National Mooring Network

National Reference Stations

Depth binned CTD product

Product Specification

Document Change Control

Version Number	Date of Issue	Brief Description of Change
Version 0.1	21-04-2021	Draft version for review and comment
Version 0.2	02-06-2021	Draft version for review and comment
Version 0.3	12-07-2022	Final

Introduction

Summary

This dataset includes conductivity-temperature-depth (CTD) profiles obtained at the National Reference Stations (NRS) as part of the water sampling program. Thanks to additional sensors combined with the CTD, additional measurements of dissolved oxygen, chlorophyll-*a* and turbidity are included to the dataset. Furthermore, the dataset includes salinity and water density as derived quantities computed from the measured properties of the water column.

All CTD product parameters are binned to 1m intervals and every NRS trip is associated with one CTD cast. The CTD cast associated with the NRS water sampling trip is the closest in time performed on the same day of the NRS trip.

All data are processed in delayed mode, with automated quality control applied. NRS are operated by the Australian National Moorings Network (ANMN), a facility of the Integrated Marine Observing System (IMOS).

Product Specifications

General information

Product name	Depth binned CTD
Geographic coverage	Australian Coastal region, 9 National Reference Stations
Temporal coverage	2009 -- present
Temporal resolution	Monthly[1]
Update frequency	Weekly
Delivery mechanism	AODN Portal OGC WFS
Format	CSV

Details of product contents

Name	Description	Units/format	Data type
Project	Name of the project the sample was collected for		string
StationName	Name of the station where sample was collected		string
TripCode	Unique code for the sampling trip	<station_code> YYYYMMDD	string
CastTimeUTC	CTD cast date and time (UTC)	YYYY-MM-DD HH:MM:SS	string
Latitude	Nominal latitude (North) of the station where sample was collected	Degrees (deg)	double precision
Longitude	Nominal longitude (East) of the station where sample was collected	Degrees (deg)	double precision
file_id	File identification number		integer
SampleTime_Local	Local date and time of sample collection	YYYY-MM-DD HH:MM:SS	string
SampleTime_UTC	UTC date and time of sample collection	YYYY-MM-DD HH:MM:SS	timestamp
SampleDepth_m	Depth below surface of the water body	Metres (m)	real

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[1] Most NRS sites are sampled about once a month. The Kangaroo Island and Darwin NRS sites (and previously Esperance and Ningaloo) are sampled about four times a year.

	binned to 1m		
Salinity_psu	Derived Salinity	Practical Salinity Unit (PSU)	real
Salinity_flag	Salinity quality control	Values from 0 to 9	real
Temperature_degC	Water temperature	Degrees Celsius (°C)	real
Temperature_flag	Temperature quality control	Values from 0 to 9	integer
DissolvedOxygen_umol kg	Concentration of oxygen (O_2) per unit mass of the water body	Micromoles per kilogram (µmol kg^{-1})	real
DissolvedOxygen_flag	Dissolved oxygen quality control	Values from 0 to 9	integer
Chla_mgm3	Mass concentration of inferred chlorophyll-*a* from relative fluorescence units in sea water	Milligrams per meter cube (mgm^{-3})	real
Chla_flag	Chlorophyll-*a* quality control	Values from 0 to 9	integer
Turbidity_NTU	Sea water turbidity	Nephelometric Turbidity Units (NTU)	real
Turbidity_flag	Turbidity quality control	Values from 0 to 9	integer
Conductivity_Sm	Sea water electrical conductivity	Siemens per metre (S m^{-1})	real
Conductivity_flag	Conductivity quality control	Values from 0 to 9	integer
WaterDensity_kgm3	Derived density of the water body	Kilograms per cubic metre (kg m^{-3})	real
WaterDensity_flag	Water density quality control	Values from 0 to 9	integer

Salinity, water density and chlorophyll-*a* derived parameters

Salinity, water density and chlorophyll-*a* (chl-*a)* represent derived parameters in this product.

Specifically, salinity is derived from conductivity, temperature and pressure measurements. These data are processed through the SBEDataProcessing-Win32 software to obtain the salinity parameter (ANMN Standardised Profiling CTD Data Processing Procedures).

Water density is derived from salinity, temperature and pressure. This quantity is calculated by the IMOS toolbox, based on the TEOS-10 Gibbs function (IMOS Toolbox).

Chl-*a* is derived from fluorometry measurements. The fluorometer sensor detects inferred chl-*a* from fluorescence at 470nm provided as a voltage output. This measure is then converted to chl-*a* concentration (mgm^{-3}) using a factory determined scale factor derived from a dark count and a chl-*a* equivalent concentration (Pre-Run Check and Field Sampling CTD Procedural Guide).

Product delivery

Format
This product is available in comma-separated values (CSV) format.

AODN Portal
Dataset collections:

- **IMOS National Reference Station (NRS) - Depth binned CTD**

The collections can be subset by

- Geographic bounding box
- Temporal range
- Station name

AODN Geoserver
The product can be accessed via a Web Feature Service (WFS) query to the AODN Geoserver. The relevant layers are:

- `imos:nrs_depth_binned_ctd_data`

The Web Map Service (WMS) layers used for preview in Step 2 on the AODN Portal is

- `imos:bgc_phytoplankton_map`
- `imos:bgc_zooplankton_map`

Data Lineage

Provenance
CTD casts are performed off small vessels at the IMOS National Reference Stations. The sampling methods are fully described in the IMOS NRS Biogeochemical Operations Manual (Davies & Sommerville 2020).

The analysis and quality control (QC) procedures on the CTD measurements and derived products are performed by the operators of each station using the IMOS Matlab Toolbox, producing a NetCDF file ingested by AODN. Binning the profiles to 1-metre intervals is part of this processing.

Harvest to AODN

The profile data and metadata are harvested from the NetCDF files directly into the AODN Harvest Database (`anmn_nrs_ctd_profiles` schema, tables `deployments` and `measurements`). The Depth-binned CTD product consists mostly of the data in these tables (cast time UTC, site code, depth, salinity, temperature, oxygen, chlorophyll-*a*, turbidity, pressure, conductivity and water density, including all associated flags).

Sampling trip metadata (station, trip code, sample date local, latitude, longitude) are harvested from the **BGC_Trip** WFS layer in the CSIRO Geoserver.

Processing at AODN

- Match-up NRS trip code: every NRS trip is associated with one specific CTD cast. The CTD cast associated with the NRS water sampling trip is selected as the closest successful CTD cast to the sampling time performed on the same day of the NRS trip.

AODN Harvest Database schema

Schema name: imos_bgc_db

Tables to hold data & metadata harvested:

- `bgc_trip`
- `anmn_nrs_ctd_profiles.deployments` (AODN collection)

Materialised views for Geoserver layers:

- `nrs_depth_binned_ctd_data`
- `imos:bgc_phytoplankton_map`
- `imos:bgc_zooplankton_map`

Glossary and abbreviations

AODN	Australian Ocean Data Network
CSV	Comma-separated values
CTD	Conductivity Temperature Depth
IMOS	Integrated Marine Observing System
NRS	National Reference Station
QC	Quality Control
WFS	Web Feature Service

References

Davies, C. and Sommerville, E. (Eds.) (2020), National Reference Stations Biogeochemical Operations Manual. Integrated Marine Observing System. DOI: 10.26198/5c4a56f2a8ae3 (http://dx.doi.org/10.26198/5c4a56f2a8ae3)