Short Term Scientific Mission (STSM)

Scientific Report

Modelling Ocean Acidification in the Gulf of Cadiz (MOsAiGC)

By Charles Galdies

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Host:	Roberta Guerra
Host Institution:	University of Bologna

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Purpose of the STSM

This study commenced in January 2018. Substantial time was devoted for both the collection and analysis of data needed for this study in preparation of the one-week visit at the University of bologna. During the one-week visit I worked closely with my host Dr Roberta Guerra to examine in detail the results obtained with regards to the modelling of ocean acidification parameters in the North Atlantic Ocean.

The ocean is one of the major global reservoirs of carbon and a major sink of anthropogenic CO2. For the understanding of the ocean carbonic acid system, Dissolved Inorganic Carbon (DIC), Total Alkalinity (TAlk), pH and the pCO2 in surface water (pCO2sw) are the four essential parameters for determining chemical changes in seawater properties. At least two and preferably three of these carbonate parameters need to be observed to fully describe the sea water carbonic system at any given depth. These four parameters are largely driven by temperature, salinity and biological activity, and this allowed the derivation of empirical relationships from in situ measurements. So far, most of our understanding of the ocean carbonate system is derived from field sampling data. Ship surveys and a growing number of autonomous moored and underway platforms directly provide accurate long-term time series for studies and modelling. But direct field measurements are inherently limited in spatial (time series, moored stations) and/or temporal resolution (ship surveys). Earth observation (EO), on the other hand, offers an avenue for expanding observations and analysing the temporal and spatial variability of the global ocean and its properties. While EO proves to be a difficult tool for the direct monitoring and detection of changes in seawater pH and their impact on marine organisms, it can measure a range of related physico-chemical and biological processes occurring at the ocean surface.

This STSM-funded project is aimed at demonstrating how a select number of geophysical fields related to ocean acidification can be derived by EO and used to understand the spatiotemporal variability of the oceanic carbonate system at the highest spatiotemporal resolution possible.

Description of the work carried out during the STSM

This study commenced in January 2018. Substantial time was devoted for both the collection and analysis of data needed for this study. The extensive in situ reference dataset used for this study was that of Barbero, Wanninkhof and Pierrot (2016) which provided surface discrete measurements of Dissolved Inorganic Carbon (DIC), Total Alkalinity (TAlk), and pH for the period the period 2015-03-07 to 2016-11-06 as part of the M/V Equinox Cruise mission in the North Atlantic Ocean. This cruise provides surface discrete measurements of dissolved inorganic carbon (DIC), total alkalinity (TAlk), and pH for the period the period 2015-03-07 to 2016-11-06 (NCEI Accession 0154382). It used flow-through pump and other instruments onboard the M/V Equinox. This research was conducted in support of the coastal monitoring and research objectives of the NOAA Ocean Acidification Program (OAP) and the Climate Program Office. The research cruise covers an area from -78.9797oW to -10.3998o E and from 38.4622oN to 19.2893oS.

A unique list of co-temporal and collocated global environmental parameters derived from satellite remote sensing were collected for this study at the highest spatial resolution possible. Using

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two case studies representing different geographical parts of the North Atlantic Ocean, the resulting correlation show very low biases and RMSE when verified against observations (i.e. in situ discrete measurements).

Description of the main results obtained

The discrete in situ measurements show that the SST varied between 15.2o C (StationID: 910000; Iberian plain; 24 April 2016) to 27.5o C (StationID: 1900000; Great Bahama Bank; 11 Nov 2016). The salinity ranged between 35.46% (StationID: 1740000; close to Canary islands; 30th October 2016) to a maximum of 36.95% (StationID: 1370000; Iberian plain; 6th May 2015). DIC ranged from a minimum 2025.35 µmol/kg (StationID: 16; Great Bahama Bank; 8 March 2015) to a maximum of 2126.23 µmol/kg (StationID 890000: Iberian Plain; 24 April 2016) . TAlk ranged from 2349.87 µmol/kg (StationID: 90000; Iberain Plain; 24 April 2016) to a maximum of 2439.1 µMOL/KG (StationID: 80000; North American Basin; 3rd November 2016). The pH ranged between a low of 7.964 (StationID: 900000; Iberian plain; 24th April 2016) to a high of 8.142 (Station ID: 1860000; Nares Plain; 5th November 2016).

Future Collaborations

Further research resulting from this STSM-sponsored work is being suggested. These include the following:

1. Presentation of the results during the poster session of the 2018 Workshop Plenary Sessions of the 2018 OCB Summer Workshop to be held in June 25-28, 2018 in Woods Hole, Massachusetts, USA. This will be in the form of joint collaboration between the University of Malta and Bologna.
2. It is being proposed that cooperation for this study will be further extended by including the Instituto Universitario de Investigación Marina (INMAR) of the Universidad de Cádiz (through the involvement of Prof. Enrique Garcia Luque; COST CA15217 MC Member). This will further enhance the study by adding the much desired oceanographic expertise in the evaluation, interpretation of the results.
3. Consolidation of the results obtained in the form of a joint, co-authored, original research article to be submitted to a suitable scholarly journal by late 2018.

Due credit to this STSM grant will be given in any publication when relevant.

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