

ICES/NAFO Decadal Symposium 2011

Poster Presentations

ICES/NAFO Decadal Symposium 2011/Ref. 7

Time-series of sea surface temperature, nutrients and chlorophyll-a in the south-eastern Bay of Biscay: “*in situ*” measurements along a land-ocean transect

M. Revilla, Á. Borja, A. Fontán, M. González, and V. Valencia

Since 2000, vertical profiles of general physico-chemical variables and chlorophyll-*a*, together with nutrients data in surface waters, are obtained at 3 stations along an inshore-offshore transect, in the south-eastern Bay of Biscay. The inshore station, D0 (43° 20.5' N, 1° 55.0' W) and the station D1 (43° 21.9' N, 1° 55.0' W) are located near the Oiartzun estuary (Basque Country, northern Spain), at 32 and 55 m water depth, respectively. The Oiartzun estuary has been historically conditioned by a high population density and industry. This anthropogenic influence could lead to nutrient over-enrichment and stimulation of primary production. An additional offshore station, D2 (43° 27.3' N, 1° 55.0' W) is considered to be non-impacted, due to its distance (13 km) from the main pollution sources on land.

Previous studies dealt with multidecadal trends of sea surface temperature (SST) and chlorophyll-*a* at D2 station, where a longer time-series exists, since 1986. The trend in the offshore surface waters, for the last 25-years, was to be warmer and with lower chlorophyll-*a*. However, chlorophyll-*a* increased at other depths in the photic layer, probably due to climatic factors. This new study focuses on the spatial and temporal variability of temperature, inorganic nutrients and chlorophyll-*a* in the surface waters along an inshore-offshore transect (D0-D1-D2). The objective is to determine the SST trends and the changes in eutrophication pressure during the last decade, as well as to explore the response of phytoplankton biomass to climatic and anthropogenic forcing over the Basque shelf.

Keywords: Chlorophyll-*a*, SST, eutrophication, Southeastern Bay of Biscay

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The spatial and temporal variability of the East Greenland and its contributions to the Denmark Strait exchanges

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The East Greenland Current originates in the Arctic Ocean and carries, in addition to sea ice and polar surface water, also denser water masses formed or transformed within the Arctic Ocean. In Fram Strait it becomes augmented by recirculating Atlantic water and exchanges waters with the Greenland and Iceland seas as it continues along the Greenland slope and shelf towards Denmark Strait. Recent observations indicate that the densest Denmark Strait overflow water is supplied by a barotropic jet that follows the 600m isobath from the Iceland Sea, while the East Greenland Current provides the warmer core and the low salinity lid. This raises the question; where do the denser waters of the East Greenland Current flow, how do they interact with the gyres in the Greenland and Iceland seas, and how much and by what paths do they contribute to the overflow? Hydrographic observations, mainly CTD data, taken during the last decade from the East Greenland shelf and slope, partly within the EU projects VEINS, ASOF, DAMOCLES and THOR, allow for studying the temporal and spatial variability of the East Greenland Current. Primarily five sections: 79°N in Fram Strait, 75°N in the Greenland Sea, the Icelandic Kogur and Latrabjarg sections in the western Iceland Sea and at the Denmark Strait sill, and the Ammassalik section south of the sill are examined, but also other relevant sections are considered. Signals identified in the different water masses are followed as they propagate southward and their advection speed and downstream transformations are discussed.

Keywords: East Greenland Current, Denmark Strait Overflow, Water masses, Mixing, The Nordic Seas.

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An analysis of the characteristics of Phytoplankton blooming along the Galician coast

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Ocean primary productivity can be highly sensitive to sea surface temperature. As a consequence of warming, latitudinal displacements of population have been reported in regions of the North Atlantic with increasing phytoplankton abundance in cooler regions and decreasing phytoplankton abundance in warmer ones. The development of satellite remote sensing technology allows making routine and high resolution measurements of chlorophyll over the oceans which can help to analyze the spatial and temporal distribution of chlorophyll concentrations in order to explain its variability.

The present work describes the chlorophyll distribution along the Galician coast (NW Iberian Peninsula) taking into account satellite data over the last decade. The related ocean-atmosphere conditions over this period are also analyzed to better describe the formation and seasonal variability of the chlorophyll patterns. Thus, the maximum values of chlorophyll are observed during the spring-summer months (April-September) near the coast, mainly along the western Galician coast. This situation agrees with the occurrence of upwelling events which are more favourable south of Cape Finisterre as can be observed taking into account Ekman transport data obtained by the satellite QuikSCAT. In fact, from the analysis of Sea Surface Temperature images it is possible to observe a band of colder water present near shore generating a longitudinal gradient in SST. During autumn and winter chlorophyll concentrations show lower values although not negligible. This situation can be related to the increase of rivers discharge during the wet season and also to the possibility of the occurrence of winter upwelling events.

Keywords: chlorophyll, SST, Ekman transport, Galician coast

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Comparison of the seasonal and interannual variability of chlorophyll *a* in two estuaries of the Bay of Biscay during the period 1997–2008

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The variability of chlorophyll *a* concentration during the period 1997–2008 in the euhaline region (30, 33 and 35 salinity zones) of two estuaries of the Basque coast (Bay of Biscay, North Atlantic) of contrasting hydrographical characteristics and anthropogenic impact (estuaries of Bilbao and of Urdaibai), was studied at the seasonal and inter-annual time scales. The seasonal pattern showed phytoplankton biomass peaks in summer all along the stratified estuary of Bilbao, whereas in the Urdaibai estuary, the inner and intermediate zones were characterized by summer peaks, but the outer estuary which is subject to more intense tidal flushing, showed a bimodal pattern, with spring and autumn peaks and low summer values. At the inter-annual scale, the highest deviation (positive) from the grand median calculated for the whole time-series occurred in 2003, the warmest year of the series, in both estuaries and at all salinity zones, except at the well flushed outer zone of the estuary of Urdaibai. In both estuaries and all salinity zones the seasonal variability was more than twice of the variability at the inter-annual scale. The year-to-year variation of the centre of gravity (in units of months) of the annual chlorophyll *a* biomass showed a negative slope (i.e. earlier in more recent years) in both estuaries for all the salinity zones except for the inner estuary of Bilbao.

Keywords: Chlorophyll, seasonal, inter-annual, estuary, Bay of Biscay

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The Winter Nutrient Status of Scottish Coastal and Offshore Waters: 2001–2009

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Over a nine year period 4,721 water samples, collected from Scottish coastal and offshore waters during January, have been analysed for nutrients (nitrate, phosphate, silicate and ammonia) with the aim of establishing regional background nutrient concentrations and contributing towards an assessment of the eutrophication status of Scottish coastal and offshore waters. The nutrient data collected from Scottish waters over this nine year period were assessed on a regional basis against assessment criteria established by OSPAR as indicators of nutrient enrichment (OSPAR 2005).

Only 5% of the samples exceeded the DIN background concentrations and only 3 out of the 4,721 samples analysed exceeded the DIN assessment level (50% above OSPAR background concentration). Overall there was no indication that TOxN concentrations in Scottish waters were of cause for concern. Furthermore, TOxN concentrations appear to be stable; temporal trends were not detected in the in any of the Scottish regions.

Nutrient ratios (Redfield, 1958) can also be used as indicators of nutrient enrichment. Most Scottish coastal and offshore waters gave DIN/DIP ratios below the corresponding assessment level. The DIN/silicate ratio was above the assessment level of 2 in a high proportion of samples from offshore areas, particularly in the Shetland and Fladen regions due to the low silicate concentrations in these regions. In all cases the TOxN concentrations were below the DIN assessment levels and therefore the high ratios should not be of cause for concern. ¹

Keywords: Nutrients, assessment levels, Redfield ratios, Scottish regions

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¹ References

- OSPAR Commission 2005. Background document on the ecological quality objectives for the greater North Sea with regards to nutrients and eutrophication effects.
- A. C. Redfield, 1958. The biological control of chemical factors in the environment, *American Scientist*, **46**, 205 – 221.

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Variability in the Galician Upwelling 2008–2010

B. Barreiro, E. D. Barton, F. de la Granda, J. Kaiser, C. Brown, K. Heywood, and P. Miller

Studies of the Galician region have indicated a reduction of the upwelling intensity over recent decades to the extent that the area has changed from a net upwelling to a net downwelling system. Within this context we examine hydrographic conditions and their variability within the last two years. As part of the Caibex and RAlA projects, monthly samplings of a section from the coast to continental slope since November 2008, combined with intensive, extended surveys in summers of 2009 and 2010, characterize variability in the region. Surveys with CTD profiler plus SeaSoar and MiniBat undulators provide unprecedented detail of spatial structure in 2009, which is compared with repeated surveys of the same zone with a SeaGlider in the GOPINA project throughout summer 2010. Continuous observations of nearshore currents maintained throughout the period resolve the short-term variability typical of the system. These *in situ* observations and remotely sensed data indicate that the summer of 2009 was one of weak upwelling while the following year was significantly stronger. How these results fit into the apparent overall decline in local upwelling intensity is discussed.

Keywords: Upwelling, Galicia, climate change, variability

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ICES/NAFO Decadal Symposium 2011/Ref. 17

Is there a rapid increase in the north Atlantic coastal upwelling?

E. D. Barton and C. Roy

Recent work concludes that a general intensification of coastal upwelling in the eastern boundary upwelling systems is taking place worldwide as a result of global warming. Evidence of a rapid and accelerating enhancement of the northwest African upwelling over the last century has been reported on the basis of alkenone unsaturation index records from a core off Cabo Ghir, Morocco at 30°N, which indicate a decrease of proxy sea surface temperature of 1°C over the last 50 years. However, circumstantial evidence in the form of increasing northward occurrence of sub-tropical fish species along the Atlantic seaboard indicates the contrary. Examination here of wind and sea surface temperature data in the international data bases shows neither a coherent increase in upwelling favourable wind nor a decline in surface temperature. Indeed sea surface temperature throughout the Portugal/Canary Current region, including off Cabo Ghir, appears to have increased by 1°C over the last half century, in contradiction of the intensification hypothesis.

Keywords: Upwelling, intensification, climate change, sea surface temperature

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ICES/NAFO Decadal Symposium 2011/Ref. 20

What is the ambient temperature of young cod, haddock, herring and capelin in the Barents Sea and how does climate change influence their spatial distribution?

E. Eriksen, Randi Ingvaldsen, Geir Odd Johansen, and Jan Erik Stiansen

The Barents Sea is a high-latitude, arctoboreal shallow shelf sea, with circulation dominated by Atlantic and Arctic water masses. In the period 1980 to 2010 the climate conditions has changed from very cold to very warm in the area. Environmental factors are commonly found as driving forces for the distribution and survival of juvenile fish, and the most severe impacts of environmental factors and climate change on fish is therefore most likely observable when studying the juveniles. Northeast Arctic cod (*Gadus morhua* L.), Northeast Arctic haddock (*Melanogrammus aeglefinus* L.), Norwegian spring spawning herring (*Clupea harengus* L.) and Barents Sea capelin (*Mallotus villosus* Müller, 1776) are commercially and ecologically important fish species, and all have parts of the Barents Sea as their nursery area. In this paper, we investigate the spatial distribution of 0-group fish (5-7 months old) to their preferred temperature range. Based on a 30 years long time series of 0-group survey data from August-September, and related spatial temperature observations we explore the following question: What is the ambient temperature for these four species and how does climate change influence their spatial distribution in the Barents Sea?

Keywords: 0-group fish, temperature, distribution, Barents Sea

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Variability of the flow of water masses on the north Icelandic shelf

S. Jonsson and H. Valdimarsson

The North Icelandic shelf is an area that shows highly variable hydrographic properties. In the Denmark Strait, between Greenland and Iceland, the warm saline Atlantic Water of the Irminger Current meets the cold and relatively fresh Polar Water of the East Greenland Current. A mixture of these two water masses then flows along the shelf north of Iceland and it can vary from being almost pure Atlantic Water to consisting nearly entirely of Polar Water. The relative amount of the water masses to some extent determines the productivity and the living conditions on the shelf north of Iceland. It has been shown to affect the primary production and also the condition of the capelin stock in the area. To determine the flow along the shelf, the Marine Research Institute in Iceland has been monitoring the flow with current meters on a section north of Iceland. Between 1994 and 1999 current meter measurements were made on a single mooring but after that the measurements were extended to three moorings. Measurements with a vessel mounted ADCP done on several occasions during this time. Together with the current measurements, CTD measurements have been made on standard sections in the area. All these measurements are used to study the structure of the flow and its variability. The amount of both Atlantic and Polar water masses carried by the flow are calculated as well as the associated heat transport. In the period 1994–2009 the flow consisted on the average of 67% of Atlantic Water and the associated heat transport was estimated to be 23 TW. In 2009 the moorings were equipped with ADCPs at all moorings giving more information on the vertical structure of the flow. The flux of the different water masses as well as the heat transport for the period from 1994–2010 will be discussed and the influence on conditions over the north Icelandic shelf.

Keywords: Decadal variability, North Icelandic shelf, Atlantic water, Irminger Current

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Interannual variability of coastal dynamics in Santander in the period 1948–2010

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It is well known nowadays that the seasonal-to-interannual variability of wave climate is linked to the anomalies of the atmosphere circulation. A very recent and widely used tool to analyze the temporal and spatial variability of wave climate is based on wave reanalysis data bases (WRDB). WRDB are adequate to improve the knowledge of large-scale (say 0.1 to 1° spatial resolution) wave climate. However, coastal wave climate in Santander area requires a more detailed spatial resolution (say, 100 m) in order to correctly evaluate different coastal processes. This specific problem of downscaling, enhancing the spatial resolution and defining in detail shallow water areas, is achieved by means of a hybrid methodology, based on a combination of mathematical tools (statistical downscaling) and wave propagation models (dynamic downscaling). The hourly time series obtained of shallow water wave climate parameters (significant wave height - SWH, mean period, mean direction) are validated with instrumental coastal buoys showing a good agreement.

These numerical time series allows the analysis of the interannual variability of different coastal dynamics parameters, such as a given percentile of SWH, the mean energy flux direction, mean bottom stress, surf resources, etc. To do this, we propose a data mining algorithm based on self-organizing maps and K-means, which relates synoptic-scale weather type (sea level pressure 3-days-averaged fields in the NAO area) with the anomalies in the coastal dynamic parameters, quantifying the relationship with climate-related indices such as the North Atlantic Oscillation or the East Atlantic Pattern.

Keywords: wave climate, coastal areas, Cantabrian Sea, weather types

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Inter-annual variability of vertical particle flux in Eastern Fram Strait since 2000. Results from the long-term observatory HAUSGARTEN

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Vertical particle flux has been measured by means of annually moored sediment traps in 200-300m depths at the AWI long-term observatory HAUSGARTEN, in the Fram Strait (79°/4°E), since the year 2000. The area of investigation, West of Spitzbergen at a water depth of 2500m, is temporarily covered by sea ice during the year. It is influenced by the inflow of warm Atlantic waters by the West Spitzbergen Current (WSC) at the surface as well as by recirculating water modified by the out flowing arctic water masses.

With our study on sedimenting organic matter we aim to follow seasonal patterns and changes therein. We also would trace effects in pelagic system structure and impacts on the transfer of organic matter to the Deep Sea and the benthos, in a region that is anticipated to react very sensitive to global warming. We will present data on the flux of total particulate matter (TPM), particulate organic carbon and nitrogen (POC/PON), biogenic particulate silica (bPSi), carbonate (CaCO₃), and the proportion of biogenic and lithogenic components acquired during the period 2000–2009. We observed a bimodal seasonal sedimentation pattern for almost all flux components. Annual fluxes showed greatest variation for TPM and CaCO₃ (3-8 fold), a decrease in bPSi and only a slight variation (1-2 fold) for POC and biogenic matter sedimentation.

The results obtained during the 9 year period of the study will be discussed and also compared to the findings of sediment trap studies conducted in the Eastern Fram Strait during the end of the eighties, as well as results obtained in the neighbouring regions of the Northern North Atlantic.

Keywords: vertical particle flux, inter-annual variability, HAUSGARTEN, Fram Strait

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Physical Variability in the North Atlantic Ocean

N. P. Holliday, S. L. Hughes, K. Borenäs, R. Feistel, F. Gaillard, A. Lavín, H. Loeng, K.-A. Mork, G. Nolan, M. Quante, and R. Somavilla

The North Atlantic Ocean is an ever-changing environment. From the surface ocean to the sea floor changes in temperature, salinity, currents, chemical and biological properties occur on timescales from as little as hours, to as long as millenia. There are spatial changes too; from one side of an ocean basin to another, but also within patches as small as a few centimetres. Making sense of all this variability is a major challenge; to understand regional change on climatic timescales requires knowledge of the processes that take place over much shorter periods of time and space. New aspects of variability are being recognised as more data are collected and existing data are re-analysed, and knowledge of the physical mechanisms within the ocean and atmosphere which affect the environment is growing rapidly.

This poster outlines one chapter in a peer-reviewed ICES Cooperative Research Report that summarises our present-day knowledge of climate change, and highlights our knowledge gaps. The chapter presents a contemporary overview of physical variability in the North Atlantic Ocean and adjacent seas. It describes the observed changes at seasonal, interannual, decadal and longer time scales, and discusses the mechanisms that influence them. Here we focus on changes and their causes during in 2000–2009, and their context in terms of longer term variability.

Keywords: circulation, interannual, mixed layer depth, North Atlantic

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ICES/NAFO Decadal Symposium 2011/Ref. 29

Sea Level Rise and Changes in Arctic Sea-ice

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This poster outlines one chapter in a peer-reviewed ICES Cooperative Research Report that summarises our present-day knowledge of climate change, and highlights our knowledge gaps. The chapter summarises sea level rise and changes to sea-ice in the Arctic, and the poster will focus on changes during 2000-2009, placing them in the context of longer term variability. Global mean sea level has risen by about 0.17m over the 20th century. Recent acceleration is due to thermal expansion of sea water and melting of land-based ice sheets, glaciers and icecaps. Satellite observations show that sea level rise is highly variable at regional scales. Coupled climate modelling studies suggest that sea level will continue to rise throughout the 21st century with rates likely to exceed significantly those already observed. Whilst global mean sea level has been estimated with some confidence, an accurate understanding of the temporal and spatial variability in sea level rise (past and future) requires a better understanding of the underlying oceanographic and climatic processes.

Arctic sea-ice extent has shown a near steady decrease since the late 1970s, reaching a new record low in 2007. No adequate and generally accepted understanding of the processes and the interactions that determine Arctic Ocean ice cover has yet been reached. Observations show that the sea-ice has become thinner by almost 40% over a 20-year period. The interaction between the warm oceanic inflows from the Atlantic and Pacific and the stratification and ice-cover is not fully understood. The feedback effects from more open water in summer and winter are complex and not well understood.

Keywords: Sea level, sea-ice, Arctic, North Atlantic

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A forty year monthly time-series of temperature and salinity in the Southern Bight of the North Sea

S. R. Dye, P. King, J. Foden, A. Joyce, and S. Norris

Near surface hydrography has been collected by a ferry along 52°N between Felixstowe/Harwich and Rotterdam since 1971. Temperature and salinity samples are taken weekly at 9 standard stations providing an insight to the seasonal, interannual and decadal variability of surface water in the Southern Bight of the North Sea. The stations range in character from riverine influenced coastal water to those with properties reflecting the inflow of water from the English Channel.

Here we present the monthly climatology for 1971–2000, examine the variability of the full 40 year time-series and consider conditions seen in the southern North Sea in during 2000–2009 in the context of those of the previous 3 decades. The section variability is analysed in comparison with local and regional climate parameters and indices (Central England Temperature, Atlantic Multidecadal Oscillation, winter NAO index, regional and local wind stress and precipitation and also with the surface hydrography made available in the ICES Report on Ocean Climate). In temperature, strong interannual to decadal changes imposed upon a warming trend are clearly related to the interlinked variations of the NAO and AMO. Low frequency variations of salinity suggest an influence of changes in the Atlantic water that is the origin of the Dover Strait inflow as well as variations in supply of freshwater from the surrounding catchments.

Keywords: climate variability, hydrography, Southern North Sea

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Effect of anchovy fluctuations on demersal fish predators in the southern Bay of Biscay

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Small pelagic fish are keystone species in coastal environments playing an important role in the benthic-pelagic coupling, as they link planktonic production and demersal predators. In the Bay of Biscay, anchovy (*Engraulis encrasicolus*) does not only play an important role as forage fish in structuring the ecosystem, but also constitutes an important fishery resource. The last years have seen fluctuations of the stock, which have been related to both changes in environmental variables and fisheries pressure.

Our data stem from annual trawl surveys carried out every autumn along the Cantabrian Sea continental shelf between 2000- 2010. The diet of demersal predators, with benthic-pelagic feeding habits, was investigated in order to determine the relative importance of anchovy. Hake (*Merluccius merluccius*), megrim (*Lepidorhombus whiffiagonis* and *Lepidorhombus boscii*) and blue whiting (*Micromesistius poutassou*) were the species that consumed the highest number of anchovy. Nevertheless, since 2008 other demersal species have started to consume it occasionally, adding up to a total of 21 species that preyed on anchovy during the study period. Anchovy consumption took place across ontogenetic changes in the different predator's diet, and in general the size of the anchovy prey was positively correlated with the predators' length. Although anchovy seemed to be a preferred resource when available, the wide trophic niche of the demersal predators probably buffered the effect of anchovy fluctuations in the assemblage. Our study reconstructs, through stomach content analysis, the dramatic reduction of the anchovy stock during the last decade and its recent recovery in the Cantabrian Sea.

Keywords: anchovy, forage fish, demersal fish, southern Bay of Biscay

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Pelagic amphipod patterns in the eastern Fram Strait at the AWI deep-sea observatory HAUSGARTEN (79°N/4°E) during the years 2000 to 2009

A. Kraft, E. Bauerfeind, E.-M. Nöthig, and U. V. Bathmann

Time series data on amphipods collected as swimmers by moored sediment traps since 2000 at the AWI deep-sea observatory HAUSGARTEN (79°N/4°E) in the eastern Fram Strait will be presented including yearly and seasonal abundance patterns. In total, amphipod abundances significantly increased during a time frame from 2000 to 2009 at ~280 m depth, accompanied by the continuous presence of the North Atlantic water species *Themisto compressa* since 2004. From 2000 to 2008, the community structure is also characterized by an increasing share of the Atlantic-boreal species *T. abyssorum* and a simultaneous decline of the typically Arctic species *T. libellula*. This development was reversed during the last observation series from summer 2008 to summer 2009. Simultaneously, mesopelagic samples were taken by sediment traps at water depths of 800 and 1300 m during time periods from 2004 to 2008, revealing a clear dominance of the deep-water amphipod *Cyclocaris guilelmi* and low abundances of *Themisto* species. While the observed monthly patterns seem to be closely associated to the seasonal vertical migration behaviour of the three *Themisto* species, we hypothesize that the yearly time series data of the pelagic amphipod community are connected to long-term temperature signals of Atlantic water masses. Hence, we propose that a continued inflow of warmer Atlantic water will promote an ongoing transition towards a pelagic amphipod community dominated by Atlantic species in the eastern Fram Strait.

Keywords: *Themisto*, sediment traps, HAUSGARTEN, Fram Strait

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Biological variability of the European Anchovy (*Engraulis encrasicolus*) year classes during 2000–2009 in the Bay of Biscay

B. Villamor, C. Hernandez, J. Landa, C. Gonzalez-Pola, and P. Abaunza

Several recruitment failures have been observed in the European anchovy (*Engraulis encrasicolus*) population of the Bay of Biscay since 2001, specially the recruitment of the 2004 year class stands out as the lowest in the historical time series. This has resulted in a declined of its population until it collapsed in 2005, with the consequent closure of the fishery that prolonged to 2009. In 2010, the SSB has been estimated above B_{lim} implying a recovery of population levels respect to the previous 5 years. Such a recovery reflects the good recruitment of 2009 year class, the most abundant since that of 2001. The decline and subsequent recovery of the Bay of Biscay anchovy provides an opportunity to analyse the dynamic of a recovering fish population. European anchovy has a very short life cycle, and the population abundance depends mainly on the success in the recruitment of each new year classes. Therefore a precise knowledge of growth and other biological characteristics and its effect of year classes is very important.

The main objective of this study is to analyse the inter-annual variability of some biological traits of the Bay of Biscay anchovy between 2000 and 2009. We explore the changes in the mean length-at-age and weight-at-age, sex-ratio indices, gonadal development in the spawning season and condition status of individual year classes of this species. Also, we investigate the potential density-dependent relationship between stock size and growth (in terms of length-at-age), finally we discuss the variability of the growth in relationship with the environmental conditions.

Keywords: Biological traits, year-classes description, density-dependence, environmental conditions, anchovy, Bay of Biscay

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Impact of phytoplankton phenology on anchovy recruitment on the Bay of Biscay

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Anchovy fisheries experience great fluctuations in catches which seriously compromise their long term sustainability. The short life cycle of anchovy and external environmental factors, including human induced climate change, are usually invoked to explain the irregular dynamics observed in these species. In the Bay of Biscay, the spawning stock biomass of European anchovy (*Engraulis encrasicolus*) has remained at low levels during the last decade, resulting in a fisheries collapse which triggered a closure between 2005 and 2009. Here, we take advantage of the availability of high quality data on both anchovy recruitment dynamics from stock assessment and long term, remotely sensed phytoplankton dynamics to analyze the impact of changes in phytoplankton phenology on anchovy recruitment success. Despite the short term nature of the data series studied, we found a promising relationship between anchovy recruitment and phytoplankton phenology comparable, at least, to those found with other environmental factors which are commonly suggested to play a role in anchovy dynamics. In this way, our results suggest a potential role for Cushing's match-mismatch hypothesis in regulating anchovy fisheries.

Keywords: match-mismatch hypothesis, anchovy fisheries, phytoplankton phenology, Bay of Biscay

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ICES/NAFO Decadal Symposium 2011/Ref. 37

Recent decadal variability in climate, oceanography and plankton in the northern Spanish shelf

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Variability in time series of oceanographic (temperature, salinity), chemical (nutrients) and plankton variables (species abundance, chlorophyll, primary production) was analysed along an upwelling gradient in the northern Spanish shelf (Galicia and Mar Cantábrico) and related to climate between 1990 and 2006. The series were decomposed in linear trends, periodic and autocorrelation components and their residuals were cross correlated with those of climate. All series displayed a strong seasonality. Warming (>0.02 °C yr⁻¹) was significant through the water column and year-round, though subjected to strong interannual variability related to regional atmospheric anomalies. Such interannual variability together with the alternating upwelling-downwelling circulation regime prevented to draw any consistent pattern concerning stratification. Nitrate and phosphate increased through the region but the low spatial correlation between series stressed the importance of local factors for fertilization. Picophytoplankton and bacteria, measured only since 2002, still do not show clear trends but the results suggest a greater contribution of the smallest cells with warming. Dinoflagellates increased in all series and diatoms decreased in Galicia, following the decreasing trend in upwelling. No significant trends emerged in chlorophyll, while primary production increased in Galicia and decreased in the Mar Cantábrico. In turn, copepod species richness and biomass increased but with large local variability: warm tolerant species increased and opportunistic species decreased, particularly in the Mar Cantábrico. Gelatinous zooplankton (medusae and tunicates) did not show any common trend at local scales. Climatic indices and upwelling showed variable and lagged correlations with nutrient and planktonic variables, suggesting the existence of non-linear interactions.

Keywords: climate, upwelling, pelagic, S Bay of Biscay

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Temporal variability of the spawning season for the southern component of the Northeast Atlantic Mackerel (*Scomber scombrus*) (1990–2010)

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There is evidence of changes in the population behaviour of the Northeast Atlantic mackerel (*Scomber scombrus*). During the last decade appears that the stock has been undergone to an increase in the recruitment variability, changes in the distribution and migration and even variation in spawning time.

Southern component of the Northeast Atlantic mackerel population migrates towards the southern spawning area (Cantabrian Sea) at the end of winter. An analysis of the fishery indicates a forward shift in the timing of the migration since 2000. Such a shift causes that spawning in the Southern component has occurred earlier in the last decade compared to the previous. Other variables as changes in spawning peaks may be also associated to these changes in the migratory pattern. This work analyses the spawning seasonality of mackerel and its inter-annual variations in the period 1990-2010, studying reproductive characteristics and condition status of mackerel. We explore monthly evolution of condition factor, gonadosomatic index, gonadal development and monthly mackerel egg abundance. Also, we investigate the impact of environmental conditions on these all these changes. The results may have implications for mackerel resources management and monitoring.

Keywords: Mackerel, *Scomber scombrus*, Spawning, Migration, Environmental conditions, Cantabrian Sea, Bay of Biscay

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ICES/NAFO Decadal Symposium 2011/Ref. 41

Growth variability of the four-spot-megrim (*Lepidorhombus boscii*) during 2000–2009 in the northern and north-western Spanish shelf

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Interannual variation in growth of four-spot-megrim (*Lepidorhombus boscii*) in the northern and north-western Spanish shelf (ICES Divisions VIIIc and IXa) during 2000–2009 is analysed using length distributions at age. Age estimation is based on annulus interpretation in the whole otoliths. Length-at-age data are fitted to the Von Bertalanffy growth curve and its parameters are estimated. Differences are found in the age range and the length at age between the years analysed. The results are compared with other studies, mainly from the previous decade.

This contribution of an updated growth pattern of four-spot megrim for the decade 2000–2009 is of interest for a wider knowledge of the demographic structure of this stock, essential in the age-structured assessment models of this commercial species and that it can make progress in a better knowledge of the importance of the different age groups in the ecosystem. These results can also provide a first step to study the fisheries-induced evolution of the life history traits of this species.

Keywords: Growth, four-spot megrim, *Lepidorhombus boscii*, northeast Atlantic, northern Spanish shelf.

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ICES/NAFO Decadal Symposium 2011/Ref. 43

Different variability between Coastal and Oceanic SST along the western Iberian Peninsula

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The inter-annual variability of the sea surface temperature (SST) was analyzed along the western Iberian Peninsula. For this purpose, the region ranging from 9.5°W to 21.5°W and from 37.5°N to 42.5°N was considered with a spatial resolution of 1°×1° from 1900 to 2008. Coastal (9.5°W) and oceanic (18.5°W) SST variability were showing an overall increase with two warming periods and one cooling period similar to those observed in previous studies across the entire North Atlantic. In spite of coast and ocean are highly influenced by global changes affecting the whole North Atlantic region, the evolution of coast and ocean water has been observed to be different, finding that both warming and cooling trends are more intense in the ocean locations than near coast. This is possible because the ocean water is influenced by the Atlantic Multidecadal Oscillation (AMO) as the coastal water is influenced by the AMO and the local wind regime (upwelling). The correlation between AMO and SST is observed to decrease coastward, but the inter-annual variability of Coastal SST shows to be best described in terms of both AMO and coastal upwelling.

Keywords: Sea Surface Temperature; Atlantic Multidecadal Oscillation; Upwelling; Thermohaline Circulation

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ICES/NAFO Decadal Symposium 2011/Ref. 45

Fisheries in mainland Portugal: Climatic influence on exploited marine fish assemblages

F. Leitão, C. M. Teixeira, I. Maximo, N. Metelo and L. Chicharo

Portugal has an historical tradition in fisheries, relying on fishing as a major mean of subsistence, particularly for coastal communities. It is also one of the largest Exclusive Economic Zones (EEZ) in the European Union (EU). Even though great scientific effort has been dedicated to the sustainable development and management of fisheries, few studies have considered climatic effect in fishing resources together with fishing impacts, an approach that is very useful to support fisheries science. The evidence that environmental factors (hydrological and oceanographic) cause long-term, large-scale (sometimes synchronous) variability in fish stocks is growing, but it is a mistake to conclude that the effects of fishing are, therefore, less important. Accordingly, fisheries managers need to consider aspects of the climate (oceanographic and hydrologic), fish stocks and fisheries in the coastal Portuguese waters. In order to understand how this information can be used to describe the ocean environment, fish stocks and fisheries, we have analysed series of data from the last decade: Hydrology (rainfall rates, river discharges), Oceanography (e.g. temperature, phytoplankton, upwelling, North Atlantic oscillation;), and fisheries (e.g. fishing effort and (landing catch data, mainly small pelagic fishes which comprise one third of the world's marine fish catch: sardines, anchovies, mackerel and other small pelagic fishes). The analysis of recent decadal trends in fisheries landing and environmental variables, with historical data series ("before situation"), showed factors influencing particular groups of species/commercial groups/functional groups, providing a basis for improved assessment and management. As the strength and influence of environmental features are site specific, varying accordingly local geographical conditions (rivers, precipitation), as is the fishing effort, different climatic and fishing zones (North, Centre and South coast) were independently studied providing different results that are discussed.

Keywords: Fishing catches; hydrology and oceanography; Coastal fisheries; Portugal (North Atlantic)

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ICES/NAFO Decadal Symposium 2011/Ref. 46

Assessing climatic and fishing impacts on crustacean fisheries

F. Leitão and L. Chicharo

As a result of the elevated biodiversity of Portuguese fish assemblages, there are several distinct fleets (métiers) covering a variety of gear types. Crustacean trade fleet has long been an important component of coastal Portuguese fisheries, adding to their overall economical value. Predictions for fish stocks have been used to guide fisheries management, but stocks continue to be over-exploited and, in fact, some crustacean species have showed clear signs of overexploitation in Portuguese waters, with resources dropping below biological limits of the population (i.e., *Nephrops norvegicus* stocks). Current trends in crustacean landings may result from increased climate variability but are more likely driven by fisheries increasing the sensitivity of marine populations, communities and ecosystems to variations in environmental conditions. Therefore, we evaluated the importance of single, and/or combined (synchronous) climatic variables (e.g. SST, upwelling, NAO, river discharges), in order to increase our knowledge regarding the causes that most contribute to explain resource variability.

Keywords: Crustacean landings; Coastal fisheries; climatic variables; Portugal coast (North Atlantic)

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ICES/NAFO Decadal Symposium 2011/Ref. 47

Propagating salinity anomalies in the Norwegian Coastal Current

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The focus of this article is on the propagation of salt anomalies in the upper layers of the Norwegian Coastal Current. In general salinity affects the stratification of the coastal waters and thereby the food availability and advection of larvae and juvenile fish. The main data used in this study are from eight fixed oceanographic stations operated along the Norwegian coast, the earliest station starting in 1936 and typically sampled every second week. The analysis shows that when the local seasonality is removed, anomalies in the upper 30m can be traced along the Norwegian Coast. We present both mean advection speeds of these anomalies along the coast, as well as showing that positive and negative anomalies have different propagation speeds. Finally we will compare the effect of both the along-coast wind and river run-off on the propagation of anomalies during the last ten years in relative to earlier periods.

Keywords: Norwegian Coastal Current, fixed hydrographic stations, salinity anomalies, propagation

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ICES/NAFO Decadal Symposium 2011/Ref. 48

Impact of the 2009/2010 extreme negative North Atlantic Oscillation on the subpolar phytoplankton bloom

Stephanie Henson and Stuart Painter¹

The North Atlantic Oscillation (NAO) in winter 2009/2010 was strongly negative, marking a switch from the pre-dominantly positive or neutral conditions of the last decade. In spring and summer of 2009/2010, a highly anomalous phytoplankton bloom was observed in the subpolar North Atlantic in satellite chlorophyll data. We examine here the anomalous wind and hydrographic conditions that may have promoted the anomalous bloom. Wind stress, typically eastward in winter, reversed direction in 2010, drawing anomalous surface water masses into the Irminger Basin. An unusually fresh surface layer, originating from the Newfoundland/Labrador Sea area, intruded into the region in spring. This promoted an unusually intense, widespread and prolonged phytoplankton bloom.

Keywords: North Atlantic Oscillation; phytoplankton bloom; remote sensing; subpolar North Atlantic

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ICES/NAFO Decadal Symposium 2011/Ref. 49

Changes during the last decade at HAUSGARTEN deep-sea observatory in the northern North-Atlantic: causes and consequences

Ingo Schewe, Michael Klages, Thomas Soltwedel, Christiane Hasemann, and Melanie Bergmann

Organisms at the gateway to the Arctic are adapted to extreme environmental conditions with strong seasonal forcing. The accelerating rate of recent climate change thus challenges the resilience of organisms in those regions in particular. The HAUSGARTEN deep-sea observatory is located west of Svalbard in the Fram Strait, the only deep-water connection between the northern North-Atlantic and the central Arctic Ocean and thus one of the most sensitive areas with regard to climate change in the North. The observatory consists out of 15 sampling sites, along a depth- and a latitudinal-transect in water depths between 1000 – 5500 m. The unique long-term record assessed at HAUSGARTEN is one of the best data sets available, to study marine Arctic deep-sea ecosystem dynamics.

One of the key elements of our work at HAUSGARTEN is our multidisciplinary approach. Measurements and yearly sampling campaigns comprise the water column, the benthic boundary layer, and the deep-sea benthos. The development of benthic assemblages on larger scales is tracked via repeated seafloor imagery. The use of autonomous systems and moorings anchored at the seafloor was initiated to assess seasonal variability. Our studies show remarkable changes in Arctic key variables. Decreases of sea-ice extent and sea-ice thickness as well as strong fluctuations in the inflow of North-Atlantic water masses in the past decade are accompanied by strong changes in food availability and microbial biomass in the deep-sea habitat of this area. These observations allow conclusions for a strong coupling between particle flux and distribution, and the deep-sea ecosystem.

Keywords: longterm observatory, inter-annual variability, HAUSGARTEN, Fram Strait

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ICES/NAFO Decadal Symposium 2011/Ref. 51

MODIS/AQUA observations of coastal turbidity and chlorophyll-*a* variability due to river discharges in the Basque coast

Y. Sagarminaga, G. Chust, and S. Novoa

River discharges are the main continental contributions to coastal waters. The quantity and quality of materials and compounds brought by these discharges directly affect the quality of coastal waters, their ecosystem conservation and their potential for socio-economic activities (bath, seafood extraction, fishing, etc.). The spatio-temporal variability of coastal water quality is closely dependent on the hydrological regimes of the rivers discharging into these areas and in turn, these regimes are strongly affected by climate change and human land-use changes. Although Adour River is the main source of continental water into the south-eastern Bay of Biscay, river runoff from other smaller rivers along the Cantabrian coast (i.e. Oria, Nervión and Bidasoa) play important roles at local scale.

This study analyses the variability of turbidity and chlorophyll-*a* on the Basque coast during the last decade, and its relationship with the hydrological regimes of the main Cantabrian rivers discharging to the study area. For this purpose, weekly MODIS/AQUA data since 2002 have been processed to obtain medium resolution images (250 m) of reflectivity at different wavelengths, total suspended matter, and chlorophyll-*a* concentration. We have estimated average patterns, interannual and seasonal variability, anomalies, and trends, for the parameters cited above. Then, we have related these results with hydrological and oceanographic data from the operational hydrologic and oceanographic observation networks to identify and describe specific coastal events and its variation during the study period.

Keywords: Coastal waters variability, river discharges, MODIS/AQUA, turbidity, chlorophyll-*a*, spatio-temporal distributions, SEAWIFS, chlorophyll-*a*, AVHRR, Sea Surface Temperature.

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ICES/NAFO Decadal Symposium 2011/Ref. 52

Sea level variability in the North and North West coast of Spain

M. J. García , E. Tel, and M. Molinero

The sea level is being monitoring by the Institute Español de Oceanografía in the north and northwest of Spain since 1943. The increasing population and urban growth in coastal areas, requires a good understanding of the behaviour of local sea level that allows carrying out proper management of the coast to avoid risks to the population and infrastructure.

The objectives of this presentation are, first, to understand the behaviour of the variability of mean sea level on the northwest coast of the Iberian Peninsula, its causes and its impacts, with particular emphasis on the evaluation of series of observations "in situ "as indicators of regional climate change, both natural and anthropogenic origin. Second is to make a statistical study of extreme levels and tidal residual in relation to the possible effects of climate change by comparing the results of the last decade (2000–2009) with the previous decades and the complete historical data set (1943–2010). For this, we analyze the series of sea level recorded at tide stations operated by the Spanish Institute of Oceanography (IEO) in the region considered for the complete period, by evaluating the meteorological contribution by North Atlantic Oscillation (NAO) and in general the impact of climate variability in the mean sea level, extremes values and tidal residuals.

Keywords: sea level, variability, extreme evens, return periods

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ICES/NAFO Decadal Symposium 2011/Ref. 55

Variability of currents in N and NW Iberia during the last decade

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The analysis of VACLAN project data set (measurements at two mooring lines and of CTD casts in hydrographical lines) combined with satellite altimetry provides a picture of variability of circulation in N and NW Iberia slopes and adjacent ocean during the 2000s. A mooring line was located at 43° 00'N, 011° 00'W, about 90 nm west of Cape Finisterre on the way to the Galician Bank, in a location where large-scale Ekman transports have been routinely computed since the 1960s. Another mooring was located at 43° 48'N, 003 46'W, northwards of Santander in the south-eastern Bay of Biscay, close to the location of a monthly hydrographical section running from 1991. Both mooring lines are placed at ~2500 m depth and have current-meters (CMs) at the levels of the cores of main intermediate water masses present in the area: East North Atlantic Central Water (ENACW ~350 m), Mediterranean Water (MW, ~1000 m) and Labrador Seawater (LSW ~1800 m).

Variability of circulation at the Finisterre mooring position is dominated by eddy activity interacting with the Galicia Bank. The seasonal and interannual variation of upwelling winds influences the observed circulation at the mooring directly or influencing eddy activity in the area. The Santander mooring line permits us to illustrate variability in circulation on the northern Iberian slopes. Occurrence of IPC (Iberian Poleward Current) penetrations in the Cantabrian Sea is measured in several years in the decade and year-to-year variability of upwelling intensity in spring and summer and even in autumn season have been observed.

Keywords: Currents, Upwelling, Iberian Poleward Current in the Cantabrian Sea, Mesoscale eddy activity

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ICES/NAFO Decadal Symposium 2011/Ref. 57

QSR 2010: Summarising, understanding and communicating hydrobiological variability in the North-East Atlantic

R. Emmerson, D. Johnson, C. Moffat, and A. Weiß

In September 2010 the OSPAR Commission published the Quality Status Report (QSR) 2010, a holistic summary of monitoring and assessment of the North-East Atlantic for the period 1998–2008. The Report is a synthesis of a series of thematic assessments gauging progress in management in relation to five strategies for the protection and conservation of the North-East Atlantic agreed in 1998. This is set against a similar exercise undertaken a decade earlier. For monitoring and assessment purposes OSPAR has sub-divided its Maritime Area (13.5 million km²) into five Regions allowing regional difference, both in terms of character and issues, to be highlighted.

Key findings of the QSR 2010 are presented as thematic chapters with recommendations. A regional summary shows clear signs of improvement in the marine environment and a decrease of certain pressures and impacts, including from fishing. But loss of biodiversity has not yet been halted. Climate change and ocean acidification cause serious concern with growing evidence of changes in the distribution and abundance of plankton, fish and seabirds in relation to changing ocean hydrography. Tools to assess ecosystem health were tested, but need further development to ensure confidence in the final results.

An essential purpose of this exercise has been to communicate collective understanding of hydrobiological variability to decision makers. Explaining human-induced trends within natural variability using the careful language of scientists is not always appropriate. The task is further complicated by different confidence levels, including data rich and data poor areas. The QSR 2010 employed a journalistic writer to present tabular summaries with concise messages. A fully searchable web-based version allows for the widest possible dissemination.

Keywords: OSPAR Commission, QSR 2010, dissemination, North-East Atlantic

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ICES/NAFO Decadal Symposium 2011/Ref. 58

Temporal analysis of the macrobenthic data along the wind farm concession areas in the Belgian part of the North Sea

D. Coates, J. Vanaverbeke, and M. Vincx

Monitoring the impact of offshore wind farms on the soft-sediment macrobenthos (organisms living in the sediment and larger than 1mm) in the Belgian part of the North Sea was initiated during 2005 by the Marine Biology Research Group of Ghent University. Baseline studies were carried out during 2005 on the Thorntonbank (C-Power) and 2008 on the Bligh Bank (Belwind). Since then, the macrobenthos has been sampled annually on the concession areas, together with carefully selected reference stations on the Goote Bank and Thorntonbank. During the first years after implementation, no large-scale impacts on the macrobenthos were detected. However, seasonal and annual variations in densities, species richness, biomass and community composition appeared to be more important (Coates & Vincx, 2010; Reubens *et al.*, 2009).

The data was integrated into the Marine Biology macrobenthos database (Macrodat) which contains information on macrobenthos and relevant abiotic factors (such as median grain size, total organic matter and temperature) from 1976 onwards. Temporal patterns within the macrobenthic community in the region of the wind farm concession areas were examined for a period of more than ten years (1998–2010). These patterns were investigated in combination with the environmental data. Performing a temporal analysis on the macrobenthos around the concession areas can be important to identify any natural fluctuations as a result of sediment movements, plankton blooms, eutrophication, climate change etc. Any impacts caused by the construction of offshore wind farms can therefore be separated from natural fluctuations in the macrobenthic community (Hiscock *et al.*, 2002).

Keywords: offshore wind farm, macrobenthic community, temporal analysis, North Sea

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ICES/NAFO Decadal Symposium 2011/Ref. 59

On the seasonality of water masses at 43°N section off Cape Finisterre

E. Prieto, C. González-Pola, A. Lavín, M. Ruiz-Villareal, and R. Sánchez

Seasonality in the hydrographical properties of waters masses west of the Iberian Peninsula (NorthEast Atlantic) is described from a series of occupations of a zonal hydrographic section. The database was gathered in the frame of VACLAN and COVACLAN projects, destined to the maintenance of an oceanic variability observational system in the Northwest Iberian margin and Bay of Biscay. The whole project provides a wide database supplied by the repetition of hydrographic deep sections since 2003, with semi-annual cruises in winter and summer.

The Finisterre Section (43°N, 009°W to 014°W, ~200 nm) reveals the existence of a marked seasonality in potential temperature, salinity and depth of isopycnals in the whole water column and along the whole section, with some differences between the slope and the outer ocean. Changes along neutral density surfaces were analyzed with the aim of disengage the two main causes of isobaric changes: isopycnal change (variations in the intrinsic thermohaline properties of water masses) and change due to heave or isopycnal displacement (indicating variations in oceanic circulation or renovation rates). There emerges a seasonal change in circulation patterns associates to an offshore displacement and broadening of the Mediterranean Water vein in wintertime. Seasonality is discussed in relationship of to the eastern boundary of the subtropical gyre, slope currents and water masses formation processes.

Keywords: Seasonality, Galician Bank, Mediterranean Water, Finisterre

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ICES/NAFO Decadal Symposium 2011/Ref. 61

Variability of nutrients and its relationship with thermohaline properties and chlorophyll along the Northern Iberian shelf in the last two decades

Enrique Nogueira, César González-Pola, Antonio Bode, Xosé Anxelu Gutiérrez Morán, Carmen Rodríguez, Gonzalo González-Nuevo, Manuel Varela, and Ricardo Anadón

Temporal variability in nutrient concentrations (nitrate, silicate and phosphate) was investigated at different depths along the North Iberian mid-shelf (75-130 m isobath). Physical (temperature, salinity and density) and biological (chlorophyll-a) variables were used as proxies of the underlying processes, such as coastal upwelling-downwelling, the slope poleward current, continental runoff and phytoplankton production. To this aim, we analyzed the series sampled monthly since the 90s in Vigo and A Coruña (Galicia), and Cudillero, Gijón and Santander (Cantabrian Sea). The temporal components of the series (climatic average, long-term trend, seasonality and autocorrelation) showed depth and along-shelf patterns defining the distinctive dynamics of the Cantabrian and Galician shelves. As deduced from stoichiometry, nitrate, followed by phosphate, appears as the limiting nutrient, particularly in the Cantabrian. Higher silicate concentrations in Galicia than in the Cantabrian agree with the larger predominance of diatoms in the former region. The high correlations for a given nutrient among water layers indicate a good transmission of anomalies (i.e. enrichment or uptake) through the water column. Contrastingly, the low along-shelf spatial correlation stress the importance of local versus mesoscale or regional factors in determining the observed variability. Wind driven upwelling greatly affects nutrient fertilization along the shelf, with a larger effect in Galicia than in the Cantabrian. Similarly, the climatic conditions promoting upwelling are positively correlated to nutrients in Galicia while those implying an increasing subtropical influence display negative correlations. In contrast, the transitional character of the Cantabrian would explain the lack of significant correlations between nutrients and climate in this area.

Keywords: Nutrients, meteo-hydrography, climate, northern Iberian shelf

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ICES/NAFO Decadal Symposium 2011/Ref. 62

Large bio-geographical shifts in the north-eastern Atlantic Ocean: From the subpolar gyre, via plankton, to blue whiting and pilot whales

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Pronounced changes in fauna, extending from the English Channel in the south to the Barents Sea in the north-east and off Greenland in the north-west, have occurred in the late 1920s, the late 1960s and again in the late 1990s. We attribute these events to exchanges of subarctic and subtropical water masses in the north-eastern North Atlantic Ocean, associated with changes in the strength and extent of the subpolar gyre. These exchanges lead to variations in the influence exerted by the subarctic or Lusitanian biomes on the intermediate faunistic zone in the north-eastern Atlantic. This strong and persistent bottom-up bio-physical link is demonstrated using a numerical ocean general circulation model and data on four trophically connected levels in the food chain – phytoplankton, zooplankton, blue whiting and pilot whales. The plankton data give a unique basin-scale depiction of these changes, and a long pilot whale record from the Faroe Islands offers an exceptional temporal perspective over three centuries. Recent advances in simulating the dynamics of the subpolar gyre suggests a potential for predicting the distribution of the main faunistic zones in the north-eastern Atlantic a few years into the future, which might facilitate a more rational management of the commercially important fisheries in this region.

Keywords: North Atlantic Ocean, Subpolar gyre, Spatial, Plankton

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The LOTOFPEL project (2011–2013): An integrative ecosystem analysis of the bi-decadal (1990–2009) dynamics of small-pelagic fishes at the North Iberian shelf

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LOTOFPEL (LONg-Term variability OF small-PELagic fishes at the North Iberian shelf ecosystem) will characterize the long-term variability in the pelagic ecosystem at the North Iberian shelf (NIS) and analyse its consequences on the dynamics of the populations of small-pelagic fishes. The analysis will consider the interactions between abiotic (meteo-climatic and hydrography) and biotic components (from plankton to top predators) at a wide range of spatial and temporal scales (from mesoscale to regional and from seasonal to interannual), at different levels of organization (populations, communities and trophic levels). The analysis will be based on extensive databases and sample collections obtained by the Spanish Institute of Oceanography at the NIS through long-term monitoring projects (time series programme RADIALES) and the “Programa Nacional de Datos Básicos” (financed by the Data Collection Regulation of the European Union), and short-term process-studies projects (National and European) aimed to investigate specific aspects of the functioning and dynamics of the pelagic ecosystem. Thus, the project will include a large set of fundamental variables of the pelagic ecosystem with special emphasis on fish populations. The project will provide a sound basis for an ecosystem-based fisheries management (EBFM) in the area. It will also generate critical information for the Marine Strategy Framework Directive of the European Community, which must contain a detailed assessment of the state of the environment.

Keywords: Small-pelagics, ecosystem-based fisheries approach, North Iberian Shelf.

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A preliminary time-series study of inorganic nutrients in five Galician rías (NW Spain) during the decade 2000–2009

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The nutrient data set of the INTECMAR time series comprises of weekly upper 15 meters water samplings and analyses in 41 oceanographic stations at the main costal embayments of Galician coast from 1992 until the present day. The four large Rías Baixas (Vigo, Pontevedra, Arousa and Muros) and a medium size central ría (Ría de Ares-Betanzos) are sampled to control oceanographic conditions. All five embayments, which are like partially stratified estuaries, were affected by wind-driven upwelling, that contribute to makes the rías an important place for the extensive culture of shellfish, especially marine mussel.

This study examines the temporal variability of inorganic nutrients (nitrate, nitrite, ammonium, phosphate and silicate) and their elemental ratios for the five rías between the years 2001–2009. The main modes of temporal variability (seasonal and linear trend) and the spatial variability between the five rías and within each ría (inner and outer areas) are considered to analyse these data. Eutrophication of inner areas will be tested with the average winter means. In addition, the nutrients condition of ecological status and the references nutrient values for the coastal waters of the fives rías will be inferred.

Keywords: inorganic nutrients, time-series, coastal upwelling, NW Spain

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Basin-scale environmental effects on ocean entry of Atlantic salmon (*Salmo salar*) during 2000–2009

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The smolt transformation process is the change in morphology, physiology and behaviour that Atlantic salmon (*Salmo salar*) parr undergoes before migrating to sea in spring. Temperature and photoperiod are the primary environmental cues regulating this process. Previous studies have identified freshwater temperature and flow as the main factors controlling the smolt downstream migration. These factors vary with geographical location and habitat characteristics suggesting that the pattern of downstream migration could differ within and among rivers. Survival appears to be dependent on a precise alignment with 'optimal' conditions when entering the sea, thus making timing of smolt descent a critical life history event. Moreover, there is heritability for timing of smolt migration. However the importance of genes and environmental conditions might be spatio-temporal dependent allowing for local adaptation and evolution.

Whereas most of the previous research has focused on analyzing single or only a few populations, here we present a meta-analysis that compiles information on downstream smolt migration covering much of the distributional range of this species within the North Atlantic basin. Using Generalized Additive Mixed Models (GAMMs), which allow for non-linearities and fixed and random effects, we show that taking into account a spatial component in the model, the timing of Atlantic salmon ocean entry is positively related with sea surface temperature (SST). This result suggests that the spatio-temporal patterns of Atlantic salmon smolt run have evolved to match optimal local environmental conditions probably related with spring blooming. In addition, during the last decade, downstream migration is occurring slightly earlier.

Keywords: Atlantic salmon, seaward migration modelling, environmental conditions, North Atlantic basin

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Modelling cephalopod paralarvae abundance in a wind-driven upwelling area, Ría de Vigo (NW Spain), using zero-inflated models

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The hydrodynamics of coastal upwelling areas may have key consequences for the cross-shelf transport and distribution of larval stages. Earlier studies provided evidences of the importance of advection, and recent research concludes that larvae distribution results from a combination of water mass circulation, species-specific larval behaviour, and larval sources. Here, we studied the short-time scale influence of the dynamic and hydrographic characteristics of the water column on the paralarval abundance of two cephalopod species, the benthic common octopus (*Octopus vulgaris*) and the pelagic common squid (*Loligo vulgaris*), in the Galician upwelling area (NE Atlantic) where seasonal winds promote upwelling from April to September and downwelling the rest of the year.

We sampled a cross-shore transect from the outer Ría de Vigo to the middle adjacent shelf during 2003, 2004 and 2005 under contrasting oceanographic conditions and used zero-inflated models to accommodate null samples. The probability of catching both species' paralarvae was higher during nighttime. However, octopus was more abundant in the surface layer at night whereas squid abundance was higher in the bottom layer independently of the time. Densities of both species increased when surface residual current flows northwards and water temperatures are higher. Furthermore, the size of both species was larger at night, and decreased at higher current speeds for octopus and when currents flow northwards for squid. These conditions suggest that paralarval abundance and distribution are influenced by the hydrography and dynamics of the area under upwelling relaxation-downwelling conditions, which together with their vertical behaviour would promote coastal retention.

Keywords: Cephalopod paralarvae, upwelling, zero-inflated models, NW Spain

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Interannual variation in ‘indicator’ chaetognaths off the east and west coasts of Scotland

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Zooplankton are sampled approximately weekly from 5 km off Stonehaven on the east coast of Scotland since 1999, and in Loch Ewe, on the west coast, since 2002. The important plankton predators, the chaetognath species *Parasagitta setosa* and *P. elegans* are traditionally considered to be indicators of water masses and climate change in seas surrounding the UK (Russell 1939). *Parasagitta elegans* is a boreal species, indicative of colder oceanic water influence, whilst *P. setosa* is a temperate neritic species that indicates warmer shelf waters. Chaetognath community abundance peaks in late summer/ autumn on Scottish east and west coasts. On the east coast the chaetognath community is dominated by *P. elegans* with only small numbers of *P. setosa* present between September and March. On the west coast the chaetognath community is dominated by *P. setosa* with *P. elegans* present all year round in low numbers. Since 2003 the abundance of *P. setosa* has increased on the west coast, whereas it has declined on the east coast. The average annual proportion of *P. setosa* on the east coast is negatively correlated with that on the west coast ($r > 0.9$). These changes in chaetognath community imply that the hydrographic characteristics at both monitoring sites have been changing between 2003 and 2009, but that the change has been different on the east and west coast of Scotland.

Keywords: Chaetognath, indicator species, Loch Ewe, North Sea

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The Porcupine Abyssal Plain open ocean observatory (PAP): Variations and trends from the Northeast Atlantic fixed-point time-series

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The Porcupine Abyssal Plain observatory (PAP) in the Northeast Atlantic is the longest running open ocean multidisciplinary observatory in Europe. Situated in the sub-polar Northeast Atlantic (49°N, 16.5°W ; 4800m), the site has produced high-resolution datasets integrating environmental and ecologically relevant variables from the surface to the seafloor for over twenty years. Since 2002, a full-depth mooring has been in place with autonomous sensors measuring temperature, salinity, chlorophyll-a fluorescence, nitrate and pCO₂. These complement ongoing mesopelagic and seafloor observations including sediment traps and time-lapse photography. With National and European project funding (including ANIMATE, MERSEA and EuroSITES) the observatory infrastructure has steadily been advanced, culminating in 2010 with a collaboration between the U.K. Met Office and Natural Environment Research Council (NERC) and the first atmospheric datasets at the site. All PAP datasets are open access in near real-time on websites (e.g. www.noc.soton.ac.uk/pap) and for modelling activities through MyOcean (GMES) and the Global Telecommunications System (GTS). The combined datasets enable short-term (daily to seasonal) variation, longer-term trends (climate driven) and episodic events to be captured, contributing to the European-wide initiative for “good environmental status” of our seas.

The PAP observatory is led by the National Oceanography Centre, Southampton, UK and is one of 10 open-ocean observatories within the EuroSITES network (www.eurosites.info). It is a key associated site in the Western Shelf Observatory (<http://www.westernshelfobservatory.org/>). Internationally the site contributes to the OceanSITES global array (www.oceansites.org), complementing other in situ observing systems (e.g. Argo, CPR, Ships of Opportunity) that monitor the region.

Keywords: observatory, time-series, Porcupine Abyssal Plain, Northeast Atlantic

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Factors driven phytoplankton variability in the Aveiro lagoon (Portugal): 1996–2010 data analysis

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The Aveiro lagoon is located in the Northwest coast of Portugal and is a very important system from both economic and ecological viewpoints. Understanding the natural variability of this coastal ecosystem is, thus, of major concern for the establishment of valuable management strategies. It increases the knowledge of the system dynamics and, at the same time, allows the distinction between the natural fluctuations and the ones that are caused by anthropogenic pressures and long term climate changes. In the present study the factors controlling the phytoplankton seasonal and inter-annual variability in the Aveiro lagoon are analyzed over the period of 1996–2010. Phytoplankton is one of main indicators of the marine systems ecological status and its patterns of distribution are driven by several environmental factors, which may affect its growth and mortality (e.g. light and nutrients availability, circulation and turbulence). The factors analyzed include: atmospheric parameters (solar radiation, air temperature, wind and precipitation, which changes the river flows and the circulation patterns), the North Atlantic Oscillation (NAO) index and the nutrients availability. Several databases and bibliographic sources were used for the data compilation (e.g. University of Aveiro meteorological station database, SNIRH database – <http://snirh.pt>). Additionally, recent field work (March and September 2009 and January 2010) was also done in the Aveiro lagoon. An integrated approach, using a numerical three-dimensional hydrodynamic and ecological model (ECO-SELFE), is used to complement the data analysis.

Keywords: Aveiro lagoon, Chlorophyll a, Climatic factors, Hydrodynamics, Nutrients

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Variation in the phytoplankton community in Scottish waters over the last decade

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Marine Scotland Science operate a long term monitoring station 5 km offshore from Stonehaven in the North East of Scotland (56° 57.8' N, 02 ° 06.2' W). Temperature, salinity, nutrients, phytoplankton and zooplankton are monitored on a weekly basis. A number of changes in the phytoplankton community have been observed since the time series began in 1997. During the early part of the time series the spring bloom was dominated by *Chaetoceros* species however since 2001, dense blooms of this genus are no longer observed and *Skeletonema* has become more abundant. From the beginning of the decade until 2004, chlorophyll values during the spring bloom were reduced. During this period a change in the species dominating the summer *Dinophysis* population was also observed. The dinoflagellate genus *Ceratium* has decreased in abundance since 2000. Variation in the physical/chemical parameters and zooplankton community have also been observed during this time period.

Keywords: Phytoplankton, spring bloom, dinoflagellates, Northern North Sea

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Trophodynamics of the regional scale ecosystems of the N.E. Atlantic: Are they out of control ?

N. McGinty, M. Johnson, and A. M. Power

In the last decade the Continuous Plankton Recorder (CPR) has been used extensively to document dramatic changes in the abundance and biogeography of several important planktonic species and species groups on a basin wide scale. Processes at the regional scale < 200 nautical miles are perhaps not so clear. There has not previously been a partitioning of the ocean to allow regional scale comparisons to take place (at scales below the Large Marine Ecosystems or similar). By applying a scheme to define regions, we used a control-chart approach to investigate if processes such as regime shifts and trophic amplification are variable at regional scales.

The approach is based on satellite-derived chlorophyll data to create “ecoregions” in the N.E. Atlantic, using an iterative clustering technique for data collected between Mar-Oct 1998–2008. CPR samples were extracted from within each region and species were divided into trophic levels based on previous literature. Multivariate control charts using a similarity distance class were used to assess if fluctuations within a trophic community reflect stochastic drift in species abundances or whether a significant underlying change has taken place. If a trophic level is deemed to have undergone a significant change, will this propagate through the other trophic levels creating an ecoregion which is “out of control”? These results from each “ecoregion” and the cross region variability will be discussed.

Keywords: Control Charts, Trophic position, Plankton, N.E. Atlantic

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Analysis of the phytoplankton blooms with respect to changes in sea ice cover based on satellite data: case study for the Greenland Sea

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Mechanisms guiding phytoplankton blooms in the Greenland Sea have not been studied in detail so far due to the lack of sufficient in-situ measurements and gaps in satellite data in the region.

In the current study the interaction between changing sea ice coverage, other physical parameters (water temperature and salinity) and phytoplankton blooms is investigated by using in-situ, remote sensing and modeling techniques. The data on chlorophyll-*a* (being a proxy of phytoplankton biomass) was obtained for 2000–2010 from GlobColour project (3-sensor-merged product with the finest spatial coverage currently possible) and validated by *in-situ* data mainly obtained from cruises conducted with RV *Polarstern*. The validated chlorophyll-*a* data was studied with respect to changes in sea ice concentration (data of the PHAROS Group of University of Bremen), as well as variations in sea ice thickness, water temperature and salinity (output of the high-resolution NAOSIM model of Alfred-Wegener-Institute).

Keywords: phytoplankton blooms, sea ice–phytoplankton interaction, satellite data validation, Greenland Sea

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Water masses variability from a monthly hydrographical timeseries at the Bay of Biscay

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The Spanish Institute of Oceanography began some ambitious programs of continuous hydrographical and biological monitoring around the Iberian Peninsula in the early 90's. The Radiales project, intended to monitor the continental shelf by one-day journeys in small vessels, exploited the existence of a very narrow shelf in front of the city of Santander in north Spain (southeastern Bay of Biscay, eastern North Atlantic) to set there a monthly hydrographical sampling for the whole water column down to 1000 m (extended to 1500 m in 2006). Such high frequency sampling supplies a detailed description of the interannual variability of the local intermediate water masses, East North Atlantic Central Water (ENACW) and Mediterranean Water (MW), allowing to infer relationships with air-sea fluxes in the areas of influence, circulation patterns and large scale climatic indexes. The decade of the 2000's was characterized by an overall warming and salinity increase, but the progression is diverse at different levels and both smooth rectification of tendencies and short-term shifts are observed. ENACW have warmed quite progressively and it is only in the last year of the decade when it was observed a first signal of cooling. MW seems to have stabilized in the first third of the decade, ending the progressive trend that was active since mid 90's.

Keywords: Hydrographical variability, intermediate water masses, Bay of Biscay

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Results from the Scottish Coastal Long Term Monitoring Project: physical variability in Scottish Coastal waters between 2000–2009

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The Scottish coastal long term monitoring project is a multidisciplinary project aimed at developing an understanding of ecosystem variability in Scottish coastal waters. The temperature and salinity data that contributes to the project is collected either directly by Marine Scotland and/or in partnership with other institutes and volunteers. Monitoring at more than 12 stations around the coast of Scotland offers reasonable spatial coverage and the majority of these observations were started before 2000 so there is very good data coverage during the decade of 2000–2009. Four of the stations are very long (25 years+) which allows the recent observations to be put into context of the longer term variability in coastal waters and further offshore. Comparison of the in-situ data is made with time-series from gridded sea surface temperature (SST) datasets (OISSTv2 and HADISST) and modelled datasets. The relationship between variability measured at shallow water coastal sites and measurements made further offshore is examined. The data are analysed to determine how the temporal patterns of variability at each site relate to the key drivers (oceanic and atmospheric forcing or local forcing such as river runoff) and how the temporal and spatial pattern of variability in both temperature and salinity relates to our understanding of ecosystem change over the same time period.

Keywords: temperature, salinity, coastal, variability, long term monitoring, Scotland, North Sea, North Atlantic

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Long-term hydrographic and chemical variability observed in the Santander timeseries (southern Bay of Biscay)

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The Spanish Institute of Oceanography (IEO) carries out a time-series program (Radiales), which occupies monthly oceanographic sections mainly located over the continental shelf around the Spanish waters. The Santander section (southern Bay of Biscay) started in 1991, and due to the proximity of the shelf break to the coast the water column can be sampled down to 1000m (extended to 1500m in 2006). The results for the hydrographic and chemical observations - including dissolved oxygen, inorganic phosphorus, nitrate and silicate- will be presented showing the variability and trends of thermohaline and chemical properties of the water masses superimposed on the different processes operating in the region as coastal upwelling, the poleward current, continental runoff or extreme events as the severe winter of 2005 which produced a deeper mixed layer depth resulting in an increase of nitrate concentration on surface waters.

In the past few years, the Santander Section has been enhanced by a new infrastructure: the meteorological and oceanographic buoy Augusto González de Linares (AGL), a mooring currentmeters line, remotely sensed data products (SST) and recently an autonomous glider have been tested for use in the area, improving the sampling resolution and allowing the observation and variability of small scale events.

Keywords: Nutrients, hydrography, Bay of Biscay

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Emerging patterns from time series of plankton sampling off the east and west coasts of Scotland, UK

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Stonehaven monitoring station, in the eastern North Sea (56°57.8'N 02°06.2'W, depth 50m) has been sampled weekly since 1997. Loch Ewe station, in a sea loch in northwest Scotland (57°50.99'N 05°38.97'W, depth 40m) has been sampled since April 2002. These sites are sampled with CTD, water samples for nutrients, chlorophyll and phytoplankton community and vertical 40cm bongo tows for zooplankton community. These time series data have achieved useful duration for analysis of seasonal patterns and interannual trends, across the sampled range of phytoplankton and zooplankton species; also enabling assessment of life cycle dynamics in relation to environmental variation. These patterns can then be related to broad scale environmental indices and to other time series site data. Examples of these data and patterns are presented.

Keywords: monitoring, plankton, environment, Scotland

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Changes in length structure and spatial distribution of some demersal species in the Northwest Atlantic (Divs. 3NO and 3L, NAFO Regulatory Area) during the last decade

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Important fisheries that have a high fishing effort have been developed over decades in the northwest Atlantic (Divs. 3NO and 3L, NAFO Regulatory Area). The constant activity, combined with physical factors, have contributed to noticeable macroecological changes as the decrease in the length range of exploited species or species suffering from a high by-catch, changes in distribution, the fall of the biomass in some species (American plaice, Yellowtail flounder, Greenland halibut) or the collapse in the case of Atlantic cod,

The purpose of this paper is analyzing the changes in biomass, length structure and in spatial distribution observed in the last decade in some demersal species characterized by different patterns: species widely distributed like thorny skate (*Amblyraja radiata*), deep-water species such as grenadiers (*Coryphaenoides rupestris*, *Macrourus berglax* and *Nezumia bairdii*) and opportunistic species such as *Synaphobranchus kaupii* (northern cutthroat eel).

Keywords: Northwest Atlantic, length structure, spatial distribution, biomass.

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Physical, Chemical and Biological Oceanographic Variability in the Labrador Sea during 2000–2009

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Variability in the water mass properties and plankton in the Labrador Sea (LS) region during the decade 2000–2009 are described based on annual spring surveys along the WOCE AR7W line, remote sensing data, Argo floats and other information sources. The surveys are being carried out as part of Canada's Atlantic Zone Off-Shelf Monitoring Program. The observed variability is interpreted in relation to longer-term and larger-scale ocean and atmospheric observations.

Temperature and salinity over the upper 2000m have generally been increasing since 1995, with the exceptions of cooling associated with enhanced deep convection in 2008 and freshening in the upper 50m since 2002. Total inorganic carbon concentrations have increased over the past decade in the central LS with a corresponding decrease in pH of 0.03. Dissolved oxygen concentrations in the same water mass have shown a persistent downward trend, attributable to both reduced solubility caused by warming and increased biological consumption. Decadal trends in near-surface nutrients are indicative of a decreasing influence of arctic waters and an increasing influence of subtropical Atlantic waters. Phytoplankton and bacteria both have shown slight positive decadal trends in abundance in the eastern LS, negative trends on the Labrador Shelf, and little apparent change in the central LS. Trends in reproduction and abundance of the dominant zooplankton species, *Calanus finmarchicus*, have been linked to ocean temperature at the time spawning and to the timing of the phytoplankton bloom.

Keywords: Physical, Chemical and Biological Oceanography; Labrador Sea

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The Marine Ecosystem of the North East Atlantic Shelf: A Hindcast Analysis

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Marine ecosystem models are currently the only tools available to provide a holistic assessment of the ecosystem state for larger areas on a multi-decadal time scale. In this work we present simulations of the lower trophic level of the marine ecosystem of the North Atlantic shelf region for the years 1965–2004, based on a coupled model experiment. The modelling framework of this experiment designed within the EC FP7 project MEECE is composed of the Proudman Oceanographic Laboratory Coastal Ocean Modelling System (POLCOMS) coupled to the European Regional Seas Ecosystem Model (ERSEM) under reanalysis forcing for the atmospheric drivers (ERA40) and ocean currents on the open boundaries and using climatological data for riverine and open boundary nutrient loads.

Model simulations are validated with in-situ and satellite data, using various single- and multivariate techniques as well as wavelet analysis to determine the model skill. Results are analysed to identify trends in the physical environment and their propagation through the ecosystem and by individuating links to the dominant tele-connection patterns of the region.

Keywords: marine ecosystem, ecosystem modeling, hindcast, North East Atlantic Shelf

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Variability of chlorophyll *a* distribution in the Fram Strait and the Greenland Sea

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Chlorophyll *a* measurements have been carried out on samples obtained during several cruises of RVs *Polarstern*, *Lance* & *Maria S Merian* to the Fram Strait and Greenland Sea over the last 15 years (1994–2010). Almost every year samples have been taken from at least six different depth horizons within the upper 100 meters of the water column; between 6 and 150 stations have been sampled per cruise leg with Niskin bottles, filtered and measured with a fluorometer, respectively.

Here we present a compilation of data obtained *in-situ* focusing on the seasonality and inter-annual variability in the chlorophyll *a* distribution. The data set is also used for comparison with a selection of satellite retrieved data in order to gain a broader view of the total area between Greenland and Svalbard. Long-term variability in chlorophyll concentration patterns within broad areas may indicate alterations in biomass and species composition of primary producers. A comparison of spring, summer and fall data from all depth (0-100 m) show slightly higher values in April and May moving towards lower values in summer. In fall only a small number of measurements show values above 1 $\mu\text{g L}^{-1}$, values below 0.1 were more abundant.

Keywords: chlorophyll *a*, long-term data, seasonal variability, Fram Strait & Greenland Sea

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Through plankton to seabirds: The variability of Arctic zooplankton distribution regulated by climate change – a multidisciplinary observations

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Climate change in the Arctic influences the ocean circulation and the hydrologic regime which leads to the substantial reconstruction of zooplankton community, notably the northward shift of dominant boreal zooplankters. These unstable Arctic environmental conditions are expected to affect the planktivores such as little auks (*Alle alle*) - very important and numerous seabirds which feed selectively on the energy-rich Arctic copepod. These birds transport organic matter from sea to land, and thus help to initiate and sustain terrestrial ecosystems.

The present study is based on multidisciplinary zooplankton observations carried out with net sampling, Laser Optical Plankton Counter (LOPC) and high frequency echosounding during two summer seasons 2009 and 2010 on the west Spitsbergen shelf. Several net samples delivered a detailed zooplankton species composition and abundance estimation at stations, while modern LOPC technique enabled continuous mapping of different zooplankton size classes with high spatial resolution. Additionally, echosounder measurements allowed us to determine the accurate vertical profiles of zooplankton biomass along LOPC transects.

Multidisciplinary observations has demonstrated that hydrological frontal zone of the West Spitsbergen Shelf, which may be first affected by progressing climate warming, contains the highest abundance of zooplankton and seems to be favourable feeding ground for planktivores such as little auks. Comprehensive knowledge on zooplankton distribution in the sensitive Arctic frontal zone region will allow us to better foresee a possible consequence of climate change for zooplankton and their predators - seabirds.

Keywords: climate change, zooplankton, seabirds, West Spitsbergen

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On the occurrence of extreme climatic events by Argo floats

R. Somavilla, C. González-Pola, C. Rodriguez, and A. Lavín

Extreme atmospheric forcing may produce abrupt changes in the physical properties and in the vertical structure of the water column with major consequences for primary production. The occurrence of such especially events enables to advance in the understanding of the relations between the atmospheric forcing and their effects in the water column vertical structure, unlikely observable under normal forcing conditions. Until now there are scarce studies since these phenomenon have been mainly studied in an isolated way when exceptionally they have been observed during hydrographic surveys as in the case of the extreme winter mixing occurred during the exceptional cold winter of 2005 in south-western Europe. In order to overcome the drawbacks associated to traditional oceanographic surveys, the present study will be based on data collected by autonomous devices (Argo floats), which functioning is not affected by weather conditions or a spatial limitation, to detect systematically any anomalies in the ocean caused by extreme atmospheric forcing. It represents the first step to evaluate at ocean basin and global scales how extreme atmospheric forcing are affecting oceanographic features, and how these changes in the ocean can affect biogeochemical and biological processes. The results from the analysis of the extreme winter mixing of 2005 in the Bay of Biscay will be also presented to illustrate the causes and effects of such events and how punctual anomalies are connected with decadal variability after years of sustained warming and the injection of heat and salt to deeper levels of the water column.

Keywords: extreme climatic events, upper ocean variability, Argo floats, global ocean

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The role of silvery pout (*Gadiculus argenteus*) as forage fish in the Cantabrian Sea ecosystem in the last two decades

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Silvery pout (*Gadiculus argenteus*, Guichenot 1850) is a very common and quite abundant species in the Bay of Biscay, which plays an important role in the Cantabrian Sea ecosystem since it is one of the main trophic resources of many commercial species. In this study we analysed data obtained from a series of bottom trawl surveys in the last two decades from 1990–2008 carried out along the continental shelf of Galicia and the Cantabrian Sea (north of Spain). We examined the changes observed in the distribution pattern and abundance indices of this species and related these with the occurrence and abundance of other commercial species in the area like hake, megrim or blue whiting. Significant correlation was found ($R=0.45$, $p=0.038$) between the abundance index of silvery pout and hake, one of the main predator of this species. A total of 137780 stomachs of 19 predators were analysed during this period. The volume percentage (%V) of *G. argenteus* in some species was very high as it was the case of *Lepidopus caudatus* (94 %) or *Molva macrophtalma* (58.2 %). High correlation between silvery pout yearly abundance in the stomachs (%F) and survey biomass indices were found as well as between the volume percentage (%V) of some predators according to the range length.

Keywords: *Gadiculus argenteus*, abundance, trophic relationships, Cantabrian Sea

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Time Series Analysis of Upwelling Index in the NW Iberian Margin from 1900 to 2010

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Using Sea Level Pressure database from the Fleet Numerical Meteorology and Oceanography Center (<http://www.usno.navy.mil/FNMOC>), monthly Upwelling Index (UI) time series was calculated from 1967 to 2010 for the NW of the Iberian Margin (43° N 11° W). This time series was completed from 1900, deriving UI from wind database of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS, <http://www.usno.navy.mil/FNMOC>). In order to study the temporal variability of the UI at different scales, harmonic time series analysis was applied. The main component of variation was the seasonality (Period (T) of 12 months) with an amplitude (A) of $273 \text{ m}^3\text{s}^{-1}\text{km}^{-1}$ and with a period of maximum (Tmax) of 6.44 months (June), explaining 20% of the total variance. Linear trends were not significant for this series. The same method of analysis was applied to each decade and A and Tmax variations of seasonal cycle were found. The A has its lower values at the beginning of the century ($A = 150 \text{ m}^3\text{s}^{-1}\text{km}^{-1}$) and increases gradually reaching its maximum at the eighties ($450 \text{ m}^3\text{s}^{-1}\text{km}^{-1}$). Subsequently it decreases up to the present ($350 \text{ m}^3\text{s}^{-1}\text{km}^{-1}$). The daily FNMOC UI time series from 1967 to 2010 was used to perform a time series analysis focusing in high frequency periodic variations. The seasonal cycle was the main source of variation as it was for the monthly series (T = 365 days, A = $442 \text{ m}^3\text{s}^{-1}\text{km}^{-1}$, $r^2 = 0.08$). In this case, other higher frequency oscillations were significant, with periods of 292, 121 and 50 days but explaining low amount of variance (less than 1%).

Keywords: Upwelling Index, Time series, Harmonic analysis, Iberian Margin, Galicia,

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Variability of physical and biological properties in the Faroe Shetland Channel between 2000–2009: results from a long-term monitoring programme and model data

B. Berx, S. Hughes, B. Hansen, S. Østerhus, T. Sherwin, and S. M. Olsen

The inflow of Atlantic Water into the Nordic Seas through the Faroe Shetland Channel (FSC) is one of three branches of Atlantic Water crossing the Greenland-Scotland Ridge (GSR). Comparable transports of ~3.8 Sv occur through the FSC and between Iceland and Faroes, with a minor contribution (0.9 Sv) West of Iceland making up the third branch. A Scottish-Faroese-Norwegian collaboration has obtained a long term time series of water mass properties (temperature, salinity, Chlorophyll-*a* and nutrients) and transports in the FSC. Volume transport is monitored by an array of Acoustic Doppler Current Profilers deployed across the channel. Established in 1994, these observations cover the 2000–2009 decade well. In addition, ship-based observations of water mass properties such as temperature, salinity, Chlorophyll-*a* and nutrients have also been collected along two standard monitoring lines in the FSC: the Nolso-Flugga and Fair Isle-Munken sections. Two water masses contribute to the circulation of AW in the FSC: North-Atlantic Water (NAW), and Modified North-Atlantic Water (MNAW; water from North of Faroes which recirculates in the FSC).

The seasonal and inter-annual variability in these observational time series over the past decade are presented, and further explored within the context of oceanic and atmospheric drivers. The presentation will also draw on model results of transport through the FSC, to explore our understanding of the observed variability over the past decade, and to demonstrate the need for discussion of uncertainty of simulated and observed time-series, as well as the need for continued, direct observations.

Keywords: volume transport, temperature, salinity, nutrients, Chlorophyll-*a*, variability, long term monitoring, Faroe Shetland Channel, North Atlantic

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Temperature fluxes in Denmark Strait

D. Quadfasel, K. Jochumsen, R. H. Käse, and A. Friedrichs

Denmark Strait is an important pathway for the oceanic circulation, exchanging heat and freshwater between the Arctic Mediterranean and the North Atlantic. To first order the exchange is hydraulically controlled and in the mean and at long time scales the baroclinicity of the flow is simply linked to the height of the dense water reservoir in the north. In addition, there exists a strong barotropic wind-driven component in the circulation that is characterized by variability extending to much shorter time scales. Also, as the width of Denmark Strait is larger than the internal radius of deformation, the in- and outflows are located side-by-side with a strong front separating the two flows. This front is bound to instabilities with time scales down to a few days.

In this talk we examine the meridional temperature fluxes in the strait and quantify the relative importance of mean temperature advection, shorter term wind-driven variability and locally generated mesoscale eddies. The analysis is based on more than ten year long time series of currents and temperatures, measured at the sill of the strait, and hydrographic measurements collected during recoveries and deployments of the moorings. Also, a suite of numerical model simulations were carried out to delineate the dynamics of the exchanges and quantify their magnitudes.

Keywords: Atlantic Meridional Overturning Circulation, hydraulic control, mesoscale variability, Denmark Strait

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ICES/NAFO Decadal Symposium 2011/Ref. 105

Poleward propagation of oceanic heat anomalies

S. Østerhus, B. Hansen, and S. M. Olsen

Observations of volume and heat transport from long term observatories in the North Atlantic Ocean and the Nordic Seas are used to study the poleward oceanic heat transport toward the Arctic. Time-series extending back to the mid 1990's exist for the exchanges across the Greenland Scotland Ridge and in the Atlantic inflow branches in the Nordic Seas. This direct volume and heat transport measurements are combined with longer hydrographic time series and model results to study variation in volume and heat transport back to 1948.

Observed volume transports shows interannual variability but no trend in the volume transport of Atlantic water toward the Arctic Ocean. The observed heat transport shows a shift to higher temperature in the Atlantic Water after 1995. These results are also supported from the model simulation for the whole period from 1948 to 2010.

Keywords: Thermohaline Circulation, Climate, North Atlantic, Nordic Seas, Arctic Ocean

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Data telemetry systems to access climate sensitive data from moored instrumentation

J. Karstensen, M. Visbeck, A. Pinck S. Østerhus, and M. Busack

Timely and save data retrieval from moored open ocean instrumentation is important in the context of scientific investigations as well as for monitoring the marine environment. Some full water depth moorings may carry a surface telemetry system that allow data retrieval via satellite communication. In other cases, which are of interest here, moorings may not reach up to the surface or the harsh surface ocean conditions and other marine activities (fishery, traffic,...) may inhibit the use of a surface telemetry system.

As part of the EU project THOR two subsurface data retrieval systems are designed and tested. One system is based on an “on demand” acoustic transmission of data from the mooring to a passing ship. The other system is based on the release of data capsules that “po-up” to the surface in predefined intervals and send the data via satellite communication to shore. Our experience in designing the systems and testing them will be presented.

Keywords: Ocean technology, mooring, data telemetry, underwater acoustics

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The seasonal cycle of mixed layer total nitrate content in the central Irminger Sea in 2003/04 and 2006/07

J. Karstensen, M. Villargarcia, T. Kemena, A. Körtzinger, and O. Llinas

In contrast to the oligotrophic subtropical gyres, subpolar gyres are characterized by relative high concentrations of nitrate in the surface layer year round. A number of reasons for the maintenance of elevated nitrate concentrations are steady as well as intermittent supply of nitrate from below through upwelling, the limitation of light or/and limited availability of other nutrients such as iron. Daily observations of total nitrate (nitrite and nitrate) from moored instrumentation in the Central Irminger Sea of two non-consecutive years (2003/2004 and 2006/2007) are evaluated in respect to their possible driving mechanisms.

A one dimensional mixed-layer model (GOTM) coupled with a simple biogeochemistry model is integrated for simulating both observational periods. Observed initial conditions and atmospheric flux data has been used. The hydrographic as well as the biogeochemical solution of the model are compared with the observations. The difference in near surface nitrate concentrations in the two periods can be at first explained by the intensity of convective overturn that lead to significantly higher nitrate concentration over the winter period 2006 compared with 2003. To investigate the effect of vertical movement, lateral fluxes and light limitation on the near surface nitrate concentrations different model scenarios are integrated.

Keywords: convective overturn, mixed layer, nitrate, interannual variability

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Population differentiation and gene flow in the North Atlantic range of the European hake (*Merluccius merluccius*)

M. Pérez, A. Pita, and P. Presa

Population genetic data would prove useful for management purposes when both a) the range of the populations connected by migration is simultaneously sampled and b) genetic data are interpreted together with environmental data and fishing records. We have analysed the molecular variation of polymorphic microsatellites and mitochondrial DNA sequences on 28 hake populations from the North Atlantic range of the European hake, to determine the genetic status and connectivity of this species along the European coast. High gene flow was observed among the seven major fishery grounds sampled in the 00's decade (from the North Sea to the Canarian Sea), indicating a large migration-mediated gene flow among populations. The deepest restriction to gene flow was observed between Atlantic and Mediterranean basins. However, this assumed divide does not preclude a large connectivity between their populations, and therefore the apparently differential phenotypic traits between them are probably environmentally shaped. This study adds information on population connectivity along the whole range of this species and could be useful to better understand its population dynamics.

Keywords: European hake, *Merluccius merluccius*, connectivity, North Atlantic

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ICES/NAFO Decadal Symposium 2011/Ref. 116

Global connectivity and interannual fluctuation of genetic diversity in the southern hake population during the last decade

A. Pita, M. Pérez, F. Velasco, and P. Presa

Recent population genetics studies on the European hake from the North Atlantic have shown the lack of any stable spatio-temporal genetic structuring between central and southern populations of this species and a broad connectivity precluding any separation between two putative Atlantic hake stocks. This pattern of connectivity studied along three consecutive years consisted of variable migration intensity between populations but fixed migration geometry (North to South Biscay Bay). Since the so-called southern stock has shown its minimal historical population size in 2003, as estimated from recruitment figures, it is interesting to explore the genetic effect that both, the north-to-south connection and its interannual variability have had on the genetic diversity of this southern population. The genetic analysis performed with microsatellites on southern samples from the last decade showed that in spite of the large fishing pressure exerted on this population, its genetic diversity levels remained stable. Such genetic stability can be explained by compensation between the overfishing-induced genetic drift and the large effective size of its populations. Knowledge on the compensatory forces palliating overfishing of European hake populations would be a great asset to work out a more focused management of this species.

Keywords: European hake, induced genetic changes, overfishing, Southern stock

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ICES/NAFO Decadal Symposium 2011/Ref. 117

Modelling oceanographic conditions in the western and northern Iberian shelf and slope affecting early stages of pelagic fish during the 2000s

M. Ruiz-Villarreal, L. García, P. Otero, M. Cobas, and M. Bernal

We present the results of numerical simulation of the oceanographic conditions in W and N Iberian shelf and slope during the 2000s. We use a high resolution (2.8km) realistic configuration of the ROMS model with atmospheric forcing coming from a limited area model, which has shown to realistically represent shelf and slope circulation in the area. Much of the variability in the area is driven by the seasonal alternation of dominance of upwelling or downwelling winds. However, there is high year to year variation in circulation associated partly to the different statistical occurrence of meteorological events among different years. In this contribution, we will concentrate mainly in the spring transition from downwelling to upwelling favourable winds, when environmental conditions are favourable for plankton proliferations and spawning of several species of pelagic fish takes place. The success of spawning and recruitment of juveniles depends on a large extent on the oceanographic conditions at that time. During the 2000s, there has been intense variability on the volume of freshwater on the shelf, on the intensity of the Iberian Poleward Current and its penetration in the Cantabrian Sea, and on the frequency and intensity of upwelling pulses around the spring transition. This has affected oceanographic conditions like temperature, frontal structures, stratification... and consequently high variability of recruitment success occurred. All these factors are studied with the results of a numerical simulation of the 2000s and an attempt to assess the impact of oceanographic conditions on the observed spawning and recruitment of sardine (*Sardina Pilchardus*) during the decade will be performed.

Keywords: Iberian western and northern shelves, 3d numerical model, spring transition, spawning and recruitment of sardine

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ICES/NAFO Decadal Symposium 2011/Ref. 118

Hydrographic variability of the Irminger Sea

H. M. van Aken and M. F. de Jong

Near-annual hydrographic surveys of a section through the central Irminger Sea have been performed since 1990. At the intermediate levels (the Labrador Sea water at ~1500 m) these have revealed an initial cooling until 1996, followed by a warming phase that lasted until present. Extension of the time series of temperature and salinity profiles from the period with data from the period 1950–1989 has shown that this is part of a long-term quasi-oscillation that started with a cooling and salinifying phase from 1950 until the early 1970s, followed by a cooling and freshening phase until 1995, after which the Labrador Sea water warmed and salinified again to values only slightly colder and fresher than it was in the early 1970s. The annual surveys also show a large but more random variability of the hydrographic properties of the Denmark Strait Overflow Water (DSOW) in the near bottom layer. Continuous observations of the DSOW properties with moored instruments have shown that annual surveys under-sample the real variability. Moored instruments, deployed since 2003, have also shown wintertime convection in the centre of the Irminger gyre. In the winters of 2008 and 2009 this convection reached quite deep, about 1000 m.

Keywords: Hydrographic variability, Convection, Irminger Sea

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ICES/NAFO Decadal Symposium 2011/Ref. 120

Indications for a persistent overflow in the western channel of the Iceland Faroe Ridge

R. H. Käse, G. Voet, Ch. Rodehacke, and D. Quadfasel

Motivated by current meter measurements showing a strong dense flow just south of the westernmost topographic trench in the Iceland-Faroe Ridge, we performed several numerical simulations to elucidate the dynamics of the exchange across this shallow ridge. Starting from a dam break experiment with just two homogenous fluids and no external forcing, we continue with realistic density distributions and finally with climatological forcing. We can verify the observed seasonal cycle with maximal overflow in summer and separate the amount of dense water converging at the mooring site from north and from southeast as the continuation of the Faroe Bank Channel Overflow by analysing the arrival of tracers injected at different release sites.

Keywords: Overflow, mixing, Iceland-Faroe Ridge

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ICES/NAFO Decadal Symposium 2011/Ref. 121

Environmental changes at Cap Blanc (Mauritania) and its impacts on the fisheries

H. Ould Taleb, M. Libraimi, A. Orbi, and K. Hilmi

The fluctuation of fisheries resources represents a relevant characteristic of upwelling ecosystem zones. This fluctuation depends mainly on SST (Sea Surface Temperature). To better managing the fisheries resources, the knowledge of environmental factors mainly the SST is required. This work deals with the evolution of SST measured on a fixed coastal station of Cansado (Mauritania) since 1982. These measurements are made in-situ every day at the same hours. The 29 years series of measurements (1982–2010) is subjected to a test nonparametric Mann- Kendall to evaluate the tendency. The existence of a link between the evolution of this series of SST and the NAO is seeking.

The results show that the increase of SST is highly significant ($p < 0.0001$) for the period 1995–2010. Analysis show also the periods of successive cooling and warming cooling which characterise this zone permanent upwelling area. Also, the strong seasonality abundance of *Sardinella* is connected with the SST cycle.

Keywords: SST, cooling, warwing, Cap Blanc (Mauritania)

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ICES/NAFO Decadal Symposium 2011/Ref. 122

Hydrographic conditions and occurrence of new groundfish species on the Greenland shelf in 2000–2009

A. Akimova, H.O. Fock, and M. Kloppmann

Waters over the Greenland shelf are subject to hydrographic variations at different time scales, which go along with variability of the Subpolar Gyre. Temperature and salinity of the water have started to increase in the end of the 1990s coinciding with the slowing down of the Subpolar Gyre. Analyses of our time series since 1981 show that this increase has continued in the first decade of the 21st century, culminating in the highest temperature in 2003 and the highest salinity in 2009. Ocean ecosystems responded to the hydrographic changes in different ways. In this study we consider one aspect of such changes. We report on the first appearance of several groundfish species, such as grey gurnard (*Eutrigla gurnardus*) and spiny dogfish (*Squalus acanthias*), on the shelf around Greenland in 2000–2009. Never before these species have been recorded in the bottom fish survey data collected since 1981. We argue that the new species have occurred on the Greenland shelf in response to ongoing large-scale changes of the Subpolar Gyre.

Keywords: hydrography, Subpolar Gyre, groundfish, Greenland shelf

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ICES/NAFO Decadal Symposium 2011/Ref. 123

Ecological monitoring of Belgian beaches prior to beach nourishment

S. Vanden Eede and M. Vincx

During the last decade, climate change has become a much debated topic. An increase in storms and rising sea levels are particularly problematic for low lying countries like Belgium. Every kilometer of our coastline is intensively used and needs protection against coastal erosion and flooding. Despite intensive monitoring and maintenance actions, some parts of our coastline do not meet the required safety level. Soft coastal defence techniques like beach nourishment might help solve the problem. As it safeguards the natural dynamics of the coast, beach nourishment has rapidly become a widely applied protective measure in Europe. However, its effect on the soft-sediment macrobenthos remains unclear.

The ecological effects of any anthropogenic influence can only be evaluated by comparing the status of the environment before (t0 situation) and after (t1 situation) the influence has taken place. Our research focuses on the effects of ecological beach nourishment (Lombardsijde, 2009) and natural beach nourishment caused by structural harbor operations (Ostend-East, in progress) on the soft-sediment macrobenthos. The soft substrates of both beaches have been and are being extensively monitored since 2002 (Speybroeck *et al.*, 2003, Welvaert, 2005; Van Ginderdeuren *et al.*, 2007; Vanden Eede *et al.*, 2008; Vanden Eede *et al.*, 2010). To distinguish the effects of beach nourishment from those of natural variation, we included reference sites in our studies. This paper presents the natural dynamics in the macrobenthic communities of Lombardsijde and Ostend beach (t0 situation).

Keywords: beach nourishment, macrobenthic community, North Sea

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ICES/NAFO Decadal Symposium 2011/Ref. 124

Variability of Atlantic Water transport and properties in the entrance to the Arctic Ocean – causes and consequences

A. Beszczynska-Möller, E. Fahrbach, U. Schauer, E. Hansen, and Ø. Skagseth

The inflow of warm Atlantic Water (AW) through Fram Strait is the only oceanic source of heat for the Arctic Ocean and potentially can affect its ice cover. In last two decades a warming trend has been observed in the North Atlantic. More than decadal observations by the array of 16 moorings in the northern Fram Strait also show significant warming in the AW inflow to the Arctic Ocean as well as in the AW branch which recirculates back to the North Atlantic. Oceanic fluxes vary strongly on monthly to decadal time scales and variability of the AW transport through Fram Strait (and its upstream splitting between the Fram Strait and Barents Sea Opening) is mostly controlled by the large-scale and local atmospheric forcing.

Propagation of the warm anomalies into the Arctic Ocean can be traced as a series of successive events, advected from the North Atlantic via Fram Strait. Two strong warm anomalies were observed in 1998/99 and from 2004 to late 2006 when AW temperature reached the record high values. Estimations of the heat flux through Fram Strait reveal an increase of order 10 TW between late 90s and early 2000s. Most of this heat is lost to the atmosphere directly north-east of Fram Strait where a retreat of the sea ice cover observed in the last decade suggests an increased ocean-atmosphere heat flux. The higher heat input may also account for observed warming in the Atlantic and deep waters of the Eurasian Basin.

Keywords: oceanic fluxes, Atlantic Water, warming, Fram Strait, moorings

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ICES/NAFO Decadal Symposium 2011/Ref. 126

Recent Variability in the Intermediate and Deep Water Masses of the Labrador Sea

I. Yashayaev, J. Loder, and B. Greenan

Extreme wintertime heat losses, together with inputs of freshwater from the Arctic, atmosphere and land, make the Labrador Sea the coldest and freshest basin of the North Atlantic. Under extreme conditions its winter mixed layer can penetrate deeper than 1000 m and develop into Labrador Sea Water (LSW) – the primary intermediate water of the North Atlantic. LSW, Denmark Strait Overflow Water and Northeast Atlantic Deep Water from the deep limb of the Atlantic Meridional Overturning Circulation and hence are important components of the global climate system.

Recent variability in the properties of the intermediate and deep water masses of the Labrador Sea will be described by using hydrographic, profiling float and altimeter data. It will be shown that the variability of intermediate-depth water is strongly influenced by the strength and duration of wintertime surface heat loss, and the advection of warmer more saline intermediate waters from the North Atlantic. With the exception of 2008 when convective mixing penetrated as deep as 1600 m to form a decade-deep LSW, the magnitude of net winter cooling and the associated strength of convection had declined toward the end of the first decade of the current century. Four variations of LSW produced in different years were identified in the 2010 annual survey of the Labrador Sea. While gradually transforming in time, these waters have been preserved in different ranges of density and depth because of gradual weakening of winter convection since 2008, and are still distinguishable by their unique signatures in temperature and salinity.

Keywords: Intermediate and deep water masses, Labrador Sea

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ICES/NAFO Decadal Symposium 2011/Ref. 127 Poster

Global tendencies in demersal communities in the northern Spanish shelf

A. Punzón, A. Serrano, F. Sánchez, F. Velasco, and I. Olaso

In last three decades the Spanish Oceanographic Institute perform the monitoring the demersal communities in the Cantabrian Sea. During this time, global events have shown it may have affected these ecosystems. The main important events have been climate change, fishing activity and biological invasions.

The consequences of these events are multiple. Some of them, like a several depletion of commercial populations (Norway lobster) are obvious. But it is necessary to identify similar changes in species without commercial interest, vertebrates and invertebrates. In addition, in this document the incorporation of new species in the Cantabrian Sea ecosystems will be analyzed.

The changes in species abundance should lead to changes in total biomass. Hence the tendencies in the total biomass will be analyzed, with special attention at local events, to identify the variables involves in these changes. Is important to note that these changes in the biomass can modify the exploitation pattern (discards, catch profile, etc) of the main fisheries in the study area.

Finally, the effects of these changes in community structure will be studied.

Keywords: Demersal Communities, Decadal Changes, Cantabrian Sea

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Study of the inter-annual variability of coastal upwelling and its impact on the productivity of medium level (South area of Morocco during the years 2001–2010)

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Based on information collected during research cruises conducted from 1994 to 1999, the Moroccan Atlantic coast was subdivided into four main areas with different hydrological characteristics. Two areas are located in the north of Cape Juby (28°N) characterized by a resurgence of activity which is greater in winter. The others two areas, are located in the south of Cap Juby characterized by a resurgence of activity during the winter and summer with variable intensity and the presence of two types of upwelling; coastal localized at Cape Boujdor and another localized on the boundary of the continental slope on both sides of Dakhla.

On another side, an inter-annual monitoring was investigated in three radial: 25°30' N, 23° 30' N and 21°N, to follow the intensity of upwelling and its impact on productivity of the marine environment during the period between 2001 and 2010. Physicochemical factors such as temperature, salinity and nutrients, were also registered. The resurgences appear from Dakhla (24° N) and reach their peak at Cap Blanc. Thus, at the whole water column of the coastal station of Cape Boujdor (25°30'N), resurgence are low in autumn (except in 2007) and are quite important in summer. The three radial shows a low resurgence in Cape Boujdour during autumn 2009. However, since summer 2009, we recorded a temperature rise of resurgence in this area which is mainly due to the invasion of the offshore waters characterised by high surface temperatures exceeding 18°C and salinity of about 36.45 psu.

This inter-annual variability of upwelling activity was confirmed by the calculation of upwelling index derived by infrared thermal imaging NOAA / AVHRR. Especially for the year 2010 that presents a positive anomaly of temperature of sea surface by +2 ° C with an activity index of upwelling attaining the lowest level.

On the other hand, the variability of the hydrological state of the environment affects the productivity, illustrated by the concentration of chlorophyll 'a' and biomass of zooplankton with a significant effect on egg production of small pelagic fishes.

Keywords: Upwelling, inter-annual variability, hydrology, satellite imaging, chlorophyll 'a' and zooplankton.

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Variability of annual primary production in the North Sea; estimates of production from observations and models

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Primary production is an important part of the food chain and is a key food source for many pelagic fish species. Observations of the spring plankton bloom have been available for many years, and the use of satellites allows chlorophyll derived estimates of surface production to be derived throughout an annual cycle. However, in stratified areas, significant production occurs at depth, in the deep chlorophyll maximum (DCM) with no surface expression. In summer this can contribute the major part of new production in stratified areas. This presentation presents high frequency observations of this DCM and associated production over a number of years (2000–2003) for much of the central North Sea and is put in to the context of total annual production. It also presents results from a coupled physical – ecosystem model GETM – ERSEM of the North Sea, which has been validated against observations. Runs have been made over a 40 years hindcast to investigate inter annual and decadal variability. Comparisons are made between model and observations and assessments made of the variability between model runs.

Keywords: Primary Production, Observations, Modelling, North Sea

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Influence of environmental factors on Rose Shrimp (*Parapenaeus longirostris*) abundance in the Gulf of Cadiz during the 2000s.

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Rose shrimp (*Parapenaeus longirostris*) is a target species of the Gulf of Cadiz bottom trawlers. Its spatial distribution is bathymetrically constrained between 90-380 m, with spawners occurring at the shallower bound. Rose shrimp abundance indices as observed from standardized bottom trawl surveys have shown dramatic decadal shifts with peaks close to 6 kg per trawl hour around 1999 and 2009 and lows otherwise. These variations have also a response in the annual catch reports. At these grounds a number of oceanographic processes interplay. The recently described equatorward Gulf of Cadiz Current sweeps the lower shelf with relatively cold, relatively low salinity water. Slightly below a previously unreported shallow pathway of the warmer and saltier Mediterranean outflow runs poleward along the upper slope (250-350 m) from the Straits of Gibraltar to Cape St. Vincent. This domain is also highly influenced by the formation of mesoscale structures of either sign that frequently impinge on the slope, disturbing the previously described two-layered pattern.

The present work aims at studying the relationships of the oceanographic setting on the rose shrimp population dynamics. This preliminary study focuses on the equilibrium structure of the prevailing flows, their oscillations around their main pathways and the changes in the thermohaline properties in the context of the recent changes that are occurring in the western Mediterranean.

Keywords: Gulf of Cadiz, Rose Shrimp, Mediterranean Outflow, Strait of Gibraltar.

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Changes in distribution of eggs of mackerel, horse mackerel and sardine during the spawning peak in the Cantabrian Sea (1995–2010)

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The Cantabrian Sea is an important area in the North Atlantic Ocean due to the occurrence of high densities of mackerel, horse mackerel and sardine eggs in spring. For this reason, this area evidences its importance as a spawning habitat for these species.

Since 1995, a series of spring research surveys for the application of the Daily Egg Production Method and Annual Egg Production Method in the Cantabrian Sea, consisting of both ichthyoplankton and hydrographic sampling, was conducted by the Instituto Español de Oceanografía (IEO). Abundance egg on mackerel, horse mackerel and sardine are collected during these surveys in order to estimate their spawning stock biomass. The surveys are designed to obtain an adequate spatial and temporal coverage during the spawning peak of these mentioned species in the Cantabrian Sea. Due to the variability of the environmental conditions, the abundance and spatial distribution of these eggs during the spawning peak may vary within the surveyed area.

Keywords: Mackerel, horse mackerel, sardine, ichthyoplankton, Cantabrian Sea.

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Fluctuations in abundance of the epibenthic communities of Minho estuary (NW Iberian Peninsula) in relation to environmental conditions during 2004–2007

J. Campos, V. Freitas, A. Bio, and S. Costa-Dias

The Minho estuary, located in the Northwest of the Iberian Peninsula, is one of the least impacted estuarine areas of Europe with special environmental interest as part of the Natura 2000 and as an Important Bird Area (IBA). The area is known as the southern limit of some fish species with commercial interest such as salmon *Salmo salar* and flounder *Plathichthys flesus*. The latter uses Minho waters as nursery grounds relying on several organisms as preys, including epibenthic species like the crustaceans, brown shrimp *Crangon crangon* and shore crab *Carcinus maenas*, and goby fishes *Pomatoschistus* spp.

A monthly sampling programme was established during the period from 2004 to 2007 to study the epibenthic communities' fluctuations at Minho estuary in relation to environmental conditions. These communities include mainly resident populations of the crustaceans *C. crangon* and *C. maenas*, and the fish *Pomatoschistus* spp besides the migratory flounder *P. flesus* populations. In this work a modeling approach is applied to relate the variability in abundance of the epibenthic communities with environmental constraints including water temperature, salinity, river flow and bottom characteristics such as sediment granulometry and organic content. Possible effects of a drought year (2005) on the abundance of the epibenthic species are also discussed. This study can ultimately provide insights into climate change impacts on estuaries.

Keywords: epibenthic communities, climate change, estuary, Portugal

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Decadal variability of phytoplankton phenology in the North Atlantic

Marie-Fanny Racault, Corinne Le Quéré, Erik Buitenhuis, Shubha Sathyendranath, and Trevor Platt

In recent years, phytoplankton phenology has been suggested as a systematic indicator to monitor the state of the pelagic ecosystem and detect changes triggered by perturbation of environmental conditions. Here we describe the phenology of phytoplankton growing season for the North Atlantic (NA) using remote-sensing ocean colour data, and analyse its variability between 1998 and 2008. The NA subtropics present generally long growing season (15-17 weeks) of low amplitude ($< 0.5 \text{ mg m}^{-3}$), whereas the high-latitudes show short growing season (< 10 weeks) of high amplitude (up to 7 mg m^{-3}). Correlation analyses suggest a close coupling between the development of the growing season and the seasonal increase in insolation in the North Atlantic. Large interannual variability is observed in the duration of growing season over the decade 1998–2008. The NA shows strong positive anomalies between 5-10 weeks at the beginning of the time series from 1998 to 2000 and similarly strong negative anomalies at the end of the time series from 2005 to 2008. As a result, negative linear trends in duration ($- 10 \%$ per year on average) are observed over a large fraction of the NA. The effects of temperature and large-scale climate variability on the duration are examined. Higher Sea-Surface Temperature (SST) over the duration of the growing season is associated with longer duration at high-latitudes indicating an extension of the growing season over summer months. The opposite is observed in the NA subtropics, where the duration is shorter when the SST is higher, indicating increased stratification. Positive phases of the North Atlantic Oscillation, associated with enhanced water mixing and nutrients supply, generally sustain longer growing season.

Keywords: Phytoplankton phenology, North Atlantic, Interannual variability, Climate Forcing

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Dynamics of distribution and abundance of demersal fish in the Barents Sea based on Russian bottom trawl surveys 2000-2009

A. Dolgov and A.K. Karsakov

Russian bottom trawls surveys are conducted in the Barents Sea during October-December since 1982. Total registration (including total abundance and weight measurement) of all fish species was started only in late 90s. Various aspects of distribution of demersal species from different zoogeographical groups (including area size, locations of northern/southern and western/eastern borders of their distribution) are considered under changes in water temperature.

Besides, dynamics of abundance of cold and warm water fish species and their ratio as results of oceanographic conditions fluctuations are analyzed.

Keywords: demersal fish, distribution, abundance, oceanography, Barents Sea

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