Vertical gas concentrations in exposed carbonate sand beach in Marathon, FL measured on Jun 6th, 2022

Website: https://www.bco-dmo.org/dataset/986654
Data Type: Other Field Results
Version: 1
Version Date: 2025-11-14

Project
» Quantification of sedimentary oxygen and carbon dioxide dynamics in a dry sandy beach affected by macroalgae deposition (Sargassum)

Contributors	Affiliation	Role
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Abstract
This project addresses carbon conversion processes in sandy beaches. To assess gas concentration gradients between the atmsphere and the beach sediment, vertical gas concentration profiles were measured below the beach sediment surface. Gas (custom probes) and temperature probes (PT100) were placed at 2.5 cm above the sediment and at -5, -15 and -25 cm below the sediment surface. Pore gas was extracted from the sediment using a syringe pump (150 ml max. volume). Gas concentrations were measured with a LI-840A. The instrument recorded CO2 concentration, (ppm) and H2O concentration, (ppt).

Table of Contents

Coverage

Location: Public Beach in Marathon/Florida Keys (24 43.807 N, 081 00.056 W)
Spatial Extent: **Lat**:24.7301166667 **Lon**:-81.0009333333
Temporal Extent: 2022-06-06

Methods & Sampling

Study Site

The study site used in this project is an exposed carbonate sand beach located at the Public Beach in Marathon/Florida Keys (24 43.807 N, 081 00.056 W). The beach sand is composed of porous biogenic carbonate grains. Air temperature ranges from 14 to 38˚C, water temperature from 22 to 31˚C. The tidal range is 0.6 m.

Measurements

Gas (custom probe, 70 cm long, 5 mm diameter) and temperature probes (PT100) were placed at 5 cm above the sediment and at -5, -15 and -25 cm below the sediment surface. Pore gas was extracted from the

sediment using a syringe pump (150 ml max. volume). After extraction of gas from the sediment, a set of stopcocks was used to switch the flow path of the syringe pump from the respective probe to a Pyroscience flow-through O_2 optode installed in series with a Licor840A gas analyzer, where the CO_2 concentrations were measured.

Data Processing Description

After the initial calibration, the Pyroscience FireSting-O2 meter produces O_2 concentrations logged in user-selectable units.

The LI-840A CO_2/H_2O Gas Analyzer internally calculates CO_2 and H_2O gas concentrations and its output gives CO_2 concentrations in µmol per mole of air (ppm), and H_2O in mmol per mole of air (ppt). No further data processing is required, as the CO_2 concentrations provided by the instrument correspond to the actual CO_2 concentrations in the pore space of the sand.

BCO-DMO Processing Description

- Imported "220606_2 O2 and CO2 profiles Marathon.xlsx" sheets 1 and 2 into the BCO-DMO system
- Joined (outer join) both sheets on "Site", "Latitude", "Longitude", "Profile", "Date", "Time", "Depth"
- Converted "Date" and "Time" to ISO 8601 Datetime format in EST/EDT, "ISO_DateTime_Local"
- Converted "Date to ISO 8601 YYYY-MM-DD format
- Converted "ISO_DateTime_Local" to "ISO_DateTime_UTC"
- Converted "Latitude" and "Longitude" to degree decimals
- Replaced spaces in parameter names with underscores, in compliance with BCO-DMO guidelines
- Exported file as "986654_v1_marathon_gas_profiles.csv"

Problem Description

A potential issue with gas measurements close to the beach surface is the potential contamination of the pore gas by air drawn into the sediment when extracting the gas. This was prevented by covering the sediment surface with a gas-impermeable carbonate sheet during the extraction process.

[table of contents | back to top]

Data Files

File	
986654_v1_marathon_gas_profiles.csv	(Comma Separated Values (.csv), 204.16 KB) MD5:9efe2f42f0cda4d3b37b91d760a20445
Primary data file for dataset ID 986654, version 1	

[table of contents | back to top]

Parameters

Parameter	Description	Units
Site	Name of study site	unitless
Latitude	Latitude of study site, positive is North	decimal degrees
Longitude	Longitude of study site, negative is West	decimal degrees
Profile	Number of the profile	unitless
Date	Date of study	unitless
Time	Time in hour, minute, second (EST/EDT)	unitless
ISO_DateTime_Local	Date and time of sample collection in ISO 8601 format in Eastern Time (EST/EDT)	unitless
ISO_DateTime_UTC	Date and time of sample collection in ISO 8601 format in UTC	unitless
Depth	Sediment depth in centimeter	Centimeter (cm)
CO2	Carbon dioxide concentration	Parts per million (ppm)
H2O	Water concentration	Parts per thousand (ppt)
Temperature	Temperature of gas sampled	degrees Celsius
Oxygen	Oxygen concentration	Percent air saturation (% air saturation)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	LI-840A CO2/H2O Gas Analyzer
Generic Instrument Name	LI-COR LI-840A CO2/H2O gas analyser
Dataset-specific Description	Carbon dioxide and moisture was measured with a LI-840A CO2/H2O Gas Analyzer is an infrared (NDIR) gas analyzer based on a single path, dual wavelength, infrared detection system. The CO2 and H2O measurements are a function of the absorption of IR energy as it travels through the optical path. Concentration measurements are based on the difference ratio in the IR absorption between a reference and sample signal. The instrument uses digital signal processing techniques to determine the temperature and pressure corrected CO2 concentration. The data output provides CO2 concentrations in µmol per mole of air (ppm), and H2O in mmol per mole of air (ppt).
Generic Instrument Description	The LI-840A is an absolute, non-dispersive infrared gas analyser based on single path, dual wavelength and thermostatically controlled infrared detection system. Operating temperature range of -20 to +40 deg C. CO2 is measured in the range 0-20,000 ppm with an accuracy of better than 1 percent of the reading. H2O is measured in the range 0-60 ppt with an accuracy of better than 1.5 percent of reading.

Dataset-specific Instrument Name	Pyroscience FireSting-O2 meter
Generic Instrument Name	Oxygen Sensor
Dataset-specific Description	Pore gas oxygen concentrations were measured with a Pyroscience FireSting-O2 meter. This instrument is a PC-controlled (USB) fiber-optic oxygen meter can read optical oxygen sensors. It allows automatic temperature compensation of the oxygen measurements in samples with varying temperatures.
Generic Instrument Description	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed

[table of contents | back to top]

Project Information

Quantification of sedimentary oxygen and carbon dioxide dynamics in a dry sandy beach affected by macroalgae deposition (Sargassum)

NSF Award Abstract:
Sandy beaches provide habitat for endangered species, protect the coast, and are appreciated for their high social and economic values. They are facing escalating anthropogenic pressures through coastal development, nutrient increases and global warming, which in recent years led to the development of extensive seaweed blooms that deposit massive amounts of algae on sandy beaches worldwide. This project investigates the fate of the deposited algae and their influence on the biogeochemical environment of the beach.

The decay of the algae locally depletes oxygen in the beach and produces toxic sulfides and high concentrations of ammonia that harm beach organisms, pollute nearshore waters and deter tourists. Research in this project quantifies biogeochemical and transport processes that control the algal decomposition. Generating these data is prerequisite for developing models that can predict the impact of the massive macroalgal deposition and thereby support decision making and coastal management. The project research is tightly linked to an educational component with instruction of graduate and undergraduate

students in marine biogeochemical methods, and a dedicated outreach program informing the public about the seaweed issue and pathways to reduce this problem.

The project produces data on the dynamics of oxygen and carbon dioxide distribution and interfacial gas flux in the dry, supralittoral zone (between high tide line and dunes) of sandy beaches and determines how distributions and fluxes are influenced by the degradation of the macroalgae. Organic carbon and nitrogen profiling characterizes the biogeochemical sedimentary environment at the two study sites, a carbonate and a silicate beach. A set of laboratory experiments relates gas fluxes to the degradation rate of buried macroalgal layers and the effects of gas exchange, temperature and moisture. The data will allow estimates of the time frame of the algal decomposition process and provide information on the degradation capacity of sandy beaches. Since beach sedimentary O2 and CO2 dynamics and fluxes are largely undescribed, the project data contribute to the mechanistic and quantitative understanding of carbon and nutrient cycling in sandy beaches.

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]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2049177

[table of contents | back to top]