey in the complex natural plankton.

Evaluation of seasonal air-sea CO_2 fluxes in global ocean carbon-cycle models

James C. Orr[1], Olivier Aumont[2], Laurent Bopp[1], and the OCMIP group
[1] LSCE/CEA-CNRS and IPSL, Bat. 709 L'Orme, F-91191 Gif-sur-Yvette, FRANCE
[2] LODyC, Univ. Pierre and Marie Curie and IPSL, Paris, FRANCE
Email: orr@cea.fr

During the second phase of the Ocean Carbon cycle Model Intercomparison Projet (OCMIP-2), we compared simulated results to data-based estimates of the air-sea CO_2 flux, obtained by multiplying the observed estimates of the difference between surface ocean and atmospheric pCO_2 (i.e., Del p CO_2) times the OCMIP-2 fields of gas exchange. To compare the full space-time distribution at the global scale, we used the recently developed Taylor diagram to assess model performance in regards to the zonal annual mean, zonal anomalies, and seasonal anomalies. The OCMIP-2 models all performed well in regard to their ability to simulate the zonal annual mean. However, none of the models showed skill in simulating the zonal or seasonal anomalies. The seasonality problem is caused by problems with ocean physics or the common Biotic model used in OCMIP-2, which has no explicit plankton dynamics. Here we will show analysis that localizes the seasonality problem, e.g., Southern Ocean vs. tropics vs. subtropics. Furthermore, we will show to what extent a more sophisticated biogeochemical model (PISCES with explicit plankton dynamics and micronutrient limitation) improves the correspondence with observed estimates of the air-sea CO2 flux.

Building the link between the basin scale signal and eastern boundary current systems using a suite of coupled models

Pierrick Penven and Claude Roy
Institut de Recherche pour le Developpement, 213 rue La Fayette, 75480 Paris Cedex 10, France
Email: penven@univ-brest.fr

On eastern side of ocean basins, wind induced divergence generates upwelling of subsurface water along the coast. The resulting enrichment of the surface waters dramatically enhances biological productivity. As a result, these eastern boundary ecosystems are able to sustain intense fishing activities and contribute to 30% of the world fish catches. In those regions, the variability of the coastal environment is controlled by instability processes, changes in surface forcing and the remote influence of large scale oceanic variations. Although upwelling processes are relatively similar in each eastern boundary current region, they exhibit important regional peculiarities. For example, the shelf can be more than 200 km wide of Northwest Africa, and is almost inexistent along the coast of Peru and Chile. The Benguela upwelling system is bounded in the South by the Agulhas current and in the North by the Angola front, while the South American upwelling extends from the equatorial region down to 45S. The importance of local versus remote forcing is also drastically different, the Pacific regions is dominated by ENSO type variability while in the Atlantic local and seasonal forcing appear to be the dominant driving forces. A framework based on a set of numerical tools will be build to perform a comparative analysis of the dynamic of three major upwelling systems: the Benguela in the South Atlantic, the Canary current system in North Atlantic, and the Humboldt in the South Pacific. The numerical choices will be the same for each configuration to allow inter-comparisons. In a first approach, we will concentrate on the mean circulation, the seasonal cycle and the mesoscale dynamics. At a later stage, it is expected that this suite of coastal models can be used to build the link between the basin scale signal and the processes on the shelf, thus providing the tools for building scenarios of the impact of global climate change on coastal ecosystems.

Effects of simple climate change on primary production on the NW European Shelf

R. Proctor[1], R; Holt, J.T. [1]; Allen, J.I.[2]; Blackford, J.[1]; Ashworth, M.I. [3]
[1] Proudman Oceanographic Laboratory, UK;
[2] Plymouth Marine Laboratory, UK
[3] Daresbury Laboratory, UK
Email: rp@pol.ac.uk

The annual cycle of primary production on the NW European continental shelf is simulated with a 3-dimensional coupled hydrodynamic/biogeochemical model (Allen et al, 2001, Sarsia,86:423-440). Simple climate changes to surface winds and air temperature, representative of the mid 21st century scenarios predicted by the Hadley Centre Climate model, are applied to the meteorological forcing to investigate their impact on the shelf-wide primary production. Changes to both the timing and amplitude of the spring bloom are produced and a complex spatial response is seen.

Particle fluxes and organic carbon budget in the Almeria-Oran front in the eastern Alboran Sea

A.Sanchez-Vidal, A.Calafat, M.Canals, J.Fabres, J.Frigola
GRC Geociències Marines, Dept. d'Estratigrafia, Paleontologia i Geociències Marines, Universitat de Barcelona, E-08028, Barcelona, Spain
E-mail: asanchez@natura.geo.ub.es

Surface Atlantic waters entering the Alboran Sea through the Strait of Gibraltar form two quasi-permanent anticyclonic gyres, the Western and Eastern Alboran Gyres, and a geostrophic front, the Almeria-Oran Front. Previous studies uncovered seasonal enhancements of the sea surface primary production both at the northern edge of the Western Alboran Gyre and at the Almeria-Oran Front triggered by coastal and eddy-related upwelling. The present study is an attempt to establish the link between the temporal evolution of biophysical processes in surface waters and particle fluxes down the water column. Particle flux data were obtained from three mooring arrays deployed during one year following a N-S transect along 1º 30' W in the Eastern Alboran Sea. The particle flux monitoring experiment was performed within the EC funded MTPII-MATER multidisciplinary project. Integrated analysis of particle flux, currentmeter data and satellite sea surface images (SST and chlorophyll-a concentration) reveals that particle fluxes down the water column are function of primary production, lateral advection and near bottom nepheloid input. The spreading of a fertilised jet, which is controlled by the position and size of the two Alboran gyres, drives the arrival of biogenic material to intermediate waters (500-700 m) everywhere in the Eastern Alboran Sea. The seasonality of particle flues is also recorded at deeper intermediate waters (1000-1200 m) and near bottom waters, thus suggesting that productivity events are rapidly transferred through the water column. Discrete lateral advection events can input particulate matter at intermediate (1000-1200 m) and near bottom depths as noted at the northern and southern stations. A vertical organic carbon budget has been estimated using satellite-derived primary production, algorithm-calculated primary organic carbon fluxes down the water column, recorded organic carbon fluxes at the three trap depths, and mean accumulation rates in bottom sediments. Results suggest high influence of the jet in the particulate organic carbon export relative to primary production, thus in the dynamics of the carbon reservoir in the Eastern Alboran Sea.

Introducing microscale patterns and processes into global scales

Schmitt F, Seuront L, Souissi S
Station Marine de Wimereux - CNRS UMR 8013 ELICO, Université des Sciences et Technologies de Lille - 28 avenue Foch - 62930 Wimereux - France
Email: souissi@pop.univ-lille1.fr

The reality and the potential impacts of microscale patterns and processes on the global scales can no longer be neglected regarding the fast growing evidence of the strong space-time structure of biological, chemical and physical fields at organisms individual scale. First, on the basis of original sampling device, data analysis and modelling techniques, we will illustrate how we can measure and quantify microscale heterogeneity of major parameters for ocean structure and function. Then, we will more specifically illustrate how the consideration of the intermittent character of turbulent processes can significantly modify the outcome of salient processes as predator-prey encounter rates, nutrient fluxes towards phytoplankton cells, phytoplankton coagulation and sedimentation rates. Further, because microscale patterns and processes are the most relevant at the individual scale, we will show on the basis of both analytic and individual based models how phytoplankton primary production and zooplankton secondary production and population dynamics can be affected of several orders of magnitude. We will also illustrate how regional and global scale modelling could be improved with a more involved closure, inspired by recent developments from engineering fluid mechanics literature. We will finally argue that if some of the previous hypotheses have been tested using specifically designed empirical set-up and in situ experiments, a complete understanding of the ocean functioning still badly needs to give more importance to small-scale processes and their variability, before performing large-scale averages and renormalizations.

Interference of hydro-electric power production with a marine food web

Stig Skreslet
Faculty of Fisheries and Natural Sciences, Bodoe College, N-8049 Bodoe, Norway
Email: Stig.Skreslet@hibo.no

The atmospheric pressure gradient in the North Atlantic forces westerly winds towards the European continent. Oscillations in the latitudinal position of the gradients cause the storm tracks to hit the continent at different latitudes in a periodic mode. During negative phases of the North Atlantic Oscillation (NAO) the winds carry Atlantic water vapor at low latitudes causing wet years in southern Europe. During positive phases the transport occurs at high latitudes and causes large precipitation in Scandinavia. Much occurs as snowfall in the Scandinavian mountain range during winter, and the amount of meltwater determines the vernal freshwater river flow to Norwegian coastal waters during summer. Positive correlations observed between the Norwegian vernal discharge and population parameters in the NE Arctic cod stock in the Barents Sea, may be due to a causal relationship that works through the food-web of the the Arctic Mediterranean Ecosystem. The copepod *Calanus finmarchicus* may be a key to the understanding of the relationship. It forms a large population system in the Northeast Atlantic, and parts of the population reproduce in Norwegian fjords and shelf waters. A spring generation of *C. finmarchicus* is produced in the spawning habitats of NE Arctic cod. The juvenile stage (nauplius) of the species is the most important food source of the cod larvae and their abundance influences the strength of cod year classes. The abundance of nauplii is proportional to the abundance of the parent stock that is produced during the previous summer, possibly as a second generation of *C. finmarchicus* in the Norwegian Coastal Current (NCC), during the period of maximum river discharge. Then, the abundance of nauplii is negatively correlated with surface salinity. The reproductive rate of the copepod is probably forced by the production of phytoplankton that may be stimulated by the volume of freshwater fed into the NCC during summer. The abundance of the second generation is positively correlated with the NAO index, possibly as a function of the hydrological cycle that feed vapor from the North Atlantic into the precipitation and runoff regime of Norway. However, the relationship has been impaired by the anthropogenic effects of regulated river flow in Norway. The construction of hydroelectric power plants has been very extensive after World War II. The reservoirs store meltwater and release the water at other seasons. They have decreased the vernal discharge of meltwater by more than 50 % in some coastal regions. The cumulative effects of numerous hydroelectric plants along the coast have pssibly changed the biological productivity and fish stock recruitment in Norwegian waters, but at present the extent can not be assessed.

On the role of remineralization from a modeling perspective

Yvette H. Spitz, Mark R. Abbott and James G. Richman
Oregon State University, College of Oceanic and Atmospheric Sciences, Corvallis, OR 97331, USA
Email: yvette@coas.oregonstate.edu

In oligotrophic environments, remineralization is a major pathway for providing nutrients to phytoplankton in the upper ocean. In coastal and frontal area, regenerated production, while less than new production, can represent a non-negligible portion of net production. Differential remineralization between nitrogen, phosphorus has been observed in the Pacific and Atlantic Oceans and can control the balance between nitrogen and phosphorus limitation. Similarly, differential remineralization between nitrogen and silicate can determine the balance between nitrogen and silicate limitation in the Southern Ocean. From a modeling perspective, remineralization rates are either taken as constant or implicitly modeled via the microbial loop. Inclusion of the microbial loop in terms of carbon, nitrogen and phosphorus is complicated and most of the models today use constant remineralization rates. Rates are computed based upon remineralization length scales and arbitrary sinking rates for the detritus pool. In this study, we will present the importance of the choice of the remineralization rate and the sinking rate of detritus in the Pacific (Hawaii Ocean Time series), the Atlantic (Bermuda Atlantic Time Series) and the Pacific sector the Southern Ocean (Antarctic Environment Southern Ocean Process Study). We will show how the model can predict either an accumulation or a decrease of nitrogen and phosphorus at HOT when the chosen remineralization rates are the same order of magnitude determined from the observations. We will also illustrate similar behavior in nitrogen and silicate in the frontal region of the Southern Ocean.

Systems and Processes in the Basque Coast (SE Bay of Biscay)

Victoriano Valencia, Javier Franco, Ángel Borja, Maria Jesús Belzunce and Oihana Solaun
AZTI Foundation. Department of Oceanography and Marine Environment. Muelle de la Herrera s/n. 20110 Pasajes. SPAIN
Email: vvalencia@pas.azti.es

The Basque Coast is a very interesting marine system due to its geographical placement and to its morphological peculiarities. The SE corner of the Bay of Biscay configures a morphological discontinuity between sharp and flat coast, narrow and wide continental shelf and some other distinctive features. In the pelagic system, the general convergence in to the area as well the influence of the different coastline orientation on the wind-driven transport of the surface water masses constitute other factor of interest of this area. Additionally, in the Basque Coast there are a high number of estuarine systems strongly differentiated by the size of the basin and by other hydrological, morphological and dynamic features and by the anthropogenic pressure (land uses, urban and industrial pollution, harbour activities, etc.) In this area, the Department of Oceanography and Marine Environment of the AZTI Foundation develops a wide spectrum of basic and applied research that include Fisheries Oceanography and Monitoring and Environmental Quality programs related with the European Directives and the International Conventions on water and environmental quality (2000/60 EU Directive, OSPAR Convention, etc.). The presented Poster shows some lines of the own and collaborative research programs of AZTI related with the topics of the I. S. Conference OCEANS. The two main scopes of the presentation are the lines related with the GLOBEC Program (Climate and Atmosphere-Oceans interactions) and with the environmental and ecological quality linked to the anthropogenic inputs of trace elements.

Latitudinal patterns of nitrogen uptake and dissolved organic nitrogen release in the Central Atlantic Ocean: the role of phytoplankton size-structure

M.M. Varela[1], A. Bode[1], E. Fernández[2], V. Kitidis[3], M. Varela[1] and M. Woodward[3]
[1] Instituto Español de Oceanografía. Centro Oceanográfico de A Coruña. Apdo. 130. 15080- A Coruña (Spain)
[2] Universidad de Vigo (Spain)
[3] Plymouth Marine Laboratory (UK)
Email: varela@nioz.nl

The relationships between ammonium, nitrate and urea uptake rates, as well as the release of dissolved organic nitrogen (DON), with phytoplankton size-structure were investigated in the euphotic zone of the Atlantic Ocean from 49º N to 33º S in September 2000. Nitrogen rates were measured using 15N-tracer techniques. In addition, chlorophyll-a concentrations and 14C-based primary production rates were determined in > 2 and < 2 μm size-classes. Inorganic nitrogen concentrations were mainly related to nitrate enrichment in upwelling areas. Ammonium and urea concentrations were generally low. Uptake rates of ammonium (18.2 to 355.4 mmol m-2 h-1), nitrate (4.6 to 2830.5 mmol m-2 h-1) and urea (25.7 to 1211.8 mmol m-2 h-1) covered a wide productivity spectrum, with f-ratio values ranging from 0.06 to 0.97. Small cells contributed between ca. 20 and 80 % to total primary production. However, they accounted for 50 to 80 % of total phytoplankton biomass. The percentage of extracellular DON release relative to nitrogen uptake (PER) was maximum when nitrate was used as substrate (mean 42.2 % ± se =3.1) while ammonium and urea produced lower PER values (21.6 ± 2.1 and 26.3 ± 1.6 %, respectively). An inverse relationship was observed between PER and productivity. In productive areas, where > 2 μm cells dominated, less than 30 % of the total incorporated nitrogen was released as DON. By contrast, in oligotrophic, picoplankton-dominated environments, such as the northern and southern Atlantic gyres, PER exceeded 50 %.

Monsoonal Influence on Seasonal Variations in Nutrients and Phytoplankton Biomass in the Pearl River Estuary and Adjacent Coastal Waters of Hong Kong

Yin, Kedong and Paul J. Harrison
AMCE, HK University of Science and Technology, Hong Kong, South China Sea
Institute of Oceanology, CAS, Guangzhou, China
Email: kyin@ust.hk

The Pearl River is the second largest river in China. Seasonal monsoons are a climatic feature of subtropical regions. However, monsoonal influences on seasonal dynamics of nutrients and phytoplankton biomass have been little studied. This is the first report of such a study using 10 years (1991-2000) time series of water quality data around Hong Kong. In winter when the NE monsoon prevailed, the Pearl River estuary and coastal waters were dominated by high salinities, low nutrients and low phytoplankton biomass. In summer as the SW monsoon dominated and the Pearl River discharge was maximal, the estuarine coastal plume moved across Hong Kong coastal waters. Nitrate was high during summer in the Pearl River estuary and decreased downstream. Chl a was low relative to high nitrogen concentrations, suggesting that the eutrophication effect is not as severe as one would expect from nitrogen over enrichment. Because PO4 was low (<1 μM) in all waters, N:P and N:Si ratios were low in winter and high in summer, suggesting P limitation. Seasonal monsoons serve as a flushing mechanism in two ways: coastal upwelling during summer which reduces seasonal eutrophication effects by nutrient enrichment and the oceanic water dominance during winter prevents long-term (years) accumulation of organic matter in the sediment due to nutrient enrichment.

Long-term variability of vertical chlorophyll profiles in the open Black Sea during warm months: consequence of cultural eutrophication or climatic changes?

Yunev Oleg
Institute of Biology of the Southern Seas, National Academy of Sciences of Ukraine, Nakhimov Av. 2, Sevastopol 99011, Crimea, Ukraine
Email: yunev@sevcom.net

To make clear relationship between development of cultural eutrophication within the coastal zone of the Black Sea, started since the end of the 60s - the beginning of the 70s, and adverse changes in the Black Sea pelagic ecosystem in the end of the 80s and the beginning of the 90s, and taking into account that chlorophyll (Chl) is an acceptable index of phytoplankton biomass and nitrate (NO_3) is the main nutrient responsible for eutrophication in the sea, long-term variability of Chl vertical profiles during warm months and vertical NO_3 profiles during the whole year in the open (>250 m) sea were investigated. The analysis of temporal variability of both characteristics used data sets of 65 cruises since 1960 to 1996 derived from the database prepared within the framework of the NATO TU Black Sea Project. Significant changes in NO_3 profiles, mainly, in maximum increase and its shoaling, were observed up to the beginning of the 1980s followed by stabilization of NO_3 profile parameters. This agrees well with changes of NO_3 discharge into the Black Sea with the waters of Danube and can be explain by the numerous dams built on the river. Opposite, visible changes in Chl profiles, the same as for NO_3, as well as changes in other pelagic ecosystem characteristics, mainly, the harsh decline of the Black Sea fishery and outburst of the comb jelly *Mnemiopsis*, were revealed after 1982, and especially, during 1988-1992. Climatic changes within this period, viz, a decrease of winter sea surface temperature that intensify circulation of the Rim Current and respective intensive uplift of bottom water, which got rich in nutrients owing to previous events, into the surface waters may be plausible cause of changes in Chl profile after 1980. So, both factors, anthropogenic nutrient enrichment before 1980 and climatic changes after 1980 may be responsible for changes in Chl as well as other structural and functional characteristics of the phytoplankton.