PRODUCT USER MANUAL

For Level 3 and 4 ODYSSEA SST products over the global ocean and north western shelves

- SST_GLO_SST_L3_NRT_OBSERVATIONS_010_010
- SST_NWS_SST_L4_NRT_OBSERVATIONS_010_003

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CMEMS version scope : Version 2.0

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
DRAFT	8 August 2011	All	First draft version, based on L3EUR PUM draft by Francoise Orain. Provided for the preparation of the POR for MyOcean V1	Jean-François Piollé	
2.0	9 november 2011		Use of latest template	L. Crosnier	
2.1	May 1 2015	all	Change format to fit CMEMS graphical rules		L. Crosnier
2.2	18 January 2016	All	Change from MyOcean to Copernicus	Jean-François Piollé	B. Hackett
2.3	25 January 2018		Rebranded from OSI to SST TAC	C. Wettre	CMEMS products team

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GLOSSARY AND ABBREVIATIONS

MFC	Monitoring and Forecasting Centre
Med	Mediterranean
NetCDF	Network Common Data Form
CF	Climate Forecast (convention for NetCDF)
SSS	Sea surface salinity.
SSC	Sea surface currents
SSH	Sea surface height
RMS	Root mean square
SDN	SeaDataNet (climatology)
CHL	Chlorophyll
SLA	Sea Level Anomalies
PC	Production Center
PU	Production Unit
Meridional Velocity	West to East component of the horizontal velocity vector
Zonal Velocity	South to North component of the horizontal velocity vector
ftp	Protocol to download files
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)
Subsetter	CMEMS service tool to download a NetCDF file of a selected geographical box using values of longitude an latitude, and time range
Directgetfile	CMEMS service tool (FTP like) to download a NetCDF file

I INTRODUCTION

I.1 Scope

The Copernicus Marine Environment Monitoring System (CMEMS) provides marine information and data products to European and other users. The Sea Surface Temperature Thematic Assembly Centre (SST TAC) is a CMEMS production Element that provides satellite-based observation products encompassing sea ice, sea surface temperature (SST) and sea winds. This document is the Product User Manual for two SST products produced by Ifremer:

SST_NWS_SST_L4_NRT_OBSERVATIONS_010_003	Atlantic European North West Shelf Ocean - ODYSSEA L4 Sea Surface Temperature Analysis
SST_GLO_SST_L3S_NRT_OBSERVATIONS_010_010	Global Ocean Sea Surface Temperature L3 Observations

I.2 Purpose

This document provides to CMEMS users practical information on the SST level 3 and 4 products over the global ocean and the Northwest European Shelf, respectively, which are processed at Ifremer.

Section III describes the processing steps and the algorithms used to derive the level 3 (L3S) and level 4 (L4) SST products at Ifremer, and provides some graphical examples of the products.

Some general characteristics of the products are given in section IV, the detailed description of the netCDF format used being provided in Annex 1.

Section V provides information on near real-time and archived products access.

II HOW TO DOWNLOAD A PRODUCT

II.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 APPLICABLE AND REFERENCE DOCUMENTS

Applicable Documents

Ref.	Document Name	Document Reference	Issue	Date

Table 1: Applicable documents

Reference Documents

Ref.	Document Name	Document Reference	Issue	Date
[RD.1]	FP7 call : WORK PROGRAMME 2007 COOPERATION THEME 9 : SPACE			
[RD.2]	DRAFT GUIDE FOR APPLICANTS Theme 9: SPACE COLLABORATIVE PROJECT Call identifier: FP7-SPACE-2007-1			
[RD.3]	The Recommended GHRSST-PP Data Processing Specification GDS (Version 1 revision 1.7) http://www.ghrsst.org/files/download.php?m=documents&f=GDS-v1.0-rev1.7.pdf	GHRSST/17	GDSv1 Revision 1.7	April 2005

Ref.	Document Name	Document Reference	Issue	Date
[RD.4]	The Recommended GHRSST Data Specification (GDS) Revision 2.0 GDS 2.0 Technical Specifications http://www.ghrsst.org/files/download.php?m=documents&f=GDS2.0_TechnicalSpecifications_v2.0.pdf	GDS2.0_TechnicalSpecifications_V2.0.doc	02.007	October 2010
[RD.5]	A. Le Borgne, P. Marsouin and F. Orain, “Collated files for sst analysis: Bias correction,” MERSEA project technical report, 2006.			2006
[RD.6]	E. Autret, J. JF. Piollé, “Implementation of a global SST analysis, WP 02 Task 2.2” MERSEA project technical report, 2007			2007
[RD.7]	G. Bertino, L. Evensen and H. Wackernagel, “Sequential data assimilation techniques in oceanography,” International	vol. 71, no. 2, pp. 223–241, 2003		2003
[RD.8]	P. Tandéo, “Modélisation spatio-temporelle de la temperature de surface de la mer à partir de données multi-sources”, Ph.D Thesis, 2010.			2010

Table 2: Reference documents

IV SST ODYSSEA PROCESSING CHAIN AND ALGORITHMS

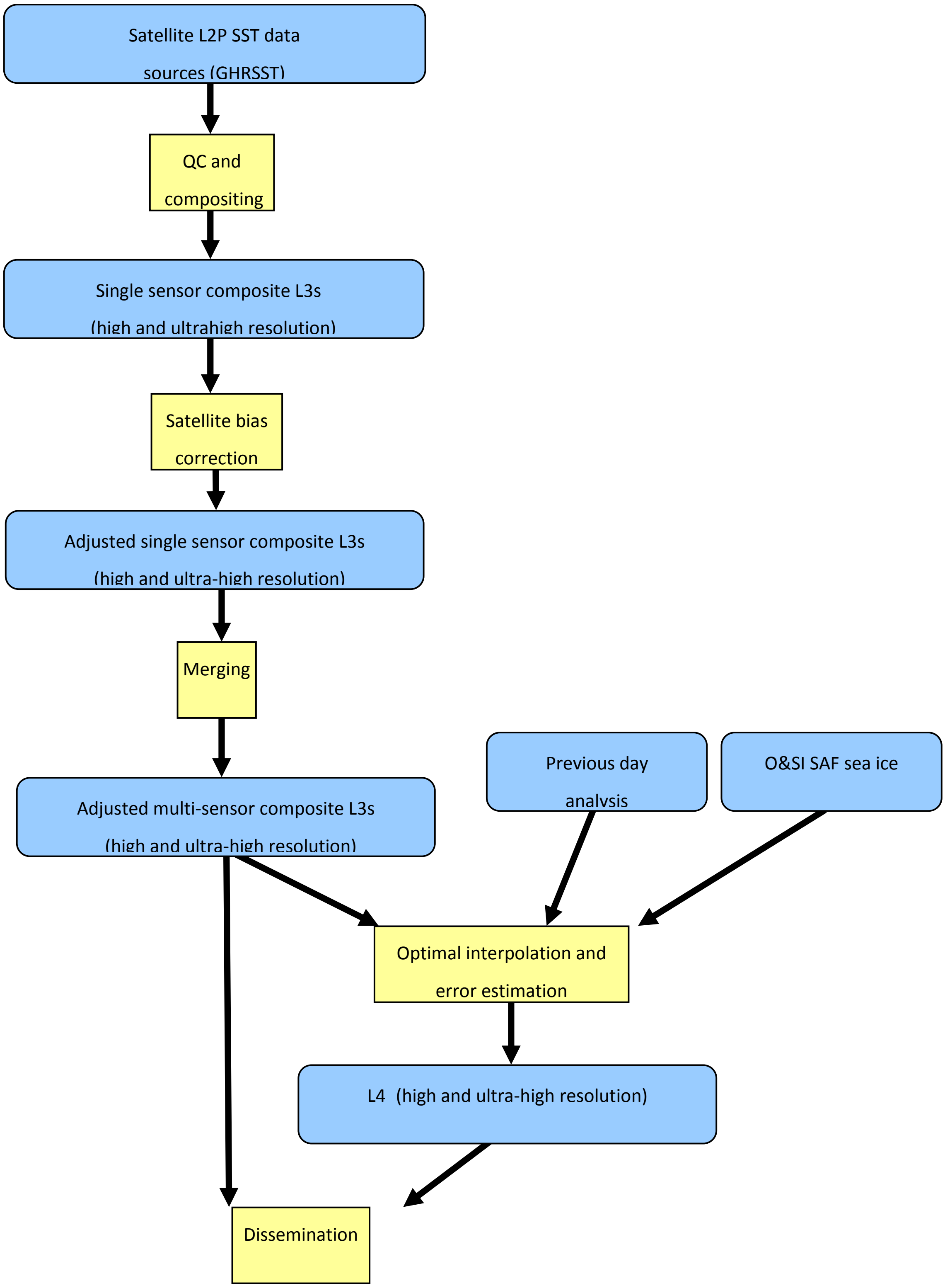

Figure III.1 Schematic diagram of the operational ODYSSEA processing chain at Ifremer

The production of the single sensor composite collated files is a continuous process, each composite file being updated as soon as a new L2P for the corresponding sensor is made available by the producing agency.

The intercalibration process and L3/L4 sea surface Temperature production system is run daily in the operational environment at Ifremer. It is run at 01:00 UTC. Products are available to users by 02:30 UTC for the Global Ocean and 03:30 for the North Western Shelves.

Figure III.1 shows the different steps for the creation of the ODYSSEA products at Ifremer. Each step of this processing is described below.

IV.1 Collection of inputs

The following inputs are collected for input to ODYSSEA:

SST satellite data: A collection of the original L2P data from different producers (NASA, NOAA, EUMETSAT OSI-SAF, ESA …) in GHRSST compliant format are collected. Currently the format of the collected data can be either GDS1.7 or GDS2.0 compliant, the processing chain being designed to ingest both formats. The L2P GDS V1.7 and GDS2.0 detailed format specifications are provided in **[RD-3]** and **[RD-4]**.

All L2P data are provided with Sensor Specific Error Statistics (SSES_bias and SSES_std variables) that give an estimate of the systematic and random errors at pixel level. In addition, quality level flags are provided.

The L2P data collected currently or for older dates for ODYSSEA are listed in the table below. Note than not all of them are used in the reference field for the cross-sensor intercalibration or until final product (either because of quality issues or because they are still under quality assessment).

Product	Provider	Resolution	Used in intercalibration reference	Adjusted single sensor composite	Used in final multi-sensor L3 and L4
AVHRR GAC NOAA1718,19 (NOAA17 discontinued)	NAVO	9 km	Yes	Yes	Yes
AVHRR LAC NOAA17,18,19 (NOAA-17 & 18 discontinued)	NAVO	1 km	Yes	Yes	Yes
AATSR ENVISAT	ESA	1 km	Yes	Yes	Yes

(discontinued)					
AVHRR METOP-A	OSI SAF	1 km	Yes	Yes	Yes
SEVIRI MSG	OSI SAF	10 km/3h	Yes	Yes	Yes
AVHRR NAR NOAA17/18/19 (discontinued)	OSI SAF	2 km	Yes	Yes	Yes
AVHRR NAR METOP-A (discontinued)	OSI SAF	2 km	Yes	Yes	Yes
MODIS AQUA	PODAAC	1 km	**No**	Yes	No
VIIRS	NAVO	1 km	**No**	Yes	No
GOES11/12	NOAA	4 km	**No**	Yes	**No**
AMSRE (discontinued)	REMSS	30 km	Yes	Yes	Yes
TMI (discontinued)	REMSS	30 km	Yes	Yes	Yes
AVHRR	ABoM	1 km	**No**	Yes	**No**

Table III.1.1 Satellite L2P data collected for ODYSSEA

Sea-ice concentration data from the EUMETSAT OSI-SAF are used in ODYSSEA.

Climatologies : the SST climatologies used have been derived from the PATHFINDER SST 5-daily climatology produced by Casey and Cornillon (1999).The fields have been spatially smoothed to reduce possible artefacts due to small scales and interpolated in time (daily).

IV.2 Algorithms for L4 production

IV.2.1 Quality control and collating of input data

All satellite SST data valid for a particular day (from previous day 12:00 to current day 12:00) are extracted from the downloaded L2P files. Each file is processed individually and will output a single collated file at the final resolution grid. It means that a high resolution file (better than 10km) will be processed two times, once for the global high-resolution grid (10km) and once for the ultra-high resolution regional grids (2km). The input SST data undergo various QC and processing steps:

- only satellite data which have a quality flag above a certain level and higher are accepted. This minimum quality level can be different depending on the data source.
- day-time data (determined using a solar zenith angle calculation) are rejected.
- the SSES biases supplied with the GHRSST data are removed from each pixel and the SSES standard deviation values are passed on to the next steps in the analysis chain.
- for skin temperature datasets (AATSR, MODIS, AVHRR ABoM), a skin-to-subskin correction factor is applied (+0.17 K).
- incidence angle for geostationary sensors is also taken into account to removed pixels with too high incidence (greater than 60°).
- ice concentration, when provided in the L2P is used to remove pixels with ice contamination greater than 10%
- aerosols, when provided in the L2P is used to remove pixels with aerosols content greater than 0.3
- pixels having the highest quality and falling into the same target grid cells are averaged together (if a minimum number of clear pixels, varying with respect to the sensor resolution, is available in order to avoid noisy grid cells).

IV.2.2 Compositing of the single sensor data

The collated files of a particular day and a particular sensor are merged together in order to produce single sensor composite file.

When several pixels are available for the target pixel, a hierarchical series of filters is applied to keep the most relevant input pixel :

- best quality level
- closest to 00:00 UTC

IV.2.3 Bias correction of the single sensor composites

Satellite data can be biased for several reasons, including: atmospheric water vapour; atmospheric aerosol (dust); surface changes (e.g. extreme roughness); instrument calibration problems. These biases can lead to biases or spatio-temporal discrepancies in the analysis if they are not treated in some way. In order to prepare a coherent daily dataset, an intercalibration method has been developed. This processing step consists in estimating a daily correction to be applied on SST values for each single source. The main issue is to define a daily reference. The first version of ODYSSEA only used the Envisat/AATSR observations as a reference and daily regional biases were estimated from ten days of match-ups. This method gives good results in average but presents the disadvantages of depending on one instrument and on the sampling of the match-ups. The method adopted in the second version of ODYSSEA for Medspiration and CMEMS consists in constructing a daily reference field (currently on a 0.25 degree grid) by optimal interpolation (Eq. 1) from a dedicated dataset including all the sources. Thus for each single source, a large scale bias field (with synoptic weather scales) is estimated from the differences between the observations and the reference of the day. The correction is applied on SST values.

The initial dataset for the construction of the reference is currently specified to be a median field obtained from multiple “trusted” data sources.

The computation of the reference is described below. A multi-sensor composite file at 25km resolution is first created :

- remapping 10 km composites to 25 km (averaging)
- taking at each pixel the median values of the available pixel values from the selected single sensor composite files (AATSR, METOP-A, AVHRR19 GAC and LAC, SEVIRI, NARxx, AMSRE and TMI) if N (the number of available pixels) is greater than 2, or the mean if N=2 or the single value

An optimal interpolation is then applied to the reference 25km multi-sensor composite, using the previous day analysis as the first guess. It is to be noted than once the single sensor composite files will be adjusted (see later), this full sequence is run a 2nd time with the adjusted single sensor composite as inputs. This 25km will be used as the first-guess the next day but also can be used independently as a mid-resolution 25km resolution SST analysis.

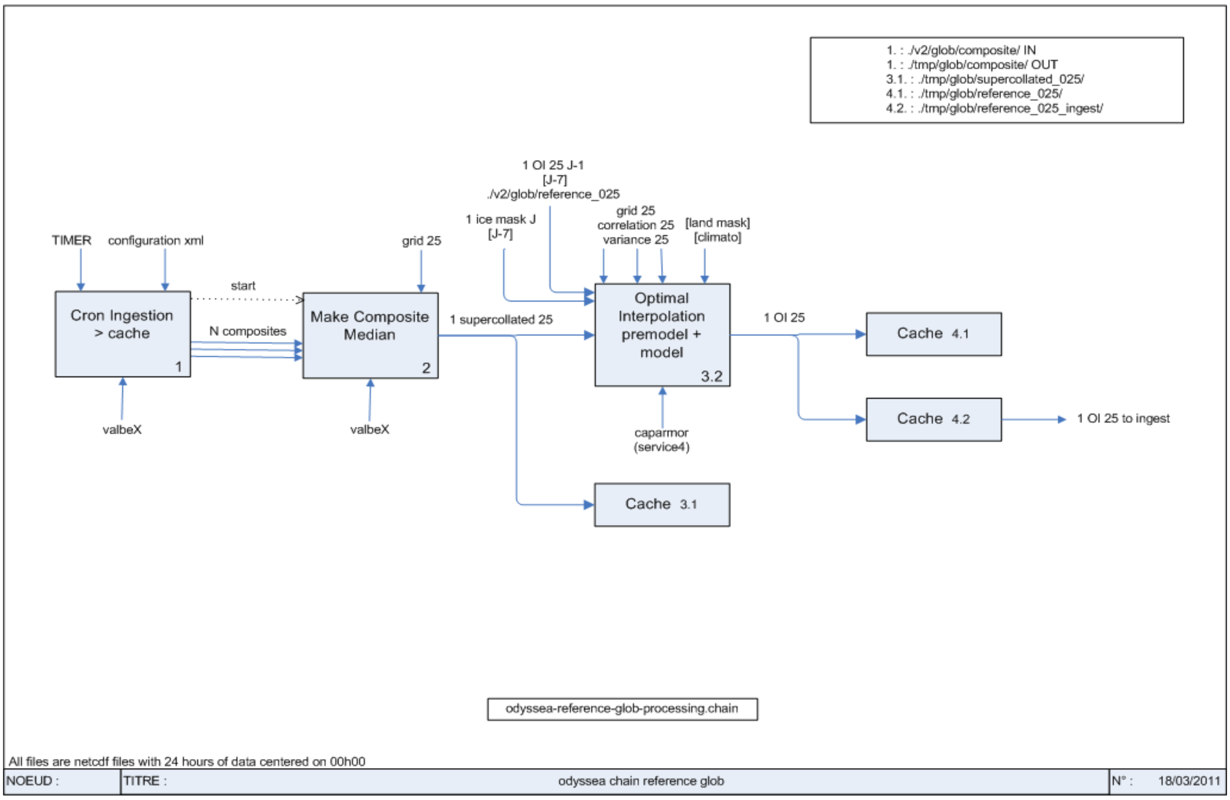

Figure III.2.3.1 Building the median reference field for intercalibration

For each satellite observation type to be calibrated:

- match-ups are calculated between each reference data point and the satellite single sensor composite (valid on the same day) producing a difference (or bias) field spatially smoothed at a 1 degree resolution
- A bilinear interpolation is calculated for each of these single sensor bias field
- The interpolated field is interpolated back to the satellite observation locations, and the bias subtracted from the satellite observation.

The outcome of this process is a new version of the L3 composite satellite data, which have been bias-corrected.

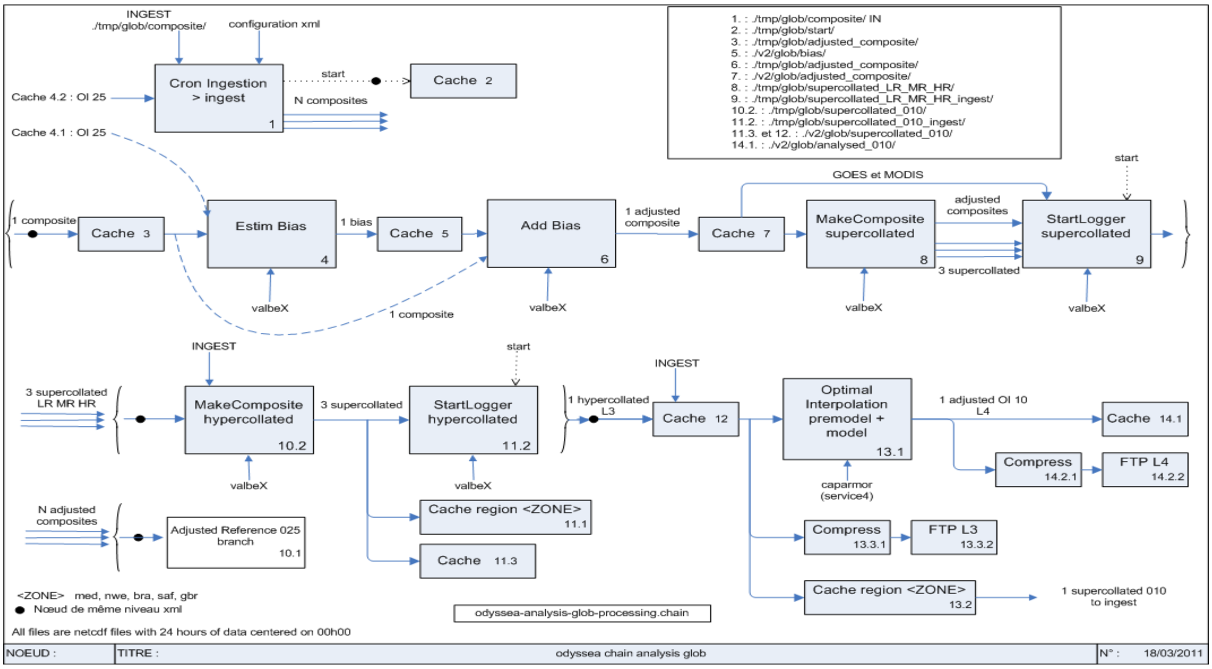

Figure III.2.3.2 Adjusting the single sensor L3 collated files and producing the multi-sensor L3 and L4

IV.2.4 Creation of the L4 analysis and error estimate

We use the state space model representation

$$\begin{aligned} x^t(t_i) &= x^t(t_{i-1}) + B^{1/2}\eta(t_i) \\ y^o(t_i) &= Hx^b(t_i) + R^{1/2}\varepsilon^o(t_i) \end{aligned} \quad (1)$$

with $y^o(t_i)$ observations at time t_i, $x^t(t_i)$ hidden state state vector (true SST measured by $y^o(t_i)$ at time t_i), H the observation operator corresponding to a possible grid transformation (model grid to observation grid), R the covariance error matrix between state and observations (the diagonal elements are the measurement errors, e.g. SSES standard deviation errors in L2P files), B covariance error matrix empirically computed (with one year of METOP AVHRR data)

Variograms are fitted by an exponential isotropic model (Eq. 2).

$$C(d) = \sigma^2 \exp\left(-\frac{d^2}{2L^2}\right) \quad (2)$$

with d the distance between two points and L the regional length scale. Note that the correlation scales are of the order of Rossby Radius (bounded by 10 km and 100 km). The optimal solution is given by optimal interpolation.

The previous day global analysis is used as background field. For spin-up or if the analysis is not available for more than 7 days, the analysis uses a reference daily climatology. We used the 4km

Pathfinder Version 5 (5-day) climatology to construct this reference, smoothed and interpolated and remapped to daily and 10km time and space resolution.

IV.3 Ice and land mask

IV.3.1 Land mask

A land mask has been defined on the ODYSSEA v1.0 analysis grid. We extracted the land mask from GMT (Graphics Mapping Tools, Wessel P. and Smith W. H. F,*The Generic Mapping Tools, GMT*, 2006).

IV.3.2 Ice mask

An ice mask is defined for each analysis. In the configuration of the daily system ODYSSEA, the ice mask is defined daily by using the ice product provided by O&SI SAF. The variable *sea_ice_fraction* provided in this product is remapped on our analysis grid and copied in our L4 file. However, for each analysis we extrapolate (with the nearest valid value) the ice data to fill the icy regions (with sea pixels) close to land.

The ice mask and the land mask used to affect fill values to our L4 product are stored in the variable *mask*. The variable *sea_ice_fraction* contain the values provided by the O&SI SAF product.

V ODYSSEA SST PRODUCTS DESCRIPTION

V.1 Common characteristics

The ODYSSEA products for CMEMS are available over two areas :

- Global Ocean, on a high resolution regular lat/lon grid spanning from 180 W to 180 E and 80 S to 80 N at a 0.1° horizontal resolution
- European North Western Shelves, on a ultra-high resolution regular lat/lon grid spanning from 18 W to 14 E and 38 N to 65 N at a 0.02° horizontal resolution

All ODYSSEA products are delivered in NetCDF format.

V.2 L3 products

The multi-sensor composite L3 product (or *supercollated*) is only available within CMEMS for the Global Ocean. The L3 product format specification is described in detail in the GHRSST format specification **[RD.3].** Annex 1 provides an example of the netCDF file header.

V.3 L4 products

The L4 products are available both over Global Ocean (0.1° resolution) and Europe North Western Shelves (0.02° resolution). The L4 product format specification is described in detail in the GHRSST format specification **[RD.3].** Annex 2 provides an example of the netCDF file header.

V.4 ODYSSEA internal products

All ODYSSEA chain's sub-products, as described in the previous section (adjusted single sensor composite, multi-sensor L3 products,...), are also available in NetCDF format, though not part of CMEMS catalog. They are however used within CMEMS for validation purposes and can be obtained on request to Jean-François Piollé (jfpiolle@ifremer.fr).

VI NOMENCLATURE OF FILES

The nomenclature of the downloaded files differs on the basis of the chosen download mechanism **Subsetter** service. CMEMS Level 3 and 4 ODYSSEA SST products over the global ocean and north western shelves are referenced as follows in the CMEMS catalogue, accessible through the CMEMS web site (http //www.copernicus.eu.org/) :

- **SST_GLO_SST_L3_NRT_OBSERVATIONS_010_010** which contains a 1/10 degree resolution global SST multi-sensor composite
- **SST_NWS_SST_L4_NRT_OBSERVATIONS_010_003** which contains a 1/50 degree resolution global SST multi-sensor analysis over the Europe North Western Shelves

VI.1 Nomenclature of files when downloaded through the CMEMS Web Portal Subsetter Service

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 MIS.

The scheme is: **datasetname-nnnnnnnnnnnnn.nc**

- where :**datasetname** is a character string within one of the following : IFREMER-NWS-SST_L4_NRT-OBS, IFREMER-GLOB-SST_L3MULTISENSOR_NRT-OBS**nnnnnnnnnnnnn**: 13 digit integer corresponding to the current time (download time) in milliseconds since January 1, 1970 midnight UTC.**.nc**: standard NetCDF filename extension.

Example:

```
IFREMER-GLOB-SST_L3MULTISENSOR_NRT-OBS_1303461772348.nc
```

VII ANNEX 1 : DESCRIPTION OF FILE FORMATS

VII.1 Example header of a high resolution L3 file

An example header of a high resolution L3 netCDF file (generated using ncdump) is given below.

```
netcdf¥20110719-IFR-L3C_GHRSST-SSTsubskin-ODYSSEA-GLOB_010_adjusted-v2.0-fv1.0
{dimensions:  time = 1 ;    lat = 1600 ;  lon = 3600 ;variables:      int   time(time)   ;
            time:time = "reference time of sst file" ;       time:units    =    "seconds
since 1981-01-01 00:00:00" ;float lon(lon) ;           lon:long_name   =   "longitude"   ;
            lon:units = "degrees_east" ;float lat(lat) ;           lat:long_name      =
"latitude" ;        lat:units = "degrees_north" ;      int  sst_dtime(time,  lat,  lon)  ;
            sst_dtime:long_name = "time difference from reference time" ;
      sst_dtime:_FillValue = -2147483648 ;           sst_dtime:add_offset = 0. ;
      sst_dtime:scale_factor = 1. ;           sst_dtime:units = "seconds" ;
      sst_dtime:valid_min = -2147483647 ;      sst_dtime:valid_max = 2147483647 ; short
sea_surface_temperature(time, lat, lon) ;       sea_surface_temperature:long_name  = "sea
surface temperature" ;           sea_surface_temperature:_FillValue = -32768s ;
      sea_surface_temperature:standard_name  =  "foundation  sea  surface  temperature"  ;
            sea_surface_temperature:add_offset = 273.15 ;
      sea_surface_temperature:scale_factor = 0.01 ;
      sea_surface_temperature:units = "kelvin" ;       sea_surface_temperature:valid_min
= -300s ;          sea_surface_temperature:valid_max = 4500s ;      byte
solar_zenith_angle(time, lat, lon) ;           solar_zenith_angle:long_name   =   "solar
zenith angle" ;          solar_zenith_angle:_FillValue = -128b ;
      solar_zenith_angle:add_offset = 90. ;           solar_zenith_angle:scale_factor   =
1. ;        solar_zenith_angle:units = "angular_degree" ;
      solar_zenith_angle:valid_min = -90b ;           solar_zenith_angle:valid_max = 90b
;           solar_zenith_angle:comment = "The solar zenith angle at the time of the SST
observations" ;     byte quality_level(time, lat, lon) ;
      quality_level:long_name = "quality level value" ;       quality_level:_FillValue  =
-128b ;      quality_level:comment  =  "These  are  the  overall  quality  indicators  and  are
used for all GHRSST SSTs" ;        quality_level:flag_meanings    =    "no_data    bad_data
worst_quality low_quality acceptable_quality best_quality" ;
      quality_level:flag_values = "0b, 1b, 2b, 3b, 4b, 5b" ;  byte  sses_bias(time,  lat,
lon) ;       sses_bias:long_name = "SSES bias error based on confidence flags" ;
      sses_bias:_FillValue = -128b ;          sses_bias:add_offset = 0. ;
      sses_bias:scale_factor = 0.01 ;          sses_bias:units = "kelvin" ;
      sses_bias:valid_min = -127b ;           sses_bias:valid_max = 127b ;
      sses_bias:comment  =  "Bias  estimate  derived  using  the  techniques  described  at
http://www.ghrsst.org/SSES-Description-of-schemes.html" ;      byte
sses_standard_deviation(time, lat, lon) ;       sses_standard_deviation:long_name = "SSES
standard deviation error based on confidence flags" ;
      sses_standard_deviation:_FillValue = -128b ;
      sses_standard_deviation:add_offset = 1. ;
```

```
      sses_standard_deviation:scale_factor = 0.01 ;
      sses_standard_deviation:units = "kelvin" ;       sses_standard_deviation:valid_min
= -127b ;           sses_standard_deviation:valid_max = 127b ;
      sses_standard_deviation:comment = "Bias estimate derived using the techniques
described at http://www.ghrsst.org/SSES-Description-of-schemes.html" ; short
or_latitude(time, lat, lon) ;            or_latitude:long_name = "original latitude of
the SST value" ;           or_latitude:_FillValue = -32768s ;
      or_latitude:add_offset = 0. ;            or_latitude:scale_factor = 0.01 ;
      or_latitude:units = "degrees_north" ;           or_latitude:valid_min = -9000s ;
            or_latitude:valid_max = 9000s ;    short or_longitude(time, lat, lon) ;
            or_longitude:long_name = "original longitude of the SST value" ;
      or_longitude:_FillValue = -32768s ;       or_longitude:add_offset = 0. ;
      or_longitude:scale_factor = 0.01 ;        or_longitude:units = "degrees_east" ;
            or_longitude:valid_min = -18000s ;       or_longitude:valid_max = 18000s ;
      short or_number_of_pixels(time, lat, lon) ;
      or_number_of_pixels:long_name = "Number of  pixels from the L2Ps contributing to
the SST value" ;           or_number_of_pixels:_FillValue = -32768s ;
      or_number_of_pixels:add_offset = 0. ;           or_number_of_pixels:scale_factor =
1. ;         or_number_of_pixels:units = "n/a" ;       or_number_of_pixels:valid_min = -
32767s ;            or_number_of_pixels:valid_max = 32767s ;  short
adjusted_sea_surface_temperature(time, lat, lon) ;
      adjusted_sea_surface_temperature:long_name = "adjusted collated sea surface
temperature" ;      adjusted_sea_surface_temperature:_FillValue = -32768s ;
      adjusted_sea_surface_temperature:standard_name = "sea_surface_subskin_temperature"
;           adjusted_sea_surface_temperature:add_offset = 273.15 ;
      adjusted_sea_surface_temperature:scale_factor = 0.01 ;
      adjusted_sea_surface_temperature:units = "kelvin" ;
      adjusted_sea_surface_temperature:valid_min = -300s ;
      adjusted_sea_surface_temperature:valid_max = 4500s ;
      adjusted_sea_surface_temperature:comment = "Bias correction using a multi-sensor
reference field" ;  byte sources_of_sst(time, lat, lon) ;
      sources_of_sst:long_name = "source of sea surface temperature" ;
      sources_of_sst:_FillValue = -128b ;byte satellite_zenith_angle(time, lat, lon) ;
            satellite_zenith_angle:long_name = "satellite zenith angle" ;
      satellite_zenith_angle:_FillValue = -128b ;
      satellite_zenith_angle:add_offset = 0. ;
      satellite_zenith_angle:scale_factor = 1. ;       satellite_zenith_angle:units =
"angular_degree" ;          satellite_zenith_angle:valid_min = 0b ;
      satellite_zenith_angle:valid_max = 90b ;         satellite_zenith_angle:comment =
"The satellite zenith angle at the time of the SST observations" ;    short
bias_to_reference_sst(time, lat, lon) ;          bias_to_reference_sst:long_name = "bias
error derived from reference" ;          bias_to_reference_sst:_FillValue = -32768s ;
            bias_to_reference_sst:add_offset = 0. ;
      bias_to_reference_sst:scale_factor = 0.01 ;
      bias_to_reference_sst:units = "kelvin" ;         bias_to_reference_sst:valid_min =
-32767s ;           bias_to_reference_sst:valid_max = 32767s ;
      bias_to_reference_sst:type = "subskin" ;  byte
standard_deviation_to_reference_sst(time, lat, lon) ;
      standard_deviation_to_reference_sst:long_name = "standard deviation of the
```

reference error" ; standard_deviation_to_reference_sst:_FillValue = -128b ;
standard_deviation_to_reference_sst:add_offset = 1. ;
standard_deviation_to_reference_sst:scale_factor = 0.01 ;
standard_deviation_to_reference_sst:units = "kelvin" ;
standard_deviation_to_reference_sst:valid_min = -127b ;
standard_deviation_to_reference_sst:valid_max = 127b ; byte adjusted_standard_deviation_error(time, lat, lon) ;
adjusted_standard_deviation_error:long_name = "standard deviation error based on L2P SSES and adjustment method" ; adjusted_standard_deviation_error:_FillValue = -128b ; adjusted_standard_deviation_error:add_offset = 1. ;
adjusted_standard_deviation_error:scale_factor = 0.01 ;
adjusted_standard_deviation_error:units = "kelvin" ;
adjusted_standard_deviation_error:valid_min = -127b ;
adjusted_standard_deviation_error:valid_max = 127b ;// global attributes:
:CONVENTIONS = "CF-1.4" ; :title = "Merged collation of sea surface temperature from multiple satellite sources" ; :summary = "Multi-sensor composite on a 0.1 degree resolution grid over global ocean" ; :id = "IFR-L3S-GLOB-ODYSSEA" ; :references = "Piolle J. F., Autret E., Arino O., Robinson I.S, Le Borgne P., (2010), Medspiration, toward the sustained delivery of satellite SST products and services over regional seas, Proceedings of the 2010 ESA Living Planet Symposium Bergen." ; :institution = "Ifremer" ; :license = "Cersat data use is free and open. Users must register at fpaf@ifremer.fr." ; :naming_authority = "org.ghrsst" ; :uuid = ; :contact = "jean.francois.piolle@ifremer.fr;emmanuelle.autret@ifremer.fr" ;
:gds_version_id = "2.0" ; :product_version = "1.0" ;
:netcdf_version_id = "¥"3.6.2¥" of Apr 5 2008 23:39:54 $" ;
:date_created = "20110719T134429Z" ; :history = "collated data file originally produced by Ifremer/Cersat with Odyssea processor 2.0" ; :platform = "METOP-A;NOAA18;NOAA19;AQUA;ENVISAT;NOAA19;TRMM;AQUA;GOES11;GOES12;NOAA18;NOAA19;NOAA17;MSG-5;NOAA18;NOAA19" ;

:sensor = "AVHRR;AVHRR;AVHRR;MODIS_A;AATSR;AVHRR;TMI;AMSRE;Imager;Imager;AVHRR;AVHRR;AVHRR;SEVIRI;AVHRR;AVHRR" ; :source_data = "EUR_L2P_AVHRR_METOP_A;NAVO-L2P-AVHRR18_L;NAVO-L2P-AVHRR19_L;JPL-L2P-MODIS_A;UPA-L2P-ATS_NR_2P;AVHRR19_D-ABOM-L2P;REMSS-L2P-TMI;USA-RSS-AMSRE-MW-L2-SST;OSDPD-L2P-GOES11;OSDPD-L2P-GOES12;NAVO-L2P-AVHRR18_G;NAVO-L2P-AVHRR19_G;EUR-L2P-NAR17_SST;EUR-L2P-SEVIRI_SST;EUR-L3P-NAR_AVHRR_NOAA_18;EUR-L3P-NAR_AVHRR_NOAA_19" ; :processing_level = "L3S" ; :cdm_data_type = "grid" ; :spatial_resolution = "0.1 degree" ; :temporal_resolution = "daily" ; :start_time = "20110718T120000Z" ; :stop_time = "20110719T120000Z" ; :southernmost_latitude = -80. ;
:northernmost_latitude = 80. ; :westernmost_longitude = -180. ;
:easternmost_longitude = 180. ; :geospatial_lat_units = "degrees_north" ; :geospatial_lat_resolution = "0.1" ; :geospatial_lon_units = "degrees_east" ; :geospatial_lon_resolution = "0.1" ;
:file_quality_level = "3" ; :metadata_conventions = "Unidata Observation Dataset v1.0" ; :metadata_link = ; :keywords = "Oceans > Ocean

Temperature > Sea Surface temperature" ; :keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Science Keywords" ; :standard_name_vocabulary = "NetCDF Climate and Forecast (CF) Metadata Convention" ; :acknowledgment = "Please acknowledge the use of these data with the following statement: these data were obtained from the Centre de Recherche et d¥'Exploitation Satellitaire (CERSAT), at IFREMER, Plouzane (France)" ; :creator_name = "Jean-Francois Piolle" ; :creator_email = "jfpiolle@ifremer.fr" ; :creator_url = "http://cersat.ifremer.fr" ; :project = "Cersat" ; :publisher_name = "Ifremer/Cersat" ; :publisher_url = "http://cersat.ifremer.fr" ; :publisher_email = "fpaf@ifremer.fr" ; :comment = "WARNING:Some applications are unable to properly handle signed byte values. If values are encountered > 127, please substract 256 from this reported value." ;}

VII.2 Example header of a high resolution L4 file

An example header of a high resolution L4 netCDF file (generated using ncdump) is given below.

netcdf ¥20110708-IFR-L4_GHRSST-SSTfnd-ODYSSEA-NWE_002-v2.0-fv1.0 {

dimensions:

time = 1 ; lat = 1350 ; lon = 1600 ;

variables: double time(time) ; time:long_name = "reference time of field" ; time:standard_name = "time" ; time:axis = "T" ; time:units = "seconds since 1981-01-01 00:00:00" ; float lat(lat) ; lat:long_name = "latitude" ; lat:standard_name = "latitude" ; lat:axis = "Y" ; lat:units = "degrees_north" ; float lon(lon) ; lon:long_name = "longitude" ; lon:standard_name = "longitude" ; lon:axis = "X" ; lon:units = "degrees_east" ; short analysed_sst(time, lat, lon) ; analysed_sst:long_name = "analysed sea surface temperature" ; analysed_sst:standard_name = "sea_surface_temperature foundation" ; analysed_sst:units = "kelvin" ; analysed_sst:_FillValue = -32768s ; analysed_sst:add_offset = 273.15 ; analysed_sst:scale_factor = 0.01 ; analysed_sst:valid_min = -300s ; analysed_sst:valid_max = 4500s ; short analysis_error(time, lat, lon) ; analysis_error:long_name = "estimated error standard deviation of analysed_sst" ; analysis_error:standard_name = "sea_surface_temperature_error" ; analysis_error:units = "kelvin" ; analysis_error:_FillValue = -32768s ; analysis_error:add_offset = 0. ; analysis_error:scale_factor = 0.01 ; analysis_error:valid_min = 0s ; analysis_error:valid_max = 32767s ; byte mask(time, lat, lon) ; mask:long_name = "land sea ice lake bit mask" ; mask:_FillValue = 0b ; mask:valid_min = 0b ; mask:valid_max = 12b ; mask:flag_masks = "0b, 1b, 2b, 3b" ;

mask:flag_meanings = "sea land lake ice" ; mask:source_data = ;byte sea_ice_fraction(time, lat, lon) ; sea_ice_fraction:long_name = "sea ice area fraction" ; sea_ice_fraction:standard_name = "sea_ice_area_fraction" ; sea_ice_fraction:units = "1" ; sea_ice_fraction:_FillValue = -128b ; sea_ice_fraction:add_offset = 0. ; sea_ice_fraction:scale_factor = 0.01 ; sea_ice_fraction:valid_min = 0b ; sea_ice_fraction:valid_max = 100b ; sea_ice_fraction:source_data = ;

// global attributes: :CONVENTIONS = "CF-1.4" ; :title = "Odyssea Sea Surface Temperature Analysis" ; :summary = "Multisensor optimal interpolation of sea surface temperature foundation over a 0.02 degree resolution grid , daily" ; :id = "IFR-L4-SSTfnd-ODYSSEA-NWE_002" ; :references = "Piolle J. F., Autret E., Arino O., Robinson I.S, Le Borgne P., (2010), Medspiration, toward the sustained delivery of satellite SST products and services over regional seas, Proceedings of the 2010 ESA Living Planet Symposium Bergen." ; :institution = "Ifremer" ; :license = "Medspiration data use is free and open. Users must register at Medspiration help desk: fpaf@ifremer.fr" ; :naming_authority = "org.ghrsst" ; :uuid = ; :contact = "jean.francois.piolle@ifremer.fr;emmanuelle.autret@ifremer.fr" ; :gds_version_id = "2.0" ; :product_version = " 1.0" ; :netcdf_version_id = "¥"3.6.2¥" of Apr 5 2008 23:39:54 $" ; :date_created = "20110709T034340Z" ; :history = "analysis originally produced by Ifremer/Cersat with Odyssea processor 2.0" ; :platform = "METOP-A;NOAA18;NOAA19;AQUA;ENVISAT;NOAA17;NOAA18;NOAA19" ; :sensor = "AVHRR;AVHRR;AVHRR;MODIS_A;AATSR;AVHRR;AVHRR;AVHRR" ; :source_data = "EUR_L2P_AVHRR_METOP_A;NAVO-L2P-AVHRR18_L;NAVO-L2P-AVHRR19_L;JPL-L2P-MODIS_A;UPA-L2P-ATS_NR_2P;EUR-L2P-NAR17_SST;EUR-L3P-NAR_AVHRR_NOAA_18;EUR-L3P-NAR_AVHRR_NOAA_19" ; :processing_level = "L4" ; :cdm_data_type = "grid" ; :spatial_resolution = " 0.02 degree" ; :temporal_resolution = "daily" ; :start_time = "20110707T120000Z" ; :stop_time = "20110708T120000Z" ; :southernmost_latitude = 38. ; :northernmost_latitude = 65. ; :westernmost_longitude = -18. ; :easternmost_longitude = 14. ; :geospatial_lat_units = "degrees_north" ; :geospatial_lat_resolution = "0.02" ; :geospatial_lon_units = "degrees_east" ; :geospatial_lon_resolution = "0.02" ; :file_quality_level = "3" ; :metadata_conventions = "Unidata Observation Dataset v1.0" ; :metadata_link = ; :keywords = "Oceans > Ocean Temperature > Sea Surface Temperature" ; :keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Science Keywords" ; :standard_name_vocabulary = "NetCDF Climate and Forecast (CF) Metadata Convention" ; :acknowledgment = "Please aknowledge the use of these data with the following statement: the data were obtained from the Centre de Recherche et d Exploitation Satellitaire (CERSAT), at IFREMER, Plouzane (France) on behalf of ESA/Medspiration project" ; :creator_name = "Jean-Francois Piolle" ; :creator_email = "jfpiolle@ifremer.fr" ; :creator_url = "http://cersat.ifremer.fr" ; :project = "Cersat" ; :publisher_name = "Ifremer/Cersat" ; :publisher_url = "http://cersat.ifremer.fr" ; :publisher_email = "fpaf@ifremer.fr" ; :comment = "WARNING:Some applications are unable to properly handle signed byte values. If values are encountered > 127, please substract 256 from this reported value." ;