CEOS NEWSLETTER

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Outcomes from the 33rd CEOS Plenary in Hanoi, Vietnam

***Dr Pham Anh Tuan**, 2019 CEOS Chair, VAST-VNSC*

In October, the Vietnam Academy of Science and Technology (VAST) and the Vietnam National Space Center (VNSC) welcomed the Committee on Earth Observation Satellites (CEOS) to Hanoi for the annual CEOS Plenary meeting, where leaders from the world's major space agencies decide upon the direction of collaborative efforts in the Earth observation domain. Numerous priorities were discussed, including the 2019 CEOS Chair Initiative, CEOS climate activities, CEOS Analysis Ready Data, and the United Nations Sustainable Development Goals (SDGs), among many others.

2019 CEOS Chair Initiative

As its headline for 2019, VAST-VNSC chose to pursue the implementation of the Vietnam Data Cube. Working with CEOS Agencies and other partners, a robust collection of satellite data and tools were pooled in support of two specific applications for the Mekong basin region: carbon observations, including forested regions; and observations for agriculture (rice). The Mekong basin is an important cross-border agricultural region strongly affected by climate change and human activities.

Thanks to the effort of the CEOS community, the Vietnam Data Cube now contains the following data: Landsat from 1986 to present (from USGS); ALOS-2 (from JAXA) from November 2016 to present; and, Sentinel-1 (from ESA, processed to Analysis Ready Data by CESBIO/CNES) from October 2014 to present.

Forest cover change monitoring in Vietnam has been achieved with a focus on *monthly forest loss* estimates – developed by VNSC and CNES/CESBIO. Rice application outputs include crop maps (developed by VNSC, CNES/CESBIO, and JAXA) and production/yield estimates.

Capacity building events (with WGCapD) focused on the use of SAR for rice, forest, and flood monitoring, as well as ground motion detection and LCLUC. These activities have supported Vietnamese capacity to use SAR and other Earth observation data and helped grow technical capabilities around the Vietnam Data Cube.

Data and tools are now being put into practice by Vietnamese scientists. The platform is expected to continue growing and to provide critical inputs for government decision-making.

Climate and Carbon

The Plenary saw the approval of the 'Roadmap' approach for the implementation of recommendations from the CEOS AC-VC Greenhouse Gas white paper. The Roadmap will be presented for endorsement at CEOS SIT-35 in March 2020 and will outline the steps CEOS will take to produce a prototype atmospheric CO_2 and CH_4 flux inventory that is available in time to inform the bottom-up inventories for the 2023 global stocktake.

CEOS will also take steps to strengthen its connection to the Greenhouse Gas; Agriculture, Forestry and Other Land Use (AFOLU) communities; and the UNFCCC Secretariat. Workshops are planned in June 2020 (hosted by the European Commission) and around the 2020 SIT Technical Workshop.

CEOS Analysis Ready Data

CEOS formally adopted a strategy on Analysis Ready Data (ARD). The Strategy, put forward by the new SIT Chair Team of CSIRO/GA, covers all aspects of development and uptake of CEOS ARD, and provides a structured and considered approach for how CEOS should move forward. The four pillars of the Strategy are: CEOS ARD User Needs & Specifications; Assured Production & Access; Pilots & Feedback; Communication & Promotion.

CEOS Analysis Ready Data are satellite data that have been processed to a minimum set of requirements and organised into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets.

The CEOS ARD Strategy builds on the foundation laid by the Land Surface Imaging Virtual Constellation and will be implemented by various groups across CEOS.

Leadership Changes

The 33rd CEOS Plenary welcomed the Indian Space Research Organisation (ISRO) as the 2020 CEOS Chair and CSIRO-GA as the CEOS Strategic Implementation Team Chair (SIT Chair) for the two-year term of 2020-2021. It endorsed NASA for the role of 2021 CEOS Chair, in addition to various changes to CEOS Working Group leadership. We thank all CEOS Agencies for actively contributing to the broad range of CEOS activities.

The 2019 CEOS Chair Team wishes to thank all outgoing Working Group Chairs (Mirko Albani, ESA, WGISS; Prakash Chauhan, ISRO, WGCapD; Simona Zoffoli, ASI, WGDisasters) for their service to CEOS and cooperation over the VAST-VNSC CEOS Chair year.

Other Highlights

The CEOS Coastal Observations and Applications Study Team (CEOS-COAST) was established – with an initial term of 12 months to assess how CEOS contributions to coastal observations might be integrated and transformed into fit-for-purpose information in support of existing and emerging stakeholder requirements.

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Report of the 2019 CEOS Strategic Implementation Team Technical Workshop

Dr. Stephen Volz,
2018-2019
CEOS SIT Chair, NOAA

In early September, over 60 members of the CEOS community traveled to the rustic city of Fairbanks, Alaska for the 2019 Technical Workshop of the Strategic Implementation Team, hosted by the University of Alaska. Workshop participants were able to explore the beauty of Alaska and experience firsthand the impacts of a changing climate. In the weeks prior to the workshop, and continuing while we were meeting, numerous large wildfires were raging across Alaska.

The Workshop was also the last meeting under NOAA's SIT Chairmanship and the theme was "CEOS operations in the global community." I am proud of the work that was accomplished during our two-year tenure and thank all the members of the CEOS community for their support, hard work, and dedication to ensuring CEOS remains a key stakeholder and data provider to the Earth Observation community. During our two year tenure we conducted an in-depth analysis of the existing organizational structure of CEOS, including changes in leadership sustainment for the Virtual Constellations (VCs), enhanced coordination among VCs and between VCs, Working Groups (WGs), and *ad hoc* Teams (AHTS), codified a path to maturation for the AHTs, and planned strategic engagement, both internally and externally, with the broader international and scientific communities.

Prior to the 2 day Technical Workshop, representatives from the CEOS VCs, WGs, and AHTs met for a "Working Day." Participants discussed outcomes of the Working Group Study Team (WGST) and the Ocean Virtual Constellation Merger Study Team (OVCMST), VC leadership and AHT life cycles, as well as a crosscutting dialogue around data, climate, and oceans/coastal themes. As an outcome from this discussion, we recommended to Plenary the formation of a Study Team to assess a pilot or similar scope activity on the integration of EO for coastal zone issues and applications, including multi-sensor observations through value chain to produce information for users.

During the Workshop, participants addressed several topics of importance, including the outcomes of the two study teams created at SIT-34. The OVCMST presented their findings and suggested that the CEOS community not merge the Ocean VCs but rather focus on improving the integration of Ocean VCs with the rest of CEOS. The WGST proposed the creation of a Task Team to consider how to better assess potential user community readiness to apply CEOS EO data and information to their specific needs. This effort will be supported by the creation of the new "CEOS External Request Process Paper."

The Joint Working Group on Climate presented on the way forward for the coordination of climate observations including on greenhouse gases (GHGs). In addition, participants reviewed the progress of data-related activities including CEOS and Open DataCube activities, and the Land Surface Imaging Virtual Constellation's work on Analysis Ready Data.

Looking ahead, NOAA congratulates the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Geoscience Australia (GA) team as they take over the reins as the SIT Chair. I thank the community for the trust they placed in NOAA to serve in the SIT Chair role, and we look forward to CSIRO/GA team to guide us through the coming two year period. Their tenure has begun with excellent focus on challenges and opportunities that we as a global community are ready to address.

Looking back on 2 years as CEO

Steven Hosford,
CEOS Executive Officer(CEO), ESA

As quickly as my two-year mandate as CEOS Executive Officer began, it is now over, and having moved back to my original organisation, CNES, I have also moved on to other activities. Since 2008 I have personally moved through a full cycle within CEOS – the steep learning curve to understand the alphabet soup, getting involved in CEOS activities (most notably for me in the Disasters theme, as a data provider in GFOI and GEOGLAM, and as a close follower of WGISS), taking on SIT leadership in 2014 and 2015 with CNES, and finally the CEOS Executive Officer role. It is now time for fresh blood in CNES's participation in CEOS and despite the rather short hand-over, I am confident that the CEOS community will help bring Selma Cherchali up-to-speed! Mirroring these changes at CEOS level, managing transition is certainly one area where, as a community, we can focus efforts for improvement. The difficulties experienced finding a replacement for the CEO role are a case in point – while we have an interim solution for 2020, I would like to reiterate the need to take a long-term approach to this key role. CEO should not only be a personal commitment, but should be considered by agencies for what it is – a unique opportunity to provide an unparalleled international network in institutional EO to the incumbent and, by extension to the agency itself.

Looking back over my CEO period, there is, I believe, significant progress to be highlighted in a number of areas including the priority themes of the two CEOS chairs that I have supported. In addition, much effort has been invested, in coordination with NOAA as the SIT Chair, in reinforcing the credibility of CEOS through a more rigorous work planning, execution and monitoring cycle. The visibility of the CEOS Work Plan as a work planning tool has been increased, and it has gradually been established as a reference for all of CEOS and not just CEOS leadership. To close the monitoring and execution loop, a Work Plan Progress Report delivered at Plenary has been established, and, overall, buy-in to the process from across CEOS has increased significantly over the past two years. As I step away, I would encourage the CEOS community at all levels to maintain this level of rigour going forward: it is critical to CEOS's credibility as an organisation which not only brings people together from across the planet, but also enables them to get work done!

(continued from page 1)

Plenary also approved a one-year extension for the *Ad Hoc* Team on Sustainable Development Goals (SDG-AHT). CEOS Agencies will consider contributions to the new SDG-AHT Work Plan. The approach proposed is to streamline CEOS efforts on the SDGs to three primary Indicators: 6.6.1, 11.3.1, and 15.3.1, which all have agreed methodologies with clear connections to EO.

Closing Remarks

I would like to thank CEOS once again for the opportunity to serve as Chair of this community during 2019. Internally, we've seen numerous benefits as a result, in particular from collaboration around the 2019 Chair Initiative – including data to help establish our in-house analysis platform (the Vietnam Data Cube), tools that use this data to create actionable information, and training to support capacity in the country and region. This year has truly demonstrated the power of collaboration through CEOS and we will remain engaged and active.

Further Information

More information on the 33rd CEOS Plenary and all of its outcomes can be found on the website and in the full record of the meeting.

GEO Week 2019: Earth Observations Announcements from Australia

Douglas Cripe, *Senior Scientific Adviser, GEO Secretariat*

The annual meeting of the Group on Earth Observations, GEO Week 2019 (http://www.earthobservations.org/geoweek19.php), held from November 4-9 in Canberra, has unveiled a suite of new announcements and partnerships to boost the economic and societal impacts of Earth observations. Over 1500 representatives from 57 countries came together to scale up the use of open Earth observation (EO) data in order to address the world's greatest challenges.

GEO Week 2019 featured several events including the Asia Oceania Symposium and the first-ever Industry Track, along with the annual GEO Plenary (16th) and the GEO Ministerial Summit (held every 3-4 years) to cap off the week-long event.

The Ministerial Summit hosted 13 Ministers and Deputy Ministers and 15 Ambassadors to discuss the need to urgently apply data derived from Earth observations for addressing societal challenges in our rapidly changing world. Ministers enthusiastically endorsed the Canberra Declaration, an ambitious plan to advance GEO's inclusive approach to applying Earth observations for the benefit of all nations. Read the Canberra Declaration in full (http://earthobservations.org/documents/geo16/MS%204.2_Draft%20Canberra%20Declaration_final.pdf).

During GEO Week, several countries introduced new open data initiatives. China, the GEO Lead Co-Chair for 2020, announced open sharing of 16m resolution Gaofen data (http://www.earthobservations.org/article.php?id=388). The Japan Aerospace Exploration Agency (JAXA) also announced that it will begin providing free and open access to the wide-swath observation data from the L-band Radar satellites, such as ALOS and ALOS-2. Read the statement from Japan here (http://www.earthobservations.org/article.php?id=392).

GEO and Google unveiled a US$3 million programme for Earth observations application development. This new programme for members of the GEO community will provide unlimited access Google Earth Engine over 2 years for projects measuring the pulse of the planet. Details on how to apply can be found here (http://earthobservations.org/article.php?id=400). In addition, Amazon Web Services (AWS), as part of the Amazon Sustainability Data Initiative, announced that they will be supporting Digital Earth Africa (DE Africa) to track changes across the African continent by means of big data from satellite observations organized into an open data cube structure.

Beyond these announcements, several new products and partnerships were also launched during GEO Week. Earth Science Information Partners (ESIP) announced Operational Readiness Levels (ORLs) to improve data-driven decision making during disaster response and recovery. The Pacific Community (SPC) announced a new partnership (http://www.spc.int/updates/blog/2019/11/better-data-will-lead-to-better-decisions-for-our-blue-continent) to harness EO technology for the Pacific region.

The week wrapped up with the news that GEO Week 2020 is heading to South Africa in Port Elizabeth, from 2-6 November 2020.

Report of CEOS Ocean Surface Topography-Virtual Constellation (OST-VC)

Annick Syvestre, *OST-VC Co-Lead, CNES*
Remiko Scharroo, *OST-VC Co-Lead, EUMETSAT*

The OST-VC is made up of members of the various institutes that have launched satellite altimeters since its very start with Seasat in 1978. It aims to coordinate efforts in providing data users – meteorological offices, oceanographers, geodesists, glaciologist, hydrologists, climate scientists, etc. – with an optimal data quality, coverage and spatial and temporal resolution. As the various applications in these respective fields have competing requirements, there is no "one-size fits all" and various missions will need to be flown simultaneously. Coming to a set of requirements that can be used as a guideline for the construction of a constellation of altimeters for the next 20 years is thus a key task of the OST-VC.

The OST-VC has strong connections with the Ocean Surface Topography Science Team (OSTST) that meets annually in the Fall to present and discuss the science yields of satellite altimetry. This group of around 250 scientists annually also makes recommendations on data product evolutions, the use of current operational missions, validation of future missions, and optimal use of missions that are reaching end-of-life. The OST-VC is a natural extension of this as it builds a set of requirements, based on user needs, for missions that are yet to be conceived.

The change of the set of requirements for the next 20 years compared to the "Ocean Surface Topography Constellation User Requirements Document" (http://www.ceos.org/images/OST/SatelliteAltimetryReport_2009-10.pdf) that was created about 10 years ago, will focus on the extension of the use of altimeter data, e.g. into coastal area, high-resolution ocean currents, and wave spectra. This aligns with a number of emerging technologies, like SAR altimetry and swath altimetry. Some are already implemented on in-orbit satellites (e.g. Sentinel-3 for SAR altimetry, SWIM on CFOSAT) or are planned to be implemented on future missions (e.g. SWOT for swath altimetry).

Current OST-VC members are:

- Chairs
  - Annick Sylvestre-Baron (CNES)
  - Remko Scharroo (EUMETSAT)
- Other members
  - Craig Donlon (ESA)
  - Eric Leuliette (NOAA)
  - Nadya Vinogradova-Shiffer (NASA)
  - Gregg Jacobs (US Navy)
  - Kai Matsui (JAXA)
  - Rashmi Sharma (ISRO)
  - Wang Chen (CNSA)

Report of CEOS Ocean Colour Radiometry Virtual Constellation (OCR-VC)

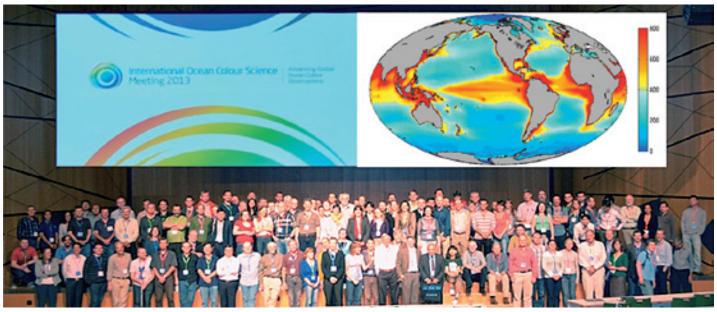
Marie-Helene RIO, ESA
Ewa Kwiatkowska, EUMETSAT

The Ocean Colour Radiometry Virtual Constellation (OCR-VC) was established in 2009, founded within the International Ocean Colour Coordinating Group (IOCCG - https://ioccg.org/). IOCCG agency members take turns in OCR-VC chairmanship. The broad objective of the OCR-VC is to produce sustained data records of well-calibrated and validated satellite ocean colour datasets from measurements obtained from multiple satellites. The existing polar constellation comprises instruments from CNSA/NSOAS (China), EU (in collaboration with ESA and EUMETSAT), ISRO, JAXA, NASA and NOAA. The first geostationary OCR mission from the Korea Institute of Ocean Science and Technology, Geostationary Ocean Color Imager (GOCI), has successfully proved the concept of OCR observations from a geostationary platform. In addition to coordinating this existing polar multi-spectral radiometers constellation, the OCR-VC supports collaboration on new technological concepts. Hyperspectral and polarimetric OCR observations are planned for the near future, while lidar technology is scientifically investigated.

By working toward the long-term Ocean Colour time-series, the OCR-VC is contributing to the CEOS Work Plan in three major application areas, namely Climate, Carbon and Water Quality: It provides information about the condition of aquatic ecosystems, which is of major importance to regional economies (fisheries, aquaculture, recreation, coastal sedimentation, erosion, etc.) and human health (pollution, harmful algal blooms, bathing and drinking water quality, etc.). In addition, it supports the monitoring and forecasting of aquatic phytoplankton which, being responsible for about half of the planet's atmospheric carbon sequestration and half of the primary production, is a fundamental component of the Earth Carbon and Climate system.

Finally, capacity building is another key element of the CEOS work plan. The Ocean Colour Radiometry user community being broad and diverse, training and outreach are of fundamental importance. OCR-VC, through the numerous IOCCG activities (quarterly newsletters, on-line books and tutorials, training courses, and International Ocean Colour Science meetings), is very active in this domain.

In order to achieve the OCR-VC objective, the guiding document is the White Paper *'Implementation of the International Network for Sensor InTercomparison and Uncertainty Assessment for Ocean Colour Radiometry'* (INSITU-OCR) (https://ioccg.org/wp-content/uploads/2016/02/INSITU-OCR-white-paper.pdf). This White Paper defines four major inter-agency collaboration areas, which include calibration and characterization of space instruments, development of algorithms and products, in situ reference measurements, and information management. OCR-VC agencies are working in concert to realize the recommendations of the White Paper, whose implementation is the main OCR-VC deliverable (VC-09) identified in the CEOS Work Plan. Major effort across the agencies has been recently devoted to the development and sustainment of OCR system vicarious calibration infrastructures, which are an integral part of OCR missions required to provide extremely accurate SI-traceable in situ in-water optical measurements for vicarious calibration. IOCCG working groups have been contributing seminal reports on algorithms, methodologies and applications, which now account to 19 volumes and constitute an established compendium of knowledge on aquatic optics and its remote sensing (see https://ioccg.org/what-we-do/ioccg-publications/ioccg-reports/). The agencies have been also actively contributing to the definition of protocols for in situ measurements of radiometry and bio-optics required for OCR product validation and algorithm development (4 volumes published, 2 in draft form, https://ioccg.org/what-we-do/ioccg-publications/ocean-optics-protocols-satellite-ocean-colour-sensor-validation/).



Report of CEOS Sea Surface Temperature-Virtual Constellation (SST-VC)

Anne O'Carroll,
SST-VC Co-Lead,
EUMETSAT

Ed Armstrong,
SST-VC Co-Lead,
NASA

The CEOS Virtual Constellation for Sea Surface Temperature (CEOS SST-VC) was established in 2012 to serve as the formal link between the Group for High Resolution Sea-Surface Temperature (GHRSST) and the broader CEOS community. The SST-VC provides a means for CEOS to be able to feed its needs and requirements to GHRSST and vice-versa, and there are also thematic links on aspects such as Climate Data Records and Calibration and Validation. GHRSST and the SST-VC have been producing standardized satellite based Sea Surface Temperature products in netCDF format since 2005. As of June 2019, 96 standardized GHRSST specified products can be found in the GHRSST LTSRF archive.

Some further key achievements have been to:

- Increase the visibility of the impact of the passive microwave satellite constellation on SST applications and to communicate the importance of the continuity of the PMW capability for SST.
- Working on an SST white paper, summarising the next generation SST constellation, including on-orbit assets, measurement methods, fiducial reference measurements (FRM) and data management systems (due out soon).
- In June 2019 the 20th GHRSST science team meeting and 8th CEOS SST-VC meeting was held at ESA-ESRIN in Frascati https://www.ghrsst.org/meetings/20th-ghrsst-international-science-team-meeting-g-xx/.
- Helped to organise an opportunity for satellite oceanography data users to meet with the data providers as part of a three-day Satellite Oceanography User Workshop (https://www.ghrsst.org/meetings/satellite-oceanography-user-workshop-2/)

The current participating CEOS agencies to the SST-VC are: NASA, EUMETSAT, ESA, CMA, SANSA, BoM, ISRO, KMA, NOAA and JAXA.

Ed Armstrong (NASA, co-lead SST-VC):

Ed is the new co-lead of the SST-VC where he has been the NASA representative for the last few years at its annual meetings. He is the task leader of the Data Engineering group in the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA Jet Propulsion Laboratory which is responsible for the integrity of the PO.DAAC satellite, airborne, and in situ data holdings and ensuring data understanding, quality, provenance, discoverability and usability. He is an expert in earth science applications of satellite data, and has managed and contributed to many information technology development projects focused on improving utilization and access to earth science data.

Anne O'Carroll (EUMETSAT, co-lead SST-VC):

Anne has been the co-lead of the SST-VC since 2015 (working with the previous co-lead, Ken Casey till 2019). She leads the Surface Temperature Radiometry team at EUMETSAT, who are responsible for ensuring the quality of Sea Surface Temperature products from Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR). She is also the chair of the Group for High Resolution Sea-Surface Temperature (GHRSST, www.ghrsst.org), which is an open international science group that promote that application of satellite for monitoring Sea Surface Temperature.

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

Nancy D. Searby, Ph.D., *WGCapD Chair, NASA*
Pham Thi Mai Thy, Ph.D., *WGCapD Vice-Chair, VNSC*

The overall objective of the WGCapD is to build capacity for the effective use of Earth observation data and provide wider and easier access to those data.

The 8th Annual Meeting of the WGCapD was hosted by ISRO in Dehradun, India on March 6-9th, 2019. 37 attendees participated (20 in-person and 17 virtual), representing 16 organizations. The meeting included tours of ISRO's training facilities and focused on lessons learned from 2018 activities, new capacity building technologies and methods, support to GEO regional initiatives, capacity building infrastructure, and opportunities for collaboration with other CEOS WGs and AHTs such as WGISS, WGDisasters, AHT-SDG, and GEOGLAM.

WGCapD 2019 achievements include:

- WGCapD supported regional GEO events, providing two trainings at the 2019 AmeriGEO Week in Lima, Peru on Aug 9-13, 2019 (focused on water resources and SDGs) and supporting one training at the AfriGEO Symposium in Nairobi, Kenya on August 13-16, 2019 (focused on SAR for monitoring forest change).
- WGCapD collaborated with the AHT-SDG to deliver an awareness webinar on SDGs on Dec 19, 2018 (http://ceos.org/meetings/wgcapd-sdg-aht-sdg-awareness-webinar/) and collaborated with WGISS to host an awareness webinar on future data architectures on Sept 4, 2019 (http://ceos.org/meetings/future-data-access-analysis-architecture-initiative/).
- WGCapD supported MOOCs, such as "Echoes in Space: Introduction to Radar Remote Sensing" in response to the global need for trainings in support of SAR data and applications. (https://eo-college.org/courses/echoes-in-space/).
- Multiple trainings and workshops focused on regional needs such as LCLUC trainings in Johor Bahru, Malaysia July 22-27, 2019 and Phuket, Thailand, Dec 17-19, 2019.
- WGCapD supported trainings at the national level focused on SAR applications and flooding in Vietnam (Sept 8-14, 2019), and forest monitoring in Mexico (Feb 26-28, 2019).
- WGCapD helped design and coordinate the launch of the CEOS Training Calendar (https://training.ceos.org/), a global resource of EO-related trainings that continues to grow as additional feeds are ingested.
- The WGCapD white paper presented at CEOS SIT on how to coordinate capacity building networks matured into a peer-reviewed paper focused on the establishment of a Space Capacity Development Advisory Board published in *Space Policy*.

In October, 2019, Nancy D. Searby (NASA) took over as the WGCapD Chair and Pham Thy (VNSC) took over as Vice-Chair.

The WGCapD-9 Annual Meeting will take place in Mountain View, CA between March 9-13, 2020. We hope you will join us!

WGCapD-8 Annual Meeting in Dehradun, India March 6-9, 2019

Report of Working Group of Calibration and Validation (WGCV)

Cindy Ong, *WGCV Chair, CSIRO*
Akihiko Kuze, *WGCV Vice -Chair, JAXA*

The mission of the CEOS Working Group on Calibration & Validation (WGCV) is to ensure long-term confidence in the accuracy and quality of Earth Observation data and products and to provide a forum for the exchange of information about calibration and validation, including the coordination of cooperative activities.

The Working Group of Calibration and Validation 45th plenary meeting hosted by CSIRO was held between 16-19 July 2019 in Perth, Western Australia. Twenty-four delegates representing 14 agencies attended the meeting. The focus of the meeting was updating and delivering on current work plan items and discussions of new items for the new cycle emphasising cross collaborations across WGCV, other WGs and VC.

The main outcomes of the meeting were

- WGCV agreed on the CARD4L peer-review process and, an initial pool of reviewers was identified, putting WGCV in a position to peer review the CARD4L self-assessments;
- WGCV agreed to proactively engage in the CEOS GHG Roadmap development. The WGCV Vice-Chair will work closely with the AC-VC and WGClimate GHG Task Team to ensure that the calibration and validation requirements in the GHG Roadmap are developed in coordination with WGCV to ensure the requirements are suitable and actionable;
- The Terrain Mapping Subgroup (TMSG) was renewed with Peter Strobl (EC/JRC) as the lead. The first task was to develop a detailed plan for a DEM intercomparison(DEMIX) task;
- The concept for SAR supersites to support multi-mission SAR calibration was presented and discussed. Exact requirements, plan, timelines was to be further developed at the SAR subgroup plenary before defining a new work plan; and,
- The Guideline for Ground Surface Reflectance Validation Measurements and Uncertainty Quantification was presented for review in completion of CEOS Work Plan Task CV-17. This continental scale work will be the basis for future extensions into global-scale surface reflectance validation protocol and associated uncertainties quantification.

Other news from WGCV include the opening of the recently updated cal/val portal (http://calvalportal.ceos.org/) which we hope to be a go to portal for all things related to calibration and validation of Earth Observation sensors. The next WGCV plenary meetings will be: WGCV-46 March 31- April 3 at Caltech, Pasedena, California and, will be hosted by NASA, and, WGCV-47 will be a joint meeting with WGISS, and will be hosted by ROSCOSMOS between 14-18 September 2020, Sochi, Russia.

Delegates who attended the joint WGCV 45 plenary 16-19 July 2019 in Perth, Western Australia.

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

Robert Woodcock, *WGISS Chair, CSIRO*
Makoto Natsuisaka, *WGISS Vice-Chair, JAXA*

WGISS assists CEOS agencies in coordinating access to Earth observation data, and collaborative development of systems and services that supply these data.

The 48th WGISS plenary was hosted by the Vietnam National Space Centre (VNSC) in Hanoi, Vietnam on October 8-11th, 2019. Representatives from 19 organizations, including commercial guests and over a dozen remote participants were in attendance. The meeting included updates on CEOS Future Data Architectures with many agencies reporting maturing experience with Data Cubes, ARD and Cloud. Dedicated sessions on Technology Exploration focused on Linked Data and Knowledge Graphs in EO and new approaches to EO metadata like STAC, on Data Stewardship quality assessment and maturity matrix tools, and a session on Data Discovery and Access with a new emphasis on Services and Tools in response to the growing interest in EO analytics. Meeting presentations can be accessed at http://ceos.org/meetings/wgiss-48/.

WGISS continues its efforts to facilitate CEOS agencies data discovery and access in the international context through interoperable standards and systems. The "WGISS Connected Data Assets Infrastructure (CDA)" provides a single-entry point to CEOS agencies space data and is widely used to search and access thousands of collections and hundreds of millions of products through external clients like the GEOSS Platform and Portal. Additional data collections and products from CEOS Agencies are continuously added to this integrated system including Essential Climate Variables (ECVs) in cooperation with WGClimate. WGISS is also progressing its activities on Future Data Architectures (FDA) and supports the CEOS ARD Strategy assessing the potential of new technologies to bridge the gap between the huge volumes of Earth observation (EO) data and the users developing applications.

Cooperation activities with the Working Group on Calibration and Validation (WGCV) and Land Surface Imaging Virtual Constellation (LSI-VC) continue with regular joint virtual meetings and actions on the CEOS FDA and ARD Strategy. Coordination with WGCapD has seen WGISS provide webinars on Cloud technologies and Future Data Architectures.

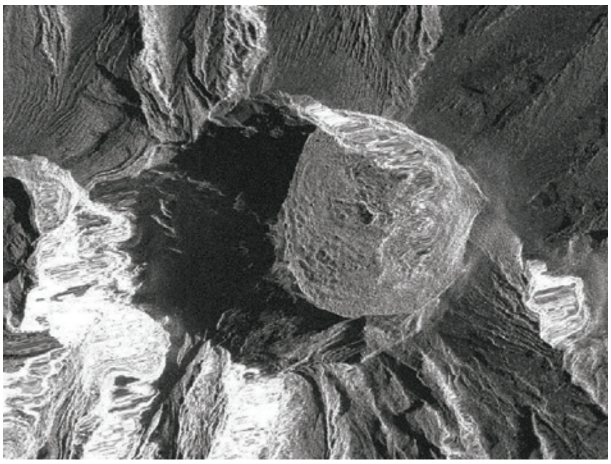
The 49th WGISS plenary will be hosted by the Comisión Nacional de Actividades Espaciales (CONAE) in Buenos Aires, Argentina, week of April 20th, 2020. WGISS 49 will include a dedicated workshop on CEOS Services and Tools, extending its work on EO data discovery to the growing area of EO analytics services. In addition, there will be working sessions on Data Cube interoperability and ARD in the Cloud. All material, information and contacts can be found at: http://ceos.org/ourwork/workinggroups/wgiss/

WGISS 48, VNSC, Hanoi, Vietnam 8-11th October, 2019

Report of Working Group Disasters (WGDisasters) - Using Satellite Data to Reduce Disaster Risk from Volcanic Eruptions

David Green, *CEOS WGDisasters Chair. NASA*

Work being done by the WGDisasters Volcano Demonstrator Group, a large international team, promises to make a critical contribution in understanding the disaster impacts from volcanic eruption. Below appears a current summary of their approach, from their perspective and in their own words.



Cosmo-SkyMed 2018 spotlight data on the Agung volcano in Bali, Indonesia provide details of lava flow emplacement and degradation that would not otherwise be accessible due to cloud cover / Image courtesy of M. Poland and S. Ebmeier

Globally, about 30 million people live within 10 kilometers, and 800 million within 100 kilometers of an active or potentially active volcano. Volcanic activity is a threat to people's lives, health and livelihoods, with impacts ranging from pyroclastic or lava flows, sector collapse, and ballistics, to severe economic loss from evacuations, loss of livelihood and disruption to infrastructure, particularly aviation.

The CEOS Volcano Demonstrator's primary goal is to increase the uptake of satellite imagery, and especially Synthetic Aperture Radar (SAR) and Interferometric SAR (InSAR) satellite measurements, for volcano research and monitoring. Volcanic risks are dynamic, varying during the course of an eruption and during episodes of unrest. Because deformation, degassing and thermal signals can be measured globally from space, these inputs can make a unique contribution to both our understanding of magma plumbing beneath a volcano, and the ability to assess volcanic activity and forecast eruptions, especially when combined with other types of remote sensing data relevant to volcanoes. Monitoring such signals is critical for forecasting when eruptions may happen, how they will develop, and what their impacts will be.

We aim to enlist satellite data for disaster risk reduction by providing data to and supporting capacity building at volcano observatories. We will build on the work of the 2014-2017 Volcano Pilot, which focused on Latin America, by including volcanoes in Africa and Southeast Asia. During the Latin American Pilot, satellite measurements were used in conjunction with other observations to provide independent checks of ground-based instruments, support situational awareness and to determine alert levels.

(to be continued on page 7)

"Team Australia" – the CSIRO/GA 2020-2021 SIT Chair Term

***Alex Held**,*
SIT Co-Chairs,
CSIRO

***Adam Lewis**,*
SIT Co-Chairs,
Geoscience Australia

It is our honour, as SIT Co-Chairs, to have taken up this important role within the CEOS leadership team at the conclusion of the 2019 Plenary in Viet Nam. It is a particular honour for Australia to be given such a central leadership role within the global community of Earth observation satellite operators. We extend our warmest thanks to NOAA for their leadership as SIT Chair over the last two years, and we will do our best to carry on the work on important issues progressed by NOAA, including opportunities to unleash the enormous power of the CEOS Virtual Constellations.

Our goal for the SIT Meetings we chair will be to take advantage of the valuable time of Principals by focusing on bringing forward issues and opportunities that require Principal-level debate, discussion and decision. CEOS has a very comprehensive Work Plan, and we need to work together as a community to bring the most critical things forward to SIT Principals so they can make decisions on where to invest precious resources. This is consistent with the vision of SIT.

We will also be looking to provide less 'formal' opportunities for Principals to engage with and consider new opportunities for CEOS, reflecting the rapid pace of change both in technology and the stakeholder environment. One concept we are exploring is that of a 'pitch' session at SIT meetings. These 'pitch' sessions will provide an opportunity for anyone in the CEOS community, whether a Principal or a working team member, to informally and briefly bring a new opportunity to the attention of Principals to determine whether there is 'in principle' support across agencies for to take action and invest resources. Of course, those ideas that have support and momentum would then be taken through the relevant CEOS processes, but having a 'low cost / low risk' way to explore new ideas with Principals will, we think, help CEOS remain agile.

We will work to drive progress across all areas of CEOS's work, as described in the comprehensive three year Work Plan. We are already undertaking deep engagement with the CEOS Working Teams, the groups that deliver most of CEOS's concrete work: the Virtual Constellations, Working Groups and Ad-Hoc Teams. We have heard about some very exciting activities and opportunities that, from our perspective, are worthy of more attention from the CEOS community and our external stakeholders.

We will also be using our engagement with the Working Teams to identify opportunities for them to collaborate more closely to deliver greater impact. It is critical that our Working Teams continue to deliver high quality outputs in their specific areas of technical competence, but it is also critical that we take advantage of opportunities to link them together to deliver impact in cross-cutting areas. We see the establishment of the COASTS Study Team as a great opportunity in this area. CEOS has all the building blocks it needs to provide integrated support on what is an increasingly critical topic, but we will need a strong team effort across at least the Ocean VCs, the LSI-VC, WGISS, WGCV, WGCapD, WGDisasters and the SDG Ad-Hoc Team.

We have also identified three priority areas where we will use the SIT Chairmanship to elevate, expedite and accelerate CEOS's activity in areas where there is already substantial agency investment, and where there is potential to delivery major impact over the next two years. These priorities are: Analysis Ready Data (for land and beyond); Biomass and Greenhouse Gas measurements; and support for the Sustainable Development Goals. Our comprehensive prospectus is available on the CEOS website, and we would welcome conversation with anyone in the CEOS community who sees opportunities to engage with this work.

We do look forward to welcoming the CEOS community to Australia over the next couple of years, and showing you some special parts of our beautiful country, starting with Hobart, Tasmania, for SIT35. We are particularly looking forward to connecting our CEOS friends with the relatively young Australian Space Agency while they are 'down under'. The establishment of an Australian Space Agency will create new opportunities for us to work with the international satellite Earth observation community.

We will host both SIT35 and SIT36 in Australia. However, reflecting the long travel time to Australia, our intention is to host the 2020 and 2021 SIT Technical Workshops in Europe, North America or Asia. We are very grateful to EUMETSAT for supporting us to host the 2020 Technical Workshop in Zagreb, Croatia. Thank you Alain and Paul!

Although the future for CEOS looks very positive to us, we did want to raise one item of concern: as it stands there is no current candidate to be CEOS Executive Officer in 2021 and beyond. We are very fortunate that NOAA has detailed Kerry Sawyer to support the CEOS Chair, ourselves and the broader CEOS community in 2020. But the CEO role is critical to the success of CEOS, and we would be very grateful for any support in filling this major gap.

(continued from page 6)

Our approach will vary geographically, depending on both the local characteristics of volcanic deformation, InSAR noise, the utility of other satellite imagery, and the requirements and capacity of the volcano observatory. In some cases we will provide raw or processed interferograms, while in others we will provide experience and expertise in interpretation.

While there are multiple international programs with the goals of automatic processing and analysis of freely available SAR datasets, our focus is on a multi-satellite "constellation" approach, with a range of radar wavelengths and resolutions.

Deformation measured using InSAR, in particular, can be made over much larger areas than can be covered by ground-based monitoring networks and is particularly important in remote settings or where ground-based instruments are sparse. Not every eruption is preceded by deformation, nor does every episode of deformation inevitably herald an eruption; however, there is a strong association between deformation and eruption, so identifying volcanoes that are deforming will help to understand where eruptions might take place in the future.

Expanding beyond Latin America to demonstrate the potential of global operational monitoring of volcanic activity from space will happen in stages, and requires building a team to work with the available data and provide training to volcano observatories in the exploitation of those data. We are therefore scaling the work of the pilot from regional to global over a period of several years and recruiting additional partners. Volcano observatory scientists collaborating with the demonstrator are enthusiastic about the potential of satellite data for supporting monitoring methods as we extend data ordering and tasking beyond Latin America.

A Message from the 2020 CEOS Chair

***D K Das**,*

2020 CEOS Chair,

ISRO

Merry Christmas and happy new year to all of you.

After 8 years, the CEOS Plenary will be convened again in India, this time for its 34th meeting. The responsibility of the position is challenging, however, being one of the early members help us to develop the required familiarity, with the organization's operating ways, as well as with the collective concerns and priorities that have a life of their own behind the wording of the Terms of Reference. Also, there is a good team of people involved in the CEOS background, and this team, especially the CEOS Secretariat, SIT, CEO/SEO who make everything easier for the Chair.

CEOS space agencies have committed themselves to a leadership role in the development and operation of the space segment to serve the global community. CEOS started in 1984 and there has been a sea change in the global scenario since then, however CEOS has remained relevant and responsive to the demands of global earth observation.

As most of you are aware that CEOS undertook a self-study to identify past successes, strengths, opportunities, and areas of challenge. This has been a good initiative by NASA as, SIT Chair. Though this exercise has brought many of the governance processes and changes through consensus. In the today's context, probably the resource crunch faced by many of the space agencies is becoming the bottleneck including the providing the key positions like CEO, which could be addressed appropriately. Further today's global economic situation is forcing individual countries to reduce their expenditure on space based activities. EO Observation needs and changing economic situation calls for greater co-ordination among CEOS agencies to ensure efficient use of already created space infrastructure and put greater emphasis on success of virtual constellations to meet the needs of information services the global community has already got used to.

One important global issue of the last decade was climate change. Improved Coordination of Space Agency activities related to Climate would be one of the focus areas of the coming year. Tremendous changes taking place in the information and communication technologies needs to be harnessed for effectively utilizing the large amount of EO data being sent down by the large space infrastructure that the CEOS agencies have put up.

The use of earth observation data for better decision making across range of crucial development and environmental, including UN 2030 agenda for sustainable development, the Paris agreement and Sendai framework for disaster risk reduction has been always the priority of CEOS. CEOS is deeply committed to the Group on Earth Observations (GEO), including leadership of more than one-third of the Tasks of GEO Work Plan. I feel CEOS can take pride of GEO success as well.

As the CEOS Chair 2020, ISRO has taken initiatives in emphasizing the need of Actual Constellation of EO satellites activities, applications focus on SDGs for BIMSTEC Region, Renewable energy assessment (Solar & Wind) from Space and explore new tools for disasters management. In this endeavor, I look forward to your active cooperation. It is indeed a great opportunity for me to work with Australian space agencies (CSIRO & GA) as SIT Chair, VNSC and NASA as a Troika Team – as well as with CEOS subsidiary bodies in the Working Groups and Virtual Constellations.

I look forward to working with you and your colleagues in the coming year to make it a fruitful year for CEOS. I also welcome you all for the 34th CEOS Plenary to be held in October 2020 at Ahmedabad, India,.

Meeting Calendar

As of February 2020

Activities	January 2020	February	March	April	May	June	July	August	September	October	November	December
CEOS Plenary and CEOS SIT (Strategic Implementation Team)			▲24–26 **SIT-35** Hobart,Australia						▲8–11 **SIT-TW** Zegreb, Croatia	▲19–21 **CEOS 34rd Plenary** Ahmedabad, India		
CEOS WGs, VCs, AHTs. Others			▲9-13 **WGCapD-9** Sunnyvale,CA,USA ▲9–13 **WGDisasters-13** Pasadena,CA,USA ▲3/30–4/3 **WGCV-46** Pasadena,CA,USA ▲27–28 **LSI-VC-9** Hobart,Australia ▲3/30–4/2 **WGClimate-12** Tsukuba, Japan	▲20–23 **WGISS-49** Buenos Aires,Argentina		▲8–10 **AC-VC-16** Brussels,Belgium			▲14–18 **WGCV-47** Sochi,Russia ▲14–18 **WGISS-50** Sochi,Russia			
GEO related Activities (Group on Earth Observations)		▲3–4 **CEOS-GEO Coordination** Geneva, Switzerland									▲2–6 **GEO Week 2020** Port Elizabeth,South Africa	
Others		▲24–28 **IPCC-52** Paris, France								△6–10(TBD) **IPCC-53** TBD	▲9–19 **UNFCCC/COP-26** Glasgow,UK	

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

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