

THE SOUTH FLORIDA ESTUARINE WATER QUALITY MONITORING NETWORK

FLORIDA BAY
WHITEWATER BAY
TEN THOUSAND ISLANDS
BISCAYNE BAY
SOUTHWEST FLORIDA SHELF

1998 Cumulative Report to:

Everglades National Park
and
South Florida Water Management District

Southeast Environmental Research Center
Florida International University
Miami, FL 33199
<http://www.fiu.edu/~serp>

PROJECT DESCRIPTION

BACKGROUND

This report includes water quality data collected monthly from 28 stations in Florida Bay, 22 stations in Whitewater Bay to Lostmans River, 25 stations in Ten Thousand Islands, and 25 stations in Biscayne Bay. A total of 49 stations on the SW Shelf were collected on a quarterly basis. Figure 1 shows the location of all the fixed sampling stations.

Each of the stations in Florida Bay were monitored on a monthly basis with monitoring beginning in March 1991 at stations 1 through 24. (Except monitoring began at stations 14, 19, 22, and 23 in April 1991). In July 1992, stations 25 through 28 were added in Florida Bay. Monthly sampling of stations 29 through 50 in Whitewater Bay were added to the monitoring program in September 1992. Biscayne Bay monthly monitoring began September 1993 for stations 100-125. In May 1996 an analysis of the data was performed to address the adequacy of spatial coverage. At that time, 10 station locations in the Biscayne Bay monitoring network were moved to provide coverage of North Biscayne Bay. The Southwest Florida Shelf was sampled quarterly beginning in spring 1995. A summary of station locations and sampling POR is shown in Table 1.

ANALYTICAL METHODS

Surface salinity (ppt) and temperature ($^{\circ}\text{C}$) were measured using a combination salinity-conductivity-temperature probe (Orion model 140). Dissolved oxygen (DO , mg l^{-1}) was measured 10 cm below the surface using an oxygen electrode (Orion model 840) corrected for salinity and temperature.

Duplicate, unfiltered water samples were collected from 10 cm below the surface using acetone-washed and sample rinsed 120 ml HDPE bottles and kept at ambient temperature in the dark during transport. Duplicate water samples for dissolved nutrient analysis were collected using sample rinsed 150 ml syringes. Samples were filtered (25 mm glass fiber GF/F) by hand into acetone-washed and sample rinsed 60 ml HDPE bottles, which were capped and immediately placed on ice in the dark for transport. The wet filters, used for chlorophyll *a* (Chl *a*) analysis, were placed in 1.8 ml plastic centrifuge tubes to which 1.5 ml of 90% acetone was added; they were then capped and put into a dark bottle on ice for transport.

Unfiltered water samples were analyzed for total organic carbon (TOC), total nitrogen (TN), total phosphorus (TP), alkaline phosphatase activity (APA), and turbidity. TOC was measured by direct injection onto hot platinum catalyst in a Shimadzu TOC-5000 after first acidifying to $\text{pH} < 2$ and purging with CO_2 -free air. TN was measured using an ANTEK 7000N Nitrogen Analyzer using O_2 as carrier gas instead of argon to promote complete recovery of the nitrogen in the water samples. TP was determined using a dry ashing, acid hydrolysis technique. The APA assay measures the activity of alkaline phosphatase, an enzyme used by bacteria to mineralize phosphate from organic compounds. The assay is performed by adding a known concentration of an organic phosphate compound (o-methylfluorescein phosphate) to an unfiltered water sample. Alkaline phosphatase in the water sample cleaves the phosphate, leaving o-methylfluorescein, a highly fluorescent compound. The fluorescence of initial and 2 hr incubations were measured using a Gilford Fluoro IV spectrofluorometer (excitation = 430 nm,

emission = 507 nm) and subtracted to give APA ($\mu\text{M h}^{-1}$). Turbidity was measured using an HF Scientific model DRT-15C turbidimeter and reported in NTU.

Filtrates were analyzed for soluble reactive phosphorus (SRP), nitrate + nitrite (NO_x), nitrite (NO_2), ammonium (NH_4), and silicate ($\text{Si}(\text{OH})_4$) by flow injection analysis (Alpkem model RFA 300). Filters for Chl *a* content ($\mu\text{g l}^{-1}$) were allowed to extract for a minimum of 2 days at -20°C before analysis. Extracts were analyzed using a Gilford Fluoro IV Spectrofluorometer (excitation = 435 nm, emission = 667 nm) and compared to a standard curve of pure Chl *a* (Sigma).

Some parameters were not measured directly, but were calculated by difference. Nitrate (NO_3) was calculated as $\text{NO}_x - \text{NO}_2$. Dissolved inorganic nitrogen (DIN) was calculated as $\text{NO}_x + \text{NH}_4$. Total organic nitrogen (TON) was defined as $\text{TN} - \text{DIN}$. Concentrations for each of these parameters are reported in this report in units of milligrams per liter (mg l^{-1}) or the equivalent parts per million (ppm), except where noted. All nutrient concentrations are based on the atomic weight of primary nutrient species (ppm-N, ppm-P, and ppm-C), not the molecular weight. Be aware that some previous data provided to Everglades National Park may be in micro-moles per liter (μM). All N:P ratios discussed are calculated on a mole:mole basis.

RESULTS

One of the primary purposes for conducting long-term monitoring projects is to be able to detect trends in the measured parameters over time. These programs are usually initiated as a response to public perception (and possibly some scientific data) that "the river-bay-prairie-forest-etc. is dying". In the case of Florida Bay, the major impetus was the combination of a seagrass die-off, increased phytoplankton abundance, sponge mortality, and a perceived decline in fisheries beginning in 1987. In response to these phenomena, a network of water quality monitoring stations was established in 1989 to explicate both spatial patterns and temporal trends in water quality in an effort to elucidate mechanisms behind the recent ecological change.

This report summarizes the existing data from the South Florida Estuarine Water Quality Monitoring Network. This includes water quality data collected 28 stations in Florida Bay, 22 stations in Whitewater Bay to Lostmans River, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, and 49 stations on the Southwest Florida Shelf (Shelf). Each of the stations in Florida Bay were monitored on a monthly basis with monitoring beginning in March 1991 at stations 1 through 24. (Except monitoring began at stations 14, 19, 22, and 23 in April 1991). In July 1992, stations 25 through 28 were added in Florida Bay. Monthly sampling of stations 29 through 50 in Whitewater Bay were added to the monitoring program in September 1992. Biscayne Bay monthly monitoring began September 1993 for stations 100-125. In May 1996 an analysis of the data was performed to address the adequacy of spatial coverage. At that time, 10 station locations in the Biscayne Bay monitoring network were moved to provide coverage of North Biscayne Bay. The Shelf was sampled quarterly beginning in spring 1995.

Summary statistics of all water quality parameters by ecosystem are shown in Table 2. The median was chosen because it is a more accurate measure of central tendency in non-normally distributed water quality data. The range is expressed as the minimum (Min.) and maximum (Max.) values for the POR, *n* is the number of data points used in the analysis, and ND means data not determined.

Data are also reported as box-and-whiskers plots (Figs. 2 & 3). The center horizontal line of the box is the median of the data, the top and bottom of the box are the 25th and 75th percentiles (quartiles), and the ends of the whiskers are the 5th and 95th percentiles. Outliers were suppressed for graphical purposes. The notch in the box is the 95% confidence interval of the median. When notches between boxes do not overlap the medians are considered significantly different. The box-and-whisker plot is a powerful statistic as it shows the median, range, and distribution of the data as well as serving as a graphical, nonparametric ANOVA.

We have begun the systematic analysis and interpretation starting with the most extensive dataset: Florida Bay. We have analyzed the data for spatial trends, temporal trends, and for freshwater loading effects. Spatial trend analysis can be performed on data of relatively short POR; however, time series analysis requires a minimum 5 year POR before significant trends can be recognized over the background noise of interannual variability. Therefore, the type of analysis performed on each estuary is determined by the length of the POR.

Trend analysis is an ongoing process; ecosystems change with climate and management strategy, therefore, analytical results may change as more data is collected. It is also important to understand that trend analysis alone will not necessarily provide cause and effect relationships. One of the purposes of any monitoring program should be to use the data gained by routine sampling to extend our understanding of the system by developing new hypotheses as to the underlying processes which drive it. Much inference into the behavior of South Florida estuaries can be made from the observed magnitude and distribution of water quality parameters. This type of multivariate approach should prove useful to scientists and managers faced with the task of interpreting large water quality datasets.

Florida Bay: Spatial Analysis

Previous analyses of Florida Bay water quality has shown that Florida Bay is a phosphorus limited marine ecosystem with a tendency towards hypersalinity. A spatial analysis of 6 years of data from our monitoring program resulted in the delineation of 3 subsets of our monitoring stations which have robust similarities in water quality. We have argued that these spatially contiguous groups of stations are the result of similar loading and processing of materials, hence we call these groups zones of similar influence (ZSI). The Eastern Bay ZSI acts most like a "conventional" estuary in that it has a quasi-longitudinal salinity gradient caused by the interaction of clearly definable seawater and freshwater endmembers. In contrast, the Central Bay is a hydrologically isolated area with low and infrequent terrestrial freshwater input, long water residence time, and high evaporative potential. The Western Bay ZSI is the most tidally influenced by the Gulf of Mexico and is also most isolated from direct overland freshwater sources.

The general view of Florida Bay that emerges from this analysis is that of an ecosystem dominated by its restricted hydrology. The shallow banks inhibit water movement within the estuary which results in spatial heterogeneity in water quality. Mixing of freshwater occurs from a northeast-southwest direction. Input of Shelf water occurs via the Western Bay and is slowly transported to the northeast into the Central Bay where, depending upon rainfall, it is either entrained by the flow of water out of Florida Bay or evaporated resulting in hypersaline conditions. In contrast, the mangrove forests of Whitewater Bay to Lostmans River possess a

well developed channel system which culminates in a series of river dominated estuaries. Tidal range and exchange is much greater in this area and results in obvious differences in salinity and nutrient distributions.

Many of the measured parameters had seasonal maxima in the summer rainy season. Obviously, water temperature followed a predictable pattern, with warmer temperatures in summer months, but concentrations of TON and TOC also tended to be greatest in the summer. This may be a result of enhanced decomposition of particulate organic matter in the warmer months or simply the concentration of solute by evaporation (salinity was also higher in the summer). Because of the lack of seasonality of TP and the fact that TON is the major component of TN, TN:TP ratios were also highest in the summer. Indicators of biomass and activity of the phytoplankton, Chl *a* and APA, tended to have maxima in the fall.

Florida Bay: Temporal Analysis

In contrast, some parameters were highest in the winter dry season, such as the TIN pool, turbidity, and DO_{sat}. It is unclear as to what drives this pattern in TIN but it is not due to increased allochthonous loading from streamflow as this is the dry season. It is possible that the lower summer/fall concentrations are due to uptake by phytoplankton or perhaps benthic remineralization as a result of seagrass senescence. Winds during this period are higher than the rest of the year and generally come from the northeast. Higher winds and the long fetch from this direction may result in more resuspension of the fine muds from the bottom of Florida Bay. The DO_{sat} maxima in winter and spring may be due to increased diffusion of oxygen across the air-water interface in the more turbulent and windy seasons, as well as there being less respiratory consumption of oxygen in the cooler months.

After removing the seasonal signal from the time series of water quality data, many aspects of water quality displayed directional change over the period of record of this data set. Three parameters displayed the same long-term trend in all three ZSI: salinity, TP and SRP. Salinity declined in all sections of Florida Bay as a function of variations in climate: the beginning of our data collection coincided with the ending of a regional drought, and the years 1994-96 have all been wetter than normal, but no statistically significant trend was evident. Fresh water enters Florida Bay as rainfall, surface water runoff and groundwater; more rainfall has led to a general increase in the surface water inputs since 1987. Regression of detrended monthly precipitation and combined monthly flows (S18C + Taylor Slough) was significant but explained <2% of the variance, supplying very little predictive power for any type of modeling effort. Full scale prediction of salinities in Florida Bay will require a more detailed assessment of inputs and mixing across Florida Bay

Freshwater entering Florida Bay from overland sources has a lower TP concentration than seawater entering Florida Bay from the Gulf of Mexico and from precipitation. This may help to explain some of the decline in P concentrations in the Bay but without process rate measurements we can only speculate as to the cause. Other water quality parameters had different long-term trends in the different zones (e.g. Chl *a*). These regional differences are the result of the varying importance of freshwater runoff, oceanic exchange, and internal processing of nutrients across Florida Bay and are discussed below.

Florida Bay: Nutrient Loading Analysis

Freshwater flows to the Eastern Florida Bay via Taylor Slough (S175 & S332) and the coastal basin (S18C) fluctuated widely during 1984-96 and were not significantly related to precipitation. However, after 1990, a seven-fold increase in freshwater input was observed. At the same time, the contribution of the S332 to the total flow increased from 47-256 Mm³ yr⁻¹ (17-32%). We believe part of this effect was due to a management strategy of increased pumping at the S332 and that these management efforts were effective in increasing water flow through Taylor Slough. Average annual salinity in Eastern Florida Bay during 1989-96 declined by 18 ppt and was significantly related to increased flow ($r^2=0.75$) but not to precipitation. TP loading ranged from 0.9-7.7 metric tons yr⁻¹ and was significantly related to flow ($r^2=0.82$) with the average concentration being 0.32 μ M (10 ppb). While TP loading increased, ambient TP concentration in Eastern Florida Bay decreased from 0.4 to 0.2 μ M. TN loading ranged from 98.7-635 metric tons yr⁻¹ and was also highly correlated with flow ($r^2=0.92$). Average input TN concentration was 62 μ M while ambient TN concentration in Eastern Florida Bay averaged 55 μ M. Ambient TN:TP ratios in Eastern Florida Bay were maintained at or near the high input TN:TP ratios (mean=224), implying that both the input ecosystem (Everglades) and the receiving waters are P limited. There was no relationship between either TP or TN loading and Chl *a* in Eastern Florida Bay; instead, there was a significant regression with ambient TP concentration ($r^2=0.75$). This indicates that phytoplankton are responding to internally cycled P and not to external loading.

For an estuary to exhibit increased P loading while P concentration declines usually requires an increase in either storage or advection. Chl *a* concentrations decreased in Eastern Florida Bay, indicating that phytoplankton uptake did not account for the decline in P in this zone. An increase in seagrass cover or greater binding to sediments with decreased salinity could possibly account for this decline but has not been quantified. We believe the answer lies in the fact that the TP concentration of the incoming freshwater is approximately equal to ambient TP concentrations in the Bay. We propose that management activities to increase input of freshwater from Taylor Slough and the coastal basin may have effected a significant decline in both salinity and TP concentrations in Eastern Florida Bay via simple dilution.

All the above results point to the simple conclusion that Florida Bay is not like other estuaries of the eastern USA. Many people continue to believe the dogma that Florida Bay is a eutrophic ecosystem polluted by nutrient runoff from agriculture. Were it not for the Everglades marshes, this might indeed be true. We have shown that the actuality is one in which the loading inputs of the limiting nutrient, P, are at or below the ambient concentrations of the Eastern Bay itself. Therefore, nutrient loading reported in metric tons yr⁻¹ is misleading because, in this case, it is the input concentration that demonstrates the greatest effect.

Whitewater Bay - Ten Thousand Islands: Spatial Analysis

Using the above approach the TTI-WWB complex was partitioned into 6 distinct zones having similar water quality. The first cluster was composed of 13 stations in and around the Shark, Harney, Broad, and Lostmans Rivers and is called the "Mangrove River" group. This cluster also included a sampling station just off the Faka Union Canal. The second cluster was made up of the 8 stations enclosed within Whitewater Bay proper (called "Whitewater Bay"). Twelve stations situated mostly in and around the coastal islands of TTI-WWB formed the

"Gulf Island" group. The water quality characteristics at the Coot Bay site were sufficiently different so as to be a cluster of its own. The next cluster contained the northernmost 2 stations in the Blackwater River estuary ("Blackwater"). Finally, the "Inland Waterway" ZSI included 11 stations distributed throughout the inside passage as well as the Chatham River and the station off Everglades City.

Marked differences in physical, chemical, and biological characteristics among zones were illustrated by this technique. The general spatial trend is one of relatively high APA, TON, and TOC in the south declining northward along the coast while salinity, turbidity, TP, and SRP increase. The net effect is the formation of a gradient with strong phosphorus limitation occurring in the southern region shifting to a more balanced TN:TP ratio in the northern area around the Blackwater River. Further analysis of this relationship is planned.

Biscayne Bay: Preliminary Spatial Analysis

Biscayne Bay was partitioned into 6 distinct ZSI using the above statistical analysis. The first cluster was composed of 2 stations closest to the shore in the south Bay; they were called the "Alongshore" group. The second cluster was made up of the 5 stations farther from the coast called "Inshore". Thirteen stations situated mostly in the bay proper were called the "Main Bay" group. The next cluster contained the 3 stations situated in areas of great tidal exchange ("Ocean Channel"). Two stations in Card Sound grouped together "Card Sound". Finally, the "Turkey Point" station comprised its own cluster. As mentioned previously, 10 stations were selected for their status as being either redundant (as in some of the Main Bay stations) or as outliers (Turkey Point and the Ocean Channel sites) and redistributed throughout the Bay to provide us with more complete coverage. For purposes of this report, the stations moved into the area north of the Rickenbacker Causeway will be defined as a distinct cluster ("North Bay") and discussed below.

It is clear that there is a gradient of increasing salinity with decreasing nutrient concentration with distance from the west coast of the Bay. For Alongshore, Inshore, and Main Bay clusters, highest concentrations of NO_3 , NO_2 , NH_4 , and TP were observed in the Alongshore stations. North Bay showed NH_4 levels comparable to the high concentrations seen Alongshore but had a higher median salinity. In addition, North Bay had the highest median TP concentration of any ZSI. Card Sound had relatively high NH_4 concentration relative to the other nutrients. Some of this may be attributed to the long water residence time of this basin as evidenced by near ocean salinities. APA as well as TON and TOC concentrations were highest in Alongshore > Inshore > Main Bay, denoting a freshwater source. It is interesting to note the northwards decreasing gradient of TON and TOC along the coast. Concentrations of SRP were so low so as to be undetectable in many instances. The relationship between SRP and Chl *a* was very weak and may have been influenced by other factors yet determined. This is a preliminary analysis and will be repeated after a few more years of data have been collected.

Southwest Florida Shelf: Preliminary Spatial Analysis

The above statistical analysis objectively classified the 49 sampling sites into 3 zones having similar water quality. The first cluster was composed of 2 stations closest to the shore off Cape Sable; they were called the "Sable" group. The second cluster was made up of the 7 more

northerly stations nearest the coast and called "Shark" after the Shark Slough, the main source of freshwater to the region. The remaining stations were called the "Shelf" group.

It is clear that the Sable stations have much higher concentrations of NO_3 , NO_2 , NH_4 , and SRP while the Shark and Shelf stations were similar. In addition, there is a decreasing concentration gradient of Sable>Shark>Shelf for TP, Chl a and turbidity. Finally, the inverse relationship between salinity and Si(OH)_4 is evident for all ZSI. The source of Si(OH)_4 in this area of carbonate sediments is from silicate sands and siliceous periphyton (diatoms) found in the Shark River Slough watershed. Si(OH)_4 is can therefore be used as a freshwater tracer in this system.

Although these analyses are very preliminary (only 10 sampling events) it is possible to speculate that the clusters are formed as a function of hydrology and circulation patterns. We believe that the Sable stations clearly show the input of freshwater from Shark Slough being transported south and east around the Cape. Water overlying the Shark stations probably originates somewhere north of the Ten Thousand Islands. Our level of resolution is very low due to the limited numbers of sampling events and by the relatively large spatial gap between coastal and Shelf sampling sites. A better understanding of local circulation patterns in addition to increased density and frequency of sampling in the nearshore region may help define the coupling between freshwater inflow and Shelf water quality. This is a preliminary analysis and will be repeated after a few more years of data have been collected.

PUBLICATIONS DERIVED FROM THIS PROJECT

- BOYER, J. N., AND R. D. JONES. (in prep.) Influence of coastal geomorphology and watershed characteristics on the water quality of mangrove estuaries in the Ten Thousand Islands-Whitewater Bay complex, Florida. *Limnology and Oceanography*.
- BOYER, J. N., AND R. D. JONES. (submitted) A view from the bridge: External and internal forces affecting the ambient water quality of the Florida Keys National Marine Sanctuary, p. #-#. In J. W. Porter and K. G. Porter (eds.), Linkages between ecosystems: the South Florida Hydroscape. St. Lucie Press.
- BOYER, J. N., P. STERLING, AND R. D. JONES. (in press) Maximizing information from estuarine and coastal water quality monitoring networks by diverse visualization approaches. *Estuarine, Coastal Shelf Science*.
- BOYER, J. N., AND R. D. JONES. 1999. Effects of freshwater inputs and loading of phosphorus and nitrogen on the water quality of Eastern Florida Bay, p. #-#. In K. R. Reddy, G. A. O'Connor, and C. L. Schelske (eds.) Phosphorus biogeochemistry in sub-tropical ecosystems: Florida as a case example. CRC/Lewis Publishers, Boca Raton. (in press)
- BOYER, J. N., J. W. FOURQUREAN, AND R. D. JONES. 1999. Seasonal and long-term trends in water quality of Florida Bay (1989-97). *Estuaries* (in press).
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PRESENTATIONS AND ABSTRACTS DERIVED FROM THIS PROJECT

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- JONES, R. D., AND J. N. BOYER. 1998. An overview of water quality in Florida Bay and surrounding waters: current status and trends. Florida Bay Science Conference, Miami, FL.
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- BOYER, J. N. AND R. D. JONES. 1996. The Florida Bay water quality monitoring program: assessing status and trends. Florida Bay Science Conference - Key Largo, FL.
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LIST OF TABLES

Table 1. List of fixed station location and sampling period of record.

Table 2. Statistical summary of water quality variables by area.

Table 1

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Card Sound Bridge	1	FB	25 16.413	-80 22.475	Mar 91 - Dec 98	1-94
Middle Key	2	FB	25 17.102	-80 23.702	Mar 91 - Dec 98	1-94
Manatee Bay	3	FB	25 15.062	-80 24.910	Mar 91 - Dec 98	1-94
Barnes Sound	4	FB	25 13.304	-80 23.299	Mar 91 - Dec 98	1-94
Blackwater Sound	5	FB	25 10.443	-80 25.385	Mar 91 - Dec 98	1-94
Little Blackwater Sound	6	FB	25 12.401	-80 26.424	Mar 91 - Dec 98	1-94
Highway Creek	7	FB	25 15.216	-80 26.649	Mar 91 - Dec 98	1-94
Long Sound	8	FB	25 13.642	-80 27.700	Mar 91 - Dec 98	1-94
Duck Key	9	FB	25 10.624	-80 29.494	Mar 91 - Dec 98	1-94
Joe Bay	10	FB	25 13.468	-80 32.195	Mar 91 - Dec 98	1-94
Little Madeira Bay	11	FB	25 10.510	-80 37.615	Mar 91 - Dec 98	1-94
Terrapin Bay	12	FB	25 08.422	-80 42.967	Mar 91 - Dec 98	1-94
Whipray Basin	13	FB	25 05.485	-80 45.287	Mar 91 - Dec 98	1-94
Garfield Bight	14	FB	25 09.029	-80 48.553	Apr 91 - Dec 98	2-94
Rankin Lake	15	FB	25 07.283	-80 48.173	Mar 91 - Dec 98	1-94
Murray Key	16	FB	25 07.096	-80 56.379	Mar 91 - Dec 98	1-94
Johnson Key Basin	17	FB	25 02.548	-80 54.889	Mar 91 - Dec 98	1-94
Rabbit Key Basin	18	FB	25 00.145	-80 54.006	Mar 91 - Dec 98	1-94
Twin Key Basin	19	FB	24 58.660	-80 45.211	Apr 91 - Dec 98	2-94
Peterson Keys	20	FB	24 55.770	-80 45.028	Mar 91 - Dec 98	1-94
Porpoise Lake	21	FB	25 00.396	-80 40.876	Mar 91 - Dec 98	1-94
Captain Key	22	FB	25 02.405	-80 36.843	Apr 91 - Dec 98	2-94
Park Key	23	FB	25 07.078	-80 35.983	Apr 91 - Dec 98	2-94
Butternut Key	24	FB	25 06.105	-80 31.884	Mar 91 - Dec 98	1-94
East Cape	25	FB	25 05.022	-81 04.835	July 92 - Dec 98	17-94
Oxfoot Bank	26	FB	24 58.844	-81 00.098	July 92 - Dec 98	17-94
Sprigger Bank	27	FB	24 55.116	-80 56.092	July 92 - Dec 98	17-94
Old Dan Bank	28	FB	24 52.032	-80 48.429	July 92 - Dec 98	17-94
First Bay	29	WWB	25 33.272	-81 11.020	Sept 92 - Dec 98	19-94
Third Bay	30	WWB	25 34.810	-81 07.256	Sept 92 - Dec 98	19-94
Big Lostmans Bay	31	WWB	25 34.055	-81 04.288	Sept 92 - Dec 98	19-94
Cabbage Island	32	WWB	25 31.764	-81 02.603	Sept 92 - Dec 98	19-94
Broad River Bay	33	WWB	25 29.984	-81 02.939	Sept 92 - Dec 98	19-94
Middle Broad River	34	WWB	25 29.163	-81 06.669	Sept 92 - Dec 98	19-94
Broad River Mouth	35	WWB	25 28.501	-81 09.176	Sept 92 - Dec 98	19-94
Harney River Mouth	36	WWB	25 24.701	-81 08.487	Sept 92 - Dec 98	19-94
Harney Rivers Junction	37	WWB	25 25.901	-81 04.943	Sept 92 - Dec 98	19-94
Tarpon Bay	38	WWB	25 25.037	-80 59.906	Sept 92 - Dec 98	19-94
Gunboat Island	39	WWB	25 22.735	-81 01.844	Sept 92 - Dec 98	19-94
Ponce de Leon Bay	40	WWB	25 20.983	-81 07.474	Sept 92 - Dec 98	19-94
Oyster Bay	41	WWB	25 19.869	-81 04.360	Sept 92 - Dec 98	19-94
North Marker 36	42	WWB	25 19.560	-81 00.873	Sept 92 - Dec 98	19-94
West Marker 34	43	WWB	25 17.168	-81 01.419	Sept 92 - Dec 98	19-94
Watson River Chickee	44	WWB	25 19.912	-80 59.022	Sept 92 - Dec 98	19-94
North River Mouth	45	WWB	25 18.054	-80 57.620	Sept 92 - Dec 98	19-94
Midway Keys	46	WWB	25 17.102	-80 58.548	Sept 92 - Dec 98	19-94
Roberts River Mouth	47	WWB	25 16.779	-80 55.846	Sept 92 - Dec 98	19-94
West Marker 18	48	WWB	25 14.448	-80 57.476	Sept 92 - Dec 98	19-94
Southeast Marker 12	49	WWB	25 13.704	-80 55.980	Sept 92 - Dec 98	19-94
Coot Bay	50	WWB	25 11.452	-80 54.848	Sept 92 - Dec 98	19-94

Table 1

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Chokoloskee	51	TTI	25 48.450	-81 20.970	Sept 94 - Dec 98	43-94
Rabbit Key Pass	52	TTI	25 46.200	-81 23.000	Sept 94 - Dec 98	43-94
Lopez Bay	53	TTI	25 47.050	-81 19.930	Sept 94 - Dec 98	43-94
Lopez River	54	TTI	25 47.130	-81 18.550	Sept 94 - Dec 98	43-94
Sunday Bay	55	TTI	25 47.760	-81 16.800	Sept 94 - Dec 98	43-94
Huston Bay	56	TTI	25 45.180	-81 15.330	Sept 94 - Dec 98	43-94
Upper Chatham River	57	TTI	25 43.050	-81 13.830	Sept 94 - Dec 98	43-94
Watson Place	58	TTI	25 42.470	-81 15.130	Sept 94 - Dec 98	43-94
Gun Rock Point	59	TTI	25 41.500	-81 17.920	Sept 94 - Dec 98	43-94
Huston River	60	TTI	25 43.880	-81 17.080	Sept 94 - Dec 98	43-94
Chevalier Bay	61	TTI	25 42.750	-81 12.420	Sept 94 - Dec 98	43-94
Alligator Bay	62	TTI	25 40.210	-81 10.120	Sept 94 - Dec 98	43-94
Lostmans Five Bay	63	TTI	25 38.000	-81 08.700	Sept 94 - Dec 98	43-94
Barron River	64	TTI	25 51.196	-81 23.602	Sept 94 - Dec 98	43-94
Indian Key Pass	65	TTI	25 49.631	-81 26.465	Sept 94 - Dec 98	43-94
Indian Key	66	TTI	25 48.290	-81 27.750	Sept 94 - Dec 98	43-94
West Pass	67	TTI	25 49.820	-81 30.170	Sept 94 - Dec 98	43-94
Panther Key	68	TTI	25 50.960	-81 32.530	Sept 94 - Dec 98	43-94
Faka Union Pass	69	TTI	25 52.450	-81 30.960	Sept 94 - Dec 98	43-94
Faka Union Bay	70	TTI	25 54.000	-81 30.960	Sept 94 - Dec 98	43-94
White Horse Key	71	TTI	25 52.007	-81 34.489	Sept 94 - Dec 98	43-94
Dismal Key	72	TTI	25 53.668	-81 33.532	Sept 94 - Dec 98	43-94
Long Rock	73	TTI	25 52.920	-81 36.380	Sept 94 - Dec 98	43-94
Shell Key	74	TTI	25 54.670	-81 36.920	Sept 94 - Dec 98	43-94
Blackwater River	75	TTI	25 55.788	-81 36.019	Sept 94 - Dec 98	43-94
Convoy Point	101	BB	25 28.700	-80 19.250	Sept 93 - Dec 98	31-94
Black Point	102	BB	25 32.750	-80 17.680	Sept 93 - Dec 98	31-94
Near Black Ledge	103	BB	25 34.400	-80 17.200	Sept 93 - Dec 98	31-94
BNP Marker C	104	BB	25 36.100	-80 13.250	Sept 93 - Dec 98	31-94
Biscayne Channel	105	BB	25 39.252	-80 11.202	Sept 93 - May 96	31-63
White Marker	106	BB	25 38.052	-80 07.800	Sept 93 - May 96	31-63
Fowey Rocks	107	BB	25 35.400	-80 06.000	Sept 93 - May 96	31-63
Marker G-1B	108	BB	25 34.150	-80 11.550	Sept 93 - Dec 98	31-94
North Midbay	109	BB	25 33.850	-80 14.100	Sept 93 - Dec 98	31-94
Fender Point	110	BB	25 30.300	-80 17.250	Sept 93 - Dec 98	31-94
Featherbed Bank	111	BB	25 30.950	-80 14.400	Sept 93 - Dec 98	31-94
Sands Cut	112	BB	25 29.300	-80 11.300	Sept 93 - Dec 98	31-94
Elliott Key	113	BB	25 26.500	-80 13.400	Sept 93 - Dec 98	31-94
Caesar Creek	114	BB	25 23.100	-80 11.502	Sept 93 - May 96	31-63
Adams Key	115	BB	25 24.252	-80 14.448	Sept 93 - May 96	31-63
Rubicon Keys	116	BB	25 24.000	-80 15.300	Sept 93 - Dec 98	31-94
Totten Key	117	BB	25 23.100	-80 15.900	Sept 93 - May 96	31-63
Broad Creek	118	BB	25 20.898	-80 15.300	Sept 93 - May 96	31-63
Pumpkin Key	119	BB	25 19.098	-80 18.198	Sept 93 - May 96	31-63
Card Bank, G-17	120	BB	25 18.852	-80 20.598	Sept 93 - May 96	31-63
North Card Sound	121	BB	25 21.300	-80 17.500	Sept 93 - Dec 98	31-94
West Arsenicker	122	BB	25 25.210	-80 18.650	Sept 93 - Dec 98	31-94
Pelican Bank	123	BB	25 26.700	-80 17.000	Sept 93 - Dec 98	31-94
South Midbay	124	BB	25 28.350	-80 14.000	Sept 93 - Dec 98	31-94
Turkey Point	125	BB	25 28.200	-80 16.998	Sept 93 - May 96	31-63

Table 1

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
BNP Marker B	126	BB	25 40.300	-80 12.300	June 96 - Dec 98	64-94
Shoal Point	127	BB	25 37.800	-80 15.000	June 96 - Dec 98	64-94
Matheson Beach	128	BB	25 41.300	-80 14.000	June 96 - Dec 98	64-94
Marker G-71	129	BB	25 44.200	-80 11.100	June 96 - Dec 98	64-94
South Dodge Island	130	BB	25 45.800	-80 10.300	June 96 - Dec 98	64-94
North Venetian Basin	131	BB	25 48.000	-80 10.000	June 96 - Dec 98	64-94
North I-195 Basin	132	BB	25 49.000	-80 10.000	June 96 - Dec 98	64-94
North Normandy Isle	133	BB	25 52.000	-80 09.000	June 96 - Dec 98	64-94
Oleta River Park	134	BB	25 54.300	-80 08.000	June 96 - Dec 98	64-94
South Card Sound	135	BB	25 19.000	-80 19.000	June 96 - Dec 98	64-94
Off Lower Harbor Keys	351	SHELF	24 41.500	-81 47.500	May 95 - Dec 98	1-14
	352	SHELF	24 46.550	-81 46.980	May 95 - Dec 98	1-14
	353	SHELF	24 51.500	-81 46.600	May 95 - Dec 98	1-14
	354	SHELF	24 56.480	-81 46.120	May 95 - Dec 98	1-14
	355	SHELF	25 01.480	-81 45.750	May 95 - Dec 98	1-14
	356	SHELF	25 06.460	-81 45.230	May 95 - Dec 98	1-14
	357	SHELF	25 11.470	-81 44.720	May 95 - Dec 98	1-14
	358	SHELF	25 16.480	-81 44.290	May 95 - Dec 98	1-14
	359	SHELF	25 21.500	-81 43.800	May 95 - Dec 98	1-14
	360	SHELF	25 26.470	-81 43.260	May 95 - Dec 98	1-14
	361	SHELF	25 31.480	-81 42.900	May 95 - Dec 98	1-14
	362	SHELF	25 36.520	-81 42.400	May 95 - Dec 98	1-14
Off Cape Romano	363	SHELF	25 41.520	-81 41.900	May 95 - Dec 98	1-14
	364	SHELF	25 41.500	-81 32.000	May 95 - Dec 98	1-14
	365	SHELF	25 36.510	-81 32.360	May 95 - Dec 98	1-14
	366	SHELF	25 31.560	-81 32.930	May 95 - Dec 98	1-14
	367	SHELF	25 26.550	-81 33.300	May 95 - Dec 98	1-14
	368	SHELF	25 21.510	-81 33.800	May 95 - Dec 98	1-14
	369	SHELF	25 16.530	-81 34.320	May 95 - Dec 98	1-14
	370	SHELF	25 11.510	-81 34.750	May 95 - Dec 98	1-14
	371	SHELF	25 06.500	-81 35.210	May 95 - Dec 98	1-14
	372	SHELF	25 01.500	-81 35.720	May 95 - Dec 98	1-14
	373	SHELF	24 56.530	-81 36.180	May 95 - Dec 98	1-14
	374	SHELF	24 51.530	-81 36.650	May 95 - Dec 98	1-14
Off Johnson Key	375	SHELF	24 46.540	-81 37.070	May 95 - Dec 98	1-14
Harbor Key Bank	376	SHELF	24 50.600	-81 26.300	May 95 - Dec 98	1-14
	377	SHELF	24 56.100	-81 25.900	May 95 - Dec 98	1-14
	378	SHELF	25 01.000	-81 24.950	May 95 - Dec 98	1-14
	379	SHELF	25 06.000	-81 24.530	May 95 - Dec 98	1-14
	380	SHELF	25 11.000	-81 24.000	May 95 - Dec 98	1-14
	381	SHELF	25 16.000	-81 23.700	May 95 - Dec 98	1-14
	382	SHELF	25 21.000	-81 23.200	May 95 - Dec 98	1-14
	383	SHELF	25 25.950	-81 22.670	May 95 - Dec 98	1-14
	384	SHELF	25 30.930	-81 22.200	May 95 - Dec 98	1-14
	385	SHELF	25 36.010	-81 21.790	May 95 - Dec 98	1-14
	386	SHELF	25 33.330	-81 20.430	May 95 - Dec 98	1-14
	387	SHELF	25 30.530	-81 19.010	May 95 - Dec 98	1-14
	388	SHELF	25 25.500	-81 17.820	May 95 - Dec 98	1-14
	389	SHELF	25 20.500	-81 16.620	May 95 - Dec 98	1-14
	390	SHELF	25 15.600	-81 15.610	May 95 - Dec 98	1-14

Table 1

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
	391	SHELF	25 10.500	-81 14.320	May 95 - Dec 98	1-14
	392	SHELF	25 05.500	-81 14.900	May 95 - Dec 98	1-14
	393	SHELF	25 00.500	-81 15.200	May 95 - Dec 98	1-14
Off Bluefish Bank	394	SHELF	24 55.500	-81 15.600	May 95 - Dec 98	1-14
Off Bullard Bank	395	SHELF	24 52.700	-81 11.500	May 95 - Dec 98	1-14
	396	SHELF	24 50.000	-81 07.700	May 95 - Dec 98	1-14
	397	SHELF	24 55.000	-81 07.100	May 95 - Dec 98	1-14
	398	SHELF	25 00.000	-81 06.600	May 95 - Dec 98	1-14
Off East Cape	399	SHELF	25 05.000	-81 05.960	May 95 - Dec 98	1-14

Table 2

Parameter	Zone	Median	Min.	Max.	n
Alkaline	Biscayne Bay	0.12	0.01	2.11	1570
Phosphatase	Central Florida Bay	1.71	0.13	6.44	374
Activity	East Florida Bay	0.38	0.01	6.11	1577
($\mu\text{M h}^{-1}$)	West Florida Bay	0.20	0.01	4.93	515
	SW Shelf	0.06	0.00	9.43	508
	Ten Thousand Is.	0.05	0.00	3.53	1270
	Whitewater Bay	0.37	0.01	4.39	1649
Chlorophyll a	Biscayne Bay	0.28	0.04	5.43	1549
($\mu\text{g l}^{-1}$)	Central Florida Bay	1.92	0.19	12.91	383
	East Florida Bay	0.69	0.04	11.35	1627
	West Florida Bay	1.79	0.20	11.62	540
	SW Shelf	0.90	0.00	10.40	686
	Ten Thousand Is.	3.18	0.12	45.11	1271
	Whitewater Bay	2.72	0.19	17.78	1648
Surface	Biscayne Bay	92.4	42.2	156.6	1570
Dissolved	Central Florida Bay	89.5	38.8	170.7	387
Oxygen	East Florida Bay	92.9	55.0	172.5	1638
Saturation	West Florida Bay	90.8	47.0	169.2	553
(%)	SW Shelf	95.4	53.7	121.3	682
	Ten Thousand Is.	78.4	22.1	157.2	1271
	Whitewater Bay	76.4	10.3	134.6	1650
Surface	Biscayne Bay	6.3	2.8	11.3	1570
Dissolved	Central Florida Bay	6.3	2.8	12.3	390
Oxygen	East Florida Bay	6.7	3.8	11.7	1649
(mg l^{-1})	West Florida Bay	6.2	3.0	10.9	559
	SW Shelf	6.4	3.5	8.3	682
	Ten Thousand Is.	5.8	1.8	12.1	1271
	Whitewater Bay	6.0	0.8	11.1	1650
NH ₄	Biscayne Bay	0.0130	0.0010	0.2280	1575
(ppm)	Central Florida Bay	0.0800	0.0000	1.6810	391
	East Florida Bay	0.0450	0.0004	1.1490	1665
	West Florida Bay	0.0140	0.0000	0.3420	564
	SW Shelf	0.0060	0.0000	0.1290	686
	Ten Thousand Is.	0.0170	0.0010	0.2850	1271
	Whitewater Bay	0.0150	0.0004	1.0460	1650
NO ₂	Biscayne Bay	0.0020	0.0001	0.0600	1575
(ppm)	Central Florida Bay	0.0020	0.0000	0.1110	395
	East Florida Bay	0.0030	0.0000	0.0370	1666
	West Florida Bay	0.0010	0.0000	0.0250	564
	SW Shelf	0.0010	0.0000	0.0080	686
	Ten Thousand Is.	0.0030	0.0002	0.0360	1271
	Whitewater Bay	0.0030	0.0000	0.1060	1650
NO ₃	Biscayne Bay	0.0070	0.0000	1.0820	1575
(ppm)	Central Florida Bay	0.0040	0.0000	0.0800	393
	East Florida Bay	0.0090	0.0000	0.1540	1656
	West Florida Bay	0.0020	0.0000	0.1020	559
	SW Shelf	0.0002	0.0000	0.0310	686
	Ten Thousand Is.	0.0090	0.0000	0.1330	1271
	Whitewater Bay	0.0110	0.0000	0.2680	1650

Table 2

Parameter	Zone	Median	Min.	Max.	n
Surface Salinity (ppt)	Biscayne Bay	33.0	12.3	38.6	1575
	Central Florida Bay	32.7	8.7	63.0	395
	East Florida Bay	28.3	0.2	53.0	1667
	West Florida Bay	34.7	25.3	51.0	567
	SW Shelf	35.1	26.0	38.9	685
	Ten Thousand Is.	23.2	0.0	37.9	1271
	Whitewater Bay	8.8	0.0	34.9	1650
SiO ₄ (ppm)	Biscayne Bay	0.0660	0.0000	1.0130	250
	Central Florida Bay	1.0930	0.0020	3.2380	48
	East Florida Bay	0.4040	0.0010	3.4260	204
	West Florida Bay	0.4190	0.0040	2.6700	72
	SW Shelf	0.0640	0.0000	2.2380	583
	Ten Thousand Is.	1.8870	0.0000	4.6290	248
	Whitewater Bay	1.7250	0.0000	4.8800	264
Soluble Reactive Phosphorus (ppm)	Biscayne Bay	0.0004	0.0000	0.0070	1575
	Central Florida Bay	0.0010	0.0000	0.0260	393
	East Florida Bay	0.0010	0.0000	0.0160	1657
	West Florida Bay	0.0010	0.0000	0.0120	558
	SW Shelf	0.0010	0.0000	0.0110	686
	Ten Thousand Is.	0.0060	0.0000	0.0660	1270
	Whitewater Bay	0.0020	0.0000	0.0340	1650
Surface Temperature (°C)	Biscayne Bay	26.9	15.9	32.8	1575
	Central Florida Bay	26.6	16.2	35.3	395
	East Florida Bay	26.7	16.0	33.5	1666
	West Florida Bay	26.5	17.6	34.7	567
	SW Shelf	27.7	20.3	32.7	685
	Ten Thousand Is.	27.2	15.0	34.4	1271
	Whitewater Bay	26.5	12.5	34.0	1650
TN:TP Ratio	Biscayne Bay	114.7	6.3	657.0	1574
	Central Florida Bay	132.2	32.2	668.5	394
	East Florida Bay	190.5	23.2	2197.0	1664
	West Florida Bay	57.9	0.0	744.4	563
	SW Shelf	44.1	8.1	140.2	675
	Ten Thousand Is.	33.7	4.6	306.9	1267
	Whitewater Bay	85.1	12.4	1911.1	1645
Total Organic Carbon (ppm)	Biscayne Bay	3.287	0.326	9.330	1574
	Central Florida Bay	13.855	4.518	42.872	392
	East Florida Bay	8.353	0.000	58.043	1662
	West Florida Bay	4.928	1.199	20.216	559
	SW Shelf	2.946	1.606	10.790	686
	Ten Thousand Is.	9.048	3.805	22.955	1270
	Whitewater Bay	15.210	3.828	64.008	1649
Total Organic Nitrogen (ppm)	Biscayne Bay	0.2350	0.0480	1.2290	1574
	Central Florida Bay	1.0430	0.1770	4.3550	389
	East Florida Bay	0.6120	0.0830	3.0990	1655
	West Florida Bay	0.3830	0.0950	1.6800	557
	SW Shelf	0.2240	0.1080	0.9570	677
	Ten Thousand Is.	0.5070	0.1570	1.5660	1270
	Whitewater Bay	0.8000	0.1300	2.9890	1649

Table 2

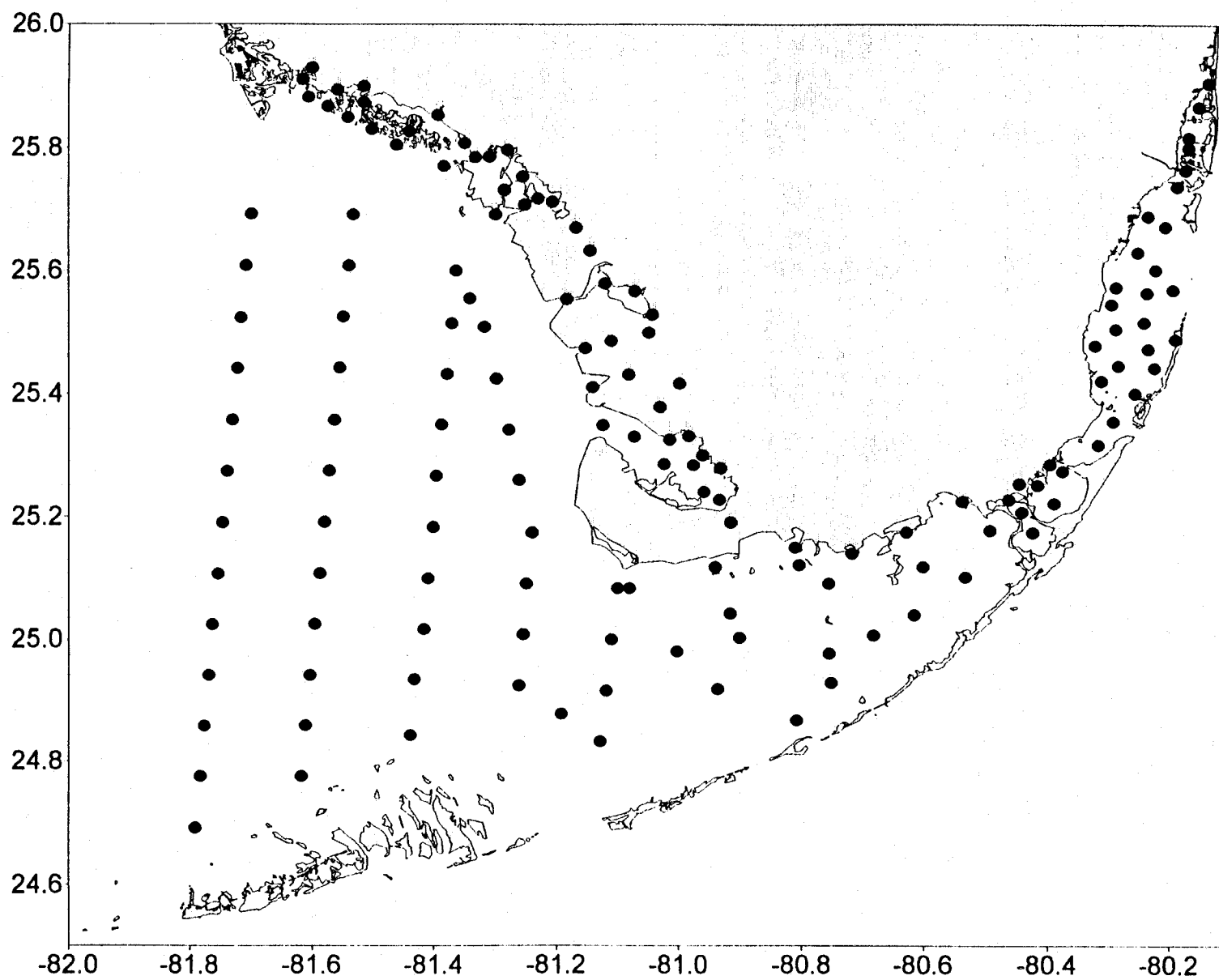
Parameter	Zone	Median	Min.	Max.	n
Total	Biscayne Bay	0.0050	0.0010	0.0200	1574
Phosphorus (ppm)	Central Florida Bay	0.0190	0.0040	0.1310	394
	East Florida Bay	0.0080	0.0010	0.0700	1667
	West Florida Bay	0.0150	0.0020	0.1270	566
	SW Shelf	0.0110	0.0000	0.1900	686
	Ten Thousand Is.	0.0360	0.0080	0.1120	1268
	Whitewater Bay	0.0220	0.0030	0.1010	1646
Turbidity (NTU)	Biscayne Bay	0.70	0.00	50.60	1572
	Central Florida Bay	6.60	0.15	125.60	379
	East Florida Bay	2.50	0.01	125.55	1595
	West Florida Bay	7.05	0.07	178.55	521
	SW Shelf	2.10	0.00	66.25	588
	Ten Thousand Is.	5.60	0.25	68.00	1270
	Whitewater Bay	3.77	0.20	107.81	1649

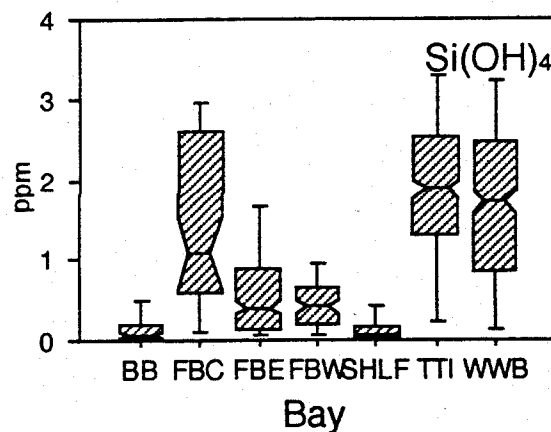
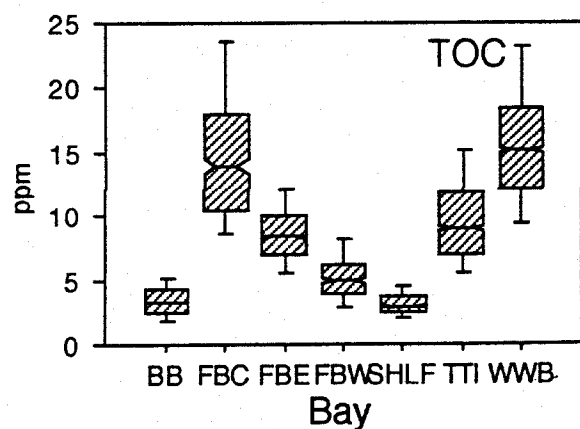
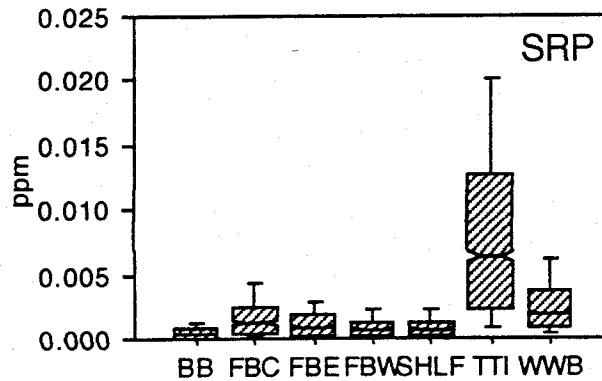
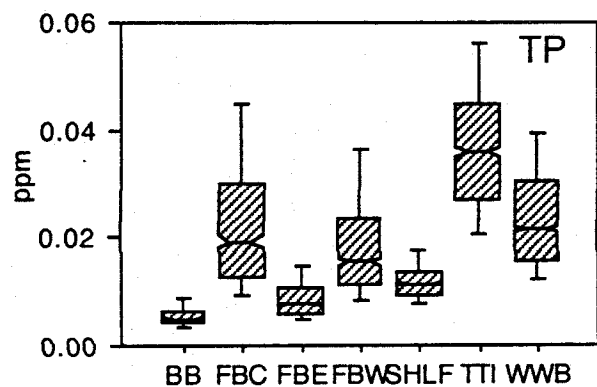
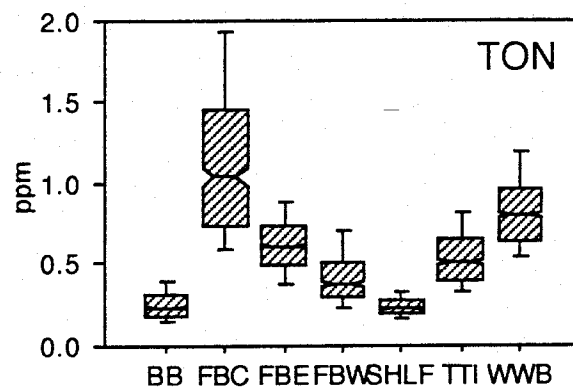
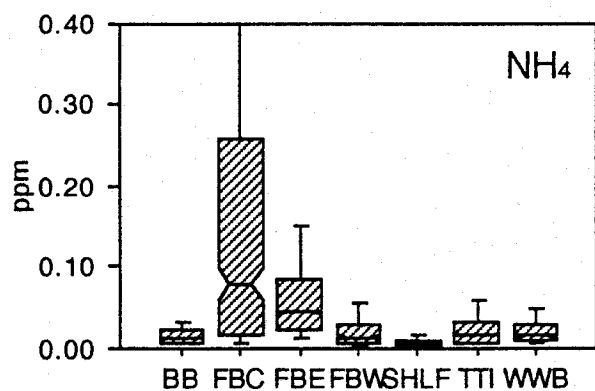
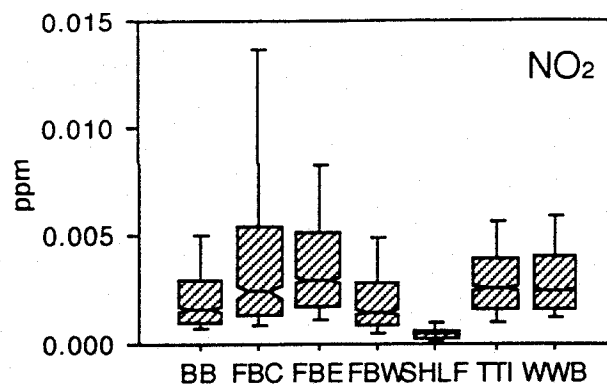
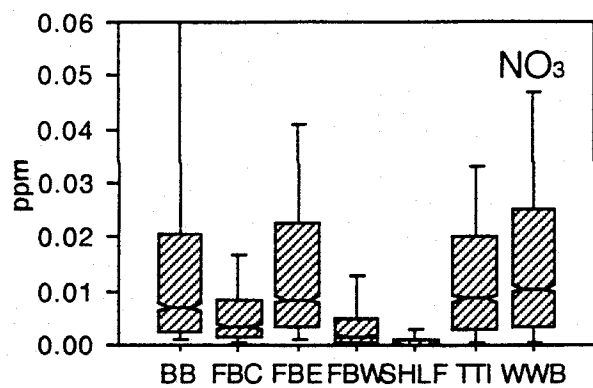
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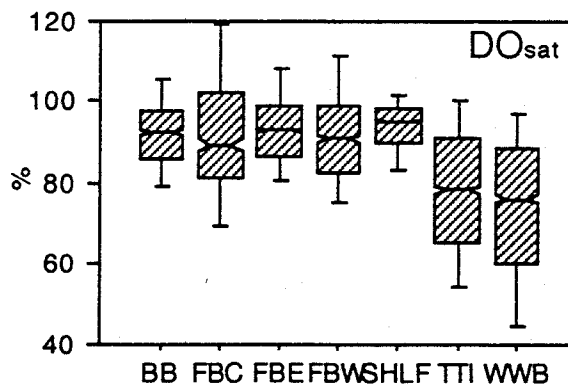
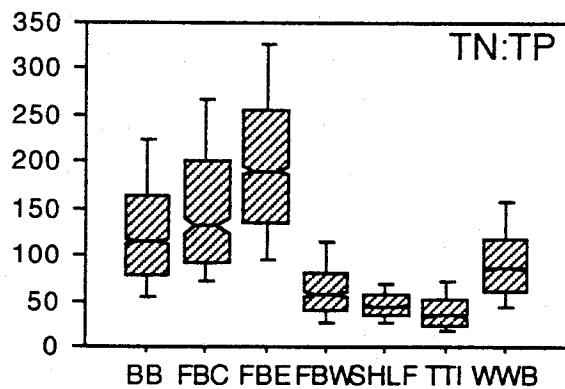
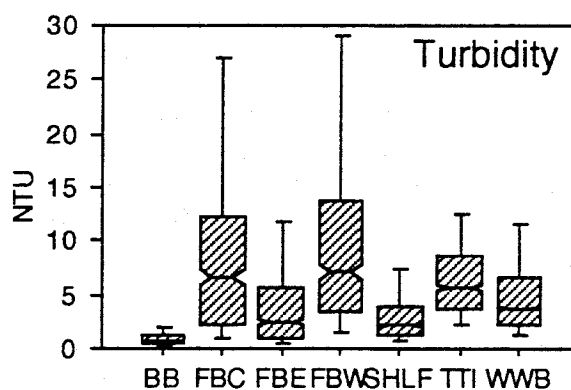
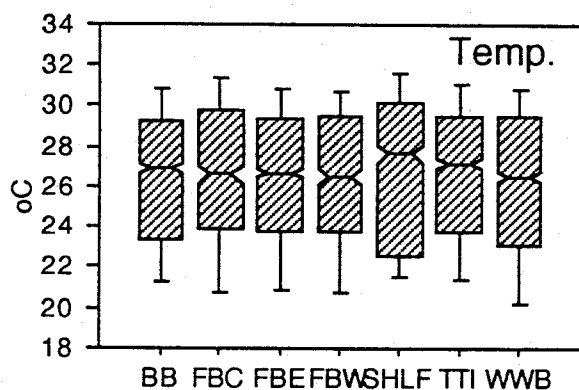
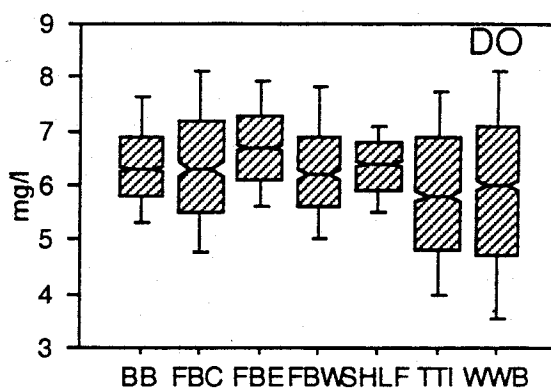
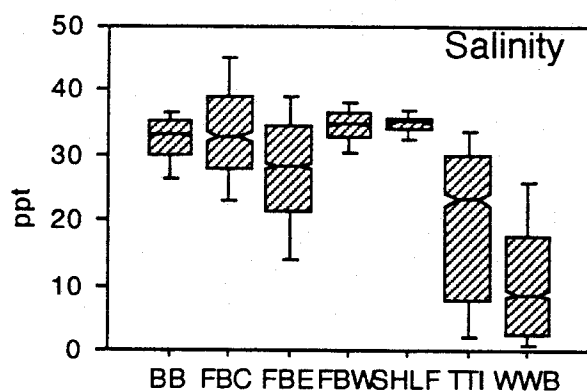
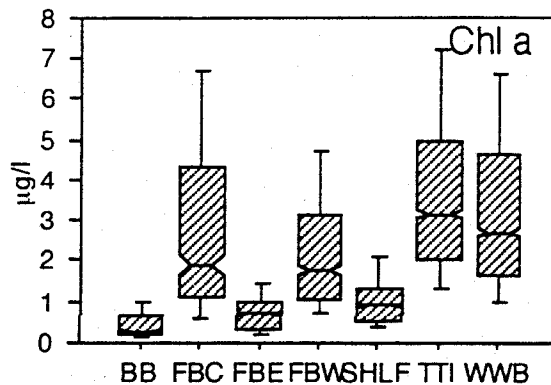
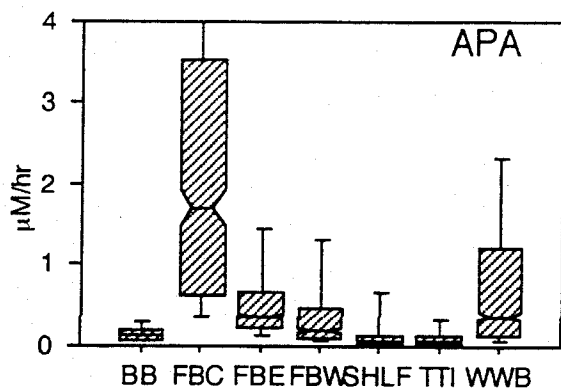
Figure 1. Map of all station locations in the network.

Figure 2. Box-and-whisker plots of NO_3 , NO_2 , NH_4 , TON, TP, SRP, TOC, and $\text{Si}(\text{OH})_4$ for the different areas sampled.

Figure 3. Box-and-whisker plots of APA, Chl a , salinity, DO, temperature, turbidity, TN:TP ratio, and DO_{sat} for the different areas sampled.



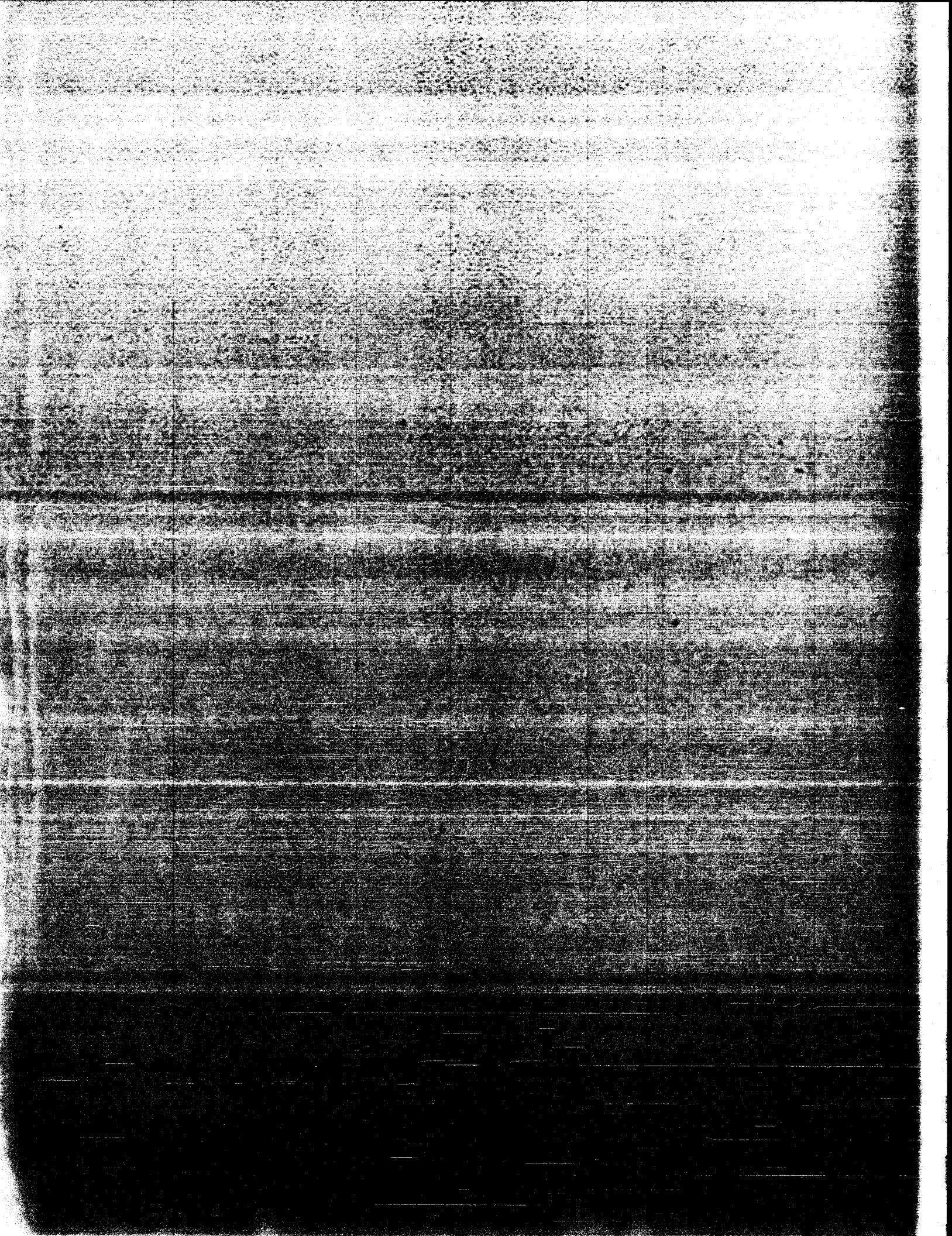


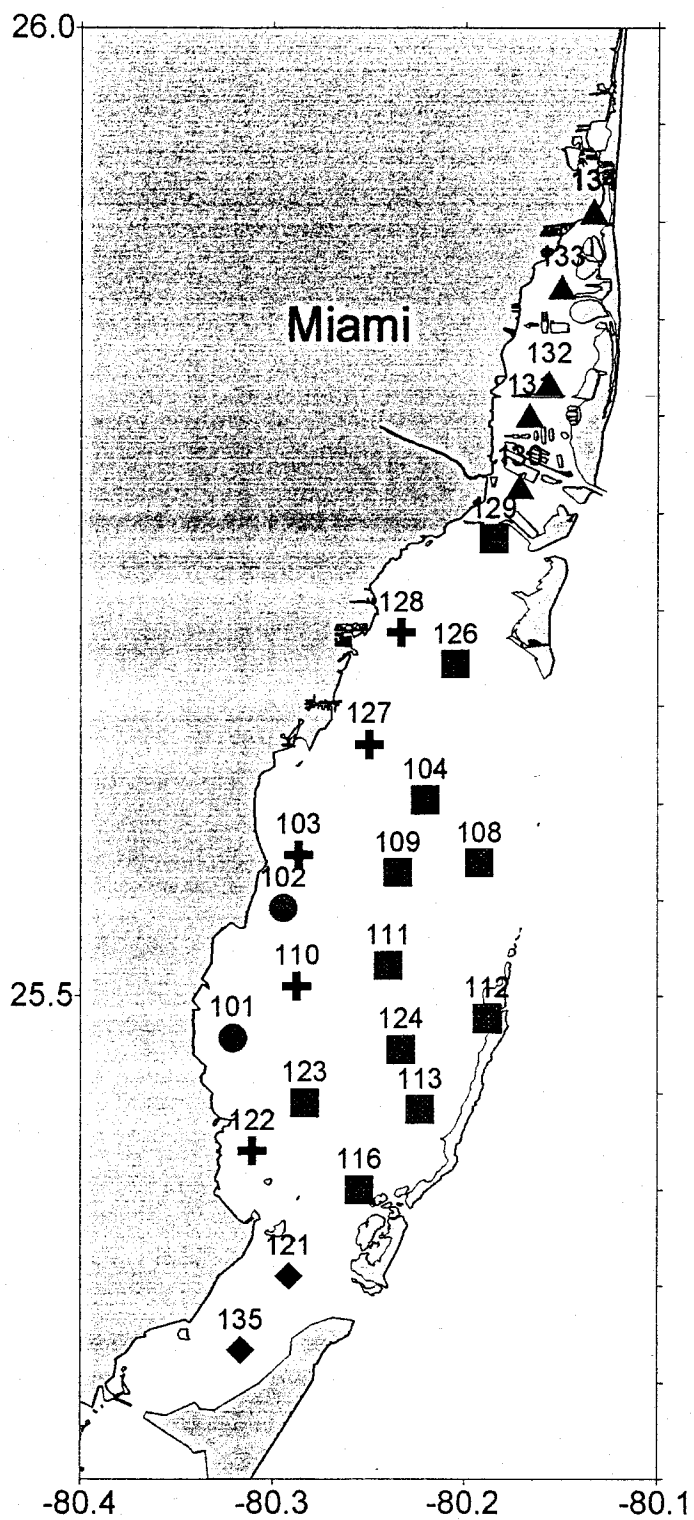


Bay

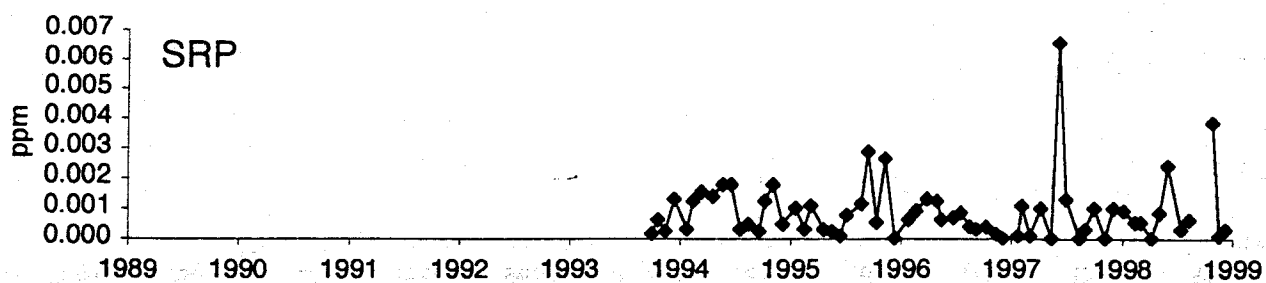
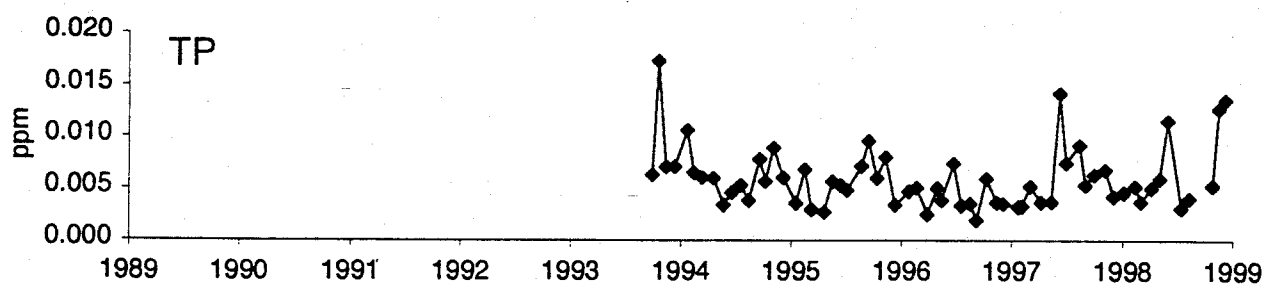
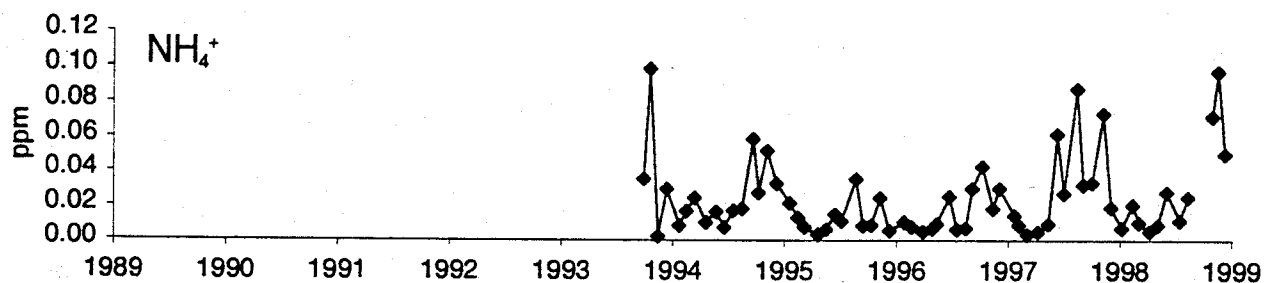
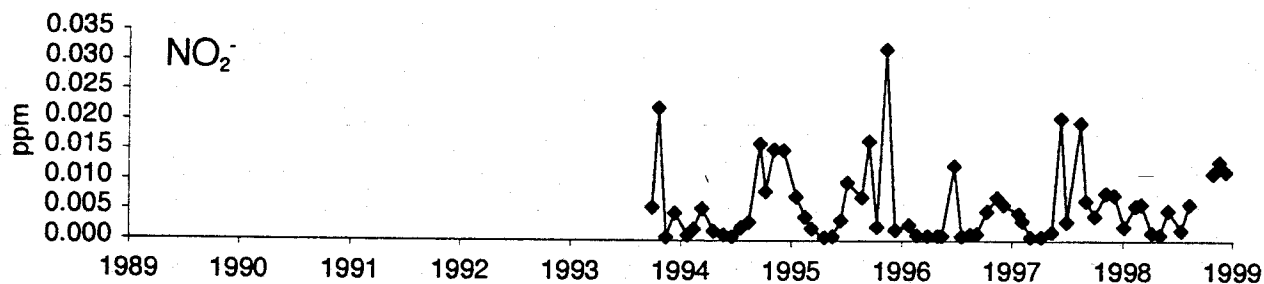
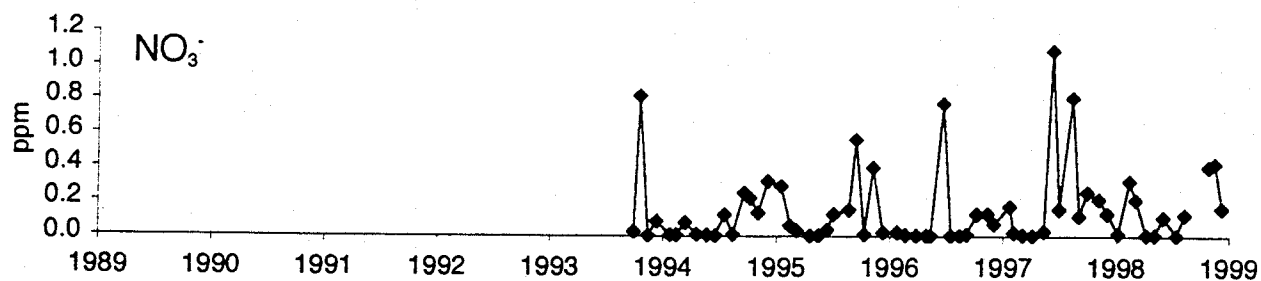
Bay

BISCAYNE BAY
Map and Times Series Graphs

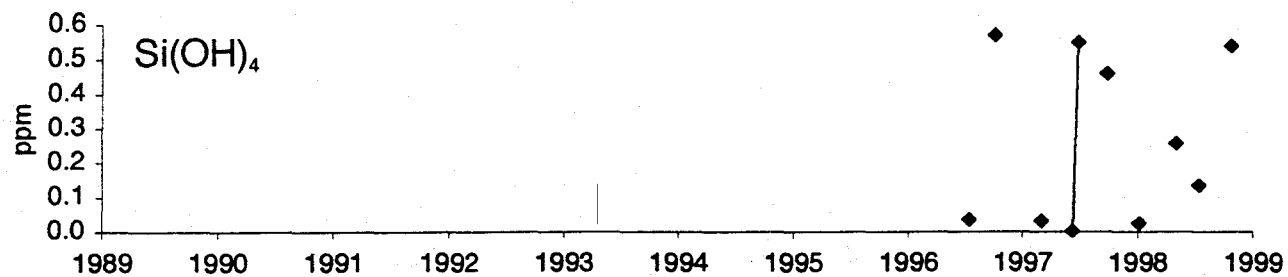
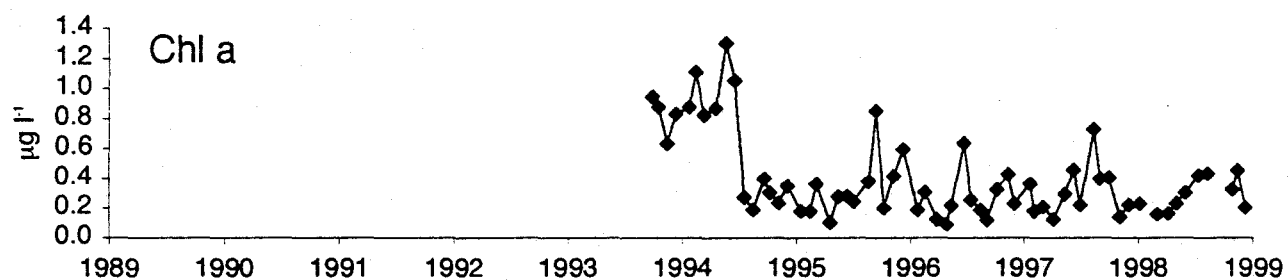
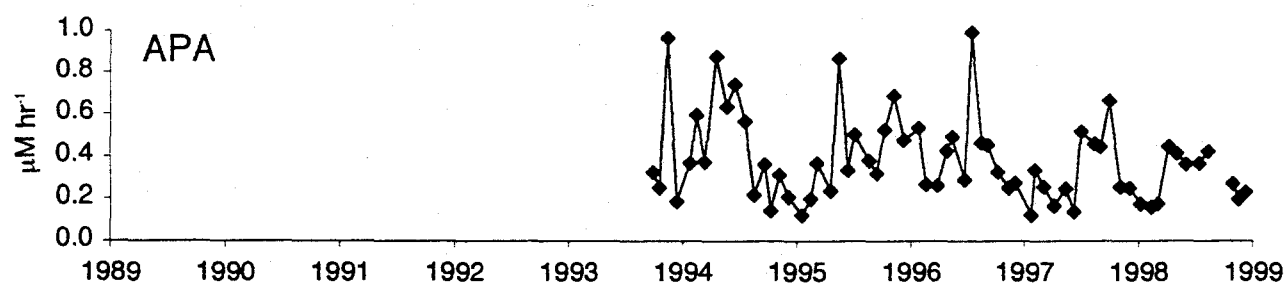
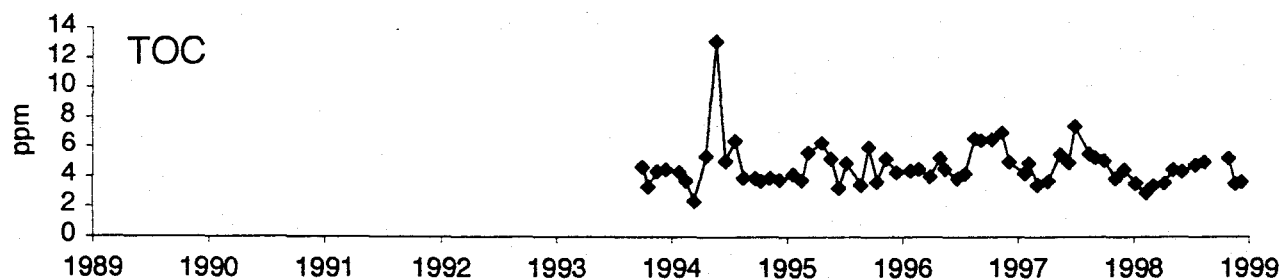
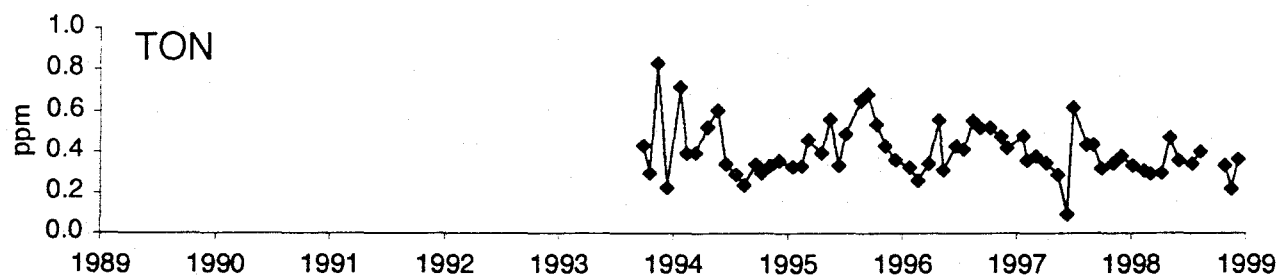




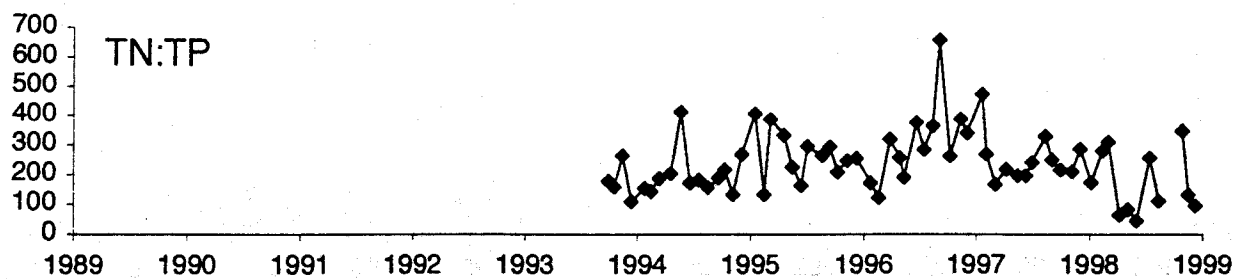
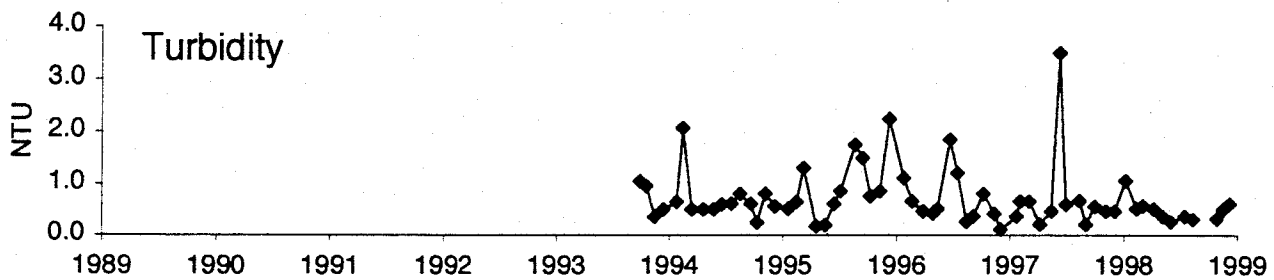
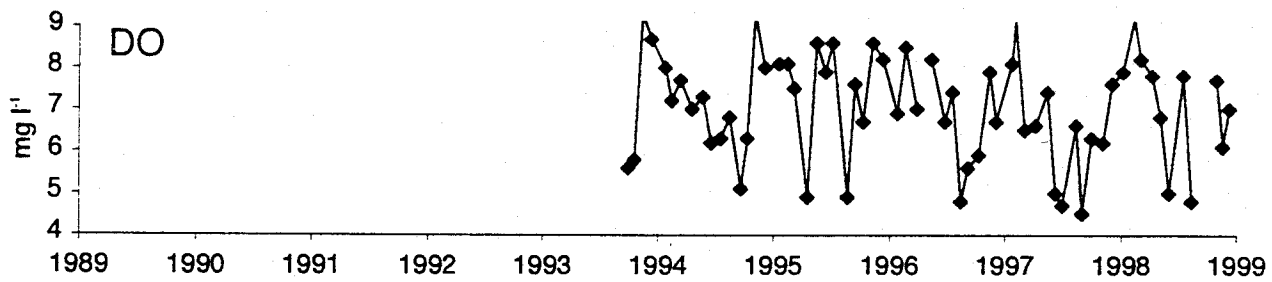
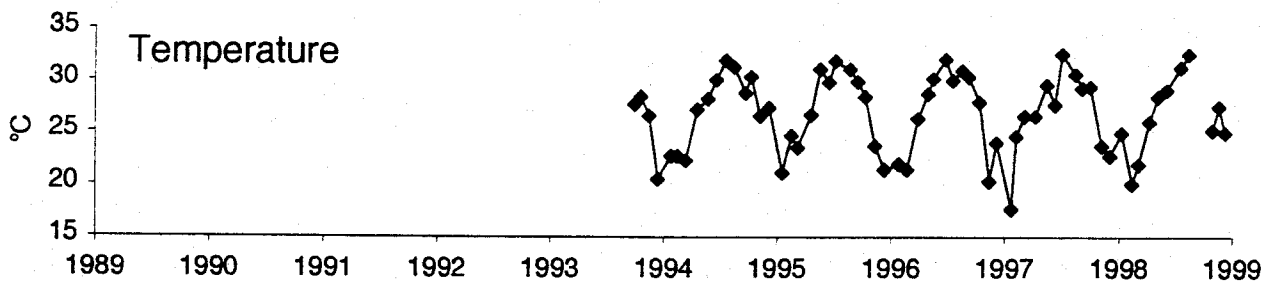
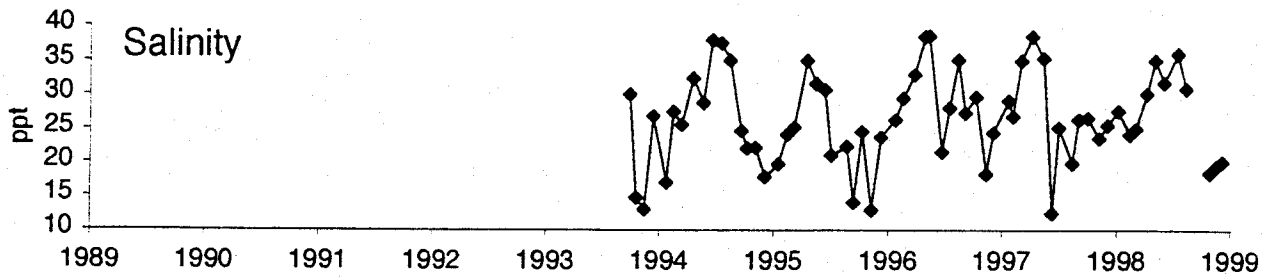
Biscayne Bay Sta. 101 Convoy Point



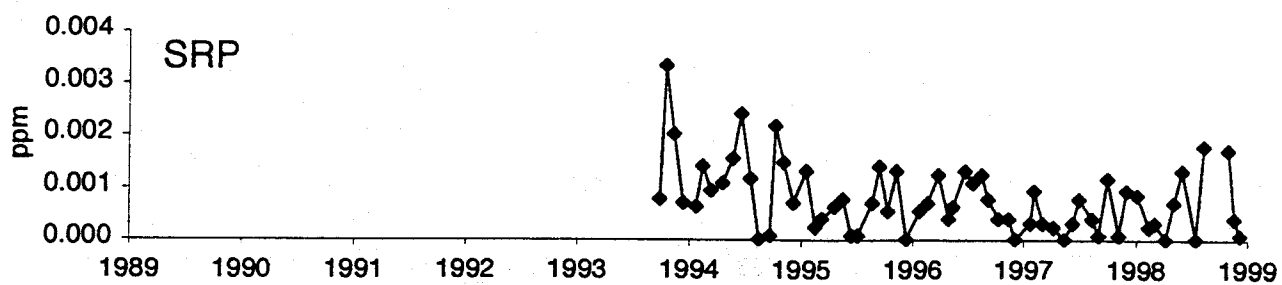
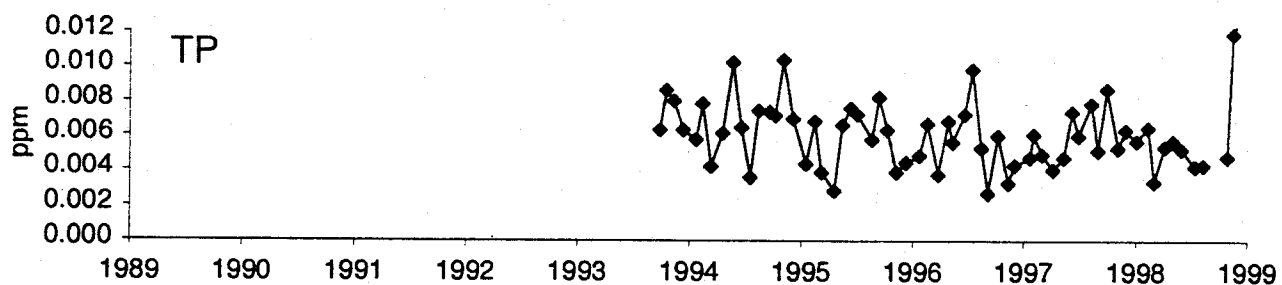
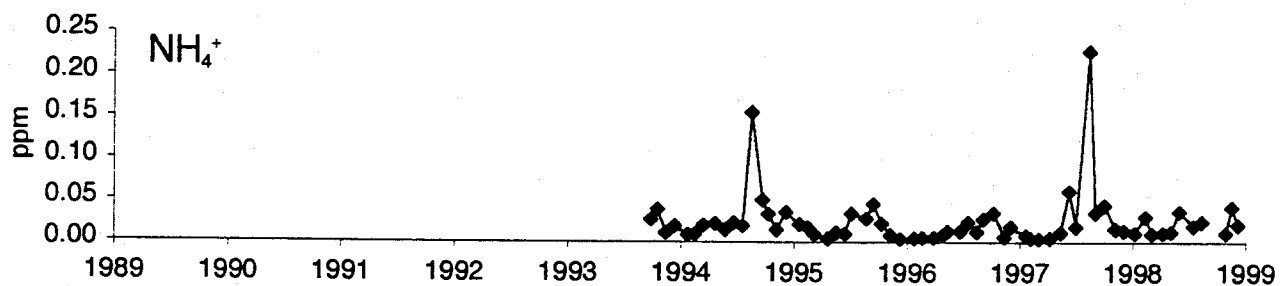
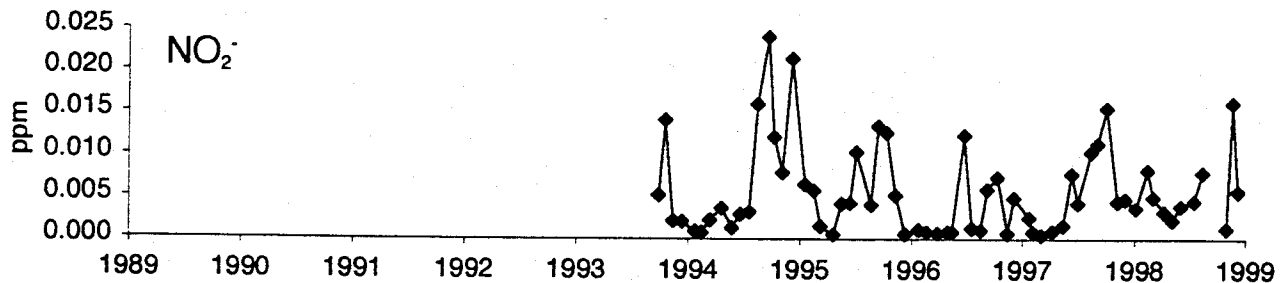
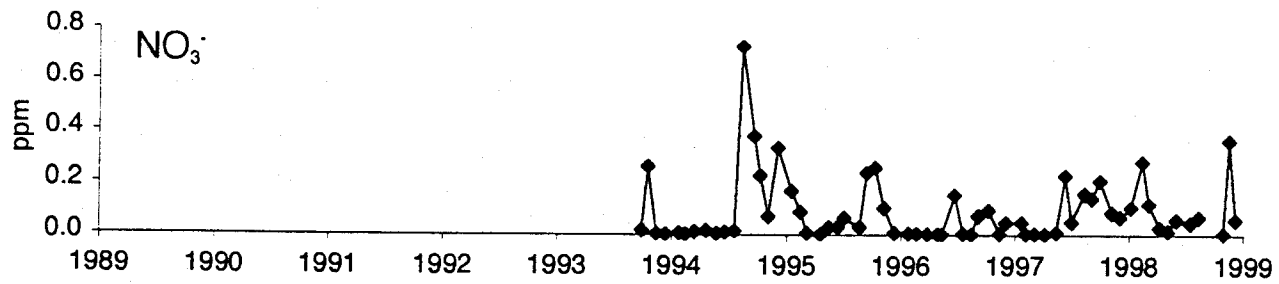
Biscayne Bay Sta. 101 Convoy Point



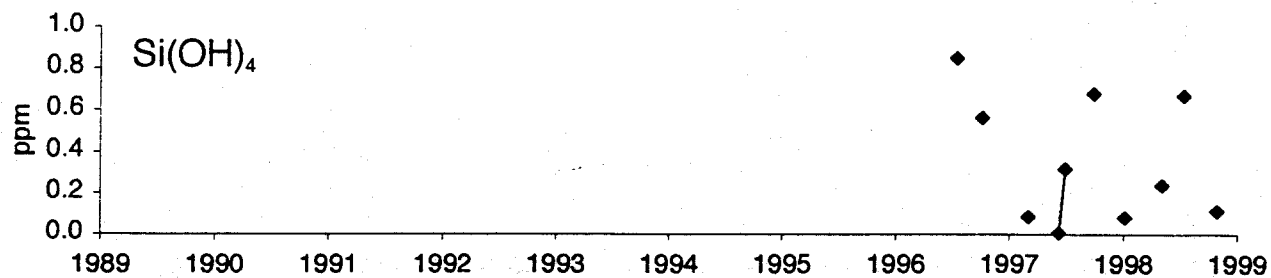
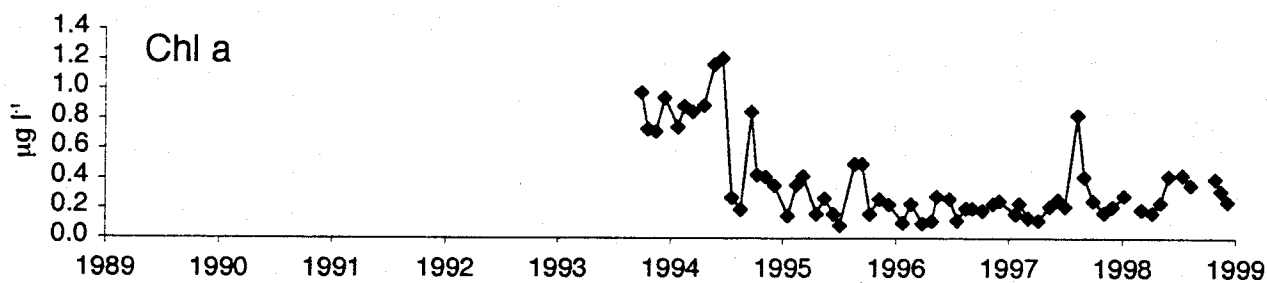
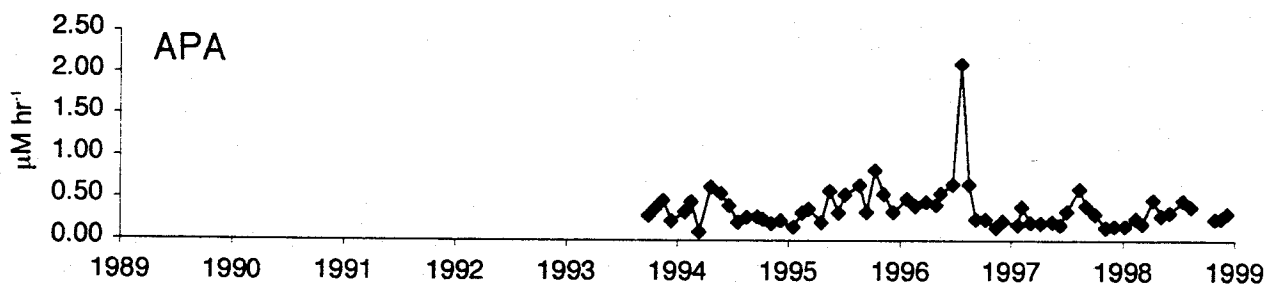
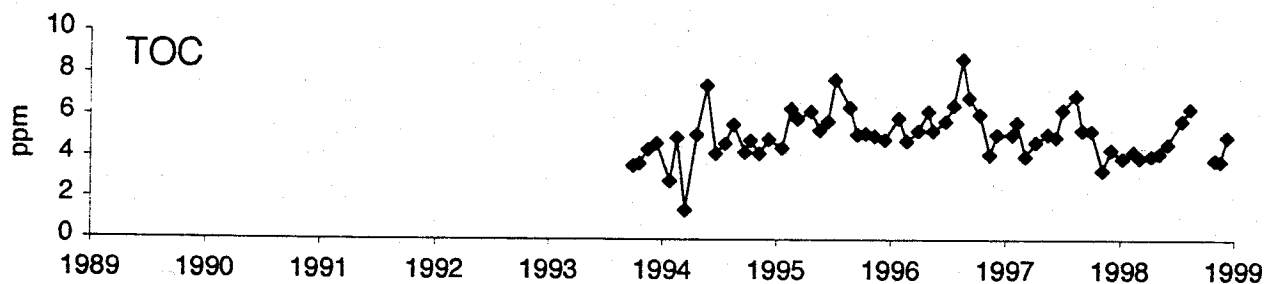
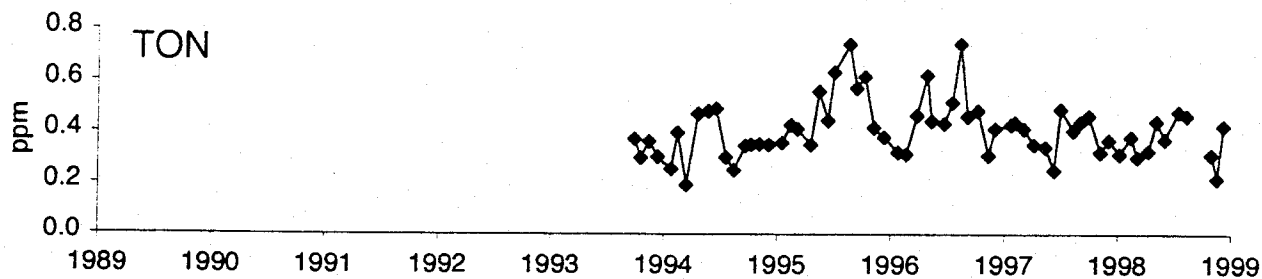
Biscayne Bay Sta. 101 Convoy Point



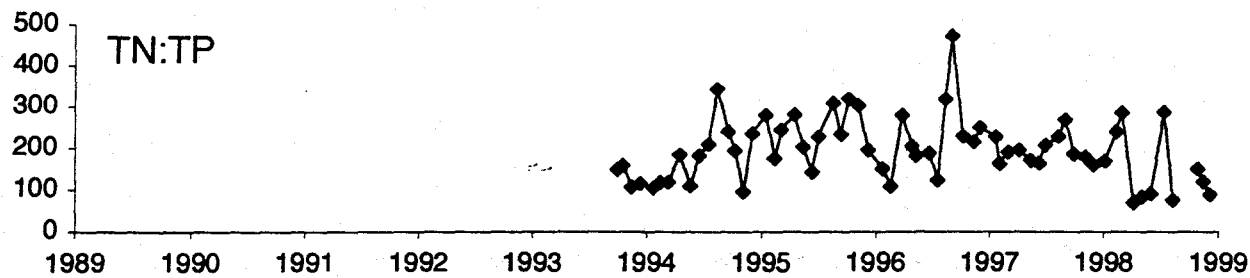
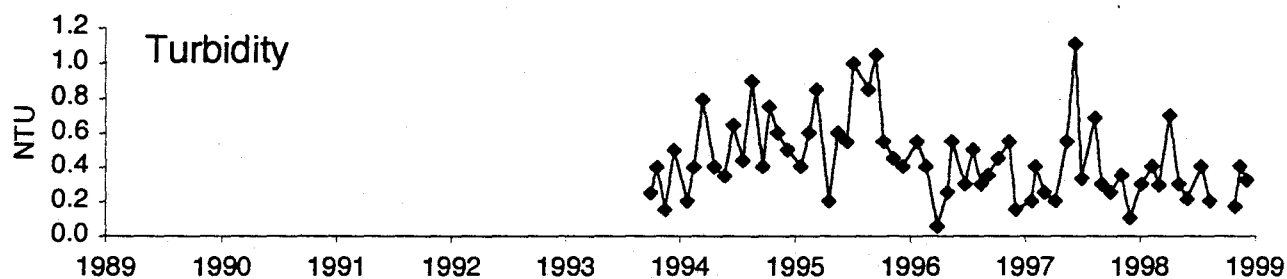
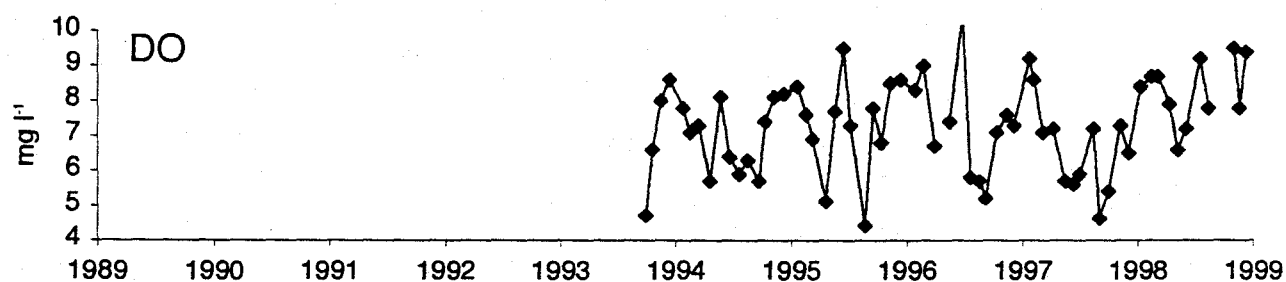
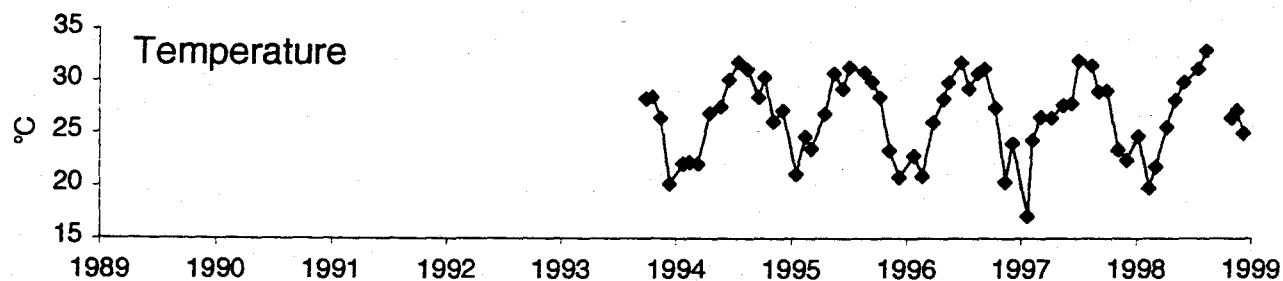
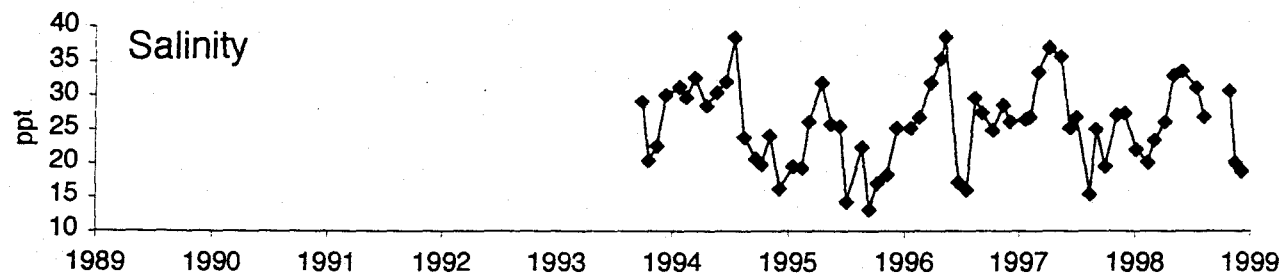
Biscayne Bay Sta. 102 Black Point



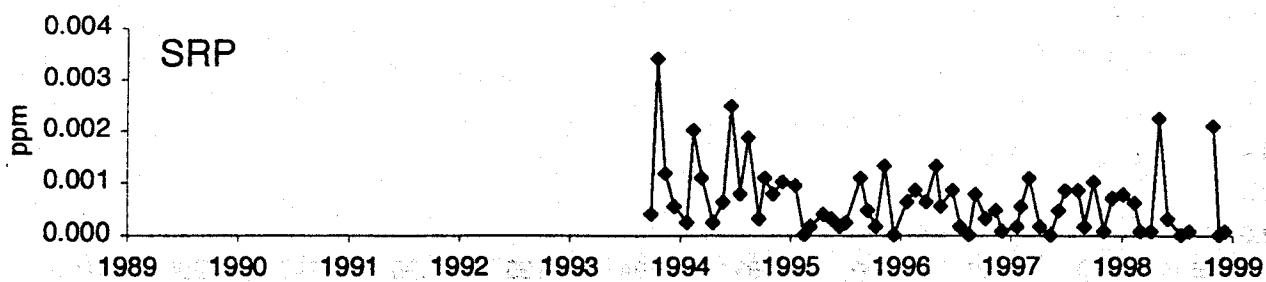
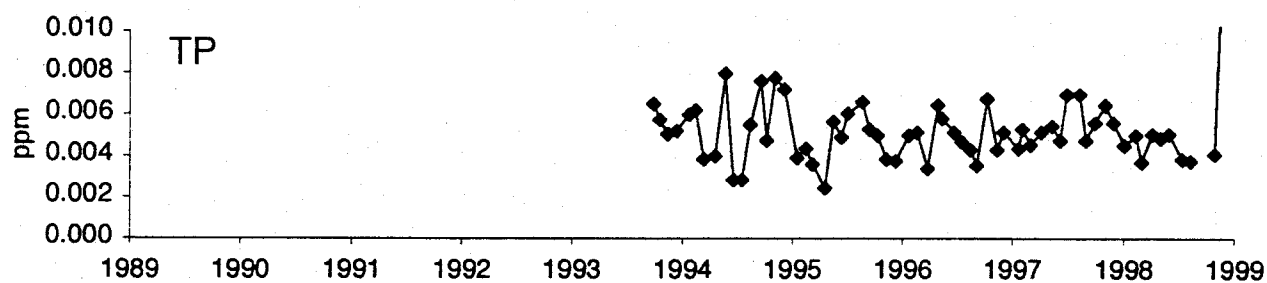
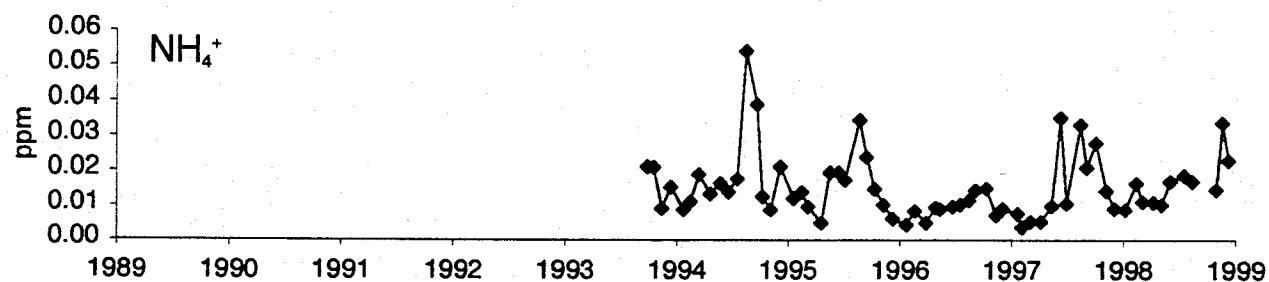
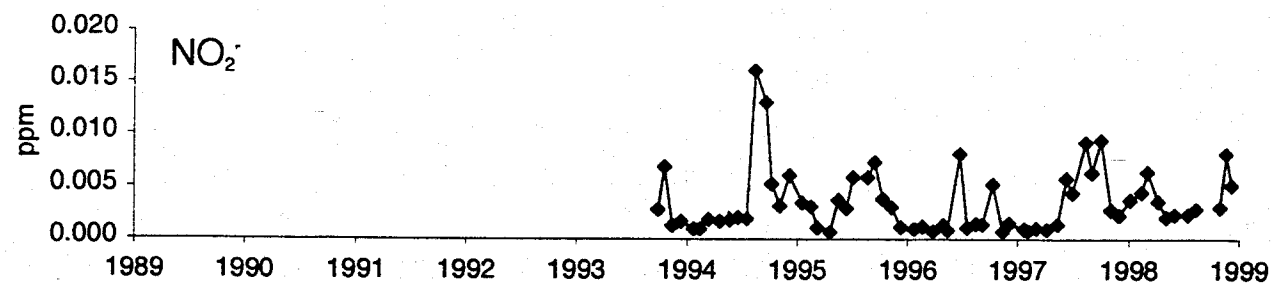
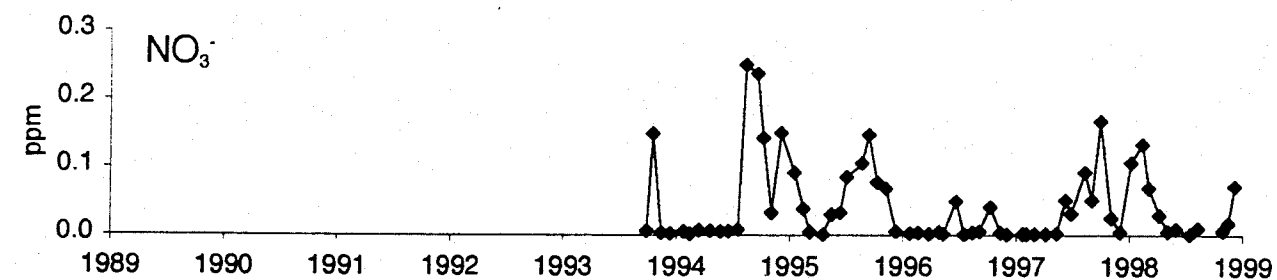
Biscayne Bay Sta. 102 Black Point



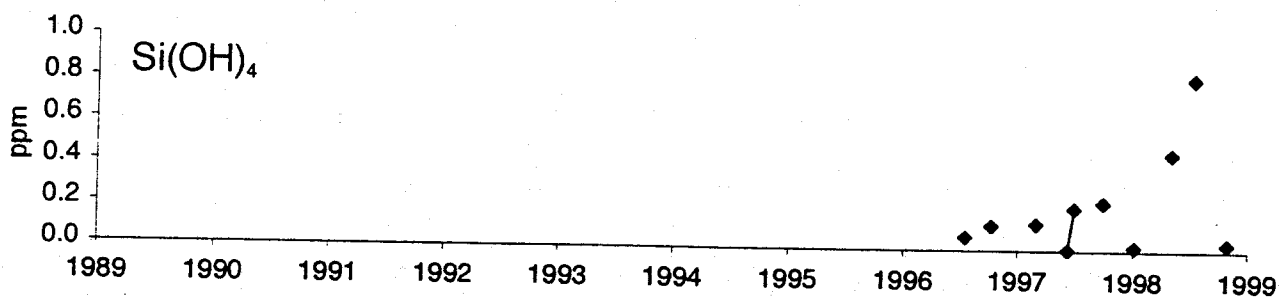
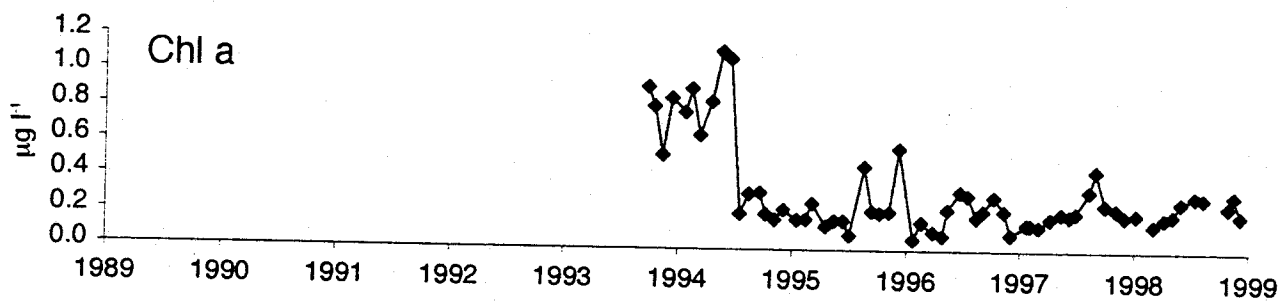
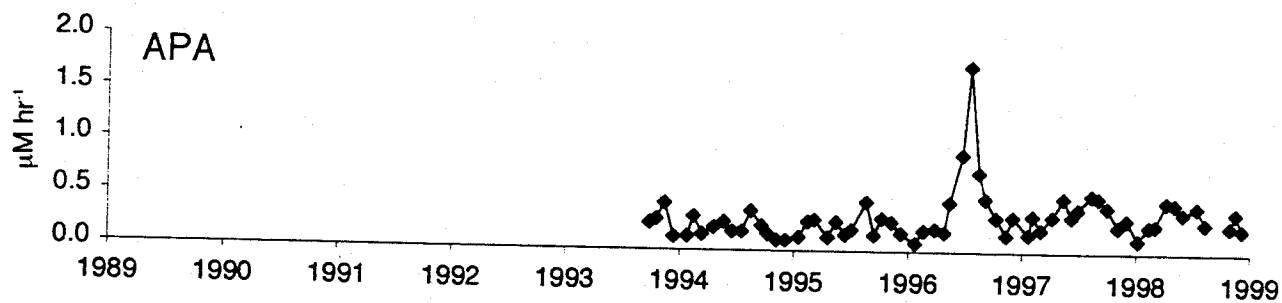
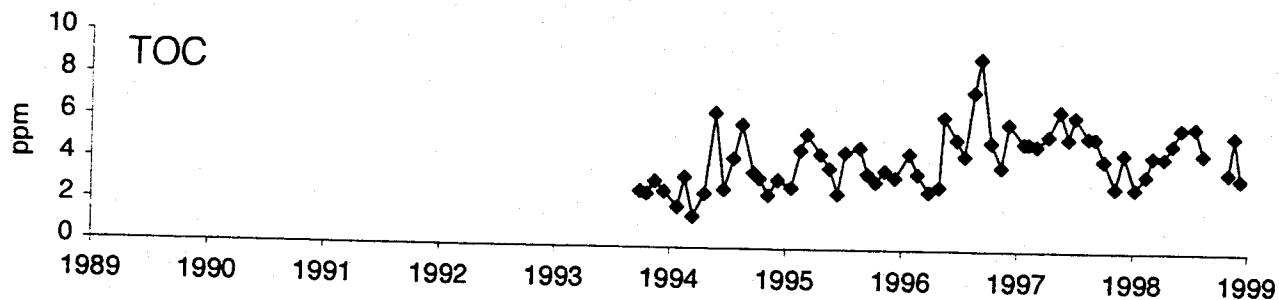
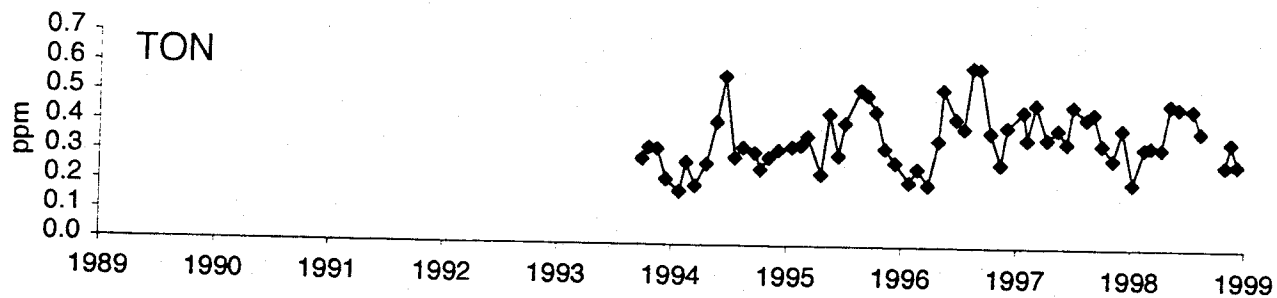
Biscayne Bay Sta. 102 Black Point



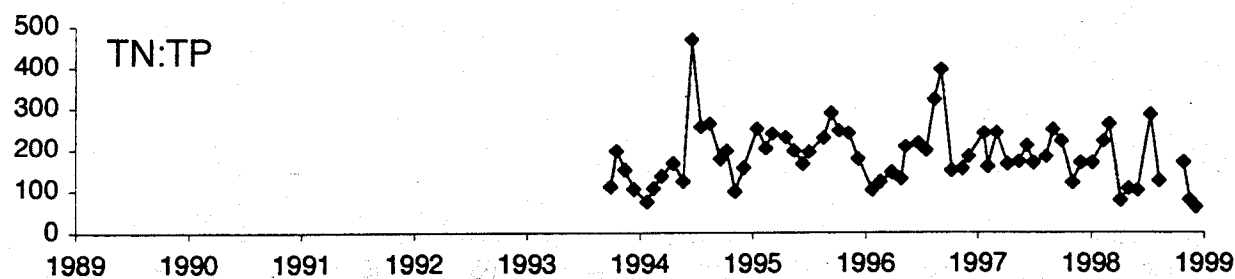
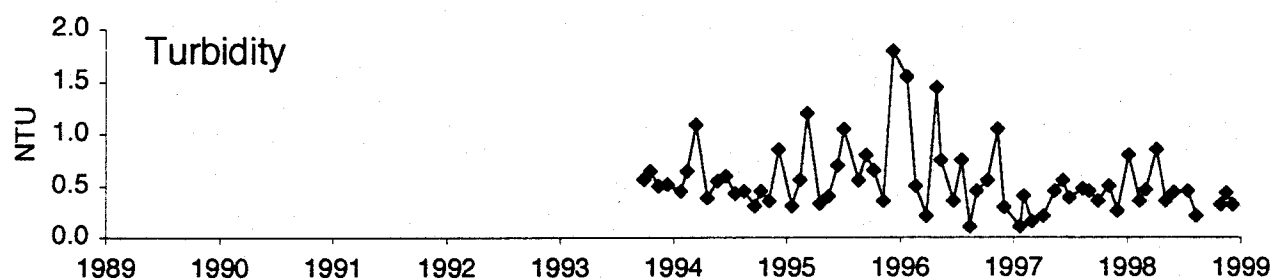
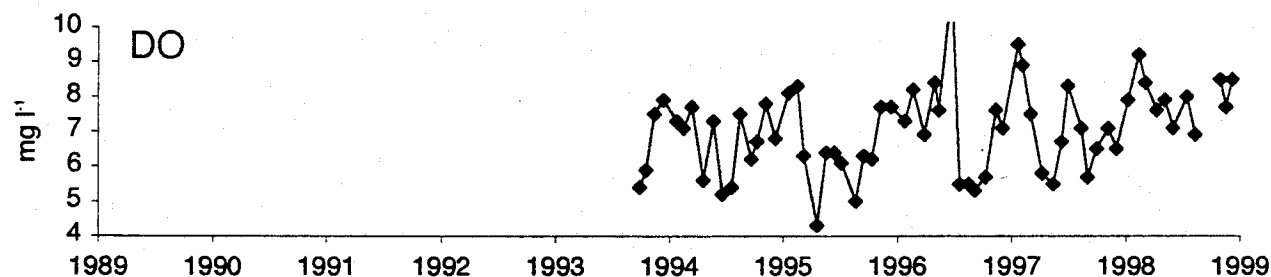
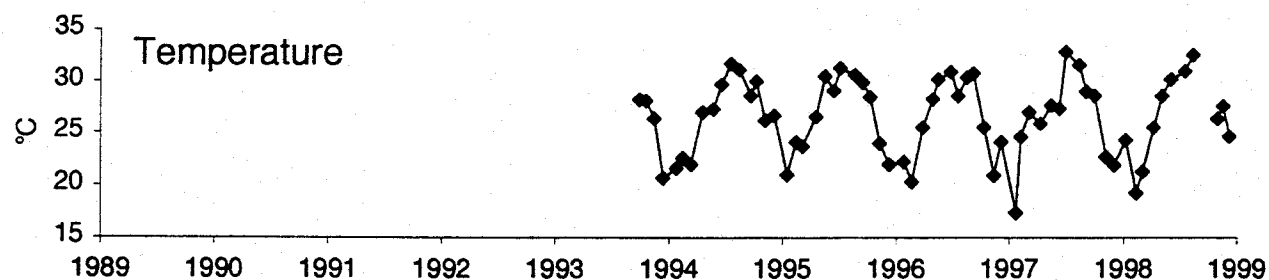
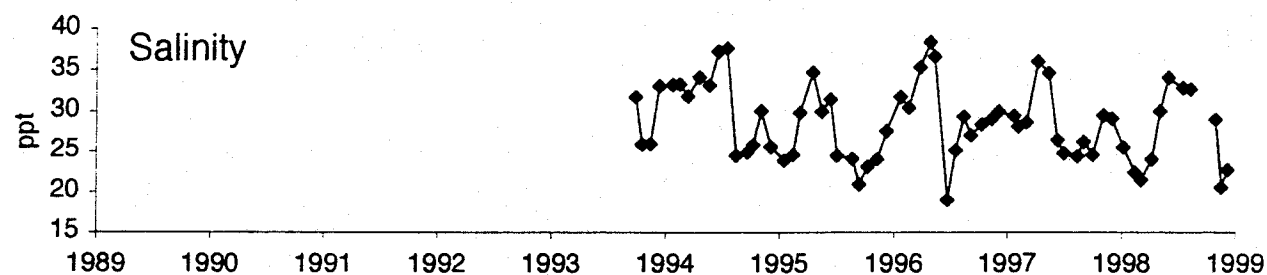
Biscayne Bay Sta. 103 Near Black Ledge



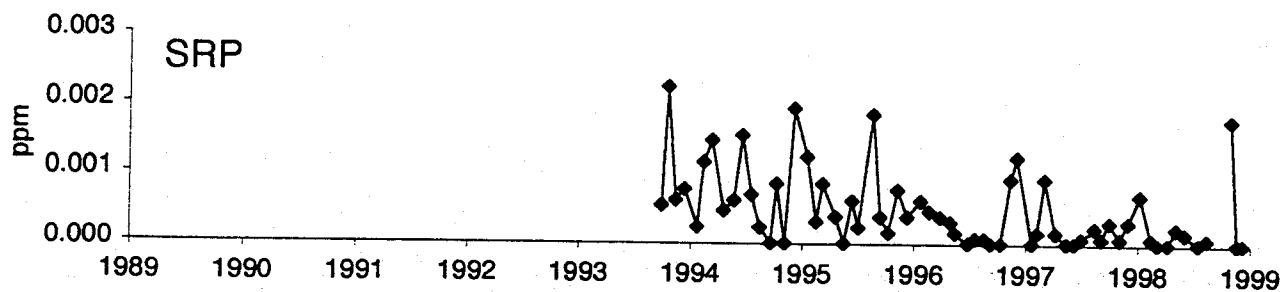
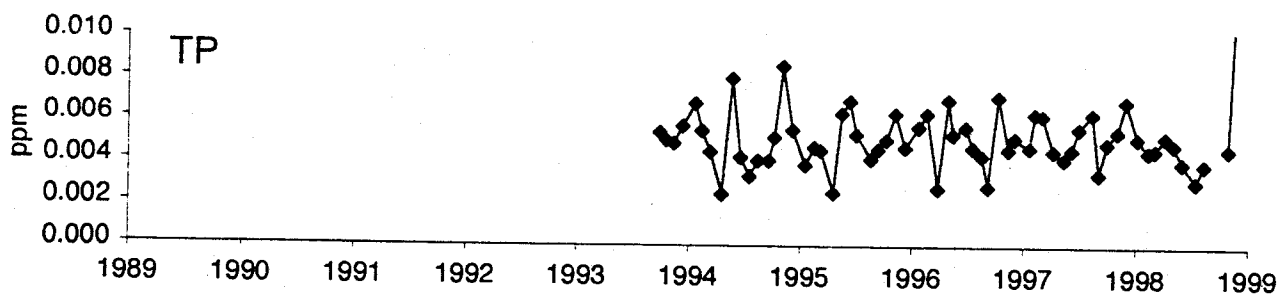
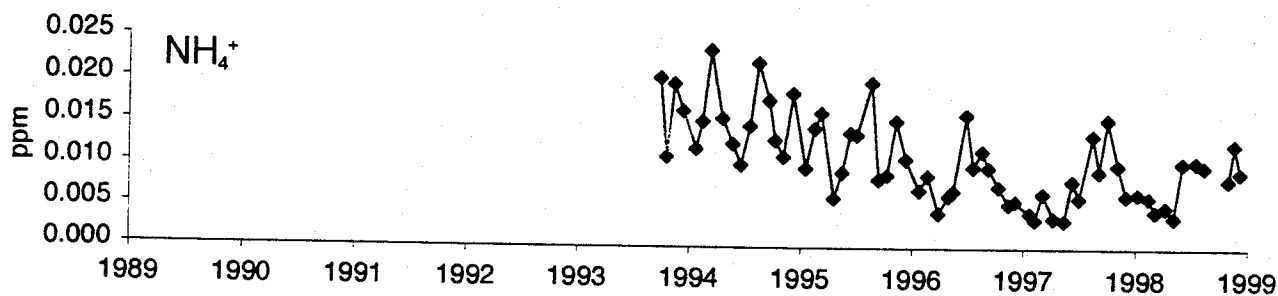
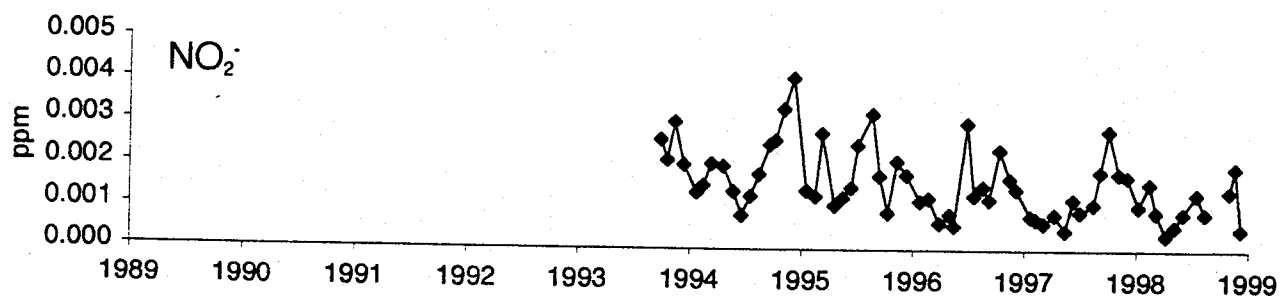
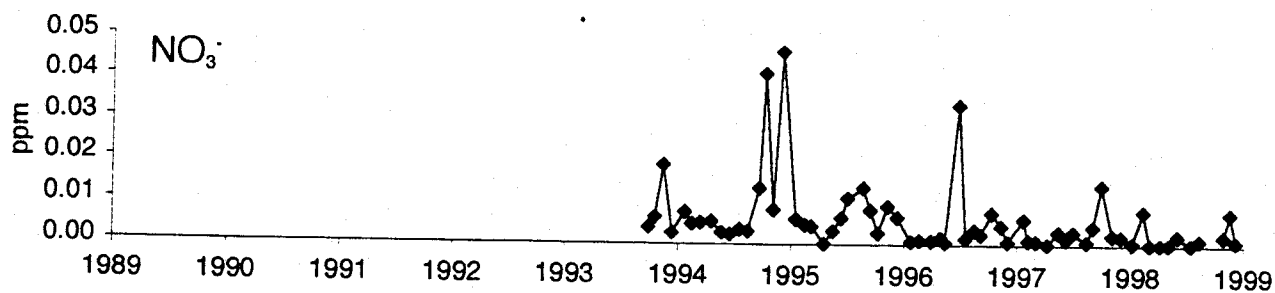
Biscayne Bay Sta. 103 Near Black Ledge



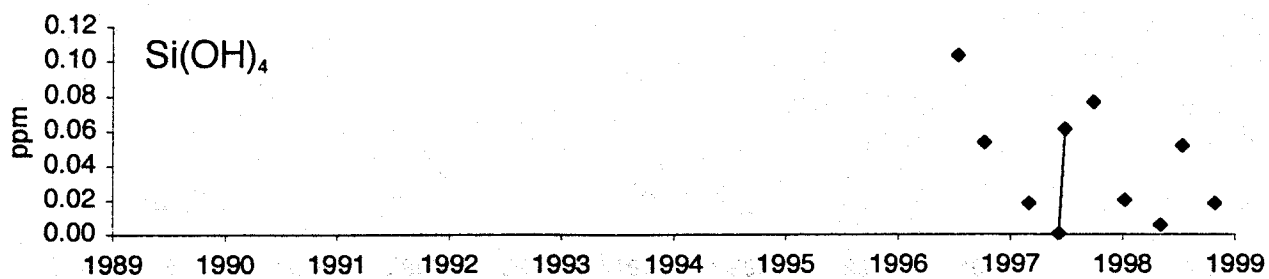
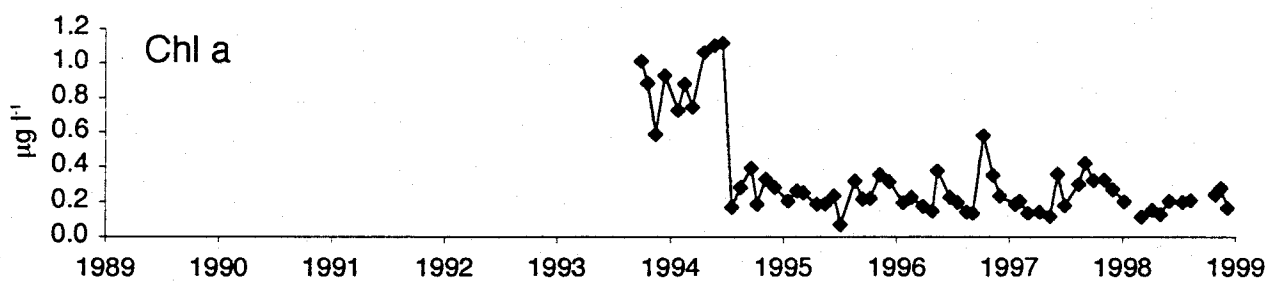
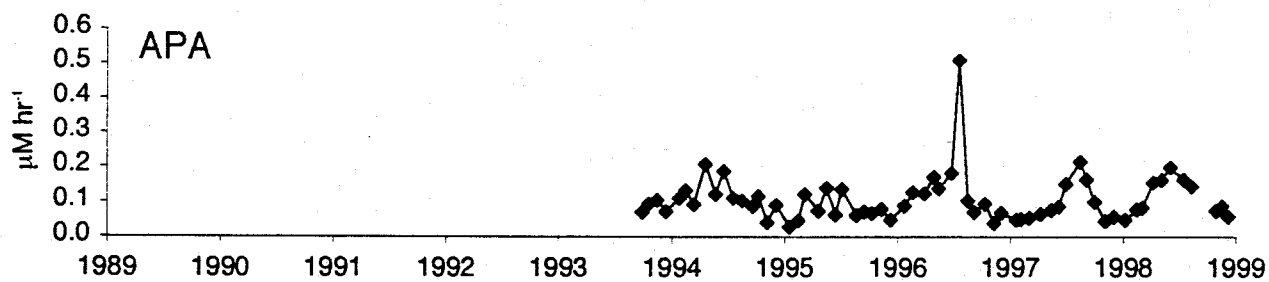
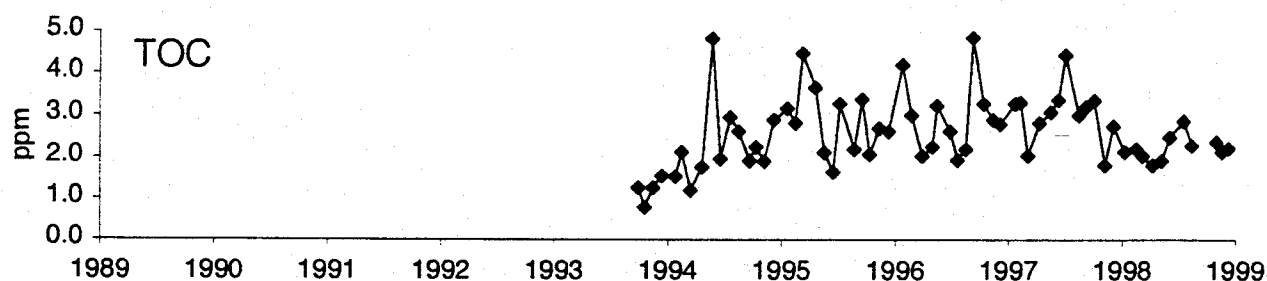
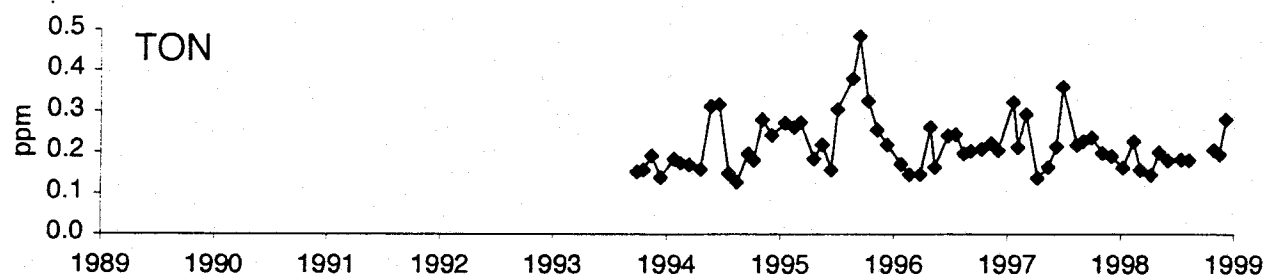
Biscayne Bay Sta. 103 Near Black Ledge



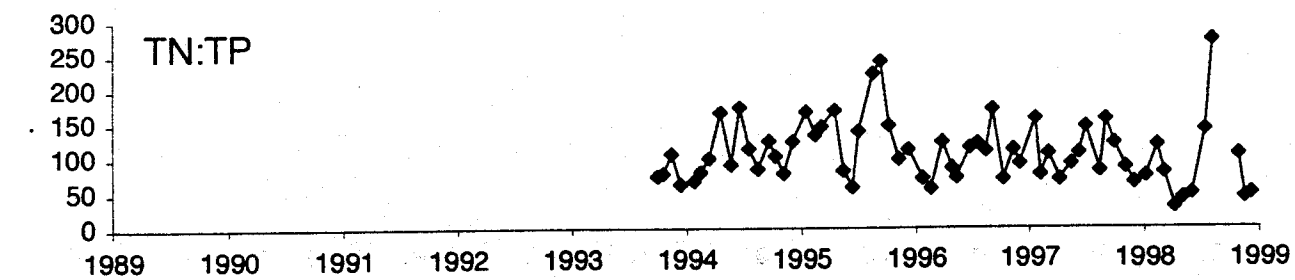
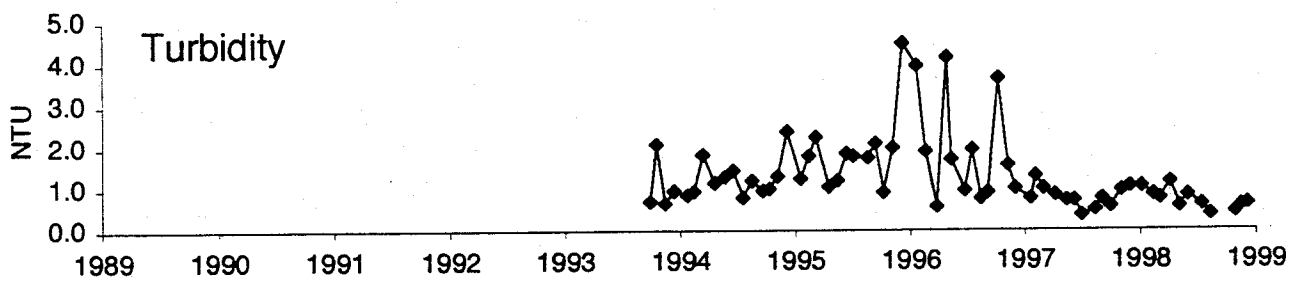
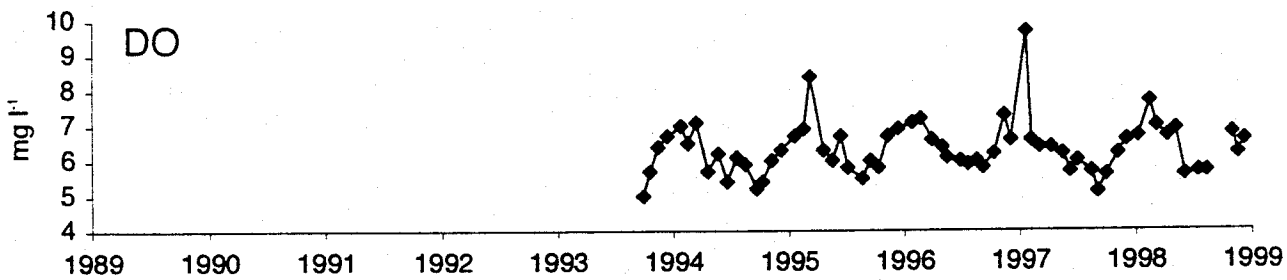
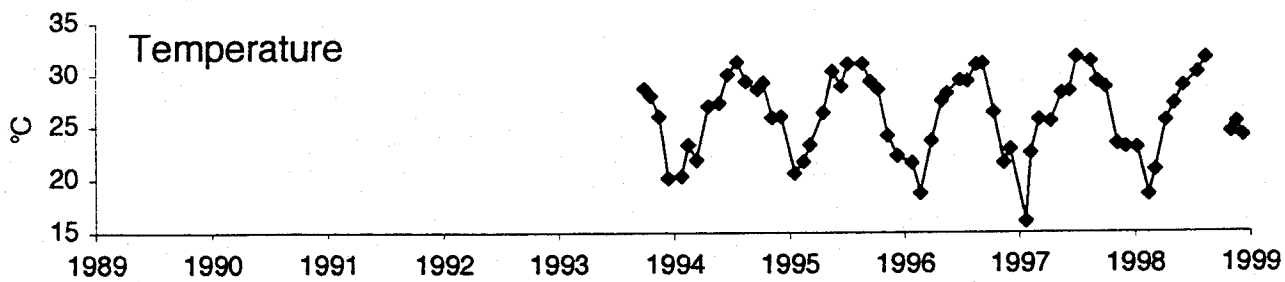
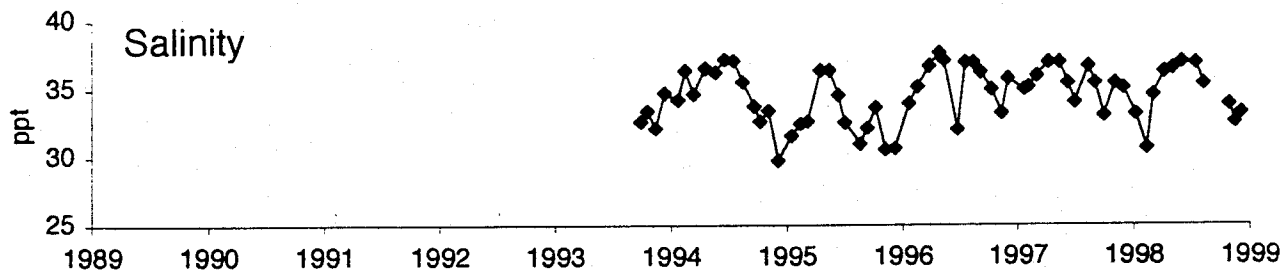
Biscayne Bay Sta. 104 BNP Marker C



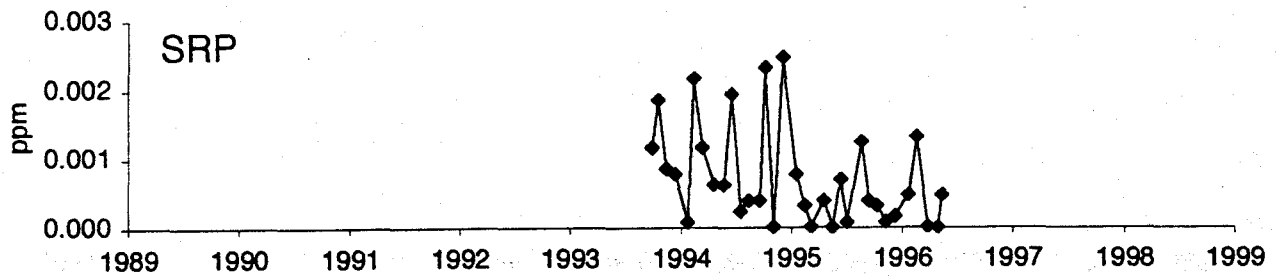
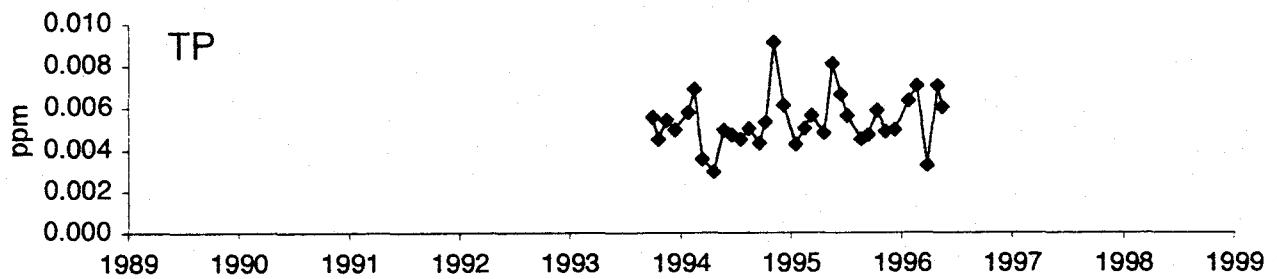
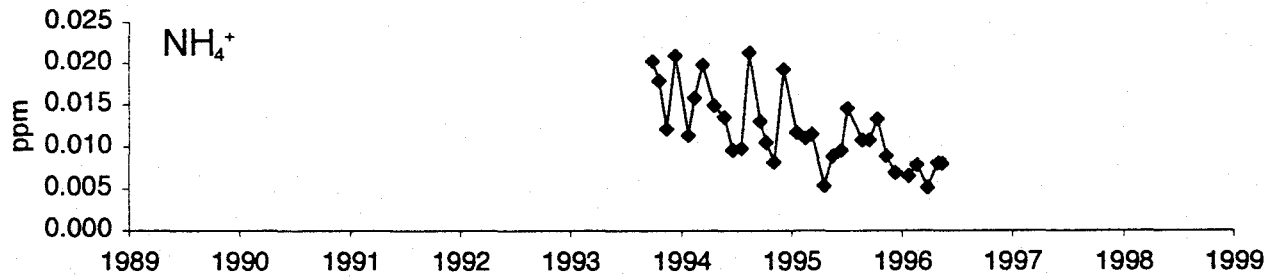
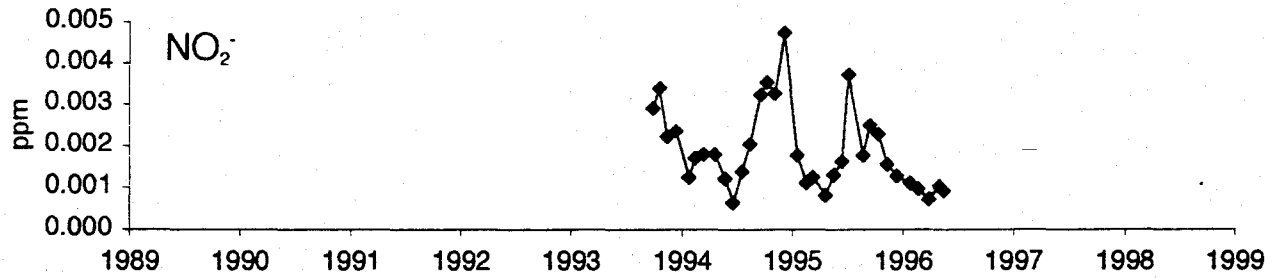
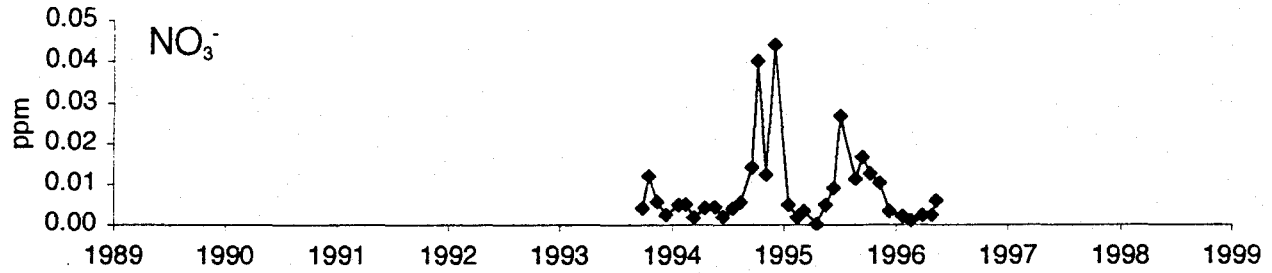
Biscayne Bay Sta. 104 BNP Marker C



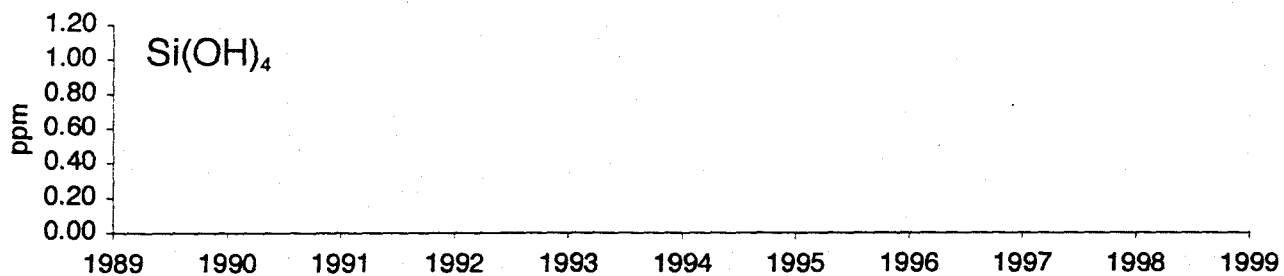
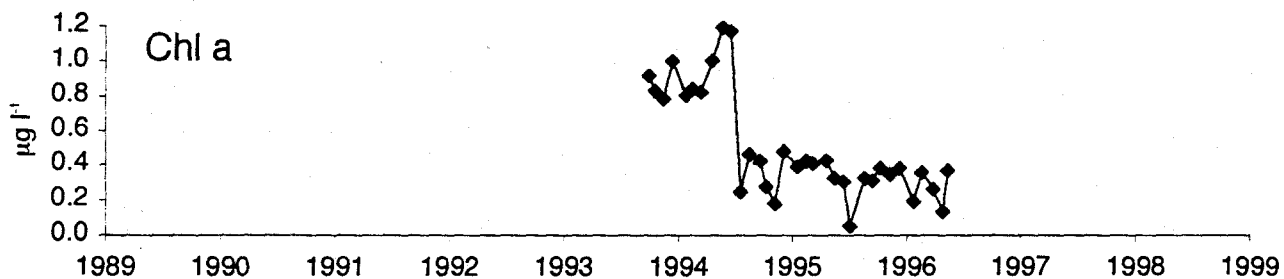
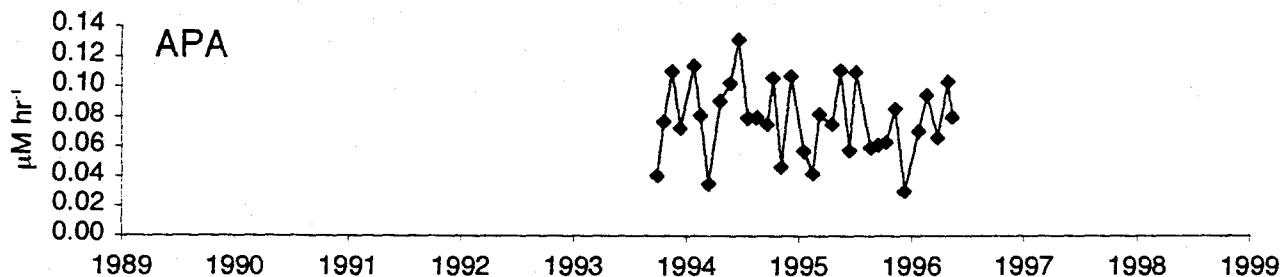
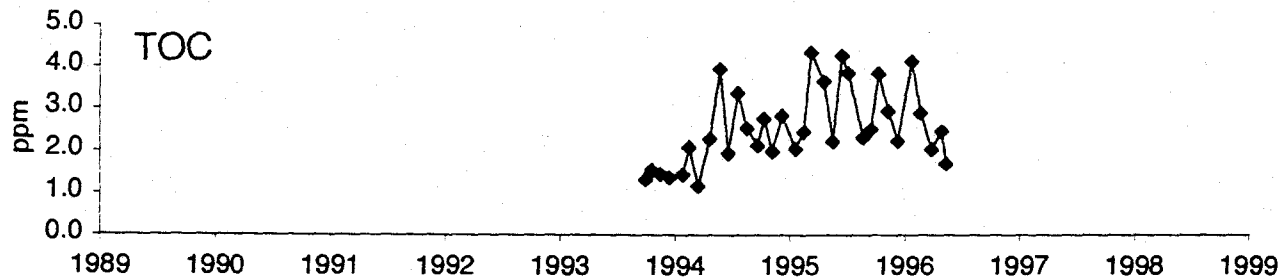
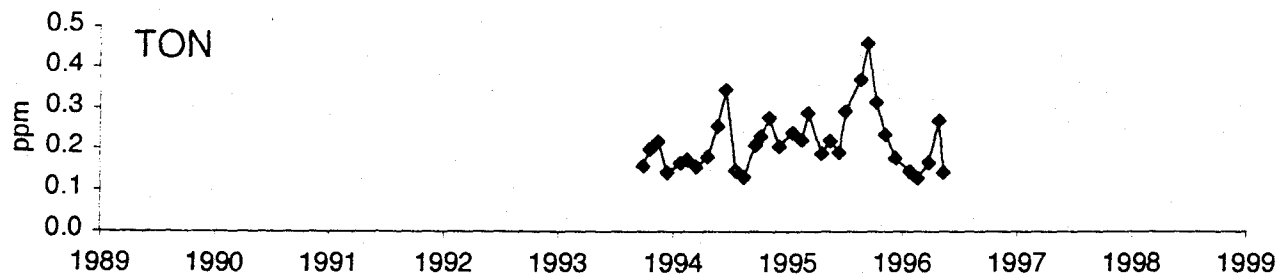
Biscayne Bay Sta. 104 BNP Marker C



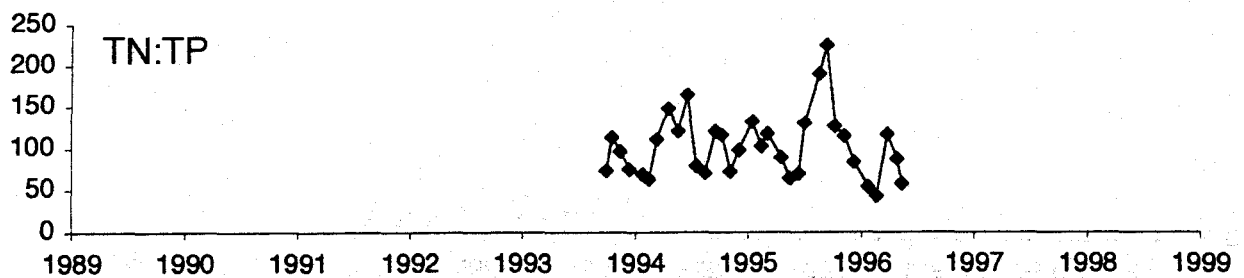
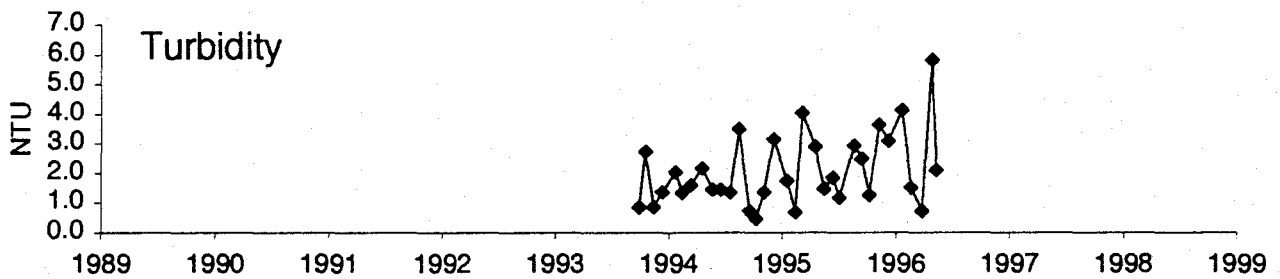
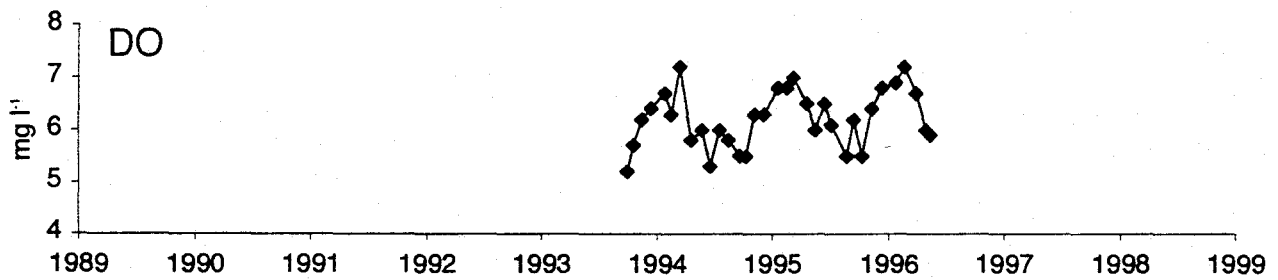
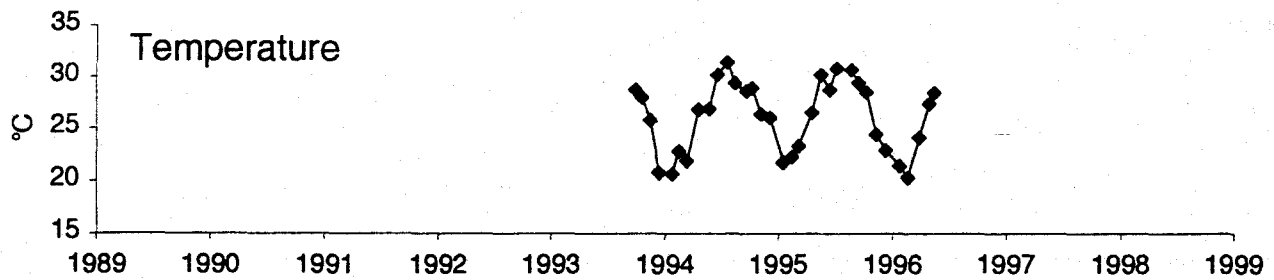
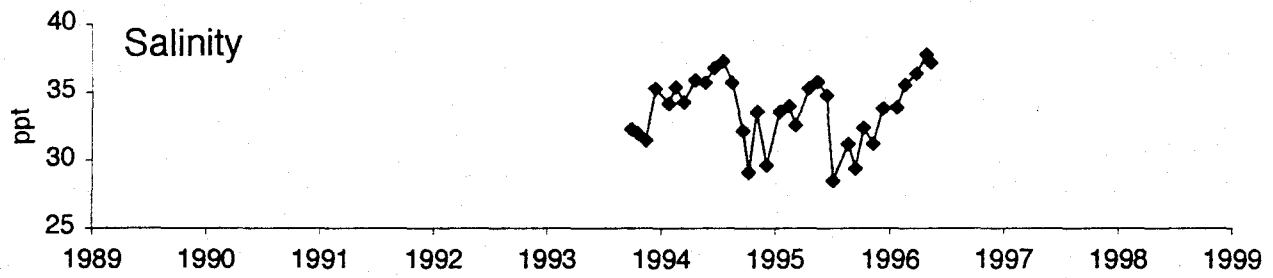
Biscayne Bay Sta. 105 Biscayne Channel



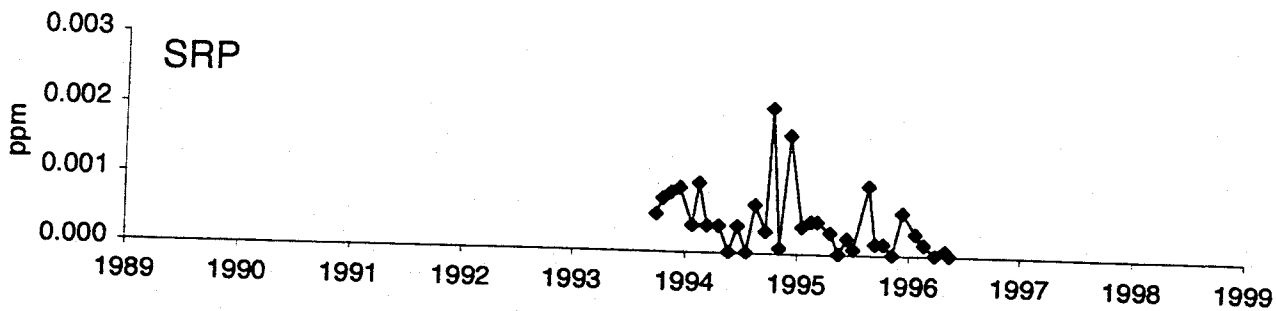
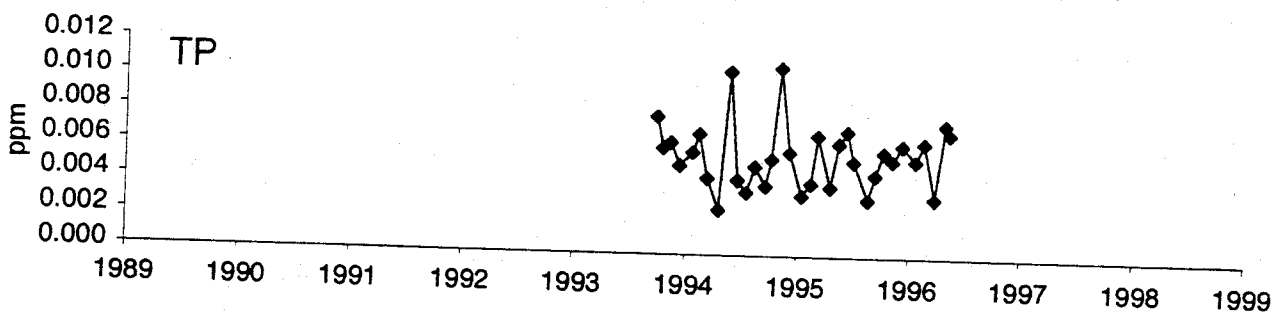
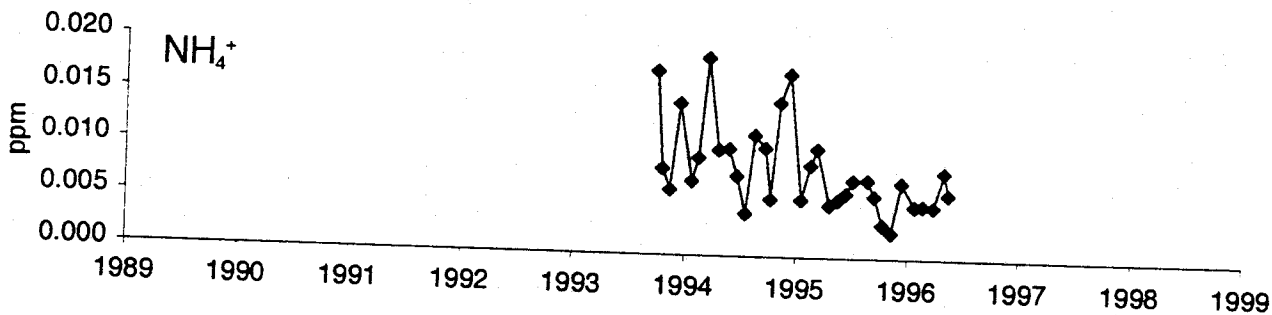
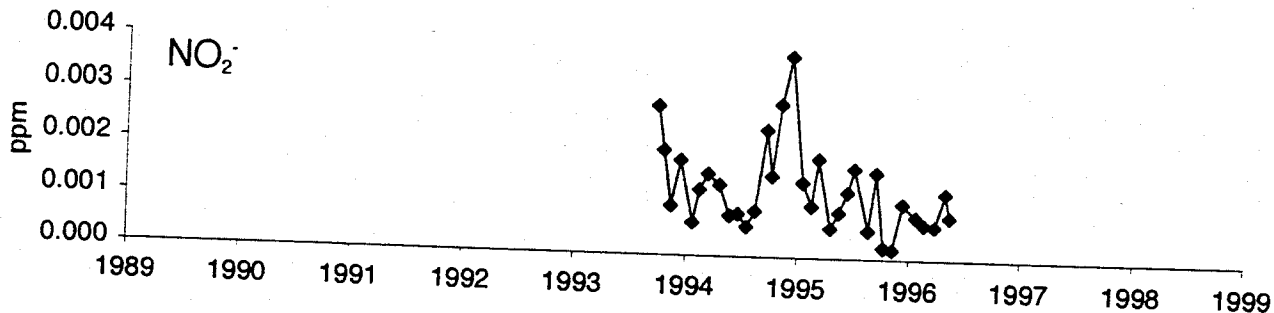
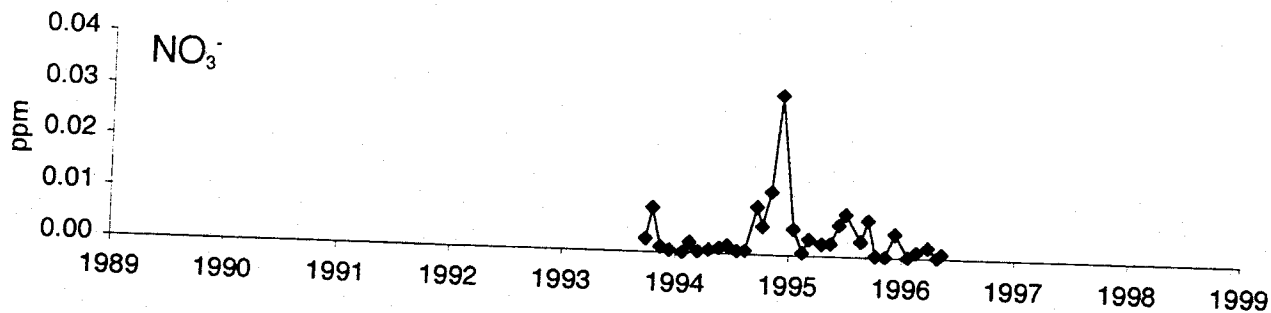
Biscayne Bay Sta. 105 Biscayne Channel



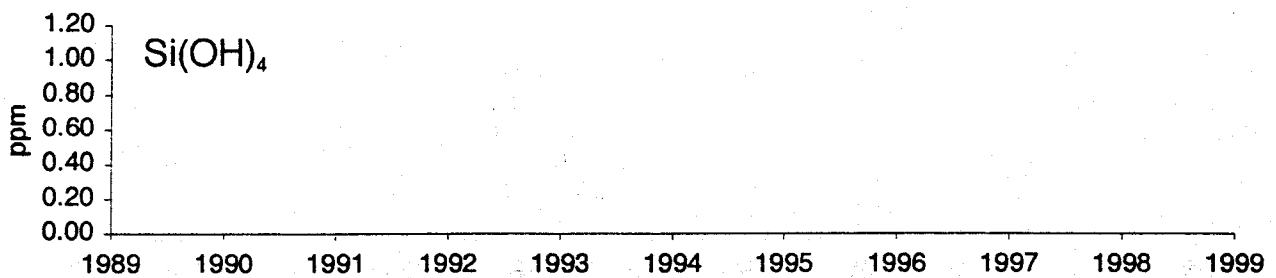
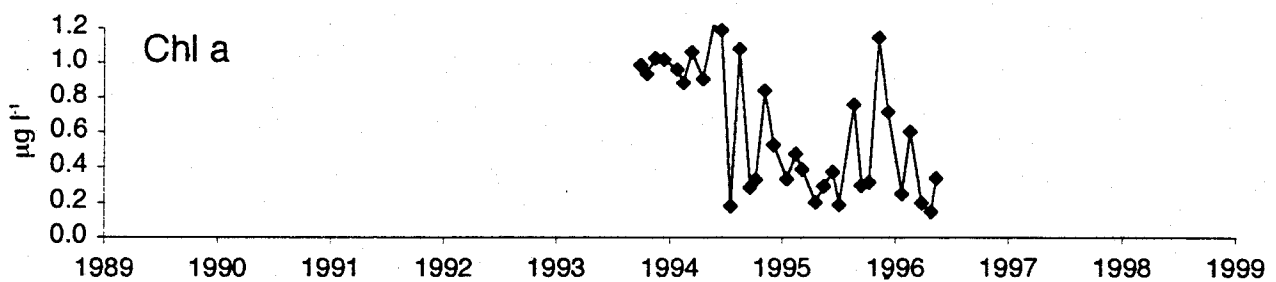
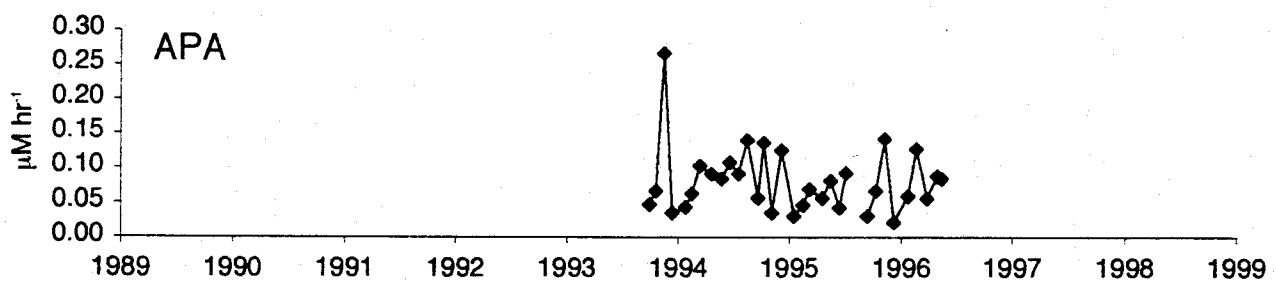
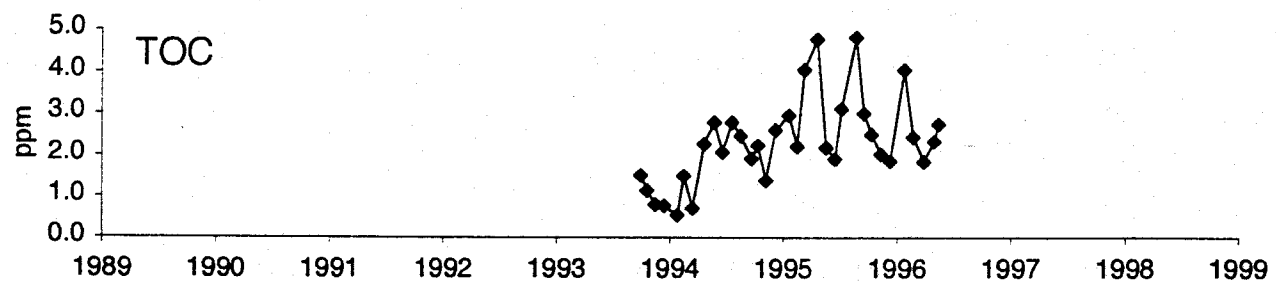
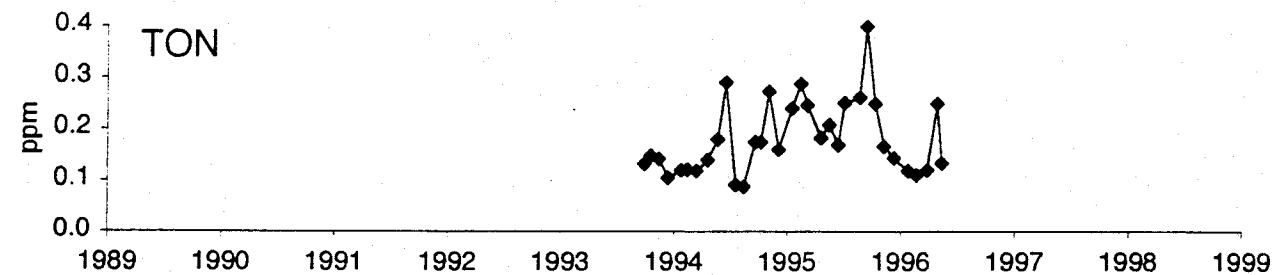
Biscayne Bay Sta. 105 Biscayne Channel



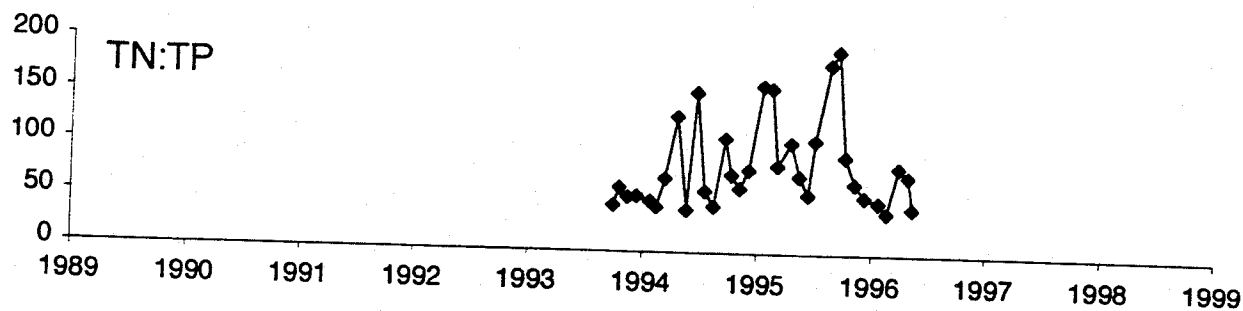
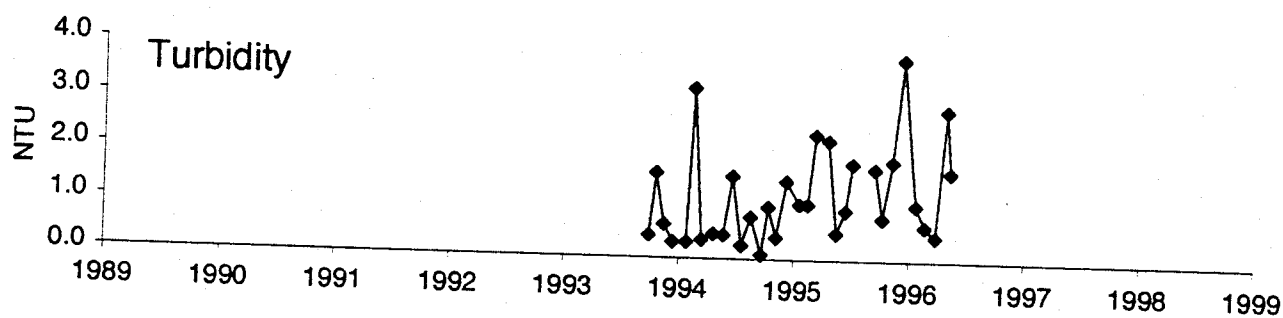
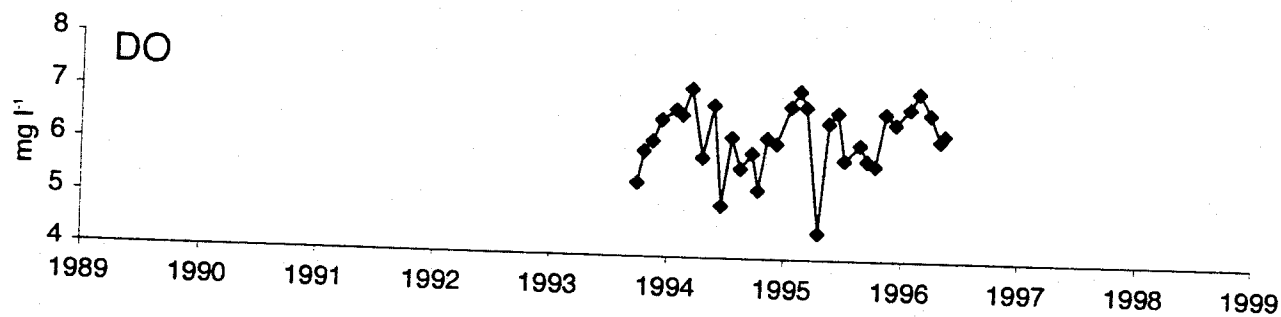
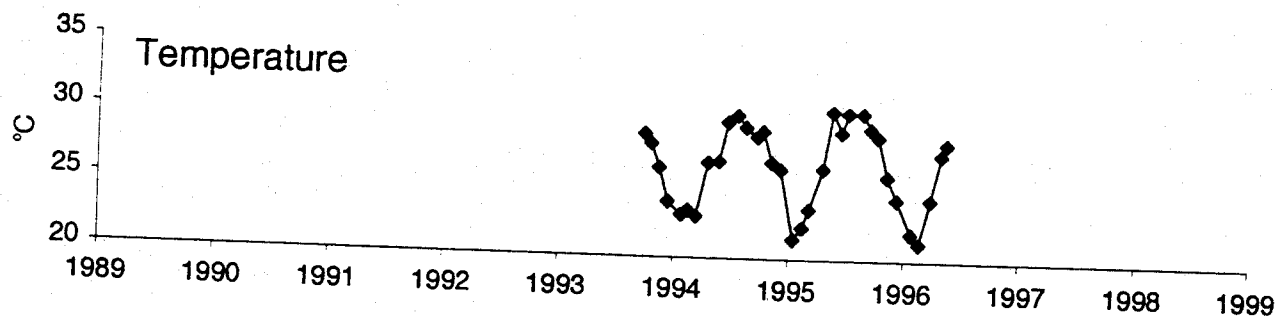
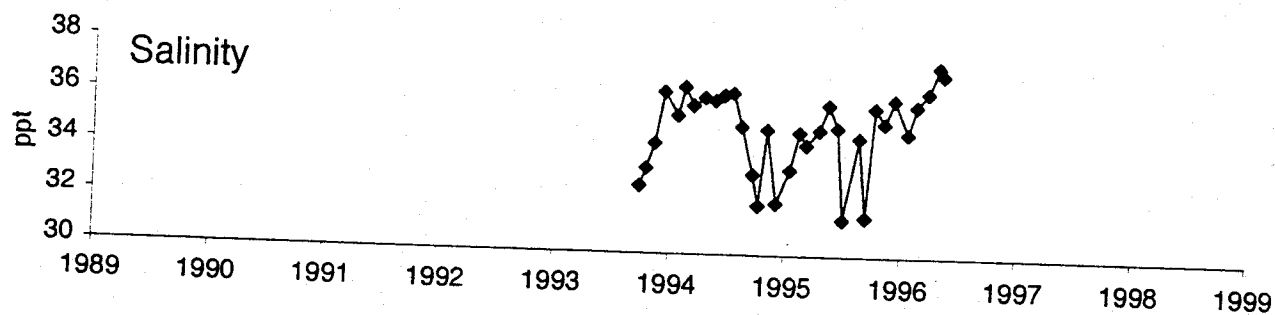
Biscayne Bay Sta. 106 White Marker



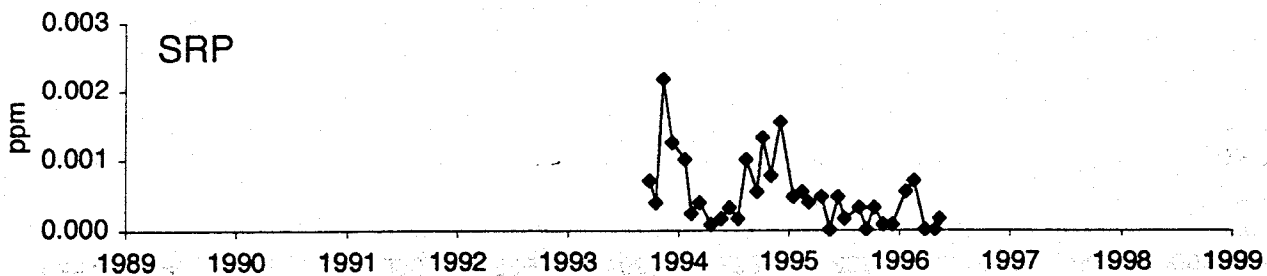
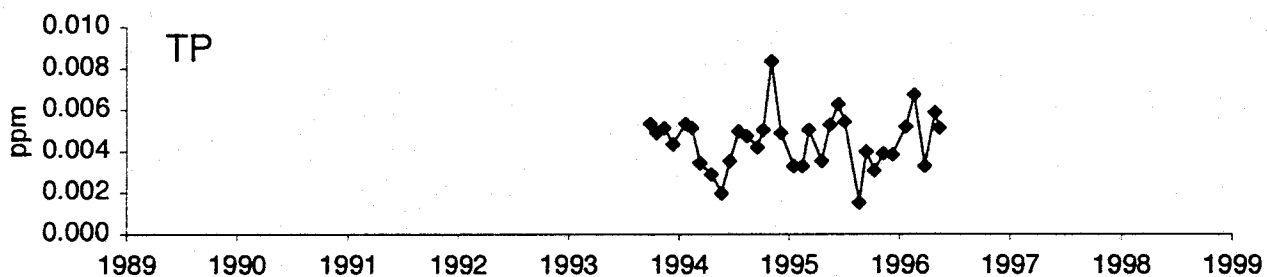
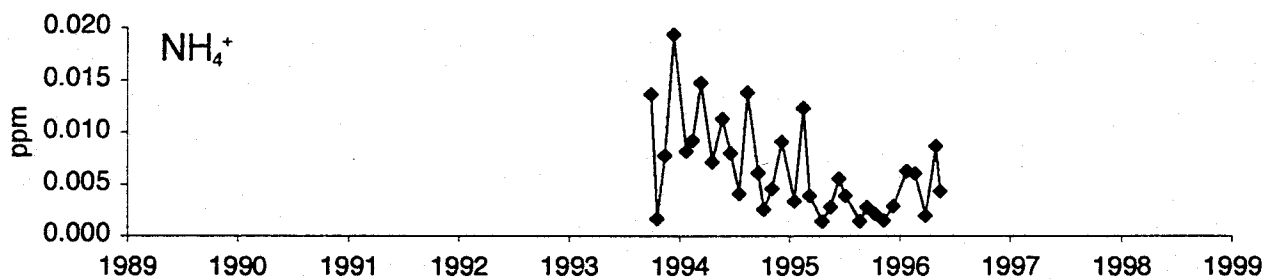
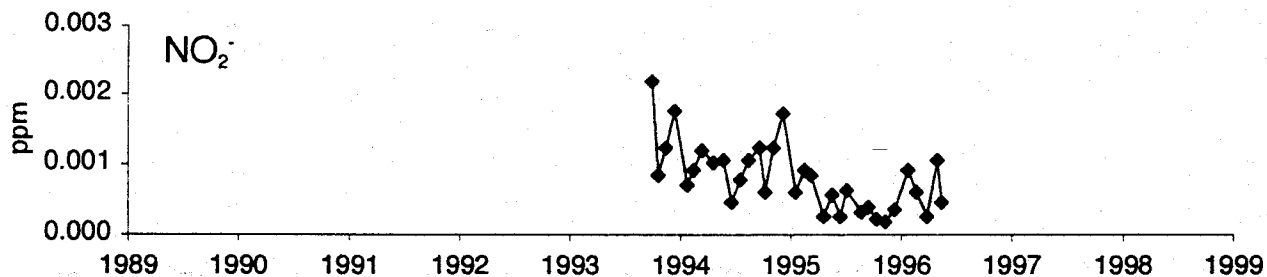
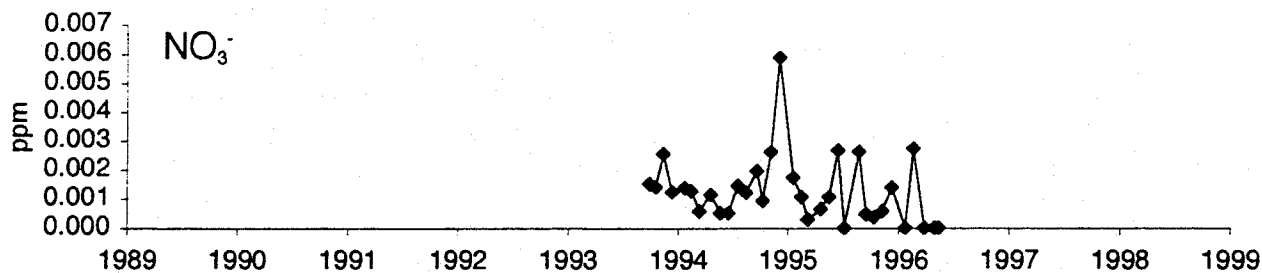
Biscayne Bay Sta. 106 White Marker



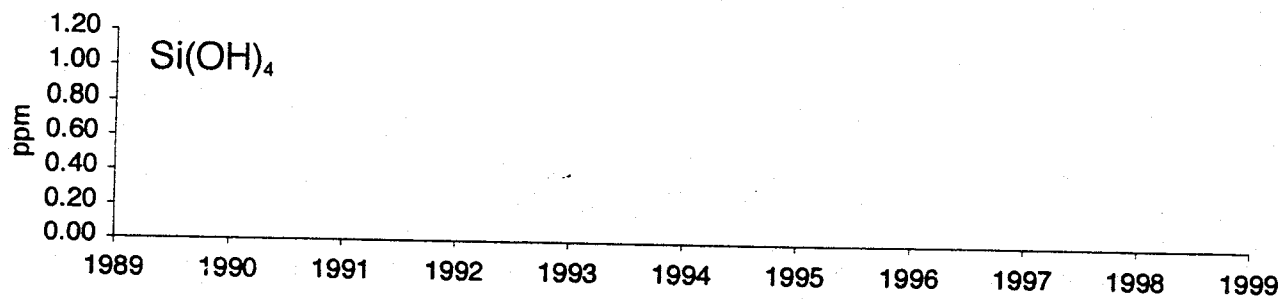
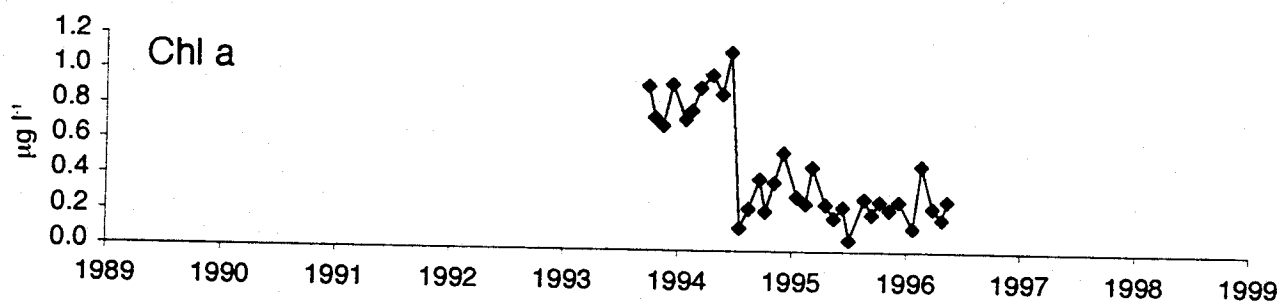
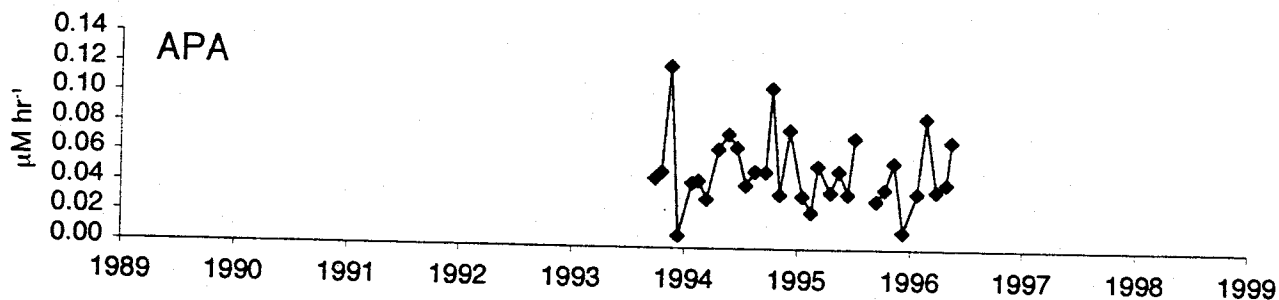
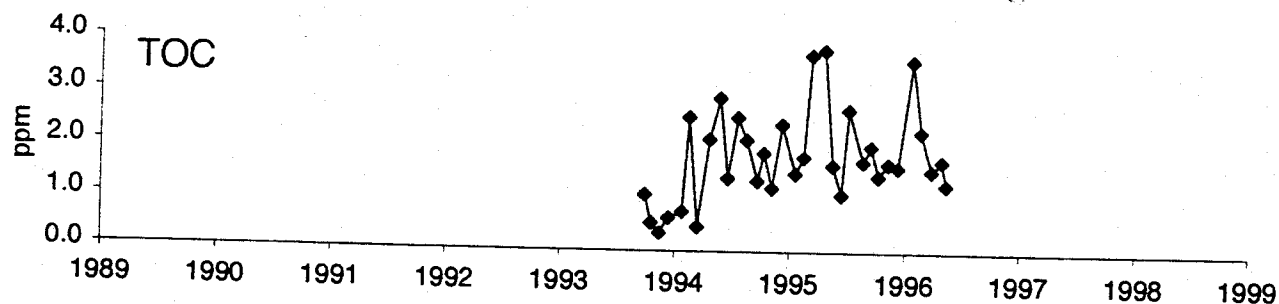
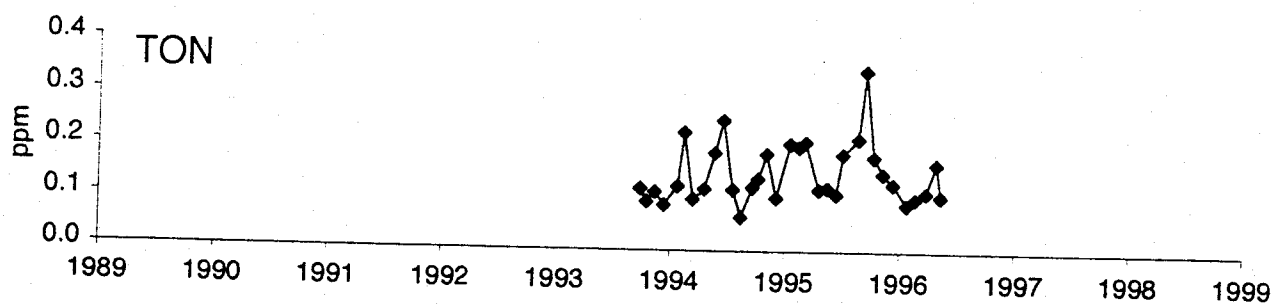
Biscayne Bay Sta. 106 White Marker



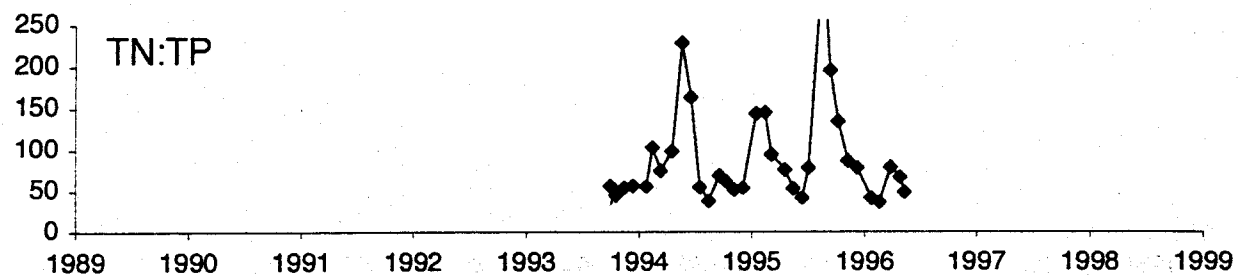
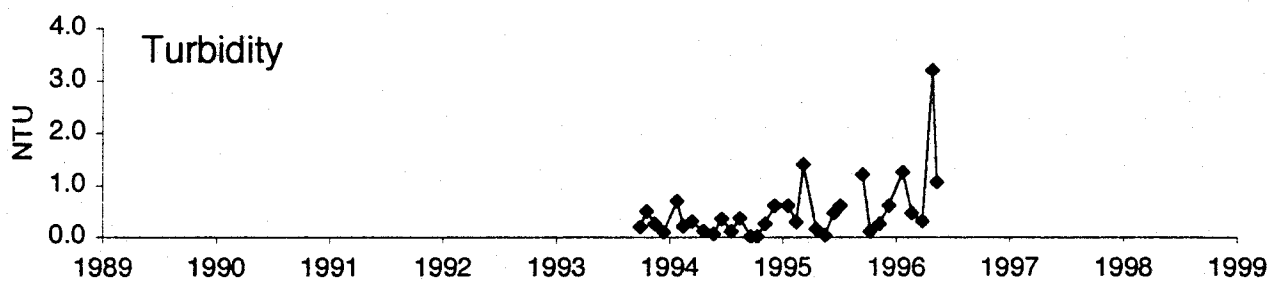
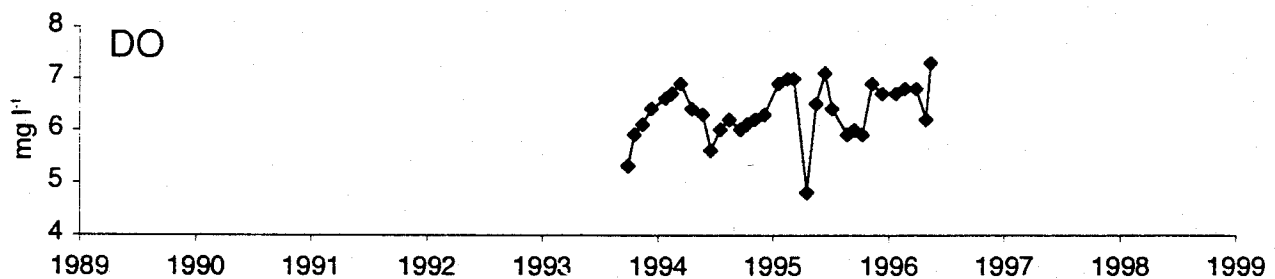
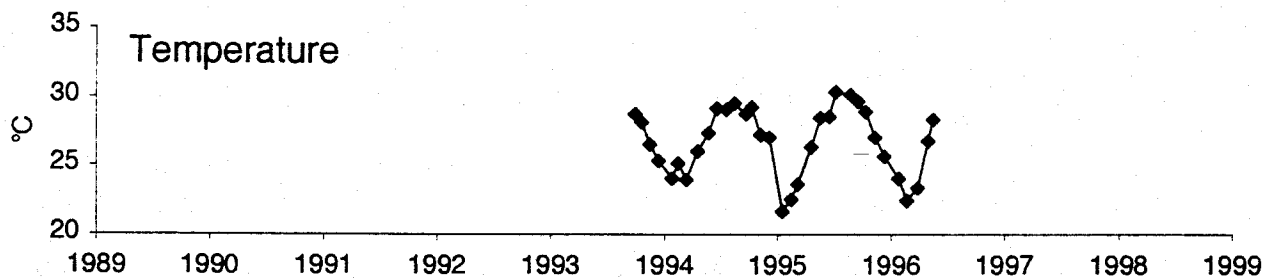
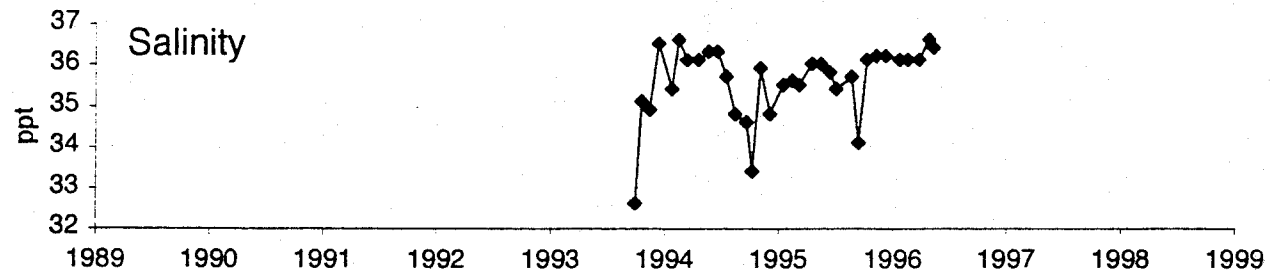
Biscayne Bay Sta. 107 Fowey Rocks



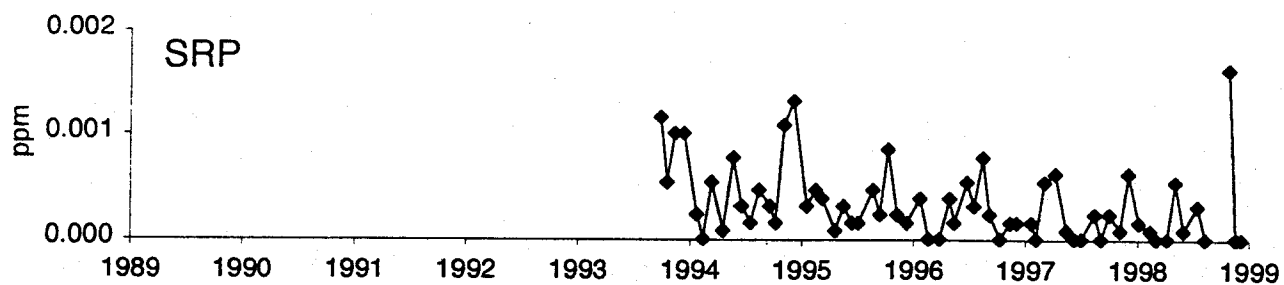
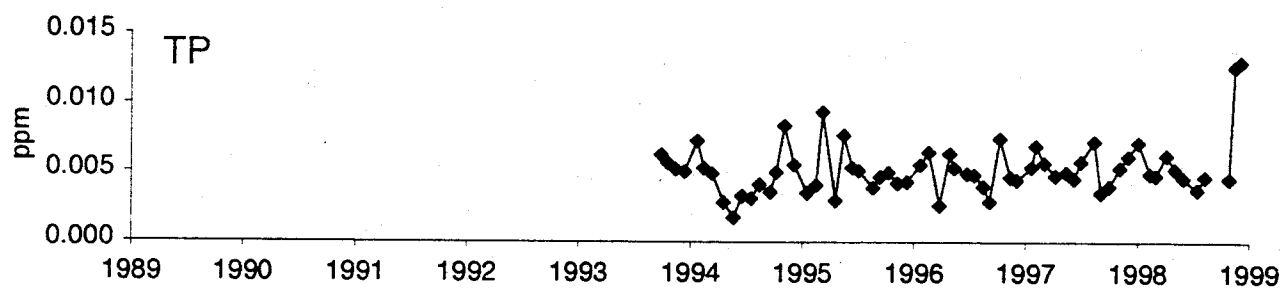
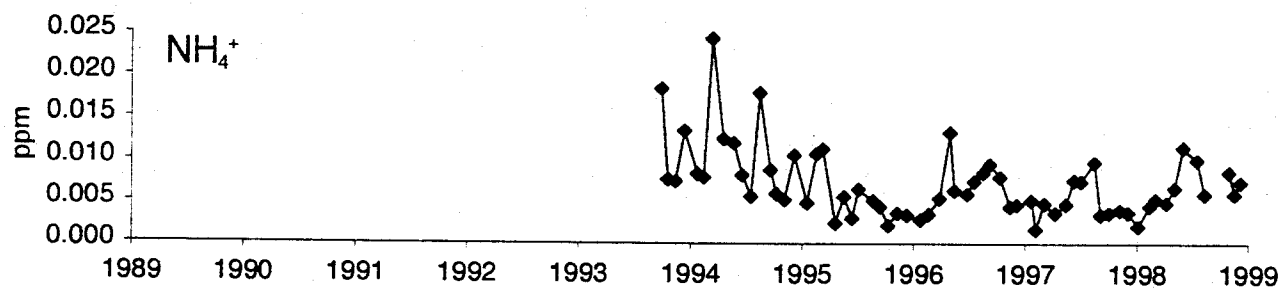
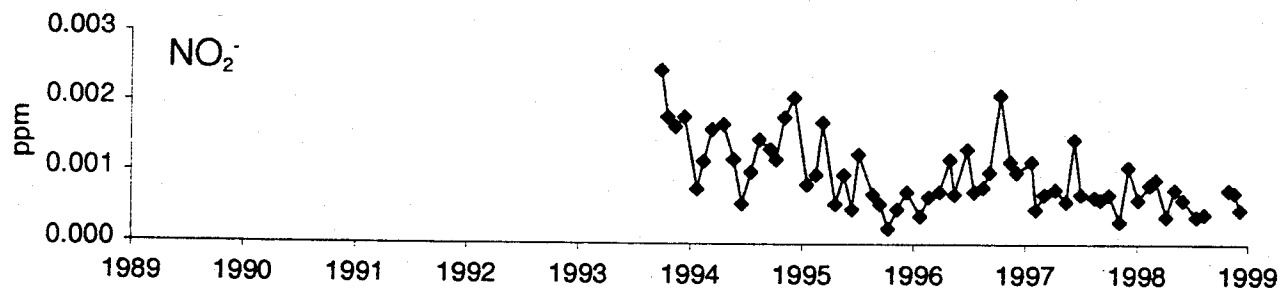
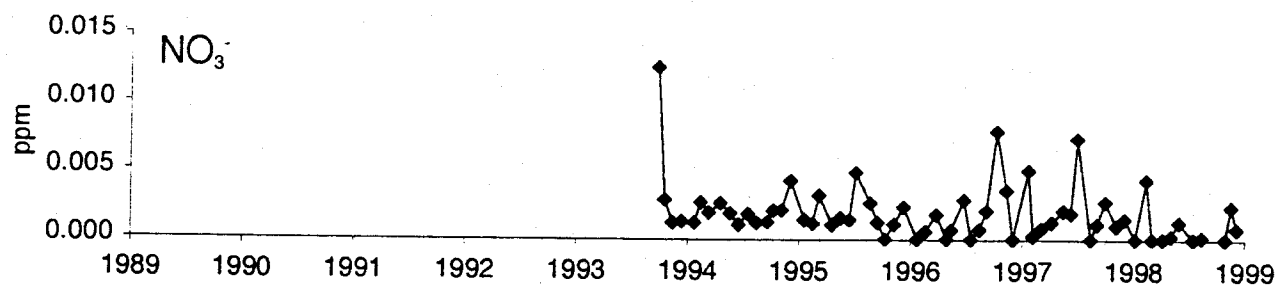
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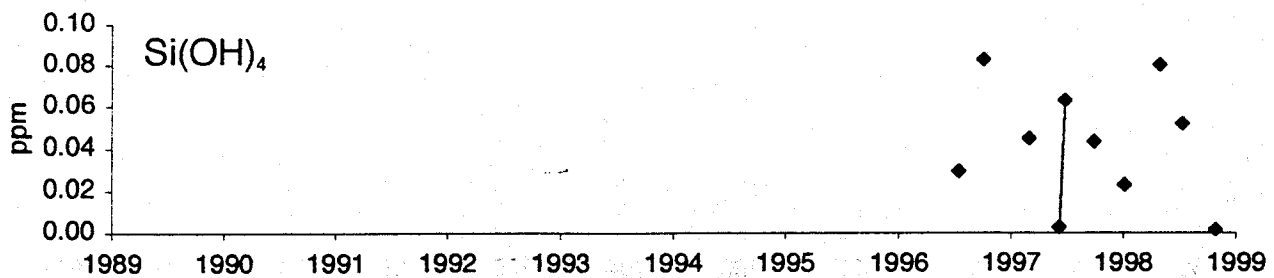
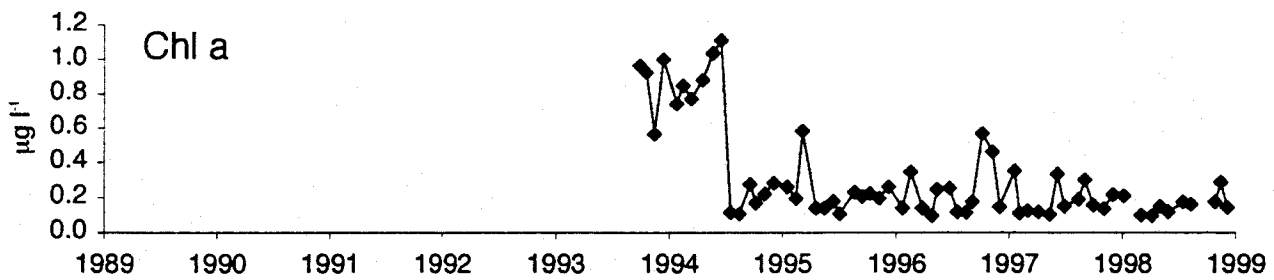
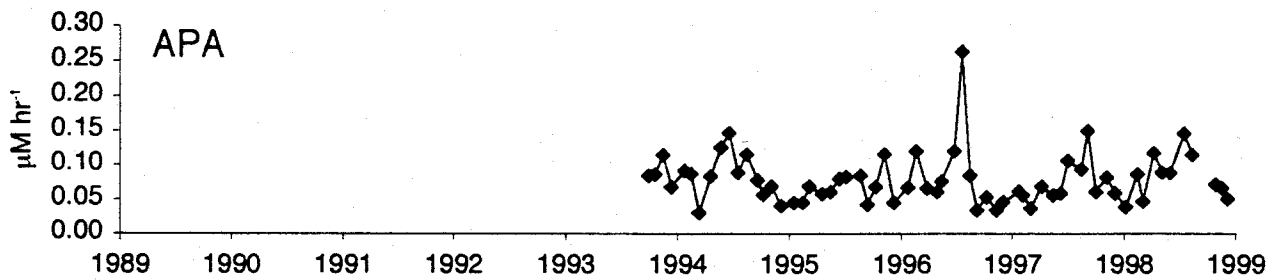
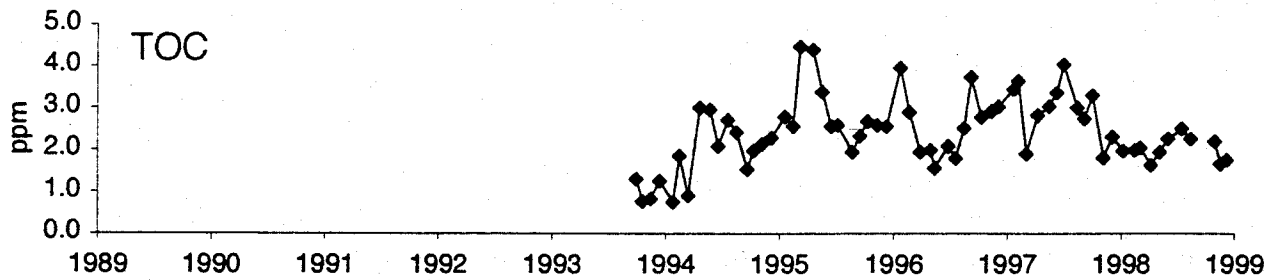
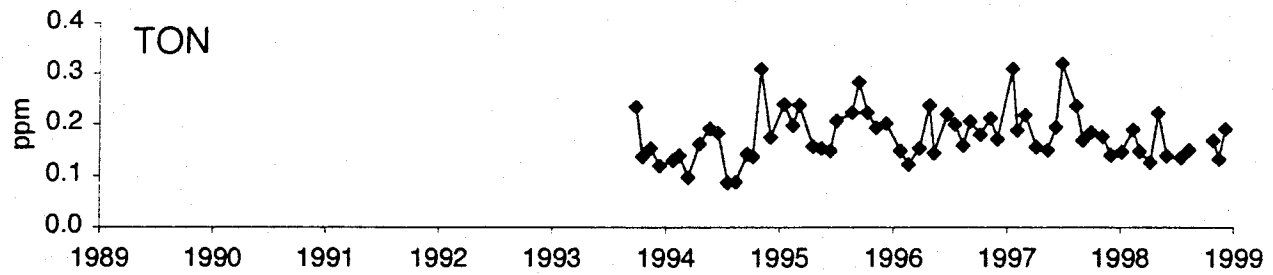
Biscayne Bay Sta. 107 Fowey Rocks



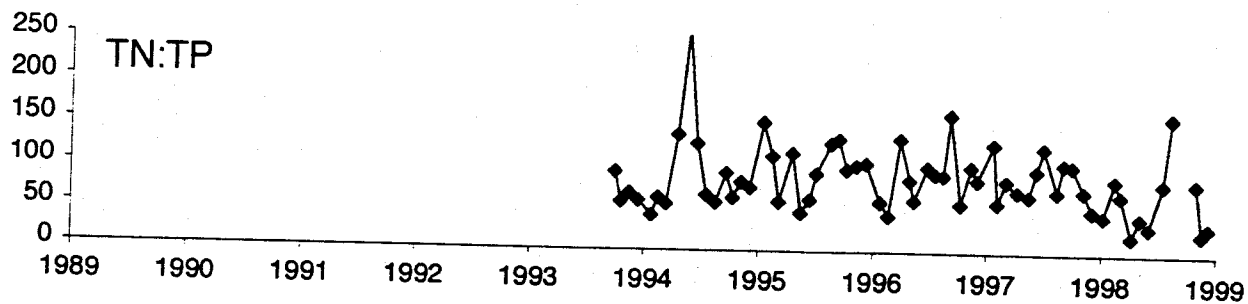
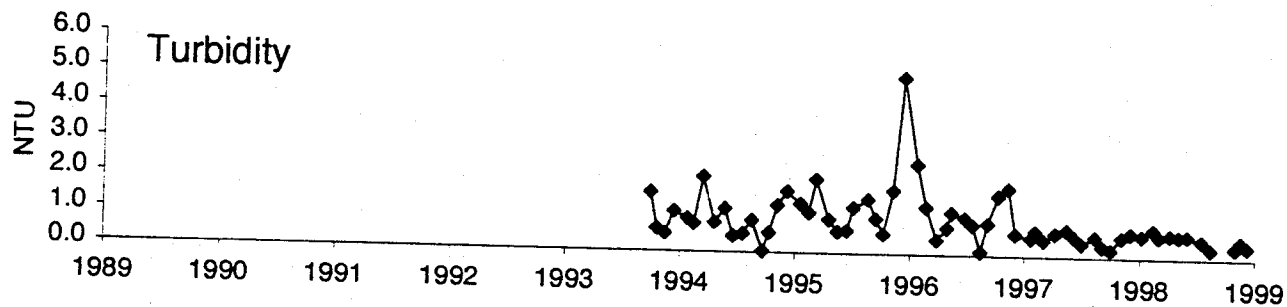
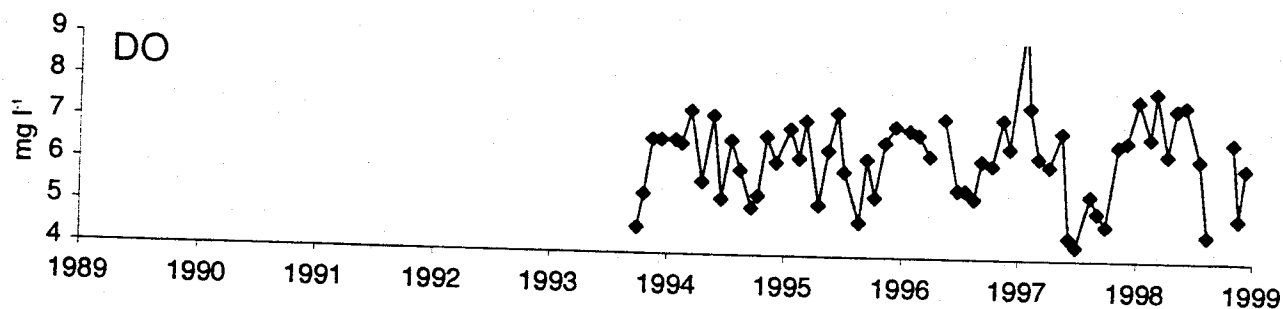
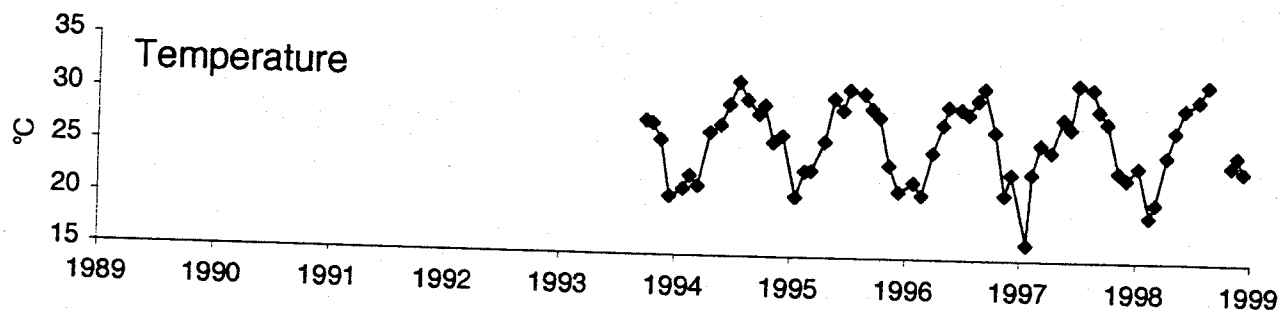
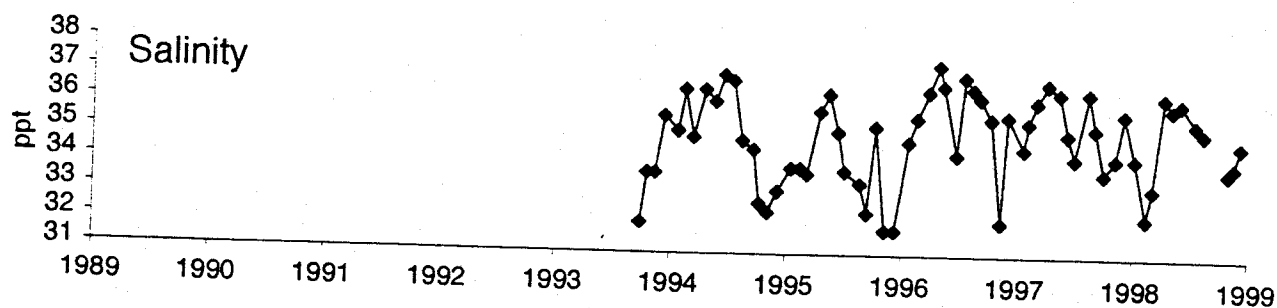
Biscayne Bay Sta. 108 Marker G-1B



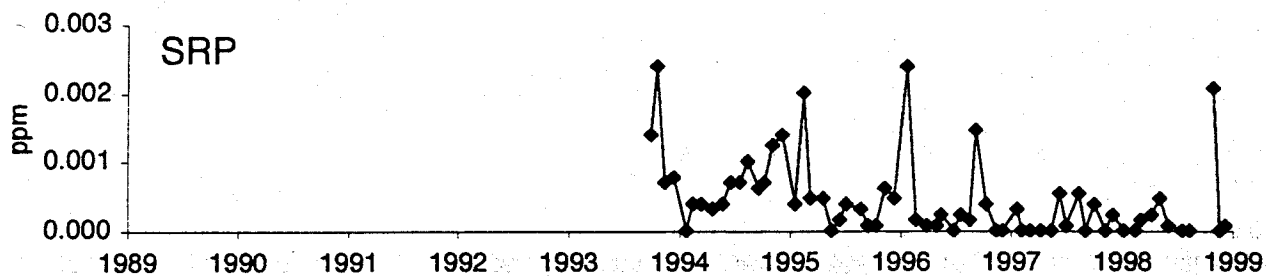
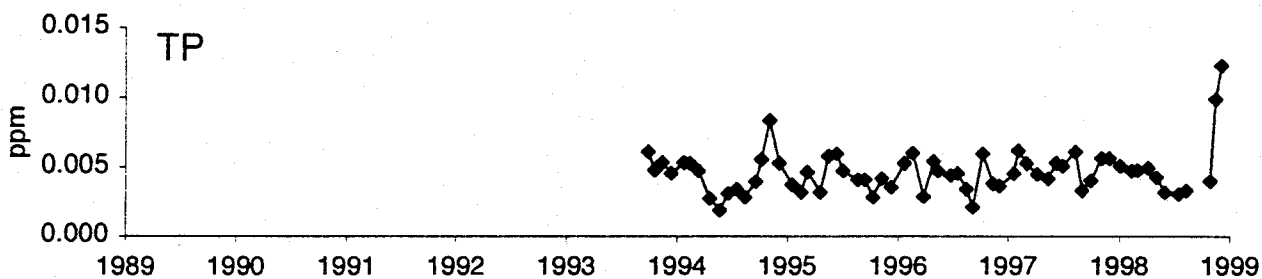
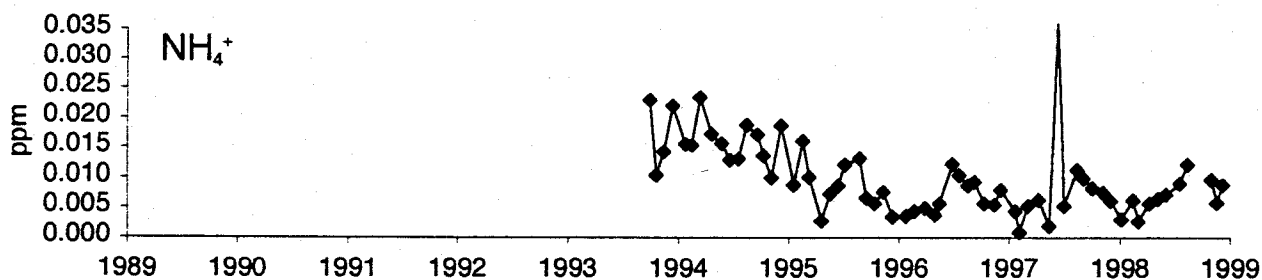
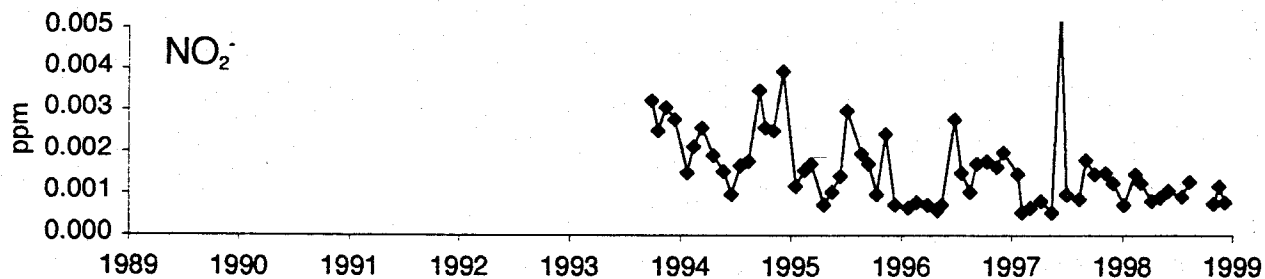
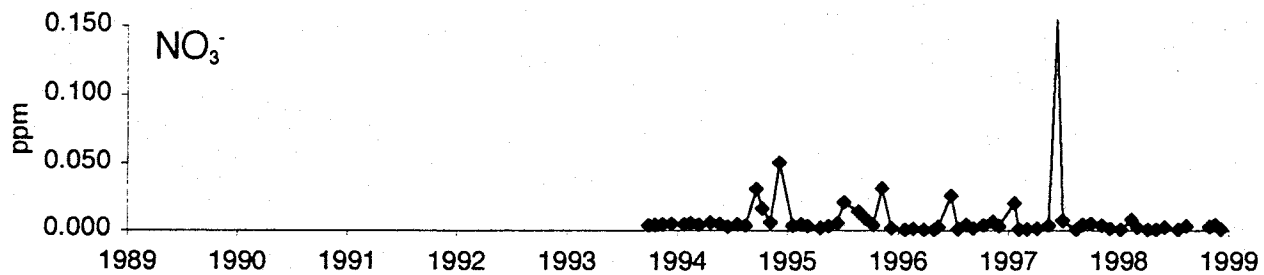
Biscayne Bay Sta. 108 Marker G-1B



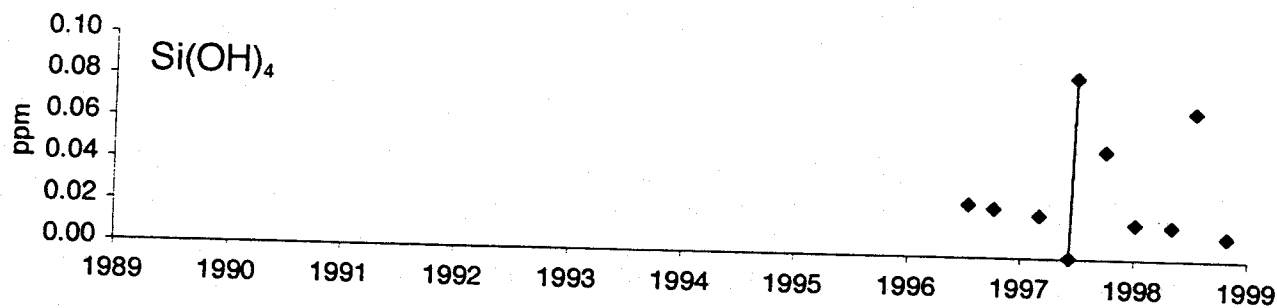
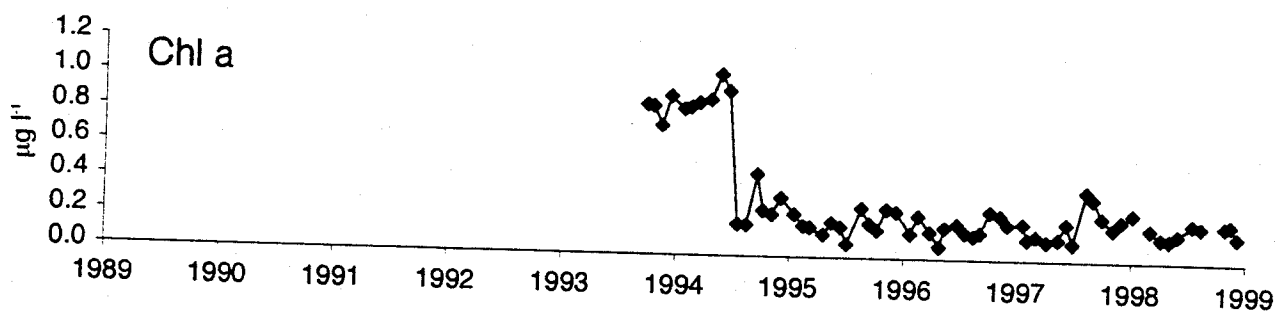
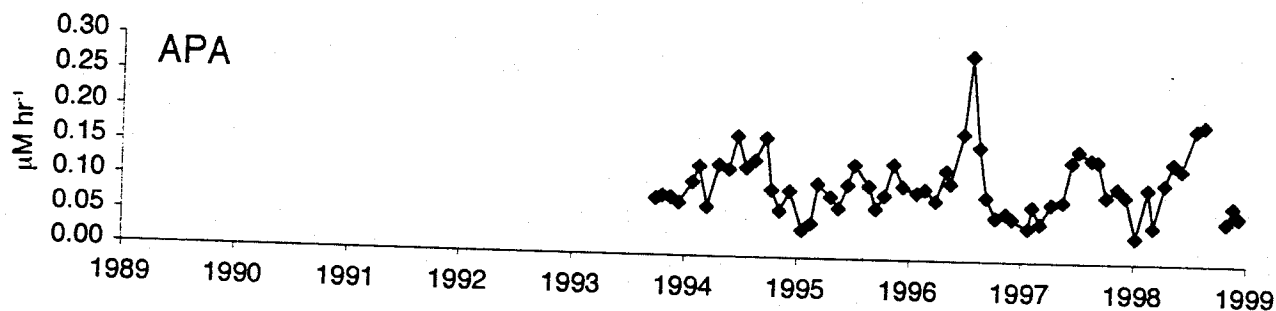
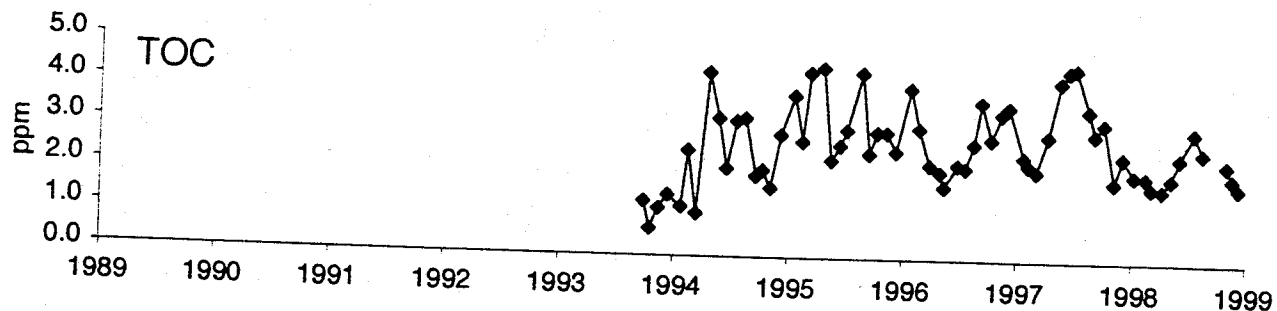
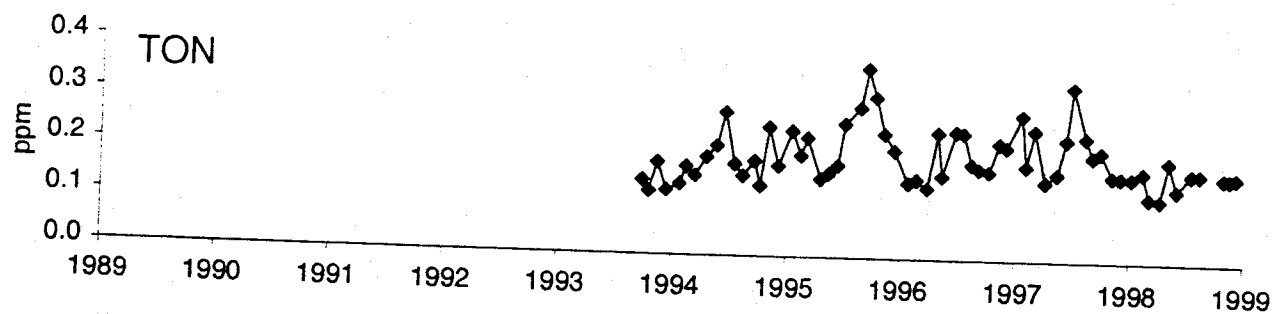
Biscayne Bay Sta. 108 Marker G-1B



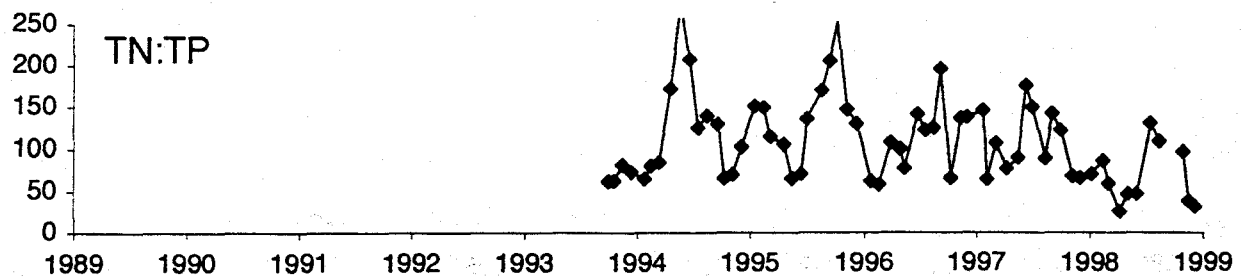
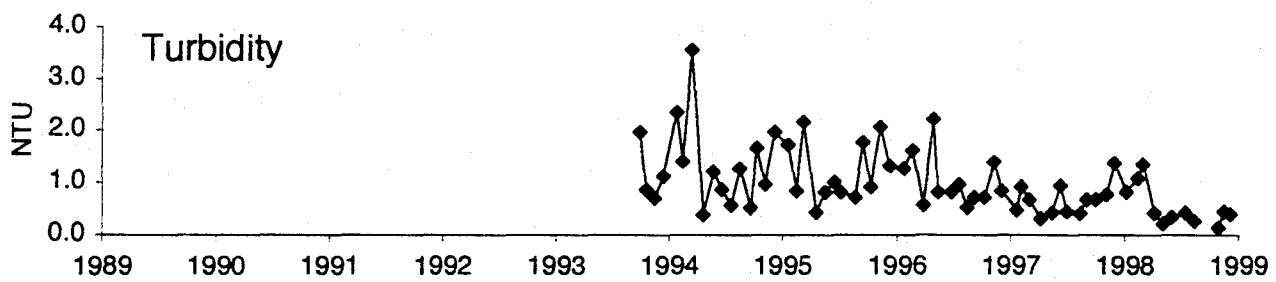
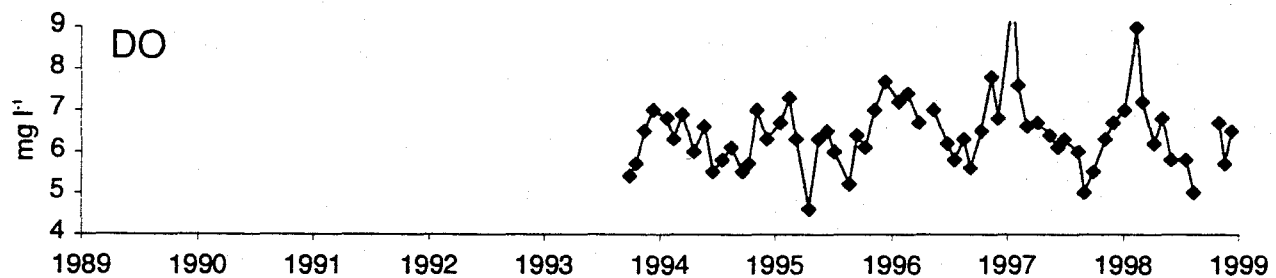
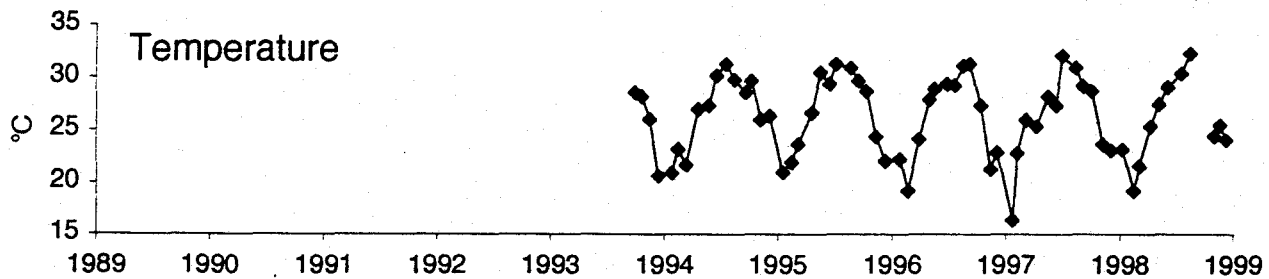
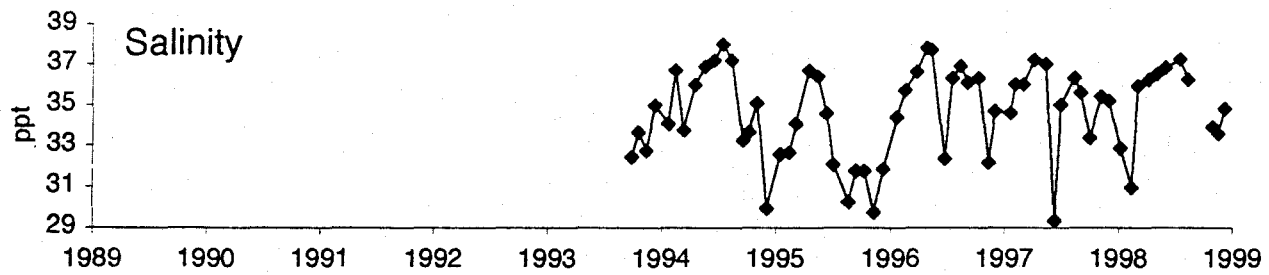
Biscayne Bay Sta. 109 Midbay North



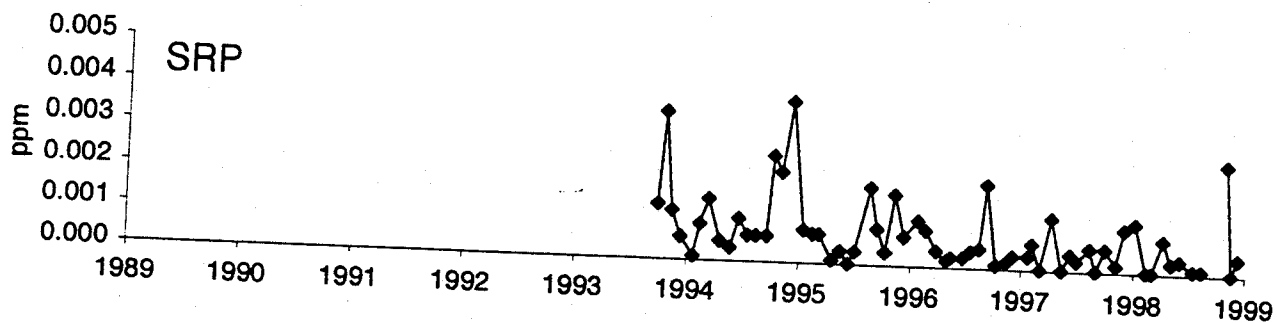
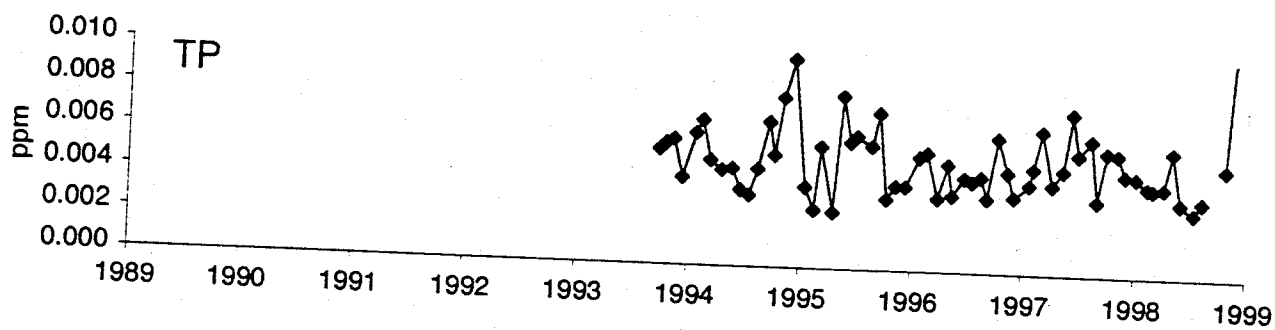
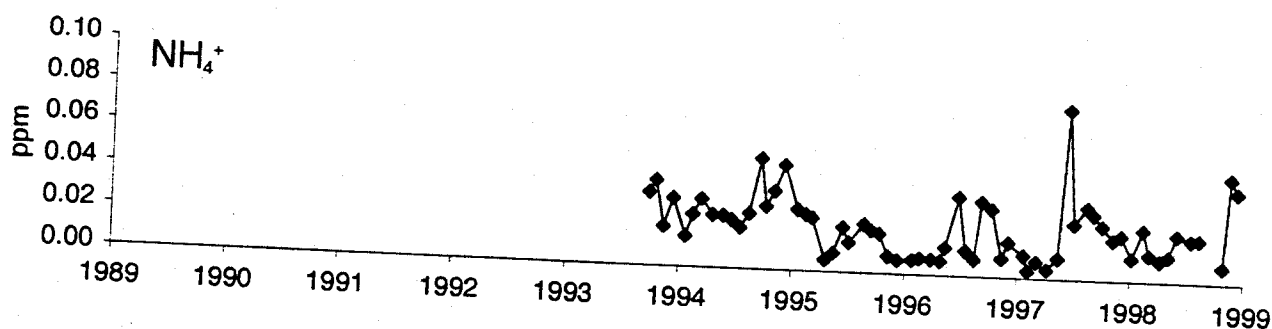
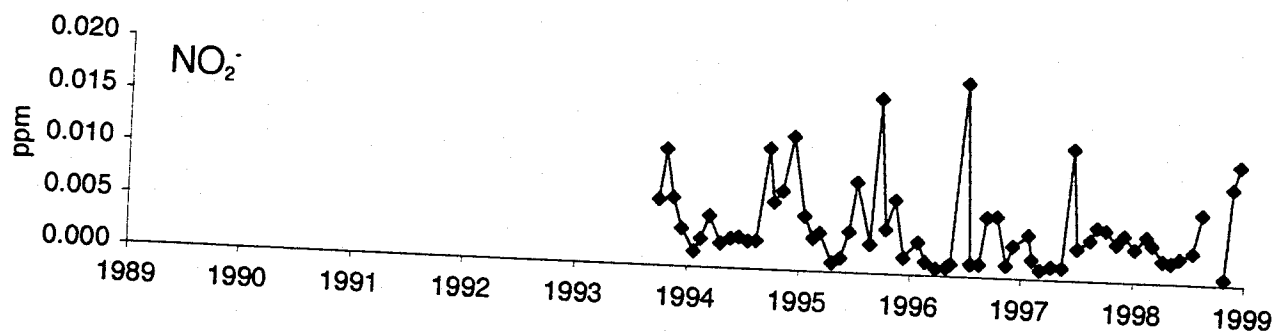
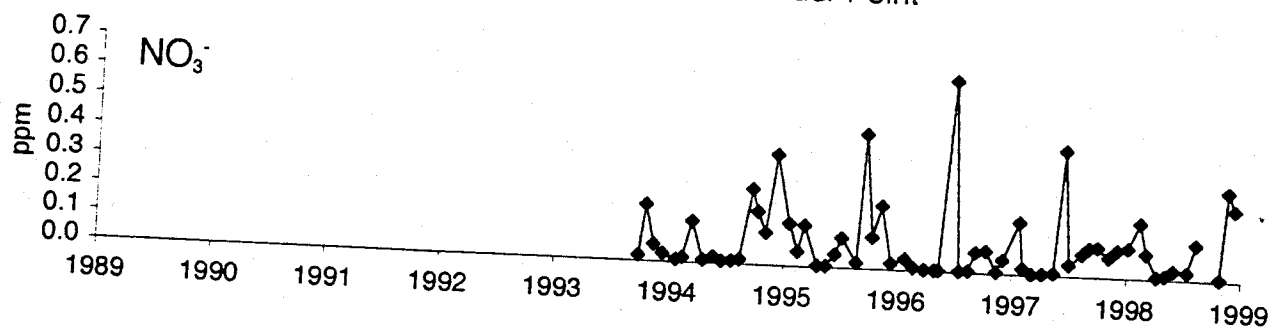
Biscayne Bay Sta. 109 Midbay North



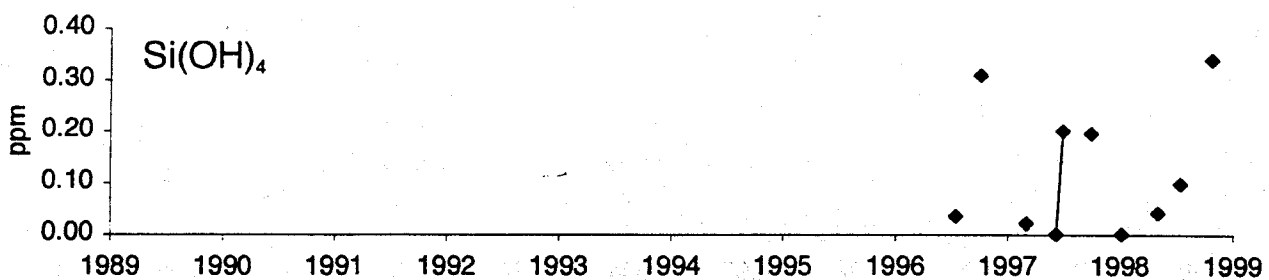
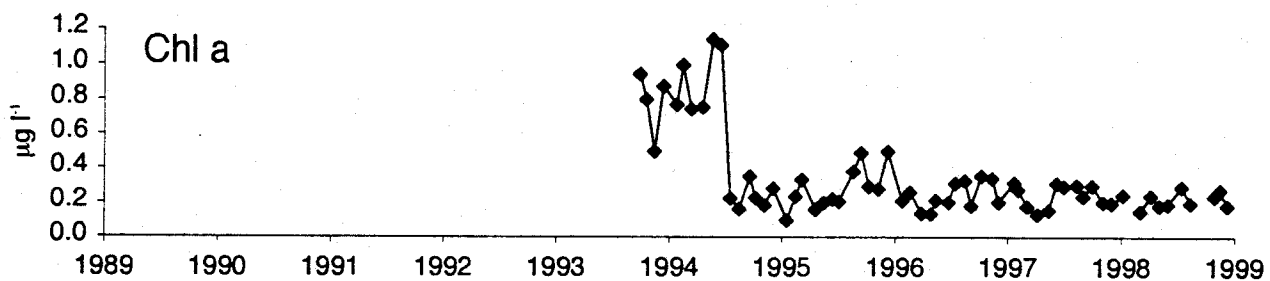
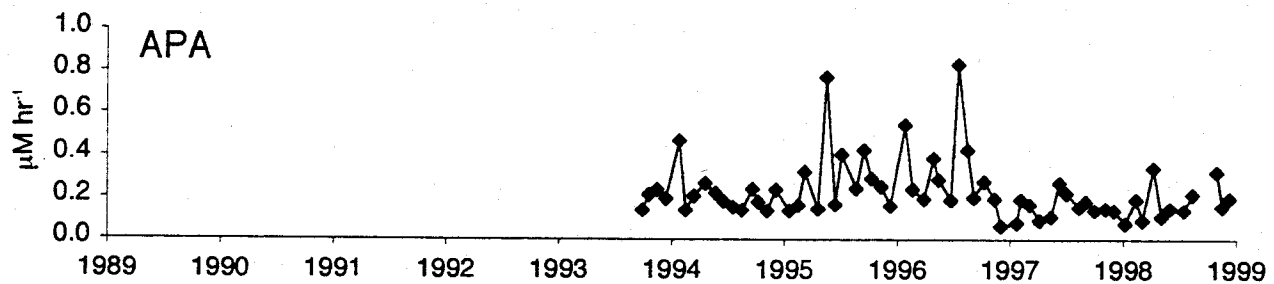
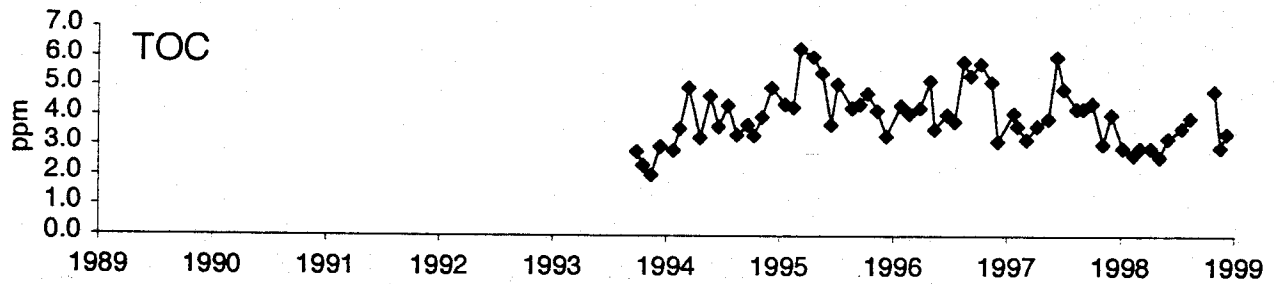
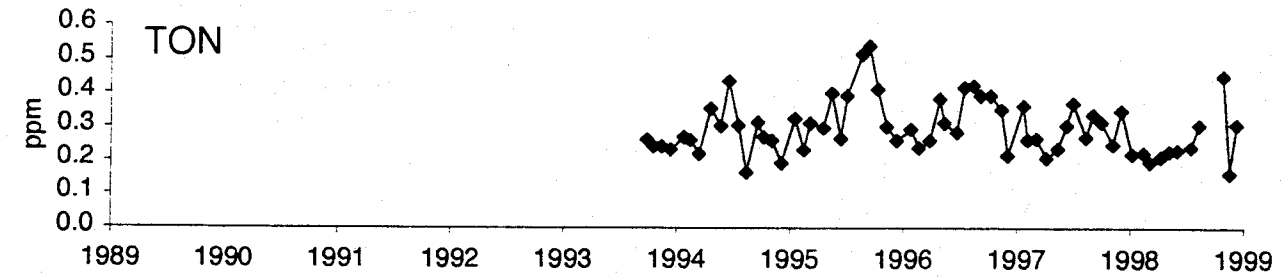
Biscayne Bay Sta. 109 Midbay North



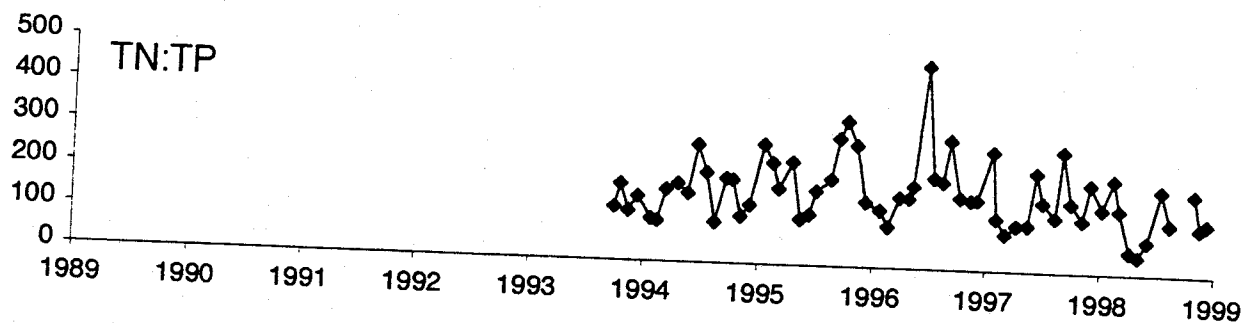
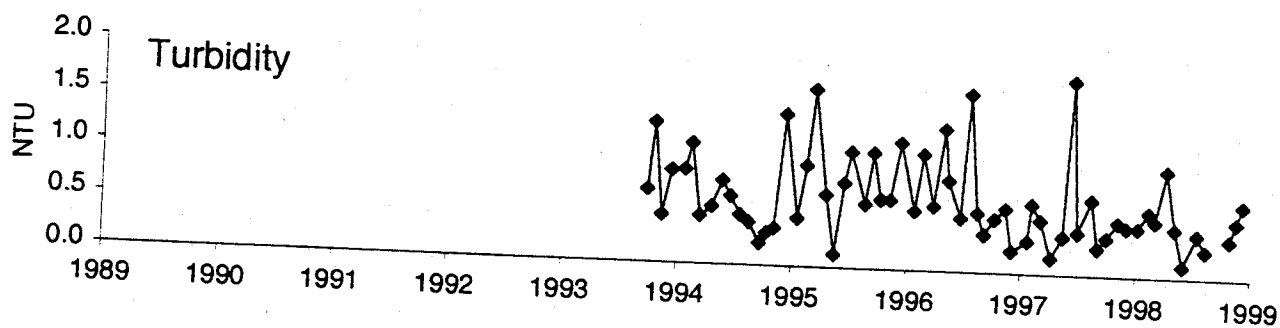
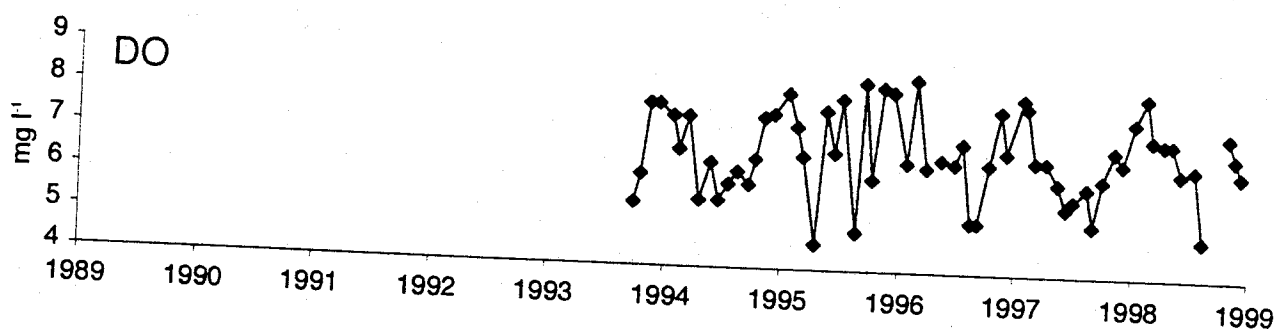
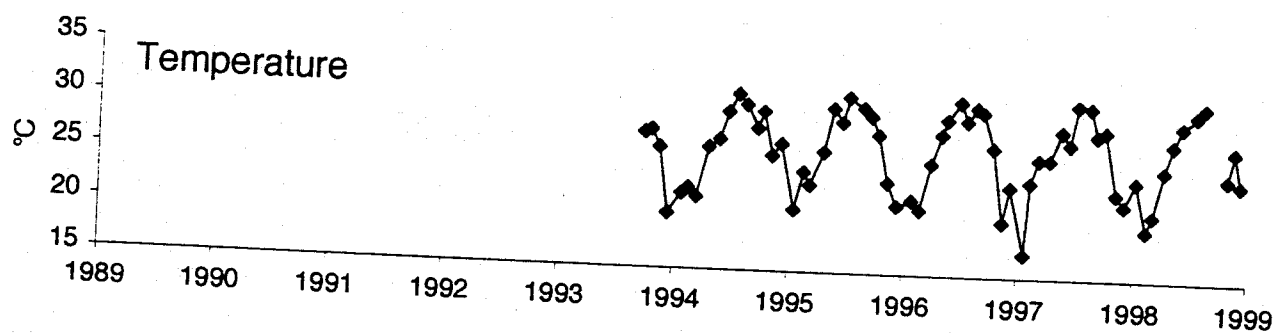
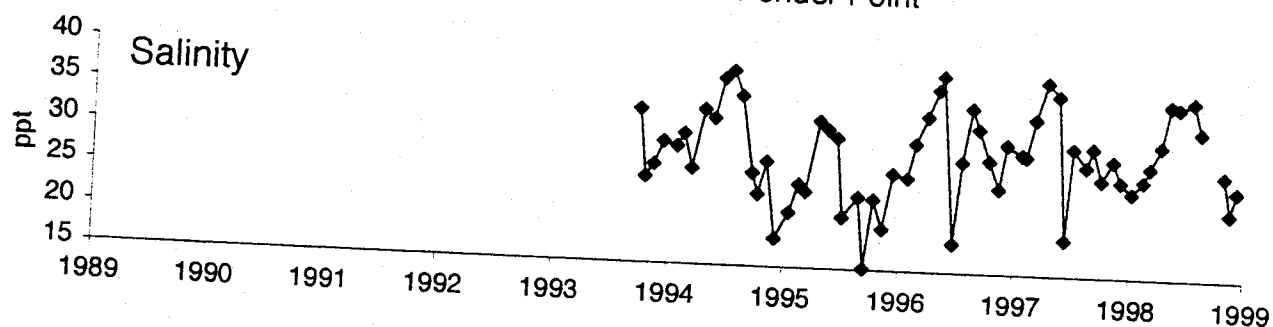
Biscayne Bay Sta. 110 Fender Point



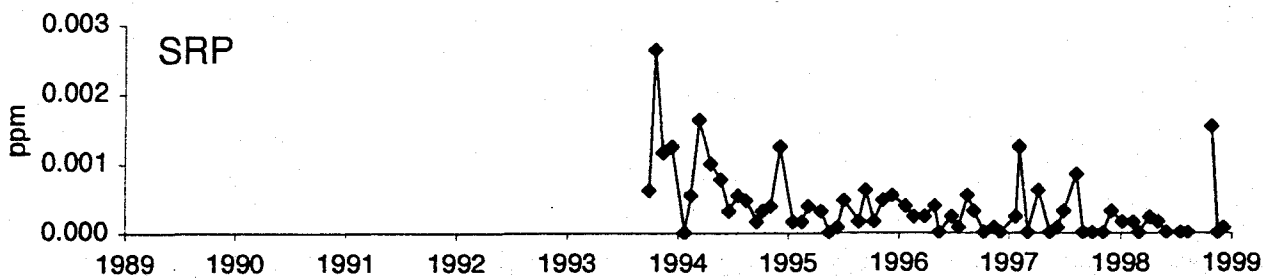
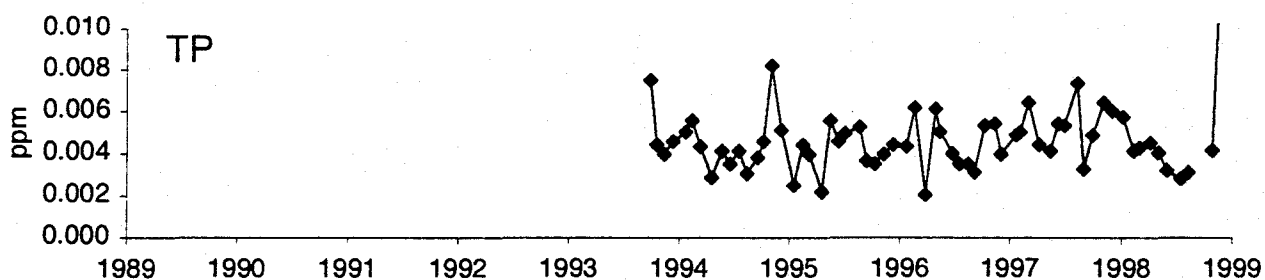
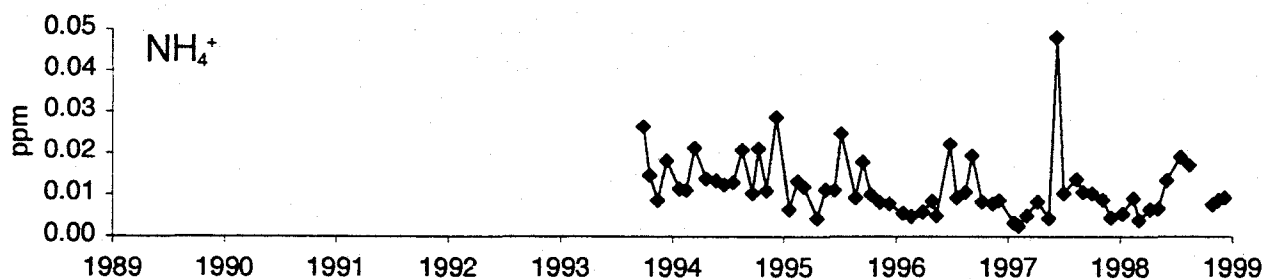
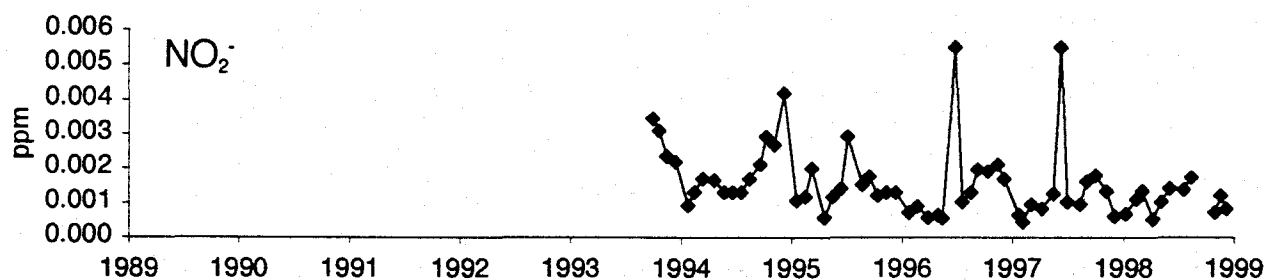
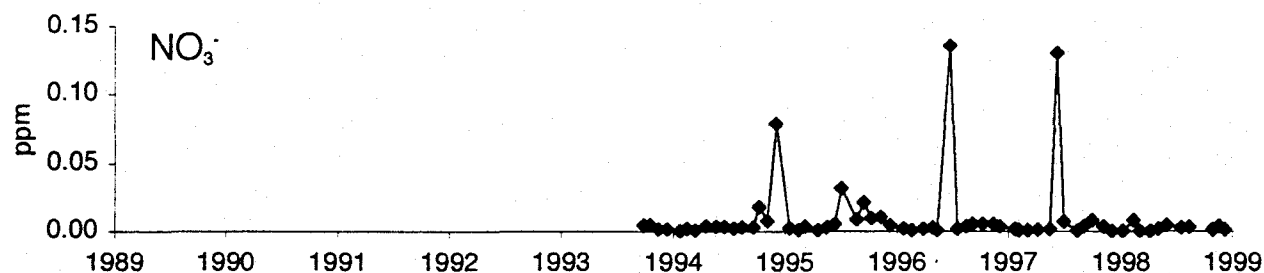
Biscayne Bay Sta. 110 Fender Point



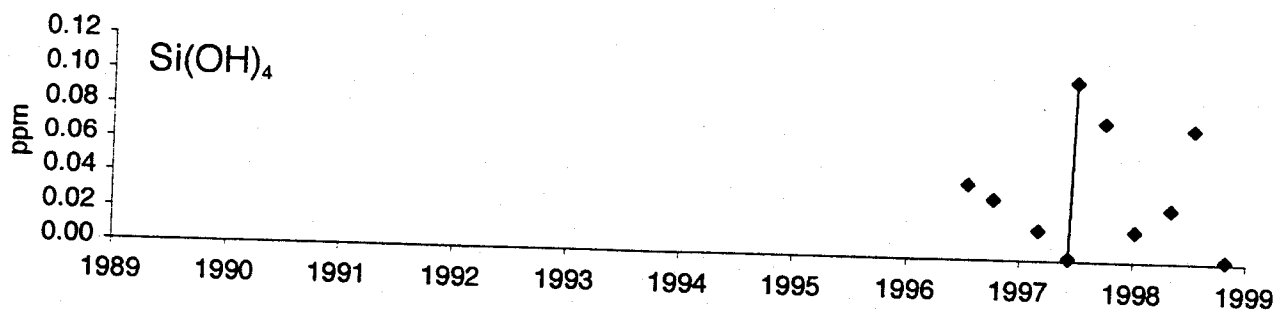
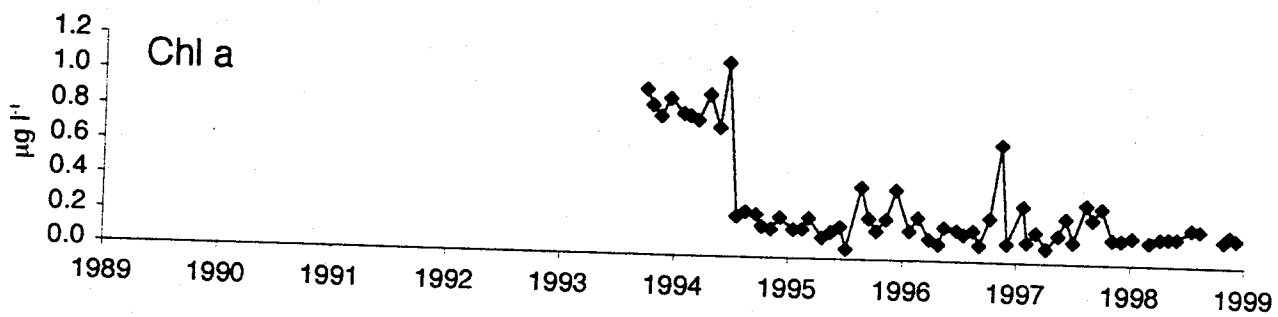
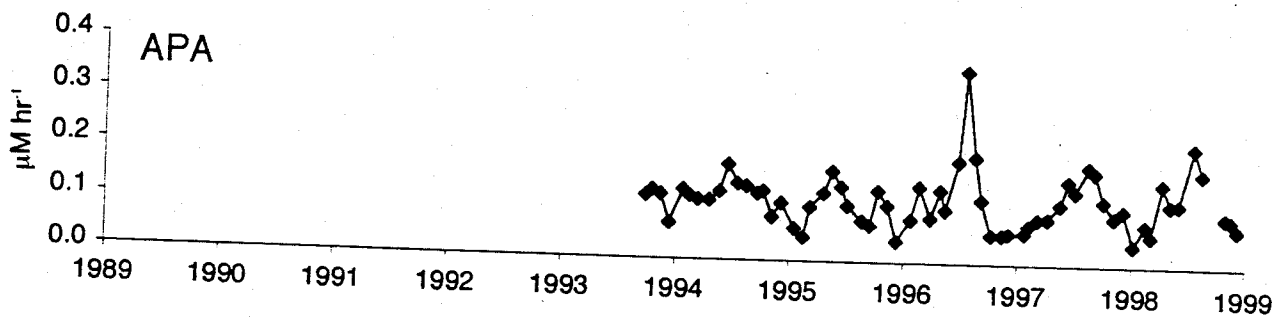
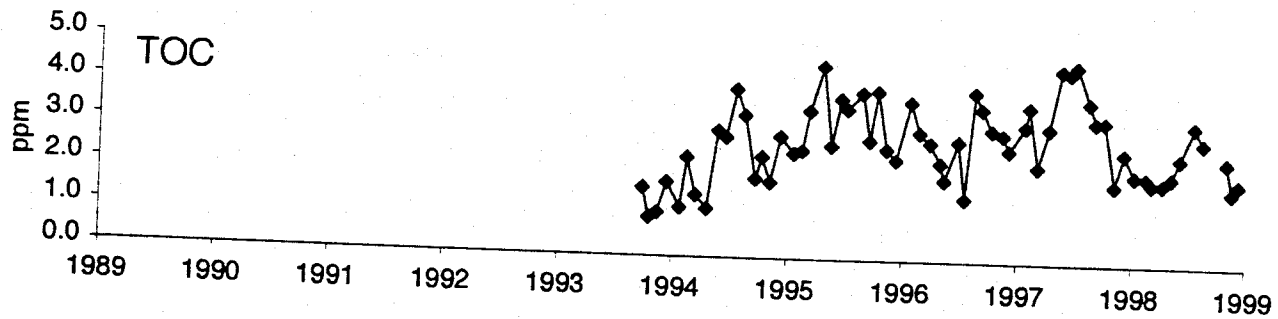
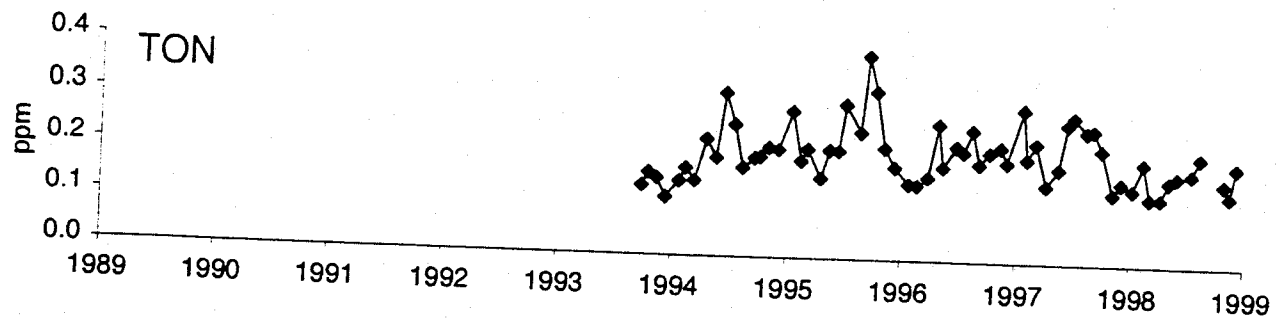
Biscayne Bay Sta. 110 Fender Point



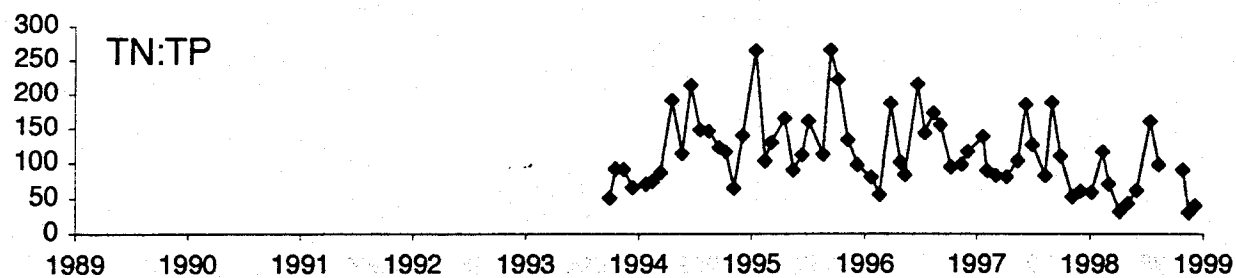
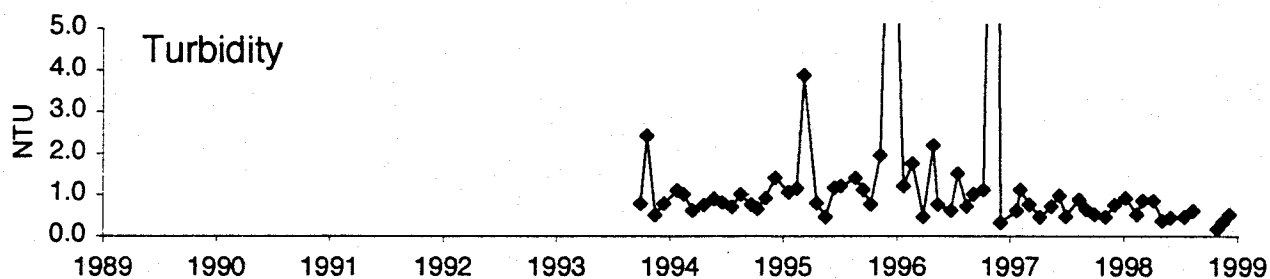
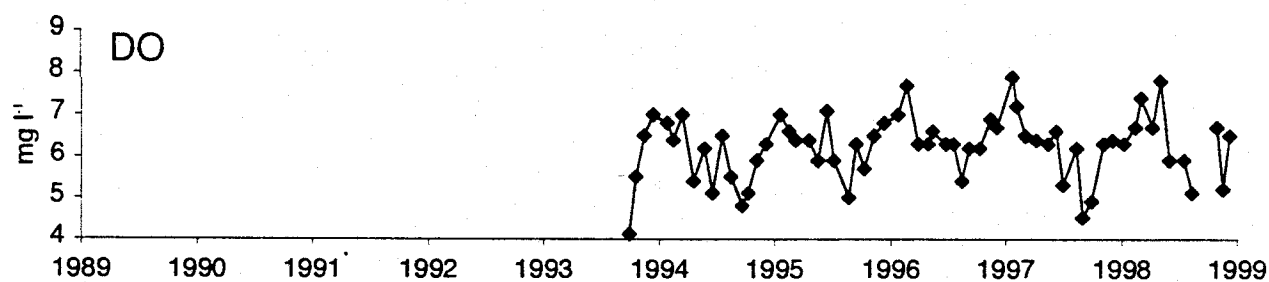
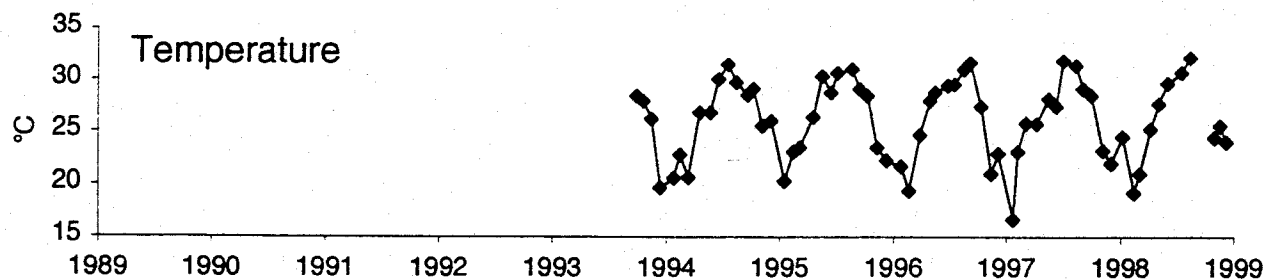
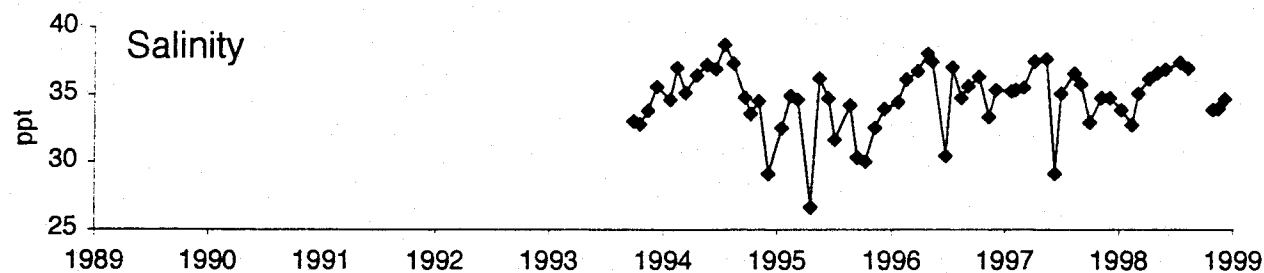
Biscayne Bay Sta. 111 Featherbed Banks



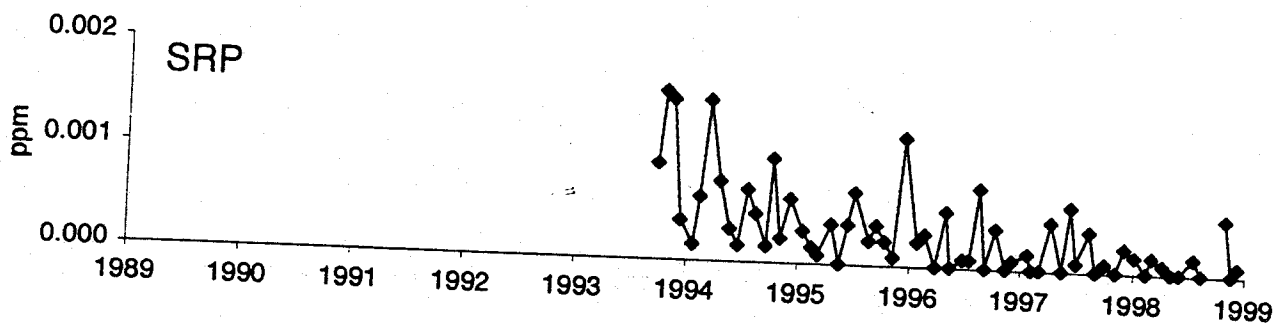
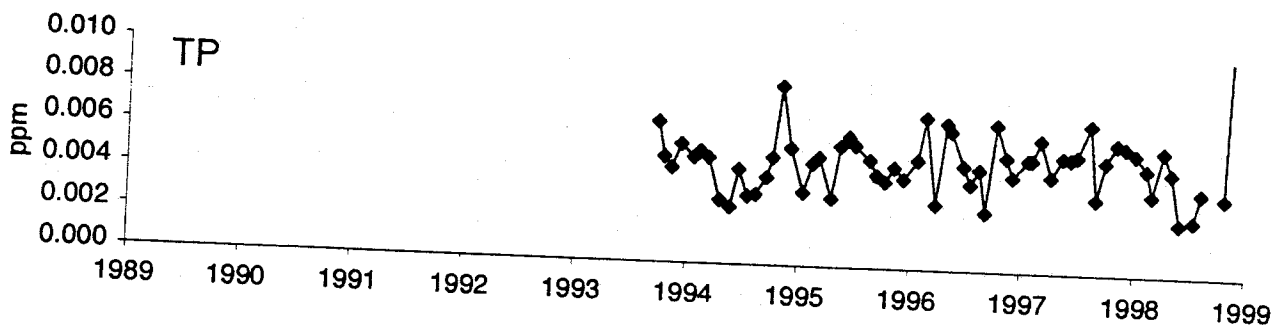
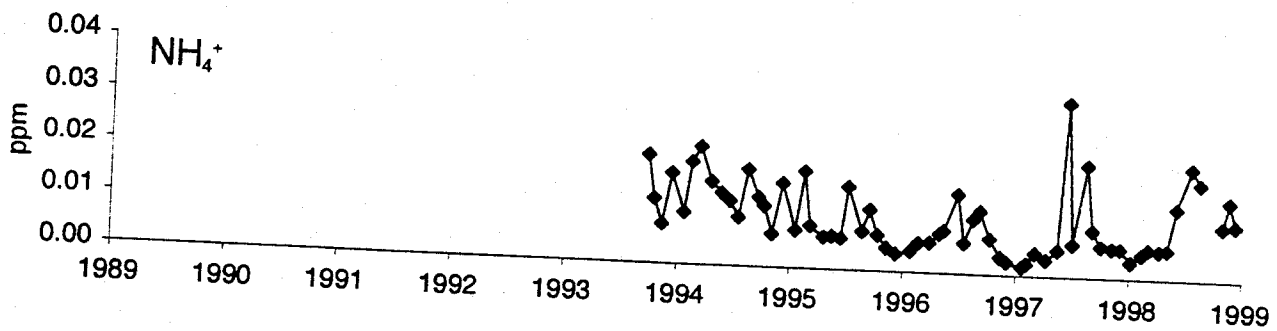
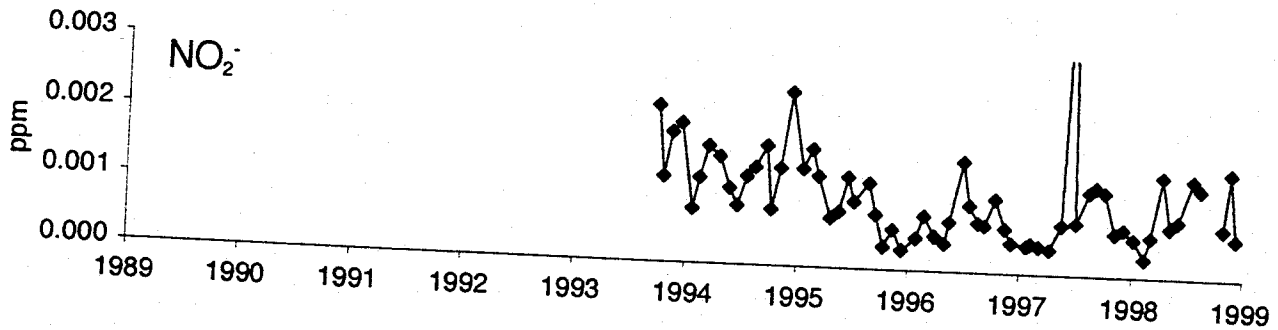
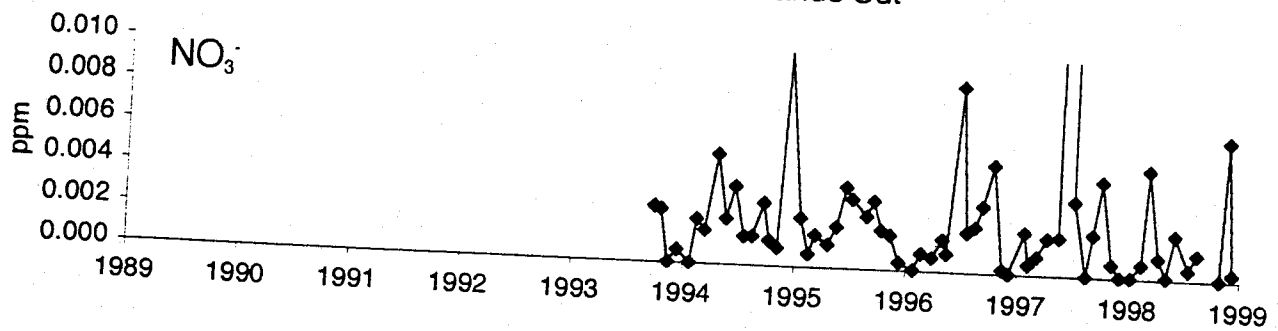
Biscayne Bay Sta. 111 Featherbed Banks



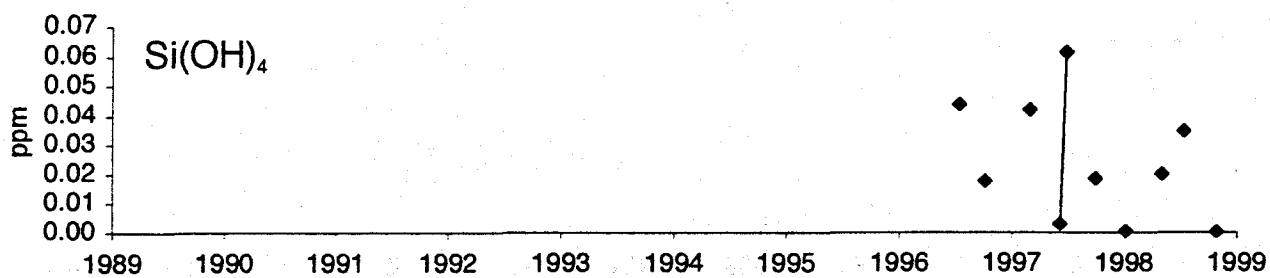
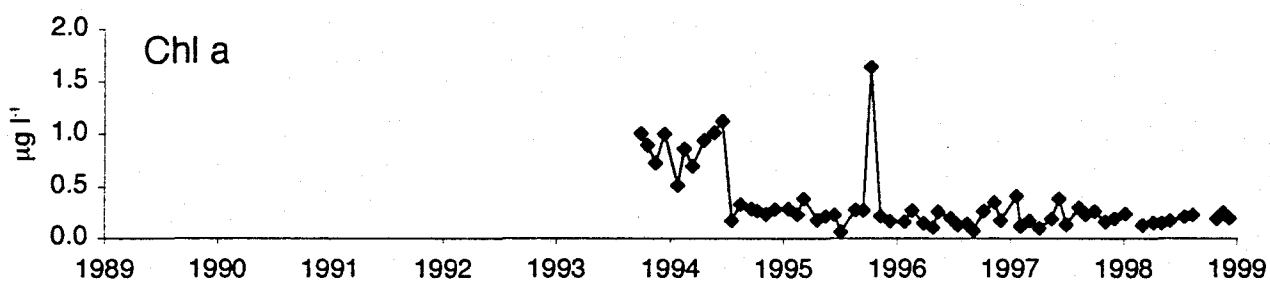
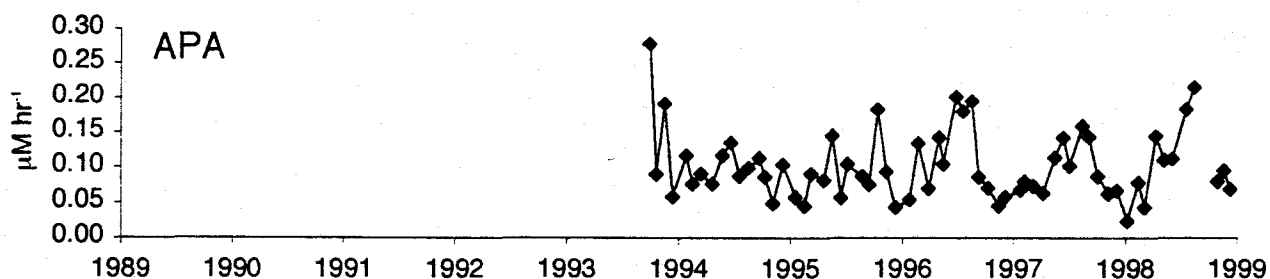
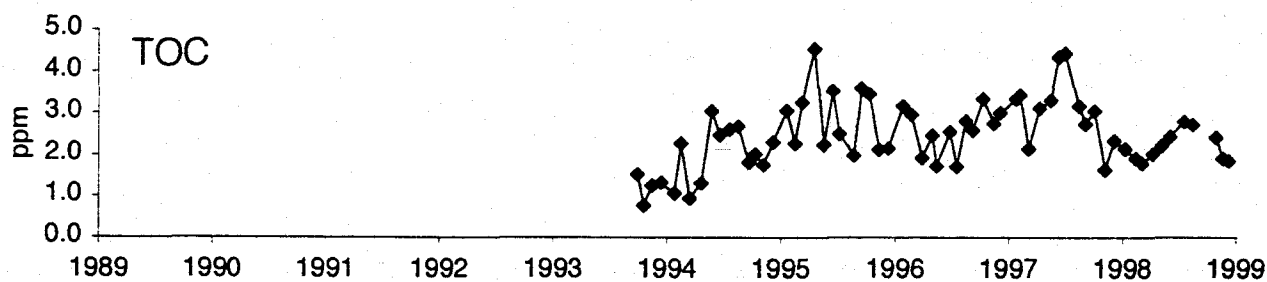
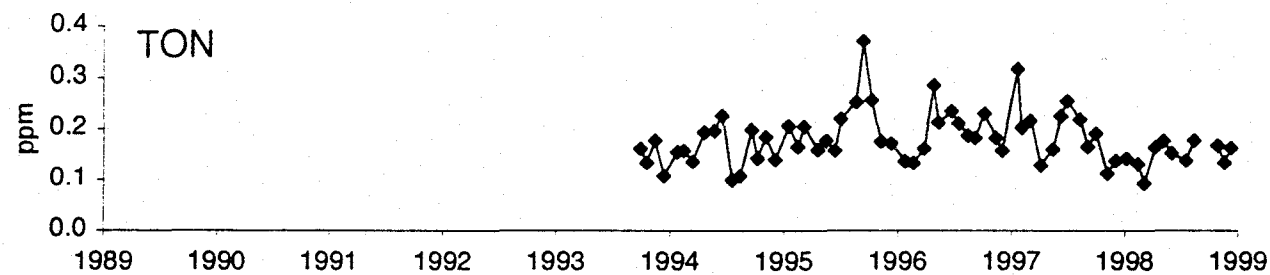
Biscayne Bay Sta. 110 Featherbed Banks



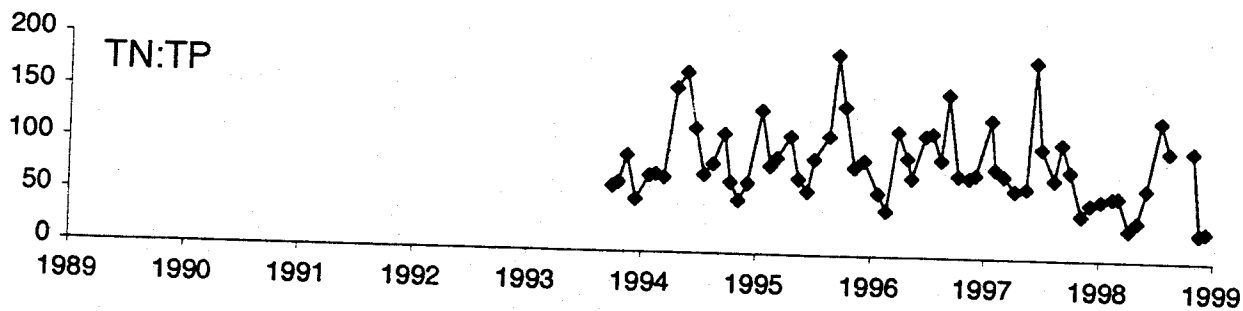
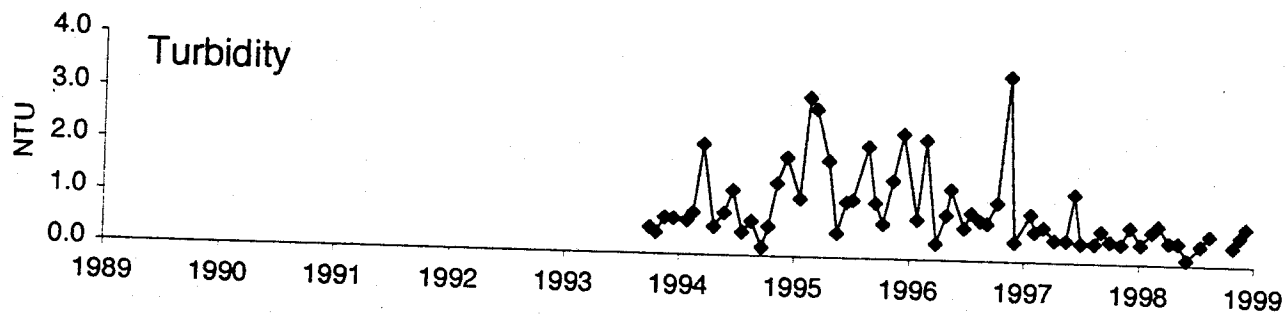
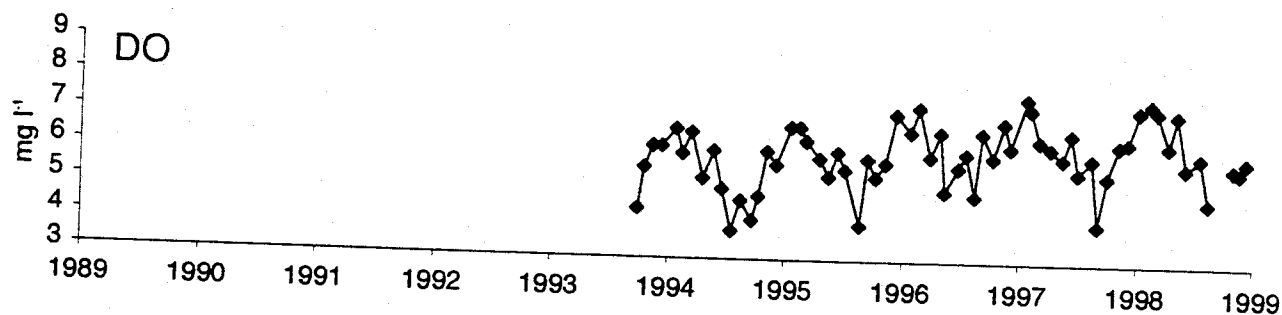
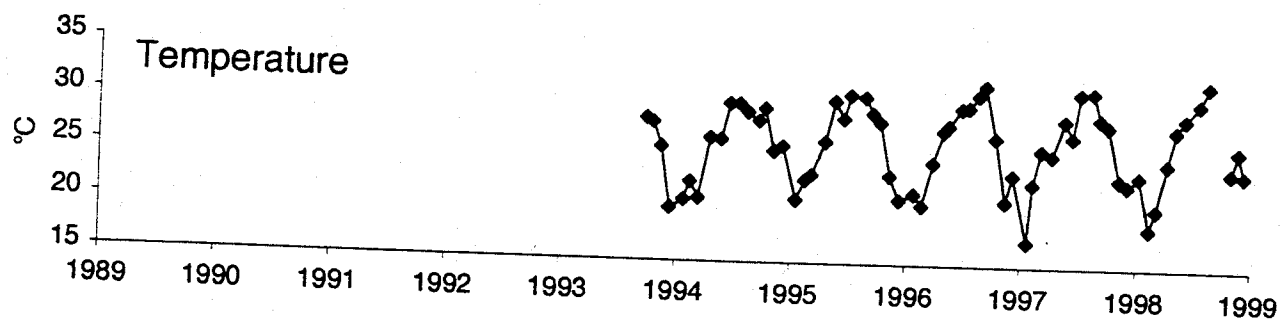
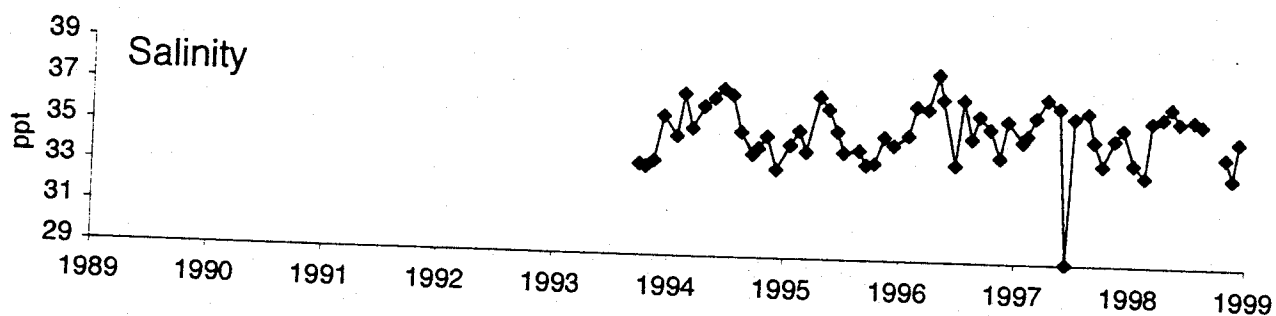
Biscayne Bay Sta. 112 Sands Cut



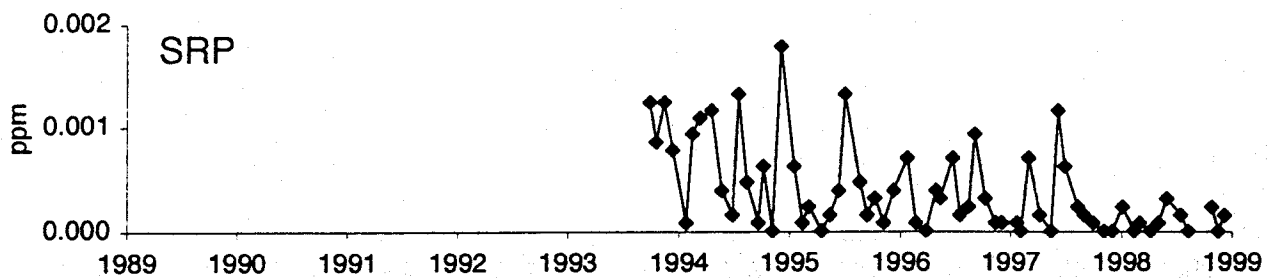
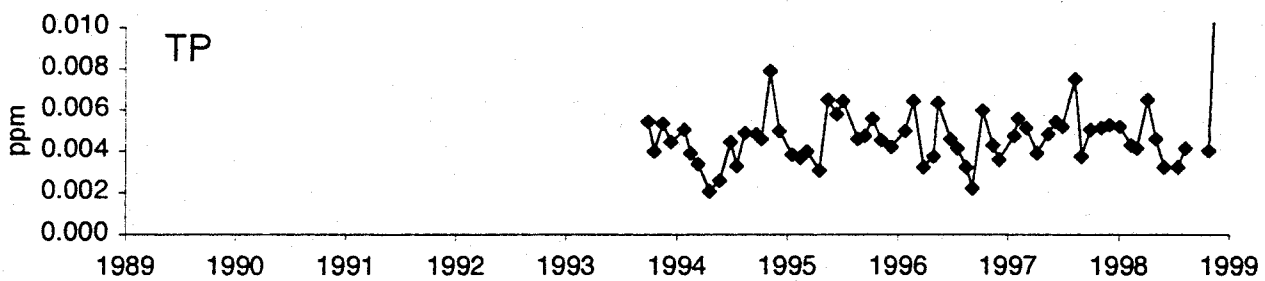
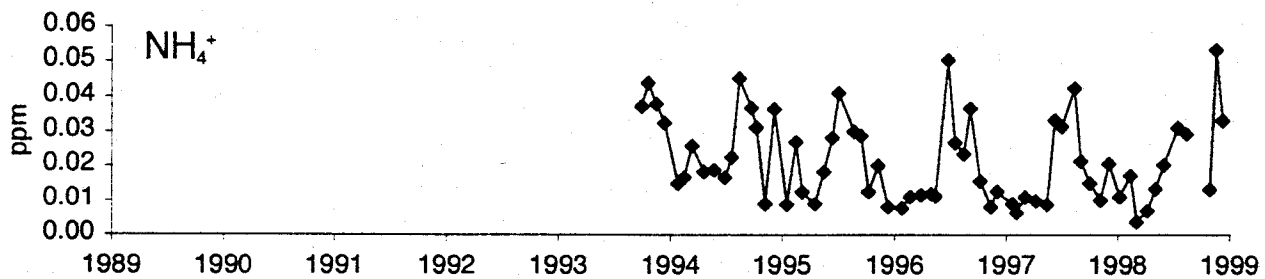
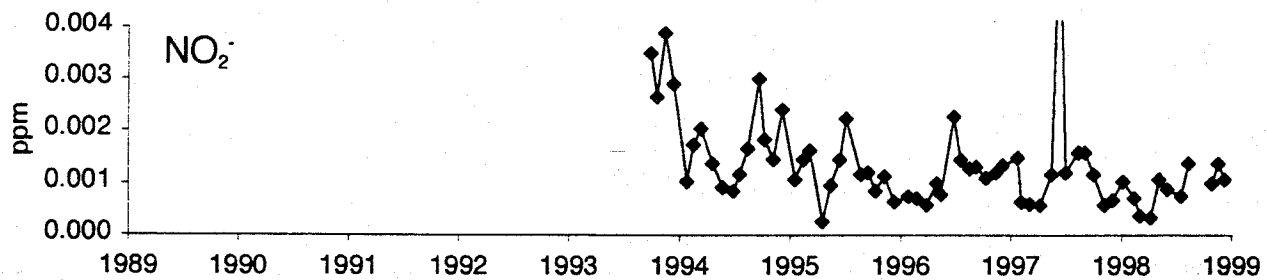
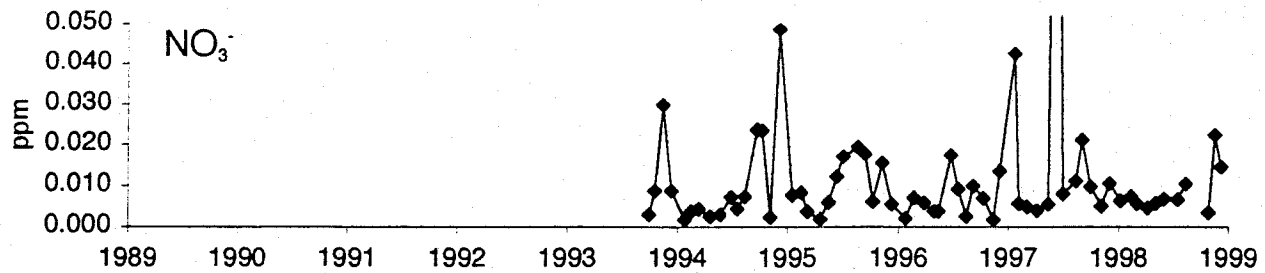
Biscayne Bay Sta. 112 Sands Cut



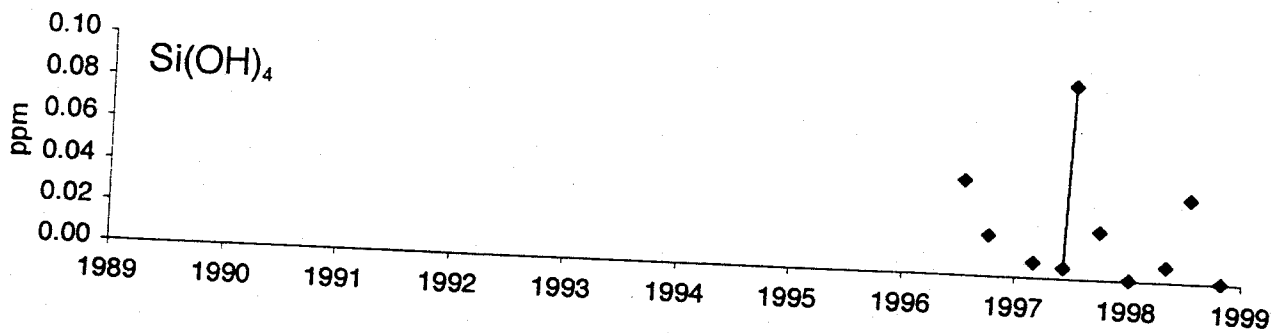
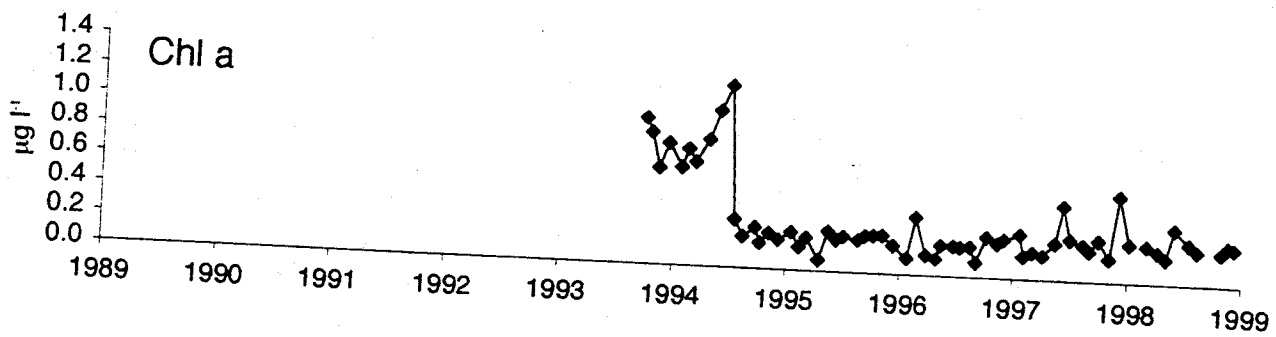
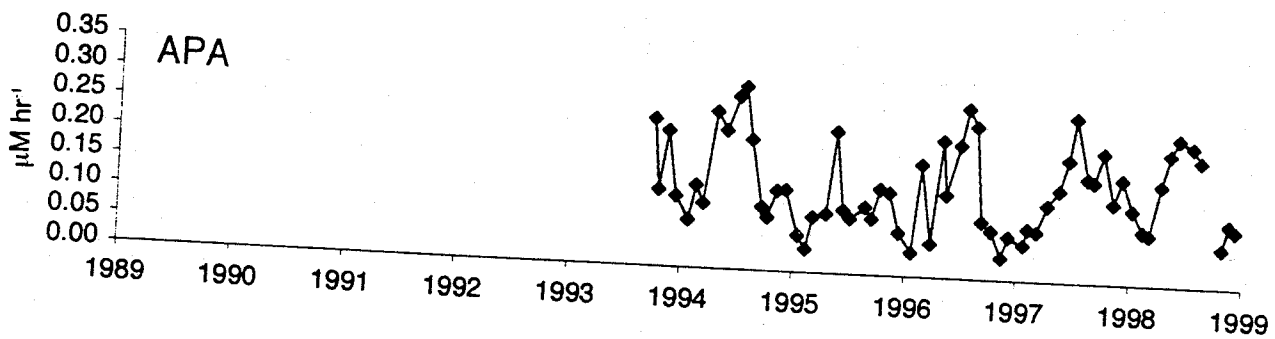
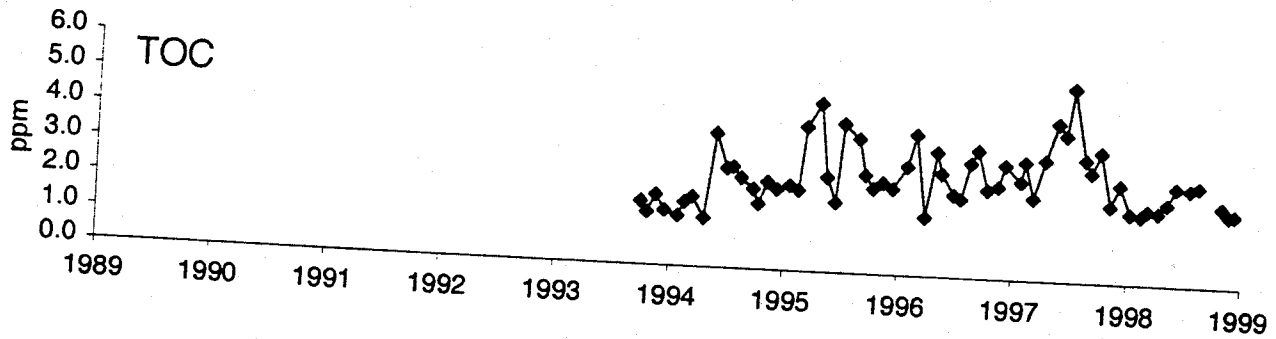
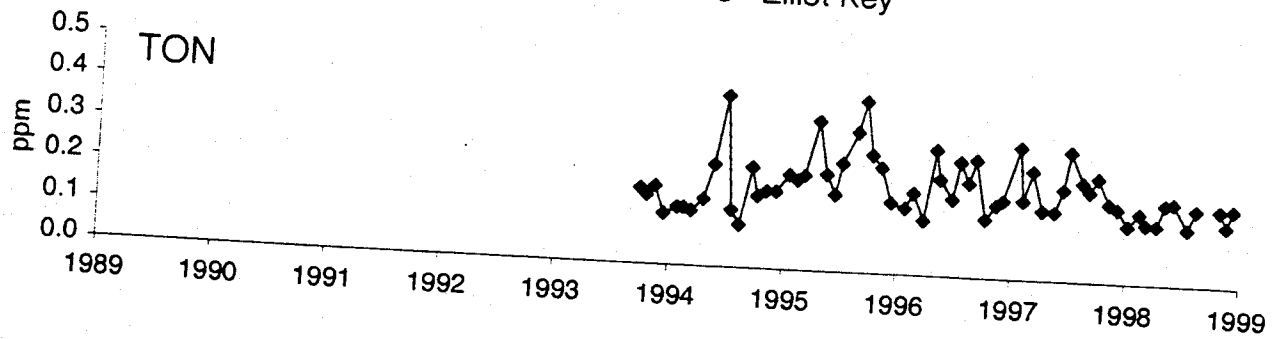
Biscayne Bay Sta. 112 Sands Cut



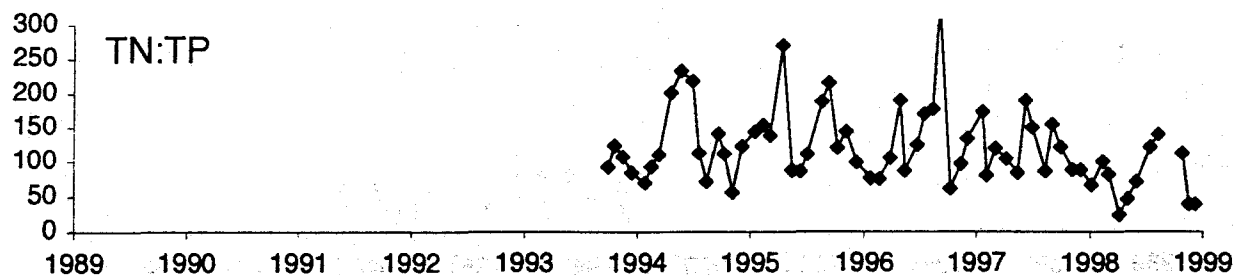
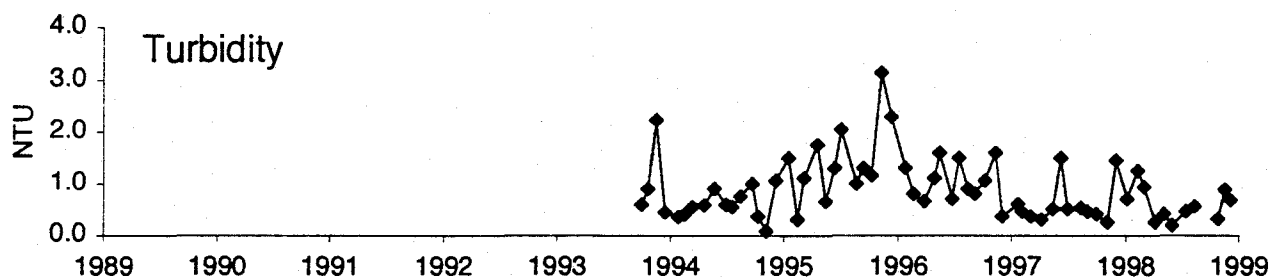
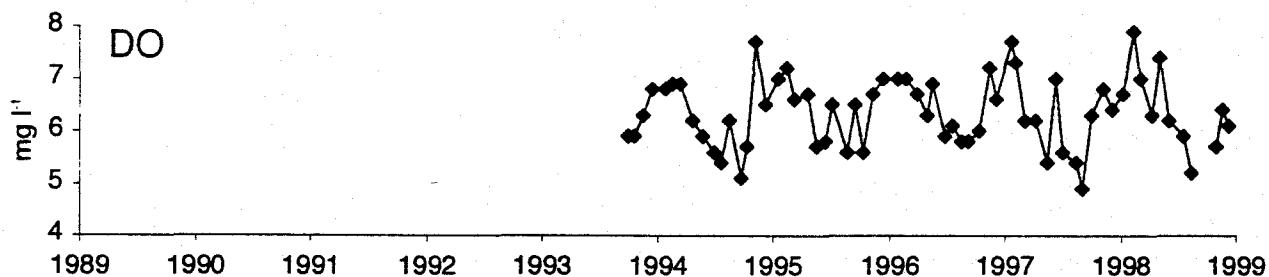
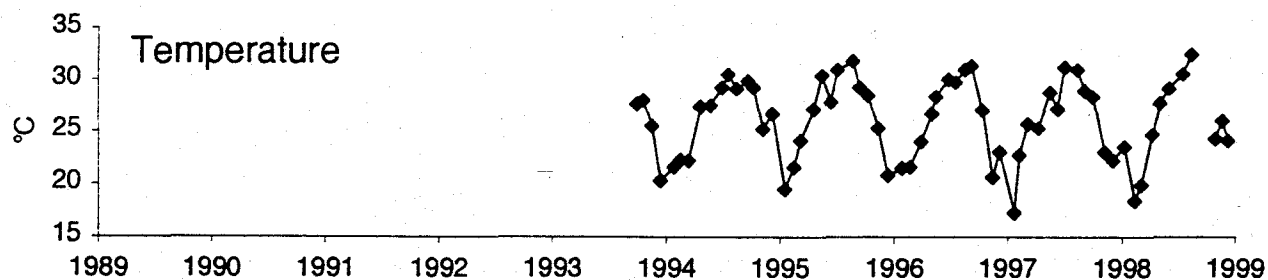
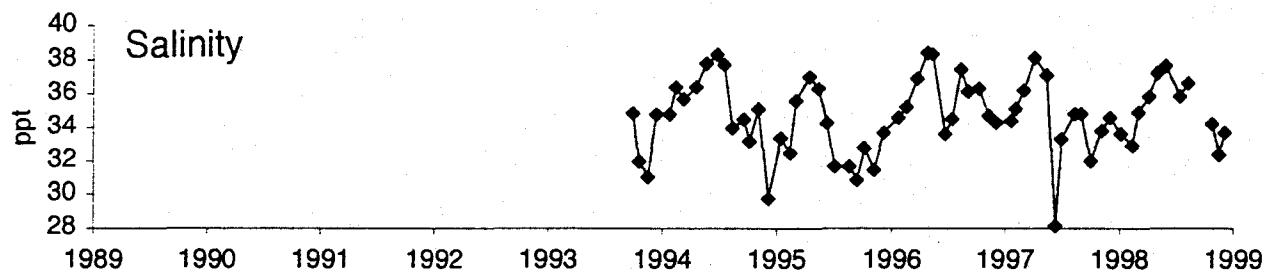
Biscayne Bay Sta. 113 Elliot Key



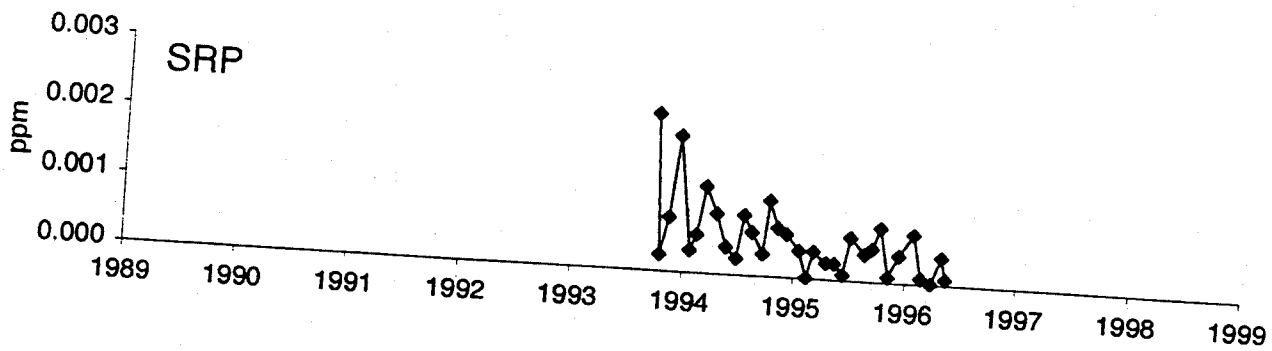
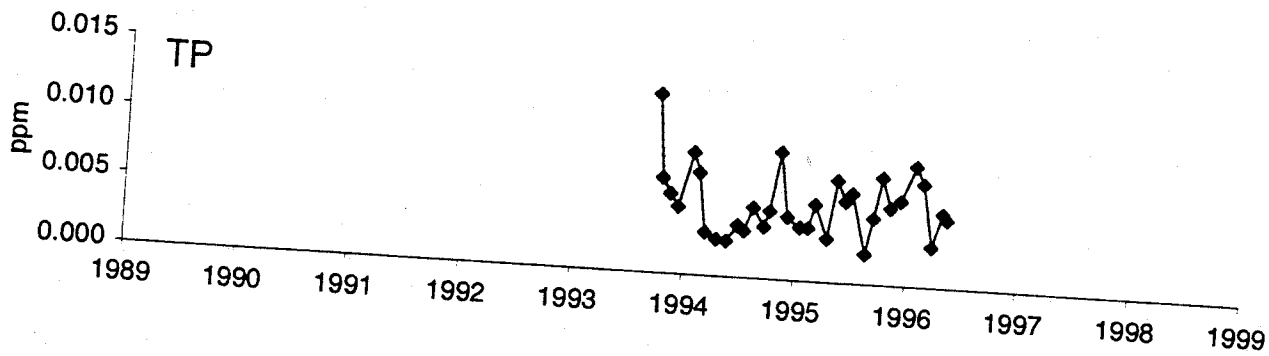
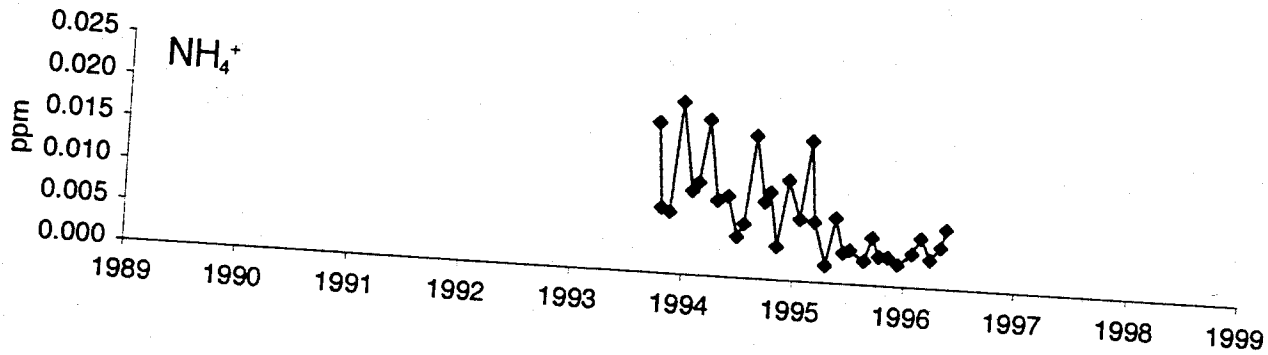
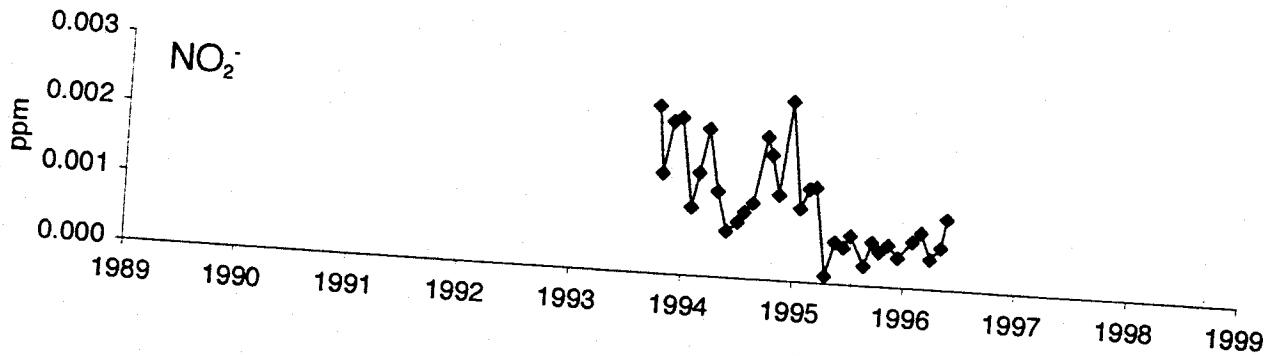
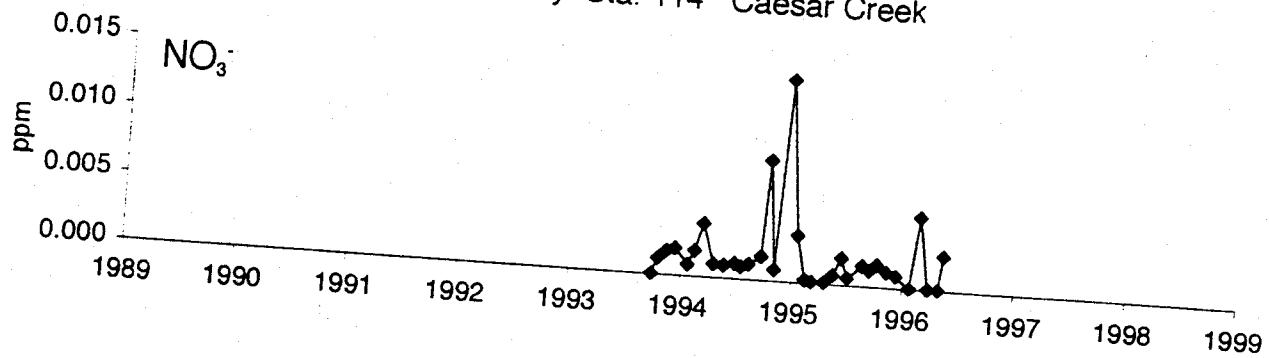
Biscayne Bay Sta. 113 Elliot Key



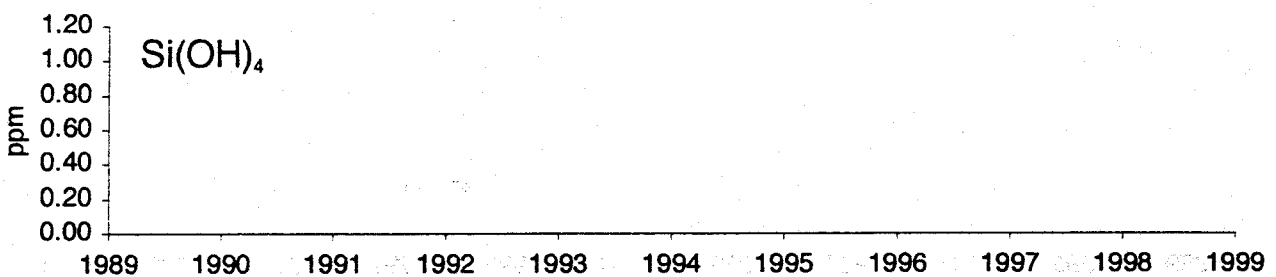
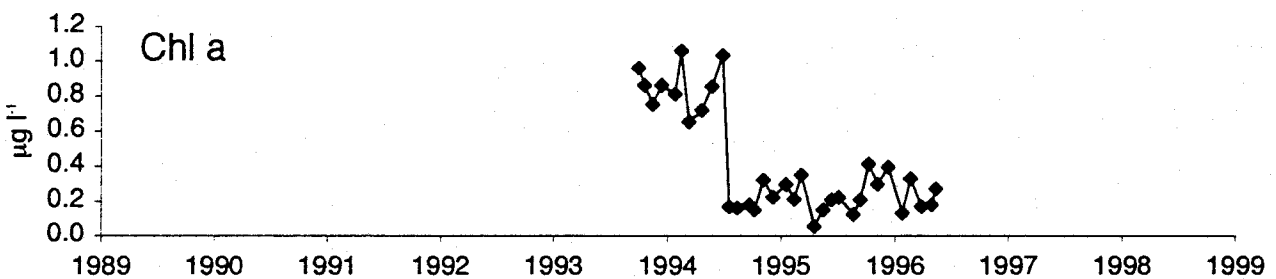
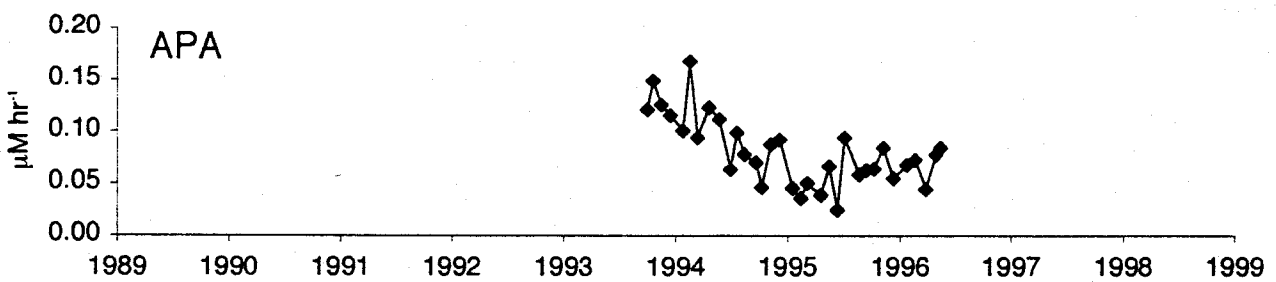
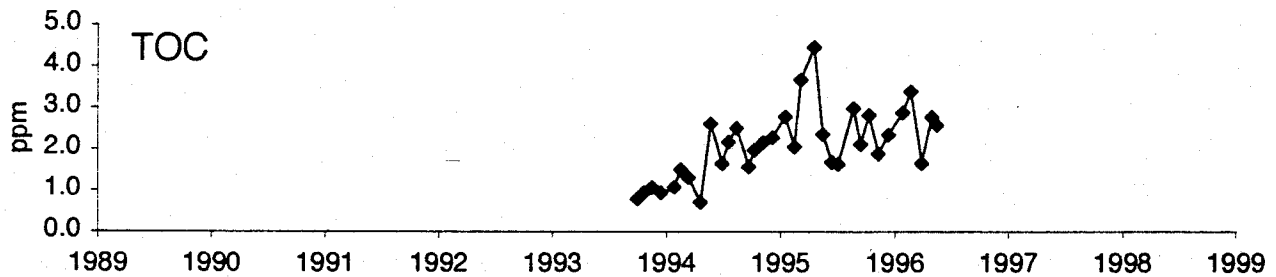
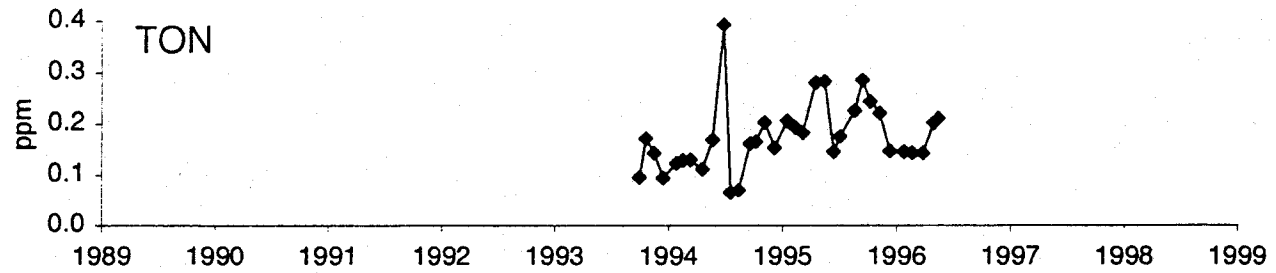
Biscayne Bay Sta. 113 Elliot Key



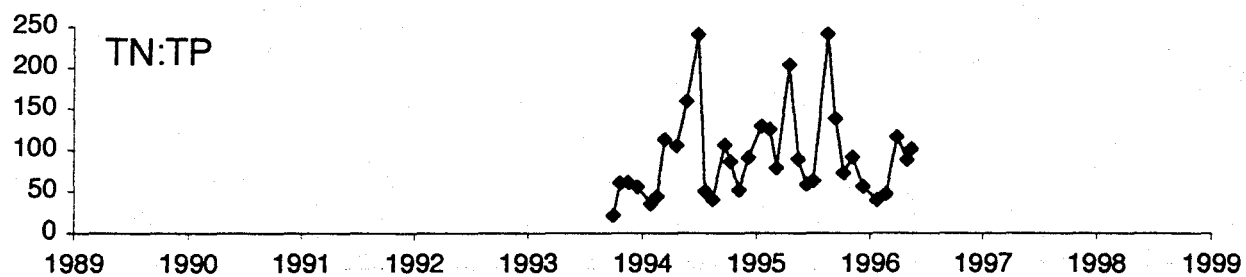
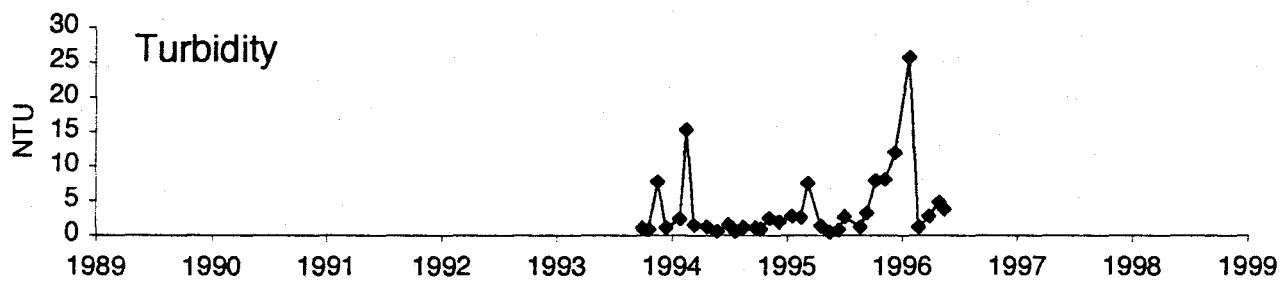
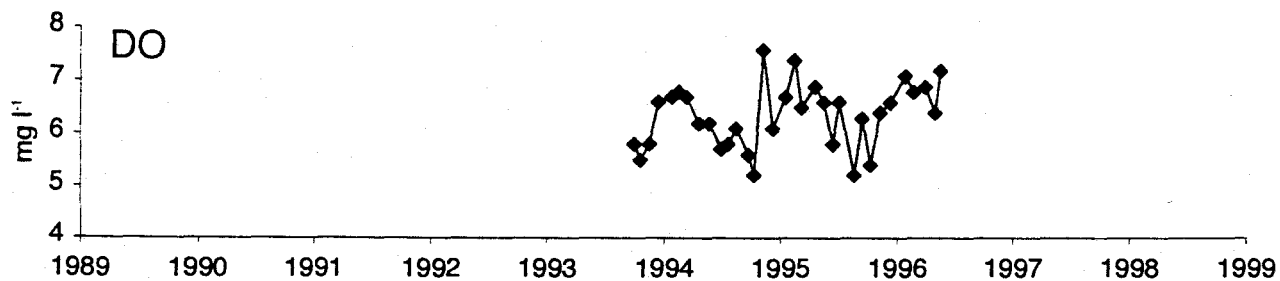
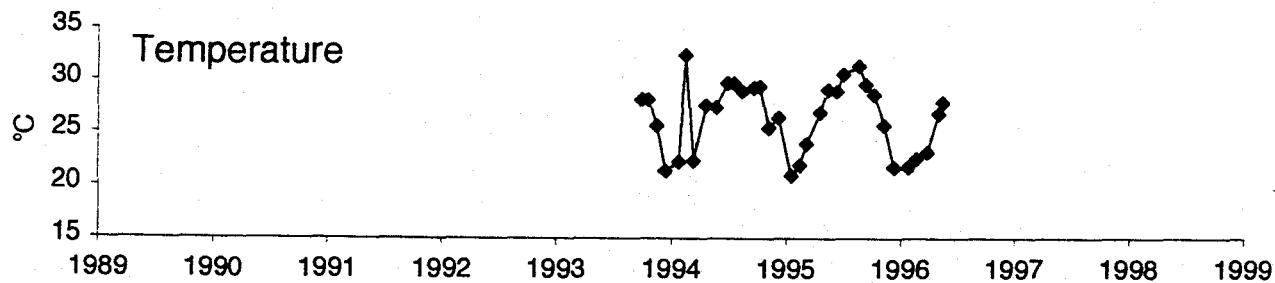
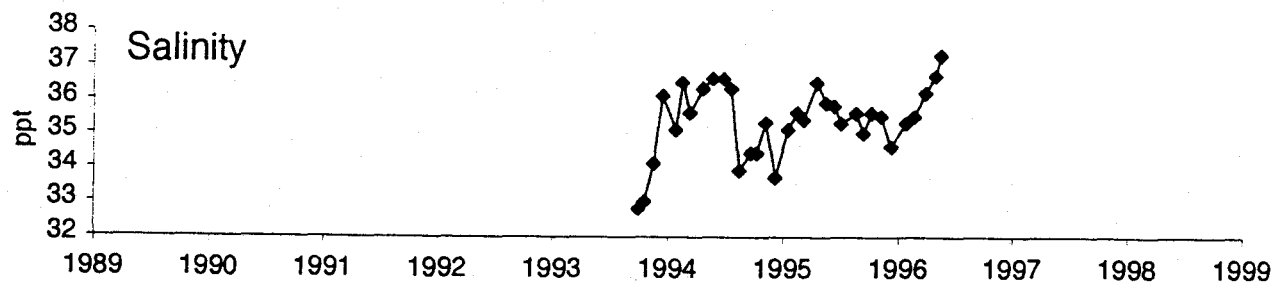
Biscayne Bay Sta. 114 Caesar Creek



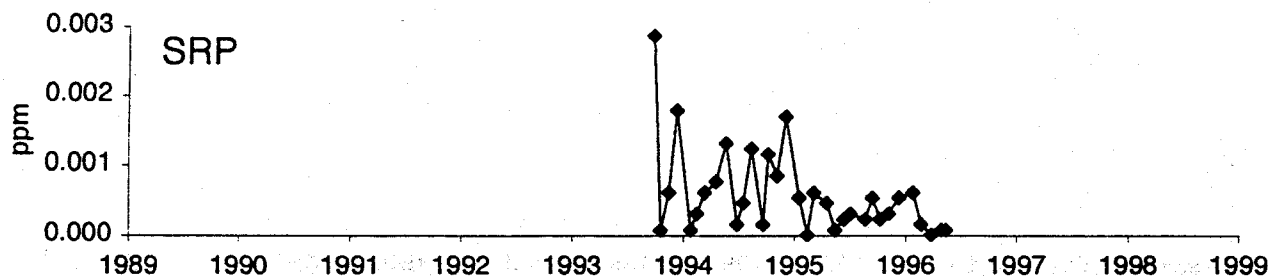
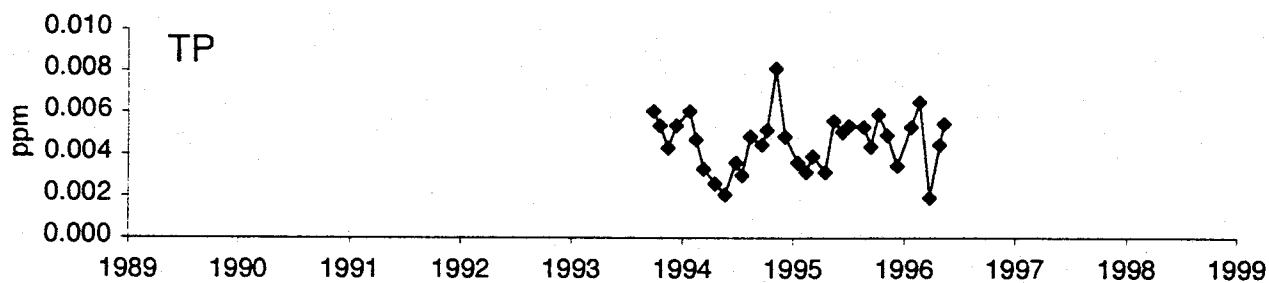
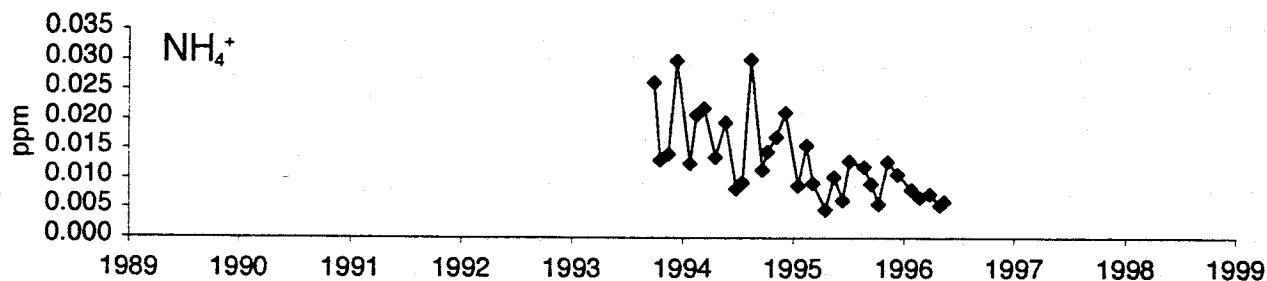
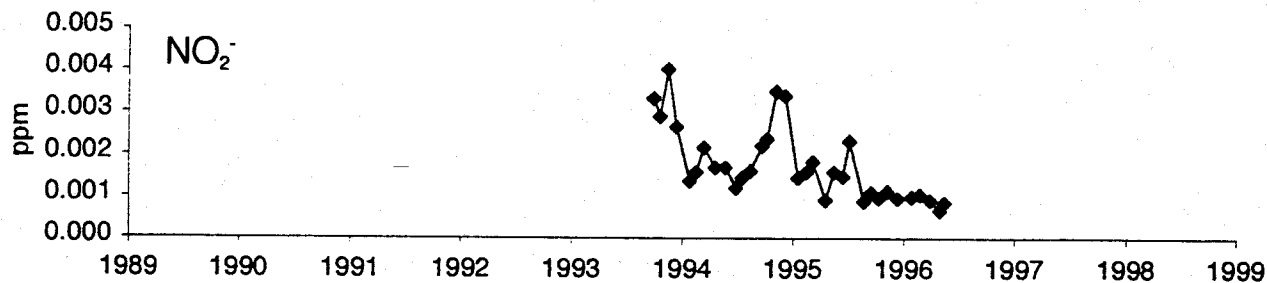
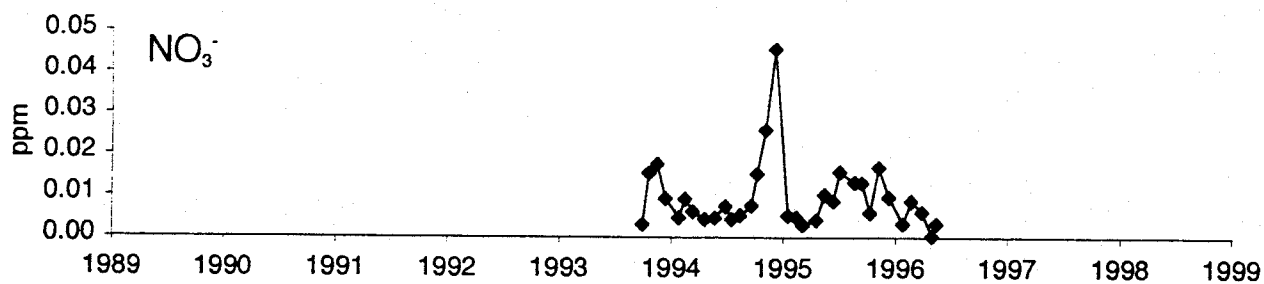
Biscayne Bay Sta. 114 Caesar Creek



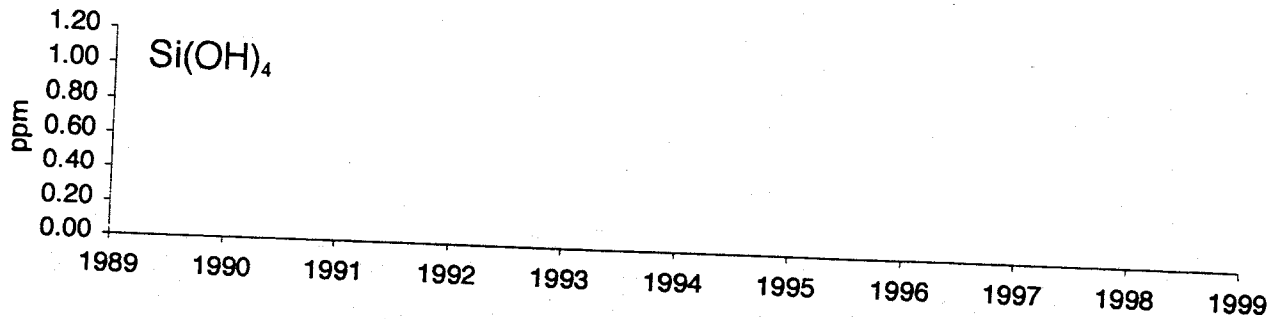
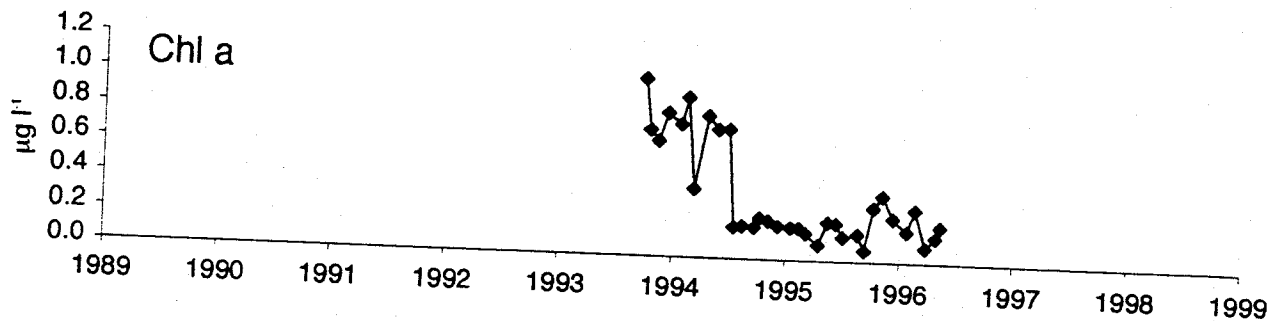
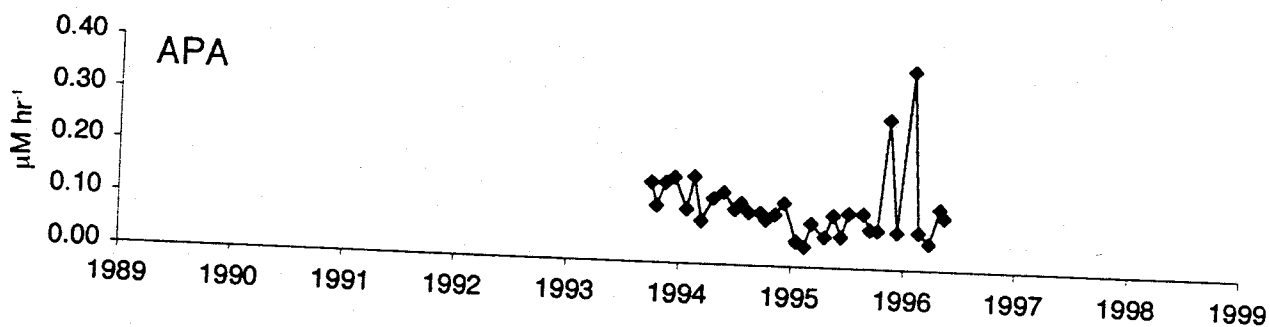
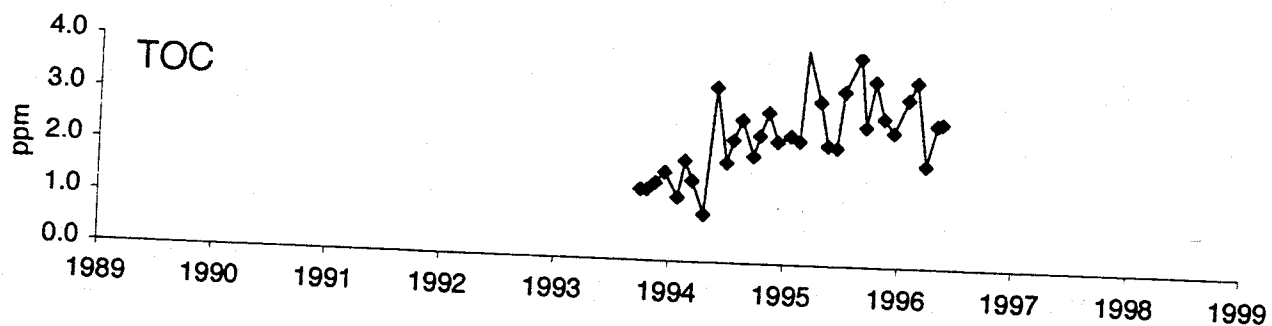
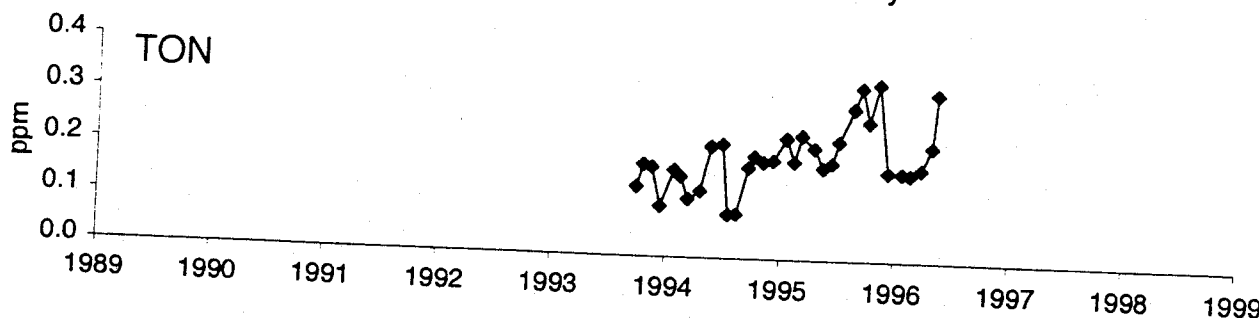
Biscayne Bay Sta. 114 Caesar Creek



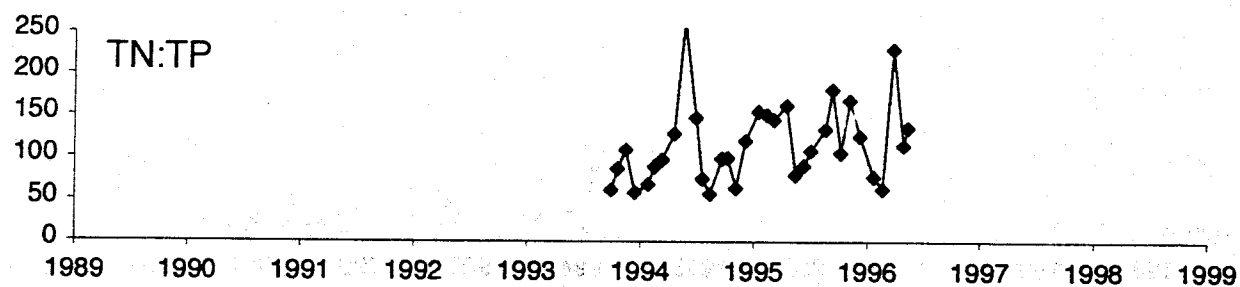
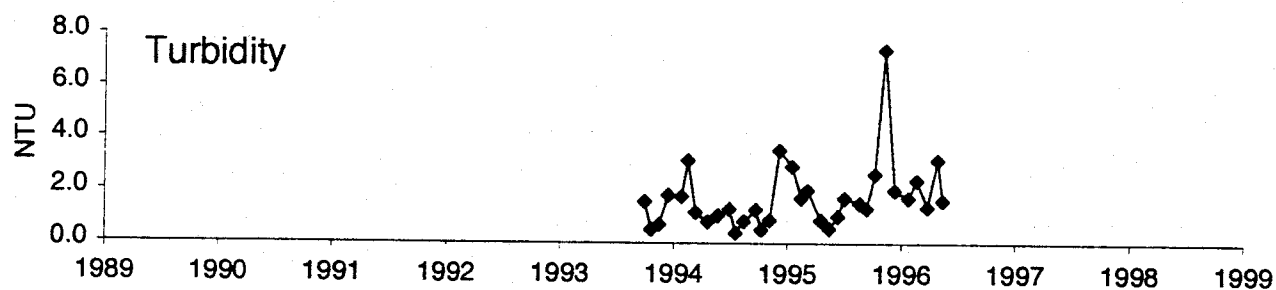
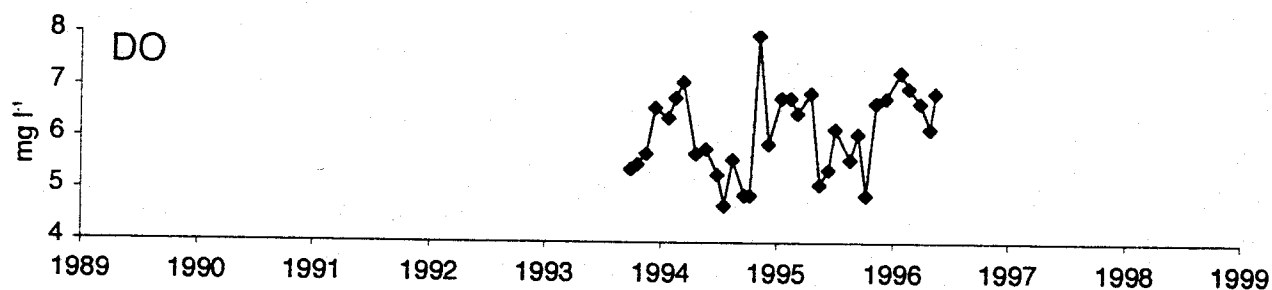
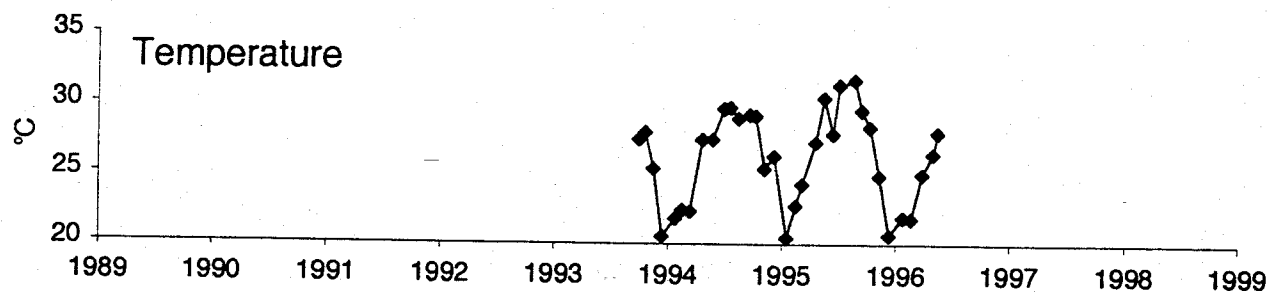
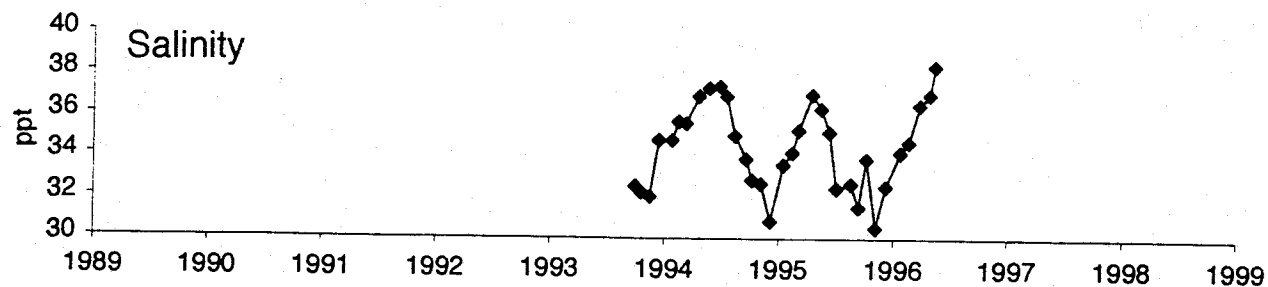
Biscayne Bay Sta. 115 Adams Key



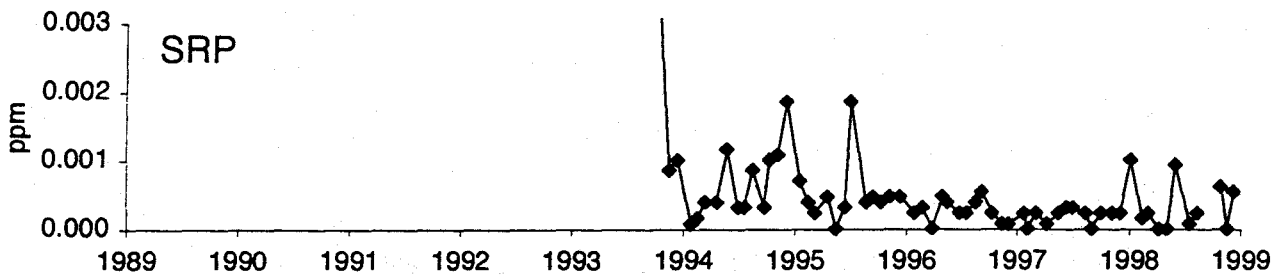
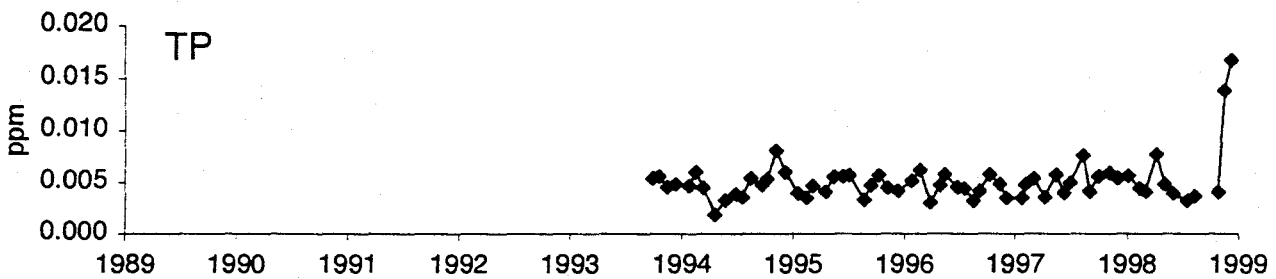
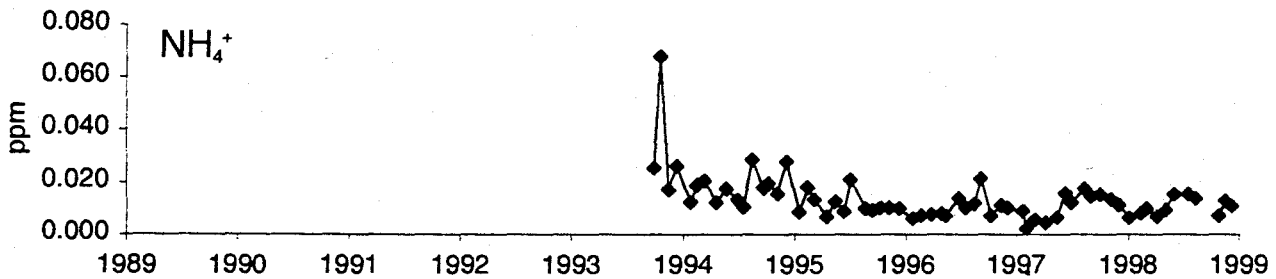
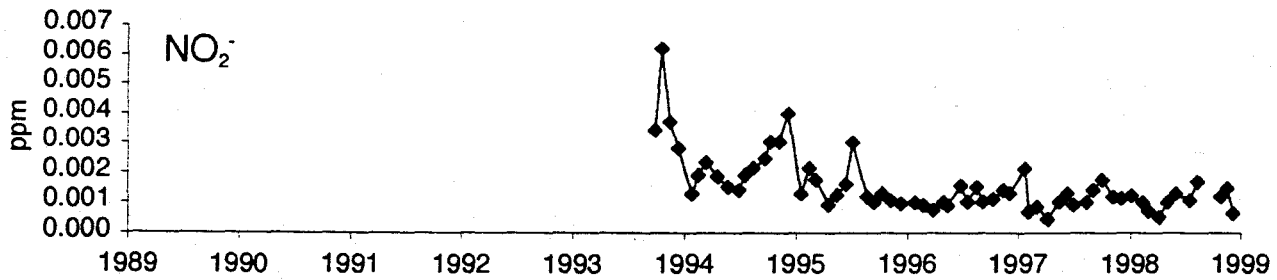
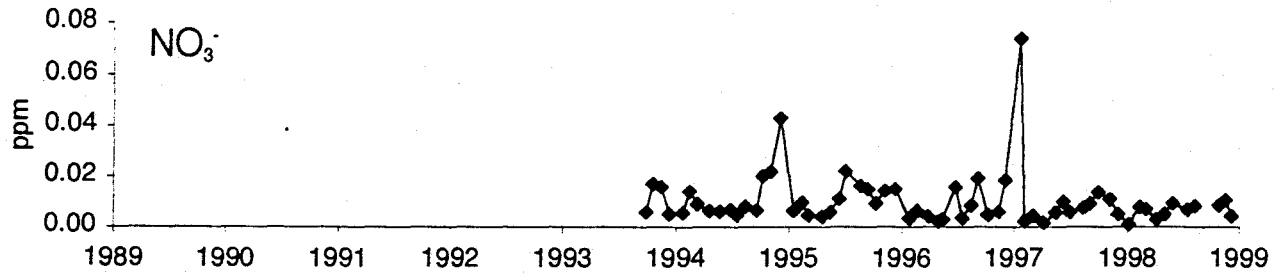
Biscayne Bay Sta. 115 Adams Key



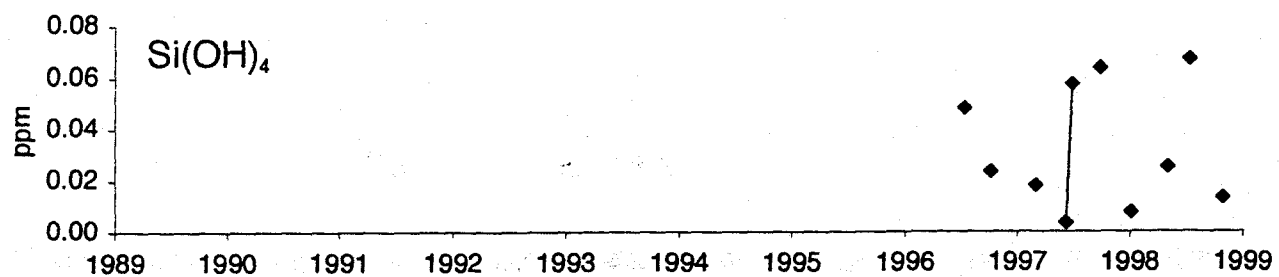
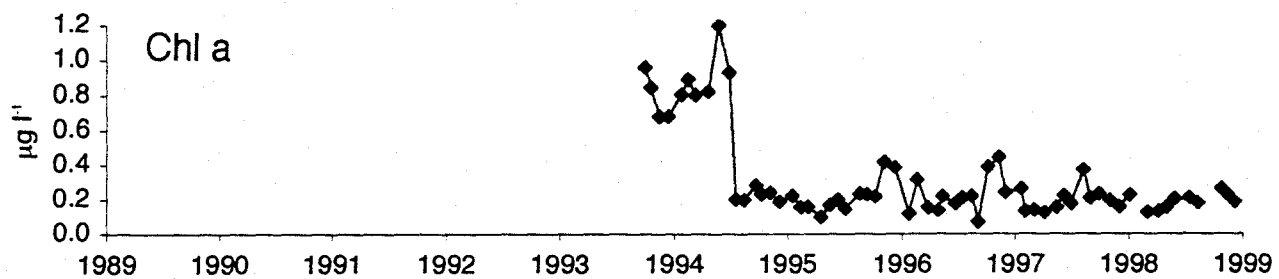
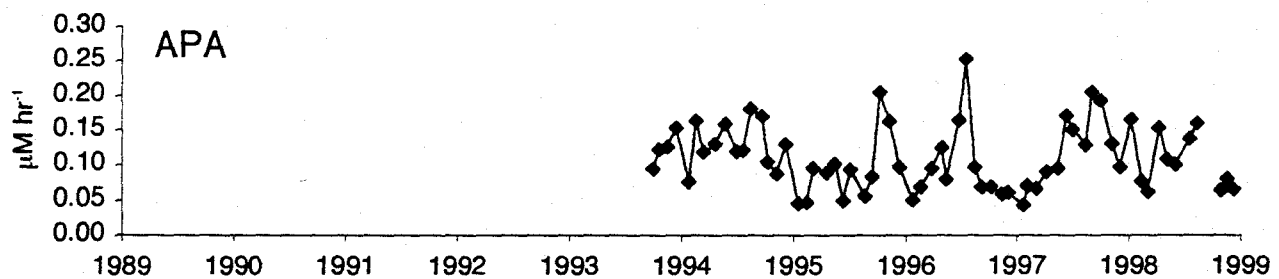
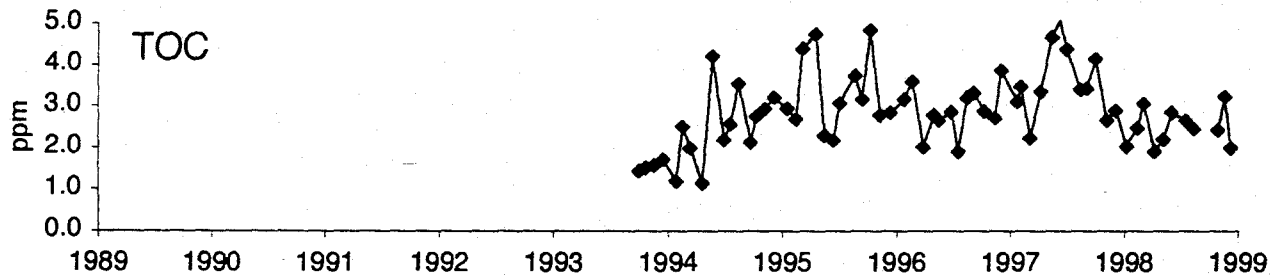
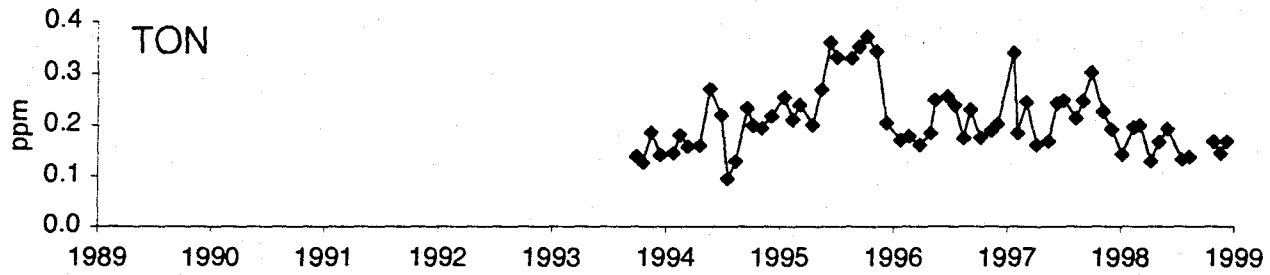
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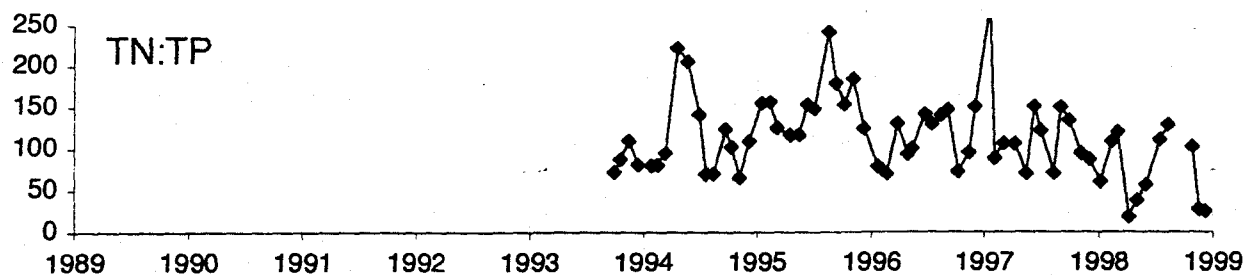
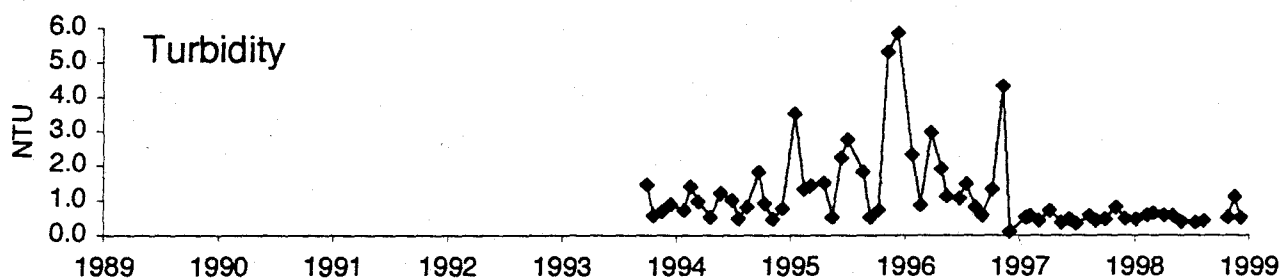
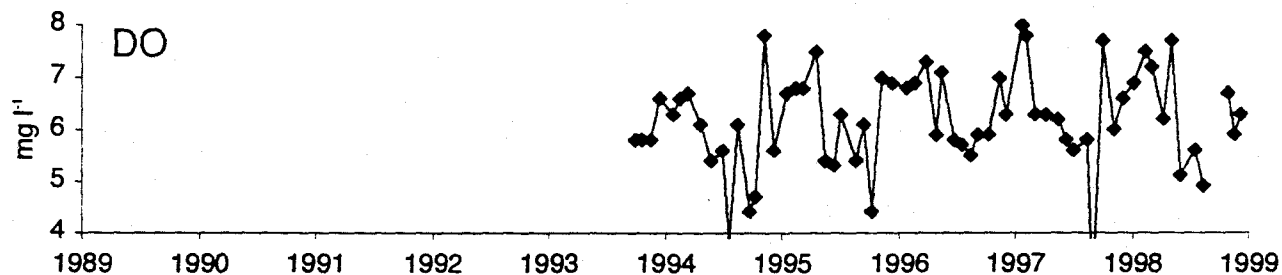
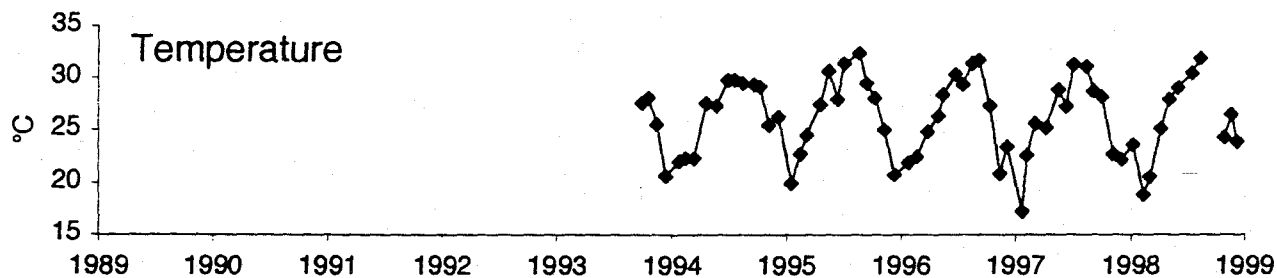
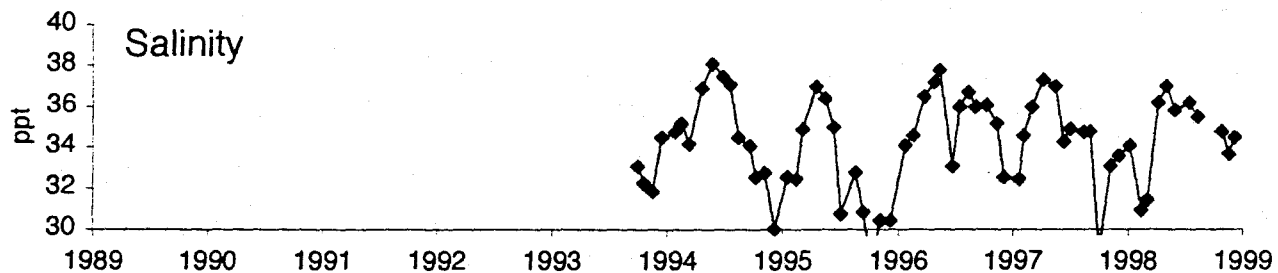
Biscayne Bay Sta. 116 Rubicon Keys



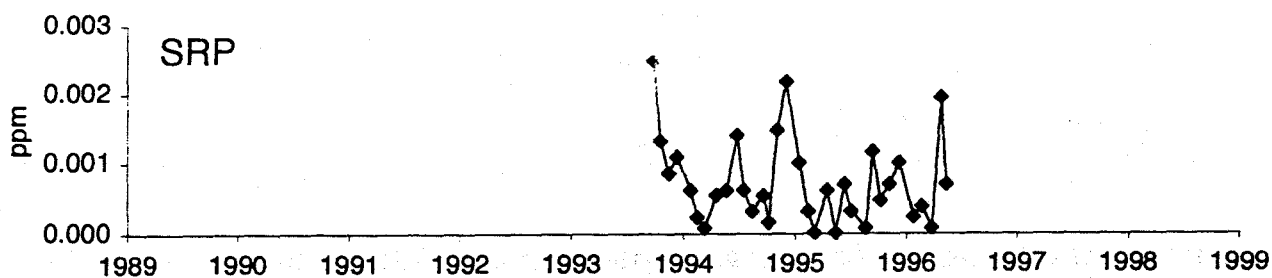
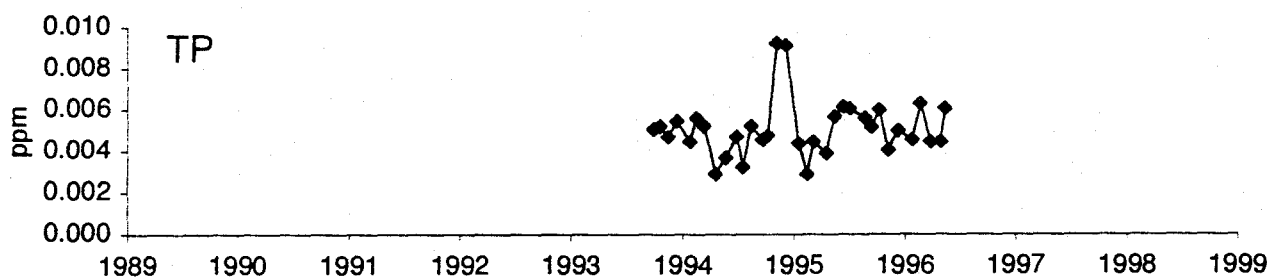
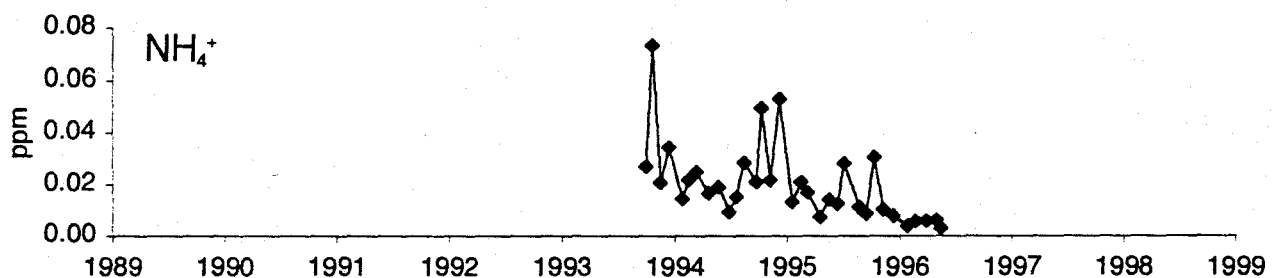
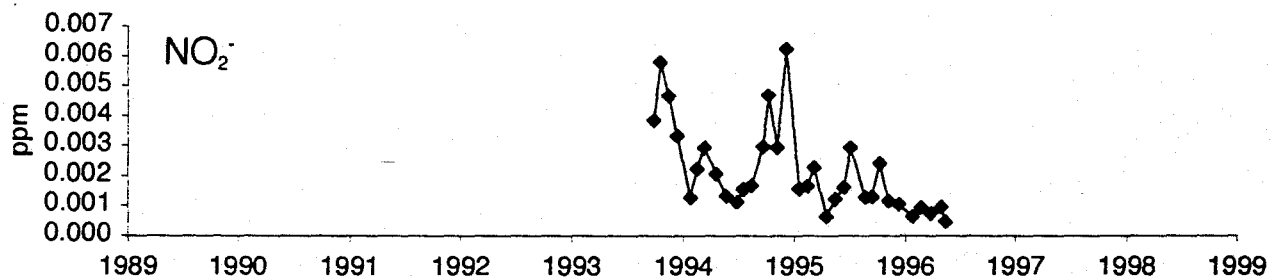
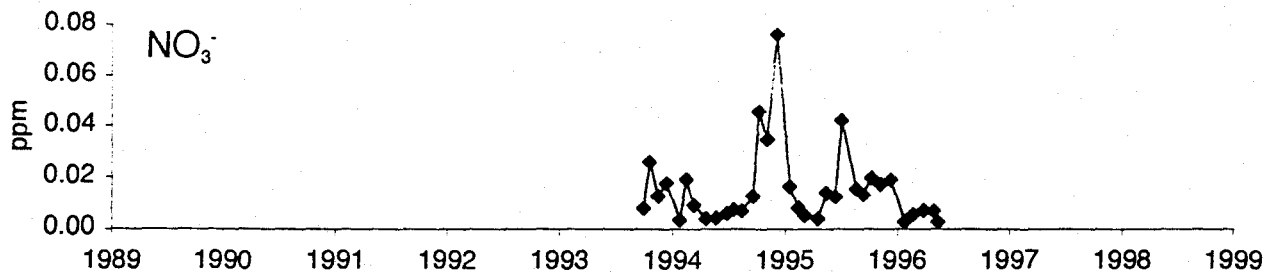
Biscayne Bay Sta. 116 Rubicon Keys



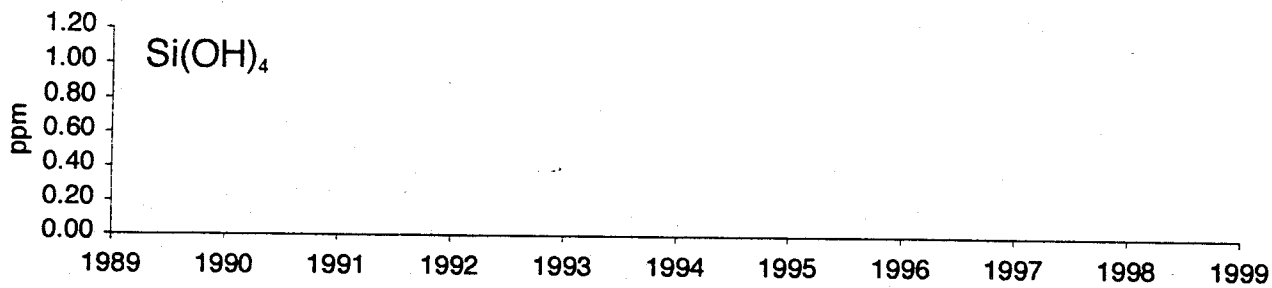
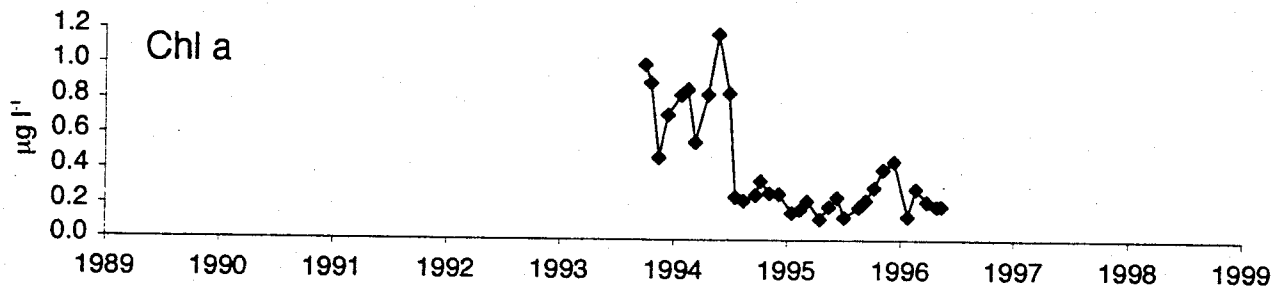
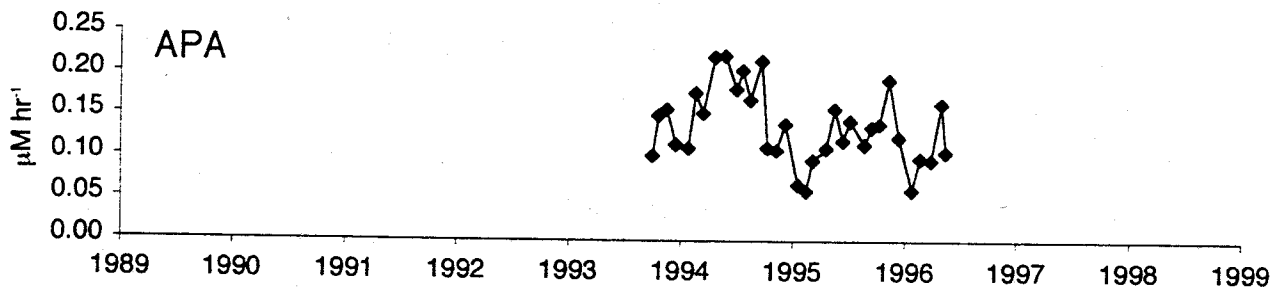
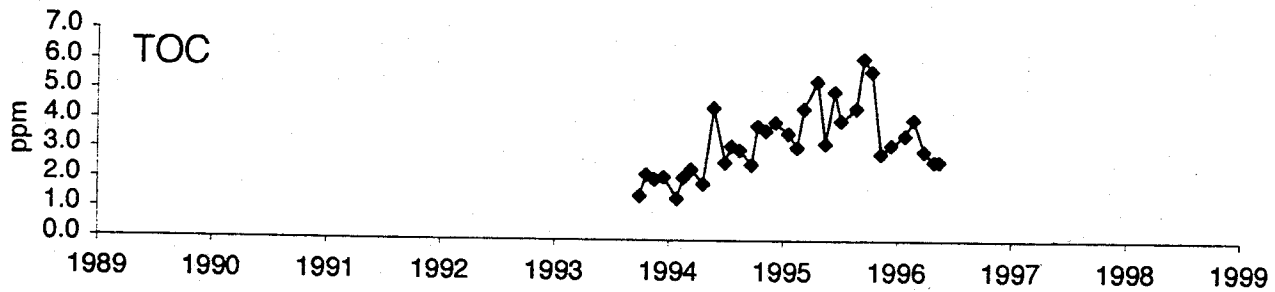
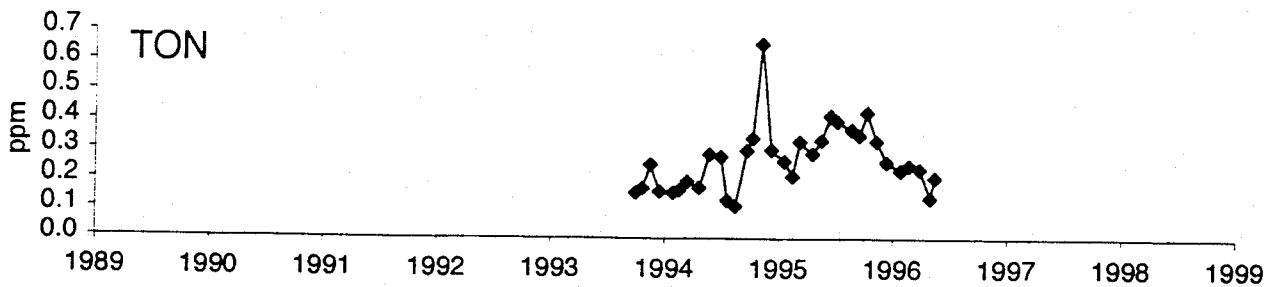
Biscayne Bay Sta. 116 Rubicon Keys



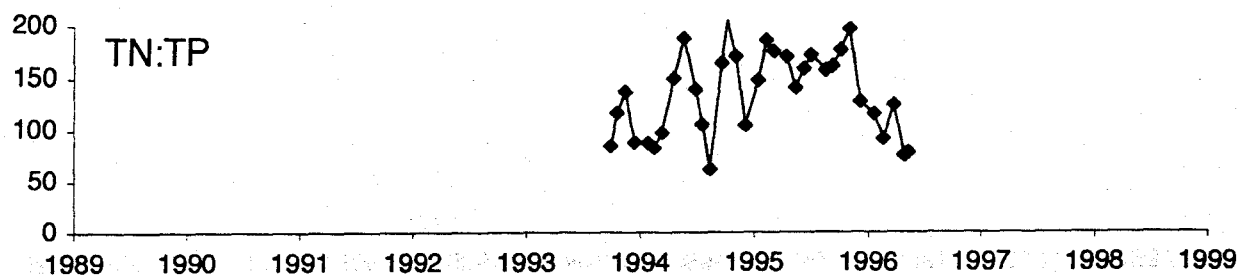
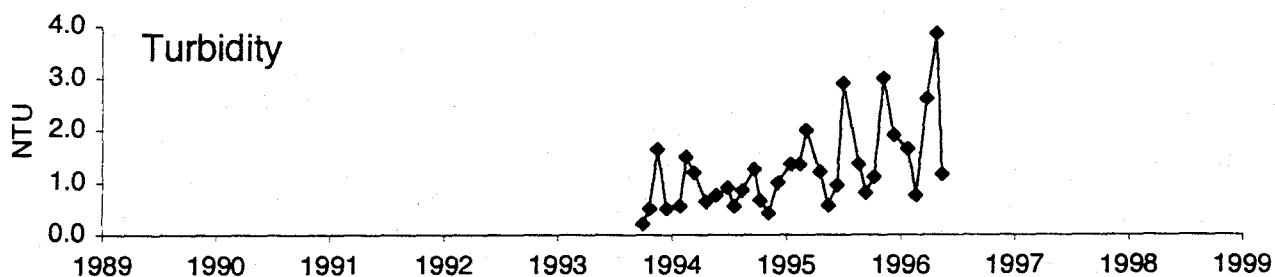
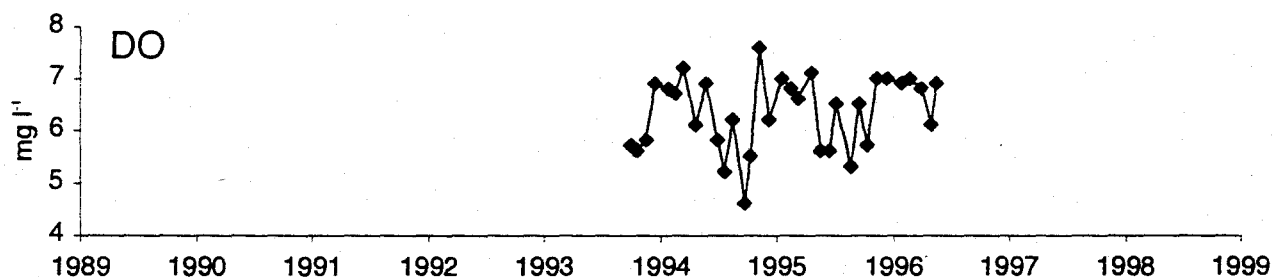
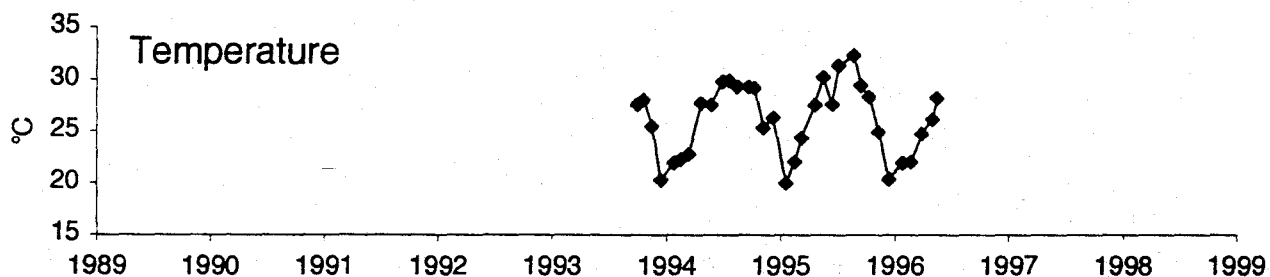
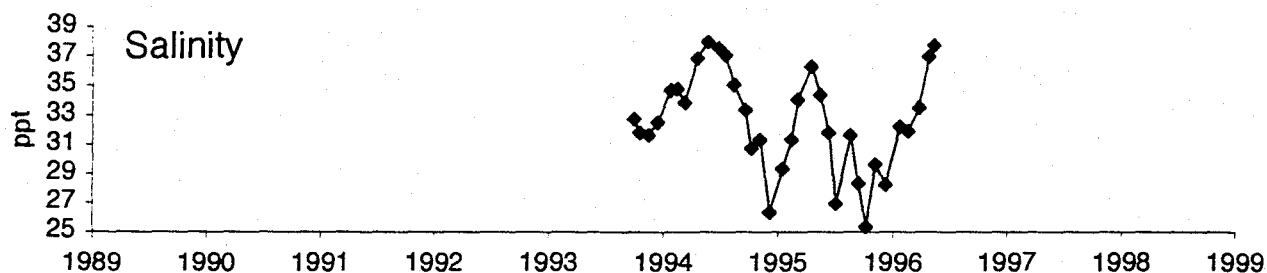
Biscayne Bay Sta. 117 Totten Key



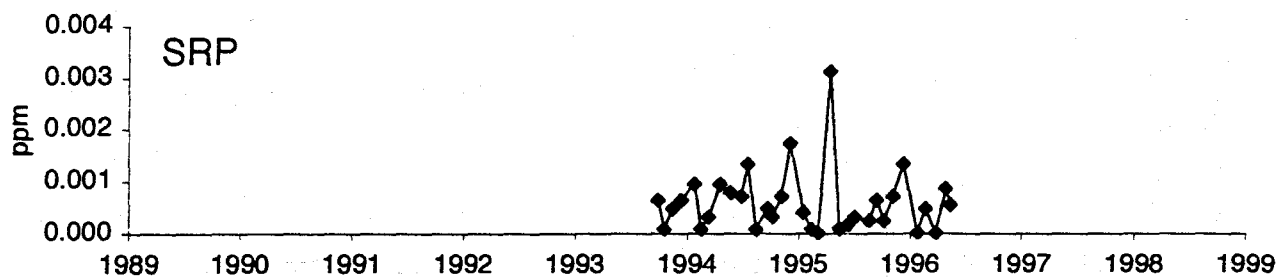
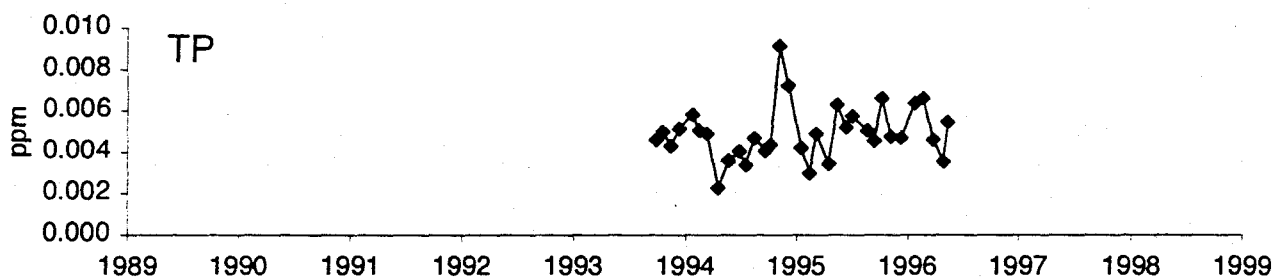
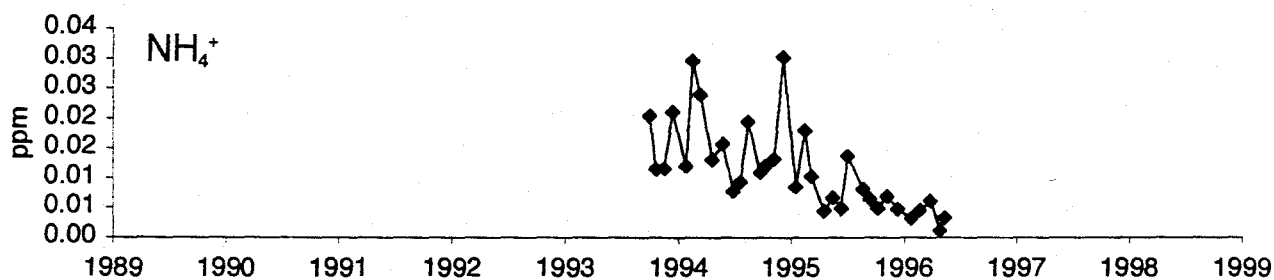
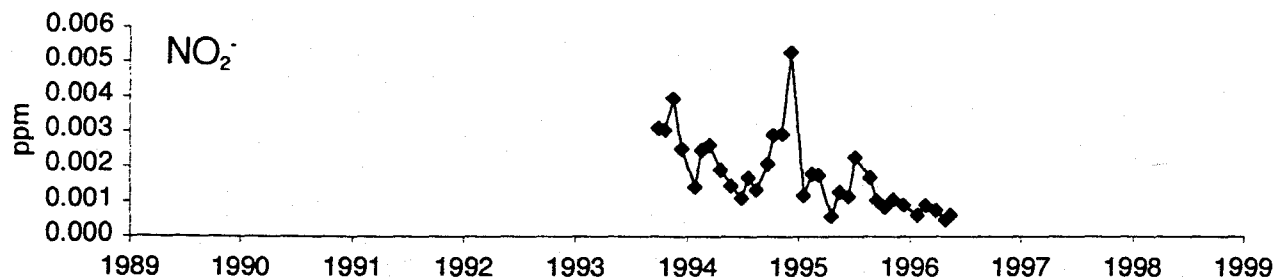
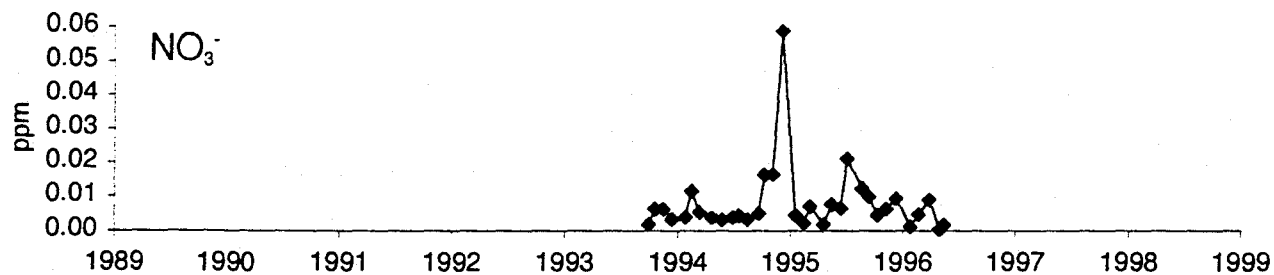
Biscayne Bay Sta. 117 Totten Key



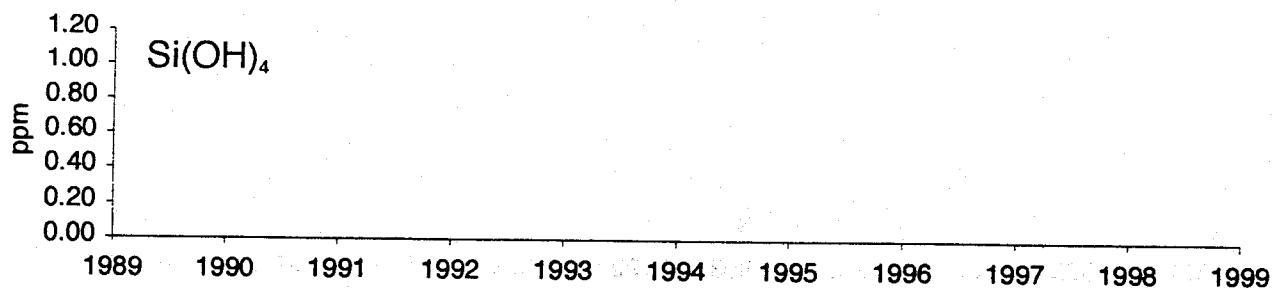
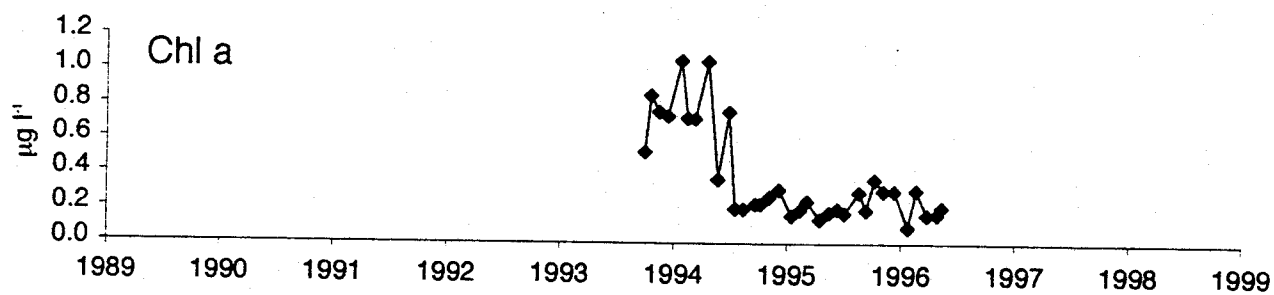
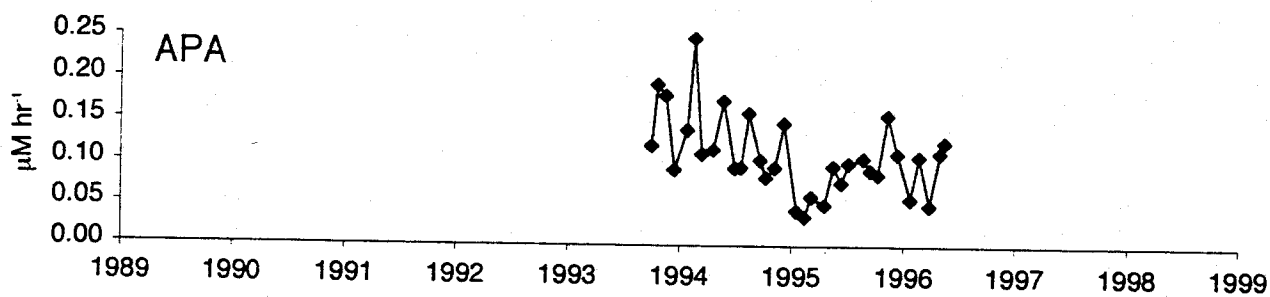
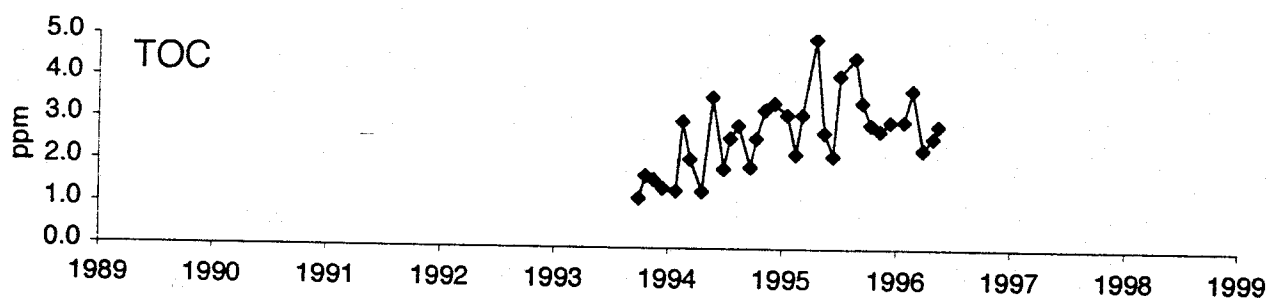
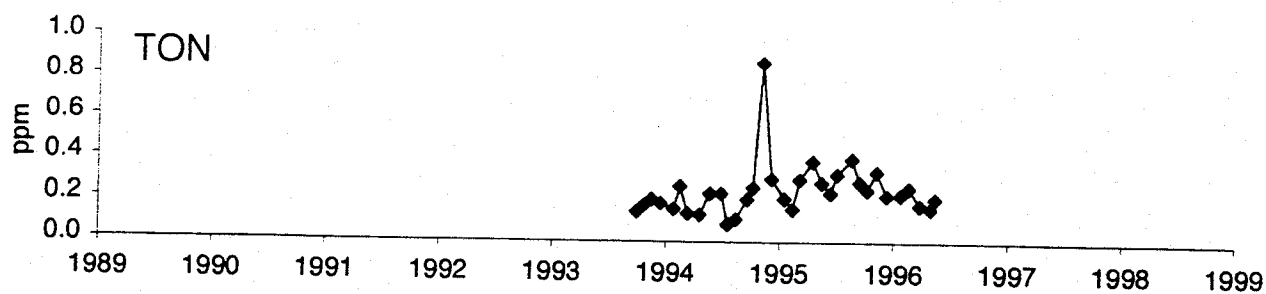
Biscayne Bay Sta. 117 Totten Key



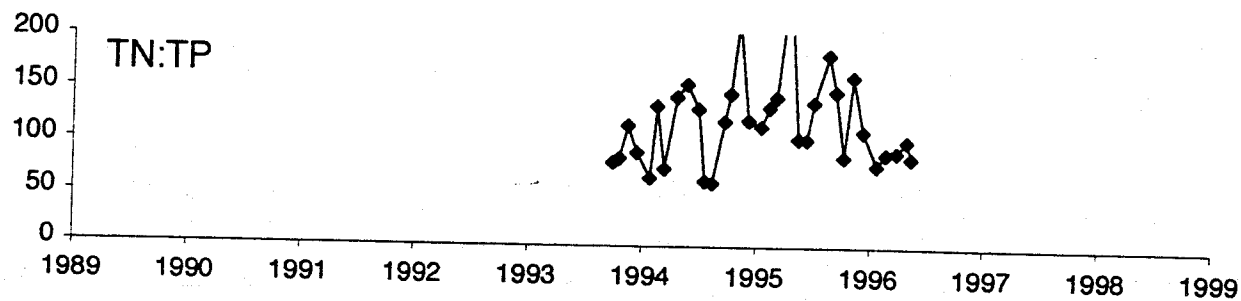
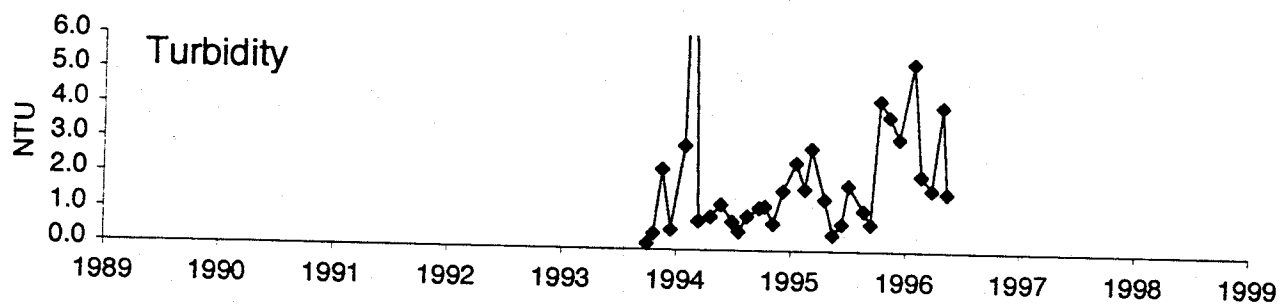
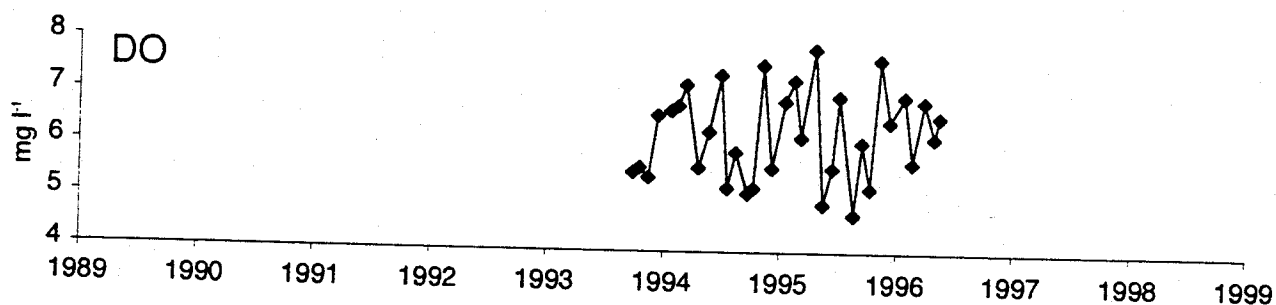
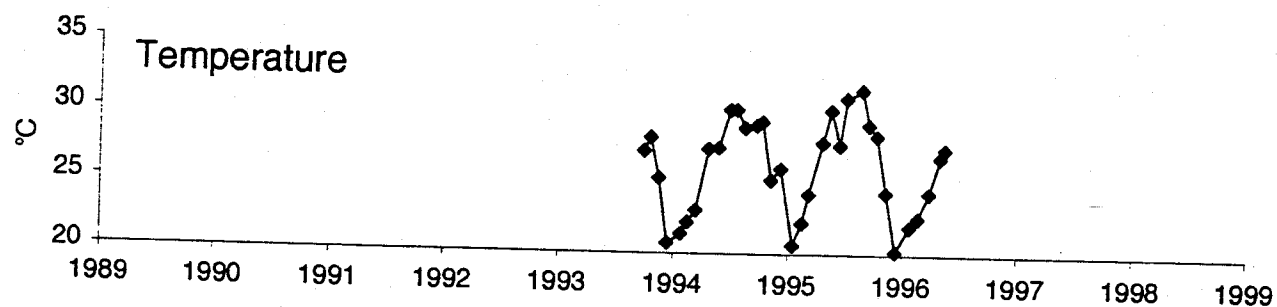
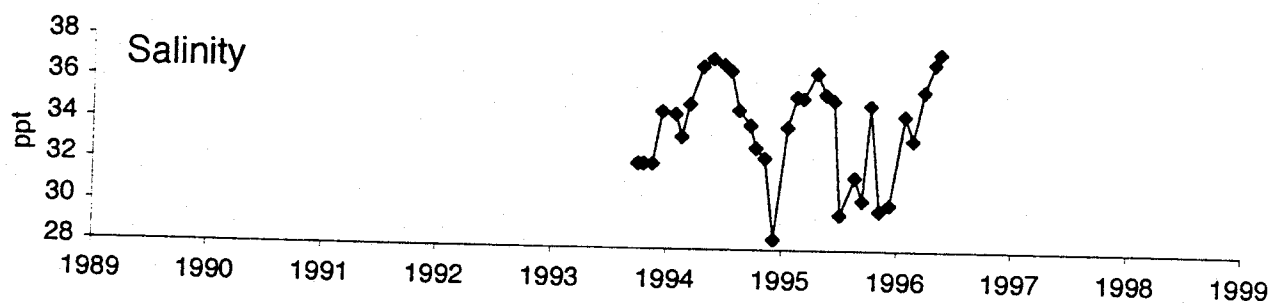
Biscayne Bay Sta. 118 Broad Creek



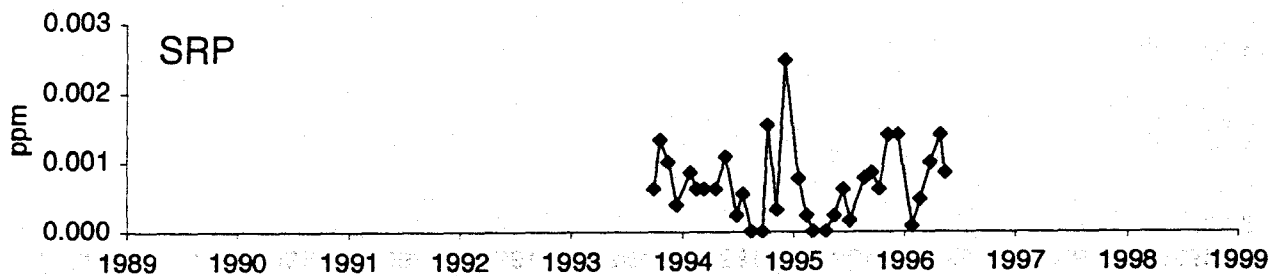
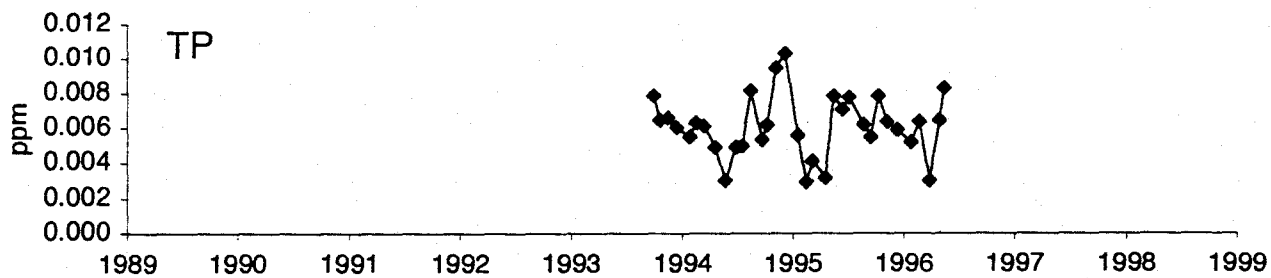
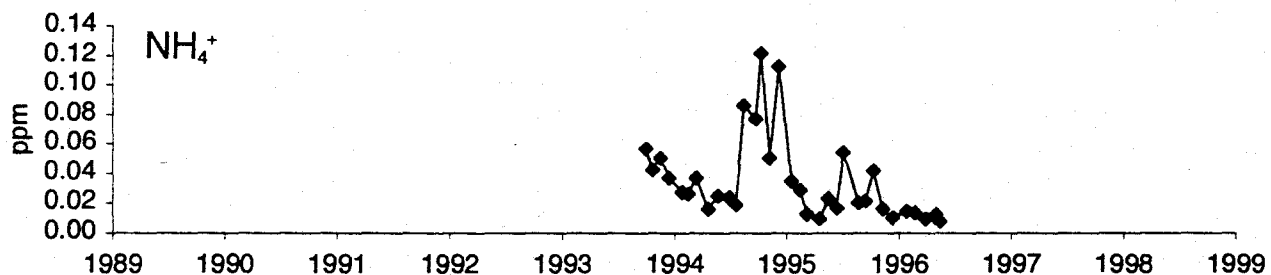
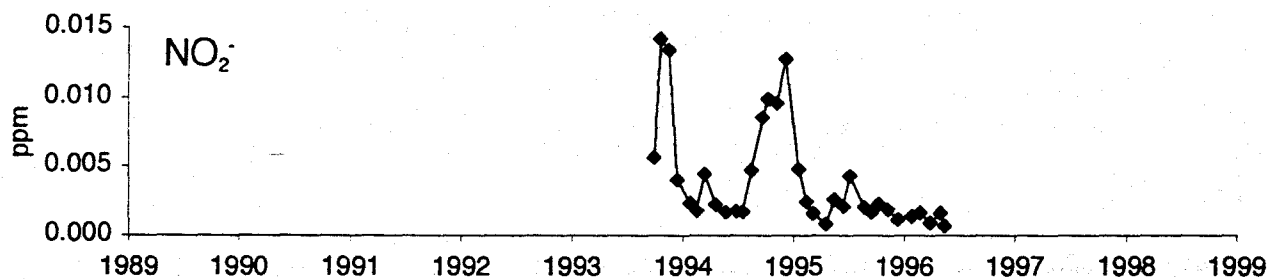
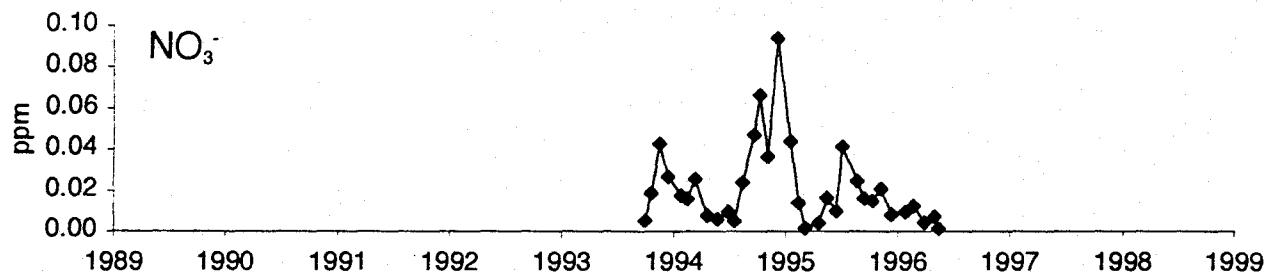
Biscayne Bay Sta. 118 Broad Creek

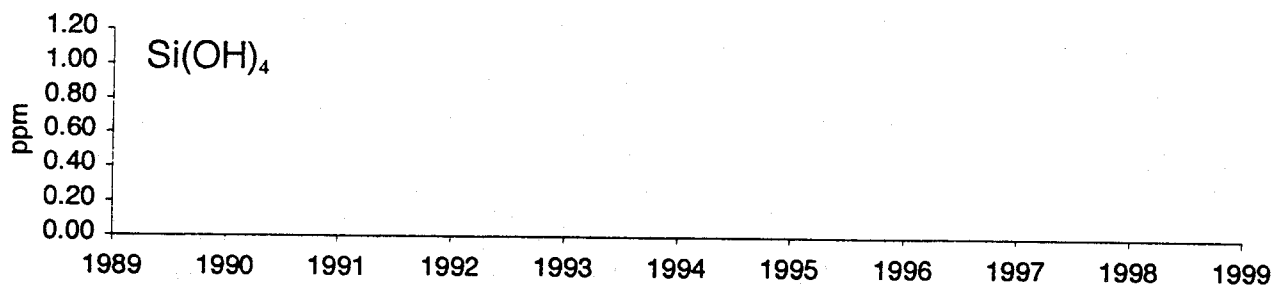
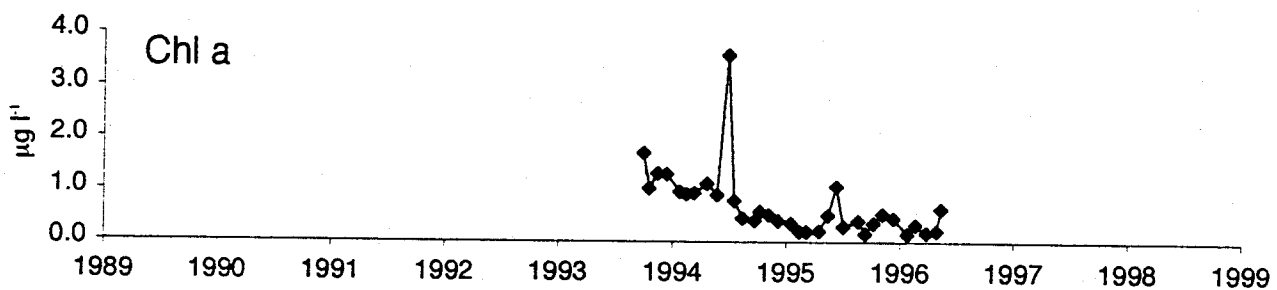
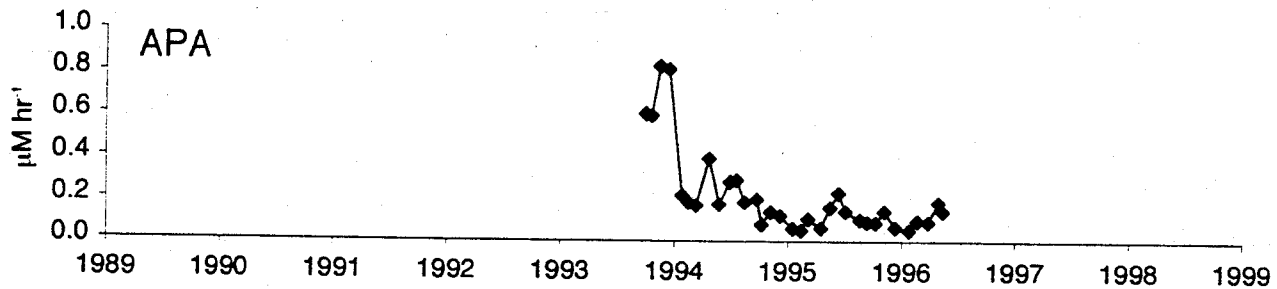
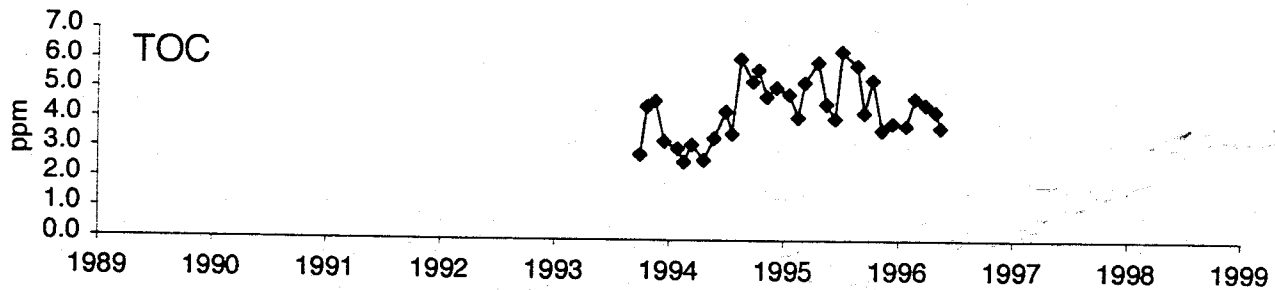
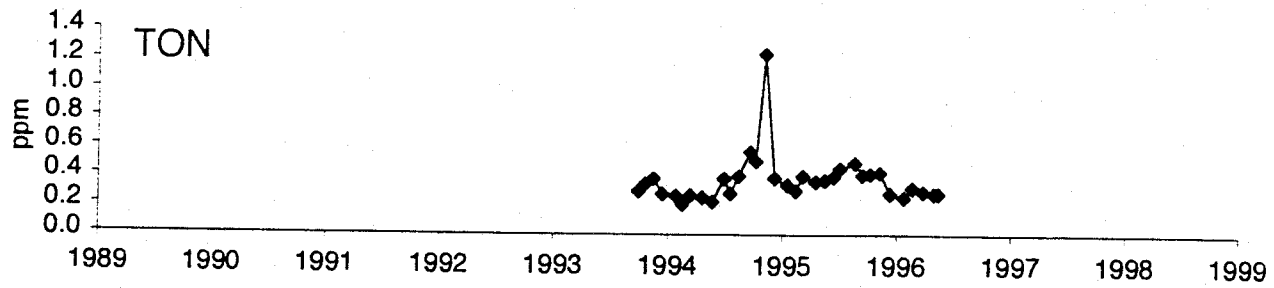


Biscayne Bay Sta. 118 Broad Creek

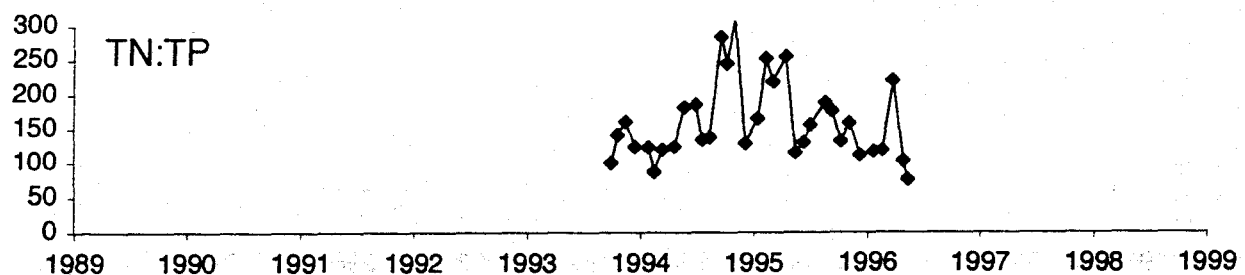
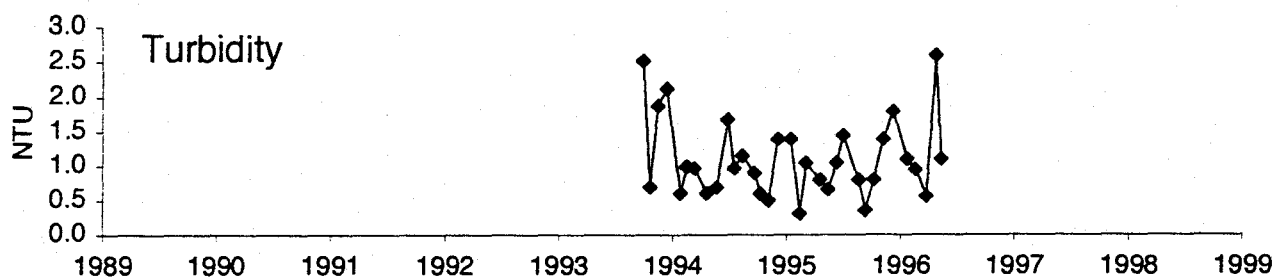
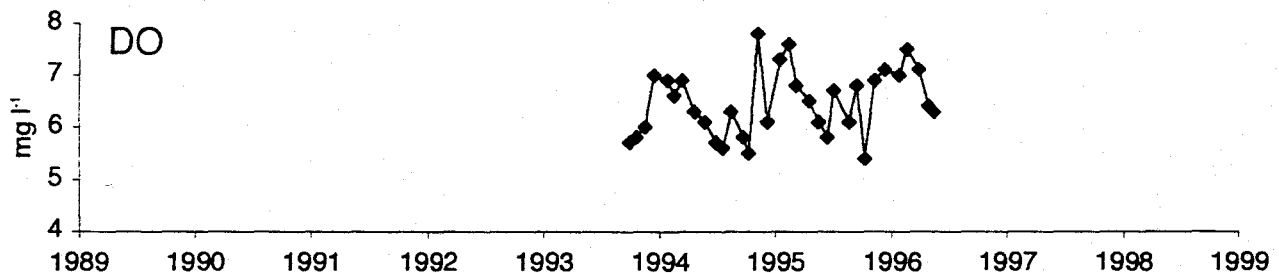
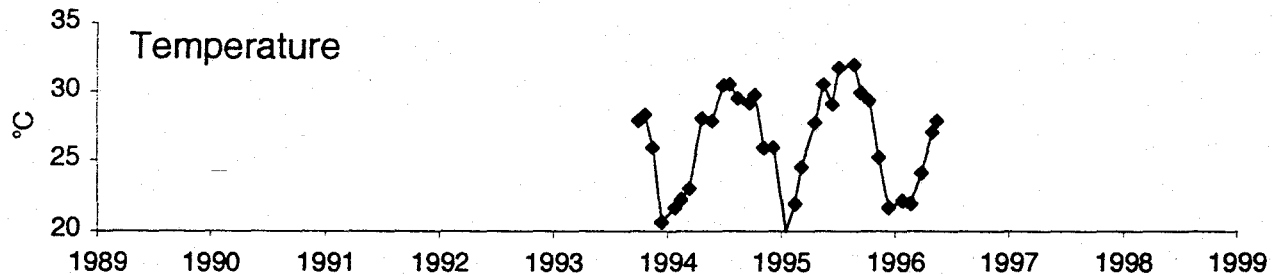
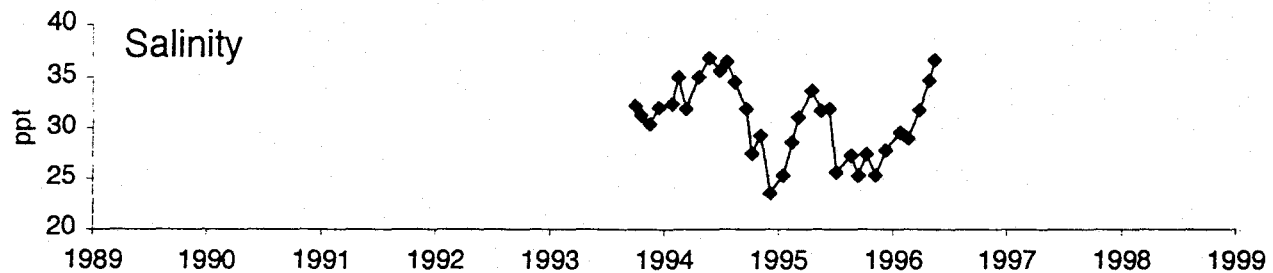


Biscayne Bay Sta. 119 Pumpkin Key

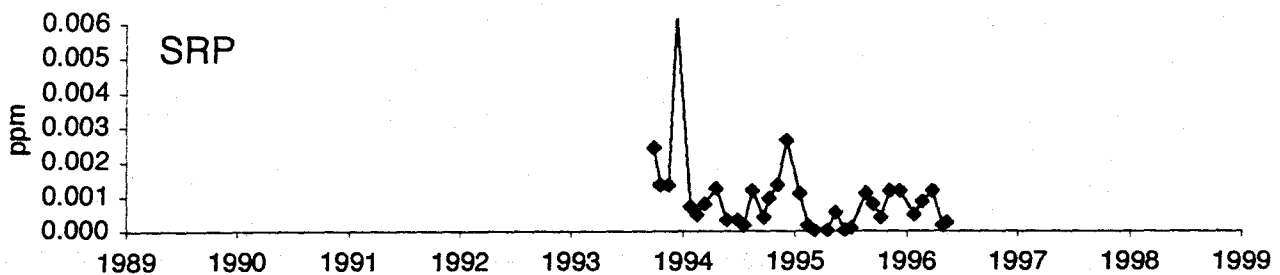
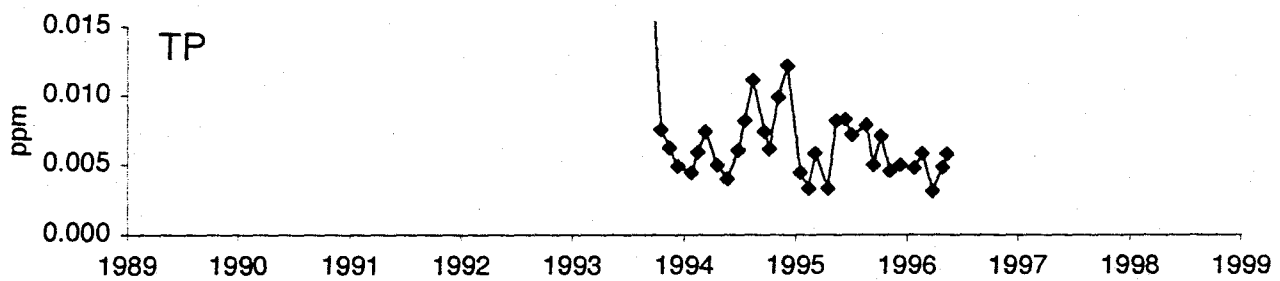
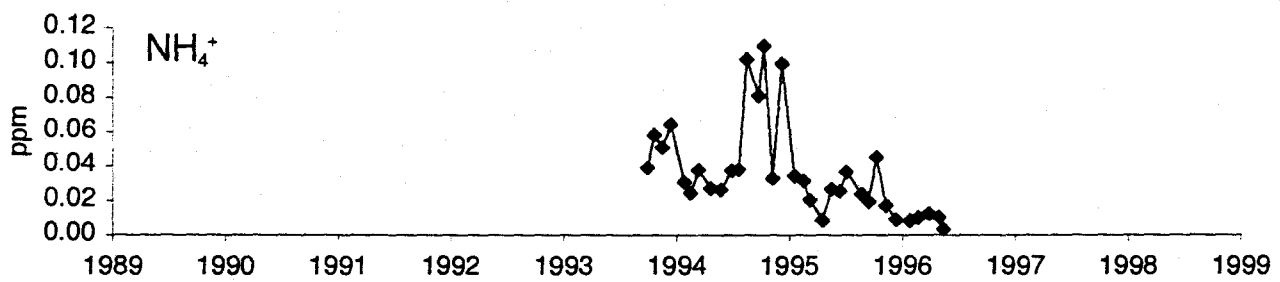
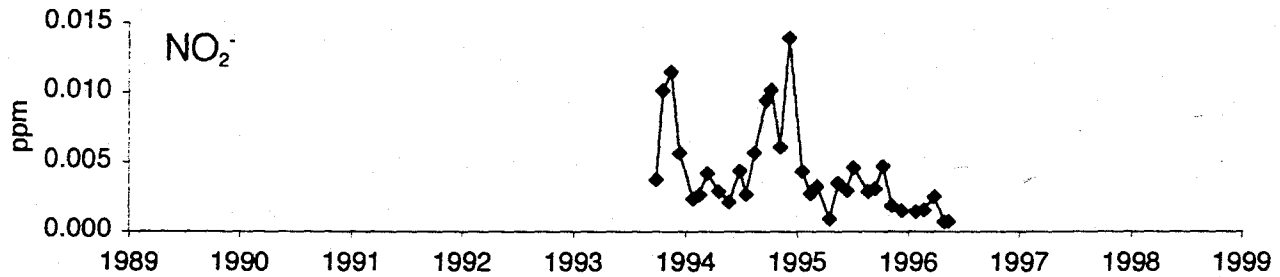
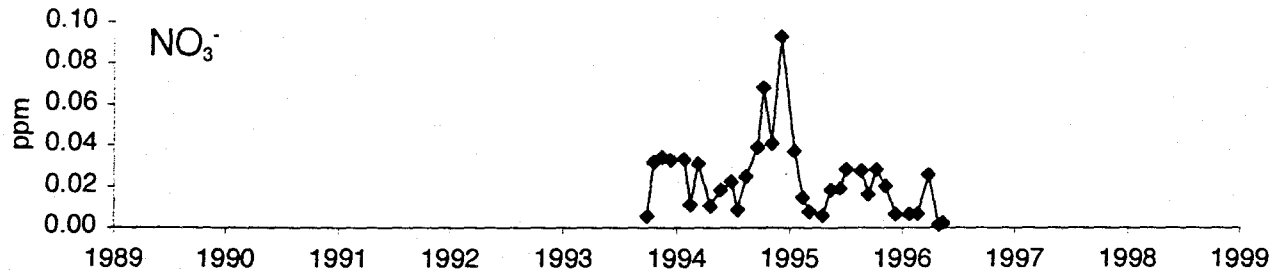




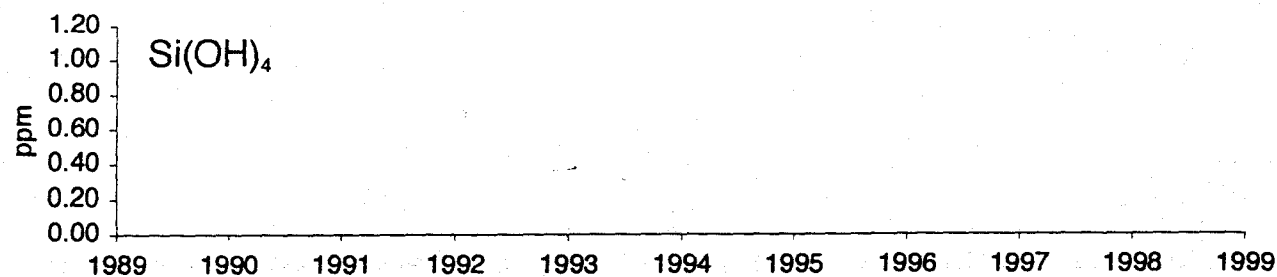
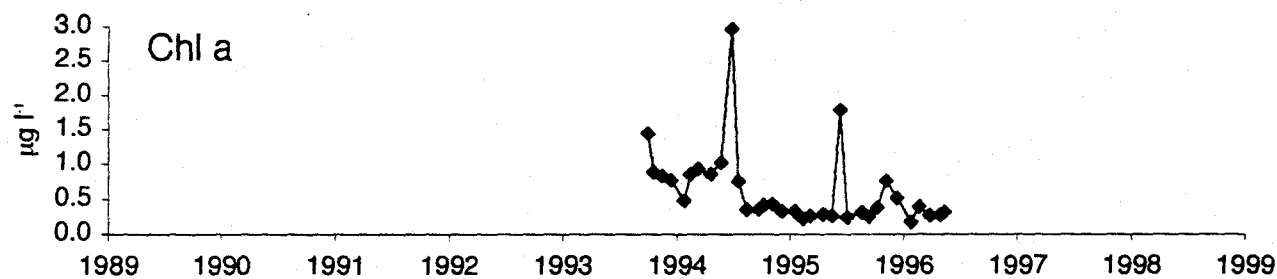
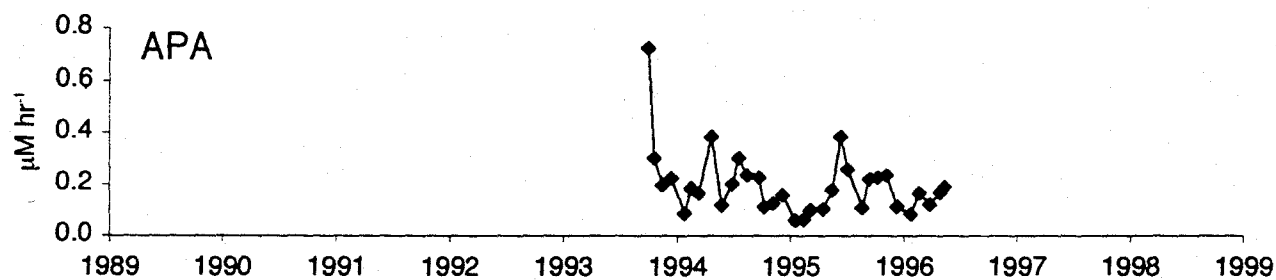
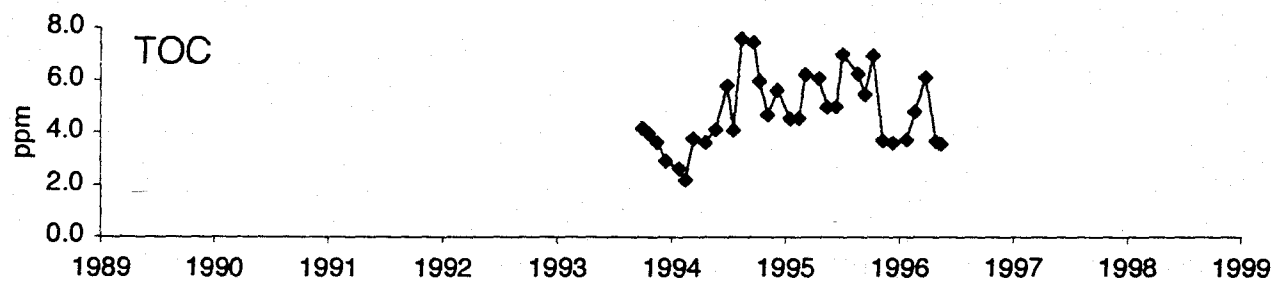
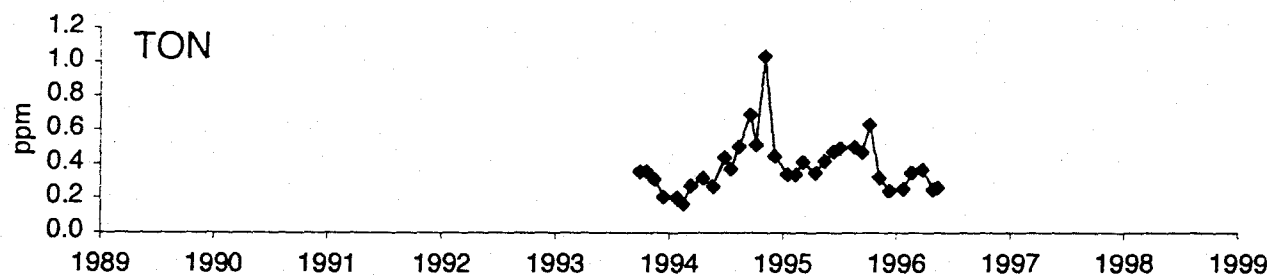
Biscayne Bay Sta. 119 Pumpkin Key



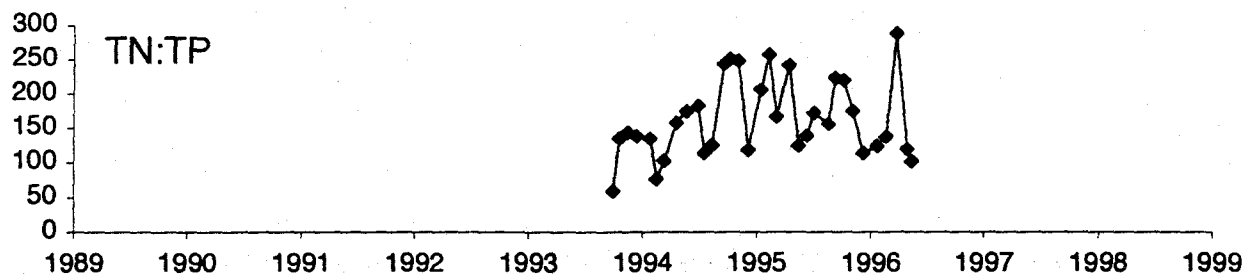
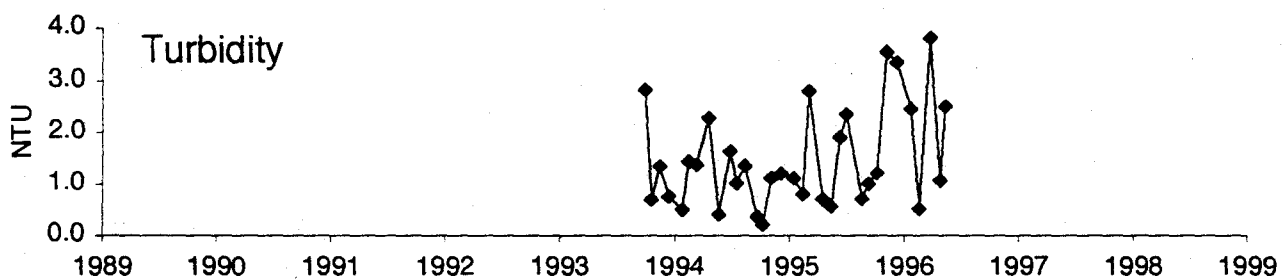
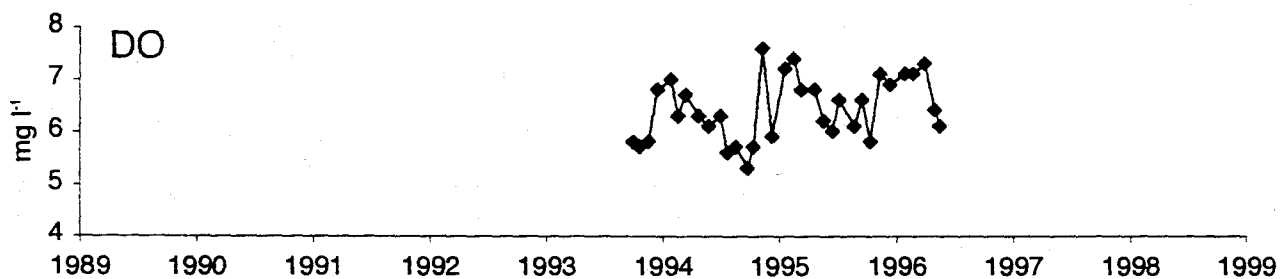
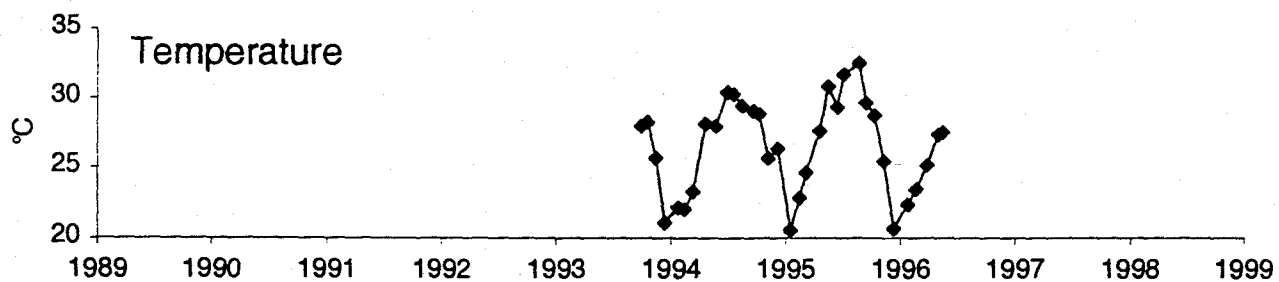
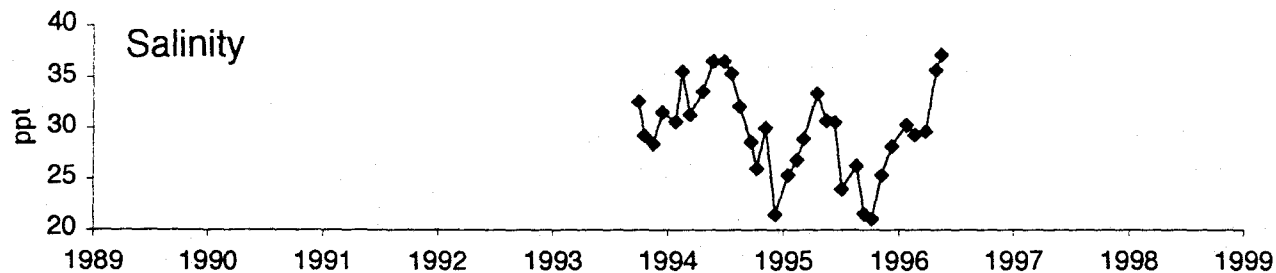
Biscayne Bay Sta. 120 Card Sound South



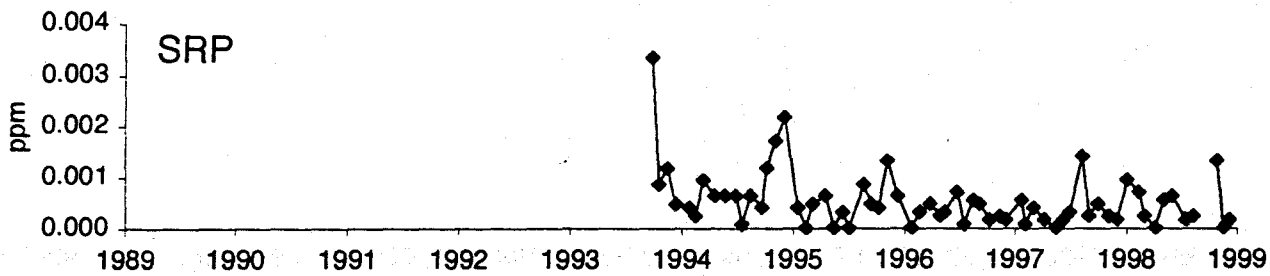
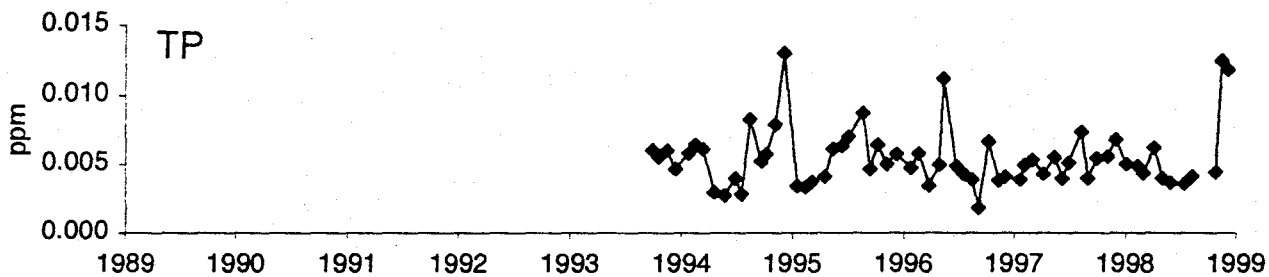
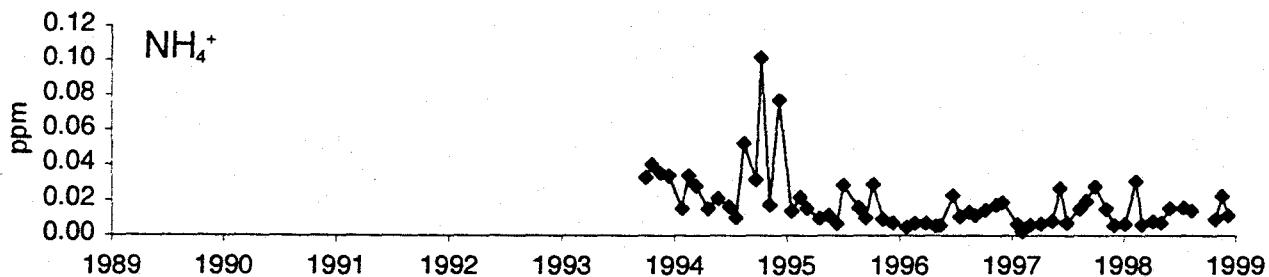
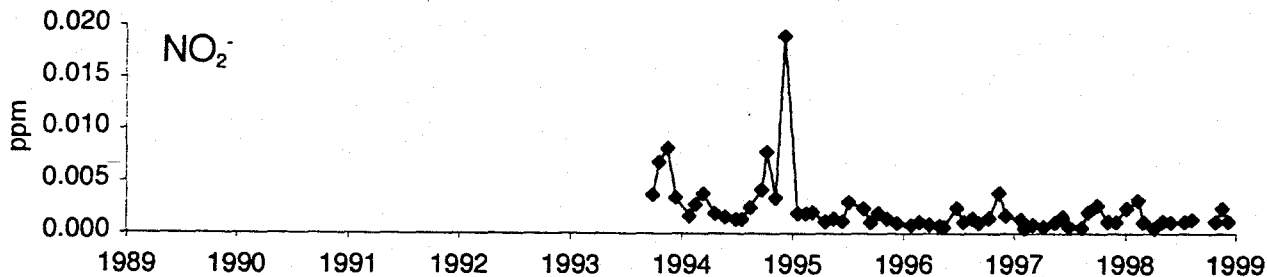
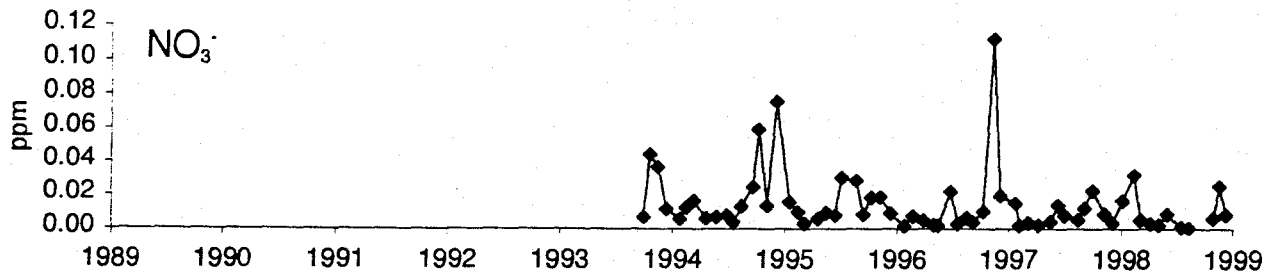
Biscayne Bay Sta. 120 Card Sound South



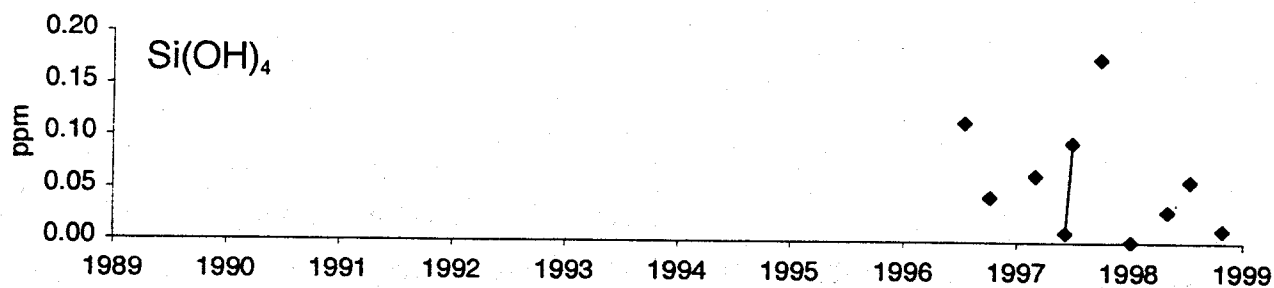
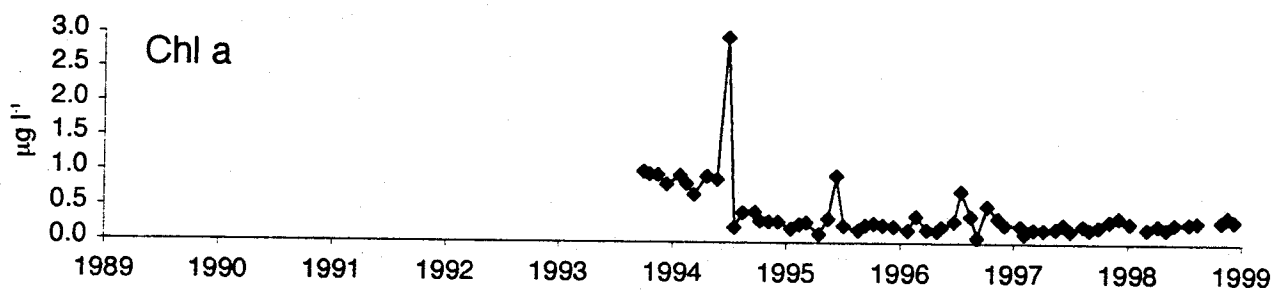
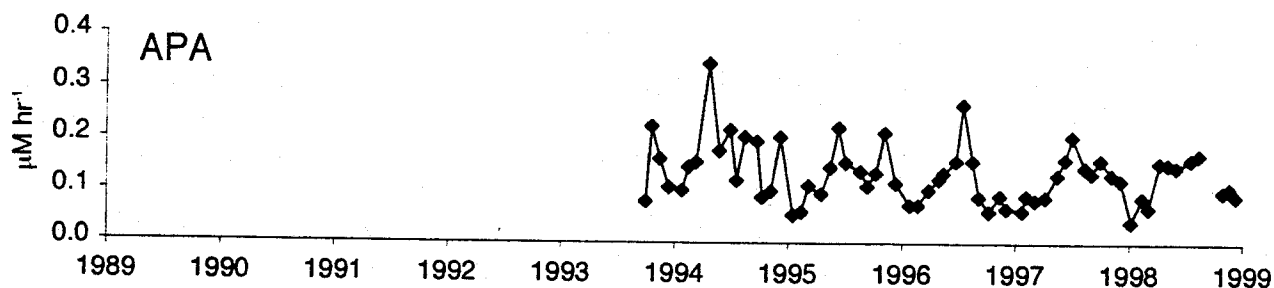
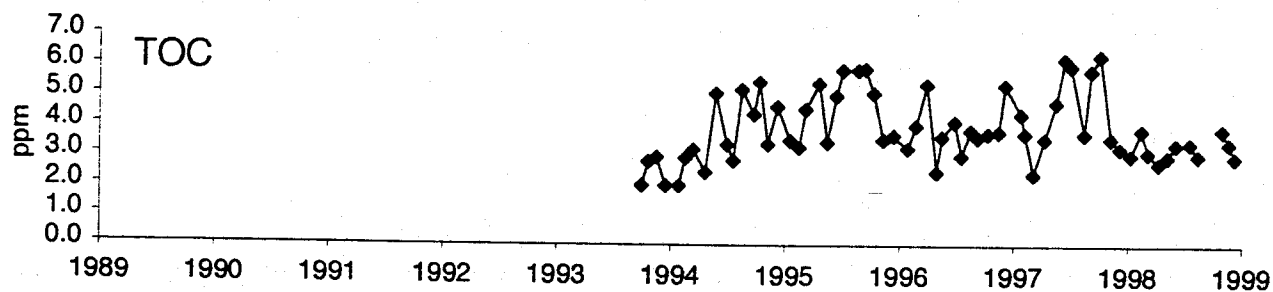
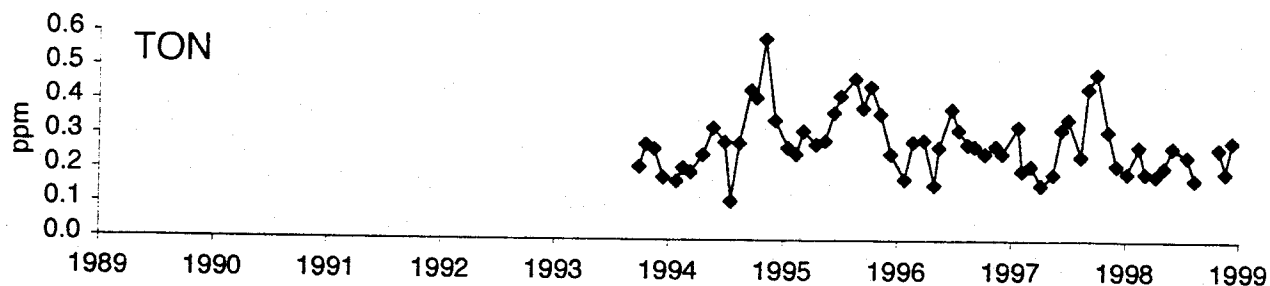
Biscayne Bay Sta. 120 Card Sound South



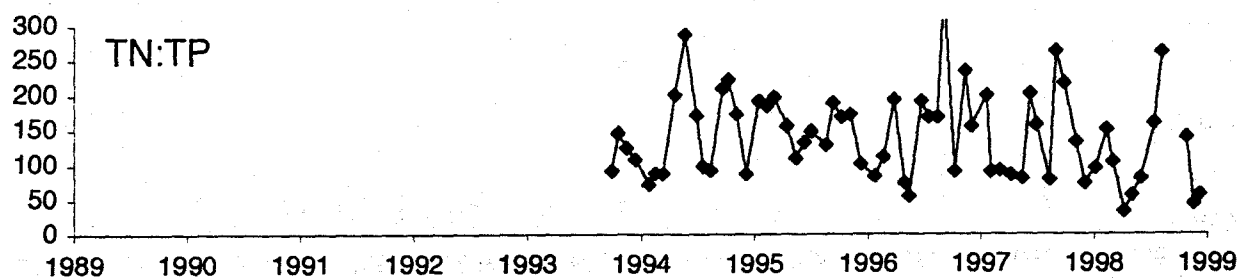
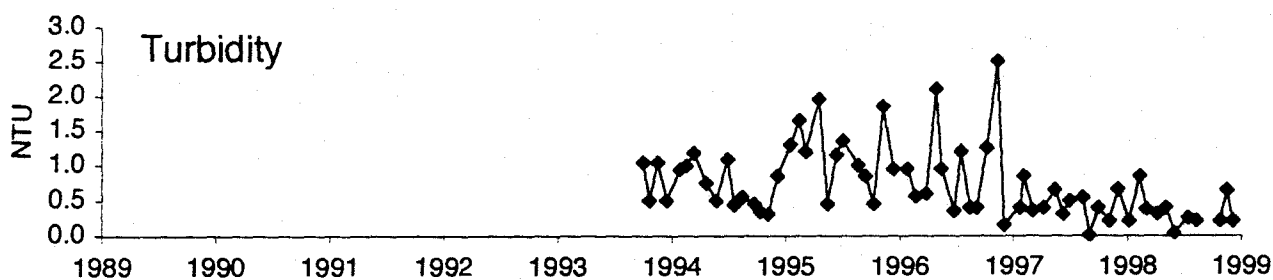
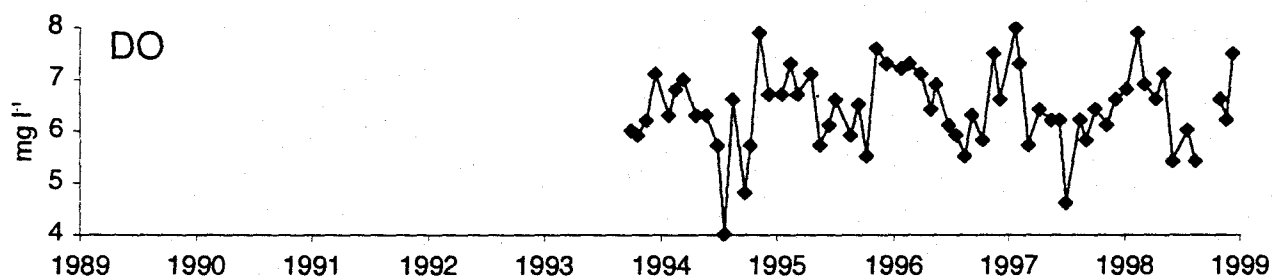
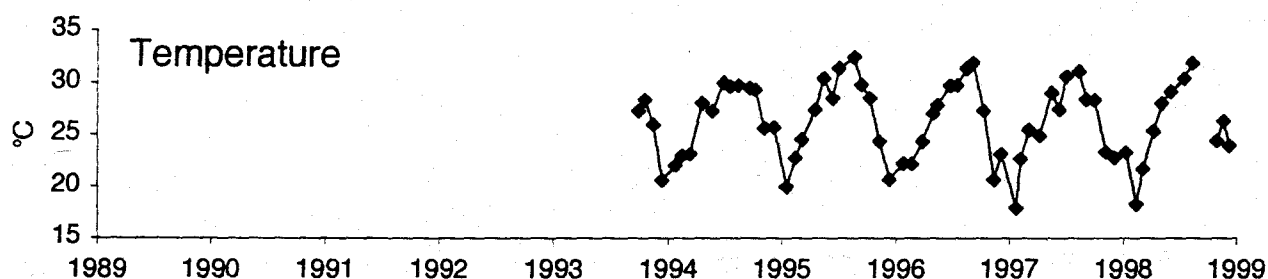
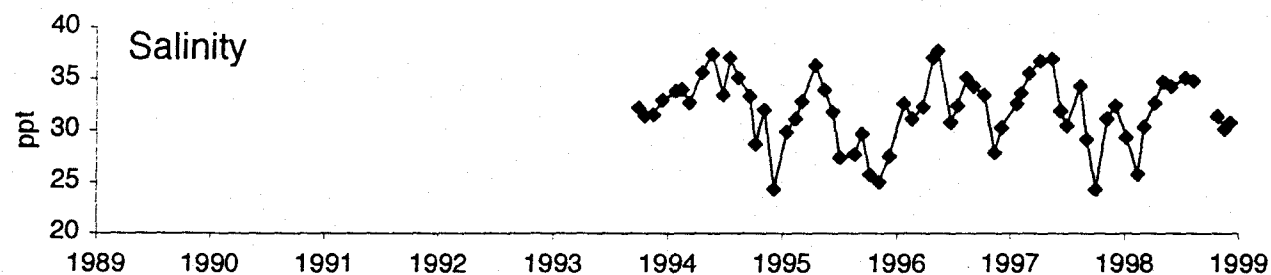
Biscayne Bay Sta. 121 Card Sound North



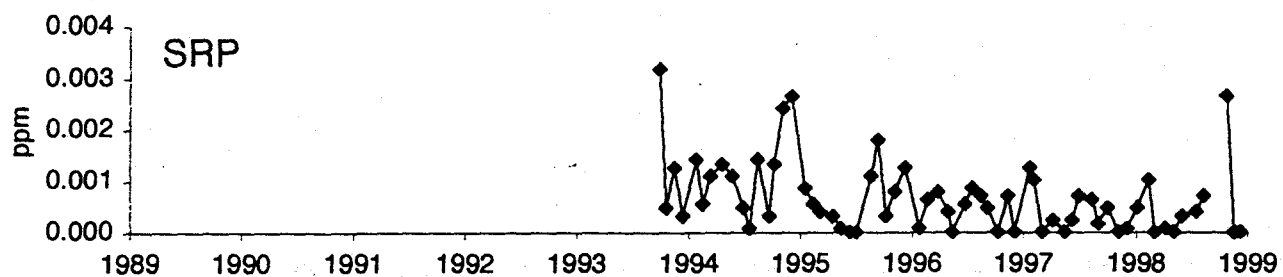
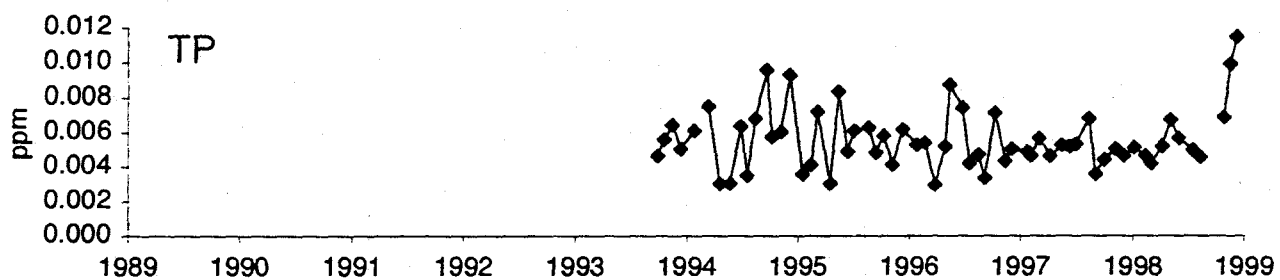
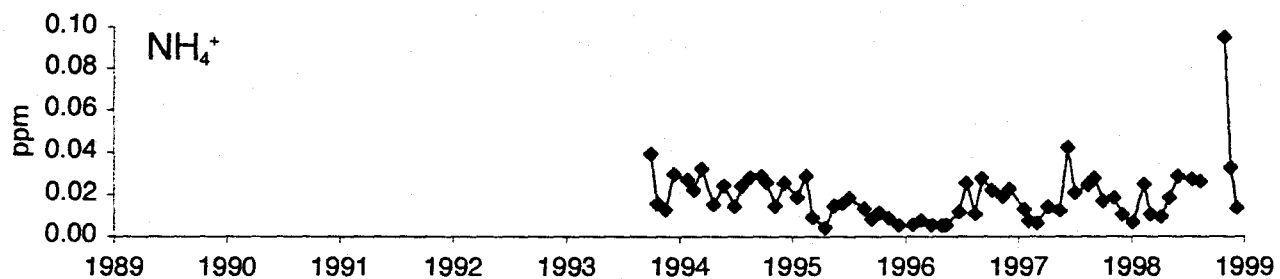
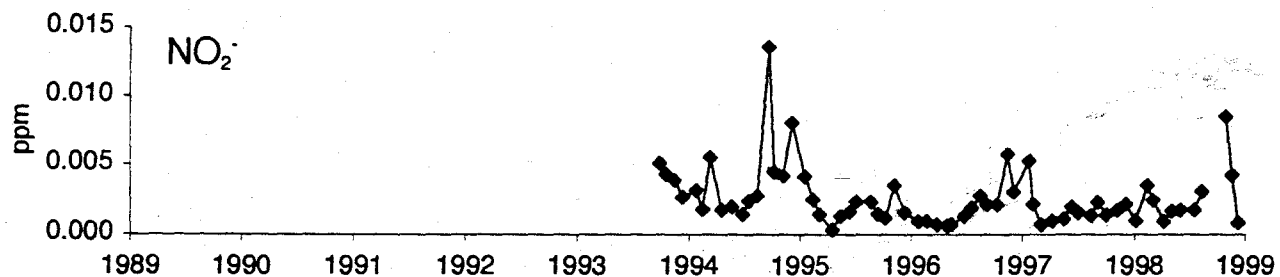
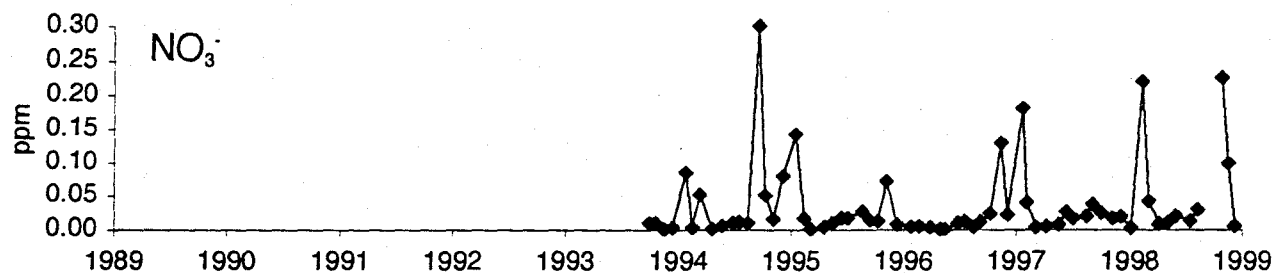
Biscayne Bay Sta. 121 Card Sound North



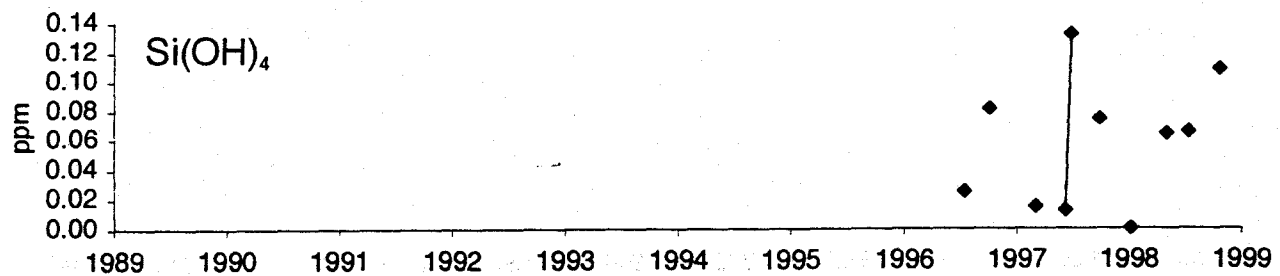
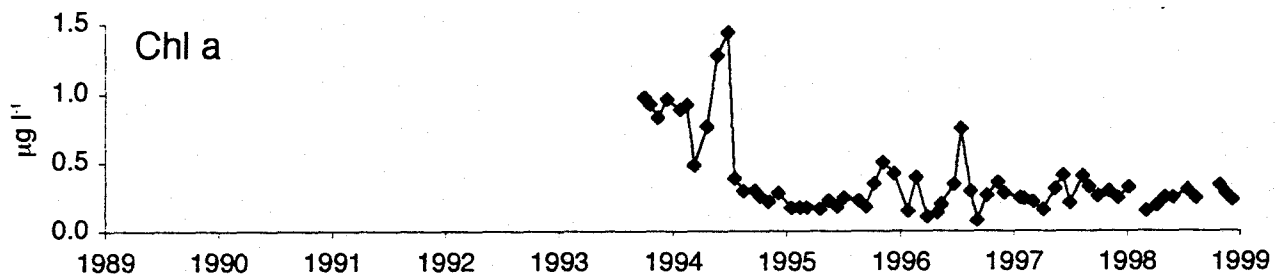
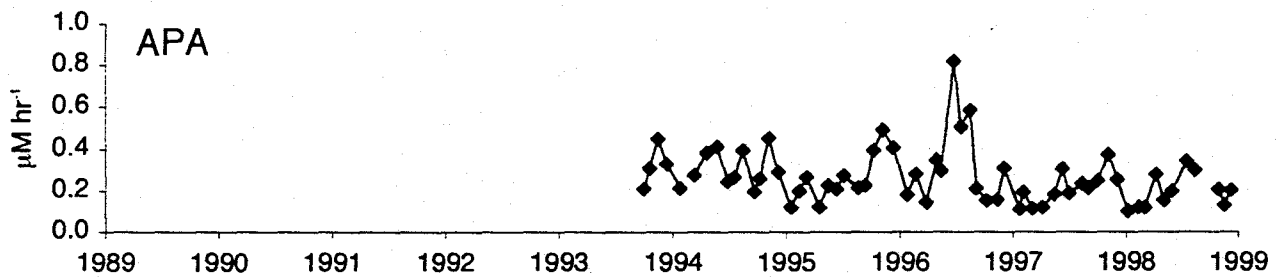
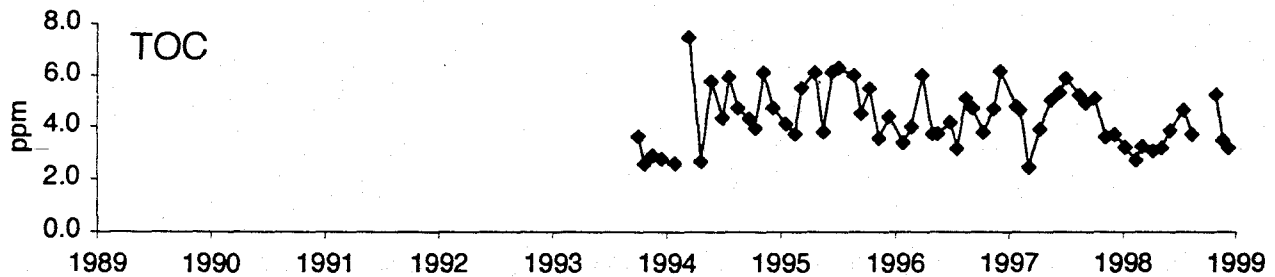
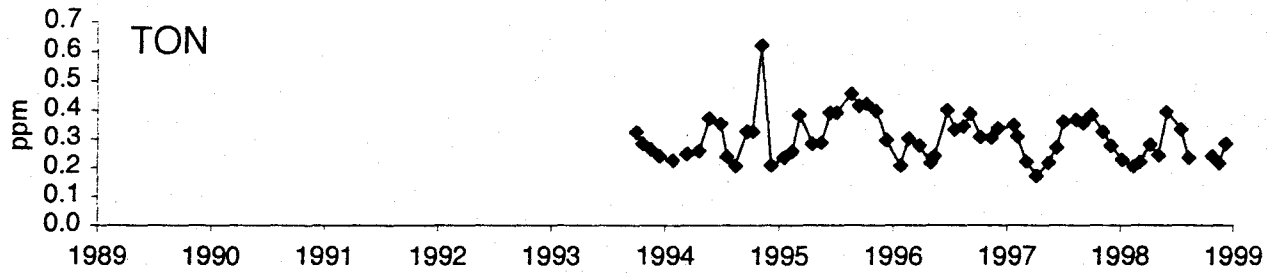
Biscayne Bay Sta. 121 Card Sound North



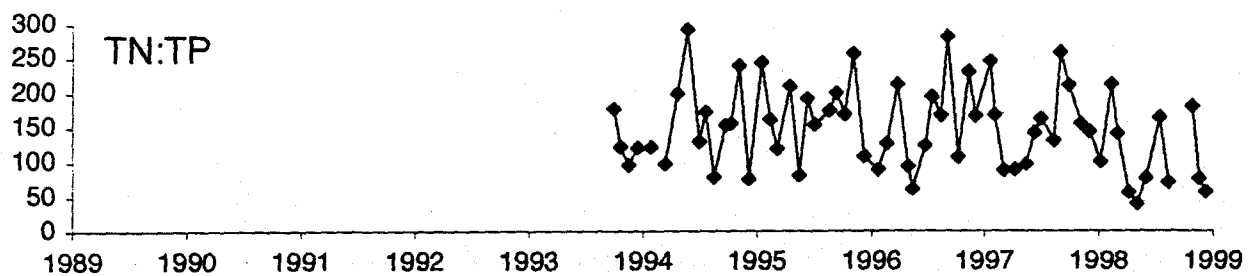
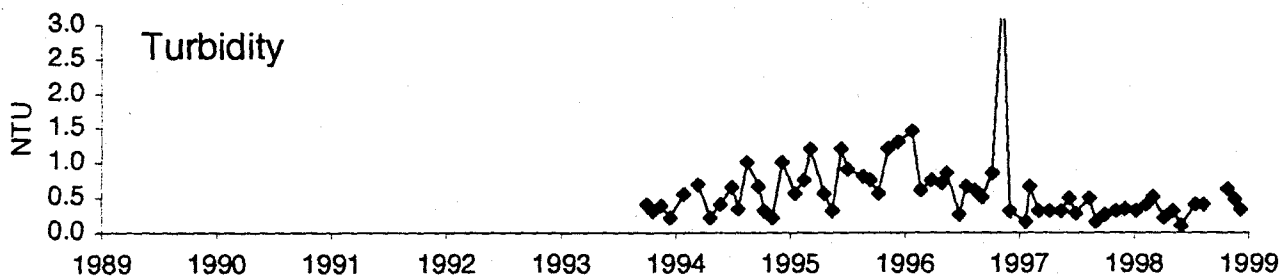
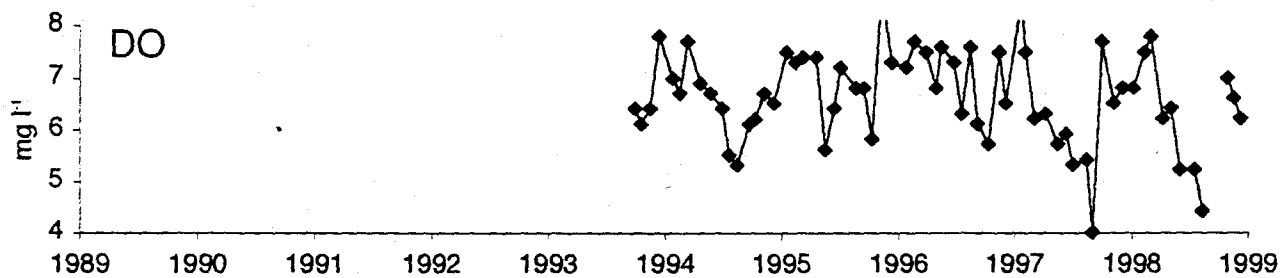
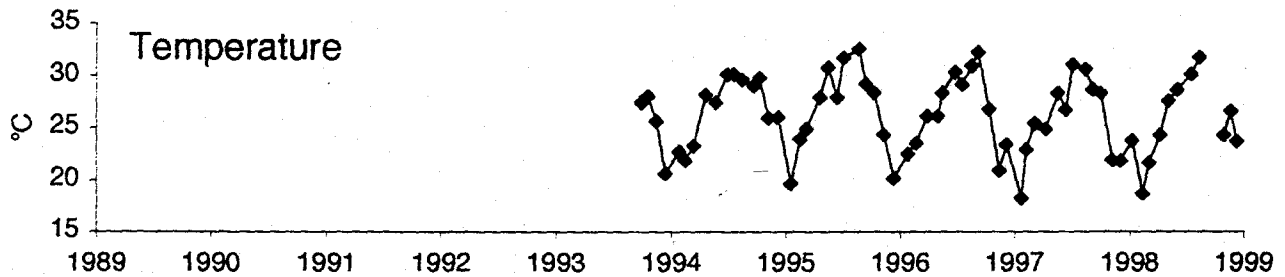
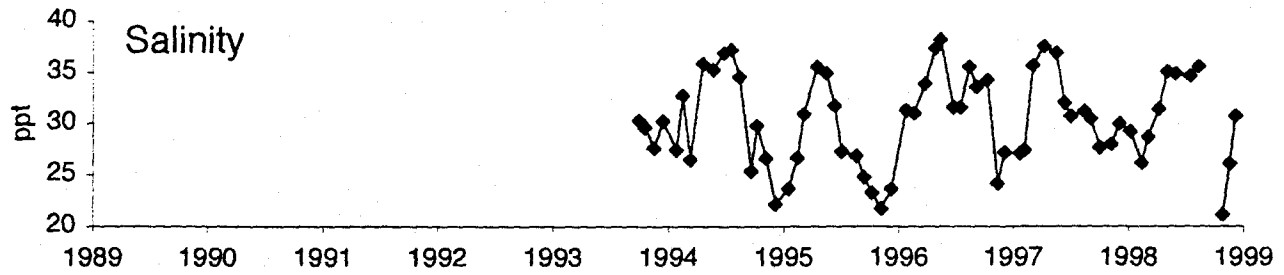
Biscayne Bay Sta. 122 West Arsenicker



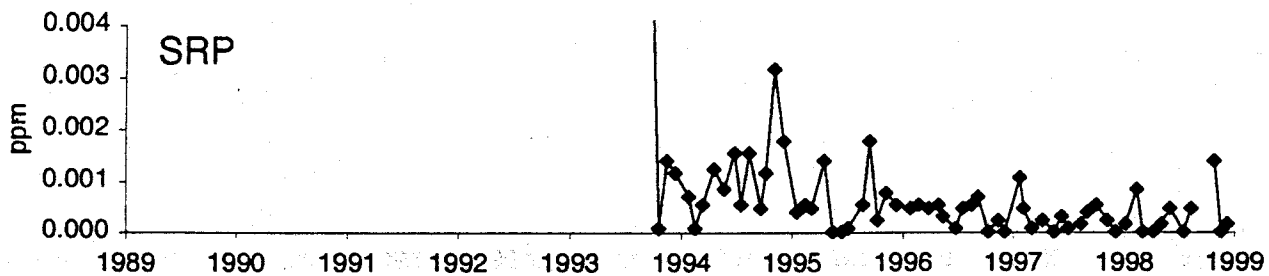
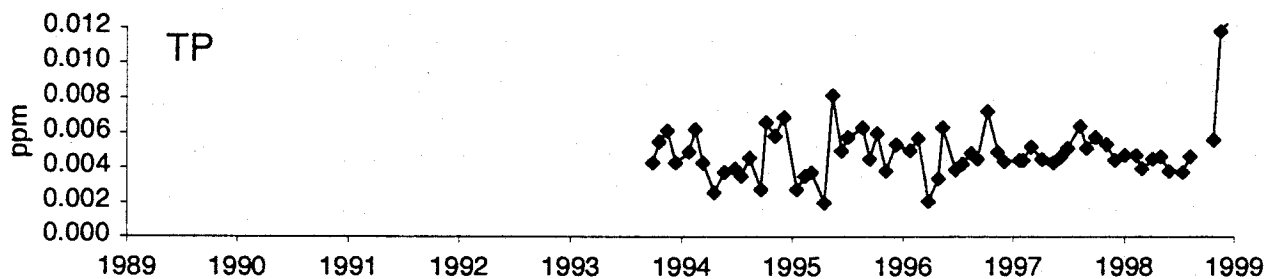
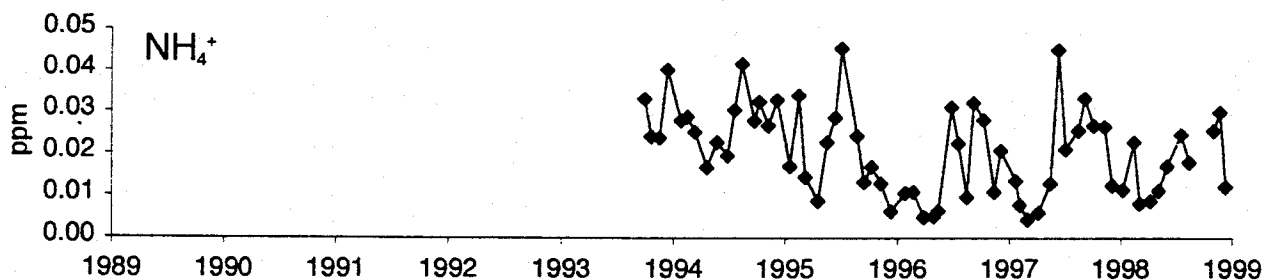
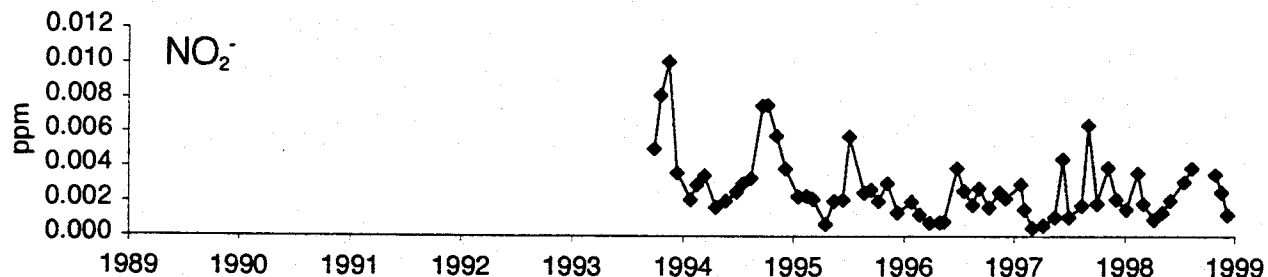
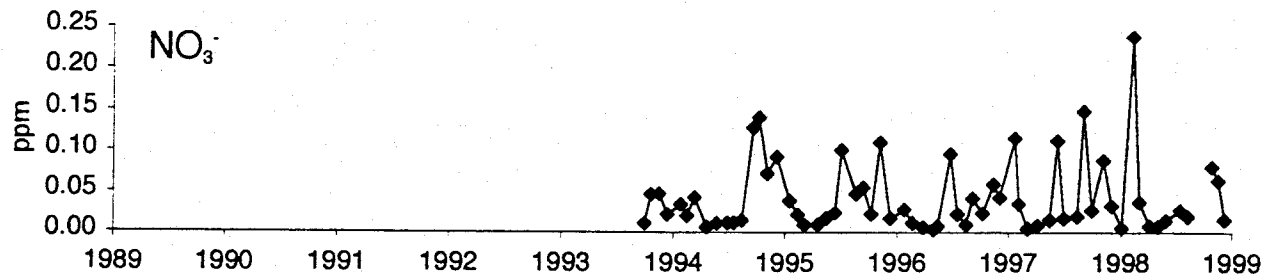
Biscayne Bay Sta. 122 West Arsenicker



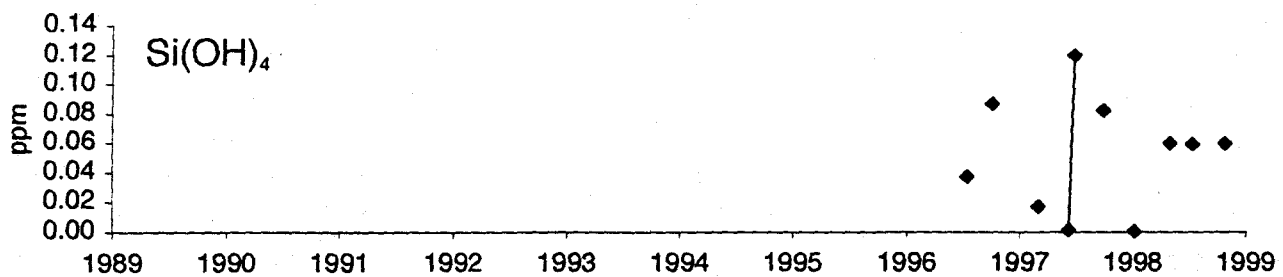
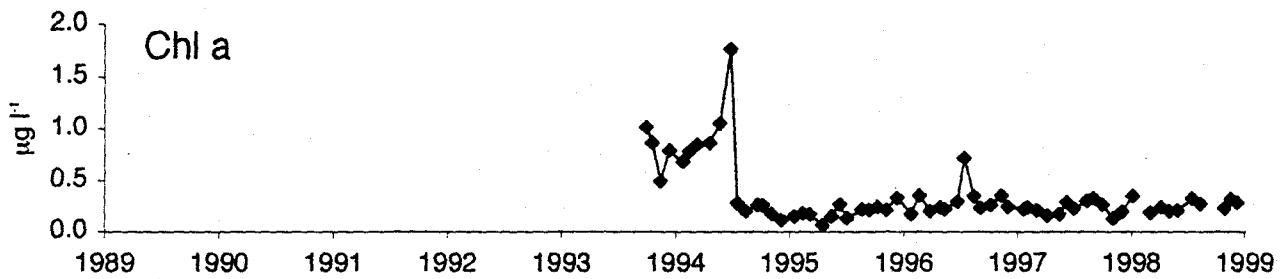
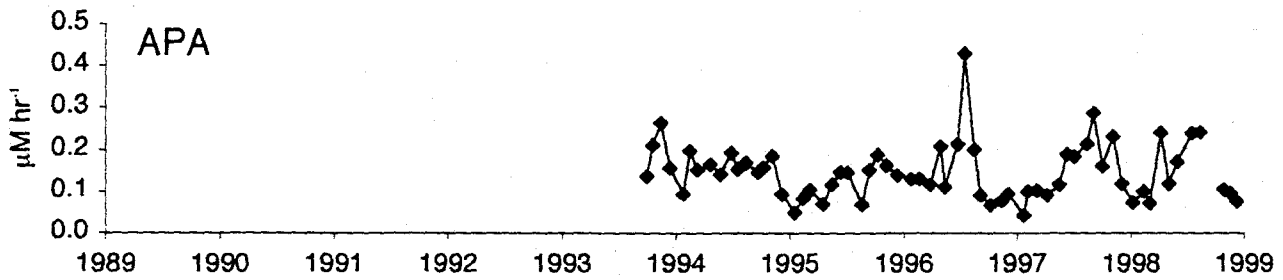
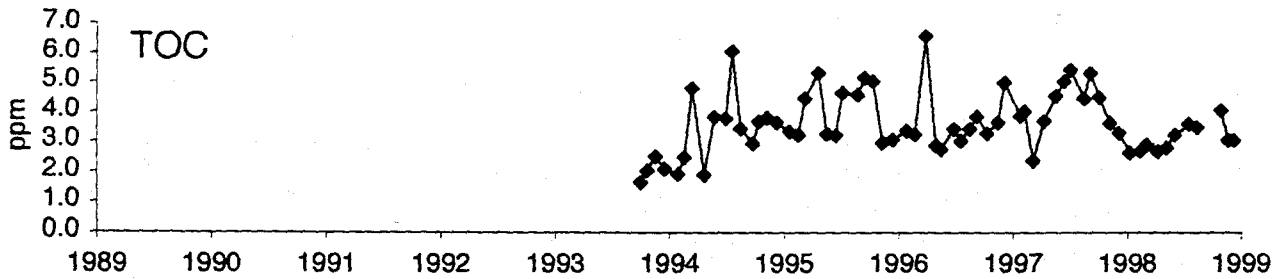
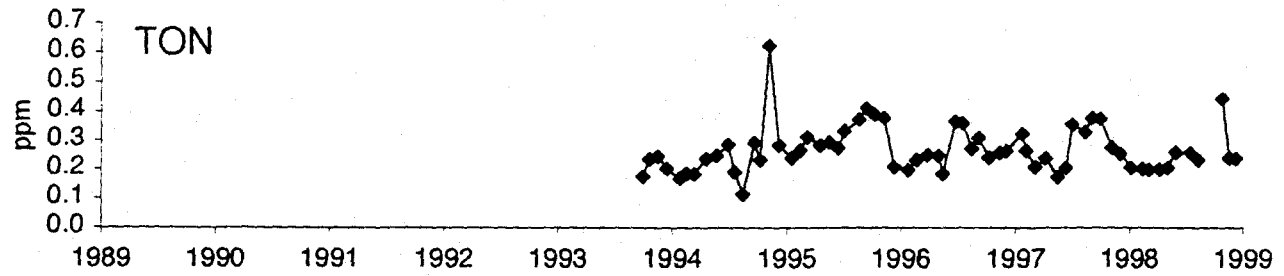
Biscayne Bay Sta. 122 West Arsenicker



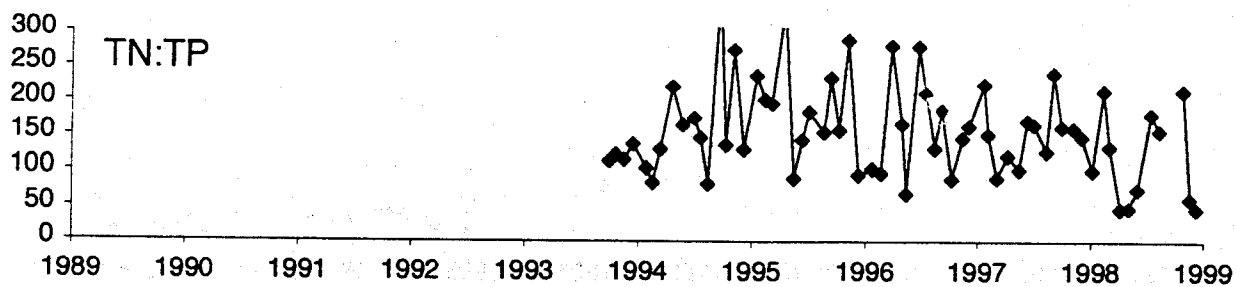
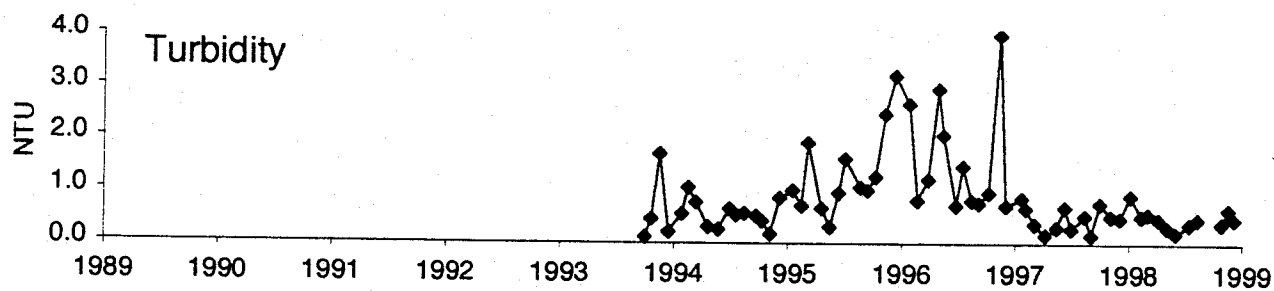
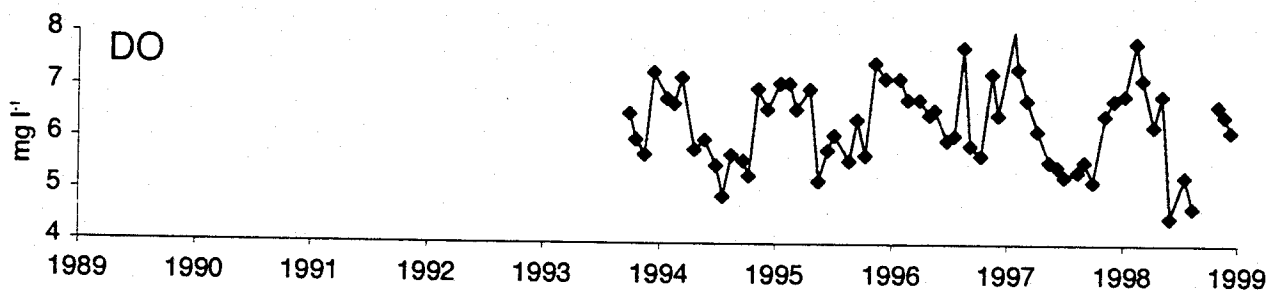
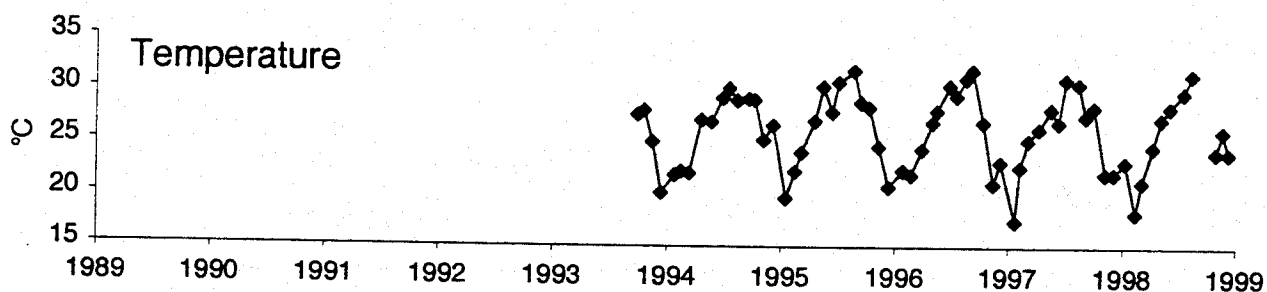
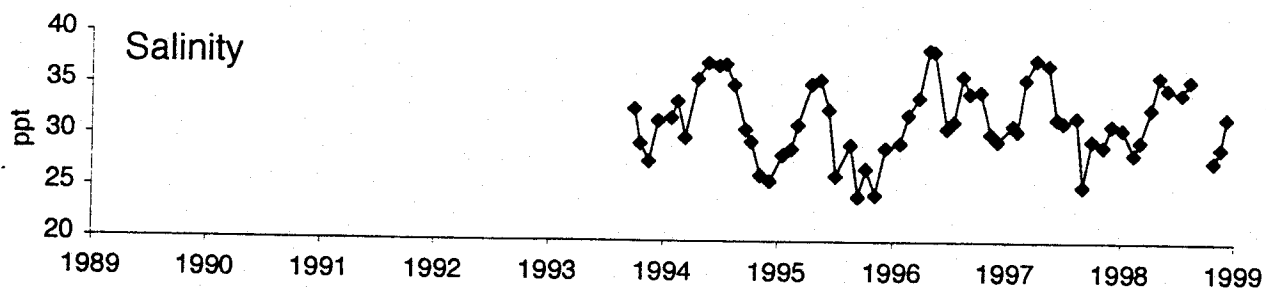
Biscayne Bay Sta. 123 Pelican Bank



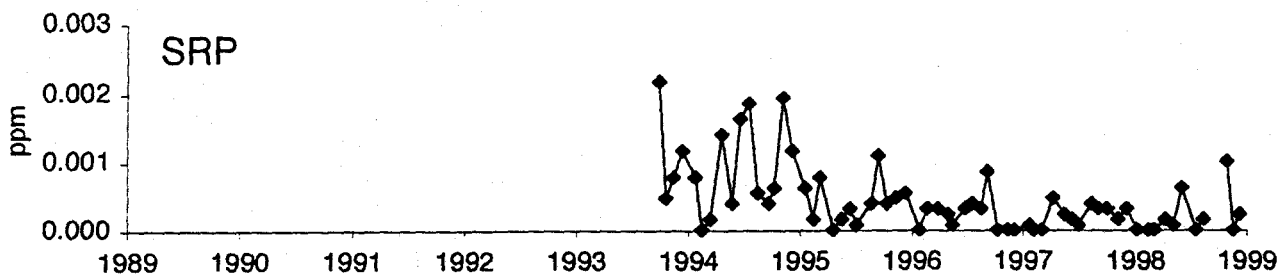
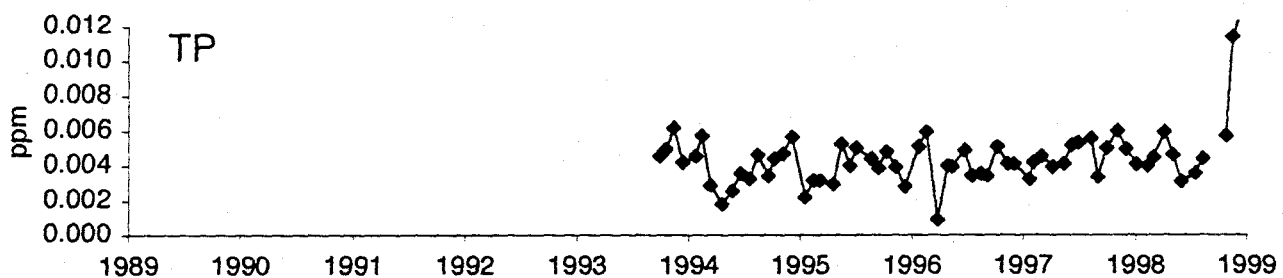
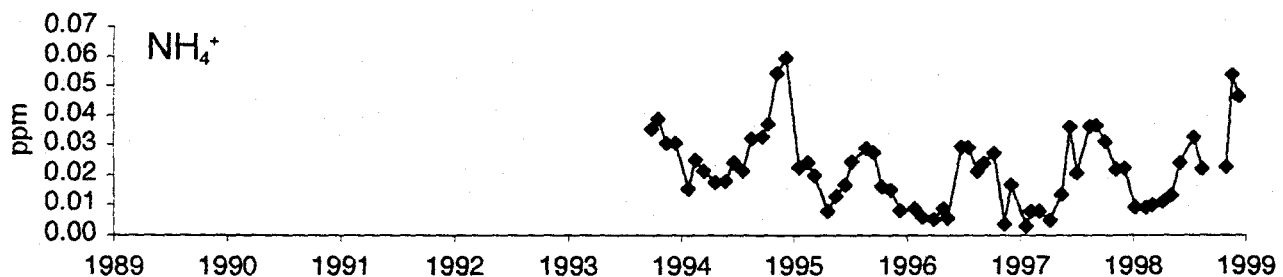
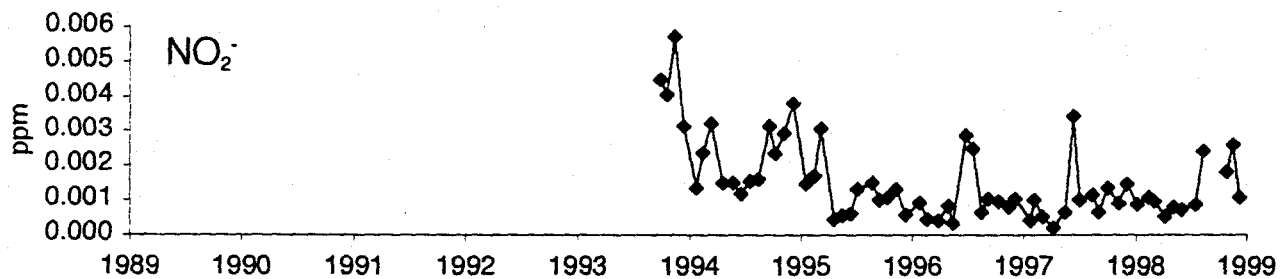
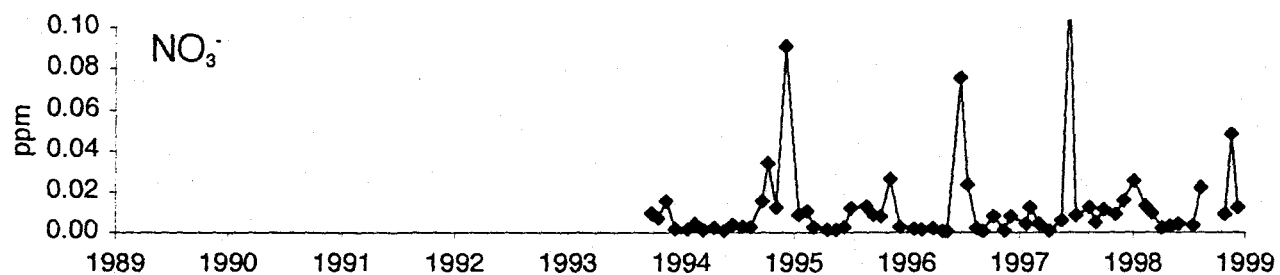
Biscayne Bay Sta. 123 Pelican Bank



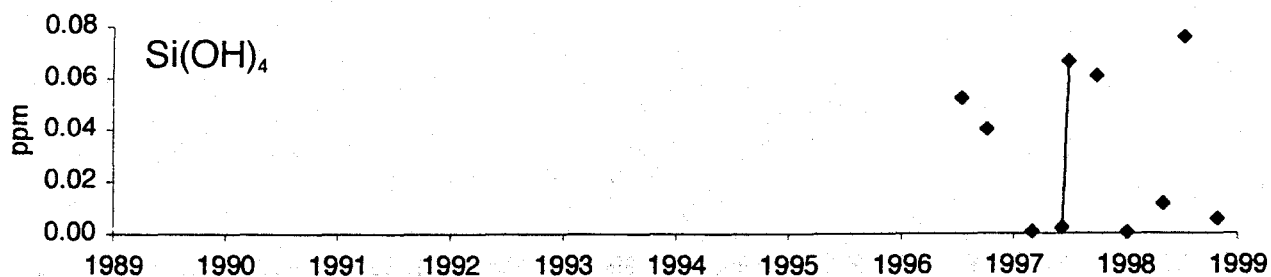
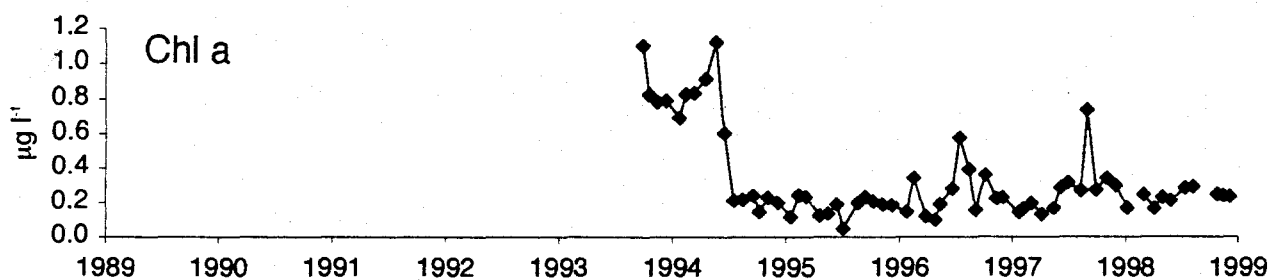
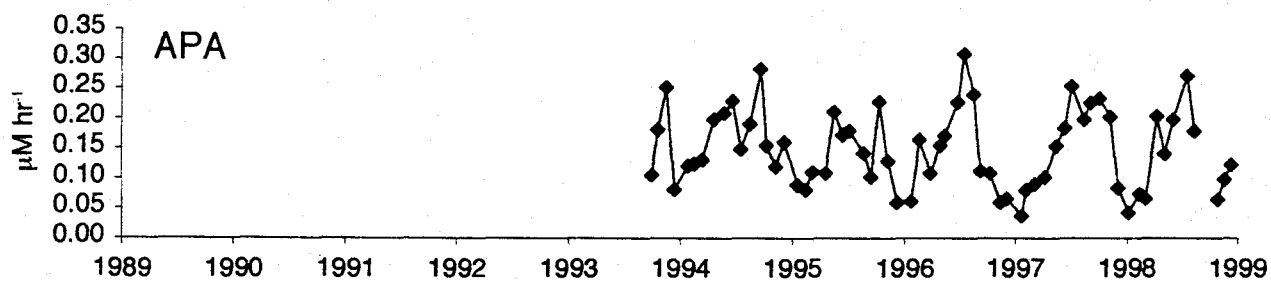
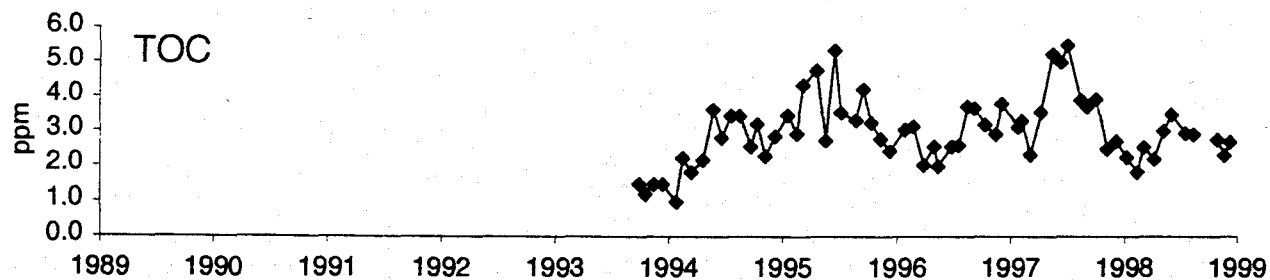
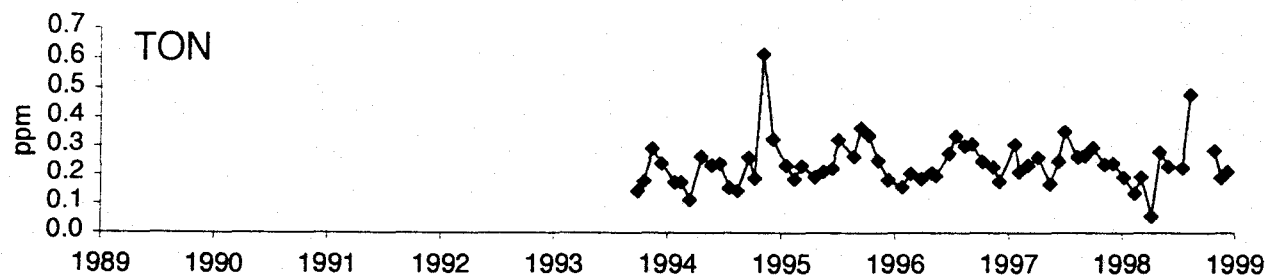
Biscayne Bay Sta. 123 Pelican Bank



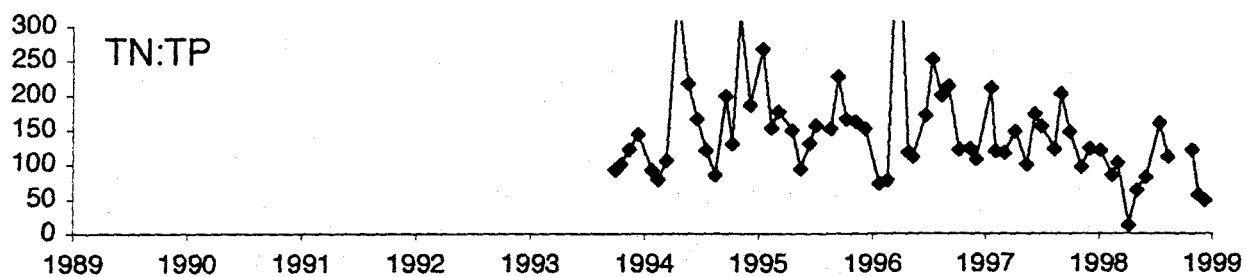
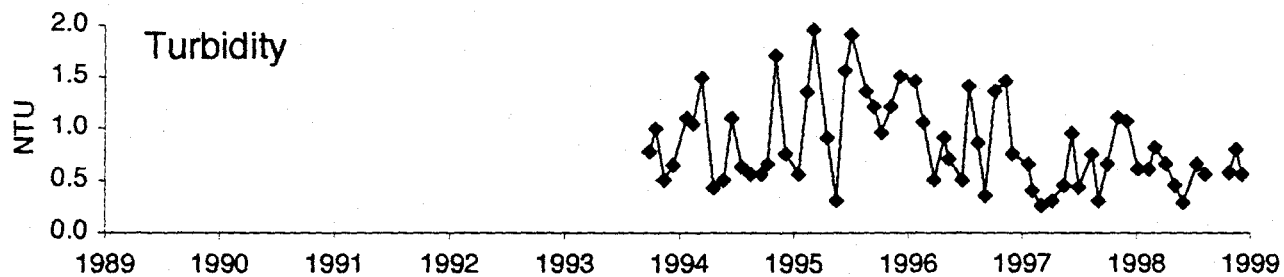
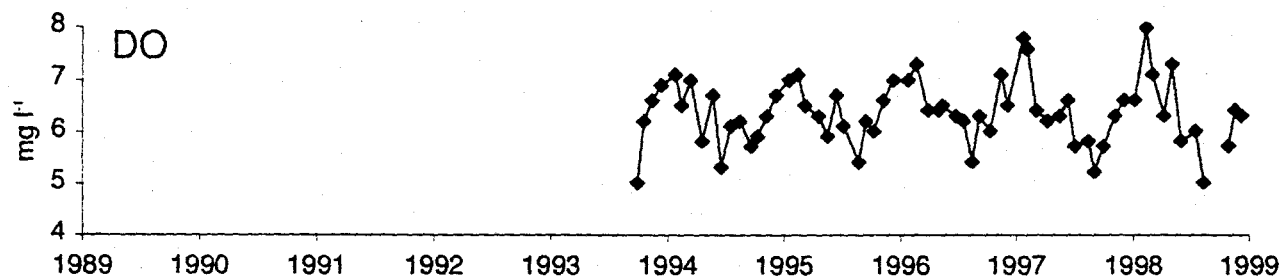
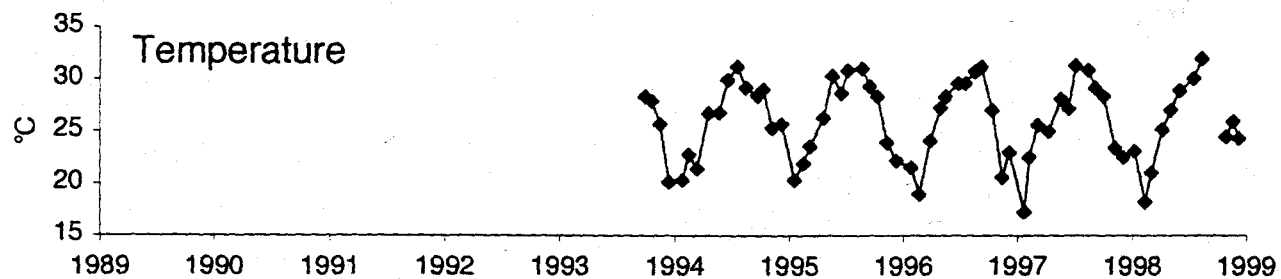
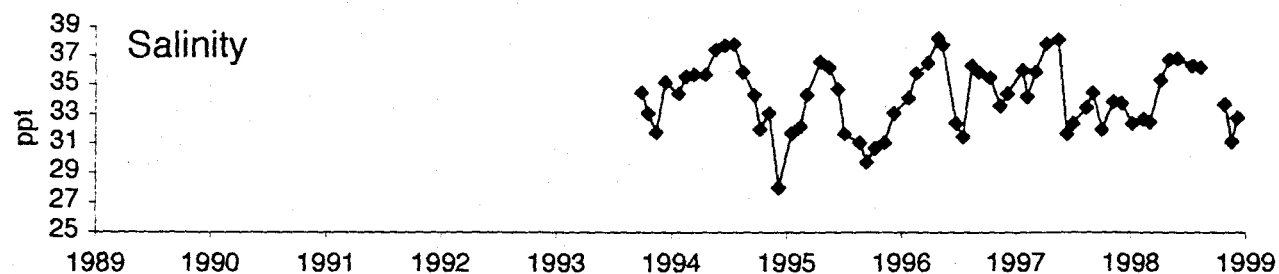
Biscayne Bay Sta. 124 Midbay South



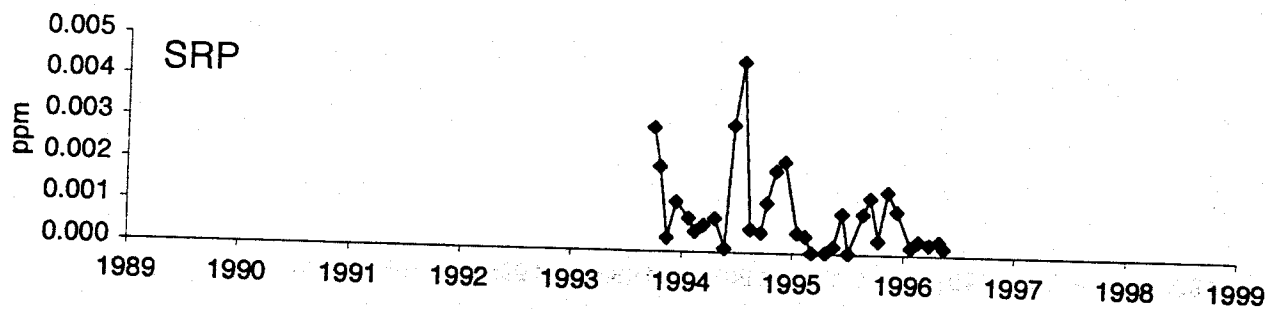
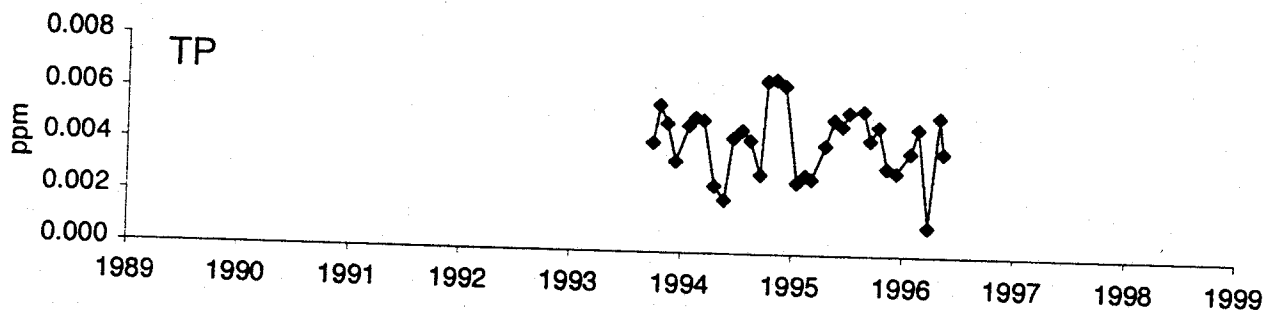
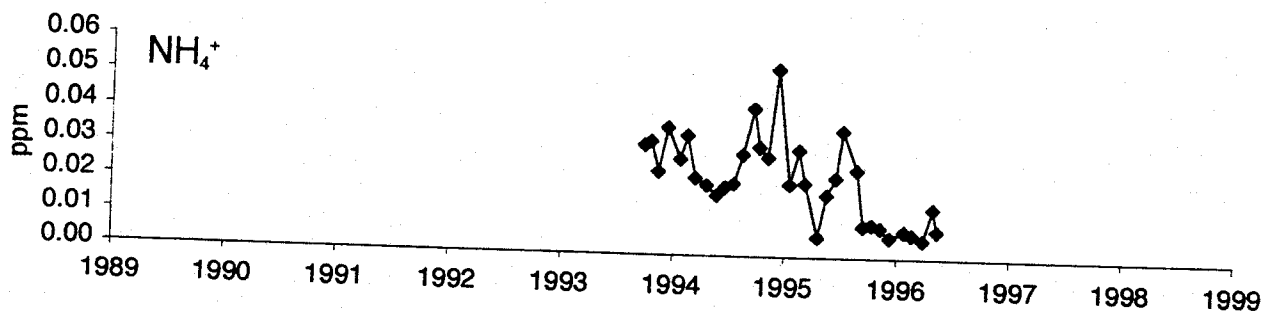
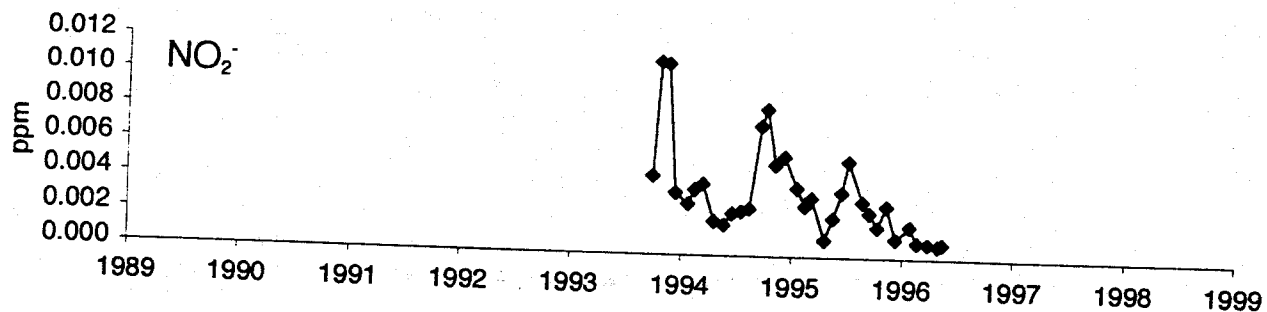
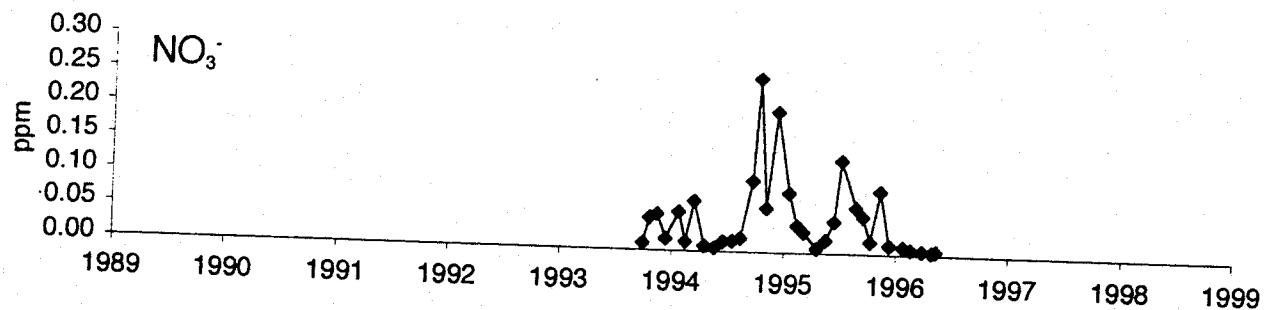
Biscayne Bay Sta. 124 Midbay South



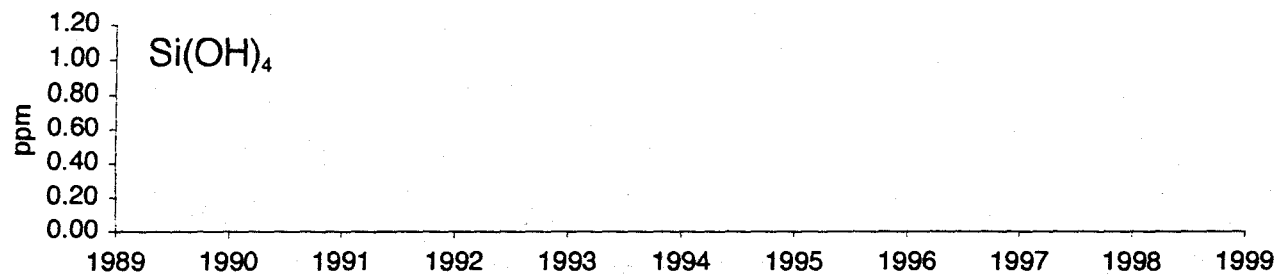
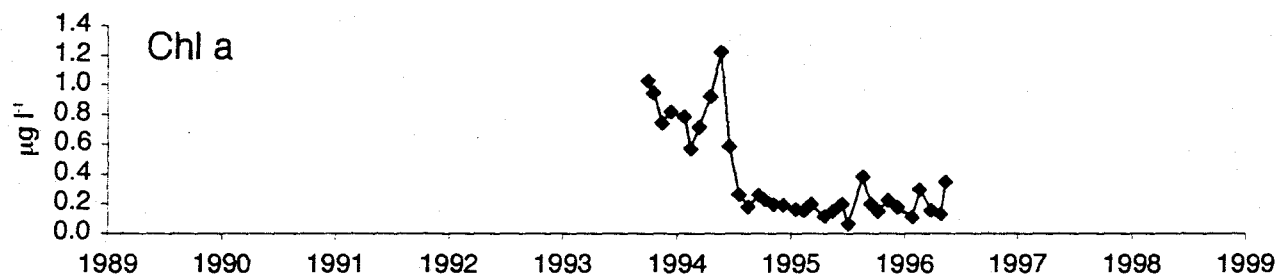
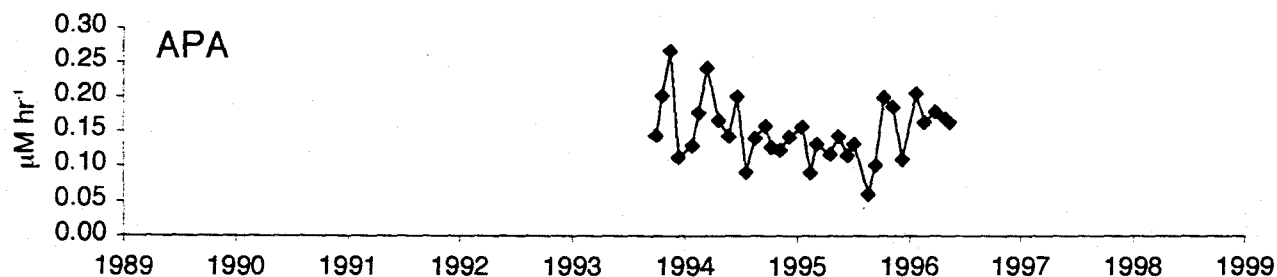
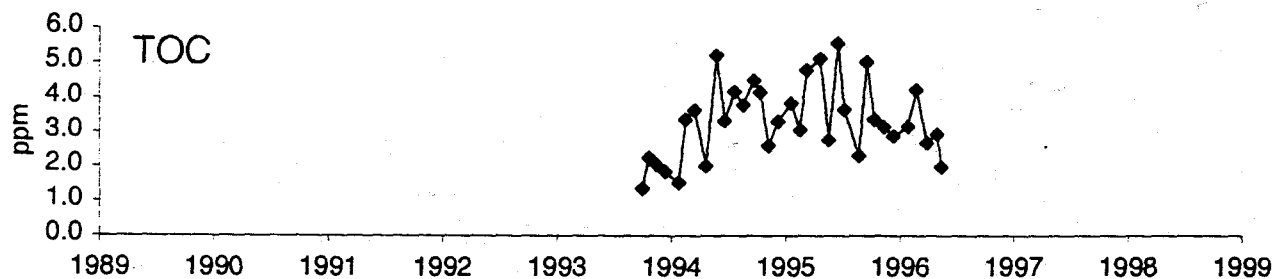
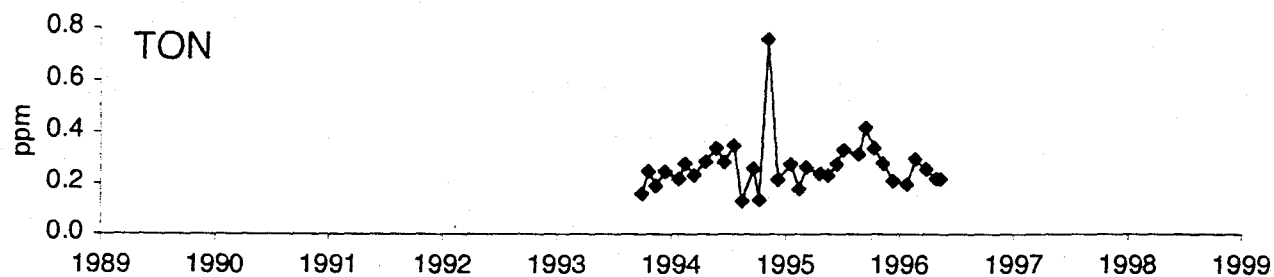
Biscayne Bay Sta. 124 Midbay South



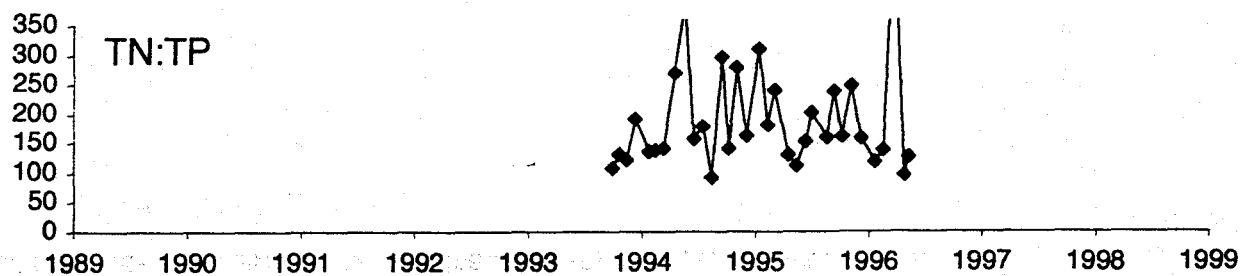
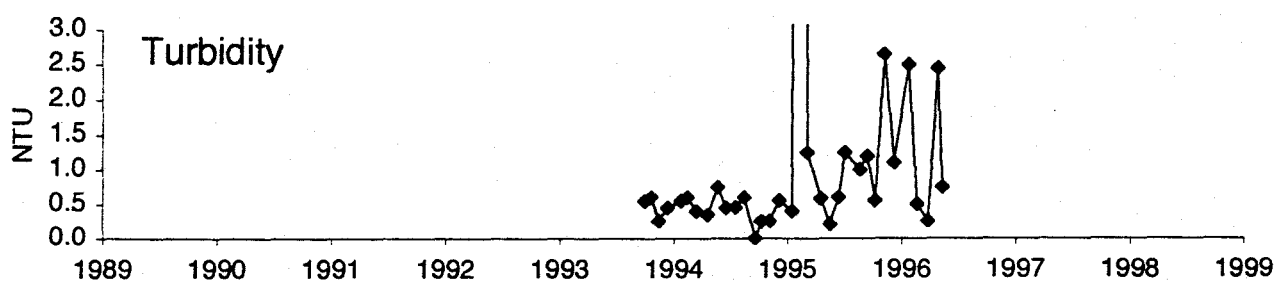
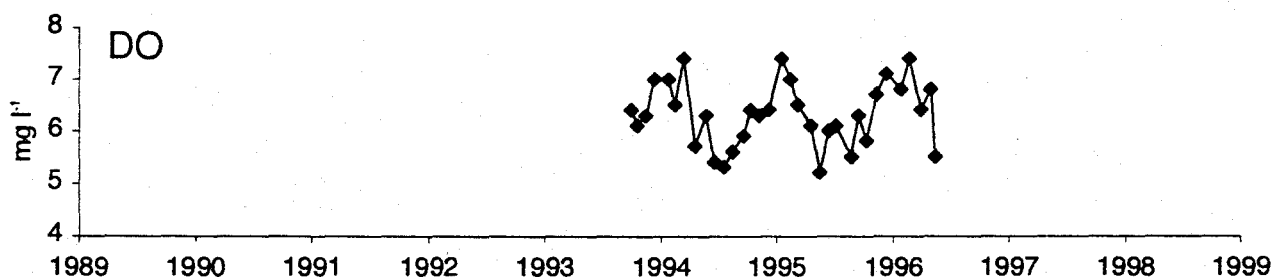
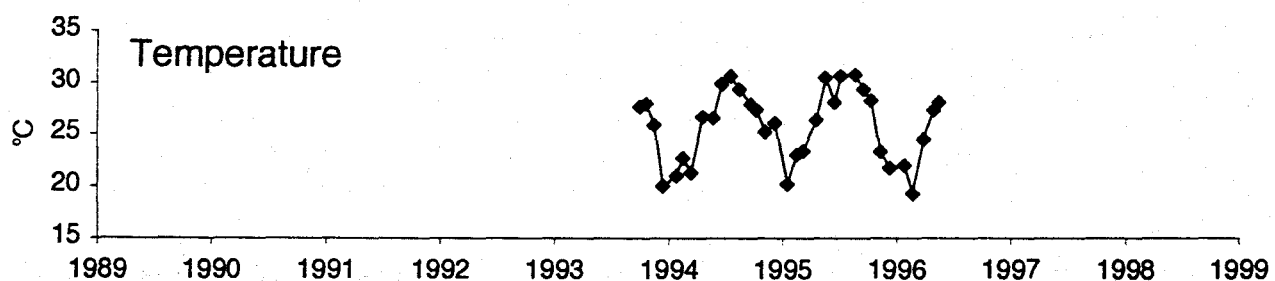
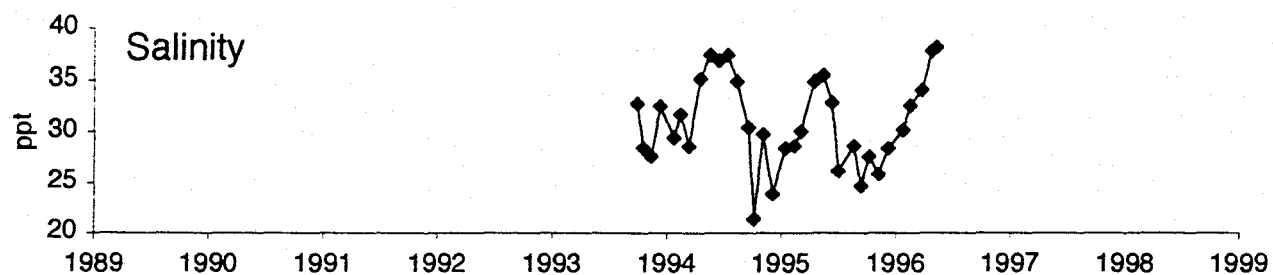
Biscayne Bay Sta. 125 Turkey Point



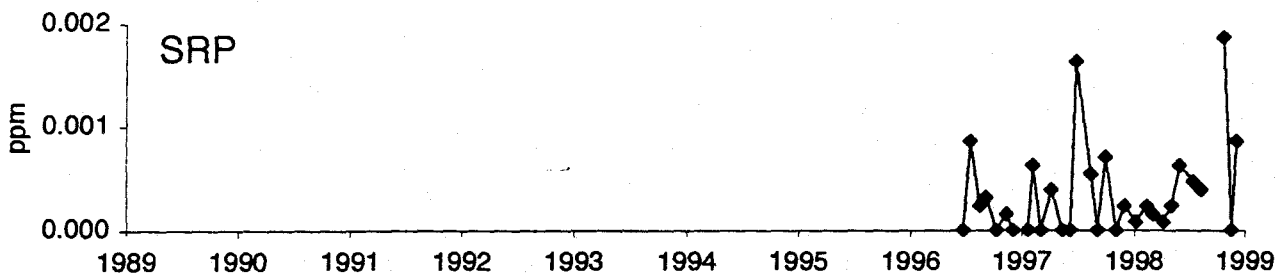
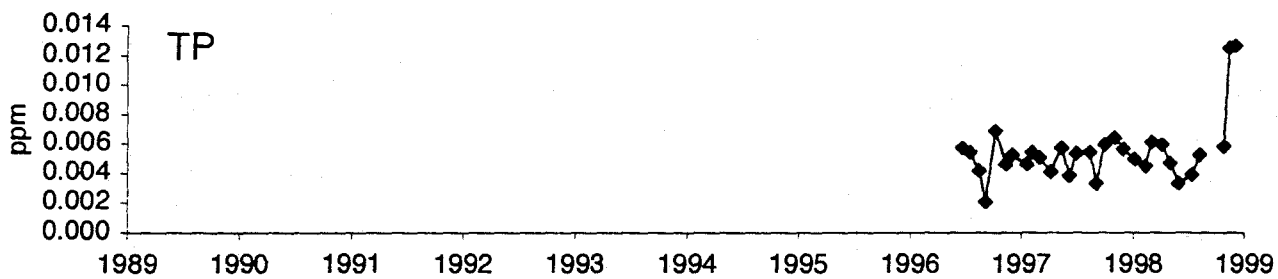
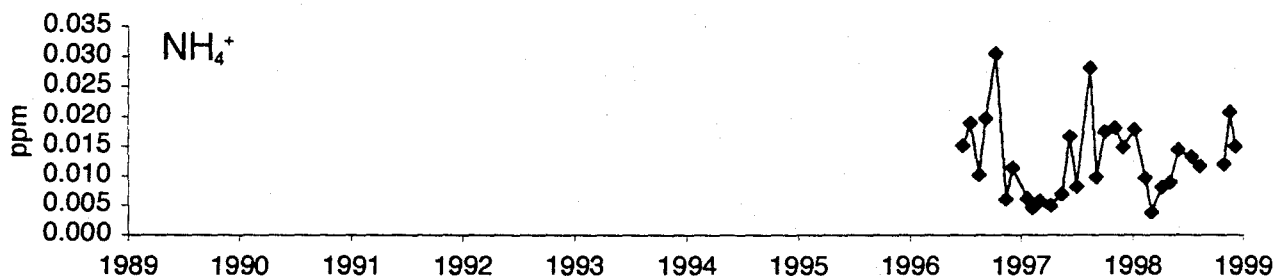
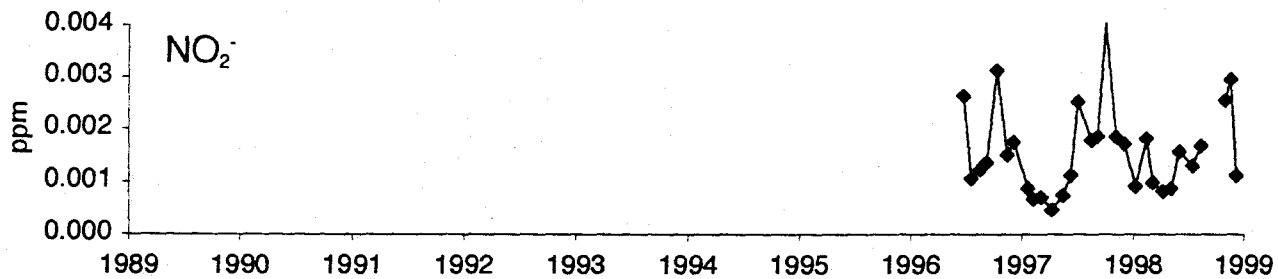
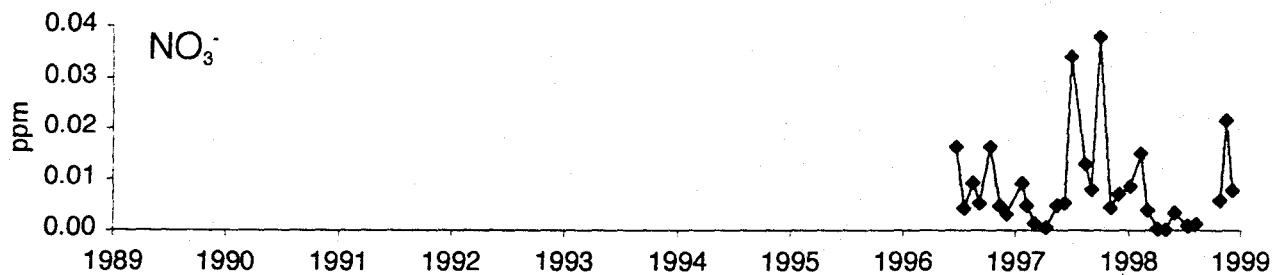
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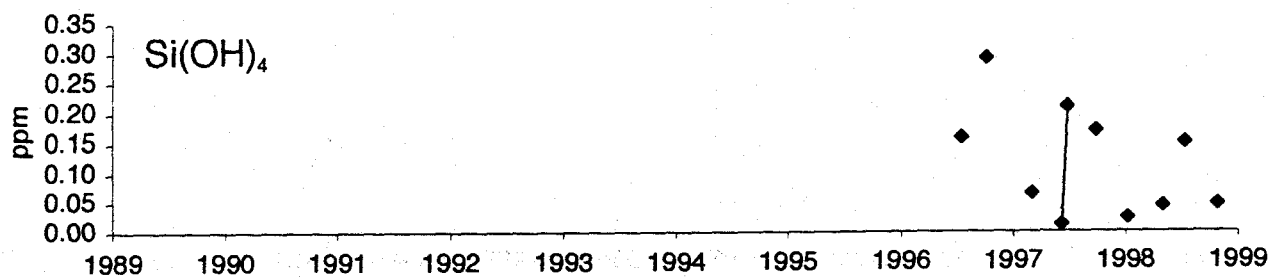
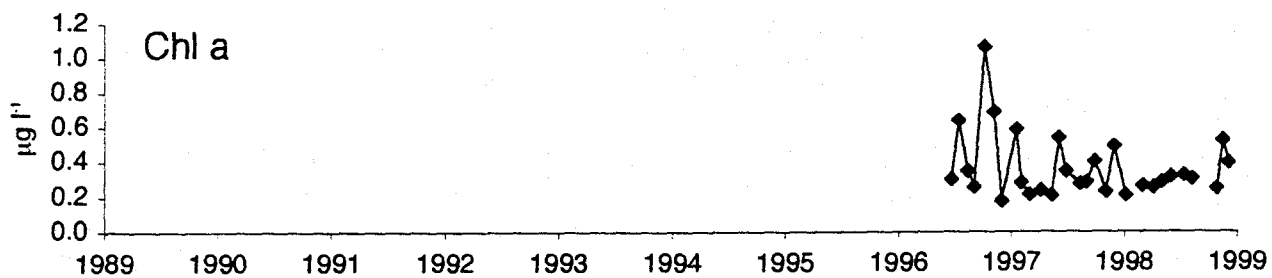
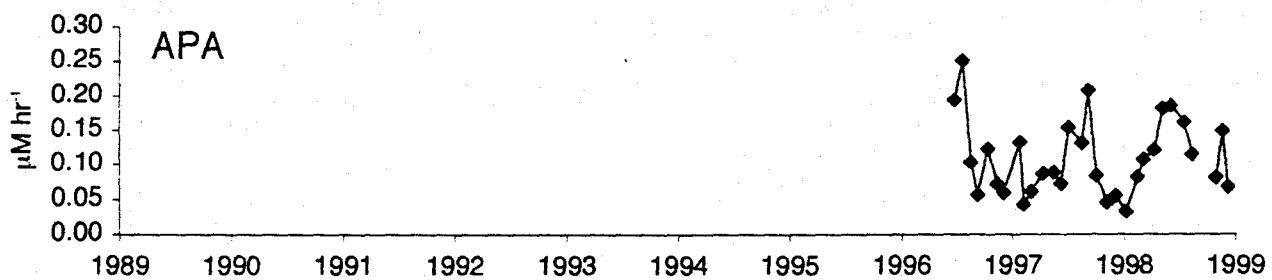
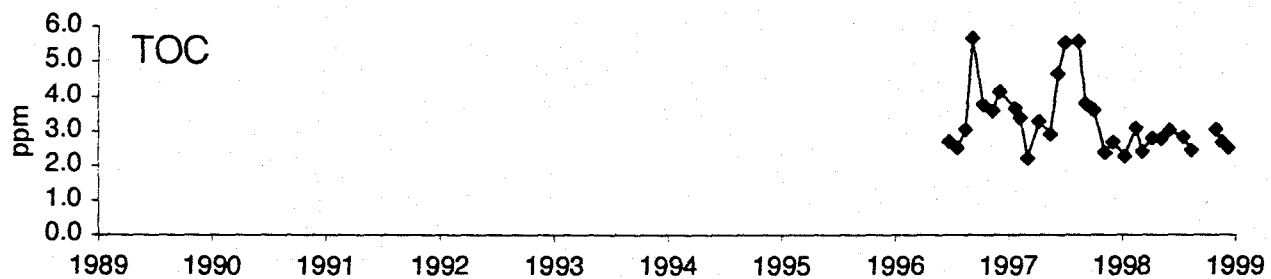
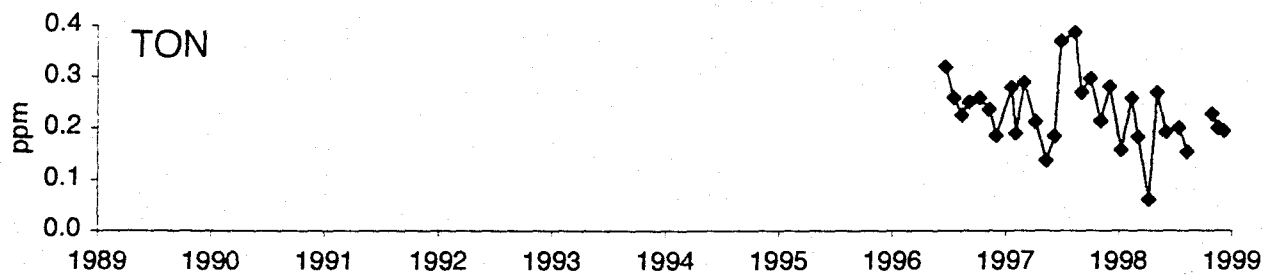
Biscayne Bay Sta. 125 Turkey Point



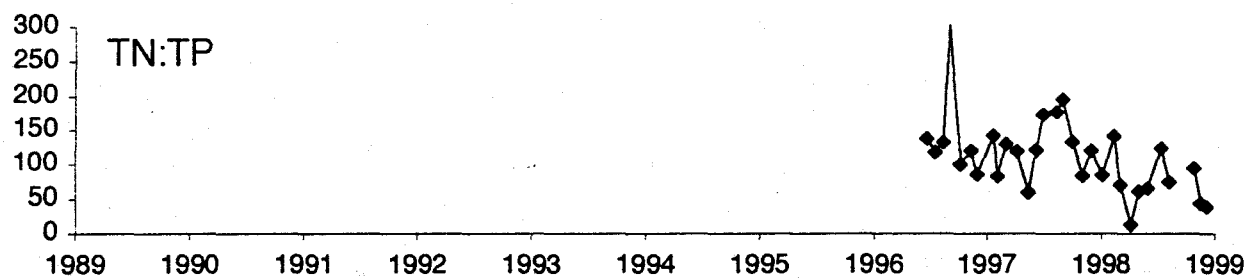
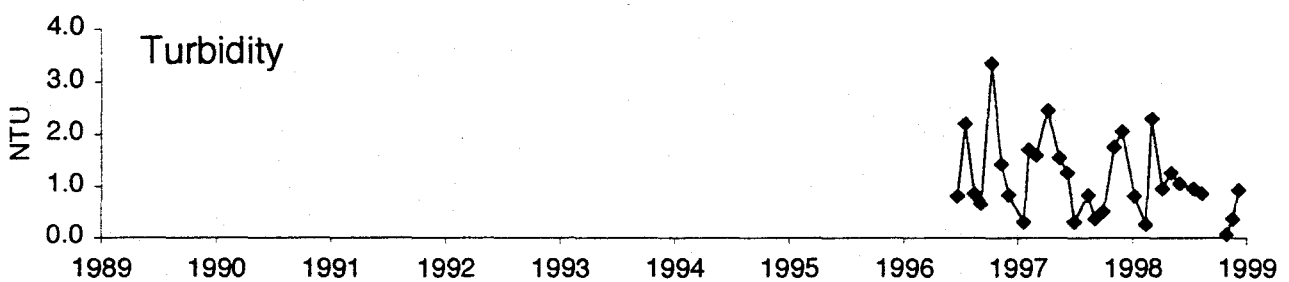
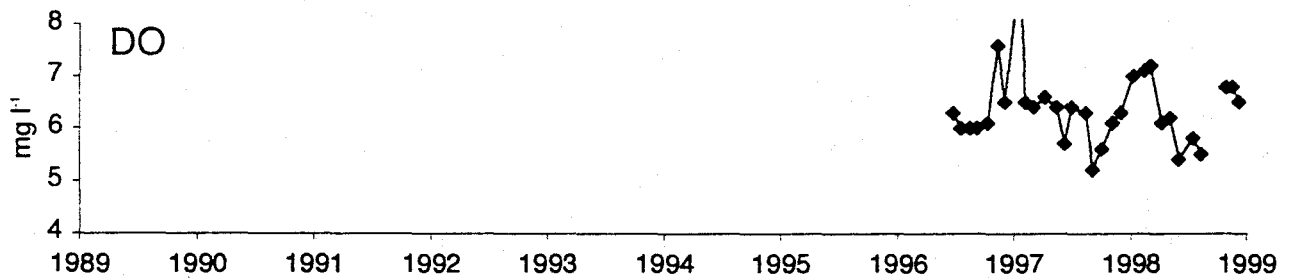
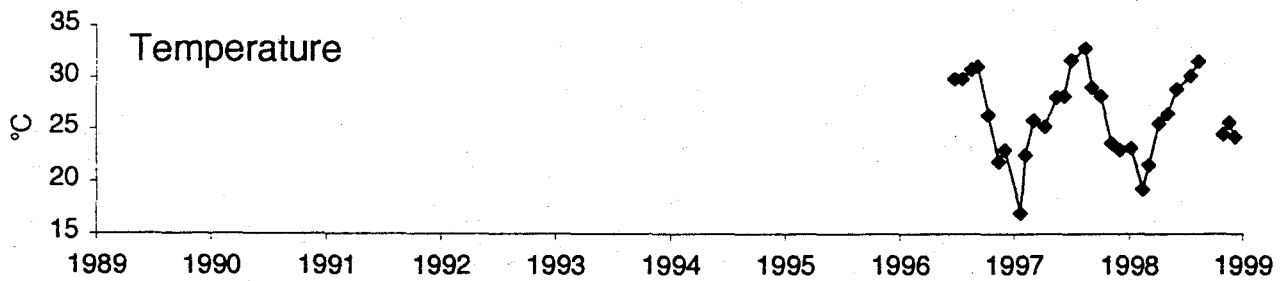
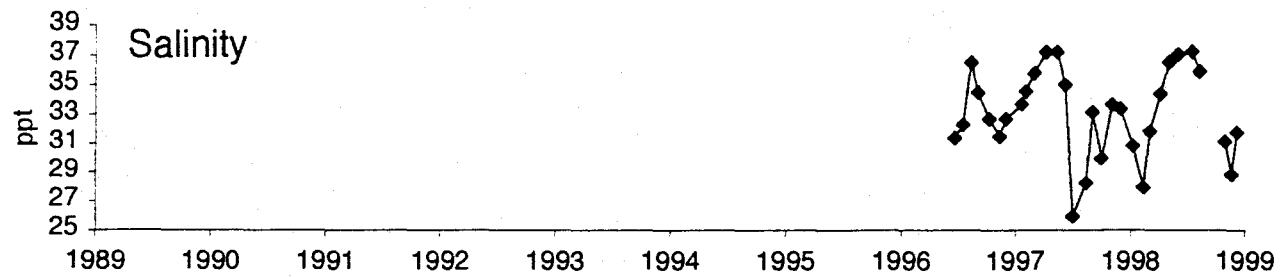
Biscayne Bay Sta. 126 BNP Marker B



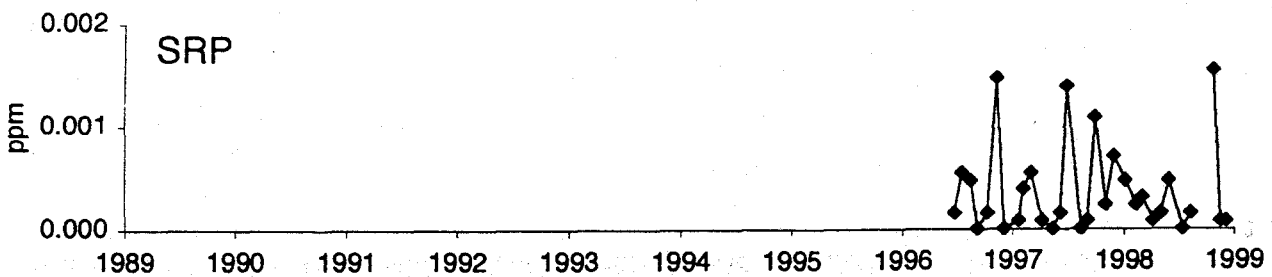
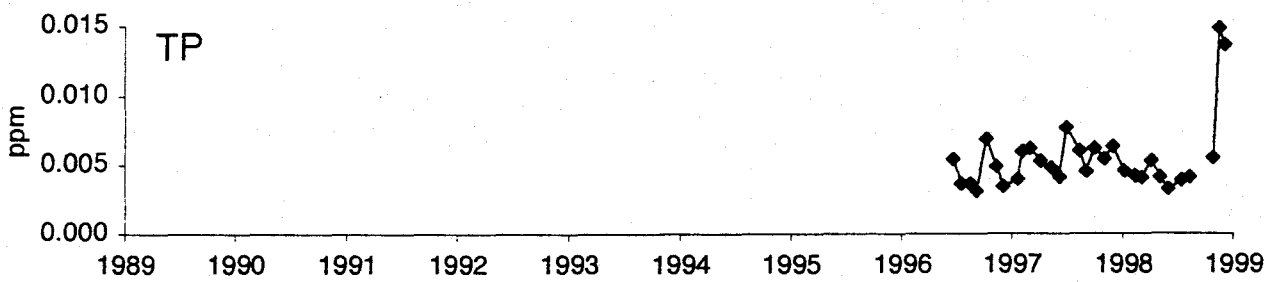
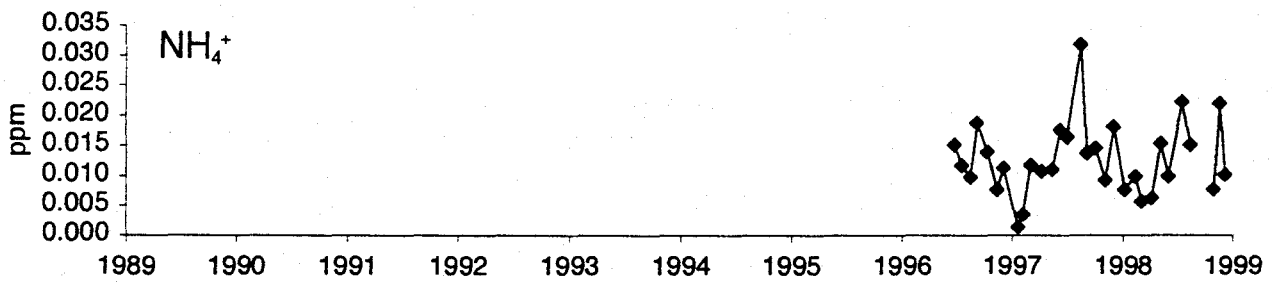
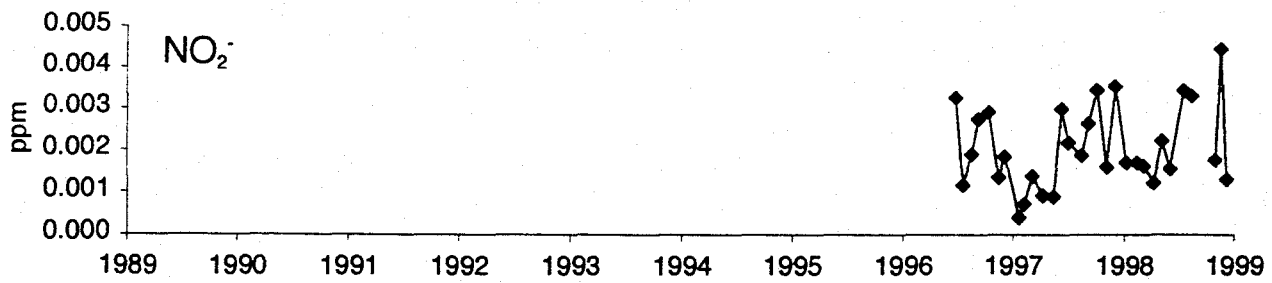
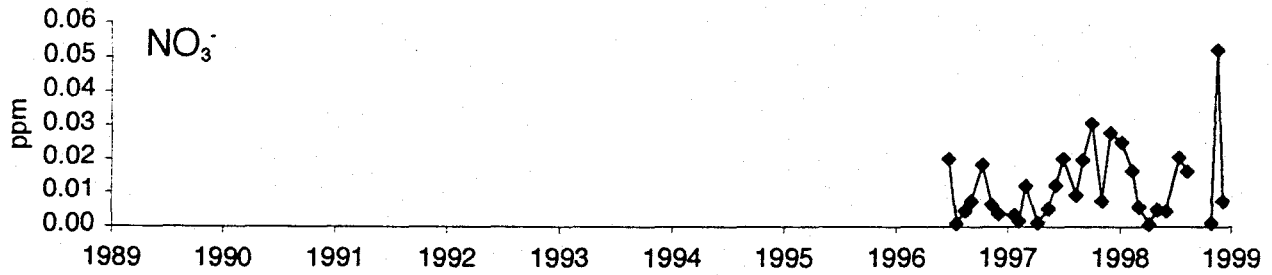
Biscayne Bay Sta. 126 BNP Marker B



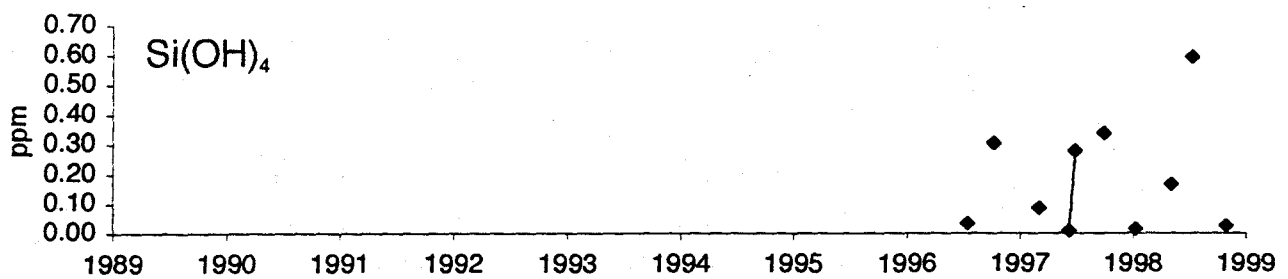
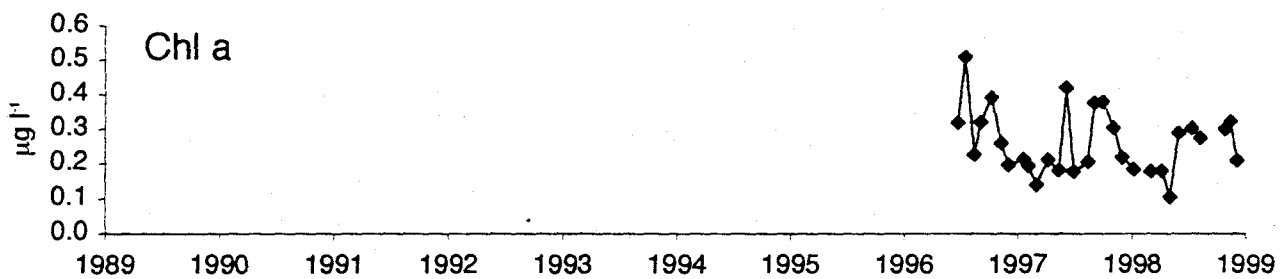
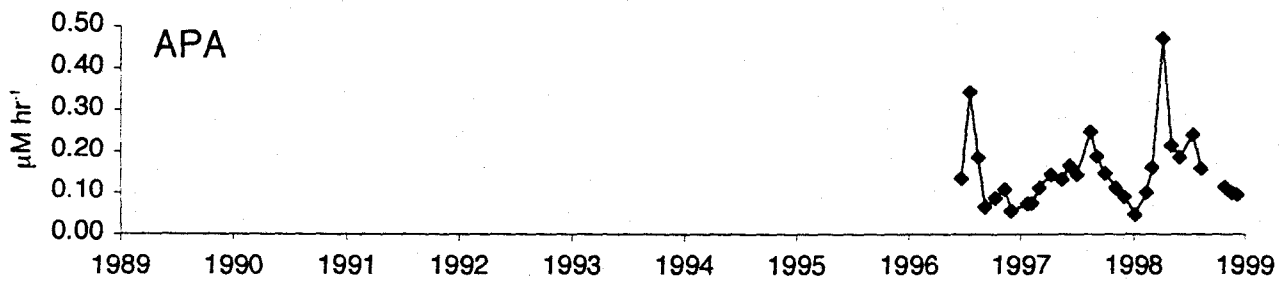
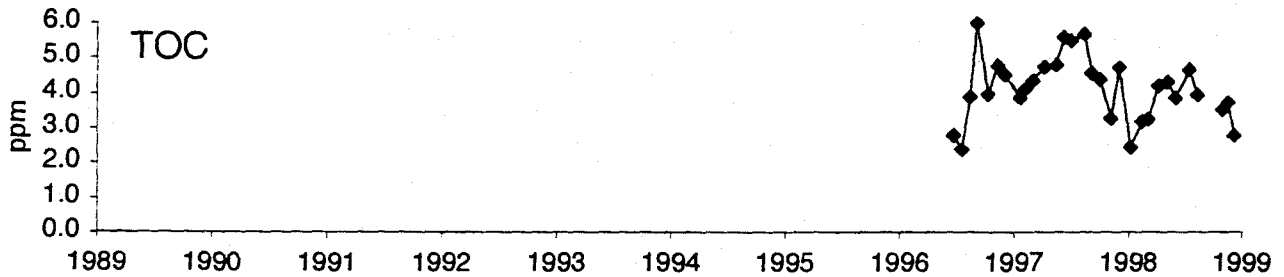
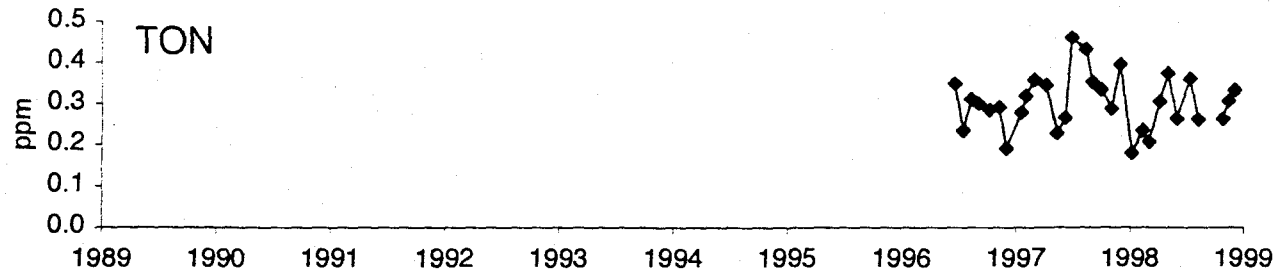
Biscayne Bay Sta. 126 BNP Marker B



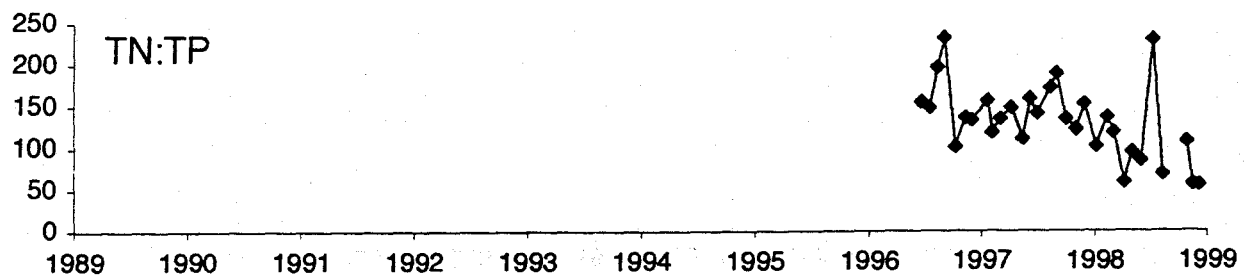
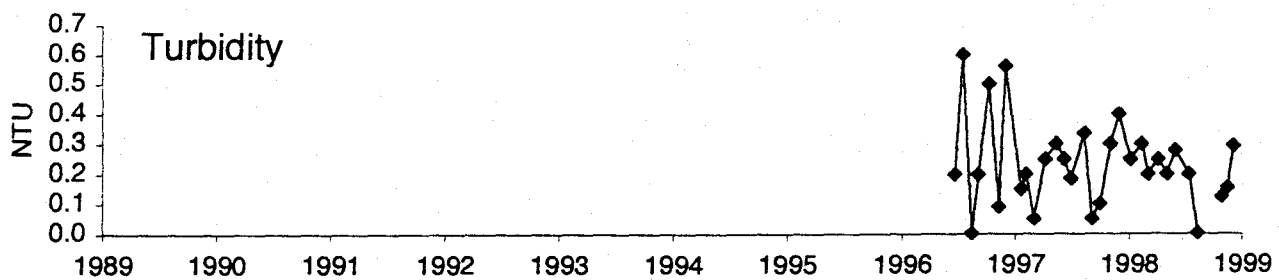
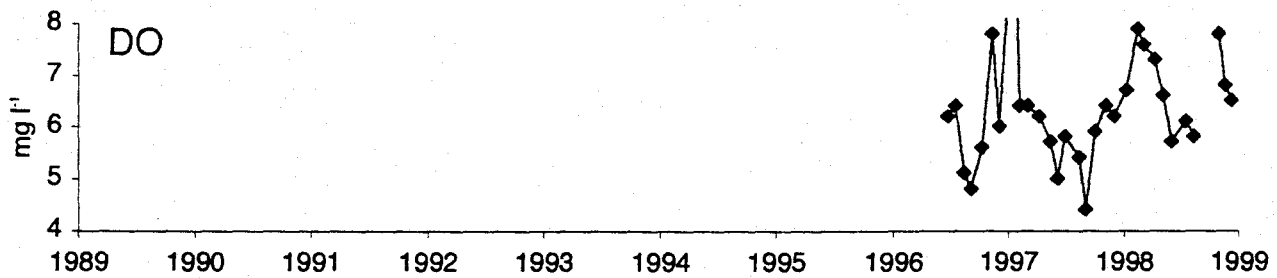
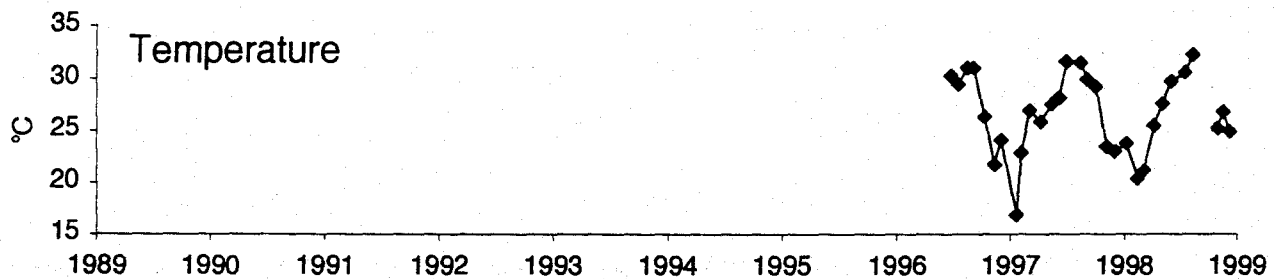
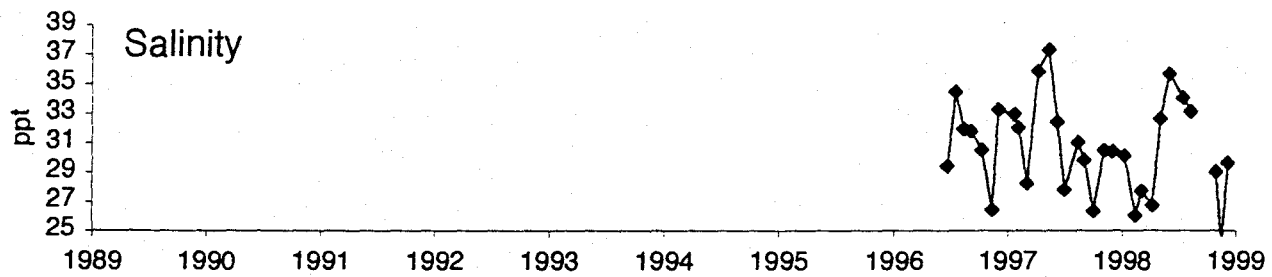
Biscayne Bay Sta. 127 Shoal Point



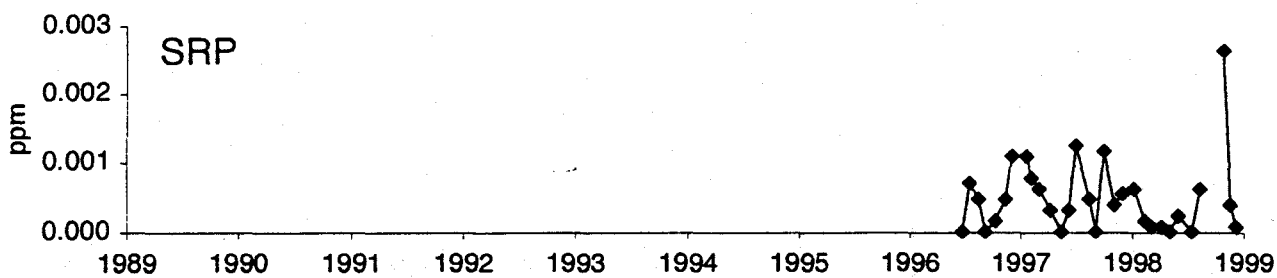
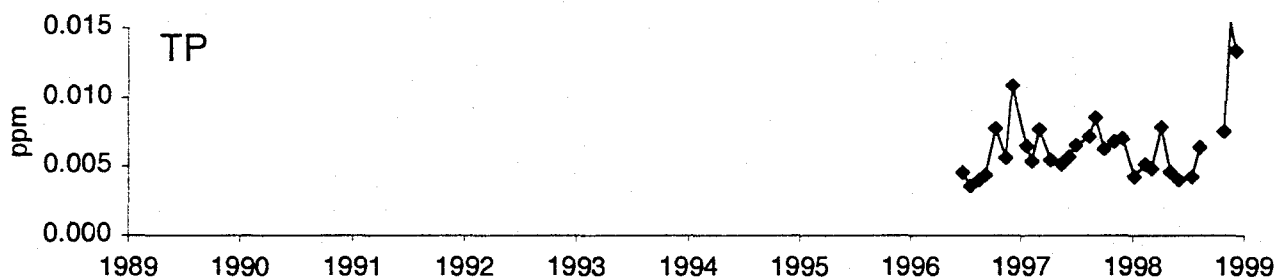
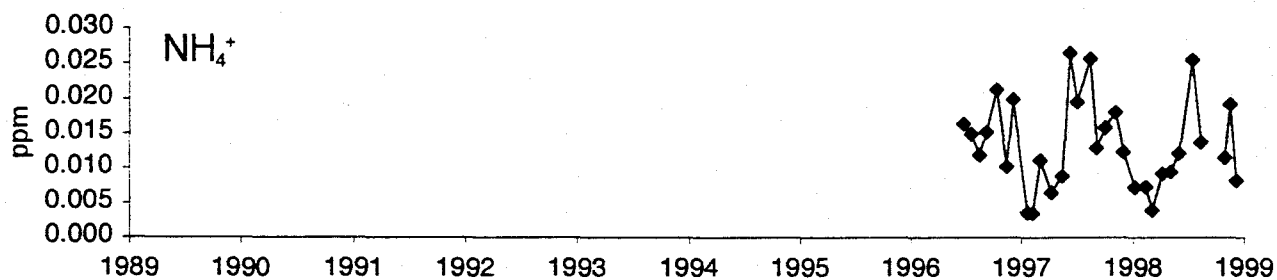
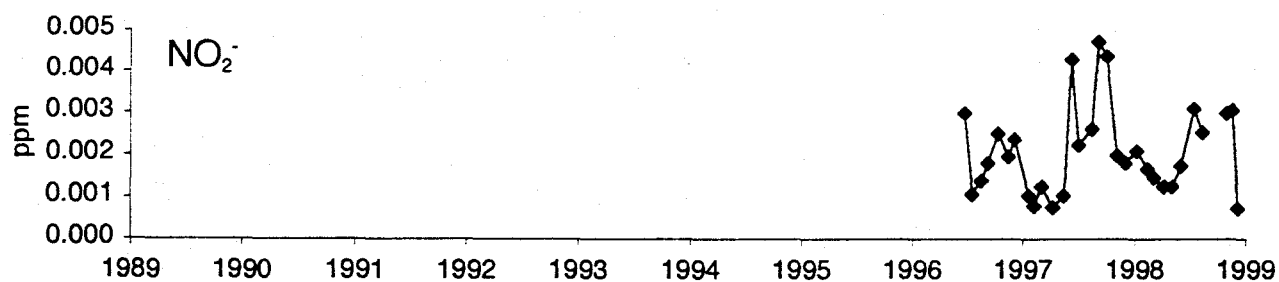
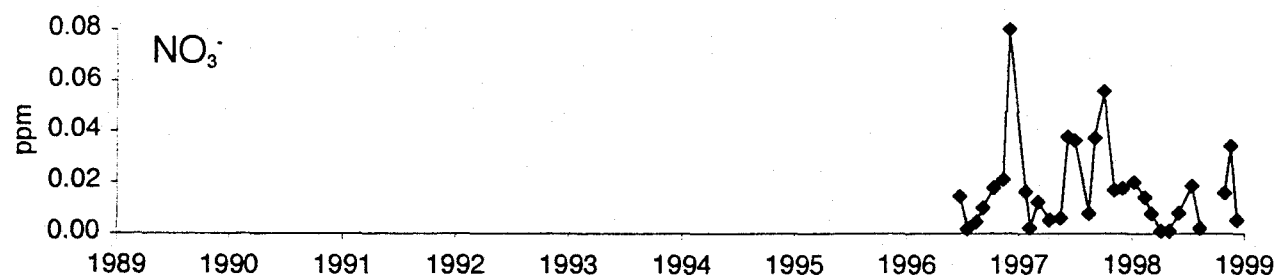
Biscayne Bay Sta. 127 Shoal Point



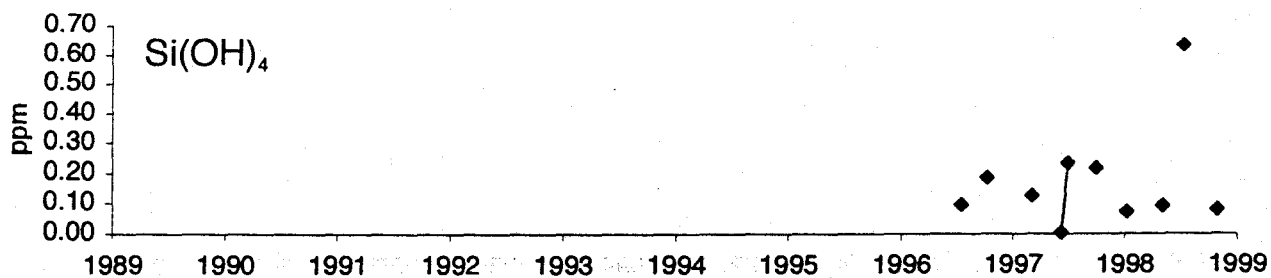
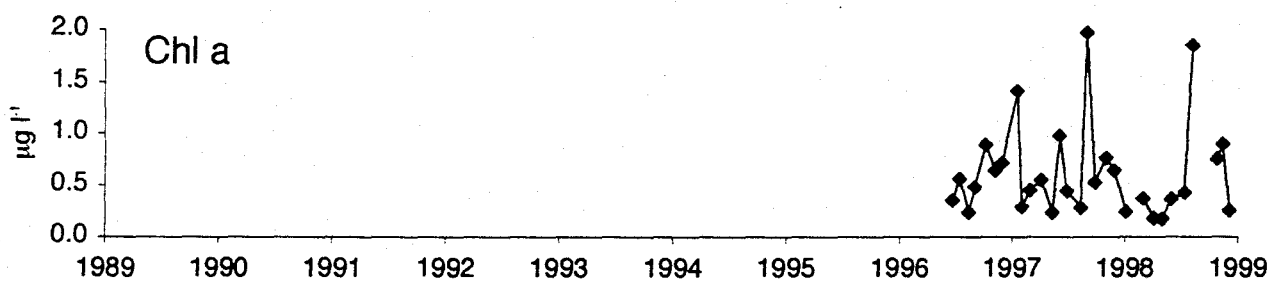
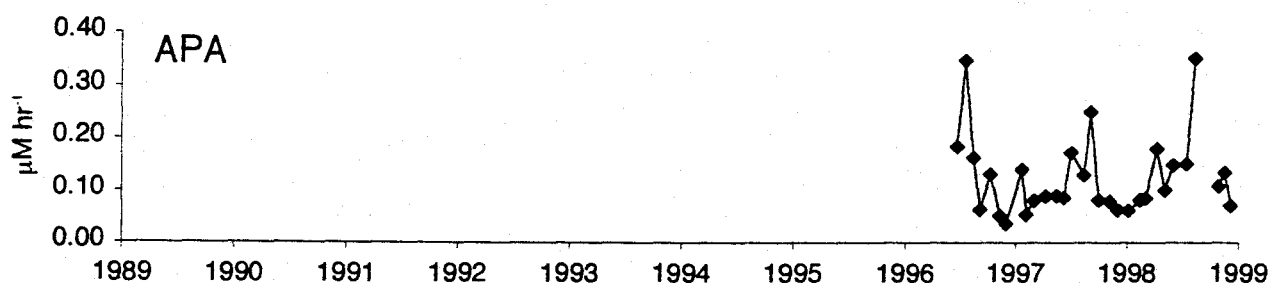
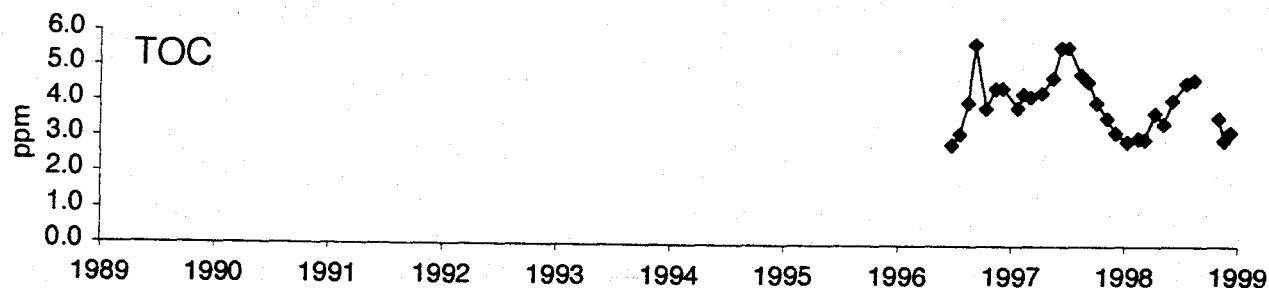
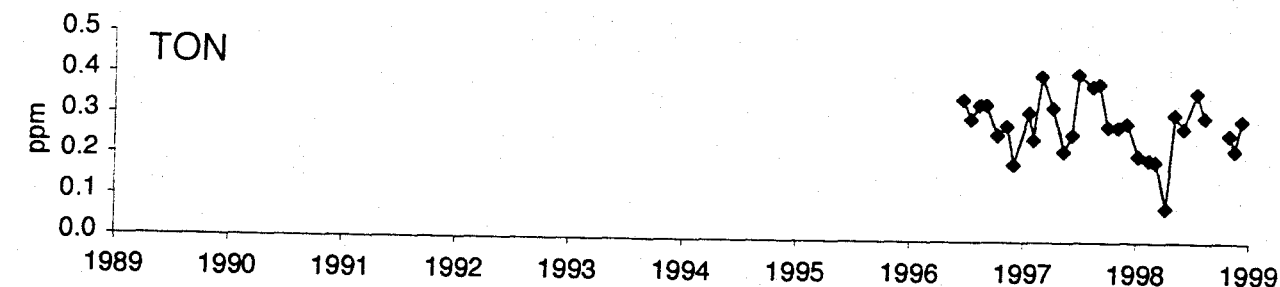
Biscayne Bay Sta. 127 Shoal Point



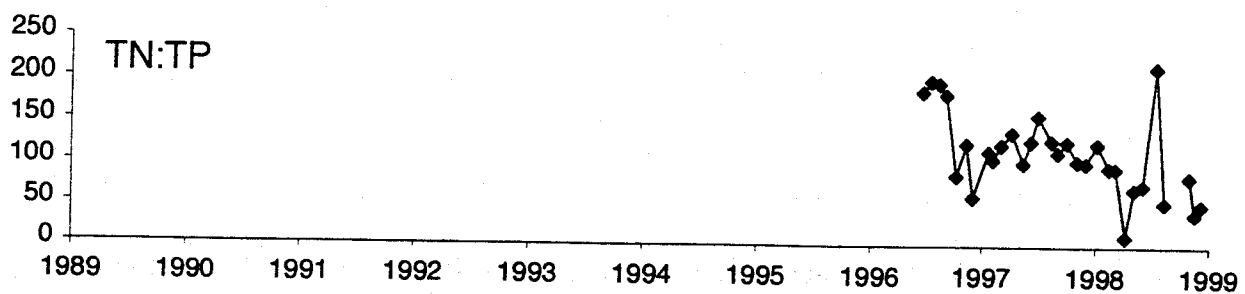
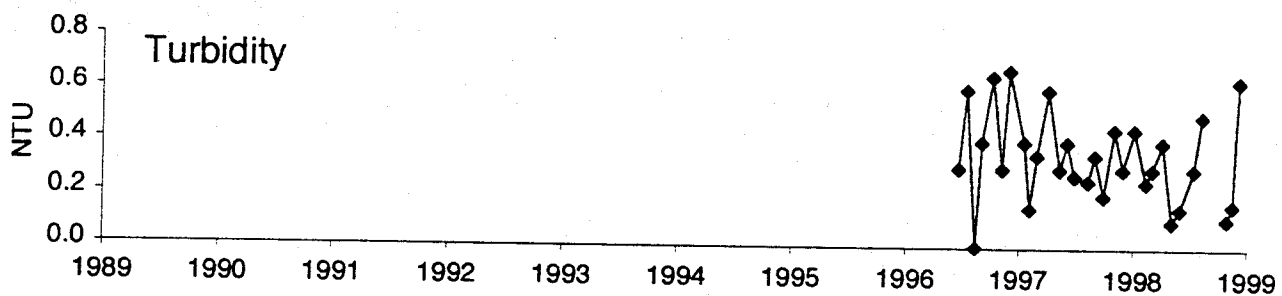
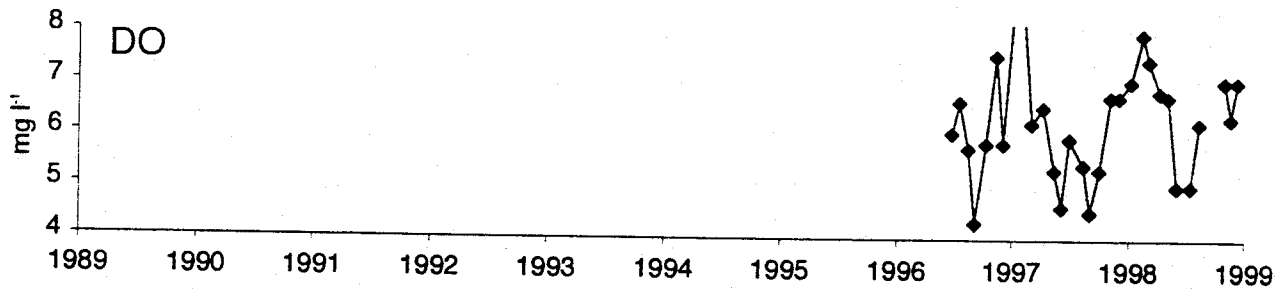
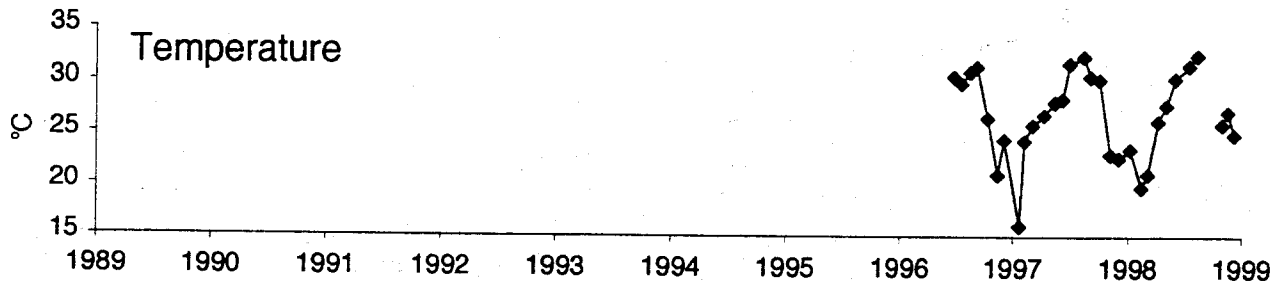
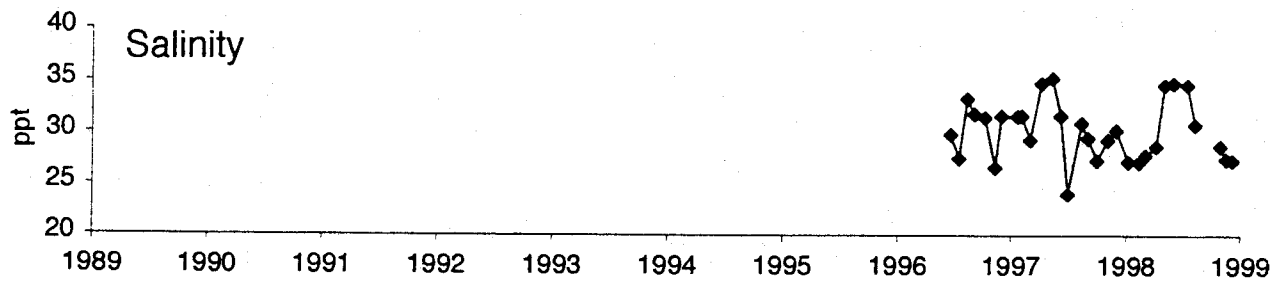
Biscayne Bay Sta. 128 Matheson Beach



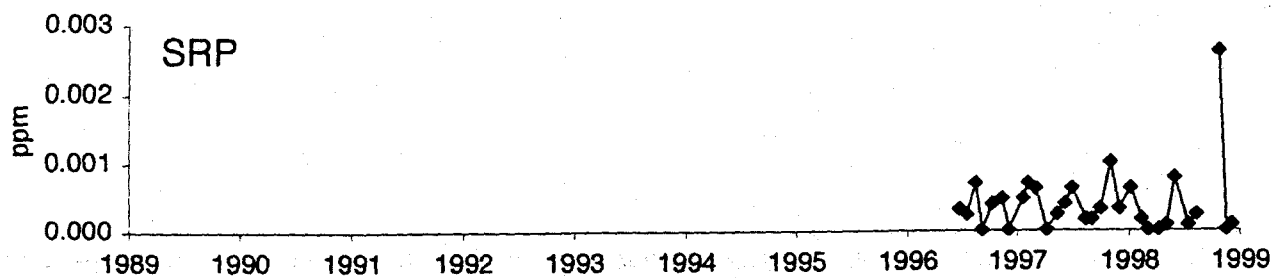
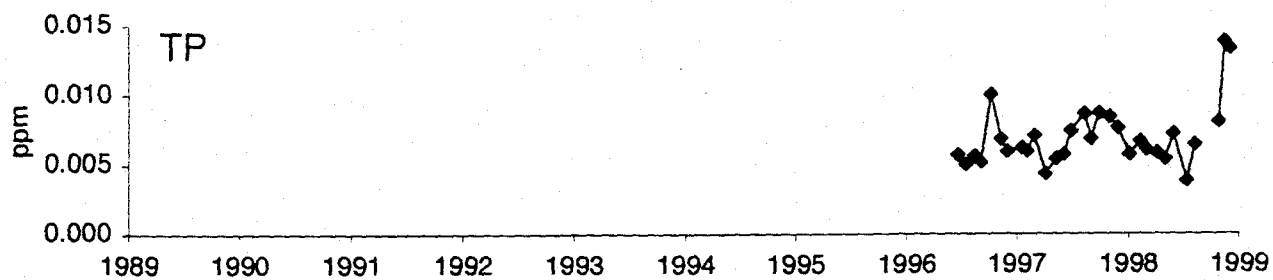
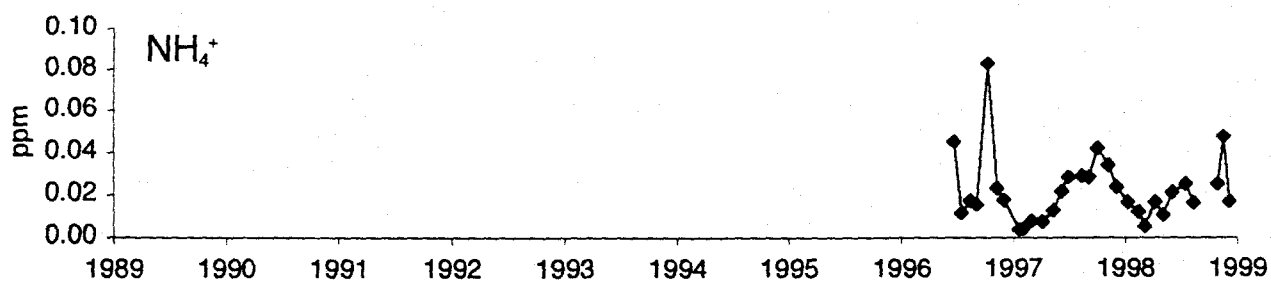
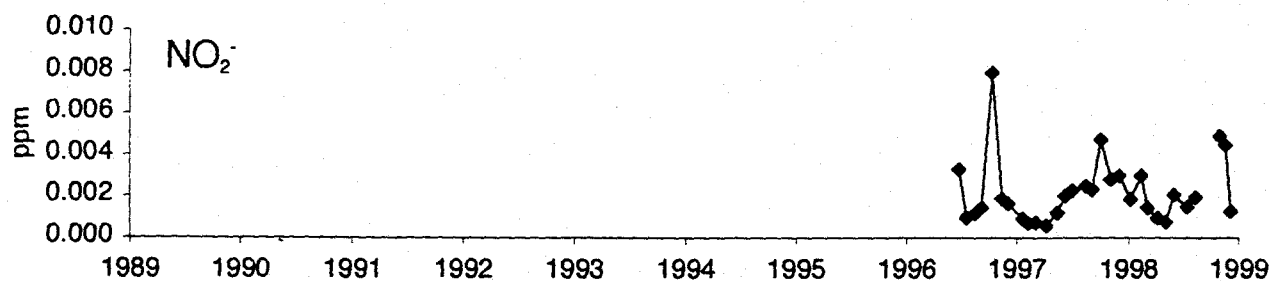
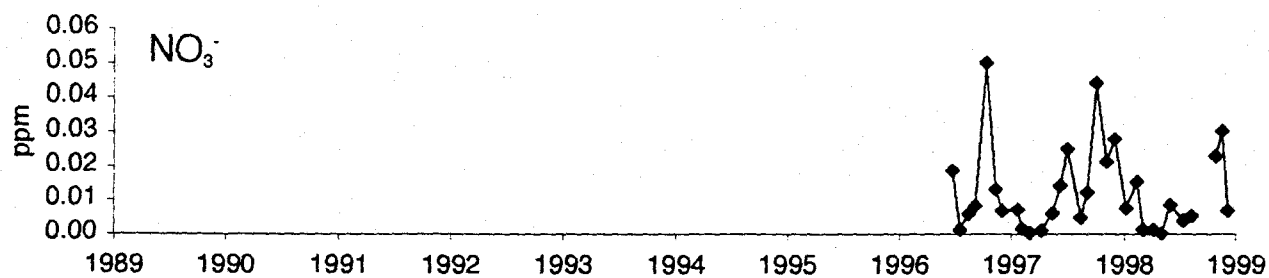
Biscayne Bay Sta. 128 Matheson Beach



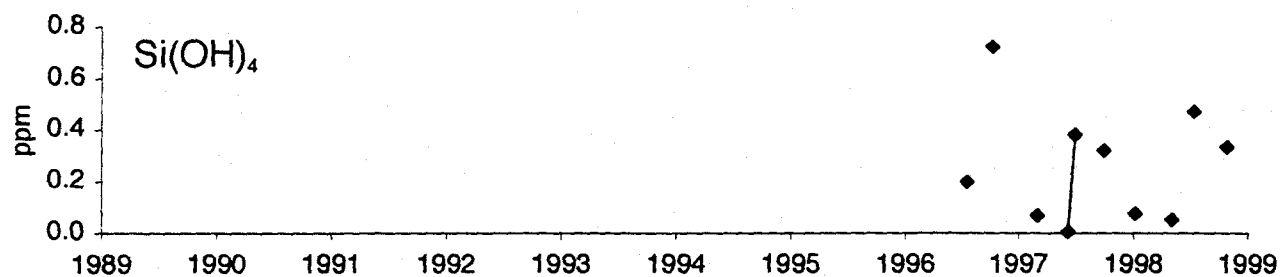
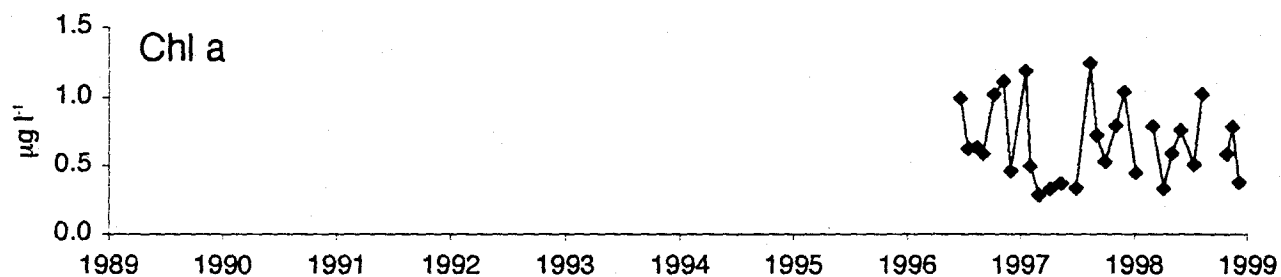
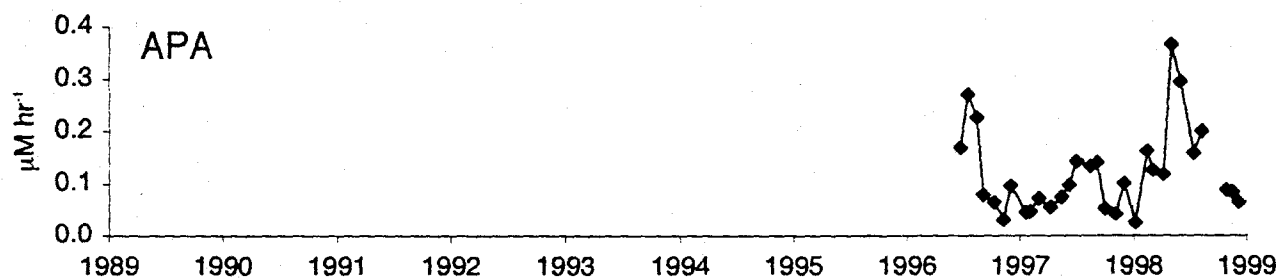
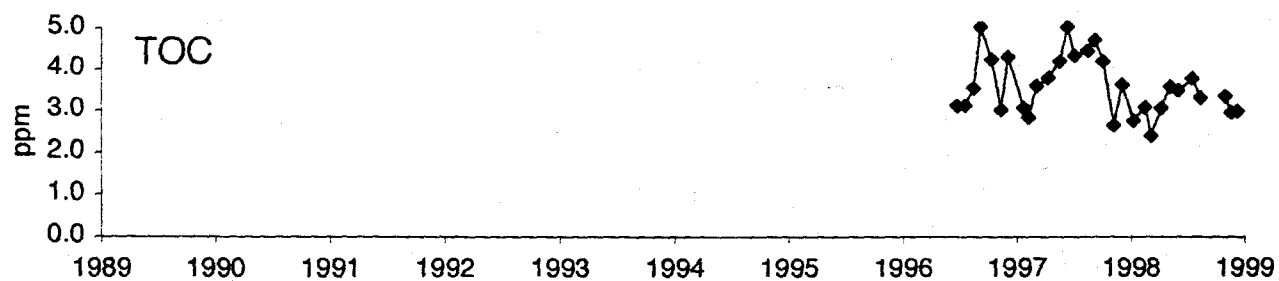
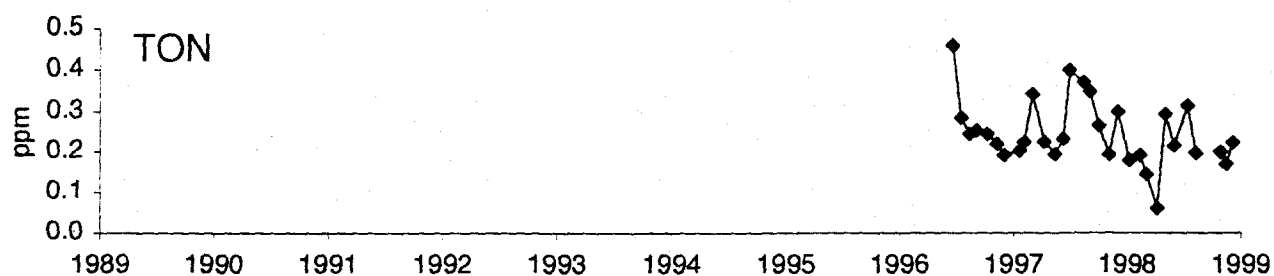
Biscayne Bay Sta. 128 Matheson Beach



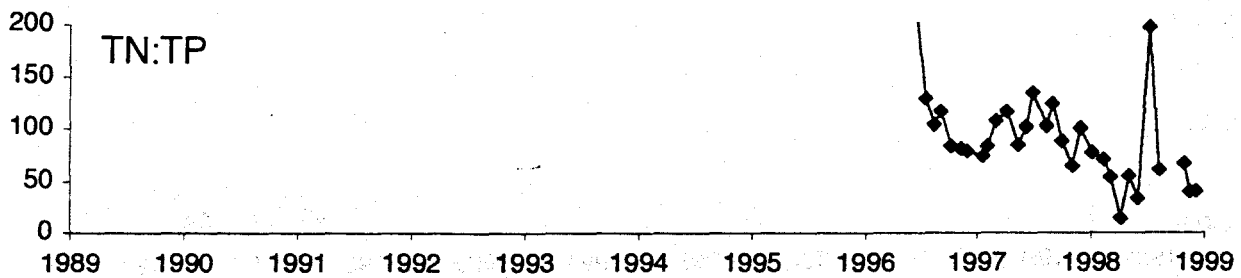
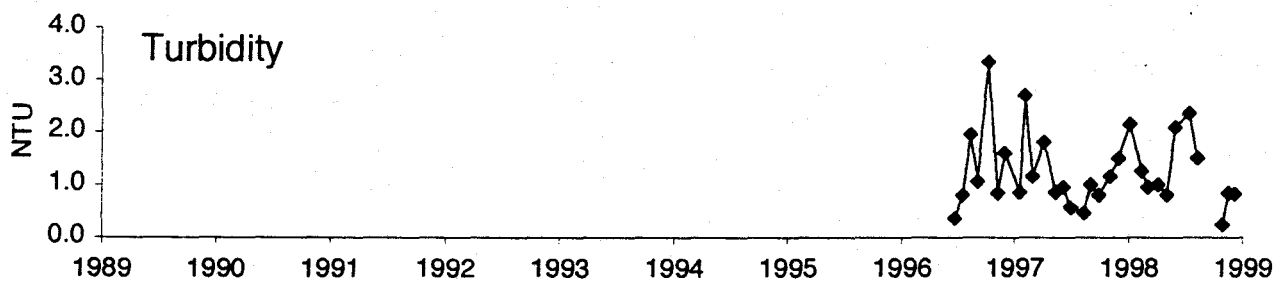
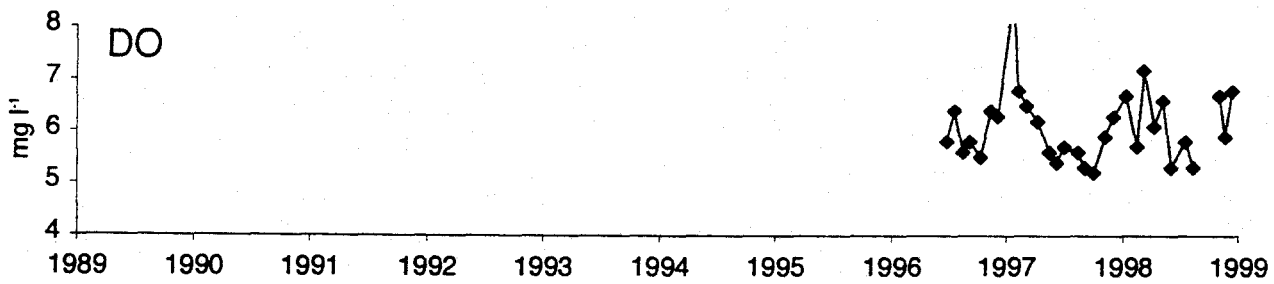
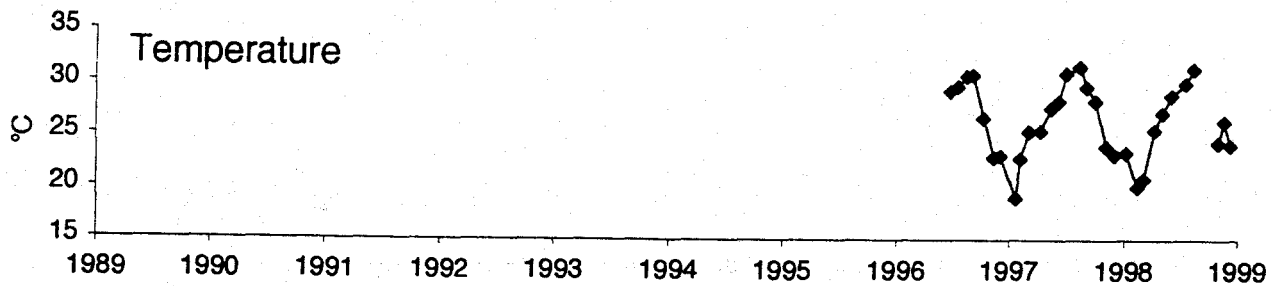
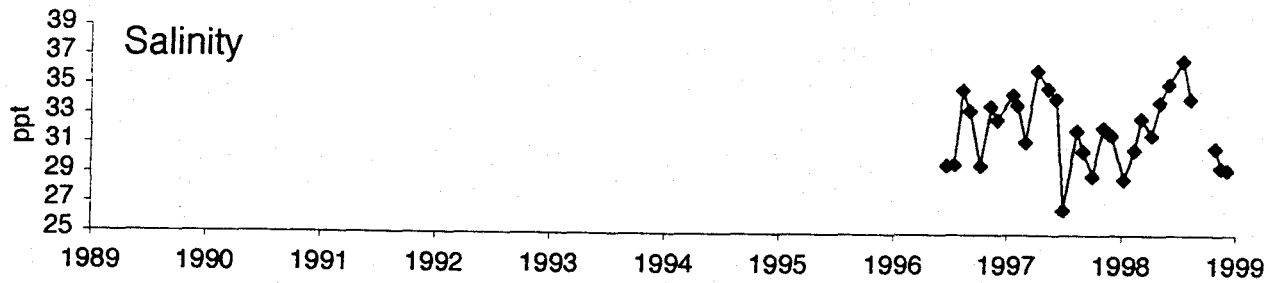
Biscayne Bay Sta. 129 Marker G-71



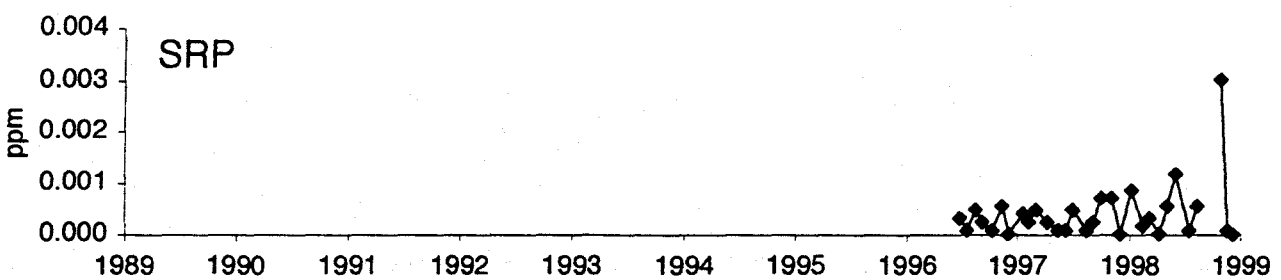
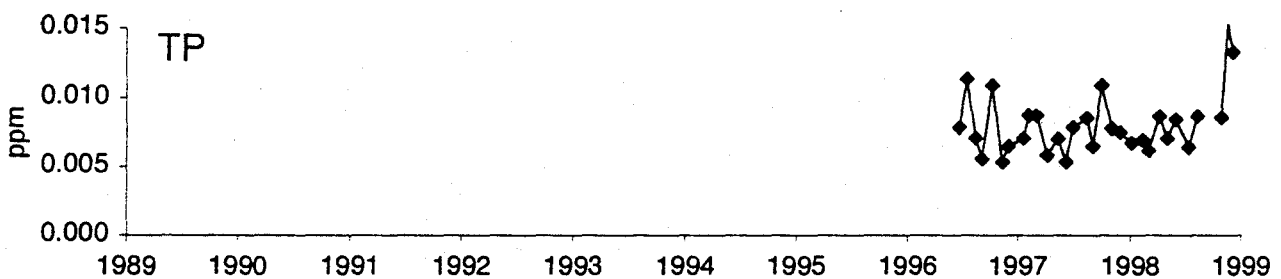
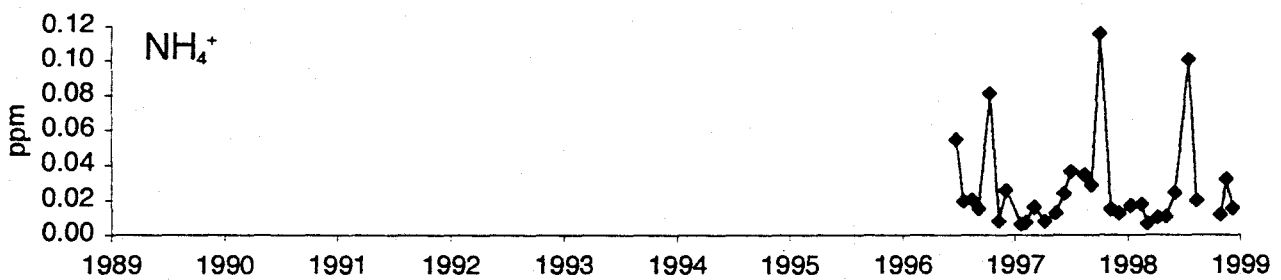
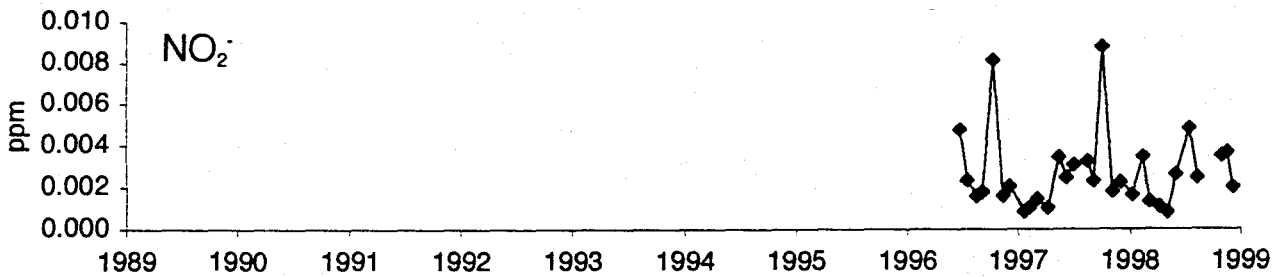
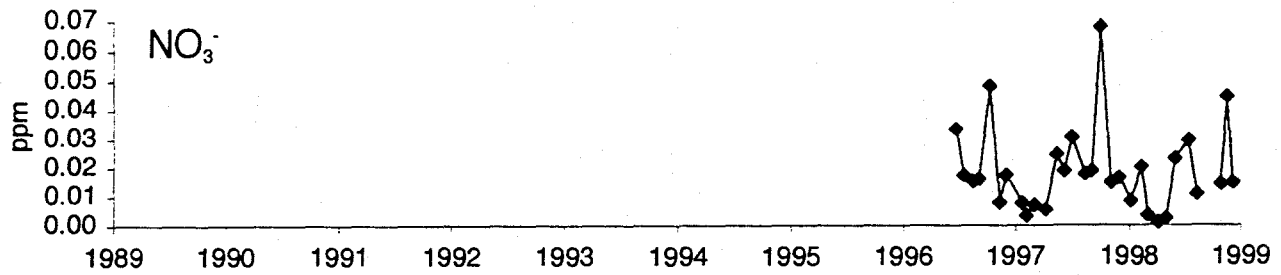
Biscayne Bay Sta. 129 Marker G-71



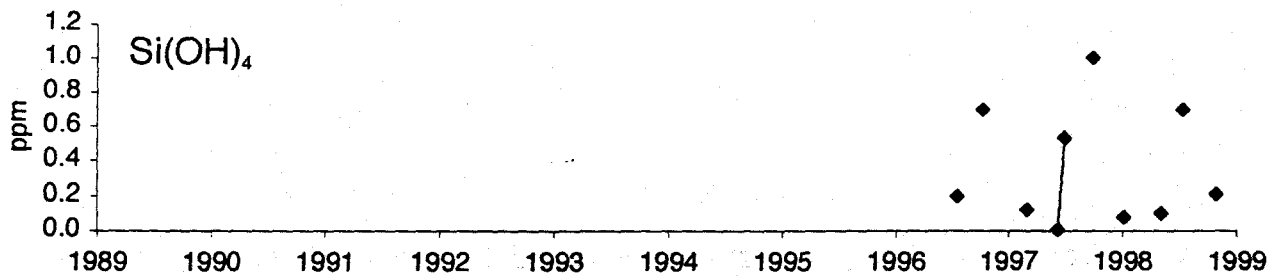
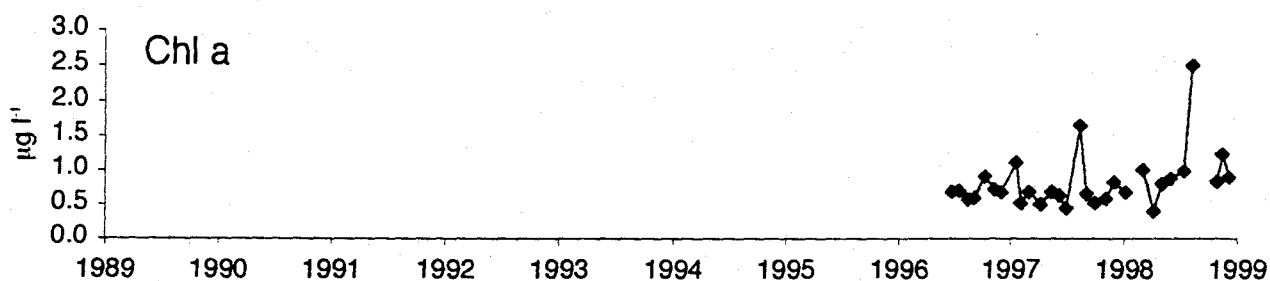
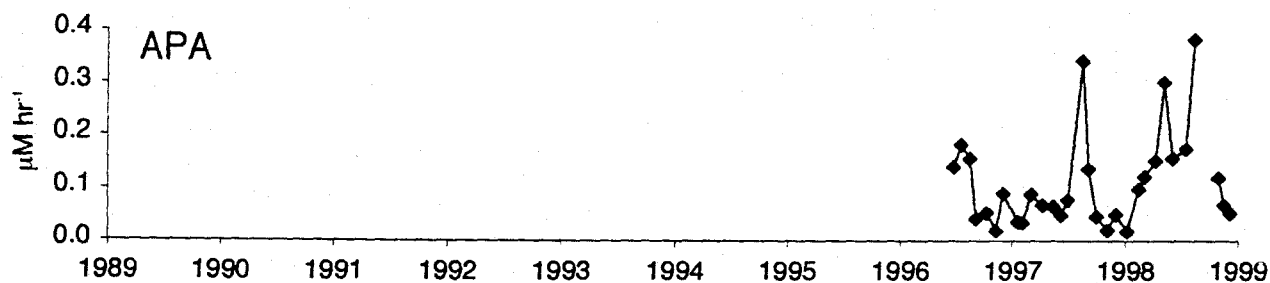
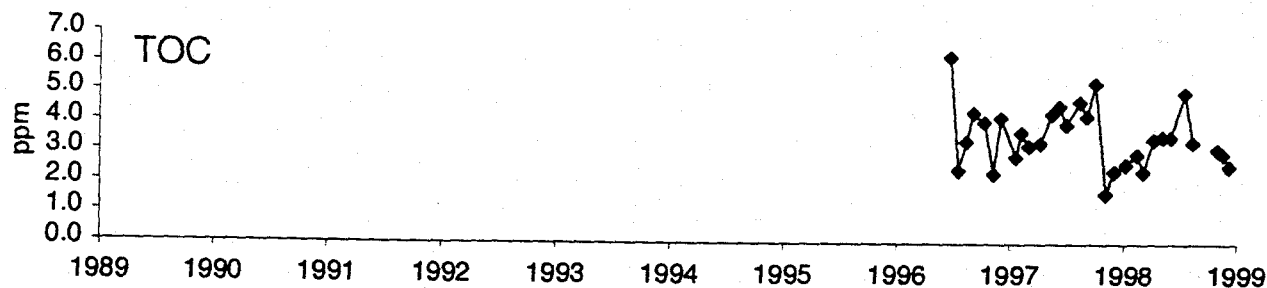
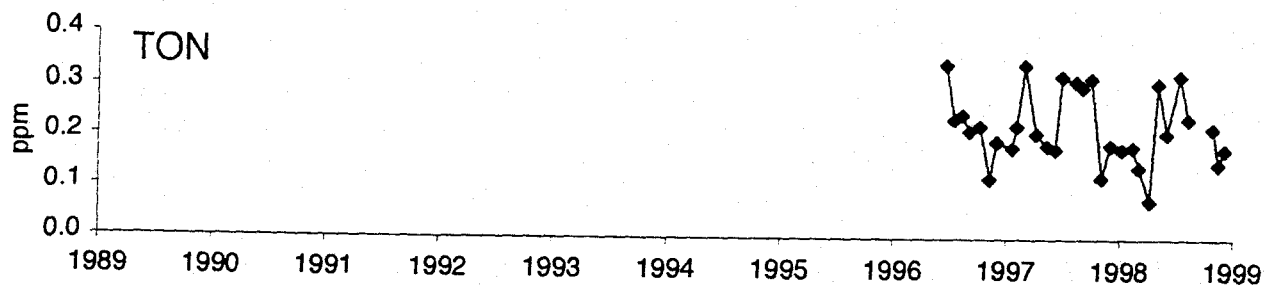
Biscayne Bay Sta. 129 Marker G-71



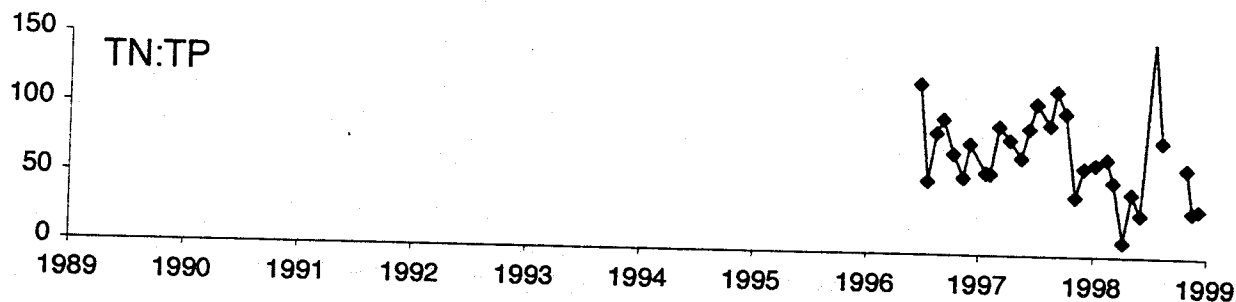
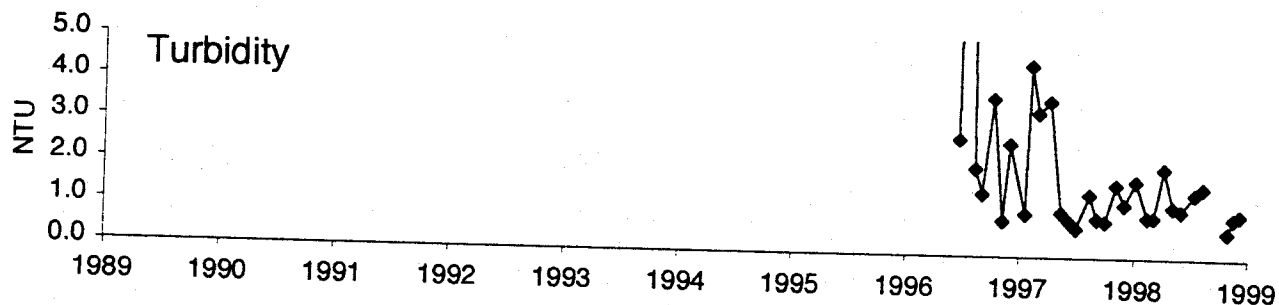
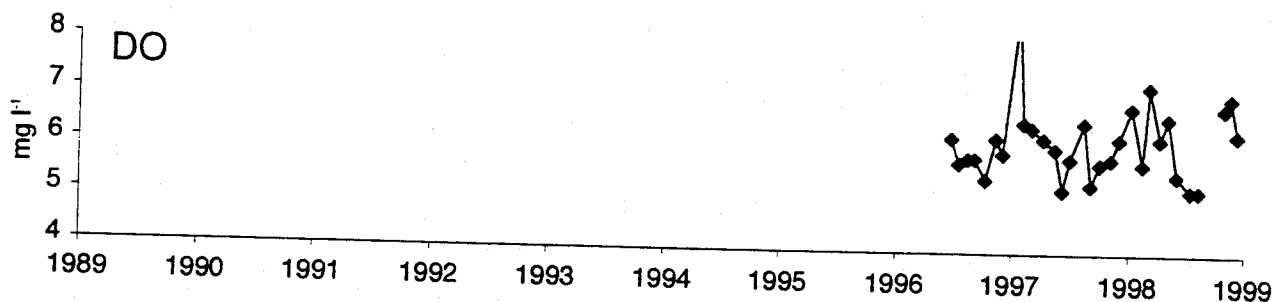
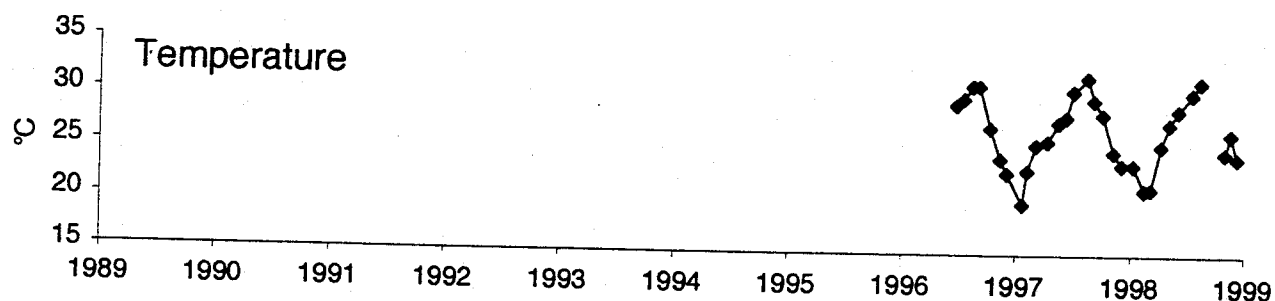
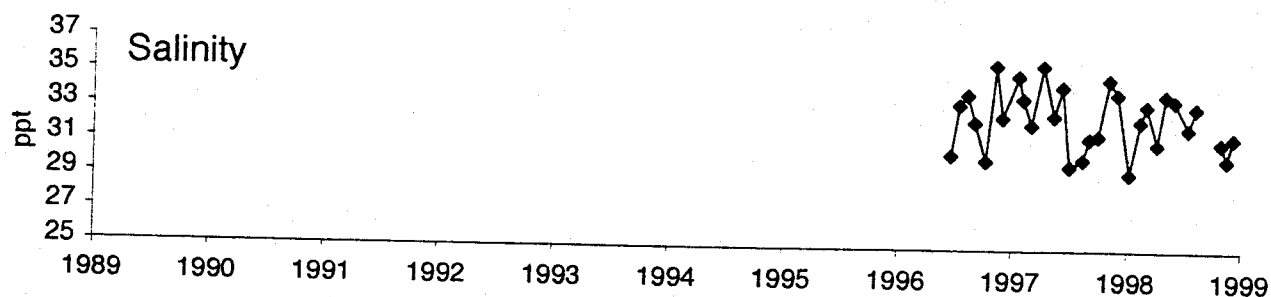
Biscayne Bay Sta. 130 South Dodge Island



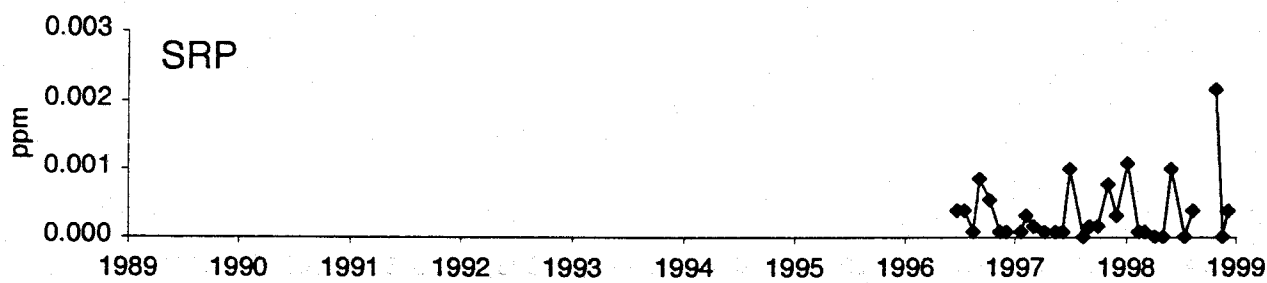
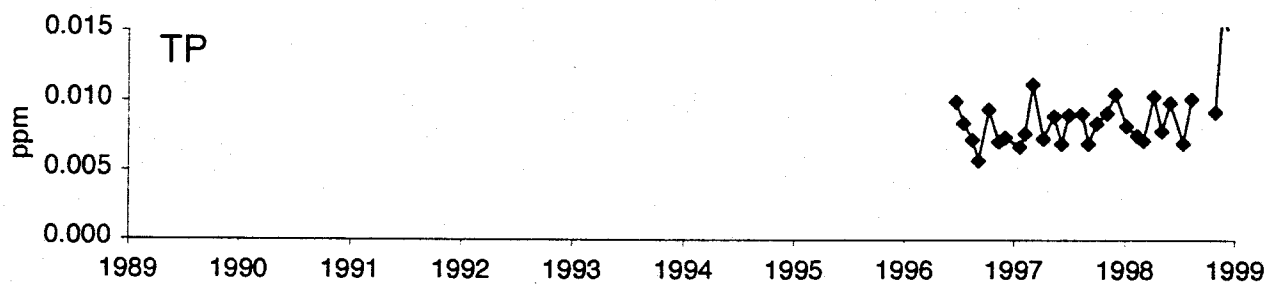
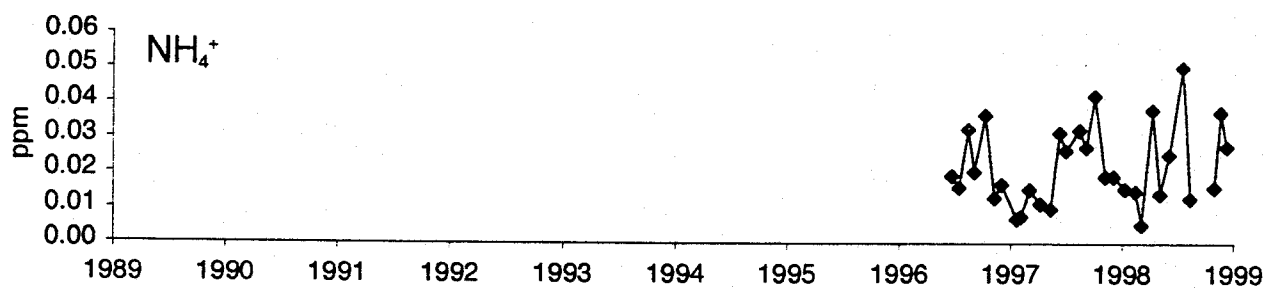
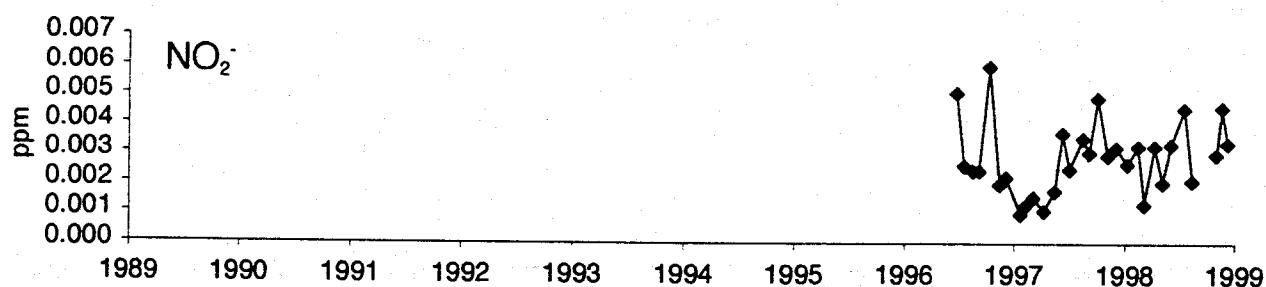
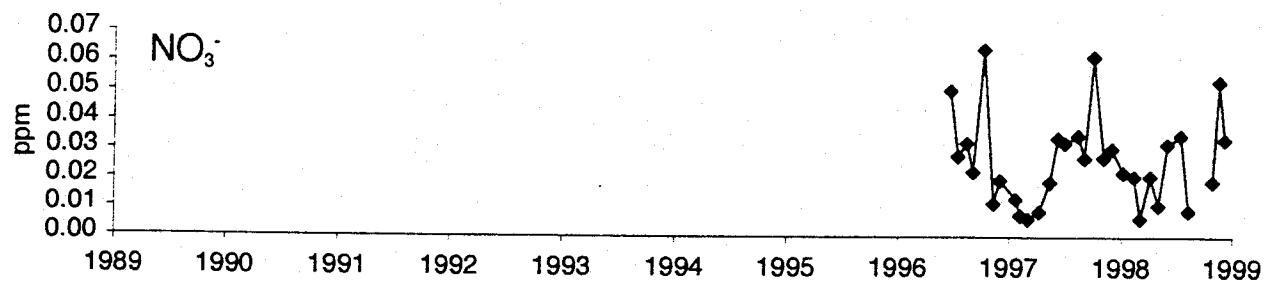
Biscayne Bay Sta. 130 South Dodge Island



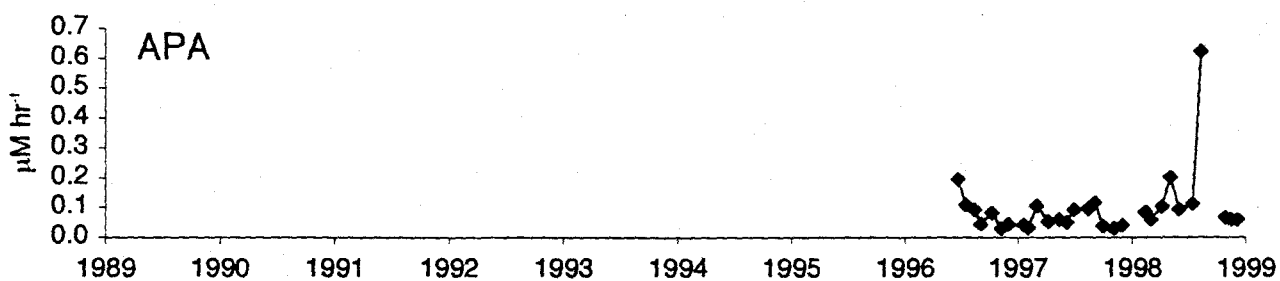
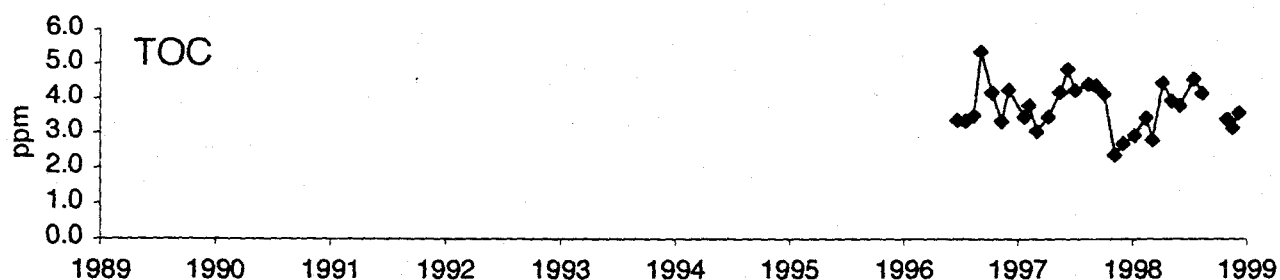
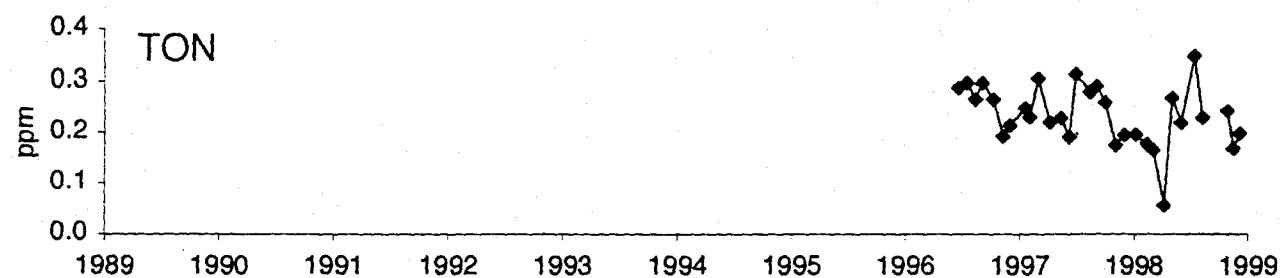
Biscayne Bay Sta. 130 South Dodge Island



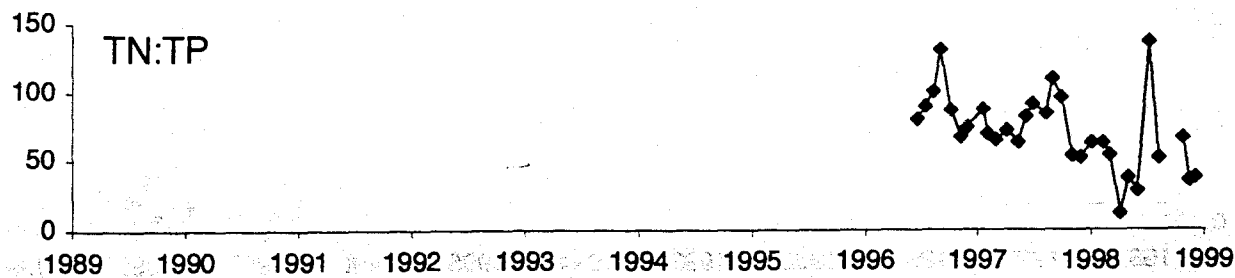
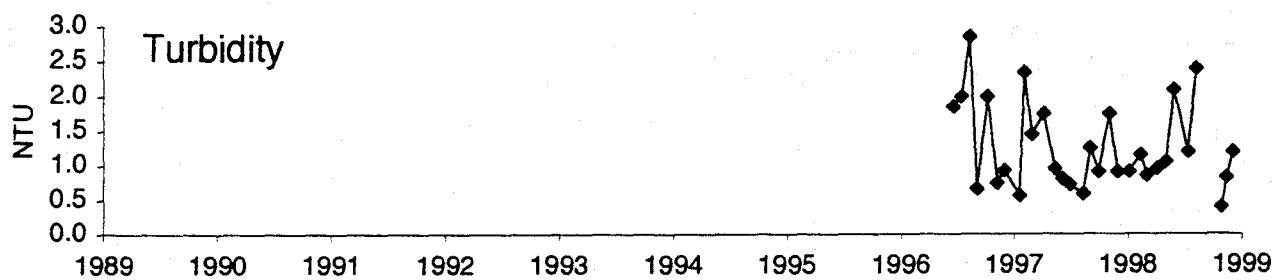
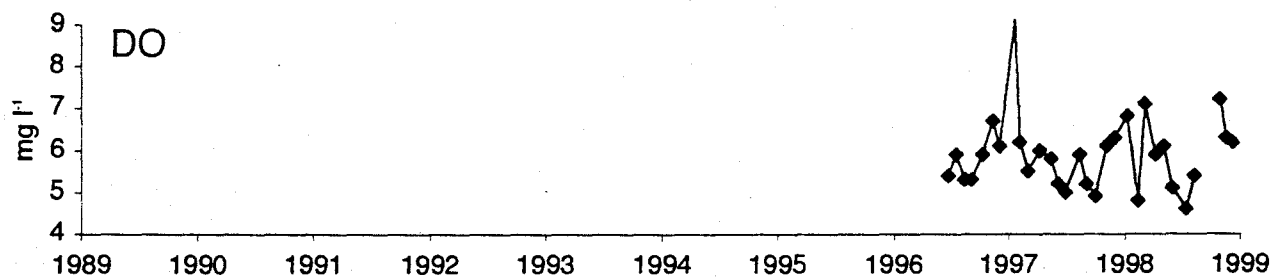
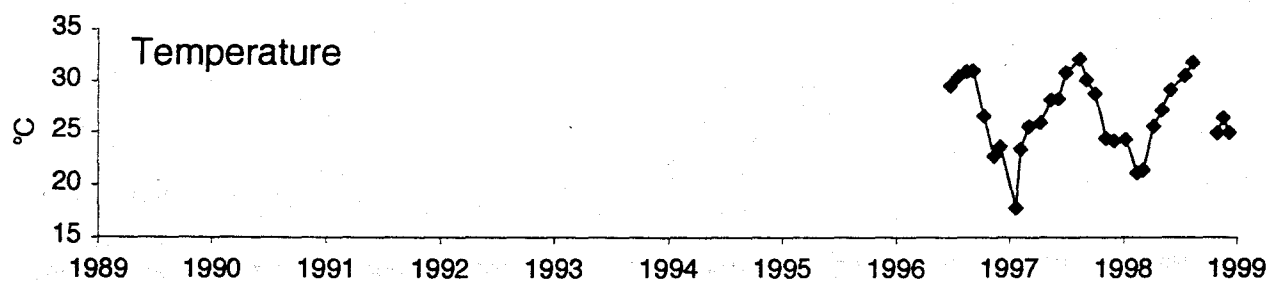
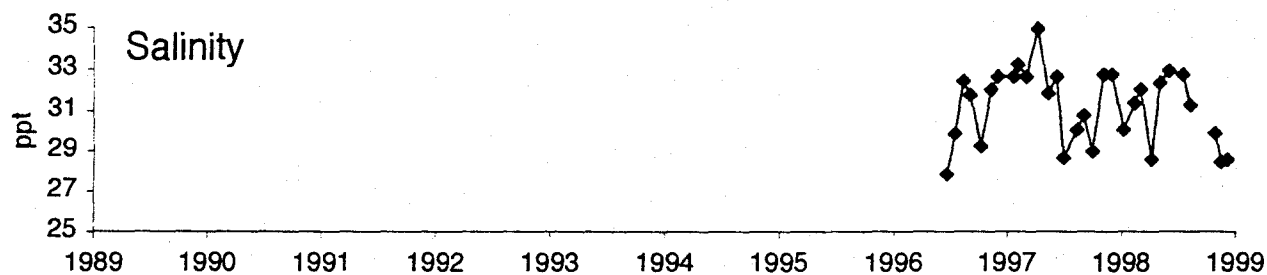
Biscayne Bay Sta. 131 North Venetian Basin



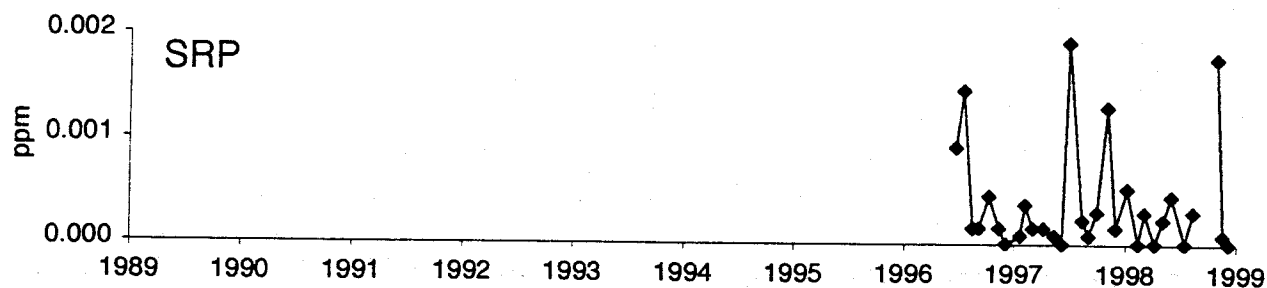
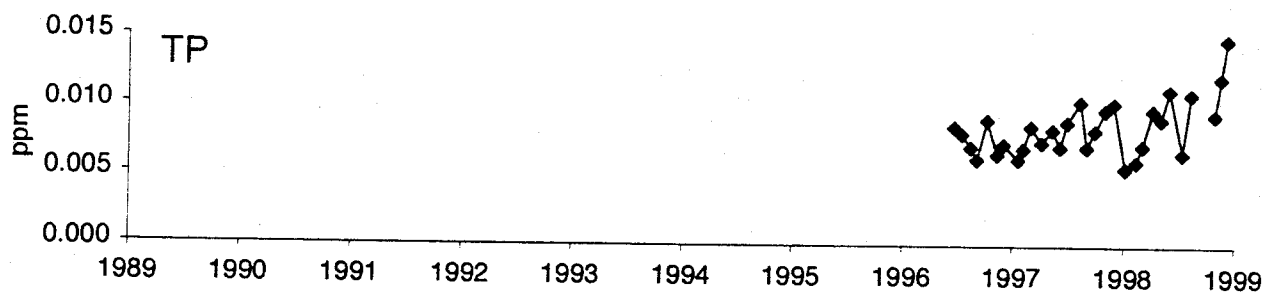
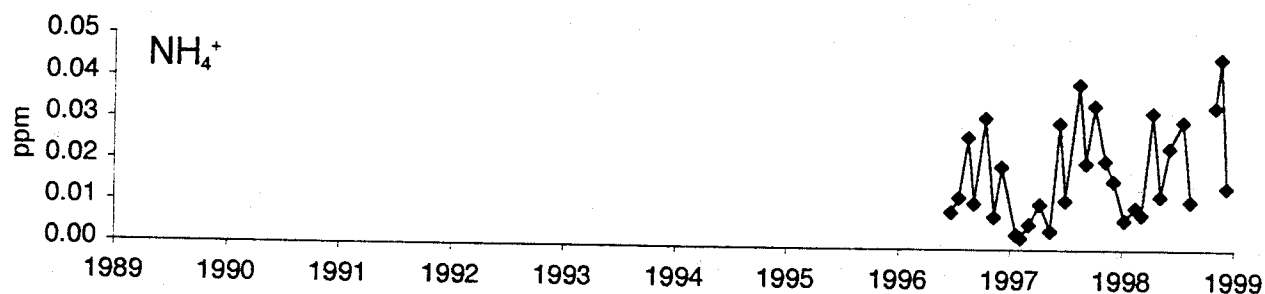
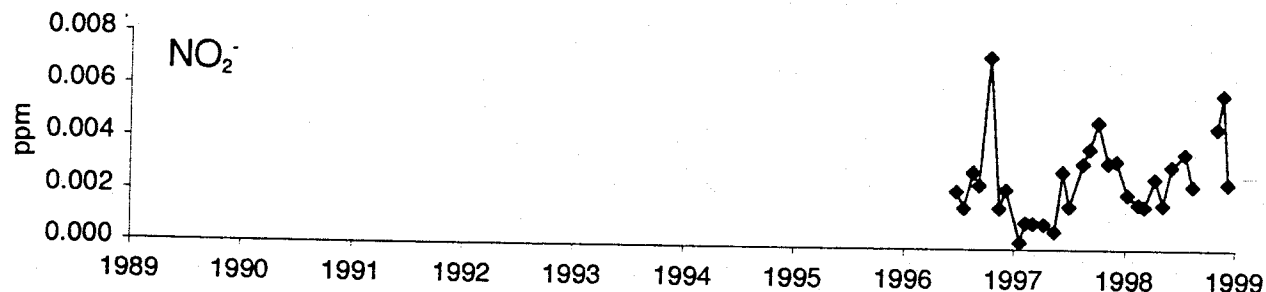
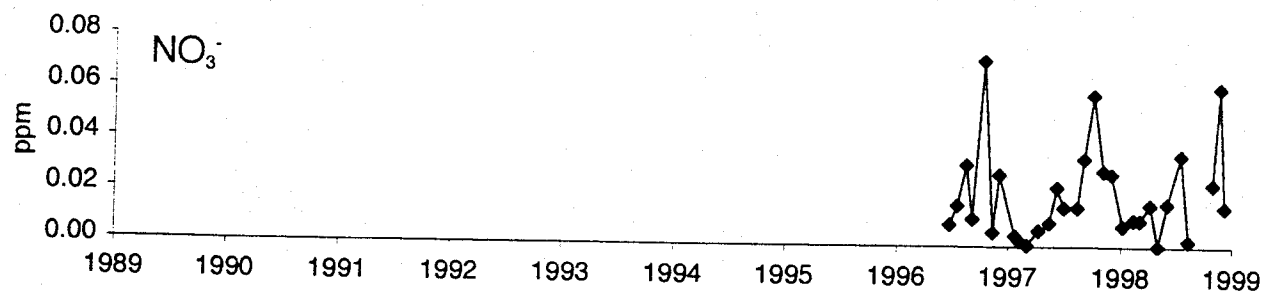
Biscayne Bay Sta. 131 North Venetian Basin



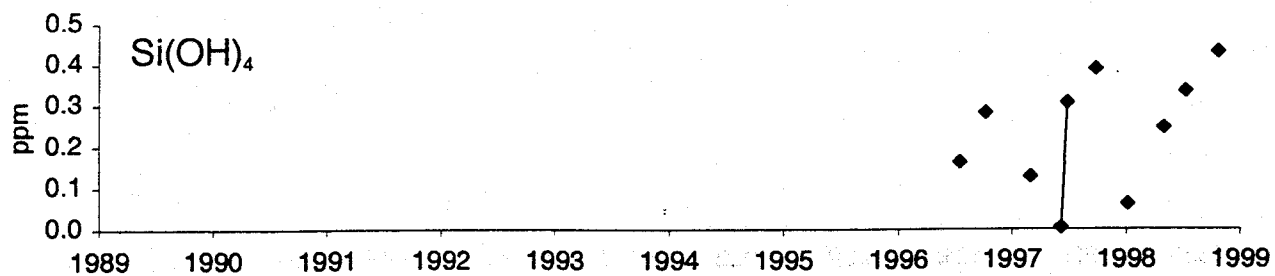
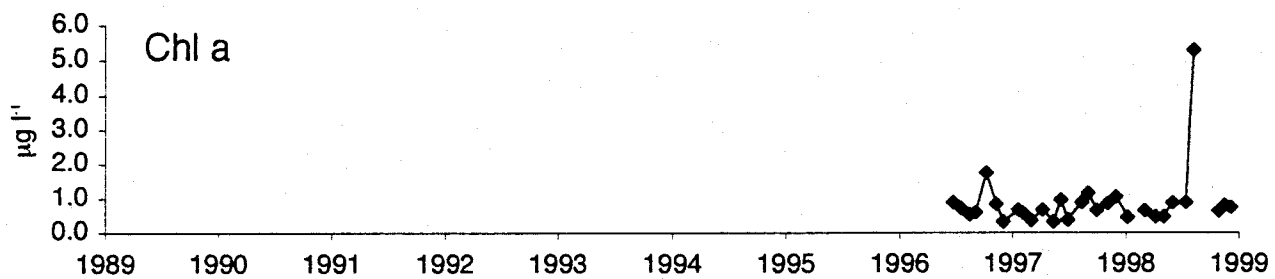
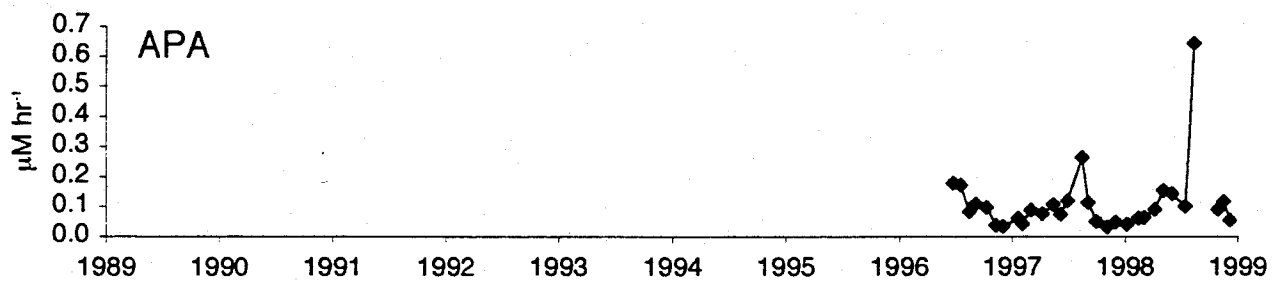
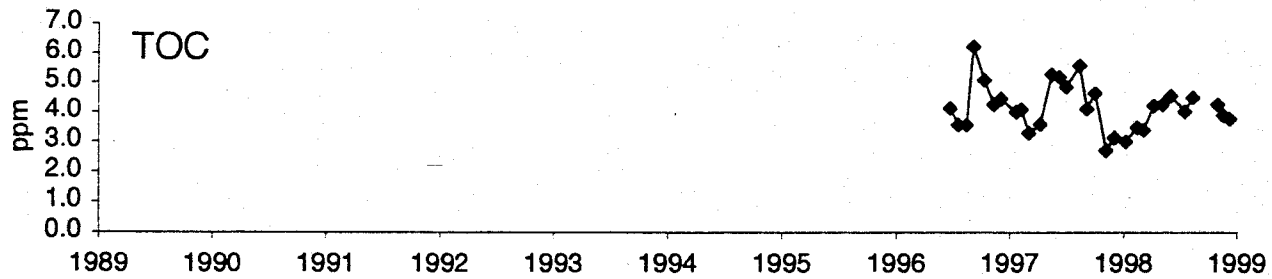
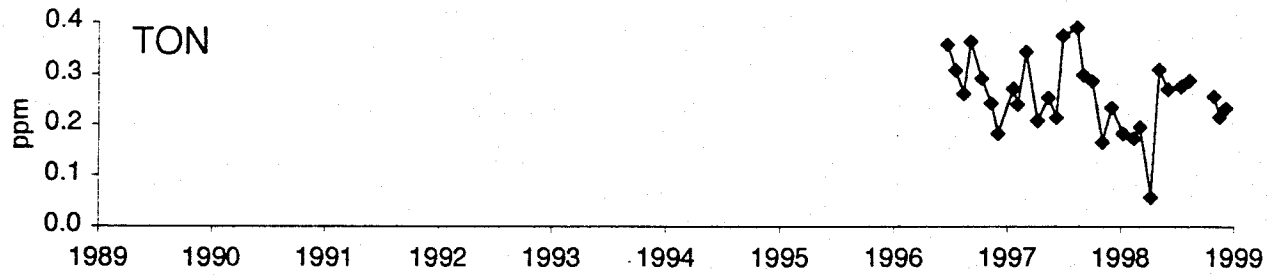
Biscayne Bay Sta. 131 North Venetian Basin



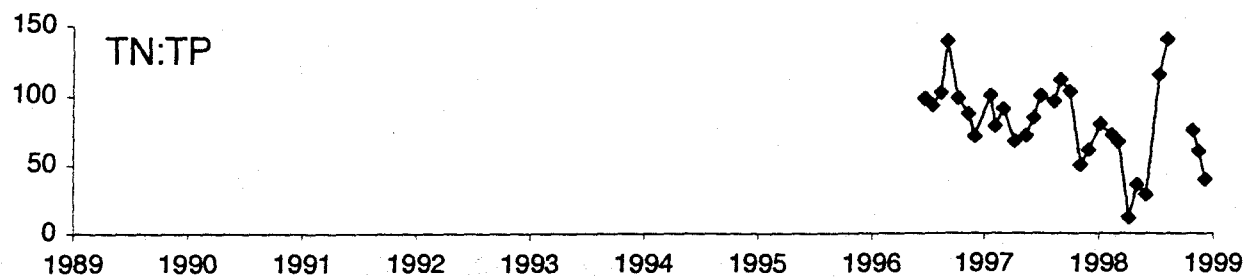
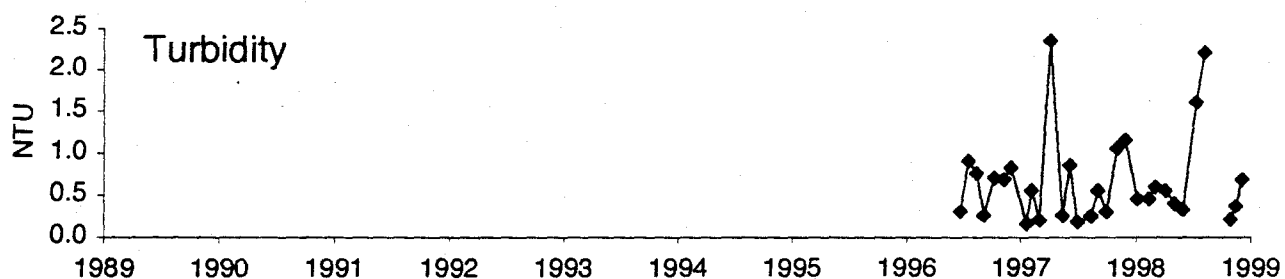
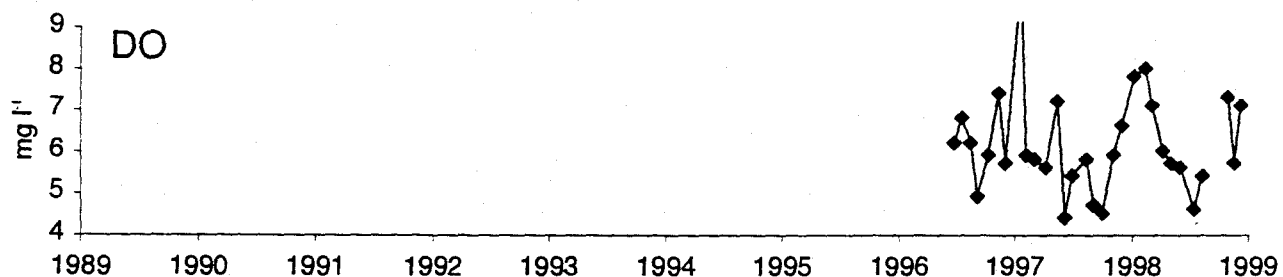
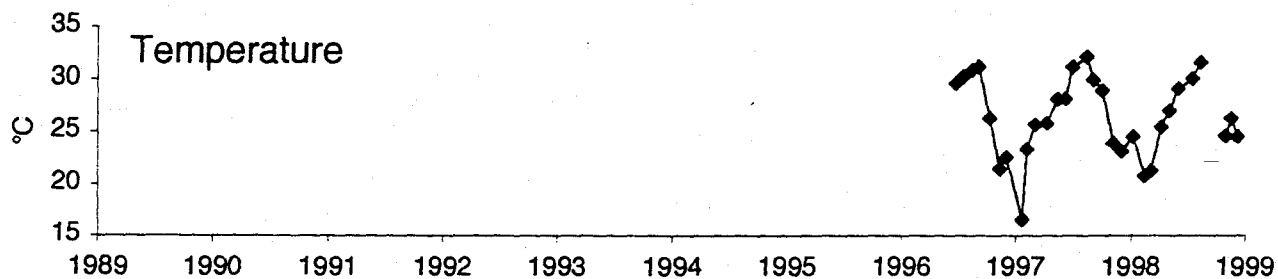
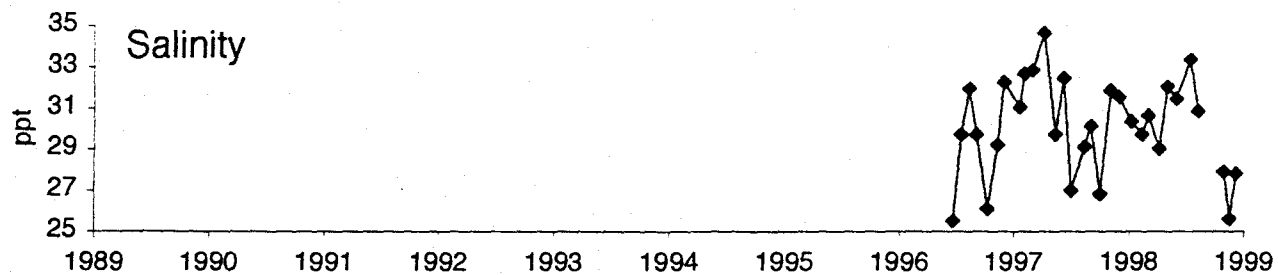
Biscayne Bay Sta. 132 North I-95 Basin



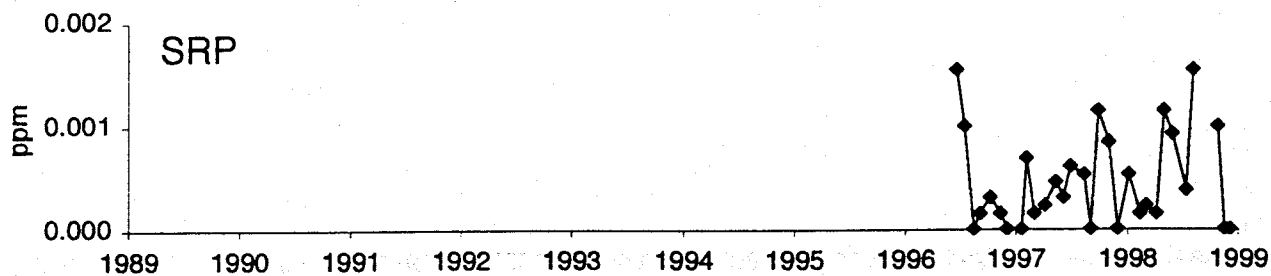
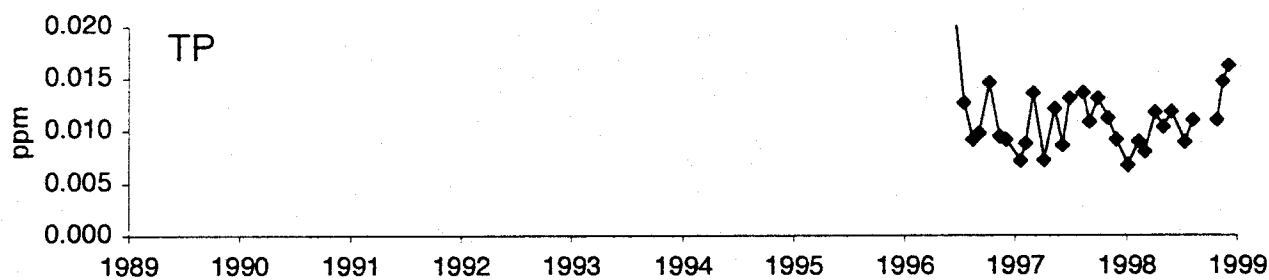
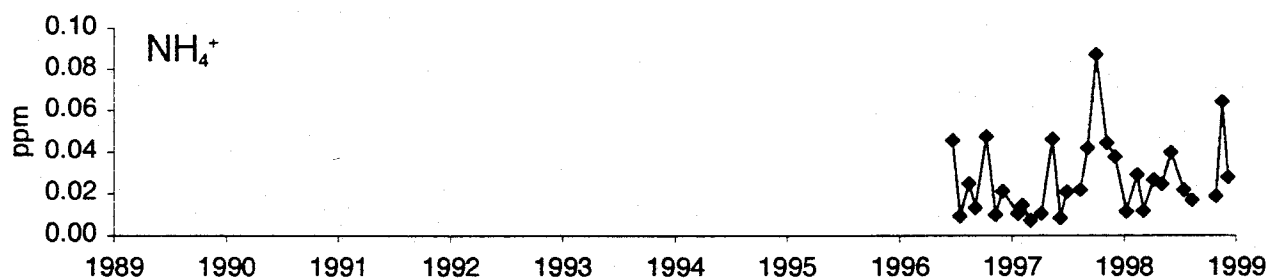
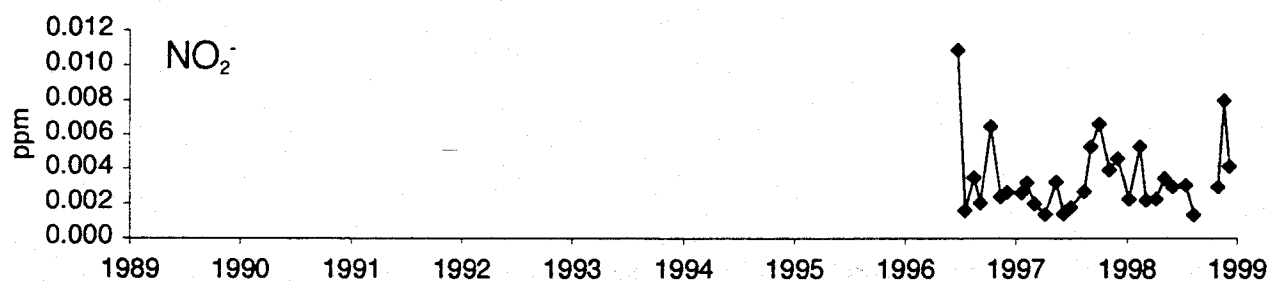
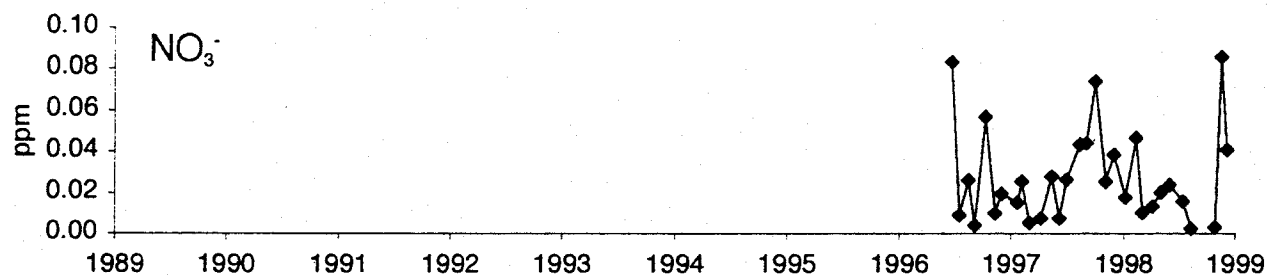
Biscayne Bay Sta. 132 North I-95 Basin



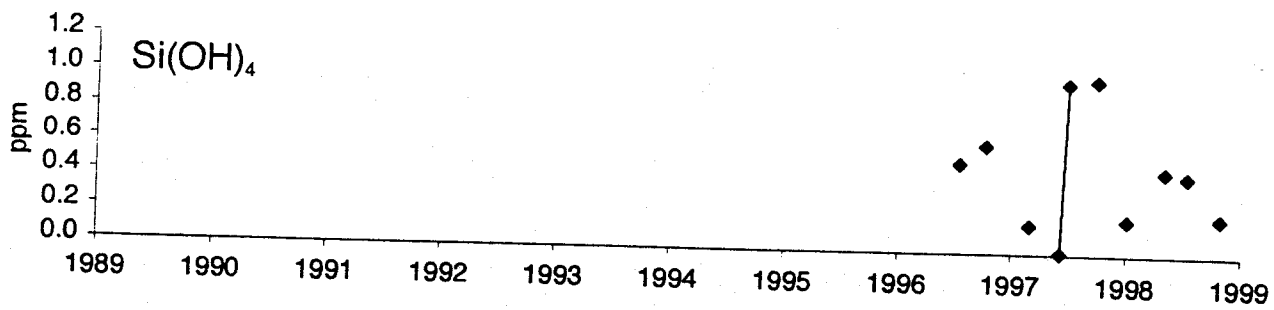
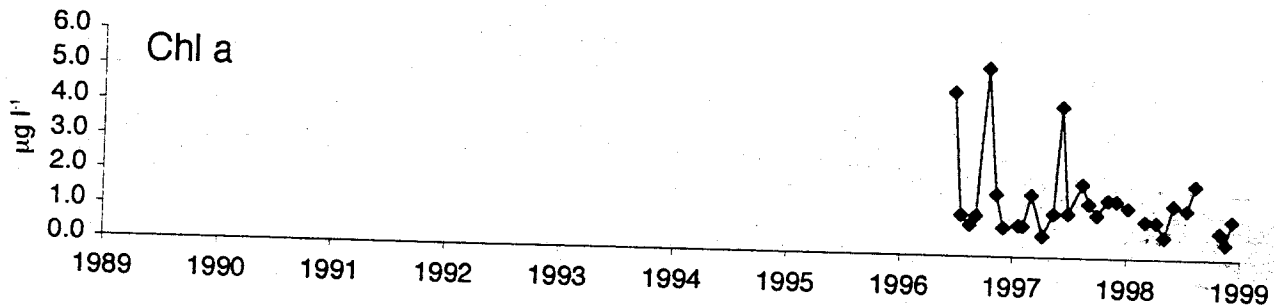
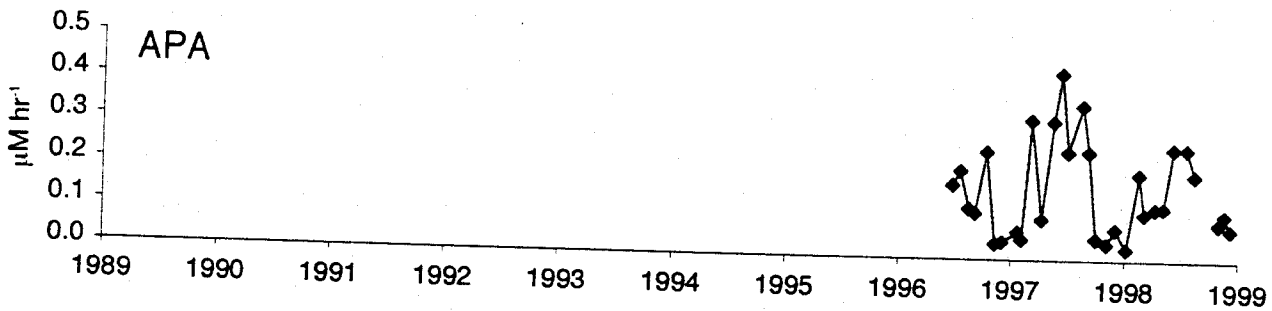
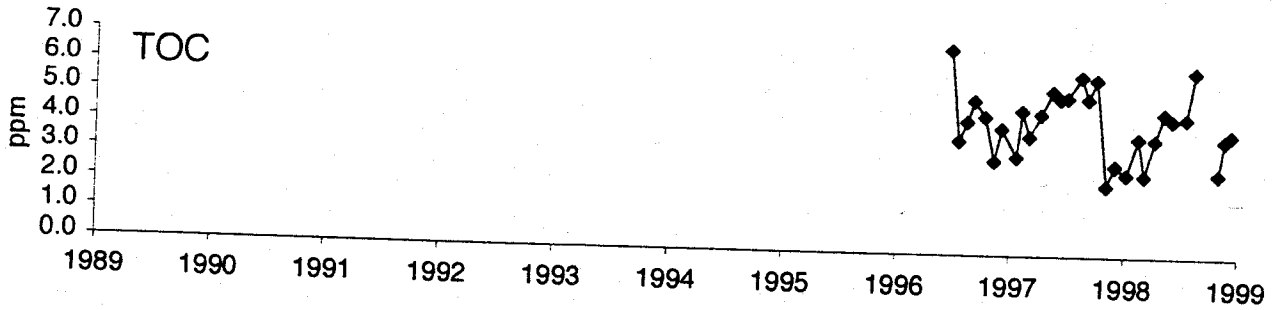
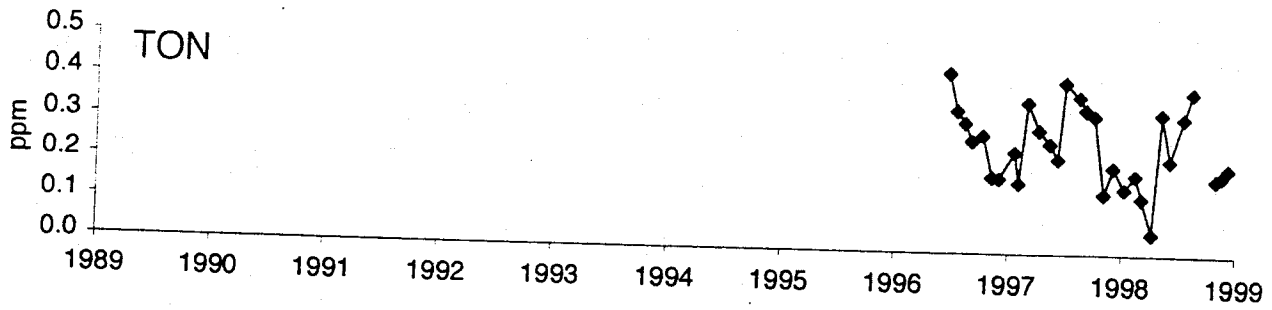
Biscayne Bay Sta. 132 North I-95 Basin



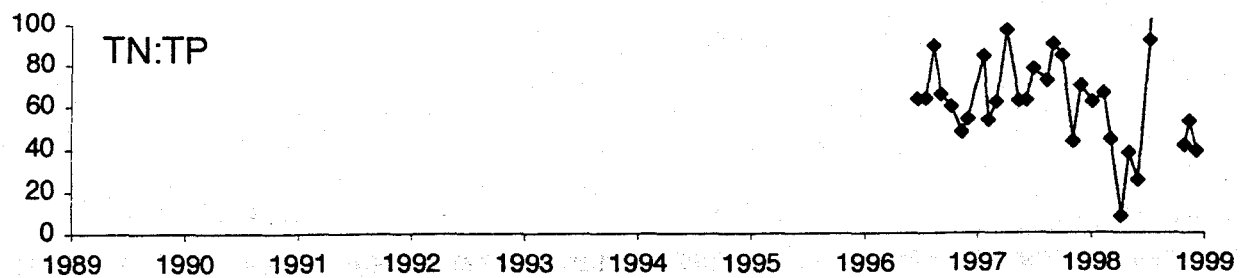
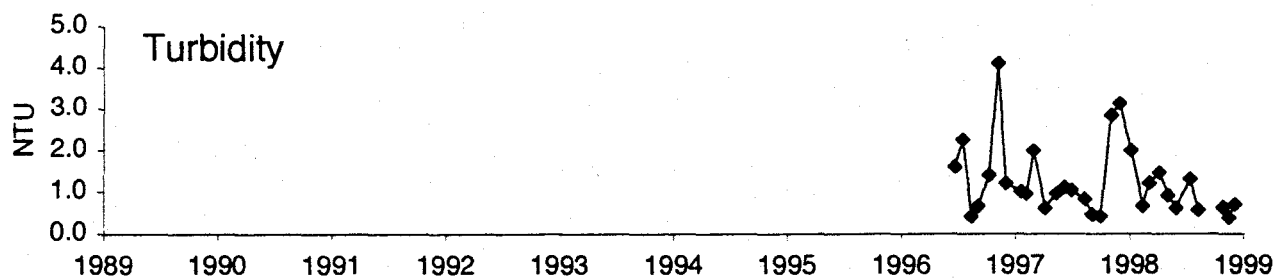
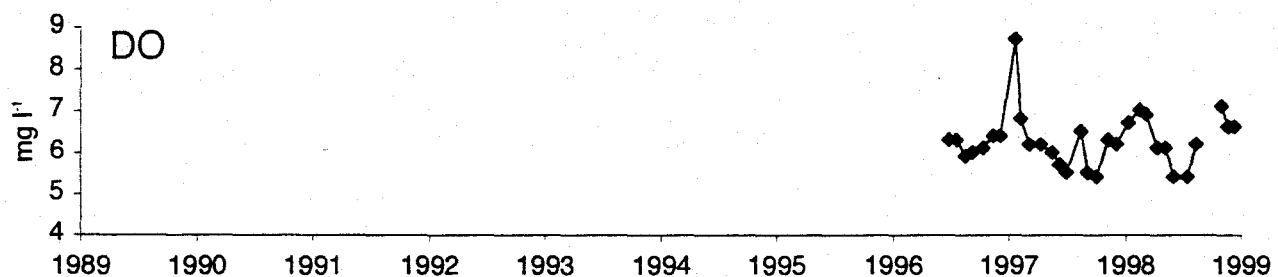
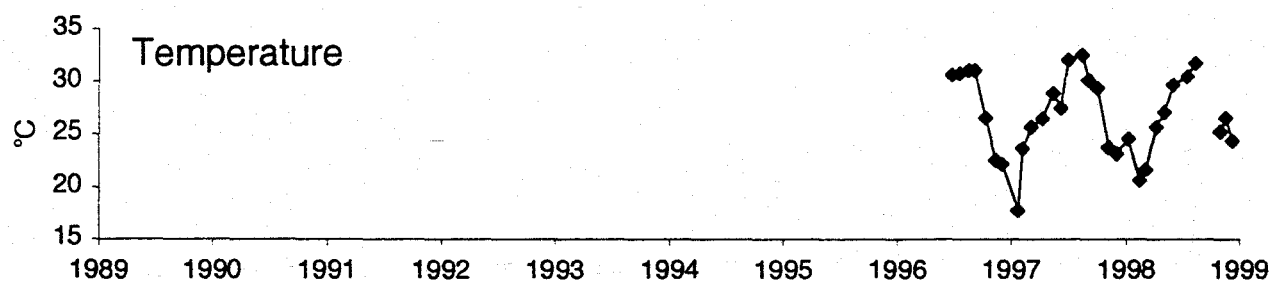
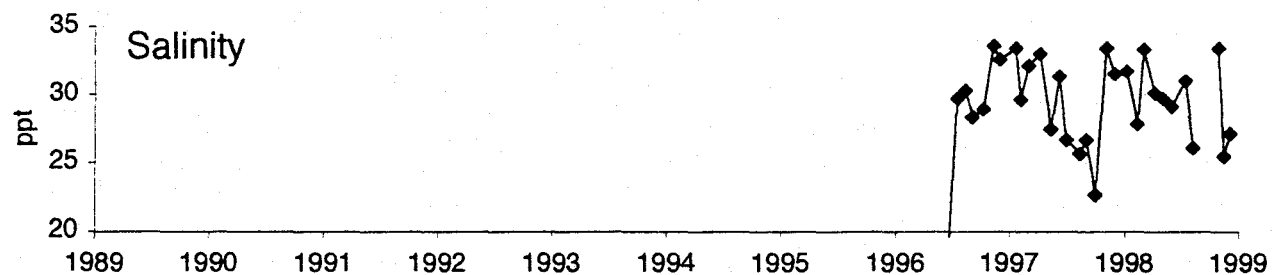
Biscayne Bay Sta. 133 North Normandy Isle



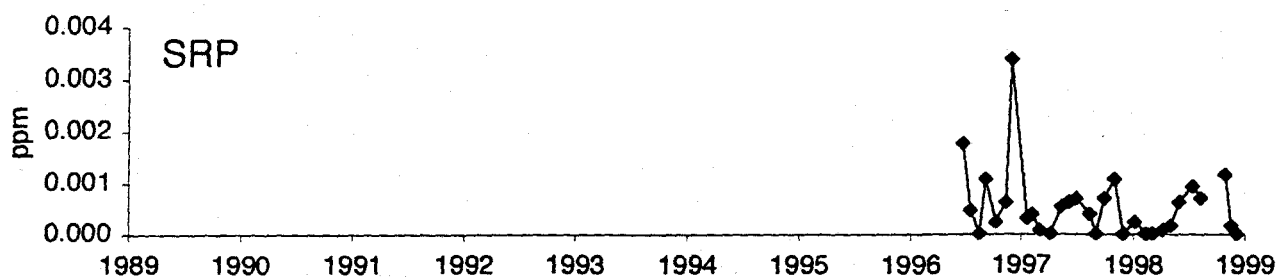
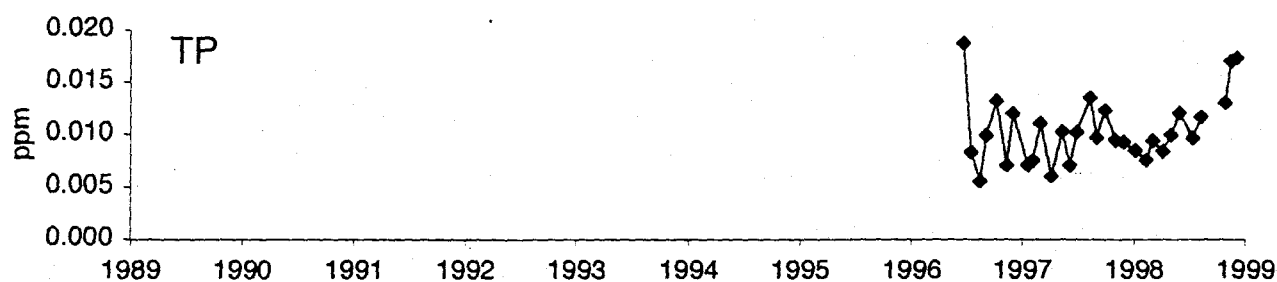
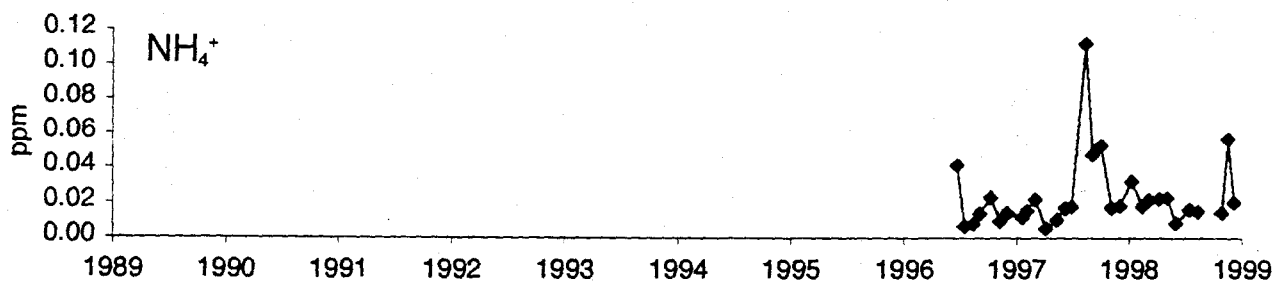
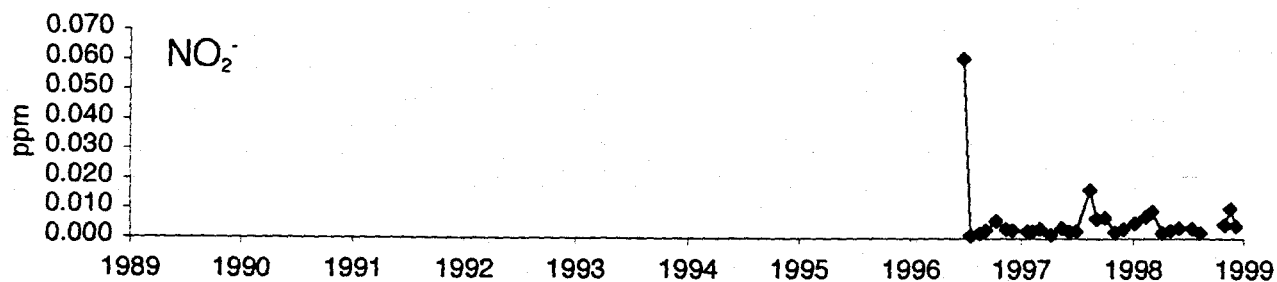
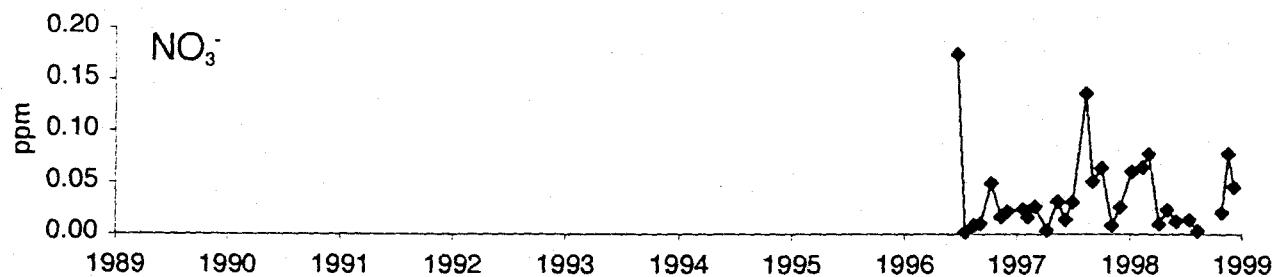
Biscayne Bay Sta. 133 North Normandy Isle



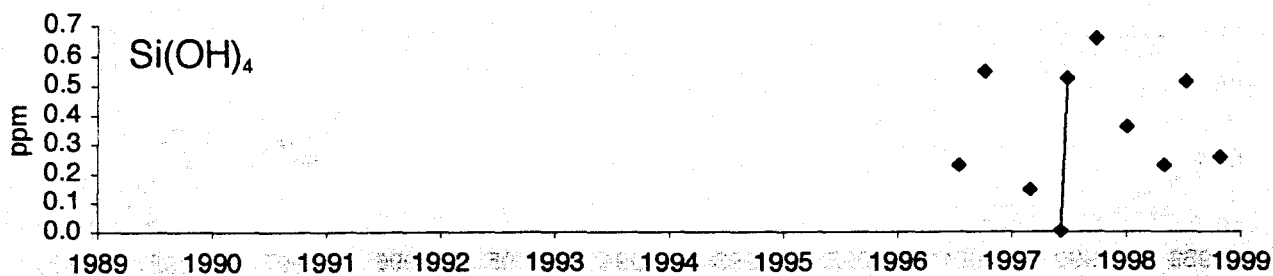
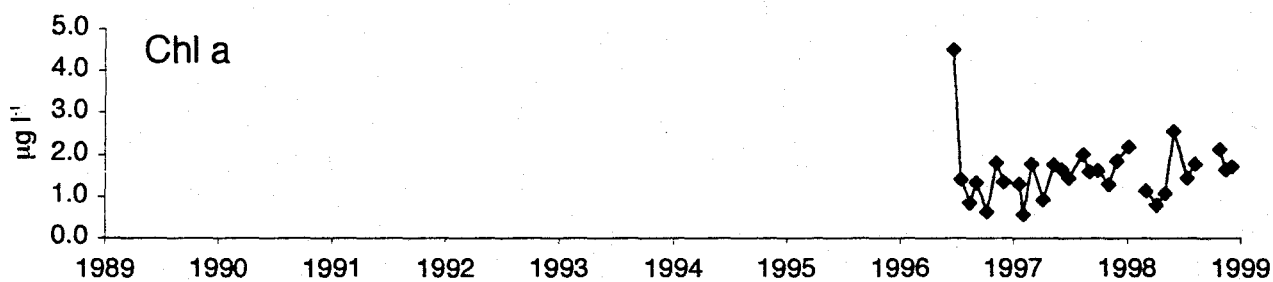
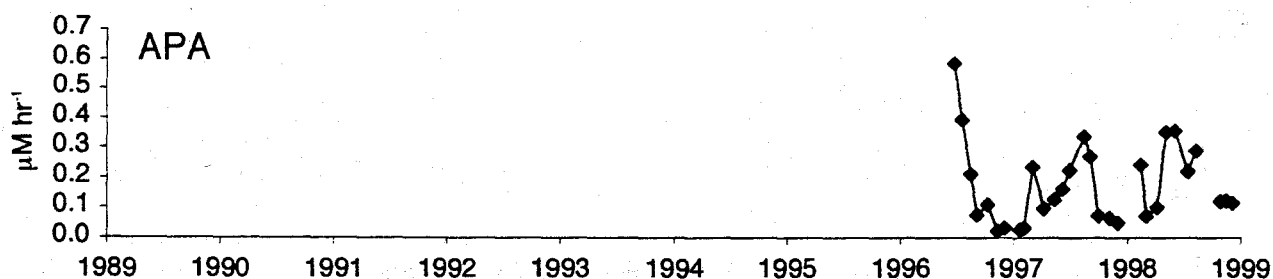
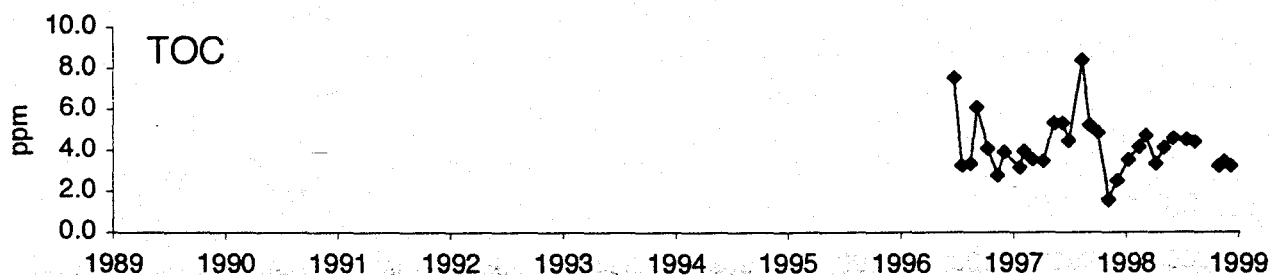
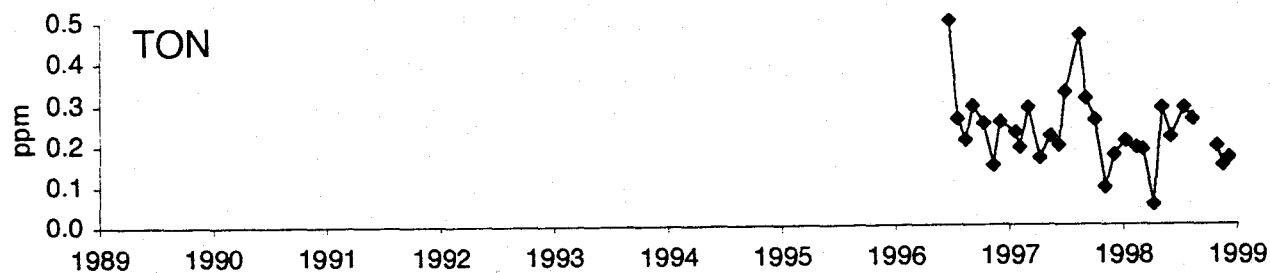
Biscayne Bay Sta. 133 North Normandy Isle



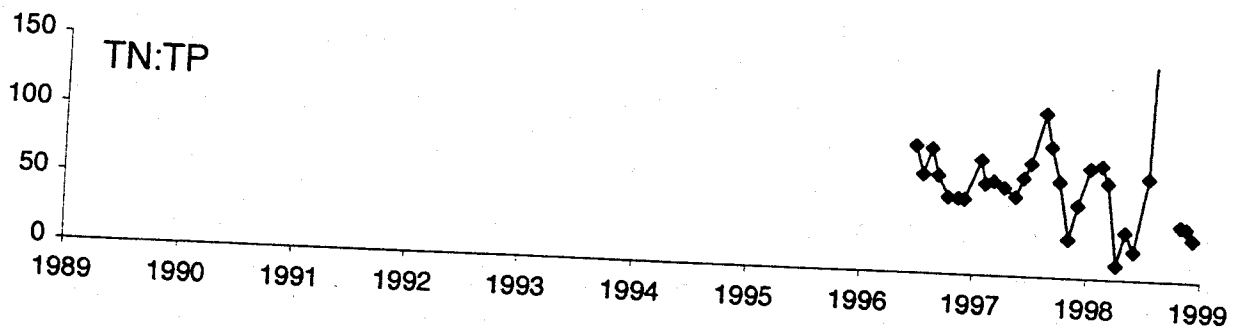
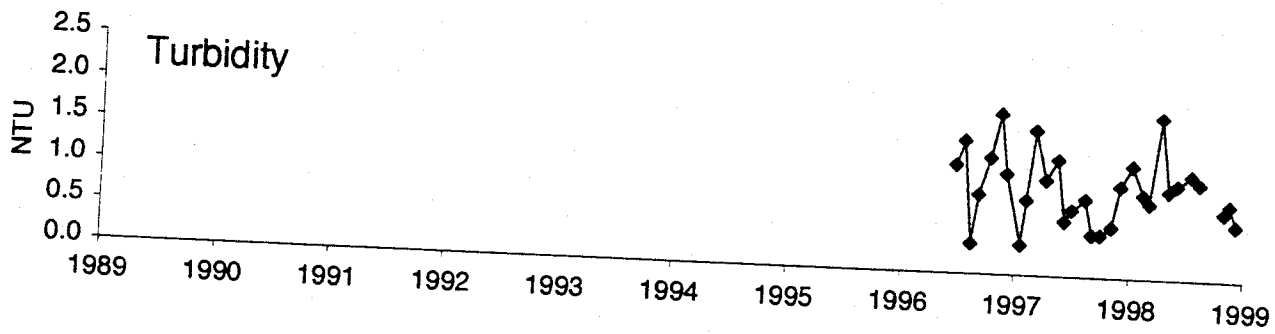
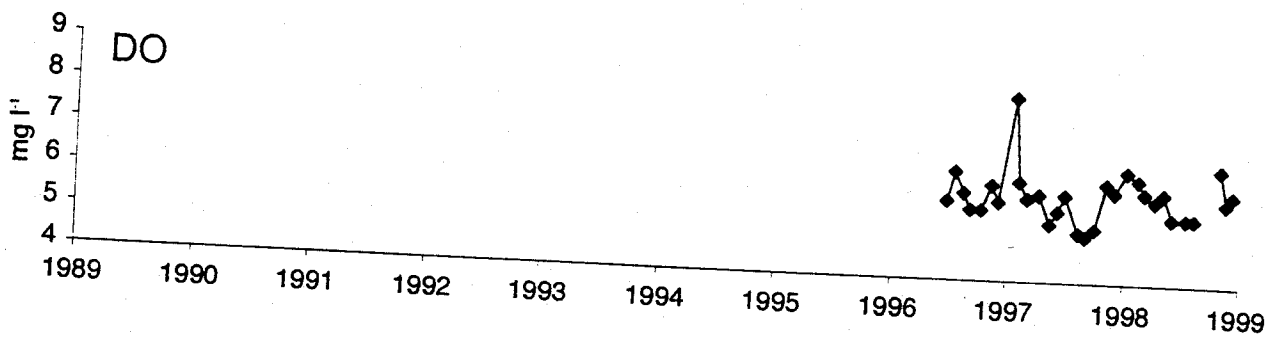
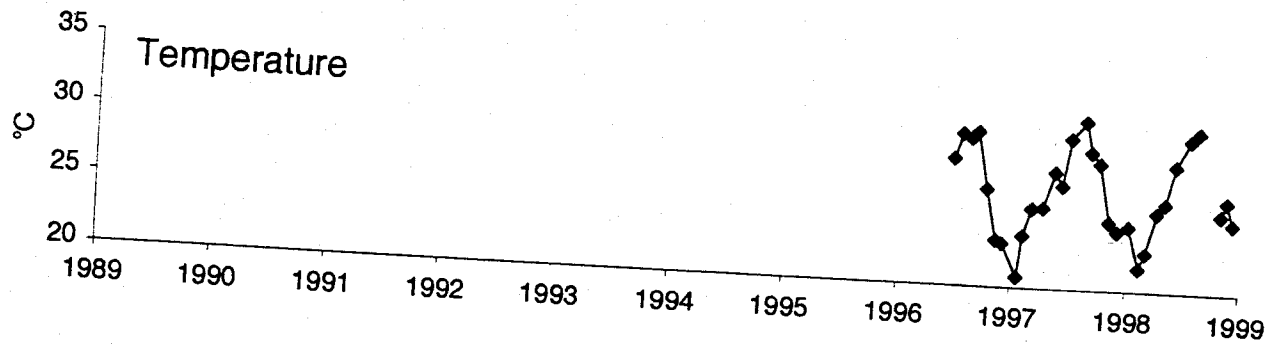
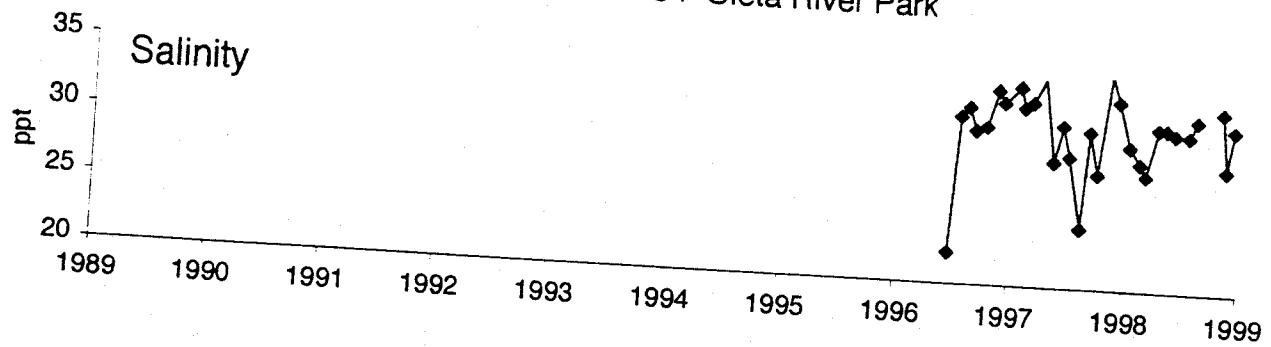
Biscayne Bay Sta. 134 Oleta River Park



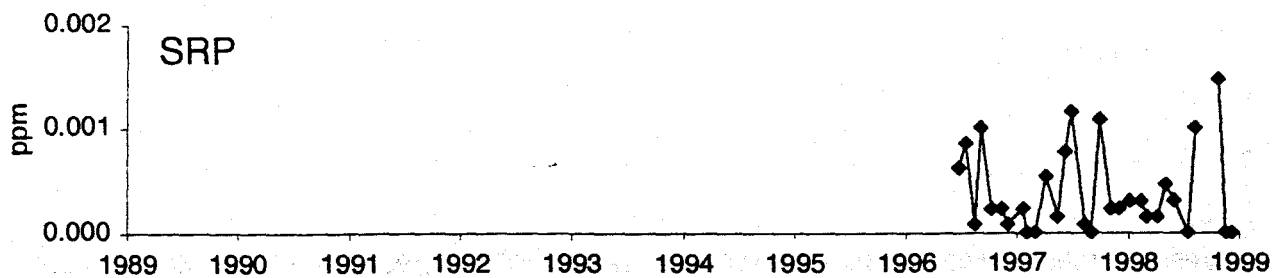
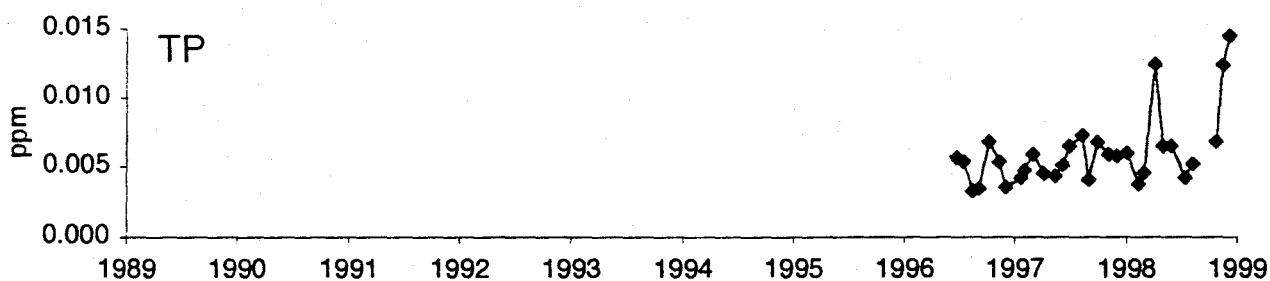
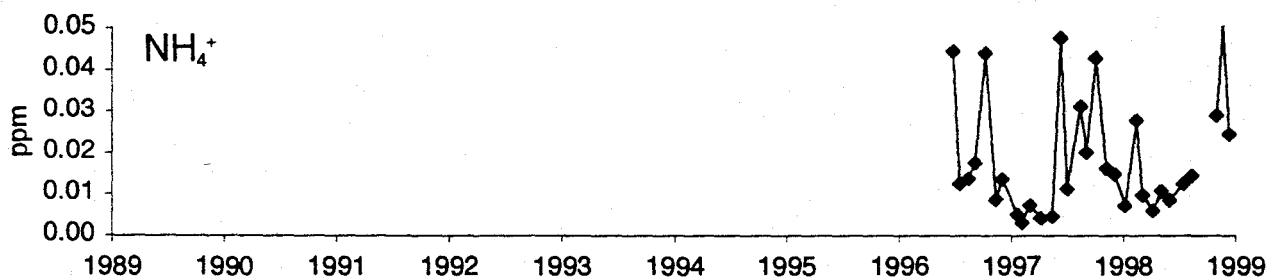
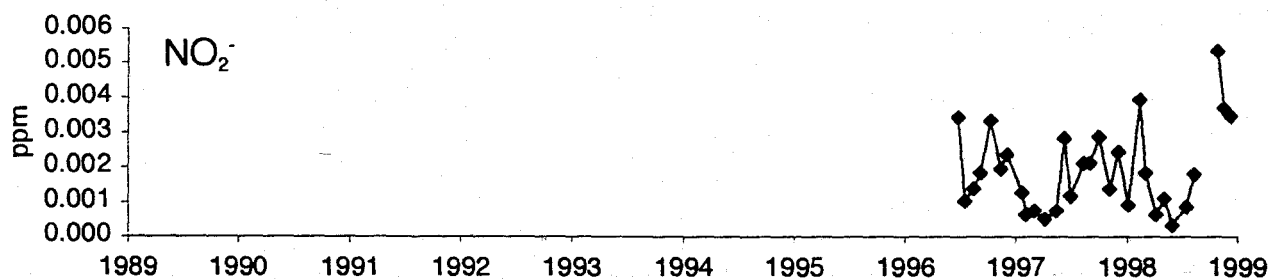
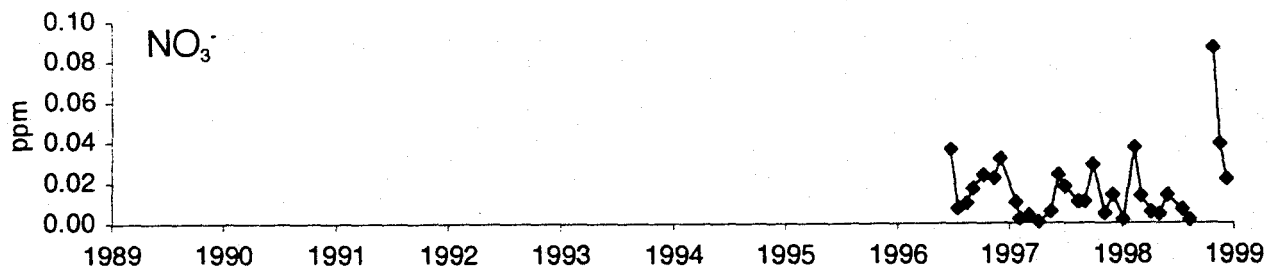
Biscayne Bay Sta. 134 Oleta River Park



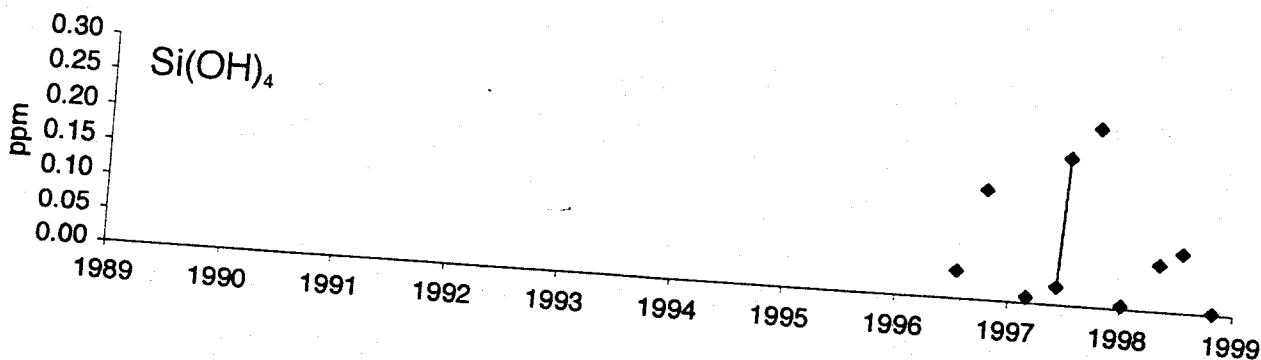
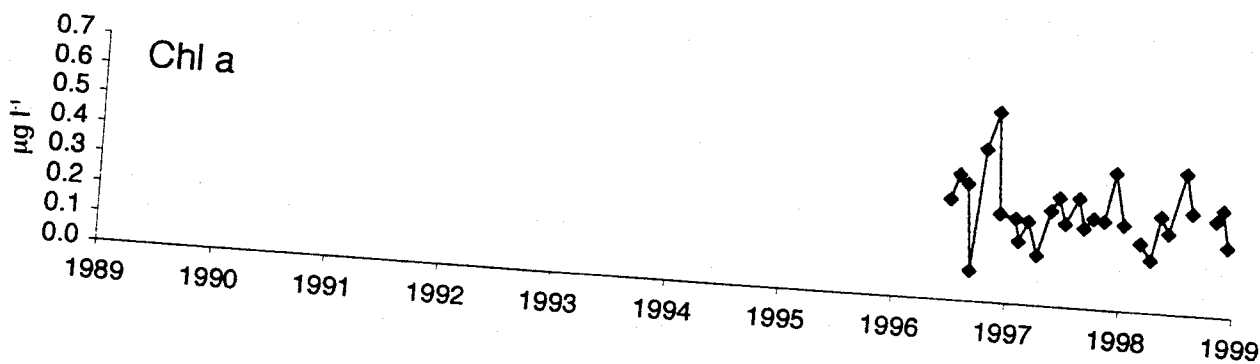
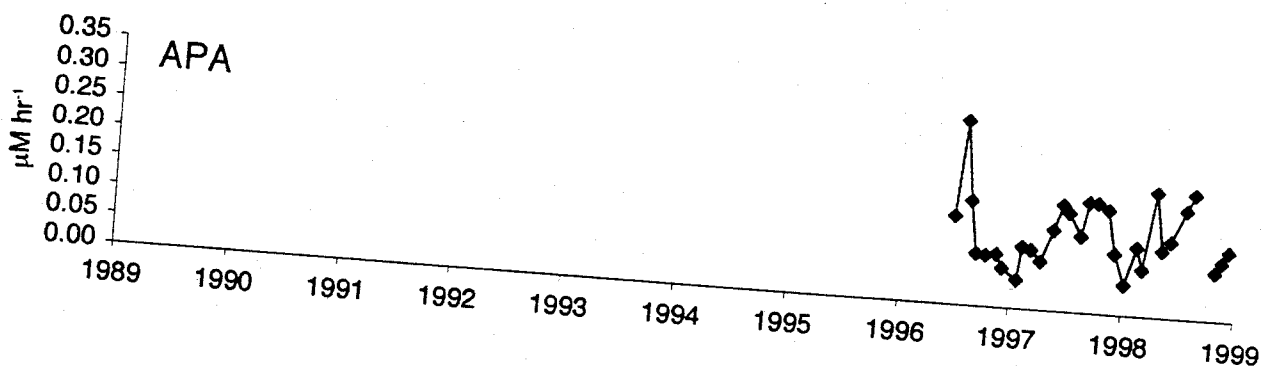
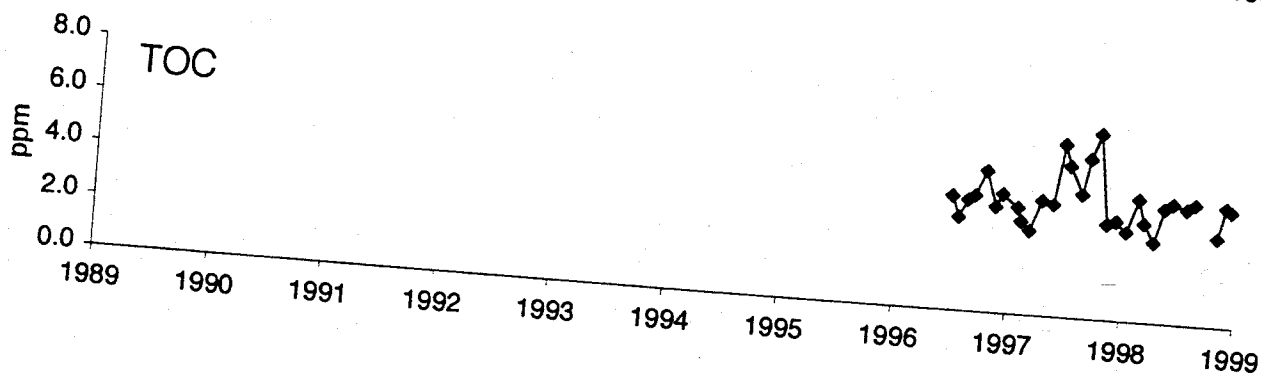
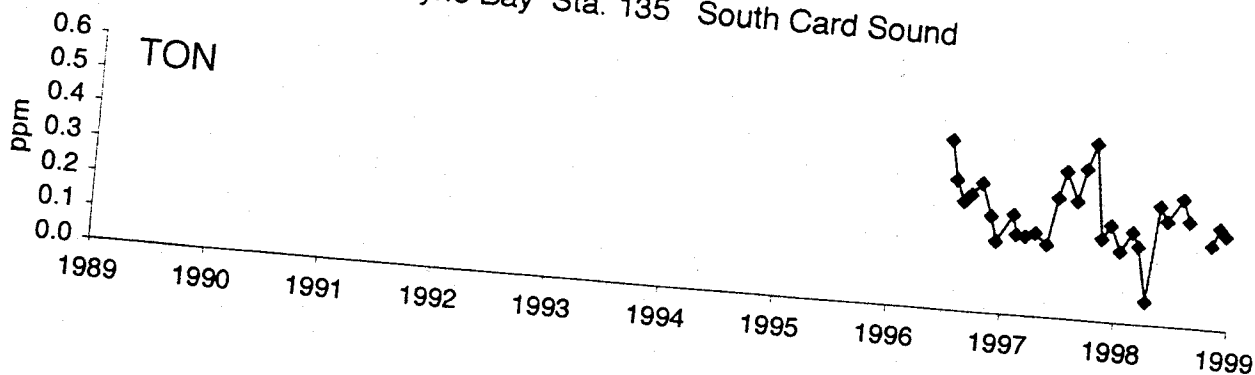
Biscayne Bay Sta. 134 Oleta River Park



Biscayne Bay Sta. 135 South Card Sound



Biscayne Bay Sta. 135 South Card Sound



Biscayne Bay Sta. 135 South Card Sound

