

CEOS NEWSLETTER

The Committee on Earth Observation Satellites

February 2021
No. 56

Report of 2020 CEOS Plenary

First time being organised in virtual mode, the 2020 CEOS Plenary was always going to be a challenge, but I am glad that the CEOS community rose to the occasion, demonstrating its strength. I am impressed by the dedication and hard work of everyone involved, due to which we were able to maintain such a large and effective programme at CEOS Plenary, covering a broad spectrum of activities.

As CEOS Chair 2020, ISRO had taken up 4 priority initiatives for 2020. We have made a great start on our work on scatterometry, SDGs and Data Cube for the BIMSTEC region, renewable energy assessments and GEO-LEO tools for disaster management. We hope to build on these foundations and look forward to seeing the relationships we have fostered throughout 2020 continue to grow and advance these efforts. I would like to thank the CEOS community for its support to above priorities.

Polska Agencja Kosmiczna (POLSA) was welcomed as the newest Associate member of CEOS. We all look forward to working with the team from POLSA and I encourage everyone to reach out and see if there are connections to be made to ongoing work.

Regarding the Working Groups, Plenary endorsed Philippe Goryl of ESA as WGCV Vice Chair and Jeff Privette of NOAA as WGClim Vice Chair for 2021-2022. Both will subsequently serve as Chair for 2023-2024. I am pleased to see the strong continuity of leadership for these critical working teams. Furthermore, I welcome the decision for WGCapD to develop a CEOS Webinar Toolkit. I was also pleased to learn the great progress on the WGISS and SEO Earth Analytics Interoperability Lab, which will be a game changer for CEOS prototyping and interoperability studies. WGDIsasters also demonstrated strong progress and Plenary endorsed the Promoting Space Data for Disaster Risk Management paper, the Recovery Observatory (RO) Demonstrator Implementation Plan, and the GEO-LEO-SAR Flood Risk Pilot Implementation Plan.

CEOS has an important role to play in the world's response to the Paris Agreement, and I am pleased to see such great progress on the Greenhouse Gas Roadmap and look forward to achieving further clarity on the accompanying Agriculture, Forestry

and Other Land Uses (AFOLU) Roadmap, and a coordinated CEOS response to the Global Stocktakes.

Biomass was another focus for the Plenary. The WGCV LPV "Aboveground Woody Biomass Product Validation Good Practice Protocol", was reviewed and is now out for comment ahead of its planned endorsement at SIT-36. CEOS was also introduced to the concept of the Global Forest Biomass Reference System and asked to consider potential contributions.

CEOS Analysis Ready Data is a topic of particular relevance to us in ISRO, given our Chair priority on developing a Data Cube platform for the BIMSTEC region. CARD4L assessments for our datasets are on the horizon, as we feel that complying with these specifications will greatly increase the use and impact of our EO data. I am encouraged by the continued pace of development on CEOS ARD and appreciative that we came away from the Plenary meeting with concrete actions to advance the discussion around the expansion of the CARD4L Framework beyond the land domain. I look forward to seeing the outcomes and encourage all CEOS Agencies to engage with the CEOS ARD process – it is in interests of all of us to ensure our data is easily understood, accessed, and applied.

Plenary endorsed the creation of the CEOS COAST Ad Hoc Team through September 2022 to continue the activities. Potential contributions from COVERAGE, COAST, and CEOS in general to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) will be considered. Plenary also agreed to extend the SDG-AHT for one year, with direction for the SDG-AHT to plan a transition of SDG activities to internal and/or external entities by the 2021 CEOS Plenary. I look forward to seeing great progress from our *ad hoc* teams over the next year.

DK Das,
ISRO,
2020 CEOS Chair



Finally, I wish the NASA team taking on the role of CEOS Chair for 2021 all the very best. ISRO fully supports the theme of Open Science and the approach of taking a holistic look across CEOS activities in support of this theme. ISRO will always be ready to assist however we can in support of this important initiative.

While it was a great disappointment that we were unable to meet in Ahmedabad, I am delighted that we were able to have such a productive virtual meeting. I commend the CEOS Chair Team, in particular Dr Raj Kumar and Dr Rajeev Jaiswal, for their great execution of the Plenary meeting, as well as the CEOS Chair year in general.

I hope to welcome you all to India at some point in the near future.

Please take care.
All the best,



2020 CEOS Plenary Virtual meeting group photo

Partnering with Purpose

The CEOS community remains hopeful for a return to in-person meetings in 2021 and to continue collaborating with purpose and in partnership for the benefit of humankind. In the last decade, the following 14 agencies (in alphabetical order by their acronym) have led as CEOS Chair, SIT Chair, or both: ASI, CNES, CSA, CSIRO, EUMETSAT, EC, ESA, GA, ISRO, JAXA, NASA, NOAA, USGS, VAST-VNSC. These were major commitments in which the CEOS community takes stock today with great appreciation.

As the faces in CEOS change, it is important to continue emphasizing that "partnership" is a shared value and a benefit among all CEOS Members and Associates. As 2021 CEOS Chair, I encourage the principals of all CEOS agencies to examine, at least on an annual basis, what their agency is contributing to the activities of the Working Groups (WGs), Virtual Constellations (VCs), and ad hoc teams. The products and services CEOS is delivering can be strengthened with your agency's engagement as principal and the direct involvement of one or more of your thematic experts. Please take a look in the CEOS website at activities of particular relevance to your organization in order to right-size where or how your agency can contribute. This is a call for wider participation by CEOS Members and Associates.

Among the large thrusts are:

- The effort to make needed Earth Observation data open, accessible, and interoperable for data users, open science and decision support worldwide through CEOS Analysis Ready Data – This effort mobilizes the Working Group on Information Systems and Services (WGISS),

the Working Group on Capacity Building and Data Democracy (WGCapD), the CEOS Systems Engineering Office (SEO), and the CEOS ad hoc team for Sustainable Development Goals;

- Ongoing efforts to communicate and deliver Earth observation open data and products of demonstrated value to accelerate elements of the 2030 United Nations Agenda for Sustainable Development in order to ameliorate the livelihoods of populations struggling with natural disasters and environmental hazards to food security, water resources, ecosystems, among other existential challenges;
- Joint efforts by CEOS, CGMS, and other forums to offer input for deliberations on the formulation of space data requirements and modalities of the 2023 Global Stocktake process. CEOS principals can consider engaging their CEOS counterparts in the context of their respective national discussions on how to prepare for the reporting of Nationally Determined Contributions (NDCs) under the Paris Accord.

Now in the second year of its two-year term, SIT Chair, CSIRO-GA, under the leadership of Dr. Alex Held and Dr. Adam Lewis, continues the CEOS best practice of teleconferences with the WGs, VCs, and ad hoc teams to discuss progress, opportunities for crosscutting cooperation, topics of concern, and most importantly, to continue aligning their activities in support of CEOS priorities. We thank the members of the WGs, VCs, ad hoc teams, and the agencies supporting them, for the

Karen M. St. Germain,

NASA,
2021 CEOS Chair



outstanding work they continue to do for the timely delivery of tangible outcomes.

The CEOS Chair team at NASA looks forward to wider engagement across CEOS in 2021. Opportunities to contribute abound, including an open invitation to nominate a candidate for the role of CEOS Deputy Executive Officer (DCEO); the opportunity to contribute open data for the Mekong initiative begun by the 2019 CEOS Chair, VAST-VNSC; and the BIMSTEC initiative begun by the 2020 CEOS Chair, ISRO. In addition, several WGs and VCs would welcome new members. We also invite all CEOS agencies with an interest in any of the relevant domains to contact the CEOS SIT Chair team, CEOS Executive Officer, or the relevant WG and VC leadership.

Working Group Chairs and Vice Chairs

WGCapD	Nancy Searby/NASA Pham Thi Mai Thy/VAST-VNSC	WGCV	Akihiko Kuze/JAXA Philippe Goryl/ESA
WGClimate	Albrecht von Bergen/DLR Jeff Privette/NOAA	WGISS	Rob Woodcock, CSIRO Makoto Natsuisaka, JAXA
WGDisasters	David Green/NASA Pierrick Ferrier, CNES		

Virtual Constellation Co-Leads

AC-VC	Barry Lefer/NASA Ben Veihelmann/ESA	OSW-VC	Paul Chang/NOAA Stefanie Linow/EUMETSAT Raj Kumar/ISRO
LSI-VC	Adam Lewis/GA Steve Labahn/USGS Zoltan Szanto/EC	P-VC	Chris Kidd/NASA Riko Oki/JAXA
OCR-VC	Ewa Kwiatkowska/EUMETSAT Marie-Hélène Rio/ESA	SST-VC	Christo Whittle/CSIR Ed Armstrong/NASA
OST-VC	Annick Sylvestre-Baron/CNES Estelle Obligis/EUMETSAT		

Report of CEOS Executive Officer (CEO)

It has been my pleasure to serve a second term as the CEOS Executive Officer. I often say I know more about CEOS than I do about my Agency, having been hired at NOAA with responsibility to support Mary Kicza as the 2008-2009 CEOS Strategic Implementation Team Chair. My strong connection, dare I say kinship, to CEOS has continued ever since.

Being the CEOS Executive Officer, I have had the opportunity to peek behind the curtain and observe the dedication and determination of the many people committed to the success of CEOS through their tireless and often unrecognized efforts. CEOS is successful not only due to those who are in positions of leadership but also because of those who actively and consistently participate in the CEOS Working Groups, Virtual Constellations, and Ad Hoc Teams; those who keep the CEOS Newsletter published and the CEOS Missions, Instruments, and Measurements Database current. We need to recognize those who are up at all hours of the day and night to participate in monthly (or more frequent) telecons; those who write implementation plans and terms

of reference long after they have wrapped up their responsibilities to their Agencies and their "day jobs." Working in a virtual environment has altered and blurred the division of work and home life, forcing many to participate in meetings at dinnertime, via Bluetooth during school drop-off time (always hands-free in vehicles), from the comfort of bed, and from mountain, country, and beach retreats. Thank goodness for the option to turn off our cameras. A nine- or ten-hour workday at the office can easily turn into a twelve-hour work-from-home day, all while dressed in the "office mullet" – business on the top (button-down shirt/tie/blouse) and comfy on the bottom (cozy pants/shorts/slippers).^{*} To all who are dedicated to CEOS, THANK YOU!

My CEO term ends on 31 December 2020. From January 2021, Marie-Claire Greening will take over as the CEOS Executive Officer. Marie-Claire's involvement in CEOS began almost 20 years ago when she took on the role of WGCV Secretariat in 2001. This began a long association with the WGCV, followed by subsequent involvement in the WGClimate, and also support to previous CEOS

Kerry Ann Sawyer,

CEO, NOAA



Marie-Claire Greening,

New CEO



Executive Officer through the Systems Engineering Office. Marie-Claire and I have been working closely over the last few months to ensure a smooth handover. Marie-Claire is honored to be taking up this keystone role for CEOS and is looking forward with great anticipation to working with its Member Agencies and Associates.

^{*}A mullet is a hairstyle that is cut short and styled nicely in the front and is long and shaggy in the back. The familiar phrase when referring to a mullet is "business in the front, party in the back."

Report from the CEOS Strategic Implementation Team (SIT): Outcomes of the SIT Technical Workshop 2020

Andreia Siqueira, GA, SIT Chair Team

CEOS is continuing to operate virtual-only due to the challenges posed by the COVID-19 pandemic crisis and has once more delivered a very successful fully virtual meeting: **CEOS SIT Technical Workshop**. The workshop was spread across two weeks period, from 7-18th September and gathered around 170 attendees from 42 CEOS Agencies who actively participated in discussions focused on key topical areas including ongoing activities within CEOS Working Groups (WGs), CEOS Virtual Constellations (VCs) and CEOS *ad hoc* Teams (AHTs) in preparation to the CEOS Virtual Plenary 2020.

In particular, the workshop's participants discussed topics related to the Coastal Observations and Applications, Sustainable Development Goals, CEOS Analysis Ready Data (CARD), and Carbon and Biomass which resulted in several decisions and actions – The full list covering decisions and actions, as well as presentations delivered at the Workshop, are now available in the CEOS webpage here [<https://ceos.org/meetings/2020-sit-technical-workshop/>].

The workshop presented several highlights including:

- Substantial work accomplished by COAST, with strong interest, partnerships, and support from CEOS agencies.
- Impressive work of the Sustainable Development Goals *ad hoc* (SDG AHT) sub-teams with strong engagement from CEOS Agencies.
- The new CEOS Thematic Observation

Coordination page (ceos.org/observations).

- The significant opportunity presented to space agencies by the UNFCCC Global Stocktake process - in terms of the policy impact of Earth Observation. And the work underway by our thematic expert teams in atmosphere (GHG) and land (AFOLU).
- Strong support from CEOS agencies to develop Analysis Ready Data (ARD) beyond land, including the expansion of the existing CEOS ARD for Land (CARD4L) Framework to accommodate non-land datasets.
- The solid relationship between GEO and CEOS and very good CEOS representation to the GEO Working Groups.
- The important progress on the CEOS ARD Strategy, particularly in relation to the private sector engagement.

The Workshop also included a special session on COVID-19 and Space in recognition of the CEOS agencies' collaboration and work to develop products and platforms using Earth Observation data to support policy and decision-making during the crisis period and how future CEOS coordination could benefit the broader community.

As the COVID-19 situation continues to unfold, the CEOS SIT Chair team is closely considering the appropriate actions for the 2021 upcoming meetings, and are planning accordingly to ensure they are as successful as they were in 2020.



Report of Systems Engineering Office (SEO)

Though 2020 was a challenging year due to the COVID pandemic, CEOS Agencies continue to make great progress with the launch of more than 10 missions and the migration of many global datasets to the cloud. Satellite data are now becoming easier to find, access, and apply to user applications. Also, NASA has announced its new 2021 CEOS Chair theme focused on open science, which will further promote progress toward data and tool accessibility, analysis transparency, and product reproducibility.

In early 2021, the CEOS Systems Engineering Office (SEO) plans to release a new Open Data Cube (ODC) "sandbox" that will provide global users with a free and open programming interface connected to Amazon Web Services (AWS) datasets or Google Earth Engine datasets. The open source tool will allow users to run

an application algorithm from the Data Cube Application Library (DCAL) using a Google Colab Python notebook environment. This tool will demonstrate rapid creation of science products anywhere in the world without the need to download and process the satellite data. Some example applications include: custom cloud-filtered mosaics, spectral index products including vegetation fractional cover, historic water extent, vegetation phenology, and vegetation change. Basic operation of the tool will support many users but can also be scaled in size and scope to support enhanced user needs.

The creation of the ODC sandbox was prompted by the migration of many CEOS satellite datasets to the cloud. Most recently, this includes the release of Landsat Collection-2 and Sentinel-2 on AWS. Though this demonstration is only connected to two cloud providers in the

Brian Killough,
Head of the CEOS Systems
Engineering Office (SEO)



United States, the same technology can easily be used to connect to cloud providers in other parts of the world. In addition, the SEO has been working with a European contractor (Sinergise) to develop a data cube processing pipeline for Sentinel-1 radar data that will produce CEOS Analysis Ready Data for Land (CARD4L) compliant data cubes. The combination of these datasets (Landsat, Sentinel-1, Sentinel-2) in an interoperable data cube framework will inspire the creation of many new application products and advance open science.

More details can be found at: <https://www.openearthalliance.org/sandbox>.

Report of GEO Week 2020

Given the global pandemic context, instead of meeting in Port Elizabeth, South Africa as originally planned, GEO Week 2020 was held on 2-6 November as a virtual event. GEO Week 2020 showcased the impact of open Earth observations (EO), with a particular emphasis on efforts to implement the Canberra Declaration [https://earthobservations.org/canberra_declaration.php].

Day 1 featured statements by each of the GEO Executive Committee Co-Chairs and GEO Secretariat Director reviewing progress over the past year in support of the Canberra Declaration.

Day 2 kicked-off of the GEO Pledge Campaign, an online fundraiser during which GEO Members, Participating Organizations (POs) and Associates were encouraged to make voluntary contributions in support of GEO's Engagement Priorities and the realization of GEO's Mission. Additionally, pre-recorded statements from GEO Members and POs provided examples of how EO helped provide

societal benefit, such as equipping disaster managers with tools and capacity to prepare for and respond to flooding and drought, or identifying informal human settlements which require shelter to ensure social distancing in the context of COVID-19. Finally, the 53rd meeting of the GEO Executive Committee commenced its initial (restricted) session via live videoconferencing.

Day 3 provided the opportunity for all GEO Member Principals to join the continuation of the GEO Executive Committee meeting and participate in deliberations, such as the proposal to make Urban Resilience a fourth Engagement Priority, and approval of both the Update to the 2020-2022 GEO Work Programme and the 2021 GEO Trust Fund budget on behalf of Plenary. In addition, the GEO Industry Track Session was launched, providing a platform for the commercial sector to engage with the GEO community. The day concluded with announcements of the winners of both the GEO Individual Excellence and 2020 Earth Observation for the Sustainable Development Goals Awards.

Douglas Cripe,
GEO Secretariat



Day 4 featured a live conversation with GEO Member Principals as to how they were leveraging EO and their membership in GEO to address national priorities and build resilient societies and economies. Principals from Australia, Canada, Colombia, Costa Rica, Morocco, Switzerland, Ukraine and Vietnam joined the discussion.

Day 5 was devoted to a live discussion on the future of open data, including challenges and approaches to data sharing. Panelists discussed approaches to open data, expanding access to in situ data and analysis ready data for continued integration in the digital economy and sustainable development, including experience from GEO Initiatives.

South Africa has graciously offered to host GEO Week 2021 – we hope to see you there!

Report of Working Group on Capacity Building & Data Democracy (WGCapD)

WGCapD builds awareness, access, and capacity to use Earth observation data. Nancy D. Searby (NASA) serves as the WGCapD Chair and Pham Thi Mai Thy (VNSC) as the Vice-Chair.

Many training events have been postponed or shifted online as e-Learning and virtual capacity development. WGCapD harnessed its collective knowledge and skills to support these efforts by proposing to create a CEOS "Webinar Toolkit," which was endorsed at Plenary. The toolkit will serve as a resource for all of CEOS to offer webinars to increase awareness, access, and ability to use CEOS data and products. The toolkit includes guidance and good practices for creating webinars, templates, and design assets. WGCapD is establishing a framework for working teams to gain WGCapD support with specific stages of webinar development.

WGCapD achievements in the past six months include:

- Provided an online training on satellite remote sensing for air quality monitoring and forecasting focused on users from Thailand's Pollution Control Department, completing deliverable CB-20-10.
- Created a Knowledge Portal website

[<https://wgcapd.iirs.gov.in/>] linked on the Resources [<http://ceos.org/ourwork/workinggroups/wgcapd/resources-2/>] page of the WGCapD website, completing deliverable CB-17-02.

- Completed the deliverable CB-18-07 to conduct global capacity building courses through Webinar on Asia-GEOGLAM, SAR Missions' Present and future, Disaster Risk Reduction. The United Nations Office for Outer Space Affairs and the Centre for Space Science and Technology Education in Asia Pacific (CSSTEAP) provided the "Geospatial Applications for Disaster Risk Management" Massive Open Online Course [<https://isat.iirs.gov.in/mooc.php>] and reached 27,000 users.
- In November and December 2020, WGCapD conducted four regional meetings (Africa, Americas, Asia-Oceania, and Europe) to discuss and coordinate capacity building activities and to engage space agencies not yet involved in WGCapD.
- CSSTEAP published a study of gender diversity in long- and short-term training programs of geospatial technologies in developing Asian countries, and recommended ways to improve participation and involvement in a multi-

Nancy D. Searby,
NASA,
WGCapD Chair



Pham Thi Mai Thy,
VNSC,
WGCapD Vice-Chair



- cultural, multi-ethnic classroom.
- The WGCapD Chair and Vice Chair continue contributions to the GEO Capacity Development Working Group (CD-WG), with the WGCapD Chair serving as one of three Co-Chairs of the CD-WG and lead for Subgroup 3 focused on dissemination events and monitoring, evaluation, and impact assessments.

Looking ahead, we invite interested parties to register for and participate in the virtual WGCapD-10 [<http://ceos.org/meetings/wgcapd-10/>] Annual Meeting the first week of March 2021.

Report of Joint CEOS CGMS Working Group on Climate (JWGClimate)

Albrecht von Bargaen, DLR, Joint Working Group Climate Chair
Jeffrey A. Privette, NOAA, Joint Working Group Climate Vice-Chair

The Joint CEOS CGMS Working Group on Climate celebrates its 10th anniversary in 2020. Its major objectives to foster the use of satellite data for climate monitoring and to optimise the planning of future satellite missions and constellations to avoid Earth observation measurement gaps is as important as it was 10 years ago when CEOS established the Working Group.

The COVID-19 crisis caused a massive slow down to some activities of the JWGClimate. However, the publication of the ECV Inventory #3 could be achieved, but the update of gap analysis report and coordinated action plan are still under revision. In addition, planned workshops on gap analysis and in the context of greenhouse gases could not be held, but a virtual format is planned for the first quarter 2021.

Nevertheless, the JWGClimate conducted its 13th regular meeting as a videoconference on October 14th, 2020 with more than 50 participants representing about 15 organisations. The major outcomes of the meeting were:

- Review of the status of the current gap analysis based on the now public available ECV inventory version 3.0 (see also <http://www.climatemonitoring.info>);
- The discussion on the GHG roadmap reviewed the current status, and discussed the way forward in 3 areas:
 1. User engagement, including with UNFCCC and GCOS should move away from the sole focus on the Global Stocktake and engage with

users to get more precise information about the routine monitoring needs;

2. For the operationalisation of the GHG monitoring system, steps need to be defined to a reasonable level of detail for reaching such a system including the involvement of the standing CGMS WGs;
 3. The actual work plan of the GHG Roadmap (Annex C) needs further harmonisation and refinement to include a reasonable level of detail before submitting the roadmap for endorsement by the CEOS and CGMS plenaries.
- Understanding of the AFOLU roadmap and its possible contribution to the UNFCCC Global stocktake including a fruitful discussion about opportunities of an interplay with the GHG task;
 - JWGClimate will directly support GCOS in drafting space relevant parts of their Status Report planned for 2021. The development of the next GCOS IP for 2022 need further discussion with GCOS on how to accommodate application-specific requirements. After the SIT TW a direct dialogue between the GCOS secretariat, steering committee and JWGClimate has been established leading to a common understanding and a first test case how to establish a requirement format suitable for JWGClimate;
 - Use Cases for climate data records were discussed and the JWGClimate is favouring that this area needs to be given more weight, with a long-term action in the CEOS and CGMS work plans. Use cases can be a mechanism for demonstrating the

utility of application-specific requirements and they have the potential for collaborative work with CEOS WGs CapD and Disasters, as well as CGMS capacity building activities. As outcome from the EID, another use case may be established including the GHG task and the needs of a Brazil NDC.

The Earth Information Day 2020 had been set-up virtually within the UNFCCC Climate week. It is seen to be a very useful mechanism by the UNFCCC for getting messages across from Space Agencies to SBSTA parties and it is likely to be a regular feature of future COP/SBSTA meetings. CEOS was represented during the adaptation panel discussion by D. Crisp (NASA/JPL) introducing the GHG atmospheric inventory. In addition three posters capturing the GHG task team, the ECV inventory, and the JWGClimate use cases (together with WMO) could be shown with an excellent representation within the poster sessions.

The 14th meeting of the JWGClimate is planned to be held in the first quarter of 2021 as another virtual meeting.

With the recent CEOS plenary, the chair was handed over from Jörg Schulz (EUMETSAT) to the current team. CEOS and the JWGClimate highly appreciate Jörg's dedication to his work. He coped very elegant his extended term of around three years with a lot of new ideas and advanced with excellence the WG for its coming challenges: Thank you very much, Jörg!

CEOS supports to Agriculture, Forestry and Other Land Use (AFOLU)

EO satellites have been acquiring global data on the state and dynamics of the global landscape for over 40 years and its role has been increasingly recognised. The recent update of the IPCC guidelines on Agriculture Forestry and Other Land Use (AFOLU; 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories on AFOLU) referred to the significant advancement of the use of EO data for monitoring land use and land change.

In the UNFCCC COP-25, CEOS stated that they were in the process of "coordinating the use of multiple satellite missions with novel capabilities to determine above ground biomass" and noted that EO data "offer new prospects and will enable more direct estimates in support of forest and carbon emission reporting – including for global stocktake. ...".

The Paris Agreement from 2015 has presented a significant opportunity for CEOS to consolidate, present evidence of and showcase the value of EO to parties and other stakeholders, specifically with the

Global Stocktake (GST), but steps need to be taken to achieve this. During the SIT-35 meeting in March 2020 it was agreed that JAXA and ESA explore 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. A team of expert volunteers has worked since SIT-35 in order to scope out a possible CEOS AFOLU Roadmap and to track the progress evolving in the GST process being established by the UNFCCC Secretariat.

This effort is documented in this first deliverable from the team - framed as a White Paper in support of debate and decision at the CEOS Plenary, with the goal of supporting agreement to proceed with the development of a full CEOS AFOLU Roadmap exercise through 2021 and beyond. It was agreed that it is important to proceed with this development, noting the need for a long-term vision, but also the urgency of clearly understanding and defining targets for the first Global Stocktake (including the AFOLU products needed for modelling within the GHG monitoring system). Coordination of the AFOLU Roadmap team

Osamu Ochiai,
JAXA



Frank Martin Seifert,
ESA



with the WGCClimate and its GHG Task Team was recognised as essential.

Since then additional space agencies have expressed interest and their willingness to contribute. Under the lead of JAXA and ESA the development of the CEOS AFOLU Roadmap is currently supported by CNES, DLR, EC, NASA, NOAA, UKSA and USGS and the partnerships with GFOI and GEOGLAM. Additional contributions are welcome.

Report of Working Group on Information Systems and Services (WGISS)

WGISS-50 meeting was virtually held on September 22 to 24, 2020. 92 people from 30 organizations participated in the meeting. Sessions related to the interest groups on Data DISCOVERY and ACCESS, TECHNOLOGY EXPLORATION, Data INTEROPRABILITY and USE, Data PRESERVATION and STEWARDSHIP were held following the plenary session.

The highlight of the meeting was discussions on the CEOS Earth Analytics Interoperability Lab (hereinafter called "EAIL") in the Data INTEROPRABILITY and USE session. EAIL is a new initiative jointly proposed by WGISS chair and SEO at WGISS-49 as an experiment mainly responding to demand from CEOS Projects related to the CEOS Future Data Architectures and Analysis Ready Data strategy. Interoperability work is strongly needed by multiple CEOS agencies and is relevant to LSI-VC, WGISS, WGCAPD, SEO, specific projects (CEOS-COAST), and collaborators (GEO GLAM, GEO Aquawatch). However, it's, associating with ARD related elements like Discovery and

Access, Analytics & Cloud Data Formats, a complex challenge with threads across multiple organizations, multiple technologies, multiple applications and algorithms. SEO and WGISS are now scrambling to get the EAIL operations in place to support these projects and has been attending multiple meetings across the Projects to help them (and us) navigate the path ahead. The initial deployment is based on CSIRO's Earth Analytics Science Innovation Lab powered by the Open Data Cube. It includes a number of technologies that are common across many CEOS technology exploration initiatives, and the broader trends in data science (particularly the PyData ecosystem). Jupyter Lab provide advanced exploratory data analytics and visualization tools. A Dask cluster is provided for large scale data processing. Argo Workflows provide even more robust and scheduled large scale or just routine workflow automation (and can of course combine with the Dask Cluster for analysis). Both of these technologies scale on the Cloud. The Hub also provides OGC Web Services for WMS and WCS access to products. It can also host

Robert Woodcock,
CSIRO,
WGISS Chair



Makoto Natsuisaka,
JAXA,
WGISS Vice Chair



Web Portal like the SEO CEOS Open Data Cube portal or a CSIRO Terria Cube portal. Behind the scenes CSIRO is providing its data-pipelines system which uses Argo Workflows and Events to automate data management from across CEOS Agencies to EAIL. We also expect EAIL to be used to explore user requirements for data discovery, particularly Cloud data discovery and use.

Other CEOS Agencies are invited to participate in developing these experiments and conducting them with a view to developing WGISS best practice documents for CEOS.

Report of Working Group Disasters (WGDisasters)

The WGDisasters ensures the sustained coordination of disaster-related activities undertaken by the CEOS Agencies and acts as an interface between CEOS and the community of stakeholders and users involved in risk management and disaster reduction.

Despite the ubiquitous challenges introduced in 2020 by COVID-19, WGDisasters itself has demonstrated resilience over the past year by continuing to complete existing deliverables and even introducing multiple new Work Plan Activities. The new reality of remote collaboration was quickly embraced, when the WGDisasters-13 biannual meeting in March 2020 was rapidly transitioned from in-person to a virtual environment. Coordination and collaboration remained consistent throughout the rest of the year, resulting in three new WGDisasters documents successfully endorsed at CEOS Plenary and the formulation of several new partnerships with the disaster risk management stakeholder community.

WGDisasters achievements over the past year include:

- Creation of a new Generic Recovery Observatory (RO) Demonstrator Activity [[http://ceos.org/document_management/Meetings/Plenary/34/Documents/CEOS_](http://ceos.org/document_management/Meetings/Plenary/34/Documents/CEOS_WGDisasters_Flood_Pilot_v4.pdf)

[Recovery_Observatory_Demonstrator_Implementation_Plan.pdf](http://ceos.org/document_management/Meetings/Plenary/34/Documents/CEOS_WGDisasters_Flood_Pilot_v4.pdf)], endorsed at CEOS Plenary 2020. In 2016, WGDisasters created a Recovery Observatory to address the role of satellite Earth observations for the monitoring of recovery and rehabilitation in the areas of southwest Haiti affected by Hurricane Matthew. This new Generic RO Demonstrator will now apply the lessons learned from the Haiti RO to provide direct support in the form of satellite data and relevant derived information products to three to five post event situations over a three-year period in other locations that experience severe impacts from disasters.

- A new Flood Pilot Activity [http://ceos.org/document_management/Meetings/Plenary/34/Documents/CEOS_WGDisasters_Flood_Pilot_v4.pdf] was introduced and endorsed at CEOS Plenary 2020. This new Flood Pilot will develop data fusion and methodology integration good practices related to flood mapping, driven by the increasing availability of optical, synthetic aperture radar and geosynchronous (GEO/LEO/SAR) data. The Pilot will work to improve access to and integration of existing imagery, data access and processing technologies, and community expertise for flood mapping from GEO, LEO and SAR approaches.

David Green,
NASA,
WGDisasters Chair



Pierric Ferrier,
CNES,
WGDisasters Vice-Chair



- A new WGDisasters Strategic Paper, "Promoting Space Data for Disaster Risk Management" [http://ceos.org/document_management/Meetings/Plenary/34/Documents/CEOS_WGDisasters_Strategy_Paper_SIT_Sept2020.pdf], was developed and endorsed at CEOS Plenary 2020. The WGDisasters itself was created after CEOS approved an original observation strategy to support disaster management efforts in 2013. However, the Earth observation and Disaster Risk Management sectors have evolved considerably since that time. This new Strategic Paper reflects the current state

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Report of Working Group of Calibration and Validation (WGCV)

The WGCV-46 meeting was originally planned to be held in Pasadena in March, 2020, hosted by NASA. It was instead held virtually on the 11th and 15th of May, 2020. The main aim of the meeting was to introduce the Vice Chair candidate for WGCV and to advise on the voting process for the position. The WGCV Sub-group Chairs and task leads also provided updates on the status of their work plan items.

WGCV-47 was a virtual meeting held over 4 days between the 14th and 17th of July, 2020. This meeting confirmed that Philippe Goryl from ESA had been voted by the WGCV member agencies as the incoming Vice Chair of WGCV. Work plans and updates from WGCV member agencies were also reported.

WGCV-48 was another online meeting, held on October 28, just after the CEOS Plenary. It served

as the informal handover of the Chair position of Cindy Ong (CSIRO) to Akihiko Kuze (JAXA). The WGCV members appreciated Cindy Ong's hard work during her Chair term.

One of our main priorities during our Chair term is to contribute to the UNFCCC Global Stocktake and the CEOS efforts in support of this process. Many Greenhouse Gas (GHG) observation satellites are now operating, planned, and proposed by space agencies. Radiance spectra from different spectrometers need to be calibrated and also compared with each other. Retrieved GHG densities are validated from ground and aerial measurements, and are compared under various conditions. International collaboration is essential for this process. Furthermore, global, regional, and local fluxes from anthropogenic emission sources estimated with satellite data should be validated. The CEOS WGCV will collaborate with WGClimat and AC-VC on this effort.

WGCV recently endorsed the Soil Moisture Product Validation Good Practices Protocol. The goal of this document is to identify and promote good practices for the validation of global (and regional) satellite soil moisture products. The document specifically addresses uncertainty assessment against reference data sets. The latter should be traceable to in situ measurements of known accuracy, and the assessments should be augmented with metrics of precision derived from ensembles of the products

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themselves. The development of validation protocols is also related to the GCOS Action Items T15-T18 to make available global soil moisture products and a reference data repository (GCOS-200, 2016).

In the same manner, Biomass Validation Protocol has been submitted by the WGCV LPV Subgroup and released by WGCV; it is now out for review and will be proposed for endorsement by CEOS Strategic Implementation Team by March 2021.

Promoting satellite data application and data reliability are also priorities. CARD4L is a good practice in this direction and we will continue to support the assessments of data providers' products. We hope to see this type of practice applied to other data such as atmospheric radiance spectra products and extended to the commercial sector.

We feel that the motivation behind CARD4L also applies to Cal/Val data, which should be open and analysis-ready. Our WGCV portal seeks to achieve this to a degree by sharing documents, tools, links to data, and site and campaign information. With thanks to Paolo Castracane (ESA), the CEOS Cal/Val portal has been updated and released at <http://calvalportal.ceos.org/>



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- of play of space-based Earth observations for disaster risk management, guided by the United Nations Office for Disaster Risk Reduction (UNDRR) Sendai Framework for Disaster Risk Reduction 2015-2030.
- CEOS WGDisasters established two new partnerships in 2020 with the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) Working Group on Geospatial Information and Services for Disasters (WG-Disasters) [<https://ggim.un.org/UNGGIM-wg5/>] and the Group on Earth Observations (GEO) Disaster Risk Reduction Working Group (DRR WG) [http://www.earthobservations.org/geoblog_obs.php?id=466]. CEOS WGDisasters

- acknowledgement and integration of the UN-GGIM WG-Disasters Strategic Framework on Geospatial Information and Services for Disasters will help ensure continued relevance to stakeholders and users. Further, with the creation of the GEO DRR WG in early 2020, CEOS WGDisasters is contributing domain expertise to the ongoing development of a coherent and crosscutting approach within GEO to advance the use of Earth observations in support of countries' disaster risk reduction and resilience efforts.
- Finally, a new Wildfire Pilot is under development. An Implementation Plan will be distributed to the CEOS community for review prior to CEOS SIT-36 in March 2021.

An important initial step towards a global coordinated approach for operational wildfire earth observation will be to conduct systems inventories and suitability assessments, as well as a detailed present and future gap analysis for each separate phase of fire monitoring (pre-, active-, post-fire). Part of this process will include the definition of detailed user requirements for each application to serve as a benchmark in the gap analysis and as a basis for planning future missions. This new Wildfire Pilot will conduct such a gap analysis of active-fire monitoring capabilities and define explicit user requirements for active fire monitoring at the global scale.

SDGs and Earth observations

The 2030 Agenda for Sustainable Development Goals (SDGs) provides unique opportunities for the promotion of Earth observation data for official statistics of the United Nations and its member countries. GEO attaches its utmost importance to the use of Earth observations for the SDGs in its Strategic Plan 2016-2025.

GEO's dedicated SDG initiative, EO4SDG, focuses on supporting the GEO Member countries and the UN in the use of Earth observation data to monitor and implement the SDGs. Its activities include dedicated projects, capacity development efforts, the generation of data and information products, and outreach and engagement. EO4SDG, under NASA's leadership, is currently developing a toolkit for SDG #11 and the New Urban Agenda – a knowledge resource containing relevant Earth observation data and tools, details of innovative approaches, and national or city-level EO use case examples. The toolkit aims to serve as the first step for countries and cities interested in applying Earth observations to SDG #11 monitoring needs and urban priorities, and promotes knowledge sharing and collaboration.

The EO4SDG team has been working very closely with the CEOS SDG Ad Hoc Team (SDG-AHT). The CEOS team established four sub teams to address four primary SDG indicators: Water (6.6.1), Urban (11.3.1), Coastal (14.1.1) and Land degradation (15.3.1). The sub teams studied satellite data requirements and data supply for each indicator. The sub teams will further develop technical guidance on the use of satellite data for these

SDG indicators. The CEOS' Systems Engineering Office (SEO) also supports the Open Data Cube initiative, an open source solution for accessing, managing, and analyzing large quantities of EO data, having developed algorithms for indicators related to freshwater ecosystems (6.6.1), urbanization (11.3.1), and land degradation (15.3.1). GEO and CEOS will continue to work closely to ensure full support for the SDGs.

In the UN, under the Inter-agency Expert Group on SDG Indicators (IAEG-SDGs), which is responsible for the SDG global indicator framework, the Working Group on Geospatial Information (WGGI) leverages the use of EO and geospatial information to monitor and report on the SDG indicators. GEO experts participate in its technical deliberations. The WGGI is focused on: 1) developing a list of indicators which Earth observations and geospatial information can directly contribute to or support, 2) collecting country use cases of Earth observations and geospatial information in the form of story maps, and 3) developing an SDG geospatial information 'roadmap'.

After studying the full list of SDG indicators, GEO and CEOS developed an initial list of targets and indicators where Earth observations can contribute. For the WGGI country use cases, the US and Mexico have already provided their story maps. The SDG geospatial information roadmap is a very important official document to bridge the EO community and the statistical community. The document provides guidance regarding how EO can be used for the preparation of SDG indicators by National Statistical Offices (NSOs) and related stakeholders. An

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EO4SDG task force for the roadmap was established and its initial contribution to the roadmap was recently submitted. EO4SDG interaction with the WGGI on the roadmap will continue through its planned endorsement by the IAEG-SDG in August 2021.

Increasingly, NSOs are applying EO data to derive SDG indicators. In Japan, JAXA is cooperating with the Ministry of Internal Affairs and Communications to validate the SDG 15.4.2 indicator (Mountain Green Cover Index) using satellite-based land cover data. Collaborating with NSOs and UN Custodian Agencies (e.g., FAO) is very useful and an effective way to promote the use of EO data for the SDG indicators by increasing the level of confidence in the methodology and data being used. The results of this effort will be reported to the WGGI, and the collaborative efforts will expand to cover other relevant indicators.

Lastly, I was appointed GEO EO4SDG Co-lead in November 2020, succeeding Chu Ishida, who has been a critical enabler in the great success and achievements of the EO4SDG team. Chu was awarded the 2020 GEO Individual Excellence Award for his long-standing international cooperation efforts and work on the SDGs. I thank Chu for his great efforts and congratulate him once again on his well-deserved award.

Meeting Calendar

As of February 2021

Activities	January	February	March	April	May	June	July	August	September	October	November	December
CEOS Plenary and CEOS SIT (Strategic Implementation Team)		▲2-3 CEOS-GEO Bilateral Meeting Virtual	▲22-26 SIT-36 Virtual						△TBD SIT-TWS TBD		△TBD 35th CEOS Plenary TBD	
CEOS WGs, VCs, AHTs. Others		△TBD CEOS ARD Webinar Virtual	▲1-5 WGCapD-10 Virtual ▲9-11 WGDisasters-15 Virtual	▲20-22 WGISS-51 Virtual						△TBD WGISS-52 TBD		
GEO related Activities (Group on Earth Observations)	▲26-28 GEO PB-19 Virtual		▲16-17 GEO ExCom-54 TBD	▲16-21 CGMS-49 Xi'an, China	△TBD GEO PB-20 TBD	△TBD GEO Symposium Virtual	▲6-7 GEO ExCom-55 TBD		△TBD GEO PB-21 TBD		▲22-27 GEO Week 2021 Port Elizabeth, South Africa	
Others				△19-30 UNCOPUOS-58 Vienna, Austria		▲IGARSS Brussels, Belgium			▲23-26 36th Space Symposium Colorado Springs, USA △8/25-9/3 UNCOPUOS-64 Vienna, Austria	▲12-14 2nd Climate Observation Conference Darmstadt, Germany ▲25-29 IAC 2021 Dubai, UAE ▲1-21 COP-26 Glasgow, UK		

▲: determined △: to be determined (Date, Host organization/Location) CEOS-related meetings are open only to designated participants.

Published by
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