Ocean impacts (risks) under different temperature scenarios (1.5°C vs. 2°C vs. 4°C)

Scientific findings: Reducing uncertainty in decision making

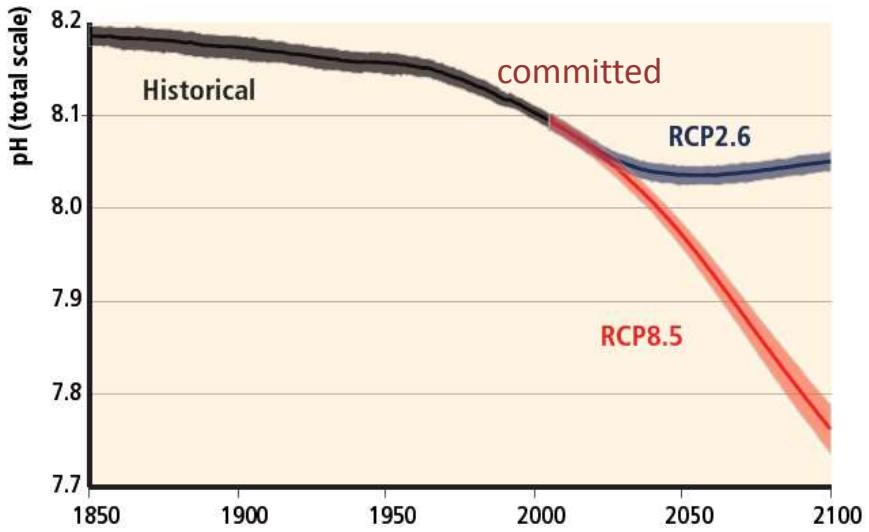
UNFCCC Art. 2:
.....prevent dangerous anthropogenic interference....
.....allow ecosystems to adapt naturally...
.....ensure that food production is not threatened...
.....enable economic development to proceed in a sustainable manner

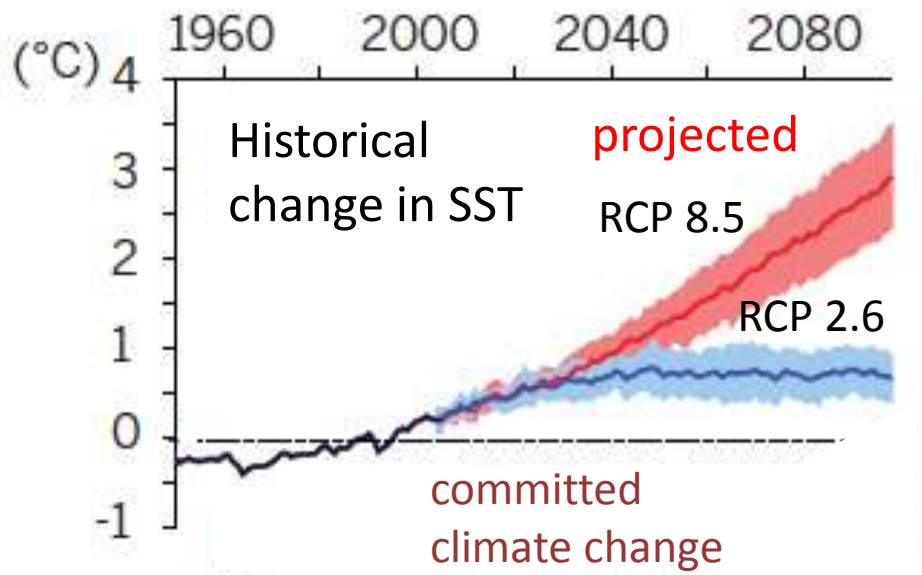
Hans-O. Pörtner: Co-Chair WGII AR6
AR5: CLA WGII CH. 6, Ocean Systems,
Ocean products in TS and SPM, CC-Boxes, SYR, SED

According to emission scenarios oceans are: ... warming

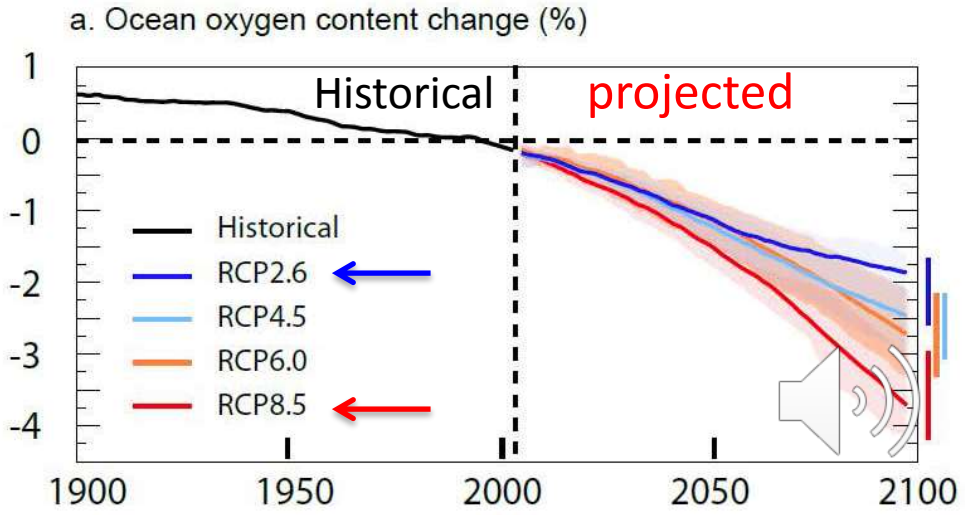
...acidifying

Historical ➔ **Projections**





... losing oxygen



CMIP5 model runs

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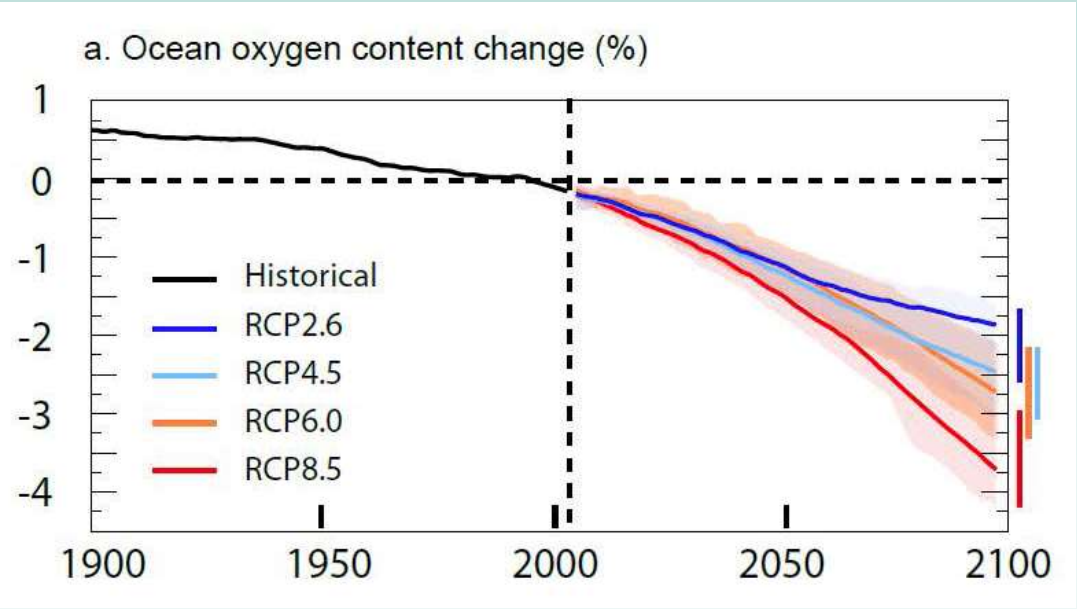
WGI Figure 6.30

OCEANS 2015 INITIATIVE

Gattuso et al., 2015

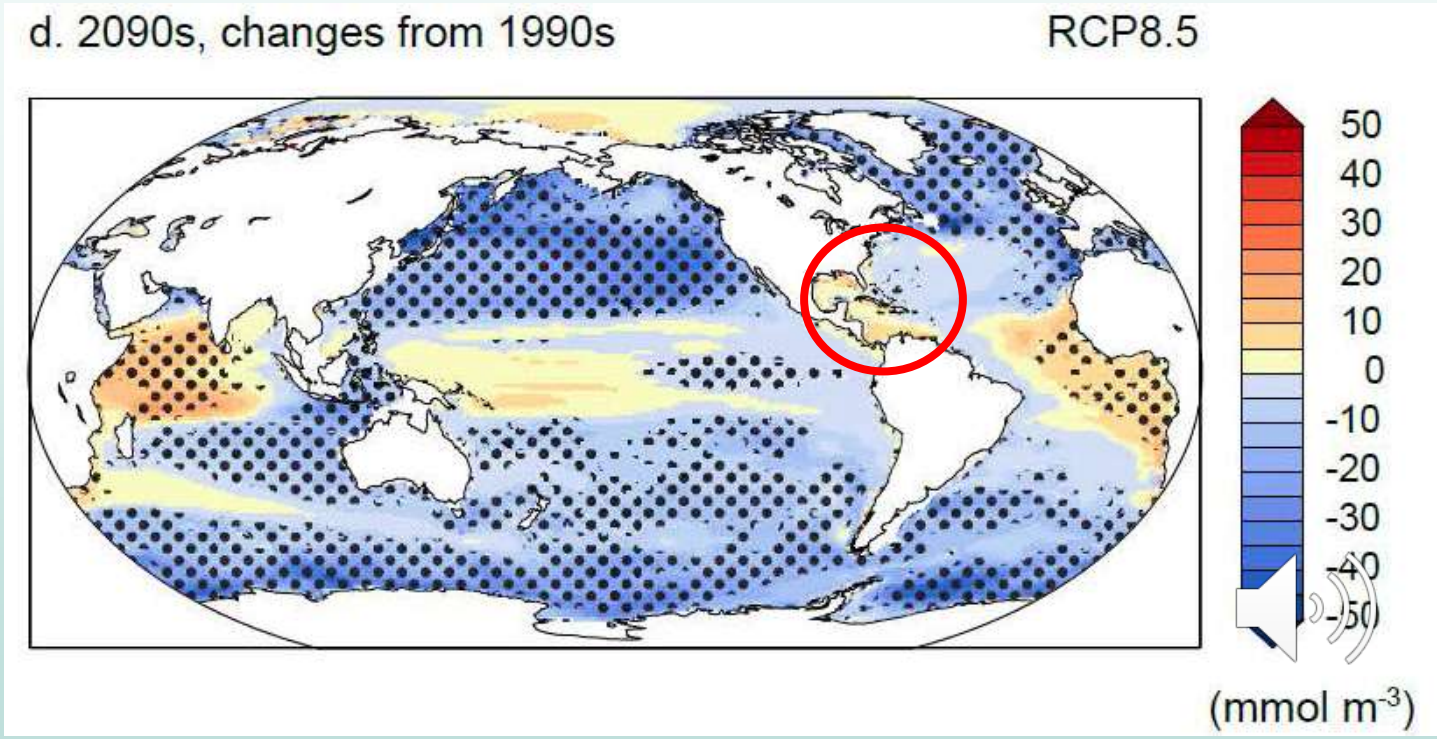
Observations and Projections: Deoxygenation



Areas of low oxygen are expanding:

coastal dead zones

midwater oxygen minimum zones



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WGI Figure 6.30

+1.5 to >>2 °C

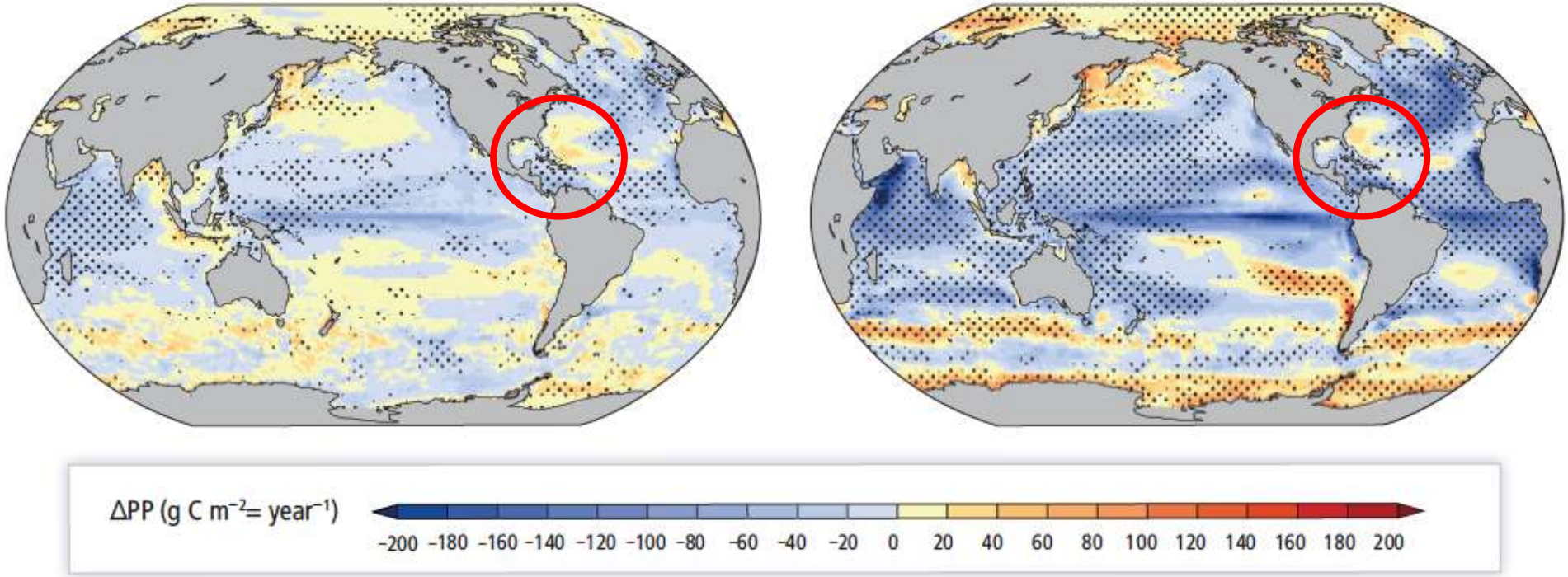
... warming: Spatial changes ...and a small overall decrease ....in ocean primary production

~1.5°C

RCP2.6

4°C

RCP8.5



IPCC AR5 WGII Figure 6.13

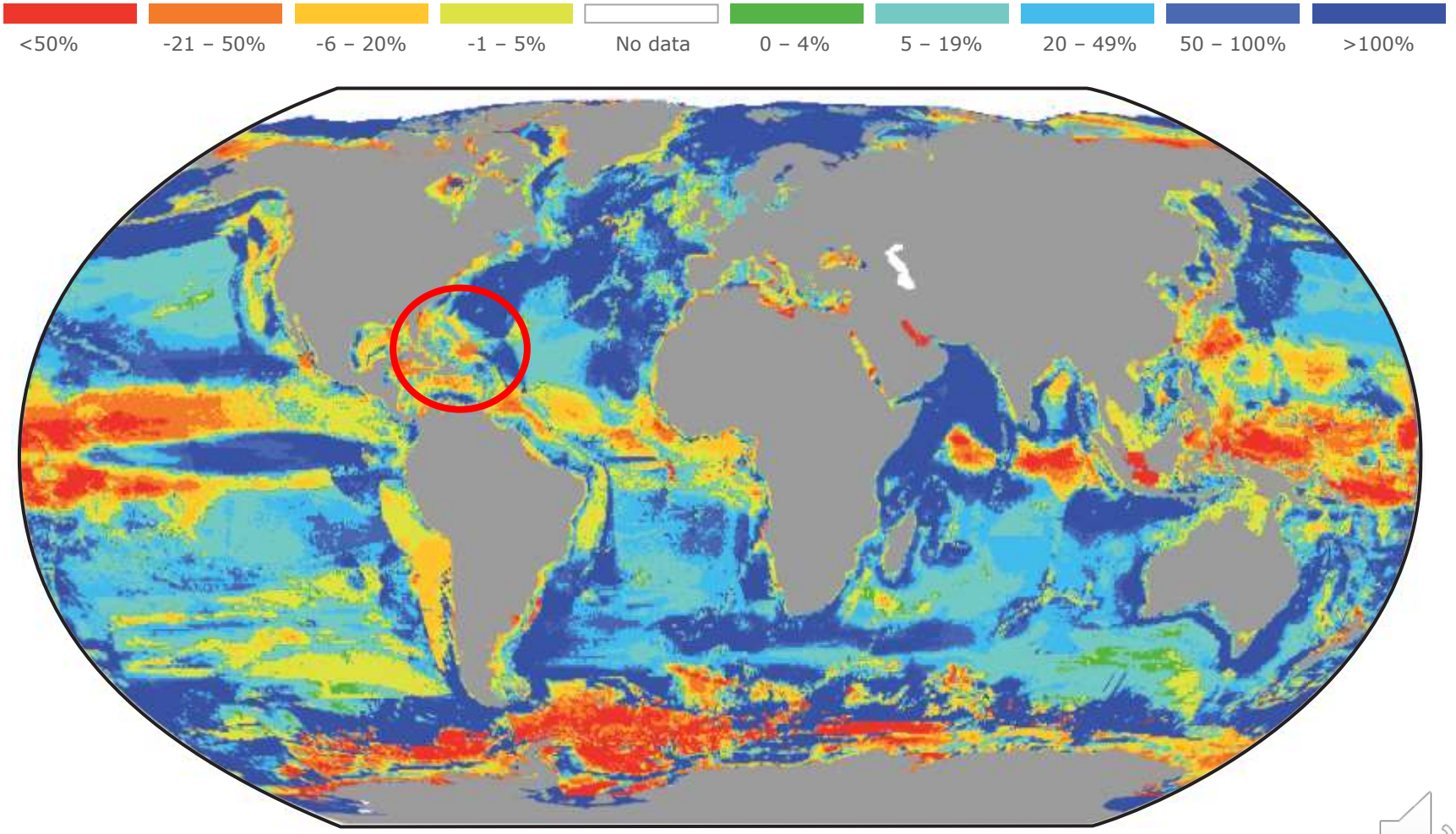
Unabated Ocean Warming by 2050

Projections

2°C

2051-60: fish and invertebrate biomass and diversity displaced and reduced at low latitudes

CHANGE IN MAXIMUM CATCH POTENTIAL (2051-2060 COMPARED TO 2001-2010, SRES A1B, 2°C warming of global surface T 0.7°C warmer Sea Surface T)



WGII, 6-14, SPM.6, SYR 2.6

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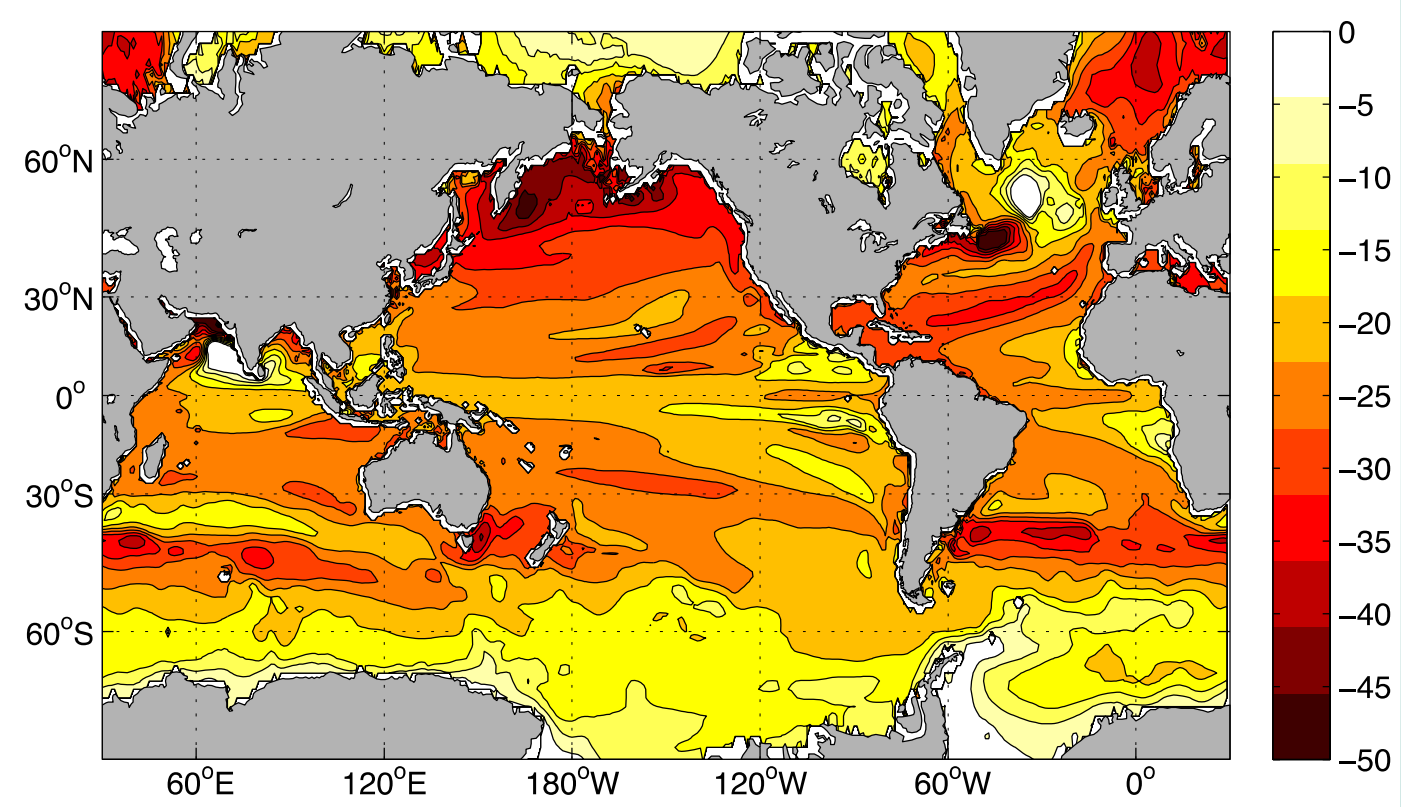
REDUCED HABITAT range of marine fishes and invertebrates due to **thermal constraints** combined with **oxygen loss** in the oceans

>>2°C



2071-2100, 0-200m
IPCC Earth System Model mean, RCP8.5 scenario

Projections

by ~20%
overall

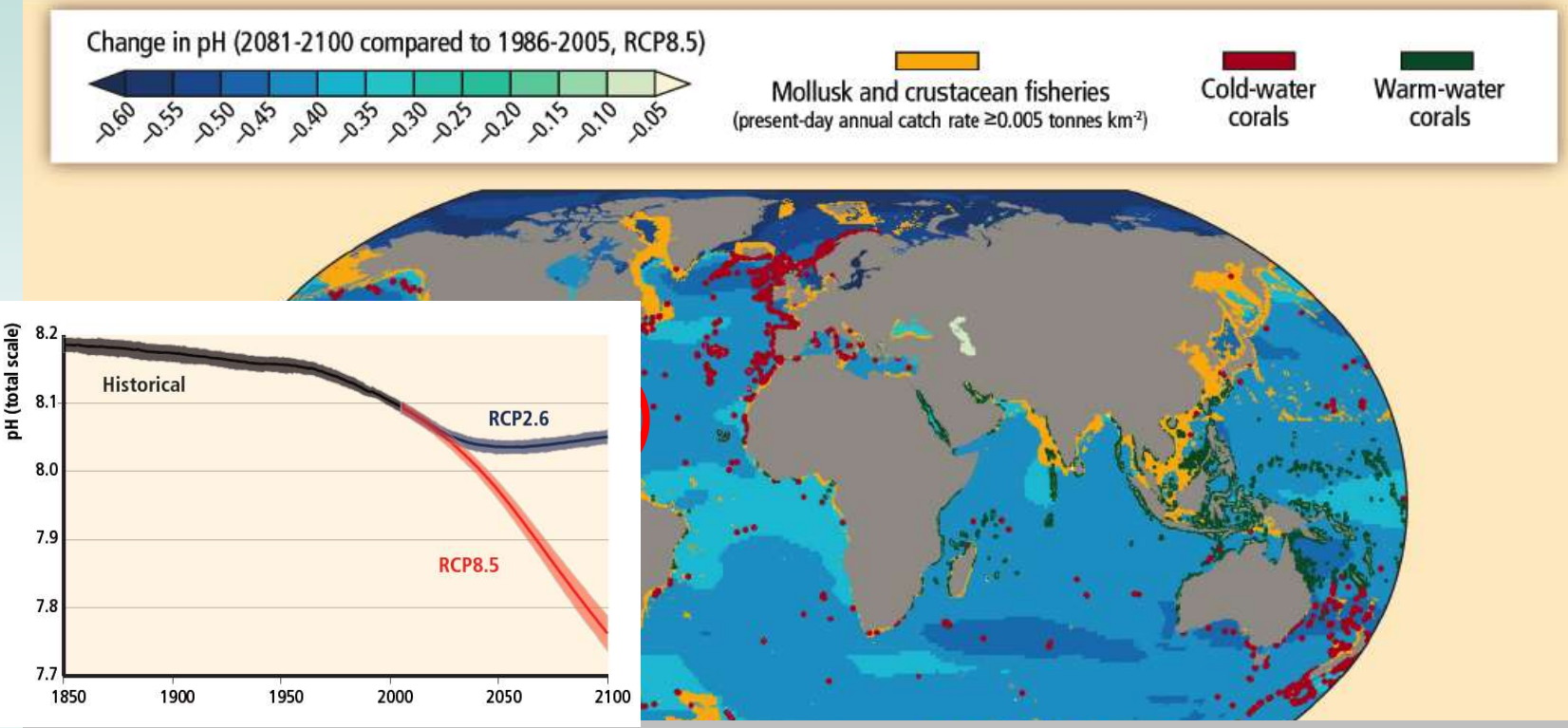
Northern High Latitudes:
by ~40%

TO BE ASSESSED IN AR6

C. Deutsch, A. Ferrel, B. Seibel, H.-O. Pörtner, R.B. Huey, *Science 2015*

Unabated Ocean acidification affecting mollusk and crustacean fisheries, and coastal protection by coral reefs

>>2 °C

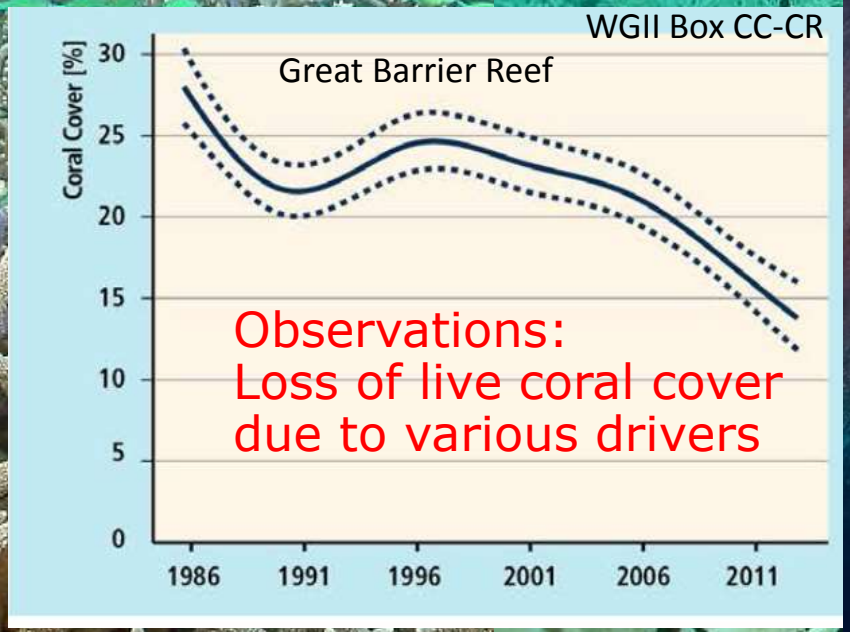


.....risks enhanced by warming extremes

OBSERVATIONS **0.8°C**

Vulnerable ecosystems identified in AR5

Warm water coral reefs under various pressures



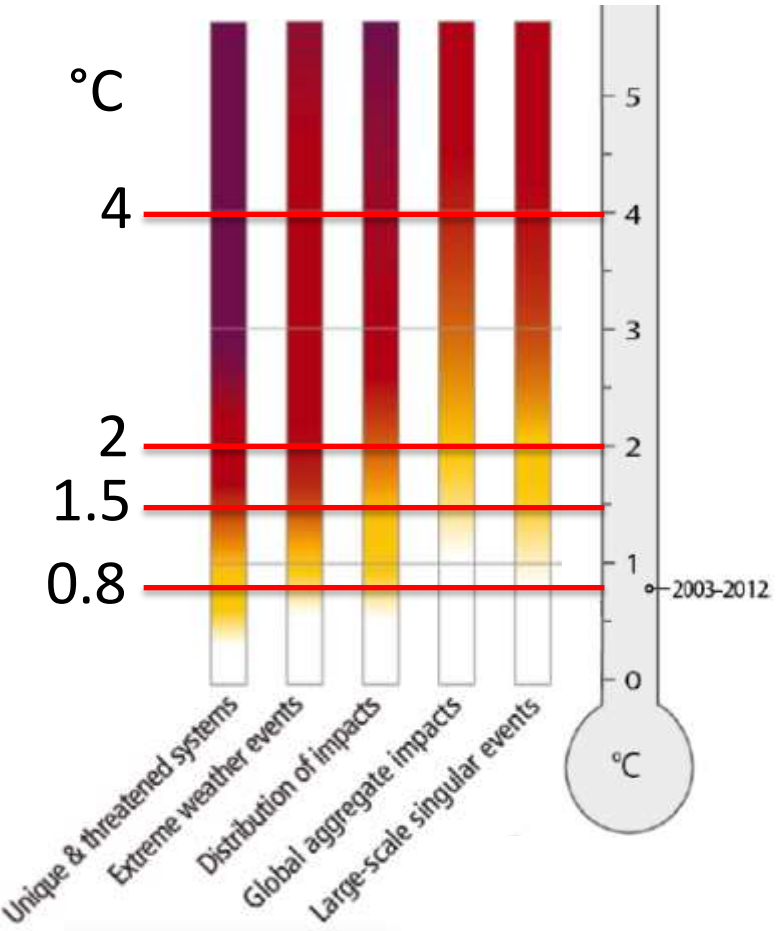
High risk of losing up to 90% of coral reefs and their services to humankind in a 1.5°C warmer world....

2016

Verons 2009

LTGG

How to widely compare climate impacts?



Risk assessment IPCC WGII:

A role for natural marine systems to guide the setting of **long-term global goals** (LTGG, relative to preindustrial), considering levels of **risk**

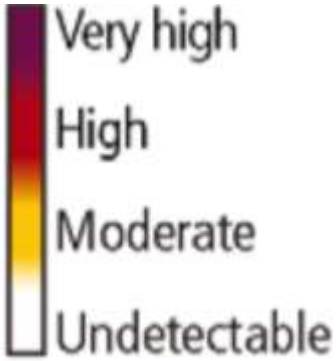
LTGG

4°C

2°C

1.5°C

0.8°C



Level of additional risk due to climate change

...comparing LTGGs,
identifying... Key risks of impacts
.... Risks to be avoided

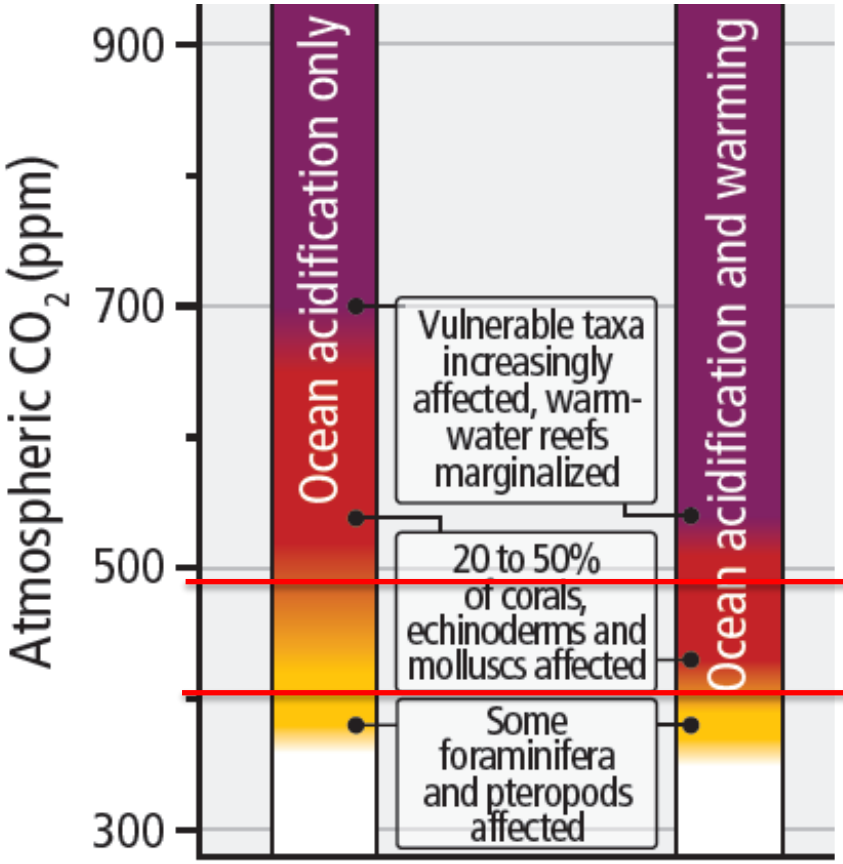
IPCC WGII

AN EXAMPLE: COMBINED IMPACTS OF CLIMATE DRIVERS:

ocean warming and acidification,

a comparative view across LTGGs based on risk

1.5°C
vs. 2°C
vs. >>2°C



LTGG
~ 4°C

~ 2°C

~1.5°C

~0.6°C

Additional risk due to climate change

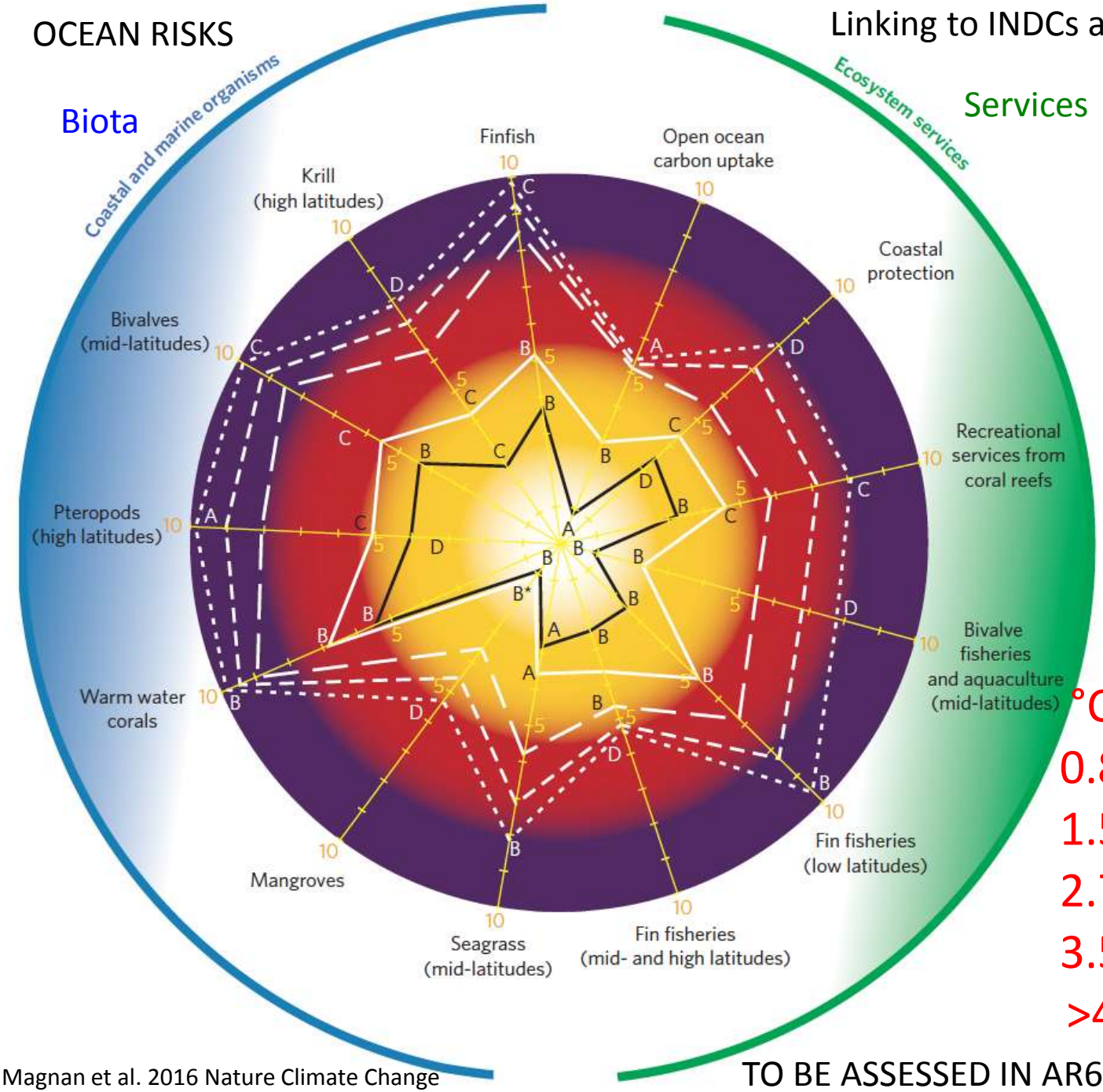
SYR 2.5

OCEAN RISKS

Linking to INDCs and Global Stocktake

Biota

Services



°C
0.8
1.5
2.7
3.5
>4

Risk of impact

Undetectable
Moderate
High
Very high

0
5
10

Confidence levels for the present day and the RCPs

E	Very low
D	Low
C	Medium
B	High
A	Very high

Emission scenarios

- Present day
- IPCC RCP 2.6
- Climate Action Tracker 2015 estimate (+2.7 °C)
- Climate Interactive 2015 estimate (+3.5 °C)
- IPCC RCP

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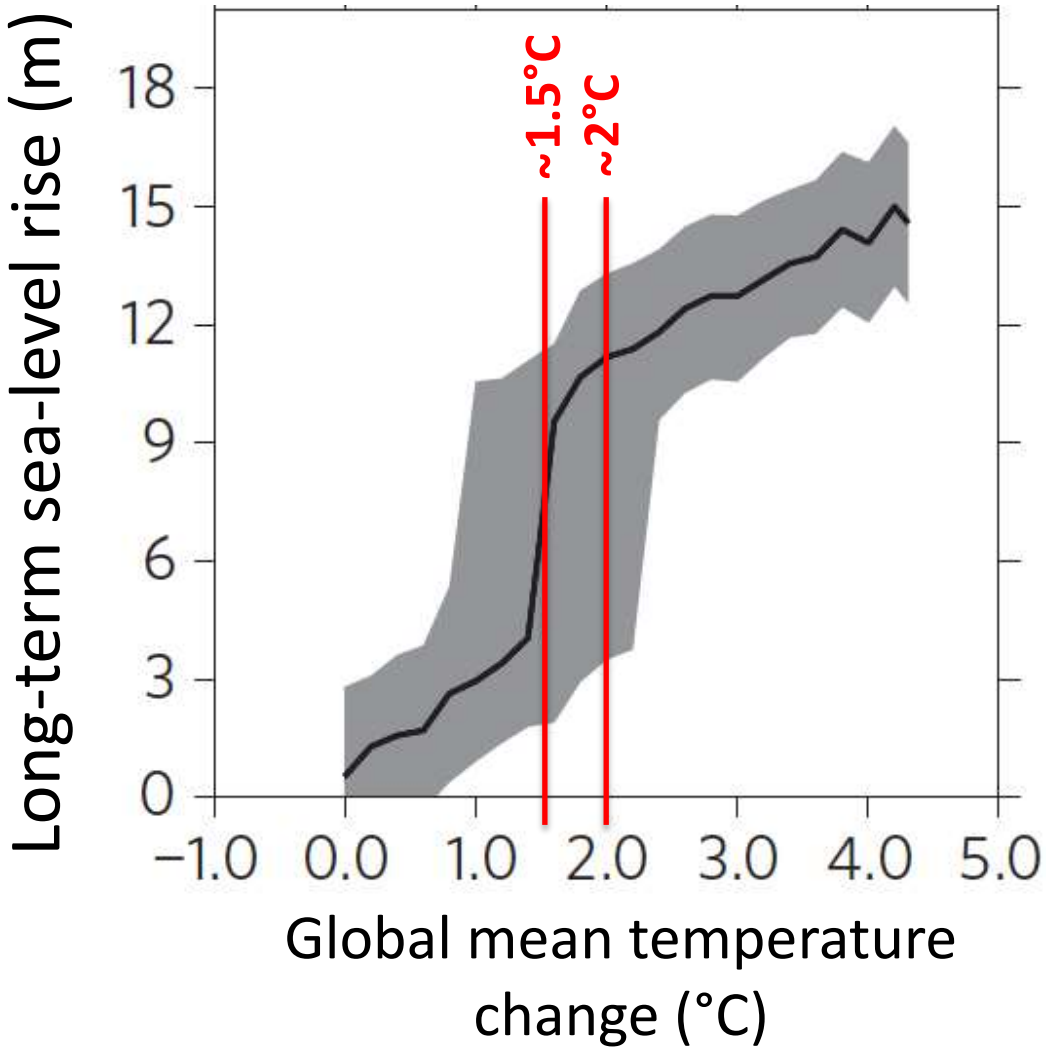
Magnan et al. 2016 Nature Climate Change

Sea level rise beyond 2100 may challenge natural and human systems:

1.5°C

....affecting habitat, freshwater resources, human society through flood events

High ambition mitigation needed



Coming close to Paleo-findings....

5-9 m : ...during the last interglacial (Eemian, 125.000 ya, at 0.7-2°C above pre-industrial)

>7m : ...last time when the atmosphere had 400 ppm CO_2 (in Pliocene, 3-5 Mya)

Knutti et al., Ngeo 2015

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Future Risks

Climate change will amplify existing risks and create new risks for natural and human systems.

Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development.

Increasing magnitudes of warming increase the likelihood of severe, pervasive, and irreversible impacts for people, species and ecosystems.

REGIONAL ADAPTATION IS ALREADY OCCURRING

- **Ocean acidification:** Defending oyster cultures at the US Westcoast against inflow of acidified water.

- **Marine Protected Areas:** Enhancing the resilience of coral reefs and their fish stocks against warming and acidification.

- **Restoration** of Mangrove Forests

…but adaptation capacity is highest under moderate climate change,
≤ 1.5°C

Thank you!

IPCC WGII Ocean Reprint Collection:
http://ipcc-wg2.gov/publications/ocean/