Kāne'ohe Bay SF_6 and Rhodamine WT data

Website: https://www.bco-dmo.org/dataset/1003412
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2026-08-03

Project
» Collaborative Research: Influence of wind and bottom generated turbulence on air-sea gas exchange in shallow water environments (Gas exchange in shallow ocean environments)

Programs
» Ocean Carbon and Biogeochemistry (OCB)
» United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Contributors	Affiliation	Role
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Abstract
A tracer release experiment using SF_6 and Rhodamine WT was conducted between 15 and 19 August 2022 in the Kāne'ohe Bay, Hawaii, USA. SF_6 concentrations were measured using a gas chromatograph equipped with an electron capture detector (GC-ECD) connected with a headspace system. The concentrations of Rhodamine WT were measured with a YSI EXO1 sonde with a Rhodamine sensor.

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Coverage

Location: Kāne'ohe Bay, Hawaii, USA
Spatial Extent: **N**:21.46721 **E**:-157.7881 **S**:21.46384 **W**:-157.79634
Temporal Extent: 2022-08-17 - 2022-08-20

Methods & Sampling

We conducted tracer release experiments using SF_6 and a dye. We bubbled SF_6 into a 2-liter (L) plastic bottle that was half-filled with seawater from the bay. After adding 2 L of Rhodamine WT (20% solution) to a 20-L carboy, we filled the carboy with bay water and the SF_6-infused water. We gently released this tracer-enriched water into the Kāne'ohe Bay at the study site in the morning (~19:30 UTC; ~9:30 local time) from 15 to 19 August (year day (YD) 227 to 231) 2022.

We slowly traversed the tracer patch multiple times, collecting discrete water samples for SF_6 while continuously measuring Rhodamine WT within the patch. Following the procedures of Ho et al. (2000), we

collected each SF_6 sample using a 50 milliliter (mL) glass syringe, with 30 mL of water drawn into the syringe. We submerged the syringes in a water-filled cooler for later measurements in the laboratory. We collected ~4 discrete SF_6 samples during each transect. We measured Rhodamine WT every 5 seconds using a YSI EXO1 sonde with a Rhodamine sensor. The sensor has a detection range of 0 to 1,000 micrograms per liter (µg L^{-1}, with an accuracy of 0.1 µg L^{-1}. We recorded data from the Rhodamine sensor using a GPS-equipped computer to track the precise time and location of each measurement. Sampling continued until the tracer patch exited the area of interest (~5 hours).

In the laboratory, we created a headspace in each syringe with UHP nitrogen gas (N_2) and shook each one for at least 3 minutes to achieve equilibration. After equilibration, we injected the sample gas into a sample loop, using magnesium perchlorate $(MgClO_4)_2$ to remove water vapor. We then transferred the loop contents to a mol sieve 5A column at 60 degrees Celsius (°C) to separate SF_6 and other gases, and measured SF_6 concentrations using a gas chromatograph equipped with an electron capture detector (GC-ECD; Shimadzu GC-8A). Measurement reproducibility was within 4%.

Data Processing Description

No data processing was conducted.

BCO-DMO Processing Description

currently being processed

Problem Description

There are no known issues.

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Related Publications

Ho, D. T., Asher, W. E., Bliven, L. F., Schlosser, P., & Gordan, E. L. (2000). On mechanisms of rain-induced air-water gas exchange. Journal of Geophysical Research: Oceans, 105(C10), 24045–24057. Portico. https://doi.org/10.1029/1999jc000280
Methods

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	Date and time (Coordinated Universal Time: UTC) in ISO 8601 format.	unitless
SF6_fmol_L	sulfur hexafluoride concentration	femtomoles per liter (fmol/L)

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Instruments

Dataset-specific Instrument Name	gas chromatograph (Shimadzu GC-8A)
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	A gas chromatograph equipped with an electron capture detector (GC-8A, SHIMADZU).
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	YSI EXO1
Generic Instrument Name	YSI EXO multiparameter water quality sondes
Dataset-specific Description	YSI EXO1 sonde with a Rhodamine, temperature, and salinity sensor.
Generic Instrument Description	Comprehensive multi-parameter, water-quality monitoring sondes designed for long-term monitoring, profiling and spot sampling. The EXO sondes are split into several categories: EXO1 Sonde, EXO2 Sonde, EXO3 Sonde. Each category has a slightly different design purpose with the EXO2 and EXO3 containing more sensor ports than the EXO1. Data are collected using up to four user-replaceable sensors and an integral pressure transducer. Users communicate with the sonde via a field cable to an EXO Handheld, via Bluetooth wireless connection to a PC, or a USB connection to a PC. Typical parameter specifications for relevant sensors include dissolved oxygen with ranges of 0-50 mg/l, with a resolution of +/- 0.1 mg/l, an accuracy of 1 percent of reading for values between 0-20 mg/l and an accuracy of +/- 5 percent of reading for values 20-50 mg/l. Temp ranges are from-5 to +50 degC, with an accuracy of +/- 0.001 degC. Conductivity has a range of 0-200 mS/cm, with an accuracy of +/-0.5 percent of reading + 0.001 mS/cm and a resolution of 0.0001 - 0.01 mS/cm.

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Project Information

Collaborative Research: Influence of wind and bottom generated turbulence on air-sea gas exchange in shallow water environments (Gas exchange in shallow ocean environments)

Coverage: Kāneʻohe Bay, Hawai'i

NSF Award Abstract:
Air-sea transfers of energy and gases are critically important for predictions of short-term weather, as well as long term climate trends. Over the past decades, considerable effort has been devoted to parameterizing these fluxes in terms of widely measured variables such as wind speed. However, these parameterizations are inadequate in shallow coastal regions where fetch, waves, and bottom-generated turbulence influence the physical mechanisms responsible for the air-sea fluxes, which have implications for our ability to understand important environmental processes such as coral reef metabolism or carbon cycling. Furthermore, shallow coastal water ecosystems are susceptible to anthropogenic pollution, leading to hypoxia or anoxia. In order to understand the future states of these ecosystems that are exposed to continued anthropogenic perturbations, biogeochemical budgets and fluxes have to be established, including exchanges across the air-

water interface, i.e., they require quantitative knowledge of factors controlling gas exchange. This project will measure the air-sea gas fluxes and multiple physical variables contributing to their variability in a shallow coral reef. It is anticipated that the results from this study will yield improved understanding of the influence of physical processes such as wind, currents, waves on producing surface-, and bottom-driven turbulence, and how they control air-sea gas exchange in shallow coastal waters. They should also allow these processes to be parameterized in terms of easily measured environmental variables such as wind speeds, current velocities, and water depth. On a more local level, the PIs will continue their efforts toward disseminating scientific understanding in the field of physical and chemical oceanography by participating in undergraduate research opportunities, local science events targeted at K-12 students, and graduate student advising. This project will provide multidisciplinary training to two graduate students, and an undergraduate student.

A series of experiments will be performed over two consecutive years on the barrier reef of Kane'ohe Bay, Hawaii to determine factors that control gas exchange in shallow ocean environments. During the experiment, gas transfer velocities will be measured with tracers (N2O, SF6, Rhodamine WT) and eddy covariance of CO2, along with concurrent measurements of processes such as wind, current, waves and turbulence. With the data collected in Kane'ohe Bay, the PIs will: (i) Assess when or whether it is valid to apply open ocean wind speed/gas exchange parameterizations to shallow water environments (ii) Improve our understanding of how physical processes such as wind, currents, waves interact with the shallow bottom to produce surface-, and bottom-driven turbulence (iii) Examine how surface and bottom generated turbulence control air-sea gas exchange in shallow coastal waters (iv) Parameterize gas exchange in shallow water environments in terms of easily measured environmental variables such as wind speeds, current velocities, and water depth.

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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Program Information

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.

United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Website: http://www.us-solas.org/

Coverage: Global

The Surface Ocean Lower Atmosphere Study (SOLAS) program is designed to enable researchers from different disciplines to interact and investigate the multitude of processes and interactions between the coupled ocean and atmosphere.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds, and also weather and hazards that are affected by processes at the surface ocean.

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Physical, chemical, and biological research near the ocean-atmosphere interface must be performed in synergy to extend our current knowledge to adequately understand and forecast changes on short and long time frames and over local and global spatial scales.

The findings obtained from SOLAS are used to improve knowledge at process scale that will lead to better quantification of fluxes of climate relevant compounds such as CO2, sulfur and nitrogen compounds, hydrocarbons and halocarbons, as well as dust, energy and momentum. This activity facilitates a fundamental understanding to assist the societal needs for climate change, environmental health, weather prediction, and national security.

The US SOLAS program is a component of the International SOLAS program where collaborations are forged with investigators around the world to examine SOLAS issues ubiquitous to the world's oceans and atmosphere.

Â» International SOLAS Web site

Science Implementation Strategy Reports

US-SOLAS (4 MB PDF file)
Other SOLAS reports are available for download from the US SOLAS Web site

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829911
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829657
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829993

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