7th EuroGOOS conference

OPERATIONAL OCEANOGRAPHY FOR SUSTAINABLE BLUE GROWTH

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Celebrating 20 years of EuroGOOS

ABSTRACTS

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EuroGOOS
European Global Ocean Observing System

ORAL PRESENTATIONS

WEDNESDAY 29 OCTOBER 2014

MEETING ROOM 1

Remote Sensing
Chair: **Hans Bonekamp**, EUMETSAT

0900	**The Sentinel-3 EUMETSAT Marine Centre** V. Fournier-Sicre (1), C. Nogueira Loddo (1), V. Santacesaria (1), Jan Løvstad (1), H. K. Wilson (1), H. Bonekamp (1), A. O'Carroll (1), E. Kwiatkowska (1), R. Scharroo (1), F. Montagner (1) 1: EUMETSAT This presentation will provide an overview of the Sentinel-3 Marine Centre and its related services and topics. Sentinel-3 is a EUMETSAT optional program which is in its phase E, and for which EUMETSAT will be both the Sentinel-3 satellite and Sentinel-3 Marine Centre operator; this to service the Marine users within Copernicus and beyond. Integration, Verification and Validation activities of the Sentinel-3 Marine Centre have recently started at EUMETSAT. Together with ESA the Cal/Val plans and Mission Performance set-ups have been defined to ensure that the core mission performances and operational products will be state of the art; this with the support and involvement of the scientific community. The presentation will focus on the system, the organisational set-ups, and on how the Marine Users will be able to retrieve the products.
0915	**Jason-CS: Continuing the Jason Altimeter Data Records as Copernicus Sentinel-6** H. Bonekamp (1), C. Ponsard (1), F. Parisot (1), M. Tahtadjiev (1), K. De Vriendt (1), A. Von Engeln (1), R. Scharroo (1), F. Montagner (1) 1: EUMETSAT Jason Continuity of Service (Jason-CS) is proposed as a multi partner program to continue the Jason altimeter data services beyond Jason-3. As its predecessors the proposed mission will fulfil key user measurement requirements within sea level rise monitoring, operational oceanography and marine meteorology. The Jason-CS mission is also named Sentinel-6 to reflect its constituting role in the High Precision Ocean Altimetry (HPOA) element within the EC Copernicus program. Jason-CS will also include a Radio Occultation mission to serve the international Radio Occultation community with substantial additional and unique measurement capabilities. The presentation will provide an overview of the state of developments of the program and of key features of the missions such as the interleaved altimeter mode of operation, the microwave radiometer, the precise orbit determination and the radio occultation mission. The presentation will also provide an initial specification of the user product services in continuation of those of Jason-3 and in alignment with those of Sentinel-3 SRAL and GRAS on Metop.
0930	**The SSALTO/DUACS Multimission Altimeter Centers: Recent improvements** M.-I. Pujol (1), Y. Faugère (1), S. Labroue (1), F. Briol (1), G. Dibarboure (1), G. Larnicol (1), E. Bronner (2), N. Picot (2), 1: Collecte Localisation Satellites (CLS), FR 2: Centre National d'Etudes Spatiales, FR During the last 20 years, altimeter Level 3 (along-track cross-calibrated SLA) and Level 4 products (merging multiple sensors as maps or time series) to be directly usable and easier to manipulate, by the user community and in particular by the ocean forecasters (GODAE members). They contribute to various studies

	in different fields that cover the ocean, from climate and meteorological phenomena, to geophysics and biology. The objective of the talk is to provide an overview of the activities performed in the frame of the DUACS center. Firstly, the quality and precision of the DUACS products were periodically improved and assessed. The main past and on going improvements will be described emphasing on the role playing by each altimeter mission and the evolution done to adapt to the altimeter events (loss of ENVISAT, change n Jason-1, etc). Secondly, we will provide main achievements on the work performed in the frame of MyOcean project to develop new specific products better tuned for assimilation purpose. Indeed, new processing has been applied as filtering, subsampling as well as an update of the corrections applied to answer to the assimilation groups needs (no dynamic atmospheric, tides corrections). Lastly, we will give some perspective relative to the launch of new (C2, HY-2, AltiKa) and future (S3, J3 but also SWOT) missions.
0945	**The MyOcean Ocean Colour Thematic Assembly Centre and its products: recent development** R. Santoleri (1), S. Colella (1), V. Forneris (1), G. Volpe (1), E. Böhm (1), M. Benincasa (1), P. Garnesson (2), B. Saulquin (2), O.Hembise Fanton d'Andon (2), A. Mangin (2), J. Demaria (2), S. Groom (3), J. Shutler (3), M. Taberner (3), S. Pardo (3), F. Gohin (4), R. Doerffer (5), M. Hieronymi (5), H. Krasemann (5), D.Müller (5), R. Röttgers (5), W. Schönfeld (5) 1: CNR- ISAC, IT 2: ACRI-ST, FR 3: PML, UK 4: IFREMER, FR 5: HZG, DE The MyOcean Ocean Colour Thematic Assembly Centre (OCTAC), developed over the past 5 years, is a key component of the European ocean monitoring and forecasting system. The OCTAC operates a European Ocean Colour Service for marine applications. Multi-mission OC satellite data are used to generate high-quality core biogeochemical parameters essential to monitor the state of the marine ecosystem at short and long time scales. The OCTAC provides Global and Regional products covering the global ocean and the European Regional Seas (Arctic Ocean, Baltic Sea, North Atlantic, Mediterranean and Black Seas). The OCTAC delivers Near Real Time (NRT) and reprocessed OC datasets. The NRT products, operationally produced daily, provide the best estimate of the OC variables at the time of processing and are supported by a data quality assessment. The reprocessed products, instead, are consistent multi-year time series produced by using a consistent input dataset, with a unique processing software configuration which results in a solid data set suitable for long-term and climate analyses. Regional products are produced using regional tailored processing chains more accurate, in regions such as the Mediterranean, where the global chlorophyll products were found to have, systematically, large biases. In addition, regional processing has allowed us to improve the chlorophyll estimates over the shelf area of the European regional seas by developing new Case1/Case2 chlorophyll merged products. The OCTAC system and its products will be presented including the major scientific and technological steps taken to develop, maintain and improve the system and its products.
1000	**EUMETSAT ocen colour products from geostationary platforms** E. Kwiatkowska (1), K. Ruddick (2) Q. Vanhellemont (2) H. Bonekamp (1) 1: EUMETSAT 2: Royal Belgian Institute of Natural Sciences, BE Ocean colour applications from medium resolution polar-orbiting satellite sensors, including SeaWiFS, MODIS and MERIS, are maturing and have provided the justification for the Sentinel-3 OLCI mission in the framework of the European Earth Observation "Copernicus" programme. Key drivers for Sentinel-3 OLCI are the national obligations of the EU member states to report on the quality of coastal and inland waters for the EU Water Framework and Marine Strategy Framework Directives. Further applications include CO2 sequestration and carbon cycling, fisheries and aquaculture management, near real time alerting for harmful algae blooms, and the assessment of sediment transport in coastal waters, particularly as related to human activities such as dredging, and offshore construction. Data from satellite polar-orbiting platforms suffers from lack of information during cloudy periods and in-between the consecutive swaths and from inadequate resolution of quickly varying processes. Ocean colour remote sensors on geostationary platforms could provide an enormous improvement in sampling frequency which would bring major advantages and new applications and services.

	This presentation will focus on newly developed ocean colour products from the EUMETSAT's SEVIRI instrument on the geostationary MSG platform. The products will enable monitoring of coastal sediment transport, water turbidity, tidal dynamics and water clarity. SEVIRI data will be reprocessed to provide the historical time-series of these observations. New data will be processed operationally to support a range of user applications. The presentation will also describe details of the new products.
1015	**Monitoring the Ocean from observations** S. Guinehut (1), M.H. Rio (1), S. Mulet (1), G. Larnicol (1) 1: CLS, FR Producing comprehensive information about the ocean has become a top priority to monitor and predict the ocean and climate change. Complementary to modeling/assimilation approaches, an observation- based approach is proposed here. It relies on the combination of remote-sensing and in-situ observations through statistical methods. The method uses first a multiple linear regression method to derive synthetic T/S profiles from the satellite measurements. These synthetic profiles are then combined with all available in situ T/S profiles using an optimal interpolation method. The thermal wind equation with a reference level at the surface is finally used to combine current fields from satellite altimetry with the thermohaline fields to generate the global 3D geostrophic current fields. Global temperature, salinity, absolute height and geostrophic current fields are available at a weekly period from the surface down to 1500-meter depth and a reanalysis is available for the 1993-2011 periods. An analysis of the ocean variability using the 18-years long time series of the global 3D-fields of temperature, salinity and current has then been performed. The temperature variability of the 1993-2011 periods shows a clear warming that is visible at all depths and for all latitudes. Changes of ocean circulation are also been studied through mass transport at key regions and maximum Atlantic Meridional Overturning Circulation strength. Although high interannual variability is observed in the AMOC time series, it is not possible to extract a clear trend. Our analyses have also been compared to other observation-based approach and to outputs from numerical models (SODA, GLORYS).
1030	**The combined use of Earth Observations, ferrybox and mooring buoy data for monitoring water bodies** J. Attila (1), S. Kaitala (1), K. Kallio (1), V. Keto (1), H. Alasalmi (1), E. Bruun (1), M. Kervinen (1), P. Kauppila (1), S. Koponen (1) 1: Finnish Environment Institute, SYKE, FI The reporting activities required by the EU marine strategy framework directive (MSFD) and the water framework directive (WFD) necessitate comprehensive collection of monitoring information on open and coastal water bodies, including definitions of the status of these water bodies. In addition to the directives, national needs exist to derive better information on the sea areas and on pressures and human impact on coastal and open sea water quality. The inclusion of Earth Observation (EO), mooring buoys and Alg@line ferrybox data can greatly complement the traditional station measurements in assessing the state of the Baltic Sea, particularly in areas and seasons out of reach of traditional methods. The northern Baltic Sea is characterized by fragmented coastline and thousands of islands of various sizes. Current EO-monitoring by SYKE is performed using MODIS instrument and complemented by VIIRS. For the future monitoring, satellite instruments Sentinel-3a OLCI and Sentinel-2 MSI can provide the best functionality for the estimation of parameters such as chlorophyll-a, transparency and turbidity. This is related to both their improved spatial resolution and optimal spectral characteristics (particularly OLCI). We present how different types of monitoring methods can complement the information on the chlorophyll-a in the Baltic Sea for the extensive period of 2003-2014. The EO instruments are MERIS (until 2011), MODIS and VIIRS (2013-2014). In the open Baltic Sea, the data consists of EO and Alg@line ferrybox transect data. In the coastal waters of Finland, the comparisons are presented using EO, Alg@line, mooring buoys and traditional monitoring station data.
1045	**Coffee Break**
1115	**Use of operational oceanography satellite products to develop environmental indicators for the European MSFD** E. Rinaldi (1), S. Colella (1), F. Bignami (1), R. Santoleri (1) 1: CNR,ISAC, Rome, IT

	The achievement of a good ecological status (GES) in European waters is the intent of the Marine Strategy Framework Directive, and since its publication the European Member States are in need of an effective monitoring system of their marine waters. Satellite data and operational oceanography products could contribute to the monitoring system by providing continuous information of some state variable required by MSFD. In this work we discuss how Ocean Color (OC) and Sea Surface Temperature (SST) satellite products relative to European Sea can be used to obtain indicators which participate in GES definitions for the marine descriptors prescribed by the MSFD. Consistent long term time series of OC data has been used to detect chlorophyll trend in the European Seas to individuate the area subject to eutrophication problems. Actually the European Environment Agency uses to monitor eutrophication by computing chlorophyll-a trend from in situ data (CSI023 indicator). In this work we demonstrate that satellite data can effectively integrate or replace the CSI023 indicator, moreover the trends computed using OC data allow to individuate the effect of the implementation or non-implementation of the EU environmental directives taken to reduce input of nutrients from rivers. Additionally, due to the fact that coastal upwelling modulates the natural distribution of nutrients the areas with frequent upwelling are naturally richer in phytoplankton respect to the other. In this work SST maps were used to define a combined SST and wind coastal upwelling index usefull to individuate the regions more subject to anthropic pressure.
1130	**A consistent, long-term, error-characterised, ocean-colour dataset for the earth observation and modelling communities** Steve Groom (1), Sathyendranath (1), Grant (1), Brewin (1), Chuprin (1), Jackson (1), Mueller (2), Krasemann (2), Mélin (3), Brockmann (4), Fomferra (4), Zulkhe (4), Steinmetz (5), Deschamps (5), Swinton (6), Regner (7), Brotas (8), Belo Couto (8), and Valente (8) 1: PML, UK 2: HZG, DE 3: EC-JRC IES 4: BC, DE 5: HYGEOS, FR 6: Telespazio VEGA UK, 7: ESA ESRIN, 8: FCUL, PT The aims of the ESA Ocean Colour Climate-Change Initiative (OC-CCI) project are to: develop & validate algorithms to meet the Ocean Colour GCOS requirements for consistent, stable, error-characterized global satellite data products; produce and validate the most complete and consistent time-series of multi-sensor global satellite data products; and strengthen inter-disciplinary, international cooperation on Earth observation, climate research and modelling. OC-CCI Phase 1 produced of a time series (1997-2012) of remote-sensing reflectance, chlorophyll concentration and inherent optical properties based on merged SeaWiFS, MODIS and MERIS data corrected for inter-sensor bias. The products were error characterized on a pixel-by-pixel basis, based on optical characterization of each pixel. The data were made available via ftp, OPeNDAP, as mapped images and within an OGC-based visualisation system (see www.esa-oceancolour-cci.org. The data are also provided as the global reprocessing product within the MyOcean2 marine core service and have been used in the MyOcean Monitoring and Forecasting Centres. Phase 2 (2014-2017) will undertake annual re-processing, utilising on-going research and development in atmospheric correction, in-water algorithms, and bias correction. Year 1 will focus on harmonisation of processing across all sensors (e.g. using the same atmospheric correction); Year 2 will extend the processing to include both case 1 and case 2 waters; Year 3 will look forward to incorporation of Sentinel 3 OLCI data into the data processing. This presentation will give an overview of the OC-CCI project and data and describe some of the uses in research and operational monitoring activities.
1145	**Spatio - temporal variability of Phytoplankton Size Classes in the Mediterranean Sea from Ocean Color data** M. Sammartino (1), A. Di Cicco (1), S. Marullo (2), R. Santoleri (1) 1:Consiglio Nazionale delle Ricerche - Istituto di Scienze dell'Atmosfera e del Clima, IT 2:ENEA - Centro Ricerca Frascati, IT Satellite-borne optical sensors can detect Phytoplankton Size Classes (PSCs) and Functional Types (PFTs). In recent years several physical, biological and ecological models have been proposed to quantify their

	contribution to the total phytoplanktonic biomass. Three models were selected: Brewin et al. (2011), Hirata et al. (2011) and Kostadinov et al. (2009), henceforth referred as B11, H11 and K09. B11 and H11 are empirical algorithms, based on the Chlorophyll a concentration, whereas K09 is a model based on the theoretical relation between the slope of the particle backscattering coefficient and the Particle Size Distribution (PSD) slope. We evaluate how these models describe the spatial distribution and temporal variability of three dominant PSCs (micro-, nano- and pico-phytoplankton) in the Mediterranean Sea during the SeaWiFS mission from 1998 to 2010. The algorithms were ground-truthed against the Mediterranean subset of the SeaBASS HPLC pigments in-situ dataset (Werdell, P.J. and S.W.Bailey, 2005). The subsequent analysis of the SeaWiFS time series by B11 and H11 suggested that pico-phytoplankton dominates the Chlorophyll a all around the year, with a relative maximum during summer and minima in late winter - spring in open sea regions. Coastal areas instead show the dominance of nano- and micro- phytoplankton, so as in the intense bloom regions in the late winter - spring months. K09 provides complementary information on the particles size distribution. Pico-size particles dominate always all around the year in Case 1 water, followed by nano and micro one.
1200	**Data and products of the SatBaltyk system for remote sensing of the Baltic ecosystem** M. Darecki (1), M. Kowalewski (1), J. Dera (1), M. Ostrowska (1), B. Wozniak (1) 1: Institute of Oceanology of the Polish Academy of Science, PL Developed recently in Poland, system SatBaltyk, is a complex set of operational instruments, mathematical models and procedures for processing of satellite data, enabling the routine monitoring of number of various characteristics of the Baltic Sea environment. The instrumentation used by the system comprises receivers of data recorded by selected satellites, sets of measurements from many marine in-situ instruments transmitted on line, as well as laboratory analytical apparatus and a network of computer servers with installed databases, the relevant mathematical models and algorithms, to be used in accordance with developed procedures. The system utilises data from more than a dozen satellites regularly passing over the Baltic, and data from measurement sondes and analytical apparatus deployed on measurement buoys and ships, and in laboratories. The computational part of the System consists of two complex sets (subsystems) of models – diagnostic models covered by the umbrella term DESAMBEM and prognostic ones (BALTFOS) – which complement and correct each other, and make the System independent of cloudiness, when satellite data from certain regions of the Baltic are inaccessible. The models making up the two subsystems are calibrated using data measured at the above-mentioned buoys and shore stations, and the quality of the Operational Systems products is assessed with the aid of in situ measurements performed during research cruises and other available sources of empirical data. The characteristics obtained from both subsystems are accumulated in a geospatial database, which enables them to be disseminated via the Internet in the form of daily-updated maps.

Users and new services
Chair: **David Mills**, CEFAS, UK

1215	**Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans)** F. Coroner, JPI Oceans The JPI Oceans is the only high-level strategic mechanism that exists involving EU Member and Associated States, to provide an integrated European approach to invest in cutting-edge and innovative marine and maritime research and technology development. Research Infrastructures, and especially the ones directly involved in Ocean Observation, are expensive to develop, operate, maintain and upgrade, and can benefit from the European strategic planning approach offered by the JPI Oceans. The oral presentation will focus on how actions within JPI Oceans could be implemented in order to help develop and sustain infrastructures to support an integrated data and information base, enabling industrial development and supporting maritime governance. Joint programming is a concept introduced by the European Commission in July 2008 and is one of the initiatives aimed at implementing the European Research Area (ERA). The concept intends to tackle the challenges that cannot be solved solely on the national level and allows Member States and Associated Countries to participate in those joint initiatives where it seems useful for them. JPI Oceans aims to increase the value of relevant national and EU R&D and infrastructure investments through a combined effort of jointly planning, implementing and evaluating national research programmes.
1230	**Actual status of operational oceanography at the Mediterranean Sea: The MONGOOS perspective** E. Alvarez Fanjul (1), G. Coppini (2), M. Tonani (3), L. Perivoliotis (4), S. Pérez (1) 1: Puertos del Estado, ES 2: Centro Euro-Mediterraneo sui Cambiamenti Climatici, IT 3: Istituto Nazionale di Geofisica e Vulcanologia, IT 4: Hellenic Centre for Marine Research, GR The Mediterranean Operational Network for the Global Ocean Observing System (MONGOOS) has been established in 2012 to further develop operational oceanography in the Mediterranean Sea. MONGOOS comprises the previous activities of MOON and MEDGOOS. MONGOOS is promoting partnerships and capacity building for GOOS in the Mediterranean Sea and creating a continuous working framework with EuroGOOS and GOOS Africa in order to define common roles and activities in the Mediterranean Sea. In this framework, a complete survey of Mediterranean Sea countries Operational Oceanography capabilities has been carried out by MonGOOS partners. This survey provides an updated and realistic synoptic vision of all existing systems in the region, as well as an image of its actual operational status. Modeling, in-situ and remote sensing capabilities have been explored. As a result of the survey, a new specific service has been developed in the MonGOOS web page (http://www.mongoos.eu/). Access to modeling systems and in-situ data is provided through this service, based on a GIS interface. The new product directly links to the services operated by all data providing institutions, being an alternative and complementary approach to the more centralized system being developed at EMODNET and MyOcean. Analysis of the data obtained by this survey shows a huge range of data availability and accessibility in the region. Operational forecasting systems in the region can be considered, in general, state of the art when compared with those from other European regions. With respect to in-situ data, the study confirms the well-known under-sampling of the African coast.
1245	**SOCIB multi-platform observing and forecasting integrated approach in response to science and society needs** Joaquin Tintore, Benjamín Casas, Emma Heslop, John Allen, Marc Torner, Mélanie Juza, Baptiste Mourre, Charles Troupin, David March, Ananda Pascual, Alejandro Orfila, Lluís Gómez-Pujol, Simón Ruiz, Temel Oguz, Amaya Álvarez-Ellacuria, Sonia Gómara, Kristian Sebastian, Sebastián Lora, Joan Pau Beltrán, Biel Frontera, Aránzazu Lana, Pau Balaguer, Romain Escudier, Miguel Martínez-Ledesma, David Roque, Irene Lizarán,

	Carlos Castilla, Tomeu Cañellas, Daniel Conti, Esther Capo, Juan Manuel Sayol, Evan Mason, Bàrbara Ba. All SOCIB, ES In the last 10 years the development of two successful international initiatives, the T/P satellite altimetry missions and the Argo in situ programme gave rise to a significant increase in our understanding of the ocean circulation at large scales, and from this, efforts focused on downscaling towards regional and/or local scales. Today, new monitoring technologies are key components of recent observing systems being progressively implemented in many regional seas and coastal areas of the world oceans. As a result, new capabilities to characterise the ocean state and more important, its variability at small scales, exists today in many cases in quasi-real time. The challenge for the next 10 years is the integration of these technologies and multiplatform observing and forecasting systems to (a) monitor the variability at small scales (mesoscale/weeks) in order (b) to resolve the sub-basin/seasonal and inter-annual variability and by this (c) establish the decadal variability, understand the associated biases and correct them. In other words, the new observing systems now allow a major change in our focus of ocean observation, now from small to large scales. Recent studies from SOCIB have shown the importance of this new small to large-scale multi-platform approach in ocean observation. Some examples from SOCIB facilities (modelling, gliders, HF radar, fixed platforms, drifters, data centre, etc.) will be presented and discussed together with initial ideas on the optimal design of an observational network in the world oceans, responding to science priorities, technology development and response to strategic society needs.
1300	**Lunch**
1415	**EMODnet - Human Activities** A. Pititto, COGEA srl, IT The European Marine Observation and Data Network (EMODNET) is a consortium of organisations within Europe that assembles marine data, data products and metadata from diverse sources in a uniform way. The main purpose of EMODnet is to unlock fragmented and hidden marine data resources and to make these available to individuals and organisations (public and private), and to facilitate investment in sustainable coastal and offshore activities through improved access to quality-assured, standardised and harmonised marine data. Started in September 2013, "Human Activities" is the latest EMODnet portal. The project aims to map the geographical position and spatial extent of a series of "human activities" related to the sea, their temporal variation, time when data was provided, and attributes to indicate the intensity of each activity. The web portal is making available 14 different datasets for users to view and download, such as aggregate extraction, shipping, cultural heritage, dredging, fisheries zones, hydrocarbon extraction, major ports, mariculture, ocean energy facility, pipelines and cables, protected areas, waste disposal, wind farms, other forms of area management/destination.
1430	**Operational Oceanography Products and Services for Maritime Industry** A. Palazov (1), A. Stefanov (1), V. Marinova (1), V. Slabakova (1) 1: Institute of Oceanology, Bulgarian Academy of Sciences, BG The ultimate goal of modern operational oceanography is an end user oriented product. Beneficiaries are the governmental services, coast-based enterprises and research institutions that make use of the products generated by operational oceanography. Direct potential users and customers are coastal managers, shipping, offshore industry, ports and harbours, fishing, tourism and recreation industry, and scientific community. Indirect beneficiaries, through climate forecasting based on ocean observations, are food, energy, water and medical suppliers. Availability of updated information on the actual state as well as forecast of marine environment are essential for the success and safety of maritime operations in the offshore industry. For this purpose different systems have been developed to collect data and to produce forecasts on the state of the marine environment and to provide them in real-time to the users in applying the latest advances in instrument-building, information and communication technologies.

	Several systems for the collection and presentation of marine data for the needs of different users have been developed and putted in operation in the Bulgarian sector of Black Sea. The systems are located both along the coast and in the open sea and the information they provide is used by both the maritime industry and the widest range of users. Combining them into a national operational marine observational system is a task that has to be solved, and that will allow to get a more complete and comprehensive picture of the state of the marine environment in the Bulgarian sector of the Black Sea.
1445	**SeaConditions: present and future sea conditions for safer navigation (www.sea-conditions.com)** G. Coppini (CMCC), P. Marra (LINKS), N.Pinardi (CMCC), R. Lecci (CMCC), S. Creti' (CMCC), M.B. Galati (CMCC), A. Bonaduce (CMCC), A. D'Anca (CMCC), C. Palazzo (CMCC), M. Scalas (LINKS), L. Tedesco (LINKS), R. Sorgente (CNR), L. Fazioli (CNR), D. Rollo (LINKS), G. Aloisio (CMCC), S. Fiore (CMCC) M. Tonani (INGV) and M. Drudi (INGV) Sea Situational Awareness (SSA) is strategically important for management purposes. The lack of adequate dissemination of marine environmental data and consequent poor knowledge available for operations at sea reduce the capacity of intervention, leading to socio-economic impacts and potential damages. The SSA topic is being addressed by "TESSA", an industrial research project funded under the PON "Ricerca & Competitività 2007-2013" program of the Italian Ministry for Education, University and Research. TESSA is a joint effort of the research groups of operational oceanography and scientific computing, and aims to strengthen and consolidate the operational oceanography service in Southern Italy and to integrate it with available technological platforms in order to disseminate information for the SSA. The first product of TESSA is "SeaConditions", a public service providing ocean and weather forecasts for the Mediterranean Sea, over the web. Every day forecasts are produced by operational systems, such as MFS at INGV for the ocean variables and IFS at ECMWF for the atmospheric variables (provided by CNMCA). The service delivers detailed information with high spatial and temporal resolution. Forecasts are displayed on Google Maps and are referred to the ocean and atmospheric forecasts. Sub-regional ocean modeling products will be soon integrated into SeaConditions. SeaConditions provides a user friendly interface with zoom and drag Google Maps' features allowing to display data with different levels of detail. SeaConditions' main strength is to provide a single point of access to meteo-marine forecasts, which are based on advanced oceanographic models, and to deliver high quality information.
1500	**Operational Oceanographic Products Supporting the eNavigation in the Baltic Sea** Tarmo Kõuts (1), Leo Käärmann (1), Aivar Usk (1) 1: MSI-TTU, EE Operational measurements at sea get more importance as navigation aids and becoming as a natural component in e-Navigation systems. Data originating from different measurement systems could use variety of protocols, but users needing operational data as decision support, mariners, search and rescue, etc. want straightforward products which give needed, parcel of data in right time and place, where decision needs to be made. Recent developments of e-Navigation tools in the Baltic Sea and in Estonian coast show way how such user oriented navigation support systems could look. Pilot version of such system was recently designed and launched within Baltic Sea Region project EfficienSea. Hydrometeorological data is harvested from 12 stations on Estonian coastal sea and utilized in e-Navigation aid products, first of all as AIS (Automatic Identification System) messages. Wave height is most critical parameter for safe navigation at sea. However, only few on-line offshore wave gauges deliver data. Study made in 2010-13, as part of EfficienSea project, to use navigational buoys as wave measurement instruments. Automated wave calculation algorithm WHAPAS (Wave Height and Period Software) was developed using acceleration of the buoys as input. Calculated wave heights were validated with pressure based wave measurements near typical navigational buoys. Comparison results showed that method well captures local variability of wave field and pilot version of wave height network (32 buoys) at Estonian coast showed good performance and stability during the test run. Wave data are directly broadcasted to mariners via same AIS channels, as well web-based wave service http://on-line.msi.ttu.ee/metoc/.

1515	**An operational service for least time routes in the Mediterranean Sea** G. Mannarini (1), G. Coppini (1), G. Turrisi (1), S. Cretì (1), Y. Kumkar (1), A. D'Anca (1), P. Nassisi (1), M. Scalas (2), P. Oddo (3), Nadia Pinardi (1), (3), (4) 1: CMCC, 2: Links MT s.p.a. 3: INGV, 4: Univ. of Bologna A new downstream service of operational oceanography is being developed at Ocean-Lab in the frame of TESSA (http://tessa.linksmt.it/) and IONIO (http://www.ionioproject.eu/) research projects. It allows computation of least-time nautical routes in the Mediterranean Sea, as resulting from wave forecast and safety constraints. After a prototype was published last year (http://www.transnav.eu/Article_A_Prototype_of_Ship_Routing_Mannarini,25,408.html) an operational service is now ready to run. Employed forecast are produced by the MFS-wave system at INGV-Bologna. The ship model accounts for main geometrical dimensions of the vessel and its engine power. The considered safety constraints implement IMO recommendations for avoiding major dangerous phenomena due to rough sea. The optimization routine is based on a dynamical programming technique on a directed graph. Both vessel course and throttle are control variables of the system. The system is accessible by the end-user through a dedicated web interface and provides information about geographical and dynamical features of the optimal route. End-user requests are processed on a Liferay web platform and are then elaborated by the CMCC super-computing center. Communication between remote hosts is designed and implemented according to the REST architectural style. During this talk, main features of the system will be presented and a demonstration of the operational service will follow.
1530	**Risk Assessment of Offshore Platforms in the Eastern Mediterranean Levantine Basin: Advance Oil Spill Predictions** G. Zodiatis, H. Radhakrishnan, R. Lardner, M. De Dominicis, N. Pinardi, X. Panayidou, S. Stylianou, A. Nikolaides, MyOcean, MEDESS4MS, RAOP and Med-Sea partnership In view of the recent discoveries and the start up of the exploitation of hydrocarbon reservoirs in the Levantine, the risk from an oil spill blow out is high. The Offshore Protocol adopted in 1994 in Madrid, urges the countries the assessment of the risk related from oil spills from the offshore platforms. The Barcelona convention, recognizing oil pollution as one of the major threats to the marine environment, initiated the preparedness for responding to such incidents. To mitigate the risk associated with the deployment and operation of offshore platforms is of importance to carry out risk assessment. The success of such assessments depends on the prediction of the movement and weathering of the oil spills. Such predictions may obtained through the application of numerical oil spill models integrated with met-ocean data. The well established MEDSLIK oil spill prediction system, has been used for the risk assessment from an existing ring in the Levantine and from 10 planned locations in the EEZ of Cyprus. The first case was carried-out in the frame of the MEDEXPOL 2013 workshop organized by REMPEC. The second case was carried-out following a requested from an oil company. MEDSLIK used the MyOcean MFS and CYCOFOS downscaled ocean data. The oil spill predictions identified parameters, such as the case of first arrive to coast from each offshore platform, the probability of oil spill occurrence, the path of the oil slick, the length of the coast affected, the amount of oil which is afloat, evaporated, etc.
1545	**On-line monitoring and forecasts of ice resistance supporting winter navigation in ice channels** Madis-Jaak Lilover, Tarmo Kõuts and Kaimo Vahter; Marine Systems Institute at Tallinn University of Technology, EE Ships in ice navigate mostly in ice channels, which icebreakers or ships themselves brake into the fast or drift ice. Ship proceeding in such an ice channel experiences the ice resistance, which influences the ships speed and maneuverability or even ship safety. When ship speed can be monitored using AIS (Automatic Identification System), then resistance caused by ice is commonly observed visually at the ship bridges and is therefore quite randomly documented. We propose to use ship hull vibration intensity as measure for ice resistance acting on ship.

	The icebreaker of the Estonian Maritime Administration EVA-316 was instrumented and vibrations of the ship hull were recorded by means of acceleration sensors. The recorded data on the ship hull vibrations together with the ship speed and course form a dataset which enables to assign a specific rank for the severity of ice conditions for the ice channel where ships operate. In order to supply the system with forecasting skill, a fuzzy logic relational scheme was defined, applied and validated. The fuzzy model relaying on HIRLAM wind forecast and ice data deduced from MODIS satellite images produces 48 hours forecasts of ice resistance. Web-based on-line system http://on-line.msi.ttu.ee/ship6/ combines measured and forecasted ice resistance data, as well most important forcing parameters and available satellite imagery. System is open for wide range of users, showing on-line in-situ navigation conditions in ice in places where ships actually are. System was designed and realised for the fairway into Pärnu Port, Gulf of Riga, the Baltic Sea.
1600	**Characterization of coastal-maritime severe events in Basque Country** Santiago Gaztelumendi (TECNALIA - meteo area / EUSKALMET), Joseba Egaña (TECNALIA - meteo area / EUSKALMET), Ivan R Gelpi (TECNALIA – meteo area / EUSKALMET), Sheila Carreño (TECNALIA – meteo area / EUSKALMET), Manuel Gonzalez (AZTI-Tecnalia), Pedro Liria (AZTI-Tecnalia), Ganix Esnaola (AZTI-Tecnalia), José Antonio Aranda (Basque Government /EUSKALMET). In this paper work done in order to provide background and inputs for the update of Basque Meteorology Agency (EUSKALMET) coastal-maritime warnings system, is presented. A study of coastal-maritime adverse events in Basque Country, taking into account different meteorological and oceanographycal aspects, including the study of available parameters in the area from observation networks, ocean-meteorological models and damages in Basque coastal areas, is made. We also present an analysis on actions and warnings issued in Basque Country during these events. Finally, we present some conclusions including those related with adverse coastal-maritime operational procedures related to wave heights. The wave climate along the Cantabrian coast is related directly to its geographical setting within the Bay of Biscay and the northeastern Atlantic. Due to its orientation and location, in relation to the low-pressure systems, which develop in the transitional area between the high-pressure region of Azores and the sub-arctic low pressures, the Basque coast is exposed to fetches. Such fetches extend to distances of more than 1,500 km, from the centre of the low-pressure areas; as such, they are located frequently to the northwest of the British Isles and Iceland. The southern part of the continental shelf of the Bay of Biscay is exposed to a large range of possible sea states, in relation to wave height and period; as such, it is considered a high-energy environment. Most registered periods range from 5 to 22 s, standing the most frequent between 8 and 12 s.
1615	**Coffee Break**
1645	**ASIMUTH: a Copernicus marine downstream service for HAB forecasts in the Galician region** M. Ruiz-Villarreal (1), L. García-García (1), M. Cobas (1), P. Diaz (1) B. Reguera (1) 1: IEO, ES The project ASIMUTH (http://www.asimuth.eu) aims to develop forecasting capabilities to warn of impending harmful algal blooms (HABs) along the European Atlantic coast. ASIMUTH is a HAB warning service for the aquaculture industry developed as a demonstration of a Copernicus marine downstream service coupled to the MyOcean service. The north-western Iberian coast (Galician rias and shelf) is frequently affected by HABs associated with dinoflagellates, which induce closures of harvesting areas in a region where aquaculture has a strong socioeconomic impact. In the framework of ASIMUTH, IEO is developing products to characterize the oceanographic conditions during periods of HABs. A forecast system is also being developed as a downstream service based on hydrodynamic, biochemical and Lagrangian particle-tracking model results combined with in-situ data and satellite imagery. In this contribution, we will present the ASIMUTH forecast system and show its skill in predicting transport of HABs and in assessing the area affected by HABs with the experience gained in 2013 and 2014. We will also report on the Galician HAB pilot bulletins that were developed as a product of the ASIMUTH project. Bulletins are aimed at providing forecasts of HAB events that might induce closures of harvesting areas or,

	when the areas are already closed, at giving some information on the oceanographic conditions that could favour or hamper the opening of areas.
1700	**COPERNICUS Coastal Service, the FP7 Space projects prospective** A. Mangin & O. Fanton d'Andon (ACRI-ST, Sophia Antipolis, FR), P. Manunta (Planetek, IT) , F-R. Martin-Lauzer (ARGANS, Plymouth, UK), C. Brockmann (Brockman Consult, DE), J. Maguire (DOMMRS, Bantry, IE), S. Peters (Water Insight, NL), N. Dwyer (University College Cork, IE), K. Ruddick (MUMM, BE) An initiative was launched in 2013 by a group of scientists and companies to draft the scope of a potential operational COPERNICUS Coastal service covering both marine and land (coastal waters, shoreline and hinterland), to be considered in the upcoming operational framework of the COPERNICUS programme. It builds on the outcomes of several on-going or recently completed EC FP7 and ESA space-marine projects. It has subsequently been endorsed by EC/REA which distributed it as a white paper at the COPERNICUS user forum. The authors' aim is to stimulate the discussion on the extent of a Sentinel satellites-based coastal general service in the COPERNICUS operational phase 2015-2020, based on the currently developed environment monitoring capacity. "Coastal monitoring" is a short name for: – the collection, analysis, publication/distribution and mapping of observations, whether in-situ or remote sensed measurements (qualitative or quantitative), and – the computation & mapping of observations-derived parameters which can be used as legal evidence for the implementation of EC directives on pollution prevention, water quality enforcement and environment preservation and as indicators for Coastal Spatial Planning and Integrated Coastal Management. Quantitative measurements are usually in-situ ones, used as such or for calibration of remote sensing, and remote sensing is an "expansion" mean. It requires: – consensus of the parties involved (authorities, scientists) on measurement and assessment methods, – undisputable measurements supported by calibration, inter-calibration and validation, – ways and means to "expand" spatially, temporarily and causally the measurements through algorithms and dynamic modelling (data assimilation), and interpolation schemes. The presentation will inform the audience of the products/information that would be readily available on reference/initial states, trends and events, incl. uncertainties assessment, which might serve the cause of national regulations and policies enforcement. The preliminary architecture of a pan-European general service will be outlined, with links to the COPERNICUS land/marine/atmosphere and other public services.
1715	**Operational forecasting and statistical products for short and medium term port management** A. Sánchez-Arcilla (LIM/UPC, Universitat Politècnica de Catalunya ; CIIRC), E. Álvarez Fanjul (Ente Público Puertos del Estado), M. Espino (LIM/UPC, Universitat Politècnica de Catalunya ; CIIRC), M. G. Sotillo (Ente Público Puertos del Estado), J.P. Sierra (LIM/UPC, Universitat Politècnica de Catalunya ; CIIRC), M. Mestres(LIM/UPC, Universitat Politècnica de Catalunya ; CIIRC), M. Grifoll (LIM/UPC, Universitat Politècnica de Catalunya ; CIIRC) Operational systems (OS) for the prediction of currents in seaports constitute a convenient instrument for short-term harbour management. However, because of their typical forecast horizon (3 to 5 days) they cannot provide information regarding the medium and long term behavior of the port system. This important limitation must be overcome by complementing the OS with a longer-term statistical description of the harbour that supports decision-making at longer timescales. We present the development and implementation of such a combined system in three Spanish harbours (Barcelona, Tarragona and Bilbao) characterized by different hydrodynamic conditions (micro- vs. meso-tidal domain; one mouth vs two mouths, etc.). For each one, a nested system of numerical models is set up to downscale the regional information (with a horizontal resolution of a few km) to the harbour scale (horizontal resolution of tens of m). The models are nested into MyOcean-IBI and use high-resolution meteorological products. Initial sensibility analyses of the results to the main forcings are carried out.

	In parallel, "offline" runs of the OS are used to develop a case atlas, based on statistically typical meteo-oceanographic conditions. Tailored to suit the needs of each port authority, the atlas provides a fast and direct knowledge of the port behaviour under typical scenarios and allows to design harbour interventions at a +3 day horizon. The final set of products (OS and atlas) will represent an extremely useful tool for all aspects of harbour management, from environmental issues to port operativity and engineering.
1730	**Integration of ecological and socio-economic issues in a Sea-Use Map toward the implementation of the MSFD** Carli F. M., Giovacchini M., Mancini E., Tofani A., Scanu S., Marcelli M. - Laboratory of Experimental Oceanology and Marine Ecology, University of Tuscia, IT European directives, Marine Strategy ahead, are based on the Ecosystem Approach, so they promote the exploitation of natural resources but only when it is considered in terms of ecosystems capabilities. Coastal environment is one of the most ecologically rich - e.g. seagrass meadows - consequently it is one of the most rich in resources. Everyday new possibilities of exploitation get into the market, from marine bioresources to renewable energy. Under the circumstances, there is an urgent need of tools for the management of conflicts between development and conservation, as well as between different users, competing for limited spaces and resources. In this work a Sea-Use Map integrating both ecological and socio-economic information is presented, in order to provide an easy-to-use instrument for coastal management and spatial planning. Ecological issues are mapped as biocenosis distribution and are managed through the point of view of the ecological economy, that is through the analysis of their ecosystem functions. At this stage no economic valuation is provided, but benefit provision, arising from specific ecosystem functions, is mapped for every coastal ecosystem along with human activities and constraints. Socio-economic issues are mapped in terms of users distribution on the coast and through the employment of indexes describing the related anthropic pressure. In the end, wave energy converters are used as a case study, simulating the integration of a new use in a coastal area (North-East Tyrrhenian Sea) busy with many strategic human activities but endowed with top-value ecosystems.
1745	**Real-time observatory of the water quality in the Tagus estuary** M. Rodrigues, A. Oliveira, A.B. Fortunato, L. M. David, J. Costa, J. Rogeiro, J. L. Gomes, G. Jesus, LNEC, PT Nowcast-forecast systems combined with online monitoring networks are becoming invaluable tools to support the water quality management in the coastal areas. These “observatories”, operating in real-time, allow the continuous surveillance of the water bodies, the anticipation of hazardous events and the adjustment of the emergency response plans. A real-time observatory of the water quality in the Tagus estuary is presented. The first prototype was developed and validated to provide early-warnings of fecal contamination in the estuary from combined sewer overflows of the Alcântara outfall, in Lisbon. It is now being extended to account for eutrophication events. This observatory, operational since 2013, relies on the Water Information and Forecasting Framework (WIFF), developed at LNEC. The WIFF runs the models automatically in a high-performance environment and includes webGIS visualization tools for both data and model results. For the Tagus estuary, it integrates the three-dimensional model ECO-SELFE, which couples the hydrodynamic model SELFE with biogeochemical and fecal contamination models, providing 2-days forecasts. It is forced by oceanographic predictions from MyOcean (www.myocean.org), Tagus river flow, Alcântara discharge forecasts computed with SWWM model and atmospheric forecasts. The system also incorporates two online monitoring stations, in the sewer and in the estuary. The estuarine monitoring station provides quasi real-time data of several variables (e.g. suspend solids, salinity, temperature, dissolved oxygen, nitrates) measured by different probes (e.g. UV-Vis spectrophotometric probe). The WIFF and its models are of generic usage, adaptable to any geographical location, and customizable for different estuarine, coastal and oceanographic applications.

MEETING ROOM 2

Modelling / Forecasting Services
Chair: **Pierre Yves Le Traon**, IFREMER, FR

0900	**Scientific challenges towards operational oceanography in 2020** J. She, representing EuroGOOS SAWG, Danish Meteorological Institute (DMI), DK The scientific direction of EuroGOOS is driven by both user needs and scientific State-of-the-Art. Although European operational oceanography has experienced a significant advancement in last two decades, great challenges exist in order to serve fast growing marine economy and make adaptation and mitigation to rapid changing climate and environment. Through coordinating research in national, regional (ROOSs) and European (e.g. Horizon2020, Copernicus Marine Service) levels, EuroGOOS will contribute to resolve scientific challenges for Blue Growth and European policy making in marine ecosystem, marine energy, navigation, bio resources, climate adaptation and mitigation and disaster prevention etc. This will strongly enhance European added-value in Blue-Growth, Climate Change Adaptation and marine ecosystem health. The EuroGOOS Scientific Strategy White Paper aims to address key scientific issues and research priorities for the development of operational oceanography and analysis and forecasting capabilities in Europe for the next 5-10 years. Knowledge gaps and deficiencies are investigated and discussed in EuroGOOS level.
0915	**Uncertainty estimation for operational forecast products - a multi-model-ensemble approach for North and Baltic Sea** I. Golbeck, Xin Li, Frank Janssen, Federal Maritime and Hydrographic Agency (BSH), DE Several forecasts of the ocean state in the North Sea and the Baltic Sea (e.g. sea level, currents, temperature and ice cover) are provided by independent operational ocean models on a daily basis. These forecasts serve as input for a variety of information and emergency response systems e.g. sea level warning systems or oil spill forecasts. Although the forecasts are highly valuable as such they often lack information on their uncertainty. A multi-model-ensemble (MME) system for sea surface temperature (SST), sea surface salinity (SSS), sea surface currents (SSC) and water transports has been set up in the framework of the MyOcean-2 project to extend the existing operational ocean forecasts in the North Sea and the Baltic Sea by a measure of uncertainty. Members of MyOcean-2, the NOOS* and HIROMB/BOOS** communities provide 48h-forecasts serving as inputs. The different variables are processed separately due to their different physical characteristics. Based on the so far collected daily MME products of SST and SSS, an Empirical Orthogonal Function analysis is applied to assess their spatial and temporal variability. SSCs are further analysed by progressive vector diagrams at specific points to estimate the performance of the circulation models especially in hydrodynamic important areas, e.g. inflow/outflow of the Baltic Sea and English Channel. For further versions of the MME system it is planned to implement weighting methods to develop more complex uncertainty measures. The methodology used to create the MME will be outlined and different ensemble products and first results of statistical analysis will be presented. *Northwest European Shelf Operational Oceanography System **High resolution Operational Model of the Baltic / Baltic Operational Oceanographic System
0930	**UK Environmental Prediction - development, integration and evaluation at the km scale** Huw Lewis (Met Office), Chris Harris (Met Office), John Siddorn (Met Office), Andy Saulter (Met Office), Martin Best (Met Office), Gilbert Brunet (Met Office), Lucy Bricheno (NOC), Jason Holt (NOC), Eleanor Blyth (CEH), Nick Reynard (CEH)

	As the impacts of hazardous weather and other environmental pressures grow, the need for a more complete prediction of our complex and interdependent environment is greater than ever to help society make more informed decisions. This was well demonstrated in the UK throughout winter 2013/14 when an exceptional run of severe winter storms, often with damaging high winds and intense rainfall led to significant damage from large waves and storm surge along coastlines, and from saturated soils, high river flows, tidal blocking and significant flooding inland. These events indicate a pressing need to understand better the value that might be delivered through more integrated environmental prediction. To address this need, the Met Office, NERC National Oceanography Centre and NERC Centre for Ecology & Hydrology had already begun to develop the foundations of a coupled high resolution forecast system for the UK at km-scale. This links existing model components of the atmosphere, coastal ocean (including currents, waves and biogeochemistry), land surface and hydrology. An initial Prototype project will demonstrate the UK coupled prediction concept in research mode. By linking science development to operational collaborations such as through the UK Natural Hazards Partnership, we can ensure that science priorities are rooted in user requirements. This presentation will provide an overview of UK environmental prediction activities, focussing on the opportunities this presents to the ocean forecasting science and user communities. We will present initial progress towards closer model integration and discuss the challenges to realise the potential for improved predictions and applications.
0945	**A hybrid algorithm for generation of a sea surface salinity field** A. Melsom, MET Norway Non-coupled simulations of the ocean circulation that don't assimilate observations of salinity generally suffer from a salt budget that is not closed. An imbalance between sinks and sources will lead to a drift in salinity. This drift will be approximately linear, possibly with a seasonal variability superimposed, due to the absence of feedback processes. Hence, results for salinity may become highly unrealistic in simulations, particularly when results are produced for a multi-year period or longer. The problem of drift in salinity can be ameliorated by sea surface salinity restoring, since many of the fluxes that govern the salinity budget take place at the ocean surface (precipitation, evaporation, river discharges). We will present a method for generation of a monthly sea surface salinity climatology, which initially is built from a simple algorithm for extrapolation of observations using results from an intermediate resolution decadal ocean reanalysis. Subsequently, the sea surface salinity field is described in more detail by an iterative process, using results from a higher resolution simulation where the original SSS restoration is applied. Particular attention is paid to the near-coast SSS climatology, where salinity gradients are large across fronts between coastal and oceanic water masses.
1000	**WIFF - A Nowcast-Forecast system for high-resolution coastal applications.** Alberto Azevedo, Anabela Oliveira, André B. Fortunato, João Rogeiro, João L. Gomes, Gonçalo Jesus, Marta Rodrigues - LNEC, PT Near shore and offshore oil spill events have huge social, economic and environmental impacts, which can ultimately cripple an entire coastal area for long periods of time. Simultaneously, adequate preparedness of harbor and maritime authorities to potential oil spills requires significant material and human resources. Timely hazard forecasting is an essential part of risk management for vulnerable communities, providing the necessary information for population evacuation, pollution protection resources allocation and efficient emergency personnel management. Forecast systems combine our ability to measure and to simulate the behavior of water bodies, by integrating numerical models, monitoring networks and information technology systems, to provide real-time, short-term, predictions of the main physical and chemical parameters. This work presents a nowcast-forecast information system, tailored for oil spill events in coastal applications. The information system integrates a suite of high- resolution numerical models, for distinct purposes like circulation, waves, oil spills, morphodynamic and water quality. The present study will focus mainly on the oil spill modeling system. A brief explanation of the numerical model and all the oil weathering processes and a description of the WebGIS platform is made.

	The Water Information and Forecasting Framework (WIFF), due to the use of non-structured simulation grids, is very well suited for cross-scale applications that can range from the ocean to coastal zones and estuaries. This feature provides the stakeholders and port authorities the capability to have all the information (in-time and with high-resolution) needed to support them in the combat of a real crises event.
1015	**Downscaling MyOcean: The CYCOFOS new forecasting systems at regional and sub-regional scales** George Zodiatis, Hari Radhakrishnan, George Galanis, Andreas Nikolaidis, Oceanography Center University of Cyprus, Nicosia, CY The MyOcean downscaled Cyprus coastal ocean forecasting system (CYCOFOS) has been providing operational flow and wave forecasts in the Mediterranean for more than a decade. Recently, it has been improved with the implementation of new hydrodynamic and wave modeling systems with the objective of targeting larger and higher resolution model domains and more accurate predictions. For CYCOFOS, the new flow system has developed and implemented a parallel version of POM using open MPI on Linux clusters, aiming to improve operational performance of the CYCOFOS flow forecasts at higher resolution. The new flow models of CYCOFOS covers the entire Eastern Mediterranean with a resolution of 2 km and the Levantine basin with resolution of 500 m. The wind drag coefficient is computed from the wave modeling system. The CYCOFOS new wave system has implemented using the latest ECMWF parallel WAM model with a novel advection scheme nesting domains capabilities and novel parameterization of the shallow water effects and the maximum expected wave height. The objective is to provide higher resolution wave predictions at basin and sub-basin scales while minimizing, at the same time, the demanded computational coast. The sea surface current data from the MyOcean regional MFS has been incorporated in the wave integration, providing, in this way a second independent forcing input, in addition to the winds speed and direction, for the wave model. Highest resolution wind forcing from SKIRON weather forecasting system is used by the CYCOFOS new wave forecasting system. The new CYCOFOS forecasting systems has been tested over a 12-month period and some key results on the forecasting performance as well as on the main characteristics of the model outputs are discussed.
1030	**Numerical Study of the Mediterranean sea level response to atmospheric pressure** P. Oddo (INGV), A. Bonaduce (CMCC), N. Pinardi (Bologna University, INGV), A. Guarnieri (INGV) The sensitivity of the dynamics of the Mediterranean Sea to atmospheric pressure and free surface elevation formulation using NEMO (Nucleus for European Modelling of the Ocean) was evaluated. Four different experiments were carried out in the Mediterranean Sea using filtered or explicit free surface numerical schemes and accounting for the effect of atmospheric pressure in addition to wind and buoyancy fluxes. Model results were evaluated by coherency and power spectrum analysis with tide gauge data. We found that atmospheric pressure plays an important role for periods shorter than 100 days. The free surface formulation is important to obtain the correct ocean response for periods shorter than 30 days. At frequencies higher than 15 days-1 the Mediterranean basin's response to atmospheric pressure was not coherent and the performance of the model strongly depended on the specific area considered. A large amplitude seasonal oscillation observed in the experiments using a filtered free surface was not evident in the corresponding explicit free surface formulation case which was due to a phase shift between mass fluxes in the Gibraltar Strait and at the surface. The configuration with time splitting and atmospheric pressure always performed best; the differences were enhanced at very high frequencies.
1045	**Coffee Break**
1115	**The TYREM System: The Tyrrhenian Sea Regional operational Model** E. Napolitano (ENEA, Italy), R. Iacono (ENEA, Italy) The TYREM system, developed in 2009, is one of the regional systems that provide operational forecasts of the circulation of the Italian seas. TYREM is based on the well-known hydrostatic, free surface, Princeton Ocean Model, which makes use of terrain following (sigma) coordinates in the vertical direction. The model implementation covers the whole Tyrrhenian Sea – the main Italian Sea – with a horizontal spatial resolution of 1/48° (about 2 Km), whereas the vertical grid is made by 40 sigma levels. The model is one-way coupled

	at the three open side boundaries with a forecasting model of the Mediterranean Sea circulation (MF1671, provided by INGV). Meteorological forcing is made up of forecast fields from ECMWF (6h, 0.25°), used for parameterizing the flow of momentum, heat and water at the air sea interface through bulk formulae. In the hindcast mode, TYREM is initialized once a week, on Tuesday, when analysis simulations from the parent model are produced and made available. The hindcast simulation is followed by a seven day forecast. This procedure allows for the damping of spurious barotropic waves produced during the initialization phase. From Wednesday to Monday, seven-day forecasts are issued, obtained by initializing the model with the previous day's forecast. The forecast archive built in the past five years is starting to show its potential as a tool for the investigation of the Tyrrhenian Sea dynamics. Besides analyzing the details of the system and its skills, we shall therefore also briefly discuss some features of the Tyrrhenian Sea circulation and of its variability that were recently clarified, thanks to a combined use of experimental data and of the model outputs.
1130	**Operational SOCIB forecasting system and multi-platform validation in the Western Mediterranean** M. Juza, B. Mourre, L. Renault, and J. Tintoré, SOCIB, ES The development of science-based ocean forecasting systems at global, regional, and local scales can support a better management of the marine environment (maritime security, environmental and resources protection, maritime and commercial operations, tourism ...). In this context, the Balearic Islands Coastal Observing and Forecasting System (SOCIB) has developed an operational ocean forecasting system in the Western Mediterranean Sea (WMOP). WMOP is a high-resolution (1.5-2km) regional configuration of the Regional Ocean Modelling System (ROMS, Shchepetkin and McWilliams, 2005) nested in the larger scale Mediterranean Forecasting System (MFS) and forced by the atmospheric forcings provided by AEMET (Hirlam, 3h, 5-6km). The high-resolution WMOP system aims at reproducing both the basin-scale ocean circulation and the mesoscale variability which is known to play a crucial role due to its strong interaction with the large scale circulation in this region. An operational validation system, based on statistical metrics and diagnostics, has been developed to systematically assess the model outputs at daily, monthly, seasonal and annual time scales. Multi-platform observations (with various spatial - temporal resolutions and coverage) are used for this validation, including satellite products (Sea Surface Temperature, Sea Level Anomaly), in situ measurements (from gliders, Argo floats, drifters and fixed moorings) and High-Frequency radar. The validation procedures allow monitoring the performance of the system and evaluating the general realism of the daily ocean forecasts. The daily forecasts and validation diagnostics are provided every day and over the last months at www.socib.es.
1145	**Oceanographic forecast system along the West-Iberian margin** Quaresma L. S. (IH), Pichon A. (SHOM), Baraille R. (SHOM) & Golde I. (IH) The Portuguese (IH) and French (SHOM) Hydrographic Offices work together to run operationally an integrated ocean circulation forecast system for the Eastern European margin (from the strait of Gibraltar to the British channel with 1/60-degree resolution). The system is based on HYCOM model, developed in the framework of the US navy research activity and improved by SHOM to reproduce shelf and coastal dynamics (including tide and river runoff forcing). The system integrates a regional observation network (Radar HF; multi-parametric off-shore buoys; tide gauges and coastal meteorological station) operated by IH, to control and validate forecast results. The project foresees also the assimilation of these real time observations into the forecast system. The accuracy of the model is controlled and improved by oceanographic experiments at sea, where the dominant oceanographic processes are being characterized and studied (tide, internal tides, upwelling and mediterranean outflow). Ship time, equipment and researchers are shared by both Portuguese and French hydrographic services, engaged to reduce the financial effort. SHOM already operates an ocean forecast system for the Bay of Biscay, while IH follows a similar approach to the west-Iberian region. The fact that most of the mesoscale ocean circulation, observed along the French continental margin has its origin further south in the Gulf of Cadiz, outlooks the integration of both models in a common prediction system.
1200	**Downscaling from the ocean to the regional level: an approach to the Portuguese Exclusive Economic Zone**

	Lígia Pinto, MARETEC - Instituto Superior Técnico; Francisco Campuzano, MARETEC - Instituto Superior Técnico; Manuela Juliano, LAMTec-ID - Universidade dos Açores; Rodrigo Fernandes, MARETEC - Instituto Superior Técnico; Ramiro Neves, MARETEC - Instituto Superior Técnico The Portuguese Exclusive Economic Zone (EEZ) is one of the largest EEZ in the world, includes a vast area of the Atlantic Ocean which resources could be exploited economically while, under the EU Marine Strategy Framework Directive (MSFD), its waters should be protected and monitored. In order to provide support to the MSFD aims, namely to generate solutions to be used by smaller regional models, an application running the MOHID model for the current Portuguese EEZ extension was developed. The Lusitania model is a 3D baroclinic regional model covering a wide area of the eastern Atlantic Ocean, including the Portuguese EEZ, and the Western Mediterranean Sea. The model is forced by the MyOcean general circulation model, the FES2004 global tide solution and the atmospheric forcing provided by the NCEP Global Forecasting System (GFS). The Lusitania application is able to represent the main oceanographic processes as temperature and salinity fronts and gradients, and the general circulation patterns of the Eastern Atlantic Ocean and Western Mediterranean Sea. The model domains limits were set to provide modelling results to the Portuguese EEZ and to supply boundary conditions to more refined regional models for the Portuguese continental coast, Madeira and Azores archipelagos and to areas that could be defined of interest following a cascade downscaling technique. Downscaling of ocean models can be done directly to the regional seas, however the use of an intermediate level has scientific and socio-economic advantages and Lusitania model aims to get advantage of both.
1215	**Reducing imbalances in the equatorial region caused by data assimilation.** Jennifer Waters, Matthew Martin, David Ford, Rosa Barciela (Met Office) The equatorial region is a particularly challenging area for ocean data assimilation. In this region the dominant balance is between the sub-surface pressure gradients and the wind stress applied to the model. When profile and altimeter observations are assimilated they change the pressure gradient which can cause an imbalance with the unchanged wind stress. This generates spurious equatorial waves and vertical velocities. The equatorial waves can degrade the quality of model currents while the increased vertical velocities have a significant negative impact on coupled biological models. The pressure correction scheme of Bell et al (2004) aims to reduce long time scale imbalances by applying a correction calculated from accumulated temperature and salinity increments. However, we still see the impact of data assimilation on the equatorial currents and vertical velocities on shorter time scales. We consider a new approach whereby a correction is applied using temperature and salinity increments from the current analysis step. We refer to this as an instantaneous pressure correction. We will present the development of this new method along with results from its application.
1230	**The Met Office Coupled Atmosphere/Land/Ocean/Sea-Ice Data Assimilation System** Daniel J. Lea, Isabelle Mirouze, Matt J. Martin, Adrian Hines, Catherine Guiavarch, Ann Shelly (Met Office, Exeter, UK) The Met Office has developed a weakly-coupled data assimilation (DA) system using the global coupled model HADGEM3 (Hadley Centre Global Environment Model, version 3). This model combines the atmospheric model UM (Unified Model) at 60 km horizontal resolution on 85 vertical levels, the ocean model NEMO (Nucleus for European Modeling of the Ocean) at 25 km (at the equator) horizontal resolution on 75 vertical levels, and the sea-ice model CICE at the same resolution as NEMO. The atmosphere and the ocean/sea-ice fields are coupled every 1-hour using the OASIS coupler. The coupled model is corrected using two separate 6-hour window data assimilation systems: a 4D-Var for the atmosphere with associated soil moisture content nudging and snow analysis schemes on the one hand, and a 3D-Var FGAT for the ocean and sea-ice on the other hand. The background information in the DA systems comes from a previous 6-hour forecast of the coupled model. We show that the weakly-coupled DA system offers some improvements over starting from separate atmosphere/ocean/sea-ice initial conditions. To isolate the impact of the coupled DA, one-month experiments have been carried out, including: 1) a full atmosphere/land/ocean/sea-ice coupled DA run, 2)

	an atmosphere-only run forced by OSTIA SSTs and sea-ice with atmosphere and land DA, and 3) an ocean-only run forced by atmospheric fields from run 2 with ocean and sea-ice DA. In addition, 5-day forecast runs, started twice a day, have been produced from initial conditions generated by either run 1 or a combination of runs 2 and 3. The different results have been compared to each other and, whenever possible, to other references such as the Met Office atmosphere and ocean operational analyses or the OSTIA data. Impacts of coupled DA on the forecasts in specific coupled phenomena like the monsoon and hurricanes has also been investigated.
1245	**HF-Radar Data assimilation in the Basque coast: optimizing wind forcing of a coastal circulation model** Ganix Esnaola (AZTI-Tecnalia), Alexander Barth (GHER, University of Liège), Luis Ferrer (AZTI-Tecnalia), Aida Alvera-Azcárate (GHER, University of Liège), Anna Rubio (AZTI-Tecnalia), Julien Mader (AZTI- Tecnalia) The equatorial region is a particularly challenging area for ocean data assimilation. In this region the dominant balance is between the sub-surface pressure gradients and the wind stress applied to the model. When profile and altimeter observations are assimilated they change the pressure gradient which can cause an imbalance with the unchanged wind stress. This generates spurious equatorial waves and vertical velocities. The equatorial waves can degrade the quality of model currents while the increased vertical velocities have a significant negative impact on coupled biological models. The pressure correction scheme of Bell et al (2004) aims to reduce long time scale imbalances by applying a correction calculated from accumulated temperature and salinity increments. However, we still see the impact of data assimilation on the equatorial currents and vertical velocities on shorter time scales. We consider a new approach whereby a correction is applied using temperature and salinity increments from the current analysis step. We refer to this as an instantaneous pressure correction. We will present the development of this new method along with results from its application.
1300	**Lunch**
1415	**The HBM-PDAF assimilation system for operational forecasts in the North and Baltic Seas** Lars Nerger (Alfred Wegener Institute, Bremerhaven, Germany), Svetlana Losa (Alfred Wegener Institute, Bremerhaven, Germany), Thorger Brüning (Federal Maritime and Hydrographic Agency, Hamburg, Germany), Frank Janssen (Federal Maritime and Hydrographic Agency, Hamburg, Germany) To improve hydrographic forecasts in the North and Baltic Seas, the HIROMB-BOOS Model (HBM) has been coupled with the Parallel Data Assimilation Framework PDAF (http://pdaf.awi.de). The forecast system assimilates satellite sea surface temperature as well as in situ data of temperature and salinity profiles to initialize forecasts up to 5 days. The assimilation uses a fully-featured ensemble Kalman filter, which dynamically estimates the uncertainty of the state estimate with an ensemble model model states and applies spatially localized updates to improve the ocean state. We discuss the structure of the assimilation system, which can analogously be used to extend other forecast models for data assimilation. Further, the forecast improvements caused by the data assimilation are discussed.
1430	**Coupling of wave and circulation models in coastal-ocean predicting systems: A case study for the German Bight** Joanna Staneva, Institute for Coastal Research, HZG This study addresses the coupling between wind wave and circulation models on the example of the German Bight and its coastal area called the Wadden Sea (the area between the barrier islands and the coast). This topic reflects the increased interest in operational oceanography to reduce prediction errors of state estimates at coastal scales. The uncertainties in most of the presently used models result from the nonlinear feedback between strong tidal currents and wind-waves, which can no longer be ignored, in particular in the coastal zone where its role seems to be dominant. A nested modelling system is used in the Helmholtz-Zentrum Geesthacht to producing reliable now- and short-term forecasts of ocean state variables, including wind waves and hydrodynamics. In this study we present analysis of wave and hydrographic observations, as well as the results of numerical simulations.

	The data base includes ADCP observations and continuous measurements from data stations. The individual and collective role of wind, waves and tidal forcing are quantified. The performance of the forecasting system is illustrated for the cases of several extreme events. Effects of ocean waves on coastal circulation and SST simulations are investigated considering wave-dependent stress and wave breaking parameterization during hurricane Xavier in December, 2013. Also the effect which the circulation exerts on the wind waves is tested for the coastal areas using different parameterizations. The improved skill resulting from the new developments in the forecasting system, in particular during extreme events, justifies further enhancements of the coastal pre-operational system for the North Sea and German Bight.
1445	**Unified Global and Regional Wave Model on a Multi-Resolution Grid** Jian-Guo Li and Andrew Saulter, Met Office, UK Models for ocean surface wave forecasting in weather centres comprise global and regional systems in order to efficiently meet service demands. Most regional models aim to resolve details near coastlines and be compatible with high resolution atmospheric models. However, these regional models cannot run alone and have to use large area or global models to provide boundary wave spectra. The most traditional nesting technique is actually running the two models together with the regional model domain covered by both resolutions. A multi-resolution wave model using a spherical multiple-cell (SMC) grid is proposed to replace the nesting system. The SMC grid allows global and regional resolutions to be achieved in one model. It also provides refined resolutions at coastlines to resolve small islands or fine costal features, which are important for ocean surface wave propagation. Besides, the SMC grid has solved the polar problems and time step restriction at refined resolutions. A 25 km resolution global grid has been refined with 12, 6 and 3 km resolutions near coastlines and around the UK waters in a unified wave model. It is validated with altimeter and buoy observations and compared with the Met Office operational global and regional models. The study indicates that the unified wave model produces comparable forecasts for much less computation time than a similarly scaled nested model.
1500	**On forecasting waves in seasonally ice-covered seas** Laura Tuomi, Finnish Meteorological Institute, FI Taking into account the effects of ice on the wave field is essential, when forecasting waves in the seasonally ice-covered seas. The ice cover changes the fetch over which the waves grow and affects also the propagation of the surface waves. To enhance the methods of handling ice conditions in the modelling of the Baltic Sea waves, utilisation of data from three different sources were studied: 1) ice concentration data produced daily by FMI's Ice Service (presently used in FMI's wave forecasts), 2) ice concentration, thickness and ice classes produced by FMI's operational ice model HELMI, and 3) OSI-SAF ice concentration product. From the Ice Service and OSI-SAF products the ice concentrations were utilised as grid obstructions. When the ice forecasts were used the wave model grid points that were covered by fast ice, were excluded from calculations. Drift ice was taken into account as additional grid obstructions. The accuracy of the modelled wave field in the partly ice-covered sea areas was evaluated against altimeter data. Although it was found that the accuracy of an ice forecast might not be as good as that of the expert analysed ice product, the more frequent update of the data (once an hour versus once a day) and the possibility to take into account the effect of different ice types on the modelling of the wave field were found to improve the accuracy of the results.
1515	**Operational ocean and sea ice modeling in Greenlandic waters and its impact on oil spill** Jun She, Till Andreas Soya Rasmussen, Kristine Skovgaard Madsen, Mads Hvis Ribergaard. All Danish Meteorological Institute (DMI), DK The Arctic sea ice cover has been retreating for the last decades, thus larger areas become ice free in summer. This increases the commercial interest in the area and therefore the risk of accidents. The nature in the Arctic region is very vulnerably and even with limited sea ice cover the Arctic ocean is hazardous, thus

	it is necessary to have a short response time in case of an oil spill. The foundation of oil spill simulations is the description of the ocean. The Danish Meteorological Institute has recently upgraded the operational Arctic/Atlantic fully coupled ocean and sea ice model, which forms the basis for the advection of the oil spill. The system consists of a coupler (ESMF), an ocean (HYCOM) and a sea ice (CICE) component, which are all considered being state of the art. This presentation evaluates the performance of the operational model with special focus on the waters around Greenland. In addition an oil spill simulation is evaluated.

Biochemical modelling
Chair: **Alessandro Crise**, OGS, IT

1545	**OSS2015 – Forerunner of the "Green" Ocean Services beyond FP7** O. Fanton D'Andon & A. Mangin (ACRI-ST, Sophia Antipolis, France); M. Pahlow & L. Arteaga (IFM- GEOMAR, Kiel, Germany) ; H. Loisel (ULCO, Wimereux, France); Ch. Trees & V. Sanjuan (CMRE, La Spezia, Italy); P. Brasseur (LEGI, Grenoble, France); K. Barker, D. Marrable & François-Régis Martin- Lauzer (ARGANS, Plymouth, UK); S. Besiktepe & M. Gunduz (DEU, Istanbul, Turkey) ; N. Dwyer (UCC, Cork, Ireland); I. Carslake (Frontiers Economics, London, UK); J. Maguire & M. Shorten (DOMMRS, Bantry, Ireland); OSS2015 fills the "green gap" of the COPERNICUS Marine Service, the goal being to provide reliable nowcast, forecast and climatological trends of bio-chemical properties of the ocean mixed/eutrophic layer, i.e. addressing the critical issue of reducing the current estimates' uncertainties to relevantly assess marine ecosystems health and to compute credible fluxes (differentials between states) between biologically mediated carbon boxes. Research targets the merging of satellite ocean colour data (multispectral radiance of the sea surface) and in situ measurements from autonomous bio-profilers (on buoys, drifters, gliders, …) through assimilation into biogeophysical models. Data are either ingested into numerical optical, biological and biogeochemical models which are linked to dynamical models of the ocean; or concurrently, new empirical/analytical models/algorithms are developed to retrieve integrated upper ocean parameters (Chlorophyll, Net Primary Production, indice of Particle Size Distribution, Particulate Organic Carbon, and Phytoplankton Functional Types), as well as extrapolated ocean-downward distribution. The programme includes the optimization of observations & measurements networks, i.e. sampling strategies. It builds on the background of: – the ESA downstream services such as Coastwatch and Marcoast, and the EU R&D projects such as Aquamar and Azimut for outlining the users' needs; as well as – the Earth Observation programs like GlobColour and MyOcean2/OCTAC which are strengthened in OSS2015 by the use of Cal/Val tools, i.e. Mermaid and Dimitri. Two pilots sites have been selected to test different types of biogeochemical assimilations, one in the Ligurian (a dedicated experiment carried out in March 2013) to qualify bio-optical assimilation techniques with HOPS, the other in the North Atlantic for assimilation of bio-profilers data and ocean colour into PISCES. The 2015 outcome is a data service prototype, including a new web-based platform for "on-demand" processing which, on the side line, opens the door to an ocean colour collaborative platform.
1600	**A new modelling tool for chemical spill modellers and responders** Rodrigo Fernandes, Instituto Superior Técnico, PT The increasing volume of chemicals transported by sea and the potentially dramatic consequences of a chemical spill, raise the global awareness about the need for implementing better planning and response tools regarding chemical spills. They carry additional challenges and difficulties to responders, environmental managers and modellers. Few chemical spill modelling tools are available for investigating processes and environmental impacts, or planning and contingency arrangements, when compared to oil spill modelling software. A new 3D chemical spill fate and behaviour model (MOHID HNS) was developed and integrated in MOHID (public-domain / open-source water modelling system). The chemical spill model uses the lagrangian parcel method, and estimates the distribution of chemical on water surface, shorelines, atmosphere, water column, sediments and seabed. Spilled mass is tracked through phase changes and transport. Model tracks separately evaporated or volatilized parcels, floating chemical, entrained droplets or suspended particles of pure chemical, chemical adsorbed to suspended particulates, and dissolved chemical.

	MOHID HNS was simulated under different modelling scenarios, including different release depths, wind velocities, suspended sediments concentration and chemical products – one per behaviour class. Model results reflect correctly the expected chemical behaviours. The main advantage of integrating the model in MOHID is the ability to take advantage of existing methods, properties, processes, user interfaces and operational services already developed and tested for this modelling system, shortening the time needed to implement an operational chemical spill modelling system in the near future, or to adapt the model to study the biological effects of released chemical substances.
1615	**Coffee Break**
1645	**Forecasting of physical and biogeochemical state of the North and Baltic Seas** Frank Janssen (1), Thorger Brüning (1), Ina Lorkowski (1), Silvia Maßmann (1) 1: Federal Maritime and Hydrographic Agency (BSH), DE Reliable forecasts of the ocean state provide an important aid for a variety of maritime services ranging from storm surge warnings and search-and-rescue applications to the support of offshore construction and tourism. Operational model systems have become the backbone for many of these tasks. During recent years the field of applications has even been extended towards biogeochemical state estimates, e.g. to meet the demands of European directives such as the Marine Strategy Framework Directive (MSFD). A comprehensive operational model system with focus on German territorial waters has been developed and applied at the Federal Maritime and Hydrographic Agency (BSH) over the last decades. The system consists of 2D and 3D ocean models, drift and dispersion models as well as model components for the simulation of ecosystem dynamics. An ocean state forecast including the variables water level, currents, temperature, salinity and sea ice is provided on a daily basis. The model region covers the whole North and Baltic Sea with a horizontal resolution of 5.5 km and the German Bight and the western Baltic Sea is simulated with a 2-way nested grid of 900m resolution. Recently, a third level of grid nesting with a horizontal resolution of 90 m was introduced in order to improve the forecast for the Elbe estuary. An overview of the model system will be presented including results for some major applications accompanied by validation information. The latest model developments, including the transitioning towards the new HBM (HIROMB-BOOS-MODEL) model code, coupled wave+circulation models, and the ecosystem component will be highlighted.
1700	**Renalysis of Mediterranean Sea biogeochemistry and the quest for biogeochemical seasonal forecasts** G. Cossarini, A. Crise, S. Salon, C. Solidoro, A. Teruzzi. All OGS, IT Interests for feasible climatological data sets of the present conditions of Mediterranean Sea biogeochemistry are constantly growing. Such requests arise both at European and at national level, where MSFD requirements are added to national marine ecosystem management regulations already in force. In parallel, demands for reliable ecological services, often oriented to seasonal forecasts with socio-economical impacts, are emerging from stakeholders and end-users. Given the scarcity of homogeneous biogeochemical observational data in the recent past, a model-based climatology can represent an useful tool to synoptically describe the biogeochemical properties of the Mediterranean basin and their evolution, and to provide boundary conditions for sub-basin models. In the frame of MyOcean2 and OPEC projects, OGS produced a reanalysis simulation of Mediterranean Sea biogeochemistry (1999-2011), assimilating satellite chlorophyll observations. Specific calibration has been considered to initial and boundary conditions, and results have been analysed comparing the outputs with a control-hindcast simulation, with satellite observations and with available in situ data. We will show that assimilation improves the model skill to better represent both the mean chlorophyll concentrations over the Mediterranean sub-basins and the spatial-temporal definition of local bloom events. Further, the comparison with nutrients climatology based on in situ measurements show that the non assimilated variables are consistent with observations. Results concerning interannual variability and guesses towards potential applications for seasonal forecasts will be also discussed.
1715	**Real-time forecasting of Ligurian Sea biogeochemical variability during March 2013**

	S. Besiktepe (1); C. Trees(2); M. Gunduz (1), V. Sanjuan (2); F. Bengil (1) (1) DEU, Izmir, Turkey; (2) CMRE, La Spezia, IT Real-time forecasting of physical and biogeochemical parameters of the Ligurian Sea has been carried out using Harvard Ocean Prediction System (HOPS) at sea on the NR/V Alliance (March 21-30, 2013; LLOMEx'13 cruise). The system consisted of coupled dynamic and statistical models, initialization procedures, data assimilation, and various visualization/post-processing tools. The biogeochemical model that was coupled to the physical model included phytoplankton, zooplankton, detritus, nitrate, ammonium and chl-a. Assimilation strategies in a forecast system provided the means for model initialization, update, melding fields, tuning parameters, and providing error estimates. Initial physical fields were derived from ONR HYCOM-Mediterranean (Mar 21) with initialization of biogeochemical fields computed by objective analyses of SEADATANET climatology. Atmospheric forcing was obtained from the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS)-EUROPE two times day-1. During initialization all available MODIS chlo-a values (1-20 Mar)were assimilated into the model. There after model initial fields for March 21 were generated. The model was run in near real-time throughout the cruise and other data (satellite and in-situ data from CTD, glider, scanfish) when available was prepared and assimilated. This made it possible to carry out real-time forecast as realistic as possible. Before any new data assimilation, model predictions were compared with observations, thus model skill was estimated. This demonstrated that real-time forecast of biogeochemical variables is feasible using satellite and in-situ data. This work was carried out within the context of OSS2015 project.
1730	**A Pressure-Impact statistical correlation analysis for eutrophication in Italian marine waters** G. Giorgi (Institute for Environmental Protection and Research ISPRA, IT), E. Magaletti (ISPRA), F. Giovanardi (ISPRA), S. Colella, ISAC-CNR, IT The EU Marine Strategy Framework Directive (MSFD) requires Member States to conduct, every 6 years starting from 2012, an assessment of environmental status (art. 8), and to define Good Environmental Status - GES (art. 9) and environmental targets (art. 10) in order to reach GES by 2020 at the regional or subregional scale. Each of the 11 descriptors of MSFD represents environmental objectives to be reached or maintained in order to ensure healthy and productive marine ecosystems. Descriptor 5 (D5) prescribes that human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters. The initial assessment carried out by Italy in 2012 for D5 took into account nutrient loads from land, from atmospheric deposition and from aquaculture activities, nutrients concentrations in marine waters, and direct (such as chlorophyll-a concentration) and indirect impacts of nutrient enrichment. Input loads of N and P from land have been estimated for riverine inputs and for coastal urban wastewater treatment discharges by statistical interpolation analysis. For nutrients and chlorophyll-a concentrations, the Mediterranean Sea Biogeochemistry Reanalysis (1999-2010) MyOcean product based on OPATM-BFM model and annual geometric mean produced from SeaWiFS satellite data have been used, respectively. In this work, a statistical correlation analysis between pressure due to input loads of N and P and nutrients and chlorophyll-a concentrations in marine waters is presented, in order to evaluate the links between pressures and impacts for nutrient enrichment as per the DPSIR paradigm.

AUDITORIUM 2

In situ Observations
Chair: **Henning Wehde**, IMR, NO

0900	**U.S. Integrated Ocean Observing System (IOOS®) Enabling decisions, Advancing Technologies** Zdenka Willis, Director US IOOS Office The United States Integrated Ocean Observing System (IOOS®) is a user-driven, coordinated network of people, organizations, and technology that generate and disseminate continuous data about our coastal waters, Great Lakes, and oceans supported by strong research and development activities. IOOS® is our Eyes on our Oceans, Coasts and Great Lakes that enable the United States to track, predict, manage, and adapt to changes in our marine environment and deliver critical information to decision makers to improve safety, enhance our economy and protect our environment. IOOS focuses on the "I" or integration. Integration is defined providing rapid access to multi-disciplinary data from many sources and to provide data and information required to achieve multiple goals that historically have been the domain of separate agencies, offices, or programs. There are plenty of examples and efforts underway within US Integrated Ocean Observing System (IOOS®) that are moving us to a fully integrated system. For US IOOS to be a vital contributor to this goal we suggest a need to move beyond Integration and deliver benefits to society. Technologies must be incubated and rapidly inserted to keep the US IOOS system operating effectively and efficiently. Since oceans know no boundaries, US IOOS is also the United States' contribution to the Global Ocean Observing System which is part of the ocean contribution to the Global Earth Observation Systems of Systems (GEOSS). US IOOS supports the Blue Planet Initiative under GEOSS in a number of efforts.
0915	**In-Situ service for Operational Oceanography and Research: a joint effort between MyOcean , EuroGOOS and EMODnet** Sylvie Pouliquen, Ifremer, & MyOcean INSTAC partners and DataMEW EuroGOOS working Group In 2008 EUROGOOS partners endorsed the recommendations proposed by the DATA Management/Exchange/Quality working group (http://eurogoos.eu/increasing-eurogoos-awareness/working-groups/data-management-exchange-quality-working-group-data-meq/) to set up a Pan-European system for EuroGOOS articulated with the Regional Operational Oceanographic Systems (ROOS) consolidating achievements realized through projects in particular MyOcean1&2 (implementation of the Copernicus Marine Service), SeaDataNET1&2 (consolidation the National Data Centres network in Europe) and EMODnet-Physics1&2 (contribution towards the definition of an operational European Marine Observation and Data Network). The in-situ Thematic Assembly Centre of MyOcean is distributed service integrating data from different sources for operational oceanography needs. It collects and carries out quality control in a homogeneous manner on data from outside MyOcean data providers, especially EuroGOOS partners in Europe, to fit the needs of internal and external users. It provides access to integrated datasets of core parameters (temperature, salinity, current, sea level, chlorophyll, oxygen and nutrient) to characterize ocean state and ocean variability, by this contributing to initialization, forcing, assimilation and validation of ocean numerical models and ocean reanalysis. It provides both near real time products aggregated from automatic observatories at sea (e.G. floats, buoys, gliders, ferrybox, drifters, SOOP) which are transmitting to the shore in real-time, and historical products over 1990-now developed jointly with SeaDataNet that provides high quality scientific data and EMODnet that foster collaboration with observing system operators in Europe.

	The product and services provided by the in situ thematic assembly centre will be presented as well as how it developed to provide products useful for operational oceanography needs both for Forecasting and reanalysis activities, downstreaming services and for the research communities.
0930	**Fixed point Open Ocean Observatory network (FixO3): One year into multidisciplinary observations from the air-sea interface to the deep seafloor** Richard Lampitt, National Oceanography Centre, UK; Luisa Cristini, National Oceanography Centre, UK The Fixed point Open Ocean Observatory network (FixO3, http://www.fixo3.eu/) seeks to integrate 23 European open ocean fixed point observatories and to improve access to these infrastructures for the broader community. These provide multidisciplinary observations in all parts of the oceans from the air- sea interface to the deep seafloor. Started in September 2013 with a budget of 7 Million Euros over 4 years, the project has 29 partners drawn from academia, research institutions and SME's coordinated by the National Oceanography Centre, UK. Here we present the programme's achievements in the first year and the activities of the 12 Work Packages which have the objectives to: – integrate and harmonise the current procedures and processes; – offer free access to observatory infrastructures to those who do not have such access, and free and open data services and products; – innovate and enhance the current capability for multidisciplinary in situ ocean observation. Open ocean observation is a high priority for European marine and maritime activities. FixO3 provides important data and services to address the Marine Strategy Framework Directive and in support of the European Integrated Maritime Policy. FixO3 provides a strong integrated framework of open ocean facilities in the Atlantic from the Arctic to the Antarctic and throughout the Mediterranean, enabling an integrated, regional and multidisciplinary approach to understand natural and anthropogenic change in the ocean.
0945	**FRAM: A multidisciplinary observatory in the North Atlantic - Arctic Ocean transition zone** Ingo Schewe and the FRAM-consortium (Olaf Boebel, Astrid Bracher, Torsten Kanzow, Katja Metfies, Marcel Nicolaus, Eva-Maria Nöthig, Ursula Schauer, Thomas Soltwedel, and Antje Boetius): Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung , Bremerhaven, DE Since about fifteen years the Alfred-Wegener-Institut Helmholtz-Zentrum für Polar-und Meeresforschung (AWI) conducts time-series observations in the transition zone between the North-Atlantic and the Arctic Ocean. Activities are focused on water mass exchange through Fram Strait and on ecosystem studies at the deep-sea observatory HAUSGARTEN. The Fram Strait ecosystem is expected to be particularly vulnerable to Global Change related variations in environmental conditions, including the progressive sea-ice retreat. Obtained time series of physical and biological observations demonstrate the tight connection between abiotic habitat properties and ecosystem characteristics. These findings clearly advocate for a multidisciplinary and multi-scale approach that combines fixed-point and region-wide time-series observations. We actually step forward for the extension of current observations and implement the transition towards the integrated deep-sea observatory FRAM (FRontiers in Arctic marine Monitoring). In addition to the integration of existing physical and ecosystem observation components to fully exploit synergies, the strategies for FRAM also include the implementation of novel instruments (e.g., ice-tethered platforms, profiling moorings, benthic crawlers, biooptical instrumentation) to extend observation-capacities in space and time – including periods of limited access due to permanent ice-coverage. FRAM represents a key site of the European Multidisciplinary Seafloor and Water Column Observatory EMSO and is a member of the Long Term Ecological Research-Network (LTER). FRAM contributes to the ESFRI project SIOS (Svalbard Integrated Arctic Earth Observing System) and as part of the Fixed-point Open Ocean Observatory network FixO3, the FRAM infrastructure provides coordinated, free-of-charge access to external users under the objective of Transnational Access (TNA).
1000	**The European Marine Data Network (EMODnet) Portals demonstration**

	Jan-Bart Calewaert (EMODnet Secretariat) & all EMODnet thematic and regional coordinators (names available upon request) Data from the marine environment are a valuable asset. Rapid access to reliable and accurate information is vital to obtain the knowledge necessary to address threats to the marine environment, in the development of policies and legislation to protect vulnerable areas of our coasts and oceans, in understanding trends and in forecasting future changes. Likewise, better quality and more easily accessible marine data is a prerequisite for innovation and further sustainable economic development or "blue growth". The European Marine Observation and Data Network (EMODnet) is a network of organisations specifically set up in the framework of EU's integrated maritime policy to address the fragmented marine data collection, storage and access in Europe. This presentation will build on the higher level presentation on "Marine Knowledge 2020 and EMODnet" by the European Commission at the start of the Conference and complement plenary EMODnet-Physics presentation by: – providing a more "hands on" live demonstrations of some of the core functionalities of key thematic (e.g. Bathymetry, Biology, Geology, Human Activities, ...) and regional (North Sea, Mediterranean) EMODnet Data Portals; – showing examples of how data can be found and obtained; and – illustrating the process of developing a central EMODnet portal (www.emodnet.eu) with added value functionalities targeting advanced use of data from several of the thematic portals. Depending on the interest of specific thematic EMODnet portals (if other abstract submissions), this presentation could be either a standalone intervention by the EMODnet Secretariat or be developed into a breakout or side-event/workshop with several EMODnet coordinators.
1015	**EMODnet Physics** A. Novellino (ETT), P. Gorringe (EuroGOOS), D. Schaap (MARIS), S. Pouliquen (IFREMER), L. Rickards (BODC), G. Manzella (ETT) The EMODnet-Physics portal (www.emodnet-physics.eu) makes layers of physical data and their metadata available for use and contributes towards the definition of an operational European Marine Observation and Data Network (EMODnet). It is based on a strong collaboration between EuroGOOS associates and its regional operational systems (ROOSs), and it is bringing together two marine but very different communities: the "real time" ocean observing institute and centers and the National Oceanographic Data Centres (NODCs) that are in charge for ocean data validation, quality check and update for marine environmental monitoring. The EMODnet-Physics is a Marine Observation and Data Information System that provides a single point of access to near real time and historical achieved data (www.emodnet-physics.eu/map) it is built on existing infrastructure by adding value and avoiding any unless complexity, it provides data access to any user, it is aimed at attracting new data holders, better and more data. With a long term-vision for a pan European Ocean Observation System sustainability the EMODnet-Physics is supporting the coordination of the EuroGOOS Regional components and the empowerment and improvement of their observing and data management infrastructure. In turn EMODnet Physics already implemented high level interoperability layers (WMS, Web catalogue, web services, etc) to facilitate connection and interoperability towards global observing system for itself, the ROOS and the Institutes within the ROOSs (www.emodnet-physics.eu/services). The on-going EMODnet-includes systems for physical data from the whole Europe (wave height and period, temperature of the water column, wind speed and direction, salinity of the water column, horizontal velocity of the water column, light attenuation, and sea level) provided mainly by fixed stations and ferry-box platforms, discovering related data sets (both near real time and historical data sets), viewing and downloading of the data from about 500 platforms.
1030	**Ocean Data Portal: from data access to integration platform** S. Belov, T. Spears, N. Mikhailov, IODE

	Development of a distributed information infrastructure is highly important for the marine science and maritime activities because of the trend towards integration of both local and geographically distributed applications that provide access to heterogeneous data and information resources of the marine environment. Data integration platform, developed within the framework of the IODE Ocean Data Portal (ODP) project is called to organize and manage distributed access and processing of information about the world oceans. Platform provides interoperability components, their integration into the system, management and monitoring, provides a dispersion of components in the interacting information technology system nodes. The Ocean Data Portal is developed as a component of the IODE system to provide modern data exchange and dissemination infrastructure to achieve the IODE objectives: i) to facilitate and promote the exchange of all marine data and information including metadata, products and information in real-time, near real time and delayed mode; ii) to ensure the long term archival, management and services of all marine data and information; iii) to promote the use of international standards, and develop or help in the development of standards and methods for the global exchange of marine data and information, using the most appropriate information management and information technology; iv) to assist Member States to acquire the necessary capacity to manage marine data and information and become partners in the IODE network; and v) to support international scientific and operational marine programmes of IOC and WMO and their sponsor organizations with advice and data management services.
1045	**Coffee Break**
1115	**Multi-sensor in-situ observations to resolve submesoscale features** Urmas Lips, Villu Kikas, Taavi Liblik, Inga Lips, Nelli Rünk, Andres Trei; Marine Systems Institute, Tallinn University of Technology, EE Analysis of high-resolution numerical modeling, in-situ and remote sensing data has revealed that submesoscale features (lateral scales comparable or less than internal Rossby radius) can significantly shape the distribution pattern of tracers in a stratified sea area. At the same time comparison of observational data and model results has identified some major problems in relation to description of physical processes at scales relevant to phytoplankton dynamics and short-term transport and dispersion of particles in the sea. In many cases a proper validation of model results is difficult due to the absence of observational data with the required resolution and coverage in time and space. In order to fill this gap a number of autonomous devices, including moored profilers and ferryboxes, is applied in the Gulf of Finland. Submesoscale variability in the subsurface layers is mapped by the towed undulating vehicle and glider surveys near the autonomous stations. The conducted surveys have revealed a variety of submesoscale features in the surface and subsurface layer, e.g. upwelling and downwelling filaments and intra-thermocline intrusions. Contribution of ageostrophic submesoscale processes into the energy cascade and their role in the development of stratification and re-stratifying the upper layer after major mixing events is described.
1130	**Interannual sampling cruises at a moored buoy site: Cross-validation and inter-comparison.** Manos Potiris, Manolis Ntoumas, Constantin Frangoulis and George Petihakis; Hellenic Center for Marine Research, GR Continuous, long-term flow of progressively higher quality measurements is required to enhance scientific study and match society needs for monitoring the marine environment. Corrosive sea properties, highly variable oceanic conditions and immature technology for measuring several variables of interest, combined with expensive ship time and shore based facilities needed for the instrumentation deployment and maintenance, constitute demanding challenges in producing appropriate data sets. To ameliorate the issues arising in maintaining accurate measurements from an operational moored observatory located in the Cretan Sea, relatively at low cost, monthly visits for four consecutive years at the site served both the cause of monitoring the sensors performance and increasing the multitude of measured variables. Physical (T, S), biological (Chl-a, Nutrients, PAR, Turbidity) and chemical (O_2) parameters sampled during the cruises, aside by concurrent mooring data, are used for the cross-validation between different sensors and/or different measuring methodologies. Random, systematic errors and contributing factors are discussed. As not all

	cruise parameters are measured by the observatory, covariability of parameters measured exclusively by the platform or during the cruise can be used as a means of tracking “pre- occurrence” conditions of rare or short living incidents. Combination of data from regional operational products (models, satellites) with in situ data (mooring, ferrybox, cruises) serves to plan future, “event- targeting” expeditions.
1145	**The Spanish Institute of Oceanography Observing System in the Atlantic Ocean: IEOOS-At** R. Balbín (IEO Baleares), J.M. Cabanas (IEO Vigo), D. Cano (IEO Santander), G. Díaz del Río (IEO Coruña), E. Fraile (IEO Canarias), M.J. García (IEO Madrid), C. González-Pola (IEO Gijón), A. Lavín (IEO Santander), J.L. López-Jurado (IEO Baleares), C. Rodríguez (IEO Santander), M. Ruiz Villareal (IEO Coruña), R. Sánchez (IEO Cádiz), E. Tel (IEO Madrid), M. Vargas (IEO Málaga) and P. Vélez (IEO Canarias) The Spanish Oceanographic Institute (IEO) maintains a large and coherent ocean observing system around the Iberian Peninsula, the Canary and the Balearic Islands. The Spanish Institute of Oceanography Observing System (IEOOS) provides quality controlled data and information about Spanish surrounding waters and comprehends several subsystems. Tide gauges time series go back to 1943. The coastal time-series observation system, that includes physical, biogeochemical and plankton variability have been monitoring north and northwest Iberian shelf and the Western Mediterranean since 1988. The oceanic time-series observation system monitors slope and oceanic waters since 2000 in Galicia, the Cantabrian Sea, the Canary region, the Gulf of Cadiz and the Western Mediterranean. The IEOOS complements the Spanish contribution to international ocean observing system as Argo, and the Global Drifter Program. Thermosalinographs, an ocean- meteorological buoy in the Bay of Biscay and modeling complete the system. From traditional oceanographic ships to modern automatic systems as buoys, gliders, or Argo floats, are used for the data acquisition. After transmission, data quality procedures, calibration and management, different products as mean sea level, beaches temperature, red tides possibilities, temperature or salinities anomalies, ... are elaborated on different time scales and delivered at IEO web pages, or on regional alliances as IBIROOS. Databases harmonization (OGC standards) is being implemented. IEOOS contributes to several EU projects as FixO3, Ferrybox, E-AIMS, MyOcean2, ASIMUTH, ECOOP, SeaDataNet or EMODNET. The IEOOS allows the IEO to fulfill, among others, the Spanish responsibilities in establishing the Good Environmental Status for the Marine Strategy Framework Directive.
1200	**Oceanographic data management at SOCIB** Charles Troupin (SOCIB), Joan Pau Beltran (SOCIB), Biel Frontera (SOCIB), Sonia Gómara (SOCIB), Sebastian Lora (SOCIB), David March (IMEDEA), Kristian Sebastian (SOCIB), and Joaquin Tintoré (SOCIB, IMEDEA). The Balearic Islands Coastal Ocean Observing and Forecasting System (SOCIB, http://www.socib.es), is a multi-platform Marine Research Infrastructure (ICTS, MINECO in Spain) that provides free, open and quality-controlled data from nearshore to the open sea. According to SOCIB principles, data have to be: 1. discoverable and accessible; 2. freely available, and 3. interoperable, quality-controlled and standardized. The DC manages the different step of data processing, ranging: acquisition using SOCIB platforms (gliders, drifters, HF radar, ...), numerical models (hydrodynamics, waves, ...) or information generated by other divisions, distribution through dedicated web and mobile applications dynamic visualisation. Among the applications developed at SOCIB: DAPP (Deployments application, http://apps.socib.es/dapp/), a web application to display information related to mobile platform trajectories. LW4NC2 (http://thredds.socib.es/lw4nc2), a web application for multidimensional (grid) data from netCDF files (numerical models, HF radar). SACOSTA (http://gis.socib.es/sacosta), a viewer for cartographic data such as environmental sensitivity of the coastline. SEABOARD (http://seaboard.socib.es), a tool to disseminate SOCIB real time data to different types of users. Smart-phone applications to access data and platform trajectories in real-time. The applications and services have been developed in line with EU funded initiatives such as MyOcean2, Perseus, Jerico, Groom, Medsea Checkpoint, among others, in order to respond to scientific and societal needs (e.g. Emodnet or Copernicus), by targeting different user profiles (e.g. researchers, technicians, policy and decision makers, educators, students, and society in general).

	The SOCIB DC constitutes an example of marine information systems within the framework of new coastal ocean observatories.
1215	**CORA 4.0 and CORA-IBI : new products available for global and regional applications.** T. Szekely (Institut Universitaire Européen de la Mer (IUEM), CNRS, Brest, France), A. Grouazel (Laboratory of Oceanography from Space (LOS), IFREMER/CNRS, Brest, France), Coriolis Partners, MyOcean Partners The Coriolis dataset for Re-Analysis (CORA 4.0) is a comprehensive in-situ product provided by the french program Coriolis and supported by MyOcean2. The main purpose of this dataset is to provide validated temperature and salinity profiles from different data types on the global scale and for the period 1990-2012 (Cabanes et al. 2013). CORA4.0 stands out from CORA 3.4 since a better cooperation with the regional data centers allowed us to increase significantly the sampling in the European Seas, especially in the shelf seas. The CORA-IBI dataset is an extraction of CORA 4.0 covering the Iberia-Biscay-Ireland (hereafter IBI) zone, combined to the existing BOBYCLIM dataset, a fully scientifically-validated dataset covering only the Bay of Biscay (Vandermeirsch et al. 2010). CORA-IBI provides measurements for the period 1958-2012 with a brand new spatial resolution, especially over the continental shelf. Several automatic tests based on the climatology are performed to control the homogeneousness of measurements from the two datasets. It is meant to be used for general oceanographic purposes, for ocean model validation and also for initialization or assimilation in ocean circulation models. The wide temporal resolution allows moving towards the development and the study of long term trend indicators.
1230	**Phytoplanktonic biomass distribution in water column and sediments in the northern Latium coastal area.** R. Martellucci, A. Pierattini, A. Madonia, D. Piazzolla, F. Paladini de Mendoza, S. Bonamano, S. Scanu, M. Marcelli. Laboratory of Experimental Oceanology and Marine Ecology, DEB, University of Tuscia, IT The purpose of this paper is to assess phytoplanktonic biomass variations in the water column and in sediment cores in the Northern Tyrrhenian Sea, Latium, Italy at different time scales. In the first time we have analysed the montly distribution of chlorophyll-a concentration (1997-2010) in the study area by satellite observations in order to individuate a main upwelling area and a zone with low phytoplanktonic biomass. Satellite data were integrated by phytoplanktonic pigments measurements in the section of two cores collected in corrispondence of the areas chosen through remote sensing analysis (interrannual scale). Core sections were compared to bibliographic data concerning the mass acccumulation rate for the study area (0.3 - 0.4 g/cm2/y) in order to obtain a datation of the sections of the cores. To analyse the vertical distribution of chlorophyll-a concentration, summer surveys were carried out on a vessel equipped with ADCP and multiparameter probe in the two stations monitored each 20 minutes from the sunset to sunrise (daily scale). During the sampling we have acquired the three components of the current velocity and the physical (temperature, salinity and sigma-t) and biological (chlorophyll-a concentraions) parameters of the water column. The results show a good correlation between interannual trends of phytoplanktonic biomass obtained by satellite data in the two points with those measured in the core sections. In the summer seansons the data collected during the surveys highlighted how the sea- brezze events control the biological activity of the phytoplanckton.
1245	**Black Sea Argo history, current status and prospect** A. Palazov (1), V. Slabakova (1), E. Peneva (2), E. Stanev (2) 1: Institute of Oceanology, Bulgarian Academy of Sciences, BG 2: HZG, DE Monitoring and understanding the role of four-dimensional circulation pattern and thermohaline structure on transport and dispersion of biogeochemical properties of the Black Sea are one of the key priority among different scientific problems than need to be addressed. The autonomous profiling floats are one of the most efficient way to collect oceanographic data on a regular basis for the whole depth of the sea. The first sets of 3 autonomous profiling floats were deployed in the Black Sea in 2002 by collaboration between USA and Turkey.

	The Black Sea Argo initiative started 2009 when the first of series of Argo floats was launched in cooperation between IFREMER and IO-BAS in the frame of EuroArgo project. Since then several Argo floats were launched within the framework of various national and international oceanographic projects: ONR-NICOP, BulArgo, MedArgo, DECOSIM, EURO-ARGO, HYPOX, E-AIMS and PERSEUS. In 2013 the Black Sea Argo array reached 23 floats of which 13 are considered already dead. Out of 10 floats that are still alive, 6 beside the traditional CTD are caring the biogeochemical sensors like DOXY, irradiance, chl-a and backscattering. Five floats with two-way IRIDIUM communication and DOXY sensors will be deployed by the Black Sea countries until the end of 2014. The floats model, technical configuration, mission parameters and type of communication vary significantly as principally depend on the scientific applications that they have been planned to serve. The Black Sea Argo is now the main in-situ data component of Copernicus in the Black Sea.
1300	**Lunch**
1415	**Greek Argo: Towards monitoring the Eastern Mediterranean - First deployments preliminary results and future planning** D. Kassis (1), L. Perivoliotis (1), G. Korres (1) 1:Institute of Oceanography, Hellenic Centre for Marine Research (HCMR), GR Being the first in-situ, global ocean-observing network in the history of oceanography, autonomous profiling floats have been expanding into regional seas providing crucial information for their dynamic processes. The Greek Argo initiative is moving towards this direction with operational activities initiated in 2010; with the first successful Greek float deployment in the Cretan Sea. During the last two years, the Greek--Argo infrastructure has become a member of Euro-Argo ERIC and therefore fully aligned with the key objectives of the European infrastructure. Moreover, during this period its activities are progressing rapidly with a successful procurement of 25 new floats and three new deployments from HCMR's Argo operational team under Greek Argo Infrastructure coordination. During the upcoming years Greek Argo aims to fill gaps in under-sampled sea areas of the Eastern Mediterranean basin such as Aegean, Ionian and Western Levantine Seas. Within this work Greek Argo's new monitoring capacities and future planning are presented. We additionally present preliminary results from previous deployments showing the level of variability and signals of different origin water masses at subsurface and deep layers for Ionian and Cretan Seas. Furthermore, additional features of these areas are described as data analysis reveals intermediate layers circulation subsystems, a dynamical behavior of the basin's upper thermocline and intermediate/deep water masses spatial variability. A first assessment is also presented regarding biochemical profiles recorded from the float in the Cretan Sea which is the first autonomous profiler with a dissolved oxygen sensor in the basin.
1430	**FerryBox Systems: Possibilities for Investigation of Short-Term and Long-Term Variability of Biogeochemical Processes** W. Petersen, M. Haller, J. Wollschläger HZG, DE The use of automated FerryBox-systems on ships-of-opportunity (e.g. ferries or cargo ships) is a promising and cost-effective way to obtain oceanographic relevant data on a routinely basis. Furthermore, the FerryBox is a modular system which can be easily extended. One innovative technical component is the application of newly developed sensors suitable for FerryBox systems that focus on biogeochemical processes. Due to fewer limitations (e.g. space, power consumption, friendly environment) compared to other platforms such as buoys new and even less robust sensor can be operated aboard a ship. The FerryBoxes are integrated in the German Coastal Observation System COSYNA to enable a synoptic description of the key state variables of coastal seas and their physical, chemical and ecological drivers and responses in the North Sea. FerryBoxes equipped with biogeochemical sensors could fill currently existing gaps of robust biogeochemical observations in the oceans and may create, together with their high spatial and temporal resolution, the possibility for new insights into physical and biogeochemical processes that were impossible to study before. Such new insights could contribute to the European Marine Strategy Framework Directive (MSFD) and include observations of the coastal carbon system and its interaction with climate change or eutrophication and productivity.

	Examples are presented that highlight the added value of the recorded data to study processes such as algal dynamics and productivity including the carbon cycle in the North Sea.
1445	**PLOCAN: a gliderport infrastructure for the East-Central North Atlantic** C. Barrera (Oceanic Platform of the Canary Islands, PLOCAN), D. Vega (Oceanic Platform of the Canary Islands, PLOCAN), M. Villagarcia (Oceanic Platform of the Canary Islands, PLOCAN), A. Cianca (Oceanic Platform of the Canary Islands, PLOCAN), J. Brito (Oceanic Platform of the Canary Islands, PLOCAN), MJ. Rueda (Oceanic Platform of the Canary Islands, PLOCAN) and O. Llinas (Oceanic Platform of the Canary Islands, PLOCAN) The use of unmanned autonomous marine vehicles is becoming nowadays normality across world oceans. Significantly more affordable and sustainable than other observing platforms, UAVs, and more specifically underwater (AUVs) and surface (ASVs) gliders, represent a key new technological approach to increase ocean presence in a sustainable and cost-effective way and therefore, improve data quality and derived products in benefit to a wide range of socio-economic sectors related to marine and maritime fields. Gliders are already consolidated as key ocean observing tools for several reasons. A noteworthy variety of commercial models and prototypes developed on the same physical principle (buoyancy) for those labeled as profilers (AUVs), and the use of renewable energies (wind and waves) for the surface (ASVs) versions, offer a broad range of features and capabilities in comparative terms between them and respect other ocean observing platforms, allowing to monitor the oceans under really new spatiotemporal scales, mainly due to higher reliability, endurance and affordability. The regular use of these autonomous devices implies to dispose dedicated infrastructures (gliderport) and highly qualified technical staff that enable such efficiency and sustainability of use. Within this context, PLOCAN represents a prime example of faithful infrastructure, providing on one side dedicated labs and workshops, equipment, staff and easily accessible operational scenarios where to run and test regularly in a cost-effective way new technological developments (test site), while offering high specialized training through its international glider school for upcoming pilots and technicians under common standards and procedures as emerging job profile.
1500	**Integrating capacities towards PLOCAN observational in-situ programme** Marimar G. Villagarcia, Oceanic Platform of the Canary Islands-PLOCAN; A. Cianca, PLOCAN; C. Barrera, PLOCAN; J. González, PLOCAN; L. Cardona, PLOCAN; O. Llinas, PLOCAN The Oceanic Platform of the Canary Islands (PLOCAN) represents an open space and singular infrastructure for science and technology at international scope. By 2015, PLOCAN will be operating a scientific offshore platform on the East coast of Gran Canaria. PLOCAN is setting up an integrated and complex observatory which aims to become part of the emerging pan-European networks, offering an extension towards the southern boundaries of interest. It will be composed of: i) The European Station for Time series in the Ocean, Canary Islands (ESTOC) is an oceanic station sampled through two decades of missions, which has provided a historical background about surface and mid-water ocean physical and biogeochemical variables. The recent transfer of mandate of ESTOC to PLOCAN guarantees the operational sustainability of this deep observatory until 2023; ii) the coastal observatory, which is a real time permanent observing system used as an instrumentation test site too, and which includes a cabled system for observation; and iii) the extended observatory, a mobile observational system carrying out coastal, regional and global observation missions (gliders, ROVs, AUVs). The management of a base for underwater vehicles and instruments, jointly with the test-site instrumentation and the existence of a long-term oceanic time series at PLOCAN/ESTOC, will permit to focus on, upgrade and enhance the quality, quantity, projection and usefulness of such an integrated observatory. The data collected expects to contribute to the understanding of factors affecting the ocean in key issues like climate change, acidification, biogeochemistry, upwelling and Saharan dust affection, among others.
1515	**High sub-seasonal variability at circulation ¿choke¿ point in the Western Mediterranean, through SOCIB glider monitoring**

	E. E. Heslop (1 & 4), S. Ruiz (1), J. Allen (2), J-L López-Jurado (3) and J. Tintoré (1 & 4) - (1) IMEDEA (CSIC-UIB), c/ Miquel Marquès 21, 07190 Esporles, Islas Baleares, Spain. (2) University of Portsmouth, School of Earth and Environmental Sciences, Burnaby Building, Burnaby Road, Portsmouth, PO1 3QL, UK. (3) IEO-COB, Moll de Ponent, 07015 Palma de Mallorca, Islas Baleares, Spain. (4) SOCIB, ParcBit, Naorte, Bloc A 2º pta. 3, 07121 Palma de Mallorca, Islas Baleares, Spain. In order to detect long-term climatic change and to better constrain our forecasting capabilities for ocean circulation it is increasingly important to understand variability in our major circulation systems, at scales from sub-seasonal to inter-annual. In 2011 SOCIB, the Balearic Islands Coastal Ocean Observing and Forecasting System, commenced regular quasi-continuous glider monitoring of a transect across the Ibiza Channel, an important 'choke' point in the Western Mediterranean circulation. Here, the basin scale geostrophic circulation is overlain by energetic mesoscale activity and modulated by the variable formation of deep and intermediate watermasses in winter. The effects of this multi-scale variability are concentrated in the Ibiza Channel, a well-established biodiversity hotspot, which, with its narrow (80 km) width and sill (800 m), governs an important north/south exchange of different watermasses, known to affect local ecosystems of global interest. Previously monitored by R/V on a seasonal basis, the glider transects have revealed the high frequency variability in this exchange, with changes of same order as the seasonal cycle (0.9 Sv) occurring over periods of days to week. Although cruise-to-cruise variability was previously noted, gliders now allow us to characterise this sub-seasonal variability, and in combination with historical R/V data from IEO, allow us to identify seasonal and non-seasonal patterns in watermass transports. Gliders are enabling a step forward in the characterisation of variability over a range of scales, useful both for model assessment and ecosystem response, making a unique contribution to European ocean observation.
1530	**HF Radar in NW Europe** Bill Turrell (Marine Scotland) and Jorge Sánchez (QUALITAS Remos) Blue growth must be obtained sustainably in European seas. Offshore hydrocarbon exploration continues to expand into deeper waters along the NW European shelf edge, and the competition for sea space on the European continental shelf is accelerating. At the same time national resources to monitor anthropogenic environmental impact are reducing. To expand our network of monitoring, in an environment of reducing resources, we must regionally coordinate monitoring activities. Legislation such as the MSFD requires single member states to coordinate environmental monitoring regionally. High frequency radar is recognized as a cost-effective solution to augment in situ measurements and provide increased spatial and temporal resolutions which can pull together regional monitoring efforts. The Brahan Project, using the Long Range SeaSonde HF radar system manufactured by CODAR Ocean Sensors measuring the speed and direction of ocean surface currents in near real time over a large region between Orkney and Shetland, is demonstrating the potential of HF radar technology in this key area of the NW European shelf seas. An operational network of HF radar deployments, between Faroe and Scotland, and between Scotland and Norway could provide the underpinning data supporting oil spill response, search and rescue response, renewable marine energy industries, prevailing conditions monitoring for the MSFD, as well as fundamental measurements that will aid the understanding of climatic change in the North Sea and Arctic Ocean. We will present the results of the Brahan project, and discuss future expansion to include the key gateway areas of the Arctic and NW European seas.
1545	**The RITMARE Italian coastal radar network: operational system and data interoperability framework** Carrara Paola (IREA-CNR), Corgnati Lorenzo (ISMAR-CNR), Cosoli Simone (OGS), Forneris Vega (ISAC-CNR), Griffa Annalisa (ISMAR-CNR), Kalampokis Alkiviadis (CoNISMa), Mantovani Carlo (ISMAR- CNR), Oggioni Alessandro (IREA-CNR), Pepe Monica (IREA-CNR), Raffa Francesco (IAMC-CNR), Santoleri Lia (ISAC-CNR), Serafino Francesco (IREA-CNR), Tronconi Cristina (ISAC-CNR), Uttieri Marco (CoNISMa), Zambianchi Enrico (CoNISMa)

	Understanding marine transport and the dispersion of tracers are crucial components of an effective strategy for protecting marine biodiversity and mitigating anthropogenic hazards. Single standalone observational sites are not effective for a long term and large scale (i.e. national or cross-border territories) strategy unless they are integrated into a network. Here we present the Italian coastal radar network, that has been designed and implemented within the flagship project RITMARE. The network nodes are both HF and X-band radars, covering wide areas with different spatial and temporal resolutions. HF radars cover up to 80 km with a spatial resolution ranging between 1 and 5 km, while X-band radars provide 5 km coverage with a spatial resolution of 10 m. Due to the combination of these two capabilities, the network operates a highly effective coverage of wide coastal areas and the collection of current and wave parameters of both open sea and coastal areas. The data sharing IT framework is under development, aimed to the design and standardization of data format definitions, Quality Control strategies, data management and dissemination policies. In particular, the implementation of tools exploits the standards of OGC (Open Geospatial Consortium), INSPIRE and CF (Climate and Forecast) convention and web services offered to manage, access and deliver geospatial data. Moreover the use of NetCDF format, allows an easy implementation of all the open source services developed by UNIDATA.
1600	**High Frequency Surface Wave Radar in the French Mediterranean Ocean Observing System on Environment (MOOSE)** Céline QUENTIN, Mediterranean Institute of Oceanography (CNRS, IRD, UTLN, AMU) A Mediterranean Ocean Observing System on Environment (MOOSE) has been set up as an interactive, distributed and integrated observatory system of the North West Mediterranean Sea in order to detect and identify long-term environmental anomalies. The surface circulation in this region is characterized by a large-scale flow (Northern Current N-C) and by a broad range of other scales of variability induced by meteorological and tidal forcing. In this framework, the Mediterranean Institute of Oceanography (former L.S.E.E.T.) is operating High Frequency Surface Wave Radar (HFSWR). The ability of HFSWR is to provide synoptic observation as sea surface current map with high temporal resolution and over long distances, which can be used to study the spatial variability of the N-C and Eddy dynamics. One site is already operational nearby Toulon for more than three years and is monitored in near real-time by WERA (Helzel Messtechnik). Its specificities (array type antenna system in non-linear configuration and bistatic operation mode) have required new development in the hardware, and in the processing (adaptation for the bistatism with direction finding method). These data were used during the TOSCA Med-project (Tracking Oil Spills & Coastal Awareness network). The second site will extend the radar observation and was just set up this year around Nice with two SeaSonde (Codar). We present here an overview of the HFSWR network, the surface current mapping facility offered by the system, and recent observation results and applications. MOOSE data management is entrusted by CORIOLIS and will use the MyOcean data distribution infrastructure.
1615	**Coffee Break**
1645	**CALYPSO – an operational network of HF radars for the Malta-Sicily Channel** A. Drago (1), G. Ciraolo (2), F. Capodici (2), S. Cosoli (3), M. Gacic (3), R. Tarasova (1), J. Azzopardi (1), A. Gauci (1), A. Maltese (2), C. Nasello (2), G. La Loggia (2) 1: Physical Oceanography Unit, IOI - Malta Operational Centre, University of Malta, Malta 2: Dipartimento di Ingegneria Civile Ambientale, Aerospaziale, dei Materiali, Università degli Studi di Palermo, IT 3: Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, IT An HF radar observing system composed of three CODAR SeaSondes is providing real-time surface current pseudo-Eulerian maps every hour in the strip of sea dividing Malta and Sicily. This initiative forms part of the CALYPSO project that principally aims to support the efficient response against marine oil spills in this busy area of maritime transportation in the Mediterranean. In combination to numerical models, an operational chain of activities provides essential data to a spectrum of applications and addresses the needs of a number of responsible entities in Malta and Sicily, targeting the better control of the transboundary maritime space and greater efficiency for security and safety at sea.

	The usefulness of this effort is measured by the level of usage of the data provided by CALYPSO through dedicated web services with browsing, viewing, and user-defined download of data. The project comprised several validation and system performance tuning exercises through the matching of radar data with direct sea current measurements using drifters and ADCP deployments. The spatial coverage and high temporal resolution of the HF radar data collected since September 2012 is permitting a unique and detailed characterization of the surface circulation variability in the area at sub-to-mesoscale and seasonal scales. Substantial eddy field structures are evidenced; their origin, dynamics, evolution and linkages to biological processes and the location of fisheries is the subject of ongoing research.
1700	**Sea Wave Italian Measurement System** M. Picone (ISPRA), S. Morucci, G. Nardone, M. Bencivenga The Italian National Wave Measurement Network (RON Rete Ondametrica Nazionale) run 15 real-time directional buoys uniformly distributed along the Italian coasts. Data have been collected since 1989 at 8 measurement stations; in 1999 two other stations were added and the remaining five buoys were moored in 2001. From 2010 all stations are equipped with meteorological instruments. Buoys provide every 30 minutes the main physical parameters useful in defining the sea state such as significant and maximum wave height, peak and mean period, wave direction, sea surface temperature, air temperature, wind speed and direction, atmospheric pressure, relative humidity. Very deeply procedures have been implemented in order to validate date: L1 and L2 algorithms have been applied in order to make data compliant with international standards. Data are monthly analysed and published in the Wave National Bulletin. Further investigations have been implemented in order to define wave climate, extreme events, sea storms, storm surges, and related meteorological information. This kind of data is very useful for all tasks and scientific activities of national interest for the protection, enhancement and improvement for the marine environment. The technical and scientific support contributes to the better environmental governance, providing a wide range of information in several key areas such as: collection, processing, management and diffusion of marine data, protection of water resources and of marine and coastal areas, monitoring of marine environmental quality, prevention and mitigation of impacts of polluted marine and coastal sites, climate change, sustainable use of inland and marine waters.
1715	**HF radar and drifter observing system in the Adriatic for fishery management and security** D.F. Carlson (ISMAR-CNR), C. Mantovani (ISMAR-CNR), L. Corgnati (ISMAR-CNR), G. Pazienza (ISMAR-CNR), M. Magaldi (ISMAR-CNR), L. Bellomo (MIO-UTLN), A. Griffa (ISMAR-CNR), R. D'Adamo (ISMAR-CNR), E. Zambianchi (CoNISMa), P. Celentano (CoNISMa) A HF radar system has been operating since May 2013 in the Southern Adriatic between the Gargano Cape and the Manfredonia Gulf. The system, that has been tested and complemented with drifter launchings during three experiments, produces maps of surface ocean velocities at 2 km resolution every hour. These data support fishery management as well as search and rescue and pollution mitigation operations. The Manfredonia Gulf is a known nursery area for small pelagic fish (anchovies and sardines), and its dynamics and connectivity properties are very relevant to the study of population dynamics. HF radar and drifter data has been used to study retention properties in the Gulf as well as its connection with spawning areas in the Adriatic.

THURSDAY 30 OCTOBER 2014

MEETING ROOM 1

Biochemical modelling and users
Chair: **Alessandro Crise**, OGS, IT

0900	**A coupled remote sensing and Lagrangian modelling approach for investigating anchovy larvae distribution and fate in the Sicily Channel** F. Falcini (CNR-ISAC), L. Palatella (CNR-ISAC), A. Cuttitta (CNR-IAMC), F. Bignami (CNR-ISAC), B. Patti (CNR-IAMC), R. Santoleri (CNR-ISAC), F. Fiorentino (CNR-IAMC) The European Anchovy (Engraulis encrasicolus, Linnaeus, 1758) is one of the most important fishery resource of the Mediterranean Sea. Despite its relevance, the influence of environmental forcing on the anchovy population off the Mediterranean coasts is poorly known. We here use remote sensing data (i.e., sea surface temperature, chlorophyll, light attenuation coefficient, surface wind), Lagrangian simulations, and ichthyoplanktonic data collected during the peak spawning season in order to analyze anchovy larvae distribution, transport processes, and fate in the Sicily Channel. The Sicily Channel dynamics is characterized by upwelling regions, fronts, vortices, and filaments. Our multi-disciplinary approach allows to investigating the role of these mesoscale features on the anchovy larvae recruitment. The analysis, in particular, shows an upwelling-induced current along the southern Sicilian coats that has a strong impact on larvae transport towards the Sicilian coast's south-eastern tip. There, larvae will be retained in a frontal structure and will be able to grow in a favorable environment, rich of phytoplankton and zooplankton. However, significant cross-shore transport events due to non-linear instabilities were also recognized. Larvae that are delivered offshore by this dynamics will not reach the recruiting areas, causing a decrease of fish landing. By monitoring and parameterizing upwelling conditions along the Sicilian coast, remote sensing data paired with a Lagrangian approach, and with the aid of a Potential Vorticity model, are able to describe and predict such a dynamics, allowing for a more sustainable fishing strategy.
0915	**Operational management of tuna fisheries in Indonesia** P. Lehodey (1), I. Senina (1), O. Titaud (1), B. Calmettes (1), T. Arief (2), M. Gehlen (3), G. Larnicol (1), P. Gaspar (1) 1: CLS Space oceanography division, FR 2: SEACORM 3LSCE/IPSL Tuna fisheries are a major economical sector in Indonesia. Despite the increasing huge amount of tuna catch in the Indonesian EEZ (annual catch > 600,000 t), very few is known about the dynamics and real abundance of tuna in the region. Fisheries statistics are still incomplete and lack accuracy. With the INDESO project, the Indonesian government is implementing a chain of operational regional models from physics to fish at a resolution of 1/12°x day. Outputs of the regional ocean model and satellite-derived primary production and euphotic depth are used to drive the Spatial Ecosystem And Population Dynamics Model (SEAPODYM) for three tuna species (skipjack, yellowfin and bigeye) and their fisheries. Primary production predicted from the coupled regional biogeochemical model will be also tested. The SEAPODYM model includes a representation of several functional groups of micronekton from surface to ~1000m and a detailed age structured spatial population dynamics. Open boundary conditions of the regional model are provided from a global operational tuna model at resolution ¼° x week driven by the ocean model PSY3 of Mercator-Ocean. The operational model is updated every week with 10 days of forecast.

	The ultimate goal of this effort is to have an integrated management system to assist in the day-to-day monitoring of Indonesian tuna fisheries, to improve reporting and to deter illegal fishing in order to maintain the Indonesian tuna resources to a sustainable level.
0930	**An operational oceanography tool for fisheries, predicting spawning habitat of Bluefin tuna in Western Mediterranean** Alvarez-Berastegui D. (SOCIB), Alemany F. (IEO), Ciannelli L. (CEOAS), Balbin R. (IEO), Aparicio A. (IEO), Reglero P. (IEO), Lopez-Jurado J.L. (IEO), Hidalgo M. (IEO), Tugores M.P. (IEO), Juza M. (SOCIB), Mourre B. (SOCIB), Pascual A. (IMEDEA), Rodríguez J.M. (IEO), García A. (IEO), Tintoré J. (SOCIB-IMEDEA) Bluefin tuna is emblematic species in the oceans with relevant fisheries in the Mediterranean Sea. In the Balearic Sea (NW Mediterranean), one of the major spawning areas of this species, purse seiners target the adult schools during the summer taking advantage of the reproductive aggregations. The location of the Bluefin tuna spawning habitats is closely linked to the mesoscale oceanographic scenarios. Improving our knowledge on the spatial distribution of these habitats will allow improving the actual management approach and to design new management strategies. Operational oceanography platforms currently provide a chance to take a step forward to model and predict essential fish habitats and to advance towards the ecosystem base management of fisheries. Here we explore how spawning habitat of Bluefin tuna can be modeled and predicted around the Balearic Sea out from operational oceanography data sources. General additive models are applied to link historical data of bluefin tuna larval spatial distribution with hydrographic variables obtained from remote sensing and hydrodynamic models. Environmental variables were previously validated for the study area. Results show that spawning habitats can be predicted for the study area providing new avenues of management of Bluefin tuna in the Mediterranean Sea.
0945	**An operational biogeochemical and mussel eco-physiological model of Bantry Bay, Ireland: products and services for the aquaculture industry.** Tomasz Dabrowski, Kieran Lyons, Alan Berry, Glenn D. Nolan. Marine Institute, IE The Marine Institute (MI), Ireland, are running an operational coastal ocean model of the south-west Ireland since 2011. The model, hereafter called the Bantry Bay model, is nested in a regional North East Atlantic model, also run operationally at the MI. Recent developments have been tailored to address several key needs of the aquaculture industry in the region. The authors present an overview of these model products and services. A shellfish model that includes growth and physiological interactions with the ecosystem has been developed and fully embedded within the 3D numerical modelling framework. Furthermore, it also consists of a microbial module for predicting the level of mussel contamination by coliforms. The model has been tested in a hindcast mode and is shown to accurately reproduce the spatio-temporal variability in the mussel growth. Furthermore, it successfully reproduced the official classification of shellfish waters. Amongst other services, the impacts of aquaculture activities on water quality, quantification of the production and ecological carrying capacities and determination of the shellfish water classes can be derived from the model. The model can also be utilised to determine the contribution of individual point sources of pollution on the microbial loading in mussels and, can provide a short-term forecasting of microbial contamination in a shellfishery. The physical model provides 3 day forecasts of shelf water movement in the region, which are assimilated into a new HAB warning system produced for the end- users; these tailored model products are also presented.

AUDITORIUM 2

Copernicus Marine Service: MFCs
Chair: **Johnny Johannessen**, NERSC, NO

0900	**The Mediterranean Forecasting System: recent developments** Marina Tonani (1), Paolo Oddo (1), Gerasimos Korres (4), Emanuela Clementi (1), Massimiliano Drudi (1), Jenny Pistoia (2), Antonio Guarnieri (1), Vito Romaniello (1), Giacomo Girardi (1), Alessandro Grandi (1), and Nadia Pinardi (3) (1) Istituto Nazionale di Geofisica e Vulcanologia, Bologna, IT, (2) Centro EuroMediterraneo per i Cambiamenti Climatici, Bologna, IT, (3) University of Bologna, Department of Environmental Sciences, Ravenna, IT, (4) Hellenic Centre for Marine Research, Greece Recent developments of the Mediterranean Monitoring and Forecasting Centre of the EU-Copernicus marine service, the Mediterranean Forecasting System (MFS), are presented. MFS provides forecast, analysis and reanalysis for the physical and biogeochemical parameters of the Mediterranean Sea. The different components of the system are continuously updated in order to provide to the users the best available product. This work is focus on the physical component of the system. The physical core of MFS is composed by an ocean general circulation model (NEMO) coupled with a spectral wave model (Wave Watch-III). Satellite Sea Level Anomaly observations and in-situ T & S vertical profiles are assimilated into this system using a variational assimilation scheme based on 3DVAR (Dobricic, 2008). Sensitive experiments have been performed in order to assess the impact of the assimilation of the latest available SLA missions together with the long term available mission of Jason2. The results show a significant improvement of the MFS skill due to the multi-mission along track assimilation. The primitive equations module has been recently upgraded with the introduction of the atmospheric pressure term and a new, explicit, numerical scheme has been adopted to solve the barotropic component of the equations of motion. This new system has been evaluated using tide gauge coastal buoys and the satellite along track data. The quality of the SSH has improved significantly while a minor impact has been observed on the other state variables (temperature, salinity and currents). Experiments with a higher resolution NWP (numerical weather prediction) forcing provided by the COSMO-MED system (provided by the Italian Meteorological Office), have been performed and a pre-operational 3-day forecast production system has been developed. The comparison between this system and the official one forced by the ECMWF NWP data will be discussed.
0915	**Ocean monitoring and forecasting at the Met Office** John Siddorn and Mike Bell. Met Office Ocean Forecasting, UK Operational oceanography has evolved from a range of user communities. From the public safety aspect there has been the wave and surge services driven by both the Safety Of Life At Sea imperative and the need to have historical datasets for planning purposes (waves) and the need to secure our coastal infrastructure and provide citizens with warnings to protect them from the dangers of the sea (waves and surge). Meteorological services have also needed to monitor the surface of the ocean for weather prediction, and so operational analyses of ice and sea surface temperature are of importance to the meteorological community. Services monitoring and forecast the three dimensional marine environment have also been developed for a range of government and commercial users. The recognition of the importance of ocean-wave-atmosphere interactions is increasingly an opportunity and challenge for our community. Integrating the surge, wave and three-dimensional capability has the potential to improve the quality of our services, bringing together the tools discussed above. Furthermore, the recognition that the ocean has a role in weather on short timescales is driving further research on integration with numerical weather prediction systems, including research on coupled data assimilation. The Ocean Forecasting group at the Met Office undertakes R&D to improve and diversify the products and services. An overview will be presented of the systems presently in place at the Met Office, of the

	assessments and assessment techniques used to evaluate them, and the research activities that will give rise to the future systems providing marine monitoring and forecasting services.
0930	**The global Mercator Océan analysis and forecasting high resolution system and its main future updates** J.-M. Lellouche (1), O. Legalloudec (1), R. Bourdallé-Badie (1), G. Garric (1), E. Greiner (2), Marie Drévillon (1), C. Regnier (1), C. Bricaud (1), C.-E. Testut (1), M. Benkiran (2) and Y. Drillet (1) 1: Mercator Océan, Ramonville Saint Agne, FR 2: CLS, Ramonville Saint Agne, FR In April 2013, Mercator Océan has performed a major upgrade of the global 1/12° high resolution system. This new MyOcean "V3" system delivers daily services, and includes numerous improvements related to the ocean/sea-ice model and the assimilation scheme. The new system gives a more accurate description of water masses almost everywhere (departures from in situ observations rarely exceed 1° C and 0.2 psu) and is closer to altimetric observations with a forecast RMS difference of 6 cm. R&D activities conducted during the end of the MyOcean2 project to deliver an improved version of this system are still under progress. The main new updates that will be integrated in the next version of the global system concern: 1) A new vertical mixing scheme: vertical physics has been explored with a special focus on the turbulent closure problem to improve the representation of temperature and salinity in the Mixed Layer Depth. 2) An adaptive tuning of observations errors: as the prescription of observation errors in the assimilation systems is often too approximate, some diagnostics have been developed. Theses diagnostics consist in the computation of a ratio which is a function of observation errors, innovations and residuals. It helps to identify inconsistency on the specified observation errors and to tune an adaptive weight coefficient acting on the error of each assimilated observation. 3) The assimilation of sea-ice concentration observations: it is being introduced in the Mercator operational systems in order to extent the assimilation control to the sea-ice model component.
0945	**Modeling and data assimilation developments of the TOPAZ system in support of Arctic operations** Laurent Bertino, François Counillon, Christoph Renkl, Pierre Rampal, Timothy Williams, Annette Samuelsen, Nansen Environmental and Remote Sensing Center We will present the TOPAZ4 modeling and data assimilation system, based on the Nansen Center's version of the HYCOM model (at horizontal resolution of about 12 km) and an Ensemble Kalman Filter (EnKF), integrating a dynamical ensemble of 100 members. The multivariate properties of the EnKF allow the TOPAZ system to assimilate several ocean and sea ice data types simultaneously, both in real-time forecasts applications (exploited operationally at MET Norway) and in reanalysis mode. The TOPAZ system constitutes the Arctic component of the MyOcean system (http://www.myocean.eu).We will analyze the results from a 20-years TOPAZ reanalysis, showing the good stability of the EnKF used in realistic settings and its ability to provide physically consistent error estimates for most variables assimilated. The reanalysis also pointed to limitations of the sea ice model in terms of sea ice drift and motivates the further developments of new sea ice rheology models for the Marginal Ice Zone and the ice pack.
1000	**Progress, status and plans of MyOcean?s Baltic Monitoring and Forecasting Centre** Ole K. Leth and Vibeke Huess; DMI, DK A status of the progress done in MyOcean's Baltic monitoring and forecasting centre (BAL MFC) will be presented. Focus will be on the progress of the quality in the provided model products and services to the users during the MyOcean 1+2 projects five years of financial support. During the MyOcean projects we have upgraded our Baltic Sea operational oceanographic products - freely available via the MyOcean portal - at least once per year with clear improvements each time. The BAL MFC group has strong focus on both high technical standards of the codes and of course also on improving the physical and bio-geochemical features in the codes. The quality improvements done through the years will be presented with focus on the latest achieved code improvements in the HBM, our physical ocean model code, and the ERGOM bio-chemical ocean model code. Our plans and ideas for further improvements of the

	Baltic Sea products and services will be presented to show that we are ready to support a potential continuation of the European marine service and deliver a high quality operational oceanographic service for the Baltic Sea in the future.

POSTER PRESENTATIONS

TUESDAY 28 OCTOBER 2014

Remote Sensing

Meteo-marine parameters observed by high-resolution radar satellite images
T. Gies (1) S. Jacobsen (1) S. Lehner (1) 1: German Aerospace Center (DLR), DE

Knowledge of marine and meteorological parameters is important for operational oceanographic services.
In-situ measurements and global, regional, and fine-resolution forecast models provide information on wind, sea state, and related processes.
Spaceborne sensors are especially useful because of their global coverage and their independence from additional input data as compared to in-situ methods and mathematical simulations. With high-resolution satellite radars and synthetic aperture radar (SAR) such as Sentinel-1 or the German TerraSAR-X satellite, images of the ocean surface can be recorded also under clouds or at night and from their intensity and structure a large spectrum of processes, parameters and features can be estimated, including surface winds and gusts, individual waves and their refraction and effects of breaking waves.
Recent development of meteo-marine parameter assessment with SAR Images allows to obtain wind and sea-state information over large areas at high resolution and thus represents a valuable complement to in-situ measurements and model results.
The presentation will especially highlight how new remote sensing systems, algorithms and procedures supports maritime applications. One focus is the automation of image evaluation and hence the optimisation of near real time services.

A new index to define algal biomass concentration and photoacclimation process through ocean color data
M. Bellacicco (1, 2); G. Volpe (2) S. Colella (2) and R. Santoleri (2) 1: University of Naples "Parthenope" and Institute of Atmospheric Sciences, IT 2: Climate, National Council of Research (ISAC-CNR), IT

Photoacclimation changes the intracellular chlorophyll-a concentration (Chl), a process that is not currently taken into account by standard ocean colour algorithms. The cellular Chl production is an energy-demanding process, so that it occurs when nutrients are available and under light limiting conditions. Historically, Chl has been used as a proxy for marine algal biomass. This work aims at comparing Chl-based with Carbon-based estimates calculated from the particulate backscattering coefficient, bbp (λ) (Behrenfeld et al., 2005). The equation for the phytoplankton carbon biomass is C = (bbp(443) – bbpN AP(443))SF, where bbpN AP(443) represents the contribution of non algal particles to bbp(443) and is a constant value, and SF a scalar factor (13,000 mg C m-2) to match the carbon biomass units. Here we allow bbpN AP to vary monthly over the Mediterranean SeaWiFS time series, and use the 555 nm channel for coherence with the method used to derive SF (Loisel et al., 2001).

The comparison between the two methods yields the Mediterranean Sea to be 2 to 7 times lower, and closer to in situ observations. In both methods, the Chl:C ratio is the footprint showing that phytoplankton cells enhance production of Chl to optimize photosynthesis under low light regime and high nutrients (e.g., winter). Minimum Chl:C ratio values are observed during summer when photo-inhibition is the dominant intracellular process.
We suggest that a new proxy for phytoplankton biomass is strongly needed, particularly for Mediterranean Sea, where Chl:C ratio varies of 1 order of magnitude, clearly highlighting dominance of photoacclimation at seasonal and basin scales.

Recent developments to the Met Office's Operational Sea Surface Temperature and Sea Ice Analysis System

J. Roberts-Jones (1) J. While (1) M. Martin (1) A. McLaren (1) P. Sykes (1) and E. Fiedler (1) 1: Met Office, UK

The Operational Sea surface temperature and Sea Ice Analysis (OSTIA) system was developed at the Met Office, where it is run in near real time on a daily basis.
OSTIA produces a global field of sea surface temperature (free of diurnal variability) every day on a 1/20 degree (~6km) grid. The system uses input data from infrared and microwave satellite measurements together with in-situ data and a sea ice concentration product. Data assimilation methods are used to combine the different input data, taking into account estimates of the observational error, to produce a gridded analysis. OSTIA is widely used, particularly in numerical weather prediction centres (including the Met Office, ECMWF, Meteo France) where it used as a lower boundary condition in forecast models. It is also used in operational ocean forecasting systems and by climate monitoring groups.
The OSTIA system is under continual development and a recent development to use a new data assimilation method will be discussed together with an assessment of the accuracy of the new system. A new diurnal skin SST analysis component has also been developed for use within OSTIA, which assimilates satellite SST measurements into a diurnal model of the instantaneous skin temperature. Results from this new diurnal component will be presented from a global 1/4 degree implementation of the system.

Reconstruction of three-dimensional salinity and temperature fields of the Black sea based on altimetry

P. Lishaev (1) V. Knysh (1) G. Korotaev (1) 1: Marine Hydrophysical Institute, UE

Daily altimetry maps allow develop an original technique of reconstruction of three-dimensional salinity and temperature fields in the Black Sea. The technique is based on an empirical relationship between values of sea level bins and corresponding values of monthly averaged salinity and temperature fields obtained from in situ measurements. Assuming adiabatic conditions, we use profiles of temperature and salinity and proper T-S relationships corresponding to zero sea level bin as a non-contaminated ones, Then we reconstruct daily salinity profiles in 100 - 500 m layer for all non-zero sea level bins based on zero bin salinity profiles. Zero bins T-S constraints are used for reconstruction of temperature profiles.
Three-dimensional salinity and temperature fields in the Black Sea basin were reconstructed for 1993- 2002 using described above algorithm. The estimation of accuracy of reconstructed temperature and salinity fields (bias and RMS for all basin and its sub-regions) is carried out in 100 - 500 m layer by the comparison with available in situ measurements. The results are quite

reasonable. Mesoscale variability of the Black Sea is clearly pronounced by reconstructed salinity and temperature fields. Hovmoller diagrams of reconstructed salinity and temperature shows freshening of waters in the upper layer and decreasing of cold intermediate layer thickness by the end of 2002.

Remote Sensing

The MyOcean IBI Monitoring & Forecasting Centre: Product novelties and roadmap to the Copernicus Service

M.G. Sotillo (1) S. Cailleau (2) R. Aznar (1) B. Levier (2) P. Lorente (1) G. Reffray (2) J. Chanut (2) A. Amo-Baladrón (1) M. Drevillon (2) E. Alvarez-Fanjul (1) 1: Puertos del Estado, ES 2: Mercator Ocean, FR

The MyOcean IBI-MFC provides continuous ocean state estimates and forecasts for the IBI waters since 2011. The IBI-MFC forecast service is based on a NEMO model application that includes high frequency processes required to characterize regional scale marine processes. The current 1/36º eddy-resolving application, is forced with up-to-date meteorological forecasts from ECMWF and nested in the MyOcean GLOBAL system.
In June 2014, a new IBI Reanalysis, comprising both physical and biogeochemical products, and covering the altimetric decade (2002-2012) will be available. Physical IBI-REA products were generated through an ocean reanalysis system based on a NEMO model application analogous to the daily IBI ocean forecast one. The reanalysis system is also free-surface and includes same tidal forcing than the IBI forecast one. Horizontal resolution decreases in the IBI-REA system (1/12º), whereas the vertical one is increased up to 75 z-levels. The reanalysis run was forced with ECMWF ERA-Interim 3-h atmospheric data. Boundary conditions were imposed from MyOcean GLOBAL reanalysis run. A similar assimilation scheme to the one used in this MyO GLOBAL reanalysis were used. The biogeochemical state of the ocean was generated through a PISCES model run coupled in the IBI REA physical run. The new IBI reanalysis system (outcome from the IBI-MFC R&D efforts) fill the current gap in terms of IBI biogeochemical product availability, meeting end-user needs, and may be seen as a preliminary step in the strategy to upgrade the IBI Ocean Forecast System through data assimilation, enhancing future Copernicus Marine Service capabilities in the IBI region.

Validation of results from a real-time ocean prediction system

A. Melsom, MET Norway, NO

On behalf of the MyOcean project, the TOPAZ model system for ocean prediction has since spring 2008 been providing regularly updated forecasts (assimilation is performed weekly, predictions are updated daily) for the Arctic region (the Arctic Sea, the Nordic Seas, and adjoining marginal polar seas).
TOPAZ consists of an Ensemble Kalman filter module for data assimilation and the HYCOM ocean circulation model for prediction. In order to assess the level of accuracy of the forecasts, an automated validation system has been implemented. Presently, this system includes validation of sea ice quantities (concentration, edge position, ice drift, tabulated contingencies), SLA, SST, salinity and temperature profiles, near-surface drift and concentration of chlorophyll a. Where available, non-assimilated data sources are used in order to establish an independent measure of quality.

We will present the validation metrics that have been implemented, with a focus on the validation of sea ice quantities. Furthermore, the evolution in the forecast quality during the past 3-5 years will be discussed.
Validation results are updated weekly, and are presented on-line at http://myocean.met.no/ARC-MFC/Validation/.

Recent development and assessment of the Met Office operational global ocean forecasting system (FOAM)
E. Blockley (1) D. Lea (1) M. Martin (1) A. McLaren (1) I. Mirouze (1) A. Ryan (1) J. Siddorn (1) D. Storkey (1) J. Waters (1) 1: Met Office, UK

The Forecast Ocean Assimilation Model (FOAM) is an operational ocean analysis and forecast system run daily at the Met Office. The FOAM system produces analyses and 7 day forecasts of ocean tracers, currents and sea-ice for the global ocean at 1/4 degree resolution and has been running operationally since 1997.
Global FOAM analyses are used as initial conditions for the Met Office's coupled ocean-ice-atmosphere seasonal and medium-range forecasting system (GloSea) which provides 7-day global ocean forecasts as part of the MyOcean project.
The FOAM system uses the NEMO ocean model as its dynamical core coupled to the Los Alamos CICE sea ice model with 5 thickness categories. Satellite and in-situ observations of temperature, salinity, sea level anomaly and sea-ice concentration are assimilated by FOAM each day over a 48 hour observation window using the NEMOVAR 3D-Var first-guess-at-appropriate-time (FGAT) data assimilation scheme.
In this poster the Global FOAM system is introduced and an assessment of forecast skill is given. Recent improvements to the model and assimilation components of the FOAM system – designed to improve the quality of near-surface ocean forecasts and the longer-term evolution of the subsurface tracer fields – will also be presented.

Modelling the biochemical ocean

Improving multi-annual high-resolution modelling of biogeochemical cycling in the Baltic Sea by using data assimilation
Y. Liu (1) H.E. Markus Meier (1) E. Kari (1) 1:Swedish Meteorological and Hydrological Institute, SE

The impact of assimilating temperature, salinity, oxygen, phosphate and nitrate observations on marine ecosystem modelling is assessed. For this purpose two 10-year (1970-1979) reanalyses of the Baltic Sea are carried out using the Ensemble Optimal Interpolation (EnOI) method and a coupled physical- biogeochemical model of the Baltic Sea. To evaluate the reanalyses, climatology data and available biogeochemical and physical in situ observations at monitoring stations are compared with results from simulations with and without data assimilation.
The free run shows the significant biases in the biogeochemical and physical variables simulation, for example the higher phosphate and lower oxygen concentration bias in the Gotland Basin in the deeper layers relative to the observations. Generally these biases have been reduced. In the first reanalysis, only observed temperature and salinity profiles are assimilated whereas biogeochemical observations are unused. Although simulated

temperature and salinity improve considerably as expected, the quality of simulated biogeochemical variables does not significantly improve and deep water nitrate concentrations even worsen. This unexpected behaviour is explained by a lowering of the halocline due to the assimilation causing increased oxygen concentrations in the deep water and consequently altered nutrient fluxes. In the second reanalysis, both physical and biogeochemical observations are assimilated and good quality in all variables is found. Especially the second reanalysis well reproduce the variation of the biogeochemical variables during the complicated inflow process.
Hence, using the EnOI method all available observations should be used to perform reanalyses of high quality for the Baltic Sea coupled physical-biogeochemical system.

An integrated forecasting system for hydro-biogeochemical and waves modelling in the Tagus estuary

G. Franz (1) F. Campuzano (1) R. Fernandes (1) L. Pinto (1) H. de Pablo (1) I. Ascione Kenov (1) R. Neves (1) 1: Maretec - Instituto Superior Técnico, Universidade de Lisboa, PT

This work describes the implementation of a hydro-biogeochemical forecasting system coupled with a wave forecasting system for the Tagus estuary (Portugal). The integrated forecasting system improved the modelling of sediment dynamics in the Tagus estuary. The wave model has the physics appropriate to shallow waters, as well as to current-wave interactions. In coastal waters, currents can become important to the growth and decay of waves. Thus, the hydro-biogeochemical model provides currents and water levels to the wave model. On the other hand, the wave model provides wave parameters to the hydro-biogeochemical model. The wave action contributes to increase the bottom shear stress and can be important to the erosion of sediments. The waves can reach different parts of the intertidal zone of the Tagus estuary depending on the tidal cycle, remobilizing the sediments trapped in low velocities areas. The turbidity caused by suspended sediments reduces light penetration in the water, affecting photosynthesis and food availability.
A downscaling approach was followed to transfer information from regional to local models. Boundary conditions for the Tagus estuary hydro-biogeochemical model were provided by a regional model for the Portuguese Coast. A downscaling approach also permits to represent the swell propagation from ocean scale models to the Tagus estuary wave model. Atmospheric forcing was provided by a high resolution model to properly represent the wind changes due to local topography. Furthermore, the Tagus river inflow was set in the model with data from a hydrometric station.

Atmospheric nutrient supply impact on the planktonic community of a Low Nutrient Low Chlorophyll marine ecosystem (1-D Modeling study)

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Atmospheric deposition of nutrients to the ocean is known to be of great importance for both carbon dioxide storage in the ocean and marine ecosystems life. The East Mediterranean Sea is of interest for both its marine and atmospheric environment. The Mediterranean atmosphere is a cross road for air masses of distinct origin, highly affected by both natural and anthropogenic emissions into the atmosphere that strongly interact chemically, leading to the

formation of nutrients such as nitrogen compounds. Dust aerosols from the African continent are also affecting the area as carriers of nutrients such as phosphorus. Moreover, East Mediterranean Sea is one of the world's most oligotrophic ecosystems and presents an unusually high Nitrogen-to-Phosphorus analogy (N:P) in the eastern (28:1) basin. In the present study, the impact of the inorganic N and P atmospheric deposition on the marine ecosystem in the East Mediterranean Sea is investigated by using a 1-D coupled physical/biogeochemical model. Analysis of this atmospheric nutrient supply impact on the planktonic community structure is performed. The results are presented and thoroughly discussed.
This research has been co–financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: THALES (ADAMANT), Investing in knowledge society through the European Social Fund.

Users and new services

Lagrangian modeling of marine tracer transport: an application to the case of anchovy dispersal in the Sicily Channel

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Numerical simulations of the marine dispersal of small organisms require the knowledge of large-scale circulation fields and a suitable parameterization of unresolved, or poorly resolved, subgrid motions.
We introduce a modeling system in which the large-scale advection is provided by Ocean General Circulation Models, and the small-scale transport is modeled by means of Lagrangian kinematic fields. We show that, by suitably tuning small-scale non linear dynamics, we can obtain meaningful statistical information about the transport properties on time lags of few days and spatial distances of few tens of kilometers.
In the realm of applications of biological interest, we discuss the specific case of anchovy egg and larva dispersal in the Sicily Channel.

SAMOA project: downscalling operational oceanography fon Harbours

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The SAMOA project (Sistema de Apoyo Meteorológico y Oceanográfico de las Autoridades Portuarias) Met-Ocean Decision support system for harbour authorities) is an on-going massive effort designed to provide the operational oceanography data required by Harbor Authorities at Spain. It follows the "core service - downstream service" philosophy, and therefore it is funded on MyOcean results. SAMOA complements the existing services provided by Puertos del Estado and pretends to provide the support for decision making on daily basis at the Harbours. The concept is a geographical extension of the products successfully developed at SAMPA project for the Algeciras Harbour and the Straits of Gibraltar region.
SAMOA, co-funded by Puertos del Estado and by 17 Spanish harbours, is based on the development of six independent modules. Each harbor has selected and funded the modules to develop as a function of its actual needs, that depends both in the exposure to the physical

environment and its commercial activities. The modules are: 1) visualization tool, with an embebed SMS and e-mail based alert system, as well as an oil spill module and an atmospheric particle advection system; 2) high resolution atmospheric forecast system; 3) wave forecast system reaching the interior of the harbour; 4) circulation forecast system inside the harbour; 5) meteorological station to be installed along existing tide gauges and; 6) high precision GPS, also for the tide gauges.
SAMOA pretends to define Operational Oceanography services for next decade in a concept that can be extended to other regions.

Cleaning Oil Pollution from Water Using Recycled Cellulose
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Oil spill pollution which persists globally in marine environment, in inland waters across the world or in soils where oil is transported. It continues to grow at an alarming rate with increased levels of oil production and transport. Its causes are either accidental or due to operation wherever oil is produced, transported, stored and used on sea or land. Hence, it is almost impossible for marine life to be free from the danger of an oil spill, despite continued international regulations.
Large plots of land have been permanently affected by its spillage .This ultimately affects the entire food chain, and warrants concern for humanity.
The ongoing disaster in the Gulf of Mexico has encouraged myself to present this abstract. Objectives of this white paper will include testing of patented recycled cellulose material in separating oil from water having different oil concentrations along with its efficiency of removal. The work focuses on effect of time of contact and dosage of materials used for oil removal SorbaSolv has been effective in addressing this problem and at the same time its byproduct does not give rise to unwanted hazards to the surrounding ecosystem.

Lagrangian tracking and localization system for the Mediterranean Sea
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An interactive database of Lagrangian trajectories exploring all the Mediterranean Sea is introduced and discussed.
The infrastructure is based on a MySQL database capable of managing large amounts of data.
All particle tracks last 30 days at 1 hour sample rate and are daily updated.
User queries are dynamically displayed by means of Google Maps API.
Forward and backward simulations within +/- 15 days since present date provide immediate information about the areas possibly involved with the release of pollutants or other kind of material.
Error control and other physical aspects of the transport and diffusion process are taken into account.

Fostering bottom-up capacity in managing and sharing marine observations: the RITMARE StarterKit

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RITMARE is a Flagship Project by the Italian Ministry of University and Research, which aims at supporting and improving Italian marine research.
RITMARE Sub-project 7 is charged of building the data sharing decentralized infrastructure of the project. It is employed by the data providers themselves (public research bodies and inter-university consortia) and also by a variety of stakeholders (public administrations, private companies, and citizens).
Data providers in RITMARE are scientists belonging to different communities (e.g., oceanography, ecosystems, biogeochemistry, geophysics, etc.). Coupling observations from abiotic and biotic realm is required.
Capacity building by data providers of heterogeneous observations is a fundamental challenge in RITMARE: it has been tackled by creating the Starter Kit (SK), a comprehensive set of domain-oriented, open-source software components that exposes OGC standard services for the management of geospatial information.
SK is a virtual appliance where standards' compliant services allows to easily manage both geographic data and sensor observations; it also provides a uniform mechanism for metadata creation. Individual installations are managed autonomously by the distinct data providers though metadata are transparently harvested by a centralized catalog service integrating the distinct contributions to Italian and international marine research.
RITMARE infrastructure provides services for the management of metadata that annotate resources semantically. They are employed to enable inter-disciplinary discovery of the heterogeneous spatial resources.
The SK is now distributed to test its features within different communities in RITMARE (mainly marine geophysics and ecology).
We report on the characteristics of SK and on the results of its testing phase.

Towards the operational monitoring of fish potential zones

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The fishery resources on eastern north Atlantic are quite important for the economy of Portugal, mainly a maritime country.
Several studies have shown good correlations exist between oceanic fronts and fish abundance (Miller, 2011).
Knowledge on the distribution of fish potential zones is needed for planning the fishery activities and for the monitoring of resources.
The automatic detection of oceanic fronts using satellite data may contribute to the implementation of operational techniques for locating fish potential zones. The composite front map techniques from Miller (2009) and the method developed by Cayula and Cornillon (1992) are tested to detect oceanic thermal fronts near Portugal, particularly fronts related to upwelling events, using 8-days averaged, 4 km resolution data from MODIS from 2004 to 2013. Their interdependences with the distribution of chlorophyll-a and phytoplankton fluorescence are analysed and discussed, with the purpose to identify fish potential zones. The experience and achievements will also be beneficial for future projects with Sentinel 3 data.

Cayula, J.F., Cornillon P., 1992: "Edge-detection algorithm for SST Images", J. Atmos. Oceanic Technol. 9(1), 67-80.
Miller, Peter I., 2009: "Composite front maps for improved visibility of dynamic sea surface features on cloudy SeaWIFS and AVHRR data", J. Mar. Syst. 78 (3): 327-336.
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High resolution ocean modeling forecast for a coastal early warning system in the Catalan Coast

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Despite the fact that during most of the year the NW Spanish Mediterranean Coast has a gentle sea state, high wave energetic conditions are not rare and can cause significant damages. In the last 20 years, extreme storms have been responsible for at least 50 casualties in the area and significant damages in coastal defenses, harbors and infrastructures.
The aim of the present study consists on providing high resolution forecast of wave conditions and sea level to a coastal early warning system so as to forecast storm events and address the coastal risks.
In order to generate the wave forecast three nested domains are used. The larger one covering all the Western Mediterranean Sea has a forecast horizon of 10 days, with a 15 km spatial resolution and forced with global winds. It is used to provide an overview of the situation and determine possible alarms near the coast. The second domain is an unstructured grid of the Balearic Sea, with a spatial resolution from 3 km to 500m. This domain has a forecast horizon of 5 days, forced with high resolution wind fields, and provides high resolution wave characteristics near the coast in an efficient way due to the usage of unstructured grids. The last domain consists on a series of local domains with a resolution of 350m, where the wave model will be coupled to the oceanic model and the atmospheric model.
The first results obtained from the hindcast of past strong storm events show accurate results.

Ocean surface vehicles for maritime security applications (The PRSEUS project)

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The PERSEUS project (Protection of European BoRders and Seas trough the IntElligent Use of Surveillance) goal is the protection of the European seas and frontiers through the use of cutting-edge technology. This 4-years duration pilot project funded by the 7th Framework Program is becoming the flagship initiative in the field of maritime security. Lead by INDRA, the consortium is formed by more than thirty partners from twelve different EU-countries, most of them having maritime frontiers.
The project attempts to answer the demand of a European integrated system for border surveillance.

The project goal is to develop and test a European system for maritime monitoring through the integration of the already existent local systems and its update and improvement using technological innovations, setting up the standards and bases for its final development.
PERSEUS includes technological innovations in the areas of detection and analysis applied to maritime security, aiming to become the first European-scale maritime surveillance system able to detect small ships and low-high flights. The overall technical and operational approach will pool multiple sensors, monitoring platforms and information sources, improving constantly with latest developments in detection, recognition and identification fields, where autonomous unmanned ocean vehicles with specific and dedicated payload sensor configurations will play a key role.

Operational modelling for supporting and characterising the Marine Renewable Energies in Western Iberia.

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Marine renewable energies comprehend a vast number of technologies including tidal, waves and offshore wind technologies. Operational modelling could contribute to support the development of such activities in several ways. Through atmospheric, waves and hydrodynamic models, the areas with enough energetic resource for these industries could be identified. Furthermore, operation and maintenance services rely on the sea conditions that operational modelling is able to provide through forecasts services. These forecasts could also be valuable for the survivability of the installed devices as extreme events could be identified and thus the possible damages could be reduced by taking measures. Moreover, operational modelling could identify the amount of energy would be available and how much could be produced by the devices thus the electric system would be more efficient in accommodating the generated energy.
During the EnergyMare project, this approach has been applied for the different sources of marine energy in the Portuguese continental coast. In order to characterise the existing energetic resources for the Western Iberia area, climatology maps for wind, waves and currents were produced with the results analysis for the period 2001-2010. GFS model results were used to determine the atmospheric element, the Mohid Water model forced with the tidal components from the global tidal model FES2004 to obtain the tidal currents and the WaveWatch III v3.18 was ran to calculate the wave distribution. Additionally, these models in their forecast mode are able produce six days forecast in order to aid in operation and maintenance services and to downscale the results for the areas of interest.

Combining operational models and data into a dynamic vessel risk assessment tool for coastal regions

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Latest scientific and technological developments on coastal monitoring and operational oceanography have provided the opportunity of building complex and integrative decision support systems for coastal risk management. A combined methodology to dynamically estimate time and space variable shoreline risk levels from ships has been developed,

integrating numerical metocean forecasts and oil spill simulations with vessel tracking positioning systems (AIS). The risk rating combines the likelihood of an oil spill occurring from a vessel navigating in the study area – Portuguese and Galician Coast – with the assessed consequences to the shoreline. The spill likelihood is based on dynamic marine weather conditions and statistical information from previous. accidents. The shoreline consequences reflect the virtual spilled oil amount reaching shoreline and its environmental and socio-economic vulnerabilities. The oil reaching shoreline is quantified with an oil spill fate and behavior model running multiple virtual spills from vessels along time. Shoreline risks can be computed in real-time or from previously obtained data.
The integration of numerical models (oil spill + metocean) with AIS and coastal vulnerability in the algorithm for quantification of shoreline risk allows the improvement of the decision support model, and a more realistic approach in the assessment of shoreline impacts. The risk assessment from historic data can help finding typical risk patterns, "hot spots" or developing sensitivity analysis to specific conditions, whereas real time risk levels can be used in the prioritization of individual ships, geographical areas, strategic tug positioning and implementation of dynamic risk-based vessel traffic monitoring.

AQUA-USERS: AQUAculture USEr driven operational Remote Sensing information services

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With global population expansion, the demand for high-quality protein is rising dramatically, and fish farming is gaining importance to ensure food security. Aquaculture is the fastest growing food production sector worldwide. Environmental conditions determine the growth and health of the produced species, while the production often releases large amounts of nutrients to the surrounding environment.
To support the growth of efficient and sustainable aquaculture production, the FP7 project AQUA-USERS will provide the aquaculture industry with user-relevant and timely information based on the most up-to-date satellite data and innovative optical in-situ measurements. The key purpose is to develop a web portal and mobile application that bring together satellite information on water quality and temperature with in-situ observations as well as relevant weather prediction and met-ocean data. A decision support system underlying the applications will link this information to a set of user-determined management decisions. Specific focus during the project will be on developing indicators based on Earth Observation data for aquaculture management including indicators for harmful algal bloom events.
AQUA-USERS is a highly user-driven project with a user board consisting of companies and organisations from 5 countries representing different European aquaculture production systems. Together with the user board, the project partners will demonstrate the applicability of the developed methods and tools in three case studies dealing with site characterisation and selection based on historic satellite data, operational management using in-situ measurements and operational management using near real-time satellite data in combination with in-situ measurements.

Oil spill simulations and pollutant trajectories projections: cases from Charente bay and Tagus estuary

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Prediction and simulation of oil spill and contaminant trajectories are essential to the development of pollution response and contingency plans, as well as for environmental impact assessment, in conformity with the objectives of the European Water Framework Directive (EU WFD).
In this study, the 3D hydrodynamic model MOHID was applied to two European coastal areas: the Charente bay, France, and the Tagus estuary, Portugal, to provide operational hydrodynamic hindcast and forecast for pollutant and oil spill simulations. Open boundary conditions were provided by the MyOcean monitoring and forecast system and downscaled by using nested domains with increasing resolution from the large to the local scale. Atmospheric forcing was provided by Weather Research and Forecasting (WRF) and by Global Forecast System (GFS) Models. After validation, the hydrodynamic model was coupled to a lagrangian model to simulate oil spill and pollutant dispersion at critical locations.
The spatial variation of transported pollutants was characterized by dividing the study area into boxes, and by integrating model results over the boxes volume. Oil spill accident scenarios were assessed under different tide and wind conditions.
The modelling approach enabled to assess the transport pattern of released pollutants in the two coastal areas and provided insights to identify areas potentially affected by oil spill.

A methodology for the assessment of a wastewater submarine outfall combining monitoring and operational modelling

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Estuaries are sites of significant biotic diversity and human development. They provide many goods and services including coastal protection, bathing areas, water purification, breeding and nursing areas for commercial fish species, etc. A direct consequence of human occupation of these coastal areas is that estuaries rank among the environments most impacted by human activities. Nature of the conflictive interests in these areas implies the need for adequate management tools.
This work reports on a study program combining monitoring and modeling approaches, developed to be used as a management tool of a coastal area adjacent to the Tagus estuary. The study is focused on the impact of a submarine outfall on the water quality of the area. The study area is under influence of oceanic processes such along shore transport, wind-induced upwelling, but also under strong influence of river outflow. We have applied a model to simulate physical and biogeochemical conditions of the area using a nested modeling approach. The estuarine and coastal area modeled domain has a 3D configuration and open boundary conditions are cascade down from the operational model for the Portuguese coast.
The model has been calibrated and the results show the major patterns of circulation and ecology dynamics of the region are adequately reproduced. The model application provides relevant information on the function of the system and its control on the fate of the submarine outfall plume. This study suggests that model results can be used to complement the lack of descriptive details of in situ data.

Towards an integrated automatic system for short-term follow-up of oil spills in the Portuguese Coast

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The evolution in operational observing systems, oceanographic forecasting services, and informatics systems provided new opportunities leading to the emergence of new of generation of decision support systems for the follow-up and response of an oil spill incident. This new generation of systems takes advantage of the current maturity related to the different data layers involved, as well as the harmonization in terms of publishing and communicating outputs using standard protocols.

A new operational automatic service for the follow-up of oil spills is being developed, gathering different operational pieces like the oil spills detection from satellite imagery (CLEANSEANET), the oil spill notifications sent to the end users (SCPM-DGAM), operational metocean forecasting services (e.g. MyOcean), and finally oil spill forecasting services (e.g. ARCOPOLplatform). The main purpose is to build a service-to-service system capable of a) automatically manage detection of oil slicks at sea; b) send automatic notifications from the oil slicks detected; c) automatically start the oil spill model (MOHID) forced by the best available forecasting results, and running both back and forward in time; d) distribute results to end-users in a user-friendly interface.

The system is being implemented in the Portuguese Coast, one of the largest Exclusive Economic Zones in Europe.

A system like this reduces the time between oil spill detection and the provision of oil spill forecasts to end users, increasing the time available for the decision-makers to prepare and take a decision. Automatic generation of backtracking results can also reduce the assessment time to track potential polluters.

Operational Metocean Forecast for Port Access and Operations using the Aquasafe platform

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The present economic context of rapid growth in the movement of goods in a lot of ports, and the predicted increase in world seaborne trade in the next decade, is key to justify the need for improved operational systems. Ports need to increase productivity as they need to cope with more demand (increase in trade), different demand (growing size of vessels) and the capital and time constraints in growing port infrastructures. Operational systems, based in the Aquasafe software, with forecasts of hydrodynamics and waves at scales of around 50 to 100 m, meteorology at scales of 4 to 9 km, validated with tidal gauges, meteo stations and wave buoys have been set up in several ports since 2011: Leixões, Viana do Castelo and Setúbal, in Portugal, and Buenaventura and Tumaco, in Colombia.

The design of each of the systems has different modelling strategies, depending on the specific problems of each port. These systems are based on an Aquasafe server that connects to third party models (global models like GFS, RTOFS, MyOcean and regional models like WRF or MM5), to databases or scada systems that manage observations, runs regional or local models (like MOHID, WW3, SWAN), sends automated reports by email, connects to desktop or web clients to show the observations and the forecast. One of the desktop clients that connect to the

forecast server is an Oil Spill Simulator. This software client helps emergency responders plan any oil spill or search and rescue related operations.

Adriatic marine meteorological Center AMMC and WIGOS/WIS implementation
D. Klaric, Meteorological and Hydrological Service of Croatia, HR

Meteorological and Hydrological Service of Croatia (DHMZ Croatia) took a lead in organizing a cooperation of national meteorological services toward a better marine services at the Adriatic sea area.
The aim of the AMMC is to apply and enhance the WMO and JCOMM standards at regional and national level in particular at: the integration of meteorological, hydrological and oceanographic "in situ" observation systems at Adriatic sea area; improving of the regional observation capabilities by implementation of WMO system of observation planning and integration system and link to WMO Information system (WIGOS/WIS); implementation of geoportal WEB site with the of data discovery, download and display functionality according to WIS and INSPIRE standards.
Rising demands for the improving the marine operative products for small and recreational vessels at East Adriatic Coast area, motivated DHMZ Croatia to took a steps for implementation of: a new regional met-ocean forecasting and warning system, with higher accuracy and more detail resolution at higher impact areas; a new digital charts of decadal average states /normal for atmospheric-ocean system parameters in order to improve the local and extreme events assessments; standardization of marine meteorological products for tourist and recreational vessels, taking into account the local climate conditions and vulnerability to extreme maritime events in order to improve marine traffic safety.

Environmental Marine Information System – A marine geoportal to assist in the management of European Seas
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The conception, development, implementation and monitoring of EU environmental policies requires the provision of timely, quality assured and easy-to-use data and information. To this end, the Joint Research Centre (JRC) of the European Commission (EC) in its role as a marine Competence Centre for Good Environmental Status (GES) has developed an Environmental Marine Information System (EMIS) to assist Member States with the monitoring and assessment of their marine and coastal waters. EMIS is a simple and easy-to-use mapping tool application, developed for the publication and dissemination of marine information for European Seas, and supplies the users with basic navigation and interrogation tools.
The system's operations include i) the provision of continuous, detailed and accurate marine / coastal environmental data as derived from satellite observations (ocean colour, sea surface temperature) and model outputs; ii) the generation of indicators for diagnostic of the coastal state and analyses of changes in marine ecosystems; iii) basic navigation and interrogation tools with a range of time-series and statistical analyses generated automatically in a format ready for reporting, and enabling decision makers to make full and lasting use of this information.
EMIS is implemented with a Web Map Service (WMS) and Web Coverage Service (WCS) in accordance with the Open Geospatial Consortium (OGC) specifications and INSPIRE standards to ensure full interoperability. These services are connected to R-written functions, enabling

the processing of EMIS data, their analysis and reporting to be integrated in a unique development environment. An application example is given with the analysis of the environmental variability of the Gulf of Sidra (Libya), in the Mediterranean Sea, as part of the EU MEDINA project.

Modelling and forecasting services

Validation of a Barotropic Tidal Model of Northern Adriatic using HF Radar and Tide Gauge Measurements

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OTPS (OSU Tidal Prediction Software), a barotropic tidal model for the Northern Adriatic domain, is compared to both high-resolution HF radar surface current observations in the Gulf of Trieste (GoT) and to sea-level tide-gauge observations in Koper.
Rotary spectra and tidal ellipse analysis is performed on observed currents and modeled tidal currents. Dominant semidiurnal components (M2, S2) from HF radar and OTPS compare favorably, as OTPS reproduces well the HF radar semidiurnal components in the interior of the GoT, while depicting their Kelvin wave propagation outside of it. Larger discrepancies are observed for the diurnal K1, as radar data appear to be biased by diurnal sea-breezes. Harmonic analyses of model tidal elevations and sea-level measurements in the port of Koper indicate that OTPS sea level forecast skill for this specific location (based on OTIS analysis of Topex/Poseidon altimeter data) is comparable to forecasts produced by tidal analysis packages like t_tide or utide. Multi-year total RMSE's of sea levels in Koper are roughly 18 cm for OTPS, 14 cm for utide, and 19 cm for t_tide. Large observed residuals stem mostly from local meteorological forcings, coarse model grid, shallow water in the gulf and imprecise bathymetry, but also from the limited input data available for the tidal analysis (tide-gauge sea levels, satellite altimetry).
We conclude the OTPS model presents a sound contribution to our ocean state forecasts.

Assessment and intercomparison of numerical simulations in the Western Mediterranean Sea

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The Balearic Islands Coastal Observing and Forecasting System (SOCIB) is developing high-resolution numerical simulations (hindcasts and forecasts) in the Western Mediterranean Sea (WMOP). WMOP uses a regional configuration of the Regional Ocean Modelling System (ROMS, Shchepetkin and McWilliams, 2005) with a high spatial resolution of 1/50º (1.5-2km). Thus, these simulations are able to reproduce (sub-)mesoscale features that are key in the Mediterranean Sea since they interact with the basin and sub-basin circulation. These simulations are initialized from and nested in larger scale simulations: the Mediterranean Forecasting System (MFS, 1/16º) or Mercator-Océan simulations (Mercator, 1/12º). The choice of the parent model may have a critical impact on the nested simulations. Quantitative comparisons along a repeated glider section in the Ibiza Channel, have revealed significant differences between the two large scale simulations.

In this study, the WMOP simulations and their parent models (MFS and Mercator) are compared and evaluated over 2009-2013 using available multi-platform observations such as satellite products (Sea Level Anomaly, Sea Surface Temperature), in situ measurements (temperature and salinity profiles from Argo floats, CTD, XBT, gliders, and fixed moorings) and High-Frequency radar. A quantitative comparison is necessary to (1) evaluate the capacity of the simulations to reproduce observed ocean features, (2) quantify the possible simulations biases, (3) improve the simulations in order to produce better ocean forecast systems, to study and understand ocean processes and to address climate studies. To this end, various statistical diagnostics have been developed to assess and intercompare the simulations at various spatial and temporal scales, in different sub-regions with typical sub-basin dynamics (Alboran Sea, Western and Eastern Algerian sub-basins, Balearic Sea, Gulf of Lion, Ligurian Sea), along key sections (Balearic Channels) and during specific events.

Estimation of regional significant wave height observation error using a triple collocation method

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Observation errors in the measurement of significant wave height can be significant; however these are often not accounted for within verification metrics. There is sufficient evidence to suggest that regional variation in these errors occur, particularly in the case of in-situ observations.

Triple collocation methods, where data from three different measurement sources are collocated and compared have been carried out previously on a global scale. The three separate estimates of the truth can be used to estimate the error associated with each different measurement method.

A regional triple collocation study has been carried out in two regions, the North Sea and the North European Atlantic Margin (NEAM), where a high density of in-situ data is available. The wave climate of the two regions is somewhat different. The North Sea comprises largely of waves generated by local winds over short to moderate fetches, while waves in the NEAM have often been generated over a long fetch and the wave climate usually consists of a mixture of locally wind generated waves and swell.

The study was carried out over the period 2010 to 2012 inclusive using model, buoy and satellite altimeter data. The study showed that is feasible to generate estimates of the observation errors using triple collocation on a regional scale. Overall the results show sufficient differences in the two domains to justify a regional approach to verification. Key sensitivities in the results were found in changes to the in-situ data used and in the averaging applied to the satellite observations.

Running WAM wave model on GPGPU - case study

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We have done a performance analysis of the WAM wave model. The main focus was on assessing the feasibility of using GPGPU technology to speed up computations. We have found that there is the potential of using GPGPU for this model, but also found some bottlenecks and architectural problems that hindered GPGPU computational advantage. The problems were centred around memory management.

The computations in WAM are performed on large matrices, which makes those computations ideal for GPGPU, but at the same time large matrices mean memory is heavily used and memory management has to be taken into account. Our findings, however, are not focused only on specific optimisations, but translate to some architectural conclusions and best practices that are applicable not only to WAM wave model. In particular improving maintainability of the code can increase the flexibility of adding and removing optimisations. This in turn can help to keep up with hardware evolution, which can help to fully utilise the hardware potential. The hardware and with it the parallelisation trends change. Simplifying, yesterday we had MPI, today we have OpenMP and GPGPU, but tomorrow we will have HSA. Hardware seems to evolve much faster than software, therefore we have to prepare software to be more flexible an prone to change following the hardware.

Long Term Assessment of the Met Office FOAM-NEMO System
N. McConnell, Met Office, UK

An investigation into the long term accuracy and forecasting skill of the Met Office 1/4 degree open ocean FOAM-NEMO system.
Using the GODAE OceanView Class4 metrics, time series of summary statistics and skill scores for specific sites, regions of interest and the full model domain have been produced for temperature profiles, salinity profiles, Sea Surface Temperature and Sea Level Anomaly. This work has been undertaken to show how a variety of model changes since March 2010 have impacted the FOAM-NEMO system.

Influence of the rivers discharge in the circulation patterns of a Western Iberia operational model
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In the Iberian Peninsula, most of the largest rivers discharge on the Atlantic coast draining almost two thirds of the territory and contributing to the coastal waters with nutrients and sediments. Rivers discharges in the Atlantic area enter estuaries before they are released into the ocean. The period that these waters are exposed to estuarine processes would depend on the estuarine residence time.
In order to evaluate the relative importance of the inland waters in the circulation patterns of Western Iberia, the rivers discharges were implemented in the PCOMS model application (Portuguese Coast Operational Modelling System), a fully 3D baroclinic hydrodynamic and ecological regional model that covers the Iberian Atlantic front.
To reproduce the water continuum including the different spatial and temporal scales, a methodology consisting in a system of integrated models using the Mohid model was designed. At the watershed level, the Mohid Land model obtained operationally water flow and properties, including nutrients, for the main river catchments of Western Iberian. Downstream, several operational hydrodynamic and biological estuarine applications used those outcomes as model boundary conditions, filling the existing gaps in the operational observation network. From the estuarine models, the tidally modulated water and properties fluxes to the coast were imposed in the Portuguese Coast Operational Modelling System (PCOMS). The influence of the rivers discharge was obtained by comparing climatologies of the PCOMS both with the

presence and absence of rivers. The differences were also analysed by calculating the fluxes of integration boxes for both scenarios. The rivers area of influence was obtained by lagrangian tracers simulations.

Data assimilation in a regional hydrodynamic operational model

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The importance of good quality oceanographic data assimilation to improve the quality of hydrodynamic model simulations is discussed.
An hydrodynamic model based on MIKE software by DHI has been used for the daily forecast of the sea currents, salinity, temperature, oxygen concentration, nutrients and chlorophyll-a distribution in the Gulf of Gdansk. The model is run in operational mode with meteorological and oceanographic data as initial conditions and sea level data from HIROMB model (High Resolution Operational Model for the Baltic Sea) as boundary conditions.
In order to improve forecast quality, monitoring data has been used for reanalysis of the simulations and for generating quasi real termohaline conditions after each monitoring cruise. Temperature, salinity, chlorophyll-a and dissolved oxygen data measured every 2 months during sea cruises are processed and interpolated by MIKE model for creating a grid of points in a 5 -layer scheme distribution for the whole gulf area.
Real meteorological data are provided for the whole hindcast period starting on the cruise date. This work presents the results obtained from the comparative analysis of the simulations for T, S and nutrients distributions obtained in daily forecast operational mode and those obtained for the same period with model run in hindcast mode with initial conditions reanalysis (cruise data assimilation). The results from both simulations are compared with measurements in situ to provide evidence on the improvement achieved by using the described methodology. Simulations which consider data assimilation show enhanced and more liable termohaline parameters distribution all over the simulation domain.

Implementation and validation of an operational wave modelling forecasting system for the Portuguese Coast

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The implementation and validation of an operational wave modelling forecasting system for the Portuguese Coast is presented in this work. The system was validated with wave buoys data available along the Portuguese Coast for the year 2012. A downscaling approach was followed to consider the swell generated in the North Atlantic into the regional and local high resolution models. The system takes into account the physical processes behind the generation, propagation and dissipation of waves along the ocean, shelf seas and coastal waters. When the waves are propagated to coastal waters, the interactions with the bottom and the shorelines become important. Thus, high spatial resolution wave models are needed to properly represent the bottom topography and land boundaries.
Wind forcing from a global atmospheric model was used to simulate the waves generated in the North Atlantic. However, to simulate smaller confined areas as the Tagus estuary, an atmospheric model with higher resolution was used to properly represent the wind changes

due to local topography. The system aim to provide wave forecasting data to: verify appropriate conditions and best locations to deploy floating barriers to contain oil spills in emergency situations, reducing the risk of oil leakage; assist in the management of wave energy devices, improving the efficiency and reducing the risk of damage in extreme events; assess the sediment transport on the coast, through the coupling with hydrodynamic models.

HAB alert system for the Portuguese coast

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Harmful algal blooms (HABs) are triggered and controlled by a complex interplay of physical, biological, geological and chemical processes. The nature of these events has changed significantly over the last decades, with a substantial increase in the number of occurrences, the types of resources affected and the resulting economic losses. HAB are frequent along the Portuguese coast and have impacts on coastal activities, mainly in the aquaculture industry.
The Portuguese HAB early warning system is a prototype that relies on weekly field data observations on HAB species along the Portuguese coast, merged with ocean circulation forecasts generated by an operational model. Model simulation and validation are supported by weekly in-situ cell counts from the national monitoring program and oceanographic cruises. The aim of this system is to predict bloom transport and potentially impacted areas along the coast. The output is a weekly bulletin that characterizes the actual oceanographic conditions of the coastal area, the water quality in terms of the presence or absence of HAB species, advances a 3-days forecast for ocean circulation, and predicts potentially impacted areas based on the current situation and model forecast. The bulletin was developed as a product in the FP7-ASIMUTH project and was made to fit the Portuguese reality of aquaculture production and needs.

Contribution to the harmonization of operational systems: data validation and dissemination through SOS and NetCDF

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In this paper we describe a new system developed to harmonize the data management practices implemented in different European operational systems. It is used for storing, validate and disseminate the data collected by the meteo-oceanographic MAMBO1 buoy (in the North Adriatic Sea) and the observatory site E2M3A (in the South Adriatic Sea) in (near) real-time. This system includes the collection of marine (near) real-time data with different formats, the conversion in a homogeneous and standard format, the structuring in a database and the validation using XML and OGC (Open Geospatial Consortium) standards.
To meet the needs of different scientific communities (RITMARE, Jerico, MyOcean, ODIP, FixO3) the dissemination follows different paths: through the adoption of Sensor Web Enablement (SWE) we answer to the needs of interact with data in near real-time (using SensorML and O&M standard in a Sensor Observation Service - SOS (http://nodc.ogs.trieste.it/SOS/sos) and a SOSClient (http://nodc.ogs.trieste.it/SOSclient) while to answer to the necessities of ocean monitoring and forecasting community we disseminate data using a NetCDF Oceansite standard.

The requirements of interoperability (as suggested by the MSFD), as ability to cooperate and exchange information, and resilience, led our technological choices.
As a further step, the compliance with the pan-European marine infrastructure SeaDataNet will be reached by the adoption of common XML schemata and vocabularies, creating a link between the operational community and the delayed mode systems.

Upwelling patterns and coastal vulnerability to oil spills in the South Iberian coast
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The South Iberia oceanography, characterized by several mesoscale processes, including upwelling filaments and fronts, it's tied up to the large scale climatological variability between the Azores high pressure cell and the Iceland low. This variability presents seasonal patterns from spring to late summer and during winter, which influence and characterize the region circulation. As the region lies on the main maritime route from the Mediterranean Sea and Southern Hemisphere to the North of Europe with tankers representing a significant part of the vessel traffic, a research study on the effects of the upwelling patterns in oil spill trajectories is presented here, with the main goal of investigating the role of these mesoscale features on the coastal vulnerability to oil spills.
Using five years worth of SST images, retrieved form both MODIS Aqua and METOP-A satellites, four different types of upwelling events where identified and considered the main upwelling patterns of the region. An operational oil spill model implemented for the South Iberian coast was used to reproduce these events and to access the evolution of spills in each of them, by simulated several oil spill hypothetical scenarios along the coast. Results obtained allow inferring about the model ability to correctly reproduce these climatological patterns of the region while at the same time provide useful clues about the effects of this mesoscale circulation in the region's coastal vulnerability to oil spills.

Improving current forecasts for the German Bight using HF radar measurements
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Three HF radar stations located at the islands of Wangerooge and Sylt as well as on the mainland in Büsum are operated in the German Bight as part of COSYNA system. Measurements are merged with numerical model data to optimise state estimates on a pre-operational basis.
The presentation introduces the spatio temporal interpolation (STOI) method, which is a statistical approach to correct data from a free model run using an analysis window of typically one tidal cycle. The scheme is based on an EOF analysis to estimate the model error background statistics and is capable of providing improved short term forecasts.
Statistics of the free model run, the HF radar data and the STOI analysis are shown for several month. Both the three dimensional primitive equation model GETM and the operational BSH model are used to provide free model run data. GETM setups with boundary forcing from the MYOCEAN North West
Shelf model are used. Maps of innovation and residuals are presented. Furthermore forecast errors for different forecast horizons are discussed. Results are also compared to independent measurements taken at the FINO-1 and FINO-2 platforms. The impact of the analysis is, e.g., illustrated by drifter trajectory simulations.

Furthermore, some results concerning the potential impact of existing and hypothetical HF radar systems are presented, which were obtained in the framework of the JERICO project making use of the STOI method as well as statistical OSE and OSSE techniques.

The Golden Trader oil spill; evaluation of operational oil spill models

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The Golden Trader accident in September 2011 outside the Danish coast was a major oil spill (say 400- 600 mt of oil). There are a number of observations on the evolution of the oil spill, and in this study we investigate the performance of three different systems for operational models for forecasting oil spill trajectories. The models we compare are the official operational oil drift model for the area, namely Seatrack Web used by Danish and Swedish authorities, the OD3D model used by Norwegian authorities, and BSHdmod used by Danish Meteorological Institute. We find that all three models have relatively similar evolutions of the drift trajectories but there are also some important differences. The models have quite similar trajectories in the initial part of the trajectory modeling, but they deviate closer to the Swedish coast. The role of correctly implemented Stokes drift for the drifter trajectory will be discussed. We will also discuss the observations that oil was not detected for some days before the beaching, and that the beaching took place in a very narrow area along the Swedish coast.

GODAE OceanView Class 4 Global Ocean Intercomparison

A.G Ryan (1) P. Divakaran (1) C. Regnier (1) F. Davidson (1) T. Spindler (1) Y. Liu (1) A. Mehra (1) F. Hernandez (1) G. Smith (1)

As part of the work of the Intercomparison and Validation Task Team (IVTT) a study was undertaken to ascertain the forecast accuracy of the various ocean forecasting centres.
Under the GODAE intercomparison metric framework, comparisons of model counterparts in observation space are referred to as class 4 metrics. Each participating forecast centre supplied model counterparts to an agreed upon set of observations. The model counterparts are delivered within a few days of the operational forecast to enable near real time forecast accuracy monitoring. The observation data sets chosen were; surface insitu SST drifters supplied by USGODAE, ARGO T/S profiles supplied by MyOcean2 and Altimeter satellites (Jason-1/2, AltiKa & Cryosat). At the time of writing participating operational oceanography forecast systems include FOAM at UKMO, HYCOM at NOAA/NWS/NCEP/EMC/MMAB, BlueLink at the Australian Bureau of Meteorology, GIOPS-CONCEPTS at Environment Canada and PSY3 and PSY4 at MERCATOR.
An investigation of summary statistics and accuracy metrics both globally and in regions of interest reveals interesting features of each operational forecast system.

Towards an operational sea state forecasting model

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Accurate forecasts of the sea state in coastal waters are very important for coastal protection. In addition, there is a growing demand of more precise forecasts for large offshore contractions like e.g. wind farms especially in their planning and construction phase and other human activities. Recent model studies show the relevance of wave-current interactions. They result in a wave set-up close to the coast, a mass flux transport along the coast as well as modified wave properties.
However, for the shallow water regions in the German Bight and western Baltic Sea, operational forecast systems have so far neglected the interaction between waves and currents. The aim of our current project is to improve the accurateness of the sea state in the operational daily forecasts by incorporating wave-current interactions.
Within the framework of the German project DeMarine2, the German Meteorological Service (DWD), the Centre for Materials and Coastal Research (HZG) and the Federal Maritime and Hydrographic Agency (BSH) formed a cooperation to develop a high-resolution model system with an interactive coupling between the Coastal Wave Model (CWAM) and the ocean circulation model HIROMB-BOOS (HBM). The spatial coverage of both models includes the German Bight and the western Baltic Sea with the same horizontal resolution (of approximately 900 m) and bathymetry.
Results of pre-operational forecasts show that the wave force can have a significant influence on ocean currents and sea surface elevation in the German Bight. The coupling of both models also improves the forecasts of wave parameters especially near the coast.

Adapting NEMO for use as a storm surge forecasting model
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Accurate forecasting of storm surge events is crucial to enable government agencies to assess the risk of overtopping of coastal defences such as sea walls so they can respond appropriately, minimising risk to life and infrastructure.
The Met Office and NOC have begun transitioning the current storm surge forecast system from the existing CS3X code base to a configuration based on the Nucleus for European Modelling of the Ocean (NEMO) code base. This work involves both adapting NEMO to add functionality, such as allowing the drying out of ocean cells, and improvements to bottom friction coefficients and changes allowing NEMO to run efficiently as a two-dimensional, baroclinic model. The surge forecast system consists of an ensemble system, run with 24 members 4 times a day, meaning computational efficiency is of high importance.
This project will enable interesting scientific comparisons to be made between a NEMO based surge model and the full three-dimensional barotropic NEMO based models currently run within the MetOffice, facilitating assessment of the impact of baroclinic processes, and vertical resolution on sea surface height forecasts. Moving to a NEMO code base will also allow many future developments to be more easily used within the storm surge model due to the wide range of options which currently exist within NEMO or are planned for future NEMO releases, such as data assimilation, and surge-wave coupling.
Preliminary results from a prototype NEMO surge model, alongside plans for further improvements and developments are presented.

The Met Office's operational analysis and forecasting system for the European NorthWest Shelf (FOAM AMM)

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The Forecasting Ocean Assimilation Model 7km Atlantic Margin model (FOAM AMM) is a coupled hydrodynamic-biogeochemical forecasting system for the tidally driven European NorthWest Shelf (NWS). FOAM AMM is run daily at the Met Office and produces 24-hour analyses and 5-day forecasts of ocean currents and tracers at hourly resolution as well as daily forecasts of biogeochemical and optical quantities which are distributed freely through the MyOcean project. The hydrodynamic core of the FOAM AMM system uses the Nucleus for European Modelling of the Ocean (NEMO) community model coupled to the European Regional Seas Ecosystem Model (ERSEM). The model uses a non-linear free surface along with 15 tidal constituents to represent tidal processes.
The FOAM AMM system has recently undergone a major upgrade which has seen the introduction of a new data assimilation scheme as well as many changes to the model components. The model upgrades include the use of real-time river inputs from SMHI's E-Hype river forecasting system and real-time Baltic boundary conditions from the MyOcean Baltic forecasting system. The model surface boundary condition (SBC) has also been changed to use the CORE bulk formulae scheme and a new terrain following coordinate system has been employed to better resolve surface processes in the deep ocean whilst maintaining vertical resolution on the shelf. Data assimilation is now performed using the NEMOVAR 3D-Var FGAT system which has been adapted for use on the NWS. Key developments include the implementation of a new parameterised background error covariances scheme and improvements to the specification of observation error variances.
This poster gives an overview of the new FOAM AMM system and provides some motivation for the recent upgrades as well as future plans for ocean and ecosystem modelling of the NWS domain.

The Mid Atlantic Current Hindcast for the Oil and Gas Industry

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The Mid Atlantic Current Hindcast (MACH) is a 20 year high resolution hindcast for the oil and gas industry. The key aim of the initiative is to produce a high quality hindcast of ocean currents near the West Coast of Africa to assist in engineering design and reduction of operational risk in the area. This project is a collaboration between the Met Office, OceanWeather Inc. and BMT ARGOSS.
The MACH modelling system uses the Forecasting Ocean Assimilation Model (FOAM) and consists of a series of nested model grids. These are a global 1/4 degree model, a 1/12th degree model covering the South Atlantic and 1/36th degree model covering the coastal waters off West Africa from the Gulf of Guinea to Namibia. The two lower resolution models both include data assimilation and a coupled sea ice model. This project provides a major update to previous hindcast studies in this region and is a significant resource for the oil and gas industry.

Global coupled short-range forecast developments at the Met Office

C. Guiavarc'h (1) Ch. Harris (1) F.X. Bocquet (1) 1: Met Office, UK

The development of a seamless global coupled numerical prediction system from weather to climate timescales is one of the Met Office's main objectives. Ocean forecasts from a global coupled system are already being delivered via MyOcean2 and we are developing a higher resolution coupled system, and working to assess the impact of increased resolution (for both atmosphere and ocean) and the inclusion of a wave model in the system.
To investigate the impact of increasing the coupled model atmospheric resolution, we developed a coupled atmosphere-ocean-sea-ice model with a 25km atmospheric model (UM-N512) and a 1/4° ocean model (NEMO-ORCA025L75). Assessment against a coupled model with the same ocean model but with a lower atmospheric resolution (60km) and against a non-coupled atmosphere model at similar resolution (25km) highlighted the positive impact on the short-range forecast of both the increased atmospheric resolution and the atmosphere-ocean coupling.
To allow understanding of the impact of wave-ocean and wave-atmosphere interactions a prototype atmosphere-ocean-wave system is currently being developed using the wave model WaveWatchIII. The prototype system has been used to test the impact of the waves on the roughness length; the Charnock parameter calculated in the wave model is passed to the atmospheric model. Comparison against an atmosphere-ocean coupled model showed a positive impact on the 10m winds.
Future work includes continuing the development of the atmosphere-ocean-wave system by introducing additional ocean-wave and atmosphere-wave interactions, and developing a very high-resolution coupled model for short-range forecasts with a 17 km atmosphere model and a 1/12° ocean model.

Modeling of the Black Sea dynamics using NEMO
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Modeling of the Black Sea dynamics is one of the key investigations which are made in Marine Hydrophysical Institute (MHI) nowdays. A quite large number of own numerical circulation models were developed here for the last two decades. The work in this direction becomes more actual since formation of the Experimental Marine Forecasting Center based on the Operational Oceanography Branch of MHI. From the other hand participation of the institute in the EU Framework Projects resulted in adaptation of well-known models (e.g. POM, NEMO) for the reconstruction of the Black Sea circulation. An important question is comparison of the reconstructed dynamics within different ocean circulation models and following scientific validation of them using available observations.
The presentation is dedicated to improvement of the Black Sea configuration for NEMO based on comparison of several setups. The spatial resolution of the domain was taken close to the configuration of the MHI Circulation model which is currently used for producing marine forecasts in forecasting center (approx. 5 km). Z-coordinate is used in vertical with different setups of z-levels and resolution of the upper layer (hard-coded, Madec-Imbard function). Simulated dynamics and thermohaline structure from different NEMO configurations and MHIC were intercompared. Data from ARGO profiling buys was used to study the quality of the reconstructed fields Despite the almost identical domain configurations NEMO and MHIC reproduce rather different dynamics.

Improving Navigation information for the Rotterdam Harbour access through a 3D Model and HF radar

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The Port of Rotterdam is one of the largest harbours in the world and a gateway to Europe. For the access to Rotterdam harbour, information on hydrodynamic and meteorological conditions is of vital importance for safe and swift navigation. This information focuses on the deep navigation channel in the shallow foreshore, which accommodates large seagoing vessels. Due to a large seaward extension of the Port of Rotterdam area in 2011, current patterns have changed. A re-evaluation of the information needed, showed a need for an improved accuracy of the cross channel currents and swell, and an extended forecast horizon. To obtain this, new information system was designed based on a three dimensional hydrodynamic model which produces a 72 hour forecast. Furthermore, the system will assimilate HF radars surface current to optimize the short term forecast. The project has started in 2013 by specifying data needed from the HF radar. At the same time (temporary) buoys were deployed to monitor vertical current profiles. The model development starts at the end of 2014. A first operational version of the system is presently planned for the end of 2015. A full operational version which assimilates the HF radar data is planned for 2016.

In-situ observations

The quality of the marine environment and mollusks according to the EU legislation

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The assessment of the quality of the marine environment and of marine mollusks was carried-out in 2012 in the four designated areas for the growth and commercial exploitation in the Romanian Black Sea coast, according to the Directive 2006/113 EC.
The National Institute for Marine Research and Development (NIMRD) 'Grigore Antipa' Constanta, Romania has implemented a monitoring system of littoral waters, sediments and mollusks according to the requirements of the EU Directive no. 2006/113/EC and of national requirements, and a set of mitigation measures towards the reduction of pollution and water quality required by EU legislation. The main species monitored were the mussel Mytilus galloprovincialis (Lamark, 1819) and the rapa whelk Rapana venosa (Lamark, 1819). The level of all parameters analyzed in mollusks were in conformity with the EU Directive requirements. Water and sediment quality along the Romanian coastline in 2012 was, overall, in conformity with the Shellfish Waters Directive 2006/113/EC.
The pH was ranged between 7 and 9. The total suspended solids had overall low values without impact on water quality. Water temperature was not influenced by point discharges. Salinity often evinced values below the minimal recommended threshold of 12‰. Dissolved oxygen complied well with the requirements in all four areas. The presence of petroleum hydrocarbon films was visually assessed, but was not reported within the investigated areas. Organohalogenated substances were identified in both water and sediments, but within concentrations allowed by the Ministerial Order no. 1888/2007. The level of compliance for salinity was 60% in Area 1 from the northern part of the Romanian coastline, which are influenced by the Danube River freshwater input (95% required). The level of compliance for nickel in sediment was 33.33% in Area 1 and 100% for the other areas (100% required).

Analysis of maritime-coastal severe events in Basque Country during 2014 winter

S. Gaztelumendi (1) J. Egaña (1) 1: Tecnalia – meteo area / Euskalmet 2:Tecnalia - meteo area / Euskalmet

During the winter of 2014 many deep Atlantic depression are formed northwest of the British Isles, deepening and moving eastward, promoting areas of high winds and generating high waves that affects large areas of west European coast. In particular affecting severely the Irish, Britain, French and Iberian coasts.
In this study a characterization of this episodes is presented in relation to its main features and effects on the Basque Country coast.
During winter season, seven main wave episodes, with high significant heights and long peak waves periods affect Basque area. In the January 6-7 event significant heights above 8 meters with wave period over 20 seconds was registered. On 27-28 January, the significant wave height is around 7-8 meters, 1-2 February, the significant wave height is around 7-8 meters concurring with spring tides. On February 5 and February 8-9 events significant heights of 9-10 m reaches Basque coast. At the end of the season two consecutive episodes affects the area, the first takes place on February 28 – March 1 and the last, which has the highest significant wave height of all studied period, takes place on March 3-4. The most important due to damages in coastal infrastructures over Basque country are 1-2 February and 3-4 March events.
This paper describes and analyzes the most significant episodes of maritime storms that have affected the Basque Country during the winter of 2014. Meteorological situation giving rise to strong waves, its characteristics and its effects at local level is analyzed.

Destructive combination of strong waves and tides in the Basque Country: 2 February case

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On 31 January a deep depression is generated in the Atlantic, northwest of the British Islands, which deepens rapidly with a minimum pressure value around 940 mb. This storm moves to east to reach the northwest of Britain and then moves northward. This storm generate strong waves traveling along the Atlantic reaching the Basque coast as swell, especially during the morning of February 2. The significant wave height exceeds 7 meters with peak wave periods of about 20 seconds in the most critical moment.
In previous wave storms have been recorded wave heights similar to this event, but the singularity of this episode is the coincidence of the high height of the waves with the extraordinary height of the tide. The waves reached its maximum value at the same time when high tide occurred, causing the waves easily surpassing structures, showing unusual strength and creating widespread damage at different points along the Basque coast.
In this paper we analyze the synoptic situation which leads to strong waves, wave characteristics that affect the Basque coast and its coincidence with spring tides. We also describe the widespread damage caused by this storm, which can be considered as one of the worst wave storm occurred in the Basque Country.

HF Radars at work: The Northern Adriatic Sea Test Case

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Following the case in several other areas of the Mediterranean basin and coastal ocean in the US, a permanent network of HF radar network is being installed in the Gulf of Trieste, northern Adriatic Sea, operated within the EU sponsored 2012-2015 HAZADR and the Italian 2012-2016 RITMARE initiatives. This network is a natural prosecution of the research programs that OGS lead since 1990 in the area of HF radars in the Adriatic Sea, which focused on circulation features offshore Ancona (1995-1996), Venice (2001-2006), Istrian peninsula (2007-2010), Gulf of Trieste (2011- onwards). Outcomes of these research programs were multiple and proved the reliability of HF radars for research purposes (i.e., as benchmark for ocean model circulation or for short-term current forecasts), as well as their potential use to optimize intervention in case of oil spill response, thus servicing public entities responsible for civil and environmental protection, and monitoring of sea conditions in critical areas.
Here we provide a summary of the Calibration, Validation, Quality Control Procedures and Error Estimates in HF Radar Current Observations implemented as part of the various research projects that granted a reliable and effective collection of sea-surface current maps.

Euro-Argo: a new European Research Infrastructure for climate change research and operational oceanography

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In May 2014, the Euro-Argo research infrastructure became a new European legal entity (Euro-Argo ERIC). The objective is to organize a long term European contribution to the international Argo array of profiling floats. Argo is now the most important global in-situ observing system required to observe and understand the role of the ocean on the earth climate. Euro-Argo is also an essential component of the in-situ infrastructure required for the Copernicus Marine Core Service and its MyOcean and MyOcean2 projects (operational oceanography). Euro-Argo will thus develop European contribution to the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS).
We will provide an overview of the development of Euro-Argo over the past years, detail the now agreed Euro-Argo long term organization, and provide some highlights on the work-plan for the years to come and the Argo extensions for the next decade. We will also illustrate some key achievements on the use of Argo in Europe both for operational oceanography, ocean and climate change research.

Active and passive acoustics for in-situ observations of the status of the ocean

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Recent European policies underlined the need to integrate available ocean observations into an overall observing system capable to assimilate data provided by a variety of different and multidisciplinary approaches.
While well consolidated methodologies are accomplished for the global monitoring of physical ocean properties (i.e., temperature, salinity, current), knowledge on biochemical characteristics and meteorological phenomena over the ocean (i.e. wind, rain) is far to be thorough.
Remote sensing techniques gives great support to ocean forecasting models and, more in general, to operational oceanography as well as equipped buoys, moorings and floats are an effective resource to acquire in-situ measurements for characterizing ocean.

Development of methodologies for the full use of all information that can be extracted from existing measurement systems represents a promising frontier for improving the knowledge of the ocean.
In this framework, the paper focused on underwater acoustic systems, both active and passive. Oceanic ambient noise measurements can be analyzed to obtain qualitative and even quantitative information about meteorological phenomena whilst backscatter echoes can describe biological activities. The use of instruments installed on moorings or floats able to listen to ambient noise could contribute to enhance the monitoring capacity of meteorological phenomena also in open ocean without the need of fixed platforms.
The paper explores the potentiality of available acoustic data analyzing long time series of acoustic data acquired in the North-Western Mediterranean Sea.
Results show wind and rain estimates obtained by ambient noise measurements and zooplankton behavioral characteristics inferred by ancillary acoustic Doppler current profiler observations.

New Tools for Dissolved Oxygen, Fluorescence and Turbidity Sensors Testing and Intercomparison

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The protection and management of the oceans requires a comprehensive understanding of the processes and conditions that affect the state of the marine environment. However, long term in-situ monitoring of bio-geo-chemical properties of the ocean is a challenging task, not only due to "hostile" marine environment, but also due to the instruments accuracy and precision needed to obtain useful data for processes analysis as well as for assimilation into forecasting models.
Although some biogeochemical parameters can be nowadays measured through non-intrusive and automatic, partially miniaturized, relatively low-power, in-situ sensors commercially available at affordable costs, their applicability in routine long-term operational monitoring of seawater quality is still challenging.
In particular, dissolved oxygen, fluorescence and turbidity measurements have a strong scientific relevance and being measurable with on-the-shelf technology are the most important “bio” variables on which the implementation of ocean observation systems must rely on.
Thus, it is fundamental to develop and test comparison and validation tools for assessing the performance of these type of sensors at each centre managing ocean observing systems.
Two different set-ups to test and calibrate multiple different dissolved oxygen and fluo-turbidity sensors at the same time have been developed and tested at the HCMR calibration facility in Crete within the framework of the European Commission project JERICO. The project, among its main objectives, aids in the optimization of the use of existing infrastructures and in the promotion of interoperability inviting the international scientific community to access key infrastructures such as coastal observatories and calibration facilities.

A Meteo-Oceanographic Data Centre of the Ligurian Sea

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The scientific impact of data collected in the ocean by different types of platforms (fixed buoys, drifters, research or opportunity vessels, etc.) can be limited by the absence of a coordinated

and agreed-upon standards for data management. Acquired data can be useful at the highest level only if quality checked measurements can be discovered, viewed, evaluated, accessed and retrieved by users in standard formats.
Since the last decades, huge efforts were performed in the marine domain towards standardization of data format and data exchange protocols asserting the increasing role in the society and a strong impact on science, technology and business that information systems have.
To this aim, a data centre collecting about 15 years of meteorological and oceanographic observations in the Ligurian Sea has been designed. It contains data acquired from the W1-M3A off-shore observing system, a multidisciplinary research platform constituted of a surface buoy and a sub-surface mooring periodically deployed near-by the main surface buoy, and during research cruises periodically carried out in the basin.
The information system, developed using open source tools (e.g., MySQL, PHP) contains historical data as well measurements collected in near real-time from the fixed buoy.
Different procedures are applied to near real-time and delayed mode data set in agreement with the WMO/JCOMM recommendations.
The system is able to produce different types of downstream services to users and to distribute subset of data on request or in automatic way in different format (e.g., MEDATLAS, BUFR, NetCDF, etc.).

ESTOC: Progress towards the harmonization of oceanic observations from different platforms
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The European Station for Time-series in the Ocean, Canary Islands (ESTOC) was initiated in 1994 about 100 km north of the Canary Islands at nominal position 29º 10'N, 15º30'W and 3618 m water depth. The main goal for the ESTOC station work consisted on the creation of an Eulerian long time series on inter- and multidisciplinary basis, in order to monitor and help understand oceanic long-term variability in the eastern North Atlantic subtropical gyre.
A ship-based sampling program, in addition to a hydrographic mooring and a particle trap mooring all were performed to carry out these observations. The ESTOC site has been witnessing several observation oceanic programs during these last 20 years. The technological progress and singular scientific interests produced changes in the observational approaches and generated large diverse data sets from different observation platforms. For instance, observations from XBT probes, drifters, surface buoys, biogeochemical moored sensors, ARGO floats and gliders have been collected in order to satisfy particular project objectives. Each data set is individually recognized as important; however they represent a stone in a pile compared to the whole. To compile all data sets to be used together require their harmonization. This task is in the same line that those proposed in some recent European framework projects such as EuroSITES and FixO3 networks.
The main goal is providing standardized data sets to EuroGOOS in order to create a unified approach.

Measuring surface currents in the Canary Region with Fifteen years of drifting buoy data
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Drifter data are applied in the study of the surface circulation in the Canary Region. 131 drifter trajectories, distributed within 15 years (1998-2013), have been deployed at the ESTOC site (European Station for Time-Series in the Ocean, Canary Islands), located in the North Atlantic (29º10´N, 15º30´W). The results of the annual surface circulation in the Canaries archipelago obtained from drifting buoys have provided a good knowledge of the surface current system in this area. The Canary Current is strongly influenced by the seasonal variation of the trade winds and the resulting upwelling of northwest Africa. It also confirms the variability in current direction as an indicator of the tendency for gyres to appear in the centre of the Canary Current. Two clear routes have been confirmed: one flowing southwards, in the lee of the archipelago, which coincides perfectly with classic descriptions; and another less known westward route, which would channel part of the volume of water flowing out towards the west without crossing the archipelago.
Data are binned into a 1° x 1° grid and splitted in 4 different seasonal scenarios: spring, summer, autumn and winter. Analyses are focused in the surface circulation and aim to estimate parameters such as mean intensity and standard deviations. Mean intensities estimated is 13 cm/s, have reached maximum speeds of 100 cm/s in summer. Standard deviations reached the same magnitude order, highlighting the great variability in the region's circulation.

R3M: The ocean-monitoring strategy for the Macaronesian region

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The Macaronesian region is a vast area in the East Central North Atlantic of with an important interest already known for marine and maritime sectors like research, technology, navigation, energy, border security, tourism, among others. However, logistics and support level to develop and maintain an accurate, useful and sustainable monitoring strategy programme are still clearly below the needs.
Despite technology advances addressed to ocean monitoring has been significantly improved during last two decades with new platforms, sensors and telemetry systems, there are still many unsolved gaps in terms of data quality, reliability, efficiency and sustainability. These gaps becomes particularly relevant in ocean regions like the Macaronesia, fitted by archipelagos located notably far away one to each other.
Based on particular and common initiatives for many years ago from several institutions across the region, nowadays there is a multidisciplinary group of universities, companies and institutions aiming in partnership to consolidate a regional ocean observing strategy under the name of R3M (Macaronesian Marine Monitoring Network). The R3M is the reference framework to gathered, manage and display the information provided by all existing in-situ observing platforms (fix and mobile) like moored buoys, ASV, underwater gliders, meteorological stations, etc. in this area, according to needs from specific end-users and the general public.
R3M aims, standards, formats and rules are always in line with the main international initiatives and programmes like Atlantic Strategy, H2020-Blue Growth, EuroGOOS, GEOSS, IOOS, INPIRE, MSFD, DCF, etc., and flag-ship European projects like GROOM, SeaDataNet, JERICO, MACSIMAR, FixO3, among others.

Monitoring Network Flemish Coast to investigate new techniques for coastal protection

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A Masterplan Coastal Safety has been set up, by the Government of Flanders, to protect the coastal area in Belgium from flooding for a 1/1.000 year storm event. The Belgian coast is sandy but has on different sections an erosive character. Part of the coast is protected by dikes, but on many stretches the beach-dune system serves as coastal protection. The management strategy is to use where possible soft techniques, such as beach nourishments, to restore the natural beach profile in order to provide adequate protection levels. There is however considerable interest in using new and innovative techniques for coastal protection. One of them is creating artificial sandbanks or topping up existing sandbanks, a possibly more cost effective measure than beach nourishments. In order to investigate in detail the impact on wave energy reduction by sandbanks and therefore also on the reduction of wave impact on the coast, a monitoring network of 7 wave buoys was established from off-shore n(open sea) to near-shore. The buoys are more or less aligned and cross several existing sandbanks. The measuring campaign started at the end of November 2013 and the intention is to continue for at least two winter seasons. Preliminary results show that the first winter season was successfully monitored.
These data will now be analysed in detail. At the same time a coupled hydrodynamic-wave model will be used to hindcast the wave propagation towards the coast and to investigate in detail the sensitivity to different formulations and parameter settings of the physics. In a later phase this set of models can then be used to investigate the impact of creating artificial sandbanks to reduce the wave load on the coast, and the consequent reduction of erosion rates and enhanced protection against flooding.

The RADMED monitoring program: towards an ecosystem approach

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The IEO-RADMED monitoring program is already conducting many of the evaluations required under the MSFD Descriptors 5 and 7 along the Spanish Mediterranean coast. The different aspects of the ecosystem that are regularly sampled are the physical environment and the chemical composition of the water column that condition the primary production. Primary producers are studied by microscopy,flow cytometry and total chlorophyll-a analysis. The photosynthetic activity, the respiration and the degradation of organic matter determine the gas interchanges with the atmosphere, being the CO2 interchange one of the most important in the actual context of climate change. This is sampled continuously using a SUNDANS system and pH and alkalinity in the water colum are systematically sampled from niskin bottles, in order to evaluate the CO2 system and to get the hole picture of the CO2 system in the water column. The relations with the next trophic level can be estimated from the zooplankton studies. The higher trophic relations with zooplanktivourous and tertiary consumers are actually not being considered. The heterotrophic bacteria are essential for the decay of the organic matter to close the cycle. Bacteria are also being sampled and analysed by flow citometry. To complement this information it would be necessary to study the transference of

organic matter to the benthos and also the CO2 content of the sediment. There is the possibility of integrating in future campaigns some dredges at critical points to characterize also the sediment contaminants.
The poster will present the objectives and opportunity of this monitoring program within the framework of the MSFD.

NeXOS Project: Cost-effective, Multifunctional Web-Enabled Ocean Sensor Systems Empowering Marine, Maritime and Fisheries Management

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As stated by the marine research decision makers in Europe, in the “Ostend Declaration” in 2010, a major challenge is to support the development of a truly integrated and sustainably funded European Ocean Observing System. This will be achieved with more long-term measurements of key parameters but is impaired by the costs and lack of reliability of ocean sensors in general.
The NeXOS project aims to improve the temporal and spatial coverage, resolution and quality of marine observations through the development of innovative and interoperable in-situ sensors deployable from multiple platforms, and Web Services for key domains and applications. This will be achieved through the development of new, low-cost, compact and integrated sensors with multiple functionalities including the measurement of key parameters useful to a number of objectives, ranging from more precise monitoring and modelling of the marine environment to an improved assessment of fisheries. New compact, cost-efficient sensors will be developed, based on optical and acoustics technologies, addressing a majority of descriptors identified by the Marine Strategy Framework Directive for Good Environmental Status. All new sensors will respond to multiplatform integration, sensor and data interoperability, quality assurance and reliability requirements.
NeXOS will base the required technology advancements on the new generation of the Sensor Web Enablement (SWE) suite of standards of the Open Geospatial Consortium (OGC). Utilization of the standardized SWE specifications and development of the required profiles, will allow seamless integration with existing international initiatives such as GEOSS and GMES.

The Coastal Observing System for Northern and Arctic Seas (COSYNA): An Integrated Approach

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The automated observing and modelling network COSYNA has been established in order to better understand the complex interdisciplinary processes of Northern Seas and the Arctic coast, to assess the impact of anthropogenic changes, and to provide a scientific infrastructure for measurements and data interpretation.
The principal objective of observations, instrument development, and modelling is to improve our understanding of the interactions between physics, biogeochemistry, and ecology of coastal seas, to investigate how they can be best described at present, and how they will evolve in the future. The natural processes of the North Sea are in numerous ways connected to the

well-being of human societies. Recurrent issues are safety of transportation, coastal defence against storm surges, slowly rising sea levels, morphology changes due to sediment transport, and environmental effects of offshore wind farms.
In COSYNA, scientific questions related to these topics are addressed and data and knowledge tools are developed and provided for the use of multiple interest groups in industry, agencies, politics, environmental protection, or the public. These data and products support national monitoring authorities to comply with the requirements of the European Water Framework Directive and the Marine Strategy Framework Directive. The coastal observatory involves national and international contributions to international programmes, such as COASTAL GOOS, GEOSS, GEOHAB and GMES. Since COSYNA is one of the densest observing systems located in one of the most heavily used coastal areas in the world, it may serve as a role model for other parts of the “Global Coast”.

Argo float measurements in the Baltic Sea – experiences and developments
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Argo floats have been important measurement platforms in researching world oceans since the early 2000s. Finnish Meteorological Institute (FMI) has experimented, deployed and operated Argo floats in the Baltic Sea since 2011. The development work for software has been done in co-operation with Aalto University.
FMI purchased the first two Baltic Argo floats in 2010 and the first experiments were made in the Baltic Sea in 2011. To our knowledge this was the first time that an Argo float was successfully operated in the shallow waters of the Baltic Sea. The first long term experiment was launched in May 2012 in the Bothnian Sea and the buoy was operating over six months. In 2013 two buoys were deployed, one in the Bothnian Sea and the other in Eastern Gotland Basin. The buoy deployed in Eastern Gotland basin was operating first time also during the winter months 2013-2014. During these years Argo floats have proved to be reliable measurement instruments in the Baltic Sea.
In 2014 FMI Baltic Sea Argo fleet consists altogether of four buoys. Two of the buoys measure temperature, pressure and salinity. Two buoys have also turbidity, chlorophyll and oxygen sensors. The floats have brought new knowledge of remote and deep sea areas, where the observation network it otherwise sparse. The data collected by Argo floats has been very valuable for studying hydrography, circulation and biochemical conditions in the Baltic Sea as well as for operational purposes in oceanographic services, for model development and validation.

Comparing evaluation of FerryBoxes data, fixed platforms and numerical models in the southern North Sea
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FerryBoxes installed on ships of opportunity (SoO) provide data of selected tracks on a regular basis. Within the European FerryBox Community, several FerryBoxes are operated by different institutions. Here we present a comparison of model simulations applied to the North Sea with FerryBox data from a transect along the southern North Sea and a more detailed analysis at

three different positions located off the English East coast, at the Oyster Ground and in the German Bight.
Resulting differences between the datasets vary between parameters. The simulation of water temperatures is generally satisfying; however, limitations of the models are existing. The mean water temperatures are underestimated by more than 1 K. Salinity data are more sensitive to tidal influence than temperature and reveal a weaker performance of both models, e.g. in terms of variability. Skill variance for both models is below 1. To combine data from FerryBox routes with other observation types seems promising for model evaluation. FerryBox datasets can be used for further data analyses in the North Sea. Additionally, data formats should be harmonized and data sets have to be made accessible to community members. This would pioneer a more comprehensive exploration of the European Seas.

A bio-optical dataset for the western Mediterranean: first results from the WMED-BIOOPT 2014

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The field campaign WMED-BIOOPT 2014 on board the research vessel Urania was carried out in April 2014 across the western Mediterranean to study the optical and biological properties of the Spring boom. During seventeen days, an average of four stations per day were sampled covering a significant variability, from the very clear Tyrrhenian waters, to moderately clear Balearic and Alboran waters to the bloom at the south of the Gulf of Lion.
The collected dataset was the following: IOP data with ac-s, ac-9 and ECO-VSF3; underwater radiances and irradiances with a free profiler OCR-507 and a reference deck; CTD data including light transmission and chlorophyll-a fluorescence; Niskin rosette water samples for laboratory analysis that included CDOM absorption, high performance liquid chromatography, phytoplankton and non algal absorption.
The acquisition of this unique dataset responds to the scarcity of optical data for such a unique and important waterbody. These dataset will be used to validate operative global and regional remote sensing algorithms and will help to push science beyond the classical quantification based on chlorophyll-a towards a more detailed based on size distribution and functional groups.

FP7 Ocean - SCHeMA: integrated in Situ Chemical MApping Probes

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Marine environments are highly vulnerable and influenced by a wide diversity of anthropogenic and natural substances and organisms that may have adverse effects on the ecosystem equilibrium, on living resources and, ultimately, on human health. Identification of relevant types of hazards at the appropriate temporal and spatial scale is crucial to detect their sources and origin, to understand the processes governing their magnitude and distribution, and to ultimately evaluate and manage their risks and consequences preventing economic losses.

SCHeMA aims at providing an open and modular sensing solution for in situ high resolution mapping of a range of anthropogenic and natural chemical compounds that may have feedback (synergic) interaction: toxic and/or essential Hg, Cd, Pb, As and Cu trace metal species; nitrate, nitrite, and phosphate nutrients; species relevant to the carbon cycle; volatile organic compounds; potentially toxic algae species and toxins.
The SCHeMA system will consist of a plug-and-play adaptive wired/wireless chemical sensor probe network serving as a front-end for gathering detailed spatial and temporal information on water quality and status based on a range of hazardous compounds. An ad-hoc ICT wireless networking solution and web-data information system will allow system localization and reconfiguration; data transfer, logging, storage, standardization, evaluation, modelling, and user-friendly accessibility.

Feasibility of Observation System and Validation of Modeling DIC System in the Baltic Sea
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It is well-known, there are two independent variables governing the system of dissolved inorganic carbon (DIC) in the seas. The observations should be feasible to describe the full dynamics of at least two parameters. To fully understand a system, one normally means to recognize the diurnal, the seasonal, the inter-annual and the decadal variations in all typical regions and their profiles and distributions. Numerical models in combination with observations are the state-of-the-art approach to gain the fully understanding. Observation system relevent to the DIC system in the Baltic Sea might be considered as one of the best in the world seas.
Our efforts in modeling DIC system and validating the model will be presented in focus with the model capability and the feasibility of observation system as well.

New developments in fluorescence based monitoring of phytoplankton taxonomy and productivity
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Chlorophyll a fluorescence is a key technique in operational oceanography to follow in situ distribution of phytoplankton biomass, despite the well-known variability in chlorophyll in vivo mass-specific fluorescence. New developments in fluorometry have emerged recently, allowing detection of phytoplankton taxonomy and productivity, and they will be discussed, including challenges in the instrument calibration, field validation and data-analysis. Phycobilin fluorescence can be used as a proxy for cyanobacterial abundance. We demonstrate the usability of phycocyanin fluorescence in the detection of filamentous cyanobacterial blooms in the Baltic Sea and the potential of phycoeryhtrin fluorescence in detection of picocyanobacteria.
Variability in the pigment content in cyanobacteria cells is one of the main challenges in the interpretation of the phycobilin fluorescence records. Few instruments are commercially available to measure spectral fluorescence of phytoplankton pigments. Spectral signals can be decomposed with various techniques, to estimate the abundance of major phytoplankton pigment groups. Main limitation of the contemporary data-analysis is the use of constrained spectral libraries, which are created using cell cultures. Some alternatives, based on statistical multivariate analysis, are demonstrated. Fast repetition rate fluorometry can be used to

estimate photosystem 2 electron transport rate, which correlates with primary production. Recent developments include automated measurements of fluorescence-light curves, several excitation channels allowing improved sensitivity under varying community composition, and instruments designed for flow-through systems. New developments have been tested in 2013-14 onboard a ship-of- opportunity, between Finland and Germany. First results are shown, indicating the sufficient sensitivity of instrument.

From regional seas to global ocean observations: the national capacity of the UK science community

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Sustained observations of the marine environment are required at both regional and global scales, to document seasonal cycles, extreme conditions and identify the causes of environmental change. Sustained observations are particularly important for disentangling natural decadal variability from anthropogenic changes. The information gained from such sustained observations is vital for informing policy at both national (e.g. Marine Protected Areas) and international level (e.g.) Marine Strategy Framework Directive). In order to ensure that the information is translated into policy, observations need to be coordinated, coherent and well managed in order to maximize the scientific outputs and knowledge exchange. A key activity, coordinated by the British Oceanographic Data Centre (BODC), is data stewardship in order to maximize information usage across the widest possible network of scientists and stakeholders.
We present case studies of key UK marine science programmes, highlighting their successes in increasing the coordination, capacity and knowledge exchange at national, European and global scales. Case studies include the FixO3 collaborative project (including the fixed-point observatory at the Porcupine Abyssal Plain (PAP), and North and South Atlantic Oligotrophic Gyres (NOG and SOG, respectively)), the Extended Ellett Line, RAPID, ARGO, Atlantic Meridonal Transect (AMT), GoShip and the Western Channel Observatory (WCO). The work of many of these projects has contributed to coordinated national programmes, including the highly successful Oceans 2025 (2007 - 2012), the Western Shelf Observatory (part of the wider European Marine Ecosystem Observatory) and UK Integrated Marine Observing Network (UKIMON), to providing connectivity between shelf seas sampling and the Atlantic Ocean.

Real-time quality control of biogeochemical in-situ measurements

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The use of biogeochemical sensors in ocean science is increasing fast. New parameters can be monitored but also new monitoring platforms are made available. These factors do not only lead to a larger volume of biogeochemical data, but also the emerging need of standardized procedures and quality assessments.
NIVA has been involved in biogeochemical measurements since it was created, both in fresh water and marine science. In the fields of sensors and platforms development and testing, NIVA has been contributing actively in a very large number of projects like EU-projects Ferrybox, Jerico, MyOcean, MyOcean2, Nexos and MariaBox. Its own network of Ferryboxes extending

from Germany into the Arctic is regularly used as platform for testing new biogeochemical sensors. As member of ESAs satellite validation teams (MVT and S3VT), light radiation measurements are also an important activity for developing satellite validation techniques, satellite products and find correlation with in-situ biogeochemical parameters. In the frame of MyOcean projects, NIVA has been responsible for implementating stronger standards for biogeochemical data acquired from any supporting platform, as well as assemble and quality assess measurements from pan european Ferryboxes in near real- time. Nomenclatures, units in use, meta data, sensor calibrations and unattended continuous real-time quality control algorithms have been key topics and development areas. Spatial and temporal variability and the relatively noisy nature of biogeochemical sensors have led to the development of unified algorithms for applications within automatic quality control.
The presentation gives an overview of challenges encountered and the methods applied to solve them.

Combining autonomous observations and sampling for operational environmental assessments

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Autonomous measurement and sampling systems, e.g. ferryboxes and moorings are increasingly used for operational environmental assessments. In the Gulf of Finland such an operational assessment system is applied by combining data from a ferrybox, profiling buoy stations and fast laboratory analyses of water samples. Laboratory analyses are essential for calibration of autonomous sensors and needed for those parameters where reliable sensors are not available yet. We demonstrate how this combination of methods is used for fast assessments of eutrophication effects and further studies of the functioning of pelagic ecosystem. Adaptive sampling in connection to high-resolution profiling allows studying in more detail biodiversity of primary producers associated with different forcing and background conditions and their functional role in nutrient cycling and/or export-import. In addition to conventional methods of laboratory analyses, fluorescence microscopy, flow-cytometry and methods of metagenomics are applied.

BSH Contribution to the Copernicus Marine Core Service “MyOcean”: Northwest-Shelf In-situ Observations

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Efficient in-situ based monitoring of marine conditions over time and space is an important and developing field to provide essential validated information for many applications such as: coastal and marine environment, marine safety, marine resources and weather, climate and seasonal forecasting.
A huge network of different ocean in-situ observatories facilitates the accessibility to an extensive range of ocean data. BSH co-operates with the EuroGOOS regional alliances to collect and integrate marine in-situ data (in real-time and delayed mode) and provide access to data and information products on a sustainable basis.
The infrastructure developed jointly by MyOcean and EuroGOOS ROOSs has set up a useful

service both for operational oceanography in Europe, but also for the research community and the development of downstream services.
A real-time data base has been developed to import and provide different data formats (e.g. NetCDF, ODV, ASCII or CDI Metadata format). An interactive web portal was established at BSH to provide a primary access point for visualisation and download of real-time and historical data.
One of the main focal points was and is the definition of standardized Real Time Quality Control (RTQC) procedures and the provision of information about the quality of data for physical parameters. These procedures are including automated tests as well as visual quality control and manual data validation of time series. Bio-geochemical (BGC) data quality control procedures are also under development following similar guidelines.