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Annex: Responses to the AIP-3 Call for Participation

Acronyms
Summary of the Third Phase of the GEOSS Architecture Implementation Pilot (AIP-3)

1. Introduction

The GEOSS Architecture Implementation Pilot develops and pilots new process and infrastructure components for the GCI and the broader GEOSS architecture through an evolutionary development process consisting of a set of phases. Each phase addresses a set of SBA and geoinformatic topics. The result of an AIP development phase is a milestone that allows GEO to examine (1) the elements of the architecture that have advanced to sufficient maturity to be considered part of the mature system baseline, and (2) the elements of the architecture that need to be enhanced or added to better meet the goals of GEO.

AIP conducts this development based on the vision defined in the GEOSS 10-year Plan. A main element of the AIP approach is to develop architecture progress based on

“Fostering interoperability arrangements and common practices for GEOSS”

The major milestones of the third AIP phase (AIP-3) are listed in Table 1. Each phase consists of architecture refinements based on interactions with users; component interoperability testing; and SBA-driven demonstrations. The results of AIP-3 are summarized in this document with substantial detail provided in a set of Engineering Reports, and captured in a series of videos.

<table>
<thead>
<tr>
<th>Table 1 - Major Milestones of AIP-3</th>
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<td>Call for Participation</td>
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<tr>
<td>Kickoff Workshop at ESA</td>
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<td>Ministerial Summit, Beijing</td>
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<tr>
<td>All Activities Complete</td>
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Statistics about AIP-3 Results

- **Responses to a Call for Participation** were received from 36 groups. As each response included multiple organizations, the responses contain contributions from over 100 organizations. (See the Annex)

- **Working Groups** were formed at the Kickoff Workshop for six SBA areas and four geoinformatic areas.

- The AIP Task coordinates with multiple other GEO Tasks both for Societal Benefit Areas and for cross-cutting technologies.

- **Distributed development** was coordinated in weekly telecons/webex of the AIP plenary, telecons/webex of the Working Groups, and several online web-based collaboration tools.

- **Interoperability Testing** of deployed components for SBA and technical areas was conducted over several months with results including screen captures recorded in 10 demonstrations (http://www.ogcnetwork.net/pub/ogcnetwork/GEOSS/AIP3/pages/Demo.html)

- **Engineering Reports** were written for 10 Areas. Summaries of the AIP-3 Engineering Report are provided in Section 2

- **The GEOSS Best Practice Wiki** contains results from the AIP-3 Working Groups: wiki.ieee-earth.org/Best_Practices/GEOSS_Transverse_Areas/Data_and_Architecture/GEOSS_Architecture

- A video showing **GEOSS Architecture Progress** was prepared for and displayed at the Beijing Ministerial Summit: http://www.ogcnetwork.net/geoss/aip-3/

**Acknowledgments**

This AIP-3 Summary ER provides a high level overview of the efforts of scores of GEOSS Members and Participating Organizations. Hundreds of individuals from those organizations have contributed to the development of the GEOSS Architecture Implementation Pilot. Our collective contributions are making it possible to create and use GEOSS.

This report was written by George Percivall and Nadine Alameh from The Open Geospatial Consortium (OGC) with contributions from the AIP-3 Working Group leaders.
2. Results of AIP-3

The major outcomes of AIP-3 were documented in:

- A set of Engineering Reports (ERs), summarized in Section 2.1 (for the SBA ERs) and Section 2.2 (for the geoinformatics ERs), capturing the requirements, design and implementation conducted in AIP-3.
- A set of videos, referenced in Section 2.3, highlighting the architecture progress, as presented at the Ministerial Summit in November 2010.

2.1 Societal Benefit Areas Results

2.1.1 Energy Results

The AIP-3 Energy scenario intends to provide spatial information on the life cycle environmental impacts of the production of photovoltaic electricity. As the production of energy is a major contributor to Greenhouse Gases (GHG) emissions, decision makers and policy planners need a better knowledge of the impacts on environment induced by the various technologies used for energy production, in order to select the most appropriate technologies. The scenario focuses on the assessment of such impacts for photovoltaic systems by a proper exploitation of data available within GEOSS.

During AIP-3, an extended set of web services related to Energy and Environment Impact Assessment has been made available as OGC Web Services and integrated with the webservice-energy Community Portal. A new OGC Catalog Service for the Web provided in the framework of the FP7 EnerGEO project has been deployed and registered in the GEOSS Registry. Rich Web Clients for geodata visualization and data retrieval allowing end-users to visualize environmental impacts parameters have also been implemented based on the FP7 GENESIS project solution.

- Point of Contact Editor: Lionel Menard, MINES ParisTech
- Contributing Editors: Isabelle Blanc, Didier Beloin- Saint-Pierre, Roland Hischier, Steven Smolders, Marc Gilles, Simone Gianfranceschi, Manfred Mittlboeck, Bernhard Vockner

2.1.2 Disaster Management Results

The AIP-3 Disaster Management Scenario describes a Reference Scenario to respond to any type of disaster. The reference scenario took into account the Thematic Product production process, the three phases of Crisis management (Early Warning, Activation and Post Crisis), and the critical role of a Coordinator actor to coordinate efforts between data processors, data providers and map producers.

An implementation of this Reference Scenario for the specific case of the flooding disaster management has been deployed by GIS.FCU integrating GEOSS standard components and services to supply the near- real-time dispatching for emergency vehicle during the response phase. The implementation involves the deployment of several services including a Historical
Typhoon Path Web Service, a Web Feature Service for potential flooding areas and a Web Processing Service shortest path calculations.

- Point of Contact Editor: Arnaud Cauchy, SPOT IMAGE
- Contributing Editors: Lan-Kun (Peter) Chung, Pi-Hui (Pinky) Huang, Hui-Ju (Fion) Tsai, Chia-Hao (Sky) Chen

### 2.1.3 E-Habitat Results

The AIP-3 E-Habitat Use Scenario focuses on climate change impacts on protected areas, and is based on the e-Habitat model currently used in the context of DOPA (Digital Observatory for Protected Areas) – a biodiversity information system currently developed as a set of interoperable web services. The scenario integrates the e-Habitat framework with the semantic enabled broker framework of EuroGEOSS infrastructure. This integration enables the leveraging of information coming from other domains (agriculture, drought, etc) into the habitat computation.

A multitude of GEOSS standard components were used to support this scenario, including the GEO Portal, the EuroGEOSS/GENESIS Client application, the EuroGEOSS Discovery Augmentation Component Service, the EuroGEOSS Discovery Broker Service, the GENESIS SKOS Repository, e-Habitat WPS service and client, and a workflow engine.

- Point of Contact Editors: Stefano Nativi & Mattia Santoro, CNR
- Contributing Editors: Gregoire Dubois, Jon Skoien, J. de Jesus, Bertrand De Longueville, Cristiano Fugazza

### 2.1.4 Arctic SDI Results

The AIP-3 Arctic Climate and Weather Forecast Model Visualization Scenario demonstrated publishing, discovery, and visualization of weather and climate data through GEOSS, highlighted value of geospatial standards common to Spatial Data Infrastructures as layers of interest to a conceptual Arctic SDI, and supported end-user desktop visualization of complex climate and weather models for decision support in the Arctic region. The support for the visualization of the data in KML viewers and globes was achieved through applying an OGC KML wrapper around data. The means to visualize and discover data in a globe viewer is especially valuable in polar regions where there’s systematic distortion of the landscape in more traditional cylindrical projections that conform at lower latitudes.

3 standards-based components were deployed and registered in GEOSS as part of this activity: a current weather forecast WMS and WCS (UCAR), a KML wrapper for wrapping the IPCC long-term model WMS services (GMU), and a station climatology KML from NOAA NCDC data (KML). Lessons learned on the experiences of deploying and registering those components as well as using the GCI are documented in the ER.

- Point of Contact Editor: Douglas D. Nebert, USGS/FGDC
- Contributing Editors: Yuqi Bai, Xuanang Cheng, Ben Domenico
2.1.5 Water Drought Results

The AIP-3 Water Drought ER focuses on the documentation of the GEO drought monitoring service, that was launched through AIP-3, to meet the GEO drought tasks, along with the European Drought Observatory implementation of advanced semantic search capability through the EuroGEOSS Discovery Broker tools. A key deliverable is the specification of a set of tools that provide access to information published through a distributed water data infrastructure.

The report first explains why certain portal IT capabilities (“user requirements”) were selected for implementation and deployment within the global drought monitoring service. Capabilities selected include a drill-down capability, a global top-down vs. bottom-up design, incorporation of soil moisture, packaging of information in a user-friendly manner and the need for advanced search and discovery capabilities. The same ontology-enabled infrastructure performing advanced search and discovery permits easy access and display of the multi-disciplinary information within GEOSS, including linkage of drought maps to drought impacts within agriculture, biodiversity, disaster, health, and the other SBAs, thereby meeting the multidisciplinary mission of GEOSS.

With respect to such advanced search capabilities, the report highlights the “search by concept” work performed within the European Drought Observatory and the EuroGEOSS discovery broker. “Search by concept” is intended to not only improve the hit or miss success rate of keyword searches, but to also reduce the high amounts of irrelevant data returned by such searches.

- Point of Contact Editor: Will Pozzi, NASA WaterNet
- Contributing Editors: C. Fugazza, M.J. Brewer, M. Santoro, S. Nativi, B. Lee, Richard Heim, Justin Sheffield, Wolfgang Wagner, and M. Enenkel

2.1.6 Air Quality Results

The AIP-3 Air Quality ER documents how the Air Quality Workgroup used and tested the GEOSS Common Infrastructure (GCI) in order to register, discover, and access datasets relevant to air quality management. During AIP-3, the Air Quality Workgroup focused on refining the air quality community infrastructure and on developing implementation scenarios using sensor observation services and web processing services.

The observation and processing services involved multiple OGC SOS services and clients for accessing, spatially interpolating and visualizing air pollution concentration point measurements from ground-based monitoring networks. For AIP-3, an SOS interface to the DataFed web services was developed to provide access to air quality and other atmospheric and environmental measurements from a variety of monitoring networks in North America and around the world. Furthermore, a WPS connector was developed to connect to an SOS and to execute the interpolation provided by the INTAMAP WPS.

- Point of Contact Editor: Stefan Falke, Northrop Grumman
- Contributing Editors: Stefan Falke, Erin Robinson, Christoph Stasch, Scott Fairgrieve
2.2 Geo-Informatics Results

2.2.1 Engineering Use Cases
This AIP ER describes a set of transverse technology Use Cases developed and used in AIP. The Use Cases define reusable activities of a service-oriented architecture tailored for GEOSS. This report contains the general Use Cases that were specialized to implement the specific SBA Scenarios. The SBA Scenarios and specialized use cases are defined in separate AIP ERs. The Use Case ER contains a mapping of the use cases to the GEOSS AIP Components Types.

Point of Contact Editor: Josh Lieberman, Traverse/OGC
Contributing Editors: Nadine Alameh, OGC; George Percivall, OGC; Hervé Caumont, ERDAS/OGC

2.2.2 Data Harmonization
The AIP-3 Data Harmonization ER reflects a set of Data Harmonization requirements, gathered from GEOSS AIP scenarios and use cases, and emphasized in the context of the registration process of contributed resources to the GEOSS Common Infrastructure (GCI). As a result, the report underlines the prominent role of quality assurance procedures and quality measurements encodings for the development of interoperable, service-based, community applications that aim at supporting the combination of multiple source data products in a coherent way, so the resulting products are known reliable to a usage domain.

Recommendations to the GEOSS governance bodies are also captured in this report. A set of 20 recommendations cover the following topics: development of the geophysical parameters semantics and use for GEOSS data discovery, registration of additional supporting standards into the SIR and the need for additional guidance on their use from the CSR and Best Practices Wiki, and enhanced governance and liaisons within GEOSS for quality assurance processes and data products quality indicators.

- Point of Contact Editor: Herve Caumont, ERDAS / OGC
- Contributing Editors: Erin Robinson, Dan Cornford, Peter Walker, Giuseppe Ottavianelli, Brad Lee, Andrew Woolf, Ken McDonald, Nigel Fox

2.2.3 Vocabularies and Semantics
The AIP-3 Vocabularies and Semantics ER summarizes the outcomes of the first exploratory use of semantics (the new integrative technologies being deployed over the world wide web) to provide more user-friendly, seamless integration across cross-cutting activities within the GEO SBAs.

Addressing semantics is critical to GEOSS because it’s a global system, involving scientific variables collected within multiple countries having multiple languages, as well as geographic place names within multiple languages for the same place. Semantics offers capabilities to preserve the underlying concepts (such as drought) within all these languages. Semantics also provides the capability to automate the process of finding the exact information that the user
needs.

The AIP-3 Vocabularies and Semantics scenario aimed at leveraging and further developing the RDF repository developed in the context of the GENESIS FP7 project and implementing the semantics-aware extension to the GI-CAT EuroGEOSS discovery broker. This new capability was tested in supporting the AIP-3 Water/Drought and e-Habitat scenarios.

- Point of Contact Editor: Cristiano Fugazza EC, JRC-IES
- Contributing Editors: Masahiko Nagai, Stefano Nativi, Mattia Santoro, Will Pozzi

### 2.2.4 Data Sharing

During AIP-3, the Data Sharing Guidelines Working Group (DSGWG) focused primarily on data access and use conditions, and secondarily on user management. For data access and use conditions, categories of use were considered, based on input from the GEO Data Sharing Task Force (DSTF) and use of the Creative Commons licensing framework. Of these categories, the only one that was used to develop detailed use cases was attribution, as realized by the Creative Commons CC BY license. The use cases support the following situations:

- Registration, in the CSR, of data requiring attribution via CC BY
- Search and discovery of registered GEOSS data requiring attribution via CC BY
- Interactive use of registered GEOSS data requiring attribution via CC BY
- Automated use of registered GEOSS data requiring attribution via CC BY
- Aggregation and layering of registered GEOSS data, where at least one accessed dataset requires attribution via CC BY

The implementation of attribution in the metadata involved only the data provider’s metadata, not that of the Components and Services Registry (CSR). This results in no impact to the CSR. For testing purposes, metadata population was only considered for the ISO 19115 metadata standard. It is recognized that other metadata standards need to be considered, as well.

User management was considered from the points of view of user registration and single sign-on (SSO) user login. Use cases and analyses were developed for two scenarios studied: a fully federated solution, and a central GEOSS Common Infrastructure (GCI) solution. OpenID and Shibboleth were used to study the federated solution. Although OpenID worked well, there were some issues raised regarding duration of login, multiple logins, and acquisition of data access metrics. Regarding Shibboleth, case studies by organizations having implemented Shibboleth were reviewed. In a majority of cases, the impact on a GEOSS data provider seemed to be too great to adopt this solution. Additionally, GEOSS data providers who require registration and login for data access most likely have their own solution already implemented.

The central GCI solution to user management suggested a new component to be deployed into the GCI. This component would implement a solution that exposed registration and login services to the GEOSS users and authentication services to the data providers. This would be done in a manner to minimize the impact on data providers, but would result in a large impact on the GCI. This component could also be used to gather data access metrics.

- Point of Contact Editor: Steve Browdy, IEEE
- Contributing Editors: Sri Vinay, CIESIN; and Bob Chen, CIESIN
2.3 GEOSS Architecture Progress Videos for the Ministerial

A set of videos developed during AIP-3 showcase the remarkable progress that has been made in implementing GEOSS. The videos were prepared for the GEO Ministerial Summit and GEO VII Plenary, November 2010 in Beijing, China.

The "GEOSS Architecture Progress" video (5 minutes) provides an overview of the substantial progress made so far in implementing the bold plan established five years ago in the GEOSS 10 Year plan. (http://www.ogcnetwork.net/GeossArchProg)

Ten AIP-3 Demonstration Videos (each 5 minutes) show some of the work that has been performed during AIP-3 by the AIP-3 SBA and geoinformatics Working Groups. (http://www.ogcnetwork.net/geoss/aip-3/)
3. Discussion of GEOSS Architecture Progress

3.1 Role of SBA Integrator

AIP has pioneered a process of development for the SBA communities to contribute to and leverage GEOSS using a cross-cutting set of tools. The approach is centered on working groups defining SBA Scenarios that are supported by geoinformatic Use Cases. This process has been applied in AIP-2 and AIP-3 with results recorded in the AIP ERs. The process has been successful in providing the SBAs with useful support while hiding the details of the information technology.

It often takes two or three phases of development for the SBA Scenarios and supporting use cases to become mature and persistent. In AIP-3, the AIP-2 baseline Use Cases were complemented by a handful of use cases representing how existing functionality can be extended to support more SBA needs.

In AIP-3, a new facet for coordinated development with the SBAs was added with the introduction of the “SBA Integrator”. This role works the EO science and the geoinformatic engineering to build a network of persons and organizations aimed at meeting the decision support needs for SBA communities. As such, the SBA Integrator role can be seen as critical to communities’ involvement in GEOSS, and hence should be promoted by the GEO organizational activities.

A set of tools and best practices should be codified to aid the SBA Integrator in their roles. The SBA Integrator would be responsible for building the community network that is possibly represented by a community portal and is supported by catalogues, datasets and other information resources and services to meet the needs of the community.

3.2 GCI and additional components

The GCI is defined by identification of a set of engineering components: GEOSS Web Portal (GWP), Clearinghouse, and a set of Registries. To achieve the ultimate vision of GEOSS, additional components may need to be added to the GCI. Further, component types for the broader GEOSS should be identified and agreed beyond those in the GCI.

Adding to the GCI

There are two facets for adding to the GCI, one involving adding new components and another involving enhancing existing ones.

Additional component instances should be considered for addition to the GCI given their essential role to the community. As an example, design and implementation of an Ontology Registry component is mature enough to be included in the GCI. User Registration elements were developed in AIP-3 and further development is needed in AIP-4. Presumably the GCI management entity will take on a role in adding components to GCI.

With respect to existing GCI components, additional functionality is needed to better support the use of GEOSS by communities. For example, the GWP should enable users to find and launch Community Portals, Client Applications and other tools that meet their needs. Development in
the AIP Energy SBA further identified the need for more proper and consistent dissemination and representation of resources in the GWP, and the need for guidance and recommendation to guide community geoinformatic developers to select the appropriate, “GEOSS recommended” graphical user interface components.

**Identifying component types beyond the GCI**

The AIP process involves working with various communities to enable them to contribute their resources to GEOSS for use in AIP scenarios and demonstrations. To-date, AIP has piloted several components beyond the GCI ones. These additional components should be reviewed and confirmed to define the broader GEOSS architecture. These components differ from the GCI components in that there will be many instances of each component type.

For example, there will be – and already are – multiple instances of GEOSS Community Portals. A Community Portal should be confirmed as a type of engineering component. A Community portal is needed for each SBA. Working with the other committees, the ADC should identify a slate of "GEOSS Community Portals" that meet a set of functional requirements, are supported by an organization for a defined period of time (years), and are listed on the GWP and GEO webpage. Defining such a well-known component type will increase reuse, for example, reuse of the GEOSS Web Portal elements in Community Portals. A Task Force may be warranted for this high visibility item.

By carefully defining engineering component types, the development of instances can be better fostered and coordinated in GEOSS. These GEOSS architecture engineering component types should receive a GEO Plenary endorsement - similar to the GCI - to confirm that GEO Members will commit to providing them.

Priority GEOSS Engineering Component Types include:

- Community portals
- Community catalogues
- Data access web servers
- Geo-processing servers
- Semantic mediation search servers
- Testing components

**3.3 Webs Service Interoperability Arrangements**

The GEOSS Ten-Year plan calls for a Service Oriented Architecture (SoA) based on Interoperability Arrangements. That vision is now being realized by GEO through an architecture based on international standards and deployed in AIP.

Use of open, consensus standards to create a system of systems is not new. The Internet - based on open standards - continues to grow and return benefits on investments. Creating a system of systems for earth observations requires going beyond what Internet standards provide. With foresight, multiple organizations began preparing for this challenge before GEOSS was defined. Standards and common practices for earth observations have been developed by organizations
like IEEE, ISPRS and OGC.

Open standards and common practices have been used to create the GCI and the broader functionality deployed in AIP. Establishment of the GCI is a significant success of GEOSS and yet further progress is needed. Building on the GCI, work done in the GEOSS AIPs demonstrates that interoperability works. With contributions from hundreds of organizations, the GEOSS AIPs have lead to substantial architectural achievements, cross-cutting all SBAs. The momentum acquired is very high. Finding the right balance of advancing and community engagement is key to further success.

Previous AIP phases have piloted Interoperability Arrangements for the functions of search and access. Those Interoperability Arrangements are now listed in the GEOSS Standards and Interoperability Registry (SIR) and are the subject of review and development by the Standards and Interoperability Forum (SIF).

In AIP-3, additional Interoperability Arrangements were piloted in several SBAs for geoprocessing. This geoprocessing function was achieved by the deployment of components with the OGC Web Processing Service (WPS) interface. WPS is a general interface for geoprocessing. Work started on that with AIP-2 where the WPS was used for societal-economic calculations. In AIP-3, WPS was used in the Energy WG, Disaster Management WG and the e-Habitat WG. Use of WPS to make geoprocessing services more generally available will aid GEOSS by allowing users to access resources in “the cloud” to process the archive data into information suitable to decision making.

3.4 Improving Data Quality

The AIP-3 Data Harmonization ER underlined the prominent role of quality assurance procedures and quality measurement encodings for the development of interoperable, service-based, community applications that aim at supporting the combination of multiple source data products in a coherent way, so the resulting products can be reliable to a usage domain. The report provides several recommendations related to improving data quality, including

- Supporting the future integration of the QA4EO questionnaire into the GEO registration procedure,
- Leveraging quality assurance guidelines and tools provided through exemplar systems, as deployed and referenced in the frame of the GCI,
- Providing initial guidance documents on the choice of encoding standards all along the processing chains, that is expanding the QA for the metrology-related Space component domain (e.g. calibration and validation), to a set of GEO thematic applications domains,
- Employ a statistical approach to quantify and manage uncertainty for the end-to-end use of EO products. UncertML was applied in this area.
- Developing and adopting a methodology for the development and registration of application schemas,
- Continuing close coordination with the GEOSS GCI Task Force and the Data Sharing Task Force.
3.5 Search/Discovery/Semantic mediation

Based on the AIP-3 results, more work remains to be done to improve the metadata description, search, discovery and presentation of GEOSS resources to enable increased usability of these resources as needed in SBAs.

In order for users to find the data they need, metadata from component and service providers need to address two questions: (1) what metadata is needed for discovery, (2) once discovered, how can one use/access the component/service? The GEOSS components and services are described by various metadata standards and profiles, typically driven by the context in which they were created or organization that created them. In order for all datasets to be discovered using the GCI, specifically the Clearinghouse, there must be a minimum set of metadata fields that allow for discovery and access across distributed organization-specific metadata. Through the collaboration between a variety of stakeholders in AIP-2 and AIP-3, a key set of these fields has emerged as a potential GEOSS Common Record. A cross-walk between the GEOSS Common Record and established practices (e.g. INSPIRE) was also defined in the AIPs. The GEOSS Common Record should be promoted to improve discovery of data by users.

AIP-3 also demonstrated the role semantics can play in further improving the discovery process. Addressing semantics is critical to GEOSS because it’s a global system, involving scientific variables collected within multiple countries having multiple languages, as well as geographic place names within multiple languages for the same place. Semantics offers capabilities to preserve the underlying concepts within all these languages. Semantics also provides the capability to automate the process of finding the exact information that the user needs. To support semantics within GEOSS, two elements are needed at least: (1) the addition of an Ontology Registry component in the GCI, and (2) the addition/definition of a semantic brokering Component type. The Semantics and Vocabularies WG in AIP-3 successfully piloted the semantic brokering concept in support of the e-Habitat and Water/Drought scenarios.

Finally, from a presentation and user experience perspective, the AIP-3 Energy Working Group detected some discrepancies between the metadata provided with the data during registration and their presentation in the GEO Web Portal. In particular, the GEO Portal query result “Summary” view does not take full advantage of the available metadata that the GEOSS Clearinghouse has harvested. This may result in decreasing the usability of the data. Furthermore, the user-friendliness of the GEO Web Portal could be improved. For example, a mechanism for being able to display map layers as part of this “Summary” view in the case of a WMS should also be a handy feature for the end-user. In general, it was determined that there’s a need for more proper and consistent dissemination and representation of resources in the GWP.

3.6 Data Sharing

Regarding data access and use conditions, the DSHWG recommends:

- Implementation of attribution as discussed in the use cases for further testing of how well attribution is handled.
- Use of the Creative Commons open standards-based licensing framework.
Regarding user management, the DSHWG recommends:
- Implementation of a central GCI component for handling GEOSS user registration and login.
- Design of appropriate service interfaces to support the interactions between the central GCI component, the GEOSS users, and the GEOSS data providers.

An overarching recommendation related to both of these categories is:
- Gather further feedback and input from the DSTF regarding any potential legal implications to data access and use conditions, and user management.

### 3.7 GEOSS Operational Components baseline

The role of pilots in an evolutionary development process is to identify workable solutions that become part of an ever growing and stabilizing baseline. Pilots are never persisted per se. Instead there is an evaluation step of the results and then explicit decisions made about what should persist. Prototypes are learning experiences. The organizations that prototype the most in the least time are the most successful (The book to read is "Serious Play" by M. Schrage).

GEO has experienced success with this evolutionary development process based on a series of pilots. This is the process that led to the GCI. Requirements developed in AIP-1 became requirements in the GCI Task Force. Design items from the three candidate portals helped the selected GEO Portal to excel. The AIP-1 "Core Infrastructure" became the GCI after explicit consideration by ADC, a Task Force and the Plenary. Persistence of AIP is through selection and confirmation after each phase.

AIP results are persisting despite the lack of a coherent baseline structure in GEOSS. The results of AIP-1 were eventually codified as the GCI through a task force. AIP-2 and AIP-3 have built SBA operational activities, e.g., Air Quality, Biodiversity, Energy, Global Drought, that continue to function. A process is needed by which GEOSS identifies a baseline of architectural components. The ADC should confirm a baseline architecture to support the evolutionary development of GEOSS. The AIP Architecture provides input to the ADC to define a “GEOSS Operational Components (GOC)” baseline.

While the Task Force approach to establishing the AIP-1 components as the GCI was successful, that approach would be too heavy for the on-going baseline management of a system of systems as flexible as GEOSS needs to be. Listing the components in the CSR registry is part of the solution. Visibility of the components through the GWP is equally important.

Beyond visibility, institutional support of the components for such a GOC will be important. The GCI TF required letters of commitment from each component provider. Perhaps a similar request for contributed components could be used. While provision of components through research activities (e.g., FP7 or NSF projects) is precisely what is needed for Pilots, institutional commitment from operational EO agencies is needed for GOC operations.
3.8 Coordination with other GEO Tasks, CoPs and Task Forces,

The role of AIP to conduct evolutionary development of the GEOSS informatics architecture is executed in coordination with other GEOSS tasks. In fact without the participation of other activities, the AIP leadership on informatics is just a tool that is unapplied.

GEO has defined several types organizational entities in order to meet the GEOSS 10 Year Plan. Table 2 and the list after Table 2 show the Tasks and communities of Practice with which AIP-3 coordinated. Additionally AIP coordinates with the GCI TF, GCI CT and DSTF. Managing the coordination between tasks should be a focus on the GEO Secretariat activities. An initial identification of the linkages between tasks was begun at the Pretoria Task Leaders meeting. But this does not seem to have been maintained. Better coordination between GEO entities would improve understanding and productivity.

Table 2. AIP Coordination with SBA Tasks and CoPs.

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<th>AIP WG</th>
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<th>CoPs</th>
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<td>Energy</td>
<td>• EN-07-02 - Energy Enviro. Impact</td>
<td>Energy</td>
</tr>
<tr>
<td>Water - Drought</td>
<td>• WA-06-02: Droughts, Floods and Water Management</td>
<td>Water Cycle</td>
</tr>
<tr>
<td></td>
<td>• WA-06-07: Water Resource Management</td>
<td></td>
</tr>
</tbody>
</table>

Additionally AIP-3 coordinated with these tasks for geoinformatic topics:

- US-09-01: User Engagement
- DA-06-01: Data Sharing Principles
- DA-09-01: Data Management
- DA-09-02: Data Integration and Analysis
- DA-09-03: Global Data Sets
- AR-09-02: Interoperable Systems for GEOSS
- AR-09-04: Dissemination and Distribution Networks
3.9 Alignment with GEO Member activities

Resources for GEO Members operations are essential to building GEOSS. For example contributions from European Commission FP projects have been substantial in providing components and resources to AIP. Examples in AIP-3 include the SAFER project in Disaster Management, the e-Habitat project for Biodiversity, EnerGEO and GENESIS for Energy, GIGAS for Data Harmonization and results from several other FP7 projects.

Previously, Ministers committed to explore ways and means for the sustained operations of GEOSS Common infrastructure. Now we need a strong commitment from GEO Members to make use of the broader GEOSS architecture on their systems in order to maximize the use of the collective investments in Earth Observations. Continued investments by GEO members are needed to achieve and sustain a critical mass, and enable societal benefits from seamless access to Earth observations.

Currently, many of the components registered in the CSR are provided by research funding (e.g. FP7). AIP-2 and AIP-3 benefited tremendously from the contributions of FP7 projects. The concern is with what happens at the end of the FP7 projects, and on whether the registration of components is sufficient for continued GEOSS contribution.

The GEOSS CORE data strategy recently identified by the Data Sharing Task Force and the Priority EO Observations identified by the UIC should be of benefit to the identification of operational data services that benefit GEOSS users.

Another issue that is worth noting here is that agencies need to invest in moving their archive services to support web-based access to their data. Making satellite data available through web services in ways that can be used by non-scientists has been demonstrated in the AIPs and other activities. It is time to invest in the transition to web-based access from the traditional satellite data archives workflow of separate ordering and delivery of data.

3.10 Postscript

Pioneers! O Pioneers!

We cannot tarry here, we must march
We must bear the brunt of danger,
We the youthful sinewy races,
All the rest on us depend,
Pioneers! O pioneers!

Walt Whitman
Annex: Responses to the AIP-3 Call for Participation

Listed below are the 36 responses to the Call for Participation in AIP-3. As each of the Responses included multiple organizations, the response represents contributions from over 100 organizations.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRNow</td>
<td>Air Quality data service and software</td>
</tr>
<tr>
<td>Aston University</td>
<td>Uncertainty propagation in chains of web services.</td>
</tr>
<tr>
<td>BKG</td>
<td>Catalogue Service</td>
</tr>
<tr>
<td>CEOS CF Portal</td>
<td>Remotely sensed atmospheric composition data web services, registered in AQ Community Catalog and tested within the GCI.</td>
</tr>
<tr>
<td>CEOS SEO</td>
<td>Support to GEO Portals for data selection; visualization of sensor swaths.</td>
</tr>
<tr>
<td>CIESIN</td>
<td>Population WPS, WMS with licenses, clients</td>
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<tr>
<td>Compusult</td>
<td>Portal, Clearinghouse, Sensor Web</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Water resource scenario, sensor web, Data Harmonization and Vocabularies</td>
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<tr>
<td>DRI</td>
<td>Drought management scenario and data service</td>
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<tr>
<td>e-Habitat</td>
<td>Protected areas and species presence</td>
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<tr>
<td>EO2Heaven</td>
<td>Air Quality and Disease scenarios</td>
</tr>
<tr>
<td>ESA</td>
<td>GEOPortal and Service Support Environment</td>
</tr>
<tr>
<td>ERDAS</td>
<td>Initial response on disaster management</td>
</tr>
<tr>
<td>ESIP</td>
<td>Air Quality operational, research and technical exemplars services</td>
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<tr>
<td>ESRI</td>
<td>GEOSS Portal and Clearinghouse and client components</td>
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<tr>
<td>EuroGEOSS and GENESIS</td>
<td>Drought products and alerts</td>
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<tr>
<td>GENESI-DR</td>
<td>Access to heterogeneous data, processing service,</td>
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<tr>
<td>Geoland2</td>
<td>Land Monitoring data for several SBAs</td>
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<tr>
<td>GIGAS Data</td>
<td>Data Interoperability</td>
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<tr>
<td>GIGAS DM</td>
<td>Disaster Management scenario and service registration</td>
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<tr>
<td>GIS.FCU</td>
<td>Flooding disaster management</td>
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<tr>
<td>GMU</td>
<td>Water and biodiversity SBAs; GOES services; semantic integration</td>
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<tr>
<td>GSDI</td>
<td>Data licensing</td>
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<tr>
<td>IFGI</td>
<td>Sensor web, geoprocessing, client for data quality in AQ</td>
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<tr>
<td>INCOSE</td>
<td>Unified modeling and RM-ODP</td>
</tr>
<tr>
<td>ISPRA and CNR</td>
<td>Services for Air Quality and DM</td>
</tr>
<tr>
<td>JAXA</td>
<td>Access and viewing for Water</td>
</tr>
<tr>
<td>MINES ParisTech, EnerGEO and GENESIS</td>
<td>Energy, CSW, WMS, WPS and Rich Web Clients for geodata visualization and data retrieval</td>
</tr>
<tr>
<td>NOAA DMIT</td>
<td>Services and consultation in support of AIP-3</td>
</tr>
<tr>
<td>Northrop Grumman</td>
<td>Two SBA scenarios: Health and Climate Impacts &amp; Disaster Response</td>
</tr>
<tr>
<td>PML</td>
<td>Ecosystems, health and disasters visualization, analysis and model validation</td>
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<tr>
<td>Pozzi Team</td>
<td>Drought scenario</td>
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<td>QA4EO</td>
<td>Data quality assurance strategy</td>
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<tr>
<td>Spot Infoterra</td>
<td>Disaster Management</td>
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<tr>
<td>University of Heidelberg</td>
<td>Emergency route planning and 3d visualization</td>
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<tr>
<td>University of Tokyo</td>
<td>Semantic interoperability</td>
</tr>
<tr>
<td>Washington Univ. - St. Louis</td>
<td>Air Quality WCS, WMS and catalogue</td>
</tr>
</tbody>
</table>

1 Full CFP Responses posted: [http://www.ogcnetwork.net/node/635](http://www.ogcnetwork.net/node/635)
<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADC</td>
<td>Architecture and Data Committee</td>
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<tr>
<td>AIP-3</td>
<td>Architecture Implementation Pilot, Phase 3</td>
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<tr>
<td>CFP</td>
<td>Call for Participation</td>
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<td>CSR</td>
<td>Component and Service Registry</td>
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<td>DSTF</td>
<td>Data Sharing Task Force</td>
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<td>DSGWG</td>
<td>Data Sharing Guidelines Working Group</td>
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<td>ER</td>
<td>Engineering Report</td>
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<td>ESA</td>
<td>European Space Agency</td>
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<td>GCI</td>
<td>GEOSS Common Infrastructure</td>
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<td>GCI-CT</td>
<td>GCI Coordination Team</td>
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<tr>
<td>GEO</td>
<td>Group on Earth Observations</td>
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<tr>
<td>GEOSS</td>
<td>Global Earth Observation System of Systems</td>
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<tr>
<td>GWP</td>
<td>GEOSS Web Portal</td>
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<tr>
<td>IOC</td>
<td>Initial Operating Capability</td>
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<tr>
<td>KML</td>
<td>(formerly Keyhole Markup Language)</td>
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<tr>
<td>OGC</td>
<td>Open Geospatial Consortium</td>
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<tr>
<td>OWS</td>
<td>OGC Web Services</td>
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<tr>
<td>SBA</td>
<td>Societal Benefit Areas</td>
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<tr>
<td>SIF</td>
<td>Standards and Interoperability Forum</td>
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<tr>
<td>SIR</td>
<td>Standards and Interoperability Registry</td>
</tr>
<tr>
<td>SKOS</td>
<td>Simple Knowledge Organizing System</td>
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<tr>
<td>SoA</td>
<td>Service Oriented Architecture</td>
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<td>SOS</td>
<td>Sensor Observation Service</td>
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<td>WCS</td>
<td>Web Coverage Service</td>
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<tr>
<td>WMS</td>
<td>Web Map Service</td>
</tr>
<tr>
<td>WPS</td>
<td>Web Processing Service (OGC)</td>
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