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Committee on Earth Observing Satellites (CEOS) Working Group on Information Systems and Services (WGISS)

Reference Model for Use of Remote Sensing Products for Disaster Management and Risk Assessment

Karen L. Moe – karen.moe@nasa.gov
NASA Earth Science Technology Office
Goddard Space Flight Center
Greenbelt, Maryland

John D. Evans – john.evans@gst.com
Global Science & Technology, Inc.
Greenbelt, Maryland

Abstract

The Committee on Earth Observing Satellites (CEOS) Working Group on Information Systems and Services (WGISS) initiated a project to describe and document a high-level reference model for the use of satellites, sensors, models, and associated data products to support disaster response and risk assessment. The project builds on results of the Group on Earth Observations (GEO) task for the Disasters Societal Benefit Area (SBA). The GEO Global Earth Observation System of Systems (GEOSS) will provide decision makers access to disaster and risk assessment information from global data and service providers.

The purpose of the reference model is to provide an enterprise perspective for managing distributed systems and services for disaster management. It is intended to provide a common vocabulary to describe the system-of-systems building blocks and how they are composed in support of disasters.

Purpose

- Effective and efficient management of distributed systems and services for 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 relationship between ongoing activities and the enterprise as a whole
  - Use enterprise architecture to guide implementation of proof-of-concept prototypes
  - Identify shortfalls, gaps, and redundancies
  - Refine the enterprise architecture
- Lessons learned, guidance, and standards

Reference Model of Open Distributed Processing (RM-ODP)

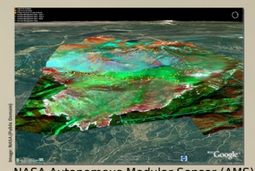
- *Enterprise viewpoint:* the purpose, scope, and policies for the system. Often articulated by means of use cases.
- *Information viewpoint:* the semantics of the information and the information processing performed.
- *Computation viewpoint:* the functional decomposition of the system into objects interacting at interfaces.
- *Engineering viewpoint:* the mechanisms and functions required for distributed interaction between objects.
- *Technology viewpoint:* the choice of technology for implementing the system.

http://tinyurl.com/GA4Disasters

The Disaster Management Enterprise

Flooding in Okalongo, Namibia

NASA's Ikhana remotely piloted aircraft with smoke from the Lake Arrowhead, CA, area wildfires (Oct. 2007)



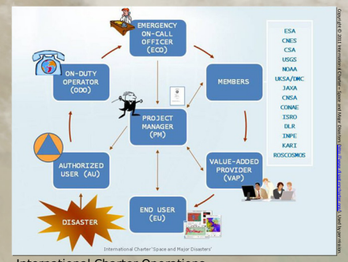
NASA Autonomous Modular Sensor (AMS) Wildfire Image overlaid on Google Earth

UN-SPIDER

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS

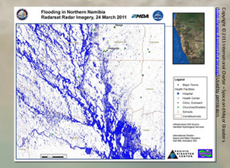
CEOS Working Group on Information Systems and Services

GEO GROUP ON EARTH OBSERVATIONS



International Charter Operations

Flooding in Northern Namibia - April 2011
WorldView image *(above)*, Radarsat *(below)*



People – Sensors – Data – Processes – Decision Support

RM-ODP Viewpoints

Disasters Table 4.1.5
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
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							

From GEOSS 10-Year Implementation Plan Reference Document, Group on Earth Observations, 2005.

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.

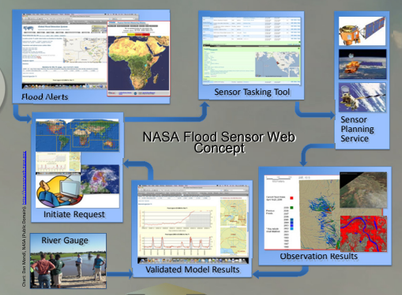
2 - Not yet widely available or not yet monitored globally, but could be within two years.

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

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

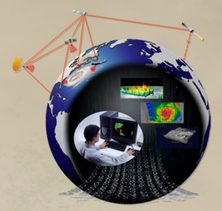
Enterprise viewpoint

- 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?



Information 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?



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**

Approach

- Evaluate existing/proposed disaster response processes
  - International Charter (esp. end user interactions)
  - Role of CEOS supersites, SERVIR, other components
- Develop evolving GEOSS enterprise architecture description
  - Key classes of people, system components, processes/services, products
  - Common terminology and high level interfaces
- Identify use cases and existing WGISS component contributions to GEOSS architecture
  - Identify and implement key proof-of-concept prototypes
  - Develop evolving architecture framework with more detail
- Capture lessons learned, recommended standards and products that can be used to implement the building blocks, concepts for sustainable capability

Expected Outcomes

- Improved product development and delivery for disaster management and risk assessment
- Faster access to, and more automated processing of, imagery during disasters, to support the response phase
- Assessment of UN-SPIDER disaster response needs
- Clear scope of the WGISS disasters project, identifying existing components and roles, such as:
  - International Charter on Disasters (space agency resources)
  - CEOS WGISS member data for disasters and risk assessment
  - CEOS Supersites on recurring disasters that affect major populations
  - Relevant portals (e.g., earthquake E-DECIDER, SERVIR regional disaster data support capability)
  - Relevant sensor web, grid, web service infrastructure
- Clarify need and recommendations for a CEOS Disasters Portal
  - Disaster type information, including sensor gaps for each type
  - Remote sensing requirements for each disaster type per phase (mitigation, preparation, response, recovery)
  - Related informational products per disaster type
  - Access to mission/instrument and in-situ data via search capability specific to disaster type
  - Access to models
- Leverage WGISS and CEOS Disasters SBA expertise for GEOSS pilots, e.g.
  - Southern Africa Flood and Health Pilot for Namibia
  - Caribbean Satellite and Disaster Pilot
- Ready access to GEOSS disasters architecture findings

References / Further Reading

- GEOSS Architecture for the use of Satellites for Disasters and Risk Assessment (GA.4.D): http://tinyurl.com/GA4Disasters
- CEOS / Disasters SBA: http://tinyurl.com/CEOS-DisastersSBA
- CEOS / WGISS: http://ceos.org/wgiss
- GEO / GEOSS: http://www.earthobservations.org/geoss.shtml
- UN-SPIDER: http://www.un-spider.org/
- International Charter: http://www.disasterscharter.org/
- Reference Model of Open Distributed Processing: ISO/IEC 10746 / ITU-T Rec. X.901-X.904, http://www.itu.int/rec/T-REC-X/en