



DOCUMENT

Long Term Data Preservation Preserved Data Set Composition LTDP/PDSC

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1 INTRODUCTION

1.1 Background

EO space data archives are extending from a few years to decades and their scientific value is continuously increasing hence is well recognized the need to preserve them without time limitation and to keep the archived EO space data well accessible and exploitable as they constitute a humankind asset. To preserve these digital assets is the aim of digital long-term preservation.

In 2006, the European Space Agency (ESA) initiated a coordination action to share a common approach towards the long-term preservation of Earth Observation space data among all European and Canadian stakeholders. During 2007, the Agency started consultations with its Member States presenting an EO Long Term Data Preservation strategy which targets the preservation of all European and Canadian EO space data for an unlimited time-span. This strategy includes the objective to ensure and facilitate access to these data and their usability through the implementation of a cooperative and harmonized collective approach among the EO space data owners.

A set of LTDP Common Guidelines have been defined (refer to RD[1]) as a first concrete and fundamental step to move ahead in creating the Long Term Data Preservation Framework. The guidelines are being adopted for old missions in a step-wise approach and straightforward for new missions and projects.

The LTDP guidelines have the aim to guarantee the preservation of EO space data and to ensure and facilitate accessibility and usability of the preserved data, respecting individual data policies, agreements and other regulatory instruments.

The LTDP guideline address eight main LTDP “themes” consisting of “guiding principles” and a set of “key guidelines” that should be applied to guarantee the preservation of EO space data in the long term ensuring also accessibility and usability. The eight themes are the following:

- Theme 1. Preserved data set composition
- Theme 2. Archive operations and organization
- Theme 3. Archive security
- Theme 4. Data ingestion
- Theme 5. Archive maintenance
- Theme 6. Data access and interoperability
- Theme 7. Data exploitation and re-processing
- Theme 8. Data appraisal and purge prevention

Earth Science (ES) is a very challenging domain as it is inherently very broad and scattered. Nine main data categories have been identified (ref. RD[3]).



Within each category, completely different source instruments are available, generally owned and operated by different entities applying different data preservation policies. Interoperability, application of common and standard preservation approaches and policies and the utilization of harmonised technological solutions and services are key aspects for making sure that ES data will be available and understandable in the future.

Long-term accessibility and exploitability of Earth Science data requires that not only data but also the associated knowledge (e.g. technical and scientific documentation, algorithms, data handling procedures, etc) is properly preserved and made accessible.

An important tasks of the current European LTDP cooperation framework focuses at capturing and understanding Earth Science users' needs in terms of long term preservation (including accessibility and exploitability aspects) of Earth Science data and associated knowledge, to support their research and application activities.

1.2 Document scope

The current revision of the document provides a preliminary description of the Preserved Data Set Composition (refer to LTDP Theme 1 RD [1]): **what** to preserve from the user perspective during all mission phases.

The document addresses the Earth Science context (i.e. Earth Science domains) and the specific Earth Observation domain, based on the data categorization taxonomy provided in [RD 3].

1.3 Document structure

The document is divided into:

1. Chapter 1 introduces the background and document scope.
2. Chapter 2 describes the Preserved Data Set Composition content provenance, &context, timeframe and ranking.
3. Chapter 3 details the expected content during the mission life.
4. Chapter 4 lists the documents to be produced in order to guarantee the content along the mission life timeframe.

1.4 Documents

1.4.1 Reference

Nr	Type	Description
RD1	LTDP Guidelines	Long Term Preservation of Earth Observation Space Data – European LTDP Common Guidelines, version 1.1 30/09/2010
RD2	LTDP EO datasets	Long Term Preservation of Earth Observation Space Data – European EO Space data set, version 1.0 12/08/2010
RD3	LTDP/FURD	LTDP Functional User Requirements Document issue 3 revision 0
RD4	Standard	OAIS , http://www.oasis-open.org/specs/
RD5	Standard	ESA ECSS , http://www.ecss.nl/

Table 1 - Reference documents

1.5 Acronyms and Definitions

In the context of this document terms like sensor and instrument are to identify a physical means necessary to capture an event of interest. The document does not take care of any technology essential to implement the sensor.

In the context of this document the word **Mission** is used generically and includes concept of “Experiment”, “Campaign”, “Project”, and similar.

This document applies LTDP Guidelines Acronyms and Definitions RD[1].

2. PRESERVED DATA SET COMPOSITION

Methods, standards and sound criteria are needed to certify whether the preserved data set composition content is complete and will meet the needs of future users.

2.1 Provenance & Context

OAIS-ISO standards RD[4] are applied in the definition of the structure of the LTDP Common Guidelines and used as reference in this document. Particularly, in accordance with OAIS, Provenance and Context are defined as below

Provenance - *The information that documents the history of the Content Information. This information tells the origin or source of the Content Information, any changes that may have taken place since it was originated, and who has had custody of it since it was originated. Examples of Provenance Information are the principal investigator who recorded the data, and the information concerning its storage, handling, and migration.*

Context - *The information that documents the relationships of the Content Information to its environment. This includes why the Content Information was created and how it relates to other Content Information objects.*

Provenance and Context for the nine categories of Earth Science data are addressed in detail in RD[3].

2.2 Phases & Ranking

To analyse what shall be preserved, the approach is based on three main dimensions :

- 1) The Content dimension referred to as **What**
- 2) The Phase during which the dataset is generated referred to as **Stage**
- 3) The current & future perceived importance referred to as **Rank**

Combination of **Stage** and **What** dimensions supports the two concepts of “**Context**” and “**Provenance**” according to the OAIS definitions (RD4) and in line with the User Requirements defined in FURD (RD3).

2.2.1 Stages

To better understand the **When** dimension it is necessary to analyze the main stages , or phases, of any project as derived from best practices and data provider engineering and project management standards. It is assumed that a feasibility studies, project’s selection and



resource assignment have been executed and a project has been selected. This document applies to a selected project or mission.

A scientific project is commonly split into the following stages:

1. **Pre-Mission (S1).** This stage is concerned with the mission scientific requirements definition. During this phase types of measurements (e.g. spectral analysis, temperature measurement, etc) are identified for the purpose of science and relationship among sensor/instruments of the project as well as relationships with other existing (or to be designed) sensors/instruments are identified too. The project can use (reuse) already existing sensors/instruments in different modes or in different combinations, or with different scientific models. According to ESA ECSS it can be identified as phases A/B of mission design.
2. **Mission Implementation (S2).** This stage defines details about sensors/instruments, (re)defines algorithms and their relationship in the frame of scientific domains, methods of measure and any other context necessary to perform measures. Typically it is the initial step in project/mission implementation. Instrument/sensor characteristics including pre-flight or pre-operational performance measurements (e.g., spectral response, noise characteristics, etc.) are considered in there. According to ESA ECSS it can be identified as phases C/D of mission design.
3. **Mission Operations (S3).** This stage identifies the operational timeframe of the mission being the period during which data are captured, algorithms are revised and improved, activities concerned with input analysis, calibration and validation of sensor/instrument as well as activities concerned with qualification of processed data are performed. According to ESA ECSS it can be identified as the phase E Operations till the end of mission lifecycle.
4. **Post Mission (S4).** This stage focuses on data captured and to be preserved for future possible use. During this stage, timeframe length is unpredictable beforehand, data and concerned information (i.e. dataset) are maintained and preserved against aging and technological changes and might be kept accessible for further future exploitation.

The following aspects are to be considered too:

- a) Cyclic evolution of similar missions, for example the Landsat Mission (e.g. <http://landsat.usgs.gov/>). In this case the scientific scenario has some evolutions while system design, technologies, algorithms etc. are changed trying to maintain data continuity. SAR missions' evolution like ERS 1/2, ENVISAT, and SENTINEL should be analysed from this view; as well as interoperability between current missions and former missions of the same type.
- b) Combined use of different sources, this is concerned with scientific missions using (or needing) scientific data generated by different sources. One example is given by scientific missions using SAR data from one satellite/sensor (current or past) and optical data coming from another satellite/sensor mission (current or past). CCI/ECV and FCDR frameworks all in this area.



- c) Combined/Joined use of similar sensors from different owners/sources (e.g. SAR, VIR, ground local sensors, etc) to reduce gaps of observed time series.

2.2.2 Ranking

Ranking of scientific data and information for long term preservation is needed to identify a minimal set of information (i.e. the minimal dataset) able to grant preservation for long terms.

In this document ranking is defined in three levels:

1. **Critical.** It identifies all data, information, documents and any other stuff necessary and critical to characterize the value of scientific data. In other words, if one single piece of *critical* is missed then the entire set of data and information is at risk or it is reduced future exploitability.
2. **Essential.** It identifies all data, information, documents and any other stuff required accessing, using or exploiting the datasets. The absence of “*Essential*” undermines the possibility to continue to use the dataset ones.
3. **Desirable.** It identifies all data, information and documents not critical neither essential. The objective is to identify data and/or information bringing value to the ensemble (i.e. dataset) possible to rebuild, retrieve or regenerate the “*desirable*” with reasonable effort in case of necessity.



3. CONTENT

This chapter describes the **What** dimension for each of the stages, and marks the proposed ranking.

3.1 Pre-Mission **Stage 1 Content**

ID	Description of content	Ranking
S1.1	Scientific scenario	Critical
S1.2	Science layer	Essential
S1.3	Mission Requirements (e.g. MIRD, MIP)	Critical
S1.4	Sensor/Instrument requirements (e.g. IRD)	Critical
S1.4	Sensor/Instrument characteristics (e.g. bands, modes, performances, etc.)	Critical
S1.5	Measurements qualification process	Critical
S1.6	Calibration data and methods	Critical
S1.7	Scientific base for data processing	Critical



3.2 Mission Implementation Stage 2 Content

ID	Description of content	Ranking
S2.1	Sensor/Instrument platform and its performances (e.g. satellite platform, buoy network, glider architecture, etc.)	Critical
S2.2	Raw data capture and saving methods	Critical
S2.3	Processing algorithms and reference to scientific bases	Critical
S2.4	Supporting information for data processing (e.g. ancillary, auxiliary)	Critical
S2.5	Data/Products structures and formats descriptions	Essential
S2.6	Instrument/Sensor calibration, tuning (data & methods)	Critical
S2.7	Campaigns for independent validation	Critical
S2.8	Product qualification process (data & methods) including raw data qualification.	Critical
S2.9	Known errors and/or limits in data processing or algorithm's application.	Essential
S2.10	Thematic information and papers	Desirable

3.3 Mission Operations Stage 3 Content

ID	Description of content	Ranking
S3.1	Raw data and/or Level 0 equivalent	Critical
S3.2	Processed data (e.g. L1,L2 or upper levels)	Critical if regularly processed otherwise Desirable (*)
S3.3	Processing algorithms and methods (e.g. technical descriptions, software coding, platform references, etc.)	Critical
S3.4	Processing evolution (e.g. changes, history)	Critical
S3.5	Processing supporting elements (e.g. ancillary, auxiliary, etc.)	Critical
S3.6	Processing support elements evolution (history of S3.5)	Critical
S3.7	Qualification methods including history	Critical
S3.8	Qualification data and references (PA/QA operations)	Critical
S3.9	Sensor/Instrument evolution (e.g. upgrading, downgrading, LUTs),	Critical
S3.10	Validation campaign data and results	Critical
S3.11	Metadata	Desirable
S3.12	Browse	Desirable
S3.13	Referred publications, articles and technical notes showing utilisation of datasets.	Desirable
S3.14	Known-errors and limits of sensors/instruments and data processors.	Essential
S3.15	Tandem campaign	Critical if any and not already covered by above elements

Notes:

(*) In all cases it is to be granted the possibility to reprocess data in order to bring out the following level of processing.

3.4 Post Mission Stage 4 Content

ID	Description of content	Ranking
S4.1	Reprocessing, reprocessed data and procedures	Critical if algorithm changes
S4.2	Processing algorithms and methods	Critical if changed
S4.3	Processing evolution (e.g. changes, history)	Critical if changed
S4.4	Processing supporting elements (e.g. ancillary, auxiliary, etc.)	Critical if changed for reprocessing
S4.5	Processing support elements evolution (history of S4.4)	Critical
S4.6	Qualification methods including history	Critical if changed
S4.7	Qualification data and references (PA/QA operations)	Critical if changed
S4.8	Metadata	Desirable if changed
S4.9	Browse	Desirable if changed
S4.10	Referred publications, articles and technical notes showing utilisation of datasets.	Essential
S4.11	Quality and integrity checks	Critical

4. DETAILED IMPLEMENTATION

This chapter proposes detailed application of the LTDP guidelines.

General data-sets have been divided into the following main categories (ref. RD03 FURD) and reported hereafter:

1. **C1:** SAR imaging missions/sensors, high and very high resolution (different radar bands).
2. **C2:** Multi-spectral imaging missions/sensors, high and very high resolution.
3. **C3:** Medium resolution Land and Ocean monitoring missions/sensors (e.g. wide swath ocean colour and surface temperature sensors, altimeter, etc).
4. **C4:** Atmospheric chemistry missions/sensors.
5. **C5:** Other Scientific missions/sensors.
6. **C6:** Airborne (e.g. digital cameras single/multiple, digital line scanners, radar, laser topographic/bathymetric, etc). Helicopter Observation Platforms (HOPs) are considered in this category.
7. **C7:** Balloon (e.g. geomagnetic instruments, wind, temperature, radiation, radio propagation, particles, optical properties, chemistry, etc).
8. **C8:** Ground (e.g. seismography, temperature, humidity, wind, pressure, radiation, radiance, pollution factors, rain, chromatography, soil property, etc).
9. **C9:** Hydro (e.g. temperature, salinity, pollution factors, wind, pressure, water flow/flux/level, etc). Here are included data coming from buoys as well as from ships, gliders or other means to capture local data.

The first five categories (C1 to C5) can be grouped and referred as “**Earth Observation Space data**”, categories C6 and C7 can be grouped and referred as “**Airborne and Balloon**” data, whilst the remaining two categories (C8 and C9) can be grouped and referred as “**In-Situ data**”.

For Earth Observation (EO) case it is to be considered that:

- a) satellite owners, like ASI, CNES, DLR or ESA, usually take care of data processing up to a certain processing level (e.g. up to L2), while value-adders (e.g. GMES services) processes data to obtain upper levels with other kinds of supporting information (e.g. thematic maps).
- b) C6, C7, C8 and C9 are considered in-situ data for comparative and supportive applications by EO point of view while are main data in other scientific contexts.

Definition of Primary and Secondary data is provided in RD03 FURD document and reported hereafter.

Primary Data are data identified as:

1. Raw data (as acquired by the platform and recorded at the stations or received via other parties).
2. Interpolated or processed data when systematically generated as part of the mission requirements and/or reprocessed.

Secondary Data are the ones identified as:

1. Ancillary data (e.g. georeference, GPS, DEM, etc.).
2. Auxiliary data required to process the telemetry payload data to generate the nominal mission products (e.g. attitude, motion, ambient state, etc.).
3. CAL/VAL databases whenever available (including processing/reference validation data sets). This includes history of calibration/validation and the qualification process used and data reliability (e.g. calibration methods, uncertainty/errors).
4. *Mission related documentation.*

Mission, or project related, documentation is generally described as:

1. Mission architecture documents describing purpose, scope and performances of the mission and of the onboard instruments, information relevant orbits, platform position, attitude, ground coverage (acquisition footprint), head-roll-pitch.
2. Data/products descriptions, documents where raw telemetries and/or processed levels are described, here are considered data and products formats and characteristics too.
3. Documents describing measurement requirements and/or measurement performances (theoretical models). Documents drawing instruments characteristics, performances and instrument description (physical implementations). Documents describing models and/or algorithms needed (used) to obtain mission data and products including specific/special cases, known errors and configuration necessities. In other words, it should be provided documents covering conceptual environment, its implementation and its operations.
4. Reports concerned with measurement trends, failures, changes of performances, and out of service for any reason.
5. Reports and outcomes from events like congresses, studies, communities and investigators concerned with models' review, algorithm changes and Cal/Val changes affecting data processing chains
6. Documents related to the process of data qualification: precision, numerical representations, formats, uncertainties, errors, adjustment/correction methods (e.g. Cal/Val documents).

4.1 Instrument/Sensor characterisation

Preferred entry point to describe dataset is the Instrument or Sensor, even if in some context it is used a different entry point. For example Earth Observation domain uses to access information looking at mission and then to the instrument within a mission, or to use (or compare) similar products of similar instruments from different missions.

The two modes have advantages and disadvantages but the instrument/sensor way is the common way of all Earth Science domains.

Instrument and sensor taxonomy for Earth Observation remote sensed data is proposed hereafter (from FURD RD3), it helps in classification only.

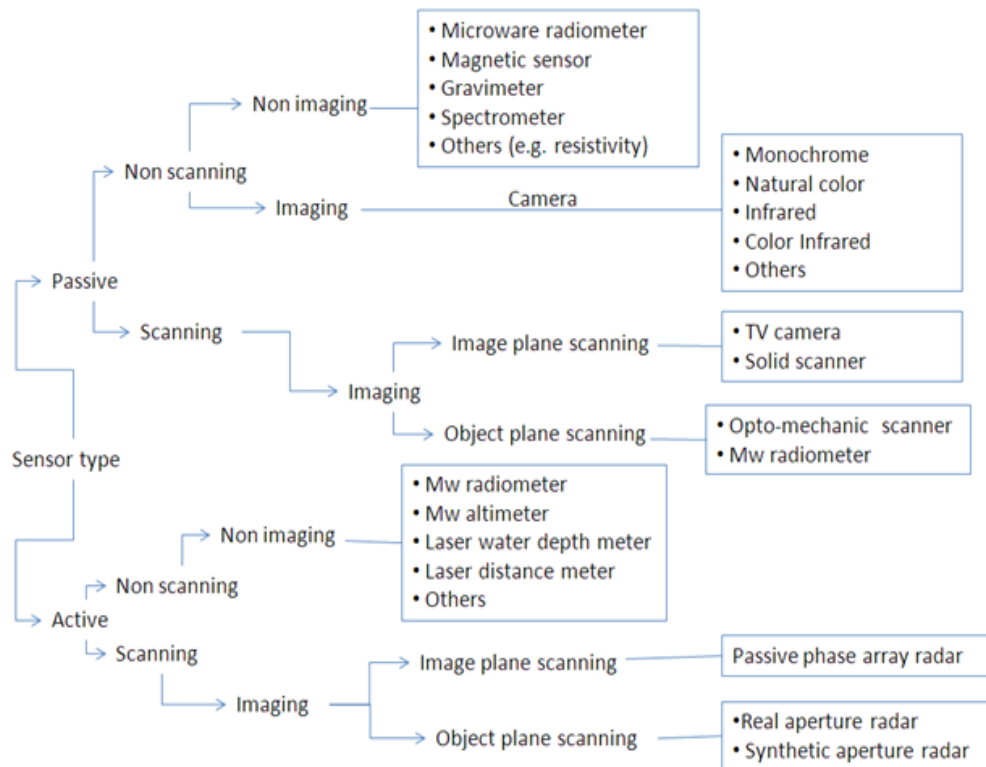


Figure 1 EO instrument/sensor taxonomy

4.1.1 C1 SAR imagines sensor (or mission)

C1: SAR imaging missions/sensors, high and very high resolution (different radar bands).

C1 : SAR imaging missions/sensors, high and very high resolution (different radar bands)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	SAR Sensor Requirements	Contains sensor requirements for design	Critical
S1	Document	SAR Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical
S1	Document	SAR qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Document	SAR calibration	Calibration requirements	Critical
S1	Data & Document	SAR calibration	Ground calibration references and scientific base	Critical
S2	Document	SAR data handling	SAR data capture and handling	Critical
S2	Document	SAR processing	SAR on-board processing, ground processing	Critical
S2	Document	SAR products	Data/product structures	Critical
S2	Document	SAR design	SAR platform and instrument design, budget performances	Critical
S2	Data & Document	SAR validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	SAR qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	SAR boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	Raw data or Level 0	Critical



S3	Data (Primary data)	Level 1	Processed L1 products	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Level 2	Processed L2 plus	Critical if systematically generated or not possible reprocessing
S3	Document (code)	SAR processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Visualizing tools and methods	Critical (and their history)
S3	Document (formats)	SAR processing	Packed telemetry, PUS, CCSDS, Instrument source packet, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Ephemeris, Navigation parameters, Observation counters, Orbital state vectors, Times, Temperatures, Antenna and Amplifiers noises, Earth relative position, Azimuth, Instrument parameters	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere correction factors, geometry correction factors, drift factors, SAR modes, incidence angle, absolute calibration constants, range spreading loss, antenna pattern gain, solar radiance, altimetry/geode model, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (Radiometric Stability, Instrument availability, Internal calibration, Doppler parameters, Radar equivalent sections, Elevation antenna pattern, etc.)	Critical (with history)
S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or Interferometric campaigns	Data and reports	Critical if any



S3	Data (secondary data)	Metadata	Metadata digital bibliotèque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital bibliotèque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	L0, L1, L2	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	SAR processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital bibliotèque	Desirable

Note:

Altimetric data (altimeter instrument) is considered as a SAR instrument and it is applied the list of C1 case.

4.1.2 C2 Optical sensors (or mission)

C2: Multi-spectral imaging missions/sensors, high and very high resolution.

C2: Multi-spectral imaging missions/sensors, high and very high resolution.				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Optical Sensor Requirements	Contains sensor requirements for design	Critical
S1	Document	Optical Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical
S1	Document	Sensor qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Document	Calibration	Calibration requirements	Critical
S1	Data & Document	Calibration	Ground/ocean calibration references and scientific base	Critical
S2	Document	Data handling	Data capture and handling	Critical
S2	Document	Processing	On-board processing, ground processing	Critical
S2	Document	Optical products	Data/product structures	Critical
S2	Document	Optic design	Optic platform and instrument design, budget performances	Critical
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Optical boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	Raw data or Level 0	Critical



S3	Data (Primary data)	Level 1	Processed L1 products	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Level 2	Processed L2 plus	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Optical data processing	Instrument processing algorithms, context and source codes, testing context. It includes special cases like de-stripping.	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing and visualizing tools.	Critical (and their history)
S3	Document (formats)	Data /Image processing	Packed telemetry, PUS, CCSDS, Instrument source packet, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Ephemeris, Navigation parameters, Observation counters, Orbital state vectors, Times, Sun position, Temperatures, Sensor/CCD/Amplifiers noises, Earth relative position, Azimuth, Instrument parameters (e.g. optical response)	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere correction factors, geometry correction factors, drift factors, albedo parameters, Instrument modes, incidence angle, absolute calibration constants, range spreading loss, antenna pattern gain, solar radiance, moon temperature brightness, local/seasonal variances, weather forecast/actual, winds, altimetry/geode model, DEM, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Valid ation data	During operations (optical/radiometric stability, Instrument availability, Internal calibration,	Critical (with history)

			Optic pointing pattern, etc.)	
S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	L0, L1, L2	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Data/Image processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

Note:

1. Altimetric data (altimeter instrument) are considered as a SAR instrument and it is applied the list of C1 case.
2. Often images with cloud coverage above some limits and images widely covered by airplane trails are trashed as useless. Even if the use of those images for the main purpose or application is minor or none at all it is to be noted some researchers use those images in the frame of cloud related analysis and hence in principle should not be wasted. Here it is suggested to apply the guiding principle of Theme 8 Data Appraisal and Purge (ref. RD1).

4.1.3 C3 Land & Ocean sensors (or mission)

C3: Medium resolution Land and Ocean monitoring missions/sensors (e.g. wide swath ocean colour and surface temperature sensors, altimeter, etc).

C3: Medium resolution Land and Ocean monitoring missions/sensors.				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Optical Sensor Requirements	Contains sensor requirements for design	Critical
S1	Document	Optical Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical
S1	Document	Sensor qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Document	Calibration	Calibration requirements	Critical
S1	Data & Document	Calibration	Ground/ocean calibration references and scientific base	Critical
S2	Document	Data handling	Data capture and handling	Critical
S2	Document	Processing	On-board processing, ground processing	Critical
S2	Document	Optical products	Data/product structures	Critical
S2	Document	Optic design	Optic platform and instrument design, budget performances	Critical
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Optical boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data	Raw data	Raw data or Level 0	Critical



	(Primary data)			
S3	Data (Primary data)	Level 1	Processed L1 products	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Level 2	Processed L2 plus	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Optical data processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing and visualizing tools	Critical (and their history)
S3	Document (formats)	Data /Image processing	Packed telemetry, PUS, CCSDS, Instrument source packet, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Ephemeris, Navigation parameters, Observation counters, Orbital state vectors, Times, Sun position, Temperatures, Sensor/CCD/Amplifiers noises, Earth relative position, Azimuth, Instrument parameters (e.g. optical response)	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Bands/Multispectral/Band-by-band parameters for algorithms, Non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere correction factors, geometry correction factors, drift factors, albedo parameters, Instrument modes, incidence angle, absolute calibration constants, range spreading loss, antenna pattern gain, solar radiance, moon temperature brightness, local/seasonal variances, weather forecast/actual, winds, altimetry/geode model, DEM, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Valid ation data	During operations (optical/radiometric stability,	Critical (with history)

			Instrument availability, Internal calibration, Optic pointing pattern, etc.)	
S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	L0, L1, L2	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Data/Image processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

Note: Instruments like ATSR, MERIS or similar are considered in this context.

4.1.4 C4 Satellite based, atmospheric chemistry missions/sensors

C4: Atmospheric chemistry missions/sensors.

C4: Atmospheric chemistry missions/sensors (note that processing level above L2 requires different auxiliary files)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Optical Sensor Requirements	Contains sensor requirements for design	Critical
S1	Document	Optical Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical
S1	Document	Sensor qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Document	Calibration	Calibration requirements	Critical
S1	Data & Document	Calibration	Ground/ocean calibration references and scientific base	Critical
S2	Document	Data handling	Data capture and handling	Critical
S2	Document	Processing	On-board processing, ground processing	Critical
S2	Document	Optical products	Data/product structures	Critical
S2	Document	Optic design	Optic platform and instrument design, budget performances	Critical
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Optical boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data	Raw data	Raw data or Level 0	Critical



	(Primary data)			
S3	Data (Primary data)	Level 1	Processed L1 products	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Level 2	Processed L2 plus	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Optical data processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing and visualizing tools	Critical (and their history)
S3	Document (formats)	Data /Image processing	Packed telemetry, PUS, CCSDS, Instrument source packet, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Ephemeris, Navigation parameters, Observation counters, Orbital state vectors, Times, Sun position, Temperatures, Sensor/CCD/Amplifiers noises, Earth relative position, Azimuth, Instrument parameters (e.g. optical response, radiometric parameters)	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Bands/Multispectral/Band-by-band parameters for algorithms, radiometric bands/parameters, optical/radiometric modes, non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere correction factors, geometry correction factors, drift factors, albedo parameters, Instrument modes, incidence angle, absolute calibration constants, range spreading loss, antenna pattern gain (radiometry), solar radiance, moon temperature brightness, local/seasonal variances, weather forecast/actual, winds, altimetry/geode model, DEM, etc.	Critical (and their history)

S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (optical/radiometric stability, Instrument availability, Internal calibration, Optic pointing pattern, etc.)	Critical (with history)
S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	L0, L1, L2	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Data/Image processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

4.1.5 C5 Satellite based, other scientific missions/sensor

C5: Other Scientific missions/sensors. This category includes gravity, magnetic field, gaussmeters, resistivity, etc. Types and levels of processing are variable.

C5: Other Scientific missions/sensors				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Sensor Requirements	Contains sensor requirements for design	Critical
S1	Document	Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical
S1	Document	Sensor qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Document	Calibration	Calibration requirements	Critical
S1	Data & Document	Calibration	Ground/ocean calibration references and scientific base	Critical
S2	Document	Data handling	Data capture and handling	Critical
S2	Document	Processing	On-board processing, ground processing	Critical
S2	Document	Products	Data/product structures	Critical
S2	Document	Sensor design	Sensor and instrument design, budget performances	Critical
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Sensor boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	Raw data or Level 0	Critical



S3	Data (Primary data)	Level 1	Processed L1 products	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Level 2	Processed L2 plus	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Data processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing visualizing tools	Critical if any (and their history)
S3	Document (formats)	Data processing	Packed telemetry, PUS, CCSDS, Instrument source packet, Product formats, and storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Ephemeris, Navigation parameters, Observation counters, Orbital state vectors, Times, Sun position, Temperatures, Sensor/CCD/Amplifiers noises, Earth relative position, Azimuth, Instrument parameters (e.g. optical response, radiometric parameters)	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Bands/Band-by-band parameters for algorithms, radiometric bands or parameters, measurement modes, non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere correction factors, geometry correction factors, drift factors, absolute calibration constants, range spreading loss, sensor pattern gain, solar influence, moon influence, local/seasonal variances, weather forecast/actual, winds, altimetry/geode model, DEM, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (sensor stability, availability) Internal calibration,	Critical (with history)

S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	L0, L1, L2	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Data processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

4.1.6 C6 Airborne based generated data

C6: Airborne (e.g. digital cameras single/multiple, digital line scanners, radar, laser topographic/bathymetric, etc). Helicopter Observation Platforms (HOPs) are considered in this category.

In-situ Auxiliary Parameters, hereafter mentioned, are the ones Critical to perform processing up to L2 equivalent. They are physical measures of various kinds in support of the primary measure of the instrument. E.g. Soot (black carbon measurement) instrument needs temperature and pressure for processing.

C6: Airborne generated data (includes airplanes, UAV and HOPs)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Sensor Requirements	Contains sensor requirements for design	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Data & Document	Calibration	Calibration requirements, references and scientific base	Critical
S2	Document	Data management	Data capture and handling	Critical
S2	Document	Processing	Platform on-board processing, ground processing methods	Critical
S2	Document	Products	Data/product structures	Critical
S2	Document	Design	Platform and instrument design, budget performances	Critical if new platform or integration model if existing platforms, instruments or sensors
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical

S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	As acquired from sensor / station	Critical
S3	Data (Primary data)	Qualified level	First qualified level, error corrected	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Interpolated level	1 st level of interpolation (typical products)	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing visualizing tools	Critical if any (and their history)
S3	Document (formats)	Product formats	Packed telemetry, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Navigation parameters, Observation counters, Times, Temperatures, Amplifiers noises, Earth relative position, Azimuth, Instrument parameters , etc.	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere and/or radiometric correction factors , drift factors, instrument modes, observation angles, solar radiance, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (Radiometric Stability, Instrument availability, Internal calibration, Doppler parameters, Radar equivalent sections, Elevation antenna pattern, etc.)	Critical (with history)

S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or Interferometric campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	Qualified / Interpolated	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

4.1.7 C7 Balloon based generated data

C7: Balloon (e.g. geomagnetic instruments, wind, temperature, radiation, radio propagation, particles, optical properties, chemistry, etc).

C7: Balloon generated data (tethered, remote-controlled, autonomous)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, and expected goals	Critical
S1	Document	Mission Requirement Document	Contains scientific mission requirements, required instrument, sensors, processing methods, qualification methods	Critical
S1	Document	Sensor Requirements	Contains sensor requirements for design	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Data & Document	Calibration	Calibration requirements, references and scientific base	Critical
S2	Document	Data management	Data capture and handling	Critical
S2	Document	Processing	Platform on-board processing, ground processing methods	Critical
S2	Document	Products	Data/product structures	Critical
S2	Document	Design	Platform and instrument design, budget performances	Critical if new platform or integration model if existing platforms, instruments or sensors
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential

S2	Document	Boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	As acquired from sensor / station	Critical
S3	Data (Primary data)	Qualified level	First qualified level, error corrected	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Interpolated level	1 st level of interpolation (typical products)	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Processing	Instrument processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing visualizing tools	Critical if any (and their history)
S3	Document (formats)	Product formats	Packed telemetry, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Attitude, Navigation parameters, Observation counters, Times, Temperatures, Amplifiers noises, Earth relative position, Azimuth, Instrument parameters , etc.	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere and/or radiometric correction factors , drift factors, instrument modes, observation angles, solar radiance, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (Radiometric Stability, Instrument availability, Internal calibration, Doppler parameters, Radar equivalent sections, Elevation antenna pattern, etc.)	Critical (with history)
S3	Data / Reports	In-situ	In-situ data and references to calibration sites	Critical if any
S3	Data / Reports	Tandem and/or Interferometric campaigns	Data and reports	Critical if any



S3	Data (secondary data)	Metadata	Metadata digital bibliotèque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital bibliotèque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if occurs (reprocessing)
S4	Data (reprocessed)	Qualified / Interpolated	Reprocessed data & products if happens	Critical if reprocessing occurs
S4	Document (reprocessed)	Processing	Instrument processing algorithms, context and source codes, testing context	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	Ancillary, Auxiliary	Changed supporting elements	Critical if reprocessing occurs
S4	Data & Document (reprocessed)	PA/QA	Changed QA/PA elements	Critical if reprocessing occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital bibliotèque	Desirable

4.1.8 C8 Ground sensors generated data

C8: Ground (e.g. seismography, temperature, humidity, wind, pressure, radiation, radiance, pollution factors, rain, chromatography, soil property, etc).

Here are considered single sensor as well as groups and networks of sensors/instruments.

C8: in-situ ground based instruments / sensors (single, network of elements)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, requirements and expected goals	Critical
S1	Document	Campaign description document	Contains campaigns description and plans with description of instruments, sensors, processing methods, qualification methods	Critical
S1	Document	Sensor Requirements	Contains sensor requirements for design	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Data & Document	Calibration	Calibration requirements, references and scientific base	Critical
S2	Document	Data management	Data capture and handling	Critical
S2	Document	Processing	Platform and network (if any) processing, processing methods	Critical
S2	Document	Products	Data/product structures	Critical
S2	Document	Design	Platform and instrument design, budget performances	Critical if new platform or integration model if existing platforms, instruments or sensors
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential

S2	Document	Boundaries	Known errors and limits	Essential
S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	As acquired from sensor / station	Critical
S3	Data (Primary data)	Qualified level	First qualified level, error corrected	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Interpolated level	1 st level of interpolation (typical products)	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Processing	Instrument pre and post processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tools	Processing visualizing tools	Critical if any (and their history)
S3	Document (formats)	Product formats	Packed telemetry, Product formats, storage formats.	Critical (and their history)
S3	Data (secondary data)	Ancillary data	Station/sensor/platform georeference, spatial resolution, positional drift, correction factors, sensor parameters, network of sensor parameters, sensor and amplifier noise, etc.	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Station/sensor/platform characteristics, relative height and sensing observation characteristics, ambient/state parameters, non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere and/or radiometric spectra correction factors , auxiliary variables, drift factors, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (Stability, availability, calibration, parameters, etc.)	Critical (with history)
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any
S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise

				Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if change occurs
S4	Data	Qualified / Interpolated	Reprocessed data & products if happens	Critical if change occurs
S4	Document	Processing	Instrument processing algorithms, context and source codes, testing context	Critical if change occurs
S4	Data & Document	Ancillary, Auxiliary	Changed supporting elements	Critical if change occurs
S4	Data & Document	PA/QA	Changed QA/PA elements	Critical if change occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable

4.1.9 C9 Hydro sensors generated data

C9: Hydro (e.g. temperature, salinity, pollution factors, wind, pressure, water flow/flux/level, etc). Here are included data coming from buoys as well as from ships, gliders or other means to capture water local and/or networked data.

C9: in-situ hydro related based instruments / sensors (single, network of elements, AUVs, buoys, gliders, ships, etc.)				
Stage	Type	Identification	Description	Ranking
S1	Document	Scientific scenario	Contains scientific scenario, requirements and expected goals	Critical
S1	Document	Campaign description document	Contains campaigns description and plans with description of instruments, sensors, processing methods, qualification methods	Critical
S1	Document	Sensor Requirements	Contains sensor requirements for design	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Sensor characteristics	Characteristics for processing of acquired data, data processing models	Critical if new sensors or datasheets if existing instruments/sensors
S1	Document	Qualification process	Qualification process for sensor, captured data, processed data	Critical
S1	Data & Document	Calibration	Calibration requirements, references and scientific base	Critical
S2	Document	Data management	Data capture and handling	Critical
S2	Document	Processing	Platform and network (if any) processing, processing methods	Critical
S2	Document	Products	Data/product structures	Critical
S2	Document	Design	Platform and instrument design, budget performances	Critical if new platform or integration model if existing platforms, instruments or sensors
S2	Data & Document	Validation	Independent validation campaign, methods, data	Critical
S2	Data & Document	Qualification process	Detailed qualification methods and data	Desirable
S2	Data & Document	Supporting information for processing	Ancillary and auxiliary files definition and identification	Essential
S2	Document	Boundaries	Known errors and limits	Essential

S2	Document	Notes	Technical Notes and scientific paper referencing the specific sensor or processing	Desirable
S3	Data (Primary data)	Raw data	As acquired from sensor / station	Critical
S3	Data (Primary data)	Qualified level	First qualified level, error corrected	Critical if systematically generated or not possible reprocessing
S3	Data (Primary data)	Interpolated level	1 st level of interpolation (typical products)	Critical if systematically generated or not possible reprocessing
S3	Document (code)	Processing	Instrument pre and post processing algorithms, context and source codes, testing context	Critical (and their history)
S3	Document (code)	Visualizing tool	Processing visualizing tools	Critical if any (and their history)
S3	Document (formats)	Product formats	Packed telemetry, Product formats, storage formats.	Critical (and their history)
S3	Document	Parameters	Sawtooth parameters, spatiotemporal sampling resolution, etc.	Critical in case of gliders, AUVs and similar (with history)
S3	Data (secondary data)	Ancillary data	Station/sensor/platform georeference, spatial resolution, positional drift, correction factors, sensor parameters, network of sensor parameters, sensor and amplifier noise, etc.	Critical (and their history)
S3	Data (secondary data)	Auxiliary data	Station/sensor/platform characteristics, relative height and sensing observation characteristics, ambient/state parameters, non linearity correction factors, Error/Failure/Gap correction factors, Calibration curve/Factors, Scaling correction factors, Atmosphere and/or radiometric spectra correction factors , auxiliary variables, drift factors, etc.	Critical (and their history)
S3	Data / Reports (secondary data)	Quality parameters	PA/QA of instrument, raw data and products	Critical (and their history)
S3	Data / Reports (secondary data)	Calibration/Validation data	During operations (Stability, availability, calibration, parameters, etc.)	Critical (with history)
S3	Data / Reports	Tandem and/or combined campaigns	Data and reports	Critical if any



S3	Data (secondary data)	Metadata	Metadata digital biblioteque	Critical if systematically generated otherwise Desirable
S3	Data (secondary data)	Browse / Images	Browse digital biblioteque	Critical if systematically generated otherwise Desirable
S4	Document (engineering / science change)	Processing	Processing and/or Calibration change including provenance and context	Critical if change occurs
S4	Data	Qualified / Interpolated	Reprocessed data & products if happens	Critical if change occurs
S4	Document	Processing	Instrument processing algorithms, context and source codes, testing context	Critical if change occurs
S4	Data & Document	Ancillary, Auxiliary	Changed supporting elements	Critical if change occurs
S4	Data & Document	PA/QA	Changed QA/PA elements	Critical if change occurs
S4	Data & Reports	Quality and integrity checks	Verification and consistency check of stored elements	Critical
S4	Data & Reports	Publications	List of publications using stored elements	Desirable
S4	Data (secondary)	Browse / Metadata	Digital biblioteque	Desirable