



PRODUCT USER MANUAL
For Mediterranean Sea Physical
Reanalysis Product
MEDSEA_REANALYSIS_PHYS_006_004

Issue: 1.5

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GLOSSARY AND ABBREVIATIONS

Analysis (Numerical)	a detailed study of the state of the ocean done in Near real Time based on observations and numerical model. The operational prediction centre produces 3D time-space analysis systems. A long series of analyses is of great utility for studying the behavior of the ocean system.
CF	Climate Forecast (convention for NetCDF)
CLS	Collecte Localisation Satellites
CMAP	CPC Merged Analysis of Precipitation
CMCC	Centro Euro-Mediterraneo sui Cambiamenti Climatici
CMEMS	Copernicus Marine Environment Monitoring Service
CNR-ISAC	Istituto di Scienze dell'Atmosfera e del Clima
CTD	Conductivity Temperature Depth
DAC	Dynamic Atmospheric Correction
DGF	DirectGetFile
DirectGetFile	CMEMS service tool (FTP like) to download a NetCDF file
ECMWF	European Centre for Medium-Range Weather Forecasts
EOF	Empirical Orthogonal Function
FAQ	Frequently Asked Question
Forecast (Numerical)	a computer forecast or prediction based on equations governing the motions and the forces affecting motion of fluids. The equations are based, or initialized, on specified ocean conditions at a certain place and time (NOAA Glossary).
FTP	File Transfer Protocol
MDT	Mean Dynamic Topography
Med/MED	Mediterranean
Meridional Velocity	South to North component of the horizontal velocity vector

MFC	Monitoring and Forecasting Centre
MFS	Mediterranean Forecasting System
NEMO	Nucleous for European Modelling of the Ocean
NetCDF	Network Common Data Form
NOAA	National Oceanic and Atmospheric Administration
OA	Objective Analyses
OCEANVAR	Oceanographic variational data assimilation scheme developed at INGV/CMCC.
OGCM	Ocean General Circulation Model
OpenDAP	Open-Source Project for a Network Data Access Protocol. Protocol to download subset of data from a n-dimensional gridded dataset (ie: 4 dimensions: lon-lat,depth,time)
OSI	Ocean and Sea Ice
PU	Production Unit
SL	Sea Level
SLA	Sea Level Anomaly
SSH	Sea Surface Height
SST	Sea Surface Temperature
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude and latitude, and time range
TAC	Thematic Assembly Centre
XBT	eXpandable BathyThermograph
WW3	WaveWatch-III
Zonal Velocity	West to East component of the horizontal velocity vector
3DVAR	Three-Dimensional Variational

I INTRODUCTION

I.1 Summary

This document is the user manual for the CMEMS reanalysis product **MEDSEA_REANALYSIS_PHYS_006_004**. An archive of reanalysis since 01/01/1987 is available on the CMEMS server.

It contains the reanalysis product of the physical state of the Mediterranean Sea, composed by 3D, daily and monthly mean fields of Potential Temperature, Salinity, Zonal and Meridional Velocity, and by 2D, daily and monthly mean fields of Sea Surface Height.

MEDSEA_REANALYSIS_PHYS_006_004 product is organised in 9 datasets:

- 4 contain the 3D daily mean fields: 3D potential temperature, salinity and currents information from top to bottom and 2D sea surface level information.
 - **sv03-med-ingv-tem-rean-d**
 - **sv03-med-ingv-cur-rean-d**
 - **sv03-med-ingv-ssh-rean-d**
 - **sv03-med-ingv-sal-rean-d**
- 4 contain the 3D monthly mean fields: 3D potential temperature, salinity and currents information from top to bottom and 2D sea surface level information.
 - **sv03-med-ingv-tem-rean-m**
 - **sv03-med-ingv-sal-rean-m**
 - **sv03-med-ingv-cur-rean-m**
 - **sv03-med-ingv-ssh-rean-m**
- 1 contains the static fields for the system: coordinates, mean sea surface level, mask and bathymetry: **MEDSEA_REANALYSIS_PHYS_006_004-statics**

The product is published on the CMEMS dissemination server after automatic and human quality controls. Product is available on-line and disseminated through the CMEMS Information System. Files downloaded are in NetCDF format.

The reanalysis system is described in the Quality Information Document (QUID) CMEMS-MED-QUID-006-004 (<http://cmems-resources.cls.fr/documents/QUID/CMEMS-MED-QUID-006-004.pdf>).

More detailed information can be obtained from the CMEMS Service Desk (servicedesk.cmems@mercator-ocean.eu).

Disclaimer: The quality of the product may vary during the proposed time series depending on the possible update of the system.

I.2 History of changes

Apr 2016	Change from NEMO version 3.2 to NEMO version 3.4
Sep 2019	New template and general revision

II DESCRIPTION OF THE PRODUCT SPECIFICATION

II.1 General Information about product

Product Specification	MEDSEA_REANALYSIS_PHYS_006_004
Geographical coverage	6°W → 36.25°E; 30.1875°N → 45.9375°N
Variables	Potential Temperature Salinity Sea Surface Height Horizontal Velocity (meridional and zonal component)
	Reanalysis
Available time series	Since 1987 Regularly updated (see product improvements pages http://marine.copernicus.eu/services-portfolio/product-improvements/)
Target delivery time	N/A
Temporal resolution	sv03-med-ingv-tem-rean-d, sv03-med-ingv-cur-rean-d, sv03-med-ingv-ssh-rean-d, sv03-med-ingv-sal-rean-d: daily mean sv03-med-ingv-tem-rean-m, sv03-med-ingv-cur-rean-m, sv03-med-ingv-ssh-rean-m, sv03-med-ingv-sal-rean-m: monthly mean
Delivery mechanism	CMEMS Information System (Subsetter, CMEMS FTP, DirectGetFile)
Horizontal resolution	1/16°
Number of vertical levels	72
Format	Netcdf CF1.0

Detailed information on the systems and products are on CMEMS web site: <http://marine.copernicus.eu/>.

II.2 Details of the datasets

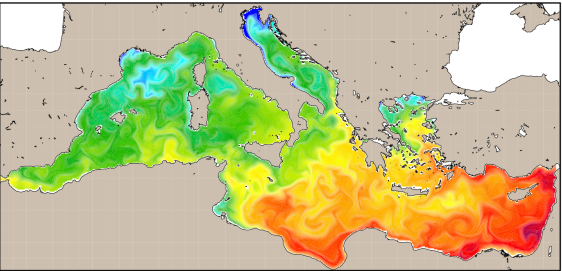
MEDSEA_REANALYSIS_PHYS_006_004	
sv03-med-ingv-tem-rean-m	contains the 3D <u>monthly mean fields</u> : 3D potential temperature information from top to bottom.
	votemper [°C] Potential temperature sea_water_potential_temperature
sv03-med-ingv-sal-rean-m	contains the 3D <u>monthly mean fields</u> : 3D salinity information from top to bottom.
	vosaline [psu] Salinity sea_water_salinity
sv03-med-ingv-cur-rean-m	contains the 3D <u>monthly mean fields</u> : 3D currents information from top to bottom.
	vozocrtx [m/s] Eastward ocean current velocity eastward_sea_water_velocity
	vomecrtx [m/s] Northward ocean current velocity northward_sea_water_velocity
	vomecrtz [m/s] Downward ocean current velocity downward_sea_water_velocity
sv03-med-ingv-ssh-rean-m	contains the 2D <u>monthly mean fields</u> : 2D sea surface level information.
	sossheig [m] Sea surface height sea_surface_height_above_geoid
sv03-med-ingv-tem-rean-m	contains the 3D <u>daily mean fields</u> : 3D potential temperature information from top to bottom.
	votemper [°C] Potential temperature

	sea_water_potential_temperature
sv03-med-ingv-sal-rean-d	contains the 3D <u>daily mean fields</u> : 3D salinity information from top to bottom.
	vosaline [psu] Salinity sea_water_salinity
sv03-med-ingv-cur-rean-d	contains the 3D <u>daily mean fields</u> : 3D currents information from top to bottom.
	vozocrtx [m/s] Eastward ocean current velocity eastward_sea_water_velocity
	vomecrtx [m/s] Northward ocean current velocity northward_sea_water_velocity
sv03-med-ingv-ssh-rean-d	contains the 2D <u>daily mean fields</u> : 2D sea surface level information.
	sossheig [m] Sea surface height sea_surface_height_above_geoid
MEDSEA_REANALYSIS_PHYS_006_004-statics	contains the static fields for the system: coordinates, mean sea surface level, mask and bathymetry.
	e1t [m] Cell dimension along X axis
	e2t [m] Cell dimension along Y axis
	e3t [m] Cell dimension along Z axis cell_thickness
	mask [1] Land-sea mask: 1 = sea ; 0 = land sea_binary_mask
	deptho [m] Bathymetry sea_floor_depth_below_geoid
	deptho_lev [1]

Model level number at sea floor model_level_number_at_sea_floor
mdt [m] Mean dynamic topography sea_surface_height_above_geoid

II.3 Product System Description

The Mediterranean Forecasting System, physical reanalysis component, is a hydrodynamic model, supplied by the Nucleus for European Modelling of the Ocean (NEMO), with a variational data assimilation scheme (OceanVAR) for temperature and salinity vertical profiles and satellite Sea Level Anomaly along track data. The model horizontal grid resolution is 1/16° (ca. 6-7 km) and the unevenly spaced vertical levels are 72.

Domain	MEDSEA (6°W-36.29°E; 30.1875°S – 45.9375°N)
Resolution and grid	1/16°; regular grid; 677 x 253 x 72
Geographic coverage	This is a regional product covering the Mediterranean Sea. It is defined on a regular grid at 1/16 degree (approx. 6km) and 72 vertical levels. 
Algorithm	NEMO
Atmospheric forcings	6-h, 0.75° horizontal-resolution ERAInterim reanalysis fields from the European Centre for Medium-Range Weather Forecasts (ECMWF)
Assimilation scheme	OceanVar (3DVAR)
Assimilated observations	Insitu vertical profiles of Temperature and Salinity from CTDs, XBTs, MBTs, bottles, ARGO floats; Sea Level Anomaly (SLA) from available satellites. Objective Analyses-Sea Surface Temperature (SST) fields are used to correct surface heat fluxes.
Initial conditions	Temperature and salinity monthly climatology (named SDN_V2aa) produced within the framework of SeaDataNet FP6 Project.
Bathymetry	DBDB1 interpolated on 1/16 degree resolution

II.4 Processing information

The Mediterranean Sea Physical reanalysis has been initialized by a temperature and salinity monthly climatology on the 1st of January 1985. The first two years are considered the period of model spin up.

II.4.1 Time coverage

The product is available from 01/01/1987.

II.4.2 Time averaging

For the monthly dataset, the fields are monthly averages over the calendar month (first to last day of the month). For the daily dataset, the fields are daily averages over a day (midday to midday, centered at midnight).

III HOW TO DOWNLOAD A PRODUCT

III.1 Download a product through the CMEMS Web Portal Subsetter Service

You first need to register. Please find below the registration steps:
<http://marine.copernicus.eu/web/34-products-and-services-faq.php#1>

Once registered, the CMEMS FAQ <http://marine.copernicus.eu/web/34-products-and-services-faq.php> will guide you on how to download a product through the CMEMS Web Portal Subsetter Service.

III.2 Download a product through the CMEMS Web Portal Ftp Service

You first need to register. Please find below the registration steps:
<http://marine.copernicus.eu/web/34-products-and-services-faq.php#1>

Once registered, the CMEMS FAQ <http://marine.copernicus.eu/web/34-products-and-services-faq.php> will guide you on how to download a product through the CMEMS Web Portal FTP Service.

III.3 Download a product through the CMEMS Web Portal Direct Get File Service

You first need to register. Please find below the registration steps:
<http://marine.copernicus.eu/web/34-products-and-services-faq.php#1>

Once registered, the CMEMS FAQ <http://marine.copernicus.eu/web/34-products-and-services-faq.php> will guide you on how to download a product through the CMEMS Web Portal Direct Get File Service.

IV FILES NOMENCLATURE AND FORMAT

IV.1 Nomenclature of files when downloaded through the Subsetter Service

MEDSEA_REANALYSIS_PHYS_006_004 files nomenclature when downloaded through the CMEMS Web Portal Subsetter is based on product dataset name and a numerical reference related to the request date on the CIS.

The scheme is: **datasetname_nnnnnnnnnnnn.nc**

where :

.datasetname is a character string within one of the following :

- sv03-med-ingv-tem-rean-d
- sv03-med-ingv-sal-rean-d
- sv03-med-ingv-cur-rean-d
- sv03-med-ingv-ssh-rean-d
- sv03-med-ingv-tem-rean-m
- sv03-med-ingv-sal-rean-m
- sv03-med-ingv-cur-rean-m
- sv03-med-ingv-ssh-rean-m

.nnnnnnnnnnnn: 13 digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.

.nc: standard NetCDF filename extension.

The fields **tem/sal/ssh/cur** are respectively for the variable of Potential Temperature (**votemper**), Salinity (**vosaline**), Sea Surface Height (**sossheig**), and Velocity (**vozocrtx**, **vomecrtx**).

Example for a file of Salinity:

```
sv03-med-ingv-sal-rean-d_1303461772348.nc
```

IV.2 Nomenclature of files when downloaded through the DGF and CMEMS FTP Services

MEDSEA_REANALYSIS_PHYS_006_004 files nomenclature when downloaded through CMEMS FTP is based as follows:

{valid date}_{freq flag}{average flag}-{producer}-{parameter}-{config}-{region}-{bul date}_{product type}-fv{file version}.nc

where

- **valid date** YYYYMMDD is the validity day of the data in the file
- **freq flag** is the frequency of data values in the file (d = daily, m = monthly)

- **average flag** is m=mean
- **producer** is a short version of the CMEMS production unit
- **config** identifies the producing system and configuration
- **region** is a three letters code for the region
- **parameter** is a four letters code for the parameter or parameter set from Standard BODC.
- **bul date** bYYYYMMDD is the bulletin date the product was produced
- **product type** is a two letters code for the product type, for example fc for forecast, an for analysis and re for reanalysis.
- **file version** is xx.yy where xx is the CMEMS version and yy is an incremental version number

valid date	YYYYMMDD
freq flag	d (daily) m (monthly)
average flag	m (mean)
producer	INGV CMCC
config	MFSs4b3 (1987-2013) MFSe1r1 (2014-2017) MFSe1r2 (2018)
region	MED
parameter	TEMP PSAL ASLV RFVL
bul date	bYYYYYMMDD
product type	re (reanalysis)
file version	fv04.00 (from 1987 to 2003) fv05.00 (from 2004 to 2013) fv06.00 (2014) fv07.00 (2015) sv04.10 (2016-2017) sv05.00 (2018)

Example for a reanalysis file of Salinity:

```
20000401_mm-INGV--PSAL-MFSS4b3-MED-b20130712_re-fv04.00.nc
```

This is the monthly mean field of salinity for the month of April 2000. The mean is computed from noon (12:00 UTC) of the 31st March 2000 to noon (12:00 UTC) of the 30th April 2000 (see section IV.8).

```
20150401_mm-INGV--PSAL-MFSe1r1-MED-b20160501_re-fv07.00.nc
```

This is the monthly mean field of salinity for the month of April 2015. The mean is computed from noon (12:00 UTC) of the 31st March 2015 to noon (12:00 UTC) of the 30th April 2015 (see section IV.8).

```
20110409_dm-INGV--PSAL-MFSS4b3-MED-b20130712_re-fv05.00.nc
```

This is the mean field of salinity centered at 00:00 UTC of the 9th April 2011, and the time coverage is from noon (12:00 UTC) of the 8th April 2011 to noon (12:00 UTC) of the 9th April 2011 (see section IV.8).

IV.3 File Format: format name

The products are stored using the NetCDF 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.

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.

IV.4 File size

DATASET NAME	NAME OF FILE	DIMENSION [MB]*
sv03-med-ingv-ssh-rean-d	{date1}_dm-INGV--ASLV-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_dm-INGV--ASLV-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_d-INGV--ASLV-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_d-CMCC--ASLV-MFSe1r2-MED-b{date2}_re-sv05.00.nc	0.7
sv03-med-ingv-sal-rean-d	{date1}_dm-INGV--PSAL-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_dm-INGV--PSAL-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_d-INGV--PSAL-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_d-CMCC--PSAL-MFSe1r2-MED-b{date2}_re-sv05.00.nc	50
sv03-med-ingv-tem-rean-d	{date1}_dm-INGV--TEMP-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_dm-INGV--TEMP-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_d-INGV--TEMP-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_d-CMCC--TEMP-MFSe1r2-MED-b{date2}_re-sv05.00.nc	50
sv03-med-ingv-cur-rean-d	{date1}_dm-INGV--RFVL-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_dm-INGV--RFVL-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_d-INGV--RFVL-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_d-CMCC--RFVL-MFSe1r2-MED-b{date2}_re-sv05.00.nc	101
sv03-med-ingv-ssh-rean-m	{date1}_mm-INGV--ASLV-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_mm-INGV--ASLV-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_m-INGV--ASLV-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_m-CMCC--ASLV-MFSe1r2-MED-b{date2}_re-sv05.00.nc	0.7
sv03-med-ingv-sal-rean-m	{date1}_mm-INGV--PSAL-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_mm-INGV--PSAL-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_m-INGV--PSAL-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_m-CMCC--PSAL-MFSe1r2-MED-b{date2}_re-sv05.00.nc	50
sv03-med-ingv-tem-rean-m	{date1}_mm-INGV--TEMP-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_mm-INGV--TEMP-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_m-INGV--TEMP-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_m-CMCC--TEMP-MFSe1r2-MED-b{date2}_re-sv05.00.nc	50

sv03-med-ingv-cur-rean-m	{date1}_dm-INGV--RFVL-MFSS4b3-MED-b{date2}_re-fv{04 5.00}.nc {date1}_dm-INGV--RFVL-MFSe1r1-MED-b{date2}_re-fv{06 7.00}.nc {date1}_m-INGV--RFVL-MFSe1r1-MED-b{date2}_re-sv04.10.nc {date1}_m-CMCC--RFVL-MFSe1r2-MED-b{date2}_re-sv05.00.nc	101
MEDSEA_REANALYSIS_PHYS_006_004-statics	MED-MFC_006_004_\${field}.nc	5.2

IV.5 Remember: scale_factor & add_offset / missing_value / land mask

The missing value for this product is: 1.e+20

Land mask is equal to “_FillValue” (see variable attribute on NetCDF file).

IV.6 Reading Software

NetCDF data can be browsed and used through a number of softwares, like:

- ✓ ncBrowse: <http://www.epic.noaa.gov/java/ncBrowse/>,
- ✓ NetCDF Operator (NCO): <http://nco.sourceforge.net/>
- ✓ IDL, Matlab, GMT...

Useful information on UNIDATA: <http://www.unidata.ucar.edu/software/netcdf/>

IV.7 Structure and semantic of netCDF maps files

DIMENSIONS	VARIABLES		
	NAME	DIMENSIONS	TYPE
lon=677 lat=253 depth=72 time=1	lon	lon	float
	lat	lat	float
	depth	depth	float
	time	time	int
	sosshieg	time,lat,lon	float
	votemper	time,depth,lat,lon	float
	vosaline	time,depth,lat,lon	float
	vozocrtx	time,depth,lat,lon	float

	vomecrt	time,depth,lat,lon	float
--	---------	--------------------	-------

For 20121223_dm-INGV--PSAL-MFSs4b3-MED-b20130712_re-fv05.00.nc
netcdf \20121223_dm-INGV--PSAL-MFSs4b3-MED-b20130712_re-fv05.00 {
dimensions:

```
depth = 72 ;  
lat = 253 ;  
lon = 677 ;  
time = UNLIMITED ; // (1 currently)
```

variables:

```
float depth(depth) ;  
    depth:units = "m" ;  
    depth:positive = "down" ;  
    depth:valid_min = 1.472102f ;  
    depth:valid_max = 5334.648f ;  
    depth:long_name = "depth" ;  
    depth:axis = "Z" ;  
    depth:standard_name = "depth" ;  
float lat(lat) ;  
    lat:units = "degrees_north" ;  
    lat:valid_min = 30.1875f ;  
    lat:valid_max = 45.9375f ;  
    lat:long_name = "latitude" ;  
    lat:standard_name = "latitude" ;  
    lat:axis = "Y" ;  
float lon(lon) ;  
    lon:units = "degrees_east" ;  
    lon:valid_min = -6.f ;  
    lon:valid_max = 36.25f ;  
    lon:long_name = "longitude" ;  
    lon:standard_name = "longitude" ;  
    lon:axis = "X" ;  
int time(time) ;
```

```
time:units = "seconds since 1970-01-01 00:00:00" ;
time:calendar = "standard" ;
time:long_name = "time" ;
time:standard_name = "time" ;
time:axis = "T" ;
float vosaline(time, depth, lat, lon) ;
vosaline:units = "1e-3" ;
vosaline:missing_value = 1.e+20f ;
vosaline:valid_min = 15.f ;
vosaline:valid_max = 42.f ;
vosaline:long_name = "Salinity" ;
vosaline:_FillValue = 1.e+20f ;
vosaline:coordinates = "time depth lat lon" ;
vosaline:standard_name = "sea_water_salinity" ;

// global attributes:
:bulletin_type = " reanalysis " ;
:institution = "Istituto Nazionale di Geofisica e Vulcanologia - Bologna, Italy" ;
:source = " MFS SYS4b3" ;
:contact = " servicedesk.cmems@mercator-ocean.eu" ;
:references = "Please check in CMEMS catalogue the INFO section for product
MEDSEA_REANALYSIS_PHYS_006_004 - http://marine.copernicus.eu/" ;
:comment = "Please check in CMEMS catalogue the INFO section for product
MEDSEA_REANALYSIS_PHYS_006_004 - http://marine.copernicus.eu/" ;
:Conventions = "CF-1.0" ;
:field_type = "daily_mean_centered_at_time_field" ;
:title = "Salinity (3D) - Daily Mean" ;
}
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