Soluble Ionic Species (Coarse) in aerosols collected on the US GEOTRACES Arctic cruise (HLY1502, GN01) from August to October 2015 from from August to October 2015

Website: https://www.bco-dmo.org/dataset/779553
Data Type: Cruise Results
Version: 1
Version Date: 2019-10-24

Project
» U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)
» Collaborative Research: GEOTRACES Arctic Section: Sampling and Analysis of Atmospheric Deposition (GEOTRACES Arctic Atmospheric Deposition)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
Gao, Yuan	Rutgers University	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Coverage

Spatial Extent: **N**:88.4088 **E**:176.7522 **S**:56.0743 **W**:-170.7498
Temporal Extent: 2015-08-10 - 2015-10-09

Dataset Description

These data are associated with the following publication:
Gao, Y., Marsay, C., Yu, S., Fan, S., Mukherjee, P., Buck, C.S., & Landing, W.M. (in press). Particle-Size Variability of Aerosol Iron and Impact on Iron Solubility and Dry Deposition Fluxes to the Arctic Ocean. Scientific Reports.

Methods & Sampling

Sampling:
Aerosol samples were collected by a MICRO ORIFIFICE UNIFORM DEPOSIT IMPACTOR (MOUDI) (MSP Corporation, MN, USA) which was installed on the forward rail of Healy's flying bridge, ~23 m above sea level, to minimize the influence of sea spray. To minimize the potential for contamination from the stack exhaust, samplers were forward of the ship's stack and sampling was controlled by wind speed and direction, through a Campbell Scientific CR800 data-logger interfaced with an anemometer and wind vane set up near the samplers.

Aerosol sampling was restricted to periods when in-sector conditions (defined as a relative wind direction from within ±60° of the ship's bow and a relative wind speed of >0.5 m s-1) persisted for at least five continuous minutes. The MOUDI impactor used Teflon filters for particle collection (Pall Corp., 47 mm diameter, 1 µm pore size), with a sampling flowrate of 30 L min-1. Both the MOUDI impactor and its pump were housed in enclosures to protect them from rain and sea-spray with an extension tube connected to the MOUDI inlet and extending from the enclosure. A rain shield was installed above the inlet. Due to the anticipated low dust conditions during GN01, and the relatively low frequency of in-sector wind conditions, sample collections lasted for an average of seven days.

Clean polyethylene gloves were worn for loading and unloading of sample filters, which were carried out underneath a high-efficiency particulate air (HEPA) filter blower within a plastic "bubble" clean area constructed in the ship's main laboratory. Filters were loaded onto the MOUDI impactor from labeled petri dishes using pre-cleaned Teflon tweezers and were transferred back to the same petri dishes after sample recovery. Filter holders were double-bagged for transfer between the ship's laboratory and the samplers. Deployment blanks were carried out using the same protocols, but with the pumps turned off. All sample and field blank filters were subsequently double-bagged and stored frozen until analysis.

Sampler Location: Flying deck, forward railings
Sampler Type: MICRO ORIFIFICE UNIFORM DEPOSIT IMPACTOR (MOUDI) (MSP CORP.,MN, USA)
Sampler Flow: 0.030 m3/min
Substrate Type: Pall corp. Teflon Filter, 47 mm discs (Teflon, 1um pore size)
Size Segregation Method: Size-segregated sample; 1um is used as a cut off size for COARSE and FINE particle sizes

Aerosol Sample Analyses:
Ionic species in aerosols were measured following the detailed procedures in Xu et al. (2013).

Aerosol samples were analyzed by ion chromatography (IC; Dionex IC-2000) to measure the concentrations of water-soluble anionic and cationic species (chloride, nitrate, sulfate, acetate, formate, oxalate, MSA, propionate and sodium, potassium, ammonium, calcium, magnesium) at Rutgers University Atmospheric Chemistry Laboratory. For anion analysis, an AS11 analytical column (2 × 250mm2, Dionex, particle size 13µm), KOH eluent generator cartridge (EGC II KOH, Dionex) and 25µl sample loop were employed, while for cations, a CS12A analytical column (2 × 250mm2, Dionex, particle size 8.5µm), 25 µL sample loop, and MSA generator cartridge (EGC II MSA, Dionex) were used, similar to Xu et al (2013). Briefly, a one-quarter subsample of each filter was submerged in 5 ml of 18.2 MΩ•cm deionized water, ultra-sonicated for 40 mins in an ultrasonic bath and then allowed to sit in the deionized water for ~10 hours, before being filtered through a 0.22µm PTFE syringe filter. The instrument detection limits (calculated as 3.143×standard deviation of 7 replicates of the lowest standard solution) were 0.007ppm for propionate, 0.008ppm for acetate and formate, 0.018ppm for oxalate, 0.013ppm for sulfate, 0.007ppm for nitrate, 0.015ppm for chloride and 0.016ppm for MSA, and below 0.01ppm for major cations. The precision, as determined for a low concentration standard (0.05ppm, n=7, and presented as relative standard deviation), was within 8% for all the species analyzed.

Data Processing Description

Data processing followed standard protocols that was included in sample analyses section; no specific software was used.

BCO-DMO Processing:
- modified parameter names (replaced spaces w/ underscores);
- formatted time to HH:MM;
- formatted months and days to two-digits;
- added ISO Date/Time fields.

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Data Files

File
Soluble_Ionic_Species_Coarse.csv (Comma Separated Values (.csv), 2.33 KB) MD5:14f38cd9f3d4543481ef566e95a2f395 Primary data file for dataset ID 779553

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Related Publications

Gao, Y., Marsay, C. M., Yu, S., Fan, S., Mukherjee, P., Buck, C. S., & Landing, W. M. (2019). Particle-Size Variability of Aerosol Iron and Impact on Iron Solubility and Dry Deposition Fluxes to the Arctic Ocean. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-52468-z
Results

Xu, G., Gao, Y., Lin, Q., Li, W., & Chen, L. (2013). Characteristics of water-soluble inorganic and organic ions in aerosols over the Southern Ocean and coastal East Antarctica during austral summer. Journal of Geophysical Research: Atmospheres, 118(23), 13,303–13,318. doi:10.1002/2013jd019496
https://doi.org/10.1002/2013JD019496
Methods

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Parameters

Parameter	Description	Units
Cruise_id	Cruise identifier	unitless
GEOTRC_EVENTNO	GEOTRACES Event Number	unitless
SAMPLE_ID	GEOTRACES Sample Number	unitless
Julian_Day	Sampling start Julian day	unitless
Start_Day	Sampling start day	unitless
Start_Month	Sampling start month	unitless
Start_Year	Sampling start year; format: yyyy	unitless
Start_Time_UTC	Sampling start time; format: HH:MM	unitless
Start_Lat	Sampling start Latitude	decimal degrees N
Start_Long	Sampling start Longitude	decimal degrees E

End_Day	Sampling end day	unitless
End_Month	Sampling end month	unitless
End_Year	Sampling end year; format: yyyy	unitless
End_Time	Sampling end time; format: HH:MM	unitless
End_Lat	Sampling end Latitude	decimal degrees N
End_Long	Sampling end Longitude	decimal degrees E
Air_Vol_Total	Total volume of air sampled	cubic meters (m^3)
ACETATE_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of acetate concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
PROPIONATE_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of propionate concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
FORMATE_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of formate concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
MSA_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of methane sulfonic acid concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
Cl_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total Cl concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
NO3_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total NO3 concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3

SO4_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total sulfate concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
OXALATE_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of oxalate concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
Na_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total Na concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
NH4_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total NH4 concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
K_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total K concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
Mg_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total Mg concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
Ca_A_SMLH2O_CONC_COARSE_IMPACTOR	soluble portion of larger size fraction of total Ca concentration in aerosols collected with size fractionation using a weak leach (ultrapure water)	nmol/m3
ISO_DateTime_UTC_start	Sampling start date and time; formatted to ISO 8601 standard (yyyy-mm-ddTHH:MM:SS.ss)	unitless
ISO_DateTime_UTC_end	Sampling end date and time; formatted to ISO 8601 standard (yyyy-mm-ddTHH:MM:SS.ss)	unitless

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Instruments

Dataset-specific Instrument Name	Micro-orifice uniform deposit impactor (MOUDI)
Generic Instrument Name	Aerosol Sampler
Dataset-specific Description	Aerosol samples were collected by a MICRO ORIFiCE UNIFORM DEPOSIT IMPACTOR (MOUDI) (MSP Corporation, MN, USA) which was installed on the forward rail of Healy's flying bridge.
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	anemometer
Generic Instrument Name	Anemometer
Generic Instrument Description	An anemometer is a device for measuring the velocity or the pressure of the wind. It is commonly used to measure wind speed. Aboard research vessels, it is often mounted with other meteorological instruments and sensors.

Dataset-specific Instrument Name	Campbell Scientific CR800 data-logger
Generic Instrument Name	Data Logger
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	Dionex IC-2000
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Aerosol samples were analyzed by ion chromatography (IC; Dionex IC-2000).
Generic Instrument Description	Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....)

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Deployments

HLY1502

Website	https://www.bco-dmo.org/deployment/638807
Platform	USCGC Healy
Report	https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf
Start Date	2015-08-09
End Date	2015-10-12
Description	Arctic transect encompassing Bering and Chukchi Shelves and the Canadian, Makarov and Amundsen sub-basins of the Arctic Ocean. The transect started in the Bering Sea (60°N) and traveled northward across the Bering Shelf, through the Bering Strait and across the Chukchi shelf, then traversing along 170-180°W across the Alpha-Mendeleev and Lomonosov Ridges to the North Pole (Amundsen basin, 90°N), and then back southward along ~150°W to terminate on the Chukchi Shelf (72°N). Additional cruise information is available in the GO-SHIP Cruise Report (PDF) and from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/HLY1502

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Project Information

U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)

Website: https://www.geotraces.org/

Coverage: Arctic Ocean; Sailing from Dutch Harbor to Dutch Harbor (GN01)

Description from NSF award abstract:
In pursuit of its goal "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions", in 2015 the International GEOTRACES Program will embark on several years of research in the Arctic Ocean. In a region where climate warming and general environmental change are occurring at amazing speed, research such as this is important for understanding the current state of Arctic Ocean geochemistry and for developing predictive capability as the regional ecosystem continues to warm and influence global oceanic and climatic conditions. The three investigators funded on this award, will manage a large team of U.S.scientists who will compete through the regular NSF proposal process to contribute their own unique expertise in marine trace metal, isotopic, and carbon cycle geochemistry to the U.S. effort. The three managers will be responsible for arranging and overseeing at-sea technical services such as hydrographic measurements, nutrient analyses, and around-the-clock management of on-deck sampling activites upon which all participants depend, and for organizing all pre- and post-cruise technical support and scientific meetings. The management team will also lead educational outreach activities for the general public in Nome and Barrow, Alaska, to explain the significance of the study to these communities and to learn from residents' insights on observed changes in the marine system. The project itself will provide for the support and training of a number of pre-doctoral students and post-doctoral researchers. Inasmuch as the Arctic Ocean is an epicenter of global climate change, findings of this study are expected to advance present capability to forecast changes in regional and globlal ecosystem and climate system functioning.

As the United States' contribution to the International GEOTRACES Arctic Ocean initiative, this project will be part of an ongoing multi-national effort to further scientific knowledge about trace elements and isotopes in the world ocean. This U.S. expedition will focus on the western Arctic Ocean in the boreal summer of 2015. The scientific team will consist of the management team funded through this award plus a team of scientists from U.S. academic institutions who will have successfully competed for and received NSF funds for specific science projects in time to participate in the final stages of cruise planning. The cruise track segments will include the Bering Strait, Chukchi shelf, and the deep Canada Basin. Several stations will be designated as so-called super stations for intense study of atmospheric aerosols, sea ice, and sediment chemistry as well as water-column processes. In total, the set of coordinated international expeditions will involve the deployment of ice-capable research ships from 6 nations (US, Canada, Germany, Sweden, UK, and Russia) across different parts of the

Arctic Ocean, and application of state-of-the-art methods to unravel the complex dynamics of trace metals and isotopes that are important as oceanographic and biogeochemical tracers in the sea.

Collaborative Research: GEOTRACES Arctic Section: Sampling and Analysis of Atmospheric Deposition (GEOTRACES Arctic Atmospheric Deposition)

NSF Award Abstract:
In this project, a group of investigators participating in the 2015 U.S. GEOTRACES Arctic Ocean expedition will study the distribution of a variety of trace elements in seawater, sea ice, and marine air. It is important to understand where they are and how they move in the Arctic because some trace elements are essential to life, others are known biological toxins, and still others are important because they can be used as tracers of a variety of physical, chemical, and biological processes in the sea. In common with other multinational initiatives in the International GEOTRACES Program, the goals of the U.S. Arctic expedition are to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions. This multi-institutional team of ocean trace element experts will focus its attention on the importance of aerosol, precipitation, and sea ice melt water in trace element cycling. Results from this work will be disseminated through public educational initiatives, such as web communications and outreach to members of the public, including indigenous populations in Alaska. The project will also provide training for graduate and undergraduate students in biology and chemistry.

Atmospheric deposition is an important pathway and transport mechanism of both natural aerosols and contaminants to the ocean. Relative to other regions, atmospheric deposition rates in the Arctic are low and aerosols and dissolved chemicals in precipitation may be deposited directly to the sea surface or, unique to polar regions, onto sea ice. Given the unique biogeochemical processes of the region and its rapid changes in response to global climate change, quantifying the current atmospheric deposition of trace elements and isotopes to differing catchments (ocean, sea ice, and melt ponds) in the Arctic is critical to our ability to predict how their distribution may evolve over time. In this study, aerosol, precipitation, and melt water samples will be collected and analyzed for trace elements and isotopes in order to evaluate the impacts on the surface ocean and sea ice chemistry from natural and anthropogenic aerosols. Through this project, collected atmospheric samples from the Arctic will also be made available for distribution to the broader scientific community.

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Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: http://www.geotraces.org/

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation.

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1438047
NSF Division of Ocean Sciences (NSF OCE)	OCE-1435871
NSF Division of Ocean Sciences (NSF OCE)	OCE-1437266

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