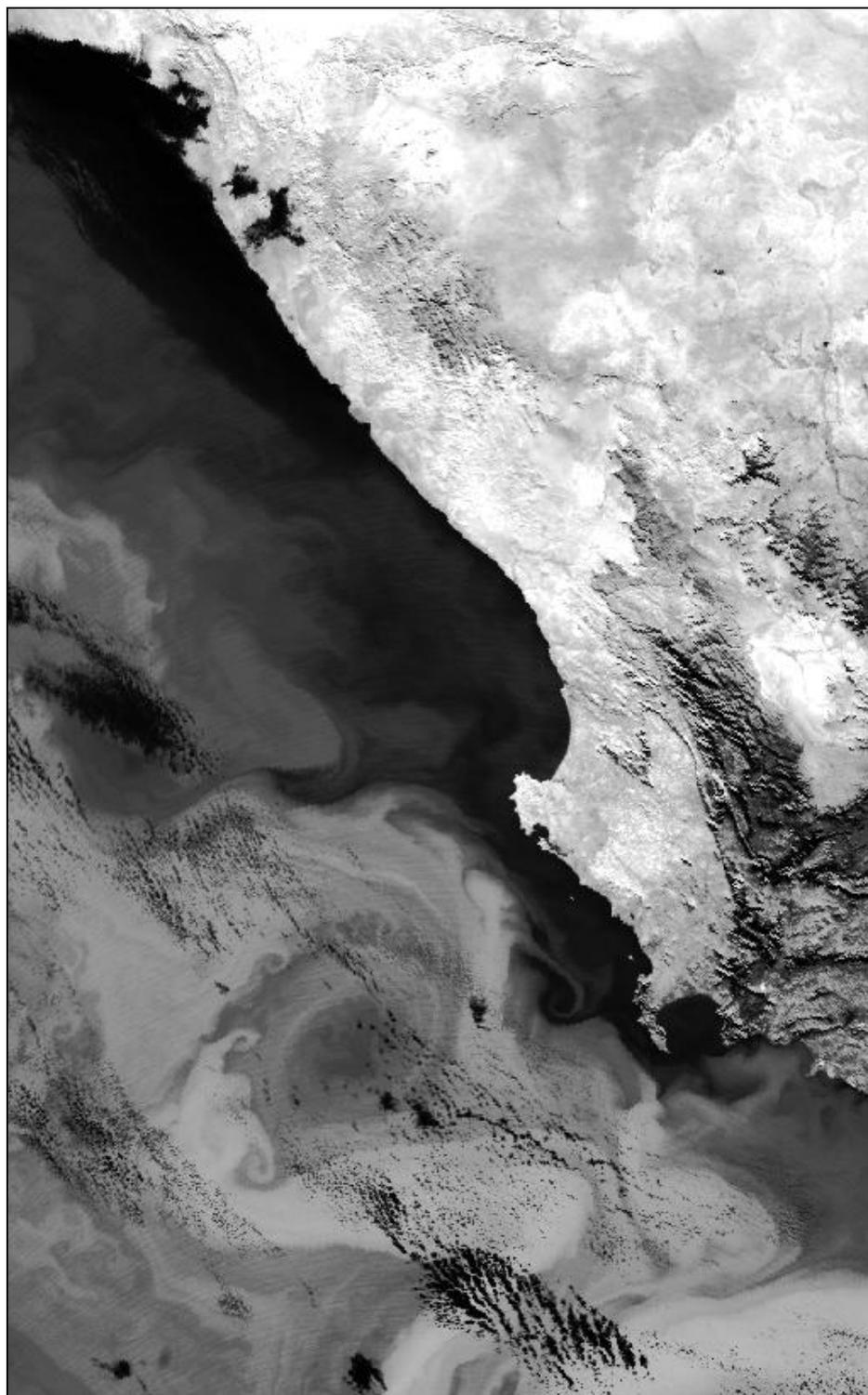
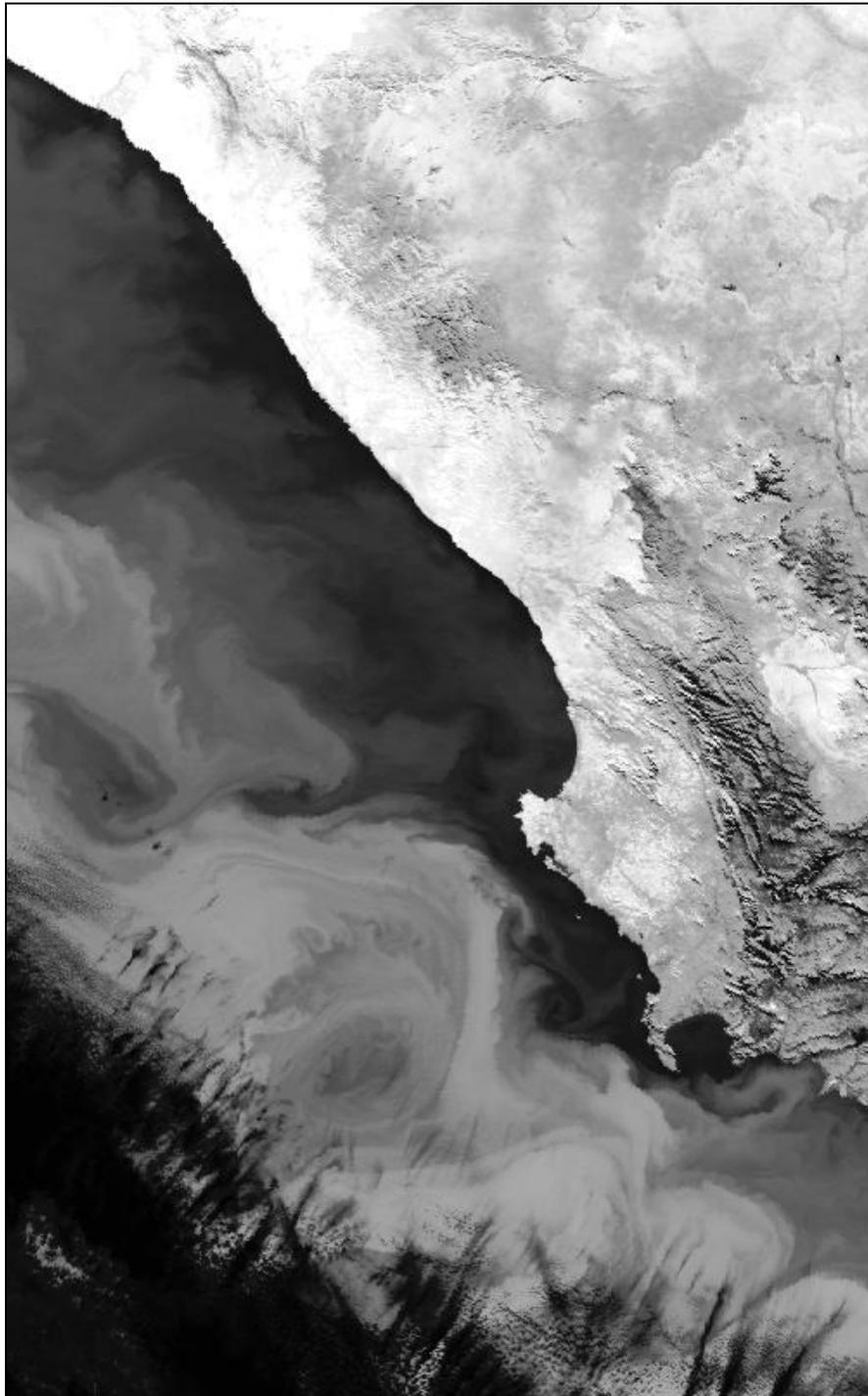


Envisat-style products for ATSR-1 and ATSR-2 data

APP-TN-005
(Issue 2.0 DRAFT, 20 March, 2007)



The cover picture shows the 11 μ m brightness temperature around the south-west coast of South-Africa as acquired by ATSR-1 on the first of June 1995. Note the complex thermal structure resolved in the sea-surface temperature. The image below was acquired on the following day by ATSR-2 and shows how the major thermal structures persist but also shows development in the fine structure. Both images were created from Envisat-format ATS_TOA_IP products read by and displayed with the Brockmann Consult BEAM (VISAT) software.



Document Change Record

Issue 1.0	Nov 24, 2005	Level1B products only, first issue
Issue 1.1	June 06, 2006	Updated with corrections, still L1B only
Issue 2.0 (Draft for comment)		L2 products included

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1 Purpose

The purpose of this document is to identify differences between AATSR data products generated by the Envisat PDS and the corresponding ATSR-1/ATSR-2 products generated by the (A)ATSR Archive Product Processor (APP). The latter are designed to match the former. This match is very close, but, owing to instrument and/or mission differences, it is not exact. Indeed, in order to distinguish between the instruments during periods of mission overlap, some content difference is essential.

N.B. This document does not attempt to describe the Envisat format - readers are assumed to be familiar with it. Anyone unfamiliar with this format should study the general and AATSR-specific sections of:

Envisat-1 Products Specifications PO-RS-MDA-GS-2009 [R1]

2 Generic Issues

2.1 Approach

Until the advent of the (A)ATSR series Archive¹, only AATSR products were available in the Envisat standard format [R1]. Now, ATSR-1 and ATSR-2 data are also available from this archive in Envisat format . These products adhere precisely to the Envisat *format* definition for AATSR ATS_TOA_1P, ATS_NR__2P and ATS_AR__2P products [R1]. In general, the *content* also matches the expected content for such products. There are exceptions, however, where mission limitations (wrt AATSR) do not allow exact content matching. These exceptions are dealt with in this document.

In the rest of this document, whenever ATSR is used, it means both ATSR-1 and ATSR-2. If ATSR-1 is used it means only ATSR-1. If ATSR-2 is used, it means only ATSR-2.

2.2 Product Naming Convention

The generic Envisat name form is defined in [R1]. ATSR products adhere to this form, as follows, for L1B, L2/NR and L2/AR respectively:

ATn_TOA_1PSRALYYMMDD_HHMMSS_0000000NMMM_RRR_AAAAA_0000.EN
ATn_NR__2PSRALYYMMDD_HHMMSS_0000000NMMM_RRR_AAAAA_0000.EN
ATn_AR__2PSRALYYMMDD_HHMMSS_0000000NMMM_RRR_AAAAA_0000.EN

Note:

1. The **YYMMDD_HHMMSS** date string shows the sensing start.
2. The **0000000** is an unused field for ATSR.
3. The **NMMM** field is the mission phase (**N**) and cycle (**MMM**). For ERS-2 the cycle duration was fixed throughout the mission (as for Envisat). For ERS, the phases are defined below (3.6).
4. The **RRR** field is the relative orbit number and **AAAAA** is the absolute orbit number. For ERS/ATSR-1, if ever the relative orbit number, cycle or phase are undefined or unknown, the exception values 999, 999 and 9 (respectively) will be used.
5. The **0000** field is the Envisat “product type file counter” and is not used for ATSR.
6. The extensions .E1 and .E2 are used to distinguish ATSR-1 (ERS) and ATSR-2 (ERS-2) from AATSR (ENVISAT) products, where the extension .N1 is used. **AT1** for ATSR-1 and **AT2** for ATSR-2 replaces the ATS used for AATSR products.

2.3 The Main Product Header (MPH)

All Envisat-style products have a common MPH format [R1]. ATSR products match this format but the content differs from the AATSR MPH as follows:

¹ Hosted by the NEOCD at RAL and funded by DEFRA

1. The PROC_STAGE field is set to S for “special product” .
2. The ACQUISITION_CENTER field is set to “ERS Stations ” as more than one ground station may have been used in data acquisition.
3. The PROC_CENTER field is set to “RAL NN” where NN is used to distinguish processing runs. E.g. “RAL ” indicates the original processing run., “RAL 01” would indicate a first reprocessing, etc. **N.B.** In the case of ATSR-2, after the ERS-2 platform lost gyro control, in January 2001, a “yaw-correction” is required to improve geolocation and co-location of the two ATSR views. The correction information is not always available. Where a correction is possible and has been applied, the letter Y is introduced in this field. “RALY “ indicates Y correction has been applied, “RAL “ indicates no correction applied.
4. For L1B products, the SOFTWARE_VER field is set to “STEP /N.M ”, where STEP is the L1 → L1B component of the APP and N.M is the version number. For L2 products, the SOFTWARE_VER field is set to proto2/N.M.
5. All times in Envisat MPH are given to 6 places of decimals in the seconds part of the time field. This is also the case for ATSR, but note that some of these times are available only to three places of decimals and so, in these cases, zero-padding is used.
6. The PHASE field is used in the following way:
 - a. For ERS-2/ATSR-2 set to 1 for the entire mission
 - b. For ERS/ATSR-1 set as follows:
 - i. 1 – Commissioning (3-day repeat starts 25-Jul-91)
 - ii. 2 – Ice Phase (3-day repeat starts 28-Dec-91))
 - iii. 3 – Experimental (No ATSR data – tbc – starts 02-Apr-92)
 - iv. 4 – Multi-disciplinary (35-day repeat starts 14-Apr-92)
 - v. 5 – Second Ice Phase (3-day repeat starts 23-Dec-93)
 - vi. 6 – Geodetic Phase (168-day repeat starts 10-Apr-94)
 - vii. 7 – Shifted Geodetic (168-day repeat starts 28-Sep-94)
 - viii. 8 – Second Multi-disciplinary (35-day repeat starts 21-Mar-95)
7. The CYCLE field is used in the following way:
 - a. For ERS-2/ATSR-2 used as for Envisat
 - b. For ERS/ATSR-1 this field is set as advised in:
<http://earth.esa.int/rootcollection/eo/ERS1.1.7.html>.
8. The REL_ORBIT field is used in the following way:
 - a. For ERS-2/ATSR-2 used as for Envisat
 - b. For ERS/ATSR-1 this field is set as advised in:
<http://earth.esa.int/rootcollection/eo/ERS1.1.7.html>
9. The ABS_ORBIT field is used as for Envisat.
10. The field DELTA_UT1 is set to +.000000 (unused)
11. The fields LEAP.UTC, LEAP_SIGN and LEAP_ERR are all unused and are set to “ ”, +000 and 0 respectively (as per [R1])
12. The ERS and ERS-2 state-vector information is not available to the same position and velocity precision as in the Envisat case. With Envisat, positions are given to 3 places of decimals (units – metres) and velocities to 6 places of decimals (units ms^{-1}). For ERS and ERS-2, the same number of decimal places is used, but these are zero-padded, e.g. Z velocity component of 7377.14 ms^{-1} is expressed as $7377.140000 \text{ ms}^{-1}$.

3 Instrument Differences

It is important to understand instrument differences when comparing ATSR and AATSR products. The table below shows the channels fitted in each of the three instruments and whether or not these channels are continuously available.

Channel	ATSR-1		ATSR-2		AATSR	
	Fitted?	Always On?	Fitted?	Always On?	Fitted?	Always On?
12µm	Yes	Yes	Yes	Yes	Yes	Yes
11µm	Yes	Yes	Yes	Yes	Yes	Yes
3.7µm	Yes	No	Yes	No	Yes	Yes
1.6µm	Yes	No	Yes	No	Yes	Yes
0.86µm	No	n/a	Yes	No	Yes	Yes
0.67µm	No	n/a	Yes	No	Yes	Yes
0.55µm	No	n/a	Yes	No	Yes	Yes

AATSR has all its seven channels available continuously while it is in “measurement mode”.

ATSR-1 has only 4 of these channels – the four longest wavelength infrared channels.

- The failure of the 3.7 µm channel on May 27, 1992, means that only 4-channel SST retrievals are available from that date up to the nominal end-of-mission in June 1996.
- After the 3.7µm channel failure, the 1.6µm data are available continuously.
- NDVI information is unavailable as the 3 shorter wavelength reflectance channels on ATSR-2 and AATSR were not fitted. Exception values fill the NDVI fields [R1].

ATSR-2 has all seven of the AATSR channels, but they are not all continuously available.

- The four reflectance channels are not continuously available for ATSR-2 [R3]. Exception values are used to flag unavailable data [R1].
- ATSR-2 switches telemetry-rate between H-Rate and L-Rate [R3]. There is nothing defined in the Envisat/AATSR L1b product to flag these events.
- ATSR-2 switches between Pixel Selection Maps (PSM) [R3]. There is nothing defined in the Envisat/AATSR L1b product to flag these events.
- While the instrument is in H-Rate, the 3.7µm and 1.6µm channels are both available. When in L-Rate and on the dayside, the 3.7µm or 1.6µm channel data are available, but not both [R3].

External metadata provide this pixel-map and telemetry-rate information for the ATSR-2 mission.

Note also:

- For AATSR the number of jittered scans is detected in the L0 → L1 processing and recorded in the SQADS. This jitter-flagging is not available in the SADIST-2 input products and consequently cannot be flagged for ATSR
- The reflectance channels' calibration coefficients GADS is not available for the ATSR data products. For ATSR-1, this is not possible as there is no VISCAL unit and so a full calibration of its 1.6µm channel is not possible. For ATSR-2 a logically different approach is adopted, with respect to that for AATSR, and although this approach is algorithmically equivalent, no GADs is produced.

4 The ATS_TOA_1P Product (Level 1B)

4.1 The Specific Product Header (SPH)

The format of the SPH is defined in [R1]. ATSR products adhere to this format. The following lists ATSR-specific points of which users should be aware:

1. ATSR detector temperatures in the fields MIN_12_MICRON_DETECTOR_TEMP etc are available at lower precision than is the case for AATSR. Zero-padding of these temperatures is used to match the Envisat SPH format for temperatures. E.g. a temperature of 79.73 is represented as +7.97300000E+01.
2. The fields MIN_FPA_BASEPLATE_TEMP & MAX_FPA_BASEPLATE_TEMP actually refer to the Stirling Cycle Cooler cold-tip temperatures for ATSR and not the baseplate temperatures as for AATSR.
3. The Data Set Descriptor (DSD) for the Visible Calibration Coefficients Global Annotation Data Set (GADS) exists but refers to the “missing” GADS.
4. The referencing DSD for the Level_0 file:
DS_NAME= “AATSR SOURCE PACKETS ”
now references the APP's ungridded intermediate orbit file, with an Envisat-style name [R2].
5. The referencing DSDs for the DIGITAL_ELEVATION_MODEL_FILE has the string ”NOT USED” since no topographic corrections are available.
6. Since the APP does not use the Level_0 to Level_1 processing approach of the AATSR PP, the following referencing DSDs are redundant but remain in place.
 - a. INSTRUMENT_DATA_FILE
 - b. VISIBLE_CALIBRATION_FILE
 - c. GENERAL_CALIBRATION_FILE

4.2 **The Annotation Data Sets (ADS)**

The format of the ADS is defined in [R1]. ATSR products adhere to this format. The following lists ATSR specific points of which users should be aware:

1. The Summary Quality ADS are present, but contain no validation/quality information. For ATSR there is no jitter flagging in the input UBTs. Other SQADs-related information – CRC failures, null packets, basic validation failures etc are flagged in each MDS but are not summarised in the SQADs.
2. The Geolocation and Topographic Corrections ADS contains no topographic information. The topography-related fields in this ADS are set to 0.
3. The Visible Calibration GADS is missing – as identified in the SPH.

4.3 **The Measurement Data Sets (MDS)**

The format of the MDSs is defined in [R1]. ATSR products adhere to this format. The following lists ATSR specific points of which users should be aware:

1. For ATSR-1, there is only one reflectance channel - at 1.6 μ m. Prior to the 3.7 μ m channel failure, data from this reflectance channel were acquired only during the day-side part of the orbit. After the failure, the 1.6 μ m data were also acquired during the night-side part of the orbit.
2. For ATSR-1, the 3.7 μ m channel MDS is filled with the appropriate exception value [R1] for products generated from data acquired after its failure.
3. For ATSR-1 the three absent short wavelength channels' MDS are filled with the appropriate exception value [R1].
4. For ATSR-2, the reflectance channels data were not acquired during the night-side of the orbit. During these periods, the MDS measurement fields are filled with the appropriate exception value [R1].
5. For ATSR-2, during the day-side of the orbit, as the instrument switches between telemetry rates and PSMs, some reflectance channels data are unavailable [R3]. During these periods, the MDS measurement fields hold the appropriate exception value [R1].
6. For ATSR, the Record Quality Indicator field is unused and always set to zero. Product users should inspect the Confidence Words MDS to assess data quality.

5 The ATS_NR__2P Product (Level 2 Gridded)

5.1 The SPH

Most of the content of the SPH of these products is copied from the corresponding ATS_TOA_1P product and so the comments in section 4.1 apply here also. In addition:

1. In the “DISTRIB_SST_CLOUD_LAND_MDS” DSD, the FILENAME field is filled for ATSR whereas it is empty for AATSR. The filename given should be ignored.
2. The final DSD in the AATSR set, “LST_COEFFS_DATA_FILE”, is omitted in the ATSR case – i.e. only 10 DSD are present.

5.2 The ADS

The seven ADS in these products are copied over from the corresponding L1B products. See section 4.2 for any differences between the AATSR and ATSR cases.

5.3 The MDS

1. The REC_QLTY_INDIC field is unused in ATSR products and set to zero.
2. The three SPARE fields following the REC_QLTY_INDIC field are set to zero in the case of ATSR, but to 32 in the case of AATSR.

There are no other known differences, but remember the ATSR-1, ATSR-2 and AATSR instrument differences mentioned in section 3 regarding the availability of a given channel in ATSR products. Where the channel is unavailable, this can impact the possibility of deriving, or the method of deriving, retrieved quantities. So:

- The NDVI cannot be derived in the absence of the 0.67 μ m or 0.86 μ m channels.
- SST retrieval approach is affected by the absence of the 3.7 μ m channel.

The appropriate Envisat/AATSR product exception values are used whenever retrieved quantities cannot be derived [R1].

6 The ATS_AR__2P Product (Level 2 Averaged)

6.1 The SPH

There are 19 DSD in the SPH of the AATSR product. There are only 18 DSD in the SPH of the ATSR product. The 19th, the referencing DSD for the LST coefficients data file, is missing.

In the DSD for all equi-angular grids MDS, the FILENAME field is space-filled in the AATSR case but contains the [APP] name of the parent product in the ATSR case. This name should be ignored.

6.2 The ADS

There are no ADS in the ATS_AR__2P product.

6.3 The MDS

Only 2 of the 4 AATSR grids are present in the ATSR case. The 10 and 30 arc-minute grids are present, the 17 and 50 kilometre grids are not. This is reflected in the SPH and its DSD.

In the case of ATSR, the AST_confidence word matches the bit-pattern and location specified in [R1]. In the case of AATSR it does not.

There are no other known differences, but remember the ATSR-1, ATSR-2 and AATSR instrument differences mentioned in section 3 regarding the availability of a given channel in ATSR products. Where the channel is unavailable, this can impact the possibility of deriving, or the method of deriving, retrieved quantities. So:

- The NDVI cannot be derived in the absence of the 0.67 μ m or 0.86 μ m channels.
- SST retrieval approach is affected by the absence of the 3.7 μ m channel

The appropriate Envisat/AATSR product exception values are used whenever retrieved quantities cannot be derived [R1].

7 The ATS_MET_2P Product (Level 2 METEO)

7.1 *The SPH*

There are 5 DSD in the SPH of the AATSR product. There are only 4 DSD in the SPH of the ATSR product. The 5th, the referencing DSD for the LST coefficients data file, is missing.

7.2 *The ADS*

There are no ADS in the ATS_MET_2P product

7.3 *The MDS*

In the case of ATSR, the AST_confidence word matches the bit-pattern and location specified in [R1]. In the case of AATSR it does not.

There are no other known differences, but remember the ATSR-1, ATSR-2 and AATSR instrument differences mentioned in section 2 regarding the availability of a given channel in ATSR products. Where the channel is unavailable, this can impact the possibility of deriving, or the method of deriving, retrieved quantities. So, in the case of the METEO product:

- SST retrieval approach is affected by the absence of the 3.7 μ m channel

8 References

R1	Envisat-1 Products Specifications	PO-RS-MDA-GS-2009
R2	ATS_TOA_UP Definition Document	APP-TN-002
R3	ATSR-1/-2 User Guide	C.T. Mutlow et al

9 Glossary

AATSR	Advanced Along-Track Scanning Radiometer
ADS	Annotation Data Set(s)
APP	[(A)ATSR] Archive Product Processor
ATSR	Along-Track Scanning Radiometer
DEFRA	Department for Environment, Food and Rural Affairs
DS	Data Set
DSD	Data Set Descriptor(s)
GADS	Global Annotation Data Set
H-Rate	High Rate [telemetry]
L-Rate	Low Rate [telemetry]
L0	Level 0 [product]
L1	Level 1 [product]
L1B	Level 1B [product]
MDS	Measurement Data Set(s)
MPH	Main Product Header(s)
NEODC	NERC Earth Observation Data Centre
NERC	Natural Environment Research Council
PP	Prototype Processor
PSM	Pixel Selection Map
RAL	Rutherford Appleton Laboratory
SPH	Specific Product Header(s)
SQADS	Summary Quality Annotation Data Set
wrt	with respect to