Field Monitoring of Environmental Contaminants of Toxic Metals in Lake Pontchartrain and Ground Water

Basic Information

Title:	Field Monitoring of Environmental Contaminants of Toxic Metals in Lake Pontchartrain and Ground Water
Project Number:	2008LA59B
Start Date:	3/1/2008
End Date:	8/30/2009
Funding Source:	104B
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Research Category:	Ground-water Flow and Transport
Focus Category:	Toxic Substances, Surface Water, Methods
Descriptors:	
Principal Investigators:	Ju Chou

Publication

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Final Report

SYNPOSIS

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Funding Source:	104B
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Research Category:	Water Quality
Focus Category:	Methods, Toxic Substances, Surface Water
Descriptors:	Field analysis, toxic metals, surface water, groundwater, portable instrument
Principal Investigators:	Ju Chou, Southeastern Louisiana University

Problem and Research Objectives

Lead, a ubiquitous and versatile metal, is considered a significant environmental threat in the global region. Even at low levels of lead exposure, there are serious side effects including kidney damage, learning disabilities, and brain damage, especially in children. The threat of arsenic pollution in drinking water is a serious environmental and health concern because of the toxicity of arsenic on human and on other living organisms. Arsenic contamination is a serious problem in many parts of the world. Even at low level arsenic exposure various skin lesions appear in human. In 2006, the US EPA lowered the maximum containment level (MCL) for arsenic in drinking water to 10 μg/L from the previous standard of 50 μg/L. The US EPA set a new MCL has created an urgent need to identify public health threats caused by environmental contaminant of arsenic.

Since Hurricane Katrina, environmental contaminants in New Orleans have attracted national attention as environmental contaminants such as lead, arsenic elevated in floodwater and sediments. The concentrations of lead and arsenic detected in many samples in eastern New Orleans exceeded EPA drinking water standards. Toxic metal exposure, especially lead and arsenic, in New Orleans increased after Hurricane Katrina. Environmental threats from lead and arsenic are a serious problem in the New Orleans area.

Lake Pontchartrain is a large and shallow estuary and has a surface area of 1632 km^2, an average depth of 4 m. For many years, Lake Pontchartrain has been a sink for environmental contamination primarily because it receives all the drainage from New Orleans' industry and populations. The contaminations in New Orleans will eventually contaminate Lake Pontchartrain and its natural habitat. Thus it is important to regularly monitor lead and arsenic concentrations in Lake Pontchartrain.

It is very important to identify contaminated areas where water levels exceed EPA standard for both lead and arsenic in New Orleans and Lake Pontchartrain.

Our overall objectives are to conduct an environmental assessment and to identify public heath threats caused by exposure to environmental contaminants such as lead and arsenic. This research focused on detection of environmental contaminant metals mainly lead and arsenic in water in Lake Pontchartrain and New Orleans.

Methodology

When we started this project, we had a problem with another funding agency that was supposed to fund to purchase a portable element detector. Since a portable equipment was not able to be purchased as planed and our original plan on monitoring toxic metals was modified. All element analysis was performed in the research lab and all results reported here were based on lab analysis, not by a portable element detector.

Concentrations of toxic metals such as Pb, As, Cd, Cr and other nonmetals such as Ca, Mg, Cu, P were analyzed by inductively coupled plasma- atomic emission spectroscopy (ICS-AEM, available at LSU). This equipment has a high sensitivity on toxic metals. One of advantage of using ICP-AES is that it can detect many elements spontaneously.

Principal Findings and Significance

Pb and Ar in water samples in New Orleans

A total of 30 locations were selected in the greater New Orleans area for water analysis. Since groundwater is not a supply for drinking water in New Orleans, we did not collect groundwater. Instead we collected water samples from ponds, rivers, lakes in New Orleans. One of our focus areas was on the eastern side of New Orleans as these areas are known to contain dangerous lead level and were heavily damaged during Hurricane Katrina.

Samples were collected from rivers, lakes, and along industrial canal from the Chalmette area all the way to the lake front. A Geographic Position System (GPS) was used to record latitudes and longitudes of the sampling locations so that these sample sites can be displayed in a regional map. Water samples from the greater New Orleans

Area were collected and filtered immediately by a 0.45 μm syringe filter after these water samples were brought into the research lab. This purpose of the filtration was to get rid of all sediments to eliminate any experimental error cause by sediments. The filtered water samples were added three drop of 1M HNO_3 and stored in a refrigerator until analysis.

The filtered water samples were then analyzed by an inductively coupled plasma–atomic emission spectroscopy (ICP-AES) which is commonly used for quantitative analysis of toxic metals. About 30 water samples were collected in the greater New Orleans area and their locations were shown in Figure 1a and 1b. Each dot in the map was determined by latitudes and longitudes recoded by the GPS. Concentrations of Pb and As were analyzed by ICP-AES at LSU lab. Concentration of As was displayed in the local map shown in Figure 1. Color of different dots represents concentration range of As. The green dots in the map in Figure 1 represent As concentration below the detection limit (20 ppb) and the red dots denote As concentration above 20 ppb. This concentration also exceeds the USEPA standard for drinking water (10 ppb) for As. About 9 out of 30

West N.O. map

water

Figure 1a. The map of arsenic distribution in the greater New Orleans area
Key: Red dot: > 20 μg/L (ppb); Green dot < 20 μg/L (ppb)

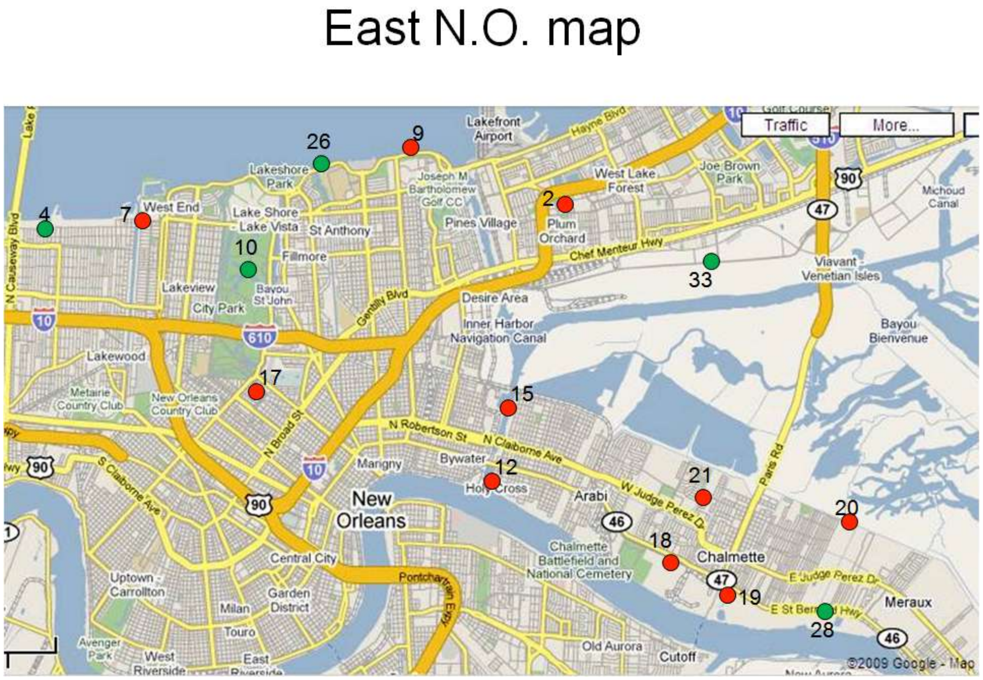


Figure 1b. The map of arsenic distribution in the greater New Orleans area
Key: Red dot: > 20 μg/L (ppb); Green dot < 20 μg/L (ppb)

samples in the greater New Orleans area were below the detection limit (20 μg/L = 20 ppb). However, since the detection limit of the ICP-AES employed is higher than the EPA standard (10 ppm), for above nine locations, we could not tell if they exceed the EPA standard or not. Among 21 out of 30 water samples, the arsenic concentration is higher than 20 ppb which is above the USEPA standard for drinking water. As shown in Figure 1b, in eastern New Orleans, water samples (location 12, 15, 18, 19,20, 21) exceeded USEPA standard for drinking water. It is important to note that water may flow into Lake Pontchartrain and this may contaminate the lake. Among 30 water sample locations, 21 water locations in the map exceeded US EPA standard (10 ppb). These data indicate that there is a widespread occurrence of arsenic in New Orleans. However none of arsenic concentrations were higher than 50 ppb, the EPA previous allowable maximum containment level.

For lead, among 30 water samples collected from above locations, there is no detectable lead in water samples and none of water samples exceeds the USEPA standard for drinking water (US EPA Pb standard: 15 μg/L).

Lake Pontchartrain

Since Lake Pontchartrain is a shallow lake, we are able to collect deep water in the lake. For Lake Pontchartrain, for each location, both surface water and deep water were collected repeatedly. Surface water was sampled directly by a pre-cleaned glass bottle. The deep water was collected by a Van Dorn horizontal sampler which can be used to collect deep water in the lake.

Industrial discharge is likely to contribute to increase lead contaminations and six locations along the spillway area were choosen since where they are close to Shell and

Exxon. The six locations present the impact of industrial discharge. There was a main reason to focus this area because of the opening of *Bonnet Carré* Spillway between April to May in 2008. The spillway was opened for the first time since 1997. Its purpose was to alleviate the flooding of the New Orleans area by the Mississippi River by opening up to 350 bays. The opening the spillway allows the river waters to flow directly into Lake Pontchartrain. The opening of the spillway is expected to lead to changes in nutrition and salinity in Lake Pontchartrain because of a rush of fresh water into the normally brackish lake. Because the Mississippi River is often polluted with agricultural runoff and factory discharge, historically, the opening of the spillway has led to eutrophication in Lake Ponchartrain and massive death of fish during the hot summer. Thus, this event enhanced the interest of environmental analysis in Lake Pontchartrain and provided us an opportunity to study the impact of the opening of the spillway on water quality in the lake.

In contrast, several locations in the central area away from industrial areas and spillway area were selected for comparison. Seven locations from the mid-lake were sampled as those areas were also highly affected by the opening of the spillway, but would likely to have different patter from the *Bonnet Carré* spillway area. All locations from Lake Pontchartrain were shown in Figure 2.

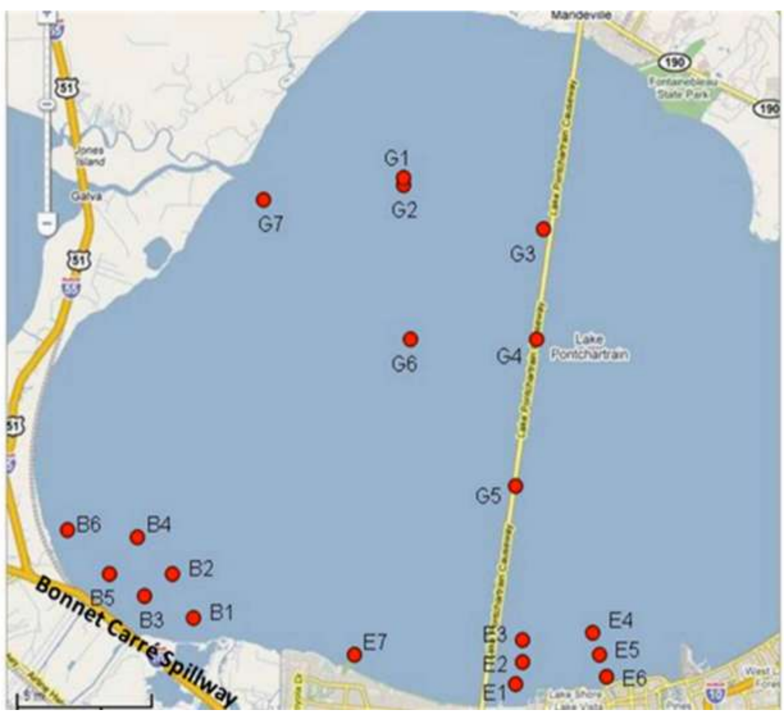
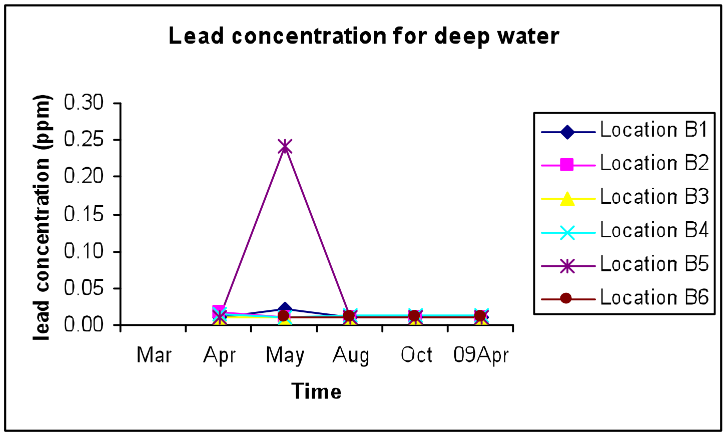


Figure 2. The sample sites in Lake Pontchartrain

Pb and As analysis

The concentrations of lead versus time were plotted for *Bonnet Carré* spillway area as shown in Figure 3A (A: surface water) and 3B (deep water). In all collect samples, only samples collected in May 2008 exceeded the EPA standard for drinking water. This high concentration of lead was observed in both deep water and surface water. The increase of lead concentration may associate with the opening of the spillway which it started from April 11, 2008. The lead concentration was dropped to lower detection limit again in August, indicating that high Pb concentration is only a transition. Since data were collected from April 2008 to April 2009, Figure 3 also illustrate seasonal changes has no effect on environmental pollutants based on our one-year data.



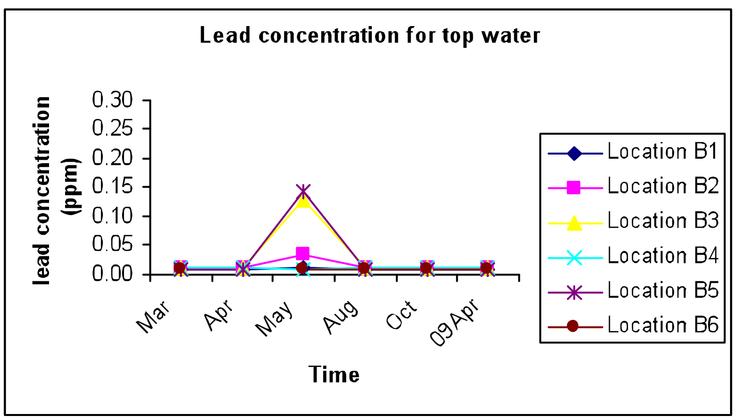


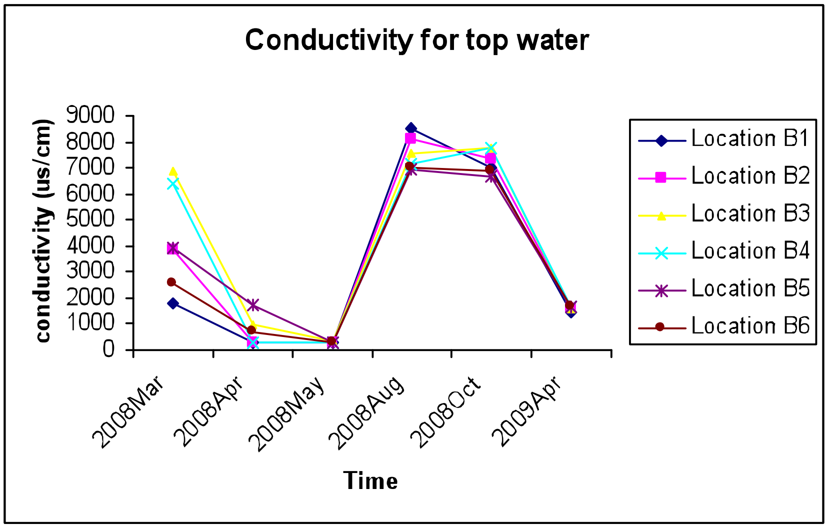
Figure 3. Lead concentration versus month in the *Bonnet Carré* spillway area. Top. Surface water; Bottom. Deep water

The lead concentration in all 7 locations in the central lake area collected at different time was lower than detection limit.

For arsenic, the concentrations of arsenic in all locations including both *Bonnet Carré* spillway and the central lake area at different time were below the detection limit of the instrument. So far, there is no correlation between seasonal changes or weather pattern associated with environmental pollutant from Pb and As based on one-year data analysis.

<u>Conductivity and other element analysis</u>

As mentioned above, the *Bonnet Carré Spillway* was opened in April in 2008 to prevent the Mississippi River from spilling water into surrounding areas. The opening of the spillway is expected to lead to changes in nutrition and salinity in Lake Pontchartrain because of a rush of fresh water from the Mississippi River into the normally brackish lake. We also monitored conductivities and other nutrients such as Na, Ca, Mg, P etc.



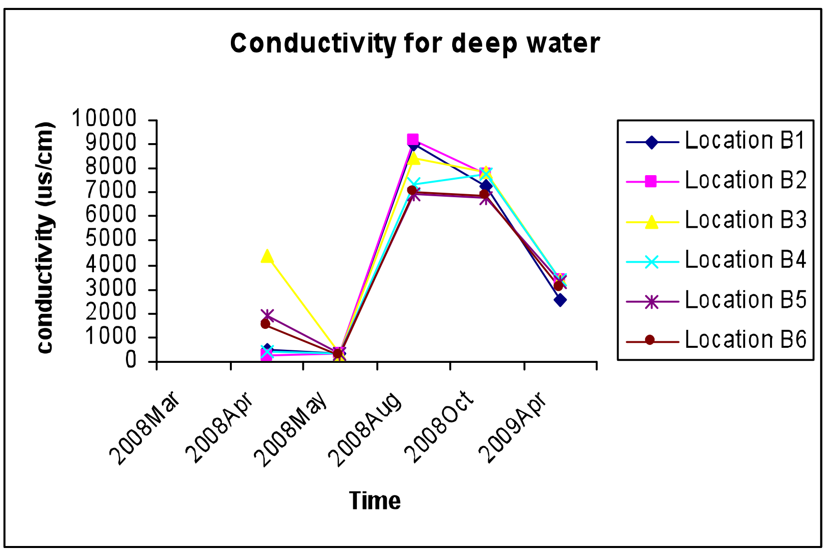
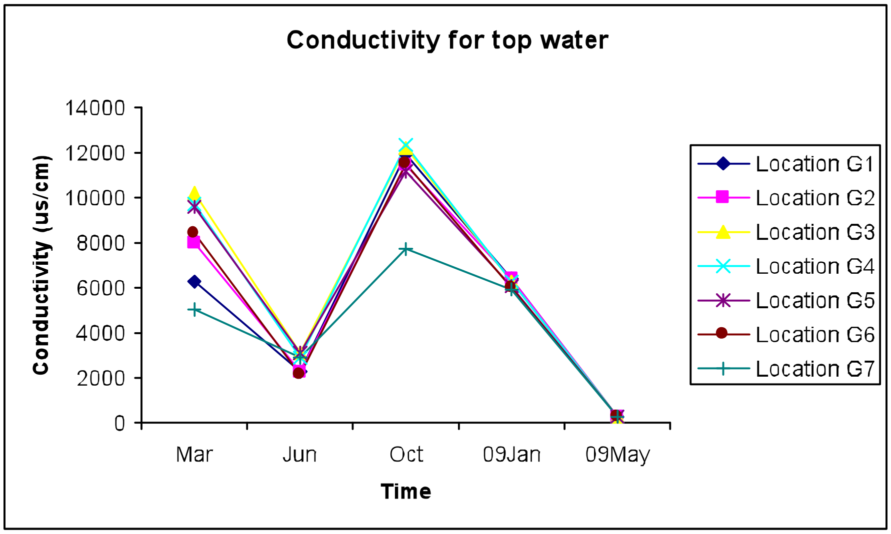


Figure 4. Conductivity versus time in the *Bonnet Carré* spillway area.

Top: Surface water; Bottom: Deep water

The conductivity versus time was plotted for the *Bonnet Carré* spillway area and was shown in Figure 4 (top: surface water; bottom: deep water). Conductivity in the *Bonnet Carré* spillway area changed dramatically from March 2008 to April 2009. The conductivity of surface water decreased from March to May, and then increased from May to August and dropped again from October 2008 to April 2009. The first drop in conductivity might be associated with the opening of the spillway as we expected. Fresh water from the Mississippi River flew into the normally brackish lake. Thus the opening of the spillway is expected to decrease the conductivity in the brackish lake. The second drop of conductivity might be associated with the weather changes since heavy rains were observed right before sample collected in January and May in 2009. In order to see weather change pattern, more data will be collected.



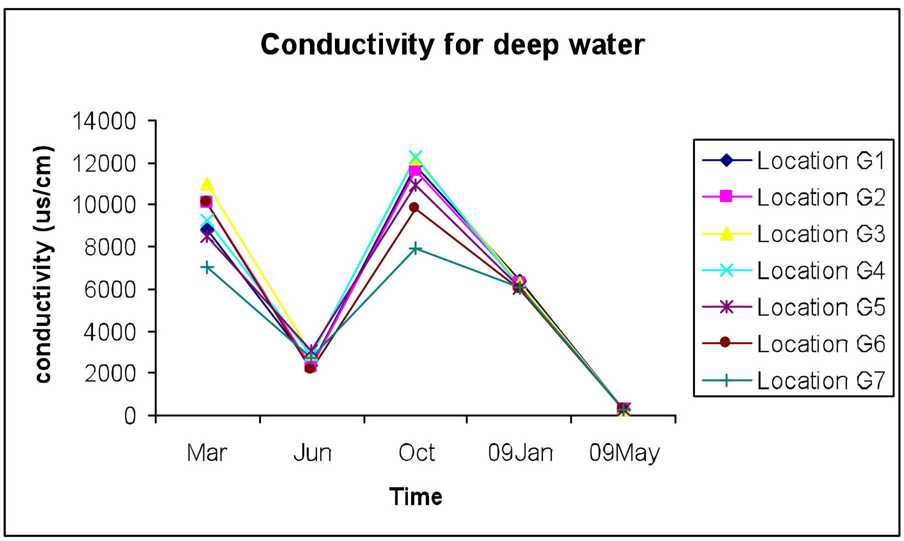
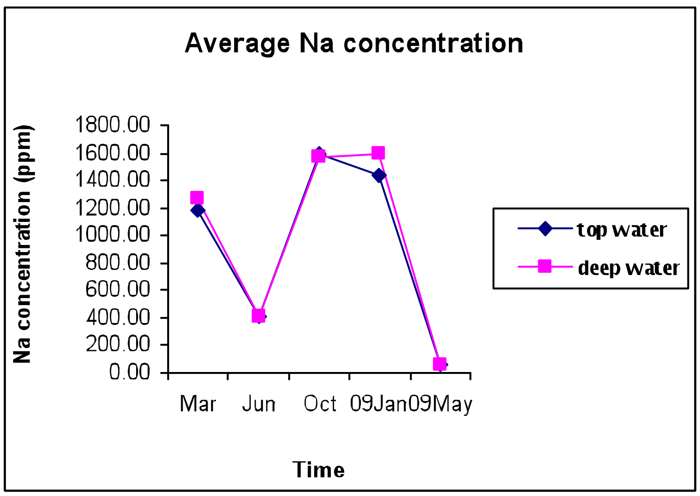


Figure 5. Conductivity versus month in the mid-lake area.
Top: Surface water; Bottom: Deep water

Conductivity changes in deep water in the *Bonnet Carré* spillway were similar to the trend of surface water in the same area.

Conductivity versus time in the central lake area was plotted and shown in Figure 5 (top: surface water; bottom: deep water). Similar to the *Bonnet Carré* spillway area, conductivity in the mid-lake area altered significantly from March 2008 to April 2009. In the mid-lake area, for both surface water and deep water, the conductivity changes followed the same pattern. The conductivity decreased from March to June, and then increased back to normal value in October and then dropped again from October 2008 to May 2009. The first drop in conductivity is again associated with the opening of the spillway as expected. The second drop of conductivity might be caused by the weather changes since heavy rains were observed right before sample collected in January and May in 2009. Like mentioned early, in order to see weather change pattern, more data should be collected and longer period should be studied.

Some other elements and nutrients such as Na, Mg, Ca and P were also determined by ICP-AES simultaneously. Only Na concentration was reported here since salinity in Lake may vary followed the opening of the spillway. The average of Na concentration was calculated for each area and then plotted against time. Figure 6 show average of Na concentration versus time in the *Bonnet Carré* spillway and the mid-lake area. For both areas, the average of Na concentrations has the same trend as shown in Figure 6. Compare to the conductivity trend in both areas, the average of Na concentration followed the trend as conductivity in the two areas as we expected.



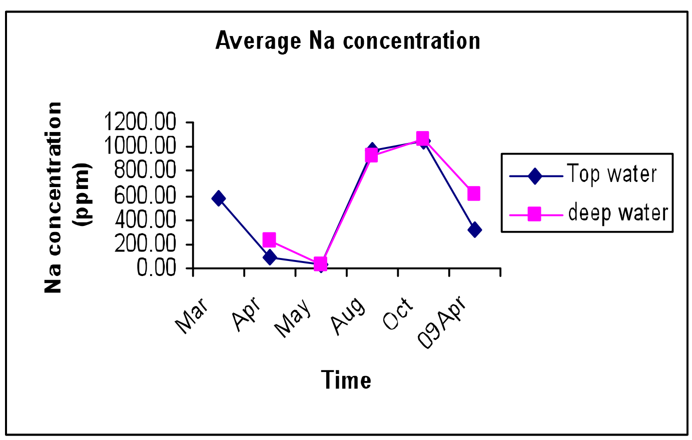


Figure 6. Average of Na concentration versus month in the mid-lake area (top) and *Bonnet Carré* spillway (bottom).

Some Photos on Samples Collecting in Lake Pontchartrain and New Orleans



Sample Collecting in Lake Pontchartrain

Water sample collecting in New Orleans