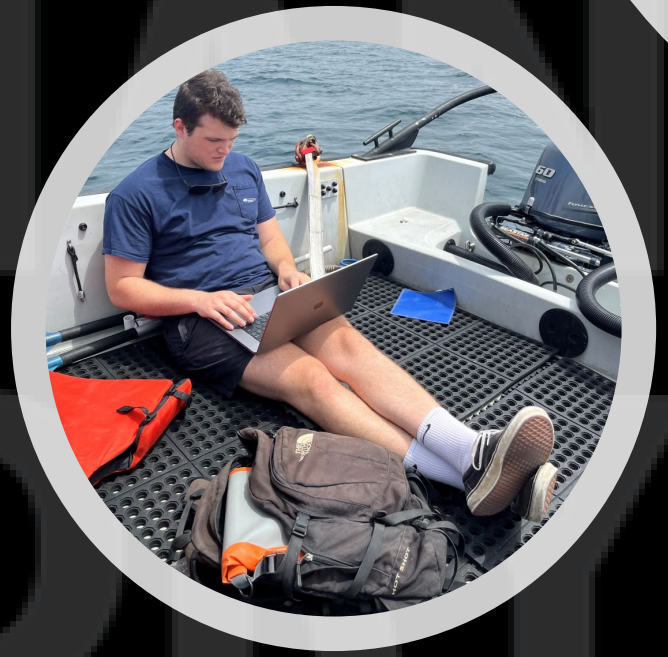
Lagrangian Drifter Lab
Real-Time Data Management



By Lance Braasch and Luca Centurioni

Lagrangian Drifter Laboratory at Scripps Institution of Oceanography

Global Drifter Program funded by NOAA

PI Luca Centurioni

Website: https://ldl.ucsd.edu

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The Lagrangian Drifter Lab

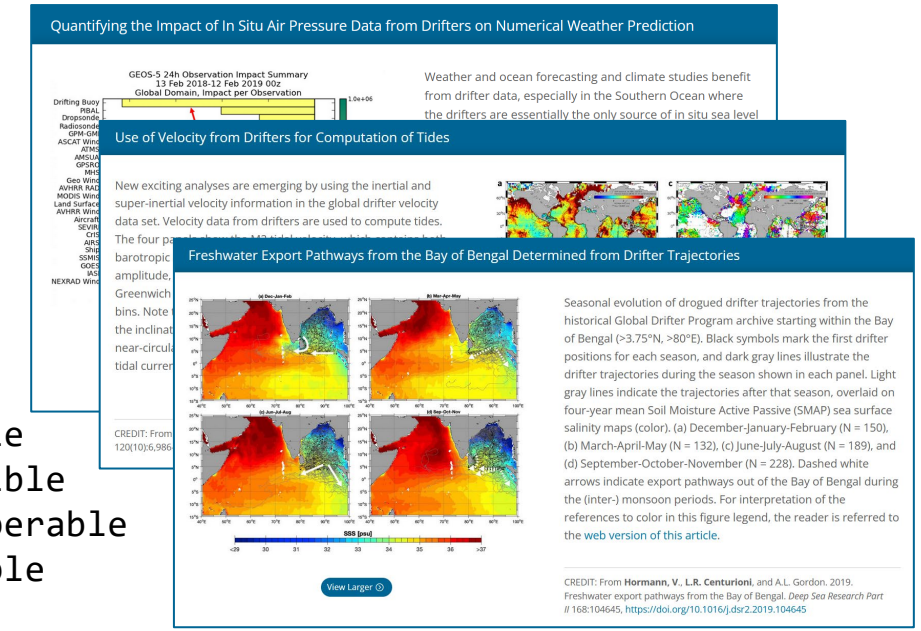
Director: Dr. Luca Centurioni, PI of the Global Drifter Program

The Lagrangian Drifter Laboratory (LDL) is a team of Scientists, Engineers, Technicians, Coordinators and external collaborators in support of the end-to-end use of Lagrangian Drifter Technology and for promoting the advancement of air-sea interaction science (1,200+ paper published resulting from the FAIR-O data approach)

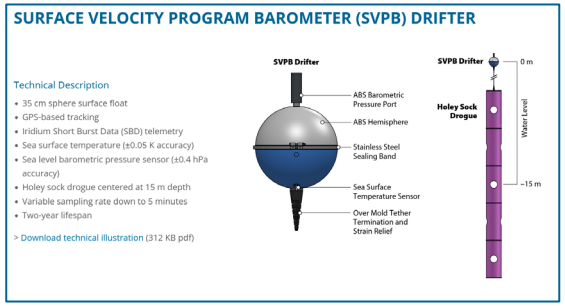
ACTIVITIES

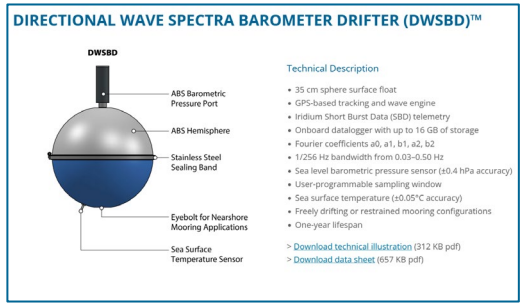
Generation of scientific publications and products; Scientific advancements and applied science

- Development of new and existing drifter technologies
- Organization of scientific field campaigns
- Data management and analysis
- Peer-reviewed publications with associated DOI and FAIR-O ERDDAP dataset.



Findable
Accessible
Interoperable
Re-usable
Open





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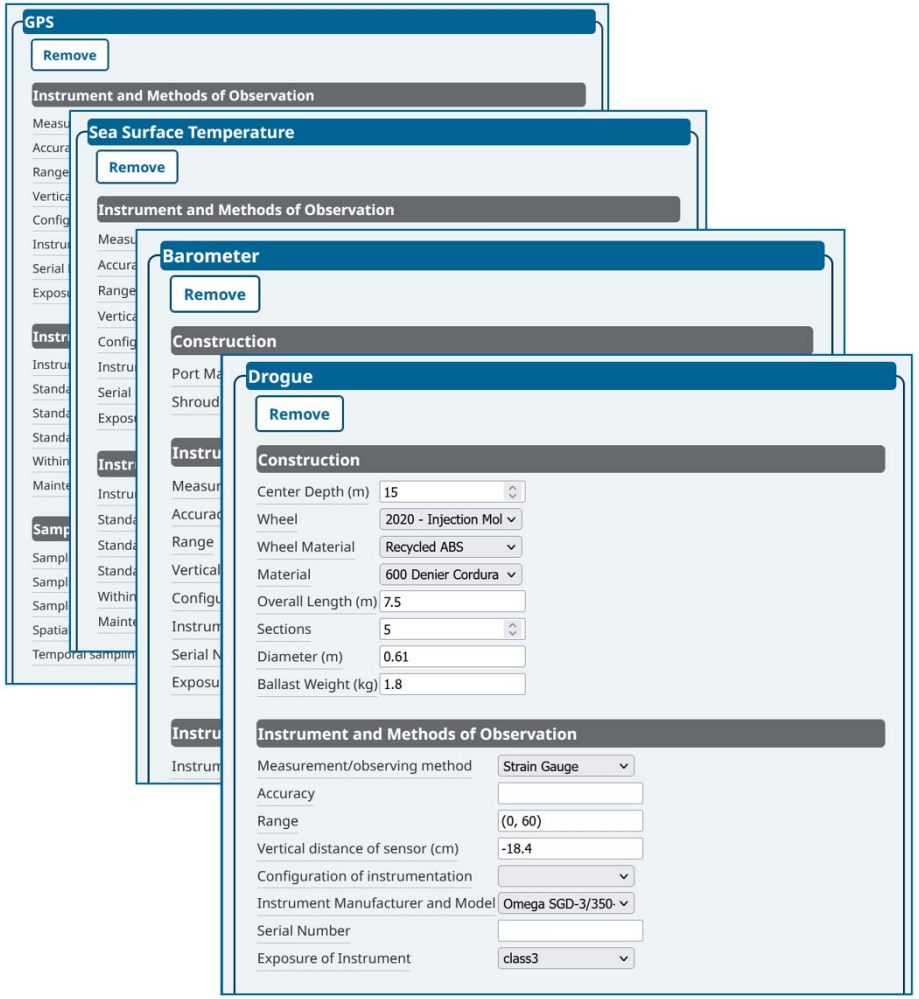
Platform Metadata

The LDL aggregates detailed hardware and platform metadata, inclusive of WIGOS specification metadata, for platforms under management using both Human and Machine-to-Machine (M2M) interfaces.

These metadata are an essential component to providing real-time data with traceable records and quality control for downstream users. Expanded metadata tracking provides additional context layers of a platform's life, including age, storage location and point of contact, and availability for a port of call.

ACTIVITIES

- Version-2 Specification Sheet with web form and M2M RESTful API
- Expanded Metadata tracking including platform registration, shipment/warehouse tracking and digital deployment submission (QR code)
- Aggregation and push into OceanOPS via their M2M RESTful API in support of FAIR-O commitment
  - Platform registration, deployment and WMO request – *testing underway*
  - WIGOS metadata via OceanOPS API or XML/JSON submission – *anticipated in 2023*



Metadata web form with underlying RESTful API for Machine-to-Machine (M2M) efficiency

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Satellite Airtime Management

The LDL has direct access to Iridium configurations enabling granular control of platforms under management.

Integrated management in collaboration with partners, who inform LDL of issues in real-time, from hardware fabrication to FAIR-O datasets with associated DOI, ensures traceability and troubleshooting of spurious issues stemming from drifter technologies or their data.

ACTIVITIES

- Scheduling of the activation, suspend, and deactivation of platforms from system checkout at the manufacturer facility to preparation for deployment and finally, deactivation at end of life.
- Real-time monitoring of platform performances with consideration to available airtime budget and current expenditure
- API (M2M) configuration of platform airtime
- Tight coupling of Metadata in support of Real-time Data management and distribution

TRACKING

Platform-ID	Date	Type	Location	Carrier	Contact Name	Contact Email	Comment
300534061651010	2022-08-09	receiving	10th Avenue Marine Terminal, Crosby Road, San Diego, CA, USA	LDL Truck	Kelsey Vogel	kdvogel@ucsd.edu	delivered directly to R/V Bold Horizon
300534061651010	2022-08-09	shipping	Nori, Downwind Way, La Jolla, CA, USA	LDL Truck	Lucia Bertero	lbertero@ucsd.edu	Delivered by LDL in wire cages directly to deployment ship

REGISTRATION AND IRIDIUM ACTIVATION

Platform-ID	POC Name	POC Email	POC Address	Deployment Name	Deployment Email	Deployment Address	Deployment Date	Deployment Ship	Comment
300534061651010	Lucia Bertero	lbertero@ucsd.edu	8861 Shellback Way, La Jolla, CA, USA	Kelsey Vogel	kdvogel@ucsd.edu	10th Avenue Marine Terminal, Crosby Road, San Diego, CA, USA	2022-08-13	R/V Bold Horizon	CalCoFi August 2022 cruise - NOAA

DEPLOYMENT

Platform-ID	POC Name	POC Email	Deployment Date	Latitude	Longitude	Ship	Speed	Height	Location	Comment
300534061651010	Kelsey Vogel	kdvogel@ucsd.edu	2022-08-27	34.0765000	-122.9548330	R/V Bold Horizon	2.00	4.00	Port Stern	CalCofi Aug 2022

Streamlined airtime management leading to cost savings without sacrifice of quality for the end user!

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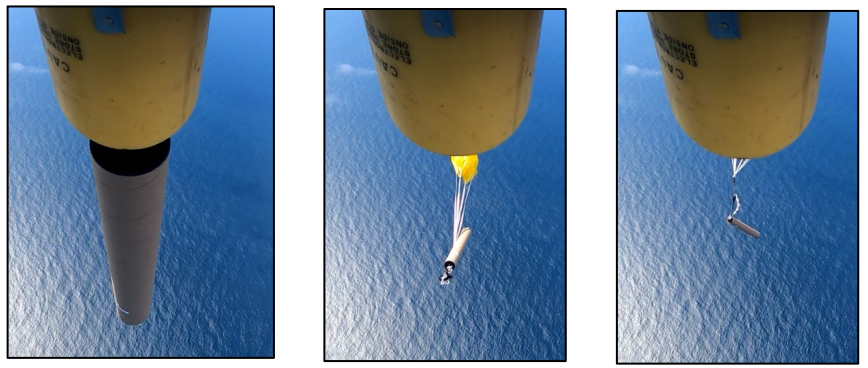
Tools: Adaptive Sampling Engine

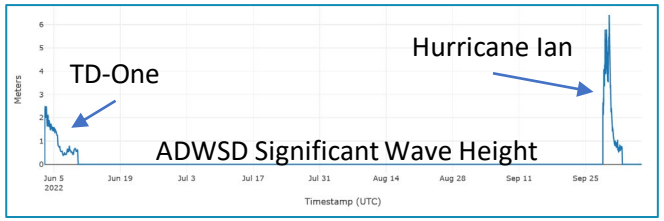
The LDL developed capabilities to enable adaptive sampling based on scheduled and algorithmic inputs.

Such capabilities include the ability to convert an SVPB into a DWSB drifter, as performed under Hurricane Sam in 2021, and ability to disable onboard sensors to conserve power and data transmission budgets as performed in the 2022 Hurricane season, for example, using an ADWS drifter deployed under TD One and placed into low power mode (6hr location, waves disabled) until the arrival of Hurricane Ian ~4 months later.

ACTIVITIES

- Algorithmic event detection based on runtime configuration for real-time monitoring
- Selective high-resolution sampling, variable sensor sampling and configuration providing power and airtime savings
- Ability to assess quality control based on sensor monitoring anomaly detection





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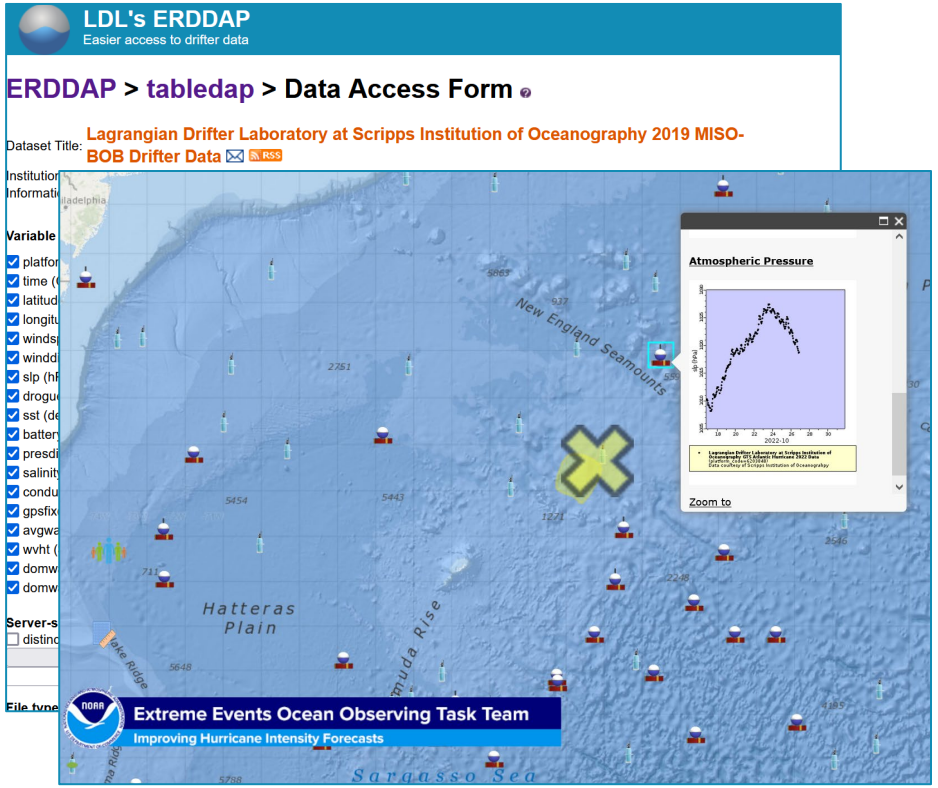
Products: API, GTS, ERDDAP, and Beyond!

The LDL produces various data products using real-time and historical data for end-users. LDL Data products are made available in a variety of formats in support of FAIR-O data commitment.

Tight coupling of data with applied partner QC for GTS processing enables multiple access points for real-time and historical drifter data.

ACTIVITIES

- Over 1,250 drifters posted daily onto GTS under IOBX02 KWBC and IOWX02 KWBC in BUFR TM315009
- GUI websites and M2M RESTful API for direct data access
- Alternate formats such as Google Earth KML and KMZ with link back to ERDDAP made available for specific applications.
- ERDDAP datasets with associated DOI and publications for scientific community



- LDL ERDDAP Data Access Portal of science driven dataset with accompanying publication (DOI available shortly)
- Real-Time LDL KML for NOAA GeoCollaborate Dashboard with associated ERDDAP plots and data access for GTS quality-controlled sensor data

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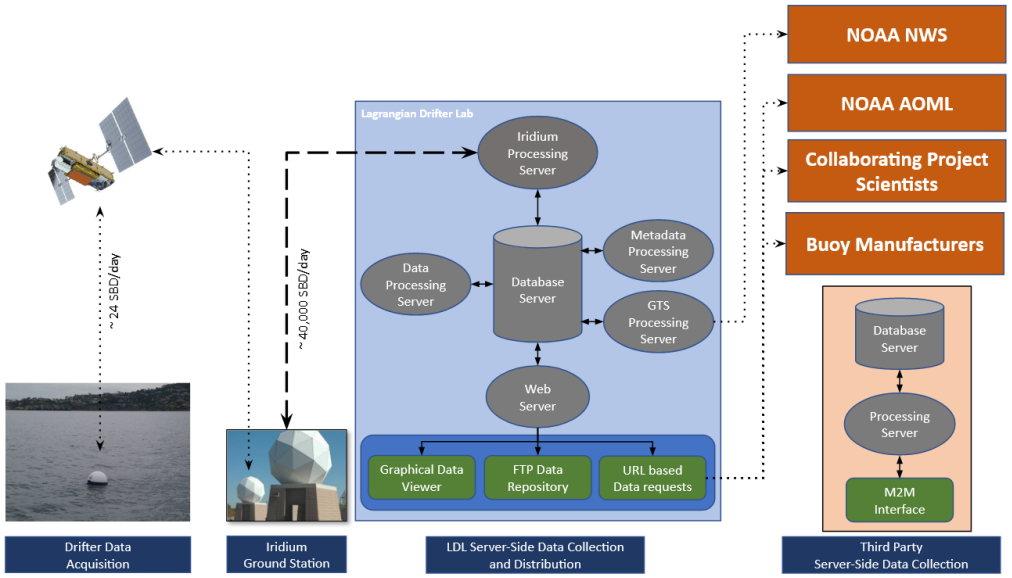
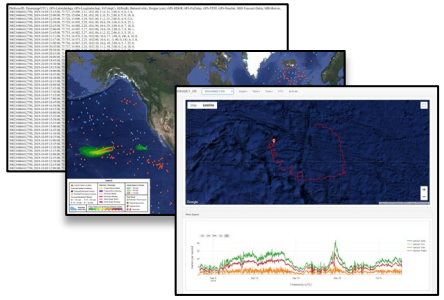
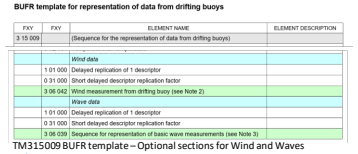
WMO/IOC Value Chain



Turn-key operation from deployment to data distribution for collaborating partners



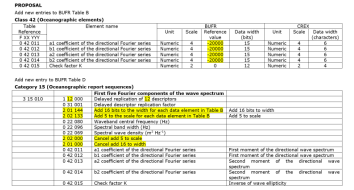


BUFR template for representation of data from drifting buoys

FXY	FXY	ELEMENT NAME	ELEMENT DESCRIPTION
3 15 009		(Sequence for the representation of data from drifting buoys)	
		Wind data	
	1 01 000	Delayed replication of 1 descriptor	
	0 31 000	Short delayed descriptor replication factor	
	3 06 042	Wind measurement from drifting buoy (see Note 2)	
		Wave data	
	1 01 000	Delayed replication of 1 descriptor	
	0 31 000	Short delayed descriptor replication factor	
	3 06 039	Sequence for representation of basic wave measurements (see Note 3)	

TM315009 BUFR template – Optional sections for Wind and Waves

Link WMO TM315009



PROPOSAL

Add new entries to BUFR Table B

Class 42 (Oceanographic elements)

Table Reference	Element name	BUFR Unit	BUFR Scale	BUFR Reference value	BUFR Data width (bits)	CREX Unit	CREX Scale	CREX Data width (characters)
0 42 010	a1 coefficient of the directional Fourier series	Numeric	4	-10000	15	Numeric	4	6
0 42 011	b1 coefficient of the directional Fourier series	Numeric	4	-10000	15	Numeric	4	6
0 42 013	a2 coefficient of the directional Fourier series	Numeric	4	-10000	15	Numeric	4	6
0 42 014	b2 coefficient of the directional Fourier series	Numeric	4	-10000	15	Numeric	4	6
0 42 015	Check factor K	Numeric	2	0	12	Numeric	2	4

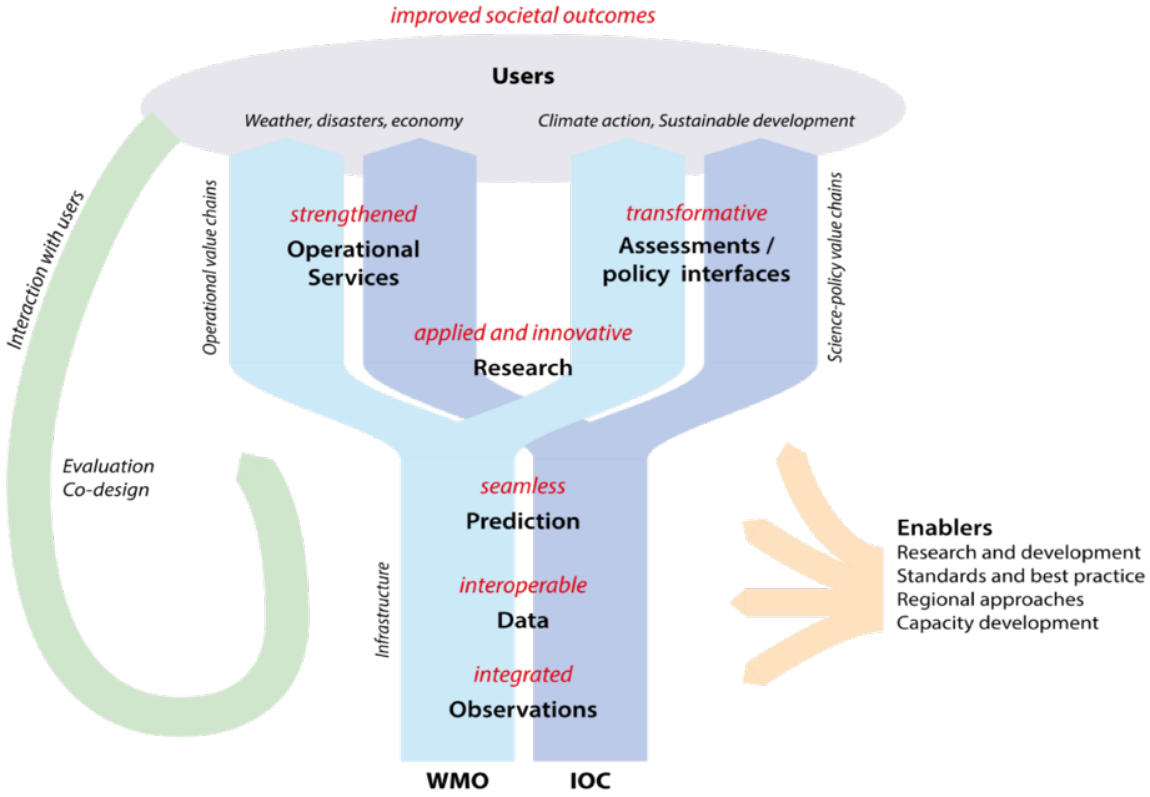
Add new entry to BUFR Table D

Category 15 (Oceanographic report sequences)

3 15 010	1 02 000	First Fourier components of the wave spectrum
	1 01 000	Delayed replication of 10 descriptors
	0 31 001	Delayed descriptor replication factor
	2 01 144	Add 16 bits to the width for each data element in Table B
	1 02 133	Add 9 to the scale for each data element in Table B
	0 22 080	Wavebuoy central frequency (Hz)
	0 22 081	Wavebuoy bandwidth (Hz)
	0 22 069	Spectral wave density (m^2 Hz^{-1})
	2 02 000	Cancel add 9 to scale
	2 01 000	Cancel add 16 to width
	0 42 011	a1 coefficient of the directional Fourier series — First moment of the directional wave spectrum
	0 42 012	b1 coefficient of the directional Fourier series — First moment of the directional wave spectrum
	0 42 013	a2 coefficient of the directional Fourier series — Second moment of the directional wave spectrum
	0 42 014	b2 coefficient of the directional Fourier series — Second moment of the directional wave spectrum
	0 42 015	Check factor K — Director of wave ellipticity

TM315010 BUFR template – Directional Wave Spectra (a's and b's)

Link to WMO TM315010



In 2020 The Lagrangian Drifter Lab submitted their application to be formalized as a Data Assembly Center (DAC) under GOOS for their role in the drifter data stream.

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