IMOS Integrated Marine Observing System

National Mooring Network

National Reference Stations

Derived indices NRS product

Product Specification

Document Change Control

Version Number	Date of Issue	Brief Description of Change
Version 0.1	24/05/2021	Draft version for review and comment
Version 0.2	07/06/2021	Draft version for review and comment
Version 0.3	12-07-2022	Final

Introduction

Summary

This dataset includes derived indices obtained from physical and biogeochemical data collected from the National Reference Stations (NRS). Nine Sites are included in the IMOS NRS field sampling stations. Maria Island (TAS), Kangaroo Island (SA), Esperance (WA), Rottnest Island (WA), Ningaloo (WA), Darwin (NT), Yongala (QLD), North Stradbroke Island (QLD) and Port Hacking (NSW).

All parameters included in this product are derived from data already provided in other NRS collections.

Product Specifications

General information

Product name	Derived indices NRS product
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
SampleDateLocal	Sampling date (Local)	YYYY-MM-DD	string
SampleTime_UTC	Sampling date (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	Degrees (deg)	double precis

	collected		ion
Biomass_mgm3	Total mass of sample	Milligrams per cubic metre (mgm^{-3})	real
AshFreeBiomass_mgm3	Total mass of organic matter in sea water	Milligrams per cubic metre (mgm^{-3})	real
Secchi_m	Secchi depth	Meters (m)	real
ZoopAbundance_m3	Number of zooplankton animals in sea water	Number of taxon (defined as any zooplankton) per cubic metre (taxon m^3)	real
CopeAbundance_m3	Number of copepods in sea water	Number of taxon (defined as any copepods) per cubic metre (taxon m^{-3})	real
AvgTotalLengthCopepod_mm	Mean total length of copepods	Millimetres (mm)	real
OmnivoreCarnivoreCopepodRatio	Ratio between omnivorous to carnivorous copepods	N/A	real
NoCopepodSpecies_Sample	Number of copepods species per sample	N/A	real
ShannonCopepodDiversity	Shannon diversity index for copepods	N/A	real
CopepodEvenness	Shannon evenness index for copepods	N/A	real
PhytoBiomassCarbon_pgL	Total phytoplankton carbon	Picograms per litre (pgL^{-1})	real
PhytoAbundance_CellsL	Total number of any phytoplankton cells in sea water	Phytoplankton cells per litre ($cellsL^{-1}$)	real
DiatomDinoflagellateRatio	Ratio between Diatoms to Dinoflagellates	N/A	real
AvgCellVol_um3	Mean biovolume of phytoplankton cells	Cubic micrometres (μm^{-3})	real
NoPhytoSpecies_Sample	Number of	N/A	real

	phytoplankton species per sample		
ShannonPhytoDiversity	Shannon diversity index for phytoplankton	N/A	real
PhytoEvenness	Shannon evenness index for phytoplankton	N/A	real
NoDiatomSpecies_Sample	Number of diatoms species per sample	N/A	real
ShannonDiatomDiversity	Shannon diversity index for diatoms	N/A	real
DiatomEvenness	Shannon evenness index for diatoms	N/A	real
NoDinoSpecies_Sample	Number of dinoflagellates per sample	N/A	real
ShannonDinoDiversity	Shannon diversity index for dinoflagellates	N/A	real
DinoflagellateEvenness	Shannon evenness index for dinoflagellates	N/A	real
MLDtemp_m	Mixed layer depth calculated from water temperature	Metres (m)	real
MLDsal_m	Mixed layer depth calculated from water salinity	Metres (m)	real
DCM_m	Deep chlorophyll maximum	Metres (m)	real
CTDTemperature_degC	Sea surface temperature from CTD	Degrees Celsius (°C)	real
CTDChlaF_mgm3	Sea surface chlorophyll-*a* concentration from fluorometer	Milligrams per cubic meter (mgm^{-3})	real
CTDSalinity_PSU	Sea surface salinity from CTD	Practical Salinity Unit (PSU)	real

Silicate_umolL	Silicate	Micromoles per litre ($\mu molL^{-1}$)	real
Phosphate_umolL	Phosphate	Micromoles per litre ($\mu molL^{-1}$)	real
Ammonium_umolL	Ammonium	Micromoles per litre ($\mu molL^{-1}$)	real
Nitrate_umolL	Nitrate	Micromoles per litre ($\mu molL^{-1}$)	real
Nitrite_umolL	Nitrite	Micromoles per litre ($\mu molL^{-1}$)	real
Oxygen_umolL	Concentration of oxygen (O_2)	Micromoles per litre ($\mu molL^{-1}$)	real
DIC_umolkg	Dissolved inorganic carbon	Micromoles per kilograms ($\mu molkg^{-1}$)	real
Alkalinity_umolkg	Total alkalinity	Micromoles per kilograms ($\mu molkg^{-1}$)	real
PIgmentChla_mgm3	Chlorophyll-*a* availability for phytoplankton	Milligrams per cubic metre (mgm^{-3})	real

Indices specification

Biomass

This index includes the total mass of living organisms in sea water collected with a 100-micron mesh net. Thus, values provided by this parameter comprise the organic carbon from the plankton.

Abundance

Abundance is measured here as total number of elements (or individuals) for a specific taxon in sea water. This derived product is provided for phytoplankton (total number of cells), zooplankton and copepods (total number of animals).

Mean total length of copepods

This index provides the mean total length of copepod in the sample.

Mean volume of cells

This index provides the mean volume of a phytoplankton cell in the sample, calculated from the individual cell size, cell morphology and cell abundance.

Total phytoplankton carbon

Total mass of phytoplankton as carbon is calculated using standard conversion factors of biovolume to carbon for each cell, then summed (Montagnes-Berges 1994, Menden-Deuer & Lessard 2000, Verity & Langdon 1984, Vogt et al 2012, Caron et al 1995).

No of species in sample

Provided for copepods, phytoplankton, diatoms, dinoflagellates as an indicator of richness.

Shannon diversity

The Shannon diversity index is a statistical metric used to quantify rarity and commonness of species in a population. Indeed, Shannon diversity accounts for both species richness (the number of species present) and species abundance (the number of individuals per species) in the analysed population. This index is provided for copepods, phytoplankton, diatoms and dinoflagellates.

Shannon evenness

Shannon evenness provides a measure of biodiversity in the population analysed. The Shannon evenness index is derived from the Shannon diversity index, dividing Shannon diversity by its maximum. Thus, Shannon evenness can vary between 0 and 1, where 1 represents a complete evenness of the species in the analysed population. In this product the Shannon evenness index is provided for copepods, phytoplankton, diatoms and dinoflagellates.

Mixed layer depth (MLD)

Mixed layer depth (MLD) is derived from the Conductivity-Temperature-Depth (CTD) measurements, provided in the *Depth binned CTD product*. MLD is calculated and provided here in two different forms, from temperature and from salinity, following Condie and Dunn, 2006 methodology.

Deep chlorophyll maximum (DCM)

The deep chlorophyll maximum (DCM) represents the region below the sea water surface where the maximum concentration of chlorophyll occurs. For this specific product the DCM is provided as the depth (m) in which the maximum fluorescence value was recorded by the fluorometer installed on the CTD.

Sea surface components: temperature (CDTSST), chlorophyll-*a* (CDTChla) and salinity (CDTSalinity)

These indices are the mean values of the top ten metres of the water column and represent surface conditions measured at the time the sample was collected.

Chemistry: SiO_4, PO_4, NH_4, NO_3, NO_2, O_2, DIC and alkalinity

These are water column average values calculated from all the samples taken across multiple depths.

Chlorophyll-*a* (Chla),

The mean value of chlorophyll-*a* plus divinyl chlorophyll-*a* from the pigments data as an indication of chlorophyll-*a* availability for phytoplankton.

Product delivery

Format

The parameters of this product are available in comma-separated values (CSV) format.

AODN Portal

Dataset collections:

- **IMOS National Reference Station (NRS) - Derived indices product**

The specific product is selected under the *Download as...* drop-down menu on Step 3.

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 layer is:

- `imos:nrs_derived_indices_data`

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

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

Provenance

Data presented in this product are derived from physical and biogeochemical data collected from the National Reference Stations (NRS). All data from which the indices presented here are derived are provided in other NRS products.

Harvest to AODN

The derived indices product is based on raw data harvested from the following WFS layers in the CSIRO Geoserver:

- **bgc_trip** - metadata for sampling trips and samples taken, biomass, ash free biomass and secchi depth
- **zoopinfo -** classification of zooplankton diet
- **bgc_zoop_raw -** observed zooplankton abundances and taxonomic details of individual taxa identified in each sample
- **bgc_phyto_raw -** observed phytoplankton abundances and taxonomic details of individual taxa identified in each sample
- **bgc_chemistry -** chemical parameters of the water column
- **bgc_pigments -** chlorophyll-a concentration
- **nrs_depth_binned_ctd_data (materialised view generated from AODN collection anmn_nrs_ctd_profiles.measurements) -** biogeochemical parameters of the water column

Processing at AODN

- Biomass: sum of the organic carbon from plankton.
- Abundance: sum of elements for every taxon.
- Mean total length of copepods: calculate the mean of all total length of copepod.
- Mean volume of cells: calculate the mean of all phytoplankton cells volume.
- Total phytoplankton carbon: sum of the phytoplankton carbon mass.
- No of species in sample: sum of specific taxon per samples.
- Shannon indices (diversity and evenness): Shannon indices calculations.
- MLD: calculation to estimate the MLD.

- DCM: calculation to estimate DCM.
- Sea surface components: calculate the mean of the top ten metres of the water column from CTD measurements
- Chemistry: calculate the mean of the water column chemical components.
- Chla: mean of chlorophyll-*a* plus divinyl chlorophyll-*a.*

AODN Harvest Database schema

Schema name: imos_bgc_db

Tables to hold data & metadata harvested:

- `bgc_trip`
- `zoopinfo`
- `bgc_zoop_raw`
- `bgc_phyto_raw`
- `bgc_chemistry`
- `bgc_pigments`
- `anmn_nrs_ctd_profiles.measurements (AODN collection)`

Materialised views for Geoserver layers:

- `nrs_derived_indices_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

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