

It was intended that the collection and downlink of data would switch between the 1.6 and 3.7 μm channels, depending on the downlink bandwidth available at the time. However, prior to the failure of the 3.7 μm channel in 1992 (up to which this issue affected ATSR-1 data), the 1.6 μm channel data was left uncalibrated (flagged as “calibration unavailable”) as the relevant blackbody (BB) data was not being downlinked correctly. This issue was resolved by defining a new way of calibrating the data but it required that the data be reprocessed from L0 first. For more information, see [RD.2].

2. WP: ATSR-1 Uncalibrated Brightness Temperatures (04/1996 – 06/1996)

This issue only appears present towards the end of the ATSR-1 mission, where the expected pseudo-linear relationship between the 11 and 12 μm channels are not seen, and is suspected to have resulted from the occasional saturation of the warm BB signal towards the end of the mission. This issue was resolved but required that the data be reprocessed from L0 first. For more information, see [RD.3].

3. WP: ATSR-1 & 2 Data Availability

The identification of missing UBT data (at orbit and sub-orbit levels, generated from any available L0 data yet to be processed) was achieved through making comparisons between the information contained in the improved pre-processor log files and ESA’s L0 archive. For more information, see [RD.4].

4. WP: ATSR-2 Data Recovery (07/2003 – 01/2008)

During the summer of 2003, the failure of ERS-2’s on-board tape recorders meant that data from then on could only be acquired through a real-time downlink whilst the satellite was in communication range with a dedicated ground station. As a result of the latter, the data retrieved was highly fragmented and could not, back then, be processed using the “standard” set of ATSR processing software. The solution to this issue was recently identified and data from post-June 2003 – 2008 (i.e. an extra 4.5 years of ATSR-2 data) is now available, for the first time, to users. For more information, see [RD.5].

2. QC METHOD

The systematic QC checks were performed on L1 (L1B) products of the ATSR v3.0.1 Reprocessing dataset using the in-house QC tool, ATSR Header Analysis Tool (AHAT), which was also used to perform the systematic QC checks on the v3.0 Reprocessing dataset. The visual QC checks were performed on L1B products also, using the Sentinels Application Platform (SNAP, v6.0) software.

Note, due to the extensive number of new ATSR-2 post-June 2003 products that had to be subjected to systematic QC, CEDA kindly ran AHAT on that section of their ATSR-2 archive and then sent all outputs back to the IDEAS+ (A)ATSR QC team for analysis.

3. QC RESULTS

The total number of ATSR L1B products assessed in the systematic QC activity is included in Table 1. Further details are provided in subsequent sections of this document.

Table 1 ATSR L1B Products QC

V3.0.1	Instrument (Archive Coverage)	# ATSR L1B Products QC
1 st Pass	ATSR-1 (07/1991 – 10/1996)	219 (sample, see Section 3.1)
	ATSR-2 (04/1995 – 06/2003)	213 (sample, see Section 3.1)
2 nd Pass	ATSR-1 (07/1991 – 10/1996)	5,594
	ATSR-2 (04/1995 – 06/2003)	666
	ATSR-2 (07/2003 – 01/2008)	19,998

The results of the systematic QC activity revealed five different AHAT errors and these are outlined in Table 2.

Table 2 AHAT QC Errors

Error	Example of Error	Comment
E #1: MPH and SPH start times disagree	<p>ERROR: Product start times do not agree:</p> <p>MPH: 01-JUL-2004 02:12:31.229000</p> <p>SPH: 01-JUL-2004 02:06:38.880000</p>	<p>Note this error was not seen in the v3.0 Reprocessing dataset; this error was only seen in ATSR-2 products from the post-June 2003 period of the v3.0.1 Reprocessing dataset. It is likely that this error is due to the way in which these particular products were generated, through processing highly fragmented L0 data.</p> <p>Only a sample of ATSR-2 products were investigated (nearly all products from this period were affected by this error) and the differences between the MPH and SPH times appear to be up to an hour in duration.</p>
E #2: Missing MPH stop time	<p>ERROR: Product stop times do not agree:</p> <p>MPH:</p> <p>SPH: 30-JAN-2004 22:44:59.946000</p>	<p>This error affects only short products, and is considered to be a result of the values not being reset correctly for short products.</p> <p>This does not affect the MDS and so does not warrant further investigation (or archive segregation).</p> <p>Detailed investigations were carried out into products affected by this error in v3.0,</p>

Error	Example of Error	Comment
<p>E #3: Invalid last longitudes in SPH</p>	<p>ERROR: Invalid longitude value, Last_First_Long = 2147483648</p> <p>ERROR: Invalid longitude value, Last_Mid_Long = 2147483648</p> <p>ERROR: Invalid longitude value, Last_Last_Long = 2147483648</p>	<p>see [RD.6].</p> <p>This error affects only short products, and is considered to be a result of the values not being reset correctly for short products.</p> <p>This does not affect the MDS and so does not warrant further investigation (or archive segregation).</p> <p>Detailed investigations were carried out into products affected by this error in v3.0, see [RD.6].</p>
<p>E #4: Missing SPH start and stop times</p>	<p>ERROR: Product start times do not agree:</p> <p>MPH: 05-SEP-2004 00:55:03.027000</p> <p>SPH:</p> <p>ERROR: Product stop times do not agree:</p> <p>MPH: 10-MAY-1995 08:59:43.982100</p> <p>SPH:</p>	<p>This error was only observed in one product from v3.0 and was attributed to a processing failure (see [RD.6]).</p> <p>This error was observed in a number of products from v3.0.1. A sample of products were inspected, confirming that they do not contain any valid data are so are non-nominal products.</p>
<p>E #5: MPH and SPH stop times disagree</p>	<p>ERROR: Product stop times do not agree:</p> <p>MPH: 16-MAR-2005 19:25:03.827000</p> <p>SPH: 16-MAR-2005 19:25:22.794000</p>	<p>As the MPH contains details from the UBT products, and the SPH contains details of the ANX-ANX L1 product, some disagreement between these times nearly always occurs, usually due to granularity issues when truncating at the ANX.</p> <p>Detailed investigations were carried out into products affected by this error in v3.0, see [RD.6].</p>

It is to be noted that there are many L1B products, spread throughout the two missions, which contain minimum and maximum detector temperatures (near-infrared and infrared channels only) that are outside the range of accepted temperature values. This appears to coincide with, and therefore likely to be attributed to, frequent outgassing events (as confirmed in previous QC activities concerning ATSR and AATSR (see [RD.7])).

3.1 QC: ATSR – 1st Pass Reprocessing

The systematic QC checks performed here were only deemed necessary in order to confirm that the pass's implementation of the processing bug fix had made no fundamental, or unintentional, changes to the products generated. These systematic QC checks were performed on a sample (i.e. 2 days from 2 months of each year of each mission) of ATSR L1B products only.

Note a number of new ATSR L1 and L2 products were unexpectedly generated by the APP (i.e. they do not exist in previous reprocessing datasets) also. It is suspected that the implemented processing bug fix allowed for easier (more forgiving) data processing, especially for where data gaps exist, than before. The new ATSR L1B products generated here were added to the sample of ATSR L1B products selected for systematic QC (i.e. as this will be the first time these products have been subjected to systematic QC).

In addition to the aforementioned systematic QC checks, visual QC checks were also performed on a small sample of ATSR L1B products in order to confirm that the implemented processing bug fix was successful in terms of providing the expected improvements (as shown in Figure 1).

Results

The results of the systematic and visual QC checks for ATSR-1 and ATSR-2 products from the 1st pass presented no new issues, or problem products, that required further investigation. See Table 3, for the ATSR L1B summary.

Table 3 1st Pass: ATSR L1B QC (Problem Products)

QC	No. ATSR Problem L1B Products		Comment
	ATSR-1	ATSR-2	
Systematic	E #1 (0) E #2 (1) E #3 (0) E #4 (0) E #5 (1)	E #1 (0) E #2 (0) E #3 (0) E #4 (0) E #5 (0)	The products in which these errors are related to were also observed in v3.0 (with the same errors). No further investigations are required.
Visual	(0) PASS	(0) PASS	The processing bug fix appears to be correctly implemented in the sample products looked at. (See Figure 1)

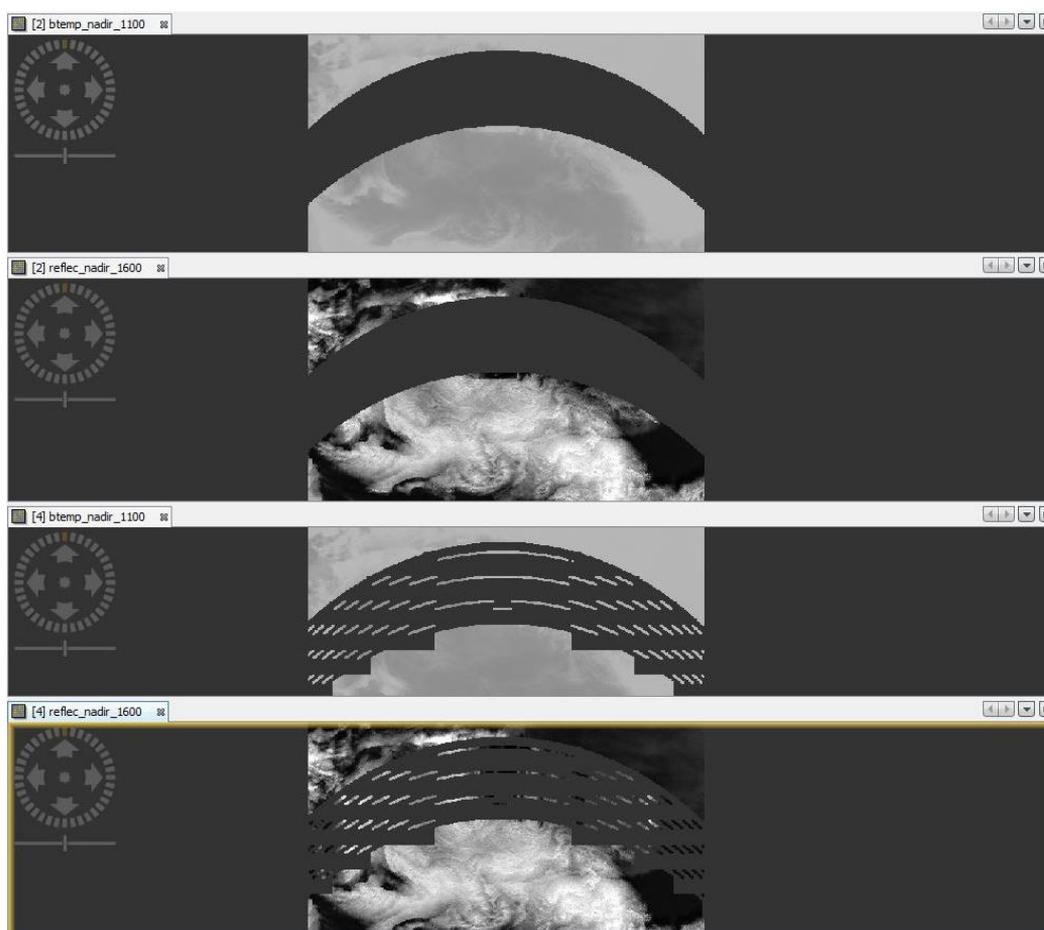


Figure 1 ATSR v3.0.1: Implementation of processing bug fix - data gap present in nadir (1.6 and 11 μm channels), comparison between v3.0.1 (top 2 images) and v3.0 (bottom 2 images). Product:

AT1_TOA_1PURAL19950712_044903_00000008004_00333_20862_0000.

3.2 QC: ATSR – 2nd Pass Reprocessing

The new L1 and L2 ATSR products generated by this pass of the reprocessing were introduced to the ATSR dataset and archived for the first time (i.e. not subjected to QC previously). Systematic QC checks were performed on all new L1 products and visual QC checks were performed on only a sample of these new L1 products (for the same reason mentioned for the 1st pass).

Results

The results of the systematic and visual QC checks for ATSR-1 and ATSR-2 products (*excluding post-June 2003* products) from the 2nd pass presented *no* new issues, or problem products, that required further investigation. See Table 4, for the ATSR L1B summary.

Table 4 2nd Pass: ATSR L1B QC (Problem Products)

QC	No. ATSR Problem L1B Products			Comment
	ATSR-1	ATSR-2 (pre-2003)	ATSR-2 (post-June 2003)	
Systematic	E #1 (0) E #2 (2) E #3 (0) E #4 (0) E #5 (3)	E #1 (0) E #2 (0) E #3 (0) E #4 (0) E #5 (0)	See Table 5.	The products in which these errors are related to were also observed in v3.0 with the same errors. No further investigations are required. (ATSR-1 L1B Problem Products included in Annex (Table 7)).
Visual	(0) Pass	(0) Pass	Fail	

The results of the systematic and visual QC checks for *post-June 2003* ATSR-2 products are summarised in Table 4 and Table 5; the results show that a large proportion (~85 %) of these products are associated with at least one systematic QC error.

The most common systematic QC error is that of E #1. E #1 indicates that the Main Product Header (MPH) and Specific Product Header (SPH) stop times do not agree and it is suspected that this originates from the way in which this highly fragmented data was processed (using “best efforts”). The results of the visual QC checks (an example of which is shown in Figure 2) supports the latter, and also indicates that these products are of a non-nominal quality.

Users should note that despite these systematic QC errors (some of which do not warrant archive segregation alone (e.g. E #2, E #3 and E #5)), the ATSR-2 data produced post-June 2003 cannot be calibrated and so segregation is required as the quality of the products cannot be guaranteed. An exception to the latter, however, are those products associated with E #4 (see list in Table 6) which do not contain valid data (and cannot be visualised in SNAP) and so it’s recommended that they are removed from the archive (see Section 4).

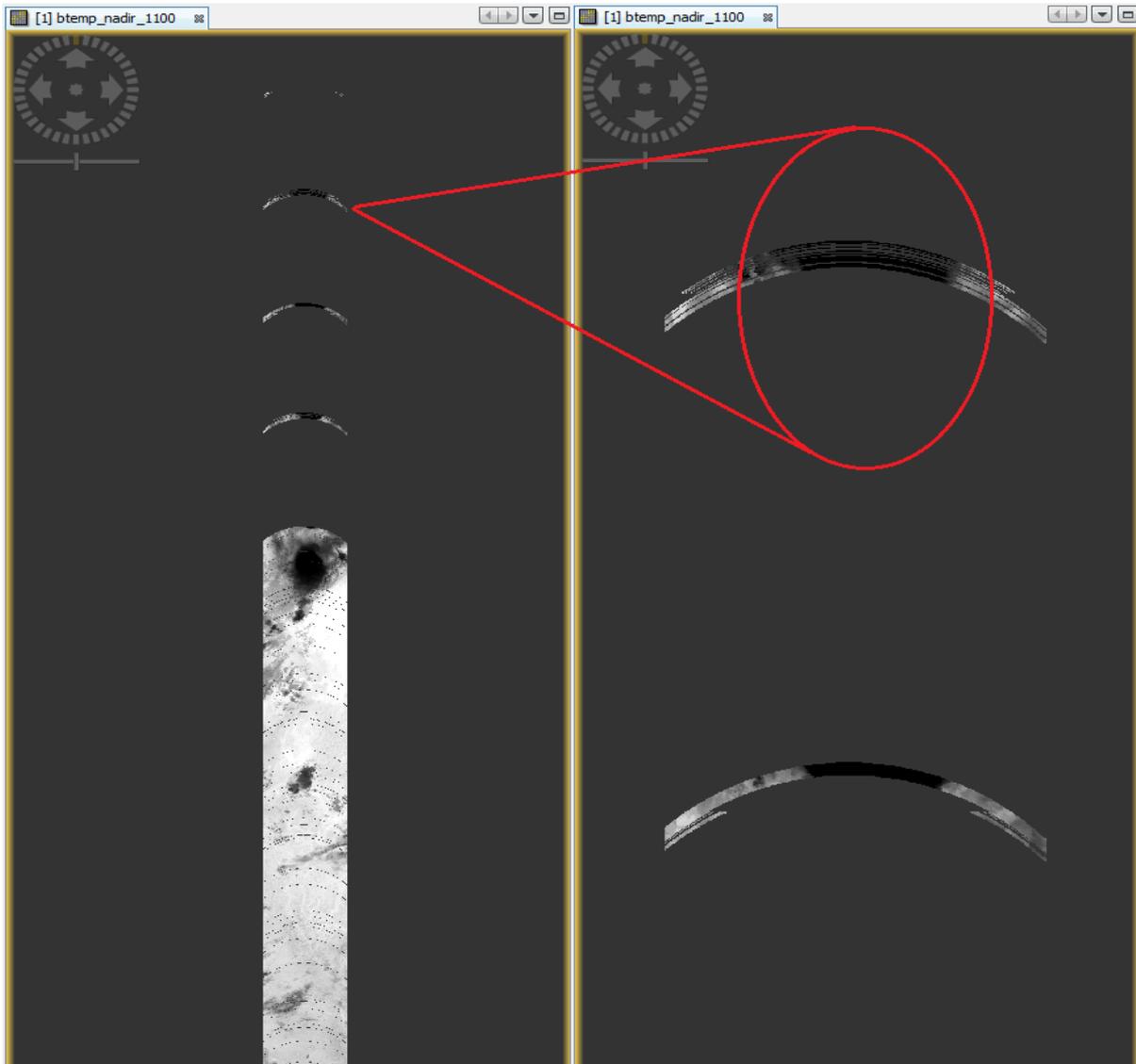


Figure 2 ATSR-2 v3.0.1 (post-June 2003): The fragmented nature of data included in products from this period. Product: AT2_TOA_1PURAL20060807_052205_00000001118_00090_59062_0000.E2 (nadir view, 11 μ m channel).

Table 5 2nd Pass: ATSR-2 2003 – 2008 L1B QC (Problem Products)

Month/Year	Products	Problem Products	Error (No. Products)
07/2003	191	175	1(174), 4(1)
08/2003	411	379	1(379)
09/2003	371	337	1(337), 5(2)
10/2003	390	352	1(352)

Month/Year	Products	Problem Products	Error (No. Products)
11/2003	389	351	1(351), 2(3), 3(1)
12/2003	371	343	1(343)
01/2004	422	383	1(382), 2(1)
02/2004	382	345	1(345)
03/2004	426	385	1(384), 3(2)
04/2004	409	379	1(379)
05/2004	422	388	1(388)
06/2004	389	359	1(359), 3(2)
07/2004	345	306	1(306), 3(1)
08/2004	365	328	1(328)
09/2004	350	319	1(318), 4(1)
10/2004	371	330	1(330), 2(1)
11/2004	391	352	1(352), 2(2), 4(3)
12/2004	363	329	1(329), 2(1)
01/2005	425	385	1(383), 2(1), 4(2)
02/2005	395	342	1(341), 2(2), 4(1)
03/2005	411	347	1(347), 3(1), 5(1)
04/2005	389	345	1(344), 2(1), 4(1)
05/2005	382	334	1(334)
06/2005	401	352	1(352), 2(1)
07/2005	412	34	1(385)
08/2005	406	362	1(365), 2(1)
09/2005	401	356	1(355), 3(1), 5(1)
10/2005	430	353	1(352), 2(1), 3(3)
11/2005	414	365	1(365), 2(2)
12/2005	438	352	1(352), 2(1)
01/2006	429	385	1(385),
02/2006	395	365	1(365), 2(1), 3(2)
03/2006	431	390	1(390), 2(1), 3(1)
04/2006	418	349	1(349), 2(3), 3(2)
05/2006	423	344	1(342), 2(1), 4(1)

Month/Year	Products	Problem Products	Error (No. Products)
06/2006	371	308	1(305), 2(2), 4(1)
07/2006	408	346	1(345), 2(1), 3(1), 4(1)
08/2006	390	331	1(327), 2(1), 3(1)
09/2006	412	313	1(311), 2(1), 3(2), 4(1)
10/2006	435	344	1(342), 2(1), 4(1)
11/2006	424	326	1(326), 3(1)
12/2006	431	334	1(334), 2(1), 5(1)
01/2007	429	330	1(328), 2(2),3(2), 5(1)
02/2007	395	306	1(305), 2(2)
03/2007	439	351	1(351),2(1)
04/2007	421	331	1(330), 2(1)
05/2007	436	348	1(346), 2(3), 3(1), 4(1)
06/2007	411	340	1(339), 2(2), 4(1)
07/2007	424	359	1(358), 2(1), 4(1)
08/2007	419	337	1(337), 4(1)
09/2007	418	339	1(339), 3(2)
10/2007	436	351	1(348), 2(2), 3(2), 4(2)
11/2007	422	328	1(327), 2(1), 3(2)
12/2007	418	334	1(334), 2(1)
01/2008	424	342	1(341), 2(2)
Total	19998	16976	

*A product can be associated with one or more errors.

4. ARCHIVE RECOMMENDATIONS

Updated ATSR-1 and ATSR-2 READMEs have been produced for the ATSR v3.0.1 archive. These updated READMEs include the following:

- ATSR-1 and 2: New orbits, corresponding to known non-nominal events (e.g. outgassings, satellite manoeuvres, etc.), for segregation.
- ATSR-2: New orbits, corresponding to the ERS-2 on-board tape recorder failure period (post-June 2003, orbits 43072 – 66831), for segregation.
- ATSR-2: New orbits for removal (listed in Table 6).

All archives concerning the ATSR v3.0.1 Reprocessing dataset should be updated according to these two READMEs.

Table 6 ATSR v3.0.1 2nd Pass ATSR L1B Problem Products for Removal

ATSR L1B Product
AT2_TOA_1PURAL20030719_225105_000000001086_00172_43112_0000.E2
AT2_TOA_1PURAL20040904_231122_000000001098_00072_49024_0000.E2
AT2_TOA_1PURAL20041115_002013_000000001100_00087_50041_0000.E2
AT2_TOA_1PURAL20041126_011452_000000001100_00245_50199_0000.E2
AT2_TOA_1PURAL20041130_004901_000000001100_00302_50256_0000.E2
AT2_TOA_1PURAL20050117_004022_000000001101_00488_50943_0000.E2
AT2_TOA_1PURAL20050127_002600_000000001102_00130_51086_0000.E2
AT2_TOA_1PURAL20050208_004900_000000001102_00302_51258_0000.E2
AT2_TOA_1PURAL20050405_231659_000000001104_00115_52073_0000.E2
AT2_TOA_1PURAL20060526_033541_000000001116_00046_58016_0000.E2
AT2_TOA_1PURAL20060607_003729_000000001116_00216_58186_0000.E2
AT2_TOA_1PURAL20060914_002556_000000001119_00130_59603_0000.E2
AT2_TOA_1PURAL20061019_002549_000000001120_00130_60104_0000.E2
AT2_TOA_1PURAL20070517_002557_000000001126_00130_63110_0000.E2
AT2_TOA_1PURAL20070614_191235_000000001127_00041_63522_0000.E2
AT2_TOA_1PURAL20070714_201006_000000001127_00471_63952_0000.E2
AT2_TOA_1PURAL20070810_192110_000000001128_00356_64338_0000.E2

5. SUMMARY

The systematic and visual QC activities concerning the ATSR v3.0.1 dataset have now been completed and the results reported in this memorandum. Note the latter QC activities covered L1 (i.e. L1B) ATSR products only, and any QC errors found at this level can be assumed to have cascaded down into the v3.0.1 L2 ATSR products generated (users are reminded that for L2 and L3 products, they should refer to the products generated by the GlobTemperature project and ESA's CCI SST project).

The results show that most problem products (i.e. products with QC errors) were known problem products, having raised the same error(s) in the QC of the v3.0 Reprocessing dataset, and so no further investigations were necessary. The results also showed that new problem products (i.e. new products generated by the v3.0.1 Reprocessing (2nd pass), with QC errors) were associated with non-nominal events (as expected) or non-nominal periods (e.g. ATSR-2 post-June 2003), and so no further investigations were necessary here either.

6. REFERENCES

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- [RD.2] Investigation into ATSR-1 1.6 & 3.7 μm channel switching, Rutherford Appleton Laboratory, PO-TN-RAL-AT-0571, Version 1.0, 29 November 2016. Available at: https://atsrsensors.org/pdf/ATSR-1_1-6um_channel%20investigation-Issue_1%200.pdf
- [RD.3] Investigation into ATSR-1 uncalibrated brightness temperatures, Rutherford Appleton Laboratory, PO-TN-RAL-AT-0572, Version 1.0, 05 August 2017. Available at: <https://earth.esa.int/documents/700255/1761550/PO-TN-RAL-AT-0572-ATSR1uncalibBTs-Issue1.pdf/cfb60fbf-2159-41b9-be5f-d21e4d847a5d?version=1.0>
- [RD.4] Investigation into ATSR-1 and ATSR-2 data availability, Rutherford Appleton Laboratory, PO-TN-RAL-AT-0573, Version 1.0, 26 August 2017. Available at: https://earth.esa.int/documents/700255/1761550/PO-TN-RAL-AT-0573-ATSR-1and2_DataAvailability-Issue_1.0.pdf/b4ff5ba0-2f8f-4a94-8754-47b8ad0573fc?version=1.0
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- [RD.6] ATSR-1 and ATSR-2 Reprocessing Systematic QC Investigation, IDEAS-VEG-OQC-REP-1331, Version 1.0, 04 September 2013. Available at: https://earth.esa.int/documents/700255/2411932/QC8_IDEAS-VEG-OQC-REP-1331+ATSR-1+and+ATSR-2+Reprocessing+Systematic+QC+Investigation+v1+0.pdf
- [RD.7] AATSR Reprocessing Systematic QC Investigation, IDEAS-VEG-OQC-REP-1261, Version 1.0, 24 May 2013. Available at: https://earth.esa.int/documents/700255/2411932/QC7_IDEAS-VEG-OQC-REP-1261+AATSR+Reprocessing+Systematic+QC+Investigation+v1.pdf

7. ANNEX

Table 7 lists problem products (new problem products, excluding post-June 2003 ATSR-2 products) from the 2nd pass of the v3.0.1 reprocessing. The first three products correspond to non-nominal periods (the first being the commissioning phase and the last

two coinciding with outgassings) and should be put into segregation (i.e. their orbits have been added to the corresponding README). The last two products correspond to nominal periods, and are associated with an error that does not affect their MDS, and so can remain in the nominal part of the archive.

Table 7 ATSR v3.0.1 2nd Pass ATSR L1B Problem Products

ATSR L1B Product	Error	Comment
AT1_TOA_1PURAL19920310_102331_000000002025_00036_03401_0000.E1	5	Non-nominal (Commissioning Phase)
AT1_TOA_1PURAL19920414_065220_000000003001_00248_03900_0000.E1	5	Non-nominal
AT1_TOA_1PURAL19920308_014736_000000002025_00002_03367_0000.E1	5	Non-nominal
AT1_TOA_1PURAL19920109_205942_000000002005_00028_02533_0000.E1	2	Nominal
AT1_TOA_1PURAL19920412_005843_000000003001_00216_03868_0000.E1	2	Nominal
(ATSR-2 Problem Products (Pre-2003) – none) (ATSR-2 Problem Products (Post-June 2003) – not listed)		