笹川平和財団
海洋政策研究所

国際シンポジウム

「海洋における温暖化と酸性化 ～現状と今後の対応策～」

International Symposium

Ocean Warming and Acidification – Current State and Future Countermeasures

2016年2月17日（水）

主催

公益財団法人 笹川平和財団
海洋政策研究所

開催趣旨

国際シンポジウム「海洋における温暖化と酸性化～現状と今後の対応策～」

人間社会が排出する温室効果ガスは、地球温暖化をもたらすとともに、海水中の二酸化炭素濃度上昇を通じて海洋酸性化を進行させます。海洋における温暖化と酸性化は、2012年の国連持続可能な開発会議（リオ+20）の成果文書や2015年9月の国連持続可能な開発目標（SDGs）など取り上げられている喫緊の課題です。しかし、我が国での対応は必ずしも十分ではありません。

そこで、これらの重要課題について、国内外の状況を共有し、我が国で取り組むべき検討課題や対応策について議論するため、世界でこの分野の議論をリードする著名な研究者を招いて、国際シンポジウム「海洋における温暖化と酸性化～現状と今後の対応策～」を開催することと致しました。本シンポジウムが、地球規模で進行する海洋環境の変化に対する行動の第一歩となりましたら幸いです。

International Symposium

Ocean Warming and Acidification – Current State and Future Countermeasures

The greenhouse gases emitted by human society cause global warming and, at the same time, accelerate ocean acidification by increasing the CO2 concentration in seawater. Ocean warming and acidification are both issues identified as requiring urgent action in documents such as the report of the 2012 United Nations Conference on Sustainable Development (Rio+20) and in the Sustainable Development Goals (SDGs) adopted in September 2015, but the Japanese response has been less than adequate.

Given this situation, today's international symposium, "Ocean Warming and Acidification – Current State and Future Countermeasures," brings together eminent researchers who are leading the world debate on these issues, to share information on both the domestic and international situations, to discuss what areas of the problems Japan should engage with, and what countermeasures might be pursued. Our hope is that the symposium will create momentum for first steps toward action to address the changes in the marine environment now unfolding on a global scale.

国際シンポジウム
「海洋における温暖化と酸性化～現状と今後の対応策～」

プログラム

13:00　開会挨拶
寺島 紘士（笹川平和財団 海洋政策研究所長）

13:10-13:50　基調講演「国際的な海洋政策の潮流と温暖化・酸性化」
Biliana Cicin-Sain（米国デラウェア大学海洋政策研究センター 所長）

13:50-14:30　基調講演「二つの異なる二酸化炭素排出シナリオを通して見た海洋と人間社会の将来 ― COP21後の状況」
Jean-Pierre Gattuso（仏国国立科学センター 上級研究ディレクター）

14:30-14:45　休　憩

14:45-16:55　パネルディスカッション「温暖化と酸性化の検討課題と対応策」

モデレータ　白山 義久（海洋研究開発機構 理事）
パネリスト　宮原 正典（水産総合研究センター 理事長）
井田 徹治（共同通信社 編集委員・論説委員）
山形 俊男（海洋研究開発機構 アプリケーションラボ所長）
Biliana Cicin-Sain
Jean-Pierre Gattuso

16:55-17:00　閉会

17:15～　意見交換会（10階）

International Symposium
Ocean Warming and Acidification –
Current State and Future Countermeasures

P r o g r a m

13:00 Opening Address

Hiroshi Terashima
President, Ocean Policy Research Institute, Sasakawa Peace Foundation

13:10–13:50 Keynote Speech: International Trends in Ocean Policies and Global Warming and Ocean Acidification

Biliana Cicin-Sain
Director, Gerard J.Mangone Center for Marine Policy University of Delaware

13:50–14:30 Keynote Speech: Futures for ocean and society from different CO2 emissions scenarios: where do we stand after COP21?

Jean-Pierre Gattuso
Directeur de recherche au CNRS

14:30–14:45 Break

14:45–16:55 Panel Discussion: Global Warming and Ocean Acidification Challenges and Countermeasures

Moderator	**Yoshihisa Shirayama**	Executive Director, JAMSTEC
Panelists	**Masanori Miyahara**	President, Fisheries Research Agency
	Tetsuji Ida	Senior Staff Reporter, Kyodo News
	Toshio Yamagata	Director, Application Laboratory JAMSTEC
	Biliana Cicin-Sain	
	Jean-Pierre Gattuso	

16:55-17:00 Closing Address

17:15～ Informal Discussions (10F)

「国際的な海洋政策の潮流と温暖化・酸性化」

Biliana Cicin-Sain
米国デラウェア大学海洋政策研究センター 所長

要旨
本講演では、世界の海洋政策の総合的推進の実現のために、国レベルの、また、世界レベルにおける主要な海洋政策の現状を概観したい。

まず国レベルでの海洋政策として、先進国、途上国合わせて15カ国・4地域における取り組み、分野横断的、総合的な海洋政策、具体的には、現行の海洋利用と法規の間の調整、海洋の持続可能な開発の促進、生物の多様性、崩壊に至りやすい資源と生態系の保護、多数の海洋関係の政府機関が行う事業の間の調整活動等について概観する。これら一連の研究は日本財団他の助成を受けて行い、その成果を『Routledge Handbook on National and Regional Ocean Policies』（2015年）として公表した。

世界レベルでの海洋政策に関する近年の主な動きについては、はじめに、2015年に採択された「持続可能な開発目標」について、なかでも海洋に関する目標を掲げる第14目標について述べる。これは現在、各国、地域、全世界において進行しつつある海洋と人の間の諸問題に対して大きな影響を及ぼすことになり、この目標が採択されたことは重要な成果である。第14目標がどのように定められたかその経緯、目標達成に導くために設けられた指標、また、持続可能な開発達成のために定められた他の諸目標とのかかわりについても述べたい。

さらに、いずれの国もその管理について単独で責任を課されることがない「国家の管轄権が及ばない海域（ABNJ）」、いわゆる「公海」の管理に関して生まれた新しい展開についても言及したい。世界に点在する公海は全海洋の64%を占め、現在地球上に残る唯一の共有地域であり、ここにはきわめて高い価値をもつ多様な生物とその生態系が存在し、漁業、海運、科学的研究、生物資源探査など数多くの分野での利用が進み、さらに今後、鉱物資源、石油・天然ガス、養殖、再生可能エネルギー、ジオエンジニアリングなどの分野での利用も始まろうとしている。

2015年6月、長年にわたって世界規模での討議が重ねられた後ようやく国連総会の場で、国の管轄権を越える海域の生物の多様性の保護と持続可能な利用を定める国連海洋法条約の下で、法的拘束力を有する新たな国際法を定めるべきことをうたった国連総会決議A/RES/69/292が採択された。この決議では、「国家の管轄権を超える海域に存する海洋生物の多様性、特に海洋遺伝資源の保護と持続可能な利用、また恩恵の共有に関する問題、海洋保護区域を含めて各地域を対象とする環境評価、人材育成、海洋技術の移転その他各種の管理ツール」などの問題が対象として掲げられている。

国・地域毎の海洋政策の策定、世界全体が合意する持続可能な目標の設定、国家の管轄権を超える海域を対象とする新しい統治体制確立のための交渉の三つが今、世界に見られる主要な動きとして挙げられるが、これらは各国、各地域の海洋政策のあり方に影響を与えるきわめて重要な展開である。海洋にかかわりをもつすべての国、地域が、これらの動きをさらに推し進め、その実施に積極的にたずさわることが求められる。

Trends of Ocean Policy Around the World

Biliana Cicin-Sain
Director, Gerard J.Mangone Center for Marine Policy University of Delaware

This presentation reviews important trends at national and global levels to advance integrated ocean policy around the world.

At the *national* level, the presentation reviews the efforts of 15 nations (both developing and developed) and 4 regions of the world that have taken concrete steps toward cross-cutting and integrated national and regional ocean policy. This includes goals and procedures to harmonize existing uses and laws, to foster sustainable development of ocean areas, to protect biodiversity and vulnerable resources and ecosystems, and to coordinate the actions of the many government agencies that are typically involved in ocean affairs. This work, published as the *Routledge Handbook on National and Regional Ocean Policies* (2015), was supported by the Nippon Foundation and other sponsors.

At the *international* level, the presentation first reviews recent major developments at the global level related to oceans: The adoption of the Sustainable Development Goals in 2015, including the stand-alone goal on oceans, Goal 14, a great accomplishment that will have major effects on advancing oceans and peoples issues in countries and regions around the world. The presentation reviews how the Goal 14 was developed, indicators being established to guide its implementation, and relationship to other sustainable development goals.

As well, the presentation reviews important new developments regarding the management of Marine Areas Beyond National Jurisdiction (ABNJ), commonly called the high seas, which are those areas of ocean for which no one nation has sole responsibility for management. ABNJ represent 64% of the surface of the ocean and the last global commons. They contain highly valuable biodiversity and ecosystems, and are used by many existing ocean uses such as fishing, shipping, scientific research, and bioprospecting, with new forthcoming uses such as mining, oil and gas, aquaculture, renewable energy, and geoengineering.

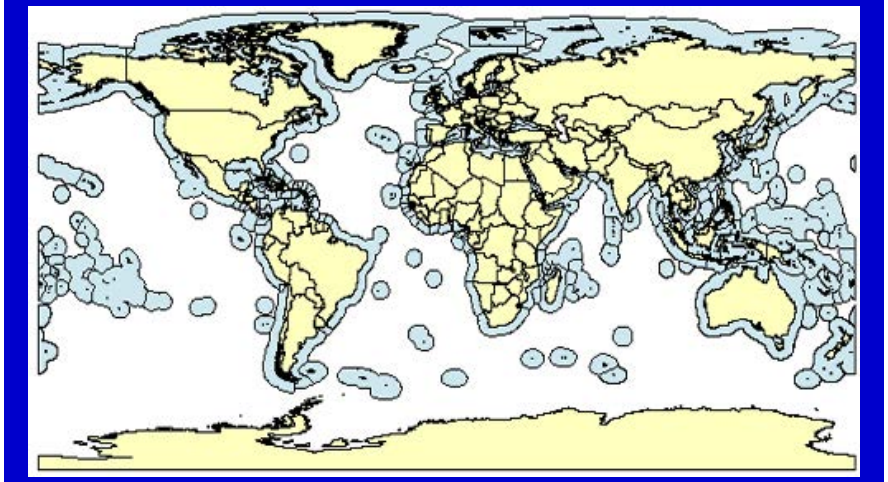
In June 2015, after many years of global deliberations, the UN General Assembly (UNGA) adopted Resolution A/RES/69/292, to develop a new internationally legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction. The issues being addressed are: "The conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction, in particular, together and as a whole, marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity building and the transfer of marine technology."

These three major trends: The creation of national and regional ocean policies, the adoption of global sustainable goals, and the negotiation of a new regime for areas beyond national jurisdiction, are highly significant developments affecting national and regional ocean policies. All ocean stakeholders should be involved in the further development and implementation of these policies.

International Trends in Ocean Policies

Presented at the International Symposium on
Ocean Warming and Acidification
Ocean Policy Research Institute, Sasakawa Peace Foundation
Tokyo, February 17, 2016

Dr. Biliana Cicin-Sain
Professor of Marine Policy, University of Delaware
President, Global Ocean Forum



Ocean Policy Trends Around the World

1. Bottom up developments– from the *national* and *regional* levels--formulation of national ocean policies around the world ↑
2. Top down developments– from the *global* level ↓
   a. Sustainable development goals– 2015 UNGA
   b. Formulation of a new climate regime– COP 21 2015
   c. Toward a new regime on Areas Beyond National Jurisdiction (ABNJ) 2016
3. Challenges and opportunities in bringing the *bottom up* developments and the *top down* developments together

Part 1

Bottom up **developments– from the** ***national*** **and** ***regional*** **levels--formulation of national and regional ocean policies around the world ↑**

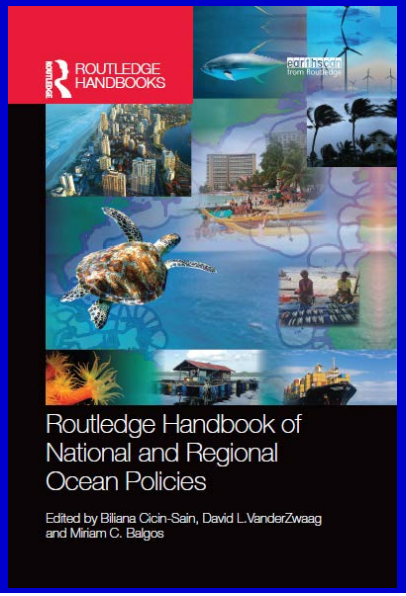
Over the last two decades, countries and regions have undertaken concerted efforts to develop and implement integrated national and regional ocean policies including by:

- Fostering sustainable development of ocean areas
- Protecting biodiversity and vulnerable resources and ecosystems
- Adopting goals and procedures to harmonize existing uses and laws
- Coordinating the actions of the many government agencies that are typically involved in ocean affairs

Response to the reality of serious conflicts of use in most national ocean zones and in regions, and to the prescriptions of both UNCLOS and the sustainable development summits

In all cases, a major challenge is how to go beyond solely sectoral approaches to oceans, to cross-sectoral and integrated approaches and to develop public decision-making processes to address the full range of multiple-use issues related to oceans and coasts.

National and Regional Policies



Especially from Chapter 1:
A Comparative Analysis of Ocean Policies in Fifteen Nations and Four Regions (2015)

By Miriam C. Balgos, Biliana Cicin-Sain, and David L. VanderZwaag

gef

Government of Portugal

15 nations and 4 regions

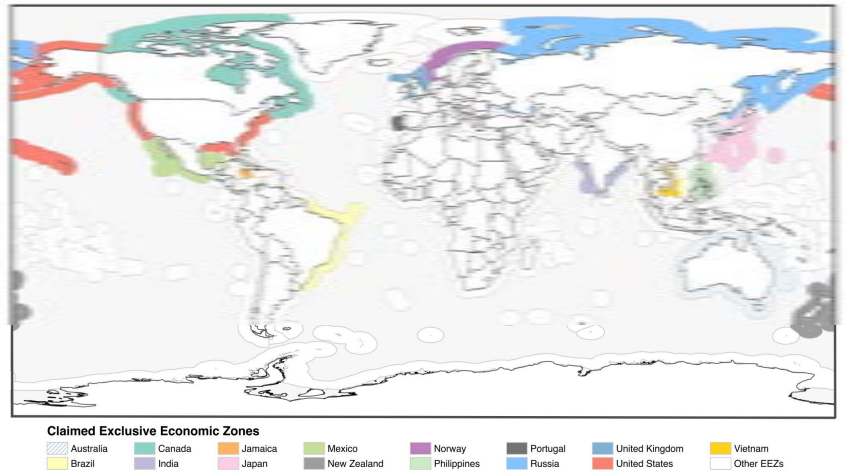
	Nations	*Regions*
Asia	India, Japan, Philippines, Vietnam	East Asian Seas
Oceania	Australia, New Zealand	Pacific Islands
Americas	Brazil, Canada, Mexico, United States	
Europe	Norway, Portugal, Russian Federation, United Kingdom	European Union
Africa		Sub-Saharan Africa
Caribbean	Jamaica	

Total area covered
- by countries included in the study: close to 50% of EEZ world total
- by regional efforts included in the study: 55 % of EEZ world total

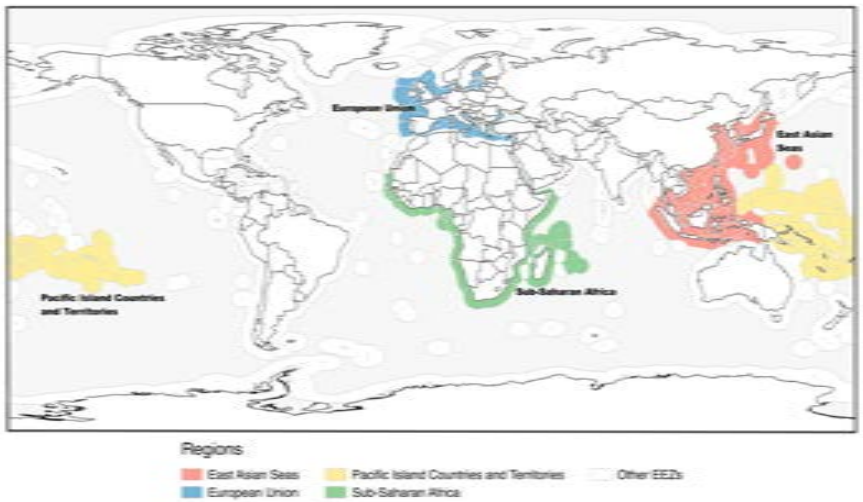
Work involved
- 59 authors/contributors from government and academia
- Spanned the period of 2005 to 2015, with a kick-off meeting at The Ocean Policy Summit, Lisbon, Portugal (2005)
- Supported by the Nippon Foundation, Japan, the Global Environment Facility, the Portuguese government, and others

Caveat
- Should note that there are other nations and regions that have also moved toward integrated ocean governance which we were not able to include in the study, e.g., China, Colombia, France, Indonesia, Mauritius, Netherlands, Seychelles, South Africa, etc. Also, other regional efforts (Regional Seas, LMEs) are not included

15 Nations – Claimed EEZs



Regions - Ocean Area Covered



Major Questions Posed

Common framework for analysis for understanding the dynamics of ocean policy formulation and implementation

Policy Formulation

- **The significance of oceans and coasts in different nations**
- **Motivation for the policy, how it got started**
- **Legal/policy basis: Was it based in a new law? Or executive policy? Product of an ocean commission?**
- **Scope and content**
- **Principles adopted**
- **Institutional arrangements**
- **Stakeholder engagement**

Major Questions Posed

Policy Implementation

- **Agency(ies) in charge of implementation**
- **Division of authority between national and subnational levels of government**
- **Evolution over time**
- **Implementation and evaluation over time**
- **Funding and monitoring mechanisms**
- **Outlook for the future**

Common Catalysts and Trajectories

Common Catalysts

- multiple use conflicts, among uses, users, and agencies
- decline/degradation of coastal and marine areas
- recognition of the value of coastal and ocean resources in terms of ecological/ecosystem, social, and economic services
- encouragement from the international level
- inequities in benefits for foreigners vs locals in ocean areas under national jurisdiction

Trajectories

- typical national trajectory, starting with coastal management, then moving to entire EEZ
- at regional level, realization that separate sectoral policies need to be harmonized and linked (e.g., EU)

Getting Started

Typically:

- ocean commissions
- study commissions
- "white papers"
- inter-agency task forces
- wide stakeholder consultation, development of shared vision
- done at the highest levels of government

Importance of stakeholder consultations

- *The consultation process demonstrated that the success of maritime policy would depend on the support of and sense of ownership of stakeholders, including regional actors already very active in developing integrated maritime actions. Furthermore, the maritime regions of Europe are so diverse and region-based that action had to be different in focus according to each region.*

(Gambert, EU case)

Common Principles Widely Adopted

Wide Adoption of Common International Principles of Integrated Ocean Governance and Sustainable Development

- Sustainable development/ sustainability
- Integrated management
- Ecosystem-based management
- Good governance
- Adaptive management/best available science
- The precautionary approach
- The preservation of marine biodiversity
- Stewardship
- Multiple use management
- Economic/social development and poverty alleviation

- Note: Most nations/regions emphasize environmental and economic dimensions of sustainable development. Goals/targets related to social dimensions and poverty alleviation are less frequent (about ½ of national cases mentioned these factors).

Principles Adopted in Ocean Policies

		x	x	x		x	x	x	x	x	x	
		x	x	x	x	x	x		x			
		x	x	x	x	x	x	x		x		
		x	x	x	x		x					
		x	x		x		x		x		x	
		x	x	x	x	x	x	x	x	x	x	
	(March 2008) (L)											
Mexico	Oceans Agenda 2001 (E)	x	x	x	x			x		x		
New Zealand	National Oceans Policy – 2000 (initiated process) (L)	x	x	x	x	x	x	x	x	x		
Norway	Ocean Resource Act 2008,	x	x	x		x	x	x			x	

Institutional Aspects

Typically involve:

- Inter-agency/inter-sectoral sectoral coordination mechanism
- A lead implementing agency(ies)

Important considerations:

- Clear terms of reference
- Involve coordination at the highest political levels (e.g. Office of the Prime Minister)
- Receive input from an external council of advisers
- Be transparent and allow for public involvement
- Have incentives for joint action, such as joint budgets

Examples of Institutional Aspects of Ocean Policies

Countries	Interagency Mechanism	Administrative Arrangement
AUSTRALIA	National Oceans Ministerial Board (2000) Sustainable Environment Committee (2004) Oceans Board of Management National Oceans Advisory Group Oceans Policy Science Advisory Group	Lead Agency: National Oceans Office (1999-2006), Department of the Environment and Heritage Marine and Biodiversity Division, Department of the Environment and Water Resources (2007) Department of the Environment (previously named Department of the Environment, Water, Heritage and the Arts (from 24 November 2007), Department of the Environment and Water Resources (from 23 January 2007 to 24 November 2007), Department of the Environment and Heritage (prior to 23 January 2007))
BRAZIL	Inter-Ministry Commission for Sea Resources (CIRM) Integration Group of the Coastal Management	Lead Agency: Brazilian Navy
CANADA	Canadian Council of Fisheries and Aquaculture Ministers	Lead: Department of Fisheries and Oceans
INDIA	Ocean Commission (proposed, Vision Perspective 2025)	Lead: Ministry of Earth Sciences
JAMAICA	National Council on Ocean and Coastal Management	Leads: Ministry of Foreign Affairs (Policy-making) National Environment and Planning Agency, and Maritime Authority (Administrative)
JAPAN	Headquarters for Ocean Policy	Secretariat of Headquarters for Ocean Policy

Lead Implementing Bodies

- Important to have a national ocean office to operationalize the national ocean policy and oversee implementation
- Separate budget and staff
- Typically prepare national ocean policy plan, "state of the ocean" reports; coordinate interagency activities, work with subnational authorities
- Example: Secretariat of Ocean Policy Headquarters in Japan, oversees Basic Act of Ocean Policy, has separate budget and about 20 staff members

Other Observations

- A number of cases involve *regional* ocean planning processes and bodies (e.g. Australia, US)
- Increased use of *marine spatial planning* (e.g., required in 2014 EU Directive on marine spatial planning)
- Dedicated and stable *oceans funding* a challenge in many cases. Efforts made to develop special funds (e.g. from oil and gas)
- In some cases, very good use of *indicators* which are tracked over time (e.g., Canada, PEMSEA)
- In some cases, evaluations from outside experts that prepare *"report cards"* on the national ocean policy (e.g., US)

Some Success Factors

- **Embracing and implementing common ocean principles**– *much of the world has already adopted and put into practice major principles of integrated ecosystem-based national and regional policies*
- **Achieving an integrated outcome through formal coordination institutions**– *having formal coordinating institutions to guide the national and regional policies with independent input from stakeholders is essential*
- **Ensuring and maintaining political support**– *the ups and downs of ocean policies, ocean policy entrepreneurs in and out of government must continuously foster high-level political support*

Success Factors

- **Promoting binding policies**–*policy embedded in law tends to be more successful in the long run, executive action can all too often be reversed with changing administrations (only 4 out of 15 national ocean policies are based on legislation)*
- **Enabling stakeholders**—*essential for molding the policy and for maintaining political support in the long run*
- **Ensuring adequate funding and other supporting elements**—*consistent funding and other support elements (research, science, public education) essential in the steady and continued implementation of the policies over time*

Part 2

Top down **developments– from the global level**

↓

a. **Sustainable development goals– UNGA 2015**

b. **Formulation of a new climate regime– COP 21—UNFCCC 2015**

c. **Toward a new regime on Areas Beyond National Jurisdiction (ABNJ)– UNGA 2016**

Part 2a

Sustainable Development Goals–UNGA 2015

Mandated in Rio+20, UN Open Working Group on Sustainable Development Goals

All the intertwined issues addressing the three dimensions of sustainable development: Environmental, economic, social

Sustainable Development Goals

- Goal 1. End poverty in all its forms everywhere
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 3. Ensure healthy lives and promote well-being for all at all ages
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5. Achieve gender equality and empower all women and girls
- Goal 6. Ensure availability and sustainable management of water and sanitation for all
- Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Sustainable Development Goals (cont.)

- Goal 10. Reduce inequality within and among countries
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12. Ensure sustainable consumption and production patterns
- Goal 13. Take urgent action to combat climate change and its impacts*
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

**Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.*

The SDG Package and Goal 14

1. Global Ocean Forum very active in the Rio+20 process and in the subsequent SDG process (policy analyses, convening of Friends of the Ocean meetings, side events, commentaries on the processes, Oceans Day at Rio+20)

2. Open Working Group on SDG process– initially limited understanding of oceans and the three pillars, but after catalytic interventions and side events (especially from the Pacific SIDS and others), a marked change. Ultimately, more than 90 nations came to favor the stand-along oceans SDG. And the UN Open Working Group on Sustainable Development Goals turned out to be a very open and transparent process.

3. Goal 14 on Oceans and Seas--very good (not perfect). A great accomplishment and will have major effects on advancing oceans and peoples issues in countries and regions around the world.

4. Goal 14 is rooted in most cases in existing global commitments on oceans and brings them together in concerted ways with a renewed sense of urgency. Some important new commitments, e.g. 14.7 on enhanced economic benefits for SIDS and LDCs.

5. Goal 14 must be understood in the context of the overall SDG package. Many of the other provisions of the package can be used to support oceans. The package is inspiring and visionary and will lead nations to truly wed all three dimensions of sustainable development

SDG 14 on Oceans, Seas and Marine Resources

Goal: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Targets:

14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution

Reinforces 1992 provisions (17.22, 17.24-17.28), 2002 provision (33), and 2012 provisions (34a & b, 58e, 158, and 163). Emphasizes marine pollution of all kinds, including marine debris (first highlighted by Rio+20) and the ongoing reduction of nutrient pollution. Provides a 2025 time target in contrast to the 2020 time target of the Convention on Biological Diversity's Aichi Biodiversity Target 8.

14.2: By 2020, sustainably manage, and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience and take action for their restoration, to achieve healthy and productive oceans

Reinforces 1992 provisions (17.5,17.6, and 17.85), 2002 provisions (21, 30 c & d), and 2012 provisions (158, 165, 166, and 176). It is noteworthy that the target emphasizes both marine and coastal ecosystems, resilience, and restoration actions.

Targets:

14.3: Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

Ocean acidification had not been addressed directly in the 1992 and 2002 summits since the phenomenon was not yet well understood. Echoes the 2012 provision (166), with a new emphasis on minimizing and taking action on ocean acidification.

14.4: By 2020, effectively regulate harvesting, and end overfishing, illegal, unreported and unregulated (IUU) fishing and destructive fishing practices and implement science-based management plans, to restore fish stocks in the shortest time feasible at least to levels that can produce maximum sustainable yield as determined by their biological characteristics

Building on 1992 provisions (17.79, 17.84, 17.86, and 17.87) and 2002 provisions (30 and 31,), it reinforces the 2012 commitments (168, 169, 170, and 171). Provides a 2020 time target replacing the 2015 time target of the 2002 Johannesburg Plan of Implementation. New time target is aligned with the Convention on Biological Diversity's Aichi Biodiversity Target 6. Echoes the 2012 provision (168) to restore stock levels at maximum sustainable yield as determined by their biological characteristics and emphasizes the effective regulation of harvesting.

Targets:

14.5: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on best available scientific information

Building on 1992 provisions (15.5g, 17.7, 17.8, 17.85, and 17.87) and 2002 provisions (32 and 44), it reinforces the 2012 commitments (177 and 180). Provides a 2020 time target in line with the Convention on Biological Diversity's Aichi Biodiversity Target 11.

14.6: By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation

Reinforces 2002 provision (32f) and 2012 provision (173). Time target is aligned with the Convention on Biological Diversity's Aichi Biodiversity Target 6.

14.7: By 2030 increase the economic benefits to SIDS and LDCs from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

While building on past 2002 (31 and 58) and 2012 (174 and 175) provisions, this target represents an important new emphasis by clearly calling for an increase of economic benefits from marine resources to developing countries and SIDS by 2030, with specific reference to three sectors—fisheries, aquaculture, and tourism.

Means of Implementation

14.a: Increase scientific knowledge, develop research capacities and transfer marine technology taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular SIDS and LDCs

While building on the capacity development provisions of the 1992 (17.40, 17.43, 17.68, 17.69, 17.92, 17.94, 17.95, 17.120a, and 17.136) and 2002 summits (10f, 30g, 32b, 33a & b, 36, and 58c), and building on the 2012 capacity development provisions emphasizing the IOC Criteria and Guidelines on the Transfer of Marine Technology (120 and 160), this Means of Implementation, for the first time, emphasizes the importance of the enhanced contribution of marine biodiversity to the development of developing countries, in particular SIDS and LDCs. It is important to note that the ability to study, collect, and sustainably use marine biodiversity resources is one of the major gaps in capacity in SIDS and LDCs.

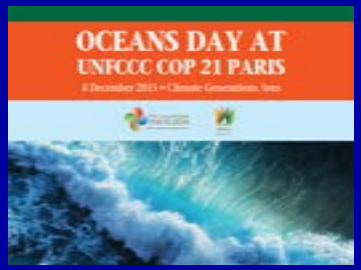
14.b: Provide access of small-scale artisanal fishers to marine resources and markets

Reinforces 1992 provisions (17.81) and reiterates the 2012 provision (175). Does not mention subsistence fisherfolk, women, local communities, and indigenous people.

14.c: Ensure the full implementation of international law, as reflected in UNCLOS for states parties to it, including, where applicable, existing regional and international regimes for the conservation and sustainable use of oceans and their resources by their parties

Building on the 1992 provisions (17.117 and 17.120a), 2002 provisions (158-160, 162, and 165) of increasing cooperation on all levels, and including the 2012 provisions (75, 76, 159,185) on implementing the obligations under UNCLOS, this Means of Implementation, broadly emphasizes the full implementation of UNCLOS and of other existing regional and international regimes for the conservation and sustainable use of oceans and their resources.

Part 2b
Advancing Oceans at the UNFCCC COP 21 Paris: Mobilization, Outcomes, and Next Steps



33

The Paris Agreement

- Historic agreement, landmark achievement, marks a common political will to stem the rise of global warming and shift from fossil fuels
- Gives hope to avoid disastrous consequences associated with climate change

34

Pour Sauver La Planète




35

The Paris Agreement

- *The Paris Agreement includes provisions for:*
  - Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C, recognizing that this would significantly reduce the risks and impacts of climate change
    - *The 1.5 °C goal had long been advocated by the 44 small island developing States, "1.5 to stay alive," referring to the threats of sea level rise, increased floods and storms which could obliterate their homes and nations.*

36

The Paris Agreement

- The Paris Agreement provides that:
- *Developed country Parties* should continue taking the lead by undertaking *economy-wide absolute emission reduction targets*.
- *Developing country Parties* should continue enhancing their mitigation efforts, and are encouraged to *move over time towards economy-wide emission reduction* or limitation targets in the light of different national circumstances.

37

The Paris Agreement

- *The Paris Agreement includes provisions for:*
  - A system of national reports by all countries reporting on reductions to emissions and other matters every five years, and a transparent system of accounting and verification, with periodic "global stocktake," with a first facilitative dialogue in 2018
  - Financing by developed countries to assist developing countries with respect to both mitigation and adaptation
    - *Prior to 2025 the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall set a new collective quantified goal from a floor of USD 100 billion per year, taking into account the needs and priorities of developing countries*
  - Strengthening of capacity development regarding mitigation and adaptation programs, and cooperative action on technology development and transfer
  - Averting, minimizing, and addressing human displacement issues related to the adverse impacts of climate change

38

Central issue for oceans community

- Oceans and climate are intertwined, with oceans driving climate and climate change affecting ocean health and coastal and island peoples. Oceans cycle over 93% of carbon dioxide in the atmosphere, produce 50% of the oxygen we breathe, store 50% of all naturally sequestered carbon, and absorb 90% of the heat added to the global system in the past 200 years.
- Oceans, seas, and coastal areas are experiencing an increased frequency and intensity of climate extremes, including stronger hurricanes, typhoons, and cyclones. Changes in ocean chemistry and temperature are causing ocean acidification, sea level rise, and fluctuations in ocean circulation and salinity. Coastal populations and small island developing States (SIDS) in 183 countries will be most affected by climate change and typically have insufficient resources to combat these changes.
- And yet oceans and coasts were not explicitly part of the UNFCCC negotiating text

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Our Strategy for COP 21

Oceans Day at the UNFCCC COP 21 Paris

December 4, 2015, Rio Conventions Pavilion, Le Bourget

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COP 21 Strategy

- Oceans Day, high-level, presentation of recommendations on oceans and climate
- Line up key partner organizations (46 partners)
- Line up key high-level speakers
- Coordinate with other alliances
- Mobilize expert international working group
- Work on the negotiating text
- Plan and mobilize a coordinated strategy for the next five years

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Oceans Day at COP 21

Building on three previous Oceans Days (Copenhagen 2009, Cancun 2010, Durban 2011), the Oceans Day at COP 21, 4 December 2015, was a high-level event held to:

- Highlight the major climate and oceans issues, with emphasis on the impacts on the most vulnerable peoples and ecosystems, and suggest next steps, both within and outside the UNFCCC framework
- Foster political leadership and move forward on the major climate and oceans solutions with the engagement of high-level leaders around the world
- Catalyze and share solutions as part of the global portfolio of actions
- Mobilize collaboration in the development of a five-year strategic plan on oceans and climate to guide policy and action.

Over 400 participants from all world regions

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46 Organizers

Intergovernmental Oceanographic Commission/ UNESCO

Global Ocean Forum

United Nations Environment Programme

Ocean Policy Research Institute, Sasakawa Peace Foundation, Japan

Ocean and Climate Platform

University of Delaware, Gerard J. Mangone Center for Marine Policy

Co-Organizers

44

Co-Organizers

Non-Governmental Organizations/Foundations (National/International)

- Coastal & Marine Union (EUCC)
- Forum do Mar, Brazil
- Global Island Partnership
- Institute for Sustainable Development and International Relations (IDDRI), France
- Institut Océanographique, Fondation Albert Ier, Prince de Monaco
- International Union for Conservation of Nature (IUCN)
- Partnership for Climate, Fisheries, and Aquaculture
- Prince Albert II of Monaco Foundation
- The Nature Conservancy
- World Ocean Network
- World Ocean Observatory
- World Wide Fund for Nature
- Nausicaá

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Co-Organizers

Academic/Scientific Institutions

- Center for Coastal Studies, Provincetown, Mass., USA
- Centre National de la Recherche Scientifique, France
- Duke University, Nicholas Institute for Environmental Policy Solutions
- Global Change Institute, University of Queensland
- Instituto Politécnico Nacional, Mexico
- Monmouth University, Urban Coast Institute
- Oceanário de Lisboa
- Plymouth Marine Laboratory
- Turkish Marine Research Foundation
- Scripps Institution of Oceanography, University of California San Diego
- Tara Expeditions

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Selected Oceans Day High Level Speakers

H.S.H. Prince Albert II of Monaco

H.E. Mr. Tommy E. Remengesau, Jr., President, Republic of Palau

H.E. Mr. Ronald Jumeau, Ambassador, Climate Change and SIDS Issues, Seychelles

H.E. Ms. Mary Robinson, President, Mary Robinson Foundation – Climate Justice

H.E. Mr. Greg Hunt, Minister for the Environment, Australia

H.E. Mr. Manuel Pulgar-Vidal, Minister of Environment, Peru

H.E. Dr. Angus Friday, Ambassador of Grenada to the US

Mr. Hans Hoogeveen, Director General for Agriculture and Nature, the Netherlands

H.E. Mme. Ségolène Royal, Minister of Ecology, Sustainable Development and Energy, France

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Mr. Hans Hoogeveen, Director General for Agriculture and Nature, the Netherlands

H.E. Mme. Ségolène Royal, Minister of Ecology, Sustainable Development and Energy, France

Extensive Preparatory Work

- Highlighted the need for a strategic action plan on oceans and climate for the next five years
- Mobilized an International Working Group on Oceans and Climate, 36 experts
- Policy Brief and emerging draft recommendations
- Focused on 5 major issues:
  - The central role of oceans in climate
  - Mitigation
  - Adaptation
  - Financing
  - Capacity development (including scientific monitoring and public education)

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Oceans Day at COP 21 Outcomes

The Oceans Day at COP 21 stressed the need for:

- Concluding an ambitious legally binding agreement with stringent reductions in greenhouse gas emissions as essential to avoid disastrous consequences for the ocean and for coastal and island peoples.
  - *This was achieved with the Paris Agreement*

- Recognizing the central role of the oceans in regulating climate, and the fact that the ocean will not be able to perform these functions in the future if global warming continues unabated.
  - *This work was begun with a new provision in the Preamble to the Paris Agreement, which notes "Noting the importance of ensuring the integrity of all ecosystems, including oceans,…when taking action to address climate change"*

- Targeting financing to address climate change impacts in coastal communities and island states—for adaptation programs, for capacity development, for mitigation efforts to preserve coastal and ocean ecosystems, and for addressing the problems of climate-induced population displacement with equity and justice,
  - *This is a work in progress which will continue in the next five years through, in part, the joint efforts of the partner organizations involved in the Oceans Day at COP 21 and other collaborators*

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Oceans Day at COP 21

Next Steps

- Develop a strategic action plan on oceans and climate for the next 5 years
  - Identify what needs to be done on each major recommendation within and outside of UNFCCC and develop a five-year plan of action
  - What action steps are needed by whom and in what time frame? What resources will be required?
  - Determine how the actions can get accomplished within the UNFCCC (interview UNFCCC key delegates, staff) and outside of the UNFCCC as relevant
  - Organize various meetings to create "alliances of the willing" to implement the recommendations
  - Invite a Leaders Group to guide the effort, involving key negotiators in the UNFCCC process and other Ocean Leaders

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Toward COP 22

The efforts to bring the ocean issues into the climate regime, especially the new Paris Agreement, will continue, including with preparations for the Oceans Day at the UNFCCC COP 22 in Marrakech, Morocco, to be held on November 7-18, 2016.

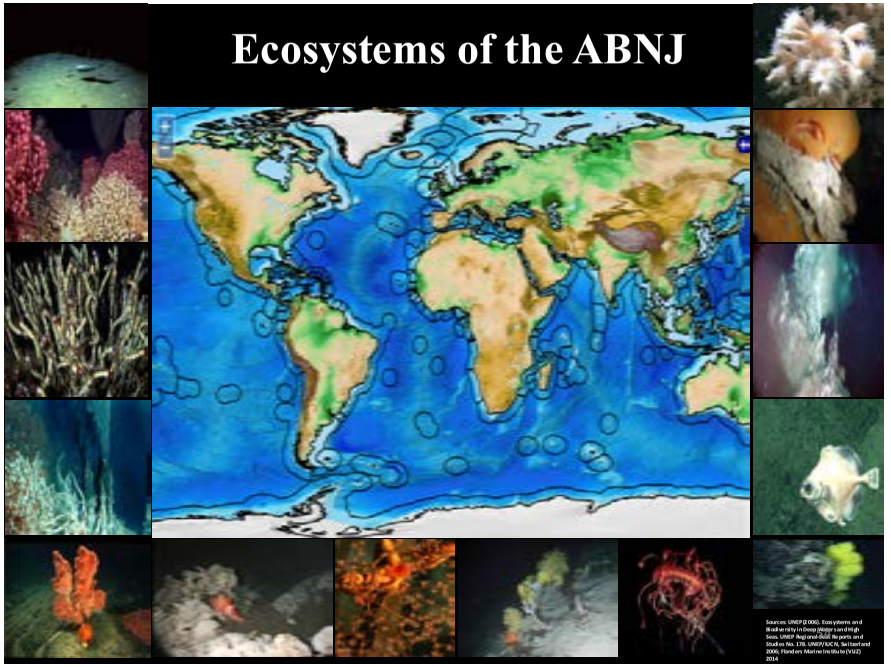
52

Part 2c

Toward a New Regime on Areas Beyond National Jurisdiction (ABNJ)– UNGA 2016

53

Ecosystems of the ABNJ



Characterizing ABNJ

Marine Areas Beyond National Jurisdiction (ABNJ), commonly called the high seas, are *those areas of ocean for which no one nation has sole responsibility for management*

- 64% of the surface of the ocean → the last global commons

Biodiversity and Ecosystems

- Incredibly diverse, unique adaptations, slow reproducing, long-lived, often highly sensitive
- Large knowledge gaps in ABNJ biodiversity and ecosystem dynamics

Major Uses

Current: Fishing, Shipping, Scientific Research, Bioprospecting

Prospective: Mining, Oil and gas, Aquaculture, Renewable energy, Geoengineering, Eco-tourism

55

Why should we care about the ABNJ?

- Unique ecosystems and biodiversity that we have yet to discover/understand
- ABNJ provides critical ecosystem services
- Important resources and uses in ABNJ (e.g., food, pharmaceuticals, shipping)
- Connectivity between ABNJ and EEZ/ICZM management
- Without a sound policy framework, tragedy of the commons will cause irreversible damage– ABNJ is our "common ocean"

56

After 10 Years of Negotiation, Decision by the UNGA to develop a Legally Binding Agreement Under UNCLOS

- June 19, 2015 - UNGA adopted the recommendations in Resolution *A/RES/69/292 - Development of the new internationally legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction*
- New UN negotiations will begin with a Preparatory Committee in 2016

57

PrepCom

- Starts in 2016 (28 March–8 April; 29 August–12 September)
- Reports to the UNGA on progress by the end of 2017
- Topics to be negotiated are:

  "namely the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction, in particular, together and as a whole, marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity building and the transfer of marine technology."

- Note that climate change is not explicitly addressed

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ABNJ Regional Leaders Program

United Nations, New York

The ABNJ Regional Leaders Program promotes knowledge sharing and leadership development regarding marine areas beyond national jurisdiction (ABNJ) among regional and national ocean leaders

Project Organizers and Sponsors

COMMON OCEANS | gef | Food and Agriculture Organization of the United Nations | University of Delaware

Project Partners

Part 3

Summary and Challenges and Opportunities in the Next Phase

60

- Great advances in recent years at the international/global level (SDGs, COP 21, ABNJ negotiations), but involve separate processes (climate change, biodiversity, UNGA, LOS, sustainable development summits), which need to be better linked
- At national and regional levels, much progress on creating and implementing national and regional ocean policies, but now these efforts must take into account the global developments– implementation of the SDGs, the new climate regime, the implications of ABNJ for national and regional management (and viceversa)
- More explicit attention by national and regional ocean decision-makers should be focused on climate and ocean matters, e.g., on integrating national ocean policies with INDCs under the UNFCCC, greater focus on adaptation, mitigation, financing, capacity development and public education on oceans and climate

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Contact information:
Biliana Cicin-Sain
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www.globaloceanforum.com

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「二つの異なる二酸化炭素排出シナリオを通して見た海洋と人間社会の将来 ― COP21後の状況」

Jean-Pierre Gattuso
フランス国立科学研究センター（CNRS） 上席研究ディレクター

要旨

海は、人為的な気候変動を減速させる機能を持つが、その一方で、このことがまさに海の物理的、化学的あり方に大きな影響を与え、生態系や人類に重大な結果をもたらすことになる。そこでまず、海洋とその生態系に起こる変化、さらに海産物その他様々な恩恵の上に表れる変化について、二つの対照的な二酸化炭素シナリオ、すなわち、現行の高排出量を想定したシナリオと、21世紀中に地球の平均気温の上昇範囲を2℃以下に抑えることを謳ったコペンハーゲン合意に則ったシナリオをもとに検証したい。

ここに、四つの重要なメッセージが浮かび上がってくる。第一に、海は気候システムに対して強い影響力を持ち、人類に重要な恩恵を与えるものである。第二に、海洋および沿岸地域の主要な生物、生態系、さらにこれらが人類にもたらす恩恵に対する影響はすでに計測可能な水準にまで達しており、そのいくつかは、排出量を低く抑えた場合でも、2100年よりはるか以前に重大な危機に直面することになる。そして、これら海洋に対する影響は、低緯度から高緯度まで地球上のあらゆる地域に及び、南北間の地域差を越えて、地球全体にとっての懸念となるであろう。第三に、低排出シナリオの水準を超える量の二酸化炭素排出が続けば、世界の海の生態系とその恵みは大規模で回復不可能な圧迫を受けることが予測されており、これを防ぐためには、二酸化炭素排出量を直ちに、そして大幅に削減することが求められる。国連気候変動枠組み条約が目標として掲げる基準を達成するためには、二酸化炭素排出量を低排出シナリオの水準に抑えることが必須で、これより緩い削減基準によるシナリオの下では、きわめて様相の異なる海が出現することになろう。第四に、大気中の二酸化炭素量の増加に伴って、海洋への保護、適応、修復策はいずれもとり得る手段の数が減り、その効果も漸減していくことになる。

2015年12月に行なわれた国連気候変動枠組み条約第21回締約国会議（COP21）で採択されたパリ協定は、「世界の平均気温上昇を産業革命前と比較して2℃未満に抑えるとともに、1.5℃以内に抑える努力を追求することが・・・」と述べている。今回の基調講演では、パリ協定の述べるところが、これを実行する上で、また海への影響の観点から何を意味することになるのかを検討したい。

Futures for ocean and society from different CO2 emissions scenarios: where do we stand after COP21?

Jean-Pierre Gattuso
Directeur de recherche au CNRS

While the ocean moderates anthropogenic climate change, this has great impacts on its fundamental physics and chemistry, with important consequences for ecosystems and people. I will evaluate changes to the ocean and its ecosystems, as well as to the goods and services they provide, under two contrasting CO_2 scenarios: the current high emissions trajectory and a stringent emissions scenario consistent with the Copenhagen Accord of keeping mean global temperature increase below 2°C in the 21st century.

Four key messages will emerge. First, the ocean strongly influences the climate system and provides important services to humans. Second, impacts on key marine and coastal organisms, ecosystems, and services are already detectable and several will face high risk of impacts well before 2100, even under the low emissions scenario. These impacts will occur across all latitudes, making this a global concern beyond the North/South divide. Third, immediate and substantial reduction of CO_2 emissions is required to prevent the massive and mostly irreversible impacts on ocean ecosystems and their services that are projected with emissions greater than those in the low emissions scenario. Limiting emissions to this level is necessary to meet stated objectives of the United Nations Framework Convention on Climate Change; a substantially different ocean would result from any less-stringent emissions scenario. Fourth, as atmospheric CO_2 increases, the protection, adaptation, and repair options for the ocean become fewer and less effective.

The Paris Agreement negotiated in December 2015 at the Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change states "*Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels*…". I will explore what that means in terms of implementation and of impacts on the ocean.

Research and Policy Trends of Ocean Acidification Around the world

Jean-Pierre Gattuso
CNRS-Université Pierre et Marie Curie-Paris 6
Institute for Sustainable Development and International Relations

The Sasakawa Peace Foundation
OPRI THE OCEAN POLICY RESEARCH INSTITUTE

cnrs UPMC IDDRI

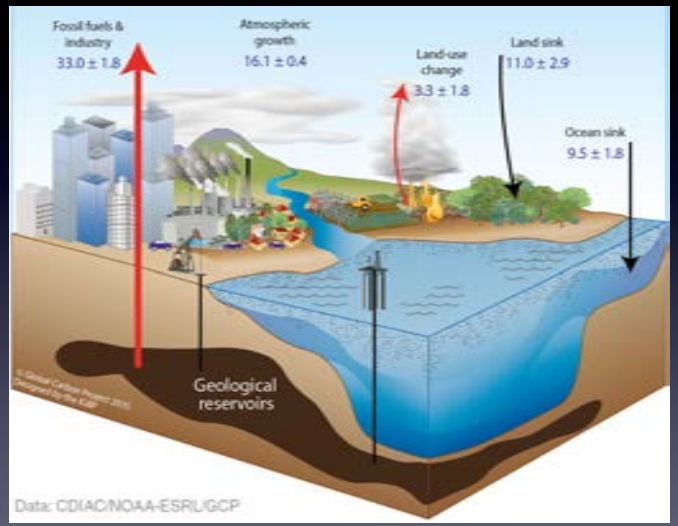
1

Impacts of human activities

McCauley et al. (2015)

2

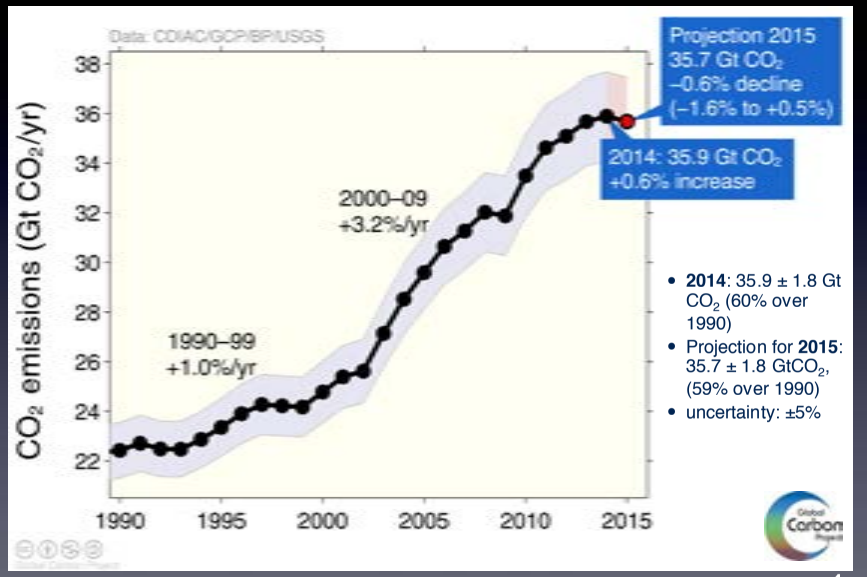
Anthropogenic perturbation of the global carbon cycle (2005-2015; Gt CO_2/yr)



Source: CDIAC; NOAA-ESRL; Le Quéré et al 2015; Global Carbon Budget 2015

3

CO_2 emissions from fossil fuels and industry

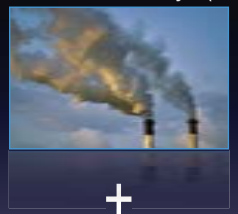


Source: CDIAC; Le Quéré et al 2015; Global Carbon Budget 2015

4

Global carbon budget (2005-2014)

33.0 ± 1.6 Gt CO_2/yr (91%)



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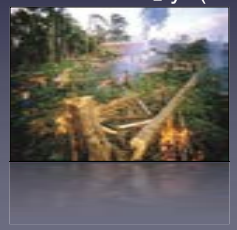
3.4 ± 1.8 Gt CO_2/yr (9%)



Le Quéré et al. (2013)

5

Global carbon budget (2005-2014)

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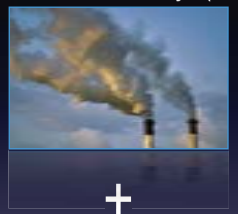

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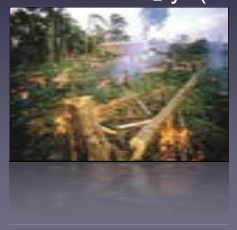
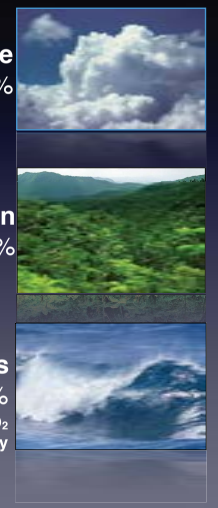


Atmosphere 44%

Vegetation 30%

Oceans 26%

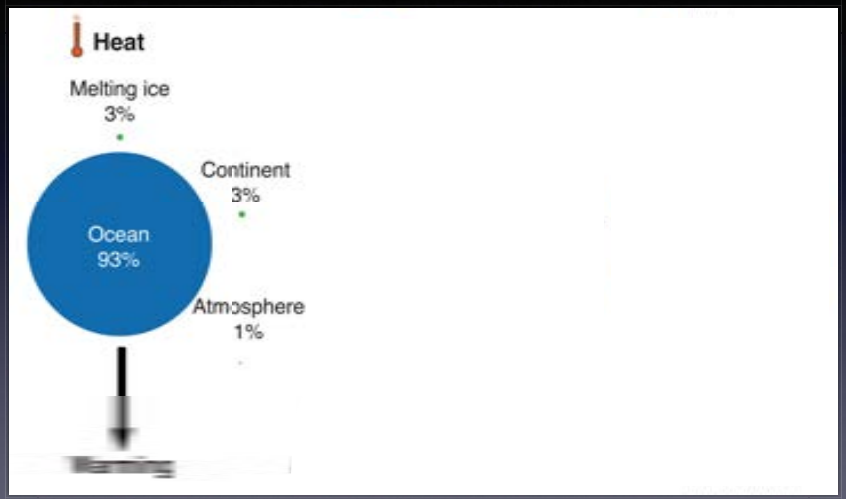
30 millions tonnes CO_2 per day



Le Quéré et al. (2013)

6

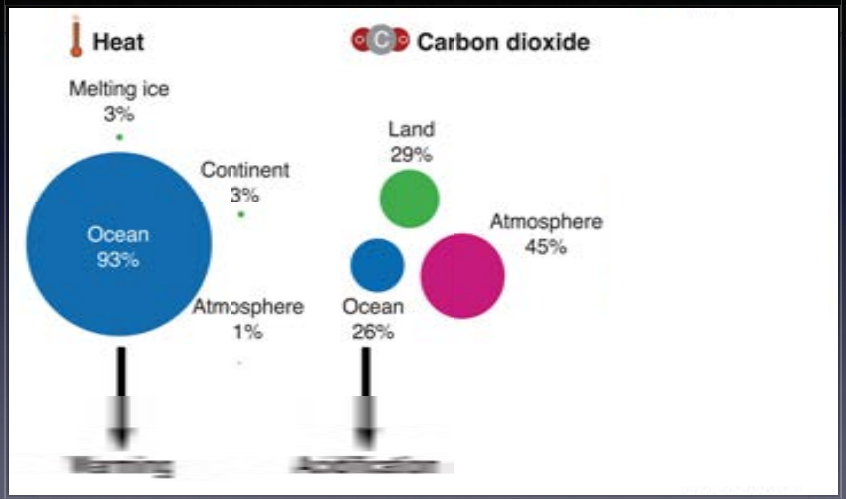
Ocean: actor and victim of climate change



Magnan et al. (2015)

7

Ocean: actor and victim of climate change



Magnan et al. (2015)

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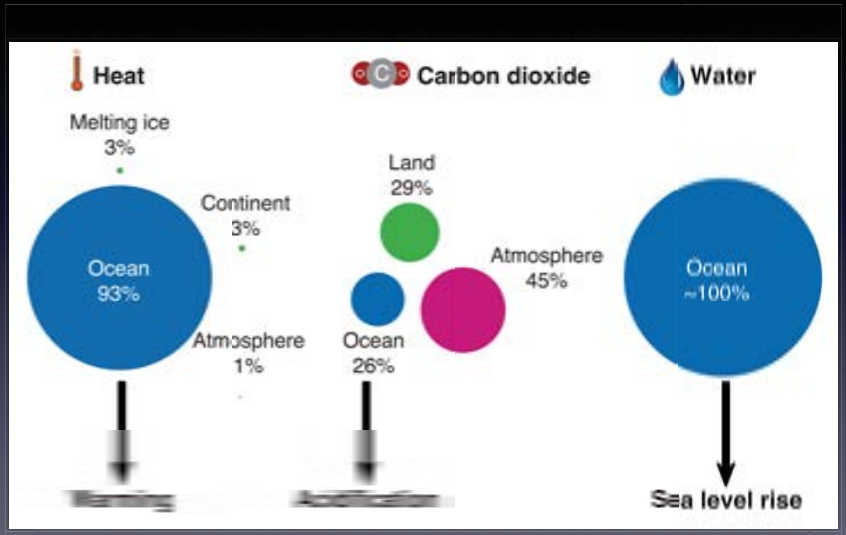
Ocean: actor and victim of climate change



Magnan et al. (2015)

9

Ocean acidification

10

What is ocean acidification?

Sam Dupont

- CO_2 is an acid gas (it produces acid when combined with water)
- Each of us adds 4 kg CO_2 per day to the ocean (increasing acidity, reducing pH)

11

What is ocean acidification?

Sam Dupont

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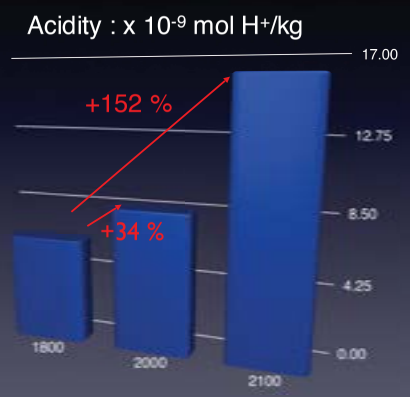

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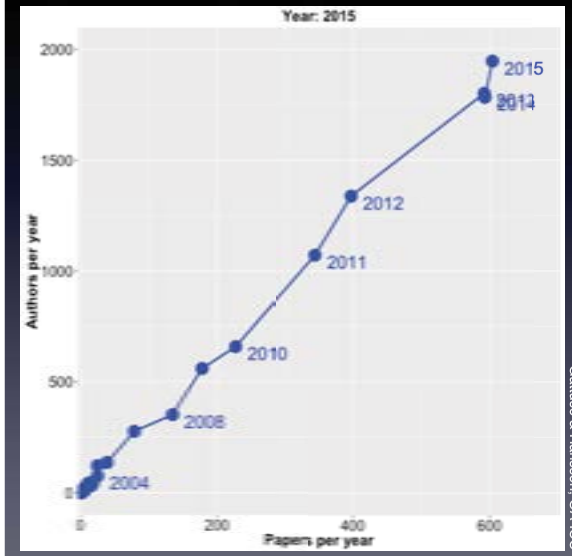
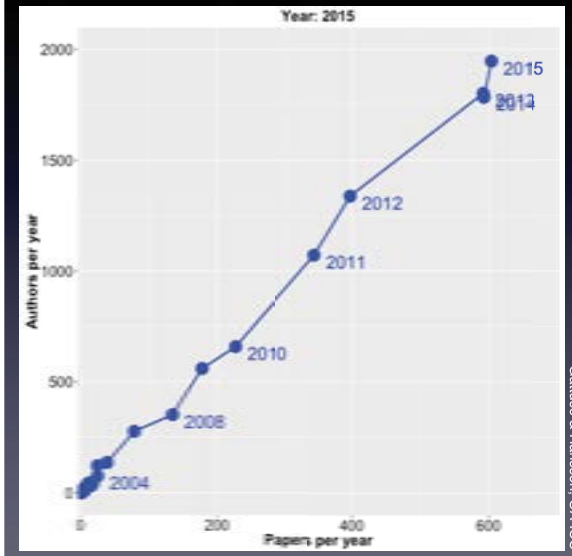
Papers on ocean acidification



13

Papers on ocean acidification



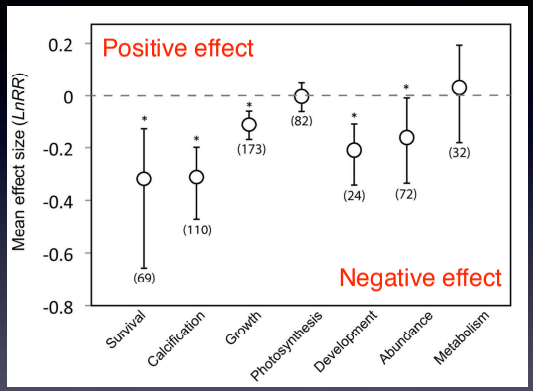
Papers:
- 604 in 2015
- 50% in past 4 years
- +33% y^{-1} since 2000 vs +4% y^{-1} in WoS

Authors:
- 1947 in 2015

14

Meta-analysis: Kroeker et al. (2013)

- Significant negative effect on:
  - survival
  - calcification
  - growth
  - development
  - abundance



15

Ocean warming

16

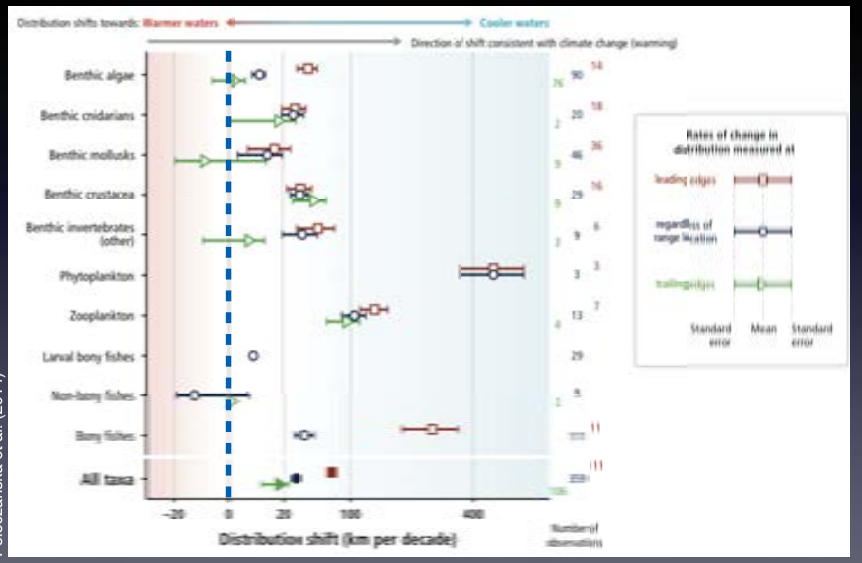
Warming: mass mortalities

Gattuso et al. (2014). © R. Berkelmans

Also elsewhere:
Mediterranean Sea

17

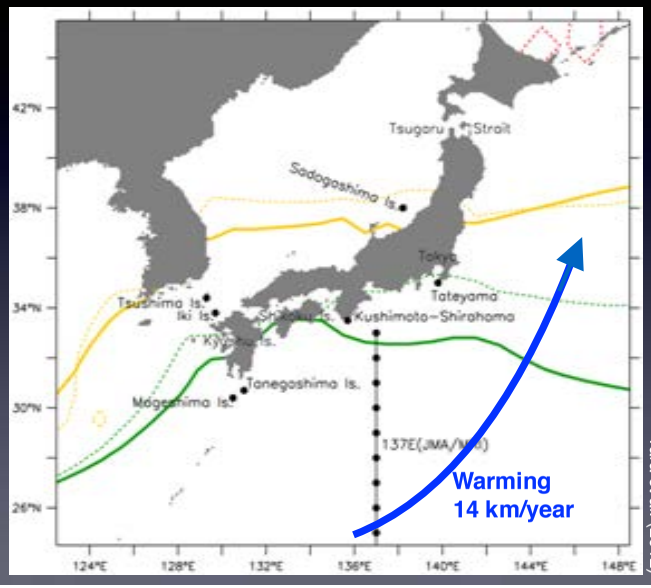
Warming: redistribution of species



Poloczanska et al. (2014)

18

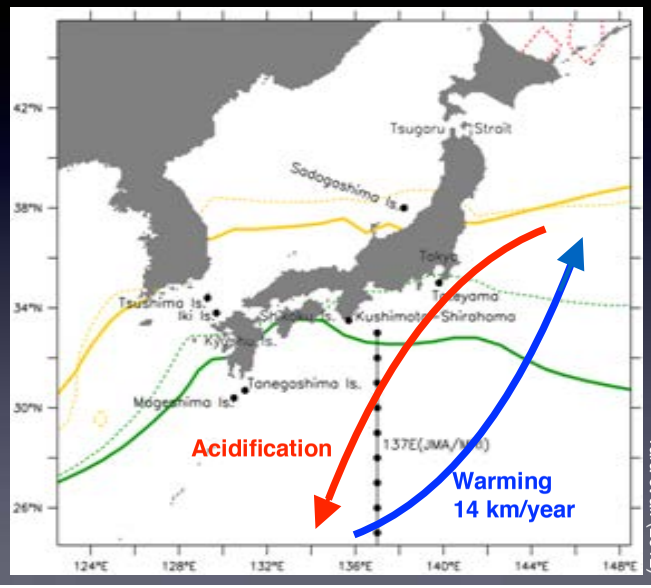
Polar displacement?
A few corals do not make a reef



Yara et al. (2012)

19

Polar displacement?
A few corals do not make a reef



Yara et al. (2012)

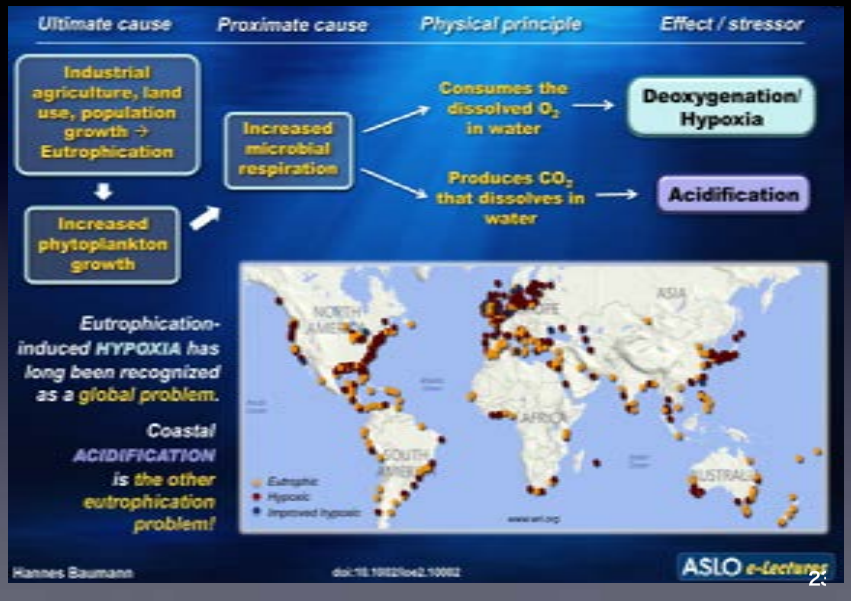
20

Ocean deoxygenation

Causes of deoxygenation

- O_2 decreases due to increase in ocean warming and stratification
- Like ocean acidification, regional and local drivers too

Causes of deoxygenation



Global impacts on the ocean

REVIEW

OCEANOGRAPHY

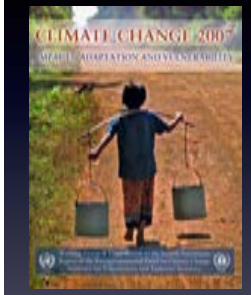
Contrasting futures for ocean and society from different anthropogenic CO_2 emissions scenarios

J.-P. Gattuso,[1,2,3]* A. Magnan,[3] R. Billé,[4] W. W. L. Cheung,[5] E. L. Howes,[6] F. Joos,[7] D. Allemand,[8,9] L. Bopp,[10] S. R. Cooley,[11] C. M. Eakin,[12] O. Hoegh-Guldberg,[13] R. P. Kelly,[14] H.-O. Pörtner,[6] A. D. Rogers,[15] J. M. Baxter,[16] D. Laffoley,[17] D. Osborn,[18] A. Rankovic,[3,19] J. Rochette,[3] U. R. Sumaila,[20] S. Treyer,[3] C. Turley[21]

Science, July 2015

IPCC coverage of ocean impacts

2007: AR4



- C6: Coastal systems

2014: AR5

- C5: Coastal systems
- C6: Ocean systems
- C30: The ocean
- Ocean reprint package
- Ocean web site

Special report?

Proposal from the Government of Monaco

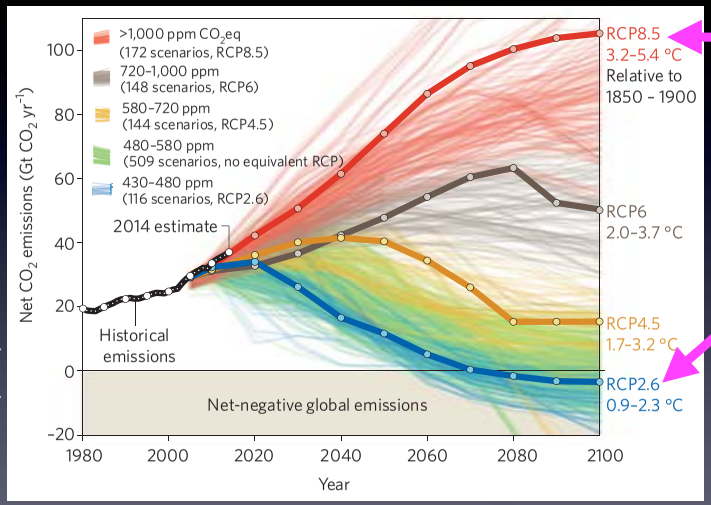
AR6?

OCEANS 2015 INITIATIVE

- Comprehensive assessment of the links between ocean and climate:
  - physics and chemistry
  - key organisms
  - key ecosystems and the services they provide
  - solutions
- Key messages to policy makers
- Building on IPCC AR5 and expanding with post AR5 literature
- Other products for policy makers and the general public

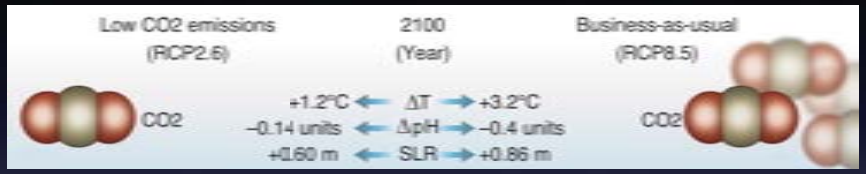
FONDATION BNP PARIBAS AMAO

Future scenarios

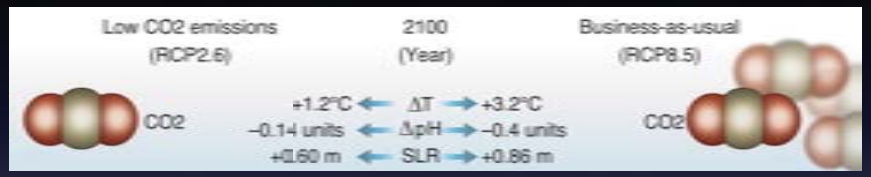


Fuss et al. (2014)

Physics and chemistry

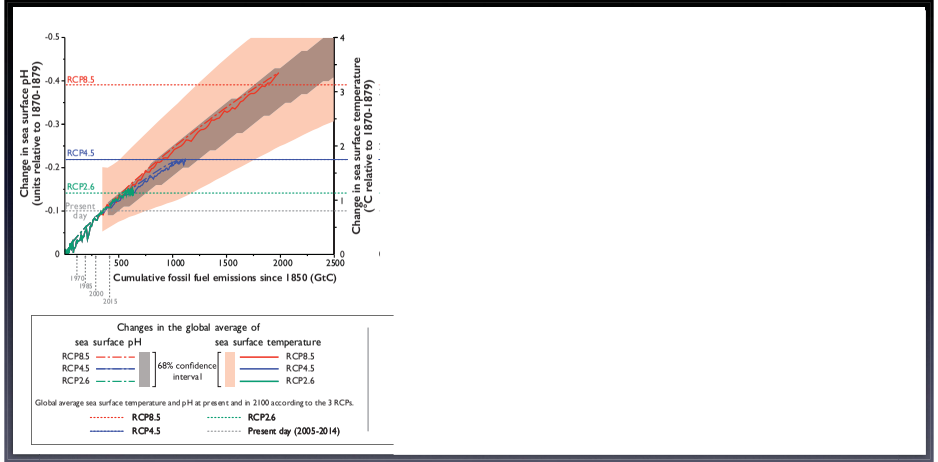


Physics and chemistry



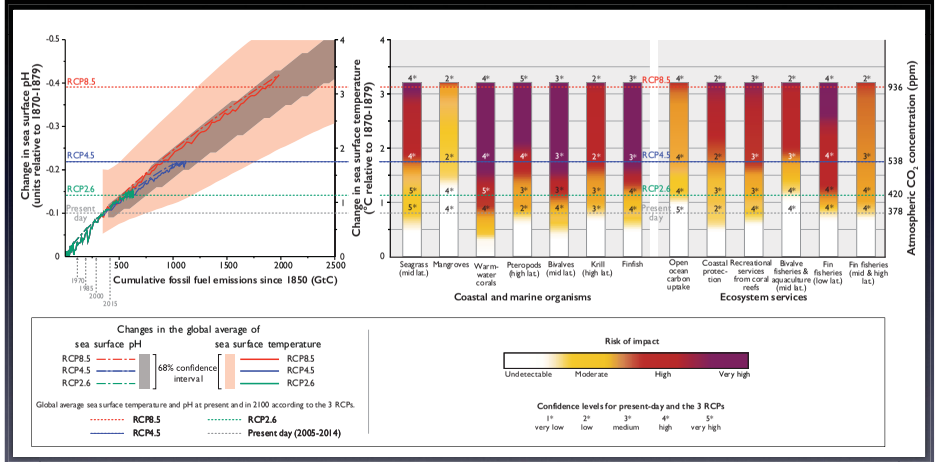
- Thresholds: +1.5 °C and -0.2 pH units relative to preindustrial
- RCP8.5: **69%** of the ocean surface will exceed both thresholds
- RCP2.6: < **1%**

Risks of impact on marine and coastal organisms and ecosystem services

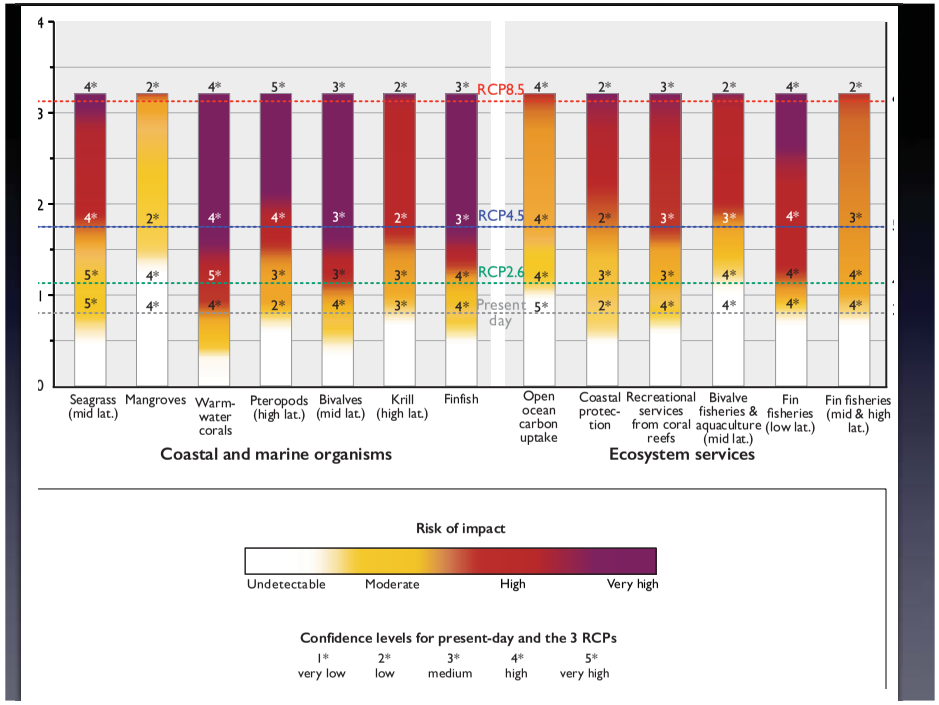


Gattuso et al. (2015)

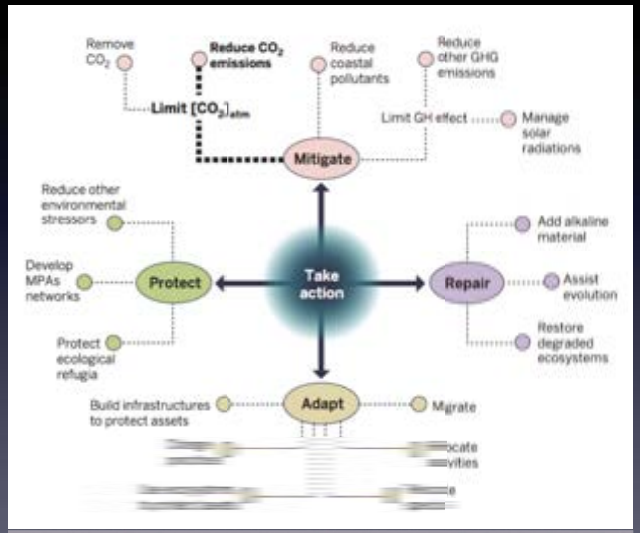
Risks of impact on marine and coastal organisms and ecosystem services



Gattuso et al. (2015)



Solutions



Gattuso et al. (2015)

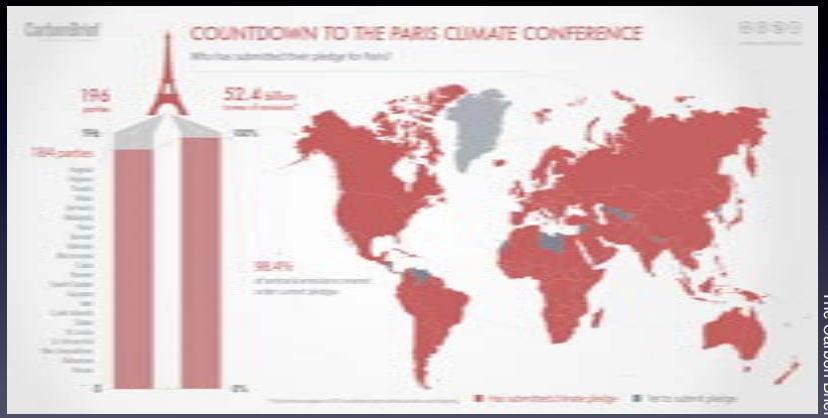
4 key messages

1. Ocean strongly influences the climate system and important provider of key services
2. Impacts already detectable, high risk of impacts well before 2100, even with a low emission scenario
3. Immediate and substantial reduction of CO_2 emissions to prevent massive and mostly irreversible impacts
4. As CO_2 increases, the protection, adaptation, and repair options become fewer and less effective

COP21

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

On the road to COP21 in Paris



The Carbon Brief

Happy end

37

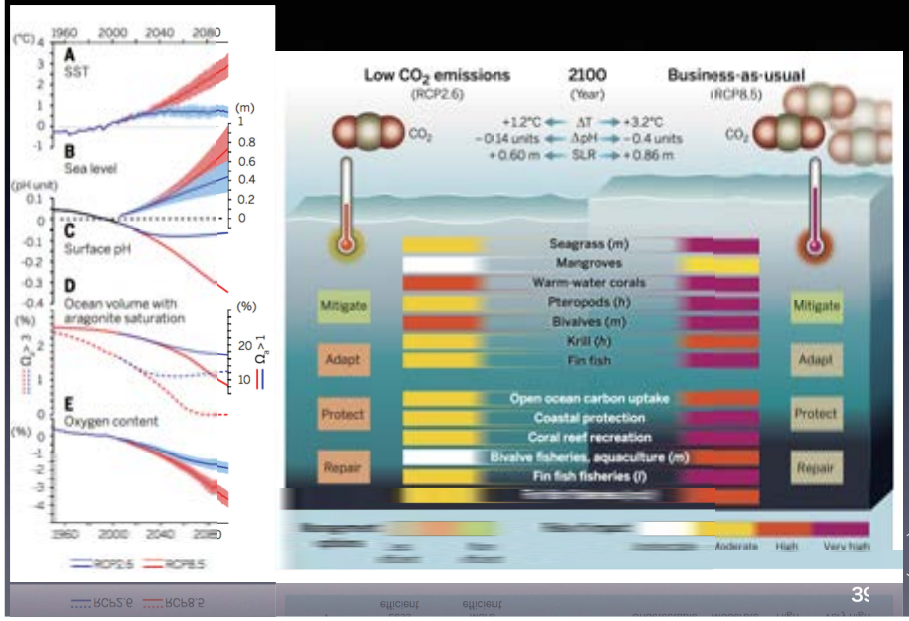
Paris Agreement

"Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels…"

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

38

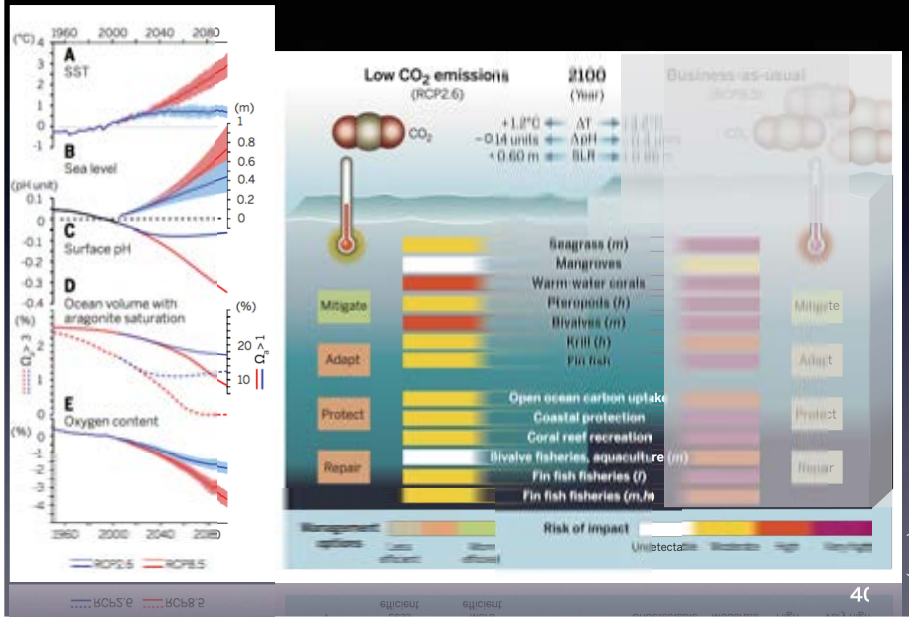
What does it means for the ocean?



Gattuso et al. (2015)

39

What does it means for the ocean?



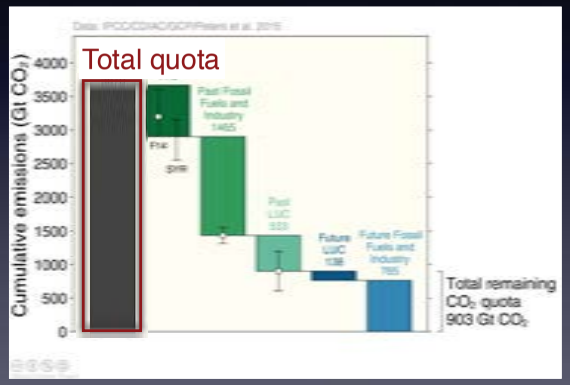
Gattuso et al. (2015)

40

The remaining carbon quota for 66% chance <2°C

41

The remaining carbon quota for 66% chance <2°C

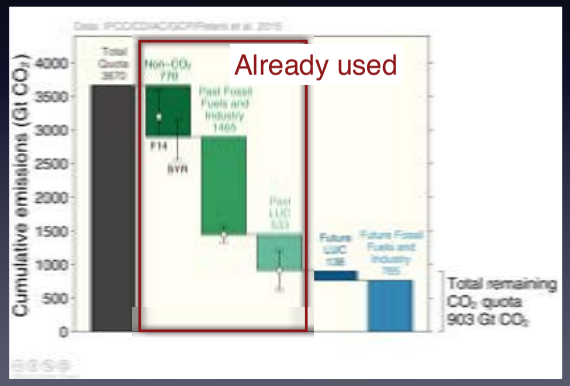


Grey: Total quota for 2°C. Green: Removed from quota. Blue: remaining quota.
With projected 2015 emissions, this remaining quota drops to 865 Gt CO_2

Source: Peters et al 2015; Global Carbon Budget 2015

42

The remaining carbon quota for 66% chance <2°C

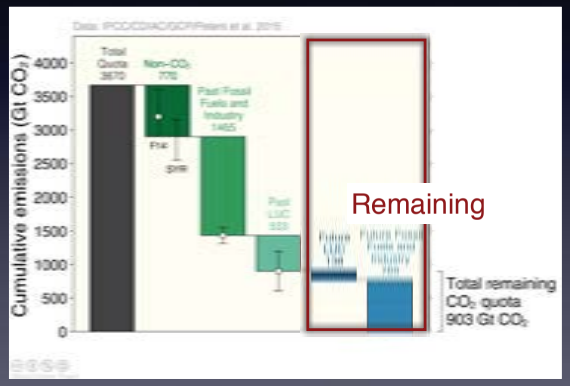


Grey: Total quota for 2°C. Green: Removed from quota. Blue: remaining quota.
With projected 2015 emissions, this remaining quota drops to 865 Gt CO_2

Source: Peters et al 2015; Global Carbon Budget 2015

43

The remaining carbon quota for 66% chance <2°C



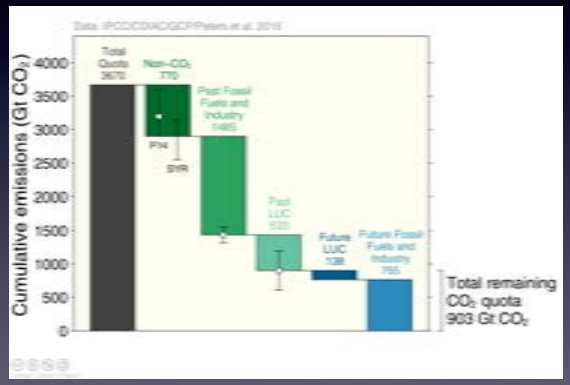
Grey: Total quota for 2°C. Green: Removed from quota. Blue: remaining quota.
With projected 2015 emissions, this remaining quota drops to 865 Gt CO_2

Source: Peters et al 2015; Global Carbon Budget 2015

42

The remaining carbon quota for 66% chance <2°C

The total remaining emissions from 2014 to keep global average temperature below 2°C (900 Gt CO_2) will be used in around 20 years at current emission rates

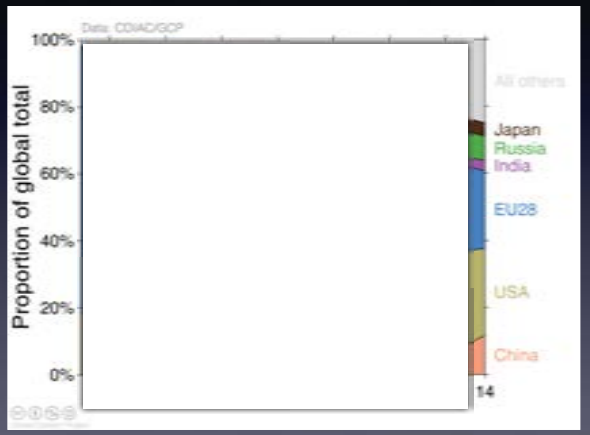


Grey: Total quota for 2°C. Green: Removed from quota. Blue: remaining quota. With projected 2015 emissions, this remaining quota drops to 865 Gt CO_2

Source: Peters et al 2015; Global Carbon Budget 2015

Historical cumulative emissions by country

Cumulative emissions from fossil-fuel and cement were distributed (1870-2014): USA (26%), EU28 (23%), China (12%), and India (3%) covering 64% of the total share



Cumulative emissions (1990–2014) were distributed USA (20%), China (19%), EU28 (15%), India (5%)

'All others' includes all other countries along with bunker fuels and statistical differences

Source: CDIAC; Le Quéré et al 2015; Global Carbon Budget 2015

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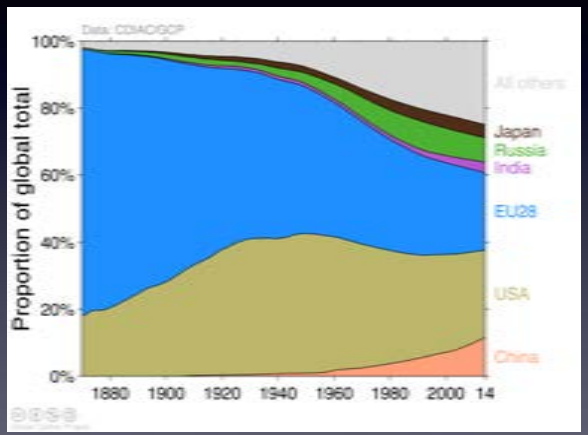

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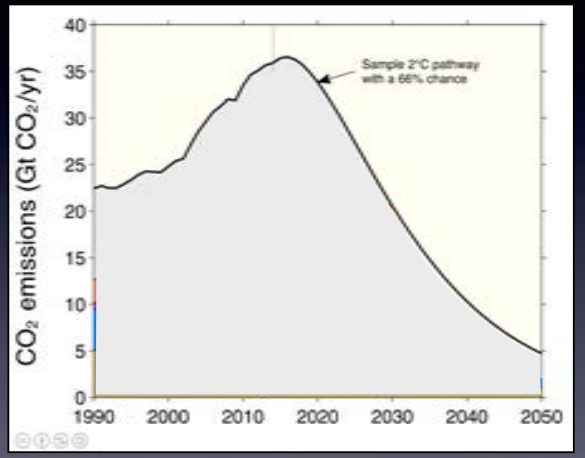
Source: CDIAC; Le Quéré et al 2015; Global Carbon Budget 2015

The emission pledges (INDCs) of the top-4 emitters



Source: Peters et al 2015; Global Carbon Budget 2015

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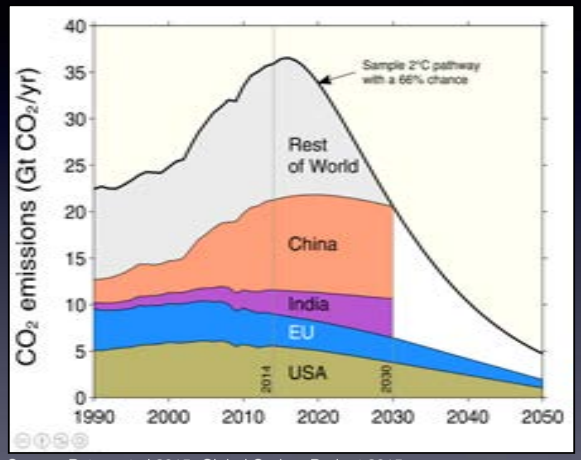
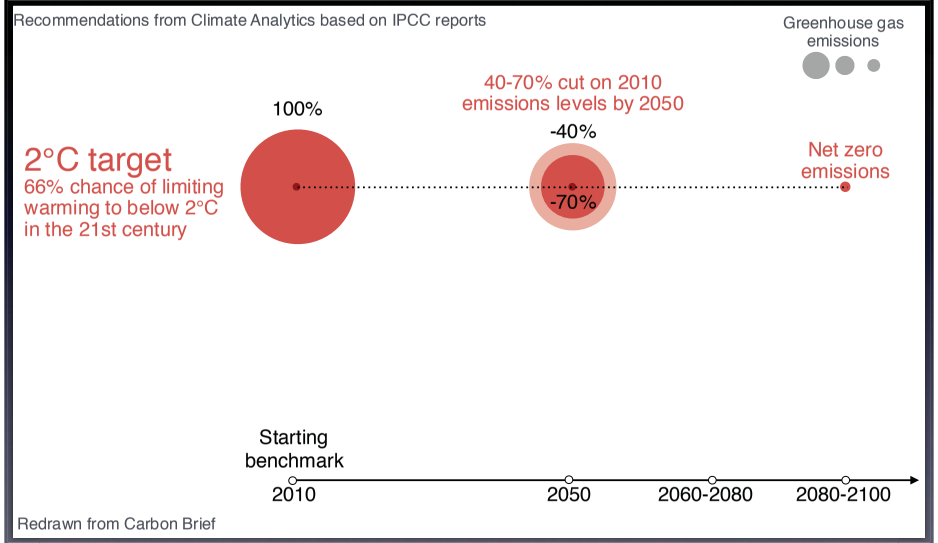


Source: Peters et al 2015; Global Carbon Budget 2015

What it means?



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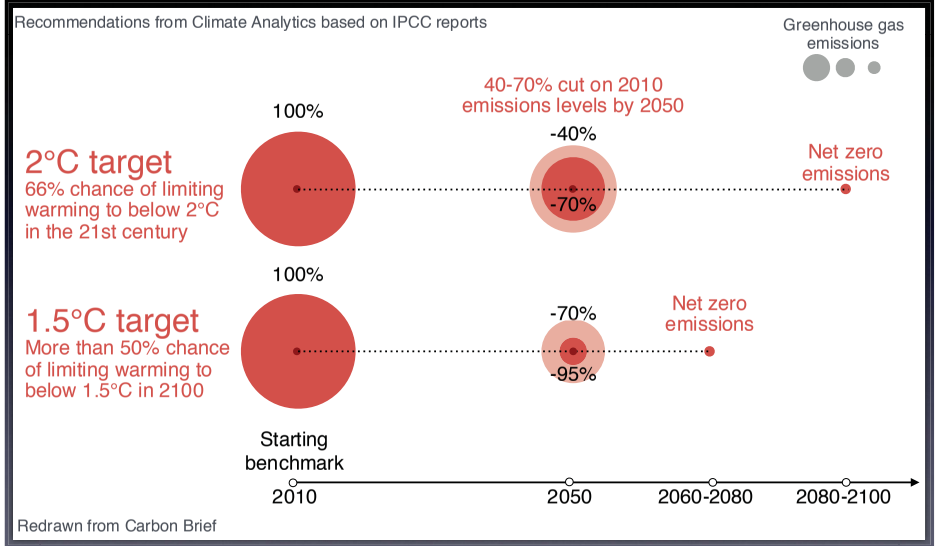


How much fossil fuel must stay underground?

To have a 66% chance to remain below 2°C

How much fossil fuel must stay underground?

To have a 66% chance to remain below 2°C

52% of natural gas reserves

35% of oil reserves

88% of coal reserves

Redrawn from Carbon Brief

OCEANS 2015 INITIATIVE

cnrs UPMC IDDRI

IAEA OA-ICC FONDATION BNP PARIBAS AMAO

「海洋酸性化問題をいかにして主流化するか？」

白山 義久
（海洋研究開発機構 理事 ）

要旨

海洋酸性化が、海洋環境の脅威として認識されるようになって、すでに20年以上の歳月が流れている。世界経済フォーラムでは、2014年の報告において5つの主要な海洋環境の脅威の一つに挙げており、世界的にその深刻さが認識されている。それに対して、我が国では、その深刻さは社会的に十分認知されているとはいえない。しかし、今後大気中の二酸化炭素濃度が今のままの速度で上昇すれば、気候変化とあいまって、日本の沿岸から、さらには世界中から、造礁サンゴの生育に好適な環境は失われてしまう。さらに、将来の環境を模した実験の結果から、貝類やウニなどの重要な水産生物も深刻な負の影響を受けることは、避けられないと考えられる。水産物に社会が大きく依存している我が国では、この深刻さは社会に容易に理解してもらえる可能性がある。その結果として、少しでも化石燃料の使用に伴う二酸化炭素の排出を削減することにつなげられれば、有力な温暖化対策にもなる。したがって、海洋酸性化の社会的理解の増進は、二重の意味で今後推進すべき重要な取り組みなのである。

How to promote public awareness regarding the threats of Ocean Acidification

Yoshihisa Shirayama
Executive Director, JAMSTEC

It is already over 20 years since acidification of the oceans and seas came to be recognized as a threat to the marine environment. The World Economic Forum listed acidification as one of the five major threats to the marine environment in its 2014 report, and the seriousness of the issue is now globally recognized. Contrary to this global trend, the gravity of the matter has not yet been fully grasped by Japanese society. Even so, if the concentration of CO_2 in the atmosphere continues to rise at the current rate in conjunction with climate change, coasts around Japan and the rest of the world will lose ecosystems suitable for the growth of reef-building corals. Furthermore, results of experiments conducted under simulated future environmental conditions reveal that it is inevitable that important marine organisms, including shellfish and sea urchins, will suffer serious negative impacts. With Japan being highly reliant on marine products, it is possible that society will readily appreciate the seriousness of this issue. If this awareness could lead to even a small reduction in CO_2 emissions associated with the use of fossil fuels, it would also serve as a powerful countermeasure to global warming. It is, therefore, doubly important for us to promote public awareness of ocean acidification.

may suggest using “extremely” or something similar here.

How to promote public awareness regarding the threats of Ocean Acidification

Japan Agency for Marine-Earth Science and Technology

Yoshihisa Shirayama

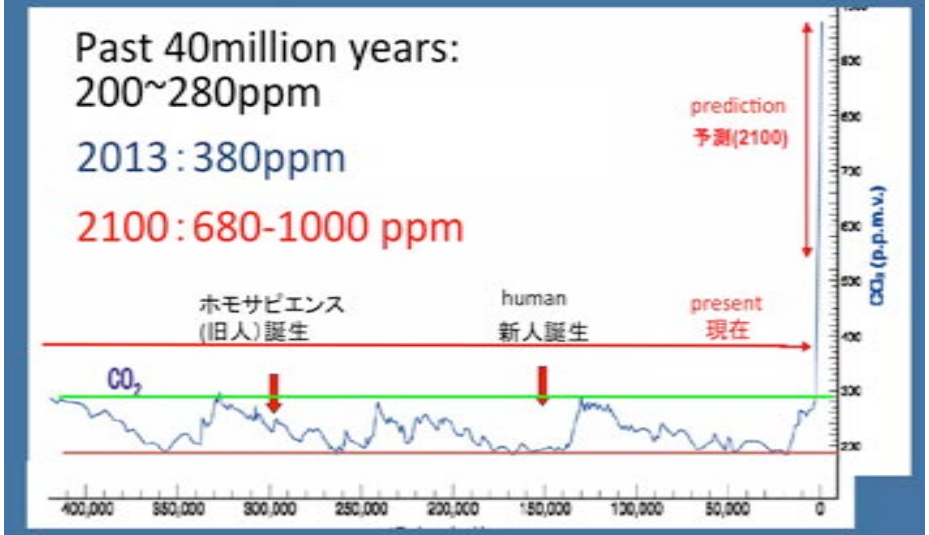
1

Atmospheric CO_2

Past 40million years:
200~280ppm

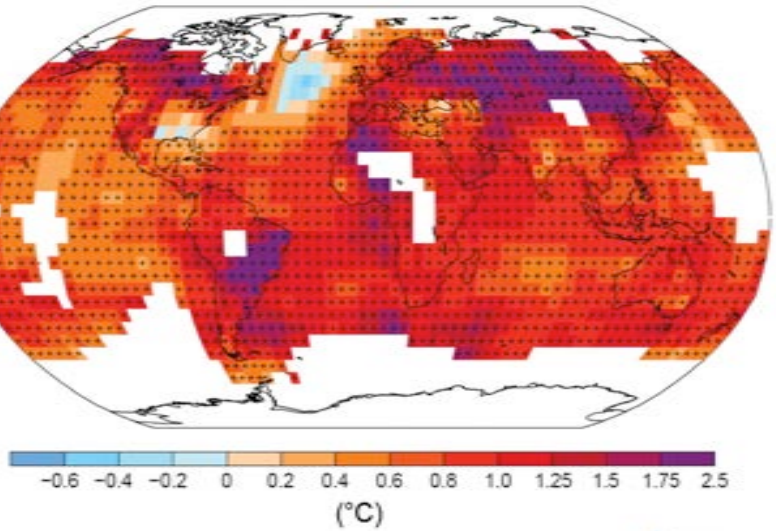
2013 : 380ppm

2100 : 680-1000 ppm



2

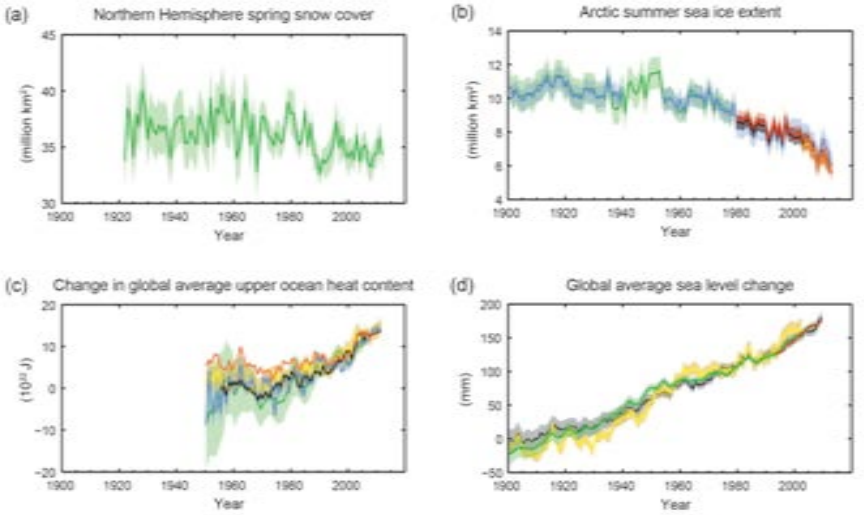
Figure SPM.1b
Observed change in surface temperature 1901-2012



ipcc
INTERGOVERNMENTAL PANEL ON climate change

3

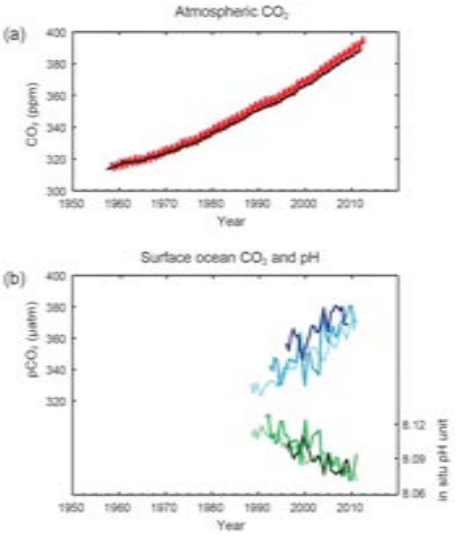
Figure SPM.3
Multiple observed indicators of a changing global climate



ipcc
INTERGOVERNMENTAL PANEL ON climate change

4

Figure SPM.4
Multiple observed indicators of a changing global carbon cycle

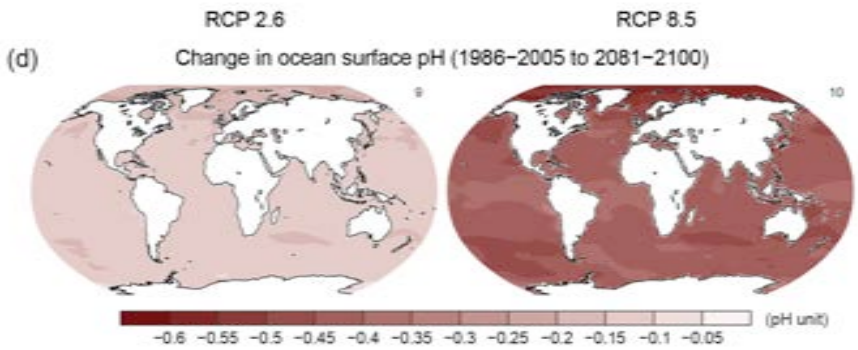


IPCC AR5 Working Group I
Climate Change 2013: The Physical Science Basis

ipcc
INTERGOVERNMENTAL PANEL ON climate change

5

Figure SPM.8d
Maps of CMIP5 multi-model mean results



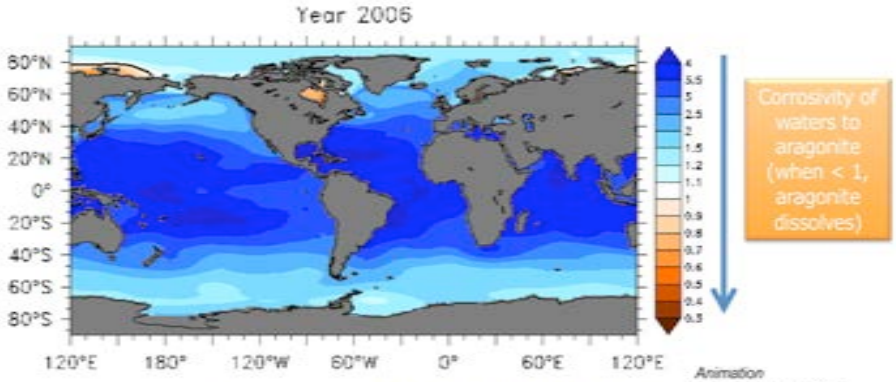
IPCC AR5 Working Group I
Climate Change 2013: The Physical Science Basis

ipcc
INTERGOVERNMENTAL PANEL ON climate change

6

#5- Polar oceans become corrosive to shell material within decades

Models project that cold waters soon become corrosive to aragonite, a ($CaCO_3$) mineral in some marine shells & skeletons



Latest model projections (IPCC AR5 WG1, 2013)

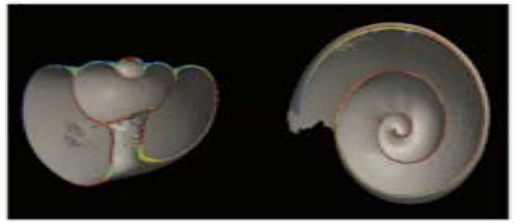
Confirms original warnings: Orr et al. (2005), Caldeira & Wickett (2005), Steinacher et al. (2009)

see also Bopp et al. (2013)

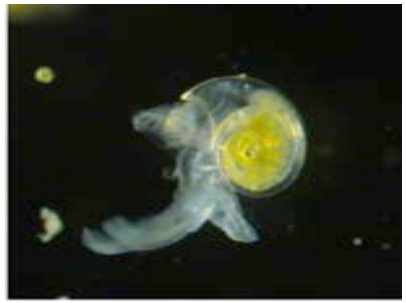
7

Shell degradation of Pteropods in the Arctic

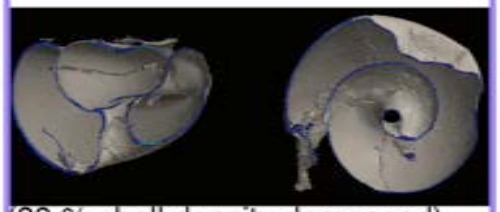
Oct., 2011



(no-damaged shell)



Nov, 2011



(28 % shell density decreased)

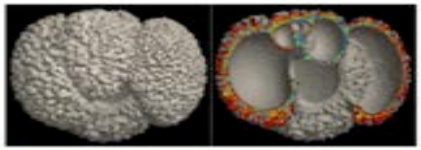
- Pteropods (Sea snail) are typical zooplankton in the Arctic ocean and are prey for a fish (i.e. Salmon, Herring etc.)
- Now pteropod shells are dissolved severely in the Arctic because of undersaturation of seawater with respect to aragonite shell.
- Ocean acidification will directly impact a wide range of marine organisms that build shells and ecosystems.

(Courtesy of K. Kimoto)

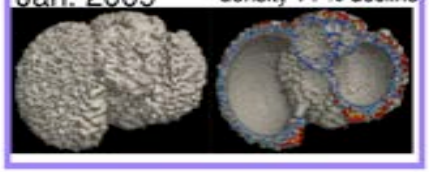
8

Shell degradation of foraminifera in the N. Pacific

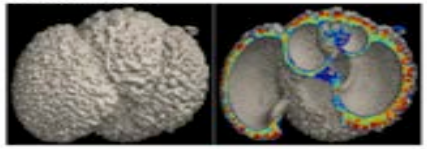
Nov. 2008



Jan. 2009 density 14 % decline



Jun. 2009



Sediment trap observations

- Calcification decline of foraminiferal shell occurs particularly in winter season (Jan - Mar) in the North Pacific.
- Shallowing of carbonate saturation depth in winter season is closely related with degradation of carbonate skeletons of marine shell-bearing plankton.
- Investigation of biological responses to ocean acidification is urgent issue for prediction of future marine ecosystems.

(Courtesy of K. Kimoto)

9

SPATIAL SHIFT FROM HARD TO SOFT CORAL COMMUNITY

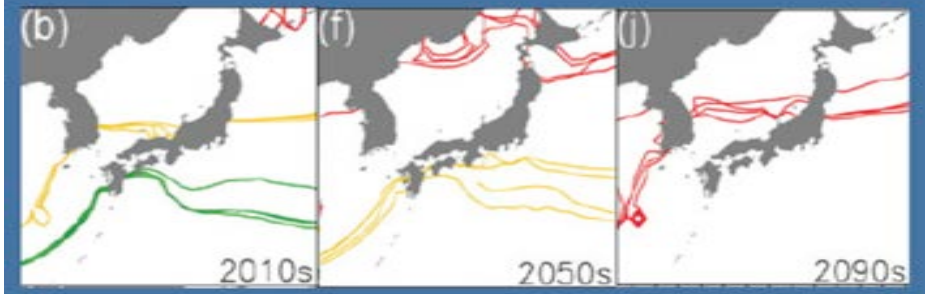
CO_2 vent site

Courtesy of Haruko Kurihara

(Inoue et al. 2013 Nature Climate Change)

10

Ω_{arag} around coastal Japan
日本沿岸における炭酸カルシウム飽和度(Ω_{arag})



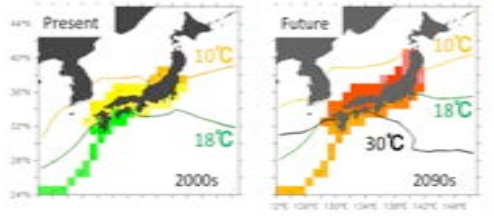
Ω_{arag} = 3
Ω_{Arag} = 2.3
Ω_{Arag} = 1

Model under SREA A2
SREA A2排出シナリオ下

Yara et al. 2012 BG

11

Demise of corals may occur in this century under the "business as usual (A1)" CO_2 emission scenario



Temperate area
Ocean acidification limits poleward expansion of coral habitats

Subtropical area
Frequent bleaching may occur

Shrinkage of potential habitats

Orange line: 10°C in winter [limit of coral occurrence]
Green line: 18°C in winter [limit of tropical coral distribution]
Black line: 30°C in summer [occurrence of bleaching]

(Yara et al., 2012)

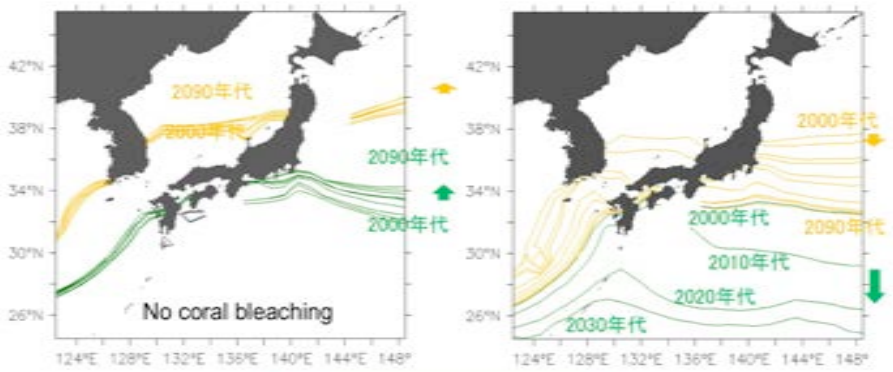
12

Future area where corals can grow under B1 Senario

(Yara et al., 2012)

The climate change is small enough to Prevent expansion of coral bleaching area

Ocean Acidification is not serious in the southern part of Japan



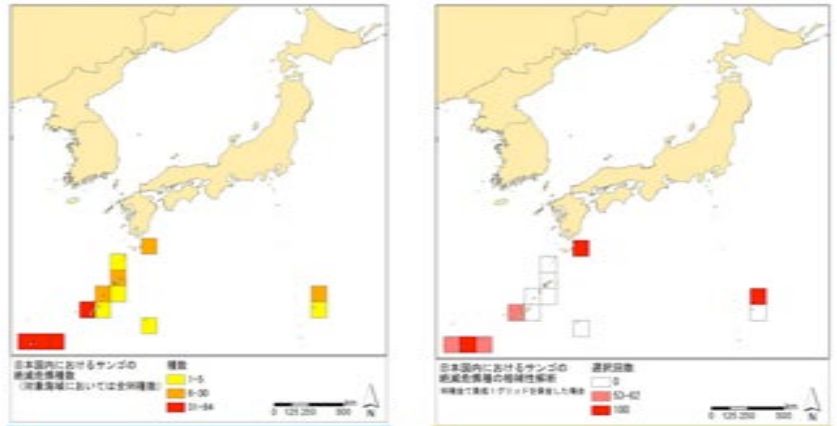
Northern limit for subtropical/tropical species (temperature)

If CO2 emission is controlled successfully, corals will survive around Japan

Southern limit for subtropical/tropical species (Aragonite saturation)

13

Ecologically or Biologically Significant Area (EBSA) of corals around Japan



Area threatened species exist

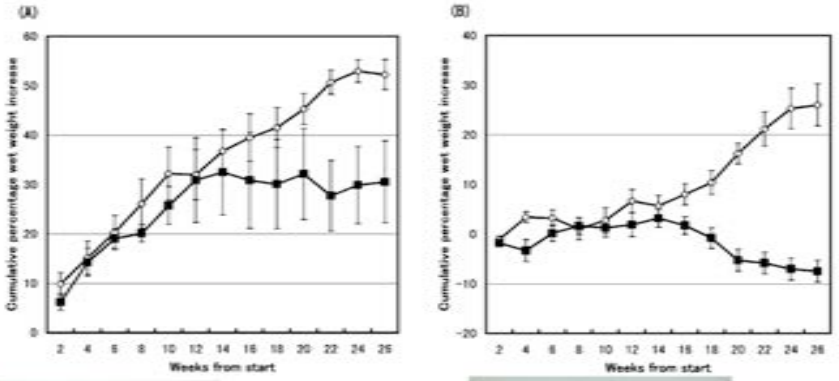
Area necessary to protect threatened spp.

- The area where many threatened species were found does not match completely with the area necessary to protect threatened species effectively

Yamakita et al., 2015

14

P_{CO_2}560ppm大気の マガキガイとナガウニの成長に対する影響



(n=30)

(n=30)

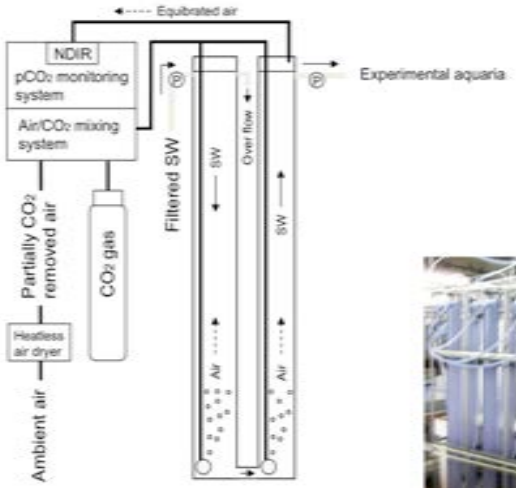
15

Sushi in the future

http://www.shiogama-sushikumi.net/shop/shiogama/ichimorisushi/

16

High-accuracy CO2 manipulation system

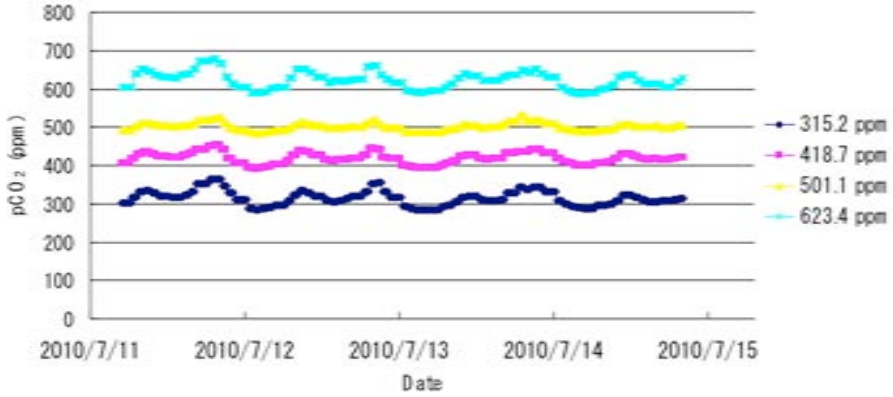


pCO2 stat system

(Nojiri et al.)

17

High-accuracy CO_2 manipulation system

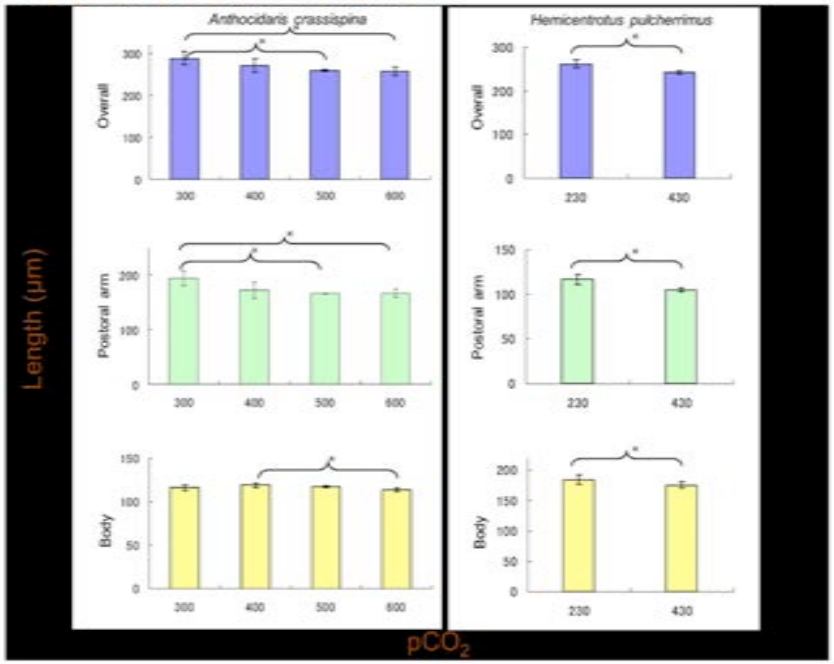


Suwa and Shirayama in press

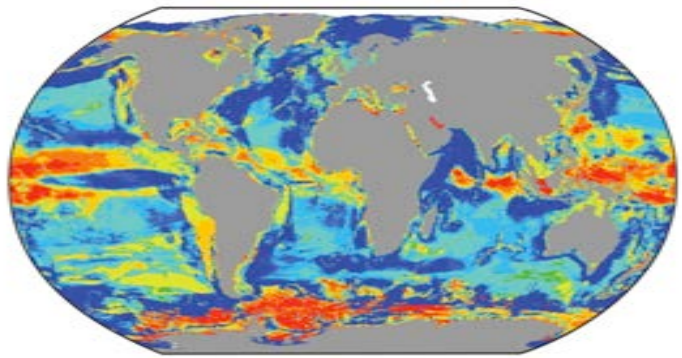
18

Effects of OA on sea urchin larvae

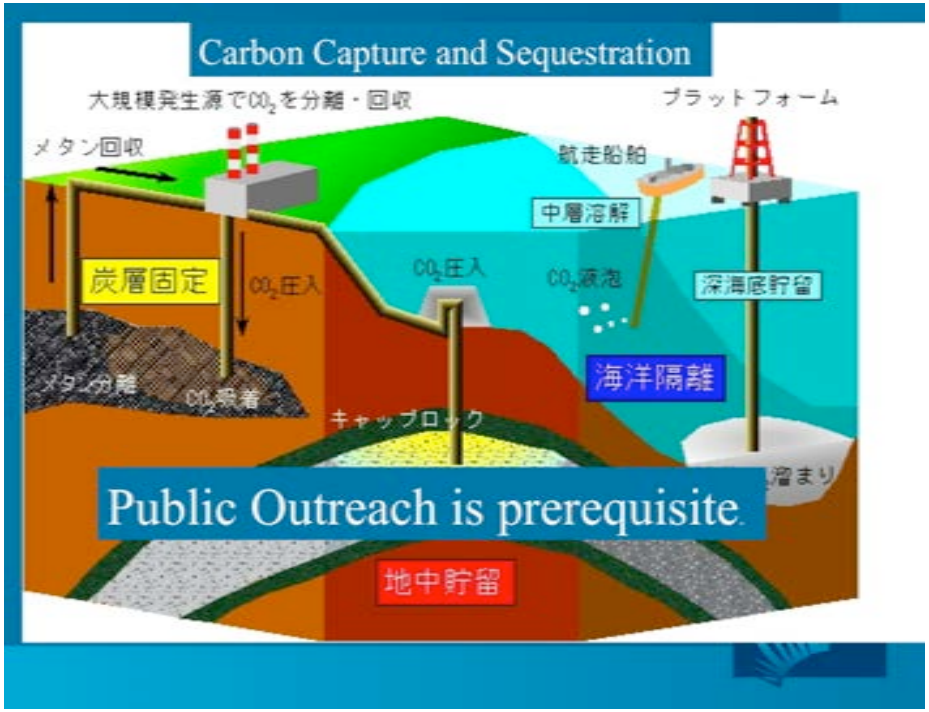
Suwa and Shirayama in press



19



20



21

Active Players for public outreach

- UNCLOS
- AC
- IOC
- CBD
- IPBES
- IPCC
- IAEA

- Many players but few in Japan

22

Summary

Ocean Acidification is inevitable
It's impact already appears in Arctic Ocean etc.

Public perception how serious it is would be the key for
promotion of mitigation for CO2 emission
implementation of adaptation such as CCS

23

「水産資源への影響と課題」

宮原 正典
（水産総合研究センター 理事長）

要旨

気温や風などの気候要素が十～二十年周期で変化するレジームシフトに対応し、マイワシ、カタクチイワシ、マサバなどの重要水産資源の卓越種が変化することがよく知られている。また、ここ数十年、人為起源の温室効果ガスの増加による地球規模の温暖化現象が顕在化している。レジームシフトに温暖化が上乗せされて変化する水温に影響を受け、日本周辺海域の水産資源やその生息環境が変化してきたことが長期の海洋モニタリングによって明らかになってきた。例えば、水温の変化に伴ってマイワシの生残率や成長速度、分布域が変化してきた。近年の水温上昇に伴う藻場の構成種の変化も観察されている。一方、重要水産資源における温暖化の影響を数値モデルで予測することが可能となりつつある。こうした技術は、市場や水産加工場などのインフラを長期的な予測に基づいて適切に整備していく上で有効なツールとなると期待される。講演では、気候変動と関係する海洋環境、生態系ならびに水産資源の変化に関する近年の成果と水産分野における気候変動への適応の取組みについて紹介する。

Impact of Climate Change on Fishery Resources and Issues in the Adaptation

Masanori Miyahara
President, Fisheries Research Agency

The dominant fish species alternation among the economically important species in fisheries such as sardine, anchovy, mackerel, etc occurred from ancient periods along with the climate regime shifts. The global warming trend in the ocean clearly observed in the recent decades was added to the decadal climate regime shifts as a major affecting factor. Long term monitoring research conducted by Fisheries Research Agency, Japan has detected the effects of the climate change on the status of phenology of fishery grounds. The research identified changes of the survival rate, growth rate, and distribution area of Japanese sardine (*Sardinops melanostictus*) in relation to the variability of water temperature and their food conditions of their habitat. The change of the flora of seaweed beds according to the recent warming trend is also clearly observed. Using the models of physical oceanography and ecosystem structure with the monitoring data, it became possible to predict the distribution pattern of the important species in fisheries, e.g. Japanese sardine or Pacific saury (*Cololabis saira*) while significant uncertainties are associated. The prediction is useful for preparation to meet the infrastructure of fish markets, fish processing industries, etc. In this presentation, the recent results of the studies in fisheries oceanography in relation to the ecosystem change, and the attempt to adapt the fisheries to climate change are shown.

Impact of Climate Change on Fishery Resources and Issues in the Adaptation

水産資源への影響と課題

Masanori Miyahara
(Fisheries Research Agency)
宮原正典
（国立研究開発法人水産総合研究センター）

FRA 1

Questions

- Does the climate change really affect the ocean ecosystems?
- Does global warming trend affect the fisheries?
- Can we adapt fisheries to climate change to sustain the status of fishery resources?

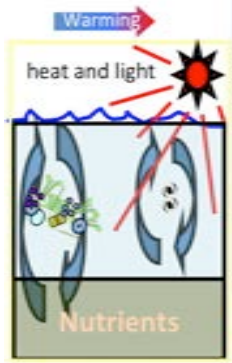
FRA 2

Does the climate change really affect the ocean ecosystems?

➡ YES !

Change of the temperature of environment affects

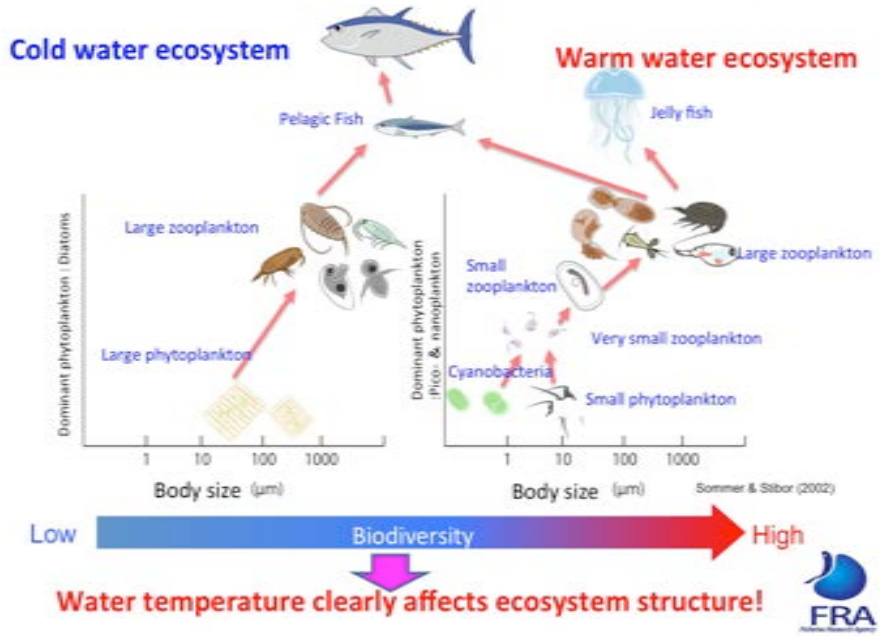
(1) Physiology of each marine organism
i.e. Metabolic rate, growth rate, feeding rate, hatching success, mortality,
and
(2) Nutrient supply to the euphotic layers, and thereby the structure of marine ecosystem.



⬅ Strong thermocline prevents the vertical nutrient mixing under high surface temperature condition

FRA 3

Does the climate change really affect the ocean ecosystems?



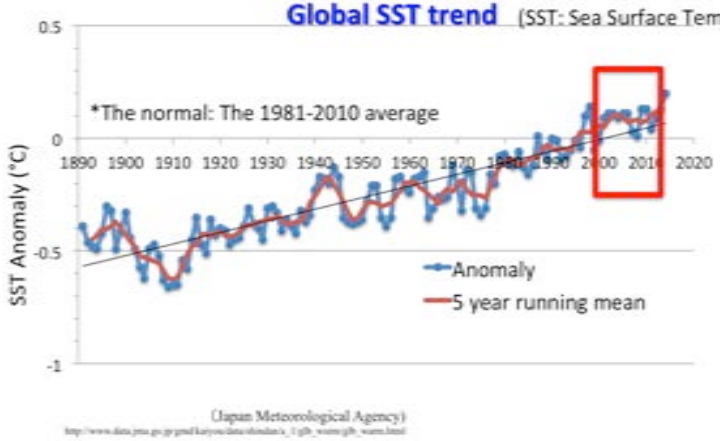
FRA 4

Has the climate changed globally?

➡ **YES !**

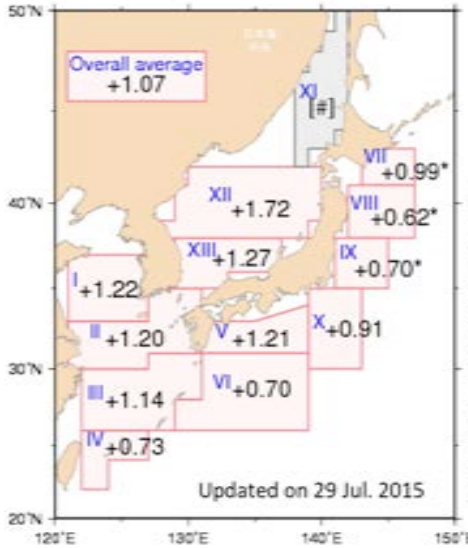
- 1900～2010 : SST has risen at speed of 0.051℃/10 years
- 2001～2013? : Climate hiatus (Delay in global warming)

Global SST trend (SST: Sea Surface Temperature)



5

The effect of the climate change in the sea areas around Japan



SST Changes around Japan during the past 100 years

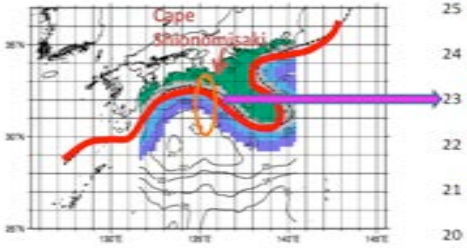
Global mean＝0.51℃/100years

Area number	Area name
I	Yellow Sea
II	Northern part of the East China Sea
III	Southern part of the East China Sea
IV	Sea around the Sakishima Islands
V	Sea off Shikoku and Tokai
VI	East of Okinawa
VII	Sea off Kushiro
VIII	Sea off Sanriku
IX	Eastern part of the sea off Kanto
X	Southern part of the sea off Kanto
XI	Northeastern part of the Sea of Japan
XII	Central part of the Sea of Japan
XIII	Southwestern part of the Sea of Japan

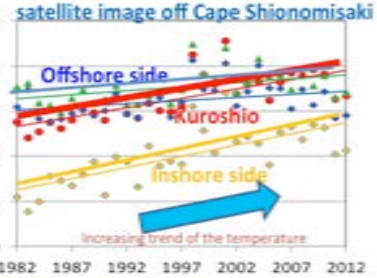
http://www.data.jma.go.jp/gmd/kaiyou/english/long_term_sst_japan/sea_surface_temperature_around_japan.html

6

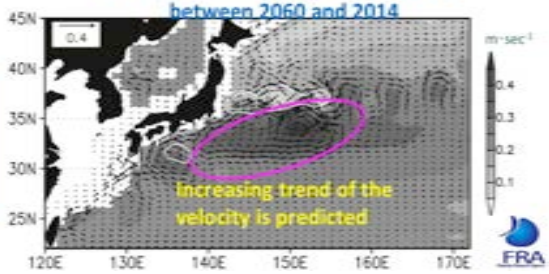
Increasing trend of the temperature and velocity of the Kuroshio warm current



Sea Surface Temperature observed from satellite image off Cape Shionomisaki



Predicted difference of the velocity between 2060 and 2014



The velocity of the Kuroshio current has increased 0.016m/sec in 10years since 2002.

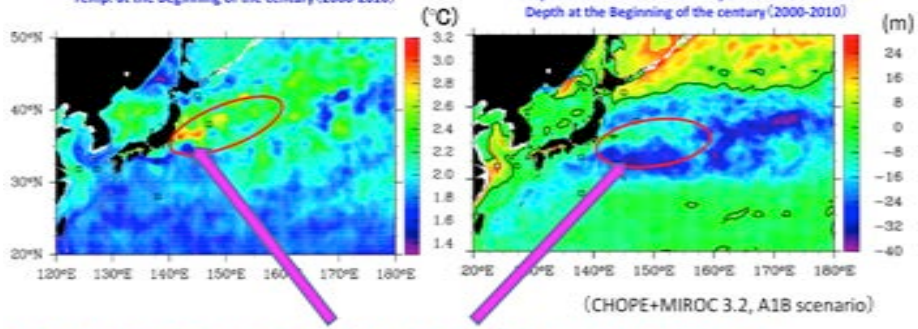
This velocity change makes 40km distance in 1 month.

7

Projection of SST and the MLD（Mixed layer depth) around Japan

Elevation of SST (℃) in the 21st century:
Temp. at the end of the century(2090-2000) minus
Temp. at the Beginning of the century(2000-2010)

Changes of MLD (m) in the 21st century :
Depth at the end of the century(2090-2000) minus
Depth at the Beginning of the century(2000-2010)



(CHOPE+MIROC 3.2, A1B scenario)

The effect of warming trend is estimated to be high in Kuroshio extension area

Kuroshio extension area is known to be important spawning and nursery grounds for pelagic fish species (e.g. Japanese sardine, Pacific saury etc.)

8

Response to temperature change is different at developmental stages

◎ Larvae with poor swimming ability (Planktonic stage) :

Climate change ➡ survival, stock size

(Temperature affects the spawning region in the spawning season)

Larval sardine

Vs.

◎ Fish with fully developed swimming ability :

Climate change ➡ migration, distribution,

(Temperature affects the food availability in the feeding area : main fishing ground)

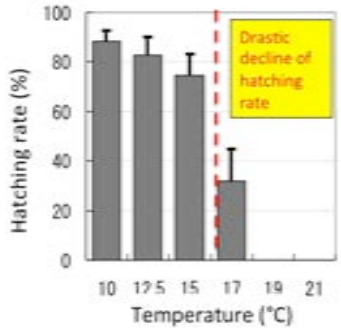
Japanese sardine (*Sardinops melanostictus*)

9

Change of water temperature has a large influence on larval fish ecology

Effects of water temperature on hatching success of Pacific herring

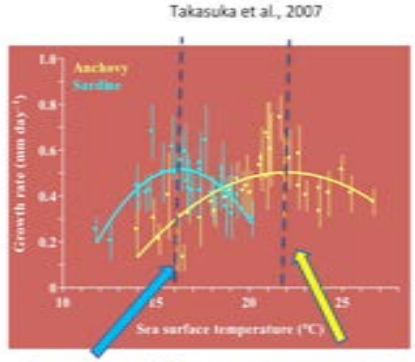
(Ministry of Agriculture, Forestry and Fishery, 2007)



➡ Warming condition is NOT favorable for herring's hatching

Relationships between SST and growth rate of sardine and anchovy larvae

Takasuka et al., 2007

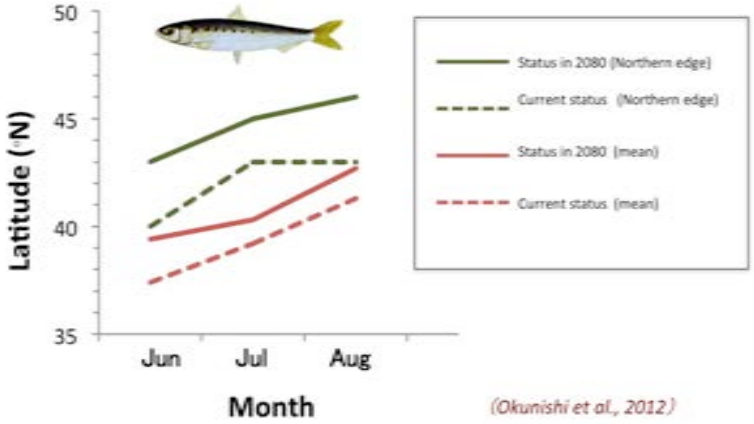


Japanese sardine Japanese anchovy

➡ Warming condition is favorable for anchovy's growth rather than sardine's

10

Prediction on the distribution of feeding area of Japanese sardine during summer in 2080 using ecosystem model

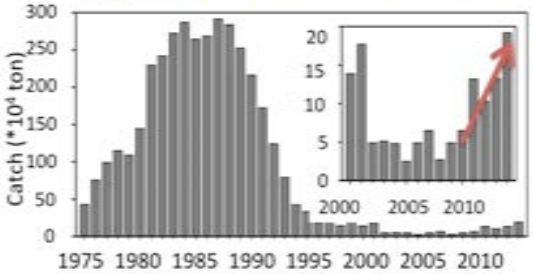


(Okunishi et al., 2012)

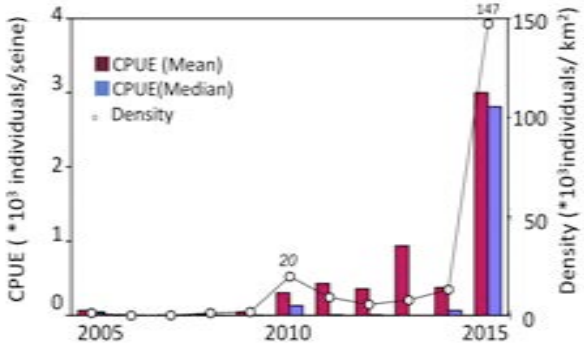
➡ The distribution area of 1st year sardine will move to 120-220km northward, and their spawning area is also predicted to move northward.

11

Topics: Recent Increase of Japanese Sardine



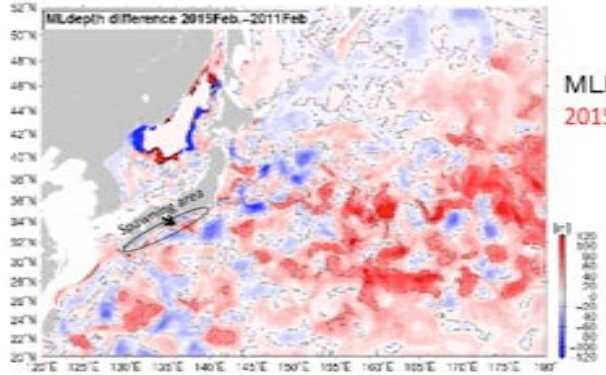
Change in catch of the Pacific stock of Japanese sardine.



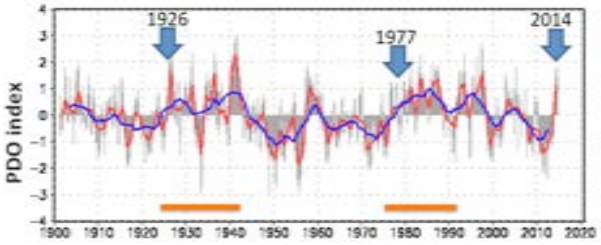
Changes in CPUE and density of the age-0 fish in the waters off the east coast of the Kurile Islands.

12

Changes in the ocean and climate



MLD difference between 2015Feb and 2011Feb

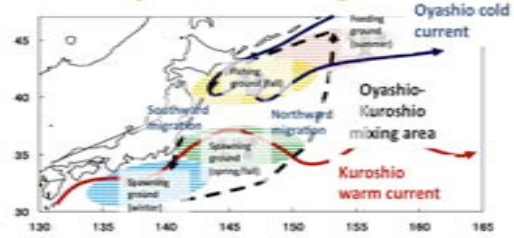


Regime shift?

Change in the PDO index. High level abundance of Japanese sardine (orange bars) occurred in the periods with positive PDO index.

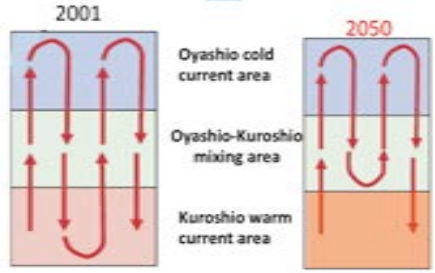
FRA

Prediction on the migration pattern of Pacific saury under the global warming condition



Warming condition will cause the delay of southward migration and season of fishing

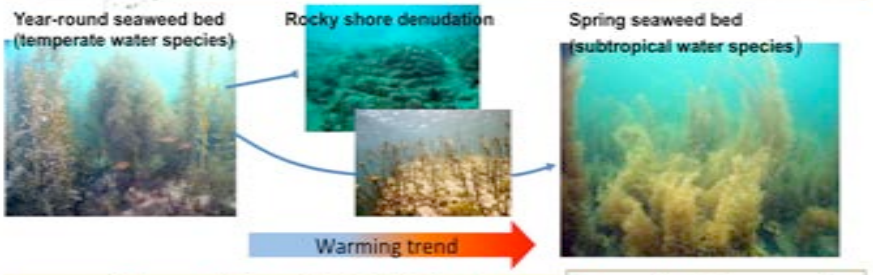
Growth rate will fall in 2050

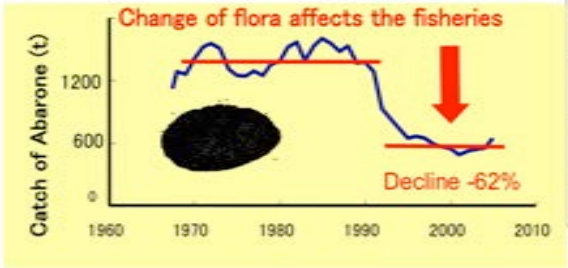


Migration pattern will change in 2050
(Ito et al., 2007; Ito, 2009)

FRA

Recent problems for coastal ecosystem and fisheries in Kyushu, southern Japan in relation to warming condition



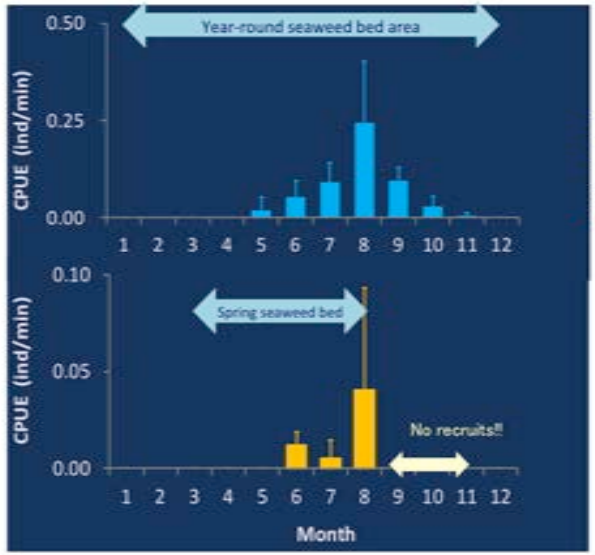


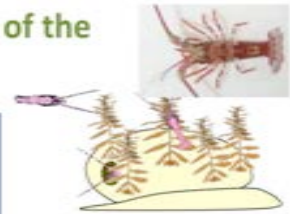
According to warming trend

- Rocky shore denudation
- Flora of seaweed change
- Change of the status of coastal important species

FRA

Adaptation of fisheries to the change of the flora of seaweeds





Seaweed bed is very important for post-larval lobster as feeding ground and shelter

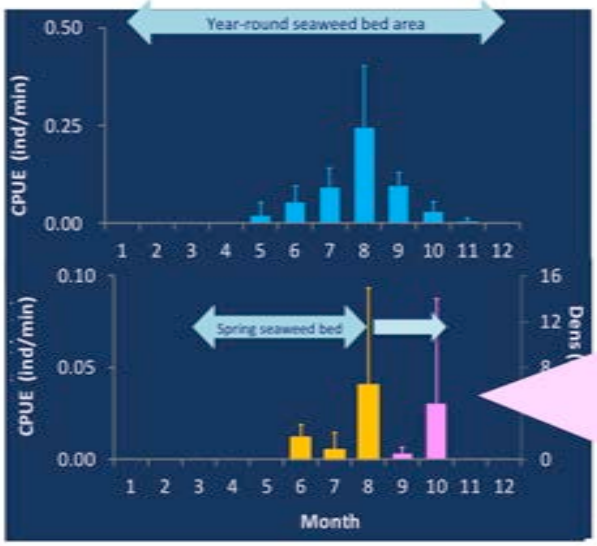
Post-larval lobster recruits in May to November

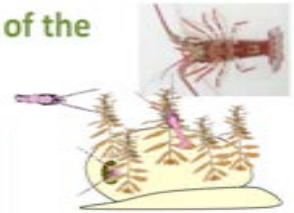
Post-larval lobster recruits in June to August

Density of post-larval stage of Japanese spiny lobster

FRA

Adaptation of fisheries to the change of the flora of seaweeds

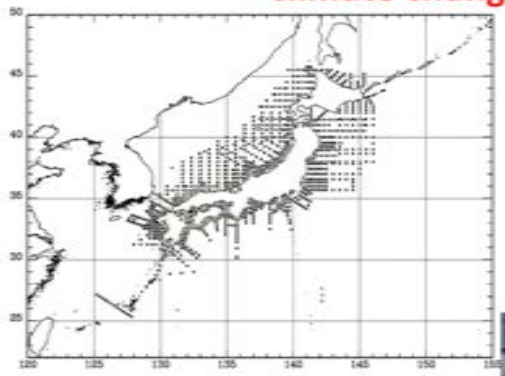




By transplantation of seaweed in the spring seaweed bed in summer restores the introduction of post-larval lobster after September.

Density of post-larval stage of Japanese spiny lobster

In order to cope with the climate change in fisheries, intensive and extensive field research is necessary to comprehend the mechanisms of the climate change



Map of the ocean monitoring stations conducted by Fisheries Research Agency and local fisheries institutes of prefectures since 1950's

Approach in the Future

Plant breeding technology using genomic methods

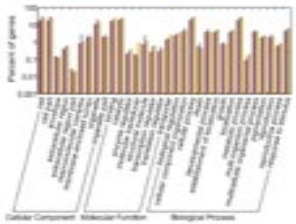
Research on
Nori seaweed (*Pyropia yezoensis*)

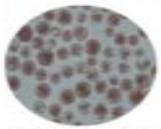
DNA extraction

next-generation sequencing technology

To collect genomic information

Genome wide linkage analysis





Select cultured cells of Nori seaweed

Nori seaweed

Using genomic technics, isogenic strain of high tolerance for warm condition are selected and cultured.

It is expected to produce the warm tolerant Nori !

「危機に立つ海」

井田徹治
（共同通信社 編集委員・論説委員）

要旨

現在、海洋は数々の危機に直面している。進む漁業資源の減少、地球温暖化が原因の海水温度上昇による生態系の変化、陸上起源の汚染物質による「デッドゾーン」の拡大やプラスチックごみの拡大などだ。二酸化炭素濃度の上昇によって起こる海洋酸性化も、海洋が直面する大きな危機の一つだと指摘されている。これらの問題は、4億5千万人といわれる漁業で生活する人の生活に悪影響を及ぼすだけでなく、何十億人もの食料安全保障にも重大な懸念材料となっている。

だが、海洋酸性化をはじめとする海の危機は目に見えにくい。森林破壊などと違って海の環境破壊を実感する機会は少ないし、巨大な海の水温上昇やその水素イオン濃度が変わるということのスケールの大きさを理解することも難しい。酸性化に限らず、地球温暖化のような長期的な視点が必要な問題についての市民や企業経営者、政治家の関心は必ずしも高くない中、これらの実態を市民に伝えることも容易ではないが、積み重ねられる多くの科学的な成果を小まめに拾い上げ、社会に伝えてゆくことしか道はないように思う。

Oceans in crisis

Tetsuji Ida
Senior Staff Reporter, Kyodo News

Currently, the oceans and seas are facing a multitude of crises: continuously dwindling fishery resources, ecosystem changes caused by the rise in seawater temperature brought about by global warming, the expansion of “dead zones” caused by land-based pollutants, increase in the amount of plastic waste, and so on. Ocean acidification caused by increasing CO_2 concentration has also been pointed out as a serious crisis being faced by the oceans and seas. These issues not only adversely affect the livelihoods of people dependent on the fishing industry, whose number is estimated to be 450 million, but also give rise to concerns about food security for billions of people.

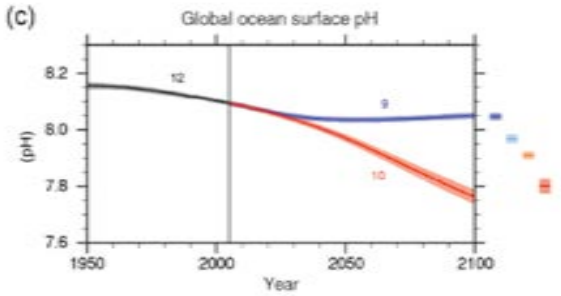
Yet, , the crises faced by oceans and seas such like ocean acidification are not readily visible. Unlike deforestation and other forms of environmental destruction, there are few opportunities for people to grasp environmental destruction in the oceans, and it is difficult to understand the magnitude of the issues when we discuss the rise in seawater temperature or changes in hydrogen ion concentration in the vast ocean. Ocean acidification is not the only issue, awareness among the public, business owners, and politicians of issues like global warming that require a long-term perspective is not exactly high. In these circumstances, it is not an easy task to try to convey the notion of these matters to the public. Even so, we must follow up on every detail of the many scientific findings that are constantly accumulating and convey those results to society. I believe this is the only path that is open for us to follow.

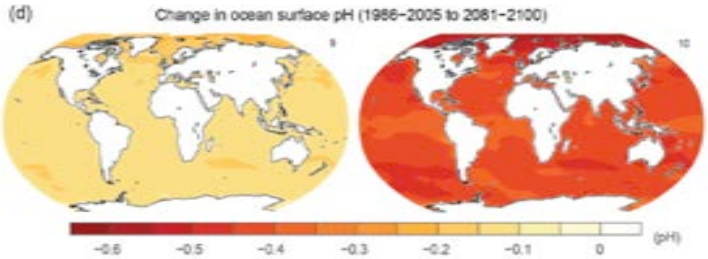
1

Oceans in crisis 海の危機

★Ocean acidification 海洋酸性化
CO2 from F Fuel 化石燃料の使用
★Temperature rise 海水温上昇
GHGs emission 温室効果ガス
★Land based pollutions 海洋汚染
化学物質、リン・窒素、ﾌﾟﾗｽﾁｯｸ、放射性物質
toxic chemicals, N&P, Plastic wastes
radioactive materials
Growing dead zone 「死の海域」の拡大
★Depleting fish stocks 漁業資源の減少

2





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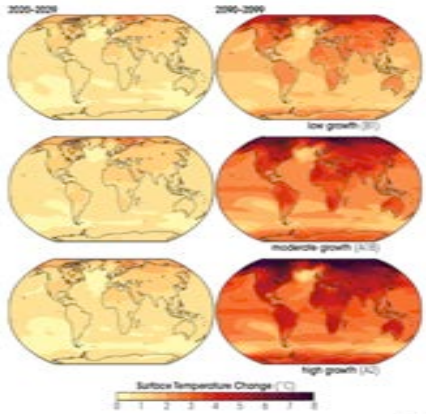

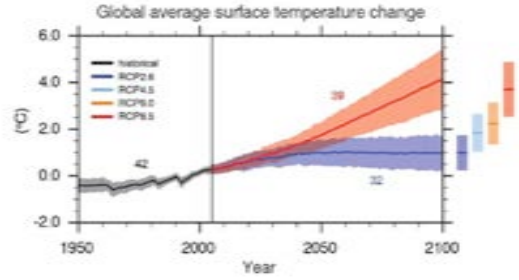

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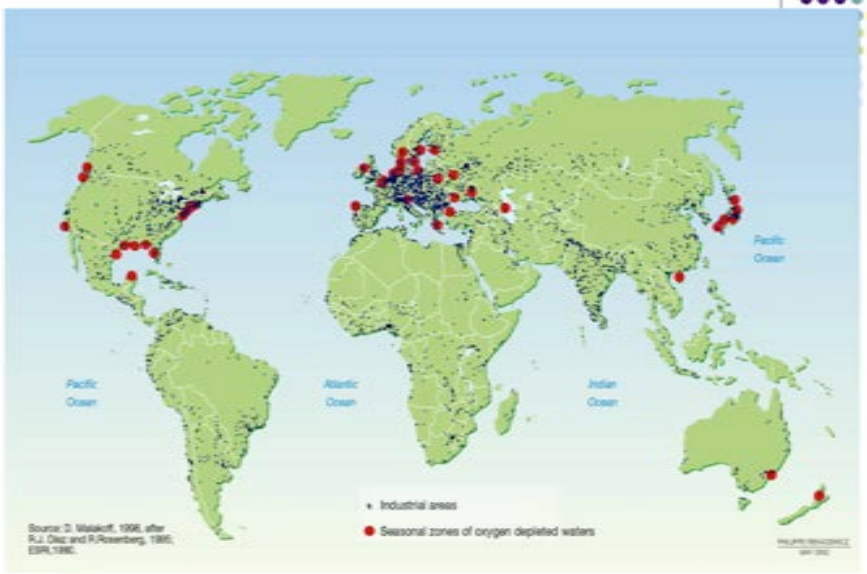

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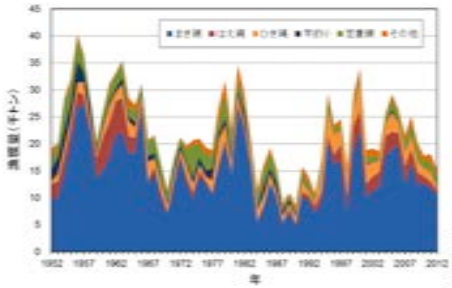
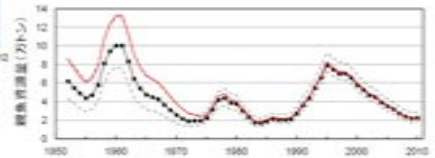
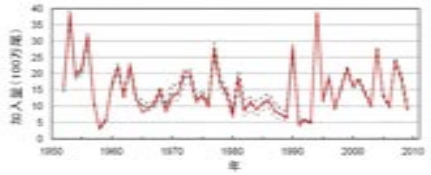
Pacific bluefin tuna
太平洋クロマグロ







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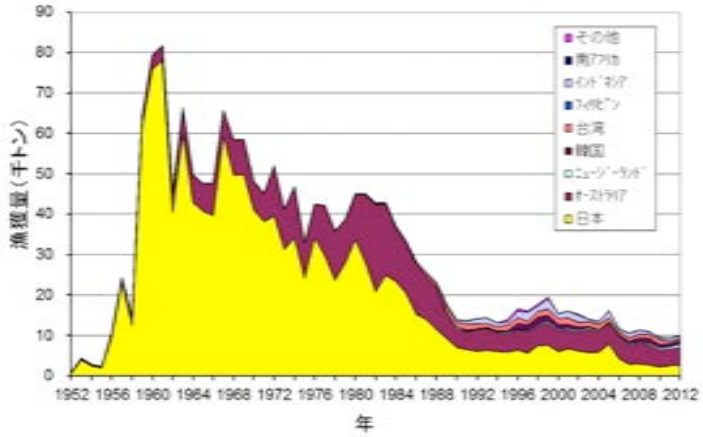
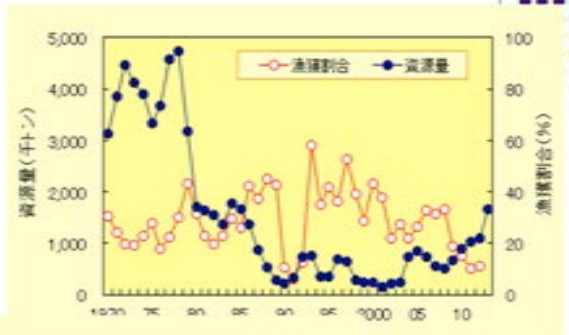
Southern blue fin tuna
ミナミマグロ



7

Chub mackerel
サバ



8

Eel　ウナギ

Japanese, European, American ell population declining severely

ニホンウナギ、アメリカウナギ、ヨーロッパウナギ

9

Blink of extinction？ 絶滅の危機

IUCN Red List of endangered species

国際自然保護連合（IUCN）のレッドリスト

<Critically Endangered　極めて絶滅の恐れが高い>

European eel,　ヨーロッパウナギ

Southern Bluefin Tuna, ミナミマグロ

<Endangered　絶滅の恐れが高い>

Japanese eel,　ニホンウナギ

Atlantic Bluefin Tuna　太平洋クロマグロ

Japanese Spiky Sea Cucumber　マナマコ

<Vulnerable　絶滅の恐れが高まっている　>

Bigeye Tuna , メバチマグロ

Spiny Dogfish,アブラツノザメ

10

Why this crisis is not visible for us?

海の危機は目に見えないのか？

★Still so many fishes in the ocean and in our market

海にはまだたくさんの魚が

＜海砂利水魚＞

Pebbles on the coast and fish in the ocean

魚がいなくなるとは想像しがたい

Hard to believe some fish species are facing crisis of extinction.

11

Why this crisis is not visible for us?

海の危機は目に見えないのか？

★Under the sea, far far away

海の中のことはそもそも見えにくい

Difference between deforestation

森林破壊との大きな違い

★Hard to grasp scale of the ocean

規模の大きさを把握することが難しい

1.35 billion km3　13億5千万立方キロ

360 million km2　3億6千万平方キロ

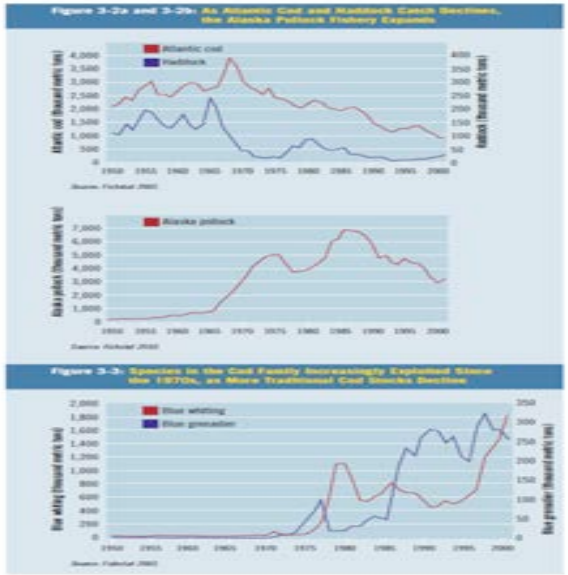
12

Why this crisis is not visible for us?
海の危機は目に見えないのか？

★ A lot of substitutes exists
多くの代替品がある
Substitute of species 代替種
Substitute of fishing grounds 代替漁場

Japanese eel => European eel
ニホンウナギ ヨーロッパウナギ
Chub mackerel => Atlantic mackerel
サバ タイセイヨウサバ

13



Fishing for Answers ,2004,WRI

14

Hard to covey these information
社会に伝えることは難しい

★Ocean acidification, temperature rise etc
海洋酸性化、海水温上昇・・・
・Complicated science information
科学的には結構、難しい
・Long term consequences
ずっと先の話が重要
・Hard to know policy effectiveness
対策の効果が出るのはずっと先

15

Hard to covey these information
社会に伝えることは難しい
cf)
★Daily economic issues
株価や景気、企業評価額・・・
・No complicated science needed
科学的には難しくない
・Very short term consequences
今日、明日の話
・Immediate policy effectiveness
すぐに結果が分かる

16

Hard to covey these information
社会に伝えることは難しい

★Ocean acidification, temperature rise etc
海洋酸性化、海水温上昇・・・

・Science information : more & careful
科学的な情報をたくさん、分かりやすく

・Long term : Link between now and future
今の行動が将来を決めることを

・Policy : Importance of long term target
長期目標の大切さ

ex)Paris agreement, パリ協定、SGDs

17

18

海洋における温暖化と酸性化 ―予測と情報基盤の必要性―

山形俊男
（海洋研究開発機構 アプリケーションラボ所長 ）

要旨

人為起源の温暖化気体、とくに二酸化炭素の濃度増大による地球温暖化は海氷を溶かすだけでなく、海洋温暖化も引き起こしている。これが海域特有の気候変動現象の変調を通して、世界各地に異常気象や極端現象を多発させている。一方で大気に放出される二酸化炭素はその30%が海水に吸収され、水素イオン濃度を高めることから、海洋酸性化も引き起こしている。海洋には炭酸カルシウムの殻や骨格を持つ生物が多く存在するので、海洋酸性化が進むと、これらの生物の存在が危うくなり、海洋生態系、ひいては私たちに食をもたらす漁業の持続可能性にも大きな影響を及ぼす可能性がある。

現在、海洋表層のpHは8.1で、弱アルカリ性の状態にあるが、それでも既に産業革命以前の値から0.1ほど減少している。pHが7.8程度で殻を作れなくなる生物が出てくるという研究があるが、これは大気中の二酸化炭素濃度が640ppmに到達すると実現する値である。IPCC第5次評価報告書で採用されている代表的濃度経路シナリオのいくつかは今世紀末までにこの濃度に到達することを想定しており、海洋酸性化は人類にとってもはや無視できない問題である。今世紀末には海洋酸性化による世界経済の損失は年間１００兆円に及ぶとする国連報告もある。実際、ワシントン州のカキ養殖場では幼生の大量死が海洋酸性化によることが報告されている。こうしたことから米国は海洋酸性化の監視と科学研究、経済社会的な影響評価、適応策などについて対応するための国内法（FOARAM）を2009年に整備した。

大気中の二酸化炭素の濃度増大はさまざまな物理・化学・生物過程を経て海洋内部に取り込まれ、確実に海洋酸性化を引き起こすが、その実態には不明なところが多い。加えて海洋酸性化は様々な時空間スケールで進行することから、海洋の現場観測と宇宙からの衛星観測の連携による実態解明、及び海洋物理・化学・生物モデルを用いたデータの統合化と予測に向けた情報基盤の整備が不可欠である。わが国は海洋温暖化と海洋酸性化に対処するために西太平洋域に「海洋危機監視（Marine　Crisis　Watch）」を展開し、周辺各国に海洋環境情報の発信をしていく必要があると考える。

Increase in ocean temperature and acidity: the need for projections and an information infrastructure

Toshio Yamagata
Director, Application Laboratory JAMSTEC

The anthropogenic warming by atmospheric gases, in particular the global warming caused by the increased levels of CO_2, is not only causing sea ice to melt but also ocean temperatures to rise. The climatic oscillations characteristic of the ocean are leading to increasingly frequent abnormal and extreme weather events around the world. Another issue is that 30% of the CO_2 released into the atmosphere is absorbed by the ocean, and this leads to acidification of seawater, as CO_2 increases the concentration of hydrogen ions. Because many marine organisms have shells and bones containing calcium carbonate, further ocean acidification will threaten the life of such creatures, thus influencing marine ecosystems and potentially greatly affecting the sustainability of the fishing industry that provides us with food.

Currently, the ocean's surface is alkalescent with a pH of 8.1, which is 0.1 lower than what it was prior to the Industrial Revolution. However, there is research that shows that some organisms fail to form a shell at pH 7.8, which is the point reached when atmospheric CO_2 concentration increases to 640 ppm. A number of the Representative Concentration Pathways scenarios set out in the IPCC 5th Assessment Report predict that the CO_2 concentration will reach 640 ppm by the end of this century, and, therefore, acidification of the oceans is an issue mankind can no longer ignore. There are also UN reports predicting that the annual global economic loss caused by ocean acidification will reach as much as 100 trillion yen at the end of this century. For example, ocean acidification was the cause for a massive oyster larvae die-off at an oyster farm in Washington state. Considering these issues, the US government enacted the FOARAM Act in 2009 to address matters such as monitoring and conducting scientific research on ocean acidification, assessing socioeconomic impacts, and developing adaptation strategies.

Seawater incorporates atmospheric CO_2 through a variety of physical, chemical, and biological processes. Although it is certain that an increase in CO_2 concentration causes ocean acidification, there is still much to learn about the actual processes. Furthermore, because acidification occurs over multiple spatiotemporal scales, it is vital that both onsite and satellite observations of the oceans are used to elucidate the overall picture and establish an information infrastructure for integrating data from models of marine physics, chemistry, and biology and for generating projections. If we are to address the issues of ocean warming and acidification, I believe that Japan should initiate a West Pacific Marine Crisis Watch and provide neighboring countries with information on the local marine environment.

2016年2月17日
国際シンポジウム「温暖化と海洋酸性化の研究と対策」
笹川平和財団　海洋政策研究所

Necessity of Network-Based Marine Watch, Knowledge and Prediction System
予測と情報基盤の必要性

Toshio Yamagata
山形　俊男
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アプリケーションラボ、海洋研究開発機構
Member, Regional Committee for Asia and the Pacific ,
The International Council for Science
国際科学会議　アジア太平洋地域委員会委員

1

人類生存に不可欠な要素を脅かすもの
Factors that endanger elements necessary for human habitability

In 2013, NASA's Cassini spacecraft captured this image of Earth from Saturn. Seen here, our planet is 898 million miles away (1.44 billion kilometers) and appears as a blue dot at center right.

- 水と生息可能な陸域・大気・海洋環境 (water and habitable environment)
- 衣食住 (food, clothing and shelter)
- 健康 (health)
- 資源・エネルギー (resources, energy)

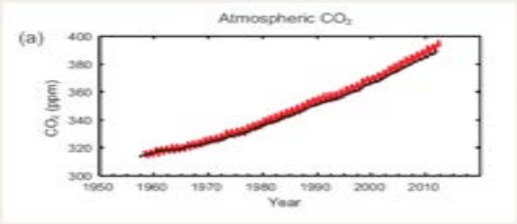
これらを不安定化する水惑星における変化と変動

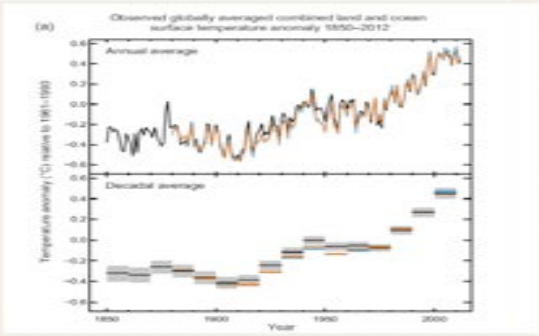
Habitability and sustainability are threatened by changes and variations occurring in the aqua-planet "Earth". ← Another Sword of Damocles !!

温暖化と酸性化は人類生存を脅かす、もう一つのダモクレスの剣

2

Increase of CO_2 Concentration and Global Warming
二酸化炭素濃度増大と地球温暖化





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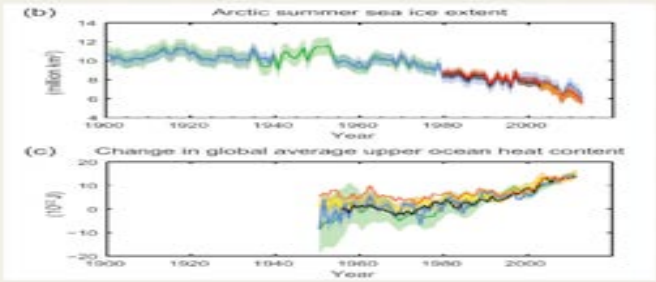
Global Ocean Warming　海洋温暖化

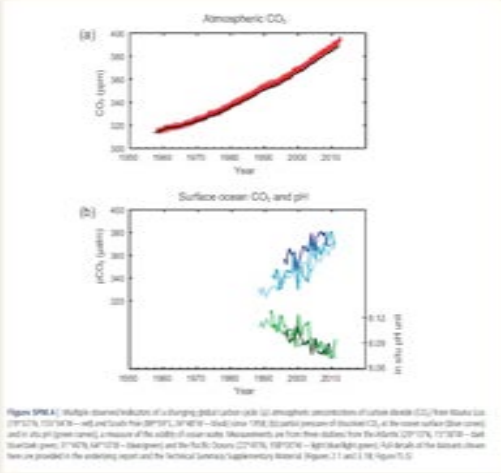


海洋の温暖化は気候システムに蓄積されたエネルギーの増加量において卓越しており、1971 年から 2010 年の間に蓄積されたエネルギーの 90%以上を占める(*高い確信度*)。1971 年から 2010 年において、海洋表層(0~700 m)で水温が上昇したことは*ほぼ確実*であり(図 SPM.3 を参照)、また 1870 年代から 1971 年の間に水温が上昇した*可能性が高い*。{3.2, Box 3.1}

Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 (*high confidence*). It is *virtually certain* that the upper ocean (0–700 m) warmed from 1971 to 2010 (see Figure SPM.3), and it *likely* warmed between the 1870s and 1971. {3.2, Box 3.1}

4

化（科）学的に不確実性のない
二酸化炭素濃度増大と海洋酸性化の関係



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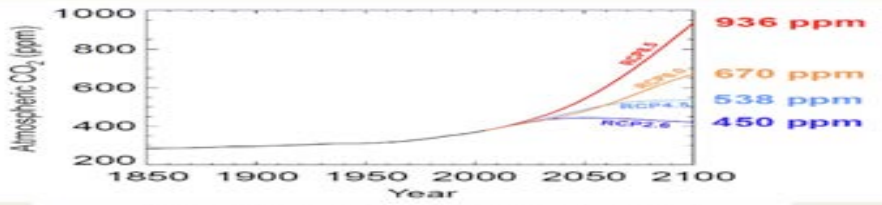
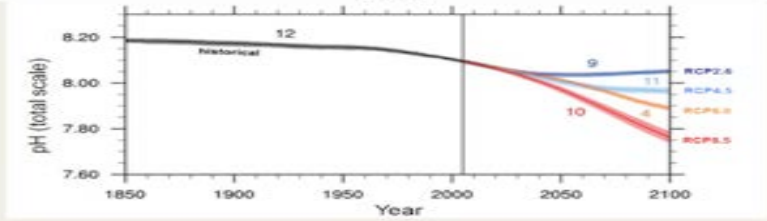
IPCC Scenarios
and Projected Ocean Acidification (AR5 WG1)
海洋酸性化の危機





大気中の二酸化炭素吸収能力の減少、海洋中の有機物の減少、
海藻によるジメチルサルファイドの放出量減少などによる地球温暖化加速効果も

6

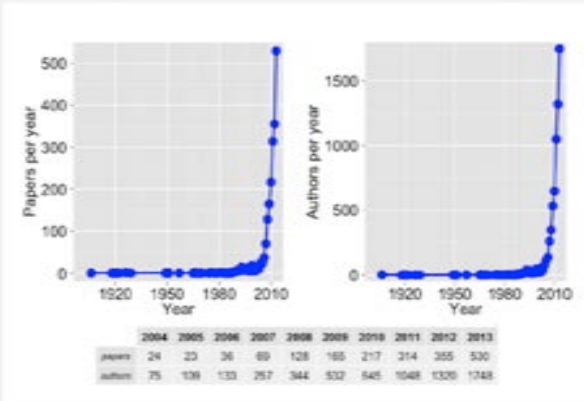
Monaco Declaration (2008)

Ocean acidification is a growing environmental concern. The chemistry and, therefore, biology of world oceans will be impacted to different degrees, depending on the region and the type of ecosystem. As a result of its impacts on marine organisms and ecosystems, ocean acidification has the potential to seriously affect the livelihood of coastal communities and their economies. From mega-cities to subsistence fishing villages coastal communities vary significantly in population, maritime activity, reliance on marine natural resources and therefore their respective degree of adaptability. Identifying the magnitude and types of consequences that ocean acidification could have on coastal communities will become a major concern for governments of coastal countries seeking to preserve current marine activities and benefits.

7

学界に注目されはじめた
海洋酸性化問題

Ocean acidification – a rapidly growing field



OA-ICC Bibliographic Database.

8

The Data Revolution for Sustainable Development

Jeffrey Sachs, Project Syndicate Sept. 18, 2015

- There is growing recognition that the success of the Sustainable Development Goals (SDGs) will depend on the ability of governments, businesses, and civil society to harness data for decision-making.
- The key is to invest in building innovative data systems that draw on new sources of real-time data for sustainable development.
- One way to improve data collection and use for sustainable development is to create an active link between the provision of services and the collection and processing of data for decision-making.

9

Global Ocean Acidification Observing Network (GOA-ON)

Urgent needs for information gathering on ocean acidification and its ecological impacts

(endorsed by UN GA, para. 153 of res. 68/70, Dec. 9, 2013)

*Policy need: robust evidence for appropriate management action at both national and international levels

*Scientific need: large-scale, long-term data to improve understanding of chemical and biological processes, to assist in the design and interpretation of experimental studies, and to improve predictive skills.

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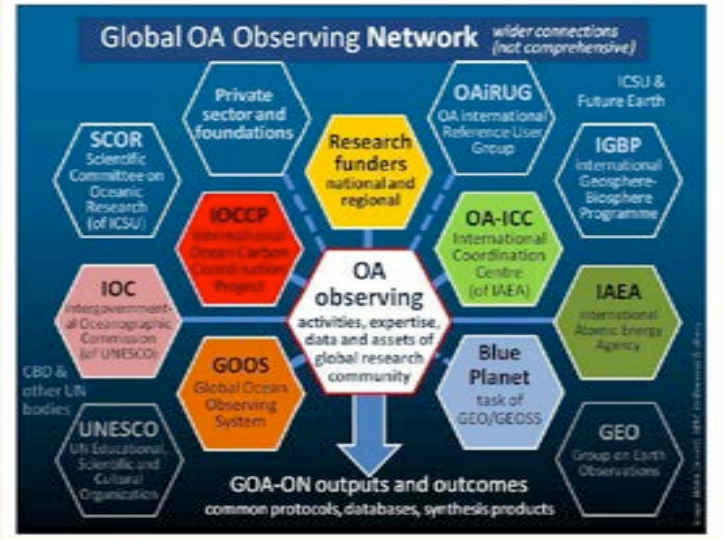
GOA-ON



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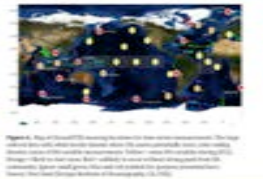
Synthesis of Satellite and *In Situ* Observations

Space-based observations for contributing to understanding physical, chemical and biological phenomena driving OA and carbon cycle dynamics by measuring SST, ocean color, salinity, wind, waves, currents and sea level.

GO-SHIP Repeat Hydrographic Survey Plan



Ocean SITES mooring locations

ARGO float locations as of May 2014

Biogeochemical ARGO float locations

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Ocean Prediction System

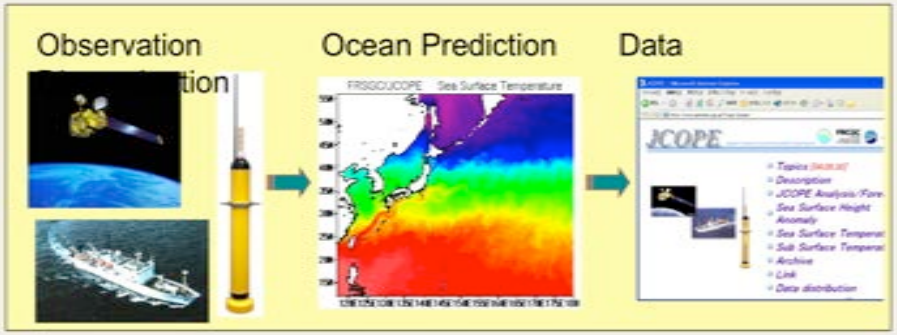
JCOPE（日本沿海予測可能性実験）

http://www.jamstec.go.jp/jcope/

海洋研究開発機構では，衛星、船舶、アルゴフロート等による観測データと数値海流モデルを使って、日本近海の海流変動を詳細に予測するシステムを開発。2001年12月から海流、水位、水温、塩分濃度の2ケ月先までの予測結果をウェブで公開。数値海流予測データを利用する多くの共同研究とベンチャー事業体(Forecast Ocean Plus, Inc.)が活動中。既に15年余の歴史。

海洋物理変動予測から海洋物理化学生物予測へ

From predicting physical quantities to predicting biogeochemical quantities



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Sustainable Development Goals

持続可能な開発目標

adopted by the UN sustainable development summit as the post 2015 development agenda

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"Future Earth" Program led by ICSU and ISSC in response to Rio+20

国際科学会議と国際社会科学協議会が主導する「未来の地球」計画のコンセプトを単純化すれば

1) to develop the knowledge for responding effectively to the risks and opportunities of global environmental change.

地球環境変化のリスクと好機に効果的に対応する知の強化

2) to support societal transformation towards global sustainability in the coming decades for wellness and well-being of all living creatures.

持続可能な社会への変革を支援

Future Earth （未来の地球）: a 10-year international research program launched in June 2012, at the UN Conference on Sustainable Development (Rio+20) that will provide critical knowledge required for societies to face the challenges posed by global environmental change and to identify opportunities for a transition to global sustainability. It is led by ICSU（国際科学会議）and ISSC (国際社会科学協議会）with UN organizations (UNEP, UNU, UNESCO, WMO) and Belmont Forum.

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Marginal Seas in Asia and the Pacific:

the largest hot spot in culture, history, environment, and industrial/trading activities

Urgent need of <Marine Crisis Watch （海洋危機監視）>

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Key sustainability challenges in Asia
アジアにおける持続可能性の課題

- Climate variability and extremes, and related hazards and disasters from typhoons, floods and landslides etc.
- Pressures of urbanization – megacities, health, pollution
- Values and lifestyles - social pressures, rapid growth in economics, population, production, consumption, and global connectivity
- Biodiversity loss in hot spots and unvalued/undervalued ecosystem services
- Food, water, energy, land security nexus
- Resilience, vulnerability, productivity of coastal, marine and terrestrial biomes

→ **Too much pressure on marginal, semi-enclosed seas of Asia**

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ICSU RCAP's Contribution to Future Earth:
SIMSEA
Sustainability Initiative in the Marginal Seas of South and East Asia
(http://simseaasiapacific.org/)
南及び東アジアの縁辺海における持続可能性イニシャチブ
-Importance of Views from Space and Oceans-
空と海の視点の重要性

The idea was born at the 16th Meeting of ICSU RCAP (Regional Committee for Asia and the Pacific), Nov. 26 - 28、2013, Hotel President, Seoul, Korea

Pre-scoping workshop was held at Application Lab, JAMSTEC, Feb. 27-28, 2014, Yokohama, Japan

1st SIMSEA SC at the University of the Philippines, June 30-July 1, 2014

Scoping workshop for prioritization at University of the Philippines, and 2nd SIMSEA SC Nov. 19-20, 2014

3rd SIMSEA SC at the University of the Philippines, Oct. 6-7, 2015

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Rich Application of Ocean and Climate Prediction to Society
海洋と気候予測システムの豊かな可能性

Our societal, economic and industrial activities are highly vulnerable to abnormal and extreme events induced by climate variations rooted in the oceans under the changing climate.

気候変化の下で進化を始めた海洋起源の気候変動現象。その結果として起きる海と空の極端現象が社会、経済、産業活動に大きな影響を与え始めた。

To mitigate impacts from such extreme events and to achieve sustainable wellness and well-being, to accelerate building an innovative ocean and climate prediction system by use of state-of-the art general circulation models harnessing the real-time satellite and *in situ* observations and the simulation technology is urgent.

その影響を緩和し持続可能な良き生を達成するにはリアルタイムの衛星及び現場観測とシミュレーション技術を統合した革新的な海洋と気候の予測システムの構築を急ぐ必要がある。

This will lead to a good practice in demonstrating an active link between the provision of services and the collection and processing of data, thus contributing to decision-making. This will contribute to <Marine Crisis Watch> in Asia and the Pacific, as well.

このシステムはサービスとデータ収集・処理の間の活発な交流の良き例を与え、政策決定に貢献する。これはアジア太平洋地域の＜海洋危機監視＞にも貢献するであろう。

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