

The CARIACO (CARbon Retention In A Colored Ocean) Time Series Program

University of South Florida, College of Marine Science

NSF Final Report for Award # 0326268

Period Covered:

October 2003 – September 2010

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SUMMARY

This document summarizes the findings of the CARIACO (CARbon Retention In A Colored Ocean) Program conducted by the University of South Florida (USF) for the period 2003-2010, as supported by the National Science Foundation Grant No. 0326268. Monthly observations were carried out at 10°30'N, 64°40'W, which collected hydrographic and biogeochemical data throughout the water column. In addition to these monthly observations, the CARIACO time series program included seasonal cruises to examine microbial processes (SUNY group) and the servicing of a sediment trap mooring (U. South Carolina). This mooring included five sediment traps (150, 226, 407, 807, and 1,205m) which provided bi-weekly sample collections at each depth. The physical oceanography component of the CARIACO program, which included a moored current meter, lasted through May 2008; the moored current meter had been in place gathering an almost uninterrupted record since 2002. To complement these observations, a bottom-mount ADCP was deployed in the Tortuga navigation channel between November 2009 and May 2010. A Lowered ADCP (LADCP) was also added to collect current profiles from the surface (~5m) to intermediate depths (~400m) during the core monthly time series cruises. A total of six regional basin-wide cruises were conducted during this funding period to better understand spatial variability during the rainy (September 2003, 2006, 2008) and upwelling (March 2004, 2006, 2009) seasons. An annual CARIACO All-Hands meeting was held in Margarita Island every May to review scientific achievements and discuss current issues with the CARIACO time-series with regards to funding, logistics, and other problems.

Scientific CARIACO findings were presented at over 30 National and International scientific conferences within the funding period. Over 50 peer-reviewed articles were published between 2003 and 2010 as a result of this support. CARIACO served as a community facility since its inception and continues to do so.

INTRODUCTION

The CARIACO time-series project has been collecting measurements in the Cariaco Basin ($10^{\circ} 30' N$, $64^{\circ} 40' W$) since November 1995. The Cariaco Basin is a 1,400-m deep depression of tectonic origin located off the coast of Eastern Venezuela. The basin is openly connected to the Caribbean Sea by two shallow (~ 140 m) sills, one to the north and one to the northwest (Figure 1). Time-series cruises to the CARIACO station were carried out monthly to collect a series of “core” observations. Additional cruises were conducted at a frequency varying between bi-monthly and seasonally to collect zooplankton samples and perform microbial process studies, as well as to service two moorings, one holding a series of sediment traps at different depths and one holding acoustic current meter profilers.

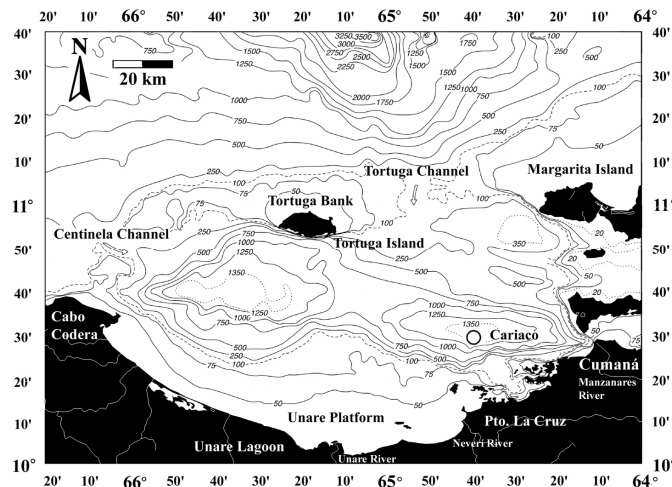


Figure 1: The Cariaco Basin. Location of the CARIACO time-series station is indicated (from Muller-Karger et al., 2001)

During each monthly core cruise, a set of key parameters (Table 1) is collected. This includes a series of CTD casts to obtain profiles of temperature, salinity, dissolved oxygen, a variety of chemical species, primary productivity, particle concentration, optical parameters and other variables to address ecological processes. Between 2003 and 2010, a total of 80 core cruises were completed. In addition, six basin-wide cruises were conducted to address spatial variability and basin-wide processes that affect the observations at the CARIACO Time-Series site.

The CARIACO data are publicly available via several Internet servers. Initially, data are posted at <http://www.imars.usf.edu/CAR/index.html>. Upon passing quality control, within periods ranging from weeks to about 6 months depending on the difficulty of processing an observation. CARIACO data are now also available through the OCB Data Management Office (BCO-DMO), <http://osprey.bcodmo.org/project.cfm?flag=viewd&id=12>, <http://mapservice.bco-dmo.org/maps-bin/global/map>, and in a Spanish language website through the INTECMAR/USB server in Venezuela (<http://cariaco.intecmar.usb.ve/>).

Table 1: List of parameters collected during each CARIACO cruise, the depth range, instrument, and processed data available online.

Parameter	Depth Range	Instrument/Method	Processed Data (Cruise No. or year)
1. Continuous Parameters			
Pressure (Depth)	0-1310 m	SBE-25 (SeaBird)	1-157
Temperature	0-1310 m	SBE-25 (SeaBird)	1-157
Conductivity (Salinity)	0-1310 m	SBE-25 (SeaBird)	1-157
Dissolved Oxygen	0-1310 m	SBE-43 (SeaBird)	1-157
Fluorescence (Chl)	0-1310	Fluorometer	1-157
Beam attenuation (c660)	0-1310	C-Star (WetLabs)	1-157
2. Water Column Chemical Measurements			
Dissolved Oxygen	0-1310 m	Titration	1-157
DOC & TOC	0-1310 m	High Temp Comb	1-63; 110-157
Total Alkalinity	0-1310 m	Gran Titration	1-157
pH	0-1310 m	Spectrophotometer	1-157
Salinity	0-1310 m	Guildline Portasal 8410	1-157
Nitrate	0-1310 m	Autoanalyzer	1-157
Nitrite	0-1310 m	Autoanalyzer	1-157
Ammonia	0-1310 m	Autoanalyzer	1-157
Phosphorus	0-1310 m	Autoanalyzer	1-157
Silicate	0-1310 m	Autoanalyzer	1-157
Diss. Org. Nitrogen	0-1310 m	Persulfate oxidation	102-137
Diss. Org. Phosphorous	0-1310 m	Persulfate oxidation	102-137
Partic. Organic Carbon	0-1310 m	High Temp Comb	1-148
Partic. Organic Nitrogen	0-1310 m	High Temp Comb	1-148
3. Biomass Measurements			
Chl. <i>a</i> and Phaeopig.	0-100 m	Fluorometry	1-157
Bacteria	0-1310 m	(Various/SUNY)	(see SUNY report)
4. Carbon Assimilation and Particle Flux			
Primary Production	0-100 m	¹⁴ C	1-157
Bacterial Production and Respiration	0-1310 m	(Various/SUNY)	(see SUNY report)
Protozoan grazing	0-1310 m	(Various/SUNY)	(see SUNY report)
5. Optical Measurements			
Incident Irradiance	Surface	Spectrascan	1-157
Upwelling Radiance and Downwelling Irradiance	0-150 m	PRR-600	1-144 (some months missing due to instrument repair)
6. Moored Instruments			
Sediment Traps	150, 275, 450, 900, 1200	(U. South Carolina)	(see USC report)
Acoustic Doppler Current Profiler (ADCP)	<200 m	ADCP (RDI)	1996-1998; 2002-2008
Lowered ADCP	1-400 m	WH Sentinel 300 (RDI)	2005-2009

FINDINGS AND RESULTS

Over the seven years covered by this funding cycle, CARIACO has advanced knowledge about several oceanographic processes that required observation using a time-series. These findings span all disciplines. The project has brought together a unique group of international and diverse researchers that strive to achieve scientific excellence under various situations that are often challenging.

Below are some of the scientific highlights of the CARIACO program:

- 1) Documented the primary annual upwelling event that characterizes the southern margin of the Caribbean Sea. Sea surface temperature is minimal in Feb-Mar and highest in Sep-Oct, following the seasonal migration of the Intertropical Convergence Zone, the cycle of Atlantic Ocean water mass movements, and the seasonal upwelling occurring along the southern Caribbean margin. We have demonstrated how the circulation is affected by the wind and regional currents, including eddies. Upwelling is forced by the Trade Wind and Caribbean-scale wind curl, but also by eddy migration through the Caribbean.
- 2) Annual surface temperature minima have increased over time, with average annual temperatures rising over the period of the time series.
- 3) Upwelling weakened in 2002-2006 relative to 1996-1999, with some recovery after 2006. This weakening is thought to be linked to changes in atmospheric circulation in the tropical north Atlantic, where a weakening of the subtropical high pressure system led to decreased northeasterly trade wind intensity and an anomalous warming of the sea surface. This warming induced an early northwards migration of the ITCZ, which led to severe droughts in the Amazon region. The period 2007-2010 showed a slight strengthening of the upwelling compared to the previous three years. Sea surface temperature in 2007 was the lowest observed in this period, showing also the highest primary productivity. 2005 was the warmest and least productive upwelling season since the program started in 1996 (Table 2, Figure 2).
- 4) A secondary upwelling period and annual production peak were identified in Jul-Aug, with implications for regional fishery science. However, this secondary upwelling has been consistently warmer and shorter since 2005.
- 5) Upwelling delivers high DIC and CO₂ fugacity into the euphotic zone from a lateral source (Subtropical Underwater). Surface fCO₂ always remains near or above atmospheric values, and yet evasion of CO₂ has decreased slightly in 10 years, due to weaker upwelling and higher atmospheric pCO₂.
- 6) A nitrogen fixation signal, which is recorded in sediments, is imported with Subtropical Underwater, rather than produced locally as suggested earlier by Walsh (1996).
- 7) On average, newly produced Particulate Organic Matter (POM) has a Si:C:N:P ratio that is consistent with the Redfield ratio. This ratio increases with depth within the oxic portion of the water column due to preferential removal of N and P relative to Si and C, but then stabilizes within the anoxic zone.
- 8) High particulate Si:N ratios and an abundance of dissolved inorganic nitrogen in surface waters suggest that silicate concentrations limit diatom production most severely during upwelling.

- 9) At present, terrestrial organic carbon input is minor, but input of other lithogenic material is significant. Particulate inorganic phosphorus (PIP) is delivered seasonally to the Cariaco Basin via river input, and is remineralized in oxic and anoxic conditions.
- 10) POC flux is poorly related to productivity, but closely related to ballast materials.
- 11) POC flux profiles are similar to those seen in oxic environments, suggesting similar remineralization rates in both environments and that high temperature in Cariaco deep waters compensates for low O₂.
- 12) Fe and Mn concentrations in the basin's anoxic portions vary by a factor of two, apparently in response to terrestrial input.
- 13) Inputs of terrigenous Fe are important in controlling H₂S in deep waters.
- 14) Depth of the oxic/anoxic interface has fluctuated between 250 and 375 m, with interannual variation in ventilation (Table 3). Ventilations have been observed between 150-350m, and were potentially linked to events in the Caribbean, such as eddies. There has been a notable reduction in ventilation frequency since they were first documented in 1997. Low O₂ conditions (<100 μM) have been seen as shallow as 50 m. Variability in suboxic zone thickness and in the depth at which H₂S first appears is controlled by oxidant supply from Caribbean water intrusions.
- 15) Seasonal changes in the composition of material delivered to the seafloor result in the annual deposition of normally one light (biogenic-rich) and one dark (lithogenic-rich) lamina.
- 16) Highest phytoplankton abundance has been documented to occur during the first half of the year, where large cells (mainly diatoms) dominate. During the rainy period (second half of the year), smaller cells dominate the population (mainly microphytoplankton). However, during the last 5 years, a change in population has been observed, with diatom abundance decreasing during the upwelling period. Whether this decrease is linked to the weaker upwelling is still unclear. This change affects the food chain and carbon cycle.
- 17) Annual integrated primary production values have remained high over the past 10 y (within 530±100 gCm⁻²y⁻¹), but the phytoplankton community composition changed from diatom-dominated before 2000 to a community of smaller flagellated cells since 2000. Figure 2 shows that, while there was a decrease in productivity during the upwelling period (Jan-Mar) between 2004 and 2006, it seemed to have recovered since 2006. However, the pronounced productivity peaks observed in the first five years of the program have not been observed since 2002.
- 18) A decrease in chemoautotrophic bacterial production has been observed since 1997.
- 19) Zooplankton diversity is high within the basin, with copepods being the most abundant group. Zooplankton abundance maxima also occurs during the first half of the year
- 20) Transient events (phytoplankton blooms, earthquake-induced turbidity flows, coastal flooding) result in the rapid delivery of large sediment and POC volumes to the sea floor, and may account for a significant fraction of the overall sediment record and for large changes in water chemistry.
- 21) Fish migration into the anoxic region of the basin was first documented in 1979; time-series ADCP data provided evidence of the multi-decadal presence and migratory behavior of these species which dive to depths of more than 600m. We have evidence that various zooplankton species also migrate daily into the anoxic zone.

- 22) Microbial populations in the redox transition zone receive significant lateral inputs of oxidant and reductant. Vertical fluxes may be secondary. Sources of reductant include the shallower sill areas. Intermediate oxidation state sulfur compounds (especially thiosulfate and elemental sulfur) appear to be most important for the microbial loop. Understanding external supplies of water to the deep basin is critical to explain the linkages between the subtropical Atlantic and the Cariaco sediment record.
- 23) Inertial motions play an important role in defining water motion in the basin.

Table 2. Basic parameters characterizing upwelling periods at the CARIACO station during January-March: surface temperature and average primary production.

Year	Surface Temperature (°C)*	Primary Production (mg/C/m ² /d)♦	Upwelling Strength
1996	23.3	1998.89	Normal
1997	22.93	2633.19	Strong
1998	23.9	1732.30	Weak
1999	23.38	2460.98	Normal
2000	23.9	1824.70	Normal
2001	21.54	3041.55	Strong
2002	23.32	2517.39	Normal-strong
2003	22.81	2358.19	Normal-strong
2004	24.51	1579.18	Weak
2005	25.52	1100.98	Weak
2006	23.88	1578.07	Weak
2007	22.93	2501.13	Normal
2008	24.36	1445.16	Weak
2009	24.26	1596.85	Weak
2010	24.78	1416.96	Weak

* Average sea surface temperature (1-25m) for the months of January-March

♦ Integrated primary production (0-100m) for the months of January-March

Table 3. Dates of observed ventilations at the CARIACO time-series station.

Date	Date
7-Jan-97	5-May-01
13-Feb-97	10-Jul-01
23-Feb-97	7-Aug-01
17-Jun-97	12-Mar-02
17-Aug-97	3-Oct-02
14-Oct-97	7-Nov-02
17-Dec-97	8-abr-03
11-Feb-98	10-Jun-03
12-Mar-98	13-Ene-04
9-Jun-98	5-Oct-04
4-Apr-01	13-Jan-09
	9-Feb-09

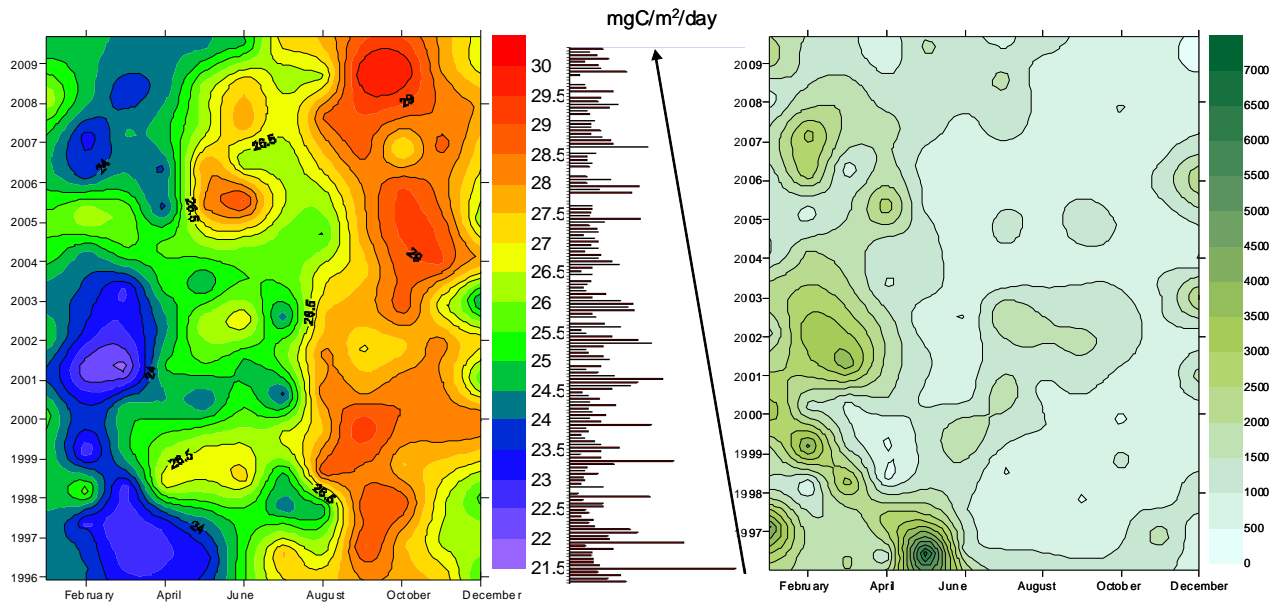


Figure 2: Sea surface temperature (left, °C), primary production (center, $\text{mg C m}^{-2} \text{d}^{-1}$) and surface *in situ* chlorophyll a (right, mg m^{-3}) at the CARIACO Time-Series site.

Spatial cruises: COHRO, CASEP and FOSA

The COHRO (2003-2004), CASEP (2006) and FOSA (2008-2009) regional cruises were designed to explore the spatial variability of biogeochemistry and hydrography of the Cariaco Basin, to further our understanding of changes that could be influencing the Time-Series site.

COHRO1 & COHRO2

COHRO (1 and 2, carried out during September 2003 and March 2004, respectively) had as main objectives (1) gauging the importance of local riverine discharge on the Cariaco Basin vs. larger, more distant rivers (e.g. Orinoco) and (2) understanding the characteristics and distribution of the upwelling in the Eastern Cariaco Basin. Results from this cruise confirmed earlier studies done by satellite remote sensing that no direct influence from larger South American rivers was observed inside the Cariaco Basin. Instead, smaller, local rivers exert a considerable influence, both in the sediment transport to the basin and on the optical properties of the adjacent Unare Shelf waters, especially during the rainy season. At the CARIACO station, the lowest salinity was consistently recorded during September, a period when local rivers such as the Unare and Neveri reached maximum water discharge rates.

During the March 2004 cruise, representing an upwelling period, temperature and salinity were extensively mapped to document the entrance of Subtropical Underwater from the Caribbean Sea into the Cariaco Basin. The main upwelling focus, the Gulf of Santa Fe, was identified and sampled for nutrients, phytoplankton and dissolved organic carbon (DOC). The temperature and salinity difference between the rainy and the upwelling season throughout the Eastern Cariaco basin for the COHRO campaigns is shown in Figure 3. During the rainy season, temperatures were $\sim 2^\circ\text{C}$ higher than in the dry season, whereas salinities were ~ 0.1 lower.

The deep colored dissolved organic matter (CDOM) pool increased threefold below the oxic-anoxic interface, due to the slow turnover of the basin and to the rapid decomposition of organic matter that occurs in this region.

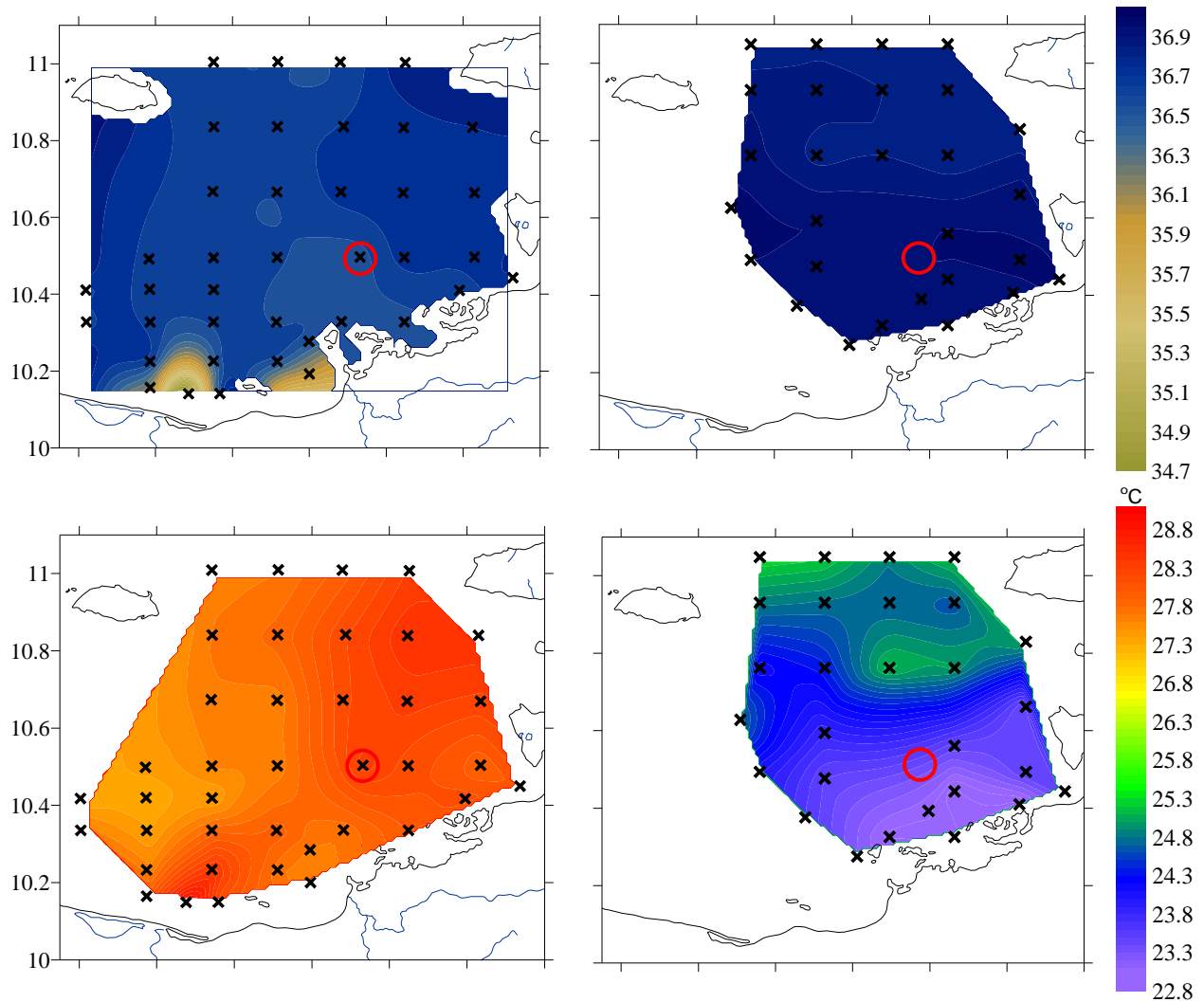


Figure 3. Surface salinity (top) and temperature (bottom) in the Cariaco Basin measured during the September 2003 (left) and March 2004 (right) COHRO cruises. Red circle indicates location of the CARIACO Time-Series station.

CASEP1 & CASEP2

The CASEP cruises (1 and 2, carried out during March 2006 and September 2006, respectively) sought to provide a better understanding of the role of local river discharge in terms of sediment deposition on the Unare Shelf, how it may be transported to the deep Cariaco Basin, and to obtain a better grasp on water circulation inside the Basin. CASEP 1 visited, for the first time in over 10 years, the Western Cariaco Basin. Between March 15-19 2006 a total of 60 stations, both hydrographic and for sediment collection were occupied in the Western Cariaco Basin. One of the objectives of this campaign was to sample the Western Basin during upwelling and compare its hydrographic and chemical characteristics to the Eastern basin. Figure 4 shows salinity and temperature maps for the two cruises.

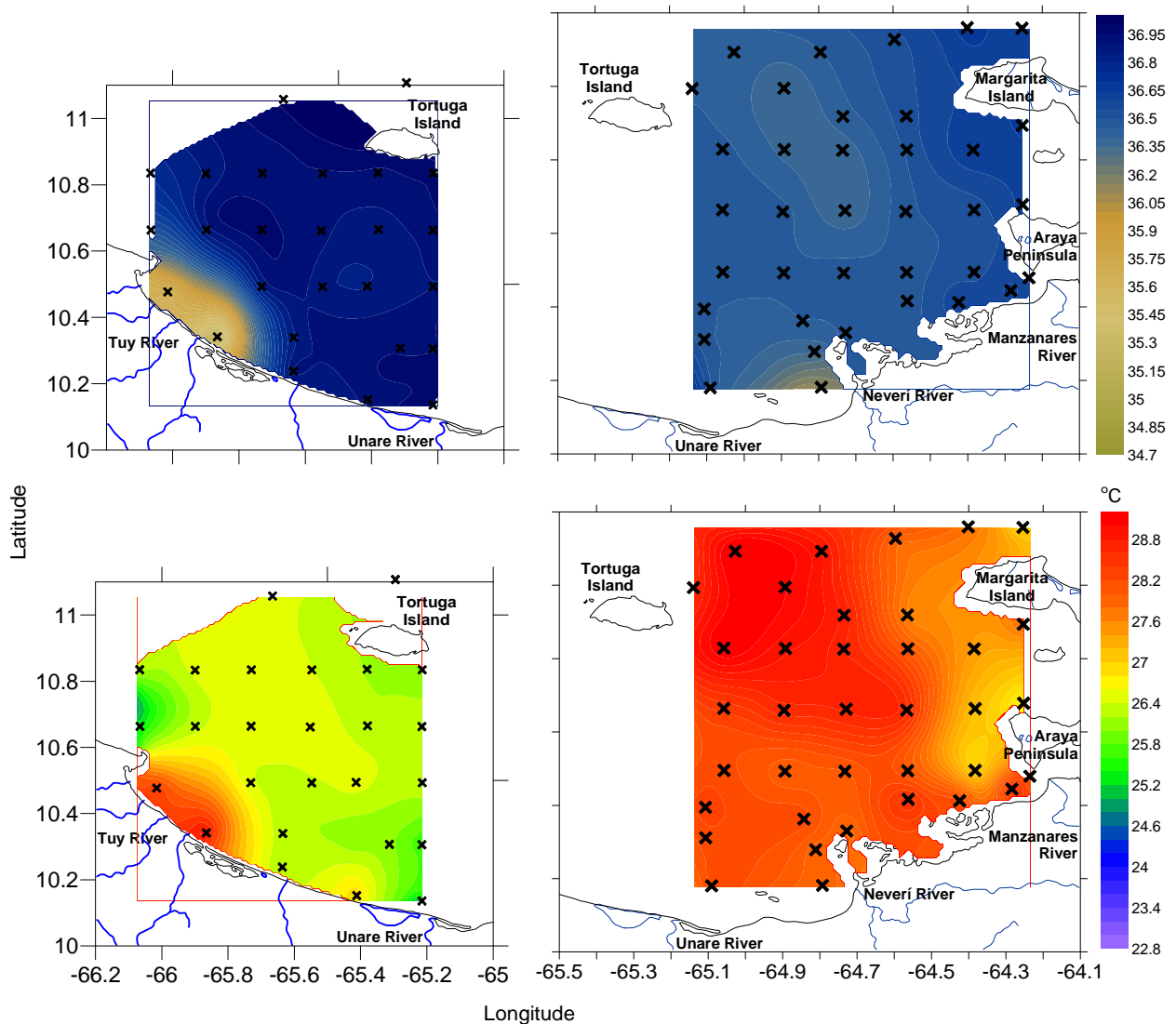


Figure 4. Surface salinity (top) and temperature (bottom) in the Cariaco Basin measured during the March 2006 (left) and September 2006 (right) CASEP cruises.

The most striking feature during the CASEP1 campaign was the influence of the Tuy, Curiepe and Capaya rivers on the Western Basin. Although March is the dry season, these rivers received enough serviced water from the Venezuelan capital, Caracas, to impact the chemical and hydrographical features of the Basin. During CASEP 2 (September 25-30, 2006) the same stations covered during COHRO 1 and 2 were revisited, as well as some additional stations close to the local rivers. A total of 60 stations were sampled for hydrography and sediment. The objectives of CASEP2 were similar to those of CASEP1, but we also sought to compare COHRO1 with CASEP2, two cruises carried out in the same location 3 years apart. We wanted to further study bottom nepheloid layers (BNL's), first observed during 2003, that span from the mouth of local rivers to the shelf break and represent a potential source of carbon and sediment to the deep basin. Because CASEP stations did not get as close to the coast as COHRO, the salinity signal from local rivers was not as apparent. However, near the southern border of the Basin, salinities were close to 36.0. The differences observed between surface temperature measurements in 2003 and 2006 could be attributed to local circulation patterns. In both years, the highest salinities were recorded south of Margarita Island. During CASEP 2, it was also determined that local rivers did not seem to be a large source of dissolved organic carbon to the Eastern Cariaco Basin, but instead appeared to contribute particulate organic carbon (POC). This POC input is mainly confined to the Unare shelf.

Lowered Acoustic Doppler Current Profiler (LADCP) measurements were also taken at 11 stations throughout the basin during CASEP2, in order to shed more light to the internal circulation of the basin and how it compares to processes occurring in the open Caribbean Sea. Two gyres were identified, one in the western and one in the eastern Basin.

FOSA 1 and FOSA2

The FOSA basin-wide cruises explored the biogeochemistry and hydrography of the Cariaco Basin in one single cruise. This was the first synoptic sampling of the basin. Of interest in the Western Basin is the entrance of water through Centinela Channel (Alvera-Azcárate et al., 2008), which affects the biology and chemistry of the Eastern Basin.

FOSA 1 was carried out in September 2008, covering the peak of the rainy period, while FOSA 2 was in March 2009, covering the upwelling period. Both the rainy period of 2008 and the upwelling of 2009 were different than expected. During 2008, heavier than normal precipitation affected the region and sea surface temperature was elevated. During March 2009 winds from the north dominated, rather than the easterly winds that are characteristic for this season (Figure 5). Upwelling was weak (Table 2). Some of the objectives of the FOSA cruises included:

1. Characterization of the hydrography and chemistry of the basin, including temperature, salinity, oxygen and inorganic nutrients.
2. Mapping of the currents around the basin, especially in the navigation channels and closer to the coast.
3. Analysis of the TCO_2 and $f\text{CO}_2$ distribution, in particular the influence of the local rivers and upwelling on these parameters.
4. Spatial and seasonal distribution DIN in the Basin, including N-isotopes.
5. Seasonal surface DOC distribution and contribution from local rivers.
6. Composition and transport mechanism of material from the coast (nepheloid layers).

7. Seasonal and spatial variability of phytoplankton species.
8. Basin-wide chlorophyll and zooplankton distribution.

The lower salinity from the Tuy/Curiepe/Capaya river plume was visible in the western basin influencing even areas westward out of the Cariaco Basin (Figure 5). The Neverí and Unare river plumes also showed lower temperature than the surface basin waters, but did not have as clear a salinity signal as the Tuy, the largest river in the region (Table 4).

The FOSA cruises showed that during the upwelling period, the western basin experienced a moderate decrease in temperature of $\sim 3^{\circ}\text{C}$ relative to the summer months, while the eastern basin showed SST over 5°C cooler (Figure 5). Large differences were visible in the distribution of nutrients and chlorophyll (lower in the western basin as compared to the eastern).

Current measurements carried out throughout the FOSA 1 and 2 cruises matched the modeled currents for the Cariaco Basin published by Alvera-Azcárate et al. (2008). During the rainy season, waters entered the basin through the Centinela Channel and moved from west to east, exiting through the Tortuga Channel. During the upwelling period, waters entered the basin through the Tortuga Channel from the north. Our current measurements carried out with the LADCP matched this pattern.

Table 4: Characteristics of main rivers feeding the Cariaco Basin

River	Drainage Area (10^3 Km^2)	Flow rate ($\text{m}^3 \text{ yr}^{-1}$)	Load ($\times 10^6 \text{ t yr}^{-1}$)
Tuy	6.6 ^a	2.59 ^a	12 ^c
Unare	22.5 ^b	1.98 ^b	1.12 ^b
Neverí	3.9 ^a	1.10 ^a	0.29 ^c
Manzanares	1.0 ^a	0.69 ^a	0.2 ^c

^a Zink, 1977

^b INIA-MARN, 2003

^c Milliman and Syvitski, 1992

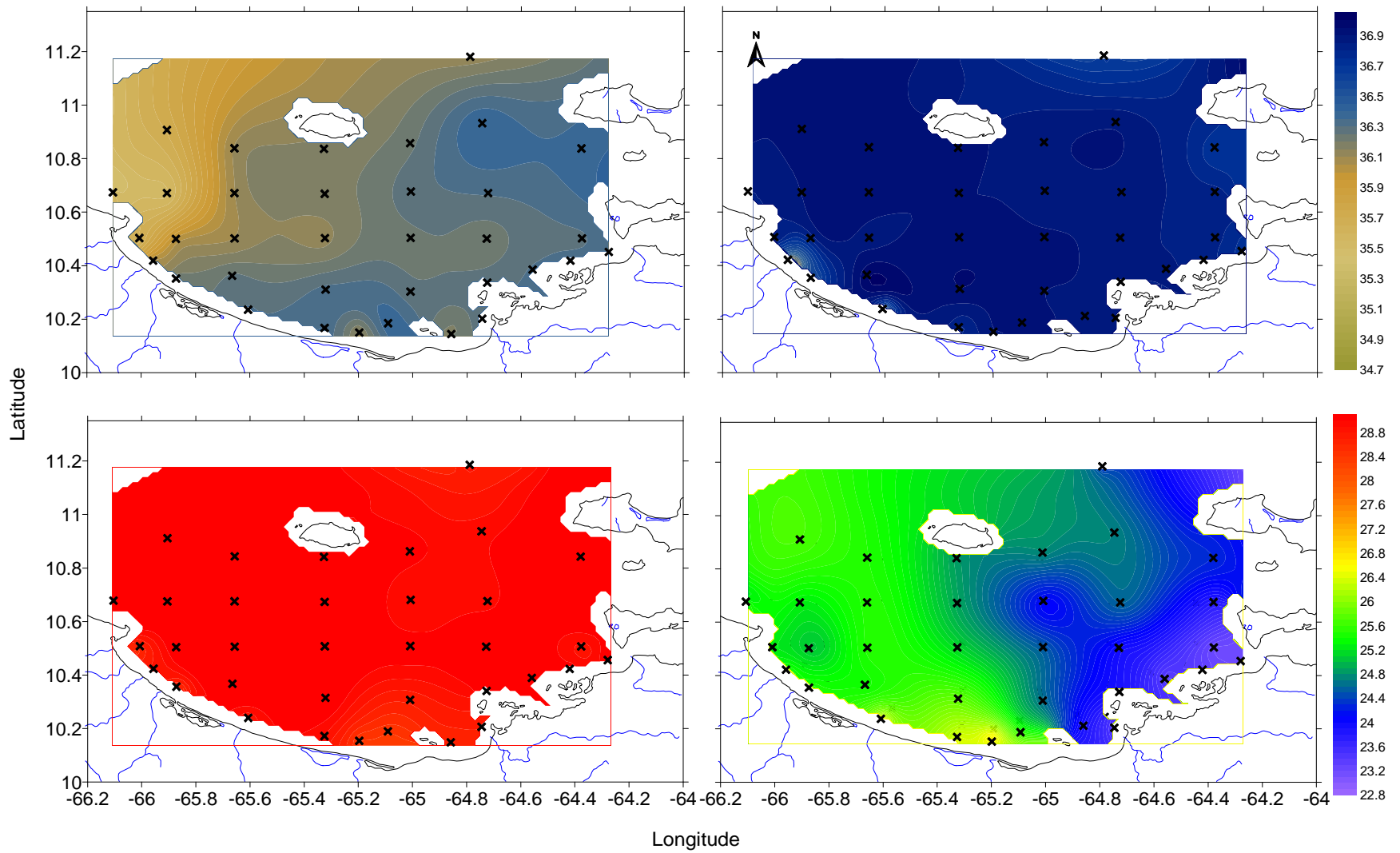


Figure 5. Surface salinity (top) and temperature (bottom) in the Cariaco Basin measured during the September 2008 (left) and March 2009 (right) FOSA cruises.

ALL HANDS MEETINGS

CARIACO held annual 'All Hands Meetings' in Margarita Island, to bring together Venezuelan and U.S. researchers. The meetings were planned to address novel scientific findings and Time-Series issues including funding and logistics. Meeting minutes and presentations were distributed to all participants within a month of the meeting. The 2004 All Hands Meeting commemorated the 100th cruise (May 2004) of the Time-Series. The 2010 All Hands Meeting is scheduled for November 2010, marking the 15 years of CARIACO time series.

US CARIACO PI's met in the US in Columbia, SC, in 2006 and in New Bedford, MA., in 2009, to discuss manuscript preparation and grant status.

CARIACO AT SCIENTIFIC MEETINGS

The CARIACO time-series program has directly participated in more than 30 national and international meetings. CARIACO data have been extensively used and presented by other researchers not directly involved with the program. Below is a summary of CARIACO presentations during the current funding cycle.

2010

- Astor, Y. The CARIACO Time-Series. AGU Meeting of the Americas, Foz do Iguassu, Brazil, August 9-12.
- Scranton, M.I., Y. Astor, X.N. Li, and G.T. Taylor. Sulfur cycling at the CARIACO redox interface: conundrums and surprises. Ocean Sciences Meeting, Portland, Oregon.
- Taylor, G. T., M Lopez-Gasca, A Podlaska, XN Li, L Lorenzoni, D Rueda, F Muller-Karger, R Thunell, K Fanning, R Varela, Y Astor, MI Scranton. Temporal Variations in the Biogeochemistry of the Permanently Anoxic Cariaco Basin. Ocean Sciences Meeting, Portland, Oregon.

2009

- Wakeham, S., Turich, C.; Podlaska, A.; Li, X.; Astor, Y; Varela, R; Gordon, T.; Scranton, M. Stable isotope probing of sulfur-oxidizing chemoautotrophic bacteria in the Cariaco Basin. Chemical Oceanography Gordon Conference.
- Turich, C.; Podlaska, A.; Li, X.; Astor, Y.; Varela, R.; Taylor, G.; Scranton, M. y S. Wakeham. Stable isotope probing of sulfur-oxidizing chemoautotrophic bacteria in the Cariaco Basin. ASLO Aquatic Science Meeting, Niece, France, January 25-30.
- Li, X.N.; Lyons, T.W.; Cutter, G.; Cutter, L.; Scranton, M.I. Biochemistry of sulfur cycling in the Cariaco Basin. Goldschmidt Conference, June 21-26.
- Lorenzoni, L, R. N. Conmy, P. Coble, G. T. Taylor, L. Guzmán, R. Varela, D. Hansell and F. E. Muller-Karger. Colored dissolved organic matter and dissolved organic carbon in the water column and in the bottom nepheloid layers of the Cariaco Basin, Venezuela. OCB summer workshop, Woods Hole Oceanographic Institution, MA. July 20-23.
- Lorenzoni, L, F. Muller-Karger, R. C. Thunell, C. R. Benitez-Nelson, M. Scranton, G. Taylor, R. Weisberg, D. Rueda, E. Montes, E. Tappa, R. Varela and Y. Astor. "CARIACO: 14 years of ocean carbon and biogeochemical observations on a continental margin (10.5°N, 64.66° W; Cariaco Basin). OCB summer workshop, Woods Hole Oceanographic Institution, MA. July 20-23.

2008

- Wang, D; Weisberg, R; Flagg, C; Scranton, M. Deep intrusion in the Cariaco Basin: an Hypothesis. Ocean Sciences Meeting, Orlando, FL. March 2-7.
- Lorenzoni, L.; Hansell, D.; Muller-Karger, F.; Taylor, G.; Varela, R. y Astor, Y. "Dissolved organic matter in the Cariaco basin". Ocean Sciences Meeting, Orlando, Florida, March 2-7.
- Montes, E.; Muller-Karger, F.; Thunell, R.; Hollander, D.; Astor, Y.; Varela, R.; Soto, I.; Lorenzoni, L. Coupling of sinking biogenic particulate fluxes and primary production in the euphotic zone of the Cariaco Basin, Venezuela. Ocean Sciences Meeting, Orlando, Florida, March 2-7.
- Li, X.; Flagg, C.; Wang, D.P.; Weisberg, R.; Taylor, G.T.; Astor, Y.; Fanning, K. and Scranton, M.I. Temporal variability of oxidant and reductant supply to the redox interface in the Cariaco Basin and controls on chemoautotrophy. Ocean Sciences Meeting, Orlando, Florida, March 2-7.
- McConnell, M.C.; Thunell, R.C.; Astor, Y.; Peterson, L.C.; Black, D. and Lea, D. A Multi Proxy approach to assess tropical climate variability during marine isotope stage 3: results from the Cariaco Basin. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Thunell, R.C., Benitez-Nelson, C.; Muller-Karger, F.; Lorenzoni, L.; Fanning, K.; Scranton, M.; Varela, R.; Astor, Y. Silicon cycling in the Cariaco Basin, Venezuela: Seasonal variability in silicate availability and the Si:C:N composition of sinking particles. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Rueda-Roa, D.T.; Ezer, T.; Muller-Karger, F. What drives unusual upwelling patterns in the southeastern caribbean sea? Analysis of local and remote sensing data. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Astor, Y.; Fuentes, G.; Lorenzoni, L.; Guzman, L.; Scranton, M.; Muller-Karger, F. Sinks and sources of CO₂ in a coastal tropical environment: The Cariaco Basin. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Goñi, M.A.; Alleau, Y.; Woodworth, M.P.; Thunell, R.T. High resolution record of organic matter fluxes in the Cariaco Basin over the past two millennia. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Muller-Karger, F.; Varela, R.; Thunell, R.; Astor, Y.; Scranton, M.; Taylor, G.; Lorenzoni, L.; Weisberg, R.; Fanning, K. The Cariaco Ocean Time Series Program. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Herron, S.E.; Benitez-Nelson, C.; Thunell, R. Insights into sediment trap fluxes: possible underestimation of opal flux in the Santa Barbara and Cariaco basins. Ocean Science Meeting, Orlando, Florida, March 2-7.
- Lopez-Gasca, M; Li, X. N.; Podlaska, A.; Taylor, G. T. Anaerobic thiosulfate and sulfur oxidation/disproportionation mediated by autotrophic bacteria in the Cariaco's Basin redoxcline. Ocean Science Meeting, Orlando, Florida, March 2-7.
- García-Amado, M. A., M. Fernández, M. Contreras, L. Bozo, H. Rojas, J. Alfonso, Y. Astor, F. Muller-Karger, F. Michelangeli, P. Suárez. Occurrence of *Helicobacter* spp. DNA in the Coastal Environment of the Caribbean Sea. American Society of Microbiology 108th General Meeting, Boston, MA, June 1-5.

2007

- Astor, Y, Scranton, M., Guzman, L., Muller-Karger, F., G. Taylor, and K. Fanning. Variabilidad de las propiedades bioquímicas de la Fosa de Cariaco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Perez, G., Varela, R., Troccoli, L., Guzman, L., Astor, Y, and J. Gutierrez. Variables Biológicas del Plancton y su relación con la hidrografía en Cariaco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Pérez Castresana, G, L. Guzmán, G. Arias, R. Varela. Relación entre el coeficiente de absorción específica de fitoplancton (a^*_{ph} (440nm)) y la hidrodinámica en la estación CARIACO, durante el periodo 2000-2006. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Lorenzoni, L., Muller-Karger, F., Hollander, D., Tappa, E., Benitez-Nelson, C., Thunell, R., Varela, R., Astor, Y., and Hu, C. Influencia de ríos pequeños en el suministro, y transporte de sedimento hacia la cuenca este de la Fosa de Cariaco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Taylor, G., Scranton, M., Chistoserdov, A., Epstein, S., Lin, X., Suarez, P., Astor, Y., Varela, R., y Muller-Karger, F. Ecología microbiana y biogeoquímica de la interfase de la Fosa de Cariaco: un resumen de la serie de tiempo Cariaco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.

- Fuentes, G.A., Astor, Y. Muller-Karger, F., Lorenzoni, L., and Varela, R. Distribución espacial del flujo de CO₂ en la Fosa de Cariaco, Venezuela. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Lorenzoni, L., Hansell, D., Muller-Karger, F., and Y. Astor. Carbono orgánico disuelto en la Fosa de Cariaco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Klein, E., I. Chollett, y J. Castillo. Dinámica del sistema de surgencia en el oriente de Venezuela mediante el empleo de imágenes satelitales. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Troccoli Ghinaglia, L., R. Díaz-Ramos. Composición, abundancia y estructura comunitaria del fitoplancton en la Fosa de Cariaco (1995- 2007). Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Muller-Karger, F, Varela, R., Thunell, R., Scranton, M., G. Taylor, Astor, Y., Benitez-Nelson, C., Lorenzoni, L., K. Fanning and D. Rueda. Balance del Carbono en la Fosa de Cariaco, Venezuela. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Rueda-Roa, D, R. Weisberg, J. Virmani, A. Alvera-Azcarate, L. Lorenzoni, C. Flagg. Circulación en la cuenca de Cariaco: una sinopsis de los resultados derivados del proyecto CARIACO. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Ojeda, P., R. Thunell, R. Varela, E. Tappa, C. Benítez-Nelson, K., Tedesco, Miguel Goñi. El flujo de partículas hacia los sedimentos profundos en la estación CARIACO. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Ojeda, P., R. Thunell, R. Varela, E. Tappa. Trampas de sedimentos: la relación entre la biomasa y la productividad del plancton con el flujo de partículas en la estación CARIACO. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Rincón, F., Astor, Y., Muller-Karger, F., Varela, R., y A. L. Odriozola. Análisis de los parámetros oceanográficos de la pluma del Río Orinoco. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Varela, R., L. Guzmán, C. Páez, L. Lorenzoni, G. Arias. Propiedades ópticas de las aguas en CARIACO. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Marin, B. Zooplancton de la Fosa de Cariaco. Síntesis y perspectivas. Congreso Venezolano de Ecología, Ciudad Guayana, Venezuela. November 5-9.
- Alvera-Azcarate, A, A. Barth, J. I. Virmani and R. H. Weisberg. A Nested Hydrodynamic Model of the Cariaco Basin: Study of the Hydrography and Interactions with the Open Ocean. AGU Fall Meeting, San Francisco, CA. December 10-14.
- Lorenzoni, L.; Muller-Karger, F; Thunell, R.C.; Tappa, E; Benitez-Nelson,C.; Hollander, D.; Varela, R; Astor, Y. and Hu, C. Importance of bottom nepheloid layers on the transport and delivery of sediment to the eastern Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA, December 10-14.
- Virmani, J. and R. Weisberg. Fish Effects on Ocean Current Observations in the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 10-14, 2007.
- Montes-Herrera, E.; Muller-Karger, F; Thunell, R.C.; Hollander, D.; Astor, Y.; Varela, R.; Soto, I. and Lorenzoni, L. Coupling of sinking biogenic particulate fluxes and primary production in the euphotic zone of the Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA, December 10-14.
- Muller-Karger, F; Varela, R.; Thunell, R.C.; Scranton,M.I.; Taylor, G.T.; Astor, Y.; Benitez-Nelson, C.; Lorenzoni, L.; Tappa, E.; Goñi, M.; Rueda, D.T.; and Hu, C. The CARIACO Time Series: Carbon fluxes in a tropical, continental upwelling margin. AGU Fall Meeting, San Francisco, CA, December 10-14.
- Thunell, R.; F. Muller-Karger; Varela, R., Astor, Y., Scranton, M., G. Taylor, K. Fanning, R. Weisberg; y E. Klein. The Cariaco Basin Ocean Time Series Program: Linking Modern and Ancient Processes. AGU Fall Meeting, San Francisco, CA, December 10-14.
- Peterson, L. C., K. A. Gibson, D. Black, R. C. Thunell, D. Lea and G. Haug. The History and Dynamics of Anoxia in Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 10-14.
- Black, D E. R. C. Thunell, A. Kaplan, E. Tappa and L. Peterson. An Eight-Century High-Resolution Paleoclimate Record From the Cariaco Basin: Baseline Variability and the 20th Century. AGU Fall Meeting, San Francisco, CA. December 10-14.
- Scher, H D. R. Thunell and M. Delaney. An Updated Method for the Measurement of Silicon Isotopes From Opal, Examples From Cariaco Basin Sediment Traps. AGU Fall Meeting, San Francisco, CA. December 10-14.

- Black, D E., R. C. Thunell, L. C. Peterson and D. Lea. High-Resolution Tropical Atlantic Climate Variability During Interstadial-12 from the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 10-14.
- McConnell, M. R. C. Thunell, L. Peterson, D. Black and D. Lea. Tropical Climate Variability During Marine Isotope Stage 3: Results from the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 10-14, 2007.
- Rueda-Roa, D., T. Ezer, F. Muller-Karger. Characterization of a secondary upwelling in the southeastern Caribbean. AGU Fall Meeting, San Francisco, CA. December 10-14, 2007.
- Montes, E., F. Muller-Karger, R. Thunell, D. Hollander, R. Varela, Y. Astor, I. Soto, L. Lorenzoni. Coupling in the euphotic zone of the Cariaco Basin, Venezuela. Ocean Carbon and Biochemistry summer workshop, July 23-26, WHOI, MA.
- Lorenzoni, L., D. Hansell, F. Muller-Karger, R. Varela and Y. Astor. Dissolved organic carbon in the Cariaco Basin. Ocean Carbon and Biochemistry summer workshop, July 23-26, WHOI, MA.
- Scranton, M.I., G.T. Taylor, X.N. Li, R. Weisberg, D-P Wang, C. Flagg, L. Lorenzoni, Y. Astor. Cross-shelf processes as primary sources of oxidants and reductants to the subóxica zone in the Cariaco Basin. IMBER/LOICZ Continental Margin Ocean Science Conference, Shanghai, September 17-21.
- Lorenzoni, L.; Muller-Karger, F.; Varela, R.; Thunell, R.C.; Scranton, M.I.; Taylor, G.T.; Astor, Y.; Benitez-Nelson, C.; Tappa, E.; Goñi, M.A.; Rueda, D. and Hu, C. The Cariaco Oceanographic time series: Carbon fluxes in a tropical, continental upwelling setting". IMBER/LOICZ Continental Margin Ocean Science Conference, Shanghai, September 17-21.
- Astor, Y.M., Fuentes, G., Lorenzoni, L., Guzman L. and Muller-Karger, F. Air-sea CO₂ fluxes in the Cariaco Basin. Surface Ocean CO₂ Variability and Vulnerability Workshop. April 11-14, Paris, France.
- Podlaska A., X Li, P. Suarez, MI Scranton, GT Taylor. In pursuit of the dominant chemoautotrophs in the anoxic Cariaco Basin, Winter ASLO Meeting, Santa Fe, NM, February 9-14.

2006

- Marquez, A., Senior, W., Martinez, G., Castañeda, J, Muller-Karger, F., Varela, R., Ríos, A. Regeneración del carbono en el agua de la Fosa de Cariaco, Venezuela durante el periodo enero 2002-septiembre 2003. Workshop: Oxygen minimum systems in the ocean: distribution, diversity and dynamics. October 24-26, Concepcion, Chile.
- Scranton, MI. The biogeochemistry of the suboxic and anoxic zones in the Cariaco Basin. Workshop: Oxygen minimum systems in the ocean: distribution, diversity and dynamics. October 24-26, Concepcion, Chile.
- Astor, Y. Variabilidad estacional en la estructura hidroquímica de las aguas subóxicas en la Estación Serie de Tiempo Cariaco. Workshop: Oxygen minimum systems in the ocean: distribution, diversity and dynamics. October 24-26, Concepcion, Chile.
- Scranton, M.I. La serie cronologica de CARIACO: algunos resultados. Comisión Nacional de Oceanología of the Ministerio de Ciencia y Tecnología, Caracas, Venezuela. 16 November.
- Lin, X., A.Y. Chistoserdov, M.I. Scranton, R.Varela, G.T. Taylor. Spatio-temporal dynamics of microbial communities in the anoxic Cariaco Basin (Venezuela): Controlled by episodic events or constant environmental variables. ASLO Summer meeting, Victoria, Canada. June 4-9.
- Lin, X., MI Scranton, AY Chistoserdov, R Varela & GT Taylor. Spatiotemporal dynamics of bacterial populations in the anoxic Cariaco Basin: Controlled by episodic events or seasonality? ASLO Summer meeting, Victoria, Canada. June 4-9.
- Chistoserdov, A.Y., V.M. Madrid, T. Luzan, M.M. Richer de Forges, M.J. Rodríguez, D. Gonzales, J.Y. Aller, R.C. Aller, M. Scranton, G. Taylor. Coupling of sulfur, iron, manganese and chemolithotrophy at the redox transition zone. ASLO summer meeting, Victoria, Canada. June 4-9.
- Rodriguez, M.J., A.Y. Chistoserdov, M.I. Scranton and G. T. Taylor. Diversity of bacterial communities across the O₂/H₂S interface of the Cariaco Basin. American Society of Microbiology (ASM) meeting, May 21-25.
- Taylor GT, X Lin, M, Iabichella-Armas, S Epstein, A Chistoserdov & MI Scranton. Glimpses into the black box: lessons from a decade's microbiogeochemical exploration of the Cariaco's redoxcline. Ocean Sciences Meeting, Honolulu, HI, February 20-24.

- Lin X., GT Taylor, MI Scranton & R Varela. Impacts of grazing and anoxia on bacterial taxon richness and activity in the Cariaco Basin's redoxcline. Ocean Sciences Meeting, Honolulu, HI, February 20-24.
- Percy, D; Y. Astor and M. Scranton. Spatial Investigations of Geochemical Variability in the Cariaco Basin. Ocean Sciences Meeting, Honolulu, HI, February 20-24.
- Scranton, M.I., K. Fanning, D. Percy, R. Bohrer and Y. Astor. Long term trends in the Cariaco Basin. . Ocean Sciences Meeting, Honolulu, HI, February 20-24.

2005

- Woodworth, M., Robert Thunell, Miguel A. Goni, and Thomas P. Guilderson. Radiocarbon Measurements of Bulk Organic Carbon in Sinking Particles from the Cariaco Basin. The 10th International Conference on Accelerator Mass Spectrometry, Berkeley, CA. September 5-10.
- Scranton, M.I., Astor, Y. and Fanning, K. Remineralization pathways in the Cariaco Basin. Gordon Conference, Tilton School. Tilton, NH. August 7-12.
- Percy, D.F., G.T. Taylor, Y. Astor and M. I. Scranton. Spatial Investigations of Geochemical Variability in the Cariaco Basin. Gordon Conference, Tilton School. Tilton, NH. August 7-12.
- Scranton, M.I., Taylor, G., Iabichella-Armas, M., Lin, X., Percy, D., Astor, Y. Relación entre geoquímica y microbiología en las Aguas de la Fosa de Cariaco, Venezuela. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11.
- Chollett, I., E. Klein y C. Castillo. Estimación del área de surgencia de la región oriental de Venezuela. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11.
- Rojas, J. and Y. Astor Características de la surgencia en la Fosa de Cariaco. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11.
- Guzman Pocaterra, L. y R. Varela. Factores que regulan la distribución de la biomasa y la producción primaria en la estación Cariaco. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11
- Stavrinaky, A., P. Spiniello y R. Varela. Efecto del microzooplancton sobre el fitoplancton en una zona de surgencia costera como la Fosa de Cariaco. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11.
- Varela, R. y J. Gutierrez. Estudios ecológicos a largo plazo en el medio marino costero, proyectos CARICOMP y CARIACO. Congreso Venezolano de Ecología, Maracaibo, Venezuela. November 8-11.
- Lorenzoni, L., F. Muller-Karger, R. Thunell. E. Tappa, R. Varela and Y Astor. Particulate matter origin, distribution, and fate in the Cariaco Basin, Venezuela. OCCC Workshop, Woods Hole Oceanographic Institution, MA. August 1-4.
- Rondón, A. N., Lewis, M. R., Müller-Karger, F., Varela, R., Troccoli, L. Seasonal variability in phytoplankton species composition in the Cariaco Basin, Venezuela. ASLO 2005 Summer Meeting, Santiago de Compostela, Spain, June 19-24.
- Varela, R., Gúzman, L., Müller-Karger, F. E. The primary production cycle at the Cariaco time-series station, 1998-2003. ASLO 2005 Summer Meeting, Santiago de Compostela, Spain, June 19-24.
- Taylor, G. T., Iabichella-Armas, M., Thunell, R. C., Varela, R., Astor, Y. "Hydrolytic ectoenzyme activity associated with suspended and sinking organic particles in the anoxic Cariaco Basin. ASLO 2005 Summer Meeting, Santiago de Compostela, Spain, June 19-24.
- Klein, E, C. Castillo, I. Chollett and M. Lurgi. CARIACO: un sistema Web para el análisis de datos oceanográficos obtenidos de sensores remotos. Iras Jornadas Nacionales de Geomática, Caracas, September 24-27.
- Chollett, I., C. Castillo and E. Klein. Estimación del área de surgencia costera del oriente de Venezuela. Iras Jornadas Nacionales de Geomática. Caracas, September 24-27.

2004

- Woodworth, M.P., M A Goni, R Thunell, E Tappa. Oceanographic Controls on the Stable Carbon Isotopic Composition of Sinking particles and Surface Sediments in the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Lorenzoni, L., M L McIntyre, Y Astor, R Varela, F E Muller-Karger. The importance of small but local vs. large rivers in the region on the Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA.

December 13-17.

- McIntyre, M.L., L Lorenzoni, R Varela, Y Astor, R Thunell, F E Muller-Karger. Sources of autochthonous and allochthonous particulate material to the Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Martinez, N.C., R W Murray, R C Thunell, L C Peterson, F E Muller-Karger. The Link between Climate and Terrigenous Deposition in the Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Elmore, A.C., R C Thunell, D E Black, R W Murray, N C Martinez. Sedimentological Signatures of Transient Depositional Events in the Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Woodworth, M.P., M A Goni, R Thunell, E Tappa, Y Astor. Major Sterol Fluxes in Sinking Particles and Surface Sediments in the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Truesdale, K., C. R. Benitez-Nelson, R. Styles and E. Tappa. The effect of sediment trap poisons on particulate phosphorus integrity. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Aceves H., Benitez-Nelson, C. R., M.A. Goni, R. Thunell, E. Tappa, F. Muller-Karger, L. Lorenzoni, M. McIntyre, Y. Astor, R. Varela. Seasonal to climate-scale variability in the vertical and burial fluxes of terrigenous organic matter in the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Ranhofer, M. R., C. R. Benitez-Nelson, and R. Thunell. Characterization of phosphorus in sinking particles in Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Scranton, M.I., M. McIntyre, G.T. Taylor, F. Muller-Karger, K., Fanning, Y. Astor. Temporal Variability in the Nutrient Chemistry of the Cariaco Basin. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Taylor, G.T., R. Luerssen, F. Muller-Karger, M.I. Scranton. Toward Resolution of Imbalance between Microbiological Energy Demand and Supply to Cariaco's Redoxcline: Horizontal Productivity Gradients. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Ingall, E., J. Brandes, D. Paterson, P. Northrup and C. R. Benitez-Nelson. Microscale Phosphorus Distribution and Chemistry in Marine Particles: New Insights From X-ray Absorption Near Edge Structure (XANES) Spectroscopy and X-ray Microscopy. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Benitez-Nelson, C. R., L. O. O'Neill, and R. Thunell. Seasonal to interannual depth-dependent changes in phosphorus flux in Cariaco Basin, Venezuela. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Benitez-Nelson, C. R., H. Aceves, M. Woodworth, M.A. Goni, R. Thunell, E. Tappa. Chemical composition of sinking particulate organic matter in the water column, and sediments of the Cariaco basin. AGU Fall Meeting, San Francisco, CA. December 13-17.
- Benitez-Nelson, C. R. The ocean's role in global climate change. AGU Lecturer, National Science Teacher's Association, April, Atlanta GA.
- Benitez-Nelson, C. R. Nutrient Cycling in the Ocean: Why is it important. Celebrating women in science in SC, University of South Carolina, March, Columbia, SC.
- Benitez-Nelson, C. R. Moving beyond phosphate: Are plankton consuming (and sinking) more than we think?, Gordon Conference, Tilton, NH, August 8-13.
- O'Neill, L. P. and C. R. Benitez-Nelson. Sediment trap inorganic and organic phosphorus composition across an oxic-anoxic interface. ASLO Summer Conference, Savannah, June 13-18.
- Ingall, E, J. Brandes, D. Paterson, P. Northrup, C. R. Benitez-Nelson. Examination of marine organic matter using x-ray microscopy and phosphorus x-ray absorption near edge structure (P-XANES) spectroscopy. ASLO Summer Conference, Savannah, June 13-18.
- Hayes, M.K., Taylor, G.,T., Astor, Y., Scranton, M.I. Vertical distributions of thiosulphate, sulfite, and elemental sulfur. ASLO Summer Conference, Savannah, June 13-18.
- Pellechia, P., C. R. Benitez-Nelson, C. R., L. Kolowith, and R. C. Thunell. The use of solid state ³¹P NMR and bloch decays to examine phosphorus speciation in an anoxic marine basin. 45th ENC Experimental Nuclear Magnetic Resonance Conference, Pacific Grove, CA, April 18-24.
- Lin, X., Astor, Y. Scranton, M.I., Taylor, G. Vertical distribution of bacterial populations in the Cariaco basin probed by fluorescent in situ hybridization (FISH). ASLO Summer Conference, Savannah, June 13-18.
- Benitez-Nelson, C. R., L.O. O'Neill, P. Pellechia, and R. C. Thunell. Phosphorus speciation under anoxic conditions: Insights from the Cariaco Basin. ASLO/TOS Ocean Research Conference, Honolulu, HI, February 15-20.

- Scranton, M.I. M. McIntyre, F. Muller-Karger, G.T. Taylor, and Y. Astor. Denitrification and other processes in the suboxic zone of the Cariaco Basin. ASLO/TOS Ocean Research Conference, Honolulu, HI, February 15-20.
- Taylor, G.T., M.I. Scranton, M. Iacichella-Armas, R. Varela, F. Muller-Karger. Energy crisis in the Cariaco Basin's redoxcline: does microbial demand exceed supply? ASLO/TOS Ocean Research Conference, Honolulu, HI, February 15-20.
- Márquez, A., Senior, W. and Martínez, G. Elementos nutritivos en la columna de agua de cuenca de Cariaco, Venezuela. V Congreso Científico de la UDO, Ciudad Bolívar, Venezuela, October 18-22.

2003

- Muller-Karger, F., R. Varela, M. Sctanton, R. Thunell, G. Taylor, Y. Astor, H. Zhang and C. Hu. Procesos de surgencia costera y flujo de carbono en la Fosa de Cariaco. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Astor, Y., M. Sctanton, Muller-Karger, F., R. Bohrer, and J. García. Variabilidad estacional e interanual de la fugacidad del CO₂ en la Fosa de Cariaco. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Goñi, M.A., Woodworth, M.P., Aceves, H., Thunell, R.C., Tappa, E., Black, D., Astor, Y., Varela, R. and Muller-Karger, F. Flujos biogeoquímicos pasados y presentes en la Fosa de Cariaco. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Rueda Roa, D.T. Variaciones horarias de la profundidad del estrato superficial mezclado en la cuenca de Cariaco (Venezuela) y su relación con la intensidad del viento. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Marquez, B. y B. Marín. Abundancia y composición por talla del zooplancton de la Fosa de Cariaco, durante noviembre 2002-mayo 2003. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Varela, R. El proyecto Cariaco, investigación ecológica a largo plazo, desarrollo, ejecución y proyecciones futuras. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Klein, E., Torres, W. Chollett, I., Ruiz, A. and Castillo, C. Dinámica espacio temporal del sistema de surgencias en el oriente de Venezuela. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Castillo, C., Chollett, I. and E. Klein. Sistema web para la visualización y análisis de información oceanográfica: Proyecto Cariaco. V Congreso Venezolano de Ecología, Isla de Margarita, Venezuela. November 3-7.
- Scranton, M.I., Taylor, G.T., Astor, Y., y Muller-Karger, F. The influence of lateral intrusions on the biogeochemistry of oxic/anoxic interfaces. NATO Advanced Research Workshop on Past and Present Water Column Anoxia, Crimea, Ukraine. October 4-8.
- Taylor G.T., M. Iacichella-Armas, R. Varela, F. Muller-Karger, X. Lin y M.I. Scranton. "Microbial Ecology of the Cariaco Basin's Oxic/Anoxic Interface: Report from the U.S.-Venezuelan CARIACO Times Series Program. NATO Advanced Research Workshop on Past and Present Water Column Anoxia, Crimea, Ukraine. October 4-8.

Additionally, over 50 CARIACO peer-reviewed articles were published between 2003-2010, and several others are still pending acceptance.