GROUP ON EARTH OBSERVATIONS

GEO User Interface Committee
Status of Task US-09-01a

UIC Member Task Lead:
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UIC Co-Chair Task Lead:
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Task Coordinator:
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12th UIC Meeting • Melbourne, Australia
14-September-2009

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Task US-09-01a

Sections of Presentation

- **Brief Review of Task**
- **Status & Schedule**
- **Preliminary Results** (Disasters, Energy)

GEO Task US-09-01a:

Establish a GEO process for identifying critical Earth observation priorities common to many GEOSS societal benefit areas, involving scientific and technical experts, taking account of socio-economic factors, and building on the results of existing systems' requirements development processes.

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Task US-09-01a

Key Tenets Followed:

- Harvest information expressed in existing, publicly-available documents; avoid duplication of efforts already performed by GEO MC & PO.

- Representative of GEO MC & POs (broad geographic representation, developed/developing countries)

- Documents need to span a range of User-Types within each SBA (e.g., managers, researchers, policy makers, forecasters, others)

- Focus is on the "demand" side of Earth observations, independent of the specific sensor technology, collection method, or current availability.

Resources to Support Task

Website: http://sbageotask.larc.nasa.gov/

Email address: geo-task-us-0901@lists.nasa.gov

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Task US-09-01a

GEO UIC US-09-01a Process: Nine Steps

-The process lists the steps serially, yet some of them can be done in parallel.

Step 1: UIC Members identify Advisory Groups and Analysts for each SBA
Step 2: Determine scope of topics for the current priority-setting activity
Step 3: Identify existing documents regarding observation priorities for the SBA
Step 4: Develop analytic methods and priority-setting criteria
Step 5: Review and analyze documents for priority Earth observations needs
Step 6: Combine the information and develop a preliminary report on the priorities
Step 7: Gather feedback on the preliminary report
Step 8: Perform any additional analysis
Step 9: Complete the final report on Earth observations for the SBA

When all SBA reports are complete, the Task Lead (and others) will perform a meta-analysis on the 9 SBA reports & parameter lists. They will write an over-arching report, including a parameter list on “Earth observation priorities common to many SBAs.” The report will include lessons learned and recommendations.

GEO UIC: Progress in Task US-09-01a by SBA (as of 11-September-09)

Societal Benefit Area	Analyst	# in Advisory Group	# of Documents	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09
				Major Process Step(s) in Progess									
Agriculture	Michael Brady	11	15	2	3	4/5/6	4/5/6	4/5/6	4/5/6	4/5/6	4/5/6		
Biodiversity	Greg Susanke	8	60	3	3	3/4/5	3/4/5	3/4/5	3/4/5	3/4/5	6		
Climate	Molly Macauley	7	35	4/5	4/5	4/5/6	4/5/6	7	7	8	8		
Disasters	Stephanie Weber	13	40	4/5	4/5/6	4/5/6	4/5/6	7	7	8	8		
Ecosystems	Thomas Gulbransen	11	71	4/5	4/5	4/5/6	4/5/6	7	7	8	8		
Energy	Erica Zell	14	53	4/5/6	4/5/6	4/5/6	4/5/6	7	7	8	8		
Human Health: Aeroallergens	Hillel Koren	16	117	1/1	2	3	1 & 3	1/3/4/5	1/3/4/5	3/4/5	6		
Human Health: Air Quality	Rudy Husar & Stefan Falke	11	50	1	2	3	1 - 3	3	3	3/4/5	6		
Human Health: Infectious Disease	Pietro Ceccato	18	278	1	2	3	1/3/4	3 & 4	4/5	5/6	5/6		
Water	Sushel Unninayar	9	56	2	3/4/5	5/6/7	6/7	6/7	6/7	6/7	6/7		
Weather	Michael Nyenhuis	5	34	1 - 4	1 - 5	6	6	6	7	7	8		

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Task US-09-01a

Earth Observation Priorities (Task US-09-01a) *Documents Reviewed & ad hoc Advisory Groups Members, by SBA* *(figures as of 4-August-2009)*		
GEO Societal Benefit Area	**Advisory Group Members**	**Documents in Meta-Analysis**
Agriculture	**11**	**15**
Biodiversity	**8**	**55**
Climate	**7**	**35**
Disasters	**13**	**40**
Energy	**14**	**53**
Ecosystems	**11**	**71**
Human Health: Aeroallergens	**16**	**117**
Human Health: Air Quality	**10**	**35**
Human Health: Infectious Disease	**17**	**165**
Water	**9**	**56**
Weather	**5**	**34**
Total	***121***	***676***

Analysts and Advisory Groups include people from Australia, Austria, Canada, China, Costa Rica, Denmark, Germany, Finland, France, Ghana, India, Iran, Italy, Kenya, Japan, Mexico, Norway, Paraguay, Russia, USA, Senegal, South Africa, Thailand, Tunisia, CEOS, DIVERSITAS, ECMWF, ESA, FAO, GCOS, IEEE, UNESCO, WMO, and others. Full Analysis at Nov. 2009 UIC Meeting.

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Task US-09-01a

Major Progress Since 11th UIC Meeting (Stresa)

1. Health (Air Quality) Analyst Identified
2. Formation of Advisory Groups for each SBA completed
3. Delivery of 5 Preliminary Reports
   - Climate, Ecosystems, Energy, Disasters, Weather
4. Creation/agreement on common template for SBA reports
5. Monthly telecons with Analysts
6. Submitted proposal for special issue of IEEE JSTARS
7. The Energy Analyst had a baby

Note: Four SBAs (Climate, Energy, Disasters, Ecosystems) created a "Revised Preliminary Report" to transform their initial Preliminary Report into the new, common report template.

- *Climate, Energy, and Disasters delivered their Revised Prelim. in August*
- *Ecosystems expects to deliver its Revised Prelim. in late September*

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Task US-09-01a

Current Task Schedule

Preliminary reports from 5 SBAs (delivered)	May/June 2009
Preliminary reports from remaining 4 SBAs	Sept/Oct. 2009
Final reports from initial 5 SBAs	Sept/Oct 2009
GEO Plenary VI & 13th UIC Meeting	November 2009
- Analysts can report findings at UIC Meeting, if desired	
Final reports from remaining 4 SBAs	Dec.-Jan. 2010
Meta-analysis across all 9 SBAs & draft report	Feb.-April 2010
Final US-09-01a Task report	May 2010
- Presentations to UIC, C4, GEO Sec., others (as needed)	
Presentation to Plenary GEO VII	November 2010

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Task US-09-01a

Common Report Template/Outline

Summary

1. **Introduction**
   - GEO, GEO Task US-09-01a, Purpose of Report, Scope of Report
2. **Methodology**
   - Task Process, Analyst and Advisory Group, Methodology
3. **Societal Benefit Area**
   - SBA Description, Sub-areas, Documents, User Types
4. **Earth Observations for the SBA Sub-areas**
   - Earth Obs. by each SBA Sub-area
5. **Priority Earth Observations for the SBA**
   - Table(s) of the observations
6. **Additional Findings**
7. **Analyst's Comments and Recommendations**
   - Process and Methodology, Challenges, Recommendations

Appendix & Bibliography/References

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Task US-09-01a

Example of expected output for each SBA

GEO Task US-09-01a: Priority Earth Observations for <<<SBA Name>>> SBA							
Observation Category	Parameter	Aggregated Characteristics of Priority Observation Parameters					
		Coverage/Extent	Spatial	Temporal	Accuracy	Latency	Other

US-09-01a:
Revised Preliminary Report

Disaster Societal Benefit Area

Note: Do not cite or quote information from Revised Preliminary Reports

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Task US-09-01a – Disasters Revised Prelim.

Preliminary Report: Do NOT Cite or Quote

Method:

Used an aggregated-weighted index, based on:

- Frequency the observation category was mentioned in the documents
- Document-specific weighting factors (i.e., type of document and geographic extent, cross-cutting applicability of observation mentioned in documents)

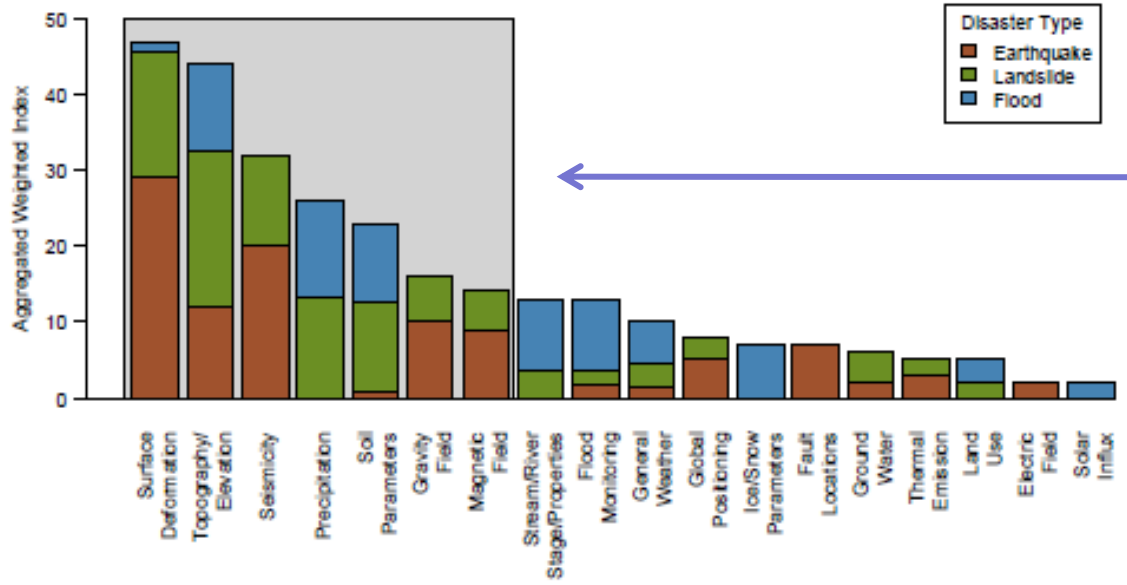

Figure 2. Aggregated weighted index value for all observation categories by disaster type.

Those parameters in the shaded area represent 75% of the total index value.

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Task US-09-01a – Disasters Revised Prelim.

Preliminary Report: Do NOT Cite or Quote

Table 8. Priority Earth

Observation Category	Parameter	Aggregated Characteristics of Priority Observation Parameters				
		Coverage/ Extent	Spatial Resolution	Temporal Resolution	Accuracy	Latency
Surface Deformation	Slip	• Seismically active areas • Along active fault lines/ near fault zones	• Moderate to High			
	Slope Movement	• Seismically active areas • Along active fault lines/ near fault zones	• 1 mm - 1 cm	• High Frequency		• Real-Time
	Strain	• Seismically active areas • Along active fault lines/ near fault zones	• 50 – 75 m	• Weekly	• Sub-cm	
	Deformation	• Seismically active areas • Along active fault lines/ near fault zones	• 1 m - 75 m	• 1 sec – 1 week • 1 month - 1 year	• sub-mm – 1 cm	
Topography/ Elevation	Elevation	• Global • Seismically Active Areas • Areas of high landslide susceptibility	• 0.15-5 m • 1 m for targeted areas • 2-5 m global	• Rapid updates after events • Monthly – 3 years	• sub-dm – 0.5m	• Months
	Bathymetry	• Near-Shore	• 90 m - < 1 km	• Monthly – 3 years		• Months
	Slope Angle, Length, Position	• Areas of high landslide susceptibility	• "High"			
	Curvature	• Areas of high landslide susceptibility	• "High"			
Seismicity	Seismicity	• National – Global Scales • Seismically Active Areas • Areas of high landslide susceptibility • Urban areas and critical facilities	• < 1 km - 2 km (urban areas) • 70 km (national scale)	• Real-Time	• Magnitudes of 1.5 - 2.0 (urban/regional) • Magnitudes of 3.0-3.5 (global)	• Real-Time
Precipitation	Precipitation Intensity, Duration, Amount	• Near potential and actual landslides • Catchment areas • Flood areas	• 1-50 km	• Continuous – Hourly • 2 times/day (satellite)	• 1 – 2 mm	• Hourly

a Blank fields indicate that no specific requirement was reported in the documents.

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Task US-09-01a – Disasters Revised Prelim.

Table 8. (Continued).

		Aggregated Characteristics of Priority Observation Parameters				
Observation Category	**Parameter**	**Coverage/ Extent**	**Spatial Resolution**	**Temporal Resolution**	**Accuracy**	**Latency**
Soil Parameters	Soil Moisture		• 100 m - 10 km	• 4 times/day - weekly		• Within 1 day
	Soil Composition and Thickness			• 5 – 10 years • More frequent in affected areas		
	Pore Pressure					
	Rock Strength, Permeability, Spacing, Orientation		• 5 m			
Gravity Fields	Gravity Fields	• Global • Along active fault lines and near fault zones	• 100 km	• Approximately Monthly	• 0.3 µGal - 1 mGal	
Magnetic Fields	Magnetic Fields	• Global • Along active fault lines and near fault zones			• Few nT	

a Blank fields indicate that no specific requirement was reported in the documents.

Preliminary Report: Do NOT Cite or Quote

US-09-01a:
Revised Preliminary Report

Energy Societal Benefit Area

Note: Energy Analyst/AG used three methods for prioritization

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Task US-09-01a – Energy Revised Prelim.

Method A

Based on a prioritization method using simple frequency analysis:

Eight Earth observation parameters were shared by numerous Renewable Energy types.

Table 8. Analysis of Parameters across All Renewable Energy Types.

Parameter Type	Parameter	RE Type: Solar	Wind	Geothermal	Hydropowe	Bioenergy	Total # of RE Types
Solar Resources	Direct normal irradiation (DNI) *	✓				✓	2
	Diffuse irradiation *	✓				✓	2
	Global horizontal irradiation (GHI) *	✓				✓	2
	Inclined plane radiation	✓					1
	Spectral distribution *	✓				✓	2
	Cloud cover (cloud index)	✓				✓	2
	Circumsolar ratio*	✓					1
Meteorological Parameters	Wind speed	✓	✓		✓	✓	4
	Wind direction	✓	✓			✓	3
	Relative humidity	✓	✓		✓	✓	4
	Air temperature	✓	✓		✓	✓	4
	Air pressure		✓		✓		2
	Surface Temperature	✓	✓		✓	✓	4
	Precipitation	✓	✓		✓	✓	4
Atmospheric Composition	Atmospheric ozone content *	✓					1
	Aerosol optical depth (AOD)*	✓					1
	Water vapor	✓					1
Land Parameters	Elevation/topography	✓	✓	✓	✓	✓	5
	Surface geology	✓			✓		2
	Land cover	✓	✓	✓	✓	✓	5
	Snow cover	✓			✓		2
	Identification of areas of heated surface water			✓			1
	Surface Displacement			✓			1
Offshore Environment	Wave height		✓				1
	Wave direction		✓				1
	Wave period		✓				1
	100-year significant wave		✓				1
	Current speed		✓				1
Vegetation, Soil, and Rock characteristics	Normalized Difference Vegetation Index (NDVI)					✓	1
	Net Primary Productivity (NPP)					✓	1
	Evapotranspiration					✓	1
	Soil Moisture					✓	1
	Rock Permeability			✓			1
Natural Hazards	Earthquakes frequency and intensity	✓					1
	Wildfire frequency and intensity	✓					1
							1
					✓		1
					✓		1
					✓		1
	Water runoff				✓		1
Geologic Properties	Groundwater storage				✓		1
	Temperature at Depth			✓			1
	Chemistry at Depth			✓			1
	Fluid pressure at Depth			✓			1

* Indicates parameters that are derived rather than measured directly. Note that some derived parameters listed here may rely upon the measured parameters also listed in this table.

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Task US-09-01a – Energy Revised Prelim.

Table 9. Parameter Characteristics of High Ranking Cross-Cutting Parameters.

Parameter	Coverage/ Extent	Temporal resolution	Spatial resolution	Timeliness	Accuracy/ Precision
Precipitation	Global	Monthly	0.25 degrees x 0.25 degrees	Ranges from unimportant, to needed in advance (forecast)	Unknown
Elevation / topography	Global to site level	One-time measurement	1 km2 to m-scale (5-10 m vertical contours)	Not important	Unknown
Wind speed	Global land surface and marine coastal zone (5-50 km offshore)	Every 10 – 30 min	<1km2 to ~20 km2 horizontal, 10-200m+ vertical	Ranges from unimportant, to needed in advance (forecast)	Within 10% of annual average wind speed, or within 0.3 m/s
Relative humidity	(Dictated by meteorological models – see Weather SBA Report)				
Air temperature	(Dictated by meteorological models – see Weather SBA Report)				
Surface temperature	(Dictated by meteorological models – see Weather SBA Report)				
Land cover	Global land surface	Unknown (depends on timescale of land	80m – 10 km	Unknown	Unknown
	surface and marine coastal zone (5-50 km offshore)	min	km2 horizontal, 10-200m+ vertical	unimportant, to needed in advance (forecast)	Within 3 degrees

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Task US-09-01a – Energy Revised Prelim.

Method B

Based on a prioritization method using IEA's projections of prominent renewable energy types for the 2006 - 2015/2030 timeframes:

The table shows the information according to the highest ranked "Renewable Energy Types" by IEA.

Within each renewable energy type, the "Top Parameters Required" are simply ranked.

Table 10. Key Parameters for Priority Renewable Energy Types.

Priority Renewable Energy Type	Top Parameters Required
Hydropower	Precipitation Reservoir/lake height Elevation Water runoff (modeled) Snow water equivalent
Onshore wind power	Wind speed Wind direction Wind shear Elevation Land cover
Bioenergy	Land cover Net primary productivity Precipitation Evapotranspiration Normalized Difference Vegetation Index (NDVI)
Offshore wind power	Wind speed Wind direction Wind shear Wave height
Solar PV and CSP	Global horizontal irradiation (GHI) Direct normal irradiation (DNI) Inclined plane radiation Air temperature Wind speed Wind direction Relative humidity
Geothermal	Water temperature at depth Water Chemistry Land Cover

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Task US-09-01a – Energy Revised Prelim.

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Method C

Based on a prioritization method using a combination of the results from the two previous methods (A & B):

Shown in 4 tiers:

1 – Parameters from Method A that are also in list of highest renewable energy type in Method A

2 – Parameters from Method A that are also in list of second highest renewable energy type in Method B

3 – Remaining parameters from Method A (which are all included in Method B)

4 – Remaining parameters from Method B not included in Method A

Table 11. Earth Observations for Energy SBA.

Tier	Parameter	Characteristics of the Observations Parameters				
		Coverage/Extent	Spatial	Temporal	Accuracy	Latency
Tier 1	Precipitation	Global	0.25 degrees x 0.25 degrees	Monthly	Unknown	Ranges from unimportant, to needed in advance (forecast)
Tier 1	Elevation / topography	Global to site level	1 km2 to m-scale (5-10 m vertical contours)	One-time measurement	Unknown	Not important
Tier 2	Wind speed	Global land surface and marine coastal zone (5-50 km offshore)	<1km2 to ~20 km2 horizontal, 10-200m+ vertical	Every 10 – 30 min	Within 10% of annual average wind speed, or within 0.3 m/s	Ranges from unimportant, to needed in advance (forecast)
Tier 2	Wind direction	Global land surface and marine coastal zone (5-50 km offshore)	<1km2 to ~20 km2 horizontal, 10-200m+ vertical	Every 10 – 30 min	Within 3 degrees	Ranges from unimportant, to needed in advance (forecast)
Tier 2	Land cover	Global land surface	80m – 10 km	Unknown (depends on timescale of land cover changes)	Unknown	Unknown

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Task US-09-01a – Energy Revised Prelim.

Method C

Based on a prioritization method using a combination of the results from the two previous methods (A & B):

Shown in 4 tiers:

1 – Parameters from Method A that are also in list of highest renewable energy type in Method A

2 – Parameters from Method A that are also in list of second highest renewable energy type in Method B

3 – Remaining parameters from Method A (which are all included in Method B)

4 – Remaining parameters from Method B not included in Method A

Table 11. (Continued).

Tier	Parameter	Characteristics of the Observations Parameters				
		Coverage/Extent	Spatial	Temporal	Accuracy	Latency
Tier 3	Relative humidity	(Dictated by meteorological models – see Weather SBA Report)				
Tier 3	Air temperature	(Dictated by meteorological models – see Weather SBA Report)				
Tier 3	Surface temperature	(Dictated by meteorological models – see Weather SBA Report)				
Tier 4	Reservoir / lake height	Unknown	350-580 m horizontal (current)	10-35 days (current)	3-10 cm RMS (current)	7-10 days (current)
Tier 4	Water runoff (modeled)	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Snow water equivalent	Unknown	7km x 7km (current)	Unknown	Unknown	Unknown
Tier 4	Wind shear	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Net primary productivity	Unknown	1 degree x 1 degree (current)	Every 8 days (current)	Unknown	Unknown
Tier 4	Evapo-transpiration	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Normalized Difference Vegetation Index (NDVI)	Unknown	Unknown	Unknown	Unknown	Unknown
	(GHI)				<< 5-20% rRMSE	Unknown

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Task US-09-01a – Energy Revised Prelim.

Method C

Based on a prioritization method using a combination of the results from the two previous methods (A & B):

Shown in 4 tiers:

1 – Parameters from Method A that are also in list of highest renewable energy type in Method A

2 – Parameters from Method A that are also in list of second highest renewable energy type in Method B

3 – Remaining parameters from Method A (which are all included in Method B)

4 – Remaining parameters from Method B not included in Method A

Table 11. (Continued).

Tier	Parameter	Characteristics of the Observations Parameters				
		Coverage/Extent	Spatial	Temporal	Accuracy	Latency
Tier 4	Direct Normal Irradiation (DNI)	Unknown	Unknown	Hourly to monthly (current)	<< 15-25% rRMSE	Unknown
Tier 4	Inclined plane radiation	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Water/fluid temperature at depth	Unknown	Unknown	Unknown	10°C-50°C (current)	Unknown
Tier 4	Fluid pressure	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Rock permeability	Unknown	Unknown	Unknown	Unknown	Unknown
Tier 4	Geologic water chemistry	Unknown	Unknown	Unknown	Unknown	Unknown

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Task US-09-01a

Current & Future States of Critical Earth Observation Priorities

Results of Gap Analysis can be shown in such a diagram.

Critical Earth Observation Priorities		Currently Available	
		Yes	No
Available in Future	Planned	Good situation	In waiting
	No Plan	Possible crisis	Major gap