

Drifting buoys Data Management

2017



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Summary

The present document describes the data formats recognized by the drifter GDAC. The document details the NetCDF internal data format employed by the GDAC. Correspondence tables between all the data formats and WIGOS metadata are also included.

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Legacy data formats

Near-real-time processing

The following data formats are recognized as legacy and their content must be supported as much as possible by the data format adopted by the drifter GDAC:

- **FM 18 BUOY** alphanumeric code [Available online from http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_v11/Publications/2015update/Sel2.pdf Last Accessed 2 May 2016]
- **BUFR** Template 315009 for representation of data from drifting buoys [Available online from http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_v12/Ref_Templates/DriftingBuoy_TM315009.doc Last Accessed .2 May 2016]
- **OceanSITES** data format version 1.3, NetCDF [Available online from http://www.oceansites.org/docs/oceansites_data_format_reference_manual.pdf Last Accessed 2 May 2016]
- **GlobCURRENT** product format and content, “Trajectory, along-track”, NetCDF [Available online from section 4.5.5 of https://globcurrent.nersc.no/system/files/pubdeliver/GlobCurrent_D-150_TN-2_v3-signed.pdf Last Accessed 2 May 2016]

There have been, or still are, other data formats used that can be termed as legacy formats:

- Never-validated BUFR templates for drifting buoy data,
- Specialized formats for non-SVP buoys, like CODE

These formats are not supported at present but the intention is to support them eventually. This may require a modification of the GDAC data format in the future.

Delayed mode processing

In addition, there are also ship-to-shore data formats originally handled by the Data Assembly Centers (DACs), to relay the information from the buoys:

- Argos formats as mandated by the Data Buoy Cooperation Panel (DBCP)
- Iridium Short-Burst Data (SBD) formats as mandated by the DBCP [Available online http://esurfmar.meteo.fr/doc/o/db/others/DB_Iridium_formats.pdf last accessed 12 June 2017]

It is intended to re-acquire as much as possible the data from these archives. However, in the first implementation of the GDAC, the Argos formats are not supported. The intention is to support them eventually. This may require a modification of the GDAC data format in the future.

Metadata

The drifter GDAC data shall be accompanied by complete metadata to assist users in their exploitation of the data.

The metadata shall be taken from the most complete and authoritative source. Currently JCOMMOPS collects some of these metadata, and feeds them into WIGOS/Surface, which contains the metadata for the WMO Integrated Global Observing System (WIGOS). There are additional platform metadata available from the manufacturers and program operators.

Definition of WIGOS metadata (regulated by WMO Pub. 1160) for drifting buoys is ongoing at time of writing. As JCOMMOPS is migrating to use such definitions, compatible with WIGOS metadata, the GDAC will directly adopt these definitions.

The metadata column should evolve with agreed definitions, and to incorporate more of the manufacturers' and programs' metadata

Account of the legacy data formats

Notes for FM 18 BUOY:

- Because all the content of FM 18 BUOY relevant to drifting buoy capabilities as of 2015 has been mapped into the BUFR template 315009, FM 18 BUOY is not considered further in the remainder of the present document.

Notes for BUFR:

- Template 3 15 009 is considered here
- The name is followed by the key and sequence number in parentheses
- * indicates parameters that are governed by a code table
- The short names are as defined by ECMWF decoding software ecCodes in the source directory definitions/bufr/tables/0/wmo/*/element.table
[\https://software.ecmwf.int/wiki/display/ECC/ecCodes+Home last accessed 12 June 2016 for version 2.0.2]

Notes for NetCDF OceanSITES:

- Version 1.3 is considered here.

Notes for Iridium SBD:

- Version 1.6 of the recommended data formats documentation is considered here (namely: data formats #000, #002, #003, #020, #021, #022, #033, #034, #040, and #080)

The following tables show corresponding elements when relevant, aligned whenever they aim to represent the same information.

Elements that are not mapped into the GDAC column are considered as non-relevant for drifting buoys or not implemented initially.

Notes for the proposed NetCDF GDAC, the following variables are considered at present:

- Environmental data: water temperature, water salinity, water pressure, water conductivity, wave parameters, ice thickness, air temperature, air pressure, and wind parameters
- Engineering data: buoy submergence, battery voltage, and several others which are generally buoy manufacturer- and data format-dependent

Drifter GDAC: NetCDF format description

Definitions

Name	Value	Comment
DATE_TIME	14	This is the length of a date/time in ASCII format: YYYYMMDDHHMISS
STRING64	64	Length of a string
STRING32	32	Length of a string
STRING16	16	Length of a string
STRING8	8	Length of a string
STRING4	4	Length of a string
STRING2	2	Length of a string
Float...		
Integer...		

Global attributes

NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC [Type]
title (O, G)	title [STRING64]
Institution (O, G) institution_abbreviation (G)	institution [STRING64]
history (O, G)	history [STRING64]
references (O, G)	references [STRING64]
comment (O, G)	comment [STRING64]
	user_manual_version [STRING64]
Conventions (O, G)	Conventions [STRING64]
naming_authority (O, G)	
summary (O, G)	

NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC [Type]
id (O, G)	
uuid (G)	
source_version (G)	
principal_investigator (O)	
principal_investigator_email (O)	
principal_investigator_url (O)	
keywords_vocabulary (O, G) keywords (O, G)	
cdm_data_type (O, G)	
featureType (O) data_type (O)	
format_version (O)	format_version [STRING64]
netcdf_version (O) netcdf_version_id (G)	
Metadata_Conventions (G)	
metadata_link (G)	
standard_name_vocabulary (G)	
publisher_name (O, G)	
publisher_email (O, G)	
publisher_url (O, G)	
update_interval (O)	
License (O, G)	
Citation (O)	
acknowledgement (O, G)	
date_created (O, G)	date_creation [DATE_TIME]
date_modified (O, G)	date_update [DATE_TIME]
product_version (G)	
product_software (G)	
globcurrent_version_id (G)	
processing_level (O, G)	
QC_indicator (O) file_quality_level (G)	
contributor_name (O) creator_name (G)	

NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC [Type]
contributor_role (O)	
contributor_email (O) creator_email (G)	
creator_url (G)	

Dimensions

Name	Value	Comment
N_TIME	Integer	Number of distinct date/time instances
N_ENGINEERING	Integer	Maximum number of engineering parameters at a single location
N_PARAM	Integer	Maximum number of environmental parameters found in the drifter data record
N_WATER	Integer	Maximum number of data entries for any single water variable (temperature, salinity, current) at a single location
N_WAVE	Integer	Maximum number of data entries for any single wave variable at a single location
N_AIR	Integer	Maximum number of data entries for any single atmospheric variable (air temperature, wind) at a single location
N_AFFIL	Integer	Number of network or program affiliations
N_REGION	Integer	Number of WMO regions sampled at least once in the data record

Notes:

- The first dimension (N_PARAM) is obtained from the contents of the data record.
- The second dimension (N_TIME) is the number of distinct date/times in the drifter data record. Note that for some locations there may be no corresponding environmental data,

and conversely for some measured data there may no corresponding location at the same time.

- The third dimension (N_WATER) is the maximum of (the first sequence 0 31 000 Short delayed descriptor replication factor in the BUFR), over the drifter data record.
- The fourth dimension (N_WAVE) is the maximum of (the fourth sequence 0 31 000 Short delayed descriptor replication factor in the BUFR), over the drifter data record.
- The fifth dimension (N_AIR) is the maximum of (the second and third sequences 0 31 000 Short delayed descriptor replication factors in the BUFR), over the drifter data record.

Metadata

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
	project (O, G) network (O) array (O) buoy_network (G)	2-02	programme_or_net work_affiliation	(N_AFFIL)
			country	(N_AFFIL)
	time_coverage_start (O, G)	1-03	time_coverage_start	Global
	time_coverage_end (O, G)	1-03	time_coverage_end	Global
	time_coverage_duration (O)		time_coverage_dura tion	Global
	time_coverage_resolution (O, G)		time_coverage_resol ution	Global
	geospatial_lat_min (O, G)	1-04	geospatial_lat_min	Global
	geospatial_lat_max (O,G)	1-04	geospatial_lat_max	Global
	geospatial_lat_units (O, G)		geospatial_lat_units	Global
	geospatial_lat_resolution (G)		geospatial_lat_resol ution	Global
	geospatial_lon_min (O, G)	1-04	geospatial_lon_min	Global
	geospatial_lon_max (O, G)	1-04	geospatial_lon_max	Global
	geospatial_lon_units (O, G)		geospatial_lon_units	Global
	geospatial_lon_resolution (G)		geospatial_lon_resol ution	Global
	geospatial_vertical_min (O, G)	1-04	geospatial_vertical_ min	Global

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
	geospatial_vertical_max (O,G)	1-04	geospatial_vertical_max	Global
	geospatial_vertical_positive (O, G)		geospatial_vertical_positive	Global
	geospatial_vertical_units (O, G)		geospatial_vertical_units	Global
	area	3-01	wmo_regions	(N_REGION)
Long station or site name (longStationName 0 01 019) (B)	station_name (G)	3-03	station_name	Global
Type of data buoy (dataBuoyType 0 02 149)* (B) Format indicator (I)	platform_type (G)	3-05	platform_type	Global
			drifter_manufacturer	Global
			drifter_serial_number	Global
			drifter_manufacturing_date	Global
			drifter_hull_diameter	Global
			drifter_battery_type	Global
			drifter_battery_capacity	Global
Drogue type (drogueType 0 02 034)* (B)			drogue_type	Global
Drogue depth (drogueDepth 0 07 070) (B)			drogue_center_depth	Global
			drogue_diameter	Global
			drogue_length	Global
			drag_area_above_drogue	Global
			drag_area_of_drogue	Global
			drag_area_ratio	Global

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
WMO marine observing platform extended identifier (marineObservingPlatformIdentifier 0 01 087) (B)	wmo_platform_code (O) wmo_id (G)	3-06	wigos_identifier	Global
Data collection and/or location system (dataCollectionLocationSystem 0 02 148)* (B)		3-08	transmission_type	Global
Platform Transmitter ID number (platformTransmitterIdNumber 0 01 051) (B) Email origin (I)		Telecom: Tel. Num (JCOMM OPS)	transmitter_number	Global
		4-04	deployment_date, deployment_ship, deployment_cruise_name, deployment_latitude , deployment_longitude, deployment_country	Global
		4-04	recovery_date, recovery_latitude, recovery_longitude, recovery_method, recovery_country	Global

Spatio-temporal reference data

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC [Type]	Shape
		date_time	(N_TIME)
Latitude high accuracy (latitude 0 05 001) (B)	latitude (O) lat (G)	latitude	(N_TIME)

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC [Type]	Shape
All formats (I)			
Longitude high accuracy (longitude 0 06 001) (B) All formats (I)	longitude (O) lon (G)	longitude	(N_TIME)
Direction of motion of moving observing platform (directionOfMotionOfMovingObservi ngPlatform 0 01 012) (B)		platform_drift_dir ection	(N_TIME)
Platform drift speed high precision (platformDriftSpeed 0 01 014) (B)		platform_drift_spe ed	(N_TIME)
Quality of buoy location (qualityOfBuoyLocation 0 33 023)*	position_qc (O)	position_qc	(N_TIME)
Location quality class range of radius of 66 % confidence (locationQualityClassRangeOfRadius OfConfidence 0 33 027)* (B)		location_quality_cl ass	(N_TIME)

Provenance

As the data record from any single drifter may be collated from various sources (e.g, to patch gaps in the original data transmission), the provenance information is at the granule of each date/time. There is no information in the BUFR for this (relevant information may be found in the GTS headers, however).

When acquiring data in delayed-mode (Argos or Iridium files), this information describes the data formats.

NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
data_assembly_center (O) source (G)	7-02	data_assembly_center	(N_TIME)
		transmission_to_shore_data_format	(N_TIME)
		transmission_to_shore_data_format_ version	(N_TIME)
		input_data_format	(N_TIME)
data_mode (O)		data_mode	(N_TIME)

Engineering data

The drifting buoy engineering data have no equivalent in the NetCDF OceanSITES or the NetCDF GlobCURRENT. They are not part of the WIGOS metadata standard either. The BUFR format contains only limited engineering data; more data are found in the Iridium SBD data.

The first entry is

engineering_parameters (N_ENGINEERING)

which can contain one or several of the following <ENGINEERING> variable(s):

BUFR Drifting Buoy Template	Iridium SBD	NetCDF GDAC <ENGINEERING> [Type]	Shape
Battery voltage large range (batteryVoltageLargeRange 0 25 026)	All formats	battery_voltage	(N_TIME)
Lagrangian drifter drogue status (lagrangianDrifterDrogueStatus 0 22 060)*		drogue_status	(N_TIME)
Lagrangian drifter submergence % time submerged (lagrangianDrifterSubmergenceTime Submerged 0 02 190)	All formats except #040	submergence	(N_TIME)
Quality of buoy satellite transmission (qualityOfBuoySatelliteTransmission 0 33 022)*	All formats except #003 and #080, but only from MetOcean buoys: Iridium SBD Signal Quality (CSQ) All formats except #003 and #080, but only from DBi buoys: Iridium Received Signal Strength Indication (RSSI)	transmission_quality	(N_TIME)
	All formats, but excluding DBi and MetOcean buoys for formats other than #003 and #080: Number of Iridium SBD Transmission Retries (SBTR)	iridium_sbtr	(N_TIME)
	All formats: Iridium SBD Duration of Transmission (SBDT)	iridium_sbdt	(N_TIME)
	All formats: GNSS Time To First Fix (TTFF)	gnss_tfff	(N_TIME)
	All formats, but excluding Metocean and Pacific Gyre buoys for formats	gnss_nsat	(N_TIME)

BUFR Drifting Buoy Template	Iridium SBD	NetCDF GDAC <ENGINEERING> [Type]	Shape
	other than #003 and #080: GNSS number of satellites		
	All formats except #003 and #080, but only from Metocean buoys: GPS signal to noise ratio	gnss_snr	(N_TIME)
	All formats except #003 and #080, but only from Pacific Gyre buoys: GPS quality flag	gnss_qc	(N_TIME)
	Formats #003 and #080: GNSS Horizontal Dilution of Precision (HDOP)	gnss_hdop	(N_TIME)
	All formats: GNSS time delay since last fix	gnss_time_delay	(N_TIME)
	Formats #003 and #080: Hull internal humidity	hull_internal_humidity	(N_TIME)
	Formats #003 and #080: Hull internal pressure	hull_internal_pressure	(N_TIME)
	Formats #003, #040, and #080: Hull internal temperature	hull_internal_temperature	(N_TIME)

Environmental data

The first entry is an array

environmental_parameters (N_PARAM)

which can contain one or several of the following <PARAM> variable(s):

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC <PARAM> [Type]	Shape	Vertical coordinate
Surface type (surfaceType 0 08 029)* (B)		surface_type	(N_TIME)	None
Ice thickness (iceThickness 0 13 115) (B)		ice_thickness	(N_TIME)	None

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC <PARAM> [Type]	Shape	Vertical coordi- nate
Pressure (nonCoordinatePressure 0 10 004) (B) All formats (I)	air_pressure (O)	AirPress	(N_TIME)	None
Pressure reduced to mean sea level (pressureReducedToMeanSeaLevel 0 10 051) (B)		AirPress_SL	(N_TIME)	None
Sea/water temperature (oceanographicWaterTemperature 0 22 043). First entry: sea-surface, optional subsequent entries: sub-surface. (B) All formats except #040	sea_water_temperatur e (O)	sea_water_temperature	(N_TIME, N_WATER)	depth
Surface: Sea-surface salinity (seaSurfaceSalinity 0 22 059) Sub-surface: Salinity (salinity 0 22 062) (B) Formats #020, #021, and #022 (I)	sea_water_salinity (O)	sea_water_salinity	(N_TIME, N_WATER)	depth
Format #022 (I)		sea_water_conductivity	(N_TIME, N_WATER)	height
Formats #033 and #034: Water pressure (I)		sea_water_pressure	(N_TIME, N_WATER)	height
Temperature/air temperature (airTemperature 0 12 101) (B)	air_temperature (O)	air_temperature	(N_TIME, N_AIR)	height
Wind direction (windDirection 0 11 001) (B)	wind_to_direction (O) (plus 180 degrees)	WindDirFrom	(N_TIME, N_AIR)	height
Wind speed (windSpeed 0 11 002) (B)	wind_speed (O)	WindSpd	(N_TIME, N_AIR)	height
Significant wave height (significantWaveHeight 0 22 070) (B)	sea_surface_wave_signi ficant_height (O)	sea_surface_wave_signi ficant_height	(N_TIME, N_WAVE)	None
Maximum wave height (maximumWaveHeight 0 22 073) (B)		NEEDED	(N_TIME, N_WAVE)	None
Average wave period (averageWavePeriod 0 22 074) (B)	sea_surface_wave_zero _upcrossing_period (O)	sea_surface_wave_zero _upcrossing_period	(N_TIME, N_WAVE)	None
Spectral peak wave period (spectralPeakWavePeriod 0 22 071) (B)		NEEDED	(N_TIME, N_WAVE)	None

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	NetCDF GDAC <PARAM> [Type]	Shape	Vertical coordi- nate
Direction from which dominant waves are coming (directionFromWhichDominantWavesAreComing 0 22 076) (B)	sea_surface_wave_from_direction (O)	NEEDED	(N_TIME, N_WAVE)	None
Directional spread of dominant wave (directionalSpreadOfDominantWave 0 22 077) (B)		NEEDED	(N_TIME, N_WAVE)	None

Vertical information

Information to document the vertical coordinate array <VERTICAL> (height or depth) is in most cases given by the buoy design (manufacturer metadata).

However, in the few cases below, the information can be found in the data themselves:

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
Depth below sea/water surface (depthBelowWaterSurface 0 07 062) (B) Formats #033 and #034 (I)	depth (O, G)	5-05	depth	(N_TIME, N_WATER)
Height of sensor above water surface (heightOfSensorAboveWaterSurface 0 07 033) for temperature and wind (B)		5-05	height	(N_TIME, N_AIR)

Additional information

Each <PARAM> or <VERTICAL> or WIND or WAVE variable may be complemented by (no shape indication implies a global attribute):

- <PARAM>_qc (N_TIME, <N_VERTICAL>)
- <PARAM>_uncertainty (N_TIME, <N_VERTICAL>)
- <PARAM>_method (N_TIME)
- <PARAM>_sensor_quality_flag (N_TIME, <N_VERTICAL>)

- <PARAM>_sensor
- <PARAM>_sensor_type
- <PARAM>_sensor_manufacturer
- <PARAM>_sensor_model
- <PARAM>_sensor_serial_number
- <PARAM>_sensor_calibration_date
- <PARAM>_sensor_uncertainty
- <PARAM>_sensor_sampling_period
- <PARAM>_sensor_sampling_rate

Information can be readily obtained from the data themselves for the following quantities:

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC <i>[Type]</i>	Shape
Precision of temperature observation (temperatureObservationPrecision 0 02 005). First entry: surface, optional subsequent entries: sub-surface (B)	sea_water_temperature_uncertainty (O)		sea_water_temperature_uncertainty	(N_TIME, N_WATER)
Formats #020 and #021: Conductivity and Temperature probe quality flag (I)			sea_water_temperature_sensor_quality_flag	(N_TIME, N_WATER)
Formats #020 and #021: Conductivity and Temperature probe quality flag (I)			sea_water_salinity_sensor_quality_flag	(N_TIME, N_WATER)
Formats #020 and #021: Conductivity and Temperature probe quality flag (I)			sea_water_conductivity_sensor_quality_flag	(N_TIME, N_WATER)
Method of salinity/depth measurement (methodOfSalinityOrDepthMeasurement 0 02 033)* (B) Formats #033 and #034 (I)			depth_method	(N_TIME)
Anemometer type (anemometerType 0 02 169)* (B)		5-09	wind_sensor_type	Global
Time significance =2, time-averaged (timeSignificance 0 08 021)* (B)		6-03	wind_sensor_sampling_strategy	Global

BUFR Drifting Buoy Template (B) or Iridium SBD (I)	NetCDF OceanSITES (O) and/or GlobCURRENT (G)	WIGOS meta- data	NetCDF GDAC [Type]	Shape
Time period or displacement averaging period in minutes (timePeriod 0 04 025) (B)		6-04	wind_sensor_sam pling_time_period	Global
Duration of wave record (durationOfWaveRecord 0 22 078) (B)		6-04	wave_sensor_sam pling_time_period	Global

Orphans

For completeness, we list here the variables found in the NetCDF OceanSITES (O) and/or NetCDF GlobCURRENT (G) but that have no correspondence in the GDAC. These are

- site_code (O)
- station_id (G)
- platform_code (O)
- platform (G)
- band (G)
- spatial_resolution (G)
- sensor (G)
- sensor_description (G)
- sensor_manufacturer (G)
- sensor_serial_number (G)
- sensor_install_date (G)
- sensor_height (G)
- sensor_sampling_period (G)
- sensor_sampling_rate (G)
- sensor_calibration_date (G)
- sensor_history (G)
- sensor_type (G)
- nominal_latitude (G)
- nominal_longitude (G)
- sea_floor_depth_below_sea_level (G)
- site_elevation (G)
- sea_surface_wave_variance_spectral_density (O)

From BUFR, only the following variable was not mapped into the GDAC NetCDF:

- Indicator for digitization (indicatorForDigitization 0 02 032)* (B)

Codes tables

Existing code tables

<PARAM>_sensor_sampling_strategy: BUFR code table 0 08 021 (timeSignificance)

platform_type: BUFR code table 0 02 149 (dataBuoyType)

drogue_type: BUFR code table 0 02 034 (drogueType)

tranmission_type: BUFR code table 0 02 148 (dataCollectionLocationSystem)

position_qc: BUFR code table 0 33 023 (qualityOfBuoyLocation)

location_quality_class: BUFR code table 0 33 027 (locationQualityClassRangeOfRadiusOfConfidence)

drogue_status: BUFR code table 0 22 060 (lagrangianDrifterDrogueStatus)

transmission_quality: BUFR code table 0 33 022 (qualityOfBuoySatelliteTransmission)

surface_type: BUFR code table 0 08 029 (surfaceType)

depth_method: BUFR code table 0 02 033 (methodOfSalinityOrDepthMeasurement)

wind_sensor_type: BUFR code table 0 02 169 (anemometerType)

New code tables

data_mode can take one of the following 3 values:

- R: Real-time (for all the parameters found for this date/time)
- D: Delayed-mode (for all the parameters found for this date/time)
- M: Mix (some data come from real-time processing, others from delayed-mode (re)processing)

<PARAM>_method can take one of the following 3 values:

- M: Measured (the data were reported by a sensor)
- D: Derived (the data were derived from measurements by sensor(s) on the buoy)
- E: Estimated (the data were estimated from other information)

STILL TODO:

- **Find NetCDF names for the 4 variables marked 'NEEDED'**: Maximum wave height, Spectral peak wave period, Direction from which dominant waves are coming, and Directional spread of dominant wave.
- **Define the type of each variable** (FLOAT, STRING, etc...)