GEOSS Architecture for the use of Remote Sensing Products in Disaster Management and Risk Assessment  (GA.4.D)

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GA.4.D Objectives

- Boost effectiveness, efficiency of satellite observation support to disaster management
  - Get beyond *ad hoc* arrangements
- New *suppliers*: clarify how to contribute data & services
- New *users*: clarify how to tap into these data & services
- *Planners*: clarify what resources are
  - Shared · Missing · Interdependent · Isolated
- Provide a precise, common understanding of processes, information & computing resources, and user needs
- Establish partnerships, standards, shared vocabulary, etc., in advance of disaster events
GA.4.D version 1.0

• Arch. Document released Dec. 2013
  — review by CEOS, UN-SPIDER, others

GEOSS Architecture for the Use of Remote Sensing Products in Disaster Management and Risk Assessment

1. Executive Summary
2. Introduction / Overview / Motivation
   2.a. Audience and scope
   2.b. Goals and Requirements
   2.c. Approach: Reference Model for Open Distributed Processing
   2.d. Approach: practitioner case studies
3. Enterprise Viewpoint
   3.a. Purpose and scope
   3.b. Hazard types and disaster lifecycle phases
   3.c. Activities (Business Processes)
   3.d. Stakeholders
   3.e. Principles
   3.f. Enterprise view: points of comparison
4. Information Viewpoint
   4.a. Overview
   4.b. Observations and parameters by disaster type
   4.c. Metadata needs in a disaster management context
   4.d. Data operations needed in a disaster management context
5. Computation viewpoint
   5.a. Overview
   5.b. Service types needed for disaster management and risk assessment
   5.c. Constraints and requirements specific to disaster management
6. Engineering and Technology Viewpoints

References
Appendix 1: Namibia Flood Pilot
Appendix 2: China Sichuan / Wenchuan earthquake
Appendix 3: Japan Sendai / Tohoku earthquake & tsunami
Appendix 4: International Charter – Space and Major Disasters
Appendix 5: (Alternative / Future) Case Study Candidates
Appendix 6: Case Study Questionnaire
• Scope & purpose based on
  • GEO Task DI-01  • GEOSS Strategic Targets

• Consistent with GEOSS principles
  – System of Systems  • Data Sharing Principles
  – Interoperability Arrangements

• Lifecycle phases
  • Mitigation  • Warning
  • Response  • Recovery

• Hazard types
  • Flooding  • Earthquakes  • Volcanoes
  • Drought  • Windstorms  • Landslides
  • Wildfires  • Tsunamis
Activities (business processes)

1. Event detection
   - Routine / Global Monitoring
   - User-generated postings
   - Routine / Global model outputs

2. Situational Awareness
   - Gather / Assimilate Information
   - Decision Analysis: Act / Plan

3. Data acquisition
   - Remote
   - In situ
   - Archive
   - Task sensors
   - Acquire data

4. Modeling
   - Forecast
   - Nowcast
   - Hindcast

5. Analysis
   - Preprocess
   - Analyze
   - Interpret

6. Dissemination
   - Visualize
   - Publish product
   - Alerts / Notices
   - Ongoing updates

7. User Access
   - Initiators
   - Actuators
   - Processors
   - Coordinators

Enterprise Viewpoint

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Applying the Information & Computation views

### Information needs by disaster type and phase

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Warning</th>
<th>Response</th>
<th>Recovery</th>
<th>Mitigation</th>
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</thead>
<tbody>
<tr>
<td><strong>Wildfire</strong></td>
<td>Predict rainfall, humidity, winds; assess ecological conditions (e.g., soil humidity)</td>
<td>Locate and assess impacts using before / after imagery.</td>
<td>Assess damage locations and extent; estimate rebuilding / recovery costs.</td>
<td>Compute (fire / flood / landslide, …) risks from long-term trends &amp; generate risk maps.</td>
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<td>Windstorm</td>
<td>Predict storm activity vs. settlements &amp; infrastructure</td>
<td>Optimize response / relief dispatch</td>
<td>Review and improve information technology and communications preparedness.</td>
<td>Simulate effects of revised land-use policies and/or building codes.</td>
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<tr>
<td>Flood</td>
<td>Assess / predict cumulative rainfall, flow, flooding; assess storm surge extent under various scenarios; overlay w/ infrastructure, settlements to pinpoint risks</td>
<td>Provide essential public information, targeted by location</td>
<td>Improve modeling, prediction, sensing, and assessment capabilities</td>
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<tr>
<td>Landslide</td>
<td>Predict coastal surge areas from offshore seismic events; provide location-specific, real time guidance</td>
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<tr>
<td>Tsunami</td>
<td>Process SAR observations to detect deformations. Estimate strain rates from satellite observation time series.</td>
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<tr>
<td>Volcano</td>
<td>Detect / predict seasonal weather anomalies; overlay w/ populations to initiate relief aid</td>
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<tr>
<td>Earthquake</td>
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<tr>
<td>Drought</td>
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New technologies and architecture viewpoints

**Information viewpoint**

*Data collection:*
- Small Satellites
- Drones (UAVs)
- Direct Broadcast / Direct Readout
- Mobile devices
- “Internet of Things”
- Crowdsourcing

**Computation viewpoint**

*Data processing:*
- Model Webs
- Cloud Computing
- Big Data analytics
- Semantic services
- Mobile devices
- Location-based services
- Collaborative services

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Disaster Risk Management Activities and emerging Earth Science Technologies

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Keywords: Direct Broadcast, UAVs / Drones, Internet Of Things, Small Satellites, Big Data Analytics, Cloud Computing, Model Webs / Models as a Service, Semantic Services, Location-Based Services

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Architecture streamlines integration of new technology

- Understand / develop / adapt technologies with greatest likely impacts on disaster management
  - Not “frozen” in current practice
  - Not embracing new toys mindlessly

- Clarify what new analytical or operational capabilities become feasible
  - New Technologies may also allow (or require) changes to the architecture

- Rely on widely-adopted, consensus-based standards
  - Information semantics
  - Data formats
  - Service definitions
  - Software interfaces