



LONG TERM PRESERVATION OF EARTH OBSERVATION SPACE DATA

EUROPEAN LTDP COMMON GUIDELINES

CHANGE LOG

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1. INTRODUCTION

1.1 Long Term Data Preservation – the issue

Monitoring of global change processes has led to increasing demand for long-term time series of Earth Observation (EO) data spanning 20 years, or more. These data are necessary to support international activities such as the United Nations Framework Convention on Climate Change (UNFCCC). Content of EO space data archives is 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.

Information technology is changing rapidly and this change also affects digital data from Earth Observation missions. Because of this rapid technological change, the long-term preservation of digital assets has to deal with specific risks and challenges. Among these risks are the corruption of the bit-stream, obsolescence of the file format, extant hardware and operating environments that make data unreadable on the physical and logical level. But also insufficient documentation of data, the inability to discover data, or service compatibility can prevent their re-use.

In addition to direct damage, data can also become damaged or destroyed by indirect actions, such as a breach of security of the data centre or physical damage of its structure by accidents or natural hazards. Besides the risks mentioned above, not all challenges to the long-term preservation of digital assets are technical in nature. Risks may also arise from organisational issues such as insufficient financial or human resources.

The large amount of new Earth Observation missions upcoming in the next years will moreover lead to a major increase of EO space data volumes. This fact, together with the increased demands from the scientific user community, marks a challenge for Earth Observation space data owners and archive holders regarding coherent data preservation and optimum availability and accessibility of the different EO data and products.

Until now, cooperation between Earth Observation space data owners and archive holders in Europe in this field has been poor with no common approach for long term-preservation and access to EO space data. Yet, cooperation, sharing and identification of commonalities are key aspects to be pursued for the benefit of the user community and for costs and efforts optimisation.

A cooperative and harmonised collective approach on Long Term Data Preservation (LTDP) in Europe (i.e. a European EO LTDP Framework) is needed to coordinate and optimise European efforts in the LTDP domain. The aim is to ultimately preserve the entire European EO space data set for the benefit of all European countries and users, while at the same time reducing the overall costs of data preservation. Reduction of operation costs will also reduce the risk that old archived data are discarded by commercial operators because the reduced commercial interest may in some cases not justify the effort to further archive these data.

1.2 Long Term Data Preservation – a coordinated approach in Europe

Main goals of the European EO Long Term Data Preservation Framework are to:

1. Preserve the European, and Canadian, EO space data set (see Section 1.3) for an unlimited time-span.
2. Ensure and facilitate the accessibility and usability of the preserved data sets respecting the individual entities applicable data policies.

3. Adopt a cooperative and harmonised collective approach among the data owners and archive holders (European LTDP Framework), based on the application of European LTDP Common Guidelines and sustained through cooperative (multi-source) long term funding schemes.
4. Ensure, to the maximum extent, the coherency with the preservation of other non-space based environmental data and international policies.

The European LTDP Framework is open to all possible members. It is intended as a collaborative framework consisting of distributed and heterogeneous components and entities cooperating in several areas to reach a harmonized preservation of the European EO space data set. The framework is based on the contribution of European Earth Observation space data owners and archive holders through their ideas and, where possible, their infrastructure in accordance to the commonly agreed LTDP Guidelines and should follow a stepwise progressive implementation plan (short, mid, long-term activities).

A common approach in the field of Long Term Data Preservation should aim at the progressive implementation of the European LTDP Common Guidelines. It should also facilitate cooperation of data archive owners in several areas for development and implementation of technology, methodology, standardisation, operational solutions and data exploitation methodologies, all of which are key aspects for the set-up of the framework. The European LTDP framework is outlined in Figure 1.

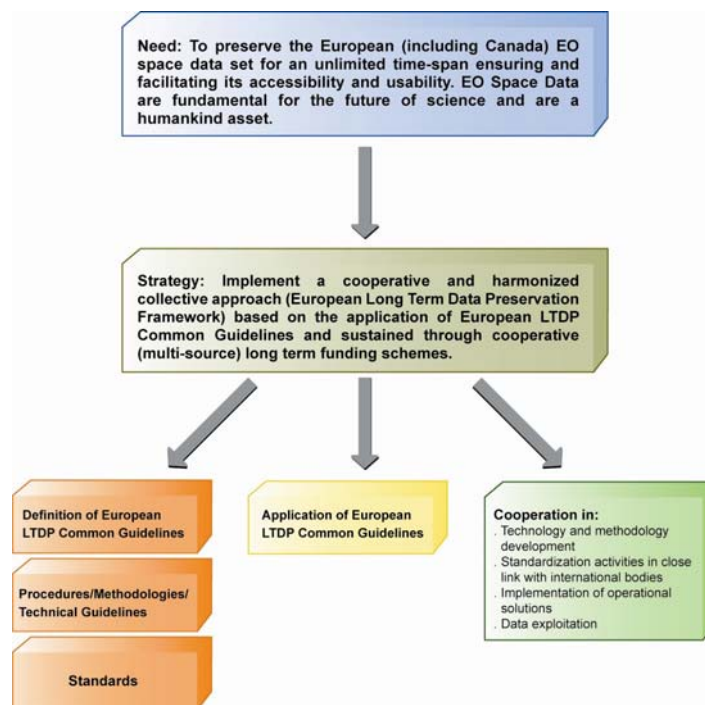


Figure 1 – Conceptual outline of the framework for long-term data preservation.

Earth Observation space data owners and archive holders will benefit from synergies in a cooperative framework through possible re-use of proven technologies, procedures and approaches. This may, in the long term, also include re-use and sharing of infrastructure elements. The adoption of standards (e.g. for data access interfaces and formats, procedures, etc.) and of common technical solutions can potentially also significantly reduce preservation costs.

1.3 European EO Space Data Set

The European EO Space Data Set consists of all EO space data from missions or instruments owned by public or private organisations from European Member States and Canada and of all EO space data over Europe from non-European Member States missions or instruments available through agreements with European entities (e.g. Third Party Missions managed by the European Space Agency). The space missions or sensors whose data constitutes the European EO Space Data Set are subdivided in the following six main categories:

- ✓ C1: High and Very High resolution SAR imaging missions/sensors (different Radar bands).
- ✓ C2: High and Very high resolution multi-spectral imaging missions/sensors.
- ✓ C3: Medium resolution Land and Ocean monitoring missions/sensors (e.g. wide swath ocean colour and surface temperature sensors, altimeter, etc).
- ✓ C4: Atmospheric missions/sensors.
- ✓ C5: Other Scientific missions/sensors.
- ✓ C6: Other Space related data (e.g. airborne campaigns for space sensors validation, etc..).

All missions and instruments comprising the European EO Space Data Set are described in a document [R. 1] which is updated every six months.

1.4 The European LTDP Common Guidelines

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 [R. 2] which targets the preservation of all European and Canadian EO space data for an unlimited time-span. This strategy includes the aim to ensure and facilitate access to these data and their usability of through the implementation of a cooperative and harmonized collective approach among the EO space data owners.

The Long Term Data Preservation Working Group with representatives from ASI, CNES, CSA, DLR and ESA was formed at the end of 2007 within the Ground Segment Coordination Body (GSCB, R. 3). The goal of this working group is to define and promote, with the involvement of all the European Earth Observation space data owners and archive holders, the European LTDP Common Guidelines and also to increase awareness for long-term data preservation. The resulting draft LTDP guidelines were reviewed by all ESA member states in the DOSTAG.

During the 1st Earth Observation Long Term Data Preservation workshop in May 2008 [R. 4], the draft guidelines and the framework were presented and discussed by all European and Canadian Earth Observation space data owners and archive holders. The participants discussed and developed a joint strategy to advance long-term data preservation of EO data both technically and programmatically and recognized the need and benefit of a common approach.

Furthermore all participants agreed on the draft LTDP Common Guidelines presented at the workshop as a first concrete and fundamental step to move ahead in creating the Long Term Data Preservation Framework. The guidelines should be adopted for old missions with a step-wise approach and straightforward for new missions and projects. ESA was given the task to trigger and coordinate the following steps toward the progressive European LTDP Framework implementation. A consolidated European LTDP Common Guidelines document has been produced by the LTDP working group on the basis of the comments and feed-backs received during the LTDP workshop.

The document has been submitted in June 2009 to a public review process with the goal to collect additional comments and feed-backs from Earth Observation space data owners and archive holders and to issue an as large as possible agreed version of the document for the end of 2009. The first issue (Issue 1.0) of the European LTDP Common Guidelines was produced by the LTDP WG starting from the feed-back and comments received in the public review process and was formally approved by GSCB. The second issue (Issue 1.1) is an update of the previous one with the goal to have a better alignment with the OAIS standard. The LTDP Guidelines are intended to be a living document and are updated periodically to include the results of additional cooperation activities in Europe.

1.5 Document Scope and Purpose

“Long Term Data Preservation” includes not only archiving but also access, processing and exploitation aspects of the EO space mission data. As such the LTDP guidelines are not referring to an isolated preserved data set or archive but to a complete system. This system extends beyond archiving of EO space data and also guarantees the generation and dissemination of data products. 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 guidelines are not intended to cover programmatic aspects (e.g. LTDP organisation, availability of LTDP dedicated programmes or budgets within organisations) or data policy aspects associated with European or Canadian EO data to be preserved through the application of the guidelines.

The document addresses 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:

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

The LTDP guidelines defined in this document constitute a basic reference for the long term preservation of EO data. Their application by European Earth Observation space data owners and archive holders is fundamental in order to preserve the European EO space data set and to create an European LTDP Common Framework. The application of the identified guidelines is not a requirement or a must for European EO data owners and archive holders but is strongly recommended along with following a step-wise approach starting with a partial adherence. To this end different levels of adherence (Levels A, B and C) have been assigned to each key guideline in this document (See Table 1 and Annex 1).

Level A has been defined as the entry level and, accordingly, Level A key guidelines should be the first ones to be addressed and implemented in order to guarantee a basic level of security, integrity and accessibility of the archived data.

Adherence Level	Description	Condition for adherence
Level A	Basic data security, integrity and access.	Implementation of all high priority key guidelines.
Level B	Medium data security, integrity, access and interoperability.	Implementation of all high and medium priority key guidelines.
Level C	High data security, integrity, access and interoperability.	Implementation of all key guidelines.

Table 1 – Levels of adherence to the LTDP Common Guidelines

The implementation of all the Level A key guidelines corresponds to a level of adherence to the European LTDP Common Guidelines as a whole equal to Level A. The implementation of all Level A and Level B key guidelines correspond to a level of adherence equal to Level B whilst the implementation of all the key guidelines (Level A, B and C) corresponds to a level of adherence equal to Level C. The levels of adherence can also be utilized to follow a step-wise approach for the implementation of the key guidelines starting from the basic ones to reach full adherence in the long term.

The key guidelines should be intended as a living practice and as such might evolve following specific research and development activities (e.g. outcome of cooperation in LTDP in Europe). Each key guideline could also have associated a set of technical procedures, methodologies or standards providing technical details on the recommended practical implementation of the guideline. These standards, methodologies and procedures are contained in an outlined box below the associated key guideline. Their selection has been made considering the results of cooperation activities in Europe with the goal to favour convergence in Europe on the LTDP approach and implementation.

Similarly to the key guidelines, these procedures or standards could be further evolved and improved with time or even developed or defined if missing. The document can therefore also be intended as a starting point to support the establishment, and aid the implementation, of such detailed procedures or methodologies when missing, favouring active cooperation in Europe in the LTDP field. In such a case this document provides the overall LTDP principles and key guidelines considered necessary to initiate this process and enable more detailed, specific and technical guidelines to be established by appropriate technical experts.

The LTDP Common Guidelines document will be periodically updated to reflect the advances of activities carried out in the LTDP area and will be submitted, in the framework of the periodical updates, to public reviews to collect feedback and comments. The updated versions of the document will be formally issued after approval by the Ground Segment Coordination Body.

It is hoped that the endorsement and encouragement of use of such guidelines and methodologies will lead to the set-up of a European LTDP Framework to coordinate and optimize European efforts in the LTDP field and will ultimately result in the preservation of the complete European data set with a coherent and homogeneous approach for the benefit of all European countries and users and with a reduction of overall costs.

1.6 Long Term Preservation of Earth Observation Satellite Data and OAIS Standard

The OAIS-ISO 14721 standard [R. 5] has been used in the definition of the structure of the LTDP Common Guidelines document. The purpose of this standard is to define the Reference Model for an Open Archival Information System (OAIS). An OAIS is an archive, consisting of an organisation of people and systems, which has accepted the responsibility to preserve information and make it available for a designated community.

OAIS is a functional reference model that can be met with different architectures and physical implementations of the Earth Observation missions Ground Segments. Physical architectures of OAIS compliant archives may therefore not be identical for different organisations.

As the OAIS standard document encompasses every domain concerned by information preservation, it has to be adapted specifically to Earth Observation Satellite Data. Scope of this section is to briefly clarify some aspects of the OAIS standard and to define the relation with the LTDP Common Guidelines.

The OAIS standard identifies the responsibilities of an organisation in charge of an OAIS system. First, the community of users of the OAIS system has to be identified and defined. Secondly, the information delivered to this community has to be “independently understandable without the help of experts who produced the information”. In Earth Observation space missions, often raw data are basically archived through an archival function in charge to guarantee the integrity of the data and processors necessary to obtain from the archived data the mission products which correspond to the information required by the users. Raw data can not be considered in any case as “independently understandable information”. It is therefore clear that both archived data and processors have to be considered to deal with an OAIS system in this domain even if the standard does not detail these issues. It is also important to consider that an OAIS system can evolve: the trade-off between archiving the products or processing the preserved data to obtain these products can give different results at different times due to technology improvements and evolution of users capabilities.

Two additional functional entities are specific to the Earth Observation Satellite Data exploitation context: the Ingest entity and the Access entity. The Ingest entity function of OAIS defines the transfer conditions of the data from the producer to the archive. The access entity function of OAIS is to be considered during and after the mission duration and deals with the users management, the catalogue access and products delivery.

In general a single organization covers all the aspects and functions identified within the OAIS standard but in some cases different entities might be in charge of different functions.

An additional responsibility of the organization in charge of an OAIS system is to follow documented policies and procedures which ensure that the information is preserved against all reasonable contingencies, and which enable the information to be disseminated as authenticated copies of the original, or as traceable to the original.

The LTDP Common guidelines defined in this document constitute a basic reference for the long term preservation of EO space data and their application by European Earth Observation space data owners and archive holders is fundamental in order to preserve the European EO space data set. Following the OAIS model, the scope of Long Term Data Preservation as intended in the LTDP Common Guidelines is not limited to the preservation of the data in the archives but includes also the capability to generate mission products (Dissemination Information Packages) from the archived data to be delivered to users. The insurance and facilitation of access, respecting the individual entities applicable data policies, and the exploitation of the archived data by the designated user communities are also part of the guidelines. Data access policies are on the other hand not part of the European LTDP Common Guidelines.

1.7 References

- R. 1 “European EO Space Data Set”, GSCB-LTDP-EOPG-RP-09-0003, Long Term Data Preservation Working Group.
- R. 2 European Strategy for Long term EO data preservation and access, ESA/PB-EO/DOSTAG(2007)2, 8 October 2007.
- R. 3 GSCB website, <http://earth.esa.int/gscb>
- R. 4 LTDP Workshop, http://earth.esa.int/gscb/ltdp/LTDP_Agenda.html
- R. 5 ISO 14721 - OAIS standard (ISO reference model for Open Archival Information System) Pink Book, Consultative Committee for Space Data Systems, Greenbelt, MD. August 2009.
- R. 6 CEOS Interoperability Handbook, Working Group on Information Systems and Services (WGISS), Issue 1.1, February 2008

1.8 Acronyms

<i>Acronym</i>	<i>Description</i>
AIP	Archival Information Package
ASI	Italian Space Agency
CAL/VAL	Calibration and Validation
CCSDS	Consultative Committee for Space Data Systems
CCRS	Canada Centre for Remote Sensing
CEOS	Committee on Earth Observation Satellites
CNES	Centre Nationale d’Etudes Spatiales (French Space Agency)
CSA	Canadian Space Agency
CSW	Catalogue Services for the Web
DIP	Dissemination Information Package
DLR	German Space Agency
DOSTAG	ESA’s Data Operations Scientific and Technical Advisory Group
EO	Earth Observation
EROS	Earth Resources Observation and Science
ESA	European Space Agency
HMA	Heterogeneous Mission Accessibility project
GML	Geography Markup Language
GSCB	Ground Segment Coordination Body
ISO	International Organization for Standardization
LTDP	Long Term Data Preservation
LTDP WG	Long Term Data Preservation Working Group
OAIS	Open Archival Information System

<i>Acronym</i>	<i>Description</i>
OGC	Open Geospatial Consortium
PAIMAS	Producer Archive Interface Methodology Abstract Standard
PAIS	Producer Archive Interface Specification
SAFE	Standard Archive Format for Europe
SAR	Synthetic Aperture Radar
SIP	Submission Information Package
SW	Software
TBC	To Be Confirmed
TBD	To Be Defined
UNFCCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
WGISS	Working Group on Information Systems and Services

The Glossary of the terms used in the current document and their relation with the corresponding OAIS terms is reported in Annex 4.

2. THEME 1: PRESERVED DATA SET COMPOSITION

2.1 Definition

The “preserved data set” composition defines a consistent and complete set of data enabling current and possible future utilization. This theme is related to the composition and description of the data and information needed to preserve knowledge and the capability to generate mission products (Dissemination Information Packages, DIPs) to be delivered to users. Also the relations to rules and standards which can be applied to the “preserved data set” are considered.

2.2 Guiding Principle

Archived data (in the form of Archival Information Packages, AIPs) shall contain all the elements necessary to be accessed, used, understood and processed to obtain mission products to be delivered to users (in the form of Dissemination Information Packages, DIPs).

2.3 Key Guidelines

GUIDELINE 1.1 – Preserved Data Set Composition - (Level A)

Preserve the following set of data associated to a specific Earth Observation space mission or instrument:

- a) Primary Data:
 - 1. Raw data (as acquired by the satellite and recorded at the stations or received via Third Parties) and/or Level 0 data.
 - 2. Global or higher level mission products when systematically generated as part of the mission requirements and/or reprocessed.
- b) Secondary data:
 - 1. Ancillary data (e.g. spacecraft ephemeris information, attitude, etc..).
 - 2. Auxiliary data required to process the telemetry payload data to generate the nominal mission products.
 - 3. CAL/VAL databases whenever available (including processing/reference validation data sets).
 - 4. Mission related documentation including description of mission products (Dissemination Information Packages, DIPs) and of the processing algorithms needed to obtain them.
- c) Metadata
- d) Browse images when generated

Generate and make available to users together with the data, the following information associated to each of the data listed above in points a) and b):

- a) Representation Information (structure, semantic and other representation information).
- b) Packaging Information.
- c) Preservation Descriptive Information (Reference, Provenance, Context, Fixity).

List of relevant regulations and standards: TBD

GUIDELINE 1.2 – Archived data format – (Level B)

Adopt a common standard archive format for Archived Information Packages (AIPs).

List of recommended archive formats (e.g. SAFE – Standard Archive Format for Europe (<http://earth.esa.int/SAFE/index.html>); TBD.

GUIDELINE 1.3 – Archived data exchange format – (Level B)

Adopt a common standard format for the exchange of archived data.

Archived data exchange format: TBD

3. THEME 2: ARCHIVE OPERATION AND ORGANIZATION

3.1 Definition

Archives operations consist of all daily activities which are carried out to run and monitor the archive system (execution and control of the applications, system monitoring, anomaly reporting, error recovery, activity reporting and statistics, etc...). An organizational structure is appropriate and needed to meet the goals and perform the tasks and processes of the digital long-term archives.

3.2 Guiding Principle

Archives automation should be pursued at the maximum extent and operations should be performed by trained personnel following consolidated operational procedures.

3.3 Key Guidelines

GUIDELINE 2.1 – Reference model for archive operation - (Level A)

Adopt a common standard reference model for the archives.

- ✓ ISO 14721 - OAIS standard (ISO reference model for Open Archival Information System) [R. 5]

GUIDELINE 2.2 – Operations procedures - (Level B)

Perform archive operations following a set of approved and consolidated documented operational procedures.

GUIDELINE 2.3 – Archives equipment maintenance - (Level A)

Keep archives equipment in conformance with manufacturer recommendations.

GUIDELINE 2.4 – Archives automation - (Level B)

Pursue automation of the archives (e.g. utilizing automatic robot archives) to minimize the number of operations requiring operators' intervention.

GUIDELINE 2.5 – Archives organisation (Level A)

Establish an appropriate archive organisational structure based on a sufficient number of qualified staffs with clear roles and responsibilities. Archive operation is governed through the organisational structure that oversees the planning and operation of preservation tasks.

GUIDELINE 2.6 – Archives Legal and Contractual aspects (Level B)

Legal aspects and contractual rules related to data ingestion, archive operations and data access and dissemination should be in place.

GUIDELINE 2.7 – Archive documentation (Level A)

Document and maintain under configuration control the archive and all its composing elements.

4. THEME 3: ARCHIVE SECURITY

4.1 Definition

This theme encompasses all the activities dedicated to the implementation of security measures for data access and storage in order to guarantee confidentiality, integrity and availability of the archived data.

4.2 Guiding Principle

Security of archived data should be guaranteed through the implementation of appropriate security measures in three main areas:

- ✓ Physical Security
- ✓ Information Security
- ✓ Staff Security

4.3 Key Guidelines

GUIDELINE 3.1 – Archives security requirements - (Level B)

Base archive security requirements on international standards and policies. The IT infrastructure should put into practice the specifications for handling the preserved data on the technology and security levels.

International Security Policies and Standards (smoothly applicable for the EO domain, certain adjustments could be necessary):

- ✓ ISO/IEC 27001:2005 - Information technology - Security techniques - Specification for an information security management system.
- ✓ ISO/IEC 27002:2005 - Information technology - Security techniques - Code of practice for information security management.
- ✓ ISO/IEC 15408:2005 - Information technology - Security techniques - Evaluation criteria for IT security.
- ✓ ISO/IEC 18045:2005 - Information technology - Security techniques - Methodology for IT security evaluation.

GUIDELINE 3.2 – Archives security certification - (Level C)

Certify conformance of archives security and services against commonly agreed international policies.

Certification Standards and Procedures:

- ✓ Data Seal of Approval (DSA), DSA booklet 2.0, 2010.
- ✓ Audit and Certification of Trustworthy Digital Repositories CCSDS652.0-R1, Draft Standard, OAIS Red Book, October 2009.
- ✓ Catalogue of Criteria for Trusted Digital Repositories - Version 2 - published by Nestor Working Group Trusted Repositories – Certification, November 2009.

✓ Trustworthy Repositories Audit & Certification (TRAC): Criteria and Checklist. OCLC and CRL, version 1.0, February 2007.

GUIDELINE 3.3 – Controlled access to archive facilities - (Level A)

Implement controlled access to facilities, sites and equipment to avoid physical intrusion by unauthorised persons. Allow access to core functions only to identified personnel provided with appropriate security clearances.

GUIDELINE 3.4 – Local risk mitigation infrastructure - (Level A)

Implement local risk mitigation infrastructure measures to safeguard the archives from external factors (e.g. floods, fire, disasters in general).

GUIDELINE 3.5 – Protection from external intrusion - (Level A)

Implement security mechanisms to avoid external intrusion that could harm core equipment functionalities and cause information loss.

GUIDELINE 3.6 – Controlled data access and products dissemination - (Level B)

Implement controlled data access and products dissemination mechanisms to avoid unauthorized data visibility and access.

GUIDELINE 3.7 – Information loss risk mitigation infrastructure - (Level A)

Implement measures to protect core equipment functionalities and mitigate against the risk of information loss as a consequence of internal unintentional or deliberate human actions, and of technical imperfection.

5. THEME 4: DATA INGESTION

5.1 Definition

Data Ingestion encompasses the services and functions that, according to OAIS standard [R. 5], accept Submission Information Packages (SIPs) from data producers, prepare Archival Information Packages (AIPs) for storage, and ensure that Archival Information Packages and their supporting descriptive information are stored in the archive system.

5.2 Guiding Principle

Common methodology has to be adopted to properly plan preservation activities and to define the interfaces between the data producers and the archives in order to propose a predictive and reusable approach in the Data Ingestion activity.
Standardization of Archival Information Packages has to be considered in order to improve the coherency and the compatibility of the data sets stored in the archive systems and to facilitate the exchange of data.

5.3 Key Guidelines

GUIDELINE 4.1 – Data ingestion process - (Level A)

Carry out data ingestion according to relevant standards with adequate tailoring and definition derived from the generic activities described in the standards.

- ✓ ISO 20652 - PAIMAS Standard (Producer Archive Interface Methodology Abstract Standard)

GUIDELINE 4.2 – Metadata generation - (Level A)

Generate metadata as part of the ingest process. The resulting metadata should be formatted according to relevant standards.

List of recommended standards (to be further extended):

- ✓ EO collection metadata: ISO 19115 Geographic Information - Metadata.
- ✓ EO product metadata: OGC's GML 3.1.1 Application Schema for EO Products (OGC-06-080)

GUIDELINE 4.3 – Definition of preserved data subsets - (Level B)

Assess and harmonise the definition of all the subsets of the “preserved data set” (see Guideline 1.1), delivered by the data producer, with the archive's standards in order to make the adopted formats understandable and sustainable.

- ✓ PAIS (Producer Archive Interface Specification): implementing PAIMAS standard (in the process of becoming a CCSDS Red Book)

GUIDELINE 4.4 – Routine quality check - (Level A)

Perform routine quality check on acquired data before ingestion in the archive.

- | |
|--|
| ✓ ISO 20652 - PAIMAS Standard (Producer Archive Interface Methodology Abstract Standard) |
|--|

GUIDELINE 4.5 – Quality check (screening) - (Level A)

Perform quality check (screening) on acquired data after transcription on media in the archive to verify correct transcription of the acquired data on the media.

Technical Procedure for quality check: TBD.

6. THEME 5: ARCHIVE MAINTENANCE

6.1 Definition

Archive maintenance consists of all the activities aimed at guaranteeing the integrity of the archived data. Data integrity assures that the archived data are complete and unaltered through loss, tampering or data corruption. Archive maintenance is based on the storage of equipment, media and hard disk arrays in secured and environment controlled rooms and a set of defined activities to be performed on routine basis like migration to new systems and media, in accordance to the technology and consumer market evolution, data compacting and data format/packaging conversion.

6.2 Guiding Principle

Earth Observation space data owners and archive holders should design a maintenance scheme for their archives to guarantee the integrity of the archived data.

6.3 Key Guidelines

GUIDELINE 5.1 – Archived data refreshment - (Level A)

Perform periodically a migration of the archived data (“media refreshment”) to the most adequate proven technology¹ for data storage ensuring data access preservation².

GUIDELINE 5.2 – Archived data formats description and converters - (Level B)

Provide formal description of old archiving formats and provide converters to new standard formats to increase technical compatibility and to reduce diversity of formats and interfaces between archives.

GUIDELINE 5.3 – Archived data repackaging/reformatting - (Level C)

Perform archived data repackaging and/or reformatting to comply with new standard formats and/or exchange formats to increase technical compatibility and to reduce diversity of formats and interfaces between archives³.

GUIDELINE 5.4 – Archived data duplication

Maintain identical copies of all archived data applying one of the security levels defined below:

- a) dual copy in the same geographical location (but different buildings) to avoid data loss due to media degradation or obsolescence. **(Level A)**

or

¹ Technology selection should not only be based on technical and cost aspects but also aim at the minimization of environmental impact (e.g. in terms of power consumption, thermal dissipation, etc..).

² Currently data and system migrations are performed at least every five/six years.

³ Repackaging and/or reformatting should be performed together with archive media migration.

b) dual copy in the same geographical location (but different buildings) based on different technology to avoid technology based principle failures. This guideline extends Guideline 5.4.a. **(Level B)**

or

c) dual copy in two different geographical locations to safeguard the archive from external hazards (e.g. floods and other natural disasters, technological hazards, etc.). This guideline extends Guideline 5.4.a. **(Level B)**

or

d) dual copy in two different geographical locations and based on different technologies to avoid technology based principle failures. This guideline extends Guideline 5.4.b and 5.4.c. **(Level C)**

GUIDELINE 5.5 – Archive system components migration (hardware) - (Level A)

Perform periodical migration of archive system components to new hardware platforms⁴.

GUIDELINE 5.6 – Media readability and accessibility tests - (Level B)

Perform periodical test for media readability and accessibility on a representative set of the archived data.

GUIDELINE 5.7 – Obsolete media disposal - (Level B)

Organize the disposal of obsolete media in conformance with national and international environmental regulations.

List of regulations to be applied: TBD, e.g. ISO 14000:2004

GUIDELINE 5.8 – Archiving systems common approach - (Level C)

Pursue a common approach for the future development of archiving systems to improve compatibility of services provided by different organizations (e.g. exchange of specifications, application software, best practices, etc)

⁴ Currently data and system migrations are performed at least each five/six years.

7. THEME 6: DATA ACCESS AND INTEROPERABILITY

7.1 Definition

Data access corresponds to the services and functions which make the archival information holdings and related services visible to consumers [R. 5]. Interoperability is related to the possibility of accessing data in a common and standardized way despite the intrinsic differences between the data sets on one hand and the accessed systems on the other hand.

7.2 Guiding Principle

Archived data, when preserved, need to be made accessible to users. They need to be retrieved and delivered to users (generally after some processing) in the form of Dissemination Information Packages (i.e. products). Data access is a fundamental element of the data preservation and should be ensured and facilitated for all archived data. In order to ensure data access, the required services and functions have to be available, maintained and evolved. Standardization has to be carefully considered to offer common access procedures and data formats, to facilitate the extension to new data sets, and to share software and tools. Interoperability and harmonization of data access should be pursued to favour an easy and cost-effective access means to heterogeneous EO mission data.

7.3 Key Guidelines

GUIDELINE 6.1 – Data accessibility - (Level A)

Ensure continuous EO missions' data/products accessibility, possibly enhancing performances and exploiting technology evolution, through the following activities:

- a) Provide and maintain mechanisms to search and discover archived data/products.
- b) Provide and maintain a searchable metadata and browse image catalogue of archived data/products.
- c) Provide and maintain mission products generation capability (systematic or through ordering) from Archival Information Packages (AIPs) to Dissemination Information Packages (DIPs) including the processing chains.
- d) Provide and maintain products dissemination capabilities through ordering and delivery and/or direct access (without ordering).

GUIDELINE 6.2 – On-line access and delivery - (Level B)

Ensure on-line direct access and on-line delivery services for the archived missions' products.

GUIDELINE 6.3 – Data access conditions - (Level A)

Provide transparency and visibility of data access conditions to users.

GUIDELINE 6.4 – Data access interfaces and delivery formats - (Level B)

Adhere to standard interfaces and delivery formats (See Guideline 6.6) to allow easy and cost-effective access and dissemination of heterogeneous EO mission (different missions, new & old) data and products: interfaces for data discovery, catalogue access, ordering, data access and dissemination, user management and administration, etc.

- ✓ Collection and service discovery (Advertisement): OGC's Cataloguing of ISO Metadata using the ebRIM profile of CS-W (OGC 07-038)
- ✓ Catalogue Service: OGC's Catalogue Services Specification 2.0 Extension Package for ebRIM Application Profile: Earth Observation Products (OGC 06-131)
- ✓ Ordering from Catalogue: OGC's Ordering Services for Earth Observation Products (OGC 06-141)
- ✓ Feasibility Analysis (Programming): OGC's Sensor Planning Service Application Profile for EO Sensors (OGC 07-018)
- ✓ Online Data Access: OGC's WMS EO Extension (OGC 07-063), OGC WCS 2.0 extension for EO.
- ✓ Identity (User) Management: OGC's User Management Interfaces for Earth Observation Services (OGC 07-118)

GUIDELINE 6.5 – Common approach for data access systems - (Level C)

Pursue common approach for the data access systems to improve compatibility of different systems (e.g. sharing of specifications, application software, etc.).

GUIDELINE 6.6 – EO products harmonization - (Level B)

Pursue harmonization of EO products (Dissemination Information Packages, DIPs) specifications (quality and content) and delivery formats (e.g. GeoTIFF) for different missions.

Delivery formats and specifications for the different types of products (Dissemination Information Packages, DIPs): TBD

GUIDELINE 6.7 - EO products realignment - (Level C)

Realign products' (Dissemination Information Packages, DIPs) characteristics and delivery format of old missions to established⁵ harmonized ones.

GUIDELINE 6.8 – Archive search capability - (Level C)

Enhance archives search capability and harmonize key features extraction methods and contents.

Search capabilities and feature extraction methods: TBD

⁵ i.e. used by a large community of users for a sufficient period of time.

8. THEME 7: DATA EXPLOITATION AND RE-PROCESSING

8.1 Definition

This theme covers all activities related to the exploitation of archived data by data processing and reprocessing, regeneration or enhancement of the catalogues (e.g. through data mining), integration of new services (e.g. through service work-flow orchestration) and quality assessment of the products and services.

8.2 Guiding Principle

Archived data represent a unique information source in the long term and can provide valuable inputs for several exploitation programmes. To guarantee and facilitate the exploitation of archived data it is necessary to:

- ✓ Maintain properly the processing chains to allow the generation of missions' related products (Dissemination Information Packages) to be delivered to users.
- ✓ Reprocess entire preserved data sets in case new approved algorithms are implemented, in case of availability of updated auxiliary data or to respond to specific requirements from the user community.
- ✓ Facilitate archived data exploitation through several actions like generating thematic data sets, implementing tools for high level processing and information extraction, etc.

8.3 Key Guidelines

GUIDELINE 7.1 – Processing chains - (Level A)

Preserve the processing capabilities for the generation of missions' products (Dissemination Information Packages, DIPs) through a proper maintenance of the processing chains.

GUIDELINE 7.2 - Reprocessing - (Level A)

Provide the capability to perform archived data reprocessing for systematically generated missions' products (Dissemination Information Packages, DIPs) when new approved algorithms are available, to provide a new coherent version of missions' products when requested. Products obtained with previous algorithm versions should be maintained after reprocessing depending on mission requirements.

GUIDELINE 7.3 – Processing/reprocessing capacity for long term data series - (Level B)

Provide the processing/reprocessing capacity to respond to missions' requirements and to projects requiring long term data series.

GUIDELINE 7.4 – Higher level applications - (Level C)

Provide reference data sets to facilitate the development of higher level applications (e.g. for information extraction).

GUIDELINE 7.5 – Earth Observation data/products quality - (Level A)

Ensure EO space data and products quality during the mission lifetime (e.g. through the application of international standards or guidelines).

- ✓ A Quality Assurance Framework for Earth Observation - Guidelines Framework (QA4EO), endorsed by CEOS in November 2008, www.qa4eo.org.

GUIDELINE 7.6 – Facilitation of data exploitation - (Level C)

Pursue simplification of the workload for the users by reducing their global data handling time and cost through implementing the following measures:

- 1) Data adaptation to specific post-processing and applications.
- 2) Hosting and executing user algorithms.
- 3) Providing capability for data fusion across sensors.

GUIDELINE 7.7 – Information extraction - (Level C)

Allow information extraction from low-level EO products and information preservation through supporting chainable information based services.

9. THEME 8: DATA APPRAISAL AND PURGE PREVENTION

9.1 Definition

“Data Appraisal” and “Data Purging” are intended respectively as the determination of the value of a set of archived data and as the deletion or removal of EO data from an archive. This theme defines a set of procedures to be applied with the objective to prevent, or minimize, EO space data loss and to ensure resources are applied towards EO data preservation and access activities through a management approval process. This theme is of particular importance when an Earth Observation space data owner or archive holder, for whatever reason, can no longer preserve the data.

9.2 Guiding Principle

EO data are episodic data and cannot be recorded again at some point in the future. EO data constitute a humankind asset fundamental for the future of science and for the activities of the scientific community and therefore should be preserved. In some cases, entities may be obliged, or might choose, to discontinue the preservation of their data. In these cases, defined and controlled procedures have to be put in place to avoid the loss of any EO data and to allow the handover of responsibility for the preservation of these data to another data centre.

9.3 Key Guidelines

GUIDELINE 8.1 – Data set description - (Level A)

Generate and maintain a complete description of each archived data set with the following items as a minimum:

- ✓ Description of the spatial mission and the payload at the source of the data.
- ✓ Description and availability of the data set (specifying all elements defined in guideline 1.1), including all information necessary to generate final products.
- ✓ Time span and volumes of the data set.
- ✓ Physical location of the data set.
- ✓ Media of storage and format.
- ✓ Responsible of data set preservation.
- ✓ Users and application fields identification from the past experience.

GUIDELINE 8.2 – Data appraisal procedure - (Level A)

Apply, when evaluating the option to dispose an Earth Observation data set and before any purging of the data, a “Data Appraisal Procedure” [R. 6] to assess and document the value and prospects of the data set.

- ✓ Data Appraisal Procedure: Annex 3 to the European LTDP Guidelines.

GUIDELINE 8.3 – Data purging alert procedure - (Level A)

Apply, when intending to dispose an Earth Observation data set and before any purging of the data, a “Data Purging Alert Procedure” [R. 6] to inform other Earth Observation data owners or archive holders with the goal to trigger a possible transfer of responsibility for the data set preservation to another interested entity. The complete description of the data set (Guideline 8.1), the results and documentation of the data set appraisal (Guideline 8.2) and proposals to facilitate data ingestion should be made available together with the data purging alert.

✓ Data Purging Alert Procedure: Annex 2 to the European LTDP Guidelines

GUIDELINE 8.4 – Purging alert response time - (Level A)

Respond to a received “Data Purging Alert” within one month from the reception of the alert if interested in the possibility to take over the responsibility of the data set preservation.

GUIDELINE 8.5 – Archived data handover - (Level A)

Provide support, when intending to dispose an Earth Observation data set and before any purging of the data, to interested entities that responded to the purge alert message (Guideline 8.3 and 8.4) to allow them to assess the value and prospects of the data set and to carry out the handover of the responsibility of their preservation.

The following figure summarizes the sequence of the activities and information exchange:

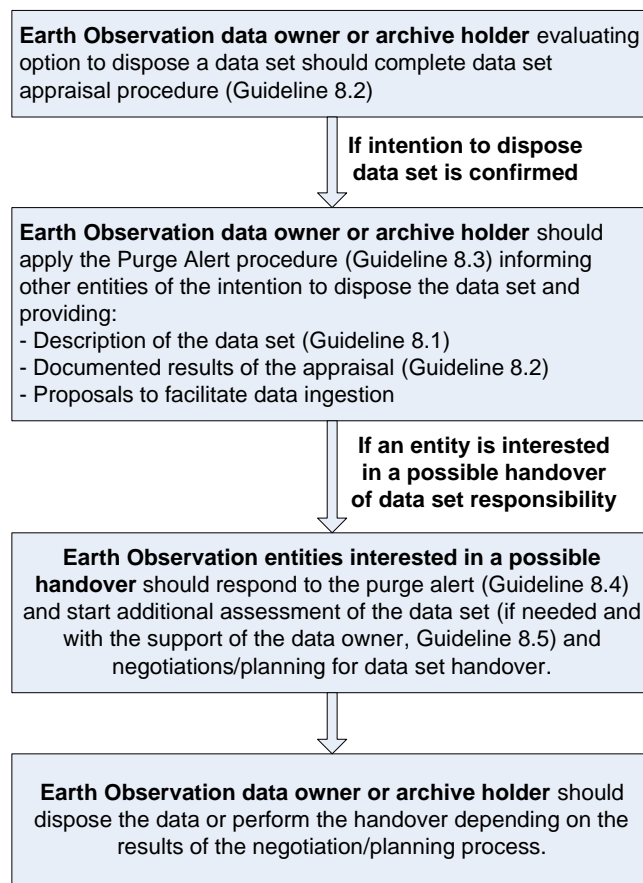


Figure 2 – Sequence of Appraisal/Purging activities

ANNEX 1 – KEY GUIDELINES PRIORITY AND LEVELS OF ADHERENCE TO THE LTDP COMMON GUIDELINES

A level of adherence (Levels A, B, C) has been associated to each key guideline identified in this document. Level A has been defined as the entry level and guidelines for Level A should be the first to be addressed and implemented in order to guarantee a basic level of security, integrity and accessibility of the archived data. The different levels of adherence to the European LTDP Common Guidelines have been defined in detail in the introductory section to the LTDP Common Guidelines^{1.5}. The priority level of the key guidelines is summarised in Table 2.

Theme	Key Guideline	Level
1. Preserved Data Set composition	1.1	A
	1.2	B
	1.3	B
2. Archive operations and organization	2.1	A
	2.2	B
	2.3	A
	2.4	B
	2.5	A
	2.6	B
	2.7	A
3. Archive security	3.1	B
	3.2	C
	3.3	A
	3.4	A
	3.5	A
	3.6	B
	3.7	A
4. Data ingestion	4.1	A
	4.2	A
	4.3	B
	4.4	A
	4.5	A
5. Archive maintenance	5.1	A
	5.2	B
	5.3	C
	5.4a	A
	5.4b	B

	5.4c	B
	5.4d	C
	5.5	A
	5.6	B
	5.7	B
	5.8	C
6. Data access and interoperability	6.1	A
	6.2	B
	6.3	A
	6.4	B
	6.5	C
	6.6	B
	6.7	C
	6.8	C
7. Data exploitation and reprocessing	7.1	A
	7.2	A
	7.3	B
	7.4	C
	7.5	A
	7.6	C
	7.7	C
8. Data Appraisal and Purge Prevention	8.1	A
	8.2	A
	8.3	A
	8.4	A
	8.5	A

Table 2 – Key Guidelines Priority

ANNEX 2 – DATA PURGING ALERT PROCEDURE

CEOS has established a "Purge Alert" service to help ensuring the long-term preservation of valuable EO space data. This initiative enables data archive managers to advise other archives of EO data holdings scheduled to be disposed of, and offer these data to other archive centers. To contact the Purge Alert members and start the purge alert procedure, an e-mail should be sent to purgealert@wgiss.ceos.org.

More information can be found at: <http://wgiss.ceos.org/purgealert/>. Organisations whose missions match the type of records being disposed, and who are willing to take on the responsibility for their preservation, will be able to respond to the purge alert message and start negotiations with the alert initiator.

ANNEX 3 – DATA APPRAISAL PROCEDURE

The data appraisal procedure consists in performing an assessment of a EO space data set under evaluation (for example in case of possible preservation discontinuing) through answering to a set of categorized questions extracted from the USGS EROS Appraisal Online Tool (<http://eros.usgs.gov/government/ratool/>) as recommended in [R. 6].

The list of questions is covering:

- ✓ Mission relevancy
- ✓ General policy (ISO Standard)
- ✓ Physical properties (Media)
- ✓ Metadata
- ✓ Cost / benefit analysis.

When performing the appraisal, an appraisal report should be produced in order to properly document the different steps performed in the appraisal procedure and the final results. The appraisal report should be provided, in case of purge decision, to other data owners and archive holders together with a description of the data set when applying the data alert procedure.

A link to a template document containing the list of questions and to generate the appraisal report is provided hereafter: <http://eros.usgs.gov/government/ratool/export.php?blank>

ANNEX 4 – GLOSSARY OF TERMS

Term	LTDP Guidelines Definition	OAIS Definition
Ancillary Data	<p>Ancillary data can be broadly defined as those used to determine when (and how) an instrument was acquiring data, where an instrument was located, where an instrument was pointed and what it targets (e.g. a surface or atmospheric feature), how those targets would appear at the time of observation and what else of potential significance to science data analysis was occurring. Examples of ancillary data are spacecraft ephemeris or attitude.</p> <p>Ancillary Data are part of the Secondary Data as defined in Key Guideline 1.1.</p>	<p>Ancillary data can be considered as a Digital Data Object (object composed of a set of bit sequences) part of a Content Information, related to other digital objects (<i>i.e. Primary Data</i>) through Context Information (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) or as a compound digital object which contains a mixture of Provenance, Context and Representation Information related to a Primary Digital Data Object.</p>
Archival Information Packages (AIP)	<p>An Information Package, consisting of the Content Information and the associated Preservation Description Information (PDI), which is preserved within an OAIS.</p>	<p>An Information Package, consisting of the Content Information and the associated Preservation Description Information (PDI), which is preserved within an OAIS.</p>
Archive	<p>An archive is to be intended as a complete system, which includes people and facilities within an organization aimed at storing data in the long term guaranteeing their integrity, usability and allowing their retrieval.</p>	<p>Archive: an organization that intends to preserve information for access and use by a Designated Community.</p>
Archives Operations	<p>Archives operations consist of all daily activities which are carried out to run and monitor the archive system. They include the execution and control of the applications, system monitoring, anomaly reporting, error recovery, activity reporting and statistics, etc. Maintenance of an archive is also generally associated to operations.</p>	<p>Administration Functional Entity: The OAIS functional entity that contains the services and functions needed to control the operation of the other OAIS functional entities on a day-to-day basis.</p>
Archives Organization	<p>The organizational structure of an archive based on a sufficient number of qualified staff with clear roles and responsibilities.</p>	<p>Open Archival Information System: an archive, consisting of an organization of people and systems that has accepted the responsibility to preserve information and make it available for a Designated Community. It meets a set of responsibilities that allows it to be distinguished from other uses of the term 'archive'.</p>
Auxiliary Data	<p>Auxiliary data are all data files used to generate a product, other than the direct measurements of the instrument. Auxiliary data include calibration data measured on-board but not part of the main measurements of the instrument, external calibration files from sources other than the satellite, processor configuration files, and any other files needed by instrument processors.</p> <p>Auxiliary Data are part of the Secondary Data as defined in Key Guideline 1.1.</p>	<p>Auxiliary Data can be considered as a Digital Data Object (object composed of a set of bit sequences) part of a Content Information, related to other digital objects (<i>i.e. Primary Data</i>) through Context Information (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).or as a specialist type of Representation Information related to a Primary Digital Data Object.</p>
CAL/VAL Data	<p>CAL/VAL Data are data needed to calibrate the satellite instruments and to monitor data quality (also determining the parameters, corrections, etc., to be applied to measurements).</p> <p>CAL/VAL Data are part of the Secondary Data as defined in Key Guideline 1.1.</p>	<p>CAL/VAL Data can be considered as a Digital Data Object (object composed of a set of bit sequences) part of a Content Information, related to other digital objects (<i>i.e. Primary Data</i>) through Context Information (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) or as a specialized type of Provenance and Representation Information related to a Primary Digital Data Object.</p>
Catalogue	<p>The cataloguing function provides search and retrieve capabilities for product metadata and browse images. It</p>	<p>Data Management Functional Entity: the OAIS functional entity that contains the services and</p>

Term	LTDP Guidelines Definition	OAIS Definition
	<p>supports data management functionality based on references to corresponding data products stored in an archive. Products can be organized in collections with restricted access depending on product type and users. Cataloguing can occur in several areas of an Earth Observation mission Ground Segment: user services, central product/order handling and archiving/inventory.</p>	<p>functions for populating, maintaining, and accessing a wide variety of information. Some examples of this information are catalogs and inventories on what may be retrieved from Archival Storage, processing algorithms that may be run on retrieved data, Consumer access statistics, Consumer billing, Event Based Orders, security controls, and OAIS schedules, policies, and procedures.</p>
Data Access	<p>Data access is intended as the services and functions which make the archival information holdings accessible to users. This includes services for data search, discovery, retrieval, and dissemination.</p>	<p>Access Functional Entity: the OAIS functional entity that contains the services and functions which make the archival information holdings and related services visible to Consumers.</p>
Data Level	<p>Raw Data: The physical telemetry payload data as received from the satellite, i.e. a serial data stream without de-multiplexing. These data are not computer compatible.</p> <p>Level 0: Reconstructed unprocessed data at full space-time resolution with all available supplemental information to be used in subsequent processing (e.g. ephemeris, health and safety) appended.</p> <p>Level 1A: Reconstructed unprocessed data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and geo-referencing parameters (e.g. ephemeris) computed and appended but not applied to the Level 0 data.</p> <p>Level 1B: Radiometrically corrected and calibrated data in physical units at full instrument resolution as acquired.</p> <p>Level 1C: L1B data orthorectified, re-sampled to a specified grid.</p> <p>Level 2: Derived geophysical parameters (e.g. sea surface temperature, leaf area index) at the same resolution and location as Level 1 source data.</p> <p>Level 3: Data or retrieved geophysical parameters which have been spatially and/or temporally re-sampled (i.e. derived from Level 1 or 2 products), usually with some completeness and consistency. Such re-sampling may include averaging and compositing.</p> <p>Level 4: Outputs or results from models using lower level data as inputs and, thus, not directly derived from the instruments.</p>	<p>Data in each level (e.g. Raw Data) are Digital Objects part of a Content Information, related to other digital objects (e.g. Secondary Data) through Context Information (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).</p> <p>Data level can be intended as Provenance Information described in the Preservation Descriptive Information.</p>
Data Search and Discovery	<p>The procedure to search an archive based on specific search criteria and to obtain information on available products. Data search and discovery is enabled by generating and maintaining searchable metadata and browse image (when applicable) catalogs and by mechanisms to retrieve the information contained therein.</p>	<p>Finding Aid: a type of Access Aid that allows a user to search for and identify Archival Information Packages of interest.</p>
Data Set Description	<p>A data set description consists of a set of information identifying an archived dataset from a long term preservation perspective. It includes a description of the spatial mission and payload, the composition of the data set itself and its availability, the data set time span, volume, storage media and archiving format. The data set description is fundamental for data set appraisals and to support the purposes of data preservation and archiving.</p>	<p>Descriptive Information: the set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.</p>
Dissemination Information Packages (DIP)	<p>A Dissemination Information Package (DIP) is the Information Package, derived from one or more AIPs (Archival Information Package), supplied to the Consumer in response to a request to the OAIS.</p>	<p>Dissemination Information Package (DIP): the Information Package, derived from one or more AIPs, received by the Consumer in response to a request to the OAIS.</p>
EO Space Data	<p>Earth Observations Data generated by spaceborne missions or instruments owned by public or private</p>	<p>Content Data Object: the Digital Data Object that together with associated Representation Information</p>

Term	LTDP Guidelines Definition	OAIS Definition
	organisations.	is the original target of preservation.
EO Space Data Owners and Archive Holders	This category is intended to include all entities dealing with the archiving of EO space data and responsible for their preservation in the long term. It includes data providers, data and mission owners, archive holders, etc...	Management: the role played by those who set overall OAIS policy as one component in a broader policy domain.
EO Space Data Producers	Producers of Earth Observation data derived products. This category includes private and public institutes which are responsible for space missions and the companies/institutes participating to the programs which produce the different levels of data to be preserved.	Producer: the role played by those persons, or client systems, who provides the information to be preserved; this can include other OAISs or internal OAIS persons or systems.
EO Space Data Users	User communities interested in various application areas heavily benefiting from the availability of Earth Observation space data and products.	Consumer: the role played by those persons, or client systems, who interact with OAIS services to find preserved information of interest and to access that information in detail. This can include other OAISs, as well as internal OAIS persons or systems.
Metadata	Metadata is intended as information describing significant aspects of a resource (Earth Observation space data in this context). They are created for the purposes of data search, discovery and access management and may exist at various levels, typically from data collection through to the individual variables of each data file in a collection.	Descriptive Information: the set of information, consisting primarily of Package Descriptions, which is provided to Data Management to support the finding, ordering, and retrieving of OAIS information holdings by Consumers.
Migration of archived data ("Media Refreshment")	Data migration is a means of overcoming technological obsolescence by periodically transferring archived data from an hardware/software environment to a different one in order to exploit new technologies for the purposes of data preservation for future use.	Digital Migration: the transfer of digital information, while intending to preserve it, within the OAIS. It is distinguished from transfers in general by three attributes: <ul style="list-style-type: none"> - a focus on the preservation of the full information content; - a perspective that the new archival implementation of the information is a replacement for the old; - an understanding that full control and responsibility over all aspects of the transfer resides with the OAIS.
Packaging Information	A description of the package which allows the user to understand the structure of the information package.	Packaging Information: the information that is used to bind and identify the components of an Information Package.
Preservation Descriptive Information	Preservation Descriptive Information consists of: Reference Information , which enumerates and describes identifiers assigned to the content information such that it can be referred to unambiguously, both internally and externally to the archive. Provenance Information , which documents the history of the content information (e.g., its origins, processing history, chain of custody, preservation actions and effects) and helps to support claims of authenticity and integrity. Context Information , which documents the relationship of the content information to its environment (e.g., why it was created, relationships to other content information). Fixity Information: documents authentication mechanisms used to ensure that the content information has not been altered in an undocumented manner (e.g., checksum, digital signature).	Preservation Description Information (PDI): the information which is necessary for adequate preservation of the Content Information and which can be categorized as Provenance, Reference, Fixity, and Context information.
Preserved Data Set Composition	The composition of the data set to be preserved in the long term defines a consistent and complete set of data enabling current and possible future utilization of the Mission data and knowledge preservation. It consists of Primary Data, Secondary Data and all associated Preservation Description Information, Packaging Information and Representation Information. It includes also Metadata for discovery and Browse images when available.	One or more Archival Information Packages (AIPs): an AIP is an Information Package , consisting of the Content Information and the associated Preservation Description Information (PDI) , which is preserved within an OAIS.

Term	LTDP Guidelines Definition	OAIS Definition
Primary Data	Primary Data include raw data or Level 0 data, and global or higher level mission products when systematically generated as part of the mission requirements and/or reprocessed.	Primary Data are Digital Data Objects (object composed of a set of bit sequences) part of a Content Information , related to other digital objects (e.g. Secondary Data) through Context Information (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). They constitute the target of preservation together with associated Secondary Data.
Products, Mission Products	Products are intended as the Earth Observation data set generated and delivered to EO space data users according to mission requirements. They are composed of metadata and data structured into one or more product components.	Dissemination Information Package (DIP) : the Information Package, derived from one or more AIPs, received by the Consumer in response to a request to the OAIS.
Reference Model	A framework for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment. In this context the Reference Model is a conceptual framework for an archival system dedicated to preserving and maintaining access to digital information. It addresses a full range of archival preservation functions including ingest, archival storage, data management, access and dissemination.	Reference Model : a framework for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment. A reference model is based on a small number of unifying concepts and may be used as a basis for education and explaining standards to a non-specialist.
Reformatting of data	A process to convert data holdings in a different format from the original one. During the process certain fields can be relocated from a positional standpoint and/or dropped or the data can be reorganized within fields. Other steps can be incorporated in the reformat, such as insertion of data from a second input file. Reformatting shall use well-described transformation rules without deterioration of information content.	Transformation : a Digital Migration in which there is an alteration to the Content Information or PDI of an Archival Information Package. For example, changing ASCII codes to UNICODE in a text document being preserved is a Transformation.
Repackaging of data	Repackaging is a digital migration in which there is an alteration in the Packaging Information of the AIP.	Repackaging : a Digital Migration in which there is an alteration in the Packaging Information of the AIP .
Representation Information	Representation information facilitates the proper rendering, understanding, and interpretation of a digital object's content. It consists of structure and semantic information. Structure information describes the format or data structure concepts to be applied to the dataset to transform it into meaningful values in their spatial and temporal context. Semantic information describes the meaning of the measurement values, e.g. the physical property observed. Both should be made available together with the Primary Data as part of the preserved data set composition.	Representation Information : the information that maps a Data Object into more meaningful concepts. An example is the ASCII definition that describes how a sequence of bits (i.e., a Data Object) is mapped into a symbol.
Secondary Data	Secondary data include ancillary data, auxiliary data required to process the telemetry payload data to generate the nominal mission products, CAL/VAL databases where available (including processing/reference validation data sets), and mission related documentation including descriptions of mission products (Dissemination Information Packages, DIPs) and of the processing algorithms needed to obtain them.	Secondary Data are Digital Data Objects (object composed of a set of bit sequences) part of a Content Information , related to other digital objects (e.g. Primary Data) through Context Information (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). They constitute the target of preservation together with associated Primary Data.
Submission Information Package (SIP)	A Submission Information Package (SIP) is an Information Package that is delivered by the Producer to the OAIS for use in the construction of one or more AIPs.	Submission Information Package (SIP) : an Information Package that is delivered by the Producer to the OAIS for use in the construction of one or more AIPs .