CARBON, ANCILLARY AND TRACER DATA IN THE MEDSEA: COMPILATION AND QUALITY CONTROL

M. Álvarez [1]*, H. Sanleón-Bartolomé [1], A. Velo [2], T. Tanhua [3] and T. Lovato [4]
[1] Instituto Español de Oceanografía (IEO) - marta.alvarez@co.ieo.es
[2] Instituto de Investigaciones Marinas (IIM-CSIC, Vigo, Spain)
[3] GEOMAR (Kiel, Germany)
[4] Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC, Lecce, Italy)

Abstract

A consistent, complete and formatted data product containing inorganic carbon relevant data 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 2014 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 CO2 synthesis data products CARINA and GLODAPV2.

Keywords: Hydrography, Oxygen, Mediterranean Sea, Ph, Time series

Introduction

The overall goal of this work is to create a merged, calibrated, homogenous, consistent and public data set collecting historic and recent subsurface measurements in the Mediterranean Sea involving carbon (pH, total alkalinity - TA, total inorganic carbon - TIC), tracer (chlorofluorocarbons, helium / tritium, sulphur hexafluoride) and ancillary (temperature, salinity, inorganic nutrients and dissolved oxygen) data. From the oceanographic point of view the processes occurring in the Mediterranean Sea (MedSea) have a global repercussion. Despite representing only 0.8% of the total surface area of the world oceans and the paucity of quality water column CO_2 measurements (Álvarez, CIESM, 2011), the MedSea has been identified as an important anthropogenic carbon storage (Schneider et al., JGR, 2010; Lee et al., Energy Envir. Sc., 2011). The reasons for this are the intrinsic physico-chemical characteristics of the MedSea waters, warm, salty and high in pH and alkalinity (Álvarez et al., Oc. Sc., 2014), 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 (e.g., the review by Schroeder et al., Elsevier, 2013). Regardless of these facts, subsurface CO_2 measurements in the MedSea are scarce (see the review in Álvarez, CIESM, 2011) and 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 (see Tanhua et al. (ESSD, 2013) and Álvarez et al. (Oc. Sc., 2014). This recent data set has been directly and widely used in modelling and observation studies related with the CO_2 chemistry in the MedSea. Referenced, public and quality controlled data bases are valuable and extremely useful products scientists and society claim.

Cruise data compilation and quality control

In order to directly quantify the inorganic carbon changes in the MedSea and study the mechanisms, either natural or anthropogenic, leading to those changes, two groups (IEO - A Coruña and CMCC – Bologna) independently started a data rescue assembly and synthesis of subsurface CO_2 and ancillary measurements in the Mediterranean Sea basins. In the same manner as CARINA but in a much much smallar scale, just for the Mediterranean Sea, we defined CARTAMED. The first steps to accomplish the CARTAMED data rescue effort consisted in: - Locate and physically find (in public data bases, by direct contact with the Principal Investigator or even typing or digitalizing old cruise reports in paper) historical and recent CO2, 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 (Velo et al., ESSD, 2009). 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 (unique code identifying each cruise as it depends on the research vessel and the date when the cruise left port. - 1st QC (Quality Control) consisting in assigning a quality flag to each measurement, thus inspecting and scrutinizing each cruise following the recommendations in Key et al. (ESSD, 2010). We will proceed with a 2nd QC to detect and quantify any measurement bias, following the expertise gained with CARINA (see Key et al., ESSD, 2010 and Tanhua et al., ESSD, 2010, and references therein). The overall goal of this step is improving the accuracy of the data set as we want to detect and quantify changes in TIC and ascribe them to natural (modelled with oxygen and inorganic nutrient data) or anthropogenic (correlated with transient tracers) drivers. 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. Remember that the oceanography in the MedSea both in the eastern and western basins has suffered dramatic changes (see the review Schroeder et al., Elsevier, 2013). 3) Quantify the relative measurement offset between cruises bsed on the crossover analysis as in CARINA (Tanhua et al., ESSD, 2010) and the nearly finished GLODAPV2. 4) Assign an adjustment factor to data deemed to have a measurement bias that exceeds some limit.

References

1 - Álvarez, M., Sanleón-Bartolomé H., Tanhua T., Mintrop L., Luchetta A., Cantoni C., Schroeder K., and Civitarese G., 2014. The CO2 system in the Mediterranean Sea: a basin wide perspective. Ocean Sci., 10, 69-92, doi:10.5194/os-10-69-2014.