Final Narrative Report

Comments and visa by the Director of the Division or the Head/Director of the Field Office or Category I Institute:

Project Title
Ocean Carbon Sources and Sinks

Target Country or Region
Global

UNESCO Budget code and donor Reference if appropriate
WBS 526GLO2002

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Extrabudgetary activity funded by the Korean Institute of Ocean Science and Technology (Republic of Korea)

Total Budget approved
247.800 USD

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July 2012 – March 2014

Executing Agency
Intergovernmental Oceanographic Commission

Implementing partners
SCOR via IOCCP (The IOCCP is co-sponsored by the Scientific Committee on Oceanic Research and the Intergovernmental Oceanographic Commission of UNESCO)

Project starting date
1 July 2012

Project completion date
31 March 2014

Responsible Sector
Ocean Science Section

Name of Person completing Report
Jorge Luis Valdes

I. Summary and Background

The concentration of carbon dioxide (CO_2) in the atmosphere has increased considerably since the beginning of the Industrial Revolution due to the burning of fossil fuels. The CO_2 emissions have not only resulted in the warming of the planet but have altered the chemistry of the ocean.

Current data demonstrate that the present level of CO_2 in the atmosphere is higher that it has been for the past 800 000 years, even though the ocean has absorbed one third of the fossil carbon released to the atmosphere since the onset of industrialization. However, the capacity of the ocean to continue to absorb carbon (to act as a sink for carbon) at the same rate is questioned by scientists. The absorbed CO_2 results in the formation of more carbonic acid, which increases the acidity of seawater by 26 % and threatens a variety of marine organisms. The rate of change may be faster than at any time during the last 300 million years.

Ocean carbon research, observations, and modelling are needed at national, regional, and global levels to quantify the global ocean uptake of atmospheric CO_2 and to understand controls of this process, the variability of uptake and vulnerability of carbon fluxes into the ocean. Improving our understanding of the marine global carbon cycle is critical to determine consequences for oceanic productivity and the rest of the food web. This will help science and society answer such questions as:

Will the ocean be able to absorb anthropogenic carbon emissions at the same rate in the future? How does this impact our climate mitigation strategy?

What are the impacts on ocean ecosystem services that we depend on, such as the provision of food? How will we need to adapt in the future?

The Intergovernmental Oceanographic Commission (IOC) of UNESCO recognizes the importance of improving our understanding of the rates of transfer and pathways in global ocean carbon cycle and the societal impacts associated with changes in ocean carbon chemistry. In the past decade IOC has initiated several efforts to advance ocean carbon research and sustained observations and to inform policymakers and stakeholders.

Understanding and quantifying ocean carbon sources and sinks are of interest to all countries of the world. Within the UN system, the IOC is the only organization focusing on ocean carbon science, and responding to high-level calls for such research from the UN Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC), the Convention on Biological Diversity (CBD), and the Rio+20 conference on sustainable development.

The overall goal of this project is to improve our understanding of the rates of transfer and pathways in global ocean carbon cycle by quantifying ocean carbon sources and sinks and anticipate consequences for oceanic biodiversity and productivity in the marine ecosystem and the societal impacts associated with changes in ocean carbon chemistry.

II. Description of project implementation

Activity 1: Continued development of the Surface Ocean CO2 Atlas (SOCAT, http://www.socat.info/) Project. The SOCAT community, together with the IOCCP of IOC-UNESCO hopes to improve on several aspects of ocean carbon data reporting by developing a largely automated data submission and quality control system.

Objectives met during the project period

During the project period more than 900 new cruises underwent a quality control, to be included in SOCAT V2. The quality control comprised two levels, revealing single data points and the whole data set. The SOCAT web site was continuously updated and the user surface improved. Remarkably, there are already 2 distinct data products available: a 2nd level quality controlled global surface ocean fCO2data set following agreed procedures, and a gridded SOCAT product of monthly surface water fCO2 means on a 1x1 grid with no temporal or spatial interpolation. The gridded products (V2) are now also available in Ocean Data View and a Matlab code for using SOCAT V2 synthesis and gridded products is under revision.

Data submission for the version 3 of the Surface Ocean CO2 Atlas (SOCAT) ended the 28 February 2014.

Activities carried out during the project period

- The IOCCP organized the First Annual SOCAT meeting at Tsukuba, Japan, 2-5 July 2012.
- The IOCCP organized a Coastal and Arctic SOCAT Data Quality Control workshop, held at the NOAA-PMEL, Seattle, USA 2-4 October, 2012.
- The Surface Ocean CO2 Atlas (SOCAT) and the International Ocean Carbon Coordination Project (IOCCP) launched SOCAT V2 in June 2013.

Outputs/deliverables

- SOCAT is an outstanding product of the international marine carbon research community. It provides access to synthesis and gridded fCO2 (fugacity of carbon dioxide) products for the surface oceans. Version 2 of SOCAT is an update of the previous release (version 1) with more data (increased from 6.3 million to 10.1 million surface water fCO2 values) and extended data coverage (from 1968–2007 to 1968–2011).
- A number of papers were published during the report period, according to Google Scholar 43, this includes six directly presenting the work of SOCAT

An outstanding willingness of more than 100 seagoing marine carbon scientists enabled a project like SOCAT to be successful, though there are limited financial resources available.

The SOCAT annual meeting - In 2012, the Japanese National Institute for Environmental Studies (NIES) and IOCCP organized the annual SOCAT meeting in Tsukuba, Japan.

Further a Coastal/Arctic SOCAT Quality Control Workshop, co-organized by the IOC-UNESCO and IOCCP was hosted in the NOAA PMEL laboratories in October 2012. - First

workshop of the coastal arctic working group after the release of the live access server (LAS). The travel of several participants and the consultant contracted with the project Ocean Carbon Sources and Sinks was paid by the project Ocean Carbon Sources and Sinks. The second version (V2) was prepared during the workshop.

SOCAT and IOCCP invited to a side event during the 9th International Carbon Dioxide Conference in Beijing, 4 June 2013, where the second version of the Atlas was released (Fig. 1). This provided an opportunity to share SOCAT-related science with a wider audience.

The travel of two members of the steering committee, Dorothee Bakker (UEA, UK) and Maciej Telszewski (IOCCP, Poland), was covered by the project Ocean Carbon Sources and Sinks.

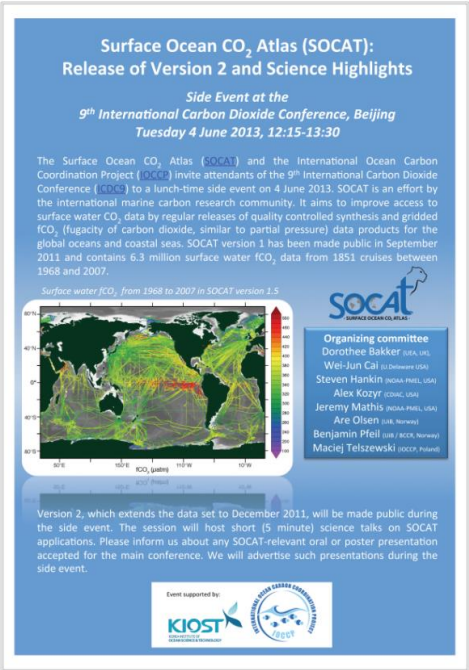

Figure 1. Official announcement for the side event during the 9th International Carbon dioxide Conference in Beijing, 4 June 2013, introducing the second version of the Surface Ocean CO2 Atlas.

Several articles in peer-reviewed journals were published since 2013:

Pfeil, B. et al.: A uniform, quality controlled Surface Ocean CO2 Atlas (SOCAT), Earth Syst. Sci. Data, 5, 125-143, doi:10.5194/essd-5-125-2013, 2013.

Sabine, C. L. et al.: Surface Ocean CO2 Atlas (SOCAT) gridded data products, Earth Syst. Sci. Data, 5, 145-153, doi:10.5194/essd-5-145-2013, 2013, 2013.

Rödenbeck, C. et al.: Global surface-ocean pCO2 and sea-air CO2 flux variability from an observation-driven ocean mixed-layer scheme. Ocean Science 9: 193-216, doi:10.5194/os-9-193-2013, 2013.

Schuster, U. et al.: Atlantic and Arctic sea-air CO2 fluxes, 1990–2009. Biogeosciences, 10, 607-627, doi:10.5194/bg-10-607-2013, 2013.

Wanninkhof, R. et al. (2013) Global ocean carbon uptake: magnitude, variability and trends, Biogeosciences, 10, 1983-2000, doi:10.5194/bg-10-1983-2013, 2013.

Bakker, D. C. E. et al. (2014) An update to the Surface Ocean CO_2 Atlas (SOCAT version 2). Earth System Science Data, 6, 69-90. doi:10.5194/essd-6-69-2014.

From the Republic Korea Geun Ha Park (KIOST) participates in the SOCAT initiative and she is also a co-author in the recently published article (Bakker et al. 2014)

Main problems encountered and measures taken to overcome them

No problems encountered.

Activity 2: Global system of Time Series stations

Objectives met during the present reporting period

Actions during the project period concentrated on the review of Time Series with regard to sampling, analytical methodologies, and the rationales behind protocol difference. To the extent possible it was attempted to define standardized methods applicable across Time Series. Further new techniques available for more accurate and simplified measurements were examined during the reporting period, and a coordinated best practices publication on sampling and measurement protocols to facilitate data inter-comparison across Time Series sites was published on the workshop website.

Furthermore a new core working group was created – The International Group for Marine Ecological Time Series (IGMETS). IGMETS targets a flashy publication, designed for a wide audience, seeks to look at changes of a variety of parameters at a global scale as seen through time-series data. Changes/variability at a regional scale will be highlighted, as well as global trends. Additional products like the internet platform (http://igmets.net), an online metadata-base and additional scientific/policy articles will facilitate to broader the audience and visibility of this activity.

Activities carried out during the present reporting period

- An international Time Series method workshop at the Bermuda Institute for Ocean Sciences (BIOS), home of the Bermuda Atlantic Time Series Study (BATS) November 28-30 2012 was organized and co-convened by the IOCCP. The technical report is available online (http://www.us-ocb.org/publications/TS_Workshop_report_FINAL.pdf). It provides assistance and best practice guidelines for future Time Series studies.
- The IOC-UNESCO was responsible for the compilation of metadata of biogeochemical time series worldwide. A map available at the IOC-UNESCO website (http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/) shows the position of more than 140 time series. The corresponding metadata information is available online (http://www.whoi.edu/website/TS-network/time-series-information).
- The IOC-UNESCO organized a meeting of a core group of IPs leading time series programmes; this initiative, IGMETS (International Group for Marine Ecological Time Series), convened in March 2014 in St. Petersburg (US). This group will produce a scientific report including time series, which last longer than 5 years, covering all regions, including the following variables: temperature, salinity, oxygen, carbon data, Chl*a*, phyto- and zooplankton data, and nutrients. Following this first meeting a new internet site was prepared and the group will update and broader the content of this site on a regularly basis. (http://igmets.net/)

Outputs/deliverables

- Technical report on Best practice guidelines for future Time Series studies: An international Time Series methods workshop jointly convened by the IOCCP and the Ocean Carbon & Biogeochemistry (OCB) Program was organized. The workshop was held at the Bermuda Institute for Ocean Sciences (BIOS), home of the Bermuda Atlantic Time Series Study (BATS), one of the long-lasting ship-based biogeochemical Time Series. The workshop focused specifically on the methods employed by the specific Time Series. The final result a workshop report, states the methods recommended for common Time Series parameters (http://www.us-ocb.org/publications/TS_Workshop_report_FINAL.pdf). In total 44 Time Series around the globe from 17 countries sent their representatives. The Korean expert Tae Siek Rhee (KIOST) travelled and participated in this workshop with the financial support of the project 'Ocean Carbon Sources and Sinks'. The project Scientists and technicians attending the meeting facilitated the common understanding of scientific goals and methodological rationale as well as sample collection and analyses.

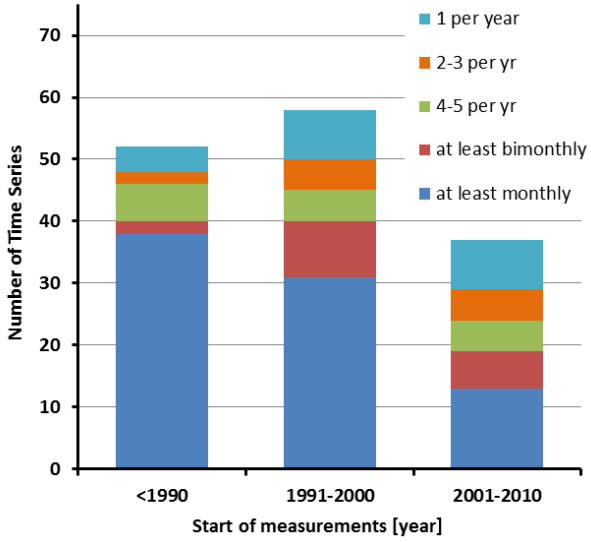

Figure 2. Number of Time Series projects, grouped by starting date; before 1990, between 1991 and 2000, or between 2001 and 2010. The color code indicates the number of measurements/cruises per year.

- Compilation of existing biogeochemical Time Series: In this regard the IOC-UNESCO continued to work on the compilation of existing biogeochemical Time Series and has put together the 44 sites presented at the Workshop with others from the North Atlantic (including the Baltic and the Mediterranean Seas). In total, more than 160 biogeochemical Time Series have been compiled so far (Fig. 2), which served as an embryo for the subsequent formation of the IGMETS. A website representing the current state of compilation is accessible here: http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/, and the support of KIOST is acknowledged (Fig.3).

Figure 3. Website presenting the ongoing process of compiling biogeochemical time series worldwide http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/

- IGMETS website: In continuation of the previously mentioned workshop held in November 2012, IGMETS was created under the lead of IOC-UNESCO, with IOCCP and the OCB. This new initiative, consisting of a core group of ten people, who met in St. Petersburg (US) to enforce the started work and to elaborate how to compile and disseminate a comprehensive, integrated interpretation of global biogeochemical ocean changes as seen through time-series. The main outcome document will be a scientific report, accompanied by e.g. a website and further science/policy publications. Integrated selected variables will be used to look at holistic changes within different ocean regions, to explore plausible reasons and connections at a global level, and to highlight any regions of especially large changes that may be at greater risk. The major audience for the envisaged publication will be the scientific community; nevertheless side products aim to guide policy makers and local stakeholders. This is a massive effort, in the hopes that the importance of Time Series sites is highlighted worldwide (Fig. 4, 5).

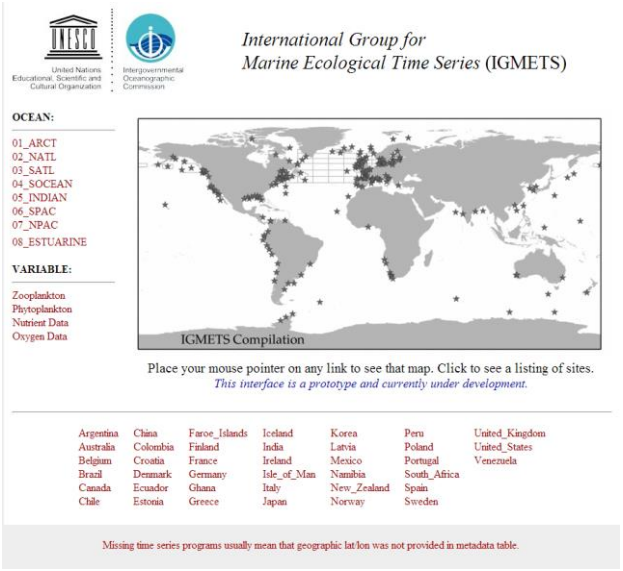

Figure 4. Website presenting the ongoing process of IGMETS. http://igmets.net/maps/index.html

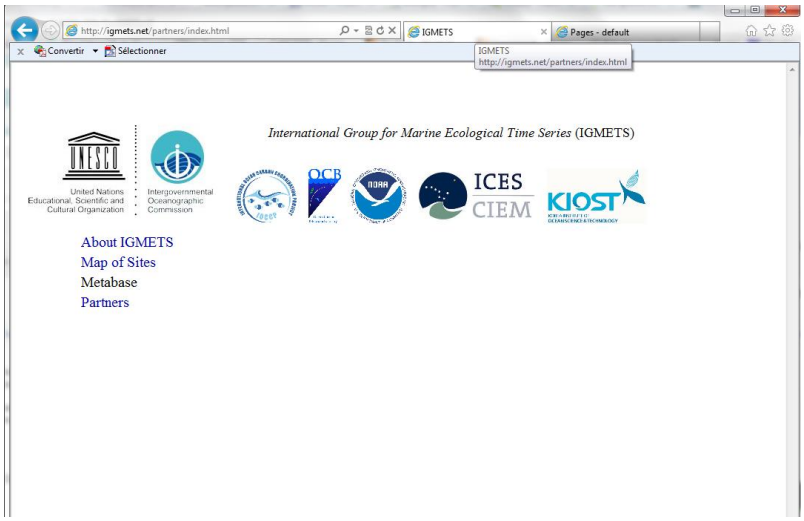

Figure 5. Website presenting the partners of IGMETS, including KIOST. http://igmets.net/partners/index.html

Main problems encountered and measures taken to overcome them

No problems encountered.

Activity 3: Symposium on the Ocean in a High-CO2 World

Objectives met during the project report

The objective was to create a forum for scientific and technical discussions. It was aimed to offer the worldwide community of scientists working to understand the impact of OA an opportunity a venue to share their research results and develop new collaborations. Hence the series of international symposia 'Oceans in a high CO_2 World' is co-organized by IOC-UNESCO, SCOR and IGBP.

Ocean acidification is an emerging global concern and is a risk to marine biodiversity, ecosystems and human society. The third Ocean in a High-CO2 World symposium built on this knowledge to show:

- The ocean continues to acidify at an unprecedented rate in Earth's history. Latest research indicates the rate of change is faster than at any time in the last 300 million years.
- Impacts start at the species level, which will cause changes in food webs and at the ecosystem level, affecting fisheries, aquaculture and hence societies.
- Multiple stressors – ocean acidification, global warming, deoxygenation, eutrophication and over-fishing – and their interactions are creating significant challenges for ocean ecosystems.
- Within decades the changes in carbon chemistry of the tropical oceans may hamper or prevent coral reef growth.
- Large parts of the polar oceans will become corrosive to calcareous marine organisms within decades due to ocean acidification.
- As the ocean takes up more carbon dioxide it becomes less efficient at absorbing this greenhouse gas and hence in moderating climate change.
- Species-specific impacts of ocean acidification have been seen in laboratory studies on organisms from tropical corals to marine snails that are important prey for fish in Polar Regions.
- Many organisms show adverse effects, for example, reduced ability to form shells and skeletons, reduced survival, growth, abundance and larval development.
- Conversely, there is evidence that some organisms tolerate more acidic conditions and others, such as seagrasses, may even thrive.
- All species have the potential to adapt, for example, through evolution, or relocation. But the ocean's chemistry may be changing too rapidly for many to maintain a sustainable recruitment.
- We do not fully understand the biogeochemical feedbacks to the climate system which may arise from ocean acidification.
- Predicting how whole ecosystems will change in response to rising CO2 levels remains challenging. While we are able to expect changes in marine ecosystems and biodiversity within our lifetimes, we are unable to make reliable quantitative predictions of socio-economic impacts.
- Socio-economic impacts of ocean acidification are a real concern. For example commercial shell fisheries will have to adapt. Coral reef loss will affect tourism, food security and shoreline protection.

The symposium was attended by a total of 529 scientists from 34 countries, four participants from the Republic of Korea: Kim Kyungsu (Pukyon National University), Noh Jeahoon (KIOST), Sharfi Rayeni Sadriyeh (ICCN), and Shi JeongHee (National Fisheries Research and Development).

Activities carried out during the present reporting period

- The IOC-UNESCO co-organized the third international symposium 'Ocean in a high CO_2 World' in September 2012. Subsequently IOC-UNESCO agreed to launch a survey among the participants and to use the provided information in order to

evaluate and decide about the individual involvement of the different organizations in the next edition.

- The IOC-UNESCO co-led the preparation of the Ocean Acidification Summary for Policymakers which was published in November 2013 (Fig. 6).

Outputs/deliverables

- Ocean Acidification Summary for Policy Makers (OA SPM): To send a very timely message to leaders attending COP19 in November 2013 that atmospheric CO_2 emissions have to be brought under control to avert serious ocean acidification impacts and socio-economic consequences, the scientific community (leaded by IOC, IGBP and SCOR) prepared a new summary for policy makers about Ocean Acidification, released a few days before the UNFCCC COP19 (Fig. 6). This summary is an international assessment by a group of experts of the latest ocean acidification research presented at the world's largest gathering of experts on ocean acidification ever convened. The assessment also includes the latest peer-reviewed publications. The experts conclude that the acidity of the world's ocean may increase by around 170% by the end of the century leading to significant changes in marine ecosystems, loss of biodiversity and economic losses. People who rely on the ocean's ecosystem services – often in developing countries - are especially vulnerable.

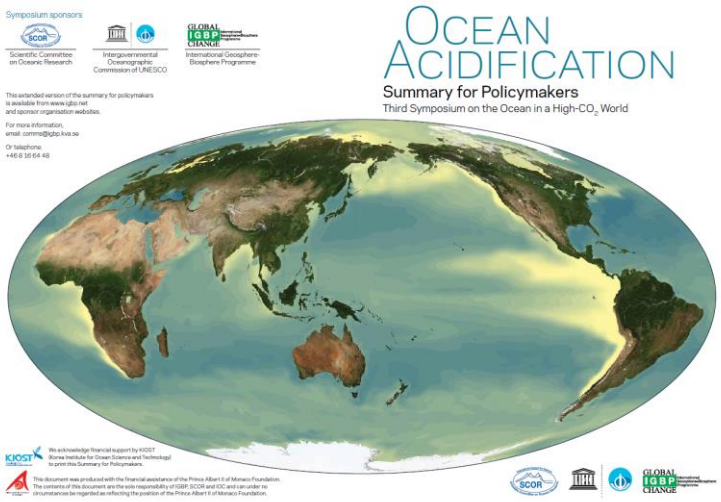

Figure 6. Front and back cover pages of the Ocean Acidification Summary for Policymakers (2013).

- Subsequently the Ocean Acidification Summary for Policymakers was translated into French and Spanish. Thanks to our colleagues from the Republic of Korea a version in Korean is available as well. The translation of the document will generate a higher visibility and increase the sensitivity.

Main problems encountered and measures taken to overcome them

No problems encountered.

Activity 4: Developing and participating in OA policy awareness activities

Objectives met during the project period

During the project period the IOC and the international Ocean Under Stress partnership raised awareness on OA on different political fora (UNFCCC, CBD and the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the "Informal Consultative Process", or ICP).

Due to the increasing awareness and sensitivity towards OA, temperature increase, and climate change, and partly due to the work of international collaboration, the outcome paper 'The Future we want' of Rio+20 stresses the critical role the ocean plays in all three pillars of sustainable development, and "commit[ed] to protect, and restore, the health, productivity and resilience of oceans and marine ecosystems, and to maintain their biodiversity, enabling their conservation and sustainable use for present and future generations". It contains 20 paragraphs (158-177) in a dedicated section on the ocean and seas, and some additional paragraphs on other subsections. OA was mentioned in three paragraphs throughout the document (166, 176, and 190). In particular there was a call to support initiatives that address OA impacts on marine and coastal ecosystems and resources.

The call was heard, and therefore the Global Ocean Acidification Observing Network (GOA-ON) was announced in July 2012.

Activities carried out during the present reporting period

- Pursuant to paragraph 261 of the UNGA resolution, the ICP focused its discussions during the fourteenth meeting (New York from 17 to 20 June 2013) on the topic entitled "Impacts of ocean acidification on the marine environment". In this regard IOC-UNESCO provided a report on the topic which was submitted to the UN Division of Ocean Affairs and Law of the Sea (DOALOS), which was included in the document - Report of the Secretary-General A/68/71: Report of the Secretary-General on Oceans and the law of the sea.
- A Global Ocean Acidification Observing network (GOA-ON) was announced in July 2012. The second international workshop of the Global Ocean Acidification Observing Network (GOA-ON) will convene in St. Andrews, Scotland, UK on 24-26 July 2013, with the support of the IOC-UNESCO.
- The IOC-UNESCO was the main organizer of a COP19 side event on Ocean Acidification. In cooperation with UN agencies, NGOs and national Ocean Acidification programmes this event was used to enhance the awareness towards the threat of Ocean Acidification and how this affects the marine environment. The public launch of the OA SPM was conducted during this side event (Fig. 7). Besides that this side event highlighted initiatives to address the challenges associated with ocean acidification, including the need for greater international observation and coordination. The side event was coordinated by the IOC-UNESCO in partnership with the International Atomic Energy Agency (IAEA), the Scientific Committee on Oceanic Research (SCOR), the World Meteorological Organization (WMO), the Plymouth Marine Laboratory (PML), the International Maritime the International Organization (IMO) and the Geosphere-Biosphere Programme (IGBP). The event attracted, 150 people, covering a broad audience including journalists, parties, NGOs and UN agencies/organizations.

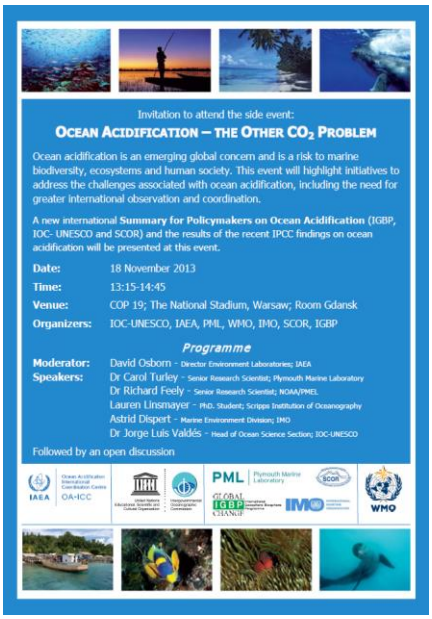

Figure 7. Announcement for the OA side event at the 19th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP19)

- Furthermore the financial support of the project Ocean Carbon Sources and Sinks enables the IOC to be part of the Global Ocean Acidification Observing Network (GOA-ON). With regard to that the IOC-UNESCO was in part of the organization team of a side event at the GEO-X in January 2014, presenting the Network and promoting its important role in coordination and improving ocean observation to detect the impacts of ocean acidification (Fig. 8).

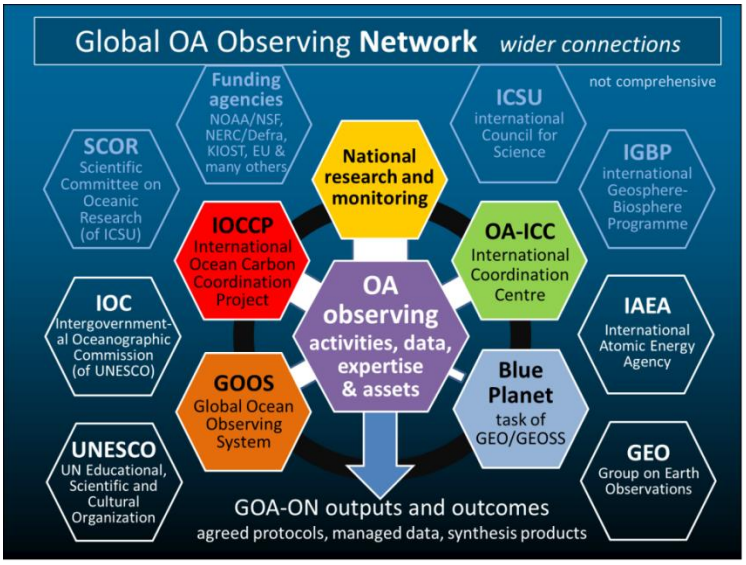

Figure 8. Overview of functions, connections, and relations within the Global Ocean Acidification Network. Note the KIOST position in the section for funding agencies.

- In addition IOC-UNESCO organized one parallel session at 'The World Science Forum', which will take place in Rio de Janeiro in November 2013 with the theme 'Science for Global Sustainable Development'.
- Preparation of a TV Corner for the Second International Ocean Research Conference in November 2014 to raise awareness for Ocean Acidification.

Outputs/deliverables

- During the second international workshop of the GOA-ON was convened in St. Andrews, Scotland, UK on 24-26 July 2013, as well thanks to the support by the project 'Ocean Carbon Sources and Sinks', the integrated global observing network for both carbon and OA that addresses the requirements of nations affected by this emerging environmental threat in response to societal needs was established. The consultant financed by the project 'Ocean Carbon Sources and Sinks' attended and co-led a breakout group; in addition, the travel of two participants was financed with the help of this project. The project 'Ocean Carbon Sources and Sinks' assured the continued engagement of IOC-UNESCO within this initiative (Fig. 8). Website of the GOA-ON http://www.pmel.noaa.gov/co2/GOA-ON/; Leaflet of the GOA-ON http://www.earthobservations.org/documents/se/165_goa_on_leaflet.pdf
- The IOC-UNESCO hosted a side event during the UNFCCC COP19 in Poland in November 2013, highlighting initiatives to address the challenges associated with ocean acidification, including the need for greater international observation and coordination. The presentations and discussions focused on OA as a policy issue, as well as the need for mitigation, adaptation, a global observing network and coordination of research, and capacity building. Beyond the UNFCCC, IOC-UNESCO and the CBD secretariat continued cooperating on issuing a report on ocean acidification and biodiversity/ecosystem function in 2014. Presentations of side event available online: https://seors.unfccc.int/seors/reports/events_list.html?session_id=COP19__(Monday 18 November 2013); Global press attention after and during the side event at the COP19 (Annex VII).
- Another side event co-organized by the IOC-UNESCO at the GEO-X in January 2014, presented the GOA-ON and promoted its important role in coordination and improving ocean observation to detect the impacts of ocean acidification (Fig. 9). IOC-UNESCO together with the other organizations used this occasion to place GOA-ON in the Blue Planet task of the GEO, which focuses on the ocean domain, crucial in all of the cycles of life on earth. Much of it is an area beyond national jurisdiction, and the common heritage of all humankind. Observations of the ocean domain contribute in different ways to all of the 9 GEO Societal Benefit Areas and Ocean Acidification specifically will affect climate, agriculture via fisheries for example, of course ecosystem health and therefore ecosystem services and nevertheless ocean acidification will alter the marine biodiversity. Interview with Kirsten Isensee on Ocean Acidification - http://www.unesco.org/new/en/natural-sciences/ioc-oceans/infocus-oceans/features/ocean-acidification-interview/

Figure 9. Announcement for the GOA-ON side event at the GEO-X January 2014.

Further the IOC-UNESCO organized a parallel session on the Ocean at 'The World Science Forum', which took place in Rio de Janeiro in November 2013 with the theme 'Science for Global Sustainable Development'. This parallel session was entitled 'Applying Ocean Sciences and Knowledge for Societal Benefit: Demands After Rio+20'. The session highlighted the direct link between climate change, the health of the ocean, and human well-being, as well as the need to apply ocean sciences knowledge for social benefit to reverse the degradation of marine ecosystems, and to minimize climate change impacts and other pressures on coastal communities and ocean ecosystems and resources; and as Rio+20 called for initiatives drawing attention toward OA this event referenced to the project 'Ocean Carbon Sources and Sinks'.

Main problems encountered and measures taken to overcome them

The quick development of the GOA-ON was not foreseen in the beginning of the project. Though, due to the fact that it is one of the emerging initiatives of the scientific Ocean Acidification community it was included in the updated workplan of the 'Ocean Carbon Sources and Sinks' project. Thanks to the support by the Republic of Korea the IOC-UNESCO can play an active role within that network.

Activity 5: Standards for quantifying and monitoring carbon storage

Objectives met during the project period

Internationally applicable standards for quantifying and monitoring carbon storage, sequestration, and emissions in coastal ecosystems on regional and local scales were identified and a 12-member subcommittee of the Working Group met in Bali, Indonesia, on July 26-28, 2011 and outlined the Field Guide for Carbon Accounting in Mangroves, Seagrasses and Salt Marshes applicable at national and local levels. The guide is subject to significant peer and user review before being published.

Activities carried out during the present reporting period

- A 12-member subcommittee of the Blue Carbon Scientific Working Group outlined a Field Guide for Carbon Accounting in Mangroves, Seagrasses and Salt Marshes applicable at national and local levels. After the presentation of a first draft in July 2012 during a meeting in Paris, the final draft was delivered in December 2012. The draft was further discussed during the last meeting of the Scientific Blue Carbon Working group in May 2013.
- During the project period the Field Guide was further reviewed and edited.
- Furthermore the scientific working group published a short document explaining Blue Carbon/Coastal Ecosystems and why sound management of these key natural carbon sinks matter for greenhouse gas emissions and climate change. FAQ about Coastal/Blue Carbon (http://thebluecarboninitiative.org/wp-content/uploads/BC_FAQ_UNFCCC-2.pdf). This leaflet is now also available in French and Spanish.

Outputs/deliverables

- Publication of the 'Coastal Blue Carbon Field Guide' (expected end of June 2014): Currently the peer review is still in process; therefore the publication of the 'Coastal Blue Carbon Field Guide' is slightly delayed and it will be launched end June 2014 (Fig. 10). Presently the group works to include last corrections.

Figure 10. Front cover page of the field guide 'Coastal Blue Carbon, methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrasses'.

- FAQ about Coastal/Blue Carbon (http://thebluecarboninitiative.org/wp-content/uploads/BC_FAQ_UNFCCC-2.pdf)

Main problems encountered and measures taken to overcome them

The publication of the field guide is delayed for a few months. The peer review process takes more time than expected, which is partly due to the voluntary commitments by authors and reviewers. Nonetheless the publication is envisaged for June 2014 and the final product will be a widely used document improving the science on coastal blue carbon. In

the meantime the published FAQs are supporting the idea of conversation and protection of coastal blue carbon areas by educating policy makers and stakeholders

Activity 6: Access to coastal "blue" carbon data

Objectives met during the project period

The Working Group is establishing a Global Coastal Carbon Data Archive to support better data management practices and standardization of data, and to bring together, in a common format, all the available carbon data for the coastal ecosystems. The next meeting is supposed to be held in fall 2014 in Brazil, followed by one early 2015 in the Republic of Korea.

According to best practice principles, the entire policy cycle from ideas to policy implementation and review must rest on a firm technical and scientific base to ensure high quality, independent, policy relevant, and "geo-politically" legitimate scientific information and advice. With this in mind, IOC-UNESCO restricts most of its activity to the scientific group while keeping up to date on the activities of the policy group.

Activities carried out during the project period

- During the project period one Blue Carbon Scientific Working Group workshop was held on May 21-23, 2013 in Sydney, Australia at the University of Technology Sydney (UTS). The meeting focused on blue carbon science in Australia and the Coral Triangle region. Coral Triangle sessions mainly discussed scientific gaps and the region's opportunities to leverage blue carbon for coastal conservation.
- A second Blue Carbon Scientific Working Group workshop was held on October 29-30, 2013 in Paris, UNESCO headquarters. The agenda for the meeting concentrated on issues related to remote sensing and mapping of coastal carbon ecosystems. This meeting was possible thanks to the financial support by the Republic of Korea. Mr. Hyun Taek Lim on behalf of the permanent Delegation of the Republic of Korea opened the workshop and welcomed the participants. Following the workshop the terms of reference and future plans for the group were evaluated and updated.
- Furthermore the consultant hired by the project Ocean Carbon Sources and Sinks participated at the UNFCCC workshop on technical and scientific aspects of ecosystems with high-carbon reservoirs not covered by other agenda items under the Convention, 24 to 25 October, Bonn, Germany. She gave a presentation dealing with 'Anthropogenic impacts on wetland – how to address them'.

Outputs/deliverables

- The activities within the Blue Carbon Scientific Working Group, which were supported by the 'Ocean Carbon Sources and Sinks' are visible at the recently released website through the display of the logo at www.thebluecarboninitiative.org (Fig. 11).

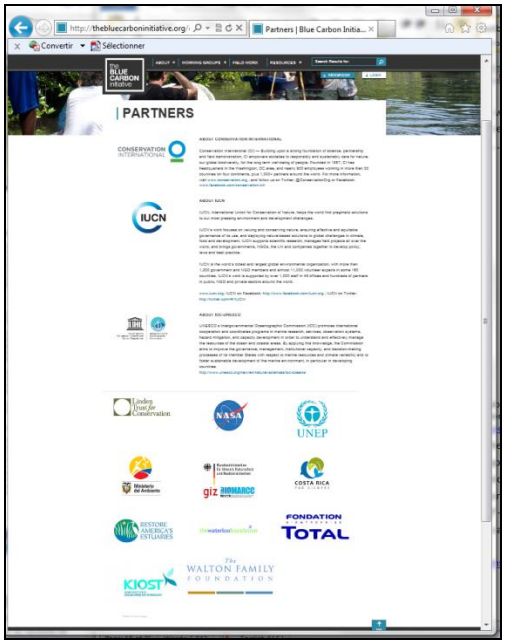

Figure 11. Website presenting the partners involved in the Blue Carbon Initiative http://thebluecarboninitiative.org/category/resources/partners/

- Following the UNFCCC workshop in Bonn the SBSTA "encouraged" Annex 1 countries to use the Supplement in preparing national inventories, dealing with newly calculated emission factors for coastal carbon environments. http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600007689#beg

Main problems encountered and measures taken to overcome them

The development of a Blue Carbon Data Archive is delayed (Activity 6). Actions towards it were started, but due to the huge technical efforts needed for this to be implemented, the development of it continues and will not be finished by the end of the project.

Activity 7: Outreach, Communication and fundraising on Ocean Carbon

Objectives met during the project period

The global community of oceanographers and more specifically in complex matters such as ocean carbon and ocean acidification needs to communicate more effectively with the public. IOC supports public outreach and communication in its projects and programmes aimed to:

- Control quality standards for public outreach and communication
- Identify the messages that resonate among specific target audiences
- Assemble best practices, formats, and tools to aid effective public outreach and communication
- Promote recognition of achievements and make public outreach and communication a visible and integral part of our projects, activities and operations
- Encourage greater linkages with successful ongoing efforts in other organizations

Activities carried out during the project period

The activities of the *Ocean Carbon Sources and Sinks* project resulted in high visibility for both KIOST and IOC-UNESCO. With the support of Mr. Hyun Taek Lim from the Republic

of Korea, outreach and communication activities represented a high proportion of the work conducted during the project period.

- During the Symposium on Integrating New Advances in Mediterranean Oceanography and Marine Biology (26-29 November 2013, Barcelona, Spain), the project Ocean Carbon Sources and Sinks (http://www.icm.csic.es/bio/medocean/images/presentations/posters/Isensee_MO_2013.pdf) was presented to the scientific audience. The talks and poster presentations addressed a wide range of topics, including the national organization of Spanish scientists and how to improve the international engagement.
- COP19 side event on Ocean Acidification
- GEO-X side event on the Global Ocean Acidification Observing Network

Outputs/deliverables

Examples from the internet are listed below:

- *Outreach OA:*
  COP19 side event on Ocean Acidification
  https://seors.unfccc.int/seors/reports/archive.html (including the presentations)
  Updated website: http://ocean-acidification.net (Fig. 12)
  Blueprint IOC-UNESCO
  http://www.unesco.org/new/en/natural-sciences/ioc-oceans/priority-areas/rio-20-ocean/blueprint-for-the-future-we-want/ocean-acidification/
  Ocean Acidification Summary for policymakers
  http://www.igbp.net/publications/summariesforpolicymakers/summariesforpolicymakers/oceanacidificationsummaryforpolicymakers2013.html (impact on media Annex VII)
- *Dedicated IOC-UNESCO web pages on OA and IOCCP:*
  http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/
- *Time Series and IOCCP:*
  http://www.ioccp.org/TS.html

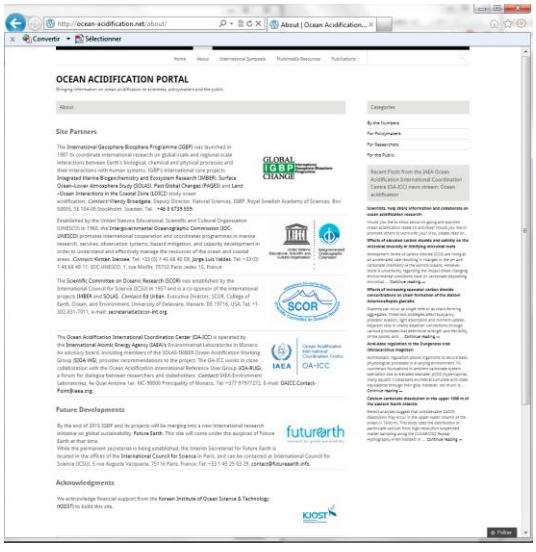

Figure 12. Screenshot of the http://ocean-acidification.net website.

- *SOCAT:*
  http://www.socat.info/
- *The Blue Carbon initiative:*
  Website 'Blue Carbon Initiative'
  http://thebluecarboninitiative.org/category/resources/partners/
  http://thebluecarboninitiative.org/wp-content/uploads/BCWG-Sydney-report_final.pdf
  UNFCCC participation
  http://unfccc.int/files/science/workshops_meetings/application/pdf/isensee_kirsten.pdf
- *Biogeochemical Time Series compilation:*
  http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/
  http://igmets.net/
- *GOA-ON:*
  GOA-ON website
  http://www.pmel.noaa.gov/co2/GOA-ON/
  GEO-X side event on the Global Ocean Acidification Observing Network
  http://www.earthobservations.org/me_sevent.php?seid=165
- *Ocean Carbon Sources and Sinks (Fig. 13)*
  http://www.icm.csic.es/bio/medocean/images/presentations/posters/Isensee_MO_2013.pdf

In addition fluid communication with MLTM and KIOST in order to search for new funding opportunities on different activities carried out by IOC-UNESCO was maintained.

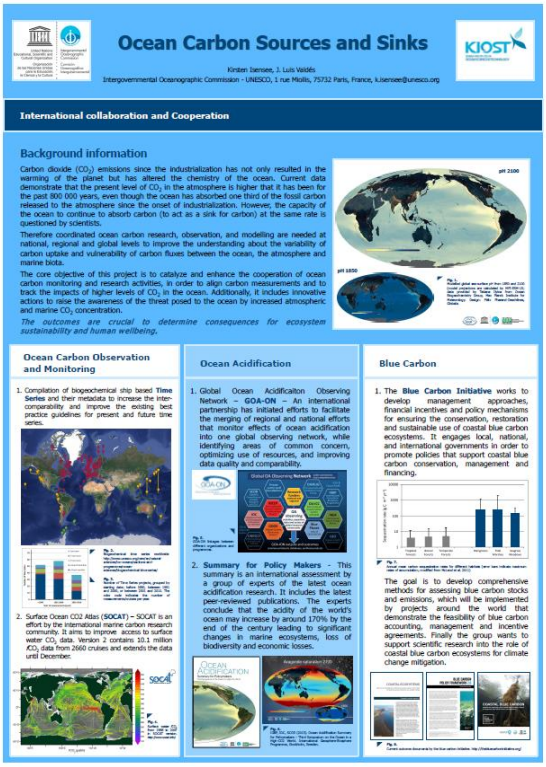

Figure 13. Poster presented at the MedOcean Symposium 'Integrating New Advances in Mediterranean Oceanography and Marine Biology' in November 2013.

In addition fluid communication with MLTM and KIOST in order to search for new funding opportunities on different activities carried out by IOC-UNESCO was maintained.

Problems encountered

No problems encountered.

III. Progress towards results

In light of the direct beneficiaries delivered by the project *Ocean Carbon Sources and Sinks* the IOC-UNESCO was able to raise awareness for threats the coastal and open ocean suffers from.

The above described actions were conducted to achieve the overall goal to improve our understanding of the rates of transfer and pathways in global ocean carbon cycle by quantifying ocean carbon sources and sinks and anticipate consequences for oceanic biodiversity and productivity in the marine ecosystem and the societal impacts associated with changes in ocean carbon chemistry.

The major results of the original project proposal were attained; solely the development of a Blue Carbon Data Archive is postponed (Activity 6). Actions towards it were started, but due to the huge technical efforts needed for this to be implemented, the development of it continues and will not be finished until the end of the project.

Besides that the strong involvement in the GOA-ON was not foreseen in the beginning of the project, nevertheless it appeared to be one of the emerging initiatives of the scientific Ocean Acidification community and the support by the Republic of Korea enabled the IOC-UNESCO to be an important partner within the network.

The strong collaboration with the Republic of Korea, the scientific community, different UN-agencies, NGOs and scientific programmes facilitated the project Ocean Carbon Sources and Sinks to be successful. During the past one and half year new relations were build and previous existing maintained. Close alliances between different organizations are mandatory to connect scientists with policy makers and stake holders.

The major goals envisaged in the project were achieved in due time and within the agreed deadline.

Summary Table

<table>
<tr><td colspan="3">Overall goal of the project

To improve our understanding of the rates of transfer and pathways in global ocean carbon cycle by quantifying ocean carbon sources and sinks and anticipate consequences for oceanic biodiversity and productivity in the marine ecosystem and the societal impacts associated with changes in ocean carbon chemistry.</td><td colspan="2">Overall assessment :

The major goals were achieved at the end of the project 31 March 2014.</td></tr>
<tr><td rowspan="2">Expected Results</td><td colspan="2">Performance Indicators (PI) and associated Target (T)/baselines (b)</td><td rowspan="2">Achievement(s)</td><td rowspan="2">Outputs/deliverables contributing to expected results</td></tr>
<tr><td>Programmed</td><td>Attained</td></tr>
<tr><td rowspan="2">Title of Expected Result N° 1

Improve compatibility and comparability of results of ocean carbon data and deliver products that can be integrated with the terrestrial, atmospheric and human dimensions components of the global carbon cycle</td><td>PI: SOCAT 2 launched in spring 2013
T/b: Number of cruises available in SOCAT increased by 15%.

Number of records available in SOCAT increased by 20%</td><td>YES</td><td rowspan="2">Enhanced compatibility and comparability of ocean carbon data, with products including the anthropogenic impact on the ocean</td><td>Output/deliverable 1:

SOCAT V2</td></tr>
<tr><td>PI: Establishment of a central management for the global system of Time Series stations measuring carbon parameters
T/b: Compilation of ship based biogeochemical Time Series</td><td>YES</td><td>Output/deliverable 2:

Updated map of biogeochemical time series worldwide, Creation of the International Group for Marine Ecological Time Series with its own internet presentation</td></tr>
<tr><td>Title of Expected Result N° 2

Raise awareness of Ocean Acidification</td><td>PI: Third Symposium on the Ocean in a High-CO_2 World
T/b: Best papers published in a scientific peer review journal by the end of 2013</td><td>YES</td><td>Ocean Acidification was recognized as an global threat for the ocean and IOC-UNESCO became one major partner within the Global Ocean Acidification Observing Network</td><td>Output/deliverable 1:

Summary for Policy Makers on Ocean Acidification, updated ocean-acidification.net website</td></tr>
</table>

Title of Expected Result N° 3 Advancing the scientific, management and policy actions and developing management and conservation tools that ensure marine coastal ecosystems continue to sequester carbon and to develop and implement a comprehensive plan to value blue carbon	**PI:** Publication of the Field Guide for Carbon Accounting in Mangroves, Seagrasses and Salt Marshes applicable at national and local levels **T/b:** The Guide will be printed by the end of 2013	**IN PROGRESS**	New developments of Blue/Coastal Carbon were recognized by the UNFCCC. Several reports and scientific articles featured blue carbon due to the support by the scientific working group of the blue carbon initiative. Korean scientists are now part of the blue carbon initiative.	**Output/deliverable 1:** FAQ concerning blue carbon were published in November 2013. The field guide will be available in June 2014.
	PI: Establish a Global Coastal Carbon Data Archive **T/b:** carbon data will be available for Mangroves, Seagrasses and Salt Marshes	**NO**		**Output/deliverable 2:** A new website including the activities of the blue carbon initiative was put online in 2013, FAQ on Coastal Blue Carbon published

IV. Sustainability and Exit/ transition strategy

Understanding and quantifying ocean carbon sources and sinks are of special interest to all countries of the world. Within the UN system, the IOC is the only organization focusing on ocean carbon science, and responding to high-level calls for such research from the UN Framework Convention on Climate Change (UNFCCC) by the Regular Process in June 2013 (IPC focussed on ocean acidification), the Intergovernmental Panel on Climate Change (IPCC), the Convention on Biological Diversity (CBD), and the Rio+20 conference on sustainable development (The Future we want - 20 paragraphs in a dedicated section on oceans and seas, and an additional three paragraphs on small island developing States (SIDS), further ocean acidification is specifically mentioned). During the reporting period the financial commitment by the Republic of Korea enabled the IOC to be involved and obtain new possibilities to communicate the problems the ocean faces by enhanced CO_2 concentrations. Nevertheless with the recent financial situation the IOC and therefore the UN system risks losing its link with this key ocean science community.

Therefore the sustained financial contribution from the Republic of Korea for ocean carbon at IOC is a strong signal of engagement with a key issue for the future of sustainable development, and an opportunity to assure an unequivocal commitment to science for sustainability in the multilateral system. By finding a second phase of the 'Ocean Carbon Sources and Sinks' project the Republic of Korea demonstrates that it is a major player in ocean sciences at the global scale. Holding some of the meetings related to the IOC's ocean carbon activities in Korea in the future will facilitate the involvement of the Korean science community and government funders of ocean science.

V. Visibility

As mentioned under activity 7 several actions were undertaken to disseminate the information gained during the project Ocean Carbon Sources and Sinks.

The logo of KIOST was placed in several publications/websites, e.g. www.thebluecarboninitiative.org, the Summary for Policy Makers on Ocean Acidification, a poster presented during the MedSea Symposium (http://www.icm.csic.es/bio/medocean/images/presentations/posters/Isensee_MO_2013.pdf), or at the website presenting the ongoing process of biogeochemical time series worldwide http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/).

VI. Challenges and lessons learnt

Due to strong collaborations with different organizations and scientists the IOC-UNESCO was able to achieve the overall goal of the project and the major results. Nevertheless collaboration between different groups also needs time and sustained communication to produce successful products for scientists, stakeholders and policy makers. Therefore the IOC approached the Republic of Korea to sustain its support for activities related to Ocean Carbon Sources and Sinks. The maintenance of new partnerships and initiated activities is needed communicate the importance of a sustainable use of the ocean and how the resilience of it is threaten by human activities.

It was especially encouraging to see that activities supported by the Blue Carbon Initiative and IOC-UNESCO were recognized and encouraged by the SBSTA.

Most of the project outputs and deliverables were on time, though the incorporation of recent scientific findings caused some delays.

The project management and implementation was conducted according to the submitted project proposal.

No modifications had to be approved regarding the project document and/or budget and/or workplan.

VIII. Annexes

i. Self-evaluation approach

SISTER

SISTER (**S**ystem of **I**nformation on **S**trategies, **T**asks and the **E**valuation of **R**esults) is one of the Organization's IT-based management tools which follows and supports the Results-Based Management (RBM) approach as applied in UNESCO. RBM is a cornerstone of UNESCO and UN reform. It constitutes a central pillar of the Organization's programming, operations and monitoring and is critical for the accountability, effectiveness and efficiency of programme and management as requested by UNESCO's Governing Bodies.

The core of the system lies in the definition of expected results - and the strategy to attain them - by the person responsible for each element at the various programme levels. Each level of the hierarchy is given the means to fully exercise its responsibilities and is fully accountable for the programming and implementation of the interventions undertaken. This process is meant to be interactive, in the sense that the proposals from each level answer to the direction of the higher level and provide for a process of a programming and budgetary negotiation.

The main sources of information for the self-evaluation were the monthly reports of the consultant contracted with the financial support by the project 'Ocean Carbon Sources and Sinks', reports by experts who received fellowships and of course the mission reports written by the staff. Additionally our partners informed us about the ongoing activities funded by the project.

The established collaborations between the different organizations and the excellent communication with partners enabled the IOC-UNESCO to do conduct the self-evaluation without problems.

ii. Logframe matrix (where it exists)

iii. List of publications, evaluation reports and other outputs

General:

http://www.icm.csic.es/bio/medocean/images/presentations/posters/Isensee_MO_2013.pdf

SOCAT:

http://socat.info

Pfeil, B. et al.: A uniform, quality controlled Surface Ocean CO2 Atlas (SOCAT), Earth Syst. Sci. Data, 5, 125-143, doi:10.5194/essd-5-125-2013, 2013.

Sabine, C. L. et al.: Surface Ocean CO2 Atlas (SOCAT) gridded data products, Earth Syst. Sci. Data, 5, 145-153, doi:10.5194/essd-5-145-2013, 2013, 2013.

Rödenbeck, C. et al.: Global surface-ocean pCO2 and sea-air CO2 flux variability from an observation-driven ocean mixed-layer scheme. Ocean Science 9: 193-216, doi:10.5194/os-9-193-2013, 2013.

Schuster, U. et al.: Atlantic and Arctic sea-air CO2 fluxes, 1990–2009. Biogeosciences, 10, 607-627, doi:10.5194/bg-10-607-2013, 2013.

Wanninkhof, R. et al. (2013) Global ocean carbon uptake: magnitude, variability and trends, Biogeosciences, 10, 1983-2000, doi:10.5194/bg-10-1983-2013, 2013.

Bakker, D. C. E. et al. (2014) An update to the Surface Ocean CO_2 Atlas (SOCAT version 2). Earth System Science Data, 6, 69-90. doi:10.5194/essd-6-69-2014.

Time Series:

http://igmets.net

http://www.us-ocb.org/publications/TS_Workshop_report_FINAL.pdf

http://www.whoi.edu/website/TS-network/time-series-information

http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-and-programmes/ocean-sciences/biogeochemical-time-series/

Ocean Acidification:

http://ocean-acidification.net

http://www.igbp.net/download/18.30566fc6142425d6c91140a/1385975160621/OA_spm2-FULL-lorez.pdf

http://www.earthobservations.org/documents/se/165_goa_on_flyer.pdf

http://www.earthobservations.org/documents/se/165_goa_on_leaflet.pdf

https://seors.unfccc.int/seors/reports/events_list.html?session_id=COP19

http://www.unesco.org/new/en/natural-sciences/ioc-oceans/infocus-oceans/features/ocean-acidification-interview/

Blue Carbon:

http://thebluecarboninitiative.org/wp-content/uploads/BC_FAQ_UNFCCC-2.pdf

http://thebluecarboninitiative.org

http://unfccc.int/files/science/workshops_meetings/application/pdf/isensee_kirsten.pdf

http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600007689#beg

iv. List of national and international staff; fellowships awarded

Staff:
Lim, Hyun Taek (RoK Secondant)
Isensee, Kirsten (IOC Consultant)
Valdes, Jorge Luis (IOC Head Ocean Science)

Fellowships:
Time Series Workshop Bermudas, November 2012
Simpson, Kyle – Canada
Lampitt, Richard – UK

Blue Carbon Workshop Sydney, Australia, May 2013
Hutahaean, Andreas Albertino – Indonesia
Gitundu, Kairo James – Kenya

SOCAT V2 release Bejing, China, June 2013
Bakker, Dorothee – UK
Telzewski, Maciej – Poland

GOA-ON Workshop St. Andrews, UK, July 2013
Lagos, Nelson A. – Chile
Duarte Pereira, Rodrigo Kerr – Brazil

Blue Carbon Workshop Paris, UNESCO HQ, France, November 2013
Hutahaean, Andreas Albertino – Indonesia
Kim, Tae-Goun – Republic of Korea
Chung, Ik Kyo – Republic of Korea
Kang, Do-Hyung – Republic of Korea
Murdiyarso, Daniel – Indonesia
Cifuentes, Miguel – Ecuador
Santamaria-Del-Angel, Eduardo – Mexico

Workshop “World in Our Oyster”, HongKong March 2014
Dupont, Sam – Sweden

Time Series Workshop St. Petersburg, US, March 2014
Cloern, James – United States
Wiebe, Peter – United States
O’Brien, Todd – United States
Bates, Nick - Bermuda
Lomas, Michael – United States
Bode, Antonio - Spain

Meeting to follow up on the Time Series Workshop St. Petersburg, US, March 2014
Santamaria del Angel, Eduardo – Mexico
Cerdeira Estrada, Sergio – Mexico

v. List of major equipment provided under the project and status after termination contract period

- Desktop PC

The computer will continue to be used in the second phase of the project.

vi. List of progress reports prepared during the contract period

Three progress reports were prepared during the project period:

- In January 2013,
- In July 2013, and
- In January 2014.

vii. Ocean Acidification – side event and summary for policy makers – Press coverage

Media Type: Online Broadcast Version and published
Media Group: Internet, newspaper
Source URL: http://www.economist.com/news/science-and-technology/21590349-worlds-seas-are-becoming-more-acidic-how-much-matters-not-yet-clear
Outlet: The ECONOMIST
Title: The Acid Test
Publication Date: 23/11/2013

http://www.bbc.co.uk/news/science-environment-24904143

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.cnn.com/2013/11/14/world/ocean-acidification-report/index.html
Outlet: CNN International
Title: CO2 causing 'unprecedented' ocean acidification
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://us.cnn.com/2013/11/14/world/ocean-acidification-report/index.html
Outlet: CNN.com
Title: CO2 causing 'unprecedented' ocean acidification
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=b92047ef939dc991138445599632 8dd7d6521a59644e3&co=f0000000009816s-1158206718
Outlet: ThinkProgress » Climate
Title: The Rapid Pickling Of The World's Oceans Affects More Than Just Shellfish
Publication Date: 14/11/2013
Text Snippet: , oceans have become 26% more acidic. By 2100, ocean acidification is predicted to increase by 170 percent if curr

Media Type: Online Print Version
Media Group: Internet
Source URL: http://www.orlandosentinel.com/features/consumer/sns-rt-us-climate-talks-oceans-20131114,0,5348681.story

Outlet: Orlando Sentinel
Title: Oceans suffer silent storm of acidification: international study
Publication Date: 14/11/2013
Text Snippet: a mild acid when mixed with water. Acidification is combining with a warming of ocean waters, also caused by a build-up of gr

Media Type: News Web Sites
Media Group: Internet
Source URL: http://sg.news.yahoo.com/oceans-suffer-silent-storm-acidification-international-study-193946370.html
Outlet: Yahoo! Singapore Online
Title: Oceans suffer silent storm of acidification - international study
Publication Date: 14/11/2013
Text Snippet: th and 19th centuries. A 170 percent increase in acidity is equivalent to cutting the Ph level
of the ocean, a scale of acidit

Media Type: News Web Sites
Media Group: Internet
Source URL:
http://www.swissquote.ch/sqi_premium/market/news/News.action?id=7079332&c1=any&c2=FINANCE
Outlet: Swissquote
Title: 14-11-2013 20:48 Oceans suffer silent storm of acidification -international study
Publication Date: 14/11/2013
Text Snippet: . Carbon dioxide, the main greenhouse gas, can become a mild acid when mixed with water.
Acidification is combining with a warming

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=aed85d142ff845941384448545934fad1ec0b45eb48b1&co=f000000009816s-1158206718
Outlet: Global Warming Crisis News for people who care.
Title: Increasing carbon emissions are rapidly acidifying the oceans
Publication Date: 14/11/2013
Text Snippet: acidification could increase by 170% by 2100. 30% of ocean species are unlikely to survive
in these conditions. In 201

Media Type: News Web Sites
Media Group: Internet
Source URL:
http://article.wn.com/view/2013/11/14/Emissions_of_CO2_driving_rapid_oceans_acid_trip/
Outlet: World News Network
Title: Emissions of CO2 driving rapid oceans 'acid trip'
Publication Date: 14/11/2013

Text Snippet: in the past 300 million years. In their strongest statement yet on this issue, scientists say
acidification could increase by 170

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.democraticunderground.com/?com=latest_threads&sort1=latest&sort2=all&sort3=86400&page=2
Outlet: Democratic Underground
Title: Latest Threads - Democratic Underground
Publication Date: 14/11/2013
Text Snippet: Discussion Expert Assessment: Ocean Acidification May Increase 170 Percent This Century By G_j - 2 hrs ago

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.reuters.com/article/2013/11/14/climate-talks-oceans-idUSL5N0IZ5FL20131114
Outlet: Reuters
Title: Oceans suffer silent storm of acidification -international study | Reuters
Publication Date: 14/11/2013
Text Snippet: * Change linked to global warming poses threat to corals, fish * Acidification may increase 170 pct by 2100 vs pre-industrial

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.news4jax.com/news/Study-Ocean-acidification-unprecedented/-/475880/22968444/-/1x9a74z/-/index.html
Outlet: News4Jax.com
Title: Study: Ocean acidification 'unprecedented' | News
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=93547948094a5ffb1384428811997399b64a9640b4fe1&co=f000000009816s-1158206718
Outlet: A Momentary Flow
Title: Emissions drive oceans 'acid trip' at an "unprecedented rate"
Publication Date: 14/11/2013
Text Snippet: could increase by 170% by 2100. They say that some 30% of ocean species are unlikely to survive in these conditions. The re

Media Type: Online Broadcast Version

Media Group: Internet
Source URL: http://www.wlwt.com/news/national/Study-Ocean-acidification-unprecedented/-/9837944/22968444/-/qemb3bz/-/index.html
Outlet: wlwt.com
Title: Study: Ocean acidification 'unprecedented' | National News
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.rocketnews.com/2013/11/emissions-drive-oceans-acid-trip/
Outlet: RocketNews.com
Title: Emissions drive oceans ‘acid trip’
Publication Date: 14/11/2013
Text Snippet: by 170% by 2100. They say that some 30% of ocean species are unlikely to survive in these conditions. The researchers conclude

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=9ee4206e33d1fd9c1384455171989d528a85d6a204f58&co=f000000000981
6s-1158206718
Outlet: DailyNewsLatest.com
Title: Emissions drive oceans ‘acid trip’
Publication Date: 14/11/2013
Text Snippet: past 300 million years. In their strongest statement yet on this issue, scientists say acidification could increase

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=88bac3cd6ae1f35513844590751778b3ccf50b70f445d&co=f000000009816s-1158206718
Outlet: Hurricane news today
Title: Oceans suffer silent storm of acidification: international study
Publication Date: 14/11/2013
Text Snippet: greenhouse gas, can become a mild acid when mixed with water. Acidification is combining with a warming of ocean waters, also

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=801b40ff381852951384453751463a1670018b28c43e4&co=f000000009816s-1158206718
Outlet: e! Science News - Popular science news
Title: Tiny 'Lego' blocks build Janus nanotubes with potential for new drugs and water

purification
Publication Date: 14/11/2013
Text Snippet: with potential for new drugs and water purificationExpert assessment: Ocean acidification may increase 170 percent thi

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.londonwired.co.uk/news.php/1520868-Emissions-of-CO2-driving-rapid-oceans-039-acid-trip-039
Outlet: londonwire
Title: Emissions of CO2 driving rapid oceans 'acid trip'
Publication Date: 14/11/2013
Text Snippet: at any time in the past 300 million years. In their strongest statement yet on this issue, scientists say acidification could incr

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.bbc.co.uk/news/science-environment-24904143
Outlet: BBC Online
Title: Emissions of CO2 driving rapid oceans 'acid trip'
Publication Date: 14/11/2013
Text Snippet: in the past 300 million years. In their strongest statement yet on this issue, scientists say acidification could increase by 170

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.clickondetroit.com/news/Study-Ocean-acidification-unprecedented/-/1719418/22968444/-/g8wftb/-/index.html
Outlet: CLICKON DETROIT
Title: Study: Ocean acidification 'unprecedented' | News
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.kxly.com/news/Study-Ocean-acidification-unprecedented/-/101270/22968444/-/d59t3e/-/index.html
Outlet: kxly.com
Title: Study: Ocean acidification 'unprecedented' | News
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Online Print Version
Media Group: Internet
Source URL: http://www.chicagotribune.com/business/sns-rt-us-climate-talks-oceans-20131114,0,4098970.story

Outlet: Chicago Tribune
Title: Oceans suffer silent storm of acidification: international study
Publication Date: 14/11/2013
Text Snippet: gas, can become a mild acid when mixed with water. Acidification is combining with a warming of ocean waters, also caused b

Media Type: Online Print Version
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=86d1adce47de86e4138445740505864a74c48932643fb&co=f000000009816s-1158206718
Outlet: leftword.blogdig.net/
Title: The Rapid Pickling Of The World’s Oceans Affects More Than Just Shellfish
Publication Date: 14/11/2013
Text Snippet: acidic. By 2100, ocean acidification is predicted to increase by 170 percent if current rates of greenhouse gas emiss

Media Type: News Web Sites
Media Group: Internet
Source URL: http://news.uk.msn.com/comment-and-analysis/ocean-acidity-qanda-scientists-warn-ofgrowing-threat-to-life
Outlet: MSN News UK
Title: scientists warn of growing threat to life
Publication Date: 14/11/2013
Text Snippet: of the world's leading experts on ocean acidification last year. Their findings will be formally presented in Poland next wee

Media Type: Online Broadcast Version
Media Group: Internet
Source URL: http://www.wbaltv.com/news/national/Study-Ocean-acidification-unprecedented/-/9379440/22968444/-/lugis5/-/index.html
Outlet: wbaltv.com
Title: Study: Ocean acidification 'unprecedented' | National News
Publication Date: 14/11/2013
Text Snippet: , researchers say that carbon dioxide emissions from human activities such as fossil fuel burning are the primary cause of ocean a

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=969838d5432ce31c13844130823051de719fc09f64152&co=f000000009816s-1158206718
Outlet: Environmental Sustainability Updates
Title: [environmental-sustainability] Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 13/11/2013
Text Snippet: 02:38 Expert assessment: Ocean acidification may increase 170 percent this century In a major new international report,

Media Type: News Web Sites
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=ade279cf65735b13138444367190895fd5315e2ea4bd2&co=f000000009816s-1158206718
Outlet: Article.wn.com
Title: Emissions of CO2 driving rapid oceans 'acid trip'
Publication Date: 13/11/2013
Text Snippet: in the past 300 million years. In their strongest statement yet on this issue, scientists say acidification could increase by 170

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=af9afd7a77324eae13844596070904fec6be42ffa4b6d&co=f000000009816s-1158206718
Outlet: Dominica Gazette
Title: Emissions of CO2 driving rapid oceans ‘acid trip’
Publication Date: 14/11/2013
Text Snippet: years. In their strongest statement yet on this issue, scientists say acidification could increase by 170% by 2100. They say

Media Type: News Web Sites
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=86aa751e3044560113844529457816f573904373d4629&co=f000000009816s-1158206718
Outlet: World Rss News
Title: Emissions of CO2 driving rapid oceans ‘acid trip’ – BBC News
Publication Date: 14/11/2013
Text Snippet: ' rate, scientists warnCNN Ocean Acidification Could Increase by 170 Percent by the End of the CenturyScience World Re

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=9eabae1be978d5f213844306820026b426c71adbc4fff&co=f000000009816s-1158206718
Outlet: Citizen Cartwright
Title: Climate change: Very bad news for the oceans
Publication Date: 14/11/2013
Text Snippet: , according to a study that will be presented at the global climate talks in Poland. Acidification could increase 170 percent

Media Type: Blogs
Media Group: Internet
Source URL:

http://ct.moreover.com/ct?haid=aaaee58daf71351113844202725026253 0c80429f4cd3&co=f00 0000009816s-1158206718
Outlet: Summit County Citizens VoiceSummit County Citizens Voice
Title: Climate: Ocean acidification will have huge costs
Publication Date: 14/11/2013
Text Snippet: vulnerable. "What we can now say with high levels of confidence about ocean acidification sends a clear message," said Ul

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.bris.ac.uk/news/2013/9942.html
Outlet: University Of Bristol
Title: Ocean acidification 'may increase by 170 per cent' by end of 21st century
Publication Date: 14/11/2013
Text Snippet: reefs may be substantial owing to the sensitivity of molluscs and corals to ocean acidification. The chair of the symposium

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=9f87bafc479f30941384447156025de7dbd97b1d64587&co=f00 0000009816s-1158206718
Outlet: Nature News Blog
Title: Ocean acidification could trigger economic devastation
Publication Date: 14/11/2013
Text Snippet: of a major impact of CO2 emissions currently available. Co-author Ulf Riebesell, an oceanographer at the GEOMAR Helmholt

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.bristol.ac.uk/news/2013/9942.html
Outlet: University Bristol
Title: Ocean acidification 'may increase by 170 per cent' by end of 21st century
Publication Date: 14/11/2013
Text Snippet: reefs may be substantial owing to the sensitivity of molluscs and corals to ocean acidification. The chair of the symposium

Media Type: News Web Sites
Media Group: Internet
Source URL: http://eponline.com/articles/2013/11/14/experts-agree-ocean-acidification-due-tohuman.
aspx?admgarea=News
Outlet: Environmental Protection
Title: Experts Agree Ocean Acidification Caused by Carbon Dioxide Emission from Human Activity -- Environmental Protection
Publication Date: 14/11/2013
Text Snippet: , and chair of the symposium, Ulf Riebesell of GEOMAR Helmholtz Centre for Ocean Research Kiel said: “What we can now s

Media Type: Blogs
Media Group: Internet
Source URL:
http://ct.moreover.com/ct?haid=82c7a5e016425f1813844498629002eb98c0be28649e3&co=f0000000009816s-1158206718
Outlet: LifeSciencesWorld
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 13/11/2013
Text Snippet: News Search in news only Expert assessment: Ocean acidification may increase 170 percent this century (posted on 12/11/

Media Type: News Web Sites
Media Group: Internet
Source URL:
http://esciencenews.com/articles/2013/11/13/expert.assessment.ocean.acidification.may.increase.170.percent.century
Outlet: e! Science News
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013
Text Snippet: acidification. One of the lead authors of the summary, and chair of the symposium, Ulf Riebesell of GEOMAR Helmholtz

Media Type: Online Print Version
Media Group: Internet
Source URL:
http://newsroomamerica.com/story/395074/ocean_acidification_may_increase_170_percent_this_century.html
Outlet: Newsroom America
Title: Ocean Acidification May Increase 170 Percent This Century
Publication Date: 14/11/2013
Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the sy

Media Type: Blogs
Media Group: Internet
Source URL: http://summitcountyvoice.com/2013/11/14/61627/
Outlet: Summit County Citizens Voice
Title: Climate: Ocean acidification will have huge costs
Publication Date: 14/11/2013
Text Snippet: acidification sends a clear message," said Ulf Riebesell, of the GEOMAR Helmholtz Centre for Ocean Research in

Media Type: News Web Sites
Media Group: Internet
Source URL: http://au.ibtimes.com/art/services/print.php?articleid=522286
Outlet: International Business Times Australia
Title: Ocean Acidification to Bring 'Significant Economic Losses' Before End of the Century

Publication Date: 14/11/2013
Text Snippet: Friday, November 15, 2013 1:15 AM EST Ocean acidification to increase by 170% by end of century (reuters) Scientist

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.ibtimes.co.uk/articles/522286/20131114/ocean-acidification-significant-economicimpact-170-increase.htm
Outlet: INTERNATIONAL BUSINESS TIMES
Title: Acid Oceans to Hurt World Economies by End of Century
Publication Date: 14/11/2013
Text Snippet: acidification so industries involving them will suffer economic losses, experts said. Ulf Riebesell from Helmholtz Cen

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=9bd36c272db3d36d1384423675854a70b5d710b440e&co=f000000009816s-1158206718
Outlet: GreenMedia.info
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 13/11/2013
Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the sy

Media Type: Blogs
Media Group: Internet
Source URL: http://www.sciencecodex.com/expert_assessment_ocean_acidification_may_increase_170_percent_this_century-122969
Outlet: Science Codex
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013
Text Snippet: summary, and chair of the symposium, Ulf Riebesell of GEOMAR Helmholtz Centre for Ocean Research Kiel said: "What we c

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=ab48b866c26c14cb138440266317977c80cdf0f4f4d6e&co=f000000009816s-1158206718
Outlet: e! Science News - Popular science news
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 13/11/2013
Text Snippet: Expert assessment: Ocean acidification may increase 170 percent this century Published: Wednesday, November 13, 2013 –

Media Type: News Web Sites

Media Group: Internet
Source URL: http://fishnewseu.com/latest-news/46-world/11491-ocean-acidity-could-rise-by-170.html
Outlet: Fishnewseu.com
Title: Ocean acidity could rise by 170%
Publication Date: 14/11/2013
Text Snippet: reefs may be substantial owing to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of t

Media Type: News Web Sites
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=83740f9bb502b5a21384451548668de43dbb59d03486b&co=f000000009816s-1158206718
Outlet: innovations-report.de
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013
Text Snippet: and corals to ocean acidification. One of the lead authors of the summary, and chair of the symposium, Ulf Riebese

Media Type: Blogs
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=bd7644a30bdb648513844030843139cadd3b06d26463c&co=f000000009816s-1158206718
Outlet: reduce carbon emissions
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 13/11/2013
Text Snippet: and corals to ocean acidification. One of the lead authors of the summary, and chair of the symposium, Ulf Rieb

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.sciencenewsline.com/articles/2013111409050006.html
Outlet: Science Newsline
Title: Expert Assessment: Ocean Acidification May Increase 170% This Century
Publication Date: 14/11/2013
Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the sy

Media Type: News Web Sites
Media Group: Internet
Source URL: http://ct.moreover.com/ct?haid=a61a23a754c4404213844455659937e06dbfbcd2a448b&co=f000000009816s-1158206718
Outlet: YubaNet
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013

Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the

Media Type: News Web Sites
Media Group: Internet
Source URL: http://www.innovationsreport.com/html/reports/environment_sciences/expert_assessment_ocean_acidification_increase_170_222729.html
Outlet: Innovations Report Online
Title: Expert assessment: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013
Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the

Media Type: News Web Sites
Media Group: Internet
Source URL: http://phys.org/news/2013-11-expert-ocean-acidification-percent-century.html
Outlet: PHYS.ORG
Title: Ocean acidification may increase 170 percent this century
Publication Date: 14/11/2013
Text Snippet: to the sensitivity of molluscs and corals to ocean acidification. One of the lead authors of the summary, and chair of the sy

Further:

http://edition.cnn.com/2013/11/14/world/ocean-acidification-report/index.html?iref=allsearch

Lemonde.fr

http://www.lemonde.fr/planete/article/2013/11/15/plancton-saint-jacques-huitres-et-autres-coquillages-menaces-par-l-acidification-des-ocea_3514469_3244.html

Lefigaro.fr (second largest newspaper in France)

http://www.lefigaro.fr/sciences/2013/11/15/01008-20131115ARTFIG00487-les-emissions-de-co2-changent-la-composition-les-oceans.php

Lejournaldelenvironnement.net

http://www.journaldelenvironnement.net/article/pourquoi-il-faut-lutter-contre-l-acidification-des-oceans,39228

http://www.scidev.net/global/climate-change/scidev-net-at-large/ocean-acidification-set-to-spiral-out-of-control.html

Ocean acidity to more than double by 2100 19-11-2013 07:00 (Telegraph.co.uk)

Ocean Acidification May More Than Double by 2100: Study 18-11-2013 17:19 (Bloomberg Businessweek) ...shellfish industry $130 billion a year, according to today s Unesco study. Substantial changes in marine ecosystems are expected and they are...

Ocean Acidification May More Than Double by 2100, Study Shows 18-11-2013 17:19 (Washington Post - Bloomberg) ...shellfish industry $130 billion a year, according to today s

Unesco study. Substantial changes in marine ecosystems are expected and they are...

Unesco: Acidificación de océanos se acelera a ritmo sin precedentes 19-11-2013 01:36 (Últimas Noticias)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 19-11-2013 00:23 (Diario El Mundo)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según UNESCO 18-11-2013 23:49 (Teletica.com)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 23:35 (ElPais.cr)

La acidificación de los océanos se acelera a un ritmo sin precedentes según la UNESCO 18-11-2013 23:29 (Gran Canaria Actualidad)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 23:05 (El Horizonte)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 23:05 (Info 7)

Acidificación de océanos se acelera a ritmo sin precedentes 18-11-2013 22:40 (Actualidad Unión Radio)

Los océanos han aumentado su tasa de acidez en un 26 % desde el comienzo de la era industrial a causa de las emisiones de CO2 que el hombre vierte en la atmósfera, según un informe de la UNESCO. 18-11-2013 22:30 (El Tiempo.com.ve)

Unesco: Acidificación de océanos se acelera a ritmo sin precedentes 18-11-2013 22:18 (Diario Correo)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 22:17 (MSN Latinoamérica)

Los océanos, cada vez más ácidos 18-11-2013 21:44 (Heraldo)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:33 (Actualidad Orange)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:30 (WVEN TV)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:29 (El Norte de Castilla.es)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:29 (Univision San Diego)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:26 (Llave en Mano)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:25 (Radio America)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:23 (Wunitv.com)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-

11-2013 21:22 (Publimetro)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:20 (Aguas Digital.com)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:20 (Univision18.com)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:18 (NoticieroIndustrial.com)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:18 (Univision Washington DC)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:17 (Univision Las Vegas)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:16 (Alianza Metropolitan News)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:15 (Somos Noticias Colorado)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:14 (Univision Laredo)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:13 (Eldiariomontanes.es)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:11 (La Rioja.com)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:06 (Lasprovincias.es)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO Varsovia, 18 nov (EFE). Varsovia, 18 nov (EFE).- Los océanos han aumentado...

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:05 (TeInteresa.es)

a acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:05 (Telemundo 33) La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:04 (Efe [ES])

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:04 (Eldiario.es)

...acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO Los océanos han aumentado su tasa de acidez en un 26 % desde el...

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 21:04 (La Informacion.com)

...acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO Varsovia, 18 nov (EFE).- Los océanos han aumentado su tasa...

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 21:01 (Terra USA)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO Los océanos han aumentado su tasa de acidez en un 26 % desde el comienzo...

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 20:59 (Diario Sur)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 20:59 (Elcorreo.com)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 20:55 (Terra México)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 20:53 (La Informacion.com)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO Los océanos han aumentado su tasa de acidez en un 26 % desde el comienzo...

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO 18-11-2013 20:52 (El Confidencial)

Acidificación de océanos se acelera a ritmo sin precedentes, según UNESCO Varsovia, 18 nov (EFE). Varsovia, 18 nov (EFE).- Los océanos han aumentado...

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 20:50 (Euronews (ES))

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO 18-11-2013 20:13 (Yahoo! Noticias España)

La acidificación de los océanos se acelera a un ritmo sin precedentes, según la UNESCO Varsovia, 18 nov (EFE). Varsovia, 18 nov (EFE).- Los océanos...

Ocean Acidification May More Than Double by 2100: Study 18-11-2013 17:37 (Bloomberg)...shellfish industry $130 billion a year, according to today s Unesco study. Substantial changes in marine ecosystems are expected and they are...

viii. List of acronyms

AAAS	American Association for the Advancement of Science
ABC	Brazilian Cooperation Agency
BATS	Bermuda Atlantic Time-Series Study
BIOS	Bermuda Institute of Ocean Sciences
BIS	British Information Service
CDIAC	Carbon Dioxide Information Analysis Center
COP	Conference of the Parties
DECC	Department of Energy and Climate Change, United Kingdom
Defra	Department for Environment, Food and Rural Affairs
EASAC	European Academies Science Advisory Council
FCO	Foreign and Commonwealth Office, the United Kingdom's Ministry of Foreign Affairs
GOA-ON	Global Ocean Acidification Observing Network
GEO	Group on Earth Observations
GOOS	Global Ocean Observing System
IAEA	International Atomic Energy Agency
ICDC	International Carbon Dioxide Conference
ICP	Informal Consultative Process
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Programme
IGMETS	International Group for Marine Ecological Time Series
IOC	Intergovernmental Oceanographic Commission
IOCCP	International Ocean Carbon coordination Project
KIOST	Korean Institute of Ocean Science and Technology
MLTM	Ministry of Land, Transport and Maritime Affairs
NEOENBIZ	Neo Environmental Business Co.
NERC	Natural Environment Research Council

NOAA	National Oceanic and Atmospheric Administration
OA	Ocean Acidification
OA-ICC	Ocean Acidification International Coordination Centre
OCB	Ocean Carbon and Biogeochemistry
REDD	Reducing Emissions from Deforestation and forest Degradation
SCOR	Scientific Committee on Oceanic Research
SOCAT	Surface Ocean CO2 Atlas
TWAS	The World Academy of Sciences
UEA	University of East Anglia
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	General Assembly of the United Nations
UTS	University of Technology, Sydney