Comments to the Reviewer:

First of all, authors want to thank the reviewer his suggestions in order to improve the manuscript. Below, a short comment to each requested item can be found.

General comments:

- Acronyms should not be use in the abstract
- The introduction should be rewritten and expanded (specially lines 20 - 25) to make clear the goal of the system, how it contributes and support the blue and green growth. Acronyms should be explained from the beginning
- Insert in the ms a figure where all or most of the observing system s are positioned
- Insert in the ms figures with data output (examples o so)

Acronyms have been avoided in the abstract and the introduction has been improved with general information about the goals of the system. A whole revision of the acronyms has been performed and new figures has been added as examples. Figure 1 shows the all hydrographic sections stations that are currently sampled and the tide gauge network. AGL buoy is close to the most external station of the Santander Hydrographic Section. Oceanographic model outputs, satellite images and vessels are not in the figure in the interest of simplicity, as they cover wide areas.

The authors are aware that this is not a traditional scientific paper, but a summary of operational oceanography the evolution along the time at the institution. The different programs began to fulfill specific needs, and have been consolidated as time passes.

Tide Gauge network:

- Line 31 explain the acronym RONIMAR,
- Line 37 what do you mean with high frequency data? Higher than 1 hour? If so, explain the reason of these type of measurements

Acronym explained and paragraph changed and completed.

Hydrographic sections

- Shelf and Slope, deep Sections should be deeply review. In some part both sections are similar. I suggest to make a clear division or to merge into one

Attending the referee suggestions, all the section has been rewritten. A table with information about the stations, contributing programs, and number of current stations has been added. The figure1 shows the position of the stations in the network.

Permanent moorings:

- Line 107 named Finisterre and Santander. Indicate when the second mooring stopped and if and when it will deployed

- Line 112 these current??? Correct and specify which ones/one
- Line 118 this second mooring will contribute to the HC program?

Revised and completed. Santander mooring is stopped, but Asturies one is working instead. The new moorings will contribute to the HydroChanges program after maintenance, and quality control of acquired data.

Ocean meteorological Buoy

- Indicate the type of parameters measured at the site

Parameters has been added to the ms, and a figure with some examples of the collected information that can be found in the dedicated web site

IEO Research Vessel

- Repeated ship track figure

Figure added, and information is completed.

ARGO

- Line 140: 47 profiles have been deployed since when?
- Line 144- 146 rephrase

ARGO-Spain began in 2003. This information has been added, and the indicated phrase changed.

Satellite SST

- Line 153: explain how you get the seasonal behavior of water masses from satellite imageries!

All the information about satellite images has been re-written and completed. Nowadays the complete service is in change in order to establish a new web-based server for the SST images.

Conclusions:

Expanded and improved

Conclusions have been expanded as it is suggested as well as the bibliography that support the scientific use of the data collected in the framework of the operational activities carried out by the institution.

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IEOOS: the Spanish Institute of Oceanography Observing System

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Abstract

Since its foundation, 100 years ago, the Spanish Institute of Oceanography (IEO) has been observing and measuring the ocean characteristics. Here is a summary of the initiatives of the IEO in the field of the operational oceanography~~(OO)~~. Some systems like the tide gauges network has been working for more than 70 years. The ~~IEO~~ standard sections began at different moments depending on the local projects, and nowadays there are more than 180 coastal stations and deep-sea ones that are systematically sampled, obtaining physical and biochemical measurements. At this moment, the ~~IEO Observing System (IEOOS)~~ Observing System includes 6 permanent moorings equipped with currentmeters, an open-sea ocean-meteorological buoy offshore Santander and ~~an SST satellital image reception~~ a seasurface temperature satellite image station. It also supports the Spanish contribution to the ARGO international program with 47 deployed profilers, and continuous monitoring thermosalinometers, meteorological stations and ~~ADCP onboard the IEO research vessels~~vessel mounted acoustic Doppler current profilers on the research vessel fleet. The system is completed with the ~~IEO~~ contribution to the ~~RAIA~~ NorthWest Iberian peninsula and Gibraltar observatories, and the development of regional prediction models. All these systematic measurements allow the IEO to give responses to ocean research activities, official agencies requirements and industrial and main society demands as navigation, resource management, risks management, recreation, etc, as well as for management development pollution-related economic activities or marine ecosystems. All these networks are linked to international initiatives, framed largely in supranational programs Earth observation sponsored by the United Nations or the European Union. The synchronic observation system permits following spatio-temporal description of some events, as new deep water formation in the Mediterranean Sea and the injection of heat to intermediate waters in the Bay of Biscay after some colder northern storms in winter 2005.

1 Introduction

The Operational Oceanography (OO) means the activity of systematic and longterm routine measurements of the seas and oceans, their interpretation and dissemination (Parrilla, 2001) in order to fulfill upcoming needs from many different sectors: industry, service, policy making, etc., besides the scientific one. The IEO aims scientific knowledge of the oceans and the marine environment and developed based on observation and research. For more than two decades ~~ago~~ it has been investing resources, time and funds in the field of OO, to promote these results ~~in~~ for the social development and benefit. Institutional strengthening is desirable to form the network core sampling it has managed to develop. This service is given to the interested national and international community and the IEO's Spanish representative in the European forums (~~ESA, ICES~~ International Oceanographic Data and Information Exchange (IODE), International Council for the Exploration of the Sea (ICES), . . .) for appropriate action. Some data collected across this Observing System are linked to international initiatives. As an example, the IEO participates in Fixed point Open Ocean Observatory network (FixO3) european project with data from ~~AGL~~ Augusto Gonzalez de Linares (AGL) buoy; and nutrients and dissolved oxygen information from water samples at different deep levels, that are collected along the hydrographic sections, are included in the ~~EMODNet (~~European Marine Observation and Data Network (EMODNet , DG-Mare/2012) initiative in order to improve the knowledge and perform distribution maps of the variables along the European coasts.

The increase in the ocean measurements and the availability of the general information on the sea behaviour and variability have to be a fundamental chance for the rational use and exploitation of the ocean. This is one of the important lines of the blue growth and green economy. In this sense, the bigger amount of ocean data we can collect, the better responses to the social demands we could offer, such as improved weather forecasts, sea-related hazards prevention, marine safety, coastal tourism, etc.

Although all the datasets are quality controlled locally, by the same researchers that are responsible of the different programs, the IEO performs a double validation when the data arrive to its datacenter for their permanent archive. Following the internationally agreed protocols, data are checked for spikes and position/date errors, and validated against climatological values in the different areas. To preserve the data for the future, all detected problems are flagged by a numerical code, that gives added value to the original data and facilitate further uses of them. Reformatted to internationally accepted standard formats, and metadated following the ~~SeaDataNet protocols~~Pan European Infraestructure for Ocean and Marine Data Management (SeaDataNet) protocols and the INSPIRE directive (2007/2/EC), both, data and metadata, are incorporated to the IEO data archive structure, linked to SeaDataNet network, and made them accessible ~~across~~ through its web portal ~~:~~ www.seadatanet.org.

This paper aims to give a ~~-~~general overview of the different programs that the IEO supports to achieve its scientific objectives as well as to serve the different demands that are imposed by the society. The different programs are been evolving as time passes, adapting the new technologies and sampling strategies to fulfill the IEO needs and the ability to manage them.

2 Tide gauge network

The Spanish tide gauge network (Red Operacional de NIvel del MAR, RONIMAR) is being operating since 1943. It has 12 stations, 4 of them on the islands, ~~meets~~ conforming the international requirements and ~~contributes~~ contributing with the data to the Permanent Service for Mean Sea Level (PSMSL). Some stations are integrated in the Global Sea Level Observing System (GLOSS) and the long period of data registered by RONIMAR has allowed to integrate these sea level time series to global and regional datasets for studies of long term trends, as well as for decadal and interannual variability (Tel and Garcia, 2002; Tel, 2007). Nowadays the ~~hourly and higher frequency data are~~ sea level is being sampled every 5 min in most of the stations and these data are also being relevant for the estimation of extreme sea levels (Garcia et al., 2012). Along the time, tide gauges network has been upgraded in line with technological advances, both in the system measurement, from the mechanical tide gauge with graphical recorder, to a radar technology, ; and for data transmission, from postal mailing to automatic transmission. Nowadays 4 stations (Palma de Mallorca, Vigo, Cadiz, and Puerto de la Luz) are sampled every minute, and could be used in seiches or tsunami studies. These tide gauge data are daily made available from http://indamar.ieo.es.

3 Hydrographic monitoring sections

The IEO has been monitoring the Spanish shelf waters for the last 25 years. This is the oldest national field program for multidisciplinary marine research addressing long term variability issues at ecosystem level(Bode et al., 2014). Core observations include ship-based hydrographichydrographical, biogeochemical and plankton observations at monthly frequency in several oceanographic sections along the Iberian shelf. First series initiated in the northwestern shelf (Valdes et al., 2002), and other programs extended the observations to the Mediterranean and, in 2009, to Gulf of Cadiz. in 1992 (López-Jurado et al., 2015). This longterm monitoring allows for the knowledge of differences in the large scale off-shore oceanographic conditions along the water column (Vargas-Yáñez et al., 2012), and the description of the intermediate water seasonal formation (Vargas-Yáñez et al., 2010).

In 2003, an initiative to monitored (RadProf) to semiannual sample off-shelf waters using the same approach had been stabled. established in order to understand the mechanisms governing the internal variability of the ocean, and therefore of the climate. The Finisterre section takes a good representation of the Eastern Boundary Waters along the Iberian Basin and western Galician bank. In 2006 the deep hydrographic section around the Canary Islands began, in order to establish the scales of variability in the range decadal/subdecadal in the subtropical gyre, specifically in its eastern margin (Velez-Belchi et al., 2014). In 2009, new stations in the Gulf of Cadiz (STOCA program) has been added to the network (Monteiro et al., 2015). The results of water samples analysis at the different levels are being included in the EMODNet(chemistry) network. The whole working network can be see at Fig. 1 and table 1.

With the data collected, the IEO was able to detect the deep changes that were produced in the Bay of Biscay and Mediterranean Sea. As an example, the extremely cold and dry Winter of 2005 in the south-western Europe was detected on the different characteristic of the water masses. In the southern Bay of Biscay, information of the IEO Shelf and Slope Sections shows that in the Bay of Biscay the episode caused a profound transformation of the upper ocean hydrographical structure, making it completely different that what it was in the previous decade (Somavilla et al., 2009). The strong local cooling and the precipitation deficit resulted in the highest density flux estimated, which triggered the mixed layer to reach unprecedented depths, affecting directly East North Atlantic Central Water (ENACW) that are usually unconnected to air sea interaction. In the Western Mediterranean the anomalous low precipitation and persistency of northerlies over the NW Mediterranean caused a large extension both in time and space of deep convection processes (Lopez-Jurado et al., 2005) and a New Western Mediterranean Deep Water (N-WMDW) was produced, slightly denser, warmer and saltier than the usual WMDW (Salat et al., 2007). Also near the continental slope, a cascading of colder and even denser water was found (Puig et al., 2013) affecting biological processes over the whole water column (p.e. Company et al., 2008; Rodríguez et al., 2013; Carbonell et al., 2014; Hidalgo et al., 2014).

3.1 ~~Shelf and slope sections~~

~~Since 1990, 181 stations are sampled over a regular grid to get information on the shelf-slope gradient (Radiales program). They conform the longest multi-disciplinary oceanographic dataset in Spain (Bode et al., 2014) and attempt to characterize the ocean variability at different scales, seasonal, inter-seasonal and decadal ones, including biogeochemistry and plankton behaviour, as well as the ecosystem responses. It covers Galicia (9 stations along 2 sections) and Bay of Biscay (13 stations along 3 sections). These observations are complemented with buoy and satellite observations and all these data are used to validate hydrographic and ecological models of plankton at local and regional~~

scales. The success of Radiales extends beyond pure scientific knowledge, as the expertise gathered with the program has been applied to solve multiple environmental issues, from fisheries and pollution to global change.

With the same approach, RadMed program, with 85 coastal, shelf and deep stations, covers the Spanish Mediterranean Sea (López-Jurado et al., 2015) in the pursuit of best monitoring of the different areas as can be see at Fig. 1. Thus, the sampling network includes the Alboran Sea productive area, the oligotrophic zones of Balearic Islands and Cape Palos, and the Ebro delta, due to its special interest as ecosystem. Besides, the longterm monitoring allows of knowledge of differences in the large scale off-shore oceanographic conditions along the water column (Vargas-Yáñez et al., 2012), and the description of the intermediate water seasonal formation (Vargas-Yáñez et al., 2010). In the last years, linked to the improving interest to know the Mediterranean Sea health state, new variables (pH, Total Inorganic Carbon, NO_2, CH_4) has been added to the original sampling (Amengual et al., 2010). this This multidisciplinary approach permits enhancing the management of short life cycle species such as Octopus vulgaris (Vargas-Yanez et al., 2009). All the RadMed oceanographic stations are included in the Mediterranean Operational Network for the Global Observing System (MonGOOS) and in the IBAMar database (Aparicio et al., 2015).

In 2009, 16 stations in the Gulf of Cadiz (STOCA program) has been added to the network (Monteiro et al., 2015). The results of water samples analysis at the different levels are being included in the EMODNet(chemistry) network.

3.1 Deep sections

In order to understand the mechanisms governing the internal variability of the ocean, and therefore climate, it is necessary to have long systematic observations. Deep hydrographic sections are sampled in N–NW Spain (RadProf program) since 2003. Sections have been occupied semiannually or at least annually. The Finisterre section has been enlarged to take a good representation of the Eastern Boundary Waters along the Along the Iberian Basin and western Galician bank. Seasonality NW slope, seasonality signals in the vein of

Mediterranean Water have been detected in the area, with the vein constrained to the shelf break in the summer and widely distributed in winter (Prieto et al., 2013). The complete deep sections in the Cantabrian Sea have been discontinued recently while some deep stations have been included for the monthly sampling. The aim is establishing the scales of variability in the range decadal/subdecadal. Its information contributes to the knowledge of the oceanographic climatic variability and global change monitoring (Prieto et al., 2015).

The Canary Islands are immersed in the eastern margin of the North Atlantic subtropical gyre, in the coastal transition zone of the Canary Current Upwelling System. ~~In 2006 the IEO began the deep hydrographic section around the Canary Islands (RaProCan program), in order to establish the scales of variability in the range decadal/subdecadal in the subtropical gyre, specifically in its eastern margin. It consists 50 hydrographic stations around the Canary Islands (Velez-Belchi et al., 2014) sampled each 6 months. In each one of the stations velocity, temperature, salinity, pressure, oxygen, turbidity and fluorescence are continuously measured (CTD) and bottle samples are taken for calibration and for determination of alkalinity, carbon and chlorophyll content in colaboration with the University of Las Palmas de Gran Canaria (ULPGC).~~ The warming of the upper 600 m continues at a rate of 0.14 °C decade^{-1} in the oceanic waters and 0.32 °C decade^{-1} in the waters between Lanzarote and Africa under influence of upwelling off the African coast. At intermediate levels the warming continues at rate of 0.04 °C decade^{-1} in the oceanic waters and 0.08 °C decade^{-1} in the waters between Lanzarote and Africa. At deeper levels, since 1997 there is not statistical significant trend. Regarding the oceanic circulation, the Canary Current presents a seasonal cycle, with the minimum transport occurring during fall, concentrated between Tenerife and Lanzarote Islands. (Vélez-Belchí et al., 2010)

4 Permanent moorings

In the Atlantic Ocean, the IEOOS comprise two deep moorings in the RadProf monitoring of N/NW Iberia since 2004: Finisterre and Santander. The second ~~one is not working nowadays~~stopped in September 2010 but in August 2010 a new mooring was established in Asturies (44°03′ N, 005°53′ W). Mooring lineswith current-meters and hydrographic sampling , equipped with currentmeters at the cores of main water masses, have been operative with some interruptions from 2003 at the western Iberian margin and in southern Biscay, and complete the hydrographic sections samplessampling. The goal is to maintain permanently at least one mooring line at each region. In the Canary Basin a permanent mooring has been placed in the eastern Boundary Current EBC4 Eastern Boundary Current (EBC) to quantify the water masses variability of these current as well as the Canary Current (Velez-Belchi et al., 2015).

In the Gibraltar Strait, the IEO is involved in the Gibraltar monitoring system with a mooring, the INGRES mooring that began in the framework of the national research project ’Water exchanges through the Strait of Gibraltar and their response to meteorological and climate forcing (INGRES)’ in colaboration with the University of Malaga. This mooring is included in the HydroChanges program. In the Mediterranean Sea, this program the HYDROCHANGES program (Schroeder et al., 2013) comprises an international set of deep moorings for the long-term monitoring of the hydrological variability(Schroeder et al., 2013). The IEOOS contributes to this program with a mooring in the continental slope at the north of the Ibiza channel . Additionally, a second mooring will be installed in the next months and another one at the NE of the Menorca island. The mooring moorings maintenance is planned to be every 6 to 12 months within the RadMed monitoring program (Balbin et al. , 2014). (Lopez-Jurado et al., 2005).

5 Ocean-meteorological buoy

Deployed in 2007, at 43°50′ N 3°47′ W, the Augusto Gonzalez de Linares (AGL) buoy is located 22 nmi (nautical miles) north of Cape Mayor, off Santander (southern Bay of Biscay). Water depth at the buoy site is 2850 m. It is equipped with meteorological sensors for air temperature and atmospheric pressure, air humidity and wind (velocity and direction), and ocean ones for waves (height and direction), subsurface seawater temperature and salinity, chlorophyll-A concentration, dissolved oxygen. Finally, a 300 kHz Doppler current profiler monitors the first 100 m horizontal currents.

The obtained information is of great importance for the scientific, meteorological, environmental, fishery, maritime and tourist activities which have a real-time marine information source. Integration of different scales has been matter of study from hourly to monthly, and some products are freely available, together AGL buoy real time data, at www.boya_agl.st.ieo.es. Also, comparisons between AGL data and monthly Santander Hydrographic Section. Delayed time data from 2007 to 2014 are also available through www.seadatanet.org. As an example, figure 2 shows the 26 m height wave recorded in the Cantabrian Sea during a big storm in winter 2009, and the timeseries for salinity and water temperature. These ones are monthly validated against CTD and water bottles that are systematically taken at the Santander hydrographic section.

The Biscay AGL buoy is the IEOOS contribution to the EU FixO3 European project.

6 IEO Research vessels underway monitoring

Nowadays the IEO maintains continuously working 5 thermosalinometers (TSG), 4 meteorological stations, 4 marine data management systems and 2 vessel mounted ADCP on board the IEO R/V fleet. Collected data are routinely sent to the IEO datacenter for QC quality control (mainly date, position, and range for near realtime data), dissemination and archive.

An automatic data processing system was developed to manage all the information generated in quasi-real time by this surface sampling network. The developed software applies standard systematic control subroutines and prepares the data to save them into local databases and generates preliminary graphical outputs. All network data are stored in a Thematic Realtime Environmental Distributed Data Services server (THREDDS) to facilitate its access by scientific community and its visualization by means of Open Geospatial Consortium (OGC) standard services. Nowadays an automatic data storage system based on postgres/postgis database is being developed in order to make easy the implementation of an user-friendly web service to visualize and download this kind of data.

These systematic measures had allowed some climatological products based on repeated ~~shiptracks~~measurements. So, from thermosalinometer data, the monthly ~~repeated track~~ sampling survey from Santander to Gijon, has enabled the subsurface temperature and salinity maps in Cantabrian Sea (Viloria et al., 2012; Viloria, 2012) and let us a better description of coastal conditions and their seasonal variability. In Galician Rias where the interseasonal variations have consequences as algae blooms that strongly affect to local fisheries, the weekly repeated surveys (see figure 3 showing the 4 tracks in December 2015) of R/V *Navaz* since 2008, allows us getting better descriptions of their variability patterns (Tel et al., 2014).

7 IEO contribution to ARGO international program

Spain participates in the international Argo program since its beginning (Roemmich et al., 2009; Freeland et al., 2010). This participation began in 2002 through the first European project where a total of 80 Argo profilers were deployed in the North Atlantic. Later, the IEO has led different special governmental actions through which Argo–Spain program is being financed. At this moment a total of 47 profilers has been deployed since 2003, and 9 are active. Additionally, 10 profilers were acquired for three Spanish research groups as part of their observational strategy. Nowadays, the ~~continuation of the Spanish participation in~~ Spanish continuity on the Argo program is ~~pending of official approval, once~~ waiting to official pass, although various European research infrastructures demonstrated the interest of such participation~~was demonstrated in various European research infrastructures~~.

The Spanish participation has always been subject to scientific objectives, whether to support independent objectives approved under the R+D National Plan or as a means to achieve their own goals of Argo–Spain program. These objectives are the study of the mass transport variability and the changes in temperature and salinity in the North Atlantic

(24.5° N) (Vélez-Belchí et al., 2010) or the ~~the~~ Meridional Overturning Circulation in the North Atlantic (Hernandez-Guerra et al., 2010).

8 Satellite SST images reception station

In July ~~-~~1998 a ~~satellite~~ satellite data reception station was mounted at the IEO Santander Centre~~to receive SST images. This information is important in order to develop~~ . From 1998 to 2007 the station acquired and stored important information for different studies of ocean ~~primary production, water quality and turbidity, identification of thermal fronts, eddies and upwelling events, seasonal behaviour of water masses, etc~~trends. Because of technical problems the station stopped working in 2007, but a ~~-~~new reception station has been mounted in ~~2010, and~~ 2010. The system receives, archives, processes and displays data from NOAA and Metop satellites. From these data, Sea Surface Temperature (SST) images are obtained for five different geographical areas and distributed in near real-time in the IEO web-page. These SST images are in jpg format with a suitable color palette applied. Nowadays, 10 ~~daily SSTimages are now available. These data are digitally processed and converted in SST images~~daily SST images are available in the web page and shortly SST data will be available in a standard distribution format for satellite images.

The main scientific objectives are related to the identification of mesoscale features, as coastal marine ecosystems and continental margins represent the transition zone between the continents and ocean basins, and they play a crucial role in regulating the materials and energy exchanges between mainland and the deep ocean (Otero et al., 2009), being areas of intense biological productivity. In particular, these data has also been used in studies of the oceanographic conditions in the Prestige oil spill accident (Ruiz-Villarreal et al., 2006). Furthermore, assimilation of satellite data is an important tool for the validation of the hydrographical circulation models of the area and an important support tool (Garcia-Soto, 2004) in the designing and developing of the Spanish oceanographic surveys and research.

9 Hydrodynamical forecasting models

The IEO runs high resolution models in the N–NW Iberian Peninsula to give response to the oceanographic water conditions, upwelling system variability (Otero et al., 2008) and harmful algal bloom prediction, among others. The main task consists of providing insight on the coastal and ocean dynamics in support to the intense IEO ecosystem and fisheries research in the area. The Regional Ocean Model System (ROMS) outputs for temperature, salinity and currents layers are freely available through a THREDDS server http://centolo.co.ieo.es:8080/thredds/catalog/ROMS-IEO/catalog.html and a data viewer http://www.indicedeafloramiento.ieo.es/index1_en.php. Using ROMS data the following derived products are generated: thermal, haline and mix layer fronts, eddies, shellfishing areas and beaches temperature.

In the last years, a high resolution ($\sim 3\,\mathrm{km}$) configuration of ~~the~~ ROMS physical model with atmospheric forcing, which has shown to represent the main features of the shelf and slope circulation in the area, was run coupled to a biogeochemical model (N2PZD2). Any biogeochemical model aimed at providing a reliable representation of the dynamics of a certain area should be tuned according to its characteristics. In an upwelling system, the composition of phytoplankton varies from the beginning to the end of the bloom. The spring bloom is reasonably reproduced in the NW and N coasts in time, space and intensity (Garcia-Garcia et al., 2015). Some examples of the use of the IEO models to get some insight on sardine recruitment variability (Bode et al., 2006) and harmful algal bloom prediction. In the last case, the circulation models at Rias, and data from RV *Navaz* thermosalinometer and CTD monthly profiles from Radiales program at Ria de Vigo, enable an HABs alert bulleting http://www.asimuth.eu/en-ie/HAB-Bulletin/Pages/default.aspx that is used by fishermen and local aquiculture enterprises in order to manage their activities.

10 Conclusions

The Spanish Institute of Oceanography (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. Furthermore, all the information obtained from the IEOOS is actually providing valuable information to study the biological resources and their dependence on the physic-chemical variables (Alemany et al., 2010, e.g.), and also physical effects like deep and intermediate water masses formation (Somavilla et al., 2013; Vargas-Yáñez et al., 2012, e.g.), modification and transport (Lopez-Jurado et al., 2005, e.g.), and oscillations and trends in environmental variables (Prieto et al., 2015; Vargas-Yáñez et al., 2010), while models information is being successfully used in local fisheries.

The success of the Hydrographical Sections extends beyond pure scientific knowledge, as the expertise gathered with the program has been applied to solve multiple environmental issues, from fisheries and pollution to global change. The Marine Strategy Framework Directive (MSFD), whose main objective is the achievement of good environmental status of ~~european seas is a~~European seas is planning of the marine environment action policy. The IEO is already conducting many of the required evaluations on the Spanish coasts. In fact, data collected in the framework of IEOOS structure has been the core of the initial assessment and ~~a key~~ the key element for the identification of environmental objectives that follow up.

The new IEO research vessels are completely equipped automatic systems that enormously increase the capacity of sampling the ocean along the ship tracks, and a collaboration with the national forecast services is expected in the near future in order to provide them data in near real-time.In the pursuit of giving visibility to the sampling network IEO data, as well as the activities of this group, a single web portal-style is currently being developed. It would help to strengthen their position and status in the national framework and international as well as responding to demands that we are proposing recently under proposals such as ~~H2020~~ Emodnet iniciatives, the EU Framework Programme for Research and Innovation: Horizon 2020, or MSFD. In this sense, the IEO is currently doing a strong effort to give visibility to all the data obtained in the framework of its OO programs, incorporating them to structures as SeaDataNet or EmodNet, developing web-based viewers and maintaining permanent servers and services along the time. This effort will result in a better reusing of data and information obtained and benefiting of wide community of final users.

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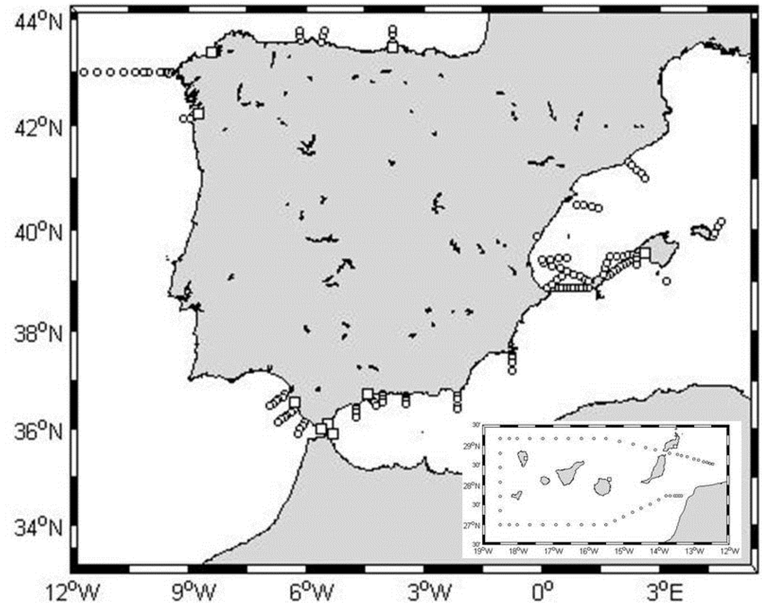
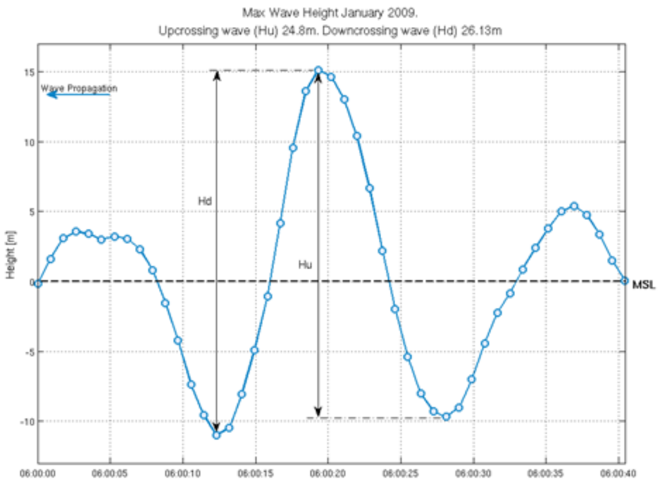
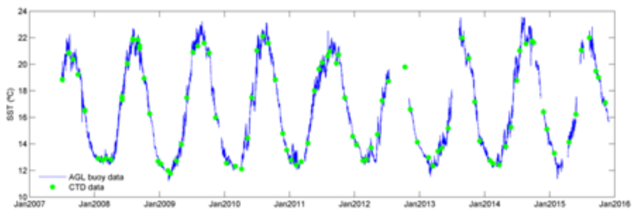


Figure 1. IEO tide-gauge network (squares) and oceanographic stations (dots) from the IEO Hydrographic Monitoring Sections. AGL buoy is close to the most external station of the Santander Hydrographic Section


Max Wave Height January 2009.
Upcrossing wave (Hu) 24.8m. Downcrossing wave (Hd) 26.13m
Wave Propagation
Hd
Hu
MSL
Height [m]
06:00:00
06:00:05
06:00:10
06:00:15
06:00:20
06:00:25
06:00:30
06:00:35
06:00:40


SST (ºC)
AGL buoy data
CTD data
Jan2007
Jan2008
Jan2009
Jan2010
Jan2011
Jan2012
Jan2013
Jan2014
Jan2015
Jan2016

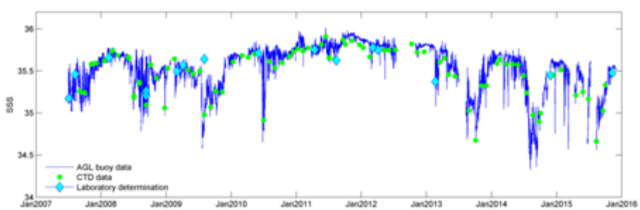

SSS
AGL buoy data
CTD data
Laboratory determination
Jan2007
Jan2008
Jan2009
Jan2010
Jan2011
Jan2012
Jan2013
Jan2014
Jan2015
Jan2016

Figure 2. Big wave recorded by the AGL buoy (above) and timeseries (below) for continuous temperature and salinity recorded at buoy, and data obtained by systematic CTD and water bottle samples taken at the Santander hydrographic section.

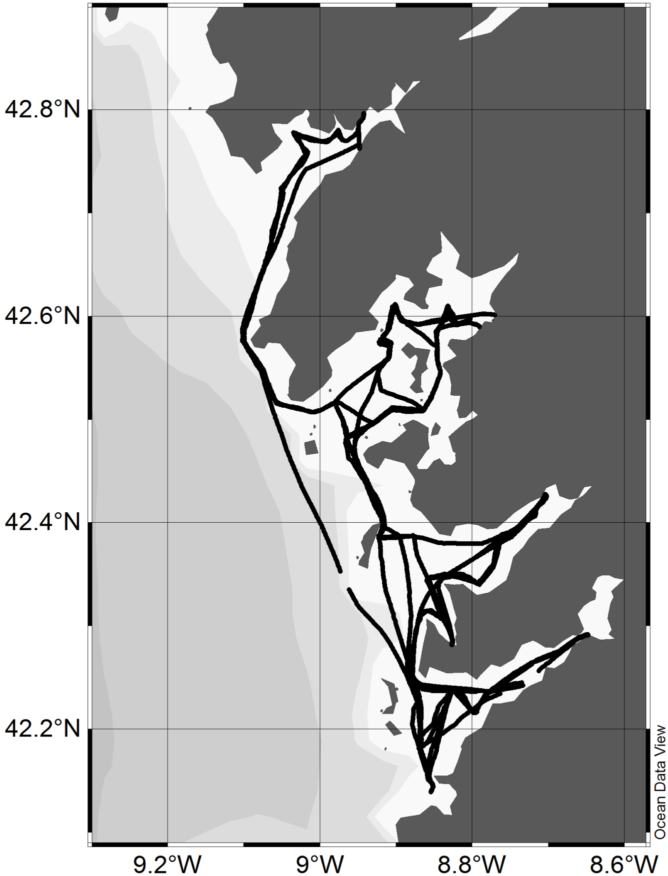


Figure 3. Weekly repeated tracks of the R/V Navaz during December 2015

Table 1. Summary of the different hydrographical sections programmes carried out by the IEO and their contributions to international iniciatives

Program	Begin	No	Geographical Area	Contributing Programs
Radiales	1990	16	Cantabrian Sea and NW Coast	EmodNet
RadMed	1992	85	Western Mediterranean, Alboran Sea, Balearic Islands	EmodNet, MonGOOS
RadProf	2003	24	NW Iberian basin, Galician Bank	EmodNet, ICES/WGOH
RaProCan	2006	50	Canarian basin	EmodNet
STOCA	2009	16	Gulf of Cadiz	EmodNet

MonGOOS: Mediterranean Operational Network for the Global Observing System is part of EuroGOOS. ICES/WGOH: ICES Working Group on Oceanic Oceanography