OCEAN ACIDIFICATION IMPACTS
ON CORAL REEFS
"From Sciences to Solutions"

Conclusions of the 4th International workshop on the economics of ocean acidification

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Bridging the gap between ocean acidification impacts and economic valuation

Oceanographic Museum of Monaco 15-17 October 2017

The Monaco Declaration - 2008

✔ Widely distributed: 9000 citations on Google

Therefore, we urge policymakers to launch four types of initiatives:

→ to help improve understanding of **impacts of ocean acidification** by promoting research in this field, which is still in its infancy;

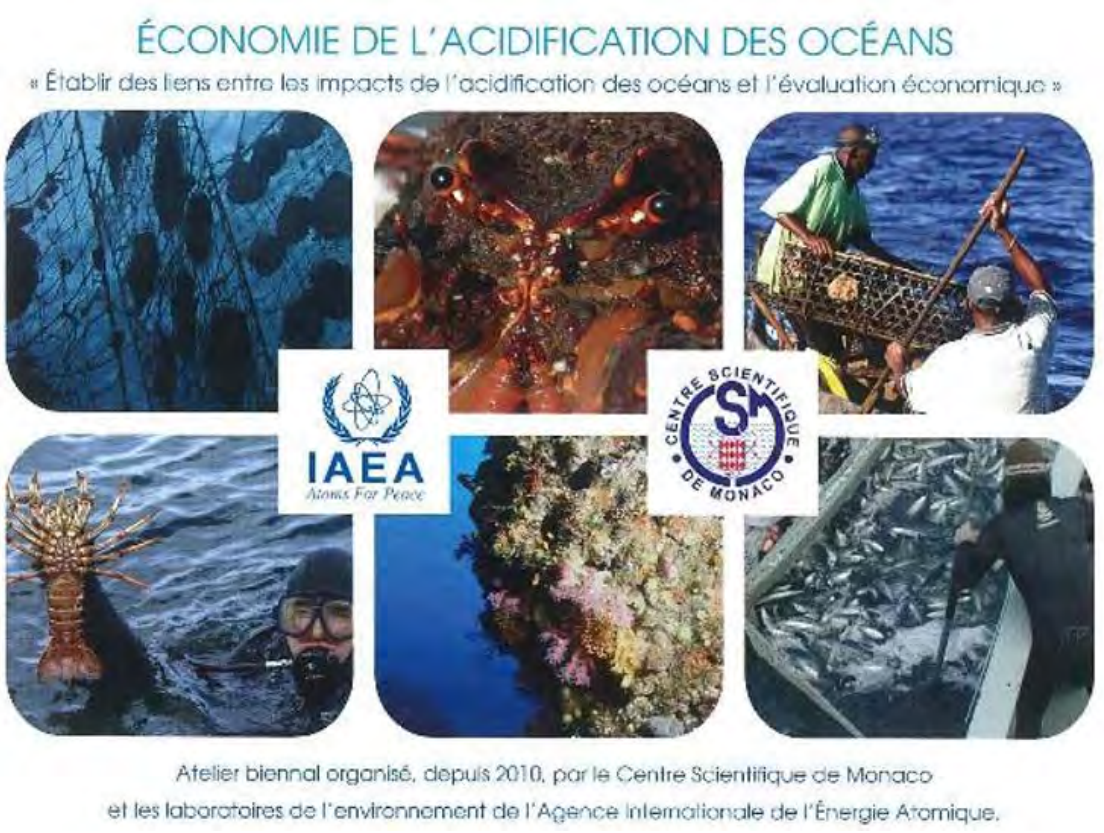
→ to help build **links between economists and scientists** that are needed to evaluate the socioeconomic extent of impacts and costs for action versus inaction;

→ to help **improve communication between policymakers and scientists** so that *i)* new policies are based on current findings and *ii)* scientific studies can be widened to include the most policy-relevant questions;

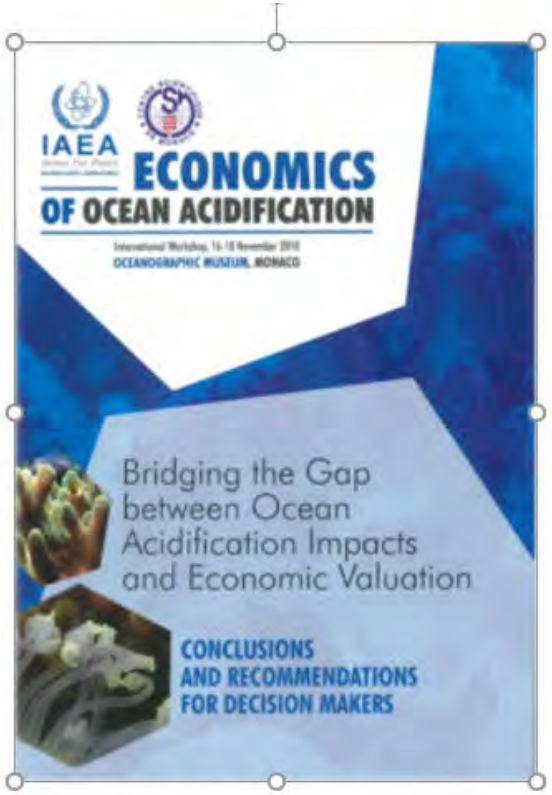
→ to **prevent severe damages from ocean acidification** by developing ambitious, urgent plans to cut emissions drastically.

Bridging the Gap between Ocean Acidification Impacts and Economic Valuation

In line with the **Monaco Declaration** and in accordance **with the wishes of Prince Albert II**, an International workshop series - « Bridging the Gap between Ocean Acidification Impacts and Economic Valuation » - was launched by the Centre Scientifique de Monaco and the Environment Laboratories of the IAEA.



Bridging the Gap between Ocean Acidification Impacts and Economic Valuation



lines of communication and foster cooperation and coordination. The second workshop (2012) focused on regional impacts of ocean acidification on fisheries and aquaculture. The third workshop (2015) discussed the socio-economic impacts of ocean acidification on coastal communities.

http://www.centrescientifique.mc/fr/Workshops/default.aspx

Bridging the Gap between Ocean Acidification Impacts and Economic Valuation

4th Workshop (*2017*) – From Sciences to Solutions: Ocean acidification impacts on ecosystem services- Case studies on coral reefs

- The workshop focused on the economically and socially important, but highly threatened, coral reefs ecosystems, using a case study approach.
- The goal of the workshop was to determine mitigation and adaptation solutions to OA impacts on coral reef ecosystems and the services they render, at several levels: biochemical (e.g. geo-engineering), socio-economic (e.g. fisheries and selective aquaculture), legal (e.g. creation of protected areas and coral parks) and technological (e.g. development of sensors and monitoring systems).

Discussions focussed on pathways and possible adaptations through **economic and social transformations** in the context of the **UN Sustainable Development Goals**

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Coral reef facts

- Coral reefs cover <0.2% of the sea surface but host ~ 30% of all known marine species;
- Coral reefs are essential to about 500 million people and have a conservative value of 1T USD which generates at least 300-400B USD each year in terms of food and livelihoods from tourism, fisheries, coastal protection and medicines;
- Coral reefs are the most endangered marine ecosystems: ~ 30% of world's coral reefs are already destroyed and 58% are potentially threatened;
- The extinction of coral reefs poses a critical threat for people in some of the world's developing countries.

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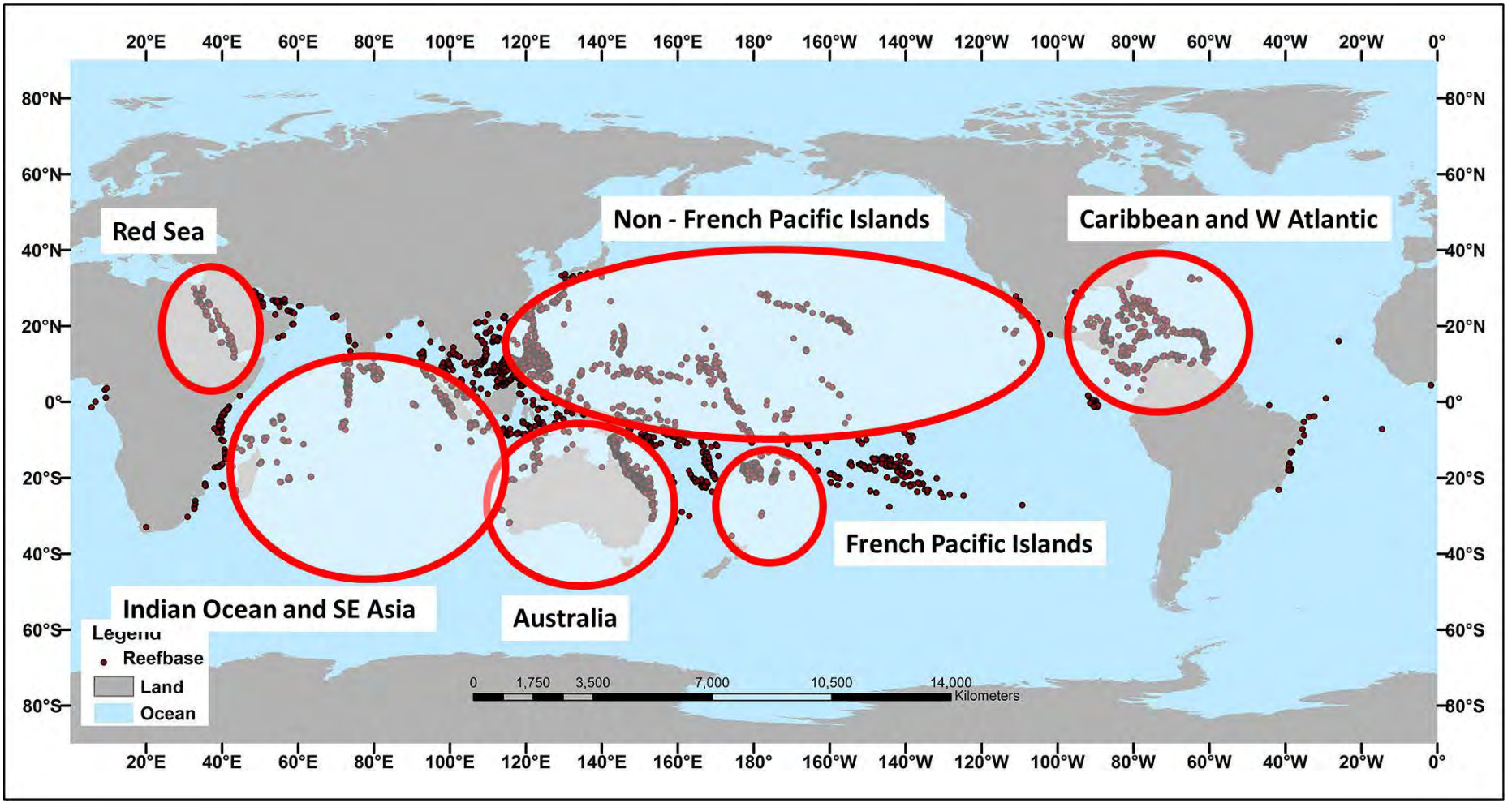
Global coral reefs organized into 6 regions



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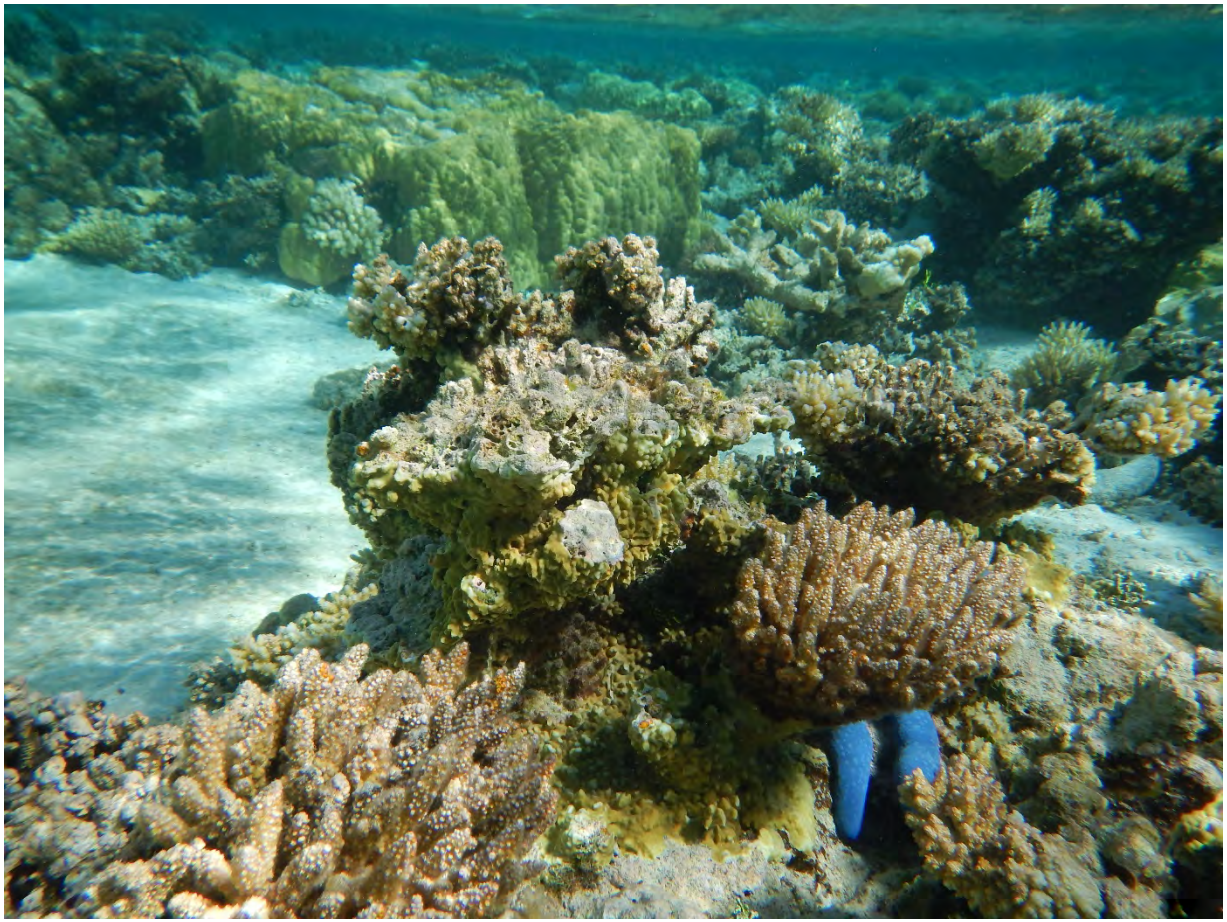
Solutions organized in ecological and socio-economic:



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CARIBBEAN AND W ATLANTIC REGION:

ECOLOGICAL SOLUTIONS

- Manage pollution discharges (e.g., sediment, nutrients) by reducing pollution input; introducing natural barriers or filters (e.g. mangroves) and by redirecting pollutants away from reef ecosystems.
- Reduce unsustainable fishing practices by developing a hierarchy of fishing rights for stakeholders, removing destructive fishing practices; invest in Marine Protected Areas (MPAs), and promoting healthy and sustainable fish stocks.
- Develop and implement new ecological engineering methods such as selective harvesting approaches to enhance coral settlement and resilience.

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SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Increase regional communication and resource mobilization through the establishment of a regional reef secretariat.
- Adopt Blue Economy Principles to coral reef economic sectors that incorporate increased investment in reef management.
- Initiate a reef label or certification program that provides positive rewards for corporations that become partners in reef restoration.

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THE INDIAN OCEAN AND SE ASIA REGION:

ECOLOGICAL SOLUTIONS

- Establish a network of locally-managed Marine Protected Areas (MPAs).
- Strengthen collaborations that adopt science-based best practices for monitoring ocean acidification and coral condition, while taking into account the local and national interests.
- Adopt coral reef restoration programs.
- Promote non-destructive use of marine resources to reduce the stress on coral reefs

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SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Work towards lowering global CO2 emissions by reducing demand for emission-intensive goods and services, and encouraging lower-carbon technologies.
- Implement a realistic cost-benefit analysis to ascertain that the cost of proposed alternatives is lower than the cost of inaction.
- Increase public and political awareness on the value of coral reef ecosystems and their services.
- Need to address sustainable use of marine resources in education programs, such as renewables, low-carbon food production and sustainable fishing practices.
- Involve community in resource management and policy actions.

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FRENCH PACIFIC ISLANDS REGION:

ECOLOGICAL SOLUTIONS

- Identify climate refuges and establish MPA networks to protect climate change-resistant corals.
- Promote growth of resistant corals.
- Restore and protect native vegetation (e.g., mangroves) for CO2 sequestration.
- Promote Pacific Islanders as guardians of their oceans.
- Promote traditional coastal management practices for sustainable use of marine resources.
- Plan and potentially relocate/develop activities according to projected climate change impacts

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SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Engage local communities at all steps to ensure buy-in and sustainability of solutions.
- Perform long-term monitoring to uncouple trends in ecological, socio-economic and cultural sub-systems (French Polynesia and New Caledonia could be a model for coral reef resilience).
- Integrate traditional and scientific knowledge at the regional scale.
- Invest in communication to reach broad audiences.

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RED SEA REGION:

ECOLOGICAL SOLUTIONS

- Increase our understanding of Red Sea coral resilience.
- Increase the number and size of MPAs.
- Regulate artisanal fishing.
- Create coral repositories to preserve vital local genotypes and rare coral species.
- Invest in coral reef restoration efforts (i.e., coral restoration toolbox).
- Apply ecological engineering approaches.
- Build regional collaborations to protect Northern Red Sea coral reef refuges.
- Support international research, monitoring, and regulatory efforts.

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SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Sustainably manage the Red Sea tourist/hospitality industry.
- Develop and populate a socio-economic database.
- Allow better monitoring and implementation of conservation policies in the region through a centralized coordination center
- Promote capacity building across the region.
- Encourage citizen science to assist in research activities.
- Explore business opportunities on reef resources, e.g., Blue Technologies.

AUSTRALIA - THE GREAT BARRIER REEF REGION :

ECOLOGICAL SOLUTIONS

- Reduce man-made CO_2 emissions.
- Maintain ecologically-sustainable fishing practices.
- Develop comprehensive tourism permitting arrangements.
- Implement controls on wastewater discharge.
- Invest in programs that reduce land-based sources of pollution

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SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Enhance measures that build resilience to climate change.
- Support the adaptive capacity of reef-dependent sectors (vulnerability assessments, adaptation strategies, metrics for success).
- Enhance ocean acidification literacy among the public and decision-makers, including accountability for climate dedicated government infrastructure.
- Increase compliance with area-based management, especially for coral reef refuges.
- Invest in ocean acidification research and development.
- Improve policy alignment and coherence across jurisdictions and sectors, including commitment to evidence-based decision-making that is consistent within and between governmental departments.

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NON FRENCH PACIFIC REGION :

ECOLOGICAL SOLUTIONS

- Reduce pollution and greenhouse gas emissions.
- Invest in more numerous and effective marine protected areas (MPAs).
- Develop innovative strategies that provide better baselines

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NON FRENCH PACIFIC REGION :

ECOLOGICAL SOLUTIONS

- Reduce pollution and greenhouse gas emissions.
- Invest in more numerous and effective marine protected areas (MPAs).
- Develop innovative strategies that provide better baselines

SOCIO-ECONOMIC AND POLICY SOLUTIONS

- Support education and communication at all levels
- Commit funding for research and development to build capacity for effective protection of ecosystems.
- Promote regional collaborations and networking between developed and developing nations with the desired goal to develop solutions in one part of the region and implement in another.
- Engage in ecologically sustainable agriculture, industry, and services.
- Provide infrastructure for effective implementation and enforcement of laws and regulations.
- Create alternative incentive models (offsets/quotas/taxes, tourism, military, fisheries).

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Common solutions for all regions:

- Reduce global CO_2 emissions;
- Implement controls on local land-based pollution;
- Promote marine conservation (MPAs);
- Create coral repositories;
- Promote sustainable economies (tourism, fishing, agriculture, Blue Economy);
- Promote social resilience (e.g., stakeholder engagement, alternative incentive models);
- Invest in monitoring of coral reef health and scientific research, e.g. to identify resilient coral species;
- Invest in creative restoration / ecological engineering activities, e.g. selective harvesting more resilient coral species;
- Promote effective communication and increased awareness about the value of coral reefs and the risks they face.

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CONCLUSIONS:

One of the resounding messages during the three-day workshop was a **message of hope**. It is **not too late,** and a variety of solutions exist.

When faced with the choice of where to focus our efforts first, Ruth Gates summarized: *"Do something, and do something now"*. She stressed that solutions as simple as installing mooring buoys over coral reefs, as opposed to having people throw anchors, could have immediate positive impacts.



CONCLUSIONS:

Beyond these solutions for adaptation and rehabilitation, one of the key messages from participants was that **reducing greenhouse gases** would effectively limit the pressure on coral reefs by curbing ocean acidification, and climate change impacts such as increase in temperature and rise in sea level.

All experts agree that the real long-term solution is to reduce CO_2 emissions. In the short and medium term, it is also possible to reduce CO_2 concentrations in seawater, for example by protecting and / or restoring seagrass beds and mangroves that capture and sequester CO_2 (blue carbon).

CONCLUSIONS:

HSH Prince Albert II of Monaco in his closing remarks said that:

"…environmental questions are not a luxury, but an absolute necessity…"

*"…the importance of an **economic perspective** in sustainable environmental management…"*

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THANKS to the The Scientific Committee of the workshop

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Association Monégasque sur l'Acidification des Océans

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THANKS to HSH Prince Albert II of Monaco:

«Ocean acidification is, I believe, one of the greatest scourges resulting from the considerable development of anthropogenic greenhouse gas emissions, to have both concrete and global impact.»

(H.S.H. Prince Albert II of Monaco)

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THANK YOU!