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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

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SATELLITE DATA ACCESS: REGIONAL REQUIREMENTS

Procedure for Defining / Maintaining Regional Requirements for Satellite Data

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Summary and Purpose of Document

Formulating precise requirements for satellite data and product access is one of the important steps foreseen in the Integrated Global Data Dissemination Strategy (IGDDS) Implementation Plan. This exercise is to be conducted at the regional level, since the needs and the capabilities are heavily depending on the technological and meteorological context, which vary considerably from one region to another.

This issue has been addressed for RA I, RA III and RA IV. Several steps are necessary to complete a set of Data Requirements for the Region.

It is desirable to adopt a standard procedure in order to build on the best practices, and ensure appropriate governance by the CBS and recognition by the data providing organizations. This document takes into account the positive experiences and lessons learnt from RA I, III and IV and proposes steps for the development and updating of satellite Data Requirements at the regional level.

ACTION PROPOSED

The sixth session is invited to:

a) Consider the proposed steps to develop and update satellite Data Requirements at the regional level;
b) Review and comment as appropriate;
c) Consider application of this approach for other regions.

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Appendix: A. Critical Earth Observations Priorities - Executive summary.

Procedure for Defining / Maintaining Regional Requirements for Satellite Data Access

Introduction

The development of a regional set of data requirements is a process that involves different levels of participants downstream and upstream of space-based observation. It implies interactions between data providers, the producers of products, the responsible for data delivery, the data users in interaction with the stakeholders and end users.

This complex interaction among different levels can best be accomplished if the process is coordinated within the WMO framework and a clear road map is defined, based on the experience acquired in regions where this process has been initiated already. Based on experiences and lessons learnt from such pilot initiatives, this document proposes a standard procedure to develop a representative set of regional data requirements and to update it on a regular basis.

The scope of this exercise is to review the needs of NMHSs for satellite observation data and derived products in order to enable the NMHSs to fulfill their national or international role in support of protection of life and property and other socio-economic benefits. The needs depend on the climatological context and the regional socio-economic priorities, but the feasibility of the requirements also depends on the available satellite information sources, the telecommunication infrastucture and the capabilities of the NMHS itself. Therefore the requirements should best be formulated at the regional level, and regularly reviewed to adapt to evolving needs and capabilities.

Standard Procedure to Prepare a Representative Regional Data Requirement

1) A Satellite Data Requirements Task Team is established by the Secretary General of WMO, and placed under the leadership of a space based applications specialist in the region (e.g. ET-SUP Member, CoE representative). Participants in the Task Team are nominated by Permanent Representatives upon proposal by WMO. Draft Terms of Reference of the Task Team are defined by the WMO Secretariat following a common template, which defines the scope, purpose, duration, methodology and reporting scheme of the Task team.It is understood that the Task team Members should – collectively – strive to represent the interest of the whole region including WMO Members who have no direct representatative in the Task team.

2) WMO Space Program provides a template for identifying requirements, as well as the data requirements already elaborated in others regions as a matter of example. Ultimately, the document should include: Product Name, Data characteristics (e.g., spatial resolution, accuracy, spectral range, length of record), Format, Geographical area, Frequency, Format expected in the Future, Final Size (compressed), Basic Application, Priority, Timeliness (min), Required data rate (kb/s).

3) The purpose being to adapt the content of existing dissemination mechanisms, or to propose new ones, the first step is to identify the data already available through the existing services (GTS, Internet, bilateral FTP transmission, Direct Readout, multi-mission broadcast services such as Geonetcast, etc.). In each category of product, the Task team shall flag which requirements are not adequately met by existing services, and recommend either adding a service (e.g. new product on DVB-S service) or moving a product from one service to another (e.g. Internet product to be put in LRIT) or assigning lower priority to an existing product (or removing it if obsolete).

4) The Data Requirements should be prioritized, in consistency with the achievable data rates of the relevant services..

5) The Task Team with help of WMO Space Programme Secretariat and data providers, will

gather information on existing products and related inventories, as for example the North America-Europe Data Exchange (NAEDEX) requirements and the Asia-Pacific Satellite Data Exchange and Utilization (APSDEU) requirements. the WMO Product Access Guide and space agencies' catalogues.

6) This process should consider both operational and non-operational satellite data, especially data recorded from research measurement capabilities.

7) As a source for identifying regional needs, the Task team should take into account: the outcome of the WMO surveys on availability and use of satellite data, the input from regional Centres of Excellence; the personal experience of the Task Team Members; global requirements registered in the WMO RRR database (including community-based requirements by GCOS and in the IGOS theme reports); the highest ranked Earth Observation priorities identified by the Group on Earth Observation (GEO) for the various Societal Benefit Areas (SBA) supported by NMHSs (See Appendix A); other sources.

8) The Task Team shall prepare a web page with the different versions of the data requirements to support its discussion and facilitate consultation and feedback from the regional user community. This web page should be hosted in or linked to the "Regional Activties" pages of the Space Programme web site.

9) The Task Team leader is responsible to stimulate the discussion, update the preliminary list and prepare a first draft after 4 months.

10) WMO to organize a meeting, in the region, with WMO participants, the Task Team and data producers, data delivering organizations, and specialists in the use of satellite data. This meeting will review the draft list and add recommendations to the various parties concerned. The recommendations may for instance call for organizations to contribute to ensure sustainability or upgrade of particular distribution services.

11) The first version of the Data Requirement shall be finalized after no more than three months by consensus among the Task Team Members, the WMO Secretariat and the data providers.

12) Based on this agreed set of requirements, data providers will strive to accommodate the new Data Requirements in the operational dissemination procedure. This phase requires active collaboration between the users and data providers in order to test the operational procedures to deliver and use the data in the list.

13) A coordination group, including at least the data providers and a representative of users should be nominated. The coordination group should have a monthly telecon to discuss the operational issues, use of the data, and to update the list.

14) Reports shall be provided to the relevant Regional Association bodies and to the CBS.

Standard Procedure to Maintain the Regional Data Requirement

1) In a routine phase, the composition of the Task Team will be replaced by a smaller Requirements coordination group.

2) The Requirements coordination group should keep the requirements under review in order to improve data delivery. For example, include flags for data quality, create metadata pertinent to each product, study new data available, and include documentation for each data/product.

3) The requirements coordination group should encourage satellite data providers and users to conduct research to improve data quality, on the aspects identified as critical by the regional user community.

4) The coordination group should be in charge of a newsletter, presenting new information, good examples of data used, best practices etc.

5) WMO SP should (maintain) an up to date list of data providers and products to the region. (see ET-SUP-6/Doc. 14.1 (Product Access Guide))

6) The coordination group should contribute to the biannual questionnaire to gather information about the use of data, new data requirements and have suggestion to improve the system.

7) After the compilation of the information from the questionnaire, the coordination group should decide on updating the Data Requirement and supporting information.

Appendix A: Critical Earth Observation Priorities – Executive Summary

Reference:

Group on Earth Observations. Task US-09-01a: Critical Earth Observation Priorities. 2010. Available at <http://sbageotask.larc.nasa.gov>.

Executive Summary

The Group on Earth Observations (GEO) is an intergovernmental organization working to improve the availability, access, and use of Earth observations to benefit society. GEO focuses on Earth observations for 9 areas of societal benefit (SBA): Agriculture, Biodiversity, Climate, Disasters, Ecosystems, Energy, Health, Water, and Weather.

An activity under GEO, known as Task US-09-01a, examined users' needs for Earth observations. The specific objective of Task US-09-01a was to establish and conduct a process to identify critical Earth observation priorities common to many of the GEO SBAs.

The Task Team approached the activity in two major phases. First, the team identified critical, priority observations for each SBA. Subsequently, the team conducted a meta-analysis across the individual SBA results, combining and prioritizing observations common to many SBAs. The GEO User Interface Committee provided oversight on Task US-09-01a.

The Task Team harvested information on observation needs expressed in existing, publicly-available documents, such as international reports, workshop summaries, conference proceedings, and national- and regional-level reports. The team made concerted efforts to ensure international breadth in the documents, including materials and needs across geographic regions and representation from developing countries. In all, the Task Team assessed over 1,700 documents that contained relevant information on Earth observations for this task.

The task addressed all observation needs articulated in the documents – ground, airborne, in situ, and space-based observations. The task included observed and derived observation parameters as well as modeled products. The task focused on the "demand" side of Earth observation needs – the observations desired and needed by users, independent of current availability or the specific sensor technology involved with producing them. Thus, the task sought to identify Earth observation needs across a full spectrum of user types associated with each SBA, such as resource managers, scientific researchers, and policy makers.

SBA Advisory Groups and Analysts

For each SBA, an Analyst and an ad hoc Advisory Group conducted a 9-step process to identify priority observations and produce a report. The Analysts served as the main coordinators for the individual SBA activities, and the respective Advisory Groups aided in identifying documents, critiquing analytic methods, reviewing priority-setting criteria, assessing results, and reviewing reports.

The Advisory Groups consisted of 6 to 23 members for each SBA. The members were technical, scientific, management, or policy experts in their fields. Across all of the SBAs, 167 experts from 43 countries participated in the Advisory Groups. The members were from all geographic regions and from developed and developing countries. The Task Team encouraged participation by the GEO Communities of Practice and former IGOS Themes in the Advisory Groups. The Advisory Groups included representatives from 31 GEO Member Countries and 14 Participating Organizations.

Geographic Distribution of Advisory Group Members

Region	# of Advisory Group Members
Africa	19
Asia & Middle East	17
East Asia	7
Europe	28
North America	45
Oceania/Australia	14
South/Central America	14
International*	23
TOTAL	**167**

*Representing international organizations or multiple geographic regions

Sub-Areas Addressed in Each SBA

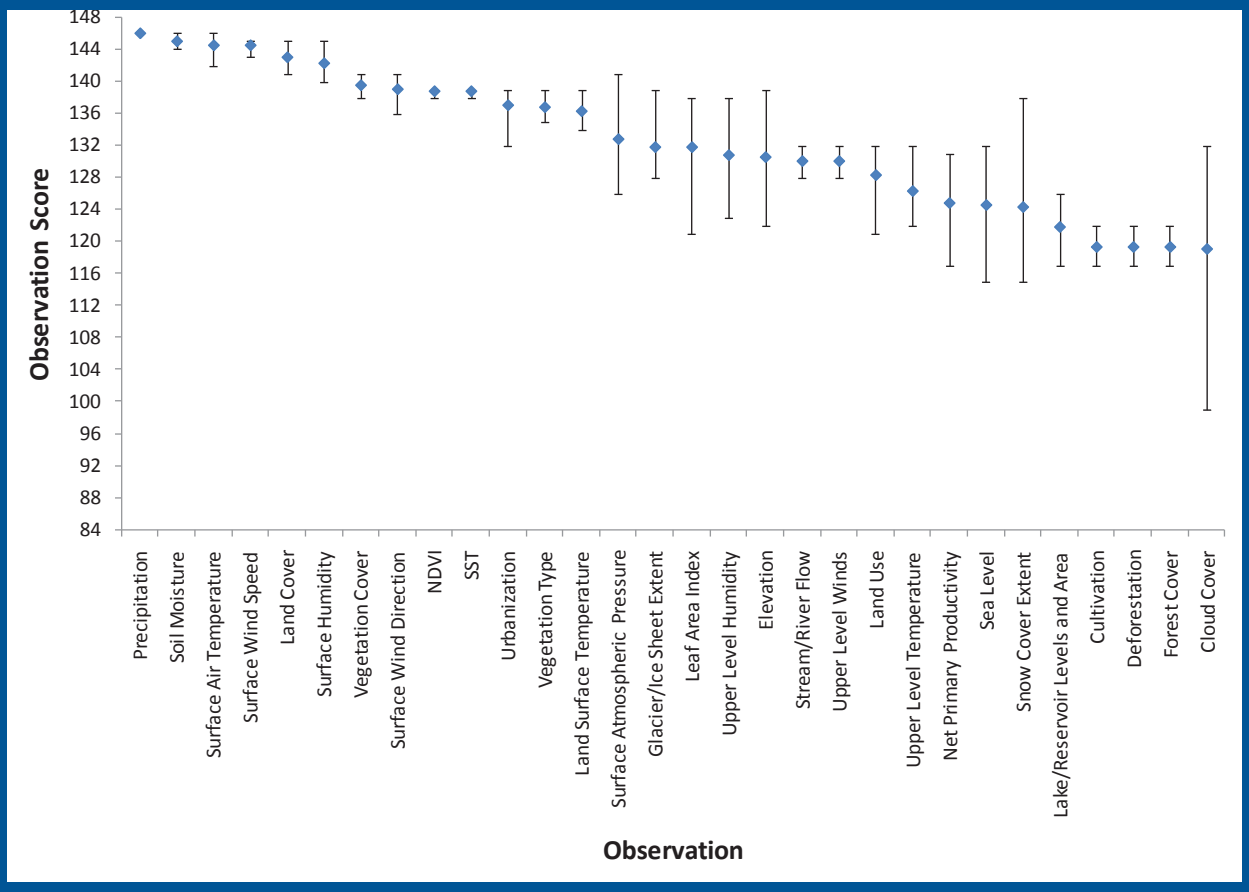
SBA	Sub-Areas of Focus	Examples of Priority Earth Observations
Agriculture	Famine Early Warning Agriculture Production Seasonal/Annual Agriculture Forecasting and Risk Reduction Aquaculture Production	• Vegetation Indices • Crop Area • Land Cover
	Forests Sub-Report: Timber, Fuel, and Fiber Management Forest Perturbations and Protection Carbon and Biomass	• Afforestation/Deforestation • Degradation • Active Fires
Biodiversity	Species Level Ecosystem Level	(The Biodiversity SBA report did not provide priority observations.)
Climate	Atmosphere Ocean Lands	• Lakes/Reservoir Levels • Sea Surface Temperature • Precipitation
Disasters	Earthquakes Floods Landslides Tropical Cyclones Volcanic Eruptions Wildfires	• Elevation • Surface Deformation • Wind Properties
Ecosystems	Coastal and Near-Shore Marine Systems Forests Inland/Fresh Water Oceanic Islands and Archipelagos Tundra Watersheds	• Permafrost Conditions and Dynamics • Vegetation Cover • Soil Carbon
Energy	Hydropower Wind power Bioenergy (Including Transportation Biofuels) Solar Power Geothermal Power	• Water Run-off • Wind Speed • GHI
Health	Aeroallergens Air Quality Infectious Diseases	• Population Density • Precipitation • Air Temperature
Water	Surface Waters Sub-Surface Waters Forcings (on the Terrestrial Waters) Water Quality/Water Use	• Precipitation • Soil Moisture • Evaporation
Weather	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	• 3D Humidity Field • 3D Temperature Field • Cloud Cover

Individual SBA Analyses

The Analysts and Advisory Groups determined the scope of their respective SBA analysis, especially the sub-areas to address. They referred to the GEO 10-Year Implementation Plan for a description and summary of topics within each SBA. This table above lists the sub-areas addressed in each SBA and provides examples of priority observations for each SBA. The Analysts developed prioritization methods and criteria, in coordination with their respective Advisory Group. The prioritization methods involved a combination of quantitative and qualitative approaches, such as bibliometric analysis, weighted frequency analysis, and cross-cutting applicability within the SBA. Some Analysts incorporated SBA-specific metrics into their criteria.

The number of critical Earth observations for each SBA averaged 43 and ranged from 15 to 77. The Task Team allowed the number per SBA to vary to allow for the inherent differences in users' needs among the SBAs. The Task Team also collected each SBA's "15 Most Critical" observations. (Note: The Biodiversity SBA did not produce a list of priority Earth observations. Thus, the meta-analysis across the SBAs involved observations from only 8 SBAs.) The combination of the individual SBA observation priorities produced a set of 146 unique observations. The combination of the SBAs' "15 Most Critical" observations lists produced a set of 97 unique observations.

30 Highest-Ranked Earth Observations by Cross-SBA Score



This chart presents the 30 highest-ranked Earth observations, shown according to score in the Cross-SBA analysis; the score is the mean of the ranks from the four methods. The chart indicates the variability of rankings across the four methods. For this chart, the ranks are 'inverted' so the highest score is 146.

Cross-SBA Analysis: Ensemble of 4 Prioritization Methods

The Task Team conducted a meta-analysis across the results of the individual SBAs and the set of 146 observations, using a statistically robust technique for the Cross-SBA analysis. The Cross-SBA technique involved an ensemble of 4 prioritization methods to rank the Earth observation priorities. The results of the 4 prioritization methods are as follows:

Cross-SBA Method 1. Method 1 ranked the 146 observations according to the number of SBAs that specified an individual observation as a priority. By this method, 100 of the 146 (68%) are common to 2 or more SBAs; 29 observations (20%) are common to 4 or more SBAs; and, 8 observations (5%) are common to 6 SBAs or more. The highest-ranked observation parameters in Method 1 are Precipitation, Soil Moisture, and Surface Air Temperature, which are critical priorities to all 8 SBAs included in the Cross-SBA analysis. Surface Humidity and Surface Wind Speed are critical priorities to 7 SBAs.

Cross-SBA Method 2. Method 2 ranked the 146 observations according to a weighted tally of the number of SBAs that specified a given observation as a priority, taking into account the observation's relative importance in that SBA. The respective SBA Analyst assigned a designation of High, Medium, or Low to each observation; these designations corresponded to numerical weightings of 3, 2, and 1, respectively, for the purpose of ranking. Total scores could range from 1 to 24. By this method, 12 observation parameters (8% of 146) received a score of 12 or above. Precipitation is the highest-ranked observation parameter in Method 2; it received the highest possible score of 24. The next 3 highest-ranked observation parameters – Surface Air Temperature, Soil Moisture, and Surface Wind Speed – received a score of 18.

Cross-SBA Method 3. Method 3 ranked the 146 observations according to a weighted tally of the number of SBAs that specify a given observation as a priority, giving extra weight to observations of High priority. The respective SBA Analyst assigned a designation of High, Medium, or Low to each observation; these designations corresponded to numerical weightings of 6, 3, and 1 respectively. Total scores could range from 1 to 48. By this method, 10 observations (7% of 146) received a score of 24 or above. Precipitation was the highest-ranked observation parameter; it received the highest possible score of 48. The next 4 highest-ranked observation parameters – Surface Wind Speed, Land Cover, Soil Moisture, and Surface Air Temperature – received scores of 31-33.

Cross-SBA Method 4. Method 4 focused on the 97 observations from the combined SBA "15 Most Critical" observations lists, ranking them according to the number of SBAs that specified an individual observation. Effectively, this method standardized each SBA's contribution in the prioritization. By this method, 58 of the 97 observations (60%) are critical priorities to 2 or more SBAs; 15 observations (15%) are common to 4 SBAs or more; and, 6 observations (6%) are common to 6 or more SBAs. The highest-ranked observation parameter is Precipitation, which is on the "15 Most Critical" observations lists for all 8 SBAs included in the Cross-SBA analysis. Surface Air Temperature, Surface Humidity, Surface Wind Speed, Soil Moisture, and Land Cover are on the "15 Most Critical" observations lists for 6 SBAs.

Critical Earth Observation Priorities Common to Many SBAs

The ensemble approach produced a mean score for each observation parameter and a corresponding range of rankings, which accounts for the variability in ranks from the 4 methods. The Task Team ordered the final set of Earth observations based on these scores and the variability, producing an overall ranking of the 146 critical Earth observation parameters.

The chart on the facing page shows the scores and associated variability of the 30 highest-ranked Earth observations from the ensemble technique. In general, the observation parameters with the highest rankings reflect lower variability among the ensemble methods than observations of lower rank. This result suggests that there was general agreement among Methods 1-4 as to the highest-ranked observation priorities, which include Precipitation, Soil Moisture, Surface Air Temperature, Surface Wind Speed, and Land Cover.

25 Highest-Ranked Earth Observations and Associated SBAs

Earth Observation Parameter	GEO Societal Benefits Areas*							
	Agriculture	Climate	Disasters	Ecosystems	Energy	Health	Water	Weather
Precipitation	■	■	■	■	■	■	■	■
Soil Moisture	■	■	■	■	■	■	■	■
Surface Air Temperature	■	■	■	■	■	■	■	■
Surface Wind Speed	■		■	■	■	■	■	■
Land Cover	■	■		■	■	■	■	
Surface Humidity	■		■	■	■	■	■	■
Vegetation Cover	■			■		■	■	■
Surface Wind Direction	■		■	■		■	■	■
Normalized Difference Vegetation Index	■			■	■	■	■	
Sea Surface Temperature		■	■	■		■		■
Urbanization	■			■	■	■	■	
Vegetation Type	■			■		■	■	■
Land Surface Temperature	■		■		■		■	■
Surface Atmospheric Pressure	■	■	■	■			■	■
Leaf Area Index	■			■		■	■	■
Glacier/Ice Sheet Extent		■		■		■	■	
Upper Level Humidity	■	■	■	■				■
Elevation			■	■	■	■	■	
River Flow Observations		■	■	■			■	
Upper Level Winds	■		■	■				■
Land Use	■			■		■	■	
Upper Level Temperature	■		■	■				■
Net Primary Productivity	■			■	■			
Sea Level		■	■	■		■		
Snow Cover Extent		■	■	■			■	■

*The Biodiversity SBA did not produce a list of priority Earth observations. Thus, the Cross-SBA analysis involved observations from only 8 SBAs.

■ the observation was included in the SBA's set of priorities

■ the observation was not included in the SBA's set of priorities

This table presents the 25 highest-ranked Earth observations, listed according to the score in the Cross-SBA analysis. The table indicates the corresponding SBAs that identified the observation as a priority in Method 1. This table conveys both the priority and commonality of the observations to many SBAs.

The Task Team used the results of the Cross-SBA ensemble approach to assess the specific SBAs that considered each observation a priority. The table on the previous page presents the 25 highest-ranked observations, conveying both the priority and commonality of the observations to many SBAs. In the final list of critical Earth observations from the Cross-SBA list, 50 observations are common to 3 or more SBAs. Task US-09-01a focused on the commonality of priority observations to many SBAs. Thus, some observations of critical importance to an individual SBA may not appear in the final Cross-SBA list of observations. The results do not imply an objective importance of any individual observation but rather a reflection of the commonality in need across SBAs.

Use of the Results

These results and overall list of priority Earth observations can support numerous activities within GEO. Possible activities include: An assessment of the availability of data from these observations – both current and planned; a review of the observations in the GEO 10-Year Implementation Plan; and, an assessment of the availability of the observations in GEOSS registries. Overall, the results can support GEO members' efforts to determine investment opportunities to serve users.

Findings

The task and the results represent a significant undertaking to analyze priority observation needs across all the SBAs, involving numerous organizations and experts. The results of the Cross-SBA analysis and individual SBAs provide a baseline for further engagement with users on their needs, especially as new needs develop and users' priorities evolve.

Precipitation Reigned the Cross-SBA Analysis
Precipitation was the highest-ranked observation; specific precipitation observation needs vary across the SBAs.

Methods Showed Agreement at Highest-Rankings
Observations with the highest mean scores generally reflect lower variability than those of lower rank.

Task's Approach Produced Users' Needs in Users' Terminology
The user-based approach generated a rich array of observations needs, though needs were often expressed as phenomena of interest rather than technical specifications.

Availability of Documents by Region Varied
Some regions were better represented than others in documents identified and reviewed, despite all the efforts to ensure international breadth.

Task's Approach Achieved Desired Diversity in Prioritization Methods in the SBAs
The task generated a variety of analytic methods and priority-setting criteria across the SBAs.

Variety in Analysts' Approaches Introduced Complexities
Analysts varied in the ways they reported their SBA's priorities, presenting challenges the Task Team had to address prior to the Cross-SBA analysis.

Advisory Groups Played Valuable Yet Variable Roles
Advisory Groups were very important for reviewing methods, criteria, and results. However, Advisory Group members varied considerably in their level of involvement and commitment.

Recommendations

The following is a sub-set of the recommendations from the US-09-01a Task Team. The recommendations address activities to pursue based on the results and refinements to the process used to identify Earth observation priorities.

Gather information and engage users on specific observation parameter characteristics for the priority Earth observations, especially Precipitation
The results can support engagement, especially by the UIC, with users across relevant SBAs to gather information on observation parameter characteristics and specific uses of the priority observations.

Conduct an assessment of the current and planned availability of the priority Earth observations
A follow-on analysis of the current and planned availability can highlight key gaps where users' needs are under-served and opportunities to enhance societal benefits.

Consider additional analytic methods to gathering users' needs and pursue an ensemble of approaches
Additional, valid approaches for assessing users' needs and establishing priorities can build on and enhance the document-based approach used in the task.

Prescribe the prioritization methods, SBA sub-areas, and other aspects of the SBA analyses
Specifying the methods, sub-areas, and required deliverables can promote enhanced consistency and augment the Cross-SBA analysis.

Continue the use of ad hoc Advisory Groups, with refinements
Efforts to improve communications and participation of the Advisory Group members can enhance their commitment, involvement, and valuable contributions.