Monitoring of physicochemical, biological and oceanographic conditions in Cartagena-Colombia ANTARES Station.

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Introduction

Cartagena Station, located 10 km offshore, across from the Cartagena Bay/Caribbean Sea at 75º45'34" W and 10º 24' 32" N (Fig. 1). It has a depth of 170 m. Joined ANTARES Network in July 2008. Oceanographic, physicochemical and biological variables are measured at this station.

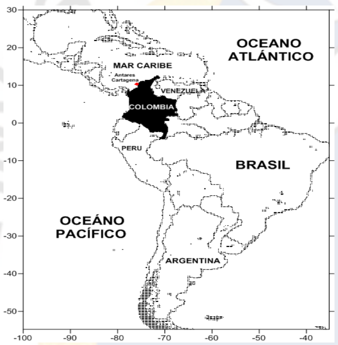

Figure 1. Location Map. Cartagena-Antares Station.

Methodology

Temperature, pressure, salinity, oxygen and chlorophyll (Chl-a) variables were taken with CTDO and Fluorescence profiler. Water transparency was measured by Secchi disk. Temperature, salinity, oxygen and pH of water samples collected at discrete depths were measured using Multiparameter probes (WTW). Water samples were taken with Niskin bottles to determine inorganic nutrients (nitrate, nitrite, ammonium, orthophosphate and silicate), Chl-a and total suspended solids (TSS). The procedure in laboratory was performed using validated methods (Table 1). Data processing includes applying statistical models to determine the oceanographic, biological and physicochemical variability in Station.

Table 1. Variables validated by the laboratory within the Quality Management System. Criterion ISOIEC 17025:2005 Standard.

Variables	Method	Technique	Variables	Method	Technique
Nitrite	Colorimetric. 4500 –NO_2-B. Standard Methods for the Examination of water and Waste Water 22 Edition New York Pp 4-118 a 4-119. Limit of detection 0,0007 mg/L,	Spectrophotometry	Silicate	Mullin and Riley. Parsons, Y, Maita and C,M, Lalli A Manual of Chemical and Bilogical Methods for Sea water Analysis, First Edition 1984, reprinted 1985,1989 with corrections, Gran Bretaña.	Spectrophotometry
Nitrate	Cadmium Reduction. 4500-NO3 E. Standard Methods for the Examination of Water and Waste Water 22 Edition New York Pp 4-123 a 4-125. Limit of detection 0.0006 mg/L.	Spectrophotometry	TSS	Filtration and Secado a 104°C ± 1°C APHA, AWWA, WEF, 2005 Standard Methods For The Examination of Water And Waster Water, 22th edition, Washington, DC 2540 D. Pp 2-58 a 2-59.	Gravimetry
Orthofosfate	Ascorbic Acid. 4500-P E Standard Methods for the Examination of water and Waste Water 22 Edition New York Pp4-153 a 4-154. Limit of detection 0,0093 mg/L	Spectrophotometry	Chl-a	Trichromatic – Extraction with acetone 90%,APHA-AEEA-WEF, 2005, Standard Methods for the Examination of water and Waster Water, 22th edition, Washington, DC 10200 H Pp 10-18 a 10-20 y Lorenzen (1967).	Spectrophotometry / acidificatioon Spectrophotometry
Amonia	Alternative Method. Detection Level 0,0009 mg/L T,R, Parsons, Y, Maita and C,M, Lalli A Manual of Chemical and Bilogical Methods for Sea water Analysis, First Edition 1984, reprinted 1985,1989 with corrections, Gran Bretaña.	Spectrophotometry			

Results

Up to-date 13 cruises have been carried out and recorded the information of 12 variables. After standardizing the CTDO and fluorometer profiles, association was observed between temperature-oxygen and salinity–Chl-*a*. This association was defined in four groups that clearly reflect seasonality in the station(Fig. 2a). The first group associated temperature (red) in the dry season (Feb., Mar. & Nov.) with a similarity of 79%, followed by 78% in rainfall (Sep., Oct. & May.). The second grouped oxygen (green) in the dry (Feb.-Mar.) and Rain (Apr., Sep. & Oct.) season with 75%. The third grouped salinity (blue) in the rainy season (Apr., Sep. & Oct.) with 67% and the fourth grouped salinity with Chl-a (purple) in the dry season (Feb. & Mar.), followed by the rains (Oct. & Sep.) with 63 %.

On the other hand, the variables considered as recorded depths and observations considered as the data obtained from 13 cruises (Fig. 2b), showed four groups. The first (red) clusters salinity with Chl-a during transition period (May. & Jul.) with a similarity of 88%. The second (green) grouped temperature with 78%. The Oxygen, was grouped in the third (purple) with 69 % and the last group (ochre) was the Chl-a and turbidity during the rainy season (Sep. & Oct).

Also seasonality at station was observed with *in situ data,* temperature, pH, salinity, SST, Chla-*a*, oxygen, transparency and first optical depth (Fig. 2c) . The period of transition (red) grouped the sampling of Jul.-08-11-12, Abr.-12 and May.-09 with 67%; the dry (green) Mar.-09-11, Feb.-11and Nov.-12 with 69% and rain (ochre) the sampling of Sep.-10-12 and Oct-12 with 70% .

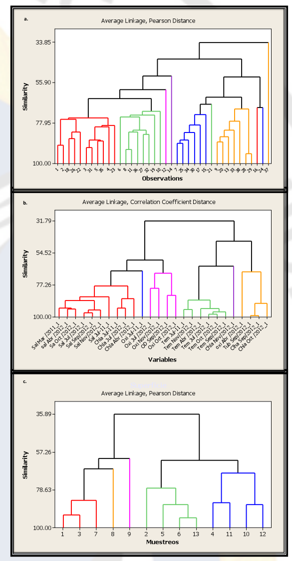

Figure 2. Analysis of data classification CTDO profiles and Chl-a profiles using the average linkage method and correlation of Person to Cartagena Antares Station 2009-2012. Where: a) Cluster observations b) cluster variables, c) cluster variables *in situ*.

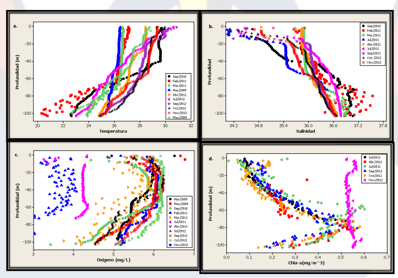

Figure 3. CTDO profiles of Cartagena Antares station. Where: a) Temperature b) Salinity, c) Oxygen, d) Chl-*a*.

The modeling profiles-Chl-*a* showed a greater variability in the location of the maximum with respect to fluorometer. In most cases the maximum Chl-*a* was maintained between 40 and 80 m. The highest concentrations were observed during the rainy season, lower in dry season and intermediate in the transition period (Fig. 4).

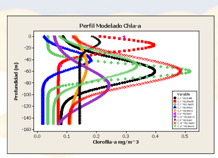

Figure 4. Modeling *ProfilesChla-a* with *in situ* data.

The temperature was about 26°C, from the surface to 40 m during the dry season (Mar. & Feb.). This temperature then increased to 28°C during the transition period (May. & Abr.) and reached up to 36ºC during the rainy season (Sep. & Oct.). From 40 m to 100 m, the profile decreased in all cases on average 7ºC (Fig. 3a). The salinity between 0 and 20 m recorded the lowest values of the entire series (24-34) during the rainy season (Sep. & Oct.). With increasing depth, the salinity increased in all profiles; the highest salinity (37.5) was during dry period (Feb.-11). The highest concentrations of oxygen were between 20 and 60 m in most of the profiles (Fig. 3c). In rainy season (Sep.,Oct. and Nov.) the maximum was between 50 and 60 m, while in the dry season (Feb,and Mar.) was between 20 and 40m. With the exception of November, the highest concentrations of Chl-*a* in the seris analyzed were between 40 and 80 m depth (Fig. 3d), but in Apr., considered a transition month, the maximum was located deeper(90 m).

Conclusions

The Cartagena station has been operation not for too long and therefore it doesn't consider all variables of Antares Network yet. Clearly, the Cartagena station needs to expand the current scope compared to the Antares Network. This would permit providing data to the scientific community devoted to investigate climate variability.