Cell abundances for taxonomic groups from manually corrected live Imaging FlowCytobot (IFCB) analysis of water samples collected from surface and chlorophyll maximum depths during R/V Pt. Sur cruise PS 18-09 in the western Gulf of Mexico, Sept-Oct 2017

Website: https://www.bco-dmo.org/dataset/840060
Data Type: Cruise Results
Version: 1
Version Date: 2021-02-08

Project
» RAPID: Hurricane Impact on Phytoplankton Community Dynamics and Metabolic Response (HRR)

Contributors	Affiliation	Role
Campbell, Lisa	Texas A&M University (TAMU)	Principal Investigator
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Abstract
Cell abundance data for taxonomic groups at seven stations from live Imaging FlowCytobot (IFCB) analysis of water samples collected from surface and chlorophyll maximum depths during R/V Pt. Sur PS 18-09, western Gulf of Mexico, Sept-Oct 2017. These data were inspected visually and manually corrected.

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Coverage

Spatial Extent: **N**:29.0649 **E**:-94.9 **S**:27.2286 **W**:-97.268
Temporal Extent: 2017-09-23 - 2017-10-01

Acquisition Description

On each of 2 cruise legs 01 and 03, samples were collected at 7 stations (S01, S06, S11, S16, S21, SS and GI) from 2 depths [surface and chlorophyll maximum depth when possible; see HRR-bottle data]) by CTD-rosette. At each station, triplicate 5-ml samples pre-filtered through 150 µm Nitex were analyzed immediately with an onboard Imaging FlowCytobot. All image data can be viewed on the TOAST dashboard: https://toast.tamu.edu/timeline?dataset=HRR_cruise.

Image analysis and feature extraction were performed using software developed by Sosik and colleagues which is available on github (https://github.com/hsosik/ifcb-analysis/). The automated classification approach of Sosik & Olson (2007), as modified and described by Anglès et al. (2019), was employed and the automated classification results were then inspected visually and **manually** corrected into a total of 102 categories that included 35 categories of diatoms, 30 categories of dinoflagellates, 10 categories of ciliates, 10 categories of flagellates, and 17 ‘others’, which included filamentous cyanobacteria, freshwater chlorophytes, coccolithophorids, and small cells that could not be identified taxonomically from images (refer to Fiorendino et al. 2021. for more details).

For comparison with the Texas Observatory for Algal Succession Time series (TOAST), IFCB images were also classified automatically into one of 112 classes utilizing a custom convolutional neural network (**CNN**) trained on a curated set of images (Henrichs et al. 2021.). See related dataset.

Biomass for each image was estimated using the algorithm developed by Moberg & Sosik (2012) to calculate cellular volume from the extracted image features and then convert to total carbon per image (Menden-Deuer & Lessard 2000) and summed for each class. See related dataset.

Sampling locations:

<table>
<tr><th>Sample ID</th><th>Station</th><th>Leg</th><th>Location
Lat ^{o}N/Long ^{o}W</th></tr>
<tr><td>L1_S01</td><td>S01</td><td>1</td><td rowspan="2">27.2286 -97.2686</td></tr>
<tr><td>L3_S01</td><td>S01</td><td>3</td></tr>
<tr><td>L1_S06</td><td>S06</td><td>1</td><td rowspan="2">27.8358 -96.9874</td></tr>
<tr><td>L3_S06</td><td>S06</td><td>3</td></tr>
<tr><td>L1_S11</td><td>S11</td><td>1</td><td rowspan="2">28.2614 -96.4129</td></tr>
<tr><td>L3_S11</td><td>S11</td><td>3</td></tr>
<tr><td>L1_S16</td><td>S16</td><td>1</td><td rowspan="2">28.5366 -95.8656</td></tr>
<tr><td>L3_S16</td><td>S16</td><td>3</td></tr>
<tr><td>L1_S21</td><td>S21</td><td>1</td><td rowspan="2">28.7644 -95.2978</td></tr>
<tr><td>L3_S21</td><td>S21</td><td>3</td></tr>
<tr><td>L1_SS</td><td>SS</td><td>1</td><td rowspan="2">28.9600 -95.0946</td></tr>
<tr><td>L3_SS</td><td>SS</td><td>3</td></tr>
<tr><td>L1_GI</td><td>GI</td><td>1</td><td rowspan="2">29.0649 -94.9000</td></tr>
<tr><td>L3_GI</td><td>GI</td><td>3</td></tr>
</table>

Processing Description

- BCO-DMO Processing Notes:
- data submitted in Excel file "manual_count_ifcb.xlsx" sheet "Cell abundance" extracted to csv
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- rounded values to 2 decimal places

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Related Publications

Anglès, S., Jordi, A., Henrichs, D. W., & Campbell, L. (2019). Influence of coastal upwelling and river discharge on the phytoplankton community composition in the northwestern Gulf of Mexico. Progress in Oceanography, 173, 26–36. doi:10.1016/j.pocean.2019.02.001
Results

Fiorendino, J.M., Ganokar, C.C., Henrichs, D.W., Thyng, K.M., and Campbell L. (2021) Coastal plankton community composition and diversity after a massive flooding event: the response to Hurricane Harvey. Limnology & Oceanography
Results

Henrichs, D.W., Anglès, S., Gaonkar, C.C. and Campbell, L. (2020) Application of a convolutional neural network to improve automated early warning of harmful algal blooms. Environmental Science and Pollution Research (in press)
Results

Menden-Deuer, S., & Lessard, E. J. (2000). Carbon to volume relationships for dinoflagellates, diatoms, and other protist plankton. Limnology and Oceanography, 45(3), 569–579. doi:10.4319/lo.2000.45.3.0569
Methods

Moberg, E. A., & Sosik, H. M. (2012). Distance maps to estimate cell volume from two-dimensional plankton images. Limnology and Oceanography: Methods, 10(4), 278–288. doi:10.4319/lom.2012.10.278
Methods

Olson, R. J., & Sosik, H. M. (2007). A submersible imaging-in-flow instrument to analyze nano-and microplankton: Imaging FlowCytobot. Limnology and Oceanography: Methods, 5(6), 195–203. doi:10.4319/lom.2007.5.195
Methods

Sosik, H. M., & Olson, R. J. (2007). Automated taxonomic classification of phytoplankton sampled with imaging-in-flow cytometry. Limnology and Oceanography: Methods, 5(6), 204–216. doi:10.4319/lom.2007.5.204
Methods

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Related Datasets

IsRelatedTo

Campbell, L., Henrichs, D. W. (2021) **Biomass data for taxonomic groups from manually corrected live Imaging FlowCytobot (IFCB) analysis of water samples collected from surface and chlorophyll maximum depths during R/V Pt. Sur PS 18-09, western Gulf of Mexico, Sept-Oct 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-02-08 http://lod.bco-dmo.org/id/dataset/840147 [view at BCO-DMO]

Campbell, L., Henrichs, D. W. (2021) **Cell abundance data for taxonomic groups using a custom convolutional neural network from live Imaging FlowCytobot (IFCB) at seven stations from surface and chlorophyll maximum depths during R/V Pt. Sur PS 18-09, western Gulf of Mexico, Sept-Oct 2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-02-08 http://lod.bco-dmo.org/id/dataset/840201 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Major_Category	5 major groups of microplankton	unitless

Class	Taxonomic names of the species or genus (if known) or group identified	unitless
L1GI_1	Cell abundance of class at Leg 1 station GI; replicate 1	cells/milliliter
L1GI_2	Cell abundance of class at Leg 1 station GI; replicate 2	cells/milliliter
L1GI_3	Cell abundance of class at Leg 1 station GI; replicate 3	cells/milliliter
L1SS_1	Cell abundance of class at Leg 1 station SS; replicate 1	cells/milliliter
L1SS_2	Cell abundance of class at Leg 1 station SS; replicate 2	cells/milliliter
L1SS_3	Cell abundance of class at Leg 1 station SS; replicate 3	cells/milliliter
L1S21_1	Cell abundance of class at Leg 1 station S21; replicate 1	cells/milliliter
L1S21_2	Cell abundance of class at Leg 1 station S21; replicate 2	cells/milliliter
L1S21_3	Cell abundance of class at Leg 1 station S21; replicate 3	cells/milliliter
L1S16_1	Cell abundance of class at Leg 1 station S16; replicate 1	cells/milliliter
L1S16_2	Cell abundance of class at Leg 1 station S16; replicate 2	cells/milliliter
L1S16_3	Cell abundance of class at Leg 1 station S16; replicate 3	cells/milliliter
L1S11_1	Cell abundance of class at Leg 1 station S11; replicate 1	cells/milliliter
L1S11_2	Cell abundance of class at Leg 1 station S11; replicate 2	cells/milliliter
L1S11_3	Cell abundance of class at Leg 1 station S11; replicate 3	cells/milliliter
L1S06_1	Cell abundance of class at Leg 1 station S06; replicate 1	cells/milliliter
L1S06_2	Cell abundance of class at Leg 1 station S06; replicate 2	cells/milliliter
L1S06_3	Cell abundance of class at Leg 1 station S06; replicate 3	cells/milliliter
L1S01_1	Cell abundance of class at Leg 1 station S01; replicate 1	cells/milliliter
L1S01_2	Cell abundance of class at Leg 1 station S01; replicate 2	cells/milliliter
L1S01_3	Cell abundance of class at Leg 1 station S01; replicate 3	cells/milliliter
L3GI_1	Cell abundance of class at Leg 3 station GI; replicate 1	cells/milliliter
L3GI_2	Cell abundance of class at Leg 3 station GI; replicate 2	cells/milliliter
L3GI_3	Cell abundance of class at Leg 3 station GI; replicate 3	cells/milliliter
L3SS_1	Cell abundance of class at Leg 3 station SS; replicate 1	cells/milliliter
L3SS_2	Cell abundance of class at Leg 3 station SS; replicate 2	cells/milliliter
L3SS_3	Cell abundance of class at Leg 3 station SS; replicate 3	cells/milliliter
L3S21_1	Cell abundance of class at Leg 3 station S21; replicate 1	cells/milliliter
L3S21_2	Cell abundance of class at Leg 3 station S21; replicate 2	cells/milliliter
L3S21_3	Cell abundance of class at Leg 3 station S21; replicate 3	cells/milliliter
L3S16_1	Cell abundance of class at Leg 3 station S16; replicate 1	cells/milliliter
L3S16_2	Cell abundance of class at Leg 3 station S16; replicate 2	cells/milliliter
L3S16_3	Cell abundance of class at Leg 3 station S16; replicate 3	cells/milliliter
L3S11_1	Cell abundance of class at Leg 3 station S11; replicate 1	cells/milliliter
L3S11_2	Cell abundance of class at Leg 3 station S11; replicate 2	cells/milliliter
L3S11_3	Cell abundance of class at Leg 3 station S11; replicate 3	cells/milliliter
L3S06_1	Cell abundance of class at Leg 3 station S06; replicate 1	cells/milliliter

L3S06_2	Cell abundance of class at Leg 3 station S06; replicate 2	cells/milliliter
L3S06_3	Cell abundance of class at Leg 3 station S06; replicate 3	cells/milliliter
L3S01	Cell abundance of class at Leg 3 station S01	cells/milliliter

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Used to collect samples
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Image FlowCytobot (McLane Research Laboratories, Inc.)
Generic Instrument Name	Imaging FlowCytobot
Generic Instrument Description	The Imaging FlowCytobot (IFCB) is an in-situ automated submersible imaging flow cytometer that generates images of particles in-flow taken from the aquatic environment. https://mclanelabs.com/imaging-flowcytobot/

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Deployments

PS1809

Website	https://www.bco-dmo.org/deployment/784313
Platform	R/V Point Sur
Start Date	2017-09-23
End Date	2017-10-01
Description	HRR study with three legs. Chief Scientists: Steve DiMarco (Leg 1); Kristen Thyng (Leg 2); Lisa Campbell (Leg 3)

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Project Information

RAPID: Hurricane Impact on Phytoplankton Community Dynamics and Metabolic Response (HRR)

Coverage: Texas coast

This project was recently funded by NSF award OCE-1760620. More information will be added as it becomes available.

Project summary from NSF RAPID proposal:
Overview: Tropical cyclones (hurricanes and tropical storms) can produce substantial impacts in marine ecosystems, including alteration of tidal regimes, upwelling, vertical mixing, sediment resuspension, and terrestrial runoff that affect estuaries, coastal areas and the open ocean. The drastic perturbations following tropical cyclones have also been shown to produce immediate shifts in phytoplankton community composition. High temporal resolution observations from the Imaging FlowCytobot (IFCB) revealed that hurricanes in the Gulf of Mexico (GOM) initially caused blooms of diatoms, which subsequently were replaced by blooms of dinoflagellates. This change in the community structure was hypothesized to be related to the ability of dinoflagellates compared to diatoms to assimilate organic nitrogen compounds supplied by the high river discharge that resulted from the rainfall. This RAPID project will address two hypotheses:
1. Community structure will be a flagellate-dominated system as long as the high river discharge continues. Community structure will shift to a diatom-dominated system when environmental conditions return to normal. Continuous, high temporal resolution data from the IFCB time series will provide estimates of abundance and biovolume to assess the temporal variability of phytoplankton from the aftermath of the hurricane until the return to normal conditions.
2. Nitrogen will be the main driver of shifts in community metabolic responses.
Analysis of gene expression profiles, environmental conditions, and water quality parameters will provide a time series of metabolic functional responses. Metatranscriptomic analysis may also provide insight into taxa-specific metabolic responses related to nutrient and other environmental stresses as a consequence of Hurricane Harvey.

We propose two rapid response cruises to sample at 5 sites along a transect from Galveston to Port Aransas. At each station, CTD profiles and water samples from surface and the chlorophyll maximum for nutrient and carbonate chemistry analysis and RNA sequencing will be collected. Concurrently, the IFCB will operate continuously onboard for comparison with the ongoing time series at Surfside Beach. If the water column is strongly stratified, samples will be collected at the low salinity surface layer and the high salinity deeper layer. Time series analyses of the response of the phytoplankton community will include high frequency data of physical and hydrological variables, water quality measurements, and metatranscriptome analyses. Results will provide novel insights on the impact that extreme hurricanes exert on the phytoplankton community and ultimately in ecosystem functioning and resilience.

Intellectual Merit: Hurricane Harvey is the strongest hurricane to hit the GOM in decades; therefore, the impact of this hurricane on the phytoplankton community may be unprecedented in terms of response and duration. It is unknown how the phytoplankton community will respond and the time to return to "normal" condition. Immediate high temporal resolution sampling is the only way to fully capture the effects of tropical cyclones on coastal phytoplankton communities. And, in combination with metatranscriptomic analysis, the time series of metabolic responses can be elucidated.

Broader Impacts: If extreme storms are predicted to increase with future climate change, the taxa-specific responses provided by the IFCB time series are tremendously valuable for detecting changes, which have implications for ecosystem functioning. Over the past decade, the high temporal resolution phytoplankton time series at TOAST has proven to be invaluable in providing early warning for 8 harmful algal blooms. Given the unknown impact of Hurricane Harvey on the Texas coast (or the duration of the impact), the IFCB time series are invaluable to resource managers. Time series data have been successfully implemented into undergraduate Oceanography laboratory courses at TAMU to teach the value of ocean observing and assessment to the students' lives. Data from this Hurricane Harvey rapid response will also be included in future problem sets for students. As a strategy for targeting general audiences, outcomes of this project will also be produced for "On the Ocean", a weekly radio program on KAMU, the public radio station on TAMU campus; podcasts are also archived linked to the Oceanography department's website.

Related data from the The Texas Observatory for Algal Succession Time-Series (TOAST) can be found at the following: https://toast.tamu.edu/timeline?dataset=HRR_cruise

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1760620

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