

# Oceans Melting Greenland

## CTD Ocean Water Properties Data

### User's Guide

#### Data Set

OMG Ocean CTD Level 2 Data

#### Author

Joshua K. Willis, Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA, USA.

#### Introduction

Global sea level rise will be one of the major environmental challenges of the 21st Century. Oceans Melting Greenland (OMG) will pave the way for improved estimates of sea level rise by addressing the question: To what extent are the oceans melting Greenland's ice from below? Over a five-year campaign, OMG will observe changing water temperatures on the continental shelf surrounding Greenland, and how marine glaciers react to the presence of warm, salty Atlantic Water. The complicated geometry of the sea floor steers currents on the shelf and often determines whether Atlantic Water can reach into the long narrow fjords and interact with the coastal glaciers. Because knowledge of these pathways is a critical component of modeling the interaction between the oceans and ice sheet, OMG will facilitate improved measurements of the shape and depth of the sea floor in key regions as well.

This temperature and salinity data were collected primarily using ship-deployed sensors called Conductivity Temperature Depth (CTD) instruments. During the ship survey the CTD instrument was lowered from the vessel in order to collect CTD data. These instruments measure temperature and conductivity as a function of pressure and the data is downloaded and stored once the instrument is taken out of the water.

#### Campaigns

This data set consists of data from multiple campaigns and varying CTD instruments.

#### 2015

A campaign was conducted by Terrasond Limited aboard the M/V Cape Race vessel. The data was collected during a survey of Greenland's Western coastline in July through September 2015 using the AML Oceanographic Minos X CTD and the Teledyne Oceanscience Underway CTD instruments.

A campaign was conducted by Ocean Research Project aboard the R/V Ault vessel. The data was collected during a survey of Greenland's Western coastline in August and September 2015 using the RBRconcerto CTD instrument.

## 2016

A campaign was conducted by Ocean Research Project aboard the R/V Ault vessel. The data was collected during a survey of Greenland's Northwestern coastline in July and August 2016 using the RBRconcerto CTD instrument.

A campaign was conducted by Arctic Access / University of California Irvine (UCI) aboard the S/Y Ivilia vessel. The data was collected during a survey of Greenland's Western coastline in September 2016 using the AML Oceanographic Minos X CTD instrument.

A campaign was conducted by Terrasond Limited aboard the M/V Neptune vessel. The data was collected during a survey of Greenland's Southeastern coastline in September and October 2016 using the AML Oceanographic Minos X CTD and the Valeport Rapid CTD instruments.

## 2017

A campaign was conducted by Arctic Access / University of California Irvine (UCI) aboard the S/Y Ivilia vessel. The data was collected during a survey of Greenland's Western coastline in August 2017 using the AML Oceanographic Minos X CTD instrument.

## 2018

A campaign was conducted by Ocean Research Project aboard the S/V Toboggan vessel. The data was collected during a survey of Greenland's Northwestern coastline in July 2018 using the RBRconcerto CTD instrument.

A campaign was conducted by Arctic Access / University of California Irvine (UCI) aboard the S/Y Ivilia vessel. The data was collected during a survey of Greenland's Western coastline in August 2018 using the AML Oceanographic Minos X CTD instrument.

## 2019

A campaign was conducted by Arctic Access / University of California Irvine (UCI) aboard the M/V Aarii Moana vessel. The data was collected during a survey of Greenland's Northwestern coastline in August 2019 using the AML Oceanographic Minos X CTD instrument.

## 2020

A campaign was conducted by Arctic Access / University of California Irvine (UCI) aboard the M/V Aarii Moana vessel. The data was collected during a survey of Greenland's Southwestern coastline in March and April 2020 using the AML Oceanographic Minos X CTD instrument.

## Content

A concerted effort was made to create a common structure for these products though not all of the instruments provided data for each of the defined variables. The specifics regarding product data population are detailed in the following table:

Year	Campaign (Instrument)	time	depth	temperature	conductivity	salinity	sound_velocity	density	pressure	sea_pressure	dissolved_oxygen
2015	Terrasond Limited (AML)	✓	✓ <sup>1</sup>	✓	✓	≠ <sup>2</sup>	≠ <sup>2</sup>	≠ <sup>2</sup>	≠ <sup>2</sup>	N/A	N/A
	Terrasond Limited (Teledyne)	✓ <sup>3</sup>	✓ <sup>1</sup>	✓	✓ <sup>4</sup>	N/A	N/A	N/A	✓	N/A	N/A
	Ocean Research Project (RBR)	✓	✓ <sup>1</sup>	✓	✓	✓	N/A	N/A	✓	✓	N/A
2016	Ocean Research Project (RBR)	✓ <sup>5</sup>	✓ <sup>1</sup>	✓	✓	✓	N/A	N/A	✓	✓	N/A
	Arctic Access / UCI (AML)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓ <sup>4</sup>
	Terrasond Limited (AML)	✓	✓ <sup>1</sup>	✓	✓	✓	✓	✓	✓	N/A	N/A
	Terrasond Limited (Valeport)	✓ <sup>3</sup>	✓ <sup>1</sup>	✓	✓	N/A	N/A	N/A	✓	N/A	N/A
2017	Arctic Access / UCI (AML)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓ <sup>4</sup>
2018	Ocean Research Project (RBR)	✓	✓	✓	✓	✓	✓	N/A	✓	✓	N/A
	Arctic Access / UCI (AML)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓ <sup>4</sup>
2019	Arctic Access / UCI (AML)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓ <sup>4</sup>
2020	Arctic Access / UCI (AML)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓ <sup>4</sup>
<b>Notes</b>											
<sup>1</sup> Calculated from Pressure and Latitude using the Gibbs-SeaWater (GSW) Oceanographic Toolbox.											
<sup>2</sup> Some of the products contain this field and others do not based on varying instrument configuration.											
<sup>3</sup> Calculated from available measurement interval data.											
<sup>4</sup> Source value was converted to match the target units for the variable.											
<sup>5</sup> Represents the beginning of data collection for the product. Time values are not available for each measurement.											

## Format

The file names for this data set are of the form

“OMG\_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. The data file is formatted as follows:

dimensions:

obs = UNLIMITED ; // (X currently)

profile = 1 ;

variables:

```

float lat(profile) ;
    lat:_FillValue = -9999.f ;
    lat:long_name = "latitude" ;
    lat:standard_name = "latitude" ;
    lat:units = "degrees_north" ;
    lat:coverage_content_type = "coordinate" ;
    lat:axis = "Y" ;
    lat:valid_max = 90.f ;
    lat:valid_min = -90.f ;
float lon(profile) ;
    lon:_FillValue = -9999.f ;
    lon:long_name = "longitude" ;
    lon:standard_name = "longitude" ;
    lon:units = "degrees_east" ;
    lon:coverage_content_type = "coordinate" ;
    lon:axis = "X" ;
    lon:valid_max = 180.f ;
    lon:valid_min = -180.f ;
double time(<campaign-specific>) ;
    2016 Ocean Research Project: "profile"
    All others: "profile, obs"
    time:_FillValue = -9999. ;
    time:long_name = "<campaign-specific>" ;
    2016 Ocean Research Project: "time_coverage_start"
    All others: "time"
    time:standard_name = "time" ;
    time:units = "seconds since 1970-01-01T00:00:00Z" ;
    time:coverage_content_type = "coordinate" ;
    time:axis = "T" ;
    time:comment = "<campaign-specific>" ;

```

**2016 Ocean Research Project:** "This value represents the beginning of data collection for the product. Specific time values are not available for each measurement."

**All others:** ""

```

float depth(profile, obs) ;
    depth:_FillValue = -9999.f ;
    depth:long_name = "depth" ;
    depth:standard_name = "depth" ;
    depth:units = "meters" ;
    depth:positive = "down" ;
    depth:coverage_content_type = "coordinate" ;
    depth:coordinates = "time lat lon" ;
    depth:axis = "Z" ;
    depth:valid_min = 0.f ;
    depth:valid_max = 5000.f ;

```

comment = "<campaign-specific> ;

**2015/2016 Ocean Research Project:** "The data was derived using the Gibbs-SeaWater (GSW) Oceanographic Toolbox."

**Terrasond Limited:** "The data was derived using the Gibbs-SeaWater (GSW) Oceanographic Toolbox."

**All others:** ""

float temperature(profile, obs) ;

temperature:\_FillValue = -9999.f ;

temperature:long\_name = "sea water temperature" ;

temperature:standard\_name = "sea\_water\_temperature" ;

temperature:units = "degrees\_C" ;

temperature:coverage\_content\_type = "physicalMeasurement" ;

temperature:coordinates = "time lat lon depth" ;

temperature:valid\_max = 35.f ;

temperature:valid\_min = -2.2 ;

float conductivity(profile, obs) ;

conductivity:\_FillValue = -9999.f ;

conductivity:long\_name = "sea water electrical conductivity" ;

conductivity:standard\_name = "sea\_water\_electrical\_conductivity" ;

conductivity:units = "mS cm-1" ;

conductivity:coverage\_content\_type = "physicalMeasurement" ;

conductivity:coordinates = "time lat lon depth" ;

conductivity:valid\_max = 60.f ;

conductivity:valid\_min = 0.f ;

conductivity:comment = "<campaign-specific>";

**2015 Terrasond Limited:** "The units of the source data are S/m and have been converted to mS/cm."

float salinity(profile, obs) ;

salinity:\_FillValue = -9999.f ;

salinity:long\_name = "sea water practical salinity" ;

salinity:standard\_name = "sea\_water\_practical\_salinity" ;

salinity:units = "1" ;

salinity:coverage\_content\_type = "physicalMeasurement" ;

salinity:coordinates = "time lat lon depth" ;

salinity:valid\_max = 45.f ;

salinity:valid\_min = 0.f ;

salinity:comment = "If this field is populated with fill values, the data was not available from the source product." ;

float sound\_velocity(profile, obs) ;

sound\_velocity:\_FillValue = -9999.f ;

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" ;

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```

    sound_velocity:coordinates = "time lat lon depth" ;
    sound_velocity:valid_max = 1560.f ;
    sound_velocity:valid_min = 1405.f ;
    sound_velocity:comment = "If this field is populated with fill values, the data was
not available from the source product." ;
    float density(profile, obs) ;
    density:_FillValue = -9999.f ;
    density:long_name = "sea water density" ;
    density:standard_name = "sea_water_density" ;
    density:units = "kg m-3" ;
    density:coverage_content_type = "physicalMeasurement" ;
    density:coordinates = "time lat lon depth" ;
    density:valid_max = 1045.f ;
    density:valid_min = 999.f ;
    density:comment = "If this field is populated with fill values, the data was not
available from the source product." ;
    float pressure(profile, obs) ;
    pressure:_FillValue = -9999.f ;
    pressure:long_name = "sea water pressure" ;
    pressure:standard_name = "sea_water_pressure" ;
    pressure:units = "dBar" ;
    pressure:coverage_content_type = "physicalMeasurement" ;
    pressure:coordinates = "time lat lon" ;
    pressure:comment = "If this field is populated with fill values, the data was not
available from the source product." ;
    float sea_pressure(profile, obs) ;
    sea_pressure:_FillValue = -9999.f ;
    sea_pressure:long_name = "sea water pressure due to sea water" ;
    sea_pressure:standard_name = "sea_water_pressure_due_to_sea_water" ;
    sea_pressure:units = "dBar" ;
    sea_pressure:coverage_content_type = "physicalMeasurement" ;
    sea_pressure:coordinates = "time lat lon" ;
    sea_pressure:comment = "If this field is populated with fill values, the data was
not available from the source product." ;
    float dissolved_oxygen(profile, obs) ;
    dissolved_oxygen:_FillValue = -9999.f ;
    dissolved_oxygen:long_name = "mole concentration of dissolved molecular
oxygen in sea water" ;
    dissolved_oxygen:standard_name =
"mole_concentration_of_dissolved_molecular_oxygen_in_sea_water" ;
    dissolved_oxygen:units = "mol m-3" ;
    dissolved_oxygen:coverage_content_type = "physicalMeasurement" ;
    dissolved_oxygen:coordinates = "time lat lon" ;
    dissolved_oxygen:comment = "<campaign-specific>" ;

```

**Arctic Access / UCI:** "This data was collected by the Aanderaa 4831 oxygen sensor. The units of the source data are uM and have been converted to mol m<sup>-3</sup> for this product."

**All others:** "If this field is populated with fill values, the data was not available from the source product."

For the profile (profile), the latitude, longitude and time (if only the start time is available) of the measurement are provided. For every observation (obs) associated with the profile, the time (if available), depth (represented in meters below sea level), temperature and conductivity are provided. When available the salinity, sound velocity, density, pressure, sea pressure and dissolved oxygen are also provided. Each data file also includes several global variables to further describe the data contained within the file. These variables are as follows (values containing X's represent variables that have product specific values):

```
:title = "OMG Ocean CTD Level 2 Data" ;
:summary = "This file contains conductivity, temperature and depth
measurements from a ship-deployed instrument. In addition, some products contain derived
variables, salinity, sound speed, density, pressure, sea pressure and dissolved oxygen." ;
:keywords = "Conductivity, Water Temperature, Water Depth, Salinity" ;
:keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Science
Keywords" ;
:Conventions = "CF-1.7, ACDD-1.3" ;
:id = "OMG_Ocean_CTD_L2" ;
:uuid = "XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX" ;
:naming_authority = "gov.nasa.jpl" ;
:cdm_data_type = "Station" ;
:history = "Transformed input product XXXXXXXXXXXXXXXXXXXX.XXX into NetCDF
format." ;
:source = "Conductivity, Temperature and Depth (CTD) data collected from a
ship-deployed CTD instrument." ;
:platform = "<campaign-specific>" ;
2015/2016 Ocean Research Project: "R/V Ault Vessel"
2018 Ocean Research Project: "S/V Toboggan Vessel"
2015 Terrasond Limited: "M/V Cape Race Vessel"
2016 Terrasond Limited: "M/V Neptune Vessel"
2016/2016/2018 Arctic Access / UCI: "S/Y Ivia Vessel"
2019/2020 Arctic Access / UCI: "M/V Aria Moana Vessel"
:instrument = "<campaign-specific>" ;
Ocean Research Project: "RBRconcerto CTD"
2015 Terrasond Limited: "AML Oceanographic Minos X CTD" or
"Teledyne Oceanscience Underway CTD"
2016 Terrasond Limited: "AML Oceanographic Minos X CTD" or "Valeport
Rapid CTD"
Arctic Access / UCI: "AML Oceanographic Minos X CTD" ;
```

```

:processing_level = "L2" ;
:comment = "This data was collected during the XXXX survey of Greenland's
XXXXXXXX coastline." ;
:standard_name_vocabulary = "NetCDF Climate and Forecast (CF) Metadata
Convention" ;
:acknowledgement = "This research was carried out by the Jet Propulsion
Laboratory, managed by the California Institute of Technology under a contract with the
National Aeronautics and Space Administration." ;
:license = "Public Domain" ;
:product_version = "1.0" ;
:references = "DOI:10.5067/OMGEV-CTDS1" ;
:creator_name = "OMG Science Team" ;
:creator_email = "omg-science@jpl.nasa.gov" ;
:creator_url = "https://dx.doi.org/10.5067/OMGEV-CTDS1" ;
:creator_type = "group" ;
:creator_institution = "NASA Jet Propulsion Laboratory" ;
:institution = "NASA Jet Propulsion Laboratory" ;
:project = "Oceans Melting Greenland (OMG)" ;
:program = "NASA Earth Venture Suborbital-2 (EVS-2)" ;
:contributor_name = "[Ocean Research Project (ORP)|Terrasond Limited|Arctic
Access / UCI" ;
:contributor_role = "<contributor_name> performed the survey in the field,
collected the data and performed the initial processing." ;
:publisher_name = "PO.DAAC" ;
:publisher_email = "podaac@podaac.jpl.nasa.gov" ;
:publisher_url = "https://dx.doi.org/10.5067/OMGEV-CTDS1" ;
:publisher_type = "group" ;
:publisher_institution = "NASA Jet Propulsion Laboratory" ;
:geospatial_lat_min = XX.XXXX ;
:geospatial_lat_max = XX.XXXX ;
:geospatial_lat_units = "degrees_north" ;
:geospatial_lat_resolution = 0.00001 ;
:geospatial_lon_min = XX.XXXX ;
:geospatial_lon_max = XX.XXXX ;
:geospatial_lon_units = "degrees_east" ;
:geospatial_lon_resolution = 0.00001 ;
:geospatial_vertical_min = X.XX ;
:geospatial_vertical_max = XXXX.XX ;
:geospatial_vertical_resolution = 0.01 ;
:geospatial_vertical_units = "meters" ;
:geospatial_vertical_positive = "down" ;
:time_coverage_start = " XXXX-XX-XXTXX:XX:XX " ;
:time_coverage_end = " XXXX-XX-XXTXX:XX:XX " ;
:time_coverage_duration = "PTXXMXXS" ;

```



```
:date_created = " XXXX-XX-XXTXX:XX:XX " ;  
:source_product_header = < header keyword value pairs separated by a  
semicolon>
```

## Citation

This research was carried out by the Jet Propulsion Laboratory, managed by the California Institute of Technology under a contract with the National Aeronautics and Space Administration. Use of this data should be cited as follows:

OMG Mission. 2020. Conductivity, Temperature and Depth (CTD) data from the ocean survey. Ver. 1. PO.DAAC, CA, USA. Dataset accessed [YYYY-MM-DD] at <https://dx.doi.org/10.5067/OMGEV-CTDS1>.

## Contact

For questions please email [podaac@podaac.jpl.nasa.gov](mailto:podaac@podaac.jpl.nasa.gov) or visit the [PO.DAAC forum](#).