CEOS WGISS / GEOSS Reference Model for the Use of Satellite Data in Disaster Response and Risk Assessment

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WGISS-34 Briefing & Discussion

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Problem statement

- Int'l disaster management involves:
  - Many activities by many players
  - Many ad hoc arrangements

    => Limited effectiveness, efficiency
- Unclear how new suppliers can plug in their data / services
- Unclear how new users can tap into these data / services
- Unclear what resources are shared … missing … interdependent … isolated
- Need to establish partnerships, standards, shared vocabulary, etc., in advance of disaster events
- Need a precise, common understanding of processes, information & computation resources, and needs

Objectives

- Effective, efficient management of distributed systems for international, collaborative disaster management
- Clear roles of information systems and services in support of disaster management & risk assessment
  - Articulate scope of the disaster management enterprise
  - Promote a common understanding of components and roles
- Clear links between ongoing activities and overall enterprise
  - High-level view able to guide future activities
    - Esp. implementation of proof-of-concept prototypes
  - Shortfalls, gaps, redundancies identified
  - Complementary with GEOSS Architecture Implementation Pilot (AIP)
- Streamlined, easily automated access by decision-makers to data, services
- Lessons learned from real-world practitioner experiences

Approach

- Characterize and evaluate disaster response processes, *e.g.*
  - International Charter (multiple perspectives, esp. end-user interactions)
  - CEOS Supersites, SERVIR, and other components
- Identify case studies and WGISS contributions to GEOSS architecture
  - Characterize key proof-of-concept prototypes
  - Use these to ground the architecture in real-world examples
- Use a well-defined architecture framework to describe the GEOSS disaster management enterprise as a whole
  - Key classes of people, system components, processes/services, products
  - Shared understanding of relationships and interdependencies
  - Common terminology and high level interfaces
  - Apply and extend GEOSS Architecture Implementation Pilot (AIP)
- Infer requirements for CEOS, UN-SPIDER, and other portals
  - *e.g.,* search indexing; access interfaces; data priorities
- Capture lessons learned; recommended standards and products suitable as building blocks for sustainable capability

Scope, purpose, structure

Enterprise Viewpoint

- Scope & purpose based on CEOS WGISS charter; GEOSS Strategic Targets; GEO Task DI-01
- GEOSS principles
  - System of Systems
  - Data Sharing Principles
  - Interoperability Arrangements
- Disaster types [1]

  Flooding Earthquakes Volcanoes Drought
  Windstorms Landslides Wildfires Tsunamis
- Lifecycle phases [1]

  Mitigation Warning Response Recovery

[1] CEOS / GEO DI-06-09 report, "Use of Satellites for Risk Management" (11/2011)

Information content & semantics

Information Viewpoint

- General-purpose concepts from AIP-5 Architecture
  - Spatial referencing – Feature Model – Data Quality / Provenance – Data Policies and Licensing – *etc.*
- Observation needs by disaster type & phase – based on
  - CEOS / GEO DI-06-09 report, Use of Satellites for Risk Management (Nov. 2011)
  - GEO report, Critical Earth Observations Priorities (Oct. 2010)
  - GEOSS 10-Year Implementation Plan Reference Document (2005)
- Metadata
  - Locating & identifying relevant data
  - Assessing fitness for use
  - Georeferencing
- Semantics / semantic translation

Information content & semantics

Information Viewpoint

- Cross-cutting needs:
  - Frequent, high-resolution observations
    - Esp. for earthquakes, floods
  - Basemaps – *e.g.,*
    - Digital terrain models – Water boundaries – Ground control points
- Data operations
  - Preprocessing (*e.g.,* decoding, georeferencing, atmospheric correction – “Level 1”)
  - Analysis & Interpretation (incl. feature extraction)
  - Product creation (incl. “image pyramids”)

Computation and Services

Computation Viewpoint

- Generic service types – from AIP-5:
  - Catalog Registration & Search
  - Portrayal / Display / Styling
  - Data Access & Ordering
  - Processing algorithms
  - Sensor access & control
  - User management
- Disaster-specific service types:
  - Event detection
  - Sensor tasking
  - Data Analysis / Interpretation
  - Modeling / Prediction

Namibia Flood Pilot Sensor Web Concept

Computation and Services

Computation Viewpoint

- Cross-cutting needs:
  - Near-Real-Time data access / delivery
  - Data broadcast
  - Cross-community interoperability
  - Ease of use; ease of operation / maintenance
  - “Last mile” to end-users (incl. telecomm. infrastructure)
- Service-Oriented vs. other
  - Broadcast / push (LDM, GeoNetCast)
  - Physical media delivery

Upcoming Plans

Milestone	Date
Review recommendations from WGISS-34 meeting	Oct. 2012
Reference Model v1.0 Release	Oct. 2012
Contribute to AIP-5 Disaster Scenario / Architecture	Oct. 2012
Draft architecture gaps / recommended enhancements	Oct. 2012
Add'l case studies & recommendations	Nov. 2012
Written contributions to AIP-5 architecture	Dec. 2012
Circulate reference architecture v2.0 draft	Jan. 2013
Release reference architecture v2.0	Feb. 2013
Findings on CEOS, UN-SPIDER *(etc.)* disaster portals	Mar. 2013
Recommendations on disaster portals	Apr. 2013
Implications for system implementation	Apr.-May 2013
Review findings & recommendations @ Sensor Web Workshop, WGISS-35	Apr.-May 2013
Final release of reference architecture	Jun. 2013

GA.4.Disasters Agenda

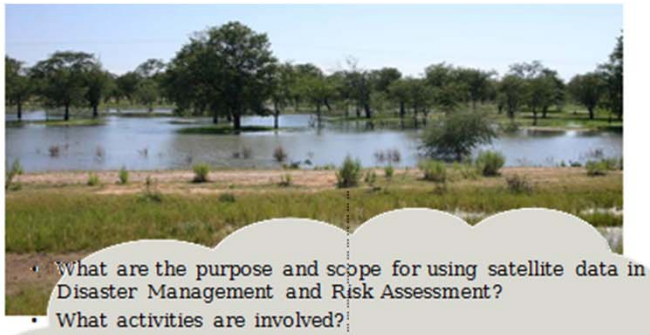
- Project Overview: GA.4.Disasters – GEOSS Architecture for the Use of Satellites for Disaster Management and Risk Assessment
- GEOSS AIP-5 contributions and outcomes
- Findings from the July ESA forum on Understanding Risk with Earth observation
- GA.4.Disasters Architecture status
- Case Study findings
- Preliminary recommendations
- Next Steps

Framework: ISO/IEC Reference Model of Open Distributed Processing (RM-ODP)

- *Enterprise viewpoint:* the purpose, scope, and policies for the system. Often articulated by means of use cases.
- *Information viewpoint:* the semantics of the information and the information processing performed.
- *Computation viewpoint:* the functional decomposition of the system into objects interacting at interfaces.
- Two additional viewpoints will see less emphasis in v1.0:
  - *Engineering viewpoint:* the mechanisms and functions required for distributed interaction between objects.
  - *Technology viewpoint:* the choice of technology for implementing the system.
- RM-ODP is the basis for GEOSS Arch. Impl. Pilot (AIP), E.U. ORCHESTRA, OGC Ref. Model, and others

Framework: ISO/IEC Reference Model of Open Distributed Processing (RM-ODP)

Working Group on Information Systems and Services



RM-ODP Viewpoints

Disasters
Table 4.1.5
Observational Requirement

	Observational Requirement	Wild land Fires	Earthquakes	Volcanoes, Volcanic Ash and Aerosols	Landslides, Subsidence	Floods	Extreme Weather	Tropical Cyclones	Sea and Lake Ice	Coastal Hazards, Tsunami	Pollution Events
1	Digital topography–broad, regional	2	2	2	2	2		2	2	2	2
2	Digital topography, bathymetry – detailed or high-resolution	3	3	3	3	3	3	3	2	3	3
3	Paper maps with natural (terrain, water) and cultural features (includes geographic names, all infrastructure and transportation routes)	1	1	1	1	1	1	1	1	1	1
4	Detailed mapping, dating of bedrock, surficial deposits, fill, dumps		3	3	3	3			3	3	3
5	Documentation/assessment of effects during & after event	2	2	2	2	2	2	2		2	2
6	Seismicity, seismic monitoring		1	2	3						
7	Strong ground shaking, ground failure, liquefaction effects		2		4						
8	Deformation monitoring, 3-D, over broad areas		3	3	3						
9	Strain and creep monitoring, specific features or structures		2	2	2						
10	Measurement of gravity/ magnetic/electric fields – all		3								

Legend for Table 4.1.5

0 – Monitored with acceptable accuracy, spatial and temporal resolution; timeliness and in all countries worldwide.

1 – Monitored with marginally acceptable accuracy, spatial and temporal resolution; timeliness or not in all countries worldwide

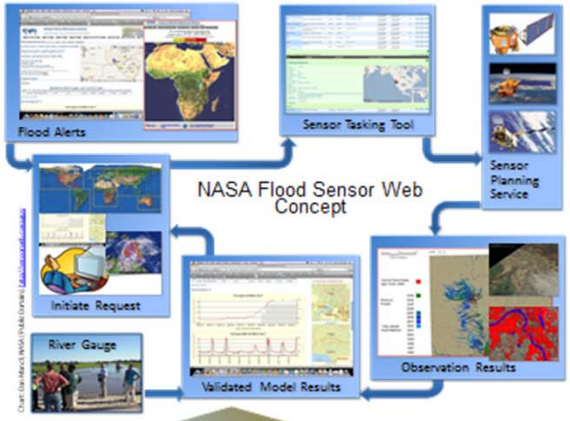
2 – Not yet widely available or not yet monitored globally, but could be within two years.

3 – Only locally available or experimental; could be available in six years.

4 – Still in research phase; could be available in ten years.

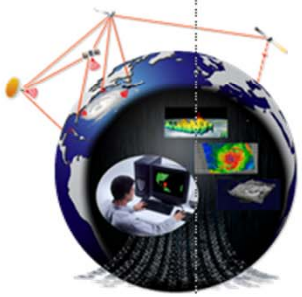
- What are the purpose and scope for using satellite data in Disaster Management and Risk Assessment?
- What activities are involved?
- In what organizational structures do (or must) these activities take place?
- Who are the participants in these activities?
- Who are the stakeholders for this architecture – who has (or should have) a say in how these activities use information from satellites (and elsewhere)?
- What other enterprises are linked to this one?

Enterprise viewpoint



- What observations or parameters are needed when responding to different kinds of disasters (or assessing their risk)?
- In what forms does this information best support the enterprise?
- What metadata are needed to ensure that data can be found and appropriately used?
- What inter-dependencies exist among these data products?
- What data transformations, interpretations, extractions, syntheses, etc. are needed between sensors and users?

Information viewpoint



Computation viewpoint

- What service types are needed to make the necessary data available to users?
  - *e.g.*, data access, visualization, catalogs
- How will these service types effect the data transformations, interpretations, extractions, syntheses, *etc.* between sensors and users?
- What requirements apply to these services and interfaces (e.g., near-real-time performance, cross-community interoperability)

Engineering viewpoint ⟷ **Technology viewpoint**

ESTO
Earth Science Technology Office

Enterprise view: purpose / scope

- GEO Task DI-01, “Informing Risk Management and Disaster Reduction” seeks to achieve the following:
  - More timely dissemination of information from globally-coordinated systems for hazard monitoring, prediction, risk assessment, early warning, mitigation, and response.
  - Multi-hazard and/or end-to-end approaches to disaster risk reduction, preparedness, and response.
  - Support for the Hyogo Framework for Action 2005-2015.
  - Improved use of observations in policies, decisions and actions associated with disaster preparedness and mitigation.
  - More effective access to observations to facilitate disaster warning, response and recovery.
  - Increased communication and coordination between national, regional and global communities.
  - Improved disaster response through delivery of space-based data, via the International Charter on Space and Major Disasters.

Enterprise view: purpose / scope

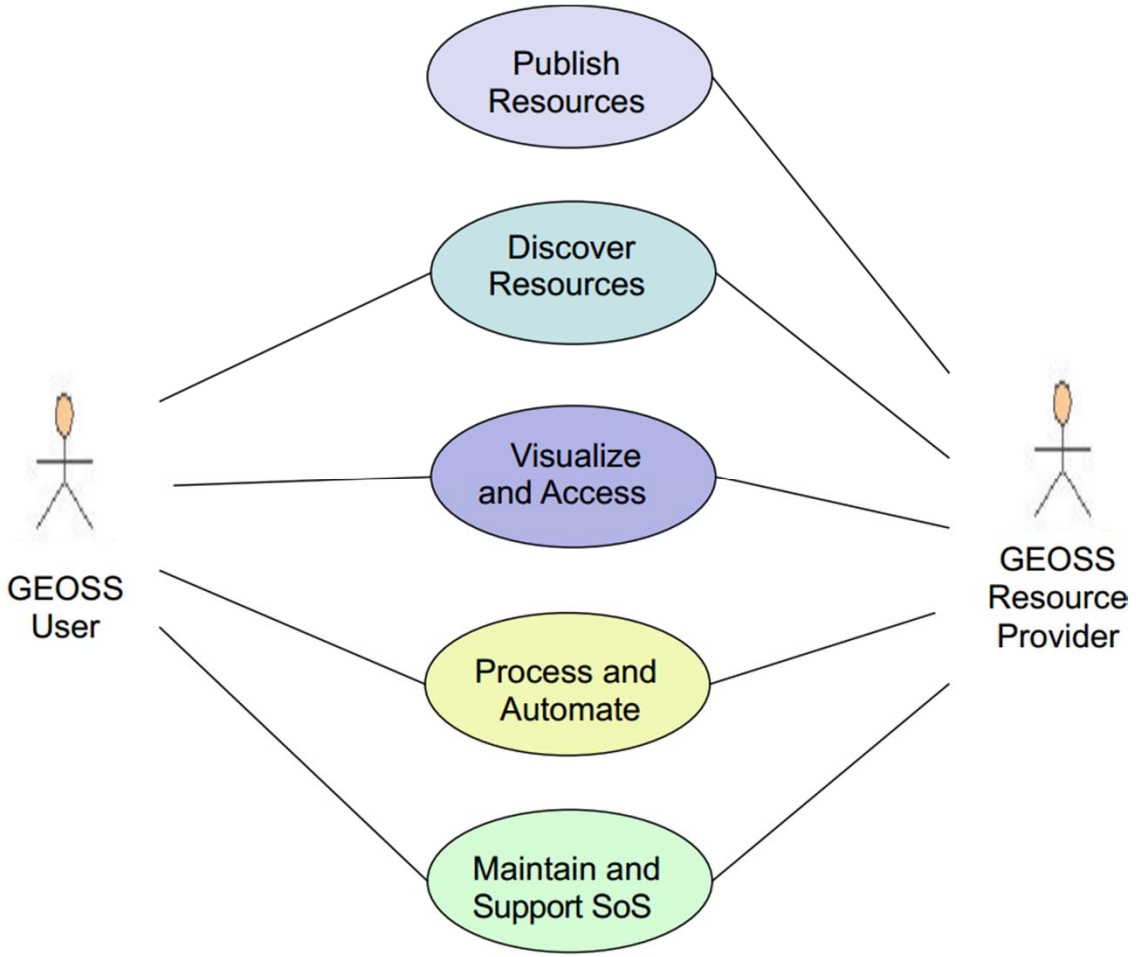
- GEO DI-01 focus areas:
  - Provide support to operational systems
  - Enable and inform risk and vulnerability analyses
  - Conduct regional end-to-end pilots with a focus on building institutional relationships
  - Conduct gap analyses in order to identify missing data, system gaps, and capacity gaps
- GEO DI-01 components:
  - Disaster Management Systems
  - Geohazards Monitoring, Alert, and Risk Assessment
  - Tsunami Early Warning and Hazard Assessment
  - Global Wildland Fire Information System
  - Regional End-to-End Pilots
- GEO DI-01 implementation Resources

Enterprise view: Stakeholders

- Often mentioned; seldom characterized or enumerated
  - Case studies will shed light on this from practitioner perspectives
- GEOSS AIP-3 (01/2010): “targeted or supported” communities
  - National agencies concerned with disaster management, meteorology, hydrology, and emergency response, and their supporting providers of data, services, research, and analysis
  - CEOS Strategic Implementation Team (SIT) and WGISS
  - GEOSS' DI-06-09 (=> DI-01) Task
  - UN-SPIDER
- GEOSS AIP-3 Disaster Management reference scenario:
  - Initiators *(trigger and coordinate the disaster response)*
  - Actuators *(respond to disaster – e.g., regional civil protection, insurance companies, NGOs)*
  - Processors *(provide raw data or derived information)*
  - Coordinators *(facilitate interactions among the other actors)*

Enterprise view: Processes

- Information support activities (from GEOSS AIP-5 architecture)

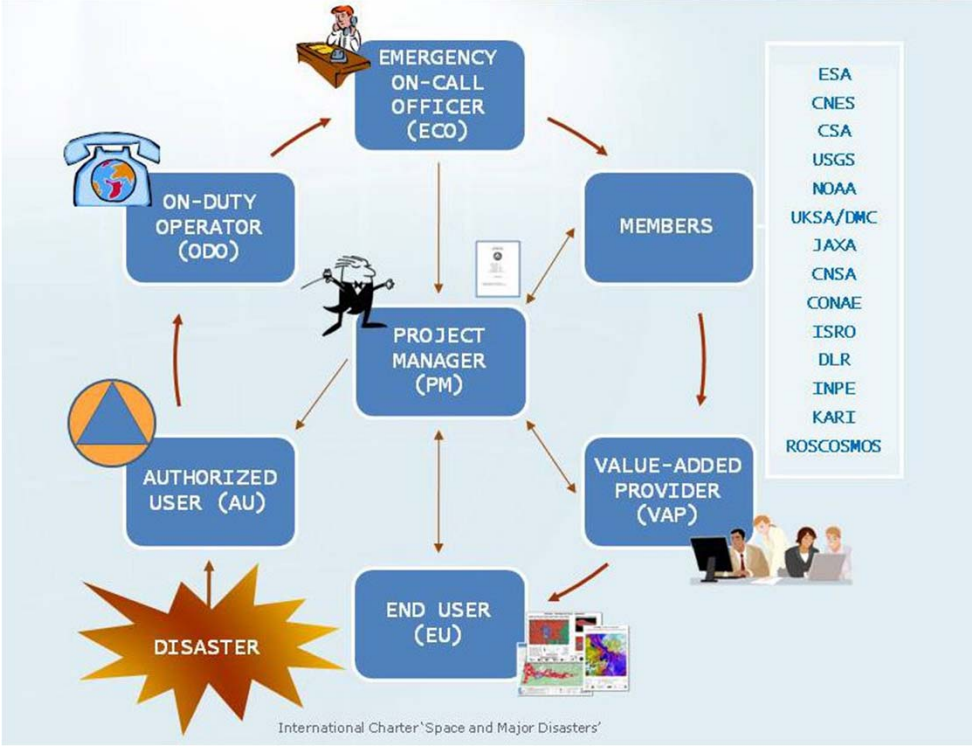


Enterprise view: Principles

- System of Systems
  - Independently operated systems contributed to (also) serve shared purposes
- Data Sharing Principles
  - Full and open exchange of data
  - Minimum delay and cost
  - Support to research or education at zero or marginal cost
- Interoperability Arrangements
  - Industry or international interface standards *(generally)*
  - Adopted by the GEO Standards and Interoperability Forum (SIF)
  - Maintained in the GEO Standards Registry

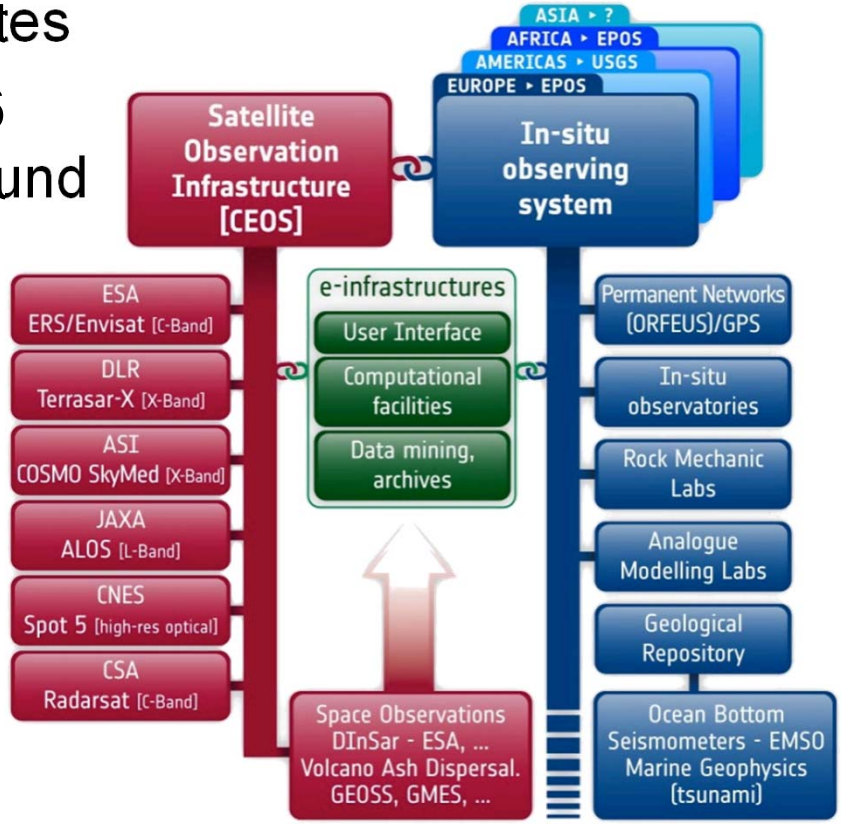
Enterprise view: points of comparison

- Example: International Charter
  - Supply space-based data to relief efforts in the aftermath of major disasters
- Differences in scope w/ GA.4.D enterprise:
  - Support disaster relief – not research, prevention, *etc.*
  - Supply data products – not original data or end-user services



Enterprise view: points of comparison

- Example: GeoHazard Supersites
  - Open access to data for 16 seismically active sites around the world
  - Spaceborne SAR; GPS deformation measures; earthquake observations
- Differences in scope with GA.4.D enterprise:
  - Seismic risks only – not floods, storms, *etc.*
  - Emphasis is on research – not operations *(so far)*



Progress so far

- Facilitated interagency development of a reference model
  - WGISS (NASA; CAS/China; GISTDA/Thailand; NASU/Ukraine; UKSA; CISR/South Africa; United Nations SPIDER)
  - CEOS (CSA / Disasters SBA; NOAA & USGS / CEO; LaRC / SEO)
  - USGS / Int'l Charter
- WGISS-32: Clarified scope, structure, priorities
- Presented project concepts at AGU, ESIP
- Coauthored IGARSS abstract w. OGC/GEOSS AIP
- Circulated 2 draft architectures
- Identified practitioner case studies to validate the viewpoints
- Joint Development Meeting with Disaster SBA Team
- Practitioner case studies now underway *(more on that in a bit)*