CTD data collected for surface and bottom samples from all five stations along the transect from Charlotte Harbor to offshore in southwest Florida from May to September 2023

Website: https://www.bco-dmo.org/dataset/1004016
Data Type: Cruise Results
Version: 1
Version Date: 2026-08-06

Project
» RAPID: Collaborative Research: Unprecedented Hurricane Ian Nutrient and Organic Matter Inputs to Southwest Florida Coastal Waters (RAPID: Ian Inputs)

Contributors	Affiliation	Role
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Abstract
This RAPID project, a collaboration between C. Heil and E. Hall (Mote Marine Laboratory) and P. Glibert and M. Li (University of Maryland Center for Environmental Science), examined the overarching hypothesis that the massive terrestrial inorganic and organic carbon and nutrient inputs to the southwest Florida coastal and shelf region from Hurricane Ian were priming this oligotrophic system for extensive phytoplankton blooms as well as significant changes in carbon chemistry and nutrient cycling that will lead to longer term regional hypoxia and anoxia. We measured a suite of water quality, carbon and nutrient parameters, as well as carbon and nutrient cycling at stations in Charlotte Harbor and the adjacent inner WFS system over four sampling efforts (May 2023, August 2023, September 2023 and October 2024) to examine how fast changes and recovery occurs in this system and the relationship of these hurricane inputs to hypoxia, anoxia and ocean acidification. This dataset includes the CTD data collected on the RV Mote from all five stations along the transect from Charlotte Harbor to offshore in southwest Florida over three of the sampling periods post-hurricane Ian (May 2023, August 2023, and September 2023). These data contribute to the understanding of how Hurricane Ian impacted biogeochemistry, blooms, and dissolved oxygen of the region.

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Coverage

Location: Southwest Florida coastal waters
Spatial Extent: **N**:26.90528 **E**:-82.1404 **S**:26.5107 **W**:-82.4424
Temporal Extent: 2023-05-02 - 2023-09-07

Methods & Sampling

Sampling Plan: Four sampling efforts were conducted (May 2023, August 2023, September 2023, October 2024; note CTD data are not reported from 2024), focusing on five stations located from Charlotte Harbor to the adjacent inner West Florida Shelf (WFS) system directly impacted by Hurricane Ian and the resulting plumes using Mote's R/V Mote (42 ft). At each station, water column CTD profiles of temperature, salinity, dissolved oxygen, and pH were made by lowering the CTD to 5 centimeters (cm) below the water surface and allowing to equilibrate for 2 minutes, then lowering the CTD to 0.5 meters (m) above the bottom. Discrete surface and bottom water samples were collected by Niskin bottles during each cast and analyzed for the biological and chemical parameters and rates listed in the accompanying dataset. CTD data were downloaded immediately upon return to the laboratory each day and data were processed within one week of collection (Seasoft V2 2018).

A Sea-Bird CTD unit was used for measurements of Conductivity, Temperature, and Depth. Specific instruments used were:
Seabird 19 plus v2;
43 oxygen sensor,
18 ph sensor;
Par sensor logic;
Eco flurnet puck;
55 controller.

Data Processing Description

CTD data were processed using SBEData Processing software (Seasoft V2, 2018), following the software recommendations for compensating for sensor thermal mass, sensor alignment, timing offset (the delay associated with pumped sensors, i.e., conductivity), and changes in instrument velocity (due to ship heave). Data were binned (~0.2 m increments) to smooth data variability and downloaded to Excel.

BCO-DMO Processing Description

- Imported data from the original file "RAPID Cruise CTD data -all samples, all stations combined as CSV.csv" into the BCO-DMO processing system.
- Marked "-9.99E-29" as a missing data value (missing values are empty/blank in the final CSV file).
- Renamed columns to comply with BCO-DMO naming conventions.
- Converted local date/time columns into a UTC ISO 8601 datetime column "ISO_DateTime_UTC", applying a fixed US/Eastern (EDT) input timezone offset because all observed timezone labels were EDT.
- Converted the same local date/time columns into a local ISO 8601 datetime column "ISO_DateTime_Local" without timezone conversion.
- Removed the original separate date and time columns.
- Saved the final file as "1004016_v1_ctd.csv".

Problem Description

Note that while four sampling efforts were conducted (May 2023, August 2023, September 2023, October 2024), CTD data are not reported from 2024.

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Related Publications

Chen, Y., & Li, M. (2025). Impact of Hurricane Ian (2022) on *Karenia brevis* Bloom on the West Florida Shelf. Geophysical Research Letters, 52(6). Portico. https://doi.org/10.1029/2024GL113500
Results

Chen, Y., Li, M., Glibert, P. M., & Heil, C. (2023). Mu*r*K*y* waters: Modeling the succession from *r* to *K* strategists (diatoms to dinoflagellates) following a nutrient release from a mining facility in Florida. Limnology and Oceanography, 68(10), 2288–2304. Portico. https://doi.org/10.1002/lno.12420
Results

Glibert, P. M., Heil, C. A., & Li, M. (2025). More sustained, more severe blooms and shifting monthly patterns of the toxigenic dinoflagellate Karenia brevis on the West Florida Shelf. Harmful Algae, 150, 102967. https://doi.org/10.1016/j.hal.2025.102967
Results

Glibert, P. M., Heil, C. A., & Li, M. (2026). Climate shifts and anthropogenic footprints driving increased severity and duration of toxic Karenia brevis blooms in the Gulf of Mexico over the past ~50 years. Frontiers in Marine Science, 13. https://doi.org/10.3389/fmars.2026.1769349
Results

Seasoft V2 (2018) Seasoft version 2.4.0. Available at: https://www.seabird.com/software.
Software

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Related Datasets

IsRelatedTo

Heil, C., Hall, E., Glibert, P. A., Li, M. (2026) **Chemical and biological data collected for surface and bottom samples from all five stations along the transect from Charlotte Harbor to offshore in southwest Florida over the four sampling periods post-hurricane Ian during 2023-2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-08-07 http://lod.bco-dmo.org/id/dataset/1003828 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Cruise	Cruise ID number	unitless
Station	Station number	unitless
Scan	Scan Length	unitless
ISO_DateTime_UTC	Date and time (UTC) in ISO 8601 format	unitless
ISO_DateTime_Local	Date and time (local, EDT) in ISO 8601 format	unitless
PrdM	Pressure, Strain Gauge	db
Latitude	Latitude	decimal degrees

Longitude	Longitude	decimal degrees
DNMEA	Depth, from NMEA navigational device	meters
Tv290C	calibrated temperature from the CTD sensor	degrees Celsius
C0S_m	Conductivity	Siemens m-1
FlECO_AFL	Fluorescence	mg L-1
TurbWETntu0	Turbidity	NTU
Sbeox0V	Oxygen sensor voltage (raw signal)	volts (V)
Par_sat_log	Photosynthetically Active Radiation (PAR)	umol photons m-2 s-1
Ph	pH (-log (H+))	unitless
Sal00	salinity derived from conductivity, temperature, and pressure	PSU
Sigma_t00	water density relative to freshwater	kg/m^3 – 1000
DepSM	Depth calculated from pressure	meters
OxsatMg_L	Oxygen saturation, theoretical maximum oxygen at that temperature/salinity	mg L-1
Potemp090C	temperature adjusted to reference pressure (surface)	degrees Celsius
Sbeox0Mg_L	Dissolved Oxygen	mg L-1
Sbeox0PS	Oxygen, percent saturation	percent
Dz_dtM	vertical speed of CTD	m s-1
Nbin	Number of samples averaged per bin	unitless
Flag	Data quality flag indicates bad or questionable data points. 0.00E+00 indicates a good value	unitless

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Instruments

Dataset-specific Instrument Name	Par sensor logic
Generic Instrument Name	Photosynthetically Available Radiation Sensor
Generic Instrument Description	A PAR sensor measures photosynthetically available (or active) radiation. The sensor measures photon flux density (photons per second per square meter) within the visible wavelength range (typically 400 to 700 nanometers). PAR gives an indication of the total energy available to plants for photosynthesis. This instrument name is used when specific type, make and model are not known.

Dataset-specific Instrument Name	18 ph sensor
Generic Instrument Name	Sea-Bird SBE 18 pH Sensor
Generic Instrument Description	A pH sensor using a pressure-balanced glass-electrode Ag_AgCl-reference pH probe to provide in-situ measurements at depths up to 1200m. The replaceable pH probe is permanently sealed and is supplied with a soaker bottle attachment that prevents the reference electrode from drying out during storage.

Dataset-specific Instrument Name	Seabird 19 plus v2
Generic Instrument Name	Sea-Bird SBE 19plus V2 SEACAT CTD
Generic Instrument Description	Self-contained self-powered CTD profiler. Measures conductivity, temperature and pressure (Digiquartz sensor) in both profiling (samples at 4 scans/sec) and moored (sample rates of once every 5 seconds to once every 9 hours) mode. Available in plastic or titanium housing with depth ranges of 600m and 7000m respectively. Miniature submersible pump provides water to the conductivity cell. Compared to the previous 19plus, the V2 incorporates an electronics upgrade and additional features, with six differentially amplified A/D input channels, one RS-232 data input channel, and 64 MB FLASH memory.

Dataset-specific Instrument Name	43 oxygen sensor
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. More information from the manufacturer: https://www.seabird.com/products/sbe-43-dissolved-oxygen-sensor

Dataset-specific Instrument Name	Eco flurnet puck
Generic Instrument Name	Wet Labs ECO Puck
Generic Instrument Description	The Puck is a miniature version of the ECO series of sensors, specifically designed for use in AUVs, profiling floats, and Slocum gliders with a dry science bay. This compact optical sensor is available in combinations of backscattering and fluorescence measurements.

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Project Information

RAPID: Collaborative Research: Unprecedented Hurricane Ian Nutrient and Organic Matter Inputs to Southwest Florida Coastal Waters (RAPID: Ian Inputs)

NSF Award Abstract:
Many coastal systems are facing the threats of continuing development and climate change, including an increased intensity of extreme weather events such as hurricanes. Such storms are now wetter than in prior years because warmer atmospheres hold more moisture. Thus, they release more rainfall and deliver more nutrients and organic matter to coastal areas. This, in turn, leads to phytoplankton blooms with potential for regional “dead zones” or areas with little or no dissolved oxygen. Hurricane Ian, a category 4 hurricane which hit southwest Florida in late September 2022, resulted in immense nutrient and organic carbon inputs to the coastal estuaries and southwest Florida shelf waters and presents an opportunity to examine the effects of a major storm disturbance on a coastal system that is under increasing coastal nutrient stress. The objective of this RAPID project is to examine carbon and nutrient cycling along a gradient of stations from the estuary to low-nutrient shelf waters to determine the rate of change and recovery in this system and the relationship of large hurricane inputs to hypoxia, anoxia, and ocean acidification. These data are being used to develop a regional model to predict the impact of future hurricanes on ocean acidification, phytoplankton blooms, and local hypoxia and anoxia. This study leverages ongoing monitoring programs funded by state and federal management agencies, as well as NSF-supported programs for undergraduate students. It provides partial support for training of postdoctoral investigators and a graduate student. Outreach will include presentations to elementary and high school students.

In September 2022, southwest Florida experienced a direct hit from category-4 Hurricane Ian, resulting in extensive watershed flooding and nutrient- and dissolved-organic-matter-laden estuarine plumes extending more than 50 miles onto the shallow oligotrophic west Florida shelf (WFS). The massive terrestrial organic carbon and nutrient inputs to the southwest Florida coastal and shelf region may be priming this oligotrophic system for extensive phytoplankton blooms, as well as significant changes in carbon chemistry and nutrient cycling that could lead to longer-term regional hypoxia and anoxia. In this RAPID project, the investigators are measuring a suite of carbon and nutrient parameters, as well as carbon and nutrient cycling, at stations in Charlotte Harbor and the adjacent inner WFS system in December 2022, February 2023, and September 2023. The objectives are to assess: 1) a timescale of system responses from shorter (weeks to months) to 1-year impacts post-hurricane; 2) how nutrient availability and forms influence hypoxia; and 3) how hurricane-driven inputs influence carbonate chemistry in this system, specifically the connection between acidification and hypoxia. The investigators are using new data collected in this study and monitoring data from regional state and federal programs in a coupled hydrodynamic-biogeochemical model to understand conditions on the WFS. Hindcast simulations and modeling experiments are assessing how large inputs of nutrients and organic matter affect phytoplankton, oxygen conditions, and carbon chemistry. Modeling experiments are exploring how storms of varying wind and precipitation intensity affect the WFS and estuaries, identifying the tipping point at which the WFS switches from episodic to persistent hypoxia.

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-2309081

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