Mind the gap: Earth Observation of Ocean Acidification in pursuit of SDG14:

A recommendation for the Intergovernmental Oceanographic Commission

- The Intergovernmental Oceanographic Commission (IOC) of UNESCO is the custodian agency for minimising and addressing the impacts of ocean acidification, to meet the UN's Sustainable Development Goal 14 (SDG14).
- This paper recommends the IOC add Earth Observation (EO) data sources to the data collection portfolio it maintains. This data can fill gaps in both time (3 day frequency) and space (worldwide coverage) for minimal cost.

Policy Recommendations

- **Invest** in further development of the salinity/acidity models;
- **Organise** a project to format and upload historical EO data (2009-21) to the data portfolio;
- **Initiate** a project to upload ongoing EO data;
- **Support** the extension of ESA's SMOS mission[1] until a replacement can be launched.

Introduction

The world's oceans are becoming more acidic at an alarming rate, due to absorption of the carbon dioxide (CO_2) released by the burning of fossil fuels. This is already beginning to have profound effects in terms of biodiversity loss and food security, among others. The UN have specified the reduction of ocean acidification as one of their Sustainable Development Goals (SDG14, see Box 1), yet the data to monitor ocean acidification is limited, in both the frequency of readings and the number of monitoring stations.

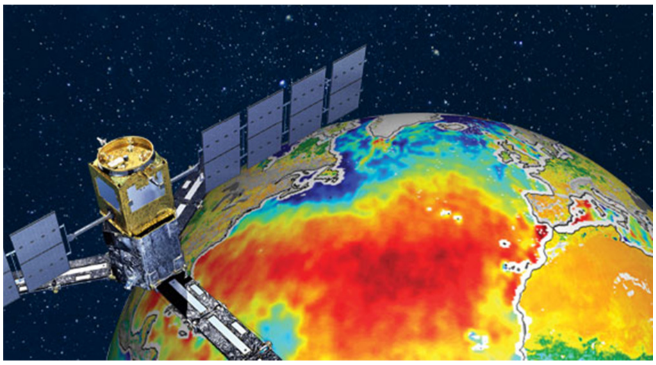
Box 1. Goal SDG 14 Life below water
Target 14.3 **Reduce ocean acidification**
Indicator 14.3.1 **Average marine acidity (pH) measured at agreed suite of representative sampling stations[3]**

Ocean Acidification – an urgent problem

Our addiction to the burning of fossil fuels has resulted in higher levels of CO_2 in the atmosphere than at any time in the last 3 million years[4]. Atmospheric CO_2 is gradually absorbed into the ocean to form carbonic acid, with the result that the ocean becomes more acidic. The change in surface water acidity in the approximately two centuries since the Industrial Revolution amounts to a difference of 0.1 pH units; considering that pH is measured on a logarithmic scale this represents nearly a 30% increase in acidity over this geologically short time period[5] .

Why does it matter?

Ocean acidification is threatening biodiversity, food security, coastal integrity and livelihoods worldwide. For example, two known effects are the bleaching of coral reefs, and damage to shelled organisms[5]. These detrimental effects are significant both because these organisms are the start of many food chains, and because there is limited data to quantify the problem. It has been calculated that expected acidification from the continued burning of fossil fuels will take the ocean into values of sustained acidity it has never experienced over the last 300 million years[6].



SMOS mission[2]

In addition as acidity increases it will reduce the oceans' capacity to absorb CO_2 from the atmosphere, accelerating the climate crisis. Thus understanding ocean acidification is also significant for **SDG goal 13, Climate Action**. Studying acidity levels over recent years shows a worrying lack of progress in slowing the trend[7].

What can be done?

As with many global problems, sufficient data is the necessary first step towards better understanding and better planning. Data for SDG indicator 14.3.1 (see Box 1) is currently gathered at only 27 locations around the world. These values are averaged over a year but there are many years where data is unavailable[8].

A feasibility study into an alternative data source for measuring ocean acidification supports the use of remote EO data to 'fill the gaps' (in both time and space) in the current dataset[9]. Satellite measurements of microwave radiation (see Box 2) give accurate readings of the 'saltiness' (salinity) of the ocean surface, worldwide. Models developed to study the effects of ocean acidification using *in situ* data were repurposed to work with EO salinity data, and shown to be sufficiently accurate at predicting acidity to be a valuable addition to current data-gathering methods. It is important to note that replacement of *in situ* data with EO data is not recommended, due to limitations of the models and their potential inability to maintain accuracy as ocean parameters change.

An added benefit is that EO data's greater frequency of measurement compared to *in situ* readings allows a far greater understanding of natural variability in levels of acidification. Additionally the World Bank reports approvingly on the 'plummeting cost of satellite data' showing that this is a cost-effective proposal[10].

Box 2. Satellites
NASA's Aquarius satellite was active over the period 2011-2015 taking readings every 7 days, with a resolution of 150km[11] .
ESA's Soil Moisture and Ocean Salinity (SMOS) mission has been active since 2009 reading every 3 days, with a resolution of 50km[1].

References

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