

Aerosol composition data of ion concentrations (ammonium, nitrate, nitrite, sodium, chloride, magnesium, calcium, potassium, sulfate); and ammonium and nitrate isotope (¹⁵N) of atmospheric particulates collected in Hawaii from March 2021 to August 2022

Website: <https://www.bco-dmo.org/dataset/946741>

Data Type: Other Field Results

Version: 1

Version Date: 2025-02-13

Project

» [Collaborative Research: Characterization of Reactive Nitrogen in The North Pacific Atmosphere](#) (North Pacific Atmos)

Contributors	Affiliation	Role
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Abstract

These data include aerosol composition data of ion concentrations (ammonium, nitrate, nitrite, sodium, chloride, magnesium, calcium, potassium, sulfate), and ammonium isotope (¹⁵N) of atmospheric particulates collected on Oahu, Hawaii. Aerosol sampling was conducted from March 2021 to June 2022 and collected roughly every seven days. A high-volume aerosol sampler operating at 1,200 L min⁻¹ with 25 × 20 cm filters was used. Recognizing the deposition of atmospheric particulates has the potential to understanding the important role of atmospheric deposition to the nitrogen cycle and biogeochemistry in the ocean. These data assess the contribution of atmospheric deposition to inorganic nitrogen and were collected by Mitchell Pinkerton at the Ocean University of Hawaii.

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Coverage

Location: North Pacific Ocean

Spatial Extent: Lat:21.32 Lon:-157.67

Temporal Extent: 2021-03-24 - 2022-06-30

Methods & Sampling

Aerosol sampling was conducted from March 24, 2021 to June 30, 2022. A high-volume aerosol sampler operating at 1,200 L min⁻¹ with 25 × 20 cm filters was used. Aerosol samples were for seven days for each

filter, with a total of 66 samples collected.

We measured for ammonium isotopes (^{15}N), and a suite of ion concentrations (calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), and potassium (K^+), Chloride (Cl^-) and sulfate (SO_4^{2-})). All measurements were conducted at the Department of Earth, Environmental, and Planetary Sciences at Brown University in Providence, RI (USA).

The filter was extracted in a pre-cleaned bottle with ~30 mL of MQ water (exact amounts were recorded via weight) and sonicated for 1 h. After sonication, the solutions were filtered via a vacuum pumped. Samples were frozen then at $-20\text{ }^\circ\text{C}$ until further analyses.

The concentration of ammonium, nitrate, and nitrite were determined colorimetrically (indophenol blue) using a discrete UV-Vis analyzer (Westco Smartchem 200). U.S. EPA Compliant Methods 350.1 (O'Dell, 1993), 353.2 (Revision 2.0), and 354.1 were followed for ammonium, nitrate, and nitrite, respectively. Standard lab protocols were followed, including calibration to standards as well as blanks and in-house quality control measurements.

The azide method (Zhang et al., 2007) was used to complete ammonium ($^{15}\text{N}/^{14}\text{N}$) isotope analyses on a continuous flow isotope ratio mass spectrometer. Values were reported in ‰ relative to standards (IAEA-N₂ and USGS-25).

Concentrations of calcium, magnesium, sodium, potassium, chloride, and sulfate were measured on an Ion Chromatography (IC) instrument (Dionex Integrion HPIC) using suppressed conductivity detection. Anions were determined using a Dionex AS19-4 μm guard ($4 \times 50\text{ mm}$) and analytical column ($4 \times 250\text{ mm}$) with 20 mM KOH as eluent with a flow rate of 1 mL min^{-1} . Cations were analyzed using a Dionex CS-16 guard column ($5 \times 50\text{ mm}$) analytical column ($5 \times 250\text{ mm}$). Eluent of 30 mM methane sulfonic acid was used to detect cations with a pump flow rate of 1 mL min^{-1} . All samples were filtered with $0.20\text{-}\mu\text{m}$ filters before being analyzed. In-house quality control standards were run approximately every six samples.

BCO-DMO Processing Description

- * Adjusted parameter names to comply with database requirements
- * Added sampling latitude and longitude to dataset
- * Converted date to ISO notation (Y-m-d)

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Data Files

File
946741_v1_hawaii aerosol.csv (Comma Separated Values (.csv), 7.06 KB) MD5:69bc8b8d91c99180c5bf1acb99688ace
Primary data file for dataset ID 946741, version 1

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Related Publications

MacFarland, A. B., Walters, W. W., & Hastings, M. G. (2024). Solid Phase Extraction Methodology for Robust Isotope Analysis of Atmospheric Ammonium. *ACS Earth and Space Chemistry*, 8(5), 1039–1047.

<https://doi.org/10.1021/acsearthspacechem.3c00375>

Results

O'Dell, J.W., 1993a. In: Method 350.1, Revision 2.0: Determination of Ammonia Nitrogen by Semi-automated Colorimetry. US EPA. https://www.epa.gov/sites/default/files/2015-08/documents/method_350-1_1993.pdf
Methods

U.S. EPA. (1993) In: Method 353.2, Revision 2.0 (August 1993): Determination of Nitrate-Nitrite Nitrogen by

Automated Colorimetry. US EPA. Retrieved from https://www.epa.gov/sites/default/files/2015-08/documents/method_353-2_1993.pdf

Methods

Zhang, L., Altabet, M. A., Wu, T., & Hadas, O. (2007). Sensitive Measurement of NH₄+15N/14N (δ15NH₄+) at Natural Abundance Levels in Fresh and Saltwaters. *Analytical Chemistry*, 79(14), 5297-5303.

doi:[10.1021/ac070106d](https://doi.org/10.1021/ac070106d)

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Parameters

Parameter	Description	Units
Sample_ID	Sample number id of atmospheric particulate sampled	unitless
Date	The sampling date in ISO format yyyy-mm-dd	unitless
Collection_Location	Location name of sampling site: Oahu, Kaena, Kahe, Aloha	units
Latitude	Sampling latitude, south is negative	decimal degrees
Longitude	Sampling longitude, west is negative	decimal degrees
CollectionPeriod_Hrs	Length of sampling time in format hh	hours (hrs)
TotalAirVolume_m3	Total air volume during the sampling	Liter (L)
ParticleWeight_g	Atmospheric particulates weight of each samples	milligram (mg)
AmmoniumConcentration_ugPerm3	Ammonium concentration	micrograms per cubic meter (µg/m ³)
NitrateConcentration_ugPerm3	Nitrate concentration	micrograms per cubic meter (µg/m ³)
SodiumConcentration_ugPerm3	Sodium concentration	micrograms per cubic meter (µg/m ³)
PotassiumConcentration_ugPerm3	Potassium concentration	micrograms per cubic meter (µg/m ³)
MagnesiumConcentration_ugPerm3	Magnesium concentration	micrograms per cubic meter (µg/m ³)

CalciumConcentration_ugPerm3	Calcium concentration	micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
ChlorideConcentration_ugPerm3	Chloride concentration	micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
SulfateConcentration_ugPerm3	Sulfate concentration	micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)
Delta15N_Ammonium	Nitrogen isotope ratio (15N/14N) of atmospheric ammonium (NH_4^+).	parts per thousand (permil) (‰)
Delta15N_Nitrate	Nitrogen isotope ratio (15N/14N) of atmospheric nitrate (NO_3).	parts per thousand (permil) (‰)

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Instruments

Dataset-specific Instrument Name	High-volume aerosol sampler operating at 1,200 L min ⁻¹ with 25 × 20 cm filters.
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	Discrete UV-Vis analyzer (Westco Smartchem 200)
Generic Instrument Name	Discrete Analyzer
Dataset-specific Description	Discrete UV-Vis analyzer (Westco Smartchem 200): for ammonium, nitrate, and nitrite concentrations.
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

Dataset-specific Instrument Name	Ion Chromatography (IC) (Dionex Integrion HPIC)
Generic Instrument Name	Ion Chromatograph
Dataset-specific Description	Ion Chromatography (IC) (Dionex Integrion HPIC): to measure chloride, sulfate, calcium, magnesium, sodium, and potassium concentrations.
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....)

Dataset-specific Instrument Name	Continuous Flow Isotope Ratio Mass Spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Continuous Flow Isotope Ratio Mass Spectrometer: for ammonium isotope values.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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Project Information

Collaborative Research: Characterization of Reactive Nitrogen in The North Pacific Atmosphere (North Pacific Atmos)

Coverage: coastal China atmosphere, Northwestern Pacific waters and atmos, Hawaii atmosphere

NSF Award Abstract:

Nitrogen is an essential element for life, and its availability can limit the growth of phytoplankton in the surface waters of the oceans. One source of nitrogen to surface waters is deposition from the atmosphere, which is the result of reactive nitrogen emissions from both human (anthropogenic) activities and natural processes. Anthropogenic nitrogen emissions to the atmosphere and nitrogen deposition to the oceans have increased exponentially since preindustrial times. In fact, global modeling studies have suggested that as much as 80% of total nitrogen deposition to the oceans is anthropogenic in origin, and that the magnitude of input to the global oceans rivals estimates of biological nitrogen fixation. The impacts associated with this increased nitrogen deposition are clear in both terrestrial and coastal systems, but the implications for open ocean biogeochemistry are less well studied. Recent work in the North Pacific Ocean (NPO) has suggested that increased nitrogen due to anthropogenic atmospheric deposition is detectable even in the open ocean, while other work can explain nutrient dynamics based upon natural biological and physical processes. The investigators propose to study the influence of both anthropogenic and natural sources on the deposition of nitrogen (as nitrate, ammonium, and organic nitrogen) in the NPO. This will be based on collection of aerosol and rainwater samples year-round at two sites: (1) Chang-Dao Island, China where they expect high

anthropogenic nitrogen inputs; and (2) Oahu, Hawaii where they expect marine sources to dominate. They will also collect ship-based samples in the marine boundary layer via already planned short-term research cruises in each season. In addition to the scientific outcomes, this project will provide for human resources and professional development of the team members (faculty members, a graduate student, undergraduate student, and technicians), advance international collaborations, and contribute to education and public outreach. Identifying the sources of nitrogen deposition to the open ocean is crucial for understanding anthropogenic impacts on biogeochemical cycles. A primary question is, is nitrogen deposition the result of external, anthropogenic processes or does it represent recycled nitrogen from the ocean's point of view? The specific objectives of this project are to: characterize the atmospheric composition and sources of inorganic (ammonium and nitrate) and organic nitrogen with an emphasis on seasonality; diagnose the influence of air-sea exchange versus anthropogenic sources of nitrogen on atmospheric deposition; and determine the isotopic composition of gaseous and particulate inorganic nitrogen in the marine boundary layer via ship-based sample collections in the NPO. Using concentration and isotopic measurements of reactive nitrogen species, in addition to transport and chemical box modeling, the study aims to characterize nitrogen deposition in two locations with very different source influences. This study will provide the first comprehensive, seasonal analysis of the isotopic values of reactive nitrogen species in the NPO atmosphere where nitrogen deposition is considered intense. Ultimately this project will lead to a better understanding of how anthropogenic changes in the atmospheric nitrogen cycle may influence the biogeochemistry of the surface ocean as well as the composition of the marine atmosphere. 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.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851318
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851343

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