SOUTH FLORIDA COASTAL WATER QUALITY MONITORING NETWORK

FY2005 Cumulative Report to the South Florida Water Management District (Contract No. C-15397)

Including the waters of:

FLORIDA BAY
WHITEWATER BAY
TEN THOUSAND ISLANDS
BISCAYNE BAY
SOUTHWEST FLORIDA SHELF
MARCO ISLAND
NAPLES BAY
ESTERO BAY
ROOKERY BAY
SAN CARLOS BAY
PINE ISLAND SOUND

Prepared by:

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EXECUTIVE SUMMARY

This report summarizes the existing data from the FIU South Florida Coastal Water Quality Monitoring Network. This includes water quality data collected from 28 stations in Florida Bay, 22 stations in Whitewater Bay, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, 49 stations on the Southwest Florida Shelf (Shelf), and 28 stations in the Cape Romano-Pine Island Sound area. Each of the stations in Florida Bay were monitored on a monthly basis with monitoring beginning in March 1991; Whitewater Bay monitoring began in September 1992; Biscayne Bay monthly monitoring began September 1993; the SW Florida Shelf was sampled quarterly beginning in spring 1995; and monthly sampling in the Cape Romano-Pine Island Sound area started January 1999.

We have continued our 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 analysis can be performed on data of relatively short period of record, however, time series analysis usually requires a minimum 5 years before significant trends can be recognized over the background noise of inter-annual variability. Therefore, the type of analysis performed on each estuary is determined by the length of the record.

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 driving processes. 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. This monitoring program has been very useful in helping to define restoration targets and will be even more valuable in determining whether these goals are met.

Florida Bay

2005 was a relatively dry year with much of the bay experiencing a period of hypersalinity which began in late spring/early summer. The Eastern and Central Bay were most affected by the hypersalinity. Even the four hurricanes circulating around South Florida did not alleviate the hypersalinity in Eastern Bay. Overall DIN concentrations in the Eastern and Central Bay were lower that the grand median, except for September when we saw a spike, possibly as a result of

the hurricanes. It is hard to tell because Florida Bay was not sampled between Aug 29 and Sept. 28 when the bulk of hurricane activity occurred.

TON, TP, CHLA, and turbidity in all parts of the Bay were lower during 2004 than the grand median. TOC fluctuated but was generally lower than the grand median. Annual patterns in temperature and DO were unremarkable with values generally fluctuating around the median for all areas of the bay.

Whitewater Bay-Ten Thousand Islands

The influence of freshwater input from the Everglades is very significant to this region. Large salinity variations are the norm, being driven by both climactic events and water management practices. As 2005 was a dry year in terms of precipitation, some hypersaline events were observed. Hypersalinity was pronounced in Whitewater Bay, Mangrove Rivers, Gulf Islands, and Inner Waterway zones. The most extensive period of elevated salinity occurred in Whitewater Bay, with salinities doubled the norm during June and July.

Overall DIN concentrations in the area were lower that the grand median. The exception was the Ten Thousand Islands during Aug. to Oct. when we saw a spike in concentration (with a concurrent drop in salinity), possibly as a result of the hurricanes.

Most of the time, TON, TP, TOC, and turbidity in all parts of the TTI_WWB were lower during 2005 than the grand median. Spikes in CHLA were evident from the record showing a generalized response of the phytoplankton to DIN inputs. An interesting spike in DIN was observed in Whitewater Bay and Mangrove Rivers during December. We have no idea as to what precipitated this event, but the data from Jan. 2005 showed that concentrations had returned to normal by the next sampling event. Annual patterns in temperature and DO were unremarkable with values generally fluctuating around the median for all areas.

Biscayne Bay

Salinity in Biscayne Bay is strongly influenced by its large tidal exchange with the ocean. Nevertheless, canal inputs do have a significant impact on the ecosystem, as evidenced by the reduced nearshore salinity patterns.

As 2005 was a relatively dry year, some areas of Biscayne Bay experienced an extended period of hypersalinity which began in late spring/early summer. Contrary to what might be expected, the areas closest to the western shore were most affected by the hypersalinity. This is because of the short residence time of water in the main section of the bay as a result of large tidal forcing. All areas of Biscayne Bay experienced large inputs of DIN during Sept./Oct. It is difficult to ascertain a cause (there was no drop in salinity), but as it was a baywide phenomena, it was probably not terrestrially driven.

TOC concentrations in almost all areas of the Bay were higher than the grand median for the first half of the year, then returned to normal levels. DO levels in nearshore waters were lower than usual; we are unsure as to the cause. Annual patterns in TON, TP, CHLA, and temperature were unremarkable with values generally fluctuating around the median for all areas of the bay.

Southwest Florida Shelf

Since this component of the monitoring program began in 1995 and is only sampled quarterly, there is little trend data to analyze. Although these analyses are very preliminary it is possible to speculate that the clusters are formed as a function of hydrology and circulation patterns. We believe that the inshore cluster clearly shows the input of freshwater from Shark

River being transported south and east around the Cape. Water overlying the shoal stations probably originates somewhere in or 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

Overall, 2005 was relatively unremarkable except for a few outliers. TON was lower than the grand median for most areas, a result observed in other areas of the southwest coast.

Cape Romano-Pine Island Sound

Overall, this area has significantly higher concentrations of CHLA, TP, and DIN than the bulk of the Ten Thousand Islands stations. Much of this is due to geological changes from carbonates to silicates, which facilitates transport of phosphorus, and to major land use changes from the Big Cypress National Preserve to suburban and agricultural.

The largest interannual variations in salinity in this area are driven by freshwater releases from the Caloosahatchee River. The large freshwater inputs result in high DIN loads and concentrations. Freshwater releases during Sept./Oct. resulted in DIN concentrations up to 10 times normal. This was due to the need to lower the water table inland because of potential flooding from the hurricanes. The large and rapid increase in N (and P) loading to the estuaries caused large phytoplankton blooms and increased turbidity across the region.

Annual patterns in TON, TOC, temperature, and DO were unremarkable with values generally fluctuating around the median for all areas of the bay.

ACKNOWLEDGMENTS

We thank all of our many field personnel, laboratory technicians, and data support staff for their diligence and perseverance in this ongoing program, especially Pete Lorenzo. This project was possible due to the continued funding by the South Florida Water Management District (District Contract No. C-15397). We also thank Rookery Bay NERR/FDEP and the captain and crew of the R/V Bellows of the Florida Institute of Oceanography for their field support of the monitoring program.

This report is contribution #T-326 of the Southeast Environmental Research Center at Florida International University.

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1. PROJECT DESCRIPTION

1.1. Background

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 our South Florida Coastal Water Quality Monitoring Network through Dec. 2005 (Fig. 1.1). This network includes water quality data collected from 28 stations in Florida Bay, 22 stations in Whitewater Bay to Lostmans River, 25 stations in Ten Thousand Islands, 25 stations in Biscayne Bay, 49 stations on the Southwest Florida Shelf (Shelf), and 28 stations in the Cape Romano-Pine Island Sound area.

Each of the stations in Florida Bay were sampled on a monthly basis with monitoring beginning in March 1991 (except stations 14, 19, 22, and 23 which began April 1991). In July 1992, stations 25 through 28 were added in Florida Bay. Monthly sampling at stations 29-50 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 Ten Thousand Islands sites 51-75 were begun in Sept. 1994, the Shelf was sampled quarterly beginning in spring 1995, and the Cape Romano-Pine Island Sound area was started Jan. 1999. A summary of station locations and sampling period of record is shown in Table 1.

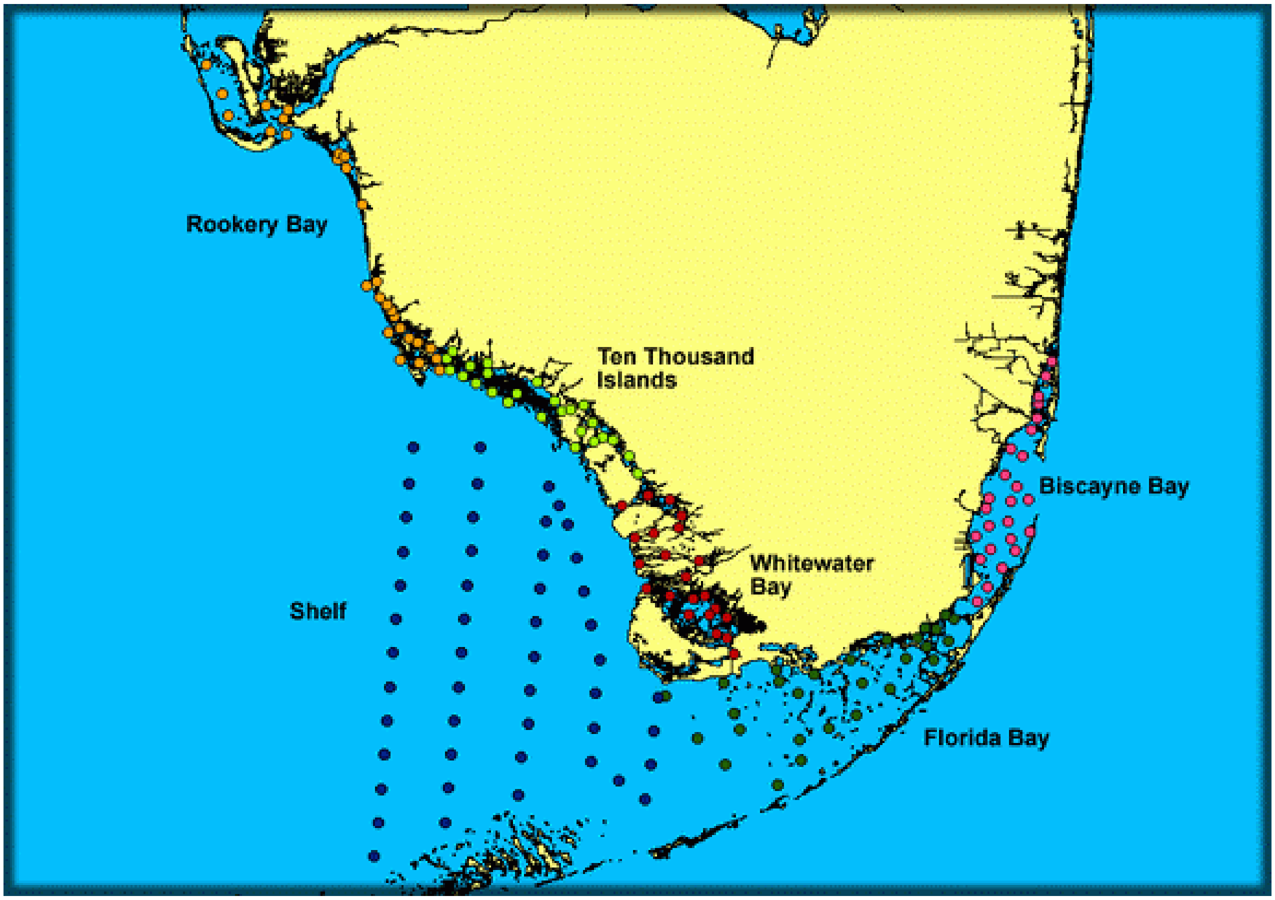


Figure 1.1. Fixed station locations for the SFWMD funded portion of the South Florida Coastal Water Quality Monitoring Network.

1.2. Field and Analytical Methods

Water samples were collected and analyzed using standard methodology outlined in the Quality Assurance Plan with prior approval from SFWMD and FDEP. Salinity, temperature (°C), dissolved oxygen (DO, mg l^{-1}), and pH were measured 10 cm below the surface and 10 cm above the bottom using a combination sonde (Hydrolab 140). Sondes were calibrated prior to and after sampling to ensure accuracy.

Duplicate, unfiltered water samples were collected from 10 cm below the surface using 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. These samples were filtered by hand (25 mm glass fiber GF/F) into acetone-washed and sample rinsed 60 ml HDPE bottles, which were then capped and immediately placed on ice in the dark for transport. The wet filters, used for chlorophyll *a* analysis (CHLA), were placed in 2 ml plastic centrifuge tubes to which 1.5 ml of 90% acetone was added. They were then immediately capped and put into a dark bottle on ice for transport (APHA 1999).

Unfiltered water samples were analyzed for total organic carbon (TOC), total nitrogen (TN), total phosphorus (TP), alkaline phosphatase activity (APA), and turbidity (NTU). TOC was measured by direct injection onto hot platinum catalyst in a Shimadzu TOC-5000 after first acidifying to 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 (Frankovich and Jones 1998). TP was determined using a dry ashing, acid hydrolysis technique (Solorzano and Sharp 1980). The APA assay measures the activity of alkaline phosphatase, an enzyme used by bacteria to mineralize phosphate from organic compounds (Hashimoto et al. 1985). This 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 (µM 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 ($Si(OH)_4$) by flow injection analysis (Alpkem model RFA 300). Filters for CHLA content (µg 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 CHLA (Sigma).

Some parameters were not measured directly, but were calculated by difference. Nitrate (NO_3^-) was calculated as $NO_X^- - NO_2^-$. Dissolved inorganic nitrogen (DIN) was calculated as $NO_X^- + NH_4^+$. Total organic nitrogen (TON) was defined as TN - DIN. Concentrations for all of these water quality variables are reported 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. All N:P ratios discussed are calculated on a molar basis.

1.3. References

APHA. 1999. Standard Methods for the Examination of Water and Wastewater.

EPA Methods for Chemical Analysis of Water and Wastes, Revised March 1983.

Frankovich, T. A., and R. D. Jones. 1998. A rapid, precise, and sensitive method for the determination of total nitrogen in natural waters. *Marine Chemistry* **60**: 227-234.

Hashimoto, Kitao, and Keiichiro. 1985. Relationship between alkaline phosphatase activity and orthophosphate in the present Tokyo Bay. *Environ. Sci. Health* **A20**: 781-908)

Solorzano, L., and J. H. Sharp. 1980. Determination of total dissolved phosphorus and particulate phosphorus in natural waters. *Limnol. Oceanogr*. **25**: 754-758.

2. STATE OF WATER QUALITY IN FLORIDA BAY

Overall Period of Record

A spatial analysis of data from our monitoring program resulted in the delineation of 3 groups of stations, which have robust similarities in water quality (Fig. 2.1). We contend that these spatially contiguous groups of stations are the result of similar hydrodynamic forcing and processing of materials, hence we call them 'zones of similar influence'. The Eastern Bay zone acts most like a 'conventional' estuary in that it has a quasi-longitudinal salinity gradient caused by the mixing of freshwater runoff with seawater. In contrast, the Central Bay is a hydrographically isolated area with low and infrequent terrestrial freshwater input, a long water residence time, and high evaporative potential. The Western Bay zone is the most influenced by the Gulf of Mexico tides and is also isolated from direct overland freshwater sources.

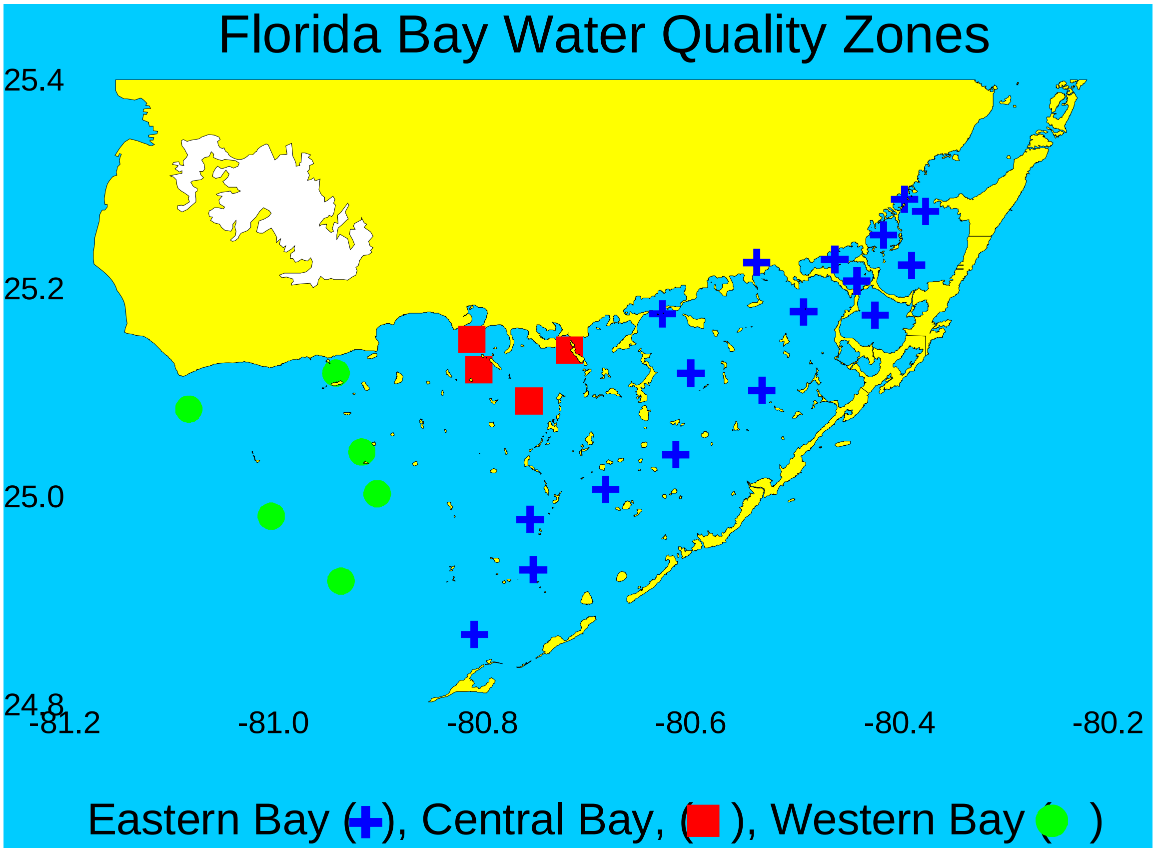


Figure 2.1. Zones of similar water quality in Florida Bay

Climactic changes occurring over the data collection period of record had major effects on the health of the bay. Precipitation rebounded from the drought during the late 1980's being equal to or greater than the long term average (141.5 cm yr^{-1}) for 10 of the last 14 years (Fig 2.2.).

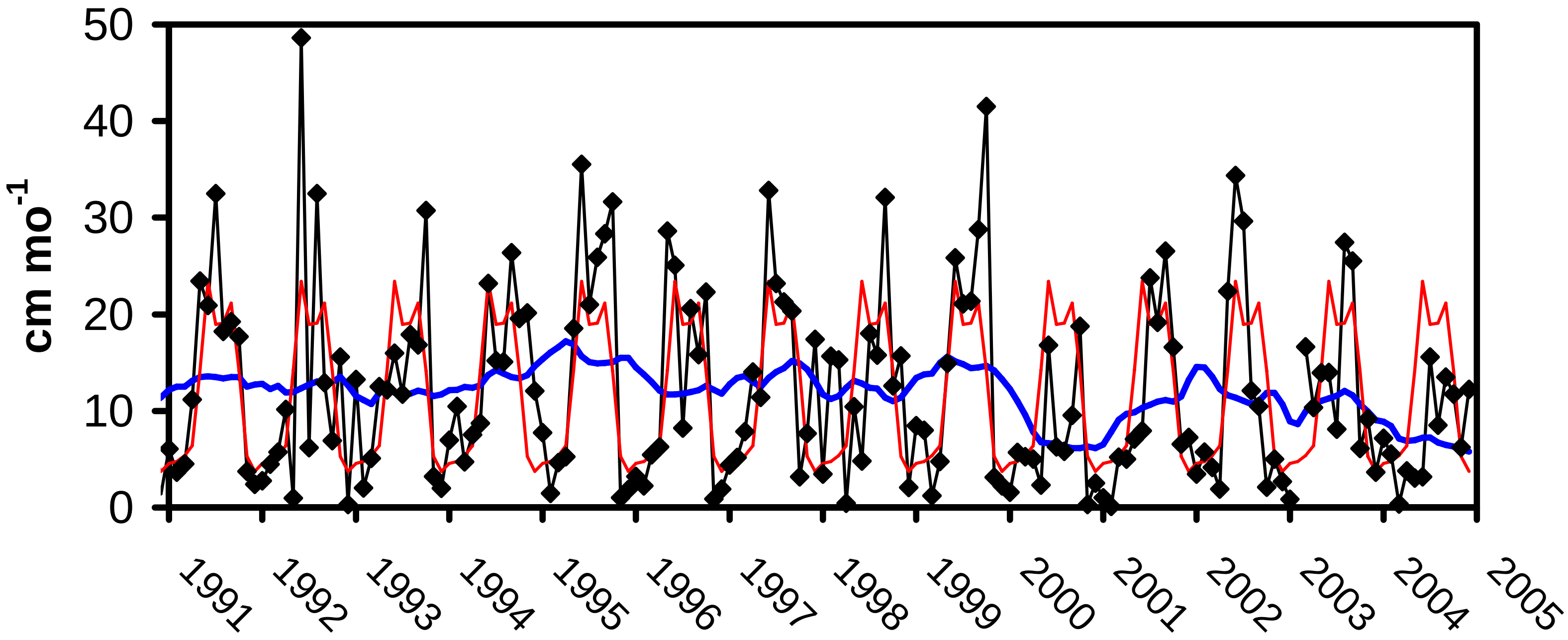


Figure 2.2. Monthly rainfall in the Florida Bay area. The red line is long term monthly average (since 1948); the blue line is 12 month moving average.

Early in the record, salinity and total phosphorus (TP) concentrations declined baywide while turbidity (cloudiness of the water) increased dramatically. The salinity decline in Eastern and Central Florida Bay was dramatic early on and has since stabilized into a regular seasonal cycle (Fig. 2.3-2.5). The box-and-whisker plots presented in this and following figures show the range (boxes are quartiles; whiskers include 90% of data) and median (line in box) of the monthly data. Some of this decrease in Eastern Bay could be accounted for by increased freshwater flows from the Everglades but declines in other areas point to the climactic effect of increased rainfall during this period. The Central Bay continues to experience hypersaline conditions (>35) during the summer but the extent and duration of the events is much smaller.

Chlorophyll *a* concentrations (CHLA), a proxy for phytoplankton biomass, were particularly dynamic and spatially heterogeneous (Fig. 2.3-2.5). The Eastern Bay generally has the lowest CHLA while the Central Bay is highest. In the Eastern Bay, which makes up roughly half of the surface area of Florida Bay, CHLA has declined by 0.9 µg l^{-1} or 63%. Most of this decline occurred over a few months in the spring/summer of 1994 and has remained relatively stable. The isolated Central Bay zone underwent a 5-fold increase in CHLA from 1989-94 then rapidly declined to previous levels by 1996. In Western Florida Bay, there was a significant increase in CHLA, yet median concentrations remained modest (2 µg l^{-1}) by most estuarine standards. There were significant blooms in Central and Western Bay immediately following Hurricanes Georges (Nov. 1998) but it was Hurricane Irene's large rainfall input (Oct. 1999) which spiked the largest blooms all throughout the bay. It is important to note that these changes in CHLA (and turbidity) happened years after the poorly-understood seagrass die-off in 1987. It is possible that the death and decomposition of large amounts of seagrass biomass might partially explain some of the changes in water quality of Florida Bay but the connections are temporally disjoint and the processes indirect and not well understood.

As mentioned previously, TP concentrations have declined baywide over the 14 year period of record. As with salinity, most of these declines occurred early in the record. Unlike most other estuaries, increased terrestrial runoff may have been partially responsible for the decrease in TP concentrations in the Eastern Bay. This is because the TP concentrations of the runoff are at or below ambient levels in the bay. The elevated TP in the Central Bay is mostly due to concentration effect of high evaporation. Recently, there have been significant peaks during the fall season in both Eastern and Western Bays. It is important to understand that almost all the phosphorus measured as TP is in the form of organic matter which is less accessible to plants and algae than inorganic phosphate.

The dissolved inorganic nitrogen assemblage (DIN) is made up of ammonium (NH_4^+), nitrate (NO_3^-), and nitrate (NO_2^-). The Western Bay is lowest in DIN; phytoplankton in this region may be limited by N availability on a regular basis. DIN in the Eastern Bay is a little higher and is mostly in the form of NO_3^- while highest levels are found in the Central Bay as NH_4^+.

Turbidity in the Central and Western Bays have increased greatly since 1991 (not shown). Turbidity in Eastern Bay increased 2-fold from 1991-93, while Central and Western Bays increased by factors of 20 and 4, respectively. Turbidity across the bay has since stabilized and possibly declined but certainly not to previous levels. In general, the Eastern Bay has the clearest water, which is due to a combination of factors such as high seagrass cover, more protected basins, low tidal energy, and shallow sediment coverage. We are unsure as to the cause, but the loss of seagrass coverage may have destabilized the bottom so that it is more easily disturbed by wind events.

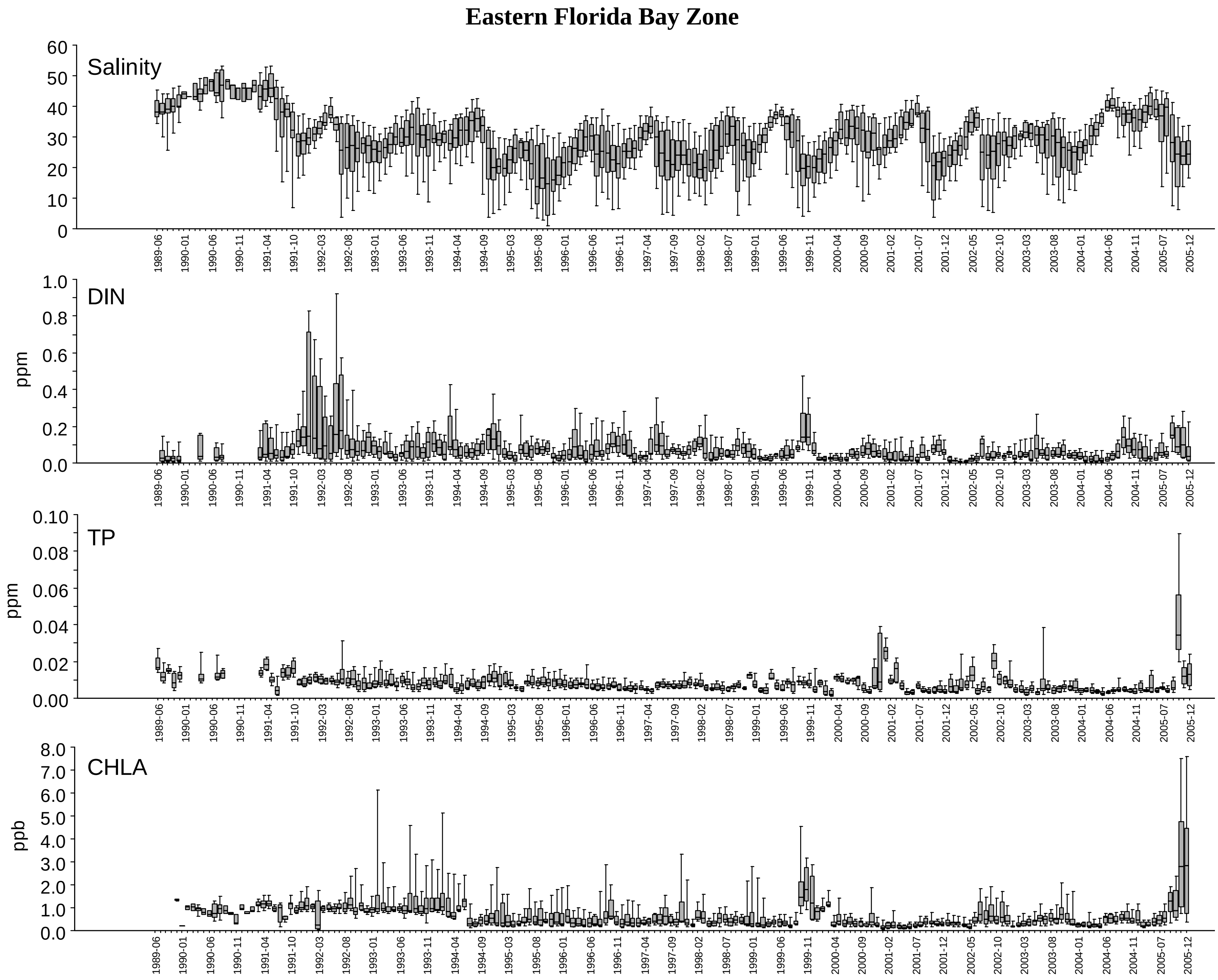
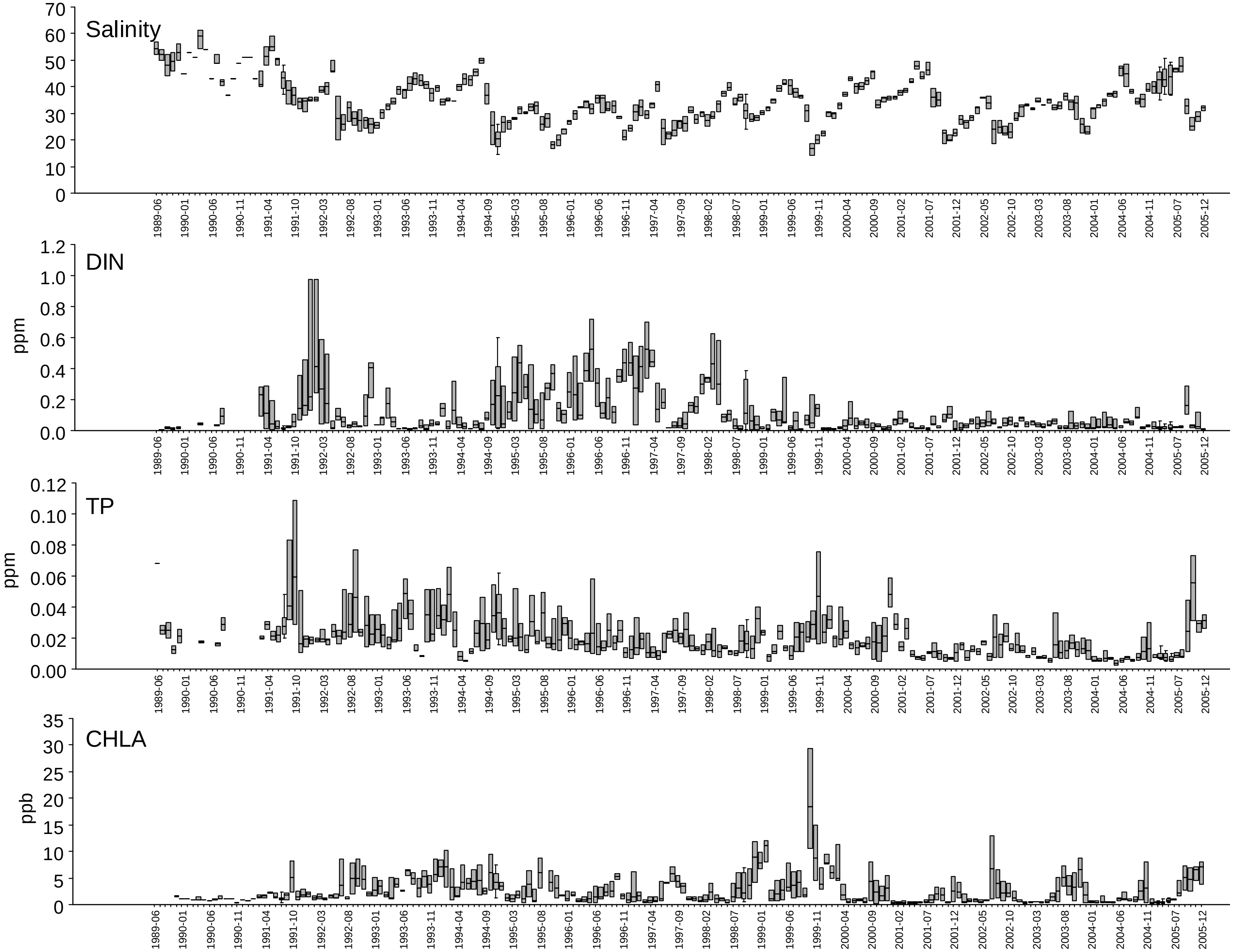


Figure 2.3. Box-and-whisker plots of water quality in Eastern Florida Bay by survey.



Central Florida Bay Zone

Figure 2.4. Box-and-whisker plots of water quality in Central Florida Bay by survey.

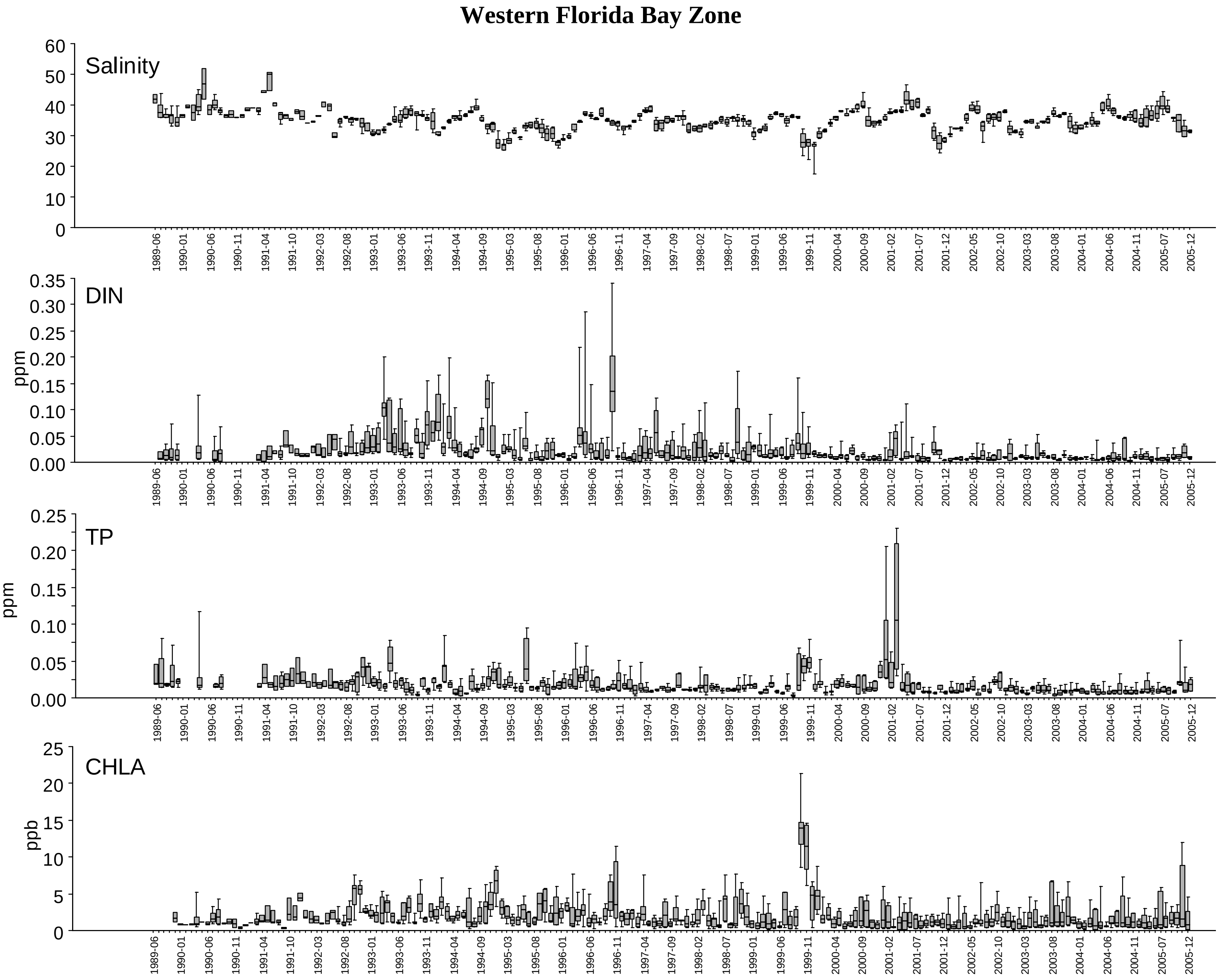


Figure 2.5. Box-and-whisker plots of water quality in Western Florida Bay by survey.

2005 Alone

2005 was a relatively dry year with much of the bay experiencing a period of hypersalinity which began in late spring/early summer (Fig 2.6-2.8). The Eastern and Central Bay were most affected by the hypersalinity. Even the four hurricanes circulating around South Florida did not alleviate the hypersalinity in Eastern Bay. Overall DIN concentrations in the Eastern and Central Bay were lower that the grand median, except for September when we saw a spike, possibly as a result of the hurricanes. It is hard to tell because Florida Bay was not sampled between Aug 29 and Sept. 28 when the bulk of hurricane activity occurred.

TON, TP, CHLA, and turbidity in all parts of the Bay were lower during 2004 than the grand median. TOC fluctuated but was generally lower than the grand median. Annual patterns in temperature and DO were unremarkable with values generally fluctuating around the median for all areas of the bay.

Data, Graphs, and Figures

All data for the period of record are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/DataDL.htm
Monthly time series graphs for all measured variables for each station are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/FB.htm
Contour maps showing spatial distributions of all measured variables (quarterly) are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/ContourMaps.htm

Eastern Florida Bay (FBE)

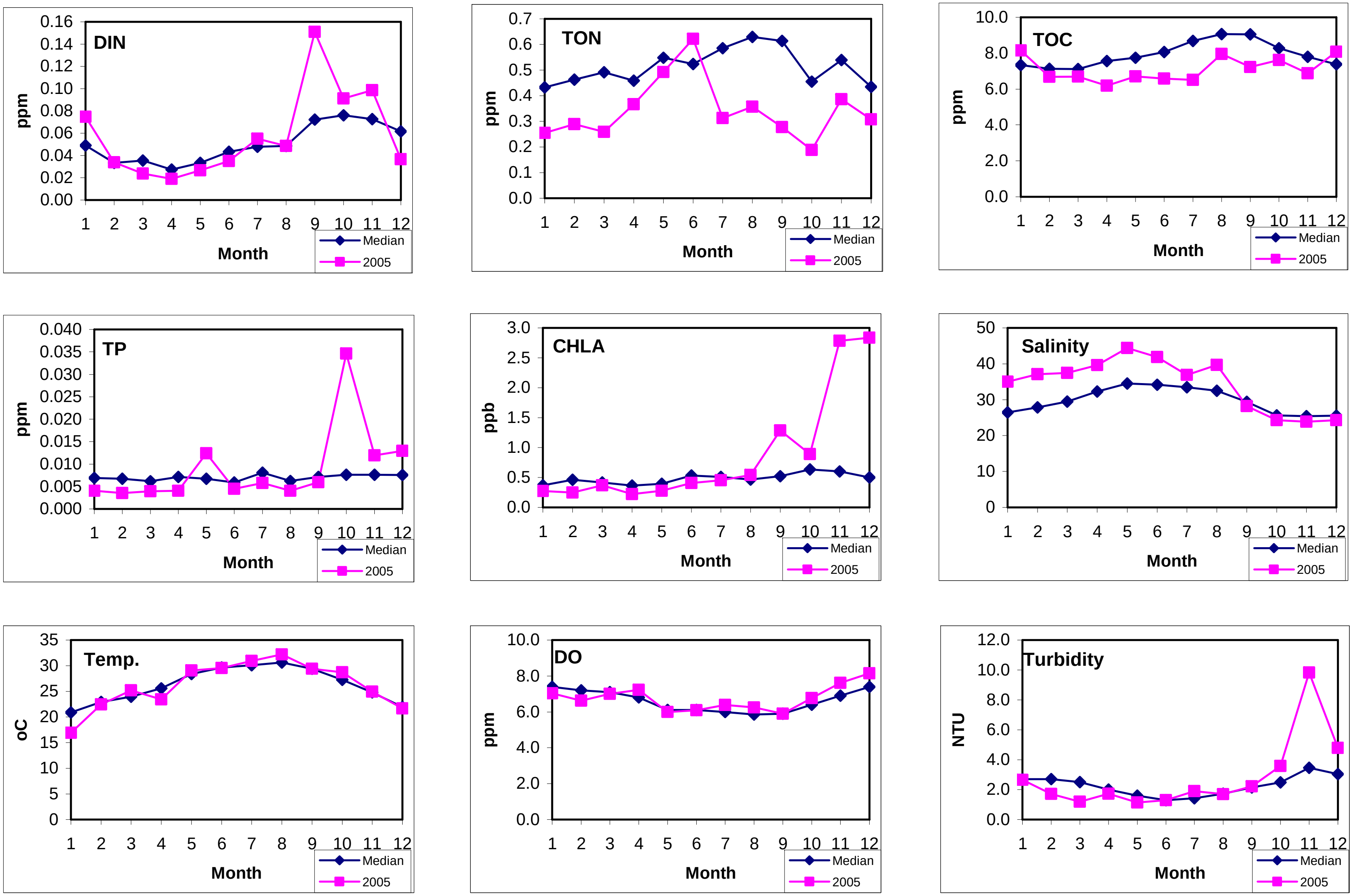


Figure 2.6. Comparison of long-term median with 2005 data.

Central Florida Bay (FBC)

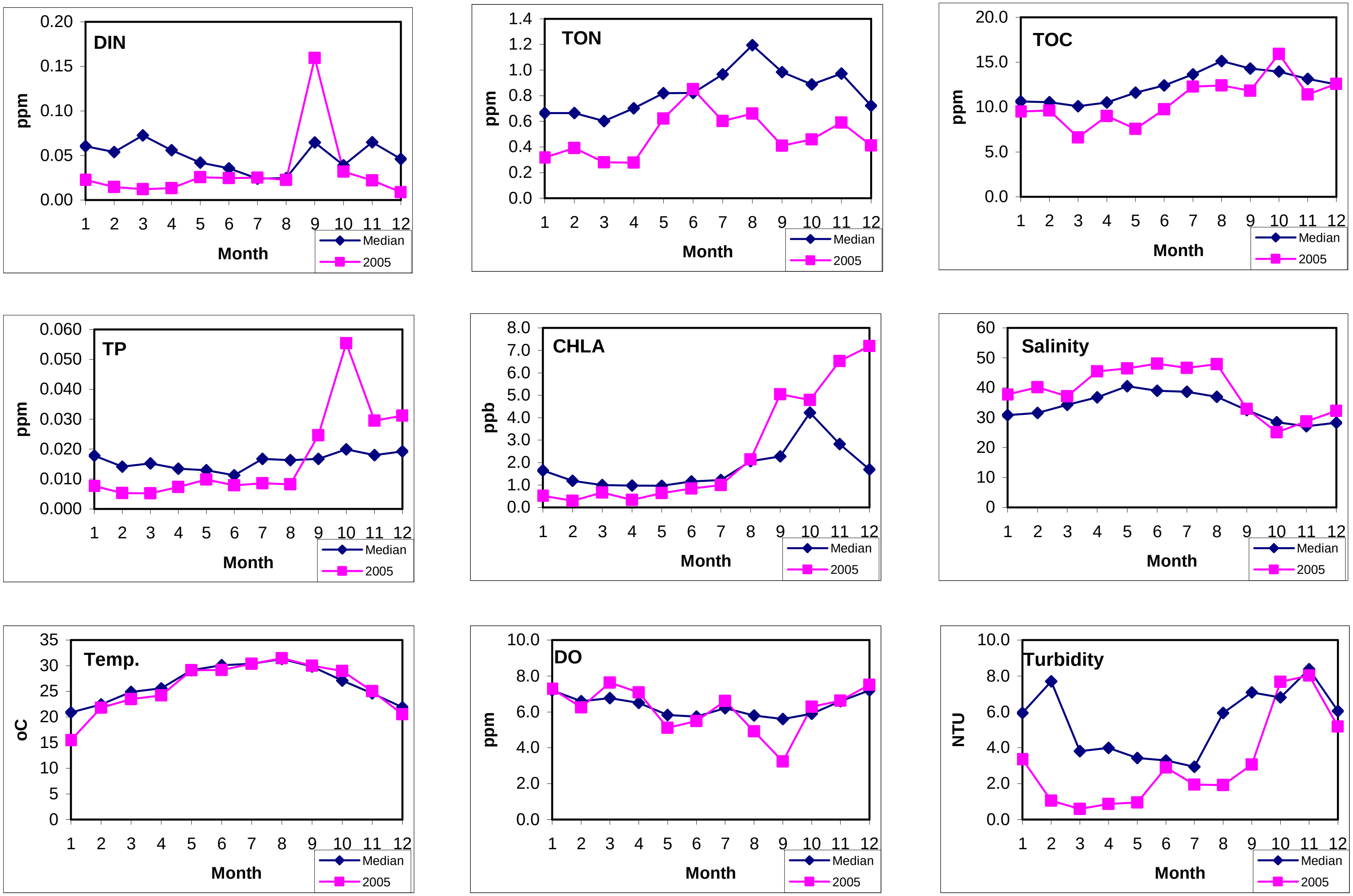


Figure 2.7. Comparison of long-term median with 2005 data.

Western Florida Bay (FBW)

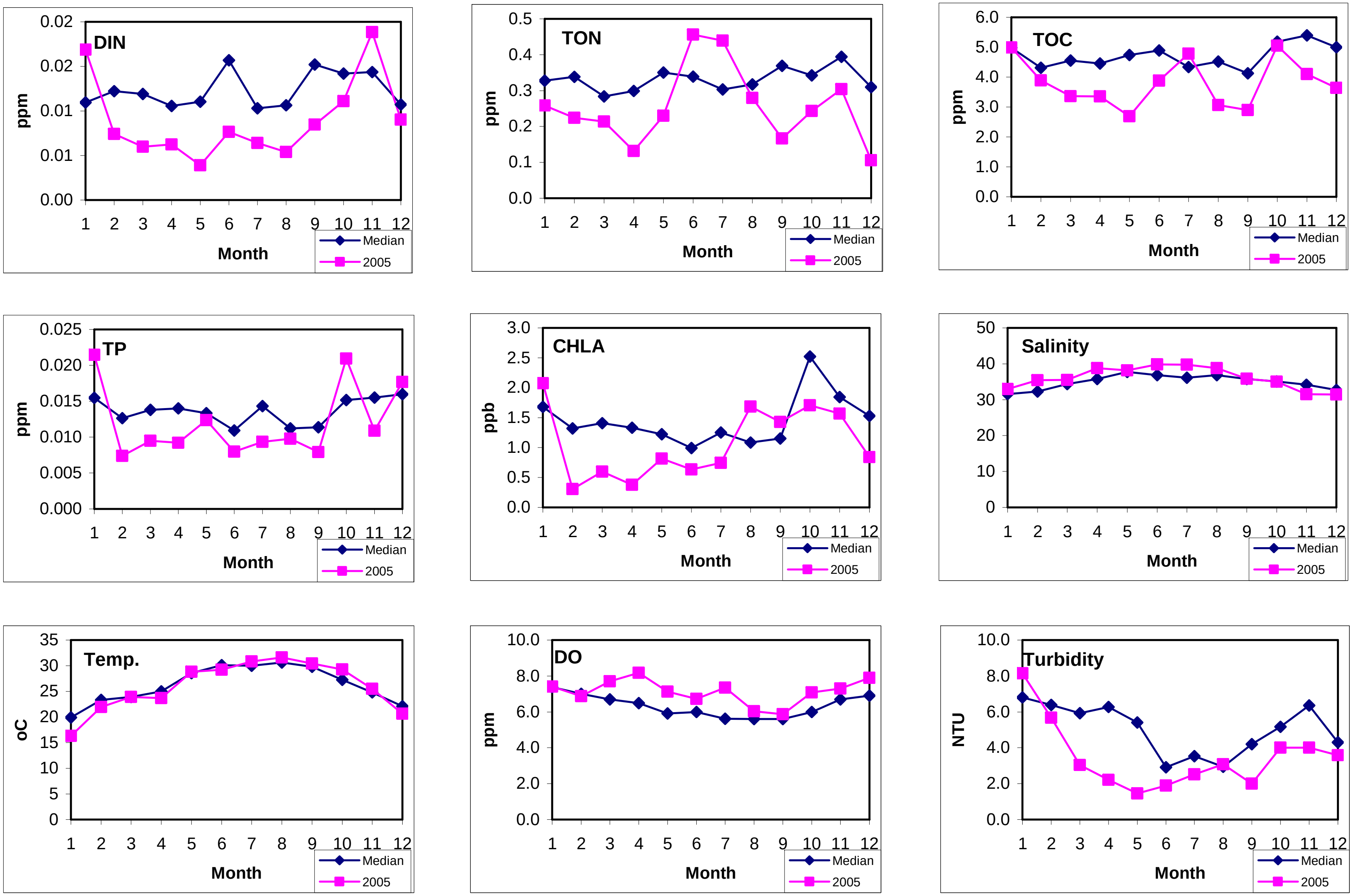


Figure 2.7. Comparison of long-term median with 2005 data.

3. STATE OF WATER QUALITY IN WHITEWATER BAY - TEN THOUSAND ISLANDS COMPLEX

Overall Period of Record

A spatial analysis of data from our monitoring program resulted in the delineation of 6 groups of stations, which have robust similarities in water quality (Fig. 3.1). The first cluster was composed of 13 stations in and around the Shark, Harney, Broad, and Lostmans Rivers and is called the Mangrove River (MR) 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 (WWB). Twelve stations were sited mostly in and around the coastal islands of TTI-WWB formed the Gulf Island group (GI). The water quality characteristics at the Coot Bay site (COOT) 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 (BLK). Finally, the Inland Wilderness Waterway zone (IWW) included 11 stations distributed throughout the inside passage as well as the Chatham River and the station off Everglades City.

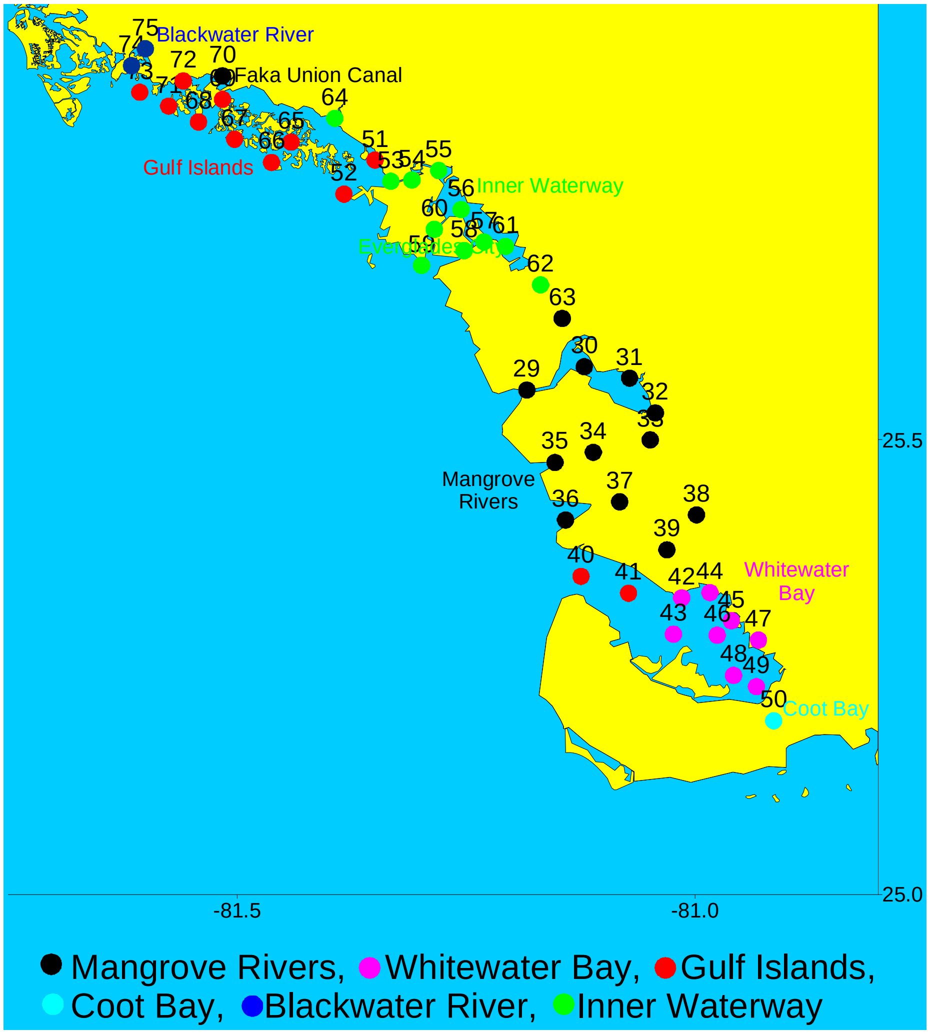


Figure 3.1. Zones of similar water quality in Whitewater Bay-Ten Thousand Islands complex

Marked differences in physical, chemical, and biological characteristics among zones were illustrated by this technique. The general spatial trend is one of highly variable salinity as a result of Shark Slough inputs in the south (Fig. 3.2-3.6). Salinity in the Gulf Islands zone was more consistent due to Gulf of Mexico influence but also is affected by Caloosahatchee River outputs. CHLA concentrations were relatively high in this region compared to Florida Bay and the Shelf. Highest CHLA were observed in the semi-enclosed areas such as Whitewater Bay and the Inner Wilderness Waterway. It is possible that the longer water residence times exhibited in these areas promoted the intensification of algal biomass. TP tended to be lowest in Whitewater Bay and Mangrove Rivers but increased northward along the coast. The spatial distribution of DIN was generally opposite to that of TP. The net effect was the formation of a gradient with strong phosphorus limitation occurring in the southern region which shifted to a more balanced N:P ratio in the northern area around the Blackwater River. The Mangrove Rivers were a significant source of TOC to the Shelf. TOC was highest in the south and declined northward along the coast.

We believe these gradients are the result of coastal geomorphology and watershed characteristics in the region. The width of the mangrove forest is widest in the south (15 km) but grades to only 4 km wide in the northern TTI; this being a function of elevation and sediment type. Whitewater Bay is a semi-enclosed body of water with a relatively long residence time, which receives overland freshwater input from the Everglades marsh. The long water residence time may explain the very low P concentrations (from biological uptake), while the high evaporation rate would tend to concentrate dissolved organic matter (DOM). The Mangrove Rivers are directly connected to the Shark River Slough and therefore have a huge watershed relative to their volume. Freshwater inputs from this source are very low in P while the extensive mangrove forest contributes much DOM. The Inner Waterway is an intermediate zone in all respects; having extensive channelization but low freshwater input. The Gulf Island zone has very low freshwater input due to the poorly drained watershed of the Big Cypress Basin. Instead of mangrove river channels there are many mangrove islands set in low tidal energy environment situated behind the Cape Romano Shoals. Finally there is the Blackwater River cluster with highest TP concentrations. There is considerable agriculture (tomatoes, etc.) in the Blackwater River watershed, which may contribute significant amounts of P to the system via drainage ditches. Further analysis of this relationship is planned.

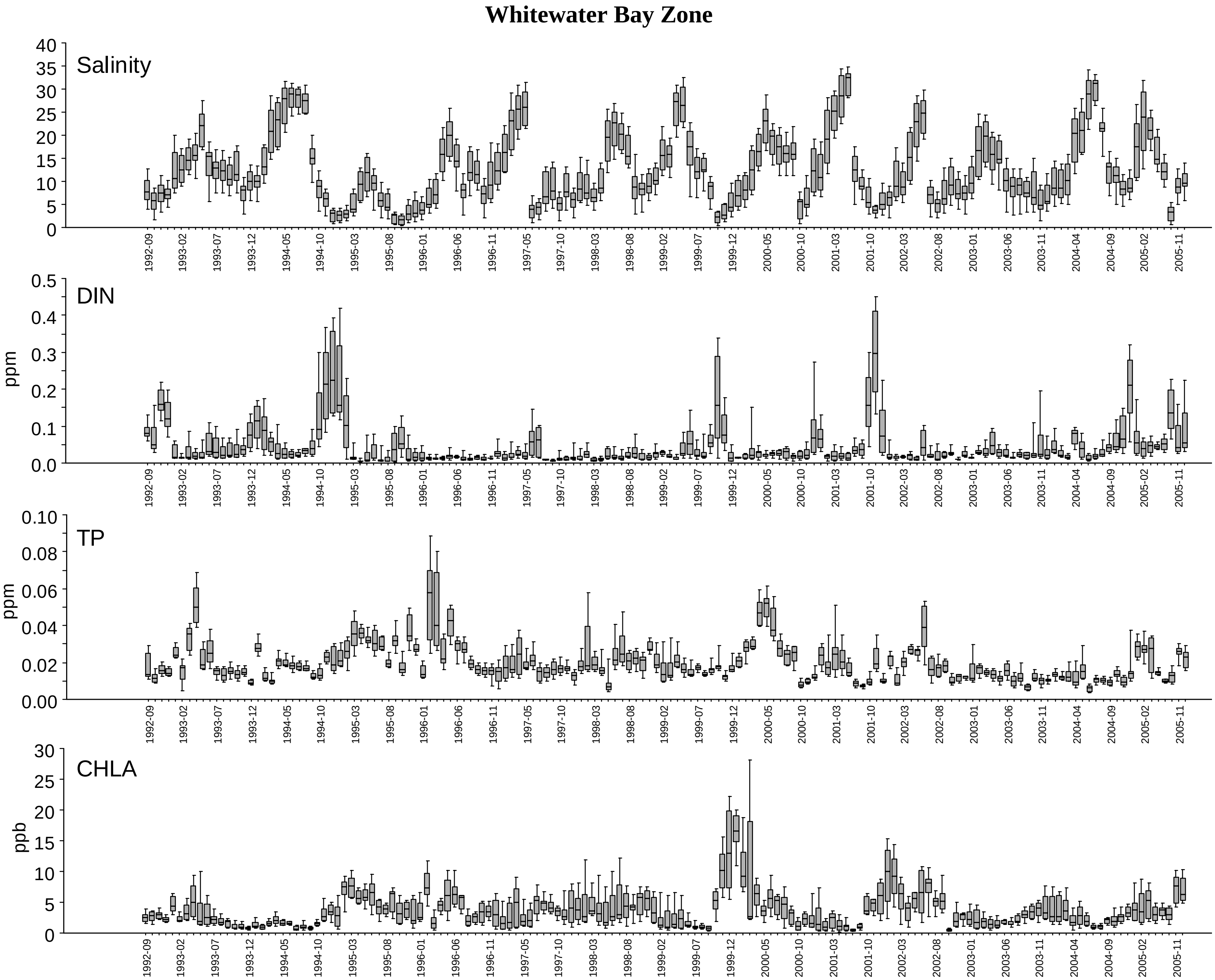

Whitewater Bay Zone

Figure 3.2. Box-and-whisker plots of water quality in WWB-TTI by survey.

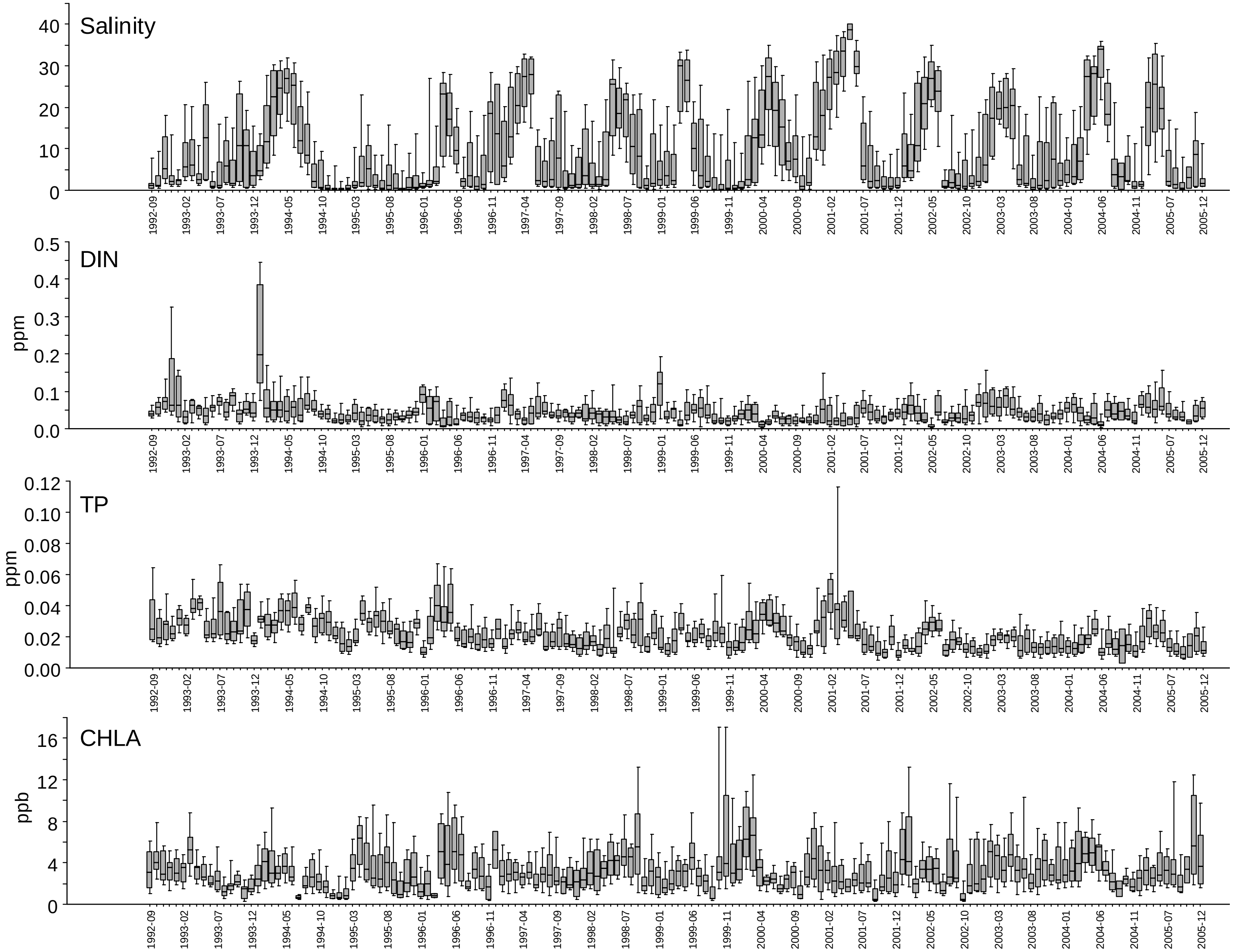

Mangrove Rivers Zone

Figure 3.3. Box-and-whisker plots of water quality in WWB-TTI by survey.

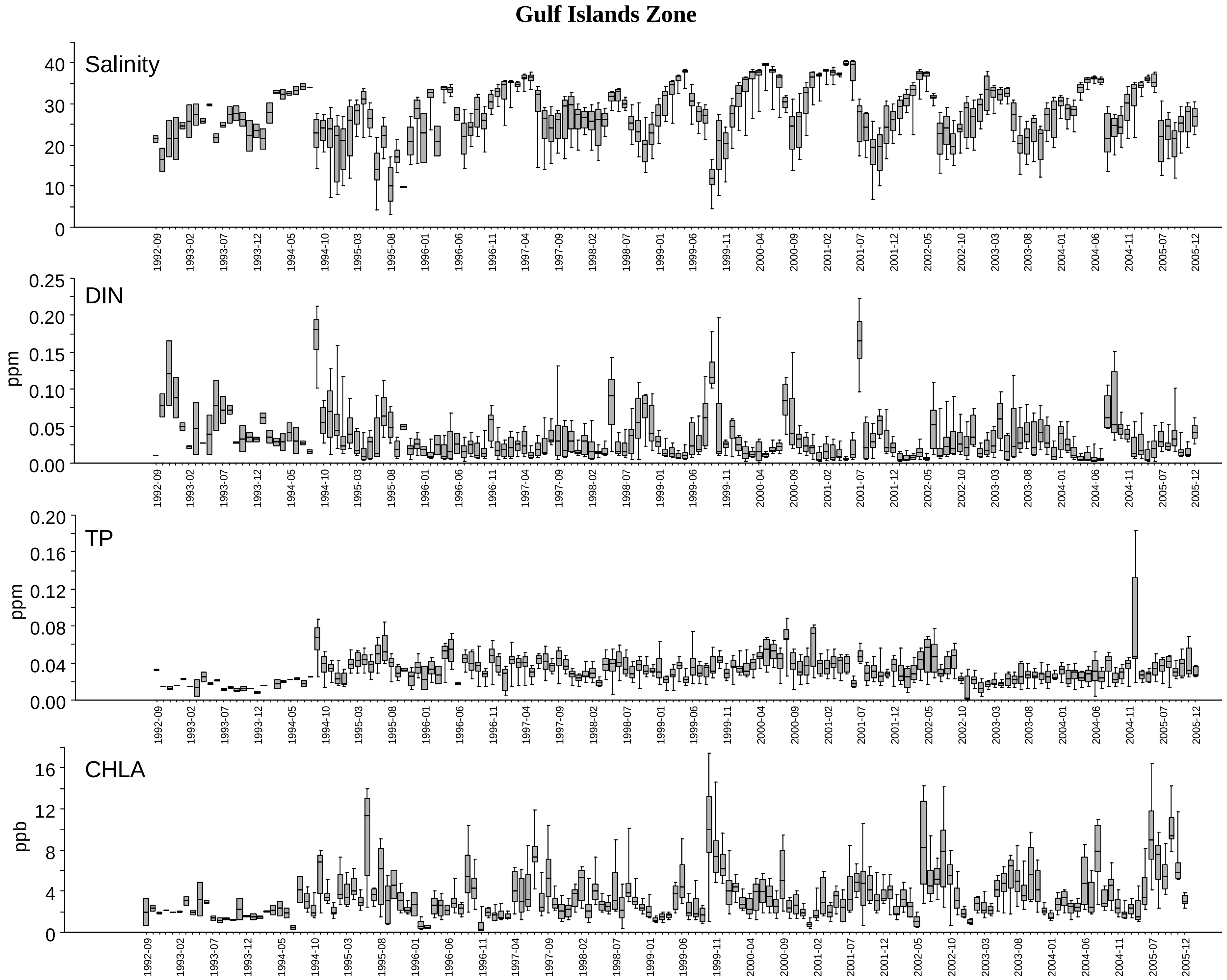

Gulf Islands Zone

Figure 3.4. Box-and-whisker plots of water quality in WWB-TTI by survey.

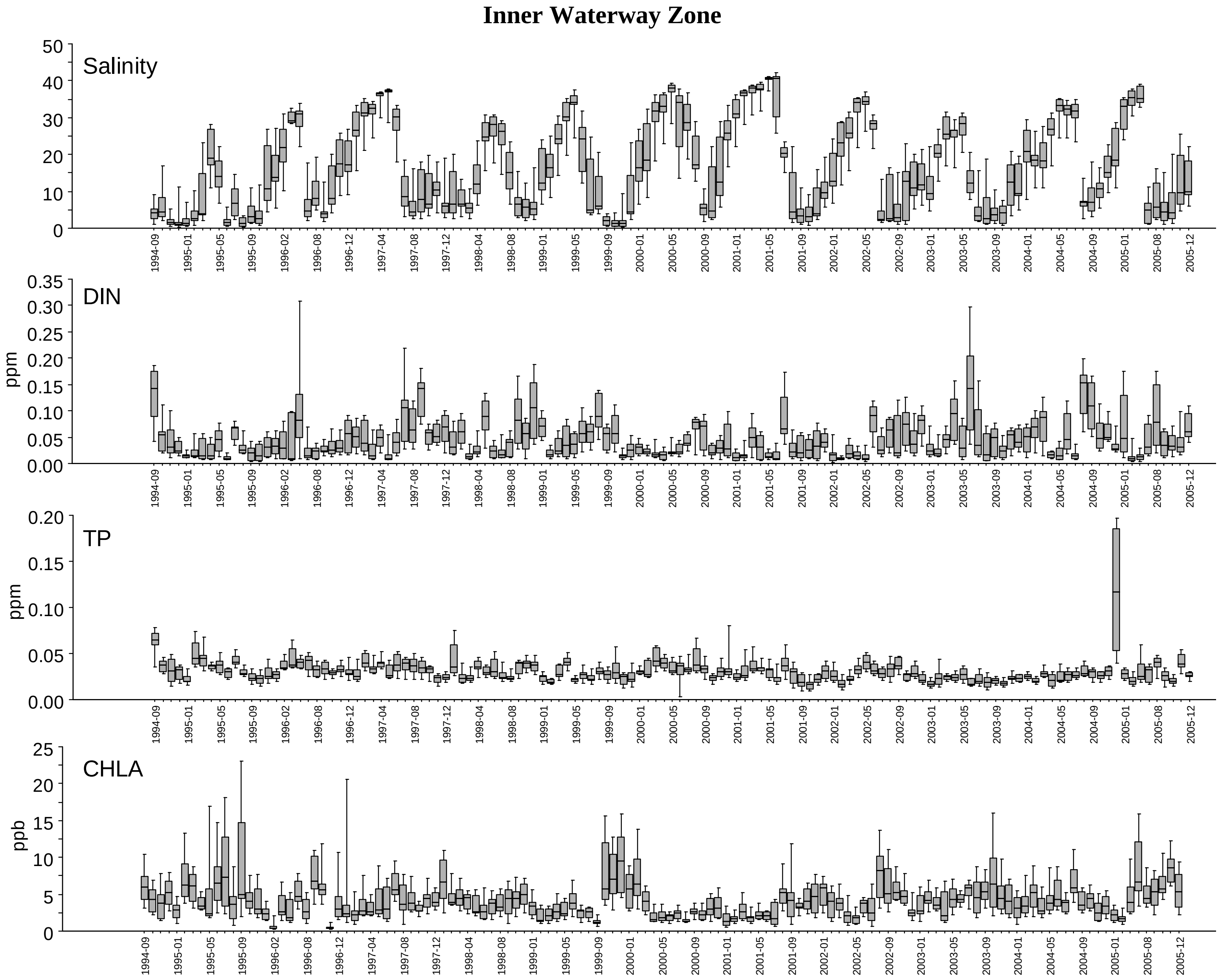
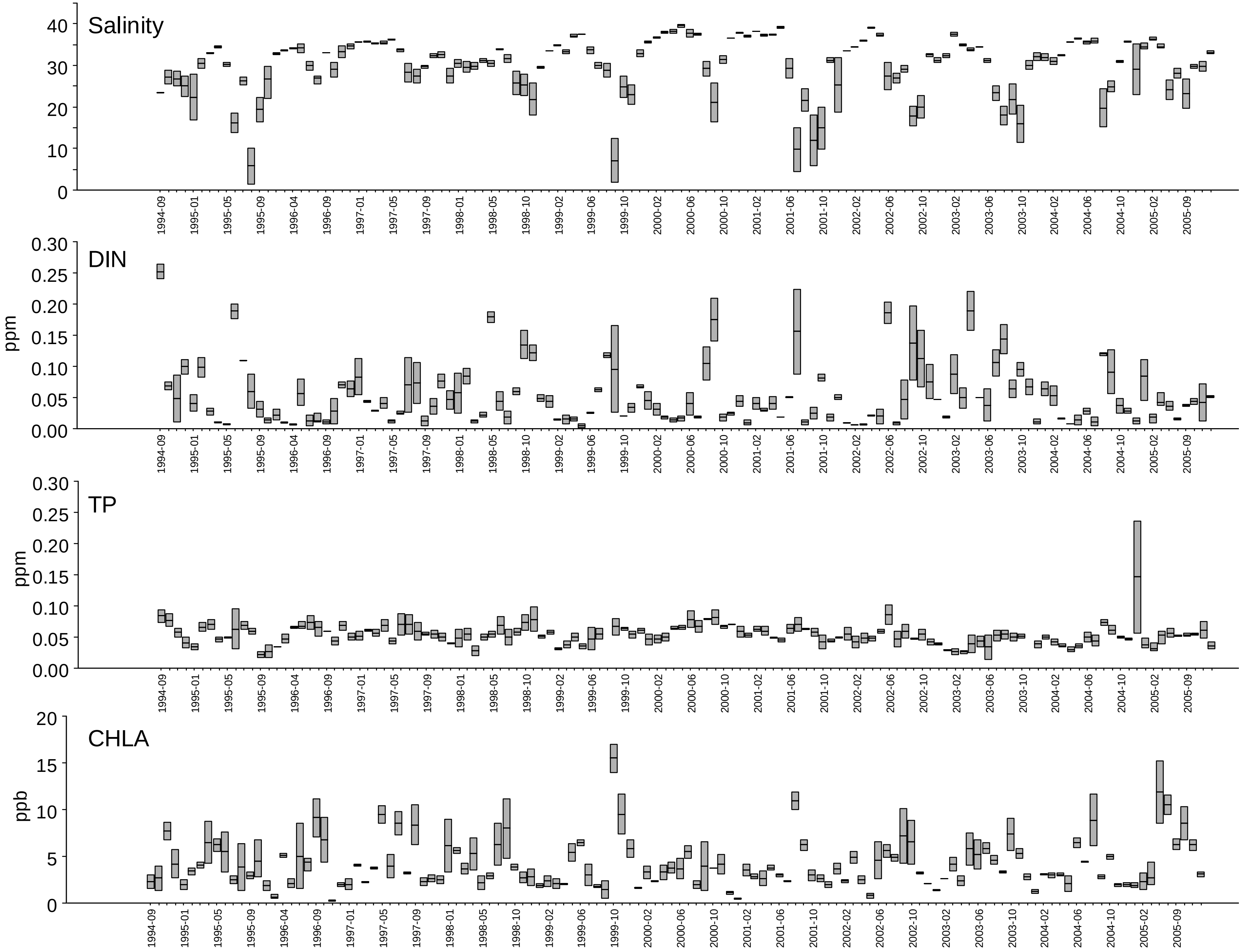


Figure 3.5. Box-and-whisker plots of water quality in WWB-TTI by survey.

Blackwater River Zone



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2005 Alone

The influence of freshwater input from the Everglades is very significant to this region. Large salinity variations are the norm, being driven by both climactic events and water management practices (Fig. 3.7-3.10). As 2005 was a dry year in terms of precipitation, some hypersaline events were observed. Hypersalinity was pronounced in Whitewater Bay, Mangrove Rivers, Gulf Islands, and Inner Waterway zones. The most extensive period of elevated salinity occurred in Whitewater Bay, with salinities doubled the norm during June and July.

Overall DIN concentrations in the area were lower that the grand median. The exception was the Ten Thousand Islands during Aug. to Oct. when we saw a spike in concentration (with a concurrent drop in salinity), possibly as a result of the hurricanes.

Most of the time, TON, TP, TOC, and turbidity in all parts of the TTI_WWB were lower during 2005 than the grand median. Spikes in CHLA were evident from the record showing a generalized response of the phytoplankton to DIN inputs. An interesting spike in DIN was observed in Whitewater Bay and Mangrove Rivers during December. We have no idea as to what precipitated this event, but the data from Jan. 2005 showed that concentrations had returned to normal by the next sampling event. Annual patterns in temperature and DO were unremarkable with values generally fluctuating around the median for all areas.

Data, Graphs, and Figures

All data for the period of record are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/DataDL.htm
Monthly time series graphs for all measured variables for each station are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/WWB.htm
Contour maps showing spatial distributions of all measured variables (quarterly) are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/ContourMaps.htm

Whitewater Bay (WWB)

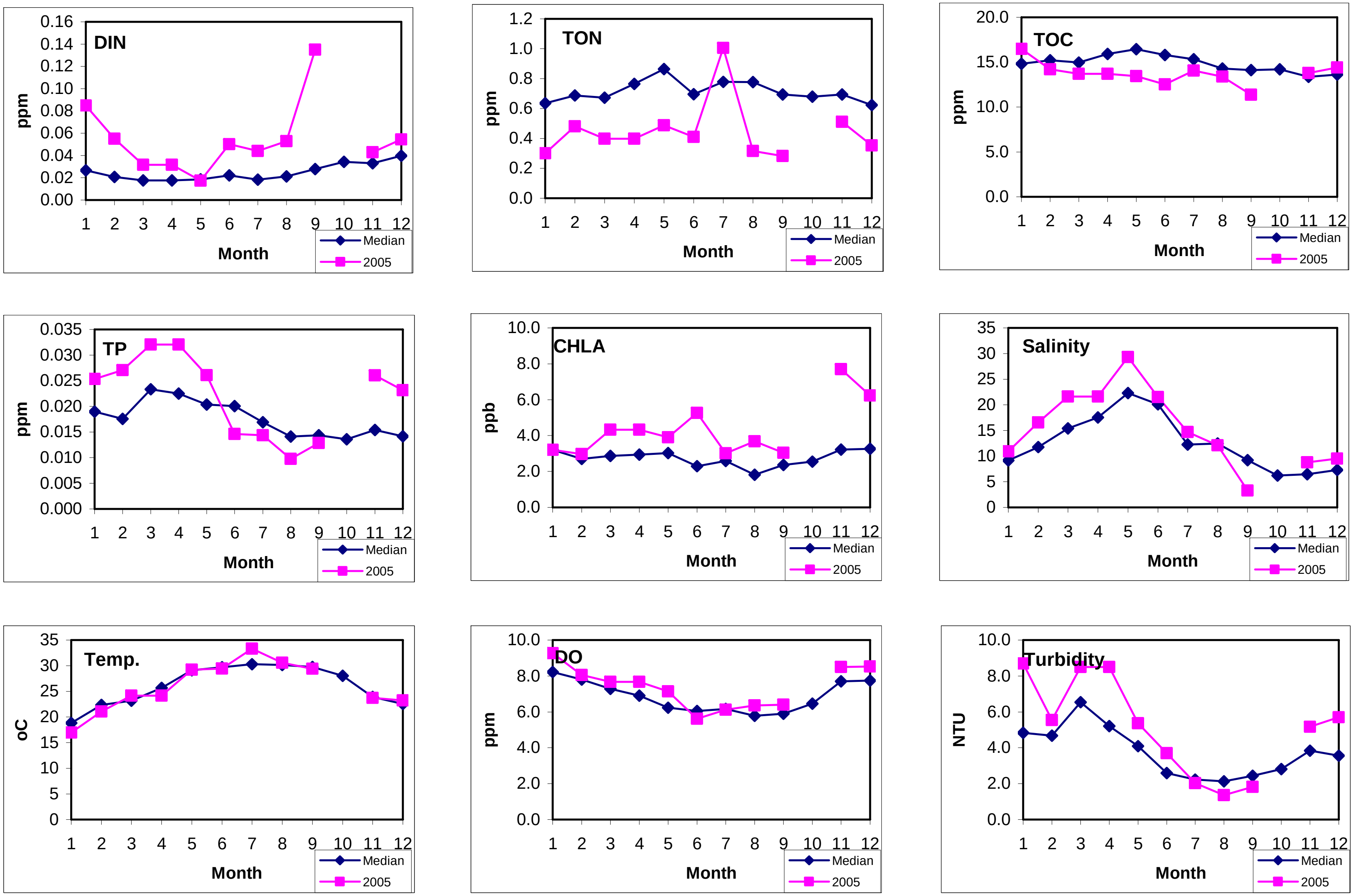

Figure 3.7. Comparison of long-term median with 2005 data.

Mangrove Rivers (MR)

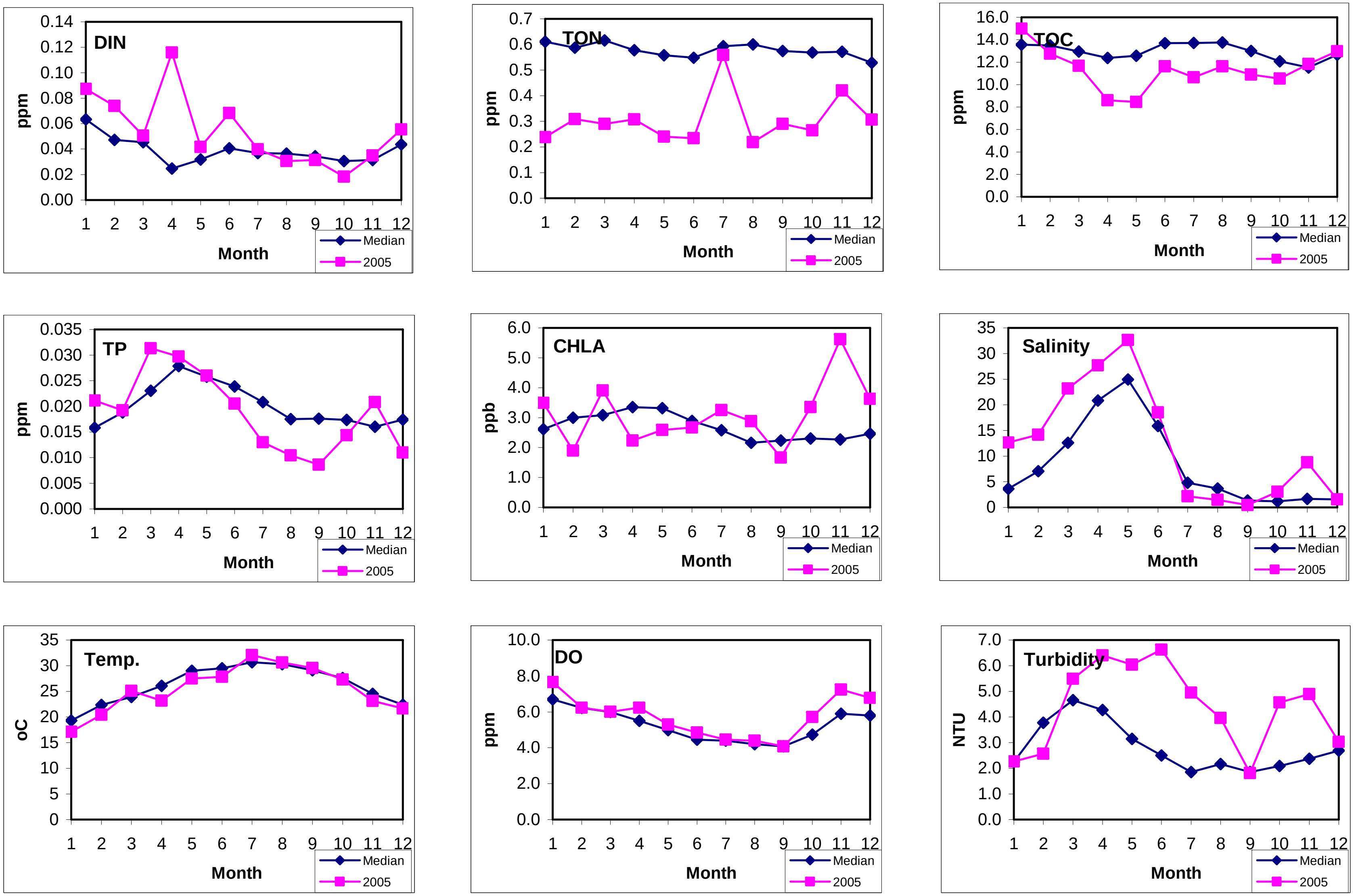

Figure 3.8. Comparison of long-term median with 2005 data.

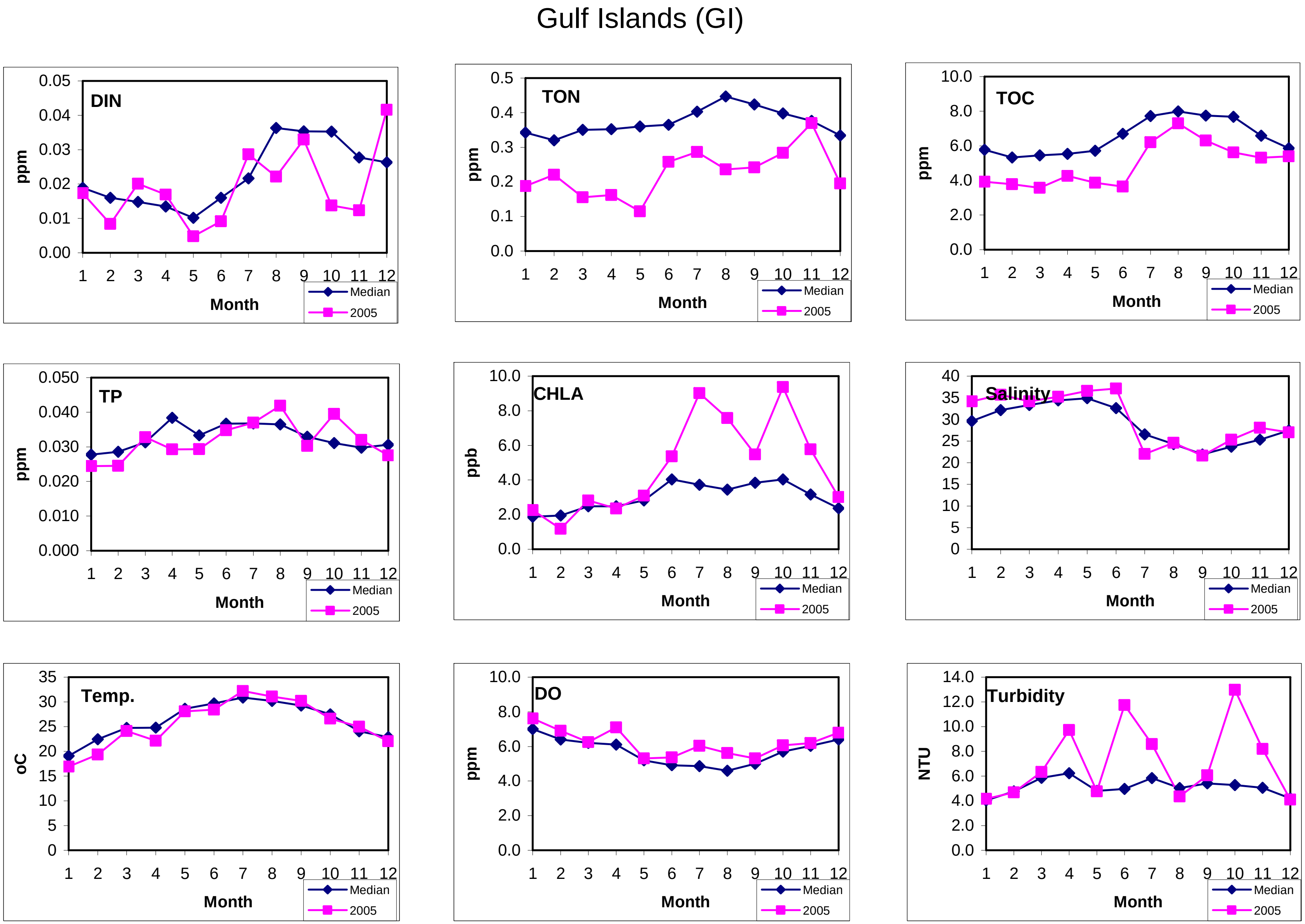

Figure 3.8. Comparison of long-term median with 2005 data.

Inner Waterway (IWW)

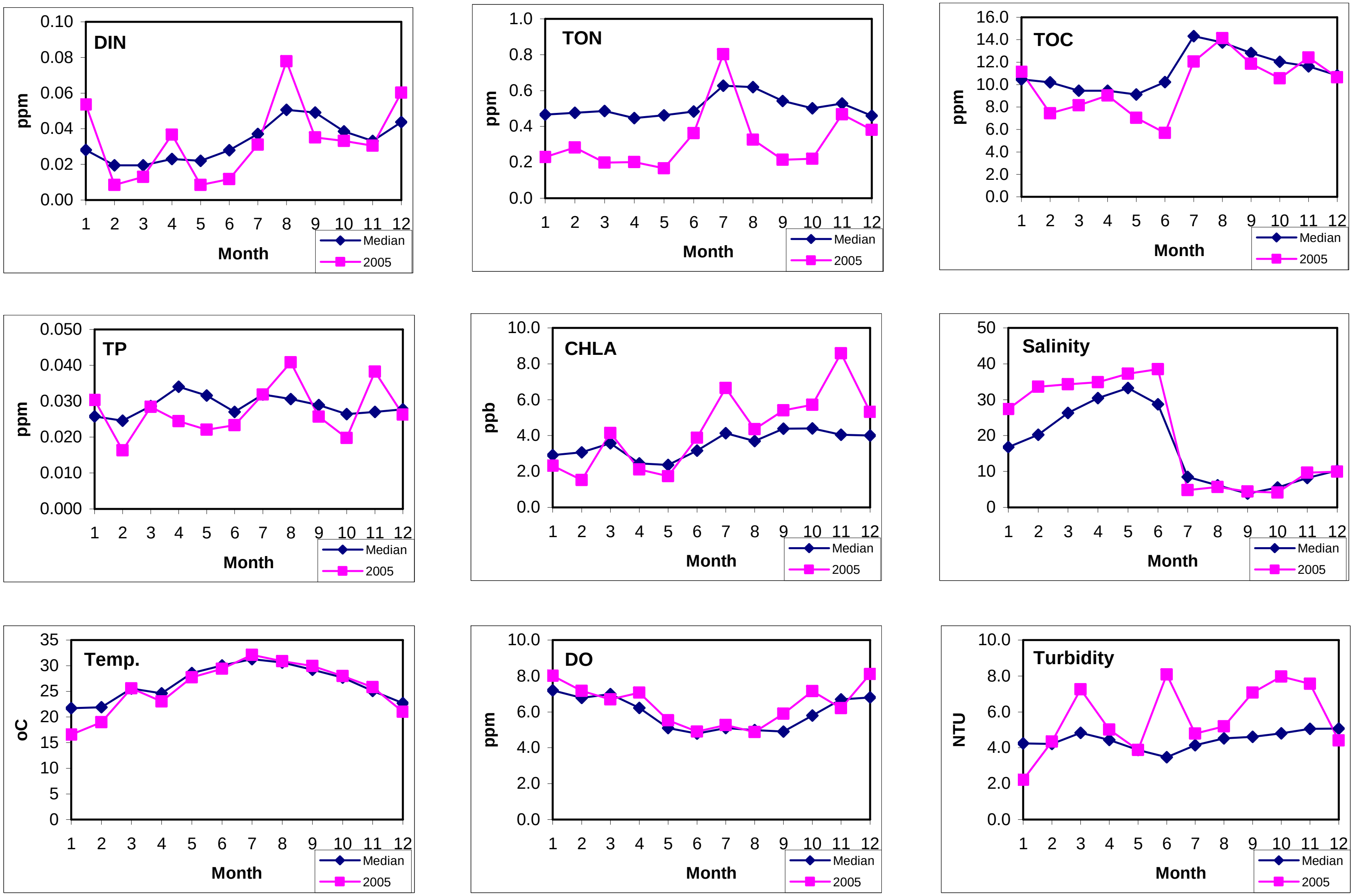

Figure 3.9. Comparison of long-term median with 2005 data.

Blackwater River (BLK)

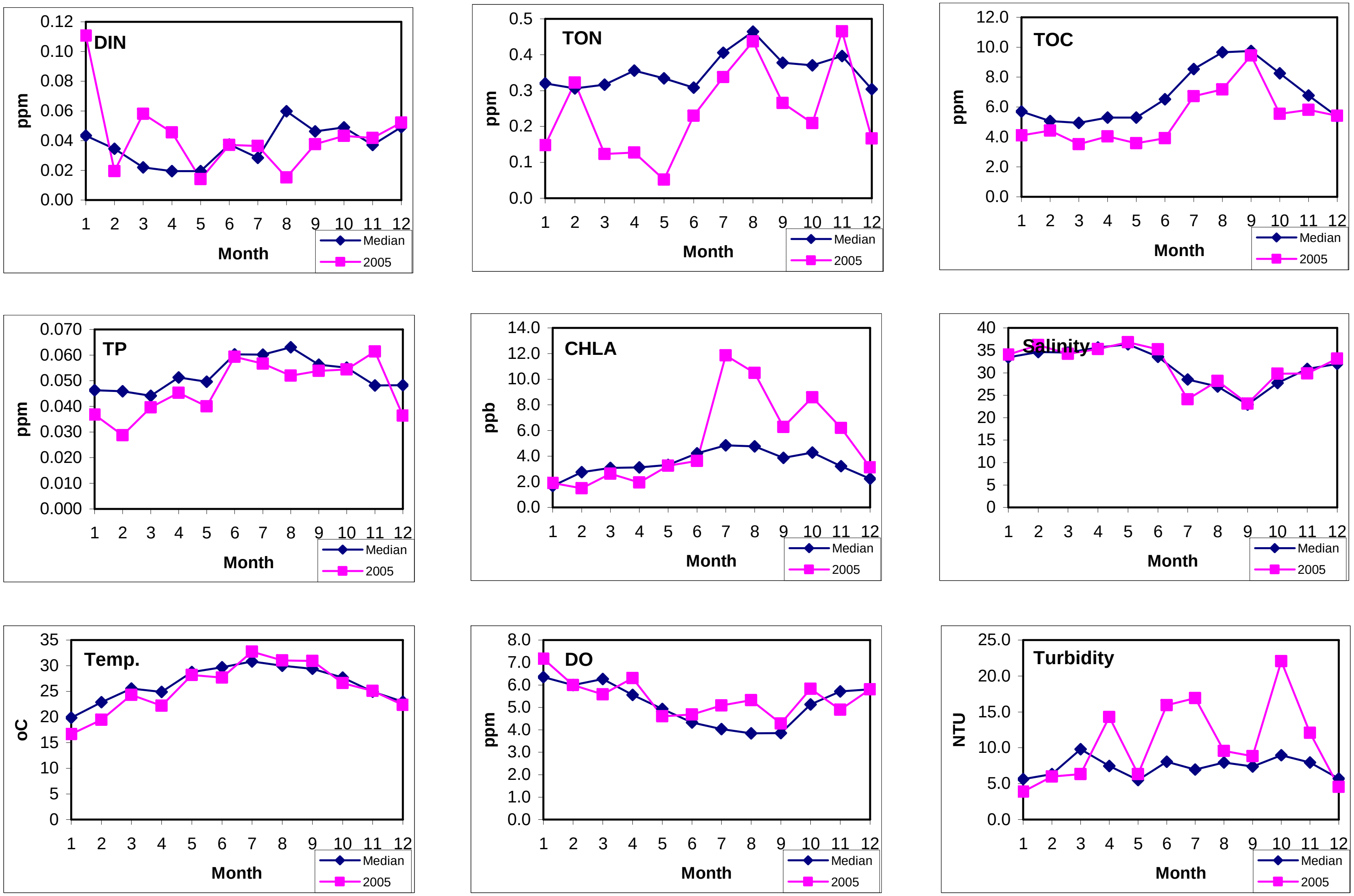

Figure 3.10. Comparison of long-term median with 2005 data.

4. STATE OF WATER QUALITY IN BISCAYNE BAY

Overall Period of Record

A spatial analysis of data from our monitoring program resulted in the delineation of 6 groups of stations, which have robust similarities in water quality (Fig. 4.1). The first cluster was composed of 2 stations closest to the shore in the south Bay and was called the Alongshore group (AS). These are stations most influenced by the Goulds, Military and Mowry Canals. The second cluster was made up of the 5 stations farther from the coast called Inshore (IS). Thirteen stations situated mostly in the bay proper were called the main Bay (MAIN) group. The next cluster contained 3 stations situated in areas of great tidal exchange (ocean channel, not shown). Two stations in Card Sound grouped together SCARD. Finally, the Turkey Point station comprised its own cluster (not shown).

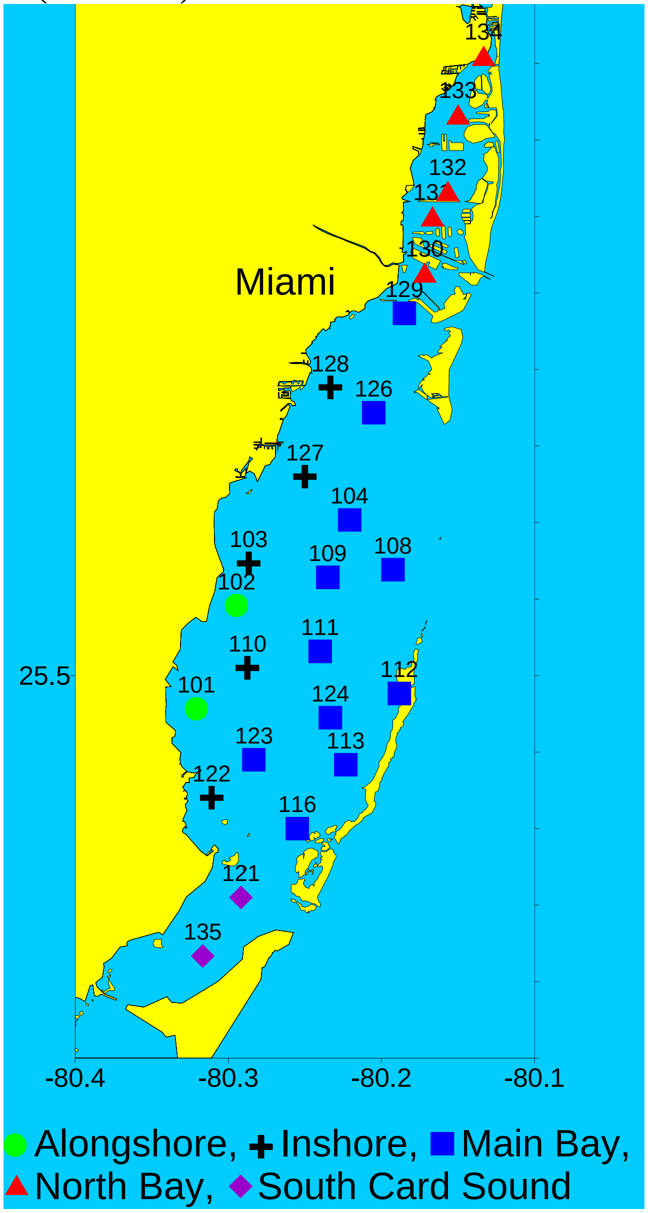

Figure 4.1. Zones of similar water quality in Biscayne Bay.

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 added to the area north of the Rickenbacker Causeway are defined, a priori, as a distinct cluster, North Bay (NBAY).

There was a gradient of increasing salinity with distance from the west coast of the Bay (AS <IS <MAIN clusters Fig. 4.2-4.6). Opposite to the salinity gradient, highest concentrations of CHLA, DIN, and TP were observed near the coast. These type of gradients are indicative of anthropogenic inputs. NBAY showed DIN levels comparable to the high concentrations seen AS but had a higher median salinity. In addition, NBAY had the highest median TP concentration of any zone. SCARD had relatively high DIN concentrations relative to the other nutrients. Some of this may be attributed to the long water residence time of this basin as evidence by near ocean salinities. TOC concentrations were highest in AS > IS > MAIN, denoting a freshwater source (not shown).

Alongshore Zone

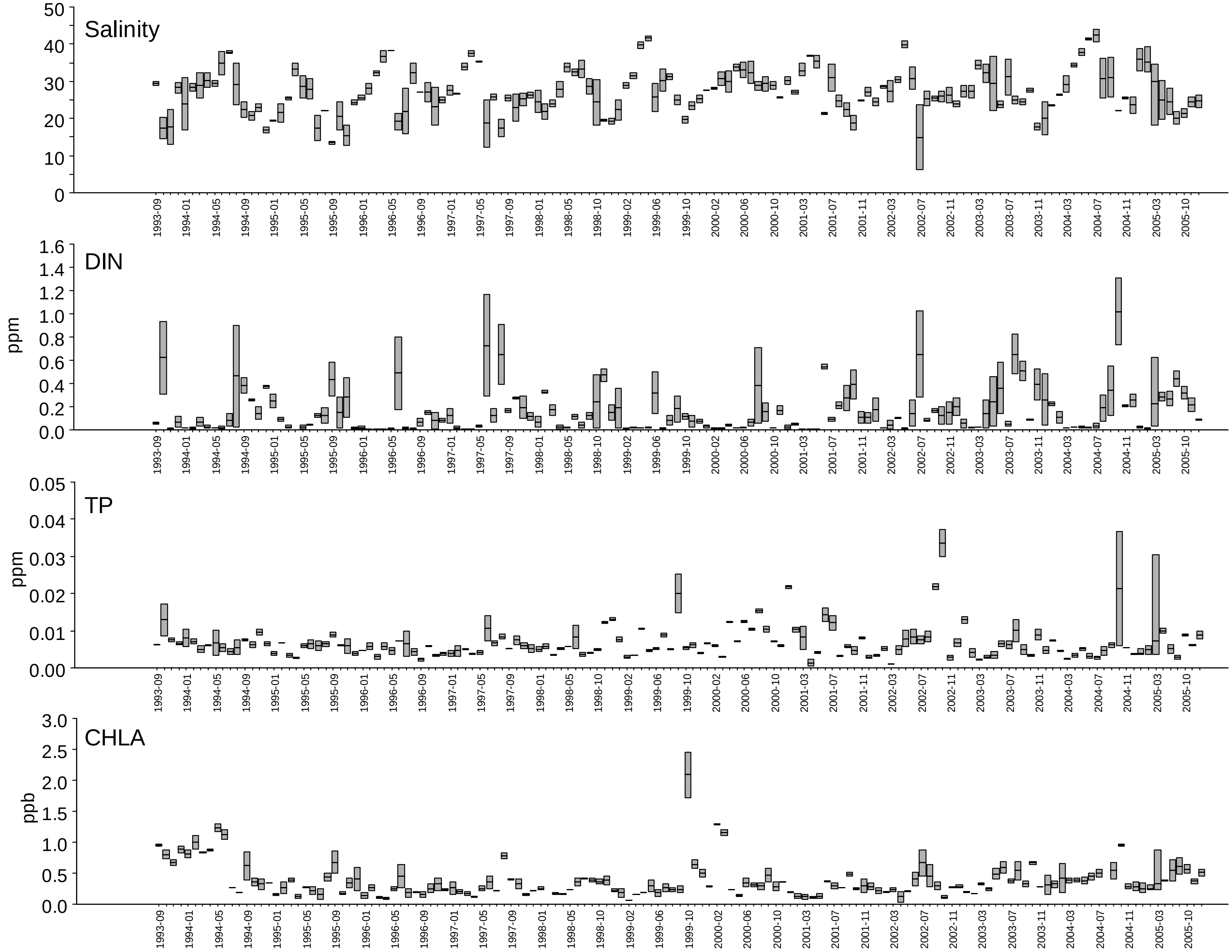

Figure 4.2. Box-and-whisker plots of water quality in Biscayne Bay by survey.

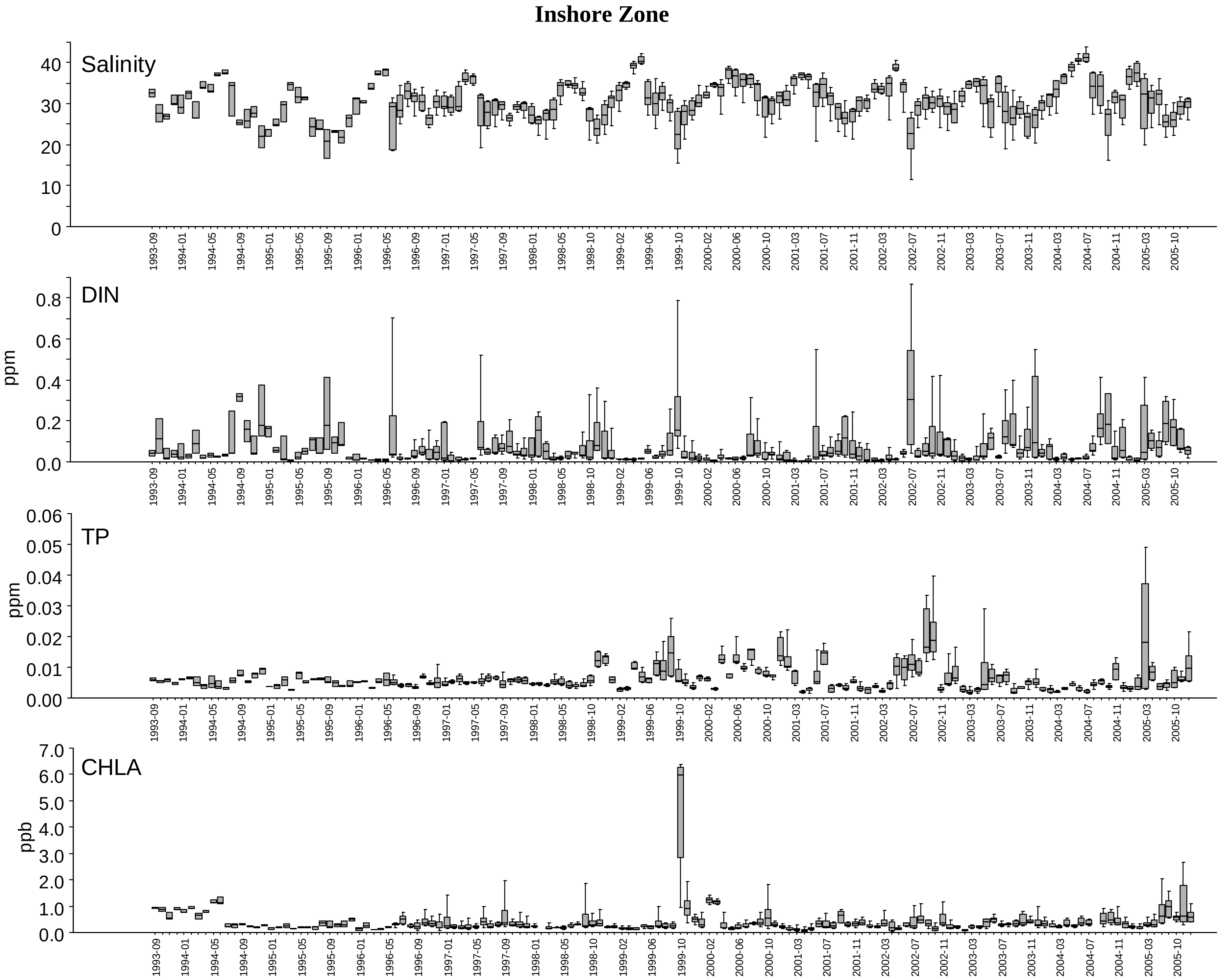

Figure 4.3. Box-and-whisker plots of water quality in Biscayne Bay by survey.

Main Bay Zone

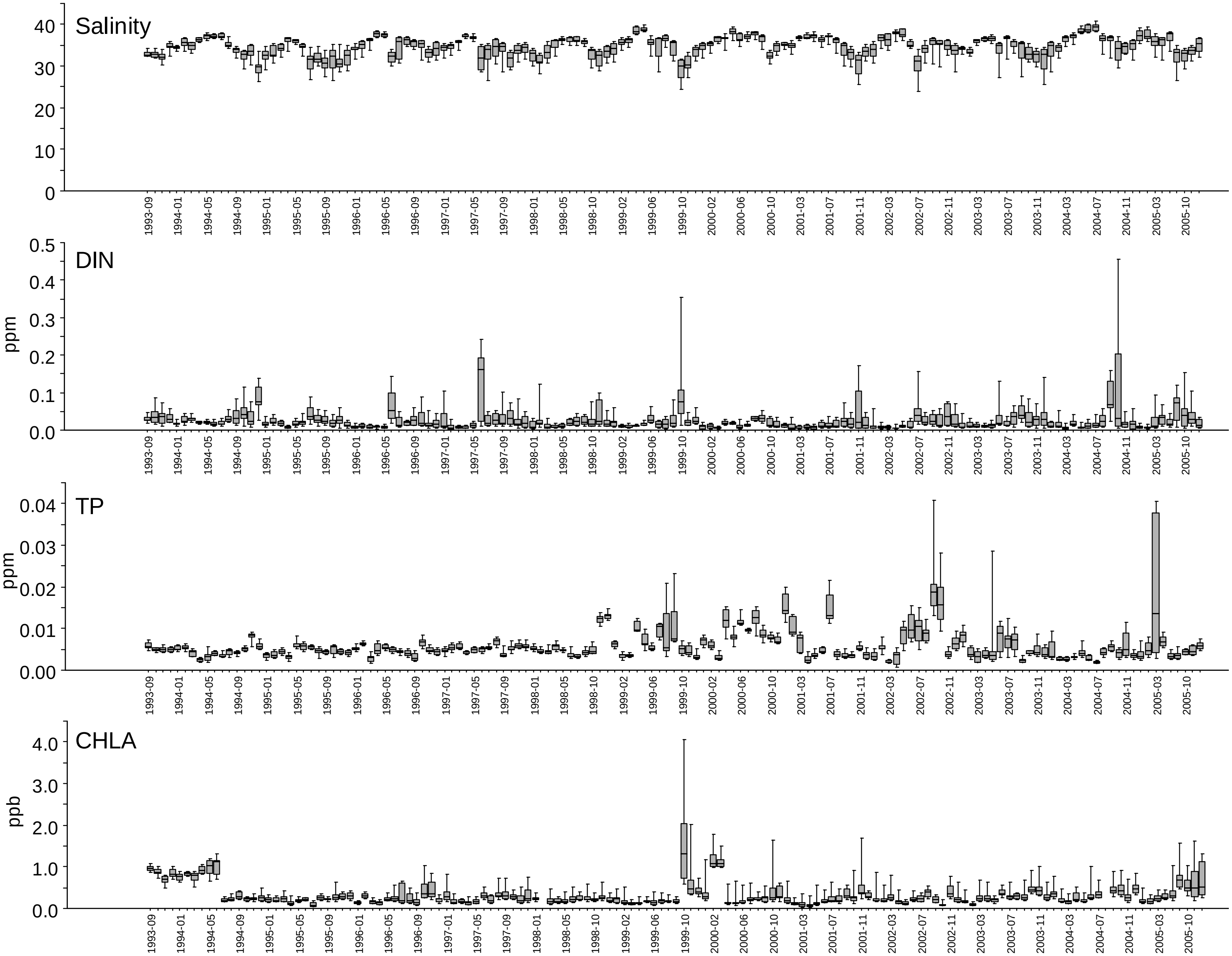

Figure 4.4. Box-and-whisker plots of water quality in Biscayne Bay by survey.

South Card Sound Zone

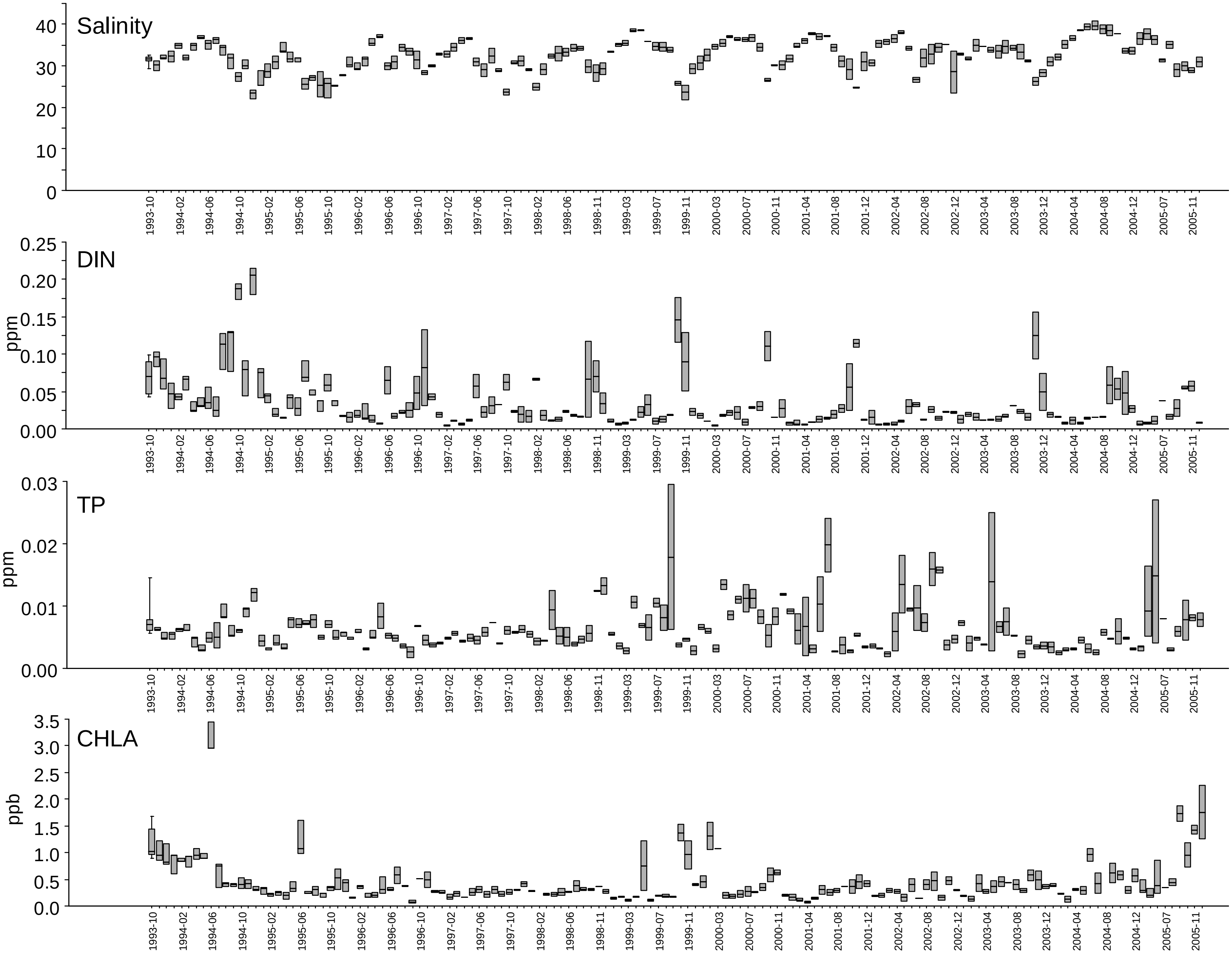

Figure 4.5. Box-and-whisker plots of water quality in Biscayne Bay by survey.

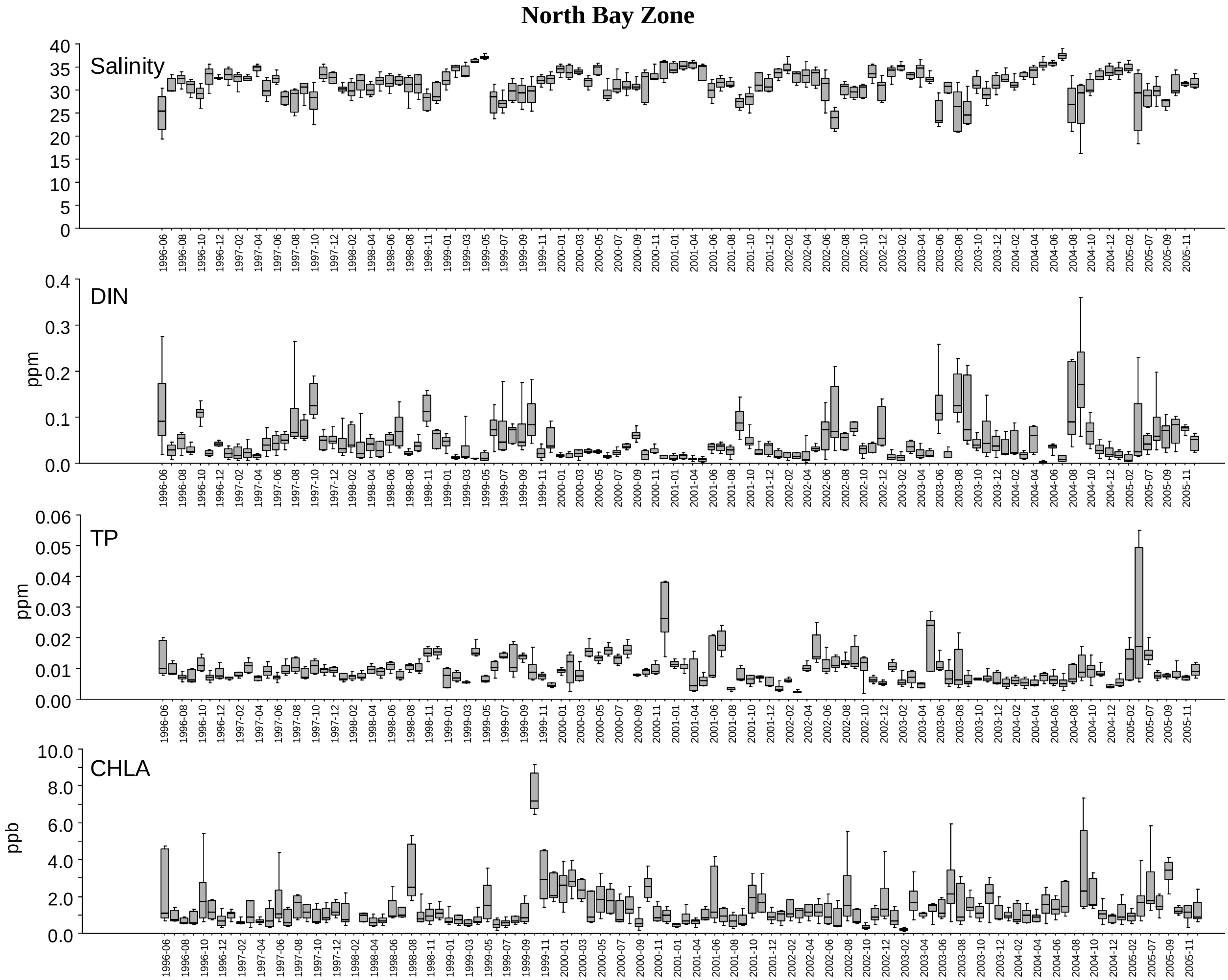

Figure 4.6. Box-and-whisker plots of water quality in Biscayne Bay by survey.

2005 Alone

Salinity in Biscayne Bay is strongly influenced by its large tidal exchange with the ocean. Nevertheless, canal inputs do have a significant impact on the ecosystem, as evidenced by the reduced nearshore salinity patterns (Fig. 4.7-4.11).

As 2005 was a relatively dry year, some areas of Biscayne Bay experienced an extended period of hypersalinity which began in late spring/early summer. Contrary to what might be expected, the areas closest to the western shore were most affected by the hypersalinity. This is because of the short residence time of water in the main section of the bay as a result of large tidal forcing. All areas of Biscayne Bay experienced large inputs of DIN during Sept./Oct. It is difficult to ascertain a cause (there was no drop in salinity), but as it was a baywide phenomena, it was probably not terrestrially driven.

TOC concentrations in almost all areas of the Bay were higher than the grand median for the first half of the year, then returned to normal levels. DO levels in nearshore waters were lower than usual; we are unsure as to the cause. Annual patterns in TON, TP, CHLA, and temperature were unremarkable with values generally fluctuating around the median for all areas of the bay.

Data, Graphs, and Figures

All data for the period of record are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/DataDL.htm
Monthly time series graphs for all measured variables for each station are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/BB.htm
Contour maps showing spatial distributions of all measured variables (quarterly) are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/ContourMaps.htm

Alongshore (AS)

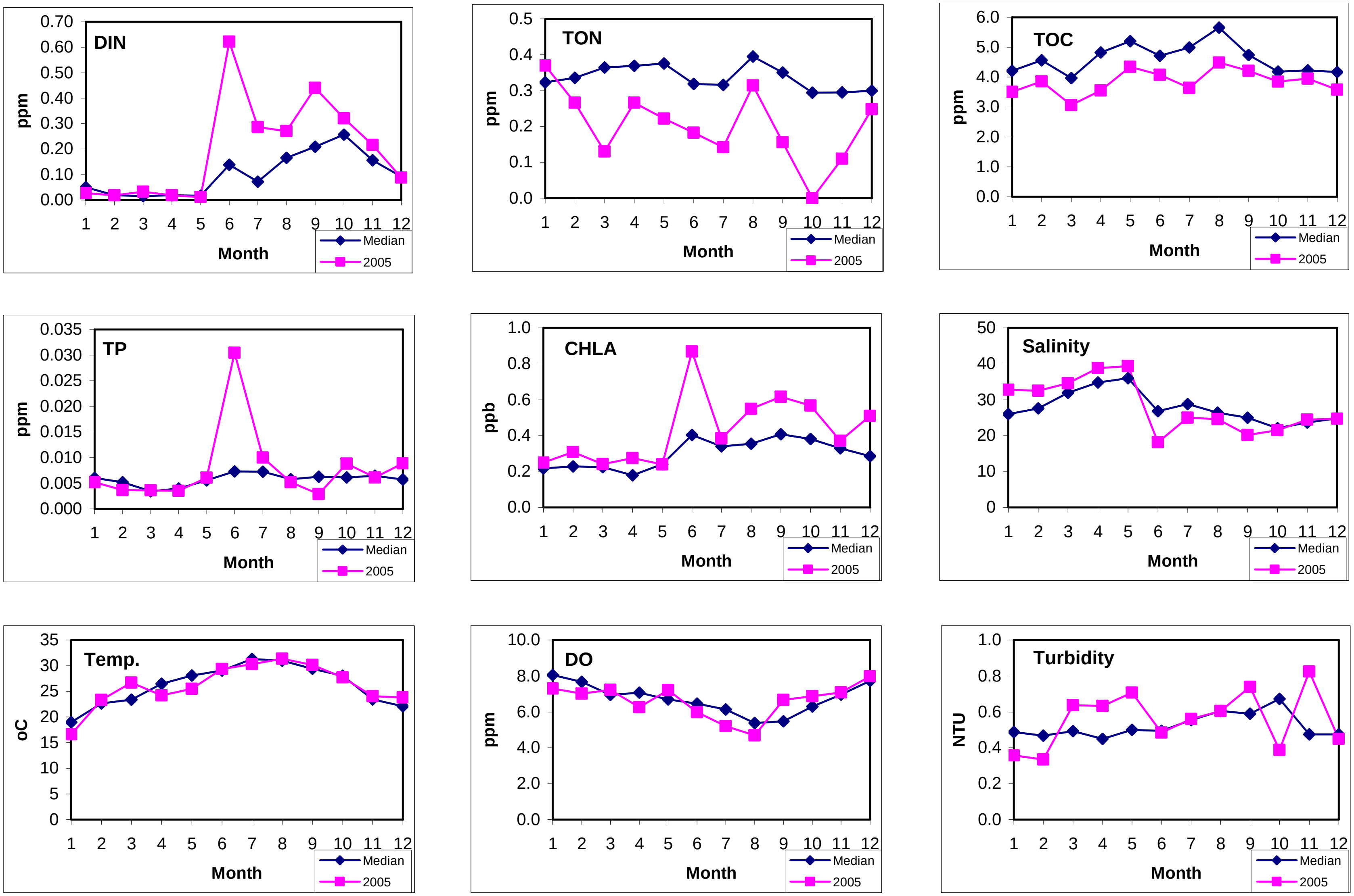

Figure 4.7. Comparison of long-term median with 2005 data.

Inshore (IS)

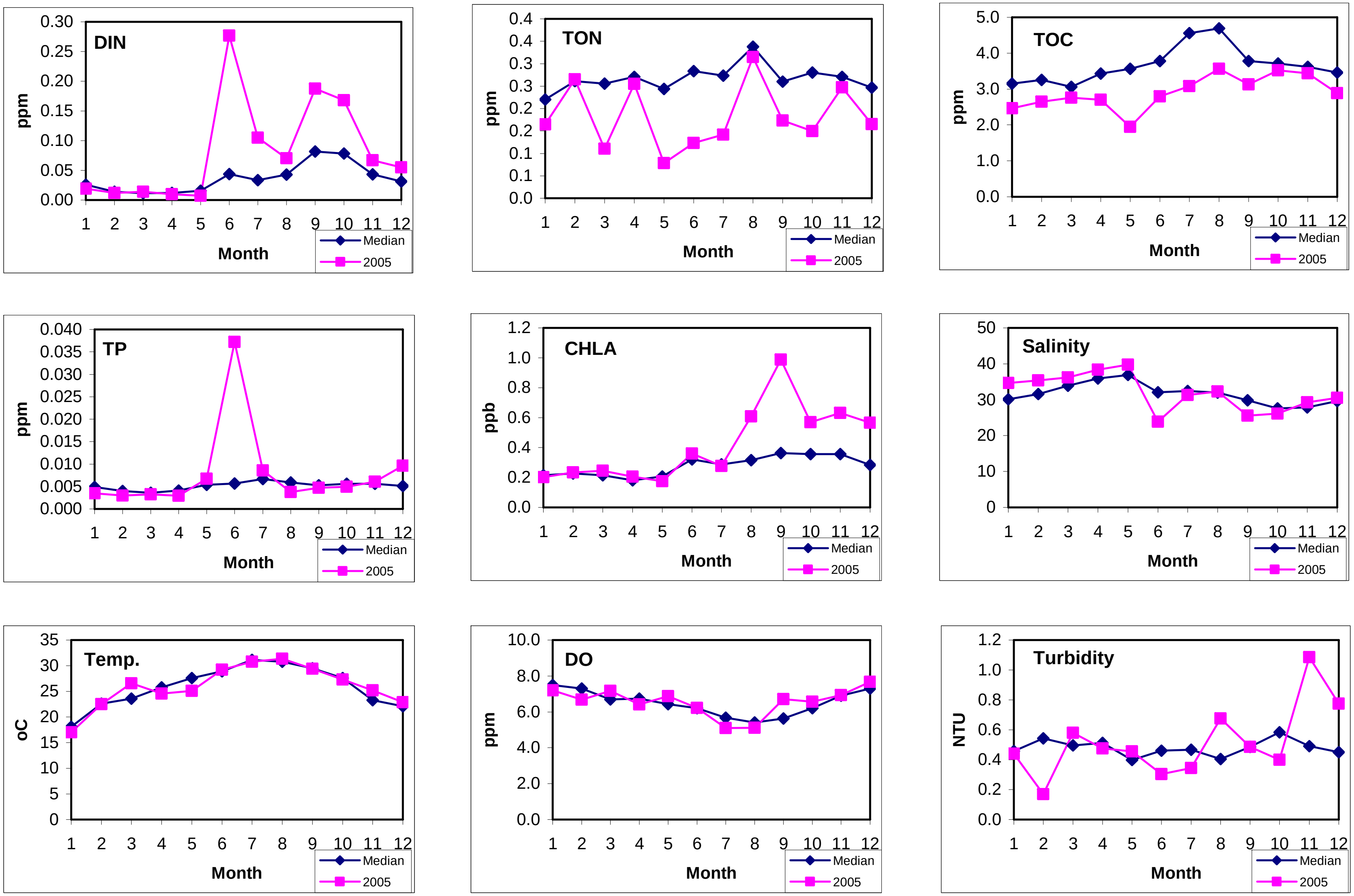

Figure 4.8. Comparison of long-term median with 2005 data.

Main Bay (MAIN)

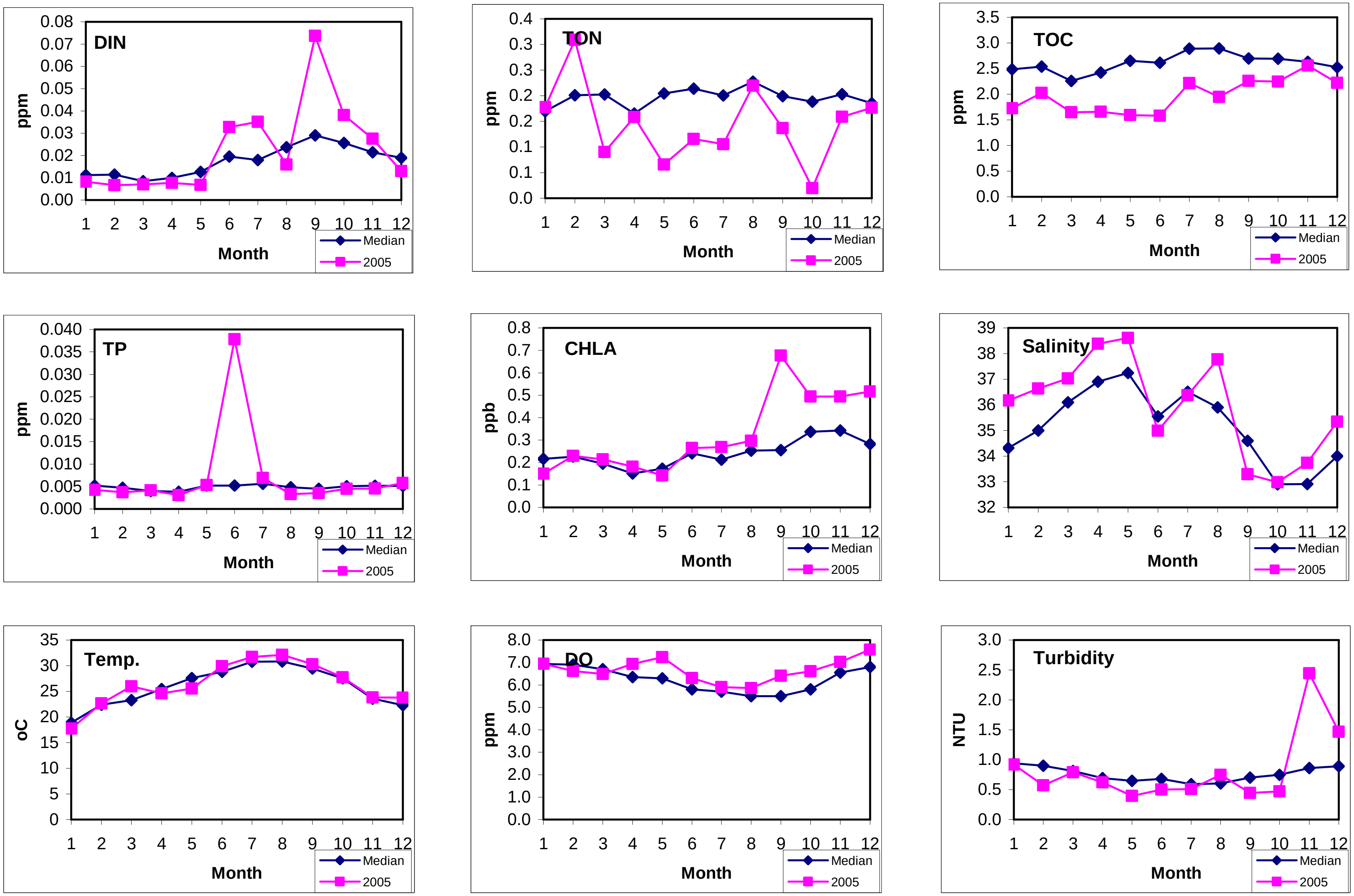

Figure 4.9. Comparison of long-term median with 2005 data.

South Card Sound (SCARD)

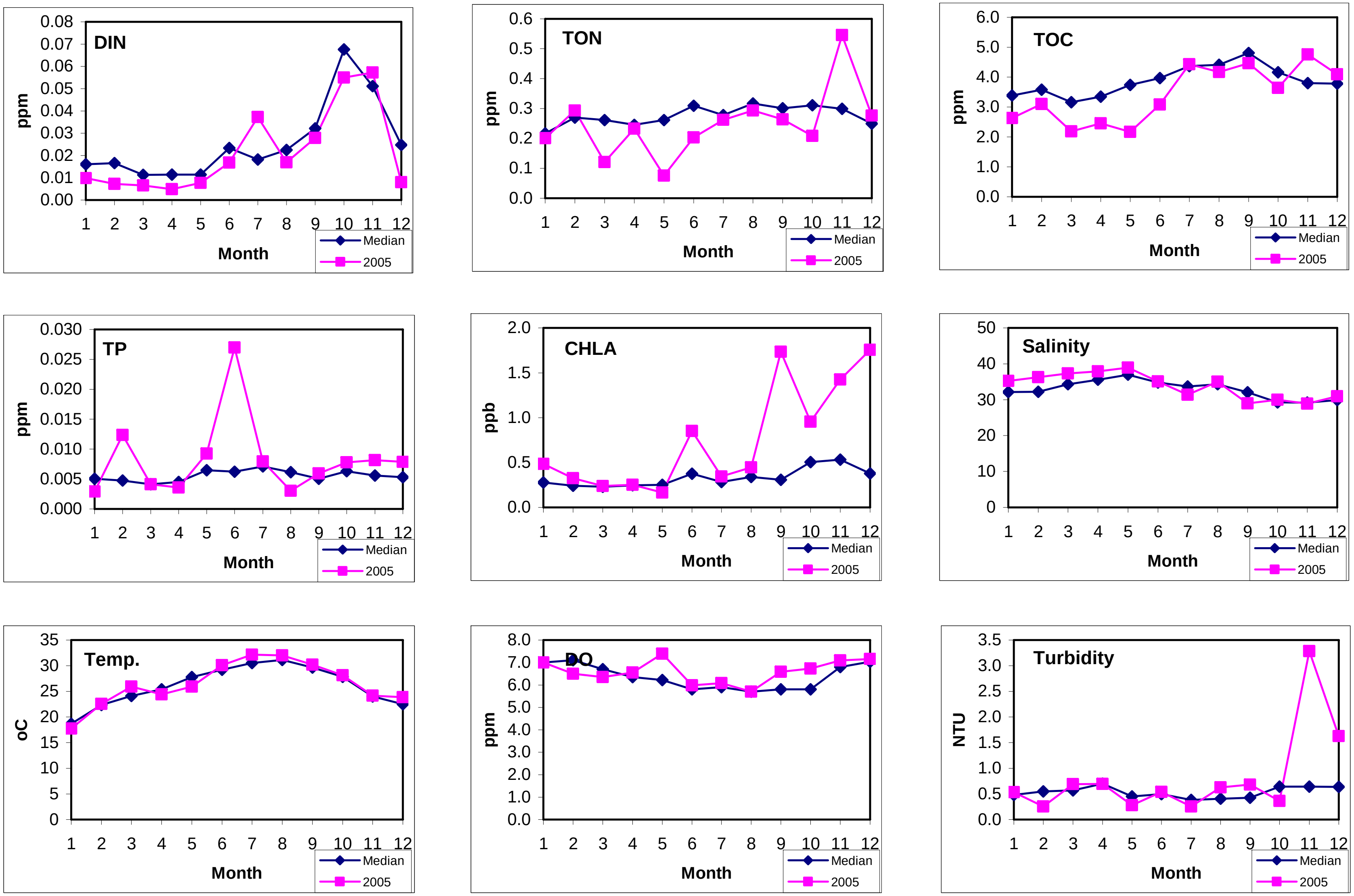

Figure 4.10. Comparison of long-term median with 2005 data.

North Bay (NBAY)

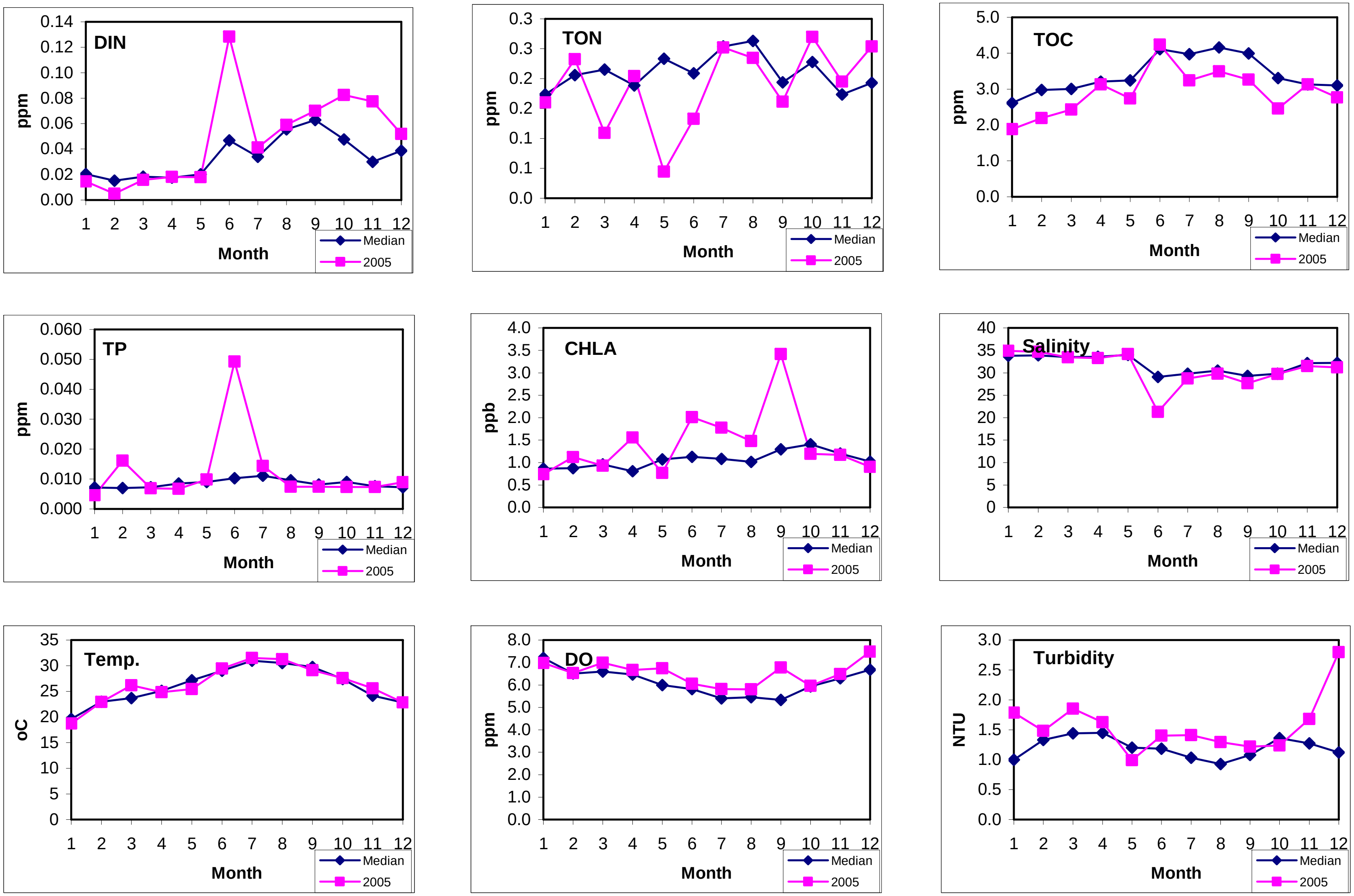

Figure 4.11. Comparison of long-term median with 2005 data.

5. STATE OF WATER QUALITY ON THE SOUTHWEST FLORIDA SHELF

Overall Period of Record

A spatial analysis of data from our monitoring program resulted in the delineation of 3 groups of stations, which have robust similarities in water quality (Fig. 5.1). The first cluster was composed of only 2 stations, which were closest to the shore off Cape Sable; they were called the SHARK group after the Shark River, the main source of freshwater to the region. The second cluster was made up of the 7 more northerly stations nearest the coast and called SHOAL. The remaining stations were called the SHELF group.

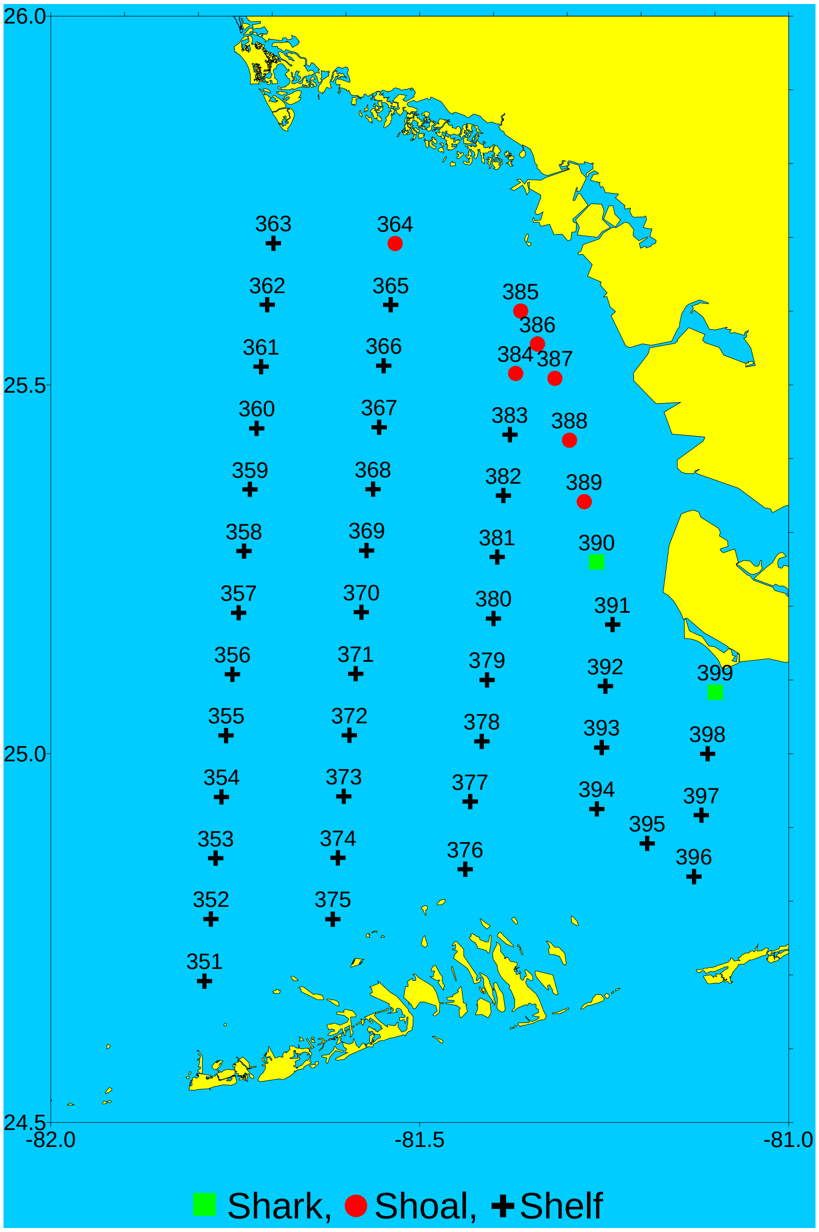

Figure 5.1. Zones of similar water quality on the SW Shelf.

Salinity was lowest in the SHARK zone as a result of the Shark River, Everglades influence (Fig. 5.2-5.4). There is a decreasing concentration gradient of SHARK > SHOAL > SHELF for CHLA, TP, and TOC. It is clear that the SHARK stations have higher DIN concentrations while the SHOAL and SHELF stations were similar.

Although these analyses are very preliminary (only 38 sampling events) it is possible to speculate that the clusters are formed as a function of hydrology and circulation patterns. We believe that the SHARK stations clearly show the input of freshwater from Shark River being transported south and east around the Cape. Water overlying the SHOAL stations probably originates somewhere in or 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.

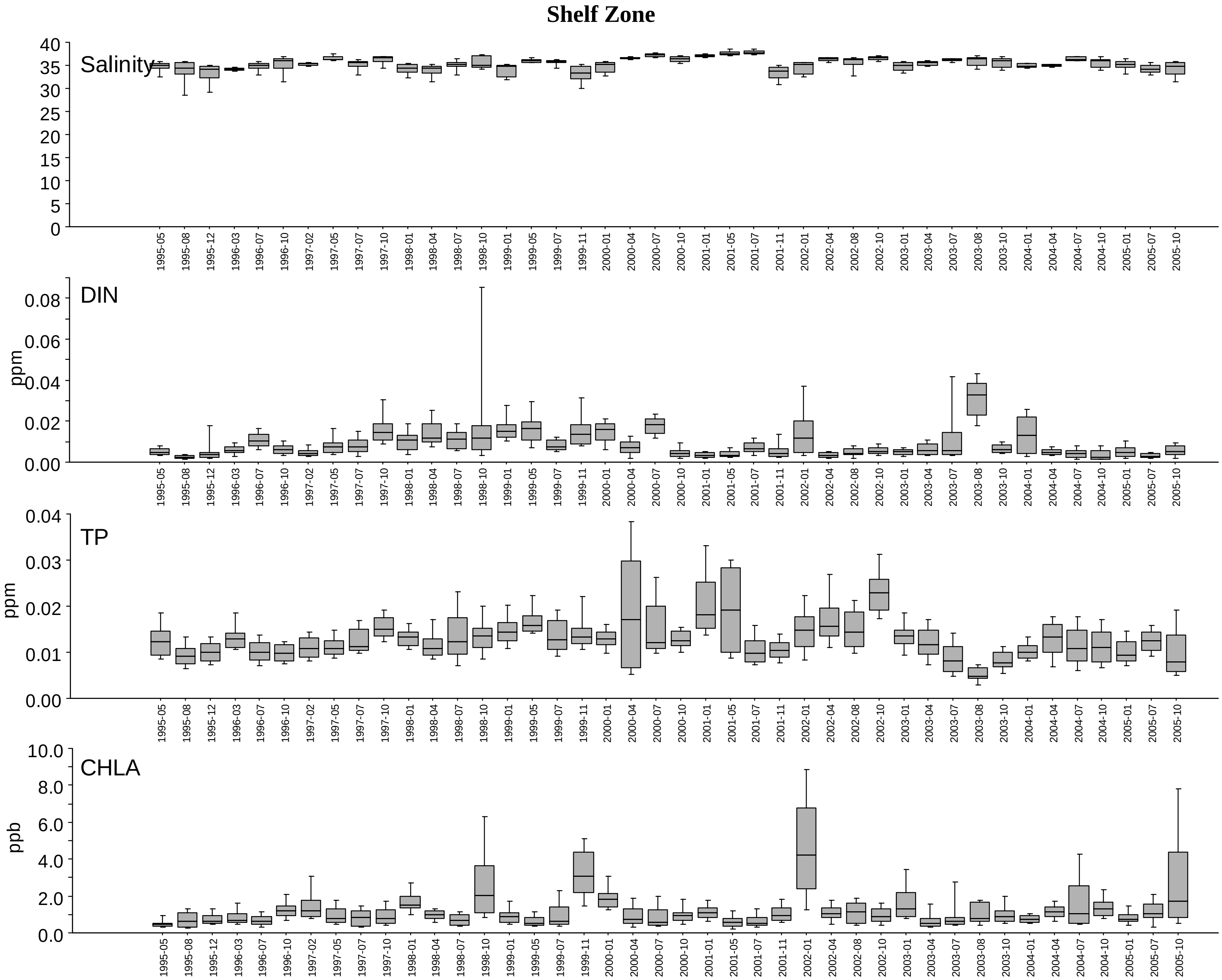

Figure 5.2. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

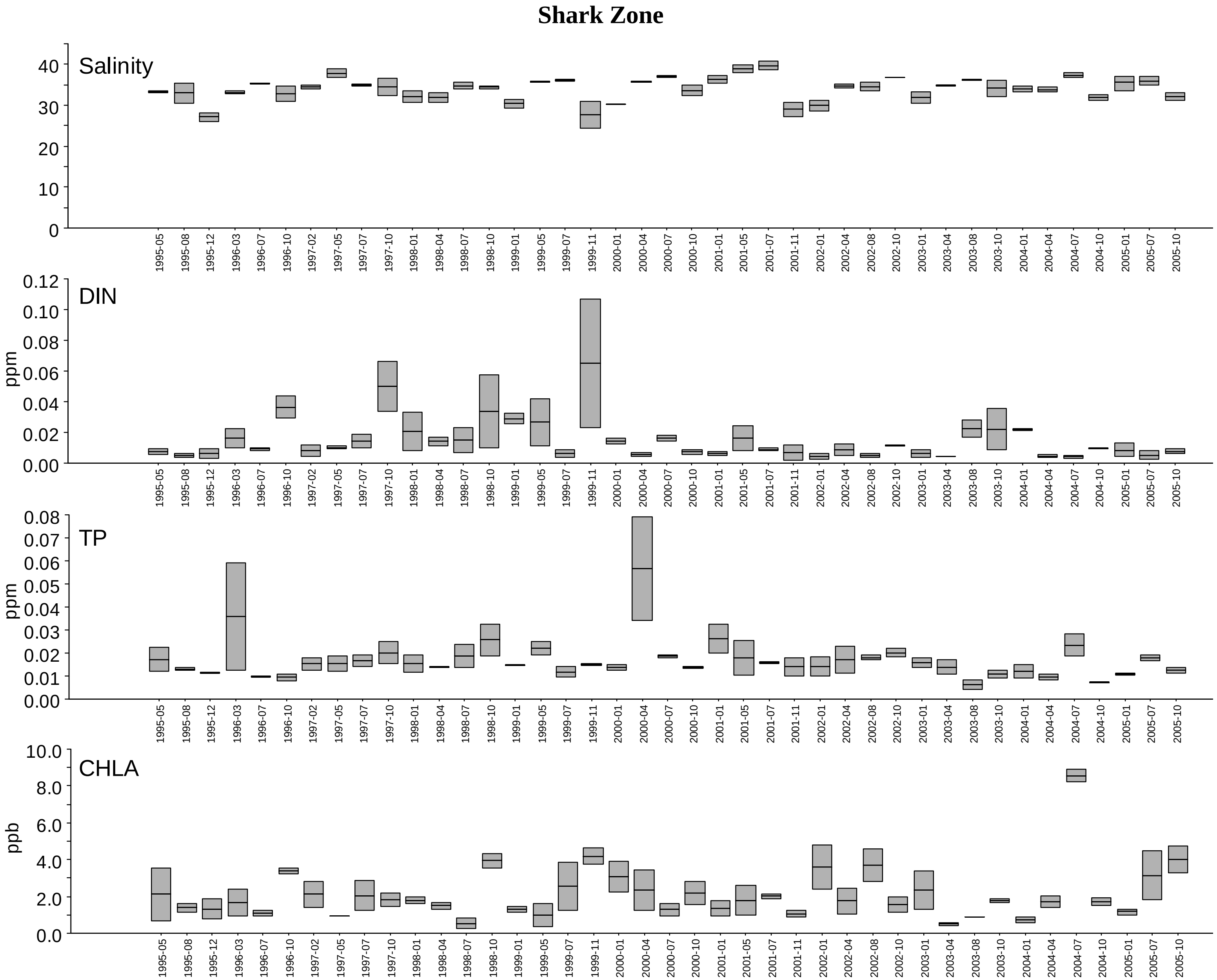

Figure 5.3. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

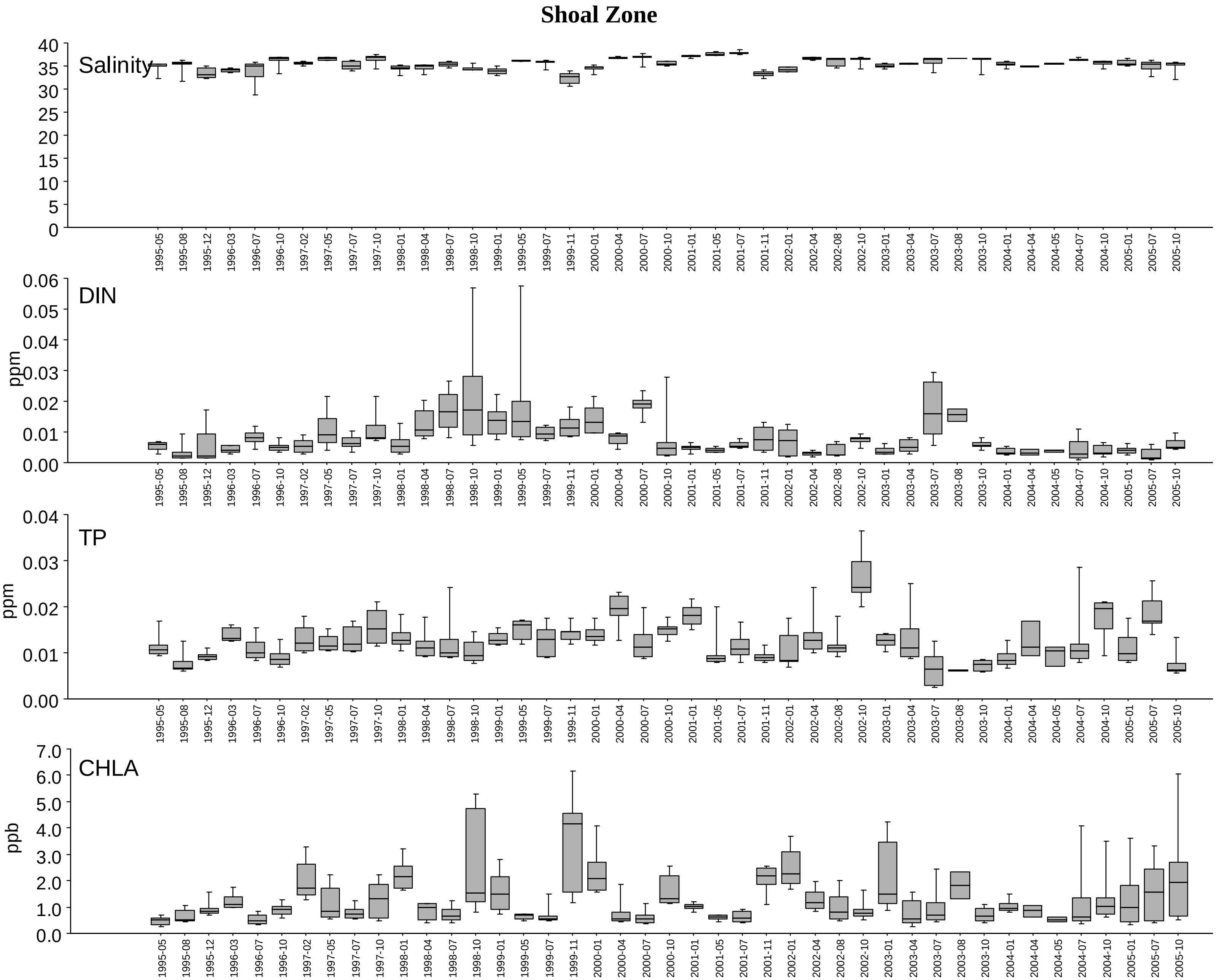

Figure 5.4. Box-and-whisker plots of water quality in SW Florida Shelf by survey.

2005 Alone

Since this component of the monitoring program began in 1995 and is only sampled quarterly, there is little trend data to analyze. Although these analyses are very preliminary it is possible to speculate that the clusters are formed as a function of hydrology and circulation patterns. We believe that the inshore cluster clearly shows the input of freshwater from Shark River being transported south and east around the Cape. Water overlying the shoal stations probably originates somewhere in or 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

Overall, 2005 was relatively unremarkable except for a few outliers (Fig. 5.5-5.7). TON was lower than the grand median for most areas, a result observed in other areas of the southwest coast.

Data, Graphs, and Figures

All data for the period of record are available at:
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Monthly time series graphs for all measured variables for each station are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/Shelf.htm
Contour maps showing spatial distributions of all measured variables (quarterly) are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/ContourMaps.htm

Shark (SHARK)

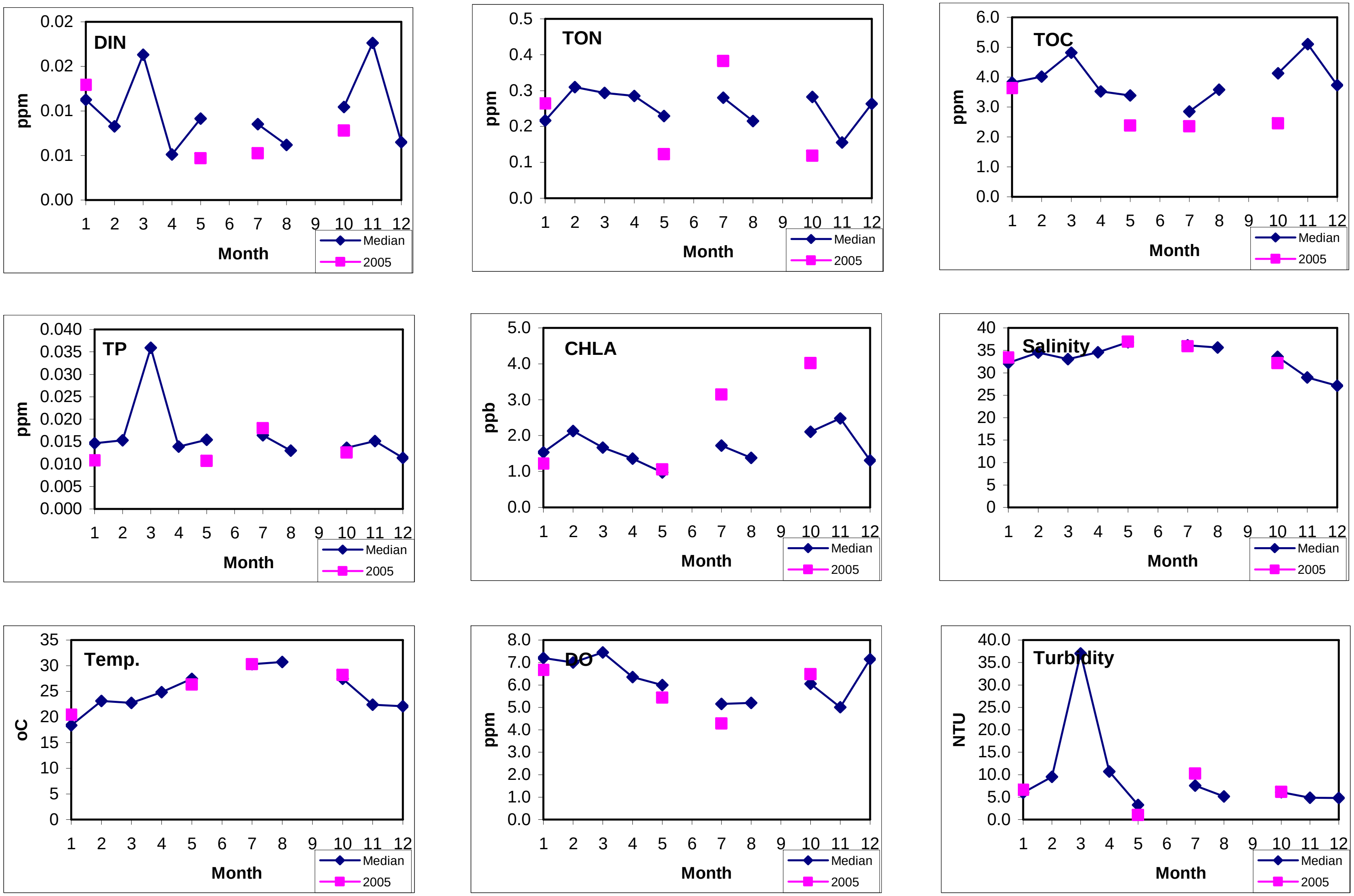

Figure 5.5. Comparison of long-term median with 2005 data.

Shelf (SHELF)

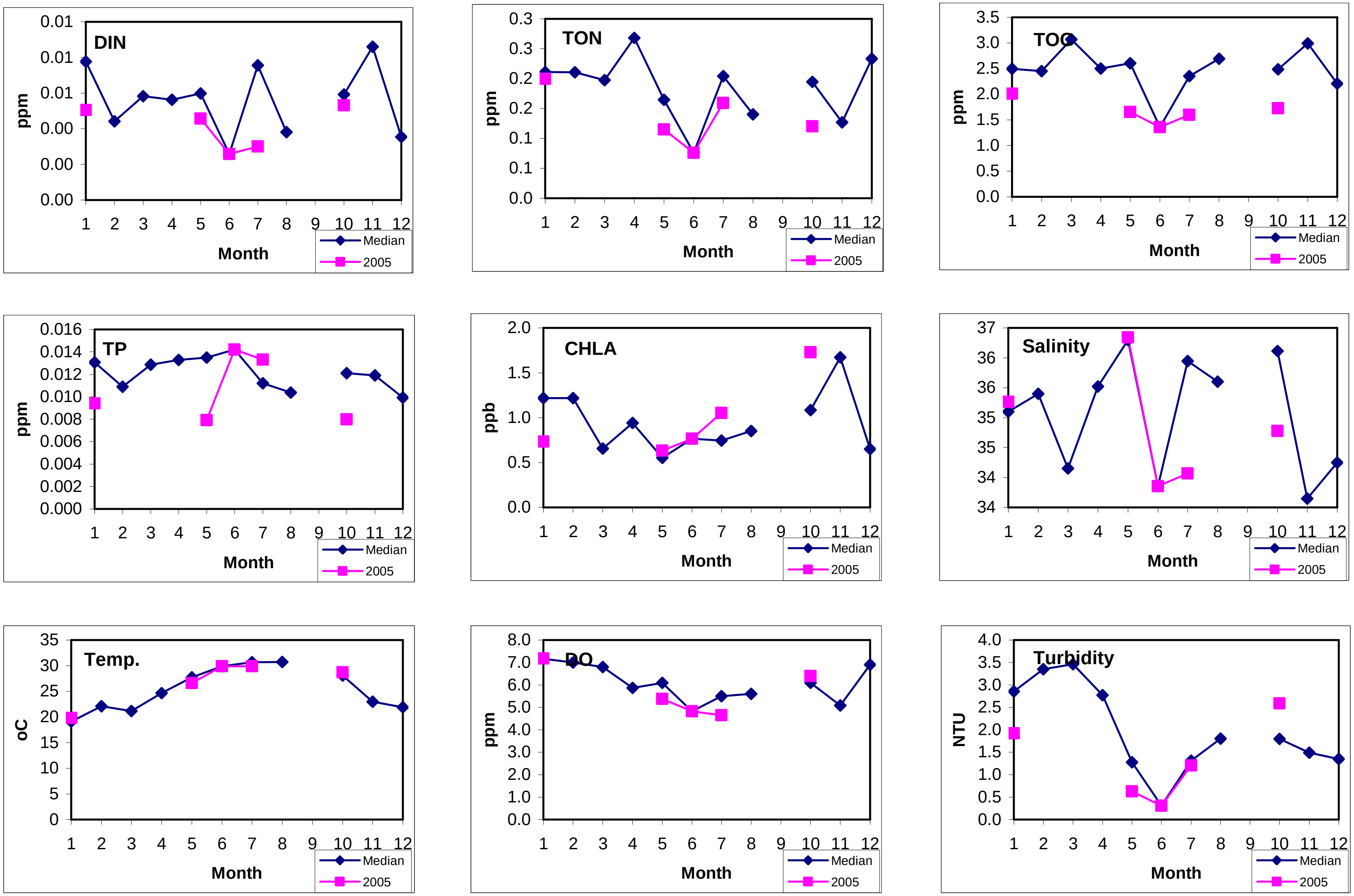

Figure 5.6. Comparison of long-term median with 2005 data.

Shoal (SHOAL)

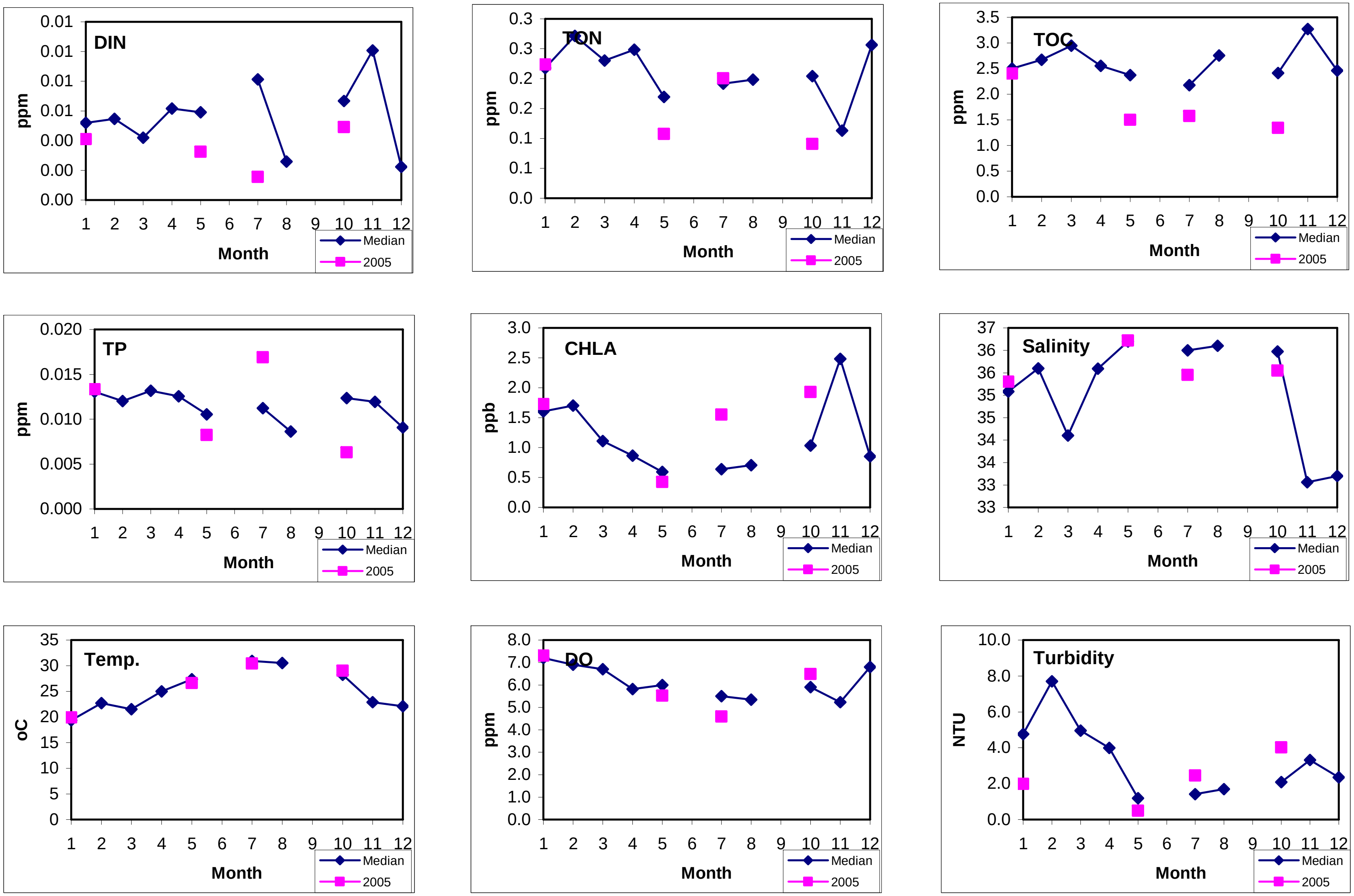

Figure 5.7. Comparison of long-term median with 2005 data.

6. STATE OF WATER QUALITY IN THE CAPE ROMANO - PINE ISLAND SOUND AREA

Overall Period of Record

Sampling in this area began Jan. 1999, therefore we now have five years of data available for analysis. However, until we perform a full spatial analysis, we will use generally accepted geomorphological characteristics to group the stations (Fig. 6.1). These groupings are the Cocohatchee River at Wiggins Pass (COCO), Estero Bay (EST), Cape Romano-Marco Island (MARC), Naples Bay (NPL), Pine Island Sound (PIS), Rookery Bay (RB), and San Carlos Bay (SCB). SCB is located at the mouth of the Caloosahatchee River, a major managed outlet for freshwater from Lake Okeechobee.

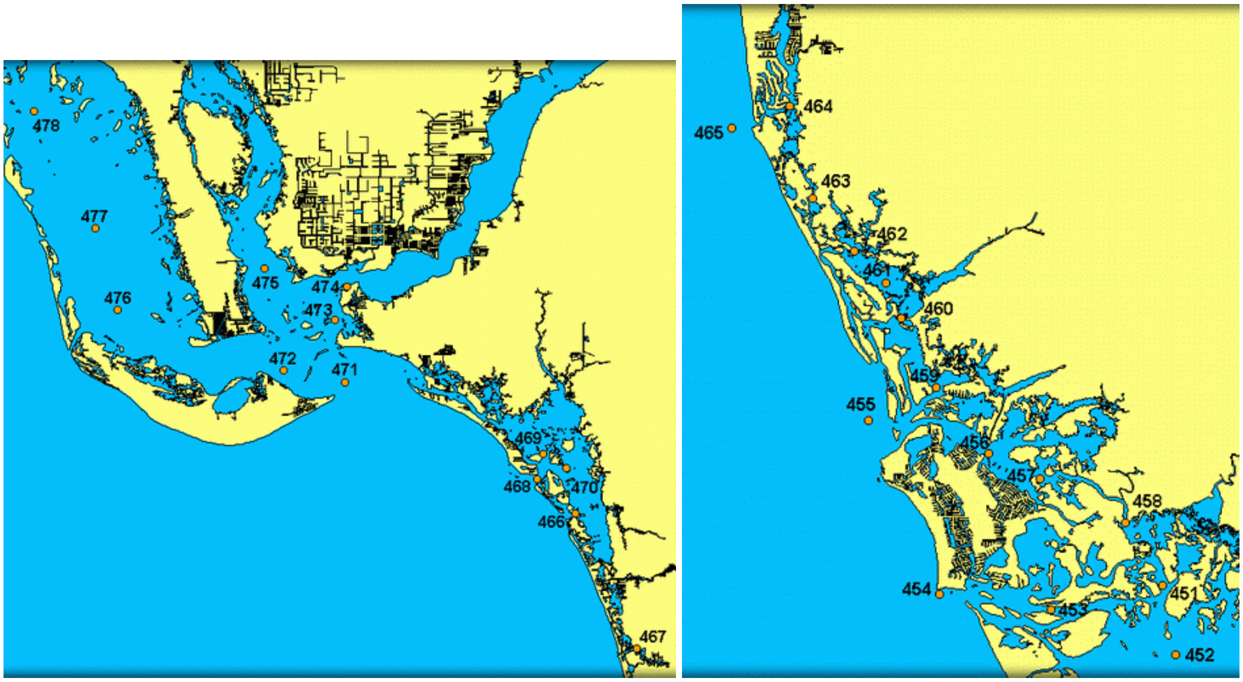

Figure 6.1. Map of station locations in Cape Romano-Pine Island Sound area.

All zones experienced low salinity during the beginning of the wet season with the opening of the Caloosahatchee structure (Fig. 6.2-6.7). CHLA is elevated in this area but not excessive when compared to the overall Ten Thousand Islands. SCB is most directly affected by the releases also had highest concentrations of TP, DIN, and TOC. Estero Bay also exhibited lower salinities than the other areas as a result of freshwater input from the Estero and Imperial Rivers as well as Hendry Creek. EST is relatively enclosed, has a long water residence time, and is bordered on the north by the city of Ft. Meyers. These facts may account for the elevated CHLA, DIN and TP.

Overall, this area has significantly higher concentrations of CHLA, TP, and DIN than the bulk of the Ten Thousand Islands stations. Much of this is due to geological changes from carbonates to silicates, which facilitates transport of phosphorus, and to major land use changes from the Big Cypress National Preserve to suburban and agricultural.

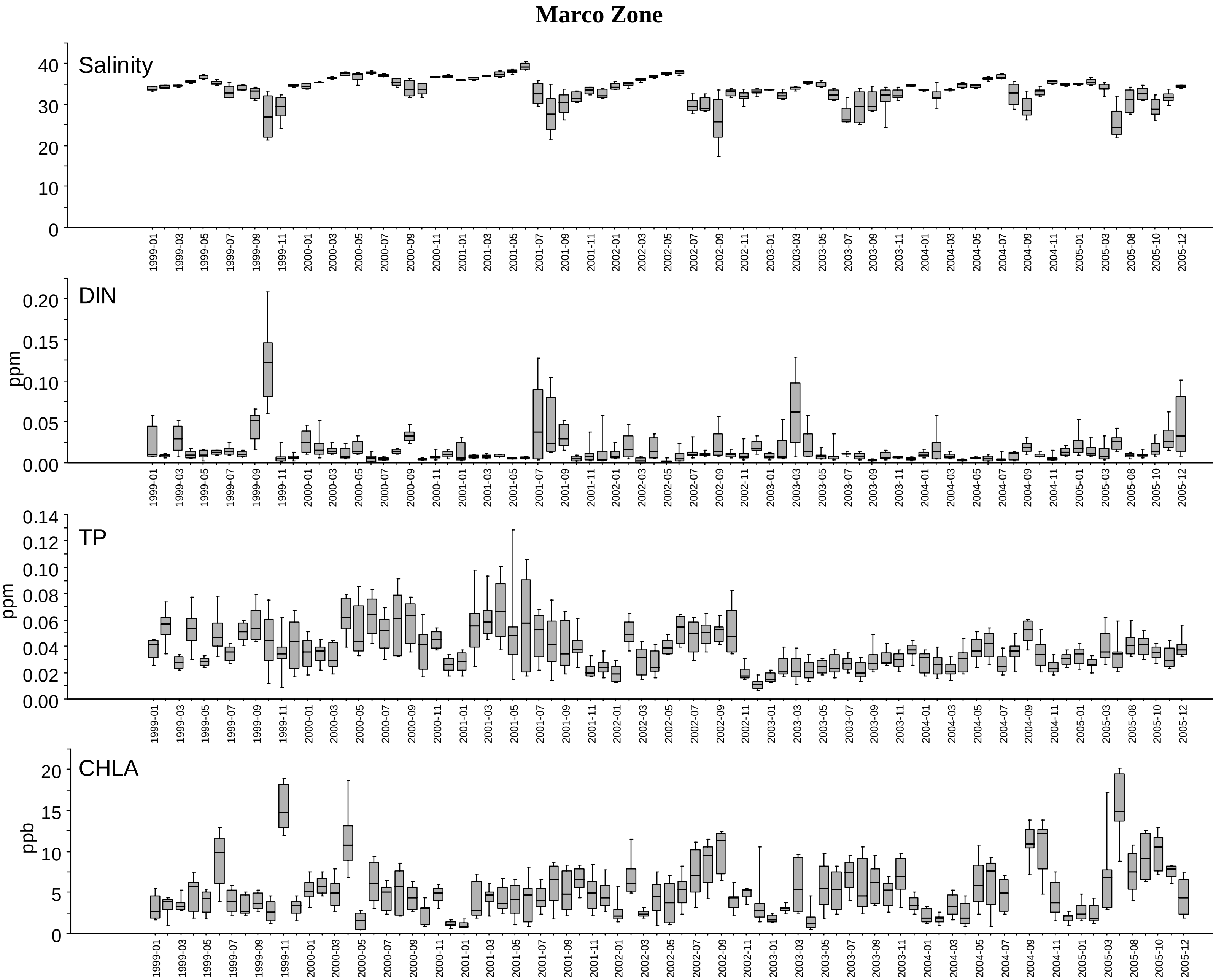

Figure 6.2. Box-and-whisker plots of water quality in RB-PIS by survey.

Rookery Bay Zone

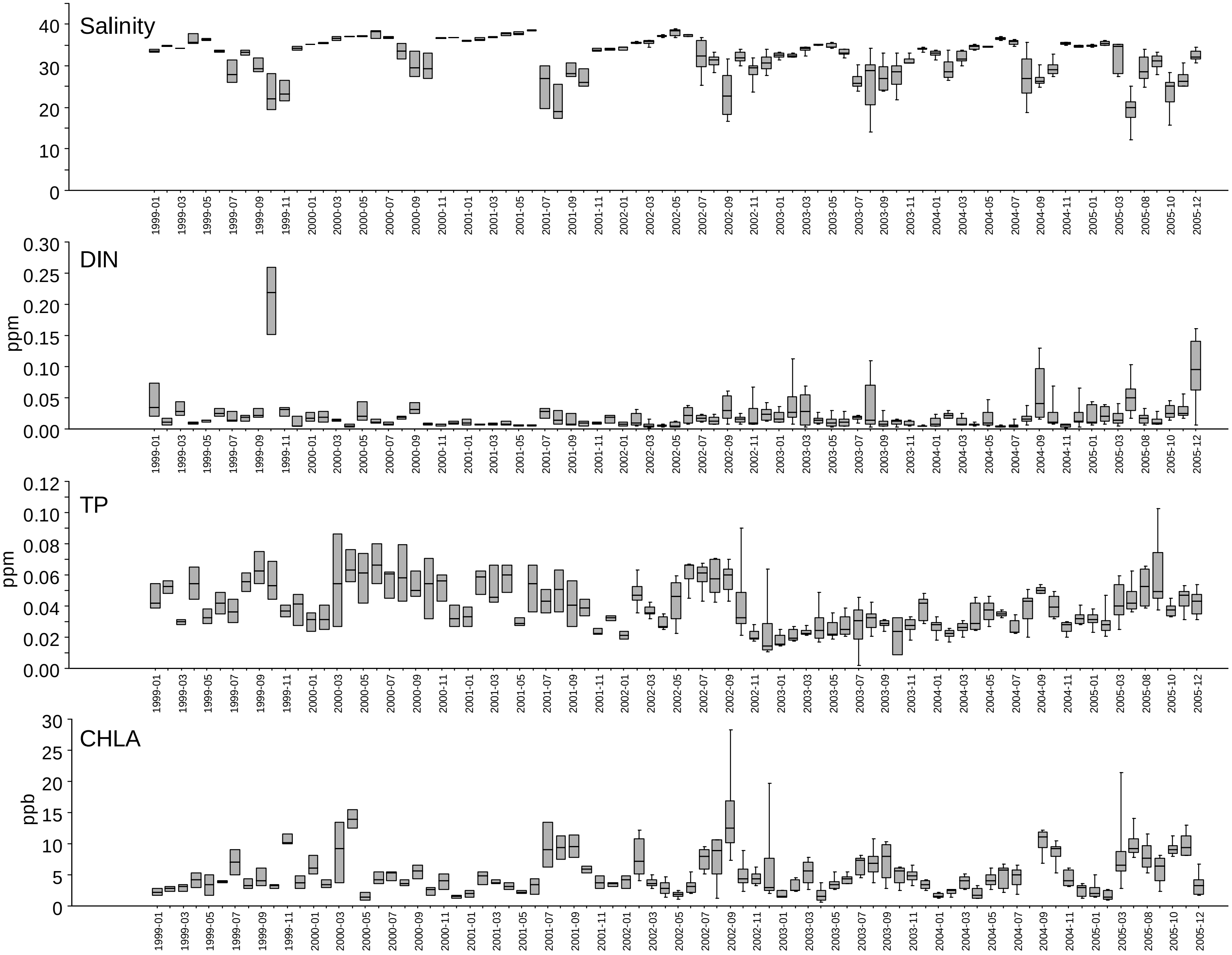

Figure 6.3. Box-and-whisker plots of water quality in RB-PIS by survey.

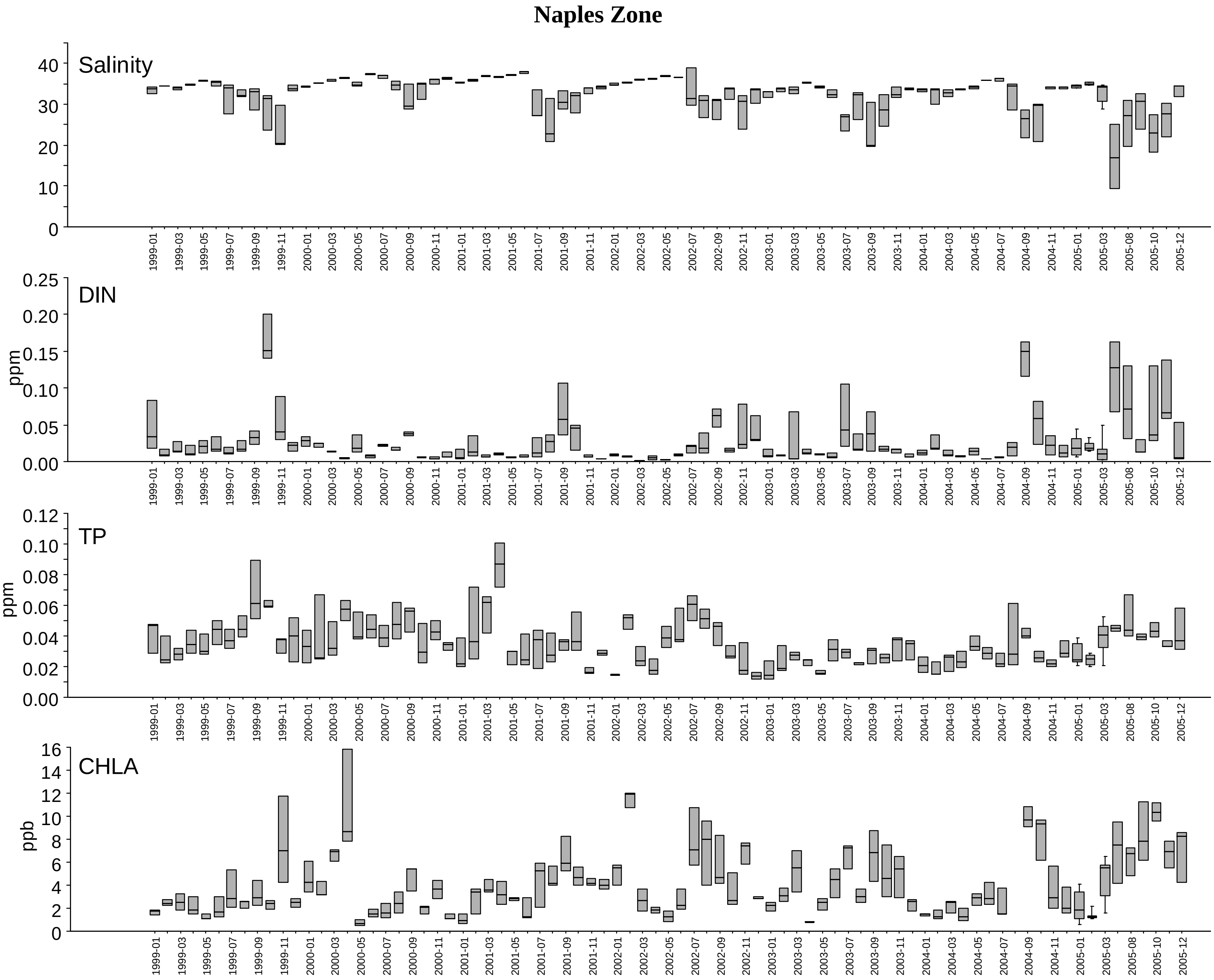

Figure 6.4. Box-and-whisker plots of water quality in RB-PIS by survey.

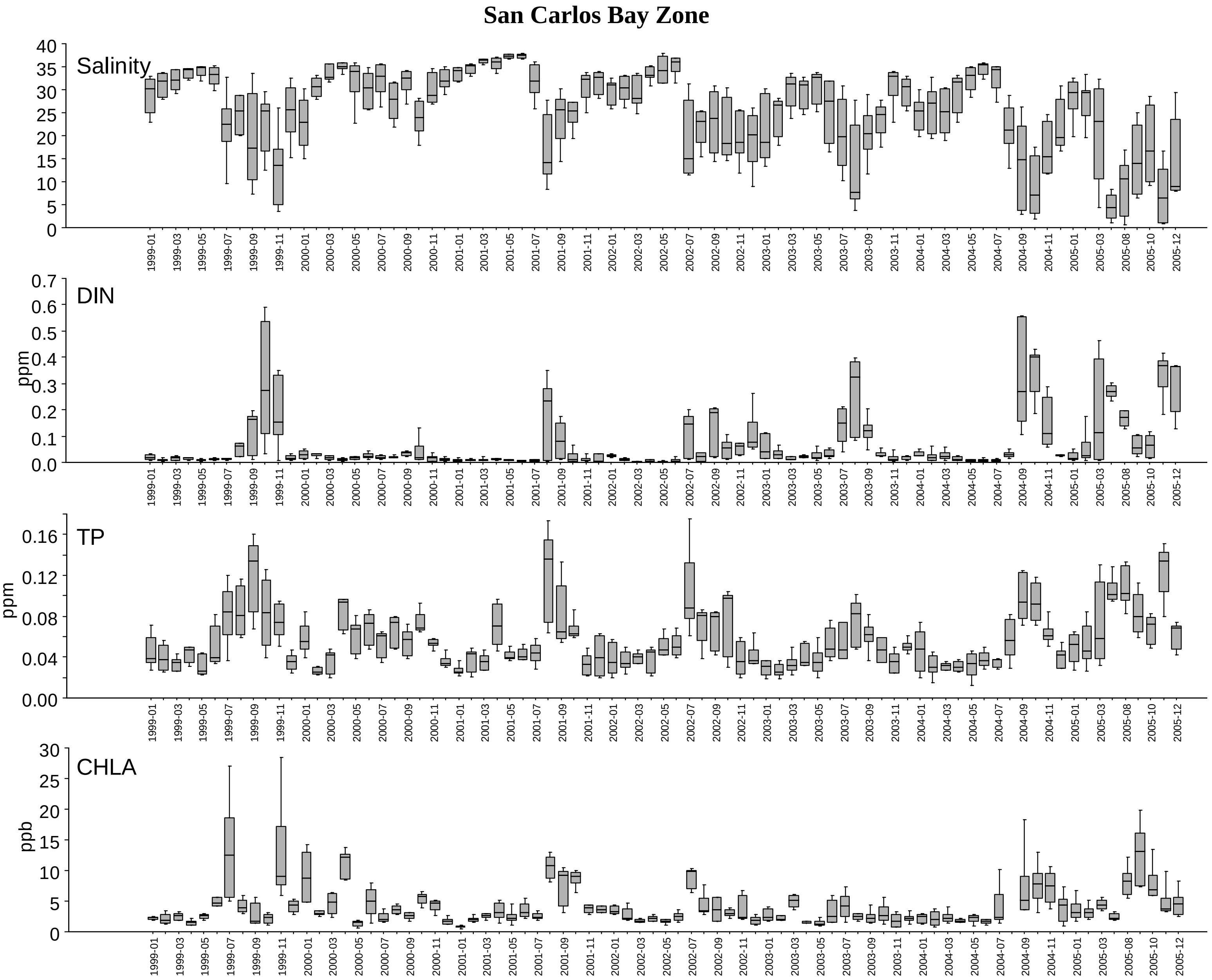

Figure 6.5. Box-and-whisker plots of water quality in RB-PIS by survey.

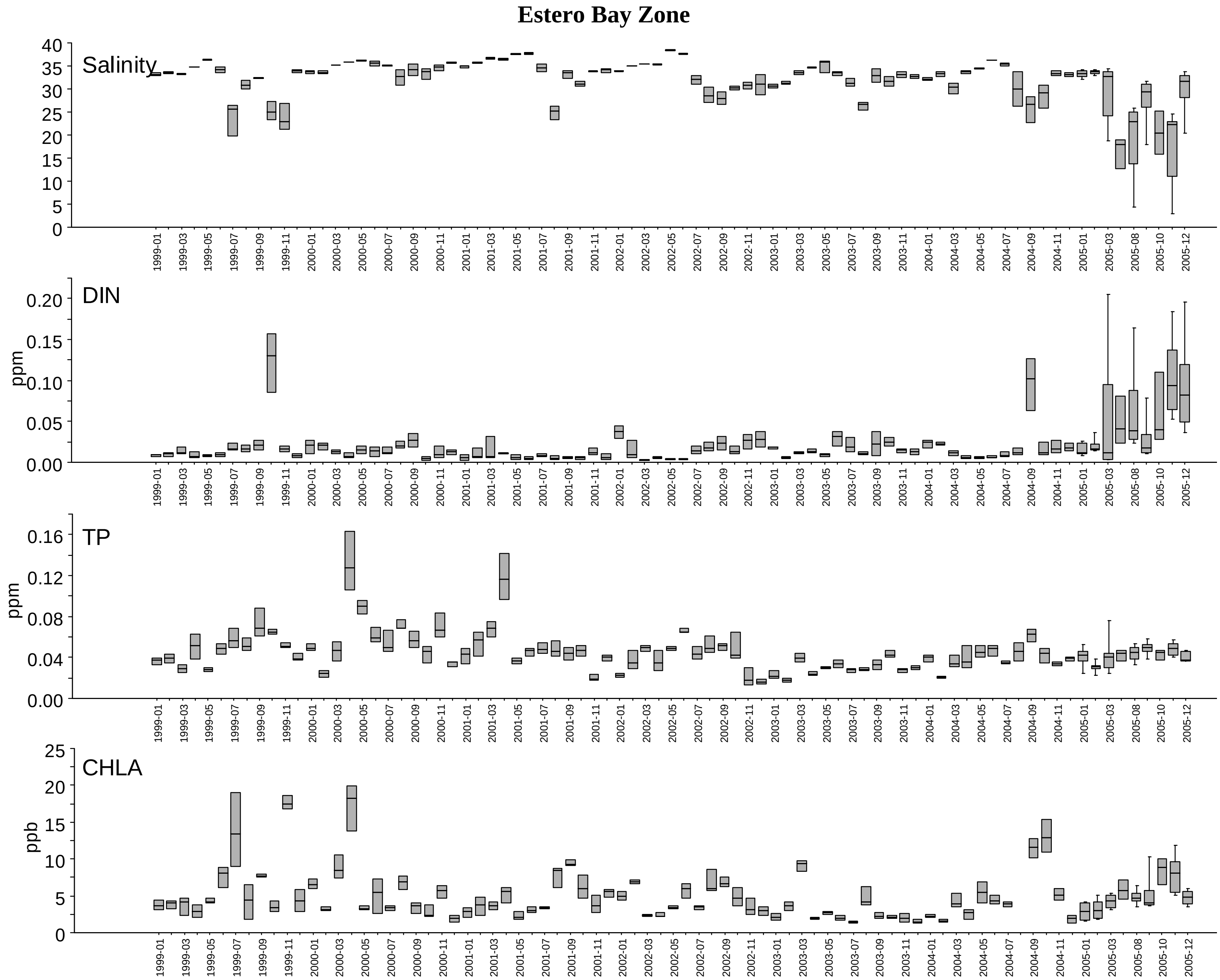

Figure 6.6. Box-and-whisker plots of water quality in RB-PIS by survey.

Pine Island Sound Zone

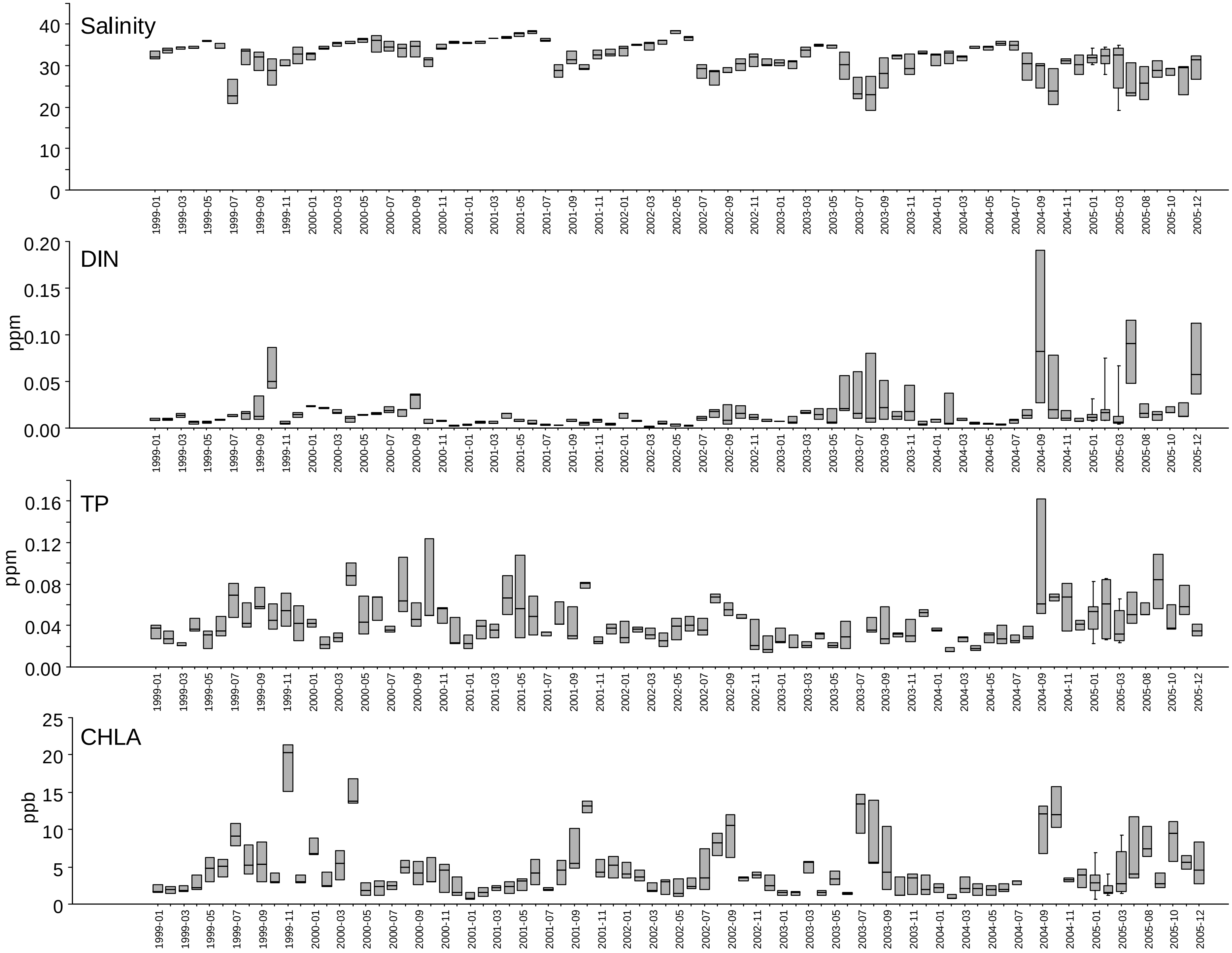

Figure 6.7. Box-and-whisker plots of water quality in RB-PIS by survey.

2005 Alone

Overall, this area has significantly higher concentrations of CHLA, TP, and DIN than the bulk of the Ten Thousand Islands stations. Much of this is due to geological changes from carbonates to silicates, which facilitates transport of phosphorus, and to major land use changes from the Big Cypress National Preserve to suburban and agricultural.

The largest interannual variations in salinity in this area are driven by freshwater releases from the Caloosahatchee River. (Fig. 6.8-6.14). The large freshwater inputs result in high DIN loads and concentrations. Freshwater releases during Sept./Oct. resulted in DIN concentrations up to 10 times normal. This was due to the need to lower the water table inland because of potential flooding from the hurricanes. The large and rapid increase in N (and P) loading to the estuaries caused large phytoplankton blooms and increased turbidity across the region.

Annual patterns in TON, TOC, temperature, and DO were unremarkable with values generally fluctuating around the median for all areas of the bay.

Data, Graphs, and Figures

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Contour maps showing spatial distributions of all measured variables (quarterly) are available at:
http://serc.fiu.edu/wqmnetwork/SFWMD-CD/ContourMaps.htm

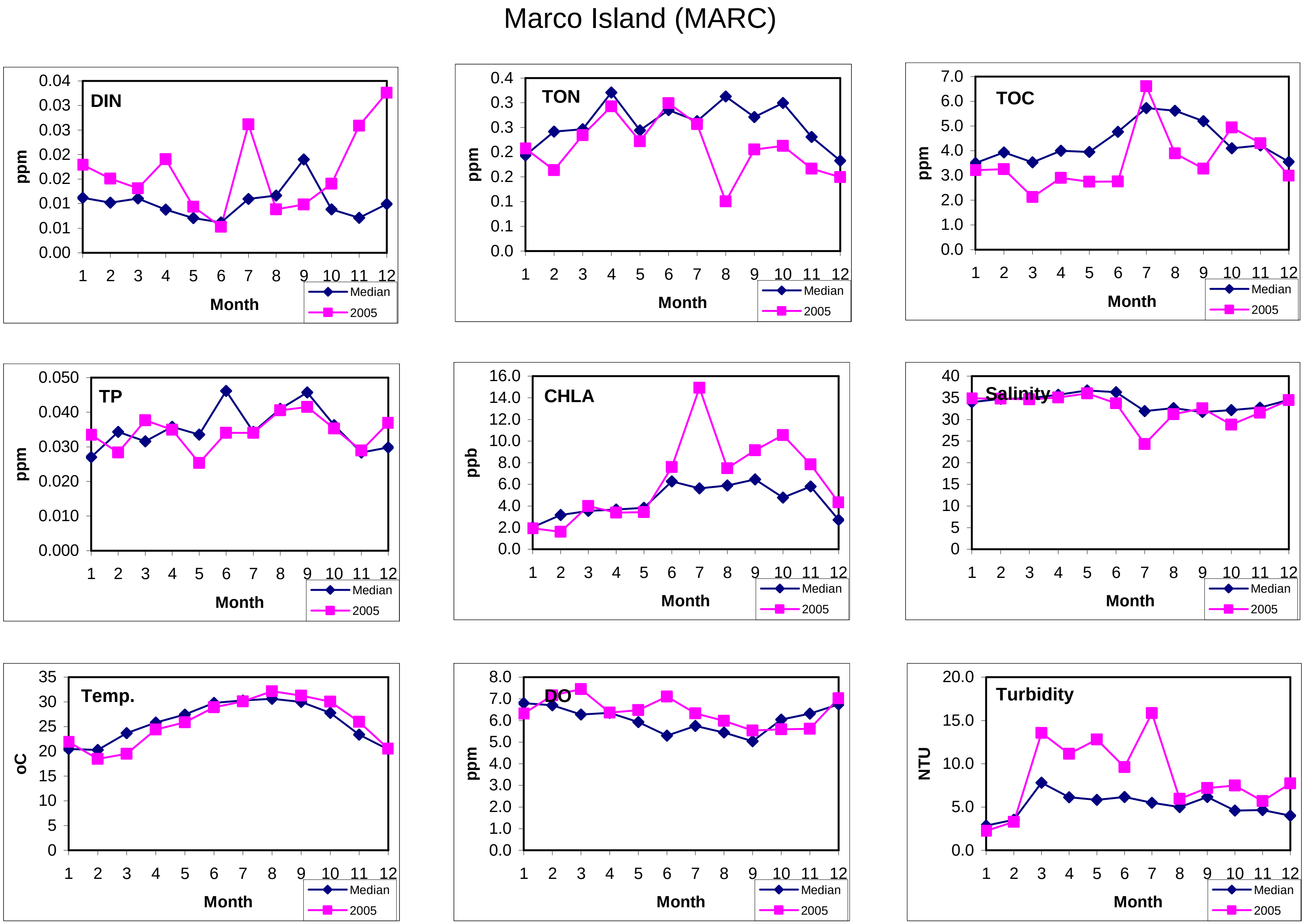

Figure 6.8. Comparison of long-term median with 2005 data.

Rookery Bay (RB)

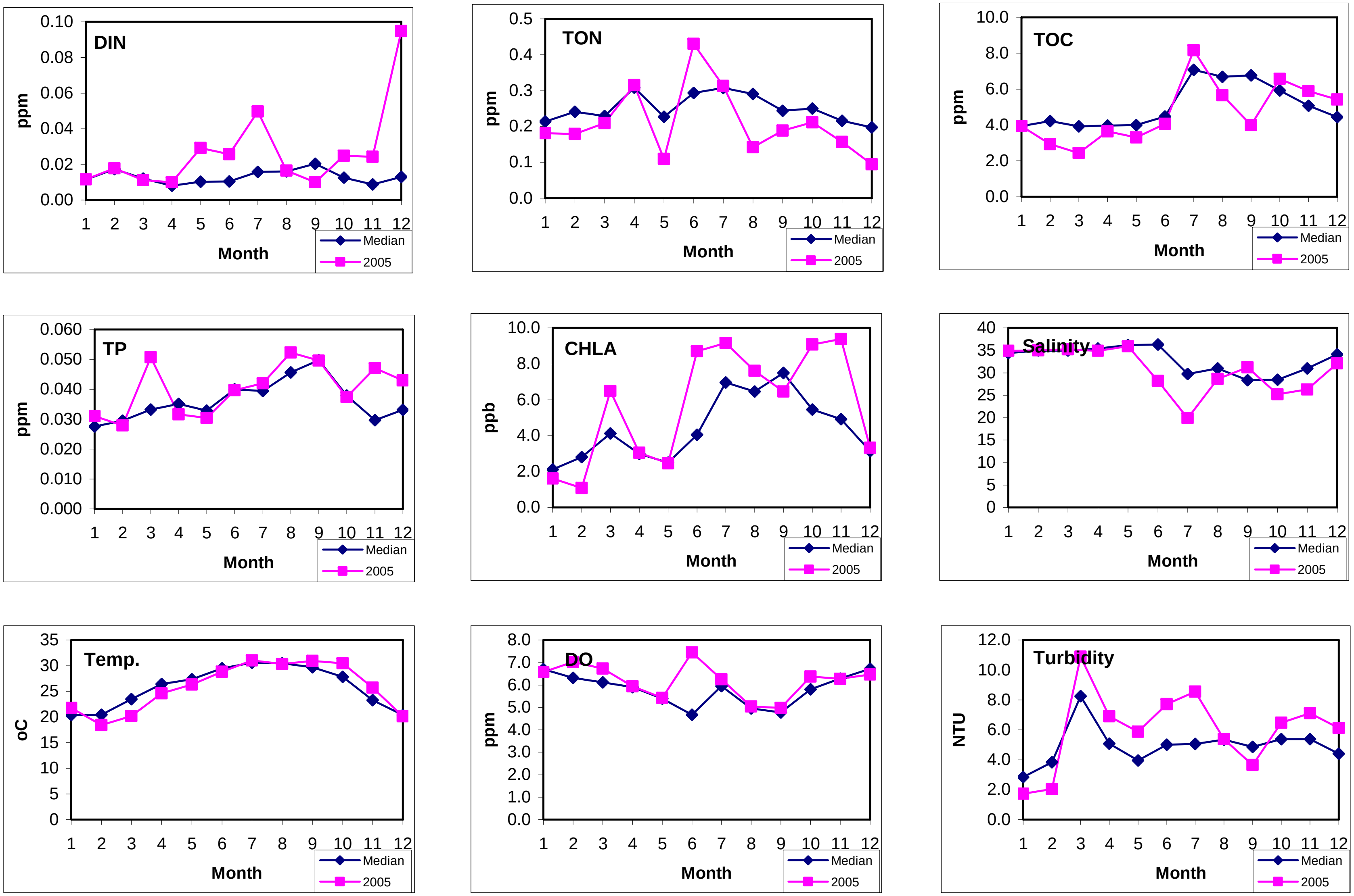

Figure 6.9. Comparison of long-term median with 2005 data.

Naples Bay (NPL)

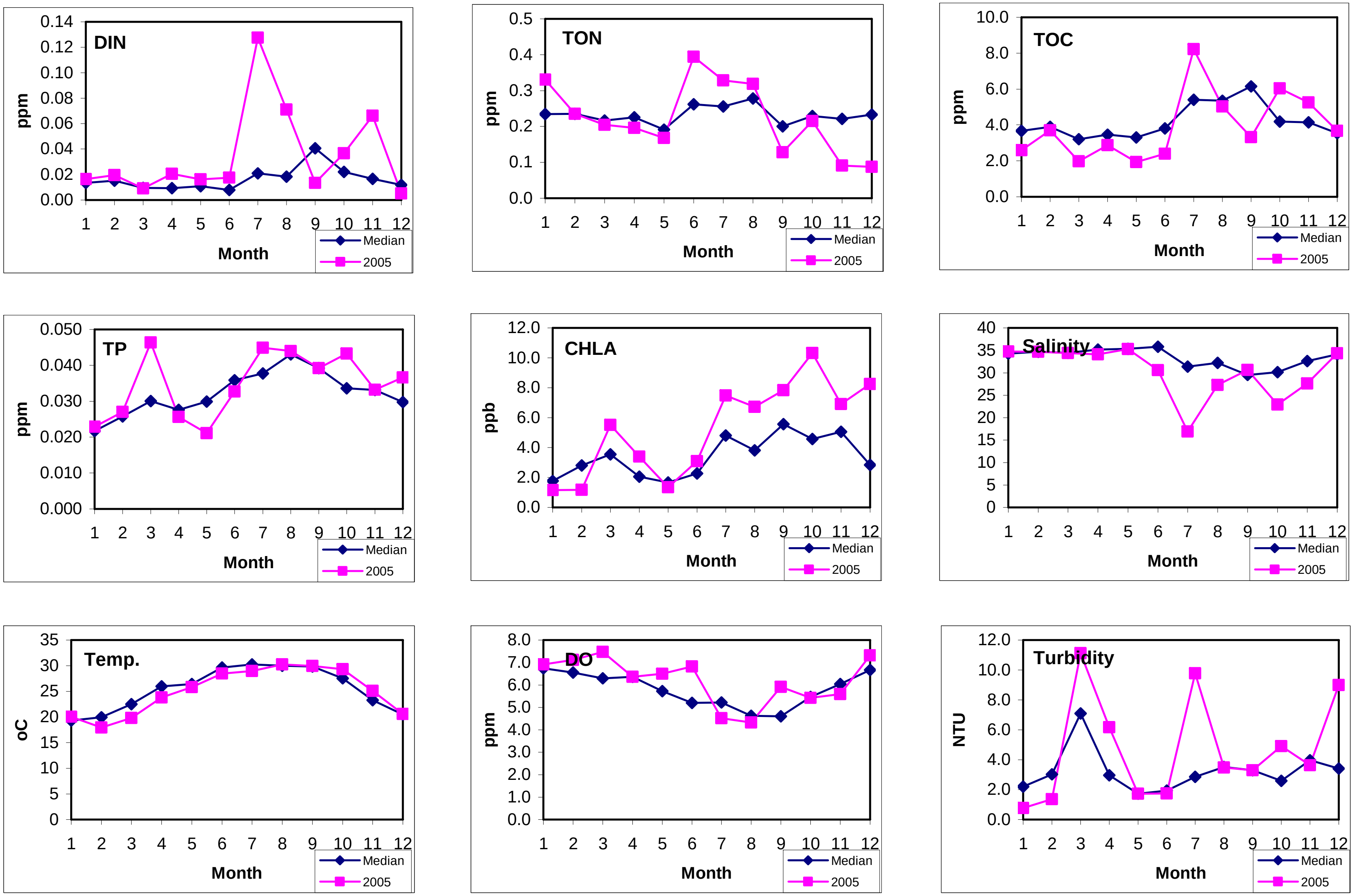

Figure 6.10. Comparison of long-term median with 2005 data.

San Carlos Bay (SCB)

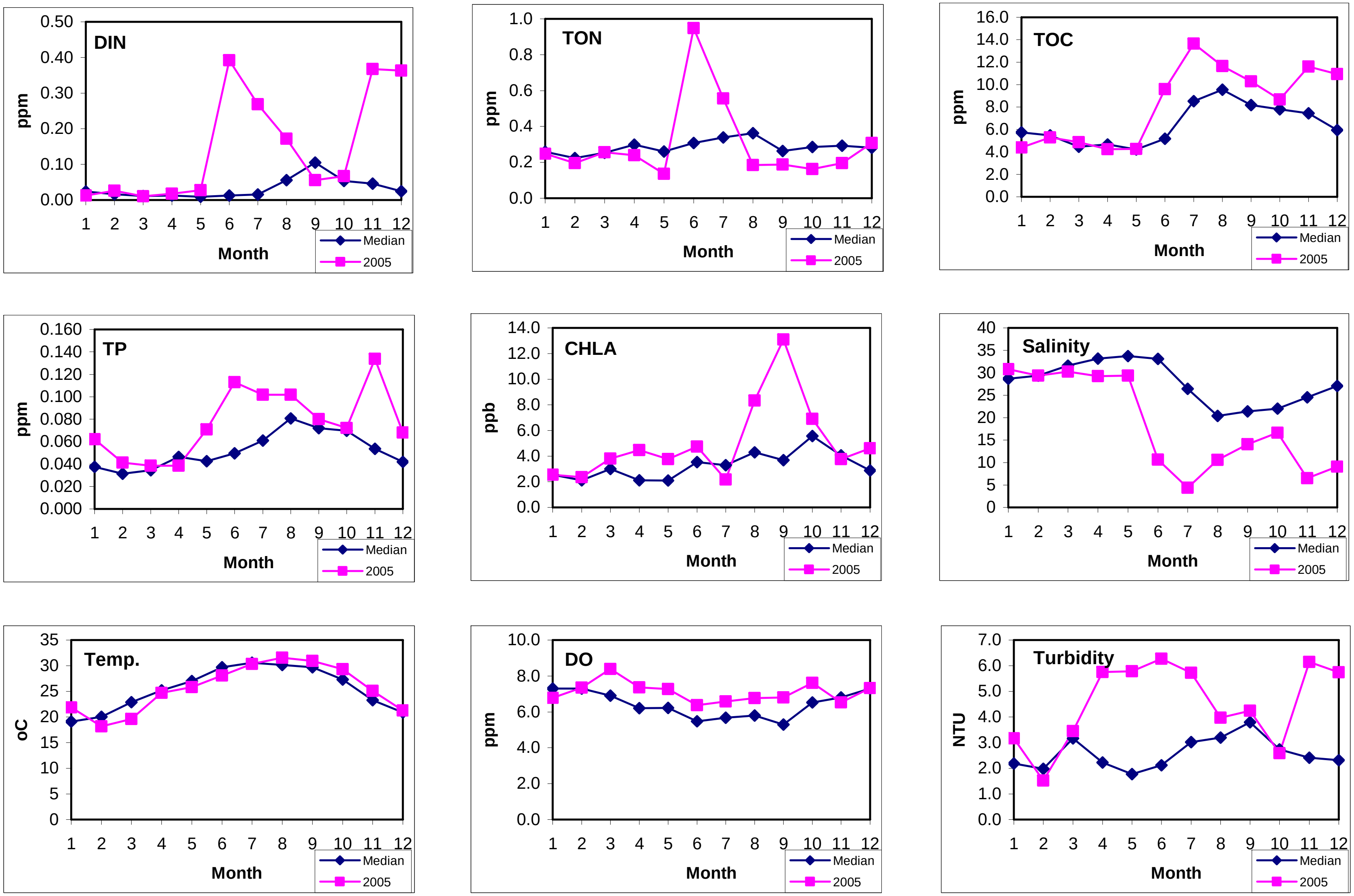

Figure 6.11. Comparison of long-term median with 2005 data.

Estero Bay (EST)

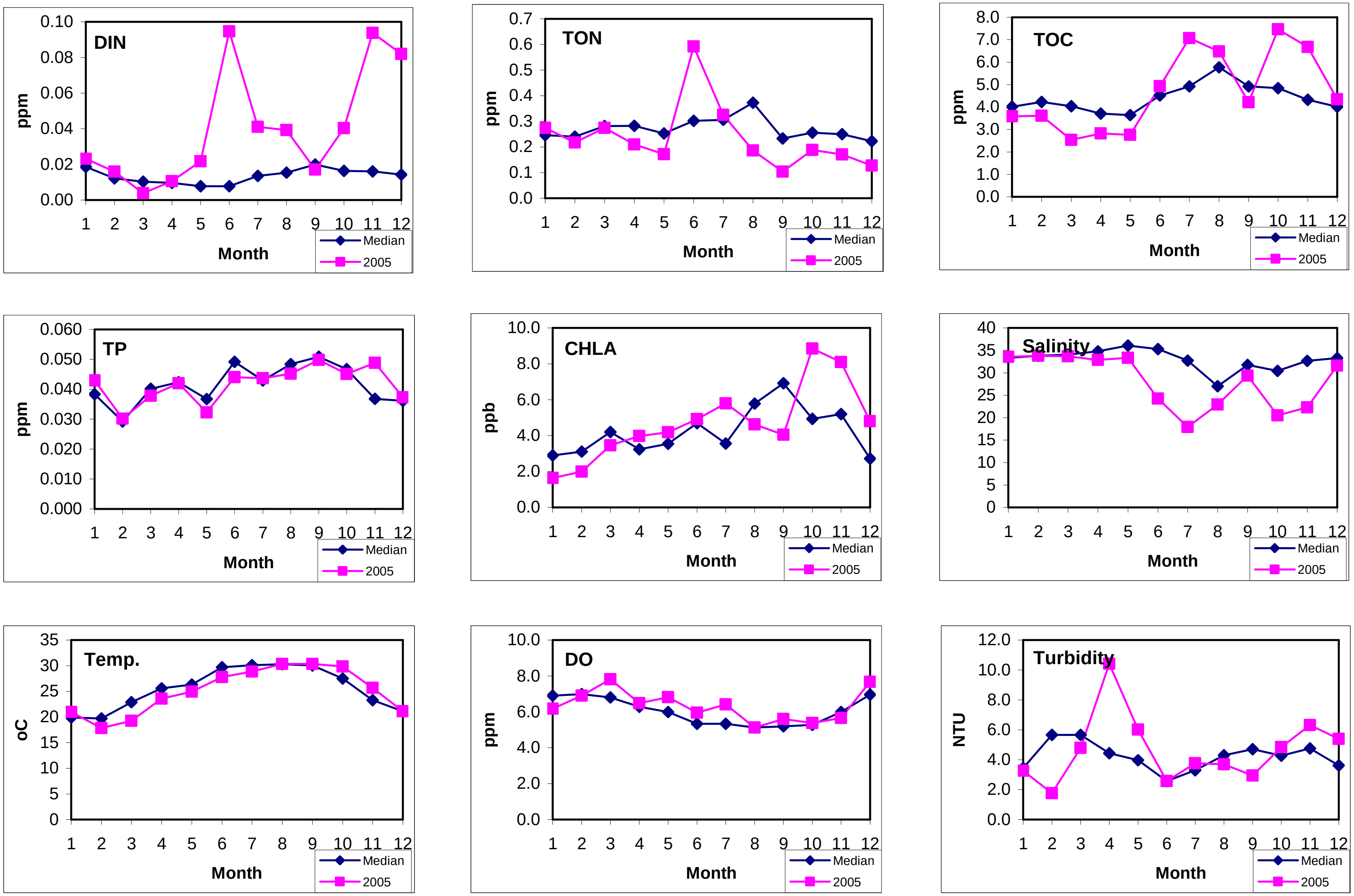

Figure 6.12. Comparison of long-term median with 2005 data.

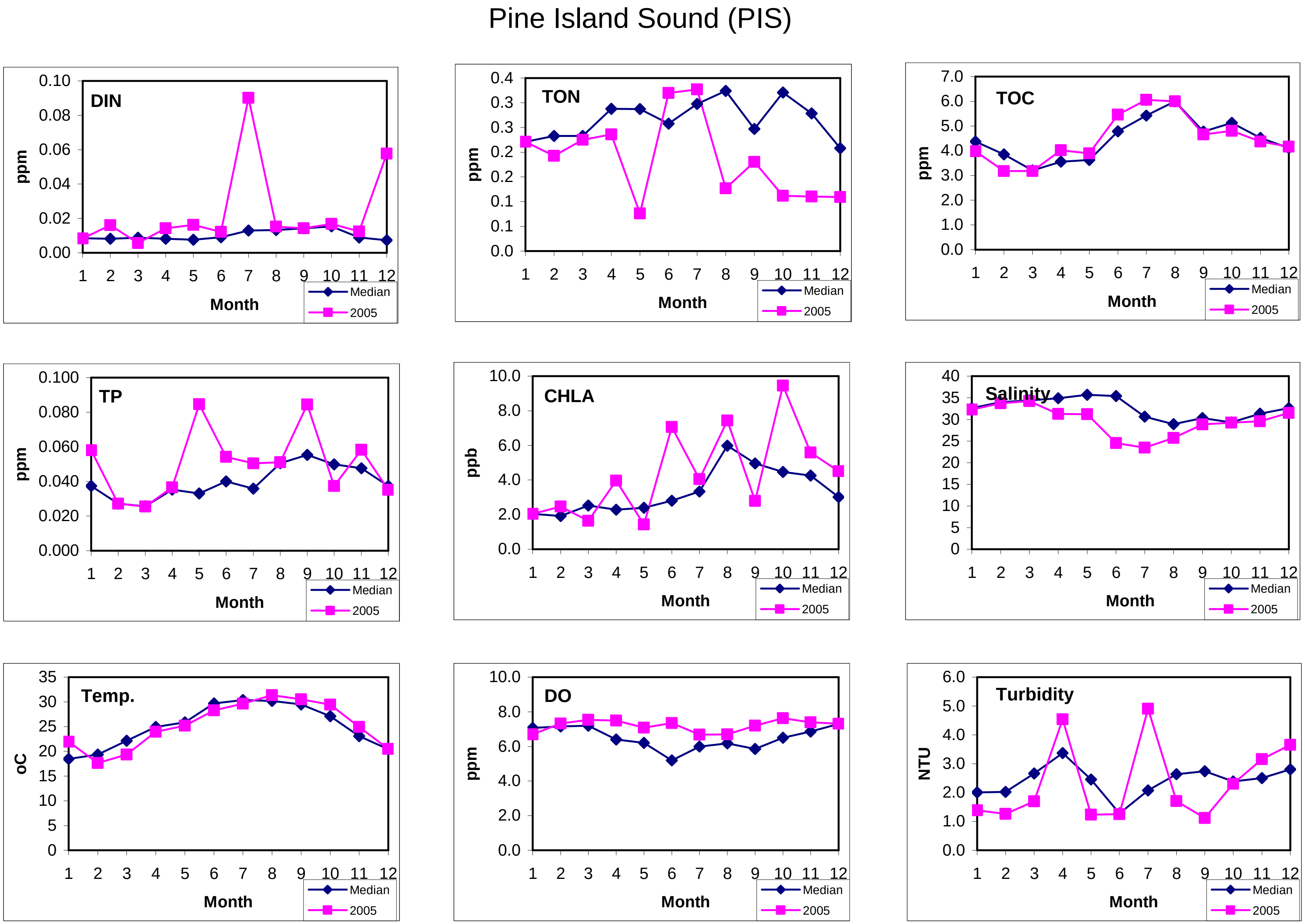

Figure 6.13. Comparison of long-term median with 2005 data.

Cocohatchee River (COCO)

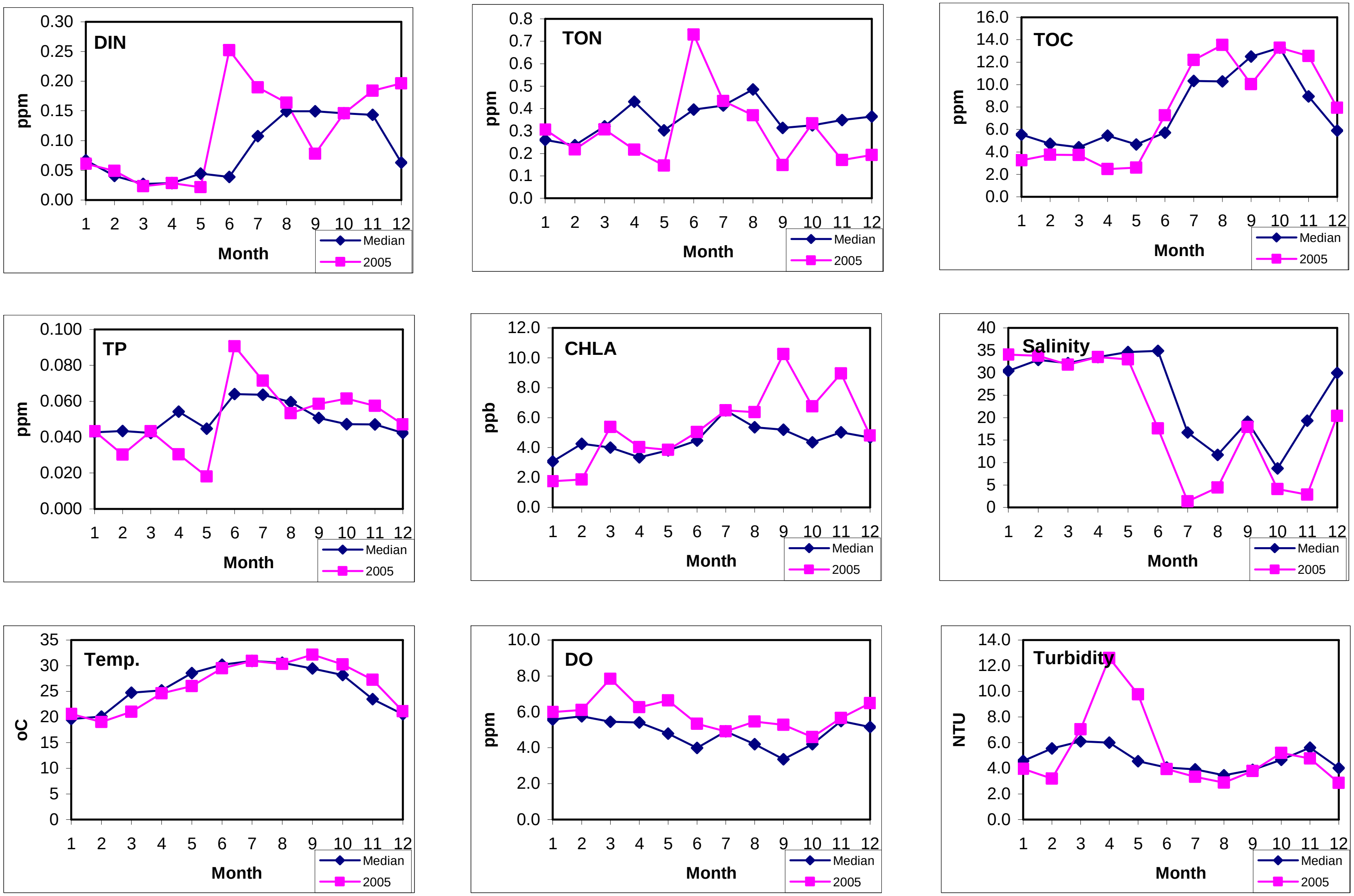

Figure 6.14. Comparison of long-term median with 2005 data.

7. PUBLICATIONS DERIVED FROM THIS PROJECT

Fourqurean, J. W., R. D. Jones, and J. C. Zieman. 1993. Processes influencing water column nutrient characteristics and phosphorus limitation of phytoplankton biomass in Florida Bay, FL, USA: Inferences from spatial distributions. *Estuarine, Coastal and Shelf Science* 36:295-314.

Boyer, J. N., J. W. Fourqurean, and R. D. Jones. 1997. Spatial characterization of water quality in Florida Bay and Whitewater Bay by principal component and cluster analyses: Zones of similar influence (ZSI). *Estuaries* 20:743-758.

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. 545-561. *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.

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* 22: 417-430.

Rudnick, D., Z. Chen, D. Childers, T. Fontaine, and J. N. Boyer. 1999. Phosphorus and nitrogen inputs to Florida Bay: the importance of the Everglades watershed. *Estuaries* 22: 398-416.

Pennock, J. R., J. N. Boyer, J. A. Hererra-Silviera, R. L. Iverson, T. E. Whitledge, B. Mortazavi, and F. A. Comin. 1999. Nutrient behavior and pelagic processes, p. 109-162. *In* T. S. Bianchi, J. R. Pennock, and R. R. Twilley (eds.), Biogeochemistry of Gulf of Mexico Estuaries. Wiley, New York.

Boyer, J. N., P. Sterling, and R. D. Jones. 2000. Maximizing information from estuarine and coastal water quality monitoring networks by diverse visualization approaches. *Estuarine, Coastal and Shelf Science* 50: 39-48.

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9. TABLES

Table 9.1. List of fixed station location and sampling period of record.

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 05	1-178
Middle Key	2	FB	25 17.102	-80 23.702	Mar 91 - Dec 05	1-178
Manatee Bay	3	FB	25 15.062	-80 24.910	Mar 91 - Dec 05	1-178
Barnes Sound	4	FB	25 13.304	-80 23.299	Mar 91 - Dec 05	1-178
Blackwater Sound	5	FB	25 10.443	-80 25.385	Mar 91 - Dec 05	1-178
Little Blackwater Sound	6	FB	25 12.401	-80 26.424	Mar 91 - Dec 05	1-178
Highway Creek	7	FB	25 15.216	-80 26.649	Mar 91 - Dec 05	1-178
Long Sound	8	FB	25 13.642	-80 27.700	Mar 91 - Dec 05	1-178
Duck Key	9	FB	25 10.624	-80 29.494	Mar 91 - Dec 05	1-178
Joe Bay	10	FB	25 13.468	-80 32.195	Mar 91 - Dec 05	1-178
Little Madeira Bay	11	FB	25 10.510	-80 37.615	Mar 91 - Dec 05	1-178
Terrapin Bay	12	FB	25 08.422	-80 42.967	Mar 91 - Dec 05	1-178
Whipray Basin	13	FB	25 05.485	-80 45.287	Mar 91 - Dec 05	1-178
Garfield Bight	14	FB	25 09.029	-80 48.553	Apr 91 - Dec 05	2-178
Rankin Lake	15	FB	25 07.283	-80 48.173	Mar 91 - Dec 05	1-178
Murray Key	16	FB	25 07.096	-80 56.379	Mar 91 - Dec 05	1-178
Johnson Key Basin	17	FB	25 02.548	-80 54.889	Mar 91 - Dec 05	1-178
Rabbit Key Basin	18	FB	25 00.145	-80 54.006	Mar 91 - Dec 05	1-178
Twin Key Basin	19	FB	24 58.660	-80 45.211	Apr 91 - Dec 05	2-178
Peterson Keys	20	FB	24 55.770	-80 45.028	Mar 91 - Dec 05	1-178
Porpoise Lake	21	FB	25 00.396	-80 40.876	Mar 91 - Dec 05	1-178
Captain Key	22	FB	25 02.405	-80 36.843	Apr 91 - Dec 05	2-178
Park Key	23	FB	25 07.078	-80 35.983	Apr 91 - Dec 05	2-178
Butternut Key	24	FB	25 06.105	-80 31.884	Mar 91 - Dec 05	1-178
East Cape	25	FB	25 05.022	-81 04.835	July 92 - Dec 05	17-178
Oxfoot Bank	26	FB	24 58.844	-81 00.098	July 92 - Dec 05	17-178
Sprigger Bank	27	FB	24 55.116	-80 56.092	July 92 - Dec 05	17-178
Old Dan Bank	28	FB	24 52.032	-80 48.429	July 92 - Dec 05	17-178
First Bay	29	WWB	25 33.272	-81 11.020	Sept 92 - Dec 05	19-178
Third Bay	30	WWB	25 34.810	-81 07.256	Sept 92 - Dec 05	19-178
Big Lostmans Bay	31	WWB	25 34.055	-81 04.288	Sept 92 - Dec 05	19-178
Cabbage Island	32	WWB	25 31.764	-81 02.603	Sept 92 - Dec 05	19-178
Broad River Bay	33	WWB	25 29.984	-81 02.939	Sept 92 - Dec 05	19-178
Middle Broad River	34	WWB	25 29.163	-81 06.669	Sept 92 - Dec 05	19-178
Broad River Mouth	35	WWB	25 28.501	-81 09.176	Sept 92 - Dec 05	19-178
Harney River Mouth	36	WWB	25 24.701	-81 08.487	Sept 92 - Dec 05	19-178
Harney Rivers Junction	37	WWB	25 25.901	-81 04.943	Sept 92 - Dec 05	19-178
Tarpon Bay	38	WWB	25 25.037	-80 59.906	Sept 92 - Dec 05	19-178
Gunboat Island	39	WWB	25 22.735	-81 01.844	Sept 92 - Dec 05	19-178
Ponce de Leon Bay	40	WWB	25 20.983	-81 07.474	Sept 92 - Dec 05	19-178
Oyster Bay	41	WWB	25 19.869	-81 04.360	Sept 92 - Dec 05	19-178
North Marker 36	42	WWB	25 19.560	-81 00.873	Sept 92 - Dec 05	19-178
West Marker 34	43	WWB	25 17.168	-81 01.419	Sept 92 - Dec 05	19-178
Watson River Chickee	44	WWB	25 19.912	-80 59.022	Sept 92 - Dec 05	19-178
North River Mouth	45	WWB	25 18.054	-80 57.620	Sept 92 - Dec 05	19-178
Midway Keys	46	WWB	25 17.102	-80 58.548	Sept 92 - Dec 05	19-178
Roberts River Mouth	47	WWB	25 16.779	-80 55.846	Sept 92 - Dec 05	19-178
West Marker 18	48	WWB	25 14.448	-80 57.476	Sept 92 - Dec 05	19-178
Southeast Marker 12	49	WWB	25 13.704	-80 55.980	Sept 92 - Dec 05	19-178
Coot Bay	50	WWB	25 11.452	-80 54.848	Sept 92 - Dec 05	19-178

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
Chokoloskee	51	TTI	25 48.450	-81 20.970	Sept 94 - Dec 05	43-178
Rabbit Key Pass	52	TTI	25 46.200	-81 23.000	Sept 94 - Dec 05	43-178
Lopez Bay	53	TTI	25 47.050	-81 19.930	Sept 94 - Dec 05	43-178
Lopez River	54	TTI	25 47.130	-81 18.550	Sept 94 - Dec 05	43-178
Sunday Bay	55	TTI	25 47.760	-81 16.800	Sept 94 - Dec 05	43-178
Huston Bay	56	TTI	25 45.180	-81 15.330	Sept 94 - Dec 05	43-178
Upper Chatham River	57	TTI	25 43.050	-81 13.830	Sept 94 - Dec 05	43-178
Watson Place	58	TTI	25 42.470	-81 15.130	Sept 94 - Dec 05	43-178
Gun Rock Point	59	TTI	25 41.500	-81 17.920	Sept 94 - Dec 05	43-178
Huston River	60	TTI	25 43.880	-81 17.080	Sept 94 - Dec 05	43-178
Chevalier Bay	61	TTI	25 42.750	-81 12.420	Sept 94 - Dec 05	43-178
Alligator Bay	62	TTI	25 40.210	-81 10.120	Sept 94 - Dec 05	43-178
Lostmans Five Bay	63	TTI	25 38.000	-81 08.700	Sept 94 - Dec 05	43-178
Barron River	64	TTI	25 51.196	-81 23.602	Sept 94 - Dec 05	43-178
Indian Key Pass	65	TTI	25 49.631	-81 26.465	Sept 94 - Dec 05	43-178
Indian Key	66	TTI	25 48.290	-81 27.750	Sept 94 - Dec 05	43-178
West Pass	67	TTI	25 49.820	-81 30.170	Sept 94 - Dec 05	43-178
Panther Key	68	TTI	25 50.960	-81 32.530	Sept 94 - Dec 05	43-178
Faka Union Pass	69	TTI	25 52.450	-81 30.960	Sept 94 - Dec 05	43-178
Faka Union Bay	70	TTI	25 54.000	-81 30.960	Sept 94 - Dec 05	43-178
White Horse Key	71	TTI	25 52.007	-81 34.489	Sept 94 - Dec 05	43-178
Dismal Key	72	TTI	25 53.668	-81 33.532	Sept 94 - Dec 05	43-178
Long Rock	73	TTI	25 52.920	-81 36.380	Sept 94 - Dec 05	43-178
Shell Key	74	TTI	25 54.670	-81 36.920	Sept 94 - Dec 05	43-178
Blackwater River	75	TTI	25 55.788	-81 36.019	Sept 94 - Dec 05	43-178
Fakahatchee Bay	76	TTI	25 53.369	-81 28.592	Jan 02 - Dec-05	131-178
Convoy Point	101	BB	25 28.700	-80 19.250	Sept 93 - Dec 05	31-178
Black Point	102	BB	25 32.750	-80 17.680	Sept 93 - Dec 05	31-178
Near Black Ledge	103	BB	25 34.400	-80 17.200	Sept 93 - Dec 05	31-178
BNP Marker C	104	BB	25 36.100	-80 13.250	Sept 93 - Dec 05	31-178
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 05	31-178
North Midbay	109	BB	25 33.850	-80 14.100	Sept 93 - Dec 05	31-178
Fender Point	110	BB	25 30.300	-80 17.250	Sept 93 - Dec 05	31-178
Featherbed Bank	111	BB	25 30.950	-80 14.400	Sept 93 - Dec 05	31-178
Sands Cut	112	BB	25 29.300	-80 11.300	Sept 93 - Dec 05	31-178
Elliott Key	113	BB	25 26.500	-80 13.400	Sept 93 - Dec 05	31-178
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 05	31-178
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 05	31-178
West Arsenicker	122	BB	25 25.210	-80 18.650	Sept 93 - Dec 05	31-178
Pelican Bank	123	BB	25 26.700	-80 17.000	Sept 93 - Dec 05	31-178

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
South Midbay	124	BB	25 28.350	-80 14.000	Sept 93 - Dec 05	31-178
Turkey Point	125	BB	25 28.200	-80 16.998	Sept 93 - May 96	31-63
BNP Marker B	126	BB	25 40.300	-80 12.300	June 96 - Dec 05	64-178
Shoal Point	127	BB	25 37.800	-80 15.000	June 96 - Dec 05	64-178
Matheson Beach	128	BB	25 41.300	-80 14.000	June 96 - Dec 05	64-178
Marker G-71	129	BB	25 44.200	-80 11.100	June 96 - Dec 05	64-178
South Dodge Island	130	BB	25 45.800	-80 10.300	June 96 - Dec 05	64-178
North Venetian Basin	131	BB	25 48.000	-80 10.000	June 96 - Dec 05	64-178
North I-195 Basin	132	BB	25 49.000	-80 10.000	June 96 - Dec 05	64-178
North Normandy Isle	133	BB	25 52.000	-80 09.000	June 96 - Dec 05	64-178
Oleta River Park	134	BB	25 54.300	-80 08.000	June 96 - Dec 05	64-178
South Card Sound	135	BB	25 19.000	-80 19.000	June 96 - Dec 05	64-178
Lower Harbor Keys	351	SHELF	24 41.500	-81 47.500	May 95 - Dec 05	1-42
	352	SHELF	24 46.550	-81 46.980	May 95 - Dec 05	1-42
	353	SHELF	24 51.500	-81 46.600	May 95 - Dec 05	1-42
	354	SHELF	24 56.480	-81 46.120	May 95 - Dec 05	1-42
	355	SHELF	25 01.480	-81 45.750	May 95 - Dec 05	1-42
	356	SHELF	25 06.460	-81 45.230	May 95 - Dec 05	1-42
	357	SHELF	25 11.470	-81 44.720	May 95 - Dec 05	1-42
	358	SHELF	25 16.480	-81 44.290	May 95 - Dec 05	1-42
	359	SHELF	25 21.500	-81 43.800	May 95 - Dec 05	1-42
	360	SHELF	25 26.470	-81 43.260	May 95 - Dec 05	1-42
	361	SHELF	25 31.480	-81 42.900	May 95 - Dec 05	1-42
	362	SHELF	25 36.520	-81 42.400	May 95 - Dec 05	1-42
Off Cape Romano	363	SHELF	25 41.520	-81 41.900	May 95 - Dec 05	1-42
	364	SHELF	25 41.500	-81 32.000	May 95 - Dec 05	1-42
	365	SHELF	25 36.510	-81 32.360	May 95 - Dec 05	1-42
	366	SHELF	25 31.560	-81 32.930	May 95 - Dec 05	1-42
	367	SHELF	25 26.550	-81 33.300	May 95 - Dec 05	1-42
	368	SHELF	25 21.510	-81 33.800	May 95 - Dec 05	1-42
	369	SHELF	25 16.530	-81 34.320	May 95 - Dec 05	1-42
	370	SHELF	25 11.510	-81 34.750	May 95 - Dec 05	1-42
	371	SHELF	25 06.500	-81 35.210	May 95 - Dec 05	1-42
	372	SHELF	25 01.500	-81 35.720	May 95 - Dec 05	1-42
	373	SHELF	24 56.530	-81 36.180	May 95 - Dec 05	1-42
	374	SHELF	24 51.530	-81 36.650	May 95 - Dec 05	1-42
Off Johnson Key	375	SHELF	24 46.540	-81 37.070	May 95 - Dec 05	1-42
Harbor Key Bank	376	SHELF	24 50.600	-81 26.300	May 95 - Dec 05	1-42
	377	SHELF	24 56.100	-81 25.900	May 95 - Dec 05	1-42
	378	SHELF	25 01.000	-81 24.950	May 95 - Dec 05	1-42
	379	SHELF	25 06.000	-81 24.530	May 95 - Dec 05	1-42
	380	SHELF	25 11.000	-81 24.000	May 95 - Dec 05	1-42
	381	SHELF	25 16.000	-81 23.700	May 95 - Dec 05	1-42
	382	SHELF	25 21.000	-81 23.200	May 95 - Dec 05	1-42
	383	SHELF	25 25.950	-81 22.670	May 95 - Dec 05	1-42
	384	SHELF	25 30.930	-81 22.200	May 95 - Dec 05	1-42
	385	SHELF	25 36.010	-81 21.790	May 95 - Dec 05	1-42
	386	SHELF	25 33.330	-81 20.430	May 95 - Dec 05	1-42
	387	SHELF	25 30.530	-81 19.010	May 95 - Dec 05	1-42
	388	SHELF	25 25.500	-81 17.820	May 95 - Dec 05	1-42
	389	SHELF	25 20.500	-81 16.620	May 95 - Dec 05	1-42

Station Name	Station Number	Area	Latitude	Longitude	Period of Record	Surveys
	390	SHELF	25 15.600	-81 15.610	May 95 - Dec 05	1-42
	391	SHELF	25 10.500	-81 14.320	May 95 - Dec 05	1-42
	392	SHELF	25 05.500	-81 14.900	May 95 - Dec 05	1-42
	393	SHELF	25 00.500	-81 15.200	May 95 - Dec 05	1-42
	394	SHELF	24 55.500	-81 15.600	May 95 - Dec 05	1-42
Off Bluefish Bank	395	SHELF	24 52.700	-81 11.500	May 95 - Dec 05	1-42
Off Bullard Bank	396	SHELF	24 50.000	-81 07.700	May 95 - Dec 05	1-42
	397	SHELF	24 55.000	-81 07.100	May 95 - Dec 05	1-42
	398	SHELF	25 00.000	-81 06.600	May 95 - Dec 05	1-42
Off East Cape	300	SHELF	25 05.000	-81 05.960	May 95 - Dec 05	1-42
Coon Key Pass, G3	451	ROOK	25 54.626	-81 38.309	Jan 99 - Dec 05	97-178
Coon Key Light	452	ROOK	25 52.918	-81 37.954	Jan 99 - Dec 05	97-178
Fred Key, G5	453	ROOK	25 53.978	-81 41.027	Jan 99 - Dec 05	97-178
Caxambas Pass, R4	454	ROOK	25 54.360	-81 43.733	Jan 99 - Dec 05	97-178
Capri Pass, R2A	455	ROOK	25 59.285	-81 43.740	Jan 99 - Dec 05	97-178
Rt. 951 Bridge, R26	456	ROOK	25 57.737	-81 42.524	Jan 99 - Dec 05	97-178
Big Marco River, R24	457	ROOK	25 57.122	-81 41.243	Jan 99 - Dec 05	97-178
Goodland Bridge, G15	458	ROOK	25 56.080	-81 39.204	Jan 99 - Dec 05	97-178
Johnson Bay	459	ROOK	25 59.291	-81 43.748	Jan 99 - Dec 05	97-178
Hall Bay	460	ROOK	26 00.941	-81 44.566	Jan 99 - Dec 05	97-178
Rookery Bay	461	ROOK	26 01.755	-81 44.888	Jan 99 - Dec 05	97-178
First National	462	ROOK	26 02.441	-81 45.955	Jan 99 - Dec 05	97-178
Kewaydin Channel, G55	463	ROOK	26 03.611	-81 46.713	Jan 99 - Dec 05	97-178
Dollar Bay, G73	464	ROOK	26 06.000	-81 47.213	Jan 99 - Dec 05	97-178
Outer Gordon Pass, G1	465	ROOK	26 05.480	-81 48.686	Jan 99 - Dec 05	97-178
Outer Clam Pass	466	ROOK	26 22.692	-81 51.508	Jan 99 - Dec 05	97-178
Wiggins Pass Bridge	467	ROOK	26 17.441	-81 49.105	Jan 99 - Dec 05	97-178
Big Carlos Pass Bridge	468	ROOK	26 24.146	-81 52.850	Jan 99 - Dec 05	97-178
Coon Key, R2A	469	ROOK	26 25.422	-81 52.400	Jan 99 - Dec 05	97-178
Central Estero Bay, R2	470	ROOK	26 24.459	-81 51.885	Jan 99 - Dec 05	97-178
Point Ybel, R8	471	ROOK	26 27.492	-82 00.444	Jan 99 - Dec 05	97-178
San Carlos Bay, R4	472	ROOK	26 28.013	-82 02.723	Jan 99 - Dec 05	97-178
Kitchel Key, G13	473	ROOK	26 30.070	-82 00.789	Jan 99 - Dec 05	97-178
Shell Point	474	ROOK	26 31.368	-82 00.417	Jan 99 - Dec 05	97-178
Reckems Point	475	ROOK	26 32.108	-82 03.548	Jan 99 - Dec 05	97-178
Sanibel	476	ROOK	26 30.472	-82 09.113	Jan 99 - Dec 05	97-178
Pine Island Sound	477	ROOK	26 33.702	-82 09.934	Jan 99 - Dec 05	97-178
Cayo Costa	478	ROOK	26 38.150	-82 12.517	Jan 99 - Dec 05	97-178

Table 9.2. Statistical summary of Florida Bay water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (μM hr^{-1})	FBC	1.19	0.01	6.90	671
	FBE	0.33	0.01	6.11	2826
	FBW	0.17	0.01	4.93	969
Chlorophyll *a* (μg l^{-1})	FBC	1.58	0.11	35.61	686
	FBE	0.49	0.00	11.35	2896
	FBW	1.37	0.13	22.08	1002
Surface Dissolved Oxygen (mg l^{-1})	FBC	6.3	1.5	12.2	658
	FBE	6.6	1.4	13.4	2786
	FBW	6.2	3.0	11.1	942
Bottom Dissolved Oxygen (mg l^{-1})	FBC	6.3	2.8	12.3	689
	FBE	6.6	0.4	11.7	2901
	FBW	6.2	3.0	11.5	1015
Ammonium (ppm)	FBC	0.043	0.000	1.681	678
	FBE	0.036	0.000	1.149	2889
	FBW	0.009	0.000	0.342	996
Nitrite (ppm)	FBC	0.002	0.000	0.111	683
	FBE	0.002	0.000	0.037	2890
	FBW	0.001	0.000	0.025	996
Nitrate (ppm)	FBC	0.003	0.000	0.080	681
	FBE	0.008	0.000	0.154	2880
	FBW	0.002	0.000	0.101	991
Surface Salinity	FBC	33.17	11.90	63.00	654
	FBE	29.00	0.20	54.30	2752
	FBW	34.80	16.60	51.00	942
Bottom Salinity	FBC	33.69	8.70	63.00	698
	FBE	29.20	0.20	54.30	2936
	FBW	35.00	16.50	52.00	1029
Silicate (ppm)	FBC	0.824	0.000	5.731	148
	FBE	0.238	0.000	4.604	629
	FBW	0.406	0.000	5.089	222
Soluble Reactive Phosphorus (ppm)	FBC	0.001	0.000	0.026	681
	FBE	0.001	0.000	0.016	2871
	FBW	0.001	0.000	0.058	989
Surface Temperature (^{o}C)	FBC	26.5	13.3	35.3	662
	FBE	26.4	14.3	34.6	2796
	FBW	26.3	14.1	34.7	948
Bottom Temperature (^{o}C)	FBC	26.6	13.3	36.7	694
	FBE	26.5	14.3	34.5	2918
	FBW	26.4	14.1	36.0	1023
Total Nitrogen (ppm)	FBC	0.986	0.188	4.408	683
	FBE	0.599	0.060	3.142	2891
	FBW	0.363	0.067	1.691	997
Total Organic Carbon (ppm)	FBC	12.401	3.585	42.872	678
	FBE	8.012	0.000	58.043	2879
	FBW	4.838	1.199	27.370	990
Total Organic Nitrogen (ppm)	FBC	0.827	0.135	4.355	676
	FBE	0.526	0.000	3.098	2879

	FBW	0.342	0.046	1.680	990

Variable	Zone	Median	Min.	Max.	*n*
Total Phosphorus (ppm)	FBC	0.017	0.002	0.131	682
	FBE	0.007	0.001	0.049	2891
	FBW	0.014	0.000	0.232	998
Turbidity (NTU)	FBC	5.85	0.12	134.85	667
	FBE	2.06	0.01	172.95	2818
	FBW	4.91	0.07	178.55	953

Table 9.3. Statistical summary of Whitewater Bay-Ten Thousand Islands water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (μM hr^{-1})	BLK	0.04	0.02	0.28	243
	GI	0.05	0.00	3.23	1514
	IW	0.10	0.00	8.31	1339
	MR	0.22	0.00	3.70	1849
	WB	1.16	0.00	5.96	1174
Chlorophyll *a* (μg l^{-1})	BLK	3.22	0.25	17.02	246
	GI	2.79	0.12	23.78	1524
	IW	3.45	0.19	45.11	1350
	MR	2.63	0.15	28.76	1862
	WB	2.67	0.11	29.78	1175
Surface Dissolved Oxygen (mg l^{-1})	BLK	5.0	0.1	9.8	246
	GI	5.6	0.2	11.8	1522
	IW	5.8	1.1	11.9	1350
	MR	5.0	0.4	12.3	1850
	WB	6.8	0.4	24.4	1168
Bottom Dissolved Oxygen (mg l^{-1})	BLK	5.2	0.3	10.3	246
	GI	5.7	1.4	12.1	1522
	IW	5.9	1.8	11.8	1350
	MR	5.2	0.4	13.9	1851
	WB	6.8	2.2	24.4	1168
Ammonium (ppm)	BLK	0.022	0.001	0.195	246
	GI	0.011	0.000	0.183	1524
	IW	0.017	0.000	0.314	1350
	MR	0.017	0.000	0.402	1862
	WB	0.013	0.000	0.408	1176
Nitrite (ppm)	BLK	0.003	0.000	0.017	246
	GI	0.002	0.000	0.033	1524
	IW	0.003	0.000	0.036	1350
	MR	0.002	0.000	0.012	1862
	WB	0.002	0.000	0.086	1176
Nitrate (ppm)	BLK	0.009	0.000	0.080	246
	GI	0.008	0.000	0.135	1524
	IW	0.010	0.000	0.133	1350
	MR	0.015	0.000	0.142	1862
	WB	0.005	0.000	0.268	1176
Surface Salinity	BLK	31.9	1.4	39.9	246
	GI	29.2	1.0	40.7	1522
	IW	16.3	0.2	53.6	1350
	MR	6.5	0.0	40.5	1847
	WB	11.2	0.3	34.9	1168
Bottom Salinity	BLK	31.8	1.4	39.9	246
	GI	28.5	1.3	40.7	1524
	IW	15.0	0.1	42.8	1350
	MR	5.6	0.0	40.5	1859
	WB	10.7	0.3	35.4	1176

Variable	Zone	Median	Min.	Max.	*n*
Silicate (ppm)	BLK	1.733	0.000	4.493	68
	GI	1.513	0.000	4.705	411
	IW	1.659	0.000	4.688	373
	MR	2.064	0.000	6.400	475
	WB	1.141	0.002	4.880	296
Soluble Reactive Phosphorus (ppm)	BLK	0.017	0.002	0.066	246
	GI	0.006	0.000	0.044	1519
	IW	0.003	0.000	0.028	1350
	MR	0.002	0.000	0.034	1859
	WB	0.002	0.000	0.026	1173
Surface Temperature (°C)	BLK	27.0	15.9	35.9	246
	GI	27.0	14.9	37.2	1522
	IW	27.1	15.2	33.3	1350
	MR	26.6	13.6	33.3	1850
	WB	26.6	11.8	33.5	1168
Bottom Temperature (°C)	BLK	27.3	15.9	38.4	246
	GI	27.0	14.9	37.2	1522
	IW	27.2	15.2	37.5	1350
	MR	26.7	13.6	34.4	1851
	WB	26.7	12.3	34.2	1168
Total Nitrogen (ppm)	BLK	0.407	0.084	1.380	245
	GI	0.408	0.077	1.955	1523
	IW	0.564	0.048	2.031	1350
	MR	0.638	0.038	3.046	1862
	WB	0.772	0.057	2.588	1176
Total Organic Carbon (ppm)	BLK	6.574	2.897	21.385	245
	GI	6.690	1.482	27.170	1515
	IW	11.078	2.112	23.348	1344
	MR	12.955	0.458	64.008	1861
	WB	14.811	5.615	39.373	1174
Total Organic Nitrogen (ppm)	BLK	0.358	0.074	1.313	245
	GI	0.379	0.066	1.896	1523
	IW	0.521	0.021	2.011	1350
	MR	0.594	0.021	2.989	1862
	WB	0.726	0.000	2.535	1176
Total Phosphorus (ppm)	BLK	0.053	0.014	0.237	240
	GI	0.032	0.001	0.204	1516
	IW	0.029	0.002	0.207	1349
	MR	0.020	0.001	0.125	1861
	WB	0.017	0.003	0.094	1176
Turbidity (NTU)	BLK	7.15	0.49	40.50	245
	GI	4.94	0.42	68.00	1523
	IW	4.33	0.06	66.60	1350
	MR	2.67	0.09	58.65	1862
	WB	3.35	0.21	107.81	1176

Table 9.4. Statistical summary of Biscayne Bay water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (μM hr^{-1})	AS	0.323	0.091	3.209	270
	IS	0.192	0.036	2.119	608
	MAIN	0.108	0.008	0.894	1550
	NBAY	0.111	0.008	1.475	508
	SCARD	0.137	0.022	0.942	303
Chlorophyll *a* (μg l^{-1})	AS	0.28	0.03	2.46	266
	IS	0.27	0.02	6.37	599
	MAIN	0.24	0.00	5.89	1528
	NBAY	0.99	0.12	9.18	500
	SCARD	0.31	0.06	3.61	299
Surface Dissolved Oxygen (mg l^{-1})	AS	7.1	3.0	12.9	268
	IS	6.6	2.6	11.8	608
	MAIN	6.3	2.8	10.6	1550
	NBAY	6.1	3.2	10.4	510
	SCARD	6.3	3.3	9.5	303
Bottom Dissolved Oxygen (mg l^{-1})	AS	6.8	3.1	11.6	268
	IS	6.5	3.7	11.5	608
	MAIN	6.3	2.8	10.2	1550
	NBAY	6.1	3.0	10.2	510
	SCARD	6.3	4.0	9.0	303
Ammonium (ppm)	AS	0.018	0.001	0.228	270
	IS	0.013	0.000	0.148	609
	MAIN	0.009	0.000	0.120	1551
	NBAY	0.014	0.000	0.220	510
	SCARD	0.012	0.000	0.121	303
Nitrite (ppm)	AS	0.004	0.000	0.039	270
	IS	0.002	0.000	0.034	609
	MAIN	0.001	0.000	0.019	1551
	NBAY	0.002	0.000	0.060	510
	SCARD	0.002	0.000	0.019	303
Nitrate (ppm)	AS	0.042	0.000	1.173	270
	IS	0.012	0.000	0.732	608
	MAIN	0.004	0.000	0.633	1551
	NBAY	0.015	0.000	0.174	510
	SCARD	0.007	0.000	0.129	303
Surface Salinity	AS	27.7	7.2	44.1	270
	IS	31.8	11.5	43.9	609
	MAIN	35.2	24.2	41.5	1550
	NBAY	33.3	24.7	39.0	510
	SCARD	33.3	20.9	40.9	303
Bottom Salinity	AS	26.8	6.2	44.1	270
	IS	31.2	11.5	43.8	609
	MAIN	35.1	21.2	41.4	1551
	NBAY	32.0	16.2	38.9	510
	SCARD	32.6	21.0	40.8	303

Variable	Zone	Median	Min.	Max.	*n*
Silicate (ppm)	AS	0.186	0.000	1.972	68
	IS	0.080	0.000	1.268	170
	MAIN	0.028	0.000	0.720	374
	NBAY	0.196	0.001	1.287	170
	SCARD	0.031	0.000	0.270	68
Soluble Reactive Phosphorus (ppm)	AS	0.001	0.000	0.010	269
	IS	0.001	0.000	0.009	605
	MAIN	0.001	0.000	0.009	1544
	NBAY	0.001	0.000	0.021	506
	SCARD	0.001	0.000	0.008	301
Surface Temperature (^{o}C)	AS	26.9	10.3	33.2	270
	IS	26.6	14.2	33.4	609
	MAIN	26.3	13.5	32.5	1551
	NBAY	25.8	14.5	32.9	510
	SCARD	26.7	15.8	33.8	303
Bottom Temperature (^{o}C)	AS	26.9	10.2	33.0	270
	IS	26.6	14.2	33.3	609
	MAIN	26.3	13.5	32.8	1551
	NBAY	26.1	14.3	32.5	510
	SCARD	26.6	15.9	32.5	303
Total Nitrogen (ppm)	AS	0.476	0.101	1.560	270
	IS	0.324	0.048	1.026	607
	MAIN	0.224	0.043	1.313	1551
	NBAY	0.258	0.047	0.847	510
	SCARD	0.305	0.055	1.325	303
Total Organic Carbon (ppm)	AS	4.571	1.379	9.330	270
	IS	3.678	1.463	9.415	608
	MAIN	2.641	0.326	11.982	1551
	NBAY	3.408	1.231	10.690	509
	SCARD	3.798	1.875	8.872	302
Total Organic Nitrogen (ppm)	AS	0.344	0.000	1.010	270
	IS	0.278	0.016	0.877	607
	MAIN	0.200	0.031	1.288	1551
	NBAY	0.213	0.032	0.823	510
	SCARD	0.274	0.030	1.229	303
Total Phosphorus (ppm)	AS	0.006	0.000	0.037	270
	IS	0.005	0.001	0.040	607
	MAIN	0.005	0.000	0.049	1551
	NBAY	0.009	0.002	0.038	509
	SCARD	0.005	0.002	0.030	303
Turbidity (NTU)	AS	0.50	0.05	11.53	270
	IS	0.47	0.00	3.75	608
	MAIN	0.75	0.00	19.00	1550
	NBAY	1.13	0.01	22.35	510
	SCARD	0.50	0.00	3.80	303

Table 9.5. Statistical summary of Southwest Florida Shelf water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (μM hr^{-1})	SHARK	0.055	0.016	2.485	69
	SHELF	0.042	0.004	12.017	1364
	SHOAL	0.046	0.006	7.627	241
Chlorophyll *a* (μg l^{-1})	SHARK	1.608	0.254	8.910	76
	SHELF	0.913	0.000	13.791	1512
	SHOAL	0.922	0.229	6.560	265
Surface Dissolved Oxygen (mg l^{-1})	SHARK	5.6	2.8	8.6	46
	SHELF	5.9	1.7	13.0	922
	SHOAL	5.9	2.6	9.7	164
Bottom Dissolved Oxygen (mg l^{-1})	SHARK	6.1	2.4	8.6	75
	SHELF	6.2	1.0	12.6	1490
	SHOAL	6.1	0.9	12.8	263
Ammonium (ppm)	SHARK	0.006	0.001	0.049	76
	SHELF	0.004	0.000	0.129	1512
	SHOAL	0.004	0.000	0.064	265
Nitrite (ppm)	SHARK	0.001	0.000	0.006	76
	SHELF	0.000	0.000	0.008	1512
	SHOAL	0.000	0.000	0.005	265
Nitrate (ppm)	SHARK	0.002	0.000	0.072	76
	SHELF	0.001	0.000	0.078	1512
	SHOAL	0.001	0.000	0.022	265
Surface Salinity	SHARK	34.8	26.0	40.7	46
	SHELF	35.9	27.8	40.1	928
	SHOAL	35.9	31.0	39.2	164
Bottom Salinity	SHARK	34.7	24.4	40.7	75
	SHELF	35.6	27.0	40.1	1496
	SHOAL	35.6	27.9	38.8	263
Silicate (ppm)	SHARK	0.424	0.000	1.199	69
	SHELF	0.069	0.000	2.238	1425
	SHOAL	0.041	0.000	1.698	250
Soluble Reactive Phosphorus (ppm)	SHARK	0.001	0.000	0.006	76
	SHELF	0.001	0.000	0.014	1512
	SHOAL	0.001	0.000	0.008	265
Surface Temperature (°C)	SHARK	25.1	14.8	31.4	46
	SHELF	25.5	14.7	31.9	928
	SHOAL	25.8	15.2	32.0	164
Bottom Temperature (°C)	SHARK	26.3	14.8	32.1	75
	SHELF	26.4	14.7	32.7	1496
	SHOAL	26.4	15.2	32.3	263
Total Nitrogen (ppm)	SHARK	0.271	0.073	0.967	75
	SHELF	0.213	0.027	1.028	1504
	SHOAL	0.219	0.023	1.043	265
Total Organic Carbon (ppm)	SHARK	3.810	1.970	5.812	75
	SHELF	2.588	1.164	16.708	1509
	SHOAL	2.560	1.130	5.864	265

Variable	Zone	Median	Min.	Max.	*n*
Total Organic Nitrogen (ppm)	SHARK	0.257	0.065	0.957	75
	SHELF	0.205	0.023	1.021	1504
	SHOAL	0.210	0.020	1.040	265
Total Phosphorus (ppm)	SHARK	0.015	0.004	0.079	76
	SHELF	0.012	0.000	0.190	1512
	SHOAL	0.012	0.003	0.038	265
Turbidity (NTU)	SHARK	6.23	1.00	66.25	72
	SHELF	2.04	0.00	45.05	1432
	SHOAL	2.78	0.21	20.70	250

Table 9.6. Statistical summary of Cape Romano-Pine Island Sound water quality variables by zone.

Variable	Zone	Median	Min.	Max.	*n*
Alkaline Phosphatase Activity (μM hr^{-1})	COCO	0.05	0.02	0.30	70
	EST	0.05	0.01	0.22	288
	MARC	0.04	0.01	0.29	575
	NPL	0.04	0.02	0.31	216
	PIS	0.04	0.02	0.17	216
	RB	0.04	0.01	0.44	323
	SCB	0.04	0.01	0.19	360
Chlorophyll *a* (μg l^{-1})	COCO	4.32	0.63	17.36	70
	EST	3.80	0.41	24.68	283
	MARC	4.35	0.38	20.85	567
	NPL	2.87	0.44	18.22	213
	PIS	3.19	0.49	21.76	213
	RB	3.86	0.67	28.30	318
	SCB	2.81	0.53	28.47	355
Surface Dissolved Oxygen (mg l^{-1})	COCO	5.4	1.8	6.4	13
	EST	5.8	2.0	9.2	288
	MARC	5.9	2.8	14.8	575
	NPL	5.7	2.1	11.7	216
	PIS	6.3	1.0	9.8	216
	RB	5.6	1.3	12.9	311
	SCB	6.2	3.0	10.4	360
Bottom Dissolved Oxygen (mg l^{-1})	COCO	4.9	2.6	7.2	71
	EST	6.1	2.8	9.4	288
	MARC	6.1	2.8	13.2	575
	NPL	5.8	2.3	11.5	216
	PIS	6.5	3.9	10.1	216
	RB	5.7	2.7	10.0	323
	SCB	6.4	3.1	11.1	360
Ammonium (ppm)	COCO	0.046	0.001	0.217	69
	EST	0.007	0.000	0.126	288
	MARC	0.005	0.000	0.194	575
	NPL	0.007	0.000	0.170	216
	PIS	0.005	0.000	0.173	216
	RB	0.007	0.000	0.239	323
	SCB	0.009	0.000	0.184	357
Nitrite (ppm)	COCO	0.002	0.000	0.015	70
	EST	0.001	0.000	0.006	288
	MARC	0.001	0.000	0.010	575
	NPL	0.001	0.000	0.009	216
	PIS	0.001	0.000	0.023	216
	RB	0.001	0.000	0.009	323
	SCB	0.001	0.000	0.024	360

Variable	Zone	Median	Min.	Max.	*n*
Nitrate (ppm)	COCO	0.013	0.000	0.134	70
	EST	0.003	0.000	0.038	288
	MARC	0.002	0.000	0.052	575
	NPL	0.003	0.000	0.079	216
	PIS	0.002	0.000	0.073	216
	RB	0.003	0.000	0.034	323
	SCB	0.006	0.000	0.424	360
Surface Salinity	COCO	33.3	10.1	38.3	13
	EST	33.7	18.6	38.3	288
	MARC	34.5	21.6	40.7	575
	NPL	34.4	17.4	41.5	216
	PIS	33.8	18.3	38.6	216
	RB	34.2	14.2	40.5	310
	SCB	30.8	2.1	37.9	360
Bottom Salinity	COCO	29.7	0.0	37.1	71
	EST	33.7	14.8	38.5	288
	MARC	34.4	15.5	40.6	575
	NPL	34.2	17.9	41.4	216
	PIS	33.6	18.0	38.5	216
	RB	34.1	13.2	39.9	322
	SCB	28.9	1.9	38.0	360
Silicate (ppm)	COCO	0.825	0.166	2.923	23
	EST	0.609	0.033	2.476	96
	MARC	0.605	0.003	3.488	191
	NPL	0.533	0.006	1.988	72
	PIS	0.374	0.000	1.612	72
	RB	0.668	0.014	2.419	107
	SCB	0.821	0.045	4.175	120
Soluble Reactive Phosphorus (ppm)	COCO	0.011	0.000	0.052	70
	EST	0.005	0.000	0.026	288
	MARC	0.004	0.000	0.032	575
	NPL	0.005	0.000	0.034	216
	PIS	0.004	0.000	0.153	216
	RB	0.004	0.000	0.026	323
	SCB	0.012	0.000	0.122	357
Surface Temperature (^{o}C)	COCO	28.7	21.5	32.7	13
	EST	25.8	15.7	32.0	288
	MARC	26.1	12.7	32.5	575
	NPL	26.1	15.4	32.0	216
	PIS	25.1	14.3	33.0	216
	RB	26.5	15.1	33.5	311
	SCB	25.4	14.9	34.5	360
Bottom Temperature (^{o}C)	COCO	26.3	17.7	32.8	71
	EST	25.8	15.7	32.2	288
	MARC	26.1	14.8	32.6	575
	NPL	26.0	15.8	32.1	216
	PIS	25.2	14.2	32.0	216
	RB	26.6	15.1	33.6	323
	SCB	25.4	15.0	32.4	360

Variable	Zone	Median	Min.	Max.	*n*
Total Nitrogen (ppm)	COCO	0.432	0.189	1.108	71
	EST	0.295	0.092	0.779	288
	MARC	0.282	0.076	0.911	575
	NPL	0.269	0.066	0.736	216
	PIS	0.297	0.019	1.250	216
	RB	0.289	0.029	1.056	323
	SCB	0.319	0.030	1.226	359
Total Organic Carbon (ppm)	COCO	5.991	2.899	16.598	71
	EST	4.413	2.087	15.565	287
	MARC	4.223	2.017	15.172	575
	NPL	3.850	1.748	13.520	216
	PIS	4.370	1.921	13.235	216
	RB	4.620	2.027	15.454	323
	SCB	5.799	1.700	19.688	360
Total Organic Nitrogen (ppm)	COCO	0.340	0.053	1.052	69
	EST	0.274	0.033	0.769	288
	MARC	0.267	0.055	0.893	575
	NPL	0.242	0.028	0.713	216
	PIS	0.287	0.017	1.229	216
	RB	0.270	0.013	1.034	323
	SCB	0.288	0.024	1.082	356
Total Phosphorus (ppm)	COCO	0.049	0.018	0.091	71
	EST	0.041	0.012	0.186	288
	MARC	0.035	0.000	0.160	573
	NPL	0.031	0.011	0.106	215
	PIS	0.036	0.014	0.196	213
	RB	0.035	0.002	0.099	321
	SCB	0.047	0.012	0.175	357
Turbidity (NTU)	COCO	4.46	0.35	18.08	71
	EST	3.92	0.13	28.75	288
	MARC	4.84	0.39	38.65	575
	NPL	2.84	0.25	27.25	216
	PIS	2.44	0.07	20.65	216
	RB	4.82	0.61	35.25	323
	SCB	2.38	0.06	12.32	360