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(A)ATSR L2P Product Description

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1 Introduction

This document is intended to describe GHRSST L2P products generated with the RAL (A)ATSR L2P Processor [R1], in particular:

- the parent ENVISAT-format (A)ATSR level 2 gridded product from which the L2P product is derived
- differences from the Medspiration L2P product
- differences between the product produced by the RAL L2P processor in its 3 intended processing contexts, namely:
    1. Historical archive reprocessing
    2. Ongoing archive production
    3. Near-real-time production

The RAL (A)ATSR L2P processor has been developed to enable production of L2P products from (A)ATSR ENVISAT-format Level 2 gridded products (ATx_NR__2P). Products follow the GHRSST Data Processing Specifications (GDS) version 1.7 [R4] in most respects, but differ in some important aspects highlighted in this document.

Table 1 describes the currently-envisaged processing contexts in which L2P products can be produced using the RAL (A)ATSR L2P processor.

Table 1: (A)ATSR L2P processing contexts

Mode	**Near-Real Time**	**Ongoing archive production**	**Offline archive reprocessing**		
Mission	AATSR	AATSR	AATSR	ATSR-1	ATSR-2
Timeframe	Acquisition + 3-6 hrs	Acquisition + 2-3 weeks	Periodic		
Parent level 2 gridded product	ATS_NR__2P unconsolidated NRT product	ATS_NR__2P consolidated archive product	ATS_NR__2P consolidated archive product	AT1_NR__2P	AT2_NR__2P
Production	UK-MM-PAF	UK-MM-PAF	RAL/NEODC	RAL/NEODC	RAL/NEODC

2 Parent (A)ATSR level 2 gridded products

2.1 *AATSR level 2 gridded product ATS_NR__2P*

The AATSR full (1 km) resolution, level 2 gridded product, ATS_NR__2P, is fully described in [R2]. Two variants are available for processing to L2P:

1. ATS_NR__2P unconsolidated NRT product

   This is available within a short time frame after acquisition by the satellite and is available via FTP from the rolling archives at ESRIN and Kiruna ground stations. Products are generated using the ESA AATSR Operational Processor from orbit segments corresponding to telemetry dumps to the respective ground stations.

2. ATS_NR__2P consolidated archive product

   This product is produced on a daily basis at ESA's UK-MM-PAF facility in Farnborough, UK, typically 2-3 weeks after acquisition. It is generated using the ESA AATSR Operational Processor from a consolidated level 0 product, in which level 0 inputs from the two ground stations are combined into consolidated, full-orbit products starting slightly before the ascending-node crossing (ANX) time of each defined ENVISAT orbit. The Level 1b product (ATS_TOA_1P) is generated from this level 0 orbit product, (applying restituted instead of predicted orbit vectors as used in the NRT case), and the level 2 product ATS_NR__2P (and associated averaged product ATS_AR__2P) are generated from the level 1b product.

2.2 *ENVISAT-style level 2 gridded product from ATSR-1 and ATSR-2*

The equivalent ENVISAT-style products, AT1_NR__2P and AT2__NR__2P, are generated from ATSR-1 and -2 data, respectively, using the RAL Archive Product Processor (APP). The level 1b component of this processor combines available Ungridded Brightness Temperature (UBT) products into consolidated level 1b products. The level 2 component of the processor produces level 2 ATx_NR__2P and ATx_AR__2P from the level 1b product.

The format of these ENVISAT-style products matches the ENVISAT format specification, but although in general the content matches the expected content for such products, there are important differences from the equivalent AATSR products, described in document [R3].

2.3 *ATx_NR__2P product content*

The ATx_NR__2P product is the full-resolution geophysical product derived from the full resolution brightness temperature and reflectance measurements in the Level 1b (ATx_TOA_1P) product. The ATx_NR__2P product is a "switchable" product, meaning that the content of each pixel field depends on the surface type (specifically, controlled by the forward and nadir cloud flags and land flag). The product contains both nadir-only and combined (nadir and forward) pixel fields. Within each of these, where the pixel is free of cloud and not flagged as over land, the pixel will contain an SST value, derived as appropriate from either nadir-only, or combined nadir and forward, observations. The content of pixel fields is defined according to the following logic:

Table 2: Content of pixel values in ATx_NR__2P product : dependency on nadir and forward cloud flags and land flag.

Nadir cloud flag	Forward cloud flag	Land flag	Nadir field	Combined field
0	0	0	SST nadir	SST combined
0	1	0	SST nadir	SST combined*
1	0/1	0	Cloud top temperature	Cloud top height
0/1	0/1	1	Land surface temperature	NDVI

*Combined SST is still calculated in this case but confidence flag is not set.

The RAL (A)ATSR L2P processor uses the "combined field" shown in Table 2 as the source of SST pixels from which to populate the sea_surface_temperature field in the L2P product. Further details regarding rejection of pixels from this set are discussed in 4.1.1. Additionally, the dual-nadir SST difference is calculated based on the value of the "combined field" and "nadir field" shown in Table 2.

3 Description of (A)ATSR L2P product

3.1 *Scope*

The GHRSST L2P product is fully described in the GHRSST Product User Guide [R5], which covers all the current GHRSST products derived from observations from a wide range of observing and processing systems. The aim of this section is to describe only the L2P product generated from (A)ATSR level 2 gridded products by the RAL (A)ATSR L2P processor, and to highlight any special features of the (A)ATSR L2P product with respect to the generic description.

3.2 *L2P filename convention*

The RAL (A)ATSR L2P processor follows the GDS convention used for L2P products which is described in [R5]:

```
<Date Valid>-<L0 ID>-<Processing Centre Code>-L2P-<SST filename>[-<optional
characteristic>]-Processing Model ID>.<base format>
```

Name	Definition	Description
<Date Valid>	YYYYMMDD	Date for which this particular data set is valid. Derived from the date in the ATx_NR__2P product id (and hence filename)
<L0 ID>	Table 2.2 (A2) [R5].	Data set name. NB, the defined value applies only to NRT ATS_NR__2P products. Here it is applicable to ATS_NR__2P products from both NRT and archive sources, since the AATSR product id can be used to distinguish between these 2 sources. Expected values: ATS_NR__2P for AATSR AT2_NR__2P for ATSR-2 AT1_NR__2P for ATSR-1
<Processing Centre Code>	Table 2.1 (A2) [R5]	Processing centre code. Expected values: RAL = RAL/NEODC UPA = UK-MM-PAF
<SST filename>	Native to parent product. See [R2] for AATSR products. See [R3] for ATSR-1/2 products.	Filename of parent ATx_NR__2P product
<optional characteristic>	String	Not used
Processing Model ID>	Vnn (where nn is the GDS version number, e.g., 01	
<base format>	String	Generic file format (nc=netCDF)

3.3 *L2P data pixel record format*

Table 3 describes the content of a L2P pixel data record created for each SST measurement within the L2P product.

Table 3: L2P data pixel record format

Name	Description	Notes	Units
sea_surface_temperature	Pixel SST values	4.1.1	K
lat	Pixel latitude	4.1.2	degrees
lon	Pixel longitude	4.1.2	degrees
sst_dtime	Deviation in seconds from reference time defined as the time of the first L2P data record in this file stored in the netCDF global variable time. It is implicit that there will be a 0 value and sst_dtime is always positive.	4.1.3	seconds
SSES_bias_error	(A)ATSR-specific SSES bias error	4.1.4	K
SSES_standard_deviation_error	(A)ATSR-specific SSES standard deviation error	4.1.5	K
DT_analysis	Deviation from previous day (T-1) SSTfnd analysis. If no analysis is available, the reference mean SST climatology.	4.1.6	K
surface_solar_irradiance	Near contemporaneous SSI value	4.1.7	Wm^{-2}
wind_speed	Near contemporaneous wind speed value	4.1.8	ms^{-1}
sea_ice_fraction	Near contemporaneous sea ice fraction value	4.1.9	percent
aerosol_optical_depth	Aerosol optical depth	4.1.10	Scaled value
satellite_zenith_angle	-90 to +90 degrees	4.1.11	degree
rejection_flags	Bit field: 0=SST out of range 1=Cosmetic value 2=IR_Cloudy 3=MW_rain 4=MW_ice 5=MW_wind 6=Land 7=spare	4.1.12	Flag

Name	Description	Notes	Units
sources_of_wind_speed	Source(s) of wind_speed value. Source codes are detailed in the 'ancillary_sources: comment' attribute.	4.1.13	Code
sources_of_aod	Source(s) of AOD data. Source codes must be detailed in the 'ancillary_sources: comment' attribute	0	Code
sources_of_sea_ice_fraction	Source(s) of fractional sea ice data. Source codes are detailed in the 'ancillary_sources: comment' attribute.	4.1.15	Code
sources_of_ssi	Source(s) of SSI data. Source codes are detailed in the 'ancillary_sources: comment' attribute.	4.1.16	Code
wind_speed_dtime_from_sst	Time difference of wind_speed measurement from SST measurement	4.1.17	Scaled hours. 25=not known.
aod_dtime_from_sst	Time difference of AOD measurement from SST measurement	4.1.18	Scaled hours. 25=not known.
ssi_dtime_from_sst	Time difference of SSI measurement from SST measurement	4.1.19	Scaled hours. 25=not known.
confidence_flag	b0 : type of retrieval in sea_surface_temperature variable (0: dual-view, 1: nadir-only); b1 : retrieval in sea_surface_temperature variable used 3.7 micron channel (0: No, 1:Yes); b2 : spare; b3 : spare; b4 : spare; b5 : 1 = sun glint suspected; b6 : 1 = L2 native bias and standard deviation; b7 : 1 = L2 native confidence value" ;	0	Flags
proximity_confidence	(A)ATSR-specific SSES proximity confidence value	4.1.21	code
atsr_dual_nadir_sst_difference	Difference between dual and nadir SST values.	4.1.22	K

4 Content of specific netCDF variables

4.1.1 sea_surface_temperature

Each dual-view SST value in the parent ATx_NR__2P product is assessed according to the following rules:

- dual view SST value >= 271.15 K
- land flag not set
- dual and nadir views not flagged as cloudy
- dual and nadir views flagged as valid

If the conditions above are all true, the dual-view SST value is inserted into the sea_surface_temperature array. If not, it is replaced by the _FillValue, the reason for rejection is set via the rejection_flag, and the remaining fields are set to their respective _FillValue to mask out other fields in this SST pixel record.

Note that the ordering of pixels within each row in the sea_surface_temperature variable (and hence other variables) in the netCDF file may not be identical to that in products produced by Medspiration. For this reason, it is important to refer to the location of a given pixel using the corresponding elements in the lat and lon netCDF variables rather than relying on the expected order of pixel rows. This is particularly important when visualising data in comparison with Medspiration products.

Note that the AATSR definition of cosmetic fill is not the same as that used by the GHRSST project. For AATSR, cosmetic fill refers to pixels where the given BT is interpolated from the BTs either side. This happens occasionally in the nadir view when the curved scan data is gridded to 1 km, and happens often in the forward view as the number of real samples across the forward view (355) is less than the number of gridded pixels (512). For GHRSST, cosmetic fill refers to pixels that have been included from a model or interpolation scheme in order to provide a completely filled product. Consequently any pixel deemed to be a cosmetic fill in the ATx_NR__2P product is included in the resulting L2P file.

Note that the SST value is reported to the same precision in the L2P product as in the parent ATx_NR__2P product.

4.1.2 lat, lon

The pixel position in latitude and longitude, derived from geolocation information in the parent ATx_NR__2P product, is stored to a precision of 3 decimal places. In the parent product, geolocation information is stored in the form of a tie-point grid, used as the basis for interpolation of the actual position of each pixel. In the L2P product, however, this interpolation is done during processing and the full array of latitudes and longitudes must be stored. Because of this, values are rounded to 3DP in order to achieve the required compression (typically ~97% using bzip2).

It should be noted that the value given for the latitude and longitude of a pixel is that of the centre (which is inconsistent with Medspiration products). Also, due to the method used to read the parent ATx_NR__2P product and to obtain its geolocation information, it is noted that in some cases, rows of pixel records may appear in reverse order in the L2P product. Care should therefore be taken when using the

product to read the actual latitude and longitude values given for each pixel, and not to assume the order is the same as in a Medspiration L2P product.Were the centre coordinate to be used, then this would not cause an issue, but as currently implemented, this can cause such "reverse swath" products to present latitude and longitude values that are in error by 1 pixel (i.e. around 1 km).

4.1.3 sst_dtime

This represents the time of the SST observation relative to the reference time, defined as the time of the first L2P data record in the file stored in the netCDF global variable time.

Due to the conical scan pattern of the (A)ATSR instruments, the linear scan lines of pixels recorded in ungridded form appear as curved lines when processed into gridded products such as ATx_NR__2P. As a result, the time value assigned to each row of pixels is only strictly valid for the pixel(s) at the centre of the swath, with other pixels being in error by an amount related to their distance from the centre of the swath. For AATSR, the scan period (i.e. the time taken to complete 1 complete conical scan) is 0.15 seconds, and the geometry of the contributing curved scan lines in the nadir view (which is used for the time value) is such that the vertical extent of one "true" scan line is approximately 16.6 seconds (Figure 1). This is also the amount by which pixels at the edge of swath will be in error if assigned the time value of the pixel(s) at the centre of swath. This error is small compared to the accuracy required for matching with ancillary data sources and so, for simplicity, is ignored in the current version of the processor (but is in line with the approach used in Medspiration products).

The actual time value for each row is calculated as a linear interpolation between the first and last DSR_TIME in the SUMMARY_QUALITY_ADS of the ATx_NR__2P product. Thus the ssd_dtime value is the value for the row in which the current pixel belongs, minus the time of the first row in the product.

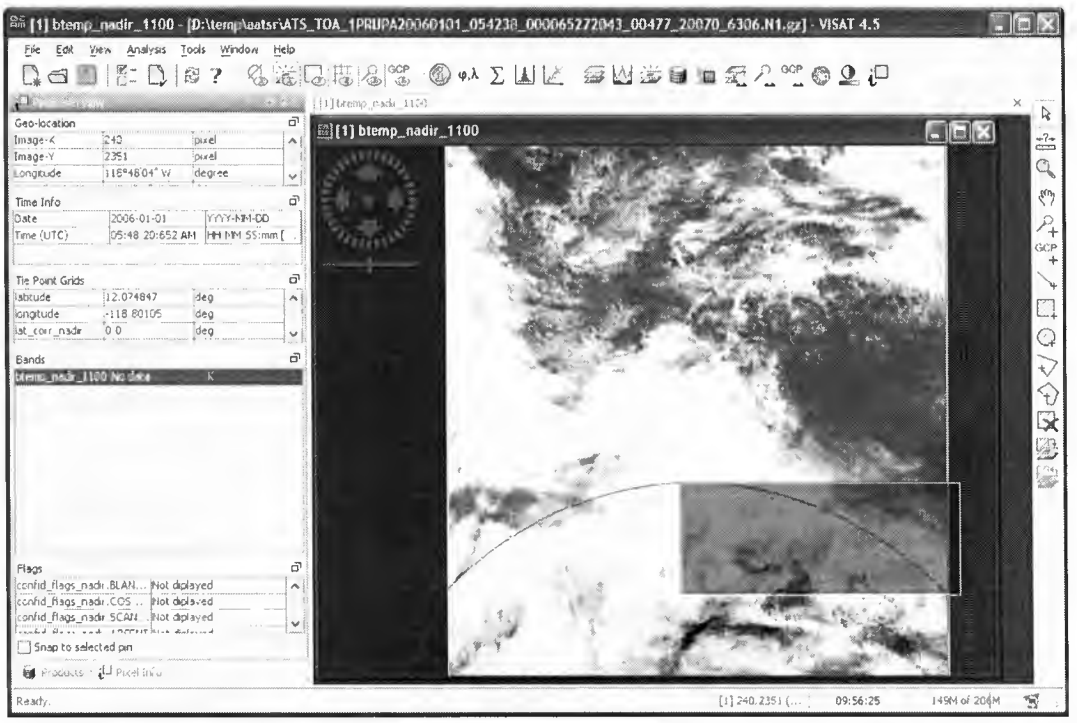

Figure 1: Error in time value for pixels other than at the centre-of-swath. The curved line of missing pixels in this brightness temperature image from an AATSR ATS_TOA_1P product reveals the underlying pattern of observations contributing to the straight rows of pixels in a gridded product. In this case, the top and bottom of the blue box represent the vertical extent of 1 nadir-view scan line feature. The time value at the top of the feature is 05:48:20.642, while the value at the bottom is 05:48:36.812, representing a time difference of 16.16 s over a vertical extent of 111 lines (corresponding to a scan period of 0.15 seconds). This means that pixels in the gridded product shown near the bottom right of the blue box should in ideally be assigned a time value closer to that of the centre-of-swath pixel at the top left of the blue box, so are in error by ~16.6 seconds.

4.1.4 SSES_bias_error

Single Sensor Error Statistics (SSES) values appropriate to each pixel are derived from a lookup table representing the SSES scheme developed by the University of Leicester specifically for (A)ATSR. Specific tables are used for each of the missions ATSR-1, ATSR-2 and AATSR for processing of consolidated archive products, with an additional table for use with NRT AATSR products. These tables are provided for reference in Appendix 2.

The lookup tables provide a bias error, standard deviation error and proximity confidence value for each of 12 cases defined in terms of:

- Wind speed
- Dual-minus-nadir SST difference
- Retrieval type (daytime 2-channel [D2], nighttime 3-channel [N3], …etc)

A full description of the (A)ATSR SSES scheme, and an explanation of the assigned bias, standard deviation and proximity confidence values is given in [R6].

4.1.5 SSES_standard_deviation_error

See 4.1.4.

4.1.6 DT_analysis

The DT_analysis table is filled from the relevant ancillary source, based on the latitude, longitude, and the time of the SST pixel.

4.1.7 surface_solar_irradiance

The value of surface solar irradiance is extracted from the relevant ancillary source, based on the latitude, longitude and time of the SST pixel. If the extracted value is higher than the upper limit of 1000, the value is rejected (and the _FillValue used) but this is recorded by the processor so that a percentage rejection rate can be calculated.

4.1.8 wind_speed

The value of wind speed is extracted from the relevant ancillary source, based on the latitude, longitude and time of the SST pixel. If the extracted value is higher than the upper limit of 16 ms^{-1}, the value is rejected (and the _FillValue used) but this is recorded by the processor so that a percentage rejection rate can be calculated.

4.1.9 sea_ice_fraction

The value of sea ice fraction is extracted from the relevant ancillary source, based on the latitude, longitude and time of the SST pixel.

4.1.10 aerosol_optical_depth

The value of aerosol optical depth is extracted from the relevant ancillary source, based on the latitude, longitude and time of the SST pixel.

4.1.11 satellite_zenith_angle

The satellite zenith angle used is taken from the nadir view elevation field of the ATx_NR__2P product. The value inserted into the L2P product is (90 – nadir view elevation).

4.1.12 rejection_flags

The rejection_flags field is not set for a valid SST value. Where an SST has failed any of the tests listed in 4.1.1, the appropriate bit is set here, recording the reason for its rejection.

Bits set when rejected:

6 = land

2 = cloudy

7 = not both views valid

4.1.13 sources_of_wind_speed

The source of wind speed, and the value used to indicate this in the sources_of_wind_speed variable, are shown in Table 4 for the processing contexts shown. Code values are taken from table 2.1.4 in [R5]

Table 4: Sources of wind speed used for (A)ATSR processing contexts

Context	Date range of SST data	Data source	Code
AATSR NRT	2008 onwards	ECMWF Forecast	3 = "NWP : ECMWF"
AATSR (Ongoing)	2008 onwards	ECMWF Forecast	3 = "NWP : ECMWF"
AATSR (Archive)	2002 – 2007	NWP_FOR_ATSR	4 = "NWP : Met Office"
ATSR-2	2002 onwards	NWP_FOR_ATSR	4 = "NWP : Met Office"
ATSR-2	1995 – 2002	ECMWF ERA-40	3 = "NWP : ECMWF"
ATSR-1	1991 - 1997	ECMWF ERA-40	3 = "NWP : ECMWF"

4.1.14 sources_of_aod

The source of aod, and the value used to indicate this in the sources_of_aod variable, are shown in Table 6 for the processing contexts shown. Code values are taken from table 2.1.6 in [R5].

Table 5: Sources of aod used for (A)ATSR processing contexts

Context	Date range of SST data	Data source	Code
AATSR NRT	2008 onwards	FAROP Forecast	3 = "NAAPS"
AATSR (Ongoing)	2008 onwards	FAROP Forecast	3 = "NAAPS"
AATSR (Archive)	2002 – 2007	Not available	
ATSR-2	2002 onwards	Not available	
ATSR-2	1995 – 2002	Not available	
ATSR-1	1991 - 1997	Not available	

4.1.15 sources_of_sea_ice_fraction

The source of sea ice fraction, and the value used to indicate this in the sources_of_sea_ice_fraction variable, are shown in Table 6 for the processing contexts shown. Code values are taken from table 2.1.3 in [R5].

Table 6: Sources of sea ice fraction used for (A)ATSR processing contexts

Context	Date range of SST data	Data source	Code
AATSR NRT	2008 onwards	ECMWF Forecast	3 = "NWP : ECMWF"
AATSR (Ongoing)	2008 onwards	ECMWF Forecast	3 = "NWP : ECMWF"
AATSR (Archive)	2002 – 2007	ECMWF Operational	3 = "NWP : ECMWF"
ATSR-2	2002 onwards	ECMWF Operational	3 = "NWP : ECMWF"
ATSR-2	1995 – 2002	ECMWF ERA-40	3 = "NWP : ECMWF"
ATSR-1	1991 - 1997	ECMWF ERA-40	3 = "NWP : ECMWF"

4.1.16 sources_of_ssi

The source of surface solar irradiance, and the value used to indicate this in the sources_of_ssi variable, are shown in Table 7 for the processing contexts shown. Code values are taken from table 2.1.5 in [R5].

Table 7 Sources of SSI used for (A)ATSR processing contexts

Context	Date range of SST data	Data source	Code
AATSR NRT	2008 onwards	ECMWF Forecast	4 = "NWP : ECMWF"
AATSR (Ongoing)	2008 onwards	ECMWF Forecast	4 = "NWP : ECMWF"
AATSR (Archive)	2002 – 2007	ECMWF Forecast	4 = "NWP : ECMWF"
ATSR-2	2002 onwards	ECMWF Forecast	4 = "NWP : ECMWF"
ATSR-2	1995 – 2002	ECMWF ERA-40	4 = "NWP : ECMWF"
ATSR-1	1991 - 1997	ECMWF ERA-40	4 = "NWP : ECMWF"

4.1.17 wind_speed_dtime_from_sst

No additional information with respect to [R5].

4.1.18 aod_dtime_from_sst

No additional information with respect to [R5].

4.1.19 ssi_dtime_from_sst

No additional information with respect to [R5].

4.1.20 confidence_flag

The definition of the confidence flag was revised for (A)ATSR and includes the following (A)ATSR specific bits:

Bit 0 may be set to 1 if a nadir-only SST is used. In this implementation of the processor, however, this not used, since only dual-view SSTs are used, so the bit is set to zero.

Bit 1 of the confidence_flag indicates whether the 3.7 micron channel was used in the SST retrieval in the parent ATx_NR__2P product. It is set to 0 if the 3.7 micron channel was not used (i.e. 2-channel retrieval) and 1 if the channel was used (3-channel retrieval).

Bit 3 of the confidence_flag is set if the wind speed is greater than the limit of 12 ms^{-1}.

4.1.21 proximity_confidence

See 4.1.4.

4.1.22 atsr_dual_nadir_sst_difference

In products produced by the RAL (A)ATSR L2P processor, an additional ("experimental") field is poplulated for valid SST pixels, containing the view difference, i.e. the difference in Kelvin between the dual and nadir SST values.

5 Content of netCDF global attributes

The global attributes section of the netCDF L2P product provides general metadata about the L2P product. The content of these attributes, as populated by the RAL L2P processor, are as defined in A1.1.1 of [R5] but are shown in the *ncdump -h* listing in Appendix 1.

6 References

L2P Processor Description
RAL-L2P-TN-02 [R1]

Envisat-1 Products Specification
PO-RS-MDA-GS-2009 [R2]

Envisat-style products for ATSR-1 and ATSR-2 data
APP-TN-005 [R3]

GHRSST Data Processing Specification GDS 1.7
GHRSST/17 [R4]

The GHRSST Product User Guide [R5]

Single Sensor Error Statistics : Report for (A)ATSR L2P Project
UL-L2P-P02 [R6]

7 Glossary

AATSR	Advanced Along Track Scanning Radiometer
ATSR-1, ATSR-2	Along Track Scanning Radiometer(-1/2)
ATS_NR__2P	Full-resolution Level 2 gridded product from AATSR
GHRSST	Group for High Resolution Sea Surface Temperature
L2P	Level 2 Pre-processed
RAL	Rutherford Appleton Laboratory
FAROP	Forecast of Aerosol Radiative Optical Properties

8 Appendices

Appendix 1 : Example output from *ncdump -h*

```
netcdf 20090426-ATS_NR_2P-RAL-L2P-
ATS_NR__2PNPDK20090426_133257_000060672078_00282_37410_6886-v01 {
dimensions:
        time = 1 ;
        nj = 40448 ;
        ni = 512 ;
variables:
        int time(time) ;
                time:long_name = "reference time of sst file" ;
                time:units = "seconds since 1981-01-01 00:00:00" ;
        float lat(nj, ni) ;
                lat:long_name = "latitude" ;
                lat:units = "degrees_north" ;
        float lon(nj, ni) ;
                lon:long_name = "longitude" ;
                lon:units = "degrees_east" ;
        short sea_surface_temperature(time, nj, ni) ;
                sea_surface_temperature:long_name = "sea surface temperature" ;
                sea_surface_temperature:units = "kelvin" ;
                sea_surface_temperature:_FillValue = -32768s ;
                sea_surface_temperature:add_offset = 273.15 ;
                sea_surface_temperature:scale_factor = 0.01 ;
                sea_surface_temperature:valid_min = -500s ;
                sea_surface_temperature:valid_max = 5000s ;
                sea_surface_temperature:coordinates = "lon lat" ;
                sea_surface_temperature:source = "ESA" ;
        short sst_dtime(time, nj, ni) ;
                sst_dtime:long_name = "time difference from reference time" ;
                sst_dtime:units = "second" ;
                sst_dtime:_FillValue = -32768s ;
                sst_dtime:add_offset = 0. ;
                sst_dtime:scale_factor = 1. ;
                sst_dtime:valid_min = -32767s ;
                sst_dtime:valid_max = 32767s ;
                sst_dtime:coordinates = "lon lat" ;
        byte satellite_zenith_angle(time, nj, ni) ;
                satellite_zenith_angle:long_name = "satellite zenith angle" ;
                satellite_zenith_angle:units = "angular_degree" ;
                satellite_zenith_angle:_FillValue = -128b ;
                satellite_zenith_angle:add_offset = 0. ;
                satellite_zenith_angle:scale_factor = 1. ;
                satellite_zenith_angle:valid_min = -90b ;
                satellite_zenith_angle:valid_max = 90b ;
                satellite_zenith_angle:coordinates = "lon lat" ;
        byte sea_ice_fraction(time, nj, ni) ;
                sea_ice_fraction:long_name = "sea ice fraction" ;
                sea_ice_fraction:units = "percent" ;
                sea_ice_fraction:_FillValue = -128b ;
                sea_ice_fraction:add_offset = 0. ;
                sea_ice_fraction:scale_factor = 0.01 ;
                sea_ice_fraction:valid_min = 0b ;
                sea_ice_fraction:valid_max = 100b ;
                sea_ice_fraction:coordinates = "lon lat" ;
        byte sources_of_sea_ice_fraction(time, nj, ni) ;
                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 = "0 No sea ice set; 1 NSIDC SSM/I
 Cavialeri et al (1992); 2 AMSR-E; 3 ECMWF; 4 CMS (France) cloud mask used by
 Medspiration" ;
                sources_of_sea_ice_fraction:coordinates = "lon lat" ;
        byte DT_analysis(time, nj, ni) ;
                DT_analysis:long_name = "deviation from sst reference climatology" ;
                DT_analysis:units = "kelvin" ;
                DT_analysis:_FillValue = -128b ;
                DT_analysis:add_offset = 0. ;
                DT_analysis:scale_factor = 0.1 ;
                DT_analysis:valid_min = -127b ;
                DT_analysis:valid_max = 127b ;
                DT_analysis:coordinates = "lon lat" ;
                DT_analysis:reference = "GHRSST Analysis" ;
        byte rejection_flag(time, nj, ni) ;
```

```
                rejection_flag:long_name = "rejection flag" ;
                rejection_flag:comment = "b0 : 1 = SST out of range; b1 : 1 = Cosmetic
value; b2 : 1 = IR cloudy; b3 : 1 = MW rain; b4 : 1 = ice; b5 : 1 = spare; b6 : 1 =
Land; b7 : 1 = unprocessed;" ;
                rejection_flag:coordinates = "lon lat" ;
        byte proximity_confidence(time, nj, ni) ;
                proximity_confidence:long_name = "proximity confidence value" ;
                proximity_confidence:_FillValue = -128b ;
                proximity_confidence:coordinates = "lon lat" ;
        byte confidence_flag(time, nj, ni) ;
                confidence_flag:long_name = "confidence flag" ;
                confidence_flag:comment = "b0 : type of retrieval in
sea_surface_temperature variable (0: dual-view, 1: nadir-only); b1 : retrieval in
sea_surface_temperature variable used 3.7 micron channel (0: No, 1:Yes); b2 : spare;
b3 : spare; b4 : spare; b5 : 1 = sun glint suspected; b6 : 1 = L2 native bias and
standard deviation; b7 : 1 = L2 native confidence value" ;
                confidence_flag:coordinates = "lon lat" ;
        byte SSES_bias_error(time, nj, ni) ;
                SSES_bias_error:long_name = "SSES bias error based on confidence flags"
;
                SSES_bias_error:units = "kelvin" ;
                SSES_bias_error:_FillValue = -128b ;
                SSES_bias_error:add_offset = 0. ;
                SSES_bias_error:scale_factor = 0.01f ;
                SSES_bias_error:valid_min = -127b ;
                SSES_bias_error:valid_max = 127b ;
                SSES_bias_error:coordinates = "lon lat" ;
        byte SSES_standard_deviation_error(time, nj, ni) ;
                SSES_standard_deviation_error:long_name = "SSES standard deviation
error based on confidence flags" ;
                SSES_standard_deviation_error:units = "kelvin" ;
                SSES_standard_deviation_error:_FillValue = -128b ;
                SSES_standard_deviation_error:add_offset = 1. ;
                SSES_standard_deviation_error:scale_factor = 0.01f ;
                SSES_standard_deviation_error:valid_min = -127b ;
                SSES_standard_deviation_error:valid_max = 127b ;
                SSES_standard_deviation_error:coordinates = "lon lat" ;
        byte aerosol_optical_depth(time, nj, ni) ;
                aerosol_optical_depth:long_name = "aerosol optical depth" ;
                aerosol_optical_depth:units = "count" ;
                aerosol_optical_depth:_FillValue = -128b ;
                aerosol_optical_depth:add_offset = 0. ;
                aerosol_optical_depth:scale_factor = 0.1 ;
                aerosol_optical_depth:valid_min = -127b ;
                aerosol_optical_depth:valid_max = 127b ;
                aerosol_optical_depth:coordinates = "lon lat" ;
        byte aod_dtime_from_sst(time, nj, ni) ;
                aod_dtime_from_sst:long_name = "time difference of AOD measurement from
sst measurement" ;
                aod_dtime_from_sst:units = "hour" ;
                aod_dtime_from_sst:_FillValue = -128b ;
                aod_dtime_from_sst:add_offset = 0. ;
                aod_dtime_from_sst:scale_factor = 0.1 ;
                aod_dtime_from_sst:valid_min = -127b ;
                aod_dtime_from_sst:valid_max = 127b ;
                aod_dtime_from_sst:coordinates = "lon lat" ;
        byte sources_of_aod(time, nj, ni) ;
                sources_of_aod:long_name = "sources of aerosol optical depth" ;
                sources_of_aod:_FillValue = -128b ;
                sources_of_aod:comment = "0 No AOD data available; 1 NESDIS; 2
NAVOCEANO; 3 NAAPS; 4-15 Spare (RDAC to suggest inputs here)" ;
                sources_of_aod:coordinates = "lon lat" ;
        byte wind_speed(time, nj, ni) ;
                wind_speed:long_name = "wind speed" ;
                wind_speed:units = "m s-1" ;
                wind_speed:_FillValue = -128b ;
                wind_speed:add_offset = 0. ;
                wind_speed:scale_factor = 1. ;
                wind_speed:valid_min = -127b ;
                wind_speed:valid_max = 127b ;
                wind_speed:coordinates = "lon lat" ;
        byte wind_speed_dtime_from_sst(time, nj, ni) ;
                wind_speed_dtime_from_sst:long_name = "time difference of wind speed
measurement from sst measurement" ;
                wind_speed_dtime_from_sst:units = "hour" ;
                wind_speed_dtime_from_sst:_FillValue = -128b ;
                wind_speed_dtime_from_sst:add_offset = 0. ;
```

```
                wind_speed_dtime_from_sst:scale_factor = 0.1 ;
                wind_speed_dtime_from_sst:valid_min = -127b ;
                wind_speed_dtime_from_sst:valid_max = 127b ;
                wind_speed_dtime_from_sst:coordinates = "lon lat" ;
        byte sources_of_wind_speed(time, nj, ni) ;
                sources_of_wind_speed:long_name = "sources of wind speed" ;
                sources_of_wind_speed:_FillValue = -128b ;
                sources_of_wind_speed:comment = "0 No wind speed data available; 1
AMSR-E data; 2 TMI data; 3 NWP:ECMWF; 4 NWP:Met Office; 5 NWP:NCEP; 6 Reference
climatology; 9-15 Spare to be defined by RDAC as required" ;
                sources_of_wind_speed:coordinates = "lon lat" ;
        byte surface_solar_irradiance(time, nj, ni) ;
                surface_solar_irradiance:long_name = "surface solar irradiance" ;
                surface_solar_irradiance:units = "watt m-2" ;
                surface_solar_irradiance:_FillValue = -128b ;
                surface_solar_irradiance:add_offset = 600. ;
                surface_solar_irradiance:scale_factor = 5. ;
                surface_solar_irradiance:valid_min = -127b ;
                surface_solar_irradiance:valid_max = 127b ;
                surface_solar_irradiance:coordinates = "lon lat" ;
        byte ssi_dtime_from_sst(time, nj, ni) ;
                ssi_dtime_from_sst:long_name = "time difference of surface solar
irradiance measurement from sst measurement" ;
                ssi_dtime_from_sst:units = "hour" ;
                ssi_dtime_from_sst:_FillValue = -128b ;
                ssi_dtime_from_sst:add_offset = 0. ;
                ssi_dtime_from_sst:scale_factor = 0.1 ;
                ssi_dtime_from_sst:valid_min = -127b ;
                ssi_dtime_from_sst:valid_max = 127b ;
                ssi_dtime_from_sst:coordinates = "lon lat" ;
        byte sources_of_ssi(time, nj, ni) ;
                sources_of_ssi:long_name = "sources of surface solar irradiance" ;
                sources_of_ssi:_FillValue = -128b ;
                sources_of_ssi:comment = "0 No SSI data available; 1 MSG_SEVIRI; 2
GOES_E; 3 GOES_W; 4 ECMWF; 5 NCEP; 6 METOFFICE; 7 For further use" ;
                sources_of_ssi:coordinates = "lon lat" ;
        short atsr_dual_nadir_sst_difference(time, nj, ni) ;
                atsr_dual_nadir_sst_difference:long_name = "sea surface temperature
nadir" ;
                atsr_dual_nadir_sst_difference:units = "kelvin" ;
                atsr_dual_nadir_sst_difference:_FillValue = -32768s ;
                atsr_dual_nadir_sst_difference:add_offset = 0. ;
                atsr_dual_nadir_sst_difference:scale_factor = 0.01 ;
                atsr_dual_nadir_sst_difference:valid_min = -5000s ;
                atsr_dual_nadir_sst_difference:valid_max = 5000s ;
                atsr_dual_nadir_sst_difference:coordinates = "lon lat" ;
                atsr_dual_nadir_sst_difference:source = "ESA" ;
                atsr_dual_nadir_sst_difference:comment = "non L2P core field;" ;
// global attributes:
                :Conventions = "CF-1.0" ;
                :title = "Sea Surface Temperature from AATSR" ;
                :DSD_entry_id = "RAL-L2P-ATS_NR_2P" ;
                :references = "GHRSST/17" ;
                :institution = "RAL" ;
                :contact = "neodc@rl.ac.uk" ;
                :GDS_version_id = "v1.r1.7" ;
                :netcdf_version_id = "3.5" ;
                :creation_date = "2009-05-06" ;
                :product_version = "1.0" ;
                :history = "L2P Processor v1.0" ;
                :platform = "ENVISAT" ;
                :sensor = "AATSR" ;
                :spatial_resolution = "1km" ;
                :start_time = "13:32:57 UTC" ;
                :stop_time = "15:14:05 UTC" ;
                :start_date = "2009-04-26 UTC" ;
                :stop_date = "2009-04-26 UTC" ;
                :northernmost_latitude = 83.78937f ;
                :southernmost_latitude = -83.77901f ;
                :easternmost_longitude = 179.9999f ;
                :westernmost_longitude = -179.9999f ;
                :file_quality_index = 0 ;
                :source_data = "ATS_NR_2P" ;
                :comment = "WARNING Some applications are unable to properly handle
signed byte values. If values are encountered > 127, please subtract 256 from this
reported value" ;
}}
```

Appendix 2 : SSES thresholds & values for (A)ATSR processing contexts.

The following tables provide the SSES thresholds and values currently used in the RAL L2P processor for each of the cases (1-12) defined in [R6].

- AATSR NRT

```
Instrument: AATSR
-----------------

Thresholds:
-----------
T2U = +0.04
T2L = -1.53
T3U = +0.51
T3L = -0.51

SSES:     Bias  StDev  PCF
--------------------------
Case 01:  +0.23        0.39    5
Case 02:  +0.18        0.34    5
Case 03:  -0.44        0.73    3
Case 04:  -0.44        0.73    3
Case 05:  +0.78        0.67    3
Case 06:  +0.78        0.67    3
Case 07:  +0.04        0.33    5
Case 08:  +0.10        0.33    5
Case 09:  -0.77        0.51    4
Case 10:  -0.68        0.42    4
Case 11:  +0.59        0.35    4
Case 12:  +0.65        0.32    4
```

- AATSR Ongoing / archive

```
Instrument: AATSR
-----------------

Thresholds:
-----------
T2U = +0.04
T2L = -1.53
T3U = +0.51
T3L = -0.51

SSES:     Bias  StDev  PCF
--------------------------
Case 01:  +0.20        0.33    5
Case 02:  +0.20        0.33    5
Case 03:  -0.41        0.71    3
Case 04:  -0.41        0.71    3
Case 05:  +0.71        0.64    3
Case 06:  +0.71        0.64    3
Case 07:  +0.11        0.32    5
Case 08:  +0.11        0.32    5
Case 09:  -0.65        0.49    4
Case 10:  -0.65        0.49    4
Case 11:  +0.69        0.32    4
Case 12:  +0.69        0.32    4
```

- ATSR-2

```
Instrument: ATSR-2
------------------

Thresholds:
-----------
T2U = +0.17
T2L = -1.23
T3U = +0.40
T3L = -0.51

SSES:     Bias  StDev  PCF
--------------------------
Case 01:  +0.07        0.43    5
Case 02:  +0.07        0.43    5
Case 03:  -0.43        0.78    3
Case 04:  -0.43        0.78    3
Case 05:  +0.24        0.83  3
Case 06:  +0.24        0.83  3
Case 07:  +0.06        0.35    5
Case 08:  +0.06        0.35    5
Case 09:  -0.61        0.57    4
Case 10:  -0.61        0.57    4
Case 11:  +0.51        0.39    4
Case 12:  +0.51        0.39    4
```

- ATSR-1

```
Instrument: ATSR-1
------------------

Thresholds:
-----------
T2U = +1.24
T2L = -0.95
T3U = +1.15
T3L = -0.38

SSES:     Bias  StDev  PCF
--------------------------
Case 01:  +0.16        0.65    5
Case 02:  +0.16        0.65    5
Case 03:  -0.54        0.72    3
Case 04:  -0.54        0.72    3
Case 05:  +0.52        1.18    3
Case 06:  +0.52        1.18    3
Case 07:  +0.07        0.49    5
Case 08:  +0.07        0.49    5
Case 09:    -          -       2
Case 10:    -          -       2
Case 11:  +0.28        0.57    4
Case 12:  +0.28        0.57    4
```