CARBON, TRACER AND ANCILLARY DATA IN THE MEDSEA, CARIMED: AN INTERNALLY CONSISTENT DATA PRODUCT FOR THE MEDITERRANEAN SEA.

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Abstract
A consistent, complete and formatted data product containing inorganic carbon relevant data in the Mediterranean Sea is presented. Ancillary (hydrographic, inorganic nutrients and dissolved oxygen), CO2 (pH, total alkalinity - TA, dissolved inorganic carbon - DIC) and transient tracer data of several basin-wide cruises in the Mediterranean Sea from 1976 until 2018 were assembled. The final aim is obtaining an internally consistent data collection of interior physical and biogeochemical variables, with emphasis on CO2 data, in order to investigate their temporal variability, natural and anthropogenic. Referred procedures for the first and secondary quality control will be applied as in previous CO2 synthesis data products as CARINA and GLODAPV2.

Keywords: Mediterranean Sea, Open sea, Carbon, Hydrography

Introduction

The overall goal of this work is to create a merged, calibrated, homogenous, consistent and public data set collecting historic and recent water column measurements in the Mediterranean Sea involving carbon (pH, TA, TIC), transient tracer and ancillary (temperature, salinity, inorganic nutrients and dissolved oxygen) data.

Despite representing only 0.8% of the total surface area of the world oceans and the paucity of quality water column CO_2 measurements [1], the MedSea has been identified as an important anthropogenic carbon storage [2,3]. The reasons for this are the intrinsic physico-chemical characteristics of the MedSea waters, warm, salty and high in pH and alkalinity [4], thus with a low Revelle factor and prone to dissolve more inorganic carbon for a given CO_2 increase in the atmosphere. In addition this anthropogenic carbon can be rapidly transported to the interior ocean with the active overturning circulation.

Regardless of these facts, the first high quality basin wide internally consistent subsurface CO_2 data were collected in April 2011 and made publicly available at CDIAC one year after approximately [5]. Referenced, public and quality controlled data bases are valuable and extremely useful products scientists and society claim.

The MedSHIP program was designed to fulfill the particular spatial (at the sub-basin scale) and temporal (high frequency regionally, and every 6-7 years the whole MedSea) observational requirements within this marginal sea, with special focus on the CO2 and transient tracers measurements. In 2016 three sub-basin sections were accomplished within a EuroFleets II grant, and in 2018 a whole MedSea repetition sponsored by GEOMAR.

CRUISE DATA COMPILATION

The first steps to accomplish CARIMED consisted in:

- Locate and physically find (either in public repositories, direct contact with the Principal Investigator or even typing or digitalizing old cruise reports) historical and recent CO_2, tracer and ancillary subsurface data in the MedSea, preferably those with a basin scale.
- Collect all the metadata and other information regarding those cruises and measurements: cruise reports, referenced or other publications.
- Gather all the data together (station location, date, time, depth, temperature, salinity..) for each individual cruise and create a unique formatted file with all the physical and biogeochemical data converted to common units. - Special care was taken with pH data regarding the scale and temperature it was measured and reported. All pH measurements were converted to pH at 25ºC on the Total scale.
- All the individual cruise files are in "WHP-exchange" format, a comma separated file including header names and units. Each file (each cruise) is named with an expocode.
- 1st QC (Quality Control) consisting in assigning a quality flag to each measurement, thus inspecting and scrutinizing each cruise following the recommendations in [6]

More tricky will be obtaining a consistent data product, i.e., without systematic biases in any of the measured variable by cruise or area. Correcting those will be the aim of a 2QC to detect and quantify any measurement bias, following the expertise gained with CARINA [7]. The overall goal of this step is improving the accuracy of the data set as we want to detect and quantify changes in DIC and ascribe them to natural (modelled with oxygen and inorganic nutrient data) or anthropogenic (correlated with transient tracers) drivers. The 2QC relies on identifying areas without temporal variability. This fact will be particularly difficult in the MedSea, a compromised solution will be attained. The 2nd QC procedure consists in the following steps:

1) Interpolation of missing values of ancillary data (salinity, oxygen and nutrients) preferably were CO_2 data is available.
2) Identify areas/ layers where the assumption of being in steady-state can be applied with reasonable confidence. The oceanography in the MedSea both in the eastern and western basins has suffered dramatic changes.
3) Quantify the relative measurement offset between cruises
4) Assign an adjustment factor to data deemed to have a measurement bias that exceeds some limit adjustment.

The 2QC procedure is based on a running cluster crossover routine analysis much improved in GLODAPV2. The automatic routine has been developed to easily obtain the crossover results cruise to cruise and particularly adapted to the MedSea, with different criteria in each sub-basin. A careful inspection of the obtained adjustments will be done before applying them with an inverse technique.

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