SALA DE PREMSA
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The ICM offers 9 PhD positions to train the next generation of researchers in marine sciences

The Institut de Ciències del Mar (ICM) aims to train the next generation of researchers in marine sciences to build the future we imagine for our oceans. This year, 9 PhD fellowships will be funded by the Spanish Ministry of Science and Innovation through a predoctoral call ('Ayudas para contratos predoctorales para la formación de doctores 2021).

Candidates should be admitted to a doctoral programme for the academic year 2021/2022 at the time of the beginning of the scholarship (estimated in spring 2022). Besides, they must have a strong commitment to scientific research and have not yet been awarded a doctoral degree.

Interested candidates can only apply to one of the following projects, and it is highly recommended that they contact the researcher in charge before submitting the application:

- **Using a network of no-take marine reserves in deep-sea waters to recover and manage highly impacted ecosystems** (PI: Joan Navarro)

- **Future climate change scenarios and marine zooplankton: Synergistic effects of temperature and nutrient deficiencies on long-term adapted populations** (PI: Albert Calbet & Enric Saiz)

- **Distribution and dynamics of Phytoplankton Functional Types in the North-Western Mediterranean through hyperspectral remote sensing** (PI: Elisa Berdalet & Marco Talone)

- **Monitoring the Arctic sea ice and water distribution changes with Remote Sensing data** (PI: Carolina Gabarró, Marta Umbert & Martí Galí)

- **Effect of phytoplankton composition and turbulence on DOM degradation in marine coastal systems** (PI: Maria Montserrat Sala and Francesc Peters)

- **Fostering the capacity of marine ecosystem models to project the cumulative effects of global change and plausible future oceans** (PI: Marta Coll ICM-CSIC, Jose Mª Bellido IEO-Murcia & Xavier Barber UMH, Elche)

- **Holistic approach for the study of reproduction in fish: the omics challenge** (PI**:** Mercedes Blázquez & Eva Calvo)

- **Impact of ICE-sheet retreat and geological controls on Fluid fLow dynAMics of the antarctic pEninsula continental margin (ICEFLAME) (**PI: Roger Urgeles & Ricardo León Buendia)

- **Use of submarine telecommunication cables and passive seismic stations for seafloor observation and monitoring of natural hazards (**PI: Rafel Bartolomé & Arantza Ugalde)

PhD fellows at ICM will receive a 4-year contract with a gross annual salary of 16,250€ for each of the first two annuities; 17,410 for the third annuity; and 21,760 for the fourth annuity, apart from an additional grant of 6,860€ for mobility and training for the 4-year period.

The ICM encourages applications from highly motivated graduates from all over the world who wish to undertake a doctoral degree in marine sciences. Successful candidates will join research groups headed by top-level scientists and will carry out their research in cutting-edge fields of marine sciences in a stimulating environment.

Applications will open the **28th October to the 11th of November 2021** through the following link. We encourage future applicants to contact the Principal Investigators of the advertised offers.

About ICM

The ICM is the fourth largest research institute of the Spanish National Research Council (CSIC) and the largest dedicated to marine research. ICM researchers study most broadly marine topics and the global ocean as a whole. Under the motto "Ocean Science for a Healthy Planet", the ICM conducts frontier research and foster both knowledge and technology transfer on topics related to ocean and climate interactions, conservation and sustainable use of marine life and ecosystems, and impact mitigation of natural and anthropogenic hazards.

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Title: Using a network of no-take marine reserves in deep-sea waters to recover and manage highly impacted ecosystems.

PhD supervisor: Joan Navarro

Summary:

Fishing activity is one of the main drivers of ecosystem change in the Mediterranean Sea. The use of high impact fishing-gears has led to overexploitation of many populations of marine resources and a global impact on the ecosystem structure. A potential management option to preserve these ecosystem services is the implementation of no-take marine reserves where no fishing activity is allowed. These marine reserves would act as recovery areas for fragile benthic fauna and the restoration of the seabed structure and its functionality. Marine reserves would also favour the recovery of highly-exploited marine resources inside and adjacent habitats by acting as sources of larvae and adults (spillover effect), thus, supporting local and regional fisheries. In this PhD project, the student, helped with the highly interdisciplinary research team of the coordinated project BITER, will to evaluate the usefulness of a network of no-take marine reserves to recover commercially-important demersal fishery stocks and habitats. Specifically, he/she will answer two main questions: (1) Is the use of a network of deep-sea marine reserves a solution to recover highly exploited benthic habitats and help sustainable exploitation of target fisheries in the Mediterranean Sea? and (2) Is it possible to use less-footprint and non-invasive technological methods to monitor the recovery of fishing-impacted marine ecosystems? To answer these questions, the student will learn the use of different methodologies related to fishery-ecology management, connectivity models, and robotic applications. The PhD student will participate in the planning and execution of the campaigns and the laboratory work, will have access to the data and samples of the project, and to the use of data processing computer programs and databases. Possibilities for further training will be provided through different research stages. The training objective is that at the end of the PhD Thesis (in the University of Barcelona), they will have a minimum of four/five papers published as first author in Q1 journals, valuing above all their good predisposition and scientific and human integration.

Requirements: Bachelor in Biology, Marine Sciences, Environmental Sciences or similar. Fluent English. Interest and some experience in Marine Ecology studies are desirable.

Contact people: Joan Navarro, ICM-CSIC, joan@icm.csic.es

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Thesis thematic: Future climate change scenarios and marine zooplankton: Synergistic effects of temperature and nutrient deficiencies on long-term adapted populations

PhD supervisor: Albert Calbet & Enric Saiz

Summary:

Microzooplankton (mostly unicellular organisms, such as ciliates and dinoflagellates) are key components of the marine pelagic food webs because of their role as the main link between primary production and higher trophic level consumers.

The progressive sea temperature increase, a consequence of the rise in atmospheric CO2 of anthropogenic sources, might be the major climate change driven factor directly affecting microzooplankton. The temperature may also affect microzooplankton by altering the nutritional status of their prey, because of the expected higher stratification and nutrient depletion in the photic layer. Given the important roles of microzooplankton, there is a mounting interest in the study of these climate change variables on them, as they may result in profound effects on the biogeochemical cycles and functioning of the entire marine system. Traditionally, the effects of temperature on marine organisms have been widely studied; however, most of the research to date has focused on short-term responses and did not properly address long-term exposures that allow phenotypic and genotypic multigenerational adaptations. Therefore, in this proposal, we aim to evaluate the physiological and biochemical effects of temperature on protozoans under scenarios of long-term temperature adaptation. Particularly, we will focus on the feeding, growth, and reproductive performance of multigenerationally adapted populations of marine protozoans under the different warming scenarios.

We are seeking for a highly motivated candidate with a very good academic record and fluent in English. Only candidates with degrees in biological sciences or related disciplines will be considered.

Contact people:
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Title: Distribution and dynamics of Phytoplankton Functional Types in the North-Western Mediterranean through hyperspectral remote sensing

PhD supervisors: Elisa Berdalet & Marco Talone

Summary: Phytoplankton distribution is commonly used as indicator of the primary production, the trophic state of the ecosystems, and biogeochemical processes in the oceans. Optical remote sensing is a useful tool for monitoring both the concentration and distribution of phytoplankton. As a first-order approximation, phytoplankton biomass is generally estimated as a function of chlorophyll-a concentration, in turn retrieved based on multispectral measurements of the sea surface water-leaving radiance.

In the last decade, the interest of the scientific community progressed from the general picture of phytoplankton bulk biomass, to the study of the distribution of the so-called Phytoplankton Functional Types (PFT), i.e., groups of phytoplankton species aggregated according to a specific "functional" characteristic. The increasing quality of the optical measurements, in fact, permits to distinguish the spectral signature of specific PFTs, and so to estimate their distribution. Further developments are expected thanks to the availability of hyperspectral satellite measurements, as those currently provided by ASI's PRISMA or the future NASA's PACE and ESA's CHIME missions.

Within this context, the proposed PhD is a contribution to the study of the distribution and dynamics of PFTs in the North-Western Mediterranean Sea. **Its main objective will be the development of retrieval algorithms for the estimation of PFTs concentrations optimized for the NW Mediterranean, based on concurrent in-situ radiometric and biological measurements and extensible to satellite observations**.

The selected candidate will benefit from ICM's long-time and recognized expertise on the *in situ* characterization of PFTs in the area, and at the same time, from the recent availability of both *in situ* and space-born hyperspectral measurements. The PhD will be developed within the ICM's Remote Sensing and Ocean Health and Plankton Ecology groups, counting on already planned field campaigns, robust international collaborations, and the availability of cutting-edge instrumentation (e.g., optical sensors, UPLC, computational power, etc..).

Contact people:

Elisa Berdalet berdalet@icm.csic.es

Marcol Talone talone@icm.csic.es

Title: Monitoring the Arctic sea ice and water distribution changes with Remote Sensing data

PhD supervisors: Carolina Gabarró Prats, Martí Galí, Marta Umbert

Summary: The Arctic ocean is under profound transformation. Increasing temperatures have resulted in reduced sea ice extent and thinning. Freshwater content is increasing in some regions due to glacier and sea ice melting and enhanced river discharges. Current climate models are limited in representing and predicting key processes of the changing Arctic Ocean, mainly due to the lack of continuous observations. **The proposed PhD project focuses on using satellite data to monitor Arctic sea ice and freshwater content by deriving new emissivity models and by studying Arctic freshwater content.**

The SMOS mission, launched by the European Space Agency (ESA) in 2009, carries an L-band (1.4 GHz) radiometer that measures thin sea ice thickness (SIT) (less than 0.7 m) and sea surface salinity (SSS) from space. The recent Arctic-drift campaign known as MOSAiC offered a unique opportunity to get in situ radiometric data over one year on the ice. These measurements will enable us to **study the sensitivity of radiometric measurements to different characteristics and types of ice and snow surfaces, as well as to derive new improved emissivity models at 1.4 GHz**, thus significantly improving the quality of the SMOS SIT products.

The second complementary component of the proposed thesis research aims to **study the changes in the Arctic freshwater distribution, mainly due to ice melt and increased river discharges**. This analysis will be focused on the Beaufort Sea.

An algorithm to discriminate different surface water types (seawater, sea ice melt water, and river water) will be developed to produce water classification maps. In addition, we will compute the freshwater content (FWC) of the Beaufort Gyre and study the trends of salinity and FWC during the available 10 years of SMOS data. Several remotely sensed variables will be used: SSS from SMOS and SMAP, sea surface temperature, sea surface height, light absorption coefficient of colored dissolved organic matter from Aqua/Terra and Sentinel 2/3.This PhD project will involve in-situ and remote sensing data, process studies, and modeling approaches to help better understand and forecast the changing Arctic.

Contact people:

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Project: DOGMA. The role of ocean plankton ecology in the remineralization, degradation and fate of organic matter.

Title: Effect of phytoplankton composition and turbulence on DOM degradation in marine coastal systems

PhD supervisors: Maria Montserrat Sala and Francesc Peters

Understanding the role of biotic and abiotic factors in regulating the decomposition rates of organic matter (OM) in marine ecosystems has become one of the top priorities in ocean biogeochemistry. The topic has generated enormous interest in recent years due to the assumed role of plankton in driving organic carbon fluxes in the ocean. However, the mechanisms that regulate the link between OM degradation and turbulence remain poorly understood. To advance in this field, the objective of this thesis will be to examine the controls that prokaryotic activity and composition and turbulence exert on the degradation of organic matter originated from different phytoplankton species. The thesis will specifically address 1) the response of heterotrophic prokaryotic communities to the addition of exudates of cultured phytoplankton species, using genomics and metatranscriptomics, and 2) the role of turbulence in the prokaryotic degradation of DOM.

The knowledge obtained in this thesis will be key to better understand the carbon cycle in the ocean specially in a climate change scenario that will favor certain types of plankton communities.

Within the project the student will use a multidisciplinary approach including expertise in biogeochemistry, microbiology and physical-biological interactions and apply state of the art methodologies. The student will be trained in biochemical and molecular techniques within the group Ecology of Marine Microbes, and will be complemented by that of the collaborators in other institutions through 3-months placements in France and Sweden.

Depending on the needs of the student, he will be invited to assist to specific courses and also to enroll on oceanographic cruises or join experiments, at the ICM or other institutions within our broad network of international contacts.

Requirements:

1) A Master degree in molecular biology, biotechnology, chemistry or environmental or marine sciences.

2) Very good English level

3) Very good academic record

4) Availability to travel

Contact:

Maria Montserrat Sala: msala@icm.csic.es

Francesc Peters: cesc@icm.csic.es

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Fostering the capacity of marine ecosystem models to project the cumulative effects of global change and plausible future oceans

PhD supervisors: Marta Coll (ICM-CSIC), Jose Mª Bellido (IEO-Murcia) and Xavier Barber (UMH, Elche)

Summary

The ocean is probably the global social-ecological system whose ecological, socioeconomic and institutional settings are changing at the fastest pace due to Global Environmental Change (GEC). Despite advances in ecological modeling to describe past and future ocean dynamics, the available Marine Ecosystem Models (MEM) have still some limitations in terms of their usefulness to evaluate the cumulative impacts of environmental change on marine species distributions and projections. To move forward, the capabilities of state-of-the-art MEMs need to be reinforced in three main fronts that we will pilot under the new project ProOceans, i.e. model development, model validation and model applicability.

This PhD project aims to advance the capacity of marine ecosystem models (MEMs) to forecast future scenarios of global change by improving the mechanisms used to capture key ecological processes such as species distributions, ecological relationships, evolutionary capacity and ecosystem changes.

Main tasks to carry out along this PhD project are the following:

- Improve the capacity to project species distributions under GEC. We will move beyond the state-of-the-art methods to pioneer the inclusion of species adaptation as well as additional environmental drivers of change. We will code and execute these approaches into the ecosystem context by combining statistical analyses and food web modelling.

- Improve MEM validation and uncertainty assessments. To constrain and quantify the validity of its results, the resulting MEM will be subjected to various validation analyses to compare spatiotemporal outputs with available observations. Recent statistical approaches and new methods from statistical modelling procedures will be applied to improve this capability. Bayesian uncertainty quantification will be an intrinsic part of each modelling components.

- Run and analyze future scenarios of global change. Current efforts towards the development of comprehensive socio-economic future scenarios for marine ecosystems are still in an initial phase. We will contribute to these efforts while testing scenarios of sustainability pathways to propose cost-effective ways to optimize synergies and mitigate trade-offs.

The PhD student of ProOceans will join the Statistics, Optimization and Applied Mathematics PhD program of University Miguel Hernandez in Elche (Mathematics Department) or similar. The supervision of the student will be multidisciplinary (from the fields of applied mathematics

and statistics, marine ecosystem modelling and marine ecology) and will participate in several training activities to acquire the right capabilities to develop the work successfully.

We are seeking for a highly motivated candidate with a very good academic record and fluent in English. Candidates with degrees from the fields of applied mathematics and statistics are invited to apply.

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Holistic approach for the study of reproduction in fish: the omics challenge

PhD supervisors: Mercedes Blázquez and Eva Calvo (ICM-CSIC)

The improvement of reproductive performance and the control of puberty are main challenges of reproduction in aquaculture. The target is focused on the initial stages of gametogenesis, specifically the early events happening before meiosis, when the number of germ cells can be modified. An alternative to modify the number of germ cells could be to arrest the process at initial stages, avoiding undesired events like precocious maturation. The European sea bass and the zebrafish are fish models that ensure the availability of basic knowledge of these events and the possibility to increase the genetic, analytic and immunological tools for the research. The **main objective** of this PhD thesis is to study the mechanisms involved in the onset of gonad maturation in fish. The **goal** is to reveal target genes and generate new knowledge of basic regulatory mechanisms that could be used to increase fertility in fish.

The PhD project will include a transcriptomic study of the complete gonad and of isolated cell types. It will use a holistic approach that incorporates the spatial dimension into the omic studies with the promising technology of spatial transcriptomics. The effect of water acidification, global warming, exposure to synthetic progestagens and other contaminants of anthropogenic origin will be evaluated, increasing synergies within different research groups in the field. The student will develop an array of molecular and cell biology tools, including different techniques for gene and protein expression analysis (qPCR, RNA-sequencing, in situ hybridisation, and immunohistochemistry), cell and organ cultures, and the analysis of epigenetic markers among others. This will allow to discover molecular biomarkers that can be used to identify germ cells at initial stages (before the onset of meiosis) and evaluate the effects of the exposure to pollutants on their reproductive success. The student will have further training provided through different research stages in international research centres.

We are seeking for a highly motivated candidate with a very good academic record and fluent in English. In addition, a master degree in molecular biology, biotechnology or environmental marine sciences is also a requirement. Background in molecular and

cell biology, systems biology and bioinformatics will be considered. Knowledge in Bioconductor/R environment and matlab software will be an asset.

Contact: Mercedes Blázquez blazquez@icm.csic.es and Eva Calvo ecalvo@icm.csic.es

Project: impact of ICE-sheet retreat and geological controls on Fluid fLow dynAMics of the antarctic pEninsula continental margin (ICEFLAME) – PID2020-114856RB-100

Thesis:

Fluid flowdynamics in the Antarctic Pensinsula continental margin: sources, traps, seeps and related geohazards.

PhD Supervisors: Roger Urgeles (ICM, CSIC) Ricardo León (IGME, CSIC)

Rationale: Multiple processes cause fluids to migrate in sedimentary basins and reach the seafloor. Most often these occur in the form of diffusive flow induced by sediment consolidation and controlled by sediment permeability. However, in some instances fluids are focused in faults, natural pipes and chimneys with fluids expelled at pockmarks, craters and/or mud mounds. Fluids that escape in focused fluid flow systems are often rich in methane (CH4) and other light hydrocarbons. Among the large CH4 carbon reservoirs that naturally interact with the ocean-atmosphere system, gas hydrates have special relevance. They are susceptible to dissociation and dissolution by key perturbations associated with global warming, namely relative changes in sea level (pressure) and increase in ocean temperatures. Polar regions that have lost a significant mass of their ice sheets since the Last Glacial Maximum are experiencing remarkable isostatic rebound and hydrate reservoirs in these areas are therefore potentially not in equilibrium. Gas hydrates have an influence on benthic ecosystems and can induce alterations in the stress-state of marine sediments resulting in major slope failures. Since methane is an effective greenhouse gas, gas hydrates have also strong feedback potential with climate change.

The thesis will address how fluid flow and gas hydrates of the Antarctic Peninsula margin respond to changes in temperature and pressure associated with Holocene to present changes in uplift rates from isostatic rebound, sedimentation pulses and temperature of bottom water masses. The thesis will provide better understanding of the hydrocarbon play of the Antarctic Peninsula: How hydrocarbon charged fluids migrate in the subsurface and are trapped in gas hydrates or emitted to the water column. Additionally, the thesis will address how the stress-state of marine sediments evolves and affects the stability of the seafloor.

The student will use a multidisciplinary approach involving the disciplines of geophysics, geochemistry, sedimentology and soil-mechanics. The student will apply state of the art methodologies such as swath bathymetry, seismic reflection and electromagnetic data. The student will use analytical techniques to determine sediment mineralogical composition and physical properties as well as the

geochemistry of interstitial waters and the water column. The student will be invited to assist specific courses, enroll in oceanographic cruises and perform experiments at ICM, IGME and other institutions within the network of project partners.

Requirements: We are seeking for an English-fluent, highly motivated candidate with a very good academic record. A master degree in the fields of Engineering Geology, Environmental Sciences, Geology or Geophysics is required. Coding/programming skills will be an asset. Candidates should be admitted to a doctoral programme for the academic year 2021/2022 at the time of the beginning of the scholarship (estimated in spring 2022). Besides, they must have not yet been awarded a doctoral degree.

Funding: The contract is funded under the FPI grant scheme of the Spanish Ministerio de Ciencia

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Project: Use of submarine telecommunication cables and passive seismic stations for seafloor observation and monitoring of natural hazards

PhD Supervisors: Rafel Bartolomé & Arantza Ugalde

Two hypotheses have been proposed for the origin of the volcanism, the most noticeable natural hazard, in the Canary Archipelago: a mantle plume and a propagating fracture related to the nearby Atlas mountains. To discard one of them, regional images of the crust and mantle obtained using ocean bottom seismometers (OBS) and land stations are essential. In addition to this, a new emergent technology named distributed acoustic sensing (DAS), which converts the existing submarine telecommunication of fiber-optic cables into an array of thousands of dynamic strainmeters, can provide information on seismicity, subsurface structure, mass movements, marine currents, and noise in the ocean with unprecedented resolution at minimal cost. This technology is still in its infancy for marine applications, but will probably revolutionize sea-floor observation in the coming future. A DAS interrogator generates large amounts of data (on the order of 1TB per day when recording at high frequency). As a result, current studies consist mainly of proof-of concept or involve very short recording times (days or hours). The objective of this Ph.D. fellowship proposal is to develop methodologies for detecting local and distant earthquakes, ocean currents, marine mammals and other phenomena, connecting large volumes of data, automating and standardizing their seismic processing, and providing real-time observations. Using the final data and models, the Ph.D. student will allow improving the seismo-volcanic monitoring in the region, the understanding of the geodynamic processes taking place in the Canary Islands and the underlying causes of the geological risks (earthquakes and volcanoes). This would also result in an improved seismic hazard map of the area where most of the population and critical infrastructures are located, having an impact on the society of the Canary Islands.

The training program of the Ph.D. student will be structured in three phases:

Phase 1: Technical training (months 1-12). The student will learn the theory and fundamentals of the different methods to be applied in the thesis. Seismic phase picking and event classification using Machine Learning codes and algorithms will be tested with data from seismic land stations, OBSs, and DAS experiments. This part of the training will be supervised by AU and the seismological training for the use of seismic reflection processing algorithms to the DAS data will be done by RB.

Phase 2: Data acquisition, processing and modeling (months 12-36). This phase will begin with the participation of the student in the oceanographic cruise to deploy and recover the OBSs in the Canary Islands (IP: RB). This would provide unique practical

training on marine seismic data acquisition in an international environment. The student will do a 3-month stay at ETH Zürich under the supervision of Prof. Andreas Fichtner to learn state-of-the-art techniques for analyzing DAS data.

Phase 3: Interpretation and writing of scientific articles (months 36-48). The modeling results obtained in phase 2 will be presented at international meetings (EGU and AGU) and published in 2-3 Q1 SCI journals. Early in this phase, the student will do another 3-month stay at Geomar (Prof. Ingo Grevemeyer, Kiel, Germany) to learn applications of marine seismic data to oceanographic and climate change problems. The Faculty of Earth Sciences of the University of Barcelona (UB) has doctoral programs in Earth Sciences and Marine Sciences that would be suitable for carrying out the Ph.D. studies. RB is an associated professor of the UB Master "Reservoir geology and geophysics" since 2017. This will give supplementary advice on doctoral courses and programs to the Ph.D. student.

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