Weather Station data from University of Washington Friday Harbor Laboratories, Friday Harbor WA, Cantilever Point from 2006 to 2024

Website: https://www.bco-dmo.org/dataset/491262
Data Type: Other Field Results
Version: 4
Version Date: 2025-02-26

Project
» The effects of temperature on ecological processes in a rocky intertidal community: a mechanistic approach (Intertidal Temp Effects)
» Collaborative Research: Microscale interactions of foundation species with their fluid environment: biological feedbacks alter ecological interactions of mussels (Microscale Mussels)

Contributors	Affiliation	Role
Carrington, Emily	University of Washington Friday Harbor Laboratories (FHL)	Principal Investigator, Contact
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes parameters measured by a weather station at the University of Washington Friday Harbor Laboratories, Friday Harbor WA, Cantilever Point from 2006 to 2024.

Table of Contents

Coverage

Spatial Extent: **Lat**:48.5461 **Lon**:-123.007
Temporal Extent: 2006-08-11 - 2024-12-31

Dataset Description

Data are collected at the Friday Harbor Laboratories (FHL) Weather Station University of Washington Friday Harbor Laboratories, Friday Harbor WA, Cantilever Point (Latitude = 48.5461 North; Longitude = -123.007 East).

Methods & Sampling

Data Gaps: all data streams
- June 20, 2007 to October 28, 2007: Lost data/failure to log data.
- November 25, 2009 to December 2, 2010: Weather station repaired after electrical storm.
- July 13, 2012 to July 27, 2012: Weather station repaired after electrical storm.

Data Gaps: Total Radiation

There are several gaps in the Total Radiometer data stream, due to instrument maintenance issues. These gaps are all filled with "nd":
- 2006 to August, 24 2009 23:59 software issue (calculation error)
- May 21, 2014 14:45 to May 22, 2014 9:45
- December 29, 2015 5:45 to January 3, 2016 12:15
- October 6, 2016 onward due to maintenance difficulties, the Total Radiometer was removed permanently.

Data calibration: Solar Radiation_PAR
The Solar Radiation_PAR meter drifted out of calibration from 2013 to 2021, evidenced by a steady decline in slope when the data were plotted against Solar Radiation_Energy. Rad_PAR were adjusted in these years using an annual correction factor that restored the expected linear relationship between Rad_PAR and Rad_Energy (2.112, the mean of slopes from 2006-2012). The correction factor for each year is a follows: 2013: 1.189, 2014: 1.235, 2015: 1.252, 2016: 1.254, 2017: 1.320, 2018: 1.336, 2019: 1.406, 2020: 1.366, 2021: 1.364.

Data availability:
Unverified data are live streamed to the FHL website: http://wx.fhl.washington.edu/vdv/VV_Frame.php

The most recent two months of unverified data are also streamed in near real-time at NANOOS (http://nvs.nanoos.org/Explorer) as asset FHL_friharbor1.

The data available here at BCO-DMO differ from the above in that they have been fully verified.

Data Processing Description

BCO-DMO Processing Notes:
Version 1:
Processed by BCO-DMO Data Manager Steve Gegg.
- Contains data from 2006 through 2014.
- Generated from original files contributed by Emily Carrington and Emily Roberts.
- Approx Lat/Lon of FHL Weather Station appended to enable data discovery in MapServer;
- Time Stamp split into separate Date and Time fields;
- Date formatted as YYYYMMDD;
- Time formatted as hhmmss;
- Parameter names were edited to conform to BCO-DMO naming conventions.

Version 2; updated on 2017-08-30:
Processed by BCO-DMO Data Manager Mathew Biddle.
- Contains additional data from 2015-01-01 through 2017-06-30 submitted by Emily Carrington.
- Time Stamp split into separate Date and Time fields;
- Date formatted as YYYYMMDD;
- Time formatted as hhmmss;
- Parameter names were edited to conform to BCO-DMO naming conventions;
- All "NaN" and "NAN" values were converted to "nd" to be compliant with the BCO-DMO system.

Version 3; updated on 2022-08-16:
Processed by BCO-DMO Data Manager Shannon Rauch.
- Contains additional data from 2017-01-01 through 2021-12-30.
- Generated from original files contributed by Emily Carrington and Grace Leuchtenberger.
- replaced #N/A" and "#VALUE!" with "nd" (no data);
- concatenated all files (one per year) into one dataset;
- converted all Time values to hhmmss format;
- added ISO8601 date-time fields (local and UTC);
- added Platform_Id, Lat, and Lon to the data;
- renamed fields to comply with BCO-DMO naming conventions.

Version 4; updated on 2025-02-26:
Processed by BCO-DMO Data Manager Shannon Rauch.
- Contains additional data from 2022-01-01 through 2024-12-31 submitted by Emily Carrington.
- Imported files "2022.xlsx", "2023.xlsx", and "2024.xlsx" into the BCO-DMO system.
- Concatenated the data files for 2022, 2023, and 2024.
- Added columns for Platform_Id, Lat, Lon, and Year to the new data files.
- Added ISO8601 date-time fields (local and UTC).

- Concatenated the new data with the version 3 data file.
- Saved the final file as "491262_v4_FHL_weather_station.csv".
- Note: in the final data file, "491262_v4_FHL_weather_station.csv", missing data ("no data") values are empty/blank.

[table of contents | back to top]

Data Files

File
491262_v4_FHL_weather_station.csv (Comma Separated Values (.csv), 82.72 MB) MD5:8ebfeddf6e2e78d05fbbbcf0276005cf Primary data file for dataset ID 491262, version 4

[table of contents | back to top]

Parameters

Parameter	Description	Units
Platform_ID	Name of data collection platform/site	unitless
Lat	Latitude position of platform (South is negative)	degrees North
Lon	Longitude position of platform (West is negative)	degrees East
Year	4-digit year of data collection	unitless
ISO_DateTime_UTC	Date and time (UTC) in ISO 8601 format	unitless
ISO_DateTime_PST	Date and time (local time zone of PST) in ISO 8601 format	unitless
Date_PST	Date (local time zone of PST) in format YYYYMMDD	unitless
Time_PST	Time (local time zone of PST) in format hhmmss	unitless
Air_Temp	Air Temperature; averaged over 15 minutes; sampled every 30 seconds	degrees Celsius
RH	Relative humidity; averaged over 15 minutes; sampled every 30 seconds	percent (%)
Rad_PAR	Solar Radiation_PAR; averaged over 15 minutes; sampled every 30 seconds	micromoles per square meter per second (?mol m-2 s-1)

Rad_Energy	Solar Radiation_Energy; averaged over 15 minutes; sampled every 30 seconds	watts per square meter (W m-2)
Rad_tot	Total Radiation (solar + sky); averaged over 15 minutes; sampled every 30 seconds. Note: Total Radiation Energy parameter data are reported only from August 25th 2009 to October 6th 2016.	watts per square meter (W m-2)
Rain	Rainfall; total over 15 minutes; sampled every 30 seconds	millimeters (mm)
Wind_speed	Wind Speed; averaged over 15 minutes; sampled every 30 seconds	meters per second (m s-1)
Wind_direction	Wind direction; averaged over 15 minutes; sampled every 30 seconds	degrees (relative to true N)
Wind_Chill	Wind Chill; averaged over 15 minutes; sampled every 30 seconds	degrees Celsius

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Friday Harbor Labs - Weather Station
Generic Instrument Name	Automated Weather Station
Dataset-specific Description	FHL Weather Station Contact: Emily Carrington (ecarring@uw.edu) University of Washington Friday Harbor Laboratories Friday Harbor WA, Cantilever Point Lat = 48.5461 Long = -123.007
Generic Instrument Description	Land-based AWS systems are designed to record meteorological information.

[table of contents | back to top]

Deployments

FHL_WeatherStation

Website	https://www.bco-dmo.org/deployment/491259
Platform	Friday_Harbor
Report	https://depts.washington.edu/fhl/wx.html
Start Date	2006-08-11
End Date	2017-06-30
Description	FHL Weather Station Contact: Emily Carrington University of Washington Friday Harbor Laboratories Friday Harbor WA, Cantilever Point Lat = 48.5461 Long = -123.007 Data Gaps Jun 20 2007 - Oct 28 2007: Lost data/failure to log data Nov 25 2009 - Dec 2 2010: Weather station repaired after electrical storm July 13 2012 - July 27 2012: Weather station repaired after electrical storm

[table of contents | back to top]

Project Information

The effects of temperature on ecological processes in a rocky intertidal community: a mechanistic approach (Intertidal Temp Effects)

Website: http://depts.washington.edu/nucella/

Coverage: San Juan Islands, Washington, USA

NSF Award Abstract:
Temperature influences organismal physiology, behavior, community interactions, and ecosystem function; yet rarely are the mechanisms understood. Accurately predicting the consequences of temperature for a species requires knowledge of: local climatic conditions, the relationship between climate and organismal body temperature, and the physiological and ecological consequences of body temperature. Few studies to date have explored all three areas concurrently. This project will examine in detail the biophysical, physiological, and ecological effects of temperature on a rocky intertidal community, a marine ecosystem that has emerged as a model system for studying the ecological consequences of temperature. It will focus on three major species, representative of rocky marine shore species worldwide: the barnacle, Balanus glandula, its predator Nucella ostrina, and the rockweed Fucus gardneri, which provides shelter for both species. The research is centered around three major goals: to develop biophysical models to explicitly link local climate to organismal body temperatures; to develop energy budget models to relate organismal body temperature to individual performance; and to identify the effect of temperature on interactions among the three species through a series of laboratory and field experiments. This research will provide a model system for understanding the effects of temperature on both individual performance and species interactions. It represents a significant contribution to understanding basic ecological questions, such as the role of temperature in structuring communities, and will also contribute to a more mechanistic understanding of the ecological consequences of future climate changes.

This research will promote a broader understanding of how temperature affects organisms and communities among scientists, students, and the general public in at least four ways. First, the research themes address a basic, yet poorly resolved, question in ecology: the influence of temperature on organismal performance and species interactions. This multiscale, integrated approach has the potential to transform current paradigms of how environmental change affects species and communities. Understanding the role of temperature in structuring communities is directly relevant to Biological Oceanography's special emphasis on biological diversity in marine systems. Second, the project is highly interdisciplinary by nature, and will forge new research partnerships among three female scientists (the PI, a postdoc, and a collaborator at an RUI institution) and will provide new educational opportunities for several graduate and undergraduate students. The investigators will offer undergraduate research opportunities to underrepresented groups with their continued participation in the FHL Blinks Program to Enhance Diversity each summer, and expect to provide several REU experiences as well (separate NSF proposal resubmission pending). Third, The PI will incorporate research results and techniques into her undergraduate and graduate courses at FHL and the UW Seattle campus. The FHL undergraduate course integrates public outreach into the curriculum; these activities are part

of FHL's broader Science Outreach Program that promotes science education and environmental stewardship. Finally, the results of this project will be incorporated into ongoing conservation and monitoring efforts conducted in the upper Puget Sound region by the University of Washington and the Friday Harbor Laboratories. The project will also enhance understanding of the ecological consequences of climate change, a significant societal problem.

Collaborative Research: Microscale interactions of foundation species with their fluid environment: biological feedbacks alter ecological interactions of mussels (Microscale Mussels)

Coverage: University of Washington Friday Harbor Laboratories

NSF Award Abstract:
The project investigates how the metabolic activity of dense aggregations of marine organisms alter the water chemistry of their interstitial spaces, and how these microscale alterations feedback to affect the organisms' interactions in coastal ecosystems. The research team focuses on bivalve mussels, foundation species that form dense 'beds' typically known for facilitating other species by ameliorating harsh flow conditions. This ability can become a liability, however, if flow is not sufficient to flush the interstitial spaces and steep, metabolically-driven concentration gradients develop. The research evaluates whether corrosive chemical microclimates (such as low oxygen or low pH) are most extreme in low flow, high temperature conditions, especially for dense aggregations of mussels with large biomass and/or high respiration rates, and if they negatively impact mussel beds and the diverse biological communities they support. The research addresses a global societal concern, the impact of anthropogenic climate change on coastal marine ecosystems, and has potential applications to aquaculture and biofouling industries by informing adaptation strategies to "future-proof" mussel farms in the face of climate change and improved antifouling practices for ships, moorings, and industrial cooling systems. The project forges new collaborations with investigators from three campuses and integrates research and education through interdisciplinary training of a diverse group of graduate, undergraduate and high school students. STEM education and environmental stewardship is promoted by the development of a K-12 level science curriculum module and a hand's-on public exhibit of bivalve biology at a local shellfish farm. Research findings are disseminated in a variety of forums, including peer-reviewed scientific publications and research presentations at regional, national and international meetings.

The research team develops a framework that links environmental conditions measured at a coarse scale (100m-100km; e.g., most environmental observatories) and ecological processes at the organismal scale (1 cm – 10 m). Specifically, the project investigates how aggregations of foundation species impact flow through interstitial spaces, and how this ultimately impacts water chemistry immediately adjacent to the organisms. The research focuses on mytilid mussels, with the expectation that the aggregation alters the flow and chemical transport in two ways, one by creating a physical resistance, which reduces the exchange, and the other by enhancing the exchange due to their incurrent/excurrent pumping. These metabolically-driven feedbacks are expected to be strongest in densely packed, high biomass aggregations and under certain ambient environmental conditions, namely low flow and elevated temperature, and can lead to a range of negative ecological impacts that could not be predicted directly from coarse scale measures of ambient seawater chemistry or temperature. The team develops computational fluid dynamic (CFD) models to predict interstitial flows and concentration gradients of dissolved oxygen and pH within mussel beds. The CFD model incorporates mussel behavior and physiological activity (filtration, gaping, respiration) based on published values as well as new empirical work. Model predictions are compared to flow and concentration gradients measured in mussel aggregations in the laboratory and field. Finally, the team conducts several short-term experiments to quantify some of the potential negative ecological impacts of corrosive interstitial water chemistry on mussel aggregations, such as reduced growth, increased dislodgement, increased predation risk, and reduced biodiversity. Because the model is based on fluid dynamic principles and functional traits, the framework is readily adaptable to other species that form dense assemblages, thereby providing a useful tool for predicting the ability of foundation species to persist and provide desirable ecosystem services under current and future multidimensional climate scenarios.

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-0824903
NSF Division of Ocean Sciences (NSF OCE)	OCE-2050273

[table of contents | back to top]