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FIRST 2003 MERIS DATA ARCHIVE REPROCESSING

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

This document presents the configuration used, in terms of algorithms and associated auxiliary parameters, for the reprocessing of the complete 2003 MERIS data archive done during Spring 2004.

1.2 Scope

This document intends to provide the users with a detailed overview of the changes performed for the 1st MERIS data reprocessing with respect to the configuration of the official MERIS processor in use at processing centres. The description is presented in terms of both data format changes and algorithm modifications in order to help the user community in understanding the impact on MERIS data quality.

1.3 Definition and Acronyms

AATSR	Advanced Along Track Scanning Radiometer
CNES	Centre National d'Etudes Spatiales
EOHELP	Earth Observation Help Desk
ESA	European Space Agency
IPF	Instrument Processing Facilities (PDS)
MAVT	MERIS AATSR Validation Team
MEGS	MERIS Ground Segment data processing prototype
MERIS	Medium Resolution Image Spectrometer
NIR	Near Infra Red
QWG	Quality Control Working Group

2 FIRST MERIS DATA REPROCESSING

The complete 2003 MERIS data archive has been reprocessed on April 2004. The decision to reprocess the complete 2003 MERIS dataset has been taken as consequence of the relevant changes introduced in the algorithms and associated auxiliary parameters of the initial MERIS data processing, following the recommendations coming from various forums (Science Advisory Group, MERIS User Workshop, MERIS AATSR Validation Team) and ratified by the QWG; the main objective of the forums being the improvement of the MERIS data quality.
All the identified changes have been early validated using the MERIS prototype processor, MEGS version 7.0. Then, being the changes important enough and in order to provide very rapidly the users with good quality data it has been decided to use the prototype itself for the 1st MERIS data reprocessing.
Since the 2003 MERIS archive has not been reprocessed using the official processor, IPF 4.06 at the time of reprocessing, but the prototype, MEGS 7.0, the dataset can not be retrieved through the official channels (for the access to the official MERIS data refer to the on-line document Access_to_MERIS_data.pdf). Indeed, the reprocessed dataset has been made available to the user community since summer 2004 on the following dedicated website:

www.brockmann-consult.de/merci.

The access to the website is subject to the ESA data policy, and can be required sending an email to:

eohelp@esa.int.

The major modifications performed in MERIS Level 1 and Level 2 products are listed per product type in the following paragraphs.

2.1 MERIS Level 1 product

The impact of the applied changes on the quality of MERIS Level 1 products is described in details below.

- Radiometric quality*:*
The accuracy observed is better than 4% over ocean surfaces, but some discrepancies still exist with respect to CNES method over Deserts. Since the beginning of the mission, the degradation is less than 3% in the blue, and is negligible in the NIR.

- Spectral calibration quality*:*
The spectral bands central wavelengths vary within the cameras field of view (< 1nm). This so-called smile effect is present in the Level 1b product where all bands are calibrated with the exact spectral characteristics of each pixel. All processing needed to minimize its impact on the geophysical products is performed in the Level 2 processing.
In order to minimize the overall spectral dispersion within the field of view, in particular in the blue, camera four was re-aligned by 1.25 nm (one pixel) toward the NIR with respect to the other cameras. This was done at orbit 846 (29-Apr-2002), after analysis of the first in-flight spectral calibration data.
In order to achieve a better accuracy for the pressure retrieval, band 11, centred on the Oxygen absorption feature (761 nm), has been shifted by one pixel towards the NIR on 24-Dec-2002.

- Geolocation quality*:*
Before the 12th of December 2003, the on-board law was not optimal. A degradation in the attitude was observed that led to a slow degradation in the MERIS Geolocation. The mean error in the absolute geolocation was about 500 meters. The error was mainly in the across-track direction (440 meters). On the 12th of December 2003, the attitude onboard software change resulted in an immediate improvement of the geolocation. The current absolute geolocation accuracy is around 230 meters.
The coastline provided in the MERIS L1b product is derived from a CIA database. The accuracy of this coastline is sometime rough, and therefore it cannot be used to derive the precise MERIS geolocation accuracy.

2.2 MERIS Level 2 product

The major changes performed in the Level 2 processing are described in details below.

- **Classification:**
  The classification at Level 1 basis is performed using a predefined land/sea mask. At Level 2, the data are re-classified using the pixel radiometry at two wavelengths (665 and 865 nm). The re-classification is now performed for pixel over land and not only for which ones closed to the coastline as in the previous processor. It allows to well classify the inland waters. The reclassification of water pixel is still restricted to those close to the coastline. A new algorithm has been introduced to better reclassify dark land surfaces, which are classified as water in Level 1b.

- **H2O absorption**:
  The smile effect within the H2O absorption correction (at 709nm) is taken into account.

- **Surface pressure**:
  The surface pressure is now retrieved through a polynomial expression of $\log(MP^2)$, instead of MP^2 as before.

- **Water Vapour**:
  The water vapour Look Up Table over water has been updated in order to include the wind speed dimension.

- **Land branch**:
  The Dark Dense Vegetation concept has been extended. The aerosol family has been extended. The cloud shadow is now screened out.

- **Water branch:**
  A High Aerosol/Ice screening has been added to the medium glint sub-branch.
  An additional test at 412 nm has been added to screen out the remaining bright target.

- **Atmospheric correction above bright water**:
  Based on Infra Red data, the Bright Pixel Atmospheric Correction (BPAC) is now forced for all pixels.
  The CASE_2S flag has been modified. It is raised now when the BPAC is on and when the Total Suspended Matter (TSM) is above a certain threshold.

- **Case 2 water processing**:
  A new neural net has been trained with an optimised set of inherent optical properties based on MAVT measurements. The concentration range was extended to lower and higher concentration ranges. A white scatterer was introduced to meet the scattering effect of cocolithophorides. The net has been further trained to work also in cases when some reflectance measurements are below a reliable value or even negative.

- **Atmospheric Correction above clear water**:
  The aerosol database has been revised according to recent publications and MAVT findings. It includes, in addition to the well-known Maritimes Coastal and Rural families, three families of Dust-like (absorbing) aerosols (Moulin et al, JGR, 2001) and the so-called Blue family of theoretical Junge distribution aerosol with steep spectral dependency.
  The logic of atmospheric correction over ocean has been reviewed. Basically, it allows all aerosols except absorbing ones in the first pass. Absorbing aerosols are used in additional passes, over Case 1 waters only, if triggered by a test on the water leaving reflectance at 510 nm as compared to climatology of rectified marine reflectances at 510 nm.

- **Aerosol:**
  The Angstrøm coefficient replaces the Epsilon coefficient.
  The Angstrøm coefficient is defined as follow:
  alpha = log(tau_a(775)/tau_a(865)) / log(lambda(865)/lambda(775))

- **Flags:**
  The check on the solar angle (> 70 deg) has been removed from all the PCD. This condition is now available as a science flag LOW_SUN.
  The flag ABSOA_CONT has been removed and is replaced by a new flag AERO_BLUE to indicate the selection of “blue” aerosol.
  The ABSOA_DUST flag is now raised only if an absorbing aerosol has been used in the atmospheric correction. In the previous processing, it indicated the potential of the existence of an absorbing aerosol. The CASE2_S flag is now indicating sediment loaded Case 2 water. It is triggered if the suspended sediment concentration is likely to be above a certain threshold.
  The meaning of the DDV flag has been extended to include less dark vegetation and now indicates that aerosol retrieval over land has been attempted.
  A new flag BPAC_ON has been introduced which indicates that the bright pixel atmospheric correction over water has been activated. In the current setting, this is the case for all water pixels (see above) so that this flag is raised everywhere.
  The flag P_Confidence has been deleted.

2.3 Open Problems

Despite the major improvements with respect to the IPF version 4.06, some problems are still present within this prototype version, as listed below:

1. Slightly negative reflectances occur at 620 nm over Case-I water, especially in conditions favourable to whitecapping, probably due to the limitation in the aerosol family, but it does not seem to affect the chlorophyll products.
2. Over Case-II waters the short wavelengths bands are sometimes overcorrected, leading partially to negative reflectances. This affects the quality of the Case-II water constituents Algal-2, TSM and Yellow Substance.
3. In a coastal fringe approximately 10 km wide the atmospheric correction may be invalid due to adjacency effects.
4. The field named “BOAVI, Bottom of Atmosphere Vegetation Index” is currently empty. It will contain the MERIS Terrestrial Chlorophyll Index (MTCI) in a future version.
5. A coding error has been identified in the PAR retrieval. It will be corrected in the next version of the processor.
6. A coding error in PCD16 has been identified for water pixels. PCD17 should be used instead as they are supposed to be identical for water pixels.

NOTE: Almost all the identified problems will be fixed in the MERIS processor upgrade foreseen for summer 2005. At that time the prototype and the processor shall be finally aligned.