

# Sensor measurements for dissolved inorganic carbon from the Sage Lot Pond salt marsh tidal creek in Waquoit Bay, MA from July to December 2015

**Website:** <https://www.bco-dmo.org/dataset/768607>

**Data Type:** Other Field Results

**Version:** 1

**Version Date:** 2019-05-23

## Project

» [Collaborative Research: The Paradox of Salt Marshes as a Source of Alkalinity and Low pH, High Carbon Dioxide Water to the Ocean: A First In-depth Study of A Diminishing Source](#) (Salt Marsh Paradox)

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## Abstract

Sensor measurements for dissolved inorganic carbon from the Sage Lot Pond salt marsh tidal creek in Waquoit Bay, MA from July to December 2015. DIC was measured with an autonomous sensor called CHANnelized Optical Sensor (CHANOS).

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## Coverage

**Spatial Extent:** Lat:41.5546 Lon:-70.5071

**Temporal Extent:** 2015-07-07 - 2015-12-18

## Methods & Sampling

Samples were collected from the Sage Lot Pond salt marsh tidal creek in Waquoit Bay, MA at approx. 41.5546N, 70.5071W.

In situ, high-frequency sensors for DIC and salinity were deployed at the mouth of the tidal creek in Sage Lot Pond at the latitude and longitude listed in the location above. DIC was measured with an autonomous sensor called CHANnelized Optical Sensor (CHANOS). An EXO2 Multiparameter Sonde (YSI Inc., Yellow Springs, OH) was submerged in the tidal creek to measure temperature and salinity. The YSI EXO2 recorded at intervals ranging from 2 min to 8 min. Reported YSI EXO2 sensor accuracy specifications are: 1% of the reading for salinity and 0.05 °C for temperature. CHANOS was placed on a platform atop the marsh adjacent to the creek with the inlet pumping from the creek at the same depth and within 30 cm of the EXO2 Sonde. This setup avoided any interference by CHANOS on water flow in the creek. There is no significant concentration

difference with depth in the creek (data not shown). In order to prevent fouling, sample water was filtered by a 100µm plastic disc filter (Keller Products, Acton, MA) followed by a copper mesh filter. CHANOS was powered by two 12 V batteries that were charged with two 250W solar panels (Renogy, Ontario, CA).

CHANOS uses spectrophotometric principles to measure DIC and pH using two independent channels (Wang et al., 2015). Briefly, CHANOS consisted of syringe pumps for delivery of reagents, junction boxes containing valves, thermistors, and optical and fluidic components for DIC and pH analysis, and an electronics housing, as well as reagent bags for storage of CRM, hydrochloric acid, reference solution, and pH- sensitive indicator solution. For this study, only [DIC] measurements were used. The DIC channel uses an improved spectrophotometric method described in detail in Wang et al. (2013) whereby a countercurrent flow configuration between acidified seawater and a pH-sensitive indicator solution in a tube-in-tube design achieves fast, continuous CO<sub>2</sub> equilibration across highly CO<sub>2</sub>-permeable Teflon AF 2400 tubing. After CO<sub>2</sub> exchange in the countercurrent flow cell, the indicator solution is directed into an optical cell for detection. Each measurement cycle is ~15min. The system achieved a precision of  $\sim \pm 2.5 \mu\text{mol kg}^{-1}$  and an accuracy of  $\sim \pm 5.0 \mu\text{mol kg}^{-1}$  during coastal deployments (Wang et al., 2015).

## Data Processing Description

CHANOS was calibrated autonomously both in the laboratory and in situ with CRM over the range of temperatures at which field measurements were conducted. CHANOS [DIC] measurements were corrected based on discrete bottle samples. Discrete bottle samples were collected over 2–3 days during each CHANOS deployment in July and December 2015. Bottle samples were matched to CHANOS measurements taken within 8 min of each other. After correction, the mean residual between CHANOS and bottle measurements was  $0 \pm 44 \mu\text{mol kg}^{-1}$  with  $n = 30$  and  $r^2 = 0.86$  for all points. Discrete bottle sample data and metadata are submitted in a separate dataset.

All EXO<sub>2</sub> sensors were cleaned and calibrated regularly according to manufacturer recommended methods to maintain performance, and antifouling measures were deployed including copper and automated wiping. After a deployment period of 2–4 weeks, YSI EXO<sub>2</sub> 2015 data were evaluated for fouling and calibration drift, similar to Wang et al. (2016) YSI data from 2012 to 2014. The YSI EXO<sub>2</sub> was recalibrated and a correction factor based on calibration standards was applied linearly across the deployment as needed. A maximum correction up to  $\pm 30\%$  of the calibration value was allowed or otherwise discarded (Wagner et al., 2006). Salinity and temperature values were interpolated to match the same time as the CHANOS measurement.

BCO-DMO Processing:

- modified parameter names (replaced spaces with underscores; removed units of measurement);
- converted original dates and times to ISO8601 format.

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## Data Files

| File   |
|--|
| <b>chanos.csv</b> (Comma Separated Values (.csv), 136.07 KB)<br>MD5:40b1735c9717ea1240b01f1e99d387a5 |
| Primary data file for dataset ID 768607  |

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## Related Publications

Chu, S. N., Wang, Z. A., Gonneea, M. E., Kroeger, K. D., & Ganju, N. K. (2018). Deciphering the dynamics of inorganic carbon export from intertidal salt marshes using high-frequency measurements. *Marine Chemistry*, 206, 7–18. doi:[10.1016/j.marchem.2018.08.005](https://doi.org/10.1016/j.marchem.2018.08.005)  
*Results*

Wagner, R. J., Boulger, R. W., Oblinger, C. J., & Smith, B. A. (2006). Guidelines and standard procedures for continuous water-quality monitors: Station operation, record computation, and data reporting. *Techniques and*

Methods. doi:10.3133/tm1d3 <https://doi.org/10.3133/tm1D3>  
*Methods*

Wang, Z. A., Chu, S. N., & Hoering, K. A. (2013). High-Frequency Spectrophotometric Measurements of Total Dissolved Inorganic Carbon in Seawater. *Environmental Science & Technology*, 47(14), 7840–7847.  
doi:[10.1021/es400567k](https://doi.org/10.1021/es400567k)  
*Methods*

Wang, Z. A., Kroeger, K. D., Ganju, N. K., Gonneea, M. E., & Chu, S. N. (2016). Intertidal salt marshes as an important source of inorganic carbon to the coastal ocean. *Limnology and Oceanography*, 61(5), 1916–1931.  
doi:[10.1002/lno.10347](https://doi.org/10.1002/lno.10347)  
*Results*

Wang, Z. A., Sonnichsen, F. N., Bradley, A. M., Hoering, K. A., Lanagan, T. M., Chu, S. N., ... Camilli, R. (2015). In Situ Sensor Technology for Simultaneous Spectrophotometric Measurements of Seawater Total Dissolved Inorganic Carbon and pH. *Environmental Science & Technology*, 49(7), 4441–4449. doi:[10.1021/es504893n](https://doi.org/10.1021/es504893n)  
*Methods*

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## Parameters

| Parameter        | Description   | Units                             |
|------------------|---|-----------------------------------|
| ISO_DateTime_UTC | Date and time (UTC) formatted to ISO8601 standard. Format: yyyy-mm-ddTHH:MM | unitless                          |
| TEMPERATURE      | Water temperature   | degrees Celsius                   |
| SALINITY         | Water salinity  | practical salinity scale          |
| CHANOSDIC        | Dissolved inorganic carbon  | micromoles per kilogram (umol/kg) |

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## Instruments

|   |   |
|---|---|
| <b>Dataset-specific Instrument Name</b> | CHANnelized Optical Sensor  |
| <b>Generic Instrument Name</b>          | CHANnelized Optical Sensor  |
| <b>Generic Instrument Description</b>   | CHANOS uses spectrophotometric principles to measure DIC and pH using two independent channels (Wang et al., 2015). Briefly, CHANOS consisted of syringe pumps for delivery of reagents, junction boxes containing valves, thermistors, and optical and fluidic components for DIC and pH analysis, and an electronics housing, as well as reagent bags for storage of CRM, hydrochloric acid, reference solution, and pH- sensitive indicator solution. Refer to Wang et al. (2015) doi: 10.1021/es504893n |

|   |   |
|---|---|
| <b>Dataset-specific Instrument Name</b> | EXO2 Multiparameter Sonde (YSI Inc., Yellow Springs, OH)  |
| <b>Generic Instrument Name</b>          | YSI EXO multiparameter water quality sondes   |
| <b>Generic Instrument Description</b>   | 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: The Paradox of Salt Marshes as a Source of Alkalinity and Low pH, High Carbon Dioxide Water to the Ocean: A First In-depth Study of A Diminishing Source (Salt Marsh Paradox)**

**Coverage:** Sage Lot Pond salt marsh tidal creek in Waquoit Bay, MA at approx. 41.5546N, -70.5071W

### *NSF Award Abstract:*

Carbon production in vegetated coastal systems such as marshes is among the highest in the biosphere. Resolving carbon production from marshes and assessing their impacts on coastal carbon cycling are critical to determining the long-term impacts of global change such as ocean acidification and eutrophication. In this project, researchers will use new methods to improve the assessment of carbon production from salt marshes. The overarching goals are to understand the role of coastal wetlands in altering carbonate chemistry, alkalinity, and carbon budgets of the coastal ocean, as well as their capacity to buffer against anthropogenically driven chemical changes, such as ocean acidification. This project will involve training for undergraduate, graduate, and postdoctoral researchers, and will provide educational opportunities for students from a local Native American tribe.

Tidal water, after exchange with intertidal salt marshes, contains higher total alkalinity (TA), higher carbon dioxide, but lower pH. These highly productive, vegetated wetlands are deemed to export both alkalinity and dissolved inorganic carbon (DIC) to the ocean. This creates an apparent paradox in that salt marshes are both an acidifying and alkalizing source to the ocean. Limited studies suggest that marsh DIC and alkalinity export fluxes may be a significant player in regional and global carbon budgets, but the current estimates are still far too uncertain to be conclusive. Unfortunately, tidal marsh ecosystems have dramatically diminished in the recent past, and are likely to diminish further due to sea level rise, land development, eutrophication, and other anthropogenic pressures. To assess the potential impacts of this future change, it is imperative to understand its current status and accurately evaluate its significance to other parts of the carbon cycle. Similarly, little is known about the distinct sources of DIC and alkalinity being exported from marshes via tidal exchange, although aerobic and various anaerobic respiration processes have been indicated. In this study, researchers will undertake an in-depth study using new methods to vastly improve export fluxes from intertidal salt marshes through tidal exchange over minutes to annual scales, characterize and evaluate the composition (carbonate versus non-carbonate alkalinity) of marsh exported TA, the role and significance of the DOC pool in altering carbonate chemistry and export fluxes, identify sources of DIC being exported in tidal water, and investigate how marsh export of TA and DIC impacts carbonate chemistry and the carbon and alkalinity budgets in coastal waters.

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## Funding

| Funding Source   | Award                       |
|--|-----------------------------|
| <a href="#">NSF Division of Ocean Sciences (NSF OCE)</a> | <a href="#">OCE-1459521</a> |

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