SDG BERGEN POLICY BRIEF #1 | JUNE 2021

A sustainable ocean: providing data to assess ocean acidification

UNIVERSITY OF BERGEN

The Bjerknes Climate Data Centre at the University of Bergen works to process measurements of ocean acidification. The data centre reports to IOC-UNESCO as part of SDG14.3 to minimize and address the impacts of ocean acidification.

The Sustainable Development Goal target 14.3 aims to 'minimize and address the impacts of ocean acidification (OA), including through enhanced scientific cooperation at all levels'. In order to do this, we need globally agreed and accepted ways for assessing the OA status of the ocean.

3 key points

- Ocean acidification affects all ocean regions, and the ocean is becoming more acidic.
- 40 Gigatons of carbon dioxide is currently released into the atmosphere every year from fossil fuel consumption, cement production and land-use change (around 23% of this enters the ocean).
- Potentially this affects the lifecycles of all organisms that make structural elements of their bodies from calcium carbonate, including corals, and it may have other effects elsewhere in the food chain.

Introduction

OA is caused by the uptake of atmospheric carbon dioxide (CO_2) by the ocean, slowing down the pace of climate change. This uptake changes the chemical composition of seawater resulting in a decreasing pH and acidification of the ocean. Ocean pH has decreased from 8.2 to 8.1 on a global average since the industrial revolution (IPCC, 2007). This decreases the capacity of the ocean to take up atmospheric CO_2 and threatens marine organisms and the benefits the ocean provides to people, which may be economic, environmental, cultural or recreational.

However, this human perturbation to the ocean carbon cycle is superimposed on a natural carbon cycle – understanding the impacts of the human perturbation demands a knowledge of how the natural carbon cycle operates. OA happens in the long-term and on top of several natural processes (e.g., biological primary production and remineralization, calcium carbonate cycling). The combination of natural and human-induced changes makes some regions particularly vulnerable, like the Arctic, the Southern Ocean and Eastern Boundary Upwelling Systems e.g., in the Western Pacific (Lauvset et al., 2020).

Regional risks and vulnerabilities to ocean warming and acidification can be further compounded by non-climate related stressors such as pollution, nutrient runoff from land, and over-exploitation of marine resources. All these influences confound the detection and attribution of the impacts of climate change and OA on ecosystems yet may also represent opportunities for reducing risks through management strategies aimed at reducing their influence (Hoegh-Guldberg et al., 2014).

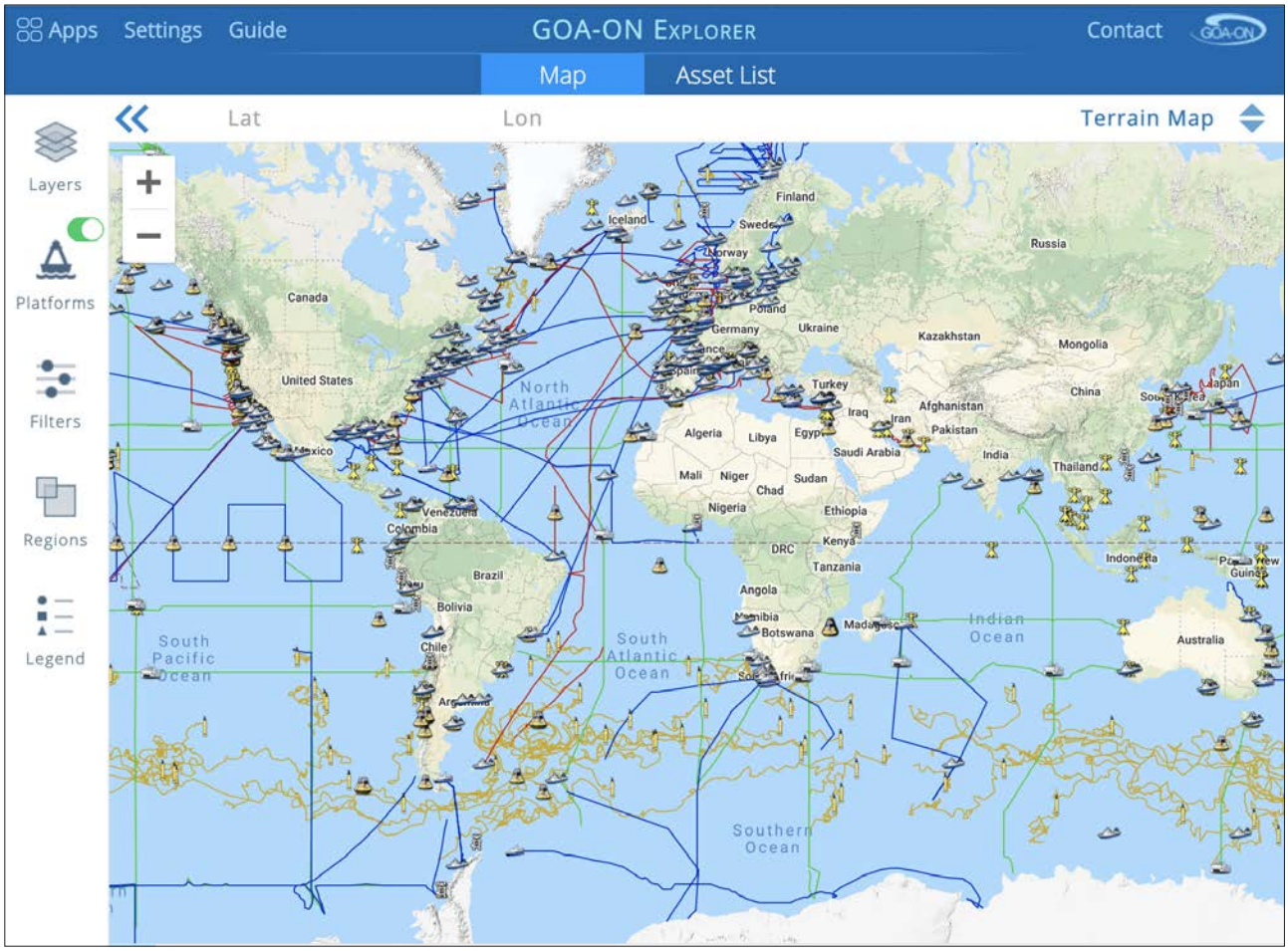
Analysis

In 2019, the methodology for the indicator 14.3.1 *Average marine acidity (pH) measured at agreed suite of representative sampling stations* was published by the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) which has the custodianship role for SDG 14.3.

This methodology provides the necessary guidance for scientists and countries on what, how and when to conduct OA observations, using different types of technology and measuring different variables. This indicator is based on observations that constrain the inorganic carbonate chemistry in seawater system, which is what governs ocean acidity.

An increasing number of countries measure carbonate chemistry data, but there are major temporal and spatial gaps in the observations that are conducted and reported. Guidance on the best sampling strategy is presented in the methodology, with advice on how to weigh possible constraints and opportunities against the expected outcome and data needs. A sampling strategy needs to be developed or adapted for each sampling site to take into consideration site-specific variability and local or regional capacity.

Scientists and data managers from the Bjerknes Centre for Climate Research with participants from the University of Bergen and NORCE play central roles in the development and maintenance of two major international, SDG 14.3-relevant data products: *GLODAP* – Global Ocean Data Analysis Project (Olsen et al., 2019) and *SOCAT* – Surface Ocean Carbon Dioxide Atlas (Bakker et al., 2016). The aim of these products is to ensure that relevant data is collected, quality controlled and aggregated into user-friendly data products. In addition, data management procedures are being modernized within the European Research Infrastructure Integrated Carbon Observation System (ICOS), making data easier to use and available in near real-time via Copernicus Marine Environmental Monitoring Services. The Bjerknes Centre is thus one of the main contributors to the first round of data reporting to the International Oceanographic Data Exchange programme of IOC UNESCO (IODE).



Map illustrating ocean carbonate chemistry measurement locations of the Global Ocean Acidification Observing Network (GOA-ON). SOURCE. WWW.GOA-ON.ORG

Conclusions

The ocean absorbs around 23% of the annual anthropogenic emissions of CO_2 to the atmosphere, thereby helping to alleviate the impacts of climate change on the planet (Friedlingstein et al., 2019). As the ocean acidity increases, its capacity to absorb CO_2 from the atmosphere decreases, hampering the ocean's role in moderating climate change. Currently there is a lack of studies quantifying how natural processes control pH globally (Lauvset et al., 2020). Regular and global observations of OA are needed to improve the understanding of its consequences, enable modelling and predictions of change and variability, and help inform mitigation and adaptation strategies (IOC-UNESCO). Furthermore, data seemingly missing may have been collected, but not been made available. Inorganic carbon data are typically processed by individual scientists before being submitted to data archives and often this work is done on an ad hoc basis using unpublished self-built software, methods and published in unique formats. This leads to challenges in data flow and data availability in respect to SDG target submissions. The Bjerknes Climate Data Centre and the Research Infrastructure ICOS work to alleviate this situation. •

Recommendations

- Introduce standardized data and metadata reporting and develop globally standardized software to ensure that relevant data is collected, quality controlled and aggregated into user friendly data products.
- Accelerate the use of Big Data to structure heterogenous data and make it machine readable, which is essential to handle growing data inventories.
- Sustained funding for high quality observations is needed.

Further relevant SDGs:

IMPRINT

SDG Bergen Science Advice, Scientific Director: Edvard Hviding
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Relevance to the 2030 Agenda

SDG 14.3 is one of the ten targets under SDG 14: *Life below Water*, building towards the 2030 Agenda; ocean acidification is also a global climate indicator by the World Meteorological Organisation.

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Partners

United Nations Educational, Scientific and Cultural Organization · Intergovernmental Oceanographic Commission

ICOS Ocean Thematic Centre

BJERKNES CENTRE for Climate Research

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SUSTAINABLE DEVELOPMENT GOALS

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