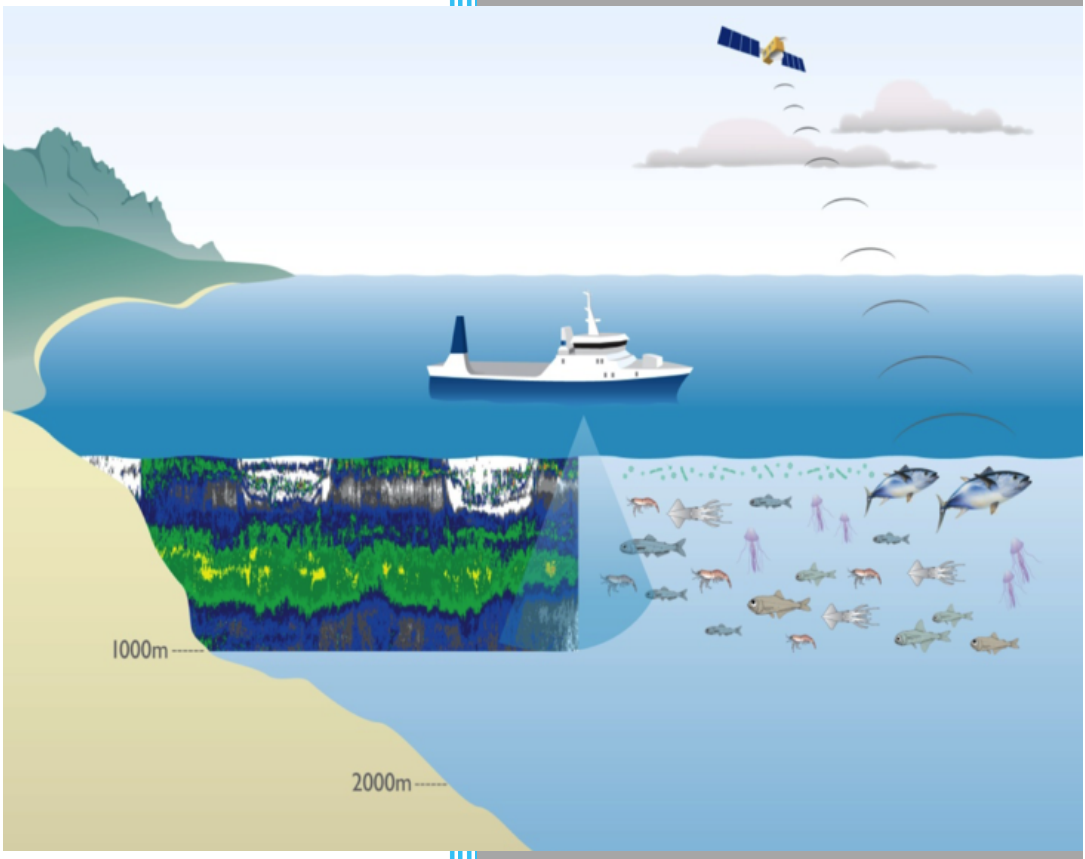
IMOS SOOP-BA NetCDF Conventions

Version 2.2



IMOS
Integrated Marine Observing System

CSIRO

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CSIRO Oceans and Atmosphere

10 July 2018

Integrated Marine Observing System - Ships of Opportunity Bio-Acoustic (IMOS SOOP-BA)

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Important disclaimer

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Contents

Document history

Version	Date	Revisions	Author
0.1	2010-12-10	○ Initial draft	
0.2	2011-01-13		Gordon Keith, Tim Ryan
0.3	2011-03-01		
0.4	2011-03-04	○ Updated variable names	
0.5	2011-03-22	○ Updated variable names	
0.6	2011-03-25	○ Updated variable names ○ Improved formatting	
0.7	2011-04-04	○ Updated variables ○ Changed variable 'DEPTH' to 'RANGE' ○ Updated 'viz_sv' function for data visualisation	Gordon Keith, Tim Ryan
0.8	2011-04-06	○ Updated variables name ○ Added variable attribute 'range_reference'	
0.9	2011-04-11	○ Revert variable 'RANGE' to 'DEPTH'	
1.0	2011-05-23	○ Changed to SI units (from dB to m^{-1})	
1.01	2011-08-03		Gordon Keith, Tim Ryan
1.1	2011-09-21	○ Updated 'viz_sv' function	Gordon Keith, Tim Ryan, Ryan Downie
2.0	2013-12-18	○ Inclusion of ICES metadata convention	Gordon Keith, Tim Ryan
2.1	2015-03-12	○ Inclusion of ICES metadata convention	Gordon Keith, Ryan Downie, Rudy Kloser, Tim Ryan
2.2	2018-07-10	○ Inclusion of ICES metadata convention ○ Added new variables 'signal_noise' and 'background_noise' ○ Renamed variable 'CARS_nitrogen' as 'CARS_nitrate' ○ The '_FillValue' for variable 'Sv' has been changed from '0' to	K. Haris, Rudy Kloser, Tim Ryan

Version	Date	Revisions	Author
		‘9999’ ○ ‘0’ is used as the ‘_FillValue’ for variable ‘mean_height’ ○ ‘0’ is used as the ‘_FillValue’ for variable ‘mean_depth’ ○ The equation used for sound speed calculation is standardized (Mackenzie, 1981) ○ The equation used for sound absorption calculation is standardized (Francois and Garrison, 1982)	

1 Overview

1.1 About IMOS SOOP-BA project

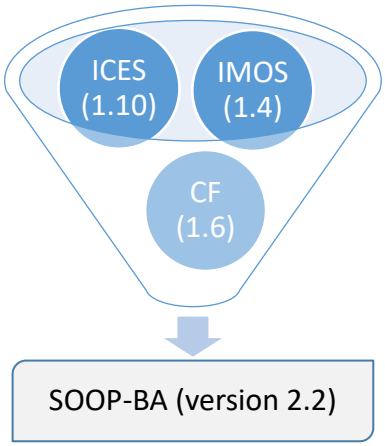
Integrated Marine Observing System (IMOS) is a distributed set of equipment and data-information services which collectively contribute to meeting the needs of marine research in Australia. The observing system provides data in the coasts and oceans around Australia. The IMOS office coordinates the deployment of a wide range of equipment and data assembly through 11 facilities distributed around the country. The data are made available to researchers through the Australian Ocean Data Network (AODN) located at the University of Tasmania. The IMOS infrastructure also contributes to Australia's role in international programs of ocean observing.

Since July 2010, the IMOS Ships of Opportunity Bio-Acoustic (SOOP-BA) sub-facility has been delivering calibrated (now multi-frequency) water column acoustic data to characterize ocean basin scale distribution and seasonal behaviour of mid-trophic level organisms (Kloser *et al.*, 2009; Ryan *et al.*, 2015). The resulting acoustic *snapshots* of mid-trophic (macro-zooplankton and micronekton) communities are combined with established ocean observing systems to improve our understanding of marine ecosystems and support their sustainable management.

1.2 About this document

This document describes the Network Common Data Form (NetCDF) format of the processed acoustic data in the context of the SOOP-BA project, including naming conventions and metadata content.

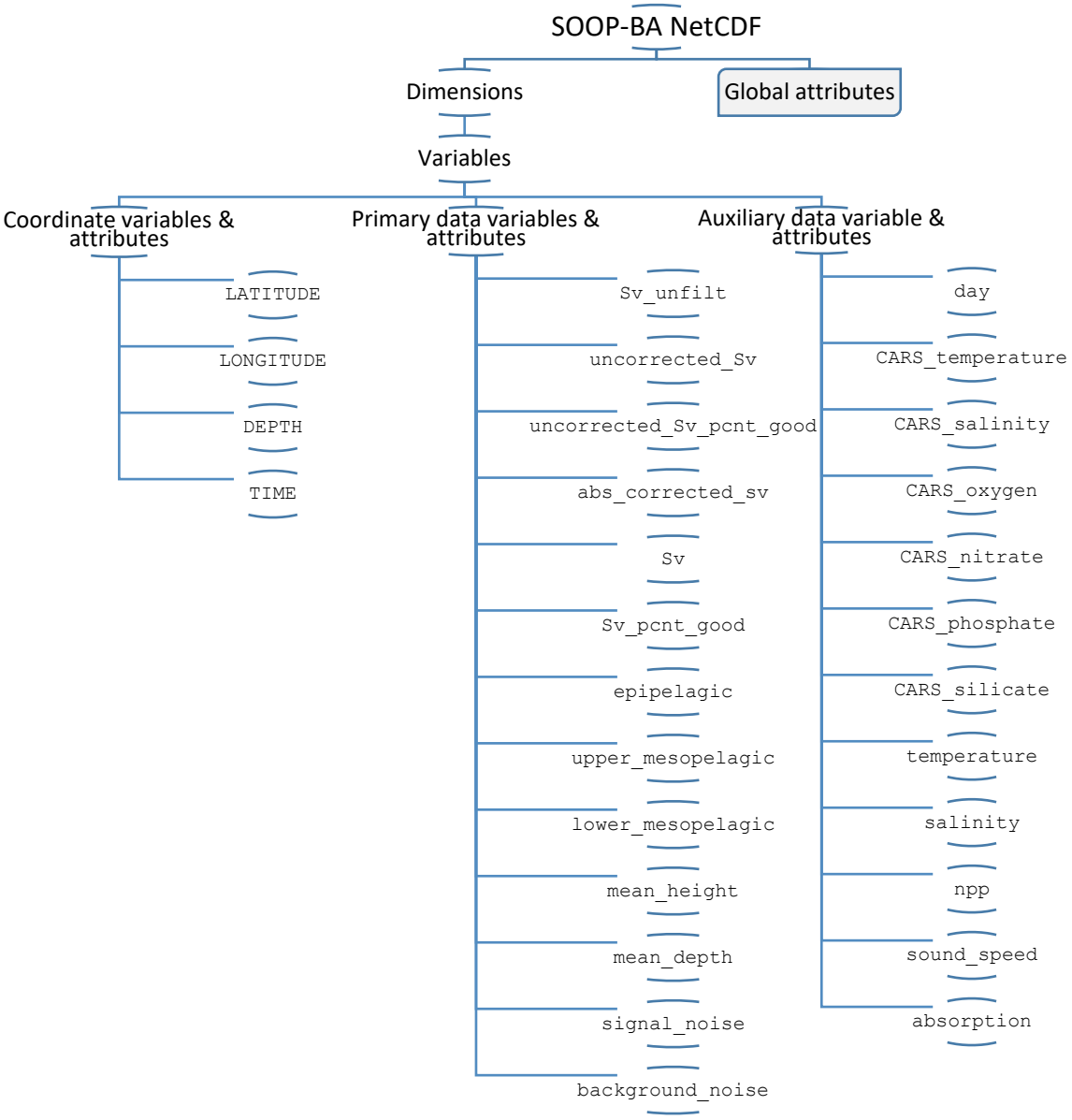
The IMOS SOOP-BA NetCDF conventions (version 2.2) comply with the Climate and Forecast (CF) (Eaton *et al.*, 2011), IMOS (IMOS, 2015), and International Council for the Exploration of the Sea (ICES) (ICES, 2016) metadata conventions as illustrated in the diagram below.



2 SOOP-BA NetCDF file structure

The SOOP-BA NetCDF file structure is designed to read and write data that has been structured according to well-defined rules (IMOS, 2015). The purpose of this SOOP-BA NetCDF conventions document is to describe each variable in the processed acoustic data file with an associated description of what it represents, physical units if appropriate, including each value that can be located in space (relative to earth-based coordinates) and time.

The components of an IMOS SOOP-BA NetCDF file are exemplified below, and described in the following sections.



2.1 Global attributes

The global attribute section of a NetCDF file contains metadata that describes the overall contents of the file and allows for data discovery.

The global attributes for an IMOS SOOP-BA NetCDF file are categorised based on the following information:

- Project
- Metadata record
- Cruise
- Ship
- Transect
- Instrument
- Calibration
- Data acquisition
- Data processing
- Dataset
- Data

All fields are human-readable and can be of either 'character' or 'numeric' type. The global attribute names are case sensitive. The 'Type' values are 'S' for string and 'N' for numeric (byte, short, long, integer, float or double).

2.1.1 List of global attributes

The following tables of global attributes are derived from CF (Eaton *et al.*, 2011), IMOS (IMOS, 2015), and ICES (ICES, 2016) conventions pertinent to SOOP-BA NetCDF files. The obligation is indicated as: mandatory (M), mandatory if applicable (MA), strongly recommended (R) or optional (O) following the ICES convention[1].

[1] **Notes on global attributes:** (a) the tables also contain MA, R or O global attributes proposed by the metadata authorities (b) the global attributes that become variables for multi-frequency data are differentiated.

2.1.1.1 Project attributes

Attribute name	Definition	Example	Type	Authority	Obligation
project	The scientific project that produced the data	Integrated Marine Observing System - Ships of opportunity - Bio-Acoustic (IMOS SOOP-BA)	S	IMOS & ICES	M
Conventions	Name of the format convention used by the dataset	CF-1.6,IMOS-1.4,ICES_SISP_4-1.10,SOOP-BA-2.2	S	CF	M
standard_name_vocabulary	Table number used for CF standard names	NetCDF Climate and Forecast (CF) Metadata Convention Standard Name Table Version 29	S	CF	M
institution	Name of the institute or facility where the original data was produced	CSIRO Oceans and Atmosphere	S	CF & ICES	M
institution_address	Address of the institute or facility where the original data was produced	Castray Esplanade, Hobart TAS 7000, Australia	S	IMOS	O
institution_postal_address	Postal address of the institute or facility where the original data was produced	GPO Box 1538, Hobart TAS 7001, Australia	S	IMOS	O
source	Method of production of the original data	Echosounder	S	IMOS	O
keywords	A comma separated list of keywords and phrases	Oceans > Ocean Acoustics > Acoustic Scattering, Oceans > Aquatic Sciences > Fisheries	S	IMOS & ICES	O (IMOS) M (ICES)
keywords_vocabulary	Identifies the controlled keyword vocabulary used to specify the values within the attribute 'keywords'	NASA/GCMD Earth Science Keywords	S	IMOS	O
references	Published or web-based references that describe the data or the methods used to produce the data. Include a reference to IMOS and a project-specific reference if appropriate. Multiple references should be separated	http://www.imos.org.au	S	IMOS & ICES	O (IMOS) M (ICES)

Attribute name	Definition	Example	Type	Authority	Obligation
	with a semicolon ';'				
site_code	Unique site code within IMOS project	SOOP-BA	S	IMOS	O
naming_authority	This will always be 'IMOS'	IMOS	S	IMOS	M
cdm_data_type	The 'cdm_data_type' attribute gives the Unidata CDM (Common Data Model) data type used by THREDDS.	Trajectory	S	IMOS	O
mission_name	Name of mission	Integrated Marine Observing System - Ships of Opportunity - Bio Acoustic	S	ICES	M
mission_abstract	Free text description of the mission	Collection of bio acoustic data from ships of opportunity	S	ICES	M
mission_start_date	Start date of mission in ISO 8601 format	2010-07-01	S	ICES	M
mission_id	ID code of mission	IMOS-SOOPBA	S	ICES	M
mission_platform	Platform type	Ship, other	S	ICES	M
data_centre	Data centre in charge of the data management or party who distributed the resource	Australian Ocean Data Network (AODN)	S	IMOS & ICES	M
data_centre_email	Data Centre contact e-mail address	info@aodn.org.au	S	IMOS & ICES	M
author	Name of the person responsible for the creation of the dataset	Ryan Downie	S	IMOS & ICES	M
creator	An entity primarily responsible for making the resource	Ryan Downie	S	ICES	M
contributor	An entity responsible for making contributions to the resource	Ryan Downie	S	ICES	M
author_email	Email address of the person responsible for the creation of the dataset	Ryan.Downie@csiro.au	S	IMOS & ICES	O (IMOS) M (ICES)

Attribute name	Definition	Example	Type	Authority	Obligation
principal_investigator	Name of the principal investigator in charge of the platform	Rudy Kloser	S	IMOS & ICES	M
principal_investigator_email	Principal investigator e-mail address	Rudy.Kloser@csiro.au	S	IMOS & ICES	O (IMOS) M (ICES)
institution_references	References that describe the data provider institution, the place to find all information on the dataset (web-based, i.e. give URLs). Multiple references should be separated with a semicolon ';'	http://imos.org.au/basoop.html	S	IMOS	O
acknowledgement	Information about how to acknowledge the source of the material. For data produced under the IMOS project, the field must be filled as shown in the example. If relevant, also credit other organisations involved in collection of this particular data stream	Any users (including repackagers) of IMOS data are required to clearly acknowledge the source of the material in this format: "Data was sourced from the Integrated Marine Observing System (IMOS) - IMOS is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative"	S	IMOS	M
disclaimer	Statement limiting the liability of the data provider. For data produced under the IMOS project, the field must be filled as shown in the example	Data, products and services from IMOS are provided "as is" without any warranty as to fitness for a particular purpose	S	IMOS	M
license	Describe the restrictions to data access and distribution. For data produced under the IMOS project, the field must be filled as shown in the example	CC BY 4.0 https://creativecommons.org/licenses/by/4.0/	S	IMOS & ICES	M

2.1.1.2 Metadata record attributes

Attribute name	Definition	Example	Type	Authority	Obligation
convention_name	Name of the convention. 'A metadata convention for processed acoustic data from active acoustic systems'	A metadata convention for processed acoustic data from active acoustic systems	S	ICES	M
convention_author	'ICES WGFAST Topic Group, TG-AcMeta'	ICES WGFAST Topic Group, TG-AcMeta	S	ICES	M
convention_year	e.g. 2016	2016	N	ICES	M
convention_organisation	International Council for the Sea (ICES)	International Council for the Sea (ICES)	S	ICES	M
convention_publisher	The Series of ICES Survey Protocols (SISP) http://www.ices.dk/publications/our-publications/Pages/Survey-Protocols.aspx	The Series of ICES Survey Protocols (SISP) http://www.ices.dk/publications/our-publications/Pages/Survey-Protocols.aspx	S	ICES	M
convention_version	A label that states the convention version that the metadata conforms to	Version 1.10	S	ICES	M
convention_reference	Record the reference for this convention	ICES. 2016. A metadata convention for processed acoustic data from active acoustic systems, SISP 4 TG-AcMeta Version 1.10, ICES WGFAST Topic Group, TG-AcMeta. 47 pp	S	ICES	M

2.1.1.3 Cruise attributes

Attribute name	Definition	Example	Type	Authority	Obligation
cruise_name	Formal name of cruise as recorded by cruise documentation or institutional data centre	in2018_v01	S	ICES	MA
cruise_description	Free text field to describe the cruise	Detecting Southern Ocean change from repeat hydrography, deep Argo and trace element biogeochemistry & CAPRICORN	S	ICES	MA
cruise_area_description	List main areas of operation	Southern Ocean	S	ICES	MA
cruise_units	The units of unlabelled numeric values of cruise_northlimit, cruise_eastlimit, cruise_southlimit, cruise_westlimit (if present)	signed decimal degrees	S	ICES	MA
cruise_zunits	The units applying to unlabelled numeric values of cruise_uplimit, cruise_downlimit (if present). SI units are 'm'	m	S	ICES	MA
cruise_projection	The name of the projection used with any parameters required	Geographic	S	ICES	MA

2.1.1.4 Ship attributes

Attribute name	Definition	Example	Type	Authority	Obligation
platform_code	Unique platform code within IMOS project. For SOOP-BA this is ship's call sign (Australian call sign if the ship has multiple call signs)	VLMJ	S	IMOS	O
ship_name	Name of the ship	Investigator	S	ICES	MA
ship_type	Describe type of ship that is hosting the acoustic instrumentation	Ship, research	S	ICES	MA
ship_code	In-house code associated with ship	IN	S	ICES	O
ship_platform_code	ICES database of known ships	096U	S	ICES	MA
ship_platform_class	ICES controlled vocabulary for platform class (31 for research vessel and 36 for fishing vessel)	31	S	ICES	MA
ship_callsign	Ship call sign	VLMJ	S	ICES	MA
ship_IMO	Ship's International Maritime Organisation ship identification number	9616888	S	ICES	O
ship_operator	Name of organisation or company which operates the ship	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	S	ICES	MA
ship_home_port	Home port of the ship	Hobart	S	SOOP-BA	MA
ship_length	Overall length of the ship in metre	93.9	N	ICES	MA
ship_breadth	The width of the ship in metre at its widest point	18	N	ICES	R
ship_tonnage	Gross tonnage of the ship in ‘t’	6082	N	ICES	R
ship_engine_power	The total power available for ship propulsion in ‘kW’	5200	N	ICES	R
ship_noise_design	For example, ICES CRR No. 209 compliant. Otherwise description of noise performance of the ship	DNV Silent-R	S	ICES	R
ship_acknowledgement	Any users (including re-packagers) of these data are required to clearly acknowledge the source of the material in this format. For example, ship of opportunity - acknowledge contribution by ship and company	CSIRO Marine National Facility	S	ICES	R

2.1.1.5 Transect attributes

Attribute name	Definition	Example	Type	Authority	Obligation
transect_description	Description of the transect, its purpose, and main activity	Transit from SW Indian Ocean to Mauritius	S	ICES	MA
transect_start_time	Start time of the transect in ISO 8601 format	2017-12-04T23:54:10Z	S	ICES	MA
transect_end_time	End time of the transect in ISO 8601 format	2017-12-10T02:29:11Z	S	ICES	MA
transect_northlimit	The constant coordinate for the northernmost face or edge	-20.1323	N	ICES	MA
transect_eastlimit	The constant coordinate for the easternmost face or edge	68.9084	N	ICES	MA
transect_southlimit	The constant coordinate for the southernmost face or edge	-38.4644	N	ICES	MA
transect_westlimit	The constant coordinate for the westernmost face or edge	57.0784	N	ICES	MA
transect_units	The units of unlabelled numeric values of transect_northlimit, transect_eastlimit, transect_southlimit, transect_westlimit (if present)	signed decimal degrees	S	ICES	MA
transect_zunits	The units of unlabelled numeric values of transect_uplimit, transect_downlimit (if present). SI units are 'm'	m	S	ICES	MA
transect_projection	The name of the projection used	Geographic	S	ICES	MA
deployment_id	Name of the ship followed by duration of the transect	Antarctic_Chieftain_20171204-20171210	S	SOOP-BA	MA
transit_start_locality	Start region of the transect	SW Indian Ocean	S	SOOP-BA	MA
transit_end_locality	End region of the transect	Mauritius	S	SOOP-BA	MA

2.1.1.6 Instrument attributes

Attribute name	Definition	Example	Type	Authority	Obligation
instrument_frequency[2]	Frequency of the transceiver/transducer combination in kHz	38	S	ICES	M
channel	Frequency of the transceiver/transducer combination	38kHz	S	SOOP-BA	MA
frequency[2]	Frequency of the data	38	S	SOOP-BA	MA
instrument_channel_id[2]	Transceiver channel id	GPT 38 kHz 00907206d17c 2-1 ES38B	S	SOOP-BA	MA
instrument_transducer_location[2]	Location of installed transducer	Hull, keel	S	ICES	M
instrument_transducer_manufacturer[2]	Transducer manufacturer	Simrad	S	ICES	M
instrument_transducer_model[2]	Transducer model	ES38B	S	ICES	M
instrument_transducer_beam_type[2]	Transducer beam type. See controlled vocabulary table for transducer types in Appendix B.3 of ICES	Single-beam, split-aperture	S	ICES	M
instrument_transducer_serial[2]	Transducer serial number	1072	S	ICES	R
instrument_transducer_depth[2]	Mean depth of transducer face beneath the water surface in metre	6.8	N	ICES	O
instrument_transducer_orientation[2]	Direction perpendicular to the face of the transducer	downwards-looking	S	ICES	M
instrument_transducer_psi[2]	Manufacturer specified transducer equivalent beam angle, expressed in dB as 10log10(ψ), where ψ has units of steradians. Note this value is not necessarily used for processing	-20.5	N	ICES	R
instrument_transducer_beam_angle_major[2]	Major beam opening in degrees, also referred to athwartship angle	6.87	N	ICES	R
instrument_transducer_beam_angle_minor[2]	Minor beam opening in degrees, also referred to alongship angle	6.97	N	ICES	R
instrument_transceiver_manufacturer[2]	Transceiver manufacturer	Simrad	S	ICES	M
instrument_transceiver_model[2]	Transceiver model	EK60	S	ICES	M
instrument_transceiver_serial[2]	Transceiver serial number	31167	S	ICES	R

[2] This attribute is a variable for multi-frequency data.

2.1.1.7 Calibration attributes

Attribute name	Definition	Example	Type	Authority	Obligation
calibration_date[2]	Date of calibration in ISO 8601 format	2016-08-17	S	ICES	M
calibration_acquisition_method[2]	Describe the method used to acquire calibration data. (see ICES Appendix B.4, Standard lists)	Standard sphere, in-situ	S	ICES	M
calibration_processing_method[2]	Describe method of processing that was used to generate calibration offsets	Echoview on axis	S	ICES	M
calibration_accuracy_estimate[2]	Estimate of calibration accuracy in dB	0.5	S	ICES	M
calibration_report[2]	URL or references to external documents which give a full account of calibration processing and results may be appropriate. We suggest to contact IMOS for obtaining calibration report	Contact IMOS http://www.imos.org.au	S	ICES	M
calibration_file_name	Name of Echoview calibration supplement file (ECS file) used for processing	Antarctic_Chieftain_18kHz_2048ms_2000w_20170321_IMOS.ecs	S	SOOP-BA	MA
calibration_name	The calibration source for an acoustic variable used in Echoview while processing	SourceCal T1	S	SOOP-BA	MA

2.1.1.8 Data acquisition attributes

Attribute name	Definition	Example	Type	Authority	Obligation
data_acquisition_software_name[2]	Name of software that controls echosounder and its data logging	Simrad ER60	S	ICES	R
data_acquisition_stored_data_format[2]	Name of the format in which data are stored. For example Simrad raw format	Simrad .raw format	S	ICES	M
data_acquisition_ping_duty_cycle[2]	Free text field to describe ping duty cycle	continuous	S	ICES	M

2.1.1.9 Data processing attributes

Attribute name	Definition	Example	Type	Authority	Obligation
data_processing_software_name[2]	Name of software that was used to process raw acoustic data	process_BASOOP; Matlab; IMOS toolbox; Echoview	S	ICES	M
data_processing_software_version[2]	Version of software that was used to process raw acoustic data	2.5 $Id: basoop.m 1020 2017-05-17 04:54:24Z $; 8.6.0.267246 (R2015b); 2.3b - ; 8.0.105.32871	S	ICES	M
data_processing_triwave_correction	Applies to Simrad ES60 and ES70 echosounders only	No	S	ICES	MA
data_processing_frequency[2]	Transmit frequency in 'kHz' associated with processed data	38	N	ICES	M
data_processing_transceiver_power[2]	Nominal transceiver power in 'W'	2000	N	ICES	M
data_processing_transmit_pulse_length[2]	Transmit pulse length in 'ms'	2.048	N	ICES	M
data_processing_on_axis_gain[2]	Total system gain value when calibration sphere is on-axis	26.5	N	ICES	M
data_processing_on_axis_gain_units[2]	Units for the data_processing_on_axis_gain attribute	dB	S	ICES	M
data_processing_Sacorrection[2]	S_A correction value (Simrad transceivers) in dB	-0.47	N	ICES	O
data_processing_absorption	Absorption of sound by seawater value in dBm^{-1}. Leave blank if absorption profile was used and give appropriate description in the data_processing_absorption_description field	0.0097472	N	ICES	R
data_processing_absorption_description[2]	Describe (i) equation used to calculate absorption, (ii) source of input data into absorption calculation, (iii) arithmetic or geometric mean of depth-absorption profile or nominal value applied to entire dataset	Sound absorption calculated using Francois and Garrison 1982 from CARS for each cell	S	ICES	R

Attribute name	Definition	Example	Type	Authority	Obligation
data_processing_soundspeed	Sound speed used by transceiver in ms^{-1}. Leave blank if sound speed profile was used and give appropriate description in the data_process_soundspeed_description field	1500	N	ICES	R
data_processing_soundspeed_description[2]	Describe (i) equation used to calculate sound speed, (ii) source of input data into sound speed calculation , (iii) arithmetic or geometric mean of depth-absorption profile or nominal value applied to entire dataset	Sound speed calculated using Coppens 1981 from CARS for each cell	S	ICES	R
data_processing_transducer_psi[2]	Transducer equivalent beam angle, expressed in dB as 10log10(ψ), where ψ has units of steradians	-20.5	N	ICES	M
toolbox_version	IMOS Matlab toolbox version used for creating NetCDF file	2.5.38 -	S	IMOS	O
data_processing_transducer_beam_angle_major[2]	Major beam opening in degrees used for processing, also referred to athwartship angle	11	N	SOOP-BA	MA
data_processing_transducer_beam_angle_minor[2]	Minor beam opening in degrees used for processing, also referred to alongship angle	11	N	SOOP-BA	MA
data_processing_transducer_depth[2]	Mean depth of transducer face beneath the water surface in metre	5	N	SOOP-BA	MA
data_processing_by	Id of processing person and information about the computer used with local date and time	kun017 on SALT-HF PCWIN64 at 2018-05-17T18:49:31 local	S	SOOP-BA	MA
echoview_version	Echoview software version used for processing	8.0.105.32871	S	SOOP-BA	MA
Echoview_template	Echoview template version used for processing	Q:\IMOS_echoview_templates\F38 \template_38kHz_Echoview8_v1.1	S	SOOP-BA	MA

Attribute name	Definition	Example	Type	Authority	Obligation
		17.EV			
matlab_version	Matlab version used for processing	8.6.0.267246 (R2015b)	S	SOOP-BA	MA
edits	Log of course level quality control and manual data cleaning applied to the NetCDF file	20180524-144918 kun017 flagged 157:167; 102:111	S	SOOP-BA	MA

2.1.1.10 Dataset attributes

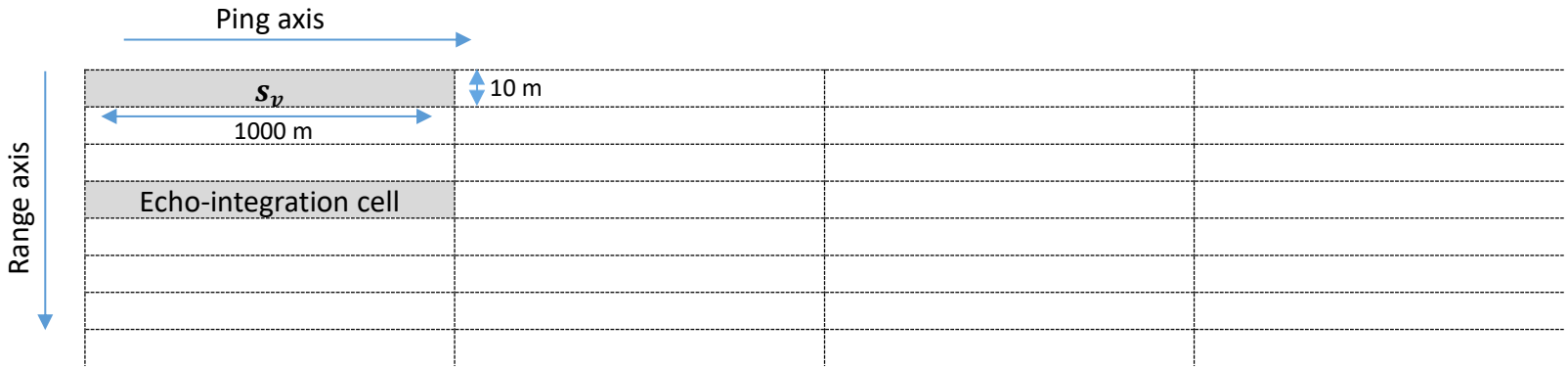
Attribute name	Definition	Example	Type	Authority	Obligation
title	Short description of the dataset	A Bio-acoustic dataset from SW Indian Ocean to Mauritius in Dec 2017	S	IMOS & ICES	M
abstract	A paragraph describing the dataset: type of data contained in the dataset, how the data was created, the creator of the dataset, the project for which the data was created, the geospatial coverage of the data, the temporal coverage of the data	This is a water column acoustic dataset from SW Indian Ocean to Mauritius in Dec 2017. Collected under the IMOS BA-SOOP program by Antarctic Longline Ltd vessel Antarctic Chieftain	S	IMOS & ICES	M
history	Provides an audit trail for modifications to the original data. It should contain a separate line for each modification, with each line beginning with a timestamp and including user name, modification name and modification arguments	2018-05-17T08:50:43Z kun017 Environmental variables read from CARS refer: http://www.cmar.csiro.au/cars/ 2018-05-17T08:51:02Z kun017 Sound speed (Coppens 1981) and absorption (Francois and Garrison 1982) corrections applied	S	IMOS & ICES	R (ICES) O (IMOS)
citation	The citation to be used in publications using the dataset should follow the format: “IMOS. [year-of-data-download], [Title], [Data access URL], accessed [date-of-access]”	The citation in a list of references is: "IMOS. [year-of-data-download], [Title], [data-access-URL], accessed [date-of-access]"	S	IMOS & ICES	M
distribution_statement	Statement describing data distribution policy	Data, products and services from IMOS are provided "as is" without any warranty as to fitness for a particular purpose	S	IMOS & ICES	M
date_created	The date on which the file was created	2018-05-17T08:51:57Z	S	IMOS & ICES	M
date_modified	The date on which the file was modified	2018-05-17T08:51:02Z	S	IMOS	O
geospatial_lat_min	The southernmost latitude, a value between -90 and 90 decimal degrees	-38.4605	N	IMOS	M
geospatial_lat_max	The northernmost latitude, a value between -90 and 90 decimal degrees	-20.1326	N	IMOS	M
geospatial_lon_min	The westernmost longitude, a value	57.0784	N	IMOS	M

Attribute name	Definition	Example	Type	Authority	Obligation
	between -180 and 180 decimal degrees				
geospatial_lon_max	The easternmost longitude, a value between -180 and 180 degrees	68.9058	N	IMOS	M
geospatial_vertical_min	Minimum depth for measurements in metres	5	N	IMOS	M
geospatial_vertical_max	Maximum depth for measurements in metres	1195	N	IMOS	M
geospatial_vertical_positive	Direction towards which depth is positive. Possible values are either 'up' or 'down'	down	S	IMOS	M
northlimit	The constant coordinate for the northernmost face or edge	-20.1326	N	ICES	MA
eastlimit	The constant coordinate for the easternmost face or edge	68.9058	N	ICES	MA
southlimit	The constant coordinate for the southernmost face or edge	-38.4605	N	ICES	MA
westlimit	The constant coordinate for the westernmost face or edge	57.0784	N	ICES	MA
uplimit	The constant coordinate for the uppermost face or edge in the vertical, z, dimension. Reference edge for this attribute is the water surface	5	N	ICES	MA
downlimit	The constant coordinate for the lowermost face or edge in the vertical, z, dimension. Reference edge for this attribute is the water surface	1195	N	ICES	MA
units	The units of unlabelled numeric values of northlimit, eastlimit, southlimit, westlimit	signed decimal degrees	S	ICES	MA
zunits	The units of unlabelled numeric values of uplimit, downlimit. SI units are 'm'	m	S	ICES	MA
projection	The name of the projection used	Geographic	S	ICES	MA

Attribute name	Definition	Example	Type	Authority	Obligation
time_coverage_start	Start date of the data in UTC	2017-12-04T23:54:10Z	S	IMOS & ICES	M
time_coverage_end	Final date of the data in UTC	2017-12-10T02:29:11Z	S	IMOS & ICES	M
file_version	Information about the file version of the file. Three levels are possible at the moment: - Level 0 - Raw data - Level 1 - Quality Controlled data - Level 2 - Derived product	2	S	IMOS	O
dataset_datum	Name of the geodetic datum used	WGS84	S	SOOP-BA	MA
dataset_ping_axis_size	Size of bin dimension on the ping-axis	1 km	S	SOOP_BA	MA
dataset_ping_axis_units	Units on the ping axis by which processed data has been binned. Must be either Time, Distance or number of pings	Distance	S	SOOP-BA	MA
dataset_range_axis_size	Size of bin dimension on the range axis. SI units are 'm'	10	N	SOOP-BA	MA

2.1.1.11 Data attributes

Attribute name	Definition	Example	Type	Authority	Obligation
data_acoustic_datatype	In what form is the acoustic data stored?	s_v, Volume backscattering coefficient (m^{-1})	S	ICES	M
data_ping_axis_interval_type	Ping-axis interval by which data have been binned	Distance (metres)	S	ICES	M
data_ping_axis_interval_origin	Location of ping axis interval value in the ping axis interval	Start	S	ICES	M
data_ping_axis_interval_value	Numeric value for data ping axis interval according to its specified type. SI units are 'm'	1000	N	ICES	MA
data_range_axis_interval_type	Range-axis interval by which data have been binned	Range (metres)	S	ICES	M
data_range_axis_interval_origin	Location of ping axis range value in the range axis interval	Start	S	ICES	M
data_range_axis_interval_value	Numeric value for data range axis interval according to its specified type. SI units are 'm'	10	N	ICES	MA



2.2 Dimensions

NetCDF file dimensions provide information on the size of the data variables, and additionally match coordinate variables to data. A variable may have any number of dimensions, including zero, and the dimensions must all have different names. The dimensions of the variable define the axes of the quantity it contains. Dimensions other than those of space and time are included (Eaton *et al.*, 2011).

The table below is the list of `Dimensions` for an IMOS SOOP-BA NetCDF file.

Name	Example	Comment
TIME	TIME=unlimited	Number of time steps present in the data
DEPTH	DEPTH=120	Number of depth levels Example: for a given transect with measurements binned at every 100 m depth interval between 0-1200 m, DEPTH=120
CHANNEL	CHANNEL=4	Number of frequency channels. This is applicable only for multi-frequency data set Example: for a given transect containing 18, 38, 70, and 120 kHz frequencies, CHANNEL=4
STRINGxx (where xx is a number)	STRING256=256	To support string variables
EV_FILENAME	EV_FILENAME=7	For listing the Echoview (*.EV) files used to process the data

Example: Single frequency data

```
Dimensions:
            TIME         = 2867
            DEPTH        = 120
            STRING256    = 256
            EV_FILENAME  = 7
```

Multi-frequency data

```
Dimensions:
            TIME         = 1314
            DEPTH        = 120
            CHANNEL      = 4
            STRING4      = 4
            STRING8      = 8
            STRING16     = 16
            STRING32     = 32
            STRING64     = 64
            STRING128    = 128
            STRING256    = 256
            EV_FILENAME  = 2
```

2.3 Variables

The SOOP-BA NetCDF variables include coordinate variables, actual measurements by an echosounder, metrics derived from the primary measurements, and environmental parameters derived from established ocean observing systems. Variables are also used to store quality flags associated to a measurement and other metadata that is not applicable to all data in a file. These variables are described in the sub-sections below with a specific set of mandatory attributes (IMOS, 2015).

2.3.1 Coordinate variables

The commonest use of coordinate variables is to locate the data in space and time. For this purpose, they have an `'axis'` attribute to indicate that they represent either `longitude` (`axis = 'X'`), `latitude` (`'Y'`), `depth` (`'Z'`) or `time` (`'T'`).

2.3.1.1 LATITUDE

The latitude coordinate in an IMOS SOOP-BA NetCDF file is specified in decimal degrees relative to the WGS84 coordinate reference system.

The example below presents the attributes used to describe the variable `LATITUDE`.

```
LATITUDE
      Size:       2867x1
      Dimensions: TIME
      Datatype:   double
      Attributes:
            standard_name       = 'latitude'
            long_name           = 'latitude'
            units               = 'degrees_north'
            axis                = 'Y'
            valid_min           = -90
            valid_max           = 90
            reference_datum     = 'WGS84 geographic coordinate
                                  system'
            ancillary_variables = 'LATITUDE_quality_control'
```

2.3.1.2 LONGITUDE

The longitude coordinate in an IMOS SOOP-BA NetCDF file is specified in decimal degrees relative to the WGS84 coordinate reference system.

The example below presents the attributes used to describe the variable `LONGITUDE`.

```
LONGITUDE
      Size:       2867x1
      Dimensions: TIME
      Datatype:   double
      Attributes:
            standard_name       = 'longitude'
            long_name           = 'longitude'
            units               = 'degrees_east'
            axis                = 'X'
            valid_min           = -180
            valid_max           = 180
            reference_datum     = 'WGS84 geographic coordinate
                                  system'
            ancillary_variables = 'LONGITUDE_quality_control'
```

2.3.1.3 DEPTH

The depth variable measures the depth below the sea surface that is positive in downward direction as defined in its `'positive'` attribute.

The example below presents the attributes used to describe the variable `DEPTH`.

```
DEPTH
     Size:       120x1
     Dimensions: DEPTH
     Datatype:   double
     Attributes:
                 standard_name   = 'depth'
                 long_name       = 'actual depth'
                 units           = 'm'
                 axis            = 'Z'
                 positive        = 'down'
                 valid_min       = '0'
                 valid_max       = '1200'
                 reference_datum = 'sea surface'
```

2.3.1.4 TIME

Time variable is represented numerically as an interval (e.g. number of days or hours) from a reference time.

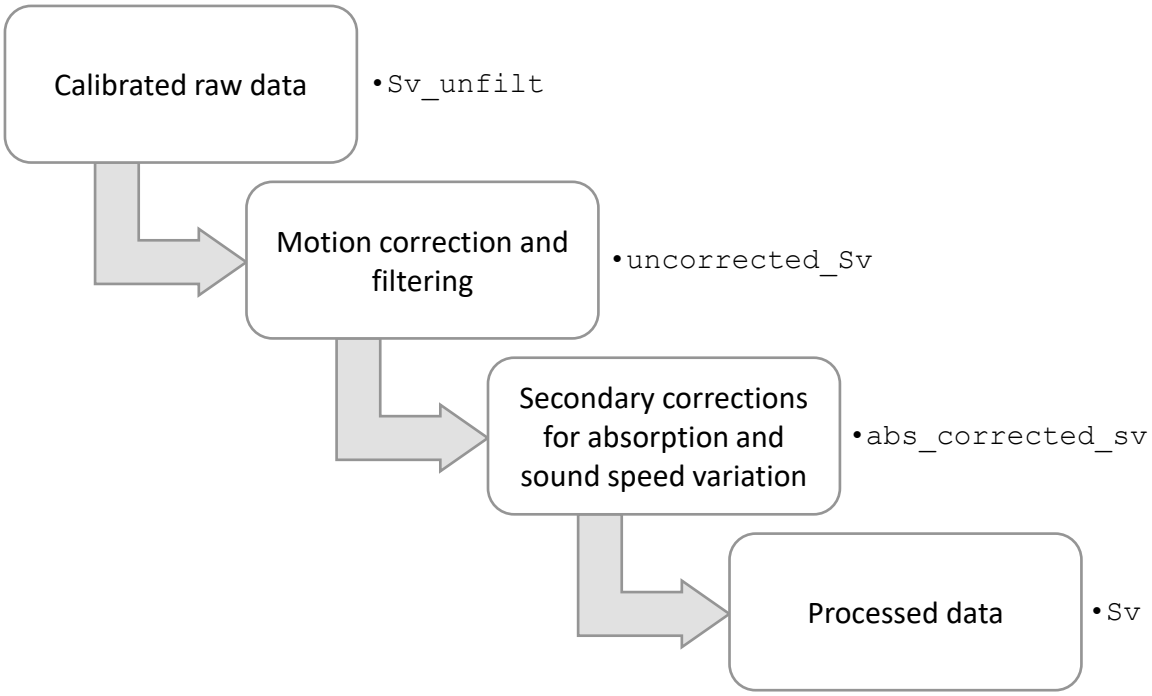
The example below presents the attributes used to describe the variable `TIME`.

```
TIME
    Size:       2867x1
    Dimensions: TIME
    Datatype:   double
    Attributes:
          standard_name = 'time'
          long_name     = 'time'
          units         = 'days since 1950-01-01 00:00:00 UTC'
          axis          = 'T'
          valid_min     = '0'
          valid_max     = '90000'
          calendar      = 'gregorian'
```

2.3.2 Primary data variables

Primary data variables contain actual measurements by an echosounder and derived metrics.

As noted by Simmonds and MacLennan (2005), the component of the echosounder measurement corresponding to transmitted sound backscattered onto the transducer surface is the 'signal', and 'noise' can be defined as all other contributions to the acoustic energy received (De Robertis and Higginbottom, 2007). The raw echosounder data collected under SOOP-BA project were post-processed to remove noise and improve data quality using a sequence of data processing filters. The flowchart below provides generic overview of processing sequence in the context of data variables present in the NetCDF file [reproduced from Ryan *et al.* (2015)].



2.3.2.1 Sv_unfilt

This variable contains 'unprocessed' mean volume backscattering coefficient (m^{-1}) values. These are an echo-integration of as-acquired 'raw' (but calibrated) acoustic water column data with cell sizes specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable `Sv_unfilt`.

```
Sv_unfilt
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            coefficient_unprocessed'
      units               = 'm-1'
      valid_min           = 0
      valid_max           = 1
      ancillary_variables = 'Sv_unfilt_quality_control'
```

2.3.2.2 uncorrected_Sv

This variable contains 'filtered' mean volume backscattering coefficient (m^{-1}) values. These are an echo-integration of 'filtered' and 'motion' correction applied (if motion data is available) acoustic water column data with cell sizes specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable `uncorrected_Sv`.

```
uncorrected_Sv
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            coefficient_filtered'
      units               = 'm-1'
      valid_min           = 0
      valid_max           = 1
      ancillary_variables = 'uncorrected_Sv_quality_control'
```

2.3.2.3 uncorrected_Sv_pcnt_good

This variable contains the percentage of `'uncorrected_Sv'` data retained before secondary corrections.

The example below presents the attributes used to describe the variable

uncorrected_Sv_pcnt_good.

```
uncorrected_Sv_pcnt_good
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'percentage_uncorrected_Sv_samples
                            _retained'
      units               = '%'
      valid_min           = 0
      valid_max           = 100
      ancillary_variables = 'uncorrected_Sv_pcnt_good_
                            quality_control'
```

2.3.2.4 abs_corrected_sv

This variable contains 'filtered and secondary corrections applied' mean volume backscattering coefficient (m^{-1}) values. Secondary absorption and sound speed corrections are applied to the 'uncorrected_Sv' variable with cell sizes specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable abs_corrected_sv.

```
abs_corrected_sv
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            coefficient_secondary_corrections_
                            applied'
      units               = 'm-1'
      valid_min           = 0
      valid_max           = 1
      ancillary_variables = 'abs_corrected_sv_quality_control'
```

2.3.2.5 Sv

This variable contains 'processed' mean volume backscattering coefficient (m^{-1}) values. These are an echo-integration of acoustic water column data that has been post-processed for quality control and filtering to remove bad data. The processed data was stored as the final data product with cell sizes specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable Sv.

```
Sv
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            coefficient_final_data_product'
      units               = 'm-1'
      valid_min           = 0
      valid_max           = 1
      ancillary_variables = 'Sv_quality_control'
```

2.3.2.6 Sv_pcnt_good

This variable contains the percentage of 'Sv' data retained at the end of post-processing. It is used as an indicator of data quality for each echo-integration cell.

The example below presents the attributes used to describe the variable Sv_pcnt_good.

```
Sv_pcnt_good
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'percentage_Sv_samples_retained'
      units               = '%'
      valid_min           = 0
      valid_max           = 100
      ancillary_variables = 'Sv_pcnt_good_quality_control'
```

2.3.2.7 epipelagic

This variable is a derived metric from the final data product 'Sv'. For each ping axis interval, the 'Sv' values (that are in linear domain) were averaged between 20–200 m depth and converted as mean volume backscattering strength (dB re 1 m^{-1}).

The example below presents the attributes used to describe the variable epipelagic.

```
epipelagic
 Size:       2867x1
 Dimensions: TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            strength_epipelagic_layer_20-200m'
      units               = 'decibel'
      valid_min           = -150
      valid_max           = -10
      ancillary_variables = 'epipelagic_quality_control'
```

2.3.2.8 upper_mesopelagic

This variable is a derived metric from the final data product `'Sv'`. For each ping axis interval, the `'Sv'` values (that are in linear domain) were averaged between 200–400 m depth and converted as mean volume backscattering strength (dB re 1 m^{-1}).

The example below presents the attributes used to describe the variable `upper_mesopelagic`.

```
upper_mesopelagic
 Size:       2867x1
 Dimensions: TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            strength_upper_mesopelagic_layer_
                            200-400m'
      units               = 'decibel'
      valid_min           = -150
      valid_max           = -10
      ancillary_variables ='upper_mesopelagic_quality_control'
```

2.3.2.9 lower_mesopelagic

This variable is a derived metric from the final data product `'Sv'`. For each ping axis interval, the `'Sv'` values (that are in linear domain) were averaged between 400–800 m depth and converted as mean volume backscattering strength (dB re 1 m^{-1}).

The example below presents the attributes used to describe the variable `lower_mesopelagic`.

```
lower_mesopelagic
 Size:       2867x1
 Dimensions: TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_volume_backscattering_
                            strength_lower_mesopelagic_layer_
                            400-800m'
      units               = 'decibel'
      valid_min           = -150
      valid_max           = -10
      ancillary_variables ='lower_mesopelagic_quality_control'
```

2.3.2.10 mean_height

This variable contains mean height (m) values for each echo-integration cell specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable `mean_height`.

```
mean_height
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'mean_cell_height'
      units               = 'm'
      valid_min           = 0.001
      valid_max           = 10
      ancillary_variables = 'mean_height_quality_control'
```

2.3.2.11 mean_depth

This variable contains mean depth (m) values for each echo-integration cell specified in section 2.1.1.11.

The example below presents the attributes used to describe the variable `mean_depth`.

```
mean_depth
  Size:       120x2867
  Dimensions: DEPTH,TIME
  Datatype:   double
  Attributes:
       long_name           = 'mean_cell_depth'
       units               = 'm'
       valid_min           = 0.001
       valid_max           = 1200
       ancillary_variables = 'mean_depth_quality_control'
```

2.3.2.12 signal_noise

The signal-to-noise-ratio (SNR) is the ratio of the signal energy to that of the noise in the bandwidth of interest (Simmonds and MacLennan, 2005). The variable `signal_noise` contains SNR values for each echo-integration cell specified section 2.1.1.11.

The example below presents the attributes used to describe the variable `signal_noise`.

```
signal_noise
  Size:       120x2867
  Dimensions: DEPTH,TIME
  Datatype:   double
  Attributes:
       long_name           = 'signal_to_noise_ratio'
       units               = 'decibel'
       valid_min           = -100
       valid_max           = 100
       ancillary_variables = 'signal_noise_quality_control'
```

2.3.2.13 background_noise

Background noise is defined as the noise measured by the echosounder with the transmit disabled and the receiver enabled (De Robertis and Higginbottom, 2007), referred to 1 m from the transducer face in dB re 1 m^{-1}. The variable `background_noise` contains background noise values for each ping axis interval.

The example below presents the attributes used to describe the variable `background_noise`.

```
background_noise
  Size:       2867x1
  Dimensions: TIME
  Datatype:   double
  Attributes:
       long_name           = 'background_noise'
       units               = 'decibel'
       valid_min           = -220
       valid_max           = -100
       ancillary_variables = 'background_noise_quality_control'
```

2.3.3 Auxiliary data variables

Auxiliary data variables contain derived products such as climatology and satellite data as described in the sub-sections below with a specific set of mandatory attributes (IMOS, 2015).

2.3.3.1 day

This variable contains information of diurnal sun cycle for each ping axis interval. The numbers 1, 2, 3 and 4 are used to represent sun cycle as below.

- 1 – Day
- 2 – Sunset ± 1 hr
- 3 – Sunrise ± 1 hr
- 4 – Night

The example below presents the attributes used to describe the variable `day`.

```
day
  Size:       2867x1
  Dimensions: TIME
  Datatype:   double
  Attributes:
       long_name           = 'diurnal_sun_cycle'
       units               = '1-Day 2-Sunset +/-1 hr 3-Sunrise
                             +/-1 hr 4-Night'
       valid_min           = 1
       valid_max           = 4
       ancillary_variables = 'day_quality_control'
```

2.3.3.2 CARS_temperature

This variable contains climatology 'temperature' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_temperature`.

```
CARS_temperature
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_temperature'
      units               = 'degrees_Celsius'
      valid_min           = -2.5
      valid_max           = 40
      ancillary_variables = 'CARS_temperature_quality_control'
```

2.3.3.3 CARS_salinity

This variable contains climatology 'salinity' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_salinity`.

```
CARS_salinity
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_salinity'
      units               = 'PSU'
      valid_min           = 2
      valid_max           = 41
      ancillary_variables = 'CARS_salinity_quality_control'
```

2.3.3.4 CARS_oxygen

This variable contains climatology 'oxygen' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_oxygen`.

```
CARS_oxygen
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_oxygen'
      units               = 'ml l-1'
      valid_min           = 0
      valid_max           = 100
      ancillary_variables = 'CARS_oxygen_quality_control'
```

2.3.3.5 CARS_nitrate

This variable contains climatology 'nitrate' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_ nitrate`.

```
CARS_nitrate
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_nitrate'
      units               = 'umole l-1'
      valid_min           = 0
      valid_max           = 50
      ancillary_variables = 'CARS_ nitrate_quality_control'
```

2.3.3.6 CARS_phosphate

This variable contains climatology 'phosphate' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_phosphate`.

```
CARS_phosphate
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_phosphate'
      units               = 'umole l-1'
      valid_min           = 0
      valid_max           = 10
      ancillary_variables = 'CARS_phosphate_quality_control'
```

2.3.3.7 CARS_silicate

This variable contains climatology 'silicate' values for each echo-integration cell, derived from CSIRO Atlas of Regional Seas (CARS).

The example below presents the attributes used to describe the variable `CARS_silicate`.

```
CARS_silicate
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'CARS_silicate'
      units               = 'umole l-1'
      valid_min           = 0
      valid_max           = 200
      ancillary_variables = 'CARS_silicate_quality_control'
```

2.3.3.8 temperature

This variable contains inferred 'temperature' values for each echo-integration cell, derived from synthetic temperature and salinity (synTS) as described in Ridgway and Dunn (2010). If synTS is not covering the transect region, `CARS_temperature` values are substituted[3]. The 'source' attribute denotes the origin of the data, either 'interpolated synTS' or 'CARS'.

The example below presents the attributes used to describe the variable `temperature`.

```
temperature
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'temperature'
      source              = 'interpolated synTS'
      units               = 'degrees_Celsius'
      valid_min           = -2.5
      valid_max           = 40
      ancillary_variables = 'temperature_quality_control'
```

2.3.3.9 salinity

This variable contains inferred 'salinity' values for each echo-integration cell, derived from synthetic temperature and salinity (synTS) as described in Ridgway and Dunn (2010). If synTS is not covering the transect region, `CARS_salinity` values are substituted[3]. The 'source'

[3] The attribute 'source' is added by the data provider to represent source of the data.

attribute denotes the origin of the data, either ‘interpolated synTS’ or ‘CARS’.

The example below presents the attributes used to describe the variable `salinity`.

```
salinity
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'salinity'
      source              = 'interpolated synTS'
      units               = 'PSU'
      valid_min           = 2
      valid_max           = 41
      ancillary_variables = 'salinity_quality_control'
```

2.3.3.10 npp

This variable contains satellite-derived ocean net primary production (NPP) values for each ping axis interval (averaged for the previous 12 months with reference to the transect start date). Source: Vertically Generalized Production Model (VGPM) based global ocean net primary production (Oregon State University).

The example below presents the attributes used to describe the variable `npp`.

```
npp
 Size:       2867x1
 Dimensions: TIME
 Datatype:   double
 Attributes:
      long_name           = 'net_primary_production'
      units               = 'mg C m-2 day-1'
      valid_min           = 0
      valid_max           = 1000
      ancillary_variables = 'npp_quality_control'
```

2.3.3.11 sound_speed

This variable contains sound speed (m/s) in water calculated for each echo-integration cell[4].

The example below presents the attributes used to describe the variable `sound_speed`.

[4] The equation used for calculation is indicated in the global attribute ‘data_processing_soundspeed_description’.

```
sound_speed
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'sound_speed'
      units               = 'm s-1'
      valid_min           = 1400
      valid_max           = 1600
      ancillary_variables = 'sound_speed_quality_control'
```

2.3.3.12 absorption

This variable contains absorption coefficient (dB/m) of sound in water at the frequency of the associated `'Sv'` data, calculated for each echo-integration cell[5].

The example below presents the attributes used to describe the variable `absorption`.

```
absorption
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   double
 Attributes:
      long_name           = 'absorption_coefficient_of_sound'
      units               = 'dB m-1'
      valid_min           = 0.0005
      valid_max           = 0.2
      ancillary_variables = 'absorption_quality_control'
```

[5] The equation used for calculation is indicated in the global attribute 'data_processing_absorption_description'.

2.3.4 Ancillary variables

When the data variable (described above) provides metadata about the individual values of another data variable, a link between the variables is provided to express this association. The attribute '`ancillary_variable`' is used to indicate these types of relationships.

The use of ancillary variables in the context of data 'Quality Control' is described below (IMOS, 2015).

2.3.4.1 Quality control (QC)

Quality control involves assessment of the data to identify data points which have errors that limit their use.

The example below describes how this data quality information is represented an IMOS SOOP-BA NetCDF file.

```
Sv_quality_control
 Size:       120x2867
 Dimensions: DEPTH,TIME
 Datatype:   int8
 Attributes:
      long_name                          = 'quality flag for mean_volume_backscattering_coefficient'
      quality_control_conventions        = 'IMOS standard flags'
      flag_values                        = [0  1  2  3  4  5  6  7  8  9]
      flag_meanings                      = 'No_QC_performed Good_data Probably_good_data
                                            Bad_data_that_are_potentially_correctable Bad_data Value_changed
                                            Not_used Not_used Not_used Missing_value'
```

3 File naming convention

The SOOP-BA file name format is:

IMOS_SOOP-BA_AE_<Start-date>_<Platform_Code>_FV02_<Product-Type>_END-<End-date>_C-<Creation_date>.nc

- 'AE' is the data code where (A: Acoustic measurements) and (E: Engineering or technical parameters)
- <Start-date> is the time of the first data point in the data
- <Platform_Code> is the call sign of the ship that acquired the data
- 'FV02' is the File Version Code Level 2: derived product
- <Product-Type> includes <Ship-Name>-<Instrument>-<Frequencies>, for example Southern-Surveyor-EK60-38-120
- <End-date> is the time of the last data point in the data
- <Creation_date> is the time at which the NetCDF file was created

Example: Single frequency data

IMOS_SOOP-BA_AE_20170930T072054Z_VJN4779_FV02_Corinthian-Bay-ES60-38_END-20171006T150415Z_C-20180513T225210Z.nc

Example: Multi-frequency data

IMOS_SOOP-BA_AE_20180218T124044Z_VLMJ_FV02_Investigator-EK60-18-38-70-120_END-20180221T120556Z_C-20180427T041820Z.nc

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Appendix – Matlab function for visualisation

A Matlab function to read and visualise SOOP-BA NetCDF files conforming to the specifications described in this document can be downloaded from the following websites.

IMOS: http://imos.org.au/facilities/shipsofopportunity/bioacoustic/balinks/
GitHub: https://github.com/CSIRO-Acoustics/Visualize-acoustic-water-column-data-