LTER Daily Estuarine Surface Water Nutrient and Water Quality, Suspended Sediment, and Chlorophyll a Data

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DATASET TITLE:	Long Term Ecological Research (LTER) Daily Estuarine Surface Water Nutrient and Water Quality, Suspended Sediment, and Chlorophyll a Data for the North Inlet Estuary, Georgetown, South Carolina: 1978-1993

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DATA FILE INFORMATION:

This condensed metadata is from the original, more extensive metadata created on 4/17/2003 by Ginger Ogburn-Matthews.

If needed, the original may be accessed at: **http://links.baruch.sc.edu/Data/LTERDWS/metadata/Adobe.LTERDWS.Metadata.pdf**

Links and email addresses in the original have not been updated as those locations and people may no longer be available.

The data manager identified on this page should be contacted for any questions about the data.

Data File Name	Water_Chemistry_LTERDWS__1978_61993.zip
Beginning Date	01-Sep-1978
End Date	30-Jun-1993
Number of Data Records	18648

RESEARCH LOCATION: North Inlet Estuary

Geographic Description

Town Creek water samples -- 33.19'38'' Lat., 79.10'0'' Long.

Clambank Creek water samples -- 33.20'0'' Lat., 79.11'33'' Long.

Oyster Landing water samples in Crab Haul Creek -- 33.21'2'' Lat., 79.11'27'' Long.

These three tidal marsh creeks reside in the North Inlet Estuary. The North Inlet Estuary lies east of the uplands of Hobcaw Barony (also known as the Belle W. Baruch Property). To the north of the Estuary is the Debordieu Colony Property. The Estuary is located in Georgetown County, South Carolina.

Location Bounding Box	
West Bounding Coordinate	-79.192
East Bounding Coordinate	-79.167
North Bounding Coordinate	33.35
South Bounding Coordinate	33.327
OR if single point location	
Latitude	
Longitude	
Elevation	

TAXONOMIC COVERAGE:	
Taxonomic Protocols	
Organisms studied	

KEYWORD INFORMATION

KEYWORDS: ammonia, chemistry, chlorophyll a, coastal, carbon, dissolved organic carbon, ecosystems, estuarine, estuary, inorganic suspended solids, lter, long-term ecological research, long-term, sediments, water chemistry, tidal creek, marsh, nitrate, nitrite, nutrient chemistry, nutrient cycling, nitrogen, organic suspended sediment, ortho phosphate, particulate organic carbon, phosphate, phosphorus, salinity, salt marsh, secchi, suspended sediments, tidal elevations, tide, total suspended solids, turbidity, volatile suspended solids, water temperature, water quality, sediment color, water color, north inlet, south carolina, town creek, clambank creek, oyster landing, crab haul creek, east coast, southeast coast, coastal, georgetown county, usa

ABSTRACT:

Abstract:
A one 1000 ml (one Liter) water sample was collected daily (at approximately 1000 hrs EST - but see note below in section 1.2.3 Supplemental Information) at a depth of 0.5 meter below the water's surface at three sites in the North Inlet salt marsh tidal creeks: Town Creek, Clambank, and Crab Haul (at the end of the Oyster Landing dock). The water samples were analyzed for chlorophyll a, phaeophytin, nitrogen (total whole and dissolved, ammonia, nitrate-nitrite), phosphorus (total and dissolved and ortho phosphate), organic carbon [total (TOC), dissolved (DOC), particulate (POC)], suspended sediment [Total Suspended Sediment (TSS), Inorganic Suspended Sediment (ISS), Organic Suspended Sediment (OSS)], and suspended sediment color. Tide level or water level (see note below in Supplemental Information), water temperature, secchi depth were noted in the field at the time of the water collection; salinity was measured when the sample was brought into the laboratory for processing. From 1977 to 1986, ATP analyzes were also run on the samples but are not part of this database. From 1985 to 1988 water chemistry analysis (listed above) were run on water samples from Debidue Creek, but are not included as part of this database. Using the Munsell Soil Chart, sediment color was determined for each suspended sediment filter starting in June 1988; this database is an ancillary database and is available for use.

Purpose:
The Daily Water Sample (DWS) program was initiated in 1978 to monitor nutrient cycling in the North Inlet Estuary system, Georgetown, SC and also to establish a long-term database on the nutrient concentration dynamics of the North Inlet salt marsh estuarine system. A larger purpose of this monitoring program is to combine the water chemistry, chlorophyll a, and suspended sediment monitoring data with other existing North Inlet ecological monitoring data to provide ecosystem level information and understanding. A side purpose of the study was to help in the interpretation of results from the North Inlet "Outwelling" study.

METHODS:

Field Collection Procedures and Protocols (Overall Field Collection Protocol)
One 1000 ml water sample was taken daily at three sites in the North Inlet Estuary at approximately 10:00 am EST*, 0.5 meters below the water's surface. Physical information temperature, tide level, and secchi were also taken at the same time. The water samples were placed in a cooler (no ice), which kept it at ambient temperature and the samples were usually filtered back in the lab within an hour of collection. If the samples could not be brought back within the hour, they were placed in an ice chest. {Test were run to determine if filtering the water in the field gave different nutrient concentration values from the samples which were filtered one hour later in the lab. There were no significant differences observed.}

The original sampling site was at Town Creek (TC) at the intersection of Town Creek and Debidue Creek; sampling began on Sept. 1, 1978. On 2 February 1981 Clambank and Oyster Landing sites were added. Samples were collected 365 days a year, but later in the sampling program weekend sampling became intermittent. There usually was a predetermined site sequence where the water samples were collected: OL was sampled first then CB and then TC. The time given in the database will indicate which site was sampled first any particular day. However, after Hurricane Hugo (Sept. 29, 1989) there was a site collection sequence change: CB, OL, and then TC because a boat had to be used to get to all the sites. Before Hurricane Hugo OL water samples were usually taken from a dock; TC and CB water samples were always taken from a boat. The time data from 1981 to 1986 listed in the database should be used with caution.

Feild Collection Procedures and Protocols (Tide Elevation, Water Temperature, Secchi)
Tide staffs were nailed on pier pilings at the three sites, OL, CB, and TC. The tide staff at OL was placed upside down in order to measure water depth (not tide magnitude) and was not calibrated to the other two sites. Therefore the data will be reversed from the other two sites. USE THE TIDE ELEVATION DATA WITH CAUTION! See Section 1.2.3 for more details. CB and TC tide gauge were carefully calibrated to one another; the CB tide gauge was placed all the way to the bottom of the piling where it hit bottom, and where the water level was on this tide gauge the TC tide gauge was nailed into place at the same level. The OL Tide staff was marked every 0.1 feet and CB and TC was marked in 0.1 meters. Water (tide) level was determined to the nearest 0.1 foot or meter and recorded into a field notebook when taking the water sample at each site. Water temperature was measured in the field with a mercury filled thermometer from the water sample taken at the 0.5 m level from the surface water. The thermometer was marked in 1degree C increments. Secchi values of the water were determined in the field by using a homemade secchi pole. The secchi disk was attached at the end of a 2.5 m long 3/4" diameter PVC pipe. The pipe was marked every 10 centimeters with black tape. Tide elevation, water temperature, and secchi readings at each site were made in the field and recorded on a nalgene data tag which was attached to the neck of the water sample bottle with a rubber band.

Laboratory Procedures and Protocols (Overall Laboratory Protocol "Prior to September 21, 1989")
Salinity values were determined after the water sample was brought back into the laboratory. Water from the sample was placed onto a hand-held refractometer. Seventy-five to 500 milliliters of the water samples were filtered through a preweighed precombusted Whatman GFF 0.7 µm (nominal pore size) glass fiber filter usually within one hour of the water sample collection at the Baruch Marine Field Laboratory's Water Chemistry Lab to separate the particulates from the water. Samples were shaken up first before filtering began; the amount of water filtered was determined by how much sediment and other solids were in the sample. In the winter in the absence of phytoplankton blooms and when sedimentation was low, up to 500 milliliters were filtered. In the summer and usually after heavy rains less water was filtered; the determining factor was to get a good sample of suspended solids on the filter from the water sample in order to get beyond the minimum detection limits of the TSS analysis.

A 0.7-micrometer (nominal pore size) glass fiber filter was used throughout the entire study to determine the cutoff between dissolved and particulate constitutes in the water sample. The filtered water is then run through a Technicon Analyzer. The following water chemistry analysis used filtered aliquots (< 0.7 micrometers): NH4, NN, OP, TNF, TPF, DOC. Water chemistries which used non-filtered aliquots or what remained on the 0.7 µm filter were TNW, TPW, POC, TOC, TSS, and Chlorophyll a.

Raw nutrient data which were represented as peak heights from the Technicon were recorded onto a strip chart (ticker-tape-type printout); DOC values were also printed out onto a strip chart. These peak heights were recorded into a master nutrient notebook; the raw peak heights were entered into a CMS file by the data management office into a data file. These peak heights had to be manually converted into nutrient concentrations by running the data through a computer program. TNW, TNF, TPW, TPF values were adjusted for volume dilutions.

Laboratory Procedures and Protocols (Overall Laboratory Protocol "afterSeptember 21, 1989"
Same protocol as described for prior to September 21, 1989 except for data output of Technicon described below:

Raw nutrient value concentrations from the Technicon were recorded onto a strip chart; DOC values were also printed out onto a strip chart. With the new Technicon there were no peak heights; the Technicon converted the peak heights directly into a nutrient concentration. The raw nutrient concentrations from the data strip chart were entered into a CMS file by the data management office into a data file. TNW, TNF, TPW, TPF values were then adjusted for volume dilutions. After September 21, 1989 there was no longer consideration given for the salt curve or refractive index for the Technicon Analyzer. This decision was made by Dr. Elizabeth Blood in that the effort to correct for these would make little (if any) difference in the concentration numbers.

Laboratory Procedures and Protocols (Ortho phosphate (OP))
The filtrate (<0.7 µm) was used in the procedure to determine the OP chemistry. The basic method was the Technicon Industrial Method No. 155-71W (1973), which was a modification of the Murphy and Riley (1962) single solution method. The method depended on the formation of a phospomolybdate blue complex, the color of which is read at a wavelength of 880 nanometers.

Laboratory Procedures and Protocols (Nitrite-Nitrite)
The filtrate (<0.7 micrometers) was used in the procedure to determine the NN chemistry. The basic method was Technicon Industrial Method No. 158-71W/B, which utilized the reaction in which nitrate was reduced to nitrite by a copper-cadmium reductor column. The nitrite ion then reacted with sulfanilamide under acidic conditions to form a diazo compound. This compound then coupled with N-1-napthylethylenediamine dihydrochloride to form a reddish-purple azo dye.

Laboratory Procedures and Protocols (Ammonia (NH4))
The filtrate (<0.7 micrometer) was used in the procedure to determine the NH4. This method was dependent upon the Berthelot Reaction, during which the formation of a blue colored compound closely related to indophenol occurred when the solution of an ammonium salt was added to sodium phenoxide, followed by the addition of sodium hypochlorite Glibert and Loder (1977). A solution of potassium sodium tartrate and sodium citrate was added to the sample stream to eliminate the precipitation of the hydroxides of calcium and magnesium.

Laboratory Procedures and Protocols (Total Nitrogen - Total Phosphorus (TNW, TNF, TPW, TPF)
Non-filtered water samples were used in the procedure to determine TNW and TPW chemistries. The filtrate (<0.7 micrometer) was used in the procedure to determine the TNF and TPF chemistries. The TN & TP method is a combination of two methods listed below, but in general the procedure consisted of an alkaline persulfate oxidation followed by automated analysis for nitrogen (as nitrate) and phosphorus (as phosphate) on a Technicon Auto Analyzer for all four chemistries. Oxidation reagent blanks (ORB) are run with each batch of persulfate digestion reagents.

With alkaline persulfate digestion, all nitrogen in the sample was oxidized to nitrate, which was then reduced by cadmium and analyzed as nitrite. The precision and recovery of this method compared favorably with a Kjeldahl procedure (D'Elia et al., 1977). The main advantage of the persulfate oxidation was the speed and convenience with which it was accomplished. Unlike the Kjeldahl method, which recovered only organic and NH4 - nitrogen, the persulfate oxidation also included NO3 and NO2 nitrogen.

This semi-automated procedure combines the persulfate oxidation with automated nitrate and phosphate analysis to provide simultaneous analysis for total persulfate nitrogen (TPN) and total persulfate phosphorus (TTP) (Glibert et al., 1977). Glibert's procedure has been further modified to use smaller sample size so that the digestion flask can double as the sampler tray cup (Loder 1978). With this method, many samples can be run quickly with a minimum of handling.

Laboratory Procedures and Protocols (Particulate Organic Carbon (POC) "April 1981 - April 1987")
Twenty ml of the water sample was filtered through a preweighed, precombusted (24 hr @ 450 degrees C) Whatman GFF 0.7 micrometer glass fiber filter. The filter with the particulate sample is waved over concentrated HCl to eliminate inorganic carbon, then placed in a precombusted ampule and frozen. Batches are dried at 60 degrees C for 48 hrs. One scoop (0.1 gr.) of precombusted (48 hr @ 750 degrees C) reagent grade CuO is added to each ampule, the ampule is purged with pure oxygen, and sealed using an Oceanographics International Purging and Sealing Unit #524PS. Ampules are etched, then heated to 580 degrees C for 4 hrs. Sorted ampules are then analyzed on an Oceanographics International #524C TOC Analyzer by comparing infrared absorption peak heights (Horiba PIR 2000) on an LDC strip chart recorder with those of KHP (Potassium Hydrogen Phthalate) standards. Standards are prepared by microsyringing a series of volumes of a KHP solution into ampules and processing them as a sample. Reagent blanks are subtracted and average concentration of duplicate samples is calculated for each water sample site. Analysis of Particulate Organic Carbon was discontinued April 15, 1987.

Laboratory Procedures and Protocols (Particulate Organic Carbon (POC) "April 1981 - April 1987")
Twenty ml of the water sample was filtered through a preweighed, precombusted (24 hr @ 450 degrees C) Whatman GFF 0.7 micrometer glass fiber filter. The filter with the particulate sample is waved over concentrated HCl to eliminate inorganic carbon, then placed in a precombusted ampule and frozen. Batches are dried at 60 degrees C for 48 hrs. One scoop (0.1 gr.) of precombusted (48 hr @ 750 degrees C) reagent grade CuO is added to each ampule,

the ampule is purged with pure oxygen, and sealed using an Oceanographics International Purging and Sealing Unit #524PS. Ampules are etched, then heated to 580 degrees C for 4 hrs. Sorted ampules are then analyzed on an Oceanographics International #524C TOC Analyzer by comparing infrared absorption peak heights (Horiba PIR 2000) on an LDC strip chart recorder with those of KHP (Potassium Hydrogen Phthalate) standards. Standards are prepared by microsyringing a series of volumes of a KHP solution into ampules and processing them as a sample. Reagent blanks are subtracted and average concentration of duplicate samples is calculated for each water sample site. Analysis of Particulate Organic Carbon was discontinued April 15, 1987.

Laboratory Procedures and Protocols (Dissolved Organic Carbon (DOC); Total Organic Carbon(TOC)"Sept 1, 1978 to Jan 23,1981 - TC site only)
Two 20 microliter samples per water sample were run on the Beckman Analyzer: one water sample is filtered through a precombusted (24 hr @ 450 degrees C) Whatman GFF 0.7 micrometer glass fiber filter, and the other is a nonfiltered sample. The filtrate is refrigerated. The filtrate and nonfiltered samples were injected into a Phosphorous and Cobalt column. The Beckman 915A TOC Analyzer was set at its normal gain and infrared absorption peak heights are compared to those of KHP standard solutions to calculate carbon concentrations. The results were Total Carbon (TC) and Inorganic Carbon (IC) dissolved and nondissolved constituents. To obtain organic carbon values, subtract the reading in Phosphorus column (IC) from the Cobalt column (TC). DOC was determined by the calculation: $TC_{dissolved}$ - $IC_{dissolved}$ = DOC, and TOC was determined by TC_{whole} - IC_{whole} = TOC; accuracy was only to the nearest 0.5 milligrams/liter.

Laboratory Procedures and Protocols (Dissolved Organic Carbon (DOC); Total Organic Carbon(TOC)"Jan 24,1981 to September 21,1989)
A procedural change in sample analysis occurred, and TOC and DOC were measured directly with the Beckman Analyzer not by subtraction. Also, an increase in the resolution of the strip chart to read more accurately was accomplished by turning up the machine gain and by using 100 microliters of sample in the analysis. For TOC, the water sample was not filtered for the water chemistry analysis. For DOC, the water sample is filtered through a precombusted (24 hr @ 450 degrees C) Whatman GFF 0.7 micrometer glass fiber filter. The filtrate is refrigerated. Samples are purged of inorganic carbon by adding 25 percent phosphoric acid to lower the pH to 2 and bubbling for 10 minutes with pure oxygen. The pH is then neutralized using ammonium hydroxide to protect the oxidizing catalyst. Every 5 minutes, using a Hamilton CR-700-200 spring loaded syringe, a 100 microliter sample is injected into a Beckman 915A TOC Analyzer and infrared absorption peak heights are compared to those of KHP standard solutions to calculate carbon concentrations. TOC analysis ended on August 16, 1989 at site TC; OL and CB sites began and ended in 1981.

Laboratory Procedures and Protocols (Dissolved Organic Carbon (DOC) "after Sept 21, 1989")
Water samples are filtered through a precombusted (24 hr @ 450 degrees C) Whatman GFF 0.7 micrometer glass fiber filter. The filtrate samples are purged of inorganic carbon by adding 10% Hydrochloric Acid and sparged with ultra zero grade air. A 40 microliter aliquot is injected, via an autosampler, into a Shimadzu TOC-500 organic carbon analyzer. A non-dispersive infrared gas analyzer is utilized to measure the carbon dioxide produced and samples are run in triplicate with means reported.

Laboratory Procedures and Protocols (Total Suspended Solids (TSS))
After the water sample is well-shaken, a known volume of sample (75 to 500 milliliters depending on the sediment load) is filtered through a precombusted, preweighed Whatman GFF 0.7 micrometer glass fiber filter. (Filters are weighed on an analytical balance with four place accuracy). The filter is dried in a drying oven at low temperature (less than 50 degrees C) until a stable weight is obtained.

Laboratory Procedures and Protocols (Suspended Sediment Color)
Starting in June 1988, Suspended Sediment Color was determined for each filter. After recording the weight for the dried filter for TSS above, each filter color was compared with the Munsell Soil Color Chart. When the color patch of the Munsell chart matched the color of the sediment on the filter, the color code from the Munsell Chart was written down on the sediment data sheet along with the rest of the sediment and filter weight information.

Laboratory Procedures and Protocols (Oragnic Suspended Solids (OSS))
After the weight is obtained for total suspended solids, the filters are returned to the muffle furnace and combusted at 450 degrees C for 24 hrs. Filters are reweighed and the final weight is subtracted from the total weight and normalized for the volume of water sample filtered. (Filters are weighed on an analytical balance with four place accuracy).

Laboratory Procedures and Protocols (Inorganic Suspended Solids (ISS))
Inorganic Suspended Solids (ISS) is a calculation of the oxidized weight (weight of filter and the inorganic material which would not volatilize at 450 degrees C) minus the initial precombusted filter weight. Weights are normalized for the volume of water sample filtered.

Laboratory Procedures and Protocols (Chlorophyll a (Chl a) and Phaeophytin)
An appropriate amount of sample (10 or 20 milliliters) is filtered through a 2.5 centimeter, 0.7 micrometer (nominal pore size) GFF glass fiber filter. The filter is then placed into a scintillation vial with 1 milliliter of saturated magnesium carbonate ($MgCO_3$) and frozen. Samples are removed from the freezer and 9 ml of 100 percent acetone is added then the samples are placed into the refrigerator for 24 hrs, then shaken and returned to the refrigerator for another 24 hrs. After extraction is complete, the samples are analyzed with a Turner Model 101 Fluorometer with a 430 nanometer filter. Analytical range can be adjusted by changing the volume of sample filtered. Phaeophytin was analyzed by the addition of 1.0 N Hydrochloric Acid due to the interference at the 430 nanometer wavelength.

VARIABLE DESCRIPTIONS:

Variable Name	Variable Description	Units	Measurement Scale	Code Information	Number Type
Date	the month day and year that the sample was collected, not necessarily processed or analyzed	1-12, 1-31, 1978-1993	datetime		
Site	tidal marsh creek code name within North Inlet Estuary where water sample was collected	TC, CB, OL	nominal		
Time	the time that the water sample was collected at each of the three tidal creek sites	0745 - 1345	datetime		
Total Nitrogen Whole (TNW)		0 - 140	ratio		real

Total Nitrogen Filtered (TNF)	T = Total (i.e. after alkaline persulfate oxidation / digestion); Second letter = element of interest (i.e. phosphorus or nitrogen);	. -1 - 145	ratio		real	
Total Phosphorus Whole (TPW)	Third letter = (F or W) whether sample was from a filtrate having passed through a precombusted 0.7 micrometer GFF Whatman glass fiber filter.	. -1 - 14	ratio		real	
Total Phosphorus Filtered (TPF)	F = (filtered aliquot) measurements taken from a filtrate passed through a precombusted 0.7 micrometer GFF Whatman glass fiber filter. W = (whole aliquot) the measurements were taken straight from the water sample bottle and analyzed. TNW = Total Nitrogen Whole, TNF = Total Nitrogen Filtered, TPW = Total Phosphorus Whole, TPF = Total Phosphorus Filtered	. -1 - 10	ratio		real	
Ortho Phosphate (OP)	ortho phosphate levels measured from a filtered aliquot (as described above)	0.0 - 4.3	ratio		real	
Ammonia (NH4)	ammonia levels measured from a filtered aliquot (as described above)	0.0 - 31.7	ratio		real	
Nitrate/Nitirite (NN)	nitrate-nitrite levels measured from a filtered aliquot (as described above)	. -0.1 - 10.3	ratio		real	
Dissolved Organic Carbon (DOC)	dissolved organic carbon levels measured from a filtered aliquot (as described above)	0.0 - 55.6	ratio		real	
Total Suspended Solids (TSS)	total suspended sediments or solids; anything such as zooplankton, algae, sand, etc. that stays on the 0.7 micrometer GFF Whatman filter after filtering the water sample. TSS = total dried sample weight minus the filter weight divided by the volume of water sample filtered.	0.100 - 1007.00	ratio		real	
Inorganic Suspended Solids (ISS)	inorganic suspended sediments (solids); the oxidized weight minus the initial precombusted filter weight divided by the volume of water sample filtered	1.60 - 910.500	ratio		real	
Organic Suspended Solids (OSS)	organic suspended sediments (solids); = total dried sample weight - oxidized weight (weight of filter and the inorganic material which would not volatilize at 450 degrees C) divided by the volume of water sample filtered.	0.000 - 262.900	ratio		real	
Chlorophyll a (Chla a)	chlorophyll a levels measured fluorometrically.	000.1 - 114.1	ratio		real	
Salinity (SAL)	salinity measured in parts per thousand from a refractometer	0 - 40	ratio		real	
Tiide Elevation (TIDEL)	tide elevation or water depth measured from tide staffs attached to pier pilings	0.0 - 3.8	ratio		real	
Water Temperature (WTEMP)	water temperature measured in degrees Celsius from a hand held thermometer	0 - 34	ratio		real	
Secchi depth	secchi depth measured from a pure white disk mounted on a PVC pole.	0.0 - 2.8	ratio		real	
Total Organic Carbon (TOC)	total organic carbon levels measured from whole water (non-filtered).	0.0 - 22.6	ratio		real	

Particulate Organic Carbon (POC)	particulate organic carbon levels measured from what remained on the 0.7micrometer filter after passing the whole water through it. (The DOC goes through the filter).	0.3 - 44.8	ratio		real	
Phaeophytin	phaeophytin values after acidification of water sample.	. -01.8 - 43.8	ratio		real	
EST Time (ESTIME)	A new time variable that was created for this database which subtracts 1 hour for recorded times greater than 1030 for April through October from 1981 to 1986. It is an estimated correction factor for those years where technicians recorded DST time instead of EST time.	0745 – 1329	datetime			