Tilt Current Meter data from a post-urban fire water quality study in Lahaina, West Maui, Hawaii from Oct 2023 to Mar 2024

Website: https://www.bco-dmo.org/dataset/1001896
Data Type: Other Field Results
Version: 1
Version Date: 2026-06-26

Project
» RAPID: Coral reef stress responses to an urban fire (Reef stress urban fire)

Contributors	Affiliation	Role
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Abstract
These data include water current velocity and direction measurements recorded by Lowell Instrument Tilt Current Meters TCM-4. This dataset was collected as part of a coastal water quality study using sensors to measure salinity, conductivity, temperature, pressure, water flow direction and velocity, dissolved oxygen, pH, chlorophyll, and turbidity. Sensors were all deployed in West Maui in coral reef systems that were within and adjacent to the burn zone of the Lahaina fires. The temporal range of deployments in the project spans from October of 2023 to October of 2024 with this dataset spanning from October of 2023 to March of 2024. The aim of these data is to understand the effects on coral reef health in response to the urban fires that occurred in August of 2023. Samples were collected by a collaborative effort of scientists Dr. Andrea K Kealoha, Dr. Craig Nelson, Dr. Eileen Nalley, and Dr. Nicholas Hawco. These high-resolution time series provide critical baseline and post-disturbance information for assessing short and long-term environmental change. The dataset is intended to support ongoing monitoring efforts and inform management strategies aimed at enhancing reef resilience and recovery.

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Coverage

Location: Lahaina, Maui, Hawai'i 20.878525, -156.683746
Spatial Extent: **N**:20.93726 **E**:-156.60764 **S**:20.80881 **W**:-156.69354
Temporal Extent: 2023-10-06 - 2024-03-02

Methods & Sampling

Sensors were deployed within the benthic reef system at the listed sites.

Lowell Instrument Tilt Current Meters TCM-4:

Each meter was configured and calibrated using Lowell Instrument's TCM-4 software prior to deployment. Meters were set to record at one minute intervals in "tilt mode," which calculates current velocity and direction based on deviations from vertical.

Data Processing Description

Quality control processing was carried out in python.

Data was plotted to calculate delta (the rate of change between each pair of data points)

Regions of bad data to exclude using the following criteria:

1. Sensor is out of the water (identified visually by sudden drop in pressure)

2. Rapid changes in temperature (large deltas, indicates sensor out of water)

3. Drastic sensor drift (Example: negative values, or regions of data over long periods of time with a slope)

BCO-DMO Processing Description

- Loaded site list table from lahaina_site_list.csv with missing values flagged as "" and "nd"
- Loaded current data table from lahaina_TCM_current_data_concatenated.csv as 1001896_v1_lahaina-tcm with missing values flagged as "" and "nd"
- Applied initial metadata (descriptions, units) to columns ISO 8601 Time, Speed (cm/s), Heading (degrees), Velocity-N (cm/s), Velocity-E (cm/s), filename, sensor_serial, and site_description in 1001896_v1_lahaina-tcm
- Renamed columns: ISO 8601 Time to ISO_DateTime_UTC, Speed (cm/s) to Speed, Heading (degrees) to Heading, Velocity-N (cm/s) to Velocity_N, Velocity-E (cm/s) to Velocity_E, site_description to Site_Name
- Converted ISO_DateTime_UTC from format %Y-%m-%dT%H:%M:%SZ (UTC) to datetime output in the same format (UTC)
- Set types: ISO_DateTime_UTC as datetime, Speed/Heading/Velocity_N/Velocity_E as number, Site_Name/filename/sensor_serial as string
- Replaced Site_Name values to match naming conventions used in site list and other project datasets: "Kahoma_outflow_reef" → "Kahoma outflow reef", "Lahaina_harbor" → "Lahaina Harbor", "Baby_beach" → "Baby Beach"
- Joined site_list table into 1001896_v1_lahaina-tcm on Site_Name (half-outer join), adding Site_ID (from source Site_ID), Site_Lat (from source Latitude), and Site_Lon (from source Longitude) to add the site identifier for consistency with other project data and to make the dataset more geospatial ready; Site_Lat and Site_Lon represent the general site position, not necessarily the exact sensor deployment location
- Updated metadata (descriptions, standard name IDs, units, primary parameter flags) for all columns including ISO_DateTime_UTC, Speed, Heading, Velocity_N, Velocity_E, Site_Name, Site_ID, Site_Lat, Site_Lon, filename, and sensor_serial
- Output written to 1001896_v1_lahaina-tcm.csv

Supplemental files:
* Supplemental site and deployment tables formatted from listed information provided in the original dataset

submission metadata section "Location." Added as lahaina_site_list.csv and lahaina_sensor_deployment.csv. These tables list all sites and deployments of the related datasets in the study.

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Related Datasets

IsRelatedTo

Kealoha, A., Calil, P. H., Hawco, N. J., Masessa, G., Mattos, J., Nalley, E., Nelson, C. E., Summers, T., Swift, S., Peterman, J., Rohrbaugh, N., Tegler, L. (2026) **HydroCAT data from a post-urban fire water quality study in Lahaina, West Maui, Hawaii from Nov 2023 to Feb 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-06-26 http://lod.bco-dmo.org/id/dataset/1001844 [view at BCO-DMO]
Relationship Description: Lahaina sensor deployment datasets conducted as part of the same study. These datasets all contain the same lahaina_site_list.csv and lahaina_sensor_deployment.csv tables which includes supplemental site and deployment information for all these related datasets.

Kealoha, A., Calil, P. H., Hawco, N. J., Masessa, G., Mattos, J., Nalley, E., Nelson, C. E., Summers, T., Swift, S., Peterman, J., Rohrbaugh, N., Tegler, L. (2026) **Sea and Sun Sensor data from a post-urban fire water quality study in Lahaina, West Maui, Hawaii from Nov 2023 to Feb 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-06-26 http://lod.bco-dmo.org/id/dataset/1001870 [view at BCO-DMO]
Relationship Description: Lahaina sensor deployment datasets conducted as part of the same study. These datasets all contain the same lahaina_site_list.csv and lahaina_sensor_deployment.csv tables which includes supplemental site and deployment information for all these related datasets.

Kealoha, A., Calil, P. H., Hawco, N. J., Masessa, G., Mattos, J., Nalley, E., Nelson, C. E., Summers, T., Swift, S., Peterman, J., Rohrbaugh, N., Tegler, L. (2026) **Temperature and dissolved oxygen from a post-urban fire water quality study in Lahaina, West Maui, Hawaii from Dec 2023 to Feb 2024.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2026-06-26 http://lod.bco-dmo.org/id/dataset/1001818 [view at BCO-DMO]
Relationship Description: Lahaina sensor deployment datasets conducted as part of the same study. These datasets all contain the same lahaina_site_list.csv and lahaina_sensor_deployment.csv tables which includes supplemental site and deployment information for all these related datasets.

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Parameters

Parameter	Description	Units
ISO_DateTime_UTC	ISO 8601 datetime with timezone (UTC time zone indicated by Z).	unitless
Speed	water speed	centimeters per second (cm/s)
Heading	direction (heading)	degrees
Velocity_N	current velocity North	centimeters per second (cm/s)
Velocity_E	current velocity East	centimeters per second (cm/s)
filename	file path	unitless
sensor_serial	serial number	unitless
Site_Name	site name (see supplemental site list file for more information)	unitless
Site_ID	Site identifier (see supplemental site list file for more information)	unitless
Site_Lat	General site latitude	decimal degrees
Site_Lon	General site longitude	decimal degrees

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Instruments

Dataset-specific Instrument Name	Lowell Instrument Tilt Current Meters TCM-4
Generic Instrument Name	Tilt Current Meter
Dataset-specific Description	This sensor tracks current velocity, direction, and temperature. It contains a tilt compensated compass for bearing measurements.
Generic Instrument Description	Tilt current meters are based upon the property that a tethered object will experience drag inside a current flow. If a restoring force perpendicular to the drag is introduced, the tethered object will tilt until the system of forces is balanced. Therefore, measuring the tilt allows calculation of drag force, from which current speed can be obtained. Measuring the direction of tilt gives current heading. Tilt current meters operate under the drag-tilt principle and are designed to either float or sink depending on the type. A floating tilt current meter typically consists of a sub-surface buoyant housing that is anchored to the sea floor with a flexible line or tether. A sinking tilt current meter is similar, but the housing is designed such that the meter hangs from the attachment point. In either case, the housing tilts as a function of its shape, buoyancy (negative or positive) and the water velocity. Once the characteristics of a housing is known, the velocity can be determined by measuring the angle of the housing and direction of tilt.

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Project Information

RAPID: Coral reef stress responses to an urban fire (Reef stress urban fire)

Coverage: Lahaina, Maui, Hawai'i

NSF Award Abstract:
Maui's coral reefs support subsistence, recreational, and commercial fishing, particularly for the large Native Hawaiian population. In August 2023, hurricane winds and low humidity combined with the recent drought to cause an unprecedented fire in Lahaina, an urban coastal town on the island of Maui. The fire quickly burned over 2170 acres and 2200 structures, releasing ash, particulate matter and potentially toxic materials into the adjacent coastal waters. This project provides novel information on the ecological impacts of wildfires to coral reefs to aid in climate change adaptation and emergency response planning. Cultural perspectives and traditional knowledge of Native Hawaiian community members are incorporated throughout the research process. The project directly supports four students, including a Native Hawaiian student, to participate in activities including field work, data collection, analyses and interpretation, and communication of research results.

A wildfire in an urban city located adjacent to a coral reef is unprecedented but may become more common as expanding shoreline development intersects with potentially increased fire risk with climate change. The overall objective of this study is to examine the direct effects of urban wildfires and associated potential stressors - such as reduced water quality, acidification, hypoxia, and heavy metals - on coral reef ecosystem function and the potential for regime shifts favoring benthic algae instead of corals. Using the 2023 Lahaina wildfire as a case study, the project employs a "before-after control-impact" design to compare three west Maui reefs both affected and unaffected by wildfire, with special attention to the anticipated remobilization of organic matter, toxic compounds (e.g., polycyclic aromatic hydrocarbons) and metals following rain events in autumn. Physical and chemical water parameters will constrain the reef-scale carbon cycle and coral metabolism before, during and after runoff events to document the ecological responses to urban fire impacts. This project will support three Early Career Researchers, contribute toward research training for multiple graduate and undergraduate students, and provide valuable information about contaminants and water quality to a community that relies heavily on coral reef resources.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2345201

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