Key global ocean drivers, impacts, and solutions

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Global carbon budget (2007-2016)

33.4 Gt CO_2/yr (88%)

+

4.8 Gt CO_2/yr (12%)

Le Quéré et al. (2017)

Global carbon budget (2007-2016)

33.4 Gt CO_2/yr (88%)

+

4.8 Gt CO_2/yr (12%)

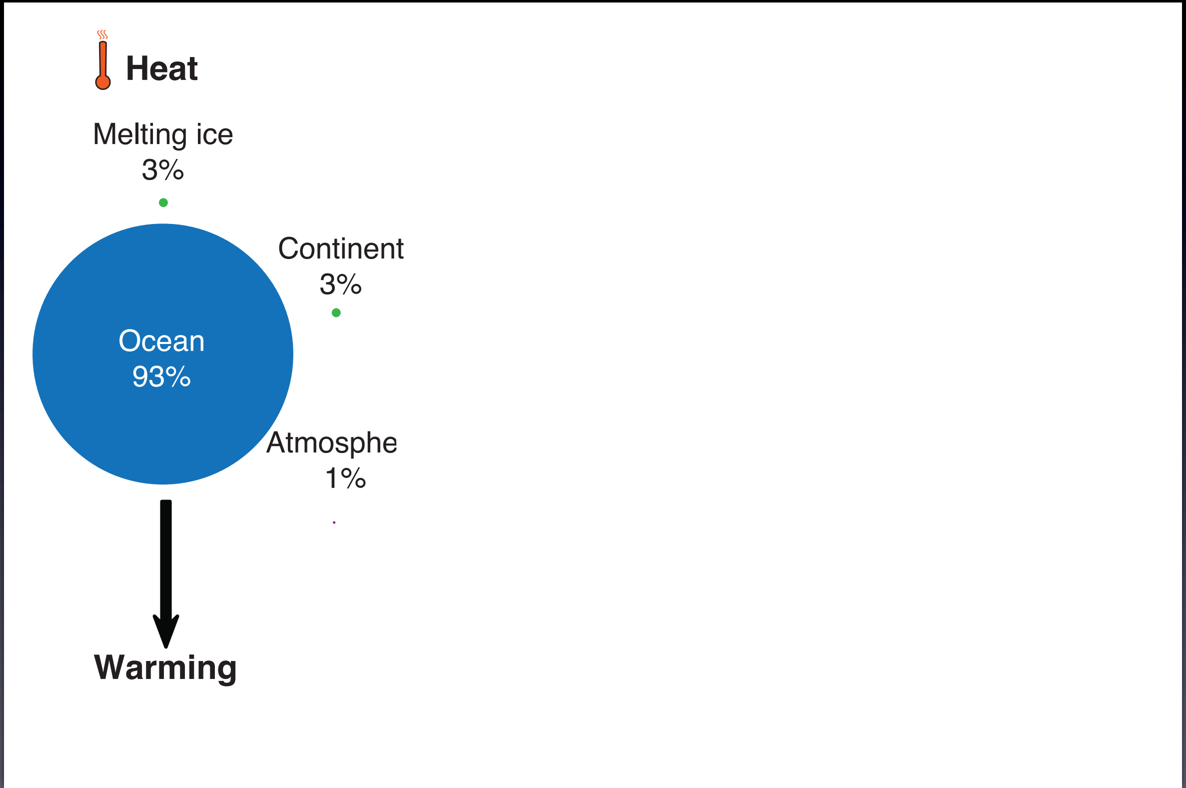
Atmosphere
46%

Vegetation
30%

Oceans
24%
30 millions tonnes CO_2 per day

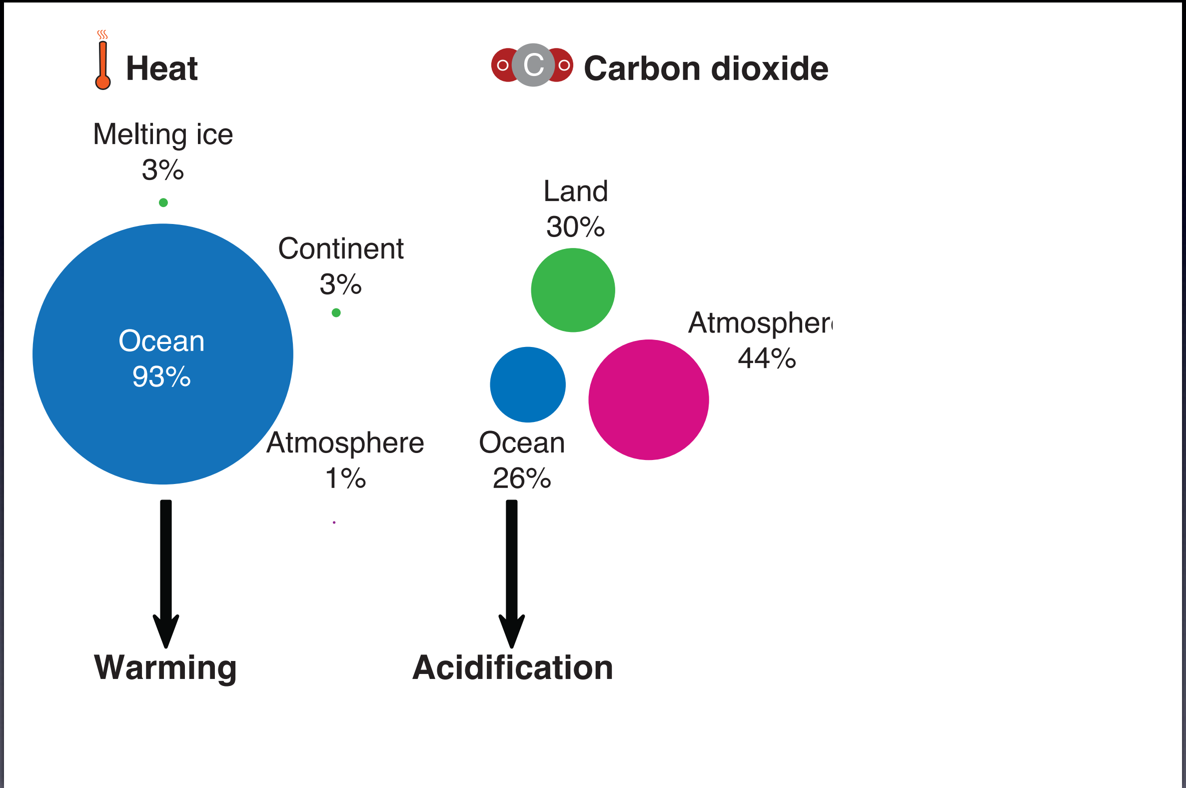
Le Quéré et al. (2017)

Ocean: actor and victim of climate change



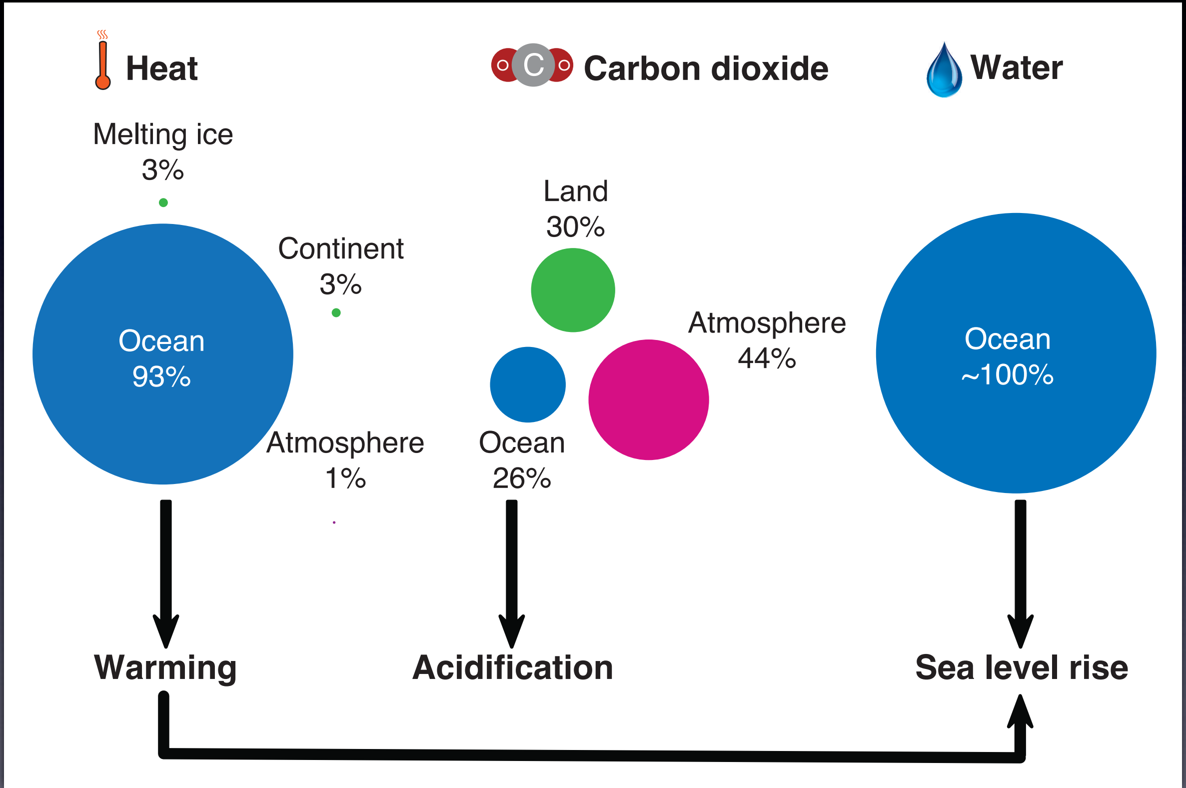
Magnan et al. (2015)

Ocean: actor and victim of climate change



Magnan et al. (2015)

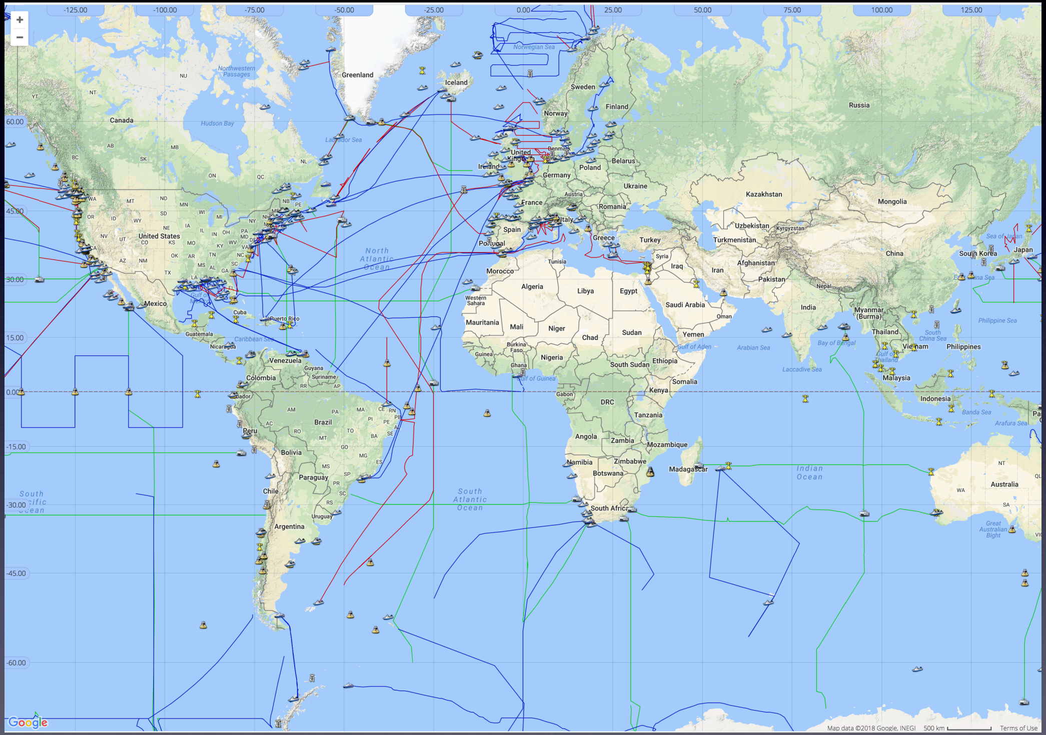
Ocean: actor and victim of climate change



Magnan et al. (2015)

Monitoring is essential

Global Ocean Acidification Observing Network



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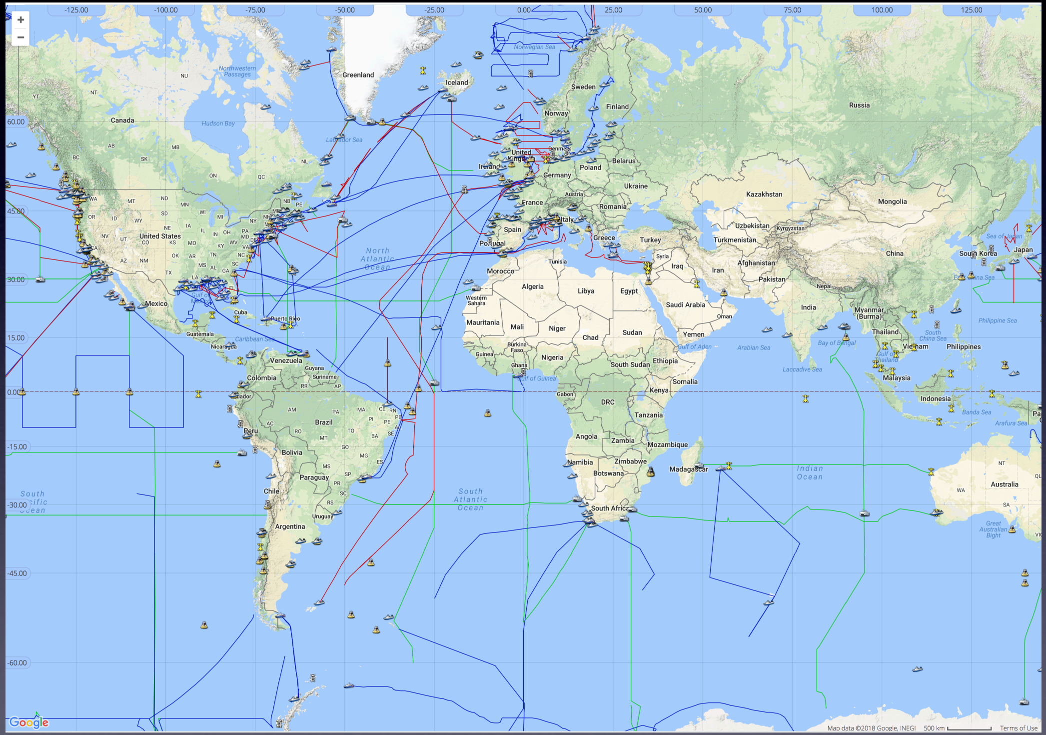
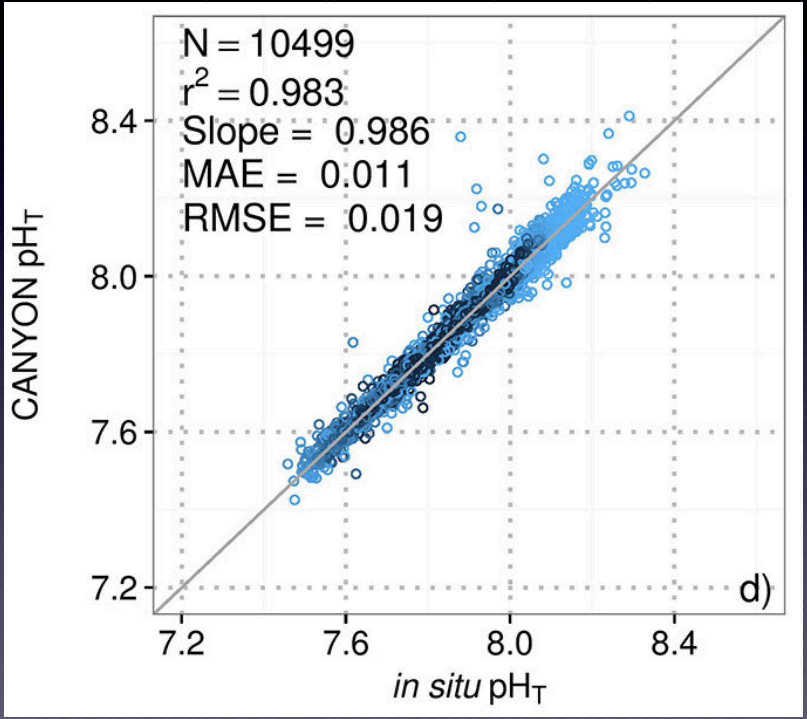
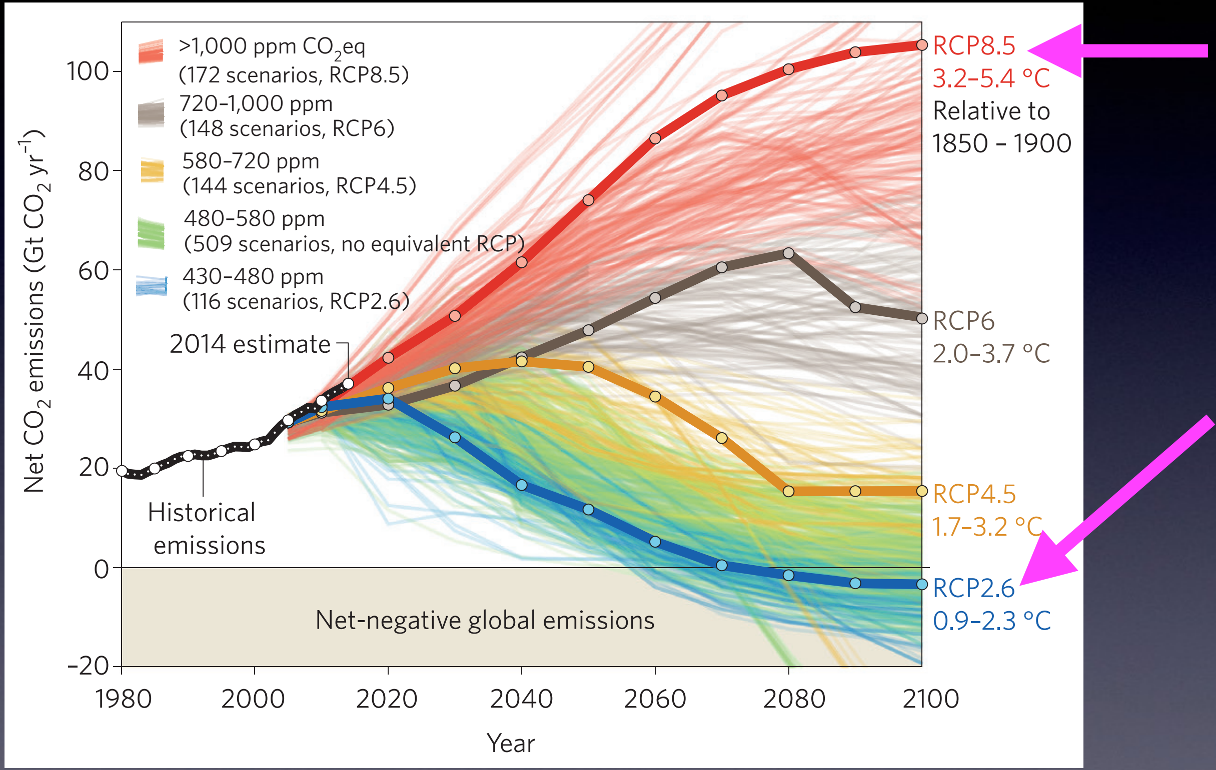


Sauzède et al. (2017, FMS)



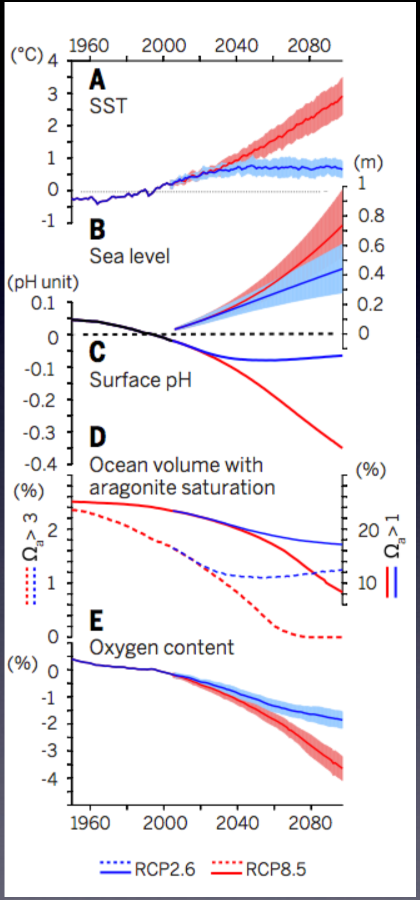
Neural network using S, T, P, O2, lat, lon, time

Future scenarios



Fuss et al. (2014)

What does it means for the ocean?



Gattuso et al. (2015)

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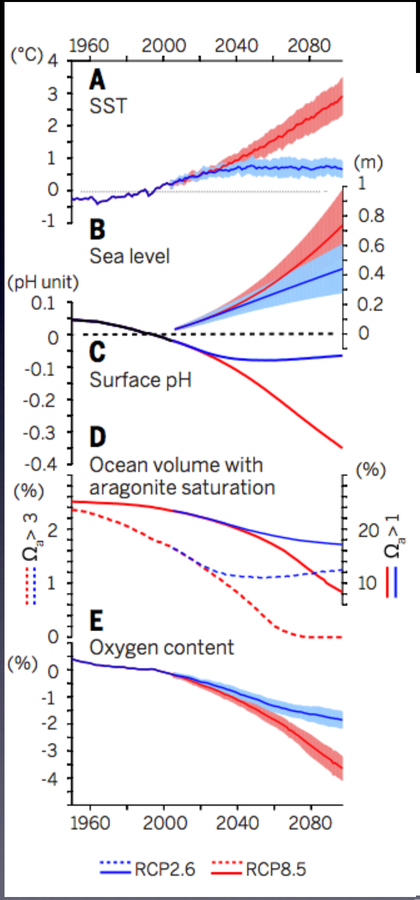

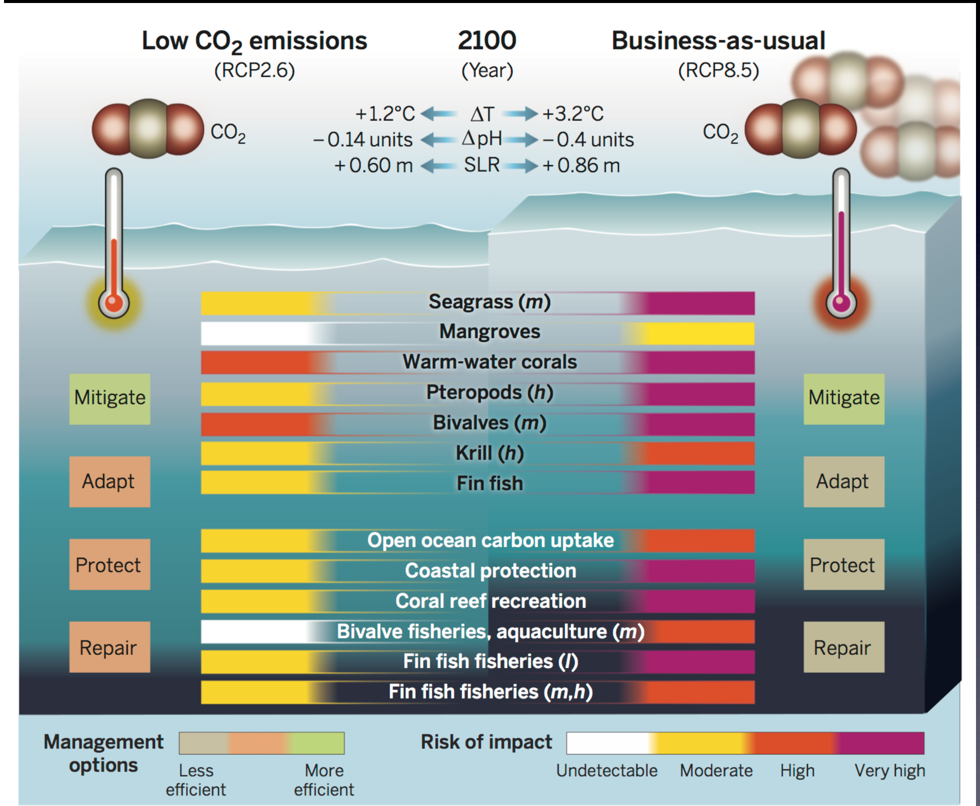

Gattuso et al. (2015)

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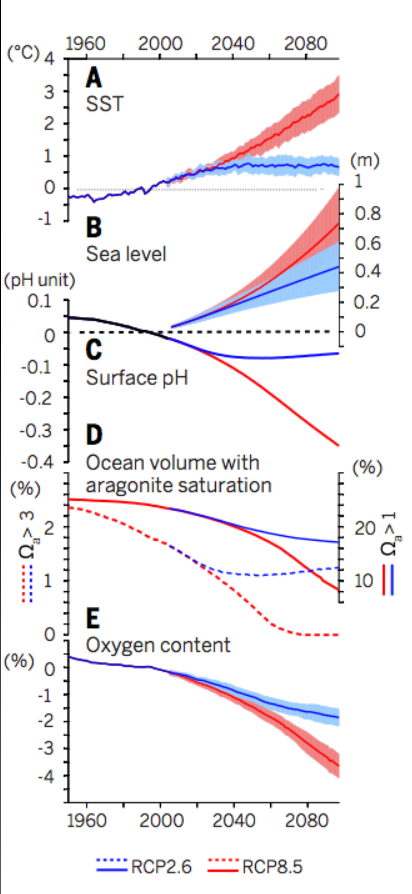

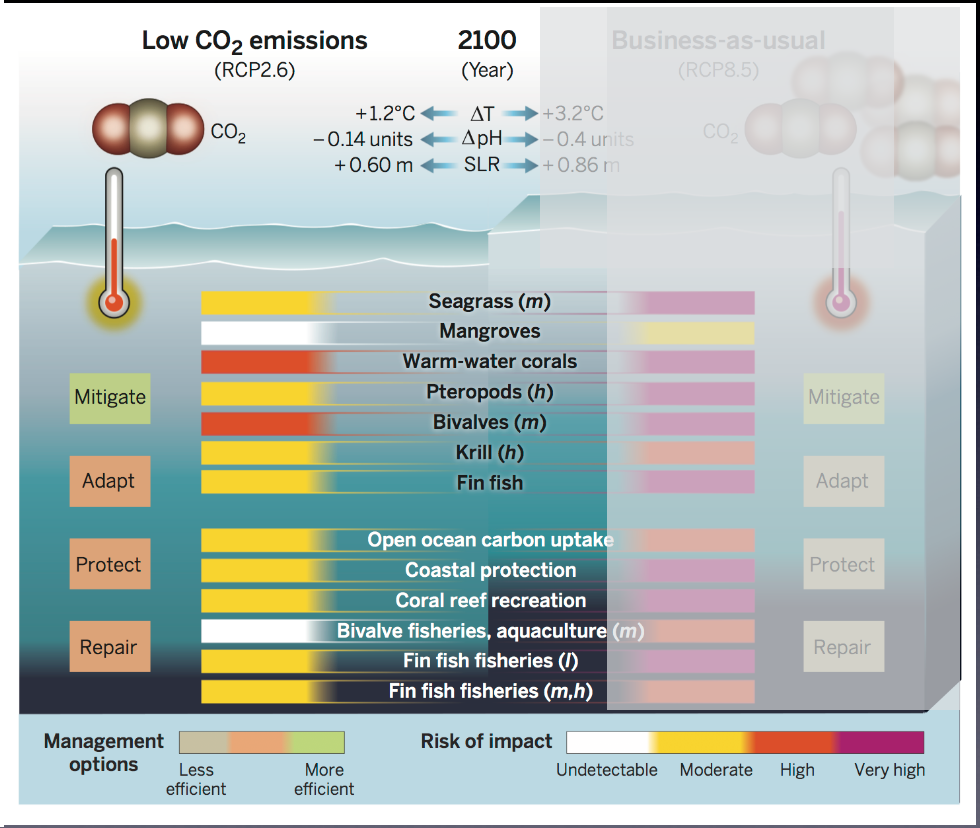

Gattuso et al. (2015)

4 key messages at COP21

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


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IAEA OA-ICC

FONDATION BNP PARIBAS

AMAO

OCEANS 2015 INITIATIVE

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SciencesPo

POLICY BRIEF

N°04/15 SEPTEMBER 2015 | CLIMATE - OCEANS AND COASTAL ZONES

Intertwined ocean and climate: implications for international climate negotiations

Alexandre K. Magnan (IDDRI), Raphaël Billé (Secretariat of the Pacific Community), Sarah R. Cooley (Ocean Conservancy), Ryan Kelly (University of Washington), Hans-Otto Pörtner (Alfred Wegener Institute), Carol Turley (Plymouth Marine Laboratory), Jean-Pierre Gattuso (CNRS-INSU, Sorbonne Universités, IDDRI)

INTRODUCTION

The atmosphere and ocean are two components of the Earth system that are essential for life, yet humankind is altering both. Contemporary climate change is now a well-identified problem: anthropogenic causes, disturbance in extreme events patterns, gradual environmental changes, widespread impacts on life and natural resources, and multiple threats to human societies all around the world. But part of the problem remains largely unknown outside the scientific community: significant changes are also occurring in the ocean, threatening life and its sustainability on Earth.

This Policy Brief explains the significance of these changes in the ocean. It is based on a scientific paper recently published in *Science* (Gattuso *et al.*, 2015), which synthesizes recent and future changes to the ocean and its ecosystems, as well as to the goods and services they provide to humans. Two contrasting CO_2 emission scenarios are considered: the high emissions scenario (also known as "business-as-usual" and as the Representative Concentration Pathway 8.5, RCP8.5) and a stringent emissions scenario (RCP2.6) consistent with the Copenhagen Accord[1] of keeping mean global temperature increase below 2°C in 2100.

1. Copenhagen Accord, *Decision 2/CP.15: Copenhagen accord* (United Nations Framework Convention on Climate Change, Geneva, 2009).

KEY MESSAGES

- Climate and ocean are inseparable: the ocean moderates anthropogenic climate change by absorbing significant proportions of the heat and CO_2 that accumulate in the atmosphere, as well as by receiving all water from melting ice.
- This climate-regulating function happens at the cost of profound alterations of the ocean's physics and chemistry, leading to ocean warming and acidification, as well as to sea level rise. These changes significantly affect the ocean's ecology (organisms and ecosystems) and eventually marine and coastal human activities (fisheries, aquaculture, tourism, health…).
- As atmospheric CO_2 increases, possible human responses become fewer and less effective.
- This scientific statement provides further compelling arguments for immediate and ambitious CO_2 emissions reduction at the international level. This conclusion applies to COP21 as well as to the post-2015 climate regime at large.

Paris Agreement

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

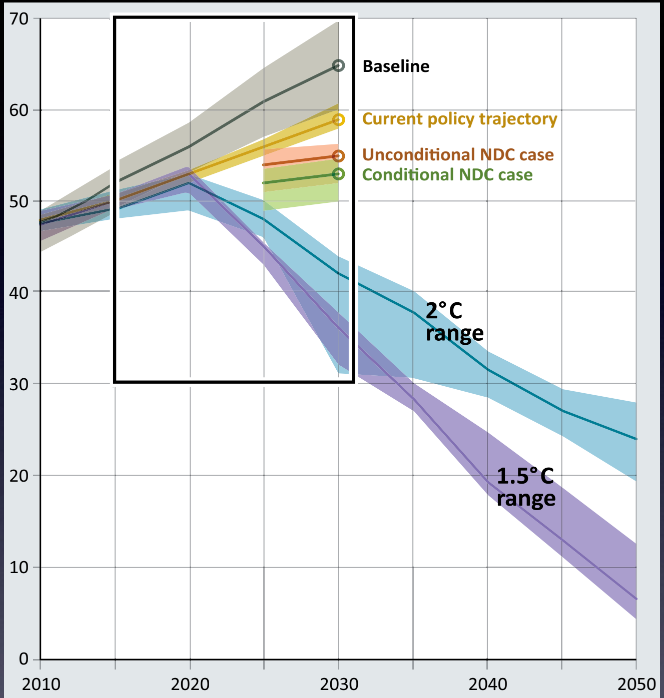
"Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels…"

Paris Agreement

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

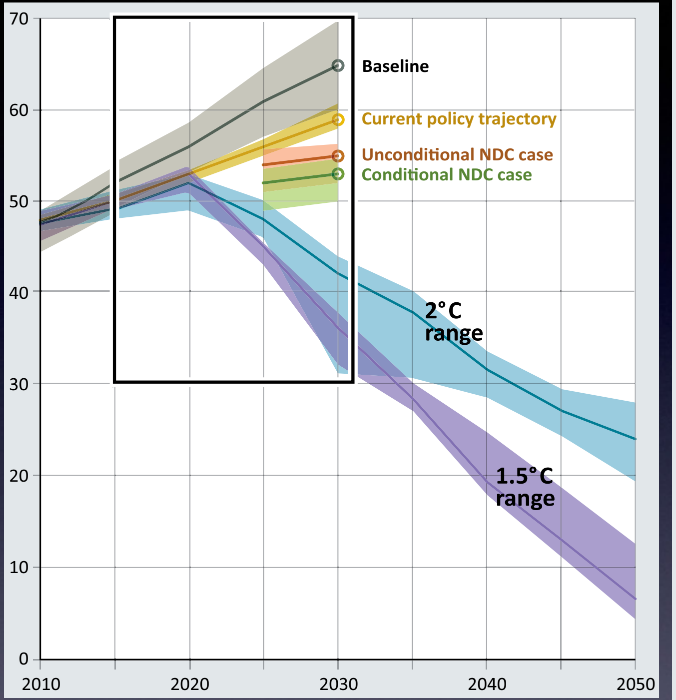
1.5 °C mostly based on ocean matters

Gap between reductions needed and NDCs is alarmingly high

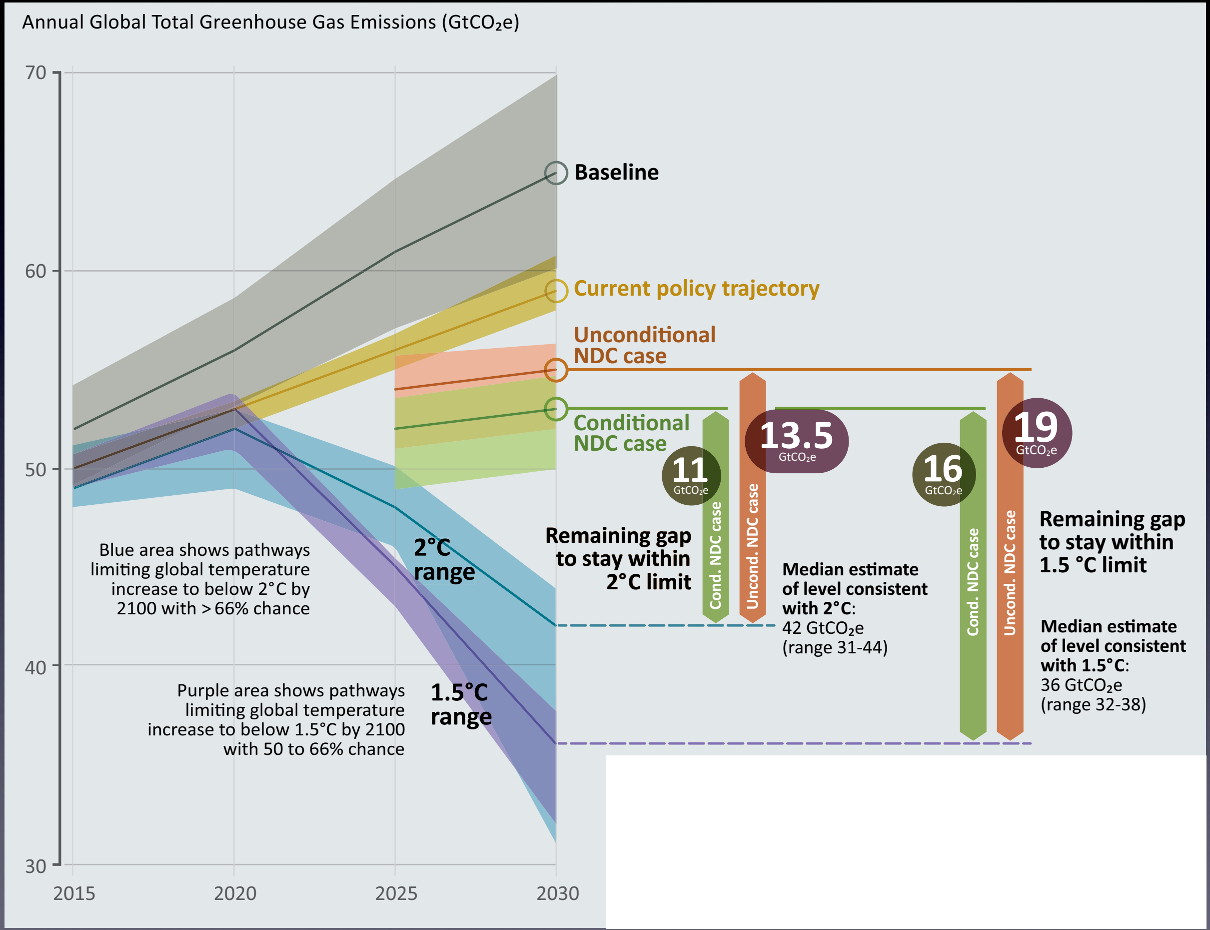


UNEP (2017)

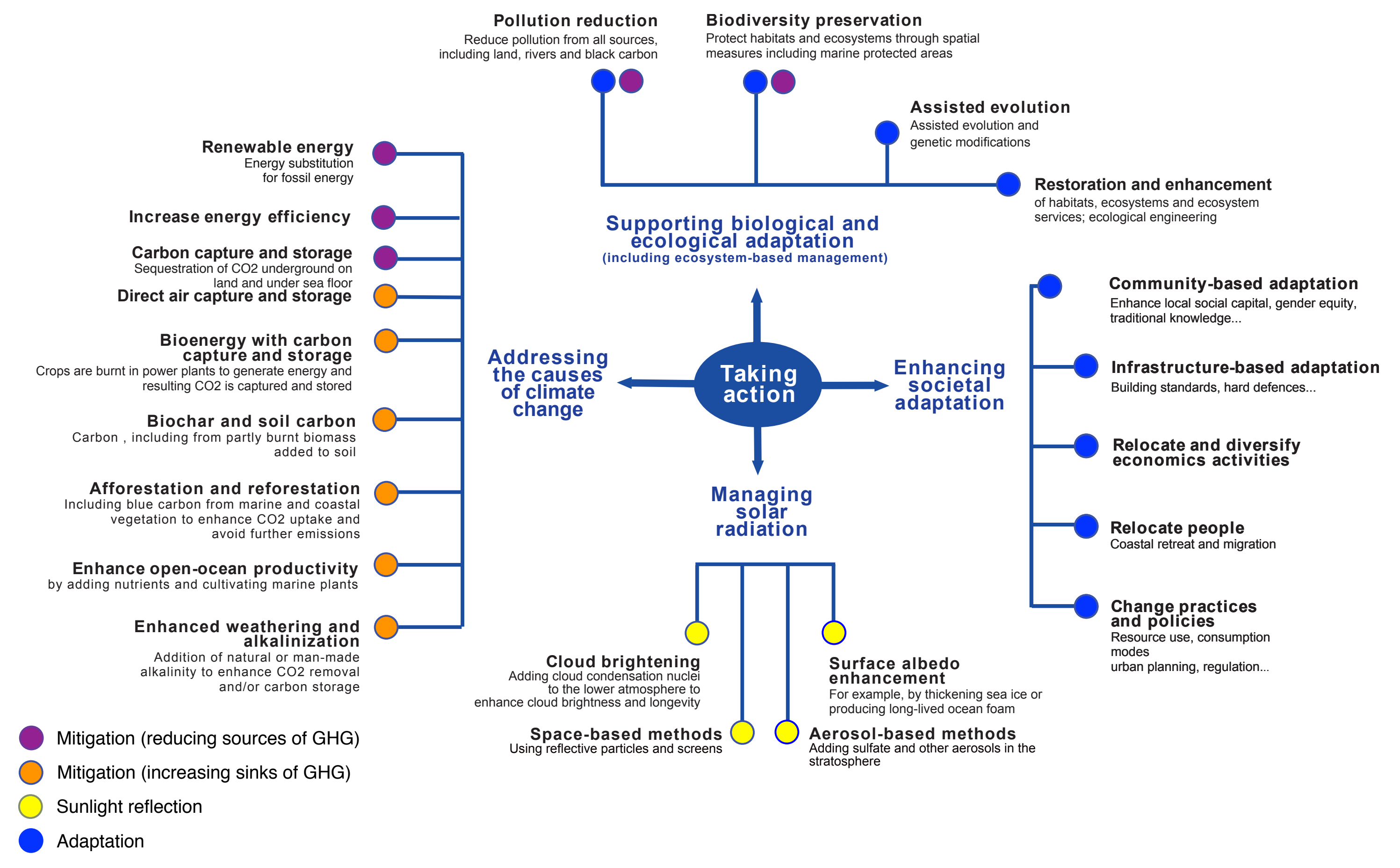
Gap between reductions needed and NDCs is alarmingly high



UNEP (2017)



Possible approaches



Gattuso et al. (sbm)

The Ocean Solutions Initiative

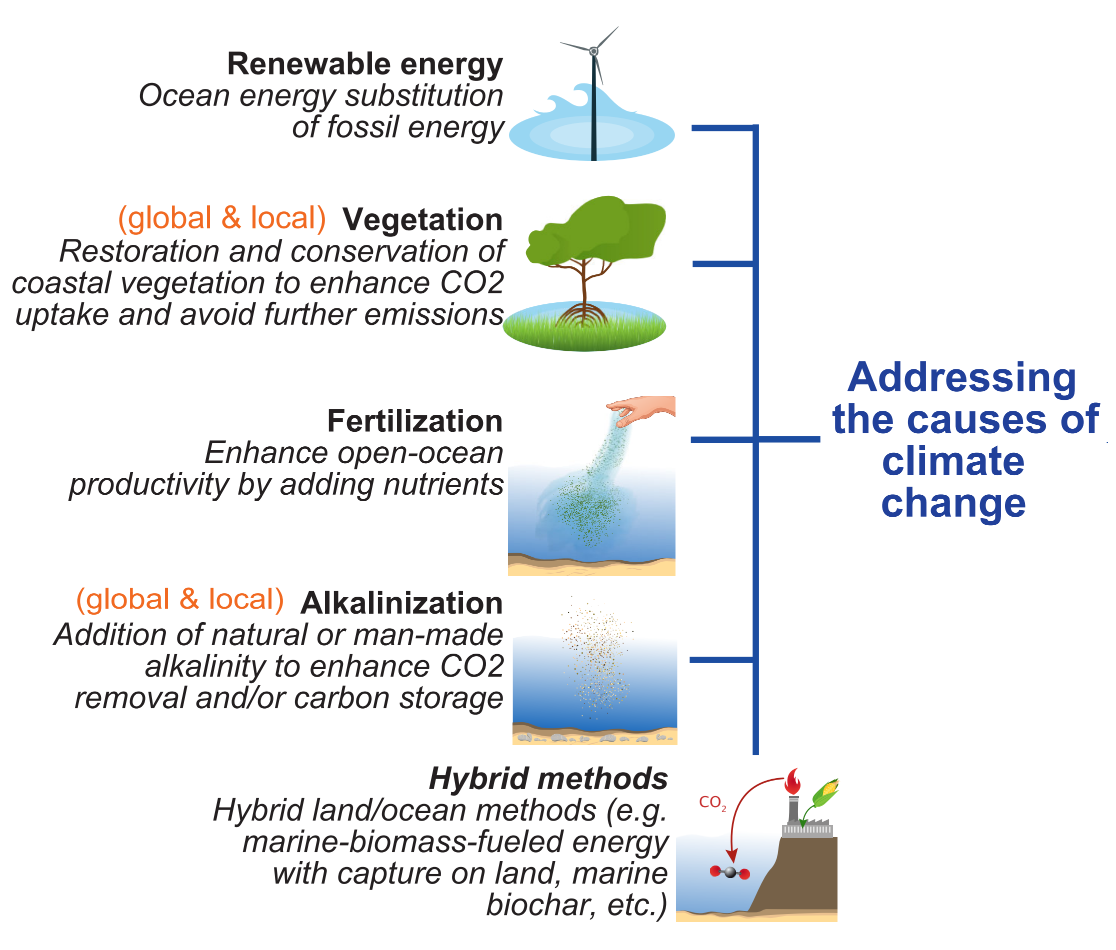
Gattuso et al. (sbm)

The Ocean Solutions Initiative

- Assess potential of ocean-based measures to:
    - reduce changes in three major climate-related drivers globally and/or locally
    - reduce adverse impacts
- Expert assessment based on 8 criteria:
    - environmental effectiveness
    - technological readiness
    - lead time until full potential effectiveness
    - duration of benefits
    - co-benefits
    - disbenefits
    - cost effectiveness
    - governability from an international perspective

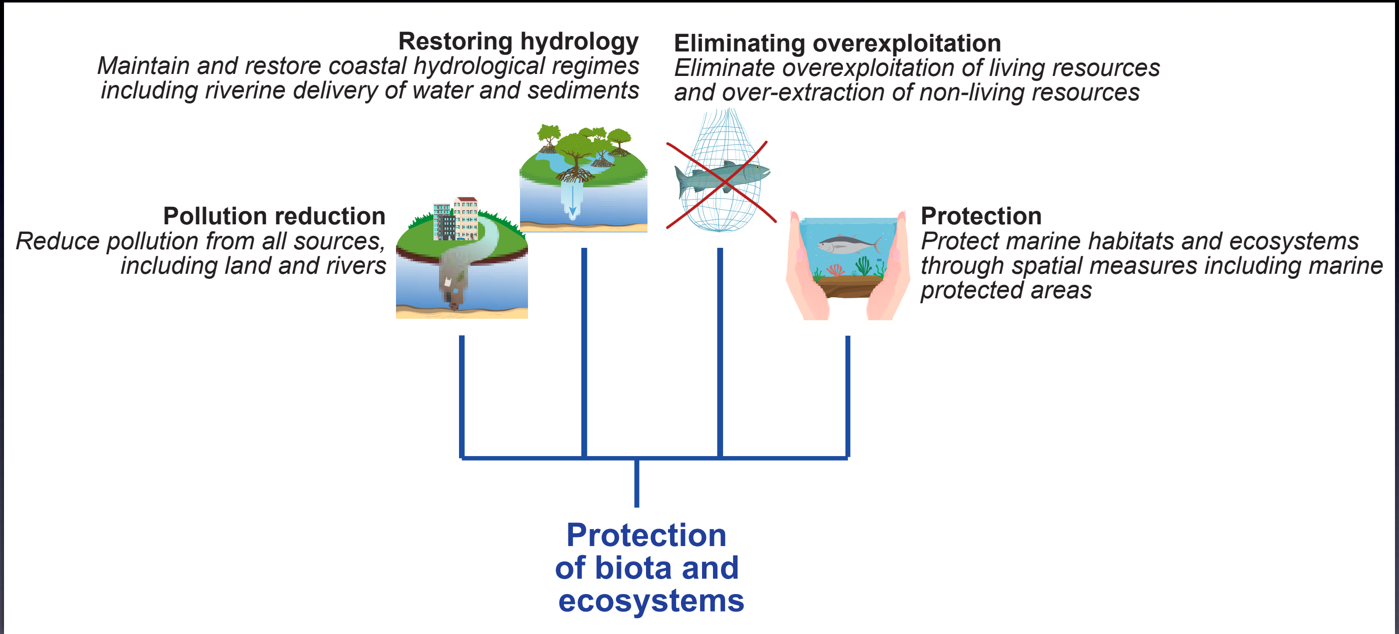
Gattuso et al. (sbm)

Addressing the causes



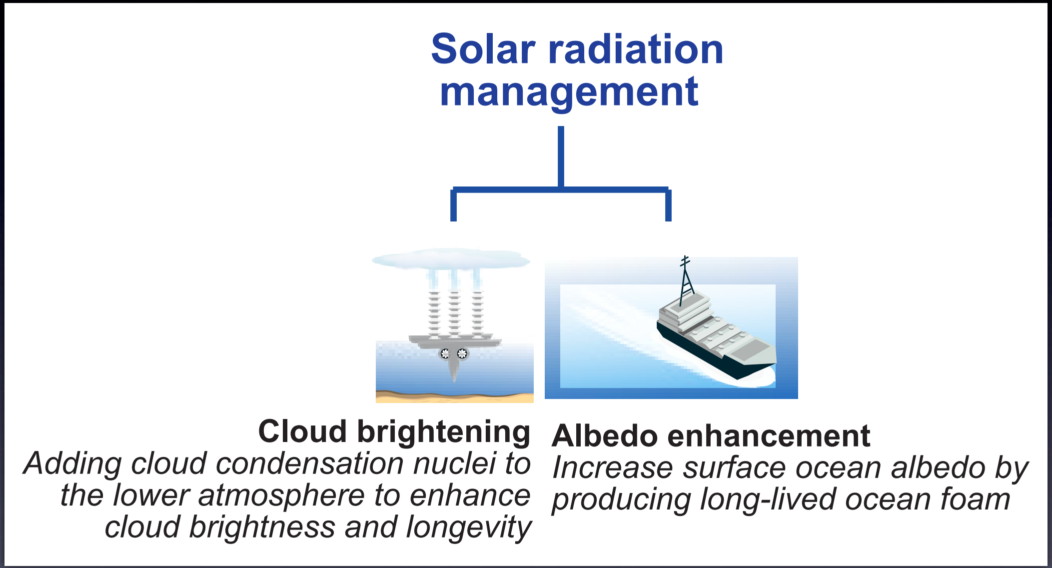
Gattuso et al. (sbm)

Protection



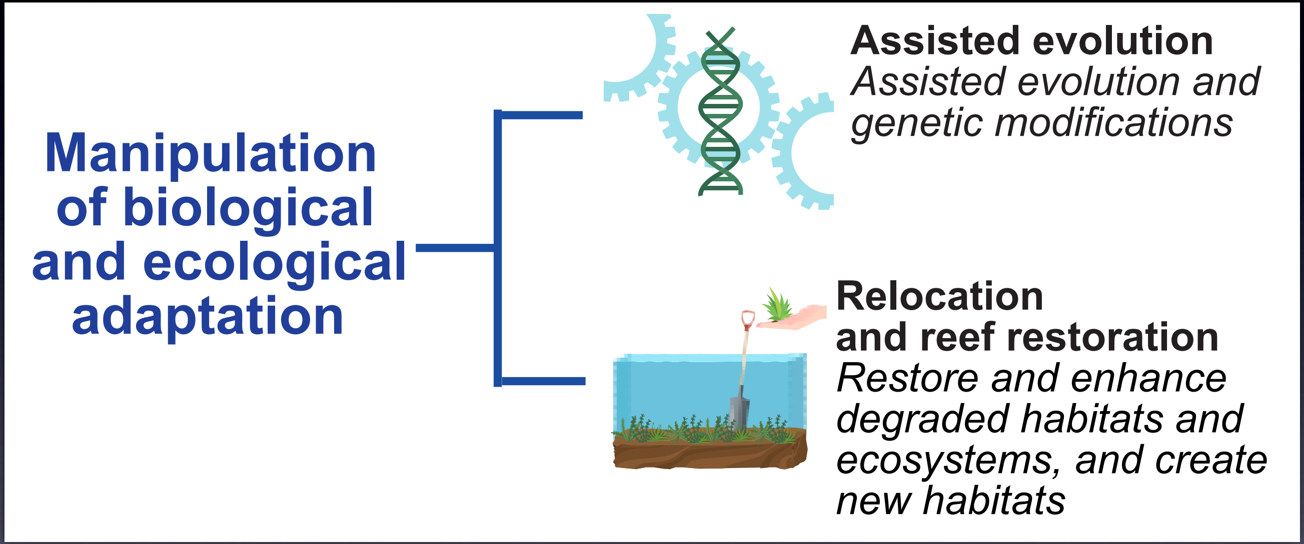
Gattuso et al. (sbm)

Solar radiation management



Gattuso et al. (sbm)

Manipulations



Gattuso et al. (sbm)

Conclusion and key messages

- Climate change already affects marine and coastal ecosystems and their services
- Paris Agreement has the potential to *avoid the unmanageable* but one must *manage the unavoidable*
- Urgent need for ambitious global mitigation and local adaptation: ocean provides solutions for both
    - Most global measures (except renewable energy) exhibit too many uncertainties to be recommended for large-scale deployment
    - Local measures are no-regret options with huge co-benefits, can be scaled up immediately (although far less effective to address the global problem)
    - Greatest benefit is derived from the combination of global and local solutions

The Ocean Solutions Initiative

Gattuso et al. (sbm)

IPCC Special Reports: cutoff dates

Special Report on Ocean and Cryosphere in a Changing Climate

Published September 2019

October 2018: submitted for publication
May 2019: accepted for publication

More: http://bit.ly/1M6YiS6

Many thanks to coauthors