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**1.1 Executive Summary**

The Millennium Institute of Oceanography (**IMO, Instituto Milenio de Oceanografía**) is a center of excellence established at the end of 2013 with the aim of studying and exploring the open and deep ocean. The host institutions are Universidad de Concepción, in Concepción, and the Pontificia Universidad Católica de Chile, in Santiago; they concentrate 7 of the 8 associate (principal) researchers. One of the associate researchers is from Pontificia Universidad Católica de Valparaíso, in Valparaíso. IMO has also 1 senior researcher, 9 adjunct researchers and 4 young researchers.

IMO’s mission is: *i*) to conduct pioneering and interdisciplinary research in oceanography, addressing scientific problems in an integrative and collaborative manner; *ii*) to develop and apply new technologies and platforms for observational and experimental work in the ocean, including the use of the new Chilean research vessel *Cabo de Hornos*, and to reach unexplored areas of the South Pacific; *iii*) to increase human resources in ocean sciences in Chile and South America, through higher education and training in research based on direct observation and experimentation in the sea, and by attracting ocean scientists from all over the world to work in Chile; and *iv*) to inform and create awareness among the general public and decision-makers about the importance of the ocean, its conservation and its relationship to humans and global change.

IMO has four initial research lines: Mesoscale Processes, Ocean Variability, Adaptations to a Changing Ocean, and The Deep Ocean. Their objectives are: to characterize physical mesoscale (and sub-mesoscale) structures and processes in the eastern South Pacific Ocean (ESP) and their impact on open-ocean and transitional (coast-ocean) ecosystems; to determine how large-scale perturbations impact the transport and gradients in physical-chemical water properties and the dynamics of the ESP; to gain new understanding about the adaptations of key planktonic groups to chemical changes taking place in the ocean (e.g., acidification, deoxygenation, desertification) and the impact of such changes on biogeochemical cycling; and to explore the pelagic environment of the deep and ultra-deep ocean, respectively.

For Research Line 1, activities concentrated on an oceanographic cruise to characterize a frontal and eddy-formation area off central Chile, analyzing field and satellite data, and modeling work. For Research Line 2, work focused on the analysis of existing data sets of previous oceanographic expeditions having large spatial coverage in the South Pacific basin, along with satellite data for recent years, and modeling work. For Research Line 3, the effort was on implementing the analytical capacity to measure the carbonate system, installing a micro/mesocosm facility, consolidating a Chilean collection of micro- and macroalgae, participating in an international expedition, and analyzing and interpreting previously collected observations and experimental data. For Research Line 4, efforts went on acquiring and constructing sampling equipment that can be used under the high pressures found in the deep ocean.

IMO’s 8 associate researchers published 28 ISI articles, one SCIELO article and two book chapters. The other researchers published 9 additional ISI articles. Because it was IMO´s first year, only 9 of the total publications had the IMO affiliation. The publication list thus reflects, principally, work carried out before the existence of the Institute.

In terms of graduate education and postdoctoral training, IMO researchers were involved in regular teaching and student guidance associated with 6 graduate programs. A total of 13 M.Sc., 9 Ph.D. students and 5 postdocs were directly linked to IMO activities. The latter were already linked to IMO researchers, and one of them was fully supported by IMO towards the end of 2014. Three of the M.Sc. students went for doctoral studies in 2014, two of which continue to be linked to IMO. In addition, 6 students (undergraduate and graduate) were co-tutored by IMO researchers. Additionally, IMO researchers trained 8 undergraduate students. IMO was also strongly involved in advanced training for undergraduate and graduate students, as well as postdocs and young researchers, through one specialized course in 2014, with theoretical and practical activities, the 1st Latin America Workshop on Ocean Acidification.

During 2014, networking activities include the creation of the “Latin-American Ocean Acidification Network (LAOCA Network), involving researchers working in ocean acidification and carbon chemistry in Latin-America, and active participation in the Conference of Parties (*20th Conference of Parties of the UNFCCC*, *United Nation Framework Convention for Climate Change, COP20*)*.* IMO researchers also participated in a joint workshop with the Millennium Nucleus of Ecology and Sustainable Management of Oceanic Islands (ESMOI) to coordinate research activities and scientific meetings associated with the study of oceanic-island environments in the South Pacific. Moreover, Ruben Escribano was appointed as a new member of the Scientific Steering Committee of the International Program Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Wolfgang Schneider was appointed as a new member of the Climate and Ocean: Variability, Predictability and Change (CLIVAR) Pacific Panel. Additionally, Cristian A. Vargas was nominated as members of the *Technical Advisory Group on Climate Change*, from the *Subsecretaría de Pesca y Acuicultura* (GTA). The challenge is to create an Adaptation Plan to contribute to mitigating the effects of climate change on resources, fishing communities and aquaculture, which contribute to the local policy in Chile.

IMO established a dedicated outreach team led by Pablo Rosemblatt, a highly respected professional in the area of scientific communication. IMO´s first-year outreach activities focused primarily on generating long-term strategies that will allow to bring marine scientific knowledge to the society in general and, particularly, to school communities. They included: sustained institutional visibility, broadcasting of audiovisual products, public seminars to leaders and stakeholders, and intensive science workshops for school children. Moreover, IMO developed a tight collaboration with the “Centro Interactivo de Ciencias, Artes y Tecnologías” (CICAT; Interactive Center of Sciences, Arts and Technologies), of Universidad de Concepción. Within this collaboration, IMO researchers and students participated in the Science Camp ChileVA!, organized by CICAT in the Biobío region, to which students were trandergradute nts tion articles. the 8 associate rese Hornos ~150 high-school students attended.

* 1. **Resumen Ejecutivo**

El Instituto Milenio de Oceanografía (IMO) es un centro de excelencia establecido a finales de 2013 con el objetivo de estudiar y explorar el océano abierto y profundo. Las instituciones albergantes son la Universidad de Concepción, en Concepción y la Pontificia Universidad Católica de Chile, en Santiago, las cuales concentran 7 de los 8 investigadores asociados (principales). El otro investigador asociado es de la Pontificia Universidad Católica de Valparaíso, en Valparaíso. IMO tiene también 1 investigador sénior, 9 investigadores adjuntos y 4 jóvenes investigadores.

La misión del IMO es: *i*) llevar a cabo investigación de punta e interdisciplinaria en oceanografía, abordando problemas científicos de una manera integrativa y colaborativa; *ii*) desarrollar y aplicar nuevas tecnologías y plataformas para el trabajo observacional y experimental en el océano, incluyendo el uso del nuevo buque chileno de investigación *Cabo de Hornos*, y para llegar a zonas inexploradas del Pacífico Sur; *iii*) aumentar los recursos humanos en ciencias del mar en Chile y Sudamérica, a través de la educación superior y la formación en investigación basada en la observación directa y la experimentación en el mar, y mediante la atracción de científicos marinos de todo el mundo para trabajar en Chile; y *iv*) informar y crear conciencia entre el público general y los responsables de la toma de decisiones sobre la importancia de los océanos, su conservación y su relación con los seres humanos y el cambio global.

El IMO tiene cuatro líneas de investigación iniciales: Procesos de Mesoescala, Variabilidad del Océano, Adaptaciones a un Océano Cambiante, y el Océano Profundo. Sus objetivos son –respectivamente-: caracterizar estructuras físicas y procesos de mesoescala (y sub-mesoescala) en el Océano Pacífico Sudorienta (PSO) y determinar su impacto en ecosistemas de alta mar y de transición (costa-océano); determinar cómo las perturbaciones a gran escala afectan el transporte y los gradientes en las propiedades físico-químicas del agua y en la dinámica del PSO; obtener un nuevo entendimiento acerca de las adaptaciones de grupos planctónicos claves a los cambios químicos que tienen lugar en el océano (por ejemplo, la acidificación, la desoxigenación, la desertificación) y el impacto de estos cambios en los ciclos biogeoquímicos; y explorar el ambiente pelágico de aguas profundas y ultra-profundas del océano.

Para Línea de Investigación 1, las actividades se concentraron en una campaña oceanográfica para caracterizar un área de frentes y la formación de remolinos frente a Chile central, el análisis de datos de terreno y de satélite, y trabajo de modelamiento. Para Línea de Investigación 2, el trabajo se centró en el análisis de conjuntos de datos existentes de expediciones oceanográficas anteriores que tienen gran cobertura espacial en la cuenca del Pacífico Sur, junto con los datos de satélite para los últimos años, y en trabajo de modelamiento. Para Línea de Investigación 3, el esfuerzo fue en la implementación de la capacidad analítica para medir el sistema de carbonato, la instalación de un centro de micro / mesocosmos, consolidar una colección chilena de micro y macroalgas, participar en una expedición internacional, y en el análisis e interpretación de observaciones recogidas anteriormente y de datos experimentales. Para Línea de Investigación 4, los esfuerzos fueron en la adquisición y construcción de equipos de muestreo que se pueda utilizar bajo las altas presiones que se encuentran en las profundidades del océano.

Los 8 investigadores asociados de IMO publicaron 28 artículos ISI, un artículo SCIELO y dos capítulos de libros. Los otros investigadores publicaron 9 artículos ISI adicionales. Debido a que fue el primer año de IMO, sólo 9 de l total de publicaciones tuvieron afiliación al IMO. Así, la lista de publicaciones refleja, principalmente, el trabajo llevado a cabo antes de la existencia del Instituto.

En cuanto a la educación de postgrado y formación postdoctoral, los investigadores IMO estuvieron involucrados en la enseñanza regular y guía de estudiantes de 6 programas de posgrado. Un total de 13 estudiantes de Magister, 9 estudiantes de doctorado y 5 postdoctorados estuvieron directamente relacionados con las actividades del IMO. Estos últimos ya estaban previamente vinculados a los investigadores del IMO; uno de ellos fue apoyado plenamente por la IMO hacia fines de 2014. Tres de los estudiantes de Magister continuaron con estudios de doctorado en 2014, dos de los cuales siguieron vinculados al IMO. Además, 6 estudiantes (pregrado y posgrado) fueron en co-tutela de investigadores del IMO. Además, los investigadores del IMO entrenaron a 8 estudiantes de pregrado. El IMO también participó activamente en la formación avanzada de estudiantes de pregrado y postgrado, así como investigadores postdoctorales y jóvenes investigadores, a través de un curso de especialización en el 2014, con actividades teóricas y prácticas, el 1er Taller Latinoamericano sobre Acidificación de los Océanos.

Durante 2014, las actividades de red incluyeron la creación de la "Red Latinoamericana-acidificación del océano (LAOCA Red) -con participación de investigadores que trabajan en la acidificación del océano y de la química del carbono en América Latina-, y la participación activa en la Conferencia de las Partes (20ª Conferencia de las Partes de la CMNUCC, la Convención Marco de las Naciones Unidas para el Cambio Climático, COP20). Investigadores del IMO también participaron en un taller conjunto con el Núcleo Milenio de Ecología y Manejo Sostenible de las islas oceánicas (ESMOI) para coordinar actividades de investigación y reuniones científicas relacionadas con el estudio de los ambientes de islas oceánicas en el Pacífico Sur. Por otra parte, Rubén Escribano fue nombrado como nuevo miembro del Comité Directivo Científico del Programa Internacional Integrado de Biogeoquímica Marina y de Investigación de Ecosistemas (IMBER), Wolfgang Schneider fue nombrado como nuevo miembro del Panel Océano y Clima: Variabilidad, Predictibilidad y Cambio (CLIVAR ), Grupo Pacífico. Adicionalmente, Cristian A. Vargas fue nominado como miembros del Grupo Técnico Asesor sobre el Cambio Climático, de la Subsecretaría de Pesca y Acuicultura (GTA). El desafío es crear un plan de adaptación para contribuir a la mitigación de los efectos del cambio climático sobre los recursos, las comunidades pesqueras y la acuicultura, que contribuyan a la política local en Chile.

El IMO estableció un equipo dedicado para la extensión, dirigido por Pablo Rosemblatt, un profesional muy respetado en el ámbito de la comunicación científica. Las actividades de extensión del primer año se centraron principalmente en la generación de estrategias a largo plazo que permitan acercar el conocimiento científico marino a la sociedad en general y, particularmente, a las comunidades escolares, entre ellas: una visibilidad sostenida institucional, la difusión de productos audiovisuales, seminarios públicos a líderes de opinión y grupos de interés, y talleres de ciencia intensivos para niños en edad escolar. Por otra parte, el IMO desarrolló una estrecha colaboración con el "Centro Interactivo de Ciencias, Artes y Tecnologías" (CICAT), de la Universidad de Concepción. Dentro de esta colaboración, investigadores y estudiantes del IMO participaron en el Campamento de Ciencias de Chile VA!, organizado por CICAT en la región del Biobío, a la que asistieron ~150 estudiantes de secundaria.

**2.- Introduction**

**a) Description of the Institute:**

The Millennium Institute of Oceanography (**IMO, Instituto Milenio de Oceanografía**) is a center of excellence established at the end of 2013 with the aim of studying and exploring the open and deep ocean. Its vision is to become an internationally recognized institute in oceanographic research and education, leading exploration in the central and eastern area of the South Pacific Ocean, with impact on the country and society in general. IMO´s commitment is to provide an intellectually stimulating environment for the production and dissemination of scientific knowledge that generates new understanding about the ocean, from a creative, daring and collaborative perspective.

IMO’s mission is: *i*) to conduct pioneering and interdisciplinary research in oceanography, addressing scientific problems in an integrative and collaborative manner; *ii*) to develop and apply new technologies and platforms for observational and experimental work in the ocean, including the use of the new Chilean research vessel *Cabo de Hornos*, and to reach unexplored areas of the South Pacific; *iii*) to increase human resources in ocean sciences in Chile and South America, through higher education and training in research based on direct observation and experimentation in the sea, and by attracting ocean scientists from all over the world to work in Chile; and *iv*) to inform and create awareness among the general public and decision-makers about the importance of the ocean, its conservation and its relationship to humans and global change.

**b) Research Lines:** The Institute has four initial research lines:

**- Mesoscale Processes:** The focus of this research line is the characterization of physical mesoscale (and sub-mesoscale) structures and processes in the eastern South Pacific Ocean (ESP) and their impact on open-ocean and transitional (coast-ocean) ecosystems. Mesoscale structures include eddies and fronts of different types, but probably other types of less studied structures associated with seamounts, ridges, and oceanic islands. The research strategy is based on field and modeling work.

Field observations will be performed to study the characteristics and evolution of mesoscale eddies, which are generated off the coast of central Chile and propagate NW, reaching the surroundings of the Juan Fernández Archipelago. They include time-series observations, through satellite remote sensing and a mooring around the Juan Fernandez Archipelago, as well as glider sections and process-oriented cruises. Perturbation experiments using single and multiple stressors in the contrasting waters will also be carried out. Additionally, using numerical experiments, we will analyze mesoscale-eddy structure, generation and transport, particularly in the OMZ and near oceanic islands and seamounts associated to the Nazca and Juan Fernandez ridges.

**- Ocean Variability:** The objective of this research line is to determine how large-scale perturbations impact the transport and gradients in physical-chemical water properties and the dynamics of the eastern South Pacific Ocean. The research strategy is based on observational and modeling work.

New hydrographic data will come from IMO and other oceanographic expeditions. Vertical high-resolution microstructure and turbulent mixing indices will also be obtained, which will allow the calculation of vertical fluxes of salt, heat and relevant biogeochemical properties. These high-resolution data, along with historical data, will allow an assessment of the interannual and lower frequency changes in the meridional transport and in the physical and chemical properties in the thermocline and intermediate waters. Different model simulations will generate output to be fed into regional models for evaluating mechanisms impacting coastal upwelling, mesoscale-eddy generation, regional circulation, and water-mass modifications.

**- Adaptations to a Changing Ocean:** The objective of this research line is to gain new understanding about the adaptations (at the genomic, physiological, behavioral and community-structure level) of key planktonic groups to chemical changes taking place in the ocean (e.g., acidification, deoxygenation, desertification) and the impact of such changes on biogeochemical cycling. The research strategy is based on laboratory and fieldwork.

For lab work, isolation of selected species of key plankton functional groups across environmental gradients and single-stressor (perturbation) experiments will be initially done in order to understand their response to variations in pCO2/pH, O2 and nutrients. Based on these results, genome analysis of selected species and multi-stressor experiments will be carried out.

For fieldwork, observations and experiments will be carried out in IMO-organized and other oceanographic expeditions. In–situ/On-board physiological/metabolic and community rates, gene content and expression, and particle flux measurements will be obtained. Also, culture-independent genetic/genome analysis of representative species will test associations among genomic variation, variability in physiology, and changes in water chemical properties. On-board experiments will expose distinct onshore and offshore plankton communities to single and multiple stressors.

**-The Deep Ocean:**The objective of this research line is to explore the deep and ultra-deep ocean, determining the pelagic-community ecology and physical/biogeochemical characteristics of the bathyal (> 1000 m), abyssal (>4,000 m) and hadal (>6,000 m) waters of the eastern South Pacific.

Special emphasis will be on mechanisms that contribute to the maintenance of endemic communities and the connectivity among the different deep biomes (i.e., islands, seamounts, trenches, etc.). IMO will organize as well as participate in major research expeditions to study the deep and ultra-deep waters of the eastern South Pacific, including the Atacama Trench. Appropriate sampling, observational, and experimental technology will be implemented and developed, accordingly.

**c) Organization of research team:**

During 2014, its first year, IMO consisted of 27 researchers: the 8 original associate researchers, 1 senior researcher, 9 adjunct researchers, 4 young researchers and 5 postdocs. The associate researchers are from Universidad de Concepción, UdeC (Osvaldo Ulloa –director-, Rubén Escribano -deputy director- Carmen Morales, Oscar Pizarro, Wolfgang Schneider, and Cristian Vargas), Pontificia Universidad Católica de Chile, PUC (Peter von Dassow) and Pontificia Universidad Católica de Valparaíso, PUCV (Samuel Hormazábal). They are distributed in Concepción, Santiago, and Valparaíso, respectively. IMO also incorporated 15 professionals/technicians and 4 administrative staff, as well as 30 students (8 undergraduate, 13 M.Sc., and 9 Ph.D.).

The functioning and budget allocation of the institute are organized around the 4 research lines, an outreach team (led by Pablo Rosenblatt, Director of Outreach), and a central administrative office based at UdeC (led by José Luis Blanco, Executive Director). IMO also has a senior researcher (Prof. Juan Carlos Castilla, PUC), who serves as a main advisor to the institute.

The 4 research lines combine and share scientific and technical personnel, laboratories, and equipment. Carmen Morales and Samuel Hormazabal lead Research Line 1; Wolfgang Schneider and Oscar Pizarro lead Research Line 2; Peter von Dassow, Cristian Vargas and Osvaldo Ulloa lead Research Line 3; and Rubén Escribano and Osvaldo Ulloa lead Research Line 4.

All the associate researchers define collectively annual research priorities for each line -as well as for education and outreach- and the budget is allocated according to these priorities. Central to IMO’s research activities are the organization of and participation in oceanographic expeditions.

* 1. **Scientific and technological research:**

1. **Current status of research lines:**

**I. Mesoscale Processes:**

During 2014, we advanced in the following scientific activities related to this theme, using IMO and additional funding, mainly from FONDECYT projects:

• An oceanographic cruise to characterize the frontal area and eddy-formation area off Concepción and their impact on nutrient concentrations and planktonic communities (February 2014). This cruise involved a collaborative effort between IMO researchers (C. Morales, S. Hormazabal, M. Cornejo, and M. Correa), a postdoc (I. Andrade), and several graduate and undergraduate students.

• Compilation and processing of satellite time series data on meteorological (winds), physical (SST), biological (Chlorophyll-a) for the region off northern and central Chile (18-42°S), in order to detect and characterize eddies and fronts.

• Preparation of an oceanographic mooring equipped with several autonomous devices to be deployed near Juan Fernandez Archipelago during 2015 to register mesoscale activity generated in the coast off central-southern Chile. This activity involved collaborative efforts between IMO researchers (S. Hormazabal, O. Pizarro, J.L. Blanco, and C. Morales), as well as several IMO technicians.

• Study of the dynamics of so-called oceanic striations (or quasi-zonal jets) and mesoscale eddies in the ESP (22°S-45°S, 105°W-70°W), based on high-resolution regional ocean modelling with ROMS, satellite altimetry and automated eddy identification/tracking algorithms, involving IMO researcher A. Bel Madani with international collaborators Alexis Chaigneau (LEGOS/IRD), Nikolai Maximenko (IPRC/U. Hawaii) and E. Di Lorenzo (SEAS/GATech), and the participation of 3 undergraduate students, a research assistant, a computer systems engineer, and an outreach specialist (see www.chilejets.com).

• Numerical models are also being used for the study of the low-frequency (interannual and decadal) modulation of eddy activity in the ESP off Peru and Chile (3°S-55°S, 115°W-70°W). Due to high computational costs, outputs of existing eddy-resolving global model simulations from OFES are being analyzed as a first step, before regional model runs can be implemented at a later stage. This activity involves collaborative efforts between IMO researchers (A. Bel Madani, A. Montecinos, O. Pizarro, W. Schneider) and a postdoc (P-A. Auger).

* A ROMS model configuration for the eastern South Pacific (parent domain 27-42.5°S and coast-85°W) with 3.8 km of resolution forced by QSCAT (2000-2008) is under validation based on SST, EKE,CTD and drifter information. The model nested for the Juan Fernandez (JF) ridge has a spatial resolution of 1.3 km. A biophysical model mimicking early life history of JF lobster has been already implemented, while short life history species are under development. An undergraduate thesis (IMO funding) is in progress to study connectivity between the JF ridge based on these coupled models. Moreover, the biogeochemical model PISCES has been implemented and simulations are in progress for the JF ridge. These activities involved collaborative support from IMO researchers (C. Parada, C. Morales, O. Pizarro), researchers and students from Geophysics department (A. Sepúlveda, C. Medel, O. Artal, C. Conejeros) and International support (V. Echevin, V. Combes and E. Di Lorenzo).

*The principal scientific achievements in Theme 1 during 2014 are:*

• The interaction between intrathermocline eddies (ITEs) and the Juan Fernández Archipelago (JFA) in the ESP, and its impact on surface Chlorophyll-a (Chl-a) concentration (as a proxy for phytoplankton biomass) was analyzed by a combination of modeling (ROMS), satellite Chl-a and altimetry data, and in situ data from oceanographic cruises. Both surface and subsurface anticyclonic eddies detected in the JFA region originated in the coastal transition zone off Chile (33-39°). Approximately one month after the beginning of the interaction between an ITE and the islands in JFA, increases in surface Chl-a associated with the eddy were observed, with values up to 3 times higher than in the adjacent oceanic waters (Andrade et al., 2014a).

• In the Easter Island Province (EIP), including Easter Island (EI) and Salas y Gómez Island (SGI), one of the most oligotrophic regions in the world ocean, satellite data compiled over a 10 year period were used to characterize the mesoscale variability in Chl-a. Chl-a showed a strong zonal dipole over EI but not in the case of SGI; a Chl-a increase is observed SE of the latter (~2 km), associated to a seamount. The mean geostrophic current in the EIP flows eastward, associated with the SE boundary of the subtropical gyre; however, recurrent mesoscale eddies traveling NW produce large surface current variability, with periods of high velocities in the opposite direction. In addition, wakes of high Chl-a concentration were observed over EI, associated with the generation and detachment of submesoscale eddies from this island during the spring; this process could have important biological implications during periods of lower production (Andrade et al., 2014b).

• High submeso- and mesoscale variability in the annual cycle and phenology of Chl-a (a proxy for phytoplankton biomass) in the coastal upwelling area off central-southern Chile (35-38°S) has been found (Corredor-Acosta, M. Sc. Thesis, UdeC-PUCV and Corredor-Acosta et al., article accepted in Journal of Geophysical Research in 2014), on top of the high magnitude variability in Chl-a magnitude that we documented in 2013. One of the implications of this finding is that the mesoscale structures originating in this region may transport very different quantities of organic matter towards the open ocean in the ESP.

• We also detected interannual changes in Chl-a phenology in the coastal upwelling region off central-southern Chile, including a 1 month longer duration during La Niña 2010–2011. The mean anomalies in the magnitudes of Chlorophyll-a and the Zonal Ekman Transport (ZET) during the upwelling season (September to March of each year) showed a slight but significant trend, negative for Chl-a and positive for ZET, during the 2002-2012 period, while SST remained relatively constant (Corredor-Acosta, M. Sc. Thesis, UdeC-PUCV and Corredor-Acosta et al., article accepted in Journal of Geophysical Research in 2014). This pattern was unexpected since three La Niña-related conditions were identified during the 2007–2012 period, for which we expected increases in phytoplankton biomass; the challenge is to understand the mechanisms that led to the observed pattern in phytoplankton biomass.

• A new application for Wavelet Analysis was developed by our group and for the objective identification of phenological indexes for physical and biological components with periodic cycles in the oceans (Corredor-Acosta, M. Sc. Thesis, UdeC-PUCV and Corredor-Acosta et al., article accepted in Journal of Geophysical Research in 2014)

• Probably the first in situ (sub)mesoscale physical-biological observations in a frontal area off Concepción were registered during an oceanographic cruise in 2014. Preliminary data analysis suggest intense activity produced by the interaction of the front with a mesocale eddy, producing upwelling and downwelling of properties and nutrients and the accumulation of phytoplankton biomass in the frontal area, but subduction of biomass in the area of the eddy (Morales, Hormazabal, Cornejo, Andrade et al., in preparation).

* Preferred eddy paths and bands of alternating polarity were found off central-southern Chile (35-40°S) in altimetry data. These patterns may help to explain the structure and variability of oceanic striations in this region. Further analysis involving other eddy identification/tracking algorithms and numerical model runs are necessary to confirm these findings.

• Significant decadal modulation of eddy kinetic energy (EKE) levels off Peru and in the coastal transition zone off central Chile was found, with amplitude ~25% of the mean EKE and a periodicity of ~50 years. The Peru and Chile zone appear to be nearly out of phase.

**II. Ocean Variability**

For this theme main activities have been focused on the analysis of existing data sets of previous oceanographic expeditions having large spatial coverage in the South Pacific basin, along with satellite data for recent years. On these aspects of large-scale variability of the region, we have gained substantial knowledge and understanding on ocean dynamics, mainly focused on the impact of such dynamics on the upwelling of the eastern south Pacific.

*The principal scientific achievements in Theme 2 during 2014 are:*

* In contrast to the rather permanent upwelling observed along the Peruvian and northern Chilean coasts, the coastal ocean off central Chile presents a highly seasonal upwelling regime that extends from early spring to mid fall. Coastal waters are highly productive during the upwelling season, but the upwelled water is very low in oxygen and even hypoxic below the surface layer over the continental shelf. Based on observations from the last decade we have observed how large-scale disturbances modulate the variability of the oxygen minimum zone at intraseasonal and interannual time scales, favoring conditions for intense hypoxic events that strongly impact the coastal ocean, and create concerns in coastal fishing communities. During recent years the cross-shelf structure of the upwelling cell and the hypoxic water in this region has been intensively sampled using underwater gliders capable of sampling the entire water column to a maximum of 1000 m and from near shore to 200 km offshore. These results form the basis of a paper currently in preparation. In the Southeast Pacific Ocean, satellite altimetry observations have long suggested surface mesoscale eddies play an important role in offshore transport of rich coastal waters.  Recently, some observational/numerical studies have highlighted the importance of subsurface eddies. We analyzed the eddy field variability using results from a high-resolution model experiment from 1979-2012 (V. Combes, S. Hormazabal and E. Di Lorenzo, under review JGR). Results indicate an asymmetry of surface and subsurface eddy fields; While surface-intensified cyclones are slightly more frequent than anticyclones, the subsurface field is dominated by anticyclones (Intrathermocline Eddies “ITEs”), triggered by the instability of the subsurface Peru Chile undercurrent (PCUC). Composite maps are consistent with in-situ observations. ITEs are associated with maximum vorticities around 150-200 m depth and warmer and more saline cores, characteristic of the equatorial subsurface water from the PCUC. We find that the variability of the ITEs is significantly correlated with the ENSO equatorial signal. During strong El Niño events (e.g. 1982; 1998), we find that the PCUC transport increases and the volume of coastal waters transported by ITEs decreases.
* The interannual sea level along the western coast of South America is highly correlated with the ENSO. During El Niño, trade winds weaken and positive sea level anomalies appears along the South American coast. Conversely, trade winds strengthen along the equator and negative sea level anomalies extend along the South American coast during La Niña. The amplitude of this interannual sea level fluctuation decays southward along the Chilean coast. Based on model simulation, the effect of eddies on the El Niño signal along the west coast of South America was estimated. Model results showed that the poleward reduction of the interannual sea level variability is due to interannual changes in the divergence of momentum flux induced by changes in mesoscale eddy activity.
* The Peru-Chile Undercurrent (PCU) transports waters with very low dissolved oxygen (DO) along the west coast of South America, shaping the southern tip of the oxygen minimum zone (OMZ). The effects of Peru-Chile Undercurrent variability on the seasonal variability of the OMZ off Central Chile was analyzed using a regional high-resolution coupled biogeochemical model (BioEBUS), that extended up to the equatorial region in order to grasp the connection with the equatorial variability, and encompassed the period 2000-2008. The annual cycle of DO was highly correlated with the annual cycle of the PCU north of 36°S but not south of it. The DO budget analysis confirms that advection processes rather than local biogeochemical processes dominate the DO tendency north of 36°S.
* A high resolution, interannual (1958-2008) model simulation was used to evaluate the impact of large scale interannual and interdecadal climate variability on the main flows that conform the Peru-Chile Current System, namely the Peru-Chile Current, the poleward flowing PCU and the Chilean Coastal Current (CCC). The current system shows an interannual ENSO variability dominated by important remote forcing. A few months prior to El Niño, the CCC weakens, while the PCU strengthens. Conversely, after El Niño peaks (about 6-8 months later) the CCC is strengthened and PCUC is weakened. During El Niño (La Niña) the transport anomalies of the CCC are ~-0.4 Sv (~+0.2 Sv), while transport anomalies of the PCUC are ~1 Sv (~-0.7 Sv).
* Recent studies have reported a slowdown in the warming of global sea surface temperature (SST) since the 90s with a strong imprint in the tropical eastern Pacific. Whether or not this so-called “hiatus” is the results of the internal/intrinsic variability of the climate system or is a response to external forcing remains unclear. Using available in situ data, we started analyzing (Dewitte et al. 2004) the existence of a decadal SST mode in the mid-latitudes of the South Hemisphere since the early 20th century that is phased with the recent hiatus in global warming. This decadal mode consists in a propagating westward SST signal travelling from the coast of South-America to the Australian coast that it reaches in about 25 years. A mode with comparable characteristics is found in some models of the CMIP5 database, which allows the investigation of its forcing mechanism. Results from this research are included in a paper in preparation, which will review the potential mechanisms associated to this decadal mode and discuss biases in CMIP5-class models that limit our understanding of decadal variability in the South-Hemisphere, will be presented in the 11th Int. Conf. on Southern Hemisphere Meteorology and Oceanography, in October 2015

**III. Adaptations to a Changing Ocea**n

During the first year, we *i*) implemented the analytical capacity to measure the carbonate system in seawater samples, including total alkalinity (AT) and spectrophotometric and potentiometric pH. The new capability for high-precision measurements of AT and pH, includes the use of *standard reference materials* (i.e. Dr. Andrew Dickson Lab, at Scripps Institution of Oceanography, USA), and follows the *Guide for Best Practices for Ocean Acidification Research and Data Reporting* (Riebesell et al. 2010). We now achieveATestimates with reproducibility better than 0.1% and accuracy of 2-3 µmol kg-1-sw, and highly precise estimates of CaCO3 saturation levels(Ωaragonite) within 0.02 units. We also *ii*) installed a micro/mesocosm facility at the Marine Biology Station at Dichato, for carrying out perturbation experiments at different *p*CO2/pH levels.This system includes a temperature and LED-light control system for experiments with photosynthetic organisms, and it is setto manipulate the CO2 system at two different levels (e.g. 400 and 1200 µatm). The system is highly stable and follows the international standards required for ocean acidification experiments. Ithas already been used for both practical activities during international courses/workshops (e.g. LAOCA 2014), as well as the development of experimental activities for our postdocs (e.g. Dra. Bárbara Jacob), MSci students (Ms. Alejandro Rangel), and guest students from foreign institutions (e.g. Anna McLaskey, University of Washington, USA).

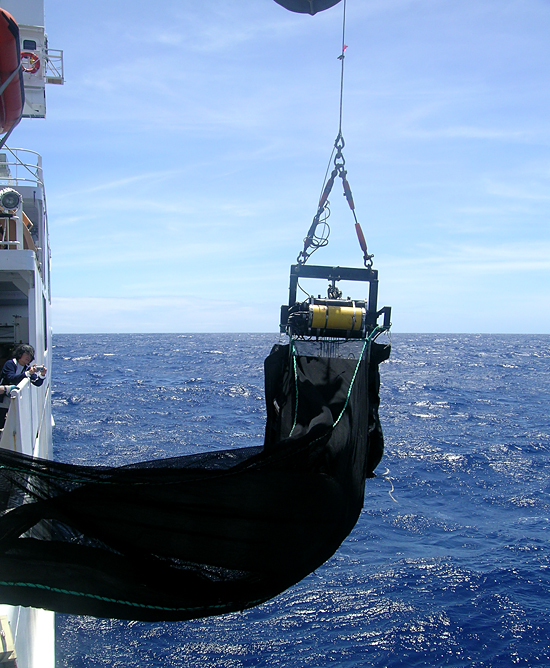
Moreover, we *iii*) consolidated a Chilean collection of micro- and macroalgae, which already contains over 400 macroalgal strains and nearly 200 phytoplankton strains. Of particular interest among these strains are several species closely related to the cosmopolitan coccolithophore *Emiliania huxleyi* (a model for understanding phytoplankton adaptation)*,* that have never been successfully cultured before (*Gephyrocapsa muellerae*, *G. ericksonii*, and *Reticulofenestra parvula*). Additionally, we i*v*) started applying single-cell genomics in combination with advanced flow cytometry and cell sorting to the study of planktonic microorganisms. Moreover, we were invited by some of our US collaborators to *v*) participate in an oceanographic expedition to the oxygen minimum zone off Mexico, which gave the opportunity to one of our postdocs and one of our graduate students to carry out research in the oxygen-deficient waters of the eastern North Pacific. We have *vi*) continued metatranscriptomic analysis of microbial gene expression and tag-sequencing of microbial communities in depth profiles through anoxic waters, including bacterial, archaeal, and eukaryotic components. Finally, *vii*) we analyzed previously collected observations and experimental data and communicated the results in the international scientific literature.

*The principal scientific achievements in Theme 3 during 2014 are:*

* Adaptations to changes in pH: In the framework of both IMO and other research initiatives, Dr. C.A. Vargas and our postdoc Dr. B. Jacob evaluated the impact of high *p*CO2 levels on the diatom *Sekeletonema pseudocostatum*. Long-term experiments were carried out with a culture of this species at two *p*CO2levels (400 and 1200 µatm). Measurements of carbonate system parameters (DIC and pH), dissolved organic carbon (DOC), nutrients, pigments, primary production and respiration, and algal fatty acids were monitored during all the study period. Our results show for this diatoms species that high *p*CO2 conditions might depress both primary production and respiration by ca. 50 and 30% respectively. Furthermore, high DOC production was observed in the high *p*CO2 treatment, as well as a decrease in the production of polyunsaturated (PUFA) and highly undersaturated (HUFA) fatty acids, proxies for algal food quality. This is the first of a set of experiments to be conducted with other functional groups (e.g. nanoflagellates and cyanobacterias), and with natural phytoplankton assemblages from coastal, upwelling, and open-ocean areas.
* Adaptations to changes in oxygen concentrations, particularly to very low levels or to anoxia (deoxygenation): we found –through a metagenomic analysis- that members of the dominant bacterioplankton group in marine oxygen-deficient waters (autotrophic -sulfur-oxiding proteobacteria) have complementary genetic metabolic potentials to function under aerobic conditions using different carbon sources (Murillo *et al*., 2014). This finding would explain their success in environments with changes in oxygen concentrations during the year, such as in the coastal waters off central Chile and in other coastal systems worldwide. In collaboration with colleagues from Denmark and USA, it was also shown -for the first time- that nanomolar levels of oxygen can reversibly suppress process rates and gene expression associated with the nitrogen loss processes of anammox and denitrification, establishing new oxygen thresholds for delimiting nitrogen loss processes in the ocean (Dalsgaard *et al*., 2014). Moreover, using new, ultra-sensitive oxygen sensors in the oxygen minimum zones off Mexico and central Chile, it was found that microbial aerobic metabolism proceeds efficiently even at extremely low oxygen concentrations (Tiano *et al*., 2014), suggesting an important role of oxygen on biogeochemical cycling even at sub-micromolar levels.
* Desertification of the Open Ocean and intensification of coastal-open ocean gradients: We focused laboratory studies on the model cosmopolitan phytoplankton *Emiliania huxleyi*. We discovered that the diploid phase of this species is more resistant to N-starvation than the haploid phase of the same species, and that correlates to a greater transcriptomic shift to N-scavenging in the diploid phase, compared to enhanced lipid oxidation pathways appearing in the haploid phase under N-starvation (Rokitta *et al*., 2014). However, we found that populations of marine phototrophs in marginal habitats have diminished capacity to reproduce sexually compared to habitats where the same species thrives (Oppliger *et al*., 2014). We also found that *E. huxleyi* isolates from open ocean oligotrophic regions tend to lose genome regions necessary for the haploid phase of the life cycle, possibly related to the loss of biotic pressure specifically attacking the diploid phase in highly productive waters (von Dassow *et al*., published *online early* in ISME Journal in 2014, for final publication in 2015). If the pattern holds generally for phytoplankton, it has important implications for adaptation to oligotrophic versus productive waters. Finally, a region of major concern for enhanced desertification is the South Pacific Gyre. We conducted a review of biological oceanography literature and reanalysis of datasets on the eastern-central portion of the Gyre including waters of Easter and Salas-y-Gomez Islands (von Dassow and Collado, 2014). This is one of the most poorly studied ocean regions on the planet, but the available knowledge suggests it functions differently to other ocean central gyres, for example, in lower contributions and distinct composition of N2-fixers.

In summary, during 2014 significant advances were made in this research line, with no major difficulties in achieving the objectives.

**IV. The Deep Ocean**

Exploring the deep ocean ecosystem represents an original and major challenge of worldwide connotation for IMO. However, this goal must be accompanied with development of technology and acquisition of sophisticated equipment capable of sampling a high pressure (>4000 m) environment. During 2014, we have devoted time and funding in developing such resources. Specifically, we designed and constructed an oceanographic carousel for sampling large amounts of seawater from as deep as 6000 m. The equipment is now ready for final testing and deployment. We also won a FONDEQUIP grant (CONICYT, Chile) Grant to acquire a deep multisampler plankton net MOCNESS. This plankton/fish sampler can be deployed as deep as 6500 m to filter large volumes (>20000 m3) of seawater, allowing the capture of deep plankton and fishes. This equipment is now being constructed in USA, expected to be tested by mid-2015, and ready to be operated during the second part of this year.

*MOCNESS Deep Multisampler net, developed at Woods Institute of Oceanography and available for IMO during 2015*.

In collaboration with PUCV in Valparaiso, we also obtained a grant to undertake a cruise to sample the seamounts near Juan Fernández Archipelago during July 2015. Deep water samples associated with seamounts will be available from this cruise.

1. **Publications:**

During this funding period, IMO members published 37 ISI articles, one SCIELO article and two book chapters. Because it was IMO´s first year, only nine of the total publications have the IMO affiliation (marked with \* in Annex 3). The relevance and impact for each research line have been described above in section 3a. See also Annex 3.

***Summary table***

|  |  |  |  |
| --- | --- | --- | --- |
| **Category of Publication** | **MSI Center Members** | **Number of Publications coauthored by students** | **Total Number of Publications** |
| ISI Publications or Similar to ISI Standard | Associate Researchers | 3 | 28 |
| Other Researchers | 9 | 9 |
| SCIELO Publications or Similar to SCIELO Standard | Associate Researchers | - | 1 |
| Other Researchers | - | - |
| Scientific Books and chapters | Associate Researchers | - | 2 |
| Other Researchers | - | - |
| Other Scientific Publications | Associate Researchers | - | - |
| Other Researchers | - | - |
| **Total of Publications** | | 12 | 40 |

c) **Other achievements**:

**Patents:**

No patents reported during the period

**Intellectual property:**

No intellectual property reported during the period

**Congress Presentations:**

During this funding period, IMO Associate Researchers and their teams attended, presented their work in, and organized numerous meetings and symposia. To evaluate them in the context of the corresponding research line, some have been described in section 3a. See Summary Table.

***Summary Table***

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Researcher** | **Type of presentation** | **National Events** | **International Events** |
| Associate Researchers | Conferences, oral communications, poster communications, others (Specify) | 16 | 9 |
| Invited presentations (not included in above row) | 4 | 9 |
| Other researchers | Conferences, oral communications, poster communications, others (Specify) | 15 | 6 |
| Invited presentations (not included in above row) | 5 | 4 |

* **Organization of Scientific Events:**

IMO was strongly involved in advanced training for undergraduate and graduate students, as well as postdocs and young researchers, through specialized courses, lectures, symposiums and seminars in 2014, including theoretical and practical activities. IMO organized two international scientific events, and twelve national scientific events, including six specialized lectures given by visiting researchers. The IMO sponsored and organized two Symposiums during the Annual Congress on Marine Sciences organized by the Chilean Society of Marine Sciences in May 2014: “*Areas of hypoxia in the Chilean coast: Studies, Perspectives and Challenges*” and “*A changing ocean: Perspective, opportunities and challenges for Chilean Oceanography*”.

Two Workshops about the Cooling in the Eastern South Pacific were held during 2014. Graduate students, faculty and researchers attended these events. See Annex 4.

IMO contributed, through the participation of Associated Researcher Dr. C.A. Vargas to the Symposium “***The* *Sea of Chile: Need for Action, Innovation and Negotiation upon Ocean Acidification Impacts***”, in which Dr. Vargas presented the Millennium Institute of Oceanography, the research lines and what we know to date, about the impacts of ocean acidification on marine resources in Chile. Various decision-makers, including the Sub-secretary of the Environment in Chile, and the Undersecretary of Fisheries attended this symposium, October 28th, UST, Santiago, Chile.

We highlight the Latin American Workshop on Ocean Acidification (LAOCA 2014), which took place in the Marine Biological Station in Dichato (UdeC) between 9-16 of November 2014. A call for applications was made throughout Latin America. 32 applications were received and 19 candidates were accepted. Their countries of origin included Argentina, Brazil, Chile, Colombia, Ecuador, and Mexico. Seven professors participated, all active in Ocean Acidification (OA) research, from the USA, Sweden, Mexico, UK, and Chile, including two IMO associate investigators (Dr. Vargas and Dr. von Dassow). An important point is that students and professors stayed at Dichato during the entire course. This allowed strong and active interactions between young researchers and experienced scientists not only inside the classroom and the lab, but also during informal meetings. This workshop was supported by funding from the Ocean Acidification International Coordination Centre (OA ICC) of the International Atomic Energy Agency (IAEA), the Millennium Nucleus MUSELS (NC120086), REDOC network at UdeC (MECESUP-MINECOM), and IMO. As a part of this activity, a Latin-American Network on OA is in being formed, with the plan to continue the LAOCA workshops every two years, the next one being planned in Mexico.

During the realization of LAOCA 2014, IMO organized a one-day Symposium, entitled “Ocean Acidification: The new threat for marine ecosystems”, held at the Main Campus of the University of Concepcion, open to the scientific community. The Symposium was attended by over 60 participants. Attendees included under- and postgraduate students, faculty and researchers. Furthermore, the Symposium was broadcast via streaming and over 300 people from 10 different countries joined the event and followed the lectures.

IMO also contributed significantly at the Conference of Parties (*20th Conference of Parties of the UNFCCC*, *United Nation Framework Convention for Climate Change, COP20*, December 1 to 14, 2014) through the support and participation of both Dr. Víctor Aguilera (Young Researcher IMO) and Dr. Bárbara Jacob (PostDoc IMO). With the support of the *Ocean Acidification International Coordination Office (OAICC)*, IMO organized the following events: a) Symposium "*Global and regional Interactions of multiple stressors with Ocean Acidification and Their Impacts on marine organisms*". Pabellón de Perú (December 5, 2014) and included presenters from OAICC (IAEA, Monaco), PML (UK), NOAA Acidification Program (USA), and IMARPE (Perú), b) Symposium "*What goes into the air, goes into the ocean: rapids talks about ocean acidification*", State Department Pavillion, USA (December 3, 2014); Symposium *Feria Voces del Clima*, Pabellón Océanos del Perú (6 December 2014). Finally, all partners (including IMO) and organizations participated in the exhibition stand: "*Hot, sour and breathless: the ocean under stress*" coordinated by Dr. Carol Turley (PML-UK) and Lisa Levin (SIO-UCSD-USA). At COP20, associate investigator Ruben Escribano also contributed with his expertise on "climate change impact of the Chilean upwelling ecosystem" to two workshops on ocean variability linked to climate changed as organized by Instituto del Mar del Perú (IMARPE). Both workshops were conducted in the framework of the Program "Oceanos" of COP20, as sponsored by the Peruvian government.

* **Scientific Editorial Boards:**

IMO researchers are currently editors or part of the editorial boards of: Journal of Plankton Research C. Morales), Journal of Marine Systems (C. Parada), Oceanography and Marine Resources of Oceanic Islands of Southeastern Pacific (S. Hormazabal), Revista Internacional de Biodiversidad, Oceanología y Conservación Gayana (M. Oliva, L. Farias), Revista de Biología Marina y Oceanografía (M. Oliva, C. Morales), Oceanides (R. Escribano), Latin American Journal of Aquatic Research (R. Escribano).

* **Awards:**

Osvaldo Ulloa, IMO Director and Principal Researcher, was elected as Corresponding Member of the Chilean Academy of Sciences. The public ceremony took place on 20 August, 2014.

*Ceremony where Osvaldo Ulloa (left) was elected as Corresponding Member of the Chilean Academ yof Sciences (also in the picture Dr. Juan Asenjo (center), President of the Chilean Academy of Sciences and Professor Juan Carlos Castilla).*

On 1 February 2014, Ali Reda Bel Madani, IMO young researcher, received the American Meteorological Society 2014 Awards, given by the American Meteorological Society Editor's Award for the Journal of Physical Oceanography.

* 1. **Education and Capacity Building**

1. **Education and Capacity Building:**

IMO’s educational and capacity building activities during the first year were diverse and involved: undergraduate and graduate education, organization of an advanced course in a specific topic, student and postdoc research-visits and conference presentations, and the incorporation to IMO of young scientists with postdoctoral fellowships. IMO associated scientists participated actively in defining the criteria for the incorporation of students and postdocs to IMO research activities and in the selection process itself.

The following mechanisms and criteria were applied for the selection of undergraduate and graduate students associated to IMO were based on the following:

* For students at the level of thesis project, thesis, and/or professional practice and which were already linked to IMO researchers before the start of IMO, a specification of their interest in continuing this link, formalized through a letter of support to the corresponding student by at least one of the IMO researchers in the case of undergraduates and at least one of the IMO associated researchers in the case of graduate students.
* For new undergraduate and graduate students, IMO called for applications and offered financial support. In this cases, the criteria applied were the following:
  + average grade obtained as part of their course work at the moment of application (above 5.0 in a scale of 1 to 7 for undergraduates and graduates).
  + a letter of intention from the student expressing the IMO research line(s) in which they would like to pursue their research.

In each case, the students were asked to send reports each semester as to evaluate their performance.

IMO is linked directly to 4 undergraduate and 6 postgraduate programs during the first year, including teaching regular or elective courses, involvement in professional practices, and/or project and thesis guidance:

* Undergraduate Programs in Marine Sciences: Marine Biology at UdeC and PUC, Geophysics at UdeC, and Oceanography at PUCV
* Postgraduate Programs in Marine Sciences: M. Sc. in Oceanography at UdeC and PUCV, M.Sc. in Ecology of Aquatic Systems at UA, Ph.D. in Oceanography at UdeC, Ph. D. in Environmental Sciences at UdeC, and Ph.D. in Biological Sciences at PUC.

In the case of the advanced course, the mechanisms and criteria applied for the selection of students or young researchers to attend the course were mainly focused on the previous experience the applicants had and the utility that such a course would have in the research they could develop in the near future.

For students and postdocs participating in conferences and/or research visits, IMO contributed with partial support if requested in the cases that the activities were related to at least one of the IMO research lines. IMO also made an open call for training-research visits by students and young researchers outside IMO.

As for IMO postdocs, we invited those who were already associated with one or more of the IMO researchers before IMO started and which were interested or working in at least one of the main IMO research lines. We also made two open calls for applications of new IMO postdocs, fully supported by IMO at least during their first year. For the younger postdocs, IMO asked them to also apply to CONICYT fellowships, in parallel or during their first year. The potential postdocs were asked to identify and contact at least one of the associated IMO researchers to formally support their application based on the proposal of the candidate, making sure that they could know, from first hand, the facilities and support available for their work in IMO. We took special care also in contacting the researchers who wrote reference letters for the candidates. The selection of the candidates also considered the fact that all 4 research lines should have postdocs and that those with more potential for interaction between IMO researchers would be of greater interest to IMO.

1. **Achievements and results:**

The involvement of IMO researchers in regular teaching and student guidance through the 10 formal Programs detailed above, allowed us to motivate new students to do their thesis or practice in one or more of the IMO research foci. During this first year, 8 undergraduate, 13 M. Sc., and 9 Ph.D. students were linked to IMO. Moreover, 3 of the M.Sc. students went for doctoral studies in 2014, 2 of which continue to be linked to IMO (J. Corredor-Acosta and M. Aldunate-Chinchón, both were incorporated to the Ph.D. Program in Oceanography at UdeC). In addition, 6 students (undergraduate and graduate) were co-tutored by IMO researchers (Annex 5.1).

IMO was also strongly involved in advanced training for undergraduate and graduate students, as well as postdocs and young researchers, through one specialized course in 2014, including theoretical and practical activities, the LATIN AMERICAN WORKSHOP ON OCEAN ACIDIFICATION (LAOCA 2014), see 3.b Organization of Scientific Events.

IMO educational activities have directly support students through the allocation of funds, allowing them to complete their projects or their professional practice. In total, IMO supported fully or almost fully 5 students during 2014:

At the undergraduate level, 3 students obtained IMO support after an open call for stipend grants for their thesis work (1: C. Cantergianni, Marine Biology at UdeC) or their professional habilitation project and/or execution of the project (2: M.P. Contreras and M.C. Medel). All of them successfully completed the academic requirements. In addition, C. Cantergianni continued to pursue graduate studies in 2015.

At the graduate level, 2 students obtained IMO support after an open call for stipend grants for their course studies or thesis work (1: A. Rangel for M.Sc. in Oceanography at UdeC, and 1: L. Florez for Ph.D. in Biological Sciences at PUC).

IMO educational activities were also sustained through additional funding, including CONICYT grants, graduate fellowships from the participating institutions (UdeC, PUC, PUCV, and UA), and FONDECYT projects obtained by IMO researchers.

At the graduate level, 1 M.Sc. (B. Franco) and 6 Ph.D. students (J. Medellin, F. Díaz, E. Velasco, V. Valdes, P. Ruz, and M. Pizarro) obtained CONICYT grants. Two of the M.Sc. students who finished their M.Sc. and continued to Ph. D, studies also obtained CONICYT grants (M. Aldunate and J. Corredor). Also, one of IMO M.Sc. students obtained a grant from his country (SENSCYT, Ecuador).

IMO provided partial support to students attending conferences or visiting laboratories, outside IMO or to IMO; 6 students benefit from this support (see Annex 5.2). In addition, undergraduate and graduate students linked to IMO, as well as IMO technicians and one postdoc, participated in a FONDECYT oceanographic cruise in February 2014 as well as other undergraduate and graduate students (PUCV and UdeC), together with 3 IMO Researchers. This activity provided a practical training for all the participating students.

During 2014, IMO attracted 5 postdocts who were previously linked to IMO researchers. One of them was fully supported by IMO towards the end of 1024 (A. Murillo), one by PUCV funding system (I. Andrade), and the rest (3) by CONICYT postdoctoral fellowships (B. Jacob, A. Muñoz, and R. Riquelme). These pre-existing postdocs were integrated to IMO because their research projects were directly linked or compatible with those of IMO. IMO made two open calls for postdocs positions in 2014, and the selected candidates started in 2015. IMO agreed to provide financial support for moving to Chile, for postdocs living in foreign countries, and some funds for their operational needs, besides that provided by the associated researchers linked more directly to them, in the same way as CONICYT grants do.

Detailed information of student is presented in Annexes 5.1 and 5.2

1. **Destination of Students:**

As this report covers only the first year of activity, the number of students finishing their training at IMO is small and is mainly the outcome of the previous activity of the labs. Nevertheless, in the spirit of the institute, there is a trend of alumni to stay in research and/or pursue more advanced training.

***Summary Table****:*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Obtained Degree | Academy | Industry and Services | Studies | Research | Other (Specify the other type of activity |
| Doctoral | - | - | - | - | - |
| Master | - | - | 3 |  | 1 (outreach) |
| Undergraduate | - | - | 1 | 1 | - |
| TOTAL | - | - | 4 | 1 | 1 |

Two undergraduate IMO student (C. Cantergianni and J.P. Espinoza) finished his undergraduate studies in 2014, one is currently part of the Ph.D. Program in oceanography at UdeC and the other is working in research at PUC. Three M.Sc. students (M. Aldunate, J. Corredor, and M. Astorga) pursued Ph.D studies after completing their degrees; 2 of them continue to be linked to IMO and one M.Sc. student (B. Leniz) after finished her degree, she joined the IMO staff working in the outreach program.

* 1. **Networking and other collaborative work**

1. **Networking:**

No formal networks were funded by MSI during 2014.

1. **Other collaborative activities:** During 2014, the IMO researcher C.A. Vargas actively participated in international collaboration networks related with the impacts of climate change, and more specifically *Ocean Acidification*, on global biogeochemistry and marine resources. A main activity the participation of Dr. Vargas, as one of the leader Chilean researcher invited to participate to the ***Global Ocean Acidification Observing Network (GOA-ON;*** [***http://www.goa-on.org***](http://www.goa-on.org)), which is also coordinated by the **OA-ICC (*Ocean Acidification International Coordination Centre***). The OA-ICC was created in 2013 and is based at the IAEA Environmental Laboratories (Monaco). This center is running by the Working Group SIOA (*SOLAS-IMBER Working Group on Ocean Acidification*). The OA-ICC brings together scientists, politicians, and decision makers, representatives of the media, education and other social actors in order to promote, facilitate and communicate research on the topic of ocean acidification. For that it tries to influence and support the implementation of key activities to be developed globally to make an effective use of investment in marine sciences. Dr. Vargas has also participated in this network through different activities as the international course LAOCA. The OA-ICC also aims to ensure that information on the impact of ocean acidification are effectively communicated to end users, for this coordinated an international collaborative network that included researchers from Plymouth Marine Laboratories (UK), Scripps Institution of Oceanography (USA), OCEANA, the major European programs on Ocean Acidification (EPOCA, MedSeA, BIOACID) and SouthAmerica (MUSELS and IMO). This network organized three events and an exhibition stand at the Conference of Parties (*20th Conference of Parties of the UNFCCC*, Lima, Perú).

Dr. Vargas has been also involved in formulation and organization of what will be the first, “**Latin-American Ocean Acidification Network (LAOCA Network)**, involving researchers working in ocean acidification and carbon chemistry in Latin-America. LAOCA Network is an initiative aimed, *(i)* to document the stage and progress of ocean acidification research in open‐ocean, coastal, and estuarine environments, (ii) to understand and disseminate knowledge regarding the potential impact of ocean acidification on local species in Latin‐American countries, (iii) to exchange and sharing carbonate system data necessary to optimize modeling at regional scale in Latin-American countries, and (iv) to generate instances of capacity building and education in Latin-American countries.

During 2014, the IMO researcher Wolfgang Schneider was appointed as a new member of the Climate and Ocean: Variability, Predictability and Change (CLIVAR) Pacific Panel, replacing Carmen Morales. CLIVAR is one of the four core projects of the World Climate Research Program. The panel will have its next meeting in Santiago, in October 2015. The organization of the meeting will be carried out by IMO.

During 2014, IMO researcher Ruben Escribano was appointed as a new member of the Scientific Steering Committee of the International Program Integrated Marine Biogeochemistry and Ecosytem Research (IMBER) as representing the expertise on dynamics and variability of coastal upwelling ecosystems

During 2014, IMO researchers interacted with the Millennium Nucleus of Ecology and Sustainable Management of Oceanic Islands (ESMOI) conducting a workshop for the evaluation of knowledge and subsequently a meeting to coordinate joint actions. As first task will be the execution of a symposium during the Marine Sciences Congress in May 2015.

During 2014, IMO researcher Peter von Dassow visited the Roscoff Culture Collection to establish a collaboration for exchange of biological resources and know-how for establishing the culture collection in Chile.

See Annex 6.2.

* 1. **Outreach and connections with other sectors**

1. **Outreach:**

During the first year of IMO, our outreach team focused primarily on generating long-term strategies that allow us to bring marine scientific knowledge to the society in general and, particularly, to school communities. We have focused on promoting the concept that our ocean, and knowledge of it, represents part of the shared wealth of the country. For this goal, we proposed to promote our activities through the use of multi-platform tools, incorporating traditional media, digital media and others. Furthermore, as IMO, we aim not only to bond with the community through the *dissemination* of scientific knowledge, but also *investigate* and *innovate* new strategies for science education in Chile and other countries in the Andean region. Thus, we pursue national and international partnerships with similar centers to enhance our products and messages. Finally, IMO's commitment is also to spread the knowledge of marine science to professionals from the area and/or that use this knowledge in their professions. During the first year we executed projects framed within this strategy.

***Sustained institutional visibility:*** During the first year we developed the IMO logo for use on all IMO products and we implemented both the website (www.imo-chile.cl) and a page on Facebook. In both of these sites we now constantly update relevant news of our researchers and center.

***Broadcasting of audiovisual products.*** An educational documentary was made for the television series “La Fuerza del Mar” (Force of the Sea) containing 7 documentaries, with the participation of two of our researchers. This series is broadcast through NOVASUR, the public educational TV network reaching the entire country through 87 regional channels and more than 6500 schools. Likewise, an institutional video that illustrates the importance of studying the ocean for Chile and the work of the IMO in this area of science was developed. Finally, a short video was produced for local television channels and social networks to publicize the IMO to the general public (see Annex 7).

***Public seminars to leaders and stakeholders.*** In January 2014, our Director Osvaldo Ivan Ulloa, participated as speaker at the Third Congress of the Future, organized by the commission of future challenges of the Senate and Plus Science Foundation. In this occasion, outstanding scientists, analysts and national thinkers, talked and debated about relevant issues, achievements and challenges of national science. Here, Dr. Ulloa presented the conference “Que intranquilo te baña…” "How restlessly you bathe...", (making reference to our national anthem that says “that sea that restfully bathes you”) where he highlighted the contributions that our country can do through oceanographic research, but for which there should be more effort in training human resources. He raised the need for Chile to invest more in oceanographic research, to become a protagonist of marine science worldwide.

Likewise, on May 2014 the seminar series “Marine Research in Chile” was held in the Pontificia Universidad Católica de Chile (Santiago) in the framework of the celebration of “Mes del Mar” (Month of the Sea), with attendance by important government and non-governmental agencies. In this series, Dr. Osvaldo Ivan Ulloa was invited to give a lecture titled: "Challenges for Oceanographic Research in Chile". He referred to the national importance of observing and studying the Eastern South Pacific Ocean, going beyond the coastal ocean to also including the open-ocean and deep sea. He also highlighted the effects of global climate change, decreased pH, and the decreasing concentration of oxygen in the water. This seminar series gave rise to the book "Marine Research in Chile", which lists the topics presented during the event by all participants speakers.

***Intensive science workshops for school children.*** During 2014, IMO developed an extensive network of collaboration with the “Centro Interactivo de Ciencias, Artes y Tecnologías” (CICAT; Interactive Center of Sciences, Arts and Technologies), of Universidad de Concepción. Because of this collaboration, IMO participated in the Science Camp Chile VA!, organized by CICAT in the region of Biobío, in the town of Pinto. On December 1º, Prof. Dr. Juan Carlos Castilla held a conference in the framework of the opening of the camp, and on December 3, our outreach team, together with a large contingent of monitors, held the educational workshop: "Day of Oceanography in Chile," where 150 high school students from different districts of the region of Biobío participated in four theoretical and practical workshops: El Niño – South Oscillation and Weather; Marine biodiversity; Earthquakes and Tsunamis; and Climate Change. All this was possible thanks to the commitment, motivation and work of the multidisciplinary team of monitors that worked in it.(see Annex 7).



*Students Science Camp Chile VA! In Dichato*



*Group of Student and IMO´s monitors during activities in UdeC*

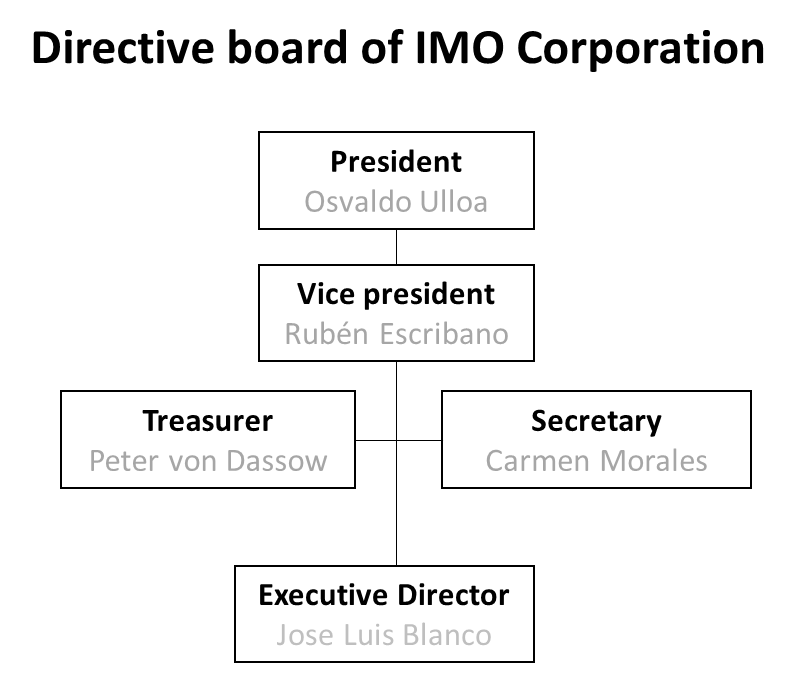
1. **Connections with other sectors:** The IMO faced the problem that the vessel Cabo de Hornos from the Chilean Navy, that will be the main research platform used by IMO, does not have a suitable device for taking multiple samples of seawater at different depths, in volumes of at least 10 liters, that could be operated from the laboratory of the ship (the wide of the door is 1.8 m) and that a solution does not exist in the international and domestic markets. Together with the metal mechanical industry “Shussler S.A.”, located in Concepción, we set out to develop a project for the design and construction of a water sampler that meets all requirements. As result we produced a prototype that will be registered and patented soon, to be promoted for sale worldwide. See annex 8.

*Deep-water sampler system for 24 bottles of 10 liters*

*Designed by IMO and constructed by Shussler S.A.*

During this year 2014, Dr. Cristian A. Vargas was nominated as members of the *Technical Advisory Group on Climate Change*, from the *Subsecretaría de Pesca y Acuicultura* (GTA). The challenge is to create an Adaptation Plan to contribute to mitigating the effects of climate change on resources, fishing communities and aquaculture, which contribute to the local policy in Chile.

* 1. **Administration and Financial Status**

1. Organization and administration:**** During 2014 IMO became a non-profit organization (RUT 65.090.637-3) and has completed all the legal requirements of the MSI. The corporation was formed with associate and adjunct researchers. The board of directors was constituted by Osvaldo Ulloa (President), Ruben Escribano (Vicepresident), Carmen Morales (Secretary) and Peter von Dassow (Treasurer). Jose Luis Blanco began in the role as Executive Director, managing the Institute, coordinating numerous internal and external activities and linking the institute to the community. The staff office is currently constituted by Monica Sorondo as executive secretary, who had the hard task of the coordination, organization and keep the Institute running; Mario Baltazar, who has extensive expertise in accounts managing Millennium funds and in charge of the monthly financial reports to the Ministerio de Economía that have been spotless. Occasional legal advisory support has come from the attorney Marcelo Troncoso, helping as to establish as a corporation.

One of our adjunct researchers, Pablo Rosenblatt, was designated as Outreach Director, who worked with Barbara Leniz and a team of journalists, filmmakers, graphic designers, and other professionals, contributing significantly to consolidate IMO's corporate image and promote its scientific and outreach activities.

An important group of fourteen research assistants and technicians facilitate our work in laboratories or in the field efficiently. A computer expert, Edwin Rodriguez who was hired to provide technical support to IMO labs and administrative staff.

|  |  |  |  |
| --- | --- | --- | --- |
| Category | Female | Male | TOTAL |
| Assistant & Technicians | 6 | 9 | 15 |
| Administrative Staff | 2 | 2 | 4 |
| TOTAL | 8 | 10 | 19 |



*First IMO corporation meeting – Dichato, October 2014*

1. **Financial Status:**

***See Annexes9.1to9.3***

* 1. **Annexes**

**Annex 1.- InstituteResearchers**

1.1.-AssociateResearchers

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Full Name** | **Research Line** | **Nationality** | **Gender** | **Date of birth** | **Profession** | **Academic Degree** | **Affiliation** | **Current Position** | **Relation with Center** |
| Oscar Roberto Pizarro Arriagada | 1,2,4 | Chilean | M | 28-03-1963 | Oceanographer | D | UdeC | Associate Professor | 2 |
| Peter von Dassow | 1,2,3,4 | American | M | 31-03-1974 | Oceanographer | D | PUC | Assistant Professor | 2 |
| Osvaldo Iván Ulloa Quijada | 3,4 | Chilean | M | 21-05-1961 | Marine Biologist | D | UdeC | Full Professor | 2 |
| Heraclio Rubén Escribano Veloso | 1,2,3,4 | Chilean | M | 16-04-1957 | Marine Biologist | D | UdeC | Full Professor | 2 |
| Carmen Morales Van De Wyngard | 1 | Chilean | F | 16-07-1955 | Biologist | D | UdeC | Associate Professor | 2 |
| Wolfgang Schneider | 2,4 | German | M | 16-02-1954 | Oceanographer | D | UdeC | Full Professor | 2 |
| Cristian Antonio Vargas Galvez | 1,3,4 | Chilean | M | 26-12-1972 | Marine Biologist | D | UdeC | Assistant Professor | 2 |
| Samuel Ernesto Hormazábal Fritz | 1,2 | Chilean | M | 08-12-1967 | Oceanographer | D | PUCV | Associate Professor | 2 |

1.2.- Young Researchers

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Full Name** | **Research Line** | **Nationality** | **Gender** | **Date of birth** | **Profession** | **Academic Degree** | **Affiliation** | **Current Position** | **Relation with Center** |
| Víctor Miguel Aguilera Ramos | 2,3 | Chilean | M | 01-11-1976 | Marine Biologist | D | UA | Assistant Professor | 2 |
| Marcela Cornejo D'Ottone | 1 | Chilean | F | 20-07-1977 | Oceanographer | D | PUCV | Associate Professor | 2 |
| Ali Reda Bel Madani | 1,2 | Finnsh | M | 04-06-1979 | Oceanographer | D | UdeC | Assistant Professor | 2 |
| Marco Alejandro Correa Ramirez | 1,2 | Colombian | M | 07-12-1974 | Marine Biologist | D | PUCV | Assistant Professor | 2 |

1.3.- Senior Researchers

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Full Name** | **Research Line** | **Nacionality** | **Gender** | **Date of birth** | **Profession** | **Academic Degree** | **Affiliation** | **Current Position** | **Relation with Center** |
| Juan Carlos Castilla Zenobi | 1 | Chilean | M | 19-08-1940 | Biology | D | PUC | Full Professor | 2 |

1.4.- Others

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Full Name** | **Research Line** | **Nationality** | **Gender** | **Date of birth** | **Profession** | **Academic Degree** | **Affiliation** | **Current Position** | **Relation with Center** |
| Carolina Eugenia Parada Veliz | 1,2 | Chilean | F | 02-10-1970 | Oceanographer | D | UdeC | Associate Researcher | 2 |
| Rodrigo De la Iglesia Cabezas | 3 | Chilean | M | 26-12-1978 | Biology | D | PUC | Assistant Professor | 2 |
| Pablo Rosenblatt Guelfenbein | 4 | Chilean | M | 06-01-1955 | Biology | M | PUCV | Adjunct professor | 2 |
| Marcelo Enrique Oliva Moreno | 4 | Chilean | M | 17-03-1952 | Biology | D | UA | Full Professor | 2 |
| Laura Farías | 3,4 | Argentinean | M | 07-07-1963 | Oceanographer | D | UdeC | Associate Professor | 2 |
| Aldo Manuel Montecinos Gula | 1,2 | Chilean | M | 24-07-1965 | Oceanographer | D | UdeC | Assistant Professor | 2 |
| Ricardo Hernán De Pol Holz | 2,3 | Chilean | M | 17-10-1973 | Marine Biologist | D | UdeC | Assistant Professor | 2 |
| Pamela del Carmen Hidalgo Diaz | 3,4 | Chilean | F | 07-06-1966 | Marine Biologist | D | UdeC | Assistant Professor | 2 |
| Alejandro Andres Murillo Cordova | 1,2,3,4 | Chilean | M | 20-01-2015 | Biology | D | UdeC | Postdoc | 1 |
| Alvaro Alfredo Muñoz Plominsky | 3,4 | Chilean | M | 24-04-1984 | Biology | D | UdeC | Post doctor | 2 |
| Ramiro Antonio Riquelme Bugueño | 1,4 | Chilean | M | 07-09-1978 | Marine Biologist | D | UdeC | Post doctor | 2 |
| Bárbara Gianella Jacob Valderrama | 3 | Chilean | F | 02-11-1972 | Marine Biologist | D | UdeC | Post doctor | 2 |
| Isabel Margarita Andrade Cornejo | 1 | Chilean | F | 22-10-1979 | Marine Biologist | D | PUCV | Post doctor | 2 |
| Jose Luis Blanco Garcia | 1,2 | Chilean | M | 03-08-1957 | Oceanographer | D | IMO | Associate Researcher | 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| **NOMENCLATURE:**  **[Gender]**  [M] Male  [F] Female | **[Academic Degree]**  [U] Undergraduate  [M] Master  [D] Doctoral | **[Relation with Centre]**  [1] Full time  [2] Part time | **[Affiliation]**  [**UdeC**]Universidad de Concepción  [**PUC**]Pontificia Universidad Católica de Chile  [**PUCV**]Pontificia Universidad Católica de Valparaíso  [**UA**]Universidad de Antofagasta |

Annex 2.- Research Lines

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **N°** | **Research Line** | **Research Line Objectives** | **Description of Research Line** | **Researchers** | **Research Discipline** | **Starting Date** | **Ending Date** |
| 1 | Mesoscale Processes | Role of mesoscale activity in governing energy and matter transfer and ecosystem dynamics in open ocean ecosystems | This research line is focused on the characterization of physical mesoscale (and sub-mesoscale) structures and processes in the eastern South Pacific Ocean (ESP) and their impact on open ocean and transitional (coast-ocean) ecosystems. Mesoscale structures in the ESP waters include eddies and fronts of different types, but probably other types of less studied structures associated with seamounts, ridges, and oceanic islands., as well as oceanic striations | Leads: Samuel Hormazábal, Carmen Morales  Ali Reda Bel Madani Marco Correa. Carolina Parada Marcela Cornejo  Juan Carlos Castilla  Isabel Andrade  Oscar Pizarro  Peter von Dassow Cristian Vargas José Luis Blanco Alejandro Murillo Rubén Escribano  Aldo Montecinos  Ramiro Riquelme | Ecology and environmental sciences.  Oceanography.  Meteorology and climatology.  Marine Biology.  Numerical methods and computation. | 26-12-13 |  |
| 2 | Ocean variability | Impact of large-scale disturbances on the transport and physical-chemical gradients of the properties of water and dynamics of the Eastern South Pacific | In this research line we aim at understanding how the subtropical cell controls the transport of large-scale heat, fresh water, carbon, nutrients and dissolved O2 through the Southeast Pacific Basin. These processes contribute to modulate chemistry, biology and the regional component of the variability of the climate system. Both models and field observations have shown that in a warming climate, the subtropical South Pacific cell strengthens in response to changes in large-scale surface winds over the tropical Pacific. | Leads: Oscar Pizarro, Wolfgang Schneider  Ricardo De Pol Holz. Carolina Parada  Samuel Hormazábal Víctor Aguilera José Luis Blanco Aldo Montecinos Ali Bel Madani  Marco Correa Rubén Escribano  Osvaldo Ulloa  Juan Carlos Castilla | Meteorology and climatology.  Oceanography..  Numerical methods and computation  Marine Biology | 26-12-13 |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **N°** | **Research Line** | **Research Line Objectives** | **Description of Research Line** | **Researcher** | **Research Discipline** | **Starting Date** | **Ending Date** |
| 3 | Adaptations to a Changing Ocean | Adaptation of the key functional groups of plankton to the oceans chemical changes and the impact on biogeochemical cycles | In this research line, we study adaptations (at the genomic, physiological, behavioral and community-structure level) of key planktonic groups to chemical changes taking place in the ocean (e.g., acidification, deoxygenation, desertification), and the impact of such changes on biogeochemical cycling. The research strategy is based on laboratory, microcosm/mesocosm, and field work, genome and transcriptome analysis, and culture-independent methods (single-cell genomics, metatranscriptomics, metagenomics, and tag-sequencing). | Leads: Osvaldo Ulloa, Cristian Vargas, Peter von Dassow Laura Farías Pamela Hidalgo Víctor Aguilera Ricardo De Pol Holz. Alvaro Muñoz Rodrigo De la Iglesia Rubén Escribano Alejandro Murillo Bárbara Jacob  Juan Carlos Castilla | Numerical methods and computation  Marine Biology  Biophysics  Biochemical  Oceanography  Microbiology | 26-12-13 |  |
| 4 | Deep Ocean | Community structure and biogeochemical characteristics of the deep and ultra-deep waters of the eastern South Pacific | This research line comprises not only an exploratory component, but it also seeks for new understanding about functioning of the deep ocean realm. The deep-water ecosystem of the ESP is virtually unknown. Exploring the mesopelagic (>500 m) and abyssopelagic communities (>3000 m) represents a unique opportunity for discovering new life styles, species and genes for science, as well as a major challenge for oceanography in the South Pacific basin. This initiative will also allow us to uncover the mechanisms by which these communities spread over such large scales and colonize particular habitats, such as the Atacama Trench, the Sala & Gomez and Juan Fernandez ridges (seamounts and canyons). | Leads: Rubén Escribano, Osvaldo Ulloa  Marcelo Oliva Pamela Hidalgo Wolfgang Schneider Oscar Pizarro Peter von Dassow Cristian Vargas Laura Farías Alejandro Murillo Pablo Rosenblatt Ramiro Riquelme  Juan Carlos Castilla | Marine Chemistry  Marine Biology  Microbiology.  Oceanography.  Biochemical  Ecology  Biogeochemistry | 26-12-13 |  |

**Annex 3.- Publications (Total or partially financed by ICM)**

***­­3.1.- ISI Publications or Similar to ISI Standard***

***3.1.1 Associate Researchers*(\* IMO affiliation)**

\* Oppliger, L., **P. von Dassow**, S. Bouchemousse, M. Valero, J. Correa, S. Mauger, C. Destombe, (2014),Alteration of sexual reproduction and genetic diversity in the kelp species *Laminaria digitata* at the southern limit of its range, PLoS ONE 9(7): e102518. doi:10.1371/journal.pone.0102518

\***von Dassow, P**., S. Collado-Fabri, (2014),Biological oceanography, biogeochemical cycles, and pelagic ecosystem functioning of the east-central South Pacific Gyre: Focus on Easter Island and Sala-y-Gómez, Latin American Journal of Aquatic Research 42(4): 703-742. DOI: 10.3856/vol42-issue4-fulltext-4

\*Rokitta, S. D., **P. von Dassow**, B. Rost, U. John, (2014),*Emiliania huxleyi* endures N-limitation with an efficient metabolic budgeting and effective ATP Synthesis, BMC Genomics. 2014, 15(1):1051. DOI: 10.1186/1471-2164-15-1051

\*Dalsgaard, T., F. J. Stewart, B. Thamdrup, L. De Brabandere, N. P. Revsbech, **O. Ulloa**, D. E. Canfield & E. F. DeLong., (2014),Oxygen at nanomolar levels reversibly suppresses process rates and gene expression in anammox and denitrification in the oxygen minimum zone off Northern Chile, mBio 5(6):e01966-14 DOI: 10.1128/mBio.01966-14

\*Tiano, L., E. Garcia-Robledo, T. Dalsgaard, A.H. Devol, B.B. Ward, **O. Ulloa**, D. E. Canfield, N. P. Revsbech, (2014),Oxygen distribution and aerobic respiration in the north and south eastern tropical Pacific oxygen minimum zones, Deep Sea Research Part I, 94(2014): 173–183. DOI: 10.1016/j.dsr.2014.10.001

\*Hirst, A.G., J.E. Keister, A.J. Richardson, P. Ward, R.S. Shreeve, **R. Escribano**, (2014),Re-assessing copepod growth using the Moult Rate method, Journal of Plankton Research 36: 1224-1232. 10.1093/plankt/fbu045

\*Pino-Pinuer, P., **R. Escribano**, **P. Hidalgo**, **R. Riquelme-Bugueño**,**W. Schneider**, (2014),Copepod community response to variable upwelling conditions off central-southern Chile during 2002-2004 and 2010-2012, Marine Ecology Progress Series 515: 83-95. DOI: 10.3354/meps11001

\***Murillo, A**., S. Ramírez-Flandes, E. F. DeLong, **O. Ulloa**, (2014).Enhanced metabolic versability of planktonic sulfur-oxidizing γ-proteobacteria in an oxygen-deficient coastal ecosystem, Frontiers in Marine Science 1:18.  DOI: 10.3389/fmars.2014.00018.

\*Castro-González, M., V. Molina, E. Rodríguez-Rubio, **O. Ulloa**, (2014), The first report of a microdiverse anammox bacteria community in waters of Colombian Pacific, a transition area between prominent oxygen minimum zones of the eastern tropical Pacific., Environmental Microbiology Reports 6(6): 595–60. DOI: 10.1111/1758-2229.12165

Valle-Levinson, A., M. A. Caceres, **O. Pizarro**, (2014), Variations of tidally driven three-layer residual circulation in fjords, Ocean Dynamics. 64(3):459-469. DOI: 10.1007/s10236-014-0694-9

Valle-Levinson, A., L. Castro, M. A. Caceres, **O. Pizarro**, (2014), Twilight vertical migrations of zooplankton in a Chilean fjord, Progress in Oceanography. 129: 114–124. DOI: 10.106/j.ocean.2014.03.008

Duarte, C.H., J.M. Navarro, K. Acuña, R. Torres, P.H. Manríquez, M. Lardies, **C.A. Vargas**, N.A. Lagos, **V. Aguilera**, (2014), Combined effects of temperature and Ocean acidification on the juvenile individuals of the mussel *Mytilus chilensis*, Journal of Sea Research 85: 308-314. DOI: 10.1016/j.seares.2013.06.002

Lardies, M.A., M.B. Arias, M.J. Poupin, P.H. Manríquez, R. Torres, **C.A. Vargas**, J.M. Navarro, N.A. Lagos, (2014), Differential response to ocean acidification in physiological traits of *Concholepas concholepas* populations, Journal of Sea Research, 90: 127-134. DOI: 10.1016/j.seares.2014.03.010

Manríquez, P.H., M.E. Jara, M.L. Mardones, R. Torres, J.M. Navarro, M.A. Lardies, **C.A. Vargas**, C. Duarte, N.A. Lagos, (2014), Ocean acidification affects predator avoidance behavior but not prey detection in the early ontogeny of a keystone species, Marine Ecology Progress Series. 502: 157-167. DOI: 10.3354/meps10703

Silva, N., **C.A. Vargas**, (2014), Hypoxia in Chilean Patagonian Fjords, Progress in Oceanography, 129: 62 - 74. DOI: 10.1016/j.pocean.2014.05.016

Lafon, A., N. Silva, **C.A. Vargas**, (2014), Contribution of allochthonous organic carbon across the Serrano River Basin and the adjacent fjord system in Southern Chilean Patagonia: insights from the combined use of stable isotope and fatty acid biomarkers. , Progress in Oceanography. 129: 98 - 113. DOI: 10.1016/j.pocean.2014.03.004

Manríquez, P.H., M.E Jara, R. Torres, M.L Mardones, N.A. Lagos, M.A. Lardies, **C.A. Vargas**, C. Duarte, J.M. Navarro, (2014), Effects of ocean acidification on developing and early post hatching larval traits of *Concholepas concholepas* (loco), Marine Ecology Progress Series. 514:87-103. DOI: 10.3354/meps10951

**Escribano, R., P. Hidalgo**, V. Valdés, L. Frederick, (2014), Temperature effects on development and reproduction of copepods in the Humboldt Current: the advantage of rapid growth, Journal of Plankton Research 36(1): 104-116. DOI: 10.1093/plankt/fbt095

Pérez-Santos, I., J. Garcés-Vargas, **W. Schneider**, A. Valle-Levinson, S. Parra & L. Ross, (2014),Double-diffusive layering and mixing in Patagonian Fjords, Progress in Oceanography 129(2014):35–49. DOI: 10.1016/j.pocean.2014.03.012

**Schneider, W**., I. Pérez-Santos, L. Ross, L. Bravo, R. Seguel & F. Hernández, (2014),On the hydrography of Puyuhuapi Channel, Chilean Patagonia, Progress in Oceanography 129(2014): 8–18. DOI: 10.1016/j.pocean.2014.03.007

Ross, L., I. Pérez-Santos, A. Valle-Levinson &**W. Schneider**, (2014), Semidiurnal internal tides in a Patagonian Fjord, Progress in Oceanography 129 (2014) 19–34. DOI: 10.1016/j.pocean.2014.03.006

De Brabandere, L., D. E. Canfield, T. Dalsgaard, G. E. Friederich, N. P. Revsbech, **O. Ulloa**& B. Thamdrup , (2014),Vertical partitioning of nitrogen-loss processes across the oxic-anoxic interface of an oceanic oxygen minimum zone, Environmental Microbiology, 16: 3041–3054DOI: 10.1111/1462-2920.12255

**Andrade, I., S. Hormazábal & M. Correa-Ramírez**, (2014),Time-space variability of satellite chlorophyll-a in the Easter Island Province, southeastern Pacific Ocean, Latin American Journal of Aquatic Resarch 42(4): 871 – 887, DOI: 10.3856/vol42-issue4-fulltext-13

**Andrade, I**., P. Sangrà, **S. Hormazabal & M.A. Correa-Ramirez**, (2014),Island mass effect in the Juan Fernández archipelago (33°S), Southeastern Pacific, Deep-Sea Research I, 84(2014):86-99. DOI:10.1016/j.dsr.2013.10.009

**Anabalón V**., J. Arístegui, **C.E. Morales**, I. Andrade, M. Benavides, **M.A. Correa-Ramírez**, M. Espino, O. Ettahiri, **S. Hormazabal**, A. Makaoui, M.F. Montero & A. Orbi, (2014),The structure of planktonic communities under variable coastal upwelling conditions off Cape Ghir (31°N), in the Canary Current System (NW Africa), Progress in Oceanography 120(2014): 320-339. Doi:10.1016/j.pocean.2013.10.015

**Andrade, I., S. Hormazábal**& V. Combes, (2014),Intrathermocline eddies at the Juan Fernández Archipelago, southeastern Pacific Ocean, Latin American Journal of Aquatic Research 42(4): 888 – 906, DOI: 10.3856/vol42-issue4-fulltext-14

Fernández, M. &**S. Hormazábal**, (2014),Overview of recent advances in oceanographic, ecological and fisheries research on oceanic islands in the southeastern Pacific Ocean, Latin American Journal of Aquatic Research 42(4): 666 – 672, DOI: 10.3856/vol42-issue4-fulltext-1

Villagran, V., G. Alarcon, **O. Pizarro**, (2014), Environmentally Friendly Anti-Fouling System for Oceanographic Equipment, Sea Technology 55(10):43

***3.1.2 Other researchers:***

Valdivia, I.M., C.D. Criscione, L. Cárdenas, C.P. Durán, **M.E. Oliva**, (2014), Does a facultative precocious life cycle predispose the marine trematode *Proctoeces cf. Lintoni* to in breeding and genetic differentiation among host species?, International Journal for Parasitology 44 (2014) 183-188. DOI: 10.1016/j.ijpara.2013.10.008

Sepúlveda, F.A., M.T. González &**M.E. Oliva**, (2014), Two new species of Encotyllabe (Monogenea: Capsalidae) based on morphometric and molecular evidence: Parasites of two inshore fish species of Northern Chile, J. Parasitol., 100(3) 2014: 344-349. DOI: 10.1645/13-230.1

**Oliva, M.E**., F.A. Sepúlveda, M.T. González, (2014), *Parapedocotyle prolatili* gen.n. et sp. n. a representative of a new subfamily of the Diclidophoridae (Monogenea), a gill parasite of *Prolatilus jugularis* (Teleostei: Pinguipedidae) from Chile , FOLIA PARASITOLOGICA 61 (6): 543-548. DOI: 10.14411/fp.2014.067

George-Nascimento, M., **M.E. Oliva**, (2014), Fish population studies using parasites from the Southeastern Pacific Ocean: Considering host population changes and species body size as sources of variability of parasite communities, Parasitology: 1-11. DOI: 10.1017/S0031182014001127

Caniupán M., F. Lamy, C. B. Lange, J. Kaiser, R. Kilian, H. W. Arz, T. León, G. Mollenhauer, S. Sandoval, **R. De Pol-Holz**, S. Pantoja, J. Wellner, R. Tiedemann, (2014), Holocene sea-surface temperature variability in the Chilean fjord region, Quaternary Research. 82(2014):342-353. DOI: 10.1016/j.yqres.2014.07.009

Moreno, P.I., I. Vilanova, R. Villa-Martínez, R.D. Garreaud, M. Rojas, **R. De Pol-Holz**, (2014), Southern Annular Mode-like changes in southwestern Patagonia at centennial timescale over the last three millennia, Nature Communications 5:4375. DOI: 10.1038/ncomms5375.

Fernández-Cadena J, S. Andrade, C.L. Silva-Coello, and **R. De la Iglesia**, (2014), Heavy metal concentration in mangrove surface sediments from the north-west coast of South America, Marine Pollution Bulletin 82: 221-226. DOI: 10.1016/j.marpolbul.2014.03.016

Cecilio, C.M., D. F. M. Gherardi, R. B. Souza, and **M. Correa-Ramirez**, (2014), Spatio-Temporal Variability of the Eddy Kinetic Energy in the South Atlantic Ocean. IEEE Geoscience and Remote Sensing Letters 11(11):2010-2014. DOI: 10.1109/LGRS.2014.2317414

Galán, A., J.T. Faundez,B.Thamdrup; J.F. Santibañez, **L. Farias**, (2014), Temporal dynamics of nitrogen loss in the coastal upwelling ecosystem off central Chile: evidences of autotrophic denitrification through sulfur-oxidation, Limnology and Oceanography 59(6): 1865–1878 doi:10.4319/lo.2014.59.6.1865

***3.2.- SCIELO Publications or Similar to SCIELO***

*3.2.1* ***Associate Researchers****:*

Pérez-Santos, I., **W. Schneider**, A. Valle-Levinson, M. Sobarzo, I. Soto, J. Garcés-Vargas. R. Montoya, N. Melo & F. Muller, (2014), Chlorophyll-a pattern and mixing processes in Yucatán basin, Caribbean Sea, Ciencias Marinas. 40(1), 11-31. DOI:10.7773/cm.v40i1.2320

***3.3.- Scientific Books and Chapters***

*3.3.1* ***Associate Researchers****:*

Stewart, F. J. &**Ulloa, O**., (2014), Microbial Metagenomics in Oxygen Minimum Zones, In: Marco, D. (Ed.). Metagenomics of the Microbial Nitrogen Cycle: Theory, Methods and Applications. Caister Academic, pp. 17-31.

\***Ulloa, O**., (2014), Desafíos de la Investigación Oceanográfica en Chile, Investigación Marina en Chile - Comité Oceanográfico Nacional (CONA), Chile. Seminario realizado el 6 de mayo de 2014. 99pp.

***3.4.- Other Publications:***

During 2014 we did not generate other publications.

***3.5.- Collaborative publications:***

Number and percentage of publications in each category among IMO researchers.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category of Publication** | **1 researcher** | | **2 researchers** | | **3 researchers** | | **4 or more** | |
| **N°** | **%** | **N°** | **%** | **N°** | **%** | **N°** | **%** |
| ISI Publications or Similar to ISI Standard | 29 | 73% | 4 | 10% | 3 | 8% | 1 | 3% |
| SCIELO Publications or Similar to SCIELO Standard | 1 | 3% | 0 | 0% | 0 | 0% | 0 | 0% |
| Books and chapters | 2 | 5% | 0 | 0% | 0 | 0% | 0 | 0% |
| Other Publications | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| **Total of publications** | **32** | **80%** | **4** | **10%** | **3** | **8%** | **1** | **3%** |

**Annex 4.- Organization of Scientific Events**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scope** | **Title** | **Type of Event** | **City** | **Country** | **Responsible Researcher** |
| International | Latin American Workshop on Ocean Acidification (LAOCA) | Workshop | Concepcion | Chile | Cristian Antonio Vargas |
| International | Ocean Acidification: The new threat for marine ecosystems | Symposium | Concepcion | Chile | Cristian Antonio Vargas |
| National | Carbon and phosphorus incorporation by marine microorganisms: What happen in the open ocean? | Conference | Concepcion | Chile | Osvaldo Iván Ulloa |
| National | Areas of hypoxia in the Chilean coast: Education, Prospects and Challenges | Symposium | Osorno | Chile | Pamela Hidalgo |
| National | A changing ocean: Education, Prospects and Challenges | Symposium | Osorno | Chile | Osvaldo Iván Ulloa |
| National | Second Workshop -Cooling in the eastern South Pacific (ESP) | Workshop | Concepcion | Chile | Oscar Pizarro |
| National | Course: Basic Electronics and Instrumentation for Oceanography | Other | Concepcion | Chile | José Luis Blanco |
| National | Solar radiation absorption by water vapor and its role in the climate of the Eocene | Conference | Concepcion | Chile | Oscar Pizarro |
| National | First Workshop -Cooling in the eastern South Pacific (ESP) | Workshop | Concepcion | Chile | Oscar Pizarro |
| National | High-resolution modelling of the eastern Tropical Pacific Oxygen Minimum Zone: Sensitivity to the tropical oceanic circulation | Conference | Concepcion | Chile | Wolfgang Schneider |
| National | N-loss isotope effects in the Peru oxygen minimum zone studied using a mesoscale eddy as a natural tracer experiment | Conference | Concepcion | Chile | Osvaldo Ulloa |
| National | Workshop over Ocean Islands, with the Millennium Nucleus Ecology and Sustainable Management of Oceanic Islands | Workshop | Coquimbo | Chile | Osvaldo Ulloa |
| National | Effects of ocean acidification on crustacean zooplankton | Conference | Concepcion | Chile | Pamela Hidalgo |
| National | Zooplankton ecology in oceanic oxygen minimum zones: Structure, trophic webs and climate change | Conference | Concepcion | Chile | Pamela Hidalgo |

**Annex 5.- Education and capacity building**

**5.1 Capacity Building inside MSI Centers**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tutor** | **Undergraduated Students** | | **Graduated Students** | | | | | |
| **Master** | | **Doctoral** | | **Postdoctoral** | |
| **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **Total** |
| Peter von Dassow | - | - | - | - | - | 2 | - | - | 2 |
| Oscar Pizarro | 1 | - | - | 1 | - | 1 | - | - | 3 |
| Carmen Morales Van De Wyngard Samuel Hormazábal Fritz | - | - | 1 | - | - | - | - | - | 1 |
| Rubén Escribano Veloso  Pamela Hidalgo Diaz | - | 1 | - | - | 1 | - | - | - | 2 |
| Cristian Vargas Galvez  Laura Farías | - | - | - | 1 | - | - | - | - | 1 |
| Osvaldo Ulloa | - | 1 | 3 | - | 1 | - | - | - | 4 |
| Samuel Hormazábal | - | - | - | 2 | - | - | - | - | 2 |
| Rubén Escribano | 1 | - | 1 | - | 2 | - | - | - | 4 |
| Wolfgang Schneider | - | - | - | - | - | 1 | - | - | 1 |
| Cristian Vargas Galvez | - | - | 1 | - | - | - | - | - | 1 |
| Rubén Escribano  Marcelo Oliva | 1 | - | - | 1 | - | - | - | - | 2 |
| Pamela Hidalgo | - | - | 1 | 1 | - | - | - | - | 2 |
| Marcelo Enrique Oliva | - | - | - | 1 | - | - | - | - | 1 |
| Pablo Rosenblatt | - | 1 | - | - | - | - | - | - | 1 |
| Carmen Morales | - | - | - | - | 3 | - | - | - | 3 |
| Oscar Pizarro  Carolina Parada | 1 | - | - | - | - | - | - | - | 1 |
| **Total** | 4 | 3 | 7 | 7 | 7 | 4 | - | - | 32 |

**Annex 5.2.- Short-term Traineeships of MSI students**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Student Name** | **Institution** | **Country** | **Advisor** | **Project Description** | **Starting Date** | **Ending Date** |
| Stefan Alexander Amthauer Hoehmann | Universidad de Concepción | Chile | Pablo Rosenblatt Guelfenbein | Development of information for website, scientific diffusion, newspaper articles, outreach and the external projection | 01-09-2014 | 30-11-2014 |
| Susana Cabrera Nuñez | Universidad de Concepción | Chile | Heraclio Ruben Escribano | Update knowledge on methods of study of marine plankton, with emphasis on zooplankton. Activities: implementation of ZooScan instrument, knowing its operation and management. Participation in experiments of grazing and estimation of metabolic rates of zooplankton. | 04-08-2014 | 02-09-2014 |
| Paula Mariela Ruz Moreno | Instituto Español de Oceanografía | España | Lidia Yebra Mora | Analysis of samples from the Bay of Mejillones in northern Chile to study the effect that the Oxygen Minimum Zone on the metabolism of pelagic copepods. | 02-11-2014 | 02-12-2014 |
| Carolina Andrea Gonzalez Espinoza | Universidad de Concepción | Chile | Heraclio Ruben Escribano | Data analysis and preparation of scientific manuscript on the subject of zooplankton adaptations to changes in oceanographic conditions. | 10-06-2014 | 11-06-2014 |
| Carolina Paz Burgos Barra | Universidad de Antofgasta | Chile | Marcelo Enrique Oliva | Extraction, fixation and staining techniques for fish parasites and samples preparation for taxonomic and molecular analysis. Identify parasitic species belonging to classes Digenea, Monogenea, Nematoda and Copepoda | 08-11-2014 | 16-01-2015 |
| Belén Anais Franco Cisterna | Instituto Oceanográfico de la Universidad de Sao Paulo | Brasil | Rubens M. Lopes | Learn the cultivation of phytoplankton (parasites and epiphytes) and samples preparation for molecular analysis. Plankton ecology, identification of parasites (dinoflagellates) on various zooplankton components (copepods and appendicularians), knowing their lifecycles and effects in the host | 10-11-2014 | 28-11-2014 |

**Annex 6.- Networking and other collaborative work**

**6.1 Networking**

During 2014 we did not participate in other networking activity funded by MCI

**6.2.- Other collaborative activities**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Activity Name** | **Co-Participant**  **Institution(s)** | **Participants**  **[Number]** | | | | **Products**  **[Type & Number]** |
| MSI center | | External | |
| Researchers | Postdocs/Students | Researchers | Postdocs/Students |
| Global Ocean Acidification observing Network (GOA-ON) | Institutions of almost all countries are incorporated in this network | 1 | 1 | 147 | - | 1 Newsletter |
| Climate and Ocean: Variability, Predictability and Change (CLIVAR), Pacific Panel | Institutions of almost all countries in the Pacific border are incorporated in this network | 2 | 0 | 25 | - | 1 Meeting |
| Oceanic Island Research | IMO and SMOI | 13 | 4 | 0 | 0 | 1 Meeting |

**Annex 7.- Outreach**

**7.1.- Outreach activities throughout the period**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Event Title** | **Type of Event** | **Scope** | **Target Audience** | **Date** | **Country** | **Region** | **N° of Student from the Center** | **N° of Attendees** | **Duration in days** | **Participating Researchers** | **Responsible for the activity** |
| ChileVA! Scientific Camp EXPLORA Program | Other | National | High school | 03-12-2014 | Chile | Bío Bío | 5 | 150 | 1 | Osvaldo Iván Ulloa | Pablo Rosenblatt |
| ChileVA! Scientific Camp EXPLORA Program | Other | National | High school | 01-12-2014 | Chile | Bío Bío | 0 | 150 | 1 | Juan Carlos Castilla | Pablo Rosenblatt |
| Exhibiton “Mes del Mar”(Month of the Sea) 2014 | Exhibition | National | Community | 05-05-2014 | Chile | Bío Bío | 0 | 100 | 20 | Pablo Rosenblatt | Pablo Rosenblatt |
| Day of Marine Sciences at the Marine Biological Station in Dichato for the Salesian College,Concepción | Other | National | Primary  Students | 30-05-2014 | Chile | Bío Bío | 0 | 25 | 1 | Pablo Rosenblatt | Pablo Rosenblatt |
| Month of the Sea:  Acidification of the ocean experiments | Workshop | Nacional | community | 14-05-2014 | Chile | Bío Bío | 0 | 120 | 3 | Osvaldo Iván Ulloa | Pablo Rosenblatt |
| Science Day exhibition | Other | Nacional | community | 05-10-2014 | Chile | Bío Bío | 0 | 100 | 1 | Pablo Rosenblatt | Pablo Rosenblatt |
| “Open Doors” University of Concepción | Other | Nacional | High school | 29-10-2014 | Chile | Bío Bío | 0 | 200 | 2 | Pablo Rosenblatt | Pablo Rosenblatt |
| 7thFair of theOcean | Exhibition | Nacional | community | 05-06-2014 | Chile | Bío Bío | 4 | 200 | 3 | Osvaldo Iván Ulloa | Jose Luis Blanco |
| III Conference of the Future | Conference | National | community | 09-01-2014 | Chile | Valp. | 0 | 250? | 1 | Osvaldo Iván Ulloa | Osvaldo Iván Ulloa |
| Seminar of Marine investigation in Chile | Conference | National | community | 06-05-2014 | Chile | Metrop. | 0 | 120 | 1 | Osvaldo Iván Ulloa  Juan Carlos Castilla | Osvaldo Iván Ulloa |

**7.2.- Products of outreach**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name of Product** | **Product Objective** | **Target Public** | **Type of Product** | **Scope** |
| Institutional video | The institutional video is a tool of external projection detailing the work of IMO and presents the research that develop their scientific | Community | TV or movie scripts | International |
| Promotional video “Mio Tuyo Nuestro” (Mine, Yours, Ours) | Create awareness of the ocean | Community | TV or movie scripts | International |
| TV series -“La Fuerza del Mar” (The force of the Sea)- Episode: “Centinelas del Cambio Climático”(Sentinels of global change). | Series Episode that presents the work of Dr. Ruben Escribano and Dra. Pamela Hidalgo | Community | TV or movie scripts | International |
| Web site | Introduce IMO, their researchers, technician and students and all the activities they do. | Community | Web design | International |

**7.3.- Articles and Interviews:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Type of Media and Scope** | **Local / Regional** | | **National** | | **International** | |
| **N° Interviews** | **N° Articles** | **N° Interviews** | **N° Articles** | **N° Interviews** | **N° Articles** | **Total** |
| Written | - | - | - | 1 | - | - | 1 |
| Internet | - | - | 2 | 25 | - | - | 27 |
| Audiovisual | - | - | 4 | - | - | - | 4 |
| **Total** | - | - | 6 | 26 | - | - | 32 |

**Annex 8.- Connections with other sectors:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Type of Connection** | **Type of Activity** | **Institution Country** | **Agent Type** | **Economic Sector** |
| Deep water sampler for 24 bottles | Industries | Project development | Chile | Industry | Metal mechanical Manufacture |

**9.- Financial status**

**9.1 Total incomes:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Funds** | **Accumulated incomes to last year [$]** | **2014 Incomes** | | **Total income to 2014 [$]** |
| **Amount**  **$** | **Percentage of resources used by the Center [%]** |
|  |
| MSI | 0 | 909,821,000 | 100 | 909,821,000 |
| Fondecyt 1120504 | 0 | 52,875,000 | 80 | 42,300,000 |
| Fondecyt 1131047 | 0 | 59,092,000 | 70 | 41,364,400 |
| Fondecyt 1130784 | 0 | 58,943,000 | 80 | 47,154,400 |
| Fondecyt 1141106 | 0 | 59,600,000 | 80 | 47,680,000 |
| Fondecyt 1120478 | 0 | 55,870,000 | 50 | 27,935,000 |
| Fondecyt 1130511 | 0 | 57,984,000 | 65 | 37,689,600 |
| Fondecyt 1121041 | 0 | 38,850,000 | 75 | 29,137,500 |
| Fondecyt 1140845 | 0 | 49,730,000 | 15 | 7,459,500 |
| Fondecyt 1130254 | 0 | 60,000,000 | 65 | 39,000,000 |
| Nucleo Milenio 120086 | 0 | 151,118,000 | 20 | 30,223,600 |
| FIP 2014-42 | 0 | 75,000,000 | 15 | 11,250,000 |
| Conicyt USA 20120014 | 0 | 50,000,000 | 75 | 37,500,000 |
| UMI 3614 (CNRS-France) | 0 | 25,000,000 | 5 | 1,250,000 |
| Contraparte PUC | 0 | 3,000,000 | 100 | 3,000,000 |
| Beca Doctorado PUC | 0 | 2,800,000 | 100 | 2,800,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca SENESCYT Ecuador | 0 | 10,199,421 | 100 | 10,199,421 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Beca Doctorado Conicyt | 0 | 9,750,000 | 100 | 9,750,000 |
| Fondecyt Postdoctorado | 0 | 22,000,000 | 50 | 11,000,000 |
| Beca Magister UAntof | 0 | 4,002,840 | 100 | 4,002,840 |
| Beca Magister Udec | 0 | 4,540,000 | 100 | 4,540,000 |
| Beca Magister Udec | 0 | 2,840,000 | 100 | 2,840,000 |
| Beca Magister Udec | 0 | 2,840,000 | 100 | 2,840,000 |
| Beca Magister Udec | 0 | 2,840,000 | 100 | 2,840,000 |
| Beca Post doctorado PUCV | 0 | 9,000,000 | 100 | 9,000,000 |
| Beca Magister PUCV | 0 | 2,000,000 | 100 | 2,000,000 |
| Beca Magister PUCV | 0 | 2,000,000 | 100 | 2,000,000 |
| **TOTAL** | 0 | 1,840,195,261 |  | 1,435,077,261 |

**9.2 Outcome structure**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ITEM** | **Accumulated expenses to last year [$]** | **2014 Expenses [$]** | | | | **Total expenses to 2014 [$]** | **%** |
| Operative | Networking | Outreach | **Total** |
| Honoraria Researchers | 0 | 113.190.002 | 0 | 0 | 113.190.002 | 113.190.002 | 17.8 |
| Honoraria students and other personnel | 0 | 99.634.278 | 0 | 0 | 99.634.278 | 99.634.278 | 15.7 |
| Tickets and travel expenses | 0 | 57.469.151 | 0 | 0 | 57.469.151 | 57.469.151 | 9.00 |
| Materials/supplies | 0 | 67.883.593 | 0 | 0 | 67.883.593 | 67.883.593 | 10.7 |
| Goods and equipment | 0 | 177.098.323 | 0 | 0 | 177.098.323 | 177.098.323 | 27.9 |
| Infrastructure | 0 | 477.239 | 0 | 0 | 477.239 | 477.239 | 0.07 |
| Administrative expenses | 0 | 59.387.630 | 0 | 0 | 59.387.630 | 59.387.630 | 9.35 |
| Publications and subscriptions | 0 | 3.232.446 | 0 | 0 | 3.232.446 | 3.232.446 | 0.51 |
| Consultancies | 0 | 15.669.666 | 0 | 0 | 15.669.666 | 15.669.666 | 2.47 |
| Overhead | 0 | 24.900.000 | 0 | 0 | 24.900.000 | 24.900.000 | 3.92 |
| Insurance costs | 0 | 16.422.625 | 0 | 0 | 16.422.625 | 16.422.625 | 2.58 |
| Legal personality expenses | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Expenses ($)** | **0** | **635.364.953** | **0** | **0** | **635.364.953** | **635.364.953** |  |

**9.3 Financial accounting**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ITEM** | **2014[$]** | | | | **TOTAL TO 2014** |
| Operative | Networking\* | Outreach\* | **Total [$]** |
| Income | 909.821.000 | 0 | 0 | 909.821.000 | 909.821.000 |
| Outcome | 635.364.953 | 0 | 0 | 635.364.953 | 635.364.953 |
| Annual balance | 274.456.047 | 0 | 0 | 274.456.047 | 274.456.047 |

*\*during this period, the institute did not received additional funds from MSI for networking or outreach.*