Workshop on Climate change in Mediterranean and Caribbean Seas: Research experiences and new scientific challenges

Guayaquil, Ecuador, May 8th – 11th 2012

Mediterranean Sea Acidification in a changing climate
MedSeA

Patrizia Ziveri
Institute of Environmental Science and Technology
Universitat Autònoma de Barcelona
pr.medsea@uab.cat

EUROPEAN INITIATIVE ON OCEAN ACIDIFICATION ENDORSED BY

IMBER surface ocean solas lower atmosphere study

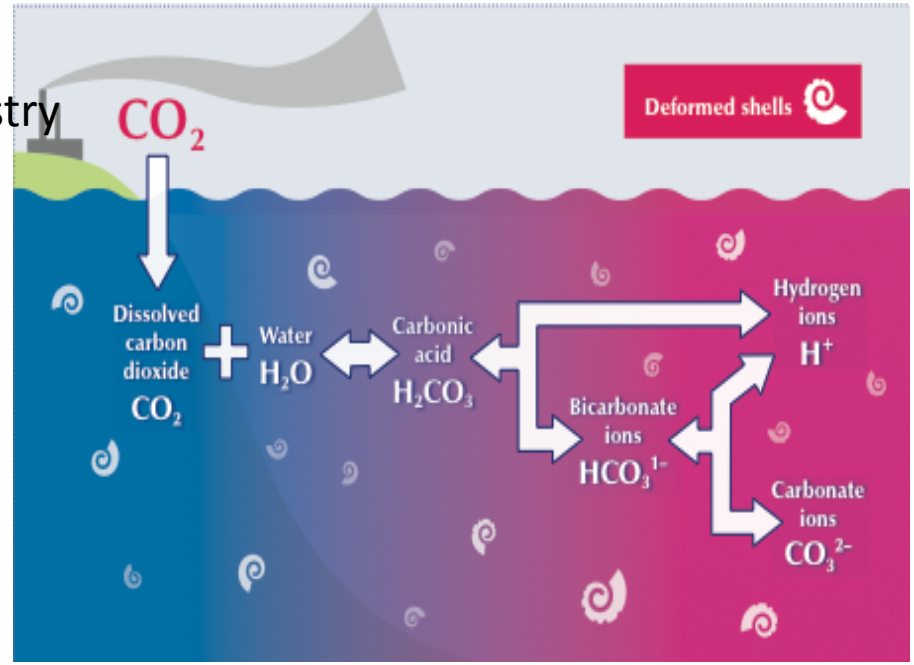
structure

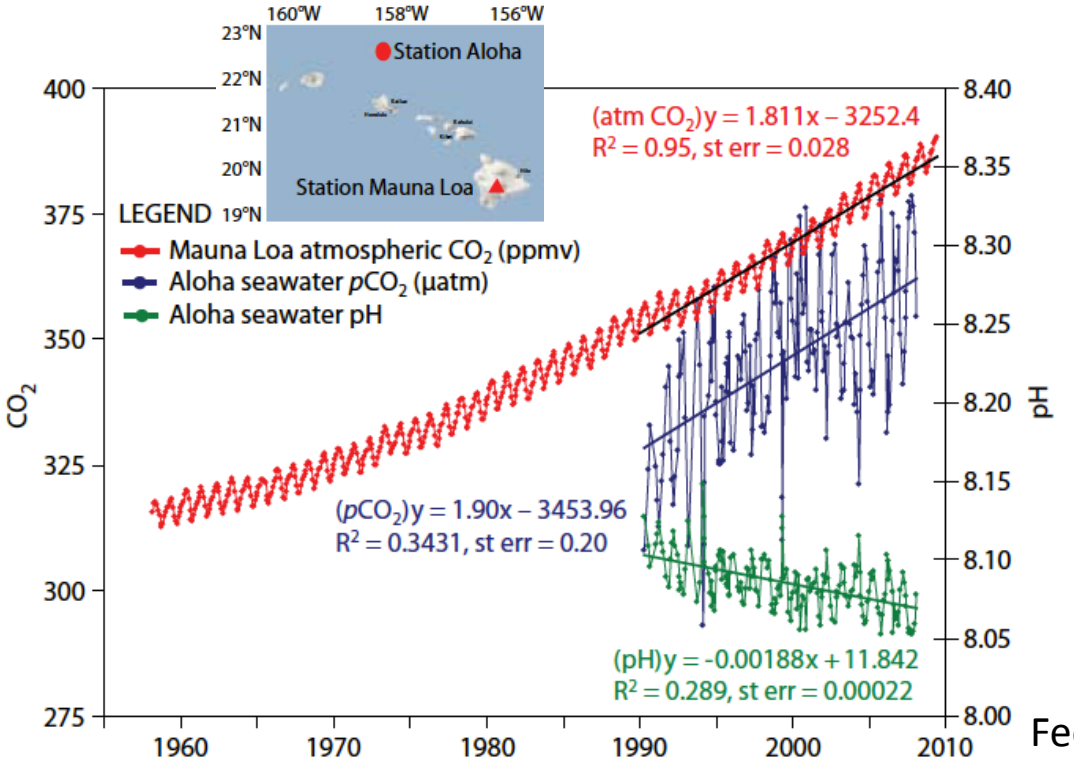
- Introduction to ocean acidification
- Why the MedSeA initiative?
- MedSeA activities and some initial results

What does ‘ocean acidification’ stand for?

CO_2 uptake triggers sweeping changes in the chemistry of the oceans:

- bicarbonate ions ↑
- carbonate ions ↓
- saturation state $CaCO_3$ (Ω) ↓
- acidity (i.e., ‘ocean acidification’) ↑





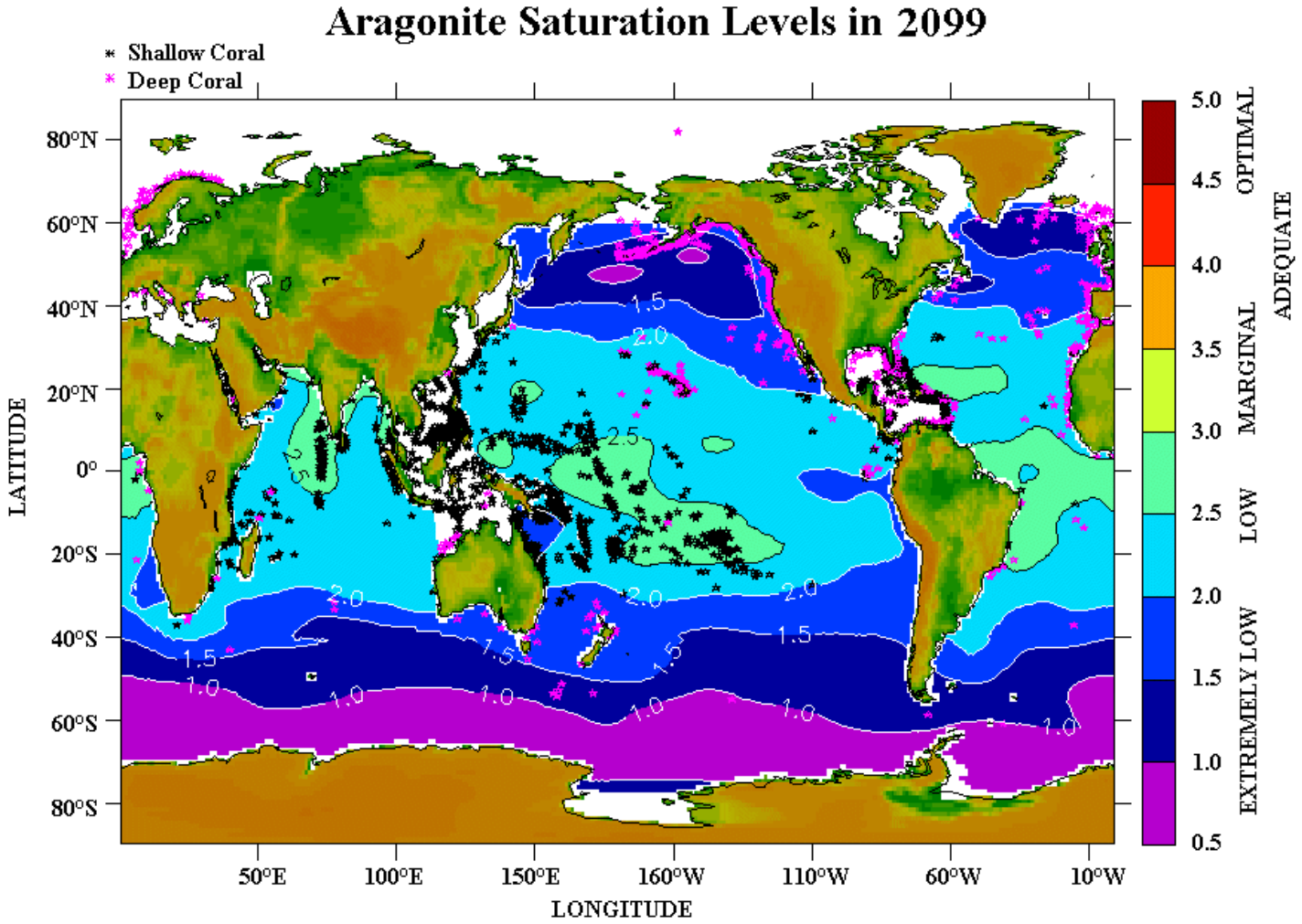
Feely et al., 2009

the oceans have become 30% more acidic, lowering the pH of seawater

….by 2060 the oceans could become 120% more acidic

Doney et al., 2009 – *Oceanography*

Declining Saturation State & Corals (1765-2099)



∗ = coral reef

Aragonite Saturation State of Surface Waters
(Orr et al 2005, Nature)

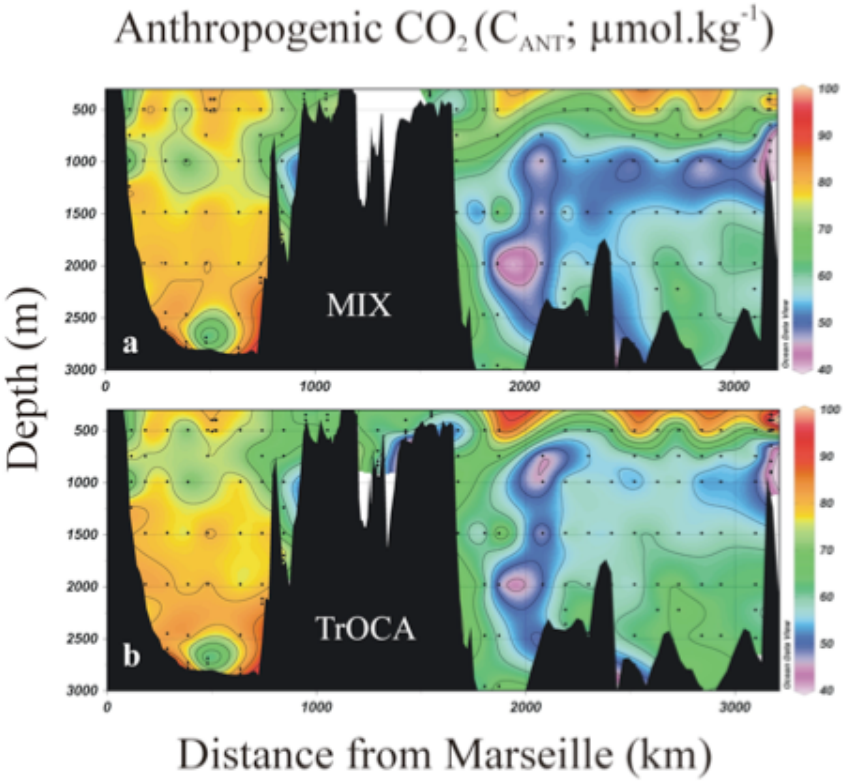
OA a global phenomena
but with a very different regional impact

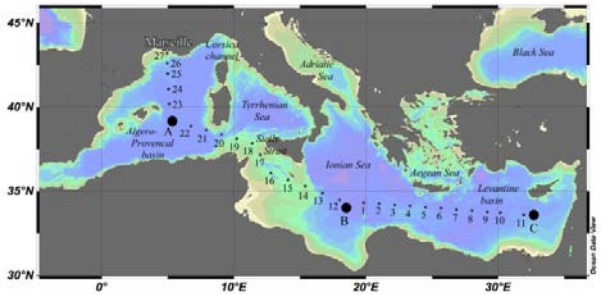
Environmental stressors in the Mediterranean Sea

Acidification is an additional anthropogenic pressure on Mediterranean Sea ecosystems, already experiencing :

- **Increase temperature**
- **Overfishing**
- **Invasion of alien species**
- **Eutrophication**

- **OCEAN ACIDIFICATION**





SEVENTH FRAMEWORK PROGRAMME

Touratier et al. BGD

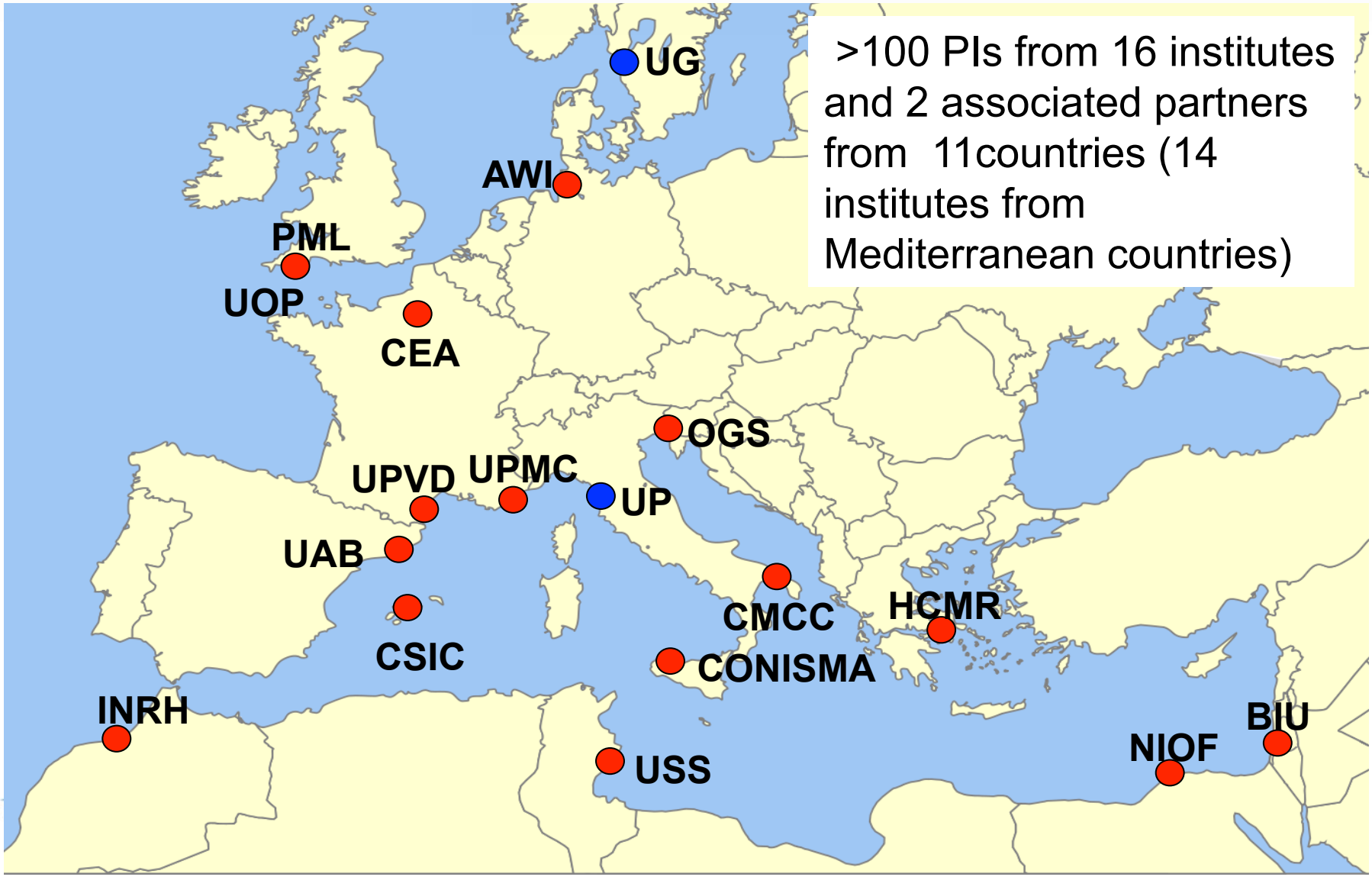
Anthropogenic carbon in the Mediterranean Sea

	Volume $[10^6\,km^3]$	Mean depth [m]	C_{ant} (error range) [Pg C]	C_{ant}/Volume $[Pg\,C/10^6\,km^3]$
Eastern Basin	2.22	1680	1.0 (0.7 - 1.2)	0.44
Mediterranean Sea	3.75	1500	1.7 (1.3 - 2.1)	0.46
Mediterranean Sea [1994]	3.75	1500	1.5 (1.1 - 1.8)	0.4
Atlantic/Indic/Pacific [1994]	1332.5	4000	134 (94 - 121)	0.1

SEVENTH FRAMEWORK PROGRAMME

Schneider et al., 2010

MedSeA consortium



>100 PIs from 16 institutes and 2 associated partners from 11countries (14 institutes from Mediterranean countries)

Overall goals:

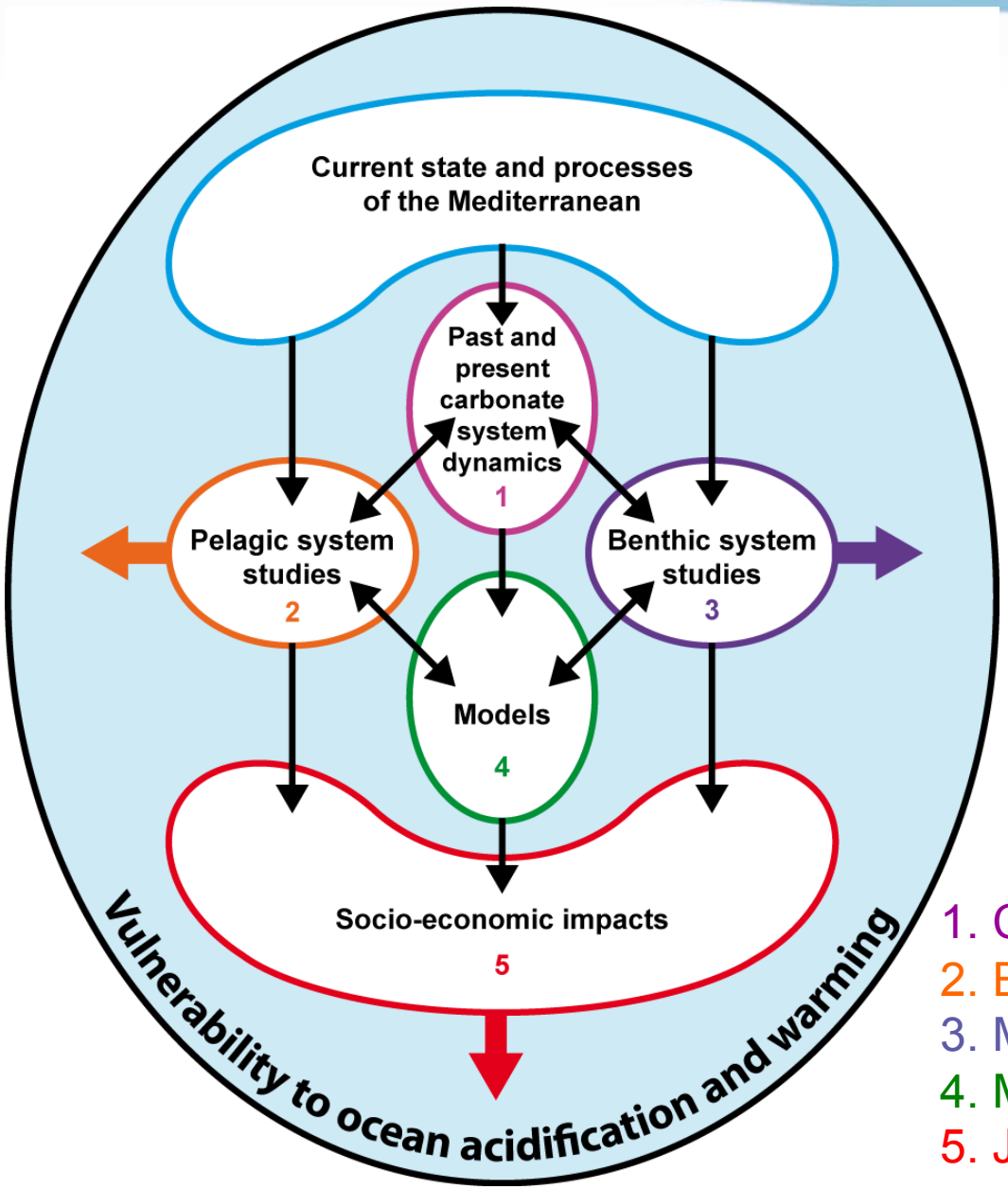
1/ Identifying where the **impacts of acidification on Mediterranean waters will be more significant** (ocean chemistry ➔marine ecosystems ➔socio-economic costs).

2/ Focus 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.**

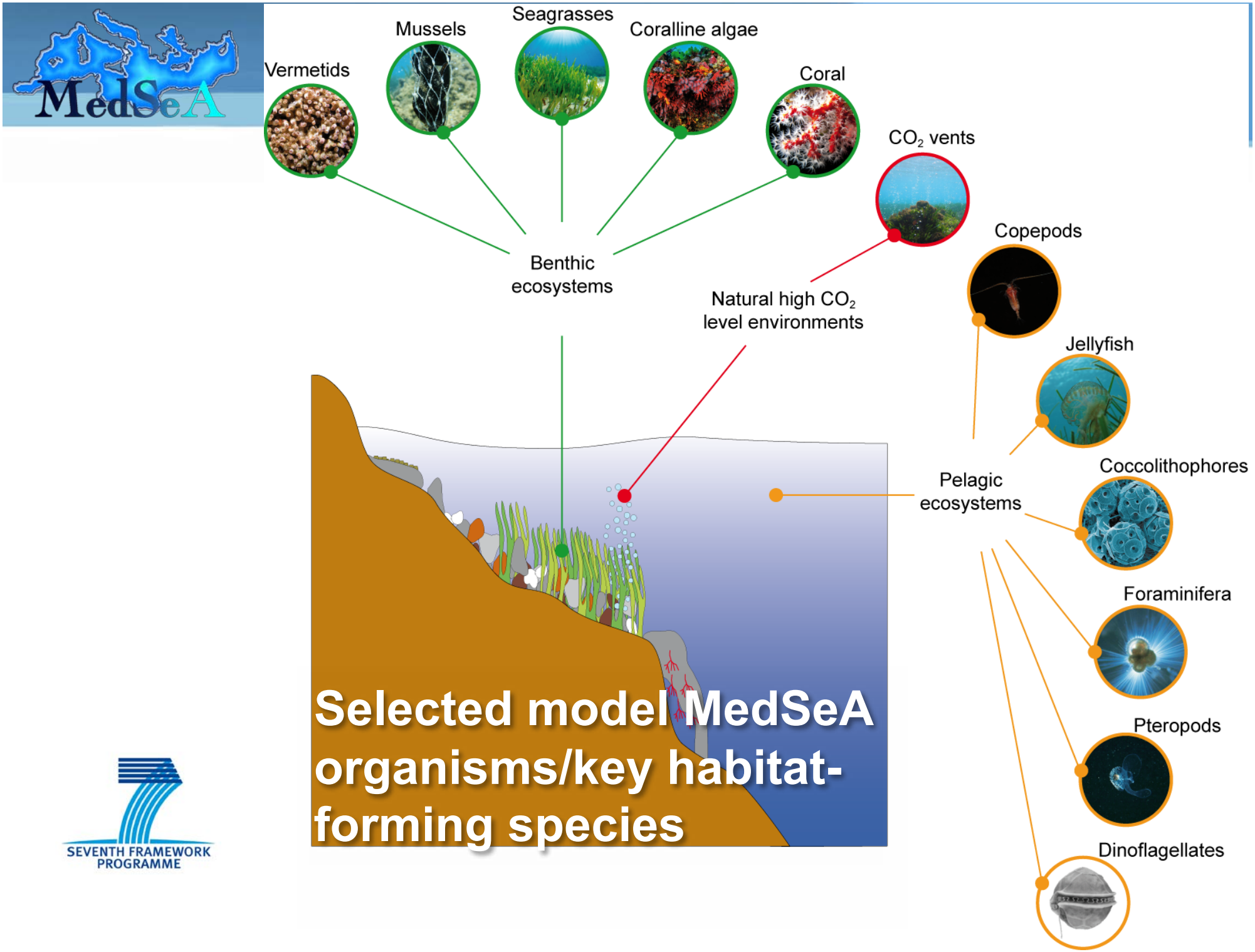
3/ Provide best estimates and related uncertainties of **future changes in Mediterranean Sea pH, $CaCO_3$ saturation states, changes in habitat suitability of relevant ecological and economically-important species**.

SEVENTH FRAMEWORK PROGRAMME

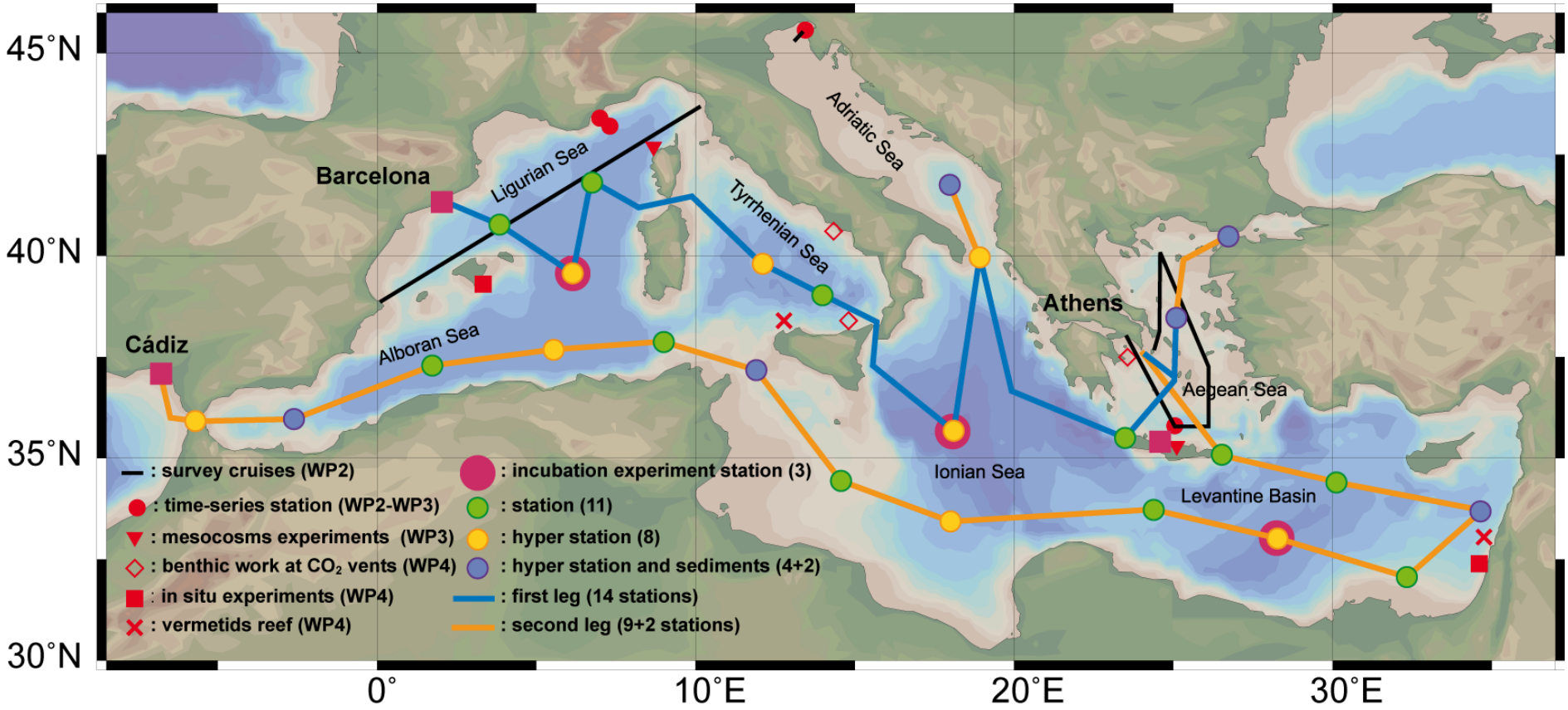
Conceptual scheme of the MedSeA scientific work



1. Catherine Goyet
2. Eva Krasakopolou
3. Maoz Fine
4. Marcello Vichi
5. Jeroen van den Bergh


MedSeA
Vermetids
Mussels
Seagrasses
Coralline algae
Coral
CO_2 vents
Benthic ecosystems
Natural high CO_2 level environments
Copepods
Jellyfish
Coccolithophores
Pelagic ecosystems
Foraminifera
Pteropods
Dinoflagellates
Selected model MedSeA organisms/key habitat-forming species
SEVENTH FRAMEWORK PROGRAMME

MedSeA Project sites & surveys



SEVENTH FRAMEWORK PROGRAMME

Training Workshops/Capacity Building

SEVENTH FRAMEWORK PROGRAMME

★ CO_2 vents as natural laboratories for acidification studies

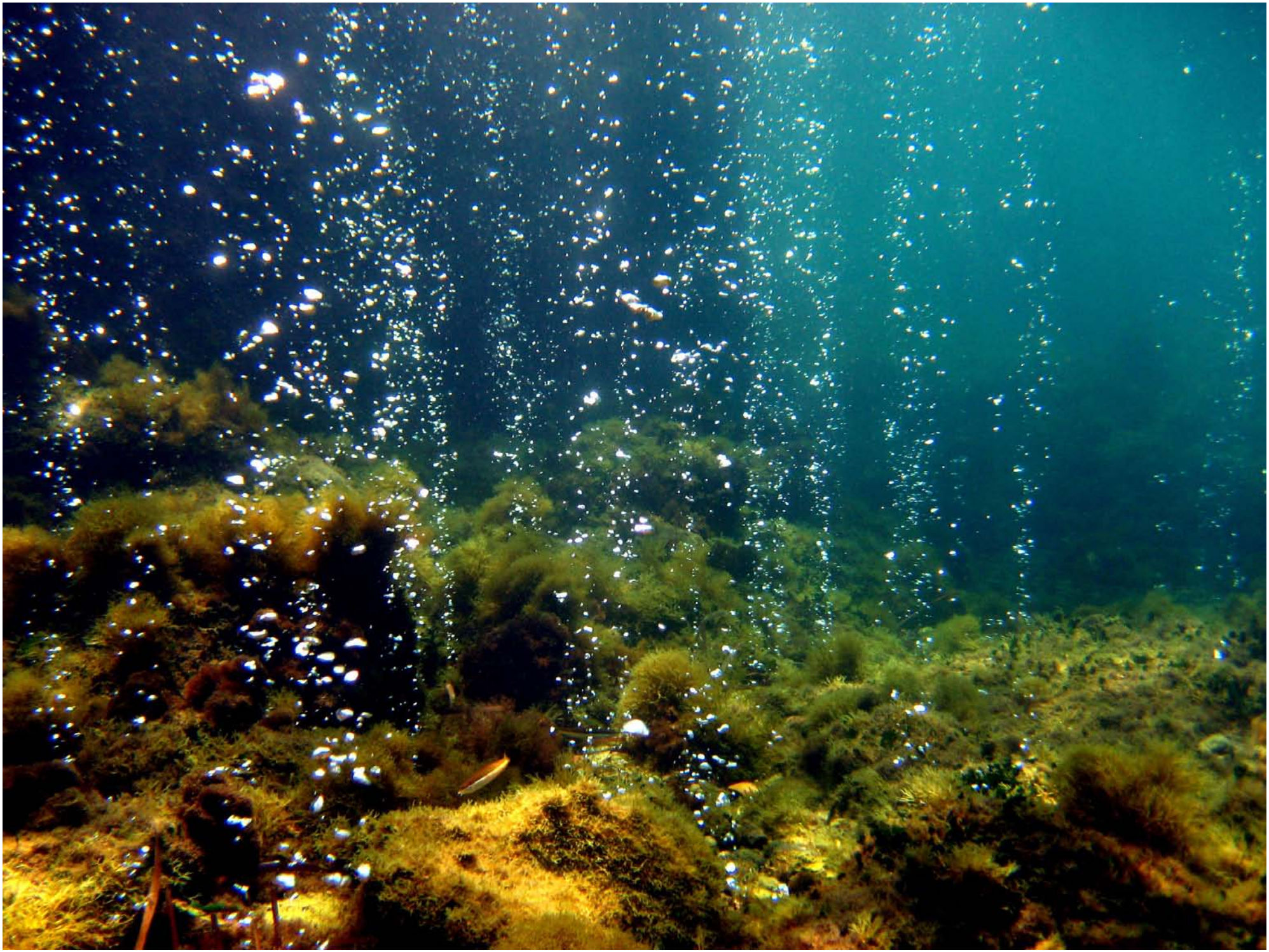
Vulcano Island (May 25-27, 2011)

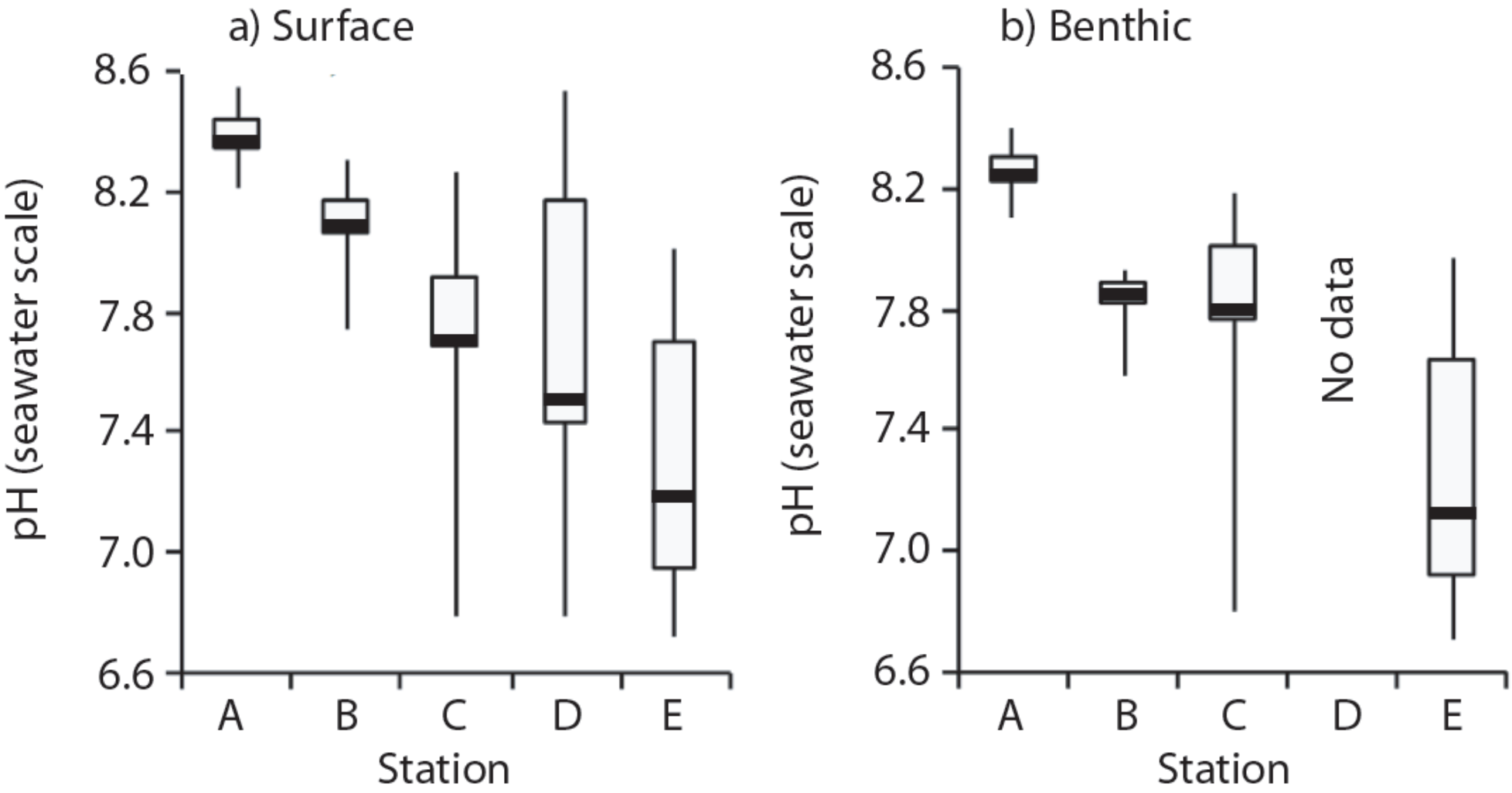
★ Carbonate biochemistry

Perpignan (June 15-17, 2011)

★ Perturbation experiments on planktonic organisms

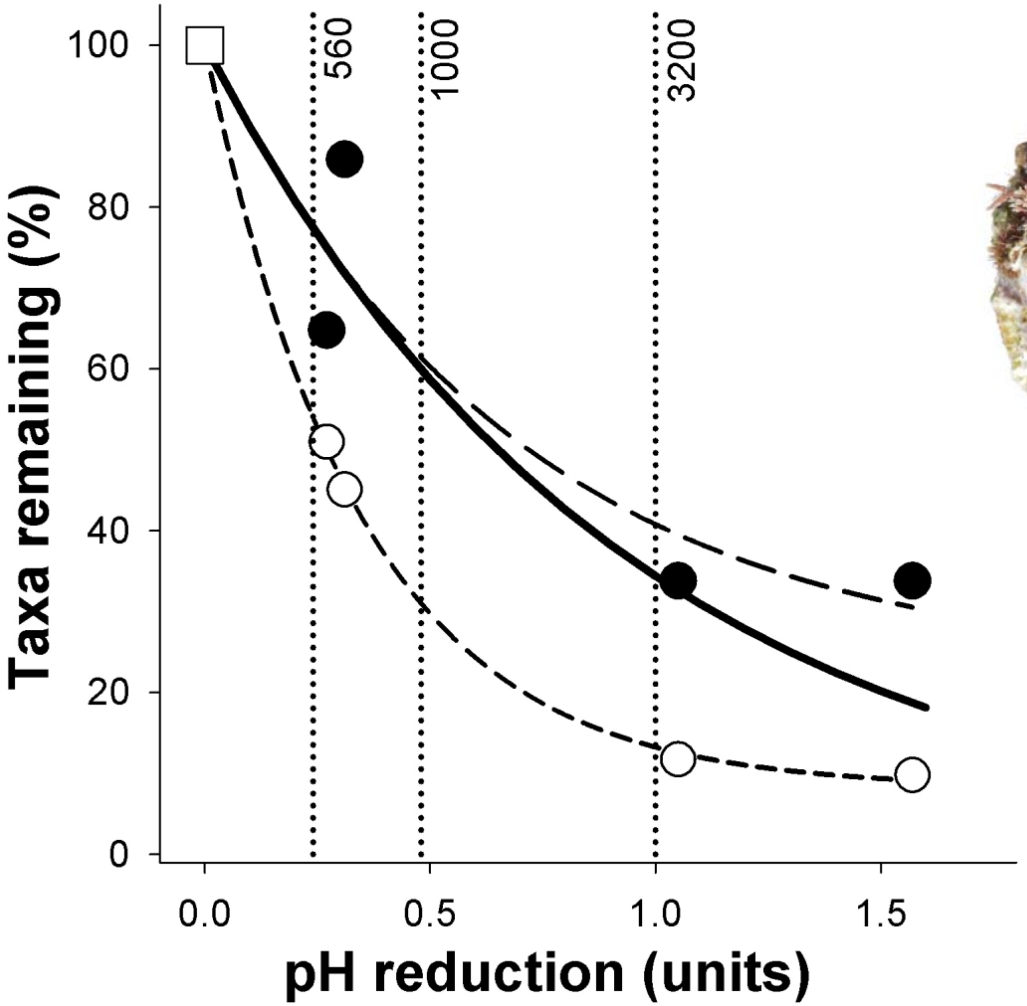
Anavyssos (September 20-22, 2011)





Kerrison et al. 2011

Biodiversity declines with increasing CO_2



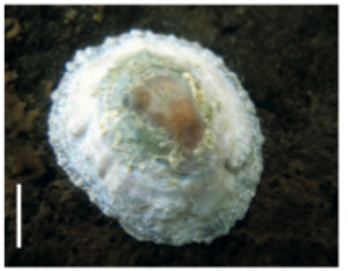
Barry et al. 2011, Hall-Spencer & Rodolfo-Metalpa in press

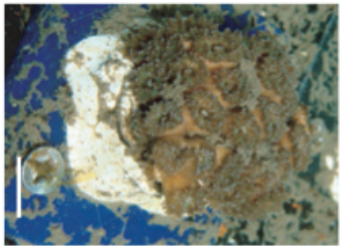
LETTERS
PUBLISHED ONLINE: 21 AUGUST 2011 | DOI: 10.1038/NCLIMATE1200
nature climate change

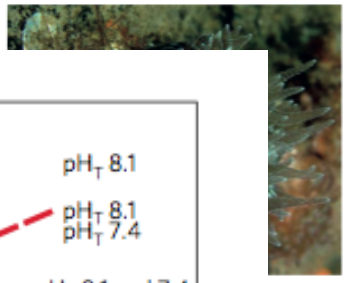
Coral and mollusc resistance to ocean acidification adversely affected by warming

R. Rodolfo-Metalpa[1,2*], F. Houlbrèque[1†], É. Tambutté[3], F. Boisson[1], C. Baggini[2], F. P. Patti[4], R. Jeffree[1†], M. Fine[5,6], A. Foggo[2], J-P. Gattuso[7,8] and J. M. Hall-Spencer[2]

- A decrease in pH, Ω, and CO_3^{2-}, does not necessarily affect calcification rates of many species.
- Organic layers protect the tests from dissolution and likely isolate the site of calcification.
- More vulnerable to the effects of ocean acidification when the water was warmest (increased mortality).







OA and Warming, WP4

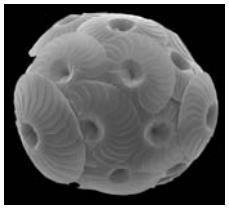
Multiple vent sites show biodiversity loss and habitat degradation as CO_2 levels increase

Identify vulnerable groups (e.g. coralline algae and sea urchins)

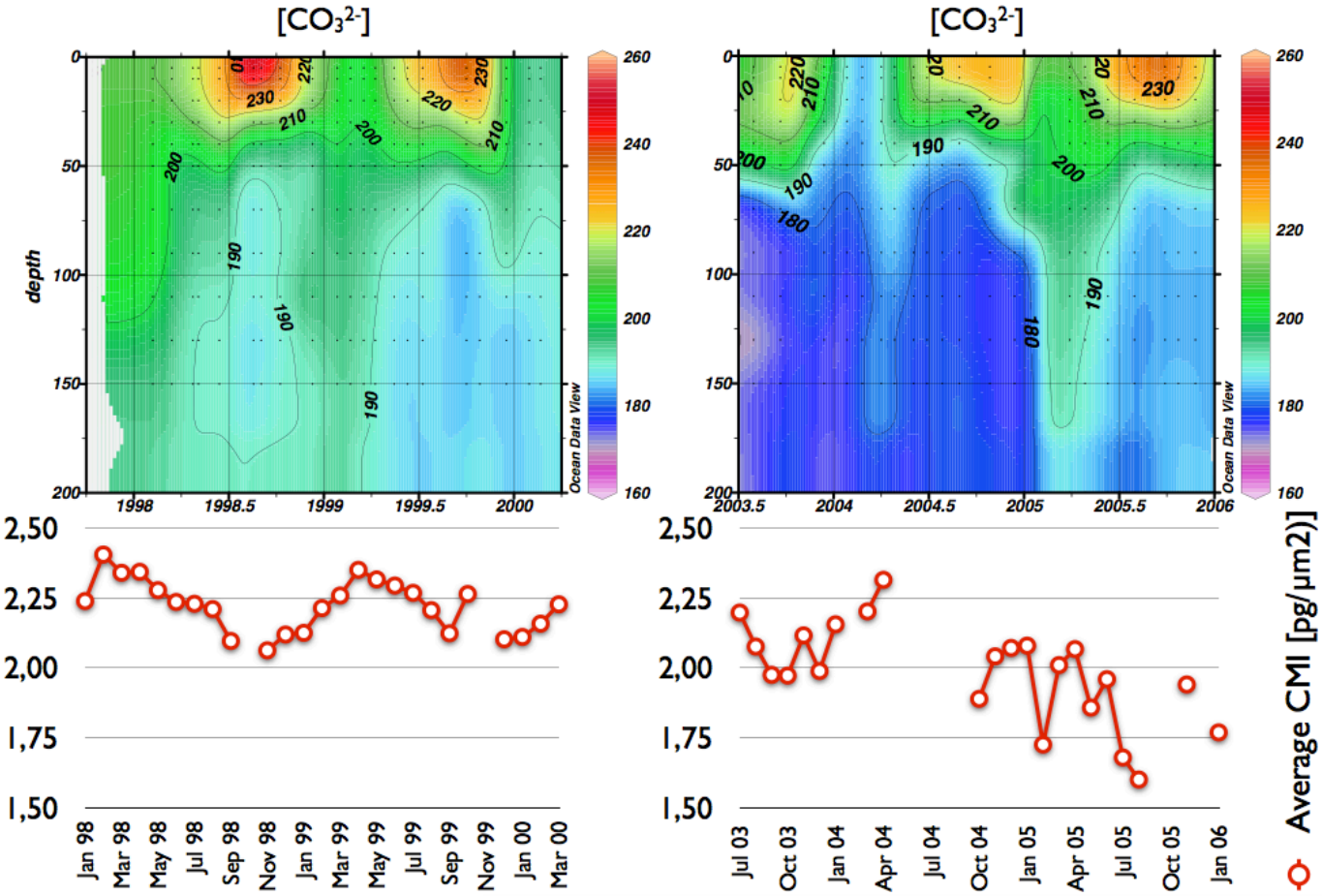
Identify tolerant groups (e.g. jellyfish and invasive algae)

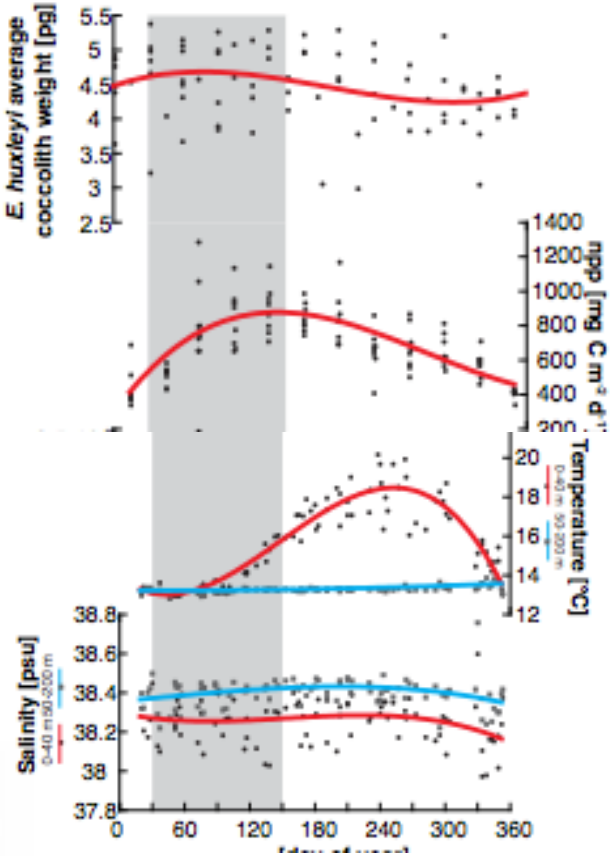
Demonstrate the impacts of multiple stressors

Thinning coccolith calcite due to ocean acidification and warming in the Med. Sea?



Influence of rising CO_2 in recent years?



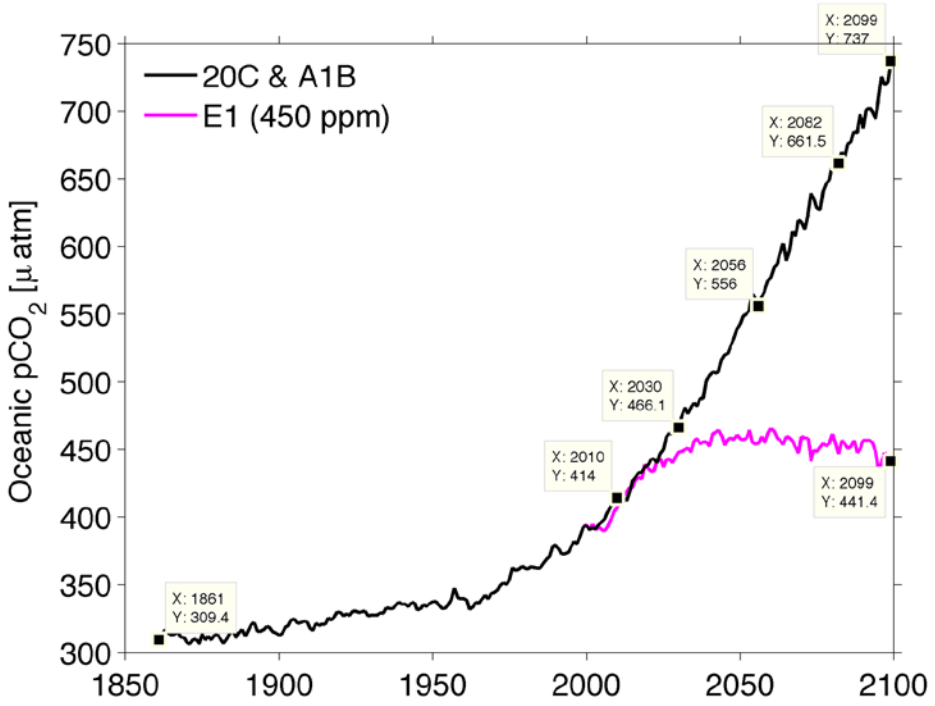


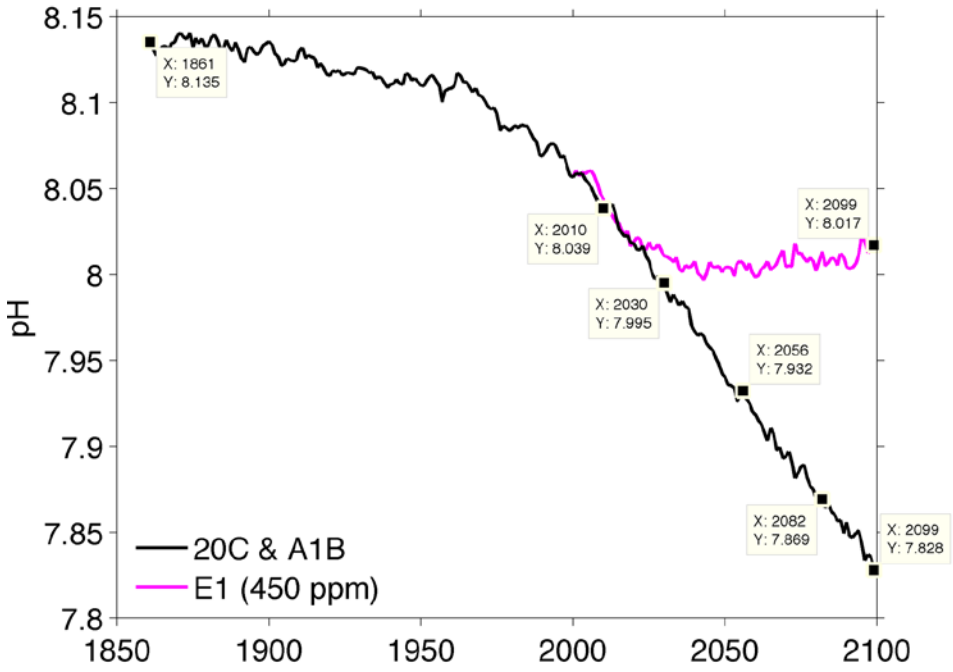
Meier et al., in review **OA and Warming, WP3**

Preliminary coarse-res results: D5.1

target values of atmospheric pCO_2 for perturbation experiments from Barry et al. (2010, Table 3.3)

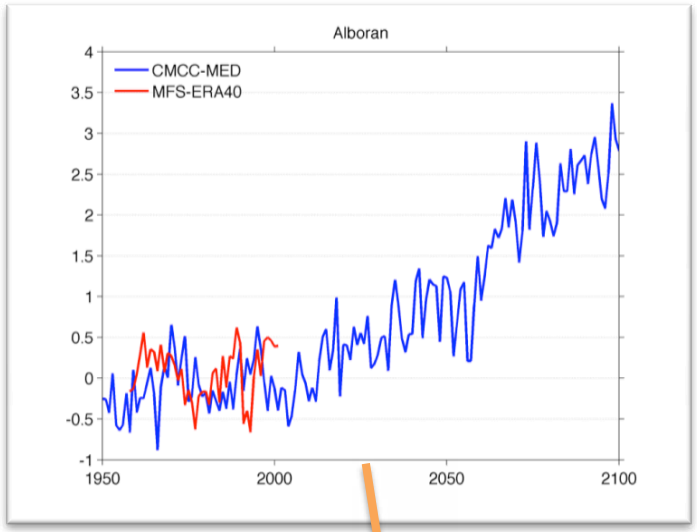
Atmospheric pCO_2 [ppm]	Ocean pCO_2 [uatm]		SST (anomaly 1980-2010) [°C]		SST [°C]		pH	
Value (year)	West	East	West	East	West	East	West	East
286 (1861)	293.1	322.9	-0.21	0.06	15.01	17.63	8.15	8.13
390 (2010)	398.9	426.6	0.39	0.33	15.62	17.91	8.04	8.04
450 (2030)	452.6	477.2	0.30	0.71	15.53	18.28	8.00	7.99
551 (2056)	546.4	564.0	1.38	1.35	16.6	18.93	7.93	7.94
650 (2082)	633.1	684.9	1.99	2.26	17.22	19.83	7.88	7.86
703 (2099)	716.3	754.1	3.09	2.86	18.32	20.43	7.83	7.83
421 (2099 E1)	*429.6*	*451.2*	*1.38*	*1.56*	*16.6*	*19.13*	*8.02*	*8.02*

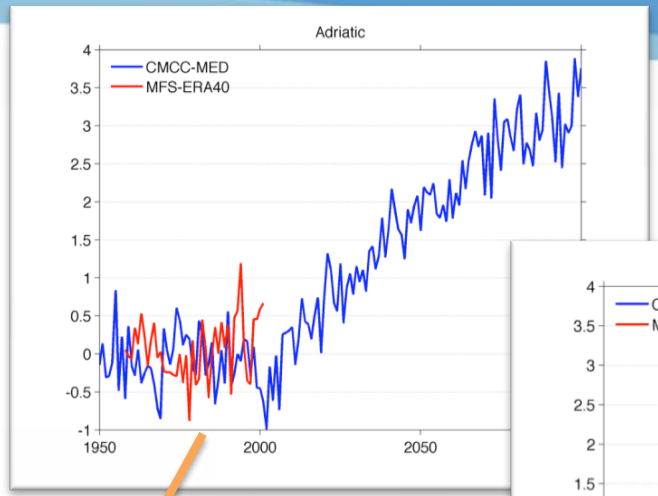


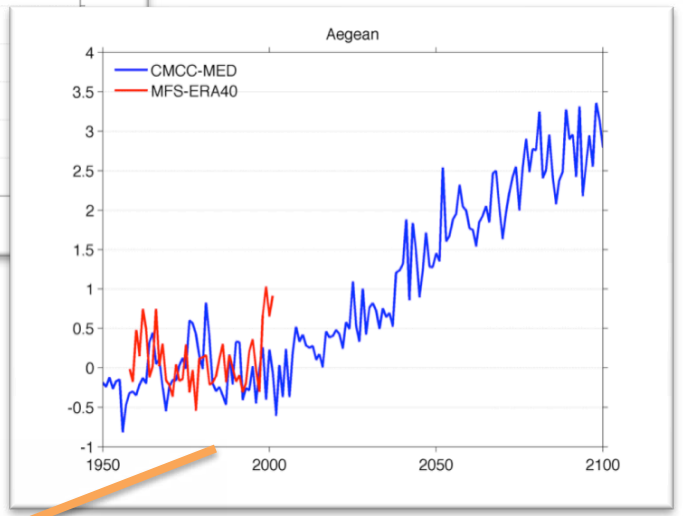


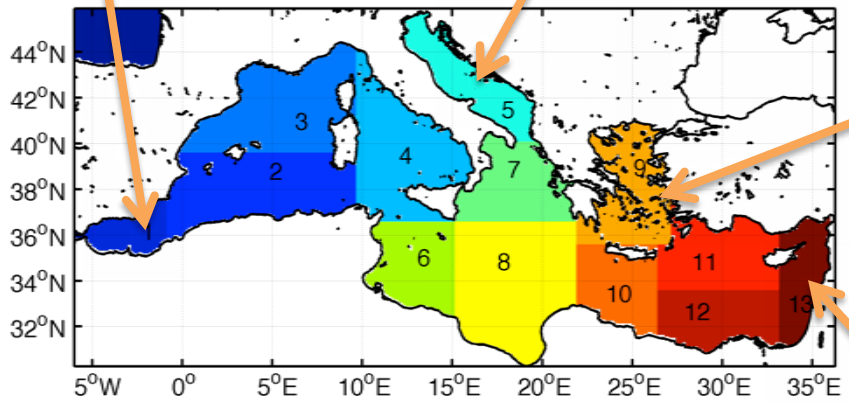
Vichi et al.

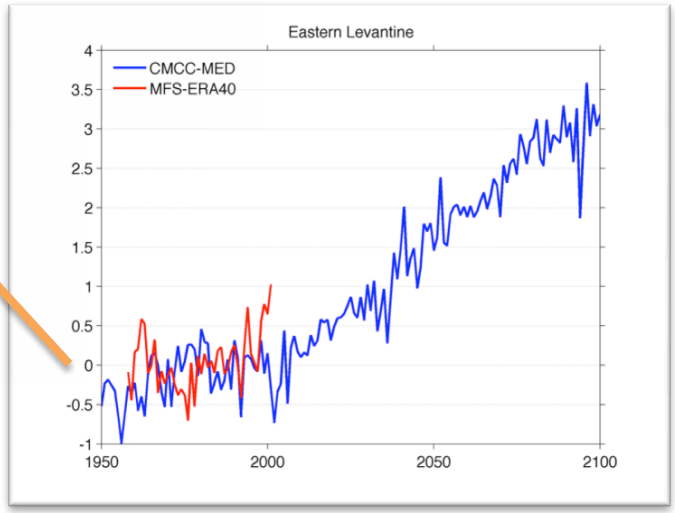
Mediterranean SST projections, WP5











SST anomaly respect to 1970-1999 mean

CMCC-MED: Scoccimarro et al., 2011

MFS-ERA40: Mattia et al., in prep.

Historical data on carbonate fluxes D5.2

220 S. Stavrakakis et al. / Progress in Oceanography 46 (2000) 217–240

Stavrakakis et al. (2000)

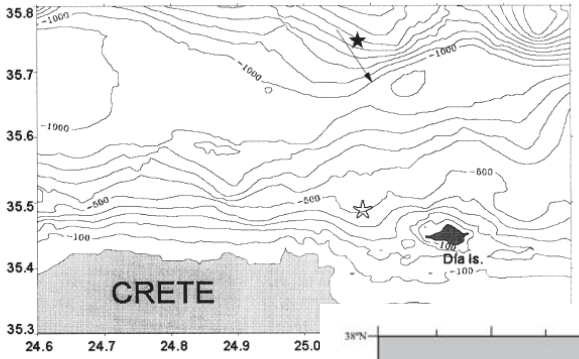
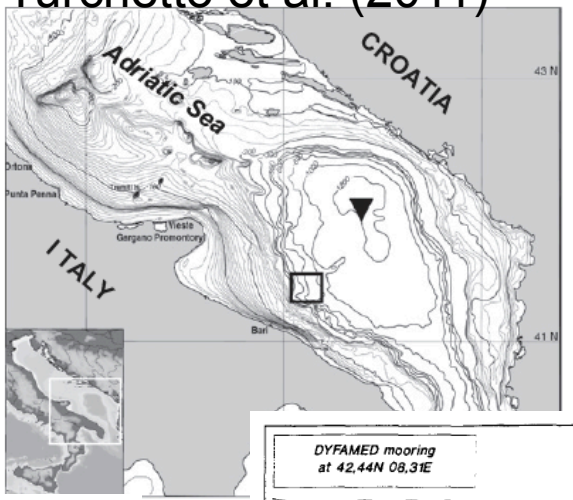


Fig. 1. Sites of moorings in the Cretan Sea. The black star white star the lost mooring line at 500 m depth. The arrow ir during the CINCS experiment.

Turchetto et al. (2011)



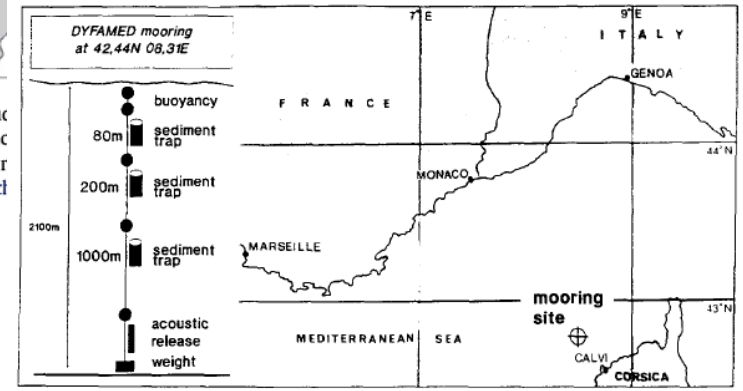


Fig. 1. Location of the mooring site and a schematic of the mooring line.

Miquel et al. (1994)

Barcena et al. (2004)

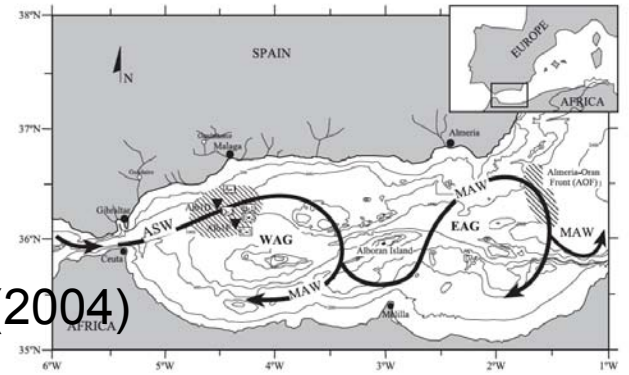
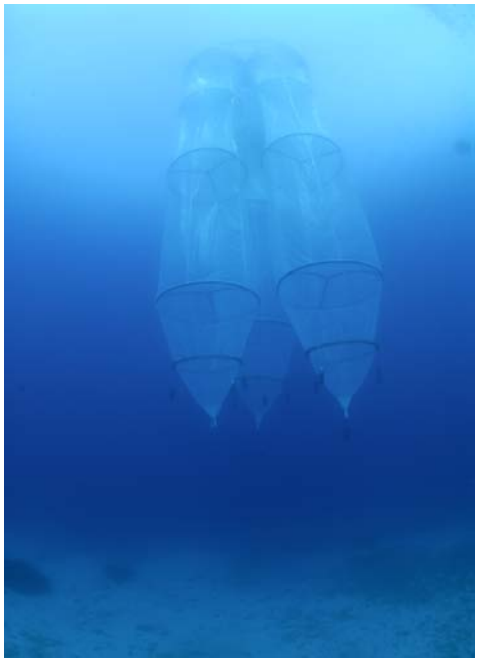


Fig. 1. Geographical setting of the study area. Bathymetric map of the Alboran Sea, inverted black triangles represent the position of the sediment traps; black dots correspond to the main localities; open squares represent the position of surface sediment samples, open dots show the locations of the two rivers considered in the discussion. Dashed areas represent the northern border of the Western Alboran Gyre (WAG) and Almeria-Oran Front (AOF). Arrows represent the theoretical surface circulation in the Alboran Sea, WAG, Eastern Alboran Gyre (EAG) and AOF.

Bibliography compiled by: E. Malinverno, P. Ziveri, M. Vichi

UPCOMING ACTIVITIES

- Corsica mesocosm pertubation experiments (June-July 2012)
- Creta mesocosm pertubation experiments (June 2013)
- Mediterranean Transect Spring 2013
- Exploring new CO_2 vent sites and further work in Vulcano (and Ischia), transplanting and plankton work

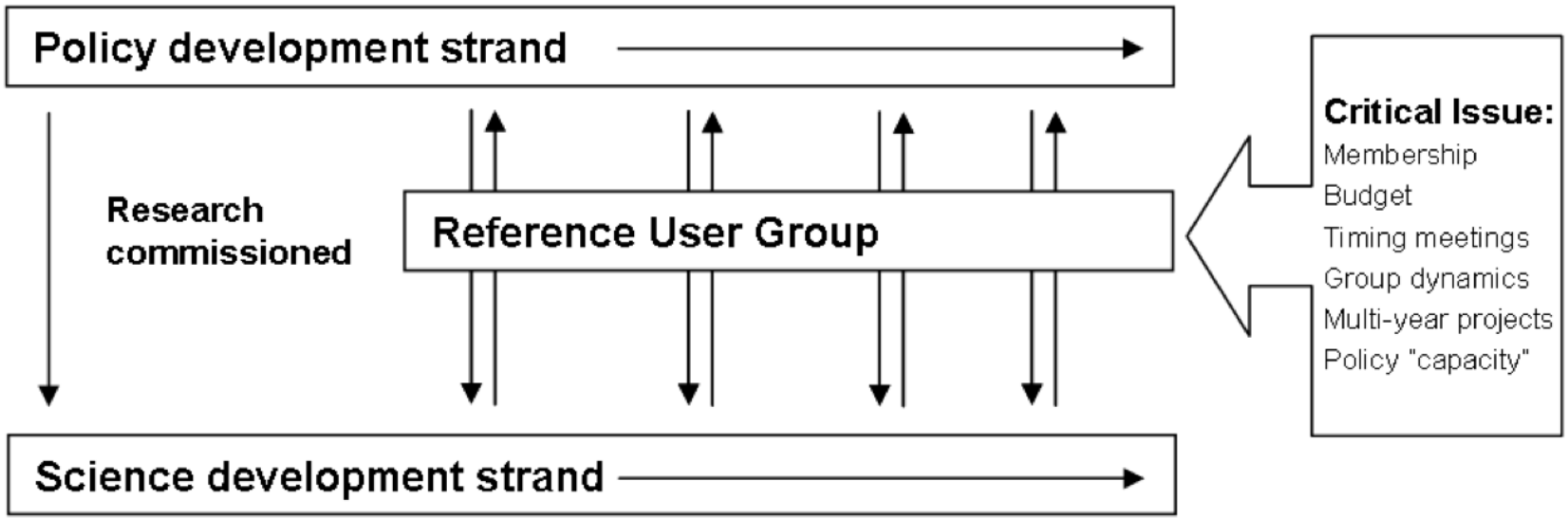


Mediterranean Reference User Group (MRUG)

From science to society: the role of MRUG

MRUG ensures dissemination both, of the issues covered by MedSeA scientists to the stakeholders organisations, and of the ocean acidification-related policy and societal issues important to those stakeholders and end-users.

Policy-science links – better practice



medsea-project.eu

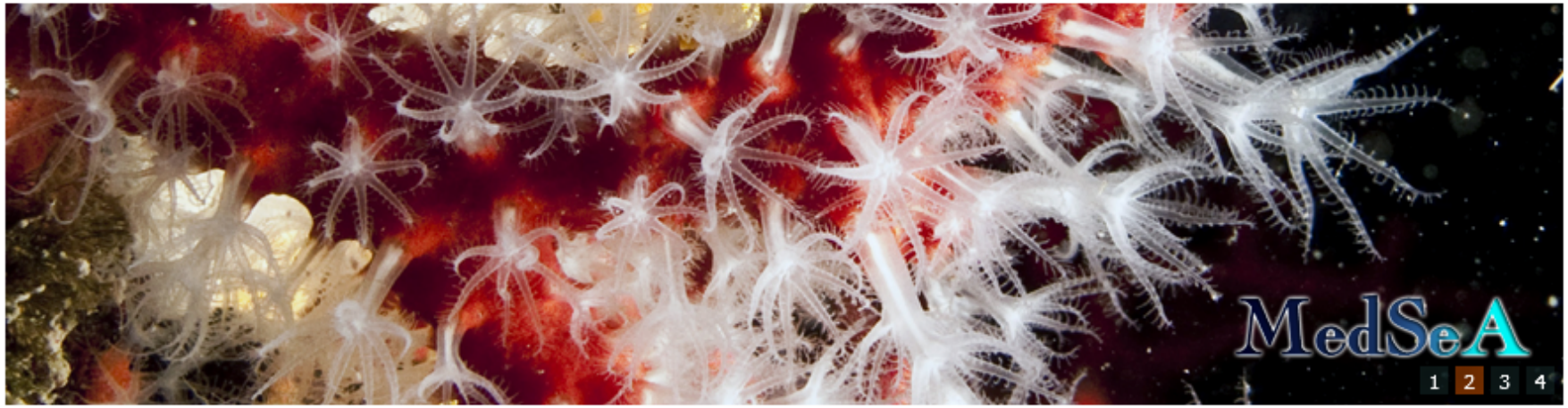
MedSeA

MEDITERRANEAN SEA ACIDIFICATION IN A CHANGING CLIMATE

Intranet

Search

HOME | MED SEA ACIDIFICATION | ABOUT | PROJECT PARTNERS | OUTREACH | TRAINING | MRUG | LINKS | CONTACT



Welcome

The European Mediterranean Sea Acidification in a changing climate (MedSeA) initiative is a project funded by the European Commission under Framework Program 7. It involves 16 institutions from 10 countries.

MedSeA assesses uncertainties, risks and thresholds related to Mediterranean acidification at

Mediterranean Sea climate and environmental change blog

Mediterranean Reference User Group (MRUG)

medseaclimatechange.wordpress.com/

Mediterranean Sea climate and environmental change

An information outlet on Ocean Acidification, Climate and Environmental Change in the Mediterranean Sea

Home About

Workshop on Climate change in Mediterranean and Caribbean Seas: Research experiences and new scientific challenges

MARCH 31, 2012

CIIFEN Headquarters, Guayaquil, Ecuador, May 8th – 11th 2012

Mediterranean and Caribbean Seas, though geographically different, present many interesting analogies when climatic change impacts, adaptation and mitigation strategies are addressed. **Read more...**

LEAVE A COMMENT *from* → Meetings

A decade of weather extremes

MARCH 31, 2012

The ostensibly large number of recent extreme weather events has triggered intensive discussions, both in- and outside the scientific community, on whether they are related to global warming. Here, we review the evidence and argue that for some types of extreme — notably heatwaves, but also precipitation extremes — there is now strong evidence linking specific events or an increase in their

SUBSCRIPTION TO THIS BLOG

Subscribe in a reader

Subscribe to Mediterranean Sea climate and environmental change by Email

SEARCH

type and press enter

RECENT POSTS

- Workshop on Climate change in Mediterranean and Caribbean Seas: Research experiences and new scientific challenges
- A decade of weather extremes
- Resilience of Cold-Water Scleractinian Corals to Ocean Acidification: Boron Isotopic Systematics of pH and Saturation State Up-Regulation
- Community structure and seasonal dynamics of tintinnid ciliates in Kaštela Bay (middle Adriatic Sea)

Thanks