

MINUTES OF THE 35th CEOS PLENARY
FINAL v1.0
1-4 November 2021
Hosted by NASA

Monday, November 1

Session 1: Welcome and CEOS Core Business

1.1: Welcome and Agency Introductions

Presenter(s): Karen St. Germain (NASA, CEOS Chair)

Main points:

- Karen welcomed all participating CEOS Agencies and stakeholders to the 35th CEOS Plenary and invited each Principal/Designee to briefly introduce their delegation. The complete attendance list can be found in Appendix C.
- Karen welcomed and recognised the lead from each of the two agencies seeking CEOS Associate membership today: Florence Rabier, Director-General of the European Centre for Medium-Range Weather Forecasts (ECMWF) and Ricardo Conde, President of the Portuguese Space Agency (Portugal Space).

1.2: Opening Remarks

Presenter(s): Karen St. Germain (NASA, CEOS Chair)

Main points:

- Thanked the CEOS community for understanding that the two early starts and two late starts over the four-day plenary are an effort to recognize the quiet acceptance and sacrifice of the CEOS community in the Asia/Pacific region over the past two years, and to ask others in the CEOS community to share some of the time zone burden this time for greater equity across the community.
- Emphasized that the CEOS community needs to meet in person soon to reinvigorate the bonds of CEOS. Meanwhile, the 35th CEOS Plenary will seek to demonstrate that the important international cooperation of CEOS has continued to thrive.
- This year's Plenary will also seek to showcase the work of the Working Groups and Virtual Constellations as the "engines" of CEOS, and it will discuss how the community integrated the 2021 theme, "Space-based Earth Observation Data for Open Science and Decision Support" into its activities.
- It will discuss CEOS efforts in support of key stakeholders and global agendas, and it will accomplish core CEOS business that is at the heart of CEOS stability. This will include the transition of leadership in the Working Groups, the transition of leadership of the CEOS Strategic Implementation Team or SIT Chair role, and the transition of leadership of the CEOS Chair role.

1.3: CEOS Chair Team Review of Matters for Decision or Endorsement [[slides](#)]

Presenter(s): Christine Bognar (NASA, CEOS Chair Team)

Main points:

- Reviewed for each day of the Plenary, the matters to be presented for decision and endorsement, all of which are detailed in the meeting agenda and in the above-linked presentation.

1.4: Applications for CEOS Associate [[ECMWF slides](#)] [[Portugal Space slides](#)]

Presenter(s): Florence Rabier, Director-General of the European Centre for Medium-Range Weather Forecasts (ECMWF) and Ricardo Conde, President of the Portuguese Space Agency (Portugal Space)

Main points:

ECMWF (Florence Rabier)

- Since the inception of the European Union (EU) Copernicus program, ECMWF has been operating climate change and atmospheric monitoring services on behalf of the European Union.
- Use of Earth observation (EO) data and modelling is a priority. Particular focus on innovative exploitation and assimilation of satellite data for weather forecasting. Using a broad system approach and a digital twin of the Earth.
- Strong links with the EU and collaborating with various CEOS space agencies. Can provide CEOS with inputs for future meteorological requirements.
- ECMWF is already contributing to CEOS activities, e.g., Joint CEOS-CGMS WGClimat; CEOS Atmospheric Composition Virtual Constellation; CEOS Greenhouse Gas Task Team.
- ECMWF and CEOS have many overlapping priorities and a variety of potential mutual benefits in user requirements, validation, climate data records and ECVs, feedback, climate monitoring, etc.
- Being a CEOS Associate would tighten these links, and ECMWF is willing to be more explicitly involved as needed.

Portugal Space (Ricardo Conde)

- Shared a brief history of Portugal Space, noting that their first satellite was launched in 1993. Since then, they have been actively involved in Earth observation.
- One of the important milestones for Portugal Space was when GEOSAT acquired the Deimos 1 and 2 satellites in Feb. 2021 and has become one of the few European operators in high-resolution EO imaging.
- Seeking to join CEOS as part of its growth strategy, which includes international relations as a pillar.
- The Santa Maria Space Hub, the Atlantic Constellation, and Digital Planet are flagship Portugal Space activities.
- Motivations for becoming a CEOS Associate member: Contribute to CEOS community discussions on data user needs, gaps and access to data; exchange experience on EO data uptake; and international engagement.
- Able to contribute to: WGCapD, the COAST *Ad Hoc* Team, WGDisasters, and WGClimat.

Main discussion points:

- Support for both of the proposals were noted via chat from: Mauro Facchini (EC), Raul Kulichevsky (CONAE), Paul Counet (EUMETSAT), Raj Kumar (ISRO), Klaus Schmidt (DLR), Timothy Stryker (USGS), Ivan Petiteville (ESA), Steve Volz (NOAA), Alex Held (CSIRO), Selma Cherchali (CNES), Osamu Ochiai (JAXA), Hasibur Rahaman (ESSO-MoES), Jorge Del Rio Vera (UNOOSA), Eric Laliberté (CSA), Christo Whittle (SST-VC), Kenneth Holmlund (WMO), Pakorn Apaphant (GISTDA), Karen St. Germain (NASA, CEOS Chair).
- Karen St. Germain (NASA, CEOS Chair) thanked everyone for expressing their support and welcomed both agencies as new CEOS Associate members.

Decision 35-01	Plenary endorsed and welcomed the European Centre for Medium-Range Weather Forecasts (ECMWF) as a new CEOS Associate member.
Decision 35-02	Plenary endorsed and welcomed Portugal Space as a new CEOS Associate member.

1.5: Agency Nomination for 2023 CEOS Chair [\[slides\]](#)

Presenter(s): Pakorn Apaphant (CEOS Principal of the Geo-Informatics and Space Technology Development Agency, GISTDA; Thailand)

Main points:

- Karen St. Germain (NASA, CEOS Chair) noted that GISTDA previously served as CEOS Chair in 2009. Pakorn noted that since then, GISTDA has been working closely with numerous CEOS Working Groups, including the Working Group on Calibration and Validation (WGCV) and the Working Group on Information Systems and Services (WGISS).
- GISTDA aims to build industry and the space sector in Thailand and the region.
- Related to CEOS priorities, GISTDA has many shared priorities, including climate change, agriculture, disaster risk reduction and management.
- GISTDA has been focused on developing more custom software. The agency developed the COVID-19 IMAP platform to monitor COVID-19 in Thailand by collaborating with government agencies. They are also working on Analysis Ready Data (ARD) and Open Data Cube development of cal/val infrastructure.
- Capacity building is a key activity of GISTDA, and they are ready to use this basis as a means to advance CEOS capacity building efforts in the Southeast Asia region.
- GISTDA fully supports the CEOS Strategy to support the Global Stocktake, Partnering with Purpose for Open Science and Decision Support, and the CEOS Analysis Ready Data (ARD) Strategy.

Main discussion points:

- Sandra Cauffman (NASA, CEOS Chair Team) noted that NASA strongly endorses GISTDA’s application for the 2023 CEOS Chair from the Asia-Pacific region.
- Selma Cherchali (CNES) welcomed and supported GISTDA’s application. The CNES CEOS Chair team will work with NASA and GISTDA to ensure a strong transition.

- Takeshi Hirabayashi (JAXA) is grateful for the 2023 nomination from GISTDA and will cooperate closely, particularly for the Asia-Pacific region.
- Alex Held (CSIRO) strongly supports the nomination from GISTDA.
- Ivan Petiteville (ESA) reported that ESA fully supports GISTDA, which is one of the major space agencies in Asia. A few years ago, GISTDA demonstrated an excellent CEOS Chair term (very active, efficient and motivated).
- Steve Volz (NOAA), Raul Kulichevsky (CONAE), Rajeev Jaiswal (ISRO), Timothy Stryker (USGS), Mauro Facchini (EC), Eric Laliberté (CSA), Klaus Schmidt (DLR), Paul Counet (EUMETSAT), Phil Evans (EUMETSAT), and Hasibur Rahaman (ESSO-MoES) provided support for the GISTDA nomination via the chat.
- David Green (NASA, WGDisasters Chair) stated that WGDisasters welcomes GISTDA. The identification of disaster risk management as a key issue is encouraging. Paul DiGiacomo (COAST) likewise looks forward to working with GISTDA and actively pursuing the significant coastal opportunities ahead.
- CEOS looks forward to working closely with GISTDA.
- Pakorn Apaphant (GISTDA) thanked everyone for their support and endorsement. He looks forward to chairing CEOS in 2023 and welcoming the CEOS community to Thailand two years from now.

Decision 35-03

Plenary endorsed the Geo-Informatics and Space Technology Development Agency (GISTDA) of Thailand as 2023 CEOS Chair from the Asia-Pacific region.

1.6: CEOS Systems Engineering Office (SEO) Annual Report [\[slides\]](#)

Presenter(s): Brian Killough (NASA), Head of the CEOS Systems Engineering Office (SEO)

Main points:

- SEO has been supporting CEOS for 14 years, providing technical and management functions.
- Highlighted some key accomplishments in 2021. Technical team accomplishments for 2021:
 - o Analysis Ready Data (ARD): advanced a Sentinel-1 Data Cube processing pipeline via Sinergise, developed Nighttime Lights CEOS ARD specification;
 - o Support to SDG-AHT: development and testing of ODC algorithms focused on SDG 6.6.1 (water) and SDG 11.3.1 (urbanization);
 - o Earth Analytics Interoperability Lab (EAIL): Worked with CSIRO to implement/test the EAIL and coordinate with CEOS initiatives (e.g., COAST, Flood Disasters, Digital Elevation Model (DEM) evaluation);
 - o COVE Tool: Migrated to the Amazon Web Services (AWS) cloud, updated detailed (63-page) user's guide, improved performance and enhanced output products;
 - o WGCapD and WGISS Databases: released new WGCapD Training Calendar, initiated work on a new EOTEC DevNet Floods Tracker tool, developed WGISS Open Source Software Inventory and Future Data Architectures Inventory. Both are available online on the WGISS website.
- Management team accomplishments for 2021: Updated CEOS website and social media content including addressing numerous IT security issues; provided meeting logistics support across many

CEOS groups; led a team to develop new CEOS Branding Guidelines and a new CEOS Communications Strategy; continued updates to the numerous CEOS mailing lists.

- Open Data Cube (ODC) is one of the main initiatives carried out by the SEO. Examples: Open Earth Alliance (OEA), Digital Earth Africa, Digital Earth Americas, Digital Earth Pacific. They continue to support ODC outreach, FOSS4G, UNGGIM, etc.
- The Open Data Cube Sandbox tool is ideal for anyone supporting Open Science and this has generated significant interest as an educational tool. Provided an example of Thailand Flooding from Tropical Storm Dianmu. SEO is working with WGDisasters to explore how the tool can be brought into the Disasters Charter website so that the users can track flood recovery.
- Plans for 2022:
 - o SDG Coordination Group: SEO implementation lead, continue development of ODC tools and case studies for specific SDGs.
 - o Digital Earth (DE) Americas: continue working with INEGI, CSIRO-Chile and AmeriGEO to explore opportunities in the region.
 - o Digital Earth (DE) Pacific: continue as a member of the Interim Steering Group to develop strategic plans and explore data options.
 - o Earth Analytics Interoperability Lab (EAIL): work with CSIRO to implement the EAIL and support data and algorithm testing for CEOS initiatives (COAST, Disasters, Rice Monitoring, DEM evaluation).
 - o Open Data Cube (ODC): continue to advance the country/region prototypes, tools (sandboxes), algorithms (Jupyter notebooks), develop a new user forum, and investigate new datasets.
 - o CEOS Analysis Ready Data (ARD): continue testing datasets and supporting development of product specifications (e.g., Nighttime Lights, NASA Black Marble), promote and demonstrate ARD value through ODC prototypes, improve production and access to Sentinel-1 products.
 - o Continue CEOS outreach at major meetings: IGARSS, GEO, AGU.
 - o Communications: Continue improvements to the CEOS website and social media.

1.7: CEOS Executive Officer (CEO) Report [[slides](#)]

Presenter(s): Marie-Claire Greening, CEOS Executive Officer (CEO)

Main points:

- Recalled for Plenary that the role of CEOS Executive Officer (CEO) was established in 2006 as a mechanism to primarily support the interactions of CEOS with the then emerging Group on Earth Observations (GEO). Since its inception, the remit of the CEO has greatly expanded, and in 2011 a Deputy CEO role was added. All the major roles and responsibilities are noted in the above-linked presentation.
- Acknowledged the previous CEOS Executive Officer, the CEOS Chair and the SIT Chair for supporting her as CEO.
- Noted that four key governing documents primarily guide the work of CEOS:
 - o [CEOS Terms of Reference](#) defines the mission and scope of CEOS activities

Decision 35-04	Plenary endorsed the updated CEOS Governance and Processes v1.2 document (September 2021).
Decision 35-05	Plenary endorsed the CEOS Statement for GEO Week 2021.

1.8: CEOS Missions, Instruments and Measurements (MIM) Database Annual Report [slides]

Presenter(s): Ivan Petiteville (ESA)

Main points:

- 2021 update survey completed with 30 new missions and 34 new instruments. 25 agencies responded to the survey this year. Almost 250 mission records were updated. There were 34 new instrument records, with more than 200 instrument records updated. 113 new instrument-measurement mappings were also added.

Missions	Instruments (Distinct)
Operating: 201	Operating: 713 (322)
Approved: 77	Being developed: 83 (59)
Planned: 61	Approved: 37 (22)
Considered: 9	Proposed: 62 (29)



- The MIM Database is used by more than 1000 people per month.
- Initiated quarterly MIM Database reports in order to increase information flow and currency. Example shown above.
- Produced a video series, which is available on the CEOS YouTube channel [here](#).
- Collaborated with the World Geospatial Industry Council on their report for COP26 on “GHG Monitoring from Space: A mapping of capabilities across public, private, and hybrid missions”.
- The ‘CEOS Database: 2021 in Review’ video is available [here](#).

1.9: CEOS Communications [slides]

Presenter(s): Kim Holloway (SEO)

Main points:

- Strategic and effective CEOS Communications are critical to raise awareness and expand the impact of the data accessibility, transparency, and reproducibility made possible by CEOS and its Agencies. This is a key priority of the 2021 CEOS Chair theme: *Earth Observation Data for Open Science and Decision Support*.
- October 2020-2021 Analytics for the website and social media: 31,218 CEOS website visitors (88% first time); 3,633 Twitter Followers (approx. 1,000 new over the last year); 1,817 Facebook Followers (approx. 200 new over the last year), 104 [LinkedIn Group](#) Members, 145 subscribers on the [YouTube Channel](#).

- Presented for endorsement today: new CEOS Branding Guidelines and a new CEOS Communications Strategy.
- CEOS Branding Guidelines cover: the CEOS logo; CEOS Mission Statement; new logos incorporating CEOS brand elements; and leveraging the CEOS Brand by CEOS Working Groups, Virtual Constellations, *Ad Hoc* Teams, and other CEOS activities (and other organisations).
- CEOS Communications Strategy covers: CEOS communications objectives; target audience definitions; goals and outcomes for each audience; types of content; content creation and publication workflow; and ideas for the future.
- An upgrade of the CEOS website is in progress to improve user experience.
- Quarterly strategy meetings will be held for CEOS communications. The first meeting will be held in January 2022. All CEOS Members are invited to provide their input and support in building a better website.

Main discussion points:

- Sandra Cauffman (NASA), Selma Cherchali (CNES), Osamu Ochiai (JAXA), Ivan Petiteville (ESA), Timothy Stryker (USGS), Ivan Petiteville (ESA), Steve Volz (NOAA), Pakorn Apaphant (GISTDA), Eric Laliberté (CSA), Klaus Schmidt (DLR), Raul Kulichevsky (CONAE), Mukosi Mukwevphoto (SANSa), and Mauro Facchini (EC) endorsed both of the documents.
- Ivan Petiteville (ESA) thanked Kim for her creative work, which has significantly improved CEOS communications, a key aspect of our organisation. A good communications strategy is a “must” for CEOS as it contributes to increasing the awareness of non-EO experts of the benefits that Earth observations from space bring to society through tailored information. A public-oriented communication also helps demystify remote sensing that might scare many people, as it is often perceived as technologically and scientifically complex.
- Steve Volz (NOAA) stated that NOAA endorses the CEOS Communications Strategy and the CEOS Branding Guidelines. NOAA also acknowledges the great work Kim and her team have done this year in support of the CEOS COAST initiative.
- Eric Laliberté (CSA) suggested that perhaps the Communications Strategy needs a fourth audience on capability development and data democratisation. Kim Holloway (SEO) agreed this should be highlighted more specifically and will bring this up in the next quarterly meeting. Kim invited CSA to participate.

Decision 35-06	Plenary endorsed the new CEOS Communications Strategy.
Decision 35-07	Plenary endorsed the new CEOS Branding Guidelines.

Working Group Session Introduction

David Green (NASA) introduced the Working Group session, noting the high level of collaboration and cross-cutting activity that has been growing and expanding across the Working Groups, CEOS Agencies, Virtual Constellations and stakeholders over the past two years. He encouraged the new CEOS Associate members to participate in the Working Groups.

1.10: Working Group on Calibration & Validation (WGCV) [[slides](#)]

Presenter(s): Akihiko Kuze (JAXA)

Main points:

- The WGCV-49 virtual meeting was held on June 29 to July 1, 2021. The WGCV CARD4L review process was revisited to improve timeliness and efficiency. Odele Coddington presented the TSIS solar reference spectra. David Crisp presented on WGCV support to the CEOS Strategy for the Global Stocktake of the UNFCCC Paris Agreement. The BRIX-2, DEMIX, ACIX-3 and CMIX-2 intercomparison activities were also discussed.
- WGCV members joined the ISO 19124 meeting on August 30, 2021, where Maturity Matrix (MM) stage and data product level definitions were discussed. The draft technical standard deadline is the end of December 2021.
- WGCV-50 is proposed as a hybrid and joint meeting with WGISS on March 21-24, 2022, in Tokyo.
- The objective of the TSIS solar reference spectra is to accurately represent the total and spectral solar irradiance to improve understanding of solar variability and Earth's climate response to solar variability. TSIS-1 HSRS has a high-accuracy (0.3-1.3%) and high-resolution (0.01 nm or better). Uncertainty in SWIR irradiance (8-10%) is much reduced compared to the current standard. A user-friendly database with various spectral resolutions from radiometers to high resolution spectrometers is available. WGCV will consider recommending the TSIS-1 HSRS as the new CEOS solar irradiance reference spectrum (within one year) and will assess its consistency between GHG sensors (OCO, TROPOMI, GOSAT, extending 2.3 micron for CH₄ and CO).
- The SI-Traceable Space-based Climate Observing System was hosted by the National Physical Laboratory, UK, on 9-11 September 2019. [SITSCOS report](#).
- The DEMIX Team published a reference paper on "[Digital Elevation Models: Terminology and Definitions](#)" Remote Sens. 2021, 13(18), 3581.
- Updated RadCalNet guidance document to describe a new site acceptance process.
- Status and future actions:
 - o A CEOS Common Terminology group has been established. The ongoing activity is merging the WGISS Data Stewardship Glossary into the CEOS WGCV '[Terms and Definitions](#)' Wiki. CEOS agencies are encouraged to participate in this effort to increase terminology consistency across CEOS.
 - o The CEOS Cal/Val portal has been re-shaped and is now operational. The portal will host new pages including: planning, methods, reports and results for [ACIX-II-Land](#), ACIX-II-Aqua, CMIX, and DEMIX (work in progress).
 - o [CEOS SAR Subgroup](#): Virtual Workshop Announcement: [CEOS SAR Workshop 2-4 November](#)
 - o [Vicarious Calibration Portal for Space-borne GHGs Sensors](#).

Main discussion points:

Maree Wilson (GA) thanked WGCV for the support to the CEOS Analysis Ready Data for Land (CARD4L) process. GA is pleased to support Medhavy Thankappan in this contribution. WGCV could consider reaching out to additional members to see if they would like to support this effort, which is expanding as an increasing number of agencies and others see the value of the CEOS ARD Framework, and seek evaluation of different types of products.

1.11: Working Group on Information Systems & Services (WGISS) [[slides](#)]

Presenter(s): Robert Woodcock (CSIRO)

Main points:

- Future Data Architectures (FDA) Achievements: Overall maturity and use of FDA and ARD has markedly increased across CEOS Agencies. A large amount of data is in the cloud, and analytics and services are now being built around this new infrastructure. This is a huge shift that is enabling projects at scales that were not possible before. Data is increasingly available in the cloud as the “business as usual” case. As such, use of the Future Data Architectures term will be deprecated as it is no longer “Future”. An amazing amount of knowledge exchange is happening across the agencies, leading to increased interoperability, even for these very new systems. Rob acknowledged all CEOS contributors.
- Data Discovery, Access, Preservation Achievements: Continue to embrace both opportunities and challenges presented by Cloud (quality standards, integrity assurance, replicas, services discovery, STAC metadata for Cloud EO data); updated open search guidelines; persistent identifier best practices.
- Interoperability and Use Achievements:
 - CEOS Earth Analytics Interoperability Lab: 46 registered CEOS project users, training in Jupyter Notebooks and Open Data Cube, CEOS cloud-hosted ARD (or nearest equivalent) and STAC metadata.
 - Open Source Software and Tools Catalogue.
 - Carbon Portal providing ARD services for ECVs.
- Technology Exploration Achievements: Jupyter Notebooks for EO with WGCapD; Blockchain for EO data integrity and provenance; artificial intelligence and machine learning in Earth observations.
- Future actions: continue to support the open science theme; continue the CEOS EAIL (will soon seek a two-year continuation and invite support for operating costs and effort to sustain and grow support for WG and VC projects); develop a best practice for EO training with Jupyter for EO with WGCapD; and, progress discovery and use of CEOS data in the cloud (covering topics like ARD, quality and integrity, operational best practices, and service discovery).
- The WGISS Chair will now transition to Dr. Makoto Natsuisaka of JAXA. Robert Woodcock (WGISS) thanked everyone for their support over the past two years of his chair term, and while being virtual, they were very productive years. USGS has nominated Mr. Tom Sohre as the next WGISS Vice Chair for two years, to be followed by a two-year term as WGISS Chair.

Main discussion points:

- Christine Bognar (NASA), Ivan Petiteville (ESA), Osamu Ochiai (JAXA), Raul Kulichevsky (CONAE), Selma Cherchali (CNES), Charles Wooldridge (NOAA), Eric Laliberte (CSA), Klaus Schmidt (DLR), Raj Kumar (ISRO), and Timothy Stryker (USGS) supported the nomination of Tom Sohre as WGISS Vice Chair.
- Ed Armstrong (NASA, SST-VC Co-Lead) asked whether the cloud data integrity checks are available as workflows that can be reused. Rob confirmed these are not yet available, as WGISS is still working out the best way to assure integrity.
- Osamu Ochiai (JAXA) communicated JAXA's congratulations for the achievements of the CEOS EAIL initiative. JAXA will fully support Dr. Natsuisaka during his term of WGISS chairmanship. JAXA also supports the nomination of Mr. Tom Sohre of USGS for WGISS Vice Chair.
- Timothy Stryker (USGS) noted that authoritative data, consistent terminology, and enhanced CEOS agencies' participation in international guidelines and standards groups will be crucial to advance our goals for CARD4L uptake and the complementarity of the ARD products of agencies and private sector entities.

Decision 35-08	Plenary endorsed Tom Sohre of USGS as WGISS Vice Chair for 2022-2023 and WGISS Chair for 2024-2025.
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1.12: Working Group on Capacity Building and Data Democracy (WGCapD) [slides]

Presenter(s): Nancy Searby (NASA)

Main points:

- WGCapD members are working on executing the CEOS 2021-2023 Work Plan that includes 32 deliverables: 21 will be implemented in the 2021 calendar year, 10 in 2022, 1 in 2023.
- Some recently completed deliverables are:
 - The Land Cover and Land Use Change MOOC has been launched on the EO College [site](#).
 - Webinar Series on Image Restoration and Processing of SAR Data was completed by 1,569 participants with 195 participants completing the image and processing training.
 - The Phase II Geospatial Applications for Disaster Risk Management [MOOC](#) launched as a joint effort by UNOOSA, the Centre for Space Science and Technology Education in Asia Pacific, and ISRO.
- WGCapD has completed the EOTEC DevNet Pilot Phase 1. EOTEC DevNet focuses on disaster risk reduction, climate adaptation, mitigation and vulnerability assessments.
- EOTEC DevNet regional exchanges on June 14, 2021 and September 21, 2021, developed new tracking tools for flood and drought related capacity building opportunities.
- To support the 2021 CEOS Chair theme, a Jupyter Notebook webinar was held (as a joint deliverable with WGISS) with a focus on Earth Observation (EO) applications that will allow more users to connect to open satellite datasets. It was attended by 288 participants across two sessions.

- The CEOS Webinar Toolkit developed by WGCapD was used in preparations for the aforementioned Jupyter Notebook Webinar and an EO-focused webinar series by VNSC. The toolkit can be used by other groups within CEOS.
- Currently working on strengthening capacity building resources for open science and decision support for flood research and applications via EOTEC DevNet and in collaboration with WGDisasters.
- For the leadership transition: UNOOSA has nominated Jorge Del Rio Vera, Scientific Affairs Officer, as WGCapD Chair for 2022-2023 and SANSA has nominated Dan Matsapola, Science Engagement Manager, as WGCapD Vice-Chair for 2022-2023 and subsequently WGCapD Chair for 2024-2025.

Main discussion points:

- Pakorn Apaphant (GISTDA), Mauro Facchini (EC) endorsed the Chair and Vice Chair nominations.
- Ivan Petiteville (ESA), Eric Laliberté (CSA), Klaus Schmidt (DLR), Christine Bogner (NASA), Paul Counet (EUMETSAT), Selma Cherchali (CNES), Julio Castillo (AEM), Raul Kulichevsky (CONAE), Timothy Stryker (USGS), Charles Wooldridge (NOAA), Raj Kumar (ISRO), and Osamu Ochiai (JAXA) endorsed the Chair and the Vice Chair nominations and the EOTEC DevNet Phase 1 report.
- Eric Laliberté (CSA) suggested that WGCapD/CEOS connect with the International Space Education Board (ISEB), given the overlapping priorities and activities.

CEOS-35-01	WGCapD to explore potential connections with the International Space Education Board (ISEB).	SIT-37
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- Kenneth Holmlund (WMO) noted that WMO is supportive of the EOTEC DevNet activities. Disaster risk reduction, and flood/drought/fire monitoring are priorities for WMO. WMO is also initiating a small project to ensure that what is done in CEOS and with other satellite data providers is used efficiently in the context of the WMO downstream services. WMO looks forward to EOTEC DevNet Phase 2 after seeing the success of Phase 1. It is important that we have a shared portal where we can coordinate activities in order to avoid duplicating activities and utilise the best resources.

Decision 35-09	Plenary endorsed the EOTEC DevNet Phase 1 Report.
Decision 35-10	Plenary endorsed Jorge Del Rio Vera of UNOOSA as WGCapD Chair for 2022-2023.
Decision 35-11	Plenary endorsed Dan Matsapola of SANSA as WGCapD Vice Chair for 2022-2023 and WGCapD Chair for 2024-2025.

1.13: Working Group on Disasters (WGDisasters) [slides]

Presenter(s): David Green (NASA)

Main points:

- WGDisasters is working to advance the CEOS Chair theme: *“Space-based Earth Observation Data for Open Science and Decision Support”* by promoting the access, use and utility of space data for disaster risk management.

- WGDIsasters' strategy paper was endorsed at the CEOS SIT-36 meeting and now guides the Working Group's direction.
- CEOS has been granted "Observer Status" for the International Charter Space and Major Disasters. The process for value-added product sharing has also been refined.
- Wildfire Pilot: Describes the feasibility of integrated EO for global wildfire regime monitoring. Global active-fire monitoring inventory and gap analysis under development.
- Flood Pilot: Analyses the feasibility of integrating GEO-LEO-SAR for flood risk monitoring. Working on improved flood mapping through data fusion with WGISS/SEO Earth Analytics Interoperability Lab (EAIL).
- Geohazard Lab: Platform with federated resources. GEO Supersites and Natural Laboratories GSNL for expanded coverage. A new Nicaragua supersite has been launched.
- Landslide Demonstrator: Application demonstration is underway for landslide disaster assessment and mitigation along transportation and pipeline critical infrastructure corridors.
- Volcano Demonstrator: Reaching global coverage demonstrating the necessity and viability of international coordination and satellite tasking for volcano monitoring.
- CARD4L: Investigating applications and use case examples highlighting benefits of CEOS ARD to the disaster risk reduction and management end user community (e.g., OGC Disaster Pilot 2021).
- Recovery Observatory (RO) Demonstrator: Demonstrating the value of EO for timely development and recovery financing. Successful fostering of the use of existing EO-based services, e.g., Copernicus activations in Lebanon, Nicaragua, and Guatemala.
- Significant deepening of institutional relationships with regional institutions. For example, CEPREDENAC in Central America.
- Successful uptake of EO-based products in post-disaster needs assessments. For example, Haiti EQ PDNA in October 2021 used Sentinel and Pleiades-products for agricultural damage and environmental impact assessments.
- Welcome new WGDIsasters Chair, CNES: Pierric Ferrier (Nov. 2021 – May 2022) and H el ene de Boissezon (May 2022 – Fall 2023).
- The incoming chair priorities are:
 - o Focus on global challenges: Relating disaster-focused UN mandates (UNFCCC, SDGs, Sendai DRR), GEO support (including urban agenda/resilient cities), and exploiting satellite EO for high benefit contributions; bringing satellite EO to national/local actors engaged in DRM, especially Climate-related DRM.
 - o Explore how CEOS WGDIsasters can employ 'new geometries': Working with industry, new missions, and new data and analysis techniques (AI) for maximum impact and continued relevance in a changing sector.
 - o Continue to develop model partnerships: Contribute to disaster risk management objectives through Demonstrators and the Recovery Observatory.
- Requested CEOS endorsement of Dr. Laura Frulla of CONAE as WGDIsasters Vice Chair for 2022-2023 and WGDIsasters Chair for 2024-2025.

Main discussion points:

- Raj Kumar (ISRO) noted that ISRO is interested in connecting further with WGDisasters on wildfire and landslide topics, in addition to the existing activity on flooding.
- ESA thanks CONAE for the nomination of Laura Frulla, which is endorsed. Added thanks to David Green for his inspiring leadership and great achievements, and to David Borges for his hard work and professionalism as WGDisasters secretariat. ESA also thanks CNES for taking the chair position with Pierric and then H el ene.
- Selma Cherchali (CNES) thanked David Green for the excellent work and leadership.
- Klaus Schmidt (DLR) noted DLR welcomes and endorses the nomination from CONAE of Laura Frulla as incoming Vice Chair for WGDisasters. This is very much appreciated. He added thanks to David Green and the whole WGDisasters team for all the achievements during the recent period. DLR welcomes the incoming chairs from CNES (Pierric and H el ene) and their priorities.
- Christine Bogner (NASA) stated that NASA strongly endorses the nomination of Dr. Laura Frulla and thanks CONAE for making this four-year agency level commitment to the CEOS Working Group on Disasters (2 years as WGDisasters Vice Chair, followed by two years as WGDisasters Chair).
- Ivan Petiteville (ESA), Raul Kulichevsky (CONAE), Charles Wooldridge (NOAA), Mauro Facchini (EC) Eric Lalibert  (CSA), Klaus Schmidt (DLR), Christine Bogner (NASA), Paul Counet (EUMETSAT), Selma Cherchali (CNES), Julio Castillo (AEM), Raul Kulichevsky (CONAE), Timothy Stryker (USGS), Osamu Ochiai (JAXA), and Timothy Stryker (USGS) endorsed the nomination of Laura Frulla of CONAE as WGDisasters Vice Chair for 2022-2023 and WGDisasters Chair for 2024-2025.

Decision 35-12	Plenary endorsed Laura Frulla of CONAE as WGDisasters Vice Chair for 2022-2023 and WGDisasters Chair for 2024-2025.
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1.14: CEOS-CGMS Working Group on Climate (WGClimate) [slides]

Presenter(s): Jeff Privette (NOAA)

Main points:

- ECV Inventory: Updated to v4 and released online on 29 October, 2021. Metadata on approximately 1,300 climate data records (current and planned). Key ECV gaps filled with new CDRs. Additional agencies contributed. Gap Analysis 3.0 close to finalisation (late 2021). Gap Analysis 4.0 will be undertaken via a February 2022 workshop with a focus on carbon cycle variables. Request agencies to accept new CDR entries throughout the year and support Gap Analysis 4.0 with subject matter experts (invitations forthcoming).
- Use Cases for CDRs in ECV Inventory: Showcases CDR value in climate monitoring, modelling, applications, and services. 18 CDR use cases were received that covered a wide range of applications. After independent review by subject matter experts, the NOAA communications team transforms the case studies to publication quality. Five are now online (rolling publication dates). Request to agencies to continue submitting new use cases and to advertise through partners, user communities and organisations.
- Greenhouse Gas (GHG) Task Team: Guided by the AC-VC White Paper and GHG Roadmap. New representatives appointed for each CGMS major Working Group. The *in situ* community is now also

represented. Presented the Agriculture, Forestry and Other Land Use (AFOLU) Roadmap at the WGClimate meeting.

- Coordination with GCOS: WGClimate contributes to the GCOS Status Report and supports the Implementation Plan. WGClimate has a regular dialogue with GCOS on new application-oriented requirements.
- Coordination with UNFCCC/SBSTA: WGClimate provides the single official CEOS conduit to UNFCCC. Coordinated CEOS contributions (Joint CEOS-CGMS statement to UNFCCC, SBSTA/RSO Earth Information Day (1 presentation and 5 posters), UNFCCC Structured Expert Dialogue Session (1 poster)). Representing CEOS and CGMS in authorship of the synthesis paper on the coordinated contribution of the systematic observation community to the first Global Stocktake.
- Endorsement of Joint CEOS-CGMS Statement for SBSTA at COP26: Statement reporting on progress by the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS) on the Coordinated Response to UNFCCC Needs for Global Observations. The statement will be given by the Party delegation (U.S.) of the CEOS chair (NASA) during the SBSTA opening session of the UNFCCC/COP. Drafted by the CEOS-CGMS Working Group on Climate with review and approval by CGMS completed. The final version has been approved by the U.S. State Department and is recommended for endorsement by CEOS Plenary.

Main discussion points:

- Raul Kulichevsky (CONAE), Christine Bognar (NASA), Selma Cherchali (CNES), Charles Wooldridge (NOAA), Eric Laliberté (CSA), Raj Kumar (ISRO), Timothy Stryker (USGS), Julio Castillo (AEM), Ivan Petiteville (ESA), Osamu Ochiai (JAXA), Jonathon Ross (GA), Klaus Schmidt (DLR), Mauro Facchini (EC), and Paul Counet (EUMETSAT) endorsed the statement via chat.

Decision 35-13	Plenary endorsed the Joint CEOS-CGMS Statement for SBSTA at COP26.
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Day 1 – Closing

Christine Bognar (NASA, CEOS Chair Team) thanked everyone for participating and concluded the first day of the 2021 CEOS Plenary.

Tuesday, November 2

Session 2: CEOS Support to Key Stakeholders and Global Agendas

Karen St. Germain (NASA, CEOS Chair) welcomed everyone to the second day of the 2021 CEOS Plenary and recalled the decisions and actions recorded on Day 1.

Stephen Briggs (ESA) reported a brief update on highlights from COP26:

- An agreement amongst 100 countries to reduce methane emissions 30% by 2030.
- An agreement to stop or reverse deforestation by 85% for forested countries by 2030.
- The GEO session on [GHG Monitoring from Space](#) and the JAXA-NIES session were both held today.

Mark Dowell (EC) added:

- Informal consultations have started for the negotiations of research and systematic observations, which is connected to CEOS. Earth Information Day (EID) is tomorrow. There will be further official deliberations thereafter. Contributions from CEOS and GEO have been referenced in the official negotiations.

2.15: Group on Earth Observations (GEO) [[slides](#)]

Presenter(s): Yana Gevorgyan (GEO Secretariat Director)

Main points:

- Noted the soft launch of a report on [GHG Monitoring from Space](#) which GEO jointly prepared with WGIC and Climate Trace. The CEOS MIM Database was used in gathering the supporting mission information for this report.
- GEO is expecting to add urban resilience as the newest engagement priority as of GEO Plenary.
- Yana reiterated GEO's aim to bring together all types of experts to form a network that will turn data into usable products for decision and policy makers. This includes open knowledge, practical guidance, policy briefs, and finance.
- There is a need to strengthen the science-policy interface and explain to policy makers the importance of these decision tools. Engagement with policy organisations, including key UN conventions and MEA secretariats is key. This engagement informs the development of policy briefs and practical guidance. For example, through engagement with UNFCCC Least Developed Countries (LDC) Expert Group, GEOGLAM is developing practical guidance for integrating early warning systems and other EO-tools into the LDCs formulation and implementation of National Adaptation Plans.
- This year GEO introduced Finance as a new topic in GEO with engagement of both international and public finance sector, e.g. climate finance, as well as private finance to use Earth observation to promote results-based financing and sustainable financing practices.
- GEO Secretariat will increase efforts to ensure effective partnering. It is crucial to think about how to use partnerships within the GEO network, to play to organisational strengths, leverage the respective positions in the value chain and not duplicate efforts. This includes organisations like CEOS, WMO, REAP, OGC, Global Partnership for Sustainable Development Goals, etc. Ensuring GEO Participating Organisations clearly communicate their value propositions was one of the suggestions in the GEO mid-term evaluation.

- In the area of SDGs, GEO invites CEOS to take part in identifying best approaches by which EO and remote sensing can support the interactions between the SDGs, particularly strengthening the synergies and positive interactions. Yana referenced the [work by ICSU here](#) as one inspiration for moving towards integrative work to look at interactions between SDGs.
- At the upcoming GEO Plenary, there will be discussions on the interactions between the different stakeholders in GEO and policy makers. The aim will be to create an integrated portfolio of tools, and this is an interesting area for GEO to work with CEOS. For example, GEOGLAM, GCOS, GFOI are all working on efforts and tools that support SDG Indicator monitoring.
- Yana noted there will be a focus on policy relevance at GEO Week 2021, and CEOS has an important role to play in this discussion.

2.16: CEOS Strategy to Support the Global Stocktake – Intro as Context for this Session [\[slides\]](#)

Presenter: Stephen Briggs (ESA, SIT Vice Chair Team)

Main points:

- The Global Stocktake (GST) is a fundamental part of the Paris Agreement and provides ongoing estimates of progress towards its objectives. It is described in the Paris Agreement itself. There are four areas that can be supported by CEOS:
 - o **Mitigation**, i.e., reporting, measurement and tracking secular decrease of GHG emissions;
 - o **Adaptation** to ongoing climate change and its consequences and impacts;
 - o **Finance** of mechanisms for adhesion;
 - o **Equity** among Parties for implementation.
- Of these four topics, mitigation of emissions has been particularly addressed in CEOS and by the scientific modelling community. Adaptation has not yet been as directly studied in CEOS, but much previous and ongoing work is very relevant. In addition, there is great scope for CEOS to further support adaptation, including in partnership with GEO. Finance and Equity are less immediately relevant to CEOS, but are to be monitored.
- The following presentations shall focus on work in CEOS to measure, track and report on anthropogenic GHG emissions. Other aspects such as adaptation, loss and damage, etc., are addressed in part through ongoing CEOS actions, and form part of a more comprehensive approach set out in the GST Strategy Paper, for endorsement at Plenary.
- In the first few days of COP26, there has already been some discussion suggesting shortening the time between Global Stocktakes from the originally planned 5 years.

2.17: Greenhouse Gas (GHG) Prototype Inventory Products for the Global Stocktake (GST) [\[slides\]](#)

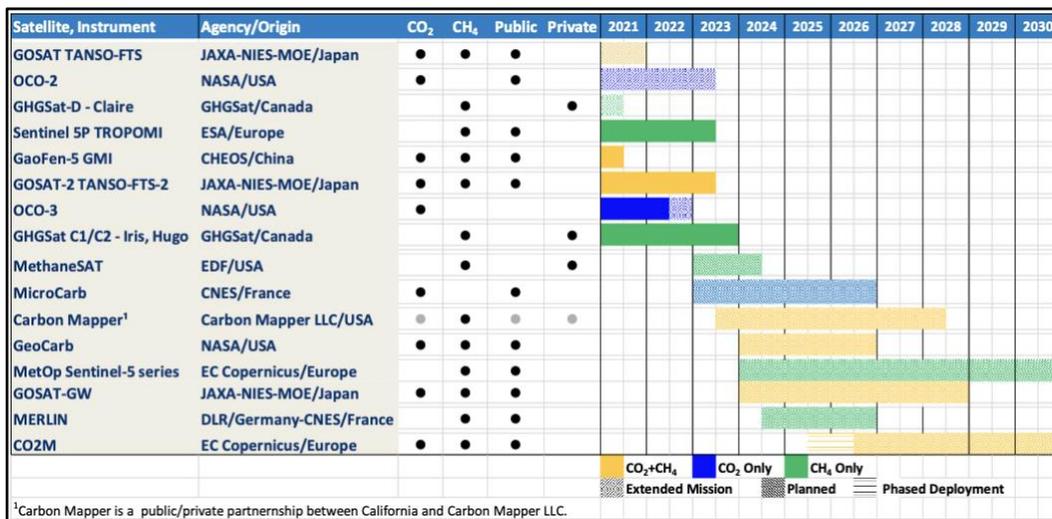
Presenter(s): David Crisp (NASA/JPL)

Main points:

- Space-based Earth Observations are a key supporting data source for the compilation of inventories to support the GST. For both bottom-up inventories of sector-specific estimates of emissions from known sources (e.g., land use change) and, increasingly, for top-down budgets of atmospheric CO₂ and CH₄ – providing an integral constraint on emissions and removals. With increasing resolution of these atmospheric instruments, we are now seeing efforts to track emission hot spots and rapid

changes and detect emission changes from the natural carbon cycle caused by human activities and climate change.

- Methane is emitted into the atmosphere by a broad range of natural processes and human activities, many of which are difficult to measure with bottom-up inventories.
- Ground-based measurements from the WMO Global Atmospheric Watch (GAW) Network and its partners provide accurate estimates of atmospheric GHG concentrations and their trends on local and global scales.
- Space-based measurements of CO₂ and CH₄ from a growing fleet of satellites provide high spatial and temporal resolution and greater coverage of the globe.
- Several missions are coming online:



- Various pilot CO₂ and CH₄ budgets are being developed by CEOS space agencies, including:
 - o Pilot global CO₂ budgets derived from flux products being developed by the OCO-2 Flux Multi-model Intercomparison Project (OCO-2 Flux MIP);
 - o Pilot global CH₄ budgets derived from flux products being developed by the NASA Carbon Monitoring System Flux (CMS-Flux) team;
 - o Urban-scale products for local source emissions (including large urban areas, power plants and oil fields) from OCO-2, GOSAT, and TROPOMI teams are being considered for demonstration. Existing capabilities do not have the resolution or coverage needed to track all local sources, but can illustrate methods for tracking emissions from hot spots for future GST's.
- The primary objective of these pilot top-down GHG products is to start a conversation with stakeholders and users to establish the utility and best practices for combining bottom-up and top-down methods to enable a more complete and accurate Global Stocktake.

Main discussion points:

- Steve Volz (NOAA) asked about smaller countries and if/when plans will get to a point where we can track a larger percentage of countries. David noted the pilot operational system is a global system that will provide quantitative constraints on net CO₂ and CH₄ emissions and removals from medium sized countries and larger. This is limited primarily by the existing observing system, which samples less than 1% of the Earth's surface each month. Future systems, such as CO2M will dramatically

improve the coverage, sampling most of the Earth's surface every few weeks. This will provide the coverage needed over all but the smallest countries. The objective is to implement a prototype system that demonstrates those capabilities in time to support the 2028 Global Stocktake.

2.18: CEOS Agriculture, Forestry and Other Land Use (AFOLU) Roadmap [\[slides\]](#)

Main points:

2021 Progress (Osamu Ochiai, JAXA and Frank Martin Seifert, ESA; LSI-VC Forest & Biomass Team)

- 2021 approach:
 - o Assess latest AFOLU products that could be readied for COP26;
 - o Engage relevant product teams and identify team leads for our purposes;
 - o Coordinate with the SIT Chair Team and Greenhouse Gas (GHG) Task Team to establish a working template for each dataset and its inclusion on the new [CEOS GST Portal](#) – as a unified point of entry to explain and offer our data;
 - o New engagement axis with national inventory users, building on our GFOI experience and in the spirit of the ambition cycle of the Paris Agreement to learn together and grow together.

National User Engagement (Sylvia Wilson, USGS)

- SilvaCarbon program is working in support of CEOS on a demonstration of uptake of satellite-based data and derived products in countries' reporting to the UNFCCC (Cambodia, Colombia, Ethiopia, Guatemala, Madagascar, Mexico, Paraguay, Peru, Solomon Islands, Zambia). Some examples are detailed in the [slides](#).
- Moving forward:
 - o Request for national forest inventory or ground-based data for calibration and validation of pantropical and global biomass datasets (AGB) for 27 countries;
 - o Include case studies of biomass in the NASA Biomass dashboard;
 - o Validation of other CEOS datasets (World Cover, Hilda+ and Copernicus);
 - o Engagement with other partners (GFOI and FAO).

GHG-AFOLU Cooperation (Mark Dowell, European Commission)

- Workshop on Systematic Observation contributions and synergies for GHG and AFOLU in support of UNFCCC now planned for 15, 18, and 19 November 2021.
- The intention is to start the dialogue between the different Earth observation communities addressing the needs of the UNFCCC. In particular, atmospheric GHG monitoring and those addressing aspects of the AFOLU sector. Will involve many relevant international coordination mechanisms.
- Aim to address the “soft” coordination and stakeholder engagement aspects, i.e., interface with the Convention, the UNFCCC Secretariat and Party user groups, but also more technical aspects of reporting, output datasets, formats, avoiding “double accounting” and the longer-term ambition of using diverse Earth observation datasets in the modelling and monitoring and verification systems being developed.

2022 Plans and Agency Support (Ben Poulter, NASA)

- AFOLU Roadmap plans for 2022 are to expand to include CH₄ and N₂O, mature the data product harmonisation workflow, feed into the national case study of SilvaCarbon activities, and integrate the bottom-up and top-down approaches and AFOLU and GHG.
- 2020-21 efforts took stock of relevant capabilities and focused on ensuring relevant datasets were on the table for COP26 and GST1.
- There is now more time to develop a considered strategy for an evolution of our GST AFOLU engagement that is in step with the timetable and process of the GST, the ambition cycle of the Paris Agreement and the reporting needs of countries.
- Key learnings observed included simplifying the offering to users. Fewer options means harmonised and recommended datasets. Engagement with countries will be key, and ensuring integration with the GHG Roadmap and products.
- A full AFOLU Roadmap should provide a long-term framework, including:
 - o Engagement in the policy process;
 - o Engagement with countries and stakeholders;
 - o Active participation of the major land surface observing programmes of CEOS Agencies and of the respective dataset teams;
 - o Internal coordination within CEOS, including with the GHG Task Team, LSI-VC, our GFOI representatives, etc. (oversight of the CEOS GST Strategy will be provided by the SIT Chair);
 - o Feedback to agency mission and product planning processes.
- Osamu Ochiai (JAXA) thanked Ben Poulter (NASA) for stepping up as a co-lead to join JAXA (Osamu Ochiai) and ESA (Frank Martin Seifert) and mentioned that the AFOLU Task Team is looking for more support from CEOS Agencies.
- Key agency programmes include those of ESA, EC, NASA, USGS, JAXA, CNES, DLR, CSA, amongst others.

Main discussion points:

- Steve Volz (NOAA) asked about the specific support being sought, e.g., data, scientists, research, infrastructure/cloud. Osamu Ochiai (JAXA) noted that for the 2022 Roadmap, there is a need for integration activities including harmonisation of activities and datasets. Mark Dowell (EC) added that these topics will be explored more at the AFOLU workshop.
- Timothy Stryker (USGS) thanked the presenters, and commented that this is a good start for CEOS and its ability to convene many EO satellite operators, scientists, members of academia, and governments to address more accurately, systematically, and comprehensively the contributions needed for carbon analyses and commitments by governments. Following NOAA's question, Tim asked the Task Team to let USGS know specifically how else they could assist.
- Steve Volz (NOAA) added that regarding the integration of the dataset as a baseline inventory in bringing all the databases together, NOAA is interested in participating in this work, and will be participating in the workshop later this month. Steve will ask his team to look for more specifics on what the roadmap is, for developing the integrated database.
- Jonathon Ross (GA) noted that GA supports the work of the team, and GA will look at how they can contribute further.

- Mark Dowell (EC) announced that as he has been serving the GHG Task Team for the past two years, he will likely be stepping down in the near future. Since this doesn't go through a formal nomination process, Mark reminded CEOS colleagues that there will be a need to identify someone else to step up in the near future. Over the next six months the team will look for someone to take over as GHG Task Team lead, possibly from the existing members.
- Hank Margolis (NASA) noted that NASA is discussing how this need for new expertise might be addressed.
- Selma Cherchali (CNES) also expressed the support of CNES for AFOLU activities and thanked all of the presenters.

2.19: CEOS Global Stocktake (GST) Portal [[slides](#)]

Presenter(s): Stephen Ward (SIT Chair Team & CEOS Chair Team)

Main points:

- The SIT Chair Team had taken an action from SIT-36 to prepare a dedicated area on ceos.org for our dataset contributions to the GST. This would provide a consolidated presentation of the various GHG and AFOLU datasets and associated guidance, alongside a thin layer of introductory information to help users find relevant CEOS contributions in one place. This was progressed as a SIT Chair and CEOS Chair cooperation and 2021 outcome.
- The CEOS GST Data Portal (ceos.org/gst) is the culmination of significant work by dozens of dataset teams across CEOS Agencies and working teams.



- Big appreciation to the GHG and AFOLU Task Teams, in particular, for development of the template and provision of consistent information to explain and characterise the different entries.

- CEOS Agencies are asked to advertise this new resource at COP26 and beyond. Version 1 of the website was expedited for COP26 as a milestone in the GST process.
- The SIT Chair Team will continue to evolve the resource to be consistent with the GST schedule and CEOS GST Strategy, developments in the supporting CEOS datasets, and to incorporate feedback from agencies and users. The data portal will also integrate links to other CEOS information systems including the CEOS Missions, Instruments and Measurements (MIM) Database.

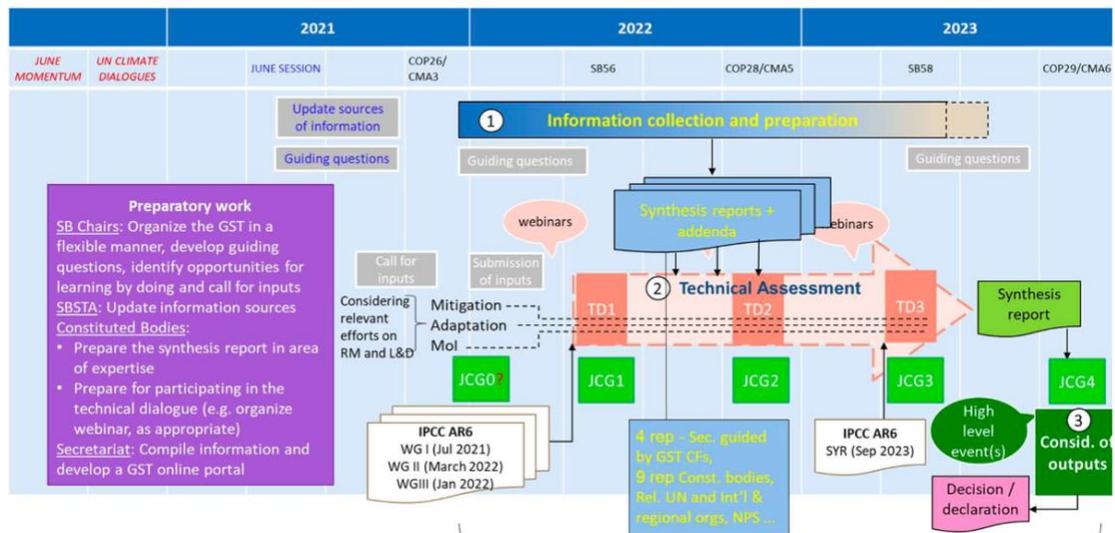
2.20: Global Stocktake Systematic Observation Synthesis Report and the CEOS Contribution [slides]

Presenter(s): David Crisp (NASA/JPL)

Main points:

- A Synthesis Report (SR) of the Systematic Observation Community (SOC) will be part of UNFCCC’s information collection and preparation phase for the Global Stocktake, and feed into the technical assessment.
- The SOC established a writing team of 12 participants in May 2021, and had several coordination calls, with weekly calls in the lead up to COP26. The chairs issued a ‘non-paper’ on 27 May 2021, which was revised on 15 September 2021 with dedicated questions for the synthesis report.
- A manuscript structure and writing team was shared, which can be found in the provided slides.

GST Timeline



- Earth Observation is increasingly supporting investment decisions for climate resilience and nature-based solutions, and the SO community is expanding relevant collaborations with the sustainable finance sector.
- CEOS is actively contributing to the UNFCCC *ad hoc* team on systematic observations to document Earth observation uses in the GST by:
 - o Leading the GHG and AFOLU inputs to the mitigation section;

- Contributing atmospheric GHG and AFOLU use cases demonstrating ways to reduce gaps and enable a more complete and transparent GST;
- Identifying the best products and producing harmonised EO datasets to facilitate adoption of EO products for national inventory development and assessment.
- CEOS participants in the UNFCCC *ad hoc* team are emphasising the value of open EO data and knowledge exchange to support the Enhanced Transparency Framework.
- Country engagement will be key. The CEOS GHG and AFOLU Task Teams are working with countries to facilitate adoption of data streams and boost capacity building.

Main discussion points:

- David Crisp (NASA/JPL) noted this may be his last presentation to CEOS as he is retiring in a few months. Karen St. Germain (NASA, CEOS Chair) and CEOS colleagues thanked David for all of his critical work over the years.
- Mark Dowell (EC) thanked David for his contributions. David’s initial contributions through the AC-VC and preparation of the white paper, “A Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space”, was the basis for these activities. David has driven the work all the way through. Mark recognised that when we started the process in 2017-18, there was a lot of emphasis on the datasets that would support the parties to the Paris Agreement. Now, there is a second dimension – how to use EO products to support collective progress and collective ambition aspects of the Paris Agreement and the Global Stocktake, where the whole synthesis and technical assessment process comes together and how that will iteratively improve over time.
- Timothy Stryker (USGS) also thanked David and the entire team. He suggested that engagement with all countries represented in CEOS will be key.
- Ken Holmlund (WMO) thanked David for his support to the WMO Integrated Global Observing System vision for 2040, particularly in terms of how the space-based component is reflected, and for keeping that vision relevant for these activities. Ken acknowledged that David has always remembered to keep ground-based observations in mind. WMO looks forward to working closely with CEOS to make this a success.

2.21: CEOS Strategy to Support the Global Stocktake of the UNFCCC Paris Agreement [[slides](#)]

Presenter(s): Stephen Briggs (ESA, SIT Vice Chair Team)

Main points:

- SIT Chair established a GST Study Team to develop a paper setting out the various elements of CEOS support to the GST. The Study Team met over several teleconferences January-April 2021, which were chaired by the SIT Chair (GA/CSIRO). The SIT Vice Chair (ESA) led the preparation of a paper.
- Following the 2021 SIT Technical Workshop, a final version (v3.1) was produced. This removed the action table, with actions to instead be included in the revised overall CEOS Work Plan for: (i) consistency with other CEOS Actions and (ii) increased longevity of the Strategy document. This Strategy is submitted to this 35th CEOS Plenary for endorsement.
- The Strategy contains various recommendations for Mitigation, Adaptation, Finance, and Equity – see the [paper](#) and [slides](#) for details. The slides include status updates for each recommendation. Many of these activities/actions/recommendations are already being progressed by CEOS, but the paper serves the important role of consolidating all of these in one place.

2.22: Carbon, Biomass, and the UNFCCC Global Stocktake – Discussion and Conclusion

Main discussion points:

- Sandra Cauffman (NASA), Jonathon Ross (GA), Osamu Ochiai (JAXA), Eric Laliberté (CSA), Ivan Petiteville (ESA), Timothy Stryker (USGS), Selma Cherchali (CNES), Laura Frulla (CONAE), Mauro Facchini (EC), Steve Volz (NOAA), Julio Castillo (AEM), Alex Held (CSIRO), Robert Husband (EUMETSAT), Florence Rabier (ECMWF), Mark Dowell (EC), and Klaus Schmidt (DLR) endorsed the *CEOS Strategy to Support the Global Stocktake of the UNFCCC Paris Agreement (v3.1)*.

Decision 35-14

Plenary endorsed the *CEOS Strategy to Support the Global Stocktake of the UNFCCC Paris Agreement (v3.1)*.

- Florence Rabier (ECMWF) commented that ECMWF will be keen to collaborate and contribute to this effort. Stephen Briggs (ESA) welcomed ECMWF support, and noted their timely addition to CEOS.
- Stephen Briggs (ESA) clarified the document is about taking account of many activities that are already ongoing, putting them in context, and augmenting the activities to make them more consistent and valuable.
- Mark Dowell (EC) noted that CEOS Principals will remember the roadmap presented last year, and the promise to indicate opportunities for increased research funding through the various research programs. The team will provide feedback on this following the workshop in a couple of weeks' time. For future research programs, agencies should consider a type of integrated field study. Additionally, a joint effort between multiple agencies is the scale of ambitions we need. How the Paris Agreement will evolve in future years will be shaped by observations, and complemented with modelling.
- Mark Dowell (EC) encouraged CEOS Agencies to look at specific critical areas as locations to pool resources and observations wherever possible. These areas need to be studied with all of our observing capabilities. Stephen Briggs (ESA) added that field experiments and ground-based measurements need to come from others in the community, noting that the suggestion comes from CEOS, but this is not something we can do on our own. Stephen highlighted that engagements like the GHG-AFOLU workshop that brings together different communities is key.
- Selma Cherchali (CNES) confirmed that the upcoming CEOS Chair, CNES, will support this area of work with strong involvement and commitments.

2.23: CEOS *Ad Hoc* Team on the Sustainable Development Goals (SDG-AHT) [[slides](#)]

Presenter(s): Alex Held (CSIRO, CEOS SIT Co-Chair) and Marc Paganini (ESA)

Main points:

- The SDG-AHT formed three sub-teams to address three specific SDG Indicators. In addition, Indicator 14.1.1 is being addressed by the COAST *Ad Hoc* Team. All have made progress on EO requirements and improved their connections with relevant GEO activities.
- The EO Requirement Reports are all in progress and likely to be completed next year (except 11.3.1).
- Marc Paganini (ESA) reported the progress of the four sub-teams: Water, Urban, Marine Pollution via COAST, and Land Degradation (see the [slides](#)).

- Alex Held (CSIRO, CEOS SIT Co-Chair) noted there have been multiple options explored since the 34th CEOS Plenary (October 2020) regarding the future of the SDG-AHT, in consultation with other CEOS entities, CEOS Agencies, and GEO. This was captured in the [Future Options Synthesis Paper](#) and has led to the [Recommendation to the 35th CEOS Plenary by the CEOS SDG AHT](#). The key recommendations are:
 1. *To disband the CEOS Ad Hoc Team on Sustainable Development Goals (SDG AHT); and,*
 2. *That CEOS Agencies adopt a Federated approach for the implementation of its SDG strategy and activities post-2021.*
- A “federated approach” was presented and discussed at the September 2021 CEOS SIT Technical Workshop as the most realistic, efficient and responsive approach, and it doesn’t close the door to a future Working Group if the need arises. This approach would allow CEOS to continue to play an active role in the 2030 Agenda on Sustainable Development, facilitating access to and use of satellite data by all countries, leaving no one behind, while taking into account current CEOS resources.
- The new approach will combine two layers of roles and responsibilities, with a small core SDG Coordination group (‘Strategy’) led by the SIT Chair, and ensuring “implementation” of the SDG deliverables by experts from CEOS groups, GEO, etc. – led by the SEO.
- There will be an annual review of SDG needs and requests in terms of satellite data and analysis.
- The CEOS SDG *Ad Hoc* Team is seeking CEOS Principals’ endorsement of the Federated approach which is described in the [paper](#).
- Alex and Marc thanked the SDG *Ad Hoc* Team members for their sustained support since the establishment of the group in 2017.

Main discussion points:

- Sandra Cauffman (NASA) thanked Alex and Marc and the rest of the SDG *Ad Hoc* Team. NASA endorses the proposed federated approach and encourages the CEOS WGs and VCs to take an active role in these discussions with external stakeholders to ensure implementation of any SDG-related deliverables.
- Ivan Petiteville (ESA) noted that ESA endorses the CEOS SDG Strategy Implementation. He thanked Alex and Marc, and confirmed ESA’s willingness to lead the group as incoming SIT Chair. Ivan encouraged CEOS Working Groups and Virtual Constellations to be involved in deliverables and to join the sub-teams as appropriate.
- Brian Killough (SEO, NASA) thanked Alex, Marc, and the rest of the SDG-AHT. The SEO looks forward to continuing this work in the future and to expanding CEOS impact for the SDGs.
- Steve Volz (NOAA) also thanked Marc, Alex and the team, and confirmed that NOAA endorses the proposed federated approach. He noted the broad nature of the SDGs, the need to draw broadly across the CEOS organisation, and said this approach appears to be workable. As the SEO team works on various user and stakeholder requests, he suggested it would be useful to collect some statistics, data, and information regarding requests from users, and to use that information to adjust the CEOS response over time (e.g., at CEOS SIT and Plenary meetings).
- Klaus Schmidt (DLR) supported the suggestion by NOAA of regular updates on SDG user and stakeholder requests (e.g., at SIT, Plenary, and SEC meetings). This was also supported by Eric Laliberté

(CSA) and Selma Cherchali (CNES). Brian Killough (SEO) noted the comment is well taken, and the team will make an effort to track requests, responses, and impact over time.

- Jonathon Ross (GA) also thanked Marc, Alex and Flora for their persistent work. There are so many areas where CEOS can contribute to the SDGs. The proposal shown is a realistic way forward; flexible and agile, with the option to scale up when opportunities present themselves.
- Alex noted CSIRO will support the SEO and all participating in the federated approach.
- Marc thanked Flora Kerblat (CSIRO), in particular, for all of her support.
- Selma Cherchali (CNES), Raj Kumar (ISRO), Laura Frulla (CONAE), Osamu Ochiai (JAXA), Steve Volz (NOAA), Eric Laliberté (CSA), Julio Castillo (AEM), Ivan Petiteville (ESA) and Sandra Cauffman (NASA) endorsed the proposal.

Decision 35-15

Plenary endorsed the “Federated Approach” for CEOS support to the SDGs as described in the *CEOS SDG Strategy Implementation* document and to disband the CEOS *ad hoc* Team (SDG AHT).

2.24: CEOS Ocean Variables Enabling Research and Applications for GEO (COVERAGE) [[slides](#)]

Presenter(s): Vardis Tsontos (NASA)

Main points:

- CEOS COVERAGE is a cross-cutting, interagency collaboration involving the ocean Virtual Constellations, GEO-MBON, GEO Blue Planet and Intergovernmental agency stakeholders (Sargasso Sea Commission, Inter-American Tropical Tuna Commission). It exists to enable more widespread, synergistic use of interagency satellite data for the oceans in support of Open Science and multidisciplinary applications for societal benefit, particularly among emerging user communities.
- The COVERAGE technology platform provides access to complementary satellite and *in situ* datasets from distributed sources via value-added data services.
- COVERAGE is demonstrating the utility of the approach through pilot thematic ecosystem applications defined jointly with partnering stakeholders.
- COVERAGE is participating in the UN Decade of Ocean Science for Sustainable Development on behalf of CEOS as a cumulative activity. It is also serving as joint CEOS liaison point (with the COAST *Ad Hoc* Team) to IOC on the UN Decade Process.
- COVERAGE “Ocean Shot” Concept: “*Next Generation Data Service Infrastructure for a Digitally Integrated Ocean Observing System in Support of Marine Science and Ecosystem-Based Management*”. This is linked to UN SDG 14 “life below water”, emphasizing the role of Earth observations and improved data infrastructures in supporting ecosystem-based management. This is being implemented in Phase C of COVERAGE.
- Providing Support for Key Stakeholders and Global Agendas: Inter-American Tropical Tuna Commission Partnership and Sargasso Sea Commission (GEF Project Partnership) – see [slides](#) for details of these partnerships.

Main discussion points:

- It was noted that there is ongoing collaboration with the CEOS ocean VCs in terms of constituent datasets, in particular for the development of additional Level 4 ocean colour datasets. COVERAGE is working with the VCs to bring data onboard. There is also participation of CEOS Agency representatives in the COVERAGE advisory board, to whom the team presents on the status of its work, and takes onboard the feedback received. Vardis noted there are still opportunities to further connect the dots with activities in CEOS. For example, some of the Phase C activities through COVERAGE could illustrate an SDG 14 related activity involving CEOS contributions.

2.25: CEOS Coastal Observations Applications Services and Tools (COAST) Ad Hoc Team [[slides](#)]

Presenter(s): Paul DiGiacomo (NOAA)

Main points:

- COAST was formally endorsed by the IOC as a UN Ocean Decade Contribution on June 8 (World Ocean Day). NOAA submitted the application paperwork on behalf of CEOS.
- Submission of the AHT Terms of Reference and Implementation Plan occurred in December 2020.
- COAST is proceeding under co-leadership by ISRO and NOAA for two pilot themes: Land2Sea and Sea2Land. There is the potential to add a Blue Carbon theme to the Land2Sea Pilot in 2022.
- Pilot product development is advancing in five thematic areas and three geographical pilot areas (Chesapeake Bay, Bay of Bengal, and West Coast of Africa) – with outreach to the La Plata Estuary and small island nations (Marshall Islands and USVI). These pilots are implemented with principles of co-design and co-development and are designed to be open, transparent, and accessible.
- Engaging with the SEO and using the CEOS EAIL content, including informal EAIL training sessions.
- Executed successful outreach and engagement efforts:
 - E-brochure and website content updates;
 - ECO Magazine article published on May 17, 2021;
 - GEO Virtual Summit 2021 side session on June 21, 2021;
 - ‘Engaging Users’ webinar hosted by GEO on October 5, 2021 (utilising guidance by WGCapD and EOTEC DevNet; jointly planned with CEOS CEO and GEO Secretariat).
- Seeking no actions for COAST at CEOS Plenary 2021, but strongly support the efforts by others on ARD and especially sustainment of the EAIL.

2.26: CEOS Coordination on Oceans [[slides](#)]

Presenter(s): Adam Lewis (GA, SIT Co-Chair) and SIT Vice Chair Team

Main points:

- At the 2021 SIT Technical Workshop, there was a discussion on CEOS ocean activities and coordination, including the idea that a new CEOS ocean and coastal strategy should be given consideration:

SIT-TW-2021-16	SIT Chair with SIT Vice Chair to present for consideration by the 2021 CEOS Plenary, the idea for CEOS to develop an Ocean Strategy. The objective at Plenary will be to give approval to explore the idea between now and SIT-37, and to identify CEOS experts for the effort.	CEOS Plenary
	<i>Rationale: Follow-up is needed to better understand the origins of the idea for CEOS to develop an Ocean Strategy, e.g., are the four CEOS ocean VCs recommending it, etc.</i>	

- IGOS demonstrated a holistic approach for thematic requirements setting and observation coordination. A crucial lesson was for the key user bodies to engage and coordinate the definition of requirements. Key stakeholders and activities include: GOOS/IOC, UN Decade of Ocean Science, SDG Stakeholders, GEO BluePlanet, and thematic groups (GHRSSST, IOCCG, IOVWST, OSTST). Key internal groups include (but are not limited to): the ocean VCs (OCR, SST, OST, OSVW), COVERAGE and COAST, and WGCV.
- Options moving forward include: improved communication of our ocean “offer”; better coordination and linking of existing activities; identifying new opportunities.
- Prerequisite is clear user need and counterpart(s), perhaps as a response to the IOC Decade of the Oceans, aligned to SDGs and statistical office needs, or other reference points.
- Multiple CEOS groups would need to be involved, with SIT Chair providing oversight.
- Propose preparation of a SIT-37 discussion by our relevant technical experts on the need for and optimal form of further CEOS coordination on ocean observations.

Main discussion points:

- Raj Kumar (ISRO) noted the complexity, given the large number of groups already working in this area. Raj asked how coordination will be handled. Adam Lewis (GA, SIT Co-Chair) responded that coordination is fundamentally what this is about.
- Kenneth Holmlund (WMO) welcomes this activity. WMO works closely with IOC, sharing many of the goals, objectives, and challenges, and addresses these issues from slightly different perspectives. WMO recently approved a new collaborative strategy, which will deepen their partnership and take a greater Earth system approach. The strategy will have implications on interoperable systems, data, info systems, etc. As we are in the ‘Ocean Decade’, now would be the time to bring together all of the activities under an umbrella of a CEOS Ocean Strategy. It is important for CEOS to contribute to activities ongoing in the broader community. WMO strongly supports the development of the CEOS Ocean Strategy, and is keen to contribute.
- Steve Volz (NOAA) noted that the needed coordination is both external and internal. There has been a need for an approach for some time. He supports the idea of developing a CEOS Ocean Strategy. However, the team needs to ensure there is internal VC coordination. Steve confirms NOAA’s support for this initiative. As NOAA has a large stake in ocean activities, the agency is happy to support.
- Selma Cherchali (CNES) raised a concern regarding better CEOS coordination on ocean observations, and whether a new strategy for coordination amongst the ocean VCs will be formed. Selma asked how the team sees the coordination happening at CEOS working level. Adam Lewis (GA, SIT Co-Chair) responded that the proposal is bigger than any one internal group in CEOS. It is about how we take

account of what is already happening and ensure internal harmonisation and effective external communication with stakeholders.

- Ivan Petiteville (ESA) commented there are plenty of ocean related activities underway by the VCs, COAST, COVERAGE, WGCV, etc., as well as important external events, SDGs, Ocean Decade, etc. This is the right time for CEOS to agree on a set of coherent and coordinated objectives for the following years. Ivan suggested assembling a small team to work towards providing an input for SIT-37 [March 2022]. ESA as SIT Chair is willing to be a part of this team. Selma Cherchali (CNES) and Raj Kumar (ISRO) supported the suggestion.
- Sandra Cauffman (NASA) recommended assembling a coordination plan in consultation with all of the ocean VCs, WGs, etc.
- Eric Laliberté (CSA) supported the need for a CEOS Ocean 'strategy' or 'integrated vision' to support coordinated internal and external engagements.
- Mark Dowell (EC) suggested a CEOS Strategy is about better internal coordination for CEOS' cumulative contributions to external requirements and needs on ocean/coastal issues (and engagement with external peers).
- Sandra Cauffman (NASA) suggested that CEOS is gradually working toward better coordination among the various ocean-related activities. Rather than a 'strategy', it may be more appropriate for Plenary to recommend working toward a coordination plan in consultation with the four Ocean VCs, WGs, COVERAGE, COAST, etc. In addition, CEOS will need to assess the needs or requirements – as has been the case with successive GCOS Implementation Plans.
- Mark Dowell (EC) noted that the new ocean and climate change dialogue in SBSTA is also a new external demand that will become more prominent in the next few years.
- Karen St. Germain (NASA, CEOS Chair) noted there is significant interest in exploring the idea of an ocean strategy/coordination plan to ensure that the ocean-related activities across both CEOS and externally have strong coordination and collaboration.
- Selma Cherchali (CNES), Raj Kumar (ISRO), Kenneth Holmund (WMO) and Robert Husband (EUMETSAT) expressed interest in participating in the group.

CEOS-35-02	ESA SIT Chair to seek CEOS Agency nominations for a small working team to scope options for improved coordination and communication of the full range of CEOS ocean-related activities and groups. The SIT Chair-led team will prepare an agenda item at SIT-37 to allow Principals to review progress.	15 December 2021
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2.27: CEOS Biodiversity Activity – Opportunities for More Robust CEOS Engagement [[slides](#)]

Presenter(s): Gary Geller (NASA)

Main points:

- Biodiversity is the variety of life in all its forms and scales—so it includes a variety of ecosystems. This is particularly important with respect to space agencies since space-based observations are particularly relevant to ecosystems—there is no better way to monitor whole ecosystems.

- Organisations working in this space have some very clearly identified needs that are not yet being met and to which space-based EO – and CEOS – can contribute. Indicators for the conventions are a good example. Many are not yet available, or only for limited areas or time frames.
- GEO BON can facilitate discussion of user needs with CEOS and its members.
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is the biodiversity equivalent of the Intergovernmental Panel on Climate Change (IPCC).
- Biodiversity and climate are both under threat, systemically intertwined, and have strong societal dependencies. Climate has Essential Climate Variables (ECVs); biodiversity has Essential Biodiversity Variables (EBVs).
- CEOS members already play a key role in space-based EO and measurements for Biodiversity. CEOS can leverage this and make EO even more pivotal to the biodiversity effort.
- Challenges that CEOS can address:
 - o Awareness of its activities by the biodiversity community;
 - o Utilization of EO for biodiversity science and monitoring;
 - o Filling gaps in important indicators
 - o Leveraging CEOS and agency connections to identify new collaborations;
 - o Increasing utilization of EBVs and derived products.
- Gary asked CEOS to support the biodiversity activity by, for example, hosting a meeting or supporting more time for experts to engage. One key aspect CEOS can support is by providing another co-lead for the CEOS biodiversity activity.

Main discussion points:

- Raj Kumar (ISRO) agreed that biodiversity is a very important topic and an indicator for climate change. He suggested that perhaps a small group could be formed under WGClimate. After some time, the group could move to a virtual constellation or a separate Working Group.
- Eric Lalibreté (CSA) noted that the post-2020 Global Biodiversity Framework, which is to be endorsed at the UN Biodiversity Conference 15 in China in 2022, covers a lot of activities CEOS is doing now. CEOS has been discussing biodiversity on-and-off for years. A group could bring together CEOS leads and the UN convention about the need for remote sensing satellite products. We need to make sure there is a connection and understand what the goals and targets will be.
- Alex Held (CSIRO, SIT Co-Chair) noted that CSIRO is interested in joining a discussion group around specific contributions that we and CEOS can make to characterise and track changes in biodiversity.
- Adam Lewis (GA, SIT Co-Chair) asked, given the strength of the relationship between biomass and biodiversity, if there are opportunities in the recent work to harmonise global biomass measurements.
- Marc Paganini (ESA) noted the adoption of a new statistical standard for ecosystem accounting by the UN. Ivan Petiteville (ESA) stated that ESA (Marc Paganini) is ready to take part in a CEOS discussion group on biodiversity.
- Gary agreed that establishing a discussion group would be a good start. An action is recorded later in the meeting when the topic is revisited.

Wednesday, November 3

Session 3: Partnering with Purpose for Open Science and Decision Support

Karen St. Germain (NASA, CEOS Chair) welcomed everyone to the third day of the meeting and highlighted the focus points for the day. Karen also noted that rather than a synthesis report, this year's plenary agenda gives the VCs a platform to showcase their work and accomplishments to the CEOS community, especially for new CEOS Principals, Members, and Associates to consider what activities their respective agencies may want to support.

Karen St. Germain emphasized that broadening the swath of agencies that contribute to CEOS activities, large and small, builds the capacity of CEOS to deliver on its commitments and to take on new ones. Karen also noted that some members of Working Groups, Virtual Constellations, and task teams have been doing this for as long as ten years. Burden sharing has become a priority as CEOS Agencies dedicate more and more resources to support global agendas, to advance Analysis Ready Data, and now, to scope options for improved coordination and communication across the full range of CEOS ocean-related activities and groups. These are just a few examples of why expanding membership and engaging all CEOS Agencies to support the growing body work must also be a focus and priority for future CEOS leadership.

3.28: Presentation on Open Science [\[slides\]](#)

Presenter(s): Kevin Murphy (NASA, Chief Science Data Officer)

Main points:

- Open-source science is characterised by transparency, inclusivity, accessibility, and reproducibility.
- Highlighted the benefits and principles of open source science. It broadens participation, collaboration in scientific investigations by lowering barriers to entry, increases the diversity, promotes transparency and reproducibility, shortens the time it takes for a new user to find and learn how to use data, enables scaling, and so on.
- This is especially important given new missions set to launch in the coming years as part of NASA's Earth System Observatory. Data is the foundational layer for making science open. So, open source science will help in open teaching and learning culture allowing more people to participate.
- NASA is beginning a new project called Transform to Open Science (TOPS), a 5-year effort focused on capacity building, partner engagement, and incentives to help accelerate scientific discovery through open science. Inviting all CEOS partners to engage in this effort.
- The open source science plan will include at a minimum: data management plan, open source software development plan, licenses, open scientific collaboration plan, documentation plans, attribution requirements, and a FAIR plan.
- Data integration with the Multi-mission Algorithm and Analysis Platform (MAAP) will enable more collaborative science.

Main discussion points:

- Alex Held (CSIRO, SIT Co-Chair) thanked Kevin and NASA for this new effort. He noted agencies are bound by their government's data policies and asked about the kinds of arguments that can be made for open data policies. Kevin noted these are substantial investments by governments, and one argument is to realise the full benefit of this investment by allowing people to access the information so they can build the economic system by using the information and building software infrastructure.

Satellite data is useless if it does not go out to the public. Of course, there is some sensitivity related to the information but, when more data is available, it makes the information more valuable.

- Karen St. Germain (NASA, CEOS Chair) noted the challenge is in driving cultural change. Kevin noted there is a lot of momentum in existing workflows. He noted the incentive of tools such as GitHub (if you publish your work there, it is recorded and recognised as your work). Recognition of open contributions is important and can encourage open platforms in the CEOS community.
- Karen added that one of the biggest arguments in support of open science is accelerating the scientific process, learning new things, building understanding, accelerating the uptake, and making information more accessible and open to communities who were previously excluded. New communities interrogate the data in different ways which promotes uptake.

3.29: CEOS Support of the 2021 CEOS Chair Theme

Presenter(s): Karen St. Germain (NASA, 2021 CEOS Chair)

Main points:

- The CEOS community embraced the open science theme and provided valuable inputs to the implementation plan. 17 objectives linked to 12 deliverables were identified and these have been progressing well.
- Karen highlighted the accomplishments of CEOS: release of EAIL; EOTEC DevNet; WGCapD webinar series; WGCapD Jupyter Notebook training webinar; WGClimate use-cases for climate data; Essential Climate Variable (ECV) inventory; Open Data Cube Sandbox through Open Earth Alliance; CEOS Communications team drafted articles to demonstrate open data and science; contributed data and tools to UN Habitat Urban tool kit; WGCV Land Product Validation Subgroup delivered the Aboveground Woody Biomass Product Validation Good Practice Protocol; released Biomass dashboard; WGDisasters obtained observer status for the International Charter Space and Major Disasters; and many more.
- CEOS should continue to support open science and accessibility to open data as a core objective.
- CEOS should continue to uphold its responsibility as a world leader for open science.
- CEOS should continue to be a known vector for capacity building in remote sensing data utilization and open data outreach.
- Karen expressed her appreciation to the CEOS community for continuous support of the 2021 CEOS Chair theme.

3.30: CEOS Analysis Ready Data (ARD) [[slides](#)]

Presenter(s): Adam Lewis (GA, SIT Co-Chair) and Ed Armstrong (NASA, SST-VC Co-Lead)

Main points:

CEOS ARD Governance Framework and Product Family Specification (PFS) Template

- The [CEOS ARD Governance Framework](#) is presented for endorsement. It seeks to formalise the process LSI-VC has used for CEOS ARD for Land (CARD4L) and explores the specifics of the broadened CEOS ARD concept ‘beyond land’.
- The CEOS ARD Governance Framework covers: generalised CEOS ARD definition; the role of the Product Family Specifications (PFS); PFS core elements; development process for new PFS; self-

assessments and CEOS roles in the process; the general process for peer review of self-assessments and approval of CEOS ARD datasets; classification and promotion of CEOS ARD datasets; and the role of Advisory Notes in providing guidance on aspects like file formats, etc. which are not part of the core Framework.

- The Governance Framework is accompanied by a template Product Family Specification (PFS). PFS will be developed when producers, experts and users perceive that there is a benefit and are prepared to invest in the effort to develop PFS, manage the process, and undertake to produce the data. The template PFS has been developed to provide a starting point for future PFS, to ensure commonality in layout, general structure, interpretation and approach. It provides a foundation and common suite of assessment factors for all PFS (optical, radar, etc.), as well as stipulations for additional required factors.
- More information on the status of CEOS ARD Specifications and datasets can be viewed on the ceos.org/ard website.
- The Governance Framework and PFS template have been developed over the past year with the involvement of many CEOS groups, including AC-VC, COAST, P-VC, LSI-VC, SST-VC, and many others.
- A key part of the expanded CEOS ARD governance is the concept of a CEOS ARD Oversight Group. The intention is to provide a forum for all matters related to CEOS ARD where all of the CEOS entities with a role in CEOS ARD can come together and discuss topics around CEOS ARD, and provide the coordination needed to ensure CEOS ARD is coherently represented in the broader (rapidly moving) community. Representatives from the CEOS Virtual Constellations are integral to the effort going forward, as these are the CEOS entities with the technical expertise to recommend, develop and maintain Product Family Specifications. The SIT Chair Team and CEOS Executive Officer have also been identified as key participants.

CEOS ARD Strategy 2021

- The [CEOS ARD Strategy 2021](#) seeks to provide the direction for the next stage of CEOS activity on ARD. The strategy aims to ensure that CEOS data is highly impactful and sustainable, including via an increased scope of the CEOS ARD concept beyond the land domain. Leadership, governance, and accessibility and utilisation of CEOS ARD emerge as pillars of the strategy.
- The CEOS ARD Strategy 2021 has been developed throughout the year with input from many people across CEOS. The draft was presented to the SIT Technical Workshop. Further adjustments were made based on feedback received during and following the workshop, and the document is now presented for endorsement.

Main discussion points:

- Karen St. Germain (NASA, CEOS Chair) recalled the CEOS Mission Statement and noted the key role CEOS ARD plays in its implementation: *“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”*.
- Ivan Petiteville (ESA) stated that the CEOS ARD concept is a real ‘game changer’. Ivan thanked Adam for his instrumental and visionary input to this concept, as well as everyone in CEOS that has progressed this important area of work. He added that there is significant interest in CEOS ARD from the private sector. ESA endorsed both the CEOS ARD Strategy 2021 and the CEOS ARD Governance Framework and nominated Ferran Gascon (ESA, Sentinel-2 mission manager) to the CEOS ARD Oversight Group.

- Steve Volz (NOAA) welcomed the evolution and continued development of CEOS ARD. He is particularly keen to see it expanding beyond land imaging. This is a key step to making CEOS data usable by a broad community.
- There was a discussion regarding the reporting structure and lead for the CEOS ARD Oversight Group. It was agreed that the group will report to the SIT Chair during 2022 and governance will be revisited at the 2022 SIT Technical Workshop to prepare for discussion at the 36th CEOS Plenary. ESA as SIT Chair will provide leadership for this period.
- Steve Volz (NOAA) supported reporting to the SIT Chair for now, and NOAA endorses based on this, however CEOS should keep in mind the growing list of responsibilities placed on the SIT Chair.
- Sandra Cauffman (NASA) stated that NASA endorses the CEOS Analysis Ready Data (ARD) Strategy 2021 and thanked the CSIRO-GA SIT Chair Team and all CEOS Agencies whose experts helped develop the Strategy.
- Selma Cherchali (CNES), Watanyoo Suksa-ngiam (GISTDA), Timothy Stryker (USGS), Osamu Ochiai (JAXA), Sandra Cauffman (NASA), Julio Castillo (AEM), Klaus Schmidt (DLR), Christo Whittle (SST-VC), Eric Laliberté (CSA), Mauro Facchini (EC), Oskar Zdunek (POLSA), Laura Frulla (CONAE), and Alex Held (CSIRO) added their endorsement of the CEOS ARD Strategy 2021 and the CEOS ARD Governance Framework.

Decision 35-16	Plenary endorsed the CEOS Analysis Ready Data (ARD) Strategy 2021.
Decision 35-17	Plenary endorsed the CEOS Analysis Ready Data (ARD) Governance Framework.

CEOS-35-03	ESA SIT Chair to seek CEOS Agency nominations for the newly established CEOS ARD Oversight Group consistent with the ARD Governance Framework document endorsed by the 2021 Plenary. The Group will report to the SIT Chair during 2022 and governance will be revisited at the 2022 SIT Technical Workshop to prepare for discussion at the 36th CEOS Plenary.	15 December 2021
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Session 1 (continued): CEOS Core Business – Virtual Constellation Reports

Karen St. Germain (NASA, CEOS Chair) prefaced this segment with brief comments. This year’s opportunity for the Virtual Constellations (VCs) to present directly at Plenary serves to recognize their hard work and coordination, internally and with stakeholders. We hope this provides further elevation of the critical work of the VCs. It will also serve to demonstrate that adding to the remit of CEOS has direct consequences and implications for those advancing already robust portfolios. Broadening the swath of agencies that contribute to CEOS activities, large and small, builds the capacity of CEOS to deliver on its commitments and to take on new ones. Karen also commended the efforts of SIT Co-chairs, Alex Held and Adam Lewis, in providing a platform for VCs to report at CEOS Secretariat meetings over the past two years.

1.31: Land Surface Imaging Virtual Constellation (LSI-VC) [[slides](#)]

Presenter(s): Steve Labahn (USGS)

Main points:

- The LSI-VC welcomes Peter Strobl (European Commission) and Andreia Siqueira (GA) as Co-Leads (Jonathon Ross will be acting as Co-Lead from GA until Andreia returns from long-term leave). LSI-VC farewells Adam Lewis (GA) and Zoltan Szantoi (European Commission) as Co-Leads and thanks them for all they have done for LSI-VC, CEOS ARD, and open science.
- CEOS ARD for Land (CARD4L) remains a core focus for LSI-VC (ceos.org/ard). CARD4L is clearly aligned with the “*Space-based Earth Observation Data for Open Science and Decision Support*” theme of the CEOS Chair – supporting data accessibility, transparency, and reproducibility.
- There has been great progress on CARD4L Product Family Specifications (PFS) and assessments, with special thanks to WGCV and Medhavy Thankappan of GA.
- Thanks to JAXA for leading the SAR CARD4L work, including the recent revision of the two SAR CARD4L Product Family Specifications (PFSs).
- The LSI-VC team is currently developing PFS for Aquatic Reflectance, Nighttime Lights Surface Radiance, additional radar PFS, and a LiDAR PFS.
- Agency reach of CARD4L is increasing, with KARI, DLR, CSIRO, ISRO, and SANSA all undertaking or planning product assessments – in addition to those from JAXA, ESA, and USGS. LSI-VC encourages all CEOS Agencies to be involved. There are also various private sector assessments against CARD4L ongoing.
- LSI-VC welcomes the endorsement by Plenary of the CEOS ARD Governance Framework and CEOS ARD Strategy 2021. LSI-VC supports the template PFS and CEOS ARD Oversight Group.
- LSI-VC also continues its assessment of land observation gaps and requirements; application and development of CEOS tools (MIM, COVE); pursues interoperability topics, including data formats (COG, STAC, metadata), related standards, and liaising with other VCs; and plans to explore global grid solutions (such as DGGS) with the goal to reach convergence and community acceptance.
- Forests & Biomass Subgroup: The AFOLU Roadmap has been a strong focus for the subgroup in 2021 – targeting initial products for COP26/GST1, including contributions to the CEOS GST Strategy development and the GST Portal. The team is currently exploring a national pilot with Digital Earth Africa to bring together the land-related datasets that CEOS is compiling for the first UNFCCC Global Stocktake in 2023. In 2022, the Subgroup will focus on the AFOLU Roadmap development, harmonisation of biomass and land cover products, and further GHG-AFOLU integration. Ben Poulter (NASA) will join as a Co-Lead of the subgroup, alongside ESA and JAXA.
- GEOGLAM Subgroup: GEOGLAM and CEOS priorities are closely aligned. Open science and co-development of agricultural monitoring systems that derive essential variables at the national level support early warning, NDC’s, and help to address the SDGs. GEOGLAM has a new initiative to better coordinate *in situ* data and develop product intercomparison best practices, building on the work of the CEOS WGCV LPV. Improved *in situ* data supports the development of priority datasets that address the EAVs. Essential variables are supported by ARD and open data access.

Main discussion points:

- Mark Dowell (EC) applauds the work of LSI-VC, which is a testament to how the VCs can be responsive to the thematic priorities of CEOS, including on the implementation side. The response to the new

needs for the AFOLU sector in particular has been impressive. Mark welcomed Peter Strobl stepping up to take over as LSI-VC Co-Lead for Zoltan Szantoi who has departed the EC, noting Peter has a broad overview of CEOS activities due to past involvement and will be a great asset.

1.32: Atmospheric Composition Virtual Constellation (AC-VC) [[slides](#)]

Presenter(s): Barry Lefer (NASA)

Main points:

- Leadership Status: Diego Loyola (DLR) leads Tropospheric Ozone, Shobha Kondragunta (NOAA) leads Air Quality Aerosol, and David Crisp (NASA/JPL) leads Greenhouse Gases. David Crisp has been a valuable and key member of the AC-VC leadership team, and is retiring from NASA JPL at the end of 2021. His JPL colleague, John Worden, has been approved by NASA's Earth Science Division to take over David's role as lead of the AC-VC Greenhouse Gas (GHG) activity.
- The GHG Roadmap implementation is a key focus for AC-VC. This involves tracking the status of GHG sensors, products, retrieval algorithms, flux inversion capabilities, validation infrastructures, etc., as well as contributing to implementation of the CEOS-CGMS WGClimate GHG Roadmap; coordinating global, space-based inventories of CO₂ and CH₄ (CARB-21-01); preparing example products for local emission hot spots; coordinating with WGClimate, the GHG Task Team and the AFOLU Roadmap Team; and participating in the UNFCCC *Ad Hoc* Coordination Group on Systematic Observations.
- Ozone Activities: AV-VC has continued working on tropospheric O₃ datasets, validation and harmonisation (VC-20-01), as well as the Tropospheric Ozone Assessment Report, including participation in the upcoming Phase II (TOAR-II) Manuscript Scoping Event held 16-18 November, 2021. AC-VC has participation in several of the 14 Focus Working Groups, providing a strong AC-VC linkage to the International Global Atmospheric Chemistry Project. Stratospheric and Tropospheric Ozone datasets and analysis by CEOS Agencies are to be utilised in the Climate Change 2021 IPCC AR6: *The Physical Science Basis*. AC-VC also actively participated in the Quadrennial Ozone Symposium 2021.
- Air Quality (Trace Gases) Activities: The team is coordinating validation activities (VC-20-02), while the Sentinel-4 and 5 cal/val plan has been jointly issued by ESA and EUMETSAT (VC-20-03). The international GEMS instrument cal/val activities are currently underway by multiple agencies (VC-20-04), linking the work of AC-VC to WGCV. AC-VC also presented on trace gases at EGU (Sentinel-4 and GeoXO ACX).
- Air Quality (Aerosol) Activities: AC-VC is progressing the production of a whitepaper on *Enhancing the Role of Satellite Observations in Monitoring Surface PM_{2.5}*, with completion expected in the first quarter of 2022 (VC-20-05). This work aligns with AEROSAT/AEROCOM, as well as with GSICS on radiometric consistency of sensors. The team is also working on the status of aerosol observations for both current and future satellite missions.

1.33: Precipitation Virtual Constellation (P-VC) [[slides](#)]

Presenter(s): Chris Kidd (NASA)

Main points:

- Chris acknowledged the passing of Dr. Gail Skofronick-Jackson (1963-2021) and expressed gratitude for her years of work in the CEOS P-VC and beyond. He conveyed condolences to friends and family. Gail was an active and respected member of the P-VC team and she will be missed greatly.

- The primary role of P-VC is to establish an international framework to guide, facilitate, and coordinate the continued advancement of multi-satellite global precipitation measurements. Its original purposes included:
 - o Facilitating implementation of the Global Precipitation Measurement (GPM) mission and encouraging more nations to contribute to the GPM constellation. GPM is currently in its 8th year of operation.
 - o Sustaining and enhancing an accurate and timely global precipitation data record, including a Fundamental Climate Data Record fit for the purposes specified by GCOS for the monitoring of precipitation as an Essential Climate Variable (ECV).
- P-VC goals:
 - o Maintain and enhance the precipitation constellation through current missions, including continuation of precipitation-capable missions beyond end-of-life (where practical) and for mitigation strategies where necessary.
 - o Development and integration of new satellites and sensors to provide a viable and sustainable precipitation constellation, including new technologies (such as EPS-SG, AMSR-3, CIMR, AOS/ACCP, etc.).
 - o Develop and refine retrieval schemes to provide precipitation products to the research and user communities, from near-real-time instantaneous products through to climate-scale data records.
 - o Validate precipitation products through maintaining, expanding, and exploiting global ground validation data.
- P-VC is an integral part of the larger precipitation community with interactions with the GPM science teams and the CGMS International Precipitation Working Group.
- Various papers and reports related to satellites and sensors, P-VC activity, and reports with CGMS/IPWG have been released in 2021. Details of the documents can be found in the [slides](#).
- TROPICS Pathfinder was launched on 30 June 2021 into a sun-synchronous polar orbit. Six constellation satellites will launch from 2022 in three low-inclination orbital planes.
- GOSAT-GW/AMSR3 is one of the future missions of P-VC. AMSR-3 (AMSR-2 follow-on) will be installed on the GOSAT-GW (Global Observation SATellite for Greenhouse gases and Water cycle) along with the GHG mission, TANSO-3. The target launch date is JFY2023 (April 2023 to March 2024).
- NASA's Atmosphere Observing System (AOS) is another future mission. A NASA-led study on the Earth Science Decadal Survey Aerosols and Clouds, Convection, and Precipitation designated observables has resulted in the Earth System Observatory/Atmosphere Observing System (ESO/AOS). This will include two projects, with a polar component focused on global climate change-related processes, and an inclined component on processes over varying times of day. The missions will include doppler radars, passive microwave radiometers, lidars, multi-angle polarimeters, tandem stereo cameras and UV-to-far-IR spectrometers.
- International contributions from JAXA, CSA and CNES are being studied. JAXA is studying the feasibility of a next-generation precipitation (Ku) radar with the Japanese science team and user community. JAXA's targets for the next generation precipitation radar will be Doppler observations, and higher sensitivity measurements with scanning capability. CNES is studying tandem microwave radiometers for time-difference (1-2 min) measurements, while CSA is providing a longwave spectrometer and studying limb sounders for aerosols and moisture.

1.34: Ocean Surface Topography Virtual Constellation (OST-VC) [\[slides\]](#)

Presenter(s): Estelle Obligis (EUMETSAT)

Main points:

- The main goal of the Ocean Surface Topography Virtual Constellation (OST-VC) is to implement a sustained, systematic capability to observe the surface topography of global oceans from the basin scale to the mesoscale.
- OST-VC's mission timeline was shared, noting that SARAL has been extended for two more years in a drifting phase; the data is still useful for oceanographic (operational wave modelling, mesoscale studies) and geodetic applications. Jason-3 has been extended for five more years. HY2-D was launched in May 2020.
- The SWOT mission is on track and will be launched in November 2022. It will have the first wide swath altimeter (KaRIn) which is expected to be used by ocean, hydrology and coastal scientists.
- Sentinel-6 Michael Freilich was launched on 21 November 2020 and is performing nominally. Operational release of all Level 2 products is planned for early December 2021, and the estimated completion of POS-4 Side B commissioning activities is February 2022. The JSG meeting to be held in March 2022 will aim to establish Sentinel-6 as a reference mission. Sentinel-6B is planned to launch in November 2025.
- An action from the 2019 SIT-35 meeting asked OST-VC to update the “*Next 15 Years of Altimetry – OST Constellation User Requirements*” document (from 2009). The delivery of the white paper was expected in Q1 2022, however, many constraints such as new missions, OSTST renewal and COVID-19 have led to a delay. A new schedule targets delivery in Q1 2023.

Main discussion points:

- Steve Volz (NOAA) looks forward to the update of the ‘Next 15 Years of Altimetry’ document. These reports are very high value for agencies as they seek to determine future investment strategies.

1.35: Ocean Surface Vector Wind Virtual Constellation (OSVW-VC) [\[slides\]](#)

Presenter(s): Stefanie Linow (EUMETSAT)

Main points:

- Reviewed the current status and future of the VC's missions. See [slides](#) for a timeline.
- OSVW observation requirements vary greatly depending on the spatial and temporal scales of phenomena that need to be captured in a model, and sampling requirements in space and time are driven by the need to capture this variability.
- The minimum requirement of the constellation calls for at least three scatterometers in orbits designed to roughly meet WMO needs (observations every six hours). Also, one instrument should be in a non-sun-synchronous orbit for sampling the diurnal cycle, to provide better mid-latitude sampling, and to provide inter-calibration data.
- Spaceborne scatterometers (C, Ku-band) are the trusted reference standard to provide global ocean surface wind vector data. Other remote sensing techniques have demonstrated varying capabilities at retrieving ocean surface winds, including microwave radiometers (multi-frequency / polarimetric / L-band), Synthetic Aperture Radar (SAR), GNSS-R and HF radars (regional coverage but frequent

temporal refresh). The team is considering how these other techniques compare with microwave scatterometry and where they fit within the OSVW observing system portfolio.

- Ongoing efforts in the IOVWST community on quality assessment of data products and wind retrievals include: wind retrievals during extreme wind, GMF development and validation, comparison of wind retrieval algorithms, assessment of rain effects in the tropics (particularly relevant for Ku-band instruments), spatial scaling effects, generation of a quality-controlled wind reference dataset linking dropsondes / buoys / SFMR (plane-based measurements) / SAR data, and cross validation of C-band and Ku-band retrievals.
- OSVW-VC works closely with the Ocean Surface Wind Task Group (OSW TG) in the CGMS IWWG that coordinates actions/recommendations with GSICS, CEOS, IOVWST, and other relevant entities.
- Within WGCV, a working team has been formed to consolidate standards and metrics, prepare a draft work plan, and share datasets for intercalibration and consolidation of standards and metrics.
- Future focus will be to clearly articulate what needs to be measured and why, how often, under what environmental conditions, and at what spatial resolution. This is important as there are many competing technologies making various claims to be able to provide ocean wind products, and data providers and users need to be able to objectively evaluate these technologies using a solid foundation based on data and facts. Users need to be able to differentiate products that are developed to retrieve actual winds versus products that are tuned to infer maximum wind speeds.

Main discussion points:

- Steve Volz (NOAA) asked whether there is a plan for a prospectus/look into the future of scatterometry. Understanding the future direction of OSVW technology will help with agency planning. Stefanie noted the ongoing production of an IOVWST white paper. Steve suggested that the incoming SIT Chair consider this topic in planning the SIT-37 meeting.
- Raj Kumar (ISRO) added that the VC is looking into this from the user point of view to determine exact requirements. The team is also investigating other technologies to work alongside scatterometers. OSVW-VC is discussing this with IOVWST and the new task group formed by CGMS.

1.36: Sea Surface Temperature Virtual Constellation (SST-VC) [[slides](#)]

Presenter(s): Christo Whittle (CSIR for SANSA)

Main points:

- The SST-VC has collaborated with the SIT Chair and other CEOS VC members on the development of the CEOS ARD Product Family Specification Template and the CEOS ARD Governance Framework.
- ESA and SANSA have collaborated to provide an ISAR for deployment during the BENFLEX cruise in southern Benguela during December 2021.
- ESA extended FRM4SST funding and support to conduct a CEOS shipborne radiometer intercalibration workshop and to maintain FRM activities.
- EUMETSAT indicated a planned release of a demonstration SLSTR sea-IST product for 2021 and expanding the release of TRUSTED drifting buoys to 150 by the end of 2021.
- KMA developed a new air-sea temperature difference product, JAXA is producing gap-free high-frequency model SST data (with assimilated satellite SST) around Japan, and ISRO produced a new algorithm for SST retrieval from INSAT-3D/3DR based on the 1DVAR technique.

- Earth observation, model and reanalysis data used to develop decision support tools have been distributed via South Africa's National Oceans and Coastal Information Management System. There has also been a regional expansion of services in the GMES & Africa Initiative: *"Africa Marine and Coastal Operations for Southern Africa"* (MarCOSouth).
- Current and future activities of the SST-VC include:
 - o Extend regional MODIS EO products to the present;
 - o Ingestion of regional EO products into a marine Data Cube to facilitate time-series metrics for decision support;
 - o Validate SST on Benguela shelf from 3 hydrodynamic models (BRAN, GLORYS and NGHYCOM);
 - o Participate in BENFLEX during December 2021;
 - o Collaborate with COVERAGE to include regional Benguela EO products as a test case.

1.37: Ocean Colour Radiometry Virtual Constellation (OCR-VC) [[slides](#)]

Presenter(s): Laura Lorenzoni (NASA)

Main points:

- The OCR-VC is working towards a CEOS Aquatic Carbon Roadmap. A community workshop is being held on 14-18 February 2022, under the leadership of ESA and NASA. It will be an online workshop with a white paper output. There is also an Earth Science Reviews special issue being produced, titled: *"Aquatic Carbon Stocks and Fluxes: The Big Picture from Remote Sensing"*, with publication anticipated in December 2022.
- The team has also been working on OCR system vicarious calibration infrastructures for the CEOS white paper on a strategy for global OC-SVC infrastructures.
- OCR-VC has been contributing to the UN Decade of Ocean Science Themes. Contributions include to the theme: *A Clean Ocean, A Safe Ocean, A Healthy and Resilient Ocean, A Predictable Ocean, and A Transparent Ocean – Open Access to Data, Information, Technologies*.
- OCR-VC agencies aim to facilitate easy online access to complete OCR data time series and processing information.
- To contribute to capacity building, OCR-VC will target students, early-career researchers, researchers from developing countries and underserved communities, as well as provide open online access to complete OCR data time series and processing information, and support transversal initiatives such as COVERAGE.
- The major challenges include extending the reach of capacity building initiatives, working towards open science principles, and new capacity building initiatives.

Main discussion points:

- Ivan Petiteville (ESA) commented on the work of OCR-VC with activities that are being done in relation to the UN Decade on Ocean Science, and asked what is the best way for CEOS to contribute to the Decade, and what should be the priorities for CEOS. Laura noted there is so much we can do to support the Decade, including a time series of ocean colour measurements, which enables us to see how the ocean has been changing and give a view on how the ocean might change in the future. Providing and ensuring that satellite data are included is a fundamental tool to better manage the ocean for future generations. There are a number of ways CEOS could contribute, mostly notable by ensuring strong

engagement, and providing and ensuring satellite data are included wherever applicable to the Decade.

- Raj Kumar (ISRO) asked whether the VC is discussing standards with respect to long-term data. Laura noted the VC is working together and collaborating on the design of new missions and better algorithms. IOCCG protocols are critical to ensuring all agencies are measuring consistently. Coastal zones can be challenging due to access constraints, so this coordination is especially important.

Day 3 – Closing

Main points:

- Karen St. Germain (NASA, CEOS Chair) thanked Sandra Cauffman (NASA, CEOS Chair Team) for her work with CEOS, as she transitions into the role of Deputy Director of the Astrophysics Division in NASA’s Science Mission Directorate.
- Sandra thanked Karen for her kind words and noted that it has been a tremendous honor to work with CEOS colleagues. Sandra added that she will miss NASA’s Earth Science Division. She also noted that she considers all CEOS members across the globe as colleagues and looks forward to seeing the work of CEOS in the future.

Thank You and Farewell to Sandra Cauffman



- Became Deputy Director, Astrophysics Division on Oct. 24, 2021.
- Has been Deputy Director, Earth Science Division since 2016, and was Acting Director from February 2019–early June 2020.
 - Leader in CEOS since 2016, instrumental in NASA Chair year.
- Prior to joining NASA Headquarters, spent 28 years at Goddard Space Flight Center.
- Awarded the NASA Exceptional Achievement Medal, and twice the NASA Exceptional Leadership Medal.
 - Four-time recipient of NASA Acquisition Improvement Award
- Costa Rica issued a postage stamp in her honor on International Women’s Day in 2017 due to her extensive work in outreach and STEM in Costa Rica and Latin America.
- Her profile has been highlighted by the United Nations Entity for Gender Equality and the Empowerment of Women for being a positive example for women, especially youth and children

Thursday, November 4

Session 4: CEOS Leadership Transitions and Closing Business

Karen St. Germain (NASA, CEOS Chair) welcomed everyone to the final day of the 2021 CEOS Plenary. Day 4 will have a particular focus on the transition of CEOS leadership. Karen recognised the outstanding work of the CSIRO-GA SIT Chair Team. She thanked the NASA CEOS Chair Team, and she encouraged the incoming CEOS Chair and SIT Chair teams to work together closely, as well as with the CEOS Executive Officer and the CEOS Systems Engineering Office.

JAXA SIT Vice Chair Nomination

Takeshi Hirabayashi (CEOS Principal from JAXA) announced JAXA's self-nomination for the role of SIT Vice Chair, commencing at the end of the 2021 CEOS Plenary, consistent with CEOS governance. This term will be followed by two years of SIT Chair, concluding at the 2025 CEOS Plenary. JAXA has served in this role in the past and is looking forward to working with ESA as SIT Chair.

Main discussion points:

- Ivan Petiteville (ESA) stated that ESA is pleased to work with JAXA for the next two years. ESA fully endorses the JAXA nomination. CEOS has experienced the professionalism of JAXA through its past leadership roles. JAXA has always been instrumental to the success of CEOS.
- Selma Cherchali (CNES) welcomed the JAXA nomination for the incoming SIT Vice Chair role. JAXA has been a key supporter of the CEOS community, and CNES looks forward to working with JAXA in this role.
- Steve Volz (NOAA), Maree Wilson (GA), Timothy Stryker (USGS), Astrid-Christina Koch (EC), Eric Laliberté (CSA), Selma Cherchali (CNES), Alex Held (CSIRO), Raksina Lekthanoo (GISTDA), and Laura Frulla (CONAE) supported the endorsement via chat.
- Karen St. Germain (NASA, CEOS Chair) added that NASA is pleased to see CEOS leadership strengthened by the JAXA nomination to be the 2022-2023 SIT Vice Chair, and the 2024-2025 SIT Chair. She thanked Takeshi Hirabayashi and said that NASA emphatically supports and endorses this nomination.
- Takeshi Hirabayashi (JAXA) thanked everyone for their support. With COVID-19, climate change, natural disasters, etc. it is clear that Earth observation satellites will play a big role in society going forward. JAXA looks forward to working with CEOS colleagues to support multiple global agendas.

Decision 35-18

Plenary endorsed and welcomed the Japan Aerospace Exploration Agency (JAXA) as SIT Vice Chair for 2022-2023 and SIT Chair for 2024-2025.

Biodiversity Topic Revisited

Gary Geller (NASA) noted that there was interest in further discussion on how CEOS can contribute to monitoring biodiversity change. Particular interest was indicated for supporting the Convention on Biological Diversity (CBD) and the post-2020 global biodiversity framework.

Main discussion points:

- Eric Laliberté (CSA) welcomed the establishment of a discussion group in CEOS and suggested CEOS identify a concrete next step. He suggested that CSA could take action to facilitate a meeting with the Convention on Biological Diversity (CBD), being geographically co-located with UN CBD offices.
- Ivan Petiteville (ESA) commented that biodiversity is a challenge that impacts all nations. ESA is interested in being part of the discussion group. He also noted the CEOS New Initiatives Process and External Requests Process, which should be checked. Ivan suggested that Marie-Claire Greening (CEO) work with Gary and CSA to consider the necessary process.
- Mark Dowell (EC) noted that the European Commission established a Knowledge Center on Earth Observation. One of its first tasks is a pilot assessment on biodiversity. This is an inward-looking assessment on EO data needs for biodiversity, but he expects this to be broadly applicable and could yield results in mid-2022.
- Selma Cherchali (CNES) added that CNES welcomes the proposal to have a dedicated group to address this critical area, which has been strongly impacted by climate change. CEOS has many assets that can be directed to support. A user needs perspective is crucial. CNES is willing to participate in the discussions around this. At the national level, France has put in place a national infrastructure to address biodiversity, but as yet, there are minimal links to EO. At the CEOS level, this could be a new key topic to address collectively.

CEOS-35-04	CEOS Biodiversity Lead to work with CSA to arrange a preliminary discussion with the Convention on Biological Diversity (CBD) regarding their needs and how CEOS agencies might respond to them – as input for further consideration of potential CEOS activity on biodiversity.	SIT-37
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- Eric Laliberté (CSA) confirmed the draft action. An early meeting with the CBD could be helpful ahead of the discussion with the group.
- Kerry Sawyer (NOAA) reminded everyone that there was a request from CBD to CEOS in 2018, and a response was sent in December 2018.
- Gary added that it would be extremely valuable if resources were available for another co-lead for the proposed action.

4.39: CSIRO-GA SIT Chair 2020-2021 Report [\[slides\]](#)

Presenter(s): Alex Held and Adam Lewis (CSIRO-GA 2020-2021 SIT Co-Chairs)

Main points:

- Reflected on the two-year shared SIT Chair journey and encouraged other countries who have smaller footprints in Earth observation to consider a similar term.
- Recalled the SIT Chair Team priorities of sustainable development, carbon and biomass and Analysis Ready Data.

- New processes for the term, building on efforts of past SIT Chairs included: All-hands calls with WGs, VCs and AHTs, with agendas set by the teams; continuity of individual calls with VC leads, informal; CEOS SEC teleconference opportunities for VCs to report.
- There is now a new thematic observations page to provide a quick overview of the key strategies in place or under development by these CEOS entities: ceos.org/observations
- There has been a substantial increase in VC representation in CEOS WP deliverables via informal calls with Leads.
- Analysis Ready Data priority was guided by the CEOS ARD Strategy v1.0. CARD4L Product Family Specification are in progress; first CARD4L datasets of USGS Landsat Collection 2 and ESA Sentinel-2 is in final assessment; cooperative processes were established LSI-VC and WGCV to assess and peer-review CARD4L datasets; CEOS ARD Beyond Land: CEOS-COAST uptake of ARD, SST-VC involvement, interest for other domains; CEOS ARD Governance Framework (Oct. 2021) was established and a template for generalised PFS has been developed. Further outcomes can be found in the [slides](#).
- Closing the SIT Chair term with two additional items to maintain momentum on CEOS ARD: CEOS ARD Strategy 2021 and the CEOS ARD Governance Framework, driven by the CEOS ARD Oversight Group.
- CEOS engagement with UNFCCC SEC has improved, with participation of UNFCCC SEC in SIT Technical Workshop 2020 and 2021.
- CEOS focal points were established for the systematic observations group for the Global Stocktake. CEOS is contributing to the synthesis report for systematic observations for the GST.
- New engagement with national inventory users via country outreach and feedback through AFOLU Roadmap activities and building on GFOI experience. Thanks to USGS/SilvaCarbon.
- A SIT Chair led study team explored the need for a CEOS-wide strategy for CEOS support to the GST Process for the UNFCCC Paris Climate Agreement. The SIT Vice Chair then led development of the Strategy Paper for CEOS to guide and track our activities.
- Productive engagement at SIT Technical Workshop 2020 and 2021 with GCOS on their requirements process and key document updates.
- CEOS Biomass Workshop was held in Canberra in March 2020, where the CEOS Biomass Protocol was progressed. Challenged the WGCV LPV team to develop the Forest Biomass Reference Network proposal, which led to the GEO-TREES initiative. CEOS Biomass Protocol of WGCV LPV was endorsed at SIT-36. GEO-TREES and the CEOS Biomass Protocol have been identified as a priority for CNES as CEOS Chair.
- GHG and AFOLU Roadmaps were progressed during 2020 and 2021. The Roadmaps include the GHG-AFOLU integration discussion, which has started already with the JRC Workshop. Full AFOLU Roadmap development is in the planning phase. NASA (Ben Poulter) has stepped up to support as Co-Lead with ESA and JAXA.
- ceos.org/gst brings together all of the information that CEOS has on GHG and AFOLU datasets. This was a key CEOS output for COP26.
- **New geometries with New Space**: International Methane Emissions Observatory (IMEO) invited to SIT Technical Workshop 2021; excellent presentation by UNEP and GHGSat highlighted opportunities for CEOS to engage in new geometries. The incoming ESA SIT Chair will follow up under the priority for their term.

- The SDG-AHT sub-team model was exercised, with three sub-teams plus COAST completing or progressing 11 SDG deliverables for CEOS.
- The SDG-AHT sustainable governance approach was developed throughout the SIT Chair term, culminating in the decisions taken at this Plenary for the SDG-AHT to be disbanded and approval of the federated approach to continue SDG work in CEOS.

Main discussion points:

- Ivan Petiteville (ESA) commended the CSIRO-GA team for their great achievements over a very difficult period. The joint representation of GA and CSIRO has proven to be very effective. Ivan recognised Jonathon Ross (GA) in particular, who has played a key role in the cooperation with ESA as SIT Vice Chair.
- Maree Wilson (GA), Selma Cherchali (CNES), Astrid-Christina Koch (EC), Eric Laliberte (CSA), Kerry Sawyer (NOAA), Raj Kumar (ISRO), Steve Volz (NOAA), Osamu Ochiai (JAXA), Chuck Wooldridge (NOAA), Christine Bognar (NASA), Timothy Stryker (USGS), Doug Cripe (GEOSEC) congratulated and thanked the SIT Chair Team.
- Mark Dowell (EC) commended the progress made on AFOLU Roadmap aspects in a very short time. This has been possible due to the direction and energy provided by the SIT Chair Team.
- Karen St. Germain (NASA, CEOS Chair) thanked and congratulated Adam Lewis, Alex Held and the entire SIT Chair Team for a highly productive SIT Chair term that has greatly advanced CEOS activities and support of global agendas. Karen also thanked them for breaking new ground during this prolonged virtual-only COVID-19 environment. Many in CEOS were unsure if it would be possible to hold successful virtual-only meetings on this scale. Karen noted that the SIT Chair team not only demonstrated that it is possible, but they excelled at it. Karen thanked them for chairing 4 highly effective meetings and for the many Working Team town halls they led for two years. She remarked that it was a tremendous contribution to CEOS.

4.40: ESA Incoming SIT Chair 2022-2023 Presentation [\[slides\]](#)

Presenter(s): Ivan Petiteville (ESA, 2022-2023 SIT Chair Team)

Main points:

- Focus on global challenges with strong UN mandates, GEO support, and high relevance for satellite Earth observation.
- Will explore how CEOS can employ new geometries with industry, new missions, and new data and analysis techniques for maximum impact and continued relevance in a changing sector.
- Strong UN mandates, GEO support, and high relevance for EO on:
 - o Climate and Carbon (UNFCCC, Paris Agreement and the GST);
 - o Sustainable Development Goals (2030 Agenda);
 - o Disaster Risk Reduction (Sendai Framework).
- ESA will track the emerging 4th GEO priority on Resilient Cities and Human Settlements, which is a response to the UN's New Urban Agenda.
- Success in these thematic priorities will translate into opportunities for engaging new users.

- The CNES 2022 CEOS Chair and ESA SIT Chair teams have conferred carefully in deriving their respective plans and ensured synergy between them. Both prospectuses apply common nomenclature and branding for ease of understanding.
- Aim to improve CEOS support to global challenges with three lines of action:
 - o New geometries for space agencies and CEOS with new space companies;
 - o New mission needs and users;
 - o New data techniques.
- Governments are integrating new arrangements with Space 2.0 firms into their satellite EO programme planning. It is important to see the expected mutual benefits, added value and the duality / complementarity of the missions operated by both New Space and space agencies. CEOS must keep up and consider implications for its thematic observation strategies and exchange experience, ideas, and lessons learned.
- A promising potential case study for the New Space angle is working with the International Methane Emissions Observatory (IMEO) and the combined use of GHGSat/EDF and Sentinel-5P / TROPOMI.
- Will explore new collaborations with organisations like UN Agencies, International Financial Institutions, National Statistical Offices.
- New platforms, new software tools (e.g., AI, machine learning), more cloud storage to foster the exploitation of data from both public and private EO programmes. All of these provide opportunities for new applications and users.
- SIT-37 will be held on 28 March to April 1, 2022 at ESA ESRIN. The 2022 SIT Technical Workshop will also be held at ESA ESRIN on 12-16 September 2022. Exact formats are to be confirmed.

Main discussion points:

- Steve Volz (NOAA) thanked ESA for the presentation and noted the focus on new observations, industries, geometries, etc. Integration of the new with the established is key and he looks forward to seeing this progress throughout the ESA SIT Chair term.
- Ivan noted that ESA's time as SIT Vice Chair has been smooth thanks to the excellent cooperative spirit of the GA and CSIRO teams. ESA will continue this efficient cooperation with JAXA as incoming SIT Vice Chair. Ivan congratulated the outgoing SIT Chair Team and reaffirmed ESA's intention to continue the legacy of the Australian team.

4.41: CEOS Strategic Implementation Team Chair (SIT Chair) Transition

Presenter(s): Alex Held and Adam Lewis (CSIRO-GA 2020-2021 SIT Co-Chairs) and Ivan Petiteville (ESA 2022-2023 SIT Chair Team)

Main points:

- The SIT Chair role was transitioned from the CSIRO-GA team to ESA.
- Karen St. Germain (NASA, CEOS Chair) thanked Alex Held (CSIRO) and Adam Lewis (GA) for their leadership and commitment to the CEOS organization, mission, and objectives at this time when sustained and well-coordinated international cooperation on space-based EO missions, data and products is essential for societal benefit, the advancement of science, and informed decision making. Karen thanked Ivan and ESA for their presentation and noted – speaking as NASA Principal

for CEOS – that NASA looks forward to working with ESA as SIT Chair on their stated objectives in support of global agendas.

Decision 35-19	Plenary welcomed the European Space Agency (ESA) as SIT Chair for 2022-2023.
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4.42: CNES 2022 CEOS Chair Presentation [[slides](#)]

Presenter(s): Selma Cherchali (CNES, 2022 CEOS Chair)

Main points:

- CNES CEOS Chair priorities for 2022 are under the banner: *“Paths to Sustainability: from Strategy to Practical Measures”*.
- Emphasis is on the evolution of R&D and demonstration activities to applications and services; supporting the UNFCCC Global Stocktake and, more specifically, AFOLU Roadmap development including CEOS Biomass Protocol uptake and GEO-TREES; and, proposing the CEOS community pursue new complementary activities, including cooperation on cal/val and thermal IR cross-calibration.
- The 2022 CEOS Chair aims to ensure continuity of the open science theme introduced by NASA and to support and complement ESA SIT Chair priorities. The 2022 effort will ensure attention to the Paris Agreement, established policy drivers and frameworks, SDGs, and the Sendai Framework.
- Will continue the work of previous CEOS Chairs to secure a long-term solution for CEO and Deputy CEO continuity.
- CNES and ESA teams have conferred carefully in deriving their respective plans and ensured synergy between them. Both prospectuses apply common nomenclature and branding for ease of understanding.
- The CNES team looks forward to welcoming CEOS to France for the 2022 Plenary.

Main discussion points:

- Akihiko Kuze (JAXA, WGCV Chair) welcomed the CNES priority on cal/val collaboration and thermal IR sensor intercomparisons.
- Karen St. Germain (NASA, CEOS Chair) thanked Selma and CNES for their presentation and commitment to continuity as a CEOS strength. As outgoing CEOS Chair, Karen thanked Selma and CNES for their willingness to ensure that matters including the Analysis Ready Data effort, CEOS support for the Global Stocktake, and other major CEOS endeavors continue to advance in step with timelines, some of which are outside of CEOS control.

4.43: CEOS Chair Transition

Presenter(s): Karen St. Germain (NASA, 2021 CEOS Chair) and Selma Cherchali (CNES, 2022 CEOS Chair)

Main points:

- Karen St. Germain (NASA, 2021 CEOS Chair) communicated her thanks to her NASA CEOS Chair Team and invited Selma Cherchali (CNES, 2022 CEOS Chair) to introduce her team.
- The CEOS Chair role was transitioned from NASA to CNES.

- Selma thanked Karen and the NASA team for their guidance and support thus far. The 2022 CEOS Chair Team aims to ensure continuity of the open science theme introduced by NASA as a priority.

Main discussion points:

- Ivan Petiteville (ESA) thanked Karen St. Germain, Christine Bognar, Brian Killough and all of the NASA team for their excellent Chair year and very productive CEOS Plenary meeting. Special thanks to Christine Bognar (NASA).
- Raj Kumar (ISRO), Paul Counet (EUMETSAT), Timothy Stryker (USGS), Kerry Sawyer (NOAA), Ana Medico (CONAE), and Laura Frulla (CONAE) thanked Karen St. Germain and the whole NASA team for their leadership over the past year and welcomed the incoming CEOS Chair Team.
- Karen St. Germain (NASA, 2021 CEOS Chair) thanked Selma Cherchali (CNES, 2022 CEOS Chair) for beginning stakeholder engagement as Head of the CEOS Delegation for GEO Week (Nov. 22-26, 2021).

Decision 35-20

Plenary welcomed the Centre National d'Études Spatiales (CNES) as 2022 CEOS Chair.

4.44: CEOS 2021 “Year in Review” Video

Presenter(s): Karen St. Germain (NASA, 2021 CEOS Chair)

Main points:

- The [link](#) for the 2021 CEOS Year in Review video was shared via the chat.

4.45: Review of Preliminary Action and Decision Record

Presenter(s): Matt Steventon (CEOS Chair Team)

Main points:

- The preliminary action and decision record was reviewed. The final action and decision record can be found in Appendix A and B below.

4.46: Closing Remarks and Adjournment of the 35th CEOS Plenary

Presenter(s): Karen St. Germain (NASA, 2021 CEOS Chair)

Main points:

- Welcomed once again the two new CEOS Associate members: European Centre for Medium-Range Weather Forecasts (ECMWF) and Portugal Space.
- Congratulated the GISTDA, ESA, JAXA, and CNES teams, who CEOS has formally welcomed to assume key CEOS leadership roles.
- Recalled all of the endorsements made during the four days of the 2021 CEOS Plenary, including nominees from CONAE, SANSa, UNOOSA, and USGS for leadership roles in CEOS Working Groups.
- Thanked the CEOS community, including the Secretariat, the CEOS Executive Officer, and the NASA CEOS Chair Team.
- Karen St. Germain (NASA, 2021 CEOS Chair) thanked all meeting participants and adjourned the 2021 CEOS Plenary.

APPENDIX A: Actions Record

No.	Action	Due Date
CEOS-35-01	WGCapD to explore potential connections with the International Space Education Board (ISEB).	SIT-37
CEOS-35-02	ESA SIT Chair to seek CEOS Agency nominations for a small working team to scope options for improved coordination and communication of the full range of CEOS ocean-related activities and groups. The SIT Chair-led team will prepare an agenda item at SIT-37 to allow Principals to review progress.	15 December 2021
CEOS-35-03	ESA SIT Chair to seek CEOS Agency nominations for the newly established CEOS ARD Oversight Group consistent with the ARD Governance Framework document endorsed by the 2021 Plenary. The Group will report to the SIT Chair during 2022 and governance will be revisited at the 2022 SIT Technical Workshop to prepare for discussion at the 36th CEOS Plenary.	15 December 2021
CEOS-35-04	CEOS Biodiversity Lead to work with CSA to arrange a preliminary discussion with the Convention on Biological Diversity (CBD) regarding their needs and how CEOS agencies might respond to them – as input for further consideration of potential CEOS activity on biodiversity.	SIT-37

APPENDIX B: Decisions Record

Decision 35-01	Plenary endorsed and welcomed the European Centre for Medium-Range Weather Forecasts (ECMWF) as a new CEOS Associate member.
Decision 35-02	Plenary endorsed and welcomed Portugal Space as a new CEOS Associate member.
Decision 35-03	Plenary endorsed the Geo-Informatics and Space Technology Development Agency (GISTDA) of Thailand as 2023 CEOS Chair from the Asia-Pacific region.
Decision 35-04	Plenary endorsed the updated CEOS Governance and Processes v1.2 document (September 2021).

Decision 35-05	Plenary endorsed the CEOS Statement for GEO Week 2021.
Decision 35-06	Plenary endorsed the new CEOS Communications Strategy.
Decision 35-07	Plenary endorsed the new CEOS Branding Guidelines.
Decision 35-08	Plenary endorsed Tom Sohre of USGS as WGISS Vice Chair for 2022-2023 and WGISS Chair for 2024-2025.
Decision 35-09	Plenary endorsed the EOTEC DevNet Phase 1 Report.
Decision 35-10	Plenary endorsed Jorge Del Rio Vera of UNOOSA as WGCapD Chair for 2022-2023.
Decision 35-11	Plenary endorsed Dan Matsapola of SANSAs as WGCapD Vice Chair for 2022-2023 and WGCapD Chair for 2024-2025.
Decision 35-12	Plenary endorsed Laura Frulla of CONAE as WGDisasters Vice Chair for 2022-2023 and WGDisasters Chair for 2024-2025.
Decision 35-13	Plenary endorsed the Joint CEOS-CGMS Statement for SBSTA at COP26.
Decision 35-14	Plenary endorsed the <i>CEOS Strategy to Support the Global Stocktake of the UNFCCC Paris Agreement (v3.1)</i> .
Decision 35-15	Plenary endorsed the “Federated Approach” for CEOS support to the SDGs as described in the <i>CEOS SDG Strategy Implementation</i> document and to disband the CEOS <i>ad hoc</i> Team (SDG AHT).
Decision 35-16	Plenary endorsed the CEOS Analysis Ready Data (ARD) Strategy 2021.
Decision 35-17	Plenary endorsed the CEOS Analysis Ready Data (ARD) Governance Framework.
Decision 35-18	Plenary endorsed and welcomed the Japan Aerospace Exploration Agency (JAXA) as SIT Vice Chair for 2022-2023 and SIT Chair for 2024-2025.
Decision 35-19	Plenary welcomed the European Space Agency (ESA) as SIT Chair for 2022-2023.
Decision 35-20	Plenary welcomed the Centre National d'Études Spatiales (CNES) as 2022 CEOS Chair.

APPENDIX C: Attendees

Organisation	Name	Organisation	Name	Organisation	Name
AEM	Adrian Guzman	EUMETSAT	Paul Counet	NASA	Gary Geller
AEM	Jesús Romero	EUMETSAT	Phil Evans	NASA	Gib Kirkham
AEM	Julio Castillo	EUMETSAT	Robert Husband	NASA	Hank Margolis
AEM	Nickté Basurto	EUMETSAT	Stefanie Linow	NASA	Jack Kaye
AEM	Rosa Ma Ramirez de Arellano y Haro	GA / SIT Chair Team	Adam Lewis	NASA	Jorge Vazquez
BoM	Agnes Lane	GA / SIT Chair Team	Jonathon Ross	NASA / CEOS Chair	Karen St. Germain
BoM	Alessandra Monerri Belda	GA	Maree Wilson	NASA	Katie Baynes
BoM	Helen Beggs	GEO Secretariat	Doug Cripe	NASA	Kevin Murphy
CEO	Marie-Claire Greening	GEO Secretariat	Yana Gevorgyan	NASA	Kim Holloway
CEOS Chair Team	George Dyke	GISTDA	Disapat Sawadisukhitkul	NASA	Laura Lorenzoni
CEOS Chair Team	Matthew Steventon	GISTDA	Kanjana Koedkurang	NASA	Lauren Childs-Gleason
CEOS Chair Team	Stephen Ward	GISTDA	Pakorn Apaphant	NASA	Lawrence Friedl
CNES	Annick Sylvestre-Baron	GISTDA	Pisut Nakmuenwai	NASA	Michael Falkowski
CNES	Aurélien Sacotte	GISTDA	Prayot Puangjaktha	NASA	Nancy D Searby
CNES	Edouard Lallouette	GISTDA	Raksina Lekthanoo	NASA / CEOS Chair Team	Sandra Cauffman
CNES	Helene De Boissezon	GISTDA	Sitthisak Moukomla	NASA	Sydney Neugebauer
CNES	Jerome Chave	GISTDA	Surassawadee Poompanich	NASA	Vardis Tsontos
CNES	Mireille Paulin	GISTDA	Suwat Sreesawet	NASA	Wenyng Su
CNES	Philippe Maisongrande	GISTDA	Warinthorn Evans	NASA	Yasha Moz
CNES	Pierric Ferrier	GISTDA	Watanyoo Suksa-Ngiam	NASA / JPL	David Crisp
CNES	Selma Cherchali	GISTDA	Yossavin Sombutpanich	NASA / JPL	Edward Armstrong
CNES	Steven Hosford	ISRO	Atul Varma	NASA / JPL	John Worden
CONAE	Álvaro Soldano	ISRO	Mini Raman	NOAA	Albert DeGarmo
CONAE	Ana Medico	ISRO	Muvva V. Ramana	NOAA	Charles Wooldridge
CONAE	Laura Frulla	ISRO	Pradeep Thapliyal	NOAA	Jeff Privette
CONAE	Marcelo Uriburu Quirno	ISRO	Raghavendra Singh	NOAA	Kerry Sawyer
CONAE	Mario Lanfri	ISRO	Raj Kumar	NOAA	Merrie Neely
CONAE	Raul Kulichevsky	ISRO	Rajeev Jaiswal	NOAA	Mitch Goldberg
CONAE	Sandra Torrusio	ISRO	Rashmi Sharma	NOAA	Nancy Ritchey
CSA	Emma Fernandes	ISRO	Santhi Sree Basavaraju	NOAA	Paul DiGiacomo
CSA	Eric Laliberté	JAXA	Akihiko Kuze	NOAA	Shobha Kondragunta
CSA	Frederic Fournier	JAXA	Florence Murakami	NOAA	Steve Volz
CSA	Marie-Josée Bourassa	JAXA	Ko Hamamoto	POLSA	Oskar Zdunek
CSA	Paul Briand	JAXA	Makoto Natsuisaka	Portugal Space	Carolina Sá
CSIRO / SIT Chair Team	Alex Held	JAXA	Misako Kachi	Portugal Space	Hugo Costa
CSIRO	Amy Parker	JAXA	Osamu Ochiai	Portugal Space	Ricardo Conde
CSIRO / SIT Chair Team	Flora Kerblat	JAXA	Riko Oki	SANSA	Christo Whittle
CSIRO	Robert Woodcock	JAXA	Takeshi Hirabayashi	SANSA	Daniel Matsapola
DLR	Klaus Schmidt	JAXA / RESTEC	Koji Akiyama	SANSA	Mukosi Mukwehwo
EC	Astrid Christina Koch	JAXA / RESTEC	Toshi Kamei	SNSA	Tobias Edman
EC	Mark Dowell	JAXA / RESTEC	Yukio Haruyama	UMD / NASA	Laura Duncanson
EC	Mauro Facchini	NASA	Andrew Mitchell	UNOOSA	Jorge Del Rio Vera
EC	Peter Strobl	NASA	Argyro Kavvada	UNOOSA	Pavel Kiparisov
ECMWF	Florence Rabier	NASA	Barry Lefer	USGS	Steve Labahn
ECMWF	Jean-Noël Thépaut	NASA	Ben Poulter	USGS	Sylvia Wilson
ESA / SIT Vice Chair Team	Ivan Petiteville	NASA / CEOS Chair Team	Brian Killough	USGS	Timothy Stryker
ESA	Marc Paganini	NASA / CEOS Chair Team	Christine Bogner	USGS	Tom Sohre
ESA / SIT Vice Chair Team	Stephen Briggs	NASA	Chris Kidd	USGS / KBR	Christopher Barnes
ESSO	Hasibur Rahaman	NASA	David Green	WMO	Kenneth Holmlund
EUMETSAT	Estelle Obligis	NASA	David Borges		
EUMETSAT	Jörg Schulz	NASA	Diane Davies		