PROJECT FINAL REPORT

Grant Agreement number: 265103

Project acronym: MEDSEA

Project title: Mediterranean Sea Acidification in a changing climate

Funding Scheme: FP7 collaborative project

Period covered: from 01/02/2011 to 31/07/2014

Name of the scientific representative of the project's co-ordinator[1], Title and Organisation:

Prof. Patrizia Ziveri, Universitat Autònoma de Barcelona

Tel: +34 93 586 8628

Fax: +34 93 581 3331

E-mail: patrizia.ziveri@uab.cat

Project website address: http://www.medsea-project.eu

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

Table of Contents

4.1 Final publishable summary report

4.1.1 Executive Summary

As carbon emissions increase and carbon dioxide levels (CO_2) in the atmosphere rise, so does the concentration of CO_2 in the ocean. The ocean has been very efficient in absorbing CO_2 and this has decreased the accumulation of CO_2 in the atmosphere and thus reduced the potential human-induced 'warming' feedback on our climate. However, the ocean is absorbing atmospheric CO_2 in such unprecedented rate that it is rapidly changing the chemistry of the ocean resulting in 'ocean acidification (OA)', a reduction in pH, carbonate ion concentration, and the capacity of seawater to buffer changes in its chemistry. OA is a global environmental issue posing a threat to open ocean and coastal marine ecosystems, including the Mediterranean Sea. The impacts of OA are generally acknowledged but in complex and highly variable coastal areas and marginal seas it remains vastly understudied. **The Mediterranean Sea Acidification in a changing climate (MedSeA) project (pr-project.eu) greatly contributed to build a clearer picture of the Mediterranean Sea's response to human-induced elevated atmospheric CO_2 conditions focusing on OA and ocean warming.** During the project duration (2011-2014) 60% of the total scientific articles contributing to OA understanding in the Mediterranean Sea were provided by the over 120 MedSeA scientists from 16 partner and 6 associated partner institutions from 12 countries. MedSeA assessed the chemical, climatic, ecological, biological, and economical changes of the Mediterranean Sea driven by increases in CO_2 and other greenhouse gases providing projections for this century and first sets of adaptation and mitigation strategies.

Mediterranean Sea acidification can be already detected. The available data sets from the North-western Mediterranean Sea indicate that in the 18-year period 1995–2013 alone, acidity has already increased more than 10 %. **Projections of CO_2 emissions indicate a sustained sea uptake of anthropogenic carbon and a 30% increase in acidification between years 2010 and 2050** if we continue to emit CO_2 at the same rate. This implies, since the industrial revolution and within only a few decades, acidification of the Mediterranean Sea is likely to increase by 150% at the end of the century. Since this deep semi- enclosed sea is characterized by an active exchange of waters from the surface to depth, which effectively distributes the heat, and anthropogenic carbon to the interior of the basin**, the deep waters are warming and acidifying too**. There is a high level of certainty that **the project change in the atmosphere CO2 (550 ppm by 2050) will lead to an average surface warming from 1 to 1.5°C in the Eastern Mediterranean, Aegean and Adriatic Sea between 2000 and 2050**. In summer, the average surface temperature is likely to constantly exceed 29°C in the South Eastern Mediterranean.

Iconic Mediterranean ecosystems such as Coralligenous reefs, Vermetid snail reefs and sea grass meadows are threatened by OA and/or warming. These ecosystem-building species create rich key habitats and homes to thousands of species, and also protect shores from erosion as well as offer a source of food and natural products to society. These hot-spots of Mediterranean Sea biodiversity prospered over millennia and served human populations in the region, but are now facing considerable decline. The slowly growing Mediterranean red coral (*Corallium rubrum*) is extremely sensitive to OA conditions. This has major implications for the Red Coral industry, which has not only economic significance but also cultural importance in the Mediterranean region. OA and warming modify the abundance and the functioning of plankton groups living in the Mediterranean, including those of shell-forming organisms like coccolithophores and pteropds. Other marine biota, like viruses and bacteria appear less sensitive.

Impacts of OA and warming may extend to several Mediterranean marine and coastal ecosystem services, including providing food, supporting recreational activities, absorbing carbon, climate regulation, and coastal protection. Coastal areas with economic activities directly depending on marine resources may face serious impacts on employment and benefits in sectors like aquaculture, open sea fisheries and tourism, which is relevant to many Mediterranean countries. **Tourism may be affected by OA and warming through degradation of marine ecosystems (loss of iconic species from the coralligenous, such as gorgonians - soft coral) on diving experiences and through jellyfish outbreaks**. **Sensitivity of shell-forming species such as bivalve mollusks to changes in temperature and acidity represent a threat to the aquaculture sector representing a** total production of about 153,000 tons in 2012 with a total value of approximately € 225 million.

Adaptation and mitigation strategies, and policies at global, regional and local scales need to be implemented as they are the only certain, effective way to reduce CO_2 emissions to the atmosphere and associated ocean acidification. Mediterranean Sea acidification may be more severe in areas where human activities and impacts, such as nutrient runoff from agriculture, further increase acidity. Agricultural run-off from land and other pressures linked with human activities on Mediterranean ecosystems needs to be more strictly regulated. In addition, adaptation policies are required as an increase in atmospheric CO_2 concentration seems unavoidable. The combination of mitigation and adaptation can assure that the Mediterranean can continue to sustain livelihoods, provide food and protect shorelines.

4.1.2 Summary of project context and objectives

As atmospheric CO_2 levels continue to rise, thermodynamics and air-sea gas transfer processes drive some of the excess CO_2 into the ocean surface waters, alleviating climate change. This process leads to shifts in seawater acid-base chemical speciation, lowering pH, increasing the concentration of bicarbonate ions, decreasing the concentration of carbonate ions and lowering the calcium carbonate saturation state (in other words “ocean acidification”). Ocean acidification is now widely recognize as a relevant issue for the future being of the nine planetary boundaries that can seriously endanger the future humanity (Rockstrom et al., 2009) posing a threat to marine ecosystems and may bringing potentially large changes in global biogeochemical cycles. In addition, this acidification may well have large socio-economic impacts ranging from those on tourism (e.g., owing to coral degradation and invasion of non-endemic species) to those on wild fisheries and aquaculture (owing to altered life cycles of key surface- and bottom-dwelling organisms, including shellfish). There is growing concern that impacts of anthropogenic acidification may propagate from individual organisms up through marine food webs, affecting commercial fisheries and shellfish industries as well as threatening protein supply and food security for millions of people. The effects on such marine-based activities could indirectly affect land-based economic activities and jobs on a much larger scale.

Although the general impact of acidification on water chemistry is globally well understood, fine-scale regional models are needed to resolve the complexity of the physical and ecological interactions of coastal and small and complex basins, such as the Mediterranean Sea. The Mediterranean Sea is considered a small-scale ocean with high environmental variability and steep physicochemical gradients within a relatively restricted region. Its circulation is characterized by zonal gradients of physicochemical variables, with salinity, temperature, stratification and alkalinity all increasing towards the east. The generally low-nutrient (from oligotrophic to ultra-oligotrophic) waters offshore stand in contrast to many near-shore regions, often containing coral and seagrass ecosystems, which are affected by human-induced eutrophication. The consequences of this process threaten the health of the Mediterranean Sea adding to other anthropogenic pressures, including those of climate change. To properly project how key biogeochemical and ecosystem processes will change, it is fundamental to adequately represent the general circulation of the Mediterranean basin, i.e., both the fine-scale processes that control it (e.g. eddies and deep convection), and the highly variable atmospheric forcing.

The Mediterranean Sea Acidification in a changing climate (MedSeA) project was the first concerted effort to study ocean acidification in the Mediterranean Sea, a highly populated region with complex and diverse physiochemistry and biology. Launched in February 2011, the MedSeA project originally consisted of 16 partner institutions and additionaly 5 associated partners joined the consortium during the project development. The MedSeA consortium institutions, located in 12 countries, mainly from the Mediterranean region, comprised over 120 scientists with the overall goal of assessing the chemical, climatic, ecological, biological, and economic changes of the Mediterranean Sea driven by increases in CO_2 and other greenhouse gases. MedSeA was cofounded by the European Commission with a contribution of 3.49 M € and a total budget of approximately 6 M€ and run for 3.5 years.

4.1.2.1 Overall objectives

The emphasis of the MedSeA research work has been put on the combined impacts of ocean acidification and warming on endemic calcifying species and related biogeochemical processes, in order to detect changes in calcification, fitness, productivity, biodiversity and the functioning of the food web. The MedSeA approach has been fully interdisciplinary, involving biologists, earth scientists, applied modellers and economists, using field observations, laboratory and mesocosm experiments, as well as formal models.

The MedSeA main objectives can be summed up as follows:

- Identify where the impacts of acidification on Mediterranean waters will be more significant, taking into account the complete chain of causes and effects, from ocean chemistry through marine biology to economic costs.
- Focus on selected sets of key ecosystems and socio-economic variables that are likely to be affected by both acidification and warming, studying the combination of effects through ship-based observations, laboratory and mesocosm experiments, physical-biogeochemical-ecosystem modelling, and economic analysis.
- Provide best estimates and related uncertainties of future changes in Mediterranean Sea pH, $CaCO_3$ saturation states, and other biogeochemical-ecosystem variables, assessing the changes in habitat suitability of relevant ecological and economically important species.

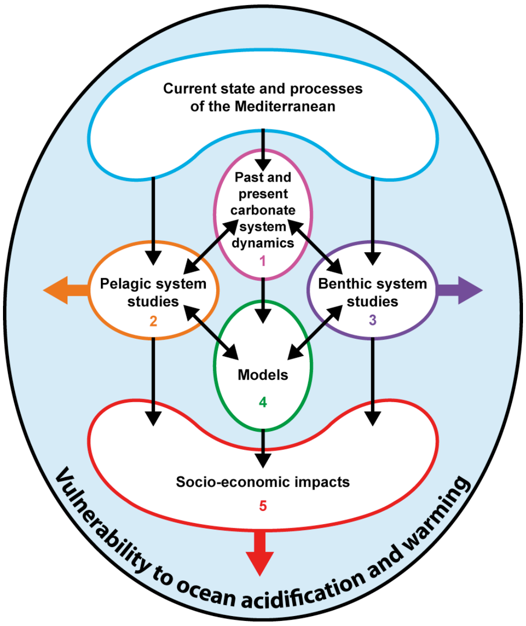


Figure 1. Conceptual scheme of the MedSeA

4.1.2.2 MedSeA main research structure

The MedSeA's strategy focused on a selected set of key ecosystem and socio-economic variables that are likely to be affected by both acidification and warming, studying the combination of both effects through ship-based observations, laboratory and mesocosm experiments, physical-biogeochemical-ecosystem modeling, and economical analyses. MedSeA organised its activities around the following main themes:

I. **Past and present carbonate system dynamics.** Carbonate system data in the Mediterranean Sea were very scarce when strating the project. New field measurements of the carbonate system variables, both in the Western and Eastern basins were provided as well as time-series measurements of the present-day carbonate system. These new data provide a solid basis for understanding the temporal evolution of the penetration of anthropogenic carbon into the Mediterranean Sea.

II. **Pelagic and benthic community responses to ocean acidification and global warming.** The MedSeA project defined the susceptibility and resilience of key-stone species and endemic ecosystems to Mediterranean acidification and warming. We assessed the effects that acidification have or will have on Mediterranean pelagic and benthic selected species (Figure 2) and examine effects on potentially sensitive processes such as photosynthesis and calcification using: 1) plankton monitoring at selected time-series stations and regional cruises to characterize present conditions, 2) laboratory experiments, to gain information on the response of single species and strains, 3) mesocosm experiments, to determine the biogeochemical and community

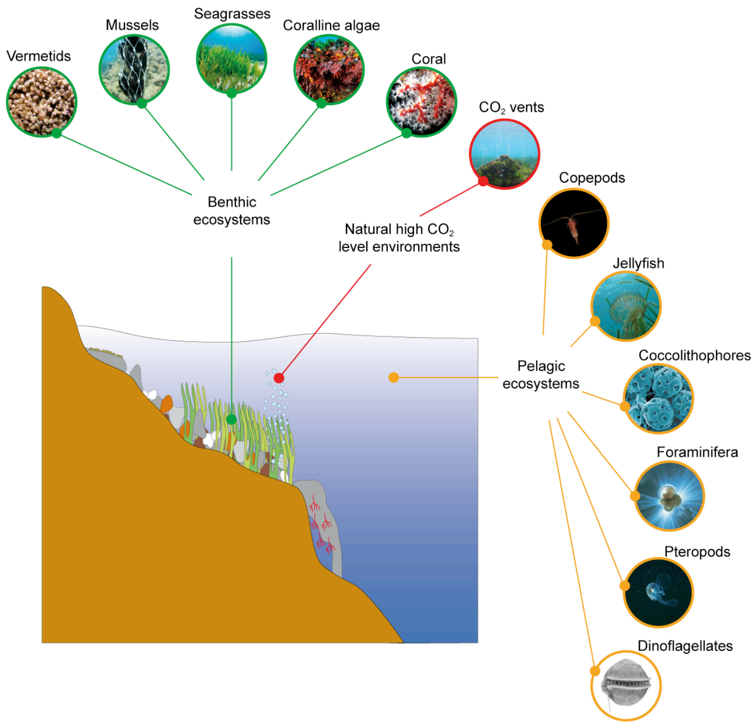


Figure 2. Main selected Mediterranean organisms and key habitat-forming species addressed in MedSeA.

responses, 4) experiments in areas naturally acidified by CO_2 vents to determine the long-term effects of acidification across multiple generations of marine organisms. In order to investigate the key groups and processes, we have selected the organisms and ecosystems that are most likely to be susceptible to acidification in the Mediterranean. The model species and processes which have been selected whether or not they are unique or endemic to the Mediterranean Sea, major contributors to habitat building, major contributors to ecological function, or species of economic value in the Mediterranean region.

III. **Modelling-projected acidification and warming, and their impacts on ecology**. Future projections of changes in Mediterranean Sea carbonate chemistry were performed using two ocean models, coupled with state-of-the-art biogeochemical models. During the 20th century, models were forced with fields from regional climate models driven by observed changes in atmospheric greenhouse gases. Model skill and bias were assessed by comparing simulated biogeochemical variables for the current state to available datasets. Model projections allowed us to construct basin-scale sensitivity maps to ocean acidification, based on combined changes in key model state variables (e.g., pH, $CaCO_3$ saturation states, O_2, temperature, stratification). The integrated analysis of these maps, helped the MedSeA scientists to identify the regions of the Mediterranean Sea that are expected to be more vulnerable to acidification under future climate scenarios. To move this investigation from the level of biogeochemical response to the ecosystem level, one task was dedicated to constructing response functions of selected target species (e.g. *Posidonia* medow, coralligenous habitats, red coral *Corallium rubrum*) to environmental parameters. This produced hybrid habitat suitability patterns, i.e. a range of projected variations of the stress factors for growth and functioning of the target species. This information were further exploited to assess socio-economic impacts associated with each considered target species, with a special focus on market species.

IV. **Socio-economic effects of ocean acidification and potential adaptation strategies and policy tools.** Direct effects of ocean acidification and warming were assessed for the first time first time on tourism and aquaculture for selected areas. These studied included information obtained by valuation studies addressing use and non-use values. Meta-analyses and benefit/value transfer studies were used in some cases, like the lost nursery value of seagrasses or corals. In other cases, the assessment included partial equilibrium analysis (PEA), which addresses both market impacts (notably on tourism and aquaculture) and non-marketed impacts (ecosystem values, including cultural services and non-use values such as option, existence and bequest values). The reduction of pH may result in loss of Mediterranean marine biodiversity, which would probably affect use and non-use values associated with both species diversity and particular unique Mediterranean ecosystems. Loss or degradation of coralligenous environments due to a pH reduction and increasing sea surface temperature could also have negative socio-economic impacts in regions that attract tourists for recreational diving, bathing, and viewing from underwater observatories or glass-bottom vessels. First adaptation strategies and policies were formulated on the basis of the qualitative and quantitative assessments by the natural and social science studies in the project.

Themes III and IV, modelling and socio-economic impacts, were transversal components, whose contents and objectives overlapped with the other themes. The overall MedSeA work programme consisted of three phases interlinked within the different themes:

Phase 1: Examination and reinterpretation of existing data from the Mediterranean Sea.

Phase 2: Obtaining new observational and experimental data.

Phase 3: Projecting future changes and related uncertainties.

At the level of project dissemination, MedSeA sought to raise awareness on the issues of ocean acidification and warming in the Mediterranean Sea through targeted presentations of such phenomena in the Mediterranean Sea and extensive communication of project's results and findings to national, regional and international stakeholders.

4.1.3 Description of the main S&T results/foreground

The sections below are organised in two main parts. The first part contains an introduction summarising the main outcome in terms of performance/research indicators (research publications, presentations at international conferences, workshop and symposia) and the second section mainly present the main progress and highlights within each project research workpackage. The 4 main project themes introduced in chapter 4.1.2 relate to the following Research and Technology Development (RTD) MedSeA work packages:

I. Past and present carbonate system dynamics (WP2)
II. Pelagic & benthic community responses to ocean acidification and global warming (WPs 3 and 4)
III. Modeling projected acidification and warming, and their impacts on ecology (WP5)
IV. Socio-economic effects of ocean acidification and potential adaptation strategies and policy tools (WP6)

4.1.3.1 MedSeA main progress

MedSeA was launched in 2011 when there was a consistent lack of field-derived and experimental information on the Mediterranean ocean acidification and related ecosystem components. A substantial effort was required to collate the few existing data and new information from the pelagic and benthic systems. The specific oceanographic features of the Mediterranean basin were assessed using high-resolution, physical-biogeochemical models to provide basin-wide and surface-to-deep distributions of pH and carbonate-related variables. The models allowed us to project such changes into the future following established scenarios for atmospheric CO_2 emissions. MedSeA experimental and field observations were shared in a comprehensive overall data management. The combination of the model projections with results from field and laboratory experiments and the socio-economic analyses allowed us to build vulnerability maps and possible economic impacts due to acidification in the Mediterranean.

This project was the first coordintated effect aiming to offer a comprehensive view on the physical, biological and socio-economic impacts of ocean acidification in the Mediterranean area using a so-called scale-basin approach. During the 3.5 year duration, MedSeA has generated a large number of critical data (see dissemination figures in Section 4.2). **105** peer-reviewed articles were published or are currently in press. They led to over **420** dissemination activities including **255** presentations at meetings (163 oral presentations and 92 posters) (from February 2011 to September 2014)

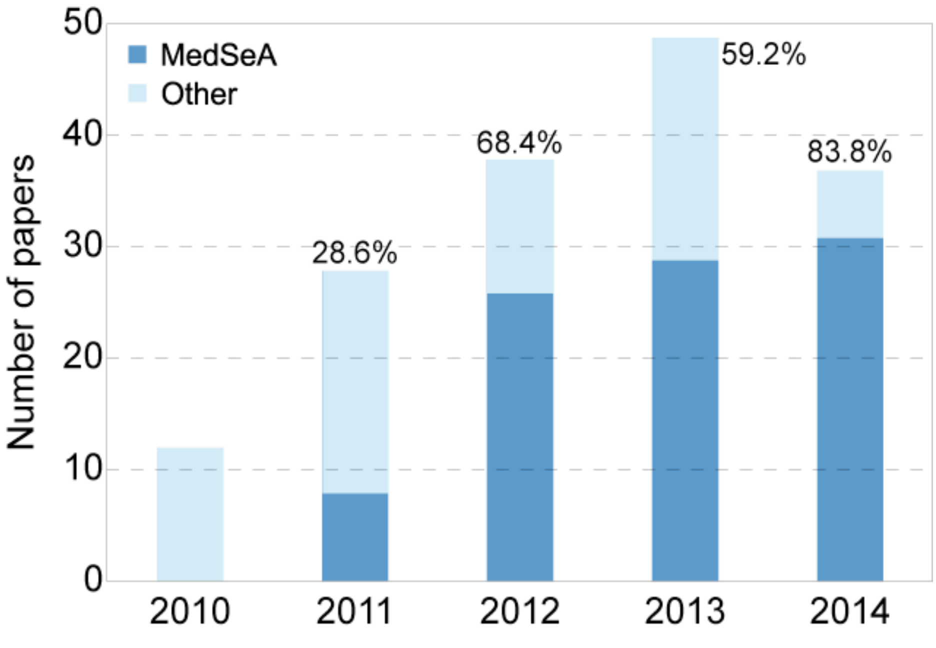


Figure 3 Number of MedSeA articles (dark blue) vs. all articles published on ocean acidification in the Mediterranean Sea (light blue). Note that MedSeA started in 2011. Overall, MedSeA papers represented 60% of all papers published on Mediterranean ocean acidification during the period 2011-2014.

The project greatly contributed and stimulated ocean acidification research in the Mediterranean Sea. Every ten publications on Mediterranean Sea acidification during the period January, 2011- September, 2014, an average of six were a MedSeA contribution (Figure 3). A summary of the major scientific results is presented in the next sections.

4.1.3.2- The MedSeA legacy – summary of major project results

4.1.3.2.1 – Work Package 2, Past and present carbonate system dynamics (WP leader: Catherine Goyet)

The aim of WP2 was to assess the impacts on the carbonate system's parameters of (a) ongoing, recent (100 to 10 years ago) and past (>10^3 years ago) changes in the Mediterranean Sea's water mass circulation; and (b) anthropogenic CO_2 forcing and much older changes in the atmospheric CO_2 levels over a range of time scales (i.e., glacial to interglacial). Continuous sampling and measurements in time-series stations and along transects in key sites of the Mediterranean Sea (western and eastern basin) constituted the observational component of the carbonate system properties characterizing the area. Past variability in ocean chemistry was studied via paleo-reconstruction methods on marine sediment archives focusing on calcifying organisms such as foraminifera or coccolithophores.

The analysis of historical (existing) data from the Mediterranean Sea confirmed that according to general spatial features of seawater carbonate system properties, the total dissolved inorganic carbon (C_T) is higher in the western basin, the total alkalinity (T_A) is higher in the eastern basin and the anthropogenic carbon has already penetrated all the waters of the Mediterranean Sea (Schneider et al., 2010). When the project was launched in 2011, no published paleo-reconstructions of Mediterranean carbonate system parameters were available. MedSeA provided for the first time this type of data and new insight of the pre-anthropogenic dynamics and timing of the Mediterranean carbonate system during the Quaternary.

The results point out that there is no C_{ant}-free water within the Mediterranean Sea. This semi-enclosed sea stores a large amount of C_{ant}, particularly in the western basin (C_{ant} > 48 µmol kg^{-1} in the south of the western basin and > 21µmol kg^{-1} in the north of this basin). This fact could be explained by the thermodynamics: the low Revelle factor, due to warm waters and high T_A, facilitates the absorption of atmospheric CO_2, making the Mediterranean Sea a source of total inorganic carbon to the Atlantic Ocean. It indicates that C_{ant} is efficiently transferred from the atmosphere to the Mediterranean Sea. Furthermore, it shows that this sea absorbs anthropogenic carbon faster than the open ocean. The most acidic waters in the Mediterranean Sea (the intermediate and deep waters of the western basin) have the lowest pH values and are highly contaminated by C_{ant}. These results highlight the tight correlation between the absorption of the anthropogenic CO_2 and the decrease of pH in seawater (Touratier and Goyet, 2011).

In order to assess the human-induced changes on the Mediterranean carbonate system properties (pH, A_T, C_T, and CO_2 partial pressure (pCO_2)), it is necessary to determine the initial conditions and in particular the estimations of pre-industrial C_T. Since it is impossible to measure the pre-industrial C_T we use results from the determination of anthropogenic carbon to estimate it. Results indicate that pre-industrial pH fields throughout the Mediterranean were higher than today (up to + 0.15 in the Western basin and up to 0.10 in the Eastern basin (Touratiet et al., in prep.).

The level of acidification is significantly high in the Mediterranean Sea: all water masses sampled in the Mediterranean Sea (even the deepest) already suffer from acidification. All the data analyzed from time-series stations, especially those from the point B (Figure 4), clearly show that acidification is at its maximum in the surface layer. Despite a strong seasonal variability due to exchanges at the air-sea interface, we estimated a significant mean increase of acidification of 0.0017 ± 0.006 pH unit yr^{-1} since 2007. These time-series data are very important to assess the acidification in the surface layer because all indirect approaches that exist to estimate acidification from anthropogenic carbon are not valid in the mixed layer because of the potential biological activities. The intermediate layer (Levantine Intermediate Waters and the upper portion of the Eastern Mediterranean Deep Waters (EMDW)) appears to be the less acidified but the maximum for ΔpH encountered in the layer is not more than -0.06 (year 2001) (Touratier et al., in prep). All deep waters, EMDW and especially the WMDW, are characterized by increasing levels of acidification (DpH is already < -0.12). This rapid increase of acidification is the direct consequence of deep convection in the open sea areas and also cascading of dense waters along the continental slope, i.e. the two main physical processes that allow the rapid and intense invasion of C_{ant} from sea surface up to the deepest layers.

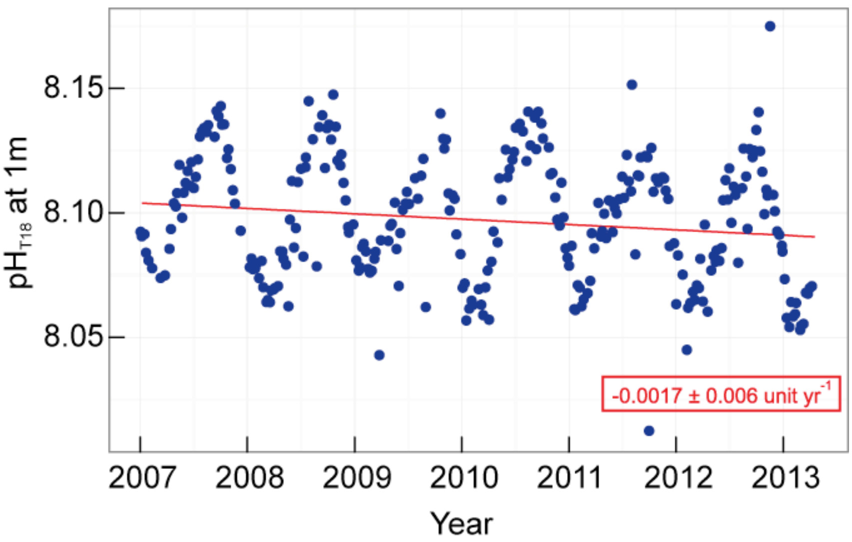


Figure 4: *Temporal variations of pH at Point B station (Bay of Villefranche-sur-Mer, France, 43°41.10'N - 7°18.94'E, 85m depth) at 1m. The pH is normalized at the average annual temperature of 18°C.*

In order to evaluate the variability of the Mediterranean carbonate system prior to the instrumental records and across intervals of elevated atmospheric CO_2 forcing (last deglaciation) and of profound changes in the basins thermohaline circulation (last interglacial period) sediment cores from the western, central, and eastern Mediterranean have been analyzed. The records of planktic foraminiferal $\delta^{11}B$ and B/Ca used as proxy for paleo pH and their shell weight, spanning the last deglaciation have been generated, respectively, from one western Mediterranean (MD99-2346, 42.04N, 4.15E, 2100 m water depth, Figure 5) and one eastern Mediterranean sediment core (MD84-629, 32.04N, 34.21E, 745 m water depth) document sea surface pH and planktic calcification decreases in both sub-basins of the Mediterranean Sea during the last deglacial episode of glacial-interglacial CO_2 rise. These datasets are complemented by contemporaneous records of coccolith assemblages and calcite mass have been generated, respectively, from another western (ODP Site976, 36.12N, 4.18W, 1108 m water depth) and a central Mediterranean (ODP Site963, 13.10N, 37.02E, 469.1 m water depth) sediment core, indicating a decrease in the calcite mass of the ubiquitous coccolithophore species *Emiliana huxleyi* between the last glacial maximum and the Holocene (Mata et al., 2013; Grelaud et al., 2013). Planktic foraminiferal boron isotope results from core LC21, in the south-eastern Aegean Sea (35.40N; 26.35E; 1522 m water depth), complemented by a record of *E. huxleyi* calcite mass indicate that sea surface pH decreased at the onset of the last interglacial sapropel event, reduction of the eastern Mediterranean thermohaline circulation, in LC21 and that this change was accompanied by a decrease in coccolithophore calcification (Grelaud et al., 2012).

Seawater pH was also estimated in the Levantine Basin, Easter Mediterranean, in the core MD84-629 derived by B/Ca measurements performed on *G. ruber*. The reconstructed pH record was compared to the core tops values. The calculated pH values reveal that the last glacial maximum (LGM) surface Mediterranean pH is about 0.1 unit higher than the Holocene, which is the order of magnitude expected for glacial-interglacial pH changes.

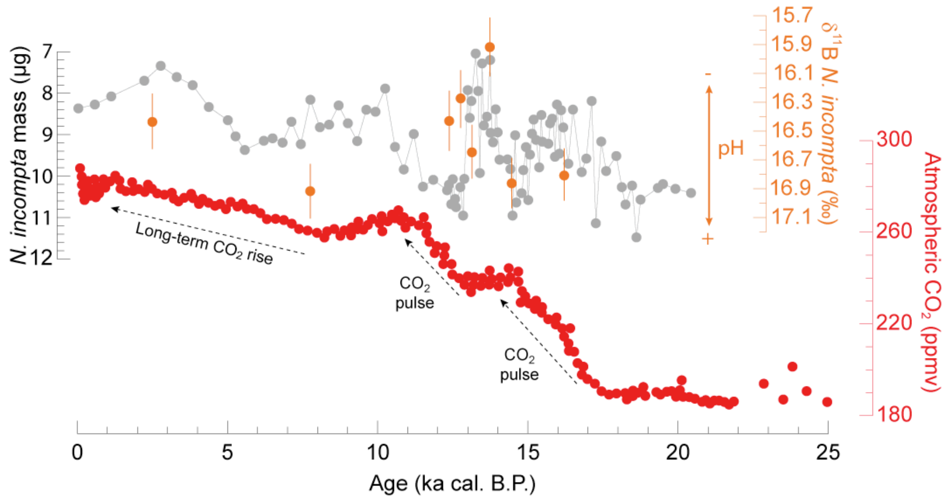


Figure 5: *Sea surface carbonate system changes in the Western Mediterranean Sea during the atmospheric CO_2 rise(s) of the last deglaciation (Marino & Ziveri, 2013). Grey circles: mass (µg) of the foraminiferal species N. incompta mass. Orange circles: $\delta^{11}B$ measured on N. incompta shells (pH reconstruction). Red circles: atmospheric CO_2 (ppmv).*

Selected WP2 highlights

- All the waters of the Mediterranean Sea, even the deepest, are affected by anthropogenic carbon.
- Ongoing time-series measurements in the eastern basin show that the eastern basin is clearly characterized by A_T>2600 µmol kg^{-1}.
- Ongoing time-series measurements show that in the surface waters of the Northwestern Mediterranean Sea, the concentration of dissolved inorganic carbon increased by 3.4 ± 0.36 µmol kg yr^{-1} and pH decreases by -0.0016 ± 0.0012 unit yr^{-1} although these trends are not yet statistically significant. In contrast, pH normalized at the average annual temperature of 18°C significantly declines by -0.0017 ± 0.006 unit yr^{-1}. At 50 m the pH decrease is of -0.0023 ± 0.0004 unit yr^{-1} but not yet significant while pH normalized at the average annual temperature of 18 °C significantly declines by -0.0020 ± 0.0005 unit yr^{-1}.
- In the North Adriatic Sea, strong seasonal changes in seawater temperature are one of the main drivers of the high seasonal variations of pH, pCO_2 and C_T.
- Results from the trans-mediterranean MedSeA 2013 research cruise confirmed that T_A, C_T and surface pCO_2 are higher in the eastern basin than in the Western Mediterranean Sea. Moreover, the eastern basin appears to be a significant source of CO_2 for the atmosphere while the western basin is close to equilibrium.
- The determination of anthropogenic carbon in the Mediterranean Sea shows that pre-industrial pH fields throughout the Mediterranean were higher than today: up to + 0.15 units in the western basin and up to 0.10 units in the eastern basin.
- The fossil record of common planktic calcifying organism (coccolithophores and foraminifera) shows that their mass increases during periods of low atmospheric CO_2 concentrations (glacials) and decreases during periods of high atmospheric CO_2 concentrations (interglacials). However, the time scale of these mass responses is remarkably longer than the ongoing anthropogenic changes (on the order of several hundreds of years).
- These planktic calcifying organisms from sediment cores across the Mediterranean Sea show that sea surface pH reconstructions and planktic mass decreased during periods of atmospheric CO_2 rise (i.e. during glacial-interglacial transition).
- The calculated pH values reveal that the last glacial maximum (LGM) surface Mediterranean pH is about 0.1 unit higher than the Holocene.

4.1.3.2.2 – Work Package 3, Effects of ocean acidification and temperature on pelagic ecosystem functioning (WP leaders: Costa Frangoulis and Eva Krasakopolou)

The MedSeA WP3 assessed the effects of OA and warming on selected Mediterranean planktonic species (calcifying and non-calcifying) and on fundamental biogeochemical processes. During the project, WP3 researchers have gained information on physiological responses of single species and strains in several laboratory experiments conducted under manipulated carbonate chemistry, and temperature conditions (and in some cases, the combined effect of OA with nutrient limitation), and have studied the biogeochemical and community responses to acidification in experiments using large-scale in situ pelagic mesocosms, and land-based mesocosms. Further evaluation of biological data from the WP2 time-series stations operating in the Mediterranean basin and from field studies (including trans-Mediterranean research cruise) were performed.

New technologies and innovative approaches were developed and applied for controlling the conditions of warming and acidification for the needs of the laboratory and mesocosm experiments studying the individual and dual impacts of acidification and temperature on pelagic organisms and on marine communities and processes, respectively.

Therefore, besides the scientific knowledge acquired per se, concerning the impact of ocean acidification and ocean warming on marine biota, another major achievement of this WP was the knowledge transfer through training activities on planktonic species perturbation experiments, in parallel to the development of techniques (e.g. review on the best practice for thecosome pteropod culture techniques). This provided a comprehensive basis for future experimental work and culture system development on many types of different pelagic organisms going from virus to jellyfish, and exploring several temporal and spatial experimental scales (laboratory, land-based and pelagic mesocosms, in situ).

There is now robust evidence that many calcifying organisms, as well as non-calcifying organisms, are adversely affected by ocean acidification and/or ocean warming. There is considerable variability in sensitivity between closely related species or even between different strains of the same species, with some species being tolerant to ocean acidification in the range of pCO_2 levels projected until the end of this century. The rapid warming will probably affect the plankton metabolism, community and ecosystem functioning earlier than acidification in an area such as the Mediterranean Sea that is generally very oligotrophic. However, the combined effect of these two stressors may enhance their consequences. In addition, it is still unknown how the effects of OA on planktonic calcifiers will propagate into the food web.

The results related to the MedSeA experimental work performed in selected target pelagic species on OA, ocean warming (OW) and greenhouse conditions (OA+OW) are presented in figure 6.

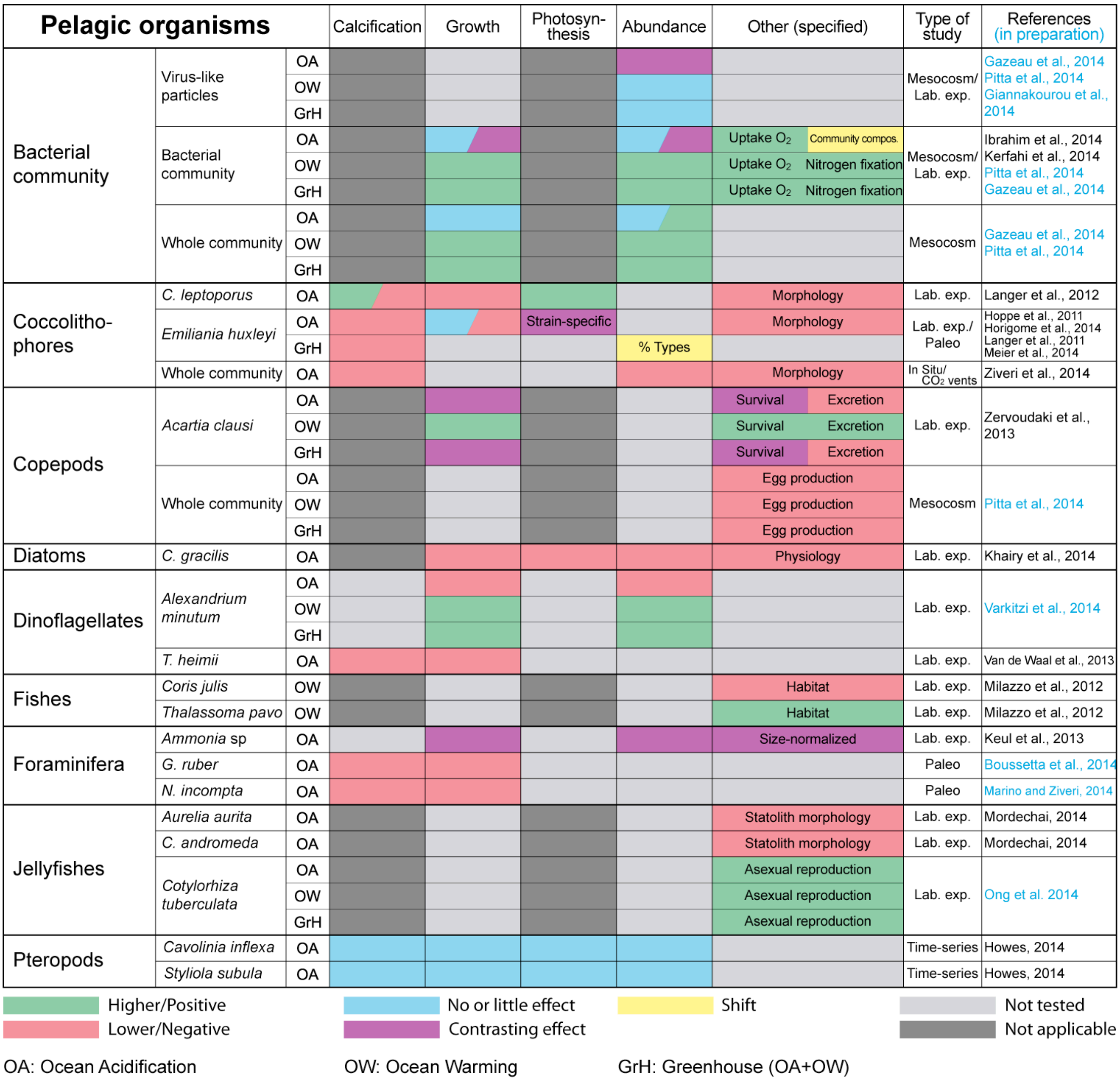


Figure 6. Summary of the effects of OA, ocean warming and the combined effects of OA and ocean warming among key selected Mediterranean pelagic taxonomic groups.

Selected WP3 highlights

- Laboratory experiments, long-term sediment trap series and observations in naturally high CO_2 concentration sites (CO_2 vents, off Vulcano, Italy) show negative impacts of ocean acidification on calcite mass and biodiversity of coccolithophores, a dominant calcifying phytoplankton group in the Mediterranean Sea.
- The planktonic calcifying community is dominated by coccolithophores in both western MedSeA mesocosm experiments (Corsica, summer 2011 & Villefranche, spring 2012).
- A large W-E gradient in foraminifera distribution number and size was revealed during the trans-Mediterranean MedSeA 2013 cruise; pteropods, although largely present, had a more scattered distribution
- Biometric comparison between modern pteropod shells and museum samples from 1910 and 1921 show that the latter were thicker and denser.
- Time series analysis (1967-2003) of pteropod population fluctuations in the NW Mediterranean (Point B) show no deleterious effect of declining pH but a 14-year periodic oscillation related to SST and indicating a possible influence of the North Atlantic quasi-decadal mode on pteropod populations.
- Experiments on the incorporation of boron in *Orbulina universa* (foraminifera) concluded that $\delta^{11}B$ is controlled by pH, as expected, but that B/Ca is controlled by $[HCO_3^-]$, which allows to fully reconstruct the carbonate chemistry beyond the ice-core record.
- The activity of primary producers has no significant effect on the carbonate system parameters and is not the driving force controlling their variability (Cretan Sea & Adriatic Sea).
- Ocean acidification does not evidently have direct effect on copepod (A. clausi) egg production and hatching success, with the possible exception of excretion. Warming resulted in an increase of excretion rate, an effect enhanced when combined with ocean acidification.
- Laboratory experiments on bacterial and viral community dynamics under acidification and warming conditions indicated that viral abundance was not considerably affected but bacterial abundance reached quickly high values under the acidified conditions.
- The increased glucose and oxygen uptake by a bacterial community in acidified and warm conditions suggest the presence of more glucose degrading bacteria. The bacterial community is slightly affected by pH changes.
- Microbial metabolism is not significantly affected by acidified treatments. Warming (but not OA) resulted in an increase in β-glycosidase activity towards the end of the experiment, pointing to a more intense degradation of polysaccharides.
- The effects of different pCO_2 concentrations on exopolysaccharides production by *Staphylococcus aureus* indicated that the more the acidification of medium, the less the *Staphylococcus aureus* growth.
- Combined effects of OA and OW on *Chaetoceros gracilis* (diatom) show a decrease of growth, an enlargement of the cell, chloroplast damage, disorganization and disintegration of thylakoid membranes and cell lysis.
- *Alexandrium minutum* (harmful algae) cell growth is reduced with the decrease of pH. However, in combination with warming, growth at future pH was substantially increased compared to growth at present pH.
- The polyp asexual reproduction of *C. tuberculata* (symbiotic jellyfish) is highest in elevated temperature conditions, followed by lower pH and lower pH/elevated temperature conditions suggesting that ocean warming could be beneficial for their proliferation and acidification leaves them unaffected.
- The 'statoliths' morphology of the two scyphozoan adult species *Aurelia aurita* and *Cassiopea andromeda* is sensitive to reduced pH, possibly causing a lesser ability to orient in the water column.
- Mesocosm experiment results show that for CO_2 conditions forecast for the end of this century, the pelagic ecosystem in both the western and eastern Mediterranean Sea will prove in general resilient to increases in the ocean acidification effect. However, the warming will have a more important effect than acidification; and that will enhance the effect of acidification on pelagic ecosystem functioning. However there was some indication of enhanced nitrogen fixation in the Corsica mesocosm experiment under warming and strongly acidified conditions.

4.1.3.2.3 Work Package 4, Effects of ocean acidification on keystone benthic ecosystems and the impact on benthic biodiversity (WP leader: Maoz Fine)

Work Package 4 aimed at assessing the response of Keystone Mediterranean benthic ecosystems to ocean acidification and climate change. Four iconic ecosystems were identified as the focal points of WP4 team: seagrass meadows, vermetid reefs, coralline algae seabeds and coralligenous reefs. A further goal of WP4 was to examine the response of commercially important species (red corals and mussels) to the projected conditions. The state of the keystone benthic ecosystems was characterised at Mediterranean level, identifying possible risks under OA and warming and assessing the physiological responses to a changing environment *in situ*, in controlled laboratory experiments and in three Mediterranean CO_2 seeps: Methana (Greece) Ischia Island and Vulcano island (Italy).

Posidonia oceanica is negatively impacted by the effects of global warming over the next century and climate change poses a significant challenge to this seagrass that is already suffering losses from anthropogenic impacts. Warming can induce declines in shoot abundance through increased shoot mortality in *P. oceanica* meadows. Younger life-stages (i.e. seedlings) of *P. oceanica* may be particularly vulnerable to climate change. Insights into OA effects on seagrasses has come from CO_2 vent surveys: showing consistent loss of crustose coralline algal epiphytes on seagrass leaves, and greater seagrass density close to the seeps with a lower pH. Lower epiphytes load can have positive consequences for seagrasses as it reduced shading and nutrient uptake by the epiphytes.

Vermetid reefs have reduced recruitment success of the main reef-builder snail *Dendropoma petraeum*, increased shell dissolution, and altered recruit shell mineralogy at expected levels of ocean acidification. Physiology of vermetids early-stages is affected by OA acting in concert with thermal increase. Benthic biodiversity associated to this ecosystem significantly differed at three pCO_2/pH levels. Although vermetid are resilient to near-future pCO_2 levels, it is likely that their reefs will not be able to withstand levels of acidification predicted for the end of this century, and the associated community will change as a result.

Laboratory cultures of coralline algae under conditions of elevated temperature and pCO_2 revealed effects on photosynthesis, growth and calcification. Crustose coralline algae (CCA) (*Neogoniolithon brassica-florida*) dropped to half of its maximal photosynthetic yield at a relatively low light intensity (50 µmol quanta $m^{-2}s^{-1}$) compared with its natural light experience, only when exposed to near-future seawater temperature levels (33°C). Sensitivity of *N. brassica-florida* to OA examined in CO_2 seeps showed no significant difference in the photosynthetic yield between pH sites except at 1500 µmol quanta $m^{-2}s^{-1}$ (mid-day) when Fv/Fm of *N. brassica-florida* at the low pH site was significantly lower than the medium and ambient pH. In the light (400 µmol quanta $m^{-2}s^{-1}$) at pH 7.9, CCA calcified at a rate half of that incubated at ambient pH 8.1. In the dark, CCA incubated in both pH levels dissolved with a much higher dissolution rate at pH 7.9. Cover of CCA decreased as pCO_2 increased in CO_2 seeps, confirming that calcifying algae are likely to be threatened by ocean acidification, especially those species living near their thermal limit.

The red coral *Corallium rubrum*, a key species of the coralligenous community with significant cultural and economical significance, showed no effects of OA on microdensity and porosity. Impaired sclerite shape and a 59% decrease of its calcification rate was found at lowered pH. Disturbances such as harvesting pressure could act in synergy with OA bringing local populations to extinction.

The assessment of the effects of OA and warming on mussel growth culture revealed that the

Mediterranean mussel *Mytilus galloprovincialis* is particularly sensitive to increasing temperature. A significant decrease in growth (total weight, shell length, shell weight) has been found in warmer conditions as well as clear dissolutions of the shells exposed to low pH conditions (-0.3 compared to ambient). Mussels exposed to low pH showed a clear loss in the organic layer covering the shell in summer, explaining the clear dissolution signal measured on these mussels.

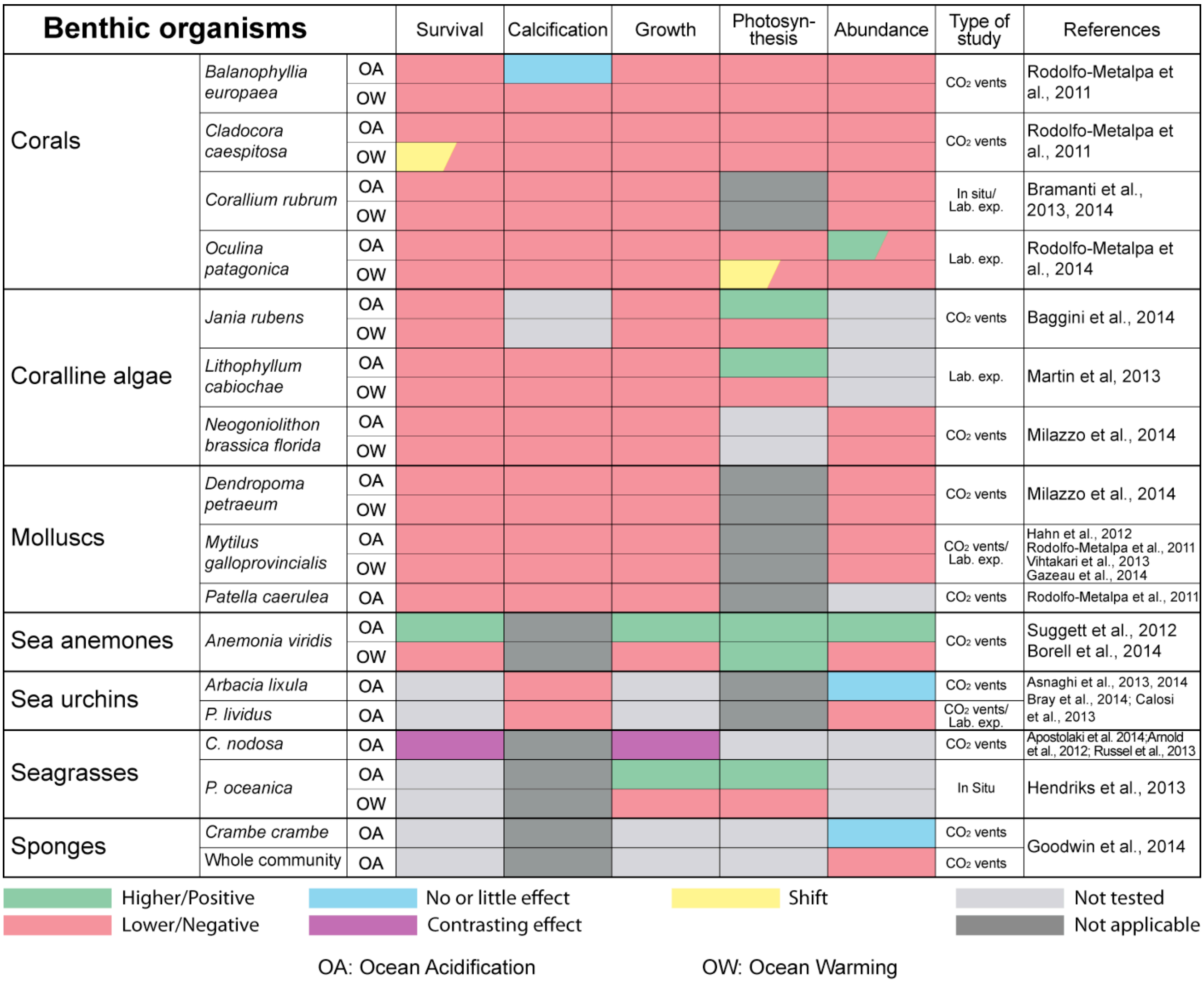


Figure 7. Summary of the effects of OA, ocean warming and the combined effects of OA and ocean warming among key selected Mediterranean benthic taxonomic groups.

Selected WP4 highlights
• Thirteen sites in Sicily and five in Israel were inspected for *Dendrepoma petraeum* and its associated calcareous algae *N. brassica-florida* live cover. Vermetid reefs sites along the Sicilian coast were overall healthy, but no living *D. petraeum* was found along Israel coasts. • Sea urchins have some ability to regulate their extracellular fluid under elevated pCO_2. The distribution of *A. lixula* was unaffected by the low pH environment, whereas densities of *P. lividus* were much reduced. There was skeletal degradation in both species living in acidified waters compared to reference sites and remarkable increases in skeletal manganese levels, presumably due to changes in mineral crystalline structure. • Sponge percentage cover decreases significantly from normal to acidified vent sites. Increasing CO_2 concentrations will likely affect sponge community composition as some demosponge species appear to be more vulnerable than others. • *Posidonia oceanica* meadows are declining across the entire Mediterranean basin, with estimates of 13 – 50 % of *P. oceanica* already lost. Warming has a negative effect on *P. oceanica* seedlings, leaf biomass, leaf growth, leaf production and leaf longevity. *Zostera noltii* showed that both the maximum photosynthetic rate (Pm) and photosynthetic efficiency (a) were higher (1.3- and 4.1-fold, respectively) in plants exposed to CO_2-enriched conditions. CO_2 vent surveys show consistent loss of crustose coralline algal epiphytes on seagrass leaves, and greater seagrass density close to the seeps with a lower pH. • The calcification rate of *Coralium rubrum* when exposed to lower pH treatment is about 59% lower compared to control conditions. Microdensity and porosity of *C. rubrum* were significantly lower at reduced pH. The survivorship in each treatment was 100% • Vermetid reefs have reduced recruitment success of the main reef-builder snail *Dendropoma petraeum*, increased shell dissolution, and altered recruit shell mineralogy at expected levels of ocean acidification. • Mitylus galloprovincialis, commonly used in Mediterranean shellfish aquaculture is highly sensitive to increase seawater temperature causing a drastic increase in its mortality rates. • Vermetid gastropods, seagrasses, corals, calcareous algae and bivalves are showing great sensitivity to ocean acidification and temperature rise. This may lead to a phase shift in benthic communities as these organisms are engineering species.

4.1.3.2.4 - Work Package 5, Future projection of the acidification of the Mediterranean Sea (WP leader: Marcello Vichi)

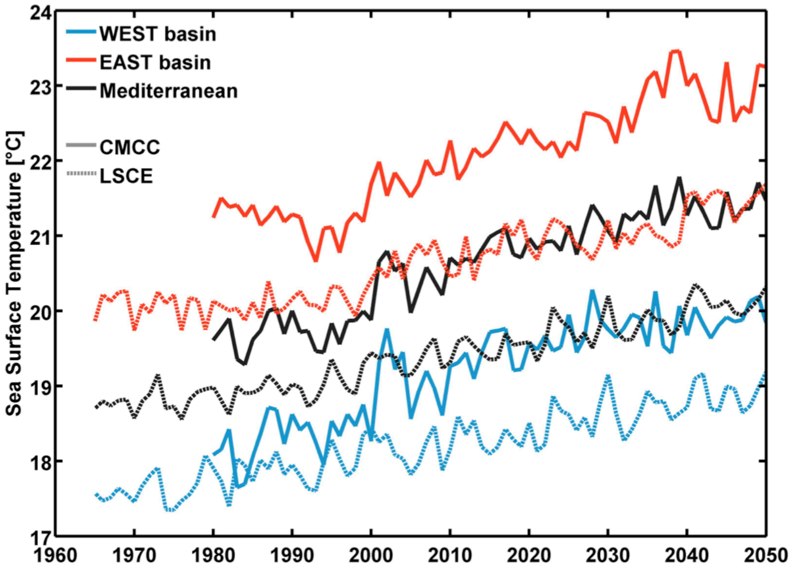
The simulation of the Mediterranean Sea carbonate system under current climate conditions was performed in this WP. A set of coupled physical-biogeochemical model was forced with climate model data to project the impacts of anticipated future climate scenarios on pH and surface temperature. It focused on the assessment of numerical models under current climate conditions and the investigation of future projections of the CO_2 system in Mediterranean using the RCP8.5 IPCC scenario. This scenario implies a maintained utilization of fossil fuel energy sources without any mitigation measure, with a resulting increase of the Earth radiative balance of 8.5 W/m^2 at the end of this century.

The main products of this work-package were the projected changes in ocean physics, carbonate chemistry (pH, saturation state of aragonite) and the projected habitat vulnerability of selected iconic Mediterranean ecosystem components. The impacts of increasing acidification and climate change in the Mediterranean Sea addressed 1) the current basin-wide distributions of pH, carbonate saturation states, and related carbon-system variables and 2) the projected changes of these variables during the 21st century, both obtained through a small ensemble of coupled physical and biogeochemical models (Figure 8). These results supported the development of the socio-economic vulnerability maps and provided reference values to implement policy tools to tackle future acidification and warming scenarios within the work-package 6.

The 50-year climate projections of Mediterranean physical and biogeochemical variables clearly show that the Mediterranean Sea will be warmer of 1 to 1.5°C more than the year 2000 and more acidic of another 0.1 pH units, with regional intensification of the warming signal in the Eastern Mediterranean, Aegean and Adriatic Sea. These projected variations of climatic conditions combined with scenarios of changes in land use will likely cause a decrease in upper layer nitrogen concentrations, which together with small changes in phosphorus availability and changes in water temperature will project a moderate decrease of plankton productivity in the western part of the basin, partially compensated by a small increase in the Eastern Mediterranean Sea. The iconic Mediterranean habitats for *Posidonia oceanica* meadows, coralligenous habitats, maërl beds, and red coral (*Corallium rubrum*) banks were selected to study their vulnerability to the projected future changes in ocean acidification, biogeochemical conditions and mean temperature from the numerical models. Specialized numerical models based on in situ and laboratory biological experiments have been used to compute the species-specific vulnerability of the response to the projected changes in selected key environmental variables such as temperature, pH, nutrients and alkalinity. Results highlight a decrease in habitat suitability for all species considered under the simulated future conditions. Also in the case of Posidonia, model projections overall suggest a decline in suitability under future conditions.

The changes in the occurrence probability obtained by differences between present conditions and future scenarios show that the projected extent of potential mortality zones is higher than in the current climate for red coral and that there is a loss of probability of coralligenous formations along the Mediterranean sites mostly due to acidification increase (Fig. 9). The adverse impact is however localized to certain regions: it is also reported an increase of probability of the presence of coralligenous in the North Aegean and Northern Adriatic Seas.

(a)



(b)

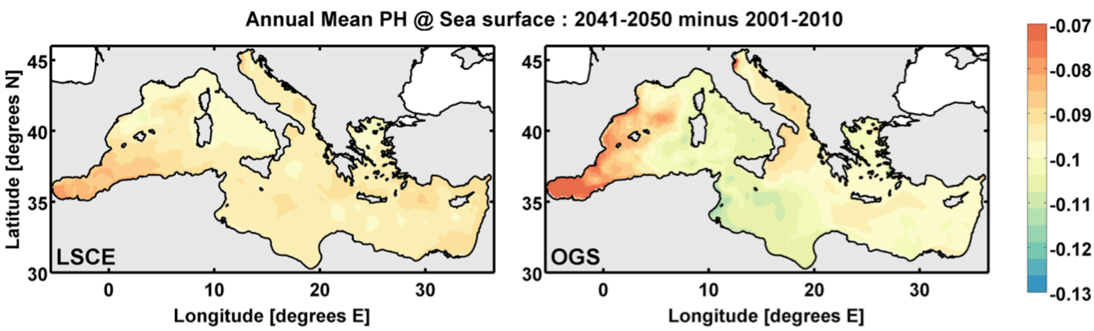
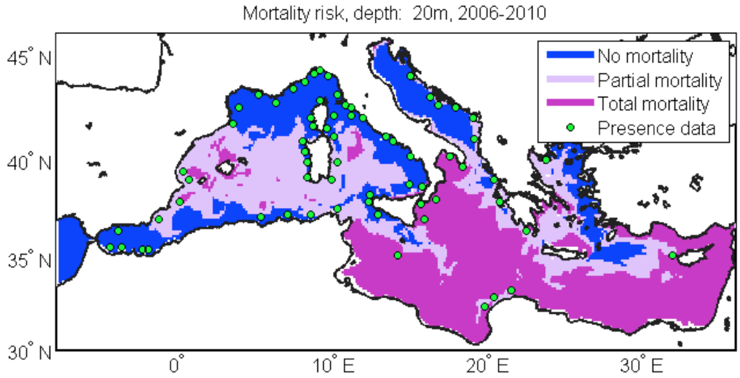
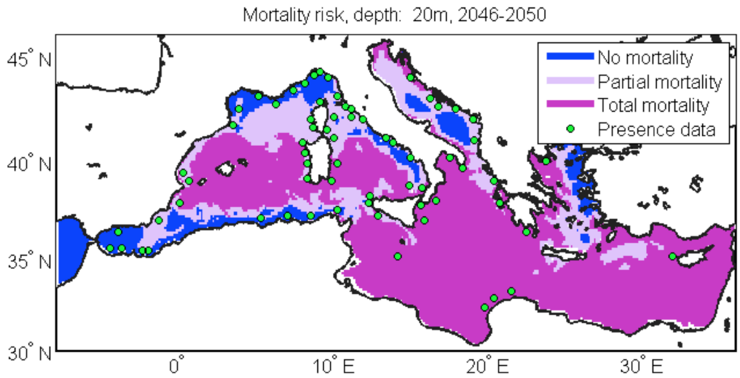


Figure 8: (a) Mean annual sea surface temperatures of the Mediterranean Sea, Western and Eastern sub-basins for the current climate and future scenario (b) Spatial distribution of the surface changes in pH between 2001-2010 and 2041-2050.

(a)





(b)

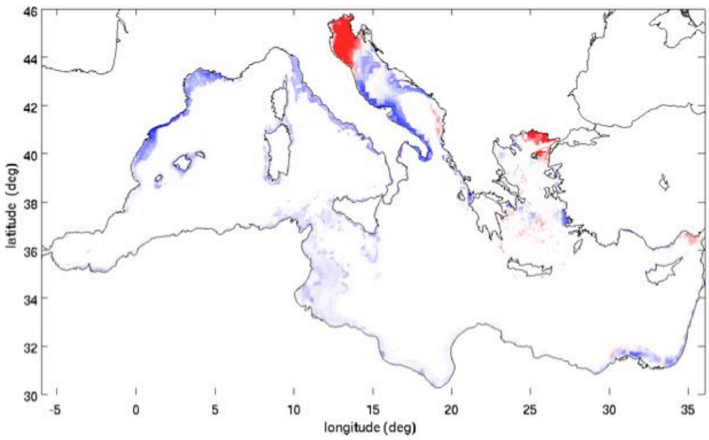


Figure 9: (a) Estimated potential mortality risk of Red Coral at 20 m for the periods 2006-2010 and 2046-2050. (b) Changes in habitat suitability for coralligenous assemblages for the future scenario (2041- 2050). Figures taken from D5.6.

Selected WP5 highlights
• Multi-model projections point toward an average surface warming from 1 to 1.5°C in the Eastern Mediterranean, Aegean and Adriatic Sea between 2000 and 2050; • Summer surface temperature is very likely to persistently exceed 29°C in the Levantine basin by the end of 2050; • Future scenarios on the Mediterranean Sea acidification agrees on a potential reduction of another 0.1 pH units during the first half of this century, consistent with model estimates for the global-ocean average; • The major contributors to uncertainties associated with estimates of carbonate system variability include the lack of data to better constrain numerical model initial conditions and external forcing. • Surface waters are likely to become unfriendly to coral growth by mid century with an expansion of potential mortality areas: projections estimate a relatively small reduction in yearly calcification, which has the potential to become substantial if extrapolated through the whole lifespan of long lived species such as *Corallium rubrum* • The use of habitat suitability models combined with the future projections of changes in acidification and environmental conditions predict a general loss of probability of presence of coralligenous formations along the Mediterranean sites with some localized increase of in the North Aegean and Northern Adriatic Sea • The natural variability of pH and environmental conditions in the Mediterranean is rather large, due to the presence of contrasting coastal and open ocean environments and the ample seasonal change in temperature typical of mid-latitudes marine systems. It is likely that local effects may offset the overall acidification, but in the longer term the pH will diminish without a reduction of global CO_2 emissions.

4.1.3.2.5 - Work Package 6, Socio-economic effects of Mediterranean Sea acidification, adaptation strategies and policy tools (WP leader: Jeroen van den Bergh)

Acidification and warming of the Mediterranean Sea will lead to substantial impacts on regional marine-related economic activities. MedSeA WP6 performed the first Mediterranean basin-scale study on acidification and warming implementing both market and non-market valuation to capture the full range of economic losses. These losses may comprise effects on important sea-based sectors, such as beach and diving tourism, and bivalve mollusc aquaculture. Additional benefits at stake include the potential disruption of ecological processes such as carbon sequestration and coastal protection, as well as effects on non-use values associated with the perceived environmental health status of iconic Mediterranean species and habitats.

WP6 successfully completed the elaboration of a methodological approach for the economic valuation of the socio-economic costs associated with ocean acidification. This involved understanding the chain of impacts generated by ocean acidification for a broad category of ecosystem services with economic significance, and identifying the appropriate set of economic non-market and market valuation techniques for the assessment of ocean acidification costs. In addition, the development of a hybrid ecosystem-based valuation approach to assess ecosystem damages, including the economic valuation of carbon sequestration services in the context of acidification in the Mediterranean Sea, and a macro-economic analysis of indirect effects in the context of fisheries and tourism.

Next, an assessment of recreationists' preferences regarding the quality of certain natural features vulnerable to ocean acidification and sea warming was undertaken. This included the potential recreational losses due to scenarios of higher presence of jellyfish species and degradation of iconic marine species and habitats (e.g., red coral, and coralligenous habitats). Economic valuation studies were performed in Mediterranean areas of considerable tourism significance, with the purpose to extrapolate the findings to similar regional areas in the Mediterranean. Finally, a questionnaire-based survey was targeted at Mediterranean mollusc aquaculture producers to characterize the environmental pressures related to climatic and non-climatic factors they are subject to.

The data collected in WP6 provided the basis for identifying a range of adaptation strategies, tools and policies to limit negative socio-economic impacts of acidification on the Mediterranean region. The main work performed in WP6 is summarised in Table 1.

Table 1. Studies performed in WP6.

Title	Objectives	Focus: Conceptual framework	Focus: Preference analysis	Focus: Vulnerability analysis	Focus: Economic valuation	Focus: Policy and management
Socio-economic impacts of ocean acidification in the Mediterranean Sea	Methodological approach for the valuation of socio-economic impacts of ocean acidification.	✓	-	-	-	-
A hybrid ecosystem model, including the valuation of the carbon sequestration services	Assessment of changes in the carbon sequestration services provided by the Mediterranean marine systems due to ocean acidification, including a macro-economic (indirect) analysis in the context of fisheries and tourism.	✓	-	-	✓	-
Using web-based platforms to inform and assess preferences of beach recreationists – 2013 pilot in Barcelona	Development of a web platform in which a survey will be distributed throughout a sample of beach goers, who will state their concerns, preferences about beach selection and awareness of different types and associated risks of jellyfish.	-	✓	-	-	-
Socio-economic impacts of jellyfish outbreaks on recreation in the Israeli coastal plain	Implementation of survey-based techniques to shed light on the impacts of jellyfish outbreaks on coastal recreation in the city of Tel Aviv and, by extension, along the entire Mediterranean shoreline of Israel. Perform a contingent valuation exercise aimed at inferring the respondents' willingness to pay (WTP) to support an environmental program aimed at the protection of the Israeli marine environment from the negative impacts of climate change and ocean acidification, including jellyfish outbreaks.	-	✓	-	✓	-
The Cost of Mediterranean Sea Warming and Acidification: A Choice Experiment among Scuba Divers at Medes Islands, Spain	Valuation of the impact of sea warming and acidification on the quality of Mediterranean diving areas with coralligenous, focusing on potential changes in the presence of jellyfish species and state of gorgonian species (*Corallium rubrum; Paramuricea clavata; Eunicella singularis*) in the Marine Protected Area of Medes Island (Spain).	-	✓	-	✓	-
Impacts of Global Warming and Ocean Acidification on Mediterranean Coastal Tourism and Recreation	Analysis of potential effects of climate change and ocean acidification on jellyfish species, coralligenous habitat, and red coral and its relation with beach and diving tourism in several Mediterranean coastal areas and Marine Protected Areas.	-	-	✓	✓	-
Impacts of Global Warming and Ocean Acidification on the Mediterranean Mollusc Sector	Assessment of knowledge, opinions and practices in the context of climatic and non-climatic pressures potentially affecting the mollusc aquaculture sector, with a special focus to extreme events such as summer heat waves and certain effects that might be expected under ocean acidification (e.g., decreases in shell thickness/resistance and in seed recruitment).	-	-	✓	-	-
A set of adaptation tools and policy suggestions	Collection and analysis of potential adaptation strategies and policies to adapt to ocean acidification in the context of economic sectors (Fisheries and aquaculture, agriculture, tourism), coastal infrastructural development, pollution, and demand side options (tastes and preferences).	-	-	-	-	✓

Selected WP6 highlights
• Total yearly benefits of carbon sequestration/buffering in Mediterranean EEZs are 2.51 billion € for 2000 – 2009 and 4.15 billion € for 2030 – 2039. These values are calculated using a carbon price of 19€/ton CO_2 recommended by the EC (DECC 2009). This is likely to be an underestimation, and if recent estimates of the social cost of carbon are used then benefits might be up to 6 times higher. • The macroeconomic benefits of marine carbon sequestration (buffering or compensation) are a 6% reduction of the negative impacts of climate change on fisheries and tourism. • The results of a valuation study of the impact of outbreaks of jellyfish blooms due to increases in seawater temperature on coastal leisure activities in the city of Tel Aviv, and by extension along the entire Mediterranean shoreline of Israel, indicate that on an annual basis a monetary loss results in the range of 8.9–31.1 million ILS (1.8–6.2 million €). Associated with this is a reduction in the number of beach trips between 3% and 10.5%. • Estimated values of a "risk of jellyfish outbreaks" indicator for each of the six sub-basins that compose the Mediterranean Sea indicate that the highest level of risk to recreational activities is found in the "Sardinia and Gulf of Lyon" sub-basin. A medium risk is found in the Levantine and Balearic basins. The lowest risk levels are predicted for the Aegean and Adriatic Seas. Since such results are largely controlled by the distribution of the available monitoring operational areas, they should be considered of a preliminary nature and be complemented by information based on more extensive monitoring in the future. • A study was undertaken in Catalonia, Spain to assess economic use values associated with diving tourism as affected by marine ecosystem changes due to climate change and ocean acidification. It shows that scuba divers require a high compensation to dive in areas where gorgonians have disappeared, namely 72 € per dive, resulting in a total of 4 million € for the total of dives made in a year. Jellyfish are, depending on the type of species (stinging or not), considered as repulsive or attractive to divers. Avoiding stinging jellyfish has an additional value of 1.7 million €. • Ocean acidification may trigger changes in the suitability of the coralligenous habitat and red coral mortality in various parts of the Mediterranean Sea. Among the studied areas, there are some highly intense diving destinations such as Calanques (France), Medes (Spain) and Portofino (Italy), with 30,000 up to 150,000 dives made in a year. A rough estimate can be derived for the compensation value of impacts of sea warming and ocean acidification for all MPAs in the Mediterranean Sea area, namely to be in the range of 150 thousand to 120 million Euros. • A survey of mollusc aquaculture producers from different Mediterranean Sea areas showed that a great majority of the respondents (76%) have experienced important difficulties in their activity in past years as a consequence of summer heat waves. These events have led to various sorts of effects with negative economic repercussions, such as juvenile and adult mortality of molluscs, and a decrease in the production of byssus. The results further indicate a high uncertainty and lack of knowledge among producers regarding what ocean acidification could mean for the future of their sector. Effects such as a decrease in shell resistance and thickness and diminished seed recruitment, which are likely to occur under continued ocean acidification, already have been observed in some production sites. • Mitigation strategies and policies at global, regional and local scales need to be implemented as they are the only certain, effective way to reduce CO_2 emissions to the atmosphere and associated ocean acidification. Mediterranean Sea acidification may be more severe in areas where human activities and impacts, such as nutrient run-off from agriculture, further increase acidity. Agricultural run-off from land and other stressors on Mediterranean ecosystems needs to be more strictly regulated. In addition, adaptation policies are required as an increase in atmospheric CO_2 concentration seems unavoidable. The combination of mitigation and adaptation can assure that the Mediterranean can continue to sustain livelihoods, provide food and protect shorelines. • Adaptation includes a wide variety of strategies: (i) making marine ecosystems more resilient by improving diversity through establishing marine protected areas; (ii) reducing local stressors (land-based pollution, coastal development, overharvesting, and invasive species) by regulating sectors like agriculture, industry and infrastructure; making marine ecosystem based sectors like fisheries, aquaculture and tourism more resilient to sea warming and ocean acidification by creating awareness and providing public assistance; and undertake marine spatial planning addressing unique threats to shorelines, estuarine, shallow coastal zones and deep waters. In addition, contentious bioengineering approaches are proposed, like dissolving carbonate minerals (e.g. limestone) in seawater or iron fertilization stimulating photosynthesis and hence carbon uptake. All of these, however, have serious drawbacks and risks.

4.1.3.3 MedSeA project-determined knowledge limits and future steps

MedSeA resolved crucial unknowns of Mediterranean acidification processes and their impacts on marine organisms and ecosystems and their socio-economic consequences. Before the inception of MedSeA, the OA issue in the Mediterranean Sea was largely unknown: data on carbonate chemistry were very rare and sparse; almost nothing was known about the biological responses of Mediterranean endemic keystone species to OA; and no knowledge was available for the economic assessment of the OA impacts. MedSeA scientists have successfully completed the planned work and although we gained a critical mass of new information, during the development of the project several key scientific questions were raised that could not be finalized to full scientific satisfaction. During the final MedSeA meeting a special session was dedicated to an open discussion on the knowledge gaps that have emerged throughout the execution of the project.
It is clear now that **regional to sub-regional studies are key to defining local impacts due to raising atmospheric CO_2.** Both **climatic and non-climatic stressors should be considered, and clearly distinguished, for projections for management, prevention and adaptation strategies.** This was also discussed recently in June 2014, in a session that was organized at the IMBER Future Ocean conference in Bergen by MedSeA scientists together with colleagues from the USA and China. The session focused on the regional responses to climatic and non-climatic drivers in a high-CO_2 ocean. **OA fine-scale regional intercomparisons are probably among the most needed work elements.** The MedSeA coordinator was also invited in September 2014 to present the MedSeA project findings in South Korea, targeting a comparative work between the marginal seas around Korea (East China Sea, Sea of Japan) and the Mediterranean. One priority that was strongly emphasized during the discussion at these meetings was the need to **entice policy makers into considering OA a real issue, and promoting concrete policy actions to address it.**

Trends and changes in the levels of CO_2, water pH and temperature were thoroughly analyzed to discern: a) the contribution of MedSeA results to th e available scientific knowledge and evidence on this subject and, b) possible policy propositions based on the predictions, the models and the evidence produced by the MedSeA work and experiments.

It is clear now that iconic and endemic Mediterranean species are vulnerable to climate change and acidification and that species biodiversity is decreasing in a rapidly changing high CO2 ocean. However, it is necessary now **to move from a species-specific to a much broader ecosystem-based scope of analysis.** Future challenges in this regard are likely to arise from both the theoretical and empirical change of perspective: from an ecosystem standpoint, new types of experiments and new techniques are likely to emerge and be developed in future research. However, the important impacts on key industries, such as aquaculture and tourism, also imply that these case studies will remain crucial for OA analysis. One of the key knowledge gaps in this regard, as well as one of the most promising future opportunities, is the need **to expand the scope of analysis from the Mediterranean Sea to other relevant basins and ecosystems, thereby also including more partners and different variables into the overall research design.**

The inability to formulate OA as a priority issue hampers the possibility to access policy-makers and their agendas, thus making it harder to drive new action based on the growing awareness and knowledge available today to scientists in this field. A priority is **to elaborate an ecosystem services approach that invokes societal needs and objectives — e.g., economic and social growth — and uses them as a roadmap to define scientific and policy priorities and achievable goals.** Most participants agreed that harder work on the part of the scientific community is needed, especially in terms of dissemination to a broader public and definition of simple policy directives. Interestingly many NGOs and Environmental organizations are already deeply interested in OA and warming effects in a high CO_2 ocean, and are willing to invest economic, political and social resources to meet the challenge of these stresses.

4.1.4 Potential impact, main dissemination activities and exploitation of results

In the MedSeA project, we raised awareness of OA in the Mediterranean region through contributions to major scientific assessments (e.g. IPCC-AR5, CBD-Technical Serie-75, SGOA-OSPAR) as well as documents for policy makers and outreach in different Mediterranean languages. MedSeA is one of the first international cooperative research projects on OA and warming within a European funding framework following the first internationally leading project on OA, EPOCA (European Project on Ocean Acidifcation). MedSeA is the first to deal specifically with the Mediterranean Sea and involved from the beginning to end several partners from Europe's Southern Neighbourhood. The breadth of its empirical endeavour, its research achievements, and its multi-scenario interdisciplinary output would have been unattainable without its international membership; the comprehensiveness and reliability of its analytical and experimental work would have been compromised without the constant inclusion of MedSeA's Southern Mediterranean partners.

The dissemination on the risk of the Mediterranean Sea acidification was developed within the work package 7 (WP leader: Carol Turley PML), aiming to better inform policymakers and other stakeholders in the Mediterranean region about the risk of OA in the Mediterranean Sea. It did so through systematic dissemination and awareness activities aimed at increasing the visibility of OA and warming as key components of climate change phenomena and a source of significant risk for marine ecosystems in the Mediterranean area. Overarching activities were also performed in the project management (work package 1) through the project websites and specific blogs. The project web page and the social networks (e.g. blogs) showing key project activities were instrumental for communicating and reaching out to a large audience and provide products for students and teachers. The website (medsea-project.eu) had almost 200.000 views from 2011 (March) to 2014 (September), the majority of which were from Mediterranean countries, North and South America and Australia. An information outlet was maintained on Mediterranean climate and environmental change (http://medseaclimatechange.wordpress.com) providing a service for the diverse scientist and projects working on the marine climatic and non-climatic marine environmental change. This blog had over 1680 posts receiving over 30.500 views from February 2012 to August 2014. Key activities such as mesocosm experiments (e.g. http://medseastareso2012.obs-vlfr.fr) and the oceanographic cruise were well covered in blogs and followed. For example the MedSeA oceanographic cruise blog (http://medseaoceancruise.wordpress.com) in May 2013 had in one month over 17.000 views.

This section 4.1.4 reports on the impacts and outcomes of MedSeA: a) on European and international research in the field of OA and warming; b) on the community of stakeholders and policy-making directly involved or affected by the results and output of MedSeA's research and analytical work; and c) on society at large, emphasizing both the ability of MedSeA partners to reach the wider public with their dissemination activities, and the relevance of MedSeA's results and outcomes in terms of economic and societal impact.

4.1.4.1 Impact on European and international research

The MedSeA project has had a significant impact on European and international research on ocean acidification, ecosystem conservation, and warming and climate-change effects in the Mediterranean area. As shown above, much of the most recent state-of-the-art scientific knowledge produced on these topics can be ascribed to the work of MedSeA partners and researchers. The MedSeA Project planned to positively affect European and global research on these topics by giving emphasis to three key roles: as coordinator of unrelenting communication among the partners and exchange of ideas and scientific material and data; as liaison between MedSeA researchers and international fora and consortia with international visibility and outreach on the topic of ocean acidification; and as scientific and institutional hub for the mobility and involvement of young researchers at various levels (PhD students, Post-docs, and junior researchers), from partner institutions as well as from a number of European, North African and Middle Eastern universities and research centres, and other institutions from around the globe.

The MedSeA project has served as a platform to coordinate the work of the sixteen partners that took part in the project and the 6 associate partners joining the consortium during the project. Constant collaboration across the consortium has offered MedSeA many opportunities for transnational academic efforts that have enhanced the visibility and impact of MedSeA-related knowledge and research output. Even beyond the added value of transnational research work in a number of experimental settings that spread across the whole Mediterranean region, MedSeA has been a unique opportunity to create synergies between institutions that have relied extensively and mutually on each other to advance their individual progress into a collective academic endeavour, with an impact that transcends the Mediterranean and increases knowledge on a phenomenon — ocean acidification and warming — with truly global consequences. In scientific terms, the result of this enhanced collaboration can be quantified in **105 published peer reviewed articles**, allowing MedSeA-related research on ocean acidification account for **an average of 60% of all published research on ocean acidification** in the Mediterranean area throughout the project's duration. These results were presented to relevant scientific audiences in international conference and events throughout the duration of the Project, allowing MedSeA researchers to obtain feedback at the highest level and engage the scientific community on further commitment to the study of ocean acidification and its effects. MedSeA European and international academic activities include **255 presentations at conferences and workshops**, and an assiduous activity at several outreach events with posters, stands, and other dedicated dissemination means. Moreover, all the data collected throughout the project, in its fieldwork will be made available through the PANGAEA (http://www.pangaea.de/) information system, a collective open-access library and database to archive and publish geo-referenced data from research on the earth system: the data is available for consultation and issued under an open-access creative commons licence. In its 2012 communication on the European Research Area (ERA), the European Commission emphasised several key objectives that were crucial to promote growth through knowledge and research and improve the productivity of scientific research with positive externalities on job creation and economic development. Among these goals, the Commission mentioned explicitly the need for *more effective national research systems* and the *optimal circulation, access to and transfer of scientific knowledge via a digital European research area*. The scientific output of the MedSeA project, the outcomes of its three-year-and-a-half long multinational collaboration scheme, and the reliance on Europe-wide infrastructure to make this knowledge accessible to the scientific community and the larger public make the MedSeA Project particularly consistent with the guidelines and compliant with the overarching strategy that the European Commission has defined for the next few years in Europe's research agenda.
MedSeA (WP leader, UAB, data curator, Michael Grelaud) has maintained two data bases, one on observational and experimental data, and the other on modelling data. **The MedSeA data management** consisted of two parts: (1) the management of data created by MedSeA and (2) the archiving of all the environmental and biological data published within the project. Most of the data produced during MedSeA have been archived in the information system PANGAEA (http://www.pangaea.de/) where they are in open access. The data can be accessed as well from MedSeA web site (http://medsea-project.eu/publications/). The data originated from continuous time-series (DYFAMED, Point B, POSEIDON E1-M3A, C1-LTER) were not archived on PANGAEA in order to avoid duplicates: they are freely accessible, on request; from different national data centers.

MedSeA database consists of 79 datasets. The largest portion of data sets originated from in situ observations, including a total of 36 data sets (more than 72000 data points) which were presented in 16 scientific articles. Laboratory experiments are the second data sets providers. They focused on many

different groups of organisms (corals, bacteria, phytoplankton, zooplankton, bryozoans, echinoderms and mollusks) and produced 23 data sets (more than 86000 data points) presented in 14 scientific articles. The three mesocosms experiments gather 5 data sets; they include more than 150 parameters and represent an amount of more than 190 000 data points. The paleo studies produced 11 data sets (mainly from the analysis of marine sedimentary archives) presented in 5 scientific articles. Finally, physical oceanography from the 2013 MedSeA-GEOTRACES cruise is also represented in the MedSeA database, including a total of 3 data sets and more than 220000 data points.
The project's model output archive will be release very soon and will be available on PANGAEA as well. The MedSeA simulations consist on coupled models NEMO+PISCES and NEMO+BFM.

Throughout its duration, the MedSeA Project has also emphasised the need for more effective networking and knowledge-sharing across the scientific community actively involved in research, dissemination, and policy counselling on ocean acidification, warming, and climate change. MedSeA was endorsed by **IMBER** (Integrated Marine Biogeochemistry and Ecosystem Research, http://www.imber.info/), an international project initiated by the International Geosphere-Biosphere Programme (IGBP, http://www.igbp.net/) and the Scientific Committee on Oceanic Research (SCOR, http://www.scor-int.org/) that studies impacts of natural climatic and anthropogenic influences on marine biogeochemical cycles and ecosystems, their interactions, and feedbacks to the human and Earth systems. MedSeA was also endorsed by **SOLAS** (Surface Ocean Lower Atmosphere Study, http://www.solas-int.org/), an international research initiative studying the key biogeochemical-physical interactions and feedbacks between the ocean and atmosphere, and how these factors regulate climate and global change. Participation in IMBER/SOLAS events has guaranteed MedSeA scientists and researchers a globally-renowned forum through which channel MedSeA advances and achievements, while significantly contributing to the efforts of the international academic community in the definition of a scientific and policy agenda to tackle acidification impacts on a larger scale. Cooperation with other European and international research frameworks, projects, and schemes was a key feature of MedSeA's research and dissemination strategy. Collaborations include dissemination actions and feedback coordinated with the **UK-OA Programme** on ocean acidification; dissemination and training activities with the **BIOACID** national German research project; MedSeA was a key partner in the development of the **OA-ICC** (Ocean Acidification International Coordination Centre (OA-ICC), funded through the IAEA's Peaceful Uses Initiative) based activities on dissemination and communication about ocean acidification worldwide. MedSeA is a founding partner of this International Atomic Energy Agency initiative and the Project Coordinator as well as other members are parts of the OA-ICC's advisory board; acknowledgment in the Inventory of EU Marine Climate-Change Research through cooperation with the **CLAMER** (Climate Change and European Marine Ecosystem Research) project; the **PEGASO** (*People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast*) project, with feedback on larger public and policy-makers/stakeholders; the **PERSEUS** (*Policy-orientated marine Environmental Research for the Southern European Seas*) project, with exchange of scientific counsel between the project coordination offices and attendance in MedSeA projects' annual meetings; the **MedPartnership Project**, set up by the UN Environmental Programme, to which MedSeA contributed as invited member of the Scientific Steering Committee; a coordinated session at the 40th **CIESM** (Mediterranean Science Commission) conference in Marseille, on October-November 2013; and the participation in the Ocean Acidification Principal Investigators' Meeting in Washington, on September 2013, in which the MedSeA coordinator was invited to present the project's findings and achievements to researchers from key American institutions working on ocean acidification worldwide. As the European Commission highlighted in its ERA communication, *optimal transnational co-operation and competition* needs to be a pillar for the evolution and strengthening of a competitive research environment on a European scale: MedSeA's extensive record of international and European collaborations throughout its duration is an additional proof of the project's consistence with the overarching strategy and guidelines laid out by European institutions.

The MedSeA Project, finally, has played a fundamental role in the European academic landscape on marine environmental policy and acidification studies as a research hub for young scholars, junior researchers, and students. The added value of participating in the MedSeA project stemmed from its multinational nature and its ability to proactively engage the academia and the research communities of several non-EU states across the Mediterranean region. Shared research work and activities within the MedSeA project have effectively translated into a multidisciplinary experience that allowed students and young researchers from often distant or diverse contexts and backgrounds to get in touch with different academic traditions, instruments and techniques, and resources. Throughout its three-year-and-a-half duration, the Project has actively involved more than **43** junior researchers, including **16 PhD students, and 27 Master's students** and several joung **postdtocoral researchers** (over **25**). Students and young researchers also benefitted extensively from the techniques and instruments that were funded by the MedSeA project to attain its results: research cruises across the Mediterranean, fieldwork experiments with cutting-edge technology, common platforms and events to update the consortium and discuss the use of relevant data all contributed to the inclusion of these categories in the Project and its achievements. Another pillar of the European Commission's overarching research strategy is *to ensure the removal of barriers to* ***researcher mobility, training and attractive careers*** and create an *open labour market for researchers*. With the training opportunities, the options for mobility among the members of the MedSeA's consortium, and the active involvement of young researchers in the work performed by all partner institutions, MedSeA has proved particularly consistent with another key instrument of the long-term vision of the European Commission for competitive and path-breaking research across Europe.

4.1.4.2 Impact on stakeholder and policy-making communities

Since its initial phases, MedSeA has been relentless in engaging and involving the policy-making community and all the societal and economic stakeholders directly interested in ocean acidification of the Mediterranean Sea and its broader impacts. The knowledge acquired and developed through the MedSeA's scientific work has added significantly to the information available to policy-makers at the European, national and local levels. This knowledge is all the more important in a context in which, globally as well as regionally, the negotiation of more stringent regulation and an adequate normative response to the challenges of climate change and warming is underway and rapidly turning into an extremely urgent, top-of-the-agenda issue at all governance levels.

Within the European context, the European Union approved in 2008 the first Maritime Strategy Framework Directive (MSFD, Directive 2008/56/EC) to establish a common European framework for a consistent marine environmental policy. In 2014, the European Commission started a tailored process of evaluation and assessment of the MSFD's reception by each individual Member State while releasing, as recently as on May 2014, a new communication on the tight link between marine preservation, innovation, and economic growth. Marine environmental protection is key in the new research framework of the Horizon 2020 Programme, as the policy-making community now acknowledges the creation of new knowledge on marine ecosystems and an increase in investments in research on these topics as top priorities.

Because of this growing interest, since its initial phases, the MedSeA Project has invested significantly in constant communication with the policy-making community. A specific tool, the Mediterranean Reference User Group (MRUG), was conceived to institutionalise this channel of communication and enhance the opportunity for fruitful exchange of information, knowledge, and updates on the output and results of the MedSeA's research work. Since 2011, the MRUG has met annually to define a strategy for the dissemination of acidification-related knowledge in the Mediterranean and beyond through a privileged information flow with interested stakeholders. Through its expanding membership, the MRUG has involved throughout the project's duration representatives from UNESCO, the Union for the Mediterranean, the United Nations Environmental Programme, the World Bank, Greenpeace, the WWF Foundation, FAO, the Global Ocean Commission, Ocean Conservancy, and Europêche among others.

The MRUG undertook a laborious job of coordination across platforms, institutions, and different recipient communities. Its activity was valuable, nonetheless, in spreading awareness on ocean acidification, in tightening the bond with the policy-making community, and in fostering feedback, comment, and advice from the various stakeholders that see MedSeA as a key interlocutor in the definition of a truly European framework for the identification and fight against ocean acidification, warming and climate-change challenges in the region. The MRUG brochures were circulated at meetings and conferences of international relevance — including *i*OA-RUG events (International Ocean Acidification Reference User Group) and the framework of the EPOCA European research project.

MedSeA scientists, researchers and institutional partners all played a key role in disseminating information to a wider audience of stakeholders and policy-makers. Throughout its duration, MedSeA has circulated a number of press releases to reach the widest audience possible about the project's achievements and results. Many MedSeA members have participated in meetings, workshops, and conferences at the international level that engaged and involved the highest level of governance representation in the fields of climate-change action and environmental policy. Within the project's Work Package 7 on the dissemination on the risk of the Mediterranean Sea acidification, MedSeA members participated in events organised by, among other, the European Union, the French government, and the United Nations' Framework Convention on Climate Change—mostly in the frame of the Rio+20 initiatives. The Project Coordinator was also actively involved in dissemination activities at the highest institutional level. In September 2013, she took part in the United States Ocean Acidification Principal Investigators' Meeting, an event that gather all main researchers and responsible scientists from the United States currently working on projects related to ocean acidification, warming and marine climate-change effects. In March 2014, she participated in the EU-organised HOPE: Healthy Oceans, Productive Ecosystems conference in Brussels, under the auspices of the European Commission, on the relation between a healthy oceanic ecosystem and sustainability and growth. As a token of the perspective contribution of MedSeA to milestone knowledge in the field of ocean acidification and to future research efforts in this field, the MedSeA Project Coordinator has been personally invited to address policy officers from the European Commission and other European agencies at a *lunch talk* at the Directorate-General MARE, on November 18, 2014, following positive feedback on the successful MedSeA's Policy Day at the European Commission on July 8, 2014.

Other relevant MedSeA scientists' dissemination activities include the collaboration to the activities of the Intergovernmental Panel on Climate Change; the collaboration of MedSeA scientists — especially from Work Package 4 — in the drafting of the FAO's report on ocean acidification impact on fisheries; the participation of several MedSeA researchers in the Convention on Biological Diversity as experts on ocean acidification in Europe; and a member of the research consortium invited to address the audience of the Our Ocean Conference, organised in September 2014 by the U.S. State Department and that featured a keynote intervention by Secretary of State John Kerry, on the effects and science of ocean acidification, warming, and the lessons learned from the European case.

The work of MedSeA scientists and partners in actively disseminating state-of-the-art knowledge and raising awareness on the comprehensiveness of the issue on society and the economy culminated, perhaps, in the elaboration of the *Ten Policy Facts on Ocean Acidification in the Mediterranean Sea*, a document that sums up the main findings, results, and impacts of the MedSeA's three-and-a-half year research work in a clear, concise and direct way and that expressly addresses policy-makers (see Annex 1). Not only does the document provide policy-makers with all the necessary key information they need as guidance in the attempt to elaborate and perfect the European policy and legislation on ocean acidification, but it also synthesises the tight connection between the scientific component of the knowledge created throughout the project's duration and the pervasive social and economic consequences that are likely to affect the day-to-day lives of European citizens. The *Ten Policy Facts* document was on of the key perspective outputs at the beginning of the project, and the result of constant feedback and negotiation across the project's different work packages. The goal was to provide the largest possible audience of stakeholders with immediate answers to sensitive questions about acidification, its impact on the economy and society, and a sustainable way to design and implement solutions for the challenges it raises.

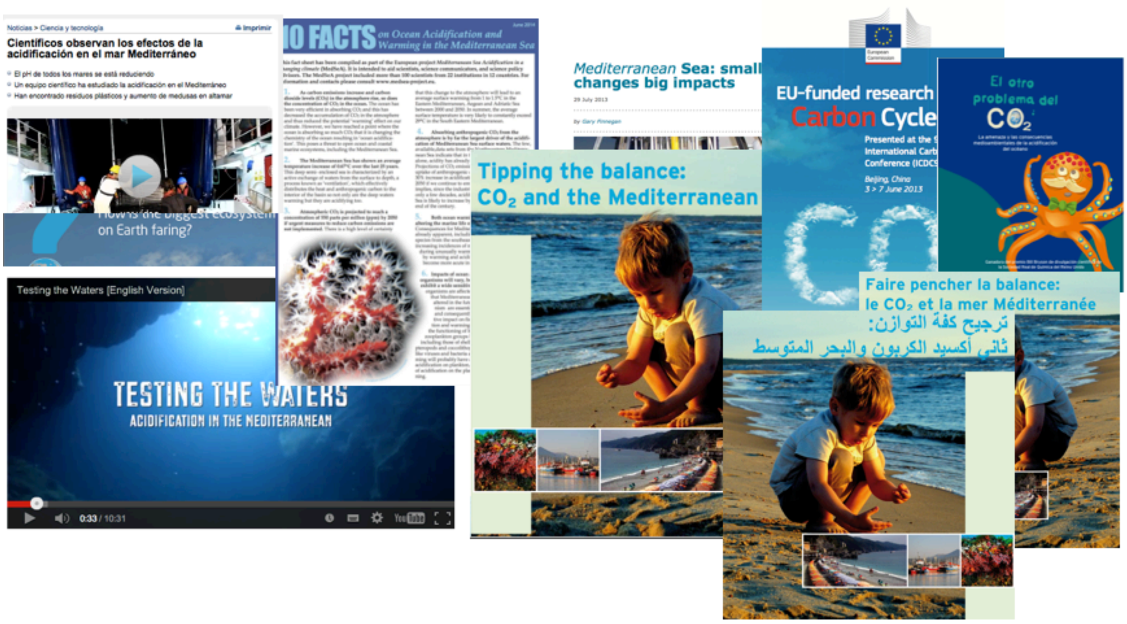


Figure 10. Highlights of some of the MedSeA outreach products and activities.

A scientific document — *Ten Facts on Ocean Acidification* — was developed at the same time to address the key priorities of academic research and knowledge building on the topic of acidification in the Mediterranean area, and was eventually presented at a dedicated press release, the coda of the Final Meeting that gathered all MedSeA partners in Barcelona on June 10-12, 2014. The *Ten Policy Facts*, on the other hand, were presented directly to policy-makers and stakeholders shortly after in Brussels, on July 8, 2014, during the MedSeA Project's *EU Policy Day*, organised by the Directorate-General of Research and Innovation. The meeting, a dedicated session in which MedSeA researchers, principal investigators, and communication managers had the opportunity to address with no intermediation policy officers from various European Commission's DGs and EU agencies—including DG MARE, DG Environment, DG REGIO, and DG Enterprise, among others. The audience was particularly consistent with the message the MedSeA had for the policy community: the need for further investment in research on ocean acidification and its impact; the necessary involvement of the Mediterranean area as a whole, empowering Southern and Eastern neighbours in the common struggle against climate change and the stressors that affect the multiplicity of Mediterranean ecosystems; the need for more transparent policy- and law-making in this field, and the big opportunity currently available to European legislators to influence national and global legislation on the topic by acting as *first movers* at least at the European level. The *Ten Policy Facts* document, the presentation of the project's results, and the official MedSeA video, *Testing the Waters*, were welcomed very warmly as effective and incisive explanations of the current priorities and overarching research goals in the field of ocean acidification, warming, and climate-change action. As mentioned above, a representative of DG MARE invited the Project Coordinator to deliver a talk on the MedSeA project, its achievements, and a roadmap for future action to a larger audience of policy-makers and policy and economic stakeholders. Together with the possibility to circulate MedSeA materials at a higher policy-making level and to showcase the MedSeA video as a powerful tool of dissemination even with non-specialised audiences, the MedSeA *EU Policy Day* and the talk at the European Commission in November will be the summit of the MedSeA's constant dissemination effort, and further evidence of the project's involvement in the definition of the European agenda on ocean acidification in the nearest future.

4.1.4.3 Socio-economic impact

One of the key objectives of the MedSeA Project was to engage society at large in the fight against ocean acidification through increased awareness, didactic and social activities and events, and dissemination of key data and results on socially and economically sensitive topics and fields. While the contribution of MedSeA to European and international research on ocean acidification has had a visible impact on the scientific knowledge now available to the scientific community on these topics; and while policy-oriented dissemination has made new key information available to the stakeholders in charge of defining the progress of climate-change and acidification policies, especially at the EU level, in the coming years, societal dissemination within the MedSeA Project has attempted, since the beginning, to address certain social categories that are sensibly affected by acidification and its effects but, at the same time, do not normally enjoy the same degree of involvement and participation in this kind of processes. Ocean acidification, in other words, goes beyond the biological and chemical elements that compose it as a scientific phenomenon. The implications of ocean acidification and warming — especially in a particular ecosystem and densely populated region such as the Mediterranean — systematically affect the social, cultural, and economic activities and practices of millions of people.

Significant parts of the MedSeA's research work have been dedicated to the analysis of the socio-economic impact of ocean acidification. The sectors more sensibly and practically affected by these effects were fisheries, aquaculture, and leisure (water sports, diving, and tourism in a larger sense). MedSeA has actively engaged these interlocutors in its research work. The researchers expressly dealing with socio-economic implications managed to reach a number of categories that are directly involved in these industries and thereby affected by the complex implications of acidification. Over 400 scuba divers were successfully contacted and participated in surveys and questionnaires distributed within these affected groups to gather significant data on these impacts: the Medas and Cap de Reus areas of the Catalan Costa Brava were particularly cooperative, with the direct involvement of scuba diving associations and the spontaneous participation of frequent travellers and sport practitioners of the area. The repercussions of the project's results and objectives attracted several public institutions of the region, especially tourism departments from coastal locations and authorities for local natural protected areas and parks. Similarly, seafood producers and harvesters as well as representatives from fisheries associations and unions engaged, individually and/or collectively, in the fieldwork developed by MedSeA researchers. In these sectors, MedSeA could count on the organisational help of the fisheries department of FAO and got in contact with a number of seafood/fisheries associations at the regional level in six countries: Spain, France, Italy, Tunisia, Montenegro, and Greece. The intermediation of collective associations was often essential to gain the trust and collaboration of individual producers as affected recipients of new knowledge and potential policy strategies. Not only were these first-hand contacts essential to guarantee the quality of the data collected within the project, but also inevitably converted into growing participation of these categories to raise awareness and spread crucial information among affected social and economic actors.

Finally, as MedSeA acknowledged since the beginning that the repercussions of ocean acidification go beyond economic and scientific interests, affecting the daily lives of citizens in the Mediterranean region and the balance of the Mediterranean ecosystems as we have known them so far, much effort was put into engaging actively layers of the population that would otherwise have scarce or incomplete access to this kind of information. Particular attention was paid to reaching a large public through dissemination via normal channels of communication — first and foremost, radio, television, and the press. By the end of the project, the media presence of MedSeA and its researchers counted on TV and radio interviews at local and national levels, as well as with widespread mentions of the project's results in a number of newspapers and more sector-specific media, ranging from the *New York Times* to Spain's *El País*, through *La Vanguardia*, *Yahoo! News* online, *EuropaPress*, Spanish national broadcaster RTVE, El Periódico, and a myriad local newspapers and publications that aimed directly at sparking the interest of local managers, administrators, policy-makers, and citizens. A promotional video, *The other CO2 problem*, was expressly produced for children and teens, in order to make them aware about such a complex issue with simple, concise and clear language, merging the effectiveness of the visual medium with the social sensitivity of the message. The MedSeA official video, *Testing the Waters*, was purposefully prepared with a *b-roll* version that could easily be distributed to newsreels and television specials, independent from language or nationality. All these means allowed MedSeA to reach the widest audience possible among those directly interested in or affected by ocean acidification and its complex, multiple impacts—fulfilling its ambition to also be a driver of cultural and social change and mobilise across Europe a conscious response to the challenges of ocean acidification.

4.1.5 Project website and relevant contact details

The MedSeA Project has established since its beginning a frequently-updated website with all basic information on the Project as well as references to the developments and results of MedSeA research work. The website was updated and managed by the Coordination Office of the MedSeA Project and is available at this link: medsea-project.eu

The Project Coordinator, Prof. Patrizia Ziveri (Universitat Autònoma de Barcelona) can be reached at this address: patrizia.ziveri@uab.cat.
The Project Coordination Office, in charge with project management, can be reached at this address: pr.medsea@uab.cat.

References

Apostolaki ET, Vizzini S, Hendriks I, Olsen YS, 2014: Seagrass ecosystem response to long-term high CO2 in a Mediterranean volcanic vent, Marine Environmental Research, 99, 9-15.
Arnold T, Mealey C, Leahey H, Miller AW, Hall-Spencer JM, Milazzo M, Maers K, 2012: Ocean Acidification and the Loss of Phenolic Substances in Marine Plants, PLoS ONE, 7(4), e35107.
Asnaghi V, Chiantore M, Mangialojo L, Gazeau F, Francour P, Alliouane S, Gattuso J-P, 2013: Cascading effects of ocean acidification in a rocky subtidal community, PLoS ONE, 8(4), e61978.
Asnaghi V, Mangialajo L, Gattuso J-P, Francour P, Privitera D, Chiantore M, 2014: Effects of ocean acidification and diet on the ultrastructure and mineralogical composition of tests of juvenile sea urchins, Marine Environmental Research, 93, 78-84.
Baggini C, Salomidi M, Voutsinas E, Bray L, Krasakopoulou E, Hall-Spencer JM, 2014: Seasonality affects macroalgal community response to increases in pCO2, PLoS ONE, 9(9), e106520.
Borell EM, Steike M, Horwitz R, Fine M, 2014: Increasing pCO2 correlates low concentrations of intracellular dimethylsulfoniopropionate in the sea anemone Anemonia viridis, Ecology and Evolution, 4(4), 441-449.
Bramanti L, Movilla J, Guron M, Calvo E, Gori A, Dominguez-Carrió C, Grinyó J, Lopez-Sanz A, Martinez-Quintana A, Pelejero C, Ziveri P, Rossi S, 2013: Detrimental effects of ocean acidification on the economically important Mediterranean red coral (Corallium rubrum), Global Change Biology, 19(6), 1897-1908.
Bramanti L, Vielmini I, Rossi S, Tsounis G, Iannelli M, Cattaneo-Vietti R, Priori C, Santangelo G, 2014: Demographic parameters of two populations of red coral (Corallium rubrum L. 1758) in the North Western Mediterranean, Marine Biology, 161(5), 1015-1026.
Bray L, Pancucci-Papadopoulou MA, Hall-Spencer JM, 2014: Sea urchin response to rising pCO2 shows ocean acidification may fundamentally alter the chemistry of marine skeletons, Mediterranean Marine Science, 15(3), 510-519, doi:10.12681/mms.579
Calosi P, Rastrick SPS, Graziano M, Thomas SC, Baggini C, Carter HA, Hall-Spencer JM, Milazzo M, Spicer JI, 2013: Distribution of sea urchins living near shallow water CO2 vents is dependent upon species acid-base and ion-regulatory abilities, Marine Pollution Bulletin, 73(2), 470-484, doi:10.1016/j.marpolbul.2012.11.040
Goodwin C, Rodolfo-Metalpa R, Picton B, Hall-Spencer JH, 2014: Effects of ocean acidification on sponge communities, Marine Ecology, 35(1), 41-49.
Grelaud M, Ziveri P, Incarbona A, 2013: Emiliania huxleyi calcite mass variability during periods of atmospheric CO2 rising in the Mediterranean Sea. 11th International Conference on Paleoceanography, Sitges.
Grelaud M, Marino G, Ziveri P, Rohling EJ, 2012: Abrupt shoaling of the nutricline in response to massive freshwater flooding at the onset of the last interglacial sapropel event, Paleoceanography, 27(3), doi: 10.1029/2012PA002288
Keul N, Langer G, de Nooijer LJ, Nehrke G, Reichart G-J, Bijma J, 2013: Incorporation of uranium in benthic foraminiferal calcite reflects seawater carbonate ion concentration, Geochemistry, Geophysics, Geosystems, 14(1), 102-111.
Kerfahi D, Hall-Spencer JM, Tripathi BM, Milazzo M, Lee J, Adams JM, 2014: Marine sediment bacterial community shifts along a natural CO2 gradient in the Mediterranean Sea off Vulcano, Italy, Microbial Ecology, 67(4), 819-828.
Khairy HM, Shaltout NA, El-Naggar MF, El-Naggar NA, 2014: Impact of elevated CO2 concentrations on the growth and ultrastructure of non-calcifying marine diatom (Chaetoceros gracilis F. Schütt), The Egyptian Journal of Aquatic Research, in press.
Hoppe CJM, Langer G, Rost B, 2011: Emiliania huxleyi shows identical responses to elevated pCO2 in TA and DIC manipulations, Journal Of Experimental Marine Biology And Ecology, 406(1-2), 54-62,
Horigome MT, Ziveri P, Grelaud M, Baumann K-H, Marino G, Mortyn PG, 2014: Environmental controls on the Emiliania huxleyi calcite mass, Biogeosciences, 11, 2295-2308
Hahn S, Rodolfo-Metalpa R, Griesshaber E, Schmahl WW, Buhl D, Hall-Spencer JM, Baggini C, Fehr KT, Immenhauser A, 2012: Marine bivalve shell geochemistry and ultrastructure from modern low pH environments: environmental effect versus experimental bias, Biogeosciences, 9, 1897-1914.

Hendriks IE, Olsen YS, Ramajo L, Basso L, Steckbauer A, Moore TS, Howard J, and Duarte CM, 2014: Photosynthetic activity buffers ocean acidification in seagrass meadows, Biogeosciences, 11, 333-346.
Howes EL, Bednarsek N, Büdenbender J, Comeau S, Doubleday A, Gallager SM, Hopcroft RR, Lischka S, Maas AE, Bijma J, and Gattuso J-P, 2014: Sink and swim: a status review of thecosome pteropod culture techniques, Journal of Plankton Research, in press.
Ibrahim HAH, El-Sayed WMM, Shaltout NA, El-Shorbagi AK, 2014: Effects of different pCO2 concentrations on marine bacterial community structure, Eastern Harbour, Alexandria, Egypt, Life Science Journal, 11(10), 781-789.
Langer G, Probert I, Nehrke G, Ziveri P, 2011: The morphological response of Emiliania huxleyi to seawater carbonate chemistry changes: an inter-strain comparison, Journal of Nannoplankton Research, 32(1), 29-34
Langer G, Bode M, 2012: CO2 mediation of adverse effects of seawater acidification in Calcidiscus leptoporus, Geochemistry, Geophysics, Geosystems, 12(5)
Marino G. and Ziveri P., 2013, Palaeo-carbonate chemistry of the Mediterranean Sea, Extended abstract, 40th CIESM Congress, Marseille, France.
Martin S, Cohu S, Vignot C, Zimmerman G, and Gattuso J-P, 2013: One-year experiment on the physiological response of the Mediterranean crustose coralline alga, Lithophyllum cabiochae, to elevated pCO2 and temperature, Ecology and Evolution, 3(3), 676-693.
Mata R, Ziveri P, Marino G, Incarbona A, Grelaud M, 2013: Mediterranean carbonate system dynamics and planktonic biocalcification during the last 19 000 years. 11th International Conference on Paleoceanography, Sitges.
Meier, S, Beaufort, L, Heussner, S, Ziveri, P (2014) Thinning coccoliths due to ocean acidification and warming in the Mediterranean Sea, Biogeoscience. 11, 2857–2869.
Milazzo M, Mirto S, Domenici P, Gristina M, 2013: Climate change exacerbates interspecific interactions in sympatric coastal fishes, Journal of Animal Ecology, 82(2), 468-477.
Milazzo M, Rodolfo-Metalpa R, Chan VBS, Fine M, Alessi C, Thiyagarajan V, Hall-Spencer JM, Chemello R, 2014: Ocean acidification impairs vermetid reef recruitment, Scientific Reports, 4, 4189.
Mordechai, T, 2013: Jelly Fish response to ocean acidification conditions, PhD thesis, Bar-Ilan University.
Ong EZ, 2013: Effects of ocean acidification and warming on the survivorship, growth and physiology of Cotylorhiza tuberculata. MS Thesis, Universitat Autònoma Barcelona.
Rodolfo-Metalpa R, Houlbreque F, Tambutte E, Boisson F, Baggini C, Patti FP, Jeffree R, Fine M, Foggo A, Gattuso J-P, Hall-Spencer JM, 2011: Coral and mollusc resistance to ocean acidification adversely affected by warming, Nature Climate Change, 1(6), 308-312.
Rockstrom et al., 2009, A Safe Operating Space for Humanity, Nature, 461: 472-475.
Rodolfo-Metalpa R, Hoogenboom MO, Rottier C, Ramos-Esplá A, Baker A, Fine M, Ferrier-Pagès C, 2014: Thermally tolerant corals have limited capacity to acclimatize to future warming, Global Change Biology, 20(10), 3036-3049.
Russell BD, Connell SD, Uthicke S, Muehllehner N, Fabricius KE, Hall-Spencer JM, 2013: Future seagrass beds: Can increased productivity lead to increased carbon storage? Marine Pollution Bulletin, 73(2), 463-469.
Schneider, A., Tanhua, T., Koertzinger, A., and Wallace, D.W.R., 2010, High anthropogenic carbon content in the eastern Mediterranean. J. Geophys. Res-Oceans, 115.
Suggett DJ, Hall-Spencer JM, Rodolfo-Metalpa R, Boatman TG, Payton R, Tye Pettay D, Johnson VR, Warner ME, Lawson T, 2012: Sea anemones may thrive in a times
JN, 2013: Combined effects of ocean acidification and warming on prefertilization and early life stages of the Mediterranean mussel (Mytilus galloprovincialis), Water, 5(4), 1890-1915.
Zervoudaki S, Frangoulis C, Giannoudi L,Krasakopoulou E, 2013: Effects of low pH and raised temperature on egg production, hatching and metabolic rates of a Mediterranean copepod species (Acartia clausi) under oligotrophic conditions, Mediterranean Marine Science, 15(1), 74-83,
Ziveri, P, Passaro, M, Incarbona, A, Milazzo, M, Rodolfo-Metalpa, R, Hall-Spencer, JM, 2014: Decline in coccolithophore diversity and impact on coccolith morphogenesis along a natural CO2 gradient, BioBul., 226(3), 282-90.

4.2 Use and dissemination of foreground

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.
- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

These tables are cumulative, which means that they should always show all publications and activities from the beginning until after the end of the project. Updates are possible at any time.

Section A1:

MedSeA publications:

105 peer reviewed articles published during the project. They are listed according to year of publication and alphabetically. **(*):** Publications for which the MedSeA project was accidentally not acknowledged.

Year	Bibliographic reference	Partner responsible / involved
2011	Barry JP, Widdicombe S, Hall-Spencer J, 2011: Effects of ocean acidification on marine biodiversity and ecosystem function, Gattuso J-P & Hansson L (Eds.), 344, 5, 192-209, Chapter in book "*Ocean acidification*"	UOP
2011	Comeau S, Gattuso J-P, Nisumaa AM, Orr J, 2011: Impact of aragonite saturation state changes on migratory pteropods, *Proceedings of the Royal Society of London, Series B: Biological Sciences*, 279, 732-738, doi:10.1098/rspb.2011.0910	UPMC LSCE
2011	Hoppe CJM, Langer G, Rost B, 2011: *Emiliania huxleyi* shows identical responses to elevated pCO_2 in TA and DIC manipulations, *Journal Of Experimental Marine Biology And Ecology*, 406(1-2), 54-62, doi:10.1016/j.jembe.2011.06.008	AWI
2011	Incarbona A, Ziveri P, Sabadino N, Salvagio Mantec D, Sproveri M, 2011: Conflicting coccolithophore and geochemical evidence for productivity levels in the Eastern Mediterranean sapropel S1, *Marine Micropaleontology*, 81(3-4), 131-143, doi:10.1016/j.marmicro.2011.09.003	CoNISMa UAB
2011	Johnson VR, Brownlee C, Rickaby REM, Graziano M, Milazzo M, Hall-Spencer, JM, 2011: Responses of marine benthic microalgae to elevated CO_2, *Marine Biology*, 160(8), 1813-1824, doi: 10.1007/s00227-011-1840-2	UOP PML CoNISMa
2011	Kerrison P, Hall-Spencer JM, Suggett D, Hepburn LJ, Stenike M, 2011: Assessment of pH variability at a coastal CO_2 vent for ocean acidification studies, *Estuarine Coastal And Shelf Science*, 94(2), 129-137, doi:10.1016/j.ecss.2011.05.025	UOP PML
2011	Langer G, Probert I, Nehrke G, Ziveri P, 2011: The morphological response of *Emiliania huxleyi* to seawater carbonate chemistry changes: an inter-strain	UAB UMPC

	comparison, *Journal of Nannoplankton Research*, 32(1), 29-34, ISSN: 1210-8049	AWI
2011	(*) Maier C, Watremez P, Taviani M, Weinbauer MG, Gattuso J-P, 2011: Calcification rates and the effect of ocean acidification on Mediterranean cold-water corals, *Proc. R. Soc. B*, 279, 1716-1723, doi:10.1098/rspb.2011.1763	UPMC
2011	Rodolfo-Metalpa R, Houlbreque F, Tambutte E, Boisson F, Baggini C, Patti FP, Jeffree R, Fine M, Foggo A, Gattuso J-P, Hall-Spencer JM, 2011: Coral and mollusc resistance to ocean acidification adversely affected by warming, *Nature Climate Change*, *1*(6), 308-312, doi: 10.1038/nclimate1200	BIU UMPC
2012	Arnold T, Mealey C, Leahey H, Miller AW, Hall-Spencer JM, Milazzo M, Maers K, 2012: Ocean Acidification and the Loss of Phenolic Substances in Marine Plants, *PLoS ONE*, 7(4), e35107, doi:10.1371/journal.pone.0035107	CoNISMa UOP
2012	Azzurro E, Milazzo M, Maynou F, 2012: First confirmed record of the Lessepsian migrant *Pteragogus pelycus* Randall, 1981 (Teleostei: Labridae) for the North African coasts, *BioInvasions Records*, 27(3), 45-48, doi:10.3391/bir.2012.1.1.10	CoNISMa CSIC
2012	Basso D, 2012: Carbonate production by calcareous red algae and global change, *Geodiversitas*, 34(1), 13-33, doi: 10.5252/g2012n1a2	CoNISMa
2012	Boussetta S, Kallel N, Bassinot F, Labeyrie L, Duplessy J-C, Caillon N, Dewilde F, Rebaubier H, 2012: Mg/Ca-paleothermometry in the western Mediterranean Sea on planktonic foraminifer species *Globigerina bulloides*, *Comptes Rendus Géoscience*, 344(5), 267–276, doi:10.1016/j.crte.2012.02.001	USS LSCE
2012	Brown A, 2012: Flourishing seaweed, *Nature Climate Change*, 2, 486, doi: 10.1038/nclimate1618	?
2012	Comeau S, Gattuso J-P, Jeffree R, Gazeau F, 2012: Effect of carbonate chemistry manipulations on calcification, respiration, and excretion of a Mediterranean pteropod, *Biogeosciences Discussions*, 9, 6169–6189, doi:10.5194/bgd-9-6169-2012	UPMC
2012	Giani M, Djakovac T, Degobbis D, Cozzi S, Solidoro C, Umani S F, 2012: Recent changes in the marine ecosystems of the northern Adriatic Sea, *Estuarine Coastal And Shelf Science*, 115, 1-13, doi:10.1016/j.ecss.2012.08.023	OGS
2012	Glas M, Langer, G, Keul N, 2012: Calcification acidifies the microenvironment of a benthic foraminifer (*Ammonia* sp.), *Journal of Experimental Marine Biology and Ecology*, 424-425, 53-58, doi:10.doi:1016/j.jembe.2012.05.006	AWI
2012	Grelaud M, Marino G, Ziveri P, Rohling EJ, 2012: Abrupt shoaling of the nutricline in response to massive freshwater flooding at the onset of the last interglacial sapropel event, *Paleoceanography*, 27(3), doi: 10.1029/2012PA002288	UAB
2012	Hahn S, Rodolfo-Metalpa R, Griesshaber E, Schmahl WW, Buhl D, Hall-Spencer JM, Baggini C, Fehr KT, Immenhauser A, 2012: Marine bivalve shell geochemistry and ultrastructure from modern low pH environments: environmental effect versus experimental bias, *Biogeosciences*, 9, 1897-1914, doi:10.5194/bg-9-1897-2012	UOP PML
2012	Hall-Spencer JM and Rodolfo-Metalpa R, 2012: Effects of ocean acidification on Mediterranean coastal habitats, In Stambler N (ed.) *Life in the Mediterranean Sea: A look at habitat changes*, 18, 10, book chapter, ISBN: 978-1-61209-644-5	UOP
2012	Hoppe CJM, Langer G, Rokitta SD, Wolf-Gladrow DA, Rost B, 2012: Implications of observed inconsistencies in carbonate chemistry measurements for ocean acidification studies, *Biogeosciences*, 9, 2401-2405, doi: 10.5194/bg-9-2401-2012	AWU
2012	Johnson VR, Russell BD, Fabricius KE, Brownlee C, Hall-Spencer JM, 2012: Temperate and tropical brown macroalgae thrive, despite decalcification, along	PML UOP

	natural CO_2 gradients, *Global Change Biology*, 18(9), 2792–2803, doi: 10.1111/j.1365-2486.2012.02716.x	
2012	Kadar E, Fisher A, Stoplpe B, Harrison RM, Parello F, Lead J, 2012: Metallic nanoparticle enrichment at low temperature, shallow CO_2 seeps in Southern Italy, *Marine Chemistry*, 140-141, 24-32, doi:10.1016/j.marchem.2012.07.001	PML CoNISMa
2012	Kletou D and Hall-Spencer JM, 2012: Threats to Ultraoligotrophic Marine Ecosystems, *Marine Ecosystems*, Dr. Antonio Cruzado (Ed.), ISBN: 978-953-51-0176-5, InTech, doi: 10.5772/34842	UOP
2012	Langer G, Oetjen K, Brenneis T, 2012: Calcification of *Calcidiscus leptoporus* under nitrogen and phosphorus limitation, *Journal of Experimental Marine Biology and Ecology*, 413, 131-137, doi:10.1016/j.jembe.2011.11.028	AWI
2012	Langer G, Bode M, 2012: CO_2 mediation of adverse effects of seawater acidification in *Calcidiscus leptoporus*, *Geochemistry, Geophysics, Geosystems*, 12(5), doi: 10.1029/2010GC003393	UAB AWI
2012	Lidbury I, Johnson W, Hall-Spencer JM, Munn CB, Cunliffe M, 2012: Community-level response of coastal microbial biofilms to ocean acidification in a natural carbon dioxide vent ecosystem, *Marine Pollution Bulletin*, 64(5), 1063-1066, doi:10.1016/j.marpolbul.2012.02.011	UOP
2012	Meron D, Rodolfo-Metalpa R, Cunning R, Baker AC, Fine M, Banin E, 2012: Changes in coral microbial communities in response to a natural pH gradient, *The ISME Journal*, 6, 1775-1785, doi:10.1038/ismej.2012.19	BIU PML
2012	Meron D, Fine M, Buia MC, Banin E, 2012: Changes in microbial communities associated with the Sea anemone *Anemonia viridis* in a natural pH gradient, *Microbial Ecology*, 65(2), 269-276, doi:10.1007/s00248-012-0127-6	BIU
2012	(*) Rees AP, 2012: Pressures on the marine environment and the changing climate of ocean biogeochemistry, *Phil. Trans. R. Soc. A*, 370, 5613-5635, doi:10.1098/rsta.2012.0399	PML
2012	Suggett DJ, Hall-Spencer JM, Rodolfo-Metalpa R, Boatman TG, Payton R, Tye Pettay D, Johnson VR, Warner ME, Lawson T, 2012: Sea anemones may thrive in a high CO_2 world, *Global Change Biology*, 18(10), 3015-3025, doi: 10.1111/j.1365-2486.2012.02767.x	UOP
2012	Touratier F, Guglielmi V, Goyet C, Prieur L, Pujo-Pay M, Conan P, Falco C, 2012: Distributions of the carbonate system properties, anthropogenic CO_2, and acidification during the 2008 BOUM cruise (Mediterranean Sea), *Biogeosciences Discuss.*, 9, 2709-2753, doi:10.5194/bgd-9-2709-2012	UPVD UPMC
2012	Turley C and Gattuso J-P, 2012: Future biological and ecosystem impacts of ocean acidification and their socioeconomic-policy implications, *Current Opinion in Environmental Sustainability*, 4(3), 278-286, doi:10.1016/j.cosust.2012.05.007	PML UPMC
2012	Wall M, Nehrke G, 2012: Reconstructing skeletal fiber arrangement and growth mode in the coral *Porites lutea* (Cnidaria, Scleractinia): a confocal Raman microscopy study, *Biogeosciences*, 9, 4885-4895, doi: 10.5194/bg-9-4885-2012	AWI
2012	Ziveri, P, Thoms, S, Probert, I, Geisen, M, Langer G, 2012: A universal carbonate ion effect on stable oxygen isotope ratios in unicellular planktonic calcifying organisms, *Biogeosciences*, 9, 1025-1032, doi: 10.5194/bg-9-1025-2012	UAB AWI
2013	Asnaghi V, Chiantore M, Mangialojo L, Gazeau F, Francour P, Alliouane S, Gattuso J-P, 2013: Cascading effects of ocean acidification in a rocky subtidal community, *PLoS ONE*, *8(4)*, e61978, doi: 10.1371/journal.pone.0061978	UPMC
2013	Beare D, McQuatters-Gollop A, van der Hammen T, Machiels M, Teoh SJ, et al., 2013, Long-Term Trends in Calcifying Plankton and pH in the North Sea, *PLoS ONE,* 8(5), e61175, doi: 10.1371/journal.pone.0061175	PML UOP

2013	(*) Bijma J, Pörtner H-O, Tesson C, Rogers AD, 2013: Climate change and the oceans – What does the future hold?, Marine Pollution Bulletin, 74(2), 495-505, doi:10.1016/j.marpolbul.2013.07.022	AWI
2013	Boatta F, D'Alessandro W, Gagliano AL, Liotta M, Milazzo M, Rodolfo-Metalpa R, Hall-Spencer JM, Parello F, 2013: Geochemical survey of Levante Bay, Vulcano Island (Italy), a natural laboratory for the study of ocean acidification, *Marine Pollution Bulletin*, 73(2), 485-494, doi:10.1016/j.marpolbul.2013.01.029	CoNISMa UOP
2013	Bonomo S, Grelaud M, Incarbona A, Malinverno E, Placenti F, Bonanno A, Di Stefano A, Patti B, Sprovieri M, Simona G, Rumolo P, Mazzola S, Zgozi S, Ziveri P, 2013: Living Coccolithophores from the Gulf of Sirte (Southern Mediterranean Sea) during the summer of 2008, *Micropaleontology*, 58(6), 487-503.	CoNISMa UAB
2013	Bramanti L, Movilla J, Guron M, Calvo E, Gori A, Dominguez-Carrió C, Grinyó J, Lopez-Sanz A, Martinez-Quintana A, Pelejero C, Ziveri P, Rossi S, 2013: Detrimental effects of ocean acidification on the economically important Mediterranean red coral (*Corallium rubrum*), *Global Change Biology*, 19(6), 1897-1908, doi:10.1111/gcb.12171	CSIC UAB
2013	Calosi P, Rastrick SPS, Graziano M, Thomas SC, Baggini C, Carter HA, Hall-Spencer JM, Milazzo M, Spicer JI, 2013: Distribution of sea urchins living near shallow water CO_2 vents is dependent upon species acid-base and ion-regulatory abilities, *Marine Pollution Bulletin*, 73(2), 470-484, doi:10.1016/j.marpolbul.2012.11.040	UOP CoNISMa
2013	(*) Calosi P, Rastik SPS, Lombardi C, de Guzman HJ, Davidson L, Jahnke M, Giangrande A, Hardege JD, Schulze A, Spicer JI, Gambi M-C, 2013: Adaptation and acclimatization to ocean acidification in marine ectotherms: an in situ transplant experiment with polychaetes at a shallow CO_2 vent system, *Phil. Trans. Roy. Soc. B*, 368, 1627, doi:10.1098/rstb.2012.0444	UOP ENEA
2013	de Carlo EH, Mousseau L, Passafiume O, Drupp PS, Gattuso J-P, 2013: Carbonate chemistry and air-sea CO_2 flux in a NW Mediterranean bay over a four-year period: 2007-2011, *Aquatic Geochemistry*, 19, 399-442, doi:10.1007/s10498-013-9217-4	UPMC
2013	Duarte CM, Hendriks IE, Moore TS, Olsen YS, Steckbauer A, Ramajo L, Carstensen J, Trotter JA, McCulloch M, 2013: Is ocean acidification an open-ocean syndrome? Understanding anthropogenic impacts on seawater pH, *Estuaries and Coasts*, 36(2), 221-236. doi:10.1007/s12237-013-9594-3	CSIC
2013	Duarte CM, Losada IJ, Hendriks IE, Mazarrasa I, Marbà N, 2013: The role of coastal plant communities for climate change mitigation and adaptation, *Nature Climate Change*, 3, 961-968, doi:10.1038/nclimate1970	CSIC
2013	Gattuso J-P, Mach KJ and Morgan G, 2013: Ocean acidification and its impacts: an expert survey, *Climatic Change*, 117(4), 725-738, doi: 10.1007/s10584-012-0591-5	UPMC
2013	Gazeau F, Parker LM, Comeau S, Gattuso J-P, O'Connor WA, Martin S, Pörtner H-O, Ross PM, 2013: Impacts of ocean acidification on marine shelled molluscs, *Marine Biology*, 160(8), 2207-2245, doi: 10.1007/s00227-013-2219-3	UPMC
2013	Geri P, Yacoubi SE, Goyet C, and Marcou O, 2013: A 1D Lattice Boltzmann Model for Ocean Acidification, *Procedia Computer Science*, *18*, 2444-2453, doi: 10.1016/j.procs.2013.05.420	UPVD
2013	Godbold JA and Calosi P, 2013: Ocean acidification and climate change: advances in ecology and evolution, *Phil. Trans. R. Soc. B*, 368, doi:10.1098/rstb.2012.0448	UOP
2013	(*) Hilmi N, Allemand D, Dupont S, Safa A, Haraldsson G, Nune PALD, Moore C, Hattam C, Reynaud S, Hall-Spencer J, Fine M, Turley C, Jeffree R,	UOP PML

	Orr J, Munday PL, Cooley S, 2013: Towards improved socio-economic assessments of ocean acidification's impacts, Marine Biology, 160(8), 1773-1787, doi: 10.1007/s00227-012-2031-5	CEA BIU CMCC Univ. Gothenburg
2013	Incarbona A, Sprovieri M, Di Stefano A, Di Stefano E, Manta DS, Pelosi N, d'Alcalà MR, Sprovieri R, Ziveri P, 2013: Productivity modes in the Mediterranean Sea during Dansgaard-Oeschger (20,000-70,000 years ago) oscillations, *Palaeogeography, Palaeoclimatology, Palaeoecology,* 392, 128-137, doi: 10.1016/j.palaeo.2013.09.023	CoNISMa UAB
2013	Keul N, Langer G, de Nooijer LJ, Nehrke G, Reichart G-J, Bijma J, 2013: Incorporation of uranium in benthic foraminiferal calcite reflects seawater carbonate ion concentration, *Geochemistry, Geophysics, Geosystems*, 14(1), 102-111, doi: 10.1029/2012gc004330	AWI
2013	Keul N, Langer G, de Nooijer LJ, Bijma J, 2013: Effect of ocean acidification on the benthic foraminifera *Ammonia* sp. is caused by a decrease in carbonate ion concentration, *Biogeosciences*, 10, 6185-6198, doi:10.5194/bg-10-6185-2013	AWI
2013	Kroeker KJ, Kordas RL, Crim R, Hendriks IE, Ramajo L, Singh GS, Duarte CM, Gattuso J-P, 2013: Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming, *Global Change Biology*, 19(6), 1884-1896, doi: 10.1111/gcb.12179	CSIC UPMC
2013	(*) Lombardi C , Taylor PD, Cocito S, 2013: Bryozoan constructions in a changing Mediterranean Sea, In S. Goffredo and Z. Dubinsky (eds.), *The Mediterranean Sea: its history and present challenges*, 373, 327-384, doi:10.1007/978-94-007-6704-1_21	ENEA
2013	Martin S, Cohu S, Vignot C, Zimmerman G, and Gattuso J-P, 2013: One-year experiment on the physiological response of the Mediterranean crustose coralline alga, *Lithophyllum cabiochae*, to elevated pCO_2 and temperature, *Ecology and Evolution*, 3(3), 676-693, doi: 10.1002/ece3.475	UPMC
2013	Milazzo M, Mirto S, Domenici P, Gristina M, 2013: Climate change exacerbates interspecific interactions in sympatric coastal fishes, *Journal of Animal Ecology*, *82*(2), 468-477, doi: 10.1111/j.1365-2656.2012.02034.x	CoNISMa
2013	Nehrke G, Keul N, Langer G, de Nooijer LJ, Bijma J, Meibom A, 2013: A new model for biomineralization and trace-element signatures of foraminifera tests, *Biogeosciences*, 10, 6759-6767, doi:10.5194/bg-10-6759-2013	AWI
2013	(*) Ogden LE, 2013: Marine life on acid, *BioScience*, *63*(5), 322-328, doi: 10.1525/bio.2013.63.5.1	UOP
2013	Pettit LR, Harta MB, Medina-Sánchez AN, Smart CW, Rodolfo-Metalpa R, Hall-Spencer JM, Prol-Ledesma RM, 2013: Benthic foraminifera show some resilience to ocean acidification in the northern Gulf of California, Mexico, *Marine Pollution Bulletin*, 73(2), 452-462, doi: 10.1016/j.marpolbul.2013.02.011	PML
2013	(*) Raitzsch M and Hönish B, 2013: Cenozoic boron isotope variations in benthic formaminifers, Geology, 41(5), 591-594, doi:10.1130/G34031.1	AWI
2013	Rodrigues LC, van den Bergh JC, Ghermandi A, 2013: Socio-economic impacts of ocean acidification in the Mediterranean Sea, *Marine Policy*, 38, 447-456, doi: 10.1016/j.marpol.2012.07.005	UAB
2013	Rossi S, 2013: The destruction of 'animal forests' in the oceans: towards an over-simplification of the benthic ecosystems, *Ocean & Coastal Management*, 84, 77-85, doi:10.1016/j.ocecoaman.2013.07.004	UAB
2013	Russell BD, Connell SD, Uthicke S, Muehllehner N, Fabricius KE, Hall-Spencer JM, 2013: Future seagrass beds: Can increased productivity lead to increased carbon storage? *Marine Pollution Bulletin*, 73(2), 463-469, doi:	UOP

	10.1016/j.marpolbul.2013.01.031	
2013	Sunday JM, Calosi P, Dupont S, Munday PL, Stillman JH, Reusch TBH, 2013: Evolution in an acidifying ocean, *Trends in Ecology & Evolution*, 29(2), 117-125, doi: 10.1016/j.tree.2013.11.001	UOP
2013	Van de Waal DB, John U, Ziveri P, Reichart G-J, Hoins M, Sluijs A, Rost B, 2013: Ocean Acidification Reduces Growth and Calcification in a Marine Dinoflagellate, *PLoS ONE*, 8(6), e65987, doi: 0.1371/journal.pone.0065987	AWI UAB
2013	Vihtakari M, Hendriks IE, Holding J, Renaud PE, Duarte CM, Havenhand JN, 2013: Combined effects of ocean acidification and warming on prefertilization and early life stages of the Mediterranean mussel (*Mytilus galloprovincialis*), *Water*, 5(4), 1890-1915, doi:10.3390/w5041890	CSIC
2013	Vizzini S, Di Leonardo R, Costa V, Tramati CD, Luzzu F, Mazzola A, 2014: Trace element bias in the use of CO_2 vents as analogues for low pH environments: Implications for contamination levels in acidified oceans, *Estuarine, Coastal and Shelf Science*, 134, 19-30, doi: 10.1016/j.ecss.2013.09.015	CoNISMa
2013	Zervoudaki S, Frangoulis C, Giannoudi L,Krasakopoulou E, 2013: Effects of low pH and raised temperature on egg production, hatching and metabolic rates of a Mediterranean copepod species (*Acartia clausi*) under oligotrophic conditions, *Mediterranean Marine Science*, 15(1), 74-83, doi:10.12681/mms.553	HCMR
2014	Apostolaki ET, Vizzini S, Hendriks I, Olsen YS, 2014: Seagrass ecosystem response to long-term high CO_2 in a Mediterranean volcanic vent, *Marine Environmental Research*, 99, 9-15, doi: 10.1016/j.marenvres.2014.05.008	HCMR CSIC CoNISMa
2014	Asnaghi V, Mangialajo L, Gattuso J-P, Francour P, Privitera D, Chiantore M, 2014: Effects of ocean acidification and diet on the ultrastructure and mineralogical composition of tests of juvenile sea urchins, *Marine Environmental Research*, 93, 78-84, doi:10.1016/j.marenvres.2013.08.005	UPMC
2014	Baggini C, Salomidi M, Voutsinas E, Bray L, Krasakopoulou E, Hall-Spencer JM, 2014: Seasonality affects macroalgal community response to increases in pCO_2, *PLoS ONE*, 9(9), e106520, doi:10.1371/journal.pone.0106520	UOP HCMR
2014	Basso L, Hendriks IE, Navaro A, Gambi M-C, Duarte CM, in press: High pCO_2 conditions affect growth, survival and metabolism of juvenile pen shells (*Pinna nobilis*) at a natural CO_2 vent system (Italy), *Estuarine, Coastal and Shelf Sciences*.	CSIC
2014	Borell EM, Steike M, Horwitz R, Fine M, 2014: Increasing pCO_2 correlates low concentrations of intracellular dimethylsulfoniopropionate in the sea anemone *Anemonia viridis*, *Ecology and Evolution*, 4(4), 441-449, doi: 10.1002/ece3.946	BIU
2014	Bramanti L, Vielmini I, Rossi S, Tsounis G, Iannelli M, Cattaneo-Vietti R, Priori C, Santangelo G, 2014: Demographic parameters of two populations of red coral (*Corallium rubrum* L. 1758) in the North Western Mediterranean, *Marine Biology*, 161(5), 1015-1026, doi: 10.1007/s00227-013-2383-5	CSIC UAB
2014	Bray L, Pancucci-Papadopoulou MA, Hall-Spencer JM, 2014: Sea urchin response to rising pCO_2 shows ocean acidification may fundamentally alter the chemistry of marine skeletons, *Mediterranean Marine Science*, 15(3), 510-519, doi:10.12681/mms.579	UOP HCMR
2014	Cossarini G, Lazzari P, Solidoro C, 2014: Space-time variability of alkalinity in the Mediterranean Sea, *Biogeosciences Discussions*, 11, 12871-12893, doi:10.5194/bgd-11-12871-2014, 2014	OGS
2014	de Nooijer LJ, Hathorne EC, Reichart GK, Langer G, Bijma J, 2014: Variability in calcitic Mg/Ca and Sr/Ca ratios in clones of the benthic foraminifer *Ammonia tepida*, *Marine Micropaleontology*, 107, 32-43,	AWI

	doi:10.1016/j.marmicro.2014.02.002	
2014	Djakovac T, Supic N, Bernardi Aubry F, Degobbis D, Giani M, in press: Dynamics of hypoxia events in the northern Adriatic Sea during the period 1972-2012, *Journal of Marine Systems*, doi:10.1016/j.jmarsys.2014.08.001	OGS
2014	Geri P, El Yacoubi S, Goyet C, 2014: Forecast of sea surface acidification in the Northwestern Mediterranean Sea, *Journal of Computational Environmental Sciences*, 201819, 1-7 doi:10.1155/2014/201819	UPVD
2014	Goodwin C, Rodolfo-Metalpa R, Picton B, Hall-Spencer JH, 2014: Effects of ocean acidification on sponge communities, *Marine Ecology*, 35(1), 41-49, doi:10.1111/maec.12093	UOP
2014	Hendriks IE, Olsen YS, Ramajo L, Basso L, Steckbauer A, Moore TS, Howard J, and Duarte CM, 2014: Photosynthetic activity buffers ocean acidification in seagrass meadows, *Biogeosciences*, 11, 333-346, doi: 10.5194/bg-11-333-2014	CSIC
2014	Hendriks IE, Duarte CM, Olsen YS, Steckbauer A, Ramajo L, Moore TS, Trotter JA, McCulloch M, in press: Biological mechanisms supporting adaptation to ocean acidification in coastal ecosystems, *Estuarine Coastal and Shelf Science*, doi:10.1016/j.ecss.2014.07.019	CSIC
2014	Hilmi N, Allemand D, Cinar M, Cooley S, Hall-Spencer JM, Haraldsson G, Hattam C, Jeffree RA, Orr JC, Rehdanz K, Reynaud S, Safa A, Dupont S, 2014: Exposure of Mediterranean Countries to Ocean Acidification, *Water*, 6, 1719-1744, doi:10.3390/w6061719	UOP PML LSCE Univ. Gothenburg
2014	Horigome MT, Ziveri P, Grelaud M, Baumann K-H, Marino G, Mortyn PG, 2014: Environmental controls on the *Emiliania huxleyi* calcite mass, *Biogeosciences*, 11, 2295-2308, doi:10.5194/bg-11-2295-2014	UAB
2014	Horwitz R, Borell EM, Fine M, Shaked Y, 2014: Trace element profiles of the sea anemone *Anemonia viridis* living nearby a natural CO_2 vent, PeerJ, 2, e538, doi:10.7717/peerj.538	BIU
2014	Howes EL, Bednarsek N, Büdenbender J, Comeau S, Doubleday A, Gallager SM, Hopcroft RR, Lischka S, Maas AE, Bijma J, and Gattuso J-P, 2014: Sink and swim: a status review of thecosome pteropod culture techniques, *Journal of Plankton Research*, doi: 10.1093/plankt/fbu002	UPMC AWI
2014	Ibrahim HAH, El-Sayed WMM, Shaltout NA, El-Shorbagi AK, 2014: Effects of different pCO_2 concentrations on marine bacterial community structure, Eastern Harbour, Alexandria, Egypt, *Life Science Journal*, 11(10), 781-789. Article.	NIOF
2014	Khairy HM, Shaltout NA, El-Naggar MF, El-Naggar NA, in press: Impact of elevated CO_2 concentrations on the growth and ultrastructure of non-calcifying marine diatom (Chaetoceros gracilis F. Schütt), The Egyptian Journal of Aquatic Research, doi:10.1016/j.ejar.2014.08.002	NIOF
2014	Kerfahi D, Hall-Spencer JM, Tripathi BM, Milazzo M, Lee J, Adams JM, 2014: Marine sediment bacterial community shifts along a natural CO_2 gradient in the Mediterranean Sea off Vulcano, Italy, *Microbial Ecology*, 67(4), 819-828, doi: 10.1007/s00248-014-0368-7	CoNISMa UOP
2014	Lovato T and Vichi M, 2014: An objective reconstruction of the Mediterranean Sea carbonate system, *Deep-Sea Research Part I*, in press.	CMCC
2014	Marcou O, El Yacoubi S, Goyet C, 2014: Computational method to quantify the evolution of ocean properties, *International Journal of Computer Applications*, 89(18), 1-8, doi: 10.5120/15728-4662	UPVD
2014	Maugendre L, Gattuso J-P, Louis J, de Kluijver A, Marro S, Soetaert K, Gazeau F, 2014: Effect of ocean warming and acidification on a plankton community in the NW Mediterranean Sea, *ICES Journal of Marine Science*, doi:10.1093/icesjmas/fsu161	UPMC
2014	Meier S, Beaufort L, Heussner S, Ziveri P, 2014: The role of ocean	UPVD

	acidification in *Emiliania huxleyi* coccolith thinning in the Mediterranean Sea, *Biogeosciences*, 11, 2857-2869, doi: 10.5194/bg-11-2857-2014	UAB
2014	Milazzo M, Rodolfo-Metalpa R, Chan VBS, Fine M, Alessi C, Thiyagarajan V, Hall-Spencer JM, Chemello R, 2014: Ocean acidification impairs vermetid reef recruitment, *Scientific Reports*, *4*, 4189, doi: 10.1038/srep04189	CoNISMa UOP BIU
2014	Orr JC, Epitalon J-M, Gattuso J-P, 2014: Comparison of seven packages that compute ocean carbonate chemistry, *Biogeosciences Discuss*., 11, 5327-5397, doi: 10.5194/bgd-11-5327-2014	LSCE UPMC
2014	Orr JC and Epitalon J-M, 2014: Improved routines to model the ocean carbonate system: mocsy 1.0, *Geoscientific Model Development Discussions*, 7, 2877-2902, doi: 10.5194/gmdd-7-2877-2014	LSCE
2014	Oviedo AM, Ziveri P, Álvarez M, Tanhua T, 2014: Is coccolithophore distribution in the Mediterranean Sea related to seawater carbonate chemistry? *Ocean Sci. Discuss*., 11, 613-653, doi:10.5194/osd-11-613-2014	UAB
2014	Oviedo AM, Langer G, Ziveri P, 2014: Effect of phosphorus limitation on coccolith morphology and element ratios in Mediterranean strains of the coccolithophore *Emiliania huxleyi*, *Journal of Experimental Marine Biology and Ecology*, 459, 105-113, doi: 10.1016/j.jembe.2014.04.021	UAB AWI
2014	Palmiéri J, Orr JC, Dutay J-C, Béranger K, Schneider A, Beuvier J, Somot S, 2014: Simulated anthropogenic CO_2 uptake and acidification of the Mediterranean Sea, *Biogeosciences Discuss*., 11, 6461-6517, doi:10.5194/bgd-11-6461-2014	LSCE
2014	Rodolfo-Metalpa R, Hoogenboom MO, Rottier C, Ramos-Esplá A, Baker A, Fine M, Ferrier-Pagès C, 2014: Thermally tolerant corals have limited capacity to acclimatize to future warming, *Global Change Biology*, 20(10), 3036-3049, doi:10.1111/gcb.12571	UOP BIU
2014	Taylor JD, Ellis R, Milazzo M, Hall-Spencer JM, Cunliffe M, 2014: Intertidal epilithic bacteria diversity changes along a naturally occurring carbon dioxide and pH gradient, *FEMS Microbiology Ecology*, 89(3), 670-678, doi: 10.1111/1574-6941.12368	UOP CoNISMa
2014	Ziveri P, Passaro M, Incarbona A, Milazzo M, Rodolfo-Metalpa R, Hall-Spencer JM, 2014: Decline in coccolithophores diversity and impact on coccolith morphogenesis along a natural CO_2 gradient, *The Biological Bulletin*, 226, 282-290. Article.	UAB CoNISMa UOP
2014	(*)Pfister, C., Esbaugh, A., Frieder, Christina; Baumann, H., Bockmon, E., White, M., Carter, B., Benway, H., Blanchette, C., Carrington, E., McClintock, J., McCorkle, D., McGillis, W., Mooney, T., Ziveri, P. 2014: Detecting the Unexpected: A Research Framework for Ocean Acidification, *Environmental Science & Technology*, 48 (17): 9982–9994, doi:10.1021/es501936p	UAB

Section A2: MedSeA dissemination and outreach

MedSeA oral presentations:

162 presentations were given during the project. They are listed according to month and year and alphabetically.

Month Year	Reference	Country	Partner Responsible / Involved
February 2011	Fine M, 2011: Effects of ocean acidification on keystone benthic ecosystems and the impact on benthic biodiversity. *MedSeA Kick Off Meeting, Barcelona*.	Spain	BIU
February 2011	Funcke A, de Nooijer L, Keul N, Langer G, Bijma J, Reichart GJ, 2011: Impact of Mg^{2+} and Ca^{2+} concentrations on calcification in the benthic Foraminifer *Ammonia tepida*. *Darwin Days 2011, Lunteren*.	Netherlands	AWI
February 2011	Gattuso J-P, 2011: International activities: IPCC, SOLAS-IMBER working group on ocean acidification international coordination office. *MedSeA Kick Off Meeting, Barcelona*.	Spain	UPMC
February 2011	Goyet C and Marino G, 2011: Past and present carbonate system dynamics. *MedSeA Kick Off Meeting, Barcelona*.	Spain	UPVD UAB HCMR AWI CoNISMa USS
February 2011	Krasakopoulou E, 2011: Effects of ocean acidification and temperature on pelagic ecosystem functioning of the Mediterranean. *MedSeA Kick Off Meeting, Barcelona*.	Spain	HCMR
February 2011	Turley C and Davidson K-M, 2011: Dissemination and exploitation, knowledge transfer, public outreach. *MedSeA Kick Off Meeting, Barcelona*.	Spain	PML
February 2011	Vichi M, Orr J, Solidoro C, Dutay J-C, Palmiery J, Touratier F, 2011: Future projection of acidification on the Mediterranean Sea. *MedSeA Kick Off Meeting, Barcelona*.	Spain	CMCC
February 2011	Ziveri P, 2011: European project on Mediterranean sea acidification in a changing climate. *MedSeA Kick Off Meeting, Barcelona*.	Spain	UAB
April 2011	Bijma J, 2011: Ocean acidification: a biogeological perspective. *International Expert Workshop on Ocean Impacts, Somerville College, Oxford*.	UK	AWI
June 2011	Bijma J, 2011: Ocean acidification: a biogeological perspective. *Seventh EGU Alexander von Humboldt International Conference on Ocean acidification: consequences for marine ecosystems and society, Penang*.	Malaysia	AWI
June 2011	Bijma J, 2011: Ocean acidification: a biogeological perspective. *GIFT WS on ocean acidification, Penang*.	Malaysia	AWI
June 2011	Turley C, 2011: Oceans under threat. *The Times Cheltenham Science Festival*.	UK	PML
June 2011	Turley C, 2011: Oceans under threat. *World Oceans Day, Plymouth, UK*.	UK	PML
July 2011	Bijma, J. 2011. Ocean acidification: a biogeological perspective. *Darwin Summerschool*	Netherlands	AWI
July 2011	Graziano M, Milazzo M, Hall-Spencer JM 2011: Sicilian	UK	CoNISMa

	CO_2 vents show effects of ocean acidification on rocky shores. *9th International Temperate Reefs Symposium*.		UOP
July 2011	Hall-Spencer JM, 2011: Ocean acidification. *ARUP Ocean Cards, London, UK*.	UK	PML
August 2011	Kranz S, Wolf-Gladrow D, Nehrke G, Langer G, Rost B, 2011: Calcium Carbonate Precipitation by the Marine *Cyanobacterium Trichodesmium*. *Goldschmidt Conference, Prague*.	Czech Republic	AWI
September 2011	Keul N, de Nooijer L, Nehrke G, Langer G, Bijma J, 2011: Seawater endocytosis not related to chamber formation of Foraminifera. *BioAcid Meeting, Bremen*.	Germany	AWI
September 2011	Rees AP, 2011: Pressures on the marine environment and the changing climate of ocean biogeochemistry. *The Royal Society, London*.	UK	PML
October 2011	Costa V., Savona A., Tumbarello V.A., Vizzini S., Mazzola A. (2011) Dinamica del detrito fogliare fanerogamico lungo un gradiente di confinamento in un'area costiera a caratteristiche lagunari. *V Congresso LaguNet*,	Italy	CoNISMa
October 2011	Graziano M, Hall-Spencer JM, Pecoraino G, Chemello R, Milazzo M 2011: CO_2 vents areas show effects of ocean acidification on benthic rocky shores assemblages. *XXI Congresso della Società Italiana di Ecologia (SItE)*	Italy	UOP CoNISMa
October 2011	Turley C, 2011: Societal challenges of Ocean Acidification. *The sixth Port-Cros Symposium, Porquerolles, "Ocean acidification and biodiversity*.	France	PML
November 2011	Turley C, 2012: Presentations on ocean acidification. *Durban UNF CCC COP17, South Africa*.	South Africa	PML
December 2011	Keul N, Langer G, de Nooijer L, Nehrke G, Bijma J, 2011: Impacts of ocean acidification on foraminiferal calcification. *AGU Fall Meeting, San Francisco*.	USA	AWI
December 2011	de Carlo EH, Mousseau L, Passafiume O, Drupp P, Gattuso JP, 2011: Carbonate chemistry and air-sea CO_2 flux at a fixed point in a NW Mediterranean Bay: Villefranche-sur-Mer, France. *AGU Fall Meeting, San Francisco*.	USA	UPMC
December 2011	Gattuso J-P, Mach KJ, Morgan GM, 2011: Ocean acidification and its impacts: an expert survey. *AGU Fall Meeting, San Francisco*.	USA	UPMC
March 2012	Turley C, 2012: Ocean acidification. *European Parliament, Brussels*.	Belgium	PML
March 2012	Fine M et al., 2012: MedSeA year 1 meeting, WP4: What's new? *MedSeA 1st annual meeting, Rome*.	Italy	BIU
March 2012	Ghermandi A, Rodrigues L, van den Bergh J, 2012: A conceptual framework for studying the socio-economic impacts of ocean acidification. *MedSeA 1st annual meeting, Rome*.	Italy	UAB
March 2012	Giani M, Ingrosso G, Comici C, De Vittor C, Falconi C, Lipizier M, Cibic T, Karuza A, Fabbro C, Celussi M, Del Negro P, 2012: Riverine and biological influences on the carbonate system of the north-east Adriatic Sea (Gulf of Trieste). *MedSeA 1st annual meeting, Rome*.	Italy	OGS
March 2012	Giannoudi L, 2012: Presentation based on D3.1: Reinterpretation of existing biological data sets where carbonate system data are available – the DYFAMED time series station (1998 – 2007). *MedSeA 1st annual meeting,*	Italy	HCMR

	Rome.		
March 2012	Goyet et al., 2012: Temporal evolution of pH at DYFAMED. *MedSeA 1st annual meeting, Rome.*	Italy	UPVD
March 2012	Hall-Spencer JM, Rodolfo-Metalpa R, Milazzo M, Vulcano workshop participants, 2012: Mediterranean warming can worsen the impacts of ocean acidification. *MedSeA 1st annual meeting, Rome.*	Italy	UOP CoNISMa
March 2012	Hendriks I, 2012: Does *Posidonia oceanica* offer a refuge for calcifiers in a high-CO_2 world? *MedSeA 1st annual meeting, Rome.*	Italy	CSIC
March 2012	Krasakopoulou E et al., 2012: 1st year activities within WP3: Effects of ocean acidification and temperature on pelagic ecosystem functioning of the Mediterranean Sea. *MedSeA 1st annual meeting, Rome.*	Italy	HCMR
March 2012	Marino G et al., 2012: Overview of past carbonate system dynamics in the Mediterranean Sea. *MedSeA 1st annual meeting, Rome.*	Italy	UAB
March 2012	Oviedo AM, Langer G, Ziveri P, 2012: Effects of phosphate limitation on PIC and POC cellular content in Mediterranean strains of the coccolithophores *Emiliania huxleyi*. *MedSeA 1st annual meeting, Rome.*	Italy	UAB AWI
March 2012	Rodrigues L, 2012: Natural science information for the analysis of the socio-economic effects of ocean acidification. *MedSeA 1st annual meeting, Rome.*	Italy	UAB
March 2012	Touratier F, 2012: Distribution of the carbonate system properties, anthropogenic CO_2, and acidification in the Mediterranean Sea. *MedSeA 1st annual meeting, Rome.*	Italy	UPVD
March 2012	Vichi M et al., 2012: Future projections of acidification of the Mediterranean Sea. *MedSeA 1st annual meeting, Rome.*	Italy	CMCC
April 2012	Savy J-P, Yao KM, Touratier F, Goyet C, 2012: Temporal evolution of the anthropogenic CO_2 and acidification of the northwestern Mediterranean Sea, from the mid-1990s to the mid-2000s. *European Geosciences Union, Vienna.*	Austria	UPVD
April 2012	Solidoro C, 2012: Ocean Acidification. *XXIII rassegna mare, mare amico (ministero politiche agricole alimentari e forestal ambiente italiano).*	Italy	OGS
May 2012	Apostolaki ET, Vizzini S, Costa V, Olsen Y, Hendriks I, 2012: Seagrass community metabolism in a Mediterranean volcanic vent. *Mediterranean Seagrass Workshop 12, Essaouira.*	Morocco	HCMR CSIC CONISMA
May 2012	Vichi M, 2012: Impatto dei cambiamenti climatici sull'ecosistema Mediterraneo: un approccio biogeochimico. *XXII Annual Meeting of the MareAmico Association, Siracusa.*	Italy	CMCC
May 2012	Rodrigues L, 2012: A Conceptual Framework for Studying the Socio-economic Impacts of Ocean Acidification in the Mediterranean Sea. *VAERNA Conference, Faro.*	Portugal	UAB
May 2012	Learning to run: the use of the stoichiometric biomass-based Biogeochemical Flux Model (BFM). *2012 NEMO Users Meeting, Exeter.*	UK	CMCC
May 2012	Palmieri J, Dutay J-C, Beranger K, Beuvier J, 2012: Biogeochemical modelling in the Mediterranean Sea with the NEMO-Med12/PISCES model. *2012 NEMO Users Meeting, Exeter.*	UK	LSCE

June 2012	Bijma J, 2012: Calcification mechanisms in foraminifera and proxy incorporation. *Darwin Summerschool, Utrecht*.	Netherlands	AWI
June 2012	Hall-Spencer JM, 2012: Ecosystem effects of ocean acidification. *Friday Harbour Marine Lab, Seattle*.	USA	UOP
June 2012	Hall-Spencer JM, 2012: Global Oceans Governance. *European Parliament, Brussels*.	Belgium	UOP
June 2012	Hall-Spencer JM, 2012: The vicious circle of CO_2 and ocean acidification. *European Parliament, Brussels*.	Belgium	UOP
June 2012	Vichi M, 2012: Future projections of climate change impacts on the Mediterranean biogeochemistry: results from past. *Workshop on "Climate change impacts on marine biodiversity in the Mediterranean" MedPAN, UNEP, IUCN*.	Malta	CMCC
June 2012	Raitzsch M and Hönish B, 2012: Cenozoic boron isotope variations in benthic foraminifera. *Goldschmidt Conference, Montréal*.	Canada	AWI
June 2012	Turley C, 2012: Ocean acidification. *Planet under Pressure, London*.	UK	PML
July 2012	Santangelo G, Cupido R, Cocito S, Bramanti L, Tsounis G, Iannelli M, 2012: Demography of long-lived octocorals: survival and local extinction. *12th International Coral Reef Symposium, Cairns*.	Australia	CSIC
September 2012	Asnaghi V, Chiantore M, Mangialajo L, Gazeau F, Francour P, Alliouane S, Gattuso J-P, 2012: Mediterranean rocky shores under global change: response of macroalgae and sea urchins to ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	CoNISMa UPMC
September 2012	Bramanti M, Rossi S, Gouron M, Movilla J, Gori A, Martinez A, Dominguez-Carrio C, Grinyo J, Lopez A, Pelejero C, Calvo E, Ziveri P, 2012: The effects of ocean acidification on the precious Mediterranean red coral. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UAB
September 2012	Calosi P, Melatunan S, Byrne JJ, Davidson RL, Viant M, Widdicombe S, Rundle S, 2012: Populations living along a thermo-latitudinal gradient vary in their response and vulnerability to ocean acidification and warming. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP
September 2012	Calosi P, Rastrick S, Lombardi C, Hardege J, M-C G, 2012: Metabolic plasticity and metabolic adaptation in marine worms species inhabiting a CO_2 vent. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP ENEA
September 2012	Hilmi N, Allemand D, Dupont S, Safa A, Haraldson G, Nunes PALD, Moore C, Hattam C, Reynaud S, Hall-Spencer JM, Fine M, Turley C, Jeffree R, Orr J, Munday PL, Cooley S, 2012: How to evaluate the socio-economic impacts of ocean acidification? *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP
September 2012	Hall-Spencer JM. Climate Change in the Marine Realm. International Summer School for Students. *Alfred Wegener Institute, Wadden Sea Station*.	Germany	UOP
September 2012	Lombardi C, Gambi M-C, Cocito S, Kearsley, Calosi P, Taylor PD, 2012: Biomineralizing epiphytes of the seagrass	USA	ENEA UOP

	Posidonia oceanica meadows from a CO_2 vent coastal system. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.		
September 2012	Turley C, 2012: The science into policy challenge of ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	PML
November 2012	Hall-Spencer JM, 2012: Policy workshop. Ocean acidification effects on fisheries and aquaculture. *International Atomic Energy Agency Monaco*.	Monaco	UOP
November 2012	Vizzini S, Costa V, Mazzola A, 2012: Seagrass response to high CO2 in volcanic vents. *10th International Seagrass Biology Workshop*	Brazil	CoNISMa
December 2012	Zervoudaki S, Orek H, Assimakopoulou G, Krasakopoulou E, Frangoulis C, Giannoudi L, Zenginer Yilmaz A, Fach B, 2012: Impact of ocean acidification on pelagic food web in a coastal area of Eastern Mediterranean Sea. *Final meeting of the Turkey-Greece Joint Research and Technology Programs 2010 – 2011, Erdemli*.	Turkey	HCMR
December 2012	Hall-Spencer JM, 2012: Marine biology & climate change. *Swire Inst. of Marine Biology, Hong Kong*.	China	UOP
December 2012	Hall-Spencer JM, 2012: FP7 MedSeA results from CO_2 vents. *University of Hull*.	UK	UOP
February 2013	Hall-Spencer JM, 2013: FP7 MedSeA results from CO_2 vents. *University of Bangor*.	USA	UOP
February 2013	Hall-Spencer JM, 2013: FP7 MedSeA results on ocean acidification. *University Brunei Darusselam*.	Brunei	UOP
February 2013	Hall-Spencer JM, 2013: Fisheries and coastal degradation. *World Fish Centre, Penang*.	Malaysia	UOP
February 2013	Rees AP, 2013: Acidification of the Marine Nitrogen Cycle. *ASLO Aquatic Sciences Meeting, New Orleans*.	USA	PML
March 2013	Canu D, 2013: Ocean Acidification and valuation of carbon sequestration in the Mediterranean Sea. *MedSeA 2nd annual meeting, Heraklion*.	Greece	OGS
March 2013	Cooley S, 2013: Ocean acidification in a social-ecological context & U.S. OA research activities. *MedSeA 2nd annual meeting, Heraklion*.	Greece	WHOI
March 2013	Frangoulis C, Psarra S, Krasakopoulou E, Petihakis G, 2013: Physical and biochemical time-series of upper water column parameters at the POSEIDON-E1-M3A site (Cretan Sea, Eastern Mediterranean). *MedSeA 2nd annual meeting, Heraklion*.	Greece	HCMR
March 2013	Giani M, Celussi M, Cibic T, Comici C, Del Negro P, De Vittor C, Fabbro C, Karuzua A, Kralj M, Ingrosso G, Lipizier M, 2013 : Physical and biological influences on the variability of pH and carbonate system in the Gulf of Trieste (northern Adriatic Sea). *MedSeA 2nd annual meeting, Heraklion*.	Greece	OGS
March 2013	Giannakourou A, Strogyloudi E, Konstadinopoulou A, Pitta P, Tsiola A, Zeri C, Gogou A, Parinos K, Pitta E, Giannoudi L, Krasakopoulou E, 2013: The effects of ocean acidification on bacterial and viral communities: a microcosm approach. *MedSeA 2nd annual meeting, Heraklion*.	Greece	HCMR
March 2013	Hall-Spencer JM, 2013: Marine Science into Policy. *Plymouth University*.	UK	UOP

March 2013	Hall-Spencer JM, 2013: Assessing the effects of ocean acidification and warming on Mediterranean ecosystems, an update. *MedSeA 2nd annual meeting, Heraklion.*	Greece	UOP
March 2013	Horwitz R, 2013: Response of sea anemone to long term changes in carbonate chemistry nearby CO_2 volcanic vents. *MedSeA 2nd annual meeting, Heraklion.*	Greece	BIU
March 2013	Howes E, 2013: WP3: Pteropods and foraminifera. *MedSeA 2nd annual meeting, Heraklion.*	Greece	UPMC AWI
March 2013	Goyet C, Giani M, Touratier F, Krasakopoulou E, Zizah S, Marino G, Abd N, Shaltout N, Gattuso J-P, et al., 2013: Two years of activities within WP2. *MedSeA 2nd annual meeting, Heraklion.*	Greece	UPVD UAB, HCMR OGS, NIOF
March 2013	Orr J, 2013: Simulated anthropogenic acidification and CO_2 uptake of the MedSeA during the industrial era. *MedSeA 2nd annual meeting, Heraklion.*	Greece	CEA
March 2013	Rees A, et al., 2013: Overview of the Stareso mesocosm experiment. *MedSeA 2nd annual meeting, Heraklion.*	Greece	PML
March 2013	Rodrigues L, 2013: Ocean acidification and warming effects on recreational scuba diving and aquaculture mollusc production in the Mediterranean Sea. *MedSeA 2nd annual meeting, Heraklion.*	Greece	UAB
March 2013	Solidoro C, 2013: State, scales of variability and trends of alkalinity and carbonate system in the Mediterranean Sea in the current conditions. *MedSeA 2nd annual meeting, Heraklion.*	Greece	OGS
March 2013	Touratier F and Goyet C, 2013: Impact of dense water formation on carbon sequestration in the northwestern Mediterranean Sea (results from the CASCADE Cruise). *MedSeA 2nd annual meeting, Heraklion.*	Greece	UPVD
March 2013	Vichi M et al., 2013: MedSeA WP5, 2nd year of activity. *MedSeA 2nd annual meeting, Heraklion.*	Greece	CMCC
March 2013	Zervoudaki S, Frangoulis C, Giannoudi L, Krasakopoulou E, 2013: Effects of low pH and raised Temperature on Egg Production, Hatching and Metabolic Rates of a Mediterranean Copepod species *Acartia clausi*. *MedSeA 2nd annual meeting, Heraklion.*	Greece	HCMR
March 2013	Ziveri P, 2013: Mediterranean Sea Acidification in a changing climate, MedSeA. *MedSeA 2nd annual meeting, Heraklion.*	Greece	UAB
May 2013	Bijma J, Nehrke G, Raitsch M, de Nooijer L, Funcke A, Keul N, 2013: Calcification mechanisms in foraminifera and proxy incorporation. *JpGU International Symposium, Chiba-City.*	Japan	AWI
June 2013	Ziveri P, MedSeA Members, The MedSeA project. Coordination of FP7 Projects in the Mediterranean and the Black Sea regions, Athens,	Greece	UAB MedSeA Consortium
May 2013	Ziveri P, Coccolithophores and ocean acidification, Coccolith geochemistry workshop, Imperial College London.	UK	UAB
May-June 2013	Bijma J, 2013: Ocean acidification – a biogeological perspective. *The Wenner-Gren Foundations and The Royal Swedish Academy of Sciences. Tenth Kristineberg Symposium "Evolution and plasticity of marine organisms in a changing world", Gothenburg.*	Sweden	AWI
August 2013	Baggini C, Salomidi M, Voutsinas E, Bray L, Krasakopoulou E, Hall-Spencer JM, 2013: Greek CO_2 vents show community	UK	HCMR

	effects of ocean acidification in the oligotrophic Aegean Sea. *11th INTECOL Congress, Ecology: Into the next 100 years, London*		
August 2013	Hall-Spencer JM, 2013: Ocean acidification. *European Marine Biology Symposium, Galway*.	UK	UOP
September 2013	Giani M, Ingrosso G, Cibic T, Comici C, Fabbro C, Karuza A, Kralj M, Lipizer M, De Vittor C, Del Negro P, 2013: Effetti fisici e biologici sulla variabilità del pH e del sistema carbonatico nel golfo di Trieste. *XXI AIOL Congress, Lignano Sabbiadoro*.	Italy	OGS
September 2013	Ziveri P, Mediterranean Sea Acidification, the XXI AIOL (Associazione Italiana di Oceanologia e Limnologia) Congress, Mediterranean Sea acidification and warming, Lignano Sabbiadoro.	Italy	UAB
September 2012	Ziveri P., Coccolithophore calcification and geochemistry, and the response to OA in the Mediterranean Sea. Why do coccolithophores calcify? Workshop funded by the UK Ocean Acidification research programme, University of Bristol.	UK	UAB
September 2013	Giani M, 2013: Lesson for high school students "Ocean acidification". *Summer school of Marine Biology, OGS, Trieste, Italy*.	Italy	OGS
September-October 2013	Hall-Spencer JM, 2013: Ocean acidification in coral reefs. *University of Tokyo*.	Japan	UOP
October 2013	Pitta P, Frangoulis C, Krasakopoulou E, 2013: Impact of warming and acidification on the pelagic, microbial food web in the Eastern Mediterranean – a mesocosm experiment. *Marbigen Conference: Mediterranean marine biodiversity in view of climate change and the invasion of alien species, Heraklion*.	Greece	HCMR
October 2013	Hall-Spencer JM, 2013: Ecology of ocean acidification roundtable. *University of British Columbia, Vancouver*.	Canada	UOP
October 2013	Milazzo M, 2013: Ecology of ocean acidification roundtable. *University of British Columbia, Vancouver*.	Canada	CoNISMa
October 2013	Hall-Spencer JM, 2013: Synthesis of ecosystem-level ocean acidification research. *ICES HQ, Copenhagen*.	Denmark	UOP
November 2013	Silva J, Olive I, Costa MM, Barrote I, Procaccini G, Mazzuca S, Vizzini S, Santos R, 2013: Seagrass photo-physiological responses in a natural high-CO2 environment. *22nd Biennial Conference of the Coastal and Estuarine Research federation-CERF 2013*	USA	CoNISMa
November 2013	Ziveri P., Regional responses to acidification and warming: the Mediterranean Sea, MedOcean Conference, ICM, Barcelona.	Spain	UAB
December 2013	Hall-Spencer JM, 2013: Lessons learnt from field studies. *International Ocean Acidification Reference User Group, Monaco*.	Monaco	UOP
December 2013	Rees AP, 2013: Acidification of the Marine Nitrogen Cycle. *University of Plymouth Christmas Conference*.	UK	PML
January 2014	Hall-Spencer JM, 2014: Effects of CO_2 on marine primary production. *Xiamen University*.	China	UOP
January 2014	Hall-Spencer JM, 2014: Volcanic seep research. *National Taiwan University*.	China	UOP

January 2014	Hall-Spencer JM, 2014: Scottish Oceans Institute invited talk. *University of St Andrews*.	UK	UOP
January 2014	Williams AG, Prusina I, De Pirro M, Dong Yun-wei, Han Guo-Dong, Giomi F, Rinaldi A, Sarà G, Glamuzina B, Hall-Spencer JM, Milazzo M, 2014: Taking the acid test: Mediterranean limpets face up to climate change. *10th International Temperate Reefs Symposium*	Australia	CoNISMa UOP
February 2014	Hall-Spencer JM, 2014: Marine Strategy Framework Directive policy meeting. *Marine Biological Association, Plymouth*.	UK	UOP
February 2014	Rees AP, 2014: Acidification of the Marine Nitrogen Cycle. *Princeton University Geosciences seminar series*.	USA	PML
March 2014	Hall-Spencer JM, 2014: *EU COST Seagrass Workshop, Olhao*.	Portugal	UOP
March 2014	Hall-Spencer JM, 2014: Coralline algae in the face of climate change policy workshop. *Scottish Natural Heritage, Edinburgh*.	UK	UOP
March 2014	Giani M, 2014: Lesson for high school students: "Carbonates and their role in the marine biology world". *OGS, Trieste*.	Italy	OGS
March 2014	Vizzini S, Martínez-Crego B, Andolina C, Massa-Gallucci A, Gambi MC, 2014: Structure of motile fauna populations in macrophytes of a Mediterranean CO2 vent system. *Seagrasses in Europe: Threats, Responses and Management*	Portugal	CoNISMa
April 2014	Hall-Spencer JM, 2014: Efectos en el ecosistema de la acidificación del océano. *University of Malaga*	Spain	UOP
April 2014	Bijma J, 2014: Ocean acidification – a biogeological perspective. *Global Change Research Institute Seminar Series, University of Edinburgh*.	UK	AWI
April-May 2014	Schwier A, Rose C, Asmi E, Gazeau F, Guieu C, Claustre H, Ras J, Ouhssain M, Sellegri K, 2014: Cloud condensation nuclei properties of marine aerosol in the Mediterranean: a mesocosm study. *EGU General Assembly Conference, Vienna*.	Austria	UPMC
April-May 2014	Solidoro C, Lazzari P, Cossarini G, Melaku Canu D, Lovato T, Vichi M, 2014: Modelling physical and biogeochemical state of the Mediterranean Sea under contemporary and future climate. *EGU General Assembly Conference, Vienna*.	Austria	OGS CMCC
June 2014	Bosello F, Cossarini G, Delpiazzo E, Eboli F, Ghermandi A, Lazzari P, Canu DM, Nunes P, Rekve I, Rodrigues L, Solidoro C, van den Bergh J, 2014: Economics of ocean acidification in the MedSeA. *MedSeA final meeting, Barcelona*.	Spain	UAB BIU CoNISMa
June 2014	Fine M, et al., 2014: Understanding the response of Mediterranean key benthic ecosystems to ocean acidification. *MedSeA final meeting, Barcelona*.	Spain	BIU
June 2014	Gazeau F, 2014: Effects of ocean acidification and temperature on pelagic ecosystem functioning of the Mediterranean Sea. *MedSeA final meeting, Barcelona*.	Spain	UPMC HCMR UAB
June 2014	Giani M, Ingrosso G, Goyet C, Gattuso J-P, Gazeau F, Krasakopoulou E, Shaltout N, 2014: Results from time-series measurements in the Mediterranean Sea. *MedSeA final meeting, Barcelona*.	Spain	UPVD UPMC NIOF HCMR
June 2014	Goyet C, Giani M, Touratier F, Krasakopoulou E, Marino G, Shaltout N, Gattuso J-P, Hassoun A, Gemayel E, Grelaud M,	Spain	UPVD UAB

	Ziveri P, 2014: WP2 Past en present carbonate system dynamics of the Mediterranean Sea. *MedSeA final meeting, Barcelona*.		OGS NIOF HCMR
June 2014	Grelaud M, et al., 2014: Overview of past carbonate system dynamics in the Mediterranean Sea – Progress. *MedSeA final meeting, Barcelona*.	Spain	UAB AWI CoNISMa USS
June 2014	Hall-Spencer JM, et al., 2014: Assessing the effects of ocean acidification and warming: CO_2 seep outputs – New data on 100s of species including bacteria, cyanobacteria, diatoms, coccolithophores, seaweeds, seagrasses, sponges, corals, polychaetes, crustaceans, molluscs, echinoderms, biogeochemistry, evolution. *MedSeA final meeting, Barcelona*.	Spain	UOP
June 2014	Hendriks IE, Olsen YS, Apostolaki ET, Vizzini S, Ramajo L, Duarte CM, 2014: The interaction between seagrass and CO_2 - current processes and future prospects. *MedSeA final meeting, Barcelona*.	Spain	CSIC CONISMA
June 2014	Krasakopoulou E, 2014: Effects of ocean acidification and temperature on pelagic ecosystem functioning of the Mediterranean Sea. *MedSeA final meeting, Barcelona*.	Spain	HCMR
June 2014	Lovato T, et al., 2014: Current state and future projections of the Mediterranean sea carbonate system. *MedSeA final meeting, Barcelona*.	Spain	CMCC
June 2014	Nunes PALD and Ghermandi A, 2014: Application of non-market valuation surveys on jellyfish outbreaks in the Mediterranean Sea. *MedSeA final meeting, Barcelona*.	Spain	BIU
June 2014	Orr J, Le Vu B, Dutay J-C, 2014: Introduction to WP5 modelling activity and some key results. *MedSeA final meeting, Barcelona*.	Spain	LSCE
June 2014	Rodrigues L, 2014: Economic valuation of impacts on aquaculture and tourism. *MedSeA final meeting, Barcelona*.	Spain	UAB
June 2014	Solidoro C, et al., 2014: Modelling ecosystem response and vulnerability. *MedSeA final meeting, Barcelona*.	Spain	LSCE CoNISMa CMCC
June 2014	Touratier F, 2014: Anthropogenic carbon and acidification throughout the Mediterranean Sea. *MedSeA final meeting, Barcelona*.	Spain	UPVD
June 2014	Van den Bergh J, Rodrigues L, Bosello F, Eboli F, 2014: Socio-economic vulnerability maps, adaptation tools and policy. *MedSeA final meeting, Barcelona*.	Spain	UAB
June 2014	Ziveri P, et al., 2014: Target organisms responses to ocean acidification and ocean warming (laboratory experiments). *MedSeA final meeting, Barcelona*.	Spain	UAB AWI
June 2014	Giani M, Ingrosso G, Kralj M, Cibic T, Fabbro C, Karuza A, De Vittor C, Del Negro P, 2014: Carbonate system variability and buffer capacity in a Mediterranean estuarine area (Gulf of Trieste, Northern Adriatic Sea). *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen*.	Norway	OGS
June 2014	Giannakourou A, Pitta P, Konstadinopoulou A, Tsiola A, Strogyloudi E, Zeri C, Gogou A, Giannoudi L, Frangoulis C, Krasakopoulou E, 2014: The combined effect of pCO_2 and temperature increase on bacterioplankton in the Eastern	Norway	HCMR

	Mediterranean. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*		
June 2014	Louis J, Guieu C, Gazeau F, 2014: Is nutrients dynamics affected by ocean acidification? Results from two mesocosms experiments in the Mediterranean Sea (FP7 MedSeA Project). *Goldschmidt Conference, Sacramento.*	USA	UPMC
June 2014	Maugendre L, Gattuso J-P, Louis J, de Kluijver A, Marro S, Soetaert K, Gazeau F, 2014: Effect of ocean warming and acidification on a plankton community in the NW Mediterranean Sea. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	UPMC
June 2014	Rees AP, Clark DR, Al-Moosawi L, Brown IJ, 2014: Acidification of the Marine Nitrogen Cycle. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	PML
June 2014	Solidoro C, Lazzari P, Cossarini G, Melaku Canu D, Vichi M, Lovato T, Scardi M, Fraschetti S, Martin C, Giannoulaki M, 2014: Modelling the state of the Mediterranean Sea under contemporary and future climate. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	OGS
June 2014	Zervoudaki S, Krasakopoulou E, Gazeau F, Pitta V, Moutsopoulos T, Grigoratou M, Protopapa M, Frangoulis C, Giannakourou A, Guieu C, Ziveri P, 2014: Effects of raised CO_2 and temperature on composition, production and feeding behavior of marine copepods during mesocosm experiments in the Mediterranean Sea. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	HCMR UPMC UAB
July 2014	Ziveri P, 2014: Hydrography during the MedSeA-GEOTRACES cruise. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UAB
July 2014	Grelaud M, 2014: Data sharing and management. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UAB
July 2014	Celussi M, 2014: Biogeochemical properties and microbial metabolism in Mediterranean waters during the MedSeA cruise. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	OGS HCMR
July 2014	Roca-Marti M, 2014: Export carbon from the upper ocean. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UAB
July 2014	Hassoun A, 2014: Mediterranean Sea circulation under anthropogenic forcing. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UPVD
July 2014	Gemayel E, 2014: Modelization of total inorganic carbon in surface waters of the Mediterranean Sea. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UPVD
July 2014	D'Armario B, 2014: Distribution of coccolith carbonate in Mediterranean seawater. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	UAB
July 2014	Gonzales Lopez R, 2014: Biodiversity and distribution of planktonic cnidarians in the Mediterranean. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona.*	Spain	CSIC

July 2014	Taillandier V, 2014: Initiation of BioArgoMed network. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona*.	Spain	UPMC
July 2014	Xicoy Espaulella E, 2014: Plantonic foraminifera and pteropod distribution during the MedSeA 2013 cruise. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona*.	Spain	UAB
July 2014	Mata R, 2014: Sediment core first results (age model, biomarkers, XRF). *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona*.	Spain	UAB
July 2014	Rodellas V, 2014: Submarine Groundwater Discharge: a major source of nutrients to the Mediterranean Sea. *Post-Cruise Meeting MedSeA-GEOTRACES, Barcelona*.	Spain	UAB
September 2014	Ziveri P, Impacts of ocean acidification and climate change on marine calcifying planktonic organisms, 2nd Workshop on Marginal Seas in Change – The East Sea and the Mediterranean Sea, Busan.	Korea	UAB
September 2014	Ziveri P and MedSeA members, MedSeA, 2nd Workshop on Marginal Seas in Change – The East Sea and the Mediterranean Sea, Busan.	Korea	UAB MedSeA Consortium
October 2014	Bijma J, 2014: Ocean acidification – a biogeological perspective. *Institut de Ciència i Tecnologia Ambientals, UAB, Seminar*	Spain	AWI

MedSea poster presentations:

92 Posters were presented during the project. They are listed according to year of publication, then alphabetically.

Month Year	Reference	Country	Partner Responsible / Involved
April 2011	Hall-Spencer JM, Passaro M, Ziveri P, Milazzo M, Rodolfo-Metalpa R: Exploring CO_2 volcanic vents at Vulcano Island, Mediterranean Sea, to study the planktonic calcifier response to long-term changes in carbonate chemistry. *EGU General Assembly 2011*.	Austria	UOP UAB CoNISMa
October 2011	Costa V, Vizzini S, Tomasello A, Calvo S, Mazzola A, 2011: Studio della comunità associata allo strato fogliare di Posidonia oceanica in sorgenti sottomarine superficiali di CO2. *XXI Congresso della Società Italiana di Ecologia*	Italy	CoNISMa
March 2012	Al-Moosawi L, Cummings D, Rees A, 2012: Carbon and nitrogen fixation at a gradient of CO_2 conditions: Vulcano Island. *MedSeA 1st anual meeting, Rome*.	Italy	PML
March 2012	Boatta F, D'Alessandro W, Gagliano L, Liotta M, Milazzo M, Parello F, Hall-Spencer JM, 2012: Geochemical survey of Baia di Levante area, Vulcano Island (Italy). *MedSeA 1st anual meeting, Rome*.	Italy	CoNISMa UOP
March 2012	Boussetta S, Kallel N, Bassinot F, Labeyrie L, Duplessy J-C, Caillon N, Rebaubier H, 2012 : Mg/Ca-paleothermometry in the western Mediterranean Sea on *G.bulloides* using paleoclimatic record. *MedSeA 1st anual meeting, Rome*.	Italy	USS LSCE
March 2012	Bramanti L, Guron M, Movilla J, Gentile M, Rossi S, 2012: The effects of ocean acidification on precious Mediterranean red coral. *MedSeA 1st anual meeting, Rome*.	Italy	UAB
March 2012	Cabrini M, de Olazabal A, Fornasaro D, Lipizier M, Minocci M, Monti M, Tirelli V, 2012: Calcifying planktonic organisms in the LTER station of the Gulf of Trieste (Northern Adriatic Sea). *MedSeA 1st anual meeting, Rome*.	Italy	OGS
March 2012	Grelaud M, Marino G, Ziveri P, 2012: Hydrographic and ecological impact of the Sapropel 5 (Eemian) on surface waters of Aegean Sea (Eastern Mediterranean). *MedSeA 1st anual meeting, Rome*.	Italy	UAB
March 2012	Hendriks I, Olsen Y, Apostolaki E, Vizzini S, Basso L, Costa V, Duarte D, 2012: Does ocean acidification affect seagrass ecosystem function? *MedSeA 1st anual meeting, Rome*.	Italy	CSIC
March 2012	Howes E, Gattuso J-P, Bijma J, 2012: Effects of ocean acidification on calcification and incorporation of elements and isotopes in Mediterranean pteropods and foraminifers. *MedSeA 1st anual meeting, Rome*.	Italy	UPMC AWI
March 2012	Johnson VR, Brownlee C, Rickaby REM, Graziano M, Milazzo M, Hall-Spencer JM, 2012: Using volcanic CO_2 gradients to investigate the responses of marine benthic photoautotrophs to ocean acidification. *MedSeA 1st anual meeting, Rome*.	Italy	UOP CoNISMa
March 2012	Montagna P, Vieulzeuf D, Lopez Correa M, Garrabou J, Taviani M, Marschall C, Linares C, McCulloch M, Silenzi S, Freiwald A, 2012: Growth rate, trace elements and stable isotopes in *Corallium rubrum* from shallow and bathyal settings in the Mediterranean Sea. *MedSeA 1st anual meeting, Rome*.	Italy	LSCE

March 2012	Olsen Y, Hendriks I, Apostolaki ET, Vizzini S, Duarte C, 2012: How does a low pH environment affect seagrass ecosystem function? *MedSeA 1st anual meeting, Rome*.	Italy	CSIC CoNISMa
March 2012	Passaro M, Ziveri P, Milazzo M, Rodolfo-Metalpa R, Hall-Spencer J, 2012: Exploring a CO_2 volcanic vents at Vulcano Island, Mediterranean Sea, to study the planktonic calcifier response to long-term changes in carbonate chemistry. *MedSeA 1st anual meeting, Rome*.	Italy	UAB CoNISMa UOP
March 2012	Sahli Adsi S, Marino G, Ziveri P, Kallel N, 2012: Dynamics of the upper column carbonate system in the Gulf of Lion (Northwest Mediterranean) during the last deglaciation. *MedSeA 1st anual meeting, Rome*.	Italy	USS UAB
May 2012	Bijma J, Nehrke G, Raitsch M, de Nooijer L, Funcke A, Keul N, 2013: Calcification mechanisms in foraminifera and proxy incorporation. *JpGU International Symposium, Chiba-City*.	Japan	AWI
June 2012	Giani M, Comici C, De Vittor C, Fabbro C, Falconi C, Karuza A, Kralj M, Ingrosso G, Lipizer M, Del Negro P, 2012: Variations in the acidity, carbonate system and bacterial activity in the North Adriatic Coastal Waters. *43rd Congress of the Italian Society of Marine Biology*.	Italy	OGS
June 2012	Giani M, Ingrosso G, Comici C, De Vittor C, Falconi C, Lipizer M, 2012: Riverine and biological influences on the carbonate system of the north-east Adriatic Sea (Trieste Gulf). *50th Estuarine and Coastal Shelf Science Conference: Today's science for tomorrow's Management, Venice*.	Italy	OGS
June 2012	Bijma J, 2012: Mg/Ca ratios in cultured foraminifers analyzed with LA-ICP-MS. *BioAcid Meeting 2012, Bremen*.	Germany	AWI
June 2012	Bijma J, 2012: Mg/Ca ratios in cultured foraminifers analyzed with LA-ICP-MS. *YOUMARES Conference 2012, Bremen*.	Germany	AWI
June 2012	Mediterranean Sea in a Changing Climate. *CMCC conference, Otranto*.	Italy	CMCC
August 2012	Raitzsch M and Hönisch B, 2012: Cenozoic boron isotope variations in benthic foraminifera. *Goldschmidt Conference, Montréal*.	Canada	AWI
September 2012	Asnaghi V, Thrush S, Gattuso J-P, Hewitt J, Mangialajo L, Bianch CN, Francour P, Chiantore M, 2012: Recovery dynamics of Mediterranean shallow rocky shore communities under scenarios of multiple stressors and ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC
September 2012	Asnaghi V, Chiantore M, Mangialajo L, Gazeau F, Francour P, Alliouane S, Gattuso JP, 2012: Ecological interplays in mediterranean rocky shores under climate change: macroalgae and sea urchins responses to ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC
September 2012	Baggini C, Rodolfo-Metalpa R, Hall-Spencer JM, 2012: Effects of ocean acidification on *Mytilus galloprovincialis* and *Patella caerulea* at natural CO_2 vents. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP
September 2012	Bramanti L, Rossi S, Movilla JI, Gouron M, Martinez A, Dominguez-Carrio C, Grinyo J, Lopez-Sanz A, Pelejero C, Calvo EM, Ziveri P, 2012: The effect of ocean acidification on the precious Mediterranean red coral. *Third International*	USA	UAB

	Symposium on the Ocean in a High-CO_2 World, Monterey, California.		
September 2012	Calosi P, Rastrick S, Lombardi C, Hardege JD, Giangrande A, Shulze A, Gambi M-C, 2012: Metabolic plasticity and adaptation in polychaete species inhabiting a CO_2 vent coastal system. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP
September 2012	Fine M and Milazzo M, 2012: Vermetid reefs in the warm temperate Mediterranean Sea are facing local extinction. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	BIU CoNISMa
September 2012	Gattuso J-P, SOLAS-IMBER Working Group on Ocean (SIOA), 2012: Towards an international coordination of ocean acidification activities. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UMPC
September 2012	Gazeau F, Alliouane S, Bramanti L, Gentile M, 2012: Effects of ocean acidification and warming on the growth and metabolism of the Mediterranean mussel, an annual study. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC CSIC
September 2012	Giani M, Ingrosso G, Comici C, De Vittor C, Falconi C, Lipizer M, 2012: Seasonal variability of pH and carbonate system in a coastal Mediterranean area. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	OGS
September 2012	Howes E, Moya A, Macoue-Labarthe T, Teyssié J-L, Forêt S, Bijma J, Gattuso J-P, 2012: Ecophysiological and molecular response of thecosome pteropods to short-term ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC AWI
September 2012	Howes E, Assailly C, Irisson JO, Stemmann L, Gattuso JP, 2012: Calcifying pteropod time series provides a baseline against which to measure local environmental change. *Time-series analysis in marine science and applications for industry, Brest*.	France	UPMC
September 2012	Maugendre L, Gazeau F, Gattuso J-P, 2012: Effect of ocean acidification and warming on a natural plankton community of the Mediterranean Sea. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC
September 2012	Noisette F, Egilsdottir H, Davoult D, Martin S, 2012: Photosynthetic and calcification responses of three species of temperate coralline algae to near future ocean acidification. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPMC
September 2012	Oviedo AM, Langer G, Ziveri P, 2012: Effects of phosphorus limitation and ocean acidification on coccolithophores: a case study in the Mediterranean Sea. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UAB AWI
September 2012	Rodolfo-Metalpa R, Hall-Spencer JM et al., 2012: Some Mediterranean corals, but also bryozoans, mollusks and gastropods keep calcifying at low carbonate ions concentrations. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UOP BIU UPMC CoNISMa
September 2012	Sallon A, Guieu C, Grisoni J-M, Louis F, Gattuso J-P, Gazeau F, 2012: Response of planktonic community to ocean	USA	UPMC

	acidification in the oligotrophic Mediterranean Sea. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.		
September 2012	Shaltout N, Goyet C, Touratier F, Sheradah MA, 2012: The distribution of pH, total alkalinity, pCO_2, anthropogenic carbon and carbonate saturation in South Eastern Mediterranean Sea and estimation of acidification from 1977 to 1996. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	NIOF UPVD
September 2012	Yao KM, Marcou O, Goyet C, Gugielmi V, Savy J-P, Touratier F, 2012: Distribution and temporal evolution of the Mediterranean Sea anthropogenic CO_2 (C_{ant}) over the past two decades. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UPVD
September 2012	Ziveri P, Abdullah R, MedSeA Consortium, 2012: Research turns to acidification and warming in the Mediterranean Sea. *Third International Symposium on the Ocean in a High-CO_2 World, Monterey, California*.	USA	UAB
February 2013	Yao KM, Marcou O, Goyet C, Guglielmi V, Savy J-P, Touratier F, 2013: Temporal evolution of total and anthropogenic CO_2 and pH in the Mediterranean Sea for the 1995-2011 period. *4th International Meeting on Meteorology and Climatology of the Mediterranean, Banyuls*.	France	UPVD
March 2013	Calosi P, Rastrick SPS, Graziano M, Thomas SC, Baggini C, Carter HA, Hall-Spencer JM, Milazzo M, Spicer JI, 2013: Distribution of sea urchins living near shallow water CO_2 vents is dependent upon species acid-base and ion-regulatory abilities. *MedSeA 2nd anual meeting, Heraklion*.	Greece	UOP CoNISMa
March 2013	Chaabane S, Mantagna P, Lopez Correa M, Kallel N, Bramanti L, Rossi S, Taviani M, Ziveri P, 2013: Skeletal architecture and growth bands of the shallow and deep-water coral *Corallium rubrum*. *MedSeA 2nd anual meeting, Heraklion*.	Greece	USS UAB LSCE
March 2013	Frangoulis C, Psarra S, Krasakopoulou E, Petithakis G, 2013: Physicla and biochemical time-series of upper water column parameters at the POSEIDON-E1-M3A site (Cretan Sea, Eastern Mediterranean). *MedSeA 2nd anual meeting, Heraklion*.	Greece	HCMR
March 2013	Giannakourou A, Strogyloudi E, Konstadinopoulou A, Pitta P, Tsiola A, Zeri C, Gogou A, Parinos K, Pitta E, Giannoudi L, Krasakopoulou E, 2013: The effects of ocean acidification on bacterial and viral communities: a microcosm approach. *MedSeA 2nd anual meeting, Heraklion*.	Greece	HCMR
March 2013	Grelaud M and Ziveri P, 2013: Biodiversity of coccolithophores and Emiliania huxleyi calcite mass from surface sediments of the Mediterranean Sea in a changing climate. *MedSeA 2nd anual meeting, Heraklion*.	Greece	UAB
March 2013	Hall-Spencer JM and Milazzo M, 2013: Assessing the effects of ocean acidification and warming on Mediterranean ecosystems, an example. *MedSeA 2nd anual meeting, Heraklion*.	Greece	UOP CoNISMa
March 2013	Hendriks I, Olsen Y, Ramajo L, Basso L, Steckbauer A, Moore T, Howard J, Duarte C, 2013: Photosynthetic activity buffers ocean acidification and provides refugia for calcifiers in seagrass meadows. *MedSeA 2nd anual meeting, Heraklion*.	Greece	CSIC
March	Hendriks I, Olsen Y, Basso L, Ramajo L, Duarte C, 2013: Will	Greece	CSIC

2013	seagrass offer a refuge for calcifiers at the end of the century? *MedSeA 2nd anual meeting, Heraklion*.		
March 2013	Howes E, Raitzsch M, Funcke A, Horn I, Bijma J, Gattuso J-P, 2013: The major factor governing the incorporation of boron into *Orbulina universa* calcite: pH or carbonate ion? *MedSeA 2nd anual meeting, Heraklion*.	Greece	UPMC AWI
March 2013	Le Vu B, Palmieri J, Orr J, Dutay J-C, Sevault F, 2013: Modern state of the carbonate system in the Mediterranean Sea: a modeling study. *MedSeA 2nd anual meeting, Heraklion*.	Greece	LSCE
March 2013	Lovato T, McKiver WJ, Wichi M, 2013: Impact of physical processes on carbonate chemistry in the Mediterranean Sea Using a high-resolution model. *MedSeA 2nd anual meeting, Heraklion*.	Greece	CMCC
March 2013	Vizzini S, Di Leonardo R, Costa V, Tramati CD, Aleo AE, Mazzola A, 2013: Biogeochemical characterization of Levante Bay (Vulcano Island, Sicily) to assess its suitability as a field laboratory for studying ocean acidification. *MedSeA 2nd anual meeting, Heraklion*.	Greece	CoNISMa
March 2013	Yao KM, Marcou O, Goyet C, Guglielmi V, Savy J-P, Touratier F, 2013: Temporal evolution of total and anthropogenic CO_2 and pH in the Mediterranean Sea for the 1995-2011 period. *MedSeA 2nd anual meeting, Heraklion*.	Greece	UPVD
March 2013	Rees A, Al-Moosawi L, Clark D, Turk-Kubo K, Zehr J, Hogan M, 2013: Investigation of the impact of ocean acidification on the marine nitrogen cycle during the Stareso mesocosm experiment; Corsica, June – July 2012. *MedSeA 2nd anual meeting, Heraklion*.	Greece	PML
May 2013	Baggini C, Krasakopoulou E, Bischof K, Hall-Spencer JM, 2013: Effects of short-term copper exposure on seaweeds acclimatized to high CO_2. *17th Pollutant Responses in Marine Organisms (PRIMO), University of Algarve*.	Portugal	HCMR UOP
May 2013	Cossarini G, Lazzari P, Solidoro C, 2013: Primary production and the carbonate system in the Mediterranean Sea. *45th International Liege Colloquium*.	Belgium	OGS
July 2013	Boatta F, D'Alessandro W, Gagliano AL, Calabrese S, Liotta M, Milazzo M, Parello F, 2013: Volcanic health hazard: the acidification of seawater and trace metals accumulation study in Blue Mussels (Mytilus galloprovincialis). Vulcano Island (Italy). *IAVCEI 2013 Scientific Assembly*	Japan	CoNISMa
June 2013	Geri P, El Yacoubi S, Goyet C, Marcou O, 2013: A 1D Lattice Boltzmann model for ocean acidification. *International Conference on Computational Science, ICCS 2013, Barcelona*.	Spain	UPVD
July 2013	Giani M, Ingrosso G, Del Negro P, De Vittor C, Fabbro C, Karuza A, Kralj M, 2013: The implementation of the carbonate system measurements at a LTER site in the gulf of Trieste. *2nd International Workshop to Develop an Ocean Acidification Observing Network of Ship Surveys, Moorings, Floats and Gliders. St. Andrews, Scotland*.	UK	OGS
August 2013	Bijma J, Brombacher A, Funcke A, Howes E, Kaczmarek K, Keul N, Langer G, Nehrke G, de Nooijer L, Raitzsch M, Reichart G-J, 2013: Opening the Foraminiferal Proxy Black Box a Bit Further. *Goldschmidt Conference, Florence*.	Italy	AWI
August 2013	Boatta F, D'Alessandro W, Gagliano A, Federico C, Calabrese S, Liotta M, Milazzo M, Parello F, 2013: Seawater	Italy	CoNISMa

	Trace Metals in acidified condition: an accumulation study in the blue mussel Mytilus galloprovincialis off Vulcano Island submarine vents (Italy). *Goldschmidt 2013 Conference, Florence*		
August 2013	Gemayel E, Hassoun A-R, Goyet C, M. Abboud-Abi Saab. Quantification and forecast of CO_2 fluxes over the Mediterranean Sea.	China	UPVD
August 2013	Hassoun A-R, Goyet C, Abboud-Abi Saab M, Gemayel E, 2013: Estimation of anthropogenic carbon dioxide (C_{ANT}) using carbonate system properties from the 2013 MedSeA cruise.	China	UPVD
September 2013	Celussi M, Dellisanti W, Del Negro P, Franzo A, Gaubert M, Gazeau F, Giannakourou A, Konstadinopoulou A, Maugendre L, Pitta P, Tsiola A, 2013: Ocean acidification effect on microbial metabolism in two different locations in the Mediterranean Sea. *13th Symposium on Aquatic Microbial Ecology SAME, Stresa*.	Italy	UPMC HCMR
September 2013	Bijma J, Brombacher A, Funcke A, Howes E, Kaczmarek K, Keul N, Langer G, Nehrke G, de Nooijer L, Raitzsch M & Reichart G-J, 2013. Opening the Foraminiferal Proxy Black Box a Bit Further. *11th International Conference on Paleoceanography, Sitges*.	Spain	AWI
September 2013	Mata R, Ziveri P, Marino G, Incarbona A, Grelaud M, 2013: Mediterranean carbonate system dynamics and planktonic biocalcification during the last 19 000 years. *11th International Conference on Paleoceanography, Sitges*.	Spain	UAB CoNISMa
September 2013	Grelaud M, Ziveri P, Incarbona A, 2013: *Emiliania huxleyi* calcite mass variability during periods of atmospheric CO_2 rising in the Mediterranean Sea. *11th International Conference on Paleoceanography, Sitges*.	Spain	UAB CoNISMa
September 2013	Ziveri P, Van de Waal DB, Langer G, Reichart G-J, Rost B, 2013: Geochemical tracers of ocean acidification in calcareous dinoflagellates. *11th International Conference on Paleoceanography, Sitges*.	Spain	UAB AWI
September 2013	Incarbona A, Martrat B, Mortyn PG, Sprovieri M, Ziveri P, Di Stefano E, Grimalt JO, Langone L, Marino G, Rodriquez Sant L, Tranchida G, Sprovieri R, Mazzola S, 2013: Eastern Mediterranean Transient-type events over the last five centuries. *11th International Conference on Paleoceanography, Sitges*.	Spain	CoNISMa UAB CSIC
September 2013	Chaabane S, Montagna P, Lopez Correa M, Kallel N, Taviani M, Ziveri P, 2013: Exploring *Corallium rubrum* for paleoceanography. *11th International Conference on Paleoceanography, Sitges*.	Spain	USS UAB LSCE
October-November 2013	Bramanti L, Rossi S, Movilla JI, Gouron M, Martinez A, Dominguez-Carrio C, Grinyo J, Lopez-Sanz A, Pelejero C, Calvo EM, Ziveri P, 2013: The effect of ocean acidification on the precious Mediterranean red coral (*Corallium rubrum*). *40th CIESM Congress, Marseille*.	France	UAB
October-November 2013	Cossarini G, Melaku Canu D, Ghermandi A, Nunes PALD, Solidoro C, Lazzari P, 2013: Carbonate system and acidification in the Mediterranean sea: variability impacts of acidification and biological processes and valuation of carbon sequestration. *40th CIESM Congress, Marseille*.	France	OGS
October	Ziveri P and MedSeA Project Members, Research turns to	France	UAB

2013	acidification and warming in the Mediterranean Sea: The MedSeA Project. Extended abstract, 40th CIESM Congress, Marseille.		MedSeA consortium
October 2013	Marino G. and Ziveri P., 2013, Palaeo-carbonate chemistry of the Mediterranean Sea, Extended abstract, 40th CIESM Congress, Marseille.	France	UAB
October-November 2013	Giannakourou A, Strogyloudi E, Konstadinopoulou A, Pitta P, Tsiola A, Zeri C, Gogou A, Pitta E, Parinos K, Giannoudi L, Krasakopoulou E, 2013: The effect of ocean acidification on bacterial and viral communities: a Microcosm approach. *40th CIESM Congress, Marseille*.	France	HCMR
October-November 2013	Ingrosso G, Giani M, Celussi M, Cibic T, Comici C, Del Negro P, De Vittor C, Fabbro C, Karuza A, Kralj M, 2013: Physical and biological influences on the variability of pH and carbonate system in the Gulf of Trieste (Northern Adriatic Sea). *40th CIESM Congress, Marseille*.	France	OGS
October-November 2013	Lovato T, Vichi M, McKiver WJ, Ziveri P, 2013: Toward the assessment of Mediterranean Sea carbonate system climatologies. *40th CIESM Congress, Marseille*.	France	CMCC UAB
October-November 2013	Zervoudaki S, Orek H, Assimakopoulou G, Krasakopoulou E, Frangoulis C, Isari S, Zenginer Yilmaz A, Fach B, 2013: Impact of ocean acidification on pelagic food web in a coastal area of Eastern Mediterranean Sea. *40th CIESM Congress, Marseille*.	France	HCMR
January 2014	Duquette AM, McClintock JB, Amsler CD, Hall-Spencer JM, Milazzo M, 2014: Effects of reduced pH on shell integrity of a common whelk from a natural undersea CO_2 vent community off Vulcano Island, Italy. *Annual Meeting of the Society for Integrative and Comparative Biology, Austin, Texas*.	USA	CoNISMa UOP
March 2014	Apostolaki ET, Vizzini S, Polymenakou P, 2014: *Cymodocea nodosa* under high CO_2: Reverse response in two Mediterranean volcanic vents. *COST Conference 'Seagrasses in Europe: Threats, Responses and Management', Olhão*.	Portugal	CoNISMa HCMR
May 2014	Cattano C, Spatafora D, Sinopoli M, Turco G, Gristina M, Milazzo M, 2014: CO2 effects on spawning rates of a Mediterranean nesting wrasse. *45° Congresso della Societa' Italiana Biologia Marina (SIBM), Venezia*	Italy	CoNISMa
June 2014	Boussetta S, Kallel N, Bassinot F, Douville E, 2014 : Reconstruction of pH evolution in the Levantine basin over the last 25 ka. *MedSeA Final Meeting, Barcelona*.	Spain	USS LSCE
June 2014	Grelaud M and Ziveri P, 2014: Biodiversity of coccolithophores and *Emiliania huxleyi* calcite mass from surface sediments on the Mediterranean Sea in a changing climate. *MedSeA Final Meeting, Barcelona*.	Spain	UAB
June 2014	Yildiz G, Cetin M, Tiryaki S, Dere S, 2014: Physiological responses of Peyssonnelia squamaria to elevated CO_2. *MedSeA Final Meeting, Barcelona*.	Spain	Uludag University
June 2014	Giani M, Ingrosso G, Kralj M, Cibic T, Fabbro C, Karuza A, De Vittor C, Del Negro P, 2014: Carbonate system variability and buffer capacity in a Mediterranean estuarine area (Gulf of Trieste, Northern Adriatic Sea). *Integrated Marine*	Norway	OGS

	Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.		
June 2014	Grelaud M and Ziveri P, 2014: Biodiversity of coccolithophores and *Emiliania huxleyi* calcite mass from surface sediments on the Mediterranean Sea in a changing climate. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	UAB
June 2014	Ziveri P and the MedSeA Consortium, 2014: Mediterranean Sea acidification in a changing climate: the European MedSeA project. *Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), Open Science Conference, Bergen.*	Norway	UAB MedSeA consortium
September 2014	Andolina C, Martínez-Crego B, Vizzini S, Massa-Gallucci A, Gambi MC, 2014: Composition and trophic structure of motile fauna populations in macrophytes of a natural CO2 vent system. *XXIV Congresso della Società Italiana di Ecologia, Ferrara*	Italy	LSCE
April 2014	Dutay JC, Modelling Mediterranean Sea acidification, EGU meeting, Vienna.	Austria	OGS, CoNISMa, UAB
September 2014	Cerino, F, Malinverno, E, Fornasaro, D, Ingrosso, G, Giani, M, Cabrini, M, Ziveri, P, 2014: Coccolithophore diversity and seasonal distribution in a coastal site of the Gulf of Trieste, INA Workshop on Extant Coccolithophores research Crete.	Greece	OGS, CoNISMa, UAB

Outreach acitivities - MedSeA web sites, blogs, TV/Films, radio:

Date	Web sites – Blogs	Country	Partner Responsible / Involved
05 March 2012	Discussing the effects of ocean acidification on the Mediterranean Sea. http://www.cmcc.it/impacts-and-risks/discussing-the-effects-of-ocean-acidification-on-the-mediterranean-sea	World	CMCC UAB
21 March 2012	A glimpse into the future of the oceans through the bubbles of Mount Vesuvius http://www.davidsuzuki.org/blogs/healthy-oceans-blog/2012/03/my-series-on-ocean-acidification/	World	UOP
22 June 2012	Saurer Ozean, Teil 1: Hintergrund. http://virtualurchin.stanford.edu/AcidOcean/AcidOcean_DE.htm	World	AWI
22 June 2012	Saurer Ozean, Teil 2: Versauerungslabor. http://virtualurchin.stanford.edu/AcidOcean/AcidOcean2_DE.htm	World	AWI
01 January 2014	Internationaler CO_2-Fußabdruck-Rechner für Schüler und Studenten. http://footprint.stanford.edu/footprint_DE.html	Germany	AWI
01 March 2011	MedSeA: Mediterranean Sea Acidification in a Changing Climate. http://medsea-project.eu/	World	UAB
18 October 2011	MedSeA Blog: Mediterranean Sea Acidification in a Changing Climate. http://medseaclimatechange.wordpress.com/	World	UAB
28 April 2013	2013 MedSeA Research Cruise Blog on Ocean Acidification and Warming. http://medseaoceancruise.wordpress.com/	World	UAB
01 August 2013	MedSeA Mesocosom Experiment in the Eastern Mediterranean Sea. http://medseacrete2013.wordpress.com/	World	HCMR
10 April 2012	MedSeA Stareso 2012 http://medseastareso2012.obs-vlfr.fr/	World	UPMC
28 November	MedSeA Villefranche 2013.	World	UPMC

2012	http://medseavillefranche2013.obs-vlfr.fr/		

Date	Videos – Films – TV clips – Radio	Country	Partner Responsible / Involved
02 April 2012	Ocean acidification: a biogeological perspective. http://www.stateoftheocean.org/ipso-2011-workshop-summary.cfm	World	AWI
08 August 2012	France 3 Corse: MedSeA Stareso Mesocosm 1 http://www.youtube.com/watch?v=YNwgmCGdbPo	France	UPMC
03 October 2012	A Forams tale. http://www.youtube.com/watch?v=xfZ_9UWcAB8	World	AWI
04 October 2013	MedSeA Scientific Cruise 2013. https://www.youtube.com/watch?v=k8FygK8w7fI&feature=youtu.be	World	UAB
10 December 2013	Crucero Cientifico en El Mediterraneo. https://www.youtube.com/watch?v=VfdwAhmWn2s&feature=youtu.be	Spain	UAB
31 January 2014	Turn down the heat, why a 4°C warmer world must be avoided. https://www.youtube.com/watch?v=Dr4jhgxDQSI&list=PLk8mh9aWmPaRzVoQTI-mjuBHOJ0x4y113&index=5	World	PML
01 April 2014	Acid Oceans. http://vimeo.com/90731883	World	UPMC
05 March 2012	Rai TV World – Leonardo. http://www.rai.tv/dl/RaiTV/programmi/media/ContentItem-dee8187f-bf66-4db9-8dce-f772fe9dfe5c.html	Italy	CMCC
08 August 2012	France 3 Corse: MedSeA Stareso Mesocosm 2. http://www.youtube.com/watch?v=aqIYAzVZRZo	France	UPMC
06 September 2012	Tele Paese: MedSeA Stareso. http://www.youtube.com/watch?v=7ZTtxe-8cHY	France	UPMC
22 February	France 3 Nice: Une expérience de grande ampleur à Villefranche-sur-Mer.	France	UPMC

2013	http://www.dailymotion.com/France3Nice		
09 April 2014	Milano-Bicocca e i Cambiamenti Climatici: Ricerca, Formazionz, Divulgazione. http://streaming.unimib.it/tcs/#page:recordingList&pageNumber:1&id:342D7E09-86A2-4BB5-9614-2B7473D27158	Italy	CoNISMa
30 August 2013	MedSea Mesocosm Experiment 2013. http://www.youtube.com/channel/UC9j6zD3tubIPgtX84XTOZGw	World	HCMR
03 June 2013	Científicos observan los efectos de la acidificación en el mar Mediterráneo. http://www.rtve.es/noticias/20130603/cientificos-observan-efectos-acidificacion-mar-mediterraneo/678860.shtml	Spain	UAB
14 June 2014	TVE: L'acidificació i l'escalfament amenacen espècies emblemàtiques del Mediterrani. http://www.uab.cat/web/videos/reproduccio-1192707516892.html?param1=50mitjans_historic&param5=1&url_video=1345672571311	Spain	UAB
05 May 2013	Mediterranean 2100: record level of acidity? (52’, © Jean-Yves Collet, COM ON PLANET, Fondation BNP-Paribas. http://www.jeanyvescollet.com/les-films-extraits-dossiers/137-mediterranee-2100-vers-une-acidification-record	World	UPMC
23 February 2012	El otro problema del CO_2. http://www.youtube.com/watch?v=ywOcLrISzCE&feature=youtu.be	World	UAB
27 February 2012	L’altro problema della CO_2. http://www.youtube.com/watch?v=R8JSWUFoasM	World	UAB
22 October 2011	Quizá somos las últimas generaciones que ven y tocan el Mediterráneo... tal como era. http://www.orm.es/servlet/rtrm.servlets.ServletLink2?METHOD=DETALLEALACARTA&serv=BlogPortal2&ofs=20&orden=11&orden2=11&idCarta=16&sit=c,5,ofs2,120&mOd=13750&autostart=RADIO	Spain	UAB
06 August	Testing the waters: Acidification in the Mediterranean.	World	UAB

2014	http://www.youtube.com/watch?v=ADJ9kg-IAxE#t=32		UOP BIU
Date	**Brochures/Flyers**	**Country**	**Partner Responsible / Involved**
01 December 2011	Hot, sour and breathless – ocean under stress. http://medsea-project.eu/wp-content/uploads/2011/11/ocean_under_stress_low_res1.pdf	World	PML
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. English Version.	World	UAB PML
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. French Version.	World	UAB UPMC
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. Spanish Version.	World	UAB
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. Greek Version.	World	UAB HCMR
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. Italian Version.	World	UAB CoNISMa
January 2012	MedSeA: Mediterranean Sea Acidification in a Changing Climate. Dissemination leaflet. Arabic Version.	World	UAB USS
June 2012	Tipping the balance: CO_2 and the Mediterranean Sea. MRUG Dissemination Leaflet. English Version.	World	UAB PML
June 2012	Tipping the balance: CO_2 and the Mediterranean Sea. MRUG Dissemination Leaflet. French Version.	World	UAB UMPC
June 2012	Tipping the balance: CO_2 and the Mediterranean Sea. MRUG Dissemination Leaflet. Spanish Version.	World	UAB

June 2012	Tipping the balance: CO_2 and the Mediterranean Sea. MRUG Dissemination Leaflet. Arabic Version.	World	UAB USS
20 July 2012	Message for Rio +20 United Nations Conference on Sustainable Development.	World	UPMC

Outreach acitivities - MedSeA Media coverage:

81 articles were published on the internet or in the press from the start of the project until 19 September 2014.

Date	Reference	Country	Partner Responsible / Involved
29 May 2011	Ocean acidification is latest manifestation of global warming. http://www.theguardian.com/environment/2011/may/29/global-warming-threat-to-oceans	UK	CoNISMa UOP
30 May 2011	L'acidification des océans est aussi grave que le réchauffement climatique. http://www.7sur7.be/7s7/fr/2668/Especes-Menacees/article/detail/1271848/2011/05/30/L-acidification-des-oceans-est-aussi-grave-que-le-rechauffement-climatique.dhtml	Belgium	CoNISMa UOP
26 August 2011	Shell-shock! Damage to marine ecosystems revealed as CO_2 emissions continue to rise. http://www.myscience.org.uk/news/2011/shell_shock_damage_to_marine_ecosystems_revealed_as_co2_emissions_continue_to_rise-2011-Plymouth	World	UOP
29 November 2011	Press release written by PML for the collaborative programme (including MedSeA) “Ocean Stress Guide“. http://www.pml.ac.uk/Media-and-events/Ocean-under-stress	World	PML
1 December 2011	Ocean Acidification: Acting on Evidence. http://www.iisd.ca/climate/cop17/od/html/ymbvol186num2e.html	Canada	PML
18 February 2012	Undersea vents a 'time machine' on climate change. http://www.theglobeandmail.com/technology/science/undersea-vents-a-time-machine-on-climate-change/article547257/	Canada	PML
1 March 2012	Oceans acidifying faster today than in past 300 million years. http://www.nsf.gov/news/news_summ.jsp?cntn_id=123324	World	UAB

2 March 2012	Sea and ocean acidification speeds up. http://fis.com/fis/worldnews/worldnews.asp?l=e&id=50414&ndb=1	World	CMCC
2 March 2012	Oceans acidifying faster today than in past 300 million years. http://www.eurekalert.org/pub_releases/2012-03/nsf-oaf030712.php	EU	UAB
2 March 2012	Pace of Ocean Acidification Has No Parallel in 300 Million Years, Paper Says. http://green.blogs.nytimes.com/2012/03/02/pace-of-ocean-acidification-has-no-parallel-in-300-million-years-paper-finds/?_php=true&_type=blogs&_r=0	US	UAB
2 March 2012	Los océanos se están acidificando a velocidades "sin precedentes" en los últimos 300 millones de año. http://www.diariodetorremolinos.com/	Spain	UAB
2 March 2012	Ambiente: a Roma primo incontro del progetto MedSea. https://www.ansa.it/ansamed/it/notizie/rubriche/scienza/2012/03/02/visualizza_new.html_126454511.html	Italy	UAB
2 March 2012	MedSeA analizza l'acidificazione del Mar Mediterraneo. http://www.rinnovabili.it/ambiente/medsea-analizza-lacidificazione-del-mar-mediterraneo3528/	Italy	UAB
2 March 2012	Clima, gli effetti dell'acidificazione nel Mediterraneo. http://www.zeroemission.tv/portal/news/topic/Eventi/id/16392/Clima-gli-effetti-dellacidificazione-nel-Mediterraneo	Italy	UAB
2 March 2012	Oceani sempre più acidi. http://www.aolamagna.it/2012/03/oceani-sempre-piu-acidi/	Italy	UAB
2 March 2012	Oceans acidifying faster today than in past 300 million years. http://www.livescience.com/18786-ocean-acidification-extinction.html	World	UAB
2 March 2012	Oceans acidifying faster today than in past 300 million years. http://earthsky.org/earth/oceans-acidifying-faster-today-than-in-past-300-million-years	World	UAB
2 March 2012	Oceans acidifying faster today than in past 300 million years. http://www.bloomberg.com/news/2012-03-01/oceans-acidifying-fastest-in-300-million-years-due-to-emissions.html	World	UAB
4 March 2012	Oceans acidification peaks in 300 mn years. http://timesofindia.indiatimes.com/home/environment/global-warming/Oceans-acidification-peaks-in-300-mn-years/articleshow/12135498.cms	India	UAB
4 March	Oceans acidification peaks in 300 mn years.	India	UAB

2012	http://www.greenmela.com/Green/News_Details.aspx?id=965		
4 March 2012	Oceans are Acidifying Faster than Ever. http://www.toonaripost.com/2012/03/green-world/oceans-are-acidifying-faster-than-ever/	World	UAB
5 March 2012	Oceans acidifying faster today than in past 300 million years. http://scienceprogress.org/2012/03/oceans-acidifying-faster-than-they-have-in-past-300-million-years/	World	UAB
5 March 2012	Oceans acidification peaks in 300 mn years. http://cmsenvis.cmsindia.org/newsletter/enews/NewsDetails.asp?id=36812	India	UAB
7 March 2012	Più acido e più caldo: il Mediterraneo è a rischio. http://www.ilsussidiario.net/News/Scienze/2012/3/14/AMBIENTE-Piu-acido-e-piu-caldo-il-Mediterraneo-e-a-rischio/2/255403/	Italy	CMCC
11 March 2012	A sea of challenges for the Mediterranean Sea. http://www.eurekalert.org/pub_releases/2012-04/acs-aso041112.php	US	UAB
11 March 2012	A sea of challenges for the Mediterranean Sea. http://www.canadafreepress.com/index.php/article/a-sea-of-challenges-for-the-mediterranean-sea	Canada	UAB
11 March 2012	The Mediterranean beneath the surface. http://pubs.acs.org/doi/abs/10.1021/cen-09015-cover	World	UAB
11 March 2012	A sea of challenges. http://www.oceansentry.org/en/3636-sea-of-challenges-for-the-mediterranean-sea.html	World	UAB
20 March 2012	Media statement for OA activities. Planet under Pressure' conference. http://www.planetunderpressure2012.net/pdf/state_of_planet_declaration.pdf	World	PML
10 July 2012	Le réchauffement climatique vu du fond de la rade de Villefranche. http://www.nicematin.com/villefranche-sur-mer/le-rechauffement-climatique-vu-du-fond-de-la-rade-a-villefranche.926884.html	France	UPMC
26 February 2013	Villefranche: à la poursuite de l'avenir des océans. http://www.nicematin.com/	France	UPMC
29 April 2013	Major pan-European study conducted on ocean acidification. http://phys.org/news/2013-04-major-pan-european-ocean-acidification.html	US	UAB

13 May 2013	CO_2-Werte erreichen neuen Höchststand. **http://www.goettinger-tageblatt.de/Nachrichten/Wissen/Wissen-aus-aller-Welt/CO2-Werte-erreichen-neuen-Hoechststand**	Germany	AWI
3 June 2013	Científicos alertan de la acidificación del Mediterráneo por emisiones de CO_2. http://www.lavanguardia.com/ciencia/20130603/54374636909/cientificos-alertan-acidificacion-mediterraneo-emisiones-co2.html	Spain	UAB
3 June 2013	Expertos alertan de grandes cantidades de medusas y plásticos en el Mediterráneo. http://ccaa.elpais.com/ccaa/2013/06/03/catalunya/1370263540_462303.html	Spain	UAB
1 July 2013	El Mediterráneo se acidifica. Si nada cambia pronto será un mar corrosivo con escasa biodiversidad. http://magazineoceano.com/	Spain	UAB
1 July 2013	O Mediterrâneo se acidifica se nada mudra, muito em breve sera um mar corrosive com escassa biodiversidade. http://magazineoceano.com/	Portugal	UAB
1 September 2013	*Auflösungserscheinungen.* ***http://www.deutschlandfunk.de/aufloesungserscheinungen.740.de.html?dram:article_id=259098***	Germany	AWI
14 March 2014	Un mar más cálido, más ácido y más alto a causa del cambio climático. http://www.lavanguardia.com/magazine/20140314/54402977574/reportaje-contaminacion-mar-magazine.html	Spain	UAB
12 June 2014	Mar Mediterráneo se calienta a un ritmo sin precedentes. http://elsemanario.com/58132/mar-mediterraneo-se-calienta-un-ritmo-sin-precedentes/	Mexico	UAB
12 June 2014	Peligran las especies del Mediterráneo porque el agua está cada vez más caliente y ácida. http://andaluciainformacion.es/sociedad/413321/peligran-las-especies-del-mediterraneo-porque-el-agua-esta-cada-vez-mas-caliente-y-acida/	Spain	UAB
12 June 2014	El Mediterráneo se calienta y se acidifica demasiado rápido. http://elcomercio.pe/ciencias/planeta/mediterraneo-se-calienta-y-se-acidifica-demasiado-rapido-noticia-1735806	Peru	UAB
12 June 2014	El CO_2 impulsa el aumento de medusas en el Mediterráneo. http://ccaa.elpais.com/ccaa/2014/06/12/catalunya/1402574364_452305.html	Spain	UAB
12 June	L'acidificació del Mediterrani amenaça la productivitat pesquera	Spain	UAB

2014	i el turismo. http://www.elperiodico.cat/ca/noticias/medi-ambient/lacidificacio-del-mediterrani-amenaca-productivitat-pesquera-turisme-3296982		
12 June 2014	Temperatura și aciditatea apei din Marea Mediterană cresc într-un ritm fără precedent. http://www.realitatea.net/temperatura-i-aciditatea-apei-din-marea-mediterana-cresc-intr-un-ritm-fara-precedent_1460659.html	Roumania	UAB
12 June 2014	Peligran las especies del Mediterráneo porque el agua está cada vez más caliente y ácida. http://www.lavanguardia.com/local/barcelona/20140612/54408927313/peligran-las-especies-del-mediterraneo-porque-el-agua-esta-cada-vez-mas-caliente-y-acida.html	Spain	UAB
12 June 2014	Peligran las especies del Mediterráneo porque el agua está cada vez más caliente y ácida, según una investigación. http://www.lavanguardia.com/local/islas-baleares/20140612/54409873289/peligran-las-especies-del-mediterraneo-porque-el-agua-esta-cada-vez-mas-caliente-y-acida-segun-una.html	Spain	UAB
12 June 2014	El Mediterráneo se calienta y se acidifica a un ritmo sin precedentes. http://www.lavanguardia.com/vida/20140612/54408930030/el-mediterraneo-se-calienta-y-se-acidifica-a-un-ritmo-sin-precedentes.html	Spain	UAB
12 June 2014	El Mediterráneo se calienta y se acidifica a un ritmo sin precedentes. http://www.rtve.es/noticias/20140612/mediterraneo-se-calienta-se-acidifica-ritmo-sin-precedentes/953281.shtml	Spain	UAB
12 June 2014	Las especies del Mediterráneo, en peligro por la alta temperatura y acidez del agua. http://www.abc.es/catalunya/20140612/abci-especies-mediterraneo-peligro-alta-201406121340.html	Spain	UAB
12 June 2014	Especies del Mediterráneo 'al borde del colapso' porque el agua está cada vez más caliente y ácida. http://www.ecoticias.com/naturaleza/92528/especies-del-mediterraneo-al-borde-del-colapso-porque-el-agua-esta-cada-vez-mas-caliente-y-acida	Spain	UAB
12 June	El agua del Mediterráneo está cada vez más caliente y ácida. http://www.20minutos.es/noticia/2165667/0/estudio-	Spain	UAB

2014	expertos/mediterraneo/caliente-acido/		
12 June 2014	El mar Mediterráneo se calienta y se acidifica a un ritmo sin precedentes. http://www.martinoticias.com/content/el-mar-mediterr%C3%A1neo-se-calienta-y-se-acidifica-a-un-ritmo-sin-precedentes/36839.html	Cuba	UAB
12 June 2014	Mediterráneo se calienta y acidifica a un ritmo sin precedentes. http://www.eluniversal.com.mx/ciencia/2014/mediterraneo-calienta-acidifica-90028.html	Mexico	UAB
12 June 2014	Peligran las especies del Mediterráneo. http://madridpress.com/not/173850/peligran_las_especies_del_mediterraneo_/	Spain	UAB
12 June 2014	El Mediterráneo se calienta a un ritmo sin precedentes. http://www.laverdad.es/alicante/sociedad/201406/12/mediterraneo-calienta-ritmo-precedentes-20140612170143.html	Spain	UAB
12 June 2014	Se calienta el Mediterráneo y se acidifica a un ritmo sin precedentes. http://www.oem.com.mx/eloccidental/notas/n3425595.htm	Mexico	UAB
12 June 2014	¿Qué está pasando con el Mar Mediterráneo? http://noticias.terra.com.pe/ciencia/que-esta-pasando-con-el-mar-mediterraneo,9af342c5faf86410VgnCLD200000b2bf46d0RCRD.html	Peru	UAB
12 June 2014	Las aguas del Mediterráneo, cada vez más calientes y más ácidas. http://www.iagua.es/noticias/investigacion/14/06/12/las-aguas-del-mediterraneo-cada-vez-mas-calientes-y-mas-acidas-50853	Spain	UAB
12 June 2014	Peligran las especies del Mediterráneo porque el agua está cada vez más caliente y ácida. http://www.europapress.es/epsocial/naturaleza-00323/noticia-amp-peligran-especies-mediterraneo-porque-agua-cada-vez-mas-caliente-acida-20140612122232.html	Spain	UAB
12 June 2014	Peligran las especies del Mediterráneo porque el agua está cada vez más caliente y ácida. http://www.larazon.es/detalle_normal/noticias/6641151/peligran-las-especies-del-mediterraneo-porque-el-agua-esta-cada-vez-mas-caliente-y-acida#.Ttt1lajSO1ZlE3c	Spain	UAB

13 June 2013	Report shows global warming threats to Mediterranean. http://summitcountyvoice.com/2014/06/13/report-shows-global-warming-threats-to-mediterranean/	USA	UAB
13 June 2014	Reto Internacional del siglo XXI: El Cambio climático. http://elsemanario.com/58342/reto-internacional-del-siglo-xxi-el-cambio-climatico/	Mexico	UAB
13 June 2014	La acidificación y el calentamiento amenazan el Mediterráneo. http://www.diariodigitaldeleon.com/sociedad/interesante/54529-la-acidificacion-y-el-calentamiento-amenazan-especies-emblematicas-del-mar-mediterraneo.html	Spain	UAB
13 June 2014	Científicos alertan sobre peligro de ecosistemas en el Mediterráneo. http://www.prensa-latina.cu/	Cuba	UAB
13 June 2014	El Mediterrani, calent i àcid a un ritme sense precedents. http://www.regio7.cat/gent/2014/06/13/mediterrani-calent-acid-ritme-precedents/271852.html	Spain	UAB
13 June 2014	Akdeniz'le ilgili korkutan rapor. http://www.turkiyegazetesi.com.tr/yasam/163521.aspx	Turkey	UAB
13 June 2014	Alerten que el Mediterrani s´escalfa i s´acidifica a un ritme sense precedents. http://www.diaridegirona.cat/cultura/2014/06/13/alerten-que-mediterrani-sescalfa-sacidifica/674095.html	Spain	UAB
13 June 2014	Acidificazione e riscaldamento: una minaccia per le specie del Mar Mediterraneo. http://gaianews.it/ambiente/clima/acidificazione-riscaldamento-minaccia-per-specie-mar-mediterraneo-55977.html#.VCmNF_1_vzY	Italy	UAB
13 June 2014	El CO_2 amenaza la vida marina. http://sociedad.elpais.com/sociedad/2010/03/30/actualidad/1269900013_850215.html	Spain	UAB
13 June 2014	Más CO_2 y calentamiento global en el Mediterráneo, Peor calidad en las playas españolas. http://cambio16.es/not/6239/peor_calidad_en_las_playas_espanolas/	Spain	UAB
13 June 2014	Aumentan la temperatura y la acidez del Mediterráneo y transforman su vida. http://www.elsol.com.ar/nota/205700/el-mundo/aumentan-la-temperatura-y-la-acidez-del-mediterrneo-y-transforman-su-	Argentina	UAB

	vida.html		
13 June 2014	The Mediterranean is heated and acidified at an unprecdented rate. https://www.technocrates.org/mediterranean-heated-acidified-unprecedented-rate/103976/	USA	UAB
14 June 2014	El Mediterráneo se calienta y se acidifica a un ritmo sin precedentes. http://www.pulso.cl/noticia/tech/ciencia/2014/06/74-44985-9-el-mediterraneo-se-calienta-y-se-acidifica-a-un-ritmo-sin-precedentes.shtml	Chile	UAB
14 June 2014	La acidificación y el calentamiento amenazan especies emblemáticas del mar Mediterráneo. http://noticiasdelaciencia.com/not/10657/la-acidificacion-y-el-calentamiento-amenazan-especies-emblematicas-del-mar-mediterraneo/	Spain	UAB
15 June 2014	El Mediterráneo se calienta “a un ritmo sin precedentes” mientras el Amazonas se llena de petróleo. http://esmateria.com/2014/06/15/repaso-semanal-del-15-de-junio/	Spain, North and South America	UAB
18 June 2014	La acidificación y el calentamiento amenazan especies emblemáticas del mar Mediterráneo. http://www.costaricaon.com/noticias/reportajes/28129-la-acidificacion-y-el-calentamiento-amenazan-especies-emblematicas-del-mar-mediterraneo.html	Costa Rica	UAB
22 June 2014	El Mediterráneo se calienta y acidifica amenazantemente. http://www.eldia.com.ar/edis/20140622/El-Mediterraneo-calienta-acidifica-amenazantemente-revistadomingo8.htm	Argentina	UAB
22 June 2014	El Mediterráneo se calienta y acidifica amenazantemente. http://www.quilmespresente.com/notas.aspx?idn=560287&ffo=20140622	Argentina	UAB
26 June 2014	Mediterranean region struggles with warming, acidification and jellyfish blooms. http://www.eenews.net/stories/1060001978	USA	UAB
28 August 2014	Mediterráneo, un mar amenazado. http://www.heraldo.es/noticias/ocio_cultura/2014/08/28/mediterraneo_mar_amenazado_307022_1361024.html	Spain	UAB

Section A3: MedSeA MS and Ph.D. researchers

43 MSc and PhD theses were generated during MedSeA. They are listed according to year of publication, then alphabetically.

Year	Bibliographic reference	Partner responsible / involved
2011	Barone M, 2011: Effetti dell'acidificazione sull'epifauna associata de *Posidonia oceanica* in sorgenti sottomarine superficiali di CO_2. *MS Thesis*.	CoNISMa
2011	Ciulla G, 2011: Valutazione degli effetti dell'acidificazione sulle comunità bentoniche di substrato duro in due aree naturalmente interessate da emissioni di CO_2. *MS Thesis*.	CoNISMa
2011	Taraud L, 2011: Effet des changements dans la chimie des carbonates sur l'huitre (*Crassostrea gigas*). *MS Thesis*.	UPMC
2011	Dellisanti, W. thesis in Mrine Biology, titlte Changes in the microbial community based on seawater pH variations. *MS Thesis*.	OGS
2012	Assailly C, 2012: Variations interannuelles d'abondance des ptéropodes de 1967 à 2003 dans la rade de Villefranche-sur-Mer - Impact de l'acidification des océans ? *MSc Thesis*.	UPMC
2012	Costa V, 2012: Dinamica del detrito fanerogamico negli ecosistemi marino-costieri: analisi lungo gradienti di confinamento e di acidificazione delle acque. Advantages and disadvantages of the *in situ* approach. *PhD Thesis*.	CoNISMa
2012	Dellisanti W, 2012: Changes in the microbial community based on seawater pH variations. *MSc Thesis*.	UPMC
2012	Fersi W, 2012: Reconstitution des paléotempératures de surface de la Méditerranée orientale pendant les derniers 65 000 ans : Apport du thermomètre Mg/Ca. *MS Thesis*.	USS
2012	Johnson V, 2012: Effects of ocean acidification on microbenthos. *PhD Thesis*.	UOP
2012	Longo AM, 2012: Effetti dell'acidificazione degli oceani su specie biocostruttrici e popolamenti algali associate di reef a vermeti. *MS Thesis*.	CoNISMa
2012	Passaro, M., 2012:"CO2 vents in the Mediterranean Sea: a natural laboratory for studying the impact of ocean acidification on marine ecosystems" *MS Thesis*.	UAB
2012	Salvo I, 2012: Dinamica del detrito fanerogamico lungo un gradient di pH in una sorgente marina superficial di CO_2. *MS Thesis*.	CoNISMa
2013	Boatta F, 2013: Ocean Acidification studies in the Baia di Levante (Vulcano island, Italy). Advantages and disadvantages of the *in situ* approach. *PhD Thesis*.	CoNISMa
2013	Bordes R, 2013: Test de la méthode de l'anomalie d'alcalinité sur 3 espèces calcifiantes. *MS Thesis*.	UPMC
2013	Domina I, 2013: Risposte della comunità intertidale a variazioni di pH e temperatura. *MS Thesis*.	CoNISMa
2013	Gaubert M, 2013: Étude de l'impact de l'acidification sur la communauté microbienne en mer Méditerranée. *MS Thesis*.	UPMC
2013	Horigome M, 2013: Carbonate dynamics during the last deglaciation". *MS Thesis*.	UAB
2013	Ong EZ, 2013: Effects of ocean acidification and warming on the survivorship, growth and physiology of *Cotylorhiza tuberculata*. *MS Thesis*.	UAB CSIC UPMC
2013	Mordechai T: Jelly Fish response to ocean acidification conditions, *PhD Thesis*.	BIU

2013	Spatafora D, 2013: Effetti della pCO_2 su comportamento riproduttivo e tassi di fertilizzazione in un labride costiero mediterraneo, *Symphodus ocellatus* (FORSSKÀL, 1775). *MS Thesis*.	CoNISMa
2013	Turco G, 2013: Potenziali effetti interattivi di nutrienti e acidificazione sulla specie invasiva *Caulerpa racemosa* (Forsskål) J.Agardh *var. cylindracea* (Sonder) Verlaque, Huisman & Boudouresque. *MS Thesis*.	CoNISMa
2013	Van der Heijden L, 2013: Developing techniques to better assess the impacts of ocean acidification on net community production and calcification rates. *Mc Thesis* 2, 36 p.	UPMC
2014	Baggini C, 2014: Effects of CO_2 seeps on coastal ecosystems. *PhD Thesis*	UOP
2014	Burt L, 2014: Bioavailability of metals in an acidifying ocean. *MS Thesis*.	UOP
2014	Delille J, 2014: Impact de l'acidification des océans sur les épointes des feuilles de Posidonies (*Posidonia oceanica*). *MS Thesis*.	UPMC
2014	Hassoun A, 2014: Analysis and modeling of the acidification in the Mediterranean Sea. *PhD Thesis*.	UPVD
2014	Howes E, 2014: The effects of ocean acidification on calcification and incorporation of isotopes and elements in Mediterranean pteropods and foraminifers. *PhD Thesis*.	UPMC AWI
2014	Rael Horwitz , The Sea anemone Anemonia viridis along a natural pH gradient in CO2 vents. *PhD Thesis*.	BIU
2014	Mata R, 2014: Mediterranean seawater carbonate system dynamics during the last deglaciation and last millennia. *MS Thesis*.	UAB
2014	Maugendre L, 2014: Response of plankton community to ocean warming and acidification in the NW Mediterranean Sea. *PhD Thesis*.	UPMC
2014	Milner S, 2014: Effects of increased pCO_2 and temperature in the coccolithophore *Emiliania huxleyi*. *MS Thesis*.	UAB AWI
2014	Palmieri J, 2014: Modélisation Biogéochimique de la mer Méditerranée avec le modèle régional couplé NEMO-MED12/PISCES. *PhD Thesis*.	LSCE
2014	Pettit L, 2014: Impacts of ocean acidification on benthic foraminifera. *PhD Thesis*.	UOP
2014	Saura G, 2014: Effects of ocean acidification on amphipods. *MRes Thesis*.	UOP
2014	Schenone S, 2014: The photosynthetic response of *Posidonia oceanica* to predicted CO2 levels. *MS Thesis*.	UPMC
2014	Urbini L, 2014: Comparison of the alkalinity and calcium anomaly techniques for the estimation of calcification rates of various calcareous species. *MS Thesis*.	UPMC
2015	Chaabane S: Geochemical investigation of the Mediterranean red coral Corallium rubrum for paleo-temperature and pH reconstructions. *PhD Thesis*, 2015.	USS UAB
2015	D'Amario B: Mediterranean Sea climate and environmental change: decoupling natural versus anthropogenic impacts on planktonic calcifying organisms, *PhD Thesis*, 2015.	UAB
2015	Gemayel E: Modelization of total inorganic carbon in surface waters of the Mediterranean Sea *PhD Thesis*, 2015.	UPVD
2015	Oviedo AM: Climate change driven alterations of carbon fixation and export production in the Mediterranean Sea. *PhD Thesis*, 2015.	UAB AWI
2015	Ingrosso, G. Ocean acidification process in coastal and offshore ecosystems *PhD Thesis*, 2015.	OGS
2015	Rodrigues L: Socio-economic impacts of ocean acidification in the Mediterranean Sea. Sea *PhD Thesis*, 2015.	UAB