MINUTES

OF THE

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OF THE

CEOS WORKING GROUP ON   
INFORMATION SYSTEMS AND SERVICES

(WGISS)

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OGC George Percival

USGS Kristi Kline, Eugene Fosnight\*, Richard Frazier, Brian Sauer\*

\* Via web conference or email



# WGISS Plenary Session, Part I

## Chair Welcome, Introductions, Adoption of Agenda

Andrew (Andy) Mitchell (WGISS Chair) welcomed the participants to WGISS-43. Andy thanked NASA-GSFC for all the excellent arrangements, and asked those present to introduce themselves.

Andy noted that the meeting has a full agenda, and WGISS is looking forward to the two workshops, one on future data access and analysis architectures, and another on GEOSS-WGISS interoperability. He reviewed the agenda and it was adopted with no modifications.

## Host Welcome and Logistics Information

Andy described the facility, breakfast, lunch, breaks, dinners, local amenities, internet connectivity, and contents of welcome package.

## NASA Opening Address

Kevin Murphy, NASA Headquarters Earth Science Program Executive, opened the meeting on behalf of NASA, welcoming the participants, and thanking them for travelling so far in order to participate. He gave an update on NASA’s Earth science data systems.

The job of the Earth Science Division is to collect the data from all NASA’s EO missions. The division’s budget funds activities in a substantial, impactful, scientifically viable, balanced, and comprehensive manner. These activities pertain to 15 missions/instruments presently on-orbit, and more than 14 ongoing missions and major instruments that are scheduled for launch before 2023.

Kevin described NASA’s open source policy: all new projects and existing core software components shall be released as open source; 15 core software projects have been open sourced since the policy was initiated. He also described commercial cloud partnerships between Amazon, Google, Microsoft and NASA, with a goal to enable efficient access and transfer of NASA’s Earth science data to different cloud infrastructures to facilitate new data-driven applications and foster new user communities.

NASA is preparing for upcoming missions, looking toward the cloud, streamlining tools, and continuing commitment to open source. NASA intends to fully utilize the information that is being collected. Hopefully the discussions will allow space agencies to have systems that can work together, and to determine what a future data system architecture look like.

NASA’s archiving goals are to better support interdisciplinary Earth science researchers, and seeks to determine which system architecture(s) will allow the holdings to become interactive and easier to use for research and commercial users. Data from multiple agencies, international partners and the private sector might be combined to study the earth as a system.

In five years NASA will have 15 new instruments and missions, measurements from the Decadal Survey, and user expectations that continue to evolve. Archive growth estimates indicate a huge growth.

NASA seeks to maintain what Earth Science Data Systems do well, data stewardship expertise to support science community needs. NASA hopes to maintain flexibility to incorporate new data sources and data producers with little disruption, providing free and open access to data products and services for all users with open APIs and software at a high level of customer satisfaction. NASA’s efforts to improve user functionality and data stewardship efficiency continue, along with the ability to conduct regional and global processing without need for data management, and with a consistent level of service and performance across the system.

Richard asked about collaborative work with commercial cloud providers. Andy replied that they have met with Amazon, Google and Microsoft to help them understand NASA’s data systems, and for NASA to understand what the providers need in order to access the data.

Martin raised the issue of handling huge volumes of data; two new missions will tremendously magnify the volume and NASA is preparing for that.

## WGISS Infrastructure Systems Project (WISP)

Anne Kennerley gave a presentation of WISP activities. She began by describing the team, and the WGISS and CEOS organization that WISP supports. She described the process for submitting and accessing presentations during the meeting. Meeting information and resources can be found at [http://CEOS.org/meetings/WGISS-43/](http://ceos.org/meetings/wgiss-43/). The project team continues to maintain the WGISS website and the email contact lists.

WISP was tasked to find a collaborative software/environment for WGISS members, and identified Confluence. Confluence allows users to create cloud-based webpages to be used as workspaces or wikis; it allows document collection, virtual drafting, and lists of links, collaboration space, and many other features. Confluence is very easy to work with, using a rich text editor, allowing inserts of links, images, text, child pages, and security set up. It also includes features for organizational hierarchy, page level permissions by groups or individual users, page history, roll-back capability, and alerts of changes made. An optional comments feature for specific pages (a discussion forum) is a key feature.

Martin noted that WISP is proposing to use Confluence as a workspace for WGISS activities, provided that the resources to pay for it can be obtained. Andy proposed to discuss this with the SEO since this is a need beyond WGISS; many have been asking for it.

**Action WGISS-43-01**: Andy Mitchell to discuss with SEO funding for the use of Confluence for CEOS collaborative websites.

## WGISS Chair Report

Andrew Mitchell gave a presentation to WGISS of current topics in CEOS. He began with an update of CEOS, whose Chair is now Frank Kelly, USGS. Frank’s goal is to ensure continuity and coherence of current CEOS activities, and ensure that the priorities and themes identified by the outgoing Chair (CSIRO) and the current SIT Chair (ESA) are supported and further developed through 2017:

Chair (CSIRO):

* Future Data Access and Analysis Architectures
* Non-meteorological Applications for Next Generation Geostationary Satellites

SIT Chair (ESA)

* Consideration of future partnerships and priorities for CEOS, notably with GEO, the UN system, development banks, and the big data players
* Expediting existing CEOS thematic acquisition strategies – in relation to forests, agriculture, disasters, climate, carbon and water
* Pursue 2017 Chair Initiatives

There are two 2017 Chair initiatives:

1. Future Data Architectures continuation.
   * Approval for the Ad-hoc Team on Future Data Access and Analysis Architectures to continue for a further year to complete the mandate and to pursue confirmation of the Co-Chairs.
   * Agreement for the proposed pilot project(s) to be progressed in parallel with the ongoing report work, with oversight by the FDA team and contributions from LSI-VC, SEO, and SDCG.
   * Invitation for further proposals for practical demonstrations in the area of FDA for ‘lessons learnt’ evaluation by CEOS Principals at CEOS-31.
   * Action for CEOS and SIT Chairs to confer with the FDA Team to ensure necessary CEOS Principal engagement on the strategic issues arising from the 2017 Report, in support of identifying common ground as the basis for a long-term CEOS strategy.
2. Moderate resolution sensor interoperability (MRI). Two priorities:
   * Priority 1: Generally applicable framework for land moderate resolution interoperability. Comprehensive framework that includes characteristics such as radiometry, geometry, data formats, browse, metadata, data access, metrics, and reporting.
   * Priority #2: Case Studies. Document, publish, and communicate clearly to the community the objectives and intended uses of the interoperable products. Case Study #1: Landsat-Sentinel-2 Interoperability. Other Case Studies welcomed.

WGISS participation at recent meetings:

* GEO-XIII Plenary Data Provider Side Event: Richard Moreno presented methods for accessing CEOS data via WGISS assets.
* GSDI World Conference: Gabor Remetey presented ‘WGISS Interoperable Standards and Information Architectures’.
* GEO Data Provider’s Workshop: Richard Moreno will present the GEO/GCI success story of GCI-CEOS Interoperability: Achievements and Next Steps

WGISS held the first Technology Exploration webinar on March 14th on ‘Relevancy Ranking of Data Search Results’. The GEODAB and NASA’s Common Metadata Repository were co-presenters. For CEOS Earth Observations, ranking data search results by their expected relevance for the user is potentially one of the most powerful ways to help users quickly zero in on the best data for their purpose. This webinar discussed some of the techniques being used within Earth Observation data search tools and also included a discussion of possible future directions in relevancy ranking. WGISS hopes to develop a bulletin board for interaction following the webinars, and is looking for suggestions for next webinar.

In response to CGMS action item # A44.03 (identify how far WGISS Interoperable standards were adopted), WGISS provided a list of CEOS agencies who have implemented CEOS OpenSearch Best Practices: EUMETSAT, NASA, ESA, CNES, USGS, JAXA, ISRO (NRSC) and CCMEO.

GEOSS EVOLVE (was GEO FT GD-07): WGISS, as a data provider of GEOSS, is now included under GEOSS EVOLVE “Work Package 2: Functional Testing”. The goal of the task is to test functionalities of the GCI, the GEOSS data providers and the GEOSS community portals needed to support the requirements expressed by the users through the dedicated foundational tasks. WGISS has representation in many other WPs including:

* WP-1: Evolving GEOSS Architecture
* WP-3: Data Management Principles
* WP-5: Demonstrations Projects (Lead OGC)
* WP-6: Community Portals

Andy concluded saying that the WGISS vice-chair position is still open.

Astrid commented that the European Commission is working on the 2018 Chair Priorities. They want to build on existing ones, and one of the priorities will be on data architecture; WGISS feedback will be greatly appreciated. Andy added there are a lot of technology-driven aspects to these activities, and WGISS is a natural place for these.

## Review of WGISS-42 Actions

Andrew Mitchell and Michelle Piepgrass reviewed the WGISS-42 actions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number | Category | Action | Actionee | Due Date | Status | Comments |
| WGISS-42-01 | GEO | Andy Mitchell and Mirko Albani to recommend to the GEO-Sec (Osamu Ochiai), if GD-07 becomes an initiative in the GEO Work Plan 2016-18, to move the Data Management Guidelines Task to GD-02. | Andy Mitchell, Mirko Albani | Oct-31-2016 | Closed | Mirko and Richard met with Osamu. This activity is now part of GEOSS Evolve. |
| WGISS-42-02 | Carbon | Andy Mitchell and Mirko Albani to obtain from WGClimate the final results of the ECV Inventory Gap Analysis for Carbon. | Andy Mitchell, Mirko Albani | Dec-01-2016 | Closed | The analysis is not expected until June, 2017. Added to the WGISS-43 tasks. |
| WGISS-42-03 | Carbon | Ken McDonald to research the GEO Carbon Portal. | Ken McDonald | Dec-01-2016 | Closed | Ken reported that there will not be a Carbon Portal; instead there are the two other systems that are being investigated: ICOS Carbon Portal, and Global Carbon Atlas. |
| WGISS-42-04 | Carbon | Andy Mitchell, Mirko Albani, Martin Yapur, and Ken McDonald to define the requirements for a CEOS Carbon Portal, working with WGClimate and the Carbon action coordinator, Mark Dowell. | Andy Mitchell, Mirko Albani, Martin Yapur, Ken McDonald | Feb-01-2017 | Closed | This will be a long term activity; move to WGISS-43 actions. The initial goal is to help with the discoverability of the ECV and climate data records, before actually implementing a portal. User requirements must be obtained prior to proceeding. |
| WGISS-42-05 | Data Access | Yves Coene to distribute to WGISS the new OGC Specification for OpenSearch. | Yves Coene | Oct-06-2016 | Closed | Done September 2016. |
| WGISS-42-06 | Data Access | OpenSearch team to finalize and post the CEOS Open Search Best Practice after making minor editorial changes referencing the OGC. | Open Search Team | Oct-31-2016 | Closed | Done October 2016. |
| WGISS-42-07 | Data Access | OpenSearch team to circulate the Open Search Developer’s Guide after allowing one additional month for comments. | Open Search Team | Oct-31-2016 | Closed | Done October 2016. |
| WGISS-42-08 | Data Access | Mirko Albani and Olivier Barois to research using the GEO-JSON encoding, and identify members that can participate in the OGC group. | Mirko Albani, Olivier Barois | WGISS-43 | Closed | Presented results and discussed at WGISS-43. |
| WGISS-42-09 | Data Access | WGISS representatives to volunteer (by sending email to Andy Mitchell and Mirko Albani) for the WGISS Connected Data Assets System Level Team. | WGISS | Oct-06-2016 | Closed | Group set up September 2016. |
| WGISS-42-10 | Data Access | Yonsook Enloe to initiate a teleconference for the first meeting of the WGISS Connected Assets System Level Team. | Yonsook Enloe | Oct-31-2016 | Closed | Done October 2016. |
| WGISS-42-11 | Data Access | Yonsook Enloe to revise the GCI User Requirements document to insert draft requirements addressing the problem of harvested/cached datasets and duplicate datasets in GEOSS.  Initiate a review of the new draft GCI User Requirements with members of WGISS. | Yonsook Enloe | WGISS-44 | Closed | The team is working to identify the policy on harvesting; GEODAB needs to harvest in order to rank the return results, and it is unclear if that can be supported in the IDN. The GEODAB identified use cases. |
| WGISS-42-12 | Data Access | WGISS to explore the possibility of including the publishing of services related to EO datasets in the IDN. | WGISS | WGISS-43 | Closed | Discussed during the MIM session at WGISS-43. |
| WGISS-42-13 | Data Access | Andy Mitchell, Yonsook Enloe and Simon Cantrell to work with WIGOS and CGMS metadata representatives to identify common collection-level metadata elements between the IDN, CGMS, and WIGOS. | Andy Mitchell, Yonsook Enloe, Simon Cantrell | WGISS-43 | Closed | Olivier Barois noted that they are doing it at the product level, but is needed at the collection level. No one in OGC is working on this; discussed at WGSS-43. |
| WGISS-42-14 | Data Use | Gabor Remetey to coordinate (via WGISS) GSDI contributors to a future WGISS geospatial applications workshop on the use of CEOS data. | Gabor Remetey | WGISS-43 | Closed | Ongoing discussion. |
| WGISS-42-15 | Data Steward- ship | DSIG team to consider developing a video on the value of WGISS Data Preservation activities for the Faces of CEOS series. | DSIG team | WGISS-43 | Closed | Ideas presented at WGISS-43, and discussed with Kim Holloway (SEO). |
| WGISS-42-16 | Data Steward- ship | Mirko Albani and Dawn Lowe to check with CCSDS and ISO on the status of the development of a standard for data preservation. | Mirko Albani, Dawn Lowe | WGISS-43 | Closed | Concept discussed at WGISS-43. |
| WGISS-42-17 | Data Steward- ship | DSIG team to identify what is available in the DIF and ISO for landing pages; to review what is recommended/required of NASA, ISRO and DLR for landing pages; and to make recommendations. | DSIG Team | WGISS-43 | In progress | Results presented at WGISS-43. Analysis has been done and PI BP has been updated. There are no PIs for Sentinel; it is under consideration. |
| WGISS-42-18 | Techno- logy | WGISS-42 participants to review Satoko Miura’s outline of the Cloud Computing Workshop and provide feedback. | WGISS-42 Participants | Oct-06-2016 | Closed | Done October 2016. |
| WGISS-42-19 | Techno- logy | Technology Exploration team to create a summary report of the Cloud Computing Workshop; the summary should be tailored for input to the FDA report. | Tech Exploration Team | 2017 CEOS Plenary | In Progress | The scope of this changed beyond the Cloud Computing Workshop. Will be an outcome of WGISS 43 |
| WGISS-42-20 | Techno- logy | Technology Exploration team to investigate user authentication interoperability. | Tech Exploration Team | WGISS-44 | Closed | Discussed at WGISS-43. |
| WGISS-42-21 | WGISS Webinars | WISP team and Kristi Kline to research technology requirements for a CEOS wiki. | WISP Team | WGISS-43 | Closed | Confluence identified as an acceptable collaborative software; discussed and demonstrated at WGISS-43. |
| WGISS-42-22 | WGISS Webinars | Technology Exploration team to send an email to WGISS-All asking for volunteers to speak on specific topics for Technology Exploration webinars. | Tech Exploration Team | Jan-01-2017 | Closed | First webinar search relevancy was produced March 2017. |
| WGISS-42-23 | WGISS Webinars | Andy Mitchell and Mirko Albani to discuss suggested webinar topics with WGCapD chair. | Andy Mitchell, Mirko Albani | Nov-15-2016 | Closed | Discussed at WGISS-43 |
| WGISS-42-24 | WGISS Logistical Support | Mirko Albani and Andy Mitchell to speak with the CEO about guidelines regarding hosts for WGISS meetings. | Mirko Albani, Andy Mitchell | Oct-31-2016 | Closed | CEO replied that non-members cannot host or attend WGISS meetings. |
| WGISS-42-25 | WGISS Logistical Support | WISP team to compile a mailing list of members who regularly attend WGISS meetings for specific communications. | WISP Team | Oct-31-2016 | Closed | Done October 2016. |

The following actions from WGISS-42 are ongoing and moved into WGISS-43:

**Action WGISS-43-02:** Andy Mitchell, Mirko Albani, Yonsook Enloe, Martin Yapur, and Ken McDonald to assist the discoverability of the ECV and climate data records which may help define the requirements for portal development.

**Action WGISS-43-03:** Yonsook Enloe to revise the GCI User Requirements document to insert draft requirements addressing the problem of harvested/cached datasets and duplicate datasets in GEOSS. Initiate a review of the new draft GCI User Requirements with members of WGISS.

**Action WGISS-43-04:** WGISS to explore the possibility of including the publishing of services related to EO datasets in the IDN.

**Action WGISS-43-05:** WGISS Exec to work with WIGOS and CGMS metadata representatives to identify common collection-level metadata elements between the IDN, CGMS, and WIGOS.

**Action WGISS-43-06**: Yonsook Enloe to publicize to active WGISS members and to GCI providers the use cases developed by GEODAB for harvesting.

## CEOS Activities

### CEOS Executive Officer (CEO) Report

Andy gave the CEO report on behalf of Jonathon Ross. Andy noted that the current chair of CEOS is Dr. Frank Kelly, USGS, gave general background information on CEOS, and described the purpose and goals of the CEOS virtual constellations and working groups. He added that he recently asked the VCs for their needs for data access, and commented that WGISS works with all of the CEOS WGs.

CEOS supports the implementation of global agendas:

* Climate: CEOS ensures that requirements identified by the Global Climate Observing System (GCOS) are addressed through Agency planning processes and works with stakeholders to support implementation of the Paris Climate Agreement.
* Disaster Risk Reductions: CEOS supports implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 by coordinating provision of data in support of disaster risk reduction and engaging with relevant UN agencies and authorities to ensure the full societal benefit potential of the data is realized in all phases of disaster risk management. CEOS is leading implementation of the strategic GEO Initiative on disaster risk reduction, GEO-DARMA (Data Access for Risk Management). CEOS is also supporting other initiatives which connect cutting-edge science to those responsible for managing major hazards, and advances the use of satellite data for disaster risk reduction applications through a dedicated Working Group on Disasters.
* Agenda for Sustainable Development: CEOS plays a leading role in the efforts of GEO and UN-GGIM to promote the use of Earth observation and spatial data in support of sustainable development, and supports Agencies to work with their national statistical offices. CEOS also monitors and promotes ways in which satellite applications can play a key role in monitoring progress, and achieving change.
* Delivering on key challenges: CEOS is providing concrete support to initiative tackling specific challenges in support of the agendas of GFOI, GEOGLAM, and strategies for water and carbon observations from space.
* Supporting GEO: CEOS is committed to the second decade of the intergovernmental Group on Earth Observation, and is increasingly more deeply engaged in GEO governance.

Andy listed the 2017 USGS CEOS Chair Initiatives:

* Future Data Architectures: Lack of data is no longer a limiting factor in many key domains, and user expectations around ease of data access and use have changed so collaborative environments where both data providers and users can work together are critical. Opportunities are offered by new high-performance ICT infrastructure and architectures. Key opportunities are to engage new user groups by lowering technical barriers and to leverage ability to “bring the user to the data”. New architectures depend on ‘analysis ready’ data if their potential is to be realized, and open source tools can support and complement proprietary efforts. The 2016 interim report highlighted key opportunities and challenges since CEOS agencies are each at different stages. An extended team is now considering what concrete actions should be taken forward:
  + Where is it most critical (for impact on key agendas) for Agencies to work together in a coordinated way?
  + Where sharing of ‘best practice’ and ‘lessons learned’ should be facilitated?
  + Where would CEOS not add value?
* Medium-Resolution Sensor Interoperability: Increasing demand for multi-mission products in land domain since it results in richer products, increased resilience to disruption, and leverages complementary data types. The goals are to develop a framework for assessing the interoperability of two datasets, with recommendations on ‘how to do interoperability if what you mean by interoperability is <x>’. They are looking at metadata interoperability, data interoperability, and at leveraging complementary data types.

CEOS Analysis Ready Data for Land (CARD4L) is a framework for establishing ‘minimum requirements’ for products that are ready for ‘immediate analysis’, that require minimal additional user effort to prepare, and are interoperable with other CARD4L datasets. The framework is intended to lower barriers and engage new communities of users, and that is complementary to other product types.

CEOS Data Cube Initiative is a platform that can support countries to take up methodologies and products coming from initiatives such as GFOI and GEOGLAM. Key criteria are to minimize the effort required to obtain and prepare satellite data with free and open source solutions. The platform should permit time series analyses and the use of multiple datasets together in familiar environments. Currently CEOS is working with Vietnam, Colombia, Kenya and Switzerland, leveraging the Open Data Cube technology, an open source project that invites others to join.

Andy reminded of the CEOS resources, especially the CEOS website which describes many aspects of CEOS and includes tools and resources, and the CEOS Work Plan 2017-2019.

**Action WGISS-43-07**: Michelle Piepgrass to create a webpage on the CEOS website for CEOS lessons learned and best practices

### CEOS 2017-2019 Work Plan Actions

Andy went through the CEOS 2017-2019 Work Plan actions that affect WGISS, giving status for each:

Data-8: Improve WGISS Interoperability Standards Architecture (Q3 2017): This is an ongoing activity being led by the WGISS System Level Team which includes partners from CWIC, FedEO and IDN.

Data-9: ECVs/CDRs discovery and access through WGISS systems (Q3 2017): Once WGClimate has completed their (Meta) gap-analysis across the Carbon ECVC, WGISS will begin the longer objective of data discoverability and access.

Data-10: Reference model for data stewardship planning and implementation (Q4 2017): In progress by ESA’s Long Term Data Preservation (LTDP) Working Group.

Data-11: Technology Exploration webinars and workshops (ongoing): The first Tech Expo Webinar occurred in March, 2017 with the topic of Data Search Relevancy. The webinar was recorded and a YouTube link to the recording was made available on the WGISS website.

Data-12: CEOS data holdings reported in GEO (ongoing): Holding regular meetings with the GEO Data Access Broker (GEODAB) team to improve data discoverability and access of CEOS data in GEO.

Data-2: Full representation of CEOS agency datasets in the IDN and accessible via supported WGISS standards (ongoing): New entries were added to the International Directory Network (IDN) from ESA, EUMETSAT, ISRO, and JAXA datasets.

FDA-6: Technical best practices relating to future data architectures opportunities: A FDA Tiger Team (Andy Mitchell – NASA, Jonathon Ross - Geoscience Australia, Bianca Hoersch – ESA, Rob Woodcock - CSIRO, Brian Killough - SEO) has been formed to do the analysis and writing of materials of the FDA Strategic Assessment Survey. In particular, this first analysis is looking to present the findings surrounding the question ‘What should CEOS agencies do together’ in regards to FDA. The findings will be presented at the SIT-32 meeting in Paris.

Carbon-15: Carbon data portal (Q4 2017): Working with Mark Dowell (CEOS Carbon lead) and Pascal Le Comte (WG Climate Chair), WGISS will begin defining a preliminary set of “requirements” for a future Carbon Portal. WGISS will start with the initial list of ECVs that are key for Carbon and start putting together a list of relevant data collections from identified data providers.

### Systems Engineering Office (SEO) Report

Brian Killough of the Systems Engineering Office gave an update of the CEOS Visualization Environment (COVE), which is a browser-based suite of tools for searching, analyzing, and visualizing actual and potential satellite sensor coverage. He noted that they have added Sentinel-2 acquisitions, and plan an improved coverage analyzer and more links to mission archives.

Brian reported that the SEO is working with GA, CSIRO and USGS to develop an open source architecture for data management and enhanced applications. This “future data architecture” is now called “Open Data Cube”. The SEO is also working with the Land Surface Imaging (LSI) group to develop a definition and technical specification for “CEOS Analysis Ready Data for Land” (CARD4L). The most recent advancements have been Sentinel-1 ARD definition, though there are still some unresolved items. There is a strong desire to use the Data Cube architecture to test data interoperability. Two cases are combining optical and SAR, or using spatially aligned optical datasets with different resolutions.

Brian noted that the rationale for data cubes is that users want to minimize the time and knowledge required to obtain and prepare satellite data, using free and open source solutions, to perform time series analyses, to use multiple datasets together, to use common GIS tools, to “own” the data and keep it locally, and to have customer service and support. The goal is to provide a solution that has value and increases the impact of satellite data.

The Open Data Cube vision is to build capability of users to apply CEOS satellite data while supporting priority CEOS/GEO agendas (SDGs, Paris and Sendai). CEOS agencies can participate through provision of CEOS ARD products and contributing to development and uptake of solutions. To keep the focus on customers, the project would provide training materials and easy installation/maintenance, a CEOS “Open Data Cube” brand that people know and trust, and an active Open Data Cube community for mutual help and support. It should be a scalable solution, supporting Data Cubes in 20 countries by 2022, with key partners (e.g. FAO, World Bank) supporting data cube projects.

Brian described the Amazon Cloud (AWS) Data Cube Demonstration portal and the Lake Chad Water Detection Demonstration. Brian also listed the 13 Data Cube prototypes, three of which are operational, two in development, and the rest under review. For ARD, Brian showed Sentinel-1 ARD processing, and a table comparing CEOS ARD, Google, CSIRO, and GA’s steps in ARD that they follow.

Interoperability test plans include: Demonstrate Landsat 7, Landsat 8, Sentinel-1, and ALOS-PALSAR data interoperability in a Vietnam Data Cube. The first goal is to evaluate the spatial alignment, and the second is to conduct a water application analysis comparing Landsat with machine learning results for S-1 and ALOS. They also intend to ask WGCV to evaluate RSM geolocation errors after resampling.

Proposed WGISS support:

* To continue support to expand the connections from mission archives to the COVE tool. Still need to get links to CBERS-4 and ResourcesSat-2 (AWIFS/LISS-3). Yonsook, Kalpana, and Lubia said that this is possible already.
* To develop an approach for automated discovery, processing, downloading and ingesting of data to support global users with Data Cubes.
* To explore using cloud-based (e.g. AWS) or mirror (e.g. USGS, ASF) archives to create “on demand” Data Cubes for download or even minor analyses.

Astrid asked if Sentinel-3 is in line to get on the COVE tool. Brian said those kinds of missions are not included because the swath is too wide to give any value added. Astrid asked if they use S-1 data for Vietnam. Brian said this was the first opportunity to use S-1 in a DC and they are now ready to introduce it to other countries. For S-2, they have put in a request for data for two new cubes.

Astrid asked about ‘on demand’ DCs; the European hub is not fit for the purpose. Some users want a cube that they download and work with – others want it processed on the cloud and only want to download the product.

Martin asked who is using the COVE. Brian replied that they have 3700 unique users all over the world, with USA and Europe as the largest users. Its use continues to grow as it is publicized more, and requests for upgrades to the system and to add other data continue to be received.

Olivier asked about Open Source data cubes. Brian replied that what Australia developed is available, and the SEO is trying to globalize it. If the data is in ARD format and the ingestor is run, the user interface on Amazon can be connected to any local DC. The DC is available on GitHub. Rob added that it is not using OGC services, but it and creating a plug-in to perform the analysis and download just the products are planned. Brian will distribute some links on where to get the best info on DCs.

Andy asked if COVE provides data access. Brian replied that it does have linkages-if you click on a scene in COVE you will see a link for ordering the data. Andy suggested that perhaps WGISS can help with making fields needed for COVE mandatory.

Brian suggested that he summarize how they connect to current archives, and summarize metadata. He also suggested investigating how to connect COVE to mission archives, and providing WGISS with feedback.

Olivier commented that it would be good to simplify the data model of the GEO JSON. He also suggested investigating the commonalities for how to download the data, and perhaps standards or BPs.

**Action WGISS-43-08:** SEO to summarize how COVE connects to current archives, and summarize metadata.

**Action WGISS-43-09**: SEO to demonstrate the success of connecting COVE to CBERS-4 and ResourcesSat-2 (AWIFS/LISS-3).

### SEO Outreach Activities

Kim Holloway discussed the CEOS webpage, noting that WGISS consistently maintains its pages. She mentioned the rotating banner on the CEOS page, which WGISS has used several times for news announcements. She added that CEOS also uses social media (Facebook, Twitter) to interact with agencies and other organizations; WGISS could use those to publicize upcoming webinars. Kim and the SEO are resources for anything WGISS may want to publicize – videos, social media, webpages, brochures, etc.

Kim mentioned the *Faces of CEOS* short videos that are intended to present CEOS as real people working together on activities that are important to its agencies and organizations, and to convey to the general public why CEOS /WGISS is valuable. For producing videos, she recommended having a clear idea of the intended audience and a concise message. After drafting and perfecting a script, video footage or images with voice-over can be produced.

There was discussion on producing a video of the topic of the FDA based on the responses from the recent questionnaire, or goals and objectives of the project, or interviews of the three co-leads summarizing and personalizing the message. The first step is to agree on the message, the findings, the high level summary, and the timing.

Astrid suggested that the users of the CEOS Data Cubes (e.g. Colombia) could present the story.

### Interaction with WGCapD

Nancy Searby, liaison of the CEOS Working Group on Capacity Building and Data Democracy to WGISS, gave a presentation on capacity building needs and activities. She began with a brief summary of the goals of WGCapD which include to raise awareness of the value of EO data products and services to user communities, and to support CEOS initiatives and help WGs and VCs undertake their own capacity building initiatives, while collaborating with GEO, UNOOSA, and other UN agencies. 2016-17 progress to date:

* Conducted SRTM-30m and SAR training workshops in AfriGEOSS, AmeriGEOSS, and Asia Oceania GEOSS regions
* Identified on-line and hands on training in EO best practices at each agency
* Drafted document available by end of 2017
* Contributed SAR expertise to 2016 AmeriGEOSS Week training
* Collaborated with UNOOSA on SAR trainings
* Provided training resources to GEOCAB, a system to collect capacity building resources

Nancy reported that through European Commission Framework Program 7 (EC-FP7) investment, GEOCAB was developed, with the objectives to provide information that helps users become more familiar with EO applications and opportunities, and to make freely accessible capacity building resources through the resource facility (GEOCAB). Nancy listed the partners for the CEOCAB Portal. GEOCAB Portal goals to move forward:

* Maintain availability of registered resources
* Continue seeking contributions to the portal
* Build awareness of the available resources in the portal
* Track usage and key areas of major interest by users
* Improve categorization and search capability of resources
* Develop the concept of a Capacity Building System of Systems

GEOCAB challenges:

* Requires each Agency to fill out extensive metadata and load resources, a task that nominally has been done already at the individual Agency level
* Only CEOS WGCapD collection is via consistent use of a tag
* Brokered approaches have been discussed by GEOCAB, but funds are lacking
* In recent test, links are broken and the site does not appear to be actively maintained

The approach that WGCapD is taking in the near-term is to post training resources on INPE’s wiki, and to post best practices document when ready on WGCapD site, INPE’s wiki, GEOCAB. She noted that CGMS and WO Global Campus offer other models. Nancy also listed what each agency in WGCapD does now for capacity building.

What could WGCapD be doing in the future and how might WGISS help:

* Collection of single agency resources discoverable at each agency’s storage location.
* WGCapD collection housed together and discoverable.
* User interface tailored for each end user class (decision makers, policy makers, EO professionals and scientists).
* Use cases and trainings available by GEO region, national, sub-national scales.
* Use cases and trainings available by GEO societal benefit area.

What could WGCapD be doing to help WGISS?

* Raise awareness of the value of EO data products and services to user communities, including support to locate and access data, products, and tools, and targeted training workshops
* Support CEOS initiatives and helps WGs and VCs undertake their own capacity building initiatives E.g. guidance on best practices
* Build awareness of WGISS efforts in WGCapD Workshops

WGCapD liaisons to WGISS are Michael Bock/DLR, Senthil Kumar/ISRO, and Nancy Searby/NASA.

Astrid commented that since the Copernicus program is new, they have trainings on their website, and offered to provide links. Chris Lynnes said it was nice to get feedback on how things are working on the ground, and capacity building helps understand what the users are trying to accomplish; this helps the agencies with designing architecture. Nancy commented that someone at NASA is doing that and reporting the information to the agency.

Andy asked if there is a need for improved discoverability of new datasets, noting that CGMS produces an annual report of newly processed products. Nancy replied that it would really help, and perhaps this is an area for WGISS participation. Martin suggested that it is a reasonable extension for the MIM.

Andy suggested expanding the UMM model to include capacity building and workshops; CGMS and WMO have two separate metadata models to accommodate this. Another suggestion is to use WGCapD resources as a focal point for best practices and lessons learned. Astrid proposed adding a link to WGCapD on the Copernicus EU website.

Other suggestions were to support multiple languages (Comet is a good translation service), especially in the area of keywords, and searching for EO data in a particular domain, targeting a specific application area. Andy wondered if there is anything that WGISS can learn from WGCapD while participating in the building of requirements for the Carbon Portal.

WGISS agreed to provide a formal reply to WGCapD on how WGISS can help them and how they can help WGISS.

**Action WGISS-43-10:** WGISS Exec to provide a formal reply to WGCapD on cooperation between the two working groups.

### WGISS Support for MIM and Service Registry

Andy reported that he met with George Dyke, who is working on the CEOS Missions, Instruments, and Measurements (MIM) database. At regular intervals, a call goes out to the space agencies, asking them to update their information into the spreadsheet provided.

Under consideration is enabling machine-to-machine access to CEOS Database content via an API that would enable the content to be embedded and leveraged by external developers. Several potential API users have been identified, including WGISS and the CEOS SEO and it could be expected that other users may develop applications on top of the API once it is published, and internal uses for the API may surface. The initial API functions proposed are:

* API call by mission ID (or name with controlled vocabulary) to get mission metadata.
* API call by instrumentID (or name with controlled vocabulary) to get instrument metadata.
* API call by wavebandID to get instruments with certain waveband properties. (Phase 2, USGS request; need to be confirmed with SEO and USGS.)
* API call by measurementTypeID to get a list of instruments making a particular measurements.
* API call by gcosipECVID (ECV = Essential Climate Variable) to get a list of instruments measuring a particular ECV, and/or metadata about the ECV.
* API call by agencyID (or name with controlled vocabulary) to get agency mission or instrument metadata.

The implementation approach is an incremental development, leveraging to the greatest extent possible existing and established services and frameworks. An initial assessment of the AWS API Gateway calling Lambda functions to access the database for the expected level of service need appears promising. The cost scales with usage, and there appears to be a significant free tier which may end up covering most of the requirements. The development process is comparatively straight forward, and allows the developer to focus directly on writing the code that will power the response. Capacity with AWS is not an issue even for the largest operators, and the application will be very modest in comparison, so scaling is not an issue. Going with the AWS does lead to some platform lock-in, but enables rapid prototyping and spin-up with minimal development effort.

WGISS can help with metadata models, Cloud Computing Lessons Learned, and service registry.

Lubia asked for the types of applications that are envisioned to be developed on top of this API. Andy replied that many agencies are doing this on their own, and the process is being repeated over and over again. This is also the same type of information that SEO needs for COVE. Brian said they get a lot of requests for gap analysis, adding that the data needs to be queryable. Robert said they may have some use cases for OGC services and API calls.

## WGISS Brochure

Andrew Mitchell presented the draft of the brochure that WGISS is preparing to replace the one developed several years ago. Its purpose would be to give a high level view of the work of WGISS, and consist of several pages, each dedicated to an activity, project, or interest group. The brochure could be distributed at meetings that WGISS members attend, and within member’s agencies. The brochure is meant to be dynamic, updated as needed every two or three years. A copy of the draft brochure was distributed, and the participants were asked to provide comments and edits.

**Action WGISS-43-11**: WGISS members, and leads of DSIG, FDA, Connected Data Assets to provide feedback to WGISS Exec on the WGISS brochure.

## ISO TC 211

Liping Di gave a presentation on ISO (International Organization for Standardization) activities, noting that the ISO Technical Committee 211 (TC 211) is responsible for setting international standards on geographic information/geometrics. ISO TC 211 has set up liaison relationship with many related external organizations, including CEOS WGISS:

* CEOS WGISS is a class-A liaison of ISO TC 211
* ISO TC 211 appointed as its liaison to CEOS WGISS
* CEOS WGISS appointed Dr. Wyn Cudlip, Mr. Lorant Czaran, and Dr. Liping Di as its liaisons to ISO TC 211 several years ago.

The scope of ISO TC 211 consists of standardization in the field of digital geographic information, aiming to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. The work of TC 211 shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data. The current working groups in ISO TC 211 are:

* Working Group 1: Framework and reference model
* Working Group 4: Geospatial services
* Working Group 6: Imagery
* Working Group 7: Information communities
* Working Group 9: Information management
* Working Group 10: Ubiquitous public access

ISO TC 211 Metadata standards include:

* ISO 19115:2003- geographic information-metadata: The base standard for geospatial metadata
* ISO 19115-2:2009 - Metadata - Part 2: Extensions for imagery and gridded data, which provided Additional metadata element and structure for remote sensing imagery and derived grid products
* ISO 19115-1:2014 – Geographic Information-Metadata-Part 1: Fundamentals - A revision of ISO 19115:2003 with much improvement in many areas, especially in the description of contents in multi-dimensional data. The Data quality part has been moved to ISO 19157
* ISO 19157:2013 – Geographic Information – Data Quality: ISO 19113 (quality principles), ISO 19114 (quality evaluation procedures), ISO 19138 (data quality measures), and the quality description part of ISO 19115.

XML schema standards for ISO metadata include:

* ISO/TS 19139:2007 - XML schema for ISO 19115:2003
* ISO/TS 19139-1:2012 - XML schema for ISO 19115-2:2009
* ISO/TS 19115-3 (near finished) - XML schema for ISO 19115-1:2014; standard to be published in this year
* ISO/TS 19157-2 (near finished) - XML schema for ISO 19157:2013; standard to be published in this year

Ongoing work on metadata includes revision of ISO 19115-2:2009: Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data. The title will change to ISO 19115-2: Geographic information -- Metadata -- Part 2: Extensions for acquisition and processing. The standard provides additional metadata on data acquisition and processing. Those metadata are applicable to not only imagery but also other type of geospatial data. Currently on committee draft (CD) stage.

ISO TC 211 Imagery and gridded data published standards/specifications include:

* ISO 19101-2:2008 Geographic information - Reference model - Part 2: Imagery
* ISO/TS 19129:2009 Geographic information - Imagery, gridded and coverage data framework
* ISO/TS 19130:2010 Geographic information - Imagery sensor models for geopositioning
* ISO/TS 19130-2:2014 Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, Lidar and sonar
* ISO/TS 19159-1:2014 Geographic information -- Calibration and validation of remote sensing imagery sensors and data -- Part 1: Optical sensors
* ISO/TS 19159-2:2016 Geographic information -- Calibration and validation of remote sensing imagery sensors and data -- Part 2: Lidar
* ISO/TS 19163-1:2016 Geographic information -- Content components and encoding rules for imagery and gridded data -- Part 1: Content model

Ongoing projects that WGISS can contribute to:

* ISO/TS 19159-3 Geographic information -- Calibration and validation of remote sensing imagery sensors and data – Part 3: SAR and InSAR. Currently at work draft (DTS) stage. Andy noted that this is more in the realm of WGCV. He will forward this request to the chair of WGCV.
* ISO/TS 19123-2 Geographic Information – Coverage Implementation Schema. Currently at DIS stage, contributed by OGC.
* ISO 19165 Geographic information -- Preservation of digital data and metadata. Currently at DIS stage.
* ISO 19130-1 Geographic information – Imagery sensor models for geopositioning - Part 1: Fundamentals. Revision of ISO/TS 19130:2010. Currently at DIS stage.
* Revision of ISO/TS 19101-2:2008 -- Reference model -- Part 2: Imagery. Project at CD stage.
* ISO 19123-1 Geographic Information – Coverage – Part 1: Fundamentals. A revision of ISO/TS 19123:2005 Schema for coverage geometry and functions.
* ISO 19150-4 Geographic information - Ontology, Part 4: Service ontology. Project at WD stage.

Standard projects being proposed:

* ISO 19165-2 Geographic Information - Preservation Content Specifications for Earth Observation Data and Derived Digital Products; proposed by US (NASA)
* ISO 19130-3 Geographic information – Imagery sensor models for geopositioning – Part 3: XML encoding; proposed by China
* ISO/TS 19163-2 Geographic information -- Content components and encoding rules for imagery and gridded data – Part 2: Implementation Schema; proposed by China

Liping concluded saying that the inputs from CEOS are very important to ISO TC 211 standard development. CEOS members can submit comments and inputs to the ISO standard project through the CEOS WGISS liaisons to ISO TC 211, or their national body to ISO TC 211. CEOS WGISS can propose and lead an ISO TC 211 standard project. WGISS could also play an important role on the revision to ISO 19123-1 Geographic Information – Coverage – Part 1: Fundamentals. A revision of ISO/TS 19123:2005 Schema for coverage geometry and functions. WGISS is also interested in ISO 19150-4 Geographic information - Ontology, Part 4: Service ontology

There followed a discussion about processing levels, and formalizing these into a standard, and how to better align the work that Liping does with the work of WGISS. Liping reports to TC on behalf of WGISS; Andy suggested other support since Wyn and Lorant are no longer active. WGISS requested that Liping report back about any projects that TC is working on that WGISS can contribute to.

Olivier noted that consideration should be given to the impact of OpenSearch on these standards.

**Action WGISS-43-12**: Liping Di to send project information on ISO/TS 19159-3 to Andrew Mitchell and Mirko Albani so they can forward it to WGCV.

**Action WGISS-43-13**: WGISS Exec to establish ways to integrate the ISO/TS 19159-3 activity into the standard WGISS organization.

# Agency and Liaison Reports

## Chinese Academy of Science (CAS) –RADI

Lizhe Wang gave a presentation of Earth Observation in China from the point of view of the Institute of Remote Sensing and Digital Earth (RADI). He reported that they have had three Remote Sensing Satellite Ground Stations since 2010, allowing for full coverage of China. Currently three more have been added, allowing more extensive coverage of eastern Asia. RADI is a member of the Landsat Ground Station Operations Working Group for acquiring, processing and distributing over 3.3 million scenes of Remote Sensing Satellite datasets since 1986, acquiring up to greater than 500 Terabytes/year at a downlink data rate greater than 1 Gbps.

Lizhe displayed a diagram of the MCCPS system overview, and discussed data integration over eight data centers. He listed their basic data products and thematic products, and discussed the dynamic workflow processing across data centers. Lizhe also discussed regional to Global Quantitative Inverse Products.

The challenges they are facing are RS Big Data Management due to massive data and explosive growth from multiple sources, platforms, resolutions, and sensors. The large scale RS data processing also requires regional to global covering a large region and increasingly longer time frames, and collaboration across data centers. These challenges are compounded by limited resources. To meet this demand, the pipsCloud is an experimental remote sensing cloud platform for RS data processing and data service, with HPC Platform as a service and RS processing as a service. Lizhe displayed a diagram of the system infrastructure; the pipsCloud is a Virtual RS HPC Environment.

Frank asked what kind of cloud they use; Lizhe replied that it is a publicly funded cloud project, used as an open stack. Lingling Ma asked if the data is available to the public for free; it is.

## European Space Agency (ESA)

Mirko Albani gave a report on the European Space Agency’s (ESA) activities. He began by announcing that the ESA Ministerial Council 2016 determined that the budgets for EO. LTDP+ and Earthnet are key EO elements in the ESA General Budget 2017-2021. The Earth Observation Envelope Programme–5th period is the EO backbone programme to implement ESA’s Space 4.0. It addresses societal challenges (climate, water, SDG, etc.) and enhances competitiveness of European space, ground and services industry. It covers pre-development to exploitation, prepares all future missions, and drives scientiﬁc excellence and innovation. The programme brings EO to all levels of society with improved user-ready data access. EOEP-5 secures the continuation of the programme, with signiﬁcantly new content and methods.

Data are central in science and in economy and are the only remaining assets once the mission is ended. Heritage Data Programme not only cares for data preservation of the data, but also for their accessibility/usability. It is implemented as a common programme across ESA with four directorates. The European international gateway for Earth Observation (Earthnet) is for equal and persistent MS access to third party missions (including historical SPOT series, Jason-3, Landsat series, …), with 24/7 coordination of the International Charter on Space and Major Disasters, and a presence in organizations and committees (e.g. UN, GEO, CEOS) and in initiatives for promoting the international use of EO data (e.g. in Africa, China) European Commission.

Mirko described the EO Innovation architectural framework, where DIAS (Data and Information Access Service) is a structuring element of the overall concept. Mirko described live missions or missions with upcoming launches, including mission status and capacity increase for Sentinel-1, -2 -3, and a mission and products overview of Sentinel-5P.

ESA oﬀers free access for all users to Sentinel products (most recent as well as complete long term archive); any user can self-register. ESA delivers on 24/7 basis near real time products (3 hours from sensing) as well as non-time critical products (24 hours from sensing). They have 65,000 registered users. Mirko described the data access hubs and configuration. Mirko provided data dissemination volume metrics, noting that on average, each product published has been downloaded 6 to 10 times (depending on the mission). Many users re-distribute the Sentinel products downloaded from ESA’s data access hubs, allowing to reach a larger community.

## European Commission (EC)

Astrid Koch gave a presentation on Copernicus dissemination on behalf of the European Commission (EC). She began with a description of Copernicus governance, and the big data challenge they are experiencing. A dual approach for risk management is meant to strengthen Copernicus Distribution Services for download, setting up of Data Access and Information Services (DIAS). DIAS gives access to all Copernicus data and information virtually collocated with computing resources, while allowing Big Data analytics without the need to download the data and information and data fusion with non-EO data and information. The functional requirements are publicly available.

Astrid gave an overview of DIAS and of distribution services. In the DIAS concept, provision of front-office infrastructure is under third-party responsibility, and chaining of value adding services between third parties is a key feature for a dynamic market ecosystem. Interfaces enable cross-operations (open API) between multiple DIAS and between DIAS and “other environments”. Third party service providers may integrate data/information from “other environment” in their service provision.

Their objectives are easy and user-­friendly availability and access to all Copernicus data and information, and to maximize uptake and exploitation of Copernicus/ EO data in an efficient environment. DIAS is an enabler, stimulating the emergence of an ecosystem, which facilitates activities by third parties, bringing together research/operational, supply/demand, different data sources (both EO and non­‐EO) and know-how (EO, ICT, thematic). The last objective is defragmentation, increased efficiency and cross-fertilization.

Key elements to be taken into account are technical performance and ability to interact with and attract third-party users. The European user communities are diverse, and need to mobilize the European EO industry. Other key elements are the ability to provide EU Member States a mutualized service offering, the ability to attract additional data, and the ability to support and facilitate third-party value-­added services (e.g. data/ information/applications).

Andy asked where the Sentinel data will be stored; Astrid replied that it will be stored in DIAS and the hubs, and one of the priorities for the EC CEOS Chair will be the use of DIAS.

## Geoscience Australia (GA)/CSIRO

Robert Woodcock gave a presentation of the status of the AGDC Data Cube. He began with a discussion of the CEOS Open Data Cube, a comprehensive solution that builds the capacity of global users to apply CEOS satellite data. It is based on Analysis Ready Data (ARD) products that contribute to the increased uptake and impact of growing data volumes, and is in coordination of GA, CSIRO, NASA, and USGS. The current prototype testing involves Colombia, Switzerland and Vietnam, with more planned. A demonstration is available on Amazon AWS with 14 sample data cubes and 7 applications: <http://www.tinyurl.com/datacubeui>.

Rob reported complete reprocessing of Landsat archive for Level 1, NBAR /T and PQ, and moving scene processes to Datacube for fractional cover and NDVI. A dashboard for visualizing data holdings and dataset metadata has been built. Collection management for providing users with a view of the archive content ensures completeness, consistency, and coherence, as well as syncing to ensure files on disk match Datacube content. Collection management uses version controlled software. Product support includes leveraging of existing datasets on NCI systems and enabling alternate protocols

Temporal stacking ingest uses netCDF: Generation of XYT NetCDF storage objects + chunking. This is an important part of enhancing data access and in managing inode counts, and relates to the combination of a number of datasets into a single file. The internal chunk size can be modified at stack creation time to tailor to a give mode of access (temporal or spatial).

Data Cube use AWS with native S3 support; AWS for exploratory analysis and market access is fast, scalable and accessible, and addresses multi-platform criteria. They are working toward new data structures for EO, aligned with S3 principles, and on analytics to take advantage of I/O concurrency. Performance trade-offs are not yet clearly understood.

Statistics tools add support for deep temporal analysis statistics, and keep full provenance of source datasets. They also split processing into small spatial chunks, never be limited by available memory, and out of the box support for standard statistical means/percentiles/etc. as well as high dimensional stats like medoid and geomedian (soon). These have been developed in a separate repository, but will be merged into core in the next month. <https://github.com/GeoscienceAustralia/agdc_statistics>

Sensor ignorance:

* Require no sensor understanding
* Spectral equivalence measures
* Below using wiki definitions of red, green and blue to find equivalent sensor bands (Landsat TM MODIS)

Earth analytics industry hub:

* Public good component using free satellite data; a global network of interoperable data cubes
* Commercial component; Business processes and engagement to sustain science and data pipelines
* “App Store” of analytics routines; EO and geoscience researchers delivering to minerals, agriculture and environment domains.
* Multi-platform; Data cube applications work seamlessly across Cloud, HPC and the desktop.

## Global Spatial Data Infrastructure Association (GSDI)

Gabor Remetey\* gave the liaison’s report on the GSDI association. He described:

* GSDI in the global geospatial community: GSDI president Dave Lovell is chairing the Joint Board of GI Societies (recently renamed as UN-GGIM: GS)
* WGISS at the GSDI 15 World Conference: WGISS presentation prepared by the WGISS Chair and Vice-Chair was delivered in the Session ‘Geo Technology and Innovation for SDI’ by the GSDI liaison. The CEOS video [(https://youtu.be/xWkuDxGdRjs](http://youtu.be/xWkuDxGdRjs)) was also introduced.
* GSDI and the UN Agenda 2030
* GSDI in the GEO activities
* GSDI in the UN-GGIM activities
* GSDI in the Capacity Building:
  + GSDI and OGC joint involvement in coastal/marine Spatial Data Infrastructure
  + Strategic Project - “GI-NSDI: Towards a Global Index of National Spatial Data Infrastructures”
  + GSDI Coastal/Marine SDI Best Practice
  + GSDI Coastal/Marine SDI Best Practice Webinar #2
* GSDI in the evaluation of the ESA-NASA WWEC 2017.
* GSDI at the Digital Silk and Belt Road Alliance
* GSDI promoting SDGs at national level and making awareness on the important role of SDIs and use of EO and geospatial data

The recent GSDI Council and Board Meeting well received the report on the liaison between GSDI and CEOS WGISS. The presentation was delivered on CEOS WGISS activities at the GSDI 15 World Conference in a session attended by President of OGC, local EO scientists and EO/geospatial experts from UN ACE, NASA, and K.U.Leuven and from industry. GSDIwill support the SDI developments and align with UN-GGIM and GEO/CEOS to support the achievement of UN SDGs by

* Delivering a Global Index of SDI implementation
* Completing the Marine SDI Best Practice Project
* Focusing on capacity building work where it is most needed
* Providing content at Regional Conferences

Andy suggested that GSDI work with the WGCapD working group since they do a lot of capacity building.

## Indian Space Research Organization (ISRO)

Sai Kalpana Tanguturu gave a presentation on the Indian Earth Observation Program. She noted the successful launches of PSLV-C35, PSLV-C36, and PSLV-C37, plus 103 co-passenger satellites. She also described future EO missions, which include CARTOSAT-2E, GISAT-1, CARTOSAT-3, RISAT-1A, OCEANSAT 3 and 3A, and RS Sampler 3S and 3SA. These missions will be used for cartography, urban planning, watershed management, monitoring of events/hazards, cadastral applications, weather condition imaging, crop estimates, disaster management, oceanographic and wind vector applications, and land surface applications.

Andy thanked her for the participation of ISRO in WGISS.

## Japan Aerospace Exploration Agency (JAXA)

Masumi Matsunaga gave a presentation of JAXA’s Satellite Applications and Operations Center (SAOC). She listed JAXA’s past, current, and future satellite/sensor activities.

Masumi discussed the ALOS-2, Global Precipitation Measurement, Global Climate Observation Mission, Greenhouse Gases Observing Satellite missions. She also gave details of future missions GCOM-C, Earth Cloud, Aerosol and Radiation Explorer (EarthCARE), GOSAT-2, and several ALOS successors.

SAOC released the G-Portal format conversion tool; Masumi listed the datasets that can be converted to GeoTIFF or KMZ. She also discussed a diagram showing their data system development plan JAXA is considering future system development to handle data transmission problems, large data volumes, and improved user services.

## National Oceanographic and Atmospheric Administration (NOAA)

Martin Yapur gave a presentation on recent activities of NOAA. He began with the successful launch of GOES-16; the first images usher in a new era of Earth and space weather observation for the U.S. He also listed upcoming launches of polar satellite programs.

Martin described the NOAA EDM Dashboard, the NOAA catalog, and he Big Earth Data Initiative.

The 2017 NOAA Emerging Technologies Workshop for Observations conference is being organized for August in order to continue to provide a conduit for the connectivity of emerging technologies’ research and development activities across NOAA, to create an integrated, impactful, and adaptable observing system portfolio.

## United States Geological Service (USGS)

Kristi Kline gave a presentation on major activities at USGS EROS:

Landsat collection processing is occurring with improved calibration, geometric accuracy, and added/improved metadata. TM and ETM+ is complete, and OLI/TIRS is in process (completion by end of April).

Mirko asked about Landsat MSS reprocessing. ESS also did this; some of the improvements are better cloud cover. New products also have a pixel based calibration file.

Collection definition is progressing; the USGS defined three basic categories of products:

* NRT (Near-real time) – products that are processed using ancillary data such as predicted ephemeris or bumper mode parameters that may be improved by reprocessing
* Tier 1 – products that meet the criteria for the collection definition (i.e. enable time-series stacking, <12m RMSEr)
* Tier 2 – products that do not meet the criteria for the collection definition and have been processed using the best known ancillary data.

Over 4 million scenes added to the Landsat Global Archive Consolidation (LGAC). Over 70% of scenes are unique additional data. Updates to State of the Archive statistics graphically shows impacts of LGAC activities.

Andy asked if they have write-ups on success stories. Kristi replied that they are working on one.

Kristi reported status of Landsat 9: Spacecraft and instruments in development, systems requirements for ground systems will be reviewed at EROS next week. Contract for flight operations in work.

Monthly downloads of Landsat data are showing a huge increase. Kristi showed metrics including customer demographics, user reported primary use of Landsat.

**Action WGISS-43-14:** WGISS to work on a method to harmonize metrics of data use.

# Future Data Access and Analysis Architectures

## Overview

Robert (Rob) Woodcock gave an overview of Future Data Access and Analysis Architectures. The goal for CEOS data is to be open, with interoperable data discovery. A digital economy, with growing EO awareness, and global services and partnerships are leading to new architectures. The FDA Ad-Hoc Team (AHT) surveyed current developments and priorities from a range of agency contributions and confirmed that there are both challenges and opportunities in the operating environment. The report also shows a number of changes that are providing new opportunities and putting pressure on existing architectures and their ability to meet demand and expectations.

CEOS decided that a further year of work is needed to continue exploration of key areas, and for facilitated strategic discussions, with parallel efforts to progress CEOS pilot projects to ensure strategic discussions are supported by real-world evidence. The FDA AHT’s task in 2017 is to establish consensus on what the CEOS FDA strategy should focus on from the various topics identified in the interim report. In February, an FDA Strategic Assessment Survey was released for comment. Responses were received from 14 organizations, including CNES, CSA, CSIRO, DLR, EC, ESA, EUM, GA, INPE, ISRO, SEO, UKSA, USGS, and WGISS. The first analysis is looking to present the findings surrounding ‘What should CEOS agencies do together to help users benefit from *all* CEOS data’, contrasted with current approaches which help improve unity of ‘discovery’ but send users off to disparate incompatible systems once they have discovered some data. Users also need to re-write their application to use alternate (but similar) sources and move large amounts of data to the compute capacity they can access.

What should agencies do together or alone? What actions have greatest potential benefit? There were many common responses and desires, including cloud and data platforms, interoperability, and open source tools. Users want data systems and analysis tools that allow easy access and use of satellite data; they want to easily use different satellite data together, and they desire ARD to minimize data preparation time and knowledge requirements. Users also expect interactivity, even with very large data.

Rob discussed a shift from interoperability which is usually limited to data discovery, to “integratability”, which also includes using the data.

Overarching comments from the survey, which are quite relevant to WGISS, include:

* Reduction of barriers to find, access and exploit EO data
* Sharing of business practices, lessons learned, and usage metrics to form a CEOS information base.
* Better understanding of data users and their needs and expectations.
* Development and management of data access and management approaches.
* Gathering of requirements for Analysis Ready Data datasets
* Creation of reference architectures and implementations (that test and demonstrate) for interoperable use of CEOS services
* Creation, adoption and testing of common standards on EO data that will facilitate EO data interoperability.

It is important to know the role of reference architectures such as OGC Reference Model and OGC Services Architecture.

Emergent first steps: A pilot, prototypes and enabling technology work underway within SEO, LSI-VC, GFOI, TEP and WGISS and others. For ARD, there are many issues with standards development and ongoing consensus. Improvement through use of dynamic on-demand processing, requiring provenance, algorithm registration and discovery are considered. Automated discovery, processing, downloading and ingesting of data into Data Cubes are also key topics.

FDA Principles:

|  |  |  |
| --- | --- | --- |
| Interaction | Discovery and Download (files)  User provides compute | In-place analysis of ready-to-use data  User application, data and compute combine from different parties on-demand |
| Integration | Single sensor discovery  Integration a user problem | Comparable observations  Global multi-sensor analysis routine |
| Interoperability | Discovery of files  Emphasis on access | Refined discovery of pixels  Emphasis on usability for analysis |
| Interfaces | Independent application development over data  Agency stores and distributes data | APIs, Virtual Labs enabled by standards  Use of third parties for storage, distribution and analysis |

User categories and characteristics:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| User Type | Examples | Data Volume | Knowledge Capacity | Computing Capacity | ARD Requirement |
| Data Holders | Google, Amazon, SERVIR | High | Medium | High (cloud, HPC) | Not required, as they will grab  what is available |
| Science | Researchers, Analyses | Low to  High | High | Medium (PC, cluster, cloud) | Varies …  some desire ARD, others do not |
| General Global Public | Developing Countries, New Users | Low | Low | Low (PC, cluster) | Typically desired |

Pilot Projects:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Location | Colombia | Switzerland | Vietnam | USA | Europe | Australia AGDC + Industry Hub |
| CEOS Lead | SEO  (Brian K) | SEO  (Brian K) | CSIRO (Alex) | USGS  (Brian S) | ESA (Mirko) | CSIRO, GA  (Rob, Adam) |
| Partners | IDEAM | UN-GRID Geneva | VNU, VNSC | BU, USGS EROS | EPOS/INGV | NCI |
| User agencies | Colombia Gov. | Swiss Gov. | FIPI, Vietnam Govt. | U.S. Gov. and Public | European Governments and Researchers | Australian Govt.,  Industry, and Public |
| Application(s) | Forest (GFOI), Change Detection (CCDC, BFAST), Water | Land Change, Water | Water, Agriculture, Disasters, Forestry | LCMAP and CCDC  (6 national  test sites) | Geohazards | Land Change, Water |
| ARD requirements | L-5,7,8, MODIS, SRTM/ASTER Future: S1, S2 | L-5, 7, 8.  Future: S1, S2. | L-5, 7, 8 + S1 + ALOS-1/2. Future: S2 | L-4,5,7,8, S-2 (future)  Resourcesat-1, -2 (future) | S1, S2 | L-5,7,8, MODIS,  S-1,2, SRTM |
| Other Information | Open Source  AWS Demo  Analysis to Data | Open Source  AWS Demo  Analysis to Data | Open Source  AWS Demo  Analysis to Data | Data Download | Analysis to Data | Open Source  Analysis to Data |

Andy suggested displaying the requirements for being an FDA Pilot.

Rob explained the CEOS Open Data Cube:

* Based on an open source operational system: Australian Geoscience Data Cube (AGDC).
* The Open Data Cube, is a comprehensive solution that builds the capacity of global users to apply CEOS satellite data.
* Based on Analysis Ready Data (ARD) products that contribute to the increased uptake and impact of growing data volumes
* Coordination between GA, CSIRO, NASA, USGS to manage an open source software repository: <https://github.com/opendatacube>
* Current prototype testing in Colombia, Switzerland and Vietnam, with more planned.
* Free/Open demo available on Amazon AWS with 14 sample data cubes and 7 applications: <http://www.tinyurl.com/datacubeui>

The Open Data Cube pilot projects have resulted in a number of key “lessons learned” that will improve the success of future deployments. These include:

* Users want “customer service” and on-demand help to resolve issues, especially during initial deployment
* Users prefer ARD to reduce processing burden, but they still have many issues getting old or new data
* Most users want to use QGIS as their GIS tool
* Switzerland has a preferred DEM, that is local, not public
* Colombia has issues with cloud masking and does not like the standard Landsat CFMask flag

Themes that need attention:

* Doing and learning: Pilots of different architectures/approaches – engaging users and other key stakeholders (e.g. partner governments, World Bank, etc.). Includes producing “ARD” – make it real to find the challenges.
* Technical frameworks: Architectural recommendations and best practices, an ARD framework, and User Requirements framework.
* Community dimension: Fostering engagement, e.g. open source community, algorithm sharing, etc. and measuring engagement
* Strategic dimension: What do we need to do *together* to support uptake of satellite EO data from the “CEOS Constellation” e.g. in support of key global agendas? What should CEOS do to support agencies to do their own things, e.g. best practices etc.? What should be ‘outside scope’ for CEOS?

Suggested ways to achieve the goals are to:

* Grow a community of contributors to underpin FDA technology (e.g. Data Cube) … CEOS, countries, domain experts
* Prototype demonstration projects … 3 now + more
* Develop a FDA Learning Center with documentation, training tools, and a user forum … end of 2017
* Conduct frequent training workshops and webinars
* Agency focus on ARD creation and provision - WGCV
* Leverage WGISS existing and expand capabilities
* Engage key stakeholders who can help with scaling and sustainability

Rob urged WGISS to continue to support existing efforts on:

* Discovery Search Engine Optimization  (search relevancy, keyword search, persistent identifiers)
* Access Common Standards for Interoperability of Product Formats (metadata/data) and Application Program Interface (API)
* Exploration of Emerging Big Data services including Cloud Computing

Frank suggested clarifying the audience of the paper. The team is taking a top down approach to develop the paper, to go beyond vision, to sharing what is being done and learned, and finding the commonalities. Ultimately the goal is to enable greater cooperation.

Emily Law pointed out that, in addition to meeting the needs of the users, they must focus on the structure, and the sheer volume of data. There are aspects of FDA that are driven by technology change. She also noted that the entire life cycle needs to be addressed; this drives the future missions, knowing what data to collect in future. Emily also commented that identifying the stakeholders is key to understanding the audience of the paper.

Other comments included making a clear distinction between data holders, providers, encapsulating in the work the end-to-end process, and clear identification of the users. Mirko added that there was some work done in GEO to identify five user categories. The challenge of incorporating the needs of GEO is that there are so many user groups in GEO. The architecture of the DC so far does meet the needs of all the use cases encountered.

## Federated User Management

### ESA EO Federated Identity Management Activities

Albrecht Schmidt\* described ESA’s EO Federated Identity Management Activities. He began with the FIM Pilot, an EO Data Service.

* The EO Data Service is a pathfinder Federated Identity Management (FIM) infrastructure deployed on the EO Innovation Platform Testbed (IPT) in Poland. The EO Data dissemination service is available both to local users and to federated users coming from IDEM and eduGAIN federations. Federated login is supported by a discovery service that allows local users to login on the EO Data Service Identity Provider, and federated users to login on their home organizations’ Identity Providers. Deployment and integration with IDEM/eduGAIN federations. Mainly administrative and interoperability challenges. FIM is a tool for co-operation with partners in the space sector (with EUMETSAT, DLR, and other partners such as CNES and NASA). Operation use, as defined usually by ESA, to be further consolidated. Refine elements such as SLAs, availability, operational procedures, configuration management, and TRLs. The ratio between services and identity providers was displayed by region.
* ESA EO - Copernicus Federation: Since the ESA EO SSO software is used for both ESA EO and EC / Copernicus services, a federation between the two user communities would be natural. There are actual use cases which we desire to implement to support this for selected services, especially unidirectional. There are differences in the procedural setup of the two federation members. However, level of trust or assurance is very high in such a controlled environment. Technically, the federation is based on Shibboleth / SAML and an Attribute Authority. Service providers will have to add a discovery facility to let users choose their home IDP. The development places an emphasis on standard tools and configurations.

Current exploratory activities include:

* OAuth2 and OIDC; Open ID Connect often seen as a more modern alternative to SAML. The ability to generate, validate, pass on and consume tokens is the basis for machine to machine communication outside the browser world. Preferred option would be to support parallel SAML and OIDC resource protection. There have been experiments with ECP but little uptake so far. There has been an STS/PEP-based solution which is used on the Copernicus side and proposed for the upcoming OGC Testbed 13.
* User Management Tools and Processes: Anonymous / homeless users are principal community. Challenge to procedures, standards, and services. Once they are registered, they might submit project proposals, for example, and get better known (higher level of assurance).

Andy commented that it is interesting that they are investigating a federated method for Copernicus, and ESA EO.

### NASA

Brett McLaughlin\* gave a presentation on Earthdata login and OpenID, looking at federated user identities. Earthdata’s login goals are to provide user access information related to ESDIS- and ESDIS-affiliated systems for use in metrics and analysis; to allow users to create and maintain a profile for preference-based data sharing between applications; and to lower the barrier of entry to application from true authentication to user “identification.”

Brett briefly described OpenID. OpenID Connect lets app and site developers authenticate users without taking on the responsibility of storing and managing passwords in the face of an internet that is well-populated with people trying to compromise your users’ accounts for their own gain.” The approach is to use Open ID first, Earthdata login (and OAuth 20) second. Participating providers are AOL, Google, PayPal, Verisign, and Yahoo.

Pros of OpenID Connect transfers the burden of authentication from a managed system to a trusted one. It introduces best practices in password/account management, and relies on established OpendID Connect partners. Cons of OpenID are that it introduces additional API and interoperability concerns, and could result in information redundancy between Earthdata Login and OpenID Connect partner. It also exacerbates the “which password” problem for users with lots of accounts.

Rob observed that the federated and OpenID methods do not provide the knowledge of who you are associated with.

Emily recommended using INCommon; it and other technologies are also great, and leaning towards cyber security.

It was agreed that a larger federated authentication discussion is needed.

**Action WGISS-43-15:** Technology Exploration to plan a federated authentication discussion.

## Prototype Systems

Various prototype systems were described.

### NASA EOSDIS Cloud Prototype Systems

Chris Lynnes discussed the NASA EOSDIS cloud prototype systems, as they deal with the challenge high volumes of data, and how to deliver these data to end users in a usable manner. Key cloud benefits for science users:

* Lower Barrier to Entry: Immediate direct access to data; immediate availability of compute
* Scalable Performance: Dynamic scaling for bursting Variety of CPU and GPU
* Cost: Purchase compute as needed Spot market for cost control No need for local copy of data
* Decrease in startup time for projects Analysis at scale for anyone Rapid iteration enabled
* Repeatability & Sharing: Experiment replication enabled Sharing of complex analysis workflow
* Promoting Science Discovery: Decrease in startup time for projects Analysis at scale for anyone Rapid iteration enabled

Key cloud benefits for data systems:

* Cost-Effective: Costs only for the compute and storage used Separate accounting for project/function
* Scalable Performance: Auto scaling, elastic load balancing Adjustable duty cycle
* Flexibility: Storage type, CPU size Operating system, languages
* Deployment Speed: Simplified procurement + provisioning DevOps automation
* Accessibility: Data next to compute; all data in the same virtual “place”

Decision considerations are cost, security, performance, and operationality. The most obvious-yet-surprising lesson: 35% savings from just the Test Environment. Efficiencies coming out of web object storage have also been seen, leading them to believe that they have not been thinking cloud-natively enough. This can lead us to more efficient architectures. Rob commented that there are huge efficiencies and cost savings with the spot market.

Martin asked Chris if NASA sees this as a two-way process for community applications; Chris replied that so far it is viewed as one-way, but the mindset is changing, and the thinking of NASA is of being in a cooperative framework with the user community. The server-less approach represents a coherent evolution of abstracting the resources available, and is the logical evolution of cloud computing.

### CNES Data Cube

Erwann Poupart\* gave a presentation of the CNES Data Cube. Their first experiment is with flood detection and flood prevision in India, using the Australian Geoscience Data Cube V1, with integration of CESBIO algorithms into the AGDC framework. Experimentation consisted of machine learning (apache spark) algorithm for the flood prevision use case. For this, five Data Cube ingestors were built.

One reference image has to be defined, and automatic thresholds computation for each image in the time series have to be identified. Results are recognition of permanent water areas, flooded/dried areas, permanently dried areas. The results were interesting.

Flood risk forecasting with the DC: Precipitation risk computation, soil moisture flood risk computation. Result: 5-class probability of a flood event (worldwide) at SMOS resolution (25 km). Machine learning experimentation (Spark, MLLib library) is underway, comparing previsions with observations. Difficulties include the handling of heterogeneous resolutions from SMOS and Sentinel1 data.

Lessons Learned summary:

* Very interesting concept. However, how to ease the use of heterogeneous data with heterogeneous resolutions? What size of data cube tiles?
* Some other points about performance that came out the study: May be deprecated now? File access parallelization? Python HDF5 vs Python GDAL binding, compression methods, etc.
* BIDS’16 conference: Flood forecasting and monitoring using Sentinel-1 and SMOS satellites; a supervised and predictive modelling.

The second DC experiment was a Jupyter notebook experimentation and comparative study, using AGDC V2 and Sentinel-2 data. The main goal was to focus on Jupyter notebook to show prototyping capabilities using Sentinel-2 data, and comparison with some Google Earth Engine capabilities, etc. A prototype has been built: AGDC V2 installed natively on one physical node of CNES HPC cluster, Jupyter notebook server « docker-installed » on one frontal processing Linux server. This prototype is currently being used to study how to use CNES Orfeo ToolBox (Open Source processing library of remote sensing images) in the AGDC framework.

The Data Cube concept is a good concept; what about the idea of a *Pyramidal Data Cube* concept, with the goal to ease the processing of multi-resolution data. This concept does already exist in Google Earth Engine and is called “scale of analysis” which is the resolution used for the data processing. The scale at which to request inputs to a computation is determined from the output. CNES has planned a study on this topic that should start at the beginning of 2018. Machine learning in the area of image data classification is also in the plan.

Erwann showed a diagram of the CNES Copernicus data processing architecture.

Rob encouraged to engage in the open DC initiative to enable farther and easier engagements. He commented that he would like to know more about Orfeo ToolBox. The pyramidal idea has come up before; should be able to produce one, and can also be left to the user. He invited similar suggestions, noting that OGC just endorsed the discrete global grid standard (DGGS), which will be an important part of how the hierarchical grid are done. Brian K. added that they are doing some nested grid already.

Brian K. added that it would be great to have CNES as part of the Open DC.

### GEOHazards Exploitation Platform Pilot Project

Mirko Albani gave a presentation on the Geohazards Thematic Exploitation Platform (TEP) project. He began with the objectives of the geohazards community and introduced Geohazards TEP (GEP). The GEP is funded by ESA since October 2015, with a number of partners. It is providing an innovative response – an EP sourced with data and processing relevant to the geohazards community. The platform is operational with more than 60 users. Over the 2016-17 time period, the GEP will have 10-20 projects. The available data is Sentinel-1, -2, and -3, ERS and Envisat SAR data. There is also data from other organizations. The three main scenarios for users: EO data exploitation, new EO service development, and new EO product development.

The purpose of the project is improving access to data collections relevant to geohazards community. They have engaged a substantial user group of early adopters. Mirko displayed the GEP roadmap. The goal is an open, consolidated and stable service in November 2017.

Mirko showed examples from the earthquake in Italy in 2016 and an earthquake in Japan. The results show vertical displacement from pre and post event. Astrid remarked with the mudslide in Colombia, one can see the real boundaries.

Rob asked how to get the lessons learned from this project into the FDA white paper. Mirko replied that the GEP is one of the pilots for the FDA, and the team will ensure that the contributions are made available. A more technical presentation will be given at WGISS-44.

Richard asked if they designed an interface for the user software. Mirko agreed to ask the project team. Olivier said that the system has heavy usage of OGC standards; in terms of interface, this is something that can be taken to the OGC.

### INPE Data Cube

Lubia Vinhas described several initiatives at INPE for data cubes. Long time series of EO data play a crucial role in INPE’s operational and research drivers, especially for land use/cover change. One significant question is whether to process the time dimension first, or the space dimension. With time first, the time series are classified first, separately, and the results are joined to get maps. With space first the images are classified separately, and the results compared in time. Lubia discussed MapReduce streaming analytics processing.

The architecture is based on array databases. They are looking for methods and real applications, and she showed some examples. Lubia explained reproducibility of the platform:

* e-sensing
* Time-Weighted Dynamic Time Warping for satellite image time series analysis – dtWSat
* Satellite Image Time Series Analysis – SITS
* Earth-Observation Time-Series filters –eotsfilter
* Docking options under study

The next steps are validation of results, improvement of the methods and of the interfaces to access data and results through OGC WMS and WCS. Domain services such as WTSS and WTSCS Web Time Series Classifying Service, and other methods and applications with researchers and partners are envisioned.

Currently INPE has no cloud computing or commercial initiatives. “A global network of interoperable data cubes” is a very interesting idea. Analysis Ready Data for Land is a key component; INPE is especially interested in data integration with CBERS-4 data, validation, and capacity building.

Andy wondered if the CBERS algorithms are open. Lubia replied that from CBERS they have not delivered any ARD Products; these initiatives would push forward to do that. Brian K. noted that a lot of examples using it were shown; though it is small subset of experimental data. Brian noted that the focus has been Landsat and Sentinel, but are interested in bringing CBERS along. Brian can work on this with INPE on this.

Brian asked for clarification on TWDTW. Lubia indicated that it is used for classifying the time series; it is a time stretching of DTW. They will soon have approaches in Brazil to do in the rest of the country what they are doing now in Amazonia, representing 5 biomes. Data cubes will be extremely necessary.

Lubia concluded saying that INPE wants to work with the technology of the cubes, and be part of the team. The idea of having a network of DCs is very intriguing.

Rob requested further sharing of the use of SciDB, which is unique.

### USGS Data Cube

Brian Sauer\* gave a presentation on the USGS EROS Land Change Monitoring Assessment, and Projection (LCMAP). LCMAP is a capability to continuously track and characterize changes in land cover, use, and condition and translate such information into assessments of current and historical processes of change as a science foundation to support evaluations and decisions relevant to environmental management and policy. Basic foundational elements include:

* “Analysis-ready” Landsat archive (ARD).
* Land change and land cover data derived from all available cloud- and shadow-free Landsat pixels.
* Independent reference data for validation and area estimation.
* Assessments focused on land change processes, characteristics, and consequences.
* Scenario driven projections of future LULC extents and patterns.

Land cover, use, and condition monitoring objectives are the generation of science-quality land change products from current and near-real time Earth observations (e.g., Landsat). Other objectives are land change detection system that characterizes historical land change at any point across the full Landsat record, detects land change as it occurs, and includes an information delivery capability that (eventually) provides global, seamless, multi-temporal land change (cover and condition) products via the Internet.

LCMAP near-term goals are for all United States (with eventual global expansion) a robust capability that uses daily Landsat observations to detect landscape change as it is occurring; a transformative Landsat science data archive that is “analysis ready” and capable of supporting near real-time science and applications; scientific and geographic evidence of the value of high frequency land change monitoring for improving the understanding of US change dynamics.

Brian displayed a schematic of the science system, and listed architectural components: a way to curate data, and get it into DC or Information Warehouse, followed by a science execution environment, and access and exploration.

LCMAP is currently supporting science evaluation of products over six test sites. First priority are Land Change Products; second priority are Land Characterization Products. Upon completion of evaluation period, the products will be generated operationally over the U.S.

The LCMAP system has deployed an initial test bed and continues system improvement and automation. Information warehouse and data store is using a hybrid cloud to store. They are working with test areas, and an API has been developed to access ARD. Evaluation use cases include pixel-level public access of ARD. The science execution environment is using hybrid cloud, running continuous change detection, with plan to produce US land change products in 2017. Access and exploration is using time series tools for evaluation and verification. The plan is to put land change products into Earth Explorer for download, and evaluation use cases for pixel level public access. They expect to contribute to Open DC in collaboration with SEO, GA, and CSIRO.

Lessons learned:

* To ensure that the systems, products, and information meet end-user needs and are of the expected quality, obtaining user input and incorporating a robust product evaluation and validation process is critical. User involvement is critical and products need to be evaluated through a robust process to obtain the desired benefits.
* The technology and systems necessary to ingest, warehouse, and allow access to pixel-level satellite data can become quite complex. System scaling and the effort required to develop these architectures should not be underestimated. Within the CEOS community, we need to work together rather than everyone doing their own thing.

USGS Landsat access goals:

* LCMAP has been a pathfinder for modernization
* Goal to modernize access to the Landsat archive
* Scientists are working on a global ARD definition and plan to have an initial draft available at the summer Landsat Science Team (LST) meeting in July. The Landsat ARD product suite for the Landsat archive could be as large as 4 PB for a single collection
* Produce Analysis Ready Data (ARD) global
* Enable access to the FULL Landsat archive at the pixel-level
* Public API(s) for user access
* Goal is start internally with U.S. ARD that is scheduled to be generated by August
* Pathfinder for global

Andy asked for reasoning on hybrid cloud. Brian S. replied that originally they were working with a study team, and did not have the need to put in much data. Under those circumstances the cost of using the cloud it was quite expensive. Now it is clear that the cloud is a very scalable approach. The trick is the size of the Landsat archive; free file data for download is offered, but not necessarily the pixel level, which would be expected in the cloud. Need to work with vendors in partnership (industry/government).

Andy asked if the ARD is that the same CARD4L. It is; some communities want top of atmosphere ARD. It is diverse, have to offer suite of products. The global WELLS is a pathfinder for USGS.

Kevin Murphy asked which communities would have access to these capabilities for the exploitation of all this data. What are the policies that will have to be applied for the analysis and product information? Agencies are paying for the compute. Brian S. replied this is an open source toolkit. Using the toolkit, the pixel level access is enabled, but user pays for the compute. Lubia noted that the specialized communities come from the specialized applications that are being researched. Kevin said that making everything openly available affects the architecture and the products.

Andy suggested adding this work as another column to SEO’s open data spreadsheet. Brian S. highlighted the need to ensure that control of the quality is not lost, and products are validated. Kevin discussed block chain technology for controlling provenance. Richard asked for an experience report from USGS. Emily noted that the business model for serving the communities is important.

### Colombia Data Cube

Brian Killough reminded the participants of the prototype for Colombia is a complete country-level Landsat Data Cube (25,000 scenes back to year 2000) was completed in Dec 2016. Brian listed their current work items:

* Colombia team has issues running WOFS (memory overload). They also desire to run WOFS on L5-L7-L8 over long time periods.
* Colombia desires to merge their local UI with our application UI.
* Colombia team has Landsat cloud mask issues (CFMASK). Gustavo will provide GeoTIFF (input), GeoTIFF (output) and cloud mask samples. The SEO will explore “machine learning” options.
* Colombia asked for support to run the median mosaic algorithm on their Data Cube. We will also look into using the new GA geometric median mosaic.
* The SEO will explore putting Colombia Sentinel-1 data on AWS. We will consider developing some statistical output products.
* Colombia asked if it is possible to get NetCDF ARD for Sentinel-1 from the Alaska Science Facility (ASF). This is basically the concept of a “data cube on demand”.
* The Colombia team would like us to explore WMS data cube links to QGIS.

Future support to UN sustainable development goals:

* Objective: Investigate how CEOS satellite data can augment or improve statistical analyses to support UN-SDGs for Colombia.
* UN-SDG: Goal 6 = Clean Water and Sanitation. Target 6.3 (water quality) and Target 6.5 (water resource management). Indicator 6.3.2 (proportion of bodies of water with good water quality) and Indicator 6.6.1 (change in the extent of water related ecosystems over time).
* Approach: Gain an understanding of how CEOS data could support statistical analyses in support of the UN-SDGs. Utilize the existing country-level data cube, installed at the University of Andes and IDEAM, that includes Landsat-7/8 and Sentinel-1/2 data (coming soon) and demonstrate applications for the detection of water (WOFS algorithm) and water quality (Total Suspended Matter).
* Brian Killough recently participated in a meeting with the Colombia Statistical Agency (DANE) to explore options and is working with NASA on next steps.

Andy suggested using an OGC testbed for the Sentinel data.

## OGC TB13 EO Cloud Thread

Cristiano Lopes gave a presentation of the OGC TB13 EO Cloud Thread. The OGC Testbed 13 is part of the Open Geospatial Consortium (OGC) Interoperability Program (IP). The IP provides global, hands-on, collaborative prototyping for rapid development and delivery of proven candidate specifications to the OGC Standards Program. A Testbed is a collaborative research and development effort to develop, architect, test, and demonstrate candidate standards for interoperability. In a Testbed participants collaborate to examine specific geo-processing interoperability questions posed by the initiative’s Sponsors.

The TB13 EO Clouds Thread is composed of two independent Work Packages, and is sponsored by NRCan and ESA. The idea is to look into how Cloud APIs can be standardized, so interaction with different clouds would have minimal impact on the customer’s components. Changing cloud services across providers would be a smooth experience. They are also investigating how to easily transfer an application or application components from one cloud service to a comparable cloud service and run the application in the target cloud service, without making significant changes to the application code.

The primary objectives for Testbed 13 are an Application Package for (Thematic) Exploitation Platforms and the definition of a package for user applications enabling automatic management (upload, deploy, run) and sharing between platforms and the definition and execution of bulk processing (time-driven) for historical data and continuous data generation. Secondary objectives are to gain experience with GeoJSoN OpenSearch extension (17-003r0), AuthN and AuthZ (IdP+STS) in interoperability context, and accounting information exchange interface between platforms. Cristiano showed an architecture overview diagram, and an application portability diagram, and discussed two scenarios:

Scenario 1: historical data generation:

* User selects an Application
* User selects a processing window parameters, as Start time -> stop time, N days shifting window, and N days shift
* User selects execution parameters of the Algorithm, such as input products selection rules, e.g.: AOI: Romania, Cloud coverage < 10%, and Cumulative time coverage: all available data. User also selects algorithm processing parameters
* User runs a Bulk Windowed execution (multiple windows are launched in parallel)
* User is notified at the end of the processing and can access the status of the different processing windows

Scenario 2 is a continuous weekly data generation similar to Scenario 1, with the following differences:

* Frequency (“each week on Tuesday”) and shifting window relative to execution date (e.g. “execution day -8” to “execution day -2”)
* User are notified upon each window execution completion
* Processing is repeated until manually disabled

The EOC thread deliverables are:

* Cloud API interoperability: Cloud Engineering Report with a 2 x Cloud environment (WPS, WMS, WCS based)
* Application portability: Application Package Engineering Report, with a 2 x Application Management Client. An Application Deployment and Execution Service Engineering Report with a 2 x Application Deployment and Execution Service Implementation

Cristiano concluded with their schedule and references.

Rob asked if execution of the application occurs on the cloud; Cristiano replied that yes and that scalability is part of the experiment.  Richard asked if there is a link between this work other standardization initiatives in Europe. Cristiano replied that no specific alignment is in-place (considering the context of a test) but will be considered for the future.

Rob noted that this is effectively a Datacube in the cloud. The focus is on the standards that will be used, recommendations of what is missing. Brian observed that any standards that are developed will be incorporated in the Open Data Cube.

It was agreed that WGISS would like to continue to be informed of the progress and outcomes of the OGC Testbed 13, part of the OGC Interoperability Program, activity.

**Action WGISS-43-27:** WGISS Exec to include a presentation at WGISS-44 on the progress and outcomes of the OGC Testbed 13, part of the OGC Interoperability Program, activity.

## Moderate Resolution Sensor Interoperability (MRI)

Brian Killough presented a CEOS Chair initiative called Moderate Resolution Sensor Interoperability Framework (MRI). This initiative addresses the CEOS strategic objective to encourage complementarity and comparability among the increasing number of Earth observing systemsin the moderate resolution class for both optical and SAR sensors and the data received from them.

Brian explained the deliverables, framework, and coordination. The MRI initiative provides a framework within which interoperable solutions can be identified and documented.

* LSI-VC agencies work with GEO and other user communities, such as GFOI and GEOGLAM, to evaluate and implement solutions. FDA pilot projects seek to exploit these opportunities.
* The WGCV is instrumental in coordinating the calibration and validation of sensors
* The WGISS is versed in metadata standards that describe image data for use in analysis and for search and discovery

Brian listed the general and per-pixel metadata and the MRI implementations. The MRI case studies will provide multi-sensor applications guidance for the user community. The user community is rapidly transitioning to surface reflectance, surface temperature, and gamma-naught SAR products. The user community is slowly transitioning to the analysis of deep and dense multi-sensor time series stored as data cubes. The 2017 MRI initiative case study deliverable will provide a user guide providing lesson learned for the interoperable use of Landsat and Sentinel-2 data. Brian concluded with the project schedule and the MRI team.

Richard wondered if the metadata model needs to be extended to the pixel level. Need to extend our metadata model? This is a subject for discussion. Olivier said this is metadata on ARD which might not be applicable to L0 and L1 metadata.

## Collaboration Session

Rob Woodcock led a collaborative session on future data access and analysis architectures. He displayed the principles of FDA, and the themes that need attention:

* Doing and learning: Pilots of different architectures/approaches – engaging users and other key stakeholders (e.g. partner governments, World Bank, etc.). Includes producing “ARD” – make it real to find the challenges.
* Technical frameworks: Architectural recommendations and best practices, ARD framework, and User Requirements framework.
* Community dimension: Fostering engagement, e.g. open source community, algorithm sharing, etc. and Measuring engagement
* Strategic dimension: What do we need to do *together* to support uptake of satellite EO data from the “CEOS Constellation” e.g. in support of key global agendas? What should CEOS do to support agencies to do their own things, e.g. best practices etc.? What should be ‘outside scope’ for CEOS?
* Connection to CARD4L.

Rob also listed CEOS achievements related to FDA.

Mirko said the kind of concept in Europe is to put in place a framework where there is data and processing power available to the user. The idea is to put in place an infrastructure that can enable closer commercial use. At the moment ESA is not considering data cubes, though DCs may be an app on top of the system, or as a service.

Several points were raised: investigating EarthCube, a science keyword translator, the contribution of DIAS, the different business models of the three big cloud providers;

To come up with a roadmap for the white paper, Rob referenced back to the list of how to reach the objectives of FDA, and suggested forming a tiger team.

**Action WGISS-43-16:** Robert Woodcock, Mirko Albani, and Andy Mitchell to provide inputs to the FDA report.

**Action WGISS-43-17:** WGISS Exec to identify a topic for a white paper in support of FDA technologies/discussions; recruit a writing team to write the paper.

# GEOSS-WGISS Interoperability Workshop

Andy Mitchell introduced the GEOSS-WGISS Interoperability Workshop, saying that the purpose is to better integrate the work of WGISS and GEOSS and the GCI. CEOS via WGISS is the largest provider to the GEODAB. WGISS is working to improve metrics reporting and data access and discovery, working on complementary activities, and sharing resources.

## GEO Report

Osamu Ochiai\* gave a status report on GEO. He began with the vision, partnerships and members. He stated a high level commitment to use EO for policy by ministerial declaration at GEO Plenary XII in Mexico City. He noted a commercial sector panel SDG support at GEO XIII Plenary, and a new look for the GEOSS portal. His focus is on how to get benefits from GEO and how to help GEO.

Osamu mentioned the GEO support to the 2030 agenda, with17 goals and 100+ targets. GEO integrates use of EO data into the methodology of measuring and achieving SDG Indicators. A brochure produced by GEO in March 2017 gives graphic illustrations of the types of EO data sets and images available for improved policy and decision-making.

A few of GEO’s Sustainable Development Goals (SDG) were described. These are informed by GEO’s Agricultural Monitor, by the Ramsar Convention (mapping extent and annual changes in the global mangrove cover), by aerosol data, and by tree cover extent and forest loss and gain over time (GFOI).

The Paris agreement national reporting is supported by GEO’s Carbon and GHG Initiative, which coordinate systems to make data available to stakeholders. The Sendai Framework, GEO’s Data Access for Risk Management (GEO DARMA) is building a synergy Framework for the Integration of Earth Observation Technologies into Disaster Risk Reduction. The UN Convention on Biological Diversity (CBD) Aichi Targets can be measured by countries with support from the GEO Biodiversity Observation Network (GEO BON) Initiative for biodiversity observations. GEO continues to advocate, engage and deliver in the Societal Benefit Areas.

GEO Flagships include GEO Biodiversity Observation Network (GEO BON), GEO Global Agriculture Monitoring (GEO GLAM), The Global Forest Observations Initiative (GFOI), and Global Observation System for Mercury (GOS4M). There are four GEO regional initiatives: AfriGEOSS, AmeriGEOSS, Asia Oceania GEOSS, and GEONETCast.

Osamu displayed tables showing activities and tasks, and discussed the GEOSS Portal to visualize and download data.

The GEO DAB supports a huge number of standards, so that providers can easily connect. There has been a large increase of yearly queries of the GEOSS Common Infrastructure (GCI). GEO promotes broad open data policies using strong economic arguments, but faces challenges in access to climate data, interoperability, and downstream services. Osamu gave the agenda for GEO Data Provider Workshop.

Yonsook noted that the metrics on satellite data access are out-of-date. Paola requested the current figures. Andy asked if the Foundational Tasks (FT) still exist, or if they have been replaced by GEOSS Evolve. Osamu replied that there has been extensive discussion on how to reduce the number of FTs. After the discussion it was agreed to move GD-08 to the initiatives; GD-03 GCI Operations still remains.

There was discussion on the sustainability of the 40+ standards that GEO is maintaining. Paola replied that once a standard is implemented it has no maintenance cost, and the many standards represent a richness rather than an issue on sustainability. There is no need to request the data provider to adapt. For new missions GEO encourages using the newer standards. A larger question is how many more to add; for example there is one for the water community that is yet to be implemented.

Osamu said that they accept all data offered, which is why they are supporting all these standards. GEO is aware that this leads to duplication. Paola said they are discussing with DMP team how to implement in a practical manner in registration and brokering process. They are also starting to implement a data certification schema. Paola added that they have begun the discussion to address the duplication of resources – data already brokered by another catalog.

Andy suggested that when a new data provider goes to GEO Sec to offer the data, it is good to see if the data is already being brokered with a newer standards. Osamu agree to this suggestion.

## GEOSS

### GEOSS Evolve

Osamu Ochiai\* presented GEOSS Evolve with its objectives, activities, and contributors. It includes six work packages:

* WP1: GEOSS Architecture and Evolution (Lead: US-USGS/Italy-CNR)
* WP2: Functionality Testing (lead China-RADI)
* WP3: Data Management Principles (Lead: ESIP, CODATA)
* WP 4: Standards Interoperability Forum (lead IEEE)
* WP5: Demonstrations Projects (Lead OGC)
* WP 6: Community Portals (Lead NOAA)

Mirko suggested that WGISS be listed as a contributor to WP1, since WGISS has a lot to contribute. He also asked if there is a WP for GEOSS Evolve; there is, but it is not yet finalized.

Andy commented that Paola is doing the GCI and Virtual meetings, and WGISS would like to be included. WGISS is also starting to have webinars, and is looking for the best process to broaden the audience. Paola said it would be great to have joint webinars, and suggested coordination this after the Data Providers Workshop.

**Action WGISS-43-18:** Technology Exploration to coordinate with Paola di Salvo a cooperation with GEO-Sec for webinars.

### NextGEOSS

Bente Lilja Bye\* presented NextGEOSS – the European Geo Data Hub. She began with a quick look at NextGEOSS, the next generation centralized hub for Earth Observation data. The concept is to provide data and resources to the user communities, together with Cloud resources, seamlessly connected to provide an integrated ecosystem for supporting applications. Strong emphasis is put on engaging the communities of providers and users, and bridging the space in between. Europe has a major EO program with satellite and ground components, with increasing volumes and higher complexity. These data have a huge potential: a large amount of information can be extracted.

Objectives of NextGEOSS are aligned with the objectives of GEOSS. There is a focus of opening up to business and private sector. Six innovative pilots focusing on the GEO Flagships and four market focused pilot activities. Other business and private sector activities contribute to the implementation of GEO’s new strategic plan with respect to advancing and facilitating cooperation with the private sector for assessment of the gap between geospatial services, and assessment of best mechanisms to support long-term usage of NextGEOSS.

NextGEOSS will deliver the next generation data hub and Earth Observation exploitation system for innovation and business by implementing a single access point, federated data hub and exploitation system for EO data, using state-­of-the-art data mining and discoverability techniques NextGEOSS will advocate GEOSS as a sustainable European approach for Earth Observation data distribution and exploitation, and disseminate the GEOSS approach to the European and wider communities – social media, webinars, summits. Bente offered to work with WGISS and GEO Sec for webinars, and to generate capacity building events and material to sustain the future of NextGEOSS.

Implementation/Approach: Bente displayed an overview diagram of NextGEOSS project, and a project overview for reference. She also displayed the budget and timeline for the next three years in four main phases.

Ongoing activities include:

* Initial deployment of catalogue and definition of metadata
* Interfaces and harvesting of datasets: Sentinels, Copernicus Marine, Land & Atmosphere, Citizen Observatories & Commercial Data
* Setting up KPIs
* Preparing for integration of NextGEOSS pilots
* Starting engagement of communities, datasets & future pilots
* Setting up the Advisory Board

Main project events to get involved are summits - an annual event in the second quarter of each year (4 in total); and training - one online training event per year (3 in total). Lilja invited WGISS to work with them – would like to also invite external pilots to test the data hubs. WGISS representatives will attend the Data Providers Workshop in April.

Bente said that NextGEOSS will connect to the GEO DAB with an API. Emily asked about pilots to be used for demonstration purposes, to show how to access and get data. Will these pilots be part of the deliverable? Bente said each of the pilots will be for gathering different types of data and products. It is not only to discover and access, but to produce new products through the pilots. For example, for the cold region pilot, they will combine satellite and in-situ data from Swoburg, and work with social scientists who are looking at how the local community is adapting to climate change. These are other inputs will be combined to get new information, and will be made available. Emily commented that it sounds like higher level product delivery; hopefully they will support a common data integration effort.

Nancy Searby asked what approach they are using for bringing together the capacity building. Bente replied that they are currently working out a strategy; they would like to have a monthly event to create continuity, covering different topics, and using different mediums.

Bente noted that NextGEOSS can be viewed as the Research and Development, followed by operational services. It is combining core services, but these are not in a position to sign agreements to deliver for operational services.

Paola asked noted that many of the required data sources are already brokered by the DAB. The connection with the DAB should be an important element before approaching data providers. Bente replied that the vision is to make it scalable, giving added value; cooperation with the DAB is essential. Paola also noted that it could be an important element to include a representative of the GCI in the project overview. It would be very beneficial to have a linkage with the GCI. Bente said the external advisory board will include several of these actors.

**Action WGISS-43-19:** WGISS Exec to reach out to NextGEOSS team to identify means of closer interaction, including identifying point of contact.

### GEOSS Component and Service Registry (CSR)

Liping Di reported that the GEOSS CSR is a web system where Earth Observation resources contributed to GEOSS are registered through dedicated secured registration forms. The GEOSS registry exposes OGC CSW interfaces to be accessed by other applications, including the GEO Discovery and Access Broker. GEO Discovery and Access Broker implementations can use the GEOSS registry to register and locate GEOSS catalog services as a basis for evaluation, configuration, harvest, and distributed query.

* Resource Providers via Secured Web Portal can register New Resource and place approval Request, modify/Delete Resource he/she owns, and search/View all Registered Resources
* Resource Users (without user account) can search/View Only Approved Resources (non-secure search/holding pages), and create User Account to become Resource Provider
* CSR Operational Team reviews the registered (pending) Resources and approves them (if qualifies) to be visible for harvesting
* GEO DAB harvests the approved resources via CSW interface

Liping also discussed the resource registration properties and standards.

Olivier asked how they differentiate dataset and metadata collection; the metadata catalog system allows user to search. So CWIC is accessible through the catalog. Nancy asked about their usage metrics; Liping said he could send her more details.

### GEODAB

Mattia Santoro\* gave a presentation on the GEO Discovery and Access Broker (GEODAB), a brokering framework that interconnects hundreds of heterogeneous and autonomous supply systems (the enterprise systems constituting the GEO metasystem) by providing mediation, harmonization and transformation capabilities. Mattia displayed a diagram describing the GCI, and listed the supported services. GEODAB includes different APIs for serving diverse Application development use cases (environments): A set of standard Web service interfaces; a set of APIs for software developers. Client side APIs, Server side APIs, and OpenSearch APIs.

GOEDAB View is a subset of the whole GEOSS resources defined by applying, via the DAB, a set of clauses: Discovery clauses (e.g. spatial envelope, keywords, sources, etc.), and access clauses (e.g. data format, access protocol, CRS, etc.). A defined “View” is exposed on the GEOSS Portal. For Consumer-defined View, the views are available only for the client application which defined the view. For Provider-defined View the views are available for all client applications.

Mattia concluded that regarding the list of 40 supported standards, you mentioned that the list will be shortened –they will be retiring some of these.

### USGEO Common Framework

Jeff de la Beaujardiere\* gave a presentation on the Common Framework for EO Data (CFEOD), USGEO. He gave the background, and described the conceptual model. The aspects of data management in the document are organized as follows: Data Search and Discovery Services, Data Access Services, Data Documentation, Compatible Formats and Vocabularies. In each category, recommendations are discussed at three levels: Standards and protocols, Methods and practices, and Implementations.

Data search and discovery services provide guidance on the creation and organization of searchable catalogs of data. Machine-to-machine interfaces should be supported. The *National Strategy for Civil Earth Observations* called for establishment of formal standards-based catalog services which could be indexed by commercial search engines. Standards-based services facilitate interoperability by making it easier to obtain and combine data form multiple sources. Some standards examples were listed. Documentation, in the form of structured metadata, makes it easier for users outside of a particular group or community to discover, access, use, and understand. Jeff listed compatible formats and vocabularies.

Olivier asked about schema.org. Is there EO vocabulary defined in there. Jeff said he is not aware of any, but it would be very nice to have it. Liping commented that NOAA will migrate from ISO part2 to ISO part 1. Part 2 is the older standard, but is currently under revision. He recommended that they use Part 2.

Mirko noted that this has been considered in the BP guidelines put out by WGISS, and invited the team to suggest needed additions. Jeff replied that they would, but their recommendations do no deal with cloud, they are for use when hosting your own server.

### AmeriGEOSS

Angelica Gutierrez and Rich Frazier gave a presentation on the AmeriGEOSS Regional Initiative, an initiative for the 16 countries in the Americas, with objectives aligned with GEOSS. AmeriGEOSS is an adaptable framework that can be leveraged for capacity building, to work with regional and global partners to advance the use of EO data, and to develop and leverage member capacities to support stakeholder and decision-maker needs.

The community is currently focusing its efforts in the following thematic areas: Agriculture, water, disaster, and biodiversity societal benefit areas. Capacity building is an essential part of engaging users by increasing and strengthening partnerships through outreach and education. The conduct workshops, webinars, and communications, and would love to participate with WGISS in this.

The near real-time, global network of satellite-based data dissemination system is designed to distribute space-based, airborne and in-situ data, metadata, and products to diverse communities lacking in high speed internet access. As part of the capacity building efforts, AmeriGEOSS works with communities to provide access to data and in 2016 partnered with GEOSur to provide integrated discovery, access and usability of EO resources from community providers.

AmeriGEOSS is supporting understanding and decision-making in the region.

The AmeriGEOSS Platform is a regional community resource to promote collaboration and coordination among the GEO members in the American continent in five major areas: data, tools, products, services, resources. A data hub has been established mobilizing data and resources to provide the capacity to support the use of social economic and environmental data through open data portals at the national, regional and global scale.

Using the platform users can discover, access and use data and tools from national, regional and global data sources. The community can access economic, social and environmental data on a variety of topics related biodiversity, ecosystem health, food security, water use, availability, quality and other indicators that will support the communities’ ability to develop products and services that support understanding and decision-making.

The platform provides a variety of methods to search for data, find data in various formats and use the resources from a variety of platforms and devices. The AmeriGEOSS Data-Hub uses the CKAN open source platform to link resources in the region. AmeriGEOSS is now in the use case development phase working with the community to leverage the platform around societal issues such as food security.

Using the platform the community can access a variety of social, economic and environmental resources from providers to understand causes and develop knowledge based products and services to model, forecast and respond. The initiative GEOGlows is initiating efforts to support capacity building to understand water use, water availability, and water quality. The outcomes of these activities will support clean water and sanitation efforts under SDG 6. Through the platform a researcher or analyst can find water data, access a variety of hydrometric data to understand variables and, access reports, community developed maps, applications and analytical tools to support understanding and decision-making.

AmeriGEOSS is currently building partnerships, data needs, gap analysis and solution development, linking data, and enabling analytical tools for data visualization. Future plans are establishing group curators, working with thematic working groups on use cases, all toward capacity building.

There are a number of opportunities and synergies to work with AmeriGEOSS. One of the things where WGISS could participate is with a user assessment. Other possible synergies: outreach and education, data and products, applications and tool, and use cases.

Yonsook asked if their users are trying to answer global questions, or are they restricted to national/regional. Angelica said the goal is to serve the local needs. Most of the users are decision makers, resource managers, responders, policy makers, and they try to target each group uniquely.

Are there specific needs that have from AmeriGEOSS? Brian K. asked about developing data cubes similar to what has been done in Colombia.

**Action WGISS-43-20**: WGISS to provide a formal response to AmeriGEOSS presentation.

### GEOSS Portal

Joost Van Bemmelen\* and Guido Colangeli\* presented an enhanced GEOSS Portal: Linking users with resource providers. They gave an overview of the timeline and coordinators, with focus on engagement, delivery and advocating. They also discussed the restyling of the Graphical User Interface, aligned with new GEO website and brand, and simpler / more intuitive. They have added smart filters for imagery (Landsat, Sentinel 2) and SAR-type (Sentinel 1) satellite data, MyWorkSpace initial set-up, Geo-localization services, base maps selection, and Proprietary ESRI data.

The current focus is user-centric, considering various user communities: GEO Flagships and Global initiatives and ESA Thematic Exploitation Platforms. Additional enhancements considered include:

* Improved search and results access
* User management and My workspace evolution
* Multi-modality (including hand-held devices)
* Modular evolution via Portlets (for reuse)
* Processing services
* Visualization services (e.g. layers, responsive web-design, …)

A demonstration was made of the capabilities of the portal, including filters so that the returned results is a manageable amount. The results panel includes a filter that is related to the results.

Nancy asked how capacity building resources will be enabled. He said that is something to discuss with Stefano, and GEO Sec.

**Action WGISS-43-21:** Yonsook to give connection details to GEOSS Portal team and GEODAB teams for access to 5000+ collections.

## CEOS WGISS Connected Data Assets

### Introduction

Yonsook Enloe gave a presentation on the WGISS connected data assets. She highlighted Connected Data Asses website (within the WGISS website) and showed the diagram of the WGISS interoperability standards architecture.

The team provides technical support and includes experts in CWIC, FedEO, and IDN. They have created an integrated system team to coordinate and oversee the WGISS integrated system and standards:

* Coordinate operations, maintenance and evolution activities (infrastructure, standards adoption, etc.)
* On-board new data partners
* Provide technical support for client partners
* Monitor the health of the federated system and report outages and errors etc. to the partners
* Test all the components of the federated system, including end to end search and data access
* Work with data and client partners to identify and resolve system and component bugs
* Provide support for metrics collection

Yonsook displayed a diagram of the current architecture, with collection search and granule search. The following considerations will lead toward a WGISS federation:

* Data collection registration at the IDN using the IDN keywords; Info about how granule search is supported will be included in the data collection registration
* Data partners need to support 1 of the 2 supported WGISS standards: CEOS OpenSearch Best Practices (v 2), and OGC CSW 2.0.2
* All searchable data must have a data access path: Data download, Data order (free or with cost), and Email order (free or with cost)
* Servers must have high availability (99 %?)
* A technical POC needed for each data partner

Client partners:

* Clients can offer search and access to all the satellite data available through the WGISS Federation
* Clients can offer search and access to a limited subset of data available through the WGISS Federation along with other services through tagging (e.g. CWIC, FedEO, LSI, Carbon,)
* Clients can offer support for a 2-step search: Discovery through collection search using platform, instrument, science keywords, etc. (IDN). The IDN data record will contain info about how granule search is supported. And Search granule metadata at data partners via CWIC, FedEO, Independent servers
* All granule search results will contain links to data access

Recent accomplishments:

* Oct 2016 – First WGISS Access System Level Team telecon
* [Access-SysTeam-Help@WGISS.CEOS.org](mailto:Access-SysTeam-Help@wgiss.ceos.org) for questions about any of the systems – e.g. IDN, FedEO, CWIC
* Will tag FedEO datasets registered in the IDN
* Identified Interoperability Issues for CEOS OpenSearch implementations (e.g. pagination handling to be advertised in the OSDD, unify how to distinguish between order/download links,)
* Came to agreement on the resolution of the interoperability issues and documented those in the CEOS OpenSearch Best Practices document
* CWIC Smart Client Validator for CEOS OS conformance testing
* Future Conformance Test document led by ESA
* ESA led effort to specify draft OGC 17-003 EO Dataset GeoJSON Encoding Standards
* Working with the GEODAB team to integrate with WGISS Connected Assets

What data is accessible?

* WGISS webpage has current list of the data collections accessible from FedEO and CWIC
* Over 5000 collections accessible (collection search)
* Over 300+ million granules accessible (granule search)
* Additional data collections/granules continuously being added from heritage and current EO missions
* Additional data partners can be added to FedEO and CWIC federations
* Independent data partners who support the WGISS standards can be added to the WGISS Connected Data Assets

Andy noted that it would improve the user experience if the agencies had a uniform way of registering/logging in.

### International Directory Network (IDN)

Michael Morahan gave a presentation on the IDN. The IDN home page now includes a search by agency data provider, in addition to all the previous things (keywords, news, contact, etc.) Michael described the IDN search interface. For submitting metadata, the tool docBuilder is a web-based metadata authoring tool that allows authors to add or modify data set descriptions (DIF-9 and DIF-10). It includes modify record, metadata fields, select field, generate error report, and view feedback.

The CMR Search API provides access to all IDN collection metadata, Catalog Services for the Web (CSW), Queryable Tags, API Query Methods, and IDN Search API result formats.

Michael listed the required, optional, and overlapping DIF-10 and DIF-9 Metadata Fields. The GCMD Keywords review is facilitated by the NASA ESDIS Standards Office (ESO).

Keyword reviewers will review the proposed keywords and complete an online questionnaire. Members were invited to become a keyword reviewer.

Michael referenced all the documentation for DIF, docBuilder, and IDN API.

Michael clarified that DIF-9 is the heritage format. Platform and instrument are not really required because it may be thematic with multiple sensors. Some of the requirements are inherited.

### FedEO

Mirko Albani discussed current advances with FedEO. He discussed a new version of the eoPortal Client, and improvements to the FedEO Gateway:

* Distributed collection search or harvested collection metadata configurable for each individual collection search endpoint - Efficiency gain
* Expected configuration: Harvested: all collections except NASA CMR. Distributed search: FedEO + NASA CMR collections
* The FedEO Gateway will expose the geo-json response (and metadata format) to the outside world as defined in OGC 17-003 (draft) and the updated OGC 13-026r8/r9 document, for dataset search in May 2017.
* GeoJSON metadata and response:

Catalog data access: NASA CMR collection search (OpenSearch) for access to CMR and CWIC is implemented as two-step search. CWIC ISO AP CSW endpoint no longer used. CWIC ISO metadata no longer harvested from IDN. NASA ECHO renamed into EOP: NASA: CMR.

In conclusion, collections are accessible through FedEO; dataset series are harvested locally using a uniform search interface: CWIC dataset catalog now via CMR, and VITO PDF Open Search (dataset/dataset series) catalog is added. EUMETSAT Open Search (dataset/dataset series) catalogs is added. DLR EOWEB is updated with new list of supported collections.

Chris wondered if they get any feedback from the community on the experience of the portal. Mirko replied that they do an ESA-wide feedback and try to gain from that. It would be helpful to work together to get feedback on portal usability and experience.

### CEOS WGISS Integrated Catalog (CWIC)

Yonsook Enloe gave a status report on CWIC. CWIC is a translating gateway, using a CSW 2-step search: collection level and granule level. She discussed the CWIC CSW Get Capabilities, and identifying data providers from dataset identifiers:

* Where to send the search request?
* CWIC client searches for granules from CWIC using the CMR Concept ID or the IDN Entry ID to identify the dataset
* CWIC identifies the data provider to which the request is to be dispatched based on the dataset identifier provided
* CWIC has an internal mapping table for CMR Concept-id/Entry ID 🡪 native dataset ID

CWIC uses the data provider’s native dataset ID in the granule search request, not necessarily the dataset identifier provided by the client. Yonsook listed the metadata returned in search response, and also the data provider protocols and requirements. Dataset Identifier changes include:

* Collection searches to IDN/CMR CSW Capabilities will give correct identifiers for dataset queries
* Collection searches to IDN/CMR OpenSearch OSDD will give correct identifiers for dataset queries
* Cached (or locally stored) identifiers or DIFs should be updated to ensure valid dataset queries
* Recommended to use CMR concept-ids when at all possible
* Some IDN EntryIDs have changed. Version numbers added to previous EntryIDs. Could cause problems for GEO CSW clients which have cached old identifiers

Publishing new CWIC datasets occurs through four stages: Registration, testing, tagging, production. CWIC/ IDN (CMR) synchronization occurs daily.

The team is welcoming new CWIC data partners. The CWIC Data Partner Guide documents and CWIC Team will provide technical support for new and current partners. Operational Data Partners are revising their internal systems; INPE is implementing OpenSearch and NOAA has re-implemented their system for GHRSST and will use this system for NCEI data. New partners include AOE (connecting three data centers), and Australia (CSIRO, GA, BoM).

The team is also welcoming new CWIC client partners. The CWIC Client Partner Guide documents and the CWIC team will provide technical support for new client partners. New partners include Earthdata Search Tool, COVE Tool (Radarsat2, CBERS4, ResourceSat-2), and GEODAB, GEO Portal.

Yonsook reminded that the WGISS Connected Data Assets webpage includes detailed CWIC metrics that are frequently updated. She concluded saying that 4329 collections are CWIC enabled, with 284+ million granules.

Doug noted that collections in CWIC are smaller than CMR. Richard asked if the client partner guide is in line with the CEOS BPs; Yonsook confirmed that it is.

#### CWIC Client Partner Report – ISRO

Sai Kalpana gave a CWIC client partner report for ISRO. She began with a diagram overview of ISRO connector Interface with CWIC. MOSDAC and NRSC data centers are interfaced with CWIC.

The following Satellite and Metadata/Products are available from MOSDAC: Meteorological and Oceanographic Satellite data archival Centre

* INSAT-3D IMAGER \
* Kalpana-1 VHRR

The following Satellite and Metadata/Products currently available from NRSC: National Remote Sensing Centre

* Data from Bhuvan NRSC Open Earth Observation Data Archive (NOEDA) Products available through CWIC include IMS-1 Hyper-spectral Data, Oceansat-2 GAC L1B products, Commercial Data, Resourcesat-2 LISS-3, LISS-4 and AWiFS data, Resourcesat-1 LISS-3 and AWiFS, Resourcesat-2 LISS-3, LISS-4 and AWiFS, and Cartosat-1 PANA and PANF.

Future plans include Registration of MOSDAC INSAT-3DR DIFS, registration of Oceansat-1 and Oceansat-2 DIFS (Initiated), and enabling of OpenSearch for MOSDAC connector.

#### CWIC Client Partner Report – AOE

Guangyu Liu gave a report for the Chinese Academy of Science – Academy of Opto-Electronics (AOE). He reported on their connector interface with CWIC, saying that AOE has implemented a CSW server, with data node adapters to the National Satellite Meteorological Center (NSMC), Beijing Twenty-first Century Science and Technology Development (Beijing-1), and China Center for Resource Satellite Data and Application (CRESDA).

The AOE connector interface with CWIC is managing and updating the satellite data information from NSMC, BeiJing-1, and CRESDA, mapping the meta-data parameters for the CWIC catalog. AOE is also improving the search efficiency in the integrated catalog and structure, and refining metadata and additional data collections. A diagram of the AOE connector interface with CWIC was displayed. Guangyu listed the data collection that is connected. It consists of CBERS-01/02, CBERS-02B, HJ-1A/B, BJ-1, FY-1D, FY-2D, FY-2C, FY-2E, and FY-3A.

Future plans are to explore the possibility of OpenSearch protocol for the China connector, test the CWIC interface to data centers, and continue to investigate access to new data resources.

### CEOS OpenSearch II Update and Status

Olivier Barois presented update and status of the WGISS OpenSearch II project. The project targets are:

* Consolidation and finalization of CEOS OpenSearch Best Practice document
* Updating of the CEOS Developer Guide document in accordance with the BP finalization
* Start discussion about CEOS OpenSearch Conformance Tests document

To set up and make available a fully standardized and interoperable CEOS (but not limited to) connected data assets, the following items need to be addressed:

* Make available CEOS OpenSearch endpoints: IDN, CWIC and FedEO
* Agree and define CEOS OpenSearch Guidelines
* Deliver CEOS conformance Test SW to quantify CEOS OpenSearch endpoints compliancy with CEOS Guideline, and Interoperability among CEOS OpenSearch endpoints
* On the basis of the identified and collected gaps/limitations, WGISS can decide to go through again the points 2 and 3 for an updating cycle in synergy with on-going OGC initiatives. (under definition)

Olivier displayed the Best Practice and Developer Guide roadmap, noting that these will be released at the end of this month.

The CEOS OpenSearch Guidelines, including CEOS OpenSearch Conformance Test document will define the procedures to assess the OpenSearch endpoints compliancy with respect to CEOS/OGC guidelines and interoperability level. Within the WGISS System Level Team (SLT) working group, it has been agreed to adopt the following documents as baseline:

* Most recent CEOS Best Practice (1.2D1 to be finalized after WGISS#43 – by April)
* NASA documentation/report about CWIC-Smart Validation Tool, once aligned to most recent CEOS-OS-BP document (SLT MoM 01/03/17)
* Abstract test suite section of applicable OGC documents (e.g., OGC 10-032r8 – OpenSearch GeoTime ext., OGC 13-026r8 – OpenSearch EO, etc.)

CEOS Conformance Test Software will permit to validate and score external OpenSearch endpoints vs CEOS/OGC guideline. This CEOS tool will be completely based on CEOS OpenSearch Conformance Test guidelines.

Within WGISS SLT working group the following has been discussed and agreed:

* NASA to keep the CWIC-Smart Validation/Test page updated with future CEOS OS BP changes (SLT MoM 01/03/2017)
* NASA does have plans to make all their software, including CWIC-Smart client, open source. Until that happens, the CWIC-Smart client is a publically accessible service (SLT MoM 01/03/2017)
* ESA available to support NASA to enhance and test CWIC-Smart Validation software, to produce a CEOS tool usable by all agencies (SLT MoM 01/03/2017). This also implies the application of an open source license for this Conformance Test Software (Sec. 4.2 WGISS#42 MoM)

Yonsook suggested that after these are released, they should be sent to the email list (GCI Data providers).

Chris wondered what the number of systems using OpenSearch clients is. Olivier said all the ESA clients are being developed in OpenSearch. Chris felt it would be nice to have a list of these so that we can communicate with them.

Andy asked about the discussion of making the client ID required; it was confirmed that no one wanted to make it required.

### CEOS OpenSearch Conformance Testing

Doug Newman gave a presentation on the CEOS OpenSearch conformance testing. The concept is to supply an OSDD location, and allow the validation tool performs a series of tests to measure compliance of OpenSearch API. The testing is split by specifications, extensions and best practices, and the results provide gains and losses based on the success/failure criteria of the example query provided. The tool is based on OpenSearch Specification Version 1.1 Draft 5 and validates according to the best practices in:

* Geo extension Version 1.0 Draft 2
* Time extension Version 1.0 Draft 1
* ESIP Best Practices Version 1.0
* Parameter extension Version 1.0 Draft 1
* Relevancy extension Version 1.0 Draft 1
* OGC Extensions Version 13-026r6
* CEOS Best Practices Version 1.1.1
* CEOS Developer Guide 2.0D3

Doug noted that Open Sourcing is coming soon, for running tests against developing, non-public APIs, and to extend validations to new standards. He demonstrated the validator. It was agreed that Doug would write the conformance document based on the current list of tests.

### GEO-JSON Encoding

Olivier Barois gave a presentation of GEO-JSON encoding. He noted that OGC has worked on GEOJSON encoding standard for OWS, and the OWS Context GeoJSON encoding standard [14-055r2] was approved in 2016: The OWS Context Document standard (OWS Context) was created to allow a set of configured information resources to be passed between applications primarily as a collection of services (but also potentially in-line content). The objective is to support use cases such as the distribution of search results, the exchange of a set of resources in a Common Operating Picture (COP), or delivery of a set of configured processing services to allow the processing to be reproduced on different processing nodes.

Olivier discussed the mapping product metadata attributes and described use cases. He displayed the metadata and search response inn GeoJSON Feature and FeatureCollection. Olivier listed OpenSearch GeoJSON standardization activities, and invited WGISS to contribute to this activity in OGC SWG. Planned activities include spec consolidation, with experiment in Testbed 13.

Olivier provided the following discussion items:

* Participation of NASA to the OGC EO OpenSearch SWG (as a voting member)
* Involvement/support from WGISS (Access System/OpenSearch Project) for document review, metadata mapping, definition of vocabulary, and additional metadata attributes
* Separate GeoJSON encoding from json-ld encoding for EO Open Search update (CEOS BP feedback, OGC 13-026r9), EO Open Search GeoJson encoding standard (as OWS context, OGC 17-xxx), EO Metadata GeoJson encoding standard (OGC 17-003), and JSON-LD encoding as best practice (OGC 17-xxx)

Olivier specifically requested NASA participation because of the UMM. He noted that he is not proposing a new Metadata model, rather a mapping from this model to a very simple structure, and present in this simple GeoJSON response the same regardless of the catalog being used. Andy pointed out that the data would have to be available in the JSON format, and Olivier noted that the encoding might be the same. We are searching for an application-friendly convention. This will open new horizons, liking data to services. Another point is how to organize between WGISS and the SWG. Andy suggested on his last slide to write it up in a proposal.

WGISS can form a team to support GeoJSON. Richard preferred to reactivate an existing interest group in WGISS than to create a new one, and a workshop dedicated to metadata was suggested.

**Action WGISS-43-22:** WGISS to consider a representative to the OGC Standards Working Group.

# Data Preservation Interest Group

## Data Stewardship Interest Group Overview and Updates

Mirko Albani gave a presentation on the activities of the Data Stewardship Interest Group. He began with a discussion on the GEOSS Evolve initiative WP3 on data management principles, the status of the WGISS Purge Alert procedure, and mentioned conferences related to data preservation.

Mirko gave status of WGISS-42 actions assigned to the DSIG. The team is working on a 90 seconds video on the value of data preservation. Astrid said that the scribble cartoon video is very popular for the broad public, but for the CEOS Plenary level, the standard form is better.

The DSIG found that there is no reference to landing pages in the ISO and DIF standards. The Recommendations for landing pages are implemented in the final circulated version of the Persistent Identifiers Best Practice.

The last action was dealing with CCSDS and ISO on the status of the development of a standard for data preservation.

**Action WGISS-43-23:** DSIG team to consider developing a video on the value of WGISS Data Preservation activities for the Faces of CEOS series.

## Data Preservation and ISO Standard – Status

H. K. “Rama” Ramapriyan gave a presentation on data preservation and ISO standards. He began explaining the motivation for data preservation.

* ISO 14721:2012 - Space data and information transfer systems – Open archival information system (OAIS) – Reference model (conceptual framework for archival):
* ISO 16363:2012 - Space data and information transfer systems -- Audit and certification of trustworthy digital repositories
* ISO 16919:2014 - Space data and information transfer systems -- Requirements for bodies providing audit and certification of candidate trustworthy digital repositories
* ISO 19115-1:2014 - Geographic information -- Metadata -- Part 1: Fundamentals
* ISO 19115-2:2009 - Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data
* ISO 19157:2013 - Geographic information -- Data quality
* ISO/TS 19157-2 - Geographic information -- Data quality -- Part 2: XML schema implementation

ISO 19165 - Geographic information -- Preservation of digital data and metadata; Rama served on the team responsible for development of ISO 19165

* + Considers geographic information preservation in general
  + Provides a good framework, but not discipline-specific detail
  + Quote from section 7. 3.1 - “In preserving data, future users need to understand what they are working with (context information) and how the data were created (provenance information). Because most Earth science data involve complex physics and mathematics, the metadata shall include sufficient documentation (or pointers thereto) that provide the derivation of the algorithms used to generate the dataset. Likewise, the metadata shall include pointers to calibration data and ancillary data that were needed to produce the dataset. The specific content items needed to preserve the full provenance and context of the data and associated metadata depend on the needs of the designated community and types of datasets (e.g., maps, remotely sensed data from satellites and airborne instruments, physical samples). Follow-up parts to this standard may be developed detailing content items appropriate to individual disciplines.”

New work item proposal: Rama has submitted NWIP for ISO standard (or technical specification) as extension to ISO 19165:

* Draft of NWIP was exchanged with Mirko Albani and comments incorporated prior to submission
* CEOS LTDP documents and NASA (2011) Earth Science Preservation Content Specification (PCS) shown in NWIP as starting points for developing new standard
* Discussed at TC 211 Plenary meeting in Redlands, CA – November 2016; received encouragement to submit
* NWIP submitted in January 2017 through US International Committee for Information Technology Standards (INCITS)/L1 (Geographic Information Systems) and is in process by INCITS Executive Committee for submission to TC 211
* After submission to TC 211 it will be sent for a vote by participating countries

Once approved, “real work” begins – a Project Team is constituted and standard is drafted, reviewed and edited iteratively – expected time to completion is two years after approval to proceed.

Mirko recommended that WGISS to support this activity.

**Action WGISS-43-24:** Mirko to look for experts to participate in the extension to ISO 19165.

## CEOS Core Document Status

Mirko Albani listed the CEOS core documents produced to this day, and displayed them using a document tree and a data management table:

* The Associated Knowledge Preservation Best Practices was adopted.
* Glossary of Acronyms and Terms completed.
* Persistent Identifiers Best Practice completed

Persistent Identifiers (PIDs) for Associated Knowledge: Documents related to a dataset should be linked on the landing page, not as subset PIDs. Points for discussion:

* Assign PIDs to data associated knowledge (e.g. documents)? Should all mission associated knowledge be considered or only the mandatory associated knowledge?
* Assign a PID only to the associated knowledge permanently archived? Possibility to lose web abstracts, articles and papers if not permanently archived

Rama asked what is meant by DOI for Knowledge. It was decided to assign a DOI to collection of documents, not to each document. Rama commented that proliferation of DOIs should be avoided. The purpose of DOIs is to be able to find things, without placing too great a burden on the publisher or the user.

**Action WGISS-43-25:** Michelle Piepgrass to post the Document Management table on the WGISS website, with links to the documents.

## DMP IG as a Maturity Matrix

Iolanda Maggio\* gave a presentation on the DMP IG as a maturity matrix. The team was tasked to create a Maturity Matrix with DMP IG simplifying the WGISS EO Data Stewardship Maturity Matrix, and to verify the WGISS Data Preservation Guidelines with respect to the WGISS EO Data Stewardship Maturity Matrix.

Iolanda gave definitions for the maturity matrix (MM) framework and the Data Management Principles. She displayed the scientific data stewardship maturity matrix, and the relationship between MM, DMP and Best Practices.

The idea is that the MM should be used not just at the beginning, but during the mission process. She described the DMP maturity matrix assessment.

Implemented solutions:

* Substituting the Key components of the Maturity Matrix with the DMP
* Normalizing the number of maturity levels reducing them to new 4 levels
* Giving a weight to every components of the principles in order to give an incremental order for the implementation of the preservation and curation activities

Preliminary results were shown. The Preservation Guidelines are already following a Maturity Matrix format thanks to the adherence level.

Next Steps:

* Finalize the WGISS Maturity Matrix using the DMP IG and circulate for comments 🡪 Due Date: End of May
* Present the final results of the exercise for verification of the WGISS Data Preservation guidelines with Maturity Matrix 🡪 Due Date: End of May

Possible Future Activities: Improvement of the Data Management Principles using the WGISS EO Data Stewardship Maturity Matrix.

Rama noted that NOAA is doing something similar. ESA has been in contact with them. Mirko asked if this matrix more suitable to our needs in WGISS. Richard said it is a good direction; the next step is to review it and go to the DMP group. They will be very happy to have this. Mirko agreed that the team will complete this work and put it in a document, and distribute to WGISS for review.

**Action WGISS-43-26:** DSIG to complete the work on the Maturity Matrix and distribute the resulting document to WGISS for review.

## Long Term Archive: Infrastructure and Processes

### INPE Archive

Lubia Vinhas described INPE’s archiving of EO data. This activity began in 1973 and in 2003, with the launching of CBERS-2, INPE inaugurated the Remote Sensing Data Center. Data received in Cuiabá is transferred to INPE, in São Paulo, via internet; this has been a big effort in cataloguing and efficient data distribution to end-users. Lubia described the reception and transmission networks. Mirko asked about the mirror site. Lubia replied that the primary is in Sao Paolo, and the mirror is in Cuiaba; they are kept aligned, and are suitably distant for disaster recovery. Mirko suggested they go through the guidelines to see where they are or if there are any gaps. The archiving and the dissemination are on the same system.

Lubia described the data storage system, processing flow, and data distribution. Working on the integration of catalogues: CWIC Connector to access via CSW, and experimental OpenSearch interface, and experimental WMS.

Slated for long term preservation are:

* LANDSAT 5 dataset repatriated to USGS (73 Tb)
* LANDSAT 7 dataset repatriated to USGS (45 Tb)

Mirko said this kind of presentation is very interesting; Andy added that the architecture ties to FDA.

Mirko asked if other countries use the reception site. Lubia replied that the site is almost saturated, and cannot receive any more data with the current antenna configuration; a new one in the north of Brazil.

### ESA Archives

Daniele Iozzino\* presented a diagram with the ESA Data Preservation System Operational Concept, showing the data that has been fully reprocessed, and also the data preservation functions, totally separated from the receiving and dissemination areas.

Data Archive Service (DAS) implements the ESA Master Archive through a dedicated service awarded to industry through an open ITT. Daniele described the DAS Consortium, DAS infrastructure, DAS tape library, and DAS data flow. Daniele described the ingestion of historical data and of live missions, data management and reporting, and the DAS web portal.

The Cold Backup Archive (CBA) keeps two copies of the data held at ESRIN in different buildings and different technology, using an ESA Internal LAN, not accessible from any network. The main Tape Library capable of storing 24 Petabytes. 10 GB Network Environment with unique data. PAC and Station Phase-out project data; unconsolidated data, live mission support. Native Format archiver to be implemented in 2017, implemented at no cost with Hardware already available at ESRIN.

Daniele described the CBA tape library, data flow, and infrastructure.

Mirko added that this is about the legacy missions and the newer missions; there are three copies of the data. This is a work in progress – from multiple distributed archives to a single archive.

Kristi will send them information on the information she has received about the available media.

## Transcription Chains

Razvan Cosac\* gave a presentation on heritage media transcription chains. The issue is recovery of unique data still on heritage media via dedicated transcriptions or to fill identified gaps in master datasets is a recurrent need in many space agencies.

Proposed Activity is the coordination of set-up and maintenance of heritage media transcription chains at different organization for possible mutual support. Next steps are:

* Definition of “Transcription Chains” metadata;
* “Transcription Chains” information survey in CEOS agencies and creation of a common inventory;
* Definition of further coordination and cooperation activities (e.g. collection of needs and potential activities).

Razvan displayed tables of transcription chain metadata. Operative transcription chains include Optical Disks (LM Optical Disks & ATG Optical Disks), HDDT Magnetic Tapes chain, D1 (SONY DTF-1), 8mm Backup Format (Exabyte readers), DLT (Type I - Type IV), LTO-2, StorageTek 9940 and T10000. Other transcription chains include Computer Compatible Tapes, Digital Cassette Recording System improved (DCRSi), IBM Magstar (NTP media), ICI 1012 optical data storage tape (aka CREO) and Pegasus Magnetic Tape.

Next steps: “Transcription Chains” information survey in CEOS agencies based on defined metadata, with circulation to WGISS and feedback by end June. Creation of a common inventory, with report back to WGISS#44. Definition of further coordination and cooperation activities (e.g. collection of needs).

Kristi requested a list of HDDT drives that they have, because USGS has data they cannot read; ESA may be able to help. Kristi will also find out about Pegasus Magnetic Tape.

# WGISS Plenary, Part II

## Future Meetings

Mirko Albani listed the following planned and projected upcoming WGISS meetings:

WGISS-44 will be hosted by the Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences. It will be held September 25-29 at the Grand Skylight CATIC Hotel in Beijing, China. Lizhe noted that the meeting will include a RADI facility tour, and gave further details on logistics and the location.

WGISS-45: March 2018 in Southern Hemisphere; SANSA, CSIRO/GA, INPE, CONAE under consideration.

WGISS-46: September 2018 in Europe: DLR (Germany), CNES (France), EUMETSAT (Germany), European Commission (Belgium) and GSDI (Hungary) under consideration.

WGISS-47: March 2019, NOAA (USA).

## WGISS-43 Summary

Andrew Mitchell gave a summary of the meeting. He began with an update of CEOS; the current Chair’s goal is to ensure continuity and coherence of current CEOS activities, and ensure that the priorities and themes identified by the outgoing Chair (CSIRO) and the current SIT Chair (ESA) are supported and further developed through 2017. These include future data access and analysis architectures, non-meteorological applications for next generation geostationary satellites, consideration of future partnerships and priorities for CEOS, notably with GEO, the UN system, development banks, and the big data players, expediting existing CEOS thematic acquisition strategies – in relation to forests, agriculture, disasters, climate, carbon and water, and pursuing the 2017 Chair Initiatives

WGISS will continue support to expand the connections from mission archives to the COVE tool, including getting links to CBERS-4 and ResourcesSat-2 (AWIFS/LISS-3). WGISS confirmed that access to CBERS-4 metadata can be obtained through CWIC.

WGISS needs to develop an approach for automated discovery, processing, downloading and ingesting of data to support global users with data cubes.

WGISS would like to explore using cloud-based (e.g. AWS) or mirror (e.g. USGS, ASF) archives to create “on demand” data cubes for download or even minor analyses. DIAS or NextGEOSS could benefit from this.

CEOS members are important users of ISO standards. The inputs from CEOS are very important to ISO TC 211 standard development. CEOS members can submit comments and inputs to the ISO standard project through the CEOS WGISS liaisons to ISO TC 211, or their national body to ISO TC 211. CEOS WGISS can propose and lead an ISO TC 211 standard project under ISO/TS 19159-3 Geographic information -- Calibration and validation of remote sensing imagery sensors and data – Part 3: SAR and InSAR. WGISS will assist Liping Di in contacting WGCV for this.

WGISS discussed the following themes in need of attention for the Future Data Architecture report:

* Pilots of different architectures/approaches – engaging users and other key stakeholders (e.g. partner governments, World Bank, etc.). This includes producing ARD – make it real to find the challenges.
* Technical frameworks: for ARD, architectural recommendations and best practices, and user requirements frameworks.
* Community dimension: Fostering and measuring engagements with user communities. This includes engaging with the open source community and algorithm sharing.
* Strategic dimension: What agencies can do together to support uptake of satellite EO data from the “CEOS Constellation” (in support of key global agendas) What CEOS can do to support agencies (best practices etc.) What should be ‘outside scope’ for CEOS.

Possible approaches:

* Grow a community of contributors to underpin FDA technology (e.g. Data Cube): CEOS, countries, domain experts.
* Prototype demonstration projects.
* Develop a FDA Learning Center with documentation, training tools, and a user forum (end of 2017?)
* Conduct frequent training workshops and webinars?
* Agency focus on ARD creation and provision.
* Leverage and expand WGISS existing capabilities.
* Engage key stakeholders who can help with scaling and sustainability

In the 2017-2019 GEO Work Plan, the GEO Foundational Task GD-07 is transitioning to a GEO Initiative titled GEOSS-EVOLVE. WGISS, as a data provider of GEOSS, is now included under GEOSS EVOLVE “Work Package 2: Functional Testing”. WGISS will provide written comments to GEOSEC on where WGISS is supporting (and can support) EVOLVE work plans.

WGISS has representation in many other GEO work plans including:

* WP 1: Evolving GEOSS Architecture,
* WP 2: Functionality Testing
* WP 3: Data Management Principles
* WP 5: Demonstrations Projects (Lead OGC)
* WP 6: Community Portals

Andy displayed a diagram of the NextGEOSS architecture, which will include a data hub, discovery and access enablers, and enhanced distributed gateway to EO data, processing enablers, publishing appliances, and community portals.

AmeriGEOSS participated in the meeting, and noted the possible synergies with CEOS in the areas of outreach and education, data and products, applications and tools, and use cases.

WGCapD also discussed synergies to collect, coordinate, and synergize capacity building resources. Possible activities where WGISS could help WGCapD include

* Collection of single agency resources discoverable at each agency’s storage location
* WGCapD collection housed together and discoverable
* User interface tailored for each end user class; users would be decision makers, policy makers, EO professionals and scientists
* Use cases and trainings available by GEO region, national, sub-national scales, and GEO societal benefit area

Suggestions of what WGCapD could be doing to help WGISS include:

* Raise awareness of the value of EO data products and services to user communities, including support to locate and access data, products, and tools, and targeted training workshops
* Support CEOS initiatives and help WGs and VCs undertake their own capacity building initiatives
* Build awareness of WGISS efforts in WGCapD workshops.

The Data Stewardship adopted the following documents: CEOS OpenSearch Best Practices, Data Purge Alert, and Preservation of Associated Knowledge Best Practices. The CEOS Maturity Matrix is under review.

WGISS outreach activities were enhanced by review of a new WGISS Brochure, work with the SEO on WGISS videos, and on using social media to promote WGISS. Other WGISS activity that has progressed is the recent webinar on Search Relevancy, with suggestions of future topics (understanding data cubes, data visualization and analytic tools) to be prepared soon. Other possible webinars may be developed in cooperation with GEOSS, WGCapD and AMERIGEOSS.

Upcoming meetings where WGISS will participate

* WGISS (Richard Moreno) will be giving a keynote presentation during the GEO Data Provider’s Workshop in April 2017 on the GEO/GCI Success story of GCI-CEOS Interoperability Achievements and Next Steps.
* CEOS SIT Meeting – Paris, FR (April 2017)
* CEOS SIT Technical Workshop – Frascati, IT (September 2017)
* WGISS 44 – Beijing, China (September 2017)
* CEOS Plenary – Rapid City, South Dakota (October 2017)
* Big Data Conference at ESA (November 2017)
* GEO Plenary – Japan (November 2017)

## WGISS-43 Actions

The actions resulting from WGISS-43 are as follows:

**Action WGISS-43-01**: Andy Mitchell to discuss with SEO funding for the use of Confluence for CEOS collaborative websites.

**Action WGISS-43-02:** Andy Mitchell, Mirko Albani, Yonsook Enloe, Martin Yapur, and Ken McDonald to assist the discoverability of the ECV and climate data records which may help define the requirements for portal development.

**Action WGISS-43-03:** Yonsook Enloe to revise the GCI User Requirements document to insert draft requirements addressing the problem of harvested/cached datasets and duplicate datasets in GEOSS. Initiate a review of the new draft GCI User Requirements with members of WGISS.

**Action WGISS-43-04:** WGISS to explore the possibility of including the publishing of services related to EO datasets in the IDN.

**Action WGISS-43-05:** WGISS Exec to work with WIGOS and CGMS metadata representatives to identify common collection-level metadata elements between the IDN, CGMS, and WIGOS.

**Action WGISS-43-06**: Yonsook Enloe to publicize to active WGISS members and to GCI providers the use cases developed by GEODAB for harvesting.

**Action WGISS-43-07**: Michelle Piepgrass to create a webpage on the CEOS website for CEOS lessons learned and best practices

**Action WGISS-43-08:** SEO to summarize how COVE connects to current archives, and summarize metadata.

**Action WGISS-43-09**: SEO to demonstrate the success of connecting COVE to CBERS-4 and ResourcesSat-2 (AWIFS/LISS-3).

**Action WGISS-43-10:** WGISS Exec to provide a formal reply to WGCapD on cooperation between the two working groups.

**Action WGISS-43-11**: WGISS members, and leads of DSIG, FDA, Connected Data Assets to provide feedback to WGISS Exec on the WGISS brochure.

**Action WGISS-43-12**: Liping Di to send project information on ISO/TS 19159-3 to Andrew Mitchell and Mirko Albani so they can forward it to WGCV.

**Action WGISS-43-13**: WGISS Exec to establish ways to integrate the ISO/TS 19159-3 activity into the standard WGISS organization.

**Action WGISS-43-14:** WGISS to work on a method to harmonize metrics of data use.

**Action WGISS-43-15:** Technology Exploration to plan a federated authentication discussion.

**Action WGISS-43-16:** Robert Woodcock, Mirko Albani, and Andy Mitchell to provide inputs to the FDA report.

**Action WGISS-43-17:** WGISS Exec to identify a topic for a white paper in support of FDA technologies/discussions; recruit a writing team to write the paper.

**Action WGISS-43-18:** Technology Exploration to coordinate with Paola di Salvo a cooperation with GEO-Sec for webinars.

**Action WGISS-43-19:** WGISS Exec to reach out to NextGEOSS team to identify means of closer interaction, including identifying point of contact.

**Action WGISS-43-20**: WGISS to provide a formal response to AmeriGEOSS presentation.

**Action WGISS-43-21:** Yonsook to give connection details to GEOSS Portal team and GEODAB teams for access to 5000+ collections.

**Action WGISS-43-22:** WGISS to consider a representative to the OGC Standards Working Group.

**Action WGISS-43-23:** DSIG team to consider developing a video on the value of WGISS Data Preservation activities for the Faces of CEOS series.

**Action WGISS-43-24:** Mirko to look for experts to participate in the extension to ISO 19165.

**Action WGISS-43-25:** Michelle Piepgrass to post the Document Management table on the WGISS website, with links to the documents.

**Action WGISS-43-26:** DSIG to complete the work on the Maturity Matrix and distribute the resulting document to WGISS for review.

**Action WGISS-43:-27:** WGISS Exec to include a presentation at WGISS-44 on the progress and outcomes of the OGC Testbed 13, part of the OGC Interoperability Program, activity.

## Adjourn

Andy adjourned the meeting, thanking the participants for their contribution to a productive and successful meeting, adding that there is an explosion of work for the future that is very exciting and will prove to be very useful.

# Glossary of Acronyms

API Application Programming Interface

ARD Analysis Ready Data

AWS Amazon Web Services

CEO CEOS Executive Officer

CEOS Committee on Earth Observation Satellites

COTS Commercial Off-the-Shelf

CSW Catalogue Service for the Web

CWIC CEOS WGISS Integrated Catalogue

DAAC Distributed Active Archive Center

DC data cube

DIF Directory Interchange Format

DOI Digital Object Identifier

ECV Essential Climate Variable

EO Earth Observation

ESIP Federation of Earth Science Information Partners

GCI GEOSS Common Infrastructure

GCMD Global Change Master Directory

GEO Group on Earth Observations

GEO-GLAM Global Agricultural Monitoring

GEOSS Global Earth Observation System of Systems

GFOI Global Forest Observations Initiative

GIS Geospatial Information System

GPM Global Precipitation Mission

GPU Graphics Processing Unit

GSDI Global Spatial Data Infrastructure

GUI Graphical User Interface

HPC High Performance Computing

IDN International Directory Network

ISO International Standards Organization

LSI Land Surface Imaging

LTO Linear Tape-Open

NRT Near real-time

NWIP New Work Item Proposal

OGC Open Geospatial Consortium

PI Persistent Identifier

PoC Point of Contact

RSS Rich Site Summary

SEO Systems Engineering Office

SDCG Space Data Coordination Group

SIT Strategic Implementation Team

SWG Standards Working Group.

TOA Top of the Atmosphere

ToR Terms of Reference

UML Unified Modelling Language

VC Virtual Constellation

WCS Web Coverage Service

WG Working Group

WGCV Working Group on Calibration and Validation

WGCapD Working Group on Capacity Building & Data Democracy

WGClimate Working Group on Climate

WGDisasters Working Group on Disasters