Format Specification for the Australian Bureau of Meteorology's SST Analysis L4 files

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This document is located at:
http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v7.pdf

The purpose of this document is to describe in detail the content and format of the Bureau of Meteorology's netCDF "L4" sea surface temperature analysis files, which have been produced for the BLUElink> Ocean Forecasting Australia Project from the Bureau's existing binary format "UARCH" files. The format of the Bureau's L4 files is based on the L4 file format described in the Global Ocean Data Assimilation Experiment (GODAE) High Resolution Sea Surface Temperature Pilot Project (GHRSST-PP) GDS v1.7 document at http://www.ghrsst-pp.org/modules/documents/documents/GDS-1.7-Part-III-L4-subsystem-v1.0.doc.

The new L4 files can be obtained from **http://godae.bom.gov.au/**

1. Bureau Current SST Analysis Binary (UARCH) Files

Global SST Analysis Files:
Daily Global Australian Multi-Sensor SST Analysis (GAMSSA) Files:
The new operational Global SST analysis files (1/4° resolution) contain daily OI analyses of foundation SST estimates, with temporary real-time files named foundSSTanal.DDMMMYYYY.Global[.fv*nn*] where DD, MMM and YYYY are day, month and year of the observations used in the analysis, and the optional extension .fv*nn* represents the file version number (*nn*). If '.fv*nn*' is absent then file is fv01. Temporary real-time UARCH files are stored currently on gale in /nm/data/ocean/sstanal/global. These files will be renamed sstanal.glob.fine.MMDD.n1.mom and archived on SAM in /samnmc/sstanal/anal/YYYY. 'MMDD' are month and day. The file version number is given by 'n1' and 'mom' is the file format.
Array dimensions: dimlon = 1440, dimlat = 720
Data Inputs: Ship data, buoys and trackobs from the GTS, NESDIS global AVHRR SST1m data (9 km) from NOAA-17, NOAA-18 and METOP-A, Meteo AATSR skin SST data (10 arcmin), Remote Sensing Systems AMSR-E (from Aqua) L2P subskin SST data (25 km) for the defined analysis region.

Weekly: The Bureau's operational global SST analysis system outputs archival weekly files (1° resolution) named sstanal.glob.sMMsDD.eMMeDD.n2.mom, where sMM sDD are start month, day of week (Monday) and eMM eDD are end of week (Sunday). The file version number is given by 'n2' and 'mom' is the file format.
Archived files are stored currently on SAM in /samnmc/sstanal/anal/YYYY.
The temporary real-time files are named SSTanal.DDMonYYYY[.fv*nn*] where DD is day of month representing the end day of the week (Sunday), Mon is the Month (eg. 'Oct'), YYYY is the year and the optional extension .fv*nn* represents the file version number (*nn*). If '.fv*nn*' is absent then file is fv01. Real-time files are stored temporarily on RTDS in /rtop/data/ocean/sstanal/.
Array dimensions: dimlon = 360, dimlat = 180
Data Inputs: Ship data, buoys, bathy, trackobs, AVHRR SST1m from GTS (2.5°) and
NESDIS global AVHRR SST1m data (9km) from NOAA-15, NOAA-17 and NOAA-18. NOTE: The OI analysis uses the whole week of data and the analysis time is the mid-point of the week, Thursday at 1200 UT.
Monthly: The Bureau's operational global weekly analysis files are averaged after each month to form monthly composite global files (1° resolution), with the archived files named sstanal.glob.sMMsDD.eMMeDD.n2.mom, where sMM sDD are start month, start day of month and eMM eDD is the end of the same month. The file version number is given by 'n2' and 'mom' is the file format. NOTE: These files are an average of all the weekly global SST analyses for that month. Archived files are stored currently on SAM in /samnmc/sstanal/anal/YYYY.

The temporary real-time files are named SSTanal.MonYYYY[.fv*nn*] where Mon is the month being averaged (eg. 'Oct'), YYYY is the year and the optional extension .fv*nn* represents the file version number (*nn*). If '.fv*nn*' is absent then file is fv01. Real-time files are stored temporarily on RTDS in /rtop/data/ocean/sstanal/.
Array dimensions: dimlon = 360, dimlat = 180

Regional SST Analysis Files (Coarse resolution):
The legacy operational regional SST analysis files (0.25° resolution) contain daily OI analyses of 1 m SST measurements. The archival files are named sstanal.reg.MMDD.n1.mom where MM DD are the month and day of the observations used in the analysis. The file version number is given by 'n1' and 'mom' is the file format. Archived files are stored currently on SAM in /samnmc/sstanal/anal/YYYY. The temporary real-time files are named SSTanal.DDMonYYYY[.fv*nn*] where DD is day of the month, Mon is the Month (eg. 'Oct'), YYYY is the year and the optional extension .fv*nn* represents the file version number (*nn*). If '.fv*nn*' is absent then file is fv01. The real time files are stored temporarily on RTDS in /rtop/data/ocean/sstanal/regional/.
Array dimensions: dimlon = 521, dimlat = 361
Data Inputs: Ship data, buoys, bathy and trackobs from the GTS, NESDIS global AVHRR SST1m data (9 km) from NOAA-17 and NOAA-18 and AVHRR local retrieval (HRPT) SST1m data (1km) from NOAA-17 and NOAA-18 for the defined analysis region. Stopped ingesting NOAA-12 HRPT AVHRR SST data on the 6 Oct 2005 and stopped ingesting NOAA-15 HRPT AVHRR SST on 27 Jun 2006. Commenced ingesting NOAA-18 HRPT AVHRR SST on 30 May 2006. Commenced ingesting NESDIS global AVHRR (9km) on 14 July 2005. Stopped ingesting AVHRR from GTS (2.5°) on 13 Oct 2005. Stopped ingesting GAC AVHRR SST from NOAA-15 on 8 June 2007.

Regional Australian Multi-Sensor SST Analysis (RAMSSA) Files (Fine Resolution):
The new operational Regional SST analysis files (1/12° resolution) contain daily OI analyses of foundation SST estimates, with temporary real-time files named foundSSTanal.DDMMMYYYY.Fine[.fv*nn*] where DD, MMM and YYYY are day, month and year of the observations used in the analysis, and the optional extension .fv*nn* represents the file version number (*nn*). If '.fv*nn*' is absent then file is fv01. Temporary real-time UARCH files are stored currently on gale in /nm/data/ocean/sstanal/regional. These files are renamed sstanal.reg.fine.MMDD.n1.mom and archived on SAM in /samnmc/sstanal/anal/YYYY. 'MMDD' are month and day. The file version number is given by 'n1' and 'mom' is the file format.
Array dimensions: dimlon = 1561, dimlat = 1081
Data Inputs: Ship data, buoys and trackobs from the GTS, NESDIS global AVHRR SST1m data (9 km) from NOAA-17 and NOAA-18, AVHRR local retrieval (HRPT) SST1m data (1km) from NOAA-17 and NOAA-18, Meteo AATSR skin SST data (10 arcmin), Remote Sensing Systems AMSR-E (from Aqua) L2P subskin SST data (25 km) for the defined analysis region. Stopped ingesting NOAA-15 HRPT AVHRR SST on 28 Jun 2006. Commenced ingesting NOAA-18 HRPT AVHRR SST on 30 May 2006.

2. Bureau L4 SST Analysis File Names

The Bureau follows the GHRSST-PP SST Analysis L4 filename convention as specified in the GHRSST-PP GDS v1.7 document. The GDS filename convention used for GHRSST-PP L4 data products has been designed to provide useful information in an easily readable format. All L4 data product filenames are derived according to the following convention:

> **<Date Valid>-<Processing Centre Code>-L4<Product Type>-<Area>-<Processing Model ID>-<File Version>[-<Optional Characteristic>].<Base Format>**

The filename fields are defined in Table A1.3.1 of the GDS v1.7:

Table A1.3.1. L4 analysed data product filename components.

Name	Definition	Description
<Processing Centre Code>	"ABOM" - Refer to Appendix A2 Table A2.1	Processing centre code
<Area>	Table A1.3.2 in GDS v1.7	The area covered by the L4

	"GLOB" = global	product
	"AUS" = Australian region	
<Date Valid>	YYYYMMDD	Refers to the date for which this particular data set is valid and represents the mid-point of the analysis time window
<Product Type>	"LR"=low resolution, ""=high resolution or "UH"=ultra-high resolution followed by either fnd (for foundation SST), skin, subskin, blend (for blended SST) or 1m, 2m, … 10m (for SST at specific depth)	Type of analysed SST data as described in Section 2 of the GDS.
<processing model ID>	vnn (where nn is the GDS version number, e.g., 01	Version number of the GDS system used to process the data file
<FileVersion>	fvxx (where xx is the release number of this file, e.g.fv01)	Release version for this L4 file
<Optional Characteristic>	« weeklyobs » = 7 days of data and analysis time is the mid-point of the week « monthlycomp » = mean of all weekly global SST analyses for the month	Free field to distinguish ambiguous cases (such as the same data centre producing two L4 files over the same region at spatial resolutions of 1/10° and 1/20° or producing more than one analysis per day)
<base format>	nc	Generic file format (nc=netCDF)

For the Bureau's SST analysis files the filenames will be as follows:

Global daily 1/4° SSTfnd analyses:
20060224-ABOM-L4LRfnd-GLOB-v01-fv02.nc
The file was produced from the original UARCH GAMSSA file with analysis date 24 Feb 2006 and file version 'n2', denoting the second running of the analysis system for observations from that date. The given date represents the mid-point of the day, 12 UTC.

Global weekly 1° SST1m analyses:
20060220-ABOM-L4LR1m-GLOB-v01-fv01-weeklyobs.nc
The file is produced from the weekly global 1 m SST analysis UARCH file (version n1) starting on Monday 0000 UTC and ending on Sunday at 2330 UTC. The given date represents the mid-point of the week (Thursday at 1200 UTC), the time that the OI analysis is valid.

Global monthly composite 1° SST1m analyses:
20060201-ABOM-L4LR1m-GLOB-v01-fv01-monthlycomp.nc
The file is produced from the monthly composite global 1 m SST analysis UARCH file (version n1), in turn produced by averaging the weekly global 1 m SST OI analysis UARCH files over the month starting at the given date. In this example four weekly files have been averaged starting at 1 Feb 2006

Regional daily 0.25° SST1m analyses:
20060224-ABOM-L4LR1m-AUS-v01-fv01.nc
The file was produced from the original UARCH file with analysis date 24 Feb 2006 and file version 'n1'. The given date represents the mid-point of the day, 12 UTC.

Regional daily 1/12° SSTfnd analyses:
20060224-ABOM-L4fnd-AUS-v01-fv02.nc
The file was produced from the original UARCH file with analysis date 24 Feb 2006 and file version 'n2', denoting the second running of the analysis system for observations from that date. The given date represents the mid-point of the day, 12 UTC.

3. Bureau L4 File Grid Specification

The GDS v1.5 specifies in Table 2.4.7.1 that the L4 file have an equidistant cylindrical projection and grid cell size 1/12° (9.28 km at the equator). The grid cell reference point for a GHRSST-PP L4 file shall be the centre of each grid cell. "For a grid cell at 35° referenced to the bottom left corner of the grid cell, the grid cell centre would be 35° + 1/24°."

Graham Warren wrote on 18 April 2006 that the Bureau's OI analysis system produces point estimates of SST. The grid is defined from the values BLAT, TLAT, WCLG, ECLG and DLAT, DLNG in the analysis code. The longitudes for the operational regional 0.25° analysis are: 60.0, 60.25, 60.5,....East. Latitudes are: -70.0, -69.75, -69.5,....North.
The longitudes for the operational global 1° analysis are: -179.5, -178.5, ... , 179.5 East. Latitudes are: -89.5, -88.5, ... , 89.5 North.

Latitudes and longitudes in the Bureau's L4 files refer to the position for the point estimates of SST and are equidistant in both latitude and longitude.

4. Bureau L4 File Global Attributes

BLUElink has added global attributes uarch_file_id, oi_scales (describing the background correlation length scale, observation correlation length scale and observation correlation time scale) and obsid_summary (including observation estimated standard deviation (OBSESD) values) to the L4 files. The OBSESD values are currently global attributes of each analysis but different for each input data stream. The current Bureau binary analysis (UARCH) files contain all observation data values, with corresponding latitude, longitude, time and rms error value. In future we may need to store these observation data values in a separate binary file as they do not lend themselves to a netCDF format.

Global 1/4° SST(foundation) Analysis (new BLUElink GAMSSA product):
```
:Conventions = "CF-1.0" ;
:title = "GAMSSA Analysed daily global low resolution foundation sea surface temperature";
:DSD_entry_id = "ABOM-L4LRfnd-GLOBAL-v01" ;
:references =
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/Bureau_HR_Regional_SST_Analysis_vg1.0.pdf\n",
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v6.pdf";
:GDS_data_centre = "ABOM" ;
:institution = "Australian Bureau of Meteorology" ;
:contact = "H.Beggs@bom.gov.au" ;
:GDS_version_id = "v1.0-rev1.7" ;
:netcdf_version_id = "3.6.0-p1 of Mar 31 2005 05:34:05 $" ;
:creation_date = "2006-12-20" ;
:product_version = "fv01" ;
:history = "2006/12/20 03:49:43 +00 : /bm/ghome/tpugh/Projects/GHRSST/bin/uarch2ghrsst.x
foundSSTanal.19Dec2006.Global" ;
:spatial_resolution = "1/4 degree" ;
:start_date = "2006-12-19" ;
:start_time = "00:00:00 UTC" ;
:stop_date = "2006-12-19" ;
:stop_time = "00:00:00 UTC" ;
:southernmost_latitude = -89.875f ;
:northernmost_latitude = 89.875f ;
:westernmost_longitude = -179.875f ;
:easternmost_longitude = 179.875f ;
:software_version = "L4 Processor v01" ;
:file_quality_index = "1" ;
:source_data = " AVHRR17_G-NAVO,AVHRR18_G-NAVO,AVHRR_METOPA_G-NAVO,,ATS_MET_2P-ESA,AMSRE-
REMSS,IN_SITU-GTS_BUOYS,IN_SITU-GTS_SHIP,IN_SITU-GTS_TESAC,GASP-WSP,NCEP-ICE" ;
:comment = "\n",
" This is a BLUElink> Ocean Forecasting Australia Project research product run operationally
at the Bureau. \n",
,
"WARNING: some applications are unable to properly handle signed byte values.\n",
"If byte values >127 are encountered, subtract 256 from this reported value." ;
:uarch_file_id = "foundSSTanal.19Dec2006.Global" ;
:oi_scales = "\n",
"Univariate Statistical Interpolation Package, SIANAL v13\n",
"background correlation length scale  =  50 km\n",
"observation correlation length scale  =   20 km\n",
"observation correlation time scale   = 0.5 days" ;
:obsid_summary = "\n",
"AVHRR17_G-NAVO        nobs= 119215  obsesd: avg=0.450 min=0.450 max= 0.450\n",
```

```
"AVHRR18_G-NAVO         nobs= 114089  obsesd: avg=0.460 min=0.460 max= 0.460\n",
"AVHRR_METOPA_G-NAVO  nobs= 116005  obsesd: avg=0.420 min=0.420 max= 0.420\n",
"ATS_MET_2P-ESA          nobs= 11636  obsesd: avg=0.390 min=0.390 max= 0.390\n",
"AMSRE-REMSS             nobs= 41688  obsesd: avg=0.660 min=0.660 max= 0.660\n",
"IN_SITU-GTS_BUOYS       nobs=  4537  obsesd: avg=0.440 min=0.440 max= 0.440\n",
"IN_SITU-GTS_SHIP        nobs=   161  obsesd: avg=1.200 min=1.200 max= 1.200\n",
"IN_SITU-GTS_TESAC       nobs=    16  obsesd: avg=1.200 min=1.200 max= 1.200" ;
```

Global Blended Weekly SST Analysis (legacy product):
```
:Conventions = "CF-1.0";
:title = "Analysed global low resolution blended sea surface temperature";
:DSD_entry_id = "ABOM-L4LR1m-GLOB-v01";
:references =
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/The_Bureau_of_Meteorology_SST_analysis_
sytem.doc\n",
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v6.pdf";
:GDS_data_centre = "ABOM" ;
:institution = "Australian Bureau of Meteorology" ;
:contact = "G.Warren@bom.gov.au" ;
:GDS_version_id = "v1.0-rev1.7" ;
:netcdf_version_id = "3.6.0-p1 of Mar 31 2005 05:34:05 $" ;
:creation_date = "2006-09-14" ;
:product_version = "fv01" ;
:history = "2006/09/14 04:59:47 +00 : /bm/ghome/hmb/fortran/sstanal/uarch2ghrsst.x
sstanal.glob.0904.0910.n1.mom" ;
:spatial_resolution = "1.0 degree" ;
:start_date = "2006-09-04" ;
:start_time = "00:00:00 UTC" ;
:stop_date = "2006-09-11" ;
:stop_time = "00:00:00 UTC" ;
:southernmost_latitude = -89.5f ;
:northernmost_latitude = 89.5f ;
:westernmost_longitude = -179.5f ;
:easternmost_longitude = 179.5f ;
:software_version = "L4 Processor v01" ;
:file_quality_index = "0" ;
:source_data = "AVHRR15_G-NESDIS,AVHRR17_G-NESDIS,AVHRR18_G-NESDIS,IN_SITU-
GTS_BUOYS,IN_SITU-GTS_BATHY,IN_SITU-GTS_SHIP,IN_
SITU-GTS_TESAC,NCEP-ICE" ;
:comment = "\n",
"This is a legacy research product run operationally at the Bureau.\n",
"WARNING: some applications are unable to properly handle signed byte values.\n",
"If byte values >127 are encountered, subtract 256 from this reported value." ;
:uarch_file_id = "sstanal.glob.0904.0910.n1.mom" ;
:oi_scales = "\n",
"Univariate Statistical Interpolation Package, SIANAL v13\n",
"background correlation length scale  = 250 km\n",
"observation correlation length scale =  80 km\n",
"observation correlation time scale   = 2.0 days" ;
:obsid_summary = "\n",
"AVHRR15_G-NESDIS        nobs= 15260  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR17_G-NESDIS        nobs= 23574  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR18_G-NESDIS        nobs= 22360  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"IN_SITU-GTS_BUOYS     nobs=182960  obsesd: avg=0.601 min=0.600 max= 0.600\n",
"IN_SITU-GTS_BATHY     nobs=   177  obsesd: avg=0.600 min=0.600 max= 0.600\n",
"IN_SITU-GTS_SHIP      nobs= 48625  obsesd: avg=1.000 min=1.000 max= 1.000\n",
"IN_SITU-GTS_TESAC       nobs=  3503  obsesd: avg=1.000 min=1.000 max= 1.000" ;
```

Regional 0.25° Blended SST Analysis (legacy product):
```
:Conventions = "CF-1.0" ;
:title = "Analysed low resolution 1m sea surface temperature over Australian Region" ;
:DSD_entry_id = "ABOM-L4LR1m-AUS-v01" ;
:references =
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/The_Bureau_of_Meteorology_SST_analysis_
sytem.doc\n",
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v6.pdf";
:GDS_data_centre = "ABOM" ;
:institution = "Australian Bureau of Meteorology" ;
:contact = "G.Warren@bom.gov.au" ;
:GDS_version_id = "v1.0-rev1.7" ;
:netcdf_version_id = "3.6.0-p1 of Mar 31 2005 05:34:05 $" ;
:creation_date = "2006-10-03" ;
:product_version = "fv01" ;
:history = "2006/10/03 02:01:24 +00 :
/bm/ghome/tpugh/Projects/GHRSST/bin/uarch2ghrsst.x sstanal.reg.0930.n1.mom" ;
```

```
:spatial_resolution = "1/4 degree" ;
:start_date = "2006-09-30" ;
:start_time = "00:00:00 UTC" ;
:stop_date = "2006-10-01" ;
:stop_time = "00:00:00 UTC" ;
:southernmost_latitude = -70.f ;
:northernmost_latitude = 20.f ;
:westernmost_longitude = 60.f ;
:easternmost_longitude = 190.f ;
:software_version = "L4 Processor v01" ;
:file_quality_index = "0" ;
:source_data = "AVHRR17_L-ABOM,AVHRR18_L-ABOM,AVHRR15_G-NESDIS,AVHRR16_G-
NESDIS,AVHRR17_G-NESDIS,AVHRR18_G-NESDIS,IN_SITU-GTS_BUOYS,IN_SITU-GTS_BATHY,IN_SITU-
GTS_SHIP,IN_SITU-GTS_TESAC,NCEP-ICE" ;
:comment = "\n",
"This is a legacy research product run operationally at the Bureau.\n",
"WARNING: some applications are unable to properly handle signed byte values.\n",
"If byte values >127 are encountered, subtract 256 from this reported value." ;
:uarch_file_id = "sstanal.reg.0930.n1.mom" ;
:oi_scales = "\n",
"Univariate Statistical Interpolation Package, SIANAL v13\n",
"background correlation length scale  =  50 km\n",
"observation correlation length scale =  20 km\n",
"observation correlation time scale   = 0.5 days" ;
:obsid_summary = "\n",
"AVHRR17_L-ABOM          nobs= 15116  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR18_L-ABOM          nobs= 22342  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR15_G-NESDIS         nobs=  1375  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR16_G-NESDIS         nobs=  2043  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR17_G-NESDIS         nobs=  2181  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"AVHRR18_G-NESDIS         nobs=  2417  obsesd: avg=0.750 min=0.750 max= 0.750\n",
"IN_SITU-GTS_BUOYS       nobs=  4980  obsesd: avg=0.601 min=0.600 max= 2.691\n",
"IN_SITU-GTS_BATHY       nobs=    23  obsesd: avg=0.600 min=0.600 max= 0.600\n",
"IN_SITU-GTS_SHIP        nobs=   235  obsesd: avg=1.016 min=1.000 max= 2.962\n",
"IN_SITU-GTS_TESAC       nobs=    29  obsesd: avg=1.000 min=1.000 max= 1.000" ;
```

Regional 1/12° SST(foundation) Analysis (new BLUElink RAMSSA product):
```
:Conventions = "CF-1.0" ;
:title = "RAMSSA Analysed high resolution foundation sea surface temperature over Australian
Region";
:DSD_entry_id = "ABOM-L4fnd-AUS-v01" ;
:references =
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/GAMSSA BoM Operational Bulletin 77.pdf
\n",
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v7.pdf";
:GDS_data_centre = "ABOM" ;
:institution = "Australian Bureau of Meteorology" ;
:contact = "H.Beggs@bom.gov.au" ;
:GDS_version_id = "v1.0-rev1.7" ;
:netcdf_version_id = "3.6.0-p1 of Mar 31 2005 05:34:05 $" ;
:creation_date = "2006-12-20" ;
:product_version = "fv01" ;
:history = "2006/12/20 03:49:43 +00 : /bm/ghome/tpugh/Projects/GHRSST/bin/uarch2ghrsst.x
foundSSTanal.19Dec2006.Fine" ;
:spatial_resolution = "1/12 degree" ;
:start_date = "2006-12-19" ;
:start_time = "00:00:00 UTC" ;
:stop_date = "2006-12-19" ;
:stop_time = "00:00:00 UTC" ;
:southernmost_latitude = -70.f ;
:northernmost_latitude = 20.f ;
:westernmost_longitude = 60.f ;
:easternmost_longitude = 190.f ;
:software_version = "L4 Processor v01" ;
:file_quality_index = "1" ;
:source_data = "AVHRR17_L-ABOM,AVHRR18_L-ABOM, AVHRR17_G-NAVO,AVHRR18_G-NAVO,AVHRR_METOPA_G-
NAVO,ATS_MET_2P-ESA,AMSRE-REMSS,IN_SITU-GTS_BUOYS,IN_SITU-GTS_SHIP,IN_SITU-GTS_TESAC,LAPS-
WSP,NCEP-ICE" ;
:comment = "\n",
"This is a BLUElink> Ocean Forecasting Australia Project research product run operationally
at the Bureau..\n",
"WARNING: some applications are unable to properly handle signed byte values.\n",
"If byte values >127 are encountered, subtract 256 from this reported value." ;
:uarch_file_id = "foundSSTanal.19Dec2006.Fine" ;
:oi_scales = "\n",
"Univariate Statistical Interpolation Package, SIANAL v13\n",
```

```
"background correlation length scale  =  20 km\n",
"observation correlation length scale =   12 km\n",
"observation correlation time scale   = 0.5 days" ;
:obsid_summary = "\n",
"AVHRR17_L-ABOM        nobs=209407  obsesd: avg=0.451 min=0.450 max= 0.450\n",
"AVHRR18_L-ABOM        nobs=239382  obsesd: avg=0.461 min=0.460 max= 0.460\n",

"AVHRR17_G-NAVO        nobs= 19215  obsesd: avg=0.450 min=0.450 max= 0.450\n",
"AVHRR18_G-NAVO        nobs= 14089  obsesd: avg=0.460 min=0.460 max= 0.460\n",
"AVHRR_METOPA_G-NAVO   nobs= 14089  obsesd: avg=0.460 min=0.460 max= 0.460\n",
"ATS_MET_2P-ESA        nobs= 11636  obsesd: avg=0.390 min=0.390 max= 0.390\n",
"AMSRE-REMSS           nobs= 41688  obsesd: avg=0.660 min=0.660 max= 0.660\n",
"IN_SITU-GTS_BUOYS     nobs=  4537  obsesd: avg=0.440 min=0.440 max= 0.440\n",
"IN_SITU-GTS_SHIP      nobs=   161  obsesd: avg=1.200 min=1.200 max= 1.200\n",
"IN_SITU-GTS_TESAC     nobs=    16  obsesd: avg=1.200 min=1.200 max= 1.200" ;
```

5. **Bureau L4 File Formats**

Coordinate variables

The dimensions and coordinate variables for the Bureau's L4 analysed_sst data file are formatted as follows (following the GDS v1.7 specification):

```
dimensions:
        time =  n; (where n = the number of analyses over the file period, eg. time = 1 for 24-hourly
SST analyses in one daily file)
        lat =  ; (user defined grid size with latitude notation from –90N to +90N)
        lon = ; (user defined grid size with longitude notation from –180E to +180E for global
analyses and either –180E to +180E or 0E to 360E for regional analyses depending on whether the
analysis crosses the international dateline)
        nv = 2; (number of vertices to define time bounds)
```

```
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"
                [time:bounds = "time_bnds";]

        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" ;

        Optional field:
        int time_bnds(time, nv) ;
                time_bnds:long_name = "bounds of each temporal point for composite or
        averaged fields" ;
                time_bnds:units = "seconds since 1981-01-01 00:00:00" ;
```

Note that although the current GHRSST-PP L4 file format specifies time as long, CDF does not support 64-bit integers and "int" is synonymous in netCDF files with "long". The current GHRSST-PP L4 time specification has inherent limitations if the data producer or user is not careful. The current specification of four byte integers representing time with a reference time of seconds since 1981-01-01 has a limitation of representing time until 2049. A common pitfall for the user is to assume the reference time will not change, and to write their software with this assumption. Time representation should be handled by udunits functions or other high level functions for consistent handling of time values and time conversions.

Also note that 'time' is the reference time of the analysis. The value is chosen to most closely represent the time at which the analysis is valid. For the Bureau's optimal interpolation analysis systems this time

is the mid-point of the nominal time window for observations from which the analysis has been derived, specified in the global attributes as start_date, start_time and stop_date, stop_time.

1. **analysed_sst variable**

The variable 'analysed_sst' is required with the format specification shown in Table 1. The analysed SST is output from the Bureau's global and regional SST analysis systems and is the AN variable in the UARCH binary analysis files.

Table 1 CDL description of analysed_sst variable

Storage type	Name	Description	Unit
short	analysed_sst	SST values from analysis system	K
CDL description			

```
short analysed_sst(time, lat, lon) ;
    analysed_sst:long_name = "analysed sea surface temperature" ;
    analysed_sst:standard_name = "sea_surface_temperature"
    analysed_sst:type = "type code"
    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 ;
    sst_foundation:valid_max = 4500s ;
```

Code definitions for analysed_sst:type (see GHRSST-PP SST definitions in Section 2 of the GDS (Notations, conventions and definitions used by the GDS)):

type	Description
skin	Skin surface temperature
subskin	Subskin temperature
foundation	Foundation temperature
depth_blended	Temperature from a blended SST analysis valid over the surface ocean in a layer with unspecified depth
1m	SST at 1m depth (SST_{1m})
2m	SST at 2m depth (SST_{2m})
3m	SST at 3m depth (SST_{3m})
4m	SST at 4m depth (SST_{4m})
5m	SST at 5m depth (SST_{5m})
6m	SST at 6m depth (SST_{6m})
7m	SST at 7m depth (SST_{7m})
8m	SST at 8m depth (SST_{8m})
9m	SST at 9m depth (SST_{9m})
10m	SST at 10m depth (SST_{10m})

2. **analysis_error variable**

The variable 'analysis_error' is required with the format specification shown in Table 2. Note that for the Bureau's analyses this variable is equivalent to the "analysis field error" (ANERR in the Bureau's UARCH files).

Table 2 CDL description of analysis_error variable

Storage type	Name	Description	Unit
short	analysis_error	Error estimate for analysed SST output from analysis system	K
CDL description			

```
short analysis_error(time, lat, lon) ;
    analysis_error:long_name = "estimated error standard deviation of
analysed_sst" ;
    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;
```

Comments
This will be different for each analysis system.

3. sea_ice_fraction variable

The variable 'sea_ice_fraction' is required with the format specification shown in Table 3. Note that the Bureau's global and regional SST analyses currently use only "NCEP_ICE" as the source of ice edge data.

Table 3. CDL description of sea_ice_fraction variable

Storage type	Name	Description	Unit
byte	sea_ice_fraction	Fractional sea ice concentration	Fraction
CDL description			

<pre>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 = " " ;
    sea_ice_fraction:_FillValue = -128 ;
    sea_ice_fraction:add_offset = 0. ;
    sea_ice_fraction:scale_factor = 0.01 ;
    sea_ice_fraction:valid_min = 0 ;
    sea_ice_fraction:valid_max = 100 ;
    sea_ice_fraction:source = "source name (eg. NCEP_ICE)"</pre>			

Comments			
Sea Ice area fraction units are between 0 -> 1.0			
This variable shall not be used for areas not containing sea ice. For a single source of sea_ice_fraction define sea_ice_fraction:source. For multiple sources use the sources_of_sea_ice_fraction variable.			

4. sources_of_sea_ice_fraction variable

The variable 'sources_of_sea_ice_fraction' is required only when more than one source of sea_ice_fraction is specified. If relevant, use the format specification shown in Table 4.

Table 4. CDL description of sources_of_sea_ice_fraction variable

Storage type	Name	Description	Unit
byte	sources_of_sea_ice_fraction	Source(s) of fractional sea ice concentration (should be the same as for L2P)	none
CDL description			

<pre>byte sources_of_sea_ice_fraction (time, lat, lon) ;
    sources_of_sea_ice_fraction:long_name = "sources of sea ice fraction " ;
    sources_of_sea_ice_fraction:_FillValue = -128b ;
    sources_of_sea_ice_fraction:comment = "source code" ;</pre>			

Comments			
Code definitions for sources_of_sea_ice_fraction:comment			

Code	sources_of sea_ice_fraction
0	No sea ice set
1	NSIDC SSM/I Cavialeri et al (1992)
2	AMSR-E
3	ECMWF
4	CMS (France) combined SI & cloud mask used by Medspiration
5	EUMETSAT OSI-SAF
6	NCEP

7-15	Spare

This variable shall not be used for areas not containing sea ice. New sources of sea_ice_fraction will need to be registered with the GHRSST-PO and a code will be assigned.

5.   mask variable

The variable 'mask' is required with the format specification shown in Table 5. It currently has been produced from NMOC's 1/12° resolution topography (glbtopog) file. Note that there are possibly valid SST analysis values where the mask denotes land.

Table 5. CDL description of mask variable

Storage type	Name	Description	Unit
byte	mask	Composite of field masks for sea, land, lake, ice	none
CDL description			

```
byte mask(time, lat, lon) ;
    mask:long_name = "sea/land/lake/ice field composite mask " ;
    mask:_FillValue = -128b ;
    mask:flag_values = 1b,2b,4b,8b
    mask:flag_meanings = "sea land lake ice";
    mask:comment = "
                    b0: 1=grid cell is open sea water
                    b1: 1=land is present in this grid cell
                    b2: 1=lake surface is present in this grid cell
                    b3: 1=sea ice is present in this grid cell
                    b4-b7: reserved for future grid mask data";
```

Comments
Refer to WP-ID2.1.1.11 for definition of bit positions in a byte

Bit 0: 1=sea

Bit 1: 1=land

Bit 2: 1=lakes

Bit 3: 1=ice

6.   sst_bgf variable

The experimental field variable 'sst_bgf' is required with the format specification shown in Table 6. Note this is the background field used in the Bureau's SST analysis systems. For global SST analyses the background field is a combination of the previous analysis and climatology (see Section 8). The regional SST analysis system uses a combination of the previous regional analysis (highest weight) and previous global analysis to calculate the background field. If the previous week's global analysis is not available then the climatology will be used. The background field is the BGF variable in the Bureau's UARCH binary files.

Table 6 CDL description of sst_bgf variable

Storage type	Name	Description	Unit
short	sst_bgf	SST background field for analysis	K
CDL description			

```
short sst_bgf(time, lat, lon) ;
    sst_bgf:long_name = "background field used for analysed_sst" ;
    sst_bgf:units = "kelvin" ;
    sst_bgf:FillValue = -32768s ;
    sst_bgf:add_offset = 273.15 ;
    sst_bgf:scale_factor = 0.01 ;
    sst_bgf:valid_min = -300s ;
    sst_bgf:valid_max = 4500s ;
```

Comments

7. bgf_error variable

The experimental field variable 'bgf_error' is required with the format specification shown in Table 7.
Note this is the background field standard deviation error used in the Bureau's SST analysis systems.
The background field error is the BGFERR variable in the Bureau's UARCH binary files.

Table 7 CDL description of bgf_error variable

Storage type	Name	Description	Unit
short	bgf_error	Error estimate for SST background field	K
CDL description			

<pre>short bgf_error(time, lat, lon) ;
    bgf_error:long_name = "estimated standard deviation error of sst_bgf" ;
    bgf_error:units = "kelvin" ;
    bgf_error:FillValue = -32768s;
    bgf_error:add_offset = 0. ;
    bgf_error:scale_factor = 0.01 ;
    bgf_error:valid_min = 0s;
    bgf_error:valid_max = 32767s;</pre>			

Comments			

8. sst_clim variable

The variable 'sst_clim' is required with the format specification shown in Table 8. Note this is the bulk
SST climatology (Reynolds and Smith, 1994) input into the Bureau's global and regional SST analysis
systems (CLIM in the UARCH files).   The climatology field in the L4 file is the 1° resolution
Reynolds and Smith (1994) climatology interpolated to the analysis resolution.

Table 8. CDL description of sst_1m variable

Storage type	Name	Description	Unit
short	sst_clim	SST climatology used in analysis	K
CDL description			

<pre>short sst_clim(time, lat, lon) ;
    sst_clim:long_name = "sea temperature climatology at 1 metre depth" ;
    sst_clim:units = "kelvin" ;
    sst_clim:_FillValue = -32768s ;
    sst_clim:add_offset = 273.15 ;
    sst_clim:scale_factor = 0.01 ;
    sst_clim:valid_min = -200s ;
    sst_clim:valid_max = 4000s ;
    sst_clim:comment = "Reynolds and Smith (1994) SST climatology"</pre>			

Comments			

6. <u>Example of BLUElink L4 SSTfnd CDL Header</u>

```
netcdf 20061219-ABOM-L4fnd-AUS-v01-fv01 {
dimensions:
        lon = 1561 ;
        lat = 1081 ;
        time = UNLIMITED ; // (1 currently)
variables:
        float lon(lon) ;
                lon:standard_name = "longitude" ;
                lon:long_name = "longitude" ;
                lon:units = "degrees_east" ;
                lon:axis = "X" ;
        float lat(lat) ;
                lat:standard_name = "latitude" ;
                lat:long_name = "latitude" ;
```

```
                lat:units = "degrees_north" ;
                lat:axis = "Y" ;
        int time(time) ;
                time:standard_name = "time" ;
                time:long_name = "reference time of sst field" ;
                time:units = "seconds since 1981-01-01 00:00:00" ;
                time:axis = "T" ;
                time:calendar = "Gregorian" ;
        short analysed_sst(time, lat, lon) ;
                analysed_sst:standard_name = "sea_surface_temperature" ;
                analysed_sst:long_name = "analysed sea surface temperature" ;
                analysed_sst:units = "kelvin" ;
                analysed_sst:type = "foundation" ;
                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 ;
        short analysis_error(time, lat, lon) ;
                analysis_error:long_name = "estimated error standard deviation of
analysed_sst" ;
                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 ;
        byte sea_ice_fraction(time, lat, lon) ;
                sea_ice_fraction:standard_name = "sea_ice_area_fraction" ;
                sea_ice_fraction:long_name = "sea ice area fraction" ;
                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 = "NCEP_ICE" ;
        byte mask(time, lat, lon) ;
                mask:long_name = "sea/land/lake/ice field composite mask" ;
                mask:_FillValue = -128b ;
                mask:flag_values = 1b, 2b, 4b, 8b ;
                mask:flag_meanings = "sea land lakes ice" ;
                mask:comment = "b0: 1 = grid cell is open sea water\n",
                        "b1: 1 = land is present in this grid cell\n",
                        "b2: 1 = lake surface is present in this grid cell\n",
                        "b3: 1 = sea ice is present in this grid cell\n",
                        "b4-b7: reserved for future grid mask data" ;
        short sst_bgf(time, lat, lon) ;
                sst_bgf:long_name = "background field used for analysed_sst" ;
                sst_bgf:units = "kelvin" ;
                sst_bgf:_FillValue = -32768s ;
                sst_bgf:add_offset = 273.15f ;
                sst_bgf:scale_factor = 0.01f ;
                sst_bgf:valid_min = -300s ;
                sst_bgf:valid_max = 4500s ;
        short bgf_error(time, lat, lon) ;
                bgf_error:long_name = "estimated standard deviation error of sst_bgf" ;
                bgf_error:units = "kelvin" ;
                bgf_error:_FillValue = -32768s ;
                bgf_error:add_offset = 0.f ;
                bgf_error:scale_factor = 0.01f ;
                bgf_error:valid_min = 0s ;
                bgf_error:valid_max = 32767s ;
        short sst_clim(time, lat, lon) ;
                sst_clim:long_name = "sea temperature climatology at 1 metre depth" ;
                sst_clim:units = "kelvin" ;
                sst_clim:_FillValue = -32768s ;
                sst_clim:add_offset = 273.15f ;
                sst_clim:scale_factor = 0.01f ;
                sst_clim:valid_min = -200s ;
                sst_clim:valid_max = 4000s ;
                sst_clim:comment = "Reynolds and Smith (1994) SST climatology" ;

// global attributes:
        :Conventions = "CF-1.0" ;
        :title = "RAMSSA Analysed high resolution foundation sea surface temperature over
Australian Region" ;
        :DSD_entry_id = "ABOM-L4fnd-AUS-v01" ;
```

```
        :references =
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/Bureau_HR_Regional_SST_Analysis_vg1.0.pdf\n",
"http://www.bom.gov.au/bmrc/ocean/BLUElink/SST/BLUElink_L4_file_format_v6.pdf ";
        :GDS_data_centre = "ABOM" ;
        :institution = "Australian Bureau of Meteorology" ;
        :contact = "H.Beggs@bom.gov.au" ;
        :GDS_version_id = "v1.0-rev1.7" ;
        :netcdf_version_id = "3.6.0-p1 of Mar 31 2005 05:34:05 $" ;
        :creation_date = "2006-12-20" ;
        :product_version = "fv01" ;
        :history = "2006/12/20 03:49:43 +00 :
/bm/ghome/tpugh/Projects/GHRSST/bin/uarch2ghrsst.x foundSSTanal.19Dec2006.Fine" ;
        :spatial_resolution = "1/12 degree" ;
        :start_date = "2006-12-19" ;
        :start_time = "00:00:00 UTC" ;
        :stop_date = "2006-12-19" ;
        :stop_time = "00:00:00 UTC" ;
        :southernmost_latitude = -70.f ;
        :northernmost_latitude = 20.f ;
        :westernmost_longitude = 60.f ;
        :easternmost_longitude = 190.f ;
        :software_version = "L4 Processor v01" ;
        :file_quality_index = "1" ;
        :source_data = "AVHRR17_L-ABOM,AVHRR18_L-ABOM,AVHRR17_G-NAVO,AVHRR18_G-
NAVO,AVHRR_METOPA_G-NAVO,ATS_MET_2P-ESA,AMSRE-REMSS,IN_SITU-GTS_BUOYS,IN_SITU-
GTS_SHIP,IN_SITU-GTS_TESAC,LAPS-WSP,NCEP-ICE" ;
        :comment = "\n",
        "This is a research product run operationally at the Bureau..\n",
        "WARNING: some applications are unable to properly handle signed byte values.\n",
        "If byte values >127 are encountered, subtract 256 from this reported value." ;
        :uarch_file_id = "foundSSTanal.19Dec2006.Fine" ;
        :oi_scales = "\n",
            "Univariate Statistical Interpolation Package, SIANAL v13\n",
            "background correlation length scale  =  20 km\n",
            "observation correlation length scale =   12 km\n",
            "observation correlation time scale   = 0.5 days" ;
        :obsid_summary = "\n",
        "NAR17_SST-ABOM          nobs=209407  obsesd: avg=0.451 min=0.450 max= 0.450\n",
        "NAR18_SST-ABOM          nobs=239382  obsesd: avg=0.461 min=0.460 max= 0.460\n",

        "AVHRR17_G-NAVO          nobs= 19215  obsesd: avg=0.450 min=0.450 max= 0.450\n",
        "AVHRR18_G-NAVO          nobs= 14089  obsesd: avg=0.460 min=0.460 max= 0.460\n",
        "AVHRR_METOPA_G-NAVO   nobs= 14089  obsesd: avg=0.460 min=0.460 max= 0.460\n",
        "ATS_MET_2P-ESA          nobs= 11636  obsesd: avg=0.390 min=0.390 max= 0.390\n",
        "AMSRE-REMSS             nobs= 41688  obsesd: avg=0.660 min=0.660 max= 0.660\n",
        "IN_SITU-GTS_BUOYS       nobs=  4537  obsesd: avg=0.440 min=0.440 max= 0.440\n",
        "IN_SITU-GTS_SHIP        nobs=   161  obsesd: avg=1.200 min=1.200 max= 1.200\n",
        "IN_SITU-GTS_TESAC       nobs=    16  obsesd: avg=1.200 min=1.200 max= 1.200" ;
}
```