Explaining Ocean Acidification – Science, Observation and Mitigation

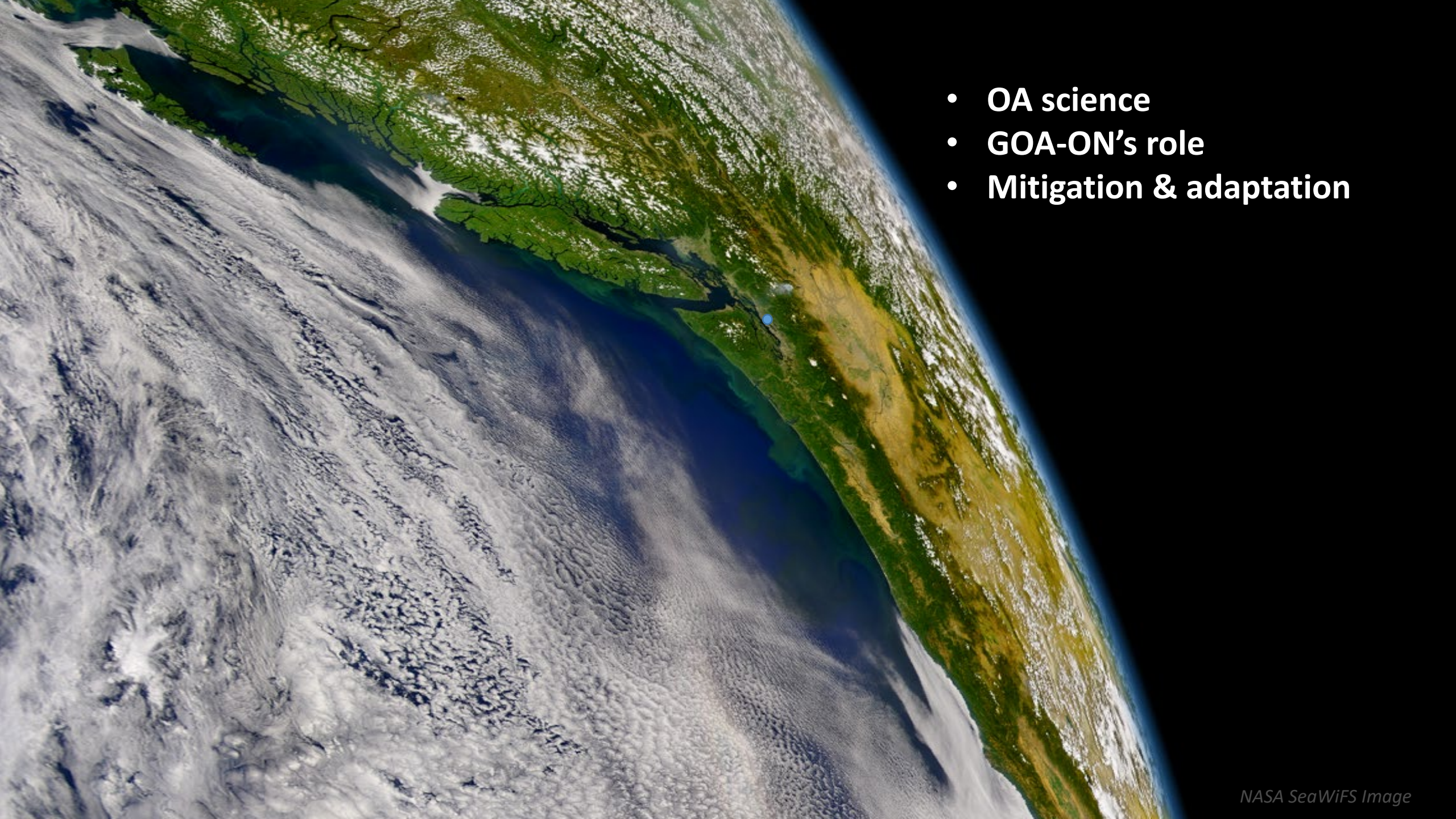
Observing a Global Issue on Local Scales

Jan Newton

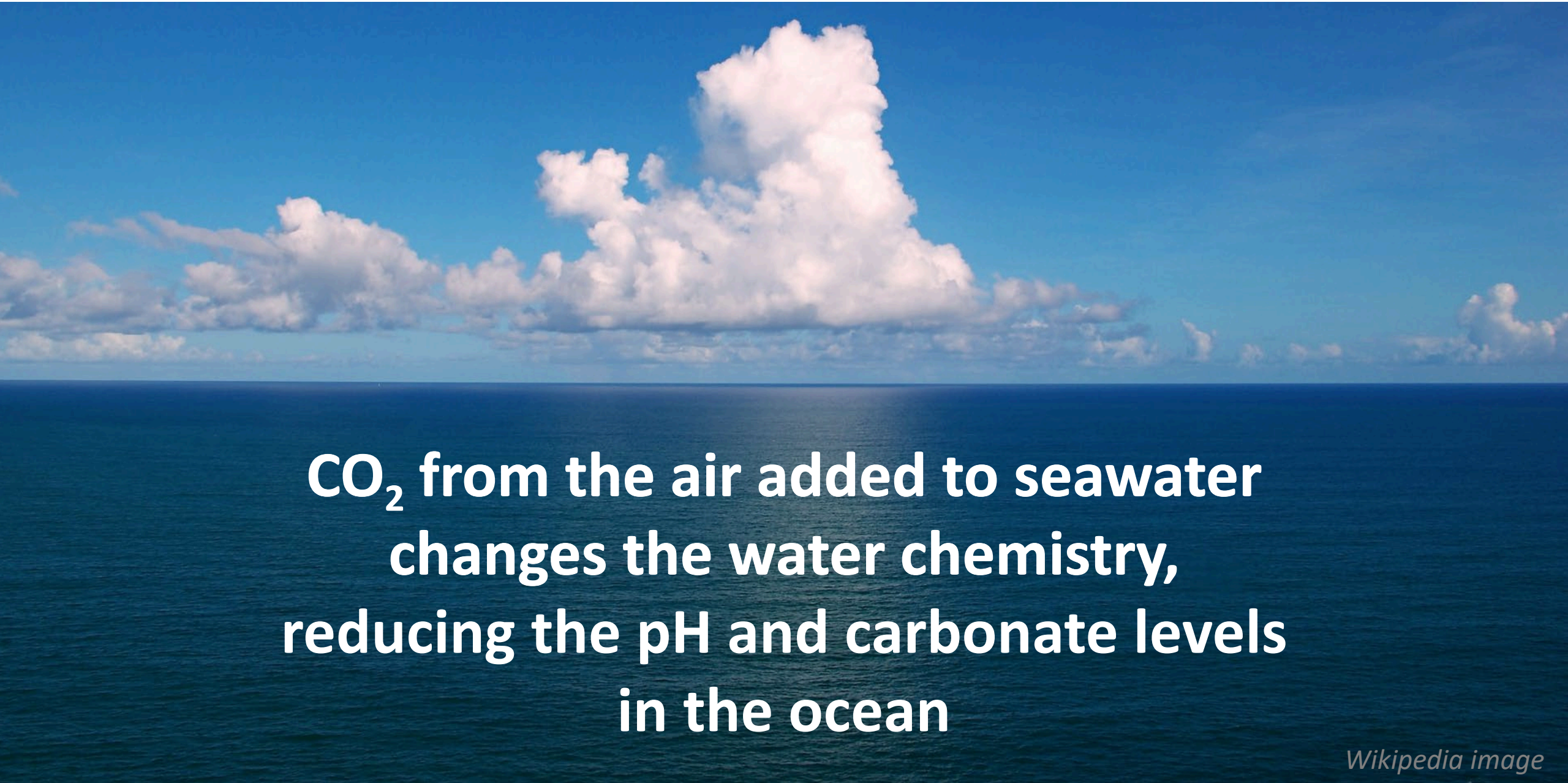
University of Washington

Washington Ocean Acidification Center (WOAC) Co-Director
Northwest Association of Networked Ocean Observing Systems (NANOOS) Director
Global Ocean Acidification Observing Network (GOA-ON) Co-Chair

GOA-ON
Global Ocean Acidification Observing Network


• OA science
• GOA-ON's role
• Mitigation & adaptation
NASA SeaWiFS Image

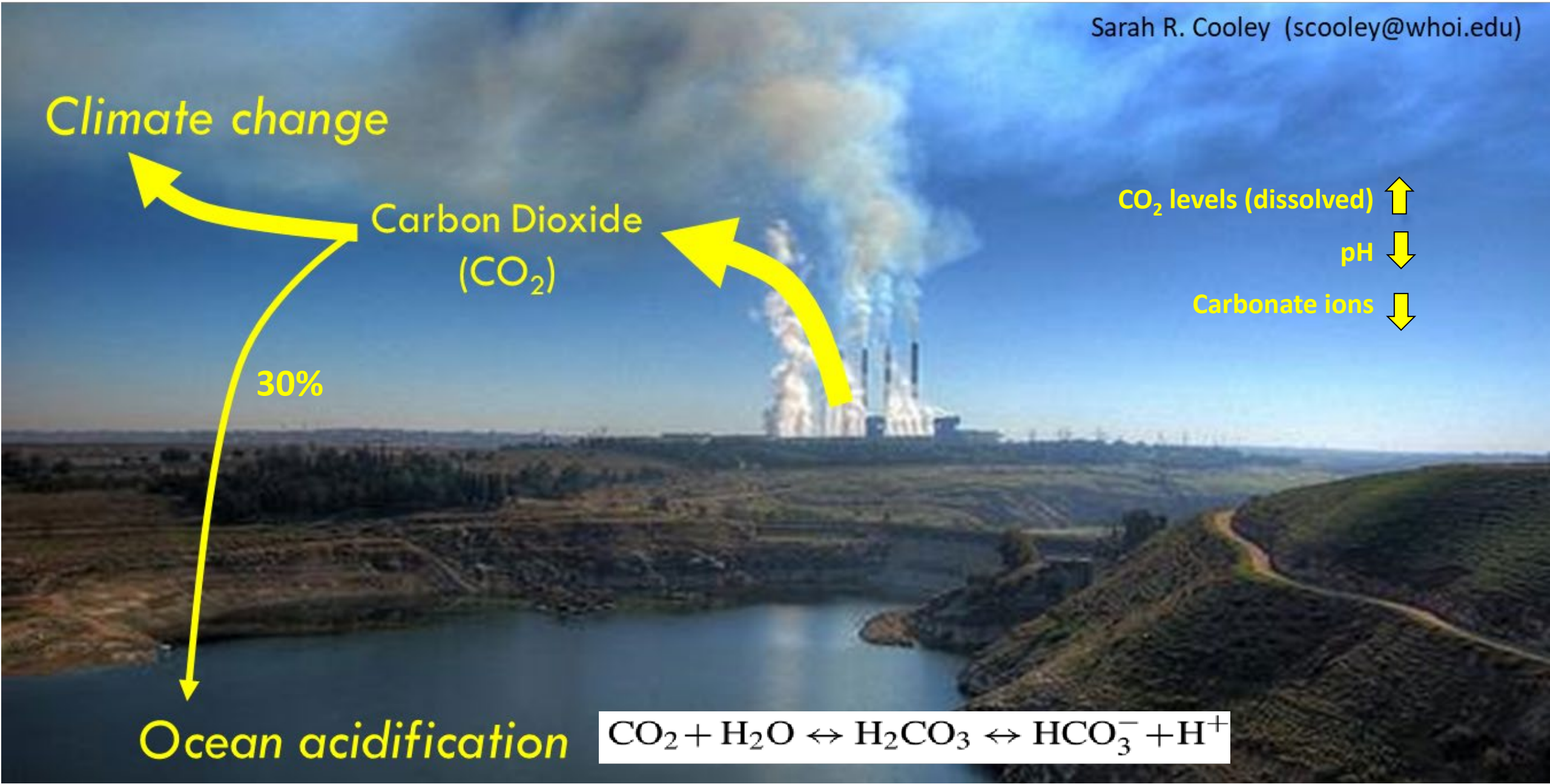
What is ocean acidification?



CO_2 from the air added to seawater changes the water chemistry, reducing the pH and carbonate levels in the ocean

Wikipedia image

What is ocean acidification?

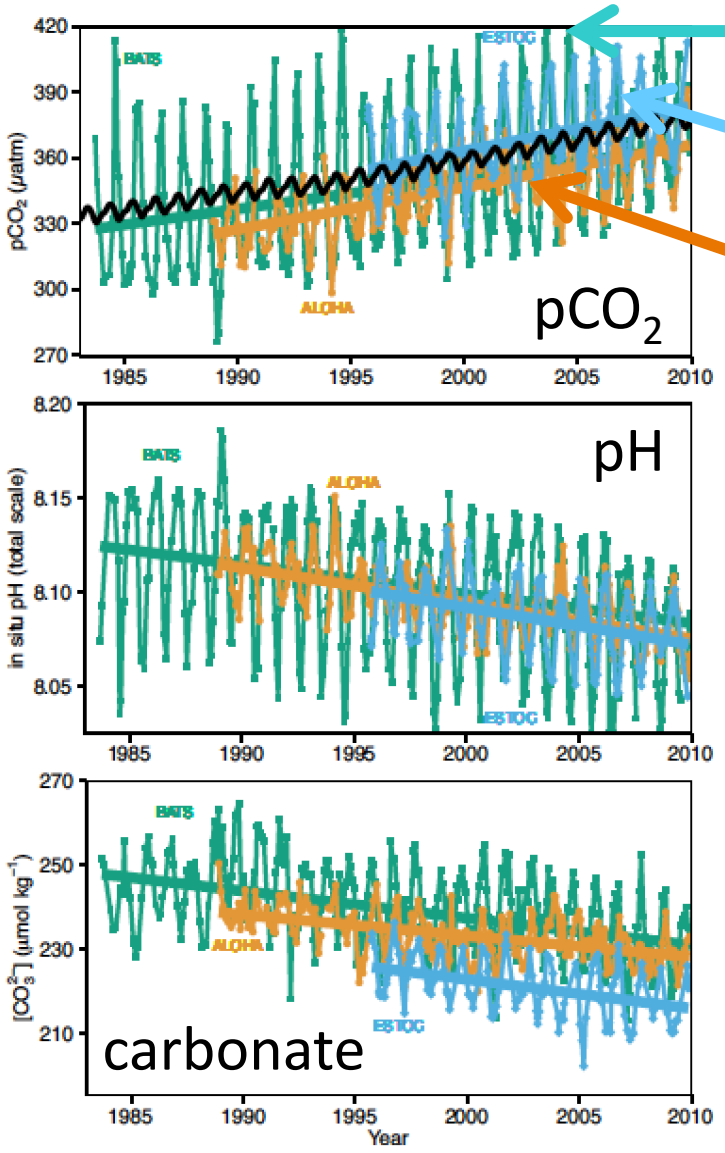


OA is a global condition

pCO_2 increases

pH declines

carbonate declines



Bermuda

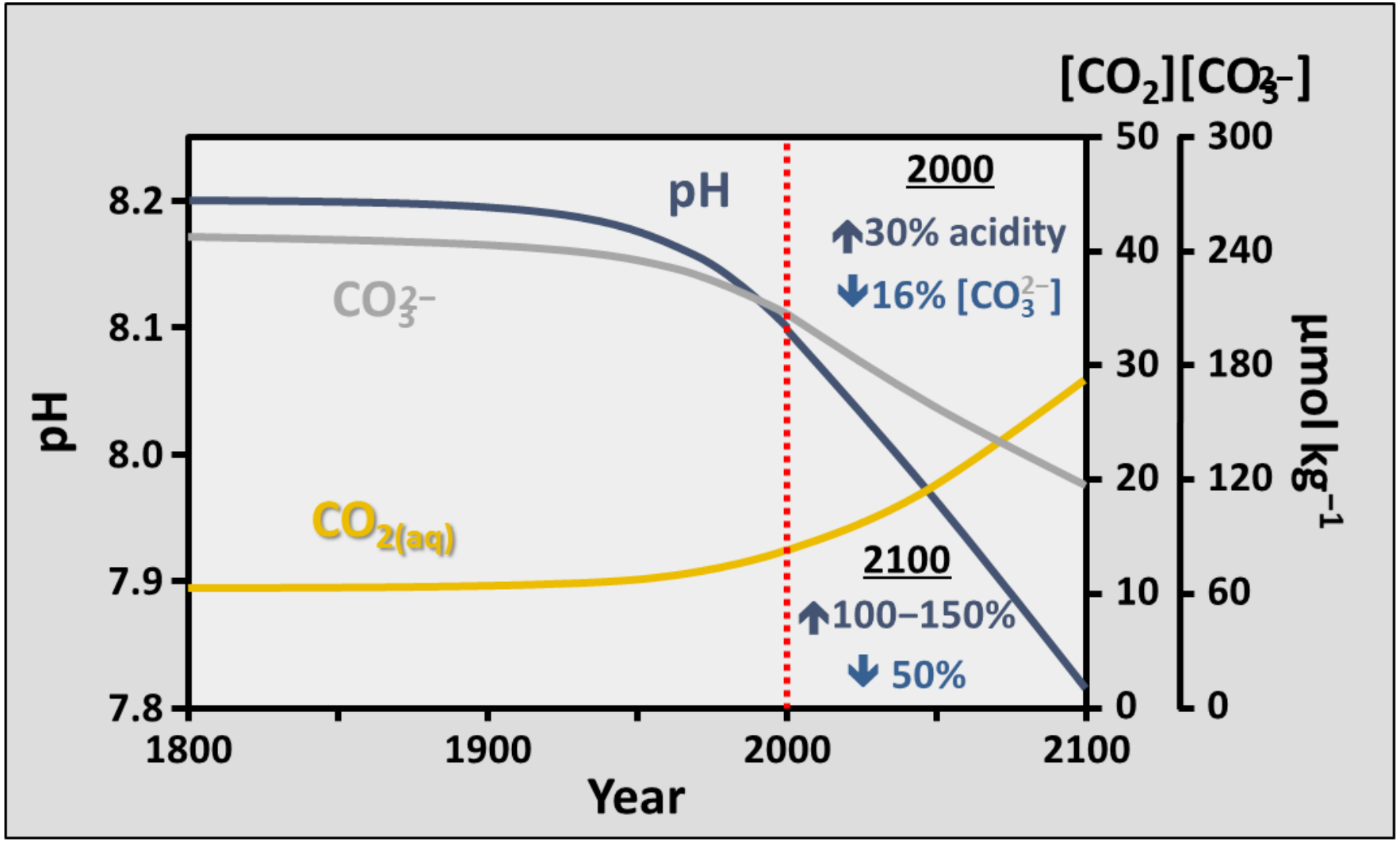
Canary Is.

Hawaii

OA trend is consistent across all ocean basins

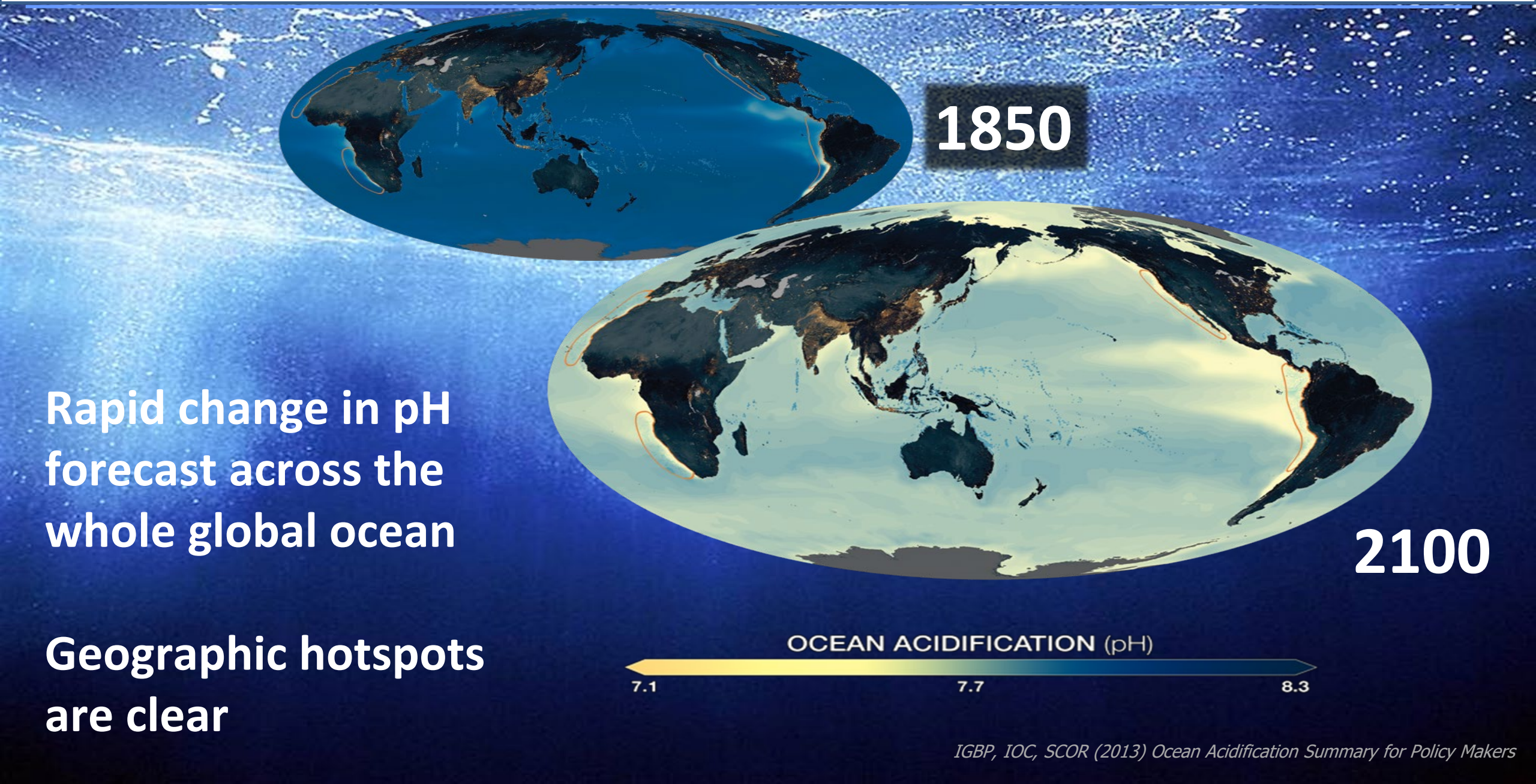
Source: IPCC, 2013

What happens in the future?



Wolf-Gladrow et al. (1999)

Ocean Acidification Threats are Global with Hotspots

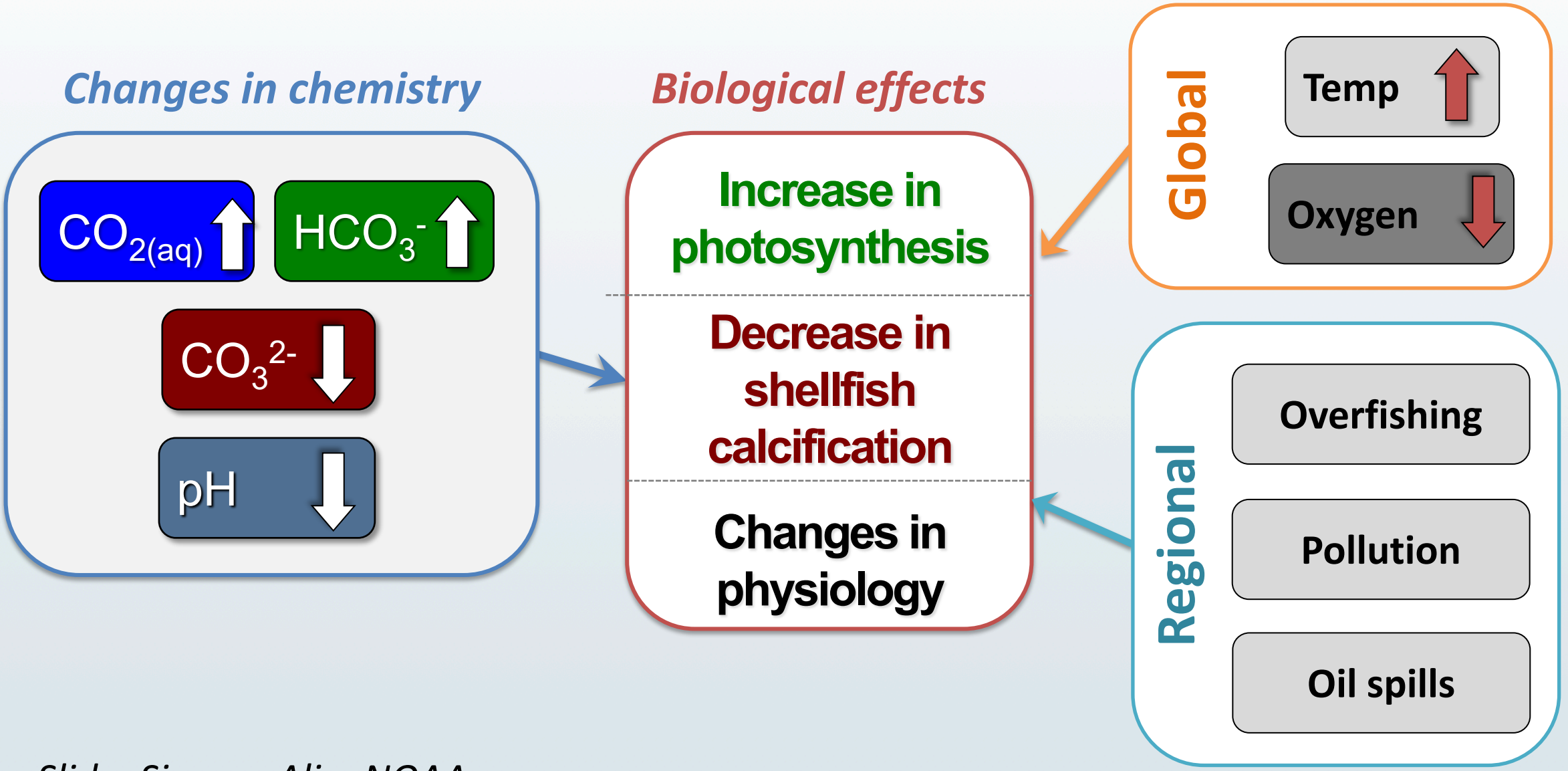


Rapid change in pH forecast across the whole global ocean

Geographic hotspots are clear

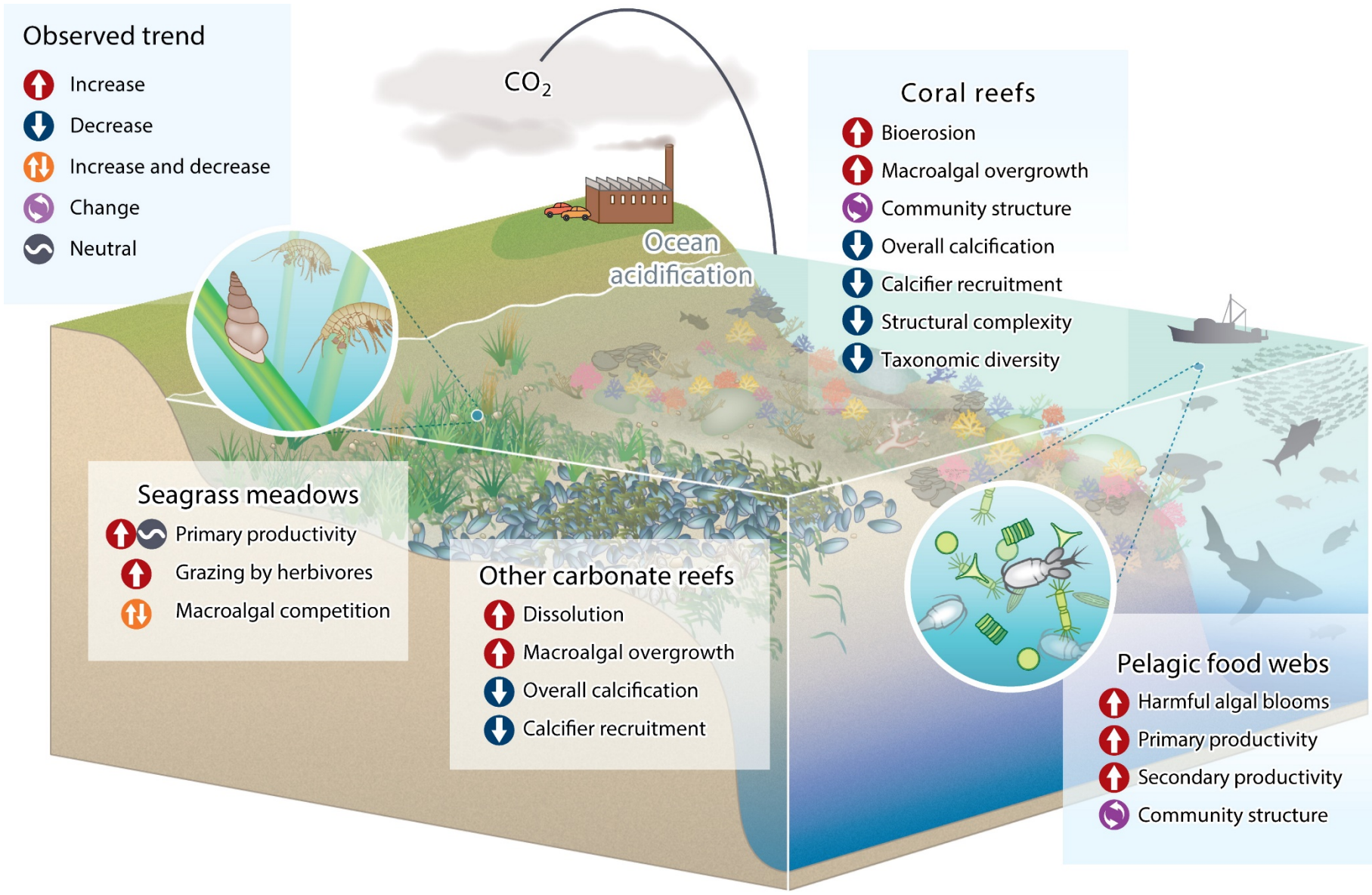
IGBP, IOC, SCOR (2013) Ocean Acidification Summary for Policy Makers

How CO_2 in seawater affects marine life



Slide: Simone Alin, NOAA

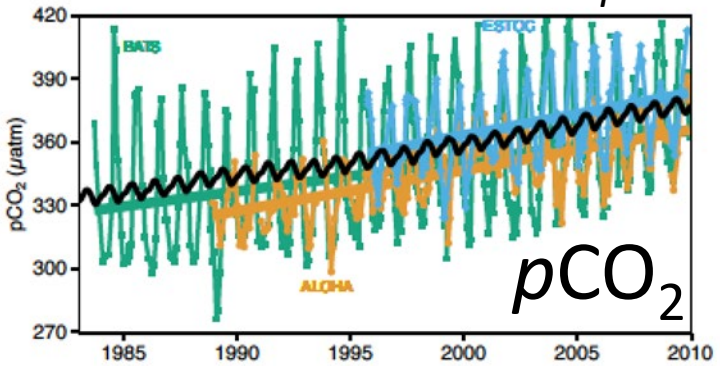
Ecosystem complexity



Doney SC, et al. 2020.
Annu. Rev. Environ. Resour. 45:83–112

Doney, S.C., D.S. Busch, S.R. Cooley, and K.J. Kroeker, 2020: The impacts of ocean acidification on marine ecosystems and reliant human communities, Ann. Rev. Environ. Resources, 45, 83–112, https://doi.org/10.1146/annurev-environ-012320-083019

Source: IPCC Report



OA is
a global condition
with
local effects

OA is
a global condition with local effects

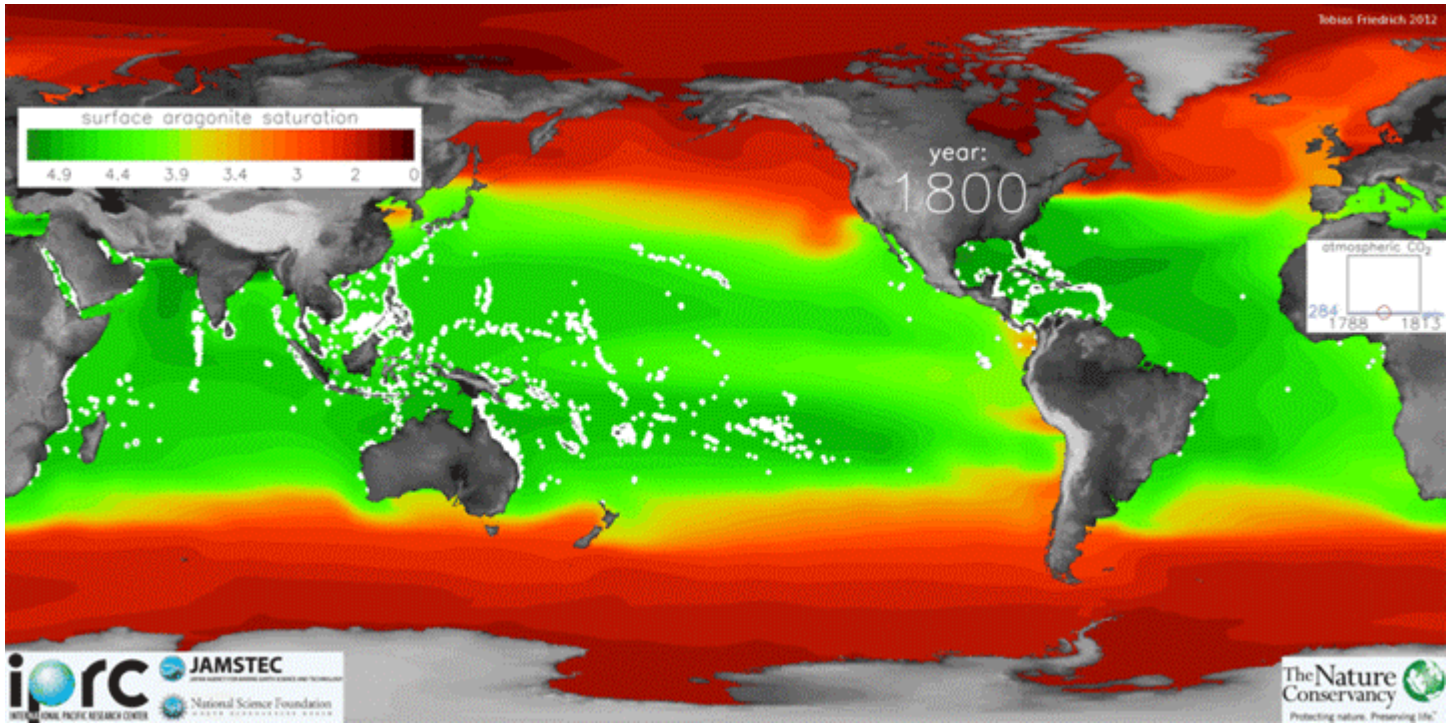
- We need local through global scale observations **in order to get either correct**

- This issue **demands our coordination**, networked skill, and open analysis

In Washington, the shellfish industry spurred action

Ocean Acidification

- *OA impacts people who depend on marine resources for food, economy, culture, and health.*
- *Increased sea temperature and hypoxia add stress to the ecosystem as climate changes.*



Credit: Tobias Friedrich/University of Hawaii

- In response, observing systems, model forecasts, and biological assessments are tools that can inform coastal communities of OA status, its effects, projections, and vulnerability.

Global Ocean Acidification Observing Network

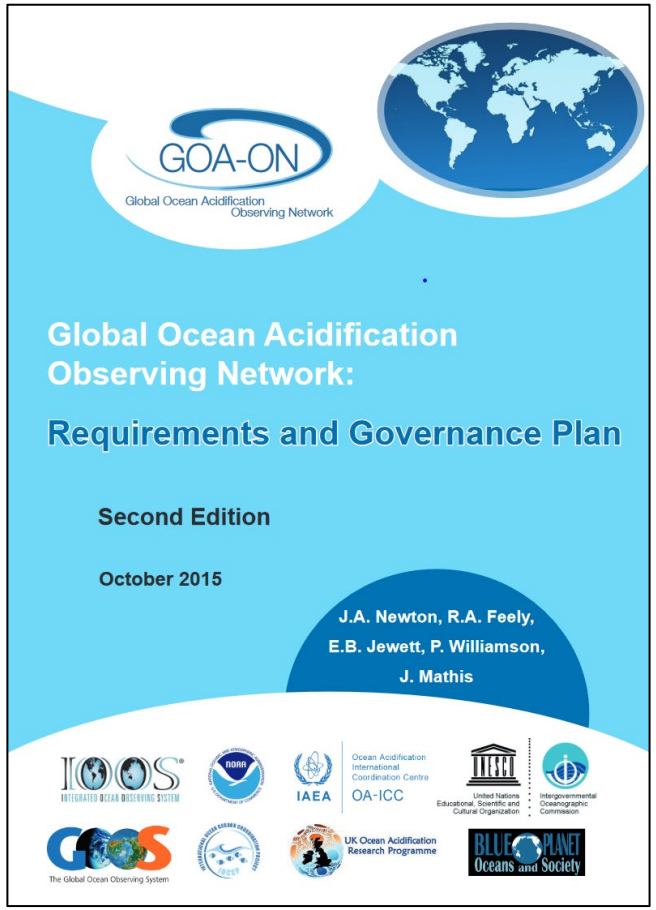
GOA-ON
Global Ocean Acidification Observing Network

GOA-ON is a collaborative international partnership designed to:

- document the **status and progress of ocean acidification** in open-ocean, coastal, estuarine, and coral reef environments,

- understand the **impacts** of ocean acidification on diverse marine ecosystems and societies, and

- support **forecasts** of ocean acidification conditions.



www.goa-on.org

A Global Problem needs a Global Effort

Formed in 2012, the Global Ocean Acidification - Observing Network (GOA-ON) is an **international community partnership**

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

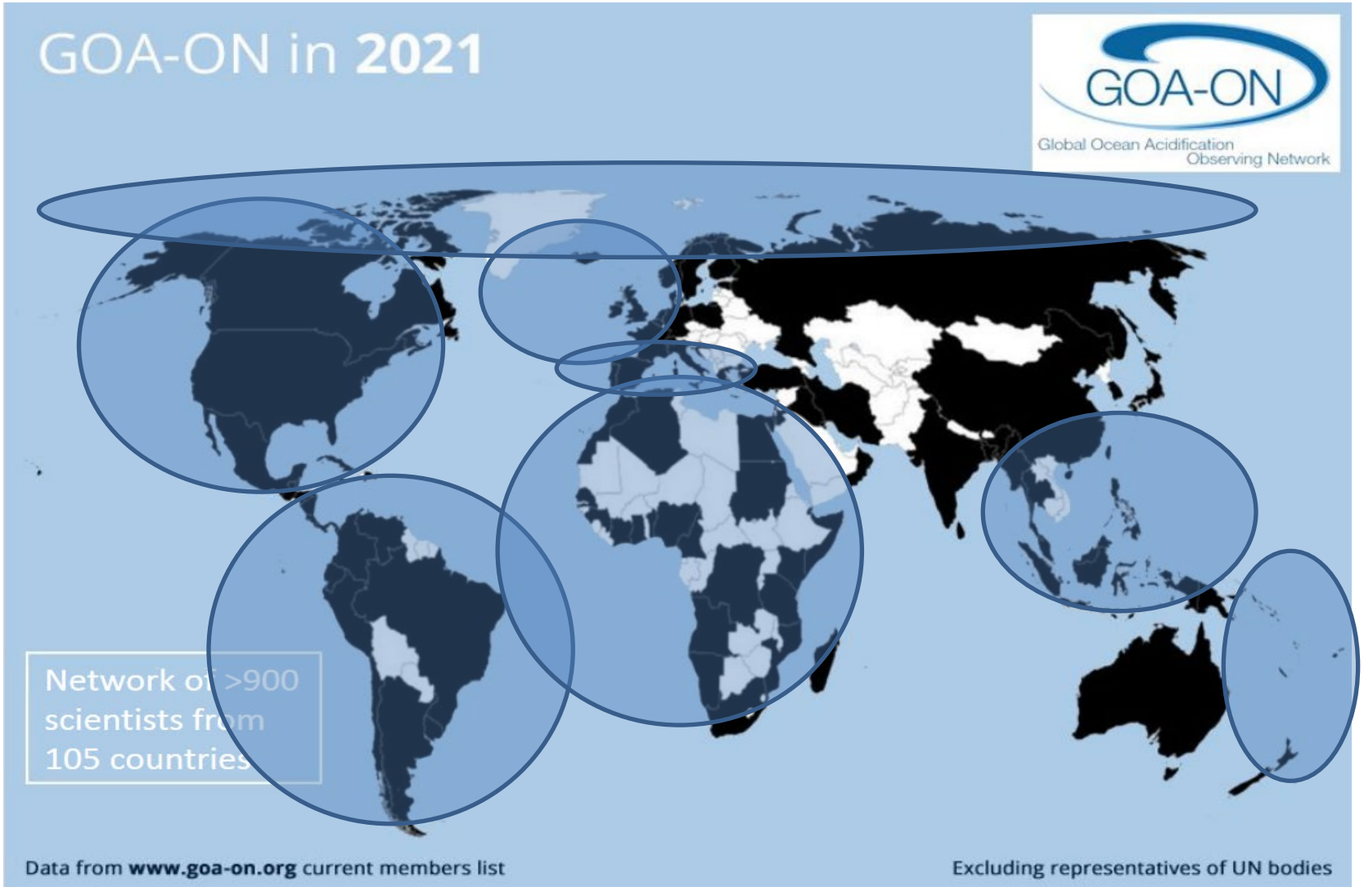
IAEA

Ocean Acidification International Coordination Centre
OA-ICC

International Ocean Carbon Coordination Project
IOCCP

A Global Problem needs Local Effort

8 **Regional Hubs:** Arctic, Africa, North East Atlantic, North America, Mediterranean, Pacific Islands, South America, South East Asia



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GOA-ON's High-Level Goals

Goal 1: Improve our understanding of global OA conditions

- Where is it happening?
- How fast is it happening?
- Why is it happening?

Goal 2: Improve our understanding of ecosystem response to OA

- What are the observed biological responses specifically to OA?
- How fast are they happening?
- What places / ecosystems are most vulnerable or most resilient?

Goal 3: Create reliable future projections of OA and its impacts

- Optimize data / knowledge exchange and knowledge
- Ensure models are robust and reliable
- Provide the spatial and temporal resolution needed to produce societally-relevant forecasts and projections.

unesco
Intergovernmental Oceanographic Commission

IAEA

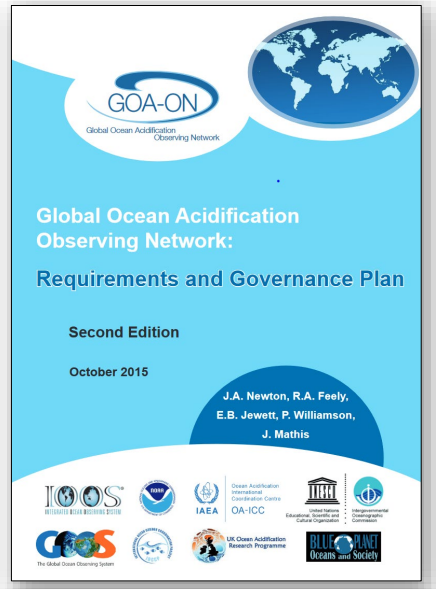
Ocean Acidification International Coordination Centre
OA-ICC

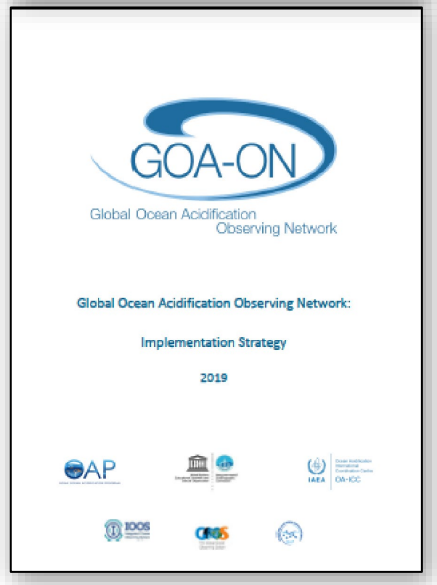
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

GOA-ON requirements:

Capacity for

- Physical infrastructure
- Operations and maintenance
- Data QA/QC
- Analytical and synthesis activities
- Intellectual infrastructure

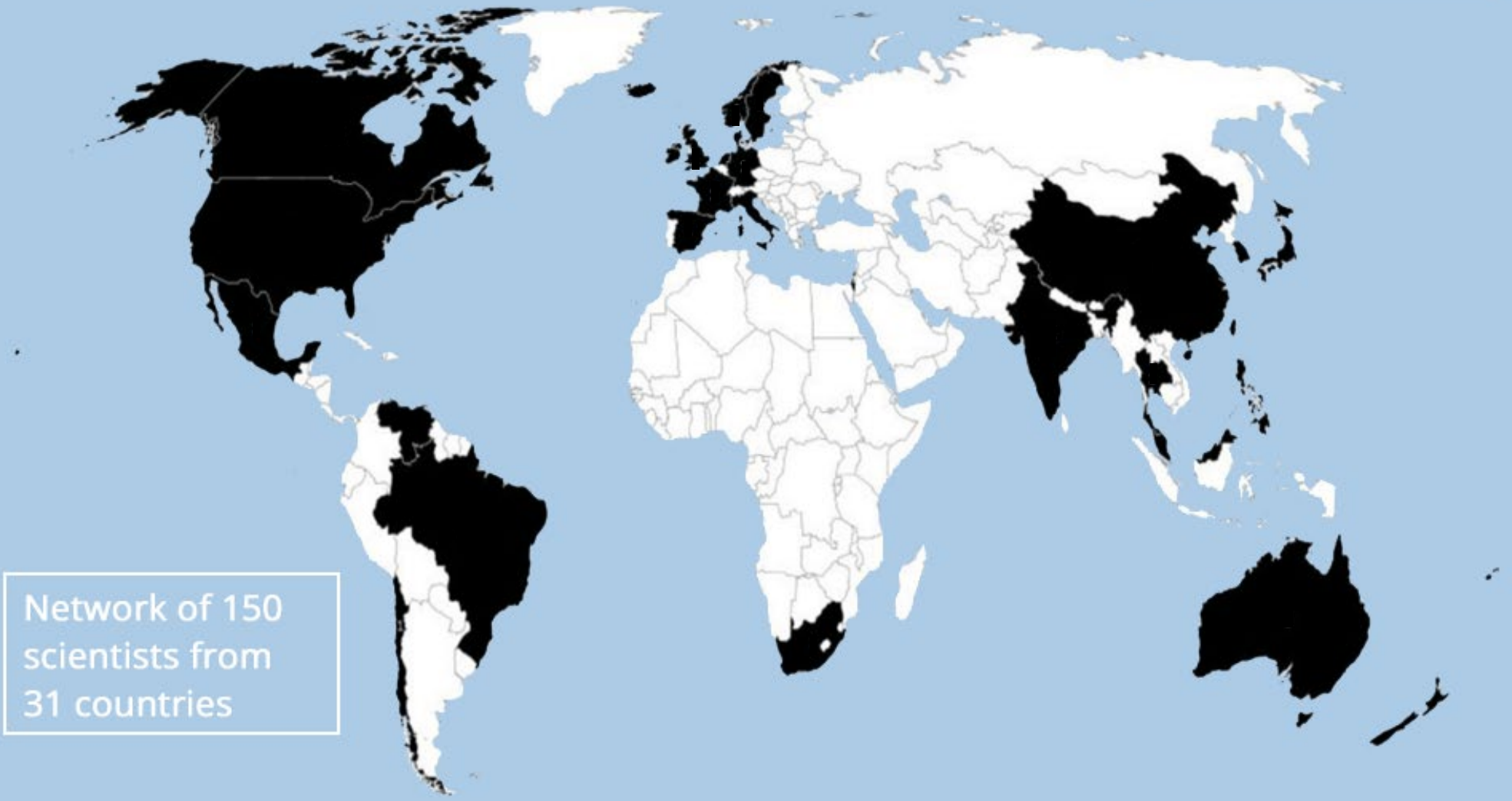




www.goa-on.org

GOA-ON in **2013**

GOA-ON
Global Ocean Acidification Observing Network



Network of 150 scientists from 31 countries

Data from validated 1st & 2nd GOA-ON workshop participant lists (Seattle, Washington 2012 & St. Andrews, UK 2013)

GOA-ON in **2021**

GOA-ON
Global Ocean Acidification Observing Network

Network of >900 scientists from 105 countries

Data from **www.goa-on.org** current members list

Excluding representatives of UN bodies

GOA-ON Capacity Building

GOA-ON
Global Ocean Acidification Observing Network

Pier2Peer:

- Scientific mentorship program
- Knowledge exchange
- Collaborations

Direct assistance:

- Training workshops
- Sensor kit provision (GOA-ON in a box)*

CO2 PIER2PEER

unesco Intergovernmental Oceanographic Commission

IAEA

Ocean Acidification International Coordination Centre OA-ICC

NOAA

**with The Ocean Foundation*

GOA-ON vision:

GOA-ON
Global Ocean Acidification Observing Network

Sharing OA expertise, data, and information, we aim to provide the world with scientifically valid OA status and biological response on local scales globally.

2016 GOA-ON meeting, Hobart

Integration of OA information to policy:

GOA-ON
Global Ocean Acidification Observing Network

2015: **Ocean acidity – SDG 14.3** is one of ten targets for **UN Sustainable Development Goal 14** to build towards the 2030 Sustainability Agenda. *GOA-ON members assisted with the development of the SDG Indicator 14.3.1 Methodology, which provides guidance on how to measure ocean acidity and how to report the collected information.*

2017: **Communities of Ocean Action** launched by the United Nations Department of Economic and Social Affairs (UN DESA). OA is one of nine, with >270 commitments. *GOA-ON members are the focal points for the OA Community of Ocean Action.*

2018: Ocean acidification accepted by the **World Meteorological Organization** as a headline climate indicator for the UNFCCC. *GOA-ON members generated indicator.*

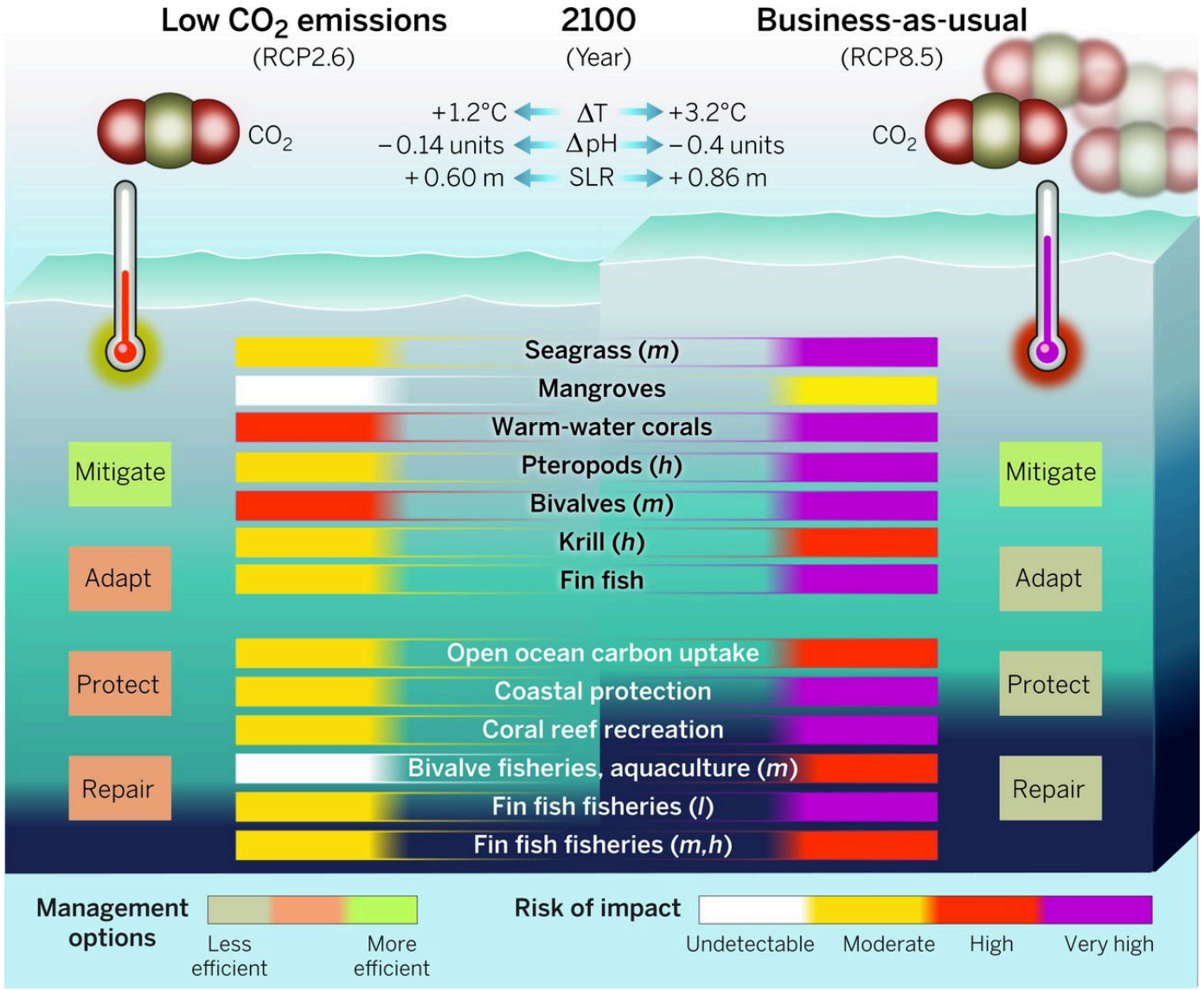
2018: **Commonwealth Blue Charter** established an ocean acidification action plan. *GOA-ON members helped host the New Zealand workshop and continue to be involved.*

2020: **UN Decade of Ocean Science for Sustainable Development (2021-2030)** solicited programmes. *GOA-ON proposal "Ocean Acidification Research for Sustainability" (OARS) endorsed.*

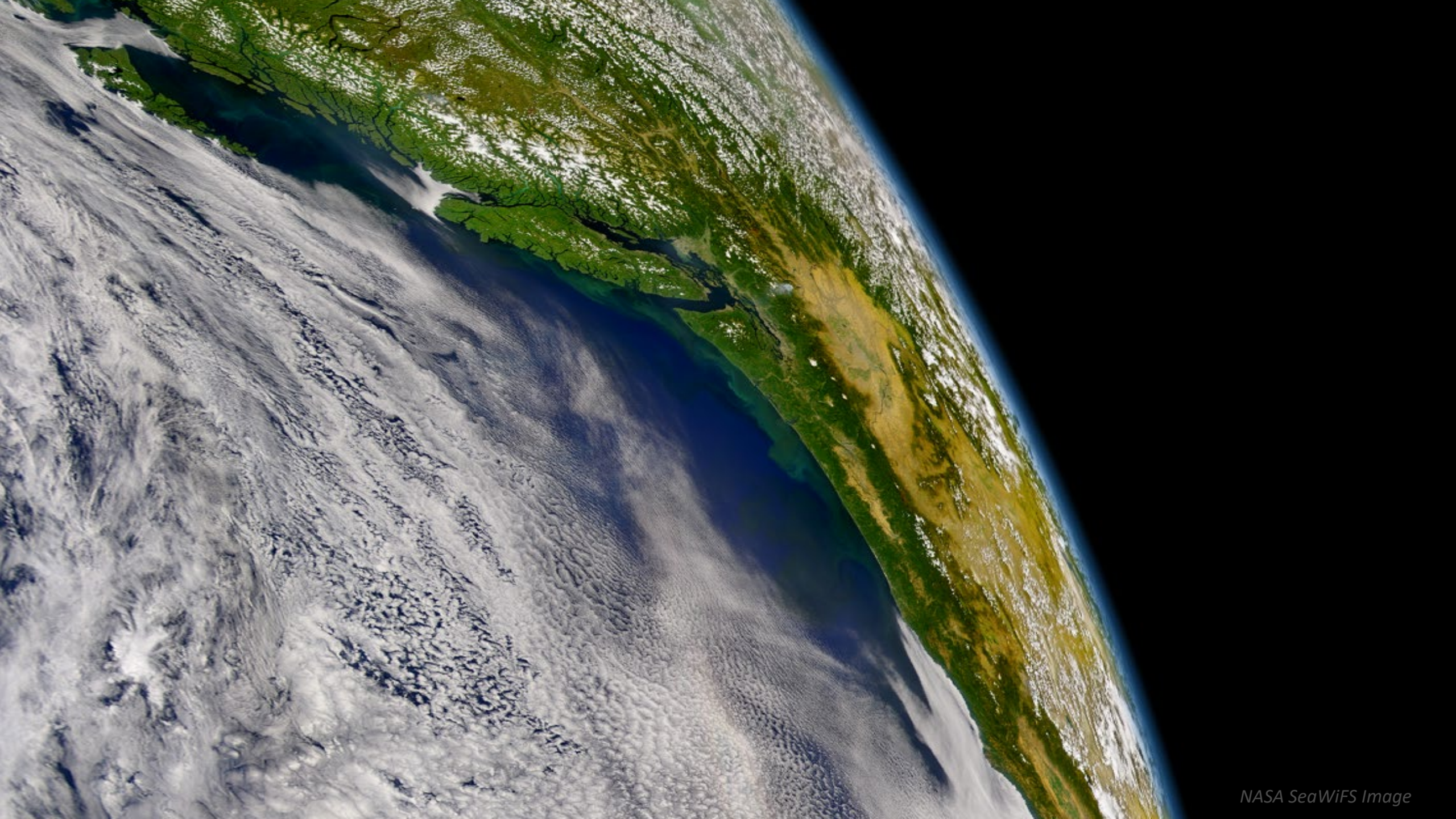
Mitigation of OA:

- **Limit CO_2 emissions:** *e.g., green energy*
- Engineering approaches: *e.g., alkalinization, direct air capture*
- Biological approaches: *e.g., blue carbon, protection and restoration*
- In addition to mitigation, adapt: *e.g., strategies for resilience*

How much CO_2 emission really matters:



Contrasting futures for ocean and society from different anthropogenic CO2 emissions scenarios JP Gattuso et al. *Science, 2015*


NASA SeaWiFS Image