Earth Observation (EO) Archives in Virtual Digital Libraries and GRID Infrastructures: an European View

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Summary

1. The situation today

2. Earth Observation requirements for environmental applications (GMES, Charter...)

3. EO infrastructure and relation with other initiatives (Oxygen, GEANT...)

4. Emerging technologies (GRID, Web Services, Digital Libraries...) for EO data access and preservation
The erpanet/Codata context

1.

- EO is a **objective source of observational data** to be preserved, made accessible, ...
- EO feeds many interdisciplinary institutional, science and business oriented users
- EO covers **time and geographic resolutions** from global to local (complementarity with in situ measurements ...)
- Long term preservation is recognised as a need
  - Mandate at European level not clearly identified
  - Archive policy not unified even at national level
- Large experience in **international community** to coordinate standards, share approach, support science at global level ...
  (CEOS, IGOS, GEO..., GxOS, WCPR, IGBP...)
- Same EO missions available/accessible only via **commercial services**
• EO operation (acquisition... archiving) community
  - Stations with multi-mission “local” coverage responsibility
  - Mission owner role to preserve mission data
  - Non uniform data policy and capabilities in data handling
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GMES – Global Monitoring for Environment and Security

GMES focuses on major global, regional and local environmental issues

- Sustainable development (WSSD Rio 1992, Johannesburg 2002 …)
- Environmental treaty monitoring (e.g. Climate Change, Desertification, Wetland, Sea pollution, …)
- Enhancing the security of citizens
- Preserving peace through transparency of information

GMES will be Europe’s contribution to better coordinated Global Earth Observing Systems, as discussed at EO Summit 2003 (GEO)
GMES builds upon existing capacities and expertise
GMES Priority Areas

• **European Regional Monitoring**
  - Land cover change in Europe
  - Environmental stress in Europe

• **Global Monitoring**
  - Global vegetation monitoring
  - Global ocean monitoring
  - Global atmosphere monitoring

• **Security-related aspects**
  - Support to regional development
  - Systems for risk management
  - System for crisis mgmt and humanitarian aid

• **Horizontal support action**
  - Information mgmt tools → “Infrastructure”
The GMES Intelligent System

- GMES has to provide timely and adequate information:
  - Provision of services - routine operation
  - Space observing systems
  - Additional in-situ observations systems
  - Data integration and information management
  - Continue Research & Technology Development
- GMES, by fact, will consider:
  - Multi source data access, interoperability
  - Long term data preservation
  - Metadata standards
International Charter
Space and Major Disasters

• An agreement between Space Agencies to use space assets (satellites) in emergency situations
  - To provide a single access point to space systems to emergency & rescue organisations in case of disasters.
  - Facilitates coordination & cooperation between space agencies and space system operators.
  - Primarily for civil protection agencies
  - Exploits existing (limited) resources with a long-term perspective
Participating Space Agencies

CSA, Canada
ESA, Europe
CNES, France
Eumetsat, Europe
NASDA, Japan
Conae, Argentina
China
Rosgidromet, Russia
ISRO, India
NOAA, USA
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ENVISAT looks at the Earth

What ENVISAT can see when it looks down at you?

Altitude 0 to 100 km: GOMOS, MIPAS and SCIAMACHY are building a three-dimensional profile of ozone concentrations in the atmosphere.

Altitude 0 to 28 km: MIPAS and SCIAMACHY are detecting low levels of gases from industry, power generation and agriculture.

Altitude 0 to 10 km: MERIS obtains an image in which the clouds you see are but a part of a complex map of the concentration of water vapour.

Altitude 0 to 4 km: ASAR and RA-2 create an accurate digital map of your surroundings, with height contours as accurate as 10 m.

Ground level: ASAR, AATSR and MERIS map the vegetation and land use around you.

Sea level: AATSR measures sea surface temperature to 0.3 °C accuracy. MERIS precisely maps ocean colour, plankton and chlorophyll distributions. ASAR and RA-2 measure ocean currents, average wave-heights and wind velocities.

Underwater: RA-2 and DORIS combine to produce a detailed map of local gravitational strength, detecting the distribution of denser and less dense rock in the Earth crust beneath the oceans.
ENVISAT data recovery

- ARTEMIS
- ENVISAT
- MATERA
- KIRUNA
- SVALBARD

Ka-Band

X-Band

Ka-Band

NRT Products

NRT Products

Users
A decentralized ground segment

- Flight Operations Control Centre (FOCC) at ESA/ESOC
- Payload Data Control Centre (PDCC) at ESA/ESRIN
- NRT Processing Stations (PDHS) at ESRIN and Kiruna
- Off-Line Processing and Archiving Centres (PAC) in 7 European countries

Users

Off line products

Svalbard
The ESA EO O$_2$ (Open, Operational) initiative

- Support the institutional community in implementing GMES
- Pursue the EO transition from science to public benefit infrastructure and service
- Account for the reduction in operations budget in the next 2-3 years
- Account for the technological evolution of the EO Ground Segment facilities landscape
- Should consider data preservation
Oxygen: Programmatic Framework

ESA Missions
- ERS
- ENVISAT
- Cryosat
- Terrasar L
- ...

ESA 3rd party missions
- Alos
- JERS
- Seawifs
- Quickscat
- Landsat
- ...

Other EO missions
- Radarsat 1, 2
- Terrasar X
- Aqua, Terra
- ...

Other aux. Environmental data
- Met. data
- In-situ data
- Maps, DEMs
- ...

Open operational integrated ground segment infrastructure

EC 6 FP

EC GMES

GMES

DUP

Market development

Science Programmes

Non-EO Service Development Programmes
GEANT connectivity in Europe

- Not yet really used by the EO community

- GEANT should provide VPN services for the EO operational community

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Extension to Earth Science User Segment

Interoperability

High Speed Network

Earth Science User Segment

GRID and other ICT resources

e-collaboration tools

Thematic Application community

EO data access

Other data

Models

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The EO community technology view

• Metadata interoperability
  - directory, guide, inventory
  - syntax and semantics
• Data Archive Models
• Web services, OGIS standards (mapping, coverage...)
• Distributed Processing Systems for the EO community
  - GRID and data interoperability
  - Digital Libraries
Web Mapping services

OpenGIS Consortium has developed specifications for WEB SERVICE

- International Consortium of 220 companies, governmental agencies and universities
- Consensus building for geographic information public access interfaces
- Interoperable solutions for geographic services in internet and mobile communications
- Consider limitations on data volumes and available bandwidth

→ EO data access / visualisation
Web Mapping services

- Environmental Data
- Location Based Services
- Satellite Images
- Catalogue Systems

USER

URL

Webmap Service

Geographical Data
European DataGRID

- Project funded by the EU
- Enable the access to geographically distributed computing power and storage facilities belonging to different institutions
- Led by CERN together with 5 main partners (+15 associated)
- 3 Application communities (HEP, EO, Biomedicine)
GRID on Demand: Ozone Application Portal

- Temporal and spatial selection of data
- Catalogue access and data transfer from ESA data warehouses to the GRID storage elements
- Job selection and status information
- Result retrieval and visualization in OWS
- Remote MySQL access (SOAP)
- Data validation with ground measurements
Present EO grid application Environment ...

AMS ESA Data Archive
MUIS ESA Catalogue

geant

ESA Distributed G/S

Local Grid

European Grid

WCS / WFS / WMS
Catalogue (CSS)
GRID experience so far …

• Interests in the user community
  - User has better control of service
  - Better access to data
  - Bring the analysis to the data or to data exploitation (yesterday Alex Szalay’s presentation)
  - Support science communities for focused collaborations, e.g. cal/val, new algorithms, high level products generation

• Interests / issues in the operational community
  - GRID architecture for next missions
  - High bandwidth connectivity across facilities
  - Provide reference application processing environment
  - Maximise use of available resources in the distributed European Ground Segment
Digital Libraries and GRID

- DLs are perceived as a necessary instrument to support multimedia, multimodal communication and collaboration among the members of communities of interest
- The involved systems lack interoperability and the services provided are difficult to reuse
- GRID offers high storage and computing capabilities
- GRID addresses the main DL architecture requirements: e.g. openness, scalability, security, quality..

- New related initiative in Europe
  - ECHO: European Culture Heritage Online – Berlin declaration
  - Alexandria Biblioteca ...

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DL, GRID and EO

- An advanced Grid-based Digital Library Infrastructure testbed proposal
  - will allow access to shared data, information and knowledge
  - EO and environmental organisation
  - Interest in re-using experience in interoperability
  - Reuse European GRID testbed (continuation of EDG)
  - Distributed access to space, in-situ data, large documentation…

Input:
- Data
- Info
- Collections
- Images
- Text
- Etc.

Application Scenario

Digital Library-ware
- Search
- Process
- Web-Services

Application Specific

Grid Services middleware

EGEE. Grid n

Local. Distributed

Application Scenario

Application Scenario

Application Virtual DL
**Scenario: Environmental Conventions for Sustainable Development**

Access to online data

many meaningful entries

Digital Library Ware

Extraction of specialised info to support

Reports
Maps
Snapshots

... on environmental status, ...
Conclusions

• Presentation has covered the European view on
  • Earth Observation requirements for environmental applications
  • EO infrastructure and relation with other initiatives
  • Some emerging technologies for EO data access and preservation

• The priorities remain:
  • Ensure “proper access” (e.g. data policy, archive policy) to EO data for the science community
  • Make sure that EO long-term data preservation is an essential tasks for ongoing and future programmes

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