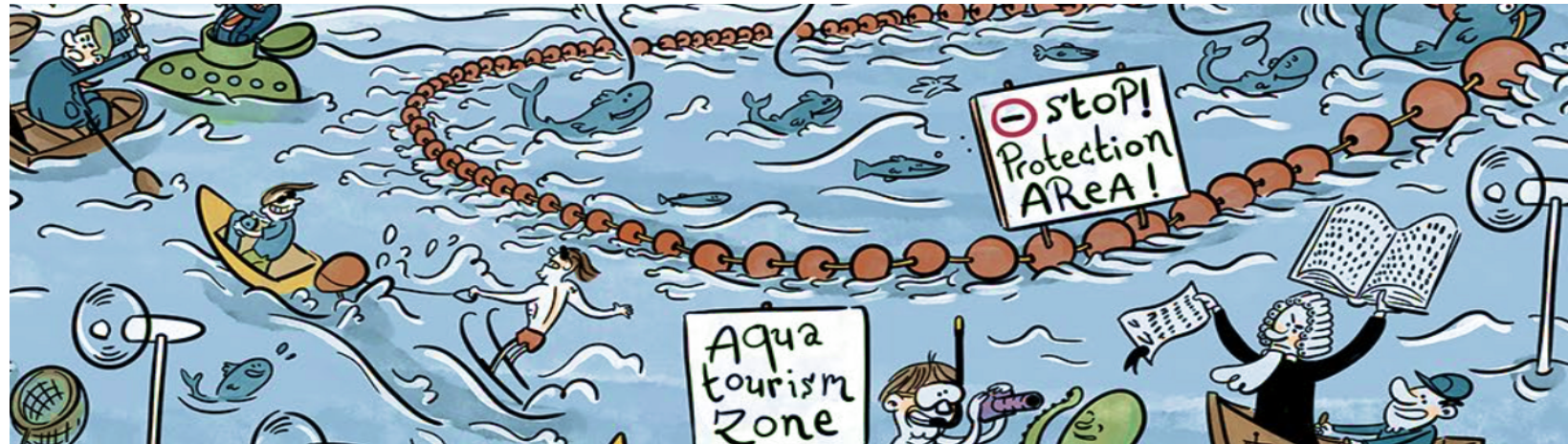


# SCIENCE COMMUNICATION & ADAPTATION TO CLIMATE CHANGE



Disciplina de Avaliação Ambiental e Ordenamento do Espaço Marítimo  
Mestrado em Ecologia Marinha

09 DEZEMBRO 2020 | T4  
CATARINA FRAZÃO SANTOS

## 4 classes:

**18/11** – MSP around the world & Sustainability issues

**25/11** – Global climate change & effects on ocean uses

**02/12** – 

**09/12** – MSP adaptation to (climate) change &  
Science Communication

## Evaluation:

18/11. Written exercise ✓

25/11. Written exercise ✓

02/12. 

09/12. Written exercise + Oral communications

Written exercises can be **delivered** by the **end of the class** OR until the **following class** (to [cfsantos@fc.ul.pt](mailto:cfsantos@fc.ul.pt))





Key rule:  
**If you have  
questions, ask**

**Today's class:**

**PART 1.**

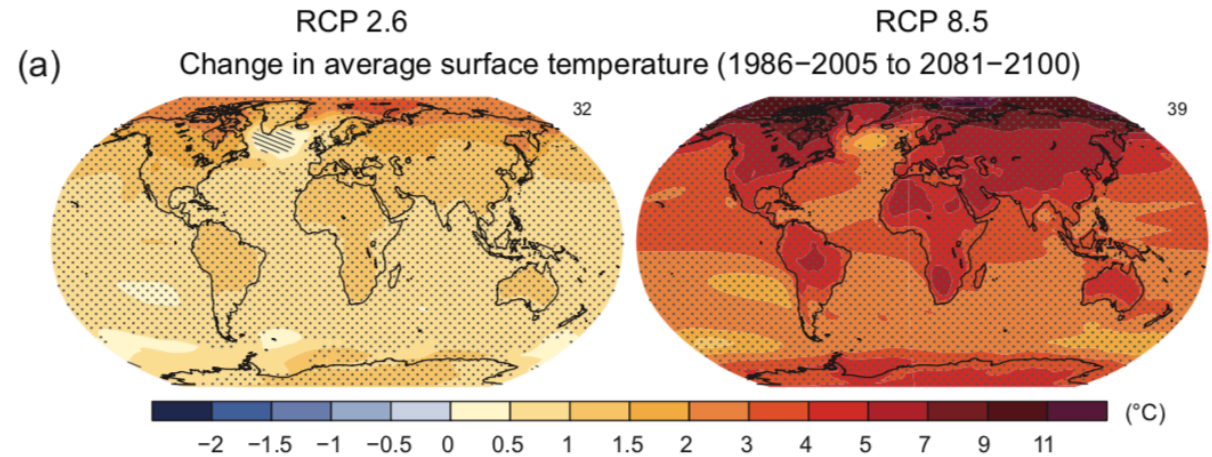
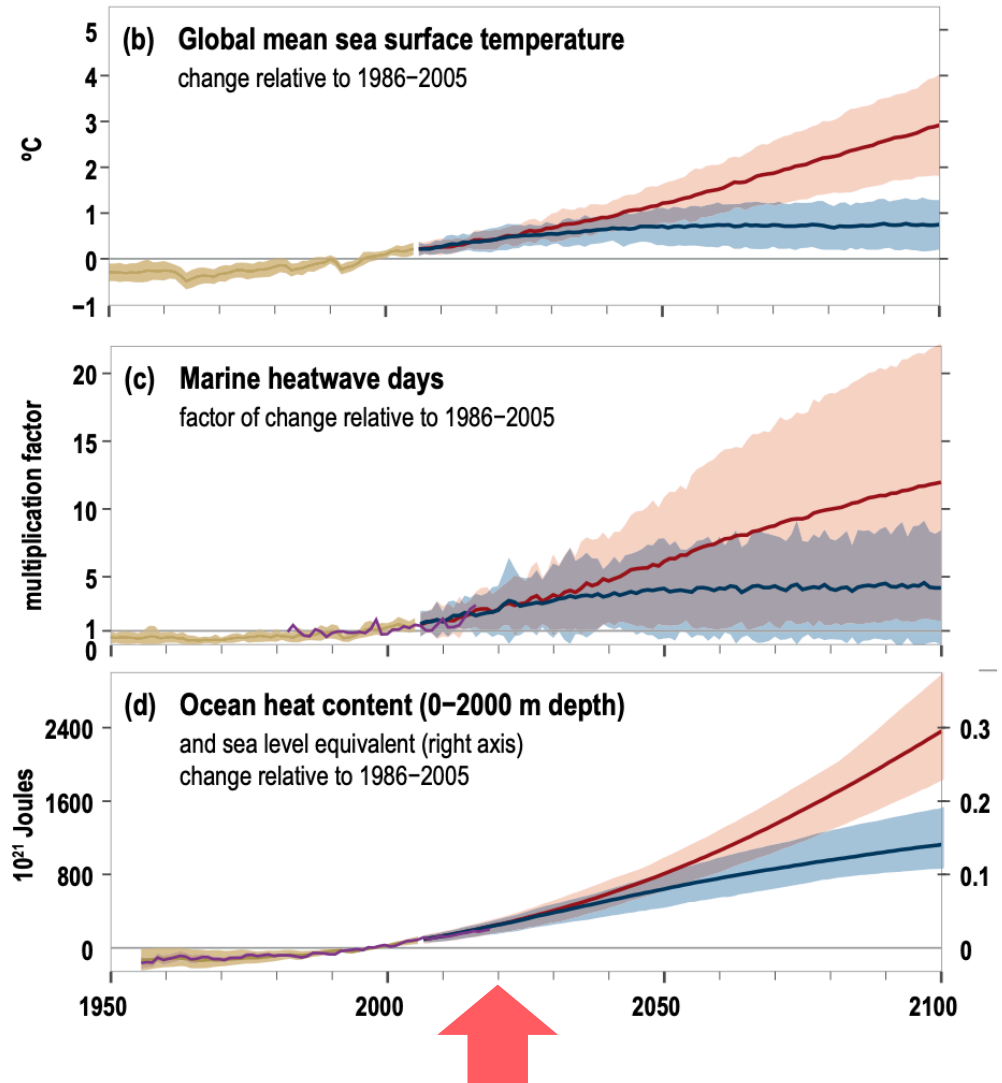
MSP Adaptation to climate change

**PART 2.**

Science communication

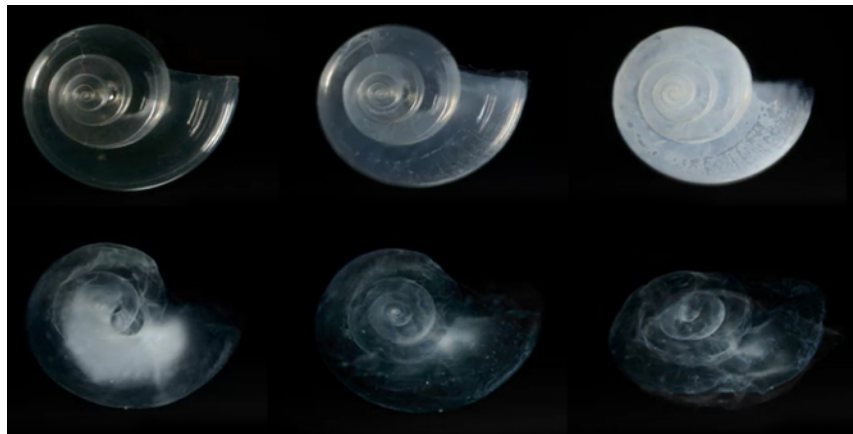
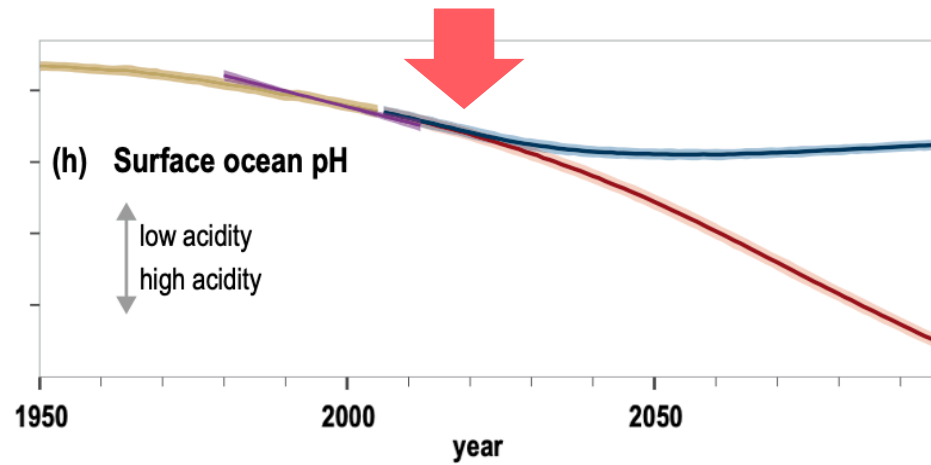
# PART 1

# GLOBAL CLIMATE CHANGE



## Ocean Warming

## Acidification



### WHAT IS OCEAN ACIDIFICATION?

The ocean **absorbs lots of CO<sub>2</sub>** from the atmosphere.

The amount it absorbs is the same as **every person on earth** throwing a **bowling ball of CO<sub>2</sub>** into the ocean — **every day.**

Different things happen to CO<sub>2</sub> once it's in the ocean.

Some of the CO<sub>2</sub> combines with **water** to form **carbonic acid**, which then breaks apart, releasing a **hydrogen ion**.

CO<sub>2</sub> + H<sub>2</sub>O = H<sub>2</sub>CO<sub>3</sub>

H<sup>+</sup> Hydrogen ions make the ocean more acidic.

**HISTORICALLY** the addition and removal of CO<sub>2</sub> were in **equilibrium**.

**WHAT'S LIKELY TO HAPPEN?** Evidence about the effects of ocean acidification is building, but scientists are uncertain about the extent of the changes. Here are some likely scenarios:

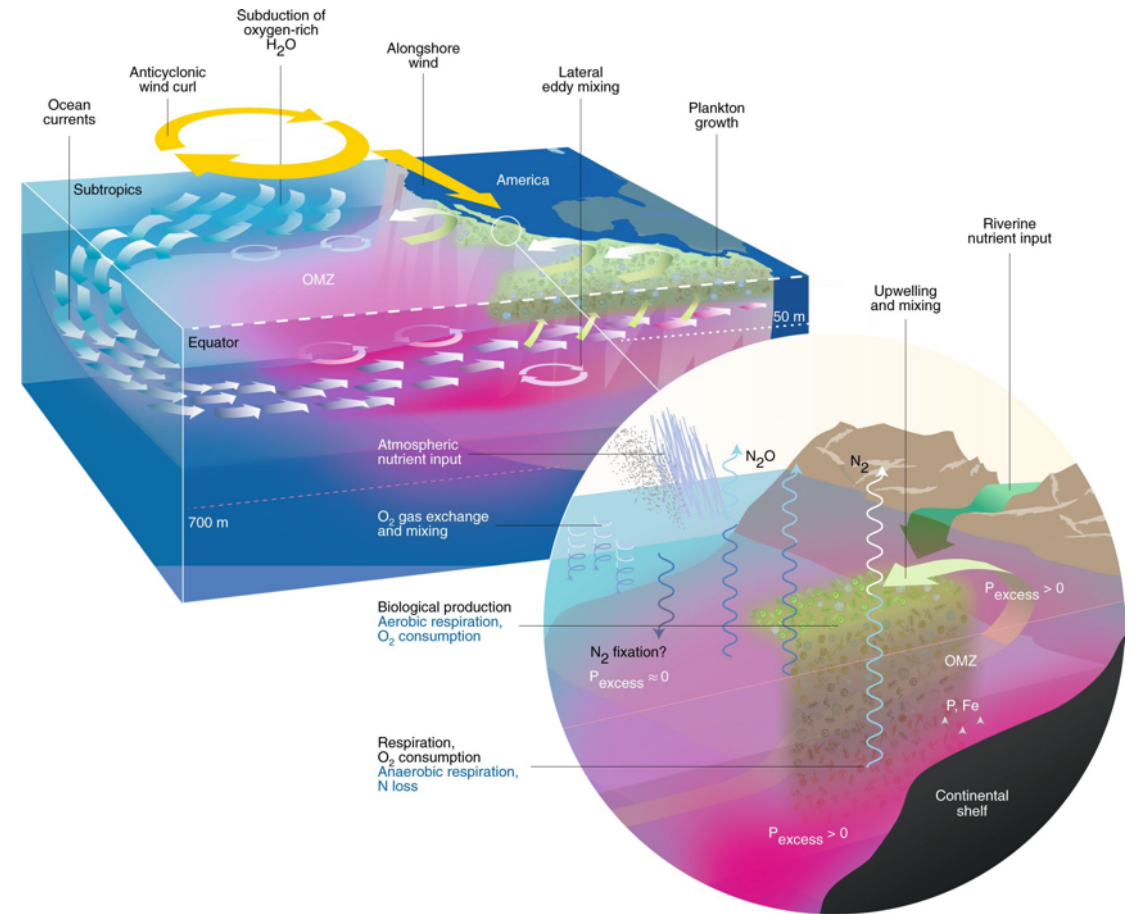
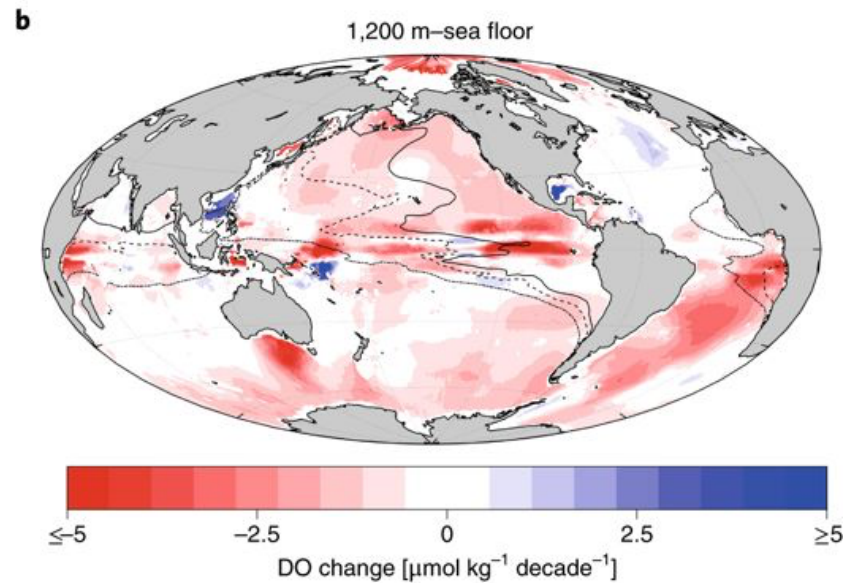
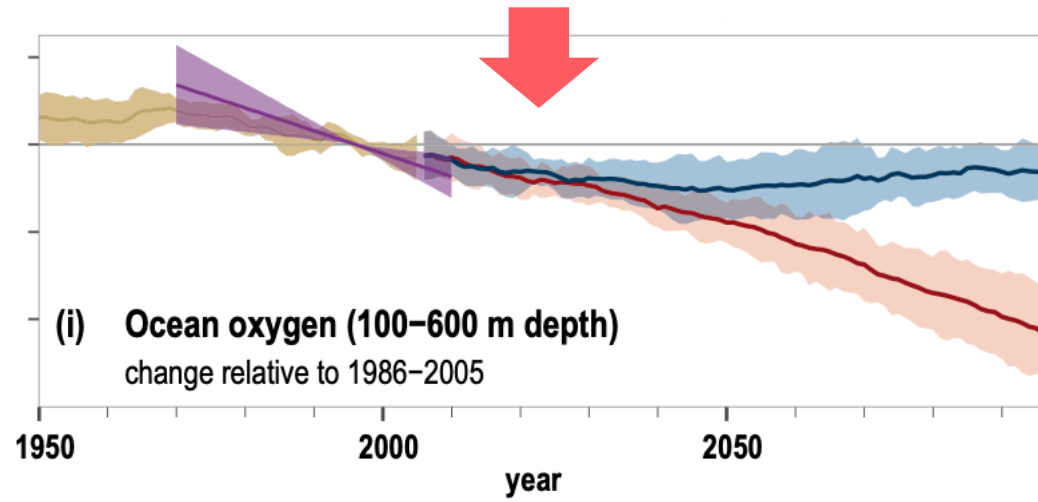
**BUT TODAY** the rate of CO<sub>2</sub> addition is **100x FASTER**. The ocean is already **34% MORE ACIDIC**.

It will be **more difficult** for many animals to **build shells**. One reason for this is less carbonate in the ocean water — a necessary building block in skeletons and shells. Animals like corals and molluscs are at risk.

The shells of **very small algae could also be affected**. As these form the base of the marine food web, their dwindling numbers might **change ocean ecosystems completely**.



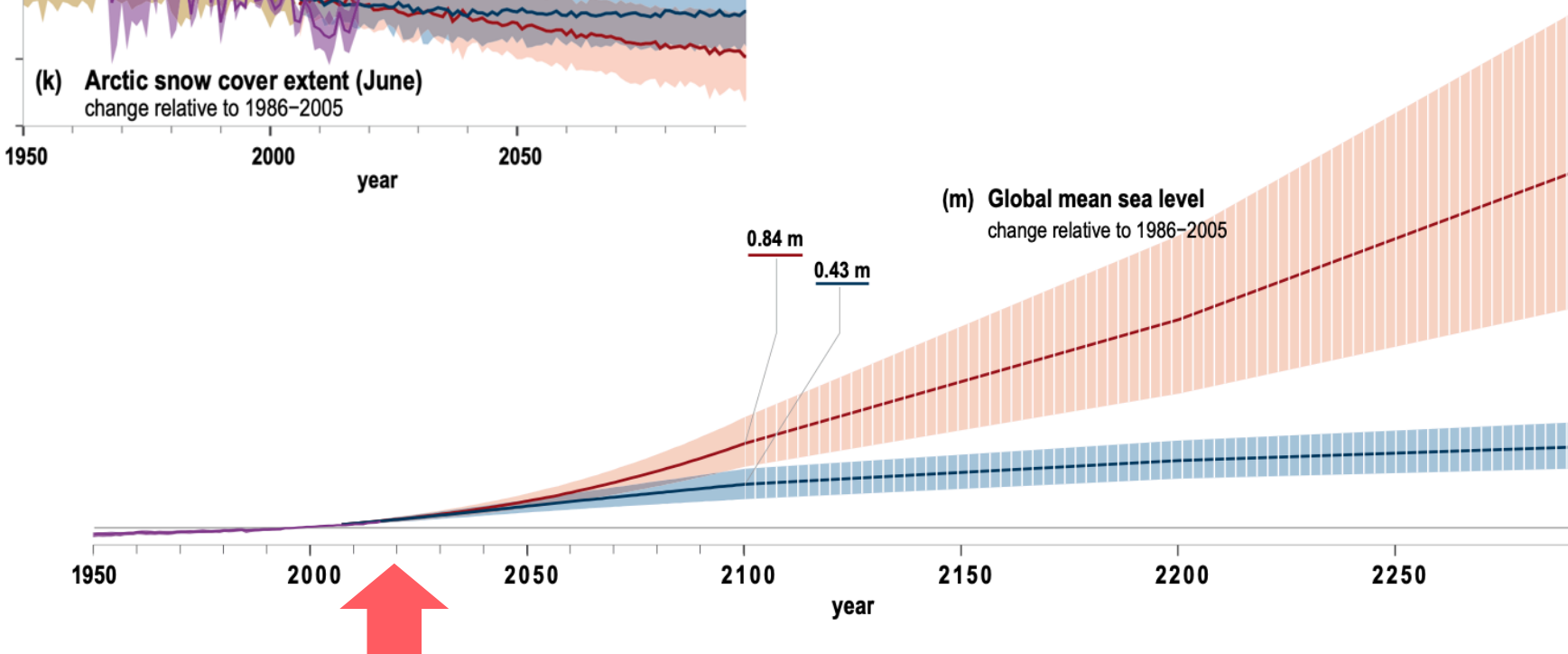
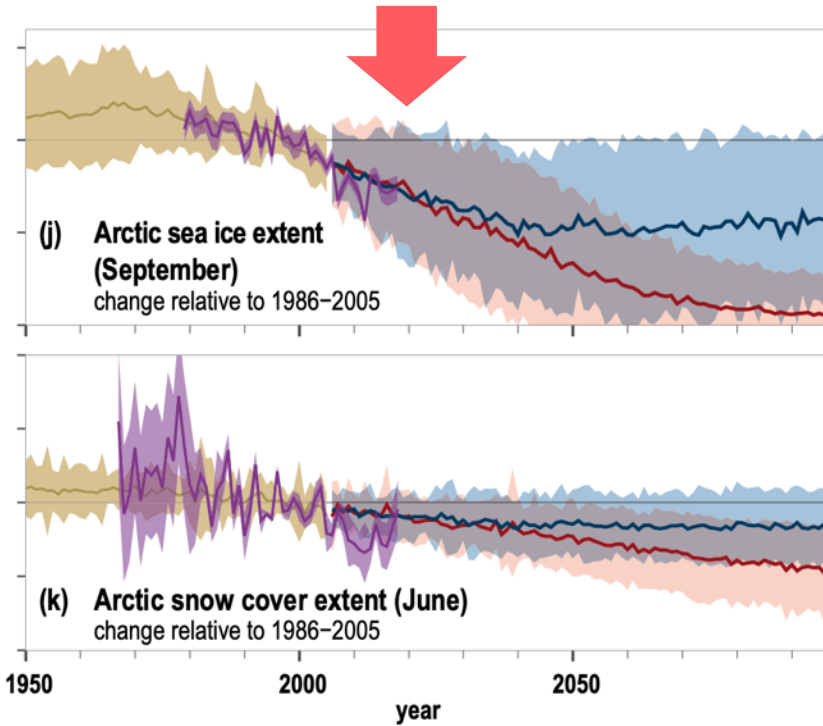
# GLOBAL CLIMATE CHANGE



# Deoxygenation

OSCHLIES ET AL. (2018)  
NATURE GEOSCIENCE

# GLOBAL CLIMATE CHANGE



## Ice loss & SLR

## Extreme events

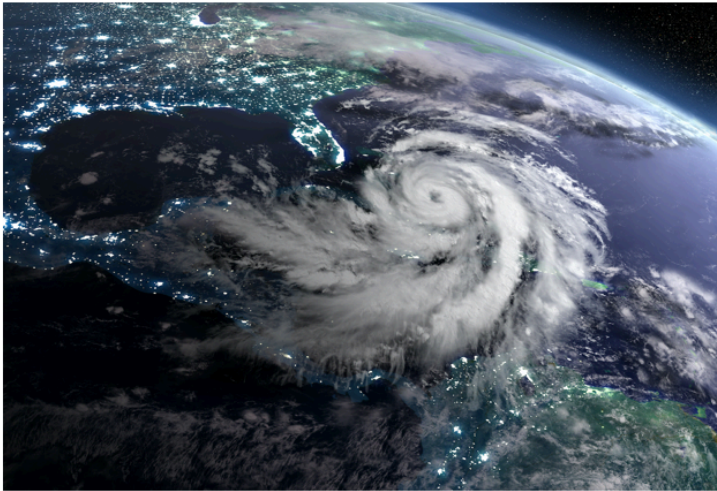
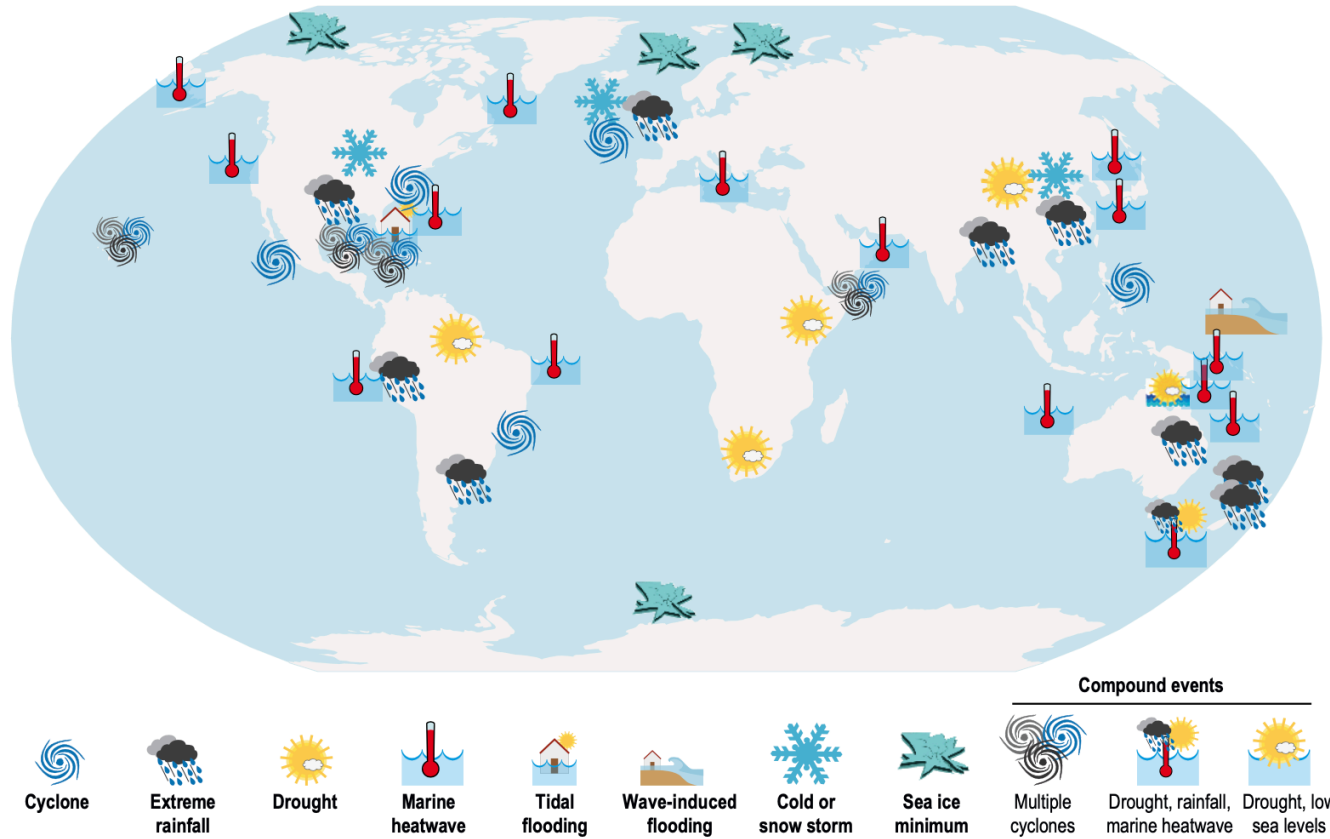
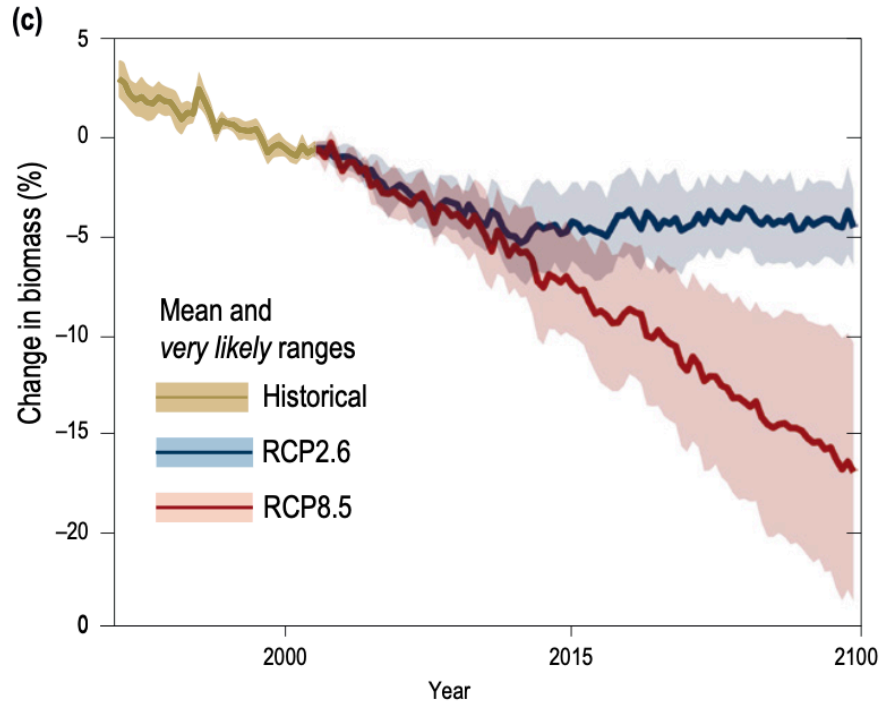


Figure 6.2 | Locations where extreme events with an identified link to ocean changes have been discussed in Table 6.2.

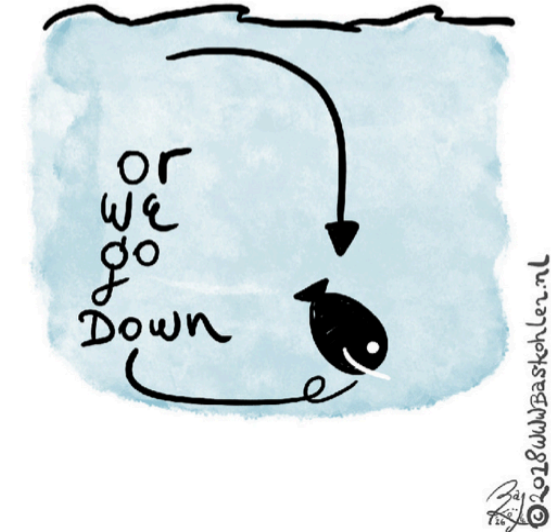


# Changes in marine ecosystems

STRUCTURE  
AND FUNCTIONING



Climate driven species redistribution



## Changes in marine ecosystems

STRUCTURE  
AND FUNCTIONING



## Changes in ocean conditions

EXTREME EVENTS,  
LOSS OF SEA ICE, ETC.

## USE-USE CONFLICTS



## USE-ENVIRONMENT



## LEGAL ISSUES



# !! Marine Spatial Planning !!












**Very few MSP plans  
address this key challenge**



*Ecological Applications*, 0(0), 2019, e02009

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## A fast-moving target: achieving marine conservation goals under shifting climate and policies

GIL RILOV <sup>1,16</sup> SIMONETTA FRASCHETTI <sup>2,3,4</sup> ELENA GISSI <sup>5</sup> CARLO PIPITONE <sup>6</sup> FABIO BADALAMENTI,<sup>4,6</sup>  
LAURA TAMBURELLO <sup>3,4</sup> ELISABETTA MENINI,<sup>7</sup> PAUL GORIUP <sup>8</sup> ANTONIOS D. MAZARIS,<sup>9</sup>  
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JOACHIM CLAUDET <sup>13,14</sup> AND STELIOS KATSANEVAKIS <sup>15</sup>

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<sup>4</sup>Stazione Zoologica Anton Dohrn, Naples 80121 Italy

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<sup>7</sup>Department of Life & Environmental Science, Polytechnic University of Marche, Ancona 60131 Italy

<sup>8</sup>NatureBureau, Votec House, Hambridge Road, Newbury RG14 5TN United Kingdom

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<sup>10</sup>Institute of Marine Sciences, CSIC, Passeig Marítim de la Barceloneta, Barcelona 37-49 08003 Spain

<sup>11</sup>Aix Marseille Université, Université de Toulon, CNRS, IRD, MIO, Marseille, France

<sup>12</sup>Department of Biology, University of Pisa, Pisa, Italy

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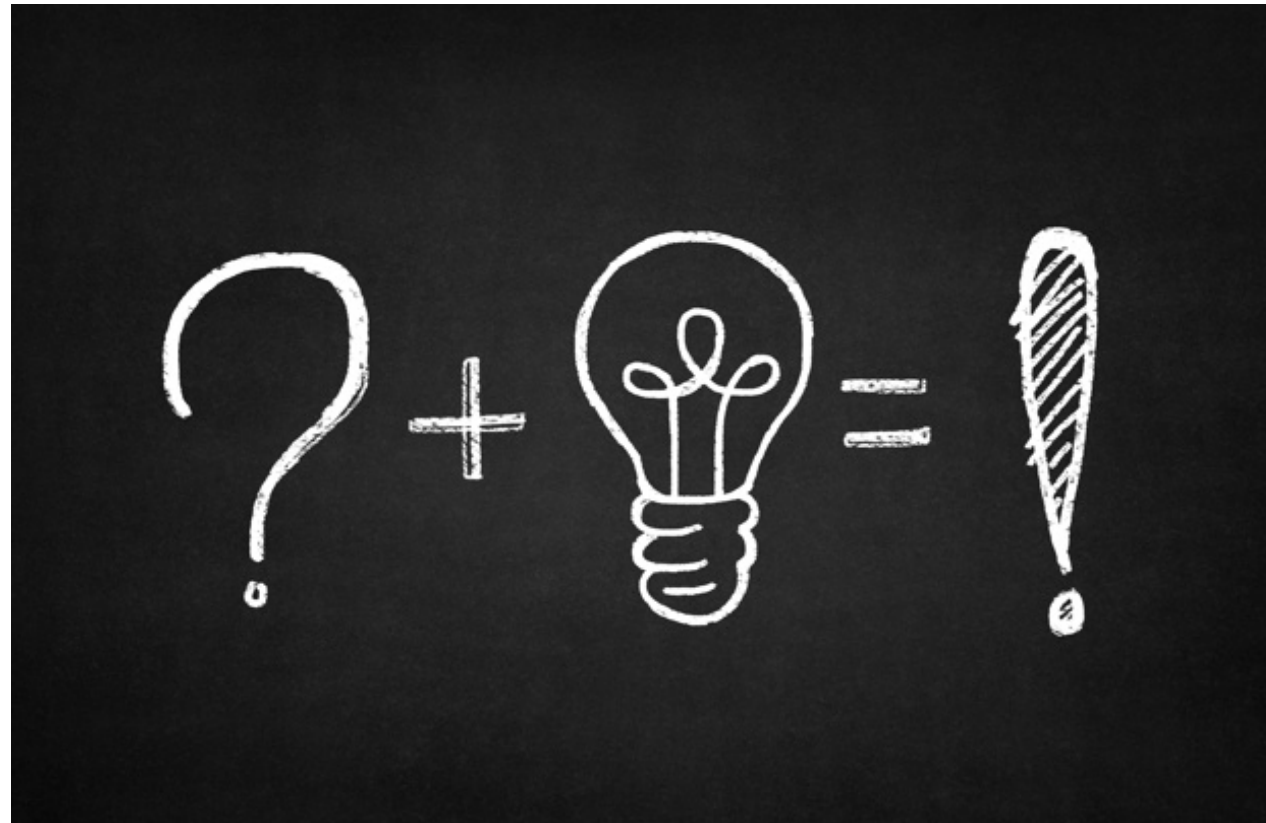
<sup>14</sup>Laboratoire d'Excellence CORAIL, Moorea, French Polynesia

<sup>15</sup>Department of Marine Sciences, University of the Aegean, 81100 Mytilene, Greece

*Citation:* Rilov, G., S. Frascchetti, E. Gissi, C. Pipitone, F. Badalamenti, L. Tamburello, E. Menini, P. Goriup, A. D. Mazaris, J. Garrabou, L. Benedetti-Cecchi, R. Danovaro, C. Loiseau, J. Claudet, and S. Katsanevakis. 2019. A fast-moving target: achieving marine conservation goals under shifting climate and policies. *Ecological Applications* 00(00):e02009. 10.1002/eap.2009

“Only three [EU] countries (...) considered **adaptation and mitigation to climate change** (...) as an objective of their **[marine spatial] plan**, for which **specific actions** are put in place.

All other (...) **ignore this threat entirely in their plans**”





## Integrating climate change in ocean planning

Catarina Frazão Santos<sup>1,2</sup>✉, Tundi Agardy<sup>3</sup>, Francisco Andrade<sup>1</sup>,  
Helena Calado<sup>4</sup>, Larry B. Crowder<sup>5</sup>, Charles N. Ehler<sup>6</sup>, Sara García-Morales<sup>1</sup>, Elena Gissi<sup>7</sup>,  
Benjamin S. Halpern<sup>8,9</sup>, Michael K. Orbach<sup>10</sup>, Hans-Otto Pörtner<sup>11,12</sup> and Rui Rosa<sup>1</sup>

**The acceleration of global warming and increased vulnerability of marine social-ecological systems affect the benefits provided by the ocean. Spatial planning of marine areas is vital to balance multiple human demands and ensure a healthy ocean, while supporting global ocean goals. To thrive in a changing ocean though, marine spatial planning (MSP) must effectively integrate climate change. By reviewing existing literature on MSP and climate change, we explore the links between them and with ocean sustainability, highlight management challenges, and identify potential pathways to guide action towards the effective integration of climate impacts in MSP.**

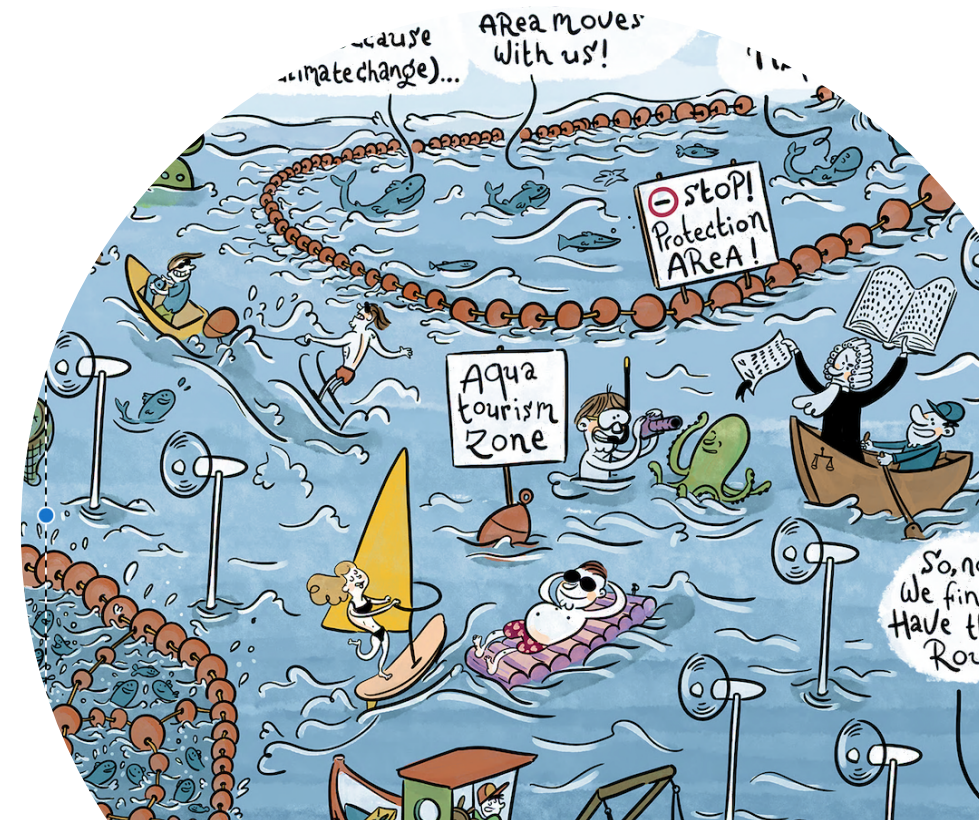
The sustainable use and conservation of the world ocean and its resources represent one of the 17 global goals set to ‘transform our world’ in the context of the United Nations (UN) 2030 Agenda for Sustainable Development<sup>1</sup>. Although such global agreement on promoting sustainability in the ocean is relatively recent, protecting marine ecosystems has been in the international agenda for decades<sup>2,3</sup>, with numerous actions, approaches, frameworks and plans being developed and implemented to support it. These include the ecosystem approach, with its origins in the UN Convention on Biological Diversity<sup>4</sup>, ecosystem-based management (EBM) that grew out of the ecosystem approach<sup>5</sup>, the integrated management concept that stemmed from Chapter 17 of the Agenda 21<sup>6</sup>, or international treaties such as the UN Convention on the Law of the Sea (UNCLOS)<sup>2</sup>.

Concomitant to these developments, and incorporating many of these concepts (for example, the ecosystem approach and integrated management; Box 1), in the 1990s a management process commonly known as marine spatial planning (MSP) emerged and has spread widely in the last 15 years<sup>7</sup>. No single definition exists for MSP; it takes many forms and names depending on context (Box 1). However, it can be generally outlined as the analysis and allocation of the spatial and temporal distribution of human uses in the ocean, with the aim of balancing conflicting objectives

most of them are in early stages of development (only 25 countries have marine spatial plans that are already implemented or at least government approved; Fig. 1)<sup>7</sup>.

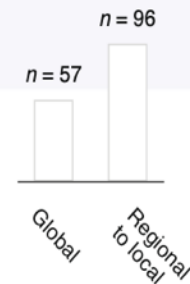
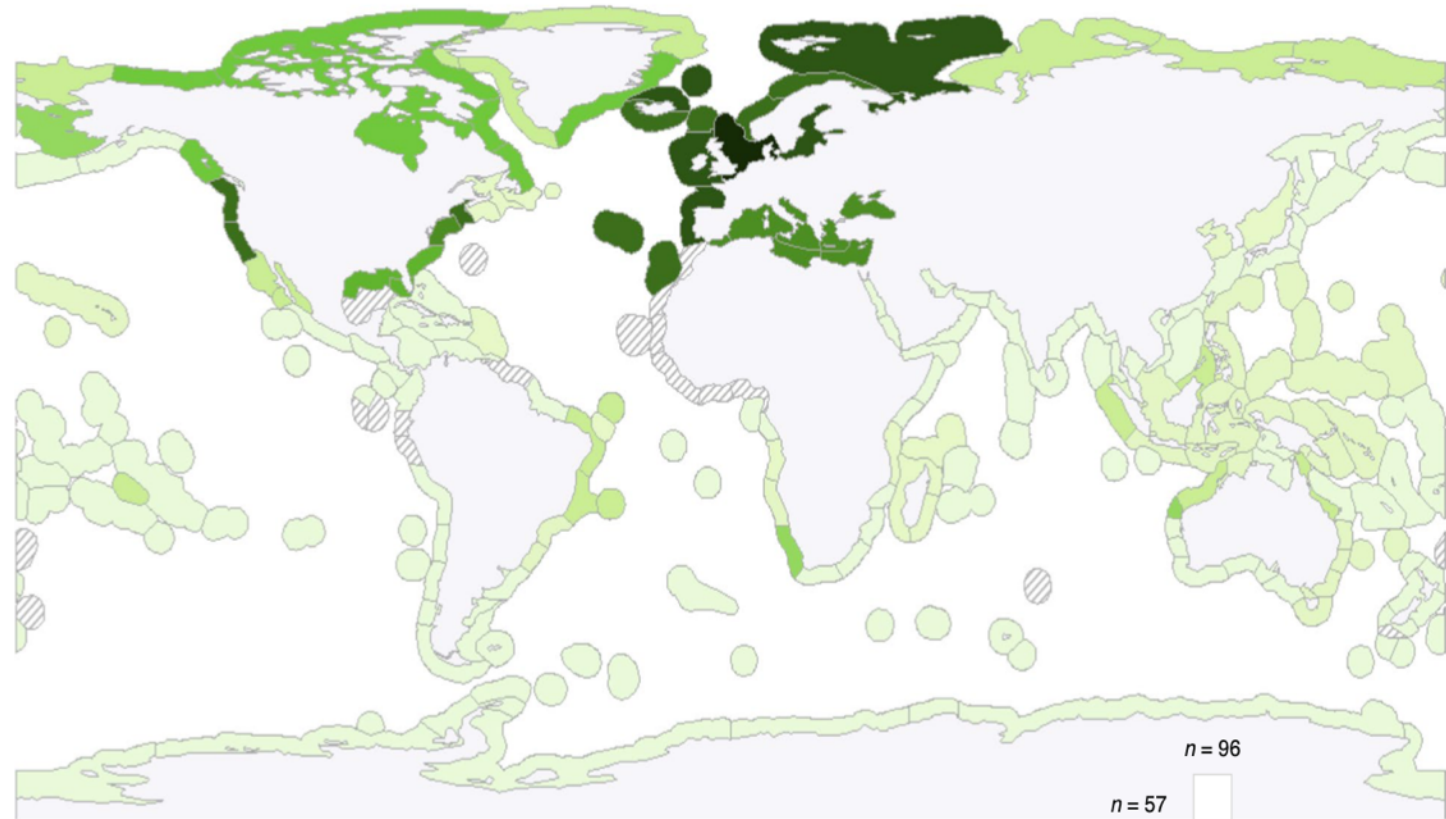
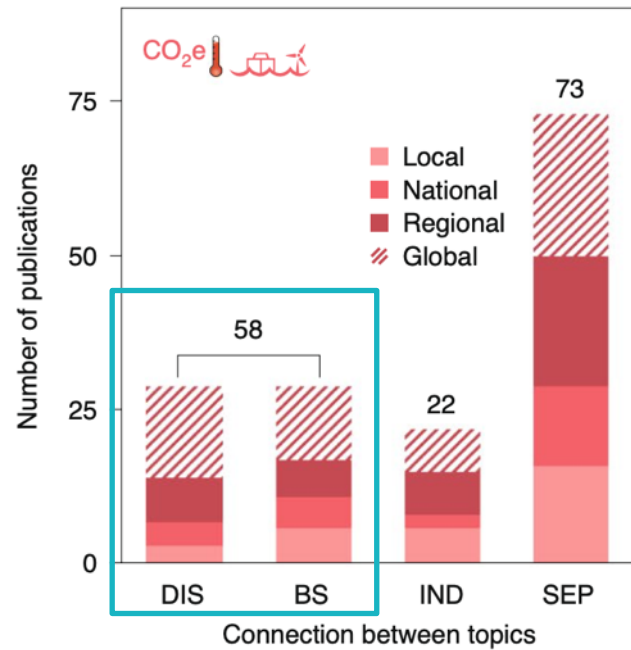
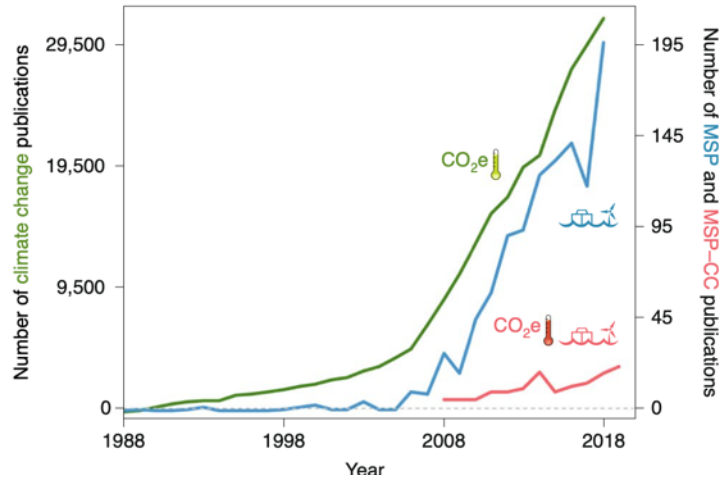
MSP will likely keep expanding in the coming decade as new countries start to discuss the development of ocean planning initiatives, especially in Africa and South America. For example, the European Union (EU) funded Paddle project (‘Planning in a liquid world with tropical stakes’; [www-ium.univ-brest.fr/paddle](http://www-ium.univ-brest.fr/paddle)) explores opportunities and limits of MSP in Brazil, Senegal and Cabo Verde, although government-led initiatives are not yet in place. MSP in international waters is also being increasingly discussed<sup>12,13</sup>, and in early 2019, the European Commission and UNESCO’s Intergovernmental Oceanographic Commission (IOC) jointly launched the MSPglobal program ([www.mspsglobal2030.org](http://www.mspsglobal2030.org)) with the intention to support the effective implementation of marine spatial plans worldwide.

Several conceptual and practical challenges limit the efficacy of MSP development and implementation<sup>14</sup>. For example, ensuring ecosystem conservation through MSP is rarely straightforward because the importance of protecting marine ecosystems is often overlooked by economic and/or political short-term goals and objectives, often insensitive to environmental impacts<sup>15,16</sup>. In addition, the increasing number of marine spatial plans worldwide is



# GLOBAL CLIMATE CHANGE & MSP

# 153 studies



# I. Raise awareness on the topic importance



# II. Integrate climate change in MSP



# III. Explore adaptation mechanisms to respond to change

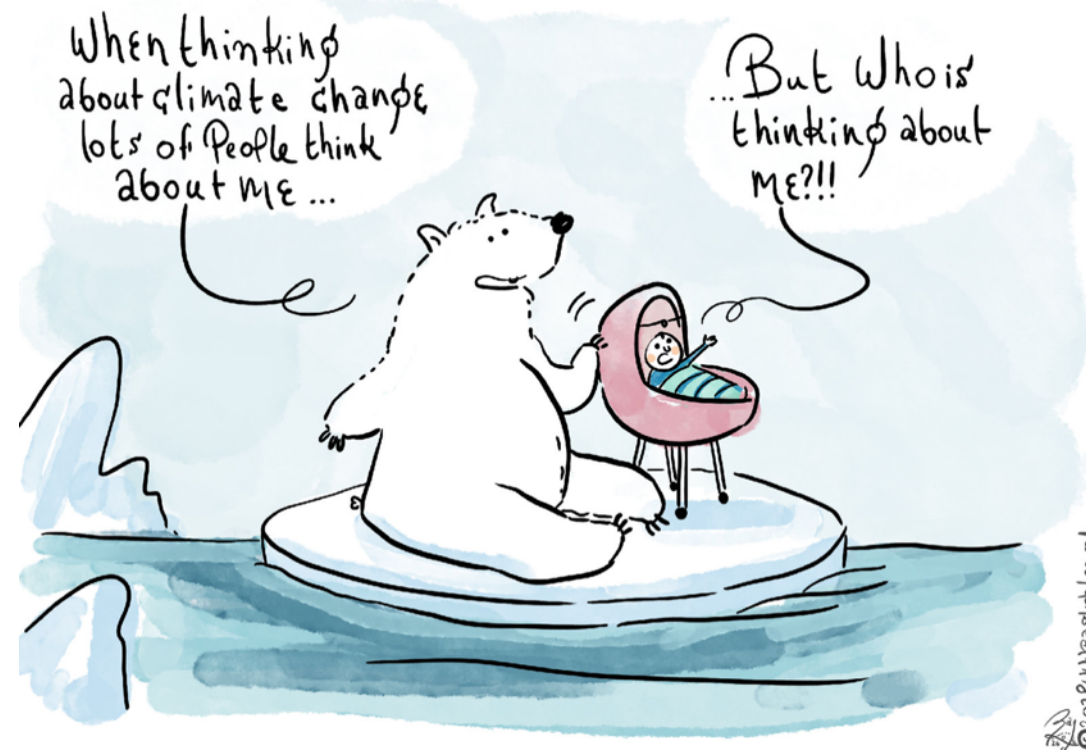
ADAPTIVE GOVERNANCE,  
DYNAMIC OCEAN MANAGEMENT, ETC.



# Recognizing the need for climate-smart MSP




# Recognizing climate change as a threat or challenge




## Recognizing climate change as a real threat or challenge



Marine Spatial Planning Programme




United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission

[Contact](#) | [Sitemap](#) | [Change language](#) Spanish

With the financial support of



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*Ecological Applications*, 30(1), 2020, e02009  
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### A fast-moving target: achieving marine conservation goals under shifting climate and policies

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Abstract: In the Anthropocene, marine ecosystems are rapidly shifting to new ecological

### OVERVIEW

**MSP Around the world**  
**"An invasive species" – Victor Hu**  
 Over the past 15 years, there has been considerable impact on marine ecosystems...



# Integrating climate change



## Spatial-use scenarios and visioning processes

### STEP 6 DEFINING AND ANALYZING FUTURE CONDITIONS

*"Before we can create a desirable future, we first need to imagine it"*

#### What outputs should be delivered from this step?

- ☞ A **trend scenario** illustrating how the MSP area will look if present conditions continue without new management interventions;
- ☞ Alternative **spatial sea use scenarios** illustrating how the management area might look when human activities are redistributed based on new goals and objectives; and
- ☞ A **preferred scenario** that provides the basis for identifying and selecting management measures in the spatial management plan (Step 7).

#### Introduction

The previous step concentrated on analyzing existing conditions within the marine management area. Its main purpose was to gain understanding of the existing distribution of important ecological and economic areas in the marine environment and the nature and scope of its human uses. Essentially, it provides an inventory of what exists today in the management area.

The purpose of this phase of the planning process is to answer another seemingly simple question: **Where do we want to be?** The answer takes the form of alternative spatial sea use scenarios and the selection of a preferred scenario.

**A spatial sea use scenario provides a vision that projects the future use of marine space based on a core set of goals, objectives, and assumptions about the future.**

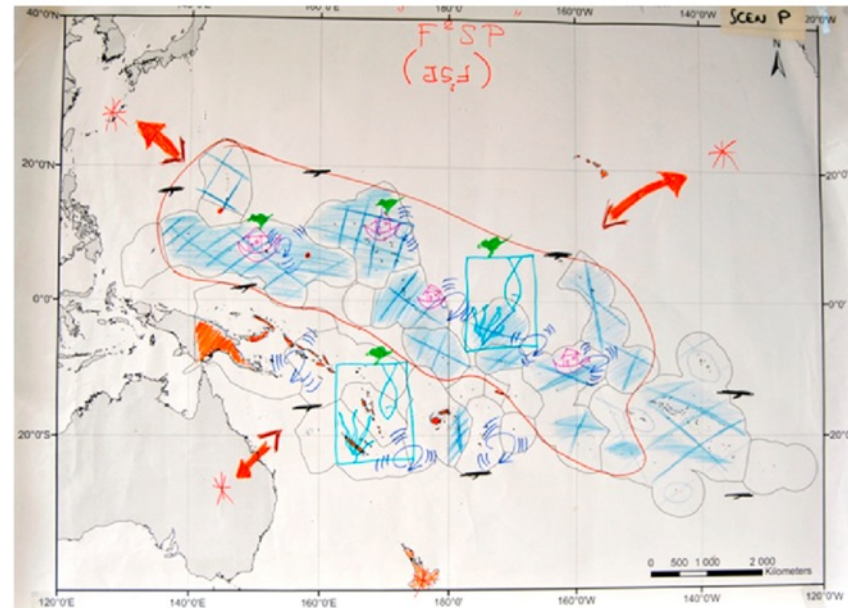
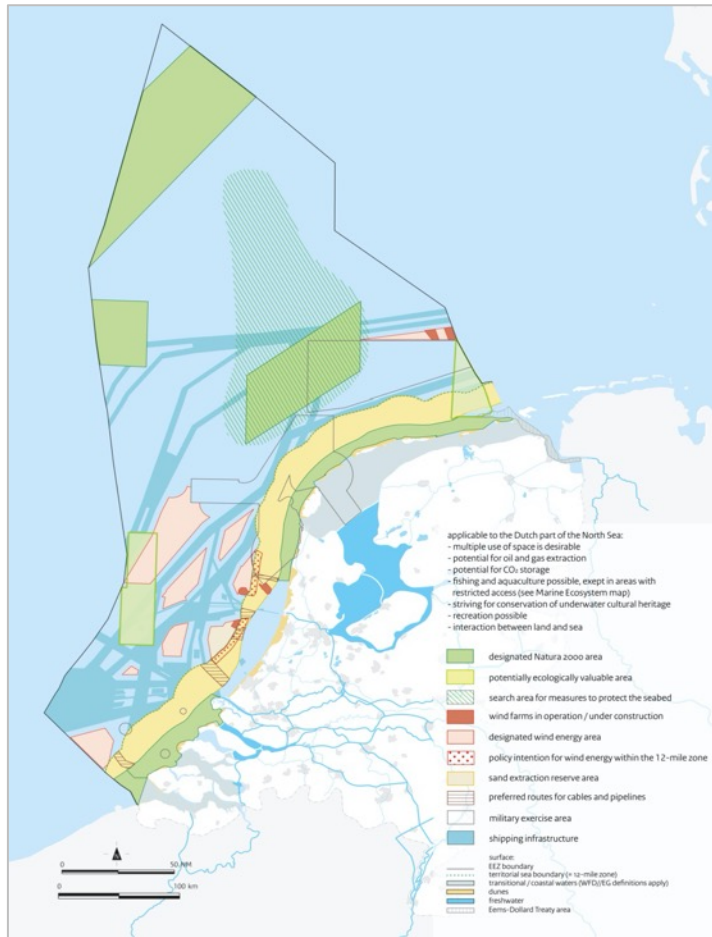
MSP is a future-oriented activity. Its purpose is to help envision and create a desirable future and enable proactive decision-making in the short run to move toward what is desired. Consequently, planning should not be limited to defining and analyzing only existing conditions and maintaining the status quo, but should reveal possible alternative futures of how the area could look like in another 10, 15, or 20 years. Box 26 lists a number of other reasons why the development of alternative spatial sea use scenarios is important.

Defining and analyzing future conditions involves the following tasks:

- (1) Projecting current trends in the spatial and temporal needs of existing human uses;
- (2) Estimating spatial and temporal requirements for new demands of ocean space;
- (3) Identifying possible alternative future scenarios for the planning area; and
- (4) Selecting the preferred spatial sea use scenario

Each of these steps are discussed in more detail in the following sections.

## Spatial-use scenarios and visioning processes












Group n° :

PAGOCIA Workshop n°2  
 18-21 August 2014 - Noosima  
 Territorial Game

Legend Scenario

« F<sup>2</sup>SP : Federated floating states of the Pacific »

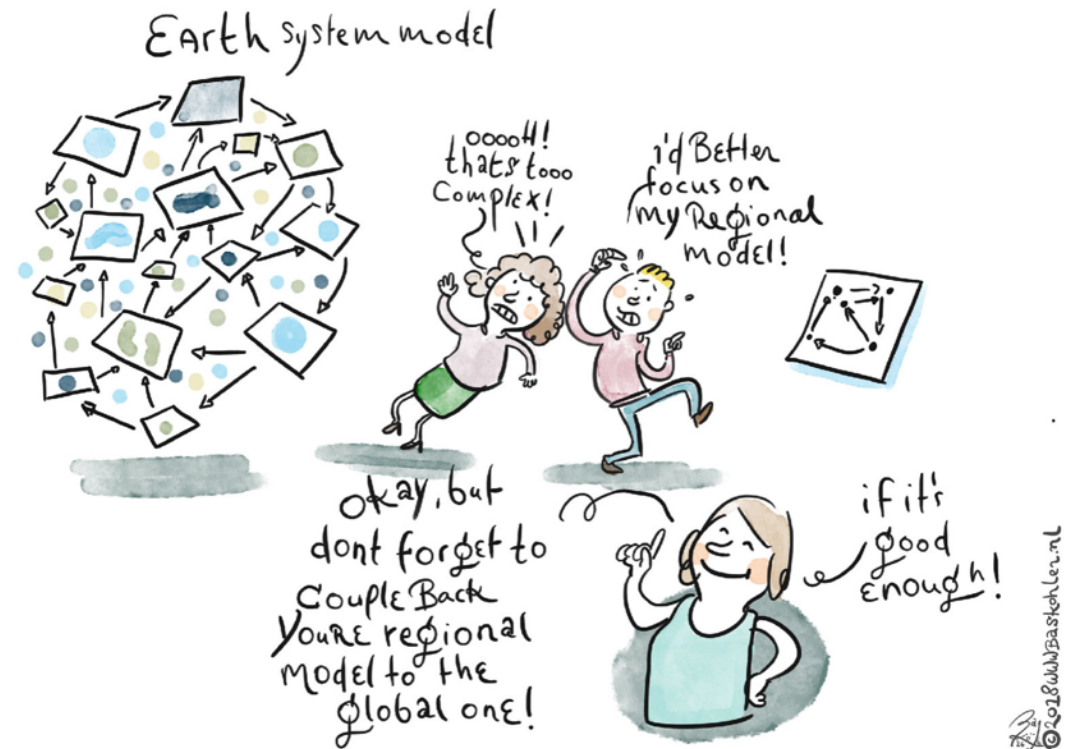
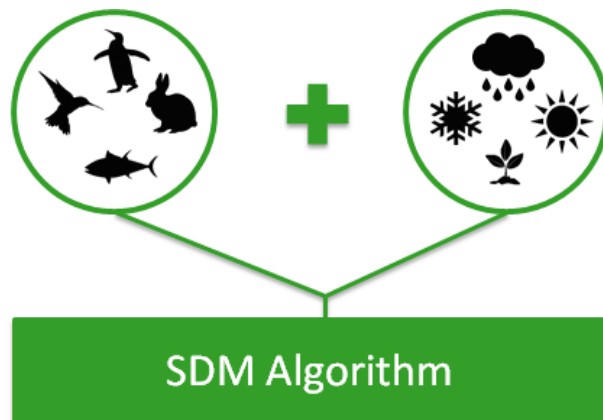
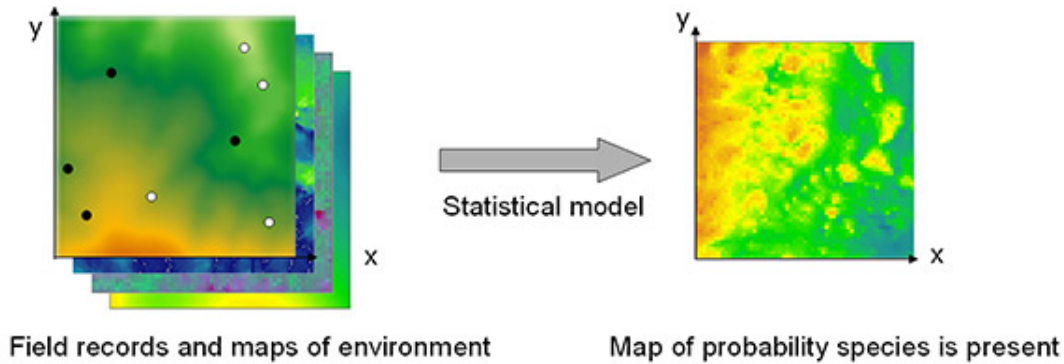
N°	Symbol	Description
1		Disappearance of land with sea level rise
2		Migration fluxes and welcoming lands
3		Exploitation of resources in exchange of population welcoming
4		High tech floating houses
5		Integrated multi-trophic aquaculture and fisheries
6		Conflicts in welcoming land because of difficulties of integration of immigrants from the Pacific
7		Gliders for safety and monitoring
8		Renewable energy production (based on marine biomass and wave dynamics)
9		Artificial structure for preservation of iconic species

Western Tropical Pacific Ocean

Netherlands

## Modelling and mapping tools

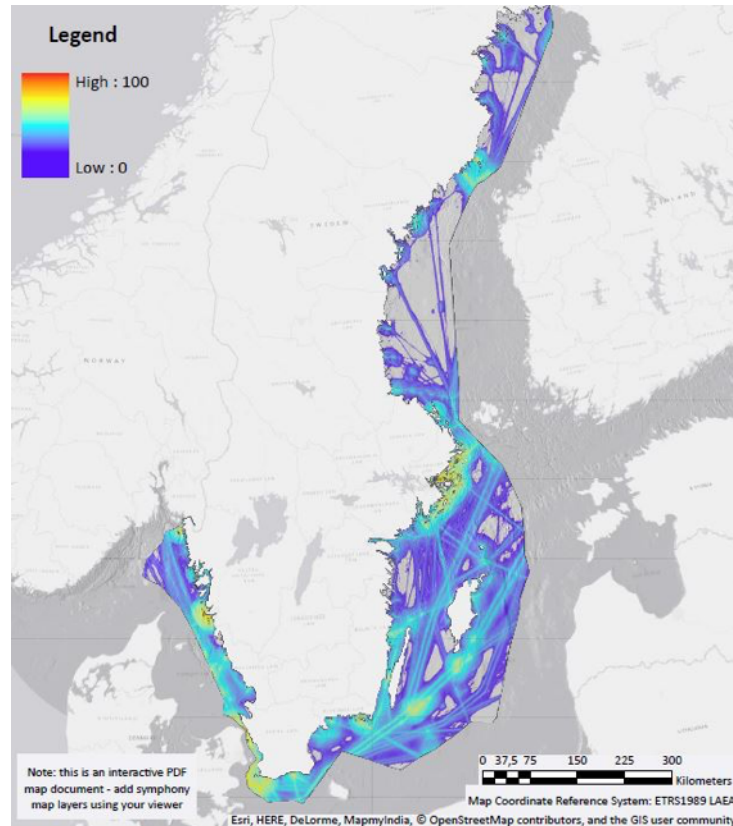
changes in ecosystem goods and services and related human activities



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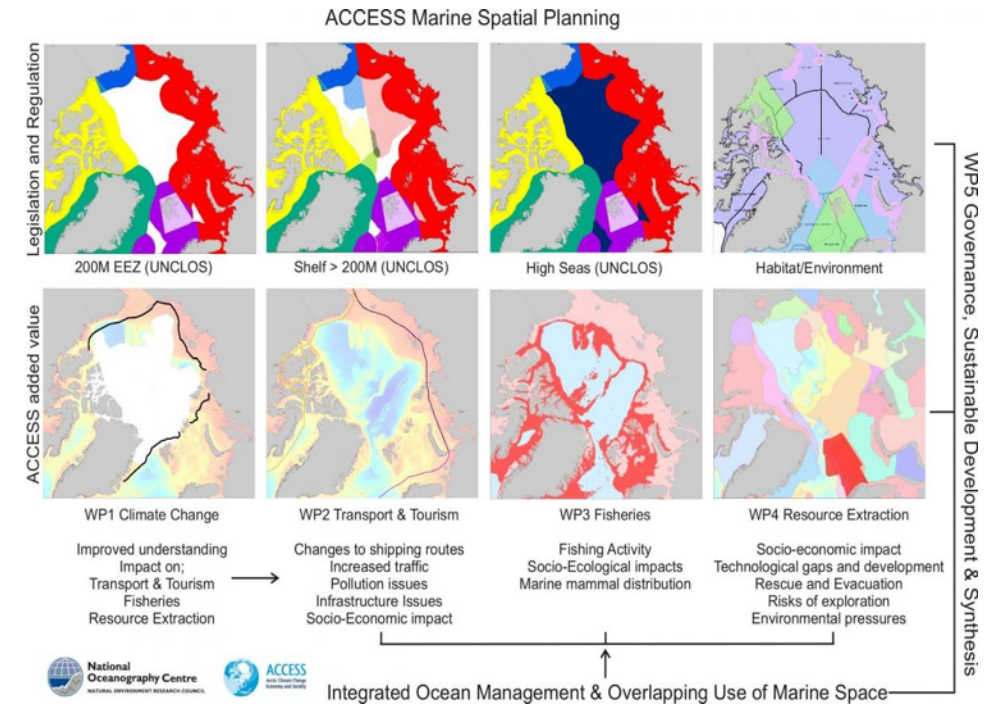
## Modelling and mapping tools

changes in ecosystem services and related human activities

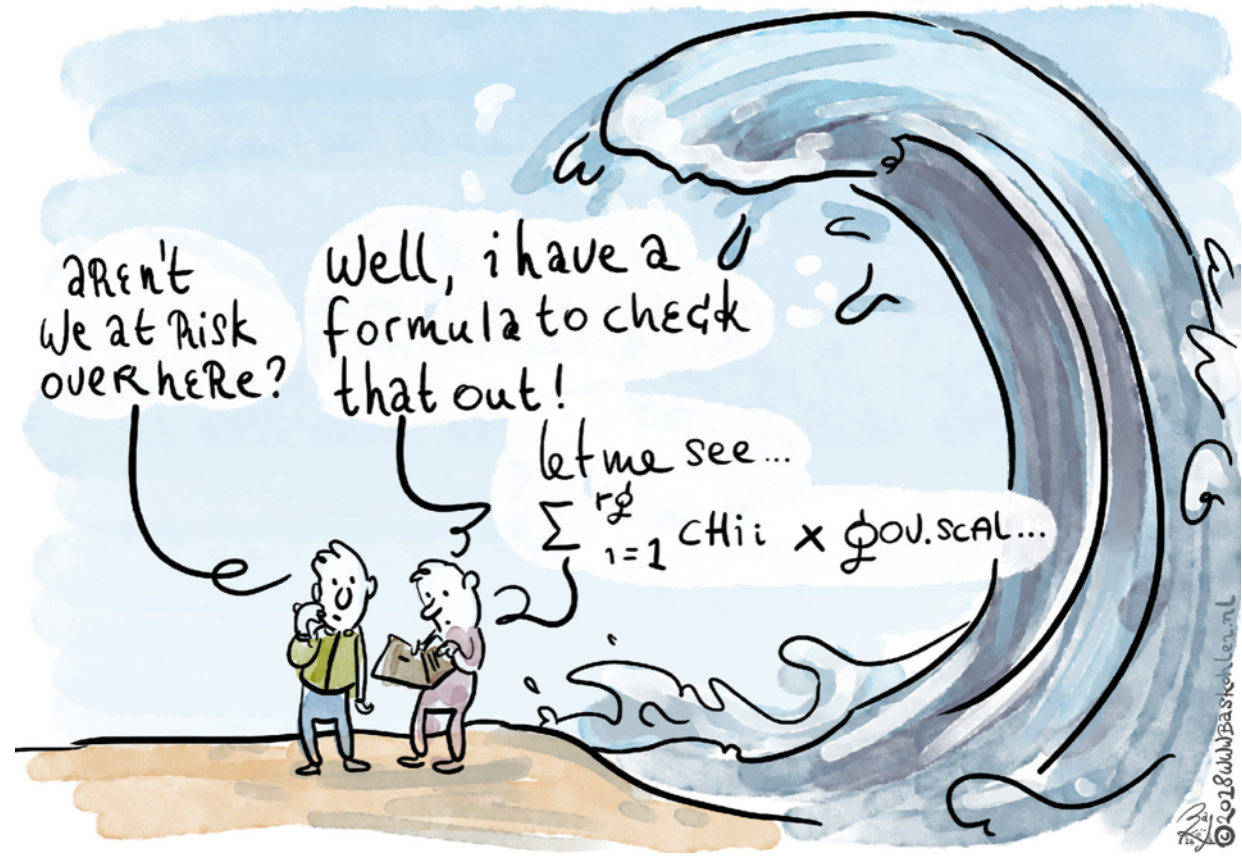


## Symphony tool (Sweden)

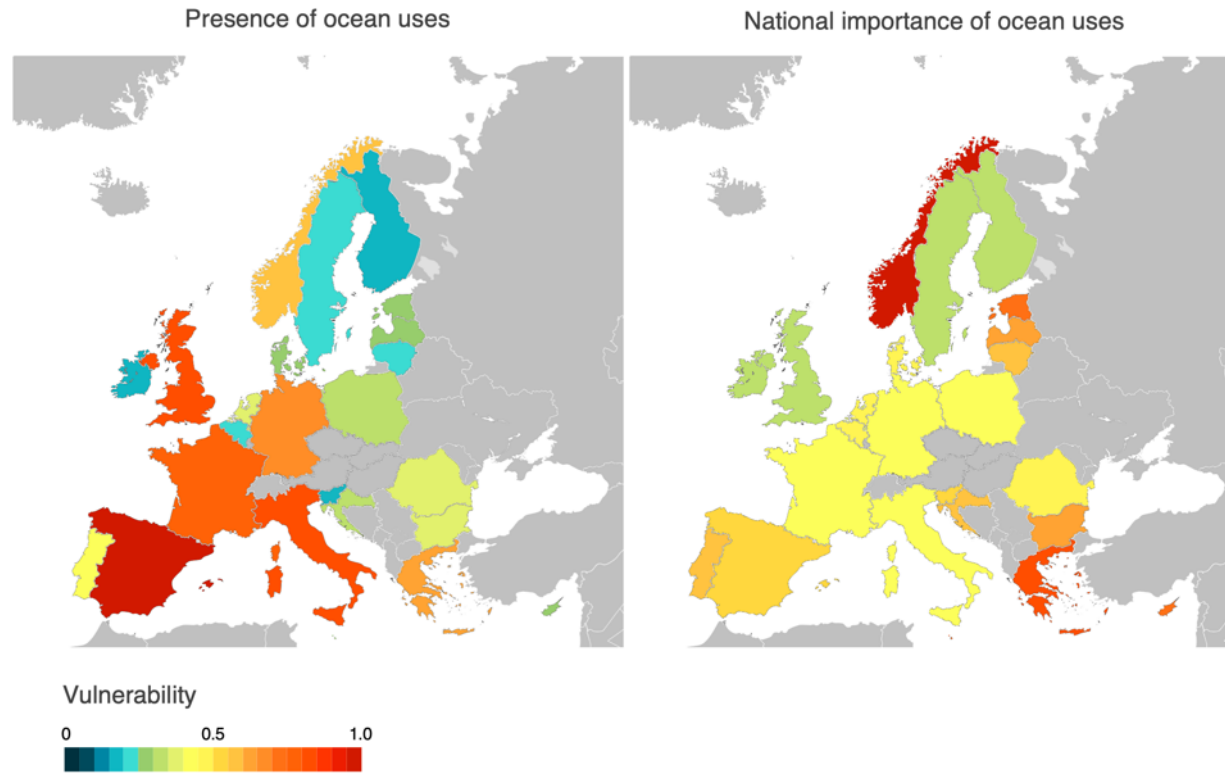
## ACCESS tool (Arctic)



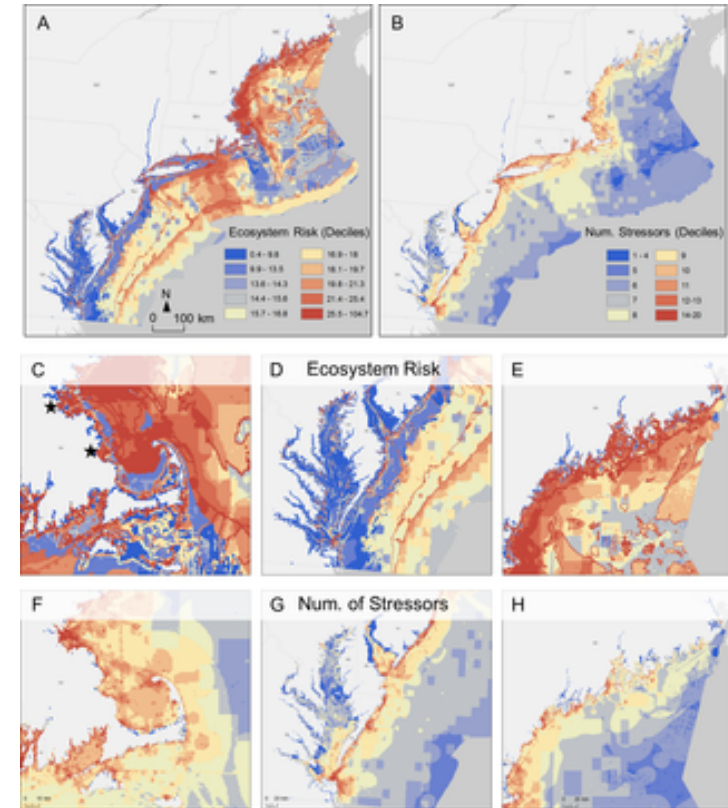
# Climate-related vulnerability and risk analyses



# Climate-related vulnerability and risk analyses

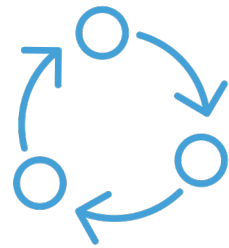


**Biogeographic (Europe) vulnerability (Moorea)**



**Habitat risk assessment (US)**

# Promoting adaptation





## Adaptação

Qualquer *ajuste* nos sistemas naturais e humanos em resposta aos **efeitos** positivos ou negativos, actuais ou esperados, das **alterações climáticas**

**ipcc**  
INTERGOVERNMENTAL PANEL ON  
climate change



## Adaptação

Envolve a **tomada de acção** (medidas)

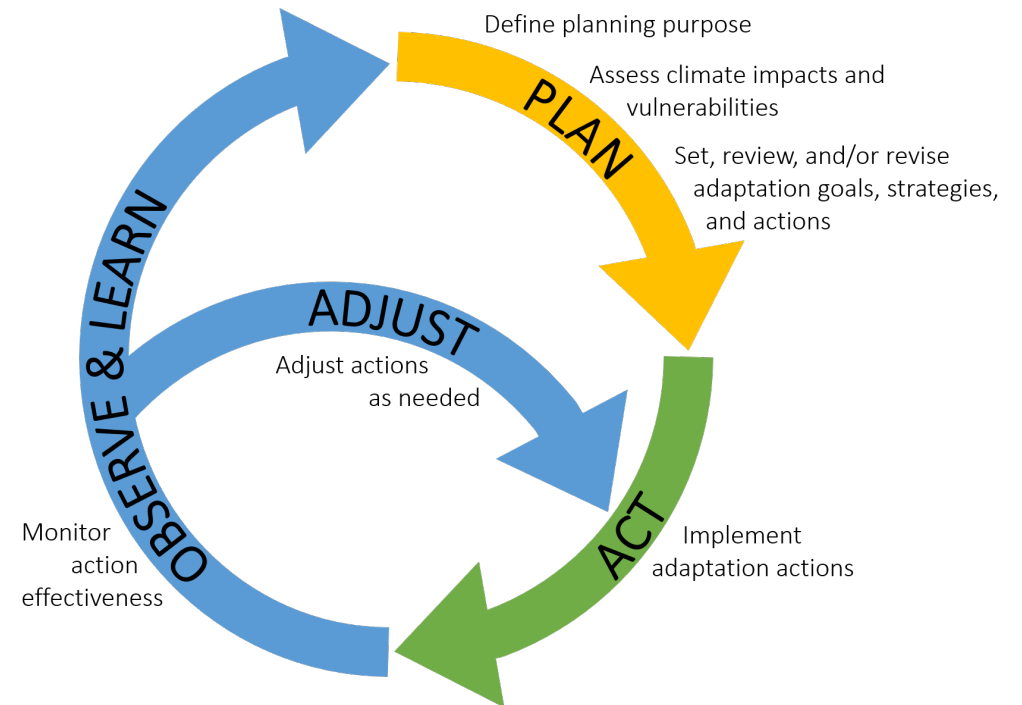
**Medidas de adaptação** são aquelas que **umentam** a nossa **resiliência**, e a capacidade de nos adaptarmos ou tiramos **vantagem** das consequências das alterações climáticas.

Podem ser **nacionais, regionais e locais**

A **adaptação** e a **mitigação** (limitar/minimizar as causas antropogénicas das AC) **são essenciais** para lidar com os **desafios e oportunidades** associadas às AC



## Climate Change Adaptation Cycle

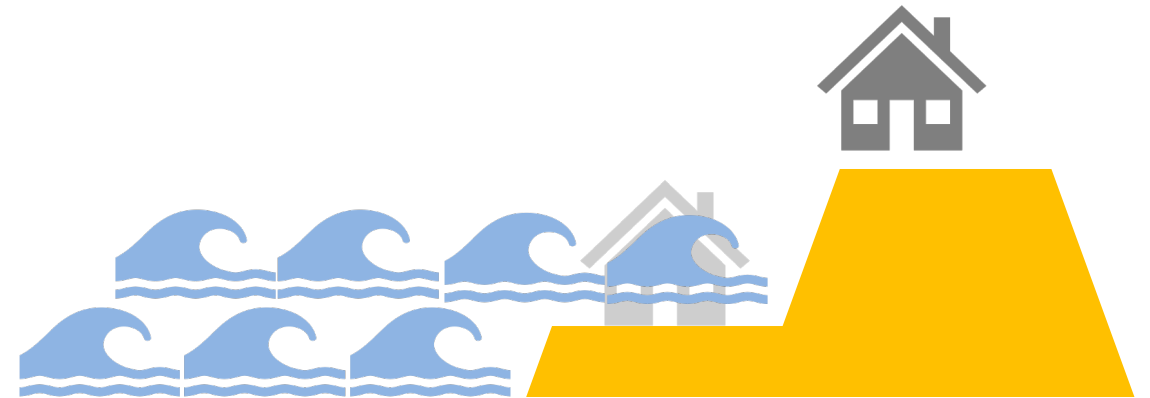


## Mitigation



actions to **prevent**  
sea level rise  
(e.g. decrease emissions)

## Adaptation



actions to **minimize**  
sea level rise **impacts**  
(e.g. relocation)



## The EU Strategy on adaptation to climate change

### Strengthening Europe's resilience to the impacts of climate change

The EU Strategy on adaptation to climate change, adopted by the European Commission in April 2013, sets out a framework and mechanisms for taking the EU's preparedness for current and future climate impacts to a new level.

To avoid the most serious risks of climate change, particularly large-scale irreversible impacts, the international community has agreed that global warming must be kept below 2°C compared to the pre-industrial temperature. International action to reduce greenhouse gas emissions will therefore be needed for decades to come. But however successful these mitigation efforts prove to be, the impact of climate change will increase in the coming decades due to the delayed impacts of past and current greenhouse gas emissions.

Europe and other parts of the world therefore have no choice but to take adaptation measures to deal with the unavoidable climate impacts and their economic, environmental and social costs. By prioritising coherent, flexible and participatory approaches, it will be much cheaper to take early, planned adaptation action than to pay the price of not adapting to climate change.

## EU recognizes the challenge

The EU Adaptation Strategy has three objectives.

### 1. Promoting action by Member States:

The Commission encourages all Member States to adopt comprehensive adaptation strategies (15 had strategies as of mid-2013) and will provide guidance and funding to help them build up their adaptation capacities and take action. The Commission will also support adaptation in cities by launching a voluntary commitment based on the Covenant of Mayors initiative.

**2. Promoting better informed decision-making** by addressing gaps in knowledge about adaptation and further developing the European Climate Adaptation Platform (Climate-ADAPT) as the 'one-stop shop' for adaptation information in Europe.

**3. Promoting adaptation in key vulnerable sectors** through agriculture, fisheries and cohesion policy, ensuring that Europe's infrastructure is made more resilient, and encouraging the use of insurance against natural and man-made disasters.

## Climate-ADAPT

(Europe)



The screenshot shows the homepage of the Climate-ADAPT European Climate Adaptation Platform. The header features the European Union flag, the text "Climate-ADAPT - Sharing adaptation information across Europe", and the main title "European Climate Adaptation Platform". A search bar and a "Log in" link are also present. A navigation menu includes "About", "Database", "EU policy", "Countries, regions, cities", "Knowledge", "Network", and "Help".

### About Climate Change Adaptation in Europe

The European Climate Adaptation Platform (Climate-ADAPT) aims to support Europe in adapting to climate change. It is an initiative of the European Commission and helps users to access and share information on:

- » Expected climate change in Europe
- » Current and future vulnerability of regions and sectors
- » National and transnational adaptation strategies
- » Adaptation case studies and potential adaptation options
- » Tools that support adaptation planning

[→ Read more](#)

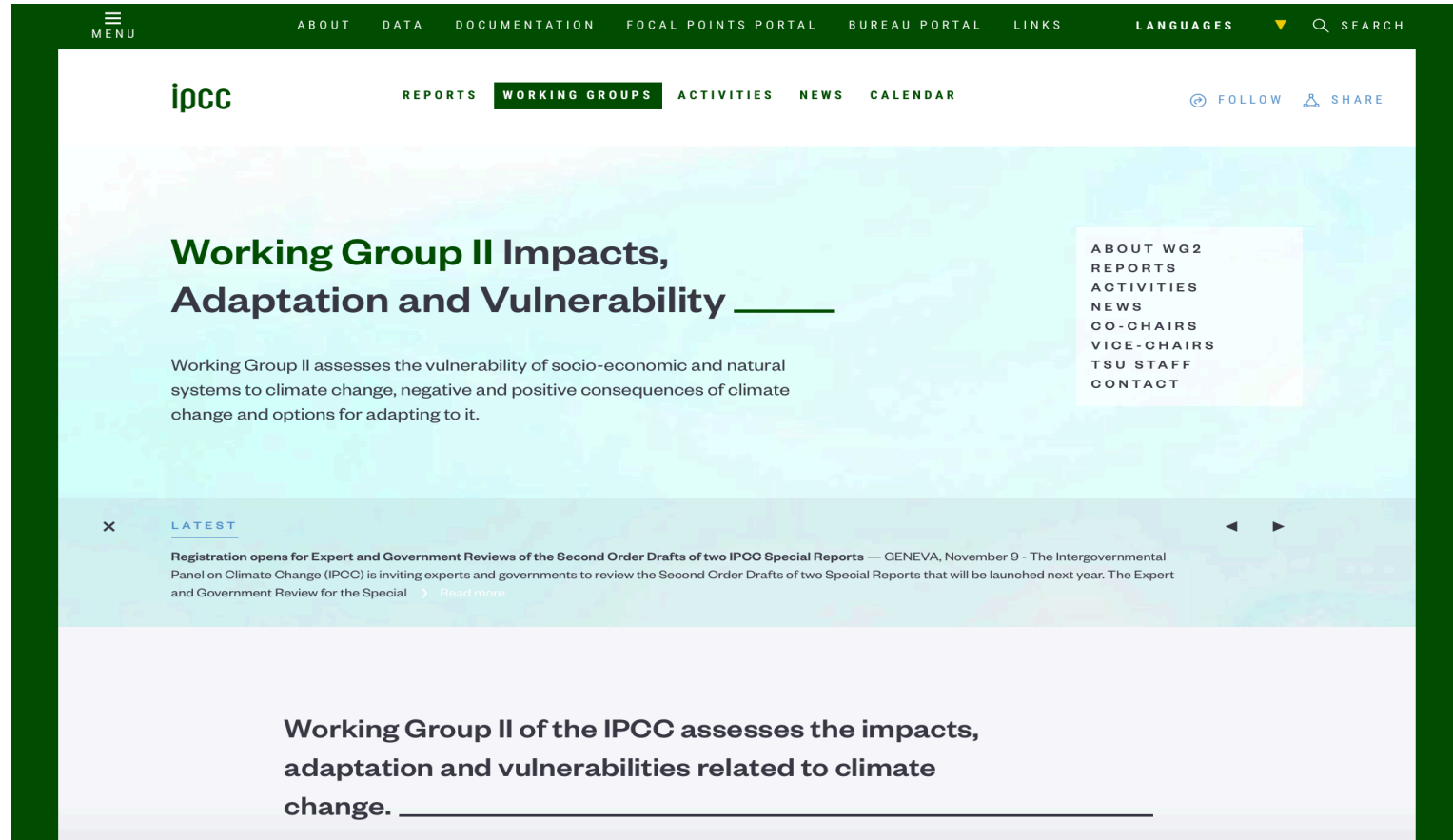
The main content area is divided into four sections:

- News:** "New to adaptation? Use the Adaptation Support Tool" (30 Nov 2018, Katowice Climate Change Conference: 2-14)
- Events:** "What are European countries doing?" (28 Feb 2019, Third World Summit on Climate Change)
- Newsletter:** "Find case studies on adaptation in Europe" (Check the European Climate Adaptation Newsletter and...)
- Latest updates:** "Share your information" (Check the latest updates in the content of the Platform.)

<https://climate-adapt.eea.europa.eu>

## IPCC – Working Group II

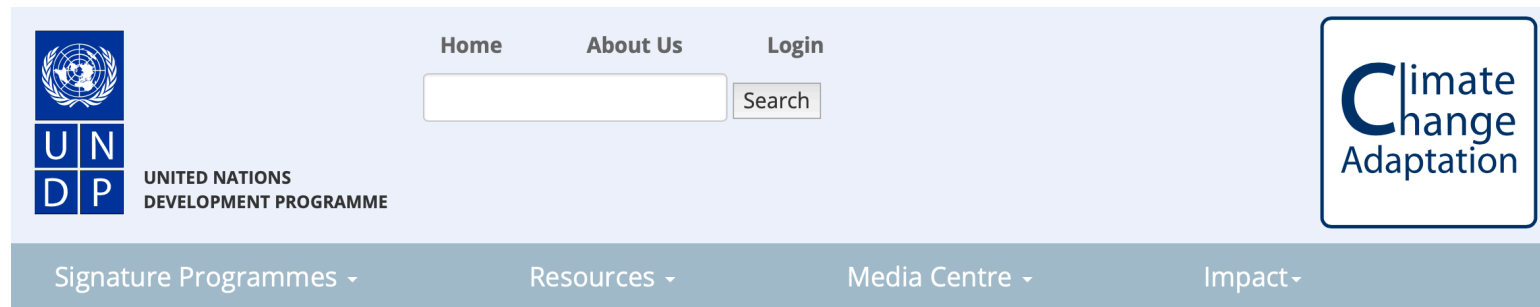
(worldwide)



The screenshot shows the IPCC Working Group II website. The top navigation bar includes 'MENU', 'ABOUT', 'DATA', 'DOCUMENTATION', 'FOCAL POINTS PORTAL', 'BUREAU PORTAL', 'LINKS', 'LANGUAGES', and 'SEARCH'. The main header features the IPCC logo, navigation tabs for 'REPORTS', 'WORKING GROUPS', 'ACTIVITIES', 'NEWS', and 'CALENDAR', and social media links for 'FOLLOW' and 'SHARE'. The main content area has a light blue background with a world map. The primary heading is 'Working Group II Impacts, Adaptation and Vulnerability'. Below it, a paragraph states: 'Working Group II assesses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change and options for adapting to it.' To the right is a vertical menu with links: 'ABOUT WG2', 'REPORTS', 'ACTIVITIES', 'NEWS', 'CO-CHAIRS', 'VICE-CHAIRS', 'TSU STAFF', and 'CONTACT'. A 'LATEST' section is visible, with a sub-heading 'Registration opens for Expert and Government Reviews of the Second Order Drafts of two IPCC Special Reports — GENEVA, November 9 - The Intergovernmental Panel on Climate Change (IPCC) is inviting experts and governments to review the Second Order Drafts of two Special Reports that will be launched next year. The Expert and Government Review for the Special' and a 'Read more' link. At the bottom, a large text block reads: 'Working Group II of the IPCC assesses the impacts, adaptation and vulnerabilities related to climate change.'

<https://www.ipcc.ch/working-group/wg2/>

## United Nations



The screenshot shows the top navigation bar of the United Nations Development Programme website. On the left is the UNDP logo, which includes the United Nations emblem and the letters 'UNDP' in a grid, with the text 'UNITED NATIONS DEVELOPMENT PROGRAMME' below it. To the right of the logo are navigation links for 'Home', 'About Us', and 'Login'. Below these links is a search bar with a 'Search' button. On the far right is a 'Climate Change Adaptation' logo. Below the navigation bar is a dark blue horizontal bar with four menu items: 'Signature Programmes', 'Resources', 'Media Centre', and 'Impact', each with a downward-pointing arrow.

## National Adaptation Programmes of Action (NAPAs)



National Adaptation Programmes of Action (NAPAs) provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage.

To date, UNDP has supported 31 countries in preparing and submitting their [National Adaptation Programme of Action \(NAPA\)](#) to the UNFCCC, with financing from the LDCF.

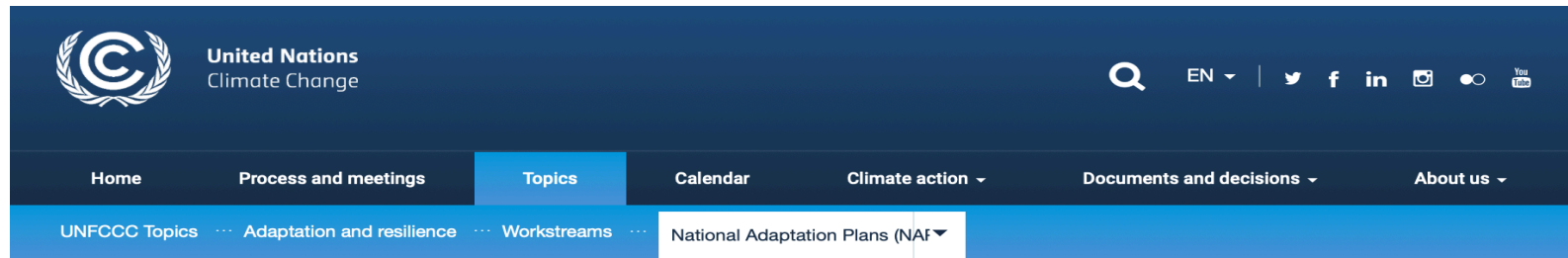
The UNDP publication, *Water Adaptation in National Adaptation Programmes for Action*, published January 2009, details some of the work in the NAPA process on integrating climate adaptation in freshwater planning.



<https://www.adaptation-undp.org/national-adaptation-programmes-action-napas>



## United Nations



## National Adaptation Plans



<https://unfccc.int/topics/adaptation-and-resilience/workstreams/national-adaptation-plans>

## OECD

(worldwide)



> A to Z

Google Custom search



OECD Home

About

Countries ▾

Topics ▾

> Français

[OECD Home](#) > [Environment Directorate](#) > [Climate change](#) > Adaptation to climate change

> Biodiversity, water and natural resource management

> Chemical safety and biosafety

> Climate change

> Consumption, innovation and the environment

> Environment and trade

> Environment in emerging and transition economies

> Environmental country reviews

> Environmental indicators, modelling and outlooks

> Environmental policy tools and evaluation

> Greening transport

## Adaptation to climate change

[Publications](#) | [Events](#) | [Blogs](#) | [Contact](#)

Climate change poses serious, wide-ranging risks to economies, societies and ecosystems. These risks include: damage to coastal infrastructure, shifting patterns of infectious diseases and loss of food security.

Reducing these risks requires action to sharply reduce greenhouse gas emissions (mitigation), combined with measures to increase resilience to the impacts that occur (adaptation).

The OECD supports countries' efforts to prepare for the effects of a changing climate by providing impartial analysis, policy advice and supporting the sharing of experiences between the public and private sectors.



### LATEST REPORTS

> [Climate-resilient Infrastructure](#) | Environment Policy Paper, December 2018

> [Innovative Approaches to Building Resilient Coastal Infrastructure](#) | Environment Policy Paper, September 2018

<http://www.oecd.org/env/cc/adaptation.htm#Publications>



**Back to MSP !**

Several approaches can foster adaptation:

**Adaptive management**

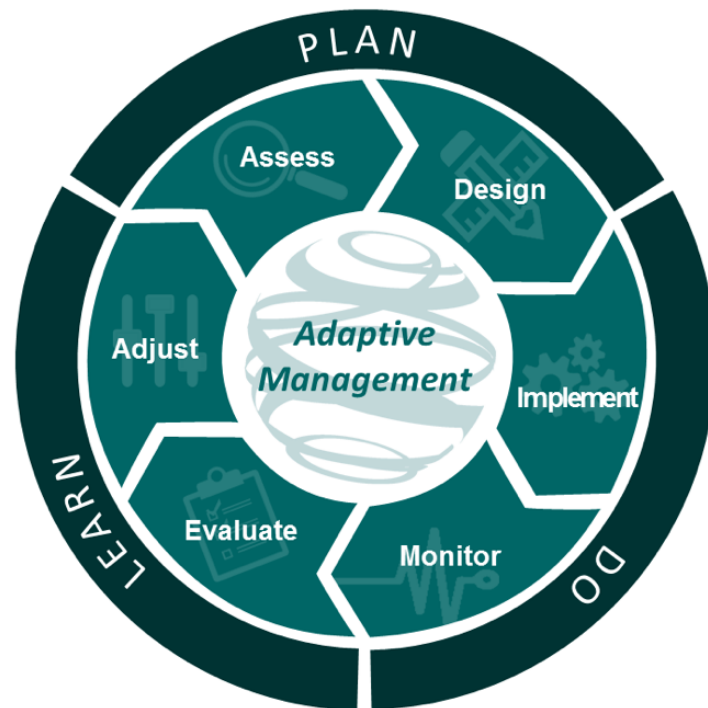
**Anticipatory Zoning**

**Dynamic Zoning**

**Dynamic Ocean Management**

**Planning Just-in-time**

Management approach focused on the **systematic learning** through **experimentation, monitoring and evaluation**, and the subsequent adaptation of policy and management options according to obtained **results**



**Actions are  
adjusted based on  
obtained results**

## Conceptually, adaptive management is embedded in MSP...



A **10-step guide** to understanding what MSP is and how it can be **put into practice** toward achieving ecosystem-based management

<http://unesdoc.unesco.org/images/0018/001865/186559e.pdf>

Developed between **November 2007** and **May 2009**

**Steps** were based on **real world MSP practices** around the globe

The guide was **refined and revised** during expert meetings and “fine-tuning” events with resource managers and decision makers (Massachusetts and Viet Nam)



## The 10 Steps

<http://msp.ioc-unesco.org/msp-guides/msp-step-by-step-approach/>

UNESCO's *Step-by-step Approach for Marine Spatial Planning toward Ecosystem-based Management* offers a 10-step guide on how to get a marine spatial plan started in your region. Explore the guide by choosing steps here.

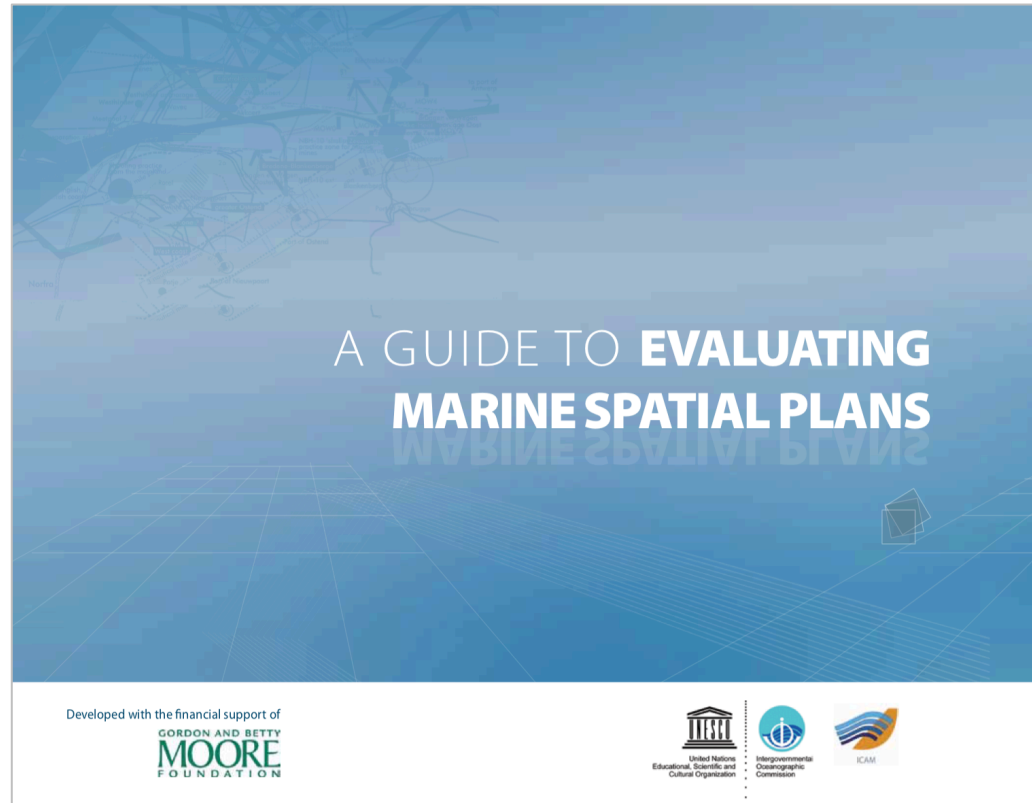


**Download Guide**  
(PDF 1.55MB)

- STEP 1** Establishing Authority
- STEP 2** Obtaining Financial Support
- STEP 3** Organizing the MSP Process
- STEP 4** Engaging Stakeholders
- STEP 5** Analyzing Existing Conditions
- STEP 6** Analyzing Future Conditions
- STEP 7** Developing the Plan
- STEP 8** Implementing the Plan
- STEP 9** Evaluating Performance
- STEP 10** Adapting the Process



## Step 9. Monitoring and evaluating performance



2014

<http://unesdoc.unesco.org/images/0022/002277/227779e.pdf>



## Step 9. Monitoring and evaluating performance

### TASK 1. DEVELOPING A PERFORMANCE MONITORING & EVALUATION PLAN

Performance monitoring and evaluation is key to adaptive management  
(STEP 10)

**! If we do not measure results, we cannot tell success from failure**

If performance monitoring and evaluation **results** are **not used to modify** revisions to **future plans**, then the process has **not been successful**

**! Selection of relevant and measurable indicators is one of the most important components of performance monitoring and evaluation**

## Step 9. Monitoring and evaluating performance

### TASK 2. EVALUATE PERFORMANCE MONITORING DATA

**Evaluation** is the element of management in which the **greatest learning** is to occur – it allows information concerning the **past** to feed back into, and improve the way management is conducted in the **future**

Evaluation consists of **reviewing the results** of actions taken and **assessing** whether these actions have **produced the desired results**

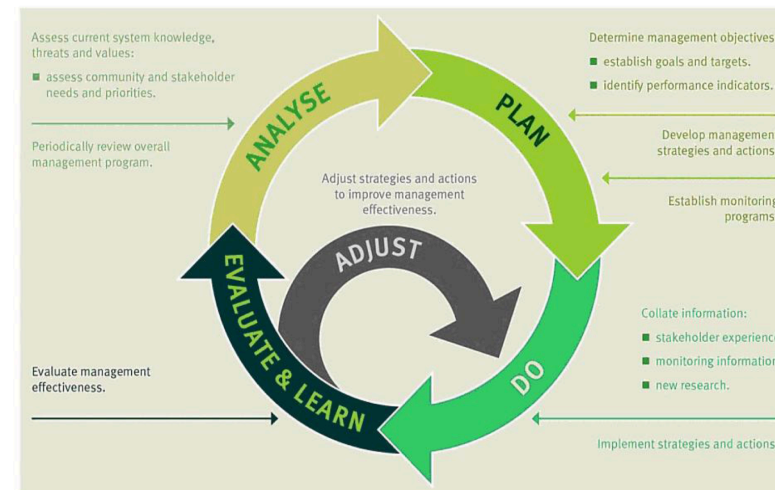
**! Ideally, evaluation should be undertaken periodically during the lifetime of the MSP process**

**Step 10.** Adapting the spatial management process

Adaptive management is **needed** for MSP is to be **sustained** over time

**! However adaptive management is rarely implemented**

Adaptive management cycle



N.B. Adapted from CSIRO Marine and Atmospheric Research 2009

**Step 10.** Adapting the spatial management process

## TASK 1. PROPOSE CHANGES IN OBJECTIVES AND MANAGEMENT ACTIONS

This step must address two broad **questions**:

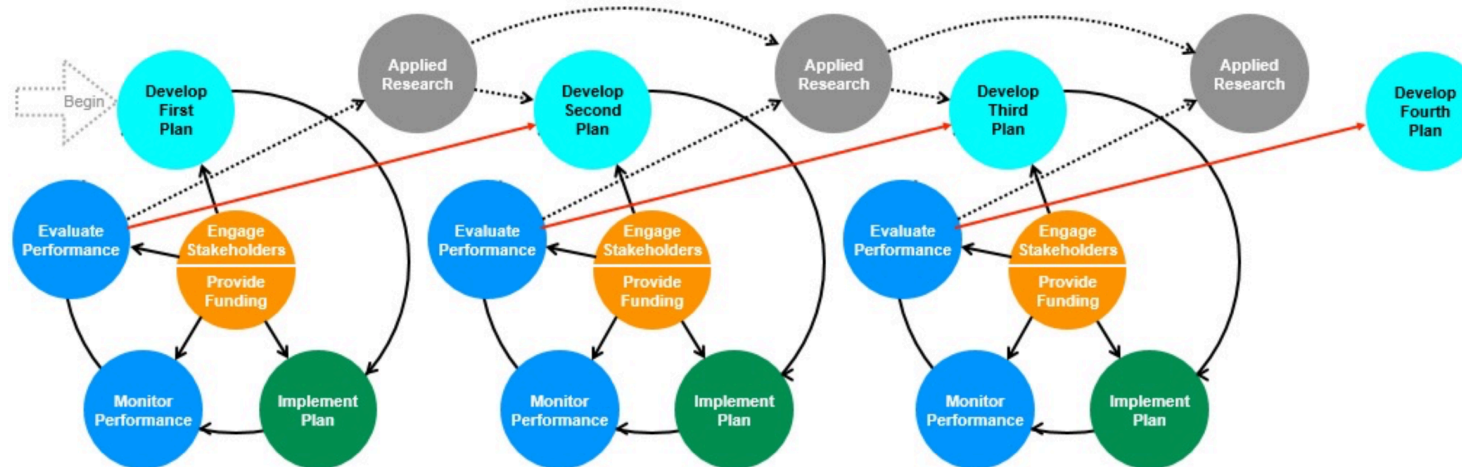
**? What has been accomplished through the MSP process and learned from its successes and failures?**

**? How has the context (e.g. environment, governance, technology, economy) **changed** since the programme was initiated?**

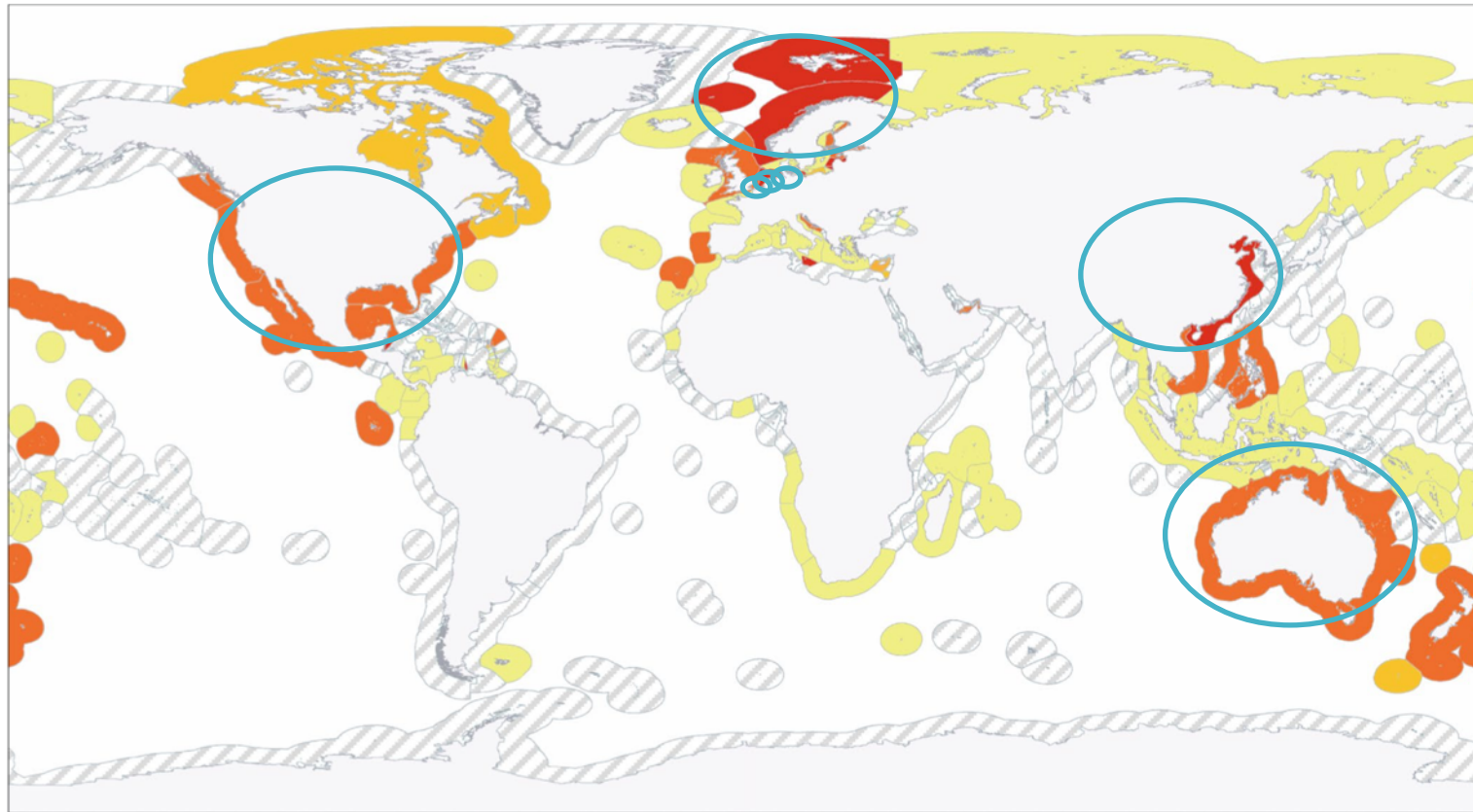
The **answers** to these questions can then be **used to re-focus planning** and management in the future

**Step 10.** Adapting the spatial management process

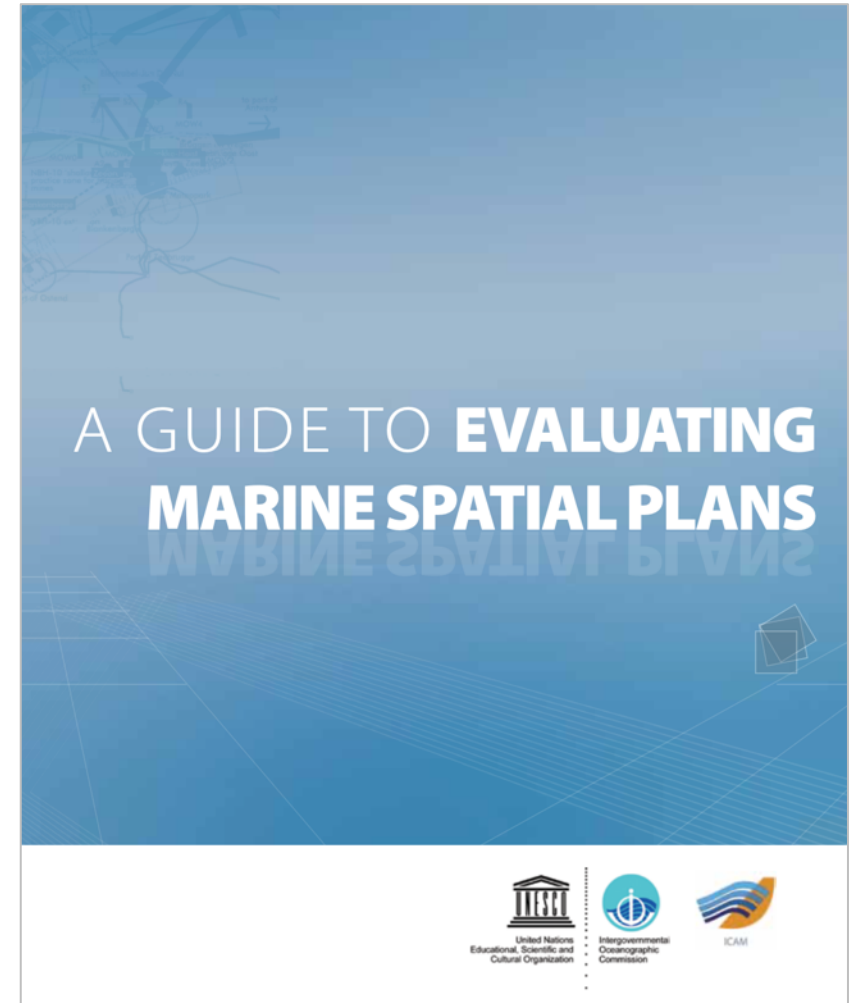
## TASK 3. START THE NEXT ROUND OF MSP



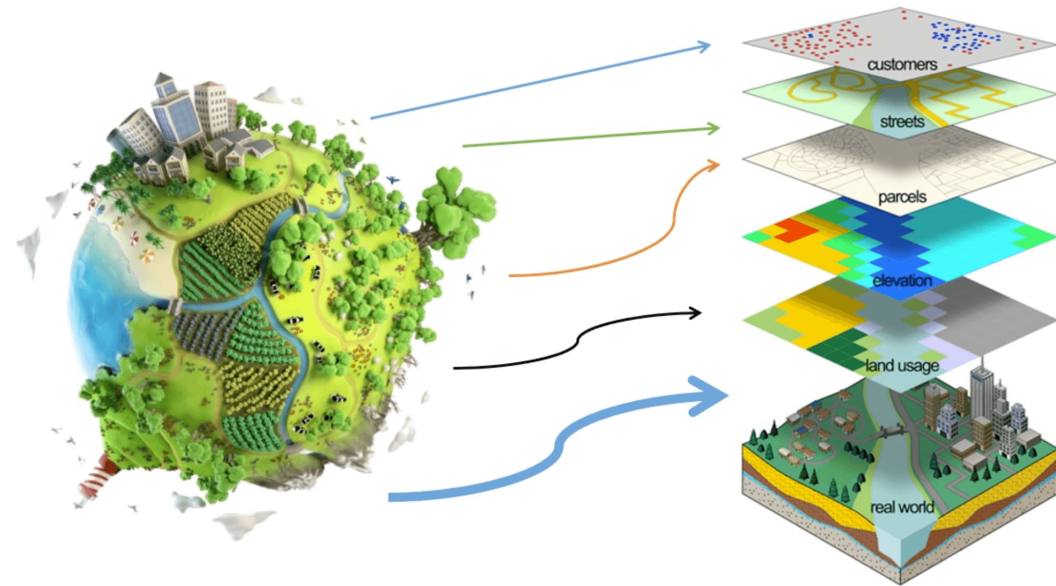
# Only 7 nations...



■ MSP approved, implemented or revised for entire maritime space   ■ MSP approved, implemented or revised only for specific areas   ■ Plans completed but not approved   ■ MSP under development   ■ No official MSP



## Many challenges



Consiste na **alocação de áreas** para o desenvolvimento **futuro** de certos usos, ou para a ausência dos mesmos, em antecipação aos impactos das alterações climáticas

Promove uma gestão mais flexível ao permitir que as entidades responsáveis **ajustem os regimes de gestão antes** dos usos estarem **instalados** no espaço marítimo (o que permite evitar problemas políticos e legais)

Permite **antecipar conflitos** futuros e **priorizar usos** do oceano, e.g. **antes** de se fazerem **investimentos** dispendiosos em infraestruturas



## Arctic



## Arctic

Redução na cobertura de gelo marinho está abrir **novas áreas** com potencial de **exploração económica** (e.g. new **shipping routes**, **hydrocarbon** exploitation, commercial **fishing**, **aquaculture**)

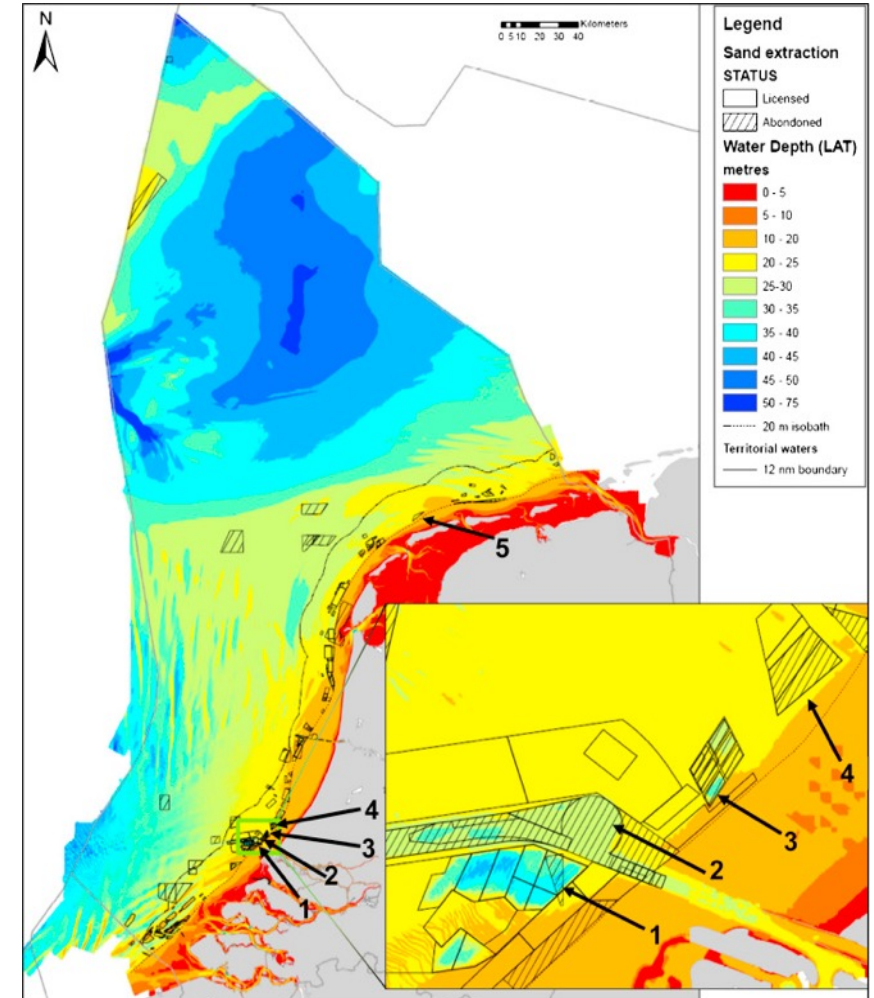
Competição pelo uso dessas novas áreas pode levar a **conflitos** entre **sectores da economia azul**, bem como a **impactos** significativos em **espécies e habitats chave**, e nas **comunidades humanas** locais que dependem dessas espécies/habitats



# Netherlands



Preferred **sand extraction zones** in the Netherlands to support climate adaptation, namely protection coastal areas against sea level rise



## Dynamic Ocean Management – DOM

**“Management that changes rapidly in space and time in response to the shifting nature of the ocean and its users based on the integration of new biological, oceanographic, social and/or economic data in near real-time”**

Maxwell et al. (2015) Marine Policy



Recognizes that...



Ocean and ocean uses  
are **highly dynamic**

but that...



**MPAs**

**MSP**

**TAC**

Management approaches  
are **relatively static**

Recognizes that...



but that...



MPAs

MSP

TAC

**! Mismatches** in rate and scale at which ocean/ocean users change, and management responds, result in **decreased efficiency and effectiveness**

**what to do** 

**Management** must become as **fluid** in **space and time** as both the ocean and ocean users

?

**! Shift to**

**near real-time management**

?



## **! By integrating...**

**1. Existing datasets (e.g. remote sensing, animal tracking, fisheries observer data)**

**2. Advanced techniques (analytical processing and modelling) that allow for predictions about key species distributions, user behaviour or oceanographic habitats, etc., in space and time**

**! By integrating...**

**3. Technology that allows rapid data-sharing (e.g. portable/handheld devices) to be used in dynamic tools that respond at finer, more detailed scales**

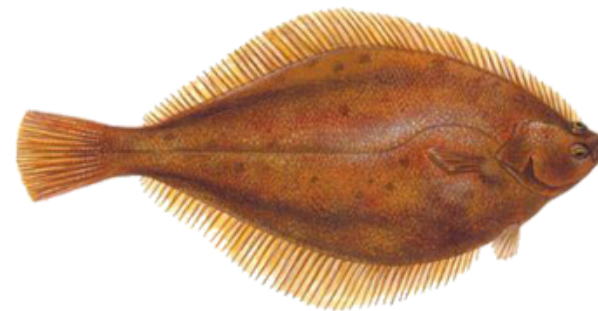


## Pesca de vieiras na Nova Inglaterra (USA)

Pescadores de vieiras reportam voluntariamente as **capturas acessórias** (*by-catch*) de solha dos mares do norte (espécie **vulnerável**, IUCN) à Universidade de Massachusetts numa base diária

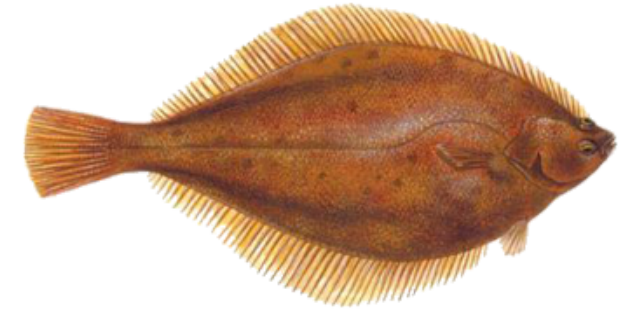
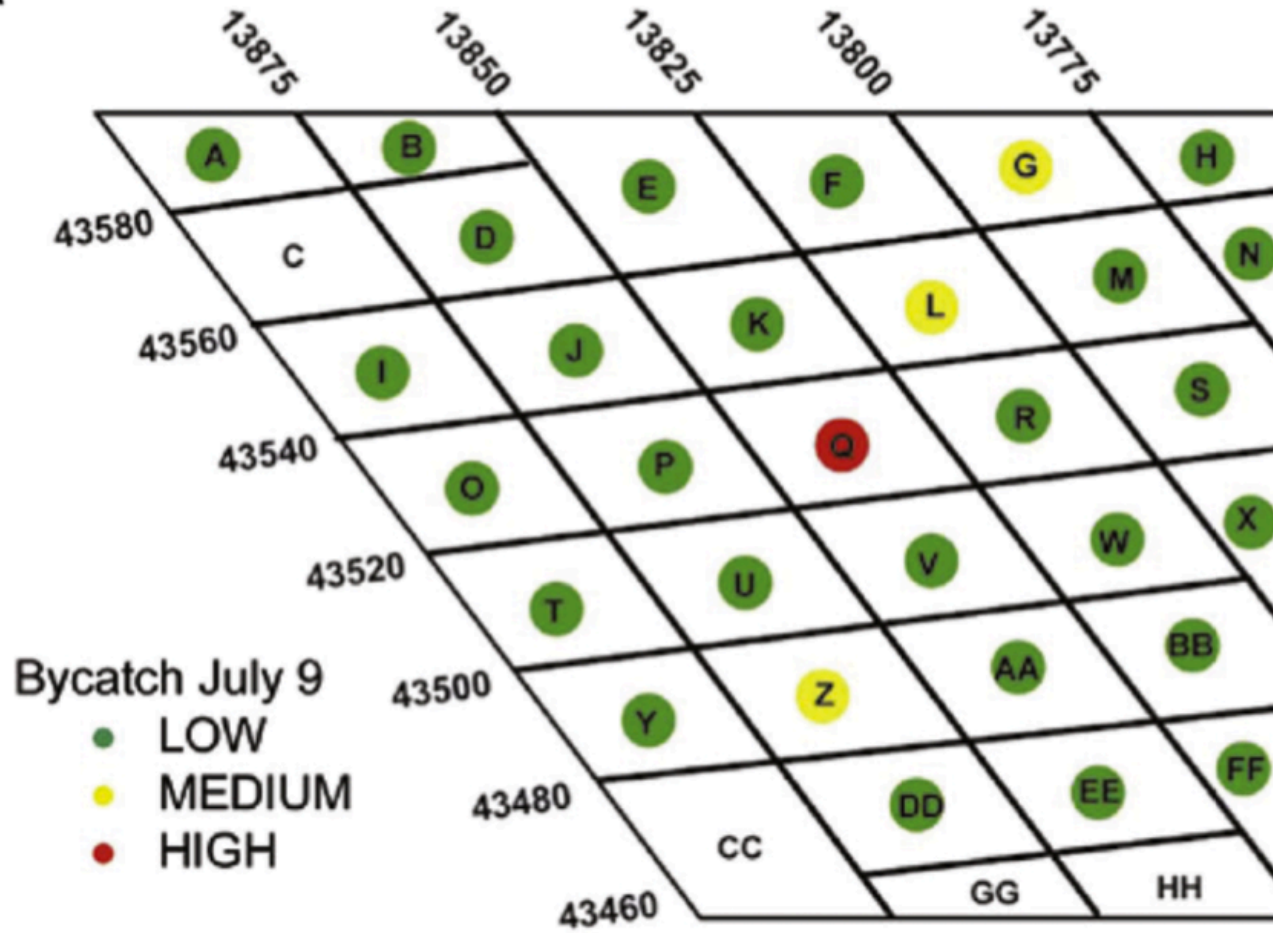


Essa informação é compilada por área e redistribuída no dia seguinte aos pescadores para estes **evitarem certas áreas** (de maior *by-catch*)



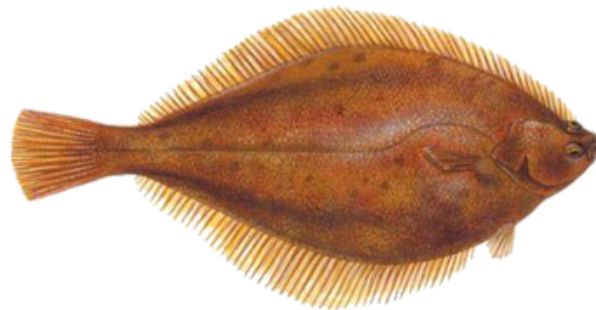
*Limanda ferruginea*

a



## Result:

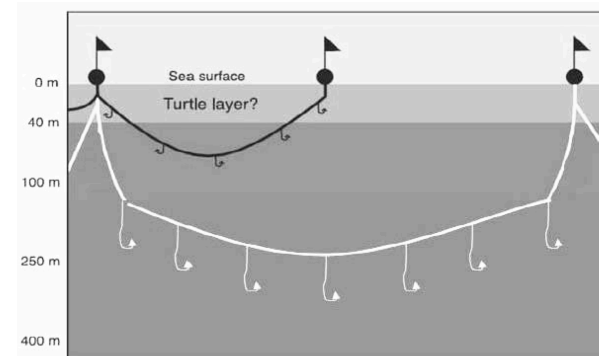
Since the program started (2010) fishermen have been able to fish the **entire duration** of the scallop season, resulting in **economic gains** upwards of \$10 million/year over previous years



## TurtleWatch (NOAA Pacific Islands Fisheries Center)

Programa desenvolvido para reduzir *by-catch* de tartarugas marinhas comuns (**vulnerável**) em pesca de palangre no Hawaii

Com base em dados de **satélite** (rastreamento), os cientistas determinaram as **temperaturas preferenciais** das tartarugas, e identificaram áreas que os pescadores deviam evitar



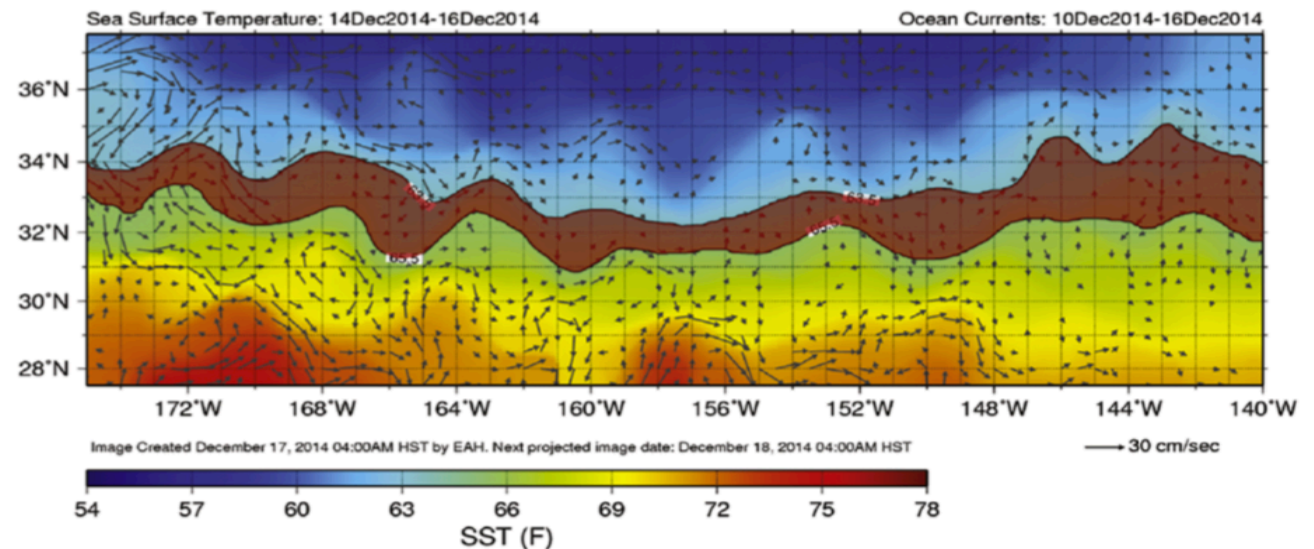
## TurtleWatch (NOAA Pacific Islands Fisheries Center)

A informação é colocada online (every few days) de acordo com as **flutuações de temperatura do Pacífico Norte Central**

C

### EXPERIMENTAL PRODUCT

avoid fishing between solid black 63.5°F and 65.5°F lines  
to help reduce loggerhead sea turtle interactions



PACIFIC ISLANDS FISHERIES SCIENCE CENTER  
ECOSYSTEMS AND OCEANOGRAPHY DIVISION  
2570 Dole Street, Honolulu, HI 96822  
<http://www.pifsc.noaa.gov/eod/turtlewatch.php>  
contact: [Evan.Howell@noaa.gov](mailto:Evan.Howell@noaa.gov)

Data provided by Central Pacific CoastWatch node

TURTLEWATCH



## WhaleAlert (EUA, costa Este)

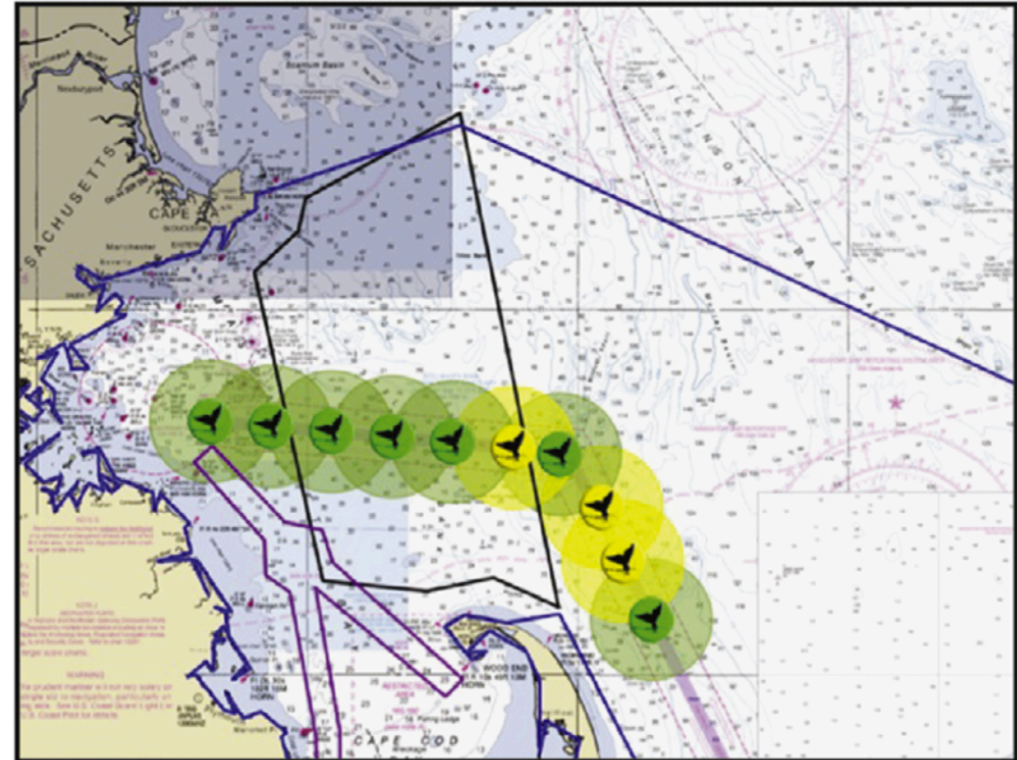
Boias acústicas e deteção remota são utilizadas para detectar a localização em tempo real de **Baleias francas do Atlântico Norte** (**criticamente em perigo**, IUCN) por forma a evitar colisões letais com navios



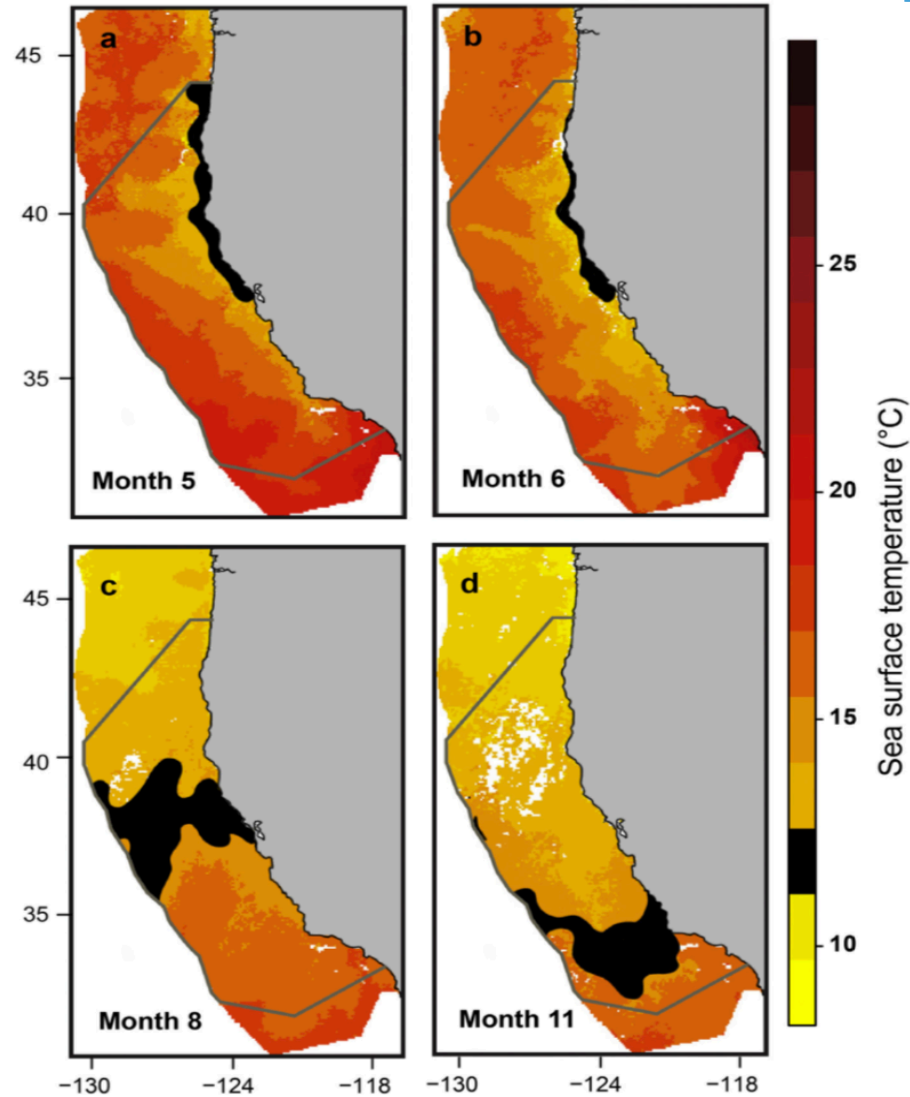


## WhaleAlert (EUA, costa Este)

A informação é fornecida aos **capitães dos navios** (aplicações móveis) para alertar para a presença das baleias, e recomendar a **redução da velocidade** ou mesmo o **evitar** dessas áreas



# Hypothetical Scenario (west coast, US)

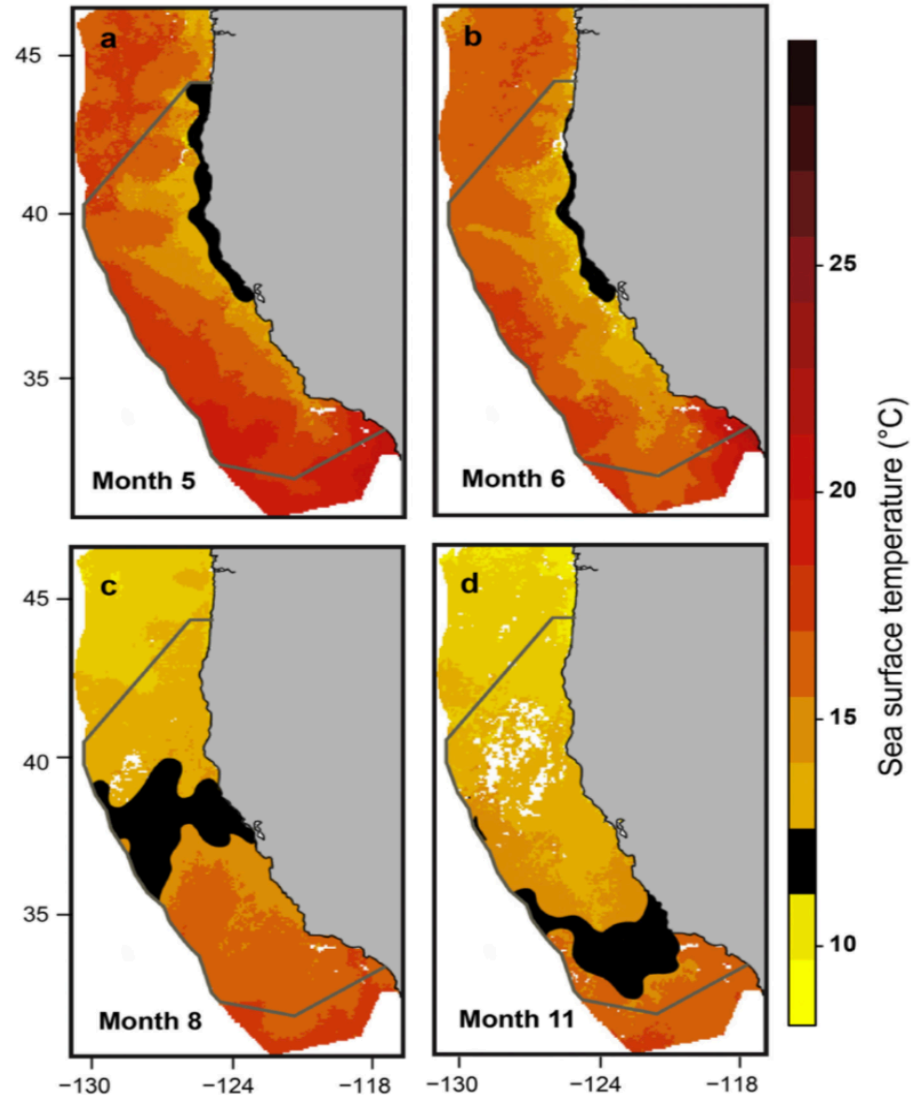


Área de **gestão estática**

*VS.*

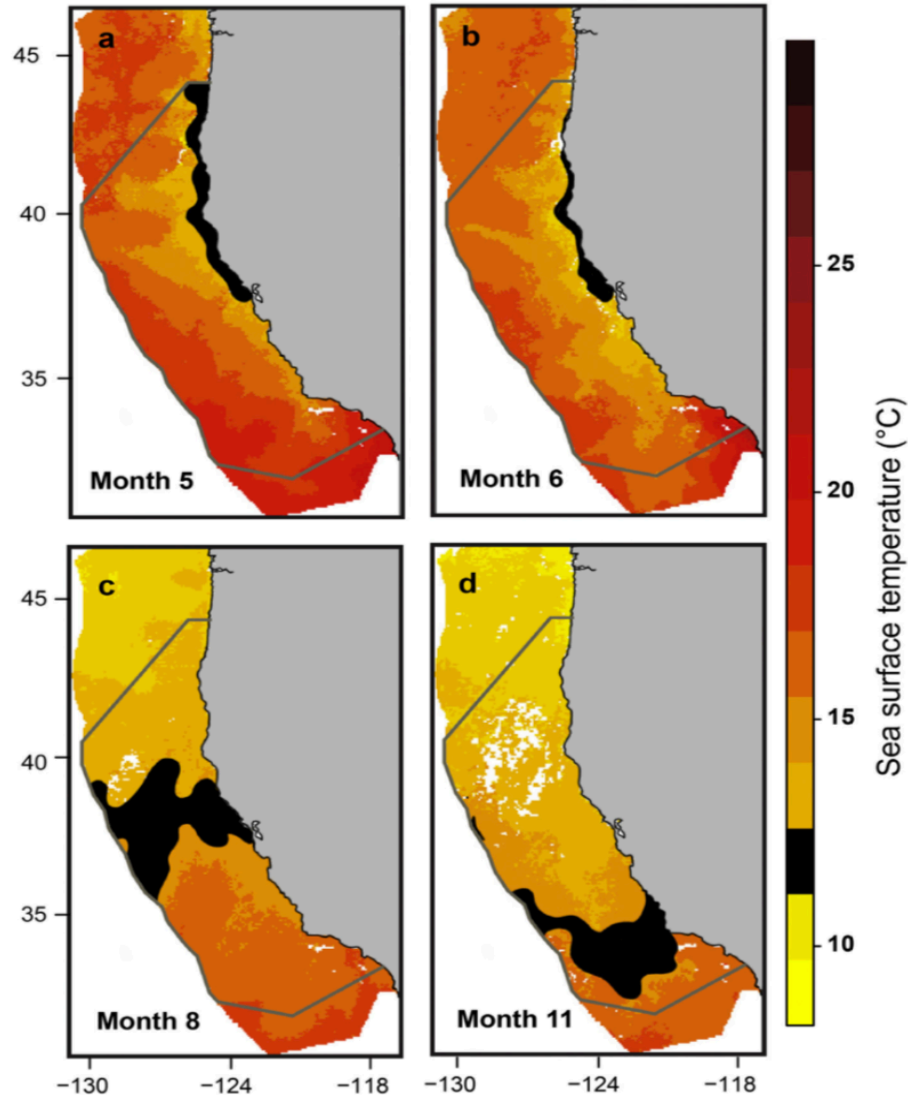
Áreas de **gestão dinâmica**

## Hypothetical Scenario (west coast, US)



Área de **gestão estática** (**linha cinzenta**) necessitaria de uma área maior por forma a incluir todos os habitats animais dependentes de variações na temperatura ao longo do ano

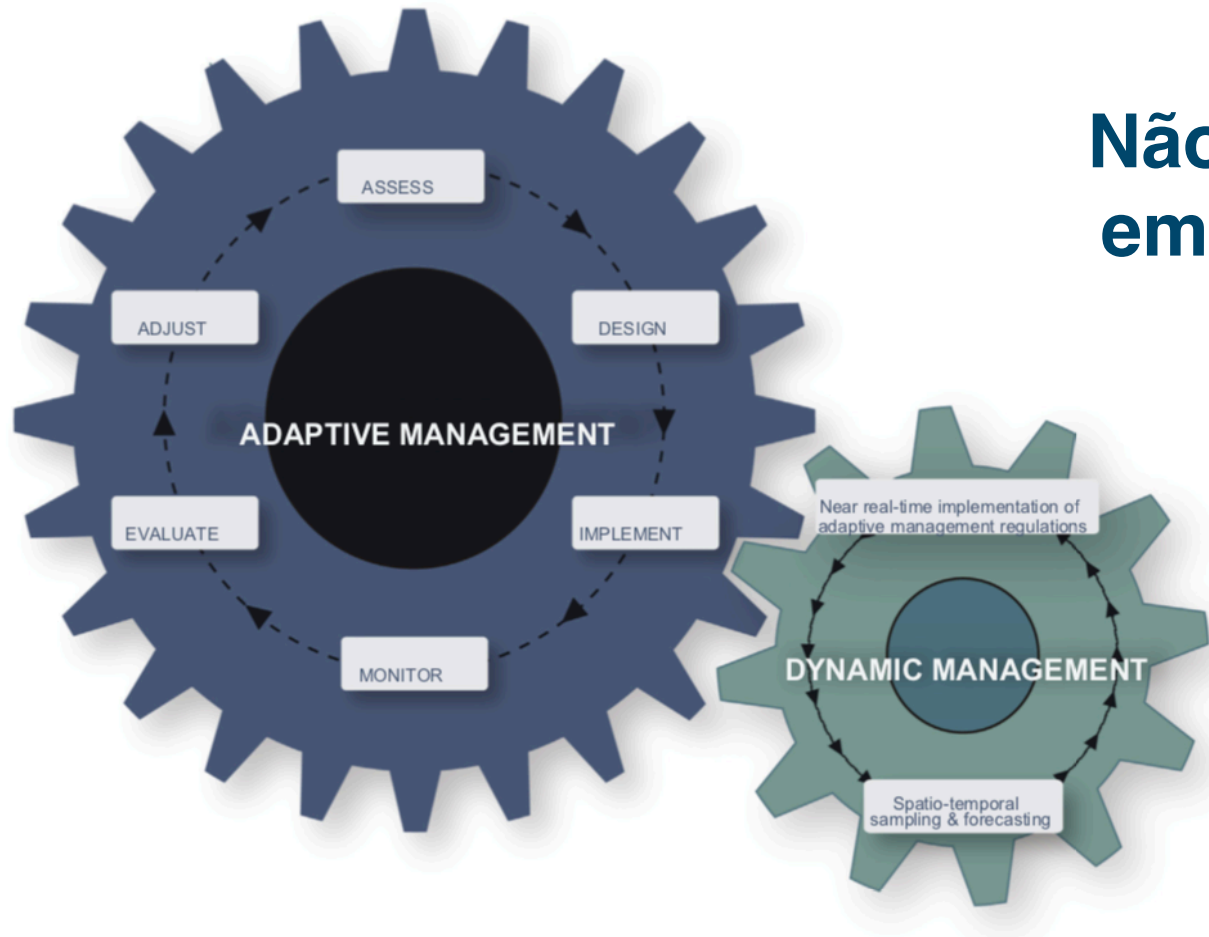
## Hypothetical Scenario (west coast, US)



Áreas de **gestão dinâmica** (**polígonos pretos**) delimitadas com base na localização provável dos habitats animais, permitem a utilização de áreas mais pequenas e que variam ao longo do ano, permitindo uma **maior utilização** por actividades humanas

**Não substitui a gestão adaptativa,  
em vez disso contribui para a sua  
implementação**

(implementa alterações em  
regimes de gestão com rapidez)



## Conclusion...



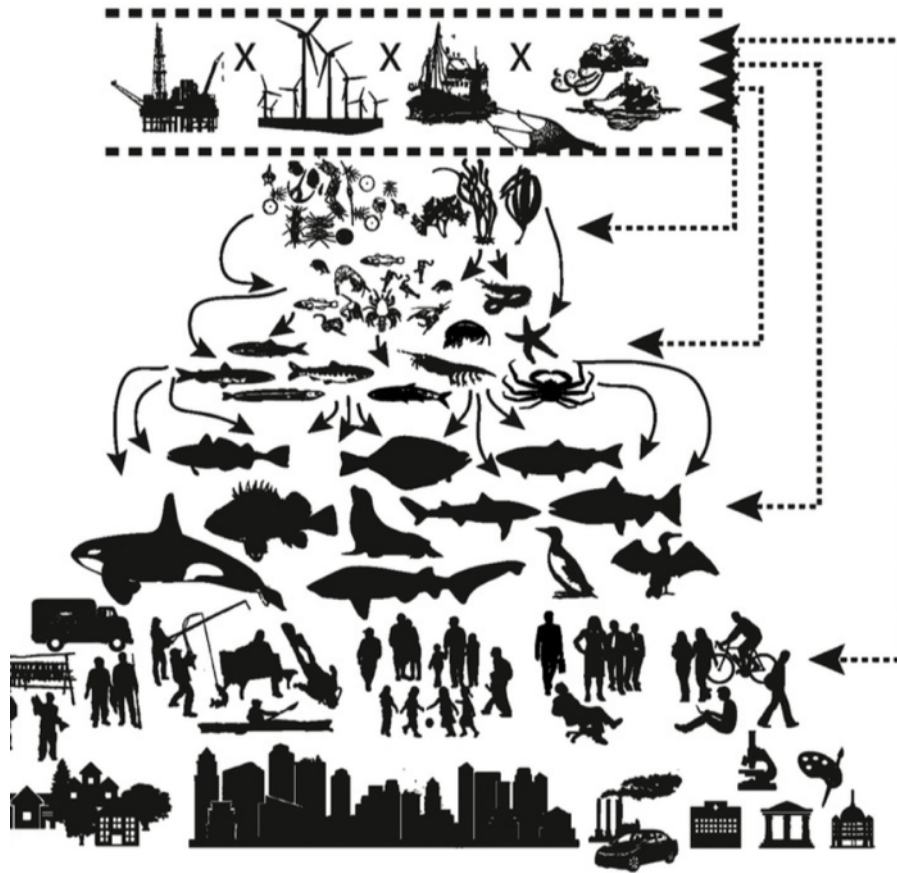
**Why is it so important to develop adaptive, climate-smart MSP?**

**As MSP operates in a changing ocean, properly addressing and integrating climate effects is vital to keep plans viable, relevant and useful in the long term**

HOEL & OLSEN (2012), CRAIG (2012), OKEY ET AL. (2014),  
FRAZÃO SANTOS ET AL. (2016), MCHENRY ET AL (2017), ETC.



# MSP AS A SOLUTION?



**Plan holistically  
(not sector-by-sector)**



**Protection of critical marine  
areas and climate refugia**

MSP AS A SOLUTION?

# Reduction of greenhouse gases emissions

(areas to renewable energy developments  
and blue carbon capture and storage)



# PERCEPTIONS OF PEOPLE KNOWLEDGEABLE ON MSP



## Ocean planning under a changing climate

As marine spatial planning (MSP) operates in a changing ocean, properly addressing and integrating climate effects is vital. However, few marine spatial plans properly or explicitly consider climate change. Our research aims to explore the perceptions of people knowledgeable on MSP - the scientific community, marine planners, managers, decision-makers, industry, NGOs, interested members of the general public - on how MSP can both be affected by, and adapt to climate change. Our goal is to advance the discussion on this important topic, one with strong links to sustainable ocean use and conservation, and further support the development of international best practices for MSP under climate change.

This survey is being developed under project OCEANPLAN (Marine Spatial Planning under a Changing Climate, [www.oceanplan-project.com](http://www.oceanplan-project.com)), supported by the Portuguese Foundation for Science and Technology (grant agreement ref. PTDC/CTA-AMB/30226/2017) and led by the University of Lisbon, University of the Azores and Nova School of Business and Economics.

We invite you to complete this anonymous survey and to forward it to others that may find it of interest. The survey takes c. 20 minutes to complete. Your participation is voluntary, and you can decline to answer any question by leaving it open, selecting/writing "prefer not to say", or leaving the survey at any time. All information received will be treated in strict compliance with data protection and privacy regulations. Data will be used for scientific purposes and published only in aggregated form and anonymised. The survey will be online until January 2021.

Please contact us if you have any questions, or if you would like to receive further information on project results and/or be involved in related publications: [oceanplanproject@gmail.com](mailto:oceanplanproject@gmail.com) (general) / [cfsantos@fc.ul.pt](mailto:cfsantos@fc.ul.pt) (project coordinator, Dr. Catarina Frazão Santos).

Many thanks for your participation and precious time!

\* Required



## Online Survey

### Marine Spatial Planning and Climate Change



Share your opinion with us!

[www.oceanplan-project.com/survey](http://www.oceanplan-project.com/survey)

OCEANPLAN  
WEBSITE

English . Español . Português

@OCEANPLAN\_MSP

nature sustainability

REVIEW ARTICLE








<https://doi.org/10.1038/s41893-020-0513-x>





OCTO  
OPEN COMMUNICATIONS  
FOR THE OCEAN  
PRODUCED BY OCTO

# Integrating climate change in ocean planning

Catarina Frazão Santos <sup>1,2</sup>✉, Tundi Agardy<sup>3</sup>, Francisco Andrade <sup>1</sup>,  
Helena Calado<sup>4</sup>, Larry B. Crowder<sup>5</sup>, Charles N. Ehler <sup>6</sup>, Sara García-Morales <sup>1</sup>, Elena Gissi <sup>7</sup>,  
Benjamin S. Halpern <sup>8,9</sup>, Michael K. Orbach<sup>10</sup>, Hans-Otto Pörtner <sup>11,12</sup> and Rui Ro

**The acceleration of global warming and increased vulnerability of marine social-ecological systems aff by the ocean. Spatial planning of marine areas is vital to balance multiple human demands and ensu supporting global ocean goals. To thrive in a changing ocean though, marine spatial planning (MSP) n climate change. By reviewing existing literature on MSP and climate change, we explore the links betw sustainability, highlight management challenges, and identify potential pathways to guide action towa tion of climate impacts in MSP.**

The sustainable use and conservation of the world ocean and its resources represent one of the 17 global goals set to ‘transform our world’ in the context of the United Nations (UN) 2030 Agenda for Sustainable Development<sup>1</sup>. Although such global agreement on promoting sustainability in the ocean is relatively recent, protecting marine ecosystems has been in the international agenda for decades<sup>2,3</sup>, with numerous actions, approaches, frameworks and plans being developed and implemented to support it. These include the ecosystem approach, with its origins in the UN Convention on Biological Diversity<sup>4</sup>, ecosystem-based management (EBM) that grew out of the ecosystem approach<sup>5</sup>, the integrated management concept that stemmed from Chapter 17 of the Agenda 21<sup>6</sup>, or international treaties such as the UN Convention on the Law of the Sea (UNCLOS)<sup>2</sup>.

Concomitant to these developments, and incorporating many of these concepts (for example, the ecosystem approach and integrated management; Box 1), in the 1990s a management process commonly known as marine spatial planning (MSP) emerged and has spread widely in the last 15 years<sup>7</sup>. No single definition exists for MSP; it takes many forms and names depending on context (Box 1). However, it can be generally outlined as the analysis and allocation of the spatial and temporal distribution of human uses

most of them are in early stages of development and many do not have marine spatial plans that are already government approved; Fig. 1)<sup>7</sup>.

MSP will likely keep expanding in the coming years as more countries start to discuss the development of marine spatial plans, especially in Africa and South America. The European Union (EU) funded Paddle to the Future: A World with Tropical Stakes<sup>8</sup>; www.paddletothefuture.org explores opportunities and limits of MSP in international waters is a case study from Cabo Verde, although government-led plans are still scarce<sup>12,13</sup>, and in early 2019, the European Union and UNESCO’s Intergovernmental Oceanographic Commission jointly launched the MSPglobal program with the intention to support the effective implementation of spatial plans worldwide.

Several conceptual and practical challenges in the development and implementation of MSP development and implementation are being overlooked by economic and/or political short-term goals and objectives, often insensitive to environmental impacts<sup>15,16</sup>. In addition, the importance of protecting marine ecosystems is often overlooked by economic and/or political short-term goals and objectives, often insensitive to environmental impacts<sup>15,16</sup>. In addition, the importance of protecting marine ecosystems is often overlooked by economic and/or political short-term goals and objectives, often insensitive to environmental impacts<sup>15,16</sup>. In addition, the importance of protecting marine ecosystems is often overlooked by economic and/or political short-term goals and objectives, often insensitive to environmental impacts<sup>15,16</sup>.

## The Effects of Climate Change in Marine Spatial Planning Pathways and Solutions

WEBINAR  
OCT 01, 2020

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Helena Calado . Larry Crowder  
Miguel Fernandes . Michael Orbach  
Sara García-Morales



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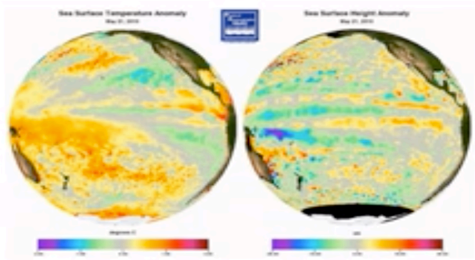
Tundi Agardy






# Exercise

# Identify the benefits and limitations of Dynamic Ocean Management



Dynamic Ocean Management:  
Management on the move

Daniel C. Dunn, Duke University: @danielcdunn  
Sara M. Maxwell, Old Dominion University: @maxwell\_lab  
Alistair J. Hobday, CSIRO: #AlistairIsTooBusyWritingToTweet



[www.openchannels.org/webinars/2016/management-move-making-ebm-and-msp-more-dynamic](http://www.openchannels.org/webinars/2016/management-move-making-ebm-and-msp-more-dynamic)


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Dynamic ocean management: Defining and conceptualizing real-time management of the ocean 

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ABSTRACT

Most spatial marine management techniques (e.g., marine protected areas) draw stationary boundaries around often mobile marine features, animals, or resource users. While these approaches can work for relatively stationary marine resources, to be most effective marine management must be as fluid in space and time as the resources and users we aim to manage. Instead, a shift towards dynamic ocean management is suggested, defined as management that rapidly changes in space and time in response to changes in the ocean and its users through the integration of near real-time biological, oceanographic, social and/or economic data. Dynamic management can refine the temporal and spatial scale of managed areas, thereby better balancing ecological and economic objectives. Temperature dependent habitat of a hypothetical mobile marine species was simulated to show the efficiency of dynamic management, finding that 82.0 to 34.2 percent less area needed to be managed using a dynamic approach. Dynamic management further complements existing management by increasing the speed at which decisions are implemented using predefined protocols. With advances in data collection and sharing, particularly in remote sensing, animal tracking, and mobile technology, managers are poised to apply dynamic management across numerous marine sectors. Existing examples demonstrate that dynamic management can successfully allow managers to respond rapidly to changes on-the-water, however to implement dynamic ocean management widely,

# Analyse how well the Portuguese legislation on MSP addresses climate change

2358

## ASSEMBLEIA DA REPÚBLICA

Lei n.º 17/2014

de 10 de abril

### Estabelece as Bases da Política de Ordenamento e de Gestão do Espaço Marítimo Nacional

A Assembleia da República decreta, nos termos da alínea c) do artigo 161.º da Constituição, o seguinte:

#### CAPÍTULO I

#### Disposições gerais

Artigo 1.º

Objeto e âmbito

*Diário da República, 1.ª série—N.º 71—10 de abril de 2014*

exterior ao longo dos molhes de proteção e pela linha de fecho na entrada do porto ou instalação portuária.

Artigo 3.º

#### Princípios

Para além dos princípios consagrados na Lei de Bases do Ambiente, o ordenamento e a gestão do espaço marítimo nacional devem observar os seguintes princípios:

- a) Abordagem ecossistémica, que tenha em consideração a natureza complexa e dinâmica dos ecossistemas, incluindo a preservação do bom estado ambiental do meio marinho e das zonas costeiras;
- b) Gestão adaptativa, que tenha em consideração a dinâmica dos ecossistemas e a evolução do conhecimento e das atividades;
- c) Gestão integrada, multidisciplinar e transversal, assegurando:

# Lei 17/2014

# DL 38/2015



**Supporting documents:**

**[www.oceanplan-project.com/aaodem2020](http://www.oceanplan-project.com/aaodem2020)**