

# Dissolved mercury (Hg) speciation in the California Current System from samples collected on R/V Roger Revelle cruise RR2105 in July to August 2021

**Website:** <https://www.bco-dmo.org/dataset/926873>  
**Data Type:** Cruise Results  
**Version:** 1  
**Version Date:** 2024-05-14

**Project**  
» [California Current Ecosystem Long Term Ecological Research site](#) (CCE LTER)  
» [Collaborative Proposal: Unravelling the Oceanic Dimethylmercury Cycle](#) (DMHg in the Ocean)

**Programs**  
» [Long Term Ecological Research network](#) (LTER)  
» [Ocean Carbon and Biogeochemistry](#) (OCB)

Contributors	Affiliation	Role
<a href="#">Lamborg, Carl</a>	University of California-Santa Cruz (UCSC)	Co-Principal Investigator
<a href="#">Schartup, Amina T.</a>	University of California-San Diego Scripps (UCSD-SIO)	Co-Principal Investigator
<a href="#">Adams, Hannah M.</a>	University of California-San Diego Scripps (UCSD-SIO)	Student
<a href="#">Cui, Xinyun</a>	University of California-Santa Cruz (UCSC)	Student
<a href="#">Rauch, Shannon</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

**Abstract**  
Monomethylmercury (MMHg) is a neurotoxicant that biomagnifies in marine food webs, reaching high concentrations in apex predators. To predict changes in oceanic MMHg concentrations, it is important to quantify its sources and sinks. Here, we study mercury speciation in the California Current System through cruise sampling and modeling. Previous work in the California Current System has found that upwelling impacts mercury biogeochemistry by transporting mercury-enriched deep waters to productive surface waters. These upwelled waters originate within the California Undercurrent water mass and are subsequently advected as a surface water parcel to the California Current. By comparing the two major water masses, we find that the California Undercurrent contains elevated dissolved total mercury (Hg) and Dimethylmercury (DMHg) concentrations by 57% and 60%, respectively, compared to the California Current. We explain that these differences result from losses during advection, specifically scavenging and DMHg demethylation. We calculate a net DMHg demethylation rate constant of  $1.8 \pm 0.9\%$  per day, and build an empirically constrained mass budget model to demonstrate that DMHg demethylation accounts for 59% of surface MMHg sources. These findings illustrate that DMHg is a significant source of MMHg in this region, challenging the current understanding of the major sources of marine MMHg. These data are associated with Adams et al., 2024 (doi: 10.21203/rs.3.rs-3909481/v1).

## Table of Contents

- [Coverage](#)
- [Dataset Description](#)
  - [Methods & Sampling](#)
  - [BCO-DMO Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Deployments](#)
- [Project Information](#)
- [Program Information](#)
- [Funding](#)

## Coverage

**Location:** California Current System, Northeastern Pacific Ocean  
**Spatial Extent:** N:36.561859 E:-120.406468 S:34.423331 W:-130.54799  
**Temporal Extent:** 2021-07-19 - 2021-08-09

## Methods & Sampling

**Sampling Plan:**  
This study was conducted during the California Current Ecosystem Long Term Ecological Research (CCE LTER) Process Cruise P2105 from July 10 to August 8, 2021, on board the R/V Roger Revelle (RR2105) where we sampled two water parcels and a seven station transect. Water parcels were sampled with a Lagrangian-style process study using drifter floats and modeled after previous CCE LTER cruises (Krause et al., 2015; Landry et al., 2009). During these process studies, an upwelled water parcel was identified by satellite temperature and chlorophyll-a concentrations. We followed an upwelled water parcel for 11 days and a water parcel that had already moved to the eastern edge of the oligotrophic gyre for three days. Profiles for dissolved Hg concentrations, including total mercury (THg), dimethylmercury (DMHg), monomethylmercury (MMHg), and elemental mercury (Hg0), were taken every other day during the water parcel studies. A seven station transect from stations S1-S7 was conducted across the California Current water mass to the coast, and profiles for THg, DMHg, and Hg0 were taken for all stations in the transect. A MMHg profile was only taken for Station S4 in the transect. Stations are colored based on their corresponding water mass in Figure 1 of Adams et al. (2024). Profiles for Hg speciation typically covered the upper water column to 200 meters (m), and those data are presented here. One station within the California Undercurrent was sampled to 600 m, and the concentrations of Hg species in the waters deeper than 200 m are used as a reference for upwelled waters in our mass budget model. Benthic Boundary Layer (BBL) stations were selected based on previous work in the region and are locations where the continental shelf drops off and can have high levels of suspended sediments within the water column (Billler and Bruland, 2013). Samples at BBL stations were taken at one depth around 40 to 70 m identified as 5 m above the sea floor (Billler and Bruland, 2013).

**Sampling Methods:**  
Vertical dissolved Hg profiles were sampled using 5-liter (L) X-Niskin bottles (Ocean Test Equipment) mounted on a trace metal rosette (Seabird) deployed on a non-metallic hydroline (Brzezinski et al., 2015; Cutter and Bruland, 2012) and triggered automatically by pressure on upcasts using a Seabird Auto Fire Module. BBL samples were collected using a 30 L Teflon™-coated GO-Flo™ bottle (General Oceanics) deployed on a non-metallic hydroline and triggered with an acid-cleaned Teflon™ messenger (Bruland et al., 1979). The Niskin or GO-Flo™ bottles were transported into a dedicated Class 100 laboratory van under trace metal-clean conditions (Cutter and Bruland, 2012). Samples were pressure-filtered (N2 gas, 99.99%) directly from the Niskin or GO-Flo™ bottles through 0.2 um capsule filters (Acropak 200, Pall Laboratory) into 2 L acid-cleaned Teflon™ bottles.

An aliquot of sample was transferred from the 2 L Teflon™ bottle into 0.25 L pre-cleaned borosilicate glass bottles (I-Chem) for THg analysis and oxidized with 0.04% bromine monochloride at least 12 hours prior to analysis (U.S. Environmental Protection Agency Method 1631, Revision E).  
The remainder of the sample in the 2 L Teflon™ bottle was analyzed for gaseous Hg0 and DMHg with a purge-and-trap method (Bowman et al., 2011; Tseng et al., 2004). Samples were purged with Hg-free N2 gas for 60 minutes ;at a rate of 0.5 L per minute. Effluent gas was passed through a soda lime trap to remove water vapor and aerosols, then DMHg was concentrated onto a Carbotrap® (graphitized carbon black, Sigma-Aldrich) matrix downstream of the soda lime trap, and Hg0 was concentrated onto a gold trap downstream of the Carbotrap® (Tseng et al., 2004; Lamborg et al., 2012). DMHg was thermally desorbed from the Carbotrap® and quantified on board via Gas Chromatographic Cold Vapor Atomic Fluorescence Spectrometry (GC-CVAFS) on a Tekran 2500 (Bowman et al., 2011; Baya et al., 2013). The detection limit for DMHg was 2 fM. Hg0 was quantified by dual gold amalgamation Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS) on a Tekran 2600 following thermal desorption from the gold trap (Tseng et al., 2004; Bloom and Fitzgerald, 1988). The method detection limits for Hg0 were 40 fM (n=14). Sample concentrations for DMHg and Hg0 were determined by a calibration curve based on a gaseous Hg0 standard (Tekran 2505 Mercury Vapor Primary Calibration Unit).

Seawater purged of DMHg and Hg0 was transferred into a 0.25 L precleaned amber borosilicate glass bottles (I-Chem) for MMHg analysis, acidified with 1% sulfuric acid (Trace Metal Grade, Fisher Scientific), stored at 4°C, and analyzed at Scripps Institution of Oceanography within 2 months of collection.  
THg samples were analyzed following U.S. EPA Method 1631 on board the ship (U.S. Environmental Protection Agency Method 1631, Revision E; Lamborg et al., 2012). Samples

were reduced to Hg0 with 20% wt:vol tin (II) chloride solution (ACS grade, Fisher Chemical) in 10% hydrochloric acid (ACS grade, Fisher Chemical). Hg0 was purged onto a gold trap with Hg-free argon gas and thermally desorbed via CVAFS for detection using a Tekran 2600 Automated Mercury Analyzer. Sample concentrations were determined by a calibration curve based on a gaseous Hg0 standard (Tekran 2505 Mercury Vapor Primary Calibration Unit). The method detection limit was 0.22 pM (n=8 blanks) and replicates had an average precision of 6.4% (n = 73).

MMHg samples were analyzed by ascorbic acid-assisted direct ethylation following Munson et al. (2014) and U.S. EPA Method 1630 (U.S. Environmental Protection Agency Method 1630; Munson et al., 2014). Samples were adjusted to a pH of 4.8 using a 2 M acetate/glacial acetic acid buffer (J.T. Baker) in ultrapure water (Milli-Q, 18.2 MW per centimeter) and 8 M potassium hydroxide (J.T. Baker) in ultrapure water (Milli-Q, 18.2 MW per centimeter). 2.5% wt:vol ascorbic acid (J.T. Baker) in ultrapure water (Milli-Q, 18.2 MW per centimeter) was added to the samples, then samples were ethylated with sodium tetraethylborate (NaTEB) solution (1% NaTEB in 2% potassium hydroxide, Strem Chemicals) to convert MMHg to volatile methyl ethylmercury. Ethylation was allowed to proceed for 10 minutes before sample analysis. Samples were analyzed by GC-CVAFS on a Tekran 2700 Automated Methylmercury Analyzer. Concentrations were determined by a calibration curve based on standards prepared from a certified 1000 ppm MMHg (II) chloride standard (Alfa Aesar). The method detection limit was 11.3 fM (n=9 blanks), and ongoing precision and recovery was 98.4 ± 7.9% (n=25). Replicates had an average precision of 9.2% (n=18) and matrix spike recovery was 112 ± 13% (n=15).

BCO-DMO Processing Description

- Imported original file "2024-0311-California Current System Dissolved Hg Speciation.xlsx" into the BCO-DMO system.
- Marked "N/A" as a missing data value (missing data are empty/blank in the final CSV file).
- Made corrections in the time column: added "AM" where needed to the times missing them and converted the times that were in 24-hour time to 12-hour AM/PM time.
- Converted the date and time columns into ISO 8601 format in PDT and UTC time zones.
- Renamed fields to comply with BCO-DMO naming conventions.
- Saved final file as "926873\_v1\_dissolved\_hg\_speciation\_california\_current\_system.csv".

[ [table of contents](#) | [back to top](#) ]

Data Files

File
<b>926873_v1_dissolved_hg_speciation_california_current_system.csv</b> (Comma Separated Values (.csv), 23.99 KB) <small>MD5:cbb43298c5a2653ff5f4ce4e405d1c86</small>
Primary data file for dataset ID 926873, version 1

[ [table of contents](#) | [back to top](#) ]

Related Publications

Adams, H. M., Cui, X., Lamborg, C. H., & Schartup, A. T. (2024). Dimethylmercury as a Source of Monomethylmercury in a Highly Productive Upwelling System. <https://doi.org/10.21203/rs.3.rs-3909481/v1>  
*Results*

Baya, P. A., Hollinsworth, J. L., & Hintelmann, H. (2013). Evaluation and optimization of solid adsorbents for the sampling of gaseous methylated mercury species. *Analytica Chimica Acta*, 786, 61–69. doi:[10.1016/j.aca.2013.05.019](https://doi.org/10.1016/j.aca.2013.05.019)  
*Methods*

Billar, D. V., & Bruland, K. W. (2013). Sources and distributions of Mn, Fe, Co, Ni, Cu, Zn, and Cd relative to macronutrients along the central California coast during the spring and summer upwelling season. *Marine Chemistry*, 155, 50–70. <https://doi.org/10.1016/j.marchem.2013.06.003>  
*Methods*

Bloom, N., & Fitzgerald, W. F. (1988). Determination of volatile mercury species at the picogram level by low-temperature gas chromatography with cold-vapour atomic fluorescence detection. *Analytica Chimica Acta*, 208, 151–161. doi:10.1016/s0003-2670(00)80743-6 [https://doi.org/10.1016/S0003-2670\(00\)80743-6](https://doi.org/10.1016/S0003-2670(00)80743-6)  
*Methods*

Bowman, K. L., & Hammerschmidt, C. R. (2011). Extraction of monomethylmercury from seawater for low-femtomolar determination. *Limnology and Oceanography: Methods*, 9(4), 121–128. doi:[10.4319/om.2011.9.121](https://doi.org/10.4319/om.2011.9.121)  
*Methods*

Bruland, K. W., Franks, R. P., Knauer, G. A., & Martin, J. H. (1979). Sampling and analytical methods for the determination of copper, cadmium, zinc, and nickel at the nanogram per liter level in sea water. *Analytica Chimica Acta*, 105, 233–245. doi:10.1016/s0003-2670(01)83754-5 [https://doi.org/10.1016/S0003-2670\(01\)83754-5](https://doi.org/10.1016/S0003-2670(01)83754-5)  
*Methods*

Brzezinski, M. A., Krause, J. W., Bundy, R. M., Barbeau, K. A., Franks, P., Goericke, R., Landry, M. R., & Stukel, M. R. (2015). Enhanced silica ballasting from iron stress sustains carbon export in a frontal zone within the California Current. *Journal of Geophysical Research: Oceans*, 120(7), 4654–4669. Portico. <https://doi.org/10.1002/2015jc010829>  
*Methods*

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. *Limnology and Oceanography: Methods*, 10(6), 425–436. doi:[10.4319/om.2012.10.425](https://doi.org/10.4319/om.2012.10.425)  
*Methods*

Krause, J. W., Brzezinski, M. A., Goericke, R., Landry, M. R., Ohman, M. D., Stukel, M. R., & Taylor, A. G. (2015). Variability in diatom contributions to biomass, organic matter production and export across a frontal gradient in the California Current Ecosystem. *Journal of Geophysical Research: Oceans*, 120(2), 1032–1047. Portico. <https://doi.org/10.1002/2014jc010472> <https://doi.org/10.1002/2014JC010472>  
*Methods*

Lamborg, C. H., Hammerschmidt, C. R., Gill, G. A., Mason, R. P., & Gichuki, S. (2012). An intercomparison of procedures for the determination of total mercury in seawater and recommendations regarding mercury speciation during GEOTRACES cruises. *Limnology and Oceanography: Methods*, 10(2), 90–100. doi:[10.4319/om.2012.10.90](https://doi.org/10.4319/om.2012.10.90)  
*Methods*

Landry, M. R., Ohman, M. D., Goericke, R., Stukel, M. R., & Tsyrlkevich, K. (2009). Lagrangian studies of phytoplankton growth and grazing relationships in a coastal upwelling ecosystem off Southern California. *Progress in Oceanography*, 83(1–4), 208–216. doi:[10.1016/j.pocean.2009.07.026](https://doi.org/10.1016/j.pocean.2009.07.026)  
*Methods*

Munson, K. M., Babi, D., & Lamborg, C. H. (2014). Determination of monomethylmercury from seawater with ascorbic acid-assisted direct ethylation. *Limnology and Oceanography: Methods*, 12(1), 1–9. doi:[10.4319/om.2014.12.1](https://doi.org/10.4319/om.2014.12.1)  
*Methods*

Tseng, C. M., Lamborg, C., Fitzgerald, W. F., & Engstrom, D. R. (2004). Cycling of dissolved elemental mercury in Arctic Alaskan lakes. *Geochimica et Cosmochimica Acta*, 68(6), 1173–1184. <https://doi.org/10.1016/j.gca.2003.07.023>  
*Methods*

U.S. Environmental Protection Agency. Method 1630: Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry; Washington, D.C., 1998. [https://www.epa.gov/sites/default/files/2015-08/documents/method\\_1630\\_1998.pdf](https://www.epa.gov/sites/default/files/2015-08/documents/method_1630_1998.pdf)  
*Methods*

U.S. Environmental Protection Agency. Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry Method 1631, Revision E; Washington, D.C., 2002. [https://www.epa.gov/sites/default/files/2015-08/documents/method\\_1631e\\_2002.pdf](https://www.epa.gov/sites/default/files/2015-08/documents/method_1631e_2002.pdf)  
*Methods*

[ [table of contents](#) | [back to top](#) ]

## Parameters

Parameter	Description	Units
Water_Mass	Identification of water mass	unitless
Station_Name	Name of the station	unitless
ISO_DateTime_PDT	Sampling date and time in ISO 8601 format in Pacific Daylight Time (PDT) time zone	unitless
ISO_DateTime_UTC	Sampling date and time in ISO 8601 format in UTC time zone	unitless
Latitude	Station latitude, south is negative	decimal degrees
Longitude	Station longitude, west is negative	decimal degrees
Trace_Metal_Cast_Num	Cast number	unitless
Depth_m	Sample depth	meters (m)
Temperature_C	Sample temperature	degrees Celsius
Salinity_PSU	Sample salinity	practical salinity units (PSU)
Oxygen_umol_kg	Dissolved oxygen concentration	micromole per kilogram (umol/kg)
Density_kg_m3	Water density	kilogram per cubed meter (kg/m^3)
DMHg_fM	Concentration of dimethylmercury; limit of detection = 2	femtomolar (fM)
DMHg_Flag	Data flag, 0 indicates that the data was used in analyses, 1 indicates that the data was removed from subsequent analysis as it was 1.5*IQR above the upper whisker when the data was plotted as a box plot	unitless
Hg0_fM	Concentration of elemental mercury; limit of detection = 40	femtomolar (fM)
Hg0_Flag	Data flag, 0 indicates that the data was used in analyses, 1 indicates that the data was removed from subsequent analysis as it was 1.5*IQR above the upper whisker when the data was plotted as a box plot	unitless
MMHg_fM	Concentration of dissolved monomethylmercury; limit of detection = 11.3	femtomolar (fM)
MMHg_Flag	Data flag, 0 indicates that the data was used in analyses, 1 indicates that the data was removed from subsequent analysis as it was 1.5*IQR above the upper whisker when the data was plotted as a box plot	unitless
THg_pM	Concentration of dissolved total mercury; limit of detection = 0.22	picomolar (pM)
THg_Flag	Data flag, 0 indicates that the data was used in analyses, 1 indicates that the data was removed from subsequent analysis as it was 1.5*IQR above the upper whisker when the data was plotted as a box plot	unitless

[ [table of contents](#) | [back to top](#) ]

## Instruments

<b>Dataset-specific Instrument Name</b>	30 L Teflon™-coated GO-Flo™ bottle (General Oceanics)
<b>Generic Instrument Name</b>	GO-FLO Bottle
<b>Dataset-specific Description</b>	Used for dissolved mercury samples collected at Benthic Boundary Layer Stations.
<b>Generic Instrument Description</b>	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

<b>Dataset-specific Instrument Name</b>	5 L X-Niskin bottles (Ocean Test Equipment)
<b>Generic Instrument Name</b>	Niskin bottle
<b>Dataset-specific Description</b>	Dissolved mercury samples were collected using a trace metal clean rosette equipped with 5-liter X-Niskin bottles.
<b>Generic Instrument Description</b>	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

<b>Dataset-specific Instrument Name</b>	Seabird Scientific SBE-43
<b>Generic Instrument Name</b>	Sea-Bird SBE 43 Dissolved Oxygen Sensor
<b>Dataset-specific Description</b>	Depth, temperature, salinity, and oxygen concentrations were determined from real-time hydrographic data from the ship's rosette using Seabird Scientific SBE11, SBE-43, and SBE-45 devices.
<b>Generic Instrument Description</b>	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

<b>Dataset-specific Instrument Name</b>	Seabird Scientific SBE-45
<b>Generic Instrument Name</b>	Sea-Bird SBE 45 MicroTSG Thermosalinograph
<b>Dataset-specific Description</b>	Depth, temperature, salinity, and oxygen concentrations were determined from real-time hydrographic data from the ship's rosette using Seabird Scientific SBE11, SBE-43, and SBE-45 devices.
<b>Generic Instrument Description</b>	A small externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. It is constructed of plastic and titanium to ensure long life with minimum maintenance. It may optionally be interfaced to an external SBE 38 hull temperature sensor. Sea Bird SBE 45 MicroTSG (Thermosalinograph)

<b>Dataset-specific Instrument Name</b>	Gas Chromatographic Cold Vapor Atomic Fluorescence Spectrometry (GC-CVAFS) on a Tekran 2500
<b>Generic Instrument Name</b>	Tekran 2500 CVAFS mercury detector
<b>Dataset-specific Description</b>	Dissolved dimethylmercury concentrations were measured using a Tekran 2500.
<b>Generic Instrument Description</b>	Tekran 2500 Total Mercury Analysis System (not automated; cold vapor atomic fluorescence spectrometry)

<b>Dataset-specific Instrument Name</b>	Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS) on a Tekran 2600 Automated Mercury Analyzer
<b>Generic Instrument Name</b>	Tekran 2600 Automated Total Mercury Analyzer series
<b>Dataset-specific Description</b>	Dissolved Total Mercury and elemental mercury were analyzed on a Tekran 2600.
<b>Generic Instrument Description</b>	The Tekran 2600 is a total Mercury (Hg) analysis system that can measure sub-picogram quantities of mercury in water, soil, vegetation, and other sample matrices. The system utilizes a Cold Vapour Atomic Fluorescence Spectroscopy (CVAFS) detector. The 2600-IVS (In-Vial Sparging) model is reconfigured for direct in-vial sparging sample introduction, and the 2600-NG (Natural Gas) model is designed for the analysis of gas phase sample cartridges. The system is capable of multiple method configurations: Dual stage gold preconcentration (EPA Method 1631); Direct measurement without preconcentration (EPA Method 245.7); Air sample analysis on gold traps (EPA Compendium Method IO-5); and Natural gas analysis on gold traps (ASTM D-6350, ISO 6978). It has a guaranteed minimum detection limit of < 0.05 nanograms per liter (ng/L). In clean room environments, with low mercury blanks, minimum detection limits as low as 0.02 ng/L are achievable. See: <a href="https://www.tekran.com/products/laboratory/tekran-model-2600-automated-t...">https://www.tekran.com/products/laboratory/tekran-model-2600-automated-t...</a>

<b>Dataset-specific Instrument Name</b>	GC-CVAFS on a Tekran 2700 Automated Methylmercury Analyzer
<b>Generic Instrument Name</b>	Tekran Model 2700 Automated Methyl Mercury Analysis System
<b>Dataset-specific Description</b>	Dissolved monomethylmercury was measured on a Tekran 2700.
<b>Generic Instrument Description</b>	The Tekran 2700 is a fully integrated Gas Chromatography Cold-Vapor Atomic Fluorescence Spectrophotometer (GC-CVAFS) automated Methyl Mercury analysis system. The 2700 can analyze distilled waters, extracted or distilled tissues and solids, and allows direct analysis of suitable water samples. The system is pre-programmed to run EPA Method 1630, however it offers complete method customization including: GC column temperature ramping; programmable analysis cycle settings; high temperature purge cycles; and choice of trap and GC column. It can also interface with ICP-MS or other analytical instruments. The sample analysis cycle is less than 7 minutes per sample. It has a minimum detection limit of 0.002 nanograms per liter (ng/L). The system has IR trap heating and active cooling. See: <a href="https://www.tekran.com/products/laboratory/tekran-model-2700-automated-m...">https://www.tekran.com/products/laboratory/tekran-model-2700-automated-m...</a>

[ [table of contents](#) | [back to top](#) ]

## Deployments

RR2105

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/926884">https://www.bco-dmo.org/deployment/926884</a>
<b>Platform</b>	R/V Roger Revelle
<b>Start Date</b>	2021-07-13
<b>End Date</b>	2021-08-13
<b>Description</b>	California Current Ecosystem Long Term Ecological Research Process Cruise, CCE LTER III. Also referred to as "P2107". See more information from R2R: <a href="https://www.rvdata.us/search/cruise/RR2105">https://www.rvdata.us/search/cruise/RR2105</a>

[ [table of contents](#) | [back to top](#) ]

## Project Information

### California Current Ecosystem Long Term Ecological Research site (CCE LTER)

**Website:** <http://cce.lternet.edu/>

**Coverage:** California coastal current

#### From ccelter.edu:

The California Current System is a coastal upwelling biome, as found along the eastern margins of all major ocean basins. These are among the most productive ecosystems in the world ocean. The California Current Ecosystem LTER (32.9 degrees North, 120.3 degrees West) is investigating nonlinear transitions in the California Current coastal pelagic ecosystem, with particular attention to long-term forcing by a secular warming trend, the Pacific Decadal Oscillation, and El Nino in altering the structure and dynamics of the pelagic ecosystem. The California Current sustains active fisheries for a variety of finfish and marine invertebrates, modulates weather patterns and the hydrologic cycle of much of the western United States, and plays a vital role in the economy of myriad coastal communities.

#### LTER Data:

The California Current Ecosystem (CCE) LTER data are managed by and available directly from the CCE project data site URL shown above. If there are any datasets listed below, they are data sets that were collected at or near the CCE LTER sampling locations, and funded by NSF OCE as ancillary projects related to the CCE LTER core research themes.

#### NSF Award Abstract (OCE-2224726):

Coastal upwelling regions are found along the eastern boundaries of all ocean basins and are some of the most productive ecosystems in the ocean. This award is supporting the California Current Ecosystem Long Term Ecological Research (CCE LTER) site in a major upwelling biome. It leverages the 73-year California Cooperative Oceanic Fisheries Investigations (CalCOFI) program which provides essential information characterizing climate variability and change in this system. The CCE LTER addresses two over-arching questions: What are the mechanisms leading to ecological transitions in a coastal pelagic ecosystem? And what is the interplay between changing ocean climate, community structure, and ecosystem dynamics? The investigators are working towards diagnosing mechanisms of ecosystem change and developing a quantitative framework for forecasting future conditions and how these might affect the management of key living marine resources, including numerous fishes, invertebrates, marine mammals, and seabirds. They are training graduate and undergraduate students, as well as providing educational opportunities for teachers. Public programs and outreach efforts in collaboration with the Birch Aquarium at Scripps Institution of Oceanography are increasing public awareness and understanding of climate effects on coastal pelagic communities and connecting the public to cutting-edge ocean research.

This project is adding to understanding of the mechanisms underlying abrupt ecological transitions with three interrelated foci: (1) investigation of marine heatwaves and resultant multiple stressors on organisms and communities, (2) elucidation of ecological stoichiometry and the response of multiple trophic levels to altered elemental ratios of source nutrients, and (3) analysis of top-down pressures mediated by a diverse suite of organisms. It is sustaining multi-scale measurements of five core LTER variables and responses to ocean warming, increased stratification, acidification, deoxygenation, and altered nutrient stoichiometry in the Northeast Pacific. The investigators are using long-term, spatially-resolved time series at multiple spatial scales to evaluate community shifts at multiple temporal scales, with new measurements allowing interrogation at finer taxonomic levels. They are conducting in situ multi-factorial experiments (temperature, macronutrients, micronutrients, light, grazing) in combination with genomic and transcriptomic analyses. These will complement time series measurements, inform next-generation biogeochemical models, and test hypotheses related to ecological stoichiometry and marine heatwaves. The team is also using a suite of imaging techniques, molecular and morphological methods, and active and passive acoustic approaches to quantify vertical structure and cooccurrence of organisms across trophic levels and test hypotheses about top-down control of the ecosystem.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

#### This project is supported by continuing grants with name variations:

- LTER: Nonlinear transitions in the California Current Coastal Pelagic Ecosystem
- Ecological Transitions in the California Current Ecosystem: CCE-LTER Phase II
- LTER: CCE-LTER Phase III: Ecological Transitions in an Eastern Boundary Current Upwelling Ecosystem
- LTER: Ecosystem controls and multiple stressors in a coastal upwelling system - CCE IV

### Collaborative Proposal: Unravelling the Oceanic Dimethylmercury Cycle (DMHg in the Ocean)

**Coverage:** Monterey Bay, California Current, Greenland

#### NSF Award Abstract:

This project will study how dimethylmercury is formed and removed in the oceans. Dimethylmercury is a naturally occurring compound. It is thought to be formed when man-made mercury is converted into monomethylmercury, a toxin that accumulates in fish. Despite representing a large fraction of mercury in the oceans, the origin and fate of dimethylmercury is not known. This research will use state-of-the-art analytical, genomic and modeling tools to address this information gap. It will also train graduate and undergraduate students to use field, experimental, and modeling methods. The results will be used in predictive models to forecast future trends in the oceanic mercury cycle. These models are needed to evaluate the effectiveness of international actions that seek to reverse increasing trends in the bioaccumulation of monomethylmercury in fish.

Methylated mercury species in the ocean are formed in sediment and the water column from inorganic divalent mercury delivered from the atmosphere and rivers. The putative mechanism is a two-step process during which monomethylmercury is formed first, followed by slow methylation into dimethylmercury. The first step, biomethylation of divalent mercury into monomethylmercury, is relatively well-studied in sediment and known to be driven by sulfate- and iron-reducing bacteria and methanogens. The mechanism for monomethylmercury formation in the water column is less well understood, and the process of dimethylmercury formation in sediment or seawater is essentially unknown. Until recently, it was assumed that dimethylmercury represented a small enough fraction of the methylated and total mercury (the sum of all mercury species) pools to be insignificant in the global mercury cycle. Recent measurements, however, show that dimethylmercury levels in seawater can be in the same range as the other mercury species. This project will identify the biological and chemical methylating agents involved in the formation of dimethylmercury. Further, it will test the impact of varying biogeochemical conditions on dimethylmercury production. Results will be used to update the mercury module of the MIT General Circulation Model (MITgcm), a global biogeochemical model, and analyze the impacts of dimethylmercury production and degradation on monomethylmercury concentrations.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[ [table of contents](#) | [back to top](#) ]

## Program Information

### Long Term Ecological Research network (LTER)

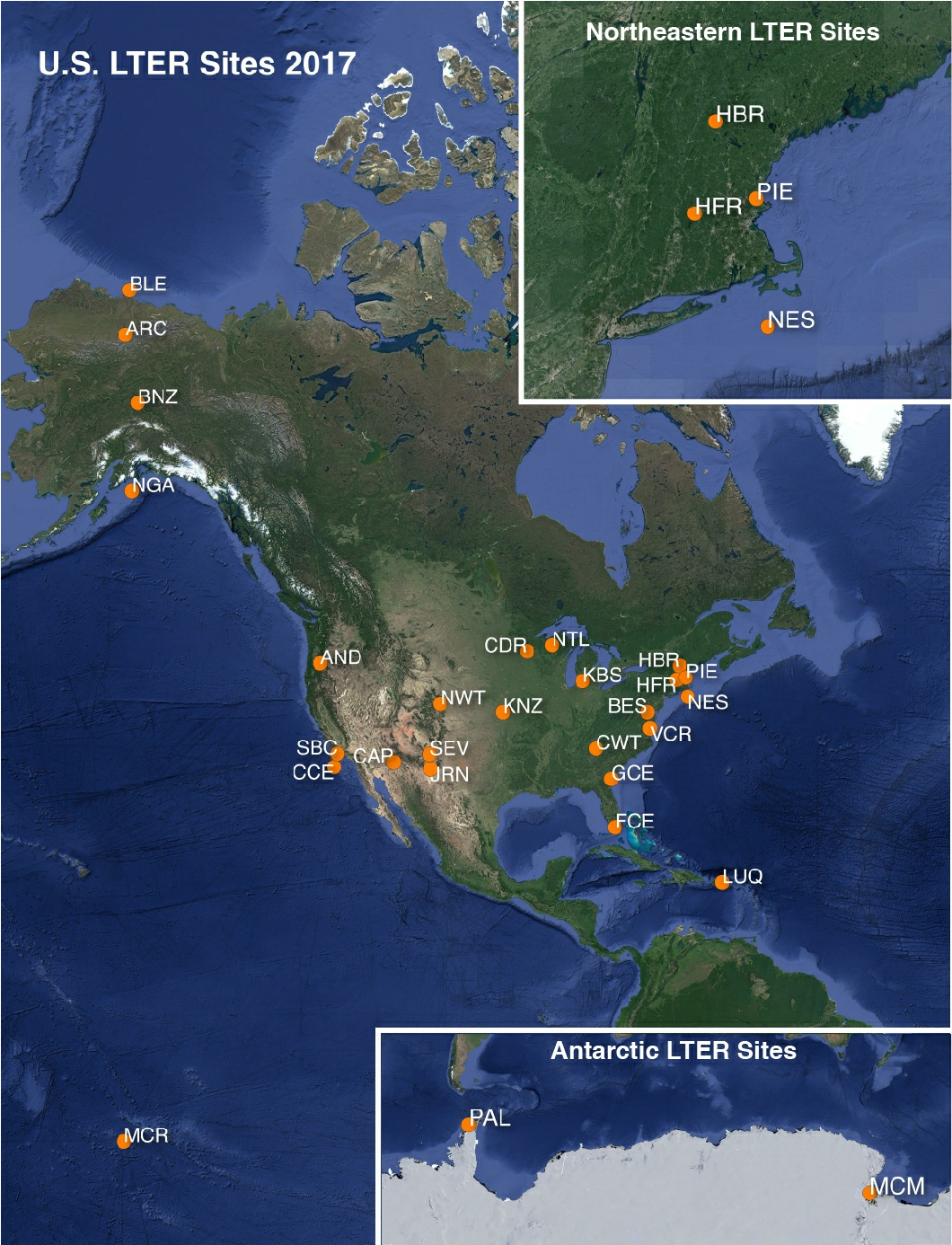


Website: <http://www.lternet.edu/>

Coverage: United States

adapted from <http://www.lternet.edu/>

The National Science Foundation established the LTER program in 1980 to support research on long-term ecological phenomena in the United States. The Long Term Ecological Research (LTER) Network is a collaborative effort involving more than 1800 scientists and students investigating ecological processes over long temporal and broad spatial scales. The LTER Network promotes synthesis and comparative research across sites and ecosystems and among other related national and international research programs. The LTER research sites represent diverse ecosystems with emphasis on different research themes, and cross-site communication, network publications, and research-planning activities are coordinated through the LTER Network Office.



Site Codes	
AND	Andrews Forest LTER
ARC	Arctic LTER
BES	Baltimore Ecosystem Stu
BLE	Beaufort Lagoon Ecosystems LTER
BNZ	Bonanza Creek LTER
CCE	California Current Ecosystem LTER
CDR	Cedar Creek Ecosystem Science Reserve
CAP	Central Arizona-Phoenix LTER
CWT	Coweeta LTER
FCE	Florida Coastal Everglades LTER
GCE	Georgia Coastal Ecosystems LTER
HFR	Harvard Forest LTER
HBR	Hubbard Brook LTER
JRN	Jornada Basin LTER
KBS	Kellogg Biological Station LTER
KNZ	Konza Prairie LTER
LUQ	Luquillo LTER
MCM	McMurdo Dry Valleys LT
MCR	Moorea Coral Reef LTER
NWT	Niwot Ridge LTER
NTL	North Temperate Lakes I
NES	Northeast U.S. Shelf LTER
NGA	Northern Gulf of Alaska I
PAL	Palmer Antarctica LTER
PIE	Plum Island Ecosystems LTER
SBC	Santa Barbara Coastal L
SEV	Sevilleta LTER
VCR	Virginia Coast Reserve L

2017 LTER research site map obtained from <https://lternet.edu/site/lter-network/>

Ocean Carbon and Biogeochemistry (OCB)

Website: <http://us-ocb.org/>

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry,

ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

[ [table of contents](#) | [back to top](#) ]

---

**Funding**

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1637632</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-2023046</a>

[ [table of contents](#) | [back to top](#) ]