

Minutes of the 34th CEOS Plenary
Version 1.0
20-22 October 2020
Hosted by the Indian Space Research Organisation (ISRO)

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Tuesday October 20th

Session 1

1.1: Welcome

Presenters: Raj Kumar, D.K. Das, Dr. K. Sivan (ISRO, 2020 CEOS Chair Team)

Main points:

- D.K. Das welcomed CEOS Principals, their representatives and other invitees to the meeting. He stated that it was unfortunate that CEOS could not hold this plenary in Ahmedabad, but that he looked forward to a productive virtual meeting. He noted that the SIT Chair Team has demonstrated how effective such virtual meetings can be, and that ISRO's hope was to replicate that for the Plenary.
- D.K. Das noted there has been strong progress on the ISRO CEOS Chair initiatives, despite the disruptions caused by COVID-19. He also noted the effort that CEOS put into the appointment of a new CEO, Dr. Marie-Claire Greening, which included a review and revision of the Terms of Reference, and he recognised the efforts of the current CEO, Kerry Sawyer. D.K. Das also thanked the SIT Co-Chairs (Alex Held and Adam Lewis) and their teams for their support this year.
- Dr. K. Sivan welcomed everyone to the 2020 CEOS Plenary, noted that ISRO is proud to host this meeting for the third time as CEOS Chair. This, he said, is evidence of the emphasis that ISRO places on international collaboration.
- Raj Kumar then invited a *tour de table* of this year's CEOS Plenary participants.

1.2: 2020 CEOS Chair Priorities [[slides](#)]

Presenter: Raj Kumar (ISRO, 2020 CEOS Chair Team)

Main points:

- ISRO as 2020 CEOS Chair pursued the following initiatives:
 - Space-based Scatterometry Constellation: A team was formed to prepare a comprehensive document to identify and recommend validation sources and metrics; inter-calibrate backscatter data from different sensors; generate climate quality products; develop unified GMFs and retrieval algorithms for all space-based scatterometers; develop algorithms for extreme wind and other environmental cases; and examine the possibility of a global space-based scatterometer constellation to monitor extreme events, diurnal variability, and to improve NWP forecasts and climate products.
 - UN Sustainable Development Goals (SDGs) Applications for the BIMSTEC Region: With a focus on Land-Cover/Land-Use Change (LCLUC), water, agriculture, and forests, ISRO is applying the AVID (Analytics & Visualization for ISRO Data Cube) package to this project. The Data Cube is populated using Analysis Ready Data (ARD) and CEOS Analysis Ready Data for Land (CARD4L) assessments are in scope. The team has also been working with JAXA to compare rice crop maps generated by agencies using ALOS-2 ARD.
 - Renewable Energy Assessment from Space (Solar and Wind): Developed web and mobile applications for calculating monthly and annual solar energy potential; a solar site selection tool; analysed offshore monthly wind energy potential; and solar and wind forecasts at 15-minute intervals. The same processes have been applied to Africa.

- Disaster Management – GEO-LEO Tools: Contributing to WGDIsasters in the following areas: improved flood monitoring using GEO-LEO-SAR; flood risk assessments; forest fire danger index; online satellite data processing tools; and a prototype initiative for the International Charter Space and Major Disasters. Connections have been made with both CSA (forest fires) and NOAA (flood mapping/monitoring).
- Additionally, ISRO has been working with WGCapD and others on capacity building programmes that support these priorities.

Main discussion points:

- Alex Held (CSIRO, SIT Co-Chair) commended ISRO’s work on these important topics and encouraged CEOS Agencies to contribute.
- Ivan Petiteville (ESA) noted the SDGs identified are outside the current scope of the CEOS SDG *Ad Hoc* Team (SDG-AHT). He suggested making a connection to the SDG-AHT as they are very active, and it would be productive for ISRO to join the AHT in this effort. Alex Held (SDG-AHT Co-Lead) welcomed the identification of an ISRO representative for the team.
- Ken Holmlund (WMO) suggested making a connection to efforts underway in WMO on flash flood monitoring and global fire assessment. He looks forward to closer CEOS-WMO collaboration in these areas. David Green (NASA, WGDIsasters Chair) welcomed WMO to partner with WGDIsasters in areas of shared significance, including flood risk and wildfires.
- David Green noted that the WGDIsasters greatly appreciates the support and interest of ISRO and invites them to present a demonstration of their online tools to the WGDIsasters and the CEOS community.
- Nancy Searby (NASA, WGCapD Chair) noted that the WGCapD appreciates the leadership and continued participation of ISRO in capacity building activities.

1.3: Membership Application by the Polska Agencja Kosmiczna (POLSA) to Become a CEOS Associate
[\[slides\]](#)

Presenter: Marek Moszynski (POLSA)

Main points:

- The Polska Agencja Kosmiczna (Polish Space Agency, POLSA) is the national governmental agency responsible for Poland’s international space matters and supports the Polish space sector by combining the world of business and science. Poland is a European Space Agency (ESA) Member State and assists entrepreneurs in accessing support from ESA.
- Niches of the Polish space sector include: data processing systems; EO and GNSS applications; and the development of small satellites.
- POLSA has been involved in a number of EO satellite programmes, including Swiatowid, a water and air monitoring satellite launched in 2019.
- The Sat4Envi project works to foster infrastructure for receiving, storing, processing, and distributing data from the Sentinel-1/2/3 satellites and related satellite products using existing Institute of Meteorology and Water Management (IMGW) resources.
- POLSA foresees broad potential for them to contribute across the CEOS Work Plan and Working Teams.

Main discussion points:

- Kerry Sawyer (CEOS Executive Officer) confirmed that POLSA meets the criteria to be an Associate member of CEOS.
- Alain Ratier (EUMETSAT) expressed support for the application of POLSA and confirmed that POLSA has a key role in EO, noting in particular its hydrology work with EUMETSAT.
- A number of CEOS Agencies expressed support and agreement with the application: JAXA (Takeshi Hirabayashi), CNES (Selma Cherchali), NOAA (Steve Volz), UKSA (Bertie Archer), CSA (Eric Laliberté), CSIRO (Alex Held), USGS (Tim Stryker), DLR (Klaus Schmidt), COM (Mauro Facchini), NASA (Karen St. Germain). No objections were noted.
- Steve Volz (NOAA) suggested it would be helpful for the SIT Chair Team and CEO to look at how to establish strong collaboration in the early years of new members’ time in CEOS, to build strong foundations that are sustainable.
- Marek thanked CEOS for the warm welcome and said POLSA looks forward to contributing to CEOS. POLSA will work with the CEOS Executive Officer to ensure that its CEOS Principal and CEOS Contact details are posted on the CEOS website and that the appropriate points of contact for mailing lists are provided.

Decision 34-01	Plenary endorsed the membership application of the Polska Agencja Kosmiczna (POLSA) to become a CEOS Associate.
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CEOS-34-01	CEOS Executive Officer to confirm the Polska Agencja Kosmiczna (POLSA) Principal and Contact details, and to update applicable CEOS mailing lists. CEO will work with the SEO to update the CEOS website to reflect the addition of POLSA as an Associate member.	ASAP
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1.4: CEOS Executive Officer (CEO) Continuity [\[slides\]](#)

Presenter: Kerry Sawyer (CEOS Executive Officer)

Main points:

- Kerry reminded CEOS of the importance of the CEO role and of the need for a long-term solution for continuity, recognising the recent challenges to nominations by CEOS Agencies of a candidate to accept the role upon the conclusion of Kerry’s term in January 2021.
- A few ideas were offered as potential solutions:
 - Tie the provision of a CEO to the SIT Vice Chair Agency and the Vice Chair two-year term.
 - Geographical rotation of CEO and DCEO with announcement of each Agency’s commitment two years in advance.
 - CEOS Agencies contribute funds to a centrally managed account to mitigate part of the financial burden associated with the CEO role and to encourage more CEOS Agencies to nominate candidates.

Main discussion points:

- Steve Volz (NOAA) suggested that the SIT Vice Chair role is not a heavy burden, and connecting the CEO position could be a helpful means for introducing the SIT Vice Chair Team to the nuances of CEOS leadership and issues.
- Karen St. Germain (NASA) noted that the CEOS Executive Officer role provides an opportunity for CEOS Agencies that may not be positioned to take on the larger CEOS roles to contribute and share the burden. NASA is in favour of building capacity for burden sharing, and therefore prefers a solution that builds a resource pool to allow agencies with qualified candidates, but lacking funding, to be able to contribute a CEO for the benefit of all.
- Steve Volz (NOAA) agreed with NASA's point about bringing new people and agencies into the role and feels this could also work through the option that connects the role to the SIT Vice Chair.
- Ivan Petiteville (ESA) suggested that CEOS leadership work to clarify the options in the coming months by looking at the pros and cons of different solutions, in consultation with CEOS Agencies.
- Alain Ratier (EUMETSAT) favoured the idea to connect the provision of the CEO to the SIT Vice Chair role, and thanked Kerry Sawyer for her service as CEO.

CEOS-34-02	CEOS Chair Team to work with the Secretariat to explore CEO continuity options.	CEOS Plenary 2021
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1.5: 2022 CEOS Chair

Presenter: Selma Cherchali (CNES)

Main points:

- CNES has been approached regarding the role of CEOS Chair in 2022. CNES is interested and willing, but the team is still investigating the possibility within the agency. A decision will be communicated by the end of November 2020.

CEOS-34-03	CEOS Chair Team to follow up with CNES on its possible interest in the role of 2022 CEOS Chair.	By end November 2020
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1.6: CEOS-GEO Coordination [\[slides\]](#)

Presenters: Alex Held (SIT Co-Chair), Andreia Siqueira (SIT Chair Team), Brian Killough (CEOS SEO)

- The CEOS-GEO relationship remains strong and deep, with CEOS serving as the ‘space arm’ of GEO. Underscoring the strength of the relationship is: the annual CEOS-GEO high-level bi-lateral meeting, CEOS participation in the GEO Executive Committee (as an observer) and GEO Programme Board, and the scope and scale of CEOS contributions to activities in the GEO Work Programme.
- Key GEO Executive Committee topics have included: follow-up on the Canberra Declaration, focused on monitoring implementation; Analysis Ready Data and cloud platforms; the GEO Knowledge Hub; the 2021 mid-term evaluation; strengthening GEO Secretariat finances; hiring a new GEO Secretariat Director (to commence in mid-2021); and, issues associated with the postponement of the GEO Plenary by one year due to the pandemic.

- CEOS has completed its first year on the GEO Programme Board; there are two years remaining in the term.
- Brian Killough (CEOS SEO) gave an update on the Open Earth Alliance (OEA), which grew out of the Open Data Cube (ODC) activity, for which CEOS has been a Partner since its inception in 2017. OEA is now approved as a GEO Community Activity. CEOS contributions to the OEA come largely from the SEO, as well as some individual CEOS Agencies. They include supporting new implementations of ODC as they emerge, developing a new ODC User Forum, Algorithm Hub, and Analysis Hubs (Amazon Web Services and Google Sandboxes).
- The [CEOS Statement to GEO Week 2020](#) has been prepared by the CEOS Chair, SIT Co-Chairs, and CEOS Executive Officer, and reviewed by the CEOS Secretariat. It covers the CEOS-GEO relationship and the mutual benefits it offers. The statement was circulated by email to CEOS Principals on October 11. It will be presented today for endorsement.

Main discussion points:

- Ivan Petiteville (ESA) noted that some CEOS Agencies are also members of the GEO Programme Board and GEO Executive Committee. For example, Ivan is Co-Chair of the GEO Programme Board on behalf of ESA. Care is taken to ensure good coordination between individual space agency and CEOS interventions.
- Gilberto Camara (GEO Secretariat Director) stated that he is very pleased with the actions CEOS has been taking in support of GEO, and he commended the effort of CEOS Agencies. He also noted the strong participation of CEOS in GEO and its activities, stating that it is difficult to overstate the contributions of CEOS. Gilberto highlighted specific examples, including the CEOS ARD Strategy, the Open Earth Alliance, the GHG and AFOLU Roadmaps/White Papers, and CEOS work on biomass.
- This is the last CEOS Plenary meeting Gilberto will attend as GEO Secretariat Director. His final message to CEOS Plenary was one of openness. Gilberto sees a great trend of openness and noted the importance of Open Science in particular. He hopes the strong CEOS and GEO relationship can drive this forward.
- Trevor Dhu (GA) thanked Brian and the CEOS SEO for their effort on OEA. Trevor encouraged CEOS Agencies to continue supporting OEA by assessing data against the CARD4L Framework, producing data to these specifications, and pushing data to highly accessible locations, e.g., cloud platforms.
- Ivan Petiteville (ESA) noted that the [CEOS Statement to GEO Week 2020](#) contains references to some topics that still need to be endorsed at this CEOS Plenary. Ivan suggested postponing its endorsement closer to the end of the meeting. This was agreed. Jonathon Ross (GA, SIT Chair Team) confirmed that the text of the Statement will be amended to ensure that it fully reflects Plenary outcomes and decisions before being presented for endorsement.

Session 2

2.1: CEOS Working Groups (WGs) and Virtual Constellations (VCs) [\[slides\]](#)

Presenters: Raj Kumar (ISRO, 2020 CEOS Chair Team), Alex Held (CSIRO, SIT Co-Chair)

Main points:

- Alex presented highlights from the VCs, using information gathered through SIT meetings and the consultative calls that CEOS SIT Chairs traditionally have with the VCs over the course of the two-year SIT Chair term:

- Precipitation (P-VC): Global Precipitation Measurement (GPM) is the realisation of the P-VC. Regarding future missions, the average age of the constellation satellites now exceeds 10 years. P-VC is seeking extended representation from key CEOS Agencies (emails sent by the SIT Chair team).
- Atmospheric Composition (AC-VC): The VC is remaining active despite COVID-19 (AC-VC-16 virtual meeting had 186 participants). Focus topics are Greenhouse Gases (including GHG Task Team activity), Ozone (tropospheric), Air Quality, Trace Gases and Aerosols (new). AC-VC has various links to COVID-19 activities and ARD.
- Land Surface Imaging (LSI-VC): The CEOS ARD Strategy is the focus for LSI-VC. It is currently working with the WGCV to evaluate datasets against the CARD4L Product Family Specifications (PFS); and new Product Family Specifications (PFS) are in development. Efforts are also underway with SST-VC, COAST, COVERAGE and others to examine the concept of ARD beyond the land domain. The Forests & Biomass and GEOGLAM subgroups of LSI-VC remain active.
- Sea Surface Temperature (SST-VC): The VC remains vibrant and held a meeting alongside the annual GHRSSST meeting (virtual meeting; June 2020). A white paper: “Next-Generation Sea Surface Temperature Constellation” was completed in 2020. There are more than 100 standardised GHRSSST products, spanning approximately 8 million CF/ACDD NetCDF data files, totalling approximately 200 TB (September 1981 - August 2020).
- Ocean Surface Topography (OST-VC): The VC has strong inter-agency cooperation on current and future missions. The Copernicus Next Generation Topography Constellation (NG-TC) Expert Team is addressing continuity; OST-VC will re-scope VC-19-06 based on the outcomes. Sentinel-6 Michael Freilich is scheduled for launch in November 2020.
- Ocean Surface Vector Wind (OSVW-VC): Optimising orbits to improve temporal sampling. Open and near-real-time data access remains challenging.
- Ocean Colour Radiometry (OCR-VC): Key drivers are climate, carbon, and water quality (new). Addressing the aquatic carbon aspects of the GHG Roadmap.
- Alex reported that no VC-related CEOS Plenary desired outcomes were identified during the SIT Technical Workshop, so the above is a report for information only.
- The SIT Chair Team has established a new thematic strategies page (ceos.org/observations) to better represent and bring consistency to communicating the observation strategy work of CEOS, in which the VCs are heavily involved/represented.

Main discussion points:

- Ivan Petiteville reported that ESA nominates Tobias Wehr (EarthCARE Mission Scientist) to become a member of the Precipitation VC (P-VC).

CEOS-34-04	SIT Chair to ensure that the P-VC Co-Leads are aware of ESA’s nomination of Dr. Tobias Wehr (EarthCARE Mission Scientist) as a member of the VC.	Upcoming Nov-Dec VC Chats
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2.2: WGDIsasters [\[slides\]](#)

Presenter: David Green (NASA, WGDIsasters Chair)

Main points:

- The WGDIsasters is seeking CEOS Plenary endorsement of:
 - CEOS WGDIsasters Strategy Paper: Promoting Space Data for Disaster Risk Management.
 - CEOS WGDIsasters Recovery Observatory (RO) Demonstrator Implementation Plan.
 - CEOS WGDIsasters Geostationary / Low Earth Orbit / Synthetic Aperture Radar Flood Risk Pilot Implementation Plan.
- There is a Wildfire Pilot proposal in development, and an invitation to contribute has been distributed to the CEOS community. The first scoping meeting was held on October 14 (with over 40 participants). The group intends to submit a Wildfire Pilot Implementation Plan for endorsement at CEOS SIT-36.
- David thanked the CEOS Chair Team in particular for their contributions to the Flood Risk Pilot Implementation Plan, interest in and development of the Wildfire Pilot concept, and their encouragement to advance data processing solutions for disasters.

Main discussion points:

- DLR, NOAA, ASI, ESA, CSA, NASA, CNES, USGS, NSO, AEM, COM, CSIRO, CONAE, ESSO and UKSA all supported the endorsements. CSIRO, NOAA and UKSA communicated their support for the Wildfires Pilot.
- David confirmed that the Recovery Observatory (RO) activity is open to participation from all CEOS Agencies and he welcomed expressions of interest.

Decision 34-02	<p>Plenary endorsed the following three WGDIsasters documents:</p> <ul style="list-style-type: none">● CEOS WGDIsasters Strategy Paper: Promoting Space Data for Disaster Risk Management● CEOS WGDIsasters Recovery Observatory (RO) Demonstrator Implementation Plan● CEOS WGDIsasters Geostationary / Low Earth Orbit / Synthetic Aperture Radar Flood Risk Pilot Implementation Plan
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2.3: WGISS/SEO: Earth Analytics Interoperability Lab (EAIL) [\[slides\]](#)

Presenter: Rob Woodcock (CSIRO, WGISS Chair)

Main points:

- The CEOS Earth Analytics Interoperability Lab (EAIL) seeks to observe and promote best practices in Jupyter Notebooks for EO analytics; cloud data formats; and, CEOS data discovery and access in the cloud.
- Many CEOS activities are seeking advice on implementation and validation of interoperability between multiple CEOS organisations and groups. The EAIL will help navigate some of the complexity

involved. Current activities include CEOS-COAST, WGCV DEMIX, the WGDisasters Flood Pilot, and the CEOS rice monitoring community (Asia-RiCE).

- The first EAIL node is hosted by CSIRO, and jointly operated by WGISS and the CEOS SEO, and seeks to validate and demonstrate interoperability approaches. Additional nodes are possible and would be welcomed.
- Next steps include the deployment of the WGISS and SEO node, working on implementation with the four activities identified, and soliciting interest in ongoing support and additional nodes.

Main discussion points:

- Tim Stryker (USGS) noted that ‘authoritative data’ is a tremendously important topic and foundational to effective analytics, transparency, and open science in supporting effective decision-making for societal benefit.
- Ivan Petiteville (ESA) reported that ESA welcomes the deployment of the Earth Analytics Interoperability Lab, given the strong interest declared by a number of CEOS groups and the potential benefits to a large variety of CEOS activities.
- Alex Held (CSIRO) thanked NASA for their support (via the CEOS SEO and Brian Killough) with the EAIL project. Alex is happy to see the strong interest from other agencies and CEOS activities and looks forward to the implementation of the EAIL and these specific applications. Alex encouraged CEOS Agencies to consider additional nodes and multiple participants across the breadth of CEOS activities. He also thanked Rob for his leadership through WGISS.
- Steve Volz (NOAA) endorsed the EAIL activity, suggesting it will be useful to see how existing data systems and archives can be integrated. He is encouraged to see COAST as one of the early adopters.
- Kerry Sawyer (CEOS Executive Officer) asked what steps should be taken now to try and ensure long-term sustainability once the current funding ceases at the end of 2021. Rob noted the original proposal looked to the users of the EAIL (i.e., specific project leads) to ensure their implementations are sustained going forward. The EAIL was intended to support experiments and temporary solutions only. He hopes that the CEOS ecosystem of technology will update as a result and projects will find a permanent home in the CEOS structure. Brian Killough (CEOS SEO) suggested that a side meeting could be held alongside SIT-36 to assess accomplishments to date, targets for the end of the calendar year, and sustainment options.
- Steve Volz suggested adding a budget assessment to the EAIL Work Plan to inform CEOS Agencies what long-term sustainment might cost. Steve will encourage the COAST leads to consider this.

2.4: CEOS Working Group (WG) Vice Chair Decisions [\[slides\]](#)

Presenter: Raj Kumar (ISRO, 2020 CEOS Chair Team)

Main points:

- Raj summarised the nominees for Plenary to confirm as new Vice Chairs for two CEOS Working Groups:
 - Philippe Goryl (ESA) for WGCV: who has been the ESA representative in the WGCV IVOS subgroup since 2005, and the ESA representative in WGCV since 2016.
 - Jeffrey Privette (NOAA) for the CEOS-CGMS WGClimate: who has worked at NOAA’s National Centers for Environmental Information (NCEI) since 2006, and managed NOAA’s Satellite Climate Data Record (CDR) Program. He has been the NOAA representative to the CEOS-CGMS WGClimate

since 2017. It was also noted that the CGMS Plenary has already endorsed the nomination of Jeffrey.

Main discussion points:

- UKSA, NOAA, ISRO, AEM, DLR, NASA, CONAE, JAXA, CSA, CNES, and ASI all voiced their endorsement for Philippe Goryl.
- Cindy Ong (CSIRO, WGCV Chair) thanked CEOS for its endorsement of Philippe and its continued support of WGCV. WGCV thanks ESA for their support with the commitment to Philippe for the Vice Chair and future Chair roles.
- ISRO, DLR, NASA, JAXA, CONAE, CNES, NOAA, EUMETSAT, UKSA, CSA, COM, ASI, AEM, and ESSO all voiced their endorsement for Jeffrey Privette.
- Jörg Schulz (EUMETSAT, WGClimate Chair) thanked CEOS for endorsing Jeffrey, and thanked NOAA for making the commitment to this important role.

Decision 34-03	Plenary endorsed Philippe Goryl of ESA as WGCV Vice Chair for 2021-2022 and WGCV Chair for 2023-2024.
Decision 34-04	Plenary endorsed Jeff Privette of NOAA as WGClimate Vice Chair for 2021-2022 and WGClimate Chair for 2023-2024.

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

Presenters: Vardis Tsonetos and Jorge Vazquez (NASA)

Main points:

- COVERAGE is a cross-cutting, collaborative effort seeking to respond to known needs of the ocean community for improved, more integrated access to interagency data from the four CEOS ocean Virtual Constellations to enable science and applications for societal benefit, for example, in support of the UN SDGs Goal 14.
- COVERAGE seeks to: enable more widespread use of ocean satellite products; improve access to a coherent set of global, interagency data products from the four Ocean VCs; promote implementation of an advanced technology platform providing access to complementary satellite and *in situ* datasets; and, demonstrate utility in the context of example thematic applications.
- The United Nations Decade of Ocean Science for Sustainable Development will be initiated in 2021, with the goal of mobilising resources and technical innovation to deliver key societal outcomes for the oceans. It has been suggested that CEOS could position COVERAGE as a cumulative contribution to the Decade, along with interested entities in the CEOS community.
- COVERAGE has also initiated discussions with GEO Blue Planet on Decade collaborations, and has discussed possible/desired connections to GOOS. COVERAGE is also considering a submission to the U.S. National Committee for the Ocean Decade’s call for “Ocean-Shot” concepts.

Main discussion points:

- Raj Kumar (ISRO, 2020 CEOS Chair Team) asked if COVERAGE requires any commitment from CEOS VCs or WGs to help it achieve its goals, and whether COVERAGE and COAST are discussing overlaps.

Vardis confirmed that COVERAGE is actively engaged with VCs and the current portfolio of products has been agreed in consultation with VC experts. This collaboration will continue. COVERAGE is also actively coordinating with COAST and interested in exploring additional synergies.

- Ivan Petiteville (ESA) asked if CEOS as an organisation needs to establish one single CEOS interface to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030), noting that various CEOS groups (including COVERAGE and COAST) are addressing the priority applications. If yes, CEOS needs to consider how these inputs are coordinated. Vardis agreed that there is scope for proposing a single CEOS point of contact for the Decade. He noted that there are different levels at which these initiatives can be fielded to the Decade (through national representatives or direct connection to IOC) and CEOS needs to decide the best approach and whether to address this at a programme or project level. Vardis suggested that COVERAGE is considering submitting a proposal for a project-level activity to Decade US, if agreed by CEOS. Vardis added that COVERAGE is not necessarily seeking to be this point of contact, but is willing to aid in the decision making and working with COAST and any other CEOS entities interested in collaborating on UN Decade efforts.
- Steve Volz (NOAA) agreed with the need to have coordination across CEOS regarding representation to the Decade of Ocean Science for Sustainable Development.
- Karen St. Germain stated that NASA thanks the CEOS Agency representatives from CNES, NOAA, EUMETSAT, European Commission, and the Australian Bureau of Meteorology who serve on the COVERAGE Advisory Board. NASA also very much appreciates the technical contributions from EUMETSAT, including WEKEO cloud computing resources during Phase-B, and we hope this productive collaboration under COVERAGE can continue.
- Selma Cherchali confirmed that CNES is willing to continue its contribution to the COVERAGE initiative and agreed that the interfaces with COAST and the Decade need to be addressed. She added that the SWOT mission will offer a number of key contributions.
- There are no COVERAGE-related decisions requested from Plenary, but CEOS does need to consider its coordinated engagement with the Decade of Ocean Science for Sustainable Development.
- Kerry Sawyer (CEOS Executive Officer) recalled that CEOS received an invitation from IOC to engage with them on the Decade, and the SIT Co-Chairs replied in June. The response didn't identify a single interface/point of contact for CEOS.
- Alain Ratier reported that EUMETSAT very much supports COVERAGE and would be delighted to contribute to its next phase. He also commended the work done to date.

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

Presenter: Brian Killough (CEOS SEO)

Main points:

- 2020 SEO accomplishments include: progressing the Open Data Cube (ODC); development of a Sentinel-1 Analysis Ready Data (ARD) Data Cube processing pipeline; support to the SDG-AHT and algorithms focused on SDG 6.6.1 (water) and SDG 11.3.1 (urbanisation); new Data Cube “sandboxes” on Amazon and Google cloud – the Amazon Web Services version will connect to the new Landsat Collection 2 and Sentinel-2 global archives; African Regional Data Cube transition to Digital Earth Africa; implementation of the Earth Analytics Interoperability Lab (EAIL); improvements to CEOS Visualization Environment (COVE) tool capabilities for coverage/revisit performance and coincident observations, and a new API for enhanced analyses.

- The SEO provides significant practical and systems support to CEOS, including: the CEOS website and social media content; meeting tools like GoToMeeting; the CEOS Deliverables Database; and the mailing lists and server software.
- Open Data Cube (ODC): the SEO is working with the Open Source Geospatial Foundation (OSGeo) to add the ODC to OSGeo; a Google Cloud prototype of ODC is being tested; a Digital Earth Pacific concept is under study; and there is ongoing work to support the growing number of global ODC users.
- Communications: the CEOS website had 29,939 unique visits in the last year. CEOS has 2736 Twitter followers and 1630 Facebook likes. The CEOS community should contact Kim Holloway (Kim.E.Holloway@nasa.gov) regarding updates to the CEOS website (including news items), meeting announcements/registration, GoToMeeting teleconference support, and Facebook/Twitter posts.
- SEO focus areas for 2021 include: the Earth Analytics Interoperability Lab (EAIL); Open Data Cube (ODC); CEOS Analysis Ready Data (ARD); support to SDG activities; COVE and the CEOS MIM (Missions, Instruments, Measurements) database; and continued CEOS outreach at major meetings (IGARSS, GEO, AGU).

Main discussion points:

- Jonathon Ross (GA, SIT Chair Team) thanked Brian, Kim, and all of the SEO support team for their work, which is critical to CEOS operation. Jonathon asked how CEOS Agencies can support the efforts of the SEO. Brian suggested that a great contribution CEOS Agencies can make would be to push CEOS Analysis Ready Data to highly accessible locations (e.g., the cloud) as this would greatly increase the pace of ODC uptake and development. Brian also asked all CEOS Virtual Constellation Co-Leads, Working Group Chairs and Vice Chairs, *Ad Hoc* Team Co-Leads, and CEOS Agency representatives to review their CEOS website content and provide updated/ revised content and information to the CEOS SEO, with a CC to the CEO. Steve Volz (NOAA) and Kerry Sawyer (CEOS Executive Officer) encouraged the CEOS community to review and provide updates for the website.
- Mark Dowell (COM) asked about the plan going forward for the new thematic observations area of the website (ceos.org/observations). Stephen Ward reported that the SIT Chair Team continues to discuss this page with various CEOS WGs/VCs/AHTs to further develop and populate it with references.

2.7: CEOS External Request and New Initiatives Process Papers [[slides](#)]

Presenter: Brian Killough (CEOS SEO)

Main points:

- Seeking endorsement of:
 - *CEOS External Request Process Paper*; and,
 - *Updated CEOS New Initiatives Process Paper*.
- The new *CEOS External Request Process Paper* (ERPP) is intended to supplement the *CEOS New Initiatives Process Paper* (NIPP; March 2014), which did not contain sufficient information to guide the assessment and decisions by CEOS regarding external requests. This is because the *CEOS New Initiatives Process Paper* focused on requests with existing CEOS "internal" sponsorship. The ERPP provides a detailed process to address requests that originate outside of the CEOS organisation and do not currently have CEOS sponsorship.
- CEOS Principals should be aware that these documents are important in guiding how CEOS works internally and externally.

- The process is managed initially by the CEOS Executive Officer, supported by the CEOS Chair and SIT Chair, becoming more detailed under SIT Chair management, consultation with CEOS Agencies, and culminating (if appropriate) in new CEOS Work Plan tasks/deliverables, or new CEOS entities (per the NIPP).

Main discussion points:

- ESA, NASA, USGS, DLR, AEM, UKSA, COM, CSA, CNES, CONAE, NOAA, and ASI endorsed the *CEOS External Request Process Paper*.
- Jonathon Ross (GA, SIT Chair Team) thanked NOAA for highlighting the underlying issue when it was SIT Chair.
- Mark Dowell (COM) noted that the ERPP provides clarity to questions we have now had for several years.

Decision 34-05

Plenary endorsed the *CEOS External Request Process Paper*.

2.8: Annual Report: CEOS MIM Database [\[slides\]](#)

Presenter: Ivan Petiteville (ESA)

Main points:

- The CEOS MIM (Missions, Instruments, Measurements) Database is a service in the CEOS Work Plan and remains a key connective resource across the CEOS community. The EO Handbook and database had over 15,000 users last year.
- Maintaining the database involves significant effort, with responses received from 32 of 38 agencies surveyed. Overall, the annual effort from the database team, as well as agency contacts, is approximately 15 weeks FTE.
- There was a significant update of the Measurements list this year, in consultation with thematic experts, and in an effort to further harmonise with the community (e.g., OSCAR, GCOS). This has enabled links to GCOS ECVs and the ECV Inventory v3. It also lays the groundwork for possible linkages to activities such as the SDGs.
- Upcoming work includes a possible integration with the COVE API and demonstrations of analysis using the database in Jupyter Notebooks.
- Efforts have been made to have the MIM Database interoperate with OSCAR/Satellite, SATCAT (NORAD tracking), COSPAR (identifiers), and the Union of Concerned Scientists database. Mission datasets are also linked via OpenSearch APIs from NASA and ESA.

Main discussion points:

- Jörg Schulz (EUMETSAT, WGClimate Chair) welcomed the activities on nomenclature harmonisation and thanked the MIM Database team for making the links to the ECV Inventory.
- Kenneth Holmlund (WMO) congratulated ESA for the great work on the MIM Database. WMO would like to see continued MIM-OSCAR collaboration.
- Kerry Sawyer (CEOS Executive Officer) thanked ESA for their sustained and significant contribution to the MIM Database.

Wednesday October 21st

Session 3

3.1: Welcome, Introduction, Agenda Review

Presenter: Raj Kumar (ISRO, CEOS Chair Team)

Main points:

- Raj Kumar (ISRO, CEOS Chair Team) welcomed everyone to the second day of the 34th CEOS Plenary and reviewed the plan for the meeting.

3.2: WGCapD: CEOS-Branded Webinar Toolkit [[slides](#)]

Presenter: Nancy Searby (NASA, WGCapD Chair)

Main points:

- Recommendation: WGCapD proposes that CEOS create a “Webinar Toolkit” that includes guidelines and good practices for creating webinars, templates for documentation, presentations, and questionnaires, and provides branding design assets like a thematic nomenclature and colour scheme, logos, and a bank of icons.
- WGCapD also proposes a framework for CEOS working teams to gain WGCapD support during the webinar creation process and amplification of promotional efforts.
- This will increase awareness of CEOS, its activities, and resources available; harness the work done by the SIT Chair Team on branding the CEOS thematic observation strategies; increase recognition of CEOS-sponsored activities and resources through standardisation; and, bring WGCapD lessons learned on webinar good practices to other CEOS WGs and VCs.
- Implementation steps were outlined and the proposal was put to CEOS Plenary for consideration.

Main discussion points:

- The audience for the webinar toolkit is CEOS, its Working Groups, Virtual Constellations and other entities.
- WGCapD still needs to work out whether the issue of ‘recognition’ (e.g., issuing certificates or their digital equivalents (badging)) will be addressed as part of this strategy/toolkit.
- Ivan Petiteville (ESA) commended this as a very useful initiative, noting most CEOS groups are not familiar with setting up webinars. ESA agrees with the activity proposed by WGCapD.
- DLR, USGS, CONAE, JAXA, ASI, UKSA, NOAA, CSA, ISRO, CNES and NASA all supported the creation of a “Webinar Toolkit” for CEOS.

Decision 34-06

Plenary endorsed the recommendation for the WGCapD to develop a “Webinar Toolkit” for CEOS.

3.3: WGCV [[slides](#)]

Presenter: Cindy Ong (CSIRO, WGCV Chair)

Main points:

- RadCalNet: since going public, the number of users has steadily increased to over 500 today. A new site was recently welcomed to the network: a sandy desert site in Baotou, China.
- CARD4L Peer Review: WGCV serves as the body that performs peer reviews of CEOS ARD for Land (CARD4L) self-assessments. The WGCV team recently approved Landsat Collection 2 Surface Reflectance and Surface Temperature as the first CARD4L products (at CARD4L Threshold level). The self-assessment and peer review of Sentinel-2 Level-2A products is in process. Cindy thanked Medhavy Thankappan (GA) for his effort leading this process.
- CEOS WGCV LPV Biomass Validation Protocol: The WGCV Land Product Validation (LPV) subgroup developed the Biomass Validation Protocol that will be presented later today by Laura Duncanson (NASA/UMD). The document is now open for feedback until 15 December 2020, and it will be presented for endorsement at the SIT-36 meeting in March 2021.
- Cindy noted this will be her last CEOS Plenary as WGCV Chair, with Akihiko Kuze (JAXA) taking over following Plenary. Cindy thanked CSIRO for their support of her term, as well as previous WGCV Chairs for their mentoring and all of the CEOS community for their support.

Main discussion points:

- Takeshi Hirabayashi (JAXA) introduced the new WGCV Chair, Akihiko Kuze of JAXA. Kuze-san's strong heritage with Greenhouse Gases and GOSAT will undoubtedly be a great asset to WGCV and CEOS.

3.4: Greenhouse Gas (GHG) Roadmap [\[slides\]](#)

Presenters: Mark Dowell (COM) and Albrecht von Bargaen (DLR, WGClimate Vice Chair)

Main points:

- The CEOS Atmospheric Composition Virtual Constellation (AC-VC) white paper (2018) defines a global architecture for monitoring atmospheric CO₂ and CH₄ concentrations from instruments on space-based platforms. The architecture proposes to:
 - Link the atmospheric GHG measurement and modelling communities and stakeholders in the national inventory and policy communities (through UNFCCC/SBSTA).
 - Exploit the capabilities of the CEOS and CGMS member agencies and the WMO Integrated Global Greenhouse Gas Information System (IG³IS) to integrate surface and airborne measurements of CO₂ and CH₄ with those from available and planned space-based sensors to develop a prototype for the UNFCCC 2023 Global Stocktake.
 - Implement a complete, operational, space-based constellation architecture with the capabilities needed to quantify atmospheric CO₂ and CH₄ concentrations that can serve as a complementary system for estimating NDCs in time to support the 2028 Global Stocktake.
- The constellation architecture was recognised by the SBSTA at their 51st meeting in a Research and Systematic Observations (RSO) conclusion.
- The UNFCCC Secretariat has also established a new *ad hoc* group on Systematic Observation Support to the Global Stocktake. Dave Crisp, Osamu Ochiai, and Jörg Schulz are participating in this group on behalf of CEOS.
- The Greenhouse Gas (GHG) Roadmap was established to coordinate ongoing and planned greenhouse gas measurement and analysis activities across space agencies and to foster the development of interfaces with stakeholders and users. The GHG Roadmap (v2.4) describes an approach for implementing the GHG Strategy and specifies resource needs. It is maintained by the WGClimate GHG

Task Team and is considered to be a living document whose Actions (Annex C) provide a snapshot of the work plan, which will be updated over time. This version of the Roadmap was endorsed by CGMS at its 2020 Plenary and is now presented for endorsement by CEOS.

- Expected outcomes of the Roadmap activities are:
 - The delivery of pilot datasets of CO₂ and CH₄ fluxes to enhance the uptake of Earth observation satellite data sets in support of the 2023 Global Stocktake;
 - The delivery of an operational system for producing future atmospheric CO₂ and CH₄ flux products to support the 2028 Global Stocktake; and,
 - The refinement of user requirements in preparation for the implementation of the operational system.
- Three broad categories of resources are envisaged and requested for consideration by Agencies (first introduced at CEOS Plenary 2019):
 - Dedicated human resources (via the WGClimate GHG Task Team and consistent with the requested subject matter expertise);
 - Support for travel and hosting of workshops and networking with national inventory communities, atmospheric GHG measurement and modelling communities, and other stakeholders; and,
 - *Longer-term*: internal funding mechanisms to support research, development and infrastructure for priorities identified by GHG Task Team and Roadmap implementation (annual updates will be provided to Agencies).
- A workshop on synergies and opportunities between the GHG and Agriculture Forestry and Other Land Use (AFOLU) Earth observation communities working in support of the UNFCCC is now planned for Q2 2021.
- CEOS Plenary is invited to endorse the GHG Roadmap document (v2.4), which describes an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the Actions in Annex C provide a current snapshot of the work plan definition that will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities.

Main discussion points:

- Alain Ratier (EUMETSAT) spoke on behalf of CGMS, noting that there was a long discussion at the CGMS Plenary on this topic, during which it was acknowledged that more resources are needed to support the GHG Task Team under the Joint CEOS-CGMS WGClimate. Actions were recorded at the CGMS Plenary to identify dedicated POCs to the Task Team and to identify the role of the CGMS Working Groups in the Task Team. An action was also recorded for CGMS Agencies to consider improved hyperspectral and infrared measurements (LEO and GEO) for GHG monitoring. There was also an action to conduct a review of lessons learned from NASA's development of the Geostationary Carbon Cycle Observatory (GeoCARB).
- ESA (Simonetta Cheli), CNES (Selma Cherchali), UKSA (Bertie Archer), COM (Astrid Koch), NOAA (Charles Wooldridge), JAXA (Takeshi Hirabayashi), ASI (Laura Candela), DLR (Klaus Schmidt), SANSA (Andiswa Mlisa), CSA (Éric Laliberté) and NASA (Sandra Cauffman) endorsed the GHG Roadmap document (v2.4).

- Mark confirmed there is a critical mass of participation in the Task Team, enough to make it viable, but further contributions are always welcomed. There will be other contributions from VCs and external partners also.
- Ken Holmlund (WMO) supports the constellation approach. The WMO Space Programme is open to looking at further opportunities to support and cooperate. Ken welcomed the references to IG³IS, noting increased interaction would be positive. He added that continued work is needed to ensure GCOS requirements are consistent with, and supportive of, the parameters under discussion here.
- Takeshi Hirabayashi (JAXA) thanked the GHG Task Team for their effort and supported the proposal. He encouraged the GHG Task Team to look into the new products that will be offered by GOSAT-GW.
- Sara Venturini (GEO Secretariat) offered GEO Secretariat support to advance this work.
- Astrid-Christina Koch (COM) thanked the leads of the GHG Task Team for their effort on the Roadmap and encouraged CEOS to consider contributions to the implementation. She thanked those that have already made offers of support.

Decision 34-07	CEOS Plenary endorsed the <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space (v2.4)</i> , describing an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the actions in Annex C provide a current snapshot of the work plan definition which will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities.
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CEOS-34-05	CEOS Agencies are asked to consider and provide the identified resources for the specific activities and entities within the endorsed <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space (v2.4)</i> .	CEOS Plenary 2021
CEOS-34-06	WGClimate GHG Task Team to update Annex C of the <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space (v2.4)</i> to ensure that the outcomes of the 48 th CGMS Plenary are appropriately reflected.	SIT-36

3.5: Discussion Paper on an Agriculture, Forestry, and Other Land Use (AFOLU) Roadmap [\[slides\]](#)

Presenters: Osamu Ochiai (JAXA) and Frank Martin Seifert (ESA)

Main points:

- Space agencies (CEOS and CGMS) have emphasised Essential Climate Variables (ECVs) and the physical climate via the GCOS Framework very effectively for the past decade. The importance of Nationally Determined Contributions (NDCs) to the Paris Agreement, and specifically the Global Stocktake (GST)

raises new challenges around country needs and implications for using Earth observation data with greater emphasis on mitigation and adaptation, and national-level datasets. This presents a new dimension to space agency climate coordination, and is both a huge opportunity and a significant challenge.

- SIT-35 called on JAXA and ESA to explore the development of a CEOS AFOLU (Agriculture, Forestry and Other Land Uses) Roadmap. An AFOLU Roadmap is seen as a counterpart to the GHG Roadmap, which is an inspiring example for land and ocean carbon to follow, if feasible. The result of this action is a discussion paper, presented to CEOS Plenary, on exploration of the development of a CEOS AFOLU Roadmap: *A CEOS AFOLU Initiative for the UNFCCC Global Stocktake Process*. The paper:
 - Provides the case to CEOS and its Agencies for investing in the development of an AFOLU Roadmap;
 - Provides a clear statement of the technical capabilities of CEOS Agency Earth observation satellite data and their characteristics (including identification of capabilities and datasets for inclusion in the UNFCCC Synthesis Report on Systematic Observations); and,
 - Proposes a specific way forward for 2021 and deliverables for the first Global Stocktake (GST) as the initial critical deadline.
- Potential Roadmap Opportunities: Improving Earth observation capabilities to better meet the needs of the Convention and Parties, globally and on national level; providing new measurements that do not currently form part of CEOS Agency capabilities; engaging with countries and stakeholders (such as GFOI and GEOGLAM) in case studies to improve understanding and uptake of Earth observation data by countries; taking actions to assure the policy relevance of new capabilities (e.g., through measures such as the CEOS Biomass Protocol); increasing efficiencies and effectiveness in the process by which climate data requirements are defined (e.g., by GCOS) and to which CEOS and CGMS space agencies respond; and, pragmatic focus for delivery to GST1 and GST2.
- Five key points for CEOS Plenary from the report:
 - CEOS Plenary is asked to recognise the magnitude of the opportunity for satellite Earth observations in support of the UNFCCC Global Stocktake process.
 - CEOS Agencies involved in the operation and data processing for missions identified as relevant to the proposed GST1 inputs are asked to support the preparation of those inputs in 2021. These agencies include: COM, ESA, JAXA, NASA, and USGS, among others.
 - These key agencies are asked to decide at Plenary whether they are willing to provide representation and resources going forward to support the development of a full CEOS AFOLU (Agriculture, Forestry and Other Land Uses) Roadmap in support of the GST process.
 - The CEOS-CGMS GHG Roadmap already envisions a number of deliverables targeting support to GST1. The AFOLU Roadmap and the GHG Roadmap deliverables will likely require a degree of coordination and collaboration and the AFOLU team will commit to that effort in 2021.
 - During the CEOS SIT Technical Workshop in September 2020, CEOS appointed three focal points to the UNFCCC Secretariat GST process: Osamu Ochiai (for AFOLU issues), David Crisp (GHG issues), Jörg Schulz (general issues). These focal points will keep CEOS informed on GST developments.
- If there is an agreement by CEOS Plenary to proceed towards a CEOS AFOLU Roadmap, the established core team – expanded with additional resources – will lead the effort in 2021. This will include the

CEOS internal relationships with WGClimate – as lead for the CEOS interface to UNFCCC – and with the GHG Task Team and the WGCV Land Product Validation (LPV) subgroup, and the external relations to GFOI and GEOGLAM. Sustained institutional arrangements within CEOS will be necessary to underpin a substantial AFOLU activity and proposals for these will be developed during 2021.

Main discussion points:

- Gilberto Camara (GEO Secretariat Director) thanked the team that developed the paper for a CEOS AFOLU Roadmap. If CEOS Agencies endorse the proposed activity, the GEO Secretariat will consult its constituents regarding contributions and supporting actions from across the GEO Work Programme.
- Mark Dowell (COM) asked if GEOGLAM is already systematically producing products that are relevant to the GST. Ian Jarvis (GEOGLAM) noted they are producing crop conditions in real time and there are other activities related to land use and land cover state. If current activities can be aligned through the AFOLU Roadmap, there is a good opportunity for contribution to the GST.
- Alain Ratier (EUMETSAT) noted the need to ensure that the products are those needed for modelling. He also stated that WGClimate shall remain the single focal point to the UNFCCC Secretariat to ensure consistency. Ivan Petiteville (ESA) and Klaus Schmidt (DLR) supported the need to maintain the CEOS-CGMS WGClimate as the focal point to the UNFCCC Secretariat.
- Selma Cherchali (CNES) supported the proposal to develop an AFOLU Roadmap and agreed with EUMETSAT regarding maintaining WGClimate as the connection to UNFCCC.
- Adam Lewis (GA, LSI-VC Co-Lead) noted that the AFOLU Roadmap team has been formed within the Forest and Biomass Team of LSI-VC, by the Leads of that Team. The Leads of LSI-VC recognise the importance of the AFOLU work and the delegation of the land aspects of the CEOS Carbon Strategy to the VC.
- Sandra Cauffman (NASA) acknowledged the progress made on defining synergies between the AFOLU Roadmap and the GHG Roadmap and recommended undertaking the AFOLU Roadmap development in alignment with the GHG Roadmap.
- Jörg Schulz (EUMETSAT, WGClimate Chair) agreed with DLR that the organisational approach should be resolved as a matter of urgency and that all CEOS entities referenced in the last slide of the presentation should have specific roles identified. As with the GHG Roadmap, the AFOLU Roadmap should look long-term (well beyond the first global stocktake) at what is needed for the construction of an operational system. Jörg also emphasised that it is WGClimate that has the interface to UNFCCC (and not the GHG Task Team, and this should apply to AFOLU as well).
- CONAE (Laura Frulla), UKSA (Bertie Archer), NOAA (Charles Wooldridge), CNES (Selma Cherchali), and ASI (Laura Candela) supported the proposal to develop a CEOS AFOLU Roadmap.
- Mark Dowell (COM) noted that AFOLU inputs to the system will have a different set of requirements. Products are often delivered directly to users (e.g., through GFOI) and CEOS needs to make sure they are compatible. The GHG-AFOLU Workshop previously mentioned will seek to address this. Regarding the suggestion of a carbon platform within WGClimate, Mark suggested that this would require a revisit of the CEOS Carbon Strategy.
- Tim Stryker (USGS) reported that USGS recognises the magnitude of the AFOLU-UNFCCC GST opportunity, and supports the continued development of the AFOLU Roadmap. USGS will maintain existing support within the LSI-VC, and seek to enhance it as needed, though the latter is still subject to identification of sufficient personnel and resources. USGS hopes that the Landsat Collection 2 global surface reflectance/temperature products can assist the AFOLU initiative. USGS also agrees that the

AFOLU and GHG Roadmaps be closely coordinated, drawing upon the responsibilities, expertise, and stakeholder connections of various CEOS entities.

Decision 34-08	It was agreed that it is important to proceed with the development of a CEOS AFOLU Roadmap, noting the need for a long-term vision, but also the urgency of clearly understanding and defining targets for the first Global Stocktake (including the AFOLU products needed for modelling within the GHG monitoring system). Coordination of the AFOLU Roadmap team with the WGClimate and its GHG Task Team was recognised as essential.
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CEOS-34-07	CEOS Agriculture, Forestry, and Other Land Use (AFOLU) Roadmap Team to follow up with CEOS Agencies to determine their willingness to contribute to the development of an AFOLU Roadmap. In 2021, the effort will prioritise AFOLU products for the first UNFCCC Global Stocktake given the urgency, followed by a longer-term vision in a CEOS Roadmap document.	November 2020
CEOS-34-08	WGClimate, including its GHG Task Team, and the AFOLU Roadmap Team to coordinate and ensure the necessary collaboration for 2023 Global Stocktake (GST1) deliverables and to ensure a unified interface with WGClimate as focal point for CEOS to UNFCCC SEC.	SIT-36

3.6: CEOS WGCV LPV Biomass Validation Protocol [\[slides\]](#)

Presenter: Laura Duncanson (NASA/UMD)

Main points:

- The community is at the beginning of a new wave of forest biomass products, and forests play a critical role in the global carbon cycle. The goal of climate-related policy activities is to maximise the carbon stored and minimise emissions from deforestation and degradation, and these efforts critically require reliable estimates of forest carbon stocks and fluxes. To date no reliable global forest biomass products have been available due to a dearth of appropriate data, though several agencies are filling this data gap through new missions (e.g., NASA/GEDI). The Biomass Protocol provides good practice guidance on validation of these new datasets.
- In 2017, a new biomass focus area was added within WGCV LPV, initiating the development of the Protocol. The Protocol is now out for public review, and the WGCV LPV will seek its endorsement at the CEOS SIT-36 meeting in March 2021.
- The combination of multiple data streams (e.g., GEDI, ICESat-2, NISAR, BIOMASS, ALOS-4) reduces errors and can lead to higher resolution maps. However, this means there are thousands of ways to combine these data streams. The Protocol provides guidance for map producers on how to estimate, propagate and report errors, and for map users on how to interpret errors, collect reference data

(field and airborne lidar), and how to use reference data to conduct independent biomass product validation.

- Conclusions and recommendations of the Protocol include:
 - The large number of new biomass data and products could reduce product uptake unless validation activities are user-friendly, transparent, and well-coordinated;
 - Reference data should be collected following shared protocols, enabling data to be used by the global community;
 - Where possible, large forest plots, TLS, and airborne lidar should be collected;
 - The use of airborne lidar allows scaling of field data, thus reference sites can validate any resolution of biomass product;
 - User-led validation with existing reference data should be conducted with caution given spatial and temporal, and definition discrepancies; and,
 - Reference data should be free and open to allow for transparent, reproducible product validation.
- The WGCV LPV subgroup is seeking feedback on the draft Protocol by 15 December 2020, prior to presenting it for endorsement at SIT-36.

Main discussion points:

- Sara Venturini (GEO Secretariat) welcomed the open science approach.
- Selma Cherchali (CNES) thanked Laura for the coordination and noted that CNES will continue its support to CEOS in this area and looks forward to endorsing the Protocol.
- Bertie Archer (UKSA) reported that UKSA continues to support the development of the Protocol and its designees who have worked on it. It’s detailed, good and necessary for credible biomass data. UKSA supports the Protocol and looks forward to endorsing it at SIT-36.
- Mark Dowell (COM) commended the team for their tremendous work on the Biomass Validation Protocol. He reminded CEOS that this activity also started in response to actions from the CEOS Carbon Strategy.
- Karen St. Germain (NASA) noted that NASA thanks and supports the efforts of the WGCV, its Land Product Validation Subgroup, Dr. Cindy Ong (WGCV Chair), Dr. Akihiko Kuze (WGCV Vice Chair), Dr. Laura Duncanson, and the many contributors to the CEOS WGCV LPV Biomass Validation Protocol. This is a milestone for the community of practice.

CEOS-34-09	CEOS Agencies to provide feedback on the CEOS WGCV LPV “Aboveground Woody Biomass Product Validation Good Practice Protocol”, with the goal of endorsement at SIT-36. CEOS Agencies are encouraged to follow Protocol guidance in biomass-relevant activities.	15 December 2020 for feedback
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3.7: Forest Biomass Reference Network [[slides](#)]

Presenter: Laura Duncanson (NASA/UMD)

Main points:

- In support of an anticipated CEOS-endorsed Biomass Validation Protocol, a proposal has been developed for the creation of a Global Forest Biomass Reference Network. This would consist primarily of a sustainably-funded system of recurrent site-based measurements that will serve as a lasting interface between the Earth observation agencies and ground-based, tree-by-tree measurement initiatives.
- No single Earth observation mission, agency, or organisation would alone support the costs of this implementation, with the infrastructure designed to become a common good for the broader community.
- The greatest value from biomass products will be realised if they are verified by independent and openly available reference data.
- A network of 100 biomass reference measurement sites, plus 210 additional distributed sites is being proposed, with an initial set of potential reference sites identified. There is a particular focus on the tropics, as these areas host the majority of aboveground biomass. These sites require significant funding to meet protocol standards for validation of forthcoming biomass products.
- Collaboration amongst CEOS Agencies, with established networks (e.g., ForestGEO, RAINFOR, NEON, TERN, AfriTRON, TMFO, IIASA, Forestplots.net, etc.), and with local collaborators is being encouraged. The WGCV LPV would welcome feedback on how to achieve the proposed creation of the Network.
- Potential opportunities for JAXA, ESA, ISRO, and NASA to support implementation were reviewed.

Main discussion points:

- Sara Venturini (GEO Secretariat) offered the support of the GEO Knowledge Hub for the Biomass Reference Network, as well as GEO Secretariat support on any financial questions.
- Mark Dowell (COM) asked if GCOS could provide additional visibility to the Network through its Reference Network Framework.
- Jeff Privette (NOAA) suggested that 100 core and 210 augmenting sites globally seems like a lot, given the required activity, equipment, data management, etc. He asked if this network size is systematically-derived. Laura noted that biomass is a particularly challenging variable, with a lot of natural variability. The community is still lacking a good first map and needs a very wide set of reference datasets. The NASA team is in the process of using GEDI data to determine how many sites would be sufficient for discerning forest structure gradient.
- Ivan Petiteville (ESA) recognised the usefulness of the Biomass Reference Network, but noted that we still have to find a realistic mechanism for funding this activity, involving not only CEOS Agencies but also organisations outside CEOS, as the estimated cost (over 30 million Euros) noted at SIT Technical Workshop cannot be entirely supported by CEOS Agencies. He added that it would be helpful to have a prioritised list of sites.
- Mark Dowell (COM) noted for comparison that FLUXNET is around 800 sites.
- Stephen Ward (CEOS Chair Team) noted that the biomass team presented the concept to the GFOI Leads and donors twice in the last few weeks, with strong interest from The World Bank and others.
- Hank Margolis (NASA) noted that NASA's Terrestrial Ecology Program supports the development of a Biomass Reference Network and will continue to work with the community to find efficient means for developing it.

CEOS-34-10	CEOS Agencies are invited to provide recommendations and feedback on how to achieve the proposed creation of a Global Forest Biomass Reference System, including possible national contributions.	15 December 2020
CEOS-34-11	CEOS Agencies are encouraged to communicate existing and potential new activities that could contribute to the collection and curation of new biomass reference data.	SIT-36
CEOS-34-12	WGCV LPV Biomass team to establish a site prioritisation for the Forest Biomass Reference System.	SIT-36

3.8: Carbon and Biomass – Closing Remarks

Presenter: Adam Lewis (GA, SIT Co-Chair)

Main points:

- Adam recapped the actions and decisions. He reported that the SIT Co-Chairs are happy to see progress on the carbon and biomass topics, given they are one of the three SIT Chair priorities. He reiterated the importance of the GHG and AFOLU Roadmaps to CEOS input for the Global Stocktakes.

3.9: Joint CEOS-CGMS WGClimate [[slides](#)]

Presenter: Jörg Schulz (EUMETSAT, WGClimate Chair)

Essential Climate Variable (ECV) Inventory v3.0, Gap Analysis Report, and Coordinated Action Plan

Main points:

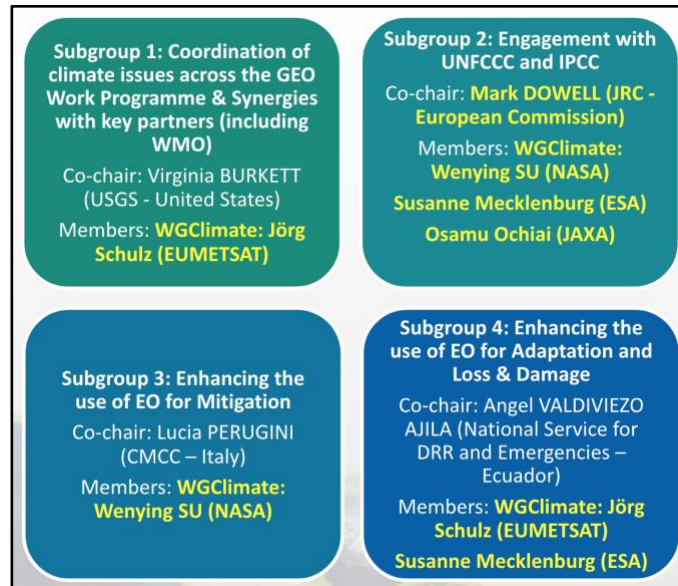
- ECV Inventory v3.0 has been live since 30 July at: climatemonitoring.info/ecvinventory. Of the 37 space-observable ECVs (13 Atmosphere, 15 Land, and 9 Ocean), 35 are covered with some contribution in the updated Inventory. From the current ECVs only Ocean Surface Currents and Anthropogenic GHG Fluxes appear as gaps, but some more ECVs can be addressed from space, e.g., River Discharge.

Domain	Existing	Planned	Total
Atmosphere	535	266	801
Ocean	90	43	133
Land	141	62	203
Total	766	371	1137

- The delivery of the Cycle 3 Gap Analysis and Coordinated Action Plan has moved to Autumn 2020 (due to COVID-19), and the group is aiming for virtual endorsement by the end of 2020. Overall, the gap analysis process will be further rationalised to ensure affordability and sustainability.
- The gap analysis process currently includes an automatic assessment, display and analysis of that automatic assessment, and then a detailed analysis for each ECV/ECV Product. The current Cycle assesses progress for 8 ECVs addressed for V2.0. An additional 13 ECVs had been selected (5 atmosphere, 5 land, 3 ocean), which were not addressed before, and are specifically part of the 2016 GCOS Implementation Plan (IP) actions. Data records are automatically assessed based on a number

of criteria including Stewardship, Generation Process, Record Characteristics, Documentation, Accessibility, and Applications. The detailed analysis for an ECV involves a specific analysis of the future available space segment to avoid potential gaps.

- Key findings include: some additional data records are available for inclusion into the Inventory for aerosol, sea level, soil moisture, land cover, and fire (burnt area) ECVs; several impending gaps could be eliminated by continuing existing and launching planned missions on time (e.g., multi-channel passive microwave radiometers and limb sounding capability for water vapour); potential contributions from Russian and Indian imagers and sounders for 3D winds; Aeolus type missions should be operationalised; and, altimetry could play a stronger role in sea ice extent and snow thickness.
- Work is ongoing to compile v4.0 of the Inventory.
- WGClimate has started to routinely collect use cases for Climate Data Records (CDRs). Use cases are being collected at climatemonitoring.info/use-cases and several have been received to date. These will be published on the web, and selected use cases will become part of a special report issued by WMO in 2021/2022. CEOS Agencies are asked to encourage institutions in their countries that use satellite climate data to submit a use case.
- There is an increasing need for application-specific GCOS requirements (e.g., for GHGs). This would help make space agency coordination, as well as individual agency investment, more efficient, though the preference is to maintain GCOS as the primary source of EO requirements. Requirements are changing, and there is a need to reflect this in the GCOS IP.
- WGClimate is helping to support the way forward for GCOS by developing proposals, in particular, addressing typology in all domains. It was suggested that the AFOLU Roadmap team engage with this activity, checking the GCOS IP land chapters for existence of the needed ECVs, including related requirements, e.g., related to biomass.
- The timeline for GCOS was reviewed, with IP4 expected to be reviewed and finalised in early 2022.
- WGClimate provided a CEOS-CGMS Statement at SBSTA-51 in Madrid, Spain, in December 2019. SBSTA-52/COP-26 has been postponed to 2021, so there will be no formal statements made in 2020. However, an Earth Information Day is planned for the second week of the climate change dialogues, on November 30, 2020.
- The CEOS/CGMS WGClimate will support the UNFCCC Secretariat in the Synthesis and Assessment phase of the first Global Stocktake process, and will actively engage in the newly established *Ad Hoc* Group on Systematic Observations in Support of the Global Stocktake. Three CEOS representatives were nominated soon after the 2020 SIT Technical Workshop (David Crisp/WGClimate GHG Task Team, Osamu Ochiai/AFOLU, and Jörg Schulz).
- The GEO Climate Change Working Group (CC-WG) has four subgroups, and 97 members from governments, academia, UN agencies, IGOs, NGOs, and the private sector.



- As ex officio member of the World Climate Research Programme (WCRP) Data Advisory Council, WGClimate took part in discussions on an overall coordination mechanism across necessary model, data and observation activities within WCRP as part of the implementation of the new WCRP strategy.
- CEOS-32-02: WGClimate to develop a ‘decision-maker’ version of the Statement of Space Agency Contributions in Support of Each Article of the Paris Agreement: WGClimate developed a presentation used at the ESA Living Planet Symposium and several other workshops, but was not able to complete this action due to resource limitations. WGClimate proposes to postpone this action and enrich the resulting material with the newest developments on GHG and AFOLU activities, as well as the partnership with the GEO CC-WG.
- CEOS climate deliverables are now fully aligned with the CGMS High-Level Priority Plan.
- In summary, the CEOS Plenary is asked to:
 - Decide that a virtual endorsement of the ECV Inventory v3.0 Gap Analysis Report and Coordinated Action Plan by the end of 2020 is acceptable.
 - Endorse the way forward for WGClimate interaction with GCOS on their work on the requirements framework.
 - Engage with the use case exercise and to facilitate the submission of use cases.
- Jörg thanked CEOS for the opportunity to serve as WGClimate Chair and for the support since 2017. He welcomed the new Chair, Albrecht von Bargaen of DLR, and Vice Chair, Jeff Privette of NOAA.

Main discussion points:

- COM (Astrid-Christina Koch and Mark Dowell), CNES (Selma Cherchali), DLR (Klaus Schmidt), ESA (Simonetta Cheli), NASA (Karen St. Germain and Christine Bognar), USGS (Tim Stryker), NOAA (Charles Wooldridge), AEM, CONAE (Laura Frulla), SANSa (Andiswa Mlisa), and the CEO (Kerry Sawyer) all thanked Jörg for his service to CEOS and leadership of WGClimate. Alain Ratier (EUMETSAT) also expressed his sincere gratitude to Jörg for his complete dedication to the role, and thanked him both personally and from an organisational point of view.
- Albrecht von Bargaen (DLR) was welcomed as the new WGClimate Chair.

- Ken Holmlund (WMO) noted the usefulness of having WGClimate as a central point of contact for the Essential Climate Variables (ECVs) in CEOS. Ken encouraged continued close cooperation between CEOS and GCOS going forward. The GCOS Status Report will demonstrate the commitments of CEOS Agencies to past GCOS Implementation Plans. WMO supported the decisions presented by WGClimate.
- The requested endorsements were also supported by ESA (Simonetta Cheli), EUMETSAT (Paul Counet), COM (Astrid-Christina Koch), CNES (Selma Cherchali), SANSa (Andiswa Mlisa), CSA (Éric Laliberté), JAXA (Osamu Ochiai), NASA (Karen St. Germain), ISRO (R P Singh), and CONAE (Laura Frulla).

Decision 34-09	It was agreed that the ECV Inventory Gap Analysis Report and updated Coordinated Action Plan will be submitted for virtual Plenary endorsement before the end of 2020.
Decision 34-10	Plenary endorsed the way forward proposed by WGClimate for interaction with GCOS regarding the requirements framework.

3.10: UNFCCC Global Stocktake Process and Space Agency Engagement [[GST slides](#)][[Engagement slides](#)]

Moderators: Mark Dowell (COM), David Crisp (NASA/JPL), Jörg Schulz (EUMETSAT, WGClimate Chair)

Main points:

- Adam Lewis (GA, SIT Co-Chair) introduced the session:
 - At the SIT Technical Workshop in September, we dedicated significant time to understanding the nature of the Paris Agreement Global Stocktake Process and the opportunities it presents for Earth observations from space and for the programmes of CEOS Agencies.
 - As SIT Chair, we felt that the issues raised merited a repeat showing in front of the CEOS Principals so we are all across the context, to the highest levels within our EO programmes.
 - At the SIT Technical Workshop, we had a number of external guests to help provide a good understanding of the key policy processes, including from the UNFCCC Secretariat and from GCOS. We chose not to invite external presenters this second time around. Instead, we chose to focus on our internal frank discussion about both the opportunity and the challenge it represents and where CEOS might best focus resources.
 - The Australian SIT Chair team priorities for our current term have included a broad theme of ‘Carbon and Biomass’, and within that we have put an emphasis on several questions:
 - What is our vision of an optimally efficient and effective partnership between space data providers and the main UN and national stakeholders that use CEOS Agency data to make and manage policy?
 - How can CEOS explore more integrated and pro-active relationships with major stakeholders in conventions and national inventories - to accelerate the policy impact and application of CEOS data?
 - Can we shine a light on the underlying technical work underway in the organisation and agencies and advocate for support from Principals for it to realise its full potential?

- Today, you have heard some of that important technical work in the GHG Roadmap, the AFOLU Roadmap and the new Biomass Protocol and related Reference Network. We need to be aware and we need to develop a consensus for the level of engagement by CEOS.
- At the Technical Workshop, we had an excellent dialogue with the UNFCCC Secretariat, and we appointed three focal points going forward for their GST process and the Synthesis Report on Systematic Observations. Osamu Ochiai (AFOLU), Dave Crisp (GHG), and Jörg Schulz (for WGClimate broadly). We also had some promising discussions with GCOS on improvements to their requirements process so that CEOS agencies can better respond to them in more productive ways.
- Mark Dowell (COM) thanked the SIT Chair team for the very productive session with UNFCCC SEC and GCOS at SIT Technical Workshop. Mark presented the following points to seed discussion:
 - What are the specific potential contributions to the first and second Global Stocktake?
 - How do we best engage with the process?
 - How should we integrate the GHG and AFOLU efforts?
 - What else can we contribute?
- David Crisp (NASA/JPL) presented some target (pilot) products for the first Global Stocktake, which need to be delivered by the end of 2021 for the 2023 Stocktake:
 - Pilot Atmospheric CO₂ Flux Inventory: to illustrate the atmospheric products needed to support the GHG Roadmap and the UNFCCC Global Stocktake. Ensemble-mean CO₂ flux estimates derived by an international team as part of the ongoing OCO-2 multi-model intercomparison project. This product incorporates global monthly and annual mean maps of optimized CO₂ fluxes at 2° by 2° spatial resolution and can also produce monthly time series for 38 geographic regions (national totals for large countries could also be extracted). Delivery formats and schedules are still under discussion.
 - Pilot products for localized sources: including large urban areas, power plants and oil fields. These products illustrate methods for tracking hot spots for future Global Stocktakes.
 - Tools for Creating Interfaces and Capacity Building: to provide a product that starts a conversation with the relevant players and establishes the role of atmospheric inventories in future Global Stocktakes. These pilot products are expected to foster the development of requirements with CEOS stakeholders (UNFCCC, GCOS) and interfaces with users in the national inventory communities who will be using the outputs of the much more capable system that will be coming on-line to support the 2028 and future Global Stocktakes at 5-year intervals.
- Jörg Schulz (EUMETSAT, WGClimate Chair) noted that in conversations earlier this year with UNFCCC, it became clear that the focus for the Synthesis Report is demonstrating how these products are being used, which is very important for building confidence and interest.
- Mark reported that CEOS engagement with UNFCCC is clearly broadening and he suggested CEOS needs a longer-term strategy that accounts for the multitude of contributions it and its member agencies can make to the Convention. Mark earlier suggested that an update of the CEOS Carbon Strategy might be worth considering. In the short-term, we will continue to work under the SIT Chair term priority and focus on the GHG-AFOLU workshop next year.
- The UNFCCC Secretariat has suggested (SIT Technical Workshop 2020 input from Joanna Post) that CEOS can support:

- Party Reporting: including through methodological support (on GHG inventories, emissions estimates, IPCC methodology), review processes, refinement of data (including as reviewers), and by providing support to developing countries.
- Global Stocktake: at the Party-level, to improve accuracy and detail, providing advice to Constituted Bodies, and by collaborating on the Synthesis Report at global level (GST 2023).
- Integrated Systems Approaches for Measurement, Reporting and Verification (MRV) and the Global Stocktakes: CO₂ and CH₄ estimates, other atmospheric GHGs, AFOLU and biomass.

Main discussion points:

- Jörg stated that perhaps the most effective part of recent SBSTA meetings for CEOS has been the Earth Information Days, which provide an opportunity to engage directly with the Parties, in particular through the poster sessions. Jörg expects that the CEOS contribution to the Synthesis Report will need to be very concise, as there most likely will only be space for a few paragraphs.
- The general strategy is to align CEOS Agency data and tools with existing methods, systems and terminologies to produce better and more effective results from these existing processes.
- Having three CEOS subject matter experts involved with the UNFCCC's *Ad Hoc* Group on Systematic Observations and their Synthesis Report is very important and provides the opportunity for detailed discussion and an iterative interface with UNFCCC, which is a significant upgrade to the previous modality. Jörg noted that 'Loss and Damage' is one aspect of the Paris Agreement that might not be reflected in the Synthesis Report, but there is a lot of potential for satellite Earth observation data. In this context, Jörg emphasised that it is important to illustrate how products can be used for the GST.
- Adam Lewis asked if there is similar clarity of the vision and requirements on the AFOLU side regarding what CEOS could provide and how it would support existing systems. Osamu Ochiai (JAXA) noted the slide in his [presentation](#) on potential products. The requirements are not as clear and traceable for the AFOLU side, however. David Crisp noted his example of biospheric response to GHG emissions, which demonstrates that the AFOLU and GHG sides are critically linked. David expects that the 2023 Global Stocktake will serve as a learning experience for all participants, and that there will be a fully end-to-end process and set of requirements by 2028. It is an ongoing process to make all of the necessary connections with the various stakeholders.
- Nancy Searby (NASA, WGCapD Chair) noted that WGCapD has a related deliverable for the Space Capacity Development Advisory Board (SCDAB), and sees opportunity for collaboration on this topic – including with the GEO CC-WG, Paris Agreement Capacity Development Group, etc.
- Mark asked CEOS to consider his idea of starting a process to revise the CEOS Carbon Strategy, to align it with new needs and requirements, approaching it from the point of view of what CEOS Agencies can provide (i.e., start with an implementation focus from the outset).

Thursday October 22nd

Session 4

4.1: Welcome, Introduction, Agenda Review

Presenter: Raj Kumar

Main points:

- Raj Kumar (ISRO, CEOS Chair Team) welcomed everyone to the third and final day of the 34th CEOS Plenary and reviewed the plan for the meeting. He summarised the main outcomes from the second day.

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

Presenters: Adam Lewis (SIT Co-Chair), Ed Armstrong (NASA/JPL), Andreia Siqueira (GA), Rob Woodcock (CSIRO, WGISS Chair)

Main points:

- The CEOS ARD Strategy was endorsed at the 2019 CEOS Plenary. The SIT Chair Team has been stewarding its implementation, which is advancing through CEOS Working Groups (WGISS, WGCV) and Virtual Constellations (LSI-VC, SST-VC). The strategy covers all aspects from user needs and specifications through to production and access, pilot activities, and communication and promotion.
- CEOS ARD progress includes:
 - Product Family Specifications (PFS): Surface Reflectance (SR), Surface Temperature (ST), Normalised Radar Backscatter (NRB), and Polarimetric Radar (PR) PFS have now been endorsed; Interferometric Radar and Geocoded SLC PFS are in development and targeting completion in early 2021; an Aquatic Reflectance PFS is also in development, and LIDAR terrain and canopy height PFS are under consideration.
 - First CARD4L Datasets: USGS Landsat Collection 2 SR and ST have been assessed as the first CARD4L and ESA's Sentinel-2 Level-2A SR products are nearing the end of the assessment process.
 - CEOS ARD Beyond Land: SST-VC (Ed Armstrong, NASA/JPL) and a small team have been tasked with exploring the possibility of revising the CARD4L Framework to accommodate domains other than land. CEOS-COAST has signalled their intention to use CEOS ARD for their pilot activities. Also related is the draft PFS for Aquatic Reflectance and provisional Aquatic Reflectance Landsat products from USGS.
 - CEOS Interoperability Terminology v1.0: A WGISS-led activity building upon work initially undertaken by LSI-VC members. The document seeks to bring consistency to various ARD and Future Data Architecture terminology in CEOS. It is being presented for endorsement at the 2020 CEOS Plenary.
 - CEOS Analysis Ready Data – Involving the Private Sector Paper: presents recommendations for CEOS regarding engagement of the private sector on CEOS ARD, and is being presented for endorsement at the 2020 CEOS Plenary.
 - CEOS ARD Communications: New CEOS ARD logo; actively updated [website](#) with a new *Frequently Asked Questions* section; the [first CEOS ARD webinar](#) was a great success with over 490 registrations, a second will follow; IGARSS 2020 paper and ARD session; and participation in OGC's TESTBED16 ARD activity.

- Ed presented perspectives from SST-VC, AC-VC, COVERAGE and CEOS-COAST regarding the expansion of the CEOS ARD concept beyond land. It was proposed that a small team be formed within CEOS to:
 - Review and prioritise the top concerns and recommendations for improving and extending the CEOS ARD Framework; and,
 - Propose additional documentation for updating or refining the existing Product Family Specifications.
- Expected outcomes of this activity are:
 - Improved PFS that can be used by other science communities besides Land and Radar
 - PFS that can be adapted to other satellite processing levels
 - PFS that can interoperate with existing ARD
 - Final Report out to CEOS Plenary 2021 on findings and implementation recommendations
 - Including advisory notes (e.g., on file formats) in the Framework
 - Advice on the future coordination between the VCs and WGISS on ARD
- The CEOS Interoperability Terminology report seeks to address the fact that the terms Analysis Ready Data (ARD), interoperability, and harmonization are often used, and to a large extent, used inconsistently. Interoperability represents a continuum of compatibility for products, services, algorithms. Various terms are presented for ARD, cloud data formats, and analysis interoperability.
- The CEOS ARD: Involving the Private Sector paper presents the following recommendations and next steps for CEOS:
 - Establish mechanisms for constructive and appropriate engagement with the private sector.
 - Avoid unnecessary barriers to participation (from industry) in the CEOS ARD discussion and processes.
 - Provide appropriate documentation on the various aspects of the CEOS ARD initiative.
 - Identify a CEOS ARD Framework process for assessing private data products for compliance with Specifications.
 - Move CEOS concepts into the broader standards discussion to be more inclusive of the private sector.
 - Continue to share Information on CEOS Analysis Ready Data to build support.
 - Understand the Industry Perspective.
 - Engage Industry in Specifications.

Main discussion points:

- Gilberto Camara (GEO Secretariat Director) suggested that it would be interesting to include points related to Data Cubes in future versions of the Interoperability Terminology document. He also suggested consideration be given to clouds and quality bands – the current definition of interoperable ARD is not clear with regard to differing methods of compensation for cloud cover, and leaves open the possibility for inconsistent terminology related to quality bands. Finally, on algorithms, Gilberto noted that they are often stochastic, and so there is a need to be careful about specifying input

conditions and claims of reproducibility. Gilberto commended CEOS for all of its work on Analysis Ready Data and advocated for open science approaches.

- Rob Woodcock (CSIRO, WGISS Chair) invited the CEOS community to provide feedback on the terminology report via either WGISS or LSI-VC. The hope is that over time, CEOS understanding and usage of the language in this field will improve in parallel to the ability as a community to implement it.
- Mark Dowell (COM) asked whether the OCR-VC has been engaged in the development of the Aquatic Reflectance PFS. He noted that there are established reflectance/radiance standards for inland and marine waters within that community of practice that may be relevant to ARD.
- Adam reported that the relationship between CEOS and the private sector on the topic of CEOS ARD has improved greatly over the past year, thanks to the open process implemented.
- Gilberto Camara (GEO Secretariat Director) reported that the GEO Secretariat thanks CEOS for preparing the ARD Private Sector Engagement paper and fully supports the work done by CEOS.
- Steve Volz (NOAA) asked if thought has been given to the complexity of communicating specifications to the private sector, specifically describing the deliverable we are trying to quantify. Adam noted that the ARD Framework has an annual review process to garner feedback from both the private and public sectors which he hopes will also serve to resolve such issues.
- Ivan Petiteville (ESA) noted similar discussions within GEO regarding the engagement of the private sector and urged CEOS to take similar steps to ensure a fair and level field for all.

Decision 34-11	Plenary endorsed the <i>CEOS Interoperability Terminology v1.0</i> document.
Decision 34-12	Plenary endorsed the “ <i>CEOS Analysis Ready Data – Involving the Private Sector</i> ” paper and its recommendations.

CEOS-34-13	SIT Chair and Ed Armstrong (SST-VC Co-Lead) to form a team of experts to review the CEOS ARD Framework (Definition, Specifications and processes around CEOS ARD) for <i>completeness</i> and <i>suitability</i> (including looking at changes that make it amenable to non-land domains).	SIT-36
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4.3: CEOS Coastal Observations and Applications Study Team (COAST) [\[slides\]](#)

Presenter: Paul DiGiacomo (NOAA, CEOS-COAST Lead)

Main points:

- The CEOS Coastal Observations and Applications Study Team (CEOS-COAST) was initiated last year at the 33rd CEOS Plenary to define a CEOS Coastal Strategy, with an underlying goal of bridging land and aquatic observations within CEOS, and helping to integrate across multiple CEOS entities and domains, both thematic and technical. This effort has also sought to leverage existing CEOS systems, services and interoperability approaches, including CEOS Analysis Ready Data (ARD).

- The Study Team looked at both land-to-sea impacts (e.g., biological, ecological), as well as sea-to-land impacts (e.g., physical forcing). These aspects involved different sets of products and stakeholders.
- Phase 1 of the study has been completed, including a draft Implementation Plan for Phase 2 (now in draft, to be delivered in December 2020). This development has been supported by the development of three white papers addressing sea-to-land and land-to-sea user needs, observations and services, and cross-cutting tools, systems and services.
- A joint GEO-CEOS COASTAL Workshop will be planned for Summer 2021, though there is some uncertainty due to the ongoing COVID pandemic.
- Bathymetry is an example of an important parameter with respect to coastal flooding and inundation hazards. This parameter has been identified by CGMS for similar reasons.
- Some COAST pilot locations have been identified, including examples of both continental and small island coastlines.
- The Study Team is requesting continuation of COAST activities through September 2022 as a CEOS *Ad Hoc* Team, to be renamed Coastal Observations, Applications, Services and Tools (COAST) *Ad Hoc* Team, with Final Terms of Reference and a Phase 2 Implementation Plan to be delivered in December 2020.
- The Study Team is requesting CEOS consider COAST as a submission to the U.N. Ocean Decade to address international coastal stakeholder needs through its global implementation.

Main discussion points:

- Steve Volz (NOAA) endorsed the transition of COAST to a CEOS *Ad Hoc* Team, and indicated he was encouraged by the progress to date. He cautioned the team and CEOS to carefully manage the scope of what is expected. He commended the team for prioritising high-level and high-impact pilots.
- Trevor Dhu (GA) supported and endorsed the transition of COAST to a CEOS *Ad Hoc* Team. He thanked the team for their effort to date. Trevor suggested that pilot activities that bring together multiple CEOS Agencies be the priority. Having a few projects with strong agency participation will be a more effective showcase than a series of disparate, lightly connected ones.
- Eric Laliberté (CSA) asked if a northern/arctic site is being considered. Paul confirmed that it is not for the current phase, but that it is under consideration for the future.
- NOAA, CNES, JAXA, ESSO, CSA, NASA, and COM supported the endorsements proposed (see decisions below). Many also agreed with the suggestion to keep watch on the scope of the team’s activities.

Decision 34-13	Plenary endorsed the creation of the CEOS Coastal Observations, Applications, Services, and Tools (COAST) <i>Ad Hoc</i> Team through September 2022 to continue the activities started under the CEOS Coastal Observations and Applications Study Team. The final Terms of Reference and a Phase 2 Implementation Plan will be delivered in December 2020. The COAST <i>Ad Hoc</i> Team will report to the CEOS Chair.
Decision 34-14	Plenary agreed that CEOS should submit COAST to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) to address international

	coastal stakeholder needs through its global implementation. This needs to be done in coordination with the SIT Chair and COVERAGE teams.
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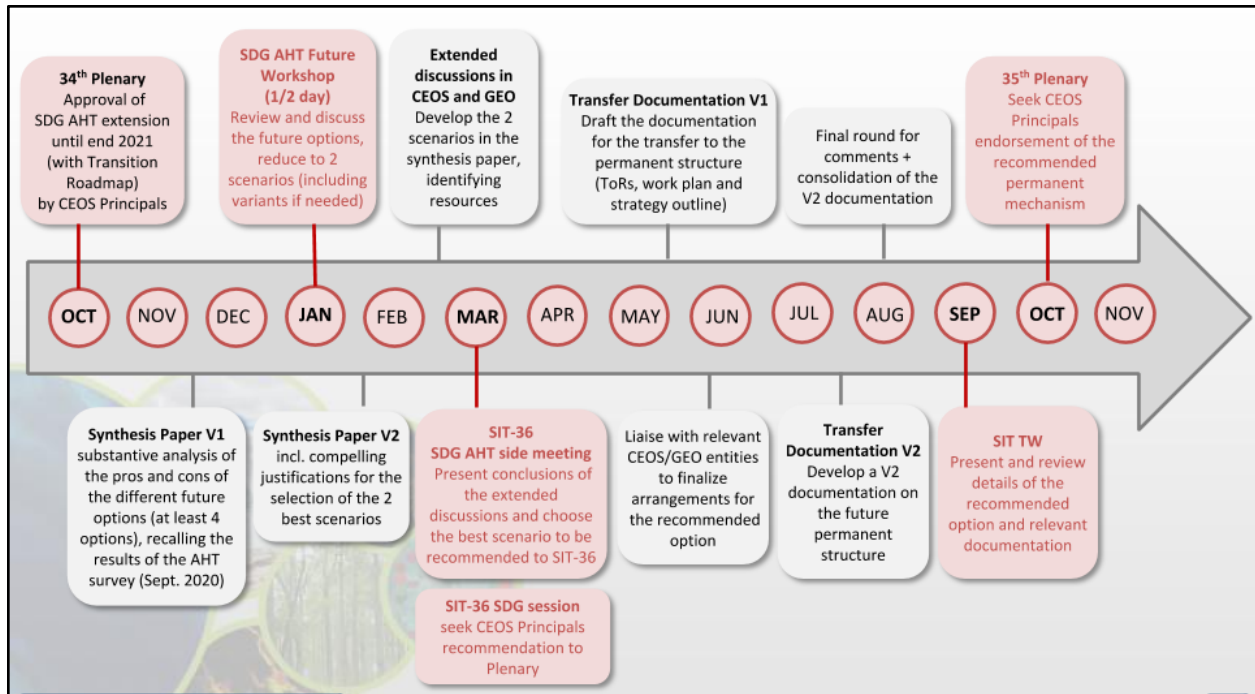
CEOS-34-14	The newly endorsed Coastal Observations, Applications, Services, and Tools (COAST) <i>Ad Hoc</i> Team to provide final Terms of Reference (in accordance with CEOS Governance and Processes) and a Phase 2 Implementation Plan.	To be delivered in December 2020; report at January's CEOS Secretariat meeting
CEOS-34-15	COAST <i>Ad Hoc</i> Team to coordinate with the SIT Chair on the submission of COAST to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). This action needs to be done in coordination with the CEOS Secretariat and COVERAGE, per action CEOS-34-20 .	

4.4: Sustainable Development Goals Ad Hoc Team (SDG-AHT) [[slides](#)]

Presenters: Alex Held (CSIRO) and Marc Paganini (ESA)

Main points:

- CEOS is focusing its SDG efforts on four key Indicators: Water (6.6.1), Urbanisation (11.3.1), Coastal pollution (14.1.1), and Land degradation (15.3.1). It has established subteams for each of these Indicators. An example output from the Land Degradation (15.3.1) subteam was shown.
- The SDG-AHT and SEO are working together on creating Open Data Cube algorithms for these SDG applications. The plan is to release a free and open Landsat ODC Sandbox and Google Cloud ODC Sandbox by the end of 2020. This will allow users to apply the technology anywhere in the world. Sentinel-1 and Sentinel-2 will also be integrated.
- The CEOS activities on SDGs and deliverables are embedded in the GEO Federated Approach on SDGs and related workflows – this includes contributing to the SDG EO Toolkits. CEOS can/should contribute through the provision of: existing datasets and products, a list of existing tools and services available (ODC, DIAS cloud services, Trends.Earth, etc.); and, links to other existing CEOS data products and tools (MIM Database, COVE tool, EO Handbook on SDG, etc.).
- An SDG-AHT Transition Roadmap for 2021 has been provided to support the AHT's application to be extended for another year:



Main discussion points:

- ESA, JAXA, NOAA, CNES, CONAE, ASI, UKSA, NSO, NASA, ISRO, CSA, ESSO, DLR, GA, and COM all supported the extension of the SDG-AHT for one year as presented in the above roadmap, and they commended the SDG-AHT for the excellent work to date.

Decision 34-15	Plenary agreed to extend the SDG-AHT for one year, with direction for the SDG-AHT to plan a transition of SDG activities to internal (within CEOS) and/or external entities by the 2021 CEOS Plenary.
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CEOS-34-16	CEOS Sustainable Development Goals <i>Ad Hoc</i> Team (SDG-AHT) to prepare inputs (according to the Roadmap proposed) to the 2021 CEOS Plenary outlining the proposed new permanent mechanism.	CEOS Plenary 2021
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4.5: COVID-19 and Earth Observation from Space

ESA / JAXA / NASA Joint Dashboard on EO and COVID-19 [[slides](#)]

Presenter: Yves-Louis Desnos (ESA), Shin-ichi Sobue (JAXA), Manil Maskey (NASA)

Main points:

- In April 2020, JAXA, NASA and ESA launched a collaboration to analyse changes in the global environment and socio-economic activities arising from the COVID-19 pandemic. This collaboration has led to the Earth Observing Dashboard, which integrates multiple satellite data records and

analytical tools to allow user friendly tracking of changes. The Dashboard was developed utilizing APIs and Data Cube technologies. It has attracted an estimated 108,800 visits since its launch on June 25, 2020.

- ESA, NASA and JAXA noted interest to continue the trilateral EO Dashboard, and possibly expand it to new areas and new indicators. In the near term (three months), they will focus on existing indicators for new geographical areas.

European Commission: Rapid Action on COVID-19 and EO (RACE) & Copernicus Products [[slides](#)]

Presenter: Astrid-Christina Koch (COM)

Main points:

- The objective of RACE is to provide public EO information on the state of European society and economy using European EO (Copernicus Sentinels and Third Party Missions), and leveraging European companies' capabilities. RACE has showcased real examples of the pandemic's effects in more than 200 representative areas of interest across the EU, providing information on 129 indicators (e.g., air and water quality, agricultural production, travel, manufacturing and trade).
- Next steps include adding new data, increasing coverage (additional Member States, new indicators), and increasing international cooperation and coordination.
- An EU Space webpage gathering initiative was launched by the Commission: www.euspace-programme.eu/coronavirus.

Joint EUMETSAT-CNES LATMOS Presentation [[slides](#)]

Presenter: Dorothee Coppens (EUMETSAT)

Main points:

- The IASI instrument was used to monitor the impact of COVID-19 over Europe and China.
- Expecting increased monitoring capability with two new missions from 2023 onwards: EPS-SG with the new generation of IASI, IASI-NG in LEO orbit; and, MTG (Meteosat Third Generation) with the advanced sounder IRS in geostationary orbit.

Studies on Environmental Impact over India [[slides](#)]

Presenter: Raj Kumar (ISRO)

Main points:

- Significant reductions in aerosols (20–37%) were observed by MODIS during the lockdown period as compared to a 2017–2019 baseline. TROPOMI observations showed large reduction (30–50%) in tropospheric column NO₂ over India during the same period. *In situ* observations of NO_x also showed an abrupt decrease over different Indian cities after the lockdown.

Main discussion points:

- Steve Volz (NOAA) asked what the results might tell us about how to best resume activities in a post-COVID-19 world. That is, is there any information that can be teased out of the results and shared with decision-makers to ensure that we resume activities in a more environmentally sustainable manner. Shin-ichi noted that the EO Dashboard teams have been collaborating with socio-economists to establish their needs and try to address them. This dialogue is ongoing with no concrete answer just yet. Manil noted that the team needs to reflect on its initial indicators and adjust them to be as

useful as possible for decision-makers. Yves-Louis reported that the team is now starting to look into the recovery side, and he is hopeful some lessons will come out of this phase.

- Gilberto Camara (GEO Secretariat Director) commended the rapid response of CEOS Agencies to the pandemic and for establishing the EO Dashboard. He questioned whether the same approach and lessons learned might also be applied to existing issues like climate change and the SDGs, for example.
- Takeshi Hirabayashi (JAXA) thanked NASA and ESA for their collaboration and welcomed contributions from other CEOS Agencies.
- Ivan Petiteville (ESA) made two remarks via the chat:
 - The dashboards currently focus on the impacts of the pandemic, but there is also a potential contribution of EO to other studies that aim to determine how some environmental factors could trigger a pandemic or could foster its spread, for instance, the sprawl of human settlements into wildlife habitats. Other factors like humidity and temperature can also influence disease spread, e.g., mosquitoes and malaria.
 - CEOS should also interface with new users such as the health community (e.g., epidemiologists) that might use EO information in combination with other socio-economic information (e.g., population density, transportation, health structure).
- David Crisp (NASA/JPL) noted that from the greenhouse gas and air quality perspective, we were able to show that we could detect and quantify the changes in greenhouse gases and NO₂ emissions associated with changes related to COVID-19. We also learned that we need more near real time products and more analysis ready data than we currently have.
- Mark Dowell (COM) asked if there has been an assessment to determine if any specific products/indicators produced should now be put into continuous production.
- Karen St. Germain (NASA) reported that NASA is funding projects (currently 19) that are specifically looking at the global response to COVID-19, and relationships with and between the natural Earth systems and human health.
- Kerry Sawyer (CEOS Executive Officer) noted the ESA-NASA-JAXA dashboard is a significant contribution to the global community for the COVID-19 crisis, but it is important to acknowledge that this was completed under a trilateral agreement and not under the CEOS umbrella. Invitations to other CEOS space agencies to contribute to this tri-agency dashboard are welcome, but is there any intent to brand this as a CEOS activity?
- Tim Stryker (USGS) supported the idea of this or other dashboards for key global issues eventually being branded as CEOS activities, with all CEOS members able to contribute on a best-effort basis.
- Steve Volz (NOAA) stated that NOAA would be interested in participating in a discussion on how to structure a CEOS approach to connecting COVID-19 observations to existing CEOS external community connections, to address the attribution side in particular.
- Mark Dowell (COM) noted that a dashboard for scientists (even non-EO scientists) would be very different to a dashboard for policymakers.

CEOS-34-17	CEOS Secretariat, with representatives of the COVID-19 initiatives, to consider the options and interest in building upon the multilateral COVID-19 activities	SEC-274
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	(including the ESA-NASA-JAXA Tri-Agency Dashboard), and the potential formation of a CEOS activity on EO and COVID-19.	
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4.6: Report: SIT Chair Term Accomplishments [\[slides\]](#)

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

Main points:

- The SIT Chair Team has remained focused on the three priorities articulated prior to the start of their term: Analysis Ready Data; Carbon & Biomass; and the Sustainable Development Goals. There have been significant agenda items on all three of these topics during Plenary, and an update on 2020 outcomes is included in the slides.
- The SIT Chair Team has continued and built upon previous SIT Chair Efforts in coordination with the Working Teams (VCs, WGs, AHTs). Two Working Team All-Hands calls were held, with the agenda set by the Working Teams. Two rounds of individual VC Chats have been completed, and CEOS SEC teleconference slots have been added for VC reports.
- A new thematic observations page has been created to give a quick overview of the key observing strategies in place or under development by all CEOS Working Teams: ceos.org/observations.
- There has been a substantial increase in VC representation in CEOS Work Plan Deliverables (in part via informal calls with Leads) with 39 VC deliverables now in the Work Plan, 30 of which were created in 2020.
- The plan for 2021 SIT meetings was reviewed:
 - [SIT-36, March 2021](#): Sydney, Australia (**default assumption now virtual**); and,
 - [SIT Technical Workshop 2021](#): September; location TBA.

Main discussion points:

- NASA, ESA, CSA, UKSA, USGS, CNES, DLR, COM, and the GEO Secretariat thanked the SIT Chair Team for their efforts throughout 2020.

4.7: CEOS Agency Updates – Highlight Synthesis Report [\[slides\]](#)

Presenter: Raj Kumar (ISRO, CEOS Chair Team)

Main points:

- Raj presented the compiled agency report summary slides on behalf of CEOS Agencies. Both the summary presentation and additional reference slides are available on the [meeting website](#).
- Sentinel-6A Michael Freilich is on track to launch in November. Sandra Cauffman (NASA) thanked the partners (ESA, EUMETSAT, NOAA, COM) for renaming Sentinel-6A in honour of Mike Freilich. Mike lives on in our memories, and we will continue his legacy, advancing Earth science.
- Alain Ratier will be retiring and therefore stepping down as EUMETSAT Principal for CEOS. Phil Evans will be the new Director General of EUMETSAT, effective January 1, 2021. CEOS thanked Alain for his friendship and commitment to CEOS.

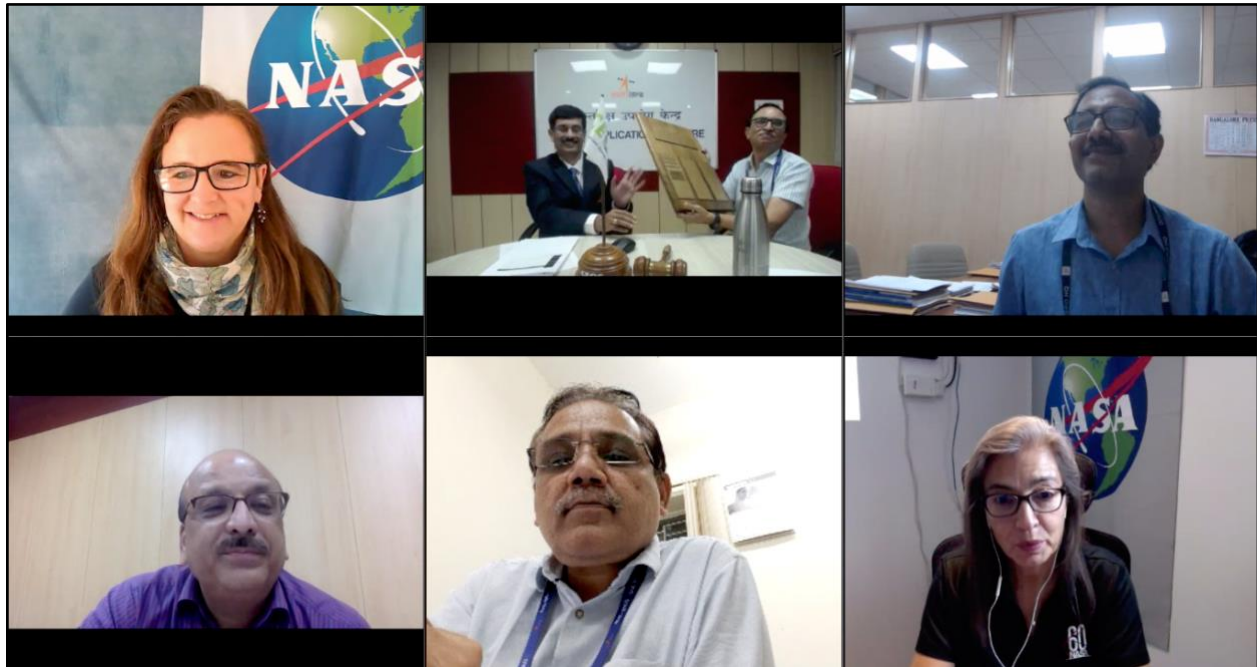
Session 5

5.1: CEOS Chair Handover

Presenters: 2020 and 2021 CEOS Chair Teams

Main points:

- Raj Kumar (ISRO, 2020 CEOS Chair Team) virtually exchanged the CEOS flag and gavel to the 2021 CEOS Chair, Karen St. Germain, signifying the transfer of the CEOS Chair role from ISRO to NASA.



- Karen thanked the ISRO CEOS Chair Team for their leadership throughout a challenging year. Karen recalled Michael Freilich’s esteemed legacy in Earth science and CEOS, which the NASA CEOS Chair Team looks forward to picking up and advancing in 2021 as CEOS Chair.

Presentation on 2021 CEOS Chair Theme and Priorities [\[slides\]](#)

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

Main points:

- NASA welcomed the role of CEOS Chair and thanked and applauded the CEOS Chair, ISRO, and SIT Chair, CSIRO-GA for their leadership throughout 2020, an unprecedented year during which the world and CEOS dealt with challenges for which science, technology, international cooperation and communication—all of which come together in CEOS—have been essential.
- The 2021 CEOS Chair team will continue advancing activities in the CEOS 2020-2022 Work Plan, including major focus areas of the current CEOS SIT co-Chairs, CSIRO and Geoscience Australia, and leverage results from the priorities of the 2020 CEOS Chair, ISRO, and the 2019 CEOS Chair, VAST-VNSC.
- NASA invites the CEOS community to dedicate the 2021 CEOS Chair term as a benchmark year to elevate and more widely communicate how CEOS is actively realizing its vision through the theme: *“Space-based Earth Observation Data for Open Science and Decision Support”*.

- The intent is to not add to the significant number of commitments that CEOS already has. Instead, the concept is to broadly disseminate the relevance of CEOS remote sensing activities and contributions in support of Open Science and decision making.

CEOS-34-18	CEOS Agencies to provide feedback to the NASA CEOS Chair Team to aid in the development of a document on how the 2021 theme, <i>“Space-based Earth Observation Data in Support of Open Science and Decision Support”</i> will be integrated into existing CEOS activities.	December 15, 2020
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Main discussion points:

- Doug Cripe noted that the GEO Secretariat appreciates the emphasis on open science. In addition to the benefits mentioned (transparency, collaboration, lowering barriers), open science is an effective way to combat disinformation.
- CONAE, ESA, CNES, AEM, ISRO, UKSA, and CSA commended the overall theme proposed by NASA and said they look forward to working together in this direction.

5.2: 2020 CEOS Plenary Final Review [\[slides\]](#)

Main points:

- Raj Kumar (ISRO, 2020 CEOS Chair Team) with the support of agenda item leads presented slides summarising the 2020 CEOS Plenary, with the goal of confirming key messages and outcomes; finalising any outstanding points that weren’t resolved or addressed during the other sessions; and, reviewing and confirming the formal actions and decisions of CEOS Plenary. The slides summarise content previously reflected in this meeting record, and as such, only additional information, actions, and decisions are recorded from this point forward.

CEOS-34-19	2020 CEOS Chair Team (ISRO) and OSVW-VC to explore the establishment of a joint CEOS-CGMS Task Team to assess user requirements and mission feasibility for the 2020 CEOS Chair Scatterometry Virtual Constellation (VC) priority.	
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- Regarding item 1.4 on CEOS Executive Officer continuity, Christine Bognar (NASA) noted that the 2020 CEOS Chair successfully secured a CEO in Dr. Marie-Claire Greening for the next two years. The Chair then invited all CEOS Agencies to nominate candidates to be Deputy CEO. This action is ongoing. Karen St. Germain (NASA, 2021 CEOS Chair) added that the CEOS Chair and CEOS Secretariat will assess all CEO continuity options via the monthly CEOS Secretariat teleconferences. Raj supported this proposed way forward. Ivan Petiteville (ESA) suggested that a subset of the CEOS Secretariat and other interested people could be convened to explore options to present to the CEOS Secretariat. Raj suggested the approach be left to the incoming CEOS Chair to decide.
- Kerry Sawyer (CEOS Executive Officer) added that CEOS has been talking about CEO continuity for more than 18 months and has not come to a conclusion on the process. CEOS needs to identify a formal mechanism to ensure sustainability and continuity of the CEO.

- Vardis Tsonetos (NASA/JPL, COVERAGE) proposed an action to seek clarity on the CEOS focal point on matters related to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). Kerry Sawyer (CEOS Executive Officer, NOAA) recalled the letter already sent to IOC on this matter and suggested that an update be submitted once a decision has been made.

CEOS-34-20	COVERAGE, COAST, and SIT Chair Teams to discuss and conclude on how CEOS will coordinate internally and externally on CEOS involvement in the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). Once determined, the SIT Chair will prepare a follow-up letter (in coordination with the CEOS Secretariat) to the IOC identifying the appropriate CEOS contact for matters relating to the Decade.	
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- Brian Killough (NASA, SEO) recalled his request for CEOS entities to review and revise their CEOS website content. An action was suggested.

CEOS-34-21	All CEOS Virtual Constellation Co-Leads, Working Group Chairs and Vice Chairs, and <i>Ad Hoc</i> Team Co-Leads to review CEOS website content and provide updated/revise content and information to CEOS SEO, with a CC to the CEO.	31 December 2020
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- Brian also recalled that the recently updated *CEOS New Initiatives Process Paper* (NIPP) was presented in combination with the newly developed *CEOS External Request Process Paper* (ERPP), but unlike the ERPP, formal endorsement wasn't announced or noted. The requested endorsement of the NIPP was raised again here for confirmation.
- ESA, COM, CSA, and NASA formally endorsed the updated *New Initiatives Process Paper* (NIPP).

Decision 34-16	Plenary endorsed the updated <i>CEOS New Initiatives Process Paper</i> .
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- Astrid-Christina Koch (COM) suggested that links to the different COVID-19 dashboards could be added to the CEOS website.
- Kerry Sawyer (CEOS Executive Officer) presented the CEOS Statement to GEO Week 2020, which had been updated to reflect the outcomes and decisions of the 2020 CEOS Plenary. COM, ISRO, JAXA, CSA, CSIRO, CONAE, NASA, NOAA, AEM, CNES, and USGS endorsed the revised statement.

Decision 34-17	The CEOS Statement to GEO Week 2020, updated to reflect the outcomes and decisions of the 2020 CEOS Plenary, was endorsed.
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5.3: Meeting Close

Main points:

- Karen St. Germain (NASA, 2021 CEOS Chair) noted that this is Alain Ratier’s final CEOS Plenary for EUMETSAT. She thanked Alain for being an outstanding space partner and friend to the whole CEOS community. We all wish Alain well and hope that our paths will cross again in the future. Alain thanked Karen for these words and wished her and the whole CEOS community well in the future.
- Tim Stryker (USGS) recognised that this Plenary would be the last for Kerry Sawyer in her second term as CEO. He thanked her for her many years of leadership of, and service to, the CEOS community.
- D.K. Das (ISRO, 2020 CEOS Chair) thanked everyone for their attendance, noting that it was a shame the ISRO team was unable to greet everyone in person and welcome them to India. Despite the virtual format, the meeting was very productive.
- D.K. Das acknowledged Dr. Michael Freilich’s great contributions to CEOS and to the remote sensing community writ large. He took the moment to remind everyone of the ‘Partnership Road’ that is CEOS. We all look forward to the launch of Sentinel-6A/Michael Freilich and we thank the partner agencies for their gesture of renaming the mission after Mike.
- D.K. Das thanked the CEOS Secretariat; SIT Chair Team; and CEOS Executive Officer, Kerry Sawyer; for their support over the CEOS Chair year. He thanked Alain for the key interactions in CEOS and CGMS and wished him all the best for the future. D.K. Das added his thanks to Jörg Schulz (EUMETSAT, WGClimate Chair) and Cindy Ong (CSIRO, WGCV Chair) for leading their respective Working Groups (Schulz for three years; Ong for the past two years). Finally, he thanked the CEOS Chair Team, and especially Raj Kumar, for chairing the CEOS Secretariat and the 2020 CEOS Plenary.
- The CEOS community thanked ISRO for their excellent chairing of CEOS throughout 2020, which has been an extraordinary and challenging year.
- D.K. Das adjourned the meeting.

APPENDIX A: Attendees

Organisation / Role	Name	Organisation / Role	Name	Organisation / Role	Name
AC-VC	Tomohiro Oda	GISTDA	Khruewan Champangern	NASA	Nancy Searby
AEM	Adrian Guzman	GISTDA	Raksina Lekthanoo	NASA	Richard Eckman
AGEOS	Aboubakar Mambimba Ndjoungui	Incoming CEO	Marie-Claire Greening	NASA	Sandra Cauffman
ASI	Laura Candela	ISRO	Arundhati Misra	NASA	Vardis Tsontos
ASI	Nunzia Paradiso	ISRO	Atul Varma	NASA	Wenying Su
ASI	Simona Zoffoli	ISRO	Bimal Bhattacharya	NASA/JPL	David Crisp
Australian BoM	Agnes Lane	ISRO	Debajyoti Dhar	NASA/JPL	Edward Armstrong
CEOS Chair Team	George Dyke	ISRO	Dipak K Das	NASA/UMD	Laura Duncanson
CEOS Chair Team	Matthew Steventon	ISRO	Krunal Joshi	NIER	Jaehoon Jeong
CEOS Chair Team	Stephen Ward	ISRO	Manoj Kumar Mishra	NOAA	Charles Wooldridge
CNES	Pierric Ferrier	ISRO	Mini Raman	NOAA	Jeff Privette
CNES	Selma Cherchali	ISRO	Muvva V. Ramana	NOAA	Merrie Neely
CONAE	Ana Medico	ISRO	Nitant Dube	NOAA	Mitch Goldberg
CONAE	Laura Frulla	ISRO	Pradeep Thapliyal	NOAA	Shobha Kondragunta
CONAE	Marisa Kalemkarian	ISRO	Prakash Chauhan	NOAA	Stephen Volz
CONAE	Raul Kulichevsky	ISRO	Raghavendra Singh	NOAA, CEO	Kerry Sawyer
CSA	Eric Laliberté	ISRO	Raj Kumar	NSMC	Jinlong Fan
CSA	Marie-Josée Bourassa	ISRO	Rajeev Jaiswal	NSO	Joost Carpay
CSA	Paul Briand	ISRO	Rashmi Sharma	POLSA	Aleksandra Bukala
CSIRO	Amy Parker	ISRO	Sampa Roy	POLSA	John Hall
CSIRO	Cindy Ong	ISRO	Santhi Sree Basavaraju	POLSA	Kinga Gruszecka
CSIRO	Flora Kerblat	ISRO	Shantanu Bhatawdekar	POLSA	Marek Moszynski
CSIRO	Neil Sims	ISRO	Shiv Prasad Aggarwal	POLSA	Marta Balcer
DLR	Albrecht von Bargaen	ISRO	Tushar Shukla	POLSA	Michal Szaniawski
DLR	Klaus Schmidt	JAXA	Akihiko Kuze	Roscosmos	Tamara Ganina
ESA	Ferran Gascon	JAXA	Kei Oyoshi	Roshydromet	Alexander Uspensky
ESA	Frank Martin Seifert	JAXA	Ko Hamamoto	Roshydromet	Alexey Rublev
ESA	Ivan Petiteville	JAXA	Koji Akiyama	Roshydromet	Konstantin Litovchenko
ESA	Marc Paganini	JAXA	Makoto Natsuisaka	Roshydromet	Zoya Andreeva
ESA	Mirko Albani	JAXA	Misako Kachi	SANSA	Andiswa Miisa
ESA	Philippe Goryl	JAXA	Osamu Ochiai	SANSA	Daniel Matsapola
ESA	Simonetta Cheli	JAXA	Rui Kotani	SANSA	Imraan Saloojee
ESA	Valentina Boccia	JAXA	Takeo Tadono	SANSA	Stewart Bernard
ESA	Yves-Louis Desnos	JAXA	Takeshi Hirabayashi	UKSA	Bertie Archer
ESSO	Hasibur Rahaman	JAXA	Toshi Kamei	UKSA	Beth Greenaway
ESSO	VS Prasad	JAXA	Yukio Haruyama	UKSA	Catherine Mealing-Jones
EUMETSAT	Alain Ratier	NASA	Andrew Mitchell	UNOOSA	Jorge Del Rio Vera
EUMETSAT	Jörg Schulz	NASA	Argyro Kavvada	US Department of State	Fernando Echavarria
EUMETSAT	Paul Counet	NASA	Barry Lefer	USGS	Christopher Barnes
EUMETSAT	Robert Husband	NASA	Brian Killough	USGS	Cody Anderson
European Commission	Astrid-Christina Koch	NASA	Christine Bogner	USGS	Sky Bischoff-Mattson
European Commission	Giancarlo Granero	NASA	Christine Mataya	USGS	Steve Labahn
European Commission	Mark Dowell	NASA	David Borges	USGS	Timothy Stryker
European Commission	Mauro Facchini	NASA	David Green	USGS	Tom Sohre
European Commission	Zoltan Szantoi	NASA	Diane Davies	VNSC	Lam Dao Nguyen
GA	Andreia Siqueira	NASA	Hank Margolis	VNSC	Pham Anh Tuan
GA	Jonathon Ross	NASA	Jay Al-Saadi	VNSC	Pham Thi Mai Thy
GA	Norman Mueller	NASA	Jorge Vazquez	VNSC	Phan Ngoc Phuong Linh
GA	Stephen Sagar	NASA	Karen St. Germain	VNSC	Vu Anh Tuan
GA	Trevor Dhu	NASA	Lauren Childs-Gleason	WMO	Anne-Claire Fontan
GCOS	Simon Eggleston	NASA	Lawrence Friedl	WMO	Guangxin He
GEO Secretariat	Douglas Cripe	NASA	Manil Maskey	WMO	Kenneth Holmlund
GGOS	Richard Gross	NASA	Michael Falkowski	WMO	Zhichao Wang

APPENDIX B: Actions Record

No.	Action	Due Date
CEOS-34-01	CEOS Executive Officer to confirm the Polska Agencja Kosmiczna (POLSA) Principal and Contact details, and to update applicable CEOS mailing lists. CEO will work with the SEO to update the CEOS website to reflect the addition of POLSA as an Associate member.	ASAP
CEOS-34-02	CEOS Chair Team to work with the Secretariat to explore CEO continuity options.	CEOS Plenary 2021
CEOS-34-03	CEOS Chair Team to follow up with CNES on its possible interest in the role of 2022 CEOS Chair.	By end November 2020
CEOS-34-04	SIT Chair to ensure that the P-VC Co-Leads are aware of ESA's nomination of Dr. Tobias Wehr (EarthCARE Mission Scientist) as a member of the VC.	Upcoming Nov-Dec VC Chats
CEOS-34-05	CEOS Agencies are asked to consider and provide the identified resources for the specific activities and entities within the endorsed <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space</i> (v2.4).	CEOS Plenary 2021
CEOS-34-06	WGClimate GHG Task Team to update Annex C of the <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space</i> (v2.4) to ensure that the outcomes of the 48 th CGMS Plenary are appropriately reflected.	SIT-36
CEOS-34-07	CEOS Agriculture, Forestry, and Other Land Use (AFOLU) Roadmap Team to follow up with CEOS Agencies to determine their willingness to contribute to the development of an AFOLU Roadmap. In 2021, the effort will prioritise AFOLU products for the first UNFCCC Global Stocktake given the urgency, followed by a longer-term vision in a CEOS Roadmap document.	November 2020

CEOS-34-08	WGClimate, including its GHG Task Team, and the AFOLU Roadmap Team to coordinate and ensure the necessary collaboration for 2023 Global Stocktake (GST1) deliverables and to ensure a unified interface with WGClimate as focal point for CEOS to UNFCCC SEC.	SIT-36
CEOS-34-09	CEOS Agencies to provide feedback on the CEOS WGCV LPV “Aboveground Woody Biomass Product Validation Good Practice Protocol”, with the goal of endorsement at SIT-36. CEOS Agencies are encouraged to follow Protocol guidance in biomass-relevant activities.	15 December 2020 for feedback
CEOS-34-10	CEOS Agencies are invited to provide recommendations and feedback on how to achieve the proposed creation of a Global Forest Biomass Reference System, including possible national contributions.	15 December 2020
CEOS-34-11	CEOS Agencies are encouraged to communicate existing and potential new activities that could contribute to the collection and curation of new biomass reference data.	SIT-36
CEOS-34-12	WGCV LPV Biomass team to establish a site prioritisation for the Forest Biomass Reference System.	SIT-36
CEOS-34-13	SIT Chair and Ed Armstrong (SST-VC Co-Lead) to form a team of experts to review the CEOS ARD Framework (Definition, Specifications and processes around CEOS ARD) for <i>completeness</i> and <i>suitability</i> (including looking at changes that make it amenable to non-land domains).	SIT-36
CEOS-34-14	The newly endorsed Coastal Observations, Applications, Services, and Tools (COAST) <i>Ad Hoc</i> Team to provide final Terms of Reference (in accordance with CEOS Governance and Processes) and a Phase 2 Implementation Plan.	To be delivered in December 2020; report at January’s CEOS Secretariat meeting

CEOS-34-15	COAST <i>Ad Hoc</i> Team to coordinate with the SIT Chair on the submission of COAST to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). This action needs to be done in coordination with the CEOS Secretariat and COVERAGE, per action CEOS-34-20 .	
CEOS-34-16	CEOS Sustainable Development Goals <i>Ad Hoc</i> Team (SDG-AHT) to prepare inputs (according to the Roadmap proposed) to the 2021 CEOS Plenary outlining the proposed new permanent mechanism.	CEOS Plenary 2021
CEOS-34-17	CEOS Secretariat, with representatives of the COVID-19 initiatives, to consider the options and interest in building upon the multilateral COVID-19 activities (including the ESA-NASA-JAXA Tri-Agency Dashboard), and the potential formation of a CEOS activity on EO and COVID-19.	SEC-274
CEOS-34-18	CEOS Agencies to provide feedback to the NASA CEOS Chair Team to aid in the development of a document on how the 2021 theme, <i>“Space-based Earth Observation Data in Support of Open Science and Decision Support”</i> will be integrated into existing CEOS activities.	December 15, 2020
CEOS-34-19	2020 CEOS Chair Team (ISRO) and OSVW-VC to explore the establishment of a joint CEOS-CGMS Task Team to assess user requirements and mission feasibility for the 2020 CEOS Chair Scatterometry Virtual Constellation (VC) priority.	
CEOS-34-20	COVERAGE, COAST, and SIT Chair Teams to discuss and conclude on how CEOS will coordinate internally and externally on CEOS involvement in the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). Once determined, the SIT Chair will prepare a follow-up letter (in coordination with the CEOS Secretariat) to the IOC identifying the appropriate CEOS contact for matters relating to the Decade.	

CEOS-34-21	All CEOS Virtual Constellation Co-Leads, Working Group Chairs and Vice Chairs, and <i>Ad Hoc</i> Team Co-Leads to review CEOS website content and provide updated/revised content and information to CEOS SEO, with a CC to the CEO.	31 December 2020
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APPENDIX C: Decisions Record

Decision 34-01	Plenary endorsed the membership application of the Polska Agencja Kosmiczna (POLSA) to become a CEOS Associate.
Decision 34-02	Plenary endorsed the following three WGDisasters documents: <ul style="list-style-type: none"> ● CEOS WGDisasters Strategy Paper: Promoting Space Data for Disaster Risk Management ● CEOS WGDisasters Recovery Observatory (RO) Demonstrator Implementation Plan ● CEOS WGDisasters Geostationary / Low Earth Orbit / Synthetic Aperture Radar Flood Risk Pilot Implementation Plan
Decision 34-03	Plenary endorsed Philippe Goryl of ESA as WGCV Vice Chair for 2021-2022 and WGCV Chair for 2023-2024.
Decision 34-04	Plenary endorsed Jeff Privette of NOAA as WGClimate Vice Chair for 2021-2022 and WGClimate Chair for 2023-2024.
Decision 34-05	Plenary endorsed the <i>CEOS External Request Process Paper</i> .
Decision 34-06	Plenary endorsed the recommendation for the WGCapD to develop a “Webinar Toolkit” for CEOS.
Decision 34-07	CEOS Plenary endorsed the <i>Roadmap for Implementation of a Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space (v2.4)</i> , describing an approach and resource needs for the implementation of the GHG Constellation Strategy. This is to be considered a living document and the actions in Annex C provide a current snapshot of the work plan definition which will be updated over time. CEOS Agencies will strive to provide the identified resources for the specific activities and entities.
Decision 34-08	It was agreed that it is important to proceed with the development of a CEOS AFOLU Roadmap, noting the need for a long-term vision, but also the urgency of clearly understanding and defining targets for the first Global Stocktake (including the AFOLU products needed for modelling within the GHG monitoring system). Coordination of the AFOLU Roadmap team with the WGClimate and its GHG Task Team was recognised as essential.

Decision 34-09	It was agreed that the ECV Inventory Gap Analysis Report and updated Coordinated Action Plan will be submitted for virtual Plenary endorsement before the end of 2020.
Decision 34-10	Plenary endorsed the way forward proposed by WGClimate for interaction with GCOS regarding the requirements framework.
Decision 34-11	Plenary endorsed the <i>CEOS Interoperability Terminology v1.0</i> document.
Decision 34-12	Plenary endorsed the “ <i>CEOS Analysis Ready Data – Involving the Private Sector</i> ” paper and its recommendations.
Decision 34-13	Plenary endorsed the creation of the CEOS Coastal Observations, Applications, Services, and Tools (COAST) <i>Ad Hoc</i> Team through September 2022 to continue the activities started under the CEOS Coastal Observations and Applications Study Team. The final Terms of Reference and a Phase 2 Implementation Plan will be delivered in December 2020. The COAST <i>Ad Hoc</i> Team will report to the CEOS Chair.
Decision 34-14	Plenary agreed that CEOS should submit COAST to the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) to address international coastal stakeholder needs through its global implementation. This needs to be done in coordination with the SIT Chair and COVERAGE teams.
Decision 34-15	Plenary agreed to extend the SDG-AHT for one year, with direction for the SDG-AHT to plan a transition of SDG activities to internal (within CEOS) and/or external entities by the 2021 CEOS Plenary.
Decision 34-16	Plenary endorsed the updated <i>CEOS New Initiatives Process Paper</i> .
Decision 34-17	The CEOS Statement to GEO Week 2020, updated to reflect the outcomes and decisions of the 2020 CEOS Plenary, was endorsed.