

CEOS NEWSLETTER

The Committee on Earth Observation Satellites

August ²⁰²¹
No. 57

From the SIT Chair Team

Serving as SIT Chair in 2020 and 2021 has clearly involved a different approach from the usual. We had looked forward to welcoming the CEOS community to Tasmania and to Sydney for our SIT meetings, and to Croatia and Japan for our Tech Workshops - thanks to our friends in EUMETSAT and JAXA.

Yet here we are, after our 2nd online SIT meeting and planning our 2nd online Workshop. But we hope and feel that we have risen to the challenge of shortening the physical distance between us and trying to innovate to ensure that our virtual version of meetings remains compelling and productive to attract participants from across the CEOS structure and at all levels from the technical to the agency Principals. The fact that we had a considerably larger than usual attendance during SIT-35 - peaking at more than 120 participants clocked in the attendee list - suggests that this is indeed the case and that our community broadly is adapting to the challenge of our remote cooperation model, and even thriving through it. Travel budgets are an obvious practical limitation to sending representatives to CEOS meetings, and with that obstacle currently removed, we saw many new faces show up to enjoy their unexpected participation in our SIT meeting.

We thank all of those who endured anti-social hours to engage with the community during the three days of teleconferences in late March. We heard great progress from a diverse range of groups across the VCs and WGs and the SIT Chair Team was extremely pleased to note the advances made in each of our chosen priorities of: Carbon & Biomass; Analysis Ready Data; and the Sustainable Development Goals (SDGs). A few highlights we might note include:

- Endorsement of the CEOS Aboveground Woody Biomass Product Validation Good Practices Protocol.
- The newly proposed GEO activity, Forest Biomass Reference System for Tree-by-Tree Inventory Data (GEO-TREES), aimed at supporting coordinated collection of new high-quality reference measurements for validation of biomass products. This activity encourages coordination on data collection for biomass validation, and CEOS Agencies are

encouraged to engage.

- Direction to the volunteer team led by SIT Vice-Chair, developing a draft CEOS Strategy for the Global Stocktake, which we will revisit at the Technical Workshop (TW). And substantial progress by our greenhouse gas (GHG) and the Agriculture, Forestry and Other Land Use (AFOLU) teams working to coordinate prototype products in time for COP-26 as inputs to the 1st Global Stocktake (GST).
 - Endorsement of the Earth Observation Training, Education, and Capacity Development Network (EOTEC DevNet) Implementation Plan proposed by the WGCapD.
 - Endorsement of the WGDIsasters Wildfire Pilot and Landslide Demonstrator Implementation Plans.
 - Focusing of the SDG Ad Hoc team on two options for the future carriage of SDG issues within CEOS, to be addressed by TW and Plenary.
 - Confirmation of CNES as 2022 CEOS Chair, in a special Plenary session chaired by NASA.
- Week of Sep 6: the equivalent of side meetings, generally self-organised as side meetings are and with SIT Chair team facilitating the arrangement of preparatory chats of groups as they prepare for TW and Plenary;
 - Week of Sep 13: with 14/15/16 Sep featuring 3-4 hour TW sessions of content aimed to help us prepare the ground for a productive CEOS Plenary meeting in early November.

SIT Chair Team would like to take the opportunity to thank the entire CEOS community for the positive spirit in which they have adapted to our new way of working and to ensuring continuity and progress throughout our Chair term on the initiatives we all recognise as being so important. We remain fully engaged through 2021 and look forward to passing the baton to ESA as the new SIT Chair Team at CEOS Plenary, confident that their experience and drive will continue to pull us forward as a community.

Looking forward, we will meet again online in September over two weeks.



The Australian SIT Chair Team, as featured in a recent episode of the Simpsons

Implementing the 2021 CEOS Chair Theme

In early 2021, CEOS Agencies, Working Groups, Virtual Constellations, and ad hoc Teams began integrating the 2021 CEOS Chair theme, “Space-based Earth Observations for Open Science and Decision Support” into their activities. The CEOS Chair team invited ideas and feedback, and the community responded. The ongoing effort is perhaps best explained through examples.

CEOS Missions, Instruments, and Measurements (MIM) Database on the CEOS Website:

To help data users more quickly identify which datasets are open source datasets, a new feature was added to the MIM. The recommendation for this upgrade came from ESA and was implemented in coordination with the CEOS Systems Engineering Office (SEO). The CEOS Secretariat also welcomed ESA's offer to begin distributing a one-page MIM Quarterly Report with the goal of updating CEOS and its stakeholders with greater frequency about upcoming missions and launches. And, with the goal of increasing MIM database users worldwide, the CEOS Chair team is now developing a few online demonstration videos.

Climate Use Cases:

The Joint CEOS-CGMS Working Group on Climate is actively collecting Climate Use Cases that support open science worldwide and serve to further inform decision making. A use case from SANSa used satellite observations to study

the impact of wildfires on air quality and human health in sub-Saharan Africa. A use case from JAXA used satellite observations to monitor extreme rainfall and drought events in East Asia and Western Pacific areas. A use case provided by NASA used satellite observations to produce crop yield forecast in Kenya. To date, CMA, JAXA, NASA, NOAA, SANSa, UKSA have contributed. All CEOS Agencies, Working Groups, Virtual Constellations, and ad hoc Teams are invited to submit climate use cases. To do so, please contact Dr. Wenying Su from the Joint CEOS-CGMS Working Group on Climate (email: wenying.su-1@nasa.gov).

Earth Observation Training, Education, and Capacity Development Network (EOTEC DevNet):

The CEOS Working Group on Capacity Building and Data Democracy is working with the SEO to develop a Flood Capacity Development Matrix and an Application Programming Interface (API) to support flood data and tools from CEOS Agencies and across the EOTEC DevNet. This upgrade will promote open science and open data sharing in support of decision making associated with flood impacts.

Data Deployments in the Cloud:

The Microsoft Azure Cloud platform is now offering global data from Landsat and Sentinel via their Planetary Computer. The SEO plans to obtain credits to explore cloud services and data offerings. Copernicus Land Cover and

Karen M. St. Germain,
NASA,
2021 CEOS Chair



Copernicus Digital Elevation Model (DEM) global data is now available for CEOS testing through the Earth Analytics Interoperability Lab (EAIL).

CEOS Communications and CEOS Website:

The CEOS Chair team is developing a video to showcase the impact of CEOS international cooperation, even during the past year when CEOS resorted to a virtual-only meeting environment after travel and meetings on location were impossible due to the COVID-19 pandemic.

A CEOS communications team is also reviewing the website as part of a larger effort to update its content, enhance design elements, and other improvements. The goal is greater efficiency and impact of the website as a trusted resource for data user communities worldwide.

The CEOS Chair team thanks the Working Groups, Virtual Constellations, ad hoc Teams, and the Secretariat for elevating, with strong commitment and intention, CEOS support for open science and decision support.

The Value to CEOS of a Three-Year Work Plan

It was an honour and a privilege to take on the role of CEOS Executive Officer (CEO) in January 2021. With every new role comes the opportunity for reflection and refocus, a particularly useful exercise in these rather challenging times when many of us have been forced to work almost exclusively in a virtual world. Establishing and maintaining working relationships across continents in a rather restrictive world of conference calls and online meetings is not easy. However, I have been heartened by the warmth and openness of the CEOS organisation at large, for selflessness in agreeing to meetings at all times of the day or night to ensure inclusivity across time zones, and for a collective persistence to strive towards agreed targets and goals. It is to its great credit that CEOS's reputation for excellence has been so effectively maintained throughout these days of great adversity brought on by the COVID-19 pandemic.

Part of CEOS's credibility has always been based on the importance that it places

upon meeting its commitments. CEOS has a defined set of overarching priorities, yet we remain mindful of our collective resource capabilities. Contributions and commitments are made on a “best efforts” basis, with every single contribution valued and respected. To support the community, a three-year work plan lies at the heart of CEOS governance. The CEOS Work Plan is updated every year, with each annual update covering a forward-looking three-year period. In a fully traceable manner, it articulates the commitments of CEOS as a key international forum that clearly and visibly identifies, formally endorses, and tracks the implementation of its objectives.

The usual annual update process for the Work Plan is to have the review complete and endorsed before the Strategic Implementation Team (SIT) plenary, usually held in March every year. Last year, due to constraints imposed upon us all at short notice by the shock of the COVID-19 pandemic, the annual Work Plan update was delayed to July 2020. This year there was a strong desire to get the

Marie-Claire Greening,
CEOS Executive Officer



Work Plan schedule back on track. Through the great efforts by all who guide, influence and contribute to the work of CEOS, I am pleased to report that we are now back on our regular update schedule.

The CEOS 2021-2023 [Work Plan](#)¹ was endorsed virtually by CEOS Principals in March 2021, prior to the SIT-36 meeting. The CEOS community reviewed all sections of the Work Plan thoroughly, and all of the deliverables that the Work Plan informs (of which there are currently 122 active deliverables) have been updated and reconciled in the online [CEOS deliverables tracking tool](#)². We now have a clear plan to guide us over the next three-year period,

(to be continued on page3)

Endorsement and Uptake of the CEOS biomass protocol

On Tuesday, March 23rd the CEOS WGCV LPV biomass protocol was formally endorsed by CEOS. This protocol was co-led by Laura Duncanson and John Armston (University of Maryland) and Mat Disney (University College London) along with 56 authors from 41 institutions. The protocol has been in development since 2017 in the WGCV LPV (chairs Miguel Roman and Fernando Camacho), with support from NASA's Terrestrial Ecology program and Jaime Nickeson (LPV Secretariat).

The protocol was developed to address a critical need for inter-comparison and validation of global forest biomass products. Forest biomass has been recognized as a Global Climate Observing System (GCOS) Essential Climate Variable

(ECV), a critical input to the United Nations' (UN) Reducing Emissions from Deforestation and Forest Degradation-plus (REDD+) program, as inputs reporting toward the UN's Sustainable Development Goals (SDGs), and an important input to Earth system models. Spatially continuous maps of forest biomass are therefore important inputs for decreasing the uncertainties in the global carbon cycle, underpinning forest management and climate mitigation strategies, and global carbon cycle science.

Several new and upcoming Earth Observing (EO) missions will collect satellite data giving information on forest structure and aboveground biomass. We anticipate these datasets will drive development of many new global forest biomass

Laura Duncanson,
Land Product Validation
Subgroup



products. Some of these products will be official mission products, but many will be generated independently by scientists, Non-Governmental Organizations (NGOs) and other interested parties, each potentially adopting a different combination of mission data, training data, and statistical algorithms according to needs and resources.

New biomass products will not necessarily agree with each other, and will vary in quality, spatial resolution and date of prediction. Products that disagree with each other will likely cause confusion and without consistent validation users will not know which products to trust. This protocol will assist biomass map producers in good practices for estimating and reporting uncertainties in their products, and will inform users how to interpret products and conduct independent validation. The goal of this protocol is to facilitate consistent and transparent biomass product uncertainty estimation so that products can be used effectively for science, forest management and policy applications.

The publication of this CEOS biomass protocol represents an exciting step toward international collaboration in the biomass remote sensing community. The protocol is now being adopted by three new activities; the first, The second Biomass Retrieval Inter-comparison Exercise (BRIX-2, <http://polinsar-biomass2021.esa.int/brix-2/>) is following protocol recommendations. The second, a new biomass harmonization activity under CEOS LSI Forests and Biomass is using the protocol to compare new global biomass products using the NASA-ESA Multi-mission Algorithm and Analysis Platform (MAAP, <https://scimaap.net>). Finally, a new GEO activity has been launched to fill the critical need for new high-quality and globally representative forest reference data (GEO TREES). These new initiatives demonstrate the timeliness of the biomass protocol and future updates to the document will reflect lessons learned by these activities.

(continued from page2)

and a good understanding of the priorities and the support needed from CEOS membership. Thank you for your continued support and commitment to the many CEOS endeavours that are demonstrating, quite dynamically, the organisation's vision: *CEOS ensures international coordination of civil space-based Earth*

observation programs and promotes exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.

¹ https://ceos.org/document_management/Publications/CEOS_Work-Plans/CEOS_2021-2023-Work-Plan_Mar2021.pdf

² <http://deliverables.ceos.org/>

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.

WGCapD members have been productive in spite of the pandemic. Members continue to collaborate on the 2021-2023 work plan that includes 33 deliverables (28 to be implemented in the 2021 calendar year, 4 in 2022, and 1 scheduled for 2023).

WGCapD achievements in the past six months include:

- Completed a webinar that served as an Introduction to CEOS Analysis Ready Data (CB-20-03). A recording is available at <https://eo-college.org/courses/>.
- Completed a CEOS COVE outreach webinar (CB-20-02). The video can be watched at: https://www.youtube.com/watch?v=7Ws7si7Y39U&ab_channel=KimHolloway/.
- The Advanced Multi-Lingual MOOC on Radar Backscatter¹ (CB-18-06) was launched, and provides training in English, Spanish, French, and German. All MOOCs are available on the EO College Portal².

- The Phase II Geospatial Applications for Disaster Risk Management MOOC (CB-21-07) was launched on June 1. Information is available at [ISRO-IIRS website](https://isat.iirs.gov.in/mooc.php)³.
- VNSC conducted the webinar Using Satellite Imagery in Urban Planning and Development on April 15 (CB-21-10). The recording is available at: <https://ceos.org/ourwork/workinggroups/wgcapd/e-learning/>.
- The Branded Webinar Toolkit (CB-21-01) deliverable was completed, and proposed thematic observation area icons and color-branding considerations were taken up by CEOS SEO as part of website refresh considerations.
- WGCapD-10 took place March 1-4 with over 170 participants from 30 countries joining working sessions, a keynote⁴ by Barb Ryan, panel discussions with experts within⁵ and outside⁶ of CEOS, and four regional exchanges focused on floods. The video agency updates are available on [CEOS YouTube channel](https://www.youtube.com/channel/UC...)⁷ and meeting materials are available at [WGCapD-10 Meeting page](https://ceos.org/meetings/wgcapd-10/)⁸. The final WGCapD-10 meeting report is available on [CEOS website](https://ceos.org/wp-content/uploads/2020/10/WGCapD-10-Final-Report.pdf)⁹.

Nancy D. Searby,
Ph.D.,
NASA,
WGCapD Chair



Pham Thi Mai Thy,
Ph.D.,
VNSC,
WGCapD Vice-Chair



[website](https://ceos.org/ourwork/workinggroups/wgcapd/e-learning/)⁹.

- The EOTEC DevNet Initiation Plan was endorsed at SIT-36 (CB-20-05). The pilot was presented at and endorsed by CGMS and Astrid-Christina Koch from the European Commission featured EOTEC DevNet in her UNCOPUOS STSC presentation. The EOTEC DevNet planning team held [Regional Meetings](https://ceos.org/ourwork/workinggroups/wgcapd/e-learning/)¹⁰ on June 14 co-facilitated by WGCapD members and floods experts from respective regions focused on the draft [Flood Tracker](https://ceos.org/ourwork/workinggroups/wgcapd/e-learning/)¹¹. The group is looking forward to a leadership meeting on September 10th.

¹ <https://eo-college.org/courses/>

² <https://eo-college.org/courses/basic-principles-of-radar-backscatter/>

³ <https://isat.iirs.gov.in/mooc.php>

⁴ https://www.youtube.com/watch?v=YFaidhaQaPw&list=PLvyKmUq3-Y_3bp1OzpZ7EZTdmezFy7NG&index=10&ab_channel=TheCommitteeonEarthObservationSatellites

⁵ https://www.youtube.com/watch?v=XI_qJtXFARl&list=PLvyKmUq3-Y_3bp1OzpZ7EZTdmezFy7NG&index=11&ab_channel=TheCommitteeonEarthObservationSatellites

⁶ https://www.youtube.com/watch?v=9rO917pTeQ&list=PLvyKmUq3-Y_3bp1OzpZ7EZTdmezFy7NG&index=12&ab_channel=TheCommitteeonEarthObservationSatellites

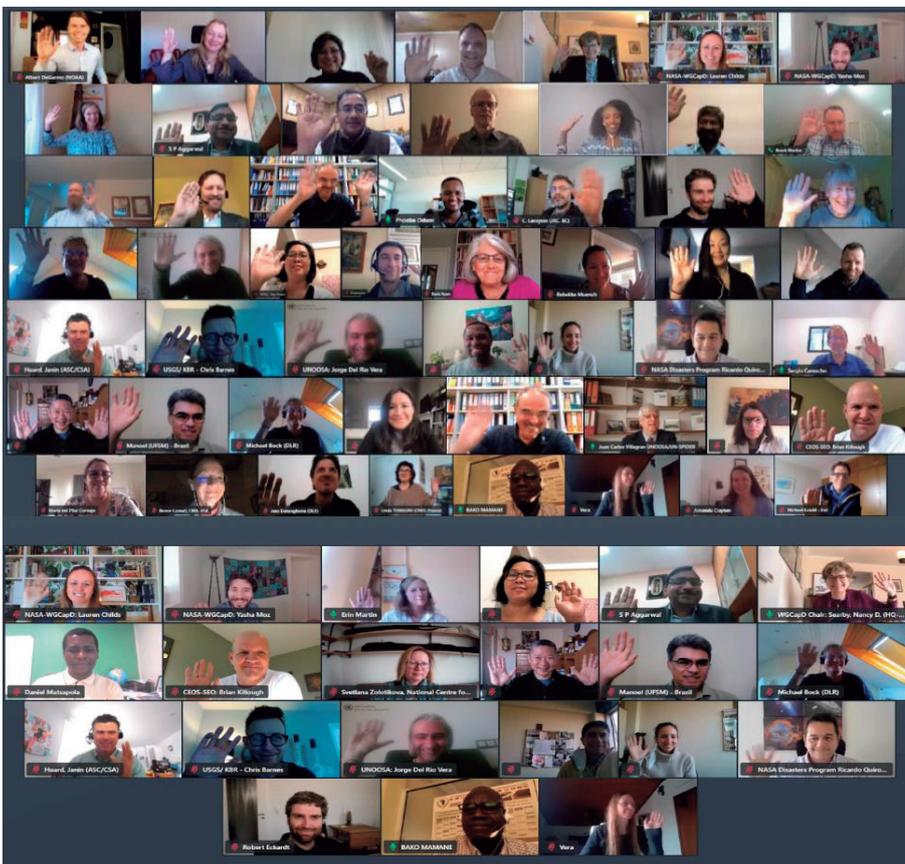
⁷ https://www.youtube.com/playlist?list=PLvyKmUq3-Y_3bp1OzpZ7EZTdmezFy7NG

⁸ <https://ceos.org/meetings/wgcapd-10/>

⁹ <https://ceos.org/wp-content/uploads/2020/10/WGCapD-10-Final-Report.pdf>

¹⁰ <https://ceos.org/meetings/eotec-devnet-regional-exchanges/>

¹¹ <https://docs.google.com/spreadsheets/d/1lhMxvHkqERx6w00uzxQV9vAwvYZ6VXRjMZtbvXdt/edit#gid=1384536287>



We look forward to convening at WGCapD's work planning meeting on September 8-9.

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

The Joint CEOS CGMS Working Group on Climate celebrates major objectives is 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. In addition, WGClimate acts as liaison for CEOS and CGMS to the relevant bodies of UN, WMO, and GEO in order to promote the position of CEOS and CGMS. An important partner is GCOS in discussing the requirements on climate observations and contributing with satellite data records. The Greenhouse Gas Task team is allocated within WGClimate bringing together all relevant CEOS and CGMS bodies and maintaining the link to UNFCCC for the implementation of the GHG virtual constellation. Finally, the most recent started activity includes use cases demonstrating the value of climate data records, favourably from satellite observations.

During the reporting report WGClimate was engaged in the formulation of the CEOS Global Stocktake Strategy. In parallel, there was a lively exchange with the team which was responsible to set up the AFOLU roadmap.

A very intensive and continuous effort was the drafting of the community-driven Synthesis Report on Systematic Observations for the Global Stocktake process for UNFCCC together with colleagues from other CEOS entities, but also from GF01, GEO, WMO and others. This effort is further ongoing and will be a cornerstone in the Global Stocktake process.

The WGClimate conducted its 14th regular meeting as a videoconference in two parts (Mid-March and Mid-April) with around 30 participants representing about 15 organisations. The

major outcomes of the meetings 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 current gap analysis shall be finalised during Northern hemisphere fall 2021 and the ECV inventory will be consolidated during summer 2021 to a new version 4.0. WGClimate plans to held a workshop to carry out then again a gap analysis dedicated to Global Stocktake relevant ECVs based on the new ECV inventory;
- Update 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 team;
- WGClimate 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. A direct dialogue between the GCOS secretariat, steering committee and WGClimate has been established leading to a common understanding and a first test case how to establish a requirement format suitable for WGClimate. The discussion is ongoing;
- Use Cases for climate data records were discussed and the WGClimate 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. WGClimate discussed the way forwards to promote the use

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(DLR),

*Joint Working Group
Climate Chair*



Jeffrey A. Privette
(NOAA),

*Joint Working Group
Climate Vice-Chair*



case activity for input. The sponsorship of WMO will allow to publish a selection of use cases at the beginning of 2022; the sponsorship of NOAA will allow to publish the use cases case-by-case on the ECV inventory website.

During the reporting period CGMS nominated the Point of Contacts from its working groups for the GHG task team which allowed a dedicated GHG task team meeting in May 2021 to update about status and plans, especially with regard to the Global Stocktake.

It is worth to note that CGMS encouraged successfully its Science working groups to contact WGClimate. WGClimate will consult with those how to bring their topics into the agenda of WGClimate and WGClimate meetings.

WGClimate is looking forward for the coming virtual meeting before SIT technical workshop.

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

The WGISS-51 meeting was virtually held on April 20 to 22, 2021. Technical elements and issues on “analysis in place in the cloud” and “cloud interoperability” (Open Data Cube, ARD, STAC, cloud formats, PID, etc.) were discussed.

(1) Data DISCOVERY and ACCESS

Status on IDN, CWIC, and FedEO were reported.

CEOS OpenSearch Best Practice Document were updated into version 1.3.

ESA QC-MMS Project: Experience with Quality Metadata, Catalog and Jupyter Notebooks was introduced. It was commented that its future plans are a great opportunity to bring such indicators into the ARD strategy update.

STAC implementations in NASA were introduced. Issues in converting a conventional catalogue into STACs were identified and it was suggested raising those to the OGC community.

Cloud data access of USGS, NASA and ESA were also introduced.

(2) Data INTEROPERABILITY and USE

The technical readiness for CARD4L were reported.

Brian Killough (SEO) introduced SEO Perspective on CEOS Satellite Data in the Cloud.

ESA Digital Twin Earth Climate Explorer Project on JASMIN, Digital Earth Australia and Digital Earth Africa were also introduced as cloud-native systems.

Challenges on the CEOS Earth Analytics Interoperability Lab (EAIL) were reported. 15 registered users across four CEOS projects (Disasters, COAST, DEMIX Asia-RICE, and OEA (open earth alliance) are engaged.

Peter Wang (CSIRO) gave a presentation on Zarr cloud format in ODC for hyperspectral data and Jean-Michel Zigna (CNES) presented on a parquet cube alternative for store gridded data.

(3) TECHNOLOGY EXPLORATION

Webinar planning on Jupyter Notebooks were reported. The webinar will be held on July 21-22, 2021 as a joint activity with WGCAPD and SEO and gave presentations on how Jupyter Notebooks can support CapD, examples in JASMIN, Google Sandbox, EAIL, and ESA - PDGS data cube. Esther Conway (JKSA) gave an idea for how to develop a Best Practice for Jupyter Notebooks.

(4) Data PRESERVATION and STEWARDSHIP

CAL/VAL Maturity Matrix in ESA and NOAA Maturity Matrix Self-Assessment Tool were presented.

Robert Woodcock,

*CSIRO,
WGISS Chair*



Makoto Natsuisaka,

*JAXA,
WGISS Vice Chair*



Discussion items / open points from previous meetings regarding PIDs were discussed and disposed through the drafting of nine new recommendations to be added in the PID Best Practice.

Archive holdings and technologies in member agencies were shared. Considering the current situation where datasets are generally archived in the clouds and frequently replicated, it was recognized that how to keep the reliabilities for those. Checksum and/or blockchains, which might be a solution for this, will be discussed in the next meeting.

Report of LSI-VC-10

The tenth meeting of the CEOS Land Surface Imaging Virtual Constellation (LSI-VC) was held as a series of thematic teleconferences in mid-May 2021, covering: CARD4L and the Product Family Specifications (PFS); LSI-GEOGLAM and LSI-Forests & Biomass; Looking Forward on CEOS ARD. We saw strong attendance across all four days from CEOS Agencies, including representation from CSA, DLR, ESA, EC, GA, ISRO, JAXA, KARI, NASA, NOAA, UKSA and USGS, as well as from the GEOGLAM and Forests & Biomass subgroups.

The meeting started with a review of the new Aquatic Reflectance PFS, which was presented for consideration. This PFS is expected to be endorsed shortly after LSI-VC-10. The Normalised Radar Backscatter & Polarimetric Radar annual revisions will also be endorsed after LSI-VC-10. The following PFS are also in development: Nighttime Lights Surface Radiance; Geocoded Single-Look Complex (GSLC); Interferometric Radar (INSAR); and LiDAR Terrain and Canopy Top Height. The first two are expected to be complete by Q3 2021, with INSAR to follow in Q1 2022.

Landsat Collection 2 was recently re-confirmed as CEOS ARD against the latest updates of the Surface Reflectance (SR) and Surface Temperature (ST) PFS (v5.0). Peer reviews are currently underway for ESA's Sentinel-2 Level-2A SR dataset and the product

specification for EnMAP SR from DLR. Five more self-assessments are underway, including for Sentinel-1 and 2, ALOS-2, and NovaSAR. Please see [the status table on ceos.org/ard](http://ceos.org/ard)¹ for the latest on the status of assessments and peer reviews.

The assessment process for CARD4L is dependent on peer review from WGCV and we are very grateful for the team's continued efforts. Attention is turning to strategies for streamlining this assessment process, which is seeing increased demand due to the encouraging adoption of the CARD4L concept. This streamlined assessment process is expected to be one feature of the new CEOS ARD Governance Framework, which seeks to broaden CEOS ARD beyond the land domain, formalise the processes set into motion by LSI-VC with CARD4L, and to engage other CEOS Virtual Constellations (VCs) in CEOS ARD.

LSI-VC-10 also featured reports from the GEOGLAM and Forests & Biomass subgroups. CEOS-GEOGLAM collaboration was discussed, with suggested tasks around the GEOGLAM reference network for in situ data, the Essential Agriculture Variables (EAVs), and the articulation of evolving satellite data user requirements for agricultural monitoring. On Forests & Biomass, the Global Stocktake (GST) and AFOLU work is the major task of the team for the foreseeable future. A key action from LSI-VC-10 was to explore the idea of a pilot built

LSI-VC Co-Leads:

**Adam Lewis (GA),
Steve Labahn (USGS),
Zoltan Szantoi (EC/JRC)**

on the DE Africa platform that will bring together all the land-related datasets that CEOS is compiling for the first UNFCCC Global Stocktake in 2023, in support of a specific country's national reporting.

Full minutes from the LSI-VC-10 meeting will be released shortly on the meeting [website](#)².

The LSI-VC Leads would like to extend an open invitation for CEOS Agencies to join the LSI-VC. Should you require information on any of our work, please feel free to get in touch with the LSI-VC Leads or the LSI-VC Secretariat:

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<http://ceos.org/ourwork/virtual-constellations/lsi/>
<http://ceos.org/ard>

¹ <https://ceos.org/ard/index.html#slide4>

² <https://ceos.org/meetings/lsi-vc-10/>

Report of CEOS AC-VC-17, and Farewell to Jay Al-Saadi and Dave Crisp

The Atmospheric Composition Virtual Constellation (AC-VC) aims at fostering scientific and technical cooperation among space agencies that are active in the space-borne observation of atmospheric composition. Since its initiation in 2007, AC-VC has been reviewing atmospheric chemistry and climate model requirements, assessing space-based measurement assets and gaps, and making recommendations for developments and future missions. The current AC-VC activities are focused on greenhouse gases, ozone, and air quality.

The 17th CEOS Atmospheric Composition Virtual Constellation (AC-VC) annual meeting was held virtually on June 7-11, 2021. A series of 2-hour sessions on five consecutive days covered all priority topics. Approximately 80 to 120 representatives from about 60 space agencies and research institutions participated in the sessions and discussions regarding all current AC-VC activities.

The week-long meeting was composed of the AC-VC topical sessions on greenhouse gases (GHGs), air quality (AQ)-trace gases, tropospheric ozone, and AQ-aerosol, and the discussions were moderated by the co-chairs and the topical leads including Dave Crisp and John Worden (JPL) for GHG, Diego Loyola

(DLR) for tropospheric ozone and Shobha Kondragunta (NOAA) for AQ-aerosol. On the last day, a session summary for the four topics was briefed, and discussions on interdisciplinary and new topics were held. In addition to current and planned mission updates, the priority discussions concentrated on GHG emission estimation and support to the Global Stocktake, validation activities for AQ-trace gases satellites, validation and modeling activities for tropospheric ozone satellites, and the combined use of satellite aerosol products with ground-based monitoring and modeling. Throughout the week, there were presentations analyzing satellite data in response to the emissions changes due to the COVID-19 lockdowns, demonstrating continued interests in the use of satellite observations in COVID-related research. The future strategy discussions focused on what can we do to make atmospheric composition satellite data more useful. We discussed what to learn from the COVID-related emission reduction as an Earth system experiment, how to facilitate the combined use of observations of multiple species from multiple satellites, and what are analysis tools for non-experts. The meeting was closed by the announcement of the next annual AC-VC-18 meeting planned in Brussels in 2022.

AC-VC Co-Chair:

**Ben Veihelmann
(ESA),**



AC-VC Co-Chair:

**Hiroshi Tanimoto
(NIES),**



AC-VC Co-Chair:

**Barry Lefer
(NASA)**



Former AC-VC Co-Chair:

**Jay Al-Saadi
(NASA),**



Greenhouse Gas Lead:

**Dave Crisp
(Caltech/NASA-JPL)**



(to be continued on page7)

CEOS Study on Global Stocktake

The Paris Agreement of the UNFCCC aims to strengthen the global response to climate change through:

- holding the increase in global temperature increase to well below 2 °C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5 °C,
- increasing the ability to adapt to the adverse impacts of climate change,
- making finance flows consistent with a pathway towards low GHG emissions and climate resilient development

Measurement of progress towards the goals for the Paris Agreement will be through the Global Stocktake (GST), a process that will take place every five years beginning in 2023, under the auspices of the UNFCCC. The GST will address all aspects of the Agreement, including mitigation (the reduction of GHG anthropogenic emissions) and adaptation (the management of unavoidable changes in caused by rising GHG and consequent climate change). The GST must also take to account principles of equity among countries, an important point for ensuring access to satellite data and services, and will be implemented in the light of best available science.

Satellite observations make a fundamental contribution to achieving these objectives in many different ways. They are able to monitor the concentrations in the atmosphere of GHG that are at the root of global change (carbon dioxide, methane and others), including the spatial and temporal variability of their distribution. Combining these observations with national emissions inventories, local measurements of GHG, and atmospheric transport and inversion models can provide an objective estimate of the temporal and geographic emissions across the globe. This can help ensure consistency between nationally reported estimates and global assessments of emissions. For some countries with less sophisticated inventory systems, satellite data may also help in their national reporting of emissions and indeed even some with well-developed

national systems, such as UK, New Zealand and Switzerland, are already using satellite data to help support estimates of methane emissions from within their territories. Satellites are also critical in providing the baseline data for estimates of natural emissions and removals of GHG which must be taken into account in the GST in order to assess anthropogenic contributions to increasing GHG.

Following the work of the Atmospheric Composition VC, the WGClimate GHG Task Team is leading the CEOS efforts to ensure that satellite atmospheric chemistry and other CEOS observations are fully utilised in the GST. Satellite data are also invaluable as a means to improve estimates of GHG emissions from land use change through the Agriculture, Forestry and Other Land Use (AFOLU) process, contributing both to the identification of changes in land cover and land use – so-called activity data – and the emissions factors associated with each change in land use between defined categories. These methodologies follow the IPCC Guidelines for such reporting. CEOS has set up an AFOLU Task Team to define more precisely how CEOS agencies can help in this process. The definition and implementation the CEOS support to the GST requires the coordinated involvement of almost all CEOS entities (CEOS Chair team, SIT and vice-SIT Chair teams, WGs, VCs, SEO, CEO).

Another important aspect of the GST is the need to assess progress in adapting to climate change. Even if we were to reach global zero GHG emissions tomorrow, their build-up in the atmosphere to date will continue to cause changes in Earth's climate for decades to come. We must therefore manage and minimise the consequences of that change, and again satellite data are invaluable in providing information on the status of the environment in vulnerable areas. Damage may be a result of increasing desertification putting agricultural production under stress, through coastal erosion being exacerbated by sea level rise, by the increasing frequency and severity of storms and other hydro-meteorological events

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putting greater pressure on society, or by many other similar impacts. CEOS agencies' data can help both to understand the impacts of climate change and to support the modelling of adaptation processes to implement the best procedures to remediate future losses. For many countries, especially those designated with Least Developed Country (LDC) status by the UNFCCC, this aspect of adaptation is perhaps the most important element of the UNFCCC negotiations.

An important underpinning consideration in implementing the GST is the principle of equity among Parties. CEOS agencies can assist in this by ensuring that their data are made available without financial or other constraints to all Parties to the convention. Furthermore, the provision of Analysis Ready Data and processing tools will improve the capacity of LDCs to make best use of satellite data. WGCAPD in particular could have an important role in ensuring transfer of relevant technologies to countries with less experience in handling satellite data. Parties will include information on loss and damage in reporting under the transparency framework and the GST. UNFCCC has asked for sharing of information on what the wider Earth observation community is already supporting through technical assistance in specific developing countries in identified support areas, in some of which CEOS agencies are already active (e.g. use of space-based EO for early warning systems, nature-based solutions and disaster risk reduction, disaster management).

In all the aspects of the GST described above, data provided from satellite platforms by CEOS Agencies will play a critical role in supporting the implementation of the Paris Agreement in general and of the GST in particular. Without the observations provided by CEOS, it is not an exaggeration to say that implementation of the GST would not be possible.

(continued from page6)

We would also like to take this opportunity to express our "good-bye" and "thank you" to two distinguished leaders for the AC-VC and the CEOS communities. In 2020, Jay Al-Saadi (NASA Langley Research Center) stepped down from the AC-VC co-chair position upon his retirement from NASA. Jay has been leading the AC-VC for about a

decade. We are grateful to him for his long-term efforts to push forward the global air quality constellation, which is taking shape now. Dave Crisp (Caltech/NASA-Jet Propulsion Laboratory), who currently serves as the GHG lead, will step down in 2021. Dave has been driving the GHG constellation work that has been picked up by AC-VC in 2013 responding

to the CEOS Carbon Task Force Report. We wish to thank him for his efforts to coerce the various stakeholders and stipulate a roadmap for the support by satellites to the Global Stocktake. We are grateful to both of you for your dedication, long-term vision, and continuous efforts to make the most of AC-VC.

