Oceans Melting Greenland (OMG) Narwhals Shipboard CTD Data, Ver. 1

User's Guide

Data Set

OMG Narwhals Shipboard CTD Level 2 Data

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Abstract

NASA's Oceans Melting Greenland (OMG) campaign obtained oceanographic observations around Greenland at an unprecedented spatial scale and confirmed that the ocean plays a key role in Greenland glacier acceleration and retreat. Yet, ocean observations along Greenland's margins are biased toward summer months with relatively few year-round measurements. OMG Narwhals, a project coupled with NASA's OMG mission, seeks to understand the ecological importance of glacial habitats to narwhals. Narwhals return to glacial outlets and fjords each summer with high site fidelity but what attracts them to specific glacier fronts remains unclear. **Seafloor-mounted ocean moorings with marine mammal acoustic recorders and oceanographic instruments were deployed near three glacier fronts with known narwhal presence in Melville Bay, northwest Greenland. This OMG Narwhals dataset contains measurements from the ship based full water column CTD profiles that were obtained during summer mooring deployment/recovery cruises.**

Citation

This research was conducted by the University of Washington, the Greenland Institute of Natural Resources, and the Jet Propulsion Laboratory, managed by the California Institute of Technology under a contract with the National Aeronautics and Space Administration. Use of these data should be cited as follows:

Zahn MJ, Laidre KL, Simon MJ, Fenty I. 2023. OMG Narwhals Shipboard Conductivity, Temperature, and Depth (CTD) profiles, 2018-2020. Ver. 1. PO.DAAC, CA, USA. Dataset accessed [YYYY-MM-DD] at https://doi.org/10.5067/OMGNW-SHIP1

Contact

For questions about access to the data product please email podaac@podaac.jpl.nasa.gov or visit the PO.DAAC forum. For questions about the data product itself please email Marie Zahn, mzahn@uw.edu, or Ian Fenty, Ian.Fenty@jpl.nasa.gov.

Introduction

Mass loss of the Greenland ice sheet has contributed substantially to global sea level rise with impacts to local ecosystems and the global climate. The Greenland ice sheet connects to the ocean via hundreds of glaciers that terminate in deep troughs and valleys. These marine-terminating glaciers are important sites of heat transfer from the ocean to the ice through complex mechanisms shaped by the interaction between Arctic and Atlantic waters, local bathymetry, and atmospheric forcing. Over six years (2015–2021), NASA's Oceans Melting Greenland (OMG) mission studied ice-ocean interactions around the entirety of Greenland by measuring ocean temperature and salinity, bathymetry, and ice elevations along the continental shelf. While OMG obtained observations at an unprecedented spatial scale, they were largely restricted to summer months and therefore could not adequately capture seasonal variability.

OMG Narwhals, a project coupled with NASA's OMG mission and funded by the Office of Naval Research, deployed ocean moorings near three glacier fronts with known narwhal presence in Melville Bay, northwest Greenland spanning two years. The primary goal of OMG Narwhals is to understand the ecological importance of glacial habitats to narwhals. Greenland's coastal margins are rich ecosystems that host a variety of marine organisms from fish to marine mammals. Narwhals return to glacial outlets and fjords each summer with high site fidelity but what attracts them to specific glacier fronts remains unclear. Between 2018 and 2020, five bottom-mounted moorings with a suite of instrumentation were deployed year-round near three glacier fronts: Sverdrup Glacier, Kong Oscar Glacier, and Rink Glacier. The moorings carried equipment with two primary objectives: 1) identify Arctic toothed whale (beluga and narwhal) presence using passive acoustic recorders to record their sounds, and 2) describe year-round hydrographic variability using oceanographic instruments. Moored hydrographic measurements provide foundational knowledge about how Melville Bay marine ecosystems evolve throughout the year.

Examination of water properties at these sites demonstrate the presence and seasonality of warm, salty Atlantic Water intrusion into Melville Bay tidewater glaciers. These data will be used to investigate what physical properties of glacier front marine ecosystems attract narwhals. Results from this work increase our understanding of narwhal habitat-use and Greenland ice-ocean interactions and enable improvements in observation methods to better monitor Arctic whales and Greenland's surrounding oceans.

This Level 2 dataset contains hydrographic observations from CTD profiles in Melville Bay that were taken when moorings were deployed and recovered in August 2018, 2019, and 2020.

Campaigns

The OMG Narwhals field effort spanned three years (2018–2020) where moorings were deployed and/or recovered in August each year. All mooring operations were conducted aboard the R/V *Sanna*.

Level 2 Product Generation

Data files produced by the instruments (*.hex) were converted to *.cnv format using Seabird's SBE Data Processing software. Conversion of L0 (*.cnv) to L2 data was done in Python. The workflow used to generate these datasets is available on GitHub: https://github.com/mjzahn/OMG_Narwhals_hydrography-manuscript/.

Data Fields

Oceanographic Measurements

Conductivity

The conductivity variable contains sea water electrical conductivity measurements (S/m).

Salinity

The salinity variable contains sea water practical salinity (psu).

Temperature

The temperature variable contains sea water temperature measurements in °C.

Potential Temperature

The potential temperature variable contains sea water potential temperature measurements in °C.

Pressure

The pressure variable contains sea water pressure measurements in decibars.

Density

The density variable contains sea water density measurements in kg m^{-3}.

Sound Velocity

The sound velocity variable contains sea water sound speed measurements in kg m^{-3}.

Coordinate Fields

Time

Time is the start time when the CTD was deployed in UTC.

Latitude

The latitude of the profile location.

Longitude

The longitude of the profile location.

Depth

The ocean depth (positive=down) in meters of the CTD instrument for each hydrographic measurement.

Depth Correction

For 2018 and 2019, an issue with the pressure transducer produced erroneous measurements. A correction of +33 meters was made to depth measurements to adjust for the error. Recommended to use this corrected depth over the 'depth' coordinate.

NetCDF File Format

The file names for this dataset are of the form:

"OMG_Narwhals_Ocean_CTD_L2_<time_coverage_start>.nc"

where <time_coverage_start> is formatted as "YYYYMMDDhhmmss". The data files are in NetCDF format and are compliant with the Climate and Forecast (CF) Metadata Conventions.

Each data file contains the following **data variables** and **metadata**:
Note: variables and metadata denoted with an 'X' represent values that differ depending on the profile.

Dimensions and data variables:

dimensions:

depth = XXXX ;
profile = 1 ;

variables:

double **latitude**(profile) ;
latitude:long_name = "latitude" ;
latitude:standard_name = "latitude" ;
latitude:units = "degrees_north" ;
latitude:coverage_content_type = "coordinate" ;
latitude:axis = "Y" ;
latitude:valid_max = 90. ;
latitude:valid_min = -90. ;
latitude:comments = "Latitude of CTD location." ;

double **longitude**(profile) ;
longitude:long_name = "longitude" ;
longitude:standard_name = "longitude" ;
longitude:units = "degrees_east" ;
longitude:coverage_content_type = "coordinate" ;
longitude:axis = "X" ;
longitude:valid_max = 180. ;
longitude:valid_min = -180. ;
longitude:comments = "Longitude of CTD location." ;

int **time**(profile) ;
time:long_name = "time" ;
time:standard_name = "time" ;
time:axis = "T" ;
time:coverage_content_type = "coordinate" ;
time:comment = "Time at which the CTD was deployed." ;
time:units = "days since 2018-08-23 00:55:11" ;
time:calendar = "proleptic_gregorian" ;

double **depth**(depth) ;
depth:long_name = "depth" ;
depth:standard_name = "depth" ;
depth:units = "meters" ;
depth:positive = "down" ;
depth:axis = "Z" ;
depth:coverage_content_type = "coordinate" ;
depth:seabird_var_name = "depSM" ;

depth:valid_min = 0. ;
depth:valid_max = 3000. ;

double **depth_correction**(depth) ;
depth_correction:long_name = "corrected depth" ;
depth_correction:standard_name = "depth" ;
depth_correction:units = "meters" ;
depth_correction:positive = "down" ;
depth_correction:coverage_content_type = "coordinate" ;
depth_correction:seabird_var_name = "depSM" ;
depth_correction:valid_min = 0. ;
depth_correction:valid_max = 3000. ;
depth_correction:comment = "Additional depth coordinate that includes a correction of +33 meters." ;

double **pressure**(depth) ;
pressure:_FillValue = 9.96920996838687e+36 ;
pressure:long_name = "sea water pressure" ;
pressure:standard_name = "sea_water_pressure" ;
pressure:units = "dBar" ;
pressure:coverage_content_type = "physicalMeasurement" ;
pressure:seabird_var_name = "prdM" ;
pressure:valid_min = 0. ;
pressure:valid_max = 1000. ;
pressure:comments = "strain gauge" ;
pressure:coordinates = "depth_correction" ;

double **temperature**(depth) ;
temperature:_FillValue = 9.96920996838687e+36 ;
temperature:long_name = "sea water temperature" ;
temperature:standard_name = "sea_water_temperature" ;
temperature:units = "degrees_C" ;
temperature:coverage_content_type = "physicalMeasurement" ;
temperature:seabird_var_name = "tv290C" ;
temperature:comments = "ITS-90" ;
temperature:valid_min = -2.2 ;
temperature:valid_max = 35. ;
temperature:coordinates = "depth_correction" ;

double **conductivity**(depth) ;
conductivity:_FillValue = 9.96920996838687e+36 ;
conductivity:long_name = "sea water electrical conductivity" ;
conductivity:standard_name = "sea_water_electrical_conductivity" ;
conductivity:units = "S/m" ;
conductivity:coverage_content_type = "physicalMeasurement" ;
conductivity:seabird_var_name = "cond0S/m" ;
conductivity:valid_min = 0. ;
conductivity:valid_max = 6. ;

conductivity:coordinates = "depth_correction" ;

double **salinity**(depth) ;
salinity:_FillValue = 9.96920996838687e+36 ;
salinity:long_name = "sea water practical salinity" ;
salinity:standard_name = "sea_water_practical_salinity" ;
salinity:units = "1" ;
salinity:coverage_content_type = "physicalMeasurement" ;
salinity:seabird_var_name = "sal00" ;
salinity:valid_min = 0. ;
salinity:valid_max = 45. ;
salinity:coordinates = "depth_correction" ;

double **sound_velocity**(depth) ;
sound_velocity:_FillValue = 9.96920996838687e+36 ;
sound_velocity:long_name = "speed of sound in sea water" ;
sound_velocity:standard_name = "speed_of_sound_in_sea_water" ;
sound_velocity:units = "m s-1" ;
sound_velocity:coverage_content_type = "physicalMeasurement" ;
sound_velocity:seabird_var_name = "svCM" ;
sound_velocity:comments = "Chen-Millero" ;
sound_velocity:coordinates = "depth_correction" ;

double **density**(depth) ;
density:_FillValue = 9.96920996838687e+36 ;
density:valid_min = 999. ;
density:valid_max = 1045. ;
density:long_name = "sea water density" ;
density:standard_name = "sea_water_density" ;
density:units = "kg m-3" ;
density:coverage_content_type = "physicalMeasurement" ;
density:seabird_var_name = "density00" ;
density:coordinates = "depth_correction" ;

double **potential_temperature**(depth) ;
potential_temperature:_FillValue = 9.96920996838687e+36 ;
potential_temperature:long_name = "sea water potential temperature" ;
potential_temperature:standard_name = "sea_water_potential_temperature" ;
potential_temperature:units = "degrees_C" ;
potential_temperature:coverage_content_type = "physicalMeasurement" ;
potential_temperature:seabird_var_name = "potemp090C" ;
potential_temperature:comments = "ITS-90" ;
potential_temperature:valid_min = -2.2 ;
potential_temperature:valid_max = 35. ;
potential_temperature:coordinates = "depth_correction" ;

Metadata:

Global attributes:

:**title** = "OMG Narwhals Ocean CTD Level 2 Data" ;

:**summary** = "This dataset contains conductivity, temperature, and pressure measurements from a ship-deployed CTD instrument. It also contains derived variables: salinity, sound velocity, density, and potential temperature. This profile is one of a series of CTD casts from the Oceans Melting Greenland (OMG) Narwhals program. Between August 2018 to August 2020, three bottom-mounted ocean moorings with a suite of instrumentation were deployed at three glacial fronts in Melville Bay: Sverdrup Glacier, Kong Oscar Glacier, and Rink Glacier. During summer cruises where moorings were deployed and/or recovered, full water column CTD profiles were obtained at the glacier fronts and offshore." ;

:**conventions** = "CF-1.8, ACDD-1.3" ;

:**keywords** = "Conductivity, Salinity, Water Depth, Water Temperature" ;

:**keywords_vocabulary** = "NASA Global Change Master Directory (GCMD) Science Keywords" ;

:**standard_name_vocabulary** = "NetCDF Climate and Forecast (CF) Metadata Convention" ;

:**id** = "OMG_Narwhals_Ocean_CTD_L2" ;

:**featureType** = "profile" ;

:**cdm_data_type** = "Station" ;

:**cast_id** = XXX;

:**uuid** = "XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX" ;

:**platform** = "R/V Sanna" ;

:**region** = "Melville Bay, northwest Greenland" ;

:**seafloor_depth** = "XXX m" ;

:**cast_depth** = "XXX m" ;

:**filename** = "OMG_Narwhals_Ocean_CTD_L2_20180823005511.nc" ;

:**serial_number** = "1906981" ;

:**instrument** = "SBE19plus" ;

:**history** = "Transformed processed *.cnv files that were converted from the instrument\'s output *.hex file." ;

:**source** = "Conductivity, Temperature, and Depth (CTD) data collected from a ship-deployed CTD instrument." ;

:**processing_level** = "L2" ;

:**acknowledgement** = "This research was carried out by the University of Washington's Applied Physics Laboratory and School of Aquatic and Fishery Sciences, the Greenland Climate Research Centre/Greenland Institute of Natural Resources, and the Jet Propulsion Laboratory, managed by the California Institute of Technology under a contract with the National Aeronautics and Space Administration. This research was funded by the US Office of Naval Research (award no. N00014-17-1-2774) and the NASA Oceans Melting Greenland EVS-2 mission." ;

:**license** = "Public Domain" ;

:**product_version** = "1.0" ;

:**creator_name** = "Marie J. Zahn" ;

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:**creator_type** = "person" ;

:**creator_institution** = "University of Washington" ;

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:**project** = "Oceans Melting Greenland (OMG) Narwhals" ;

:**contributor_name** = "Marie J. Zahn, Kristin L. Laidre, Malene J. Simon, Ian Fenty" ;

:**contributor_role** = "author, principal investigator, co-investigator, co-investigator" ;

:**contributor_email** = "mzahn@uw.edu; klaidre@uw.edu; masi@natur.gl; ian.fenty@jpl.nasa.gov" ;

:**naming_authority** = "gov.nasa.jpl" ;

:**program** = "NASA Earth Venture Suborbital-2 (EVS-2) and Office of Naval Research (ONR) Marine Mammals and Biology Program" ;

:**publisher_name** = "Physical Oceanography Distributed Active Archive Center (PO.DAAC)" ;

:**publisher_institution** = "NASA Jet Propulsion Laboratory (JPL)" ;

:**publisher_email** = "podaac@podaac.jpl.nasa.gov" ;

:**publisher_url** = "https://podaac.jpl.nasa.gov/" ;

:**publisher_type** = "group" ;

:**geospatial_lat_min** = XX.XXXXXX ;

:**geospatial_lat_max** = XX.XXXXXX ;

:**geospatial_lat_units** = "degrees_north" ;

:**geospatial_lon_min** = -XX.XXXXXX ;

:**geospatial_lon_max** = -XX.XXXXXX ;

:**geospatial_lon_units** = "degrees_east" ;

:**geospatial_vertical_min** = -XXX ;

:**geospatial_vertical_max** = XXX ;

:**geospatial_vertical_units** = "meters" ;

:**geospatial_vertical_positive** = "down" ;

:**time_coverage_resolution** = "P0.25S" ;

:**time_coverage_start** = "20XX-08-XXTXX:XX:XX" ;

:**time_coverage_end** = "20XX-08-XXTXX" ;

:**time_coverage_duration** = "P0DTXHXXMXXS" ;

:**date_created** = "2023-XX-XXTXX:XX:XX" ;

:**coordinates** = "latitude longitude time" ;