GEO Task US-09-01a: 
*Earth Observations Priorities Common to Many Societal Benefit Areas*

Discussion of Task Results & Activities

US-09-01a Task Lead: 
Lawrence Friedl, USA-NASA 
User Interface Committee Member

January 2011
Objective:
Establish and conduct a process for identifying critical Earth observation priorities common to many GEO 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.

GEO Societal Benefit Areas:
- Agriculture
- Disasters
- Health
- Biodiversity
- Ecosystems
- Water
- Climate
- Energy
- Weather
GEO Task US-09-01a
Main Topics for UIC Discussion & Decision

A. Task Results and Priority Observations
   - Discussion
   - Issue: Biodiversity

B. Next Steps
   - Gap Analysis – Discussion
   - Parameter Characteristics – Discussion

C. Introduction to GEO Plenary
   - Decision: Whether or not to pursue formal acceptance
Cross-SBA Analytic Methodologies

**Method 1: Tally of All Priorities**
Frequency analysis is a simple tally of the SBAs that require a given observation. (Total of 146 observations were included in this prioritization.)

**Methods 2&3: Weighted Sums of All Priorities**
Weighted frequency analysis is a weighted sum of the number of SBAs that require a given observation, taking into account the high/medium/low importance assigned by SBA Analysts. Different weighting schemes in the two methods (Same 146 parameters as Method 1.)

**Method 4: Top 15 Priorities by SBA**
This key parameters method is based on each SBA Analyst preparing a list of the “top 15” for that SBA. (Total of 99 observations were included.)

**Final Set: Ensemble approach across the methods.**
Calculated mean rank and the range of ranks for all 146 parameters across methods. Natural breaks at top 19 and top 36 parameters.
Group on Earth Observations

Task US-09-01a

Method 1: Distribution of Observations by Number of SBAs

- 8 observations (5% of 146 total) are common to 6 or more SBAs
- 29 observations (20%) are common to 4 or more SBAs
- 100 observations (68%) are common to 2 or more SBAs

The figure shows the distribution of the 146 Earth observations by the number of SBAs that specified an observation as a priority (Method 1). 29 observations (20%) are priorities to 4 or more SBAs.
This chart presents the 30 highest-ranked Earth observations, shown according to score in the Cross-SBA analysis. The range in ranks is also shown.

Ranks are ‘inverted’ so highest score is 146.
### GEO Task US-09-01a

## Highest Ranked Observations (#1-20) and Associated SBAs

All of the 20 Highest-Ranked observations are common to 4 or more SBAs.

All of 30 Highest-Ranked observations are common to 3 or more SBAs.

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<table>
<thead>
<tr>
<th>Earth Observation Parameter</th>
<th>Agriculture</th>
<th>Climate</th>
<th>Education</th>
<th>Ecosystems</th>
<th>Energy</th>
<th>Health</th>
<th>Water</th>
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<tbody>
<tr>
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* Biodiversity SBA Team did not produce a set of Earth observations priorities.
Findings

- Precipitation Reigns the Cross-SBA Analysis
- Methods Showed Agreement at Highest-Rankings
- Priorities of a Single SBA May Not Be on the Cross-SBA List
- Task’s Approach Produced Users’ Needs in Users’ Terminology
- Articulation of Observation Needs in Documents Varied
- Regional Needs Incorporated but Not Featured
- Availability of Documents by Region Varied
- Insufficient Information across Documents on Parameter Characteristics
Recommendations

• Gather information and engage users on specific characteristics of the priority Earth observations, especially Precipitation.
• Conduct an assessment of the current and planned availability of the priority Earth observations.
• GEO and/or Regional Caucuses could consider pursuing similar assessments at regional levels.
• Consider additional analytic methods to gathering users’ needs and pursue an ensemble of approaches.
• Prescribe the prioritization methods, SBA sub-areas, and other aspects of the SBA analyses.
• Pursue broader incorporation of documents in many languages.
• Continue the use of ad hoc Advisory Groups, with refinements.
• Strongly consider a single organization to manage the individual SBA analyses.
• Articulate an SBA’s community of users to support systematic collection of users’ needs.
Task Lead’s Comments

Task’s efforts and results represent significant contributions and first steps within GEO to articulate Earth observation priorities. GEO has documented in a transparent way how Earth observation needs have been identified, involving numerous organizations and experts.

The value of the Task’s results and cross-SBA report is at least twofold:

- Provide a baseline and entry point for further engagement with end users on their needs.
- Confirm any expected priority observations as backed up by an analysis of the literature.
Issue:

Biodiversity SBA Sub-Report
Notice

Cross-SBA Report – Notice on Biodiversity

Biodiversity report is referenced in the Final Report. However, Biodiversity did not produce a set of Earth observations priorities. Thus, Cross-SBA team had no Biodiversity-specific observations to include in the Cross-SBA meta-analysis. It was assumed that the Ecosystems observations were likely similar, so Biodiversity is partly indirectly included.
Biodiversity SBA

Since Plenary, people in Biodiversity community have approached Task Lead about providing set of observation priorities.

From Michele Walters, GEO BON Executive Officer (13.jan):
“GEO BON fully intends to submit a list of priority variables. We are currently organising a workshop for 1-4 March on the observation capabilities as related to the CBD 2020 targets. ... The last day will be a closed GEO BON meeting where we were hoping to discuss the priority variables matter. ...”

Status: In discussion with M.Walters about existing report (i.e., whether to revise or start over), timeline, procedure for other SBAs to ensure some consistency & comparability, etc.

Issue: May require revision to Final Cross-SBA report

Any UIC concerns over re-issuing a Final report?
GEO Task US-09-01a

Main Topics for UIC Discussion & Decision

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Next Steps: US-09-01a Gap Analysis

Gap analysis of observation priorities relative to current and future availability.

Current & Future States of Critical Earth Observation Priorities

Results of Gap Analysis can be shown in such a diagram.
Finding #13:
GEO has not conducted a comprehensive gap analysis of either their implementation approach (structural) or observation needs (observational).

Recommendation #7:
GEO should conduct comprehensive observational and structural gap analyses as anticipated in the 10-Year Implementation Plan and Strategic Targets document.

Executive Committee Response:
EC Action 19.11 calls for process to conduct the gap analysis
US-09-01a Gap Analysis

Report Recommendation: Conduct an assessment of the current and planned availability of the priority Earth observations.

Assess Current and Planned Availability of Observations
- Up to 15 years for planned missions
- Approx. top 25 observations from report
- Initial Focus on Satellite observations
  
  Use CEOS Mission, Instruments, and Measurements” database as primary source

Parameters to Capture (Preliminary List)
- status (operational vs. planned)
- satellite name
- instrument name
- organization
- product name
- product description
- coverage
- temporal resolution
- spatial resolution
- swath width
- link to data archive (URL)
- data begin/end date
- satellite orbit type
US-09-01a Parameter Characteristics

Report Recommendation: Gather information and engage users on specific characteristics of the priority Earth observations, especially Precipitation.

Users and Applications
- Examine users and applications across SBAs as systematic way to capture breadth of needs (e.g., famine early warning, agriculture production, hydropower, flood prediction, landslides, tropical cyclones, numerical weather prediction systems, groundwater recharge).

Parameter Characteristics
- Assess the needed parameters in the breadth of applications and users to identify common loci of common parameter needs
  - e.g., some may need weekly averages at 1km resolution, some may need $1^\circ \times 1^\circ$ every hour

This activity could be repeated for a second observation of importance, such as soil moisture or land cover.
GEO Task US-09-01a

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US-09-01a Report

Decision: Introduce the report for Acceptance by Plenary

Issue:
Having introduced and distributed this at Plenary VII and as an annex to the UIC report, the document has received circulation to plenary. What is gained by re-introducing it? What is gained by formal acceptance by Plenary?

Timeline:
Introduce to Joint Committee for discussion/endorsement. Deliver to ExCom 2-3 weeks prior for their recommendation to Plenary. 2011 ExCom meetings: March 22-23, July 12-13, November

Note: No apparent precedent for handling of task reports
US-09-01a Report

Pro (Introduce it)

Formal acceptance by Plenary will give the document additional weight. With follow-on gap analysis, the formality of a Plenary acceptance allows members to reference the document, especially in relationship to data sharing principles and societal benefits. Introducing it allows us to explain the results, validity, and follow-on activities. With Biodiversity changes, timing is right.

Con (Do Not Introduce it)

Additional “weight” may not be needed. The information content is the important aspect. Whether accepted or not formally doesn’t change the information. People and organizations will likely use the information or not. MC/POs have additional documents also that they’ll be basing decisions on. Introducing it will open up all aspects of the process, which are defensible but time-consuming to explain.
Final Report and Individual SBA Reports

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

UIC Actions on US-09-01a
GEO Task US-09-01a

Action Items

CC-20. Sometime before GEO Plenary VII, M. Nyenhuis will brief WMO on the results of US-09-01a results.

CC-22. Before GEO Plenary VII, F. Pignatelli will present the US-09-01a results to the JRC committees.

CC-26. By 30 September 2010, L. Friedl will ask the UIC for a list of member countries and organizations to target the US-09-01a briefing and will prepare a briefing
Cross-SBA Analysis

Prioritization Methods
The figure shows the distribution of the 146 Earth observations by the number of SBAs that specified an observation as a priority (Method 1). 29 observations (20%) are priorities to 4 or more SBAs.
The figure shows the distribution of the 146 Earth observations by the scores of the Method 2 weighting scheme. Scores range from 1 to 24. 81 observations (55%) received scores of 4 or above.
Method 3: Distribution of Observations by Method 3 Weighting

The figure shows the distribution of the 146 Earth observations by the scores of the Method 3 weighting scheme. Scores range from 1 to 48. 109 observations (75%) received scores of 4 or above.
Method 4: Distribution of “15 Most Critical” Observations by Number of SBAs

The figure shows the distribution of the 97 observations on the “15 Most Critical” lists, according to the number of SBAs that specified an observation as a priority (Method 4). 58 observations (60%) are priorities to 2 or more SBAs.
### 20 Highest Ranked Observations and Method 1-4 Rankings

<table>
<thead>
<tr>
<th>Rank</th>
<th>Observation Parameter</th>
<th>Rank From Method</th>
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<tbody>
<tr>
<td></td>
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<td>1</td>
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<tr>
<td>1</td>
<td>Precipitation</td>
<td>1</td>
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<tr>
<td>2</td>
<td>Soil Moisture</td>
<td>1</td>
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<tr>
<td>3 (tie)</td>
<td>Surface Air Temperature</td>
<td>1</td>
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<tr>
<td>3 (tie)</td>
<td>Surface Wind Speed</td>
<td>4</td>
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<tr>
<td>5</td>
<td>Land Cover</td>
<td>6</td>
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<tr>
<td>6</td>
<td>Surface Humidity</td>
<td>4</td>
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<tr>
<td>7</td>
<td>Vegetation Cover</td>
<td>9</td>
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<td>8</td>
<td>Surface Wind Direction</td>
<td>6</td>
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<tr>
<td>9 (tie)</td>
<td>NDVI</td>
<td>9</td>
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<tr>
<td>9 (tie)</td>
<td>Sea Surface Temperature</td>
<td>9</td>
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<td>11</td>
<td>Urbanization</td>
<td>9</td>
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<td>12</td>
<td>Vegetation Type</td>
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<td>13</td>
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<td>14</td>
<td>Surface Atmospheric Pressure</td>
<td>6</td>
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<td>15 (tie)</td>
<td>Glacier/Ice Sheet Extent</td>
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<td>15 (tie)</td>
<td>Leaf Area Index</td>
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<td>18</td>
<td>Elevation</td>
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<td>19 (tie)</td>
<td>Stream/River/Flow</td>
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<tr>
<td>19 (tie)</td>
<td>Upper Level Winds</td>
<td>19</td>
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Additional Materials
US-09-01a Process: Nine Steps

The process lists the steps serially, yet some are 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

Based on the SBA reports, the Team Team performed a meta-analysis on the individual SBA reports. The team combined and prioritized parameters from the SBA lists and prepared an over-arching report to identify “Earth observation priorities common to many SBAs.” The report includes findings, lessons learned, and recommendations.
## Group on Earth Observations

### Task US-09-01a

**General structure:**

An “Advisory Group” and an “Analyst” work together to identify documents, analyze them, and prioritize observations within each SBA.

<table>
<thead>
<tr>
<th><strong>Advisory Group (1 per SBA)</strong></th>
<th><strong>Analyst (1 per SBA)</strong></th>
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<tbody>
<tr>
<td><strong>Functions:</strong></td>
<td><strong>Functions:</strong></td>
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<tr>
<td>- Will help to identify documents</td>
<td>- Will read and analyze the documents</td>
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<tr>
<td>- Comment on analytic methods and priority-setting criteria</td>
<td>- Develop an analytic method and priority-setting criteria</td>
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<tr>
<td>- Review the analysts’ findings, priorities, and reports.</td>
<td>- Conduct the meta-analysis to identify common priorities within a SBA.</td>
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Involved 6-23 people from developed and developing countries that represent experts in an SBA.

Involved Communities of Practice, former IGOS Themes, GEO Countries and Participating Organizations.

The Analyst was the primary coordinator and organizer of the activity to meet the schedules and deadlines.

Interacted with and utilized the Advisory Group to vet prioritization methods and review results and reports.
Advisory Groups

Sought broad international and regional representatives.

Involved GEO CoPs, former IGOS Themes, GEO Countries and Participating Organizations.

CEOS Participants:
Disasters: Guy SÉGUIN
Health: Murielle LAFAYE
Water: Osamu OCHIAI
Weather: Paul COUNET and
Robert HUSBAND

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<thead>
<tr>
<th>Geographic Distributions of Advisory Group Members</th>
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<tbody>
<tr>
<td>Africa</td>
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<td>Total</td>
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GEO Societal Benefit Areas
15 Most Critical:
Agriculture

Report Sub-Areas
- Famine Early Warning
- Agriculture Production
- Seasonal/Annual Agriculture Forecasting and Risk Reduction
- Aquaculture Production

Number of Documents: 54
15 Most Critical:
Biodiversity

15 Most Critical Observations

The Biodiversity SBA report did not include Earth observation priorities per se. The Biodiversity SBA Analyst did not provide the Task Team with Earth observations priorities for Method 1-3 nor a list of “15 Most Critical” observations.

Report Sub-Areas

- Species
- Ecosystem

Number of Documents: 60
Group on Earth Observations
Task US-09-01a

15 Most Critical:
Climate

Report Sub-Areas
- Atmosphere
- Oceans
- Lands
Number of Documents: 40

15 Most Critical Observations (unordered)
- Reservoir/Lake Level and Surface Temperature
- River Discharge
- Precipitation
- Aerosol Properties
- Sea Surface Temperature
- Land Cover Type
- Soil Moisture
- Sea Level
- Sea Ice
- Snow Cover Area
- Glacier/ice Cap Area Maps
- Glacier/ice Cap Elevation
- Water Use
- Groundwater
- Surface Radiation Budget
15 Most Critical: Disasters

Report Sub-Areas
- Earthquakes
- Landslides
- Floods
- Tropical Cyclones
- Wildfires
- Volcanic Eruptions

Number of Documents: 40
15 Most Critical:
Ecosystems
15 Most Critical: Energy

Report Sub-Areas
- Solar Energy
- Wind Energy (land-based)
- Wind Energy (offshore)
- Hydropower
- Bioenergy
- Geothermal Energy

Number of Documents: 54
### 15 Most Critical: Health

**Report Sub-Areas**
- Aeroallergens
- Air Quality
- Infectious Diseases

**Number of Documents:** 1093

**15 Most Critical Observations (unordered)**
- Population Density
- Precipitation
- Air temperature
- Humidity
- Land Use/Land Cover
- Vegetation
- Water Bodies
- Sea Surface Temperature
- Wind
- Sea Surface Height
- Topography
- Vector population
- Atmospheric Particulates
- Biodiversity
- Atmospheric Trace Gases
15 Most Critical: Water

### Report Sub-Areas
- Surface Waters
- Ground Waters
- Forcings
- Water Quality & Water Use

Number of Documents: 200

### 15 Most Critical Observations* (unordered)
- Precipitation (liquid, solid and mixed phase).
- Soil Moisture: Surface/Sub-Surface
- Soil Temperature: Surface/Sub-Surface
- Evaporation-Lakes and Wetlands
- Evapotranspiration - From Land Surface.
- Runoff/Stream Flow.
- River Discharge (To Ocean Coastal Zones/Estuaries)
- Glaciers & Ice Sheets (Extent/Depth)
- Aquifer Volumetric, & Change
- Land Cover – Vegetation Cover/Type
- Elevation/Topography
- Water Quality – Large Water Bodies, Major Rivers, Estuaries
- Lakes/Reservoirs Levels (Including Other Surface Storages)
- Snow: Cover/Depth/Type, Snow Water Equivalent
- Ground Water Recharge/Discharge Rates
15 Most Critical: Weather

Report Sub Areas

- Global Numerical Weather Prediction
- Regional Numerical Weather Prediction
- Synoptic Meteorology
- Nowcasting and Very Short Range Forecasting
- Seasonal and Inter-annual Forecasts
- Aeronautical Meteorology
- Atmospheric Chemistry
- Ocean Applications
- Agricultural Meteorology
- Hydrology

Number of Documents: 25

15 Most Critical Observations (unordered)

- 3D Humidity Field
- 3D temperature field
- Cloud Cover
- Cloud Water/Ice Amounts (3D distribution)
- Land Surface (skin) Temperature
- Ozone
- Precipitation
- Sea Surface Temperature
- Soil Moisture
- Surface Air Humidity
- Surface Air Temperature
- Surface Pressure (over land)
- Surface Wind
- Vegetation Cover
- Wind (3D) - vertical and horizontal components