Ocean Acidification:
Latest science and socio-economic impacts

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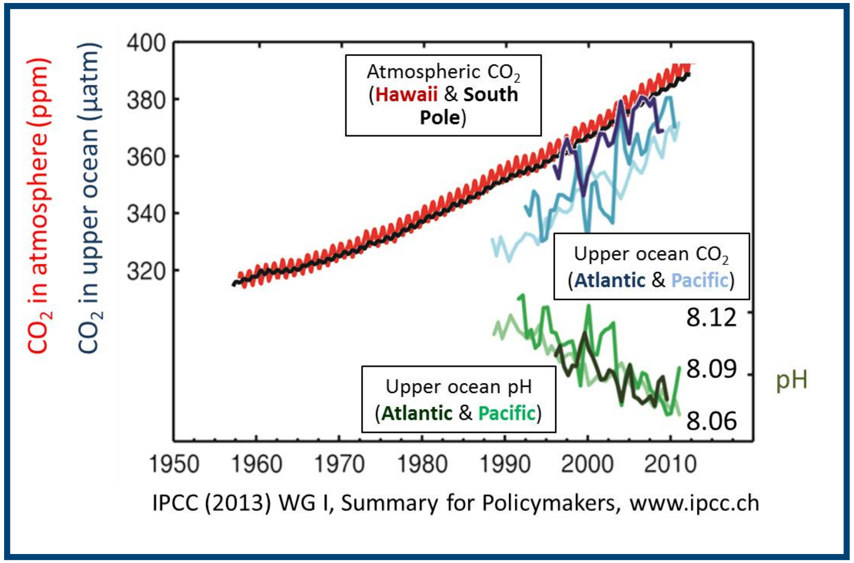
Session: **7**
Day of presentation: **7 December 2016**

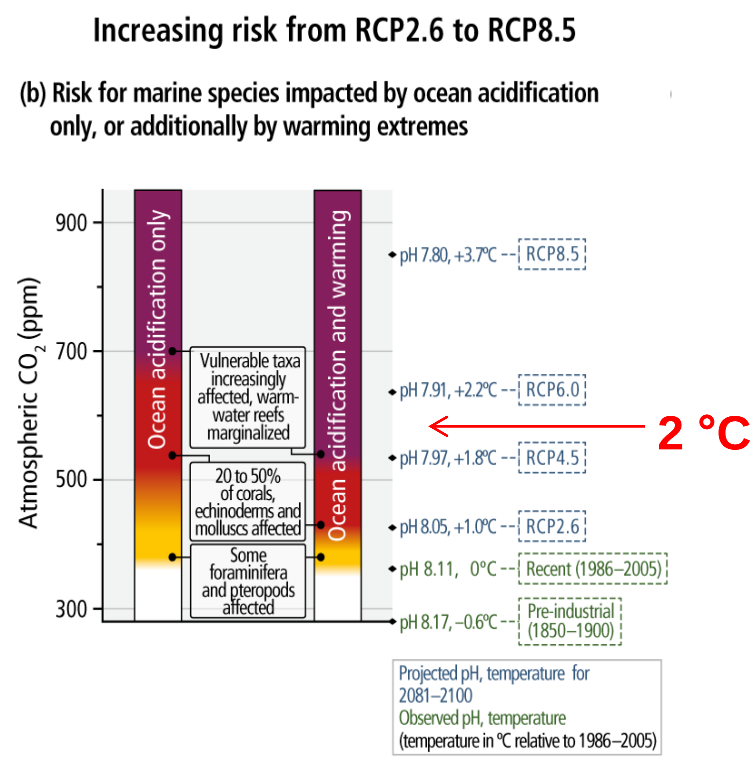
Ocean Acidification – So What?

- The ocean has absorbed 1/3 of the fossil carbon released



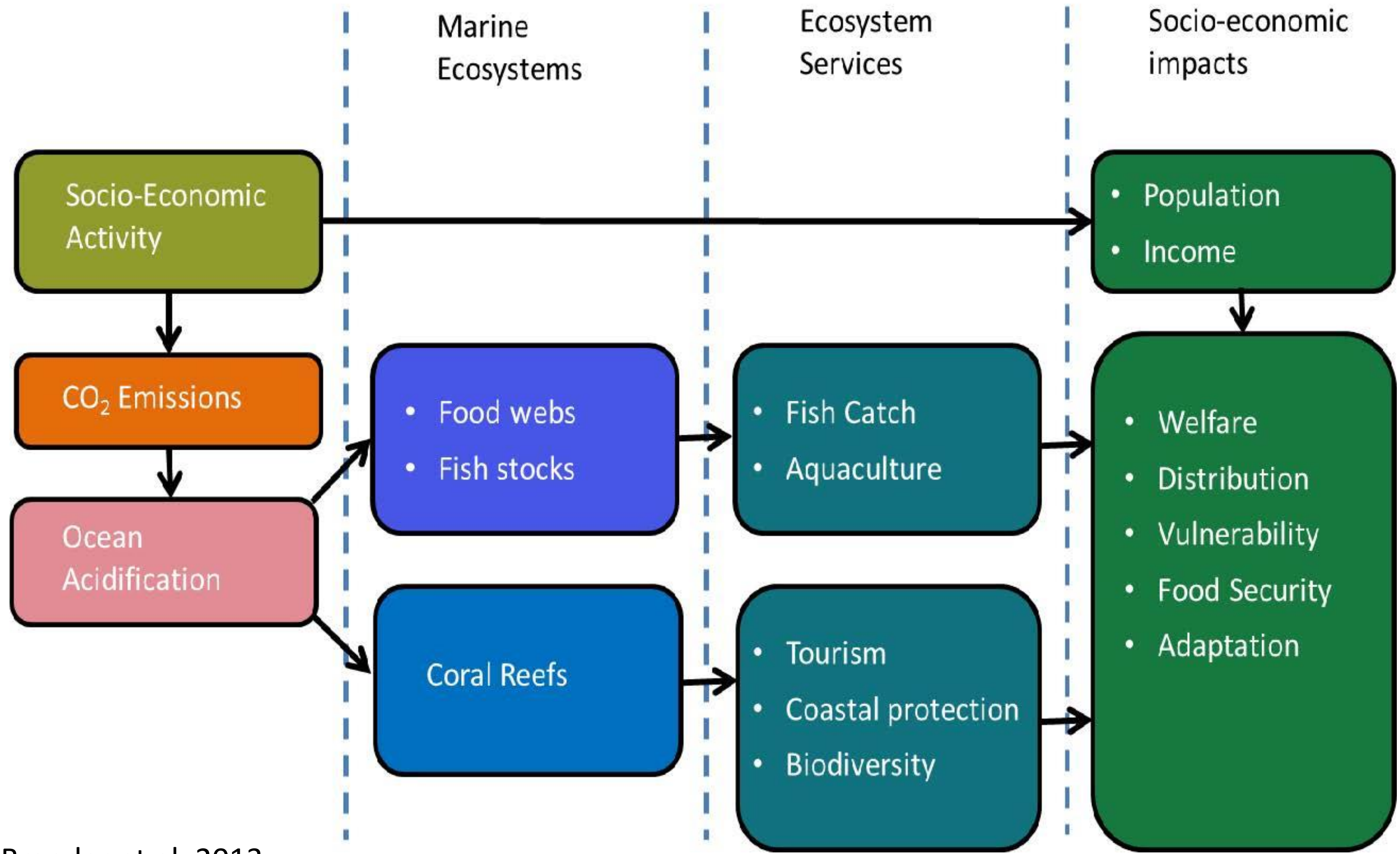
IPCC (2013) WG I, Summary for Policymakers, www.ipcc.ch

- Capacity of the ocean to continue to absorb carbon at the same rate is questioned by scientists.
- Absorbed CO_2 increased the acidity of seawater – **26 %** since 1900 and about **150%** in 2100



- The **rate of change may be faster** than at any time during the last **300 million years**

OA – Socio-economic impact



Brander et al. 2013

OA – Research – Data - Action

GLOBAL challenges

GLOBAL/LOCAL data
[meta-analysis of case study]

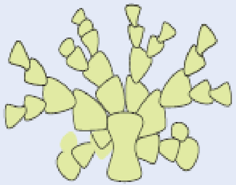
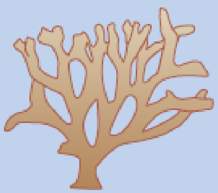
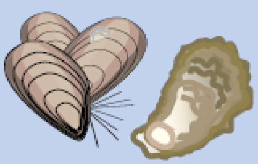
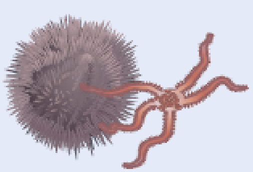
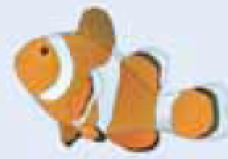
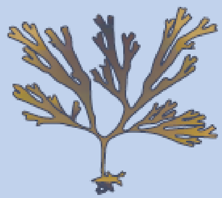
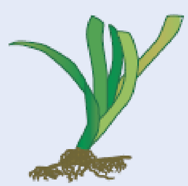
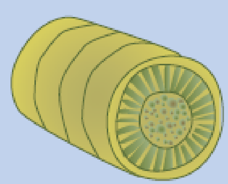
GLOBAL options: ↓ CO_2
mitigation

LOCAL challenges

LOCAL data
[chemistry, **biology**, economy, policy]

LOCAL options
[management, adaptation, etc.]

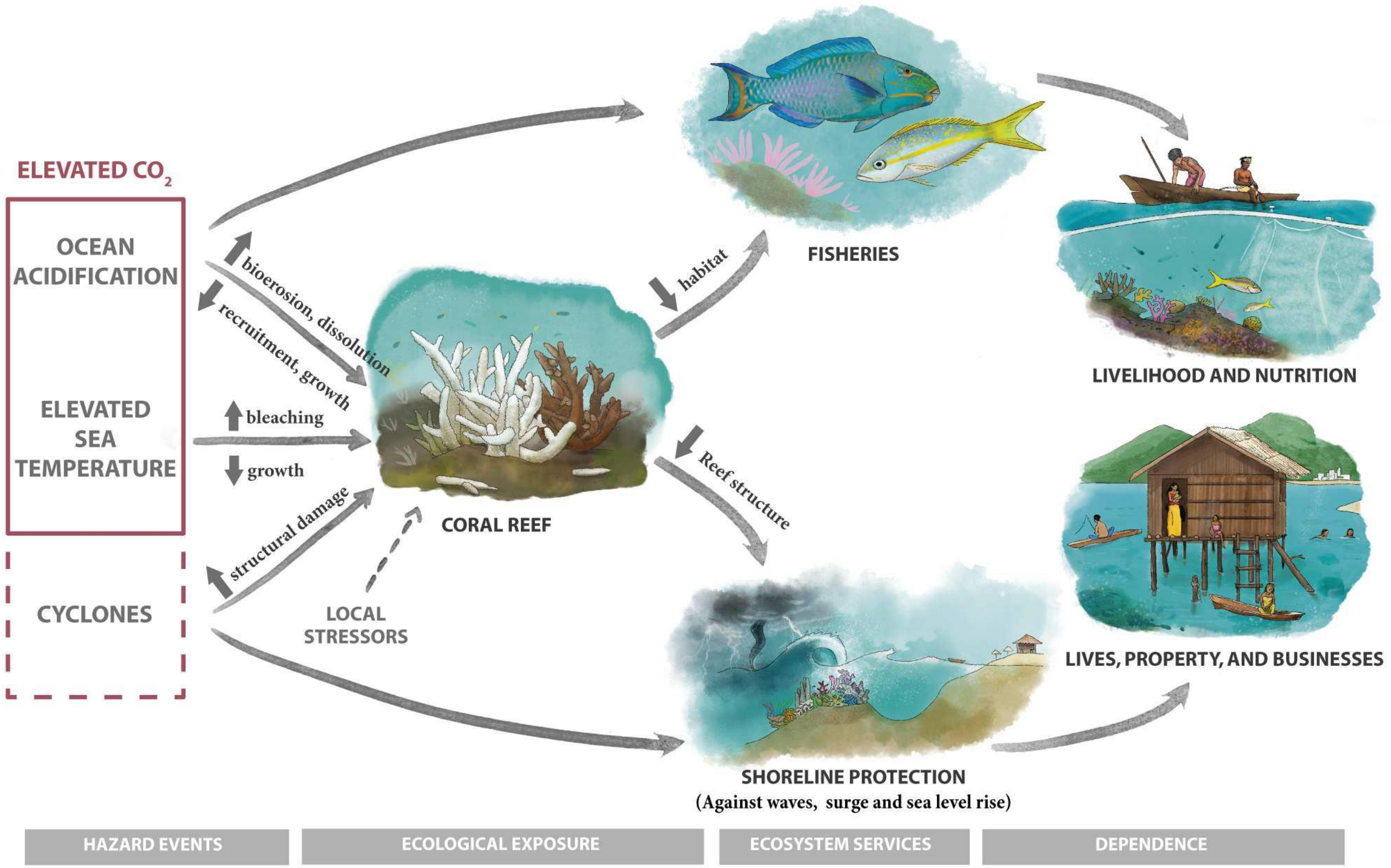
OA – Metadata-analysis

TAXA	RESPONSE	MEAN EFFECT
 Calcifying algae	Survival	
	Calcification	
	Growth	
	Photosynthesis	−28%
	Abundance	−80%
 Corals	Survival	
	Calcification	−32%
	Growth	
	Development	
	Abundance	−47%
 Coccolithophores	Survival	
	Calcification	−23%
	Growth	
	Photosynthesis	
	Abundance	
 Molluscs	Survival	−34%
	Calcification	−40%
	Growth	−17%
	Development	−25%
	Abundance	
 Echinoderms	Survival	
	Calcification	
	Growth	−10%
	Development	−11%
	Abundance	
 Crustaceans	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
 Fish	Survival	
	Calcification	
	Growth	
	Development	
	Abundance	
 Fleshy algae	Survival	
	Calcification	
	Growth	+22%
	Photosynthesis	
	Abundance	
 Seagrasses	Survival	
	Calcification	
	Growth	
	Photosynthesis	
	Abundance	
 Diatoms	Survival	
	Calcification	
	Growth	+17%
	Photosynthesis	+12%
	Abundance	

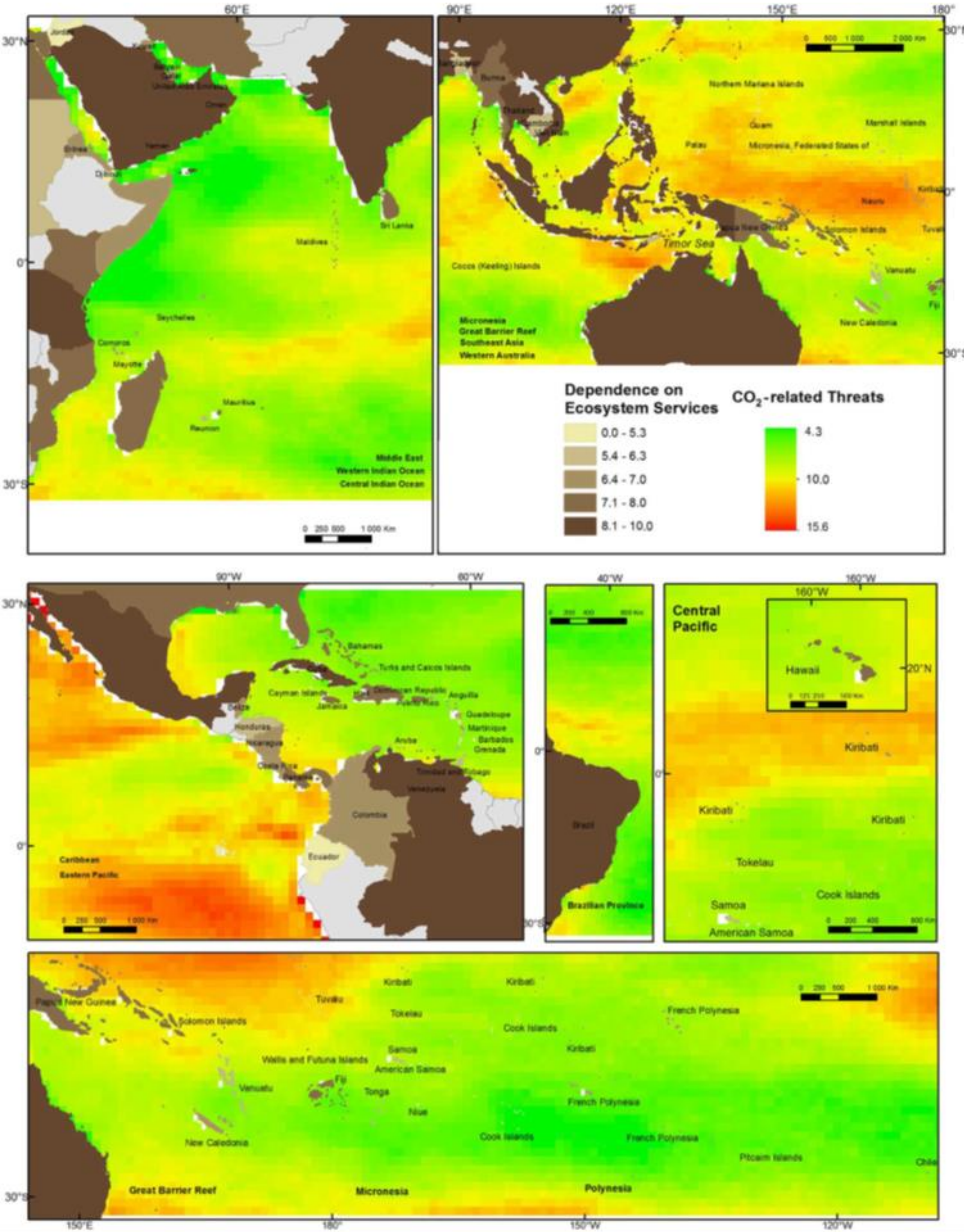
(Kroeker et al. 2013)

- Not tested or too few studies
- Enhanced <25%
- No overall +ve or -ve response
- Reduced <25%
- Reduced >25%

OA – Coral Reefs



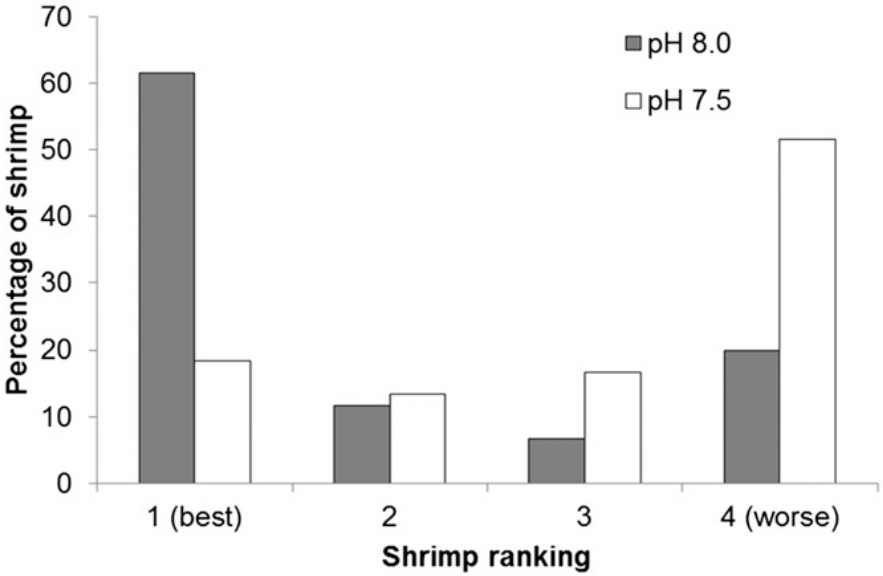
A conceptual diagram linking stresses related to increased atmospheric CO_2 (elevated sea surface temperature and ocean acidification), storms, and local stressors to coral reef condition, selected ecosystem services provided by reefs, and human dependence on these ecosystem services (Pendelton et al. 2016)



OA – Coral Reefs

A conceptual diagram linking stresses related to **increased atmospheric CO_2** (elevated sea surface temperature and ocean acidification), storms, and local stressors to coral reef condition, selected ecosystem services provided by reefs, and human dependence on these ecosystem services (Pendelton et al. 2016)

OA – Seafood



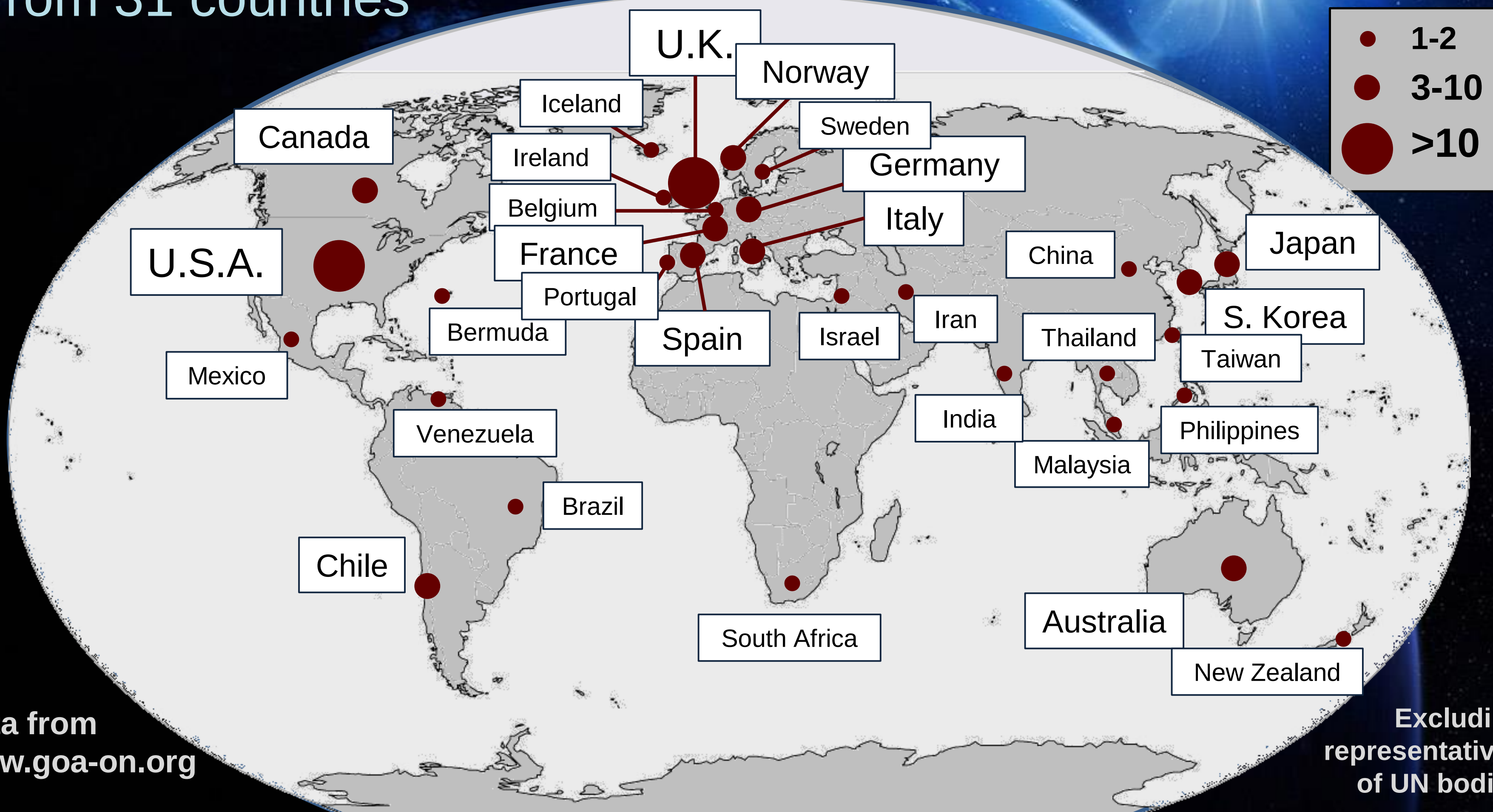
Research demonstrates that **Ocean Acidification has the potential to impact the quantity and taste of seafood** – affecting both coastal economies and cultural traditions.
(Dupont et al. 2014)

GOA-ON
Global Ocean Acidification Observing Network

Version shown at 3rd Ocean in a High CO2 World symposium, 4 May 2016

Activities and outputs

Network of ~150 scientists from 31 countries



Data from www.goa-on.org

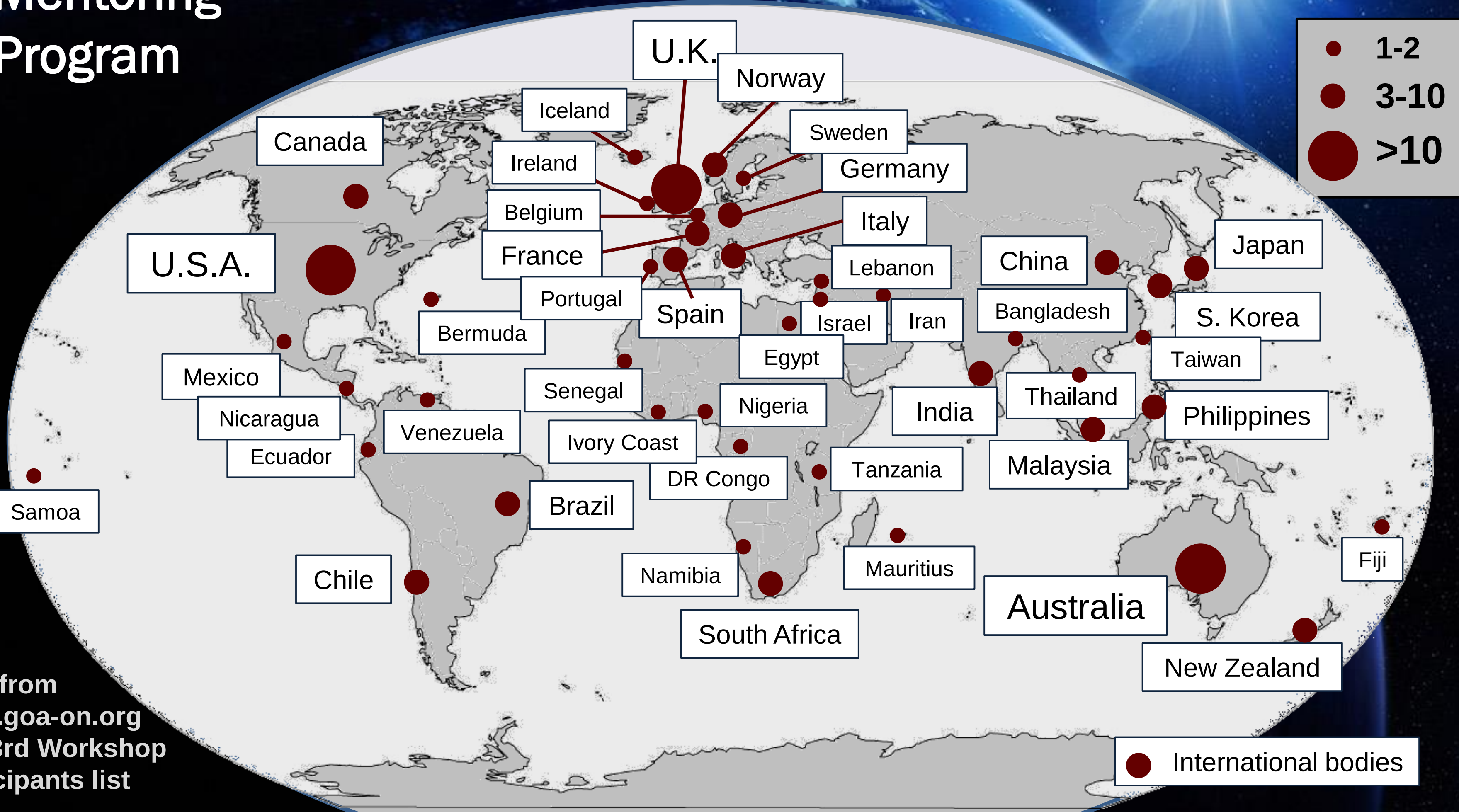
Excluding representatives of UN bodies

Update based on participants list for 3rd GOA-ON Workshop, 8-10 May 2016

Activities and outputs

Network of ~240 scientists
from 45 countries

PIER 2 PIER Mentoring Program



Data from www.goa-on.org and 3rd Workshop participants list

GOA-ON biology working group

Organism/Environment relationship is complex [local adaptation, evolution, plasticity, etc.]

- <u>Not</u> a single parameter problem

-> OA driver can be pH, CO_2, Ω

-> Other modulating parameters (global & local, biotic & abiotic)

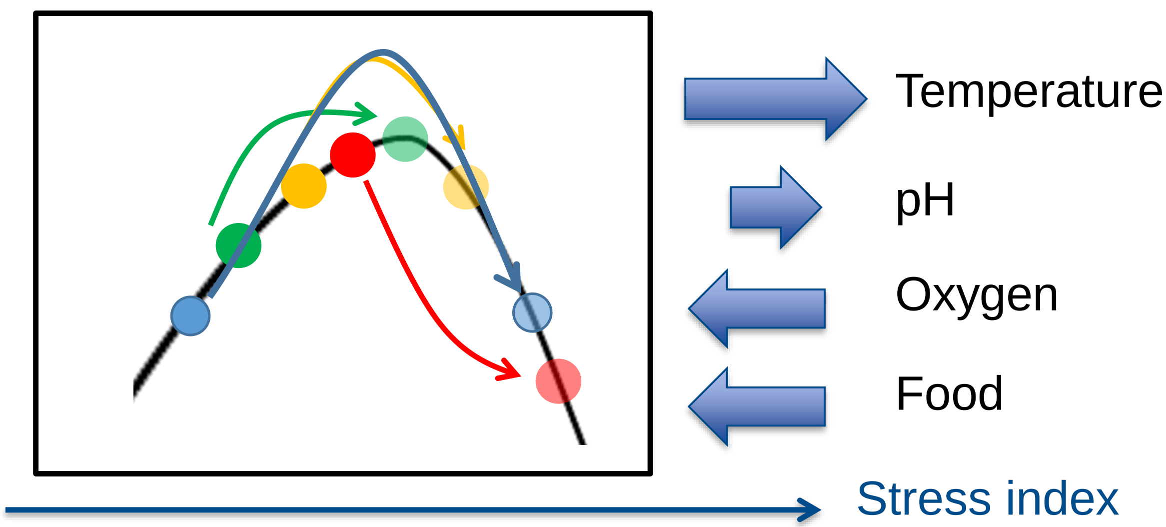
- <u>Not</u> a single tipping point

Bridging will require creative data collection, analysis & conceptualization

GOA-ON biology working group

- OA not occurring in isolation – consider in combination with other stressors
- Need to weight the stressors, this will likely be specific for each functional group

Probability index = weighted deviation from niche (multiple stressors)



Key messages:

1. **Communities and activities most at risk** include:
   a. Small scale fisheries and mariculture in developing countries;
   b. Poorer communities and social groups dependent on subsistence fisheries, with potential gender inequalities;
   c. Economies reliant on aquaculture or threatened ecosystems, such as coral reefs;
   d. Poorly diversified local economies.
2. **Economic impacts of OA on tourism** may include loss of profits and employment, tourist infrastructure due to decreased storm protection from reefs.
3. **Reducing** the root cause of OA – **CO_2 emissions**
4. **Adaptation methods** include behavioral change, infrastructure investment and building economic resilience.
5. **Governance reforms** should include mitigation and adaptation actions at national and subnational, as well as multilateral collaboration, CB and technology transfer.
6. **Significant knowledge gaps** in the understanding of OA processes and their impacts.
7. Open-ocean **models on OA** are not applicable to coastal assessment and there are currently very few socio-economic models
8. **OA impacts need to be assessed in relation to existing trends**, e.g. declining labour and incomes in capture fisheries, growth of aquaculture, and the impacts of other environmental stressors.

Thanks to GOA-ON, the biological working group of GOA-ON, Linwood Pendelton, Sam Dupont, Libby Jewett, Lina Hansson etc.

United Nations Educational, Scientific and Cultural Organization

Organisation des Nations Unies pour l'éducation, la science et la culture

Intergovernmental Oceanographic Commission

Commission océanographique intergouvernementale

Further Information:

http://goa-on.org
http://ioc.unesco.org

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