PRODUCT USER MANUAL

For OSTIA Near Real Time Level 4 SST products over the global ocean

SST-GLO-SST-L4-NRT-OBSERVATIONS-010-001

Document version: 4.0

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
DRAFT	31 May 2011	All	First draft version, based on L3EUR PUM draft by Francoise Orain. Provided for the preparation of the POR for MyOcean V1	Matthew Martin	
1.0	25 October 2011	All	New version for V2 updates	Matthew Martin	
2.0	9 November 2011		Use of latest template	L. Crosnier	
3.0	13 February 2013	All	Dissemination changes for MyOcean V3, and update to latest template	A Sellar, N McConnell	
3.1	12 March 2013		Updating to include the addition of lake ice into OSTIA NRT products	E. Blockley	
3.2	14 November 2013		Updating to include the addition of monthly and seasonal means of the OSTIA NRT products. Update	A. McLaren	L. Crosnier
3.3	10 February 2014	I.4 III.2.3	Added information on correction made to analysis error computation on 5 Feb 2014. Also corrected relaxation timescale information in III.2.3.	A. McLaren	L. Crosnier
3.4	1 May 2015	all	Change format to fit CMEMS graphical rules		L. Crosnier
3.5	22 October 2015	All	Changed MyOcean references to CMEMS.	S. Good	
3.6	23 February 2016		Update for new data sources	E. Fiedler	B. Hackett
3.7	15 August 2016	I.3, I.4, III.1, III.2.2	Reprocessing of period in early 2016 (revert to MetOp-A data)	E. Fieldler, B. Hackett	B. Hackett
3.8	24 October	I.4	Change to reference data used for bias	S. Good	B. Hackett

	2016		correction (VIIRS)		
3.9	18 September 2017		Change data assimilation scheme used to make the product to NEMOVAR	S. Good	
4.0	25 May 2018	I.3. I.4, III.1	Remove old information about TAC structure, record change to Baltic and lake ice and update satellite data usage information.	S. Good	C. Derval

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GLOSSARY AND ABBREVIATIONS

CMEMS	Copernicus Marine Environment Monitoring Service
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

I INTRODUCTION

I.1 Scope of this document

This is the Product User Manual describing the SST-GLO-SST-L4-NRT-OBSERVATIONS-010-001 CMEMS product: how it is built, which content, which data services are available to access it.

I.2 The CMEMS project

The main objective of the CMEMS project is to deliver and operate a rigorous, robust and sustainable Ocean Monitoring and Forecasting system to users for all marine applications: maritime safety, marine resources, marine and coastal environment and climate, seasonal and weather forecasting.

I.3 Short introduction to the product

The CMEMS system is composed of various sub-systems, among which the Monitoring and Forecast Centers (MFCs), in charge of producing analyses and forecasts of the ocean state, and the Thematic Assembly Centers (TACs), in charge of producing satellite and in-situ observations-based products.

CMEMS SST satellite observations are managed by the Sea Surface Temperate (SST) TAC. Some quality monitoring and validation statistics of the SST TAC near real-time products are displayed at http://marine.copernicus.eu/services-portfolio/scientific-quality/.

I.4 History of the latest updates of the product

January 2012:

Changed NetCDF format to the latest GHRSST standard (described in section III).

17th January 2013:

A number of improvements were made, aimed at improving the quality of the product. The main impact was that OSTIA is now able to resolve finer scales. The changes were:

- Update of the background error covariances in the OSTIA system:
    - New updated seasonal background error variances are used for both the mesoscale and synoptic scale components of the background errors.
    - Latitudinally varying anisotropic correlation length scales are used.
    - For in situ observations, type dependant measurement errors have been implemented which are added to spatially varying representivity errors.

- The number of iterations of the assimilation has been increased from 10 to 100 iterations to ensure convergence.

- Change in the minimum quality flag of the geostationary satellite SST data used in the OSTIA analysis (SEVIRI/MSG data; GOES-E data).
- Set a minimum SST on the OSTIA SST analysis.
- The reference data set used for the bias correction of the satellite data was expanded to include a subset of the most accurate MetOp AVHRR SST data (based on low satellite zenith angle). This replaces AATSR data which was included in the reference data set prior to its loss on 8th April 2012.

17th April 2013:

Lake ice was added to OSTIA ice field using 2013 NCEP data for ice in inland waters. This change includes a slight relaxation to 0ºC under lake ice but otherwise there is no effect on global ocean SST.

11th November 2013:

A change was made to the OSTIA system to routinely produce monthly and seasonal mean files of the L4 product. In addition, the archive of NRT OSTIA data from 1st January 2007 to 15th February 2012 was changed to the current GDS2.0 file format, so that the data archive from 1st January 2007 onwards became directly available to users from the MyOcean SubSetter or FTP service.

5th February 2014:

A change was made to OSTIA to correct the computation of the analysis error estimates in the system. This fixes a problem in the system that was present during the period 17 Jan 2013 to 4 Feb 2014 and will have caused the analysis error to be overestimated during this time. The SST analysis and sea ice fields were unaffected by this correction.

23rd February 2016:

The high quality subset of MetOp-A AVHRR observations used in the bias correction reference dataset was updated to MetOp-B AVHRR due to an upstream change in data availability.

23rd March 2016:

Problems with the quality of MetOp-B AVHRR data necessitated a reversion to MetOp-A AVHRR in the bias correction reference dataset.

15th March 2016:

Two new global SST datasets were included in the OSTIA analysis: an infra-red dataset from the VIIRS instrument and a microwave dataset from the AMSR2 instrument, leading to an improvement in the OSTIA analysis accuracy.

5th September 2016:

Reprocessing of analyses for the period 23 February to 7 April 2016 using MetOp-A AVHRR data - instead of MetOp-B AVHRR data - in the bias correction reference dataset. The bias correction reference data are now consistent for the whole period. No MetOp-B AVHRR data are used.

8th November 2016:

The satellite reference data used for bias correcting other satellite data was changed to nighttime VIIRS SSTs. This improves the accuracy of the OSTIA analyses.

28th November 2017:

The data assimilation scheme used to generate the product was changed to the NEMOVAR variational scheme. The sea ice field included in the files began to be generated using NEMOVAR rather than a regridding of the input observations.

18th September 2018

Water temperature in the Baltic Sea used to infer when ice is present, in order to overcome issues due to sparse ice concentration observations in the region. The method was already being used to infer when there is ice in lakes. It was, however, refined to reduce artefacts that can occur due to interactions between the ice concentration observations and the ice inferred from the water temperature, so both the Baltic ice and lake ice were improved by this change.

II REFERENCE DOCUMENTS

Ref.	Document Name	Document Reference	Issue	Date
[RD.4]	The Recommended GHRSST Specification (GDS) Revision 2.0 Data 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	Oct 2010

III SST LEVEL 4 PROCESSING CHAIN AND ALGORITHMS

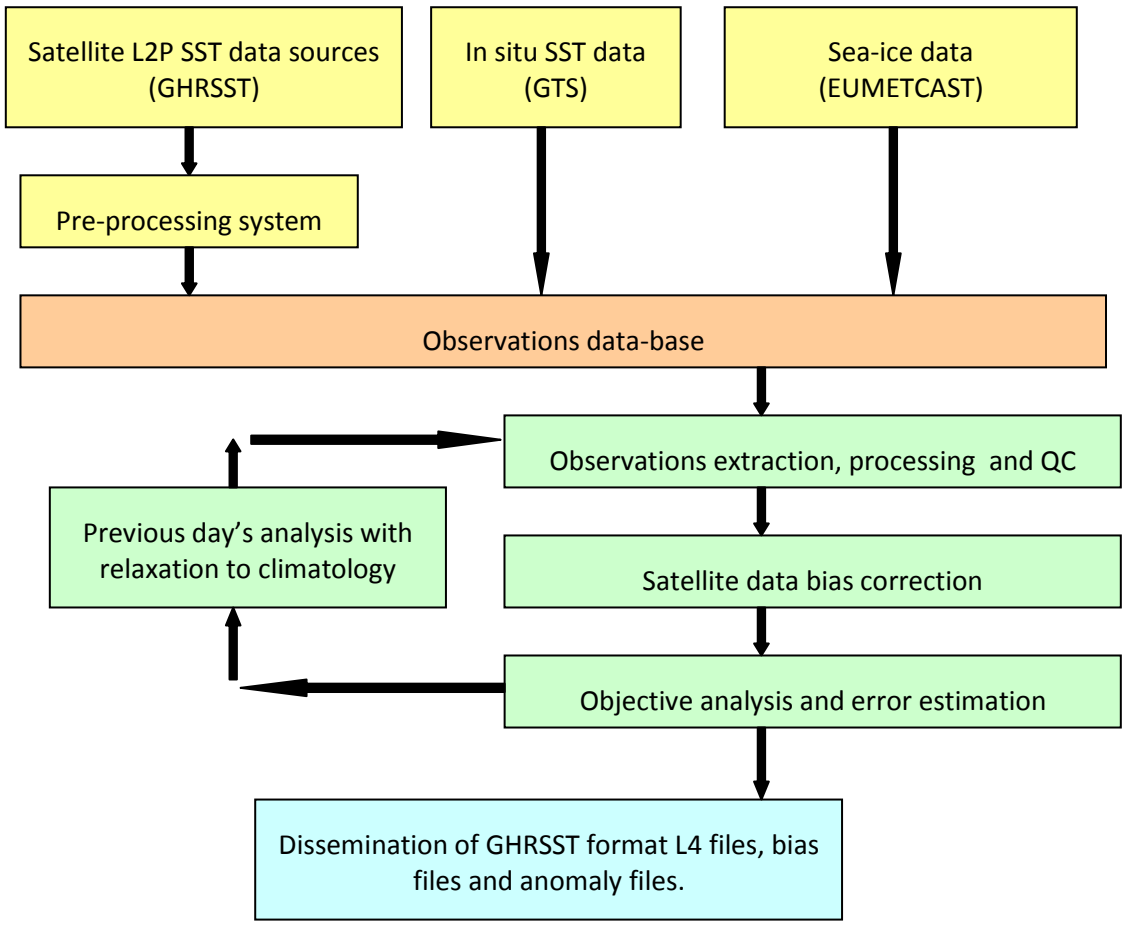


Figure III.1 Schematic diagram of the operational OSTIA processing chain at the UK Met Office.

The Operational Sea surface Temperature and Ice Analysis (OSTIA) system is run daily in the operational suite at the UK Met Office. It is run at 05:50 UTC and is completed before 06:45 UTC. Products are available to users by 08:00 UTC.

Figure III.1 shows the different steps for the creation of the OSTIA products at the UK Met Office. Each step of this processing is described below.

III.1 Collection of inputs

The following inputs are collected for input to OSTIA:

SST satellite data: The original L2P data from different producers (including NASA, NOAA, IFREMER, EUMETSAT OSI-SAF, ESA) in GHRSST compliant format are collected. Currently the format of the collected data is a combination of GHRSST GDS V1.6 **[RD-3]** and the new GHRSST GDS V2.0 **[RD-4]** formats.

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 used in OSTIA include: infra-red data from the AVHRR instruments on board NOAA and MetOp-A satellites, IASI data on MetOp-A (prior to 29th September 2014), SEVIRI on board the MSG-3 satellite, GOES Imager data on board the GOES-13 satellite (until 12th December 2017), AATSR on board ENVISAT (prior to 8th April 2012) and VIIRS data on board Suomi NPP (after 15th March 2016). Microwave data from the TMI instrument on board TRMM (prior to 14th February 2015), the AMSR-E instrument on board Aqua (prior to 4th October 2011) and the AMSR2 instrument on board GCOM-W1 (after 15th March 2016) are also used.

In situ SST data from ships, drifting and moored buoys are used in OSTIA.

Ice concentration data from the EUMETSAT OSI-SAF are used in OSTIA for the ocean. Since mid-April 2013 NCEP data have also been used for ice in inland waters.

Climatologies: the SST climatologies used have been derived from the OSTIA reanalysis, produced as part of MyOcean (SST_GLO_SST_L4_REP_OBSERVATIONS_010_011).

Lake Surface Water Temperature (LSWT) data is available within the GHRSST L2P files from NOAA and MetOp-A AVHRR instruments, AATSR (prior to 8th April 2012), and MetOp-A IASI (prior to 14th February 2015). These data are processed using the SST algorithms rather than lake-specific algorithms (which take into account the emissivity and altitude of the lakes) and are therefore less accurate than the data over the open ocean. In situ data over lakes are also available over the GTS, mainly for the Great Lakes.

III.2 Algorithms for L4 production

III.2.1 Quality control and pre-processing of input data

All satellite and in situ SST data valid for a particular day, with a 6-hour overlap on the days either side, are extracted from the observations data-base. The input SST data undergo various QC and processing steps:

- only satellite data which have a quality flag of 4 and higher are accepted, except for AATSR data where only data of quality 5 are accepted.

- a Bayesian statistical check against the background field is carried out for all input data using the same error covariance information used to perform the objective analysis later in the process.
- a diurnal check is carried out whereby day-time data (determined using a solar zenith angle calculation) with a wind-speed of less than 6m/s 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 the AATSR data, a skin-to-bulk correction factor is applied.

III.2.2 Bias correction of input satellite data

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 in the analysis if they are not treated in some way. OSTIA uses a bias correction system based on match-up statistics between satellite and reference measurements (which are assumed to be unbiased). The reference data-set is currently specified to be all in situ data and a high quality satellite dataset. Prior to 8th April 2012 AATSR data was included in the reference data-set. After 17th January 2013, a high-quality subset of MetOp AVHRR data was used. From 20th September 2016 nighttime VIIRS SSTs were used for the bias correction. For each satellite observation type to be calibrated:

- match-ups are calculated between each reference data point and the satellite data-set (valid on the same day) with a spatial radius of 25km.
- A large scale objective analysis is calculated for each satellite observation type using the match-ups as pseudo-observations of the bias, and a background from the previous day's bias analysis. The horizontal correlation scales are set to be 700km for this bias analysis.
- The bias analysis 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 L2 satellite data, which have been bias-corrected.

III.2.3 Creation of the L4 analysis and error estimate

- The main SST analysis uses a persistence based approach using the previous analysis field as a **background with a relaxation to climatology**. The background field $x^b_{i,k}$ at grid point i and time k is defined as

$$x^b_{i,k} = \lambda_{i,k}(x^a_{i,k-1} - x^c_{i,k-1}) + x^c_{i,k} \qquad (1)$$

Where $\lambda_{i,k}$ is a scalar less than 1, $x^a_{i,k-1}$ is the previous analysis, and $x^c_{i,k}$ is a reference climatology valid for the same time of year as time k. For each grid point and at each analysis time, a relaxation time scale is derived in order to determine $\lambda_{i,k}$. For ice-free areas this time scale is 30 days. SSTs under ice with a concentration greater than 50% are relaxed

toward 271.35 K with a shorter time scale. The time scale varies from ~17.5 days to ~5 days linearly with ice concentration from 50% to 100%. A digital Gaussian filter with a half-width of 4.7 km is applied to the background field to remove small scale noise.

- The background field calculated using equation (1) and the bias corrected measurements (described previously) are then used to produce an analysis using a **multi-scale Optimal Interpolation** (OI) type scheme. An iterative procedure is used to calculate the OI solution that is both efficient and flexible when processing large numbers of observations. The system was upgraded to use the NEMOVAR variational data assimilation scheme on 28 November 2017.
- The **background error covariance matrix** is split into two components, one of which has spatial correlation scales specified as 10km and the other of which has spatial correlation scales of 100km. Both components of the error have spatially varying variances. On 17th January 2013 the background error covariances were improved; the background error variance fields now vary seasonally and the spatial correlations length scales are anisotropic and vary latitudinally. The shorter (mesoscale) length scales vary from 15km to 40km while the longer (synoptic) length scales vary from 200km to 450km. Following the upgrade to use the NEMOVAR scheme, the lengthscales were set to 0.36 and 2.70 degrees respectively.
- The **observation error covariance matrix** is assumed to be a diagonal matrix (observation errors are uncorrelated with each other). The diagonal elements are specified using the SSES standard deviation values supplied with the GHRSST data. Following the upgrade to use NEMVOAR, the operator for all observations is an interpolation.
- The **observation operator** is used to transform from the analysis grid to observation space. A number of different observation operators have been developed for use in OSTIA in order to represent the full range of satellite observation footprints. In the case of microwave data for instance, the observation footprint is larger than the model grid, and the background gridded values which fall within the observation footprint are used to estimate the model equivalent of the observation.
- Each SST analysis value is accompanied by an **uncertainty estimate**. Various methods of approximating analysis error exist. The OSTIA system uses an analysis quality (AQ) optimal interpolation approach to produce this estimate. In this scheme, a second optimal interpolation analysis is performed that is identical to the main SST analysis except that all observations are given a value of 1.0, the background field is set to zero, and the error estimates used in the main analysis (background & measurements) are preserved. This field is then combined with the background error variance estimates described above to produce an analysis error estimate at each grid point.

III.2.4 Creation of the anomaly field

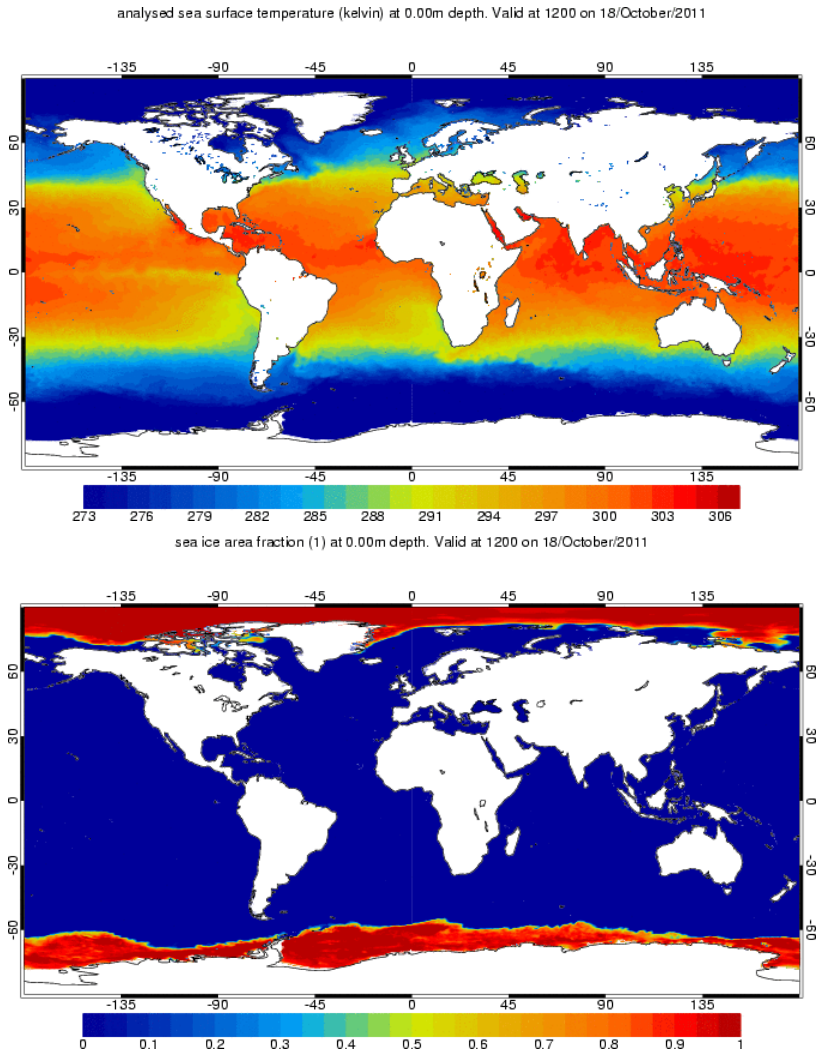
The SST analysis field described in the previous section is interpolated to a ¼ degree latitude/longitude grid. The Pathfinder climatology for the relevant date (derived from the PATHFINDER SST 5-daily climatology produced by Casey and Cornillon, 1999) is then subtracted to produce an anomaly field.

III.2.5 Creation of the monthly and seasonal mean fields

At the end of each month, a monthly mean of the daily L4 analyses is produced. Similarly, seasonal means are produced at the end of each season, with seasons defined as: December-February; March-May; June-August; September-November. The daily SST analyses are first interpolated to a ¼ degree latitude/longitude grid and then the mean values are calculated. The standard deviation of the daily SST analyses over the month or season is also calculated and provided in the mean files.

III.3 Graphical examples of the L4, anomaly and bias products

III.3.1 L4 products: SST, sea-ice concentration and error estimate



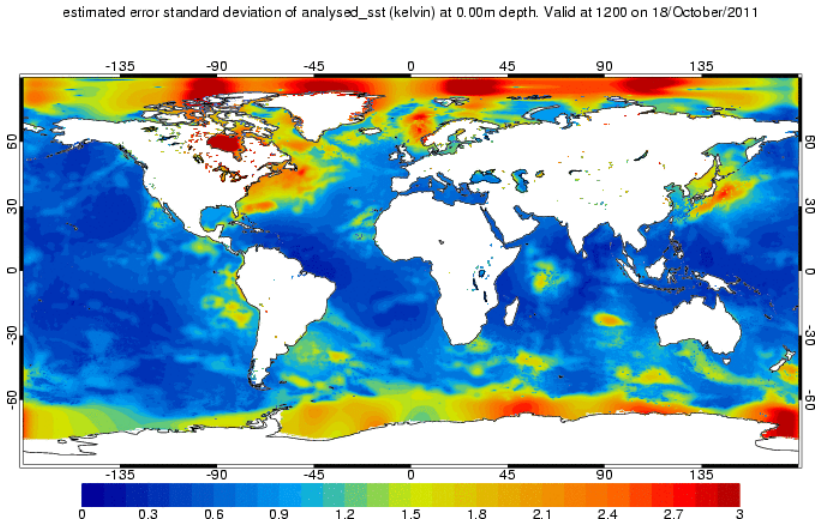


Figure III.3.1.1 Examples of outputs from the high resolution daily L4 OSTIA product on 18th November 2011 (from top to bottom: analysed SST, sea-ice concentration, analysis error.

III.3.2 Anomaly product

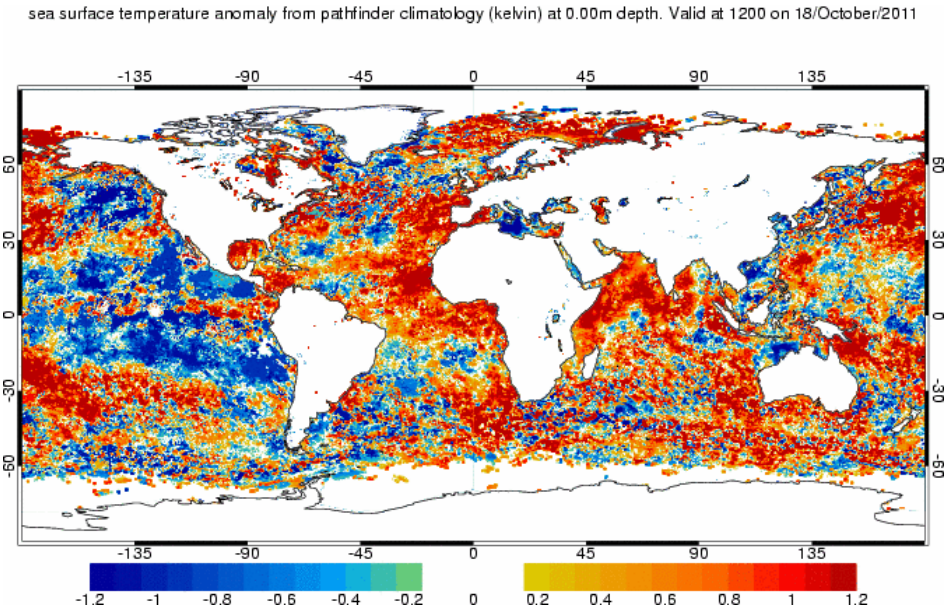


Figure III.3.2.1 Example of the ¼ degree resolution SST anomaly product on 18th October 2011.

III.3.3 Satellite bias product

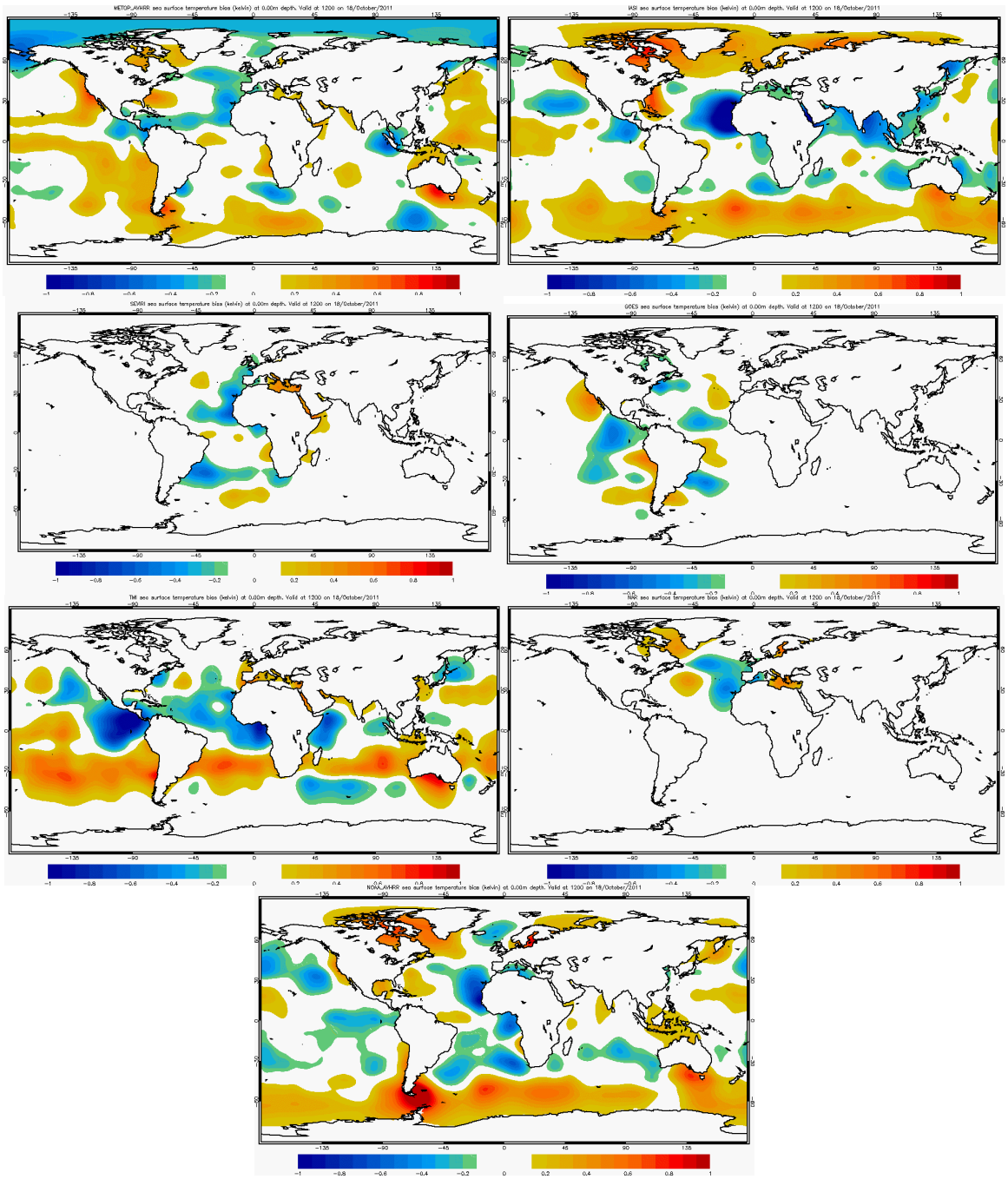


Figure III.3.3.1 Examples of the ¼ degree resolution satellite bias product on 18th October 2011 (from top to bottom, on the left: MetOp AVHRR, SEVIRI, TMI; on the right: MetOp IASI, GOES-E, NAR; at the bottom: NOAA AVHRR).

IV PRODUCTS DESCRIPTION

IV.1 Common characteristics

The format of SST files within CMEMS follows that defined by the GHRSST project: GDS 2.0. Examples are shown in Annex 1.

The daily high resolution L4, lower resolution anomaly and bias products are delivered on a regular lat/lon grid, from 180° W to 180° E and 90° S to 90° N (at a 0.05° horizontal resolution for the high resolution product, and at 0.25° horizontal resolution for the anomaly and bias products), in netCDF format. The monthly and seasonal mean products are delivered on the same lower resolution grid as the anomaly and bias products.

Product SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001 is composed of 5 datasets described below:

- METOFFICE-GLO-SST-L4-NRT-OBS-SST-V2 (daily analysis)
- METOFFICE-GLO-SST-L4-NRT-OBS-ANOM-V2 (daily anomalies)
- METOFFICE-GLO-SST-L4-NRT-OBS-BIAS-V2 (daily bias)
- METOFFICE-GLO-SST-L4-NRT-OBS-SST-MON-V2 (monthly mean analysis)
- METOFFICE-GLO-SST-L4-NRT-OBS-SST-SEAS-V2 (seasonal mean analysis)

Dataset	Name	Description	Standard name	Unit	Dimensions

METOFFICE-GLO-SST-L4-NRT-OBS-SST-V2 (High resolution, daily analysis)	**analysed_sst**	analysed sea surface temperature	sea_surface_foundation_temperature	kelvin	(time, lat, lon)
	sea_ice_fraction	sea ice area fraction	sea_ice_area_fraction	1	(time, lat, lon)
	analysis_error	estimated error standard deviation of analysed_sst	sea_surface_temperature_error	kelvin	(time, lat, lon)
	mask	land sea ice lake bit mask			(time, lat, lon)
METOFFICE-GLO-SST-L4-NRT-OBS-ANOM-V2 (Low resolution, daily anomalies)	**sst_anomaly**	sea surface temperature anomaly from pathfinder climatology	-	kelvin	(time, lat, lon)
	analysed_sst	analysed sea surface temperature	sea_surface_foundation_temperature	kelvin	(time, lat, lon)
METOFFICE-GLO-SST-L4-NRT-OBS-BIAS-V2 (Low resolution, daily biases)	**sst_bias_SEVIRI**	SEVIRI sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_METOP_AVHRR	METOP_AVHRR sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_GOES	GOES sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_NOAA_AVHRR	NOAA_AVHRR sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_IASI	IASI sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_TMI	TMI sea surface temperature bias	-	kelvin	(time, lat, lon)
	sst_bias_NAR	NAR sea surface temperature bias	-	kelvin	(time, lat, lon)
METOFFICE-GLO-SST-L4-NRT-OBS-SST-MON-V2 (Low resolution, monthly mean analysis)	**analysed_sst**	analysed sea surface temperature	sea_surface_foundation_temperature	kelvin	(time, lat, lon)
	standard_deviation_sst	standard deviation of analysed sea surface temperature	standard_deviation_sea_surface_temperature	kelvin	(time, lat, lon)
METOFFICE-GLO-SST-L4-NRT-OBS-SST-SEAS-V2 (Low resolution, seasonal mean analysis)	**analysed_sst**	analysed sea surface temperature	sea_surface_foundation_temperature	kelvin	(time, lat, lon)
	standard_deviation_sst	standard deviation of analysed sea surface temperature	standard_deviation_sea_surface_temperature	kelvin	(time, lat, lon)

Table1: description of each dataset in product SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001.

IV.2 L4 products

The L4 product format specification is described in detail in the GHRSST format specification **[RD.4].** Annex 1 provides an example of the netCDF file header.

IV.3 Anomaly products

The format for the anomaly product follows as much as possible the specification of the L4 products in **[RD.4].** The attributes are the same as those for the L4 product. The changes are that an SST

anomaly field is provided, and no error or sea-ice information is provided. Annex 1 provides an example of the netCDF file header.

IV.4 Bias products

The format for the bias product follows as much as possible the specification of the L4 products in **[RD.4].** The attributes are the same as those for the L4 product. The differences are that no SST, error or sea-ice fields are provided. Instead a number of bias fields are provided, with variable names specified as "`sst_bias_SENSOR`", where `SENSOR` can be one of `AMSRE`, `NOAA_AVHRR`, `METOP_AVHRR`, `NAR`, `SEVIRI`, `TMI`, `IASI`, `GOES`.

IV.5 Monthly and seasonal products

The format for the monthly and seasonal products follows as much as possible the specification of the L4 products in **[RD.4]**. The attributes are the same as those for the L4 product. The changes are that a SST standard deviation is additionally provided, and no error, sea ice or mask information is provided. Annex 1 provides an example of the netCDF file header.

V PRODUCT DISTRIBUTION

V.1 Which Download mechanism is available for this product?

The download mechanisms available for this product are:

- Subsetter
- Authenticated FTP

V.2 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.

V.3 Download a product through the CMEMS 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

The ftp site is accessed using your CMEMS user name and password and the files are located in the directory called SST-GLO-SST-L4-NRT-OBSERVATIONS-010-001.

VI NOMENCLATURE OF FILES

The nomenclature of the downloaded files differs on the basis of the chosen download mechanism **Subsetter** or **FTP** service.

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:

METOFFICE-GLO-SST-L4-NRT-OBS-SST-V2

METOFFICE-GLO-SST-L4-NRT-OBS-ANOM-V2

METOFFICE-GLO-SST-L4-NRT-OBS-BIAS-V2

METOFFICE-GLO-SST-L4-NRT-OBS-SST-MON-V2

METOFFICE-GLO-SST-L4-NRT-OBS-SEAS-V2

. 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:

METOFFICE-GLO-SST-L4-NRT-OBS-BIAS-V2_1303461772348.nc

VI.2 Nomenclature of files when downloaded through the CMEMS FTP Service

Files nomenclature when downloaded through the CMEMS FTP is based as follows:

You will download, for example, the following file:

20130131120000-UKMO-L4_GHRSST-SSTfnd-OSTIAbias-GLOB-v02.0-fv02.0.nc.bz2

VII ANNEX 1 : DESCRIPTION OF FILE FORMATS

VII.1 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 \20111018120000-UKMO-L4_GHRSST-SSTfnd-OSTIA-GLOB-v02.0-fv02.0 {
dimensions:
      time = 1 ;
      lat = 3600 ;
      lon = 7200 ;
variables:
      int time(time) ;
            time:long_name = "reference time of sst field" ;
            time:standard_name = "time" ;
            time:axis = "T" ;
            time:calendar = "Gregorian" ;
            time:units = "seconds since 1981-01-01 00:00:00" ;
      float lat(lat) ;
            lat:standard_name = "latitude" ;
            lat:units = "degrees_north" ;
            lat:valid_min = -90.f ;
            lat:valid_max = 90.f ;
            lat:axis = "Y" ;
            lat:reference_datum    =    "geographical    coordinates,    WGS84
projection" ;
      float lon(lon) ;
            lon:standard_name = "longitude" ;
            lon:units = "degrees_east" ;
            lon:valid_min = -180.f ;
            lon:valid_max = 180.f ;
            lon:axis = "X" ;
            lon:reference_datum    =    "geographical    coordinates,    WGS84
projection" ;
      short analysed_sst(time, lat, lon) ;
            analysed_sst:long_name = "analysed sea surface temperature" ;
            analysed_sst:standard_name                                          =
"sea_surface_foundation_temperature" ;
            analysed_sst:units = "kelvin" ;
            analysed_sst:_FillValue = -32768s ;
            analysed_sst:add_offset = 273.15f ;
            analysed_sst:scale_factor = 0.01f ;
            analysed_sst:valid_min = -300s ;
            analysed_sst:valid_max = 4500s ;
            analysed_sst:source    =    "REMSS-L2P-AMSRE,    UPA-L2P-ATS_NR_2P,
NAVO-L2P-AVHRR18_G, NAVO-L2P-AVHRR19_G, EUR-L2P-AVHRR_METOP_A, SEVIRI_SST-
OSISAF-L3C-v1.0, REMSS_L2P-TMI, GOES13-OSISAF-L3C-v1.0" ;
```

```
            analysed_sst:comment = "" ;
      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.f ;
            analysis_error:scale_factor = 0.01f ;
            analysis_error:valid_min = 0s ;
            analysis_error:valid_max = 32767s ;
            analysis_error:comment = "" ;
      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.f ;
            sea_ice_fraction:scale_factor = 0.01f ;
            sea_ice_fraction:valid_min = 0b ;
            sea_ice_fraction:valid_max = 100b ;
            sea_ice_fraction:source = "EUMETSAT OSI-SAF" ;
            sea_ice_fraction:comment = "" ;
      byte mask(time, lat, lon) ;
            mask:long_name = "land sea ice lake bit mask" ;
            mask:_FillValue = -128b ;
            mask:valid_min = 0b ;
            mask:valid_max = 8b ;
            mask:flag_masks = 1b, 2b, 4b, 8b ;
            mask:flag_values = 0, 1, 2, 4, 8 ;
            mask:flag_meanings = "water land optional_lake_surface sea_ice
optional_river_surface" ;
            mask:source = "NAVOCEANO_landmask_v1.0 EUMETSAT_OSI-SAF_icemask
ARCLake_lakemask" ;

// global attributes:
            :Conventions = "CF-1.4" ;
            :title = "Analysed foundation sea surface temperature over the
global ocean" ;
            :summary = "A merged, multi-sensor L4 Foundation SST product" ;
            :references = "Donlon, C.J., Martin, M., Stark, J.D., Roberts-
Jones, J., Fiedler, E., Wimmer, W., 2011. The Operational Sea Surface
Temperature and Sea Ice Analysis (OSTIA). Remote Sensing of the
Environment" ;
            :institution = "UKMO" ;
            :history     =     "Created     from     sst:temperature     from
/critical/para/op/daily/datawg6/sst.nc;
error:/critical/para/op/daily/datawg6/20111018-UKMO-L4HRfnd-GLOB-v01-fv02-
OSTIA_err.nc; sea ice:/critical/para/op/daily/datawg6/seaice.nc" ;
```

```
            :comment = "WARNING Some applications are unable to properly
handle signed byte values. If values are encountered > 127, please subtract
256 from this reported value" ;
            :license = "These data are available free of charge under the
GMES data policy" ;
            :id = "UKMO-L4HRfnd_GLOB-OSTIA" ;
            :naming_authority = "org.ghrsst" ;
            :product_version = "2.0" ;
            :uuid = "536d4865-f5a8-45b2-806f-1f1db491069a" ;
            :gds_version_id = "2.0" ;
            :netcdf_version_id = "3.6" ;
            :date_created = "20111019T062259Z" ;
            :start_time = "20111018T000000Z" ;
            :time_coverage_start = "20111018T000000Z" ;
            :stop_time = "20111019T000000Z" ;
            :time_coverage_end = "20111019T000000Z" ;
            :file_quality_level = 3 ;
            :source = "REMSS-L2P-AMSRE, UPA-L2P-ATS_NR_2P, NAVO-L2P-
AVHRR18_G, NAVO-L2P-AVHRR19_G, EUR-L2P-AVHRR_METOP_A, SEVIRI_SST-OSISAF-
L3C-v1.0, REMSS_L2P-TMI, GOES13-OSISAF-L3C-v1.0, OSISAF_ICE" ;
            :platform = "Aqua, Envisat, NOAA-18, NOAA-19, MetOpA, MSG1,
SSMI, TRMM" ;
            :sensor = "AATSR, AMSR, AVHRR, AVHRR_GAC, SEVIRI, TMI" ;
            :metadata_conventions = "Unidata Observation Dataset v1.0" ;
            :metadata_link                                          =
"http://data.nodc.noaa.gov/NESDIS_DataCenters/metadata/NODC/FGDC-
GHRSST_all-UKMO-L4HRfnd-GLOB-v01-OSTIA.xml" ;
            :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" ;
            :westernmost_longitude = -180.f ;
            :easternmost_longitude = 180.f ;
            :southernmost_latitude = -90.f ;
            :northernmost_latitude = 90.f ;
            :spatial_resolution = "0.05 degree" ;
            :geospatial_lat_units = "degrees_north" ;
            :geospatial_lat_resolution = "0.05 degree" ;
            :geospatial_lon_units = "degrees_east" ;
            :geospatial_lon_resolution = "0.05 degree" ;
            :acknowledgment = "Please acknowledge the use of these data
with the following statement: These data were provided by GHRSST, UKMO and
MyOcean" ;
            :creator_name = "UKMO as part of MyOcean" ;
            :creator_email = "servicedesk@myocean.eu.org" ;
            :creator_url = "http://www.myocean.eu.org" ;
            :project = "Group for High Resolution Sea Surface Temperature"
;
            :publisher_name = "GHRSST Project Office" ;
```

```
            :publisher_url = "http://www.ghrsst.org" ;
            :publisher_email = "ghrsst-po@nceo.ac.uk" ;
            :processing_level = "L4" ;
            :cdm_data_type = "grid" ;
}
```

VII.2 Example header of an anomaly file

An example header of an anomaly netCDF file (generated using ncdump) is given below.

```
netcdf \20111018120000-UKMO-L4_GHRSST-SSTfnd-OSTIAanom-GLOB-v02.0-fv02.0 {
dimensions:
      time = UNLIMITED ; // (1 currently)
      lat = 720 ;
      lon = 1440 ;
variables:
      short sst_anomaly(time, lat, lon) ;
            sst_anomaly:_FillValue = -32768s ;
            sst_anomaly:long_name = "sea surface temperature anomaly from
pathfinder climatology" ;
            sst_anomaly:type = "foundation" ;
            sst_anomaly:units = "kelvin" ;
            sst_anomaly:scale_factor = 0.01f ;
            sst_anomaly:add_offset = 0.f ;
            sst_anomaly:valid_min = -5000s ;
            sst_anomaly:valid_max = 5000s ;
            sst_anomaly:source = "UKMO-L4HRfnd-GLOB-OSTIA" ;
            sst_anomaly:comment = "" ;
      short analysed_sst(time, lat, lon) ;
            analysed_sst:_FillValue = -32768s ;
            analysed_sst:long_name = "analysed sea surface temperature" ;
            analysed_sst:standard_name                                    =
"sea_surface_foundation_temperature" ;
            analysed_sst:type = "foundation" ;
            analysed_sst:units = "kelvin" ;
            analysed_sst:scale_factor = 0.01f ;
            analysed_sst:add_offset = 273.15f ;
            analysed_sst:valid_min = -300s ;
            analysed_sst:valid_max = 4500s ;
            analysed_sst:source = "UKMO-L4HRfnd-GLOB-OSTIA" ;
            analysed_sst:comment = "" ;
      int time(time) ;
            time:long_name = "reference time of sst field" ;
            time:units = "seconds since 1981-01-01 00:00:00" ;
            time:standard_name = "time" ;
            time:axis = "T" ;
            time:calendar = "Gregorian" ;
      float lat(lat) ;
```

```
            lat:units = "degrees_north" ;
            lat:standard_name = "latitude" ;
            lat:axis = "Y" ;
            lat:valid_min = -90.f ;
            lat:valid_max = 90.f ;
            lat:reference_datum = "geographical coordinates, WGS84
projection" ;
      float lon(lon) ;
            lon:units = "degrees_east" ;
            lon:standard_name = "longitude" ;
            lon:axis = "X" ;
            lon:valid_min = -180.f ;
            lon:valid_max = 180.f ;
            lon:reference_datum = "geographical coordinates, WGS84
projection" ;

// global attributes:
            :Conventions = "CF-1.4" ;
            :title = "Foundation sea surface temperature anomaly over the
global ocean" ;
            :summary = "A merged, multi-sensor L4 Foundation SST anomaly
product" ;
            :references = "Donlon, C.J., Martin, M., Stark, J.D., Roberts-
Jones, J., Fiedler, E., Wimmer, W., 2011. The Operational Sea Surface
Temperature and Sea Ice Analysis (OSTIA). Remote Sensing of the
Environment" ;
            :institution = "UKMO" ;
            :history = "Created from sst:temperature regridded with area
avg. to grid of temperature on new grid. sst_anomaly from NODC/RSMAS AVHRR
Pathfinder Verison 5.0 Climatology regridded with area avg." ;
            :comment = "WARNING Some applications are unable to properly
handle signed byte values. If values are encountered > 127, please subtract
256 from this reported value" ;
            :license = "These data are available free of charge under the
GMES data policy" ;
            :id = "UKMO-L4LRfnd_GLOB-OSTIAanom" ;
            :naming_authority = "org.ghrsst" ;
            :product_version = "2.0" ;
            :uuid = "5c1665b7-06e8-499d-a281-857dcbfd07e2" ;
            :gds_version_id = "2.0" ;
            :netcdf_version_id = "3.6" ;
            :date_created = "20111019T062416Z" ;
            :start_time = "20111018T000000Z" ;
            :time_coverage_start = "20111018T000000Z" ;
            :stop_time = "20111019T000000Z" ;
            :time_coverage_end = "20111019T000000Z" ;
            :file_quality_level = 3 ;
            :source = "UKMO-L4HRfnd-GLOB-OSTIA" ;
            :platform = "Aqua, Envisat, NOAA-18, NOAA-19, MetOpA, MSG1,
SSMI, TRMM" ;
            :sensor = "AATSR, AMSR, AVHRR, AVHRR_GAC, SEVIRI, TMI" ;
```

```
            :metadata_conventions = "Unidata Observation Dataset v1.0" ;
            :metadata_link                                          =
"http://data.nodc.noaa.gov/NESDIS_DataCenters/metadata/NODC/FGDC-
GHRSST_all-UKMO-L4LRfnd-GLOB-v01-OSTIAanom.xml" ;
            :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" ;
            :westernmost_longitude = -180.f ;
            :easternmost_longitude = 180.f ;
            :southernmost_latitude = -90.f ;
            :northernmost_latitude = 90.f ;
            :spatial_resolution = "0.25 degree" ;
            :geospatial_lat_units = "degrees_north" ;
            :geospatial_lat_resolution = "0.25 degree" ;
            :geospatial_lon_units = "degrees_east" ;
            :geospatial_lon_resolution = "0.25 degree" ;
            :acknowledgment = "Please acknowledge the use of these data
with the following statement: These data were provided by GHRSST, UKMO and
MyOcean" ;
            :creator_name = "UKMO as part of MyOcean" ;
            :creator_email = "servicedesk@myocean.eu.org" ;
            :creator_url = "http://www.myocean.eu.org" ;
            :project = "Group for High Resolution Sea Surface Temperature"
;
            :publisher_name = "GHRSST Project Office" ;
            :publisher_url = "http://www.ghrsst.org" ;
            :publisher_email = "ghrsst-po@nceo.ac.uk" ;
            :processing_level = "L4" ;
            :cdm_data_type = "grid" ;
}
```

VII.3 Example header of a bias file

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

```
netcdf \20111018120000-UKMO-L4_GHRSST-SSTfnd-OSTIAbias-GLOB-v02.0-fv02.0 {
dimensions:
      time = UNLIMITED ; // (1 currently)
      lat = 720 ;
      lon = 1440 ;
variables:
      int time(time) ;
            time:long_name = "reference time of sst field" ;
            time:units = "seconds since 1981-01-01 00:00:00" ;
      float lat(lat) ;
            lat:units = "degrees_north" ;
```

```
            lat:valid_min = -90.f ;
            lat:valid_max = 90.f ;
            lat:reference_datum = "geographical coordinates, WGS84
projection" ;
      float lon(lon) ;
            lon:units = "degrees_east" ;
            lon:valid_min = -180.f ;
            lon:valid_max = 180.f ;
            lon:reference_datum = "geographical coordinates, WGS84
projection" ;
      short sst_bias_AMSRE(time, lat, lon) ;
            sst_bias_AMSRE:long_name = "AMSRE sea surface temperature bias"
;
            sst_bias_AMSRE:units = "kelvin" ;
            sst_bias_AMSRE:_FillValue = -32768s ;
            sst_bias_AMSRE:add_offset = 0.f ;
            sst_bias_AMSRE:scale_factor = 0.01 ;
            sst_bias_AMSRE:valid_min = -32767s ;
            sst_bias_AMSRE:valid_max = 32767s ;
      short sst_bias_NOAA_AVHRR(time, lat, lon) ;
            sst_bias_NOAA_AVHRR:long_name = "NOAA_AVHRR sea surface
temperature bias" ;
            sst_bias_NOAA_AVHRR:units = "kelvin" ;
            sst_bias_NOAA_AVHRR:_FillValue = -32768s ;
            sst_bias_NOAA_AVHRR:add_offset = 0.f ;
            sst_bias_NOAA_AVHRR:scale_factor = 0.01 ;
            sst_bias_NOAA_AVHRR:valid_min = -32767s ;
            sst_bias_NOAA_AVHRR:valid_max = 32767s ;
      short sst_bias_NAR(time, lat, lon) ;
            sst_bias_NAR:long_name = "NAR sea surface temperature bias" ;
            sst_bias_NAR:units = "kelvin" ;
            sst_bias_NAR:_FillValue = -32768s ;
            sst_bias_NAR:add_offset = 0.f ;
            sst_bias_NAR:scale_factor = 0.01 ;
            sst_bias_NAR:valid_min = -32767s ;
            sst_bias_NAR:valid_max = 32767s ;
      short sst_bias_SEVIRI(time, lat, lon) ;
            sst_bias_SEVIRI:long_name = "SEVIRI sea surface temperature
bias" ;
            sst_bias_SEVIRI:units = "kelvin" ;
            sst_bias_SEVIRI:_FillValue = -32768s ;
            sst_bias_SEVIRI:add_offset = 0.f ;
            sst_bias_SEVIRI:scale_factor = 0.01 ;
            sst_bias_SEVIRI:valid_min = -32767s ;
            sst_bias_SEVIRI:valid_max = 32767s ;
      short sst_bias_TMI(time, lat, lon) ;
            sst_bias_TMI:long_name = "TMI sea surface temperature bias" ;
            sst_bias_TMI:units = "kelvin" ;
            sst_bias_TMI:_FillValue = -32768s ;
            sst_bias_TMI:add_offset = 0.f ;
            sst_bias_TMI:scale_factor = 0.01 ;
```

```
            sst_bias_TMI:valid_min = -32767s ;
            sst_bias_TMI:valid_max = 32767s ;
      short sst_bias_METOP_AVHRR(time, lat, lon) ;
            sst_bias_METOP_AVHRR:long_name = "METOP_AVHRR sea surface
temperature bias" ;
            sst_bias_METOP_AVHRR:units = "kelvin" ;
            sst_bias_METOP_AVHRR:_FillValue = -32768s ;
            sst_bias_METOP_AVHRR:add_offset = 0.f ;
            sst_bias_METOP_AVHRR:scale_factor = 0.01 ;
            sst_bias_METOP_AVHRR:valid_min = -32767s ;
            sst_bias_METOP_AVHRR:valid_max = 32767s ;
      short sst_bias_IASI(time, lat, lon) ;
            sst_bias_IASI:long_name = "IASI sea surface temperature bias" ;
            sst_bias_IASI:units = "kelvin" ;
            sst_bias_IASI:_FillValue = -32768s ;
            sst_bias_IASI:add_offset = 0.f ;
            sst_bias_IASI:scale_factor = 0.01 ;
            sst_bias_IASI:valid_min = -32767s ;
            sst_bias_IASI:valid_max = 32767s ;
      short sst_bias_GOES(time, lat, lon) ;
            sst_bias_GOES:long_name = "GOES sea surface temperature bias" ;
            sst_bias_GOES:units = "kelvin" ;
            sst_bias_GOES:_FillValue = -32768s ;
            sst_bias_GOES:add_offset = 0.f ;
            sst_bias_GOES:scale_factor = 0.01 ;
            sst_bias_GOES:valid_min = -32767s ;
            sst_bias_GOES:valid_max = 32767s ;

// global attributes:
            :Conventions = "CF-1.4" ;
            :title = "Foundation sea surface temperature bias over the
global ocean" ;
            :summary = "SST bias fields calculated as part of OSTIA" ;
            :references = "Donlon, C.J., Martin, M., Stark, J.D., Roberts-
Jones, J., Fiedler, E., Wimmer, W., 2011. The Operational Sea Surface
Temperature and Sea Ice Analysis (OSTIA). Remote Sensing of the
Environment" ;
            :institution = "UKMO" ;
            :history = "" ;
            :comment = "WARNING Some applications are unable to properly
handle signed byte values. If values are encountered > 127, please subtract
256 from this reported value" ;
            :license = "These data are available free of charge under the
GMES data policy" ;
            :id = "UKMO-L4LRfnd_GLOB-OSTIAbias" ;
            :naming_authority = "org.ghrsst" ;
            :product_version = "2.0" ;
            :uuid = "85e8f8f5-e368-43a6-98f0-c30aab25ac62" ;
            :gds_version_id = "2.0" ;
            :netcdf_version_id = "3.6" ;
            :date_created = "20111019T062433Z" ;
```

```
            :start_time = "20111018T000000Z" ;
            :time_coverage_start = "20111018T000000Z" ;
            :stop_time = "20111019T000000Z" ;
            :time_coverage_end = "20111019T000000Z" ;
            :file_quality_level = 3 ;
            :source = "UKMO-L4HRfnd-GLOB-OSTIA" ;
            :platform = "Aqua, NOAA-18, NOAA-19, MetOpA, MSG1, TRMM" ;
            :sensor = "AMSR, AVHRR, AVHRR_GAC, SEVIRI, TMI" ;
            :metadata_conventions = "Unidata Observation Dataset v1.0" ;
            :metadata_link                                                  =
"http://data.nodc.noaa.gov/NESDIS_DataCenters/metadata/NODC/FGDC-
GHRSST_all-UKMO-L4LRfnd-GLOB-v01-OSTIAbias.xml" ;
            :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" ;
            :westernmost_longitude = -180.f ;
            :easternmost_longitude = 180.f ;
            :southernmost_latitude = -90.f ;
            :northernmost_latitude = 90.f ;
            :spatial_resolution = "0.25 degree" ;
            :geospatial_lat_units = "degrees_north" ;
            :geospatial_lat_resolution = "0.25 degree" ;
            :geospatial_lon_units = "degrees_east" ;
            :geospatial_lon_resolution = "0.25 degree" ;
            :acknowledgment = "Please acknowledge the use of these data
with the following statement: These data were provided by GHRSST, UKMO and
MyOcean" ;
            :creator_name = "UKMO as part of MyOcean" ;
            :creator_email = "servicedesk@myocean.eu.org" ;
            :creator_url = "http://www.myocean.eu.org" ;
            :project = "Group for High Resolution Sea Surface Temperature"
;
            :publisher_name = "GHRSST Project Office" ;
            :publisher_url = "http://www.ghrsst.org" ;
            :publisher_email = "ghrsst-po@nceo.ac.uk" ;
            :processing_level = "L4" ;
            :cdm_data_type = "grid" ;
}
```

VII.4 Example header of monthly or seasonal file

An example header of a monthly netCDF file for January 2007 (generated using ncdump) is given below:

```
netcdf \200701-UKMO-L4_GHRSST-SSTfnd-OSTIAmonthly-GLOB-v02.0-fv02.0 {
dimensions:
```

```
      lon = 1440 ;
      lat = 720 ;
      time = 1 ;
variables:
      int time(time) ;
            time:long_name = "reference time of sst field" ;
            time:standard_name = "time" ;
            time:axis = "T" ;
            time:units = "seconds since 1981-01-01 00:00:00UTC" ;
            time:comment = " " ;
      float lat(lat) ;
            lat:long_name = "latitude" ;
            lat:standard_name = "latitude" ;
            lat:axis = "Y" ;
            lat:units = "degrees_north" ;
            lat:valid_min = -90.f ;
            lat:valid_max = 90.f ;
            lat:comment = " Latitude geographical coordinates,WGS84
projection" ;
      float lon(lon) ;
            lon:long_name = "longitude" ;
            lon:standard_name = "longitude" ;
            lon:axis = "X" ;
            lon:units = "degrees_east" ;
            lon:valid_min = -180.f ;
            lon:valid_max = 180.f ;
            lon:comment = " Longitude geographical coordinates,WGS84
projection" ;
      short analysed_sst(time, lat, lon) ;
            analysed_sst:long_name = "analysed sea surface temperature" ;
            analysed_sst:standard_name                                    =
"sea_surface_foundation_temperature" ;
            analysed_sst:units = "kelvin" ;
            analysed_sst:_FillValue = -32768s ;
            analysed_sst:add_offset = 273.15f ;
            analysed_sst:scale_factor = 0.01f ;
            analysed_sst:valid_min = -300s ;
            analysed_sst:valid_max = 4500s ;
            analysed_sst:coordinates = "lon lat" ;
            analysed_sst:source = "REMSS-L2P-AMSRE, UPA-L2P-ATS_NR_2P,
NAVO-L2P-AVHRR18_G, NAVO-L2P-AVHRR19_G, EUR-L2P-AVHRR_METOP_A, SEVIRI_SST-
OSISAF-L3C-v1.0, REMSS_L2P-TMI, GOES13-OSISAF-L3C-v1.0" ;
            analysed_sst:reference = "C.J. Donlon, M. Martin, J.D. Stark,
J. Roberts-Jones, E. Fiedler, W. Wimmer. The operational sea surface
temperature and sea ice analysis (OSTIA) system. Remote Sensing Environ.,
116 (2012), pp. 140u2013158 http://dx.doi.org/10.1016/j.rse.2010.10.017" ;
            analysed_sst:comment = " Monthly OSTIA foundation SST" ;
      short standard_deviation_sst(time, lat, lon) ;
            standard_deviation_sst:long_name = "standard deviation of
analysed sea surface temperature" ;
```

```
            standard_deviation_sst:standard_name                                =
"standard_deviation_sea_surface_temperature" ;
            standard_deviation_sst:units = "kelvin" ;
            standard_deviation_sst:_FillValue = -32768s ;
            standard_deviation_sst:add_offset = 0.f ;
            standard_deviation_sst:scale_factor = 0.01f ;
            standard_deviation_sst:valid_min = 0s ;
            standard_deviation_sst:valid_max = 4500s ;
            standard_deviation_sst:coordinates = "lon lat" ;
            standard_deviation_sst:comment = " Monthly standard deviation
of OSTIA foundation SST" ;

// global attributes:
            :Conventions = "CF-1.4" ;
            :title = "Analysed monthly foundation sea surface temperature
over the global ocean" ;
            :references = "Donlon, C.J., Martin, M., Stark, J.D., Roberts-
Jones, J., Fiedler, E., Wimmer, W., 2011. The Operational Sea Surface
Temperature and Sea Ice Analysis (OSTIA). Remote Sensing of the
Environment, 116" ;
            :institution = "UKMO" ;
            :netcdf_version_id = "4.1" ;
            :product_version = "2.0" ;
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handle signed byte values. If values are encountered > 127, please subtract
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            :stop_time = "20070131T000000Z" ;
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            :westernmost_longitude = -0.f ;
            :easternmost_longitude = 360.f ;
            :summary = "A merged, multi-sensor L4 Foundation SST product" ;
            :license = "These data are available free of charge under the
GMES data policy" ;
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AVHRR_METOP_A, EUM-L2P-IASI_METOP_A, SEVIRI_SST-OSISAF-L3C-v1.0, REMSS_L2P-
TMI, GOES13-OSISAF-L3C-v1.0, OSISAF_ICE, NCEP_ICE" ;
            :platform = "NOAA-19, MetOpA, MSG2, TRMM, GOES13, DMSP-F17,
DMSP-F15" ;
            :sensor = "AVHRR, AVHRR_GAC, AVHRR_LAC, IASI, SEVIRI, TMI,
GOES_Imager, SSMIS, SSM/I" ;
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            :metadata_link                                                  =
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KMO-L4HRfnd-GLOB-OSTIA" ;
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Temperature" ;
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(GCMD) Science Keywords" ;
            :standard_name_vocabulary = "NetCDF Climate and Forecast (CF)
Metadata Convention" ;
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            :geospatial_lat_resolution = 0.05f ;
            :geospatial_lon_units = "degrees_east" ;
            :geospatial_lon_resolution = 0.05f ;
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with the following statement: These data were provided by GHRSST, UKMO and
MyOcean" ;
            :creator_name = "UKMO as part of MyOcean" ;
            :creator_email = "servicedesk@myocean.eu.org" ;
            :creator_url = "http://www.myocean.eu.org" ;
            :project = "Group for High Resolution Sea Surface Temperature"
;
            :publisher_name = "GHRSST Project Office" ;
            :publisher_url = "http://www.ghrsst.org" ;
            :publisher_email = "ghrsst-po@nceo.ac.uk" ;
            :processing_level = "L4" ;
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