MSS CNES_CLS 2025: User Handbook

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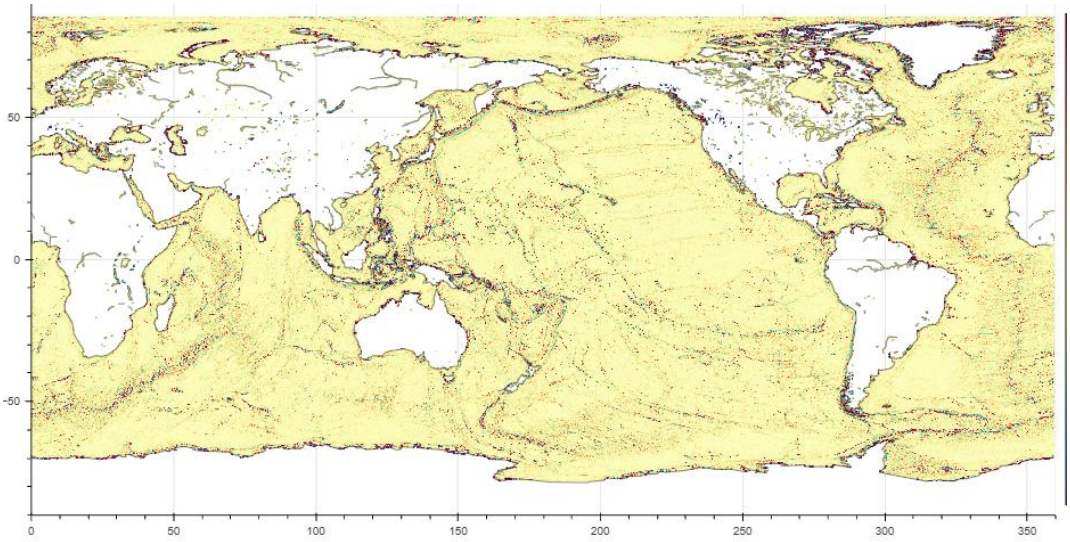

Nomenclature: SALP-MU-P-EA-23767-CLS

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Chronology Issues:			
Issue:	Date:	Validated by	Reason for change:
1.0	2026/06/01		Creation of the document

List of Acronyms:

MSS	Mean Sea Surface
Aviso+	Archiving, Validation and Interpretation of Satellite Oceanographic data
CLS	Collecte, Localisation, Satellites
DUACS	Data Unification Altimeter Combination System
CNES	Centre National d'Etudes Spatiales
DT	Delayed Time
SSHA	Sea Surface Height Anomaly
SWOT	Surface Water Ocean Topography
KaRIn	Ka Radar Interferometer
MIOST	Multiscale Inversion of the Ocean Surface Topography
WGS84	World Geodetic System 1984

Contents

1. Introduction

The SWOT mission equiped with its KaRIn instrument provides two dimensionnal data with unnprecedented precision. Therefore, it promises huge improvements in plenty of altimetric products and applications. MSS is no exception. The CNES CLS 25 MSS was built with the aim of exploring the use of KaRIn SWOT data to propose a next-generation MSS able to better represent short wavelengths, thereby addressing the shortcomings of state-of-the-art nadir-based MSS.

2. Description

The mean sea surface MSS_*CNES*_CLS_2025 (Charayon et al., in prep) is the latest mean sea surface model developed at CNES_CLS and is referenced to the [1993-2012] period.

Long wavelengths come from a MSS draft chosen to be the Hybrid 23 MSS (https://doi.org/10.24400/527896/a01-2024.002) low pass filtered at 20km since this nadir-based MSS model already captured well long wavelengths (Laloue et al., 2025).

The wavelengths shorter than 100km are improved thanks to a SWOT-KaRIn mean profile anomaly to the MSS draft. This mean profile anomaly is built with:

- The SWOT-KaRIn science dataset (L3 v3.0 Expert, cycles 1 to 31 included except cycle 17, https://doi.org10.24400/527896/a01-2023.018)
- The experimental multimission gridded L4 sea level heights and velocities with SWOT using MIOST (dataset: https://doi.org/10.24400/527896/a01-2025.001) (MIOST method: Ubelmann et al., 2021)
- In SWOT diamonds, since KaRIn data are not available, we used another innovation only based on DT2024 1Hz CryoSat2 and AltiKa SSHA data (https://doi.org/10.48670/moi-00146): period from 2010 to 2025, SSHA data relative to MSS Hybrid 23 low pass filtered at 5km. To build this nadir-based innovation, we used the static part of the mapping from MIOST method.

Characteristics of this MSS:

Reference ellipsoid : WGS84

Reference time period : 1993-2012 (20 years)

Geographic coverage : lat (79.4°S to 88°N), lon (0°E to 360°E)

Spatial resolution : Regular grid with a 1/60° (1 minute) spacing (i.e. ~1.8 km at the equator)

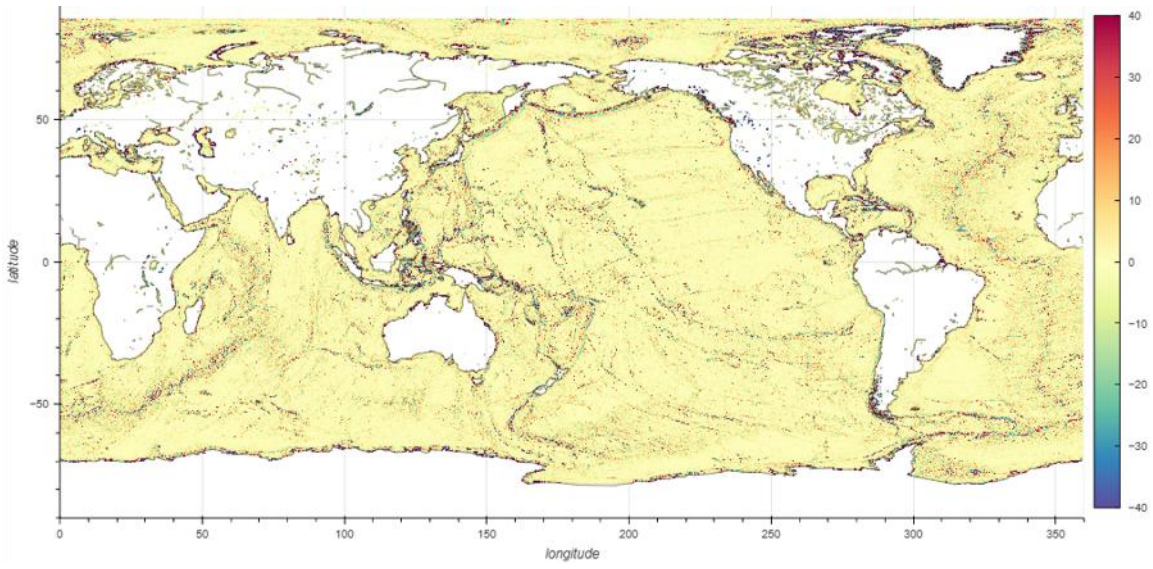

Figure: Short wavelengths (<20km) of the CNES-CLS 2025 MSS on ocean

3. Nomenclature of files

The nomenclature used for these products is:

< PRODUCT>_<*MODEL*NAME>.nc

PRODUCT	mss	Mean sea surface
MODELNAME	cnes_cls_2025	Mean sea surface model developed in 2025 by CNES and CLS institutions

4. Data format

This chapter presents the data storage format used for the Mean Sea Surface product.

4.1. NetCdf

The products are stored using the NetCDF-4 format.

NetCDF (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The netCDF library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data. The netCDF software was developed at the Unidata Program Center in Boulder, Colorado. The netCDF libraries define a machine-independent format for representing scientific data. Please see Unidata NetCDF pages for more information, and to retrieve NetCDF software package on:

http://www.unidata.ucar.edu/packages/netcdf/index.html

NetCDF data is:

- Self-Describing. A netCDF file includes information about the data it contains.
- Architecture-independent. A netCDF file is represented in a form that can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.
- Direct-access. A small subset of a large dataset may be accessed efficiently, without first reading through all the preceding data.
- Appendable. Data can be appended to a netCDF dataset along one dimension without copying the dataset or redefining its structure. The structure of a netCDF dataset can be changed, though this sometimes causes the dataset to be copied.
- Sharable. One writer and multiple readers may simultaneously access the same netCDF file.

The CF convention generalises and extends the COARDS convention but relaxes the COARDS constraints on dimension and order and specifies methods for reducing the size of datasets. A wide range of software is available to write or read NetCDF/CF files. API are made available by UNIDATA http://www.unidata.ucar.edu/software/netcdf :

- C/C++/Fortran
- Java
- MATLAB, Objective-C, Perl, Python, R, Ruby, Tcl/Tk

4.2. File content

```
netcdf mss_cnes_cls_2025 {
dimensions:
	lat = 10045 ;
	lon = 21600 ;
variables:
	double mssh(lat, lon) ;
		mssh:_FillValue = NaN ;
		mssh:units = "m" ;
		mssh:long_name = "Mean Sea Surface Height over the [1993, 2012] period" ;
		mssh:standard_name = "mean_sea_surface_height_above_reference_ellipsoid" ;
		mssh:grid_mapping = "crs" ;
	double crs ;
		crs:_FillValue = NaN ;
		crs:comment = "This is a container variable that describes the grid_mapping used by the data in this
file. This variable does not contain any data; only information about the geographic coordinate system." ;
		crs:grid_mapping_name = "latitude_longitude" ;
		crs:inverse_flattening = "1/298.257223563" ;
		crs:semi_major_axis = 6378137. ;
	double lon(lon) ;
		lon:_FillValue = NaN ;
		lon:long_name = "longitude" ;
		lon:units = "degrees_east" ;
		lon:actual_range = 0., 360. ;
	double lat(lat) ;
		lat:_FillValue = NaN ;
		lat:long_name = "latitude" ;
		lat:units = "degrees_north" ;
		lat:actual_range = -79.4, 88. ;

// global attributes:
		:Conventions = "COARDS, CF-1.5" ;
		string :title = "CNES_CLS_2025 Mean sea surface (using L3 v3.0 SWOT KaRIn data, mss_innov_miost
with H23_LO>5km draft, mean profile innov with H23_LO>20km draft), referenced to the [1993, 2012] period,
above WGS84 ellipsoïde." ;
		:FileType = "GRID_DOTS" ;
		:contact = "aviso@altimetry.fr" ;
		:creator_url = "http://www.aviso.altimetry.fr/en/data/products/auxiliary-products/mss.html" ;
		:license = "http://www.aviso.altimetry.fr/fileadmin/documents/data/License_Aviso.pdf" ;
		:institution = "CNES, CLS" ;
		:CreatedBy = "R.Charayron" ;
		:CreatedOn = "2026/01/30" ;
		:OriginalName = "MSS CNES_CLS_2025" ;
		:DOI = "10.24400/527896/a01-2024.011" ;
}
```

5. Accessibility of the products

5.1. How to download a product

- CNES AVISO FTP/SFTP access (with AVISO+ credentials):
  - ftp://ftp-access.aviso.altimetry.fr:21
  - sftp://ftp-access.aviso.altimetry.fr:2122
    - /auxiliary/mss/mss_cnes_cls2025

- CNES AVISO THREDDS Data Server access (with AVISO+ credentials):
  - https://tds-odatis.aviso.altimetry.fr/thredds/catalog/auxiliary/AUXILIARY-MSS/AUXILIARY-MSS.html

6. Bibliography

Charayon, R., Delepoulle, A., Schaeffer, P., Ballarotta, M., Pujol, M.-I., Dibarboure, G., Introducing the CNES CLS 25 Mean Sea Surface, benchmarking an emerging generation of SWOT KaRIn based Models, in preparation

Laloue, A., Schaeffer, P., Pujol, M.-I., Veillard, P., Andersen, O., Sandwell, D., et al. (2025). Merging recent mean sea surface into a 2023 hybrid model (from Scripps, DTU, CLS, and CNES). Earth and Space Science, 12, e2024EA003836. https://doi.org/10.1029/2024EA003836

Ubelmann, C., Dibarboure, G., Gaultier, L., Ponte, A., Ardhuin, F., Ballarotta, M., & Faugère, Y. (2021). Reconstructing ocean surface current combining altimetry and future spaceborne Doppler data. Journal of Geophysical Research: Oceans, 126, e2020JC016560. https://doi.org/10.1029/2020JC016560

7. Contacts

For more information, please contact:

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Parc Technologique du canal
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France
E-mail: aviso@altimetry.fr
On Internet: https://www.aviso.altimetry.fr/

The user service is also interested in user feedbacks; questions, comments, proposals, requests are much welcome.