MERIS Multitemporal Synthesis

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DOCUMENT STATUS SHEET

Issue	Date	Comments	Author
1.0	05/05/2003	Creation of the document	S. Riazanoff
	15/05/2003	Integration of elements of progress report 02 sent on 15/05/2003	S. Riazanoff
	22/05/2003	Comments mail O. Arino dated 16/05/2003	S. Riazanoff
	21/08/2003	DRAFT 03: Project closure	S. Riazanoff
	27/08/2003	DRAFT 04: Comments A. Mambimba	S. Riazanoff
	28/08/2003	DRAFT 04: Comments P.L. Frison	S. Riazanoff
	28/08/2003	DRAFT 04: English correction M. Taylor	S. Riazanoff
	06/11/2003	Final version 1.0 – “Absolute location” “ESA WMS” control	S. Riazanoff
1.1	09/10/2004	Corrections	S. Riazanoff

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1 INTRODUCTION

1.1 Purpose of this document

This document reflects the research performed and algorithms options that have been selected in the framework of the “Mosaic MERIS of the world (segments march-April 2003)” on behalf of the European Space Agency (ESA-ESRIN) by the purchase order P4320066 dated on 03/04/2003.

The aim of this document is to provide ESA with elements enabling it to select the best radiometry and geometry processing options for the generation of a poster to be shown at “Salon du Bourget” on 15-22 June 2003.

Most of the images produced in the framework of this contract have been using the applications of the TELIMAGO software developed by GAEL Consultant. The MERSYN process performing the MERIS synthesis has been developed for the purpose of this project. This process is fully documented and may be upgraded for further processing.

Particular thanks have to be addressed to Pierre-Louis FRISON, Conference Lecturer at the University of Marne-la-Vallée, who has participated during all the projects giving an appreciated scientific support.

1.2 Document overview

- Section 1 — the present section giving the framework of the project and all the conventions used in this document,.
- Section 2 — describes the MERIS instrument radiometry, some of the observed defects and the algorithmsproposed to process the radiometry,
- Section 3 — describes the MERIS instrument geometry and the way the data are geolocated up to a panel of proposed projections,
- Section 4 — gives the operational way synthesis are processed, some of the encountered defects and describes in-depth the obtained results,
- Section 5 — gives statistics about the produced synthesis, shows how data are post-processed and the obtained results,
- Section 6 — describes some possible enhancements of the produced synthesis demonstrating the potential of the produced data,
- Section 7 — includes the conclusions of the study providing guidelines for further processing or new synthesis generation,
- Appendix A — shows the contents of a MERIS segment,
- Appendix B — lists the data receptions and the processed MERIS segments.

1.3 Applicable documents

A-1	*Mosaique mondiale MERIS* Mail Olivier ARINO – March 17th, 2003 ESA-ESRIN ..\management\mail_20030317_Arino_Re Mosaique mondiale MERIS.msg

1.4 Reference documents

This section describes the related documents and applied conventions to be considered within the present document.

R-1 PO-RS-MDA-GS-2009 (1) *ENVISAT-1 products specifications*
Volume 1: introduction
Issue 3, Revision L, January 30th, 2001
European Space Agency – Alcatel Space

R-2 PO-RS-MDA-GS-2009 (2) *ENVISAT-1 products specifications*
Volume 2: overview of instruments
Issue 3, Revision A, June 19th, 1997
European Space Agency – Macdonald Dettwiler

R-3 PO-RS-MDA-GS-2009 (3) *ENVISAT-1 products specifications*
Volume 3: product terms and definitions
Issue 3, Revision A, February 10th, 1997
European Space Agency – Macdonald Dettwiler

R-4 PO-RS-MDA-GS-2009 (4) *ENVISAT-1 products specifications*
Volume 4: products overview
Issue 3, Revision C, November 28th, 2000
European Space Agency – Alcatel Space

R-5 PO-RS-MDA-GS-2009 (5) *ENVISAT-1 products specifications*
Volume 5: product structures
Issue 3, Revision C, October 16th, 1997
European Space Agency – Macdonald Dettwiler

R-6 PO-RS-MDA-GS-2009 (11) *ENVISAT-1 products specifications*
Volume 11: MERIS products specifications
Issue 3, Revision F, November 20th, 2000
European Space Agency – Alcatel Space

R-7 PO-TN-MEL-GS-002 *MERIS Level 1 Detailed Processing Model,*
Parameters Data List.
Issue 6 Revision 1 – March 28th, 2003
ACRI
..\reference_documents\DPM1b_i6r1.pdf

R-8 PO-TN-MEL-GS-005 *MERIS Level 2 Algorithms Theoretical Basis Document.*
Issue 4 Revision 0 – December 5th, 2003
ACRI / ESA
..\reference_documents\PO-TN-MEL-GS-0005_issue_4-0_atbd_full.pdf

R-9 PO-TN-MEL-GS-006 *MERIS Level 2 Detailed Processing Model*
Issue 6 Revision 1 – March 28th, 2003
ACRI
..\reference_documents\DpmL2_i6r1.pdf

R-10 B. Duchemin, P. Maisongrande *Normalisation of directional effects in 10-day global syntheses derived from VEGETATION/SPOT:*
I. Investigation of concepts based on simulation.
Ed. ELSEVIER Science Inc. -
Remote Sensing of Environment 81 (2002) pp. 90-100
http://www.elsevier.com/locate/rse

R-11 B. Duchemin, B. Berthelot, G. Dedieu, M. Leroy, P. Maisongrande *Normalisation of directional effects in 10-day global syntheses derived from VEGETATION/SPOT:*
II. Validation of an operational method on actual data sets.
Ed. ELSEVIER Science Inc. -
Remote Sensing of Environment 81 (2002) pp. 101-113
http://www.elsevier.com/locate/rse

R-12 B. Duchemin, P. Maisongrande, G. Dedieu, M. Leroy, J.L. Roujean, P. Bicheron, O. Hautecoeur, R. Lacaze *A 10-days Compositing Method Accounting for Bidirectional Effects:*
20th International Geosciences And Remote Sensing Symposium (IGARSS), Hawaii, USA, 24-28 July 2000
http://vegetation.cnes.fr/vgtprep/vgt2000/duchemin.pdf

R-13 G. Lissens, P. Kempeneers, F. Fierens *Development of a cloud, snow and cloud shadow mask for VEGETATION imagery.*
VEGETATION 2000 symposium, Belgirate, Italy
3-6 April 2000
..\reference_documents\lissenscloud.pdf

R-14 Wim J.D. van Leeunwen, Alfredo R. Huete, Trevor W. Laing *MODIS Vegetation Index Compositing Approach: A Prototype with AVHRR Data.*
Ed. ELSEVIER Science Inc. -
Remote Sensing of Environment 69 (1999) pp. 264-280
http://www.elsevier.com/locate/rse

R-15 *Excerpt from CNES specifications:*
Mail Janssens GREET (VITO) – March 3rd, 2003
..\management\mail_20030325_Greet_RE_Mosaic of SPOT Vegetation - Technical collaboration.msg

R-16 J.M. Melinotte, O. Arino *The Ionia 1-km Net-Browser Experience Quicklook Processing and Access Statistics:*
Earth Observation Quarterly N°50 pp. 6-10 – December 1995

1.5 Abbreviations and Acronyms

This section controls the definition of all abbreviations and acronyms used within this document. Special attention has been paid to inherit abbreviations, acronyms and their definitions from international standards as ISO, ANSI or ECSS.

ANSI	American National Standards Institute
ARVI	Atmospherically Resistant Vegetation Index
ATBD	Algorithm Theoretical Basis Document
BRDF	Bidirectional Reflectance Distribution Function
DDV	Dark Dense Vegetation
ECSS	European Cooperation for Space Standardization
ISO	International Organization for Standardization
MDS	Measurement Data Set
NDVI	Normalised Difference Vegetation Index
PCD	Product Confidence Data
UMLV	University of Marne-la-Vallée

1.6 Definitions

This section controls the definition of all common terms used within this document. Special attention has been paid to inherit definitions from international standards as ISO, ANSI or ECSS.

segment A part of the ENVISAT / MERIS acquisition delimited by an acquisition date start and an acquisition duration. Usually a full segment matches half one orbit reduced to the part of the observed Earth for which the sun azimuth is greater to a threshold.

2 RADIOMETRY PROCESSING

The scope of this section is to check the documents and analyse the original data within the MERIS segments in order to prepare the selection of the radiometry processing algorithms defined in section 2.5.

2.1 Selection based on information found within the MERIS RR 1B product

The product MER_RR__1PNPDK20030408_093303_000023202015_00208_05773_0848.N1 (referenced 20030408_093303 here above) analysed in this section is fully described in APPENDIX A. The acquisition segment crosses Europe and Africa and includes many clouds.

Product location

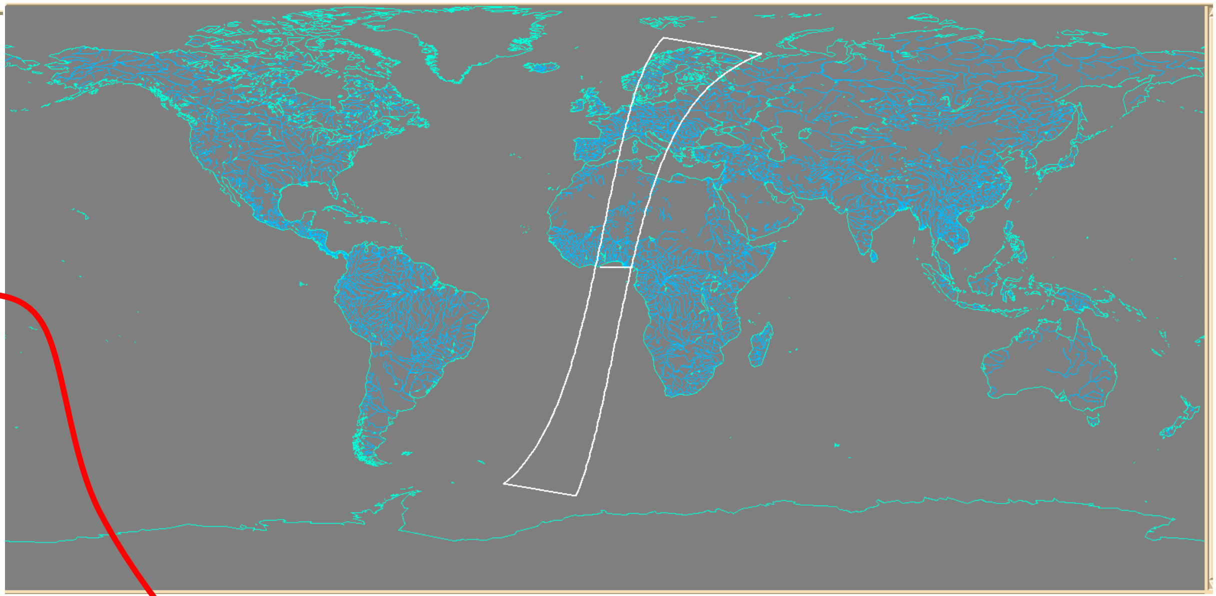


fig. 1 - Footprint of acquisition 20030408_093303

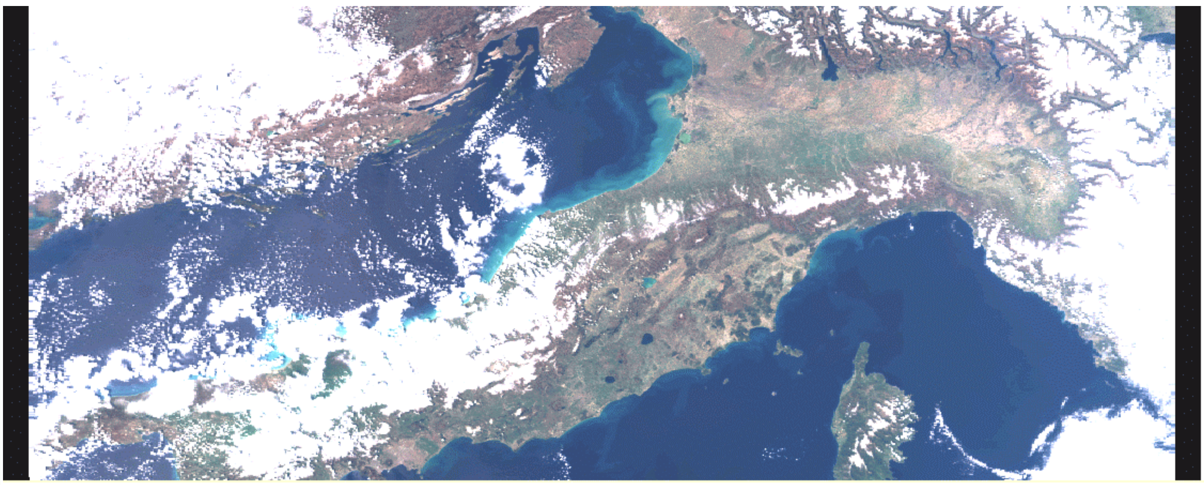


fig. 2 - Acquisition segment (full image) and window over Italy (full resolution) bands 3-5-7 ("True colour).

Size of 20030408_093303 product is 16 bands x 13184 lines x 1121 pixels x 16-bits (≈500 MB).

We may observe that:

- pixels are stored within the file from East to West,
- the top of the acquisition contains black lines,
- left and right borders are filled with a variable number of black pixels (non significant background).

Spectral bands analysis

Fifteen spectral bands can be selected by ground command, each of which has a programmable width and a programmable location in the 390 nm to 1040 nm spectral range (http://envisat.esa.int/instruments/meris/descr/concept.html).

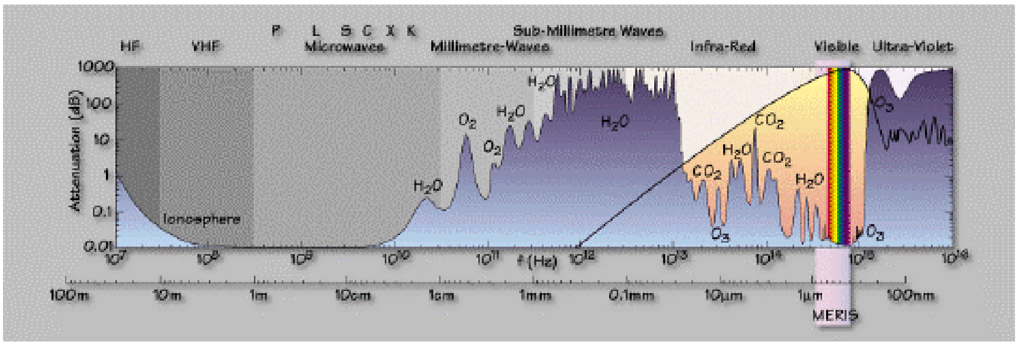
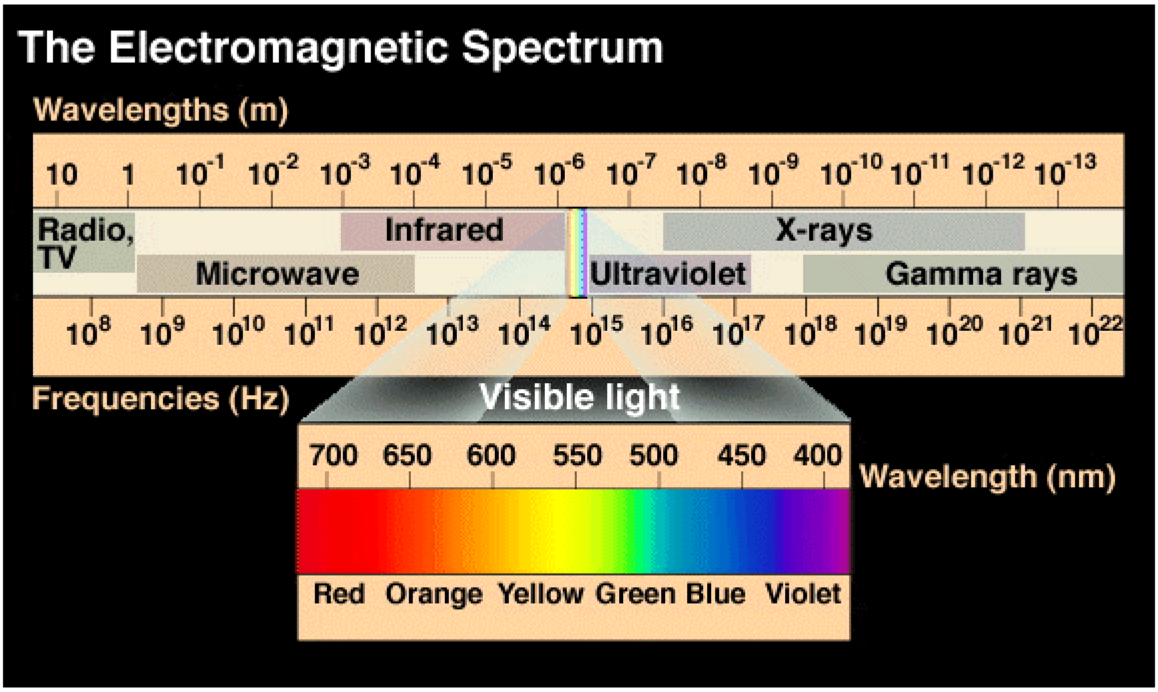


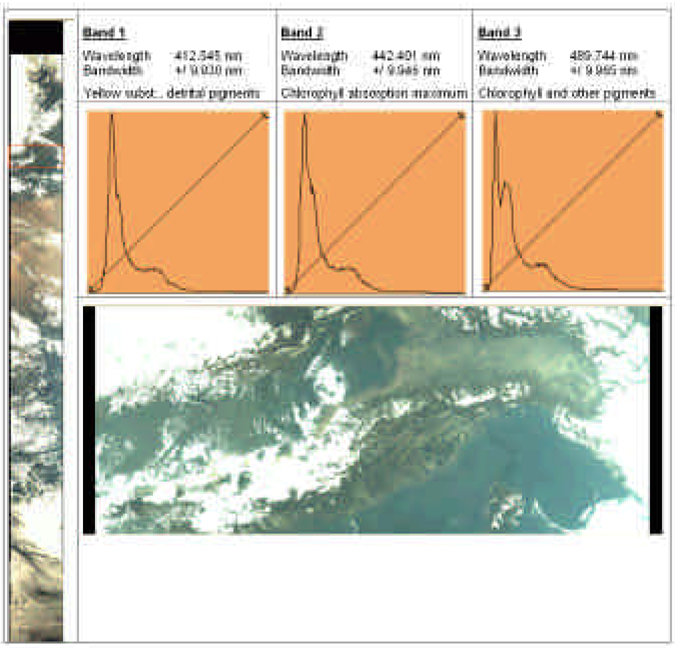
fig. 3 - MERIS Spectral footprint



	Band	Band centre (nm)[1]	Bandwidth (nm)	Primary Use
VISIBLE	1	412.5	10	Yellow substance and detrital pigments
	2	442.5	10	Chlorophyll absorption maximum
	3	490	10	Chlorophyll and other pigments
	4	510	10	Suspended sediment, red tides
	5	560	10	Chlorophyll absorption minimum
	6	620	10	Suspended sediment
	7	665	10	Chlorophyll absorption and fluo. reference
	8	681.25	7.5	Chlorophyll fluorescence peak
	9	708.75	10	Fluo. Reference, atmospheric corrections
INFRARED	10	753.75	7.5	Vegetation, cloud
	11	760.625	3.75	Oxygen absorption R-branch
	12	778.75	15	Atmosphere corrections
	13	865	20	Vegetation, water vapour reference
	14	885	10	Atmosphere corrections
	15	900	10	Water vapour, land
[1] Bands width 1 to 15 are given in nm				

table 1 - MERIS spectral bands

In the following, the segment 20030408_ 093303 acquired over Italy is displayed using the 15 bands through five RGB colour compositions (see the opposite figure).

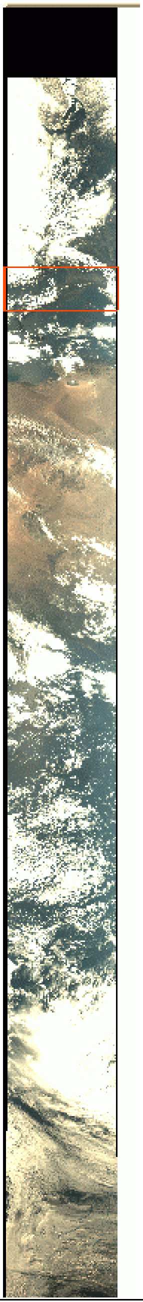


The leftmost image encompasses the full segment and has been linearly stretched.

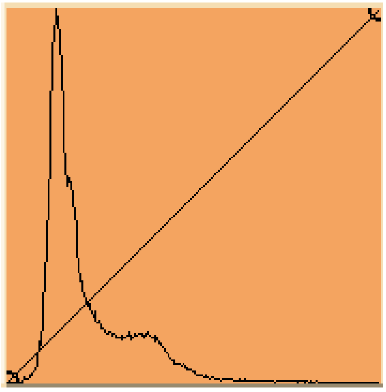
BGR (Blue Green and Red) colour composition is performed from the three bands which captions are reported at the top of the three columns and exactly in the order BGR (i.e. here band 1 is mapped on the blue plan, band 2 on the green plan and band 3 on the red plan).

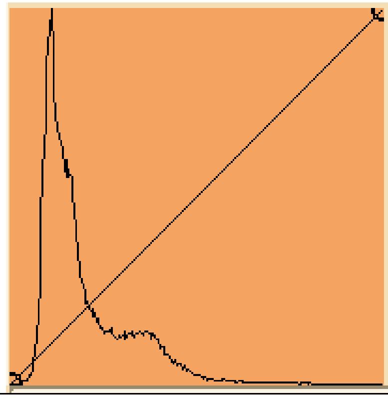
The three diagrams match the histogram of each one of the three BGR bands. Horizontal axis is the input radiometry representation in range [0,65535].

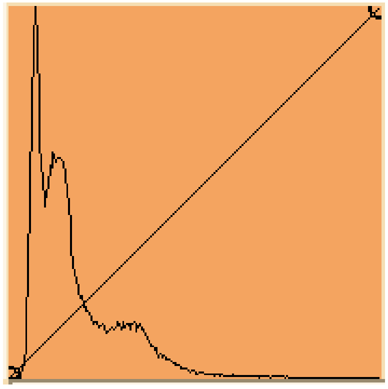
The largest image bottom-right is a full resolution display of a part of the segment centred on Italy.



Band 1	Band 2	Band 3
Wavelength 412.545 nm	Wavelength 442.401 nm	Wavelength 489.744 nm
Bandwidth +/ 9.930 nm	Bandwidth +/ 9.946 nm	Bandwidth +/ 9.965 nm
Yellow subst., detrital pigments	Chlorophyll absorption maximum	Chlorophyll and other pigments







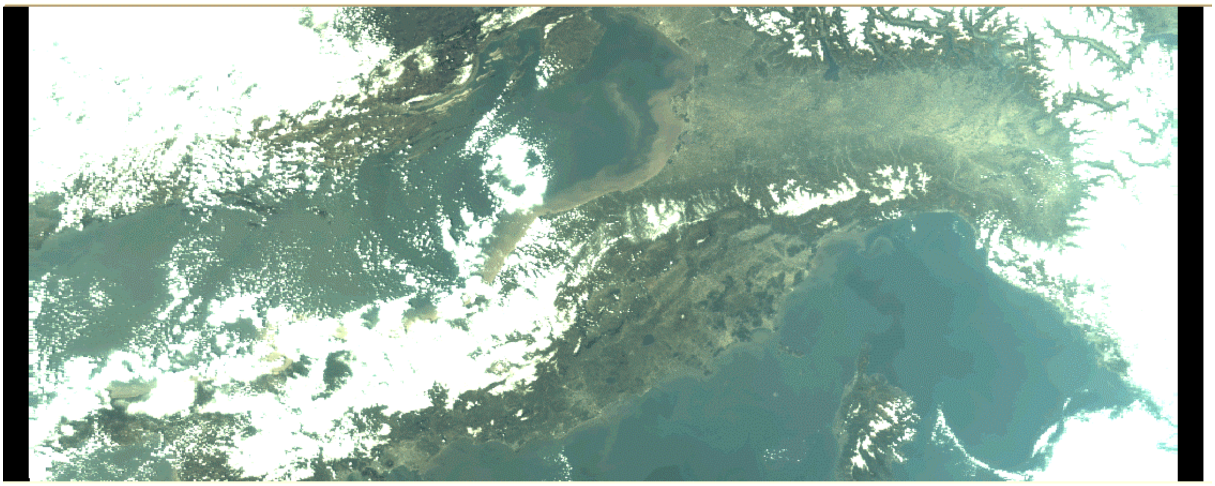
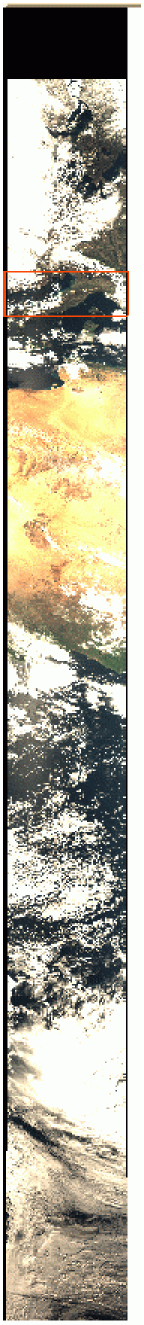
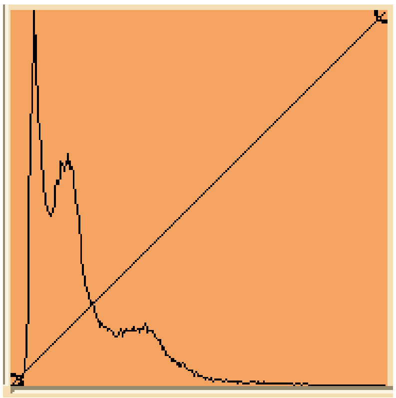
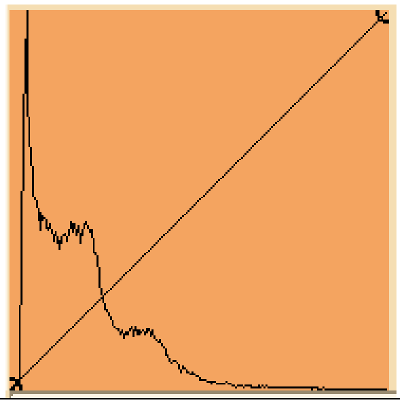


fig. 4 - Bands 1 (blue), 2 (green) and 3 (red)



Band 4	Band 5	Band 6
Wavelength 509.700 nm Bandwidth +/ 9.971 nm	Wavelength 559.634 nm Bandwidth +/ 9.983 nm	Wavelength 619.620 nm Bandwidth +/ 9.991 nm
Suspended sediment, red tides	Chlorophyll absorption minimum	Suspended sediment





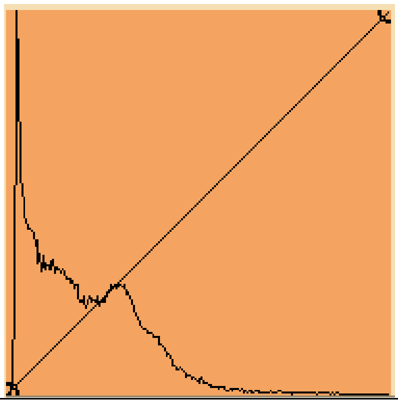
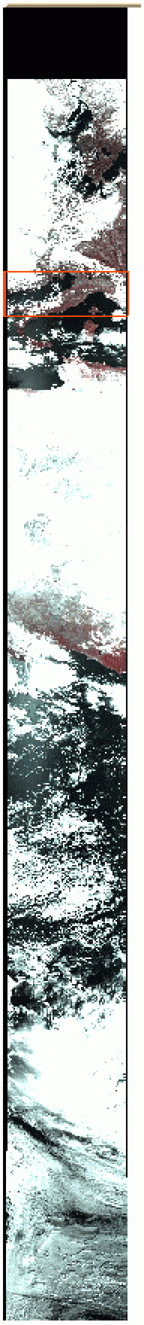
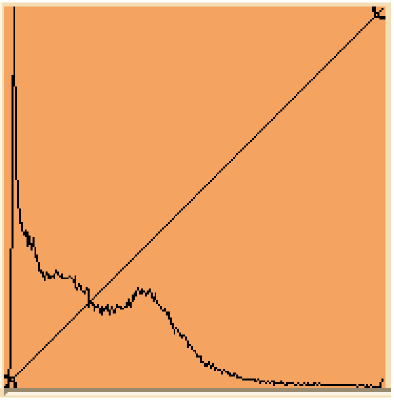
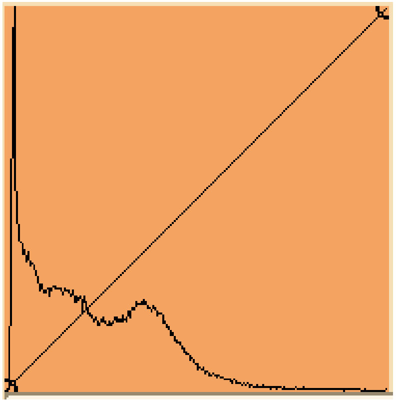


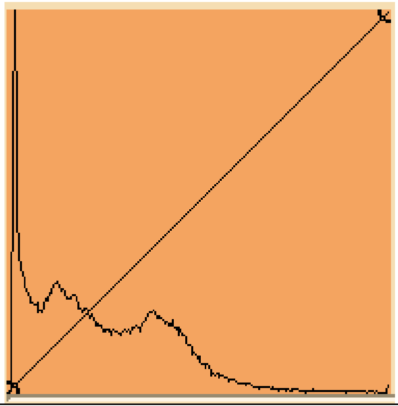
fig. 5 - Bands 4 (blue), 5 (green) and 6 (red)



Band 7	**Band 8**	**Band 9**
Wavelength 664.640 nm Bandwidth +/ 9.994 nm	Wavelength 680.902 nm Bandwidth +/ 7.493 nm	Wavelength 708.426 nm Bandwidth +/ 9.996 nm
Chlorophyll absorption, fluo. ref.	Chlorophyll fluorescence peak	Fluo.ref, atmospheric corrections







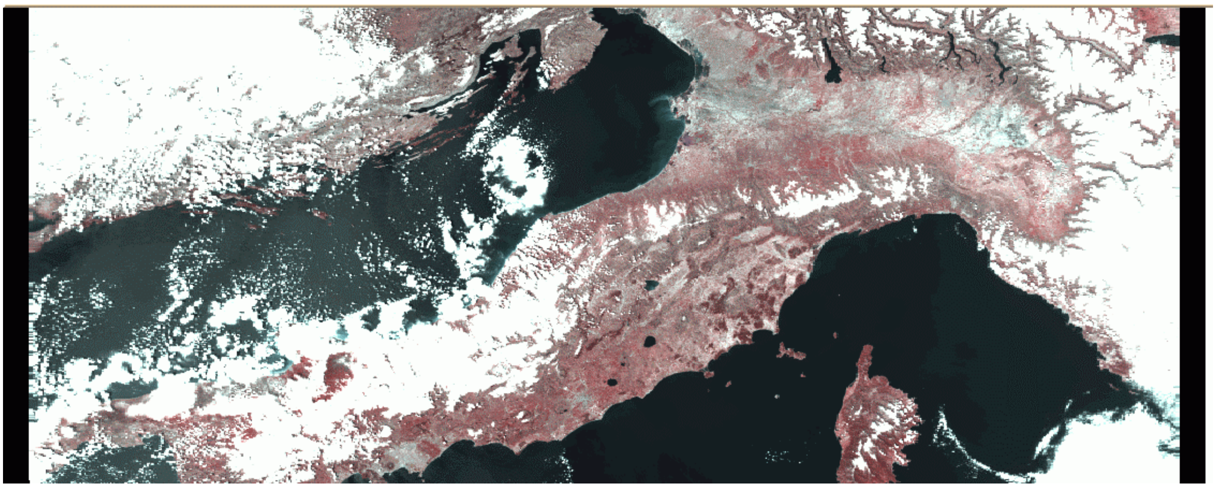
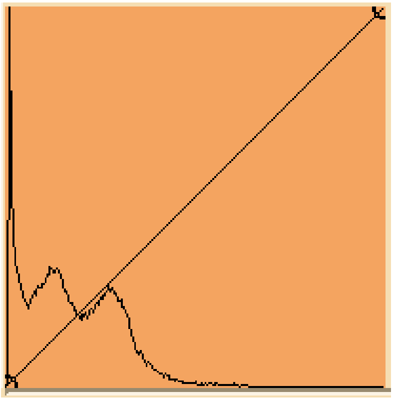
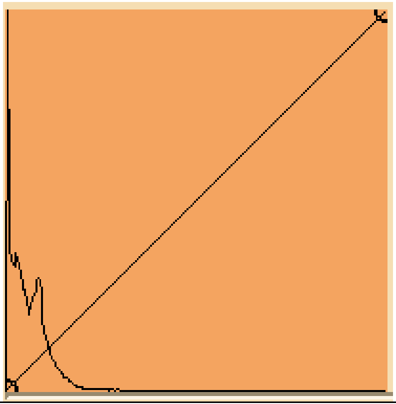
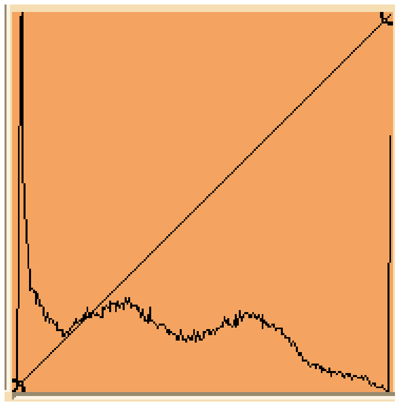


fig. 6 - Bands 7 (blue), 8 (green) and 9 (red)

Band 10	**Band 11**	**Band 12**
Wavelength 753.472 nm	Wavelength 760.354 nm	Wavelength 778.498 nm
Bandwidth +/ 7.493 nm	Bandwidth +/ 3.742 nm	Bandwidth +/ 15.000 nm
Vegetation, cloud	Oxygen absorption R-branch	Atmosphere corrections







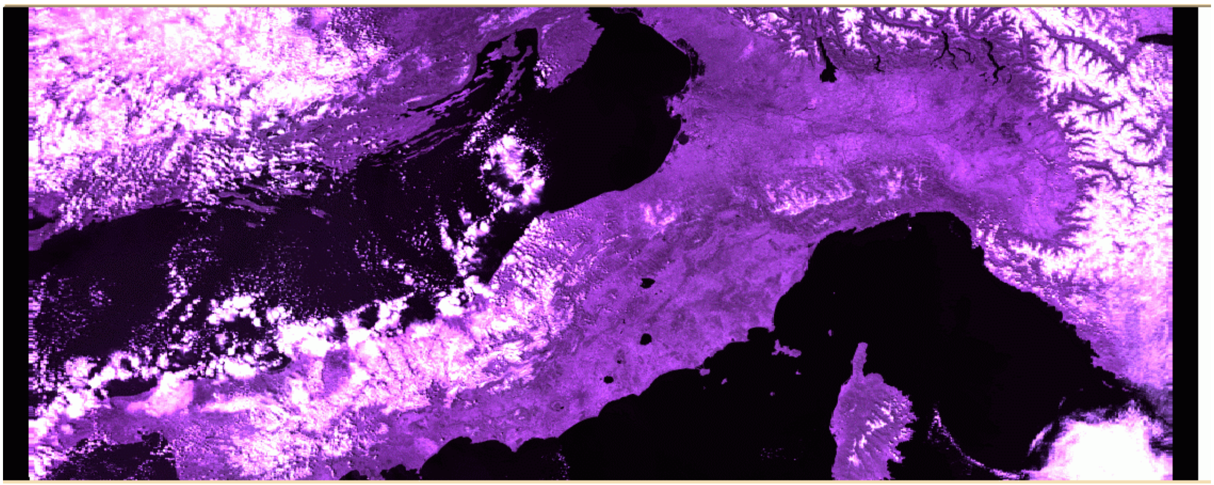
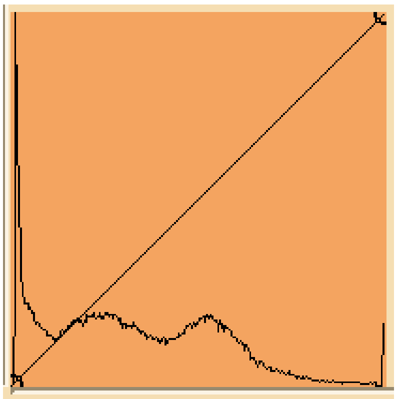
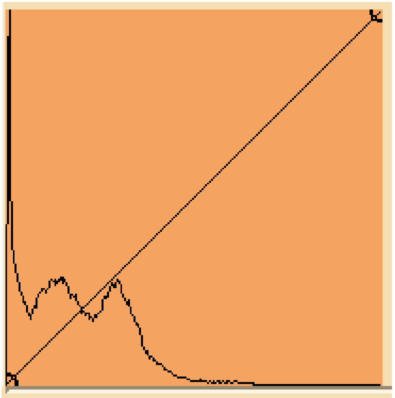
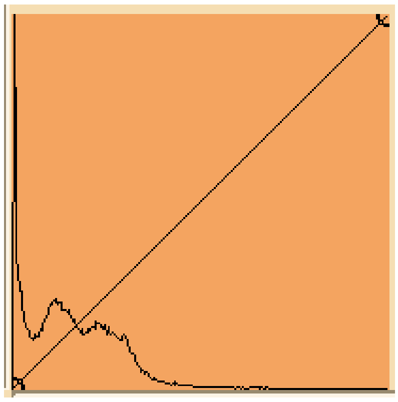


fig. 7 - Bands 10 (blue), 11 (green) and 12 (red)

Band 13	**Band 14**	**Band 15**
Wavelength 864.833 nm Bandwidth +/ 19.999 nm	Wavelength 884.849 nm Bandwidth +/ 9.990 nm	Wavelength 899.860 nm Bandwidth +/ 9.989 nm
Vegetation, water vapour ref.	Atmosphere corrections	Water vapour, land
		

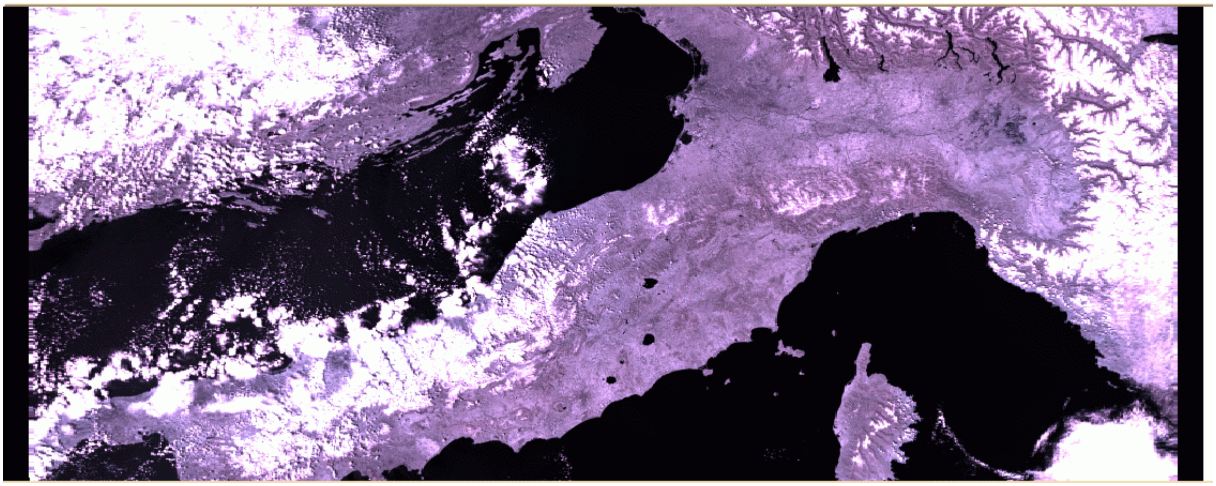


fig. 8 - Bands 13 (blue), 14 (green) and 15 (red)

Flags of MDS(16)

Flags of Measurement data Set (MDS) 16 are described in section 11.4.1.7.4 of document R-6 and are summarized here below.

Flag type	Bit number
cosmetic	0
duplicated	1
glint risk	2
suspect	3
land / ocean	4
bright	5
coastline	6
invalid	7

table 2 - Flags of the first byte of each MDSR(16) values.

Spectral shift index

The second byte of each 16-bits values of the Measurement Data Set Record 16 corresponds to the “Spectral shift index”. The meaning of these values has not been found within the documentation and these values will not be used.

Right figure shows these values along the entire segment.

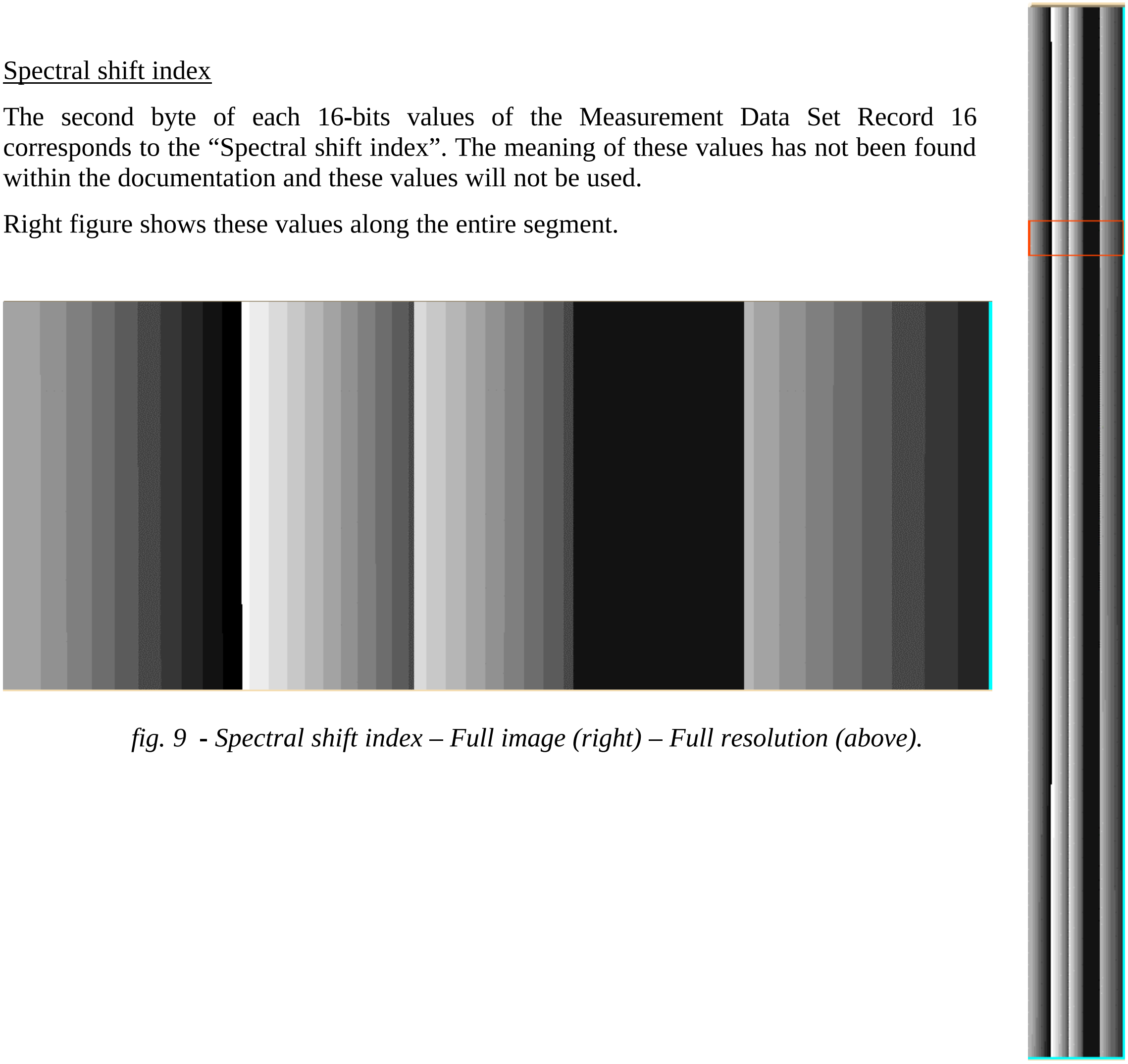


fig. 9 - Spectral shift index – Full image (right) – Full resolution (above).

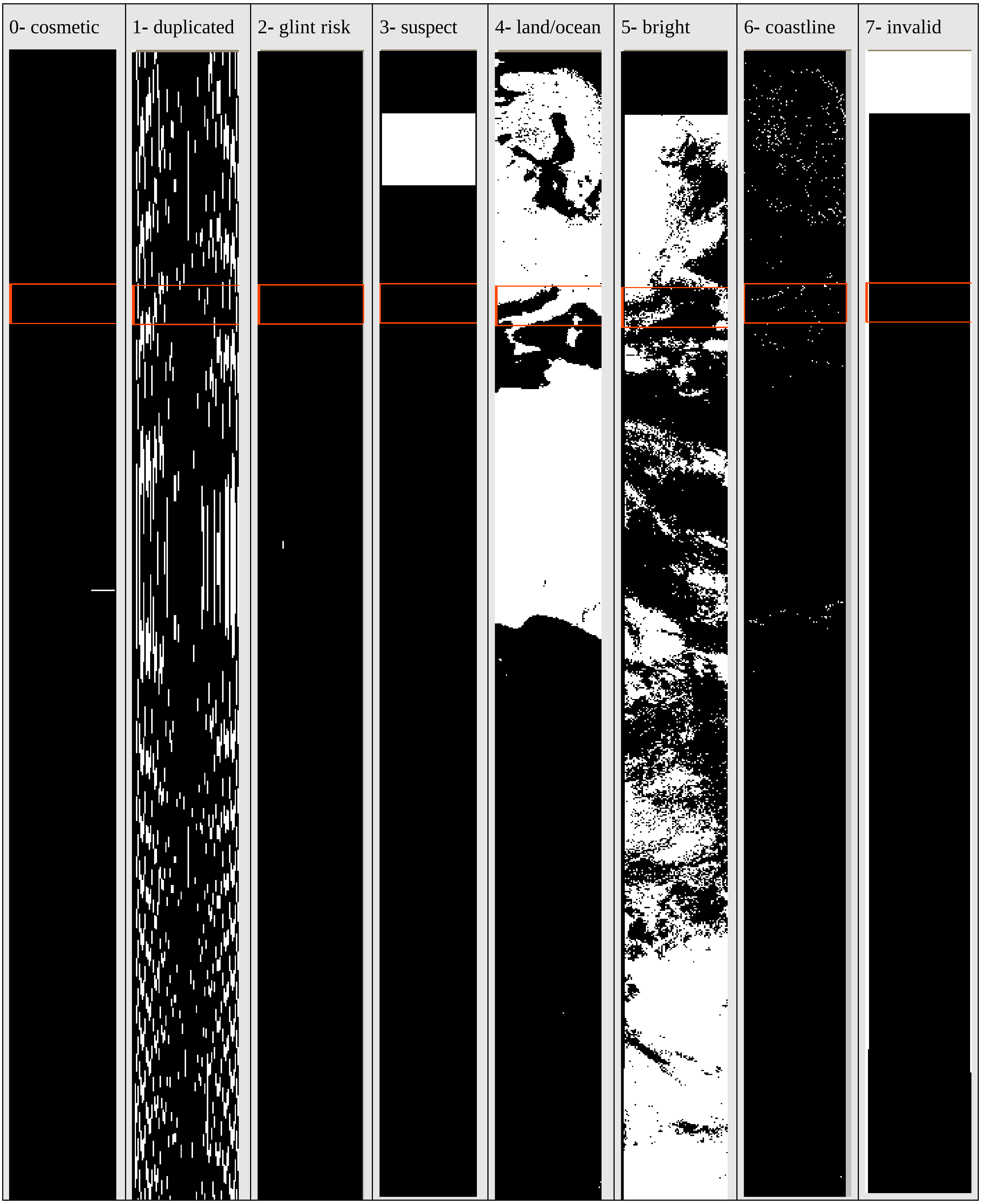


fig. 10 - Flag values of MDSR(16) – Full image.

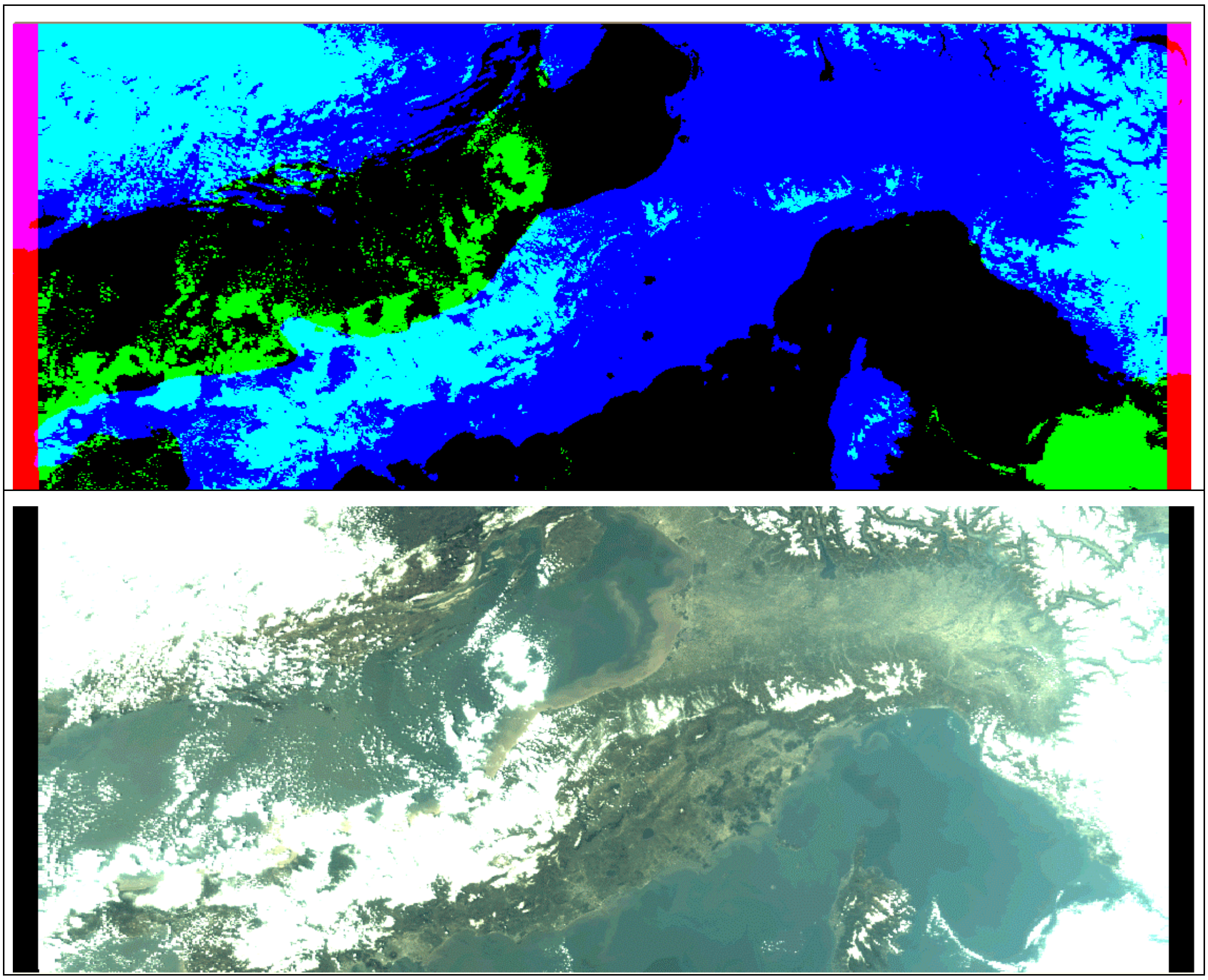


fig. 11 - Comparison between the flag values (B:land/ocean, G:bright, R:invalid) and the colour values (B:band 1, G:band 2, R:band 3).

2.2 ATBD – Pixel Identification

Section ATBD 2.17 of document R-8 (Level 2 Algorithm Theoretical Basis Document) proposes a series of algorithms to refine the pixel identification present within the level 1B product. In particular, the following issues are addressed:

- land / water discrimination,
- bright over ocean,
- bright over land,
- dark dense vegetation (DDV),
- cirrus clouds over land and ocean,
- cloud heterogeneity.

Land – water

The land / water discrimination is to be based on absolute values of radiometry in band 7 (665 nm) setting a threshold and comparison with band 13 (NIR 865 nm).

Bright surfaces over ocean

The 6S atmospheric correction model is applied on bands 1 (412.5 nm) and 2 (442.5 nm) comparing the 3 conditions: -pure Rayleigh, -aerosol 23 km-visibility, and –Rayleigh+aerosols.

Bright surfaces over land

A first algorithm is identical to the one used over ocean but taking into account altitudes to correct pressures.

DDV detection

Seven (7) Dark Dense Vegetation (DDV) models are provided in section ATBD 2.15 (Atmospheric corrections over land) of document R-8. For each one a threshold is provided based on the Atmospherically Resistant Vegetation Index (ARVI) given by the following equation:

$$ARVI = \frac{\rho_{NIR} - \rho_{rb}}{\rho_{NIR} + \rho_{rb}}$$

with

$$\rho_{rb} = \rho_r - \gamma \times (\rho_b - \rho_r)$$

where:

- ρ_r, ρ_b and ρ_{NIR} are the reflectance in channels blue, red and near infrared respectively,
- γ red / blue weight empirically equal to 1.3 over DDV.

2.3 Experience of SPOT/VEGETATION processing

Document R-15 specifies the way SPOT/VEGETATION synthesis are processed. Documents R-10, R-11 and R-12 are more focused on the corrections of bi-directional effects on the reflectance distribution setting a BRDF model.

To enable comparison with ENVISAT/MERIS, table here below summarizes the wavelength of SPOT/VEGETATION instrument (sources http://vegetation.cnes.fr) and the closest band of MERIS.

Spectral bands	Wavelength	MERIS equivalent
BLUE	0.43 – 0.47 µm	B2: 0.4425 µm
RED	0.61 – 0.68 µm	B7: 0.665 µm
NIR	0.78 – 0.89 µm	B13: 0.865 µm
SWIR	1.58 – 1.75 µm	None

SPOT VEGETATION synthesis are computed using the **Maximum Value Compositing (MVC)** method by selecting the maximum Normalised Difference Vegetation Index (NDVI) at top of atmosphere. After this selection, atmospheric effects are corrected to obtain surface reflectance and NDVI using the SMAC code.

Document R-13 presents a new algorithm elaborated by VITO Research Team for the detection of clouds, snows and cloud shadows within VEGETATION images. This algorithm has been experimented as the MVC-2 model (see R-11).

2.4 Observed defects

The scope of this section is to analyse the defects that have been observed while processing the "world_test" image (10-km resolution), to define the algorithms to select a pixel of the segment and the algorithm to merge the pixel of the segment inside the synthesis image.

Calibration error

The figure beneath here below shows a calibration defect observed on the MERIS segment MER_RR__1PNPDK20030404_064241_000020502015_00149_05714_4531.N1

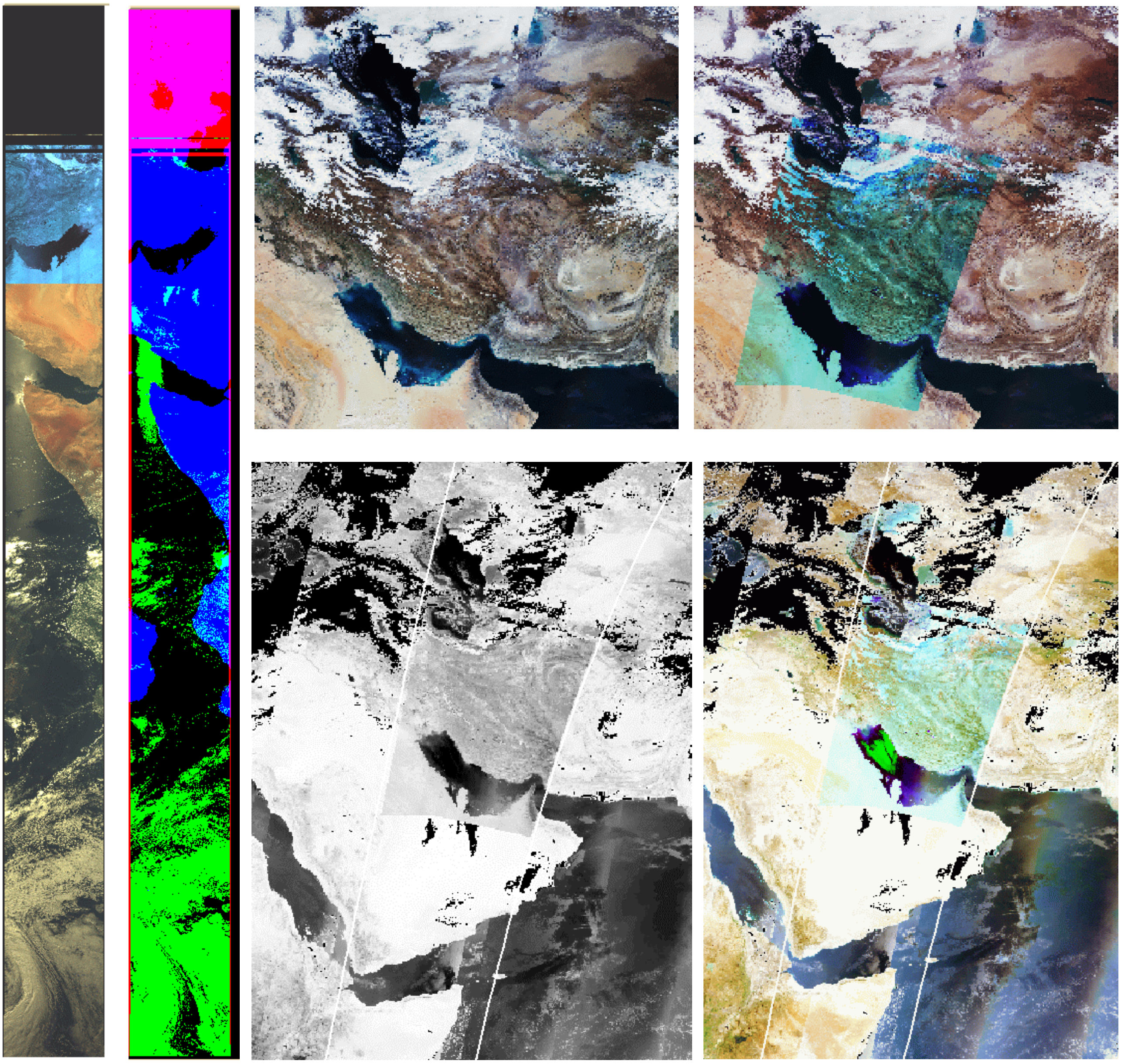


fig. 12 - Calibration error.

Calibration defects of input segments may dramatically degrade the output synthesis depending on the replacement algorithm (see next section) being used. When the replacement algorithm is "Minimum radiance", a segment with too low radiometry will inlay a mark within the synthesis. This indelible mark cannot be overlaid anymore because all the successive segments will have a radiometry greater than this too low radiometry.

The presence of such defects has justified the set up of the systematic quality control service (see the “Synthesis generation” section).

Systematic gaps

Sometimes, gaps are encountered within each one of adjacent segments and almost systematically around the same latitude (see figure here below).

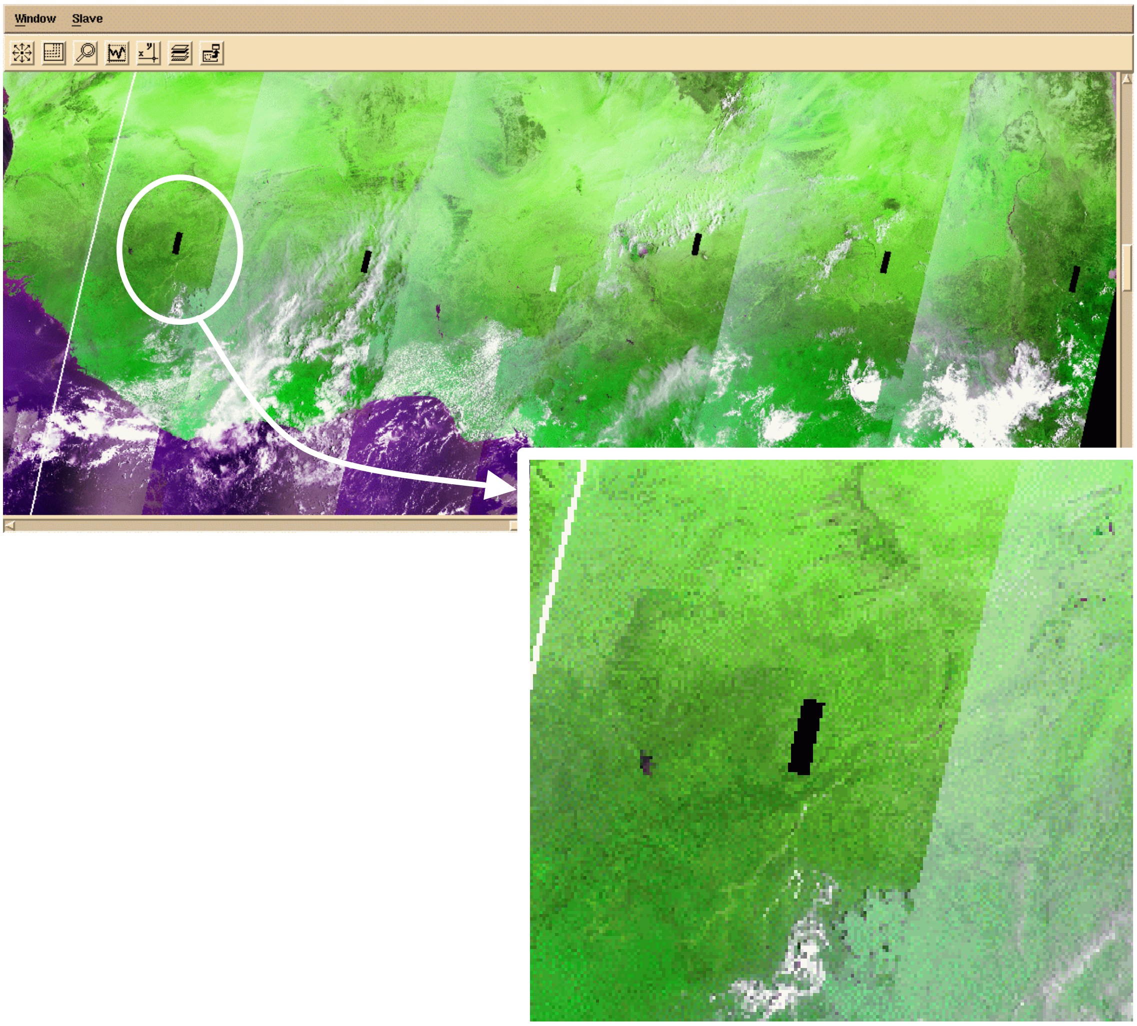


fig. 13 - Systematic gaps.

BRDF anisotropy

As shown in fig. 14 the Bidirectional Reflectance Distribution Function (BRDF) observed on the sea areas is very dependant on the direction of the sun reflex ion angles with regard to the viewing angles but seems also to depend on the state of the sea surface, and indirectly on the wind distribution.

To avoid the wave/aliasing effect observed on the sea areas, a BRDF model should be set enabling to set uniform the sun response and to set in evidence the sea colours (phytoplankton…).

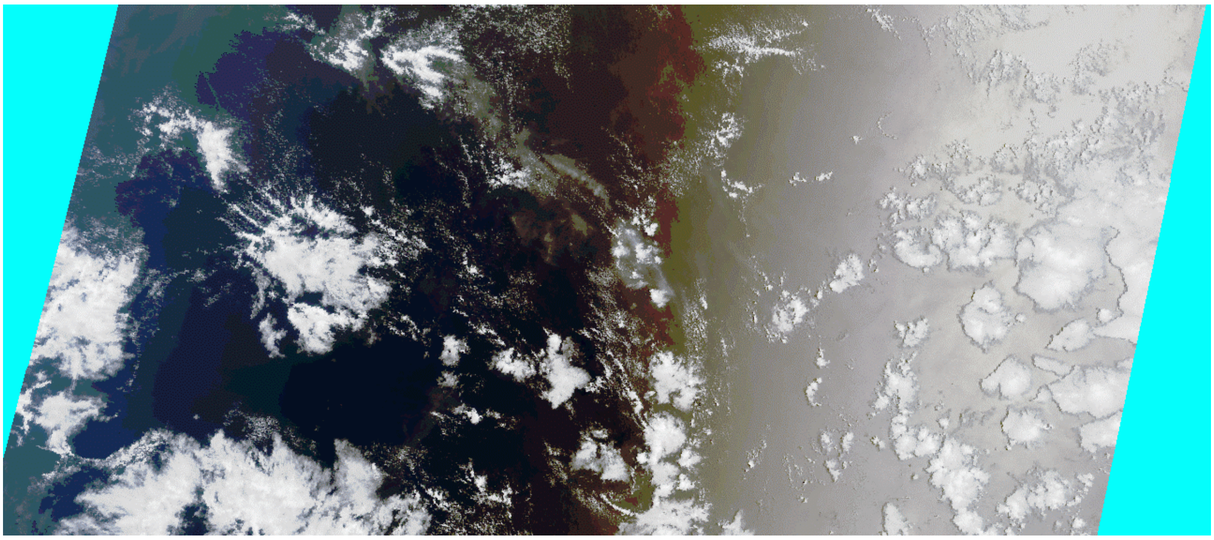


fig. 14 - Specular reflection defect on sea areas.

"Grid effect" on Philippines

Segment tape10-01/MER_RR__1PNPDE20030429_021103_000002472016_00003_06069_2380.N1 leads to the defect shown in fig. 15 with a type of oblique "grid" over the Java islands.

synthesis before merging **synthesis after merging**

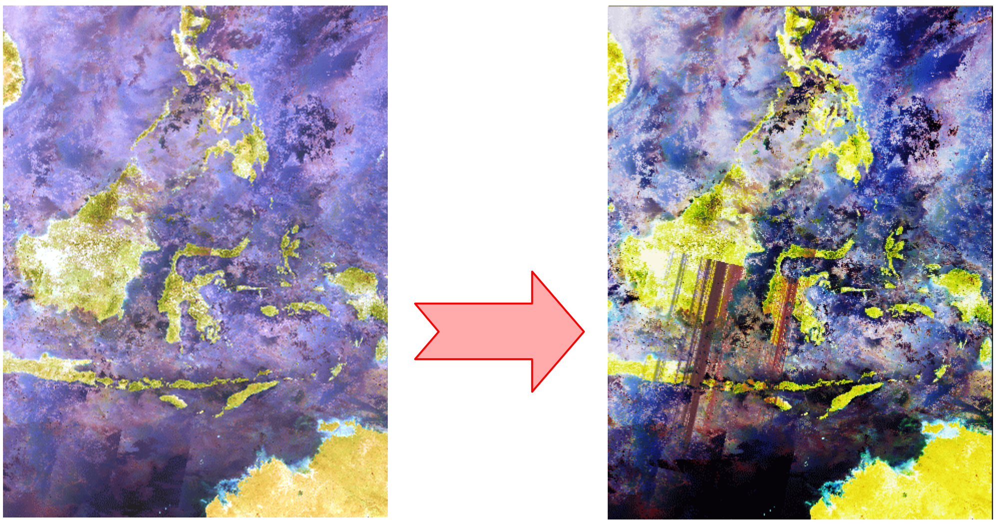


fig. 15 - Effect of insertion of segment MER_RR__1PNPDE20030429_021103_000002472016_00003_06069_2380.N1.

Decoding of the original segment shows a strange duplication of the image originally acquired on the Northwest coast of Australia (see the left image of fig. 16).

Mapping the segment alone, i.e. not overlaying the mapped segment over a synthesis computed at a previous step, leads to the defect demonstrated within the right image of fig. 16.

This image clearly shows that almost the entire image is filled with a repetition (or at least a large vertical stretching) of one of the bottom lines.

Only a small part of the image is topologically correct at the bottom of the segment but this part is not correctly located on the "Shark Bay" surrounded in the figure.

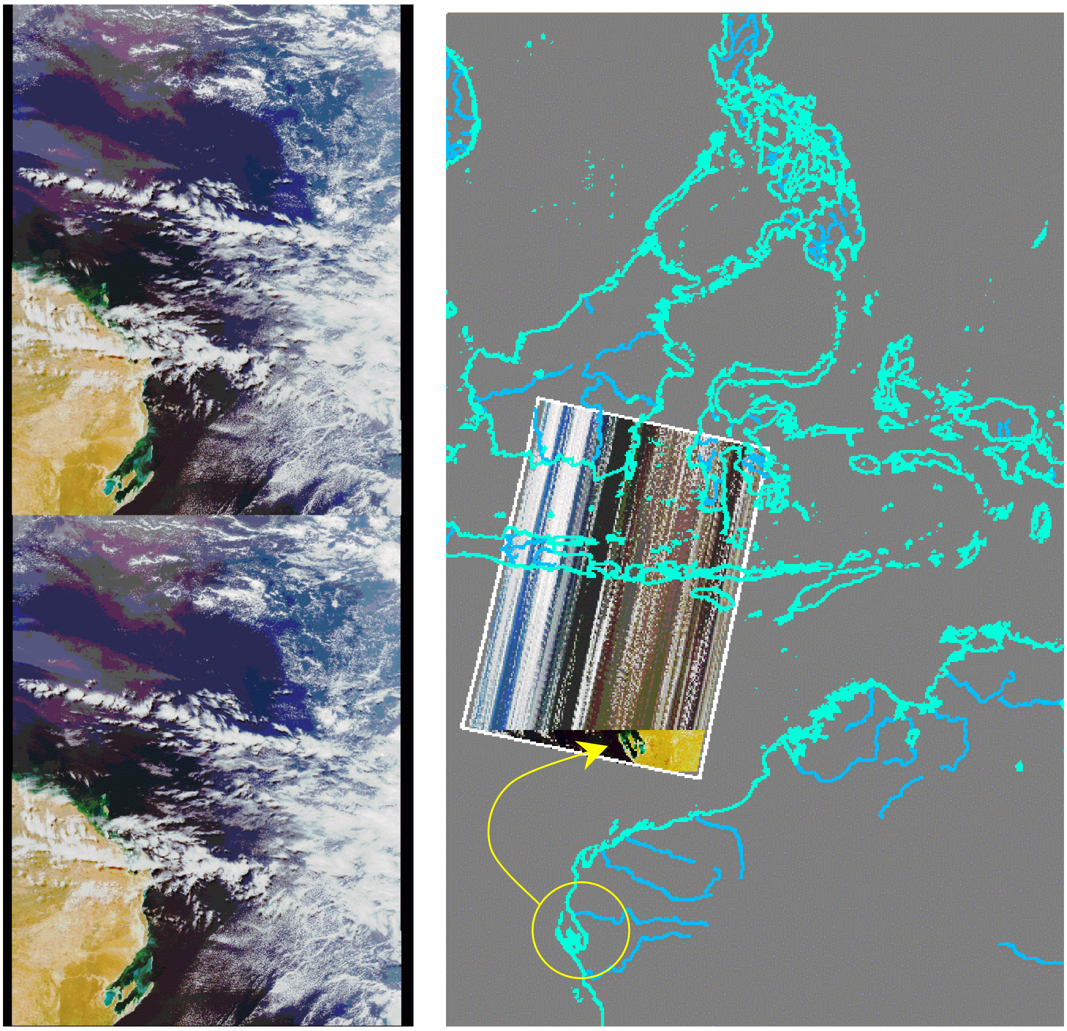


fig. 16 - Original data and single mapping of segment MER_RR__1PNPDE20030429_021103_000002472016_00003_06069_2380.N1.

Shift on Borneo

During the processing of April-2 (second half of April) a strong radiometric defect appeared obliging us to go more than 20 steps backward (see 0 here below). Such a defect is more noticeable on band 13 and shall be detected as early as possible by the quality control engineer because all the successive synthesis will be wrong. It is not possible anymore to overlay an erroneous radiance minimum.

Once noticed, it is very difficult to retrieve the segment causing the defect. One method is to overlay the segment boundaries as shown in fig. 17.

Here the segment in error was present in tape10-01:

MER_RR__1PNPDE20030429_020611_000002702016_00003_06069_2287.N1 \

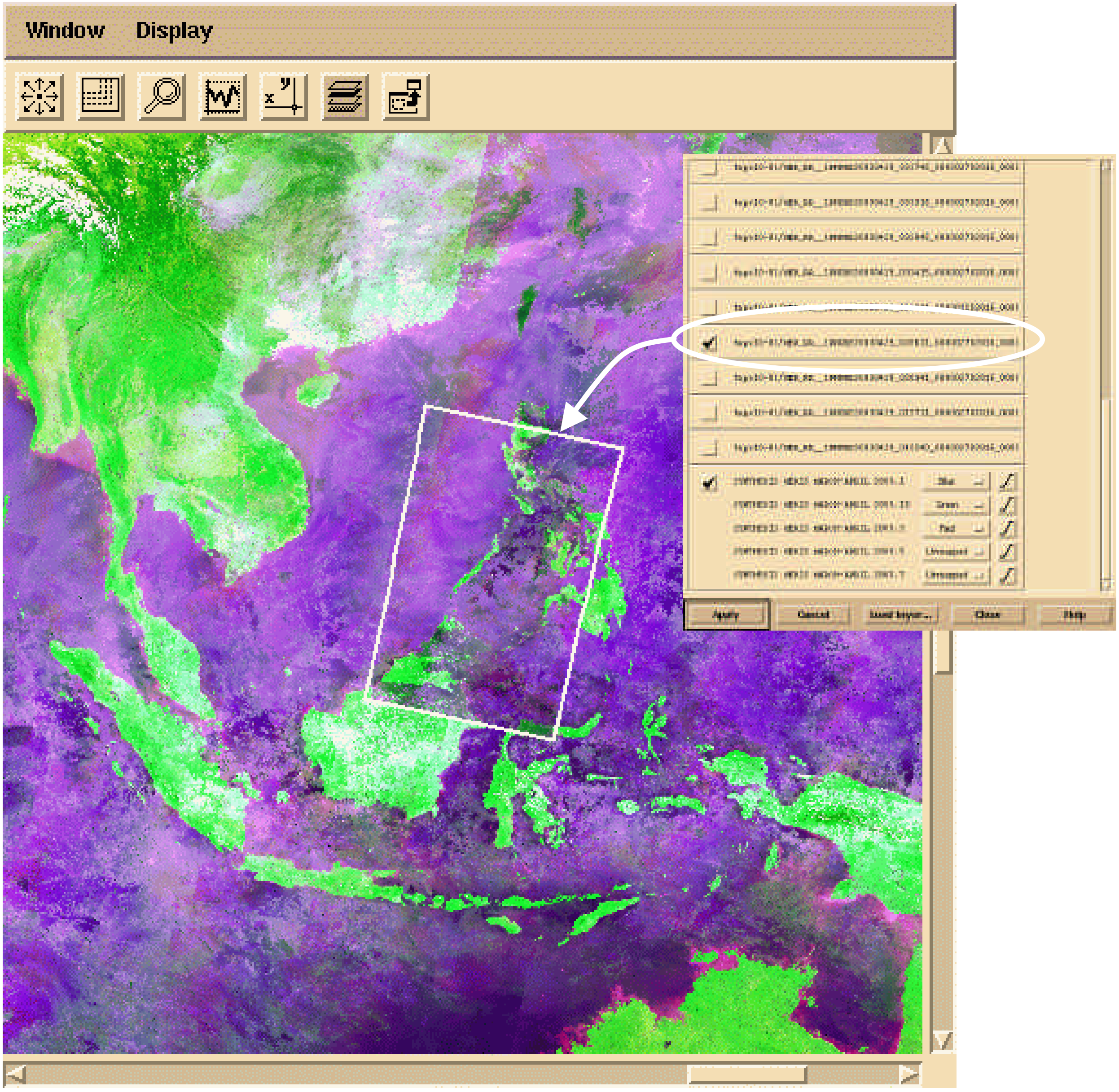


fig. 17 - Defect on Borneo – Identification of segment.

The defect is due to a wrong absolute location of the segment along its orbit. This defect is demonstrated mapping the segment MER_RR__1PNPDE20030429_020611_000002702016_00003_06069_2287.N1 alone as shown in fig. 18. Borneo Island has been mapped around 1500 km northward of its exact location symbolised by the vector layer of the coasts.

Such defects could be due to a wrong on-board counter value attached to the ephemeris data.

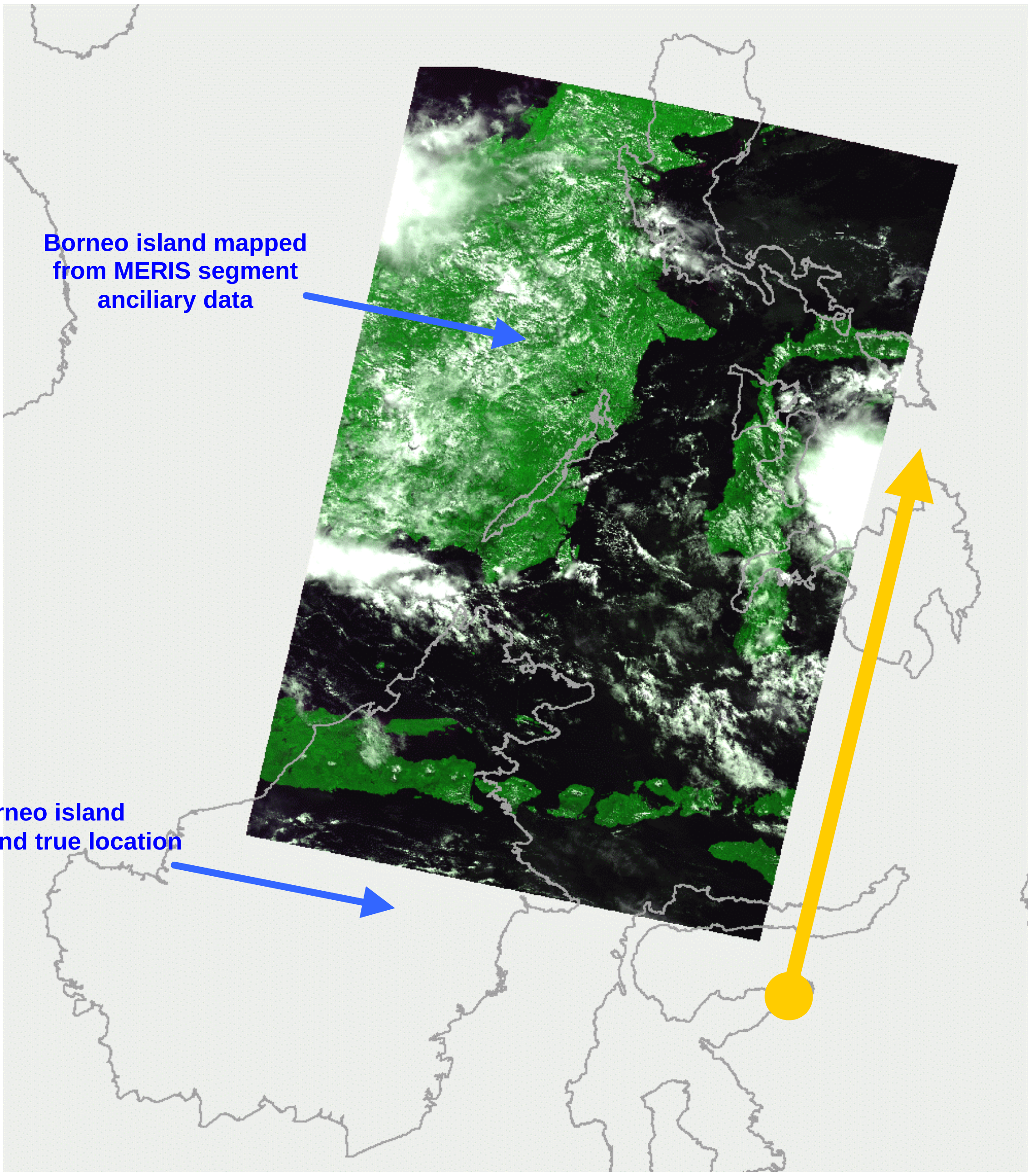


fig. 18 - Single mapping of segment MER_RR__1PNPDE20030429_020611_000002702016_00003_06069_2287.N1.

2.5 Selection and replacement algorithms

As shown in the figure here below, the synthesis is progressively computed band per band merging one MERIS segment in a synthesis computed one step before.

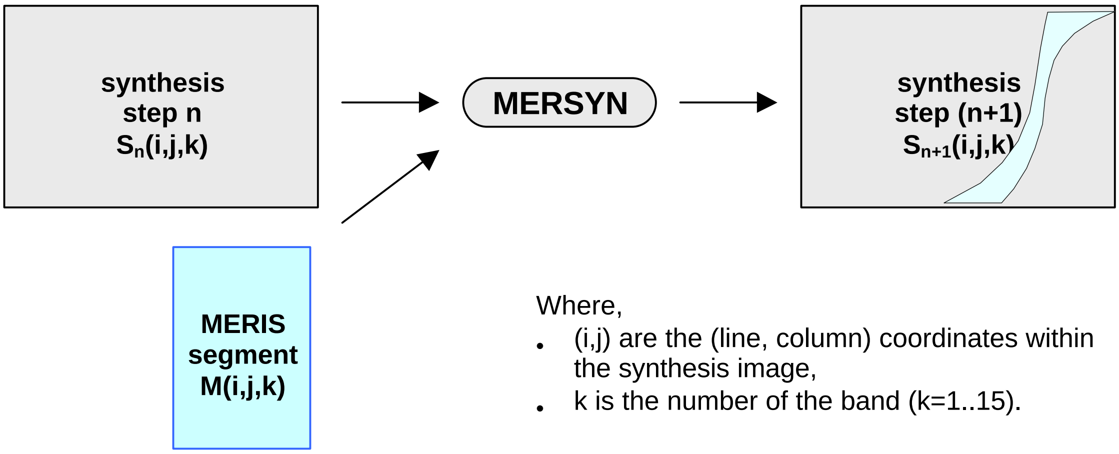


fig. 19 - Iterative computation of the synthesis.

In close collaboration with Pierre-Louis FRISON (UMLV) a bibliography inventory has been performed to determine the best algorithm to be used for the selection and for the merging of the MERIS segment pixel within a synthesis.

Selection algorithm

The selection algorithm shall decide if the output pixel $S_{n+1}(i,j)$ shall be replaced by the MERIS segment value M(I,j) (or by a value deriving from M(I,j) or if this pixel $S_{n+1}(i,j)$ shall be left to the value $S_n(i,j)$.

Radiance minimum

The main scope is to remove the clouds and to keep only the-on-ground reflectances. Clouds having a higher reflectance in almost all the bands, the first idea is to simply keep the minimum radiance.

```
for each band k do
     if (M(i,j,k) < Sn(i,j,k)
     then
          Sn+1(i,j,k) ← MA[M(i,j,k)...]
     else
          Sn+1(i,j,k) ← Sn(i,j,k)
     fi
done
```

Where *MA*[M(i,j,k)...] is the merging algorithm (see next section) applied to the MERIS segment value and possibly other variables.

Note: The radiance minimum applies to each band independently. An alternative to such a choice could be to monitor the selection checking only one band (for example the one the more segregates the cloud presence).

NDVI maximum

A more sophisticated algorithm leads to select the MERIS segment pixel only if the Normalised Difference Vegetation Index (NDVI) is greater for this pixel.

For each pixel (i,j) the NDVI value is computed from the Near Infrared band 13 and the Red band 7 according to the following formula:

$$NDVI_M(i,j) \leftarrow \frac{M(i,j,13) - M(i,j,7)}{M(i,j,13) + M(i,j,7)}$$

Where:

- M(i,j,k) is the interpolated value of band k within the MERIS segment matching the position (i,j) within the synthesis image.

Let $NDVI\_MAX_n(i,j)$ be the maximum NDVI values kept up to the step n of the synthesis generation, the NDVI maximum selection is given by the following algorithm:

```
if (NDVI_M(i,j) > NDVI_MAX_n(i,j))
then
     for each band k do
          S_n+1(i,j,k) ← MA[M(i,j,k)...]
     done
     NDVI_MAX_n(i,j) ← NDVI_M(i,j)
else
     for each band k do
          S_n+1(i,j,k) ← S_n(i,j,k)
     done
fi
```

Merging algorithm

The merging algorithm (*MA*) describes the way the MERIS segment value M(i,j,k) is merged within the output synthesis $S_{n+1}(i,j,k)$.

Replacement

The simplest algorithm consists in replacing the value $S_n(i,j,k)$ by the value M(i,j,k).

```
MA[M(i,j,k)...] ← M(i,j,k)
```

Mean

Because such a replacement could be instable, it has been suggested to compute a sliding mean from the N last selected values. Such a process would oblige to always keep for each pixel (i,j,k) the number N(i,j, of selected samples and the N(i,j) sample values. This strategy would lead to multiply by (N+1) the huge amount of data (1.6 GB per band) and cannot be supported.

A degraded alternative is to compute a “sliding mean” just keeping the number N(i,j,) of samples involved in the computation of the mean at step n $MEAN_n(i,j,k)$.

$$MA[M(i,j,k)...] \leftarrow \frac{M(i,j,k) + N(i,j) \times MEAN_n(i,j,k)}{1 + N(i,j)}$$

2.6 The MERSYN application

The MERIS synthesis application (called MERSYN) has been developed in the framework of this project. This application has been used during the short research phase to select the algorithm and has therefore the two last parameters enabling to choose the selection and merging algorithms.

Header here below contains the user help relative to the MERSYN process.

```
/*****************************************************************************/
/* NAME                                                                      */
/* MERSYN (abbreviation "syn") adds the MERIS segment to the synthesis.      */
/*****************************************************************************/
/* SYNOPSIS                                                                  */
/* MERSYN [<sequence_name>] [-mer <MERIS_segment_in_input>]                  */
/*                          [-isy <input_synthesis_channel_list>]            */
/*                          [-ivi <input_NDVI_maximum_image>]                */
/*                          [-ioc <input_occurrence_image>]                  */
/*                          [-osy <output_synthesis_channel_list>]           */
/*                          [-ovi <output_NDVI_maximum_image>]               */
/*                          [-ooc <output_occurrence_image>]                 */
/*                          [-sal <selection_algorithm>]                     */
/*                          [-mal <merging_algorithm>]                       */
/*****************************************************************************/
/* DESCRIPTION                                                               */
/* MERSYN merges radiances found within the MERIS segment into the various   */
/* bands of the synthesis provided in input. Merging is performed according to*/
/* an algorithm to avoid clouds and invalid values. This algorithm requires   */
/* keeping the maximum NDVI (Normalised Difference Vegetation Index) that has */
/* to be provided in input (parameter "-ivi") and will be updated and stored  */
/* into the file which name is provided as "-ovi" parameter. When the MEAN    */
/* algorithm is to be applied, occurrences of each pixel of the synthesis     */
/* shall be kept (see "-ioc" and "-ooc" parameters in input and output        */
/* respectively).                                                            */
/*                                                                           */
/* Input segment (<MERIS_segment_in_input>) is a Foreign file formatted in    */
/* Earth Explorer (ENVISAT) format. Its name should normally start with       */
/* "MER_RR__1P..." prefix and should have ".N1" as suffix. Decoding of its    */
/* Main Product Header (MHS) and Specific Product Header (SPH) will lead to   */
/* a long listing printed on the standard output.                            */
/*                                                                           */
/* Synthesis in input includes a list of 16-bits 2D-Raster files matching the */
/* various bands of the MERIS data to be processed. MERIS instrument has 15   */
/* bands in visible and near infrared spectra. The "channel" ressource of the */
/* provided channels shall be distinct and within the range [1,15].          */
/* Synthesis images includes a background to indicate that no valid value has */
/* been yet found for this pixel location.                                   */
/*                                                                           */
/* For each pixel of the input synthesis, the maximum NDVI matching the       */
/* initialised values shall be kept and provided as <input_NDVI_maximum_image>*/
/* parameter. For the first time (i.e. if the synthesis does not yet include  */
/* any segment), this "-ivi" parameter may not be given.                     */
/* NDVI values are in the range [-1,+1] and are represented within a 16-bits  */
/* image within the range [1,65535] (value 0 being to represent the           */
/* background).                                                              */
/*                                                                           */
/* For each pixel of the input synthesis, the occurrence (i.e. the number of  */
/* input radiances that have been summed from the various segment already     */
/* merged) is useful if the MEAN algorithm is selected. In this case, the     */
```

```
/* occurrences shall be given as <input_occurrence_image> parameter. For the  */
/* first time (i.e. if the synthesis does not yet include any segment), this  */
/* "-ioc" parameter may not be given.                                         */
/* Occurrence image is a 16-bits image in which each pixel has a value in the */
/* range [0,65535]. This image is to be initialised with zeroes before the    */
/* first segment merging.                                                     */
/*                                                                            */
/* Synthesis in output (<output_synthesis_channel_list>) contains a file list */
/* matching the synthesis provided in input (same number of bands and channel */
/* list). For each pixel, if the pixel is declared as valid, pixels of all the*/
/* bands will be updated according to the algorithm.                          */
/*                                                                            */
/* The NDVI maximum image (<output_NDVI_maximum_image>) is an updated version */
/* of the <input_NDVI_maximum_image> in which the pixels having a NDVI greater*/
/* than the one found in input (if any) will be set to the value of this      */
/* maximum.                                                                   */
/* When no NDVI maximum image is provided in input, all the pixels of the     */
/* output NDVI image will be initialised with a background value.             */
/*                                                                            */
/* Occurrences in output (<output_occurrence_image>) is an updated version of */
/* the <input_occurrence_image> in which the pixels having been selected by   */
/* the algorithm will lead to an increment of its relative occurrence. When no*/
/* <input_occurrence_image> file has been provided in input, the assumed      */
/* occurrence in input is assumed being filled with zeroes. Like for the input*/
/* parameter <output_occurrence_image> parameter shall be provided only if the*/
/* MEAN algorithm is being used.                                              */
/******************************************************************************/
/* DOCUMENT                                                                   */
/* "PO-RS-MDA-GS-2009 - ENVISAT PAYLOAD DATA SEGMENT - ENVISAT-1 PRODUCTS     */
/*  SPECIFICATIONS - VOLUME 11: MERIS PRODUCTS SPECIFICATIONS - Issue 3       */
/*  Revision F - 20/11/2000 - ESA, ALCATEL SPACE"                             */
/******************************************************************************/
/* COPYRIGHTS                                                                 */
/* Copyrights 2003 by GAEL Consultant - All rights Reserved.                  */
/* GAEL Consultant Proprietary - Delivered under License Agreement.           */
/* Copying and Disclosure Prohibited Without Express Written Permission From  */
/* GAEL Consultant.                                                           */
/******************************************************************************/
/* ADMINISTRATION                                                             */
/* Serge RIAZANOFF  | 11.04.03 | v00.01 | Creation of the SW component        */
/* Serge RIAZANOFF  | 15.05.03 | v00.02 | Maximum NDVI option                 */
/* Serge RIAZANOFF  | 29.05.03 | v00.03 | Flag is_replaced -> added_point_nu..*/
/* Stephane MBAYE   | 09.08.03 | v00.04 | Checked/Addapted for FR mode        */
/******************************************************************************/
```

2.7 Selection algorithm results

As shown in the next figures, the radiance minimum (fig. 20) gives almost the same results as the NDVI maximum (0) on land areas, but the NDVI maximum retains much more clouds on the seas.

For this reason the “Radiance minimum” has been chosen for the synthesis.

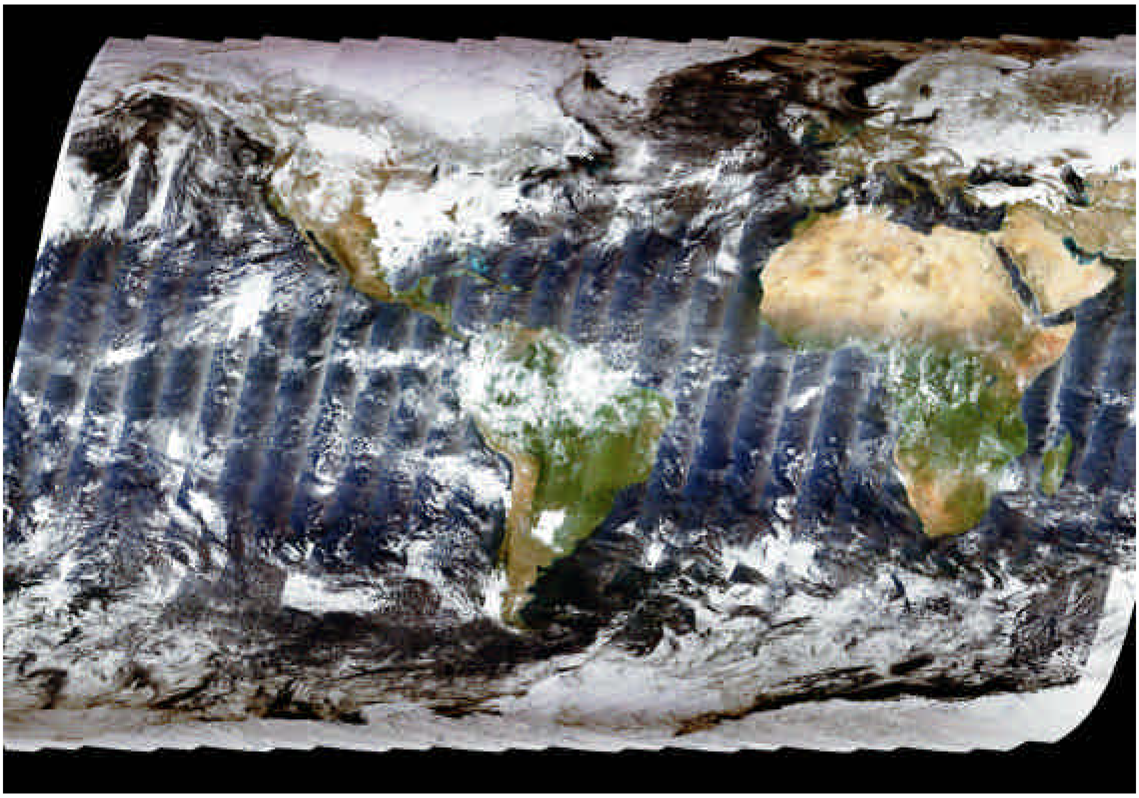


fig. 20 – Radiance minimum

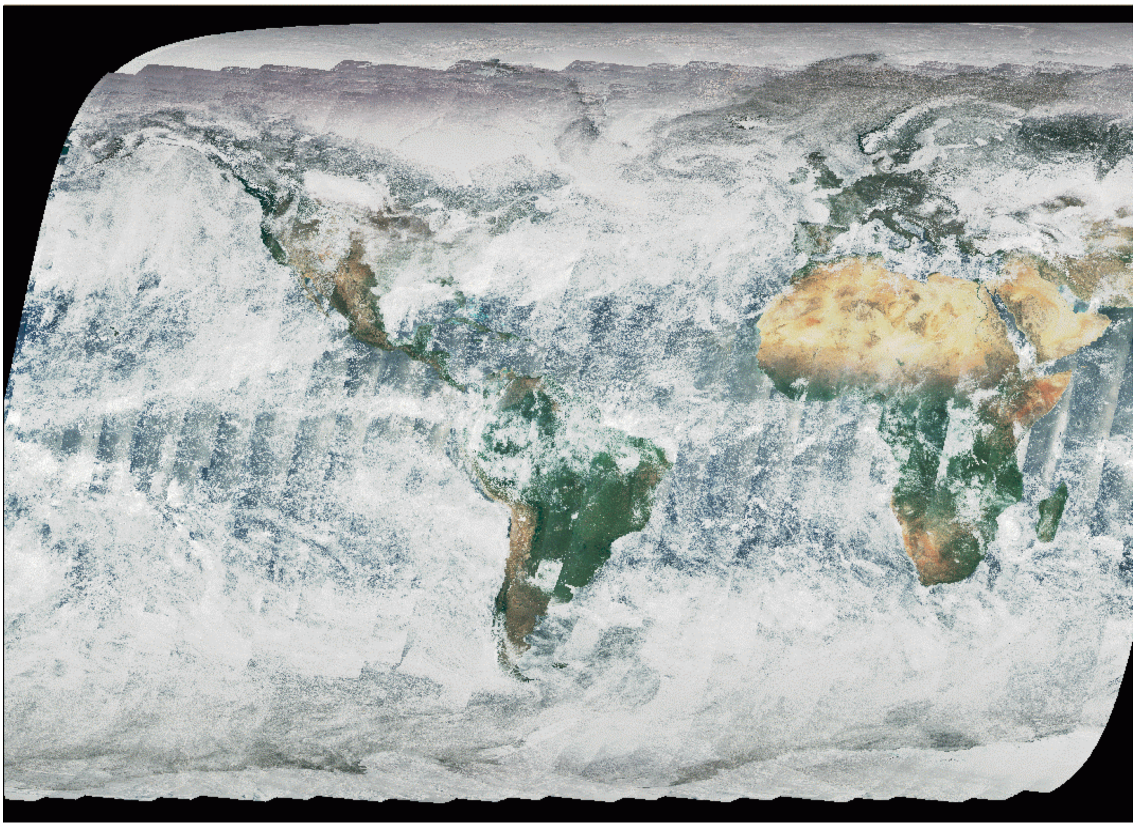


fig. 21 - NDVI maximum

The “NDVI maximum synthesis” (see fig. 22) computed according to the “NDVI maximum” selection algorithm is a very interesting product that could be delivered on a regular basis.

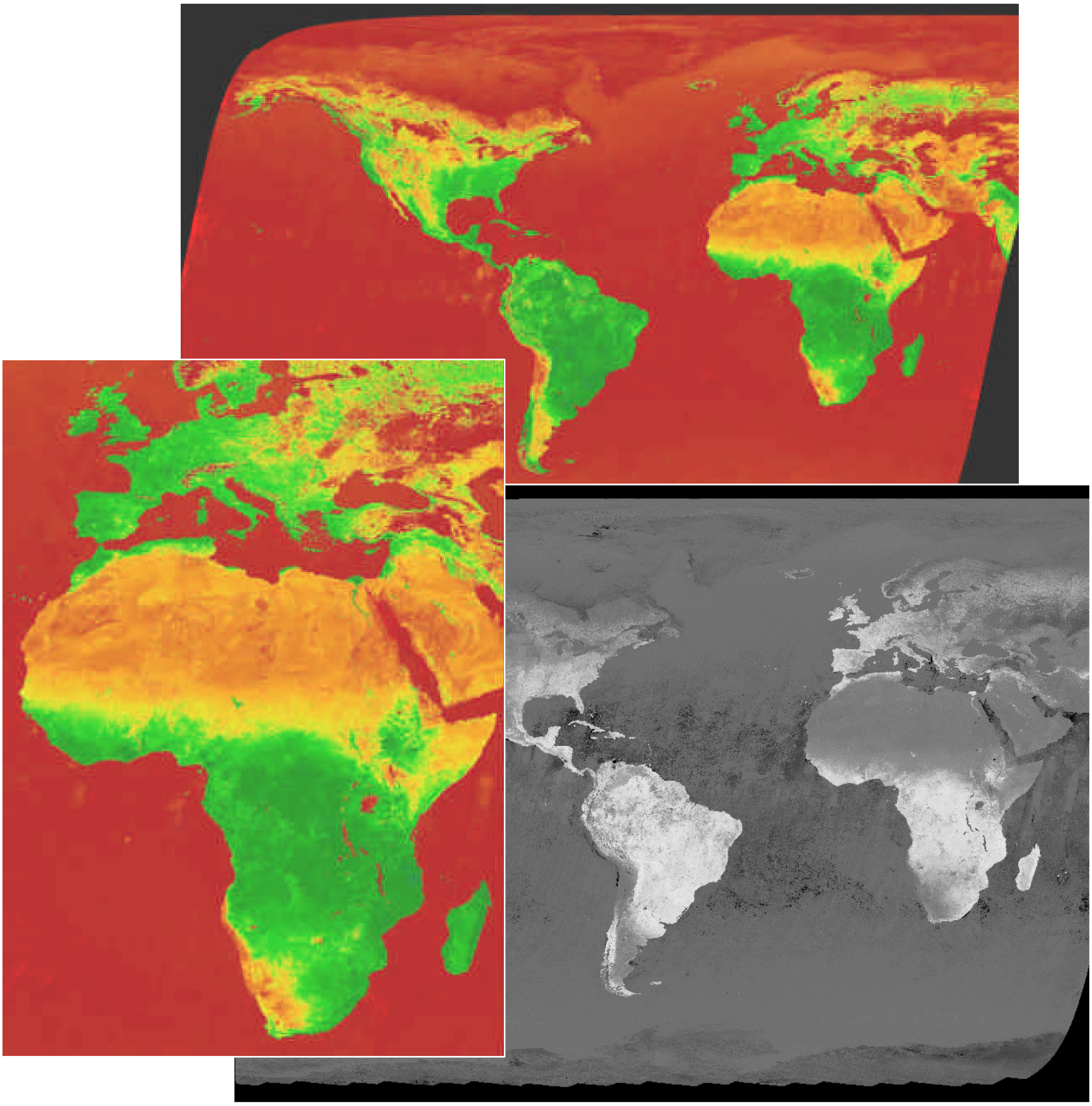


fig. 22 - “NDVI maximum synthesis” image computed from bands 13 (NIR) and 7 (Red).

2.8 Merging algorithm results

Merging algorithm may be a simple replacement of the synthesis value by the MERIS segment value or a sliding mean (see section 2.5 here above) computed on the last replaced values and the new segment value.

The figure beneath summarizes the results obtained by varying these two options combined with the two possible selection algorithm (“Radiance minimum” or “NDVI maximum”) which results have been presented in the previous section.

These images have been computed synthesising the 192 first MERIS segments of March 2003.

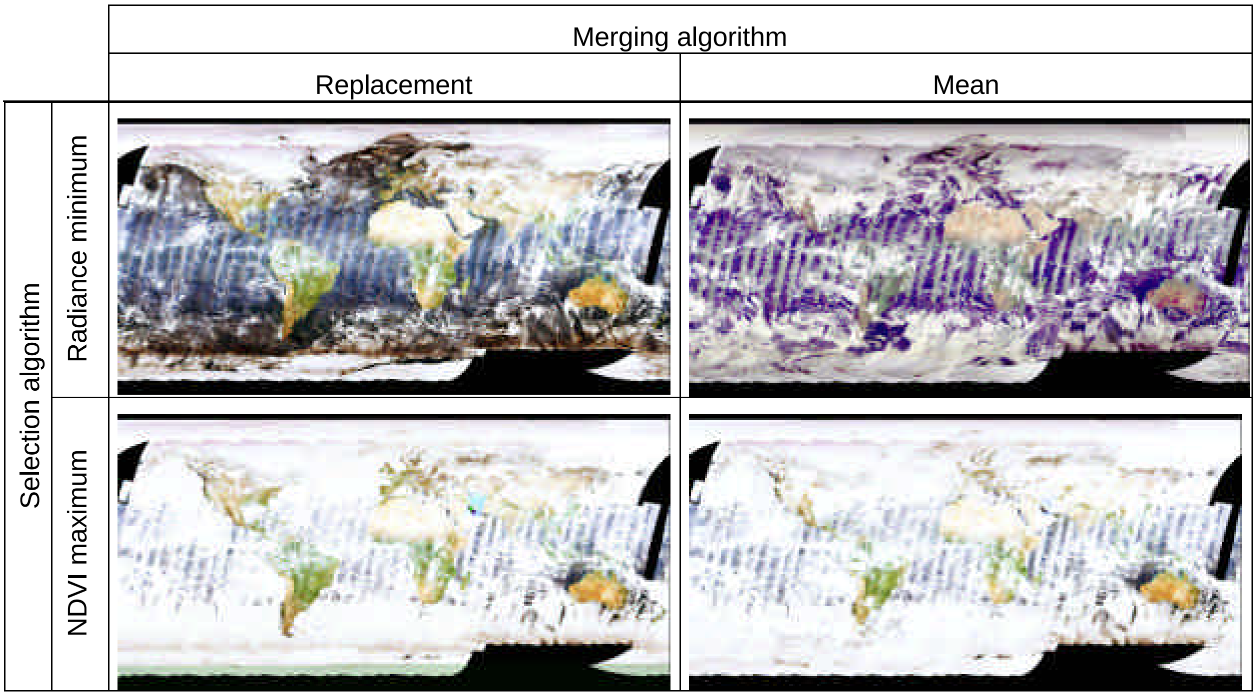


fig. 23 - Results of the selection and merging algorithms options.

More detailed images are displayed in the next sub-sections.

The major drawback of the “Mean” algorithm is to not completely suppress the clouds each time it is possible. The different values are “smoothed” by the “Mean” algorithm.

On the contrary, this smoothing enables keeping some details within regions saturated using the “Replacement” algorithm. For example, more details are visible with the “Mean” algorithm (see fig. 26).

<u>Nevertheless, the “Replacement” has been chosen as the best merging algorithm.</u>

"Replacement" merging algorithm

"Radiance minimum" selection algorithm

fig. 24 - "Replacement" merging algorithm - "Radiance minimum" selection algorithm.

"NDVI maximum" selection algorithm

fig. 25 - "Replacement" merging algorithm - "NDVI maximum" selection algorithm.

<u>"Mean" merging algorithm</u>

"Radiance minimum" selection algorithm

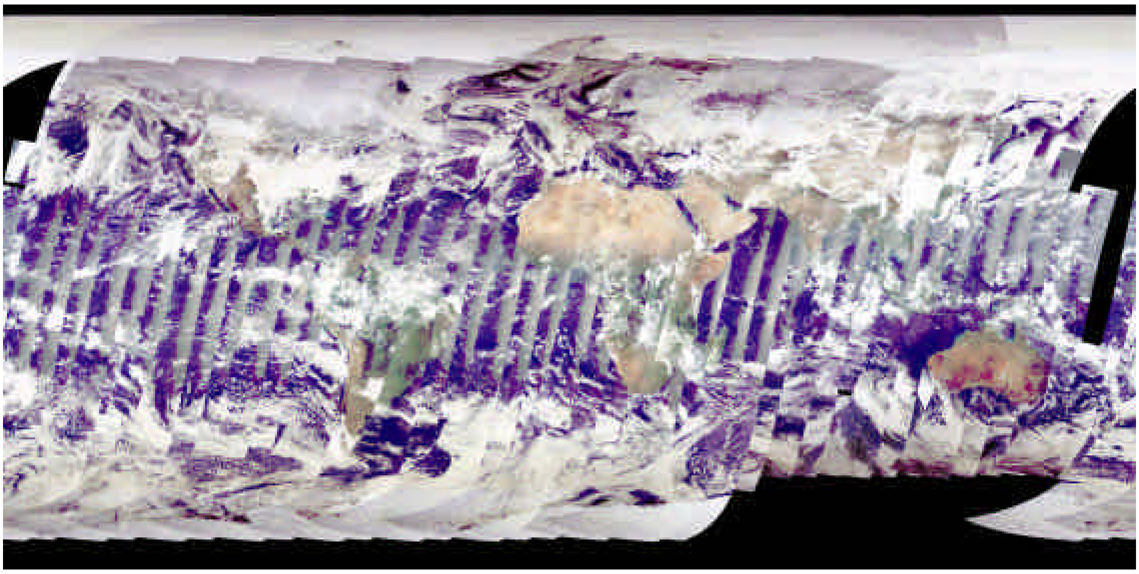


fig. 26 - "Mean" merging algorithm - "Radiance minimum" selection algorithm.

"NDVI maximum" selection algorithm

fig. 27 - "Mean" merging algorithm - "NDVI maximum" selection algorithm.

The "Mean" merging algorithm obliges keeping the "occurrence N(i,j)" image that gives the number of samples that have been involved in the computation of the $MEAN_n(i,j)$ pixel. This interesting image (see fig. 28) shows the number of times a NDVI maximum has been found.

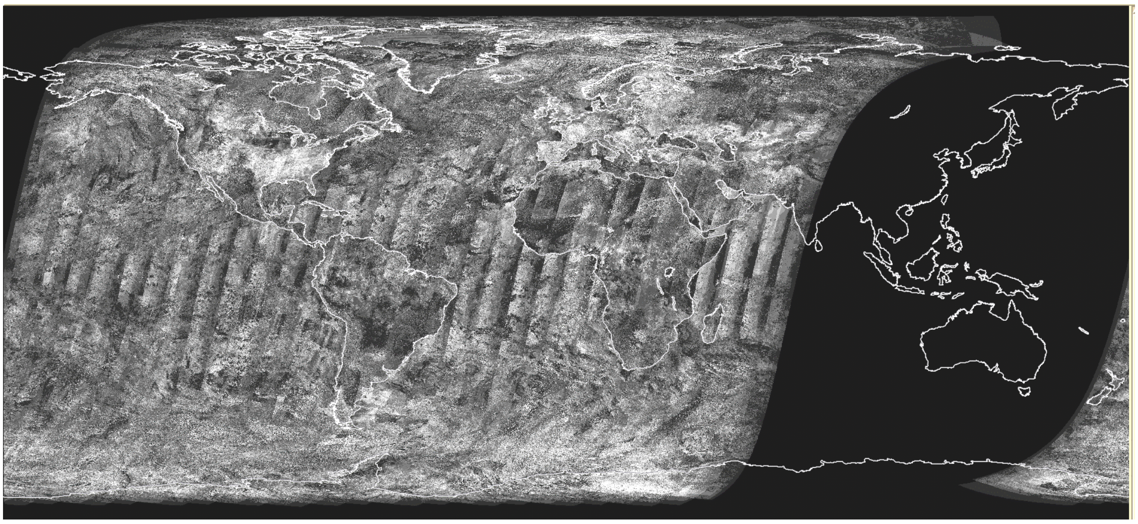


fig. 28 - "Occurrence image" of the "NDVI maximum" / "Mean" algorithms.

3 GEOMETRY PROCESSING

3.1 Orthorectification interpolating the tie-points

Precision of localisation seems to be satisfactory, better than 1-km pixel resolution. As shown in fig. 29 and fig. 30, the superimpositions of GMT vector layers over Italy match perfectly.

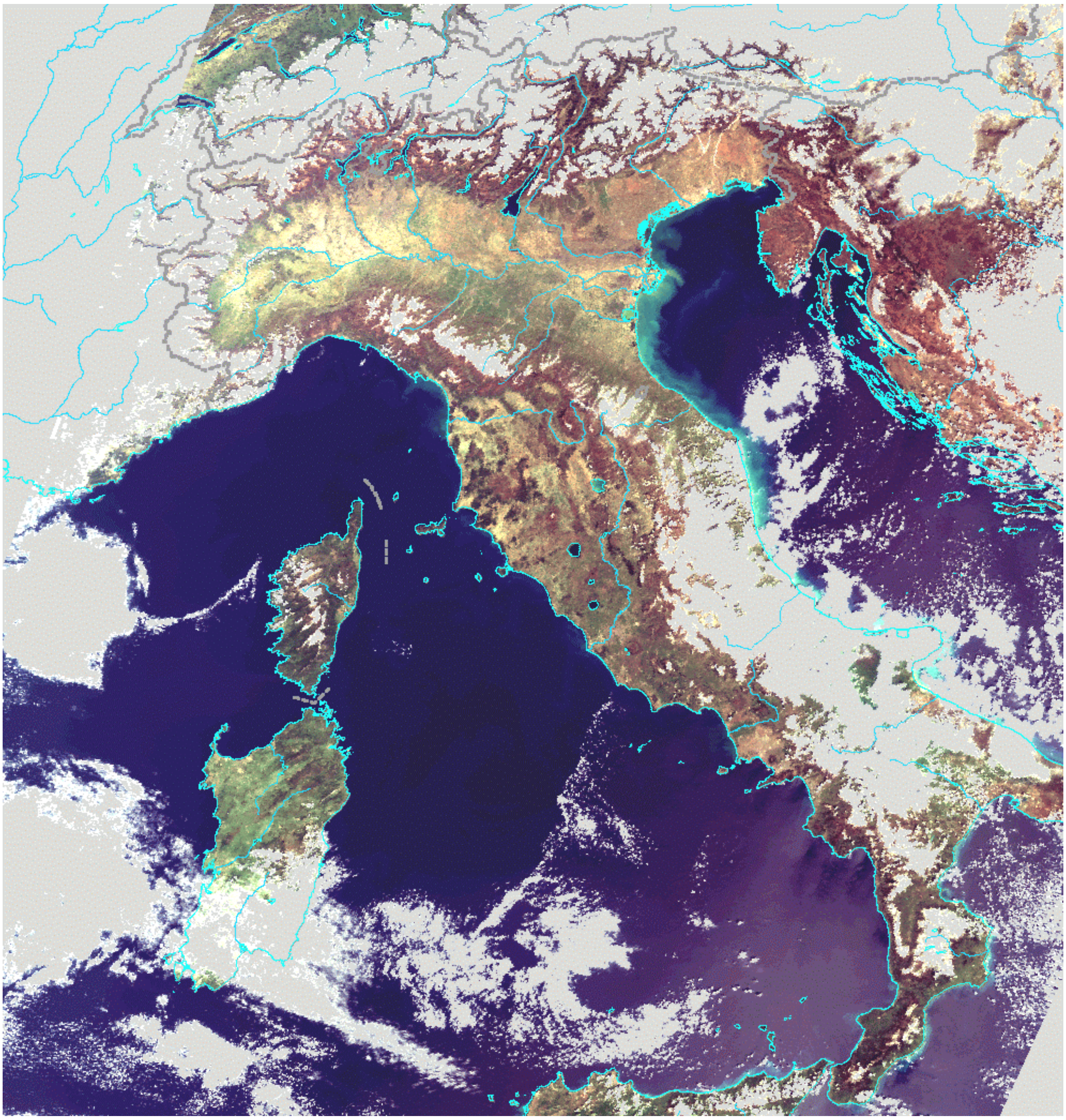


fig. 29 - Localisation test over Italy.

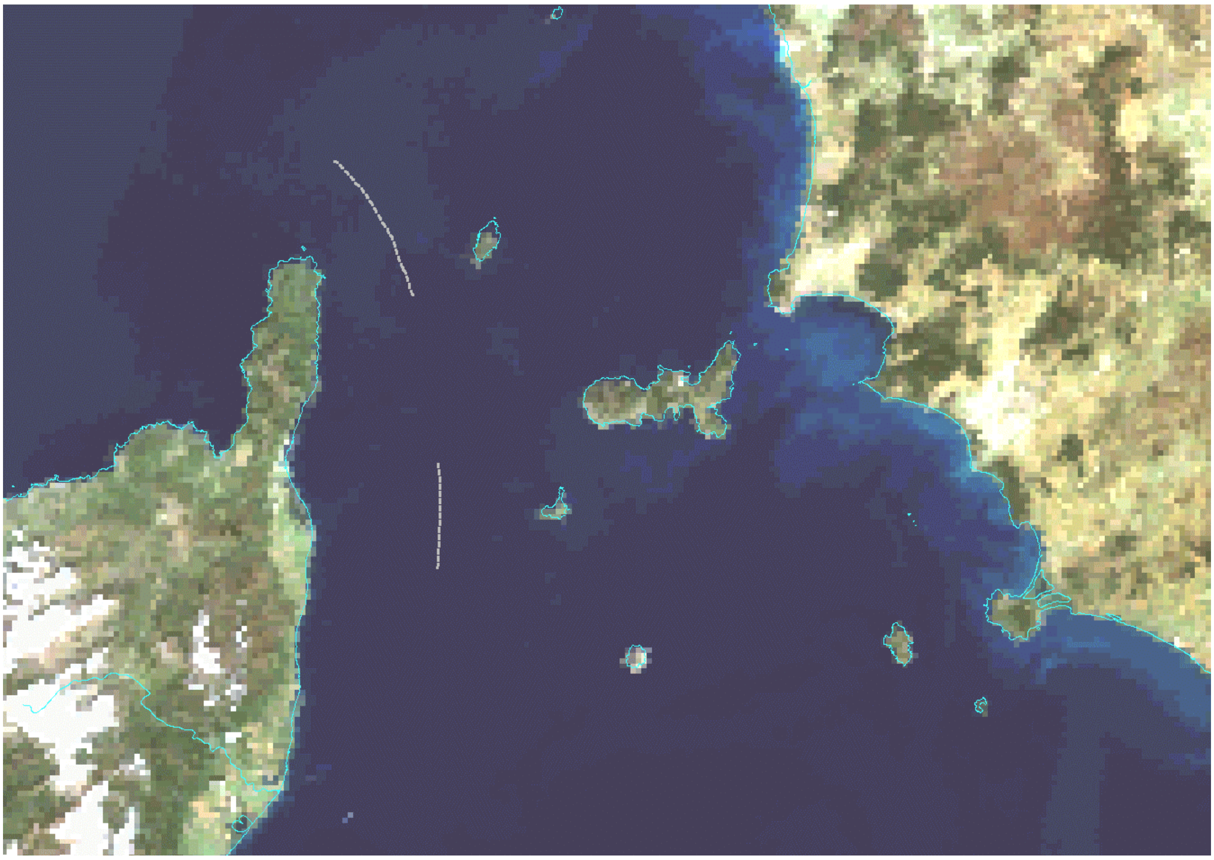


fig. 30 - Localisation test over Italy (zoom).

An orthorectification process has been developed based on the "prediction-correction" algorithm from the altitudes and viewing angles provided within the tie-point ADS. This processing is required when using the inverse model enabling retrieveal the location of the point within the segment from the output image coordinates.

As shown in fig. 32, let (λ,φ) be the geodetic coordinates matching the point (i,j) of the output image being processed, an inverse location mode f^{-1} enables retrieving the (l_0,p_0) coordinates of the source point within the MERIS segment.

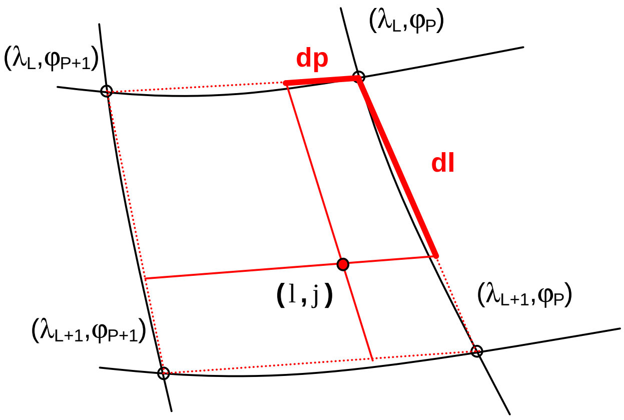


fig. 31 - Retrieving the (dl,dp) coordinates of the point within the facet.

This inverse location model f^{-1} (also called prediction model) simply retrieves the "facet" (L,P) of the tie-point grid checking for the geographic coordinates (λ_L,φ_P) of the vertices of this tie-point grid (see fig. 31). A linear interpolation is performed to compute the coordinates (dl,dp) of the point within the facet. These coordinates are in the range [0,1].

Coordinates (l,p) of the antecedent point within the source MERIS segment are given by the formula:

$$l = 16 \times (L + dl)$$

$$p = 16 \times (P + dp)$$

Let M(dl,dp) be the measure to be interpolated within the tie-point facet (M may be the latitude, longitude, altitude, DEM corrections, viewing angles…), the interpolated value is simply given by the bi-linear formula given in R-7:

$$M(dl,dp) = (1-dl) \times (1-dp) \times M(L,P) + (1-dl) \times dp \times M(L,P+1) + dl \times (1-dp) \times M(L+1,P) + dl \times dx \times M(L+1,P+1)$$

Parallax error may be computed from the couple "DEM altitude" and "viewing zenith/azimuth angles" or may be directly interpolated using the "DEM latitude/longitude corrections". These corrections ($d\lambda_1,d\varphi_1$) are applied to the origin coordinates (λ,φ) leading to a new location (l_1,p_1) in the source image. The same correction loop may be applied to (l_1,p_1) leading to ($d\lambda_2,d\varphi_2$) calculation, and so on…

Process is stopped when (l_i,p_i) and (l_{i+1},p_{i+1}) are the same or when a maximum iteration is attained.

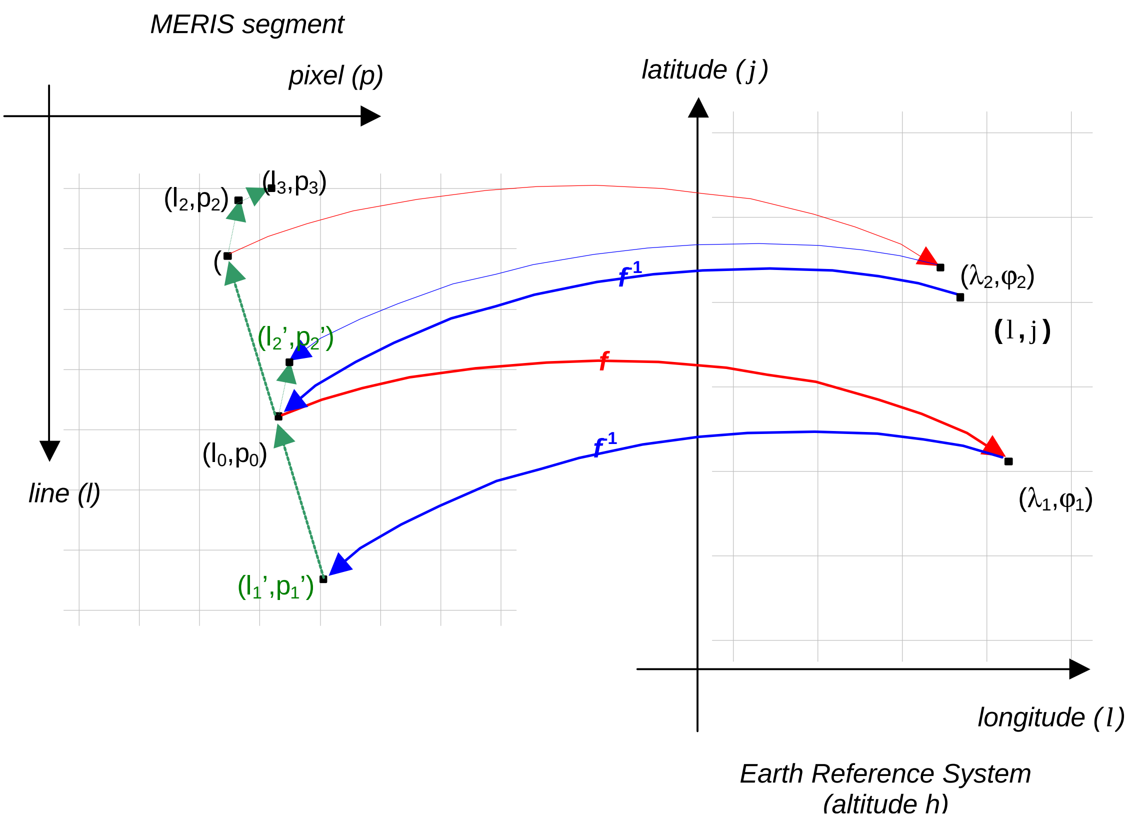


fig. 32 - Prediction-correction algorithm.

3.2 Worldwide projections

This section contains different cartographic projections that have been applied to the step 167 of the test world synthesis (10-km resolution).

The reprojections are processed by the TimPrj package of the TELIMAGO application developed by GAEL Consultant.

Goode Homolosine

fig. 33 - Goode Homolosine projection.

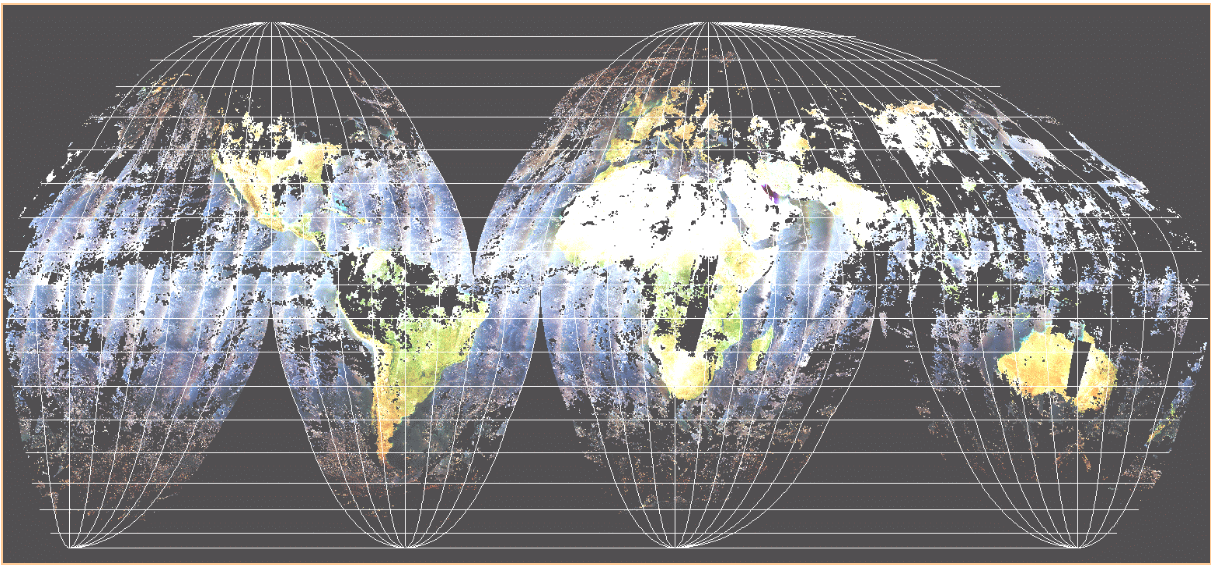


fig. 34 - Goode Homolosine projection + reticule 10°.

Note: The horizontal reticule between the six regions may be removed.

Goode sinusoidal

fig. 35 - Goode sinusoidal projection.

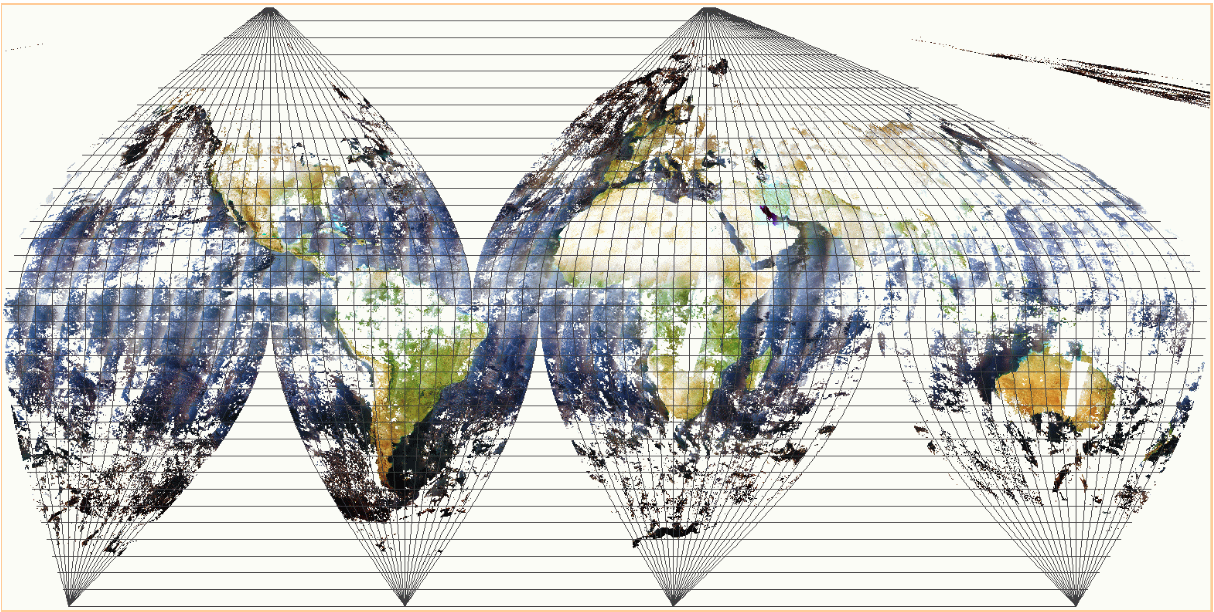


fig. 36 - Goode sinusoidal projection + reticule 5°.

Note: Upper-right lines are an error that would be cancelled for the final version.

Mercator

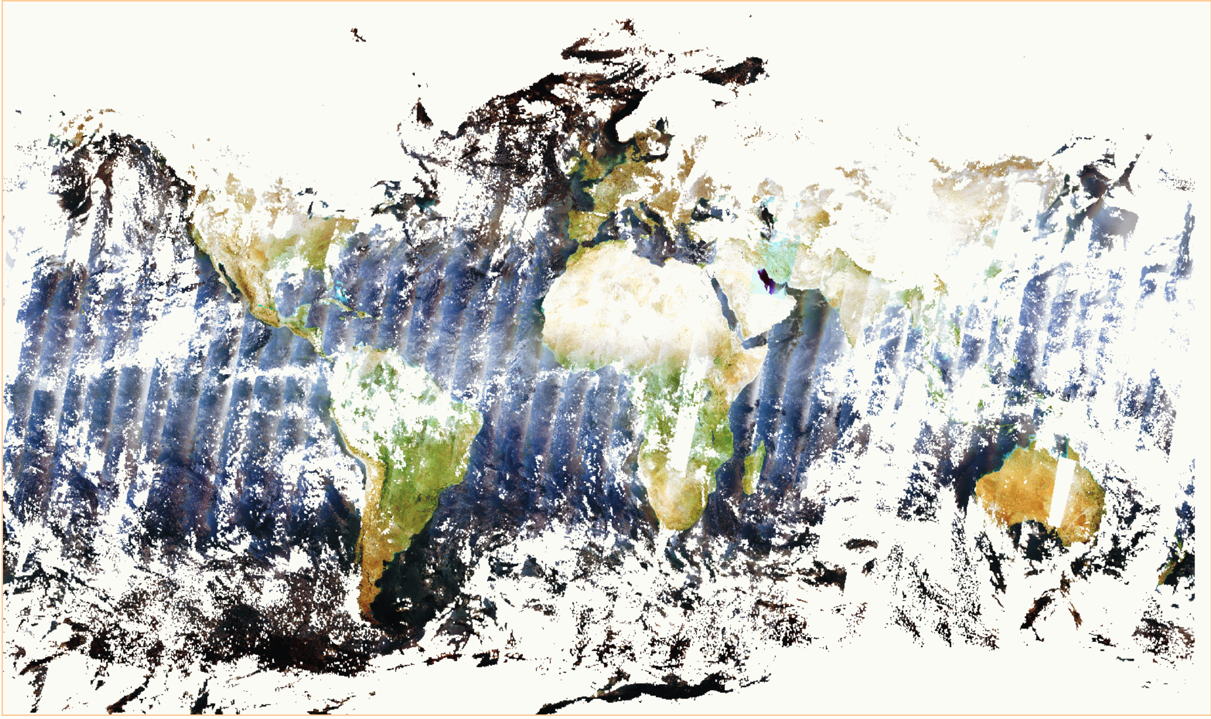


fig. 37 - Mercator projection.

Plate-Carrée

fig. 38 - Plate-Carrée projection.

This Plate-Carrée projection has been chosen by ESA (e-mail O. Arino 16/05/2003).

4 SYNTHESIS GENERATION

4.1 General description

A simplified representation of the whole processor is given in the figure here below.

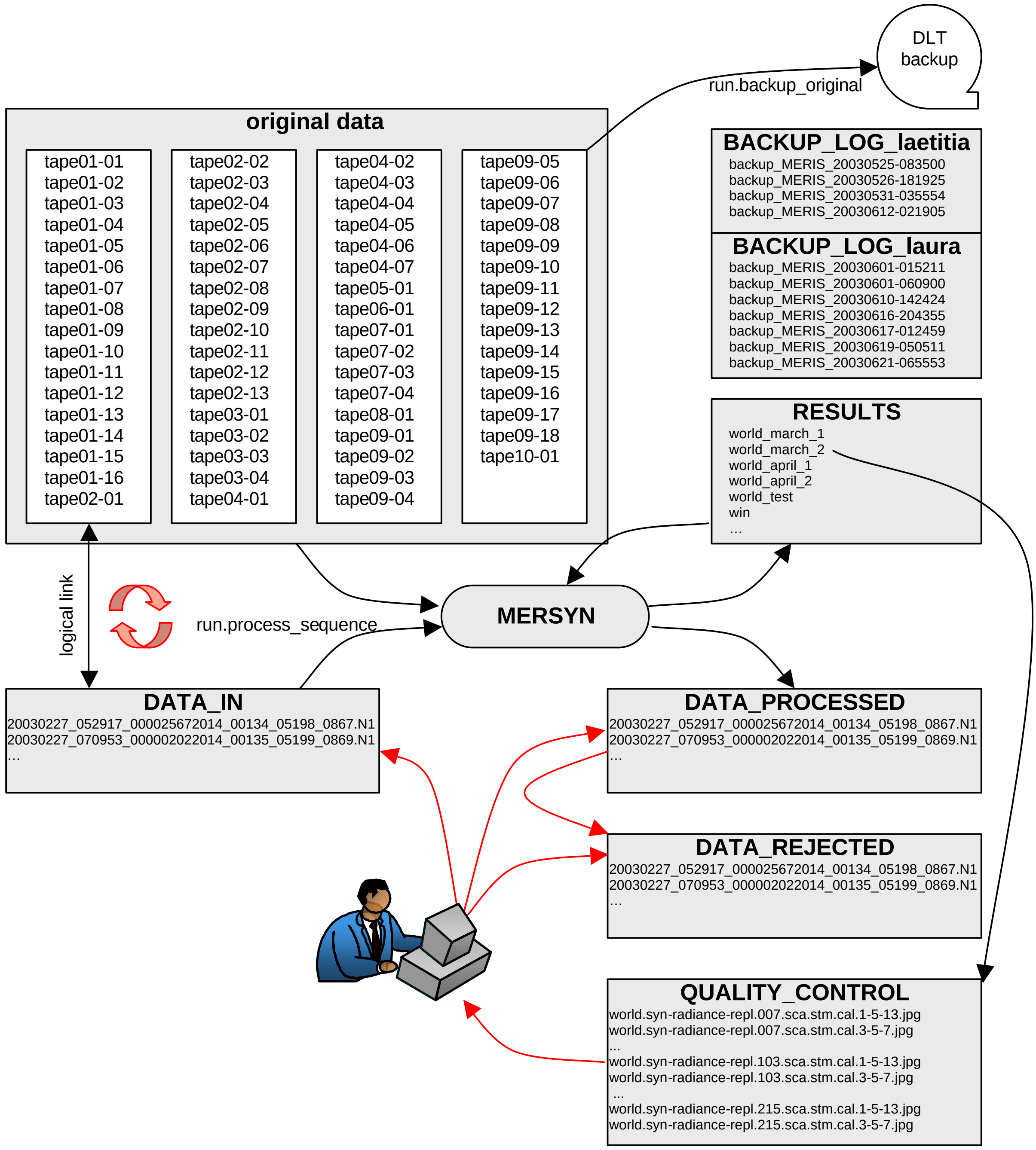


fig. 39 - MERIS synthesis processor.

Original data

After having been received and registered, tapes (Exabytes or DLTs) lead to the creation of the corresponding directory "tapeRR-TT where RR matches the number of the reception and TT the number of the tape within the reception. The MERIS segments "MER…N1" are extracted under the directory. The ancillary data are extracted from IMPORT application and ASCII information is stored in the "MER…N1.log.IMPORT" file. From this file, the coordinates of the footprint of the segment are extracted and converted into a vector layer in TELIMAGO format "MER…N1.vec".

At the end of importation, the tapeRR-TT directory contains for each file three other files as shown in the following example found in "tape01-01":

- MER_RR__1PNPDK20030227_052917_000025672014_00134_05198_0867.N1
- MER_RR__1PNPDK20030227_052917_000025672014_00134_05198_0867.N1.geo
- MER_RR__1PNPDK20030227_052917_000025672014_00134_05198_0867.N1.log.IMPORT
- MER_RR__1PNPDK20030227_052917_000025672014_00134_05198_0867.N1.vec

For each input segment, a logical link is performed within the DATA_IN directory cancelling the prefix « MER_RR__1PNPDK" and in order to get the list of segments sorted in the acquisition date chronological order.

Synthesis processing

The synthesis is an infinite loop in which the MERSYN application get the first segment from DATA_IN, get the last synthesis processed at the previous step n and generates a synthesis (n+1). Synthesis images are stored in the result directory matching the current loop.

When a segment has been consumed, it is moved from DATA_IN to DATA_PROCESSED.

Because of the huge amount of data processed at each iteration (8 GB), data processed at previous steps shall be deleted. Nevertheless, because of the quality control, a "security roll-back" (buffer of the last 10 synthesis) is preserved.

Quality control

The synthesis process may be definitively corrupted by one segment having a location or calibration defect. It is therefore necessary to perform a continuous quality control to check if the last segment has not introduced too low radiometry or if strange patterns (see "defect of Borneo") have not been introduced.

Let N be the number of synthesis kept in the "security roll-back" (N is configurable), the quality control engineer launch the "run.quality_control" procedure that post-process the latest generated synthesis and displays the results in 3-5-7 and 1-5-13 colour compositions.

If a defect is found, the processing loop is aborted and the engineer looks for the last synthesis not showing the defect. The corrupted segment is moved from DATA_PROCESSED to DATA_REJECTED while all the successive segments to be played back are reinserted from DATA_PROCESSED to DATA_IN. The step number of "run.process_sequence" procedure is restored at the last correct synthesis and the procedure is relaunched.

4.2 Hardware performances

For the completion of this contract, a new machine with the highest speed of 2 GHz has been bought with four (4) disks of 200 GB. Disks have been configured on the two machines obliging the installation of the latest release of Linux (RedHat 9), an operating system able to process such large disks.

Performances for the processing of each synthesis (8 GB in output) is illustrated by fig. 40 and summarized in the table here below. The total of CPU time is greater than 1,467,952 seconds, i.e.; more than **17 uninterrupted days**.

machine	CPU speed	time / synthesis	
		Sample number	Mean elapsed time (seconds)
laetitia	1 GHz	272	**2106,57 s.**
laura	2 GHz	868	**1031,07 s.**

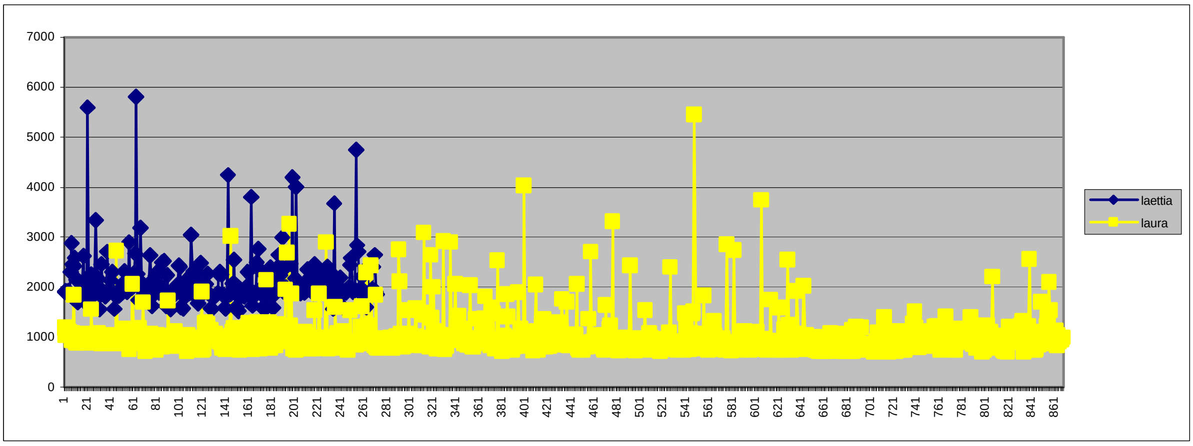


fig. 40 - Elapsed time per synthesis on each one of the two machines.

4.3 Processed data in input

Number of processed segments

Initially (see e-mail Olivier ARINO on 17 march 2003) the contract was foreseen to process a total of **2 months x 30 days x 14 orbit segments MER_RR_1P x 530 Mbytes**, i.e. exactly 840 segments leading to a total of 445 GB to be processed.

For the two months, 1303 segments have been received (see APPENDIX B "Data Inventory") and **1242 segments** have been processed in input dispatched as follows:

1st half of March	183 segments
2nd half of March	338 segments
1st half of April	215 segments
2nd half of April	506 segments
TOTAL	**1242 segments**

Number of processed synthesis

One synthesis has the following size:

5 bands x 20,000 lines x 40,000 pixels x 2 bytes/pixel = **8 GB**

Generating 1242 synthesis leads to an amount of computed data equal to:

1242 synthesis x 8 GB = 9936 GB ≈ **10 TB**

Useless processing

Due to the progressive reception of the data (10 receptions over more than 2 months), it has not been immediately noticed that segments have been received more than once (called “double” segments) or that some segments were included within an other one (called “sister” segments).

As detailed in section B.2, 80 segments have been given twice within two different receptions and another five have the same acquisition time start meaning that one segment is included within the other one.

Figure fig. 41 lists a series of 14 segments displayed executing the following command:

```
FRAME –if tape*/*20030424_11*.vec
```

Three anomalies are present:

- Sub-segments – an acquisition segment is cut in a series of adjacent sub-segments.
- “Double” segments – Exabyte 10 and Exabyte 11 of delivery 9 contain both the seven sub-segments.
- Included (sub)segments – sub-segment b seems to be an anomaly including sub-segment a but not adjacent with sub-segment c.

Not filtering the input segments and concatenating the adjacent sub-segments leads to process 14 occurrences of synthesis instead of only 2 !

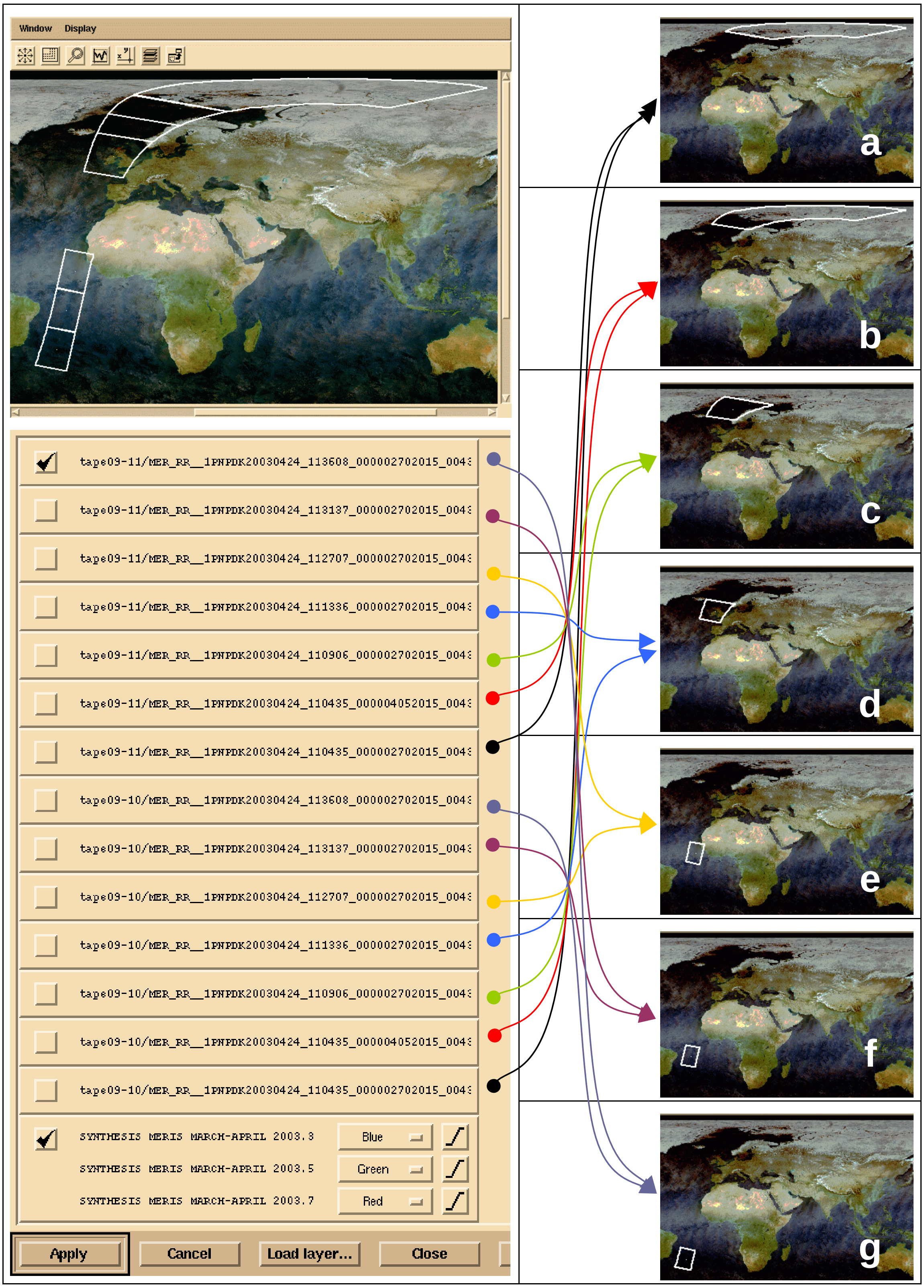


fig. 41 - List of segments acquired on 24/04/2003 around 11 o'clock.

4.4 Results – Comparison March % April % March+April

The scope of this section is to show the results obtained for the true-colour combination (bands 3, 5 and 7) during the first month (March) and the second month (April) and to compare these two results with the final synthesis (March+April) which is the "Minimum radiance" of both monthly synthesis.

Images of the global results are the two following images to be found in the fourth DVD of the second delivery (delivery_dvd4):

- March 2003 world.syn-radiance-repl.1+2.stm.sta.sca-01.3-5-7.jpg
- April 2003 world.syn-radiance-repl.3+4.stm.sta.sca-01.3-5-7.jpg
- March+April 2003 world.syn-radiance-repl.1+2+3+4.stm.sta.sca-01.3-5-7.jpg

A set of 19 windows displays the full resolution of the 2 km resolution resampled 3-5-7 synthesis as displayed from the commands:

- `REGIST -if1 world_1+2/world.syn-radiance-repl.1+2.stm.sta.sca-05.{3,5,7} \`
- `-if2 world_3+4/world.syn-radiance-repl.3+4.stm.sta.sca-05.{3,5,7}`
- `REGIST -if1 world_3+4/world.syn-radiance-repl.3+4.stm.sta.sca-05.{3,5,7} \`
- `-if2 world_1+2+3+4/world.syn-radiance-repl.1+2+3+4.stm.sta.sca-05.{3,5,7}`

Global result

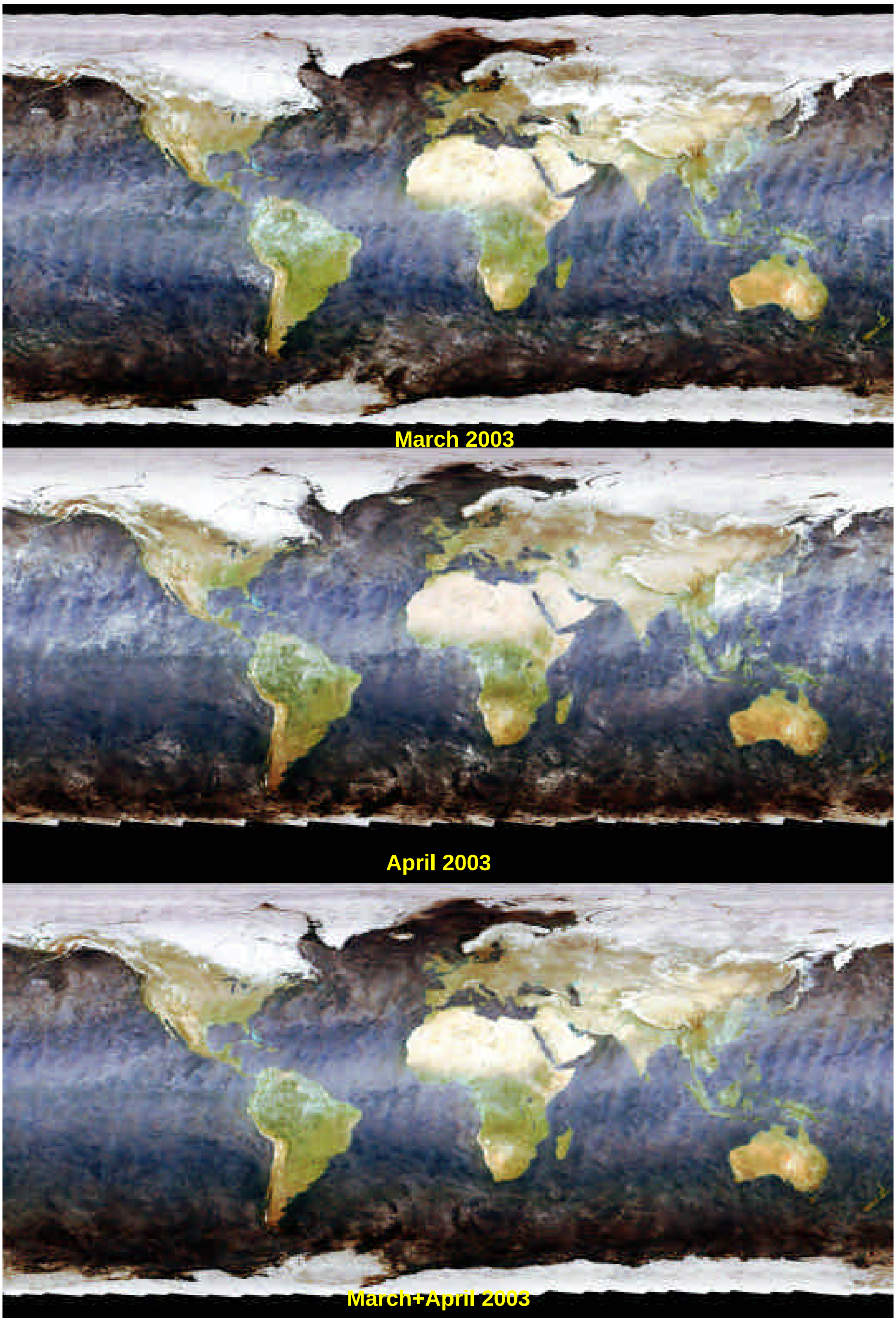
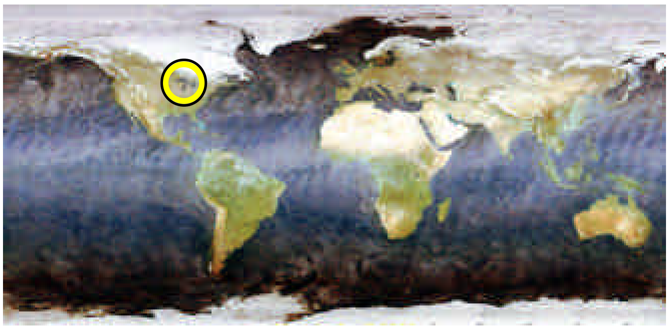


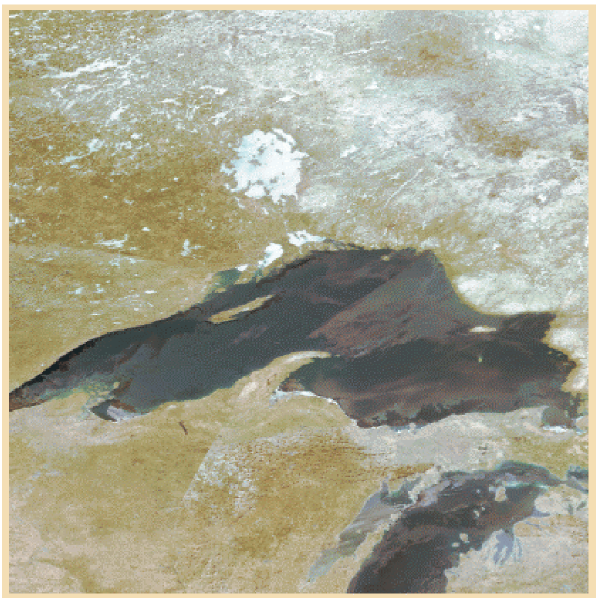
fig. 42 - Synthesis March (top), April (middle) and March+April 2003 (bottom).

Window 1 – Lake Superior



March 2003

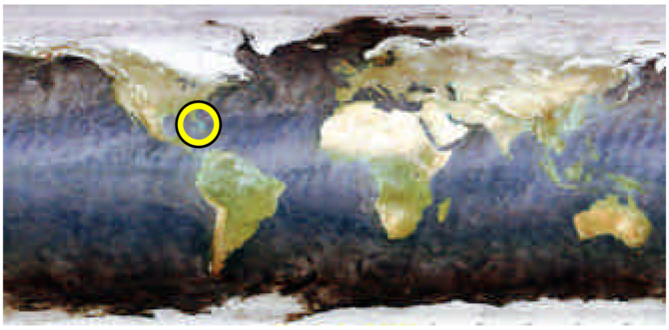
April 2003



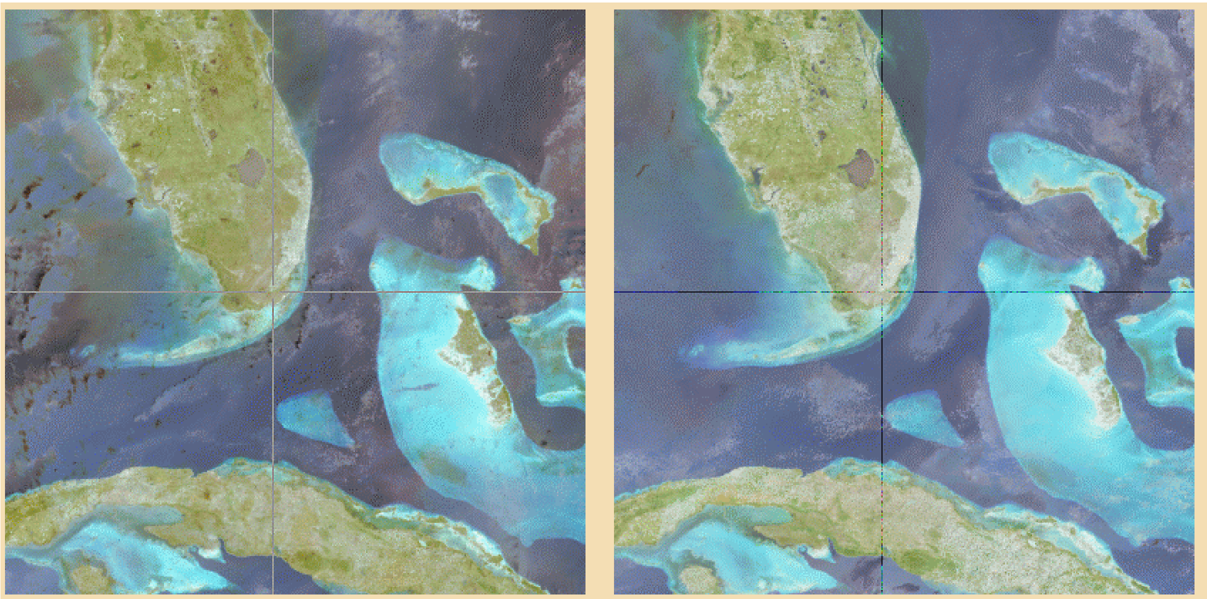
March+April 2003

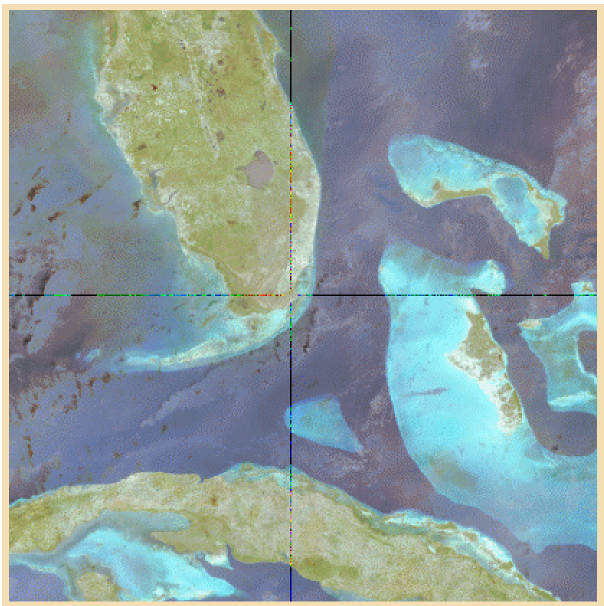
fig. 43 - Window 1 – Lake Superior

Window 2 – Florida and Bahamas



March 2003 | April 2003

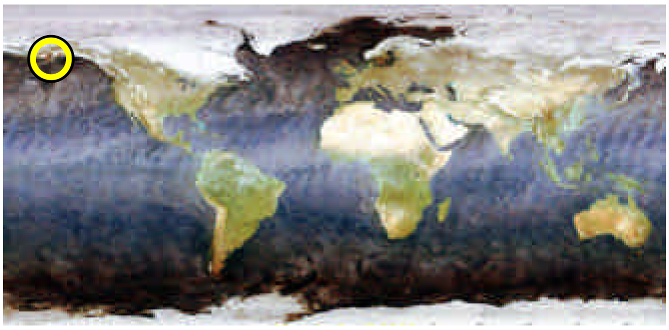




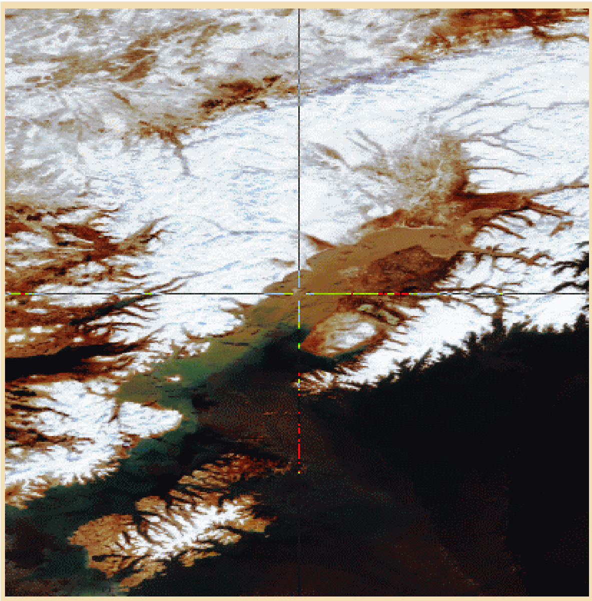
March+April 2003

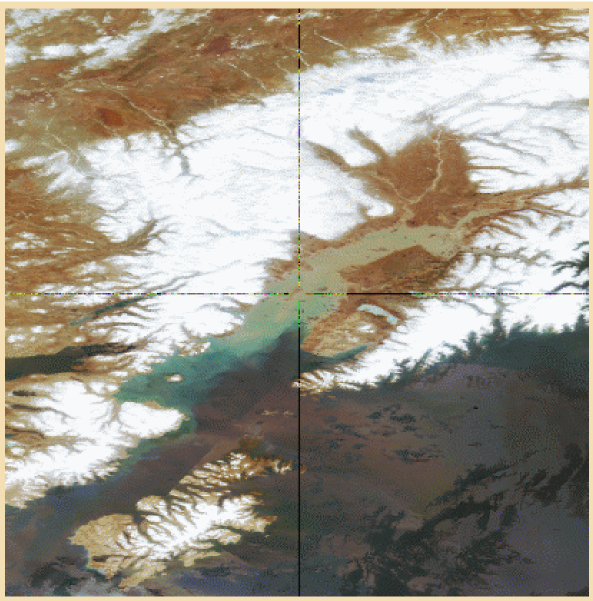
fig. 44 - Window 2 – Florida and Bahamas

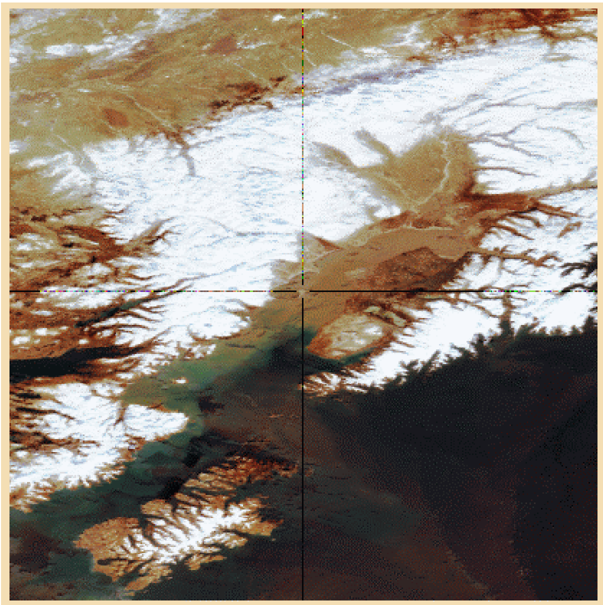
<u>Window 3 – Alaska, Gulf of Cook</u>



March 2003 **April 2003**



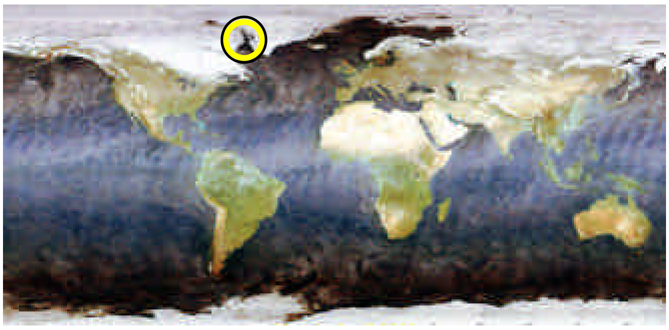




March+April 2003

fig. 45 - Window 3 – Alaska, Gulf of Cook

Window 4 – Greenland, West coast



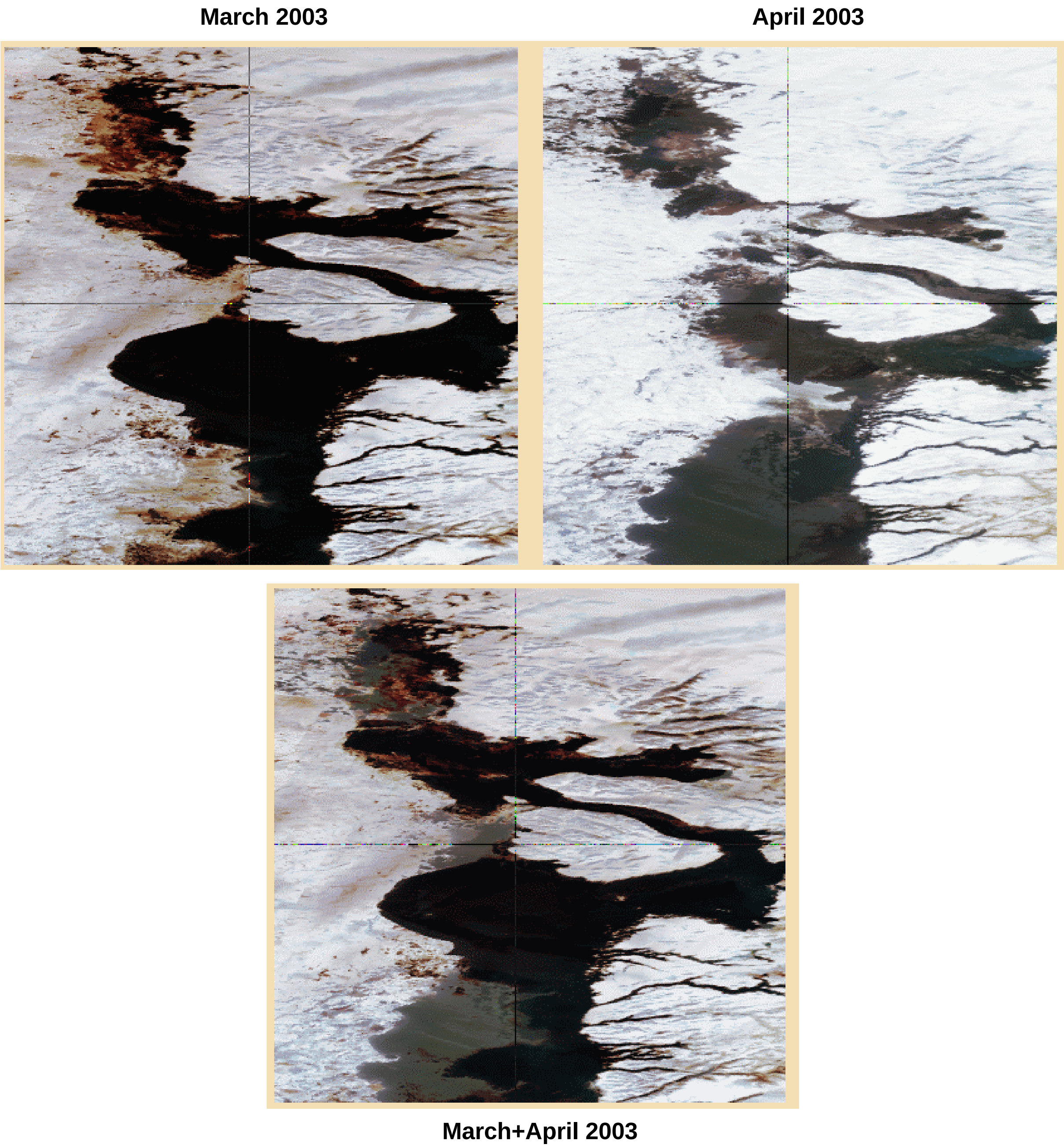
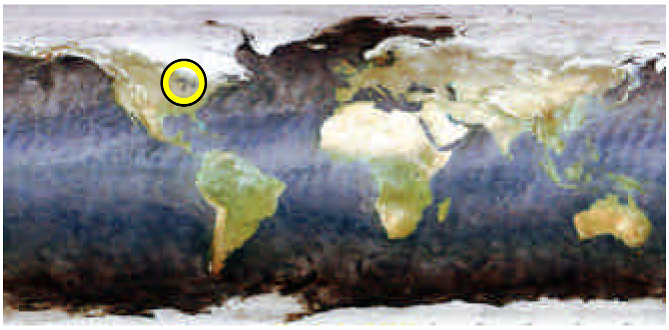


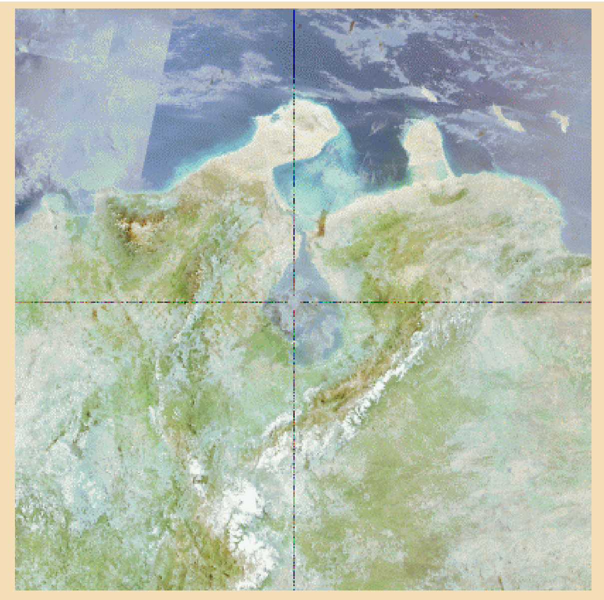
fig. 46 - Window 4 – Greenland, West coast

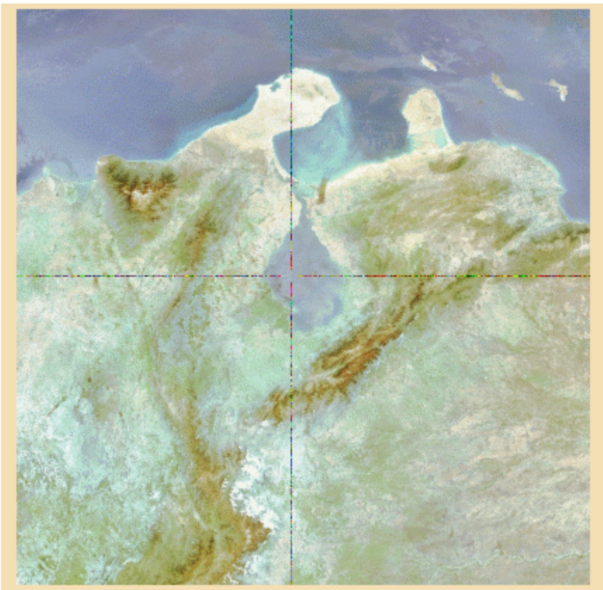
Window 5 – Lake of Maracaibo



March 2003

April 2003

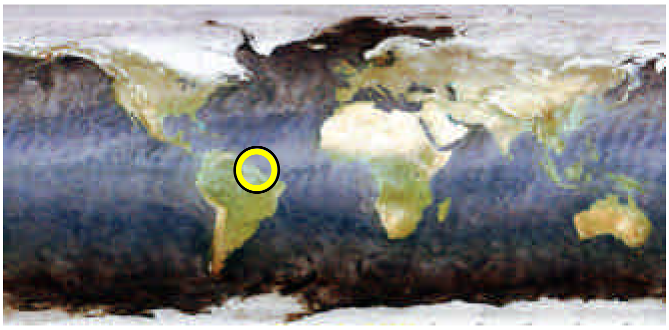




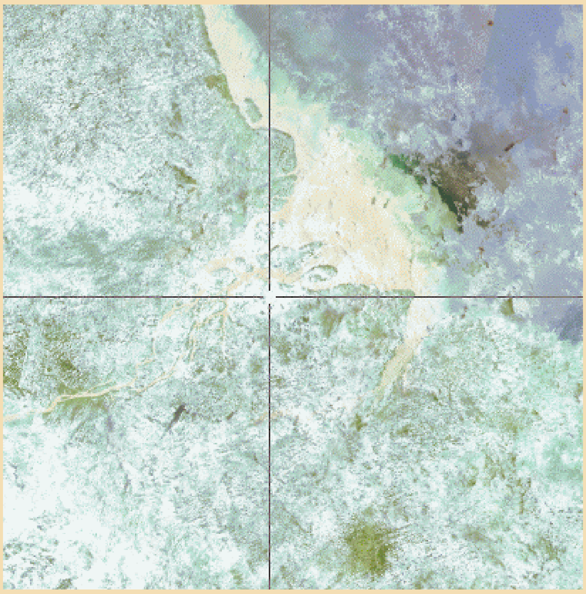
March+April 2003

fig. 47 - Window 5 – Lake of Maracaibo

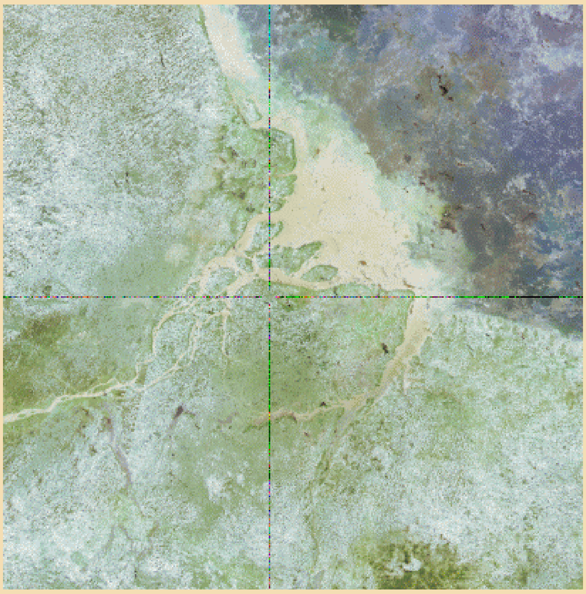
Window 6 – Amazone delta

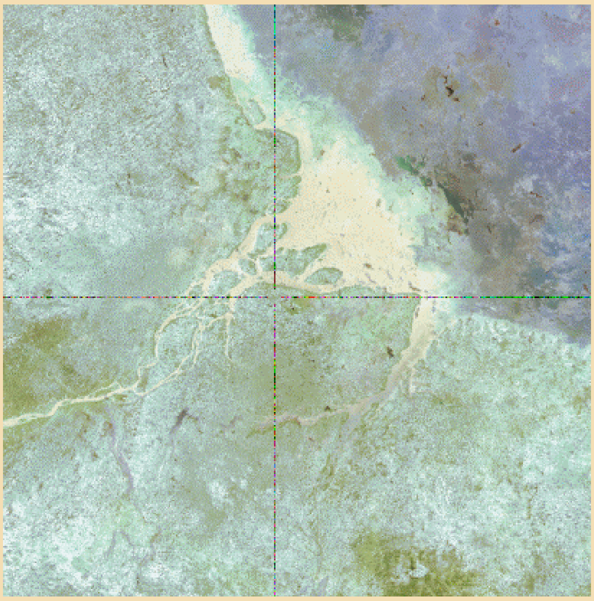


March 2003



April 2003

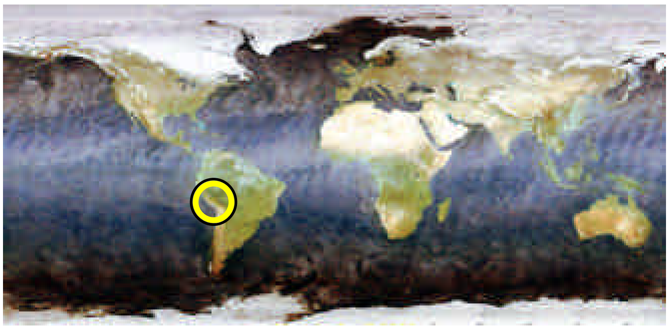




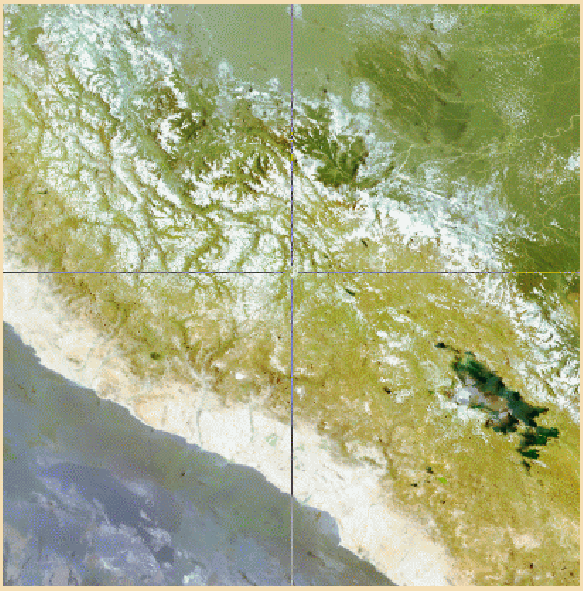
March+April 2003

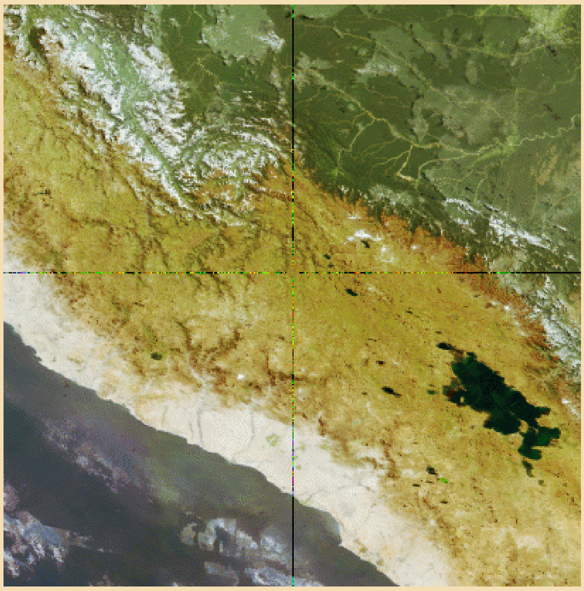
fig. 48 - Window 6 – Amazon delta

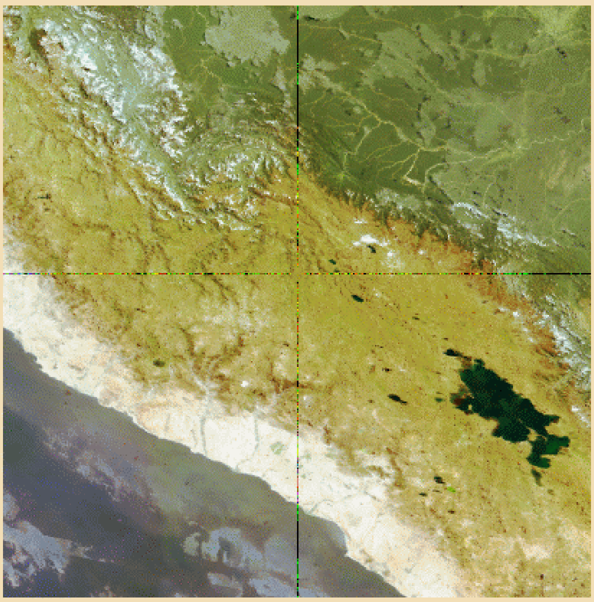
Window 7 – Andes Cordilleras, Peru, Titicaca Lake



March 2003 **April 2003**



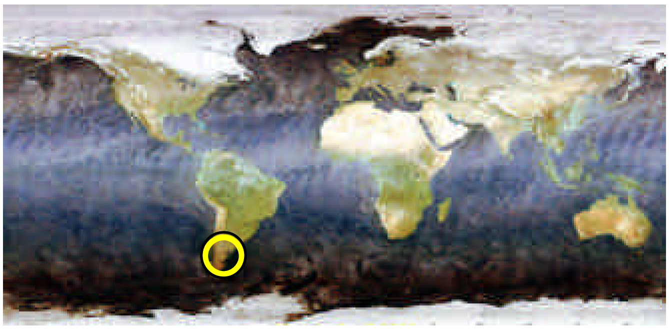




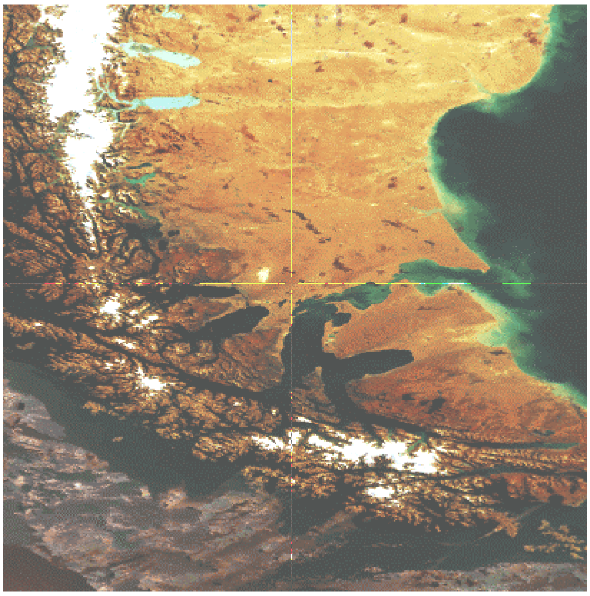
March+April 2003

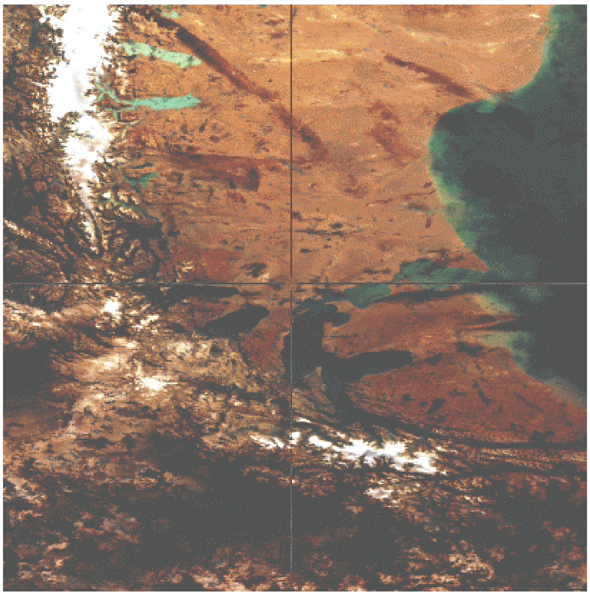
fig. 49 - Window 7 – Andes Cordilleras, Peru, Titicaca lake

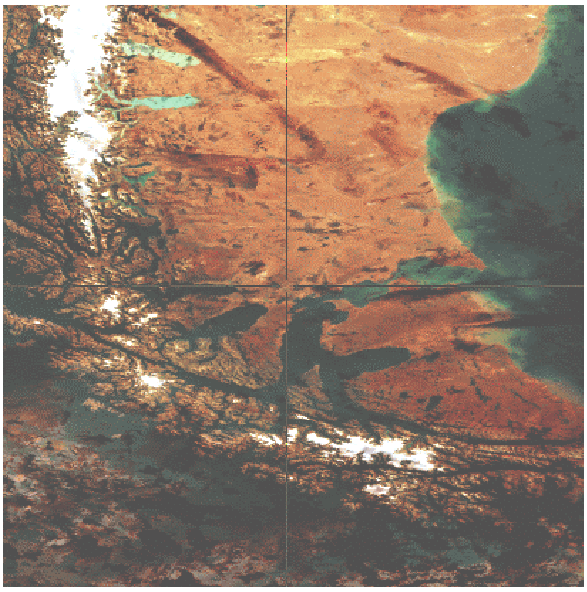
Window 8 – Patagonie



March 2003 **April 2003**



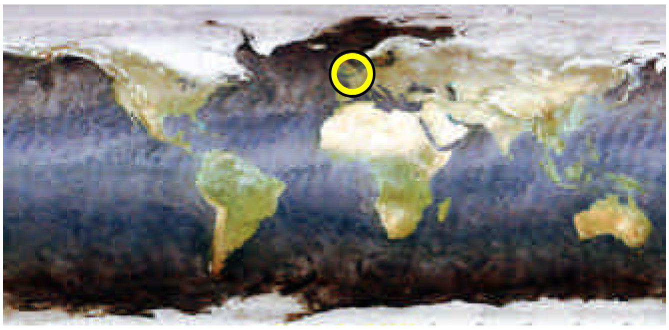




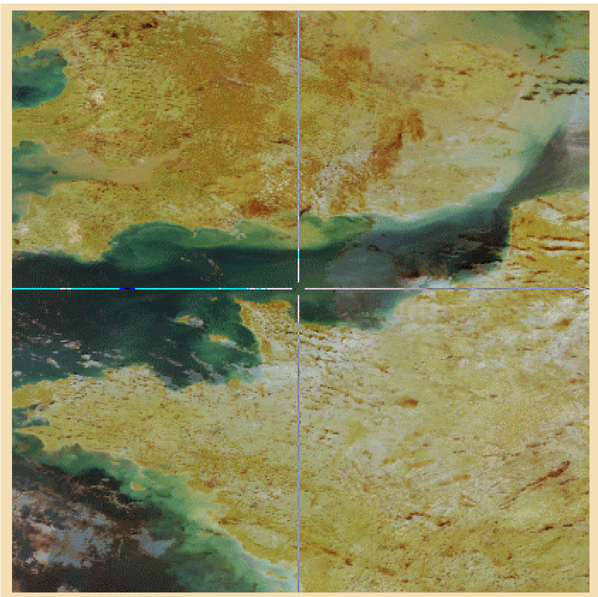
March+April 2003

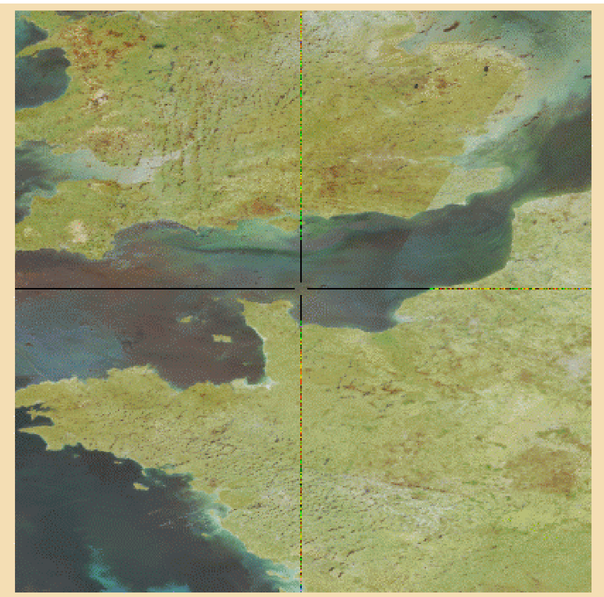
fig. 50 - Window 8 – Patagonia (brightness has been increased)

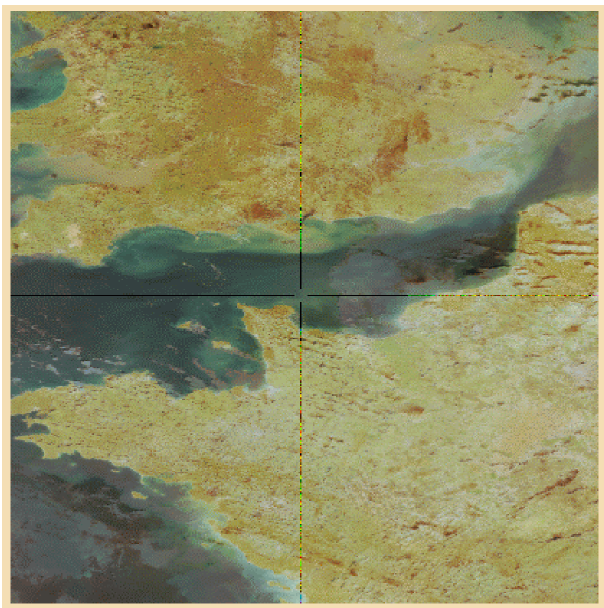
Window 9 – France / England channel



March 2003 **April 2003**



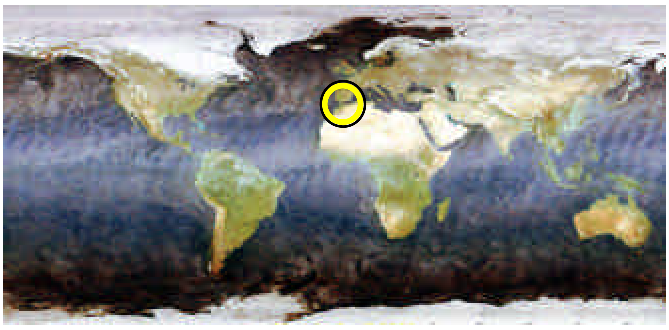




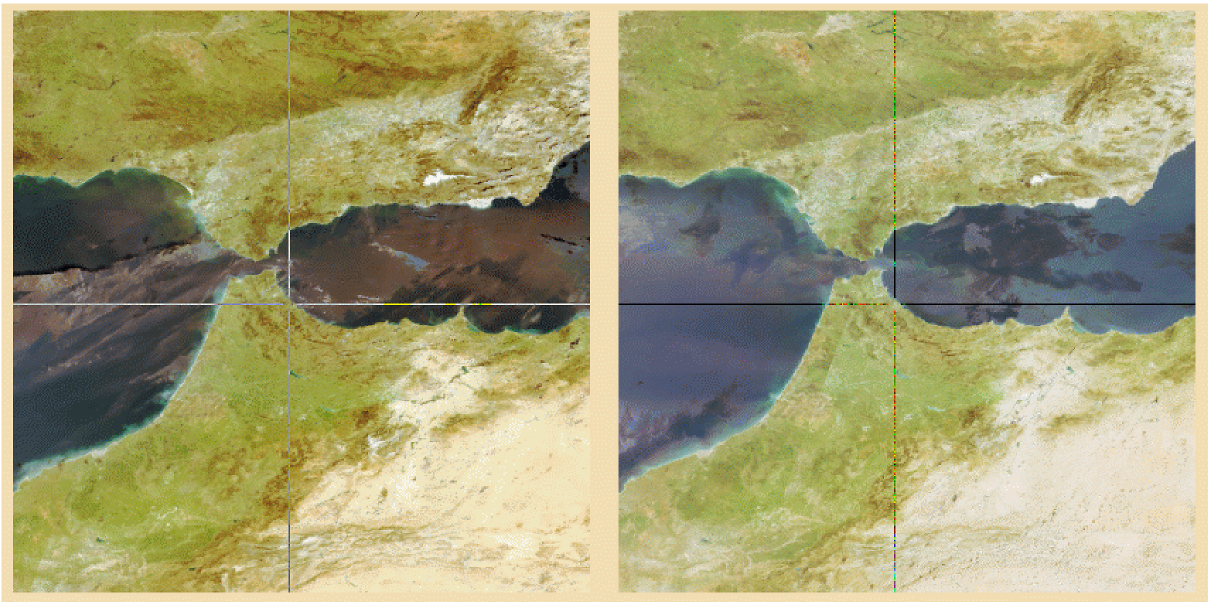
March+April 2003

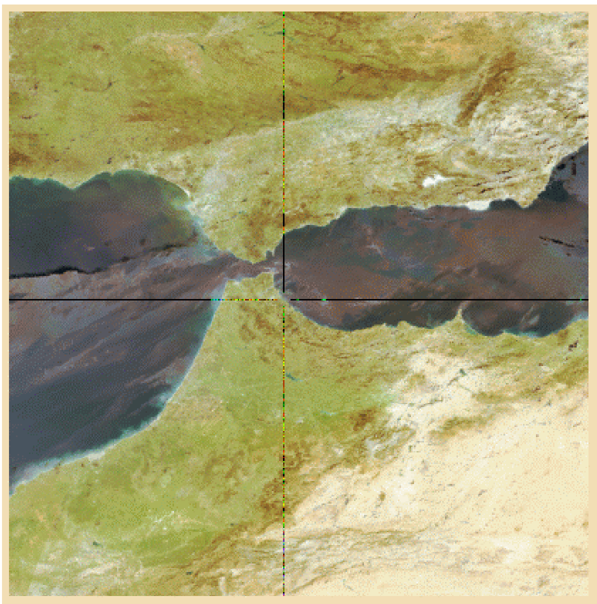
fig. 51 - Window 9 – France / England channel

Window 10 – Strait of Gibraltar



March 2003 April 2003

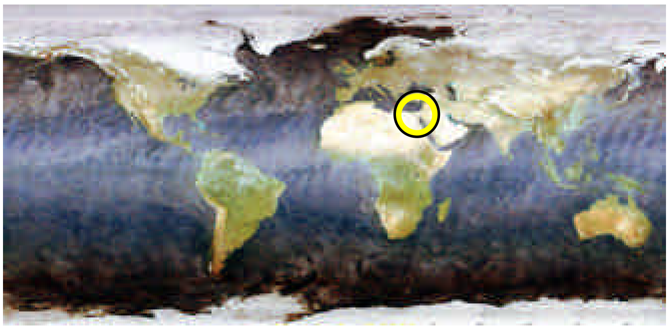




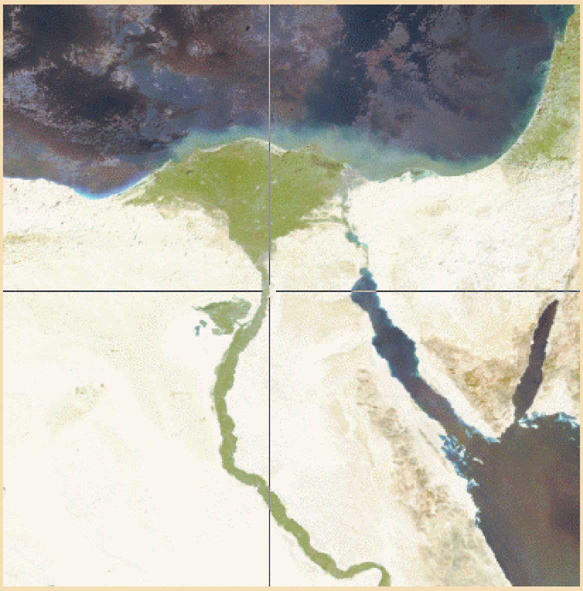
March+April 2003

fig. 52 - Window 10 – Strait of Gibraltar

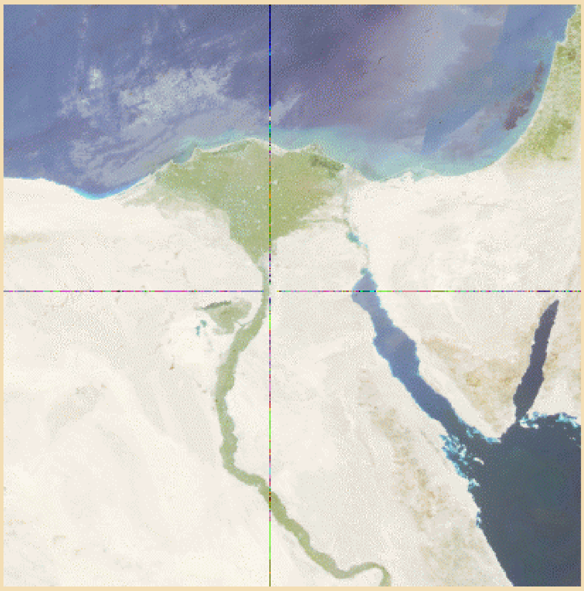
Window 11 – Nil delta

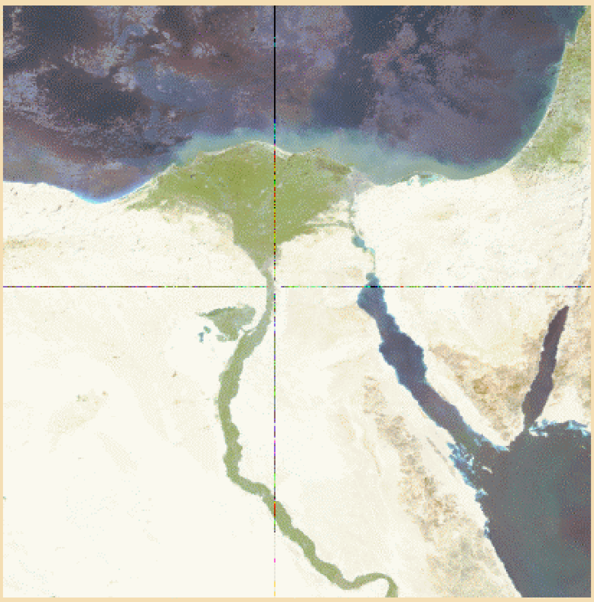


March 2003



April 2003

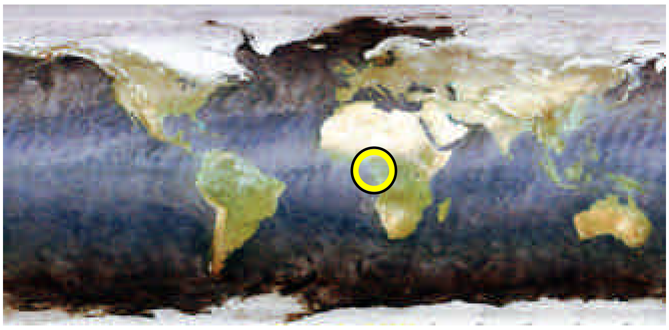




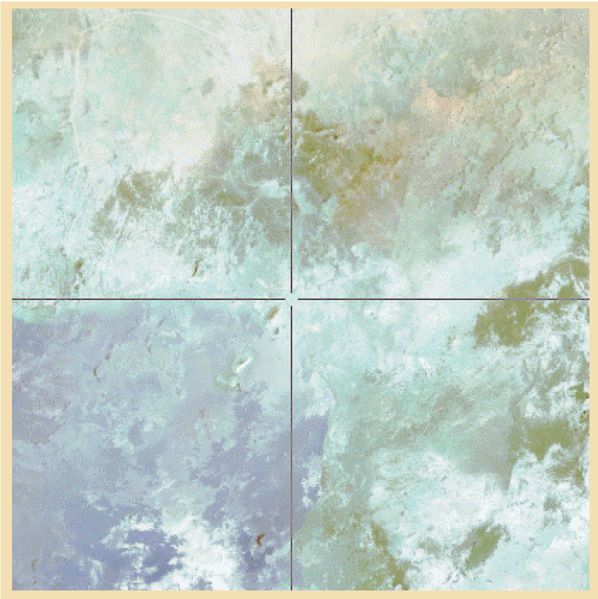
March+April 2003

fig. 53 - Window 11 – Nil delta

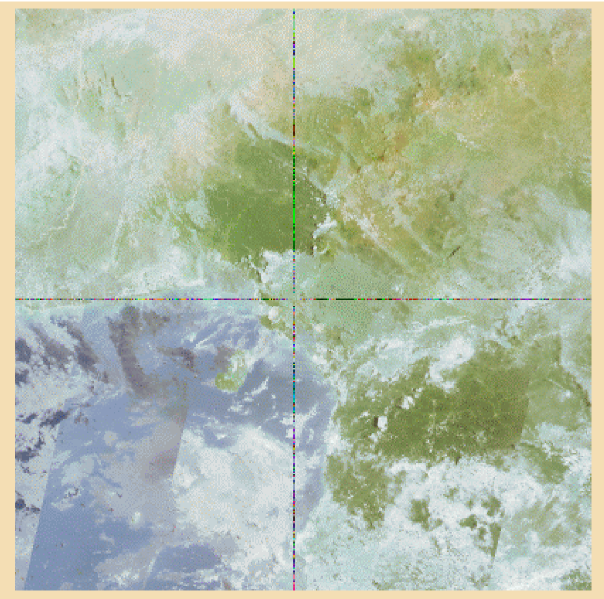
Window 12 – Gulf of Guinea

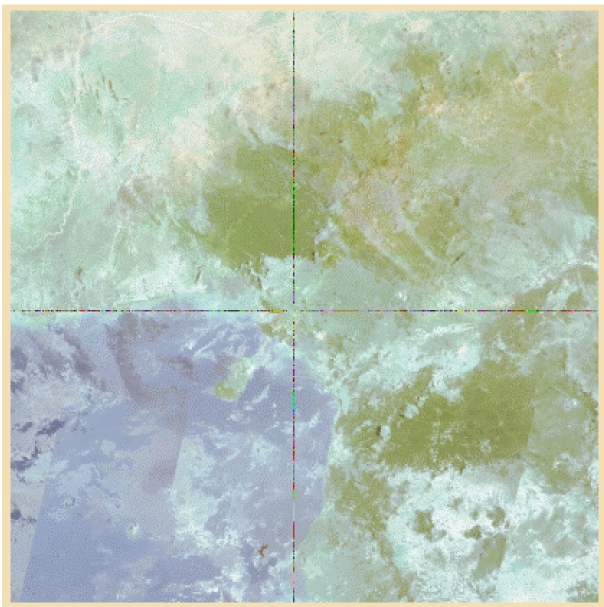


March 2003



April 2003

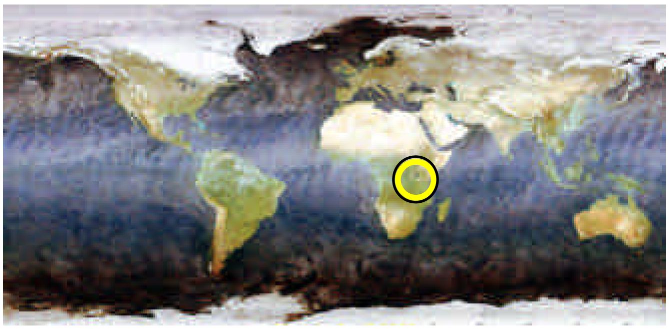




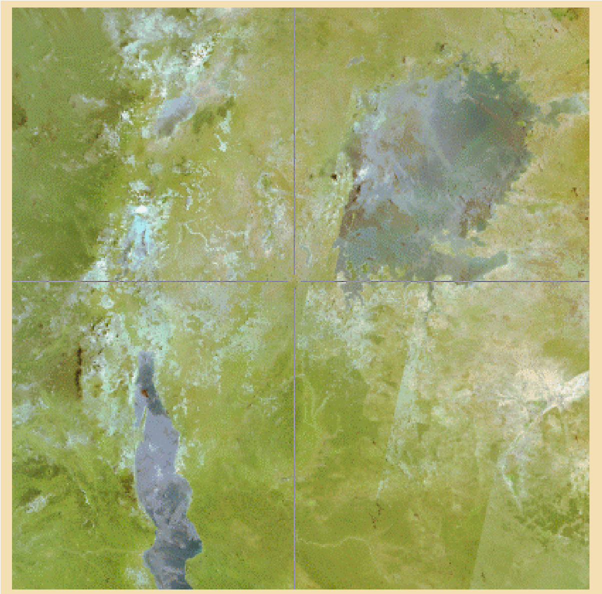
March+April 2003

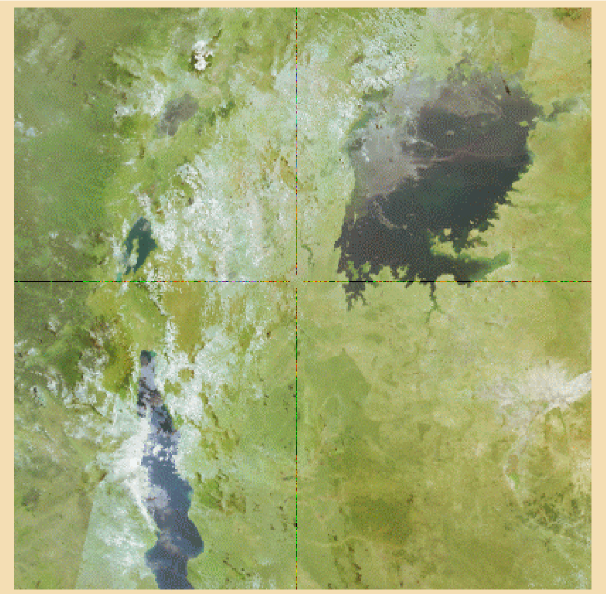
fig. 54 - Window 21 – Gulf of Guinea

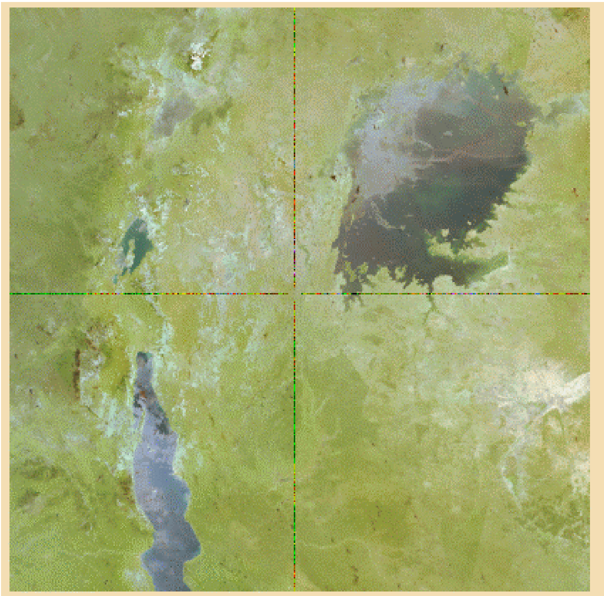
Window 13 – Lakes Victoria and Tanganyika



March 2003 **April 2003**



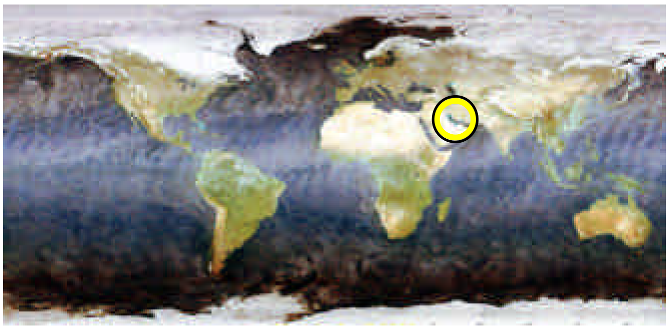




March+April 2003

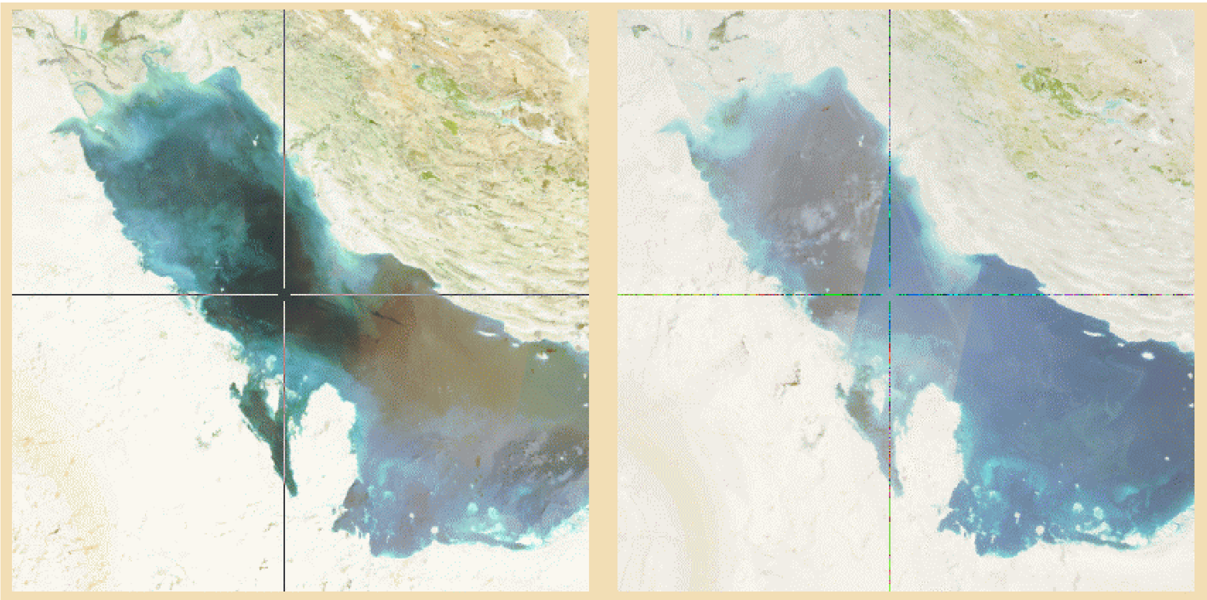
fig. 55 - Window 13 – Lakes Victoria and Tanganyika

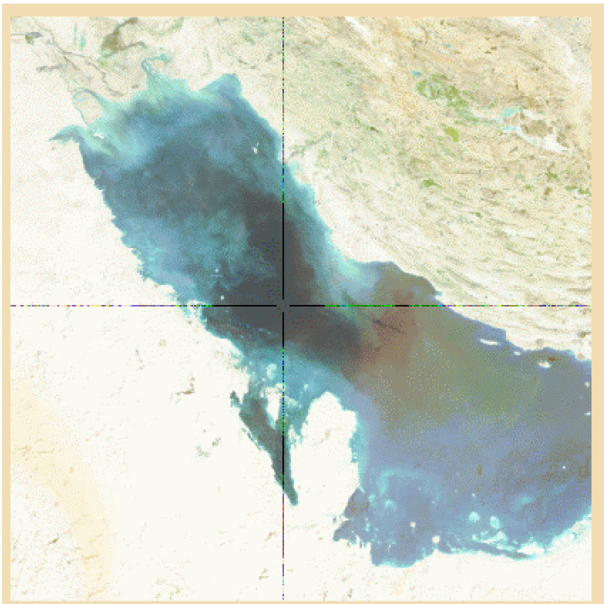
Window 14 – Persian Gulf



March 2003

April 2003

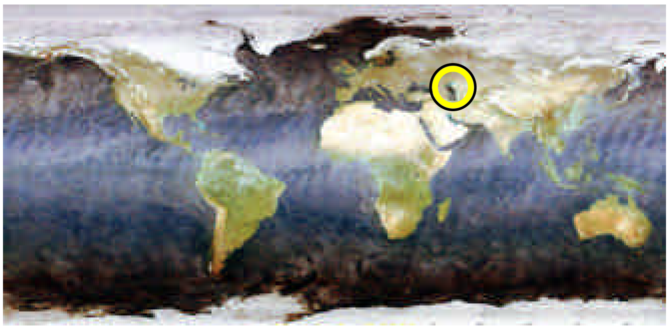




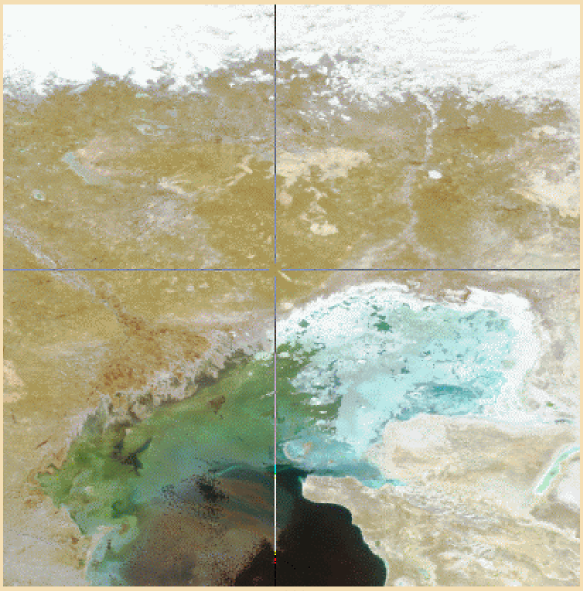
March+April 2003

fig. 56 - Window 14 – Persian Gulf

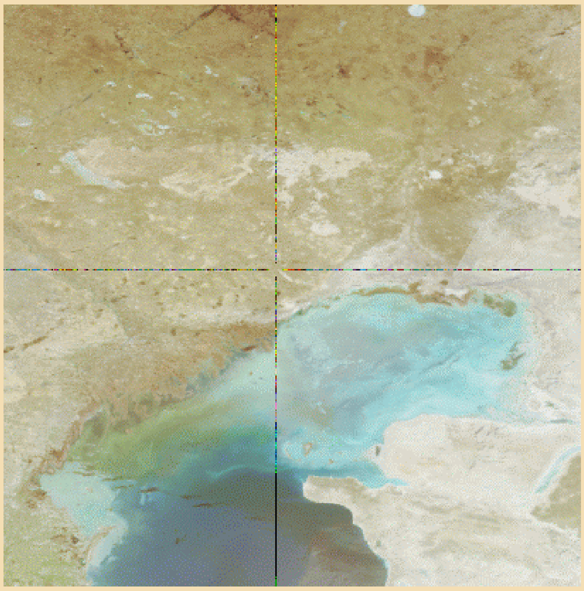
Window 15 – Caspian Sea

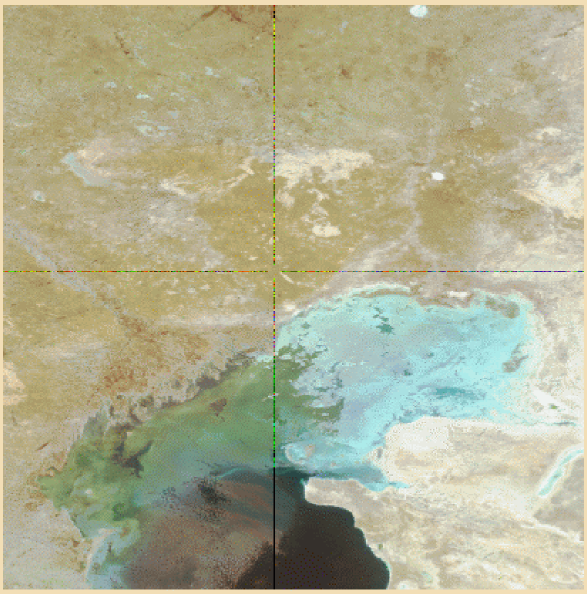


March 2003



April 2003

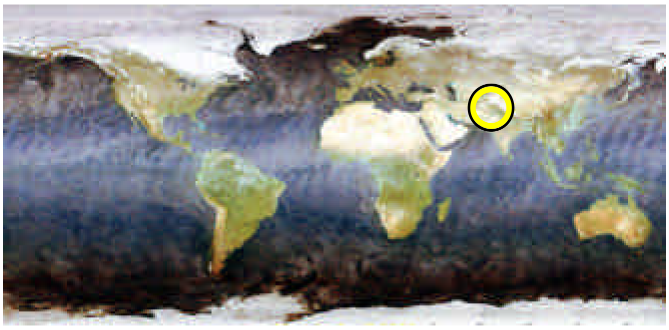




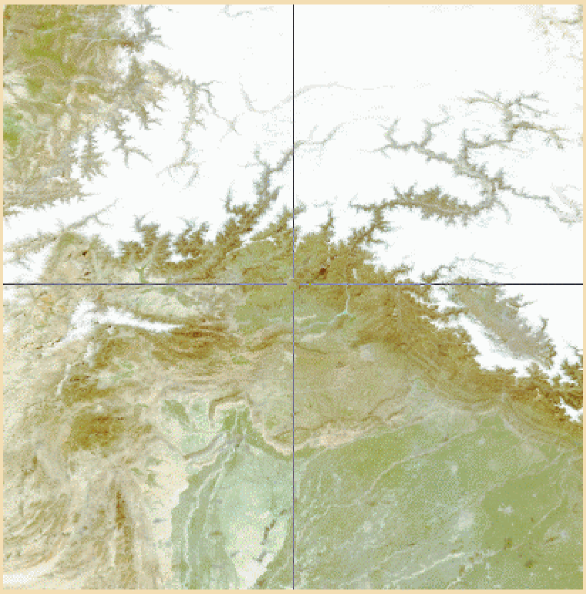
March+April 2003

fig. 57 - Window 15 – Caspian Sea

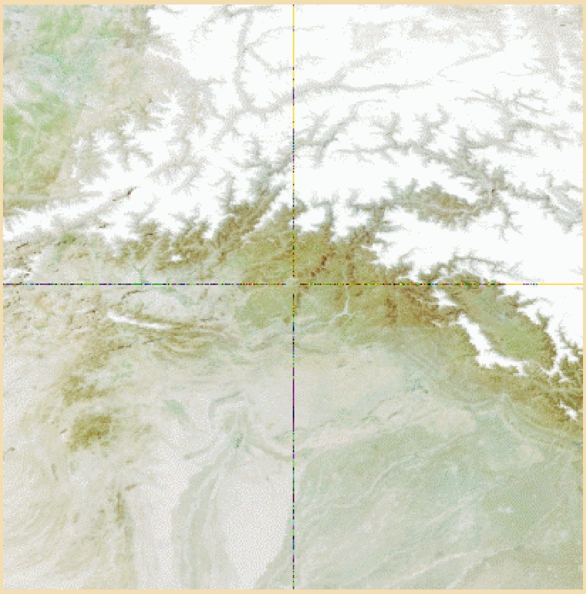
Window 16 – Himalayan West

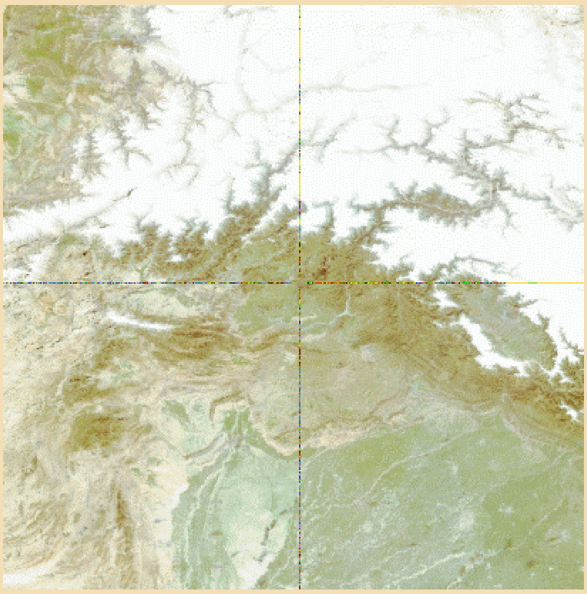


March 2003



April 2003

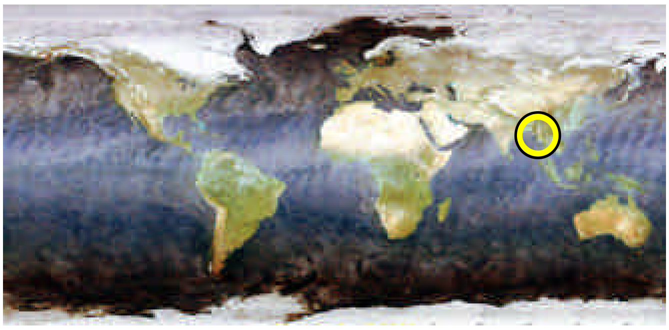




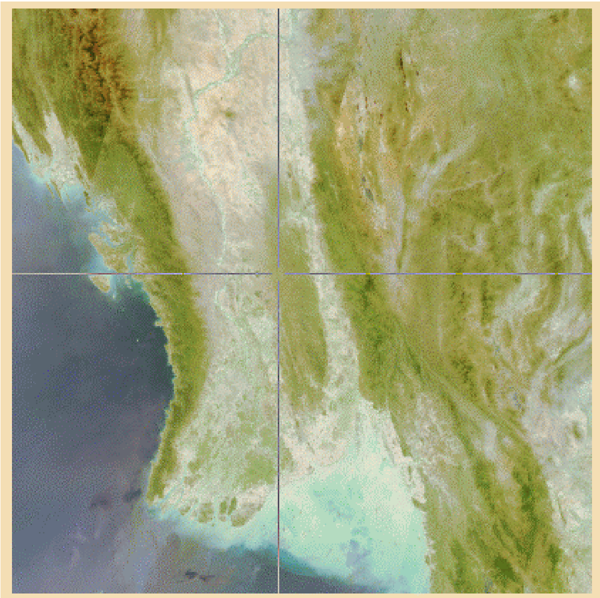
March+April 2003

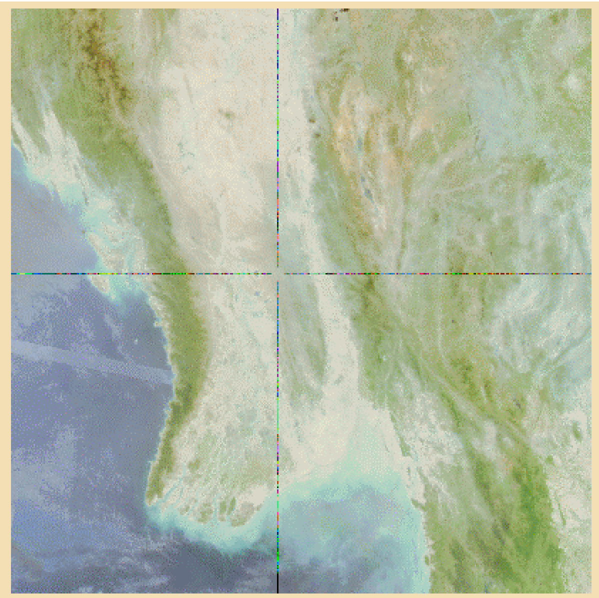
fig. 58 - Window 16 – Himalayan West

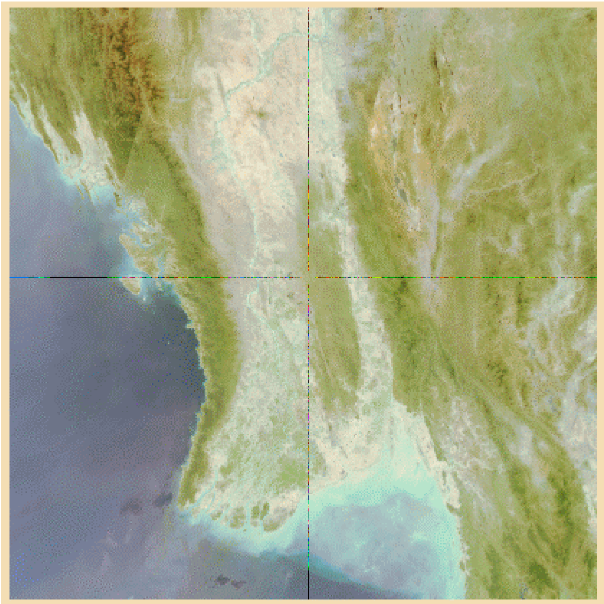
Window 17 – Burma



March 2003 **April 2003**



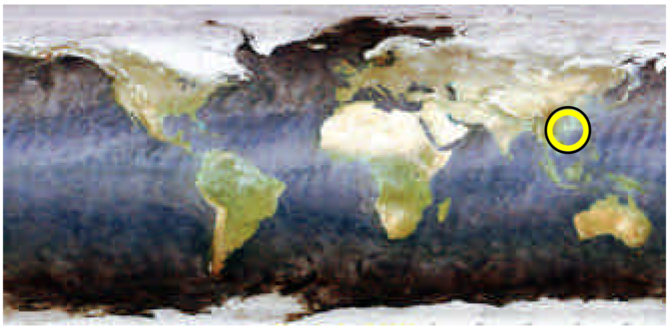




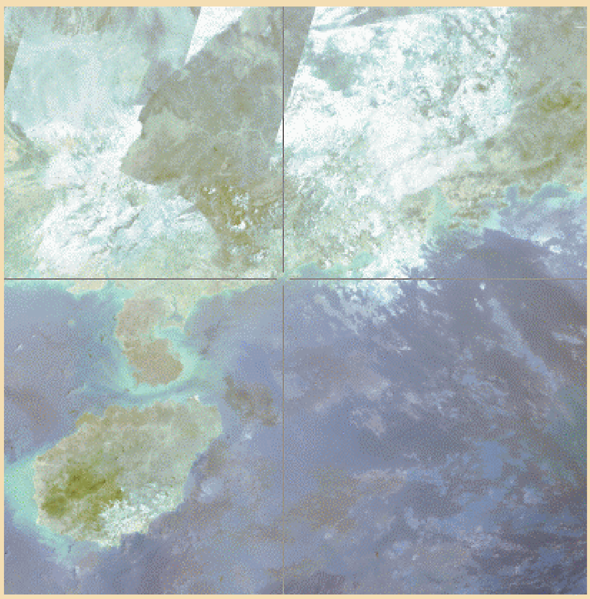
March+April 2003

fig. 59 - Window 17 – Burma

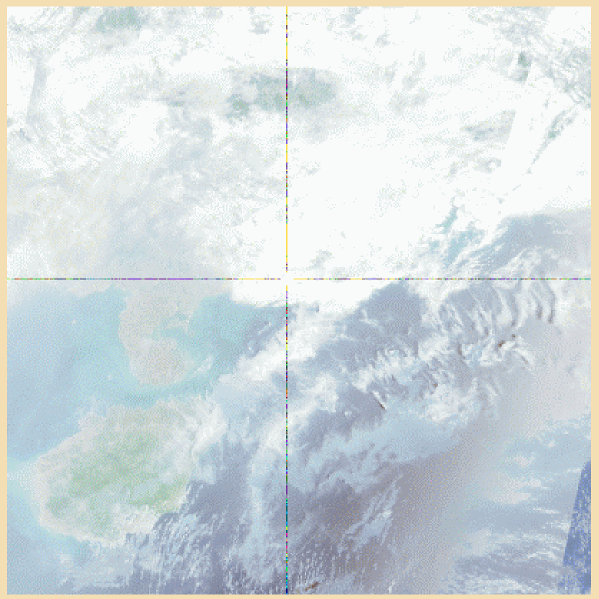
Window 18 – South of China

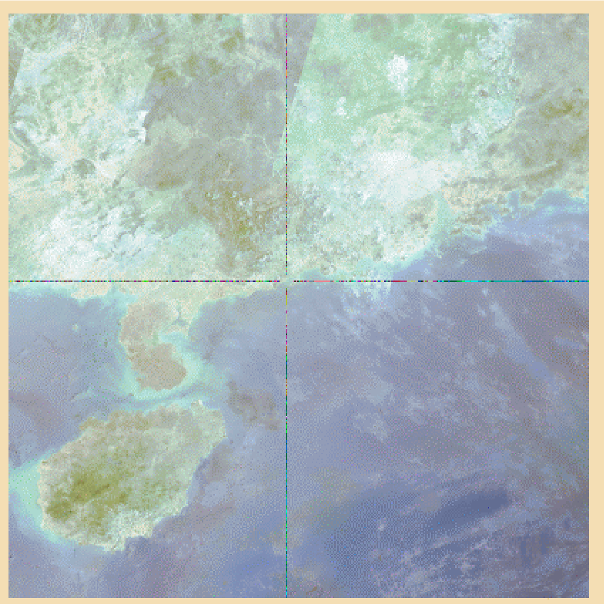


March 2003



April 2003

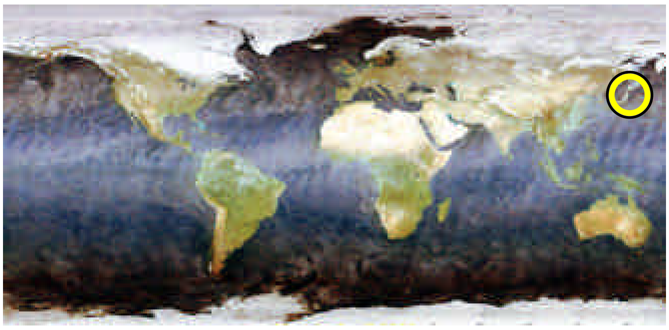




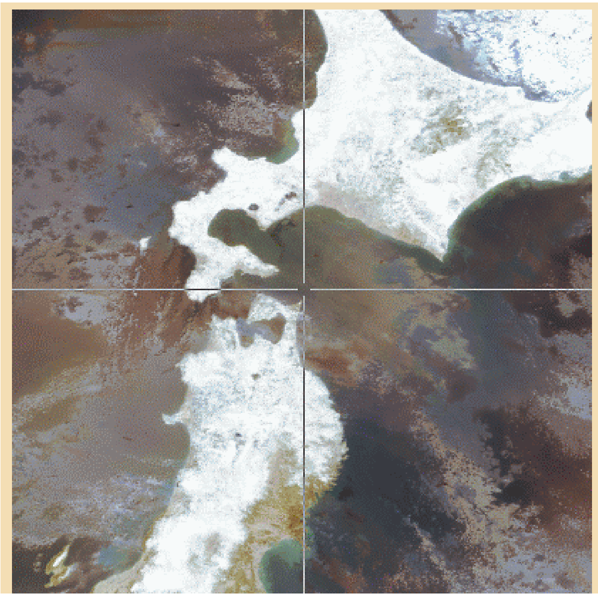
March+April 2003

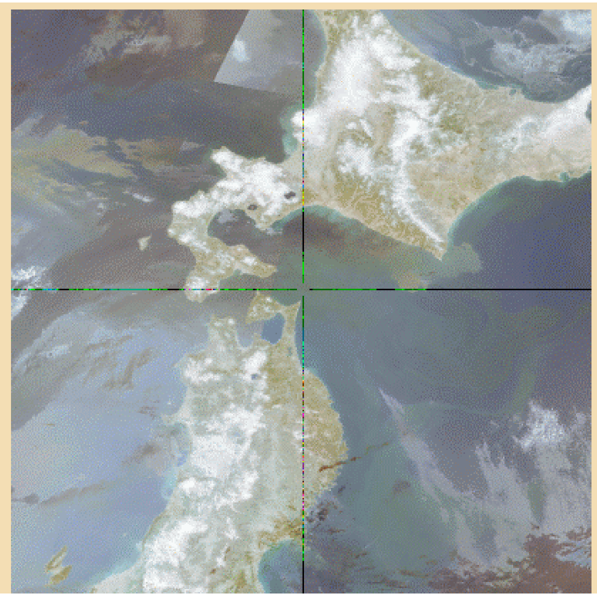
fig. 60 - Window 18 – South of China

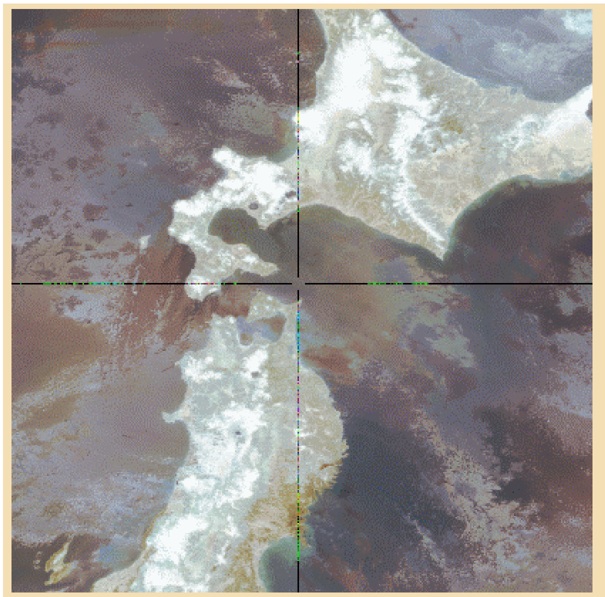
<u>Window 19 – Japan North, Strait of Isugaru</u>



March 2003 **April 2003**







March+April 2003

fig. 61 - Window 19 – Japan North, Strait of Isugaru

4.5 Absolute location control

In that follows, the GMT layers ("borders" in grey, "coasts" in grey, "rivers" in blue, "shore" in blue) are superimposed on the March+April synthesis. This image has been post-processed with the Gauss equalisation model.

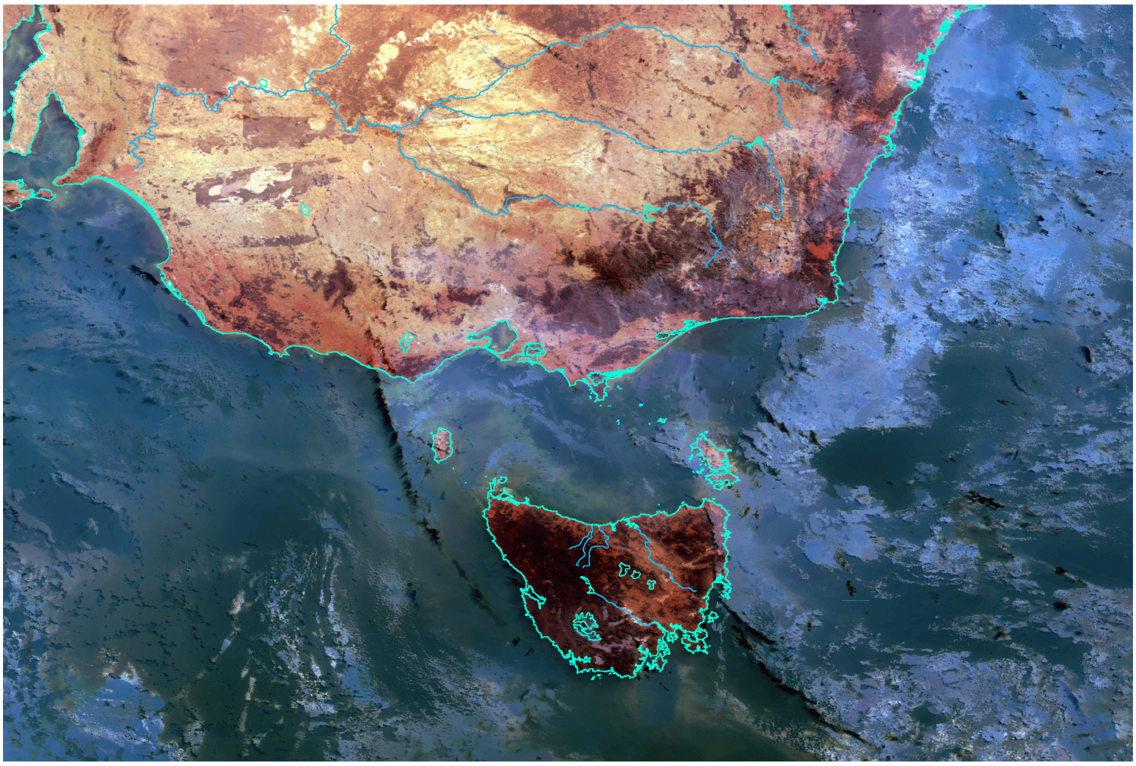


fig. 62 - Localisation control – South Australia.

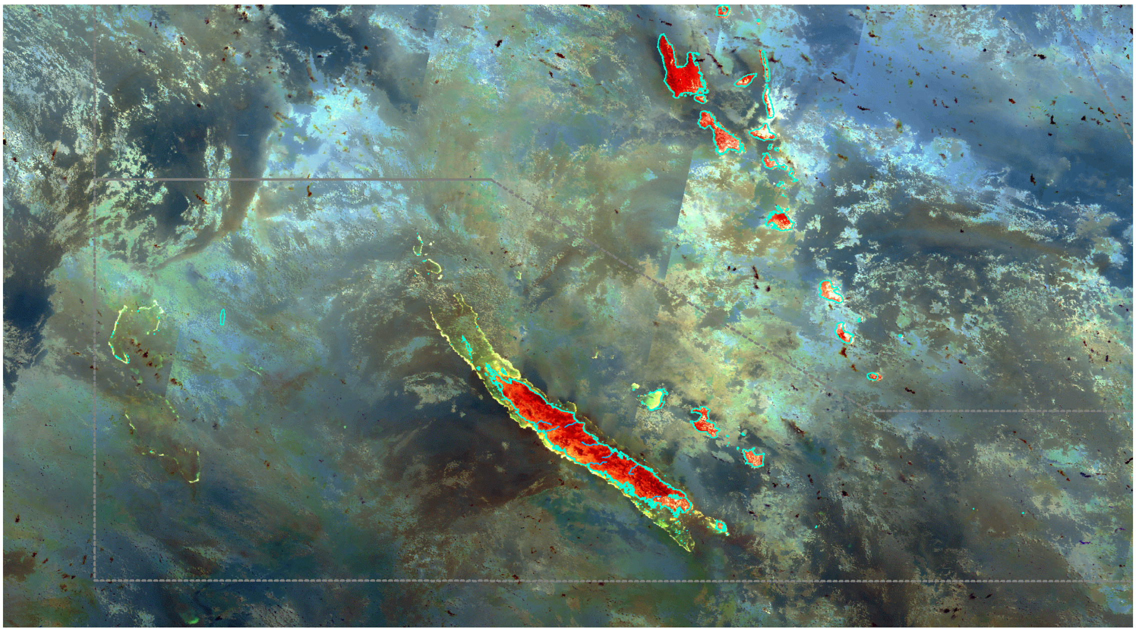


fig. 63 - Localisation control – French Caledonia.

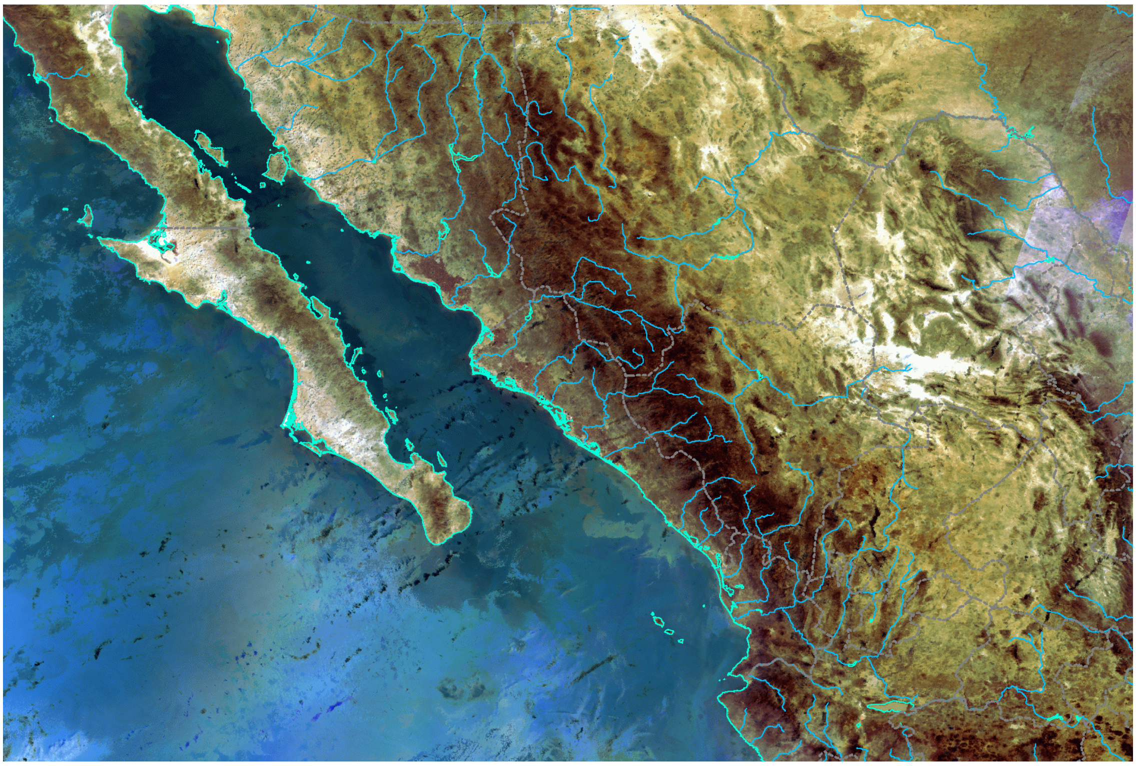


fig. 64 - Localisation control – California.

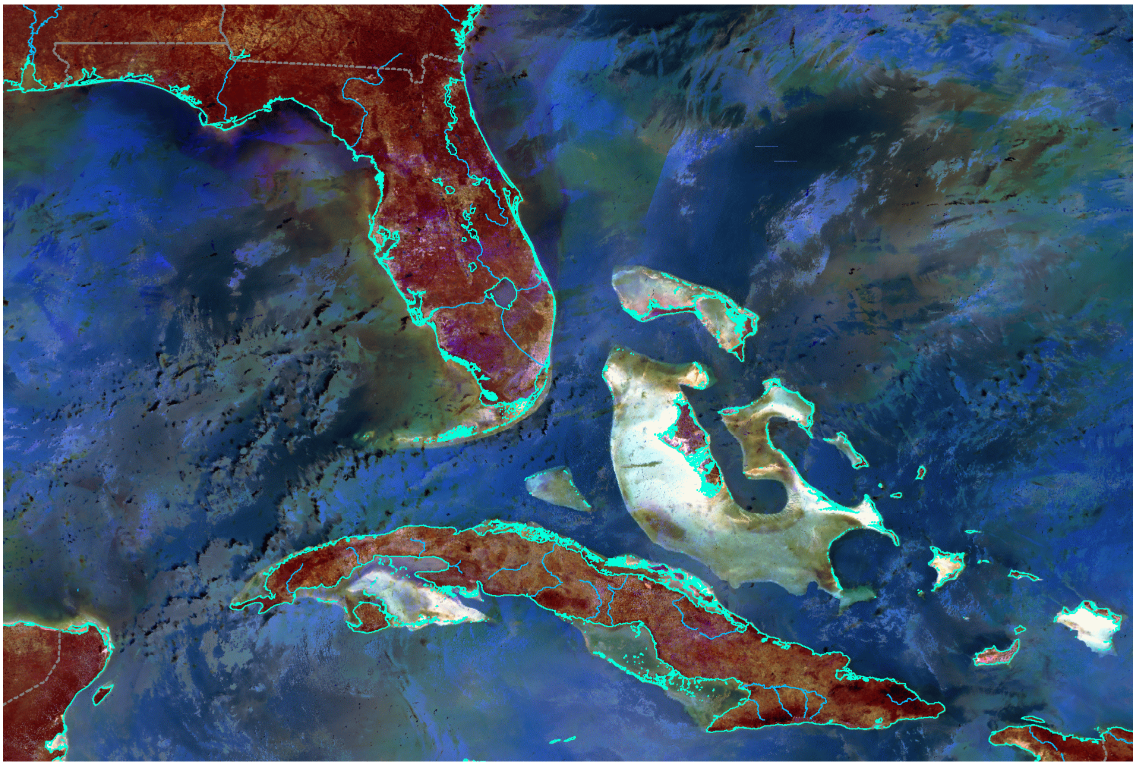


fig. 65 - Localisation control – Florida and Cuba.

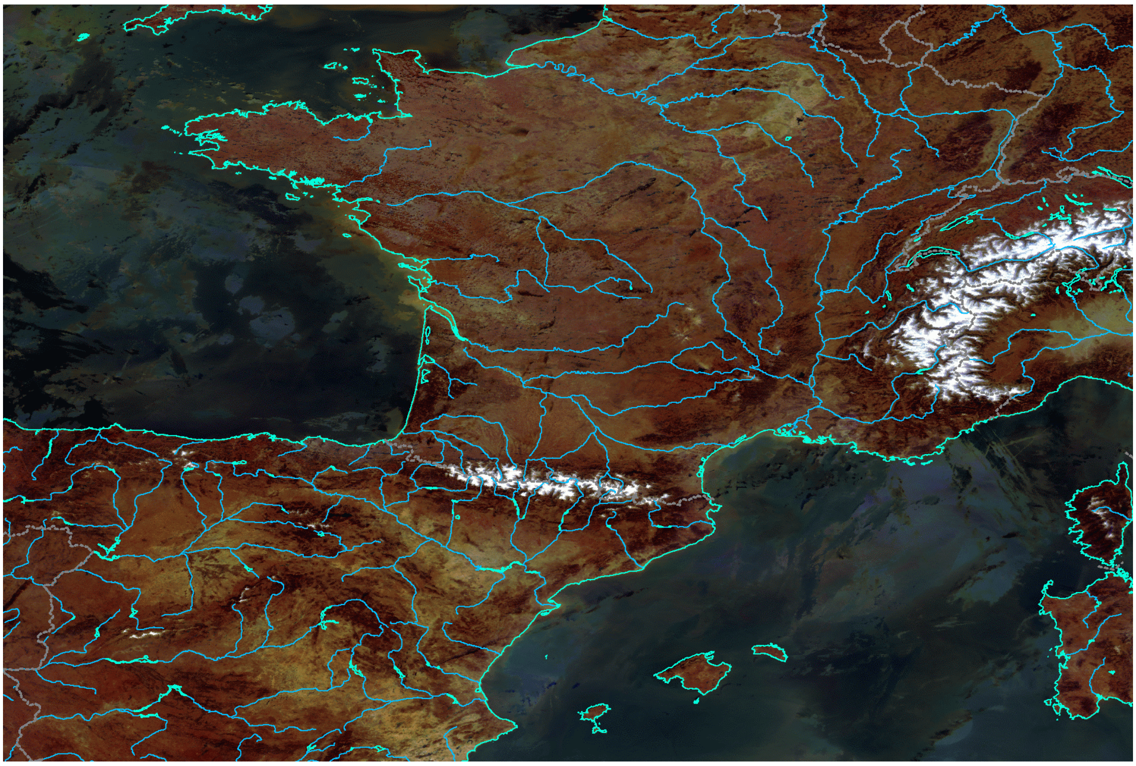


fig. 66 - Localisation control – France and Spain.

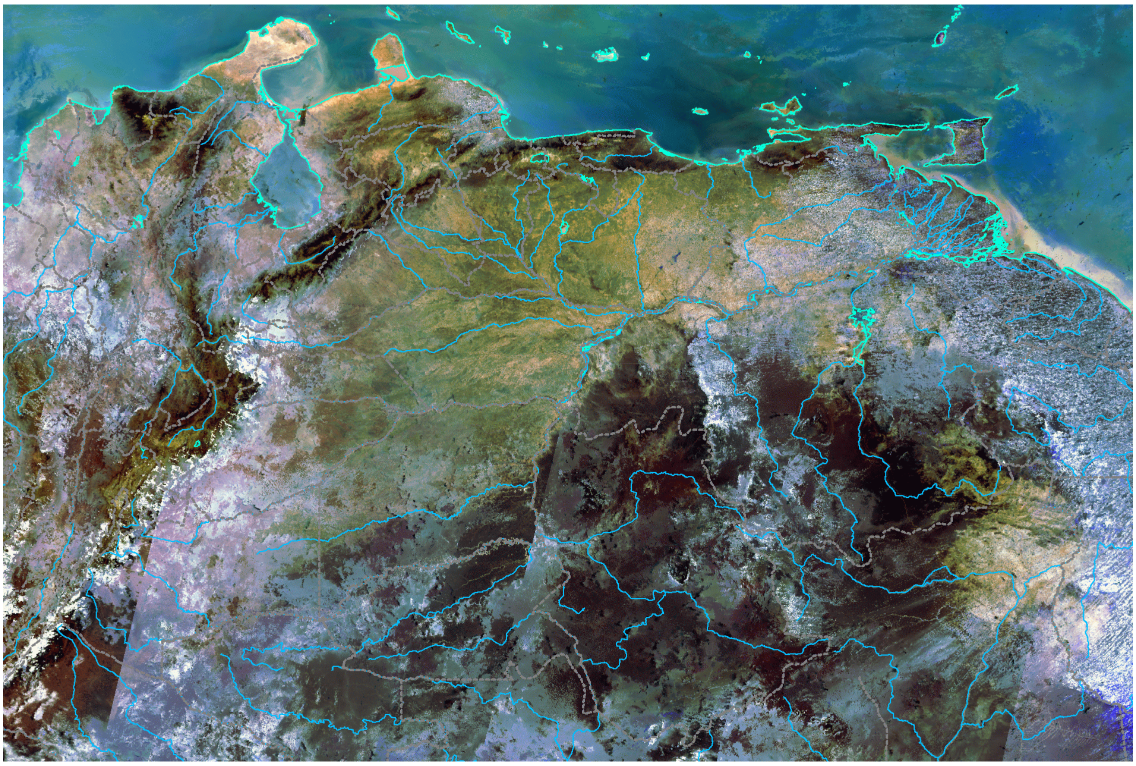


fig. 67 - Localisation control – Venezuela.

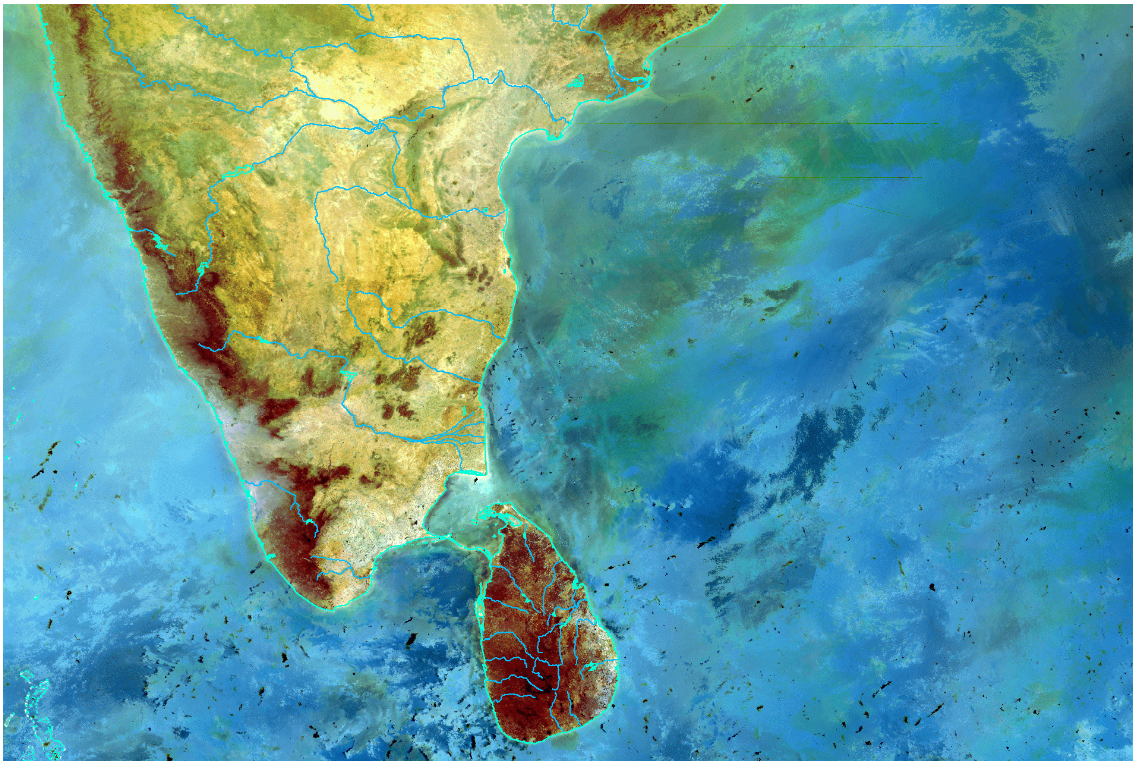


fig. 68 - Localisation control – South India.

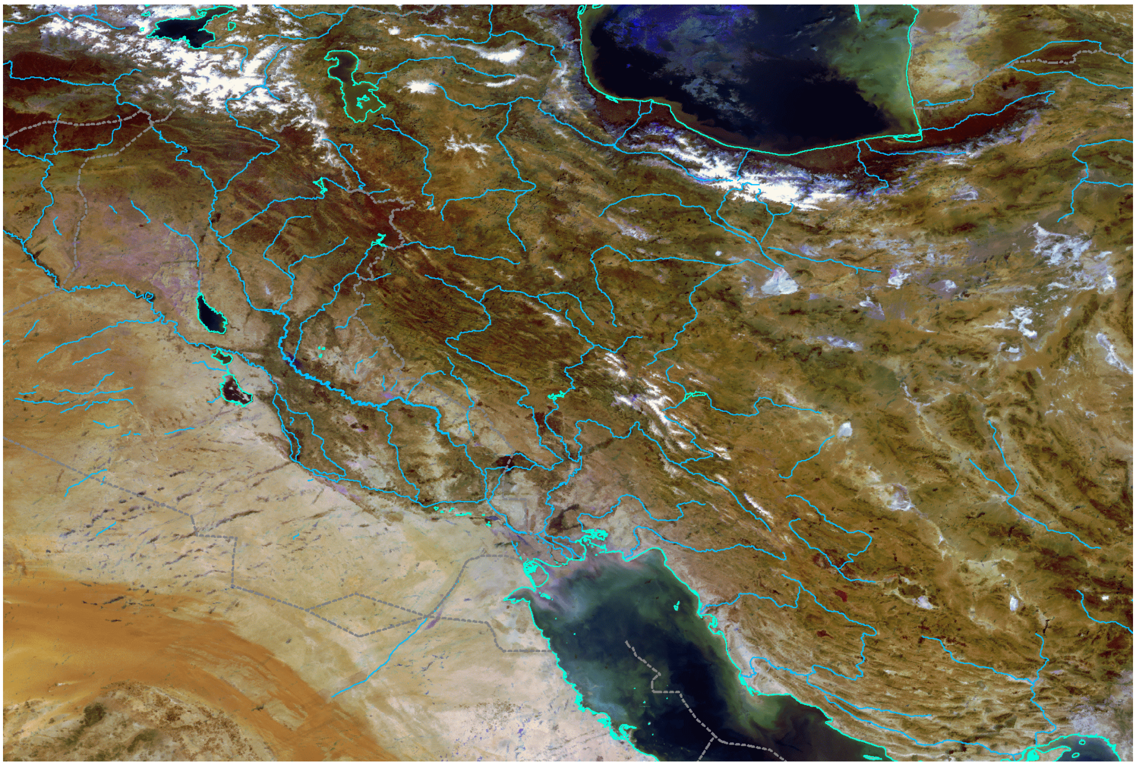


fig. 69 - Localisation control – Iraq.

fig. 70 - Localisation control – Italy.

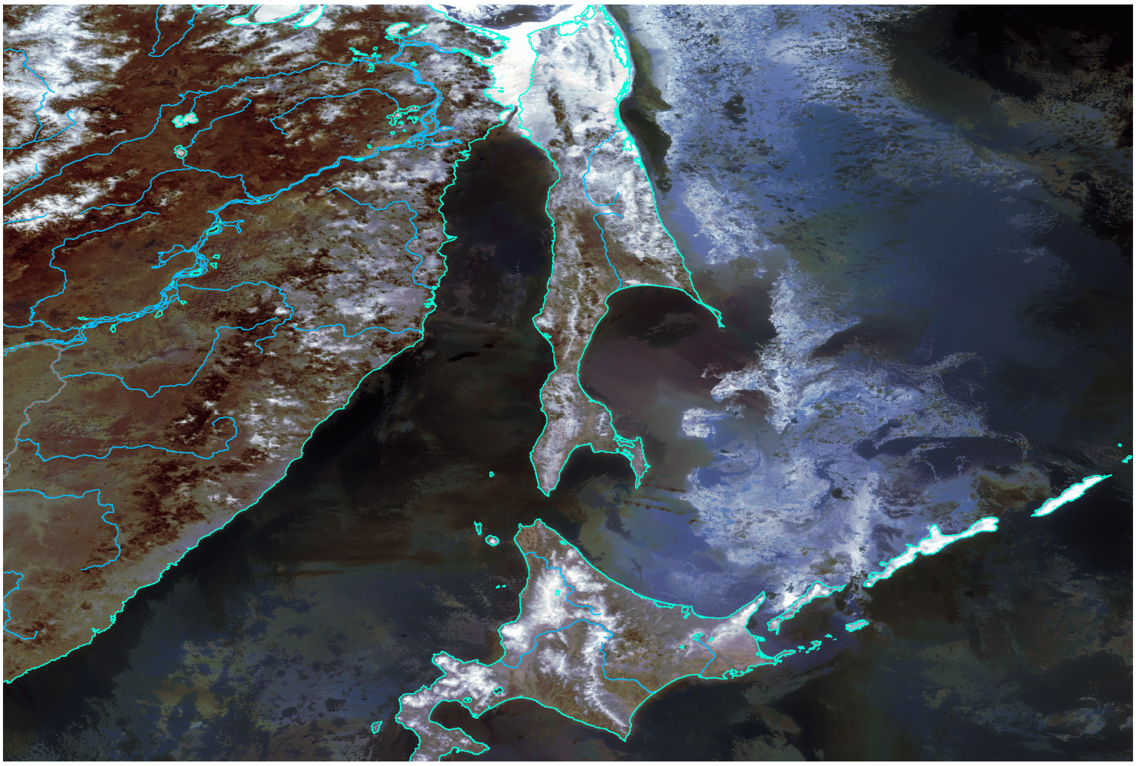


fig. 71 - Localisation control – Japan.

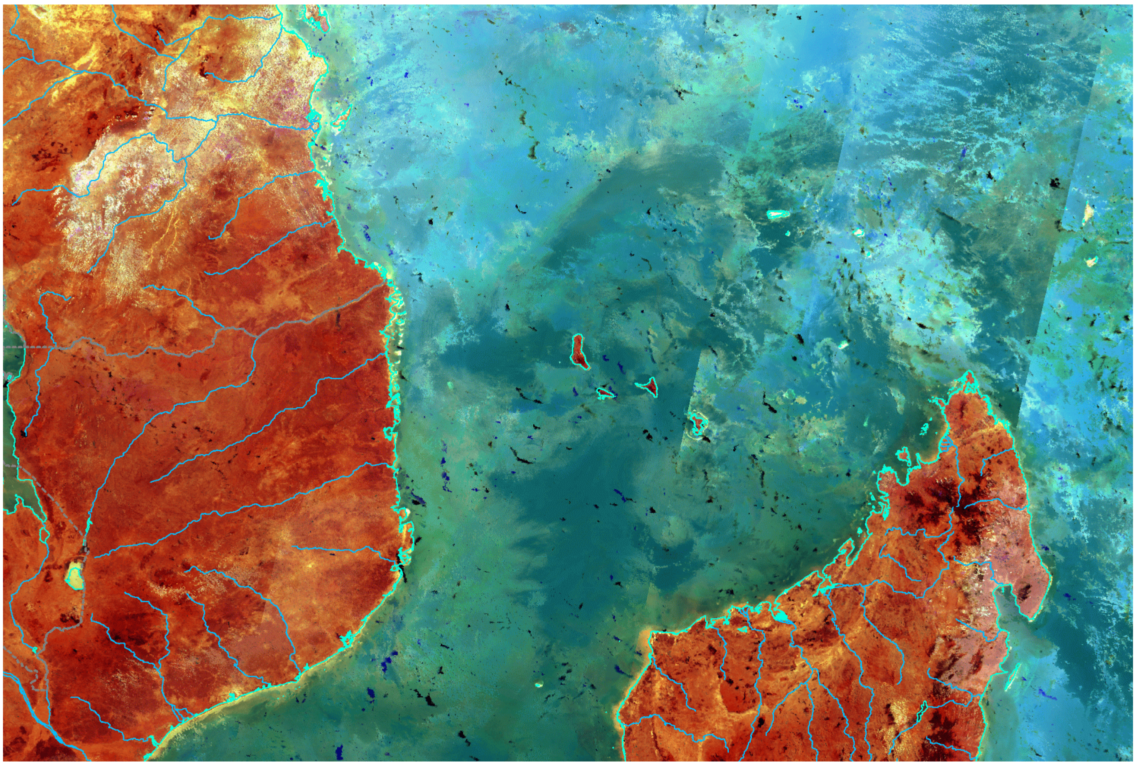


fig. 72 - Localisation control – Madagascar.

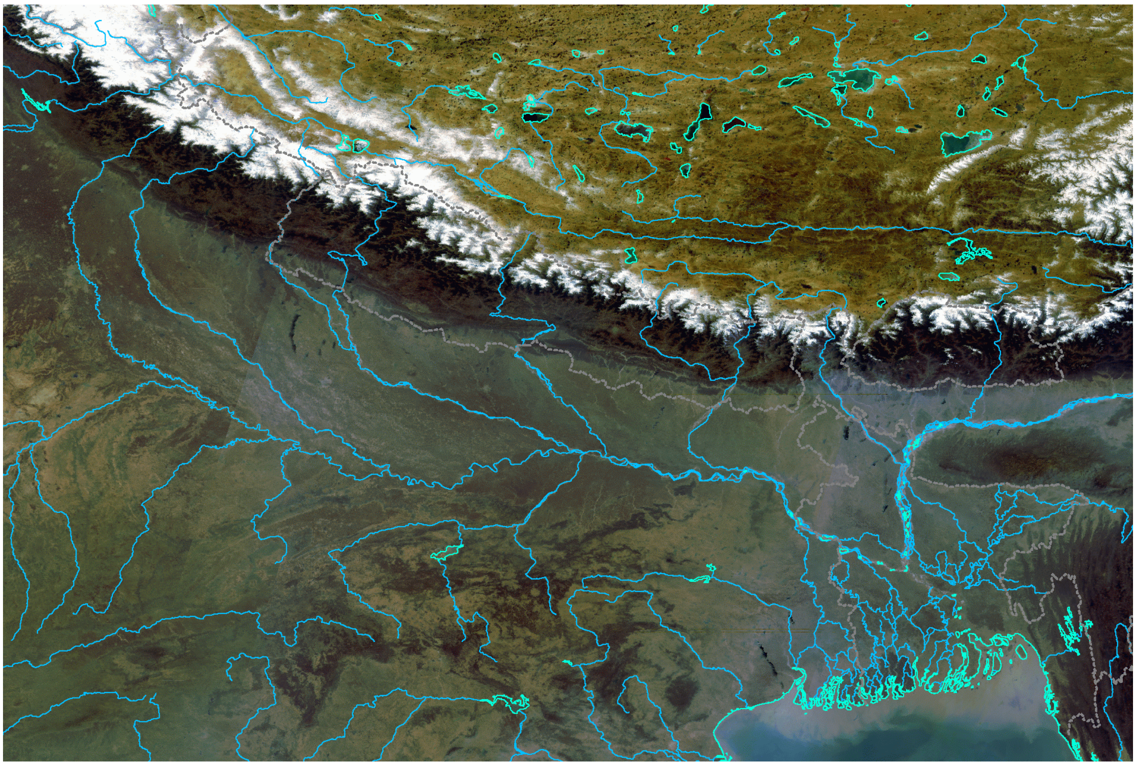


fig. 73 - Localisation control – Nepal.

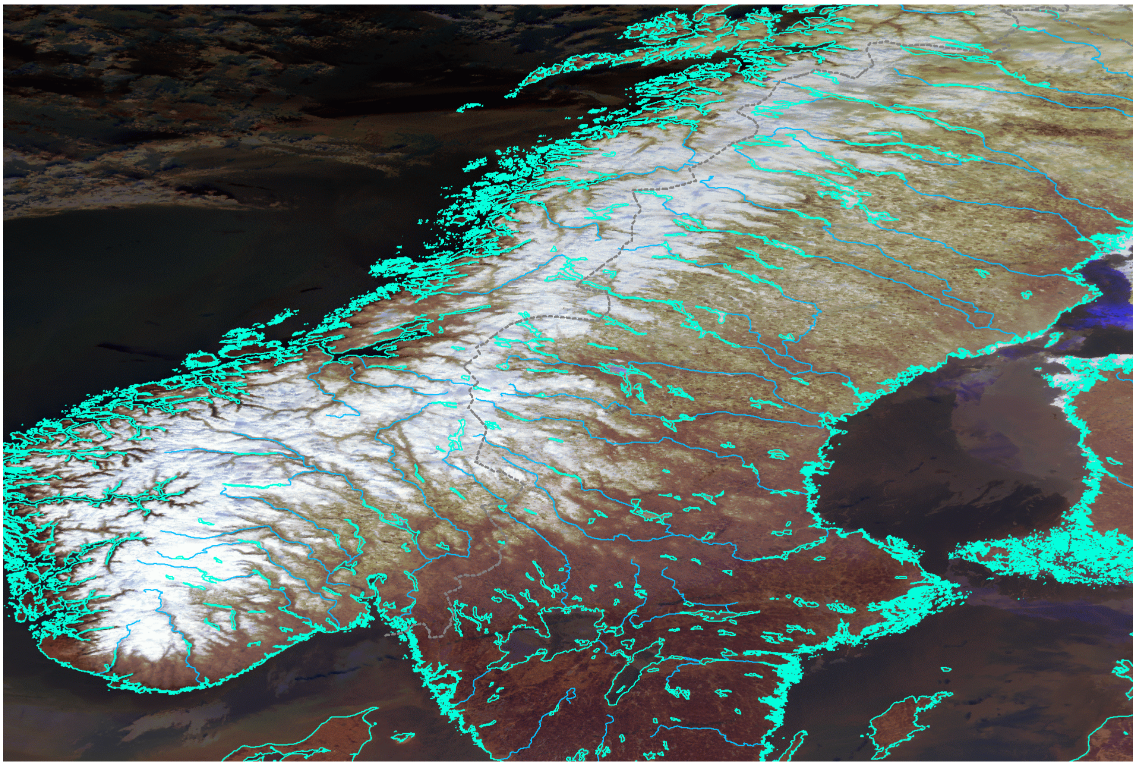


fig. 74 **-** *Localisation control – Norway and Sweden.*

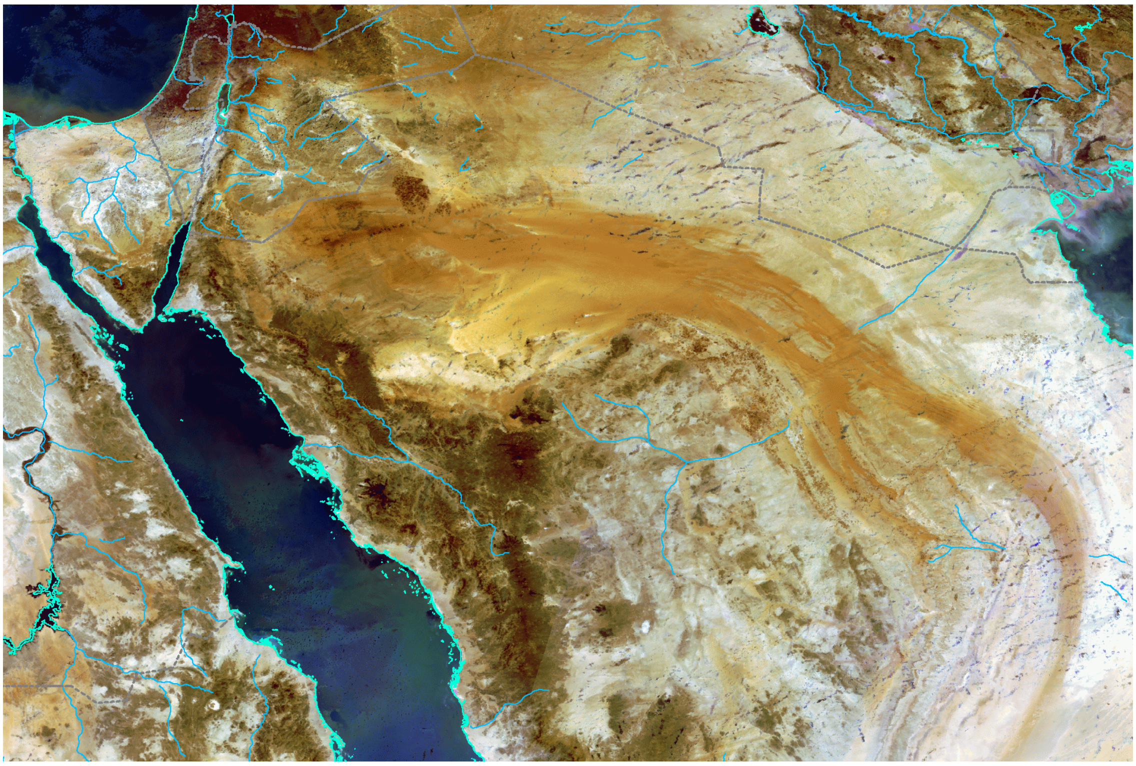


fig. 75 **-** *Localisation control – Red Sea.*

5 POST-PROCESSING

To enable understanding the processes that have been run to produce an image, operations use the "timHelp –l *TELIMAGO_file_name*" that displays the contents of the history header giving the name of the process, its date/time of launch, the parameters being used and possibly output parameters computed by the process.

Another shorter way to identify the processes that have been applied is given in the name of the file itself. These conventions are used in this document and have been reported in the README.TXT file of the delivered DVDs and CD-ROMs.

```
These DVDs contain the results of the synthesis of ENVISAT-MERIS RR acquired on March
and April 2003. The output images have been computed by GAEL Consultant under contract
with ESA and using the software developed by GAEL Consultant.

A total of 1242 MERIS segments have been processed:
. 521 segments on March, and
. 721 segments on April,
leading to a total of 663 GB processed in input.

The output images are in "Plate-Carrée" with a spatial resolution of 1000 metres and
have a size of 20000 lines x 40000 columns. The processed spectral bands are 1, 3, 5, 7
and 13.

For each channel, a histogram equalization has been performed followed by a 0.2%
automatic linear stretching in order to go from a 16 bits to a 8 bits representation.


Syntax of the files is explained on the following example:

       world.syn-radiance-repl.1+2+3+4.stm.sta.sca-05.3-5-7.tif

Where:
.world       gives the extents of the output image.
.syn         is the abbreviation of the synthesis (MERSYN) application.
. radiance   is the "selection algorithm". Here the "Radiance minimum" but could have
             been the "NDVI maximum".
.repl        is the "merging algorithm". Here the "Replacement" but could have  been the
             "Mean".
.1+2+3+4     are the "half-months" concerned by the synthesis:
              1 March 1-15,
              2 March 16-31,
              3 April 1-15,
              4 April 16-30.
.stm         is the abbreviation of the histogram equalization (STRETM) application.
.sta         is the abbreviation of the automatic linear stretching (STRETA)
             application.
.sca         is the abbreviation of the resampling (SCALE) application.
             .05 is the sampling factor used by SCALE. Here 0.5 (i.e. 1 pixel over 2)
             but could have been 0.1 (1 pixel over 10) also written 01.
.3-5-7       is the colour combination. Here the BGR visible colours (band 3 on Blue,
             band 5 on Green and band 7 on Red).
.tif         is the standard extension of TIFF v6.0 images. An accompanying file with
             the suffix ".tfw" gives the pixel size and the coordinates of the upper-
             left corner in the reference system of the projection.
Other extensions are supported:
.tfw for the cartographic ancillary file of TIFF (explained here above).
.jpeg for the JPEG image format.
.txt for the TELIMAGO header contents giving technical and administrative
 information about the image but also the history log of the processes
 executed to produce this image file.
```

5.1 Statistics of the synthesis image

After having been processed by MERSYN application (see section 2.6) merging 1242 MERIS segments, the synthesis displays statistics on each one of the five computed bands as shown by the next tables.

band 1

```
FILE world.syn-radiance-repl.1+2+3+4.1

TOTAL NUMBER OF PIXELS =   800000000
BACKGROUND FLAG        = "YES"
IMAGE PIXELS           =   740772421 (92.60%)
BACKGROUND PIXELS      =    59227579 ( 7.40%)
BACKGROUND VALUE       =           0
MINIMUM                =        1870
MAXIMUM                =       45399
LEFT  BOUND 2%         =        3082
RIGHT BOUND 2%         =       12163
MEAN                   =    6802.669
VARIANCE               = 4640228.477
STANDARD DEVIATION     =    2154.119
```

```
HISTOGRAM (step=512)
202778 |              *
       |              *
       |              **
       |              **
       |              **
168982 |             ***
       |             ***
       |             ***
       |             ***
       |            *****
135185 |            *****
       |            *****
       |           ******
       |           ******
       |           ******
101389 |          *******
       |          *******
       |         ********
       |         *********
       |        **********
 67593 |      ************
       |      ************
       |      ************
       |     *************
       |     **************
 33796 |     **************
       |     **************
       |     ***************
       |     ***************
       |     ******************
     0 ++---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+-------
                5120     10240     15360     20480     25600     30720     35840     40960     46080     51200     56320     61440
```

[0- 255]= 0 (0.00%, 0.00%)	[16384-16639]= 285581 (0.04%, 99.59%)	[32768-33023]= 1584 (0.00%,100.00%)	[49152-49407]= 0 (0.00%,100.00%)
[256- 511]= 0 (0.00%, 0.00%)	[16640-16895]= 278227 (0.04%, 99.63%)	[33024-33279]= 1295 (0.00%,100.00%)	[49408-49663]= 0 (0.00%,100.00%)
[512- 767]= 0 (0.00%, 0.00%)	[16896-17151]= 250250 (0.03%, 99.66%)	[33280-33535]= 1056 (0.00%,100.00%)	[49664-49919]= 0 (0.00%,100.00%)
[768- 1023]= 0 (0.00%, 0.00%)	[17152-17407]= 234036 (0.03%, 99.69%)	[33536-33791]= 965 (0.00%,100.00%)	[49920-50175]= 0 (0.00%,100.00%)
[1024- 1279]= 0 (0.00%, 0.00%)	[17408-17663]= 226649 (0.03%, 99.72%)	[33792-34047]= 762 (0.00%,100.00%)	[50176-50431]= 0 (0.00%,100.00%)
[1280- 1535]= 0 (0.00%, 0.00%)	[17664-17919]= 208835 (0.03%, 99.75%)	[34048-34303]= 622 (0.00%,100.00%)	[50432-50687]= 0 (0.00%,100.00%)
[1536- 1791]= 0 (0.00%, 0.00%)	[17920-18175]= 199640 (0.03%, 99.78%)	[34304-34559]= 528 (0.00%,100.00%)	[50688-50943]= 0 (0.00%,100.00%)
[1792- 2047]= 3133 (0.00%, 0.00%)	[18176-18431]= 187594 (0.03%, 99.81%)	[34560-34815]= 341 (0.00%,100.00%)	[50944-51199]= 0 (0.00%,100.00%)
[2048- 2303]= 30524 (0.00%, 0.00%)	[18432-18687]= 169768 (0.02%, 99.83%)	[34816-35071]= 288 (0.00%,100.00%)	[51200-51455]= 0 (0.00%,100.00%)
[2304- 2559]= 326993 (0.04%, 0.05%)	[18688-18943]= 151997 (0.02%, 99.85%)	[35072-35327]= 259 (0.00%,100.00%)	[51456-51711]= 0 (0.00%,100.00%)
[2560- 2815]= 3402485 (0.46%, 0.51%)	[18944-19199]= 128392 (0.02%, 99.87%)	[35328-35583]= 205 (0.00%,100.00%)	[51712-51967]= 0 (0.00%,100.00%)
[2816- 3071]=10501663 (1.42%, 1.93%)	[19200-19455]= 110679 (0.01%, 99.88%)	[35584-35839]= 158 (0.00%,100.00%)	[51968-52223]= 0 (0.00%,100.00%)
[3072- 3327]=15119634 (2.04%, 3.97%)	[19456-19711]= 91491 (0.01%, 99.89%)	[35840-36095]= 92 (0.00%,100.00%)	[52224-52479]= 0 (0.00%,100.00%)
[3328- 3583]=16895282 (2.28%, 6.25%)	[19712-19967]= 76378 (0.01%, 99.90%)	[36096-36351]= 65 (0.00%,100.00%)	[52480-52735]= 0 (0.00%,100.00%)
[3584- 3839]=16709125 (2.26%, 8.50%)	[19968-20223]= 61487 (0.01%, 99.91%)	[36352-36607]= 36 (0.00%,100.00%)	[52736-52991]= 0 (0.00%,100.00%)
[3840- 4095]=15673175 (2.12%, 10.62%)	[20224-20479]= 54831 (0.01%, 99.92%)	[36608-36863]= 26 (0.00%,100.00%)	[52992-53247]= 0 (0.00%,100.00%)
[4096- 4351]=15874731 (2.14%, 12.76%)	[20480-20735]= 43918 (0.01%, 99.93%)	[36864-37119]= 25 (0.00%,100.00%)	[53248-53503]= 0 (0.00%,100.00%)
[4352- 4607]=18148126 (2.45%, 15.21%)	[20736-20991]= 37448 (0.01%, 99.93%)	[37120-37375]= 14 (0.00%,100.00%)	[53504-53759]= 0 (0.00%,100.00%)
[4608- 4863]=21019248 (2.84%, 18.05%)	[20992-21247]= 30645 (0.00%, 99.93%)	[37376-37631]= 18 (0.00%,100.00%)	[53760-54015]= 0 (0.00%,100.00%)
[4864- 5119]=21945464 (-2.84%, 21.01%)	[21248-21503]= 27505 (0.00%, 99.94%)	[37632-37887]= 7 (0.00%,100.00%)	[54016-54271]= 0 (0.00%,100.00%)
[5120- 5375]=24239906 (-2.53%, 24.28%)	[21504-21759]= 25674 (0.00%, 99.94%)	[37888-38143]= 8 (0.00%,100.00%)	[54272-54527]= 0 (0.00%,100.00%)
[5376- 5631]=25481892 (-2.36%, 27.72%)	[21760-22015]= 23822 (0.00%, 99.94%)	[38144-38399]= 2 (0.00%,100.00%)	[54528-54783]= 0 (0.00%,100.00%)
[5632- 5887]=29546037 (-1.81%, 31.71%)	[22016-22271]= 22235 (0.00%, 99.95%)	[38400-38655]= 6 (0.00%,100.00%)	[54784-55039]= 0 (0.00%,100.00%)
[5888- 6143]=31803795 (-1.50%, 36.01%)	[22272-22527]= 21290 (0.00%, 99.95%)	[38656-38911]= 4 (0.00%,100.00%)	[55040-55295]= 0 (0.00%,100.00%)
[6144- 6399]=32765156 (-1.37%, 40.43%)	[22528-22783]= 19097 (0.00%, 99.95%)	[38912-39167]= 8 (0.00%,100.00%)	[55296-55551]= 0 (0.00%,100.00%)
[6400- 6655]=34366208 (-1.16%, 45.07%)	[22784-23039]= 17575 (0.00%, 99.96%)	[39168-39423]= 7 (0.00%,100.00%)	[55552-55807]= 0 (0.00%,100.00%)
[6656- 6911]=36923638 (-0.81%, 50.05%)	[23040-23295]= 16477 (0.00%, 99.96%)	[39424-39679]= 10 (0.00%,100.00%)	[55808-56063]= 0 (0.00%,100.00%)
[6912- 7167]=40401647 (-0.34%, 55.51%)	[23296-23551]= 15717 (0.00%, 99.96%)	[39680-39935]= 3 (0.00%,100.00%)	[56064-56319]= 0 (0.00%,100.00%)
[7168- 7423]=48061039 (0.69%, 61.99%)	[23552-23807]= 15414 (0.00%, 99.96%)	[39936-40191]= 7 (0.00%,100.00%)	[56320-56575]= 0 (0.00%,100.00%)
[7424- 7679]=50593232 (1.03%, 68.82%)	[23808-24063]= 14538 (0.00%, 99.96%)	[40192-40447]= 6 (0.00%,100.00%)	[56576-56831]= 0 (0.00%,100.00%)
[7680- 7935]=46461962 (0.47%, 75.10%)	[24064-24319]= 13995 (0.00%, 99.97%)	[40448-40703]= 4 (0.00%,100.00%)	[56832-57087]= 0 (0.00%,100.00%)
[7936- 8191]=40612800 (-0.32%, 80.58%)	[24320-24575]= 13443 (0.00%, 99.97%)	[40704-40959]= 3 (0.00%,100.00%)	[57088-57343]= 0 (0.00%,100.00%)
[8192- 8447]=32549561 (-1.40%, 84.97%)	[24576-24831]= 12763 (0.00%, 99.97%)	[40960-41215]= 8 (0.00%,100.00%)	[57344-57599]= 0 (0.00%,100.00%)
[8448- 8703]=25138523 (-2.40%, 88.37%)	[24832-25087]= 12539 (0.00%, 99.97%)	[41216-41471]= 6 (0.00%,100.00%)	[57600-57855]= 0 (0.00%,100.00%)
[8704- 8959]=18845338 (2.54%, 90.91%)	[25088-25343]= 12073 (0.00%, 99.97%)	[41472-41727]= 3 (0.00%,100.00%)	[57856-58111]= 0 (0.00%,100.00%)
[8960- 9215]=13720528 (1.85%, 92.76%)	[25344-25599]= 11826 (0.00%, 99.97%)	[41728-41983]= 2 (0.00%,100.00%)	[58112-58367]= 0 (0.00%,100.00%)
[9216- 9471]= 9511514 (1.28%, 94.05%)	[25600-25855]= 11469 (0.00%, 99.98%)	[41984-42239]= 2 (0.00%,100.00%)	[58368-58623]= 0 (0.00%,100.00%)
[9472- 9727]= 6346778 (0.86%, 94.90%)	[25856-26111]= 11467 (0.00%, 99.98%)	[42240-42495]= 1 (0.00%,100.00%)	[58624-58879]= 0 (0.00%,100.00%)
[9728- 9983]= 4477904 (0.60%, 95.51%)	[26112-26367]= 10745 (0.00%, 99.98%)	[42496-42751]= 1 (0.00%,100.00%)	[58880-59135]= 0 (0.00%,100.00%)
[9984-10239]= 3335556 (0.45%, 95.96%)	[26368-26623]= 10317 (0.00%, 99.98%)	[42752-43007]= 1 (0.00%,100.00%)	[59136-59391]= 0 (0.00%,100.00%)
[10240-10495]= 2794102 (0.38%, 96.34%)	[26624-26879]= 9839 (0.00%, 99.98%)	[43008-43263]= 1 (0.00%,100.00%)	[59392-59647]= 0 (0.00%,100.00%)
[10496-10751]= 2455606 (0.33%, 96.67%)	[26880-27135]= 9645 (0.00%, 99.98%)	[43264-43519]= 1 (0.00%,100.00%)	[59648-59903]= 0 (0.00%,100.00%)
[10752-11007]= 2180961 (0.29%, 96.96%)	[27136-27391]= 9299 (0.00%, 99.98%)	[43520-43775]= 1 (0.00%,100.00%)	[59904-60159]= 0 (0.00%,100.00%)
[11008-11263]= 1955429 (0.26%, 97.23%)	[27392-27647]= 8640 (0.00%, 99.99%)	[43776-44031]= 4 (0.00%,100.00%)	[60160-60415]= 0 (0.00%,100.00%)
[11264-11519]= 1790389 (0.24%, 97.47%)	[27648-27903]= 8596 (0.00%, 99.99%)	[44032-44287]= 6 (0.00%,100.00%)	[60416-60671]= 0 (0.00%,100.00%)
[11520-11775]= 1648408 (0.22%, 97.69%)	[27904-28159]= 8367 (0.00%, 99.99%)	[44288-44543]= 4 (0.00%,100.00%)	[60672-60927]= 0 (0.00%,100.00%)
[11776-12031]= 1546384 (0.21%, 97.90%)	[28160-28415]= 8164 (0.00%, 99.99%)	[44544-44799]= 8 (0.00%,100.00%)	[60928-61183]= 0 (0.00%,100.00%)
[12032-12287]= 1458484 (0.20%, 98.10%)	[28416-28671]= 7690 (0.00%, 99.99%)	[44800-45055]= 1 (0.00%,100.00%)	[61184-61439]= 0 (0.00%,100.00%)
[12288-12543]= 1385326 (0.19%, 98.28%)	[28672-28927]= 7548 (0.00%, 99.99%)	[45056-45311]= 4 (0.00%,100.00%)	[61440-61695]= 0 (0.00%,100.00%)
[12544-12799]= 1308762 (0.18%, 98.46%)	[28928-29183]= 7271 (0.00%, 99.99%)	[45312-45567]= 3 (0.00%,100.00%)	[61696-61951]= 0 (0.00%,100.00%)
[12800-13055]= 1131713 (0.15%, 98.61%)	[29184-29439]= 6891 (0.00%, 99.99%)	[45568-45823]= 0 (0.00%,100.00%)	[61952-62207]= 0 (0.00%,100.00%)
[13056-13311]= 979228 (0.13%, 98.74%)	[29440-29695]= 6306 (0.00%, 99.99%)	[45824-46079]= 0 (0.00%,100.00%)	[62208-62463]= 0 (0.00%,100.00%)
[13312-13567]= 824106 (0.11%, 98.86%)	[29696-29951]= 5732 (0.00%, 99.99%)	[46080-46335]= 0 (0.00%,100.00%)	[62464-62719]= 0 (0.00%,100.00%)
[13568-13823]= 696583 (0.09%, 98.95%)	[29952-30207]= 5296 (0.00%, 99.99%)	[46336-46591]= 0 (0.00%,100.00%)	[62720-62975]= 0 (0.00%,100.00%)
[13824-14079]= 614520 (0.08%, 99.03%)	[30208-30463]= 4591 (0.00%,100.00%)	[46592-46847]= 0 (0.00%,100.00%)	[62976-63231]= 0 (0.00%,100.00%)
[14080-14335]= 568939 (0.08%, 99.11%)	[30464-30719]= 4071 (0.00%,100.00%)	[46848-47103]= 0 (0.00%,100.00%)	[63232-63487]= 0 (0.00%,100.00%)
[14336-14591]= 538631 (0.07%, 99.18%)	[30720-30975]= 3570 (0.00%,100.00%)	[47104-47359]= 0 (0.00%,100.00%)	[63488-63743]= 0 (0.00%,100.00%)
[14592-14847]= 483000 (0.07%, 99.25%)	[30976-31231]= 3388 (0.00%,100.00%)	[47360-47615]= 0 (0.00%,100.00%)	[63744-63999]= 0 (0.00%,100.00%)
[14848-15103]= 446013 (0.06%, 99.31%)	[31232-31487]= 2976 (0.00%,100.00%)	[47616-47871]= 0 (0.00%,100.00%)	[64000-64255]= 0 (0.00%,100.00%)
[15104-15359]= 413970 (0.06%, 99.36%)	[31488-31743]= 2651 (0.00%,100.00%)	[47872-48127]= 0 (0.00%,100.00%)	[64256-64511]= 0 (0.00%,100.00%)
[15360-15615]= 392058 (0.05%, 99.42%)	[31744-31999]= 2407 (0.00%,100.00%)	[48128-48383]= 0 (0.00%,100.00%)	[64512-64767]= 0 (0.00%,100.00%)
[15616-15871]= 366879 (0.05%, 99.47%)	[32000-32255]= 2027 (0.00%,100.00%)	[48384-48639]= 0 (0.00%,100.00%)	[64768-65023]= 0 (0.00%,100.00%)
[15872-16127]= 332712 (0.04%, 99.51%)	[32256-32511]= 1818 (0.00%,100.00%)	[48640-48895]= 0 (0.00%,100.00%)	[65024-65279]= 0 (0.00%,100.00%)
[16128-16383]= 312767 (0.04%, 99.55%)	[32512-32767]= 1773 (0.00%,100.00%)	[48896-49151]= 0 (0.00%,100.00%)	[65280-65535]= 0 (0.00%,100.00%)

band 3

```
FILE world.syn-radiance-repl.1+2+3+4.3

TOTAL NUMBER OF PIXELS =   800000000
BACKGROUND FLAG        = "YES"
IMAGE PIXELS           =   740772421 (92.60%)
BACKGROUND PIXELS      =    59227579 ( 7.40%)
BACKGROUND VALUE       =           0
MINIMUM                =         933
MAXIMUM                =       40759
LEFT  BOUND 2%         =        1777
RIGHT BOUND 2%         =       10447
MEAN                   =    4354.392
VARIANCE               = 4519390.397
STANDARD DEVIATION     =    2125.886
```

```
HISTOGRAM (step=512)
219816 |     *
       |     ****
       |     ****
       |     ****
       |     ****
183180 |     ****
       |     ****
       |     ****
       |     ****
       |    *****
146544 |    *****
       |    *****
       |    *****
       |   *******
       |   *******
109908 |   *******
       |   *******
       |   *******
       |   *******
       |   ******* **
 73272 |   ******* **
       |   ******* **
       |   **********
       |   ***********
 36636 |   ***********
       |   ***********
       |   ************
       |   *************
       |  ***************
       |  ******************
     0 ++---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+-------
                 5120      10240     15360     20480     25600     30720     35840     40960     46080     51200     56320     61440
```

[0- 255]= 0 (0.00%, 0.00%)	[16384-16639]= 149964 (0.02%, 99.85%)	[32768-33023]= 79 (0.00%,100.00%)	[49152-49407]= 0 (0.00%,100.00%)
[256- 511]= 0 (0.00%, 0.00%)	[16640-16895]= 125926 (0.02%, 99.87%)	[33024-33279]= 38 (0.00%,100.00%)	[49408-49663]= 0 (0.00%,100.00%)
[512- 767]= 0 (0.00%, 0.00%)	[16896-17151]= 105860 (0.01%, 99.88%)	[33280-33535]= 34 (0.00%,100.00%)	[49664-49919]= 0 (0.00%,100.00%)
[768- 1023]= 1868 (0.00%, 0.00%)	[17152-17407]= 88113 (0.01%, 99.90%)	[33536-33791]= 36 (0.00%,100.00%)	[49920-50175]= 0 (0.00%,100.00%)
[1024- 1279]= 82325 (0.01%, 0.01%)	[17408-17663]= 72349 (0.01%, 99.91%)	[33792-34047]= 16 (0.00%,100.00%)	[50176-50431]= 0 (0.00%,100.00%)
[1280- 1535]= 1537273 (0.21%, 0.22%)	[17664-17919]= 61379 (0.01%, 99.91%)	[34048-34303]= 24 (0.00%,100.00%)	[50432-50687]= 0 (0.00%,100.00%)
[1536- 1791]=14573649 (1.97%, 2.19%)	[17920-18175]= 54389 (0.01%, 99.92%)	[34304-34559]= 21 (0.00%,100.00%)	[50688-50943]= 0 (0.00%,100.00%)
[1792- 2047]=29364177 (-1.83%, 6.15%)	[18176-18431]= 43396 (0.01%, 99.93%)	[34560-34815]= 11 (0.00%,100.00%)	[50944-51199]= 0 (0.00%,100.00%)
[2048- 2303]=31936348 (-1.49%, 10.46%)	[18432-18687]= 36662 (0.00%, 99.93%)	[34816-35071]= 12 (0.00%,100.00%)	[51200-51455]= 0 (0.00%,100.00%)
[2304- 2559]=37409078 (-0.75%, 15.51%)	[18688-18943]= 31268 (0.00%, 99.94%)	[35072-35327]= 13 (0.00%,100.00%)	[51456-51711]= 0 (0.00%,100.00%)
[2560- 2815]=41283843 (-0.22%, 21.08%)	[18944-19199]= 27734 (0.00%, 99.94%)	[35328-35583]= 5 (0.00%,100.00%)	[51712-51967]= 0 (0.00%,100.00%)
[2816- 3071]=52097641 (1.23%, 28.12%)	[19200-19455]= 25081 (0.00%, 99.94%)	[35584-35839]= 7 (0.00%,100.00%)	[51968-52223]= 0 (0.00%,100.00%)
[3072- 3327]=51846726 (1.20%, 35.12%)	[19456-19711]= 24030 (0.00%, 99.95%)	[35840-36095]= 8 (0.00%,100.00%)	[52224-52479]= 0 (0.00%,100.00%)
[3328- 3583]=47153213 (0.57%, 41.48%)	[19712-19967]= 22175 (0.00%, 99.95%)	[36096-36351]= 4 (0.00%,100.00%)	[52480-52735]= 0 (0.00%,100.00%)
[3584- 3839]=51399493 (1.14%, 48.42%)	[19968-20223]= 20399 (0.00%, 99.95%)	[36352-36607]= 4 (0.00%,100.00%)	[52736-52991]= 0 (0.00%,100.00%)
[3840- 4095]=55169640 (1.65%, 55.87%)	[20224-20479]= 19450 (0.00%, 99.95%)	[36608-36863]= 8 (0.00%,100.00%)	[52992-53247]= 0 (0.00%,100.00%)
[4096- 4351]=52720750 (1.32%, 62.99%)	[20480-20735]= 18169 (0.00%, 99.96%)	[36864-37119]= 5 (0.00%,100.00%)	[53248-53503]= 0 (0.00%,100.00%)
[4352- 4607]=40507986 (-0.33%, 68.45%)	[20736-20991]= 16726 (0.00%, 99.96%)	[37120-37375]= 4 (0.00%,100.00%)	[53504-53759]= 0 (0.00%,100.00%)
[4608- 4863]=27362353 (-2.10%, 72.15%)	[20992-21247]= 15862 (0.00%, 99.96%)	[37376-37631]= 0 (0.00%,100.00%)	[53760-54015]= 0 (0.00%,100.00%)
[4864- 5119]=19010440 (2.57%, 74.71%)	[21248-21503]= 15218 (0.00%, 99.96%)	[37632-37887]= 2 (0.00%,100.00%)	[54016-54271]= 0 (0.00%,100.00%)
[5120- 5375]=15262809 (2.06%, 76.77%)	[21504-21759]= 14810 (0.00%, 99.97%)	[37888-38143]= 2 (0.00%,100.00%)	[54272-54527]= 0 (0.00%,100.00%)
[5376- 5631]=14428140 (1.95%, 78.72%)	[21760-22015]= 13901 (0.00%, 99.97%)	[38144-38399]= 3 (0.00%,100.00%)	[54528-54783]= 0 (0.00%,100.00%)
[5632- 5887]=16203577 (2.19%, 80.91%)	[22016-22271]= 13716 (0.00%, 99.97%)	[38400-38655]= 1 (0.00%,100.00%)	[54784-55039]= 0 (0.00%,100.00%)
[5888- 6143]=19641405 (2.65%, 83.56%)	[22272-22527]= 13097 (0.00%, 99.97%)	[38656-38911]= 1 (0.00%,100.00%)	[55040-55295]= 0 (0.00%,100.00%)
[6144- 6399]=19830856 (2.68%, 86.24%)	[22528-22783]= 12883 (0.00%, 99.97%)	[38912-39167]= 1 (0.00%,100.00%)	[55296-55551]= 0 (0.00%,100.00%)
[6400- 6655]=16016106 (2.16%, 88.40%)	[22784-23039]= 12367 (0.00%, 99.97%)	[39168-39423]= 1 (0.00%,100.00%)	[55552-55807]= 0 (0.00%,100.00%)
[6656- 6911]=12597903 (1.70%, 90.10%)	[23040-23295]= 12139 (0.00%, 99.98%)	[39424-39679]= 8 (0.00%,100.00%)	[55808-56063]= 0 (0.00%,100.00%)
[6912- 7167]=10319593 (1.39%, 91.49%)	[23296-23551]= 11466 (0.00%, 99.98%)	[39680-39935]= 5 (0.00%,100.00%)	[56064-56319]= 0 (0.00%,100.00%)
[7168- 7423]= 8327905 (1.12%, 92.62%)	[23552-23807]= 10876 (0.00%, 99.98%)	[39936-40191]= 7 (0.00%,100.00%)	[56320-56575]= 0 (0.00%,100.00%)
[7424- 7679]= 6758652 (0.91%, 93.53%)	[23808-24063]= 10955 (0.00%, 99.98%)	[40192-40447]= 2 (0.00%,100.00%)	[56576-56831]= 0 (0.00%,100.00%)
[7680- 7935]= 5641610 (0.76%, 94.29%)	[24064-24319]= 10588 (0.00%, 99.98%)	[40448-40703]= 5 (0.00%,100.00%)	[56832-57087]= 0 (0.00%,100.00%)
[7936- 8191]= 4668502 (0.63%, 94.92%)	[24320-24575]= 10420 (0.00%, 99.98%)	[40704-40959]= 2 (0.00%,100.00%)	[57088-57343]= 0 (0.00%,100.00%)
[8192- 8447]= 3960608 (0.53%, 95.46%)	[24576-24831]= 9857 (0.00%, 99.98%)	[40960-41215]= 0 (0.00%,100.00%)	[57344-57599]= 0 (0.00%,100.00%)
[8448- 8703]= 3408917 (0.46%, 95.92%)	[24832-25087]= 9468 (0.00%, 99.99%)	[41216-41471]= 0 (0.00%,100.00%)	[57600-57855]= 0 (0.00%,100.00%)
[8704- 8959]= 3024274 (0.41%, 96.32%)	[25088-25343]= 8871 (0.00%, 99.99%)	[41472-41727]= 0 (0.00%,100.00%)	[57856-58111]= 0 (0.00%,100.00%)
[8960- 9215]= 2697009 (0.36%, 96.69%)	[25344-25599]= 8738 (0.00%, 99.99%)	[41728-41983]= 0 (0.00%,100.00%)	[58112-58367]= 0 (0.00%,100.00%)
[9216- 9471]= 2412045 (0.33%, 97.01%)	[25600-25855]= 8510 (0.00%, 99.99%)	[41984-42239]= 0 (0.00%,100.00%)	[58368-58623]= 0 (0.00%,100.00%)
[9472- 9727]= 2191951 (0.30%, 97.31%)	[25856-26111]= 8078 (0.00%, 99.99%)	[42240-42495]= 0 (0.00%,100.00%)	[58624-58879]= 0 (0.00%,100.00%)
[9728- 9983]= 1997501 (0.27%, 97.58%)	[26112-26367]= 7674 (0.00%, 99.99%)	[42496-42751]= 0 (0.00%,100.00%)	[58880-59135]= 0 (0.00%,100.00%)
[9984-10239]= 1785147 (0.24%, 97.82%)	[26368-26623]= 7216 (0.00%, 99.99%)	[42752-43007]= 0 (0.00%,100.00%)	[59136-59391]= 0 (0.00%,100.00%)
[10240-10495]= 1618383 (0.22%, 98.04%)	[26624-26879]= 6556 (0.00%, 99.99%)	[43008-43263]= 0 (0.00%,100.00%)	[59392-59647]= 0 (0.00%,100.00%)
[10496-10751]= 1475243 (0.20%, 98.24%)	[26880-27135]= 6286 (0.00%, 99.99%)	[43264-43519]= 0 (0.00%,100.00%)	[59648-59903]= 0 (0.00%,100.00%)
[10752-11007]= 1359554 (0.18%, 98.42%)	[27136-27391]= 5628 (0.00%,100.00%)	[43520-43775]= 0 (0.00%,100.00%)	[59904-60159]= 0 (0.00%,100.00%)
[11008-11263]= 1261760 (0.17%, 98.59%)	[27392-27647]= 4687 (0.00%,100.00%)	[43776-44031]= 0 (0.00%,100.00%)	[60160-60415]= 0 (0.00%,100.00%)
[11264-11519]= 1185668 (0.16%, 98.75%)	[27648-27903]= 4563 (0.00%,100.00%)	[44032-44287]= 0 (0.00%,100.00%)	[60416-60671]= 0 (0.00%,100.00%)
[11520-11775]= 1042952 (0.14%, 98.89%)	[27904-28159]= 3848 (0.00%,100.00%)	[44288-44543]= 0 (0.00%,100.00%)	[60672-60927]= 0 (0.00%,100.00%)
[11776-12031]= 867170 (0.12%, 99.01%)	[28160-28415]= 3528 (0.00%,100.00%)	[44544-44799]= 0 (0.00%,100.00%)	[60928-61183]= 0 (0.00%,100.00%)
[12032-12287]= 718017 (0.10%, 99.11%)	[28416-28671]= 3033 (0.00%,100.00%)	[44800-45055]= 0 (0.00%,100.00%)	[61184-61439]= 0 (0.00%,100.00%)
[12288-12543]= 611511 (0.08%, 99.19%)	[28672-28927]= 2661 (0.00%,100.00%)	[45056-45311]= 0 (0.00%,100.00%)	[61440-61695]= 0 (0.00%,100.00%)
[12544-12799]= 544260 (0.07%, 99.26%)	[28928-29183]= 2432 (0.00%,100.00%)	[45312-45567]= 0 (0.00%,100.00%)	[61696-61951]= 0 (0.00%,100.00%)
[12800-13055]= 484695 (0.07%, 99.33%)	[29184-29439]= 2234 (0.00%,100.00%)	[45568-45823]= 0 (0.00%,100.00%)	[61952-62207]= 0 (0.00%,100.00%)
[13056-13311]= 441595 (0.06%, 99.39%)	[29440-29695]= 1794 (0.00%,100.00%)	[45824-46079]= 0 (0.00%,100.00%)	[62208-62463]= 0 (0.00%,100.00%)
[13312-13567]= 412512 (0.06%, 99.44%)	[29696-29951]= 1485 (0.00%,100.00%)	[46080-46335]= 0 (0.00%,100.00%)	[62464-62719]= 0 (0.00%,100.00%)
[13568-13823]= 384969 (0.05%, 99.50%)	[29952-30207]= 1277 (0.00%,100.00%)	[46336-46591]= 0 (0.00%,100.00%)	[62720-62975]= 0 (0.00%,100.00%)
[13824-14079]= 351848 (0.05%, 99.54%)	[30208-30463]= 1059 (0.00%,100.00%)	[46592-46847]= 0 (0.00%,100.00%)	[62976-63231]= 0 (0.00%,100.00%)
[14080-14335]= 322474 (0.04%, 99.59%)	[30464-30719]= 987 (0.00%,100.00%)	[46848-47103]= 0 (0.00%,100.00%)	[63232-63487]= 0 (0.00%,100.00%)
[14336-14591]= 290426 (0.04%, 99.63%)	[30720-30975]= 686 (0.00%,100.00%)	[47104-47359]= 0 (0.00%,100.00%)	[63488-63743]= 0 (0.00%,100.00%)
[14592-14847]= 270370 (0.04%, 99.66%)	[30976-31231]= 591 (0.00%,100.00%)	[47360-47615]= 0 (0.00%,100.00%)	[63744-63999]= 0 (0.00%,100.00%)
[14848-15103]= 243863 (0.03%, 99.70%)	[31232-31487]= 475 (0.00%,100.00%)	[47616-47871]= 0 (0.00%,100.00%)	[64000-64255]= 0 (0.00%,100.00%)
[15104-15359]= 228816 (0.03%, 99.73%)	[31488-31743]= 348 (0.00%,100.00%)	[47872-48127]= 0 (0.00%,100.00%)	[64256-64511]= 0 (0.00%,100.00%)
[15360-15615]= 217227 (0.03%, 99.76%)	[31744-31999]= 267 (0.00%,100.00%)	[48128-48383]= 0 (0.00%,100.00%)	[64512-64767]= 0 (0.00%,100.00%)
[15616-15871]= 202318 (0.03%, 99.78%)	[32000-32255]= 229 (0.00%,100.00%)	[48384-48639]= 0 (0.00%,100.00%)	[64768-65023]= 0 (0.00%,100.00%)
[15872-16127]= 190428 (0.03%, 99.81%)	[32256-32511]= 126 (0.00%,100.00%)	[48640-48895]= 0 (0.00%,100.00%)	[65024-65279]= 0 (0.00%,100.00%)
[16128-16383]= 169993 (0.02%, 99.83%)	[32512-32767]= 127 (0.00%,100.00%)	[48896-49151]= 0 (0.00%,100.00%)	[65280-65535]= 0 (0.00%,100.00%)

band 5

```
FILE world.syn-radiance-repl.1+2+3+4.5

TOTAL NUMBER OF PIXELS =   800000000
BACKGROUND FLAG        = "YES"
IMAGE PIXELS           =   740734281 (92.59%)
BACKGROUND PIXELS      =    59265719 ( 7.41%)
BACKGROUND VALUE       =           0
MINIMUM                =         584
MAXIMUM                =       44664
LEFT  BOUND 2%         =        1183
RIGHT BOUND 2%         =       11532
MEAN                   =    3690.053
VARIANCE               = 6601510.827
STANDARD DEVIATION     =    2569.341
```

```
HISTOGRAM (step=512)
323861 |   *
       |   *
       |   *
       |   *
       |   *
269884 |   *
       |   *
       |   *
       |   ***
       |   ***
215907 |   ***
       |   ***
       |  ****
       |  ****
       |  ****
161931 |  ****
       |  ****
       |  *****
       |  *****
       |  *****
107954 |  *****
       |  *****
       |  *****
       |  ******  *
       |  ****** ***
 53977 |  **********
       |  ***********
       |  ************
       | **************
       | ******************
     0 ++---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+-------
                5120      10240     15360     20480     25600     30720     35840     40960     46080     51200     56320     61440
```

[0- 255]= 0 (0.00%, 0.00%)	[16384-16639]= 179930 (0.02%, 99.81%)	[32768-33023]= 982 (0.00%,100.00%)	[49152-49407]= 0 (0.00%,100.00%)
[256- 511]= 0 (0.00%, 0.00%)	[16640-16895]= 154340 (0.02%, 99.83%)	[33024-33279]= 905 (0.00%,100.00%)	[49408-49663]= 0 (0.00%,100.00%)
[512- 767]= 34556 (0.00%, 0.00%)	[16896-17151]= 130189 (0.02%, 99.85%)	[33280-33535]= 704 (0.00%,100.00%)	[49664-49919]= 0 (0.00%,100.00%)
[768- 1023]= 2240902 (0.30%, 0.31%)	[17152-17407]= 108963 (0.01%, 99.86%)	[33536-33791]= 575 (0.00%,100.00%)	[49920-50175]= 0 (0.00%,100.00%)
[1024- 1279]=26256326 (-2.25%, 3.85%)	[17408-17663]= 92460 (0.01%, 99.88%)	[33792-34047]= 468 (0.00%,100.00%)	[50176-50431]= 0 (0.00%,100.00%)
[1280- 1535]=44964890 (0.27%, 9.92%)	[17664-17919]= 81428 (0.01%, 99.89%)	[34048-34303]= 411 (0.00%,100.00%)	[50432-50687]= 0 (0.00%,100.00%)
[1536- 1791]=69526591 (-2.21%, 19.31%)	[17920-18175]= 70470 (0.01%, 99.90%)	[34304-34559]= 289 (0.00%,100.00%)	[50688-50943]= 0 (0.00%,100.00%)
[1792- 2047]=69974528 (-2.15%, 28.75%)	[18176-18431]= 58452 (0.01%, 99.90%)	[34560-34815]= 273 (0.00%,100.00%)	[50944-51199]= 0 (0.00%,100.00%)
[2048- 2303]=50894012 (1.07%, 35.63%)	[18432-18687]= 48043 (0.01%, 99.91%)	[34816-35071]= 183 (0.00%,100.00%)	[51200-51455]= 0 (0.00%,100.00%)
[2304- 2559]=56782704 (1.87%, 43.29%)	[18688-18943]= 40674 (0.01%, 99.92%)	[35072-35327]= 146 (0.00%,100.00%)	[51456-51711]= 0 (0.00%,100.00%)
[2560- 2815]=58907214 (2.15%, 51.24%)	[18944-19199]= 35453 (0.00%, 99.92%)	[35328-35583]= 125 (0.00%,100.00%)	[51712-51967]= 0 (0.00%,100.00%)
[2816- 3071]=45649375 (0.36%, 57.41%)	[19200-19455]= 32151 (0.00%, 99.93%)	[35584-35839]= 84 (0.00%,100.00%)	[51968-52223]= 0 (0.00%,100.00%)
[3072- 3327]=30695510 (-1.65%, 61.55%)	[19456-19711]= 28124 (0.00%, 99.93%)	[35840-36095]= 74 (0.00%,100.00%)	[52224-52479]= 0 (0.00%,100.00%)
[3328- 3583]=22117940 (-2.81%, 64.54%)	[19712-19967]= 25462 (0.00%, 99.93%)	[36096-36351]= 65 (0.00%,100.00%)	[52480-52735]= 0 (0.00%,100.00%)
[3584- 3839]=18017480 (2.43%, 66.97%)	[19968-20223]= 22874 (0.00%, 99.94%)	[36352-36607]= 36 (0.00%,100.00%)	[52736-52991]= 0 (0.00%,100.00%)
[3840- 4095]=15808518 (2.13%, 69.10%)	[20224-20479]= 21539 (0.00%, 99.94%)	[36608-36863]= 30 (0.00%,100.00%)	[52992-53247]= 0 (0.00%,100.00%)
[4096- 4351]=14633382 (1.98%, 71.08%)	[20480-20735]= 20443 (0.00%, 99.94%)	[36864-37119]= 23 (0.00%,100.00%)	[53248-53503]= 0 (0.00%,100.00%)
[4352- 4607]=14523380 (1.96%, 73.04%)	[20736-20991]= 19391 (0.00%, 99.94%)	[37120-37375]= 25 (0.00%,100.00%)	[53504-53759]= 0 (0.00%,100.00%)
[4608- 4863]=15272607 (2.06%, 75.10%)	[20992-21247]= 18412 (0.00%, 99.95%)	[37376-37631]= 28 (0.00%,100.00%)	[53760-54015]= 0 (0.00%,100.00%)
[4864- 5119]=17007290 (2.30%, 77.40%)	[21248-21503]= 16932 (0.00%, 99.95%)	[37632-37887]= 33 (0.00%,100.00%)	[54016-54271]= 0 (0.00%,100.00%)
[5120- 5375]=19042256 (2.57%, 79.97%)	[21504-21759]= 16147 (0.00%, 99.95%)	[37888-38143]= 13 (0.00%,100.00%)	[54272-54527]= 0 (0.00%,100.00%)
[5376- 5631]=19026861 (2.57%, 82.54%)	[21760-22015]= 15602 (0.00%, 99.95%)	[38144-38399]= 17 (0.00%,100.00%)	[54528-54783]= 0 (0.00%,100.00%)
[5632- 5887]=16276157 (2.20%, 84.73%)	[22016-22271]= 15054 (0.00%, 99.96%)	[38400-38655]= 9 (0.00%,100.00%)	[54784-55039]= 0 (0.00%,100.00%)
[5888- 6143]=13410821 (1.81%, 86.54%)	[22272-22527]= 14494 (0.00%, 99.96%)	[38656-38911]= 9 (0.00%,100.00%)	[55040-55295]= 0 (0.00%,100.00%)
[6144- 6399]=11075996 (1.50%, 88.04%)	[22528-22783]= 14276 (0.00%, 99.96%)	[38912-39167]= 6 (0.00%,100.00%)	[55296-55551]= 0 (0.00%,100.00%)
[6400- 6655]= 9446634 (1.28%, 89.31%)	[22784-23039]= 13902 (0.00%, 99.96%)	[39168-39423]= 7 (0.00%,100.00%)	[55552-55807]= 0 (0.00%,100.00%)
[6656- 6911]= 7954003 (1.07%, 90.39%)	[23040-23295]= 13795 (0.00%, 99.96%)	[39424-39679]= 2 (0.00%,100.00%)	[55808-56063]= 0 (0.00%,100.00%)
[6912- 7167]= 6685878 (0.90%, 91.29%)	[23296-23551]= 12974 (0.00%, 99.96%)	[39680-39935]= 5 (0.00%,100.00%)	[56064-56319]= 0 (0.00%,100.00%)
[7168- 7423]= 5705986 (0.77%, 92.06%)	[23552-23807]= 12798 (0.00%, 99.97%)	[39936-40191]= 4 (0.00%,100.00%)	[56320-56575]= 0 (0.00%,100.00%)
[7424- 7679]= 4941327 (0.67%, 92.73%)	[23808-24063]= 12470 (0.00%, 99.97%)	[40192-40447]= 3 (0.00%,100.00%)	[56576-56831]= 0 (0.00%,100.00%)
[7680- 7935]= 4316255 (0.58%, 93.31%)	[24064-24319]= 12277 (0.00%, 99.97%)	[40448-40703]= 9 (0.00%,100.00%)	[56832-57087]= 0 (0.00%,100.00%)
[7936- 8191]= 3832671 (0.52%, 93.83%)	[24320-24575]= 11700 (0.00%, 99.97%)	[40704-40959]= 3 (0.00%,100.00%)	[57088-57343]= 0 (0.00%,100.00%)
[8192- 8447]= 3469672 (0.47%, 94.30%)	[24576-24831]= 11423 (0.00%, 99.97%)	[40960-41215]= 1 (0.00%,100.00%)	[57344-57599]= 0 (0.00%,100.00%)
[8448- 8703]= 3214709 (0.43%, 94.73%)	[24832-25087]= 11209 (0.00%, 99.97%)	[41216-41471]= 1 (0.00%,100.00%)	[57600-57855]= 0 (0.00%,100.00%)
[8704- 8959]= 2969871 (0.40%, 95.13%)	[25088-25343]= 10992 (0.00%, 99.98%)	[41472-41727]= 0 (0.00%,100.00%)	[57856-58111]= 0 (0.00%,100.00%)
[8960- 9215]= 2772541 (0.37%, 95.51%)	[25344-25599]= 10584 (0.00%, 99.98%)	[41728-41983]= 3 (0.00%,100.00%)	[58112-58367]= 0 (0.00%,100.00%)
[9216- 9471]= 2589870 (0.35%, 95.86%)	[25600-25855]= 10452 (0.00%, 99.98%)	[41984-42239]= 2 (0.00%,100.00%)	[58368-58623]= 0 (0.00%,100.00%)
[9472- 9727]= 2424664 (0.33%, 96.18%)	[25856-26111]= 10030 (0.00%, 99.98%)	[42240-42495]= 3 (0.00%,100.00%)	[58624-58879]= 0 (0.00%,100.00%)
[9728- 9983]= 2268520 (0.31%, 96.49%)	[26112-26367]= 9882 (0.00%, 99.98%)	[42496-42751]= 0 (0.00%,100.00%)	[58880-59135]= 0 (0.00%,100.00%)
[9984-10239]= 2133481 (0.29%, 96.78%)	[26368-26623]= 9575 (0.00%, 99.98%)	[42752-43007]= 1 (0.00%,100.00%)	[59136-59391]= 0 (0.00%,100.00%)
[10240-10495]= 2017761 (0.27%, 97.05%)	[26624-26879]= 9378 (0.00%, 99.98%)	[43008-43263]= 4 (0.00%,100.00%)	[59392-59647]= 0 (0.00%,100.00%)
[10496-10751]= 1910833 (0.26%, 97.31%)	[26880-27135]= 9156 (0.00%, 99.99%)	[43264-43519]= 6 (0.00%,100.00%)	[59648-59903]= 0 (0.00%,100.00%)
[10752-11007]= 1787042 (0.24%, 97.55%)	[27136-27391]= 9011 (0.00%, 99.99%)	[43520-43775]= 4 (0.00%,100.00%)	[59904-60159]= 0 (0.00%,100.00%)
[11008-11263]= 1685717 (0.23%, 97.78%)	[27392-27647]= 8389 (0.00%, 99.99%)	[43776-44031]= 8 (0.00%,100.00%)	[60160-60415]= 0 (0.00%,100.00%)
[11264-11519]= 1579595 (0.21%, 97.99%)	[27648-27903]= 8116 (0.00%, 99.99%)	[44032-44287]= 1 (0.00%,100.00%)	[60416-60671]= 0 (0.00%,100.00%)
[11520-11775]= 1496477 (0.20%, 98.19%)	[27904-28159]= 7899 (0.00%, 99.99%)	[44288-44543]= 3 (0.00%,100.00%)	[60672-60927]= 0 (0.00%,100.00%)
[11776-12031]= 1396276 (0.19%, 98.38%)	[28160-28415]= 7722 (0.00%, 99.99%)	[44544-44799]= 4 (0.00%,100.00%)	[60928-61183]= 0 (0.00%,100.00%)
[12032-12287]= 1271210 (0.17%, 98.55%)	[28416-28671]= 7010 (0.00%, 99.99%)	[44800-45055]= 0 (0.00%,100.00%)	[61184-61439]= 0 (0.00%,100.00%)
[12288-12543]= 1141591 (0.15%, 98.71%)	[28672-28927]= 6291 (0.00%, 99.99%)	[45056-45311]= 0 (0.00%,100.00%)	[61440-61695]= 0 (0.00%,100.00%)
[12544-12799]= 1019163 (0.14%, 98.84%)	[28928-29183]= 6068 (0.00%, 99.99%)	[45312-45567]= 0 (0.00%,100.00%)	[61696-61951]= 0 (0.00%,100.00%)
[12800-13055]= 899374 (0.12%, 98.97%)	[29184-29439]= 5490 (0.00%, 99.99%)	[45568-45823]= 0 (0.00%,100.00%)	[61952-62207]= 0 (0.00%,100.00%)
[13056-13311]= 816172 (0.11%, 99.08%)	[29440-29695]= 5004 (0.00%, 99.99%)	[45824-46079]= 0 (0.00%,100.00%)	[62208-62463]= 0 (0.00%,100.00%)
[13312-13567]= 742164 (0.10%, 99.18%)	[29696-29951]= 4583 (0.00%,100.00%)	[46080-46335]= 0 (0.00%,100.00%)	[62464-62719]= 0 (0.00%,100.00%)
[13568-13823]= 681871 (0.09%, 99.27%)	[29952-30207]= 4054 (0.00%,100.00%)	[46336-46591]= 0 (0.00%,100.00%)	[62720-62975]= 0 (0.00%,100.00%)
[13824-14079]= 618408 (0.08%, 99.35%)	[30208-30463]= 3861 (0.00%,100.00%)	[46592-46847]= 0 (0.00%,100.00%)	[62976-63231]= 0 (0.00%,100.00%)
[14080-14335]= 551833 (0.07%, 99.43%)	[30464-30719]= 3334 (0.00%,100.00%)	[46848-47103]= 0 (0.00%,100.00%)	[63232-63487]= 0 (0.00%,100.00%)
[14336-14591]= 484560 (0.07%, 99.49%)	[30720-30975]= 3215 (0.00%,100.00%)	[47104-47359]= 0 (0.00%,100.00%)	[63488-63743]= 0 (0.00%,100.00%)
[14592-14847]= 428613 (0.06%, 99.55%)	[30976-31231]= 2887 (0.00%,100.00%)	[47360-47615]= 0 (0.00%,100.00%)	[63744-63999]= 0 (0.00%,100.00%)
[14848-15103]= 381266 (0.05%, 99.60%)	[31232-31487]= 2481 (0.00%,100.00%)	[47616-47871]= 0 (0.00%,100.00%)	[64000-64255]= 0 (0.00%,100.00%)
[15104-15359]= 341793 (0.05%, 99.65%)	[31488-31743]= 2161 (0.00%,100.00%)	[47872-48127]= 0 (0.00%,100.00%)	[64256-64511]= 0 (0.00%,100.00%)
[15360-15615]= 307211 (0.04%, 99.69%)	[31744-31999]= 1812 (0.00%,100.00%)	[48128-48383]= 0 (0.00%,100.00%)	[64512-64767]= 0 (0.00%,100.00%)
[15616-15871]= 276146 (0.04%, 99.73%)	[32000-32255]= 1588 (0.00%,100.00%)	[48384-48639]= 0 (0.00%,100.00%)	[64768-65023]= 0 (0.00%,100.00%)
[15872-16127]= 239948 (0.03%, 99.76%)	[32256-32511]= 1412 (0.00%,100.00%)	[48640-48895]= 0 (0.00%,100.00%)	[65024-65279]= 0 (0.00%,100.00%)
[16128-16383]= 210685 (0.03%, 99.79%)	[32512-32767]= 1319 (0.00%,100.00%)	[48896-49151]= 0 (0.00%,100.00%)	[65280-65535]= 0 (0.00%,100.00%)

band 7

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FILE world.syn-radiance-repl.1+2+3+4.7

TOTAL NUMBER OF PIXELS =   800000000
BACKGROUND FLAG        = "YES"
IMAGE PIXELS           =   740734281 (92.59%)
BACKGROUND PIXELS      =    59265719 ( 7.41%)
BACKGROUND VALUE       =           0
MINIMUM                =         371
MAXIMUM                =       53157
LEFT  BOUND 2%         =         849
RIGHT BOUND 2%         =       16126
MEAN                   =    3807.553
VARIANCE               = 15524514.636
STANDARD DEVIATION     =    3940.116
```

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HISTOGRAM (step=512)
532059 |  *
       |  *
       |  *
       |  *
       | **
443383 | **
       | **
       | **
       | **
       | **
354706 | **
       | **
       | **
       | ***
       | ***
266030 | ***
       | ***
       | ***
       | ***
       | ***
177353 | ***
       | ***
       | ****
       | ****
       | ****
 88677 | ****
       | ****
       | *****
       | ******    *****
       | *****************
     0 ++---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+-------
                5120     10240     15360     20480     25600     30720     35840     40960     46080     51200     56320     61440
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[0- 255]= 0 (0.00%, 0.00%)	[16384-16639]= 645290 (0.09%, 98.18%)	[32768-33023]= 7137 (0.00%, 99.99%)	[49152-49407]= 0 (0.00%,100.00%)
[256- 511]= 17099 (0.00%, 0.00%)	[16640-16895]= 631328 (0.09%, 98.26%)	[33024-33279]= 7023 (0.00%, 99.99%)	[49408-49663]= 2 (0.00%,100.00%)
[512- 767]= 4481621 (0.61%, 0.61%)	[16896-17151]= 606470 (0.08%, 98.34%)	[33280-33535]= 6687 (0.00%, 99.99%)	[49664-49919]= 3 (0.00%,100.00%)
[768- 1023]= 65524416 (-2.75%, 9.45%)	[17152-17407]= 582583 (0.08%, 98.42%)	[33536-33791]= 6428 (0.00%, 99.99%)	[49920-50175]= 1 (0.00%,100.00%)
[1024- 1279]=119684609 (-1.24%, 25.61%)	[17408-17663]= 558906 (0.08%, 98.50%)	[33792-34047]= 6304 (0.00%, 99.99%)	[50176-50431]= 2 (0.00%,100.00%)
[1280- 1535]= 85214177 (-0.09%, 37.11%)	[17664-17919]= 543947 (0.07%, 98.57%)	[34048-34303]= 5821 (0.00%, 99.99%)	[50432-50687]= 1 (0.00%,100.00%)
[1536- 1791]= 74491786 (-1.54%, 47.17%)	[17920-18175]= 532379 (0.07%, 98.64%)	[34304-34559]= 5791 (0.00%, 99.99%)	[50688-50943]= 1 (0.00%,100.00%)
[1792- 2047]= 49779651 (0.92%, 53.89%)	[18176-18431]= 513181 (0.07%, 98.71%)	[34560-34815]= 5517 (0.00%, 99.99%)	[50944-51199]= 1 (0.00%,100.00%)
[2048- 2303]= 28904649 (-1.90%, 57.79%)	[18432-18687]= 497855 (0.07%, 98.78%)	[34816-35071]= 5066 (0.00%, 99.99%)	[51200-51455]= 4 (0.00%,100.00%)
[2304- 2559]= 18715590 (2.53%, 60.32%)	[18688-18943]= 483178 (0.07%, 98.85%)	[35072-35327]= 4982 (0.00%, 99.99%)	[51456-51711]= 4 (0.00%,100.00%)
[2560- 2815]= 13946426 (1.88%, 62.20%)	[18944-19199]= 470525 (0.06%, 98.91%)	[35328-35583]= 4368 (0.00%, 99.99%)	[51712-51967]= 5 (0.00%,100.00%)
[2816- 3071]= 11241704 (1.52%, 63.72%)	[19200-19455]= 460047 (0.06%, 98.97%)	[35584-35839]= 4066 (0.00%,100.00%)	[51968-52223]= 6 (0.00%,100.00%)
[3072- 3327]= 9724815 (1.31%, 65.03%)	[19456-19711]= 445514 (0.06%, 99.03%)	[35840-36095]= 3828 (0.00%,100.00%)	[52224-52479]= 3 (0.00%,100.00%)
[3328- 3583]= 8866204 (1.20%, 66.23%)	[19712-19967]= 430399 (0.06%, 99.09%)	[36096-36351]= 3415 (0.00%,100.00%)	[52480-52735]= 1 (0.00%,100.00%)
[3584- 3839]= 8410127 (1.14%, 67.37%)	[19968-20223]= 417881 (0.06%, 99.15%)	[36352-36607]= 3206 (0.00%,100.00%)	[52736-52991]= 3 (0.00%,100.00%)
[3840- 4095]= 8094798 (1.09%, 68.46%)	[20224-20479]= 406056 (0.05%, 99.20%)	[36608-36863]= 2949 (0.00%,100.00%)	[52992-53247]= 4 (0.00%,100.00%)
[4096- 4351]= 7903053 (1.07%, 69.53%)	[20480-20735]= 394258 (0.05%, 99.25%)	[36864-37119]= 2504 (0.00%,100.00%)	[53248-53503]= 0 (0.00%,100.00%)
[4352- 4607]= 7794108 (1.05%, 70.58%)	[20736-20991]= 384502 (0.05%, 99.31%)	[37120-37375]= 2363 (0.00%,100.00%)	[53504-53759]= 0 (0.00%,100.00%)
[4608- 4863]= 7782554 (1.05%, 71.63%)	[20992-21247]= 370180 (0.05%, 99.36%)	[37376-37631]= 2249 (0.00%,100.00%)	[53760-54015]= 0 (0.00%,100.00%)
[4864- 5119]= 7858297 (1.06%, 72.69%)	[21248-21503]= 353322 (0.05%, 99.40%)	[37632-37887]= 2100 (0.00%,100.00%)	[54016-54271]= 0 (0.00%,100.00%)
[5120- 5375]= 8118566 (1.10%, 73.79%)	[21504-21759]= 336568 (0.05%, 99.45%)	[37888-38143]= 1772 (0.00%,100.00%)	[54272-54527]= 0 (0.00%,100.00%)
[5376- 5631]= 8566440 (1.16%, 74.94%)	[21760-22015]= 320149 (0.04%, 99.49%)	[38144-38399]= 1500 (0.00%,100.00%)	[54528-54783]= 0 (0.00%,100.00%)
[5632- 5887]= 9119725 (1.23%, 76.17%)	[22016-22271]= 306188 (0.04%, 99.53%)	[38400-38655]= 1479 (0.00%,100.00%)	[54784-55039]= 0 (0.00%,100.00%)
[5888- 6143]= 9794489 (1.32%, 77.50%)	[22272-22527]= 291685 (0.04%, 99.57%)	[38656-38911]= 1198 (0.00%,100.00%)	[55040-55295]= 0 (0.00%,100.00%)
[6144- 6399]= 10644560 (1.44%, 78.93%)	[22528-22783]= 280464 (0.04%, 99.61%)	[38912-39167]= 1102 (0.00%,100.00%)	[55296-55551]= 0 (0.00%,100.00%)
[6400- 6655]= 11440578 (1.54%, 80.48%)	[22784-23039]= 260995 (0.04%, 99.65%)	[39168-39423]= 965 (0.00%,100.00%)	[55552-55807]= 0 (0.00%,100.00%)
[6656- 6911]= 11848239 (1.60%, 82.08%)	[23040-23295]= 241191 (0.03%, 99.68%)	[39424-39679]= 911 (0.00%,100.00%)	[55808-56063]= 0 (0.00%,100.00%)
[6912- 7167]= 11612606 (1.57%, 83.64%)	[23296-23551]= 228088 (0.03%, 99.71%)	[39680-39935]= 748 (0.00%,100.00%)	[56064-56319]= 0 (0.00%,100.00%)
[7168- 7423]= 10855804 (1.47%, 85.11%)	[23552-23807]= 214815 (0.03%, 99.74%)	[39936-40191]= 600 (0.00%,100.00%)	[56320-56575]= 0 (0.00%,100.00%)
[7424- 7679]= 9809236 (1.32%, 86.43%)	[23808-24063]= 192171 (0.03%, 99.76%)	[40192-40447]= 541 (0.00%,100.00%)	[56576-56831]= 0 (0.00%,100.00%)
[7680- 7935]= 8641881 (1.17%, 87.60%)	[24064-24319]= 167485 (0.02%, 99.79%)	[40448-40703]= 440 (0.00%,100.00%)	[56832-57087]= 0 (0.00%,100.00%)
[7936- 8191]= 7599034 (1.03%, 88.63%)	[24320-24575]= 147731 (0.02%, 99.81%)	[40704-40959]= 333 (0.00%,100.00%)	[57088-57343]= 0 (0.00%,100.00%)
[8192- 8447]= 6648367 (0.90%, 89.52%)	[24576-24831]= 131533 (0.02%, 99.82%)	[40960-41215]= 310 (0.00%,100.00%)	[57344-57599]= 0 (0.00%,100.00%)
[8448- 8703]= 5844711 (0.79%, 90.31%)	[24832-25087]= 117741 (0.02%, 99.84%)	[41216-41471]= 262 (0.00%,100.00%)	[57600-57855]= 0 (0.00%,100.00%)
[8704- 8959]= 5106058 (0.69%, 91.00%)	[25088-25343]= 107615 (0.01%, 99.86%)	[41472-41727]= 211 (0.00%,100.00%)	[57856-58111]= 0 (0.00%,100.00%)
[8960- 9215]= 4489761 (0.61%, 91.61%)	[25344-25599]= 98071 (0.01%, 99.87%)	[41728-41983]= 184 (0.00%,100.00%)	[58112-58367]= 0 (0.00%,100.00%)
[9216- 9471]= 3975808 (0.54%, 92.15%)	[25600-25855]= 92423 (0.01%, 99.88%)	[41984-42239]= 143 (0.00%,100.00%)	[58368-58623]= 0 (0.00%,100.00%)
[9472- 9727]= 3544434 (0.48%, 92.62%)	[25856-26111]= 88973 (0.01%, 99.89%)	[42240-42495]= 93 (0.00%,100.00%)	[58624-58879]= 0 (0.00%,100.00%)
[9728- 9983]= 3211250 (0.43%, 93.06%)	[26112-26367]= 82218 (0.01%, 99.90%)	[42496-42751]= 76 (0.00%,100.00%)	[58880-59135]= 0 (0.00%,100.00%)
[9984-10239]= 2909941 (0.39%, 93.45%)	[26368-26623]= 73281 (0.01%, 99.91%)	[42752-43007]= 76 (0.00%,100.00%)	[59136-59391]= 0 (0.00%,100.00%)
[10240-10495]= 2645900 (0.36%, 93.81%)	[26624-26879]= 64810 (0.01%, 99.92%)	[43008-43263]= 71 (0.00%,100.00%)	[59392-59647]= 0 (0.00%,100.00%)
[10496-10751]= 2452496 (0.33%, 94.14%)	[26880-27135]= 56831 (0.01%, 99.93%)	[43264-43519]= 51 (0.00%,100.00%)	[59648-59903]= 0 (0.00%,100.00%)
[10752-11007]= 2255057 (0.30%, 94.44%)	[27136-27391]= 49012 (0.01%, 99.94%)	[43520-43775]= 46 (0.00%,100.00%)	[59904-60159]= 0 (0.00%,100.00%)
[11008-11263]= 2103979 (0.28%, 94.73%)	[27392-27647]= 42375 (0.01%, 99.94%)	[43776-44031]= 34 (0.00%,100.00%)	[60160-60415]= 0 (0.00%,100.00%)
[11264-11519]= 1994036 (0.27%, 95.00%)	[27648-27903]= 36333 (0.00%, 99.95%)	[44032-44287]= 25 (0.00%,100.00%)	[60416-60671]= 0 (0.00%,100.00%)
[11520-11775]= 1886073 (0.25%, 95.25%)	[27904-28159]= 29371 (0.00%, 99.95%)	[44288-44543]= 34 (0.00%,100.00%)	[60672-60927]= 0 (0.00%,100.00%)
[11776-12031]= 1785289 (0.24%, 95.49%)	[28160-28415]= 25326 (0.00%, 99.95%)	[44544-44799]= 19 (0.00%,100.00%)	[60928-61183]= 0 (0.00%,100.00%)
[12032-12287]= 1688681 (0.23%, 95.72%)	[28416-28671]= 22695 (0.00%, 99.96%)	[44800-45055]= 19 (0.00%,100.00%)	[61184-61439]= 0 (0.00%,100.00%)
[12288-12543]= 1617792 (0.22%, 95.94%)	[28672-28927]= 21798 (0.00%, 99.96%)	[45056-45311]= 21 (0.00%,100.00%)	[61440-61695]= 0 (0.00%,100.00%)
[12544-12799]= 1549229 (0.21%, 96.15%)	[28928-29183]= 20549 (0.00%, 99.96%)	[45312-45567]= 19 (0.00%,100.00%)	[61696-61951]= 0 (0.00%,100.00%)
[12800-13055]= 1459277 (0.20%, 96.34%)	[29184-29439]= 19654 (0.00%, 99.97%)	[45568-45823]= 9 (0.00%,100.00%)	[61952-62207]= 0 (0.00%,100.00%)
[13056-13311]= 1362767 (0.18%, 96.53%)	[29440-29695]= 18241 (0.00%, 99.97%)	[45824-46079]= 4 (0.00%,100.00%)	[62208-62463]= 0 (0.00%,100.00%)
[13312-13567]= 1283055 (0.17%, 96.70%)	[29696-29951]= 16138 (0.00%, 99.97%)	[46080-46335]= 7 (0.00%,100.00%)	[62464-62719]= 0 (0.00%,100.00%)
[13568-13823]= 1207067 (0.16%, 96.86%)	[29952-30207]= 14393 (0.00%, 99.97%)	[46336-46591]= 6 (0.00%,100.00%)	[62720-62975]= 0 (0.00%,100.00%)
[13824-14079]= 1148096 (0.15%, 97.02%)	[30208-30463]= 13013 (0.00%, 99.97%)	[46592-46847]= 7 (0.00%,100.00%)	[62976-63231]= 0 (0.00%,100.00%)
[14080-14335]= 1085706 (0.15%, 97.17%)	[30464-30719]= 11859 (0.00%, 99.98%)	[46848-47103]= 4 (0.00%,100.00%)	[63232-63487]= 0 (0.00%,100.00%)
[14336-14591]= 1058290 (0.14%, 97.31%)	[30720-30975]= 10809 (0.00%, 99.98%)	[47104-47359]= 3 (0.00%,100.00%)	[63488-63743]= 0 (0.00%,100.00%)
[14592-14847]= 1020157 (0.14%, 97.45%)	[30976-31231]= 10138 (0.00%, 99.98%)	[47360-47615]= 6 (0.00%,100.00%)	[63744-63999]= 0 (0.00%,100.00%)
[14848-15103]= 959182 (0.13%, 97.58%)	[31232-31487]= 9568 (0.00%, 99.98%)	[47616-47871]= 5 (0.00%,100.00%)	[64000-64255]= 0 (0.00%,100.00%)
[15104-15359]= 885985 (0.12%, 97.70%)	[31488-31743]= 8746 (0.00%, 99.98%)	[47872-48127]= 4 (0.00%,100.00%)	[64256-64511]= 0 (0.00%,100.00%)
[15360-15615]= 807286 (0.11%, 97.80%)	[31744-31999]= 8127 (0.00%, 99.98%)	[48128-48383]= 5 (0.00%,100.00%)	[64512-64767]= 0 (0.00%,100.00%)
[15616-15871]= 749612 (0.10%, 97.91%)	[32000-32255]= 7772 (0.00%, 99.98%)	[48384-48639]= 1 (0.00%,100.00%)	[64768-65023]= 0 (0.00%,100.00%)
[15872-16127]= 702067 (0.09%, 98.00%)	[32256-32511]= 7745 (0.00%, 99.98%)	[48640-48895]= 1 (0.00%,100.00%)	[65024-65279]= 0 (0.00%,100.00%)
[16128-16383]= 664860 (0.09%, 98.09%)	[32512-32767]= 7490 (0.00%, 99.99%)	[48896-49151]= 1 (0.00%,100.00%)	[65280-65535]= 0 (0.00%,100.00%)

band 13

```
FILE world.syn-radiance-repl.1+2+3+4.13

TOTAL NUMBER OF PIXELS =   800000000
BACKGROUND FLAG        = "YES"
IMAGE PIXELS           =   740655636 (92.58%)
BACKGROUND PIXELS      =    59344364 ( 7.42%)
BACKGROUND VALUE       =           0
MINIMUM                =           1
MAXIMUM                =       63008
LEFT  BOUND 2%         =         448
RIGHT BOUND 2%         =       22714
MEAN                   =    5160.852
VARIANCE               = 40395255.690
STANDARD DEVIATION     =    6355.726
```

```
HISTOGRAM (step=512)
687689 | *
       | *
       | *
       | *
       |**
573074 |**
       |**
       |**
       |**
       |**
458459 |**
       |**
       |**
       |**
       |**
343845 |**
       |**
       |***
       |***
       |***
229230 |***
       |***
       |***
       |***
       |***
114615 |***
       |***
       |****
       |****
       |*****        *********
     0 ++---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+---------+-------
               5120      10240     15360     20480     25600     30720     35840     40960     46080     51200     56320     61440
```

```
[    0-  255]=     5170 ( 0.00%,  0.00%)  [16384-16639]=  2375479 ( 0.32%, 93.86%)  [32768-33023]=   182184 ( 0.02%, 99.65%)  [49152-49407]=      111 ( 0.00%,100.00%)
[  256-  511]= 46662320 ( 0.50%,  6.30%)  [16640-16895]=  2285548 ( 0.31%, 94.17%)  [33024-33279]=   174644 ( 0.02%, 99.67%)  [49408-49663]=       85 ( 0.00%,100.00%)
[  512-  767]=163441007 (-1.13%, 28.37%)  [16896-17151]=  2194820 ( 0.30%, 94.46%)  [33280-33535]=   167095 ( 0.02%, 99.69%)  [49664-49919]=       61 ( 0.00%,100.00%)
[  768- 1023]=108923798 (-2.69%, 43.07%)  [17152-17407]=  2115277 ( 0.29%, 94.75%)  [33536-33791]=   160839 ( 0.02%, 99.71%)  [49920-50175]=       56 ( 0.00%,100.00%)
[ 1024- 1279]= 56953846 ( 1.89%, 50.76%)  [17408-17663]=  2035981 ( 0.27%, 95.03%)  [33792-34047]=   154216 ( 0.02%, 99.73%)  [50176-50431]=       42 ( 0.00%,100.00%)
[ 1280- 1535]= 28388321 (-1.97%, 54.60%)  [17664-17919]=  1963894 ( 0.27%, 95.29%)  [34048-34303]=   149834 ( 0.02%, 99.76%)  [50432-50687]=       34 ( 0.00%,100.00%)
[ 1536- 1791]= 15686610 ( 2.12%, 56.71%)  [17920-18175]=  1868929 ( 0.25%, 95.54%)  [34304-34559]=   146301 ( 0.02%, 99.77%)  [50688-50943]=       33 ( 0.00%,100.00%)
[ 1792- 2047]=  9598075 ( 1.30%, 58.01%)  [18176-18431]=  1758365 ( 0.24%, 95.78%)  [34560-34815]=   139779 ( 0.02%, 99.79%)  [50944-51199]=       28 ( 0.00%,100.00%)
[ 2048- 2303]=  6348332 ( 0.86%, 58.87%)  [18432-18687]=  1613056 ( 0.22%, 96.00%)  [34816-35071]=   129324 ( 0.02%, 99.81%)  [51200-51455]=       16 ( 0.00%,100.00%)
[ 2304- 2559]=  4243461 ( 0.57%, 59.44%)  [18688-18943]=  1489684 ( 0.20%, 96.20%)  [35072-35327]=   118500 ( 0.02%, 99.83%)  [51456-51711]=       13 ( 0.00%,100.00%)
[ 2560- 2815]=  3113816 ( 0.42%, 59.86%)  [18944-19199]=  1366768 ( 0.18%, 96.38%)  [35328-35583]=   109900 ( 0.01%, 99.84%)  [51712-51967]=       21 ( 0.00%,100.00%)
[ 2816- 3071]=  2492616 ( 0.34%, 60.20%)  [19200-19455]=  1268484 ( 0.17%, 96.55%)  [35584-35839]=   100293 ( 0.01%, 99.86%)  [51968-52223]=       16 ( 0.00%,100.00%)
[ 3072- 3327]=  2185918 ( 0.30%, 60.49%)  [19456-19711]=  1175780 ( 0.16%, 96.71%)  [35840-36095]=    93325 ( 0.01%, 99.87%)  [52224-52479]=       12 ( 0.00%,100.00%)
[ 3328- 3583]=  2050944 ( 0.28%, 60.77%)  [19712-19967]=  1097486 ( 0.15%, 96.86%)  [36096-36351]=    84713 ( 0.01%, 99.88%)  [52480-52735]=       13 ( 0.00%,100.00%)
[ 3584- 3839]=  2019738 ( 0.27%, 61.04%)  [19968-20223]=  1029861 ( 0.14%, 97.00%)  [36352-36607]=    77656 ( 0.01%, 99.89%)  [52736-52991]=        8 ( 0.00%,100.00%)
[ 3840- 4095]=  2071715 ( 0.28%, 61.32%)  [20224-20479]=   966862 ( 0.13%, 97.13%)  [36608-36863]=    72417 ( 0.01%, 99.90%)  [52992-53247]=        5 ( 0.00%,100.00%)
[ 4096- 4351]=  2177722 ( 0.29%, 61.62%)  [20480-20735]=   911171 ( 0.12%, 97.25%)  [36864-37119]=    66842 ( 0.01%, 99.91%)  [53248-53503]=        3 ( 0.00%,100.00%)
[ 4352- 4607]=  2324175 ( 0.31%, 61.93%)  [20736-20991]=   864032 ( 0.12%, 97.37%)  [37120-37375]=    62369 ( 0.01%, 99.92%)  [53504-53759]=        2 ( 0.00%,100.00%)
[ 4608- 4863]=  2514273 ( 0.34%, 62.27%)  [20992-21247]=   815794 ( 0.11%, 97.48%)  [37376-37631]=    61007 ( 0.01%, 99.93%)  [53760-54015]=        2 ( 0.00%,100.00%)
[ 4864- 5119]=  2753413 ( 0.37%, 62.64%)  [21248-21503]=   769234 ( 0.10%, 97.59%)  [37632-37887]=    58707 ( 0.01%, 99.93%)  [54016-54271]=        6 ( 0.00%,100.00%)
[ 5120- 5375]=  3028400 ( 0.41%, 63.05%)  [21504-21759]=   723656 ( 0.10%, 97.68%)  [37888-38143]=    55552 ( 0.01%, 99.94%)  [54272-54527]=        7 ( 0.00%,100.00%)
[ 5376- 5631]=  3344486 ( 0.45%, 63.50%)  [21760-22015]=   681164 ( 0.09%, 97.77%)  [38144-38399]=    53381 ( 0.01%, 99.95%)  [54528-54783]=        3 ( 0.00%,100.00%)
[ 5632- 5887]=  3701877 ( 0.50%, 64.00%)  [22016-22271]=   640941 ( 0.09%, 97.86%)  [38400-38655]=    48857 ( 0.01%, 99.95%)  [54784-55039]=        7 ( 0.00%,100.00%)
[ 5888- 6143]=  4103249 ( 0.55%, 64.56%)  [22272-22527]=   605510 ( 0.08%, 97.94%)  [38656-38911]=    42840 ( 0.01%, 99.96%)  [55040-55295]=        4 ( 0.00%,100.00%)
[ 6144- 6399]=  4559704 ( 0.62%, 65.17%)  [22528-22783]=   574963 ( 0.08%, 98.02%)  [38912-39167]=    37799 ( 0.01%, 99.97%)  [55296-55551]=       10 ( 0.00%,100.00%)
[ 6400- 6655]=  5090528 ( 0.69%, 65.86%)  [22784-23039]=   545110 ( 0.07%, 98.09%)  [39168-39423]=    32030 ( 0.00%, 99.97%)  [55552-55807]=        7 ( 0.00%,100.00%)
[ 6656- 6911]=  5664976 ( 0.76%, 66.62%)  [23040-23295]=   518878 ( 0.07%, 98.16%)  [39424-39679]=    26704 ( 0.00%, 99.97%)  [55808-56063]=        1 ( 0.00%,100.00%)
[ 6912- 7167]=  6240039 ( 0.84%, 67.47%)  [23296-23551]=   497566 ( 0.07%, 98.23%)  [39680-39935]=    22801 ( 0.00%, 99.98%)  [56064-56319]=        4 ( 0.00%,100.00%)
[ 7168- 7423]=  6841184 ( 0.92%, 68.39%)  [23552-23807]=   474232 ( 0.06%, 98.30%)  [39936-40191]=    20023 ( 0.00%, 99.98%)  [56320-56575]=        6 ( 0.00%,100.00%)
[ 7424- 7679]=  7493991 ( 1.01%, 69.40%)  [23808-24063]=   457423 ( 0.06%, 98.36%)  [40192-40447]=    18179 ( 0.00%, 99.98%)  [56576-56831]=        3 ( 0.00%,100.00%)
[ 7680- 7935]=  8097840 ( 1.09%, 70.49%)  [24064-24319]=   441615 ( 0.06%, 98.42%)  [40448-40703]=    16591 ( 0.00%, 99.98%)  [56832-57087]=        2 ( 0.00%,100.00%)
[ 7936- 8191]=  8626429 ( 1.16%, 71.66%)  [24320-24575]=   423573 ( 0.06%, 98.47%)  [40704-40959]=    14884 ( 0.00%, 99.99%)  [57088-57343]=        3 ( 0.00%,100.00%)
[ 8192- 8447]=  8968842 ( 1.21%, 72.87%)  [24576-24831]=   408142 ( 0.06%, 98.53%)  [40960-41215]=    13712 ( 0.00%, 99.99%)  [57344-57599]=        4 ( 0.00%,100.00%)
[ 8448- 8703]=  9110926 ( 1.23%, 74.10%)  [24832-25087]=   391716 ( 0.05%, 98.58%)  [41216-41471]=    12600 ( 0.00%, 99.99%)  [57600-57855]=        2 ( 0.00%,100.00%)
[ 8704- 8959]=  9019610 ( 1.22%, 75.32%)  [25088-25343]=   377647 ( 0.05%, 98.63%)  [41472-41727]=    11391 ( 0.00%, 99.99%)  [57856-58111]=        3 ( 0.00%,100.00%)
[ 8960- 9215]=  8746418 ( 1.18%, 76.50%)  [25344-25599]=   363000 ( 0.05%, 98.68%)  [41728-41983]=    10671 ( 0.00%, 99.99%)  [58112-58367]=        4 ( 0.00%,100.00%)
[ 9216- 9471]=  8439189 ( 1.14%, 77.64%)  [25600-25855]=   347989 ( 0.05%, 98.73%)  [41984-42239]=     8686 ( 0.00%, 99.99%)  [58368-58623]=        4 ( 0.00%,100.00%)
[ 9472- 9727]=  8113989 ( 1.10%, 78.73%)  [25856-26111]=   333967 ( 0.05%, 98.77%)  [42240-42495]=     6811 ( 0.00%, 99.99%)  [58624-58879]=        6 ( 0.00%,100.00%)
[ 9728- 9983]=  7702164 ( 1.04%, 79.77%)  [26112-26367]=   322806 ( 0.04%, 98.82%)  [42496-42751]=     5639 ( 0.00%,100.00%)  [58880-59135]=        3 ( 0.00%,100.00%)
[ 9984-10239]=  7176479 ( 0.97%, 80.74%)  [26368-26623]=   311446 ( 0.04%, 98.86%)  [42752-43007]=     4967 ( 0.00%,100.00%)  [59136-59391]=        2 ( 0.00%,100.00%)
[10240-10495]=  6655365 ( 0.90%, 81.64%)  [26624-26879]=   299501 ( 0.04%, 98.90%)  [43008-43263]=     4403 ( 0.00%,100.00%)  [59392-59647]=        2 ( 0.00%,100.00%)
[10496-10751]=  6199831 ( 0.84%, 82.48%)  [26880-27135]=   291080 ( 0.04%, 98.94%)  [43264-43519]=     3812 ( 0.00%,100.00%)  [59648-59903]=        1 ( 0.00%,100.00%)
[10752-11007]=  5785093 ( 0.78%, 83.26%)  [27136-27391]=   282334 ( 0.04%, 98.98%)  [43520-43775]=     3155 ( 0.00%,100.00%)  [59904-60159]=        9 ( 0.00%,100.00%)
[11008-11263]=  5403980 ( 0.73%, 83.99%)  [27392-27647]=   276287 ( 0.04%, 99.01%)  [43776-44031]=     2774 ( 0.00%,100.00%)  [60160-60415]=       13 ( 0.00%,100.00%)
[11264-11519]=  5094130 ( 0.69%, 84.68%)  [27648-27903]=   268613 ( 0.04%, 99.05%)  [44032-44287]=     2250 ( 0.00%,100.00%)  [60416-60671]=        6 ( 0.00%,100.00%)
[11520-11775]=  4793248 ( 0.65%, 85.32%)  [27904-28159]=   261641 ( 0.04%, 99.09%)  [44288-44543]=     1834 ( 0.00%,100.00%)  [60672-60927]=        7 ( 0.00%,100.00%)
[11776-12031]=  4553281 ( 0.61%, 85.94%)  [28160-28415]=   254484 ( 0.03%, 99.12%)  [44544-44799]=     1435 ( 0.00%,100.00%)  [60928-61183]=        0 ( 0.00%,100.00%)
[12032-12287]=  4340408 ( 0.59%, 86.52%)  [28416-28671]=   247978 ( 0.03%, 99.15%)  [44800-45055]=     1211 ( 0.00%,100.00%)  [61184-61439]=        1 ( 0.00%,100.00%)
[12288-12543]=  4130700 ( 0.56%, 87.08%)  [28672-28927]=   243949 ( 0.03%, 99.19%)  [45056-45311]=      956 ( 0.00%,100.00%)  [61440-61695]=        1 ( 0.00%,100.00%)
[12544-12799]=  3983362 ( 0.54%, 87.62%)  [28928-29183]=   238649 ( 0.03%, 99.22%)  [45312-45567]=      965 ( 0.00%,100.00%)  [61696-61951]=        0 ( 0.00%,100.00%)
[12800-13055]=  3834427 ( 0.52%, 88.14%)  [29184-29439]=   234854 ( 0.03%, 99.25%)  [45568-45823]=      848 ( 0.00%,100.00%)  [61952-62207]=        0 ( 0.00%,100.00%)
[13056-13311]=  3677921 ( 0.50%, 88.63%)  [29440-29695]=   231754 ( 0.03%, 99.28%)  [45824-46079]=      657 ( 0.00%,100.00%)  [62208-62463]=        0 ( 0.00%,100.00%)
[13312-13567]=  3550658 ( 0.48%, 89.11%)  [29696-29951]=   228475 ( 0.03%, 99.31%)  [46080-46335]=      688 ( 0.00%,100.00%)  [62464-62719]=        0 ( 0.00%,100.00%)
[13568-13823]=  3464780 ( 0.47%, 89.58%)  [29952-30207]=   225411 ( 0.03%, 99.34%)  [46336-46591]=      577 ( 0.00%,100.00%)  [62720-62975]=        0 ( 0.00%,100.00%)
[13824-14079]=  3379376 ( 0.46%, 90.04%)  [30208-30463]=   222750 ( 0.03%, 99.37%)  [46592-46847]=      519 ( 0.00%,100.00%)  [62976-63231]=        1 ( 0.00%,100.00%)
[14080-14335]=  3265954 ( 0.44%, 90.48%)  [30464-30719]=   217831 ( 0.03%, 99.40%)  [46848-47103]=      437 ( 0.00%,100.00%)  [63232-63487]=        0 ( 0.00%,100.00%)
[14336-14591]=  3167079 ( 0.43%, 90.91%)  [30720-30975]=   215933 ( 0.03%, 99.43%)  [47104-47359]=      381 ( 0.00%,100.00%)  [63488-63743]=        0 ( 0.00%,100.00%)
[14592-14847]=  3078594 ( 0.42%, 91.32%)  [30976-31231]=   211945 ( 0.03%, 99.46%)  [47360-47615]=      310 ( 0.00%,100.00%)  [63744-63999]=        0 ( 0.00%,100.00%)
[14848-15103]=  2990457 ( 0.40%, 91.73%)  [31232-31487]=   208311 ( 0.03%, 99.49%)  [47616-47871]=      320 ( 0.00%,100.00%)  [64000-64255]=        0 ( 0.00%,100.00%)
[15104-15359]=  2914791 ( 0.39%, 92.12%)  [31488-31743]=   204465 ( 0.03%, 99.52%)  [47872-48127]=      267 ( 0.00%,100.00%)  [64256-64511]=        0 ( 0.00%,100.00%)
[15360-15615]=  2802613 ( 0.38%, 92.50%)  [31744-31999]=   199622 ( 0.03%, 99.54%)  [48128-48383]=      241 ( 0.00%,100.00%)  [64512-64767]=        0 ( 0.00%,100.00%)
[15616-15871]=  2672171 ( 0.36%, 92.86%)  [32000-32255]=   195253 ( 0.03%, 99.57%)  [48384-48639]=      160 ( 0.00%,100.00%)  [64768-65023]=        0 ( 0.00%,100.00%)
[15872-16127]=  2561527 ( 0.35%, 93.20%)  [32256-32511]=   191365 ( 0.03%, 99.60%)  [48640-48895]=      140 ( 0.00%,100.00%)  [65024-65279]=        0 ( 0.00%,100.00%)
[16128-16383]=  2477315 ( 0.33%, 93.54%)  [32512-32767]=   189427 ( 0.03%, 99.62%)  [48896-49151]=      128 ( 0.00%,100.00%)  [65280-65535]=        0 ( 0.00%,100.00%)
```

5.2 Bands 3-5-7 - Linear stretching

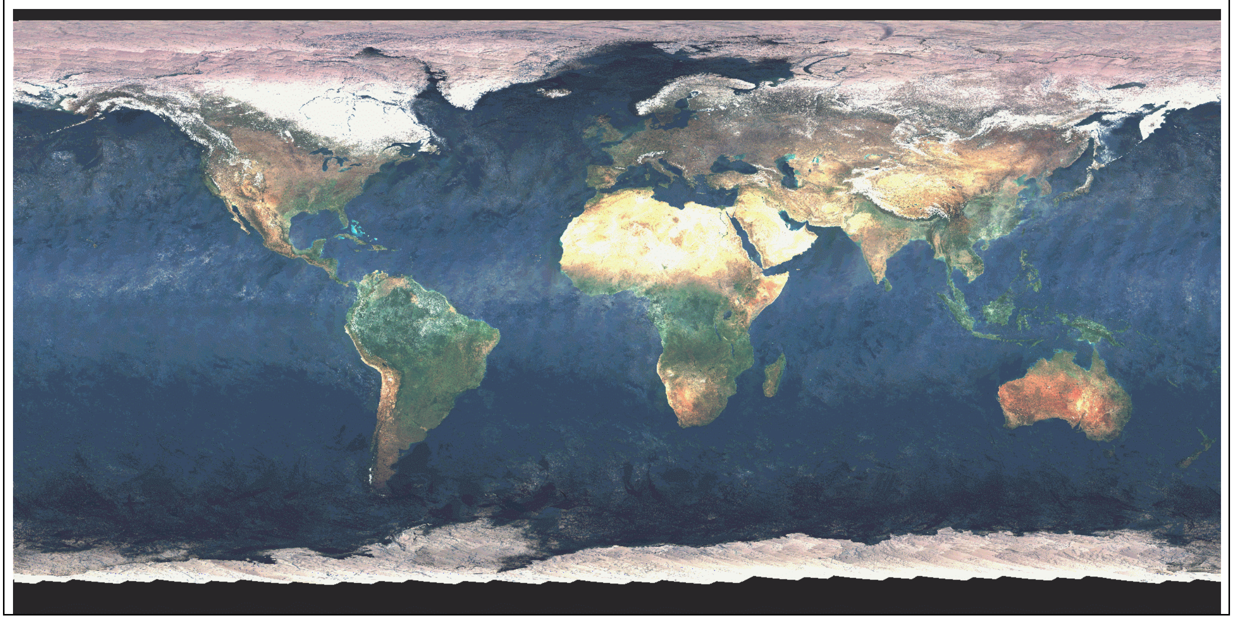


fig. 76 - 16 bits synthesis – Bands 3-5-7 - Linear stretching.

5.3 Bands 3-5-7 - Histogram equalisation

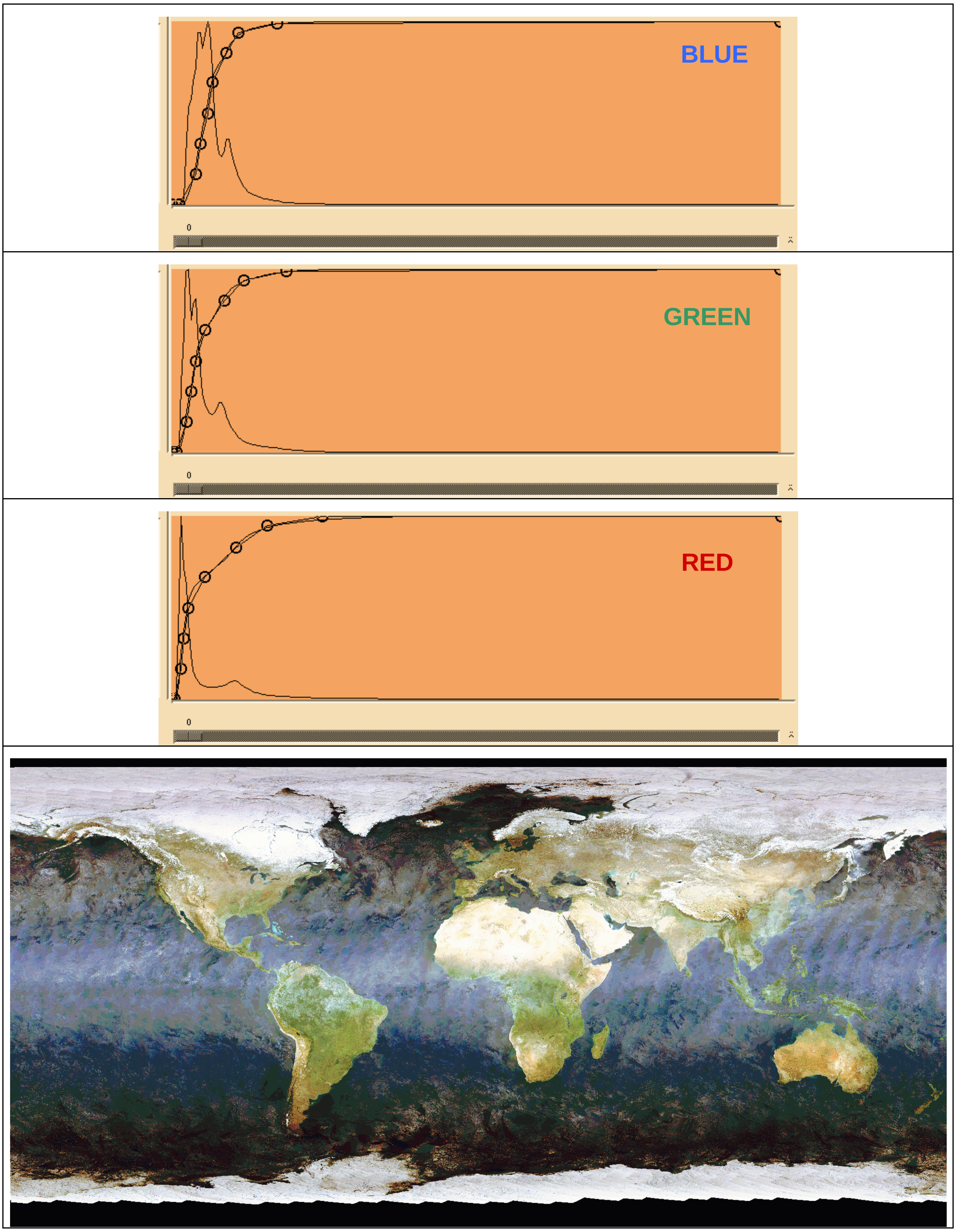


fig. 77 - 16 bits synthesis – Bands 3-5-7 - Histogram equalisation.

5.4 Bands 1-13-5 - Linear stretching

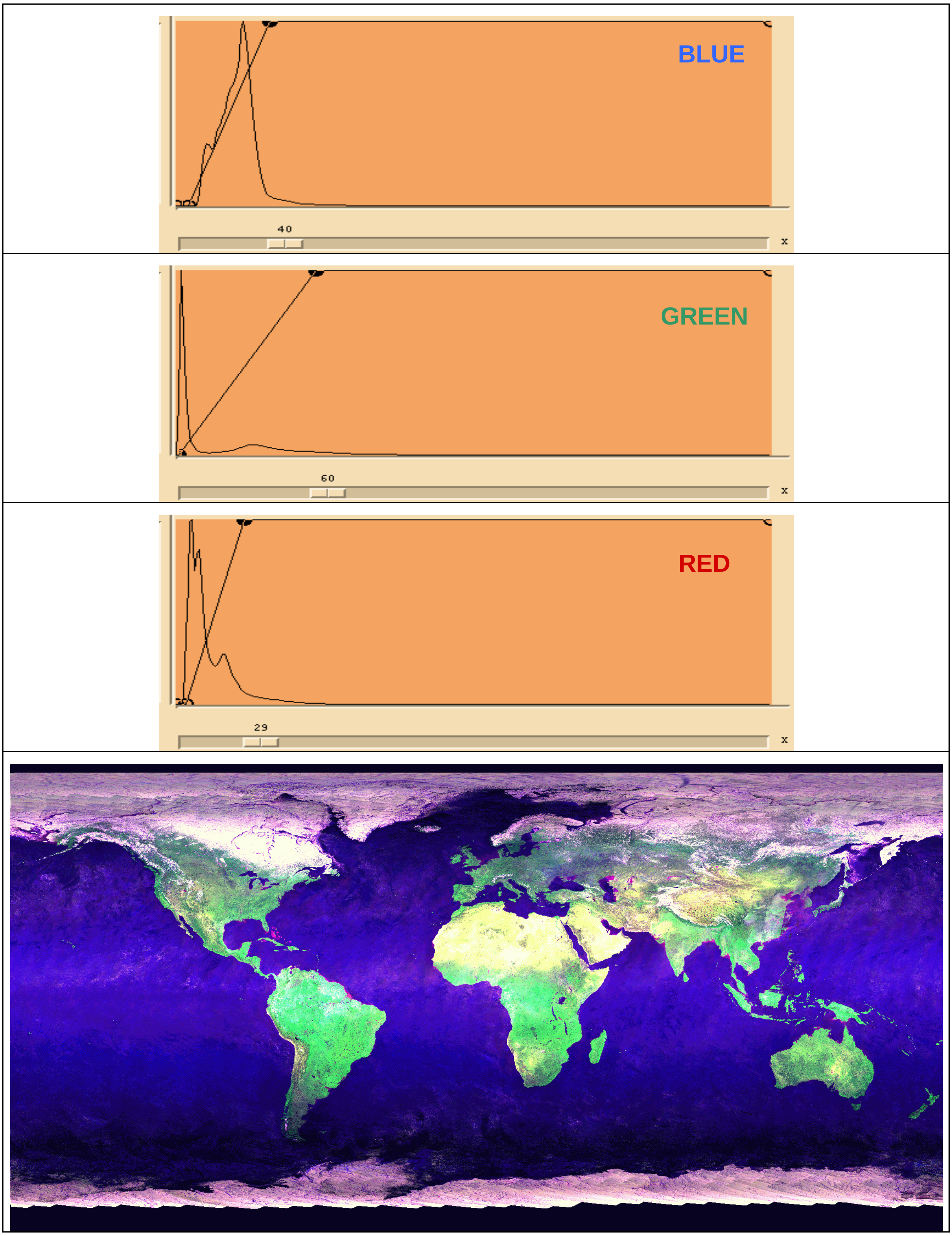


fig. 78 - 16 bits synthesis – Bands 1-13-5 - Linear stretching.

5.5 Bands 1-13-5 - Histogram equalisation

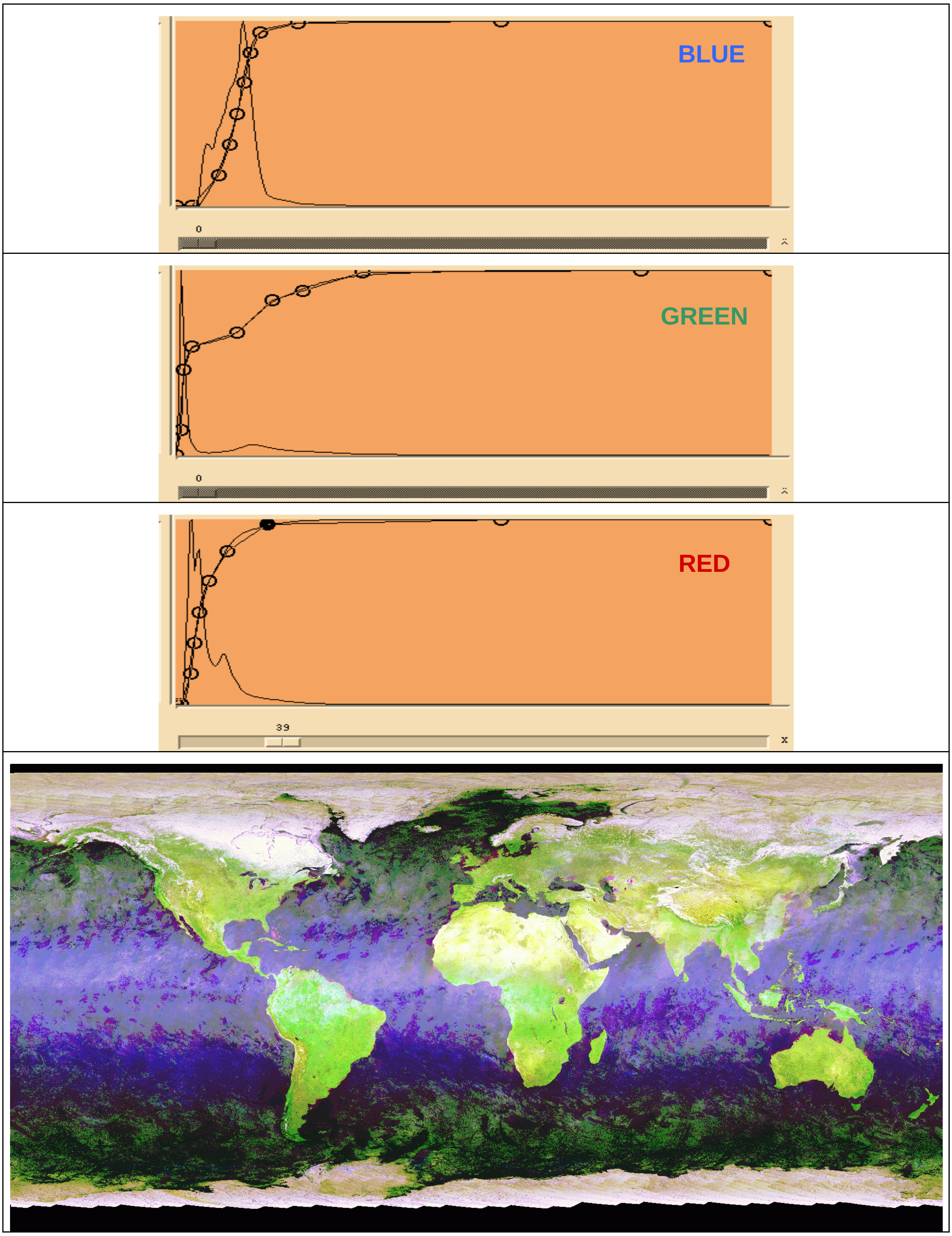


fig. 79 - 16 bits synthesis – Bands 1-13-5 - Histogram equalisation.

6 SOME ENHANCEMENTS

The scope of this section is to demonstrate the potential of the delivered products. In particular, the 5 bands on 16 bits per pixels may be viewed in particular regions for specific processing trying to get the best of the radiometry.

6.1 Europe

A window centred on Europe has been extracted, the radiometry has been processed locally and the resulting image is reprojected on the Lambert Conformal Conic projection recommended by EuroGeographics.

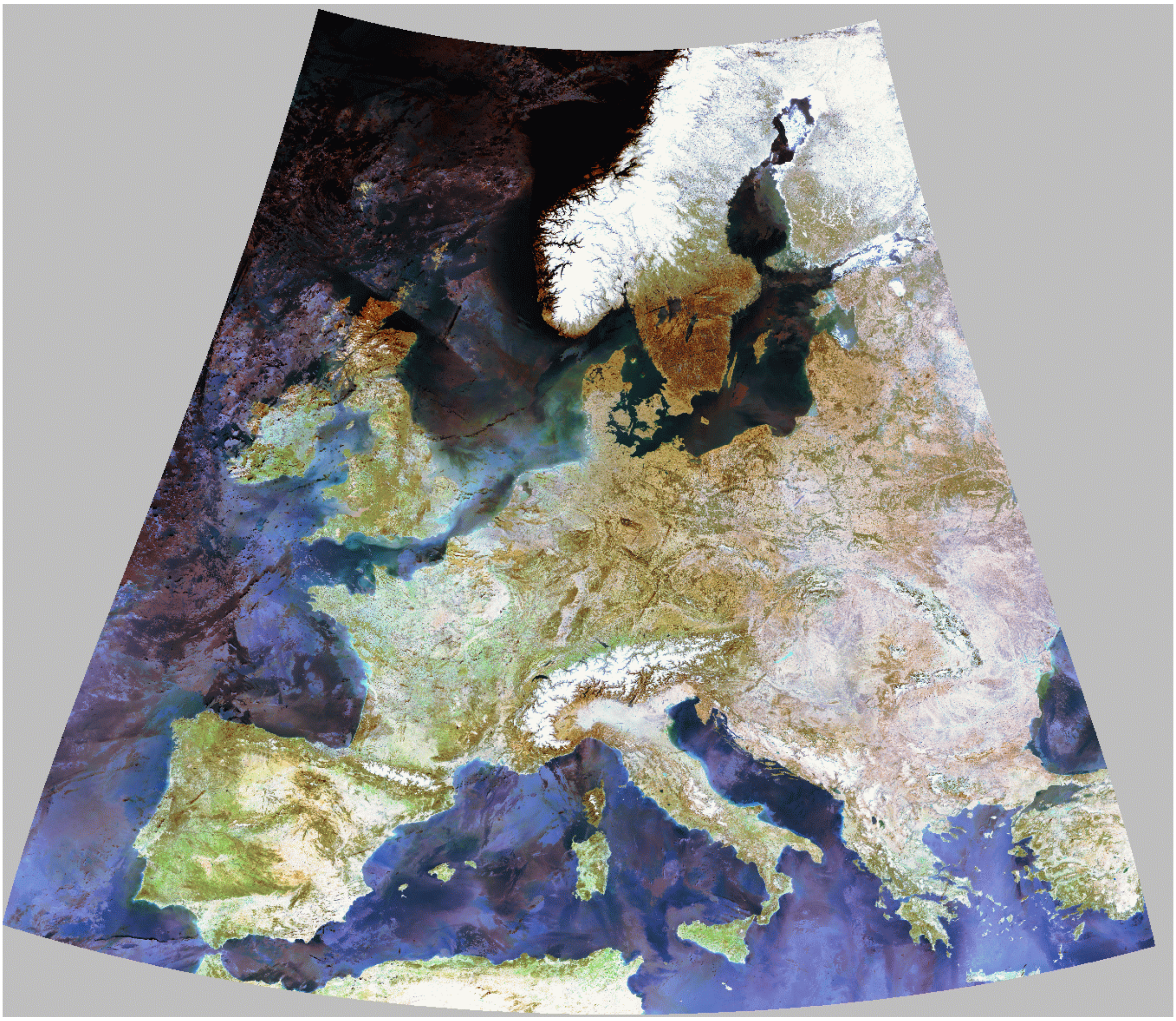


fig. 80 - Europe – Bands 3-5-7.

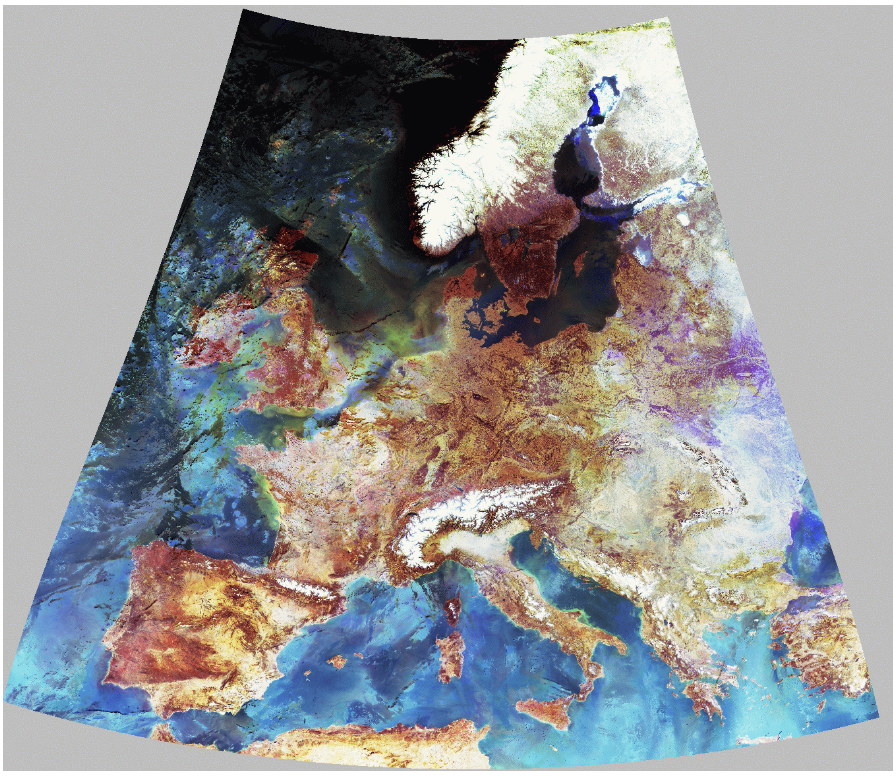


fig. 81 - Europe – Bands 1-3-5.

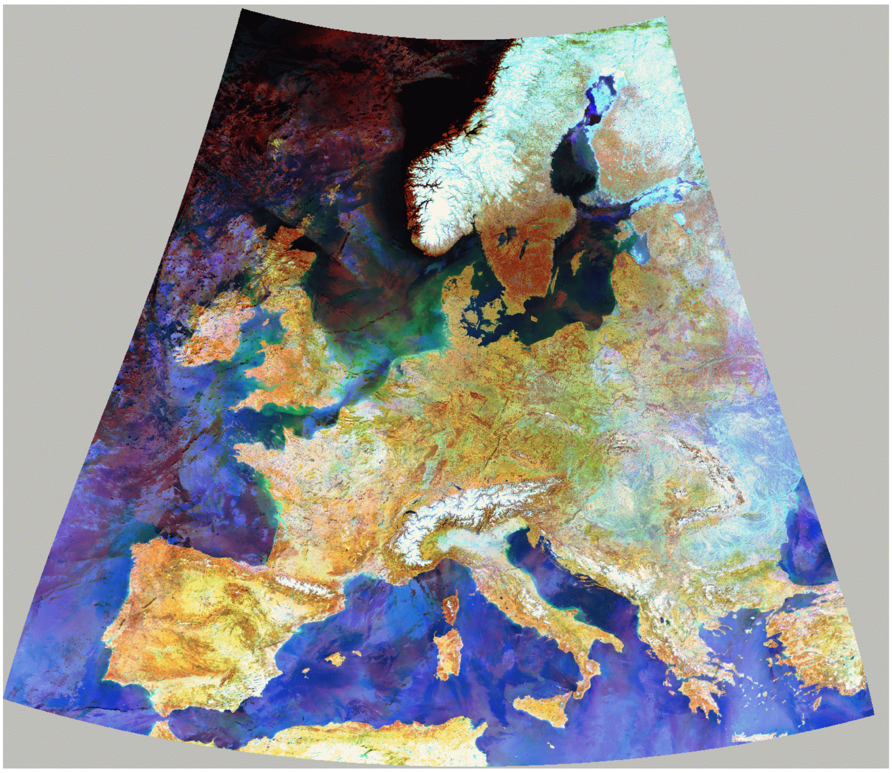


fig. 82 - Europe – Bands 1-5-13.

6.2 North Africa

Processing a particular and homogeneous region avoids the compromises required when processing the whole world. Figure fig. 83 shows the difference between the global “natural colour” composition and the local one.

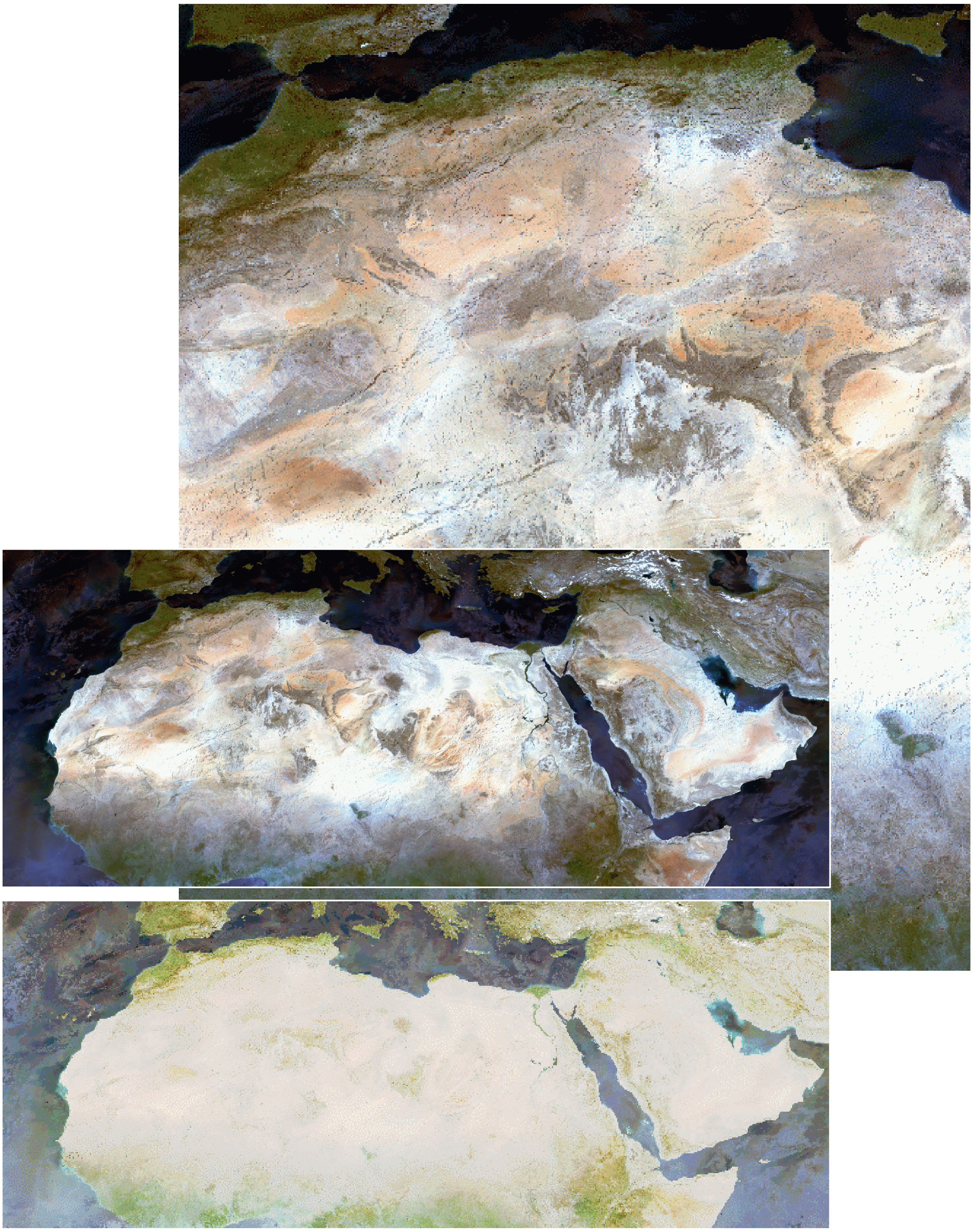


fig. 83 - North Africa – Bands 3-5-7.

Other colour compositions may be appreciated by end users. For example, in this region of oil exploration, geologists are more interested in colour compositions underlying the differences within the various sands and rocks (see figures here below).

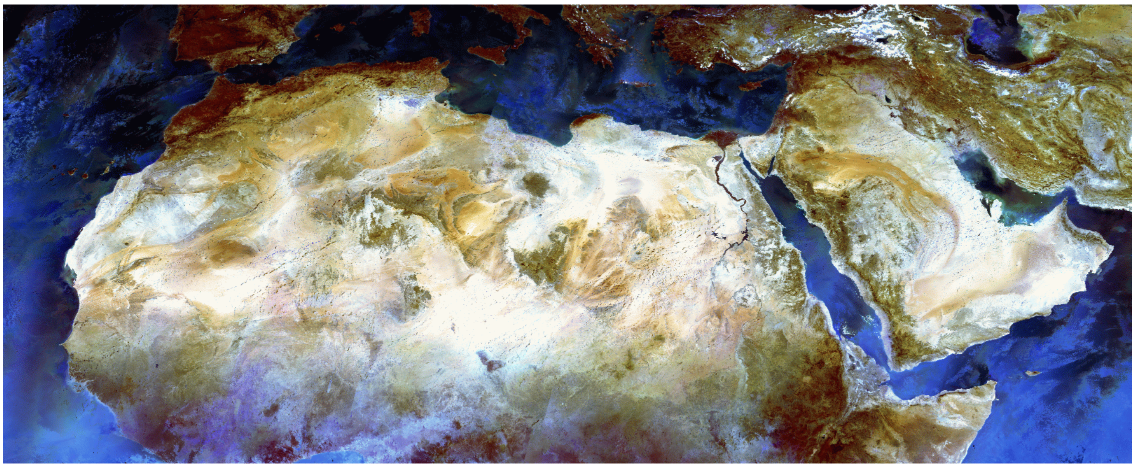


fig. 84 - North Africa – Bands 1-3-5.

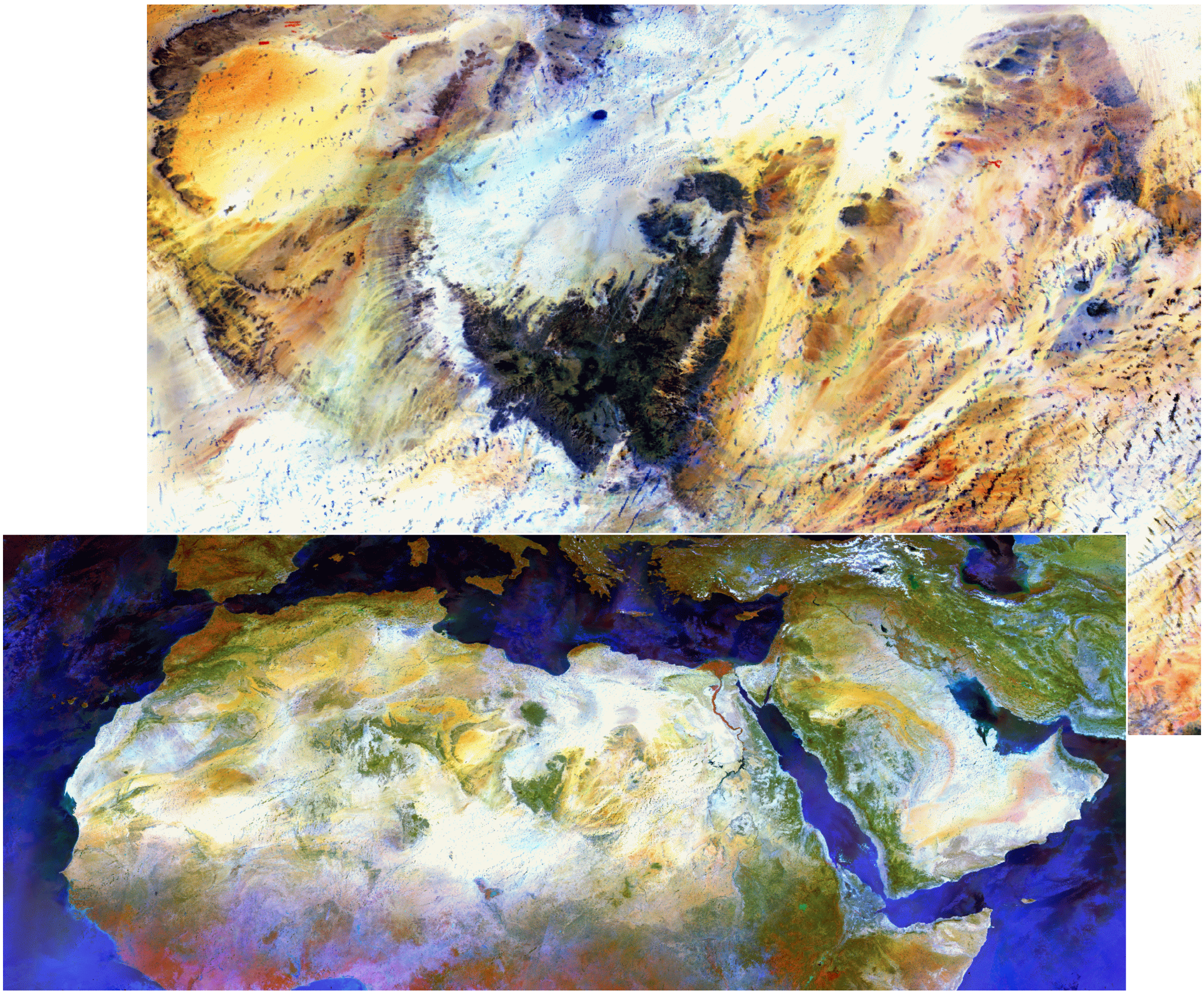


fig. 85 - North Africa – Bands 1-5-13.

Zooming within the image shows a major defect: the cloud shadows.

This defect is principally due to the selection algorithm always keeping the "radiance minimum". This defect is very difficult and time consuming, to cancel. Figure here below shows an attempt to diminish the defect filling the smallest shadow traces using the median filter. The chosen parameters have been the default ones, i.e. a 5x5 sliding window with at least one pixel to process at time.

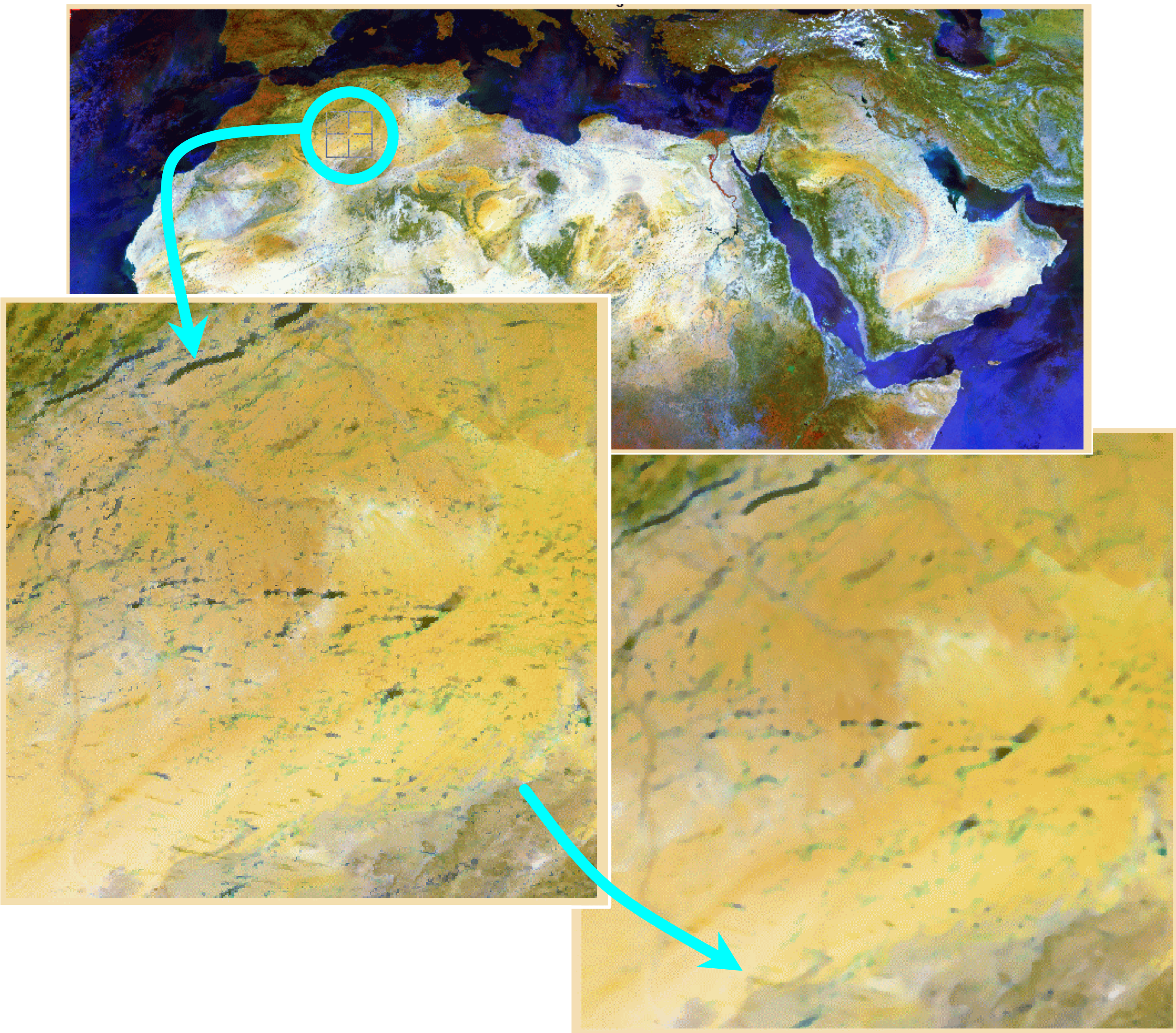


fig. 86 - North Africa – Bands 1-5-13 – Cloud shadow defects in original image (left) and in the image corrected by the median filter (lower right).

6.3 Spain

Figures herebelow demonstrate that MERIS RR data may be used at national level in EU15.

fig. 87 - Spain – Projection UTM 30
Up: bands 3-5-7 – Bottom: bands 3-5-pca1 (first principal component analysis).

7 CONCLUSIONS

7.1 Data ordering and segment determination

As demonstrated in section 4.3 (sub-section “Useless processing”) the huge amount of data processed each time (8 GB per synthesis) requires more accurate control of the input data.

In place of the 840 segments foreseen initially, 1242 segments have been processed leading to an extra cost of approximately 50% and for approximately 10 TB synthesis data generated.

A particular effort should be made to get the MERIS segments as large as possible and not cut in various sub-segments. Another obvious demand would be to avoid providing redundant data (doubles).

7.2 Band selection

The “natural colour” composition is 3-5-7 mapped respectively on BGR. This composition has been the one selected by ESA.

Band 13 is more penetrating and is able to ignore some clouds. The brightness of this band is more uniform even when going closer the poles (see for example across Patagonia).

Involvement of band 1 in colour composition may be of interest when processing the sea waters (see fig. 81 and fig. 82) to get more details.

7.3 Radiometric calibration

Except for the segment acquired on 04/04/2003 over the Persian Gulf (see fig. 12 in section 2.4) MERIS radiometry looks perfectly calibrated. In particular, no segment limits are noticeable over the lands.

On the contrary, over sea, not applying a BRDF correction leads to strip and aliasing effects.

7.4 Geometry – Absolute location

Except for the series of (sub) segments acquired on 29/04/2003 over the West Pacific, the absolute location of MERIS data is excellent.

When an anomaly occurs, its impact on the quality of the synthesis is very acute, obliging retrieval of the erroneous segment(s) and reprocessing all the other segments from this corruptive event.

Such monitoring is difficult to perform fully automatically and continuous quality control monitoring is required.

7.5 Selection algorithm

The “radiance minimum” has been chosen with regard to the “NDVI maximum” because their behaviour are almost equivalent over land while the “radiance minimum” is much better over sea avoiding conserving clouds.

Nevertheless the “radiance minimum” leads to darker images, giving preference to reflectance of colder days / months / seasons. For example, fig. 45 shows that the “radiance minimum” algorithm has preferred the image of April rather than the one of March even if this last was showing interesting sediments within the Gulf of Cook (Alaska).

Due to the strong time constraints (delivery was expected the first of June), no other selection algorithms have been tested. In particular, the solution proposed by Duchemin (see R-10 and R-11) should be tested in a further study.

7.6 Merging algorithm – The "cloud shadow" defect

The "Replacement" is better than any "Mean" when setting the value in output synthesis. A mean necessarily keeps a trace (memory) of the cloudy pixels selected at the previous steps leading to artefacts.

Nevertheless, the binary decision of the "Replacement" merging algorithm combined with the "Radiance minimum" selection algorithm leads to definitive settings that cannot be undone.

For example, the shadows of the clouds decrease the on-ground reflectance and are definitively kept within the synthesis. Such defects are particularly visible within homogeneous areas like the deserts of fig. 85 or fig. 86 but they also give a granular aspect to landscape like in France (see fig. 51).

This "Cloud shadow" defect is certainly the major drawback of the present synthesis. Developing a method to cancel this defect when processing the segment should be the first task for further synthesis generation.

7.7 Specific processing

As demonstrated in section 6 ("Some enhancements") regional processing ammows obtaining the best of the data. Such regional processing could use other bands, other image processing techniques, merging of other data… to demonstrate the excellence and potential of MERIS data.

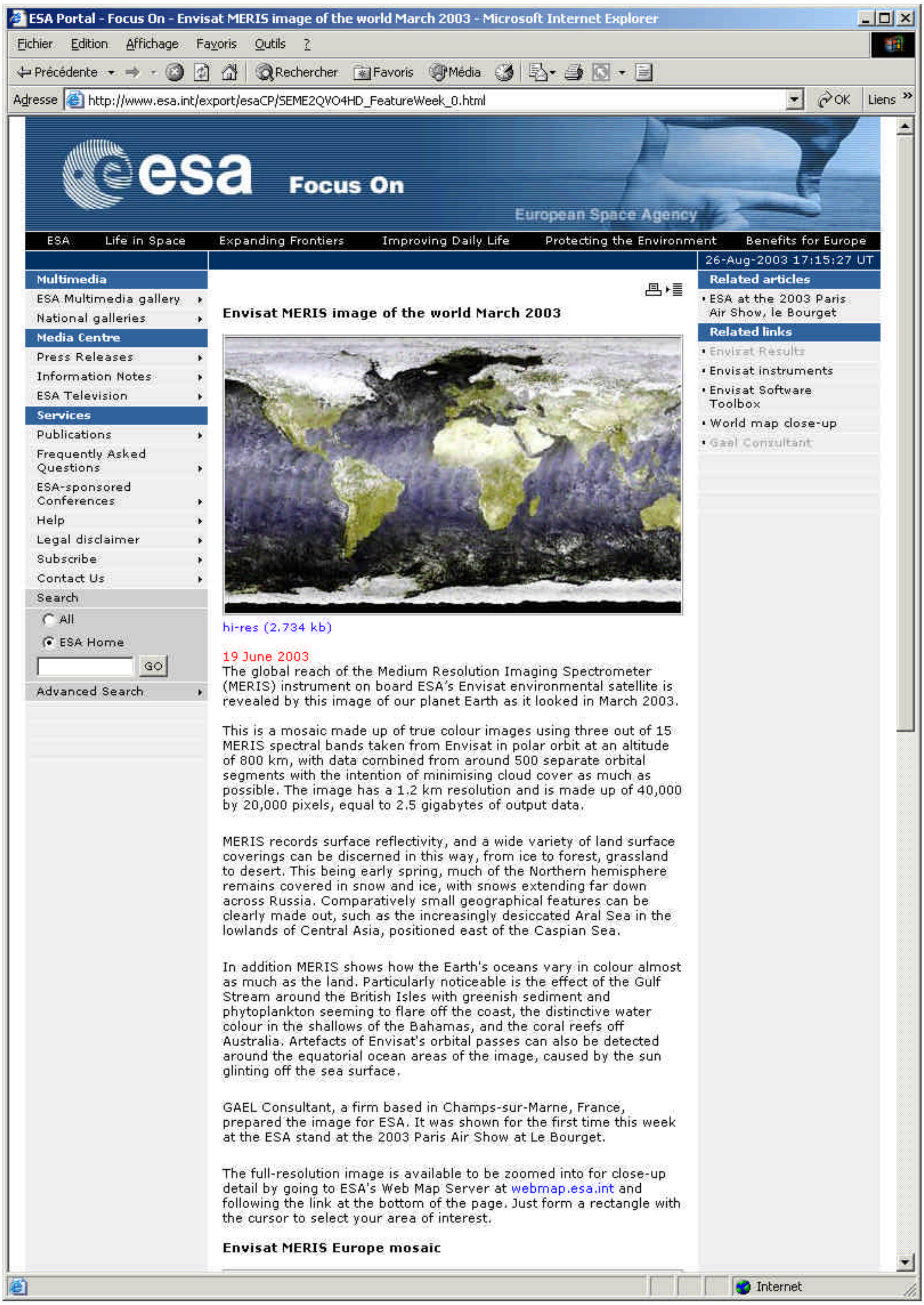
7.8 Success story

The first version of the synthesis has been delivered to Olivier Arino on the 2nd of June 2003 to be printed on a poster. The image included most of the March 2003 segments and the first half of April.

ESA Web site

The "true-colour" colour composition has been displayed on ESA Web site at the address:

http://www.esa.int/export/esaCP/SEME2QVO4HD_FeatureWeek_0.html



Paris Le Bourget 2003

As shown in the figure here below, this first MERIS synthesis has been printed and displayed on the entry wall of ESA pavillon at Paris Bourget Air show on 16-22 June 2003.

The event is presented on ESA Web site at the address:

http://www.esa.int/export/esaCP/SEMKZ9WO4HD_Protecting_1.html with the following caption:

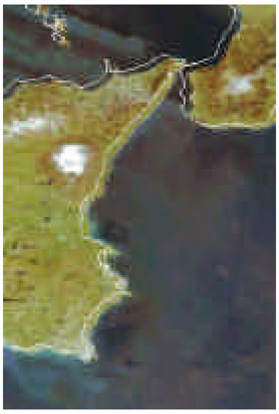
“ESA Director of Earth Observation José Achache points out Envisat's new MERIS image of the world to French Science Minister (and former ESA astronaut) Claudie Haigneré. To the left is current ESA Director-General Antonio Rodotá and incoming ESA Director-General Jean-Jacques Dordain.”.

fig. 88 - José ACHACHE showing the MERIS synthesis to Claudie HAIGNERE.

ESA Web map server

The first MERIS synthesis has also been inserted within the ESA Web map server (accessible at the address http://mapserv2.esrin.esa.it/eomosaic/) to enable visitors displaying vector layers on whatever part of the world.

Upon demand of Christophe CASPAR and in order to avoid misregistration between the MERIS synthesis and the vector layers (see the opposite figure), the origin coordinates and the pixel size are computed in the following way.



The cartographic information relative to the synthesis is:

projection	**Plate Carrée**
ellipsoid	**WGS 1984**
datum	**WGS 1984**
pixel size	**1000 metres**
UL	**X = 20 003 916 metres** **Y = 10 001 959 metres**

The “Plate Carrée” projection is proportional to the “geodetic coordinates reference system” (sometimes shortly called “Geographic projection”) according to the following formula:

$$l = \frac{X}{\frac{a+b}{2}}$$

$$j = \frac{Y}{\frac{a+b}{2}}$$

Where:

- (λφ) are the geographic coordinates,
- (X,Y) are the Plate carrée coordinates,
- a is the semi-major axis of the ellipsoid (here WGS 1984),
- b is the semi-minor axis of the ellipsoid (here WGS 1984).

Size of WGS 1984 (a = 6378137.000 m, b=6356752.3142452 m) leads to a mean Earth radius equal to **6367444.657 m**.

Applying the conversion formula leads to the following values:

	Plate Carrée (metres)	**Geodetic (decimal degrees)**
Pixel size	1000 m	0.009982375 dd
UL X	-20 003 916 m	-179.9999878 dd
UL Y	10 001 959 m	+90.00000289 dd

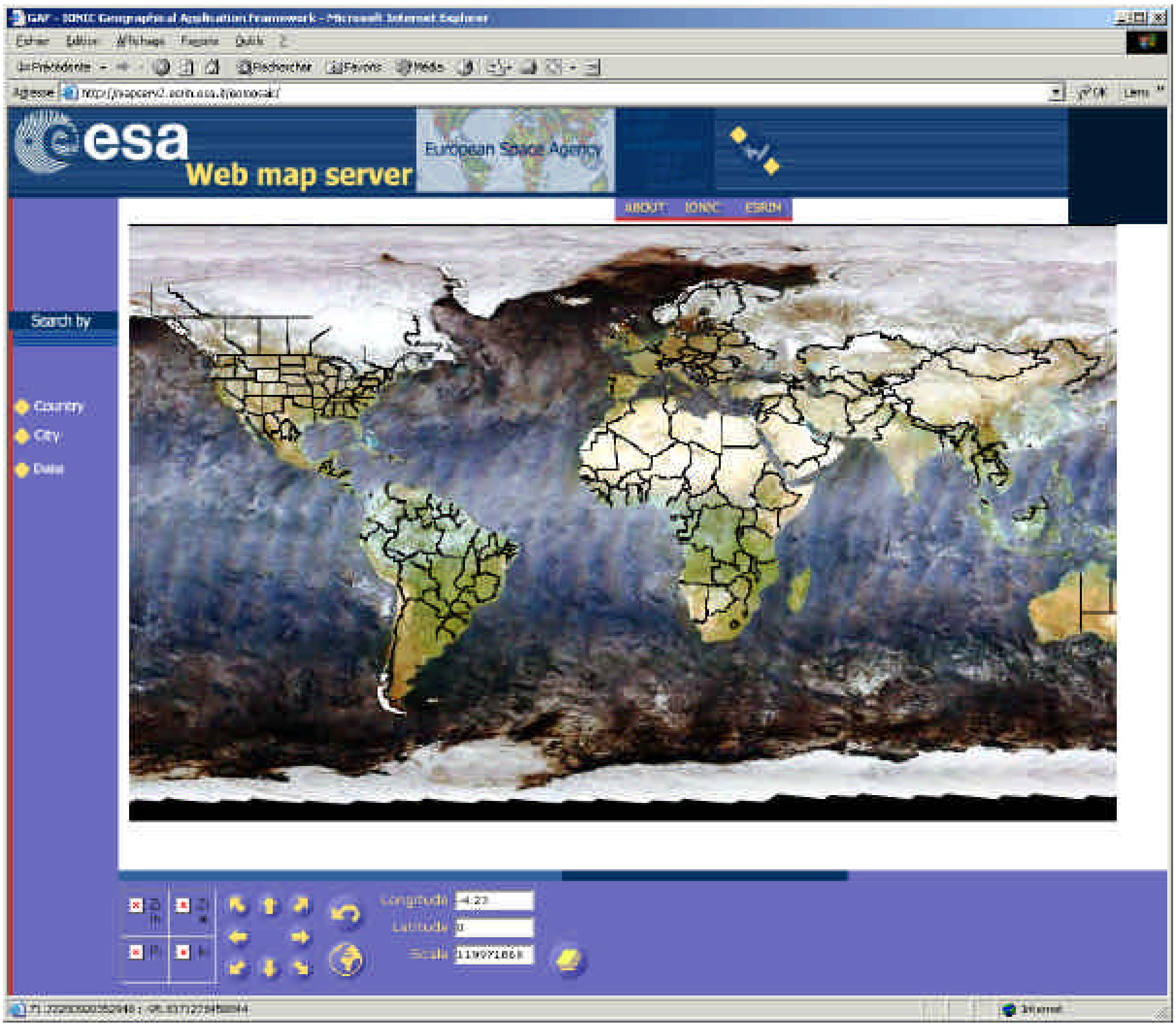


fig. 89 - ESA Web map server – MERIS world + Political boundaries and coastlines.

On 01/09/2003, Christophe CASPAR has suggested a methodology to find the causes of the misregistrations between the MERIS synthesis and the vector layers.
As shown in the figure here above, the "Political boundaries and coastlines" are displayed over the MERIS synthesis. Zooming on Sicily, the image is captured by the "Save as" option of the rightmost button when the pointer is on the image. Unfortunately, the GIF file is not readable by other viewers. Therefore, a snap shot has been captured and cut (see fig. 90).

The request having generated this image has been retrieved selecting the "Properties" option of the menu displayed when clicking on the rightmost button when the pointer is on the image. To be more readable, this request has been split here below:

```
http://mapserv2.esrin.esa.it/cubestor/cubeserv/cubeserv.cgi?VERSION=1.1.0&
   REQUEST=GetMap&SERVICE=WMS&SRS=EPSG:4326&
   BBOX=12.137229587703352,36.32239275147928,
        16.626908486785922,39.041142751479288&
        WIDTH=838&
        HEIGHT=507&
        LAYERS=COASTL_1M%3AMapAdmin%2CPOLBNDL_1M%3AMapAdmin&
        STYLES=default%2Cdefault&FORMAT=GIF&BGCOLOR=0xffffff&
        TRANSPARENT=TRUE&EXCEPTIONS=INIMAGE&
```

This image has been imported in the TELIMAGO format and geocoded just providing the auxiliary data previously computed from the request parameters:

```
LL: X = 12.137229587703352 degrees     Y = 36.32239275147928 degrees
      = 0.211834623 radians              = 0.633945345 radians
      = 1348845 m                        = 4036612 m

UR: X = 16.626908486785922 degrees     Y = 39.04114275147928 degrees
      = 0.290194297 radians              = 0.681396484 radians
      = 1847796 m                        = 4338754 m

   DX = 498951 m                      DY = 302142 m
   -> pixelWidth = 596.831 m          -> pixelHeight = 597.119 m
```

The image has been geocoded in Plate Carré projection:

```
timHeader -if sicilia_mapserv2.? -res \
           projection "projection=Plate_carree ellipsoid=WGS_1984 datum=WGS_84"
           origin "1348845 4338754"
           pixelWidth 596.831
           pixelHeight 597.119
```

fig. 90 - Georeferenced image elaborated by the ESA Web Map Server.

Once geocoded, the GMT vector layers (analogous to VMAP1) have been displayed over the “Map server image” of Sicily. Figure fig. 91 clearly shows that GMT layers are very close the vector layers of the ESA Web Map Server. Such superimposition demonstrates that the “Map server image” has been correctly geocoded and that vector layers are analogous.

In fig. 92, GMT vectors have been displayed over the MERIS synthesis demonstrating that this synthesis is correctly geocoded.

fig. 91 - GMT layers displayed over the "Map server image".

fig. 92 - GMT layers displayed over the "MERIS synthesis".

APPENDIX A DECODING OF MER_RR__1PNPDK20030408_093303_000023202015_00208_05773_0848.N1

This appendix contains an example of MERISS RR 1B crossing Europe. This product is the first one contained within the tape 1 (label Mehsk00000064_1) of the fourth reception (internal ID R04.1).

A.1 Main Product Header

```
Product File Name                         : MER_RR__1PNPDK20030408_093303_000023202015_00208_05773_0848.N1
Processing Stage Flag                     : N
Reference Document Describing Product     : PO-RS-MDA-GS2009_11_3H
Acquisition Station ID                    : PDHS-K
Processing Centre ID                      : PDHS-K
UTC Time of Processing                    : 08/04/2003  11:33:59.000000
Software Version Number of Processing SW  : MERIS/03.55
UTC Start Time of Data Sensing            : 08/04/2003  09:35:09.081712
UTC Stop Time of Data Sensing             : 08/04/2003  10:11:57.913628
Phase                                     : 2
Cycle                                     : 15
Start Relative Orbit Number               : 208
Start Absolute Orbit Number               : 5773
State vector at ascending node:
   Date Time                              : 08/04/2003  09:03:30.451218
   Position                               : -6947785.380000  -1751674.549000  -1966.053000
   Velocity                               : -392.238864  1582.544698  7377.569122
DUT1=UT1-UTC                              : -0.348922
Source of Orbit Vectors                   : FP (FOS predicted)
UTC time corresponding to SBT below       : 08/04/2003  09:27:10.128613
Satellite Binary Time (SBT)               : 336978688
Clock Step Size (in picoseconds)          : 0.003906249792
UTC time of occurrence of Leap Second     : 17/10/2001  00:00:00.000000
Leap second sign                          : 1
Leap second error                         : 0
Product error                             : 1
Total Size of Product error               : 478633075
Length of SPH                             : 9942
Number of DSDs                            : 30
Length of each DSD                        : 280
Number of DSs attached                    : 19
```

A.2 Specific Product Header

```
SPH Descriptor                          : MER_RR__1P SPECIFIC HEADER
Stripline Continuity Indicator          : 0
Slice Position                          : 1
Number of Slices in this Stripline      : 1
Azimuth time first line of product      : 08/04/2003  09:33:03.820036
Azimuth time last line of product       : 08/04/2003  10:11:44.230507
Geo. Lat. of first sample of first line  : 69.01020700
Geo. Long. of first sample of first line : 47.01814500
Geo. Lat. of middle sample of first line : 72.08250700
Geo. Long. of middle sample of first line : 34.29443800
Geo. Lat. of last sample of first line   : 74.04261900
Geo. Long. of last sample of first line  : 17.62096200
Geo. Lat. of first sample of last line   : -64.61428500
Geo. Long. of first sample of last line  : -8.68476200
Geo. Lat. of middle sample of last line  : -63.19316600
Geo. Long. of middle sample of last line : -20.11827200
Geo. Lat. of last sample of last line    : -60.95152700
Geo. Long. of last sample of last line   : -30.20017600
Transmission error flag                 : 0
Format error flag                       : 1
Database error flag                     : 0
Coarse error flag                       : 0
Forecast (0) / Analysis (1) ECMWF data   : 0
Number of transmission errors in product : 0
Number of format errors in the product   : 26336
Threshold for setting TRANS_ERR_FLAG     : 0.000000 %
Threshold for setting FORMAT_ERR_FLAG    : 0.000000 %
Number of bands in the product          : 15
Central wavelength of the bands:
   Band 1                               : 412.545 nm
   Band 2                               : 442.401 nm
   Band 3                               : 489.744 nm
   Band 4                               : 509.700 nm
   Band 5                               : 559.634 nm
   Band 6                               : 619.620 nm
   Band 7                               : 664.640 nm
   Band 8                               : 680.902 nm
   Band 9                               : 708.426 nm
   Band 10                              : 753.472 nm
   Band 11                              : 760.354 nm
   Band 12                              : 778.498 nm
   Band 13                              : 864.833 nm
   Band 14                              : 884.849 nm
   Band 15                              : 899.860 nm
```

```
Bandwidth of the bands:
   Band 1                              : 9.930 nm
   Band 2                              : 9.946 nm
   Band 3                              : 9.965 nm
   Band 4                              : 9.971 nm
   Band 5                              : 9.983 nm
   Band 6                              : 9.991 nm
   Band 7                              : 9.994 nm
   Band 8                              : 7.493 nm
   Band 9                              : 9.996 nm
   Band 10                             : 7.493 nm
   Band 11                             : 3.742 nm
   Band 12                             : 15.000 nm
   Band 13                             : 19.999 nm
   Band 14                             : 9.990 nm
   Band 15                             : 9.989 nm
Instantaneous Field of View            : 0.076639 deg.
Processor mode of oper. (1:Raw,0:Full)   : 1
Offset compensation flag (1:Yes,0:No)    : 1
Line spacing in time                   : 0.175988 s.
Number of samples per output line      : 1121
Nb. of lines between along track tie pts : 16
Nb. samples between across track tie pts : 16
On ground spacing between columns      : 1040.000 m.
```

A.3 Data Set Descriptors

```
DATA SET DESCRIPTOR #1:
Data Set Name                          : Quality ADS
Data Set Type                          : A
External Product Reference             :
DS Offset in bytes                     : 11189
Total Size of DS in bytes              : 3399
Number of DSRs within the DS           : 103
Length of the DSRs in bytes            : 33


DATA SET DESCRIPTOR #2:
Data Set Name                          : Scaling Factor GADS
Data Set Type                          : G
External Product Reference             :
DS Offset in bytes                     : 14588
Total Size of DS in bytes              : 292
Number of DSRs within the DS           : 1
```

```
Length of the DSRs in bytes             : 292


DATA SET DESCRIPTOR #3:
Data Set Name                           : Tie points ADS
Data Set Type                           : A
External Product Reference              :
DS Offset in bytes                      : 14880
Total Size of DS in bytes               : 2939475
Number of DSRs within the DS            : 825
Length of the DSRs in bytes             : 3563


DATA SET DESCRIPTOR #4:
Data Set Name                           : Radiance MDS(1)
Data Set Type                           : M
External Product Reference              :
DS Offset in bytes                      : 2954355
Total Size of DS in bytes               : 29729920
Number of DSRs within the DS            : 13184
Length of the DSRs in bytes             : 2255


DATA SET DESCRIPTOR #5:
Data Set Name                           : Radiance MDS(2)
Data Set Type                           : M
External Product Reference              :
DS Offset in bytes                      : 32684275
Total Size of DS in bytes               : 29729920
Number of DSRs within the DS            : 13184
Length of the DSRs in bytes             : 2255


DATA SET DESCRIPTOR #6:
Data Set Name                           : Radiance MDS(3)
Data Set Type                           : M
External Product Reference              :
DS Offset in bytes                      : 62414195
Total Size of DS in bytes               : 29729920
Number of DSRs within the DS            : 13184
Length of the DSRs in bytes             : 2255


DATA SET DESCRIPTOR #7:
Data Set Name                           : Radiance MDS(4)
Data Set Type                           : M
```

```
External Product Reference            :
DS Offset in bytes                    : 92144115
Total Size of DS in bytes             : 29729920
Number of DSRs within the DS          : 13184
Length of the DSRs in bytes           : 2255


DATA SET DESCRIPTOR #8:
Data Set Name                         : Radiance MDS(5)
Data Set Type                         : M
External Product Reference            :
DS Offset in bytes                    : 121874035
Total Size of DS in bytes             : 29729920
Number of DSRs within the DS          : 13184
Length of the DSRs in bytes           : 2255


DATA SET DESCRIPTOR #9:
Data Set Name                         : Radiance MDS(6)
Data Set Type                         : M
External Product Reference            :
DS Offset in bytes                    : 151603955
Total Size of DS in bytes             : 29729920
Number of DSRs within the DS          : 13184
Length of the DSRs in bytes           : 2255


DATA SET DESCRIPTOR #10:
Data Set Name                         : Radiance MDS(7)
Data Set Type                         : M
External Product Reference            :
DS Offset in bytes                    : 181333875
Total Size of DS in bytes             : 29729920
Number of DSRs within the DS          : 13184
Length of the DSRs in bytes           : 2255


DATA SET DESCRIPTOR #11:
Data Set Name                         : Radiance MDS(8)
Data Set Type                         : M
External Product Reference            :
DS Offset in bytes                    : 211063795
Total Size of DS in bytes             : 29729920
Number of DSRs within the DS          : 13184
Length of the DSRs in bytes           : 2255
```

```
DATA SET DESCRIPTOR #12:
Data Set Name                          : Radiance MDS(9)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 240793715
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #13:
Data Set Name                          : Radiance MDS(10)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 270523635
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #14:
Data Set Name                          : Radiance MDS(11)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 300253555
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #15:
Data Set Name                          : Radiance MDS(12)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 329983475
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #16:
Data Set Name                          : Radiance MDS(13)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 359713395
```

```
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #17:
Data Set Name                          : Radiance MDS(14)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 389443315
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #18:
Data Set Name                          : Radiance MDS(15)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 419173235
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #19:
Data Set Name                          : Flags MDS(16)
Data Set Type                          : M
External Product Reference             :
DS Offset in bytes                     : 448903155
Total Size of DS in bytes              : 29729920
Number of DSRs within the DS           : 13184
Length of the DSRs in bytes            : 2255


DATA SET DESCRIPTOR #20:
Data Set Name                          : MERIS_SOURCE_PACKETS
Data Set Type                          : R
External Product Reference             : MER_RR__0PNPDK20030408_093509_000022082015_00208_05773_0110.N1
DS Offset in bytes                     : 0
Total Size of DS in bytes              : 0
Number of DSRs within the DS           : 0
Length of the DSRs in bytes            : 0


DATA SET DESCRIPTOR #21:
```

```
Data Set Name                           : INSTRUMENT_DATA_FILE
Data Set Type                           : R
External Product Reference              : MER_INS_AXVIEC20021009_091219_20020730_120000_20121008_190821
DS Offset in bytes                      : 0
Total Size of DS in bytes               : 0
Number of DSRs within the DS            : 0
Length of the DSRs in bytes             : 0


DATA SET DESCRIPTOR #22:
Data Set Name                           : PROCESSING_PARAMS_L1B_FILE
Data Set Type                           : R
External Product Reference              : MER_CP1_AXVIEC20021001_093058_20020730_120000_20120920_173421
DS Offset in bytes                      : 0
Total Size of DS in bytes               : 0
Number of DSRs within the DS            : 0
Length of the DSRs in bytes             : 0


DATA SET DESCRIPTOR #23:
Data Set Name                           : RADIOMETRIC_CALIBRATION_FILE
Data Set Type                           : R
External Product Reference              : MER_RAC_AXVIEC20030327_143814_20030331_130000_20130213_194602
DS Offset in bytes                      : 0
Total Size of DS in bytes               : 0
Number of DSRs within the DS            : 0
Length of the DSRs in bytes             : 0


DATA SET DESCRIPTOR #24:
Data Set Name                           : DIGITAL_ELEVATION_MODEL_FILE
Data Set Type                           : R
External Product Reference              : AUX_DEM_AXVIEC20020123_121901_20020101_000000_20200101_000000
DS Offset in bytes                      : 0
Total Size of DS in bytes               : 0
Number of DSRs within the DS            : 0
Length of the DSRs in bytes             : 0


DATA SET DESCRIPTOR #25:
Data Set Name                           : DIGITAL_ROUGHNESS_MODEL_FILE
Data Set Type                           : R
External Product Reference              : MER_DRM_AXVIEC20020122_083343_20020101_000000_20200101_000000
DS Offset in bytes                      : 0
Total Size of DS in bytes               : 0
Number of DSRs within the DS            : 0
```

```
Length of the DSRs in bytes              : 0


DATA SET DESCRIPTOR #26:
Data Set Name                            : LAND_SEA_MASK_DATA_FILE
Data Set Type                            : R
External Product Reference               : AUX_LSM_AXVIEC20020123_141228_20020101_000000_20200101_000000
DS Offset in bytes                       : 0
Total Size of DS in bytes                : 0
Number of DSRs within the DS             : 0
Length of the DSRs in bytes              : 0


DATA SET DESCRIPTOR #27:
Data Set Name                            : ECMWF_DATA_FILE
Data Set Type                            : R
External Product Reference               : AUX_ECF_AXNECM20030408_061255_20030408_090000_20030408_210000
DS Offset in bytes                       : 0
Total Size of DS in bytes                : 0
Number of DSRs within the DS             : 0
Length of the DSRs in bytes              : 0


DATA SET DESCRIPTOR #28:
Data Set Name                            : ORBIT_STATE_VECTOR_FILE
Data Set Type                            : R
External Product Reference               : AUX_FPO_AXVPDS20030407_230111_20030407_193842_20030417_210458
DS Offset in bytes                       : 0
Total Size of DS in bytes                : 0
Number of DSRs within the DS             : 0
Length of the DSRs in bytes              : 0


DATA SET DESCRIPTOR #29:
Data Set Name                            : ATTITUDE_DATA_FILE
Data Set Type                            : R
External Product Reference               : AUX_ATT_AXVIEC20020924_131534_20020703_120000_20781231_235959
DS Offset in bytes                       : 0
Total Size of DS in bytes                : 0
Number of DSRs within the DS             : 0
Length of the DSRs in bytes              : 0
```

A.4 Data Set #1 – “Quality ADS”

No.	Date	Blank	Out of Range 1	Out of Range 2	Out of Range 3	Out of Range 4	Out of Range 5	Out R. blank 1	Out R. blank 2	Out R. blank 3	Out R. blank 4	Out R. blank 5
1	103109583.820036	1	....	....	....	....	....	....	....	....	....	....
2	103109606.346500	1	....	....	....	....	....	....	....	....	....	....
3	103109628.872964	1	....	....	....	....	....	....	....	....	....	....
4	103109651.399428	1	....	....	....	....	....	....	....	....	....	....
5	103109673.925892	1	....	....	....	....	....	....	....	....	....	....
6	103109696.452356	0	....	....	....	....	....	....	....	....	....	....
7	103109718.978820	0	....	....	....	....	....	....	....	....	....	....
8	103109741.505284	0	....	....	....	....	....	....	....	....	....	....
9	103109764.031748	0	....	....	....	....	....	....	....	....	....	....
10	103109786.558212	0	....	....	....	....	....	....	....	....	....	....
11	103109809.084676	0	....	....	....	....	....	....	....	....	....	....
12	103109831.611140	0	....	....	....	....	....	....	....	....	....	....
13	103109854.311191	0	....	....	....	....	....	....	....	....	....	....
14	103109876.837655	0	....	....	....	....	....	....	....	....	....	....
15	103109899.364119	0	....	....	....	....	....	....	....	....	....	....
16	103109921.890583	0	....	....	....	....1...........	....	....	....	....	....	....
17	103109944.417047	0	....	....1...........	....	....1...........	....	....	....	....	....	....
18	103109966.943511	0	....	....1...........	....	....1...........	....	....	....	....	....	....
19	103109989.469975	0	....	....1...........	....	....1...........	....	....	....	....	....	....
20	103110011.996439	0	....	....1...........	....	....1...........	....	....	....	....	....	....
21	103110034.522903	0	....	....1...........	....	...11...........	....1...........	....	....	....	....	....
22	103110057.049367	0	....	....1...........	....	...11...........	....1...........	....	....	....	....	....
23	103110079.575831	0	....	....1...........	....	...11...........	....1...........	....	....	....	....	....
24	103110102.102295	0	....	....1...........	....	...11...........	....1...........	....	....	....	....	....
25	103110124.631489	0	....	....	....	....	....1...........	....	....	....	....	....
26	103110147.157953	0	....	....	....	....	....1...........	....	....	....	....	....
27	103110169.684417	0	....	....1...........	....	....	....1...........	....	....	....	....	....
28	103110192.210881	0	....	....1...........	....	....	....1...........	....	....	....	....	....
29	103110214.737345	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
30	103110237.263809	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
31	103110259.790273	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
32	103110282.316737	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
33	103110304.843201	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
34	103110327.369665	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
35	103110349.896129	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
36	103110372.422593	0	....	...11...........	....	....1...........	....1...........	....	....	....	....	....
37	103110394.951787	0	....	....	....	....	....1...........	....	....	....	....	....
38	103110417.478251	0	....	....	....	....	....1...........	....	....	....	....	....
39	103110440.004715	0	....	....	....	....	....1...........	....	....	....	....	....
40	103110462.531179	0	....	....	....	....	....1...........	....	....	....	....	....
41	103110485.057643	0	....	....	....	....	....1...........	....	....	....	....	....
42	103110507.584107	0	....	....	....	....	....1...........	....	....	....	....	....
43	103110530.110571	0	....	....1...........	....	....1...........	....1...........	....	....	....	....	....
44	103110552.637035	0	....	....1...........	....	....1...........	...11...........	....	....	....	....	....
45	103110575.163499	0	....	....1...........	....	....1...........	...11...........	....	....	....	....	....
46	103110597.689963	0	....	....1...........	....	....1...........	...11...........	....	....	....	....	....
47	103110620.216427	0	....	....1...........	....	...11...........	...11...........	....	....	....	....	....
48	103110642.742891	0	....	....1...........	....	...11...........	...11...........	....	....	....	....	....
49	103110665.268179	0	....	....	....	....	....1...........	....	....	....	....	....
50	103110687.794643	0	....	....	....	....	....1...........	....	....	....	....	....
51	103110710.321107	0	....	...11...........	....	....	....1...........	....	....	....	....	....
52	103110732.847571	0	....	...11..1........	....	....	....1...........	....	....	....	....	....
53	103110755.374035	0	.......1.1......	...11..1.1......	....	....	....1...........	....	....	....	....	....
54	103110777.900499	0	.......1.1......	...11..1.1......	....	....1...........	...11...........	....	....	....	....	....
55	103110800.426963	0	...1...1.1......	...11..1.1......	....	....1...........	...11...........	....	....	....	....	....
56	103110822.953427	0	...1...1.1......	...11..1.1......	....	...11...........	...11...........	....	....	....	....	....

```
 57 103110845.479891  0  ...1...1.1...... ...11..1.1...... ................ ...11........... ...11...........  ................ ................ ................ ................ ................
 58 103110868.006355  0  ...1...1.1...... ...11..1.1...... ................ ...11........... ...11...........  ................ ................ ................ ................ ................
 59 103110890.532819  0  ...1...1.1...... ...11..1.1...... ................ ...11........... ...11...........  ................ ................ ................ ................ ................
 60 103110913.059283  0  ...1...1.1...... ...11..1.1...... ................ ...11........... ...11...........  ................ ................ ................ ................ ................
 61 103110935.588477  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 62 103110958.114941  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 63 103110980.641405  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 64 103111003.167869  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 65 103111025.694333  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 66 103111048.220797  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 67 103111070.747261  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 68 103111093.273725  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 69 103111115.800189  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 70 103111138.326653  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 71 103111160.853117  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 72 103111183.379581  0  ................ ....1........... ................ ....1........... ................  ................ ................ ................ ................ ................
 73 103111205.904869  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 74 103111228.431333  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 75 103111250.957797  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 76 103111273.484261  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 77 103111296.010725  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 78 103111318.537189  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 79 103111341.063653  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 80 103111363.590117  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 81 103111386.116581  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 82 103111408.643045  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 83 103111431.169509  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 84 103111453.695973  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 85 103111476.225167  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 86 103111498.751631  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 87 103111521.278095  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 88 103111543.804559  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 89 103111566.331023  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 90 103111588.857487  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 91 103111611.383951  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 92 103111633.910415  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 93 103111656.436879  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 94 103111678.963343  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 95 103111701.489807  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 96 103111724.016271  0  ................ ................ ................ ................ ....1...........  ................ ................ ................ ................ ................
 97 103111746.721246  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 98 103111769.247710  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
 99 103111791.774174  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
100 103111814.300638  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
101 103111836.827102  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
102 103111859.353566  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
103 103111881.880030  0  ................ ................ ................ ................ ................  ................ ................ ................ ................ ................
```

A.5 DATA SET #2 - “Scaling Factor GADS”

```
Scaling factor - altitude               : 1.000000
Scaling factor - roughness              : 1.000000
Scaling factor - zonal wind             : 0.100000
Scaling factor - meridional wind        : 0.100000
```

```
Scaling factor - atmospheric pressure    : 0.100000
Scaling factor - ozone                   : 0.010000
Scaling factor - relative humidity       : 0.100000
Radiances:
   Band 1                                : 0.009333
   Band 2                                : 0.010466
   Band 3                                : 0.011501
   Band 4                                : 0.010642
   Band 5                                : 0.009280
   Band 6                                : 0.008147
   Band 7                                : 0.006815
   Band 8                                : 0.006899
   Band 9                                : 0.006270
   Band 10                               : 0.008617
   Band 11                               : 0.008811
   Band 12                               : 0.003613
   Band 13                               : 0.003546
   Band 14                               : 0.006090
   Band 15                               : 0.005418
Gain setting:
   Module #1 - Band 1                    : 9
   Module #1 - Band 2                    : 10
   Module #1 - Band 3                    : 11
   Module #1 - Band 4                    : 11
   Module #1 - Band 5                    : 11
   Module #1 - Band 6                    : 11
   Module #1 - Band 7                    : 11
   Module #1 - Band 8                    : 10
   Module #1 - Band 9                    : 11
   Module #1 - Band 10                   : 11
   Module #1 - Band 11                   : 11
   Module #1 - Band 12                   : 10
   Module #1 - Band 13                   : 9
   Module #1 - Band 14                   : 11
   Module #1 - Band 15                   : 10
   Module #1 - Band 16                   : 0
   Module #2 - Band 1                    : 9
   Module #2 - Band 2                    : 10
   Module #2 - Band 3                    : 11
   Module #2 - Band 4                    : 11
   Module #2 - Band 5                    : 11
   Module #2 - Band 6                    : 11
   Module #2 - Band 7                    : 11
   Module #2 - Band 8                    : 10
   Module #2 - Band 9                    : 11
   Module #2 - Band 10                   : 11
```

```
Module #2 - Band 11                  : 11
Module #2 - Band 12                  : 10
Module #2 - Band 13                  : 9
Module #2 - Band 14                  : 11
Module #2 - Band 15                  : 10
Module #2 - Band 16                  : 0
Module #3 - Band 1                   : 9
Module #3 - Band 2                   : 10
Module #3 - Band 3                   : 11
Module #3 - Band 4                   : 11
Module #3 - Band 5                   : 11
Module #3 - Band 6                   : 11
Module #3 - Band 7                   : 11
Module #3 - Band 8                   : 10
Module #3 - Band 9                   : 11
Module #3 - Band 10                  : 11
Module #3 - Band 11                  : 11
Module #3 - Band 12                  : 10
Module #3 - Band 13                  : 9
Module #3 - Band 14                  : 11
Module #3 - Band 15                  : 10
Module #3 - Band 16                  : 0
Module #4 - Band 1                   : 9
Module #4 - Band 2                   : 10
Module #4 - Band 3                   : 11
Module #4 - Band 4                   : 11
Module #4 - Band 5                   : 11
Module #4 - Band 6                   : 11
Module #4 - Band 7                   : 11
Module #4 - Band 8                   : 10
Module #4 - Band 9                   : 11
Module #4 - Band 10                  : 11
Module #4 - Band 11                  : 11
Module #4 - Band 12                  : 10
Module #4 - Band 13                  : 9
Module #4 - Band 14                  : 11
Module #4 - Band 15                  : 10
Module #4 - Band 16                  : 0
Module #5 - Band 1                   : 9
Module #5 - Band 2                   : 10
Module #5 - Band 3                   : 11
Module #5 - Band 4                   : 11
Module #5 - Band 5                   : 11
Module #5 - Band 6                   : 11
Module #5 - Band 7                   : 11
Module #5 - Band 8                   : 10
```

```
   Module #5 - Band 9                 : 11
   Module #5 - Band 10                : 11
   Module #5 - Band 11                : 11
   Module #5 - Band 12                : 10
   Module #5 - Band 13                : 9
   Module #5 - Band 14                : 11
   Module #5 - Band 15                : 10
   Module #5 - Band 16                : 0
Sampling rate                         : 175988 (1.e-6 s)
Sun spectral flux:
   Band 1                             : 1712.932861
   Band 2                             : 1870.372070
   Band 3                             : 1922.504639
   Band 4                             : 1925.252441
   Band 5                             : 1799.244751
   Band 6                             : 1647.355835
   Band 7                             : 1527.762451
   Band 8                             : 1468.159302
   Band 9                             : 1403.901978
   Band 10                            : 1262.930786
   Band 11                            : 1250.996094
   Band 12                            : 1173.983521
   Band 13                            : 955.977417
   Band 14                            : 927.749390
   Band 15                            : 893.166138
```

A.6 DATA SET #3 - “Tie points ADS”

No.	Date	FIRST (Lat., Lon.)	Alt.	Rough.	Corr. Lat.	Lon.	Sun (Zen., Azi.)	View (Zen., Azi.)	LAST (Lat., Lon.)	Alt.	Rough.	Corr. Lat.	Lon.	Sun (Zen., Azi.)	View (Zen., Azi.)
1	103109583.820036	(69.010207, 47.018145)	-51	0	-4 1e-6	-14 1e-6	(62.2, 191.0)	(40.5, 311.8)	(74.042619, 17.620962)	-242	0	7 1e-6	114 1e-6	(67.9, 158.9)	(40.5, 103.8)
9	103109606.346500	(67.975274, 44.591548)	20	11	1 1e-6	5 1e-6	(61.1, 188.4)	(40.5, 309.6)	(72.747260, 16.535418)	-437	0	13 1e-6	192 1e-6	(66.8, 157.7)	(40.5, 103.1)
17	103109628.872964	(66.908355, 42.372819)	-7	1	0 1e-6	-1 1e-6	(59.9, 186.1)	(40.5, 307.6)	(71.447998, 15.575876)	-1293	0	37 1e-6	532 1e-6	(65.7, 156.5)	(40.5, 102.5)
25	103109651.399428	(65.813653, 40.339576)	-8	27	0 1e-6	-2 1e-6	(58.7, 183.9)	(40.5, 305.8)	(70.145543, 14.717798)	-2501	0	69 1e-6	966 1e-6	(64.6, 155.4)	(40.5, 102.0)
33	103109673.925892	(64.694747, 38.471623)	-1	16	0 1e-6	0 1e-6	(57.6, 181.9)	(40.5, 304.2)	(68.840428, 13.942550)	-91	0	2 1e-6	33 1e-6	(63.5, 154.4)	(40.5, 101.5)
41	103109696.452356	(63.554680, 36.750928)	180	30	13 1e-6	45 1e-6	(56.4, 180.0)	(40.5, 302.7)	(67.533060, 13.235743)	-238	0	6 1e-6	82 1e-6	(62.5, 153.5)	(40.5, 101.2)
49	103109718.978820	(62.396046, 35.161501)	60	23	4 1e-6	14 1e-6	(55.3, 178.2)	(40.5, 301.3)	(66.223758, 12.586091)	-71	75	1 1e-6	23 1e-6	(61.4, 152.5)	(40.5, 100.9)
57	103109741.505284	(61.221061, 33.689225)	120	19	8 1e-6	28 1e-6	(54.1, 176.5)	(40.5, 300.0)	(64.912769, 11.984627)	233	77	-5 1e-6	-72 1e-6	(60.3, 151.6)	(40.5, 100.6)
65	103109764.031748	(60.031621, 32.321670)	10	9	0 1e-6	2 1e-6	(53.0, 174.8)	(40.5, 298.9)	(63.600293, 11.424131)	442	65	-10 1e-6	-131 1e-6	(59.3, 150.7)	(40.5, 100.4)
73	103109786.558212	(58.829354, 31.047899)	50	6	3 1e-6	11 1e-6	(51.9, 173.2)	(40.6, 297.8)	(62.286487, 10.898731)	647	83	-15 1e-6	-184 1e-6	(58.3, 149.8)	(40.6, 100.2)
81	103109809.084676	(57.615663, 29.858292)	64	11	3 1e-6	14 1e-6	(50.7, 171.7)	(40.6, 296.9)	(60.971483, 10.403599)	635	88	-14 1e-6	-173 1e-6	(57.2, 149.0)	(40.6, 100.1)
89	103109831.611140	(56.391762, 28.744384)	148	11	8 1e-6	32 1e-6	(49.6, 170.3)	(40.6, 296.0)	(59.655387, 9.934729)	195	92	-4 1e-6	-51 1e-6	(56.2, 148.1)	(40.6, 100.0)
97	103109854.312018	(55.149121, 27.690865)	173	5	9 1e-6	36 1e-6	(48.5, 168.8)	(40.6, 295.1)	(58.328084, 9.485400)	-635	0	14 1e-6	160 1e-6	(55.2, 147.2)	(40.6, 99.9)
105	103109876.838482	(53.907758, 26.707302)	207	12	11 1e-6	43 1e-6	(47.4, 167.4)	(40.6, 294.4)	(57.010045, 9.059673)	4	0	0 1e-6	0 1e-6	(54.2, 146.3)	(40.6, 99.8)
113	103109899.364946	(52.658958, 25.779529)	148	5	7 1e-6	30 1e-6	(46.3, 166.0)	(40.6, 293.6)	(55.691137, 8.651612)	25	4	0 1e-6	-5 1e-6	(53.2, 145.4)	(40.6, 99.7)
121	103109921.891410	(51.403423, 24.902395)	166	7	8 1e-6	33 1e-6	(45.2, 164.6)	(40.6, 293.0)	(54.371413, 8.259167)	-12	0	0 1e-6	2 1e-6	(52.2, 144.5)	(40.6, 99.7)
129	103109944.417874	(50.141770, 24.071324)	221	14	11 1e-6	42 1e-6	(44.1, 163.2)	(40.6, 292.4)	(53.050918, 7.880573)	12	4	0 1e-6	-2 1e-6	(51.2, 143.5)	(40.6, 99.6)
137	103109966.944338	(48.874542, 23.282246)	788	90	39 1e-6	149 1e-6	(43.0, 161.9)	(40.6, 291.8)	(51.729692, 7.514298)	80	13	-1 1e-6	-17 1e-6	(50.3, 142.5)	(40.6, 99.6)

145	103109989.470802	(47.602224, 22.531532)	127	10	6 1e-6	23 1e-6	(42.0, 160.5)	(40.6, 291.2)	(50.407769, 7.159013)	467	47	-10 1e-6	-97 1e-6	(49.3, 141.5)	(40.6, 99.6)
153	103110011.997266	(46.325245, 21.815938)	155	132	7 1e-6	28 1e-6	(40.9, 159.1)	(40.6, 290.7)	(49.085180, 6.813549)	268	16	-6 1e-6	-54 1e-6	(48.4, 140.5)	(40.6, 99.6)
161	103110034.523730	(45.043987, 21.132555)	103	22	4 1e-6	18 1e-6	(39.9, 157.6)	(40.7, 290.3)	(47.761952, 6.476881)	335	12	-7 1e-6	-66 1e-6	(47.5, 139.4)	(40.7, 99.6)
169	103110057.050194	(43.758792, 20.478773)	324	116	14 1e-6	56 1e-6	(38.9, 156.2)	(40.7, 289.8)	(46.438111, 6.148100)	1288	259	-29 1e-6	-248 1e-6	(46.6, 138.3)	(40.7, 99.6)
177	103110079.576658	(42.469970, 19.852244)	1694	429	75 1e-6	292 1e-6	(37.9, 154.7)	(40.7, 289.4)	(45.113678, 5.826400)	496	410	-11 1e-6	-93 1e-6	(45.7, 137.2)	(40.7, 99.7)
185	103110102.103122	(41.177797, 19.250847)	-85	0	-3 1e-6	-14 1e-6	(36.9, 153.2)	(40.7, 289.0)	(43.788677, 5.511059)	541	48	-12 1e-6	-99 1e-6	(44.9, 136.0)	(40.7, 99.7)
193	103110124.632316	(39.882367, 18.672597)	-128	0	-5 1e-6	-21 1e-6	(35.9, 151.6)	(40.7, 288.6)	(42.462966, 5.201393)	-1915	0	43 1e-6	345 1e-6	(44.0, 134.8)	(40.7, 99.7)
201	103110147.158780	(38.584220, 18.115900)	-2583	0	-109 1e-6	-424 1e-6	(34.9, 150.0)	(40.7, 288.3)	(41.136887, 4.896896)	-2581	0	59 1e-6	456 1e-6	(43.2, 133.6)	(40.7, 99.8)
209	103110169.685244	(37.283408, 17.579107)	-2866	0	-119 1e-6	-463 1e-6	(34.0, 148.3)	(40.7, 287.9)	(39.810298, 4.597003)	-792	0	18 1e-6	137 1e-6	(42.4, 132.3)	(40.7, 99.8)
217	103110192.211708	(35.980119, 17.060785)	-3596	0	-147 1e-6	-572 1e-6	(33.1, 146.5)	(40.7, 287.6)	(38.483217, 4.301234)	-2584	0	59 1e-6	439 1e-6	(41.7, 130.9)	(40.7, 99.9)
225	103110214.738172	(34.674525, 16.559626)	-1544	0	-62 1e-6	-242 1e-6	(32.2, 144.7)	(40.7, 287.3)	(37.155664, 4.009153)	-2339	0	54 1e-6	391 1e-6	(40.9, 129.5)	(40.7, 99.9)
233	103110237.264636	(33.366786, 16.074438)	-1212	0	-48 1e-6	-187 1e-6	(31.3, 142.8)	(40.7, 287.0)	(35.827656, 3.720359)	664	20	-15 1e-6	-109 1e-6	(40.2, 128.1)	(40.7, 100.0)
241	103110259.791100	(32.057047, 15.604127)	-64	0	-2 1e-6	-9 1e-6	(30.5, 140.9)	(40.7, 286.7)	(34.499212, 3.434483)	1038	32	-24 1e-6	-167 1e-6	(39.5, 126.6)	(40.7, 100.0)
249	103110282.317564	(30.745443, 15.147690)	152	22	5 1e-6	22 1e-6	(29.7, 138.8)	(40.8, 286.5)	(33.170350, 3.151185)	755	9	-17 1e-6	-120 1e-6	(38.9, 125.1)	(40.8, 100.1)
257	103110304.844028	(29.432101, 14.704209)	344	17	13 1e-6	51 1e-6	(28.9, 136.7)	(40.8, 286.2)	(31.841091, 2.870148)	689	18	-16 1e-6	-108 1e-6	(38.3, 123.5)	(40.8, 100.2)
265	103110327.370492	(28.117135, 14.272835)	546	18	20 1e-6	80 1e-6	(28.2, 134.4)	(40.8, 286.0)	(30.511453, 2.591077)	453	7	-10 1e-6	-70 1e-6	(37.7, 121.8)	(40.8, 100.3)
273	103110349.896956	(26.800654, 13.852787)	504	21	18 1e-6	73 1e-6	(27.5, 132.1)	(40.8, 285.8)	(29.181457, 2.313696)	471	12	-11 1e-6	-71 1e-6	(37.1, 120.2)	(40.8, 100.3)
281	103110372.423420	(25.482760, 13.443343)	646	3	23 1e-6	93 1e-6	(26.8, 129.6)	(40.8, 285.5)	(27.851122, 2.037744)	529	23	-12 1e-6	-79 1e-6	(36.6, 118.4)	(40.8, 100.4)
289	103110394.948708	(24.163617, 13.043857)	717	6	25 1e-6	102 1e-6	(26.2, 127.1)	(40.8, 285.3)	(26.520540, 1.762992)	152	2	-3 1e-6	-22 1e-6	(36.1, 116.6)	(40.8, 100.5)
297	103110417.475172	(22.843176, 12.653666)	767	12	27 1e-6	108 1e-6	(25.7, 124.4)	(40.8, 285.1)	(25.189593, 1.489176)	305	26	-7 1e-6	-44 1e-6	(35.7, 114.8)	(40.8, 100.6)
305	103110440.001636	(21.521591, 12.272217)	719	4	25 1e-6	101 1e-6	(25.2, 121.7)	(40.8, 284.9)	(23.858374, 1.216089)	306	7	-7 1e-6	-44 1e-6	(35.3, 112.9)	(40.8, 100.7)
313	103110462.528100	(20.198940, 11.898976)	400	6	13 1e-6	55 1e-6	(24.7, 118.9)	(40.8, 284.8)	(22.526905, 0.943519)	360	1	-9 1e-6	-51 1e-6	(35.0, 111.0)	(40.8, 100.7)
321	103110485.054564	(18.875300, 11.533442)	555	3	18 1e-6	77 1e-6	(24.4, 115.9)	(40.8, 284.6)	(21.195211, 0.671259)	382	3	-9 1e-6	-54 1e-6	(34.7, 109.1)	(40.8, 100.8)
329	103110507.581028	(17.550742, 11.175152)	411	0	13 1e-6	56 1e-6	(24.0, 112.9)	(40.8, 284.4)	(19.863315, 0.399112)	381	2	-9 1e-6	-53 1e-6	(34.4, 107.1)	(40.8, 100.9)
337	103110530.107492	(16.225334, 10.823668)	397	6	13 1e-6	54 1e-6	(23.8, 109.9)	(40.8, 284.2)	(18.531245, 0.126886)	403	2	-10 1e-6	-56 1e-6	(34.2, 105.1)	(40.8, 101.0)
345	103110552.633956	(14.899140, 10.478584)	437	4	14 1e-6	59 1e-6	(23.6, 106.8)	(40.8, 284.1)	(17.199026, -0.145608)	324	3	-8 1e-6	-45 1e-6	(34.1, 103.1)	(40.8, 101.1)
353	103110575.160420	(13.572225, 10.139516)	465	12	15 1e-6	63 1e-6	(23.5, 103.6)	(40.8, 283.9)	(15.866684, -0.418554)	386	9	-10 1e-6	-53 1e-6	(33.9, 101.0)	(40.8, 101.2)
361	103110597.686884	(12.244646, 9.806103)	361	5	11 1e-6	48 1e-6	(23.4, 100.5)	(40.8, 283.8)	(14.534250, -0.692135)	302	12	-8 1e-6	-41 1e-6	(33.9, 99.0)	(40.8, 101.3)
369	103110620.213348	(10.916460, 9.478006)	610	24	19 1e-6	81 1e-6	(23.5, 97.3)	(40.8, 283.6)	(13.201750, -0.966529)	303	12	-8 1e-6	-41 1e-6	(33.9, 96.9)	(40.8, 101.4)
377	103110642.739812	(9.587724, 9.154905)	1139	12	35 1e-6	152 1e-6	(23.5, 94.2)	(40.8, 283.5)	(11.869216, -1.241915)	273	0	-7 1e-6	-37 1e-6	(33.9, 94.9)	(40.8, 101.5)
385	103110665.269006	(8.258327, 8.836457)	170	6	5 1e-6	22 1e-6	(23.7, 91.1)	(40.8, 283.3)	(10.536516, -1.518506)	152	19	-4 1e-6	-20 1e-6	(34.0, 92.9)	(40.8, 101.6)
393	103110687.795470	(6.928644, 8.522453)	152	4	4 1e-6	20 1e-6	(23.9, 88.0)	(40.8, 283.2)	(9.204005, -1.796414)	178	6	-4 1e-6	-23 1e-6	(34.1, 90.9)	(40.8, 101.7)
401	103110710.321934	(5.598562, 8.212579)	152	14	4 1e-6	20 1e-6	(24.2, 85.1)	(40.8, 283.0)	(7.871554, -2.075851)	229	23	-6 1e-6	-30 1e-6	(34.3, 88.9)	(40.8, 101.8)
409	103110732.848398	(4.268129, 7.906576)	-4	0	0 1e-6	0 1e-6	(24.6, 82.2)	(40.8, 282.9)	(6.539196, -2.357001)	146	77	-4 1e-6	-19 1e-6	(34.6, 86.9)	(40.8, 101.9)
417	103110755.374862	(2.937389, 7.604195)	-2314	0	-69 1e-6	-306 1e-6	(25.0, 79.4)	(40.8, 282.8)	(5.206967, -2.640048)	41	1	-1 1e-6	-5 1e-6	(34.8, 85.0)	(40.8, 102.1)
425	103110777.901326	(1.606388, 7.305199)	-1644	0	-48 1e-6	-217 1e-6	(25.5, 76.7)	(40.8, 282.7)	(3.874902, -2.925181)	-2916	0	83 1e-6	387 1e-6	(35.2, 83.1)	(40.8, 102.2)
433	103110800.427790	(0.275169, 7.009358)	-2809	0	-82 1e-6	-371 1e-6	(26.0, 74.2)	(40.8, 282.5)	(2.543036, -3.212592)	-4979	0	143 1e-6	660 1e-6	(35.5, 81.3)	(40.8, 102.3)
441	103110822.954254	(-1.056227, 6.716454)	-3197	0	-93 1e-6	-423 1e-6	(26.6, 71.7)	(40.8, 282.4)	(1.211409, -3.502478)	-5006	0	145 1e-6	662 1e-6	(36.0, 79.5)	(40.8, 102.4)
449	103110845.480718	(-2.387761, 6.426274)	-3625	0	-104 1e-6	-480 1e-6	(27.2, 69.4)	(40.8, 282.3)	(-0.119941, -3.795045)	-5006	0	147 1e-6	662 1e-6	(36.4, 77.8)	(40.8, 102.5)
457	103110868.007182	(-3.719394, 6.138614)	-4544	0	-129 1e-6	-603 1e-6	(27.9, 67.1)	(40.8, 282.2)	(-1.450976, -4.090501)	-5000	0	148 1e-6	661 1e-6	(36.9, 76.1)	(40.8, 102.6)
465	103110890.533646	(-5.051087, 5.853275)	-4817	0	-136 1e-6	-640 1e-6	(28.6, 65.0)	(40.8, 282.1)	(-2.781653, -4.389063)	-4803	0	143 1e-6	635 1e-6	(37.4, 74.5)	(40.8, 102.8)
473	103110913.060110	(-6.382805, 5.570063)	-4885	0	-137 1e-6	-651 1e-6	(29.4, 63.0)	(40.8, 282.0)	(-4.111930, -4.690959)	-4402	0	133 1e-6	582 1e-6	(38.0, 72.9)	(40.8, 102.9)
481	103110935.585398	(-7.714442, 5.288802)	-5090	0	-141 1e-6	-680 1e-6	(30.1, 61.2)	(40.7, 281.8)	(-5.441695, -4.996407)	-4740	0	144 1e-6	627 1e-6	(38.6, 71.4)	(40.7, 103.0)
489	103110958.111862	(-9.046103, 5.009279)	-5289	0	-145 1e-6	-709 1e-6	(31.0, 59.4)	(40.7, 281.7)	(-6.771040, -5.305685)	-4410	0	135 1e-6	585 1e-6	(39.3, 70.0)	(40.7, 103.2)
497	103110980.638326	(-10.377686, 4.731325)	-5416	0	-147 1e-6	-729 1e-6	(31.8, 57.7)	(40.7, 281.6)	(-8.099851, -5.619034)	-4600	0	143 1e-6	611 1e-6	(39.9, 68.6)	(40.7, 103.3)
505	103111003.164790	(-11.709158, 4.454759)	-5467	0	-147 1e-6	-739 1e-6	(32.7, 56.1)	(40.7, 281.5)	(-9.428079, -5.936724)	-4299	0	135 1e-6	573 1e-6	(40.6, 67.3)	(40.7, 103.4)
513	103111025.691254	(-13.040488, 4.179403)	-5429	0	-145 1e-6	-738 1e-6	(33.6, 54.6)	(40.7, 281.4)	(-10.755675, -6.259039)	-4438	0	140 1e-6	593 1e-6	(41.4, 66.0)	(40.7, 103.6)
521	103111048.217718	(-14.371647, 3.905077)	-5434	0	-144 1e-6	-743 1e-6	(34.5, 53.2)	(40.7, 281.3)	(-12.082587, -6.586279)	-4405	0	141 1e-6	591 1e-6	(42.1, 64.8)	(40.7, 103.7)
529	103111070.744182	(-15.702605, 3.631604)	-5437	0	-142 1e-6	-748 1e-6	(35.5, 51.9)	(40.7, 281.2)	(-13.408761, -6.918758)	-3984	0	129 1e-6	536 1e-6	(42.9, 63.7)	(40.7, 103.9)
537	103111093.270646	(-17.033335, 3.358804)	-5403	0	-140 1e-6	-748 1e-6	(36.4, 50.7)	(40.7, 281.1)	(-14.734143, -7.256813)	-4198	0	137 1e-6	568 1e-6	(43.7, 62.6)	(40.7, 104.0)
545	103111115.797110	(-18.363809, 3.086495)	-5407	0	-139 1e-6	-754 1e-6	(37.4, 49.5)	(40.6, 281.0)	(-16.058674, -7.600796)	-4331	0	143 1e-6	589 1e-6	(44.6, 61.6)	(40.6, 104.2)
553	103111138.323574	(-19.694000, 2.814495)	-5376	0	-137 1e-6	-755 1e-6	(38.4, 48.5)	(40.6, 280.9)	(-17.382294, -7.951087)	-4194	0	140 1e-6	574 1e-6	(45.4, 60.6)	(40.6, 104.4)
561	103111160.850038	(-21.023885, 2.542617)	-5388	0	-136 1e-6	-764 1e-6	(39.4, 47.4)	(40.6, 280.9)	(-18.704940, -8.308085)	-3829	0	129 1e-6	527 1e-6	(46.3, 59.7)	(40.6, 104.5)
569	103111183.376502	(-22.353439, 2.270668)	-5181	0	-130 1e-6	-741 1e-6	(40.5, 46.5)	(40.6, 280.8)	(-20.026546, -8.672218)	-3715	0	127 1e-6	515 1e-6	(47.2, 58.8)	(40.6, 104.7)
577	103111205.905696	(-23.682798, 1.998420)	-5244	0	-130 1e-6	-757 1e-6	(41.5, 45.6)	(40.6, 280.7)	(-21.347203, -9.043991)	-3992	0	138 1e-6	557 1e-6	(48.1, 58.0)	(40.6, 104.9)
585	103111228.432160	(-25.011619, 1.725736)	-5155	0	-127 1e-6	-752 1e-6	(42.6, 44.7)	(40.6, 280.6)	(-22.666518, -9.423801)	-4085	0	143 1e-6	575 1e-6	(49.0, 57.3)	(40.6, 105.1)
593	103111250.958624	(-26.340042, 1.452371)	-5241	0	-128 1e-6	-773 1e-6	(43.6, 43.9)	(40.6, 280.5)	(-23.984574, -9.812219)	-4182	0	148 1e-6	593 1e-6	(50.0, 56.6)	(40.6, 105.3)
601	103111273.485088	(-27.668044, 1.178107)	-4589	0	-111 1e-6	-684 1e-6	(44.7, 43.2)	(40.5, 280.4)	(-25.301289, -10.209809)	-4038	0	145 1e-6	578 1e-6	(50.9, 55.9)	(40.5, 105.5)
609	103111296.011552	(-28.995607, 0.902712)	-4421	0	-106 1e-6	-667 1e-6	(45.8, 42.5)	(40.5, 280.3)	(-26.616578, -10.617177)	-3976	0	144 1e-6	574 1e-6	(51.9, 55.3)	(40.5, 105.7)
617	103111318.538016	(-30.322710, 0.625946)	-2517	0	-60 1e-6	-385 1e-6	(46.9, 41.9)	(40.5, 280.3)	(-27.930350, -11.034978)	-3569	0	131 1e-6	521 1e-6	(52.9, 54.8)	(40.5, 106.0)
625	103111341.064480	(-31.649335, 0.347551)	-4504	0	-106 1e-6	-698 1e-6	(48.0, 41.2)	(40.5, 280.2)	(-29.242505, -11.463918)	-3003	0	112 1e-6	443 1e-6	(53.9, 54.3)	(40.5, 106.2)
633	103111363.590944	(-32.975464, 0.067257)	-2615	0	-61 1e-6	-411 1e-6	(49.1, 40.7)	(40.5, 280.1)	(-30.552940, -11.904761)	-3593	0	136 1e-6	536 1e-6	(54.9, 53.8)	(40.5, 106.4)

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641  103111386.117408  (-34.301080,  -0.215225 ) -4596    0 -107 1e-6  -733 1e-6 ( 50.2,  40.2 )  ( 40.5, 280.1 )   (-31.861543, -12.358337 ) -3451    0  132 1e-6   521 1e-6 ( 55.9,  53.4 )  ( 40.5, 106.7 )
649  103111408.643872  (-35.626165,  -0.500208 ) -4842    0 -112 1e-6  -785 1e-6 ( 51.3,  39.7 )  ( 40.4, 280.0 )   (-33.168194, -12.825543 ) -3134    0  122 1e-6   479 1e-6 ( 57.0,  53.0 )  ( 40.4, 107.0 )
657  103111431.170336  (-36.950703,  -0.788024 ) -5002    0 -115 1e-6  -824 1e-6 ( 52.4,  39.2 )  ( 40.4, 279.9 )   (-34.472761, -13.307359 ) -3626    0  143 1e-6   562 1e-6 ( 58.0,  52.7 )  ( 40.4, 107.3 )
665  103111453.696800  (-38.274677,  -1.079036 ) -5025    0 -115 1e-6  -843 1e-6 ( 53.5,  38.8 )  ( 40.4, 279.9 )   (-35.775105, -13.804851 ) -3494    0  140 1e-6   549 1e-6 ( 59.1,  52.4 )  ( 40.4, 107.6 )
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689  103111521.278922  (-42.243219,  -1.975369 ) -4179    0  -94 1e-6  -742 1e-6 ( 57.0,  37.7 )  ( 40.3, 279.7 )   (-39.667357, -15.403651 ) -3021    0  128 1e-6   496 1e-6 ( 62.3,  51.9 )  ( 40.3, 108.6 )
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705  103111566.331850  (-44.885692,  -2.597094 ) -4021    0  -89 1e-6  -745 1e-6 ( 59.2,  37.2 )  ( 40.3, 279.7 )   (-42.247771, -16.572383 ) -2979    0  131 1e-6   506 1e-6 ( 64.5,  51.7 )  ( 40.3, 109.3 )
713  103111588.858314  (-46.205944,  -2.916923 ) -4186    0  -93 1e-6  -794 1e-6 ( 60.4,  37.0 )  ( 40.3, 279.6 )   (-43.533023, -17.192706 ) -3027    0  136 1e-6   523 1e-6 ( 65.6,  51.7 )  ( 40.3, 109.7 )
721  103111611.384778  (-47.525514,  -3.243639 ) -4239    0  -94 1e-6  -823 1e-6 ( 61.5,  36.8 )  ( 40.3, 279.6 )   (-44.814626, -17.839679 ) -3510    0  161 1e-6   618 1e-6 ( 66.7,  51.8 )  ( 40.3, 110.2 )
729  103111633.911242  (-48.844383,  -3.578024 ) -3947    0  -87 1e-6  -786 1e-6 ( 62.7,  36.6 )  ( 40.2, 279.6 )   (-46.092284, -18.515580 ) -3976    0  186 1e-6   713 1e-6 ( 67.8,  51.9 )  ( 40.2, 110.6 )
737  103111656.437706  (-50.162529,  -3.920955 ) -2962    0  -65 1e-6  -606 1e-6 ( 63.9,  36.5 )  ( 40.2, 279.6 )   (-47.365666, -19.222939 ) -4000    0  191 1e-6   732 1e-6 ( 68.9,  52.0 )  ( 40.2, 111.1 )
745  103111678.964170  (-51.479928,  -4.273426 ) -2400    0  -53 1e-6  -504 1e-6 ( 65.0,  36.4 )  ( 40.2, 279.6 )   (-48.634404, -19.964570 ) -3326    0  163 1e-6   621 1e-6 ( 70.0,  52.2 )  ( 40.2, 111.7 )
753  103111701.490634  (-52.796553,  -4.636560 ) -2033    0  -45 1e-6  -440 1e-6 ( 66.2,  36.3 )  ( 40.2, 279.6 )   (-49.898088, -20.743613 ) -4096    0  205 1e-6   781 1e-6 ( 71.2,  52.5 )  ( 40.2, 112.2 )
761  103111724.017098  (-54.112373,  -5.011641 ) -2463    0  -54 1e-6  -549 1e-6 ( 67.3,  36.2 )  ( 40.2, 279.7 )   (-51.156253, -21.563575 ) -4540    0  233 1e-6   885 1e-6 ( 72.3,  52.8 )  ( 40.2, 112.9 )
769  103111746.718167  (-55.437543,  -5.403206 ) -2992    0  -66 1e-6  -689 1e-6 ( 68.5,  36.2 )  ( 40.2, 279.7 )   (-52.418057, -22.435275 ) -4501    0  238 1e-6   897 1e-6 ( 73.4,  53.2 )  ( 40.2, 113.5 )
777  103111769.244631  (-56.751636,  -5.806939 ) -3104    0  -69 1e-6  -739 1e-6 ( 69.7,  36.2 )  ( 40.1, 279.8 )   (-53.663494, -23.349747 ) -4018    0  218 1e-6   819 1e-6 ( 74.6,  53.7 )  ( 40.1, 114.2 )
785  103111791.771095  (-58.064801,  -6.227764 ) -4006    0  -90 1e-6  -988 1e-6 ( 70.8,  36.3 )  ( 40.1, 279.8 )   (-54.901622, -24.318486 ) -3991    0  223 1e-6   833 1e-6 ( 75.7,  54.2 )  ( 40.1, 115.0 )
793  103111814.297559  (-59.376981,  -6.667977 ) -4999    0 -114 1e-6 -1279 1e-6 ( 72.0,  36.3 )  ( 40.1, 279.9 )   (-56.131674, -25.347094 ) -7005    0  403 1e-6  1498 1e-6 ( 76.9,  54.8 )  ( 40.1, 115.8 )
801  103111836.824023  (-60.688109,  -7.130273 ) -5220    0 -120 1e-6 -1389 1e-6 ( 73.2,  36.5 )  ( 40.1, 280.1 )   (-57.352774, -26.441906 ) -1893    0  112 1e-6   414 1e-6 ( 78.0,  55.5 )  ( 40.1, 116.7 )
809  103111859.350487  (-61.998105,  -7.617840 ) -5204    0 -121 1e-6 -1442 1e-6 ( 74.3,  36.6 )  ( 40.1, 280.2 )   (-58.563918, -27.610088 ) -3209    0  196 1e-6   721 1e-6 ( 79.2,  56.2 )  ( 40.1, 117.6 )
817  103111881.876951  (-63.306870,  -8.134481 ) -5228    0 -124 1e-6 -1513 1e-6 ( 75.5,  36.8 )  ( 40.1, 280.4 )   (-59.763948, -28.859770 ) -2518    0  159 1e-6   580 1e-6 ( 80.3,  57.1 )  ( 40.1, 118.6 )
825  103111904.403415  (-64.614286,  -8.684763 ) -5193    0 -125 1e-6 -1573 1e-6 ( 76.7,  37.1 )  ( 40.1, 280.6 )   (-60.951527, -30.200177 ) -4133    0  271 1e-6   976 1e-6 ( 81.5,  58.1 )  ( 40.1, 119.8 )
```

APPENDIX B DATA INVENTORY

B.1 List of MERIS segments in input

The list of all the receptions is given here below.

RR	Date of reception	Number of tapes	Medium	date of acknow-ledgement e-mail
01	21/03/2003	16	Exabyte	21/03/2003
02	11/04/2003	13	Exabyte	11/04/2003
03	14/04/2003	4	DLT	14/04/2003
04	15/04/2003	7	Exabyte	15/04/2003
05	17/04/2003	1	DLT	17/04/2003
06	25/04/2003	1	DLT	25/04/2003
07	30/04/2003	4	Exabyte	30/04/2003
08	09/05/2003	1	DLT	09/05/2003
09	16/05/2003	18	Exabyte	16/05/2003
10	27/05/2003	1	DLT	27/05/2003

table 3 - List of MERIS data receptions.

The table beneath resumes all the data received for the completion of the work. Data are grouped according to:

- RR Reception. Each reception having been acknowledged by an e-mail.
- TT Number of the tape within the reception.
- SS Number of the MERIS segment found within the tape.

The MERIS file name is the standard one as described in Appendix A of document R-1 (general description) and section 11.2 of document R-6 (“Product Overview” for MERIS instrument). Values of the fields composing the name are recorded here below:

Field	Length	Description
Product ID	10	**MER__RR_1P**: Reduced Resolution Geolocated and Calibrated TOA Radiance (stripline).
Processing Stage flag	1	**N**: Near Real Time product.
Originator ID	3	**PDK**: PDHS-K (Kiruna). **PDE**: PDHS-E (ESRIN).
Start day	8	**YYYYMMDD**: Start day UTC of the first DSR.
		“_”
Start time	6	**HHMMSS**: Start time UTC of the first DSR.
		“_”
Duration	8	**dddddddd**: Time coverage of the product expressed in seconds.
Phase	1	**2**: Mission phase identifier.
Cycle	3	**12, 14, 15, or 16**: Cycle number within the mission phase.
		“_”

Relative orbit	5	**rrrrr**: Relative orbit number within the cycle at the beginning of the product.
		"_"
Absolute orbit	5	**aaaaa**: Absolute orbit number at the beginning of the product.
		"_"
Counter	5	**cccc**: Numerical wrap-around counter incremented by 1 for each new product generated by the product originator.
		"."
Satellite ID	2	**N1**: ENVISAT-1.

RR	TT	SS	File name
01	01	01	MER_RR__1PNPDK20030227_052917_000025672014_00134_05198_0867.N1
01	01	02	MER_RR__1PNPDK20030227_070953_000002022014_00135_05199_0869.N1
01	01	03	MER_RR__1PNPDK20030227_070953_000025672014_00135_05199_0880.N1
01	01	04	MER_RR__1PNPDK20030227_085028_000025672014_00136_05200_0891.N1
01	01	05	MER_RR__1PNPDK20030227_103103_000025672014_00137_05201_0902.N1
01	01	06	MER_RR__1PNPDK20030227_121139_000025672014_00138_05202_0913.N1
01	01	07	MER_RR__1PNPDK20030227_135214_000025672014_00139_05203_0924.N1
01	01	08	MER_RR__1PNPDK20030227_153249_000025682014_00140_05204_0935.N1
01	01	09	MER_RR__1PNPDK20030227_171325_000025672014_00141_05205_0946.N1
01	01	10	MER_RR__1PNPDK20030227_185401_000013512014_00142_05206_0957.N1
01	01	11	MER_RR__1PNPDK20030227_192533_000006752014_00142_05206_0958.N1
01	01	12	MER_RR__1PNPDK20030227_203436_000025672014_00143_05207_0969.N1
01	02	01	MER_RR__1PNPDK20030226_060102_000025672014_00120_05184_0723.N1
01	02	02	MER_RR__1PNPDK20030226_074137_000025672014_00121_05185_0735.N1
01	02	03	MER_RR__1PNPDK20030226_092213_000025672014_00122_05186_0746.N1
01	02	04	MER_RR__1PNPDK20030226_110248_000025672014_00123_05187_0757.N1
01	02	05	MER_RR__1PNPDK20030226_124323_000025672014_00124_05188_0768.N1
01	02	06	MER_RR__1PNPDK20030226_142359_000025672014_00125_05189_0779.N1
01	02	07	MER_RR__1PNPDK20030226_160434_000025672014_00126_05190_0790.N1
01	02	08	MER_RR__1PNPDK20030226_174510_000025672014_00127_05191_0801.N1
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09	12	10	MER_RR__1PNPDK20030422_134837_000002702015_00411_05976_2531.N1
09	12	11	MER_RR__1PNPDK20030422_135307_000002702015_00411_05976_2532.N1
09	12	12	MER_RR__1PNPDK20030422_135737_000002702015_00411_05976_2527.N1
09	12	13	MER_RR__1PNPDK20030422_140208_000002702015_00411_05976_2529.N1
09	12	14	MER_RR__1PNPDK20030422_140638_000002702015_00411_05976_2525.N1
09	12	15	MER_RR__1PNPDK20030422_141108_000002702015_00411_05976_2528.N1
09	12	16	MER_RR__1PNPDK20030422_141539_000002702015_00411_05976_2530.N1
09	12	17	MER_RR__1PNPDK20030422_142009_000002702015_00411_05976_2533.N1
09	12	18	MER_RR__1PNPDK20030422_142439_000002702015_00411_05976_2526.N1
09	12	19	MER_RR__1PNPDK20030422_152912_000000892015_00412_05977_2536.N1
09	12	20	MER_RR__1PNPDK20030422_152912_000002702015_00412_05977_2544.N1
09	12	21	MER_RR__1PNPDK20030422_153342_000002702015_00412_05977_2538.N1
09	12	22	MER_RR__1PNPDK20030422_153813_000002702015_00412_05977_2540.N1
09	12	23	MER_RR__1PNPDK20030422_154243_000002702015_00412_05977_2541.N1
09	12	24	MER_RR__1PNPDK20030422_154713_000002702015_00412_05977_2542.N1
09	12	25	MER_RR__1PNPDK20030422_155144_000002702015_00412_05977_2543.N1
09	12	26	MER_RR__1PNPDK20030422_155614_000002702015_00412_05977_2536.N1
09	12	27	MER_RR__1PNPDK20030422_160044_000002702015_00412_05977_2537.N1
09	12	28	MER_RR__1PNPDK20030422_160515_000002702015_00412_05977_2539.N1
09	12	29	MER_RR__1PNPDK20030422_170948_000026132015_00413_05978_2556.N1
09	12	30	MER_RR__1PNPDK20030422_185023_000002702015_00414_05979_2564.N1
09	12	31	MER_RR__1PNPDK20030422_185454_000002702015_00414_05979_2556.N1
09	12	32	MER_RR__1PNPDK20030422_185924_000002702015_00414_05979_2562.N1
09	12	33	MER_RR__1PNPDK20030422_190354_000002702015_00414_05979_2557.N1
09	12	34	MER_RR__1PNPDK20030422_190825_000002702015_00414_05979_2558.N1
09	12	35	MER_RR__1PNPDK20030422_191255_000002702015_00414_05979_2563.N1
09	12	36	MER_RR__1PNPDK20030422_191725_000002702015_00414_05979_2560.N1
09	12	37	MER_RR__1PNPDK20030422_192156_000002702015_00414_05979_2559.N1
09	12	38	MER_RR__1PNPDK20030422_193056_000001802015_00414_05979_2561.N1
09	12	39	MER_RR__1PNPDK20030422_203059_000002702015_00415_05980_2573.N1

RR	TT	SS	File name
09	12	40	MER_RR__1PNPDK20030422_203529_000002702015_00415_05980_2566.N1
09	12	41	MER_RR__1PNPDK20030422_204000_000002702015_00415_05980_2568.N1
09	12	42	MER_RR__1PNPDK20030422_204430_000002702015_00415_05980_2571.N1
09	12	43	MER_RR__1PNPDK20030422_204900_000002702015_00415_05980_2570.N1
09	12	44	MER_RR__1PNPDK20030422_205331_000002702015_00415_05980_2569.N1
09	12	45	MER_RR__1PNPDK20030422_210231_000002702015_00415_05980_2572.N1
09	12	46	MER_RR__1PNPDK20030422_210702_000002702015_00415_05980_2567.N1
09	12	47	MER_RR__1PNPDK20030422_211132_000001802015_00415_05980_2565.N1
09	13	01	MER_RR__1PNPDK20030427_060816_000026132015_00478_06043_0783.N1
09	13	02	MER_RR__1PNPDK20030427_074852_000005402015_00479_06044_0787.N1
09	13	03	MER_RR__1PNPDK20030427_093008_000025672015_00480_06045_0798.N1
09	13	04	MER_RR__1PNPDK20030427_111003_000004272015_00481_06046_0801.N1
09	13	05	MER_RR__1PNPDK20030427_111433_000023432015_00481_06046_0812.N1
09	13	06	MER_RR__1PNPDK20030427_125038_000003382015_00482_06047_0815.N1
09	13	07	MER_RR__1PNPDK20030427_125038_000026132015_00482_06047_0826.N1
09	13	08	MER_RR__1PNPDK20030427_143114_000002022015_00483_06048_0828.N1
09	13	09	MER_RR__1PNPDK20030427_143114_000026132015_00483_06048_0839.N1
09	13	10	MER_RR__1PNPDK20030427_161149_000026132015_00484_06049_0850.N1
09	13	11	MER_RR__1PNPDK20030427_175225_000026132015_00485_06050_0861.N1
09	13	12	MER_RR__1PNPDK20030427_193300_000026132015_00486_06051_0872.N1
09	13	13	MER_RR__1PNPDK20030427_211336_000026132015_00487_06052_0883.N1
09	14	01	MER_RR__1PNPDK20030430_061814_000023432016_00020_06086_1161.N1
09	14	02	MER_RR__1PNPDK20030430_075419_000005412016_00021_06087_1165.N1
09	14	03	MER_RR__1PNPDK20030430_080115_000021852016_00021_06087_1176.N1
09	14	04	MER_RR__1PNPDK20030430_094020_000022752016_00022_06088_1187.N1
09	14	05	MER_RR__1PNPDK20030430_111530_000004282016_00023_06089_1190.N1
09	14	06	MER_RR__1PNPDK20030430_111530_000026132016_00023_06089_1201.N1
09	14	07	MER_RR__1PNPDK20030430_125606_000002702016_00024_06090_1204.N1
09	14	08	MER_RR__1PNPDK20030430_125606_000026132016_00024_06090_1215.N1
09	14	09	MER_RR__1PNPDK20030430_143641_000001572016_00025_06091_1217.N1
09	14	10	MER_RR__1PNPDK20030430_143641_000026132016_00025_06091_1228.N1
09	14	11	MER_RR__1PNPDK20030430_161717_000026132016_00026_06092_1239.N1
09	14	12	MER_RR__1PNPDK20030430_175752_000026132016_00027_06093_1250.N1
09	14	13	MER_RR__1PNPDK20030430_193828_000026132016_00028_06094_1261.N1
09	14	14	MER_RR__1PNPDK20030430_211904_000026122016_00029_06095_1272.N1
09	15	01	MER_RR__1PNPDK20030501_054631_000023432016_00034_06100_1283.N1
09	15	02	MER_RR__1PNPDK20030501_072237_000005402016_00035_06101_1287.N1
09	15	03	MER_RR__1PNPDK20030501_072928_000022072016_00035_06101_1298.N1
09	15	04	MER_RR__1PNPDK20030501_090312_000004952016_00036_06102_1301.N1
09	15	05	MER_RR__1PNPDK20030501_090824_000022962016_00036_06102_1312.N1
09	15	06	MER_RR__1PNPDK20030501_104348_000004272016_00037_06103_1315.N1
09	15	07	MER_RR__1PNPDK20030501_104348_000026132016_00037_06103_1326.N1
09	15	08	MER_RR__1PNPDK20030501_122423_000003382016_00038_06104_1329.N1
09	15	09	MER_RR__1PNPDK20030501_122423_000026132016_00038_06104_1340.N1
09	15	10	MER_RR__1PNPDK20030501_140459_000002252016_00039_06105_1342.N1
09	15	11	MER_RR__1PNPDK20030501_140459_000026132016_00039_06105_1354.N1
09	15	12	MER_RR__1PNPDK20030501_154534_000026132016_00040_06106_1365.N1
09	16	01	MER_RR__1PNPDK20030429_050451_000026132016_00005_06071_0981.N1
09	16	02	MER_RR__1PNPDK20030429_064526_000006752016_00006_06072_0985.N1
09	16	03	MER_RR__1PNPDK20030429_065335_000021172016_00006_06072_0995.N1
09	16	04	MER_RR__1PNPDK20030429_082602_000005402016_00007_06073_0998.N1
09	16	05	MER_RR__1PNPDK20030429_083209_000022522016_00007_06073_1009.N1
09	16	06	MER_RR__1PNPDK20030429_100637_000004732016_00008_06074_1012.N1
09	16	07	MER_RR__1PNPDK20030429_100707_000025672016_00008_06074_1023.N1
09	16	08	MER_RR__1PNPDK20030429_114713_000004042016_00009_06075_1026.N1
09	16	09	MER_RR__1PNPDK20030429_115143_000023432016_00009_06075_1037.N1
09	16	10	MER_RR__1PNPDK20030429_132748_000002702016_00010_06076_1040.N1
09	16	11	MER_RR__1PNPDK20030429_132748_000026132016_00010_06076_1051.N1
09	16	12	MER_RR__1PNPDK20030429_150824_000001572016_00011_06077_1053.N1
09	16	13	MER_RR__1PNPDK20030429_150824_000026132016_00011_06077_1064.N1
09	16	14	MER_RR__1PNPDK20030429_164859_000026132016_00012_06078_1075.N1
09	16	15	MER_RR__1PNPDK20030429_182935_000026132016_00013_06079_1086.N1
09	16	16	MER_RR__1PNPDK20030429_201011_000026132016_00014_06080_1097.N1
09	17	01	MER_RR__1PNPDK20030428_054104_000023432015_00492_06057_0914.N1
09	17	02	MER_RR__1PNPDK20030428_071709_000006302015_00493_06058_0918.N1
09	17	03	MER_RR__1PNPDK20030428_072434_000021842015_00493_06058_0929.N1
09	17	04	MER_RR__1PNPDK20030428_085744_000005182015_00494_06059_0932.N1
09	17	05	MER_RR__1PNPDK20030428_090334_000010802015_00494_06059_0943.N1
09	17	06	MER_RR__1PNPDK20030428_092605_000009242015_00494_06059_0944.N1
09	17	07	MER_RR__1PNPDK20030428_135931_000002022015_00497_06062_0946.N1
09	17	08	MER_RR__1PNPDK20030428_135931_000026132015_00497_06062_0957.N1
09	17	09	MER_RR__1PNPDK20030428_154006_000000892015_00498_06063_0959.N1
09	17	10	MER_RR__1PNPDK20030428_154006_000026132015_00498_06063_0970.N1
09	17	11	MER_RR__1PNPDK20030428_172041_000026132012_02002_06064_1108.N1
09	17	12	MER_RR__1PNPDK20030428_190117_000026132012_02003_06065_1119.N1
09	17	13	MER_RR__1PNPDK20030428_191018_000002702012_02003_06065_1109.N1
09	17	14	MER_RR__1PNPDK20030428_192349_000002702012_02003_06065_1111.N1
09	17	15	MER_RR__1PNPDK20030428_192819_000002702012_02003_06065_1110.N1
09	17	16	MER_RR__1PNPDK20030428_193249_000002702012_02003_06065_1108.N1
09	17	17	MER_RR__1PNPDK20030428_194150_000001802012_02003_06065_1112.N1
09	17	18	MER_RR__1PNPDK20030428_204152_000026132012_02004_06066_1130.N1
09	18	01	MER_RR__1PNPDK20030429_050451_000026132016_00005_06071_0981.N1
09	18	02	MER_RR__1PNPDK20030429_064526_000006752016_00006_06072_0985.N1
09	18	03	MER_RR__1PNPDK20030429_065335_000021172016_00006_06072_0995.N1
09	18	04	MER_RR__1PNPDK20030429_082602_000005402016_00007_06073_0998.N1
09	18	05	MER_RR__1PNPDK20030429_083209_000022522016_00007_06073_1009.N1
09	18	06	MER_RR__1PNPDK20030429_100637_000004732016_00008_06074_1012.N1
09	18	07	MER_RR__1PNPDK20030429_100707_000025672016_00008_06074_1023.N1
09	18	08	MER_RR__1PNPDK20030429_114713_000004042016_00009_06075_1026.N1
09	18	09	MER_RR__1PNPDK20030429_115143_000023432016_00009_06075_1037.N1
09	18	10	MER_RR__1PNPDK20030429_132748_000002702016_00010_06076_1040.N1
09	18	11	MER_RR__1PNPDK20030429_132748_000026132016_00010_06076_1051.N1
09	18	12	MER_RR__1PNPDK20030429_150824_000001572016_00011_06077_1053.N1
09	18	13	MER_RR__1PNPDK20030429_150824_000026132016_00011_06077_1064.N1
09	18	14	MER_RR__1PNPDK20030429_164859_000026132016_00012_06078_1075.N1
09	18	15	MER_RR__1PNPDK20030429_182935_000026132016_00013_06079_1086.N1
09	18	16	MER_RR__1PNPDK20030429_201011_000026132016_00014_06080_1097.N1

table 4 - List of MERIS segments in input (1303 items).

B.2 Analysis of “double” (duplicated) and “sister” (included) segments

During the operational phase, an analysis has shown that some segments have exactly the same start date and acquisition duration. These segments are called “double”.

Other segments have the same start date while the acquisition durations are different, leading to one segment being fully included within the other one from the start. These segments are called “sister”.

Analysis performed on the list of segments gives the following statistics:

```
NUMBER OF DOUBLE  DATA   80
NUMBER OF SISTER  DATA    5
NUMBER OF USELESS DATA   85 / 1379
```

The list of double segments is given in the table here below.

```
/****************************************************************************/
/* LIST OF DOUBLE DATA                                                      */
/****************************************************************************/
/*--------------------------------------------------------------------------*/
/* Double data found (1)                                                    */
/*--------------------------------------------------------------------------*/
05-01-57      MER_RR__1PNPDE20030411_025136_000001802015_00247_05812_1238.N1
06-01-05      MER_RR__1PNPDE20030411_025136_000001802015_00247_05812_1238.N1
/*--------------------------------------------------------------------------*/
/* Double data found (2)                                                    */
/*--------------------------------------------------------------------------*/
05-01-58      MER_RR__1PNPDE20030411_025136_000025902015_00247_05812_1249.N1
06-01-06      MER_RR__1PNPDE20030411_025136_000025902015_00247_05812_1249.N1
/*--------------------------------------------------------------------------*/
/* Double data found (3)                                                    */
/*--------------------------------------------------------------------------*/
05-01-59      MER_RR__1PNPDE20030411_043212_000002472015_00248_05813_1251.N1
06-01-07      MER_RR__1PNPDE20030411_043212_000002472015_00248_05813_1251.N1
/*--------------------------------------------------------------------------*/
/* Double data found (4)                                                    */
/*--------------------------------------------------------------------------*/
05-01-60      MER_RR__1PNPDE20030411_043212_000016212015_00248_05813_1262.N1
06-01-08      MER_RR__1PNPDE20030411_043212_000016212015_00248_05813_1262.N1
/*--------------------------------------------------------------------------*/
/* Double data found (5)                                                    */
/*--------------------------------------------------------------------------*/
05-01-61      MER_RR__1PNPDE20030411_050344_000006982015_00248_05813_1263.N1
06-01-10      MER_RR__1PNPDE20030411_050344_000006982015_00248_05813_1263.N1
/*--------------------------------------------------------------------------*/
/* Double data found (6)                                                    */
/*--------------------------------------------------------------------------*/
08-01-80      MER_RR__1PNPDE20030425_235737_000026132015_00460_06025_2104.N1
10-01-01      MER_RR__1PNPDE20030425_235737_000026132015_00460_06025_2104.N1
/*--------------------------------------------------------------------------*/
/* Double data found (7)                                                    */
/*--------------------------------------------------------------------------*/
09-10-01      MER_RR__1PNPDK20030424_074324_000005412015_00436_06001_2722.N1
09-11-01      MER_RR__1PNPDK20030424_074324_000005412015_00436_06001_2722.N1
/*--------------------------------------------------------------------------*/
/* Double data found (8)                                                    */
/*--------------------------------------------------------------------------*/
09-10-02      MER_RR__1PNPDK20030424_074921_000022522015_00436_06001_2733.N1
09-11-02      MER_RR__1PNPDK20030424_074921_000022522015_00436_06001_2733.N1
/*--------------------------------------------------------------------------*/
/* Double data found (9)                                                    */
/*--------------------------------------------------------------------------*/
09-10-03      MER_RR__1PNPDK20030424_092400_000004502015_00437_06002_2736.N1
09-11-03      MER_RR__1PNPDK20030424_092400_000004502015_00437_06002_2736.N1
```

```
/*--------------------------------------------------------------------------*/
/* Double data found (10)                                                   */
/*--------------------------------------------------------------------------*/
09-10-04      MER_RR__1PNPDK20030424_092831_000023422015_00437_06002_2747.N1
09-11-04      MER_RR__1PNPDK20030424_092831_000023422015_00437_06002_2747.N1
/*--------------------------------------------------------------------------*/
/* Double data found (11)                                                   */
/*--------------------------------------------------------------------------*/
09-10-05      MER_RR__1PNPDK20030424_110435_000002702015_00438_06003_2758.N1
09-11-05      MER_RR__1PNPDK20030424_110435_000002702015_00438_06003_2758.N1
/*--------------------------------------------------------------------------*/
/* Double data found (12)                                                   */
/*--------------------------------------------------------------------------*/
09-10-06      MER_RR__1PNPDK20030424_110435_000004052015_00438_06003_2750.N1
09-11-06      MER_RR__1PNPDK20030424_110435_000004052015_00438_06003_2750.N1
/*--------------------------------------------------------------------------*/
/* Double data found (13)                                                   */
/*--------------------------------------------------------------------------*/
09-10-07      MER_RR__1PNPDK20030424_110906_000002702015_00438_06003_2756.N1
09-11-07      MER_RR__1PNPDK20030424_110906_000002702015_00438_06003_2756.N1
/*--------------------------------------------------------------------------*/
/* Double data found (14)                                                   */
/*--------------------------------------------------------------------------*/
09-10-08      MER_RR__1PNPDK20030424_111336_000002702015_00438_06003_2753.N1
09-11-08      MER_RR__1PNPDK20030424_111336_000002702015_00438_06003_2753.N1
/*--------------------------------------------------------------------------*/
/* Double data found (15)                                                   */
/*--------------------------------------------------------------------------*/
09-10-09      MER_RR__1PNPDK20030424_112707_000002702015_00438_06003_2757.N1
09-11-09      MER_RR__1PNPDK20030424_112707_000002702015_00438_06003_2757.N1
/*--------------------------------------------------------------------------*/
/* Double data found (16)                                                   */
/*--------------------------------------------------------------------------*/
09-10-10      MER_RR__1PNPDK20030424_113137_000002702015_00438_06003_2754.N1
09-11-10      MER_RR__1PNPDK20030424_113137_000002702015_00438_06003_2754.N1
/*--------------------------------------------------------------------------*/
/* Double data found (17)                                                   */
/*--------------------------------------------------------------------------*/
09-10-11      MER_RR__1PNPDK20030424_113608_000002702015_00438_06003_2755.N1
09-11-11      MER_RR__1PNPDK20030424_113608_000002702015_00438_06003_2755.N1
/*--------------------------------------------------------------------------*/
/* Double data found (18)                                                   */
/*--------------------------------------------------------------------------*/
09-10-12      MER_RR__1PNPDK20030424_124511_000002702015_00439_06004_2762.N1
09-11-12      MER_RR__1PNPDK20030424_124511_000002702015_00439_06004_2762.N1
/*--------------------------------------------------------------------------*/
/* Double data found (19)                                                   */
/*--------------------------------------------------------------------------*/
09-10-13      MER_RR__1PNPDK20030424_124511_000026132015_00439_06004_2773.N1
09-11-13      MER_RR__1PNPDK20030424_124511_000026132015_00439_06004_2773.N1
/*--------------------------------------------------------------------------*/
/* Double data found (20)                                                   */
/*--------------------------------------------------------------------------*/
09-10-14      MER_RR__1PNPDK20030424_142546_000026132015_00440_06005_2784.N1
09-11-14      MER_RR__1PNPDK20030424_142546_000026132015_00440_06005_2784.N1
/*--------------------------------------------------------------------------*/
/* Double data found (21)                                                   */
/*--------------------------------------------------------------------------*/
09-10-15      MER_RR__1PNPDK20030424_160622_000026132015_00441_06006_2795.N1
09-11-15      MER_RR__1PNPDK20030424_160622_000026132015_00441_06006_2795.N1
/*--------------------------------------------------------------------------*/
/* Double data found (22)                                                   */
/*--------------------------------------------------------------------------*/
09-10-16      MER_RR__1PNPDK20030424_174658_000026132015_00442_06007_2806.N1
09-11-16      MER_RR__1PNPDK20030424_174658_000026132015_00442_06007_2806.N1
/*--------------------------------------------------------------------------*/
/* Double data found (23)                                                   */
/*--------------------------------------------------------------------------*/
09-10-17      MER_RR__1PNPDK20030424_192733_000026132015_00443_06008_2817.N1
09-11-17      MER_RR__1PNPDK20030424_192733_000026132015_00443_06008_2817.N1
/*--------------------------------------------------------------------------*/
/* Double data found (24)                                                   */
/*--------------------------------------------------------------------------*/
09-10-18      MER_RR__1PNPDK20030424_210809_000026132015_00444_06009_2828.N1
09-11-18      MER_RR__1PNPDK20030424_210809_000026132015_00444_06009_2828.N1
/*--------------------------------------------------------------------------*/
/* Double data found (25)                                                   */
/*--------------------------------------------------------------------------*/
09-16-01      MER_RR__1PNPDK20030429_050451_000026132016_00005_06071_0981.N1
09-18-01      MER_RR__1PNPDK20030429_050451_000026132016_00005_06071_0981.N1
/*--------------------------------------------------------------------------*/
/* Double data found (26)                                                   */
/*--------------------------------------------------------------------------*/
09-16-02      MER_RR__1PNPDK20030429_064526_000006752016_00006_06072_0985.N1
09-18-02      MER_RR__1PNPDK20030429_064526_000006752016_00006_06072_0985.N1
/*--------------------------------------------------------------------------*/
/* Double data found (27)                                                   */
/*--------------------------------------------------------------------------*/
09-16-03      MER_RR__1PNPDK20030429_065335_000021172016_00006_06072_0995.N1
09-18-03      MER_RR__1PNPDK20030429_065335_000021172016_00006_06072_0995.N1
/*--------------------------------------------------------------------------*/
/* Double data found (28)                                                   */
/*--------------------------------------------------------------------------*/
09-16-04      MER_RR__1PNPDK20030429_082602_000005402016_00007_06073_0998.N1
09-18-04      MER_RR__1PNPDK20030429_082602_000005402016_00007_06073_0998.N1
/*--------------------------------------------------------------------------*/
/* Double data found (29)                                                   */
/*--------------------------------------------------------------------------*/
09-16-05      MER_RR__1PNPDK20030429_083209_000022522016_00007_06073_1009.N1
09-18-05      MER_RR__1PNPDK20030429_083209_000022522016_00007_06073_1009.N1
/*--------------------------------------------------------------------------*/
/* Double data found (30)                                                   */
/*--------------------------------------------------------------------------*/
09-16-06      MER_RR__1PNPDK20030429_100637_000004732016_00008_06074_1012.N1
09-18-06      MER_RR__1PNPDK20030429_100637_000004732016_00008_06074_1012.N1
/*--------------------------------------------------------------------------*/
/* Double data found (31)                                                   */
/*--------------------------------------------------------------------------*/
09-16-07      MER_RR__1PNPDK20030429_100707_000025672016_00008_06074_1023.N1
09-18-07      MER_RR__1PNPDK20030429_100707_000025672016_00008_06074_1023.N1
/*--------------------------------------------------------------------------*/
/* Double data found (32)                                                   */
/*--------------------------------------------------------------------------*/
09-16-08      MER_RR__1PNPDK20030429_114713_000004042016_00009_06075_1026.N1
09-18-08      MER_RR__1PNPDK20030429_114713_000004042016_00009_06075_1026.N1
/*--------------------------------------------------------------------------*/
/* Double data found (33)                                                   */
/*--------------------------------------------------------------------------*/
09-16-09      MER_RR__1PNPDK20030429_115143_000023432016_00009_06075_1037.N1
09-18-09      MER_RR__1PNPDK20030429_115143_000023432016_00009_06075_1037.N1
/*--------------------------------------------------------------------------*/
/* Double data found (34)                                                   */
/*--------------------------------------------------------------------------*/
09-16-10      MER_RR__1PNPDK20030429_132748_000002702016_00010_06076_1040.N1
09-18-10      MER_RR__1PNPDK20030429_132748_000002702016_00010_06076_1040.N1
/*--------------------------------------------------------------------------*/
/* Double data found (35)                                                   */
/*--------------------------------------------------------------------------*/
09-16-11      MER_RR__1PNPDK20030429_132748_000026132016_00010_06076_1051.N1
09-18-11      MER_RR__1PNPDK20030429_132748_000026132016_00010_06076_1051.N1
/*--------------------------------------------------------------------------*/
/* Double data found (36)                                                   */
/*--------------------------------------------------------------------------*/
09-16-12      MER_RR__1PNPDK20030429_150824_000001572016_00011_06077_1053.N1
09-18-12      MER_RR__1PNPDK20030429_150824_000001572016_00011_06077_1053.N1
/*--------------------------------------------------------------------------*/
/* Double data found (37)                                                   */
/*--------------------------------------------------------------------------*/
09-16-13      MER_RR__1PNPDK20030429_150824_000026132016_00011_06077_1064.N1
09-18-13      MER_RR__1PNPDK20030429_150824_000026132016_00011_06077_1064.N1
/*--------------------------------------------------------------------------*/
/* Double data found (38)                                                   */
/*--------------------------------------------------------------------------*/
09-16-14      MER_RR__1PNPDK20030429_164859_000026132016_00012_06078_1075.N1
09-18-14      MER_RR__1PNPDK20030429_164859_000026132016_00012_06078_1075.N1
/*--------------------------------------------------------------------------*/
/* Double data found (39)                                                   */
/*--------------------------------------------------------------------------*/
09-16-15      MER_RR__1PNPDK20030429_182935_000026132016_00013_06079_1086.N1
09-18-15      MER_RR__1PNPDK20030429_182935_000026132016_00013_06079_1086.N1
/*--------------------------------------------------------------------------*/
/* Double data found (40)                                                   */
/*--------------------------------------------------------------------------*/
09-16-16      MER_RR__1PNPDK20030429_201011_000026132016_00014_06080_1097.N1
09-18-16        MER_RR__1PNPDK20030429_201011_000026132016_00014_06080_1097.N1
```

table 5 - List of double segments.

The list of sister segments is given in the table here below.

```
/****************************************************************************/
/* LIST OF DOUBLE SISTER DATA                                               */
/****************************************************************************/
/*--------------------------------------------------------------------------*/
/* Sister data found (1)                                                    */
/*--------------------------------------------------------------------------*/
05-01-59      MER_RR__1PNPDE20030411_043212_000002472015_00248_05813_1251.N1
05-01-60      MER_RR__1PNPDE20030411_043212_000016212015_00248_05813_1262.N1
/*--------------------------------------------------------------------------*/
/* Sister data found (2)                                                    */
/*--------------------------------------------------------------------------*/
09-10-05      MER_RR__1PNPDK20030424_110435_000002702015_00438_06003_2758.N1
09-10-06      MER_RR__1PNPDK20030424_110435_000004052015_00438_06003_2750.N1
/*--------------------------------------------------------------------------*/
/* Sister data found (3)                                                    */
/*--------------------------------------------------------------------------*/
09-10-12      MER_RR__1PNPDK20030424_124511_000002702015_00439_06004_2762.N1
09-10-13      MER_RR__1PNPDK20030424_124511_000026132015_00439_06004_2773.N1
/*--------------------------------------------------------------------------*/
/* Sister data found (4)                                                    */
/*--------------------------------------------------------------------------*/
09-16-10      MER_RR__1PNPDK20030429_132748_000002702016_00010_06076_1040.N1
09-16-11      MER_RR__1PNPDK20030429_132748_000026132016_00010_06076_1051.N1
/*--------------------------------------------------------------------------*/
/* Sister data found (5)                                                    */
/*--------------------------------------------------------------------------*/
09-16-12      MER_RR__1PNPDK20030429_150824_000001572016_00011_06077_1053.N1
09-16-13      MER_RR__1PNPDK20030429_150824_000026132016_00011_06077_1064.N1
```

table 6 - List of sister segments.