Standing stocks and rates for organic sulfur compounds during summer in the subarctic Northeast Pacific

Website: https://www.bco-dmo.org/dataset/705636
Data Type: Cruise Results
Version: 2
Version Date: 2021-06-14

Project
» Collaborative Research: Resolving the processes controlling the distribution of the biogenic trace gas dimethylsulfide and related compounds in the Subarctic NE Pacific (DMS Dynamics)

Contributors	Affiliation	Role
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Abstract
Data include standing stocks and rates for organic sulfur compounds during summer in the subarctic Northeast Pacific. Water samples were collected on R/V Oceanus cruises OC1607A in July 2016 and OC1708A in August 2017.

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Coverage

Spatial Extent: **N**:56.9539 **E**:-124.539 **S**:43.6233 **W**:-145.952
Temporal Extent: 2016-07-11 - 2017-08-25

Methods & Sampling

Latitude and Longitude - These were obtained from the ship positioning system and represent the time the CTD-rosette was deployed.

CTD Temperature and Salinity - Values taken from the CTD instrument at the depth sampled. Salinity based on conductivity.

Mixed Layer Depth - Represents the depth of the well-mixed surface layer. The criteria for defining the depth of the mixed layer was a change of more than 0.05 mg/m3 in the density profile from the near-surface

average.

Chlorophyll a concentration, discrete - Samples were filtered in duplicate onto 25mm GF/F filters. They were extracted in 90% acetone at -20 deg C for 24 hours and kept in the dark. The extracted samples were run on a Turner Trilogy Fluorometer with a non-acidification chlorophyll module. See: Welschmeyer, N A. (1994).

3H-Leucine incorporation rate - Index of bacterial biomass production - A modification of the microcentrifuge method of Smith and Azam (1992) was used. 1.5 ml water samples were pipetted into acid-cleaned 2 ml microcentrifuge tubes (Axygen SCS-020TC). Three live tubes and one killed sample (5% final concentration of trichloroacetic acid (TCA)) were used for each depth sample. Each tube was spiked with 20 nM of L-[4,5-3H] Leucine (NET116600 from Perkin-Elmer) and incubated at the in situ temperature in the dark for 1.5 to 2 hours. After incubation, each of the live samples was killed with TCA (5% final conc.) and shaken. Samples were left to sit in the refrigerator for several hours before processing. Each microcentrifuge tube was spun at 15,000 x g in a microcentrifuge for 15 minutes. After centrifuging, the supernatant was poured into a waste container and the vial was tapped onto a paper towel. Next, 1.5 ml of ice cold 5% TCA was added to each tube, the tube shaken and then spun at 15,000 x g for 5 min. The supernatant was poured off and the vial tapped on a paper towel. Then 1.5 ml of 80% ethanol was added, the tube shaken and centrifuged again for 5 minutes. After pouring out the supernatant, the tubes were left open to dry for several hours. After drying, 1.5 ml of Ecolume scintillation cocktail was added to each tube and the tube placed in a glass scintillation vial for counting. The amount of radioactivity (in disintegrations per minute, dpm) in killed samples was subtracted from that in live samples. The corrected dpm together with the specific activity of the added 3H Leucine and the incubation time was used to calculate the rate of leucine uptake (in nanomoles Leu per liter of seawater per day). See: Smith, D C, & Azam, F. (1992).

Dissolved DMSP (DMSPd) concentration - The small volume drip filtration (SVDF) method of Kiene and Slezak (2006) was used.

Water samples, in triplicate, were collected directly from the Niskin bottles soon after the bottles came aboard the ship. The water flowed out of the Niskin bottles through silicone tubing and care was taken to ensure that flow was laminar (without bubbles). Approximately 50-100 ml of water was filled into PALL polysulfone magnetic filter towers fitted with 47 mm glass fiber filters (Whatman GF/F). The water was allowed to drip through the filter by gravity and only the first 3.5 ml was collected into a 15 ml polypropylene centrifuge tube that contained 100 ul of 50% HCl. The acid was used to kill any bacteria in the filtrate and preserve the DMSP. Samples were stored, typically 1 or 2 days during the cruise, until analysis.

Immediately prior to analysis, each sample was sparged with helium to remove any preexisting DMS. Three ml of each sample was pipetted into a 14 ml serum vial, treated with 1 ml of 5 M NaOH and quickly sealed with a teflon-coated rubber septum (Wheaton 224100-175). After allowing at least 15 minutes for the alkaline cleavage of DMSP into DMS, the samples were purged with He into a cryotrap and the DMS was quantified with a gas chromatograph with flame photometric detection. Standardization for DMS analysis was carried out by injecting different volumes of a calibrated gas stream from a permeation system. The detection limit was 0.166 nM for both cruises (OC-1607A, OC-1708A).

Total DMSP (DMSPt) concentration - Unfiltered water samples of ~50 ml, in triplicate, were collected into 50 ml centrifuge tubes and immediately acidified to 1.5 % HCl final concentration to preserve DMSP. The samples were stored for up to 2 days during the cruise before analysis. Immediately prior to analysis, each sample was sparged with helium to remove any preexisting DMS. 0.2 to 1.0 ml of each sample was pipetted into a 14 ml serum vial, treated with 1 ml of 5 M NaOH and quickly sealed with a teflon-coated rubber septum (Wheaton 224100-175). After allowing at least 15 minutes for the alkaline cleavage of DMSP into DMS, the samples were purged with He into a cryotrap and the DMS was quantified with a gas chromatograph with flame photometric detection. Standardization for DMS analysis was carried out by injecting different volumes of a calibrated gas stream from a permeation system. The detection limit was 0.125 nM for both cruises (OC-1607A, OC-1708A).

Dimethylsulfide (DMS) and methanethiol (MeSH) concentrations - Water samples were collected from the Niskin bottles using a silicone transfer tube taking care to make sure the flow from the Niskin was laminar with no bubbles. Samples were filled into 50 ml centrifuge tubes and stored at in situ temperature in the dark until analysis (< 2 h). Four ml of sample was withdrawn with a glass syringe using a teflon tube attached to a luer fitting. The teflon luer fitting was replaced by a 25 mm screw-together filter unit (Pall) with an attached 22 g hypodermic needle. The filter unit contained a Whatman GFF filter. The sample was then injected through the filter directly into a sparge vial connected to a purge and trap system. The water sample was purged for 5 minutes and the sulfur gases trapped in a loop of teflon tubing immersed in liquid nitrogen. After trapping the liquid nitrogen was replaced by hot water and the sulfur gases injected into a Shimadzu 2014 gas

chromatograph equipped with a Chromosil 330 column (2m) held at 50 deg C isothermal. Peaks were detected with a flame photometric detector. Standardization for DMS and MeSH analysis was carried out by injecting different volumes of a calibrated gas stream from a permeation system. The purge and trap system used for DMS and MeSH was never used for DMSP analysis and never used to purge alkaline samples. This precaution was necessary to accurately quantify MeSH, which is removed by alkali in the purge tubing. The detection limit for DMS was 0.125 nM (OC-1607A) and 0.08-0.1 nM (OC-1708A). The detection limit for MeSH was 0.125 nM (OC-1607A) and 0.07-0.1 nM (OC-1708A).

Biological DMS consumption rate - Water samples were collected from the Niskin bottle into 60 ml Qorpak bottles and kept at in situ temperature in the dark until DMS consumption incubation was started, typically < 30 min. From one Qorpak bottle per depth, 8 ml of seawater was pipetted into a series of six replicate 10 ml serum vials. The vials were quickly sealed with a teflon-faced rubber septum (Wheaton 224100-175). Small volumes (20-50 ul) of gaseous 35S-DMS (generated by alkaline cleavage of 35S-DMSP) were injected into each vial, and the vial shaken briefly to allow the 35S-DMS to dissolve. The samples were then incubated for 4 to 8 hours in the dark at in situ temperature After incubation, the vials were opened and a 0.5 ml subsample was removed and added to 4 ml of Ecolume scintillation cocktail for counting of the amount of added radioactivity per ml. After all sub-samples were collected, each vial was placed on a rack that allowed a 1/16" teflon tube to be inserted into each open vial and a flow of air was used to purge the samples of volatile 35S-DMS. After 15 min of sparging, the teflon sparging tubes were removed from the vials. 0.5 ml of each water sample was pipetted into 4 ml of Ecolume scintillation cocktail for counting of non-volatile 35S transformation products of 35S-DMS. The fraction of 35S-DMS converted to non-volatile products and the incubation time were used, assuming first order kinetics, to calculate the biological loss rate constant for DMS, kbio-DMSC. The kbio-DMSC was multiplied by the in situ DMS concentration to obtain the biological DMS consumption rate in nM per day.

Biological DMSPd consumption rate - From each depth, water samples were collected from the Niskin bottle into three replicate 60 ml glass Qorpak bottles (60 ml Teflon bottles for Stations 1, 2 & 3, OC-1607A) and kept at in situ temperature in the dark until DMSPd consumption incubation was started, typically < 15 min. Care was taken to minimize disturbance of the water samples in the bottles to avoid release of DMSPd. Each bottle was spiked with 35S-DMSPd (specific activity >1000 Ci/mmol; synthesized by R. Kiene from 35S-Methionine) to about 1000 dpm per ml. Sub-samples of 0.5 ml were removed from each incubation bottle to determined the exact amount of 35S activity added per ml of sample in each bottle. The concentration of added 35S-DMSP was < 3 picomolar, so it was at true tracer concentrations. At four time points, typically over 0.5 to 4 h, three ml of seawater was removed from each bottle by pipette and filtered through a 25 mm 0.2 um Nylon filter using a Hoefer filtration manifold. The filter was rinsed 3x with 0.2 um filtered seawater from the same location and after rinsing, the filter was removed with forceps and placed in a 6ml plastic scintillation vial. 4 ml of Ecolume scintillation cocktail was added and the samples counted for 35S activity which represented total 35S-DMSP uptake. The filtrate and all of the rinse liquid from each time point sample was captured in a 50 ml polypropylene centrifuge tube held inside the Hofer filtration manifold. The filtrate was allowed to sit for 2-6 h with occasional shaking to allow any volatile 35S to be lost from the sample. At that point, the entire contents of the storage tube was poured into a 70 ml serum bottle and the bottle sealed with a septum that held a plastic well cup. The well cup contained a 25 mm glass fiber filter (Pall A/E) that was soaked with 0.2 ml of 3% H2O2 (drugstore grade). After all serum bottles were sealed, 0.2 ml of 5 M NaOH was injected through the septum taking care to avoid getting NaOH on the suspended filter. The NaOH cleaved remaining 35S-DMSP into 35S-DMS. The bottles were placed on a shaker table at 100 rpm and allowed to trap the 35S-DMS for 6-12 h. After this time, the septa with the hanging cups were removed, and the A/E filters were collected with a forceps and placed in 6 ml plastic scintillation vials. 4 ml of Ecolume scintillation cocktail was added and after letting the scintillation vials stabilize for >2 h, the radioactivity on the filters was determined. The 35S activity captured in trap bottles represented the 35S-DMSPd remaining in the dissolved fraction. The fraction of added 35S-DMSP lost from the dissolved fraction over time was used to calculate the first order loss rate constant, kDMSPd. The kDMSPd was multiplied by the concentration of DMSPd obtained by small volume drip filtration from the Niskin bottle to obtain the DMSPd consumption rate in nM per day.

Note on Incubation bottles of DMSPd consumption - For stations 1, 2, and 3 (OC-1607A), 60 ml Teflon bottles were used. These were found to cause DMSPd release during the incubations and rate constants for 35S-DMSP consumption were low because of that. We switched to 60 ml glass Qorpack bottles at Station 4 and used those for all the other stations. Rate constants were much higher in glass bottles and DMSPd in seawater incubated in glass bottles for 1-2 h was similar to that collected directly from the Niskin indicating minimal bottle effects by the glass.

DMS Yield from DMSPd and sulfur assimilation fraction - The procedure of Slezak et al. (2007) was used.

General incubation - At each station, water sample was collected from the 5 meter depth Niskin directly into

a 60 ml glass Qorpak bottle. The sample was kept at in situ temperature in the dark for up to 1 h before processing. From the Qorpak bottle, 10 ml water samples (4 replicates) were pipetted into 14 ml glass serum vials. Each vial was spiked with 35S-DMSP to about 4000 dpm/ml, and quickly sealed with a rubber septum and subsequently injected with an aqueous solution of DMDS to a final concentration of 200 nM to block DMS consumption. The samples were then incubated for 10-12 hours in the dark at in situ temperature. After incubation, each vial was opened and a 0.5 ml subsample removed to determine total added 35S activity.

DMS Yield - For DMS yield determination, 4 ml from each incubation vial was pipetted into a 70 ml glass serum bottle (trap bottle) that contained 0.1 ml of a solution containing 10% sodium dodecyl sulfate (SDS, stops bacterial activities) and 200 mM unlabeled DMSP (to stop further uptake of 35S-DMSP). The bottle also contained 0.05 ml of 5,5-dithiobis-2-nitrobenzoic acid (DTNB or Ellmans Reagent; 1 mg DTNB per ml of 50 mM TRISMA-HCl, pH 8, Sigma) to complex thiols, including methanethiol. After pipetting the 4 ml water sample into the 70 ml trap bottle, the bottle was quickly sealed with a septum that held a plastic well cup inside the vial. The well cup contained a 25 mm glass fiber filter (Pall A/E) that was soaked with 0.2 ml of 3% H2O2 (drugstore grade). The H2O2 on the filter oxidized volatile 35S compounds and trapped them as non-volatile materials on the filter. Because we included DTNB in the trap bottle to complex methanethiol in solution, the only volatile trapped would be DMS. The trap bottles were placed on a shaker table and the volatile 35S allowed to trap for 8-12 h. After trapping, the septa were removed and the filter picked up with a forceps and placed in a 6 ml plastic scintillation vial to which 4 ml Ecolume was added. After waiting at least 2 h for counts to stabilize, the amount of 35S on the filters was determined by liquid scintillation counting. The amount of 35S-DMSP remaining in those same samples was determined by placing a new septum with hanging cup and H2O2-soaked filter on each trap bottle. 0.2 ml of 5M NaOH was then injected through the septum to cleave any remaining 35S-DMSP into 35S-DMS, which was subsequently trapped on the H2O2-soaked filter for 8-12 h. The amount of 35S on these filters represented the amount of 35S-DMSP remaining and the amount of 35S-DMSP consumed was calculated as the difference between the added amount (from the 0.5 ml sub-sample) and the amount remaining. All counts were normalized per ml of seawater and expressed as a fraction of the added 35S-DMSP. Generally, the fraction of 35S-DMSP consumed was >90% during the 10-12 h incubations. The DMS yield was calculated as the [fraction of 35S-DMSP converted to 35S-DMS]/[fraction of 35S-DMSP consumed].

DMSP-sulfur assimilation - The fraction of 35S-DMSP-sulfur assimilated into macromolecules was determined from the same incubation samples as used for the DMS yield. 4 ml of the remaining water in the incubation vial was filtered through a 0.2 µm Nylon filter to capture microbial cells. After rinsing 3x with filtered seawater, the filters were covered with 3 ml of ice cold 5% trichloroacetic acid (TCA). A small volume of the TCA was allowed to pass through the filter and then the vacuum was shut off and the TCA allowed to sit on the filter for 5 minutes. After that time the vacuum was turned on again and the TCA was filtered through. Each filter was rinsed 3x with MilliQ water, and the filter removed to a 6 ml plastic scintillation vial and covered with 4 ml of Ecolume scintillation cocktail. 35S-activity on these filters was normalized to the amount of 35S-DMSP consumed during the incubation. This fraction represented the 35S-DMSP-sulfur assimilated into TCA insoluble macromolecules during the incubation.

Description of data correction: The following (italicized text) is personal communication from late PI (R. Kiene) to project collaborators regarding the rationale for the empirical corrections applied to cruise DMSP data archived with BCO-DMO:

"*The correction is needed because of the way we standardized the GC. First, I will point out that my permeation system is robust and accurate. I have checked it every way possible and compared it to gravimetric DMS liquid standards prepared in ethylene glycol (the old Andreae method, which I used 25 years ago too).*

Routinely (as done during the cruises) we injected our permeation gas standard DIRECTLY into a sparge vial that was connected to the purge and trap system of the GC. This was usually done into an empty vial with the helium purge gas flowing. I will call these Direct standards. This gives us a high relative slope for our standard curves.

Over the past few years, we had run several comparisons of our permeation standards with DMSP reagent standards (hydrolyzed with NaOH to produce DMS in sealed 14 ml serum vials which are then separately connected to the sparge system). These always showed the DMSP standards to give a LOWER slope than the permeation standard by an average factor of 0.70. Since I had checked my permeation system and couldn't find a flaw, I attributed the lower DMSP response to the reagent being either impure or wet. But then I stored the DMSP in a vacuum desiccator and compared several different sources of DMSP and they all gave the same response to each other, and all low relative to the permeation system. I sent some of our DMSP standard to Dr. David J. Kieber (State University of New York ESF) and ours agreed with his. And he checked his standard with a DOC analysis that confirmed its predicted DMSP concentration So the DMSP seems to be correct, and the permeation system is correct. I was at a loss to reconcile the differences.

After a while, I decided to test the permeation standard by injecting the gas into independent EXTERNAL vials (i.e. not already connected to the sparge system), and then connecting each one to the sparge system, as we would do for the DMSP standards. Lo and behold, the permeation standards prepared in the External vials gave a slope about the same as the DMSP standards (also prepared in external vials). And they both gave lower slopes than for permeation gas injected DIRECTLY into the sparge vial.

So, after a bunch of additional tests, I have narrowed down the issue to be the process of connecting the external vial to the sparge system, which is what we do for DMSPt and DMSPd samples. Those are prepared in external vials to which sample and NaOH are added. We have to disconnect the previous sample from the helium purge needle and the excurrent sample line needle when we switch vials. We also shut off the helium purge flow during this switch over. The liquid nitrogen is placed on the Teflon loop and we wait about 5 seconds or more for the loop to freeze before we connect the sample to the system via the needles. We always connect the sample line needle first, then the helium purge needle. Something about this process causes the lower response of the External vial samples compared to Direct injection of the permeation standards into the sparge vial. We still don't know exactly why this is. I have ruled out the Nafion dryer (makes no difference if it is in-line or not), whether External vials are full of air or inert gas (He or N_2), and a few other things. I am thinking that somehow, when the liquid nitrogen is on the loop, while we swap vials, it may suck in air from the valve vent or sample line needle and something about that air either oxidizes the DMS or causes a quenching of the FPD signal for those samples. But the 14 ml of air in the External sample vials doesn't seem to make a difference so it is not clear why liquid nitrogen trapping of air from open ports would be worse.

After all this, all cruise DMSP data were corrected since they were all run as external vials. We had done several DMSP/Permeation comparisons in the two years around the cruises and the average relative slope for standards is 0.7.

Our DMS/MeSH data should not be affected because we inject those water samples Directly into the sparge vial (much like we do for the permeation standards). This is supported by the fact that our DMS values matched your MIMS DMS values and your standard."

Data Processing Description

BCO-DMO Processing Description

- filled in Mixed_Layer_Depth values where missing (one value per station);
- modified parameter names to conform with BCO-DMO naming conventions;
- created additional date/time field in UTC;
- filled in blank cells (missing data) with "nd";
- replaced "0.00" (analytical zero) with "BDL" to indicate "below detection limit";
- replaced values less than 0.00 with "<0.00".

Version history:
- 2021-06-14 (v2) - version 2 processed by BCO-DMO; includes corrections to data values (see description of corrections under Methods & Sampling) and addition of data from OC1708A cruise.
- 2017-07-14 (v1) - version 1 processed by BCO-DMO (OC1607A data only).

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Data Files

File
Org_S_NE_Pacific.csv (Comma Separated Values (.csv), 36.13 KB) MD5:d61f9771bf5f246b231ea9562f290f8d Primary data file for dataset ID 705636

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Related Publications

Kiene, R. P., & Slezak, D. (2006). Low dissolved DMSP concentrations in seawater revealed by small-volume gravity filtration and dialysis sampling. Limnology and Oceanography: Methods, 4(4), 80–95. doi:10.4319/lom.2006.4.80
Methods

Slezak, D., Kiene, R. P., Toole, D. A., Simó, R., & Kieber, D. J. (2007). Effects of solar radiation on the fate of dissolved DMSP and conversion to DMS in seawater. Aquatic Sciences, 69(3), 377–393. doi:10.1007/s00027-007-0896-z
Methods

Smith, D.C. and F. Azam (1992). A simple, economical method for measuring bacterial protein synthesis rates in seawater using 3H-leucine. Marine Microbial Food Webs 6:107-114
http://www.gso.uri.edu/dcsmith/page3/page19/assets/smithazam92.PDF
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/lo.1994.39.8.1985
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Station	Station number	unitless
Cast	Cast number (for OC-1708A drift stations only)	unitless
ISO_DateTime_PDT	Date and time (PDT) in ISO8601 format: YYYY-MM-DDThh:mm:ss	unitless
ISO_DateTime_UTC	Date and time (UTC) in ISO8601 format: YYYY-MM-DDThh:mm:ss	unitless
Depth_Z	Depth of the sample in meters from the surface.	meters (m)
Latitude	Degress of latitude expressed in full decimal units.	degrees North
Longitude	Degress of longitude expressed in full decimal units.	degrees East
CTD_Temp	Temperature in degrees celsius, at depth sampled, as measured by CTD sensor package.	degrees Celsius (C)

Salinity	Practical salinity (unitless), at depth sampled, calculated by conductivity ratio of seawater to standard, but generally considered g/kg of seawater.	unitless
Mixed_Layer_Depth	Mixed layer depth represents the depth of the well-mixed surface layer. The criteria for definining the depth of the mixed layer was a change of more than 0.05 mg/m3 in the density profile from the near-surface average.	meters (m)
Chl_a_discrete	Chlorophyll a in micrograms per liter of seawater.	micrograms per liter (ug/L)
Std_Dev_Chl_a	Standard deviation of chl_a_discrete.	micrograms per liter (ug/L)
Bacterial_Production	Bacterial Production (3H-Leu incorp.): Tritiated leucine incorporation in nanomoles per liter per day.	nanomoles per liter per day (nM d-1)
DMSPd_SVDF	Dissolved DMSP (DMSPd SVDF) from Niskin: Dissolved dimethylsulfoniopropionate concentration as determined by small volume drip filtration (SVDF) in nanomoles per liter. Detection limit = 0.166 nM.	nanomoles per liter (nM)
Std_Dev_DMSPd_SVDF	Standard deviation of DMSPd_SVDF	nanomoles per liter (nM)
DMSPt	DMSPt: Total DMSP in nanomoles per liter. Includes particulate and dissolved pools of DMSP. Detection limit = 0.125 nM.	nanomoles per liter (nM)
Std_Dev_DMSPt	Standard deviation of DMPSt	nanomoles per liter (nM)
DMS	Dimethylsulfide (DMS) concentration in nanomoles per liter. Detection limit = 0.125 nM.	nanomoles per liter (nM)
Std_Dev_DMS	Standard deviation of DMS.	nanomoles per liter (nM)
MeSH	Methanethiol (MeSH) concentration in nanomoles per liter. Detection limit = 0.125 nM.	nanomoles per liter (nM)
Std_Dev_MeSH	Standard deviation of MeSH.	nanomoles per liter (nM)
k_DMS_35S_loss	35S k DMS loss (d-1): Rate constant (k) for biological dimethylsulfide (DMS) consumption determined with 35S-DMS. Fraction per day.	per day

biol_DMS_consumption_rate	Biol. DMS consumption rate (nmol L-1 d-1): Rate = k x DMS concentration. Units are nanomoles per liter per day	nanomoles per liter per day (nmol/L/d)
k_DMSPd_35S	35S kDMSPd (d-1): Rate constant (k) for biological consumption of dissolved dimethylsulfoniopropionate (DMSPd) determined with 35S-DMSP. Fraction per day.	per day
DMSPd_35S_consumption_rate	35S-DMSPd Consumption rate (nmol L-1 d-1). Rate = k x DMSPd concentration. Units are nanomoles per liter per day	nanomoles per liter per day (nmol/L/d)
DMS_Yield	DMS Yield: fraction of DMSPd consumed.	unitless
DMSP_Assimilation	DMSP Assimilation: fraction of DMSPd consumed.	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Centrifuge
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Turner Trilogy Fluorometer
Generic Instrument Name	Fluorometer
Generic Instrument Description	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.

Dataset-specific Instrument Name	Shimadzu GC2014-with Flame Photometric Detector
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Beckman LS6500 Liquid Scintillation Counter
Generic Instrument Name	Liquid Scintillation Counter
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used the quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples. Liquid scintillation counters are instruments assaying alpha and beta radiation by quantitative detection of visible light produced by the passage of rays or particles through a suitable scintillant incorporated into the sample.

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Generic Instrument Description	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.

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Deployments

OC1607A

Website	https://www.bco-dmo.org/deployment/705639
Platform	R/V Oceanus
Start Date	2016-07-10
End Date	2016-07-27
Description	See additional cruise information at the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/OC1607A

OC1708A

Website	https://www.bco-dmo.org/deployment/853468
Platform	R/V Oceanus
Start Date	2017-08-11
End Date	2017-08-27
Description	See additional cruise information from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/OC1708A

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Project Information

Collaborative Research: Resolving the processes controlling the distribution of the biogenic trace gas dimethylsulfide and related compounds in the Subarctic NE Pacific (DMS Dynamics)

Coverage: LineP: Transect between shore and station Papa, 50N 145W

Researchers from the University of South Alabama and Woods Hole Oceanographic Institution will use a new method to quantify the cycling of dimethylsulfide (DMS) and its related compounds in the Subarctic Northeast Pacific Ocean. DMS is a sulfur-containing gas that is abundant in the world's oceans. Oceanic DMS emissions are the largest source of biologically-produced sulfur to the atmosphere, with important implications for atmospheric chemistry and the world's climate. Research over the last two decades has revealed that a complex web of processes is involved in the cycling of DMS in the ocean. However, many of these processes remain poorly understood. Results from this research will provide key information to a broad range of disciplines from microbiology to Earth-system science, and further develop methods and technologies useful to the broader research community.

Dimethylsulfide (DMS), dimethylsulfoniopropionate (DMSP), and dimethylsulfoxide (DMSO) play critical roles in marine microbial ecology as metabolic substrates and as essential components of the oceanic sulfur cycle. Moreover, oceanic DMS emissions are geochemically important as the largest source of biogenic sulfur to the atmosphere and have been implicated as a contributing factor for the atmospheric radiative balance, with important climate implications. The researchers will study the dynamics of the biogenic trace gas DMS, and the related compounds DMSP and DMSO in the Subarctic Northeastern Pacific, a high-nutrient, low-chlorophyll (HNLC) region with exceptionally high DMS concentrations. They will use a novel isotope tracer method to quantify the in-situ turnover rates of these compounds in different surface water masses across frontal boundaries with contrasting DMS/phosphorus/oxygen and nutrient concentrations, and in Lagrangian experiments to investigate temporal evolution of cycling rates. Using newly-developed methods for automated underway sampling, researchers will map the surface distributions of DMS, DMSP and DMSO at unprecedented spatial resolution. Results from this study will improve our understanding of the spatial variability in oceanic DMS, DMSP, and DMSO concentrations in surface waters by accurately measuring the cycling rates of these compounds.

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