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ALGORITHM DEFINITION, ACCURACY AND SPECIFICATION VOLUME 7: NEAR REAL TIME CONTROL PROCESSING

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ABBREVIATIONS

Sigle	Definition
ADA	Algorithm Definition and Accuracy
ADx	Applicable Document x
CAL	Calibration
CFA	Control Flag Altimeter
CLS	Collecte Localisation Satellite
CMA	Centre Multi-missions Altimètre
CNES	Centre National d'Etudes Spatiales
DAD	Dynamic Auxiliary Data
GDR	Geophysical Data Record
IGDR	Interim Geophysical Data Record
IONO	IONOspheric Data
OFL	Off- Line
ORF	Orbit Revolution File
RDx	Reference Document x
SAD	Statistic Auxiliary Data
SSALTO	Segment Sol Altimétrie et Orbitographie
SWH	Significant Wave height
TBC	To Be Confirmed
TBD	To Be Defined

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APPLICABLE AND REFERENCE DOCUMENTS

Reference	Document title
SMM-ST-M-EA-10879-CN	AD1 SSALTO Product Specification – Volume 1: JASON-1 User Products
SMM-ST-M2-EA-11003-CN	AD2 Algorithm Definition, Accuracy and Specification Volume 2: CMA Altimeter Level 1B Processing
SMM-ST-M2-EA-11005-CN	AD3 Algorithm Definition, Accuracy and Specification Volume 4: CMA Altimeter Level 2 Processing
SMM-ST-M2-EA-11009-CN	AD4 Algorithm Definition, Accuracy and Specification Volume 8: CMA Off Line Control Processing
SMM-ST-M2-EA-11010-CN	AD5 Algorithm Definition, Accuracy and Specification Volume 9: CMA Mechanisms
SMM-ST-M2-EA-11011-CN	AD6 Algorithm Definition, Accuracy and Specification Volume 10: CMA Expertise processing
SMM-ST-M2-EA-11012-CN	AD7 Algorithm Definition, Accuracy and Specification Volume 11: CMA Visualization processing
SMM-SP-M2-EA-32012-CLS	AD8 CMA Production: Specification of the data management algorithms
SMM-SP-M2-EA-32007-CLS	AD9 Algorithm Definition, Accuracy and Specification Volume 6: Altimeter/Radiometer Verification processing
SMM-DD-M2-EA-32037-CLS	AD10 CMA Production : Internal Interfaces
TP-NT-613-697-CLS	RD1 Etat des lieux des contrôles sur POSEIDON1

TBC AND TBD LIST

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1. INTRODUCTION

This document is aimed at defining and at specifying the functions of the control processing for the near real time products (OSDR). The mission concerned is JASON-1. The phase of control processing begins automatically after the computation of the parameters. The data distribution is conditioned by the results of the control phase. The data flow considered is the same as the flow just computed.

The algorithms of the near real time control processing are defined and are specified in order to be used for several kinds of parameters. These parameters are issued from the altimeter or radiometer or DORIS of JASON-1. All the parameters (1Hz) that are computed in the corresponding chains and that are written in the external output product (OSDR) have to be controlled.

The definitions and specifications of the near real time control processing are derived from the specifications of the corresponding POSEIDON-1 processing (RD1), accounting for the evolution of POSEIDON-2 with respect to POSEIDON-1 (AD2). The algorithms used for the Off Line control are defined and specified in AD4.

Definition of the near real time control processing

The definition of the near real time control processing consists of the identification and the description of the main functions. It will provide the reader with an overview of the processing and a global understanding of the algorithms.

Specification of the near real time control processing

Regarding the specifications of the near real time control processing, two kinds of algorithms are distinguished:

- The “scientific” algorithms, which represent the core of the processing
- The other algorithms, which will be called the “data management algorithms”, ensuring functions such as:
  - To get the input data
  - To prepare the data to be processed
  - To perform unit conversions or changes of reference systems
  - To perform general checks (relative for example to the presence of input files, to the data conformity or to the compatibility of input data with the data set to be processed)
  - To build the output product(s)
  - To manage the processing

The “scientific” algorithms are specified in this document or specified as mechanisms (AD5), while the “data management algorithms”, which strongly depend on the format of the input and output data, are specified in AD8. The complete set of specifications (to be associated to the corresponding interface documents) is intended for the team in charge of the software development.

Most of the algorithms used in the near real time control processing can be seen as mechanisms and are defined in AD5. The algorithms described in this document can be considered as a baseline. Most of them are also used in the Off Line Control Processing (AD4) and in the Verification Processing (AD9).

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Organization of the document

- The interfaces of the processing (input and output data) are defined in section 2.
- An overview of the processing is given in section 3. It consists of the presentation of the general flowchart, and of a brief description of the control of the OSDR parameters.
- The detailed description of the algorithms is finally given in section 4.

  For the near real time control processing, the description consists in:
  - An overview of the overall processing (list of functions).
  - The definition and the specification of the algorithms, using the following items:
    - Name and identifier of the algorithm
    - Heritage
    - Function
    - Applicability to the various processing procedures
    - Algorithm definition:
      - Input data
      - Output data
      - Mathematical statement
    - Algorithm specification:
      - Input data
      - Output data
      - Processing
    - Accuracy (if any)
    - Comments (if any)
    - References (if any)

The general information required for a global understanding of the algorithm within the overall processing is provided in the “Algorithm definition” sections.

The detailed information required by the team in charge of the software development is provided in the “Algorithm specification” sections, which precisely define the scientific part (i.e. the core) of the algorithms.

Basic rules

The following basic rules relative to the specification of the algorithms are applied:

- Elementary functions that are common to several algorithms (also called “mechanisms”) are specified in AD5.
- The input and output data are always identified by a precise description, an explicit name (that may be used in the coding phase), a unit and if necessary a reference system.
- Regarding the errors that may occur during the processing (for example, negative argument for logarithmic or square root functions), the algorithms systematically output an execution status. The building and the management of this information will be defined during the architectural design of the software.

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- Regarding the representation of tables, the following conventions are used:
  - $X[N_1:N_2]$ represents a one-dimension table whose elements are $X(i)$ (or X_i) with $i \in [N_1, N_2]$
  - $X[N_1:N_2][M_1:M_2]$ represents a two-dimension table whose elements are $X(i,j)$ (or X_{ij}) with $i \in [N_1,N_2]$ and $j \in [M_1,M_2]$
  - And so on

2. INPUT AND OUTPUT DATA

2.1. INPUT DATA

Input data consist of three types of data:

- Product data, which may be:
  - level 1b altimeter and radiometer parameters for JASON-1
  - level 2 altimeter and radiometer parameters for JASON-1
  - DORIS parameters
- Dynamic auxiliary data: None
- Static auxiliary data:
  - List of thresholds, processing parameters, universal constant data.

It is assumed that the level 1.0 is controlled by the CCI.

2.2. OUTPUT DATA

Output data consist of two types of data:

- altimeter or radiometer flags
- editing reports

2.3. SUMMARY OF THE INTERFACES

The interfaces of the near real time control processing are summed up in **Figure 1**.

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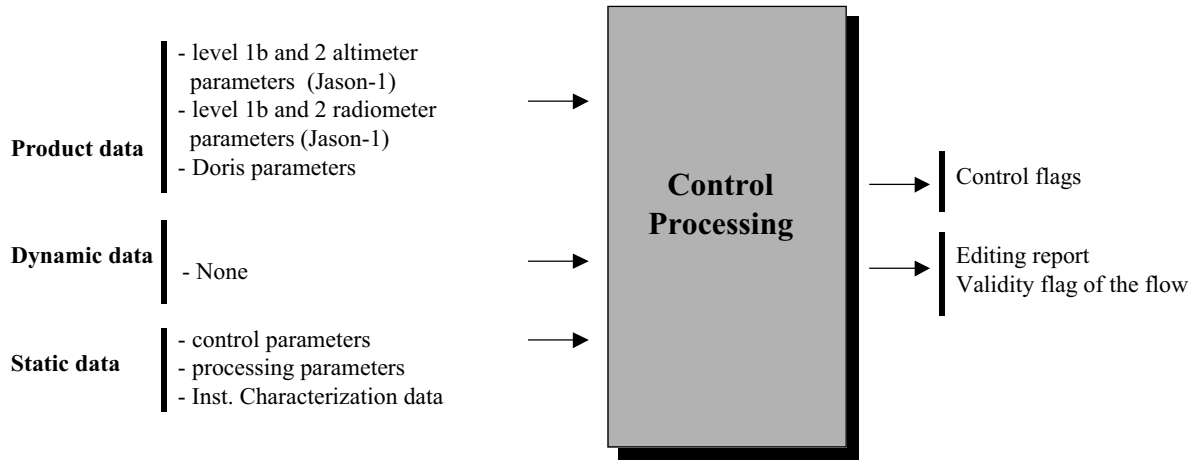

Figure 1: Interfaces of the near real time control processing

3. OVERVIEW

3.1. GENERAL DESCRIPTION

The near real time control processing is aimed at controlling the 1Hz parameters of the OSDR product. The control is performed on the “ocean” data.

3.2. CONTROL OF THE PRODUCED PARAMETERS

The aim of the control processing for the produced parameters is to:

- detect the outliers with respect to predefined thresholds that are given in the control parameters files
- generate a set of quality flags for the computed parameters
- determine statistical characteristics of the parameters (mean, standard deviation)
- generate quality flags for the data flow

As already stated, the following types of parameters are to be controlled:

- Altimeter and Radiometer (1 Hz) parameters for Jason-1
- DORIS parameters

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3.2.1. BASIS OF CONTROL FLAG GENERATION

The data flow in input of the control processing consists of N measurements (measurements are at the rhythm of 1 Hz for the OSDR parameters). Each of these measurements contains several fields that can be grouped in families. For example, the OSDR (Jason) parameters can be split in several families like “significant waveheight”, “backscatter coefficient”, “altimeter range”.

The control consists in several algorithms:

- 1st algorithm: setting flags by comparison with predefined thresholds (field or combination of fields can be checked). This phase is aimed at generating a validity flag (2 states: “valid” or “invalid”) for each field (or combination of fields) of each measurement of the flow depending on the result of the comparison of the measurement with predefined thresholds. This procedure is performed using the (See AD4 “GEN_CTL_QUA_05 - To edit data measurements using thresholdsREF”).

- 2nd algorithm: computing a “family flag” taking into account the flags of all fields in the family.
  - If the flags of all the fields of the family are “valid”, the family flag is set to “valid”.
  - If the flag (at least) of one field of the family is “invalid”, the family flag is set to “invalid”.

  This computation is performed using the algorithm “GEN_CTL_QUA_01 - To compress an array of flags ”.

- 3rd algorithm: a “general” flag is computed taking into account the flags of all families (for each measurement).
  - If the flags of all the families are “valid”, the total flag is set to “valid”.
  - If the flag (at least) of one family is “invalid”, the total flag is set to “invalid”.

  This computation is performed using the algorithm “ GEN_CTL_QUA_01 - To compress an array of flags”.

- 4th algorithm: counting the “valid” and “invalid” data measurements. The percentages of valid and invalid data on the flow are then computed.

  This computation is performed using the algorithm “ GEN_CTL_QUA_03 - To determine percentages”.

Figure 2 sums up the whole flags management in the control processing of the produced parameters. “Valid” flags are set to “0” and “Invalid” flags are set to “1”.

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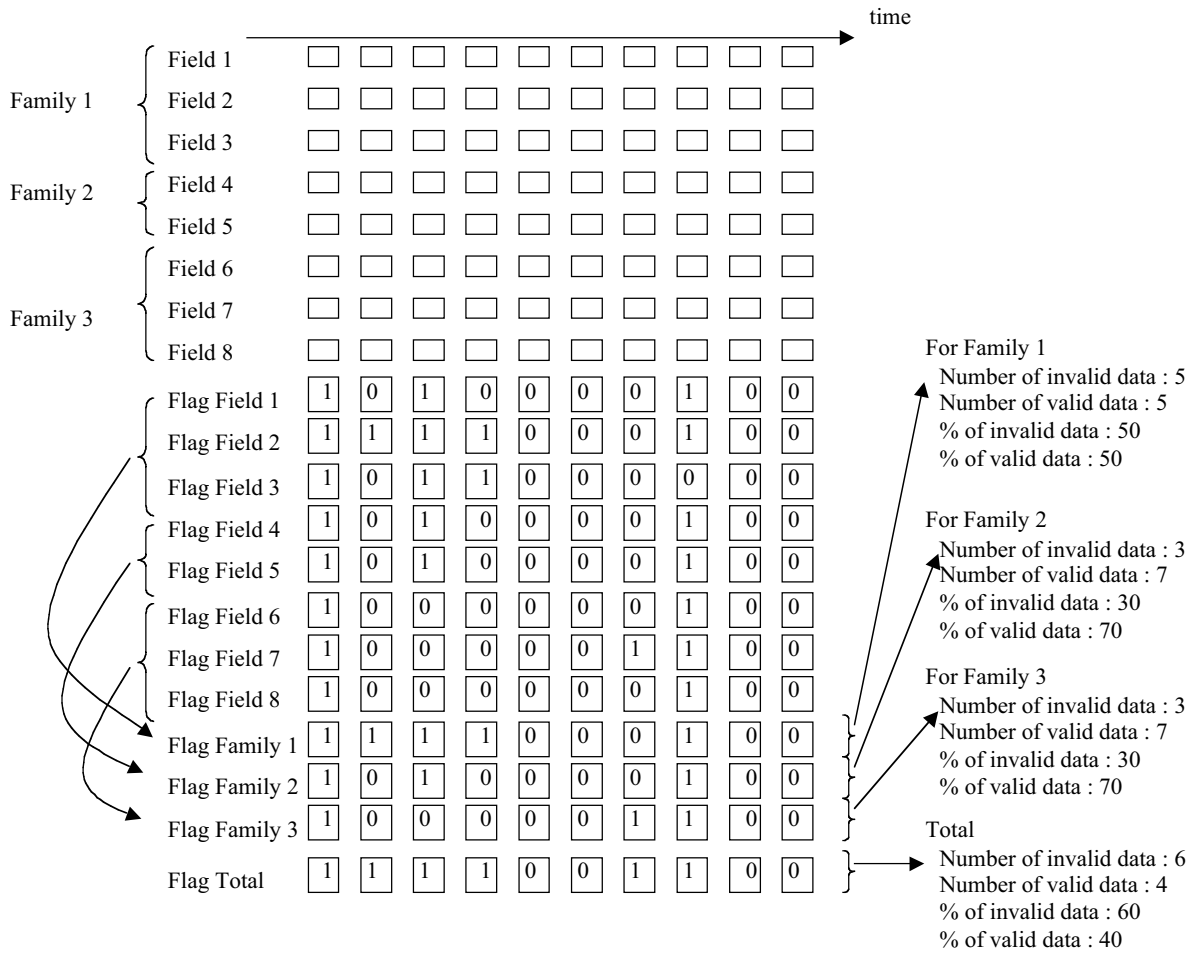

Figure 2: flags management

By definition, the control processing doesn't consider the following type of control:

- "Production flags" generated by the production processing are not described in this document but are described in the production algorithms at different levels (1.0, 1b, 2).

The visualization functions are defined in the AD7.

3.2.2. CONTROL OF THE OSDR (1 HZ) PARAMETERS FOR JASON-1

For these parameters, the control is performed on the "ocean" data for JASON-1. In input, each measurement has an "over-flown surface flag".

The 1 Hz parameters (or combination of parameters) that are written in the OSDR product are likely to be controlled using the processing steps that have been described in the previous section.

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The 1st, 2nd, 3rd and 4th algorithms are used.

If the percentage of "valid" data obtained from the 4th step is greater (or equal to) than a predefined value, the flow is declared "OK" and the general validity flag of this flow is set to "valid". If the percentage of "valid" data obtained by the 4th step is smaller than a predefined value, the flow is declared "NOK" and the general validity flag of this flow is set to "invalid".

In the OSDR product, the parameters can be split in families: "On board retracked significant waveheight", "On board retracked backscatter coefficient", "On board retracked altimeter range", "off nadir angle", "brightness temperatures", "environmental parameters".

The following table gives the list of parameters that can be controlled. The algorithm(s) that product(s) the parameter is identified in the third column. These algorithms are defined and specified in AD2.

Field Number	Parameter	Algorithm(s)
1	Range_Main	ALT_COR_RAN_04
2	RMS_Range_Main	ALT_COM_RAN_04
3	NVP_Range_Main	ALT_COM_RAN_04
4	Range_Aux	ALT_COR_RAN_04
5	RMS_Range_Aux	ALT_COM_RAN_04
6	NVP_Range_Aux	ALT_COM_RAN_04
7	SWH_Main	ALT_COR_SWH_01
8	RMS_SWH_Main	from Alt 1.0 (controlled only if SWH_Main is computed)
9	NVP_SWH_Main	from Alt 1.0 (controlled only if SWH_Main is computed)
10	Sig0_Main	ALT_PHY_WIN_01
11	RMS_Sig0_Main	from Alt 1.0 (controlled only if Sig0_Main is computed)
12	Sig0_Aux	ALT_PHY_WIN_01
13	RMS_Sig0_Aux	from Alt 1.0 (controlled only if Sig0_Main is computed)
14	Off_Angle_Wave_Main	ALT_COM_MIS_01
15	Rad_BT1	RAD_PHY_TEM_01

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16	Rad_BT2	RAD_PHY_TEM_01
17	Rad_BT3	RAD_PHY_TEM_01
18	Rad_Wind	RAD_PHY_GEN_01
19	Rad_Water_Vapour_Content	RAD_PHY_GEN_01
20	Rad_Liquid_Water	RAD_PHY_GEN_01
21	Alt_Wind	ALT_PHY_WIN_01
22	Alt_TEC	ALT_COR_RAN_12

The flags corresponding to each parameter described above are grouped by families. The list of flags and families are given in Annex 1 of AD10.

Family flags are constructed as it has been described (2nd step) and correspond to the bitfields described in A1 of AD10.

As previously seen in section 3.2.1, general flags are then computed from family flags according to the following table:

	Flag_Gen_Main	**Flag_Gen_Aux**	**Flag_Gen_Other**	**Flag_Gen_Final**
Flag_Fam_Range_Main				
Flag_Fam_Range_Aux				
Flag_Fam_SWH_Main				
Flag_Fam_Sig0_Main				
Flag_Fam_Sig0_Aux				
Flag_Fam_Off_Angle				
Flag_Fam_Rad_BT				
Flag_Env_Par				
Flag_Gen_Main				
Flag_Gen_Aux				
Flag_Gen_Other				

Figure 3 : Construction of the general flags from family flags

The percentages of valid and invalid data are computed with the values of these flags:

“Perc_Valid_Main” and “Perc_Non_Valid_Main” are computed with Flag_Gen_Main

“Perc_Valid_Aux” and “Perc_Non_Valid_Aux” are computed with Flag_Gen_Aux

“Perc_Valid_Other” and “Perc_Non_Valid_Other” are computed with Flag_Gen_Other

The general percentages of valid and invalid data are computed with Flag_Gen_Final: “Perc_Valid_Global” and “Perc_Non_Valid_Global”.

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4. FUNCTIONS

A list of the functions of the near real time control processing is given in figure 4.

APPLICABILITY	ALGORITHMS
JASON-1 OSDR Product	
	GEN_CTL_QUA_01 - To compress an array of flags
	GEN_CTL_QUA_03 - To determine percentages
	GEN_CTL_QUA_05 - To edit data measurements using thresholds

Figure 4: functions of the Near Real Time Control Processing

4.1. GEN_CTL_QUA_01 - TO COMPRESS AN ARRAY OF FLAGS

See AD4

4.2. GEN_CTL_QUA_03 - TO DETERMINE PERCENTAGES

See AD4

4.3. GEN_CTL_QUA_05 - TO EDIT DATA MEASUREMENTS USING THRESHOLDS

See AD4

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