Minutes of CEOS Strategic Implementation Team Technical Workshop (SIT TW 2020)

Final

Virtual Meeting

Thursday 8th September

Session 1.1: Technical Workshop Opening Session

1.1: Welcome and Introductions [slides]

Presenters: Alex Held (SIT Co-Chair, CSIRO), Adam Lewis (SIT Co-Chair, GA)

Main points:

- Confirmed the objectives of this Workshop as being: to support progress of the CEOS Chair priorities for 2020; showcase the Working Teams; identify Plenary issues and support preparation; support new initiatives; support activities related to key CEOS relationships; identify progress against the CEOS Work Plan; progressing SIT Chair Priorities.

CEOS Work Plan [slides]

Presenter: Kerry Sawyer (CEOS Executive Officer, CEO, NOAA)

Main points:

- Key facts to note: 136 Deliverables for 2020-2022; 53 existing/carried over from previous work plan; 83 new deliverables; 10 CEOS Services in addition;
- the online Deliverables Tool remains a work in progress; responsibilities for deliverable updates need to be set;
- will be preparing a Deliverables Database "Users and Access Guide"; and,
- 60 Deliverables have 2020 Completion Dates and should be reported at Plenary. Hopefully TW will update some of these.

SEO Report [slides]

Presenter: Brian Killough (CEOS Systems Engineering Office, SEO, NASA)

Main points:

- Key SEO activities include: Analysis Ready Data (ARD); support to SDGs; Open Data Cube (ODC) Amazon Sandbox; Africa Regional Data Cube - continuing to support the transition to Digital Earth Africa; CEOS Earth Analytics Interoperability Lab (EAIL), working with CSIRO to support data and algorithm testing for CEOS initiatives (COAST, Disasters, Rice Monitoring, GHG, DEM evaluation); COVE Tool; participation at the IGARSS Conference; and,
- CEOS social media presence continues to grow: 2528 Twitter followers, 1603 Facebook likes, 20,000+ website visits.

Main discussion points:

- Trevor Dhu (GA) asked about ODC running on Google Cloud, and whether you can connect to the Google Data Catalogue from another cloud provider / infrastructure. Brian confirmed this should be possible, but for efficiency the SEO team has set up their ODC instance on Google Cloud. Alex mentioned work ongoing in Latin America involving ODC, in addition to the SEO's work.
- Kerry asked about the links between ODC, CEOS and the new GEO Community Activity called 'Open Earth Alliance' (OEA). Brian noted that CEOS is a founding partner of ODC. Earlier this year, the ODC Partners made the decision to formulate a GEO Community Activity in order to try and better organise and seek further resources. Further discussion is required before the concept can be endorsed by CEOS. Adam noted that ODC requires a broader base to sustain itself, and Alex agreed that this was a key motivation for the ODC Partners in the ongoing formulation of the OEA.
- Adam asked about the provenance of the data in Google Earth Engine, and Brian noted there are some questions which need to be asked to better understand its nature.

- Alex noted the launch of ESA's PhiSat-1 on 2nd September. Josef Aschbacher (ESA) confirmed the launch and looked forward to the results that will be shared with CEOS.
- Laura Frulla (CONAE) reported on the successful launch of SAOCOM-1B on 30th August. The commissioning phase is currently underway, and with early results positive. Alex noted the utility of SAOCOM-1A images provided in support of assessment of the recent Australian bushfires (wildfires).

SIT-TW-2020-01	SEO to keep CEOS SEC updated on progress on the new GEO Community Activity on the Open Earth Alliance as an evolution of the Open Data Cube activity in which CEOS has been participating.	**CEOS SEC-270**
	Rationale: Provide an opportunity for CEOS SEC to hear an update on the potential scope of CEOS engagement with GEO's Community Activity Open Earth Alliance.	

1.2: CEOS Chair Priority Topics [slides]

Presenter: Raj Kumar (CEOS Chair Team, ISRO)

Main points:

- ISRO's CEOS Chair priorities have been: Virtual Constellations; SDG applications for BIMSTEC region; Renewable energy assessment from space; new disaster tools (including geo-leo solutions);
- VC study has focused on scatterometer applications; WGCV (Microwave) has shown interest in working with OSVW-VC on standards and metrics for scatterometry; a special session on *"Coordination of global scatterometer constellation including coverage optimisation and data sharing in response to WIGOS 2040"* was held in CGMS; the suggestion is to have coordinated CEOS-CGMS team to take into account the user requirement from CGMS and missions feasibility by CEOS; a working team is being formed; participation from NOAA, EUMETSAT, CMA, NSAOS, ISRO;
- a number of potential SDGs applications have been considered for BIMSTEC: Land Use and Land Cover (LULC), Water, Agriculture, and Forests; ISRO will discuss use of the EAIL prototype platform with WGISS;
- ISRO is developing a web application and mobile app for monthly and yearly solar energy potential and a solar site selection tool; they are also forecasting offshore monthly wind energy potential; and,
- ISRO has proposed a flood pilot using GEO and LEO satellites to map flood hazard and depth using time series of SAR & optical datasets and DEM; they also proposed to develop a Decision Support System for forest fire danger.

Main discussion points:

- Adam asked if BIMSTEC was using ODC, and it was confirmed they are using ODC. Currently they haven't contributed back to the code base, but once testing is completed this is expected.
- Ivan Petiteville (ESA) asked whether the CEOS Sustainable Development Goals *Ad Hoc Team* (SDG AHT) has been involved in the topics proposed by CEOS Chair. Raj welcomed this possible connection, though there is not currently an ISRO representative on the SDG AHT.

Plenary Agenda and Outcomes [slides]

Presenter: Raj Kumar (CEOS Chair Team, ISRO)

Main points:

- The Plenary agenda has been drafted and open for comments. The meeting will be virtual and reduced from the usual 2 full days. It will be held online on 20, 21 and 22 October; and,

- A draft Plenary agenda has been circulated with comments currently open.

Main discussion points:

- Osamu Ochiai (JAXA) suggested Plenary include Agency reports if possible to get necessary updates - even if only on the website for offline digestion. Raj confirmed this would be planned.
- Karen St. Germain (NASA) offered a presentation on 2021 Priorities from NASA.

Outcome 01	The 2020 CEOS Plenary agenda will include the opportunity for CEOS Agency updates. The SIT Technical Workshop recommended that agency updates be posted virtually (no oral reports).
Outcome 02	As in the past, the CEOS Plenary agenda will include a presentation on the theme and priorities of the incoming CEOS Chair.

CEOS Chair 2022

Presenter: Raj Kumar (CEOS Chair Team, ISRO)

Main points:

- Ivan recalled the recent CEOS Secretariat (CEOS SEC) discussions around a European candidate for 2022 Chair, noting that there is not yet a conclusion. One agency remains interested. ESA hopes to have a conclusion by CEOS Plenary with a CEOS European coordination meeting planned in first week October.

1.3: COVID and Earth Observation from Space

Presenter: Mauro Facchini (Session Lead, COM)

Main points:

- It is hoped that the session can lead to a Plenary discussion, building on the cooperation to date.
- A list of CEOS Agency websites related to COVID was provided.
- **RACE Dashboard [Simonetta Cheli, ESA] [slides]**: Collaboration between EC and ESA using Copernicus and other missions. Focus areas are GHG emissions, air and water quality, economic indicators and agricultural status. 31 companies contributed to the dashboard indicators. Looking for further international coordination.
- **NASA-ESA-JAXA Dashboard [Michael Falkowski, NASA, Shin-Ichi Sobue, JAXA] [slides]:** JAXA/NASA/ESA collaboration to monitor environmental and economic activity changes. The Earth Observing Dashboard was published on 25th June. (eodashboard.org). Examples include air quality (Sentinel-5P & Aura) and water quality (GCOM-C, Sentinel-3 & Aqua).
- **Copernicus activities [Astrid Koch, COM] [slides]:** The EU space response to COVID is outlined here: www.euspace-programme.eu/coronavirus. There are also dedicated services on air quality, pollution, and health. There have been contributions by the Copernicus Atmosphere Service (CAMS) and epidemiological studies trying to evaluate links between air pollution and COVID-19.
- **NOAA activities [Mitch Goldberg, NOAA] [slides]:** NOAA has a dashboard to track economic activity using satellite aerosol and trace gas products. NOAA will be reprocessing the entire SNPP and NOAA-20 record to produce consistent aerosol and trace gas products. A number of related AGU sessions are planned.

- **Initiative EUM/CNES/LATMOS [Dorothee Coppens, EUMETSAT] [slides]:** IASI has been used to monitor air composition in Europe and China. Improved capabilities will be possible with IASI-NG in LEO orbit and MTG (Meteosat Third Generation) with the advanced sounder IRS in geostationary orbit.

Main discussion points:

- Agencies can join eodashboard.org by reaching out to JAXA (Shin-Ichi Sobue) or NASA (Michael Falkowski).
- Ivan asked about the differences between TROPOMI and JPSS instruments measurements, and Mitch noted this was due to a combination with spectral and noise. We are not as sensitive to the surface but comparisons with TROPOMI will help us to better characterize the differences. The wavelength from OMPS does not cover the really strong NO_2 absorption between 400 and 420nm.
- Simonetta hoped that national statistical offices could benefit from these dashboards. Mauro noted links also to EC Directorates responsible for industrial policy.
- Steve Volz (NOAA) noted the COVID response is a great example of small coalitions showing initiative, and then CEOS overall enabling global coordination.
- Mauro proposed that a report on this session be brought to Plenary, demonstrating the existing collaboration and utility of the data. (JAXA, ESA, NASA to lead the preparation.) Whether there should be a session at Plenary on COVID remains to be determined. There are some areas where EO may add value, but trials in progress need to complete before coordination could be considered. User engagement would be key to any future coordination activities.
- Mark Dowell (COM/JRC) suggested monitoring some parameters that could play a role in triggering the spread of the disease like the destruction of the forest and the proximity with the human that could be factors that ease the transmission of animal diseases to the human beings.

Outcome 03	It was agreed that there will be a report to the CEOS Plenary on the productive discussion on COVID-19 that occurred during the CEOS SIT Technical Workshop.

SIT-TW-2020-02	JAXA (Shin-ich Sobue), ESA (Simonetta Cheli), NASA (Michael Falkowski) to coordinate a report to Plenary on the Technical Workshop COVID-19 session. This should include inputs from all agencies presenting at the SIT Technical Workshop, as well as a list of COVID-relevant weblinks from CEOS Agencies.	**CEOS Plenary**
	Rationale: Provide CEOS Agencies and Principals with a snapshot of the discussion to date as background for a Plenary discussion session on COVID-19 and space-based EO.	

1.4: CEOS Coastal Observations and Applications Study Team (CEOS-COAST) Pilots Update

[slides] [whitepapers] [annotated bibliography]

Presenter: Paul DiGiacomo (COAST Study Team lead, NOAA)

Main points:

- Phase 1 deliverables (should be completed by 30 September) include: CEOS-COAST website: http://ceos.org/ourwork/ad-hoc-teams/ceos-coast/; an annotated bibliography; a compilation of COAST-related projects/activities; draft satellite data requirements inventory for SDG 14.1.1a (coastal eutrophication); Phase 2 Pilot project components, priorities and sites identified; draftPhase 1 White Papers on "Sea to Land Impacts: User Needs, Observations, and Services", "Land to Sea Impacts: User Needs, Observations, and Services", and "Cross-Cutting Tools, Systems and Services" (white papers); and, a COAST Phase 2 Implementation Plan.
- Anticipated COAST Pilot Locations are: Odisha/Bay of Bengal; Coastal Virginia/Chesapeake Bay; West Coast of Africa; Rio de la Plata region (Backup/TBD); Bahamas; and, Tahiti/Kiribati/New Caledonia.
- The group will be requesting continuation at CEOS Plenary of COAST activities through 2021 as a CEOS *Ad Hoc Team*, with approval of impending Phase 2 Implementation Plan as well as pledges/commitment of resources as appropriate by CEOS Agencies.
- Merrie-Beth Neely (NOAA) summarised the COAST white papers.

Main discussion points:

- Paul noted there are seven countries envisioned for the Bay of Bengal pilot.
- The current pilots are based on locations where the team believed they could make progress, however they'd welcome more specific contributions to expand the set of pilots. (e.g. Arctic and sea ice). Steve Volz suggested keeping the Arctic topic in mind as COAST progresses, pending identification of clear resources and agency interest.
- Osamu noted that JAXA would like to join the study team. Mark Dowell (COM/JRC) noted it would be interesting to include pilot(s) on coastal carbon as another land-sea emphasis. Raj supported this as a topic.
- Trevor asked what work needs to be done between now and Plenary in terms of forming the Ad Hoc Team, in particular to really test agency commitment for this going forward and where they may be contributor gaps (which could be resolved before or at Plenary). Paul noted that these questions have been considered as the proposal for Plenary has been developed.
- Kerry noted it would be helpful to identify another co-lead for the AHT before the request goes to Plenary.
- Mark asked about translating the needs of COAST into requirements for products (e.g. along the lines of the IGOS-P Coastal theme). Paul noted that Phase 2 does include a detailed assessment and identification of observing system capability gaps, including a revisit of the IGOS-P Coastal theme.
- Kerry asked if there is a role for agencies to help support and instrument new sites or areas, and Paul confirmed this would be welcome.

Outcome 04	CEOS Coastal Observations and Applications Study Team (COAST) will ask Plenary for approval to be recognized/proceed as a *CEOS Ad Hoc Team* for 2 years. Next steps will include a call for Agency expressions of interest/support for Phase 2 (2021) activities (including a co-Chair for the AHT).
Outcome 05	JAXA asked to join CEOS COAST (nominating Ko Hamamoto and Osamu Ochiai), and AEM (Adrian Guzman) and USGS (Tim Stryker) projects might support COAST.

SIT-TW-2020-03	CEOS COAST Team to seek a co-Lead for the Ad Hoc Team to be proposed at Plenary.	**CEOS Plenary**

	Rationale: A COAST Co-Lead will help share the workload and bring new capabilities. (ISRO has agreed in principle to Co-Lead.)

SIT-TW-2020-04	Paul DiGiacomo (NOAA) to develop a high level draft Terms of Reference for a CEOS-COAST Ad Hoc Team ahead of Plenary.	**CEOS Plenary**
	Rationale: While not required before the October 2020 CEOS Plenary, draft TORs can be helpful information for review by CEOS Agencies preparing for this year's Plenary discussions. The requirement in the CEOS Governance and Processes Document (page 7) is, "Within two months of creation, the Ad Hoc Team will prepare defined objectives and appropriate path forward for meeting those objectives to include identifying needed resources."	

Wednesday 9th September

Session 2.1: Sustainable Development Goals

2.1.1: Welcome and Overview [slides]

Presenters: Alex Held (SDG AHT Co-lead, CSIRO) and Marc Paganini (SDG AHT Co-lead, ESA)

Main points:

- The main outcome for this session is to reach an understanding of what the SDG-AHT should propose to CEOS Plenary regarding its future. A number of other updates will also be presented, such as reports from the subteams looking at the four target Indicators and demonstration of some ongoing SDG toolkit work, including applications of the Open Data Cube technology.

2.1.2: Progress Reports from SDG-AHT Sub-teams

Water (6.6.1) [slides]

Presenters: Marc Paganini (SDG AHT Co-lead, ESA), Aurélien Carbonniere (CNES)

Main points:

- Focusing on the UNEP monitoring guidelines (one of two Custodian Agencies) as they involve direct references to Earth observation (EO). There are already a number of CEOS Agency products that have been identified as global datasets for 6.6.1: Global Surface Water Explorer (EC/JRC), Copernicus Global Land Service (CGLS) - Lake WQ (EC), Global Mangrove Watch (JAXA), DHI GRAS (with the support of ESA).
- Key messages for CEOS and CEOS Agencies:
  - a coordinated response from space agencies greatly facilitates the integration of EO in the UN monitoring guidelines, and CEOS should foster multilateral cooperation;
  - Multi-sensor approaches are needed for most of the sub-indicators and associated variables, and this requires multi-scale development (revisit, spatial resolution). VCs could support.
  - Uncertainty assessment is as important as measurements. Default global datasets don't include in most cases any uncertainty information. CEOS could support the development of these.

- Global, ready-to-use, publicly available WSE time series (e.g., Copernicus GLS Water Level, HydroWeb, DAHITI, HydroSAT) to be improved with full catchment-scale coverage, shorter time-lag between data acquisition and availability. Role for CEOS?
- Sentinel-3 dataset is available on public processing platforms for WSE extraction over inland water. For full benefit of high spatio-temporal coverage of Sentinel-3, dedicated processing workflows and evaluation tools for WSE extraction over inland water targets are needed.

Urbanization (11.3.1) [slides]

Presenters: Argyro Kavvada (NASA), Nale Mudau (SANSA)

Main points:

- Currently identified EO contributions to this Indicator include:
  - Mapping and monitoring changes in built-up areas and defining urban area extent, with several available global EO datasets (e.g., GHS-BU by JRC/EC, GUF by DLR, GMIS & HBASE by NASA/UMD).
  - Generating disaggregated maps of global, regional or national census data (e.g., GHS-POP by JRC/EC, GPW by CIESIN, WorldPop).
  - Derived urban extent products based on EO and open source processing tools (e.g., GHSL, Trends.Earth Urban Mapper, U-TEP, ODC).
  - Qualitative or more detailed assessments (e.g., night-time lights (DMSP/OLS,VIIRS)).
  - Assessments of derived impacts of urbanization (heat islands, building volumes, air quality).
- Summary Inventory of EO Data & Tools from GEO–UN Habitat Urban SDG EO Toolkit Working Group was presented (at global, regional and local levels).
- Key messages for CEOS and CEOS Agencies:
  - Multi-Sensor efforts such as the Harmonized Landsat Sentinel-2 (HLS) data set can help support 11.3.1 by e.g., providing future Landsat-scale data at much improved temporal resolution (every 2-3 days).
  - Need for more rigorous validation or inter-comparison to evaluate the usefulness of global public datasets and tools for national & sub-national reporting (SDGs, NUA).
  - UN Habitat & GEO Urban Activities well connected with countries & cities (increased attention to urban issues within GEO WP).
  - Leveraging strengths of the commercial sector in expanding potential of EO-based solutions.

Marine Pollution (14.1.1) [slides]

Presenter: Emily Smail (CEOS-COAST team, NOAA)

Main points:

- Focus is on 14.1.1a (index of coastal eutrophication potential) specifically, related to Chlorophyll-a, due to the applicability of satellite EO.
- Main findings:
  - Many countries lack *in situ* data required for monitoring eutrophication
  - Satellite data is crucial for providing some information about 14.1.1a
- Key messages for CEOS and CEOS Agencies:
  - Capacity development for level 2 and level 3 sub-indicators will be needed for many of the regional seas programmes.

Land Degradation (15.3.1) [slides]

Presenters: Neil Sims (CSIRO), Uta Heiden (DLR)

Main points:

- GEO LDN defined minimum data quality standards, while avoiding specifying datasets. Available here. New products are required to meet these needs, e.g., Carbon stocks above and below ground.

- Consistent and frequent observations are needed for all sub-indicators (baseline: 1 January 2000 to 31 December 2015; through to 2030).
- Key messages for CEOS and CEOS Agencies:
  - Improved coverage needed globally (e.g., Pacific Islands).
  - Establish closer links to local scale needs (GEO, local working groups).
  - UNCCD and GEO LDN are well connected and informed on end user needs, and data provider network.

2.1.3: Questions & Answers

Main points:

- Raj Kumar (CEOS Chair Team, ISRO) asked the scale at which wetland datasets are being planned, and Marc noted this is one of the least developed datasets. 10-30m available on GEE. Same spatial resolution as surface water. Surface water level is not present in the guidelines. Quite confident however that the volume of lakes and reservoirs can be monitored, and this will be proposed to UNEP as soon as possible. Raj asked about larger lakes (surface water level). Marc noted the surface water level Copernicus service has a methodology for large rivers and this will be expanded to large lakes in future.
- Neil noted that the Land Degradation definition is tricky as there are many different ones. The subteam has adopted a working definition, but tries to maintain flexible approaches. Raj asked if this contains the degradation processes also or only the types. Neil noted this is not so important for the indicator itself, but important for LDN which is part of the repair process in response to the indicator.

2.1.4: Showcase SDG Applications Using Open Data Cube Technology [slides]

Open Data Cube: Brain Killough (CEOS SEO, NASA)

Main points:

- 6.6.1 (water extent) and 11.3.1 (urbanisation) are the focus. Brian/SEO is using the ODC and Notebooks to run some processes in line with the accepted guidelines.
- Next steps:
  - Release a new free/open "Amazon ODC Sandbox" by October 2020. This will allow users to test the SDG algorithms anywhere in the world! Initially it will use the global Landsat ARD archive and
  - Eventually will add Sentinel-2 ARD.
  - Develop and release a free/open "Google ODC Sandbox" by the end of 2020. This will use Google Cloud and Earth Engine global datasets.
  - The two "Sandbox" concepts (noted above) will be advertised as an "Open Earth Alliance" activity which is a new GEO Community Activity focused on ODC exploitation. In addition, these concepts will be discussed with GEO to manage the number of users and utilize cloud credits from Amazon and Google.
  - Continue testing and enhancements to the existing SDG data cube notebooks and also add and improve training resources (documentation and videos).
  - Progress the production of Sentinel-1 ARD to generate data cubes on-demand. Continue to discuss plans for global data production and hosting of that data on public clouds.
  - Add all of these resources to the EO4SDG Toolkits.

Digital Earth Africa: Adam Lewis (SIT Co-Chair, GA) [slides]

Main points:

- Digital Earth Africa (DE-Africa) is providing access to the data and tools for countries and actors in Africa to address SDGs and other resource questions.
- A broad range of use-cases is arising according to user interest - there is appetite for EO based methods. However, local ownership of methods is important.

- A target for the CEOS SDG team could be to deliver practical and transparent methods that can be extended and applied through data cube platforms.
- Should position the SDG work to allow others to use them on platforms such as ODC/DEAfrica, etc. Provide methods that users can take and apply to their situation.

Discussion:

- Adam noted that DE-Africa is not currently using Sen2Agri (esa-sen2agri.org). DE-Africa is working with GEOGLAM and targeting the definition of the crop mask as an essential agricultural variable. They are looking at a method that can be operationally applied at scale and routinely, based on machine learning. They have had one telecon with GEO and Sen2Agri, and will be following up.

2.1.5: CEOS Contributions to SDG Toolkits [slides]

Presenters: Argyro Kavvada (NASA)

Main points:

- Main Objective: Provide coordinated and sustained information about the use of, and access to, EO for SDGs at various levels of planning, monitoring, tracking, and reporting. To complement the Custodian Agency approved guidelines.
- Pilot SDG Toolkit: EO Toolkit for Sustainable Cities & Communities with UN Habitat, HPI, GUOI. Beta Version Release of Urban SDG/ NUA Toolkit (planned for Q4 2020).
- Ongoing CEOS contributions include:
  - Synthesis of the satellite data availability and observation gaps for SDG targets & indicators (based on the satellite data requirements analysis).
  - Inventory of relevant global reference datasets, tools, and platforms accompanied by short guidance on relevance & applicability for SDG targets/ indicators.
  - Improved tools and algorithms such as CEOS Open Data Cube solutions (through the work of CEOS SEO) and ones developed by CEOS agencies.
- Additional requirements:
  - Increased access and visibility to relevant CEOS ARD products for SDG indicators
  - Learning and Support (capacity development), including step by step guides, online trainings, recordings, presentations, news on upcoming trainings, as well as direct technical support for countries engaged in Toolkit (e.g., support national or sub-national institutions in testing the applicability of global EO products).

Main discussion points:

- Adam suggested making a link between these activities and the observation requirement work of the LSI-VC.

2.1.6: Continuity of the SDG-AHT [slides]

Moderators: Alex Held (SDG AHT Co-lead, CSIRO) and Marc Paganini (SDG AHT Co-lead, ESA)

Main points:

- Three options being considered: 1) renew AHT for another year with a transition plan for next year; 2) become a new WG or be integrated into an existing CEOS body; or, 3) disband and transfer CEOS related activities on SDGs to GEO from November 2020.
- A recent survey of the group was conducted. 9 out of 10 agreed to propose the 3 options as proposed, with slight changes proposed included for option 1 to leave the door open for next year. 3 are in favour of a new WG; 2 of transferring all to GEO; 1 to another CEOS body; 4 have no preference or opinion.
- A few main messages came through in the survey: the AHT has made significant progress this year; SDGs are critical for GEO and CEOS; and, we still need to reassess AHT trajectory in future after 2021.

Main discussion points:

- Ivan Petiteville (ESA) noted that the role of the space agencies is not to produce final decision making products. It primarily includes translating the needs of the external users into observational requirements, coordinating cal/val activities, generating and distributing EO products so other stakeholders can further process them in support of GEO EO4SDG activities. Multiple, frequent observations are needed to support the four focus Indicators which will require many different missions and good coordination to secure data. CEOS support to GFOI and the COVID Dashboard are good examples, where planning observations is the task of CEOS done for practitioners that further process this satellite data in their respective GEO teams, to generate final decision making products.
- Ivan added that the amount of GEO Secretariat resources applied to SDGs is quite low, and currently he does not believe sufficient resources are being applied within GEO as one of the headline priorities.
- Ivan noted that ESA expects to continue to push on SDGs as the next CEOS SIT Chair.
- Ivan doesn't support any transition of the work going on in CEOS to GEO due to a lack of resources to take on the level of technical and high-level work that CEOS has been doing as space arm of GEO.
- Astrid Koch (COM) commended work of the SDG AHT. She noted there is a lot to do in next year, but thinks the team should work after Plenary to develop a roadmap for 2021. She cautions against more groups and coordination mechanisms, but agrees we need a good home for the SDG activity in CEOS, closely linked to the work of GEO.
- Charles Wooldridge (NOAA) noted that moving forward for Plenary, strongly suggests that along with a recommendation for option 1 that a clear set of deliverables for the next year be presented to Principals. Flora Kerblat (SIT Chair Team, CSIRO) noted that the AHT has already proposed future deliverables in the CEOS WP in case of the AHT renewal, and will ensure to provide a Roadmap for next year at the Plenary.
- Brian noted option 2 is not a viable option for plenary to make a decision on. Need a year to make this path viable, and we need an AHT to do that. Therefore option 2 is not an option.
- Osamu Ochiai (JAXA) noted JAXA supports option 1, and suggests CEOS undertaking a readiness assessment of datasets to support SDG Indicators. This is a CEOS-level task.
- Sandra Cauffman (NASA) suggested we need significant time for a discussion at Plenary on the role for the SDG-AHT going forward, including avoiding overlaps with GEO. She suggested we could go with Option 1 or Option 3, but the way forward is currently unclear. We need clarity on the role, potential overlaps with GEO activity in this area before making a decision. Flora directed Sandra to the Data Supply Analysis and Strategy document, available on the SIT TW website, including a graph highlighting the recent discussions between CEOS and GEO along these lines.
- Mark Dowell (COM/JRC) stressed the importance of space agencies interacting directly with custodian agencies to help translate formal requests for long-term sustainability of datasets. It is obvious that custodian agencies will not buy in unless there is a long term commitment to the delivery of these products. We need to think about this and whether CEOS has authority to make these assurances, and this should be discussed at Plenary.
- Doug Cripe (GEO Secretariat) noted there is no central coordinator for SDGs at GEO Secretariat, but Steven Ramage, Sara Venturini and he are keeping tabs on SDG issues.
- Raj suggested option 2 in future, but not yet as it is likely not currently feasible. He suggested option 1 as the next step.

Outcome 06	Two options for the way forward on the ad hoc Team for Sustainable Development Goals (SDG AHT) will be presented to the 2020 CEOS Plenary (i.e., either extend or stop), with the recommendation to adopt Option 1 (extension of the SDG AHT for another year). The SDG AHT will also present a Roadmap to the Plenary for its transition into a permanent structure, proposed to begin at the end of 2021.

SIT-TW-2020-05	When requesting a one-year extension, CEOS SDG AHT will submit a Roadmap for its activities in 2021, highlighting its transition plan and the proposed activities to be undertaken in support of GEO.	**CEOS Plenary**
	Rationale: This will provide further insight to Principals on how another year of ad-hoc team activity will help clarify CEOS's role in the broader SDG context.	

Session 2.2: CEOS Analysis Ready Data: Beyond Land [slides]

2.2.1: Session Introduction, Context, Welcome

Presenter: Alex Held (SIT Co-Chair, CSIRO)

Main points:

- Purpose is to advance the discussion around an expansion of the CEOS Analysis Ready Data Definition and effort beyond the land domain and assign leads for each of the domains.

2.2.2: SST-VC Perspectives on CEOS ARD and Findings from the Ocean Domain ARD Survey [slides]

Presenter: Ed Armstrong (SST-VC, NASA)

Main points:

- There has been some work on 'ARD' in SST already, specifically the Level 4 SST example from Chelle Gentemann.
- Conducted a survey to assess the ARD readiness of GHRSST MODIS Aqua/Terra SST Level 2P datasets, applying the existing CARD4L Surface Temperature template. Overall, nearly every category was sufficiently addressed. (See slides).
- The foundation state of these datasets are ARD and lend themselves to further data manipulation services.
- CARD4L assessment could be improved with a quantitative scoring and factor weighting.
- More ARD assessments will be performed in the SST-VC community and collaboration with others is welcomed.
- There are ongoing complementary NASA/Interagency ARD activities such as CEOS COVERAGE, CEOS Interoperability Lab, NASA/ESA MAAP which they are hoping to leverage.

2.2.3: AC-VC's Possible Contributions to CEOS ARD in the Atmosphere Domain [slides]

Presenters: Diego Loyola (AC-VC, DLR)

Main points:

- Atmospheric observations are typically columns/profiles of trace and GHGs, usually sampling systems, not imagers. Operational products of current missions like TROPOMI/Sentinel-5P already cover several characteristics expected from ARD.
- Have compared CARD4L description and TROPOMI/Sentinel-5P: general and quality metadata are compliant, measurement-based/radiometric calibration are not applicable; geometric calibration: atmos products usually provided in satellite-grid and not regular-grid; Solar and View Angle Correction

is not applicable (the radiative transfer modeling used for atmospheric retrievals takes into account solar and view angles); and, Atmospheric Correction: not applicable.

- The usability of Atmospheric Level-2 products as ARD is limited, Level-3 (gridded data) and Level-4 (fluxes, sources/sinks) are needed to create useful ARD products.
  - Atmospheric instruments often provide incomplete spatial coverage and/or temporal coverage on time scales over which the trace gas or aerosol concentrations can be changed by local production/loss or transport.
  - The observed concentration of an atmospheric trace gas or the abundance of an aerosol species is determined by both its local sources and sinks and by the ambient wind field.
  - In general, atmospheric Level-2 products can't be ingested in Geospatial Data Cubes
- Considerable work is needed to adapt and extend the CARD4L Framework (Definition, Product Family Specification, PFS, and Product Assessment) to the Atmosphere domain
- AC-VC could perform a future study of the requirements for specific atmospheric ARD products including reactive gases, aerosols and greenhouse gases. This would depend on the expansion of the ARD framework (action SIT-TW-2020-06).

2.2.4: CEOS-COAST & CEOS ARD [slides]

Presenter: Paul DiGiacomo (CEOS-COAST Study Team, NOAA)

Main points:

- One of COAST goals is: leveraging CEOS Systems, services and interoperability approaches, including the CEOS Analysis Ready Data (ARD) framework already demonstrated for terrestrial and oceanic applications.
- What: Successful realization and utilization of trans-boundary Analysis Ready Data (ARD) will be one of the unifying factors & primary engines that drives the COAST effort forward.
- Why: Because there have been significant challenges to date, and more so great opportunities looking ahead, in bridging and coordinating geophysical satellite data across the land-sea (~aquatic) interface, as well as *in situ* and diverse biological (and ultimately socio-economic) data sets. ARD provides a common framework.
- How: As COAST moves toward implementation, we will guide and leverage current and planned capabilities and approaches within CEOS for ARD, i.e., SST-VC, CARD4L/LSI-VC, USGS Aquatic Reflectance Demo, COVERAGE and WGISS/SEO.
- Trans-boundary CEOS ARD is the key for COAST.

2.2.5: Aquatic Reflectance Demonstration Product and Product Family Specification [slides]

Presenters: Chris Barnes (USGS)

Main points:

- Landsat Aquatic Reflectance is a provisional on-demand USGS product that provides nondimensional normalized remote-sensing reflectance for coastal and inland waters (global, Landsat 8 OLI, visible bands only, i.e., bands 1-4).
- Now available on-demand through the USGS EROS Science Processing Architecture (ESPA) for Landsat-8 Collection 1 and eventually with Landsat-8 Collection 2 in mid-2021 (https://espa.cr.usgs.gov/).
- The Aquatic Reflectance CARD4L PFS currently in development. Expert Review Panel from the aquatic user community. Review and endorse final AR PFS at LSI-VC-11 (target, early 2021).

2.2.6: Beyond Land: Options to Expand the CEOS ARD for Land Framework to Oceans and Atmosphere [slides]

Moderator: Ed Armstrong (SST-VC, NASA)

Main points:

- Adam asked about Ed's definition, and why making a geophysical measurement is not mentioned. Ed noted this is implied/assumed (e.g., chlorophyll, SST).
- Jorge Vazquez (NASA) asked whether thought had been given to defined ARDs based on sensors and/or level of processing, for example uncertainties are different between passive, infrared.
- Adam noted we need to work on drawing together the different definitions that have been presented here. The CARD4L priority is the geophysical measurement (where, when, how, quality, uncertainty), and in a form that can support existing or new users. He noted assessments presented today are against the existing PFS, but it is anticipated that the other domains would come up with their own PFS.
- Adam noted the importance of gridding for alignment and time series analysis. This is one of the core objectives of ARD.
- Alex asked if each of the presenters could talk about the users beyond the science community in each of these domains (atmosphere, ocean) that would benefit from a concept like ARD.
- Paul noted Nancy's comment about engaging the statistics community, and SDGs could provide a great example.
- Diego noted the atmosphere needs dedicated information for the different processing levels. Another dimension for the atmosphere beyond ARD. He noted that changes in air quality due to covid have been very prominent recently, with many of new non-expert users, e.g. environmental, health, journalists. ARD however cannot aid the interpretation of the data, though it works towards going one step further and providing INTERPRETATION Ready Data, combining data over time and with auxiliary data (e.g., winds etc.) to provide more usable info.
- Ake Rosenqvist (JAXA): ARD should be provided in addition to lower level products, which expert users still prefer to use. Whereas the non-expert uses ARD. He noted the SAR PFS and the fact there is a range of products.
- Adam: The 'ARD' for the atmospheric community may be Level-4 or Level-3 products. Jay Alsaadi noted an atmosphere ARD definition would need to be broad enough to include L2, L3, and L4.
- Paul noted Ake Rosenqvist highlighting the significant opportunity to get more use from SAR data. From the COAST perspective, this includes bringing together SAR with optical (e.g., ocean color) data which are very complementary and crucial for many of the COAST priorities. Having these both as ARD would facilitate broader geospatial analyses for/by users.
- Adam noted they are implementing a workflow for the low level ARD for all of Africa. i.e. Normalised Radar Backscatter, so that we can have a time series of Sentinel-1 data generated automatically and added to the Data Cube.
- Brain noted that he is funding the development of a pipeline that can generate Data Cubes of SAR ARD. Once this is ready, there will be a need to think about how this process/service can be offered to users.
- CARD4L doesn't prescribe product levels.
- Vardis Tsontos (NASA/JPL) asked if we foresee the ARD definitions and guidelines being extended to Services delivering data in ARD form. Adam noted that for land they have been focused only on the measurement and not how it is delivered. He also noted that the industry has moved to STAC and GeoTIFF, and that is the technology to build data cubes in the cloud.
- Nancy Searby (WGCapD Chair, NASA) asked if we considered global subsetting at the national and provincial scale. Chris noted that the US is the focus for now for USGS, Geoscience Australia for Australia, SANSA for South Africa, etc.
- Jorge asked if there will be future discussions on how to integrate the ARD to make it easier to use remote sensing and *in situ* data. COVERAGE is making contributions in this direction.
- Vardis noted a framework for the *in situ* observations is an ongoing process within COVERAGE. Until data are in a common framework it is difficult to combine them, and they are currently pursuing this in COVERAGE.

- Adam suggested designing new systems (e.g. new SAR satellites) to produce ARD from day one. Following the specifications that the ARD specialists have developed. Alex confirmed they are building an ARD processing pipeline for Australia's share of the NovaSAR mission.

2.2.7: Wrap-up

Main points:

- Ed asked for suggestions on the way forward.
- It was agreed to initiate a team to review the CARD4L Framework and consider how to expand it for other domains.
- It was agreed to try and have a proposal for this team for Plenary to consider endorsing, and also seek agency Principal interest and nominees.
- Paul noted that COAST is happy to support the proposal given their interest in the outcomes.
- Adam also noted LSI-VC would be happy to contribute to the team. He suggested it would be healthy if LSI-VC did not chair the group, given their ongoing interest.
- Diego confirmed AC-VC would support the team.

Outcome 07	Plenary (Principals) will be asked to consider supporting a small team to review the Analysis Ready Data (ARD) framework and to consider making it amenable to additional Product Family Specifications (PFS) for domains beyond land.

SIT-TW-2020-06	SIT Chair to work with CEOS Sea Surface Temperature VC (SST-VC) co-lead Ed Armstrong on a proposal to the 2020 CEOS Plenary for Principals to support the establishment of a small study team to examine the ARD framework in the context of potential Product Family Specifications (PFS) for domains beyond land.	**CEOS Plenary**
	Rationale: To propose that the 2020 CEOS Plenary approve a small expert study team to look at broadening the ARD framework, with a final report and close at Plenary 2021. (COVERAGE, AC-VC (Diego Loyola), LSI-VC, COAST expressed willingness to contribute	

Thursday 10th September

Session 3.1: Working Teams Session Scene Setter [slides]

Presenter: Jonathon Ross (SIT Chair Team, GA)

Main points:

- This session seeks to showcase our WGs and VCs and provide an opportunity for them to identify issues and highlights for exposure at Plenary.
- The SIT Chair Team's approach to working teams has been to promote information flow outside major meetings, including via rounds of informal chats, the Working Team All Hands calls, and VC reports to the monthly CEOS SEC meetings.

- There has been a notable increase in VC representation in the CEOS Work Plan based on discussions during the VC Chats.

Session 3.2: Working Groups (WG) Showcase

3.2.1: Session Introduction [slides]

Presenter: Raj Kumar (CEOS Chair Team, ISRO)

Main points:

- This session seeks to showcase our WGs and provide an opportunity for them to identify issues and highlights for exposure at Plenary. Additionally, it is hoped that the session might identify opportunities for collaboration across the working teams.
- Kerry Sawyer (CEO, NOAA) noted some WG leadership rotations will be taking place at CEOS Plenary. WGCV and WGClimate. And she highlighted the CEOS Work Plan and its importance in support of coordination.

3.2.2: WGCapD - CEOS Branded Webinars [slides]

Presenter: Nancy Searby (WGCapD Chair, NASA)

Main points:

- Branding of webinars proposed to address inconsistency in approaches used across CEOS with aims including increasing awareness of activities and resources, sync with the work done by SIT Chair on branding the CEOS thematic observation strategies (TOS), increase recognition of CEOS-sponsored activities and resources, and share WGCapD lessons learned and good practice.
- Suggested path forward is to create a "CEOS Webinar Toolkit" including guidance for creating webinars, templates for documentation, presentations, questionnaires, and colour schemes and icons.
- Looking Ahead plans are to:
  - Promote the CEOS thematic observation areas and develop a webinar toolkit;
  - Poll WGCapD members to understand who is conducting webinars and who could benefit from hosting webinars but is not; and,
  - Work with other Working Teams to support CEOS webinars with branding, quality checks, best practices, and communication.

Discussion:

- Webinars are recorded, but practice varies between working teams, and WGCapD will work on a consistent approach.
- Nancy noted that at Plenary WGCapD would like agreement on the approach presented today. Need to consider the resource ramifications of the proposal - noting the significant amount of work needed to review other groups' work.

3.2.3: WGDisasters - Documents for Plenary Endorsement [slides]

Presenter: David Green (WGDisasters Chair, NASA)

Main points:

- WG Disasters plans to present three items to Plenary for endorsement:
  - **WGDisasters Strategy Document** seeks to facilitates engagement with users and decision makers; guide data policy/business evolution; and, inform gap-filling observations and background missions, data and information systems design, analysis ready data;
  - **Recovery Observatory (RO) Demonstrator Implementation Plan** which has the goal of demonstrating reproducibility and global extension for disaster recovery;

- **GEO/LEO/SAR Flood Pilot Implementation Plan** defines a collaborative project with regional case studies examining the feasibility of sharing and integrating optical, SAR and geostationary methodologies (CEOS, CGMS, and other private sector), and assess new tools; and,

- The documents have been provided for review at the time of SIT TW. Agencies have been involved in the drafting, and they are currently in a proposed final form, but they are receptive of any last minute minor changes.

Discussion:

- Flood pilots are seeking to demonstrate the coordination and the sharing data for specific objectives. Next immediate steps are engagement with other stakeholders, and draw up a data plan. Follow on from a successful pilot is the concept of a demonstrator, including working further with stakeholders and other partners to work toward more operational projects.
- Ivan Petiteville (ESA) asked about the RO, noting the experience in Haiti has been successful thanks in part to huge efforts by CNES in funding several expert missions to Haiti. He asked if we expect the same type of engagement of one agency for each RO. David Green noted that each RO triggers the establishment of a structure with a leading agency for that RO, and as appropriate, membership from other agencies and partners.
- Tim Stryker (USGS) asked about complementarity between the RO and the Disasters Charter, and David Green noted the Charter more short-term post-event response focused, with the RO focused more on pre- and post-event resiliency.
- Alex Held (SIT Co-Chair, CSIRO) asked about the new Wildfire Pilot, and Dave Borges noted the creation of a new Wildfire Pilot was presented and discussed during WGDisasters-14 last week. We are moving forward with Pilot development. Multiple WG member agencies have expressed interest, and a dedicated WG-wide meeting will be scheduled in the near future.

Outcome 08	Three WGDisasters documents will be presented to the 2020 CEOS Plenary for endorsement: 1) CEOS WGDisasters Strategy Paper; 2) Recovery Observatory Demonstrator Implementation Plan; and 3) the GEO/LEO/SAR Flood Pilot Implementation Plan.

3.2.4: WGISS - Earth Analytics Interoperability Lab (EAIL) [slides]

Presenter: Robert Woodcock (WGISS Chair, CSIRO)

Main points:

- WGISS and the SEO have been working jointly on the EAIL.
- Recently there has been an emphasis on cloud infrastructure and an increase in data volumes, and this has presented challenges for data delivery and analytics.
- WGISS and SEO receive a lot of questions around implementation of ARD, cloud data format, analysis platforms, and it is quite difficult to validate the advice being given around interoperability aspects.
- The first Lab node is hosted by CSIRO and jointly operated by WGISS and SEO with the overall goal of jointly developing CEOS Best Practices via interop experiments, and validating and demonstrating interoperability approaches.
- There has been interest from CEOS-COAST, DEMIX (WGCV), WGDisasters Flood Pilot, and the CEOS Rice Monitoring Community (JAXA).
- Initial features of EAIL include: Jupyter Labs for exploratory data analytics, scalable cloud computing, web portal hosting, cloud data formats best practices, and a 'recipe book' (JupyterNotebooks) of interoperable practices.

- Current availability of public data on the various cloud platforms is inconsistent, with various access conditions (e.g., requester pays), and this is something WGISS is looking at how to address.

Discussion:

- Ivan asked who will be entitled to use the EAIL, noting that if there were sufficient resources and are ready to share them, opening the Lab to external users might foster the use of satellite data by new user communities. Robert noted the current plan is for CEOS Agencies only, and specifically CEOS projects/initiatives, with the limitation primarily being the budget of the SEO and WGISS (CSIRO). The demand/interest has caught us by surprise and we are looking for ways to overcome this limitation, and welcome further suggestions as well as additional nodes.
- Raj asked about plans to have demonstration and training through WGCapD. Robert noted WGISS has a good relationship with WGCapD and we are currently discussing several webinar topics with them along the best practice lines and potentially using EAIL as a training tool.

3.2.5: WGCV - RadCalNet Uptake and the CARD4L Review Process [slides]

Presenter: Cindy Ong (WGCV Chair, CSIRO)

Main points:

- RadCalNet provides an essential CEOS service. Currently there are 499 users, growing at about 15 per month since going public. (462 are public, non-CEOS). A new RadCalNet site near Baotou City, China.
- Systematic calibration standards have been developed for RadCalNet addressing quality control, processing, and delivery. Some of these have been adopted for the CARD4L review process.
- CARD4L Review Process: two assessments have been completed for Landsat Collection 2 (Surface Reflectance (SR) and Surface Temperature (ST), vs. Product Family Specification v4.0). Currently we are at PFS v5.0, and assessments have been re-submitted against this version for Landsat Collection 2 for SR and ST, and we are awaiting an updated submission from ESA for Sentinel-2 SR. Cindy thanked Medhavy Thankappan for all of his effort on this.
- We are expecting Element84 to submit an assessment for their Sentinel-2 Surface Reflectance products.
- Overall the assessments are going well, but we will need to monitor and be aware of resources needed for these assessments.

Discussion:

- Adam Lewis (SIT Co-Chair, LSI-VC Co-Chair, GA) thanked Cindy, noting this is a great example of different parts of CEOS playing to their strengths. On behalf of LSI-VC and the SIT Chair Team I would like to express thanks to WGCV for their willingness to support this work.

3.2.6: WGClimate - Use Cases for Climate Data Records [slides]

Presenters: Wenying Su (WGClimate, NASA)

Main points:

- A Use Case gathering tool, developed by WMO Space Programme Office, has been integrated into climate "Use Cases" web page (climatemonitoring.info/use-cases). Use cases will be published on the web and selected use cases will become part of a special report issued by WMO in 2021/22.
- The objectives include demonstrating the value of climate data records for decision/policy making, and understanding the application needs to provide feedback towards quality improvements for the ECV requirements defined by GCOS.
- They also hope to validate the top-down architecture for climate monitoring from space with a down-top approach ensuring traceability from usage to space-based observing system, and to help optimise the use of climate data records in applications relevant for climate services and science

- CEOS representatives are invited to submit use cases. The call has also been sent out via social media, CGMS, GEO, and the CEOS website.

Discussion:

- Paul DiGiacomo (COAST Team, NOAA) noted that COAST would like to discuss coastal use cases further.
- Karen St. Germain (NASA) thanked the WGClimate Chair (Jörg Schultz of EUMETSAT) and Vice Chair (Albrecht von Bargen of DLR) for their efforts to maintain and improve the ECV inventory, and all of the agencies contributing data to the ECV inventory.
- Ko Hamamoto (JAXA) asked if there is a deadline for submission for the first Use Case report, and Jörg noted the selection process will start in the second half of 2021.

Session 3.3: Virtual Constellations Showcase

3.3.1: Welcome [slides]

Presenter: Jonathon Ross (GA, SIT Chair Team)

Main points:

- The objectives for this session are to hear the latest highlights from the VCs, including in relation to CEOS Work Plan Deliverables, and to identify VC-related Plenary highlights, topics and issues.

3.3.2: P-VC [slides]

Presenter: Chris Kidd (P-VC Co-Lead, NASA)

Main points:

- There has been a recent transition of NASA co-lead from Gail Skofronick Jackson to Chris Kidd, with JAXA Co-Lead remaining (Riko Oki). ISRO has been welcomed as a new P-VC member, and invitations being sent to agencies and organisations for representation on P-VC.
- P-VC remains closely linked and coordinated with the GPM mission, as well as an active link to the precipitation community. Good engagement with the science and broader community via the International Precipitation Working Group (IPWG).

Discussion

- Atul Varma (ISRO) asked about plans for F-20 SSMIS, and Chris noted this has likely been shelved (existing hardware moved out of launch-ready storage).
- Ivan noted that CIMR is not approved yet, and remains a candidate mission for the time being.
- Nancy asked about the biggest gap in meeting users' needs, and Chris noted broad resolution requirements (temporal, spatial from metres to km, minutes to months) remains a significant challenge.

3.3.3: AC-VC [slides]

Presenter: Ben Veihelmann (AC-VC Co-Lead, ESA)

Main points:

- Jay Al-Saadi (NASA) will retire soon after the 2020 Plenary and will be succeeded as a Co-Chair by Barry Lefer (NASA). Hiroshi Tanimoto (NIES) joined as a Co-Chair in 2020.
- Some highlights of current AC-VC activities:
  - GHG: contributing to CEOS/CGMS GHG Constellation Strategy / Roadmap;
  - Ozone: contributing to Tropospheric Ozone Assessment Report – Phase II (TOAR-II);
  - AQ Trace Gases: coordination of validation (VC-20-02), S4&S5 Cal/Val Plan (VC-20-03), GEMS AO (VC-20-04);

- AQ Aerosol (new): status of current research and approaches to constrain particulate pollution; status of observations, operational and future satellite missions; whitepaper on satellite-informed estimates of aerosol-related AQ (VC-20-05); and,
- COVID-19: observed impact on emissions and of GHG and air pollutants.

Discussion:

- David Green asked if there is an interest to look at wildfire plume analysis and mission requirements, perhaps join in scoping of future WGDisasters wildfire pilots. Ben confirmed this could be of interest (e.g. CO, other trace gasses).
- Karen congratulated CEOS members KARI and NIER on the successful launch of the world's first geostationary air quality mission, Korea's GEMS on-board GEO-KOMPSAT 2B.

3.3.4: LSI-VC [slides]

Presenter: Zoltan Szantoi (LSI-VC Co-Lead, COM-JRC)

Main points:

- LSI-VC is awaiting an update on USGS leadership transition after Steve Labahn.
- Have integrated the SDCG for GFOI and GEOGLAM AHWG as subgroups on Forest and Biomass and GEOGLAM respectively.
- Connecting with various industry contacts on CEOS ARD and a few have indicated interest in undertaking CARD4L self-assessments.
- CEOS ARD Webinar #1 – July 1, 2020: Watch here. 500 registrations, 725 views, with further webinars planned.
- Participating in OGC's TESTBED16 ARD activity as a means for introducing CARD4L concepts to a broader community and establishing CARD4L as best practice (in lieu of a formal standard).
- Current endorsed CARD4L Specifications: Surface Reflectance (SR), Surface Temp (ST), Normalized Radar Backscatter, Polarimetric Radar. In progress CARD4L Specifications: Aquatic Reflectance (Coastal), Interferometric SAR, Geocoded Single-Look-Complex (SLC).
- The first CARD4L datasets have been assessed: USGS Landsat Collection 2 SR & ST. The COM/ESA Sentinel-2 SR dataset is currently being assessed.
- Exploring opportunities for CARD4L pilots with the SIT Chair Team with the goal of getting feedback to support improvement of PFS.
- LSI-VC GEOGLAM subgroup: GEOGLAM work is now principally executed by the GEOGLAM Coordination Team on EO Data Coordination. Essential Agricultural Variables remain the primary focus. CEOS-relevant updates associated with this will be forthcoming (observations table will be updated; our R&D and capacity development agendas will flow from this; and we are finding the ARD certification discussions informative for our own EAV certification talks). This was supposed to be done for Plenary, but has been impacted by COVID.

3.3.5: SST-VC [slides]

Presenter: Ed Armstrong (SST-VC Co-Chair, NASA)

Main points:

- Anne O'Carroll, EUMETSAT (co-lead since 2015, outgoing 2020). Christo Whittle (SANSA) is an incoming Co-Lead, replacing Anne.
- The ninth CEOS SST-VC meeting was held online, alongside the annual GHRSST-online Science Team meeting in June 2020.
- The CEOS SST-VC White Paper has been completed for publication.
- There are 100+ standardized GHRSST products, spanning ~8 million CF/ACDD netCDF data files, ~200 TB, from Sep 1981 – Aug 2020.

- GHRSST Regional / Global task sharing (R/GTS) framework evolution continues, toward implementation of a federated distribution architecture.
- Further SST-VC activities:
  - Build on the results of Ocean SST ARD presentation in section 2.2: Continue to survey more GHRSST datasets; engage other VCs and ARD collaborators (e.g., CEOS COAST); report by April 2021.
  - Provide recommendations for improving search relevancy and data access across CEOS VC partners (Ongoing work within GHRSST).
- Long-term SST-VC goals: engaging early career scientists, more collaboration with other VCs on common themes e.g. coasts, GHRSST data management evolution, search relevancy / decision trees based on GHRSST product search, maintain SST needs on Passive Microwave Radiometers.

Discussion:

- Jonathon asked about the search relevance / decision trees and whether there might be a, and Ed noted this is aimed at meeting user needs/requests to mine through datasets in order to decide what dataset to use.
- Rashmi Sharma (ISRO) asked about the accuracy requirement for coastal applications and are there any gaps in meeting them, and Ed noted that managing cloud pixels near the coast is one important area/gap.

3.3.6: OST-VC [slides]

Presenter: Annick Sylvestre-Baron (OSV-VC Co-Lead, CNES)

Main points:

- Remko Scharroo (EUMETSAT) also OSTST Project Scientist, to be replaced by Estelle Obligis (proposed to the SIT meeting for approval in October).
- Eric Lindstrom retired at the end of 2019, replaced by Nadya Vinogradova (NASA). Wang Chen left CNSA last year, with a new CNSA representative to be designed.
- An update of 2009's "Next 15 Years of Altimetry – OST Constellation User Requirement Document" is planned. Will integrate new user needs (included specific requirements from the CEOS-COAST team) from recent books and white papers from the community.
- Delivering a new OST-VC White Paper Document (action VC-19-06) by Q4 2020. OSTST will be solicited for specific contributions in their area of expertise and overall review of the first draft. At the beginning of 2020 ESA kicked off the Copernicus Next Generation Topography Constellation (NG-TC) Expert Team. Because of the large overlap with the activities considered for the writing of a White Paper on this by the OST-VC, it was concluded that the activities for the White Paper would best be delayed until the NG-TC activities have concluded (later 2020), and the scope of the OST-VC White Paper can be reassessed. The NG-TC MATER (Mission Assumptions and the derived Technical Requirements) will be an additional input to update the OST-VC white paper. **New deadline for VC-19-06 is End of 2021.**

3.3.7: OSVW-VC [slides]

Presenter: Raj Kumar (OSVC-VC Co-Lead, ISRO)

Main points:

- The WGCV Microwave Subgroup has shown interest in working with OSVW-VC. Meeting was organised between OSVW-VC and WGCV on April 21 to discuss standards and metrics for scatterometry. Draft of the work plan discussed and work components and team members also identified.
- Organised a special session on scatterometry in CGMS with the objective: "Coordination of global scatterometer constellation including coverage optimisation and data sharing in response to WIGOS 2040". CGMS resolved to form a working team to discuss the present issues, future scatterometer

missions and gap analyses. OSVW-VC suggests having a coordinated CEOS-CGMS team to take into account user requirements from CGMS and mission feasibility assessment from CEOS.

- A working team is being formed to prepare comprehensive document to:
  - identify and recommend validation sources and metrics;
  - undertake inter-calibration of the backscatter data from different sensors;
  - generate climate quality products;
  - development of unified GMFs and retrieval algorithms for all space-borne scatterometers;
  - investigate algorithms for extreme wind cases and impact of other environmental parameters;
  - identify the components of a global scatterometer constellation to monitor extreme events and diurnal variability and improve NWP forecasts and climate products; and,
- Future plans and key issues include:
  - Optimisation of orbits to improve temporal sampling (at a minimum to achieve the 6 hour WMO minimum observation cycle requirement);
  - Open and near real-time data access to support the marine weather mission; and,
  - Systematic and sustained high quality and consistent observations of the ocean surface vector wind field at sufficient temporal and spatial resolutions to support, e.g., sampling the intensity of a tropical cyclone at any instant in time (requires a spatial resolution of less than 5km) – need to better understand and validate what remote sensing is really responding to with extreme winds.

Discussion:

- Ivan asked Raj about the difference between the Vision for an OSVW Constellation (slide 9) and the current OSVW-VC, and Raj noted one main difference was near-real-time availability of data.
- Ed asked where passive wind measurements like from CYGNSS fit into the VC, and Raj noted this will be assessed as the Vision is developed.
- David Crisp (NASA) noted we are also beginning to explore passive measurements for high resolution (2 km) wind estimates for coastal applications.
- Jonathon asked whether the joint CEOS-CGMS group referenced above might need to be raised at Plenary. Raj noted they are awaiting the final outcomes/document from the meeting during which this was raised. Paul Counet (EUMETSAT) noted that CGMS Plenary concluded the work should be short (six months) and focused.

3.3.8: OCR-VC [slides]

Presenter: Marie-Helene Rio (OCR-VC Co-Lead, ESA)

Main points:

- Climate is a key deliverable, with OCR being an Essential Climate Variable.
- Aquatic carbon from space, as well as water quality are key areas where new technologies are emerging and starting to be applied.
- OCR-VC is strongly linked to the CEOS Work Plan 2020-2022, with one existing and six new deliverables, spanning five sections of the Work Plan.
- Expanding synergies with COVERAGE as well as the IOCCG is a future goal (VC-20-29) with the aim of having better integration across IOCCG/COVERAGE.

Discussion:

- Mark Dowell (COM/JRC) noted that the WGClimate/GHG Task Team welcome OCR-VC taking initiative to address the Aquatic Carbon aspects of the GHG Roadmap (and eventually a dedicated Strategy). He suggested assigning a dedicated colleague from the OCR community to be a formal member of GHG Task Team, noting that if there was a more direct relationship it would allow us to align things and add specific intermediate milestones in the GHG roadmap that are relevant and provide further feedback on requirements.

3.3.9: COVERAGE [slides]

Presenter: Vardis Tsontos (COVERAGE Team, NASA)

Main points:

- COVERAGE is a cross-cutting, collaborative effort to enable more widespread use of ocean satellite products in support of science and applications. They are implementing an advanced technology platform providing improved access to value added data and services. This features a distributed system architecture across JPL, EUMETSAT, and many others – with the priority being to minimise large file transfers.
- Satellite Data Inventory Core Requirement: coherent set of global products across the 4 CEOS Ocean VC parameters (SST, SSH, Winds, Ocean Color) at a common 0.25 degree spatial resolution.
- COVERAGE Website: https://coverage.ceos.org
  - Web-based Visualization: integrated visualization of satellite and *in situ* datasets; synchronized horizontal and vertical views of data and their evolution over time; integrated search; open source technology: JPL Common Mapping Client (CMC) framework. Will soon serve as a UI for subsetting, analytics capability integration.
  - Science Data Analytics Platform (SDAP): http://sdap.apache.org
- At the conclusion of this 1-year Phase B activity, they have a range of useful outcomes: a prototype system; collection of integrated, interagency data products; and a reusable set of technical capabilities that show considerable promise.
- This provides a solid foundation for a possible Phase C follow-on activity involving refinement and hardening of technical capabilities, and consideration of additional use cases, more regionally focused with an emphasis on higher resolution datasets.

Discussion:

- Mark noted as previously, he thinks CEOS should position COVERAGE as a cumulative contribution to Decade on Ocean Science. Maybe addressing targeted applications highlighted through that process. Vardis confirmed he does see the relevance, and Mark noted there were requests to agencies for contributions to the Decade of Ocean Science, however CEOS as a whole was not asked. One example could be via programmatic connectivity to GOOS (animal telemetry and remote sensing).
- Karen St. Germain (NASA) thanked the CEOS Agency representatives from CNES, NOAA, EUMETSAT, European Commission, and the Australian Bureau of Meteorology who serve on the COVERAGE Advisory Board.
- Flora Kerblat (SIT Chair Team, CSIRO) asked if COVERAGE is engaging with the GEO EO4SDGs, and Vardis noted the main connection to GEO is via the GEO-BON activity.

Outcome 09	CEOS could position COVERAGE as a valuable contribution to the Decade on Ocean Science for Sustainable Development, and 2020 CEOS Plenary should discuss ways to make this possible (e.g. via programmatic connectivity to GOOS).

Tuesday 15th September

Session 4.1: Carbon and Biomass - external [slides for entire session]

4.1.1: Introduction

Presenter: Adam Lewis (GA, SIT Chair Team)

Main session objectives:

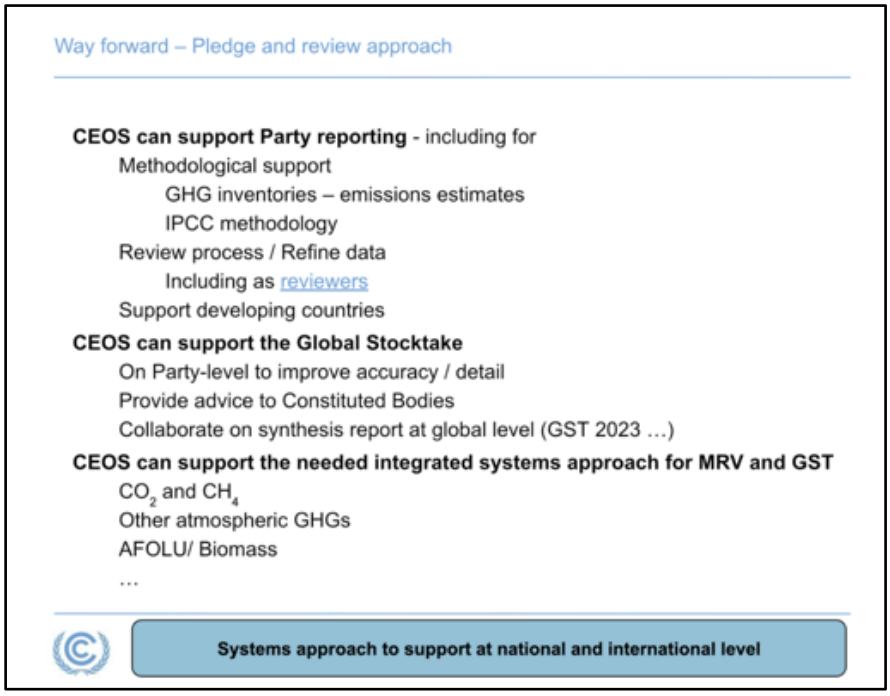
- Carbon and Biomass is one of the three priorities for the SIT Chair Team.
- Further engagement of UNFCCC SEC, including more specificity on how CEOS and agencies should engage in all aspects of the GST process.
- Refreshed input from GCOS and identification of any issues for Plenary - discuss additional efficiencies in requirements setting process.
- Report on the Biomass Protocol and confirmation of readiness for Plenary endorsement.
- Review of the implementation measures for support to the Biomass Protocol and discussion on tuning the pitch to Principals.
- Review of the draft AFOLU Roadmap and determination of pitch at Plenary.
- Update on the GHG Roadmap and hearing any issues to raise with Plenary
- Discuss synergies between GHG and AFOLU activities and support to Conventions.
- Update from WGClimate, notably on ECVI 3.0 and SBSTA plans.

4.1.2: Brief Global Stocktake Process Update

Presenter: Joanna Post (UNFCCC SEC)

Main points:

- The systematic observations community (WMO, GCOS, CEOS, GEO..) will contribute to the Global Stocktake for the Paris Agreement – indirectly, through Parties, constituted bodies, IPCC, UN Agencies, but it is an open question as to whether it can contribute directly.
- Noted establishment of the ad hoc group on systematic observations. CEOS should engage this ad hoc coordination group.
- Global stocktake components: information collection and preparation (2021/2022 - 2023), technical assessment (2022-2023) and consideration of outputs (2023). Follows thematic approach.
- EO can support at the Convention/global level and at the country level.
- CEOS was encouraged to input to the synthesis report. Guiding questions (where are we? where do we need to be?) are encouraged. Focus on aggregate information and identify indicators of progress and baselines and on the outcomes of mitigation and adaptation. We should identify information gaps, good practices and lessons learned.

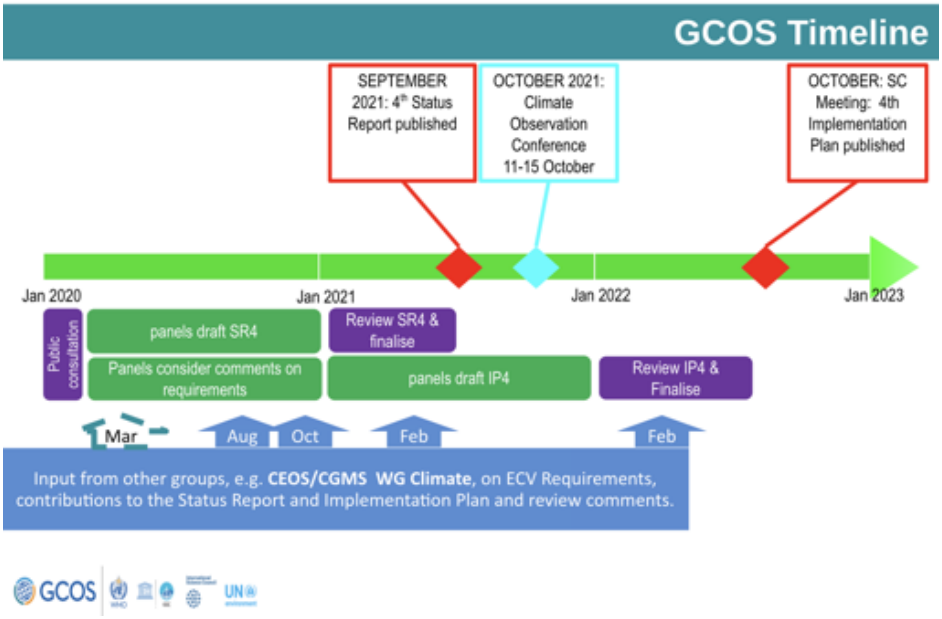


4.1.3: Brief GCOS Process Update

Presenter: Anthony Rea (GCOS, WMO)

Main points:

- Fourth GCOS Implementation Plan targeted for October 2022. 4th Status Report to be published in September 2021.
- Climate Observation Conference (11-15 October 2021, Darmstadt, Germany).
- Paris agreement catalysed an update of ECVs to better tackle anthropogenic carbon cycle.
- Closing of GHG budgets is currently unsatisfactory. EO can play a key role in better atmospheric inventories - in combination with other observations.
- New set of GHG requirements planned for new GCOS IP.



4.1.4: Heritage and Context

Presenter: Jörg Schulz (CEOS-CGMS WGClimate, EUMETSAT)

Main points:

- CEOS & CGMS has been very effective over the last 8 years in establishing a positive and proactive dialogue with UNFCCC/SBSTA.
- This is in large part due to the symbiotic relationship we have established with the Global Climate Observing System (GCOS) and the Climate Monitoring Architecture, which has been our guiding framework.
- The creation of the Joint WGClimate established an unambiguous entry point for the discussion between SBSTA and the Space Agencies.
- To date, this engagement, through the SBSTA Research and Systematic Observation (RSO) subgroup has largely focused on our support on Climate Data Records for GCOS ECVs.
- In recent years, our support has been visibly expanding: CEOS Carbon Strategy, CEOS GFOI support and evolution to biomass, other AFOLU, Climate Services and support to Climate Adaptation etc.
- CEOS needs a long-term strategy accounting for the multitude of contributions it and its member Agencies can make to the Convention: maintaining the effective focal point established through WGClimate; increasing communication on contributions from other parts of CEOS (in statements, SBSTA Briefings etc.)

- Use, and reinforce, CEOS Carbon Strategy as a framework for carbon relevant aspects.
- Give greater visibility to GFOI/Biomass aspects as well as Agriculture, not only through REDD+ but also RSO.
- In the short/mid term: build on priorities of SIT Chair (AUS) on Carbon and Biomass, as well as current visibility on GHG Monitoring; initiate dialogue between GHG and AFOLU communities – Workshop hosted by EC June 2021; dedicated discussion at SIT TW with all CEOS entities, GCOS and UNFCCC Secretariat

4.1.5: CEOS AFOLU Roadmap [slides]

Presenter: Osamu Ochiai (JAXA)

Main points:

- The importance of NDCs to the Paris Agreement, and specifically the Global StockTake (GST), raises new challenges around country needs and implications for using EO data with greater emphasis on mitigation and adaptation, and national-level datasets.
- JAXA and ESA have been exploring the development of a CEOS AFOLU Roadmap. The aim of the Roadmap is to assess the will, direction and capability of the relevant CEOS Agencies, with the SIT Chair team supporting communications with Principals and identifying team nominees.
- A discussion paper will be presented to CEOS Plenary: *A CEOS Roadmap for AFOLU Inputs to the UNFCCC Global Stocktake Process*.
- Objectives: Provide the case to CEOS and its agencies for investing in development of such a Roadmap; ensure a coordinated and comprehensive response from CEOS and space agencies to policy process; provide a clear statement of the technical capabilities of CEOS agency EO satellite data and their characteristics; provide a mechanism for further engagement and iteration between CEOS and the GST processes, including in support of the synthesis reports, and with UNFCCC SEC.
- Potential Roadmap Actions:
  - Improving EO capabilities to better meet the needs of the Convention or Parties, globally and on national level
  - Providing new measurements that do not currently form part of CEOS
  - Engaging with countries and stakeholders (such as GFOI and GEOGLAM) in case studies to improve understanding and uptake of EO data by countries
  - Taking actions to assure the policy relevance of new capabilities (e.g., through measures such as the CEOS Biomass Protocol)
  - Increasing efficiencies and effectiveness in the process by which climate data requirements are set (e.g., by GCOS) and to which CEOS and CGMS space agencies respond.
  - Pragmatic focus for delivery to GST1 and GST2 like GHGs
- Next steps:
  - Reflect on SIT TW discussions
  - Engage with UNFCCC SEC offline re the SO Synthesis Report
  - Solicit support from CEOS Principals on the case for an AFOLU Roadmap
  - Prepare CEOS Plenary decision: seeking approval (& resources) to proceed; will need large AFOLU investor agencies on board to be viable.

Discussion:

- Albrecht von Bargen (DLR): DLR wants to provide a rep to the AFOLU roadmap team.
- Sara Venturini (GEO Secretariat): Would welcome engagement of GEO activities like GEO-Land Degradation Neutrality and GEO Wetlands with the AFOLU Roadmap.

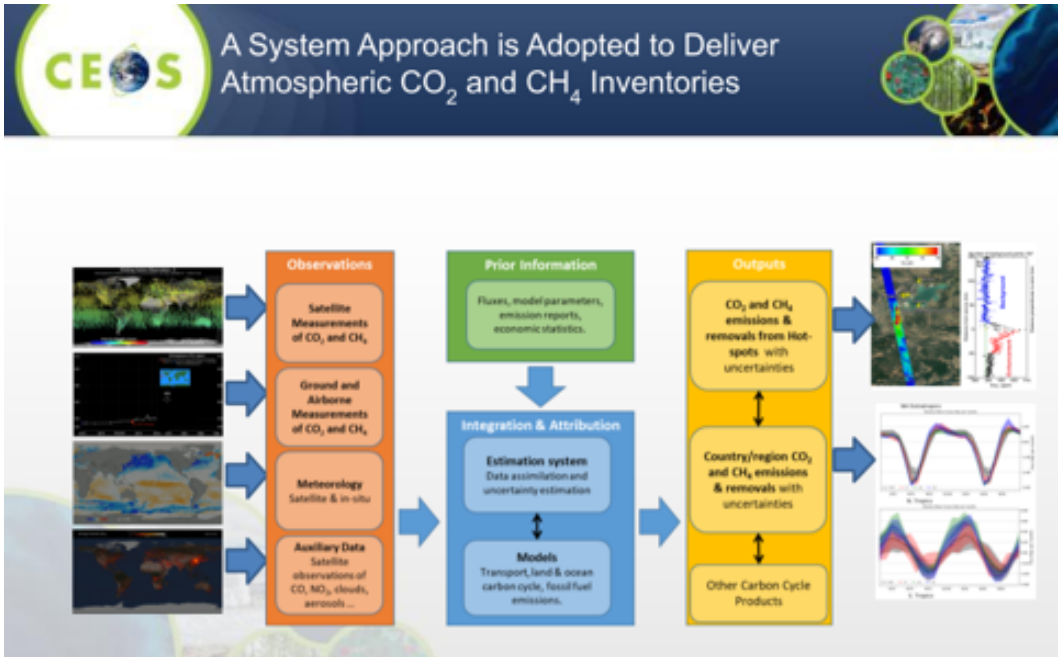
SIT-TW-2020-07	DLR to provide a nominee to represent the agency on the Agriculture, Forests, Other Land Use Change (AFOLU) Team that is working on the development of an AFOLU Roadmap.	**CEOS Plenary**
	Rationale: DLR has relevant missions and data to support the AFOLU Roadmap.	

4.1.6 & 4.1.7: GHG Roadmap & AFOLU Synergies

Presenter: Mark Dowell (COM/JRC)

Main points:

- The CEOS Atmospheric Composition Virtual Constellation (AC-VC) white paper defines a global architecture for monitoring atmospheric CO2 and CH4 concentrations from instruments on space-based platforms. Response to the CEOS Carbon Strategy. These observations can be used to deliver atmospheric CO2 and CH4 inventories as follows:



- The GHG Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stakeholders and users. Being presented to CEOS Plenary.
- It describes an approach for implementing the GHG Strategy and specifies resource needs: maintained by the WGClimate GHG Task Team; considered to be a living document whose Actions (Annex C) provide a snapshot of the work plan, which will be updated over time.
- Expected Outcomes of the Roadmap Activities: delivery of pilot datasets of CO2 and CH4 fluxes to enhance the uptake of EO satellite data sets in support of the Global Stocktake 2023; an operational system for producing future atmospheric CO2 and CH4 flux products to support the Global Stocktake 2028; refinement of user requirements in preparation of the implementation of the operational system.

- External stakeholder engagement crucial: inventories community, policy frameworks, and international implementing entities like WMO IG3IS.
- GHG-AFOLU Workshop postponed to Q2 2021 should include CEOS/CGMS, GFOI, GEO, UNFCCC Sec, GCOS, GOFC-GOLD etc.
- CEOS must consider GHG-AFOLU Roadmap synergies and integration.

4.1.8: Discussion: Climate Data Requirements & Policy processes - optimising the space agency contribution

Moderators: Mark Dowell (COM) and Jörg Schulz (WGClimate, EUMETSAT)

Seed questions were shown as follows:

1. CEOS/CGMS contributions to the Global Stocktake process

- Contribution to UNFCCC Sec *ad hoc* group on Systematic Observation support to Global Stocktake
- Contributions to first GST: products (also beyond GHG), user engagement (GHG Roadmap)?
- Realistically what contributions on AFOLU can we expect for the first GST?
- What are our contributions to synthesis and technical assessment phases?
- What links should we establish to other "contributors" e.g. WMO, GEO Climate Change WG?
- Should we plan for Guidance documents, case studies, interpretation/analysis tool development?

2. Efficiencies in GCOS Requirements process

- GCOS has been an effective partner, and the GCOS IP and requirements are the primary framework against which agencies make substantial investments in the space segment for climate and climate data record production
- There is increasing need for application specific requirements (e.g. for GHGs)
- Would make the space agency coordination, as well as individual agency investment more efficient. Our preference is to maintain GCOS as the primary "source" of EO requirements.
- Can we define a typology of requirements for ECV products in all domains, i.e., linking the requirements with the GCOS objectives?
- Can we use the WGClimate Case Study Exercise to emerge some additional and refined requirements?
- What are opportunities for gathering requirements, e.g., for adaptation through other initiatives e.g. WMO GFCS, GEO Climate Change WG?
- Can the envisaged GCOS study team help in this process? What could be realistically achieved for the next GCOS IP?
- What are the implications for ECV Inventory, Gap Analysis, and Action Plan process?

Discussion:

- Gilberto Camera (GEO Secretariat Director) expressed delight to see the substantial initiatives of CEOS and commends the effort on an AFOLU Roadmap. GEO Secretariat expresses interest in collaborating with CEOS on the AFOLU and GHG Roadmaps in support of countries that need to report. GEO is ready to support. Jörg suggested that the new GEO Climate Working Group would be a good focal point.
- Ivan Petiteville (ESA) noted that the next GCOS IP will be published in October 2022. It would be difficult for space agencies to implement it for the 2023 GST. Wondering if we can get some draft ahead of time to ease implementation. On requirements, wondering if we can expect requirements coming from individual countries for providing data observations - helping them to develop their own NDC's / reports - requirements that are not yet captured in the GCOS IP.
- Anthony: difficult to accelerate IP, recognise it will be tough time wise. First opportunity to get a flavour of the IP will be the Climate Observation Conference (11-15 October 2021, Darmstadt,

Germany). Not GCOS role to get into country requirements - happy to take discussion offline with Han and Ivan.

- Jörg: suggested 'live' set of requirements that are updated more frequently than traditional IP. Anthony said that this is something that the GCOS Study Group could look at.
- Joanna: regarding Paris reporting requirements - for mitigation, Parties need to report on fixed things like GHGs and precursors - they are somewhat set and clear; there is a clear opportunity for EO to support that; adaptation is perhaps less specific and also needs to be aggregated globally. The measurements and indicators are poorly developed and there is an opportunity for EO community to consider there, including for biomass. Biomass as a CO2 removal measure is another point where observations can help. Inputs to GST should be short and sweet. Good practices and lessons learned. There will be many inputs so concise inputs will be essential. CEOS should also make continued use of the Earth Information Days.
- Mark noted the CEOS call for case studies. May reveal areas where we want to be proactive with parties to help with areas of assessments using EO. Start to develop a compendium of best practices for Parties.
- Florin Vladu (UNFCCC SEC): they would welcome a look at the Roadmaps but are most interested in the aggregated outcomes as datasets for the GST assessment. Baselines are important for future comparison.
- Maria J. Sanz (GFOI): NDCs are key to increase ambition, and therefore its fundamental to understand country needs and different capacities to improve and report on their progress (transparency FW). Understanding their capacities and how they want to progress in their observation, early warning, monitoring and reporting systems will be fundamental to ensure the best contribution. Forest aspects during the last years due to REDD+ efforts have advanced in this understanding and dialogue with countries.
- Shaun Quegan: there's a clear contribution of AFOLU to GHG budget and NDCs. 25% of mitigation efforts will come from forests and related activities. It's an essential thing to link GHG and AFOLU as they are inextricably connected.
- Osamu: noted that CEOS needs to converge the GHG and AFOLU activities in terms of integrated outcomes and we need to accelerate this given the GST1 timeframes.
- David Crisp (GHG Task Team, NASA): AFOLU needs an institutional home in CEOS. Jörg noted that AFOLU and GHG need to be linked well and this may impact the decision in the CEOS structure. He noted that the GHG equivalent is looking at operationalisation, more so than AFOLU.
- Adam: LSI potentially has a big role to play, but not active in this area at the moment. This could be a helpful catalyst for LSI's requirements thread - but need a counterpart, happy to discuss. Jörg suggested that CEOS Plenary could be briefed on the options, but a decision would take place next year between direct stakeholders.
- Jörg asked if anyone has checked back on GCOS IP Land chapters on related requirements, e.g. related to biomass. Would be useful to follow up and share the GCOS IP sections with the AFOLU team.
- Jörg noted that there has been communication with Anthony and GCOS to move forward on some of the points around the GCOS requirements. CEOS is asked to be more specific on their points and needs and to make proposals to GCOS to address the points made on the structure of requirements and dialogue can go from there. They will follow up with a telcon. GCOS Study team will be getting kicked off ASAP and will look at governance and outputs. Changes to the IP can be addressed by SEC and the current Steering Cttee. Interim updates to the ECVs could be looked at by the study team. They may not go into much detail.
- Steve Briggs (EC-CHE): the GCOS-CEOS relationship is very constructive. We were initially wary to take on the GHG Roadmap given the scale of it. Caution on doing too much in too many different areas. AFOLU is relatively simple. Adaptation and the national adaptation plans will be important. These plans are a possible angle. Mark noted the idea of using the case studies and national adaptation plans.

- Joanna: UNFCCC is planning with SB Chairs an event called the Climate Change dialogues in late Nov and early Dec with a virtual Earth information Day. We will get more news soon. It was suggested that regarding the CEOS reports to events like Information Days that we are not giving full exhibition of our full capability to support the different aspects of the convention. Many parties are interested in adaptation and loss and damage and we should be clear about what we can do and consider emphasising that.
- Joanna: Decision 19/CMA.1 identifies what the GST will consider.
- Sara on the linkages between CEOS and GEO - having Mark Dowell as one of the GEO CC-WG co-chairs will ensure alignment with CEOS work. And then in particular a number of tasks that we are planning to deliver are actually meant to support the GST process, and will require the involvement of CEOS partners (e.g. technical guidance on integrating EO into NAPs). The same goes with the issue of gathering requirements for all areas of the Paris Agreement.

SIT-TW-2020-08	AFOLU team Co-Leads to review the Land chapters of the GCOS IP to assess any impacts on AFOLU requirements.	**CEOS Plenary**
	Rationale: GCOS IP may hold some useful requirements for the AFOLU Roadmap.	
SIT-TW-2020-09	WGClimate Chair to confirm details with UNFCCC SEC of the global Earth Information Day in late November 2020.	**CEOS Plenary**
	Rationale: Await news from UNFCCC SEC on how CEOS can engage.	

Session 4.2: Carbon and Biomass – Internal

4.2.1: Biomass Protocol & Implementation [slides]

Presenter: Laura Duncanson (UMD)

Main points:

- Many upcoming missions will provide data used to map biomass. Upcoming explosion of never before obtained biomass information. Volume of new data presents challenges in itself. Many different products that need to be independently validated, compared, combined, etc. Many different ways to combine and compare – biomass protocol seeks to address this and bring guidance and consistency in cal/val. Protocol is now in public draft and seeking endorsement at CEOS Plenary.
- The protocol summarises the state of knowledge for biomass mapping as well as gaps and areas for R&D. Presents recommendations for a CEOS Forest Biomass Reference System.
- To maximise the impact of the Protocol and to ensure maximum value of the data, the team has developed recommendations for implementation. High quality reference data is needed from an *in situ* network. Called a CEOS Forest Biomass Reference System as system of recurrent site-based measurements that will serve as a lasting and sustainably-funded system of recurrent site-based measurements that will serve as a lasting interface between EO agencies and ground-an equitable interface between the Earth Observation agencies and ground-based tree-by-tree measurement initiatives.
- Benefits of a CEOS Forest Biomass Reference System: The greatest value for the enormous EO investment will be gained if products are trusted; helps the missions achieve their ultimate goals by

allowing users to apply biomass products with confidence for science and applications; leverages existing investments both by agencies, missions, and established ecosystem and forest networks; we are not starting from scratch; develops a framework for lasting contributions to the advancement of the field, independent of grant cycles, mission lifetimes or shifting agency priorities; enables open forest reference data by providing ongoing support to local researchers and field stations.

- To minimize the cost, selected sites should preferably belong to existing plot networks. These sites are potential reference sites, but often need augmentation (+lidar, +TLS), and will be outdated by the 2022 missions. They require significant funding for coordinated re-measurement to meet protocol standards for validation of forthcoming biomass products.
- The *CEOS Forest Biomass Reference System* is a network of 100 Biomass Reference Measurement (BRM) sites, plus 210 additional distributed sites (distributed BRM). Such an infrastructure is needed to provide confidence in the outputs of biomass EO missions. Its estimated cost is 33.75 M€ over a 5-year period.
- If most agencies could sponsor ~5-10 sites we can meet this goal. Cost estimates will vary by region, and can be reduced through leveraging existing cal/val investments.
- No space agency alone can fund the required work to establish a global network of biomass reference sites but each Agency can make a contribution by e.g. funding national supersites or by adopting reference sites (i.e. by making a binding commitment to finance the collection and delivery of ground data over a certain period).
- Space agencies are encouraged to collaborate with established networks (e.g. ForestGEO, Rainfor, NEON, TERN, Afritron, TMFO, IIASA, etc) and their local collaborators.
- Welcome feedback on how to achieve the proposed creation of a Forest Biomass Reference System.

Discussion:

- Osamu Ochiai (JAXA): JAXA welcomes the collaboration. Working with japanese university network. will try to organise Japanese contributions across sat, airborne lidar, etc. Making data free and open as much as possible. Looks like a great project for collaboration through GFOI.
- Ivan: Anticipates cautious reaction from Principals at Plenary given the scale of the funding. Suggested a staged approach. Identify existing sites, necessary updates, and a plan forward – distributing costs across years. Secondly: can funding be expected from sources other than CEOS agencies?
- Laura: hoping each of the agencies can use this information to either 1) consider how their existing activities can contribute and 2) consider appetite for new contributions. Remainder could come from others. Welcome suggestions for others to approach (e.g. World Bank, climate fund donors and philanthropics)
- Sara: GEO Secretariat has brainstormed and has ideas on how to collaborate with CEOS on this. The question of the mandate for the sites is important to establish. Through the Belmont Forum, GEO could launch a call to national research agencies. Also through the GEO Climate Change WG.
- Mark: Not convinced it should be seen as a large cost, and agencies should think of this with respect to the space segment investments, and should be presented as an integrated part of that investment.

SIT-TW-2020-10	SIT Chair Team to interface with GEO Secretariat on ideas around collaboration and funding for the Forest Biomass Reference Network concept.	**CEOS Plenary**
	Rationale: Diverse funding solutions will be essential for this to be viable.	

4.2.2: WGClimate: ECVI 3.0 and Use Case development [slides]

Presenter: Jörg Schulz (EUMETSAT, CEOS-CGMS WGClimate Chair)

Main points:

- WGClimate-12 in May 2020 has unanimously recommended Jeff Privette (NOAA) as next WGClimate Vice Chair - becoming Chair in November 2022. CGMS-48 Plenary has endorsed this proposal. CEOS Plenary is asked to endorse the proposal as well.
- CEOS Plenary is invited to take note:
  - The ECV Inventory V3 was published in August 2020. Work on the ECV Inventory gap analysis needs to be rationalised to ensure long term affordability. The 12th session of WGClimate in April 2020 made the proposal to host specific workshops starting in 2021. The delivery of the Gap Analysis and Coordinated Action Plan has moved to autumn 2020 (due to COVID-19 impact), but should be ready for Plenary approval.
  - WGClimate sees an improved approach for GCOS ECV requirements as essential for GCOS. The pathway to a new approach is under discussion with GCOS but should be effective for the next GCOS Implementation Plan. CEOS entities (WGs, VCs, SHTs) should support this discussion when requested.
  - WGClimate has published a call for use cases for climate data records https://climatemonitoring.info/use-cases. CEOS agencies are requested to organise submission of use cases for climate data records - demonstrating the value of climate data records for decision/policy making, e.g., usage of satellite data in a use case with UNFCCC Parties to support the Global Stocktakes.
- General status of gap analysis: existence of Climate Data Records – done; GCOS criteria analysis – significant amount of data sets not assessed but statistics very stable; progress on already assessed ECVs – 40%; individual ECVs – new ECVs assessed with various degree of information
- Gap Analysis Rationalisation: Reduce number of data records for analysis in the ECV Inventory, .e.g., if they differ only by time and space sampling; decouple in time ECV Inventory update from gap analysis, i.e., ECV Inventory #4 published in 2021 – gap analysis report published in 2022; reformat gap analysis work into one workshop event per year collating experts on ECVs to perform the gap analysis. (First was planned for 31/08-04/09/2020@EUMETSAT but was cancelled due to COVID-19).
- Schedule 2021: Concentrate on chasing identified missing data records and add contributions from CMA and JAXA for ECV Inventory #4; start analysis of ECV Inventory #4 in Q3/4 2021 with a gap analysis workshop; publish gap analysis report on Inventory #4 in 2022.

SIT-TW-2020-11	CEOS Agencies are requested to organise submission of use cases for climate data records via https://climatemonitoring.info/use-cases.	**CEOS Plenary**
	Rationale: To ensure that CEOS Agency use cases are further disseminated.	

4.2.3: GHG Roadmap [slides]

Presenter: Mark Dowell

Main points:

- The GHG Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and foster the development of interfaces with stakeholders and users.
- The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs.
- Expected Outcomes of the Roadmap Activities:

- The delivery of pilot datasets of CO2 and CH4 fluxes to enhance the uptake of EO satellite data sets in support of the Global Stocktake 2023;
- The delivery of an operational system for producing future atmospheric CO2 and CH4 flux products to support the Global Stocktake 2028; and
- The refinement of user requirements in preparation of the implementation of the operational system.

- Engagement with external stakeholders and end users is fundamental to the success of the implementation of the system approach (emission inventory community, e.g. Global Emissions InitiAtive - https://www.geiacenter.org; champion users on real applications; continued engagement with international policy frameworks, i.e. UNFCCC/SBSTA, IPCC TFI; technical implementing entities at international level, i.e. WMO IG3IS and Joint Programmes supporting the Convention, i.e., GCOS, as well as the broader modelling community).
- This version of the Roadmap was submitted to the 2020 CGMS Plenary for endorsement.
- At this meeting, we seek feedback in preparation for endorsement of the GHG Roadmap at the CEOS Plenary and the provision of the resources identified for the specific activities and entities.
- CEOS Plenary will be invited to endorse: *"The GHG Roadmap document (v2.4), describing an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the Actions in Annex C provide a current snapshot of the work plan definition which will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities."*

4.2.4: AFOLU Roadmap [slides]

Presenter: Frank Martin Seifert (ESA)

Main points:

- Current AFOLU document is a "White Paper" - highlighting our capabilities and the opportunity in front of us. It aims to support Plenary discussion among Principals to launch a strategic initiative, starting with Roadmap
- Roadmap team would need the big AFOLU investor agencies for the activity to be viable and relevant (NASA, ESA, JAXA, USGS, amongst others)
- Opportunity for space agencies:
  - The GST is a major new dimension to the UNFCCC and both an opportunity and challenge for space agencies and CEOS
  - Land sector issues are a major part and proposed AFOLU Roadmap offers a structured response and approach
  - CEOS agencies have many relevant assets and programmes - not necessarily all within current CEOS coordination scope
  - Long term and complex process (GST every 5yrs) and wide variety of areas (AFOLU) - supporting national-scale reports is a major task but one we are uniquely capable of supporting
- Pragmatic deliverables for GST1:
  - Aggregate potential inputs (Datasets at Global and Country levels) from Space Agency (Agriculture, Forest, Biomass, OLU)
  - Discuss how to input to the UNFCCC synthesis report
  - Synergy and alignment with GHG Roadmap for GST1 and GST2
  - Further discussion needed for consolidation - hopefully at the GHG and AFOLU workshop in 2021
- Land sector focal point for the UNFCCC Sec process:
  - Given its significance to NDCs, we think we should confer to identify a focal point for EO land sector issues to the Ad-hoc WG. CEOS is well placed given broad scope of member programmes.
- Next steps:
  - Engage with UNFCCC SEC offline re the SO Synthesis Report (through focal point of Ad-hoc WG).
  - Solicit support from CEOS Principals on the case for an AFOLU Roadmap.

- Prepare CEOS Plenary decision seeking approval (& resources) to proceed (will need large AFOLU investor agencies to be viable).

Discussion:

- Mark: it would be very useful to explain to CEOS Principals what might be delivered for GST1 (datasets, guidance, etc.).
- Ivan Petiteville (ESA): what support is needed from CEOS Principals? need to be clearer on what is requested at Plenary.
- Mark: Do we need to ask for continuity? Could not a progress report be given? is permission needed from Plenary to continue working on the roadmap? thought this was already agreed. Alex Held (SIT Co-Chair, CSIRO) agreed.
- Stephen Ward: work thus far has been done by a team of volunteer experts, many are not even CEOS-affiliated. Need Principals to commit CEOS Agency experts and resources commensurate with the scale of the task. That's the ask.
- Stephen Briggs: look carefully at requirements and deliver on those, rather than demonstrating everything we can do. Work backwards from requirements.

Wednesday 16th September

Session 5.1: GEO Session

5.1.1: Session Introduction [slides]

Presenter: Andreia Siqueira (SIT Chair Team, GA)

Session objectives:

- Understand which areas CEOS contributes to the GEO work programme.
- Have an overview of emerging requests for support from the CEOS community.
- Identify key messages that CEOS may wish to communicate to GEO.
- Understand future planned CEOS-GEO actions around global data flows.
- Understand and discuss GEO Knowledge Hub and the implications for CEOS.
- Work with GEO to understand and ensure requests to CEOS Plenary are clear and feasible.

5.1.2: Update on GEO Priorities and Directions [slides]

Presenter: Doug Cripe (GEO Secretariat)

GEO Symposium Select Messages:

- AquaWatch: variety of sensors and platforms providing water quality information – disparate data sources, different sensors, time-periods, product processing, degree of validation, open vs proprietary are leading to conflicting results from different products for the same location/time period. Working with CEOS (WGISS, WGCV, LSI-VC) to develop aquatic ARD: "ARD no longer a desire of global users but becoming a requirement and expectation."
- EVs (GCOS, GEO BON, MBON, GEO EVs CA):
  - Spatial/temporal/taxonomic gaps still hamper progress -> ongoing dialogue with user community;
  - Challenge is to adapt EVs for use with SDG monitoring frameworks;
  - Need for harmonized multi-mission datasets for comprehensive time-series analysis; and,
  - Need for continued cal/val based on expansion of *in situ* networks.

Key Messages for CEOS:

- Community needs: many want to make use of ARD in the cloud; more documented ARD, with SpatioTemporal Asset Catalog (STAC) indexing to facilitate discovery and access.

- Plethora of data cube projects on the landscape: Does CEOS see the OEA Community Activity as *the* coordination mechanism?
- Full support of GEO Secretariat for further development of sandbox approach (DE-Africa; SDGs on AWS, Google).
- GEO Secretariat appreciates work of the SDG and CEOS-COAST AHTs, and Biomass protocol, AFOLU, and would like to continue engaging with CEOS for translation of needs from user communities into satellite observation requirements.

5.1.3: CEOS Contributions to the GEO Work Programme [slides]

Presenter: Kerry Sawyer (CEO, NOAA)

Main points:

- Working Groups were one of the mechanisms used to implement the Foundational Tasks in the 2017-2019 GEO Work Programme (GWP). Included Capacity Building WG and Data Sharing WG.
- For the 2020-2022 GWP, the Secretariat proposed a realignment of the Foundational Tasks (FT), simplifying the structure from 10 FT to 5.
- 2020-2022 Working Groups:
  - Capacity Development (revised from the previous CB-WG)
  - Data (revised from the previous DSWG)
    - Includes a subgroup on *in situ* data
  - Climate Change (expanded from the PB Paris Agreement Subgroup)
  - Disaster Risk Reduction (expanded from the PB DRR Subgroup

GEO Capacity Development Working Group (CD-WG) [slides]

Presenter: Nancy Searby (WGCapD, NASA)

Main points:

- The CD-WG is convened to facilitate GEO's efforts on CD and will support the translation of the Canberra Declaration into concrete actions within the GEO Work Programme.
- The Working Group established 3 subgroups to assist in fulfilling its duties: Subgroup 1: GEO mapping and needs assessment (lead Hanna Albrecht/GIZ); Subgroup 2: Collecting, sharing and developing CD tools (lead Allison Craddock/IAG); Subgroup 3: Organizing dissemination events, M&E and impact assessment (lead Nancy Searby/CEOS WGCapD).

GEO Disasters Risk Reduction Working Group [slides]

Presenter: David Green (WGDisasters, NASA)

Main points:

- Three subgroups:
  - Coordination across the GEO WP: Develop and implement a coherent and crosscutting approach within GEO to advance the use of EO in support of countries' DRR and resilience efforts.
  - UNDRR coordination: leverage SG1 efforts and use combined resources of SG2to promote the dissemination and use of EO to strengthen capabilities to reduce disaster risk according to the needs of countries as identified by UNDRR
  - Climate change, SDG and urban activities coordination: leverage SG1 efforts to provide an overview of links, and actionable opportunities, between DRR, climate change, SDGs and urban activities.

GEO Climate Change Working Group (CC-WG) [slides]

Presenter: Jörg Schulz (WGClimate, EUMETSAT)

Main points:

- Subgroup 1: Coordination of climate issues across the GEO Work Programme & Synergies with key partners (including WMO).
- Subgroup 2: Engagement with UNFCCC and IPCC.
- Subgroup 3: Enhancing the use of EO for Mitigation.
- Subgroup 4: Enhancing the use of EO for Adaptation and Loss & Damage.
- Assume work plans come without resource estimates, thus need to apply a realism check. CEOS contributions need to be existing or feasible in a near future CEOS Work Plan.
- Observe overlaps between Subgroup 2 and WGClimate GHG Task Team – need to coordinate several items that are contributions by CEOS-CGMS to GEO.
- Need to ensure that CEOS outputs are used in CC-WG activity *"Preparation of GEO's response on EO gaps identified by IPCC Special Reports / AR6"* involving all CC-WG subgroups.
  - Same applies to CC-WG activity *"Definition of application specific EO requirement addressing all aspects of the UNFCCC, including through a stakeholder workshop"*, planned for Q3/4 2021 - Q2/Q3 2022 – Here it would be important that this is coordinated with the GCOS IP and that it is compatible with CEOS needs, e.g., for the ECV Inventory.
- CC-WG activity *"Organisation of joint GEO-IPCC Expert meeting on the topics of land representation, the role of remote sensing and field measurements, and uncertainty"*. The remote sensing element of this activity could be covered by CEOS (e.g. a mix of WGClimate and LSI-VC).
- Several other CC-WG activities need to be analysed on overlap/contribution when work plans are available

GEO Data Working Group Report (D-WG) [slides]

Presenter: Brian Killough (SEO, NASA)

Main points:

- Purpose of D-WG: Address data policy, data ethics and data governance issues impacting the use of EO and improving its uptake. Also, support the translation of the GEO Canberra Declaration which noted the benefits and impact of EO.
- Duties of D-WG: Monitor trends in open data and data management practices to revise and promote the GEOSS Data Sharing Principles and the GEOSS Data Management Principles, advance discussions about data with stakeholder communities, recommend ways for GEO to advance EO interoperability, and identify, analyze and describe best practices for EO data sharing and management.
- Proposed Sub-Groups: (a) *in situ*, (b) Data Sharing and Data Management Principles, (c) Data Rights, Ethics, Legal, and Privacy.

CEOS and Thematically Focused GEO Work Programme Activities [slides]

Presenter: Kerry Sawyer (CEO, NOAA)

Main points:

- 1:1 mapping between the CEOS Work Plan and GEO Work Programme.
- CEOS as the space arm is a key contributor to GEO. Only body to have a dedicated bilateral annually.
- Numerous CEOS contributions to GEO Flagships, Initiatives, Community Activities, Foundational Tasks.
- How do we get recognition for these contributions?

GEO-DARMA [slides]

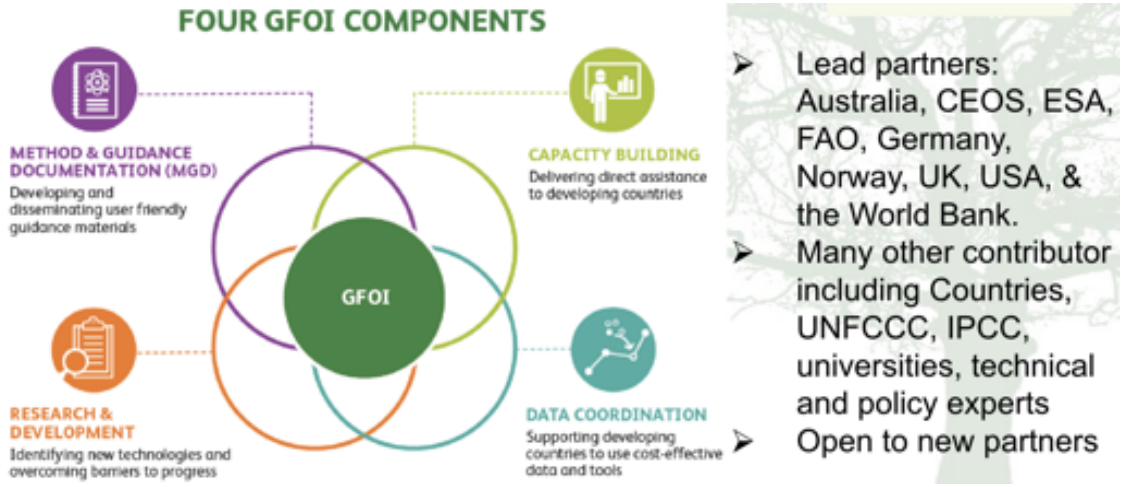
Presenter: Ivan Petiteville (ESA)

- GEO-DARMA is focusing on identification of users needs and DRR priorities per region.
- A number of regional prototypes have been launched with partners.
- Some impact of COVID on project progress but outlook good for African and Asian projects.
- Hoping to see more engagement by CEOS WGDisasters.

GFOI [slides]

Presenter: Osamu Ochiai (JAXA)

- Osamu presented a brief reminder of the structure and activities of GFOI.
- GFOI will hopefully play an active role with CEOS on forest and biomass aspects of the UNFCCC GST.



GEOGLAM [slides]

Presenter: Ian Jarvis (GEO Secretariat)

- During 2020 GEOGLAM has been working towards the definition of Essential Agricultural Variables (EAV's) to support shared CEOS-GEOGLAM priorities (climate, SDG's and disaster response).
- In 2021, anticipate the EAV's will transform the CEOS-GEOGLAM relationship as together we strive to harmonize the CEOS data and service requirements with GEOGLAM's EAV driven user needs.

5.1.4: Emerging requests from cloud service providers for support from CEOS [slides]

Presenter: Doug Cripe (GEO Secretariat)

Main points:

- AWS: request for harmonized index for data on the cloud that could be leveraged by anyone trying to build/access a data cube.
- GEE: use of commercial cloud to scale and operationalise projects and activities. Set of best practices for reference would be very useful (WGCapD?).
- Microsoft: Disparate conversion approaches for hosting data cloud-optimized formats (e.g. COGs) because few (no?) public-sector providers are providing data in cloud-optimized formats - can CEOS help? *AI for Earth* program interested in not only hosting public-sector data on Azure (aka.ms/ai4edata), but also in working closely with the sustainability community to develop specific conservation projects that use remote sensing data on Azure, leveraging AI for Earth funding and in some cases Microsoft data science expertise.

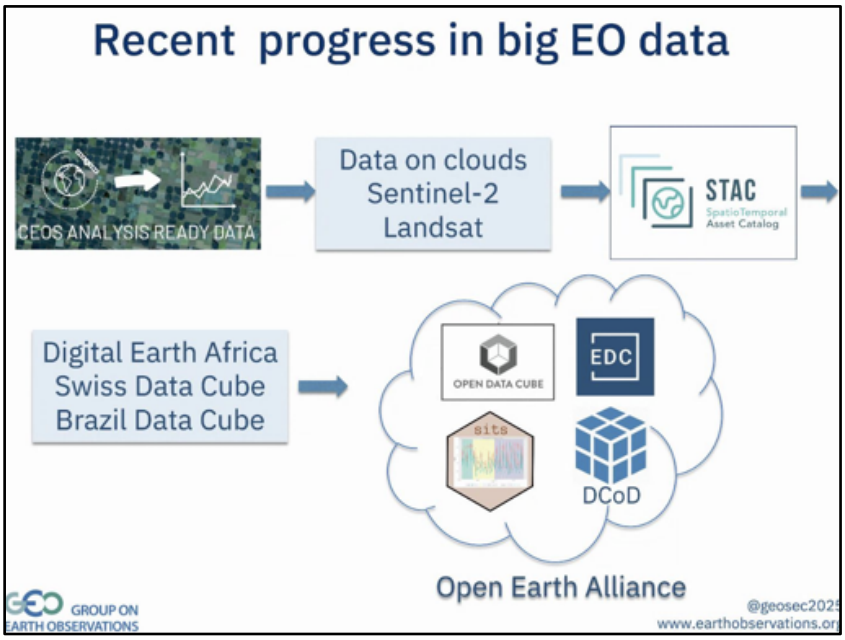
5.1.5: CEOS-GEO actions around global data flows [slides]

Presenter: Gilberto Camara (GEO Secretariat)

Main points:

- CEOS ARD work has been essential. Thank ESA and USGS in particular for their effort here. Encourage other agencies to work on CEOS ARD from their missions. Thanked all CEOS Agencies.

- Emergence of STAC as a common way of describing catalogues in the cloud and the Data Cube – both key developments for providing grounds for interoperability.



- Open Earth Alliance: gather together all of those that would like to work together on understanding shared development and results of making Data cube available.
- GEO sees itself pushing OEA and DC initiatives to promote activities where CEOS is providing ARD, etc.
- Big satellite data + Data cube + ML = big EO data for sustainable development. use big time series to achieve insights.
- GEO Secretariat and partners are thinking about a simple API for Data Cubes, covering tasks like 'build data cube', 'get data', 'train model', 'classify'. Reduce the learning curve for users and split the processing (local vs remote).

5.1.6: GEO Knowledge Hub and its links to CEOS [slides]

Presenter: Florian Franziskakis (GEO Secretariat)

Main points:

- GEO Knowledge Hub (GKH): Digital library of Earth Observation applications and Curated and linked resources into "Knowledge Packages". Implementation from July 2020 to June 2021. The GKH is based on InvenioRDM.
- Knowledge packages comprise: publications, satellite imagery, *in situ* data, open source software, documentation, results, and cloud resources.
- Potential links to CEOS:
  - EO solutions are easier to develop and work best with facilitated access to ARD;
  - Users looking for a solution need algorithms and guidelines on how to process satellite imagery; and,
  - Use of the GKH by Space Agencies, to share their applications for others to reuse.

5.1.7: Discussion

Main points:

- Gilberto responded to a question from Trevor Dhu (GA), noting that if you have an API where training is done separately from the model, you can have a situation where you preserve sensitive data. He noted a proof of concept has been completed, and offered to share this information.

- Nancy asked Florian which communities have been engaged in co-development of the GKH so far, and Florian noted the process has not started yet but will be done up to June 2021. Nancy noted the GEO CD-WG would welcome working with GKH on that engagement with flagships and initiatives so we can work on the capacity development components alongside you.
- Ivan noted that as the space arm of GEO, CEOS supports the translation of user needs into observation requirements, and this is a critical task that requires competences & knowledge in remote sensing that exist in space agencies. This is exactly what the 4 CEOS SDG subteams have started to do on behalf of GEO, for the relevant GEO activities. No other GEO members or Participating Organisations in GEO is capable of doing that task. Then no other GEO actor than CEOS agencies can plan the necessary coordinated observations, in support of all the SDG-relevant GEO activities. It is a key aspect for the future of CEOS SDG AHT.

SIT-TW-2020-12	CEO to liaise with the GEO Secretariat to identify and promulgate the full extent of geo-spatial support of CEOS to GEO Flagships, Initiatives, Foundational Tasks, and other activities in the GEO Work Programme.	**CEOS Plenary**
	Rationale: CEOS noted and communicated to the GEO Secretariat Director that references to CEOS and its substantive contributions are noticeably diminished in the GEO Work Programme.	
SIT-TW-2020-13	SIT Chair Team and WGISS Chair to organise a meeting (call) with GEO Secretariat (POC: Doug Cripe) on feedback around access to CEOS ARD and commercial cloud service providers.	**Before CEOS Plenary**
	Rationale: To follow up the feedback solicited by the GEO SEC.	

Session 5.2: CEOS Analysis Ready Data Strategy and Early Progress

5.2.1: Session Introduction [slides]

Presenter: Zoltan Szantoi (LSI-VC Co-Chair, COM/JRC)

Session objectives:

- Take stock of the CEOS ARD Strategy and progress, and identify any highlights or challenges to be taken to Plenary.
- Review the CEOS Analysis Ready Data – Involving the Private Sector paper prior to submission for endorsement at Plenary.
- Review WGISS work on CEOS Interoperability Terminology and discuss issues to be addressed to allow endorsement at Plenary.
- Demonstrate results from CEOS ARD (Landsat Collection-2) (provisional) applied for Modified Normalised Difference Water Index (MNDWI).

5.2.2: CEOS ARD Strategy Progress Update [slides]

Presenter: Adam Lewis (LSI-VC Co-Chair, GA)

Main points:

- PFS progress: SR, ST, NRB, PR endorsed; Interferometric and Geocoded SLC SAR in development; Aquatic Reflectance PFS in development; LIDAR terrain and canopy height PFS under discussion;
- First CARD4L compliant datasets: USGS Landsat Collection 2 SR & ST, ESA Sentinel-2 SR currently being assessed);
- Cooperative processes to assess and peer-review: WGCV pivotal, Peer reviews have been completed or are in train;
- ARD beyond land: CEOS-COAST uptake of ARD; SIT WS Session 2.2 - "Beyond Land" - Actions to follow; Draft PFS for Aquatic Reflectance; Provisional Aquatic Reflectance Product from USGS;
- Draft Interoperability Terminology report: LSI-VC and WGISS collaboration, for endorsement at CEOS Plenary;
- Draft CEOS Paper on the Interplay of Industry and CEOS ARD: lead by LSI-VC, for endorsement at CEOS Plenary;
- Communication & Promotion: ARD Website updates (first ARD Webinar materials, ARD Frequently Asked Questions (following from the Webinar), Samples of CARD4L complaint datasets (coming soon), Table of dataset compliance (work in progress)), 2nd ARD webinar (Nov 2020); Paper and ARD session - virtual IGARSS 2020; Engagement with Standards - Participation in OGC's TESTBED16 ARD activity;
- CARD4L Pilots – DE Africa data flows (Sentinel-2, Landsat, Sentinel-1): DE Africa is establishing continental coverage of CEOS ARD (CARD4L compliant where possible); Industry is playing key roles in production (Sinergise, Element-84); and,
- **Looking forward, key will be demonstrating to agencies the user demand and user needs, and gathering this from users, so that agencies can invest confidently in the development and routine production of CEOS ARD. Pilots are key to achieving this as well as feedback on the suitability of the PFS.**

Discussion:

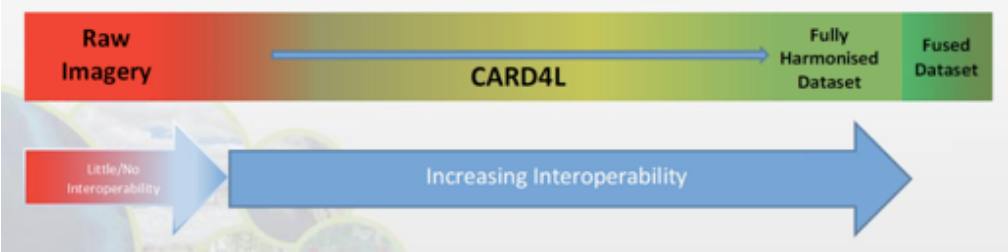
- Ed Armstrong (SST-VC, NASA) asked Adam how can ad hoc SST-VC and AC-VC ARD assessment activities contribute to user needs activities, and Adam noted LSI-VC welcomes all inputs.
- Gilberto suggested 4.4 (engagement with standards organisations) could be addressed by STAC. Adam noted the in progress action from LSI-VC-9 (#19) for the LSI-VC Leads to work with WGISS and the SIT Chair Team to consider how to tie the work of WGISS (and WGCV) on guidance materials related to data policy, data formats, interoperability, etc. to CEOS ARD under the CEOS ARD Strategy and CARD4L Framework. This is where references to STAC would make sense. Adam welcomed expressions of interest.

5.2.3: Interoperability Terminology Report [slides]

Presenter: Robert Woodcock (WGISS Chair, CSIRO)

Main points:

- The Interoperability Terminology Report is focused on ARD and Cloud.
- The terms Analysis Ready Data (ARD), interoperability, and harmonization are often used and, to a large extent, used inconsistently. Report seeks to introduce some consistency across CEOS.
- Interoperability represents a continuum of compatibility for products, services, algorithms. Five ARD terms are defined in this document: Analysis Ready Data (ARD), CEOS ARD for Land (CARD4L) Products, Interoperable Products, Harmonised Products, Fused Products.



- Additionally, three cloud data format terms for ARD are defined: cloud-friendly, cloud-native, cloud data access API, and three types of Analysis Interoperability: Executable code – black box service, same API; Source code - Same source, different systems; Algorithm - multiple implementations, same result.
- Aiming to validate Data Cube Interoperability in the EAIL ecosystem for CEOS projects.

Discussion:

- Gilberto commended the WGISS and LSI-VC teams on the report. He noted that for algorithms implemented in source code, without open access, you cannot verify the result is the same.
- Regarding Best Practice Guides on Cloud Data Formats and CEOS Data Discovery and Access in the Cloud, Zoltan asked about the time frame for completion. Robert noted this was delayed due to a team member leaving. Hoping by WGISS-51 should see some results.

5.2.4: Private sector paper engagement: lessons, feedback and next steps [slides]

Presenter: Andreia Siqueira (SIT Chair Team, GA)

Main points:

- Paper was circulated in March 2020 for comments and presented at SIT-35 and presents an initial evaluation of the views from the private sector on how the CEOS community needs to engage to take CARD to the next level.
- LSI-VC wants to review the draft paper prior to submission for endorsement at CEOS Plenary.
- Main recommendations:
  - Establishing mechanisms for constructive and appropriate engagement with the private sector.
  - Avoid unnecessary barriers to participation (from industry) in the CARD discussion and processes.
  - Provide appropriate documentation on the various aspects of the CARD initiative.
  - Identify a CEOS ARD framework process for assessing private data products for compliance with Specifications.
  - Move CEOS concepts into the broader standards discussion to be more inclusive of the private sector.
- Next steps are:
  - Continue to share information on CEOS Analysis Ready Data to build support;
  - Understand the industry perspective; and,
  - Engage industry in specifications, i.e. PFS development.

Discussion:

- Nancy: Has the group reached out to the private sector GEO Associates. Andreia noted the PCI relationship and their involvement in AR PFS. Zoltan noted ~500 registrations for the first webinar, so likely covered many.
- Nancy noted WGCapD is happy to work with you regarding our earlier presentation on branding webinars and using the WGCapD toolkit of good practices for the next webinar.

5.2.5: Pilot: DE Africa Trial of CEOS ARD [slides]

Presenter: Adam Lewis (Digital Earth Africa Establishment Team)

Main points:

- Digital Earth Africa (DE-Africa) is entirely dependent on CEOS Analysis Ready Data, with about 2PB of continental data pipelines for Sentinel-2, Landsat, Sentinel-1.
- Ideally, the pipelines of ARD would be direct from the space agencies. Programs like DE-Africa still have to "wrangle data", e.g.:
  - Landsat Collection-II : direct from USGS (anticipated);
  - Sentinel-2 surface reflectance : Sen2cor, BRDF correction is needed; and,
  - Sentinel-1 NRB : We are developing a pipeline with Sinergise and SEO.
- DE-Africa is establishing a pipeline of Sentinel-1 data for all of Africa.
- Sinergise will process the data to meet CARD4L Normalised Radar Backscatter (NRB) specification.
- After a self-assessment DE Africa will ask Geoscience Australia to sponsor peer-review under the WGCV processes and will approach the EC and ESA asking that they consider producing a NRB product (following CEOS ARD specifications).

Discussion:

- Brian: The SEO is also co-funding the Sentinel-1 ARD pipeline project.

5.2.6: Wrap-up – Preparing for Plenary [slides]

Presenter: Zoltan Szantoi (LSI-VC Co-Chair, EC) and Adam Lewis (LSI-VC Co-Chair, GA)

Main CEOS ARD related points for CEOS Plenary:

- ARD and Interoperability: Interoperability terminology for endorsement.
- Engaging with the Private Sector: Private sector paper to Plenary for endorsement.
- Interest beyond land ARD framework (extension):
  - AC-VC and SST-VC next steps regarding re-working the CARD4L Framework to include other domains (ref: SIT-TW-2020-06); and,
  - Seeking expressions of interest to be included in the work.
- Report progress on the growing number of Specifications (PFS): Aquatic Reflectance, Space Lidar, Radar.
- Share use cases and feedback on CEOS Agency ARD pipelines.

Discussion:

- Ake Rosenqvist noted on lidar PFS that a group has been assembled from GEDI, IceSat-2, MOLI teams. Will pick up progress in coming months. Hoping for a mature draft by the end of the year.
- Ed asked about the way forward for SIT-TW-2020-06. Adam: think we are trying to achieve: CEOS retains one definition and approach that can also encompass atmosphere and oceans. Understand what needs to be done. Ad hoc team working out edits needed. This plan is what will be presented to Plenary, with the work to take place after Plenary.
- Vardis Tsontos (NASA): Please consider engagement of COVERAGE as well. Adam confirmed COVERAGE, COAST, AC-VC and others will be engaged (see SIT-TW-2020-06).

Thursday 17th September

Session 6.1: CEO Continuity [DRAFT CEO Terms of Reference]

Presenter: Raj Kumar (CEOS Chair Team, ISRO)

Main Discussion Points:

- Raj summarised the work on the CEO TOR by the CEOS SEC.
- Brain Killough (SEO, NASA) noted the changes were mainly to the 'Organization' section in order to enable a contractor to fill the role.

- Raj noted that we wanted to have the updated ToR in place before Plenary so that the new CEO can be in place.
- Sandra Cauffman (NASA) noted that this draft has been reviewed and revised, and supports moving forward.
- Paul Counet (EUMETSAT) also noted that EUMETSAT supported the text, and thanked ISRO for the coordination efforts.
- Ivan Petiteville (ESA), Osamu Ochiai (JAXA), Astrid Koch (COM), Steve Volz (NOAA) all noted (via the chat box) that their agencies were in support.
- Kerry Sawyer (CEO, NOAA) will prepare an email for CEOS Chair to send requesting endorsement by 28th September. This should enable Plenary participation by the new CEO candidate.
- Raj thanked NASA for making the proposal to solve the CEO continuity issue. And noted that the long-term conundrum remains to be addressed so the gap issue does not arise again.
- Sandra noted that NASA is supporting the new CEO for 2 years so we have an adequate period in which to address the longer term. Ideally another agency could identify a deputy in that time.
- Mark Dowell (COM/JRC) asked whether the agency supervision could be assigned on an ad hoc (meeting to meeting) basis, or whether that person is permanently assigned. Raj noted the intention was only to have agency oversight, and Brian Killough (SEO, NASA) confirmed the intention was that it could be handled meeting by meeting.
- Ivan asked whether the CEO as a contractor would be able to commit CEOS resources at a meeting, and Brian noted that the CEO is never able to directly commit CEOS agency resources regardless of whether they are agency staff or a contractor. Ivan concluded that in that case it would not be necessary to systematically have an Agency staff accompanying the CEO to various meetings. It would be a waste of resources (mission budget and staff time) and perceived as a lack of trust. He asked to remove the corresponding sentence from the Terms of Reference.
- After some discussion of Mark and Ivan's points, it was agreed to do some small final text changes and to confer offline amongst the drafting team to conclude these.

Outcome 10	Minor changes to the CEOS Executive Officer Terms of Reference were reviewed and agreement was reached to circulate the revised ToRs for virtual endorsement in time to support Plenary participation by the incoming Executive Officer.

SIT-TW-2020-14	CEOS Chair to coordinate the virtual endorsement by CEOS Principals of the updated CEOS Executive Officer Terms of Reference with support provided by Kerry Sawyer (CEO).	**ASAP**
	Rationale: Aiming to complete virtual endorsement to allow Plenary participation by the incoming CEO and overlap with the current CEO, Kerry Sawyer.	

Session 6.2: Closing [slides]

Session Co-Leads: Alex Held (SIT Co-Chair, CSIRO), Adam Lewis (SIT Co-Chair, GA)

Refer to the session slides for the points made under each topic. Below are major discussion items raised in addition.

6.2.1: Review of Workshop Outcomes by Session Chairs

2020 CEOS Chair Initiatives (Raj Kumar, CEOS Chair Team) [slide]

COVID and EO (Astrid Koch, COM) [slide]

- Raj noted ISRO agreed to include a COVID session at Plenary.

CEOS-COAST (Paul DiGiacomo, CEOS COAST Team Lead, NOAA) [slide]

- Raj noted ISRO is willing to serve as the Co-Lead of the CEOS-COAST Ad Hoc Team to be proposed at CEOS Plenary.
- Jonathon Ross (SIT Chair Team, GA) suggested a high level draft Terms of Reference for a CEOS-COAST Ad Hoc Team to discuss at Plenary.

Sustainable Development Goals (Alex Held, SDG AHT, CSIRO) [slide]

- Doug Cripe (GEO Secretariat) noted that the GEO Secretariat is expecting an SDG coordinator secondment from France, starting February 2021. Steve stressed the importance of improved coordination with GEO.

Working Teams and **VCs** (Jonathon Ross, SIT Chair Team, GA), **WGs** (Raj Kumar, CEOS Chair Team, ISRO) [slides]

- Nancy Searby (WGCapD Chair, NASA) noted that WGCapD can prepare a companion document about the CEOS branded webinars for review prior to the Plenary.

Carbon and Biomass Session (Stephen Ward, SIT Chair Team with inputs by Jörg Schulz, Mark Dowell, Osamu Ochiai) [slides]

- Joanna Post (UNFCCC) encouraged CEOS Agency staff who engage with their national government UNFCCC delegations to take the chance to do so during 2020, in particular given that negotiations are delayed this year.
- Frank Martin Seifert (ESA) noted the heritage of the AFOLU Roadmap lies partly with the CEOS support for GFOI (e.g. via SDCG and the LSI Forest and Biomass Subgroup).
- Steve Volz asked about the meaning of the Plenary endorsement of the CEOS Biomass Protocol and how in-depth an Agency review should be. Stephen noted that the implications are entirely voluntary, and mostly it falls to the Agencies with the relevant missions and data to determine their level of engagement.
- The Forest Biomass Reference Network Concept is separate from the CEOS Biomass Protocol. Cindy Ong (WGCV Chair, CSIRO) clarified that the Biomass Protocol endorsement is separate from the Reference Network.

GEO (Doug Cripe, GEO Secretariat) [slide]

- Doug noted that the GEO Secretariat will work with the CEO to identify and reflect the full extent of CEOS support to activities of the GEO Work Programme.
- He also noted GEO Secretariat will liaise with WGISS to organize a teleconference with commercial cloud service providers. Adam noted that Digital Earth Africa would be happy to be involved in these discussions.

ARD Beyond Land (Ed Armstrong, NASA) [slide]

CEOS ARD Strategy (Andreia Siqueira, SIT Chair Team, GA) [slide]

- Zoltan Szantoi (COM-JRC) stressed the potential importance of Sentinel-1 ARD datasets. Ivan noted this would require coordination between ESA and the Commission.

CEO Continuity (Raj Kumar, CEOS Chair Team, ISRO) [slide]

6.2.2: Other CEOS Business

- Brian presented [slides] a summary of the External Request Process Paper [ERPP] and the New Initiatives Process Paper [NIPP]. Final versions of the ERPP and NIPP will be ready for endorsement at CEOS Plenary.

6.2.3: Review of Actions to Plenary (George Dyke, SIT Chair Team) [DRAFT Decisions and Actions]

6.2.4: CEOS Plenary Update (Raj Kumar, CEOS Chair Team, ISRO) [slides]

- Mark suggested Dave Crisp give a presentation on the GHG GST1 deliverables at CEOS Plenary.

Adam thanked all for participating over the two weeks and six sessions, thanked those who prepared, chaired and contributed to the sessions, and he closed the Workshop.

APPENDIX A: Attendees (All Virtual)

Note: Not all participants participated in all sessions over the two week period.

Agency	Name	Agency	Name
Agencia Espacial Mexicana	Adrian Guzman	JAXA	Ko Hamamoto
AGEOS	Rufin Mikala-Mussavu	JAXA	Misako Kachi
AGEOS	Aboubakar Mambimba Ndjoungui	JAXA	Akihiko Kuze
ASI	Laura Candela	JAXA	Hiroshi Murakami
Australian BoM	Agnes Lane	JAXA	Osamu Ochiai
Basque Centre for Climate Change	Maria J. Sanz	JAXA	Mariko Harada
CNES	Carole Deniel	JAXA	Chu Ishida
CNES	Anne Lifermann	JAXA	Makoto Natsuisaka
CNES	Annick Sylvestre-Baron	JAXA	Shirou Kawakita
CNES	Aurélien Carbonniere	JAXA	Riko Oki
CNES	Pierric Ferrier	JAXA	Ake Rosenqvist
COM	Mauro Facchini	JAXA	Kei Shiomi
COM	Astrid Christina Koch	JAXA	Shin-Ichi Sobue
COM/JRC	Zoltan Szantoi	JAXA	Hiroshi Suto
COM/JRC	Mark Dowell	JAXA	Takeo Tadono
CONAE	Laura Frulla	JAXA/RESTEC	Koji Akiyama
CONAE	Marisa Kalemkarian	JAXA/RESTEC	Yukio Haruyama
CONAE	Ana Medico	JAXA/RESTEC	Toshi Kamei
CSA	Marie-Josée Bourassa	NASA	Jorge Vazquez
CSA	Paul Briand	NASA	Jay Al-Saadi
CSA	Eric Laliberté	NASA	Christine Bognar
CSA	Helena Van Mierlo	NASA	Dave Borges
CSIRO	Alex Held	NASA	Sandra Cauffman
CSIRO	Flora Kerblat	NASA	Lauren Childs-Gleason
CSIRO	Neil Sims	NASA	Diane Davies
CSIRO	Robert Woodcock	NASA	Bradley Doorn
CSIRO	Cindy Ong	NASA	Richard Eckman
CSIRO	Stephen Ward	NASA	Michael Falkowski
CSIRO	George Dyke	NASA	Lawrence Friedl
CSIRO	Matthew Steventon	NASA	Gary Geller
DLR	Diego Loyola	NASA	David Green
DLR	Helmut Staudenrausch	NASA	Kim Holloway
DLR	Albrecht Von Bargen	NASA	Kimberly Hurst

DLR	Uta Heiden	NASA	Brian Killough
EC-CHE	Steve Briggs	NASA	Barry Lefer
ESA	Josef Aschbacher	NASA	Christine Mataya
ESA	Valentina Boccia	NASA	Andrew Mitchell
ESA	Simonetta Cheli	NASA	Kevin Murphy
ESA	Philippe Goryl	NASA	Nancy Searby
ESA	Marie-Helene Rio	NASA	Karen St. Germain
ESA	Yasjka Meijer	NASA	Wenying Su
ESA	Ivan Petiteville	NASA	Nima Pahlevan
ESA	Simon Pinnock	NASA	Vardis Tsontos
ESA	Ben Veihelmann	NASA	Argyro Kavvada
ESA	Marc Paganini	NASA	Hank Margolis
EUMETSAT	Paul Counet	NASA	Jaime Nickeson
EUMETSAT	Robert Husband	NASA	David Crisp
EUMETSAT	Anne O'Carroll	NASA	Edward Armstrong
EUMETSAT	Estelle Obligis	NASA	Chris Kidd
EUMETSAT	Remko Scharroo	National Statistical Office	Atusaye Mwambyale
EUMETSAT	Jörg Schulz	NIES	Hiroshi Tanimoto
EUMETSAT	Dorothee Coppens	NOAA	Stephen Volz
FAO	Zhongxin Chen	NOAA	Albert Degarmo
GA	Adam Lewis	NOAA	Mitch Goldberg
GA	Trevor Dhu	NOAA	Shobha Kondragunta
GA	Norman Mueller	NOAA	Kerry Sawyer
GA	Jonathon Ross	NOAA	Charles Wooldridge
GA	Andreia Siqueira	NOAA	Emily Smail
GCOS	Han Dolman	NOAA	Paul DiGiacomo
GEO Secretariat	Gilberto Camera	NOAA	Merrie Neely
GEO Secretariat	Douglas Cripe	NOAA	Jeff Privette
GEO Secretariat	Florian Franziskakis	SAC/ISRO	Arundhati Misra
GEO Secretariat	Sara Venturini	SANSA	Andiswa Mlisa
GEOGLAM	Ian Jarvis	SANSA	Christo Peter Whittle
GFOI	Nikki Fitzgerald	SANSA	Nale Mudau
ISRO	Muvva V. Ramana	U. Sheffield	Shaun Quegan
ISRO	Neeraj Agarwal	UAE SA	Fatima Alaydaroos
ISRO	Abhisek Chakraborty	UK NCEO	John Remedios
ISRO	Shantanu Bhatawdekar	UK NCEO	Svetlana Zolotikova
ISRO	Nitant Dube	UK Space Agency	Catherine Mealing-Jones

ISRO	Neha Gaur	UMD	Laura Duncanson
ISRO	Rajeev Jaiswal	UNFCCC	Joanna Post
ISRO	Raj Kumar	UNOOSA	Coen Bussink
ISRO	Indranil Misra	USDA	Michael Cosh
ISRO	Muvva V. Ramana	USGS	Timothy Stryker
ISRO	Sampa Roy	USGS	Christopher Barnes
ISRO	Ghansham Sangar	USGS	Sky Bischoff-Mattson
ISRO	Rashmi Sharma	VNSC	Nguyen Lam-Dao
ISRO	Vivek Sharma	VNSC	Thy Pham
ISRO	Shashikant Sharma	WGCV LPV	Fernando Camacho
ISRO	Tushar Shukla	WMO	Michel Rixen
ISRO	Santhi Sree Basavaraju	WMO	Werner Balogh
ISRO	Pradeep Thapliyal	WMO	Heikki Pohjola
ISRO	Bimal Bhattacharya	WMO	Alexander Baklanov
ISRO	Atul Varma	WMO	Anthony Rea

APPENDIX B: Outcomes and Actions Record

OUTCOMES

Outcome 01	The 2020 CEOS Plenary agenda will include the opportunity for CEOS Agency updates. The SIT Technical Workshop recommended that agency updates be posted virtually (no oral reports).
Outcome 02	As in the past, the CEOS Plenary agenda will include a presentation on the theme and priorities of the incoming CEOS Chair.
Outcome 03	It was agreed that there will be a report to the CEOS Plenary on the productive discussion on COVID-19 that occurred during the CEOS SIT Technical Workshop.
Outcome 04	CEOS Coastal Observations and Applications Study Team (COAST) will ask Plenary for approval to be recognized/proceed as a *CEOS Ad Hoc Team* for 2 years. Next steps will include a call for Agency expressions of interest/support for Phase 2 (2021) activities (including a co-Chair for the AHT).
Outcome 05	JAXA asked to join CEOS COAST (nominating Ko Hamamoto and Osamu Ochiai), and AEM (Adrian Guzman) and USGS (Tim Stryker) projects might support COAST.
Outcome 06	Two options for the way forward on the ad hoc Team for Sustainable Development Goals (SDG AHT) will be presented to the 2020 CEOS Plenary (i.e., either extend or stop), with the recommendation to adopt Option 1 (extension of the SDG AHT for another year). The SDG AHT will also present a Roadmap to the Plenary for its transition into a permanent structure, proposed to begin at the end of 2021.
Outcome 07	Plenary (Principals) will be asked to consider supporting a small team to review the Analysis Ready Data (ARD) framework and to consider making it amenable to additional Product Family Specifications (PFS) for domains beyond land.
Outcome 08	Three WGDisasters documents will be presented to the 2020 CEOS Plenary for endorsement: 1) CEOS WGDisasters Strategy Paper; 2) Recovery Observatory Demonstrator Implementation Plan; and 3) the GEO/LEO/SAR Flood Pilot Implementation Plan.

Outcome 09	CEOS could position COVERAGE as a valuable contribution to the Decade on Ocean Science for Sustainable Development, and 2020 CEOS Plenary should discuss ways to make this possible (e.g. via programmatic connectivity to GOOS).
Outcome 10	Minor changes to the CEOS Executive Officer Terms of Reference were reviewed and agreement was reached to circulate the revised ToRs for virtual endorsement in time to support Plenary participation by an incoming Executive Officer.

ACTIONS

SIT-TW-2020-01	SEO to keep CEOS SEC updated on progress on the new GEO Community Activity on the Open Earth Alliance as an evolution of the Open Data Cube activity in which CEOS has been participating	**CEOS SEC-270**
	Rationale: Provide an opportunity for CEOS SEC to hear an update on the potential scope of CEOS engagement with GEO's Community Activity Open Earth Alliance.	
SIT-TW-2020-02	JAXA (Shin-ich Sobue), ESA (Simonetta Cheli), NASA (Michael Falkowski) to coordinate a report to Plenary on the Technical Workshop COVID-19 session. This should include inputs from all agencies presenting at the SIT Technical Workshop, as well as a list of COVID-relevant weblinks from CEOS Agencies.	**CEOS Plenary**
	Rationale: Provide CEOS Agencies and Principals with a snapshot of the discussion to date as background for a Plenary discussion session on COVID-19 and space-based EO.	
SIT-TW-2020-03	CEOS COAST to seek a co-Lead for the Ad Hoc Team to be proposed at Plenary.	**CEOS Plenary**
	Rationale: A COAST Co-Lead will help share the workload and bring new capabilities. (ISRO has agreed in principle to Co-Lead.)	
SIT-TW-2020-04	Paul di Giacomo (NOAA) to develop a high level draft Terms of Reference for a CEOS COAST Ad Hoc Team ahead of Plenary	**CEOS Plenary**
	Rationale: While not required before the October 2020 CEOS Plenary, draft TORs can be helpful information for review by CEOS Agencies preparing for this year's Plenary discussions. The requirement in the CEOS Governance and Processes	

	Document (page 7) is, "Within two months of creation, the Ad Hoc Team will prepare defined objectives and appropriate path forward for meeting those objectives to include identifying needed resources."	
SIT-TW-2020-05	When requesting a one-year extension, CEOS SDG AHT will submit a Roadmap for its activities in 2021, highlighting its transition plan and the proposed activities to be undertaken in support of GEO.	**CEOS Plenary**
	Rationale: This will provide further insight to Principals on how another year of ad-hoc team activity will help clarify CEOS's role in the broader SDG context.	
SIT-TW-2020-06	SIT Chair to work with CEOS Sea Surface Temperature VC (SST-VC) co-lead Ed Armstrong on a proposal to the 2020 CEOS Plenary for Principals to support the establishment of a small study team to examine the ARD framework in the context of potential Product Family Specifications (PFS) for domains beyond land.	**CEOS Plenary**
	Rationale: To propose that the 2020 CEOS Plenary approve a small expert study team to look at broadening the ARD framework, with a final report and close at Plenary 2021. (COVERAGE, AC-VC (Diego Loyola), LSI-VC, COAST expressed willingness to contribute.)	
SIT-TW-2020-07	DLR to provide a nominee to represent the agency on the Agriculture, Forests, Other Land Use Change (AFOLU) Team that is working on the development of an AFOLU Roadmap.	**CEOS Plenary**
	Rationale: DLR has relevant missions and data to support the AFOLU Roadmap.	
SIT-TW-2020-08	AFOLU team Co-Leads to review the Land chapters of the GCOS IP to assess any impacts on AFOLU requirements.	**CEOS Plenary**
	Rationale: GCOS IP may hold some useful requirements for the AFOLU Roadmap.	
SIT-TW-2020-09	WGClimate Chair to confirm details with UNFCCC SEC of the global Earth Information Day in late November 2020.	**CEOS Plenary**
	Rationale: Await news from UNFCCC SEC on how CEOS can engage.	
SIT-TW-2020-10	SIT Chair Team interface with GEO SEC on ideas around collaboration and funding for the Forest Biomass Reference Network concept.	**CEOS Plenary**

	Rationale: Diverse funding solutions will be essential for this to be viable.	
SIT-TW-2020-11	CEOS Agencies are requested to organise submission of use cases for climate data records via https://climatemonitoring.info/use-cases	**CEOS Plenary**
	Rationale: To ensure that CEOS Agency use cases are further disseminated.	
SIT-TW-2020-12	CEO to liaise with the GEO Secretariat to identify and promulgate the full extent of geo-spatial support of CEOS to GEO Flagships, Initiatives, Foundational Tasks, and other activities in the GEO Work Programme.	**CEOS Plenary**
	Rationale: CEOS noted and communicated to the GEO Secretariat Director that references to CEOS and its substantive contributions are noticeably diminished in the GEO Work Programme.	
SIT-TW-2020-13	SIT Chair Team and WGISS Chair to organise a meeting (call) with GEO Secretariat (POC: Doug Cripe) on feedback around access to CEOS ARD and commercial cloud service providers.	**Before CEOS Plenary**
	Rationale: To follow up the feedback solicited by the GEO SEC.	
SIT-TW-2020-14	CEOS Chair to coordinate the virtual endorsement by CEOS Principals of the updated CEOS Executive Officer Terms of Reference with support provided by Kerry Sawyer (CEO).	**ASAP**
	Rationale: Aiming to complete virtual endorsement to allow Plenary participation by the incoming CEO and overlap with the current CEO, Kerry Sawyer.	