ESA Missions and Sentinels ground segment interoperability

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18th June 2009
1. ESA Missions
2. HMA implementation
3. Quality Assurance
4. ESA Missions Data Flow – network infrastructure
5. Recommendations for ground segment standardisation
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EO missions handled by ESA

METEOSAT
M-1, 2, 3, 4, 5, 6, 7

METEOSAT Second Generation
MSG-1, -2, -3

METOP-1, -2, -3

ERS-1, -2

ENVISAT

Cryosat 2 (Polar Ice Monitoring)

GOCE (Gravity and Ocean Circulation Explorer)

SMOS (Soil moisture)

ADM/Aeolus (Atmospheric Dynamics)

EarthCARE (Clouds, Aerosol & Radiation)

SWARM (Magnetic)

GMES

Sentinel 1 (SAR imaging)

Sentinel 2 (Multispectral)

Sentinel 3 (Ocean global monit)

Sentinel 4 (Atmospheric)

Sentinel 5

Meteo in cooperation with EUMETSAT

Science to better understand the Earth

Applications Services

long term monitoring systems and services
ESA Missions launch schedule

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GMES Contributing Missions

~15 European Entities (+ their partners)
More than 40 EO satellites
More than 60 instruments
…and related ground segments, operations, infrastructure

+ around 20 data policies
ESA’s Third Party Missions (Cat-1)

2009

- ~30 historical and operational TPMs with data from ~45 instruments
- ~11 TPMs under integration/planning with data from ~14 instruments
- Partnerships with 21 European and non-European Space Agencies/Mission owners
- Annual review of TPM status with PB-EO approval and ESAC review

Accessible under

- ONE Terms and Conditions document
- TWO project registration mechanisms
- ONE Web domain for all technical information

...through ground segment harmonisation

...for complementary data exploitation with

ESA EO missions
The plans of new ESA missions indicates 5-10 times more data to be archived in next 10-15 years.
Sentinels data volumes

High Data Volumes in space & on-ground!
Systematic availability, timeliness

Systematic NRT

GB

Systematic NRT(Average S-1 Scenario) [GB/day]
1. ESA Missions

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5. Recommendations for ground segment standardisation
Interoperability with other EO Systems

GMES Data Access
- Coherent access to 40 different EO missions
- HMA implementation in the GCMs will simplify the operational data access
- Started in 2007, GMES Space Component funding approved until 2013

Coherent access to archives to support scientific exploitation like the Climate Change Initiative
- Planned to reuse the HMA architecture and standards
HMA Status in the ESA Missions

✓ HMA interfaces being implemented in the ESA Multi-mission ground segment
  ➢ Discovery, Catalogue, ordering, user management (2009)
  ➢ On-line Access to ESA archives (mid 2010)
  ➢ Ordering client (EOLI-SA) planned to be align to HMA

✓ Allowing standard HMA access to current ERS, Envisat, ESA Third Party data for GMES
HMA Interfaces implemented

- **HMA Catalogue OGC 06-131 V0.2.4**
  - for accessing ESA Catalogue via the EBRIM protocol.
  - translates EOLI-XML “native catalogue requests” in EBRIM

- **HMA Ordering OGC 06-141 V0.9.4**
  - authorisation on classic orders targeted to Multi-mission Ordering Handling (ESA and TPM missions)
  - authorization for on on-line orders targeted to E-OA

- **OGC Web Map Services – Application Profile for EO Products OGC 07-063r1**
  - for accessing to ESA browses

- **HMA Programming OGC 07-018 V0.9.5**
  - For issuing future products order requests to SPOT Image
✓ Use of generic interfaces opposed to specific schema
  ➢ Increased flexibility
✓ Catalogue and Order easy to implement
✓ Programming interface is more complex as impacts some practices established for ESA science users

✓ HMA Catalogue Comments
  • HMA Catalogue support more complex queries than EOLI XML
  • HMA Catalogue responses contains more information than EOLI- XML
  ➢ **Recommendations**
    • Investigate the support of a simplified query (e.g via Stored Queries)
    • Tailor the use of HMA for the access to heterogeneous missions

✓ HMA Identity Management Comments
  • Management of the Encryption and Digital Signature complex due to levels of flexibility in the OASIS specification.
  • Supported by few COTS
  ➢ **Recommendations**
    • Consider “packaging” the services implemented in EO-DAIL
Required interoperability among Sentinels Collaborative ground segments and the Core ground segment
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Acknowledged QA4EO as keystone for overall mission success

QA4EO will take time to implement comprehensively
• but the process has been initiated

Difficult to be applied retrospectively, but since instrument production but shall be applied to all future missions
• Both Operational and Science

Five main points for the implementation:
• Pre-launch instrument calibration and characterisation
• Post-launch L1 and L2 Quality Indicators considering all processing steps
• Cal/Val strategy throughout mission lifetime and bridging missions
• Maintain key supporting elements (e.g. test sites, RTM, POD, instruments intercalibration activities)
• Maintain information for effective long-term knowledge management

Opportunity for Europe (ESA and other national missions) to establish an international leadership
**ENVISAT, ERS and TPM missions**
- Raising awareness of QA4EO in Quality Working Groups across all instruments groups
- Provide guidance for development of detail technical procedures
- Support end-to-end QA case studies on specific instruments
- Independent analysis of TPM product quality (e.g. ALOS, Landsat, DMC)
- Active participation in international efforts for inter-calibrations programmers: Dome-C project, Miami III project and Comparisons to Maintain Traceability and Equivalence for Post-launch Optical Sensors Cal/Val (CONTROLS)

**Sentinel missions**
- Pre-launch full characterisation of instruments for S1/2/3 under evaluation
- Starting to introduce QI as a possible requirement to L1 products
- Targeting to have QI in Level 2 products, plan of implementation under discussion
- Cal/Val operational strategy under evaluation
✓ Earth Explorers
   ➢ Missions follow strong scientific driven requirements that stress the need for QA.

✓ Active support the implementation of the QA4EO guidelines through
   ➢ Test Sites references definition, Cal/Val portal, Cal/Val procedures development, GECA
   ➢ Continuous information (workshop, communication, education)

✓ ESA plans to
   ➢ Encourage EO end-users to request QA4EO compliant data/products
   ➢ Make QA4EO guidelines applicable in future procurement activities (from instrument production to processing and data distribution and long term preservation)
Recommendations on the guidelines

✓ Encourage all entities related to EO to be actively involved in the implementation of QA4EO:
  - Implementation in their respective programmes from pre-launch activities to long-term data
  - Development of procedures and subsequent integration in QA4EO

✓ Strong support for QA4EO implementation as a mean to:
  - Guarantee the performance of the delivered products to the customers (satisfying MRD)
  - Maximise correct applicability of data
  - Facilitate interoperability between products from different sensors/missions
  - Ensure accurate traceability for Long-term applications

✓ Pursue GEO Endorsement (end of 2009)
✓ Support future QA4EO Governance
✓ Enhance involvement of airborne and ground-based GOESS communities
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Product Distribution to users

1- Physical media
CD-ROM, DVD-ROM, Discs...

2- Internet (HiSEEN)

3- DDS
Satellite-based Dissemination

Multicast (Europe, Africa, soon America)
Access to on-line data

Currently different systems and interfaces providing direct access to EO data for download:

- Rolling archive of recent products
- Geographical interface for recent Envisat products
- Geographical interface for MERIS/ATSR archived products
- ftp pick-up for SPOT archived products
Ground EO data flow concept

✓ Products distribution and data access services to EO Users (Sat and Ground)

✓ Data Circulation among PDGS Centers
  ➢ Data repatriation from Stations to PACs
  ➢ Dataflow between PACs
  ➢ Data replication

✓ Ground Segment Monitoring and Control
  ➢ Station Scheduler
  ➢ Order Transfer
  ➢ Activity report

✓ Data relay from Satellite (Artemis)
HiSEEN: Ground Network 1

- High Speed Internet Access and
- IP VPN among Station and Archive Centers

High-Speed ESA Earth Observation Network

- Farnborough (Infoterra)
- ESAC (ESA, Villafranca)
- Maspalomas (INSA)
- Toulouse (CNES)
- RedIRIS (Spain)
- Ukerna (UK)
- Uninett (Norway)
- SUNET (Sweden)
- DFN (Germany)
- GARR (Italy)
- Matera (ASI, Telespazio)
- Frascati (ESA, ESRIN)
- Tromsoe (KSAT)
- Kiruna Salmijarvi (SSC)
- Neustrelitz (DLR)
- Oberpfaffenhofen (DLR)
- Svalbard (KSAT)
- Esrange (SSC)

100 Gbps, 100 Mbps, 10 Mbps, 40 Gbps, 10 Gbps, 100 Gbps via DLR NET

High-Speed ESA Earth Observation Network

- GEANT
- HiSEEN

High Speed Internet Access and IP VPN among Station and Archive Centers
Transport of Critical data (low volume) and high availability among Centers

IP VPN with Differentiated Classes of Services (CoS)
Cooperation with ESA Telecom for Data Dissemination and Exchange

- Multiple Uplinks
- Ku-Band Europe
- C-Band Africa
- Ku-band South-America
- More than 1 PByte of data disseminated so far
ENVISAT service

- 2x 150 Mbit/sec channels up to 14 times/day
- Worldwide nearly Real Time (NRT) access for ENVISAT Global Mission Data (Atmospheric Chemistry, Altimetry, AATSR, MERIS RR and ASAR Global Monitoring and Wave mode)
- Tape recorder dumping 12 times/day extends the Regional Mission Data (ASAR High Rate and MERIS Full Resolution)
European Data Relay Satellite
(2012 -2013)
ESA study performed in 2005 demonstrated that procuring high capacity network decreases its cost per Mbps.

Antarctica satellite link sharing pilot for data repatriation, demonstrated that the same paradigm could be applied in the sharing of the telecommunication satellites.

⇒ Sharing a network infrastructure among several EO operator entities could bring economic benefits to each of the missions.

GEONET task in the GEO Workplan plans to address the concept of global EO communication network

- Global communication network of interconnected networks by which GEOSS related information, data and products can be circulated and distributed in response to users and providers needs.
- Based on the sharing of national, regional and global telecommunications networks.
- It comprises User Access, Data Exchange and Dissemination services addressing all the nine SBAs.
- Based on communication network typologies, satellite and terrestrial, considered most suitable to meet the service requirements.
- Lead by ESA, interested contact Mirko.Albani@esa.int
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Recommendations for GSCB Work

✓ Start addressing EO Product specifications and format harmonisation

✓ Study the operational concept and business model of a global EO network, exploiting the on-going GEONET task in GEO

✓ Address the basic standards needed to support the Sentinels PDGS collaborative ground segments

✓ Standardise the security specification in civil EO ground segments
Conclusions

- ESA targets the introduction of HMA, QA4EO and LTDP for GMES

- Future ESA EO ground segments (Earth Explorers, GMES) will consider the GSCB recommendations.

Additional information: http://earth.esa.int
Thank you!

Any question?