Oceans Melting Greenland
AXCTD Ocean Water Properties Data User's Guide

Data Set
OMG Ocean AXCTD Level 2 Data

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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.

Temperature and salinity data are collected primarily using air-deployed sensors called Airborne eXpendable Conductivity Temperature Depth (AXCTD) instruments. These expendable instruments are launched from an aircraft, fall under a small parachute and float on the surface after impact. The floating portion then release a probe, which sinks to a depth of up to 1000 meters. The probe is connected to the float by a thin wire which unspools at the probe sinks, measuring temperature and conductivity as a function of time. This information is sent by radio to the aircraft, where it is used to compute temperature and salinity as a function of depth.

Campaigns
This data set consists of data from multiple campaigns.

2016
This campaign was conducted by the OMG Science Team aboard the Grumman Gulfstream III (G-III) aircraft. The data was collected during a survey of Greenland's coastline in September and October 2016 using AXCTD instruments.

2017

This campaign was conducted by the OMG Science Team aboard the C-130 Hercules aircraft. The data was collected during a survey of Greenland's coastline in October 2017 using AXCTD instruments.

2018

This campaign was conducted by the OMG Science Team aboard the Basler BT-67 aircraft. The data was collected during a survey of Greenland's coastline in August and September 2018 using AXCTD instruments.

Format

The file names for this data set are of the form "OMG_Ocean_AXCTD_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 ;
    frame_len = 8 ;
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. ;
        lat:valid_min = -90. ;
        lat:comment = "Represents the latitude of the plane position when the probe was deployed which is an estimate of the actual location where the probe hit the surface of the water." ;
    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. ;
        lon:valid_min = -180. ;

lon:comment = "Represents the longitude of the plane position when the probe was deployed which is an estimate of the actual location where the probe hit the surface of the water." ;

double time(profile) ;

time:_FillValue = -9999. ;

time:long_name = "time" ;

time:standard_name = "time" ;

time:units = "seconds since 1970-01-01T00:00:00Z" ;

time:axis = "T" ;

time:comment = "Represents the time the probe was deployed from the plane." ;

float profile_time(profile, obs) ;

profile_time:_FillValue = -9999.f ;

profile_time:long_name = "time since probe began descent from ocean surface" ;

profile_time:units = "seconds" ;

profile_time:comment = "Represents the time in seconds since the weighted probe was released from the floating buoy. Depth is calculated from this variable based on a standard formula." ;

char frame(profile, obs, frame_len) ;

frame:long_name = "frame" ;

frame:coordinates = "time lat lon" ;

frame:comment = "Represents the observed measurement, format unknown. A value of 00000000 indicates no data available." ;

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 = "physicalMeasurement" ;

depth:coordinates = "time lat lon" ;

depth:axis = "Z" ;

depth:valid_min = 0. ;

depth:valid_max = 5000. ;

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_min = -2.2 ;

temperature:valid_max = 35. ;

```
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_min = 0. ;
        conductivity:valid_max = 60. ;
float salinity(profile, obs) ;
        salinity:_FillValue = -9999.f ;
        salinity:long_name = "sea water salinity" ;
        salinity:standard_name = "sea_water_salinity" ;
        salinity:units = "1e-3" ;
        salinity:coverage_content_type = "physicalMeasurement" ;
        salinity:coordinates = "time lat lon depth" ;
        salinity:valid_min = 0. ;
        salinity:valid_max = 45. ;
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" ;
        sound_velocity:coordinates = "time lat lon depth" ;
        sound_velocity:valid_min = 1405. ;
        sound_velocity:valid_max = 1560. ;
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_min = 999. ;
        density:valid_max = 1045. ;
```

For the profile (profile), the latitude, longitude and time of the measurement are provided. For every observation (obs) associated with the profile, the depth (represented in meters below sea level), temperature, conductivity, salinity, sound velocity and density are 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 AXCTD Level 2 Data" ;
:summary = "This file contains conductivity, temperature and depth measurements from an AXCTD instrument. In addition, it contains derived variables, salinity, sound speed and density, as computed by a Sippican MK21 receiver." ;
:keywords = "Conductivity, Salinity, Water Depth, Water Temperature" ;
:keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Science Keywords" ;
:Conventions = "CF-1.6, ACDD-1.3" ;
:id = "OMG_Ocean_AXCTD_L2" ;
:uuid = "XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX" ;
:naming_authority = "gov.nasa.jpl" ;
:cdm_data_type = "Station" ;
:history = "Transformed input product XXX_XXXXXXXXXXXXX_XXXX_XXX.edf into NetCDF format." ;
:source = "Temperature and salinity data are collected using air-deployed sensors called Airborne eXpendable Conductivity Temperature Depth (AXCTD) instruments purchased from Lockheed Martin/Sippican, Inc." ;
:platform = "Grumman Gulfstream III (G-III)" ;
:instrument = "Airborne eXpendable Conductivity Temperature Depth (AXCTD)" ;
:processing_level = "L2" ;
:comment = "This data was collected during the XXXX campaign." ;
: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 = "Freely Distributed" ;
:product_version = "1.0" ;
:references = "DOI:10.5067/OMGEV-AXCT1" ;
:creator_name = "Joshua K. Willis" ;
:creator_email = "Joshua.K.Willis@jpl.nasa.gov" ;
:creator_url = "https://dx.doi.org/10.5067/OMGEV-AXCT1" ;
:creator_type = "Person" ;
: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 = "OMG Science Team" ;
:contributor_role = "OMG Science Team 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-AXCT1" ;
:publisher_type = "group" ;

:publisher_institution = "NASA Jet Propulsion Laboratory" ;
:geospatial_lat_min = "XX.XXXXX" ;
:geospatial_lat_max = "XX.XXXXX" ;
:geospatial_lat_units = "degrees north" ;
:geospatial_lat_resolution = "0.00001f" ;
:geospatial_lon_min = "XX.XXXXX " ;
:geospatial_lon_max = "XX.XXXXX " ;
:geospatial_lon_units = "degrees east" ;
:geospatial_lon_resolution = "0.00001f" ;
:geospatial_vertical_min = "X.XXXX" ;
:geospatial_vertical_max = "XXX.XXXX" ;
:geospatial_vertical_resolution = "0.0001f" ;
: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 = "PT15M" ;
:date_created = "XXXX-XX-XXTXX:XX:XX" ;
:raw_data_filename = "XXXX-XX XXX XXX-XXXXXXX XXXXXXXXXXXXXX" ;
:probe_type = "AXCTD" ;
:drop_number = "XXX" ;
:channel = "XX" ;
:terminal_depth = "1000 m" ;
:depth_equation = ;
:depth_coefficient_1 = "0.72" ;
:depth_coefficient_2 = "2.76124" ;
:depth_coefficient_3 = "-0.000238007" ;
:depth_coefficient_4 = "0.0" ;
:sequence_number = "XXXXX" ;
:serial_number = "XXXXXXXX" ;
:mk21_device = "MK21 Ethernet" ;
:cal_coefficient_state = "Original" ;
:temperature_coefficient_1 = "XXXXXXXXXX" ;
:temperature_coefficient_2 = "XXXXXXXXXX" ;
:temperature_coefficient_3 = "XXXXXXXXXX" ;
:temperature_coefficient_4 = "XXXXXXXXXX" ;
:conductivity_coefficient_1 = "XXXXXXXXXX" ;
:conductivity_coefficient_2 = "XXXXXXXXXX" ;
:conductivity_coefficient_3 = "XXXXXXXXXX" ;
:conductivity_coefficient_4 = "XXXXXXXXXX" ;
:coefficient_comment = "Temperature and conductivity coefficients are instrument dependent. The coefficients were used by the Lockheed/Sippican MK21 data acquisition system to calculate depth, temperature and conductivity." ;

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. 2016. 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-AXCT1.

Contact

For questions please email podaac@podaac.jpl.nasa.gov or visit the PO.DAAC forum.