Hudson River (HUD) NERR Nutrient Metadata
January - November 2007
Latest Update: September 27, 2021

I. Data Set and Research Descriptors

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None

2. Research objectives:

a) Monthly Grab Sampling

The objective of this study is to monitor nutrient concentrations at the Tivoli Bays component of the Hudson River National Estuarine Research Reserve. Grab samples are taken from two freshwater tidal wetlands, Tivoli North Bay and Tivoli South Bay, and their primary upland tributaries, Stony Creek and Saw Kill Creek respectively. YSI datasondes are deployed at all grab sampling sites and meteorological data are collected continuously, thus relationships can be established between nutrient levels, the aquatic environment and meteorological conditions. The tributaries are sampled above the area of tidal influence, allowing for determination of nutrient inputs to the Tivoli Bays via stream flow. This is important because it has previously been determined that urban and residential land use practices are markedly influencing the water chemistry of the tributaries, especially Saw Kill Creek. Since residential coverage continues to increase, we hope that the intensive monitoring of the surface waters in this watershed will identify trends caused by this rapid development. Tivoli North and South Bays are sampled on an ebb tide, which accounts for nutrient inputs to the wetlands via stream flow and tidal exchange, and includes the influence of intertidal areas on nutrient levels. In addition, ebb tide sampling allows for determination of nutrient inputs to the Hudson River Estuary via the Tivoli Bays.

b) Diel Sampling

Monthly diel sampling is conducted at Tivoli South Bay. Diel sampling highlights the relative importance of tidal forcing on nutrient levels within Tivoli South Bay through the inclusion of two complete tidal cycles (a lunar day). Sampling on a flood tide allows for isolation of nutrient inputs via tidal exchange. As with grab sampling, diel sampling on an ebb tide accounts for nutrient inputs via tidal exchange and stream flow and includes the influence of intertidal areas on nutrient levels. The combination of grab and diel sampling data will provide a better understanding of the relative importance of each water source in terms of nutrient delivery to Tivoli South Bay. In addition, these data will help us develop a better understanding of the effects of the intertidal area on nutrient dynamics.

3. Research methods:

a) Monthly Grab Sampling

Monthly grab samples are collected near the four YSI data logger locations within the Tivoli Bays component of the Hudson River National Estuarine Research Reserve. These sites include Tivoli South Bay, Tivoli North Bay, Saw Kill Creek, and Stony Creek. Monthly sampling at the two bays and the two creeks is conducted on the same day, during an ebb tide within three hours of slack low-water. Efforts are made to avoid precipitation events within 48 hours of sampling. Two replicate samples are collected sequentially at each site using 1 L amber Nalgene bottles. Prior to sample collection, bottles are acid washed with 10% HCL and rinsed with distilled-deionized water. At each site, bottles are rinsed three times with ambient water just before sample collection. All sampling sites are highly mixed and samples are collected at only one depth, approximately 15 cm below the surface. At the time of sample collection, a YSI Model 85 meter is used to measure temperature, salinity, specific conductivity and dissolved oxygen (% and mg/L), and the values are recorded. Cloud cover, precipitation, and tide stage conditions are also noted. Grab samples are placed on ice and returned to the laboratory. Within 24 hours, pH and alkalinity are measured (available by contacting the Reserve directly) and samples are filtered for seston (TSS) and chlorophyll A (CHLA). The filtrate is collected and transferred to 125 ml Nalgene bottles that have been acid washed, rinsed with distilled-deionized water, and rinsed three times with the filtrate. Filtered samples are stored at 4°C until nutrient analysis and 1 ml of 1 N H_2SO_4 is added to samples that will be analyzed for ammonium. Filters for CHLA analysis are placed in borosilicate vials and stored in a freezer.

b) Diel Sampling

Monthly diel sampling occurs at Tivoli South Bay near the YSI datasonde location. An ISCO 6712 Portable Sampler equipped with a 25 ft siphoning tube is used for sample collection. The siphoning tube is deployed approximately one meter from the datasonde and water is collected 20 cm off the bottom, approximate sampling depths are 0.5 meters at low tide and 2.5 meters at high tide. Two sequential samples were collected once every 2 hours for 22 hours until November 2002, when collection of the two sequential samples changed to once every 2.5 hours for 27.5 hours. Cloud cover and precipitation conditions were noted for at least the first and last samples. Tide stage is noted for all samples; the first sample is always collected at slack low tide. Samples are collected in 1 liter clear Nalgene bottles that are acid washed with 10% HCL and rinsed with distilled-deionized water prior to deployment of the ISCO. The second sample bottle in each sequence receives 2 ml of 10 N H_2SO_4 prior to deployment in order to preserve the sample for ammonium analysis. The inside of the ISCO is packed with ice to keep the samples cool until the instrument is retrieved. Samples are processed on the day of retrieval. Acidified samples, the second in each collection sequence, are filtered and the filtrate is collected and transferred to 125 ml Nalgene bottles that have been acid washed and rinsed as described previously. Non-acidified samples, the first in each collection sequence, are filtered for seston and CHLA. The filtrate is collected and transferred to 125 ml Nalgene bottles that have been acid washed and rinsed as described previously. All filtered water samples are stored at 4°C until nutrient analysis is conducted. Filters used for CHLA analysis are placed in borosilicate vials and stored in a freezer.

4. Site location and character:

The Hudson River National Estuarine Research Reserve (HUDNERR) is a multi-component site totaling approximately 5,000 acres. Each component of the reserve is referenced by River Mile (RM) of the Hudson River in New York State proceeding north from the southern tip of Manhattan (RM 0). The reserve includes the following four component sites: Piermont Marsh, Rockland County (RM 24)(41°02'30"N 73°54'15"W), Iona Island, Rockland County (RM 45)(41°18'15"N 73°58'45"W), Tivoli Bays, Dutchess County (RM 98)(42°02'15"N 73°55'10"W), and Stockport Flats, Columbia County (RM 124)(42°02'30"N 73°46'00"W). The four component sites include open water, tidal wetland, and adjacent upland buffer habitats and are representative of the diverse plant and animal communities that occupy the salinity gradient within the Hudson River Estuary. Development within the watersheds of the four component sites ranges from predominantly urban/suburban to forested/agricultural.

The highlighted component for this study is the Tivoli Bays in Annandale, NY. This component includes four monitored sites: Tivoli South Bay, Tivoli North Bay, Saw Kill Creek, and Stony Creek. All four monitored sites are freshwater (0.0 ppt salinity).

Tivoli South Bay (latitude 42° 01' 37.336" N, longitude 73° 55' 33.445" W) is a tidal freshwater wetland with intertidal mudflats exposed at low tide. During the growing season (June – September), the subtidal area of Tivoli South Bay is dominated by the invasive floating macrophyte *Trapa natans*. Tivoli South Bay has a tidal range of 1.19 meters and a soft, silt/clay bottom type. The depth at the sampling location ranges from 0.5 to 2.5 meters. The non-tidal freshwater input to Tivoli South Bay includes that of a large upland tributary and a few small perennial streams.

Tivoli North Bay (latitude 42° 02' 11.56464" N, longitude 73° 55' 31.16645" W) is a freshwater tidal marsh with emergent marsh vegetation dominated by the cattail *Typha angustifolia.* Tivoli North Bay has a tidal range of 1.19 meters, a soft, silt/clay bottom type, and a depth range from 0.5 to 3.0 meters at the sampling location. The non-tidal freshwater input to Tivoli North Bay includes that of a large upland tributary and a few small perennial streams.

Saw Kill Creek (latitude 42° 01' 01.543" N, longitude 73° 54' 53.589" W) is the main tributary flowing into Tivoli South Bay. The Saw Kill Creek watershed is 26.6 square miles and land use within the watershed includes forested (51.1%), agricultural (25.8%), and urban (16.5%) areas. Characteristics of Saw Kill Creek at the sampling location include a rocky bottom type, a depth range of 0.5 to 2.0 meters, and discharge that can range from $2x10^{-5}$ to 1.2 m^3/sec.

Stony Creek (latitude 42° 02' 45.556" N, longitude 73° 54' 40.237" W) is the main tributary flowing into Tivoli North Bay. The Stony Creek watershed is approximately 23 square miles and is dominated by agricultural land use. Characteristics of Stony Creek at the sampling location include a solid rock bottom and a depth range of 0.5 to 1.5 meters. Stony Creek discharge is currently being determined. Both Stony Creek and Saw Kill Creek are non-tidal and freshwater input to the tributaries consists of smaller creeks in the watershed.

The entire tidal Hudson River south of the Troy Dam is affected by polychlorinated biphenyls (PCBs), and Tivoli North and South Bays have low sedimentary concentrations of PCBs. Nutrient inputs to the Tivoli Bays via the non-tidal tributaries are the main concern in terms of pollutants. High concentrations of nitrate and phosphate have previously been documented in both Saw Kill Creek and Stony Creek. Saw Kill Creek appears to be strongly influenced by residential land use practices. This highlights the importance of continued monitoring and identification of non-point sources of pollution at these sites.

5. Coded variable definitions:

Site name codes:
SK=Saw Kill Creek, SC=Stony Creek, TN=Tivoli North Bay, TS=Tivoli South Bay

Station codes:
hudsknut = Hudson River Reserve nutrient data for Saw Kill Creek

hudscnut = Hudson River Reserve nutrient data for Stony Creek
hudtnnut = Hudson River Reserve nutrient data for Tivoli North Bay
hudtsnut = Hudson River Reserve nutrient data for Tivoli South Bay

Monitoring program codes:
1=Monthly grab sampling
2=Diel sampling

6. Data collection period:

Monthly grab samples have been collected at the four monitored sites of the Tivoli Bays since 06/17/1991. Diel sampling at Tivoli South Bay began in June 2002. The exact dates and times for the 2007 Nutrient Data collection period are listed below. Data collection is hampered during the winter months (December-March) because snow and ice often prohibit safe access to the sites.

a) Grab Sampling

Site	**Date**	**Rep 1 Time**	**Date**	**Rep 2 Time**
SC	01/10/07	10:30	01/10/07	10:32
SC	02/07/07	11:35	02/07/07	11:37
SC	03/12/07	9:40	03/12/07	9:42
SC	04/23/07	13:50	04/23/07	13:52
SC	05/23/07	10:15	05/23/07	10:17
SC	06/25/07	13:00	06/25/07	13:02
SC	07/16/07	8:55	07/16/07	8:57
SC	08/15/07	10:10	08/15/07	10:12
SC	09/13/07	9:05	09/13/07	9:07
SC	10/17/07	12:35	10/17/07	12:37
SC	11/14/07	12:00	11/14/07	12:02
SC	No December sample taken due to ice			
SK	01/10/07	10:15	01/10/07	10:17
SK	02/07/07	11:15	02/07/07	11:17
SK	03/12/07	9:20	03/12/07	9:22
SK	04/23/07	15:05	04/23/07	15:07
SK	05/23/07	9:50	05/23/07	9:52
SK	06/25/07	12:30	06/25/07	12:32
SK	07/16/07	9:15	07/16/07	9:17
SK	08/15/07	10:30	08/15/07	10:32
SK	09/13/07	9:25	09/13/07	9:27
SK	10/17/07	13:00	10/17/07	13:02
SK	11/14/07	12:20	11/14/07	12:22
SK	No December sample taken due to ice			
TN	01/10/07	11:00	01/10/07	11:02
TN	No February sample taken due to ice			
TN	03/27/07	14:40	03/27/07	14:42
TN	04/23/07	13:20	04/23/07	13:22
TN	05/23/07	10:35	05/23/07	10:37
TN	06/25/07	13:25	06/25/07	13:27
TN	07/16/07	8:00	07/16/07	8:02
TN	08/15/07	9:40	08/15/07	9:42

TN	09/13/07	8:35	09/13/07	8:37
TN	10/17/07	10:45	10/17/07	10:47
TN	11/14/07	10:05	11/14/07	10:07
TN	No December sample taken due to ice			
TS	01/10/07	11:15	01/10/07	11:17
TS	No February sample taken due to ice			
TS	03/27/07	14:25	03/27/07	14:27
TS	04/23/07	12:50	04/23/07	12:52
TS	05/23/07	10:50	05/23/07	10:52
TS	06/25/07	13:40	06/25/07	13:42
TS	07/16/07	8:20	07/16/07	8:22
TS	08/15/07	9:25	08/15/07	9:27
TS	09/13/07	8:15	09/13/07	8:17
TS	10/17/07	10:55	10/17/07	10:57
TS	11/14/07	10:20	11/14/07	10:22
TS	No December sample taken due to ice			

b) Diel Sampling

Site	**Start Date**	**Start Time**	**End Date**	**End Time**
TS	No January diel sample taken due to ice			
TS	No February diel sample taken due to ice			
TS	No March diel sample taken due to ice			
TS	04/24/07	1:30	04/25/07	5:00
TS	05/22/07	1:00	05/23/07	04:30
TS	06/26/07	5:00	06/27/07	8:30
TS	07/16/07	21:30	07/18/07	2:00
TS	08/21/07	2:00	08/22/07	5:30
TS	09/10/07	19:30	09/11/07	23:00
TS	10/17/07	1:00	10/18/07	4:30
TS	11/12/07	22:00	11/14/07	1:30
TS	No December diel sample taken due to ice			

7. Associated researchers and projects:

The HUDNERR water quality monitoring program examines the physical and chemical constituents of tributary and tidal waters entering and leaving HUDNERR marshes. Field measurements include dissolved oxygen, alkalinity, pH, temperature, salinity, and conductivity. Laboratory measurements include concentrations of suspended solids, nitrate, phosphate, sulfate, and chloride. Meteorological data are collected continuously at the Tivoli Bays component site, including air temperature, barometric pressure, precipitation, wind speed and direction, relative humidity and photosynthetically active radiation. These data will help us to better understand the relationships between the atmospheric and aquatic environments at this component site.

Associated researchers working at Tivoli Bays include scientists from the Cary Institute of Ecosystem Studies, Millbrook, NY; Yale School of Forestry and Environmental Studies, New Haven, CT; and Rensselaer Polytechnic Institute, Troy, NY.

8. Distribution:

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program, NOAA/ERD retains the right to analyze, synthesize and publish summaries

of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format.

II. Physical Structure Descriptors

9. Entry verification:

Following sample analysis (ammonium, nitrate, orthophosphate), data files are transferred directly from analytical instruments to desktop computers. Reports are generated as Excel spreadsheets and verified by the head of the CIES analytical laboratory. Data are examined for completeness, consistency and outliers. Suspect data are flagged, data are reviewed at CIES, and if possible, samples are analyzed a second time. The Excel spreadsheets are then sent to Hudson River Research Reserve staff.

For chlorophyll a and phaeophytin data, raw fluorescence data are entered by hand into spreadsheets that have been set up to perform necessary calculations. Entered data are checked twice for errors and calculated values are examined for completeness, consistency and outliers.

Laboratory data are then assigned an ID and imported into an Access database. Field data are entered directly into Access with a corresponding sample ID. The field and laboratory data for the four sites described here are then queried out of Access, imported into Excel, reformatted and pre-processed. In addition, laboratory values are reported as PO4, NO3, and NH4 in mg/L and must be converted to mg/L P or N. The following calculations are used:

P = PO4 x 0.3261
N = NO3 x 0.2259
N = NH4 x 0.7765

All nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker's rounding rules; allows the user to input MDL values and automatically flags and codes values below MDL; calculates parameters chosen by the user and automatically flags for component values below MDL and negative values; allows the user to apply QAQC flags and codes to the data; graphs selected parameters for review; append files; and export the resulting data files to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

The research coordinator, Sarah Fernald, is responsible for QA/QC of the data.

10. Parameter titles and variable names by data category:

Required NOAA/NERRS System-wide Monitoring Program water quality parameters are denoted by an asterisk "*".

Data Category	Parameter	Variable Name	Units
Phosphorus and Nitrogen:			
	*Orthophosphate	PO4F	mg/L as P
	*Nitrate, Filtered	NO3F	mg/L as N
	*Ammonium, Filtered	NH4F	mg/L as N
Plant Pigments:			
	*Chlorophyll a	CHLA_N	ug/L
	Phaeophytin	PHEA_N	ug/L
Other Lab Parameters:			
	Total Suspended Solids	TSS	mg/L
Field Parameters:			
	Water Temperature	WTEM_N	degrees C
	Specific Conductivity	SCON_N	mS/cm
	Salinity	SALT_N	ppt
	Dissolved oxygen (conc.)	DO_N	mg/L
	Dissolved oxygen (% sat)	DO_S_N	%

Notes:

1. Time is coded based on a 2400 hour clock and is referenced to Eastern Standard Time (EST).
2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3. HUD NERR has always measured only NO3.

11. Measured or calculated laboratory parameters:

a) Parameters measured directly:

Nitrogen species: NO3F, NH4F
Phosphorus species: PO4F
Other: CHLA_N, PHEA_N, TSS

b) Calculated Parameters:

None

12. Limits of detection:

A method detection limit (MDL), the lowest concentration of a parameter an analytical procedure can reliably detect, has been established by the CIES Analytical Laboratory for each parameter. The MDL is determined as three times the standard deviation of a minimum of 10 replicates of a single low concentration sample.

A Reporting Limit is also determined for each parameter as the greater of either ten times the standard deviation of a minimum of 10 replicates of a single low concentration sample, or the value of the lowest concentration calibration standard. The CIES Analytical Laboratory does not report measured data below the Reporting Limit. As a result, all data flagged and coded as "below minimum limit of method detection" for the NERRS dataset, are more specifically below the established reporting limit.

The current Reporting Limits are listed below. These values are reviewed and revised periodically.

Parameter	Variable	Reporting Limit	Dates in Use
Ammonium	NH4F	0.02 mg/L as N	1991-2007
Nitrate	NO3F	0.004 mg/L as N *	1991-2007
Orthophosphate	PO4F	0.001 mg/L as P	1991-2007
Chlorophyll a	CHLA_N	0.02 ug/L	2004-2007
Phaeophytin	PHEA_N	0.02 ug/L	2004-2007
Total Suspended Solids	TSS	0.1 mg/L	2004-2007

*NITRATE IS NOT ANALYZED DOWN TO THE DETECTION LIMIT; HUDNERR HAS BEEN USING 0.128 mg/L NO3 (ion) AS THE CONCENTRATION OF THE LOWEST NITRATE STANDARD FOR SAMPLE ANALYSIS SINCE 1991. THEREFORE, THE MINIMUM REPORTED CONCENTRATION (MRC) OF NITRATE AS NITROGEN IS 0.029 mg/L as N.

13. Laboratory methods:

a) Parameter: TSS

Method reference: Standard Methods for Examination of Water and Wastewater, # 2540D.
Method Descriptor: Well-mixed samples are filtered through a combusted, weighed glass fiber filter and the residue on the filter (suspended solids) is dried to a constant weight. The concentration of TSS (mg/L) is calculated by subtracting the original weight of the filter from the weight of the filter + suspended solids and dividing by the total volume filtered.
Preservation method: N/A

b) Parameter: NH4F

Method Reference: Lachat Quikchem8000 Flow Injection Analyzer using Lachat method 10-107-06-1-J
Method Descriptor: Ammonium reacts with alkaline phenol, and sodium hypochlorite to form indophenol blue. Sodium nitroprusside (nitroferricyanide) is added to enhance sensitivity. The absorbance of the reaction product is measured at 630 nm, and is directly proportional to the original ammonium concentration in the sample.

Preservation Method: Samples are filtered using 25mm GF/F filters within 24 h of collection and 1 ml of 1 N H2SO4 is added to the filtrate. Samples are stored at 4°C for up to one month prior to analysis.

c) Parameter: NO3F

Method Reference: Small, H., Stevens, T.S. and Bauman, W.C. 1975. Anal. Chem. 47:1801-1809.
Method Descriptor: A small volume of sample is injected into an ion-exchange column and eluted with a flowing stream of carbonate-bicarbonate. The sample is pumped through two different ion exchange columns, a suppressor device, and into a conductivity detector. Ions from the sample are separated into discrete bands due to different retention times, and the ions are compared to known standards.
Preservation Method: Samples are filtered using 25mm GF/F filters within 24 h of collection. Samples are stored at 4°C for up to two months prior to analysis.

d) Parameter: PO4F

Method Reference: Lachat Quickchem8000 Flow Injection Analyzer using Lachat method 10-115-01-1-M with modifications to eliminate silica interference, Phosphomolydate method.
Method Descriptor: The orthophosphate ion reacts with ammonium molybdate and antimony potassium tartrate under acidic conditions to form a complex. This complex is reduced with ascorbic acid to form a blue complex which absorbs light at 880nm. The absorbance is proportional to the concentration of orthophosphate in the sample. Note that the stock Lachat Color Reagent was modified to decrease the level of silica interference. It was found that a decrease in pH of this reagent would decrease the level of silica interference (Jarvie et al 2002). However, a decrease in pH also creates a decrease in color development. Therefore a series of experiments were conducted to determine the optimal level of sulfuric acid concentration within the color reagent. The optimal sulfuric acid concentration that was determined is 1.98N.
Preservation Method: Samples are filtered with 25mm GF/F filters within 24 h of collection. Samples are stored at 4°C for up to one month prior to analysis.

e) Parameter: CHLA_N and PHEA_N

Method references:
Holm-Hansen, O. and B. Riemann. 1978. Chlorophyll a determination: improvements in methodology. Oikos 30: 438-447.
Wetzel, R.G. and G.E. Likens. 1991. Limnological Analysis, 2nd ed. Springer-Verlag, New York: 168-169.
Method Descriptor: CHLA and PHEA are measured fluormetrically. Standards with known CHLA concentrations in 90% acetone are used to determine a relationship between CHLA and fluorescence (F). The standards are then acidified with 0.1 N HCL to determine the fluorescence ratio (t) of CHLA and PHEA for pure chlorophyll. Sample filters are extracted using basic methanol (5 ml) and the fluorescence is recorded (Rb). The samples are then acidified with 0.1 N HCL and the fluorescence is recorded (Ra). The following equations are used to determine CHLA and PHEA concentrations in samples:

$$CHLA\ (ug/L) = F*(t/t-1)*(Rb-Ra)*(v/V)$$
$$PHEA\ (ug/L) = F*(t/t-1)*(tRa-Rb)*(v/V)$$

where v is the volume used for extraction (ml) and V is the volume filtered (ml).
Preservation method: Filters are stored in borosilicate vials in the dark at -20°C. Extraction solvent is not added until 24 h prior to fluorometry.

14. Field and Laboratory QA/QC programs:

a) Precision

i) Field variability

At each monitored site, monthly duplicate grab samples are true replicates, collected separately and sequentially, not simultaneously.

During diel sampling at Tivoli South Bay, two samples are collected at each time, but one is acidified for ammonium analysis. Therefore, diel samples do not have replicates.

ii) Laboratory variability

At each monitored site, duplicate monthly grab samples are analyzed for NO3F, PO4F, and NH4F, providing two true replicates for each parameter. CHLA_N and PHEA_N are also analyzed as true replicates, one from each grab sample.

Diel samples are analyzed for NO3F, PO4F, NH4F, CHLA_N and PHEA_N, but only one replicate is analyzed for each parameter. Analytical QA/QC procedures include periodic duplicate analysis of the same sample in order to verify precision of the analytical instrumentation.

iii) Inter-organizational Splits

None.

b) Accuracy

i) Sample Spikes

None

ii) Standard Reference Material Analysis

A blind standard test was performed in May 2007 for NH4, NO3, and PO4. However, results were inconclusive due to possible contamination in the standard dilution step.

iii) Cross Calibration Exercises

None

15) QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-4 Outside Low Sensor Range*
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP Supported Parameter
0 Data Passed Initial QAQC Checks
1 Suspect Data
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

*The -4 Outside Low Sensor Range flag was added to the 2007 dataset in August of 2011. See the Other Remarks section for more details.

16) QAQC code definitions

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Value calculated with a value that is below the MDL
SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Cloud cover

CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)

CFY	foggy
CHY	hazy
CCC	cloud (no percentage)

Precipitation

PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow

Tide stage

TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide

Wave height

WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters
WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters

Wind direction

N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest
W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest

Wind speed

WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots

WS5 > 40 knots

17) Other remarks/notes

Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO23F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded with -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL's or missing, suspect, or rejected data is needed, contact the Research Coordinator at the Reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

*The 2007 dataset was updated on August of 2011 to include the -4 Outside Low Sensor Range flag. The 2007 data published prior to that time used the -3 Rejected data flag with the SBL and SCB QAQC codes to indicate that data were below the minimum detection limit. These flag code combinations were all replaced with the -4 SBL or SCB update as mandated by the Data Management Committee.

Negative numbers reported for some phaeophytin values are thought to be due to an incomplete acidification of the pigment in basic methanol solution. More care will be given to thoroughly mix the sample during the procedure.

Negative numbers reported for some TSS values are thought to be due to an incomplete removal of the filter sample from the filtration apparatus. More care will be given in transferring the filter to the weighing pan.