sea state cci

Data Access Requirement Document (DARD)

version 2.0, 14 October 2021

Contents

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Issue	Date	Comments
0.5	14 Dec 2018	Full draft for internal review
1.0	5 Feb 2019	First version for review by ESA
1.1	27 Mar 2019	Table added for microseism data
2.0	14 Oct 2021	Addition of Jason-1 in altimetry table, updates to in situ data

1. Introduction

This document presents the Data Access Requirement Document (DARD) for **Sea_State_cci**, deliverable 1.3 of the project. This second version is prepared in the final year of the project in order to update the list of input data required and any access constraints and conditions.

The remainder of this Data Access Requirements Document contains a list of data and access requirements and / or a description of data, broken into subsections according to category as follows:

- Altimetry data
- SAR data
- in situ data
- Microseism data

In general the data required are publicly available, and there are no access constraints unless otherwise stated.

2. List of data and access requirements

2.1 Altimetry data

The list of the input altimetry product required for the CCI project is as follows:

Product	Source	Volume over CCI time frame, in TB	Temporal coverage	Access
S-GDR Jason-1	Aviso+		Jan-2002 - Mar-2012	open and public
S-GDR Jason-2	Aviso+ or NODC	currently: 3.1 TB	Jul 2008 - ongoing	open and public
S-GDR Jason-3	Aviso+ or NODC	currently: 0.4 TB	Feb 2016 - ongoing	open and public
RA2_MWS_2P EnviSat	ESA	2.9 TB	June 2002 - Apr 2012	open and public
S-GDR AltiKa	CNES/ Aviso+	currently: 3 TB	March 2013 - ongoing	open and public
Cryosat-2 L1B LRM L1B SIR L1B SI	ESA	currently: 1.5 TB 0.7 TB 5.3 TB	2010 - ongoing	open and public
S3A_SR_1_SRA_A_ Sentinel-3 L1A data (*)	EUMETSAT		2017-2018	open and public
S3A_SR_2_WAT Sentinel-3A + SR_1_SRA_BS___NTC SR_1_SRA_A_ (L1A)	Eumetsat	currently: 3.2 TB	Dec 2016 - ongoing	open and public
S3B_SR_2_WAT Sentinel-3B+ possibly some L1 (*)	Eumetsat		2018 - ongoing	open and public

Note: ERS-1 & 2, TOPEX/Poseidon, GFO and GeoSat altimeters are left out for versions 2 and 3 of the Sea State CCI dataset. All but GeoSat were included in version 1 prior to implementing dedicated sea state retrieval algorithms. An archive of these product's waveforms is however available already on Ifremer platform as they were used for Ifremer/CNES Altiberg project (http://cersat.ifremer.fr/about-us/projects/item/402-altiberg) .

2.2 SAR data

The SAR wave mode data currently hold at Ifremer cover the need of the project, they are summarized here:

Product	Source	Volume over CCI time frame, in TB	Temporal coverage	Access
ERS-1 wave mode L1	ESA/F-PAF (Ifremer)	9.5	1991-1996	restricted; available to project
ERS-2 wave mode L1		11.5	1995-2011	
Envisat/ASAR wave mode L1	ESA/F-PAF (Ifremer)	27.6	2003-2012	
Sentinel-1A wave mode L1	ESA	455	2014-2020	open and public
Sentinel-1B wave mode L1		309	2016-2020	

2.3 In situ data

For the calibration and validation of CRDP v2, the project will rely on the publicly available **CMEMS in situ TAC** (CMEMS INSTAC) that collects all buoy data from more than 80 sources including the following:

- Fisheries and Oceans Canada (MEDS)
- National Data Buoy Center (including CDIP)
- Environment and Climate Canada
- Rijkswaterstaat Water, Traffic and Environment, Netherlands
- SCRIPPS Institution of Oceanography
- CEREMA
- Puertos del Estado
- Western Australian Government
- Swedish Meteorological and Hydrological Institute
- Private Industry Oil Platforms

Figure 1 shows the location of all wave platforms included in the CMEMS In Situ TAC dataset. The different symbols represent the major 19 data providers.

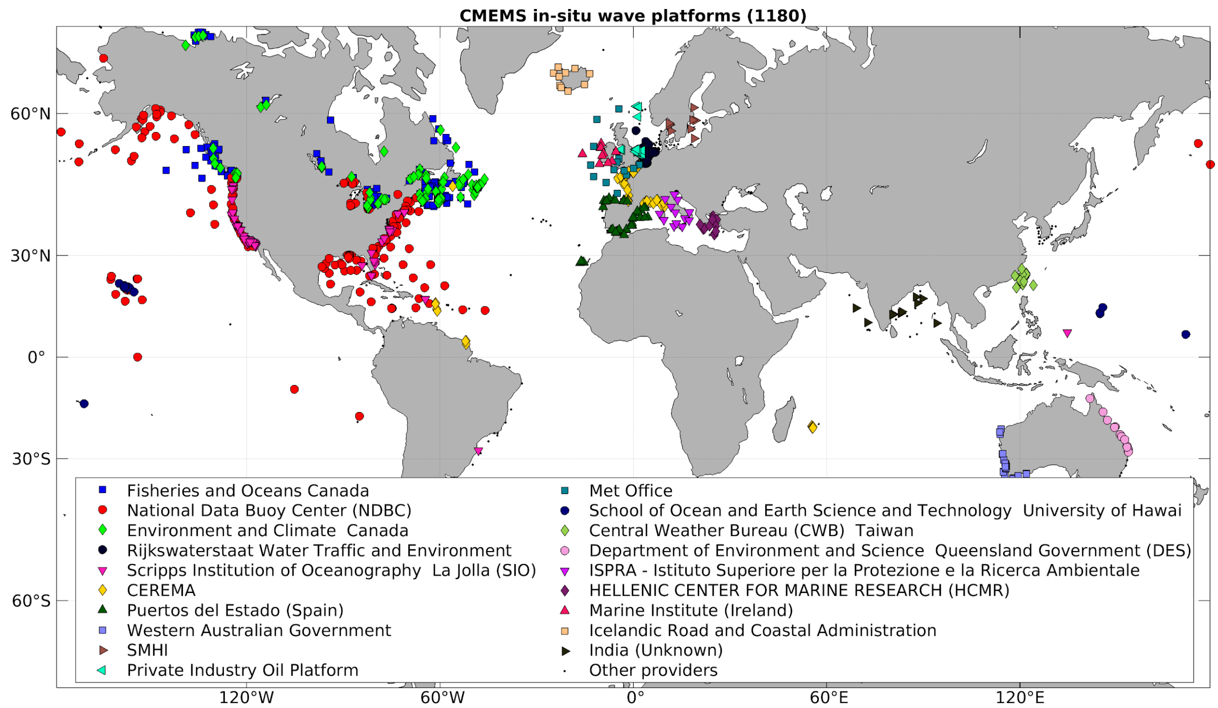

Figure 1: Location of the 1180 wave platforms included in the CMEMS In Situ TAC dataset.

This service takes over the task previously performed through ESA/GlobWave project and both teams work together to ensure a smooth and seamless transition. The data are fully homogenized (variable names and format), quality controlled and delivered in NetCDF format.

A preliminary analysis of the CMEMS INSTAC dataset was performed in order to identify the parameters that need to be considered before selecting the platforms to be used for the calibration and validation of altimeter data. These parameters are :

1) Distance to the coast of the platform;
2) Water depth at the location of the platform (mooring or floating structure);
3) Method for computing the significant wave height (spectral or time domain analysis);
4) Quality of the position information;

The reference dataset used for the calibration and validation of the CRDP v2 - a subset of the CMEMS INSTAC dataset - will be selected based on thresholds and qualitative information that are currently assessed by the Sea State CCI team. Moreover, the long-term consistency of the selected records will be assessed utilizing the metadata describing the payload and hull changes. For this endeavor we propose to use existing tools such as RHtestV4 developed to assess homogeneity in time series developed by Wang and Feng (2013). This task will be performed in collaboration with Bob Jensen of the USACE and Ian Young of University of Melbourne.

A preliminary list of the selected platforms used for assessing long-term consistencies in multi-decadal Hs records is provided in Table 1.

Network	Buoy ID	Region	Latitude	Longitude	Time Deployed	Depth (m)	Daily Coverage
ndbc	WMO46035	Bering Sea	57.05	-177.6	33	3660	0.8363
	WMO46001	Northeast Pacific	56.3	-148.1	44	4178	0.9319
	WMO46005	Northeast Pacific	46.05	-131	42	2811	0.7863
	WMO46002	Northeast Pacific	42.58	-130.4	43	3390	0.7933
	WMO46006	Northeast Pacific	40.8	-137.5	40	4186	0.7138
	WMO46014	US West Coast	39.22	-124	37	362	0.9123
	WMO46025	US West Coast	33.75	-119.1	36	576	0.9279
	WMO51001	Hawai'i	23.52	-162.2	37	3727	0.7334
	WMO51003	Hawai'i	19.18	-160.7	34	5013	0.9102
	WMO51004	Hawai'i	17.53	-152.5	34	5130	0.8353
	WMO42039	Gulf of Mexico	28.79	-86	23	301	0.9525
	WMO42002	Gulf of Mexico	25.41	-94.2	42	3612	0.8993
	WMO42001	Gulf of Mexico	25.86	-89.7	43	3229	0.8687
	WMO42003	Gulf of Mexico	26.01	-85.8	41	3224	0.8632
	WMO41002	US East Coast	32.19	-75.3	43	3571	0.7336
	WMO41001	US East Coast	34.68	-72.7	41	4443	0.6903
	WMO44004	US East Coast	38.47	-70.6	30	3168	0.8318
	WMO44008	US East Coast	40.5	-69.4	36	62	0.8565
	WMO44011	US East Coast	41.11	-66.6	34	73	0.7937
	WMO51028	Equatorial Pacific	0.02	-153.9	11	4710	0.8126
	WMO32012	Southeast Pacific	-19.66	-85.3	11	4454	0.9216
	WMO41041	West Tropic Atlantic	14.27	-46	13	3512	0.9677
	WMO41040	West Tropic Atlantic	14.5	-53	13	5000	0.8722
	WMO41043	West Tropic Atlantic	21.06	-65	11	5332	0.9889
	WMO41046	West Tropic Atlantic	23.85	-69.3	11	5399	0.9342
	WMO41047	West Tropic Atlantic	27.49	-71.5	11	5334	0.8813
	WMO52200	West Tropic Pacific	13.37	144.8	14	137	0.9385
meds	C46184	Canada West Coast	53.91	-138.8	26	3372	0.8579
	C46004	Canada West Coast	50.95	-136	25	3638	0.7943
	C46036	Canada West Coast	48.34	-133.9	26	3580	0.9204
	C44137	Canada East Coast	41.85	-61.5	27	4261	0.7605
	C44141	Canada East Coast	42.62	-57.2	26	4548	0.7911
	C44139	Canada East Coast	44.25	-57.2	29	1371	0.7123
	C44138	Canada East Coast	44.25	-53.6	25	1657	0.6259
	C44140	Canada East Coast	43.23	-51.5	23	93	0.6835
cdip	WMO51201	Hawai'i	21.67	-158.1	16	200 - 198	0.9189
	WMO51202	Hawai'i	21.41	-157.7	17	100 - 82	0.9289
oceansites	WMO62029	Northeast Atlantic	48.71	-12.4	21	1992	0.7355
	WMO62001	Northeast Atlantic	45.23	-5	18	4424	0.8527
	WMO62095	Northeast Atlantic	53.07	-15.9	10	3240	0.8525
imos	DCH38	Indian	-31.98	115.7	18	38	0.9167
	RDW47	Indian	-32.09	115.4	13	68	0.9833
	NAT46	Indian	-33.53	114.8	14	50	0.9727
	COUDEDIC	Southern	-36.07	136.6	17	46	0.9354
	SORELL	Southern	-42.12	145	20	334	0.967
	WAVEEDN	Southwest Pacific	-37.17	150.1	40	91	0.8884
	WAVEPOK	Southwest Pacific	-34.47	151	41	77	0.8978
	WAVECOH	Southwest Pacific	-30.36	153.3	42	74	0.8925
	Brisbane	Southwest Pacific	-27.49	153.6	41	75	0.9319
	Mackay	Southwest Pacific	-21.04	149.5	42	17	0.8365

Table 1. Selected platforms used for assessing long-term consistencies in multi-decadal Hs records (provided by J. Stopa and D.Leyva, from Univ. Hawaii). These buoys were selected based on location, availability of metadata and length of time-series.

2.4 Microseism data

Seismic records of ground displacement anywhere on Earth contain the signature of ocean waves in a broad frequency band that typically ranges from 0.003 Hz to 1 Hz, this signature is known as microseisms. The quantitative link between waves and microseism is well understood for the vertical displacements in the “secondary microseism” peak that is around 0.2 Hz (e.g. Bernard 1941, Longuet-Higgins 1950, Hasselmann 1963, Ardhuin & Herbers 2013). This is dominated by Rayleigh waves generated where ocean waves of opposing direction and same frequency are found in the ocean. Such seismic sources can be put in three broad classes of events (Ardhuin et al. 2011).

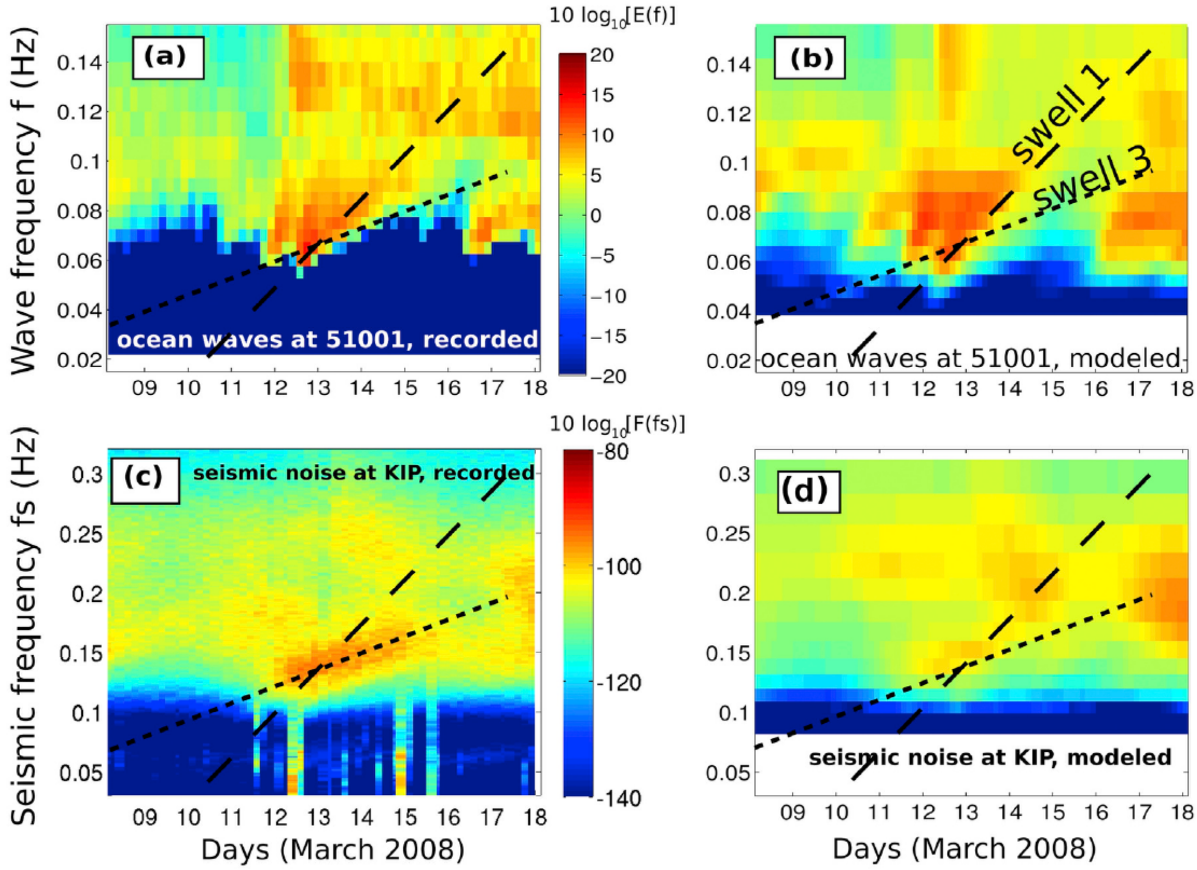

Figure 2: Example of seismic spectrogram (bottom) observed and modeled, compared to wave spectra (top). Taken from Ardhuin et al. (2011).

Due to the importance of opposing directions, there is no simple relation between wave height and microseism amplitude. However, for a same ocean wave spectrum shape, an increase in microseism correspond to an increase in wave height. As a result, microseism amplitudes can be use to track the magnitude of ocean waves over time (Bernard 1990, Grevemeyer et al. 2000). Any given station gives some sea state index in a region that varies in size from a few hundreds of kilometers to a few thousand of kilometers with a clear influence of regional sea ice for example (Stutzmann et al., 2009, Stutzmann et al. 2012, Sergeant et al. 2013). Furthermore, secondary microseism can provide independent constraints on the amount of ocean wave reflection coefficient.

The seismic data product and access is summarised here:

Product	**Source**	**Volume over CCI time frame**	**Temporal coverage**	**Access**
GEOSCOPE Seismic data doi:10.18715/GEOSCOPE.G	IPGP Datacenter	1TB	1982 - ongoing	Open access by request to IPGP

The processed data will include all Geoscope stations (see map below, http://geoscope.ipgp.fr/index.php/en). Data are converted into seismic acceleration and spectrogram are computed using windows of 3 hours. Three-hourly spectra data for the vertical components with 512 frequencies takes about 7 Mb for a full year. The total volume for 40 stations over 30 years is only 8 Gb, including quality flags indicating the likely occurrence of earthquakes. Synthetic spectrograms will be computed and the comparison between observed and modelled spectrogram will enables to constrain the ocean wave coastal reflection coefficient.

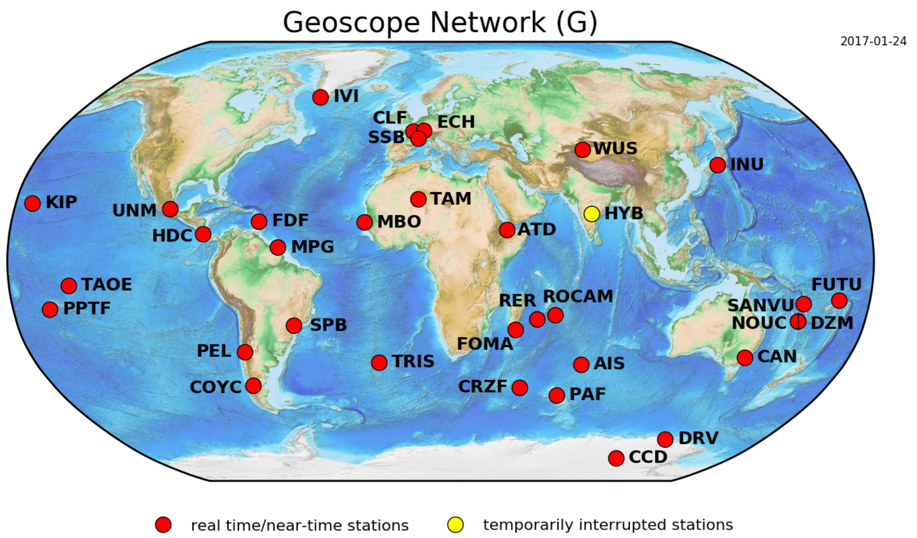

Figure 3: Extension of the Geoscope network of seismic stations

Ongoing developments on seismic array processing also shows that a single array can be used to get a map of microseism sources (Farra et al., 2015, Meschede et al., 2017). We will further explore the capability of using long-term arrays such as the Grafenberg array for mapping sources and their evolution over the past 40 years.

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