esa	**MERIS ESL**	Algorithm Theoretical Basis Document

Title: **MERIS Level 2 Algorithms Theoretical Basis Document**

Doc. no: PO-TN-MEL-GS-0005

Issue: 4

Revision: 0

Date: 05 December 1997

	Function	Name	Company	Signature	Date
Prepared:		MERIS Team			
Approved:	Project Manager	F. MONTAGNER	ACRI		
Released:	Project Manager		ESA		

External Distribution

Name	Quantity
S. DELWART (ESA / ESTEC)	5
J.P. GUIGNARD (ESA / ESRIN)	1

Internal Distribution

Name	Quantity
J. AIKEN	
M. BABIN	
C. BROCKMANN	
R. DOERFFER	
J. FISCHER	
F. MONTAGNER	
A. MOREL	
R. SANTER	

Change Record

Issue	Revision	Date	Description	Approval
1	0	17/10/95		
2	0	26/07/96	Complete rework according to study progress	
2	2	16/09/96	Revision of sections 2.5 (pp 78-82), 2.6 (pp83-90), 2.8 (pp159-165), 2.10 (pp.201-207), 2.11(pp208-214), 2.15(pp266-311), 2.17(pp321-349)	
3	0	29/11/96	Prototyping phase final report	
3	1	23/01/97	Revised sections : 2.12, 2.15, 2.18 (new section)	
3	2	21/03/97	Revised sections : 2.1&2.2, 2.3, 2.4	
4	0	05/12/97	Re-issue following: - peer review in 1997 (NWP/4057/GL) - advances in design, sensitivity testing	

0. Introduction

0.1 Purpose and scope

This document provides the theoretical justification for the algorithms developed and implemented for the Level 2 processing of MERIS. That processing is part of the ENVISAT-1 mission Payload Data Segment. The purpose of Level 2 processing is to derive geo-physical parameters, depending on the nature of the observed surface, from the MERIS Level 1B products. The Level 1B products contain Radiance measurements at Top Of Atmosphere for the 15 MERIS bands, re-ordered, calibrated, geo-located, annotated with Product Confidence Data, calibration data, classification flags, and environment parameters. The Level 2 products contain different types of mixed geo-physical information according to the type of each pixel :

1. water pixels : normalised water-leaving reflectance, algal pigment index I, algal pigment index II, yellow substance, suspended sediment, photosynthetically active radiation, aerosol type, aerosol optical thickness, total water vapour column;
2. land pixels : normalised surface reflectance, top of atmosphere and Rayleigh-corrected Vegetation Indices, aerosol type, aerosols optical thickness, total water vapour column, surface pressure;
3. cloud pixels : normalised surface reflectance, cloud top pressure, cloud optical thickness, cloud albedo, total water vapour column.

All Level 2 algorithms which require geo-physical modelling and justification are described in sections of this ATBD. These are intended to support understanding of the MERIS processing and of the contents of the Level 2 products. They are the basis for the software specifications which are implemented in the operational MERIS processors of the ENVISAT-1 Ground Segment.

The ATBDs has been prepared by the members of the MERIS Expert Support Laboratories (ESL), under ESA assignment and directives:

- Freie Universität Berlin (FUB), Berlin, Germany
- GKSS Forschungszentrum, Geesthacht, Germany
- Laboratoire de Physique et Chimie Marines (LPCM), Villefranche-sur-Mer, France
- Laboratoire de Physique Appliquée aux Milieux Océaniques et Côtiers (PAMOC), Wimereux, France
- Plymouth Marine Laboratory (PML), Plymouth, United Kingdom

under the coordination of ACRI S.A, Sophia-Antipolis, France, and with the support of Scicon, Geetshacht, Germany.

Each ATBD section is a self-standing document according to the following typical layout:

1. Introduction
2. Algorithm Overview
3. Algorithm Description
    - 3.1 Theoretical Description
        - 3.1.1 Physics of the Problem
        - 3.1.2 Mathematical Description of the Algorithm

3.1.3 Error Budget Estimates
3.2 Practical Considerations
3.2.1 Calibration and Validation
3.2.2 Quality Control and Diagnostics
3.2.3 Exception Handling
3.2.4 Outputs
4. Assumptions and Limitations
4.1 Assumptions
4.2 Constraints and Limitations
5. References

0.2 The MERIS Level 2 processing architecture

The architecture of the MERIS Level 2 processing is schematically represented in the block diagram of figure 0-1 below. Each processing step, symbolised by a rectangle (process) or diamond (decision), produces its own products (parallelogram symbols) which are re-used by down-stream steps, stored in the Level 2 product, or both.

Each processing step corresponds to one or more ATBDs, with the numbers shown in each box. ATBDs with their number between parentheses describe algorithms relevant to the problem but not implemented in the MERIS operational baseline. Processing steps without a number will be described in a future ATBD issue.

0.3 ATBD Summary List

No	Title	Author
2.1 (&2.2)	Cloud Albedo and Cloud Optical Thickness	FUB
2.3	Cloud Top Pressure	FUB
2.4	Retrieval of Total Water Vapour Content	FUB
2.5	Case 2 Turbid Water Flag	PML
2.6	Case 2 (Sediment) Bright Water Atmospheric Correction	PML
2.7	Atmospheric Correction over the Ocean (Case 1 Waters)	LPCM
2.8	Case 2 (Gelbstoff) Water Flag	PML
2.9	Pigment Index Retrieval in Case 1 Waters	LPCM
2.10	Pigment Index and Gelbstoff Retrieval in Case 2(Y) Waters	PML
2.11	Pigment Index, Sediment and Gelbstoff Retrieval in Case 2(S) Waters	PML
2.12	Pigment Index, Sediment and Gelbstoff Retrieval from directional Water-leaving Reflectances using Inverse Modelling Technique	GKSS
2.13	Sun glint Flag Algorithm	ACRI
2.14	Whitecaps Algorithm	ACRI
2.15	Atmospheric Corrections over Land	PAMOC
2.16	Cloud Reflectance	FUB
2.17	Pixel Identification	PAMOC
2.18	Photosynthetically Available Radiation (PAR)	PML

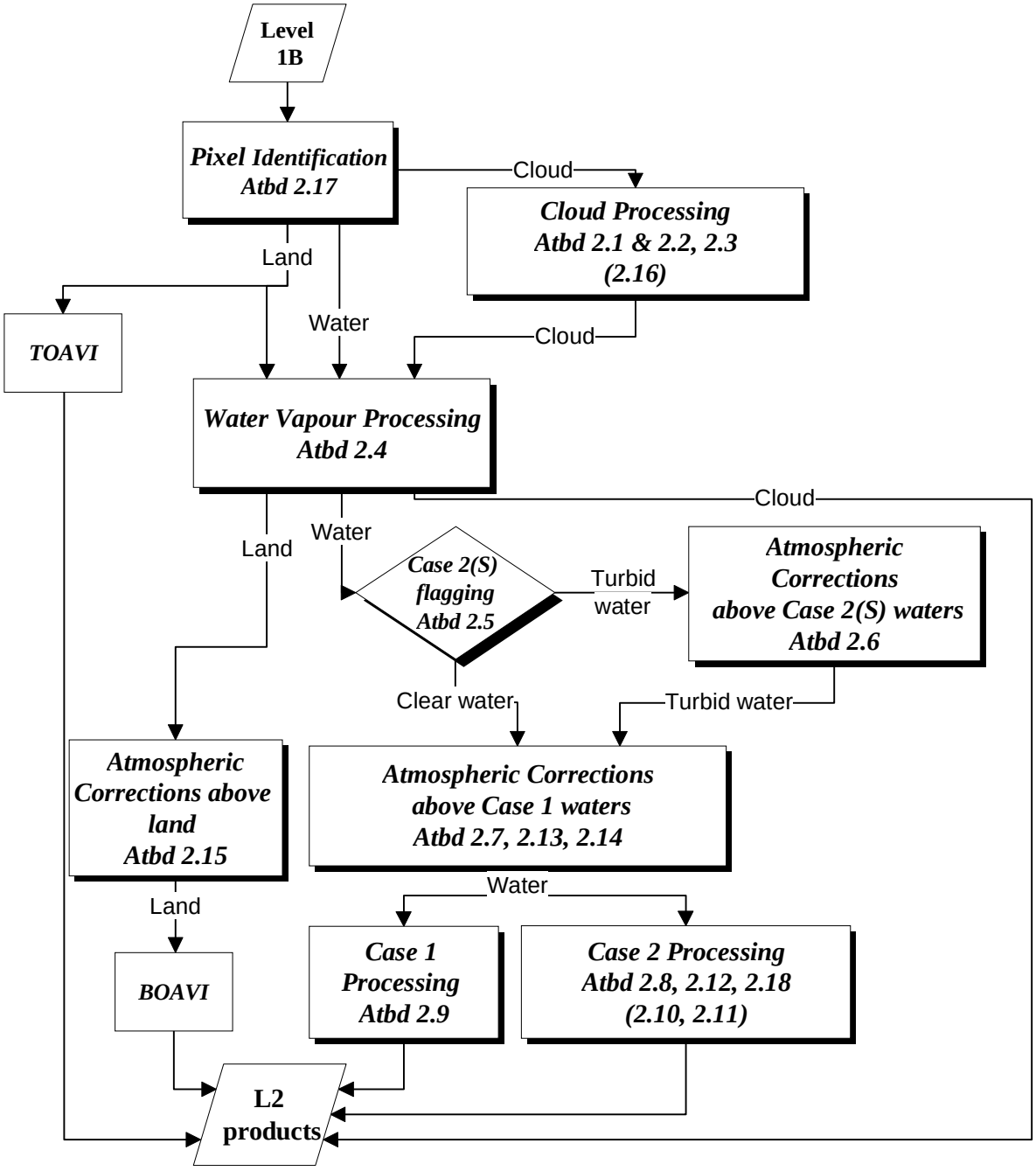

Figure 0-1: MERIS Level 2 processing overview

Key: rectangle: process; diamond: decision; parallelogram: data
Labels on the arrows indicate the processing path taken according to the type of surface.