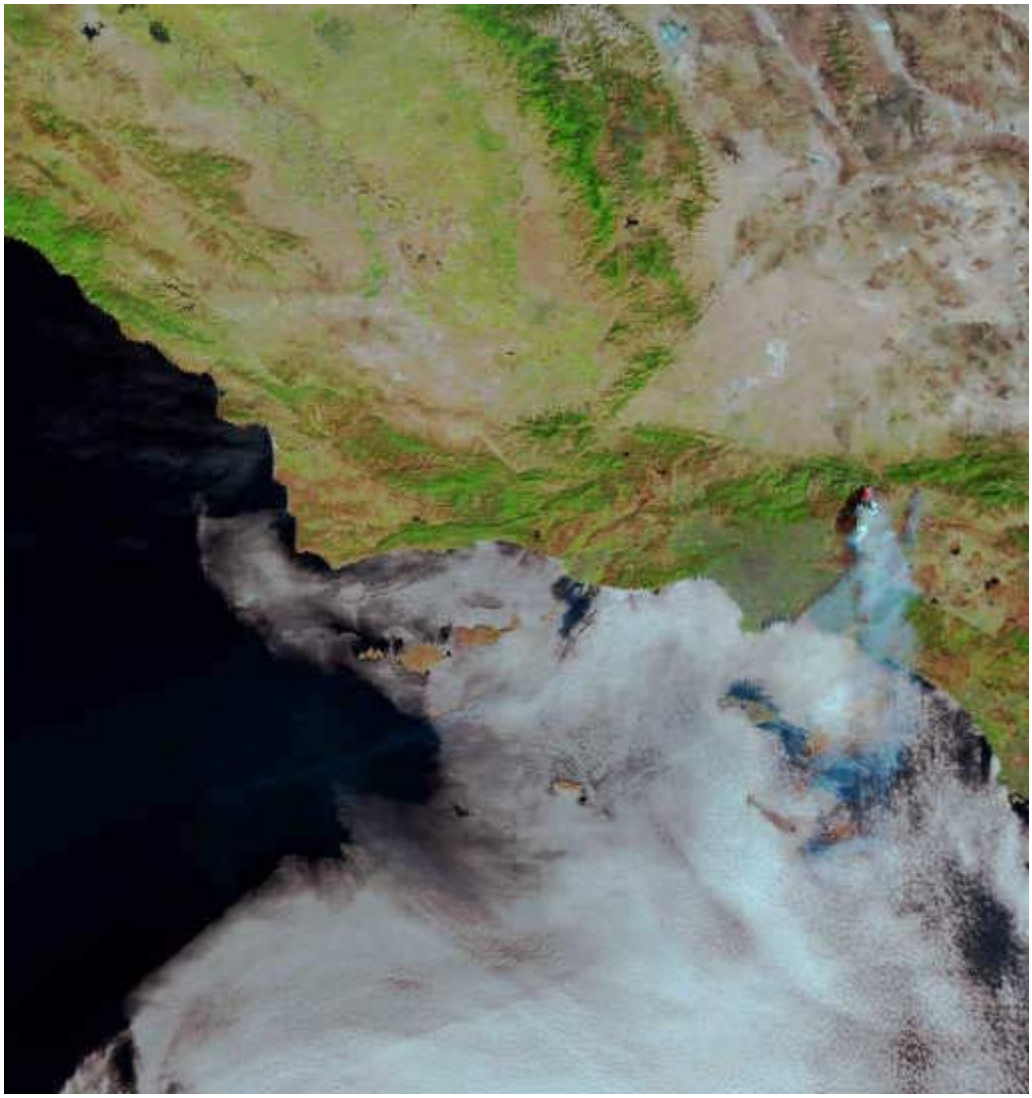
AATSR Cycle Report
Cycle # 20

15 September 2003, 21:59:29 orbit 8071
20 October 2003, 21:59:29 orbit 8571



Scene acquired over California on October 2003.
RGB combination of 1.6u (red), 0.87u(green), 0.67u (blue) reflectance channels.
In the image is well distinguishable the smoke columns and the fires which have hurt Los Angeles and surrounding during the second half of October. The two red spots in the middle of the image, detected by the 1.6um channel, demonstrate a very high temperature of the fires.

prepared by/*préparé par*	AATSR PCF team and QWG team
reference/*réference*	
issue/*édition*	1
revision/*révision*	0
date of issue/*date d'édition*	
status/*état*	Draft
Document type/*type de document*	Technical Note
Distribution/*distribution*	

A P P R O V A L

Title *Titre*	AATSR Cyclic Report – Cycle 20th	issue *issue*	1	revision *revision*	0

author *auteur*	Luigi Accica	date *date*	7 November 2003

approved by *approuvé by*		date *date*	23 January 2004

C H A N G E L O G

reason for change / *raison du changement*	issue / *issue*	revision / *revision*	date / *date*

C H A N G E R E C O R D

Issue: 1 Revision: 0

reason for change / *raison du changement*	page(s) / *page(s)*	Paragraph(s) / *paragraph(s)*

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1 THE CYCLIC REPORT #20

1.1 Acronyms and abbreviations

AATSR	Advanced Along Track Scanning Radiometer
CR	Cyclic Report
DMOP	Detailed Mission Operation Plan
DMS	Data Management System
EN-UNA-YYYY/#	Envisat Unavailability (plus year and number)
ESOC	European Space Operation Center
IECF	Instrument Engineering and Calibration Facilities
IPF	Instrument Processing Facilities
NRT	Near Real Time
OCM	Orbit Control Manoeuvre
PDS	Payload Data Segment
PMC	Payload Management Computer
SPR	Software Problem Reporting
SW	Software
VISCAL	Visible Calibration

The AATSR list of acronyms and abbreviation is in the following site:
http://envisat.esa.int/dataproducts/aatsr/CNTR5-1.htm#eph.aatsr.glossary.acronabbr:nrt

1.2 Summary

Cyclic number: 20
Cycle Start Time: 15-SEP-2003, 21:59:29 orbit stop: 8071
Cycle Start Time: 20-OCT-2003, 21:59:29 orbit stop: 8571

The main activities during the cycle have been the following:

- **Processor L0 and IPF Version**: No changing in the version of AATSR processor for Level0 and in the IPF version for the Level1 and Level2
- **Visible calibration data**: The visible calibration coefficients data (ATS_VC1_AX) are changed regularly during the cycle. These VC1 files are being used within the time criteria set for NRT processing. Off-line data processing is expected to take place within 2 weeks of acquisition. When this is the case the VC1 file used should be +/- 1 day from the date of acquisition (i.e. within specification). If off-line data are generated before 2 weeks from acquisition, this may not be achieved.
- **Data Acquisition**: The data acquisition for the Level0 has been of 99.34% of the whole period, for the Level1 of the 97.20% of the whole period.

- **Calibration activities**: see section 1.6 and 1.7
- **Validation activities**: see section 1.6 and 1.7

1.3 Software version and Auxiliary files version

1.3.1 Software version

AATSR processor for Level0; version: PFHS/5.22
AATSR IPF for Level1 and Level2; version: AATSR/05.55

DOCUMENTATION Applicable: PO-RS-MDA-GS-2009 Is. 3 Rev. F

1.3.2 Auxiliary file version

This is the list of AATSR auxiliary files.

- ***Browse Product Look-up Data (ATS_BRW_AX)***
- ***L1b Characterization Data (ATS_CH1_AX)***
- ***Cloud Look-up Table Data (ATS_CL1_AX)***
- ***General Calibration Data*** **(ATS_GC1_AX)**
- ***AATSR Instrument Data*** **(*ATS_ INS_AX*)**
- ***Visible Calibration Coefficients Data (ATS_VC1_AX)***
- ***Level1B Processing Configuration Data (ATS_PC1_AX)***
- ***Level2 Processing Configuration Data (ATS_PC2_AX)***
- ***SST Retrieval Coefficients Data (ATS_SST_AX)***

In this section will be reported the list of the auxiliary files changed in the cycle and for each file will be specified the date and the reason of the changing.
Will be also reported the list of the latest filename for every auxiliary file currently in use by the PDS.

Only the ATS_VC1_AX file is expected to change regularly. These VC1 files are being used within the time criteria set for NRT processing. Off-line data processing is expected to take place within 2 weeks of acquisition. When this is the case the VC1 file used should be +/- 1 day from the date of acquisition (i.e. within specification). If off-line data are generated before 2 weeks from acquisition, this may not be achieved. **(1)**

Product name	Start validity	Reason of changing
ATS_VC1_AXVIEC2003	September 16, 17, 18, 22, 23, 24, 25, 29 October 1, 2, 3, 6, 7, 8, 9, 10, 13, 14, 16, 17, 20	(1)

Tab 1.3.2.1: Auxiliary files list changed during the period

Product name
ATS_BRW_AXVIEC20020123_072338_20020101_000000_20200101_000000
ATS_CH1_AXVIEC20021114_113144_20020301_000000_20070801_235959
ATS_CL1_AXVIEC20020123_073044_20020101_000000_20200101_000000
ATS_GC1_AXVIEC20020123_073430_20020101_000000_20200101_000000
ATS_INS_AXVIEC20030731_092706_20020301_000000_20070801_235959
ATS_VC1_AXVIEC20031020_162003_20031019_071723_20031026_071723
ATS_PC1_AXVIEC20030430_211727_20020301_000000_20070801_235959
ATS_PC2_AXVIEC20020123_074151_20020101_000000_20200101_000000
ATS_SST_AXVIEC20020123_074408_20020101_000000_20200101_000000

Tab 1.3.2.2: Latest auxiliary files currently in use by the PDS

1.4 PDS status

1.4.1 Instrument Unavailability

No instrument unavailability during this period.

1.4.2 Level0 data acquisition and Level1b processing status

In this chapter will be reported the Level0 missing and the data unavailability not planned in the period.
Only the Level1b data not processed starting from the corresponding Level0 will be reported.
The figure below shows the Level0 data missing measurements (yellow line) and the Level1 data not processed starting from the corresponding Level0 (red line).

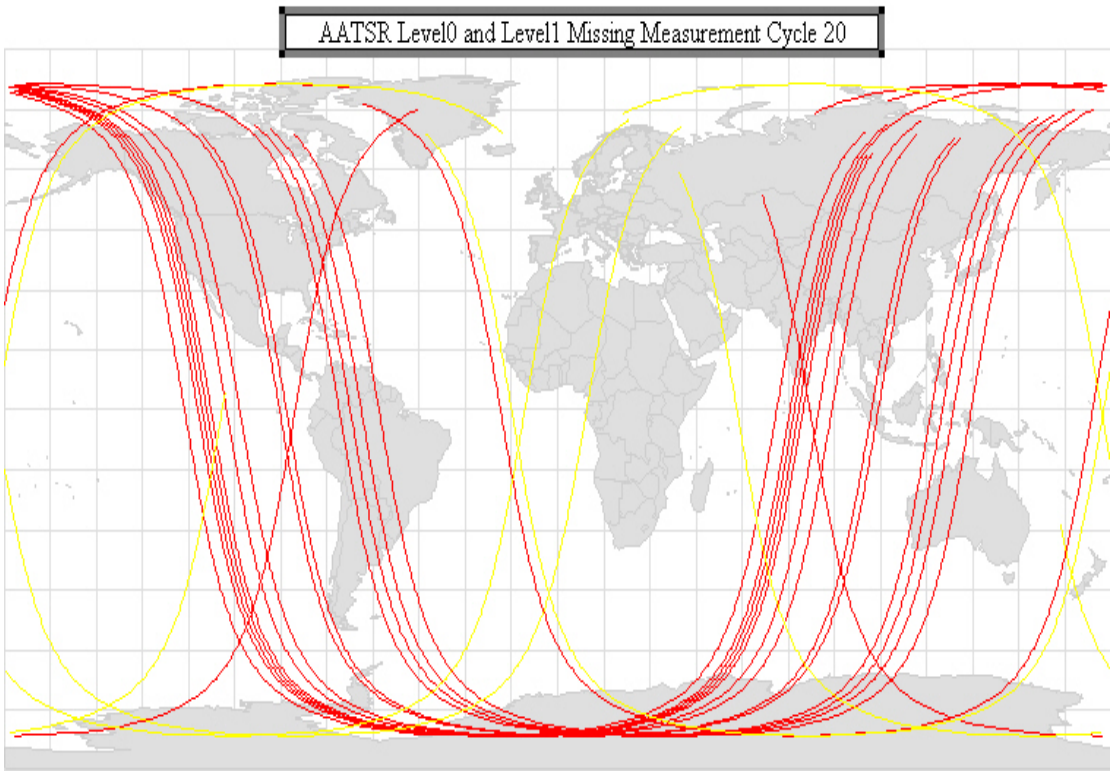

Figure 1.4.2.1: Missing measurements during cycle 20.
Yellow line: Level0 missing (unknown missing)
Red lines: Level1 missing

The total number of missing data is equivalent to 3 orbits on 501 (0.6 %).
The Level0 data was available the 99.34% of the time during the cycle.
The Level1b data was available the 97.20% of the time during the cycle.
The following tables show the list of Level0 and Level1 lack of data.

UTC Start: start time of the missing acquisition.
UTC Stop: stop time of the missing acquisition.
Duration: duration of the missing acquisition.
Orbit Start: absolute orbit start of the missing acquisition.
Orbit Stop: absolute orbit stop of the missing acquisition.

UTC Start	UTC Stop	Duration (sec)	Orbit Start	Orbit Stop
16-SEP-03 17:15:04	16-SEP-03 18:23:32	4108	8082	8083
29-SEP-03 21:38:55	29-SEP-03 23:19:35	6040	8271	8272
01-OCT-03 09:01:43	01-OCT-03 10:41:16	5973	8292	8293
08-OCT-03 10:21:35	08-OCT-03 11:24:47	3792	8393	8393

Tab 1.4.2.1: ATS_NL__0P missing data during cycle 20

UTC Start	UTC Stop	Duration (sec)	Orbit Start	Orbit Stop
17-SEP-03 01:17:57	17-SEP-03 02:50:00	5523	8087	8088
19-SEP-03 15:19:39	19-SEP-03 16:47:04	5245	8124	8125
19-SEP-03 21:57:30	19-SEP-03 23:36:22	5932	8128	8129
22-SEP-03 03:43:15	22-SEP-03 05:17:40	5665	8160	8161
24-SEP-03 04:22:04	24-SEP-03 05:54:14	5530	8189	8190
27-SEP-03 01:03:12	27-SEP-03 02:35:17	5525	8230	8231
27-SEP-03 04:27:55	27-SEP-03 05:59:50	5515	8232	8233
30-SEP-03 02:51:43	30-SEP-03 06:05:36	11633	8274	8276
01-OCT-03 03:59:24	01-OCT-03 05:38:17	5933	8289	8290
03-OCT-03 04:37:02	03-OCT-03 06:11:16	5654	8318	8319
12-OCT-03 01:32:33	12-OCT-03 03:09:55	5842	8445	8446
12-OCT-03 04:54:52	12-OCT-03 06:33:58	5946	8447	8448
13-OCT-03 02:43:07	13-OCT-03 04:12:33	5366	8460	8461
20-OCT-03 00:40:07	20-OCT-03 02:11:53	5506	8559	8560

Tab 1.4.2.2: ATS_TOA_1P missing data during cycle 20

1.4.3 Level0 and Level1b backlog processing status

In this chapter a check with respect to the previous cycle is done to verify if the status of the missing data has changed after a backlog processing. In the following tables (showed only if a change whit respect the previous cycle has been detected) will be point out three kinds of missing products modified:

- Data gap cancelled: it refers to data gap that was identified in the previous report but hasn't now been detected as a result of backlog processing (red line).
- Duration change of data gap: it refers to data gap/s still exists but that it has got longer or shorter since the last report (green line).
- New data gap: it refers to data gap now filled as a result of a backlog processing (blue line).

The list of data missing during the previous cycle has not changed (see the list in the Cyclic Report #19).

1.5 Quality Control

1.5.1 Monitoring of parameters

JITTER:

The average scan-mirror jitter rate during this cycle was 0.01 jitters/sec or better, and on most days it was 0.00 jitters/sec.

SENSOR TEMPERATURE:

All sensors maintained their nominal orbital and seasonal ranges.

VISCAL:

Reflectance channel calibration files (ATS_VC1_AX) are available for most days of the cycle except October 12, October 18 and October 25.
Nominal viscal characteristics were observed throughout the cycle.

TOTAL NOISE:

Total noise in the thermal infrared channels, as represented by the standard deviation of the black-body signal in each channel, was nominal throughout the cycle.
Total noise in the reflectance channels was nominal throughout the cycle.

NE∆T:

Info unavailable.

1.5.2 Users Rejection

No user complaints during this cycle.

1.5.3 Software Problem Reporting. Potential impact

In this section will be described the SPR open with the potential impact on the data quality, and the SPR closed.

1.5.3.1 SPR open

None

1.5.3.1.1 Existing SPRS that are still open

None

1.5.3.1.2 New SPRs since the last Cyclic Report

None

1.5.3.2 SPR closed

The SPRs still opened (see Cyclic Report #19) have been corrected and they will be fixed in the next version of the processor, planned in early February 2004.

1.6 Calibration/Validation activities and results

1.6.1 Calibration

No further information on instrument calibration is reported. The current status of the instrument calibration can be found in Section 1.7.1

1.6.2 Validation

A complete update on the status of the instrument validation can be found in Section 1.7.4. A monthly mean global SST plot for October 2003, provided by the UK Met Office, corresponding to part of Cycle 20, is shown in Figure 1.6.2-1.

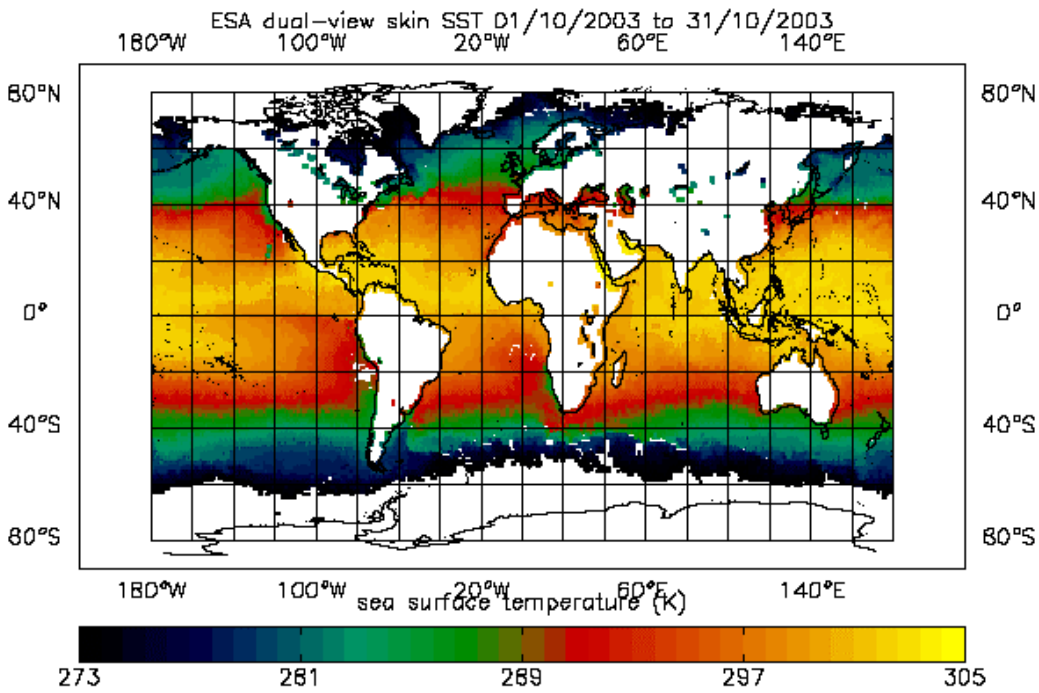

Figure 1.6.2-1: Monthly Global Average SST for October 2003. Image provided by the UK Met Office.

Using the above data, the UK Met Office has done a comparison with data collected from a network of buoy SST values, the results for July 2003 being shown in Figure 1.6.2-2. In October 2003, there were 884 match-ups in total, with a mean (ESA operational dual-view skin SST minus buoy SST) of 0.048 K, standard deviation 0.474 K, and a mean (dual-view bulk SST minus buoy SST) of 0.226 K, standard deviation 0.492 K.

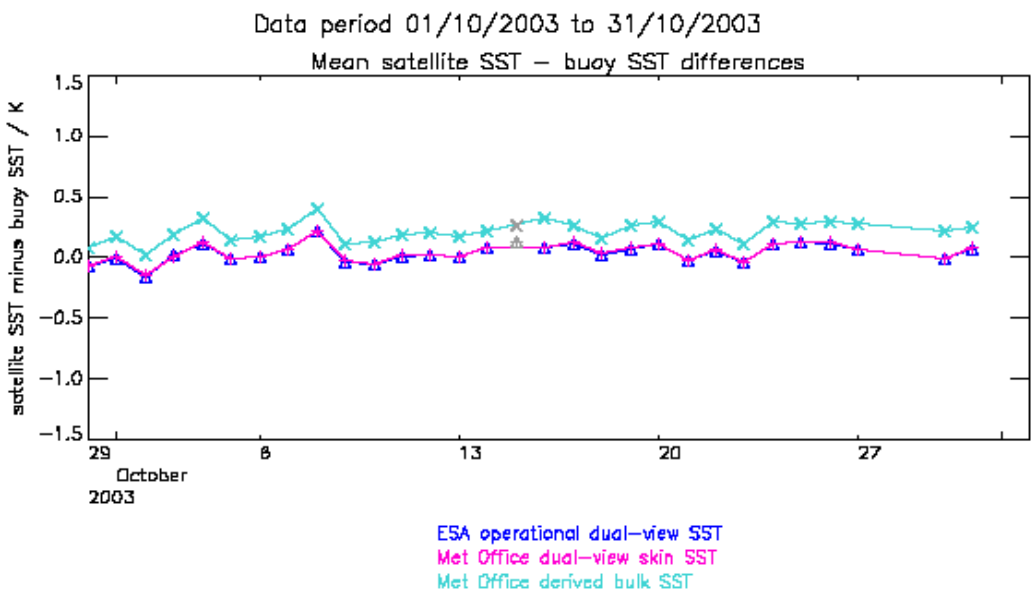

Figure 1.6.2-2: Comparison of daily mean difference between AATSR SST and buoy SST for october 2003. image provided by the UK Met Office.

1.7 MAVT 2003. Summary

The MERIS and AATSR Calibration and Geophysical Validation (MAVT) 2003 meeting was held between October 20th- 24th at ESRIN. A summary of the results will be presented in the following sections.

1.7.1 Visible Channel Calibration Summary

The calibration of the AATSR visible channels is derived from four kinds of comparison: the comparison with MERIS and ATSR-2 using desert and ice targets (relative comparison), the inter-comparison with GOME, ATSR-2 and SCIAMACHY (relative comparison), comparison with cirrus and deep convention clouds (absolute and relative comparison) and a comparison with the CNES database (absolute and relative comparison).

In the comparison with MERIS and ATSR-2, the choice of desert site (for monitoring and calibration of AVHRR, ATSR-2, GOES, POLDER, Vegetation MISR) requires a uniform reflectance over a large area, long term-radiometric stability of the site, a high surface reflectance to maximise the signal-to-noise and minimise atmospheric effects on the radiation measured by the satellite. The bi-directional reflectance factor (BRDF) owing to surface anisotropy and other angular effects must be accounted for when determining long-term calibration trends.

The comparison of AATSR reflectance and MERIS reflectance brings to the following results:

- **Over desert**: 0.56um -> Raatsr/Rmeris = 1.041, 0.67um -> Raatsr/Rmeris = 1.001, 0.87um -> Raatsr/Rmeris = 1.037
- **Over Greenland**: 0.56um -> Raatsr/Rmeris = 1.034, 0.67um -> Raatsr/Rmeris = 1.012, 0.87um -> Raatsr/Rmeris = 1.037

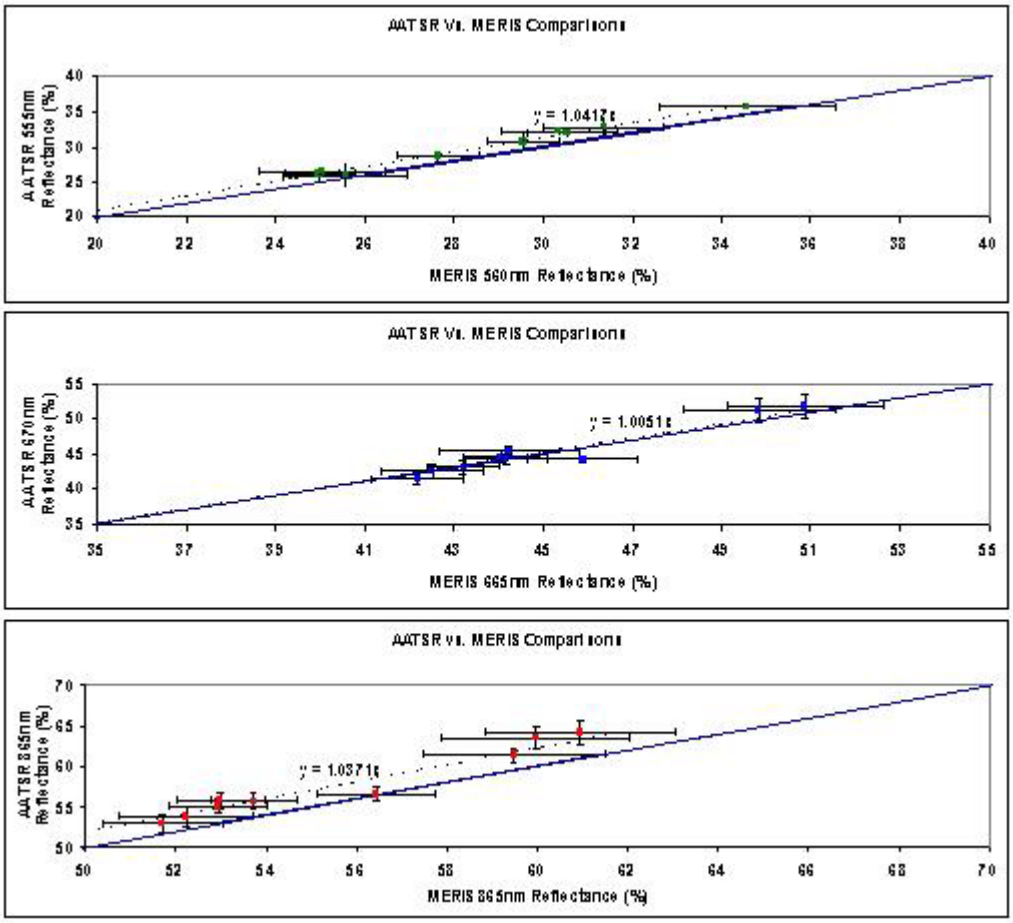

Fig. 1.7.1-1 AATSR vs MERIS comparison over desert (0.86um, 0.67um, 0.56um channels), 0.56um -> Raatsr/Rmeris = 1.041, 0.67um -> Raatsr/Rmeris = 1.001, 0.87um -> Raatsr/Rmeris = 1.037

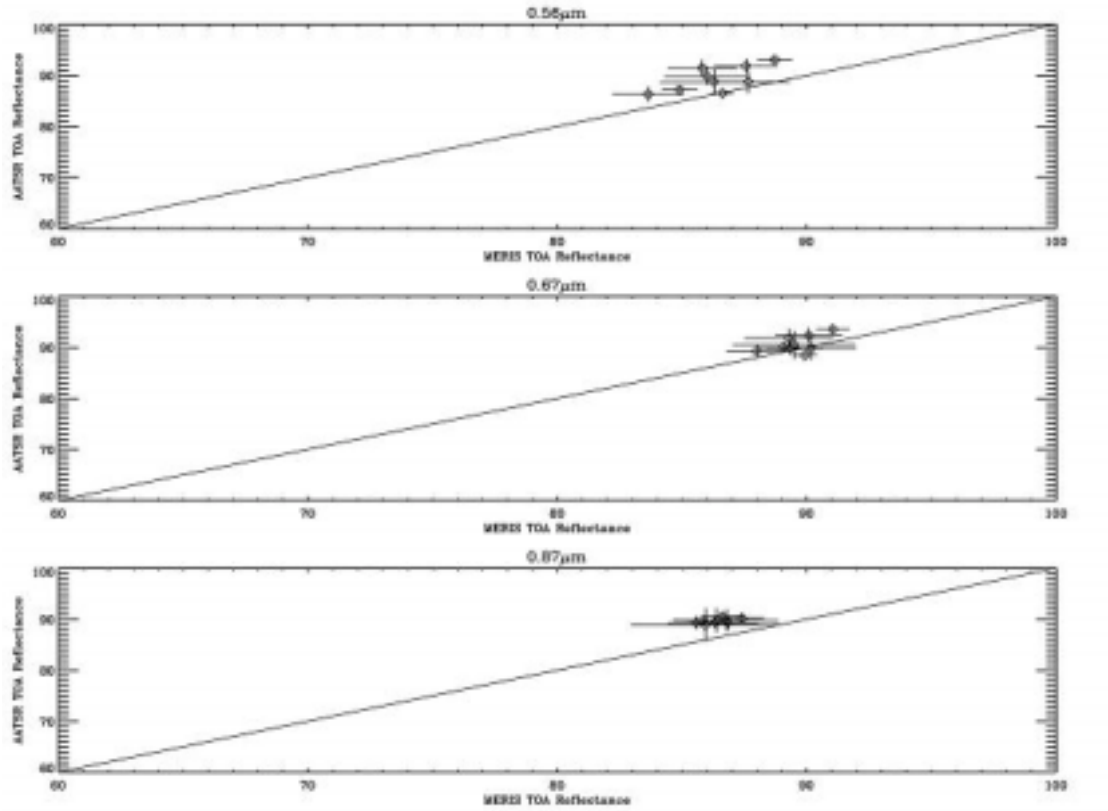

Fig 1.7.1-2 AATSR vs MERIS comparison over Greenland (0.86um, 0.67um, 0.56um channels), 0.56um -> Raatsr/Rmeris = 1.034, 0.67um -> Raatsr/Rmeris = 1.012, 0.87um -> Raatsr/Rmeris = 1.037

The inter-comparison with different instruments requires the spectral averaging of SCIAMACHY and GOME, the spatial averaging of AATSR and ATSR-2, as GOME and SCIAMACHY pixels are not the same size or coincident. The methodology for the comparison is therefore:

- To co-locate GOME and ATSR-2
- To average SCIAMACHY data to give scene comparable to GOME that can be properly compared to AATSR
- To associate nearest neighbour GOME/SCIAMACHY pixels to allow for the cross platform comparison; note that a certain amount of “noise” is acceptable owing to scene variations arising from different overpass times.

The comparison between ATSR-2/AATSR/GOME on 0.56um and 0.67 um reflectance channel on 15th of December 2002 (orbit comparison), produces the following results:

- AATSR is high relative to ATSR-2
- AATSR agrees well with GOME
- ATSR-2 is low relative to GOME
- There is better agreement with AATSR and GOME if ATSR-2 data not corrected for long-term drift.

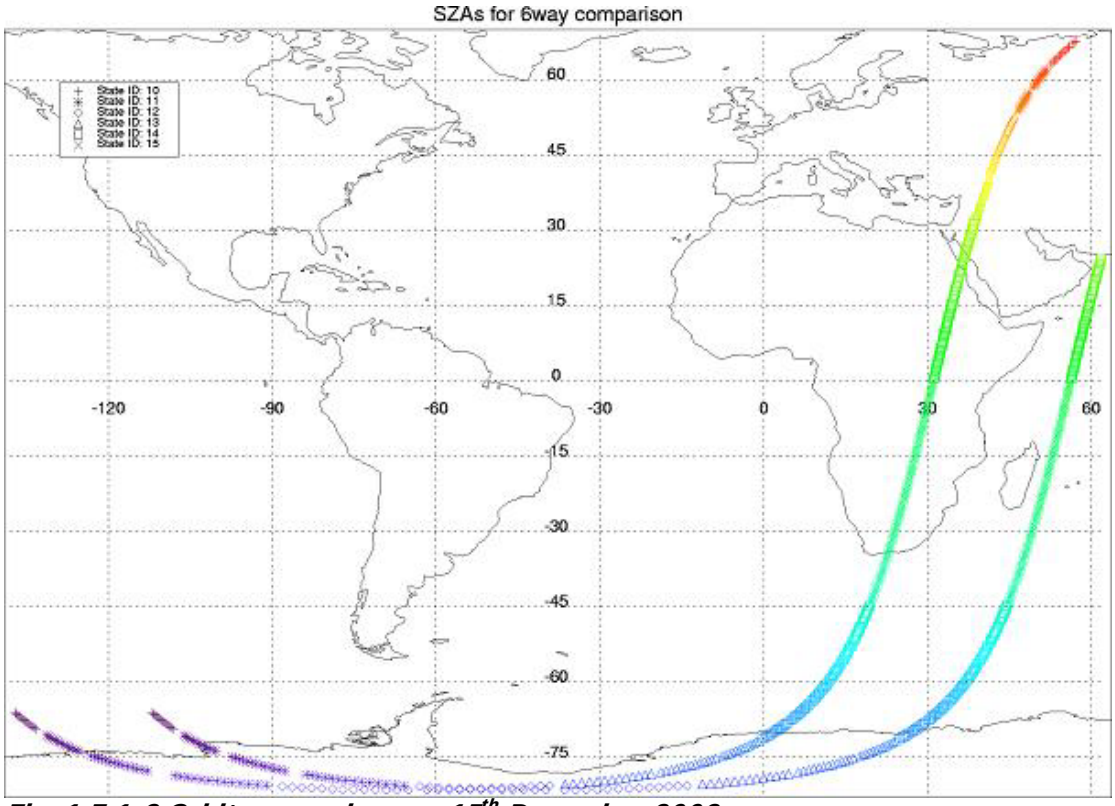

Fig. 1.7.1-3 Orbit comparison on 15th December 2002

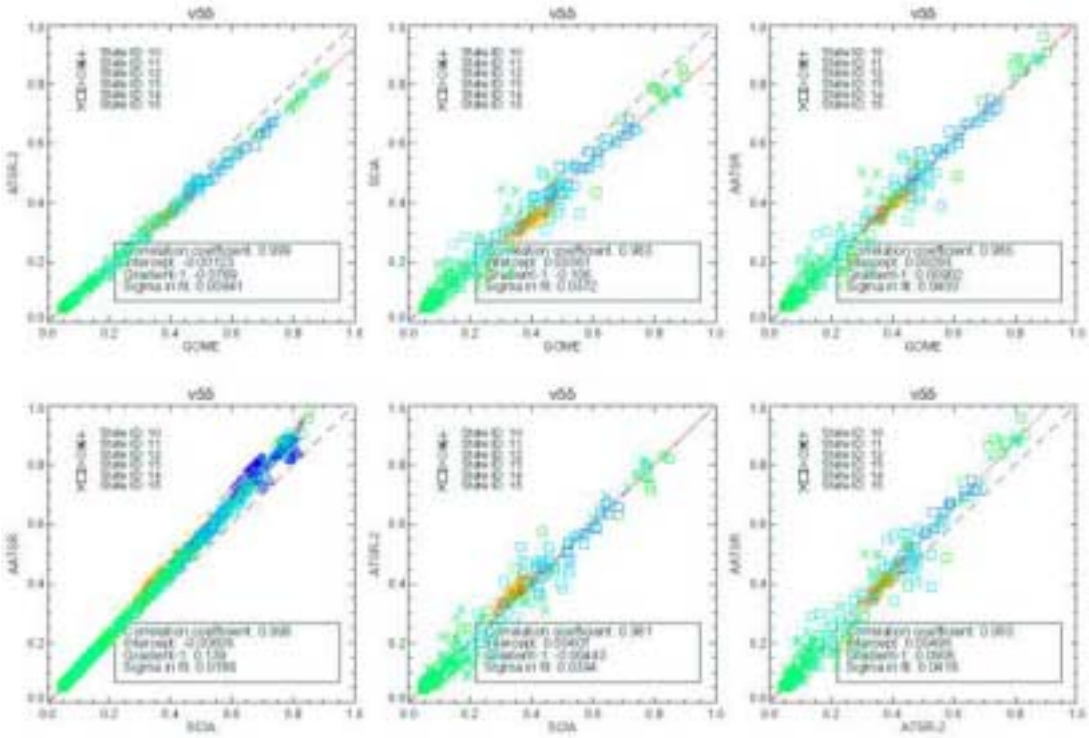

Fig. 1.7.1-4 Comparison of AATSR, ATSR-2, GOME. Reflectance 0.56um

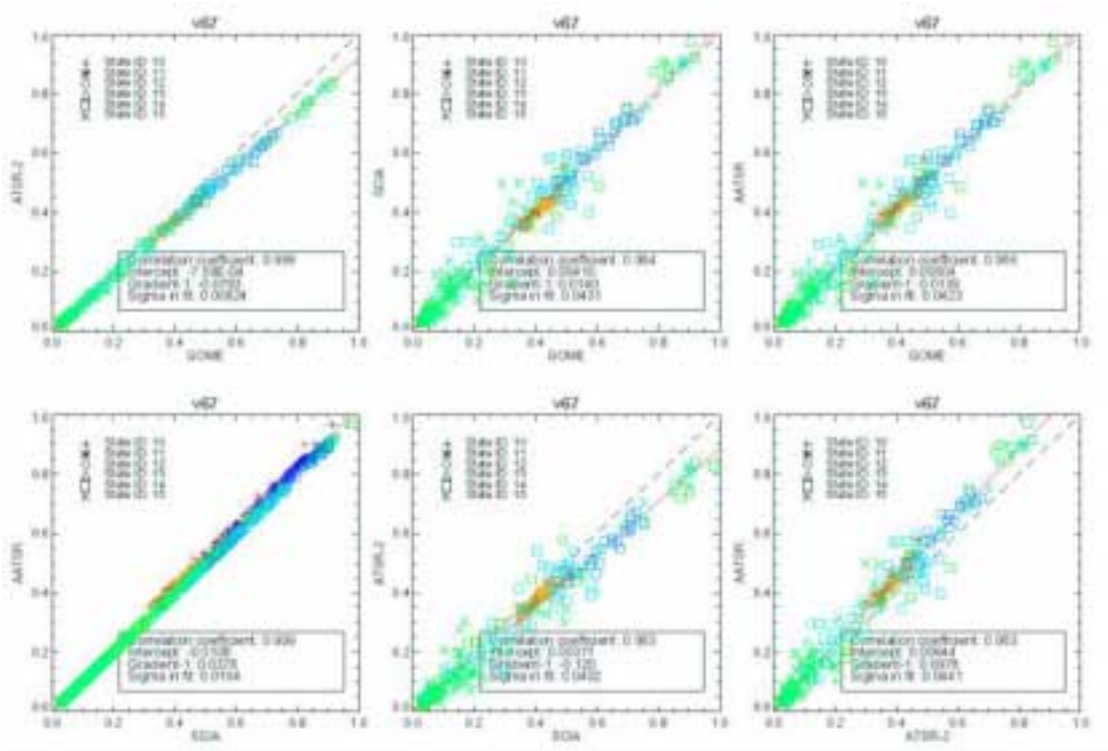

Fig. 1.7.1-5 Comparison of AATSR, ATSR-2, GOME. Reflectance 0.67um

The cirrus and deep convection clouds comparison (absolute and relative) is based on the absolute calibration of AATSR (ATSR-2) using Artic stratus clouds and on the inter-channel calibration of AATSR and MERIS using tropical clouds. The results obtained using this method concluded that:

Absolute Calibration:

- Slight positive bias of AATSR reflectance channels. No significant sensitivity to ozone or aerosols
- Calibration is sensitive to molecular scattering (0.55 and 0.67) channels.
- Sensitive to cloud top height. Cloud top height could be found from L2 data.

Inter Channel Calibration:

- MERIS and AATSR well spectrally inter-calibrated. The channel ratio between AATSR and MERIS is: **0.55µm ->** 1.047**,** **0.67µm ->** 1.026, **0.87µm ->** 1.054

The comparison with the CNES database (Absolute and Relative) offers the ability to combine all necessary data sets for relative and multi-temporal calibration. Continuous monitoring and archiving helps the consistency of these calibration studies and improves our knowledge of the sites.
The results obtained using this method concluded that:

- The MERIS comparison shows consistency between the two sensors at the 3% level

- All other results show a consistent overestimation of reflectances by AATSR from 0.56um to 0.87um and under estimation at 1.6um.
- A small inconsistency with ATSR2 instrument calibrated in the same way as AATSR that was not expected.

1.7.2 Calibration Conclusion and future activities

The visible channel calibration results for the 1st full year of available Level 1b data have provided the following conclusions (comparison between AATSR, MERIS, and ATSR-2 results):

- Result from a range of calibration targets show that AATSR visible channel radiances are higher than those measured by ATSR-2.

	1.6 um	0.87um	0.66um	0.56um
AATSR vs. ATSR-2 Desert BRDF	0.932	1.079	1.078	1.126
AATSR vs. ATSR-2 Desert - Coincident Measurements	0.947	1.090	1.093	1.144
AATSR vs. ATSR-2 Greenland – BRDF	-	1.108	1.050	1.033
AATSR vs. ATSR-2 Greenland – Coincidence	0.986	1.157	1.108	1.108
AATSR vs. ATSR-2 Orbit difference	1.101	1.124	1.179	1.176
AATSR vs. ATSR-2 Arctic Stratus Cloud	1.023	1.023	1.020	1.056
Sade database	0.935	1.078	1.069	1.054
Average	0.987	1.094	1.071	1.085
Standard Dev	0.066	0.042	0.029	0.041

Tab. 1.7.1-1

- AATSR agrees well with MERIS.

	0.87um	0.67um	0.56um
Desert	1.037	1.001	1.041
Greenland	1.037	1.012	1.034
Deep Convention Clouds	1.054	1.026	1.047
SADE	1.027	1.004	1.025
Average	1.039	1.011	1.037
Standard Deviation	0.011	0.011	0.009
MERIS relative to ATSR-2	1.053	1.060	1.057

Tab. 1.7.1-2

- Significant differences observed between AATSR/MERIS and ATSR-2
- Results consistent with other investigations.
- If difference are real then possibly due to:
    - Degradation/Contamination of VISCAL optics since calibration- most likely during launch
    - Pre-launch calibration
    - Out of band leakage. Available data suggest that this is insignificant.
    - Incorrect assumption respect ATSR-2

The future calibration activities will point out to:

- Include 1.6µm channel in analysis
    - Data has been processed but non-linearity effect needs to be included
- Download further METRIC files and perform additional comparisons
- Investigate possible seasonal effects
- Investigate differences between ATSR-2 and GOME
- Long Term analysis
    - Requires data for early mission phase March 2002 – End September 2002 (excluding some commissioning phase activities)
    - Requires data products delivered on a regular (monthly) basis – preferably on CD-ROM rather than FTP site

1.7.3 Calibration Acknowledgements

- O. Hagolle, B. Latter, Kerridge, T. Nightingale, C. Poulsen, Siddans, D. Smith, P. Watts.

1.7.4 Validation Summary

1.7.4.1 Requirements and General Approach

In situ surface-leaving radiance measurements are needed to establish ultimate accuracy of AATSR retrieval schemes; in fact it is the atmospheric correction that is being validated and not the retrieved product. Coincident Atmospheric profile information is important for testing atmospheric corrections independently.
The measurements of surface parameters e.g. soil temperature, bulk water temperature, canopy temperature etc. are not part of the formal level 2 validation, but they are scientifically important and needed by many users.

In the next IPF update, a new algorithm for LST products will be applied. The new product will be based on coefficients retrieved from regional and seasonal coefficients, depending on the surface type and atmospheric climatology. There are 14 different classifications of land surface, including 'lake surface temperature' owing to topological effects not observed for oceans. The measurements accuracy is required to be better than 1°C. Currently, validation results have been obtained for a prototype LST product, covering 9 land sites and the Lake Tahoe site (10 of 14 surface types covered). The validation results collected so far show that the LST algorithm is performing well, and is within specification.

1.7.4.2 SST Validation

The AATSR instrument is required to provide SST measurements better than 0.3°C globally, with the ultimate aim of providing SST to better than 0.1°C. The general approach for the SST Validation involves continuous checks of global SST fields through inter-comparison with drifting-buoy data, analysis fields or data from other satellite sensors, continuous and autonomous radiometric measurements of SST from ship-borne platforms and high precision radiometric measurements from selected sites.

For the validation of global SST fields, the UK Met Office and the University of Leicester presented the following results:

- The UK Met Office provided a comparison of global SST fields with *in situ* buoy data. This methodology shows a very consistent acquisition rate over one year (~ 6,600 matchups), closest agreement between AATSR skin and buoy (bulk) values – unexpected (AATSR SST values could be warm by ~ 0.2°K). The biases detected came from:
    - Matchup RMSD values (~0.3- 0.4K) are consistent with expected buoy uncertainties
    - Day/night differences are very small
    - Regional analyses under way

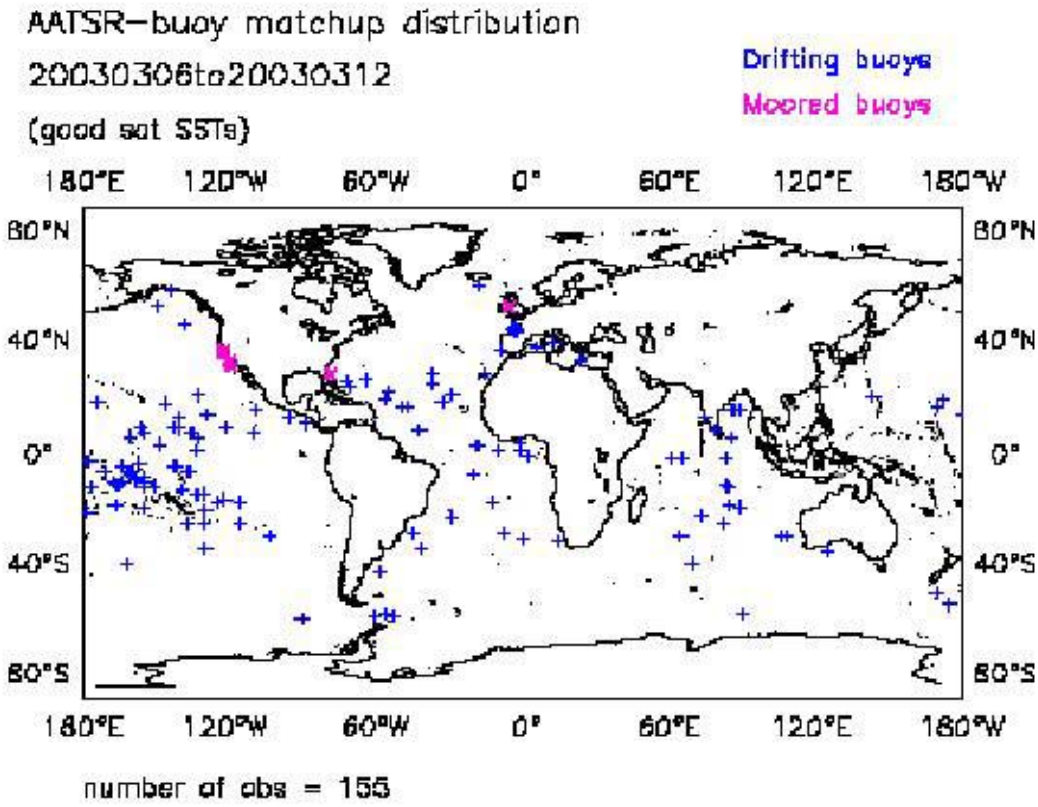

Fig 1.7.4.2-1 AATSR-buoy matchp distribution

- The University of Leicester provided a global comparison with other sensors, as MODIS, AVHRR and (A)ATSR produce single view SST using near-identical channel wavelengths. Inter-comparisons with (A)ATSR dual-view SST confirms the benefits of the along-track scanning method, essential for providing accurate SST in the presence of aerosols for example. Note: the TMI (TRMM microwave Imager) uses microwave channels and is unaffected by aerosol.

  The comparison with other sensors is shown in the figures below.

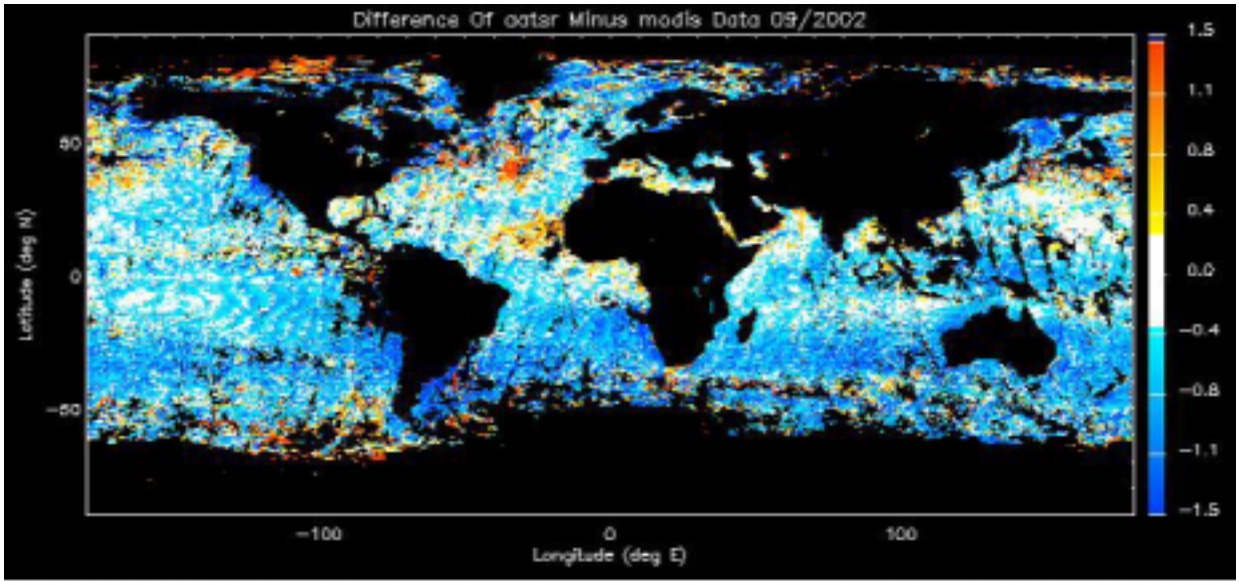

Fig 1.7.4.2-2 Difference of SST AATSR and SST MODIS data

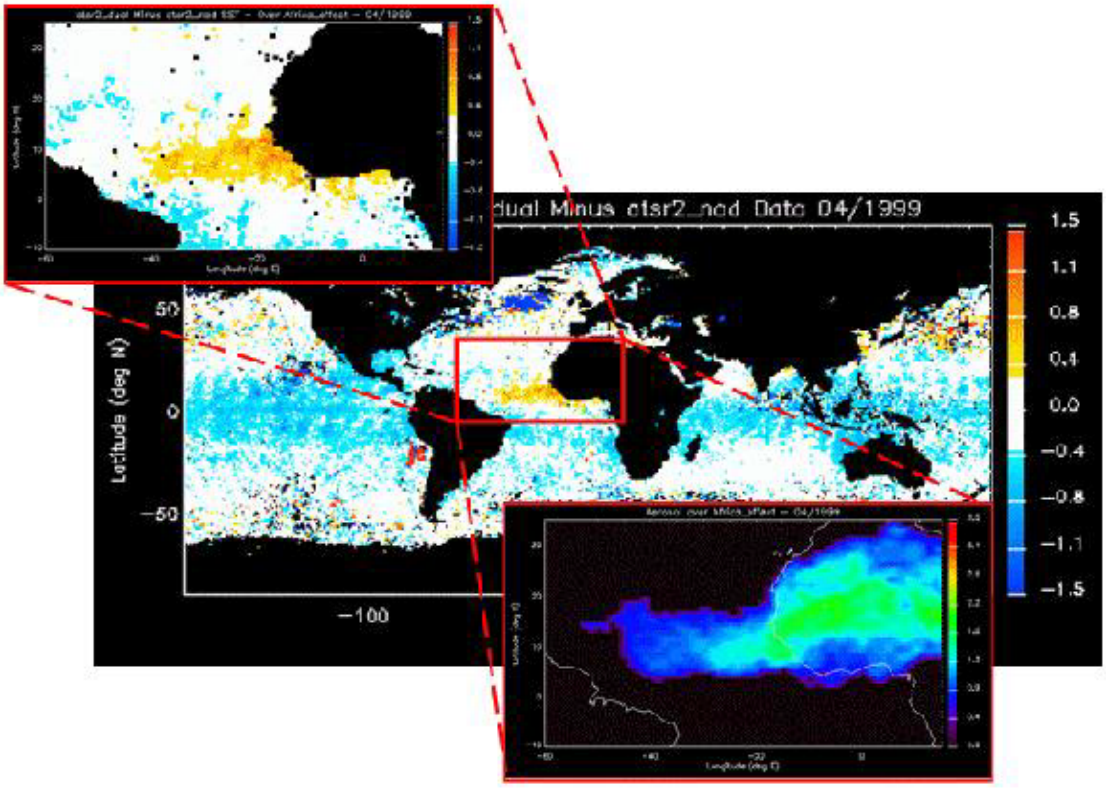

Fig 1.7.4.2-3 ATSR-2 SST (dual nadir) vs TOMS aerosol comparison

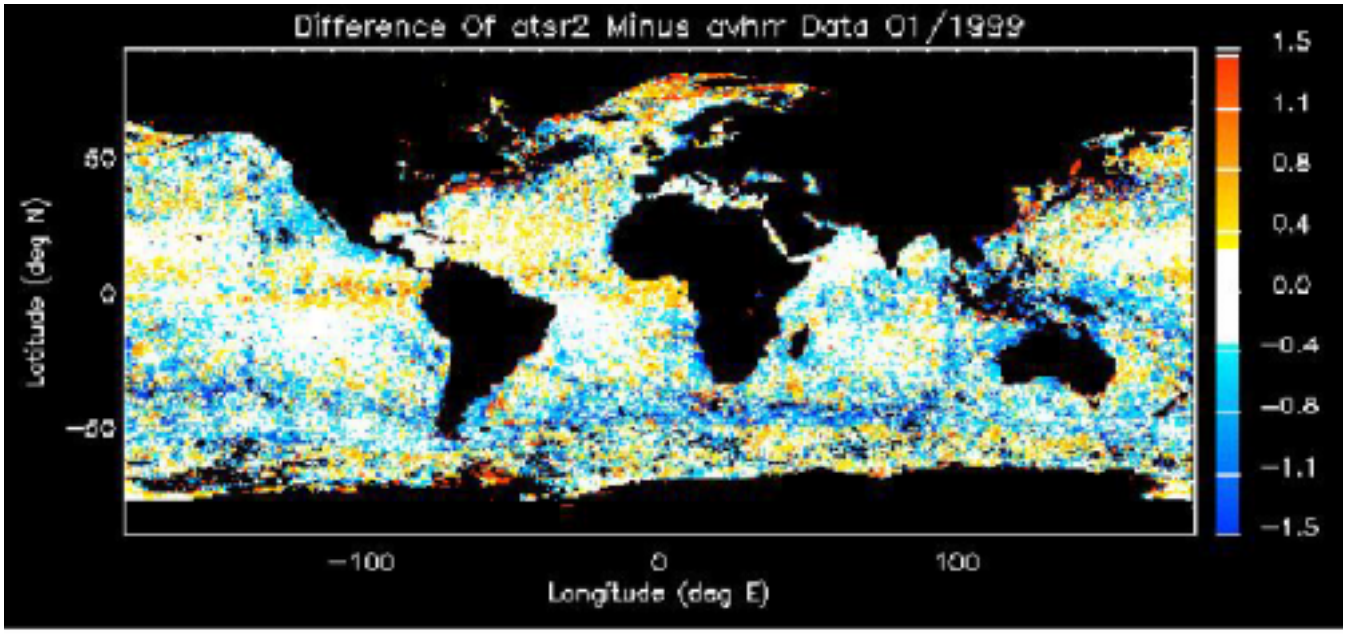

Fig 1.7.4.2-4 Difference of ATSR-2 and AVHRR data (2 year's data)

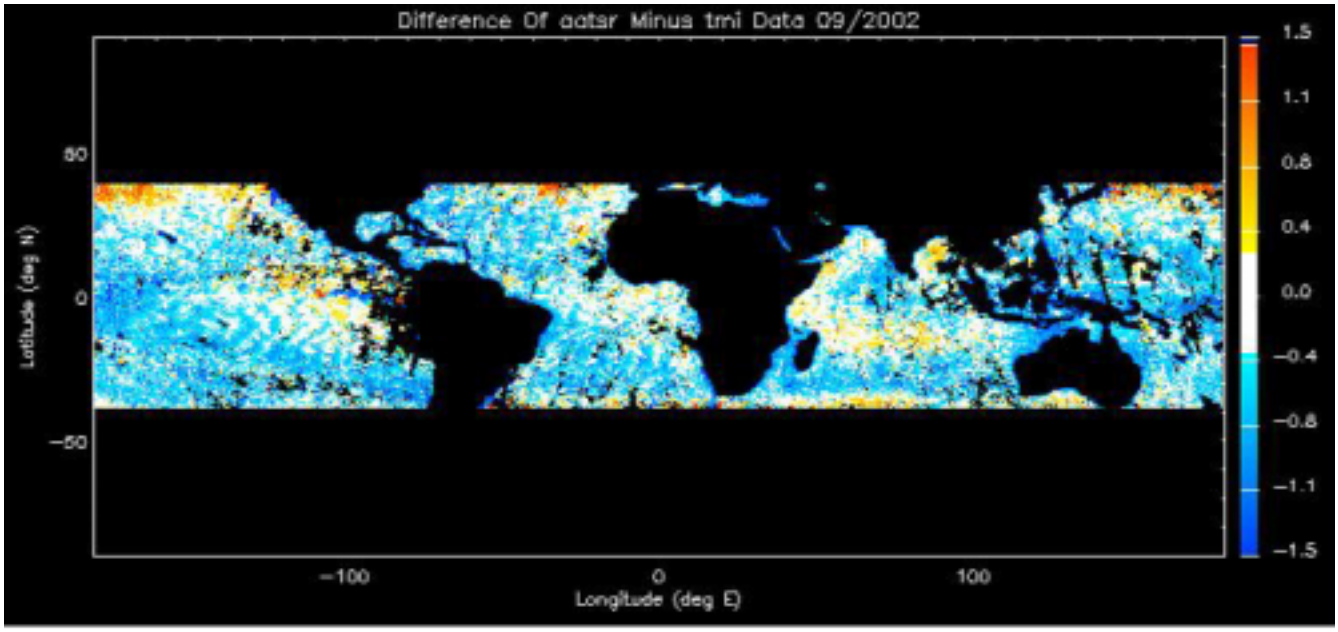

Fig 1.7.4.2-5 Difference of AATSR and TMI data (TMI measurements warmer)

- Four research groups from CSIRO, RAL, the University of Southampton and the University of Miami (through analysis performed at the University of Leicester) provided results from single point comparisons of AATSR Level 2 SST products and in-situ Skin SST measurements from ocean–going high precision infrared radiometers. In total, 25 match-ups have been returned so far from the first year of Sea campaigns. Of these 25 measurements, 14 were during daytime and 11 were during nighttime overpasses. The geographical representation

covered areas from the Caribbean, to the Bay of Biscay, to the Indian Ocean and to waters off the coast of Australia. Unfortunately, most of the match-ups are all in warm waters (24°-29° C); two match-ups were provided at lower temperatures (12°-14° C).

The match-ups were combined into one data set and provided the following statistical conclusions:

- During the day, AATSR SST values were on average slightly cooler than the radiometers by 0.04° C (Standard Deviation of 0.19° C)
- During the night, AATSR SST values were on average slightly warmer than the radiometers by 0.02° C (Standard Deviation of 0.16° C)
- No obvious inconsistencies were found between the two cooler points and the rest of the data set.

1.7.5 Validation Conclusions and future priorities

The results provided by 15 projects describe the current status of overall programme.

In particular:

- Excellent first year results show that AATSR SST data is meeting its specifications. As such the data can be recommended for wide distribution.
- Some problems require further attention, notably small residual biases in SST comparisons.
- The comparison with data from other sensors are interesting and encouraging.
- The validation of the prototype LST product bodes well for the operational product.
- The need for more targeted regional campaigns in SST and in LST (to cover all classifications used).
- Continual monitoring is required to detect any instrument drift.

1.7.6 Validation Acknowledgements

- DEFRA, the UK Department of Environment, Food and Rural Affairs, who funded AATSR to support their programme of climate prediction and research, which in turn provides inputs to their policy-making processes
- Funding agencies in Australia and from NERC, the UK Natural Environment Research Council who made significant contributions
- ESA for ENVISAT and associated support to the AOP

- J. Aylmer-Brewin, I. Barton, A.R. Birks, C. Coll, G. Corlett, C.Donlon, M. Edwards, L. Horrocks, S. Hook, D. Llewellyn-Jones, D. Levett, B. Mannerings, P. Minnet, E. Noyes, T. Nightingale, A. O'Carroll, F. Olesen, A. Pearce, F. Prata, I. Robinson, R. Rayner, J. Remedios, J. Stroeve, J. Sobrino, R. Saunders, J. Watts.

1.8 General information

- ENVISAT/ERS Symposium will be held on 6 to 10 September 2004 in Salzburg, Austria. The symposium will be open to all interested parties, from scientists to operational users, and will cover both ENVISAT and ERS missions. Any information will be published on the ESA's web site: http://envisat.esa.int, ENISAT/ERS Symposium.

- Following the installation of the new IPF (February 2004) a data reprocessing will be done since July 24th, 2002. The reprocessing will be done to include the new LST products (1 Km resolution) and to provide a better visible calibration status and a better nadir/forward collocation.