Impacts of climate change, Paris COP21: setting the Long-Term Global Goal(s)

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

... quantifying natural and socio-economic impacts in relation to LTGGs?

H.O Pörtner
AR5 WGII CLA CH. 6, Ocean Systems,
ocean products in TS and SPM, CC-Boxes, Synthesis Report
Co-Chair WGII AR6

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Photo ©H.O. Pörtner

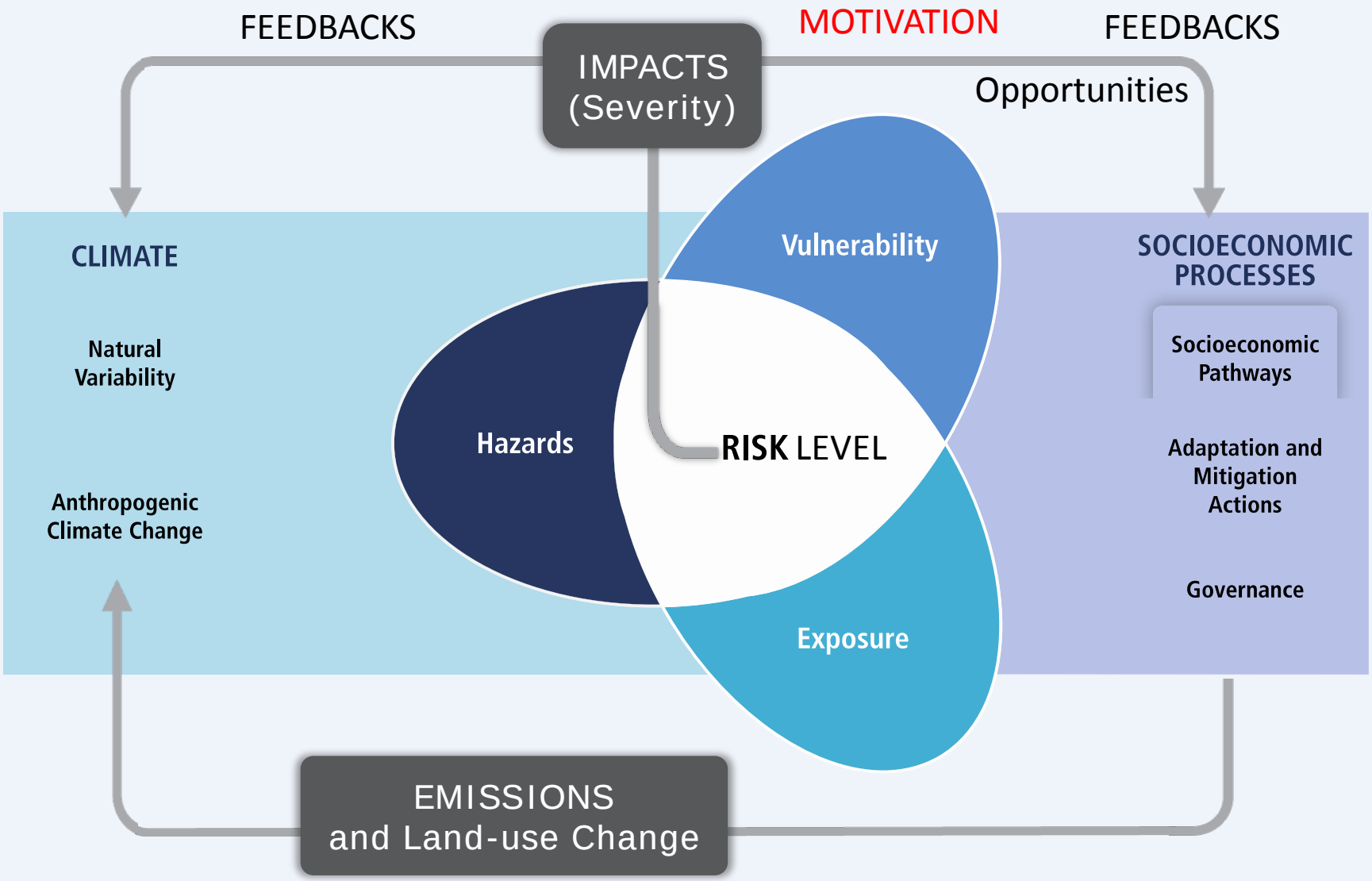
Paris COP 21
November /
December 2015

Leading to the COP21 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."

Heads of delegations

Defining and comparing Long-Term Global Goals (LTGG) in AR5 and beyond?



…. the risk concept of IPCC WGII, liaising to WGI and WGIII approaches

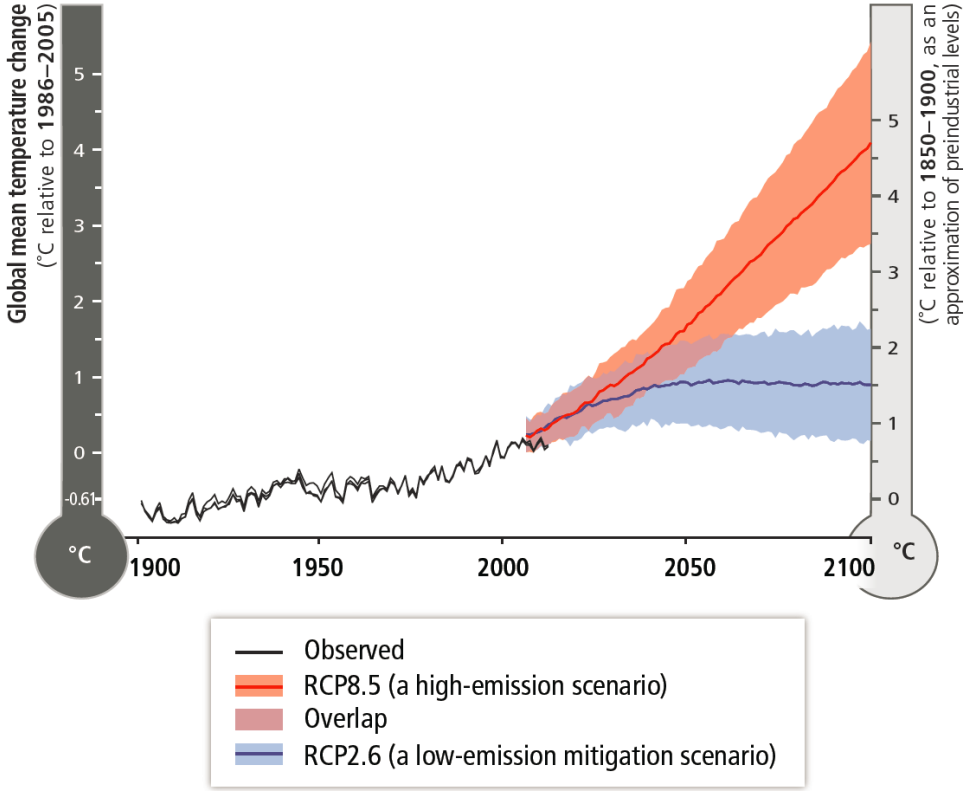
…. linking to Article 2, UNFCCC

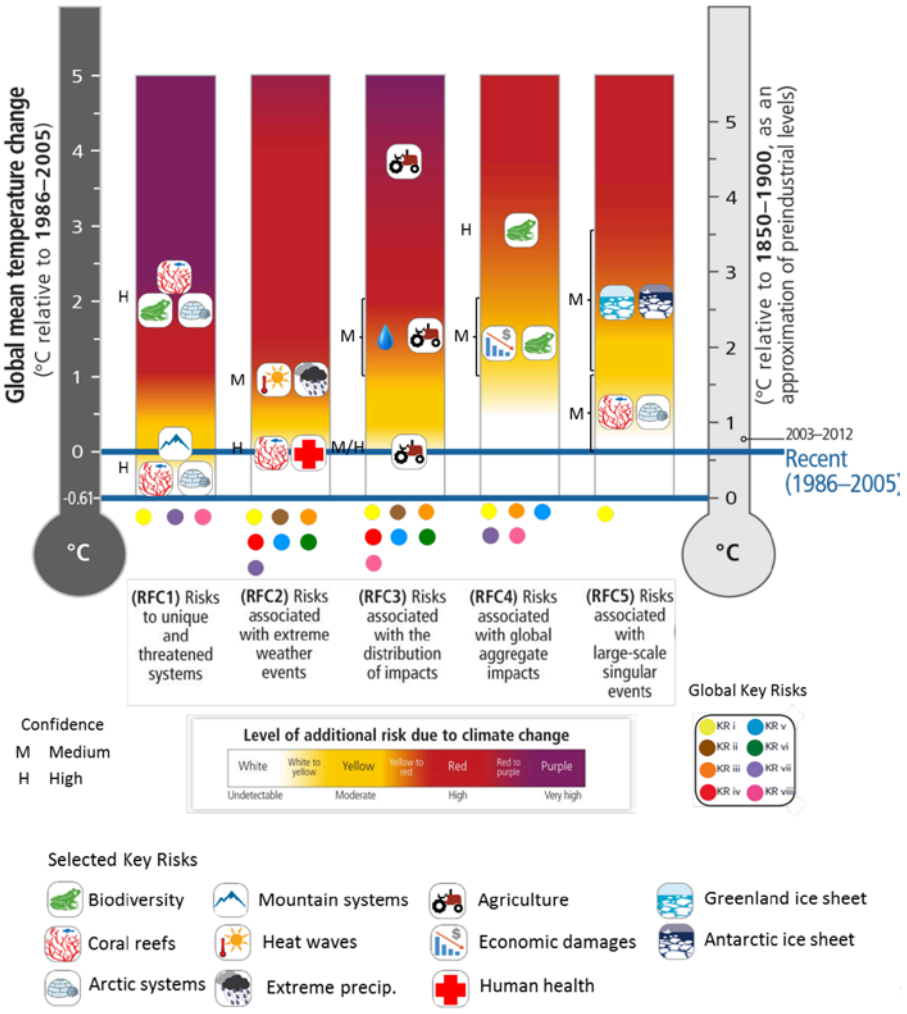
ipcc
INTERGOVERNMENTAL PANEL ON climate change

"Burning ember diagrams"

provide a perspective on risks

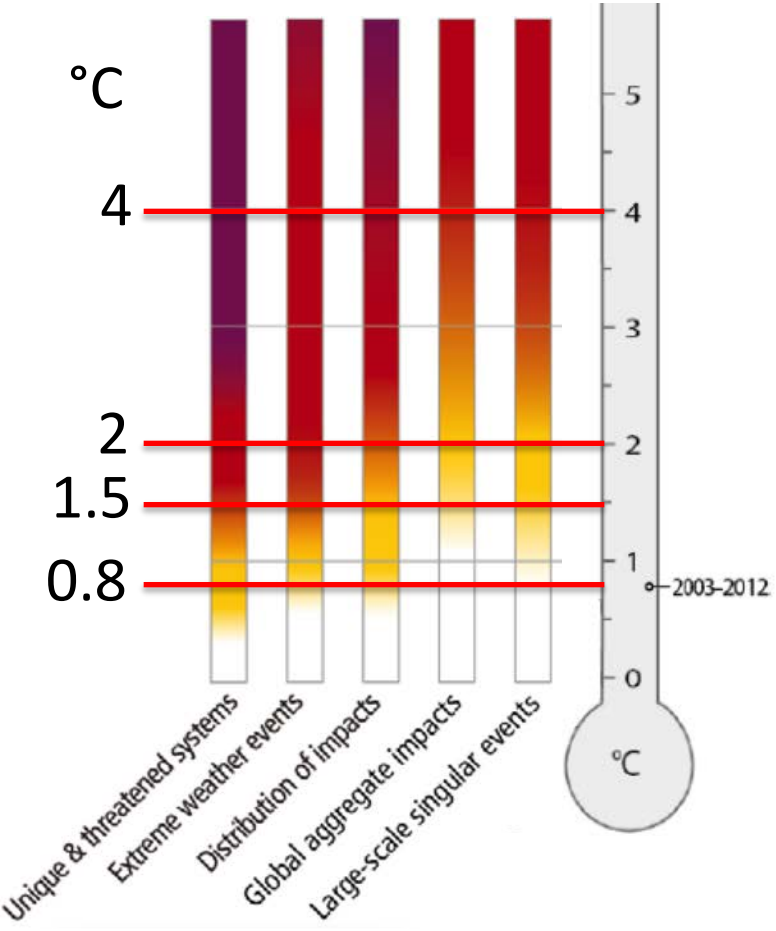
…in relation to global mean temperatures

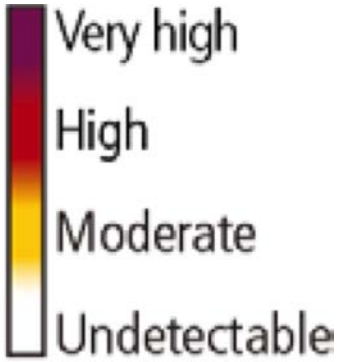




O'Neill et al., 2016

LTGG Risk assessment: Reasons for concern





Level of additional risk due to climate change

A role for natural and human 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

AR5 and UNFCCC Structured Expert Dialogue, 2013 -2015:
...comparing 1.5 and 2°C,
identifying... Key risks of impacts
Avoided impacts

ipcc
INTERGOVERNMENTAL PANEL ON climate change

UNEP

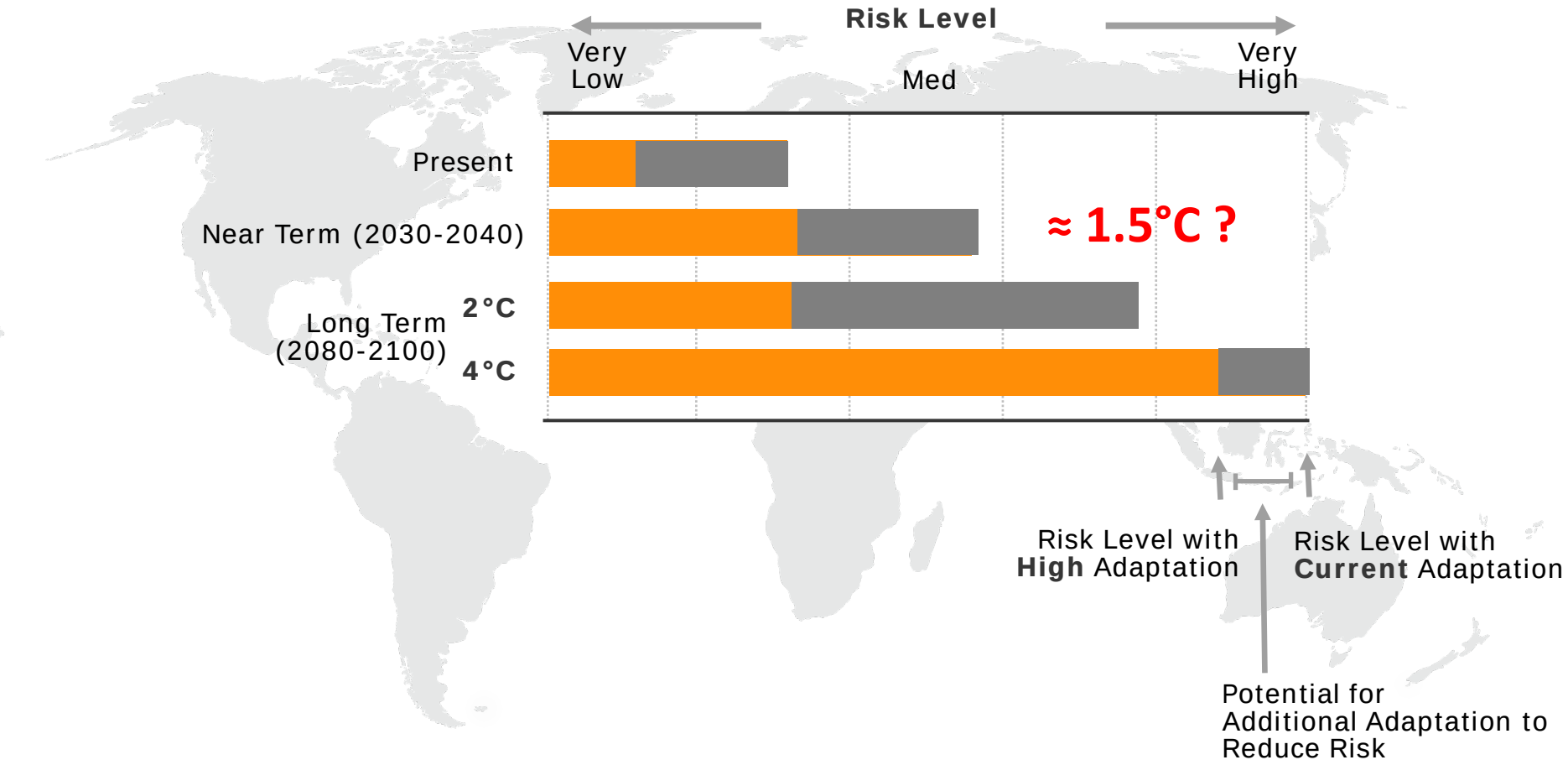
Climate change….causing risks

….which were assessed in AR5, with open questions for AR6:

1.5°C not fully covered and compared

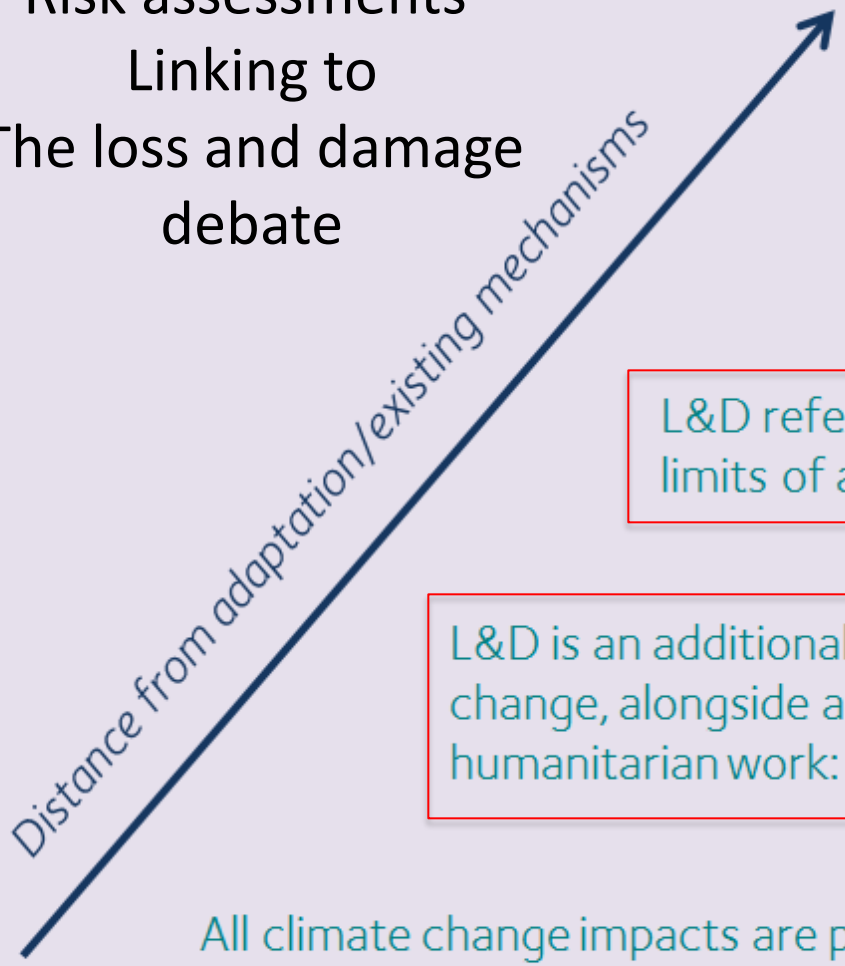
(key risks are those relevant to article 2, UNFCCC:

"avoid dangerous anthropogenic interference with the climate system")



…. should be complemented by
Potential for Mitigation to Reduce Risk

Risk assessments
Linking to
The loss and damage debate



L&D is a debate about how to address harm done to vulnerable countries: "Existential"

L&D refers to climate-related impacts beyond the limits of adaptation: "Limits to Adaptation"

L&D is an additional mechanism to address risk from climate change, alongside adaptation, disaster risk reduction and humanitarian work: "Risk Management"

All climate change impacts are potential L&D, and these can be dealt with through mitigation and adaptation: "Adaptation and Mitigation"

Boyd et al. 2016

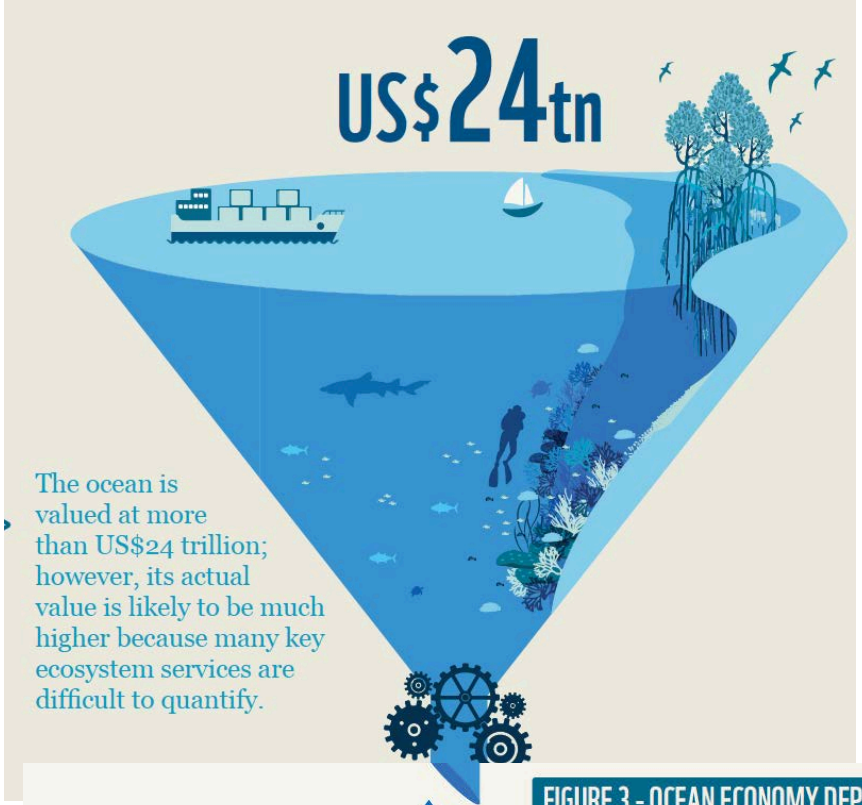
(Economic and non-economic) Losses, Limits to Adaptation, and Valuation

- **Losses**= irreversible, when restoration and reparation are impossible
- **Limits to adaptation**: The point at which an actor's objectives (or system needs) cannot be secured from *intolerable risks* through adaptive actions (IPCC AR5, 2014)
- **Intolerable loss** (or risk of loss) – compared to acceptable and tolerable ones
- Intrinsically linked to **what people value** and **how** ('socially constructed')

Valuation of NELs (Technical paper UNFCCC 2013):

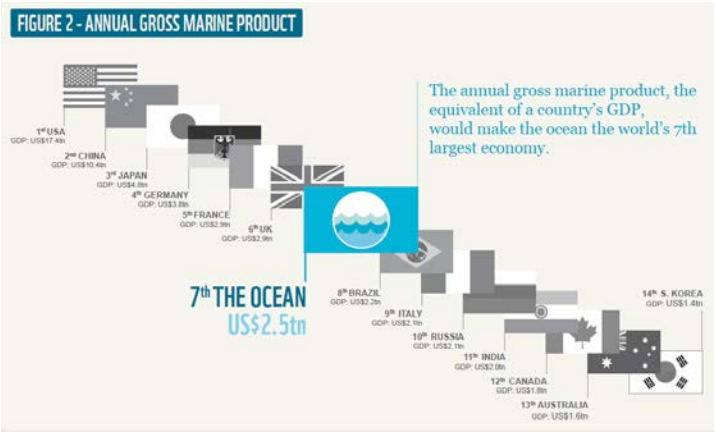
- Economic – putting an economic value on a good or service (e.g. willingness to pay)
- Scoring and weighting of criteria (MCDA) (e.g. impacts, poverty reduction, costs)
- Risk and vulnerability indices - expert assessments (env/climatic hazards, disasters)
- (Semi) Qualitative scoring and trade-offs in decision making (e.g. climate risks)

UNFCCC, 2013

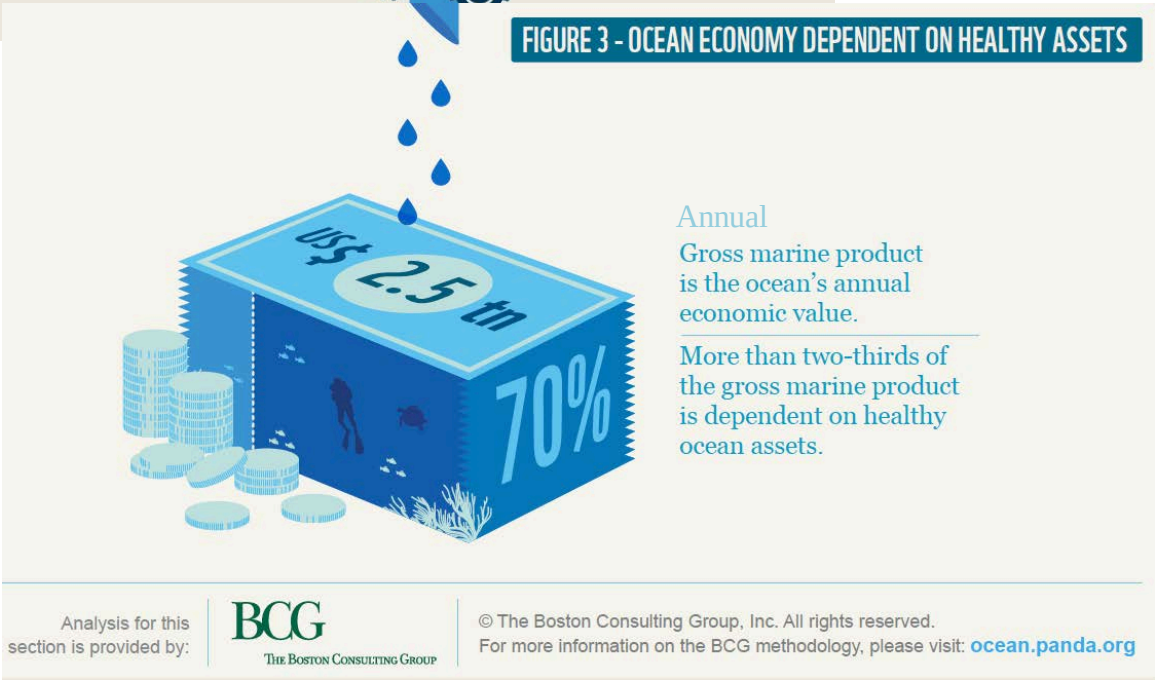


What should we know?

Annual gross marine product



...no. 7 in the world...



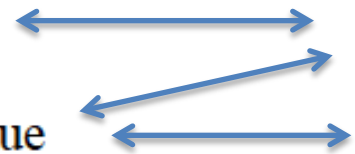
.....depending on healthy oceans

Quantifying L&D in monetary value

WWF 2015

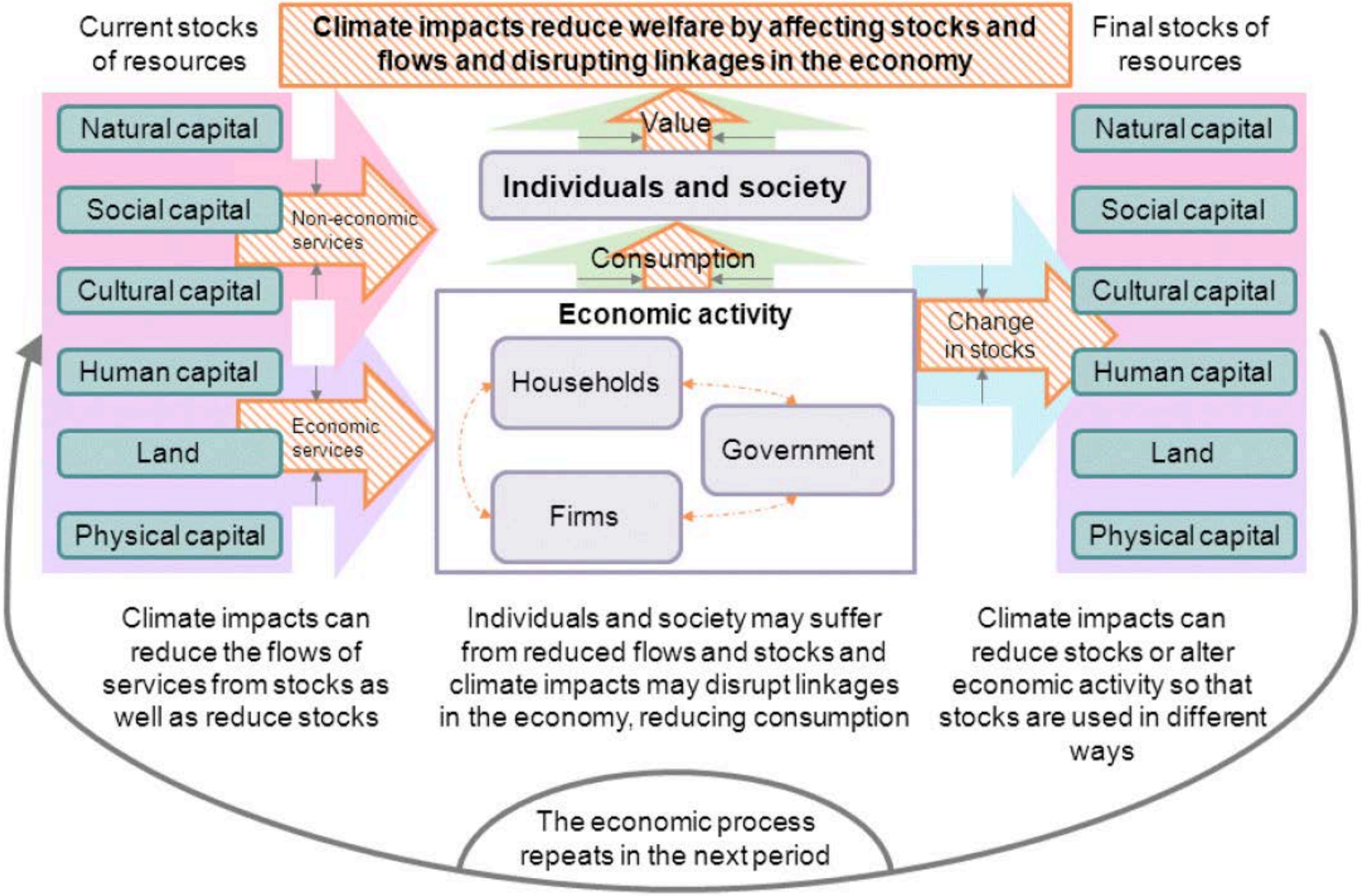
Examples of economic and non-economic loss and damage (some intertwined)

Economic losses	*Non-economic losses*
Loss of wages	Loss of life
Loss of crops	Reduction in biodiversity
Reduction in tourism revenue	Destruction of items of cultural significance
Loss of economic revenue from coastal activity due to inundation	Loss of sovereignty due to inundation



UNFCCC technical paper 2013

Gradual losses to be quantified in relation to LTGGs: Motivation sufficient?



UNFCCC 2013

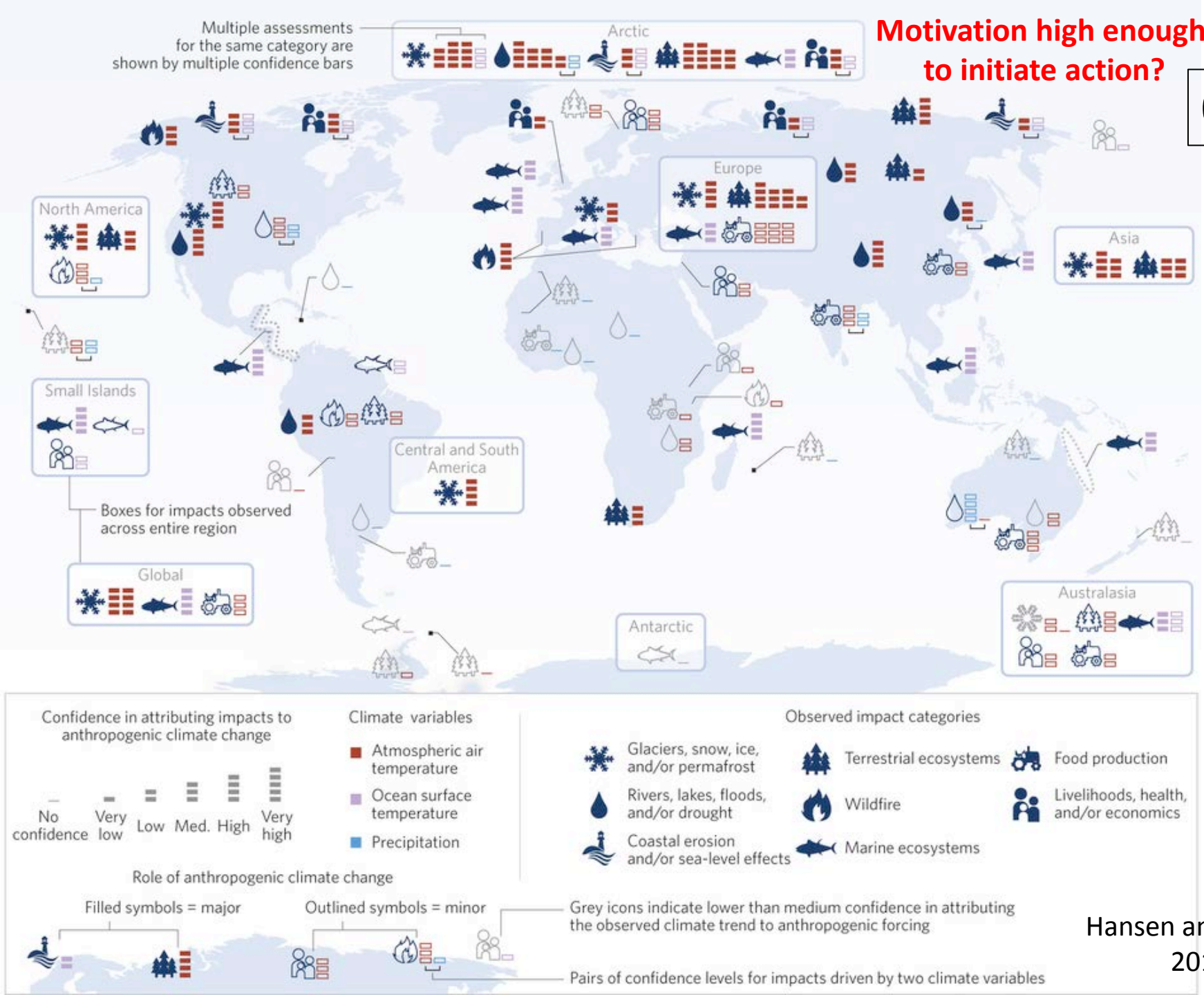
Psychosocial background of decision making

Identifying the risk of irreversible losses in physical, biological and human systems (partly non-economic) in relation to LTGGs:

- loss of glaciers and ice sheets, (linked to sea level rise)
- loss of subsurface ice (permafrost) and related loss of lake systems; (linked to climate feedback)
- loss of (home) land area due to coastal and hillslope erosion and sea level change;
- loss of plant and animal species,
- loss of ecosystems and biodiversity (coral reefs);
- loss of human lives, homelands, and cultural identity, indiginous knowledge.

Highest Motivation to take Action

After Surminski and Mechler 2016, Tschakert 2016



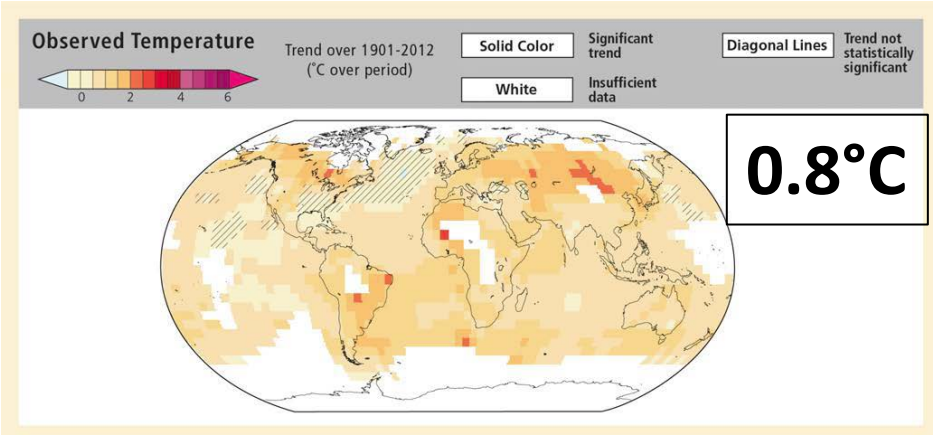
Motivation high enough to initiate action?

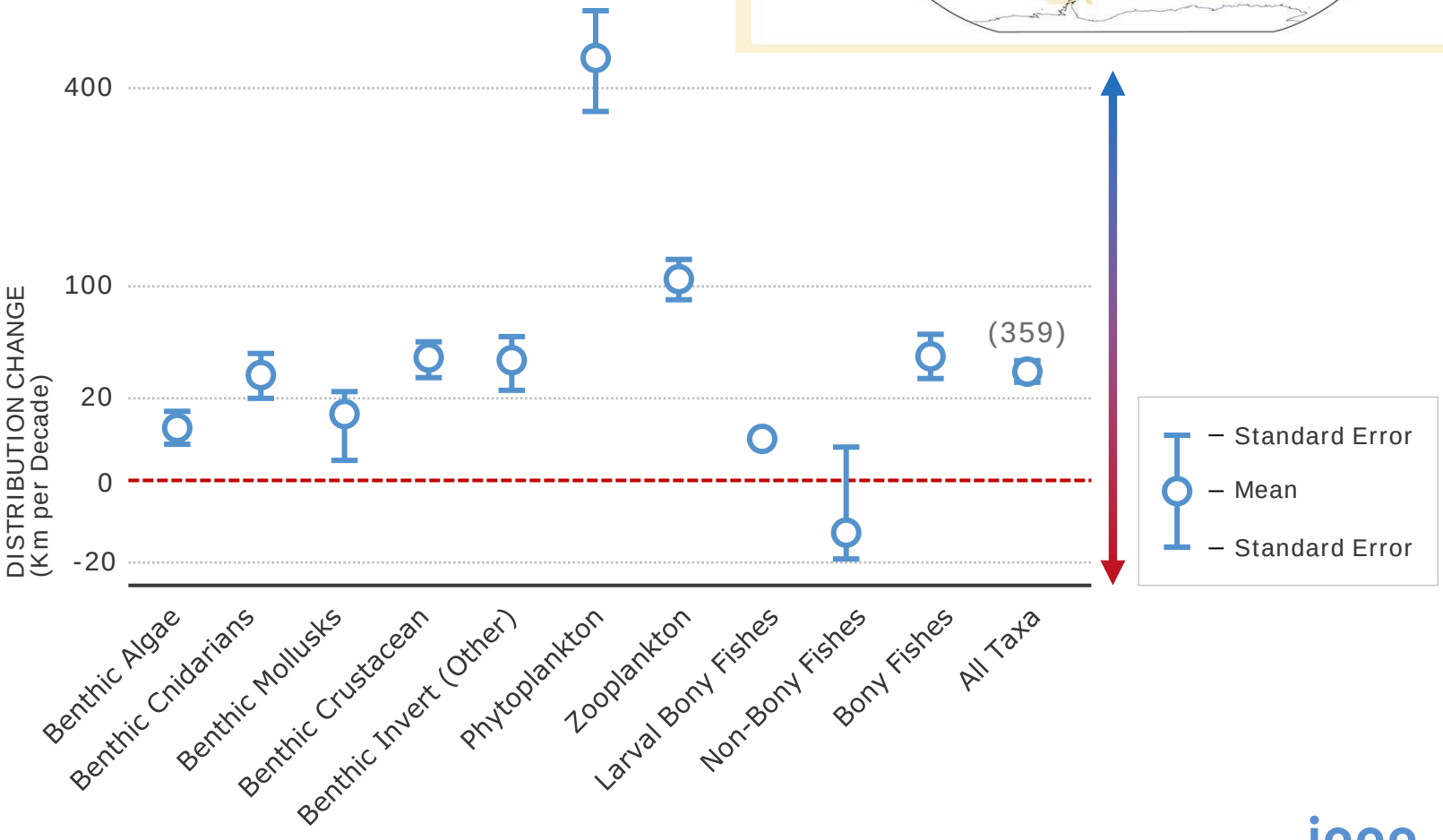
0.8°C

Hansen and Stone, 2016

OBSERVATIONS

World-wide marine species displacements due to climate change





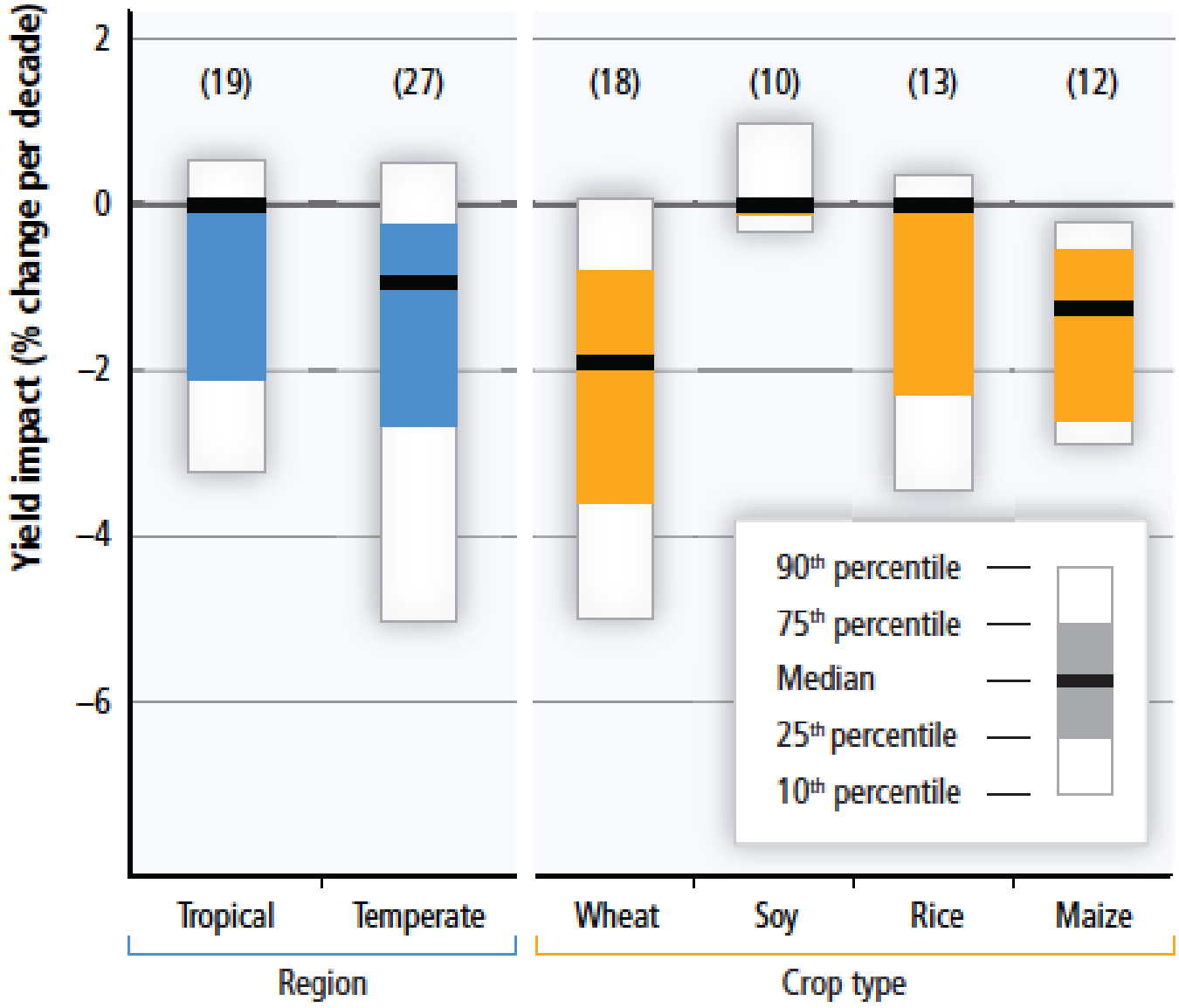
WGII, SPM.2

ipcc
INTERGOVERNMENTAL PANEL ON climate change

UNEP

Food security constrained: increase in crop production reduced

0.8°C

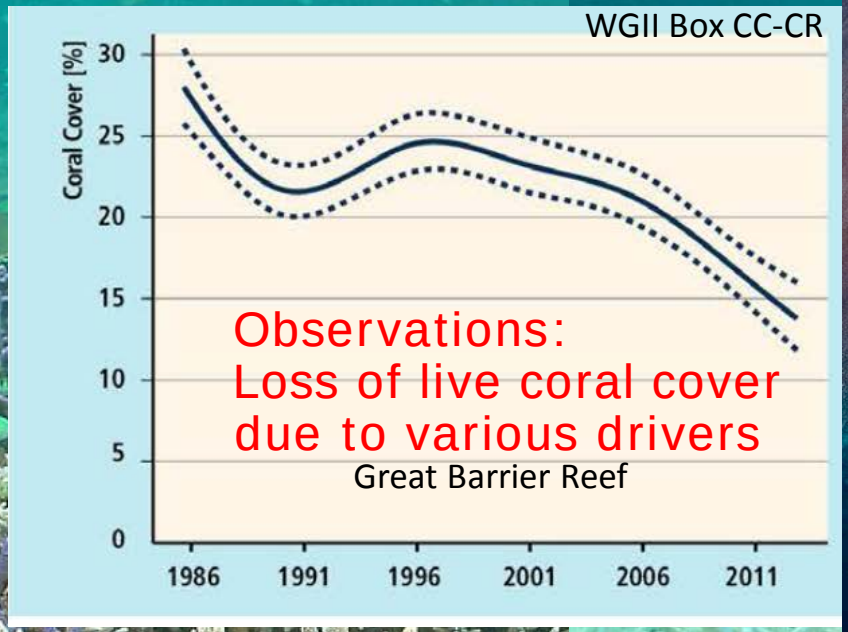


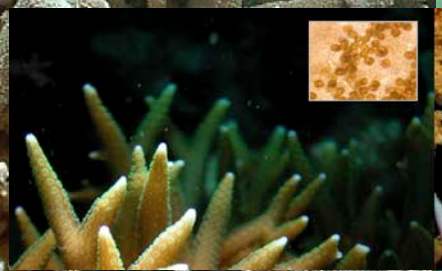
WGII, SPM.2

Vulnerable AND unique:

EXAMPLE **0.8°C**

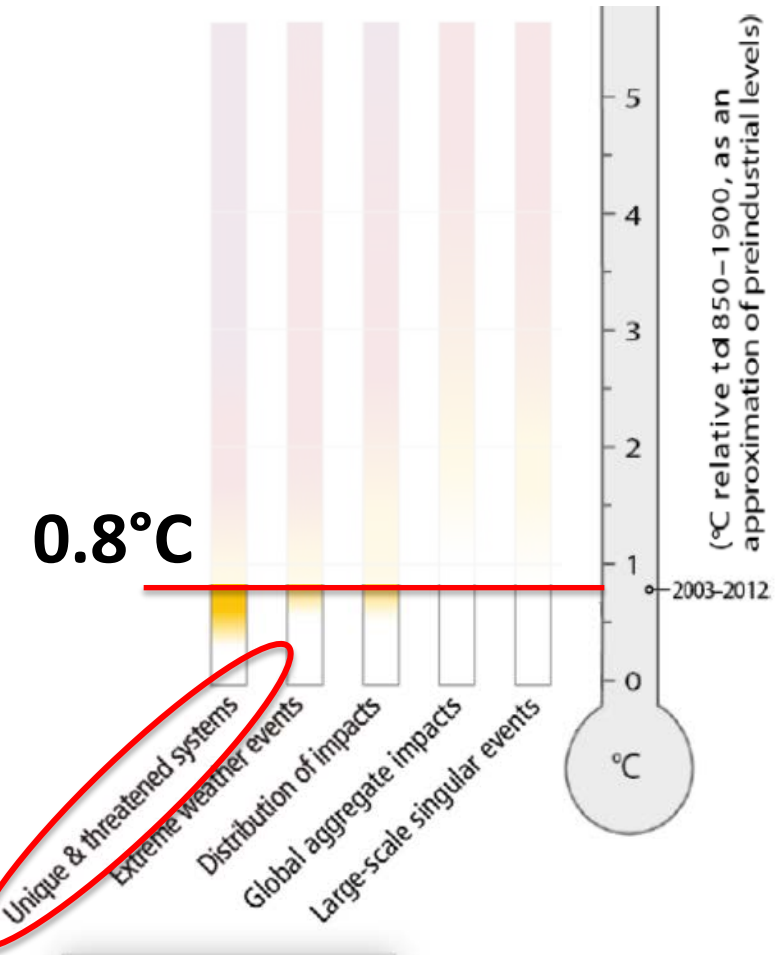
Warm water coral reefs irreversibly marginalized?





0.8°C

(Unacceptable) Consequences for Sustainable (Economic) Development



Arctic communities + N Europe:

Livelihoods of indigenous people

Increased shipping traffic (Bering Street)

Livelihoods of Sámi people

High mountain communities:

Declining livelihood trajectories Aymara

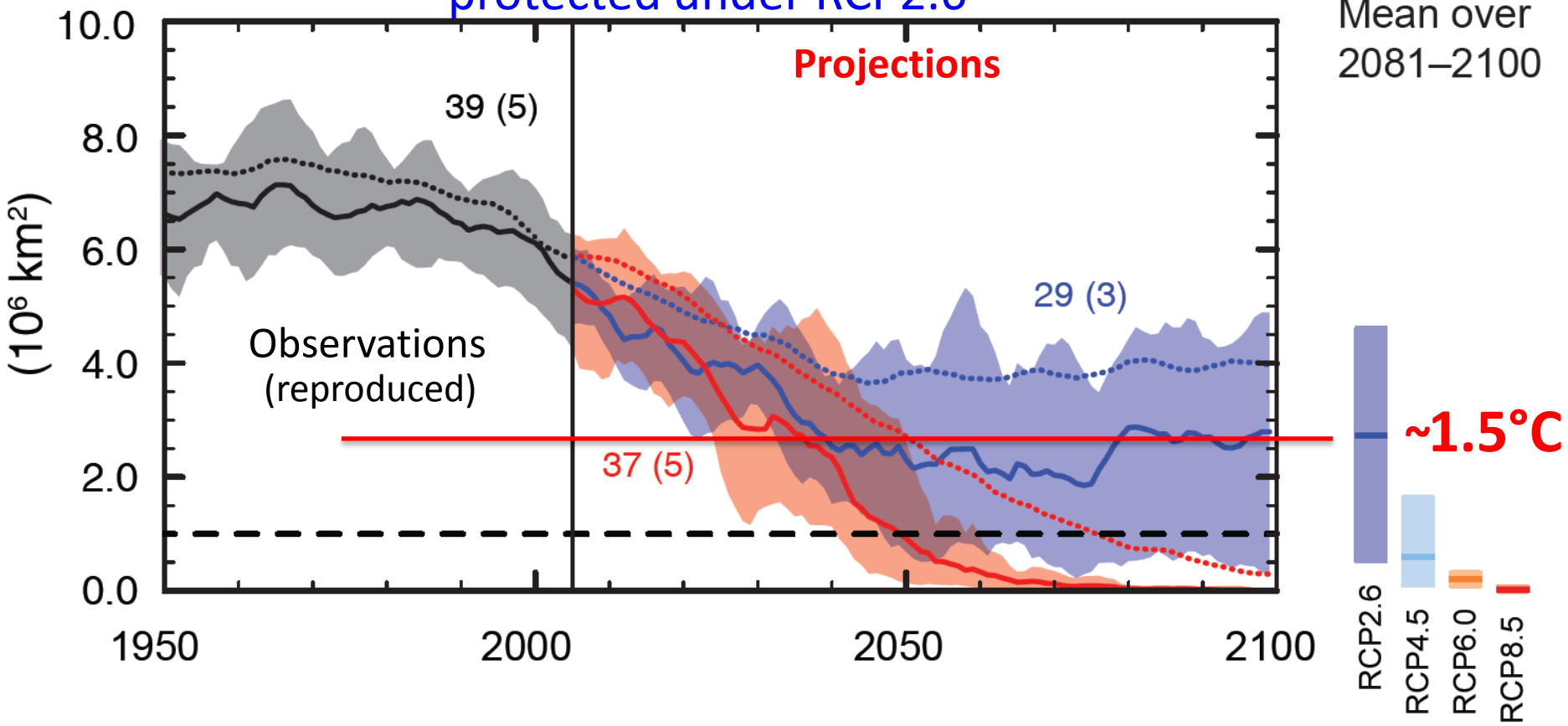
African rural communities:

Increases in malaria, Kenyan highlands

IPCC WGII, Petra Tschakert, SED 2014

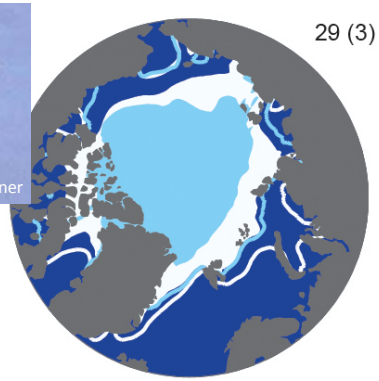
Positive perspective: Some Arctic summer sea ice may be protected under RCP2.6

1.5°C



Northern Hemisphere September sea ice extent (average 2081–2100)

RCP 2.6

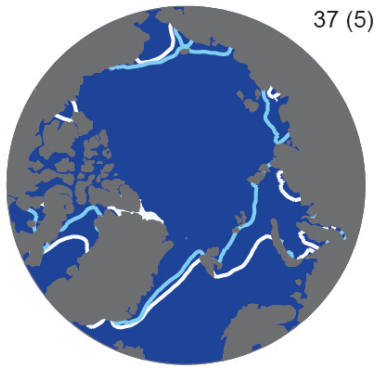


CMIP5 multi-model average 1986–2005

CMIP5 multi-model average 2081–2100

CMIP5 subset average 1986–2005

CMIP5 subset average 2081–2100

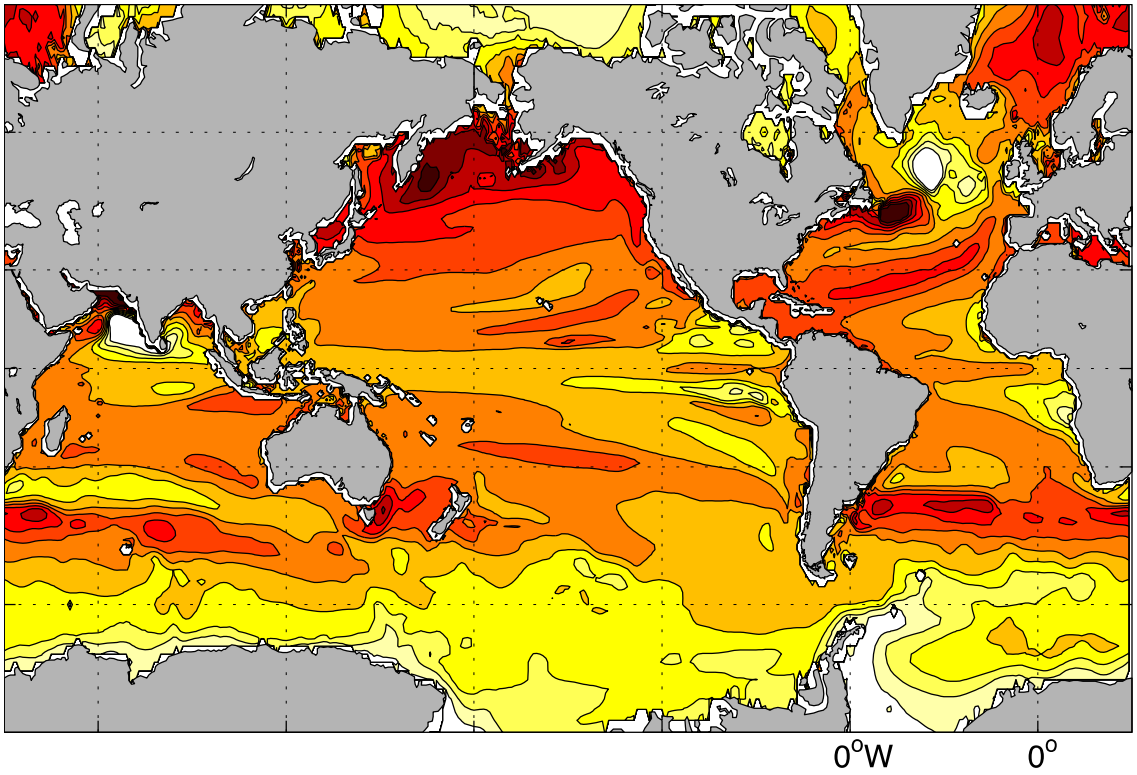


RCP 8.5

WGI SPM.7b, 8c

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

% Decline in Metabolic Index Φ
(= routine metabolic scope in marine animals)

by ~20% overall

Northern High Latitudes:
by ~40%

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

BIOACID
Biological Impacts of Ocean ACIDification

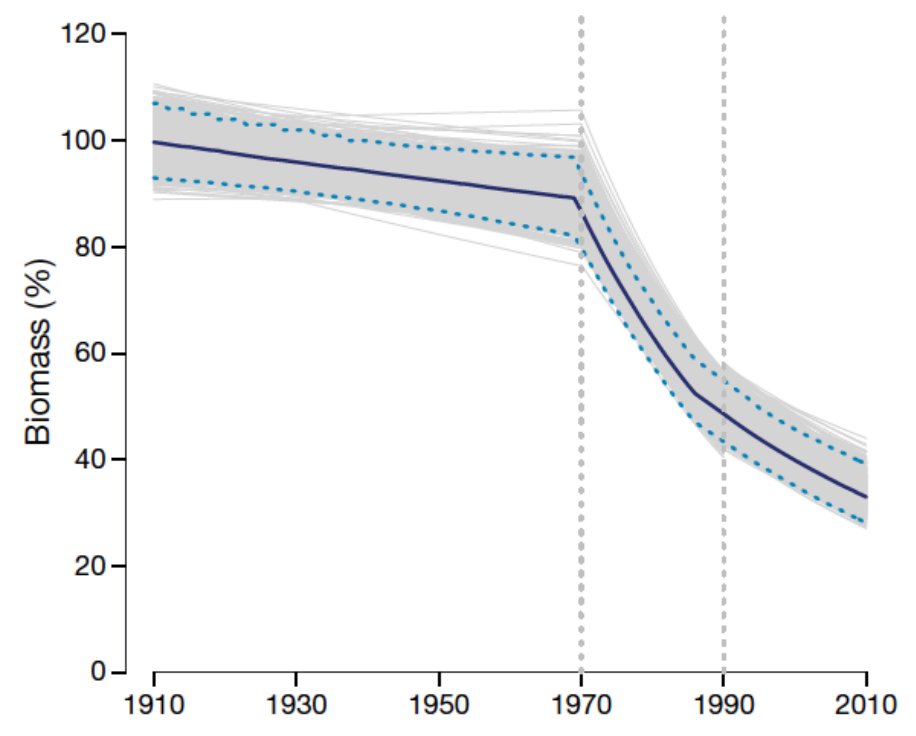
2°C

Food security constrained: ....Fisheries

2051-60: displaced and reduced fish and invertebrate biodiversity

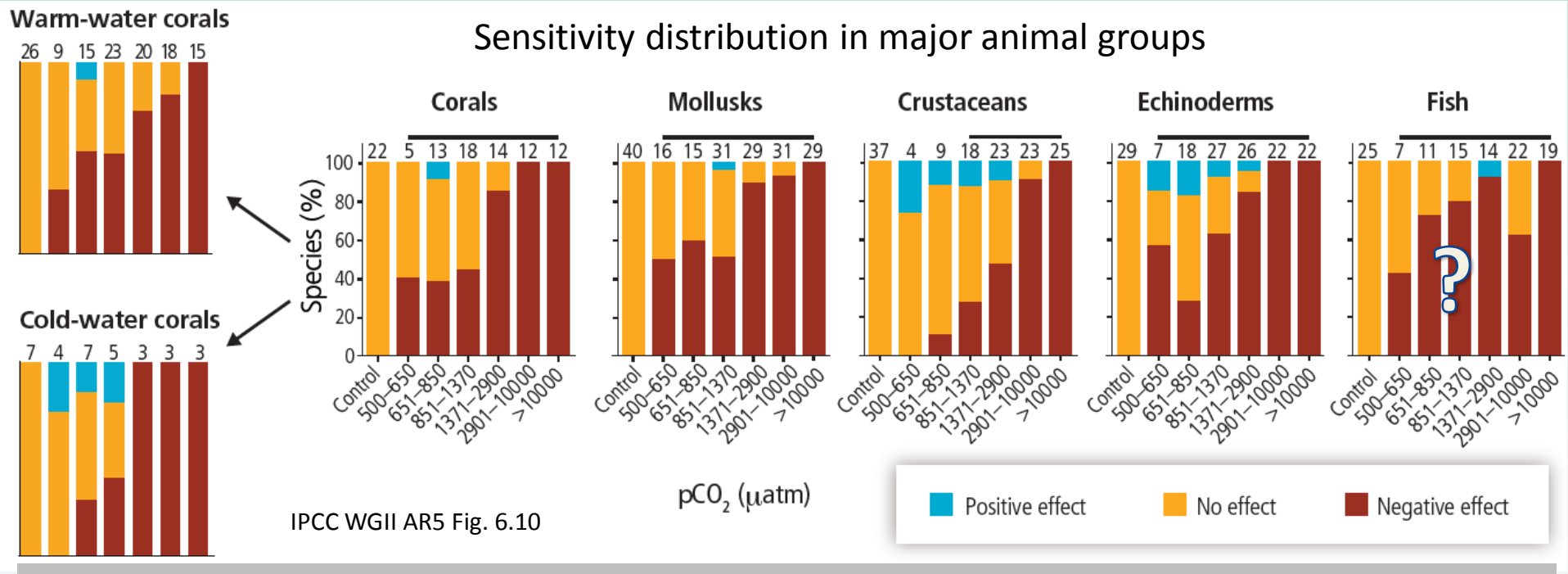
..... 2°C:

Combined human pressures: oceans are warming, acidifying, losing oxygen, affecting presently overexploited stocks.



BACKGROUND:
OVERFISHING caused predatory fish biomass to decline
(by ≈ 70%!)

Christensen et al.
MEPS 512: 155–166, 2014

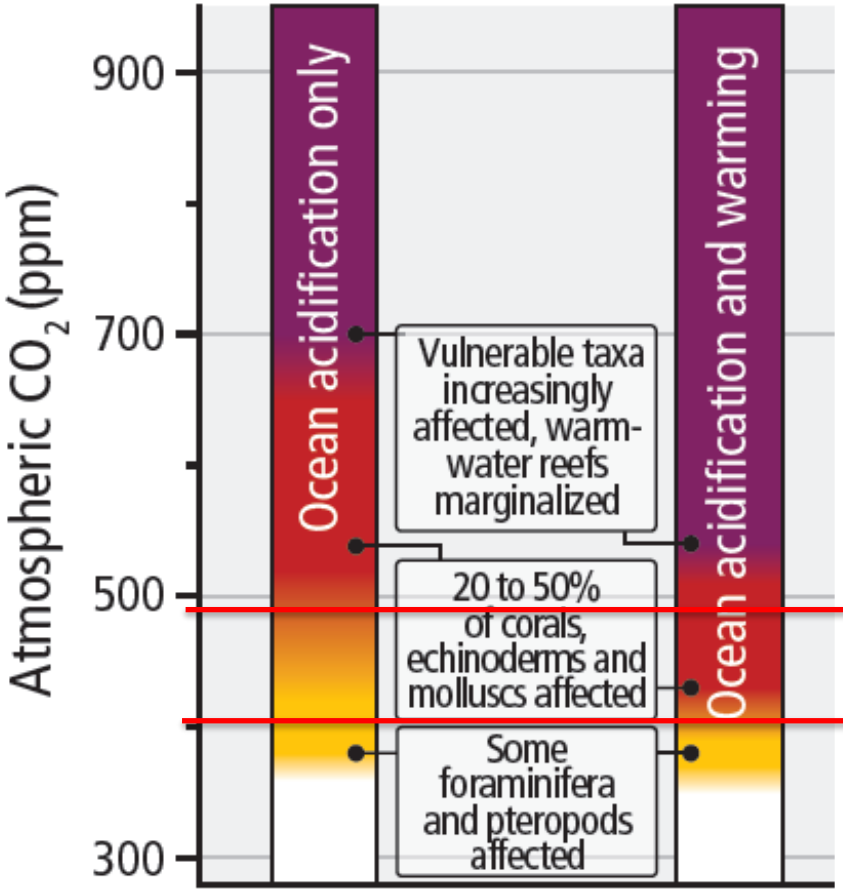


IPCC WGII AR5 Fig. 6.10

Effects of ocean acidification

.....exacerbated by warming extremes...

Risks due to combined impacts of climate drivers: **ocean warming** and **acidification**



LTGG
~ 4°C

~ 2°C

~1.5°C

~0.6°C

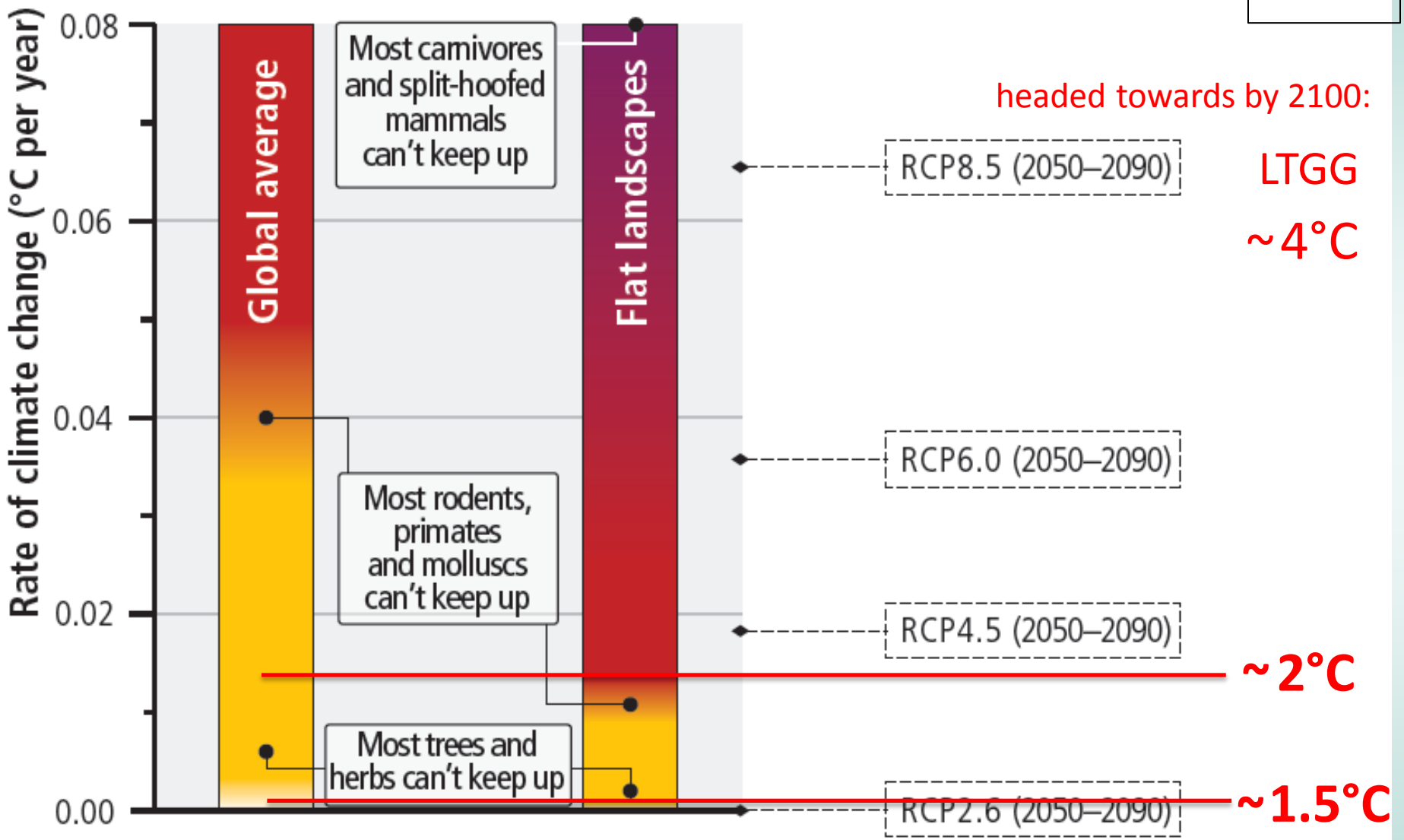
Additional risk due to climate change

Comparing climate scenarios and risks

1.5°C
vs. 2°C
vs. >>2°C

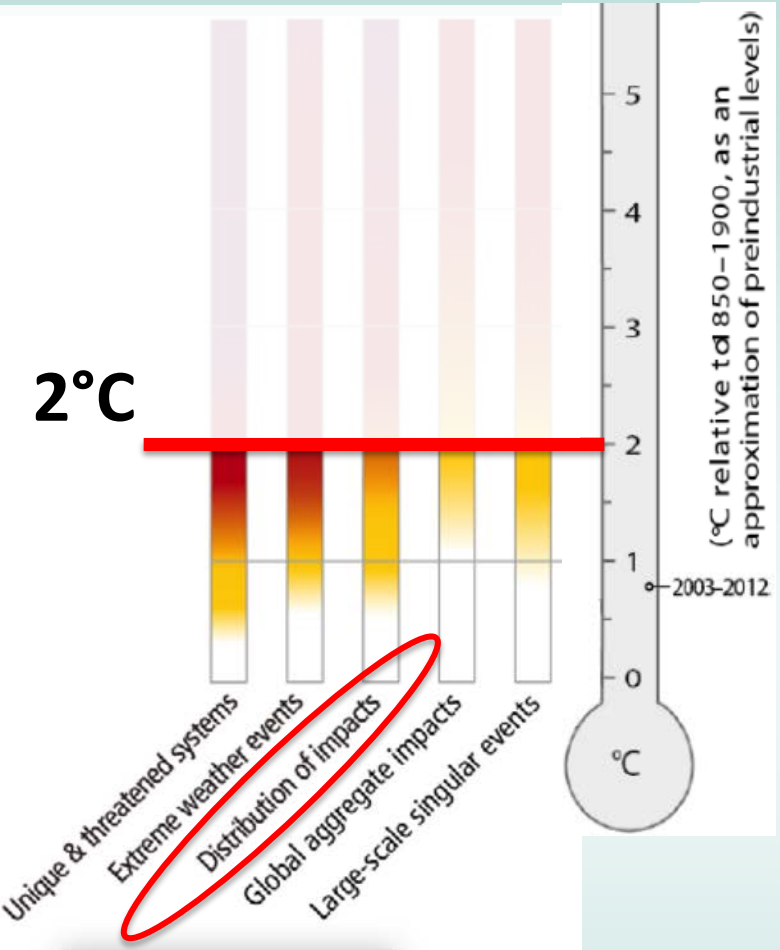
A role model for AR6?

1.5°C
2°C



2°C

(Unacceptable) Consequences for Sustainable (Economic) Development



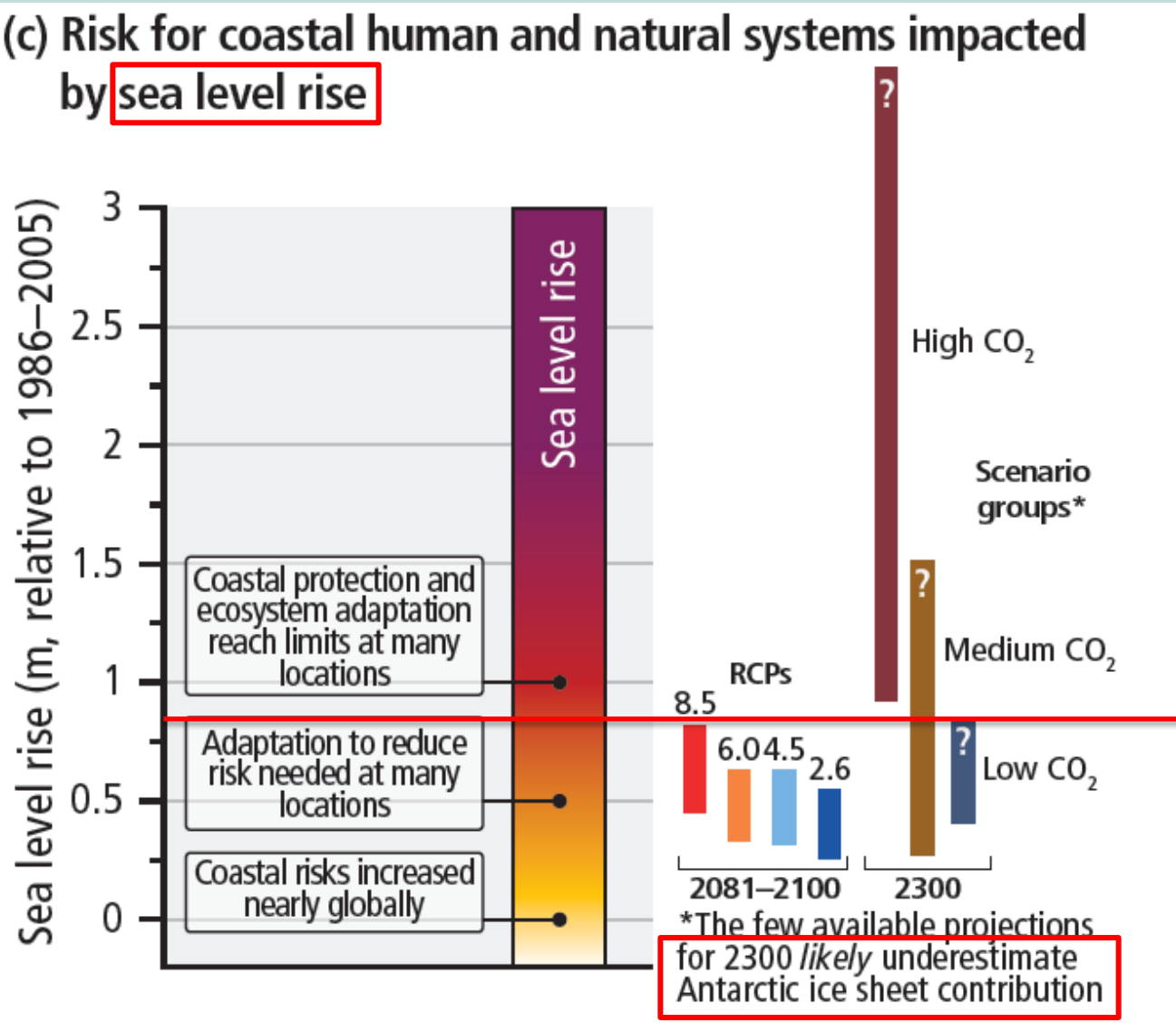
Increasingly unevenly distributed risks, esp. due to impacts on crop yields and water availability, as well as increasing inequalities

Shifts from transient to chronic poverty (social marginalization & food insecurity)

Elderly, children, the socially marginalized, and outdoor workers (farmers, construction, women securing water and firewood) disproportionally at risk from heat stress

IPCC WGII, Petra Tschakert, SED 2014

1.5°C



Increasing risk associated with high sea level beyond 2100 under RCPs > 2.6

~1.5°C (2300)

However..... Contribution of Antarctic ice sheet likely underestimated

SYR 2.5

ipcc INTERGOVERNMENTAL PANEL ON climate change

UNEP

Trade-offs and psychosocial background in decision pathways

The Role of Human Mobility and the Right to Stay

- Mobility = continuum (voluntary movements – forced migration/displacement)
- Secondary losses (mental and physical health, agency, security, identity, sense of place/place attachment, knowledge)
- Best practices and institutional arrangements to reduce loss under relocation
- Reducing vulnerabilities and risk of displacement through expanding opportunities for mobility (as adaptation strategy)
- Freedom/right to move *versus* freedom/right to stay (intrinsic values) – cultural ties to land, psycho-social needs, identity, agency, knowledge
- Premature or exuberant policies to reduce loss from displacement (e.g. relocation with dignity/facilitated migration) may narrow or undermine adaptation through loss of confidence in places 'at risk" - who decides? timing? (e.g. Small Island States)
- **Assessment**: investments in building resilience in place *vs* preparation to leave

Tschakert 2016

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 limited and may be highest under moderate climate change, ≤ 1.5°C

Thank you!

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

AWI

GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

OCEANS 2015 INITIATIVE

PRINCE ALBERT II OF MONACO FOUNDATION

IAEA
Ocean Acidification International Coordination Centre
OA-ICC

BIOACID
Biological Impacts of Ocean ACIDification
Bundesministerium für Bildung und Forschung


ADAPTATION
IS NECESSARY AND IS OCCURRING
...but without mitigation adaptation will not be sufficient.
ipcc
INTERGOVERNMENTAL PANEL ON Climate change