

# Trace-metals from CTD casts and underway water samples collected during the R/V Hugh R. Sharp cruise HRS1414 in the Mid and South-Atlantic Bight in August of 2014 (DANCE project)

Website: <https://www.bco-dmo.org/dataset/734324>

Data Type: Cruise Results

Version: 1

Version Date: 2018-04-25

## Project

» [Collaborative Research: Impacts of atmospheric nitrogen deposition on the biogeochemistry of oligotrophic coastal waters](#) (DANCE)

Contributors	Affiliation	Role
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## Abstract

Dissolved iron, nitrate+nitrite, ammonium, and phosphate were measured from CTD bottle samples, and underway water samples collected with a towfish system during the R/V Hugh R. Sharp cruise HRS1414 in the Mid and South-Atlantic Bight in August of 2014. This dataset also includes temperature, salinity, chlorophyll fluorescence, depth, latitude, and longitude.

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## Coverage

**Spatial Extent:** N:38.6456 E:-71.1548 S:33.628 W:-74.4656

**Temporal Extent:** 2014-08-01 - 2014-08-10

## Methods & Sampling

[The following methodology applies where dataset parameter "sample\_source" is "UNDERWAY"]

Near-surface sample collection: Near-surface (~4 m depth) seawater was collected whilst underway at ~5 knots using a trace-metal clean towfish system [Sedwick et al., 2011]. The subsamples for analysis of DFe, NO<sub>3</sub>+NO<sub>2</sub>, PO<sub>4</sub> were taken directly from the towfish line, after filtration through a 0.8/0.2 µm AcroPak Supor filter capsule (Pall), in acid-cleaned 125 mL low-density polyethylene bottles (Nalgene) for shore-based DFe

determinations, and 60 mL polypropylene tubes (Falcon) for shipboard NO<sub>3</sub>+NO<sub>2</sub>, PO<sub>4</sub> and NH<sub>4</sub> analyses.

Near-surface underway measurements: Continuous underway measurements of near-surface seawater temperature, salinity and chlorophyll fluorescence were made using the ship's underway seawater supply, which is pumped from a water depth of ~1m. The data presented correspond to the approximate times when subsamples were collected from the towfish seawater outlet for measurements of dissolved iron and macronutrients (see above).

DFe: Filtered seawater samples were acidified at-sea to pH ~1.8 with Fisher Optima grade ultrapure hydrochloric acid, and then stored at room temperature until post-cruise analysis at Old Dominion University. Dissolved iron was determined by flow injection analysis with colorimetric detection after in-line preconcentration on resin-immobilized 8-hydroxyquinoline (Sedwick et al., 2015), using a method modified from Measures et al. (1995). Analyses were performed on a volumetric basis, so concentrations are reported in units of nanomole liter<sup>-1</sup> (nM). Analytical precision is estimated from multiple (separate-day) determinations of the SAFe seawater reference materials, which yield uncertainties (expressed as one relative standard deviation on the mean, or one sigma) of ~15% at the concentration level of SAFe S seawater (0.090 nM), and ~10% at the concentration level of SAFe D2 seawater (0.90 nM). The analytical limit of detection is estimated as the DFe concentration equivalent to a peak area that is three times the standard deviation on the zero-loading blank (manifold blank), which yields an estimated detection limit below 0.04 nM (Bowie et al., 2004). Blank contributions from the ammonium acetate sample buffer solution (added on-line during analysis) and hydrochloric acid (added after collection) are negligible.

NO<sub>3</sub>+NO<sub>2</sub>: Dissolved nitrate and nitrite was determined at sea using an Astoria Pacific nutrient autoanalyzer using standard colorimetric methods with an estimated detection limit of 0.14 μM (Parsons et al., 1984; Price and Harrison, 1987). In surface waters, nitrate and nitrite were determined using the same autoanalyzer equipped with a liquid waveguide capillary cell (World Precision Instruments) (Zhang, 2000) to achieve an estimated detection limit of 0.02 μM.

PO<sub>4</sub>: Dissolved phosphate was determined at sea using an Astoria Pacific nutrient autoanalyzer using standard colorimetric methods with an estimated detection limit of 0.03 μM (Parsons et al., 1984; Price and Harrison, 1987).

NH<sub>4</sub>: Dissolved ammonium was determined at sea using the manual orthophthaldialdehyde method (Holmes et al., 1999), with an estimated detection limit of 10 nM.

Temperature: Underway temperature was measured using a conductivity-temperature-depth sensor (SBE 45, SeaBird Electronics).

Salinity: Underway salinity was calculated from in-situ conductivity, as measured using a conductivity-temperature-depth (CTD) sensor (SBE 45, SeaBird Electronics).

Fluorescence: Underway chlorophyll fluorescence was measured using a Turner AU10 fluorometer.

[The following methodology applies where dataset parameter "sample\_source" is "CTD"]

Water column sample collection and in-situ measurements: Water-column samples for analysis of dissolved iron, nitrate plus nitrite, phosphate and ammonium, and continuous profiles of temperature, salinity and chlorophyll fluorescence were collected using a trace-metal clean conductivity-temperature-depth sensor (SBE 19 plus, SeaBird Electronics) mounted on a custom-built trace-metal clean carousel (SeaBird Electronics) fitted with custom-modified 5-L Teflon-lined external-closure Niskin-X samplers (General Oceanics), deployed on a Kevlar line. Upon recovery, the Niskin-X samplers were transferred into a shipboard Class-100 clean laboratory, where seawater was filtered through pre-cleaned 0.2-μm pore AcroPak Supor filter capsules (Pall) into acid-cleaned 125 mL low-density polyethylene bottles (Nalgene) for shore-based dissolved iron determinations, and 60 mL polypropylene tubes (Falcon) for shipboard nutrient analyses.

DFe: Filtered seawater samples were acidified at-sea to pH ~1.8 with Fisher Optima grade ultrapure hydrochloric acid, and then stored at room temperature until post-cruise analysis at Old Dominion University. Dissolved iron was determined by flow injection analysis with colorimetric detection after in-line preconcentration on resin-immobilized 8-hydroxyquinoline (Sedwick et al., 2015), using a method modified from Measures et al. (1995). Analyses were performed on a volumetric basis, so concentrations are reported in units of nanomole liter<sup>-1</sup> (nM). Analytical precision is estimated from multiple (separate-day) determinations of the SAFe seawater reference materials, which yield uncertainties (expressed as one relative standard deviation on the mean, or one sigma) of ~15% at the concentration level of SAFe S seawater (0.090 nM), and ~10% at the concentration level of SAFe D2 seawater (0.90 nM). The analytical limit of detection is estimated as

the DFe concentration equivalent to a peak area that is three times the standard deviation on the zero-loading blank (manifold blank), which yields an estimated detection limit below 0.04 nM (Bowie et al., 2004). Blank contributions from the ammonium acetate sample buffer solution (added on-line during analysis) and hydrochloric acid (added after collection) are negligible.

NO<sub>3</sub>+NO<sub>2</sub>: Dissolved nitrate and nitrite was determined at sea using an Astoria Pacific nutrient autoanalyzer using standard colorimetric methods with an estimated detection limit of 0.14 μM (Parsons et al., 1984; Price and Harrison, 1987). In surface waters, nitrate and nitrite were determined using the same autoanalyzer equipped with a liquid waveguide capillary cell (World Precision Instruments) (Zhang, 2000) to achieve an estimated detection limit of 0.02 μM.

PO<sub>4</sub>: Dissolved phosphate was determined at sea using an Astoria Pacific nutrient autoanalyzer using standard colorimetric methods with an estimated detection limit of 0.03 μM (Parsons et al., 1984; Price and Harrison, 1987).

NH<sub>4</sub>: Dissolved ammonium was determined at sea using the manual orthophthaldialdehyde method (Holmes et al., 1999), with an estimated detection limit of 10 nM.

Temperature: In-situ temperature was measured using a conductivity-temperature-depth sensor (SBE 19 plus, SeaBird Electronics).

Salinity: Salinity was calculated from in-situ conductivity, as measured using a conductivity-temperature-depth (CTD) sensor (SBE 19 plus, SeaBird Electronics).

Fluorescence: In-situ chlorophyll fluorescence was measured using a WET Labs ECO-FL(RT)D deep chlorophyll fluorometer with 125 μg L<sup>-1</sup> range mounted on the CTD rosette.

## Data Processing Description

CTD data (temperature, salinity) were processed using SeaSoft processing software (SeaBird Electronics).

BCO-DMO Data Manager Processing Notes:

- \* added a conventional header with dataset name, PI name, version date
- \* modified parameter names to conform with BCO-DMO naming conventions
- \* combined two Excel files, one for the underway data and one for the ctd data into one dataset.
- \* missing data shown as default missing data identifier "nd" for "no data" or "BDL" for below detection limit.

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## Data Files

File
<b>trace_metals_toplevel.csv</b> (Comma Separated Values (.csv), 10.66 KB) MD5:4439f7648b40332c64ef59cca7390b97
Primary data file for dataset ID 734324

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## Related Publications

Bowie, A. R., Sedwick, P. N., & Worsfold, P. J. (2004). Analytical intercomparison between flow injection-chemiluminescence and flow injection-spectrophotometry for the determination of picomolar concentrations of iron in seawater. *Limnology and Oceanography: Methods*, 2(2), 42-54. doi:[10.4319/lom.2004.2.42](https://doi.org/10.4319/lom.2004.2.42)

Holmes, R. M., Aminot, A., K  rouel, R., Hooker, B. A., & Peterson, B. J. (1999). A simple and precise method for measuring ammonium in marine and freshwater ecosystems. *Canadian Journal of Fisheries and Aquatic Sciences*, 56(10), 1801-1808. doi:[10.1139/f99-128](https://doi.org/10.1139/f99-128)

## Methods

Measures, C. I., Yuan, J., & Resing, J. A. (1995). Determination of iron in seawater by flow injection analysis using in-line preconcentration and spectrophotometric detection. *Marine Chemistry*, 50(1-4), 3-12. doi:[10.1016/0304-4203\(95\)00022-j](https://doi.org/10.1016/0304-4203(95)00022-j)

### Methods

Mulholland, M. R., Bernhardt, P. W., Heil, C. A., Bronk, D. A., & O'Neil, J. M. (2006). Nitrogen fixation and release of fixed nitrogen by *Trichodesmium* spp. in the Gulf of Mexico. *Limnology and Oceanography*, 51(4), 1762-1776. doi:[10.4319/lb.2006.51.4.1762](https://doi.org/10.4319/lb.2006.51.4.1762)

### General

Parsons, T. R., Y. Maita, and C. M. Lalli. "A Manual of Chemical and Biological Methods of Seawater Analysis", Pergamon Press (1984). ISBN: [9780080302874](https://doi.org/10.1016/0304-4203(95)00022-j)

### Methods

Price, N. M., & Harrison, P. J. (1987). Comparison of methods for the analysis of dissolved urea in seawater. *Marine Biology*, 94(2), 307-317. doi:10.1007/bf00392945 <https://doi.org/10.1007/BF00392945>

### Methods

Sedwick, P. ., Sohst, B. M., Ussher, S. J., & Bowie, A. R. (2015). A zonal picture of the water column distribution of dissolved iron(II) during the U.S. GEOTRACES North Atlantic transect cruise (GEOTRACES GA03). *Deep Sea Research Part II: Topical Studies in Oceanography*, 116, 166-175. doi:[10.1016/j.dsr2.2014.11.004](https://doi.org/10.1016/j.dsr2.2014.11.004)

### Methods

Sedwick, P. N., Bernhardt, P. W., Mulholland, M. R., Najjar, R. G., Blumen, L. M., Sohst, B. M., Sookhdeo, C., & Widner, B. (2018). Assessing Phytoplankton Nutritional Status and Potential Impact of Wet Deposition in Seasonally Oligotrophic Waters of the Mid-Atlantic Bight. In *Geophysical Research Letters* (Vol. 45, Issue 7, pp. 3203-3211). American Geophysical Union (AGU). <https://doi.org/10.1002/2017gl075361>

<https://doi.org/10.1002/2017GL075361>

### General

Sedwick, P. N., Marsay, C. M., Sohst, B. M., Aguilar-Islas, A. M., Lohan, M. C., Long, M. C., ... DiTullio, G. R. (2011). Early season depletion of dissolved iron in the Ross Sea polynya: Implications for iron dynamics on the Antarctic continental shelf. *Journal of Geophysical Research*, 116(C12). doi:[10.1029/2010jc006553](https://doi.org/10.1029/2010jc006553)

### Methods

Welschmeyer, N. A. (1994). Fluorometric analysis of chlorophyll a in the presence of chlorophyll b and pheopigments. *Limnology and Oceanography*, 39(8), 1985-1992. doi:[10.4319/lb.1994.39.8.1985](https://doi.org/10.4319/lb.1994.39.8.1985)

### General

Zhang, J.-Z. (2000). Shipboard automated determination of trace concentrations of nitrite and nitrate in oligotrophic water by gas-segmented continuous flow analysis with a liquid waveguide capillary flow cell. *Deep Sea Research Part I: Oceanographic Research Papers*, 47(6), 1157-1171. doi:10.1016/S0967-0637(99)00085-0 [https://doi.org/10.1016/S0967-0637\(99\)00085-0](https://doi.org/10.1016/S0967-0637(99)00085-0)

### Methods

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## Parameters

Parameter	Description	Units
sample_source	Source of sample water (CTD or UNDERWAY). UNDERWAY samples were collected by a trace-metal clean towfish system (Sedwick et al., 2011)	unitless
Sample_ID	Unique identifier for each water sample	unitless
Station	DANCE cruise station number	unitless
Depth	Sample collection depth (below surface)	meters (m)
Date	Local date (EST) of collection in format yyyy-mm-dd	unitless
Time	Local time (EST) of collection of sample/data in format HH:MM	unitless
Latitude	Latitude of water sample, if source is CTD then this latitude is the start of the CTD cast	decimal degrees
Longitude	Longitude of water sample, if source is CTD then this longitude is the start of the CTD cast	decimal degrees
Dfe	Dissolved iron concentration	nanomoles per liter (nmol/L)
DFe_flag	Dissolved iron data quality flag. 2 (good), 3 (contamination suspected)	unitless
NO3_NO2	Dissolved nitrate plus nitrite concentration	micromoles per liter (umol/L)
PO4	Dissolved phosphate concentration	micromoles per liter (umol/L)
NH4	Dissolved ammonium concentration	nanomoles per liter (nmol/L)
Temp	Temperature	degrees Celsius (°C)
Salinity	Salinity	Practical salinity units (PSU)
Fluor	Chlorophyll fluorescence	volt

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## Instruments

<b>Dataset-specific Instrument Name</b>	SBE 45, SeaBird Electronics
<b>Generic Instrument Name</b>	CTD Sea-Bird
<b>Dataset-specific Description</b>	SBE 45, SeaBird Electronics: CTD sensor (temperature and conductivity)
<b>Generic Instrument Description</b>	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

<b>Dataset-specific Instrument Name</b>	SBE 19 plus
<b>Generic Instrument Name</b>	CTD Sea-Bird
<b>Dataset-specific Description</b>	SBE 19 plus, SeaBird Electronics, calibrated by calibrated by SeaBird Electronics: CTD sensor (temperature and conductivity)
<b>Generic Instrument Description</b>	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

<b>Dataset-specific Instrument Name</b>	Shimadzu RF1501 (Spectrofluorophotometer)
<b>Generic Instrument Name</b>	Fluorometer
<b>Dataset-specific Description</b>	Spectrofluorophotometer: NH4
<b>Generic Instrument Description</b>	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

<b>Dataset-specific Instrument Name</b>	Turner AU10 fluorometer
<b>Generic Instrument Name</b>	Fluorometer
<b>Dataset-specific Description</b>	Fluorometer: in-situ chlorophyll fluorescence
<b>Generic Instrument Description</b>	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

<b>Dataset-specific Instrument Name</b>	: WET Labs ECO-FL(RT)D deep chlorophyll fluorometer
<b>Generic Instrument Name</b>	Fluorometer
<b>Dataset-specific Description</b>	WET Labs ECO-FL(RT)D deep chlorophyll fluorometer, calibrated by SeaBird Electronics: in-situ chlorophyll fluorescence
<b>Generic Instrument Description</b>	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

<b>Dataset-specific Instrument Name</b>	Astoria Pacific nutrient autoanalyzer
<b>Generic Instrument Name</b>	Nutrient Autoanalyzer
<b>Dataset-specific Description</b>	Macronutrient analysis: NO3+NO2, PO4
<b>Generic Instrument Description</b>	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

<b>Dataset-specific Instrument Name</b>	Shimadzu SPD-10AV
<b>Generic Instrument Name</b>	UV Spectrophotometer-Shimadzu
<b>Dataset-specific Description</b>	UV-visible spectrophotometric detector: DFe
<b>Generic Instrument Description</b>	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

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## Deployments

### HRS1414

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/731505">https://www.bco-dmo.org/deployment/731505</a>
<b>Platform</b>	R/V Hugh R. Sharp
<b>Start Date</b>	2014-07-29
<b>End Date</b>	2014-08-16

## Project Information

### **Collaborative Research: Impacts of atmospheric nitrogen deposition on the biogeochemistry of oligotrophic coastal waters (DANCE)**

**Coverage:** Offshore Mid-Atlantic Bight and northern South-Atlantic Bight between latitudes 31.60°N and 38.89°N, and longitudes 71.09°W and 75.16°W

NSF abstract:

Deposition of atmospheric nitrogen provides reactive nitrogen species that influence primary production in nitrogen-limited regions. Although it is generally assumed that these species in precipitation contributes substantially to anthropogenic nitrogen loadings in many coastal marine systems, its biological impact remains poorly understood. Scientists from Pennsylvania State University, William & Mary College, and Old Dominion University will carry out a process-oriented field and modeling effort to test the hypothesis that deposits of wet atmospheric nitrogen (i.e., precipitation) stimulate primary productivity and accumulation of algal biomass in coastal waters following summer storms and this effect exceeds the associated biogeochemical responses to wind-induced mixing and increased stratification caused by surface freshening in oligotrophic coastal waters of the eastern United States. To attain their goal, the researchers would perform a Lagrangian field experiment during the summer months in coastal waters located between Delaware Bay and the coastal Carolinas to determine the response of surface-layer biogeochemistry and biology to precipitation events, which will be identified and intercepted using radar and satellite data. As regards the modeling effort, a 1-D upper ocean mixing model and a 1-D biogeochemical upper-ocean will be calibrated by assimilating the field data obtained a part of the study using the adjoint method. The hypothesis will be tested using sensitivity studies with the calibrated model combined with in-situ data and results from the incubation experiments. Lastly, to provide regional and historical context for the field measurements and the associated 1-D modeling, linked regional atmospheric-oceanic biogeochemical modeling will be conducted.

Broader Impacts. Results from the study would be incorporated into class lectures for graduate courses on marine policy and marine biogeochemistry. One graduate student from Pennsylvania State University, one graduate student from the College of William and Mary, and one graduate and one undergraduate student from Old Dominion University would be supported and trained as part of this project.

## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1260574</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1260454</a>