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

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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 use cases and WGISS contributions to GEOSS architecture
  - Characterize key proof-of-concept prototypes
  - Use these to ground the architecture in real 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

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

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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	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 scales		3								

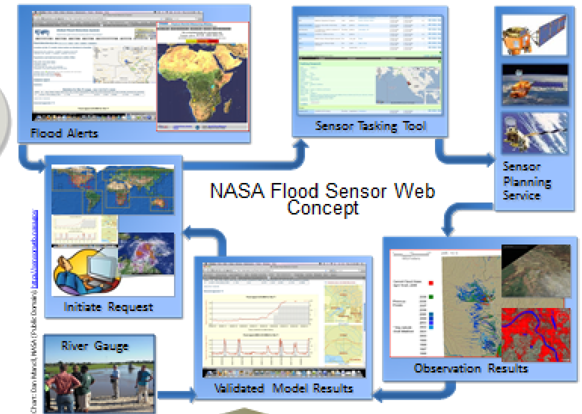
Legend for Table 4.1.5

- 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.

From GEOSS 10-Year Implementation Plan Reference Document, Group on Earth Observations, 2006

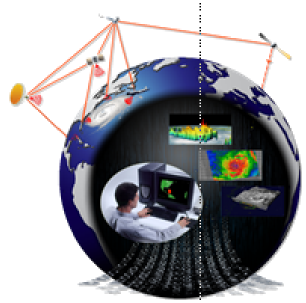
- What are the purpose and scope for using satellite data in Disaster Management and Risk Assessment?
- What activities are involved?
- In what organizational structures do (or must) these activities take place?
- Who are the participants in these activities?
- Who are the stakeholders for this architecture – 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

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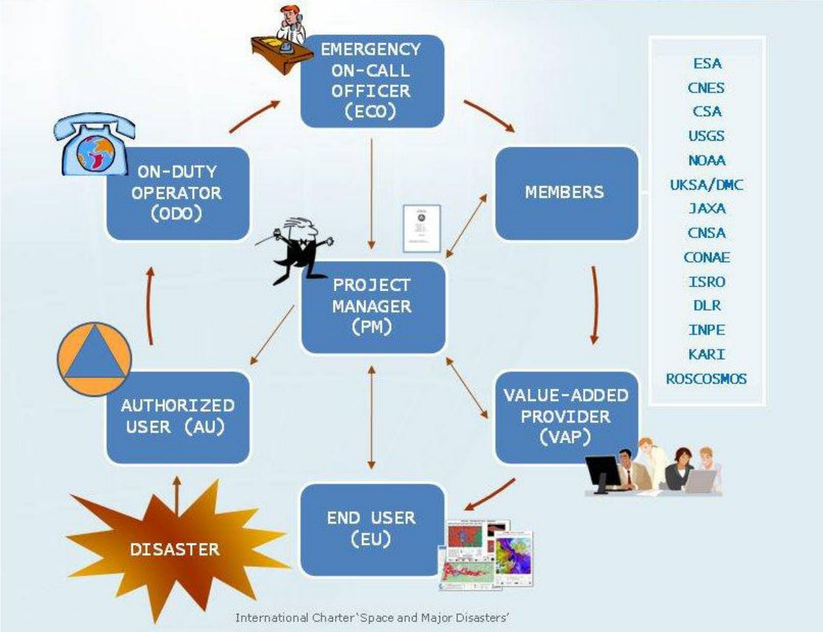
Enterprise view

- Support to DI-06-09 / DI-01 components and GEOSS Strategic Targets
- Stakeholder characterization
  - Drawing on AIP "target communities" and "actors"
- Collaboration with Int'l Charter, UN-SPIDER
- Example input: Int'l Charter process diagram



Information viewpoint

- Information content & semantics
- Build on AIP-3/AIP-5 information viewpoint (location referencing, metadata, access policy)
- Add disaster-specific topics:
  - Observation types vs. disaster types
  - Metadata for effective finding/binding in a disaster context; Shared definitions and vocabulary
  - Data transformations
- Example input: GEOSS worksheet on observation types vs. disaster types

Disasters
Table 4.1.5

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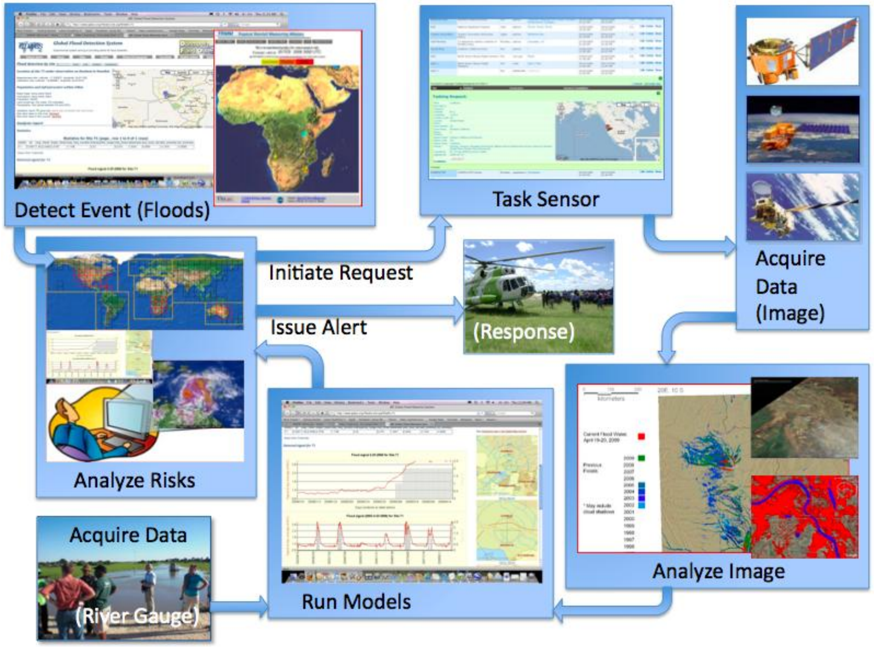
Computation viewpoint

- Processing / transformation used *(or available, or desirable)* in the datastream from sensors to users
- Emphasis on characterizing types of services; roles and priorities; constraints and requirements
  - E.g., near-real-time data access; data broadcast; cross-community interoperability; "last mile" to end-users
- Example input: NASA Flood Sensor Web sketch



Case Studies

- Disaster response scenarios and lessons from WGISS members:
  - China Sichuan earthquake 2008 *(Densheng Lui)*
  - Japan: Tōhoku / Sendai earthquake / tsunami 2011 *(via Satoko Miura)*
  - Thailand monsoon floods 2011 *(via Pakorn Apaphant)*
- NASA technology pilots *(via the AIST use case template*):
  - Namibia flood sensor web/dashboard *(Dan Mandl, Guido van Langenhove)*
  - Caribbean disasters task for CEOS *(Stuart Frye*
  - Thailand wildfire sensor web *(Steve Chien/JPL)*
  - VMOC support to USGS HDDS *(Will Ivancic/GRC*)
- Experience with the International Charter:
  - USGS member view *(Brenda Jones - June 2011 interview)*
  - NOAA member view *(Yana Gevorgyan, NOAA*)
  - UK member view *(via Wyn Cudlip, WGISS*)
  - NASA EO-1 provider view *(Stuart Frye)*
  - Namibia end user view *(Guido van Langenhove - 2011 email)*
  - Japan earthquake data for eDecider *(Maggi Glasscoe/JPL)*
- Other Systems & Roles
  - GEONETCAST (NOAA)

Expected Outcomes

- Improved product development and delivery
- Faster access to (and more automated processing of) imagery during disasters
- Clear scope of the WGISS disasters project, identifying components and roles:
  - International Charter on Disasters (space agency resources)
  - UN-SPIDER disaster response needs
  - 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)
  - Relevant sensor web, grid, web service infrastructure
- Clarify recommendations regarding Disasters portal(s)
  - Disaster type information, including sensor needs and gaps for each type
  - Remote sensing and other info. needs per disaster type & response phase
    - Mitigation, Preparation, Response, Recovery
  - Search capabilities specific to each disaster type
    - Mission, Instrument, Model, and *In Situ* data
- Engage CEOS, WGISS, and GEOSS Disasters SBA
- Ready access to GEOSS disasters architecture findings
  - Streamlined participation and access by new, diverse players