



Committee on Earth Observation Satellites
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CEOS SIT-31 Report

CEOS has worked over the past several years to focus and sharpen efforts by its member agencies in support of coordinated and optimised global observations. In order to increase its leverage, CEOS support is channelled through a number of partners and initiatives, including GEO and its supported activities, GCOS, UN agencies, development banks, and the G7 and G20. As the technology and investment basis of satellite Earth observations grows, new capacity, capabilities, and pathways to users are being established, further unlocking potential applications - which makes this a very exciting time indeed to be involved in the work of CEOS.

Some of the implementation realities of this development were discussed at SIT-31, held 19-20 April at ESA/ESRIN. The meeting was the first of four to be hosted by ESA during its SIT Chair term, and sought to establish a basis to support the priorities presented at the 29th CEOS Plenary in Kyoto, Japan. These priorities include successful advancement of ongoing CEOS commitments, full exploitation of Copernicus Sentinel data, further development of climate observations, optimisation of strategic partnerships, and support to CEOS Chair initiatives.

Successful advancement of ongoing CEOS commitments and deliverables

The importance of CEOS support to both carbon and water cycle observations was affirmed at SIT-31. Satellites provide many unique monitoring capabilities, and a number of CEOS agencies confirmed their belief that more can be achieved through coordination.

The implementation of the *CEOS Strategy for Water Observations from Space* was discussed in detail, including the ongoing Water Constellation Feasibility Study. The importance of linkages to broader coordination mechanisms was flagged, including the GEO Water Resources Management SBA and emerging GEO activities such as GEOGLOWS.

It was acknowledged that progress on the actions defined by the *CEOS Strategy for Carbon Observations from Space* was slow, and a dedicated meeting on this topic will be held at the SIT Technical Workshop, in conjunction with the

Virtual Constellations and Working Groups day.

Continuity of these observations are also expected to complement the updated GCOS Implementation Plan, which is anticipated to address global environmental cycles.

Further development of support to climate observations

It is expected that the 2016 update of the GCOS Implementation Plan will be completed in time for COP22, building on the 2015 Status Report. Drivers include the need for an extensive set of indicators, the need for long time series of records characterising the energy and carbon budgets, the need for in situ observations, improved observations of land and ocean surface stress and heat flux, and the need for more research to exploit these observations.

In addition, it was agreed that there are a range of measures that space agencies can take in response to opportunities arising from COP21 and the Paris Agreement, including support to local initiatives as a complement to GCOS's global focus.

Optimisation of strategic partnerships

For more than 10 years, CEOS has sought to align itself with GEO by providing coordination of satellite observations in support of its many initiatives and activities - an arrangement which has benefitted both groups. This is affirmed by ongoing CEOS support to initiatives like GFOI, GEOGLAM, Blue Planet, and others, and is reflected in the greater contribution CEOS is now making to GEO's governance and leadership through the Programme Board and Executive Committee.

CEOS could benefit from greater use of GEO's 'convening power' to improve high level interaction with UN agencies and development banks, rather than establishing such relationships on a project-by-project basis. At SIT-31 it was agreed that CEOS will approach the UN SDGs in conjunction with GEO and UN-GGIM, and also support the coordination of SBA data requirements through GEO Work Plan Foundational Task GD-08 ("SBAs process: Systematic determination of user needs / observational gaps").

Stephen Briggs,
SIT Chair



Full exploitation of Copernicus Sentinel data

Since the launch of the first Sentinel mission in 2014, three additional satellites have been launched, and capabilities now include global SAR and optical coverage. Data from these missions serves the needs of European users through Copernicus Services, and global users via a free and open data policy. The response to these data streams has been very positive, and it is anticipated that a number of new application areas will be opened up as capacity and capability is added.

ESA as SIT Chair intends to continue to foster the application of Copernicus Sentinel data, and SIT-31 provided an opportunity for user feedback. Plans to increase data distribution capacity via international mirror sites and Collaborative Ground Segments were welcomed.

Support to initiatives proposed by the CEOS Chair

SIT Chair looks forward to hearing the progress of the ad hoc teams (i.e. FDA and NMA) at both the SIT Technical Workshop, and CEOS Plenary. Discussions are already underway on potential continuity for these studies through the 2017 CEOS Chair term (USGS).

The SIT Chair Team is also pleased to report that during a special Plenary session at SIT-31, NOAA was confirmed as the 2016-2017 SIT Vice Chair, and will then serve as 2018-2019 SIT Chair commencing at the 2017 CEOS Plenary.

In preparation for the 30th CEOS Plenary in Brisbane, Australia, the SIT Technical Workshop will be held in Oxford, UK 14-15 September, with side meetings on 12 September, and a focused carbon strategy and VC/WG day held on 13 September. The SIT Chair Team looks forward to welcoming our CEOS colleagues and continuing to progress our coordination efforts.

CEOS Work Plan 2016-2018

CEOS's three year work plans describe the concrete action that CEOS, through its Agencies and in collaboration with its partners, will take. It is through these concrete actions that CEOS achieves its strategic objectives, and delivers benefits to the public at large as well as to its own Agencies.

The CEOS work plan is an important communication tool. It helps external stakeholders understand what CEOS is doing and how it might benefit them. It also helps CEOS Agencies identify new opportunities to join in, contribute, and benefit from, the work of CEOS.

The 2016-2018 Work Plan builds on the successful 2015-2017 Work Plan, through which CEOS delivered some major achievements, with notable highlights including the coordinated set of actions that saw the value of satellite Earth observation recognised in major global agendas on climate, disaster risk reduction and sustainable development.

The 2016-2018 Work Plan sees CEOS continue its strong commitment to: climate observations through its partnership with CGMS;

agricultural observations through its pivotal role in GEOGLAM; carbon observations including through its major contribution to the Global Forest Observation Initiative; oceans through BluePlanet; and disasters through a set of pilots and contributions to the Geohazard Supersites and Natural Laboratories initiative.

It also sees CEOS's underpinning work around calibration/validation, information systems and services, and capacity development, continue to grow and evolve to meet new opportunities and challenges. The Virtual Constellations, also, remain a prominent and active area of CEOS's work.

The 2016-2018 Work Plan also sees CEOS grow into new areas. Following the endorsement of CEOS's strategies for carbon observations and water observations, the 2016-2018 Work Plan sees a ramp-up in effort from CEOS Agencies to take those strategies and turn them into the concrete actions necessary for delivery. CEOS will also play a leading role in a new global GEO initiative on disaster risk reduction: GEO-DARMA. GEO-DARMA aims to ensure satellite

CEOS Executive Officer

Earth observations make an impact in regional and local-level efforts to reduce risks from natural disasters.

The 2016-2018 Work Plan also includes new activities that reflect the focus of the 2016 CEOS Chair, Australia's CSIRO, on ensuring CEOS is fully engaging with big new technical opportunities. These 'Chair Initiatives' will provide guidance on two important emerging topics: the major leap in capability offered by next-generation meteorological satellites, and the potential of new approaches to data analysis to make 'big satellite EO data' much more usable in agendas like the *Global Goals for Sustainable Development*.

The 2016-2018 Work Plan is the product of contributions from across the CEOS family, and the CEO Team would like to thank everyone who contributed.

All Agencies are invited to play an active role in the development of the 2017-2019 Work Plan, which will begin shortly after the 2016 Plenary in Brisbane, Australia.

State of progress implementing GEOSS, 2016

This year, the start of the second decade to build a Global Earth Observation System of Systems (GEOSS) began with a new governance structure and transitional GEO Work Programme.

The first GEO Program Board meeting was held February 2-3 in Geneva Switzerland, with an objective to support the development and implementation of GEO activities. Three Co-chairs were appointed: John Matuzak (USA), Tim Haigh (EEA) and Pengde Li (China). For the first time, Participating Organizations were elected as Observers to the Executive Committee with CEOS, GOOS and WMO being represented.

The 2016 Work Programme Symposium took place from 2-4 May in Geneva Switzerland, covering the GEO 2016-2025 Strategic Plan targets and new arrangements, including the Programme Board and Implementation Mechanisms. There was also the opportunity to discuss and provide recommendations on the content of the GEO 2017-2019 Work Programme.

The second GEO Programme Board meeting was held 5-6 May, also in Geneva. The agenda covered criteria for GEO Foundational Tasks, as well as branding of GEO Flagships, Initiatives

and data labels. A sub-group was established to formulate a monitoring and evaluation framework.

The 37th GEO Executive Committee Meeting was held in Geneva from 6-7 July. The meeting featured an assessment of the state of play of GEOSS as compared to the original vision of a Global Earth Observation System of Systems (GEOSS). It was also agreed to further refine the GEO Engagement Strategy.

Eight new Participating Organizations recently joined GEO, which now has 103 Participating Organizations and 103 Member governments! Welcome to: Association of Geospatial Industries (AGI); African Regional Centre for Space Science and Technology Education-English (ARCSSTEE); Arab States Research and Education Network (ASREN); Global Flood Partnership (GFP); Humanitarian Open Street Map (HOT); Integrated Carbon Observation System (ICOS); World Ocean Council (WOC); and World Health Organization (WHO).

The GEO Secretariat is moving ahead with preparations for the GEO-XIII Plenary meeting, to be held in St. Petersburg Russia, November 9-10, 2016. The Executive Committee recommended a more creative and radical restructuring of the agenda. It also recommended

the use of interactive tools for real-time feedback during the Plenary meeting and a more innovative format for delivery of formal Statements.

As we embark on this new decade, GEO welcomes continued contributions from CEOS as the space arm of GEOSS, as well as developing further coordination such as integrating In Situ observation networks.



Osamu Ochiai, GEO Secretariat

Working Group on Disasters (WGDisasters)

Stéphane Chalifoux, CSA, WGDisasters Chair

The WGDisasters has continued to respond to the three Disaster Risk Management (DRM) pilots: floods, seismic hazards, and volcanoes. CEOS Agencies have continued providing data to support the pilots' activities and the GEO Geohazards Supersites and Natural Laboratories Initiative. Through the Data Coordination Team, there is now an excellent collaboration with the International Charter Space & Major Disasters in order to increase the volume of useful data.

The Flood Pilot has been very active on the floods in Sri Lanka. For the Seismic Hazards Pilot, the validation of InSAR-based velocity measurements over California and

regional analysis of Sentinel-1 data in Turkey are ongoing, and three major events were covered (Nepal 2015, Greece 2015 and Ecuador 2016), resulting in the generation of advanced science maps. The Volcano Pilot team continues monitoring Latin American volcanoes, looking at data provided by space agencies. The Geohazards Exploitation Platform is fully functional, and several users already process data (seismic hazards and volcano pilots). The Landslide Pilot is still in development, and the group has agreed to focus on two primary regions (Nepal and the Pacific Northwest in North America) and five secondary regions (Norway, Southeast Asia, the Caribbean, Central or South America, and Southeast Alaska).

CEOS Agencies will also continue to ensure readiness to activate the Disaster Recovery Observatory (RO) for a one-time demonstration in the 2016–2017 period. A sub-group is working on an overarching Data Licensing document for the RO. Working with the World Bank and the Government of Malawi, a Malawi Demonstrator has been implemented in order to validate the RO approach.

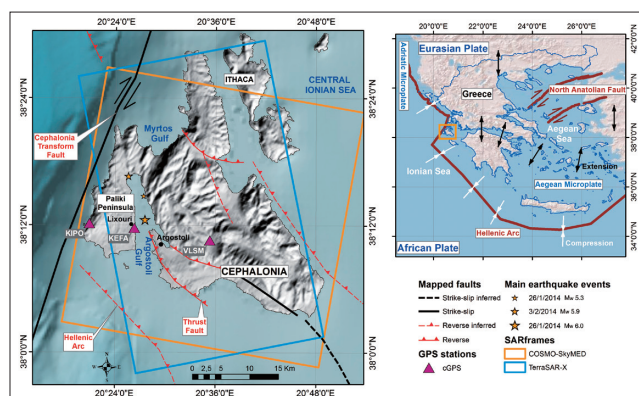
On Jan. 26, 2014, a magnitude 6.0 earthquake struck the island of Cephalonia, Greece, followed by a magnitude 5.9 event on Feb. 3, 2014 (image above). The combined events caused extensive structural damage and widespread environmental effects. Following the first earthquake, CEOS coordinated the acquisition of satellite imagery from the COSMO-SkyMed satellites and the TanDEM-X satellite. These data enabled Seismic Hazards Pilot researchers to measure the 3D permanent co-seismic deformation field. The results show that the fault rupture causing the earthquake also generated a displacement of the ground over a wide area, with diffuse surface motions reaching as much as 35 cm in the north-south direction, as well as a relative uplift of about 20 cm of the whole Paliki Peninsula with respect to the rest of the island.

Link to published SRL paper:

<http://srl.geoscienceworld.org/content/86/1/124.full.pdf+html>

It is with great pleasure that I welcome the UK Space Agency and the World Bank as new members of the WGDisasters.

The 6th CEOS WGDisasters meeting, hosted by the U.S. Geological Survey, will be held in Vancouver, Washington, USA, from September 6 to 8, 2016.



Satellite data play a critical role in understanding how the Earth moves.

The Joint CEOS/CGMS Working Group on Climate (WGClimate)

The WGClimate held its 6th meeting in Paris, hosted by CNES on March 7th, 2016. 25 people both from CEOS and CGMS participated to the meeting. The objectives of the meeting were achieved with in particular the main documents being endorsed by the Working Group (the 4-year Work Plan, the Inventory Questionnaire Guidelines and the Gap Analysis-Guidelines). This finalisation of this documentation was essential to start the population of the ECV Inventory Data Base.

ECV Inventory & Climate Architecture.

The activities related to the cycle #2 of the ECV Inventory as described in the 4-year work plan have started with the call to support the population of the Cycle 2 ECV Inventory which has been issued on June 2nd as planned. This call included the questionnaire in order to fill the Inventory. In order to help the responders, WGClimate has nominated a specific Point of Contact dedicated to the ECV Inventory.

90 people have been contacted, this includes the WGClimate members, Space Agencies Focal Points, other effective Responders already known and some potential Responders. More than 70 Focal Points and WGClimate members have been given access credentials to the web interface.

A dedicated support service has been put in place to help the people providing the information.

Each response will also be quality checked to ensure the coherency of the information included in the Inventory. This step is essential to be in position to perform the gap analysis

as planned.

COP, GCOS and UNFCCC / SBSTA

As defined in its Terms of Reference, WGClimate ensures the planning and development of a response to climate information needs, reporting to UNFCCC/SBSTA and GCOS. WGClimate was active in the preparation of the new GCOS Implementation plan which has just been released by GCOS for public review <http://www.wmo.int/pages/prog/gcos/index.php?name=PublicReview>. This public review will be closed early September for a formal release of the document at COP-22 in Marrakech. A side event will be organised for that purpose. In parallel, WGClimate will initiate the preparation of the Space Agency response to the GCOS IP based on the preliminary version, in order to be in position to publish its response by the end of 2017 at COP-23.

WGClimate was also represented at SBSTA-44 in Bonn and is drafting the Space Agency report on the need for global satellite observations to be presented at SBSTA-45 in Marrakech.

Supporting CEOS Strategy for Carbon Observations

WGClimate nominated a point of contact to handle the actions emerging of the CEOS Carbon Strategy and to act as point of contact within CEOS for the interface between CEOS and the GEO Carbon Flagship.

The report produced for CEOS in response to the GEO Carbon Strategy made 42 recommendations for

Pascal Lecomte,
ESA, WGClimate Chair



action by CEOS. These have been assessed and assigned to the relevant parts of CEOS. Progress against the actions are being monitored within CEOS and progress will be assessed at a meeting of CEOS in Oxford in September. As well as reviewing progress internally with CEOS, a critical part of achieving the actions requires interfaces externally with, in particular, GEO Carbon Community of Practice And hence the GEO Carbon Flagship. Progress by CEOS against the actions constitutes a major contribution in kind to the GEO Carbon Flagship with individual space agencies and CEOS collectively taking responsibility.



Working Group on Information System and Services (WGISS)

The 41st WGISS plenary was hosted by GEOSCIENCE Australia and CSIRO in Canberra from March 14th – March 18th, 2016. The meeting was held jointly (in parts) together with the WGCV-40 plenary. There were 42 participants (including 10 remotely) from 15 agencies /institutions. During this meeting, in addition to discussions on current projects and interest groups, WGISS and WGCV used this opportunity to jointly discuss important global issues such as the access & analysis of data as future “Big Data” architectures evolve. This is a critical topic in preparation for the deluge of “big data” coming from present and future missions like the Copernicus Sentinel and Himawari satellites.

WGISS has successfully completed the CEOS Water Portal Project. The goal is to provide assistance to scientists and general users (or non-researchers) from the water domain in the development of data services associated with data

integration and distribution. The operation of the portal was transferred to Tokyo University (<http://waterportal.diasjp.net/>).

In support of the CEOS study of ‘Future Data Access and Analysis Architectures’, WGISS is reporting on the ‘challenge of changing user expectations and increasing EO data volume, variety and velocity on EO systems architecture’ and ‘the future of EO data architectures’.

WGISS is continuing to advocate for CEOS agency mission data to be contributed to Global Earth Observation System of Systems (GEOSS) via the WGISS interoperable systems and standards (e.g. IDN, CWIC, and FedEO). As more CEOS data providers adopt WGISS supported standards (e.g. OGC CSW 2.0.2 and CEOS OpenSearch Best Practices) these data providers’ holdings will be made discoverable via these systems. The CEOS

Andrew E. Mitchell,

NASA, WGISS Chair



OpenSearch Best Practices version 1.1 was recently released. Based on previous 1.0.1 version, this release addresses comments, reviews and feedback agreed with the CEOS OpenSearch working group. To accompany this release, WGISS is now re-working the CEOS OpenSearch Developer Guide.

WGISS is working to provide a common data framework to identify and connect data assets at CEOS member agencies. To complement this effort, WGISS is investigating the validity of developing a common ‘interoperable’ data format (i.e., JSON). WGISS is also reviewing the following metadata models in preparation for discussions on a common metadata model that improves discovery and search results when searching across multiple catalogues:

- CEOS International Directory Network (IDN) – Directory Interchange Format (DIF)
- WMO Integrated Global Observing System – WIGOS Metadata Standard
 - Coordination Group for Meteorological Satellites (CGMS) - Satellite Data Essential Information for WIS Discovery Metadata

The 42nd WGISS meeting will be hosted by ESA in Frascati, Italy from September 19th – September 22nd 2016. During this meeting, WGISS will convene a one-day workshop on the Earth observation data system use of Cloud Computing.



Working Group on Capacity Building and Data Democracy (WGCapD)

The first half of the year has been spent on planning the implementation of major group activities as stated in the approved WGCapD Work plan 2016-17 approved. SAR Training Workshops that form the major activity of the working group has received financial support from ESA, UNOOSA and SANSA for the two workshops, one in Zambia and other in Gabon

Dates for these two workshops are set for October 2016 (Zambia) and February 2017 (Gabon). Furthermore, JICA in partnership with RESTEC and JAXA is providing financial support to SAR training workshop for sub-Saharan Countries in January 2017. Trainers have been kindly provided ESA, DLR, JAXA, RESTEC, NASA and SANSA.

Jane Olwoch,

SANSA, WGCapD Chair



focused on applications in the areas of seismology and volcanology.

Another very exciting activity that was completed by the Working Group is to Build awareness and demonstrate the value and applications of earth observation targeting teachers, students and practitioners in major conferences. The joint School Lab during the Living Planet Symposium 2016 in Prague targeted Czech secondary school students and teachers. Members of WGCapD from ESA and DLR hailed the event a very successful initiative. With more than 280 participants it had a great impact, raising awareness and demonstrating the principles of remote sensing and Earth Observations and show case activities of ESA, ESERO CZ, DLR and National Space Academy.



WGCapD 5th Annual Meeting Participants

The first Working Group's SAR training workshops took place in Columbia during the AmeriGEOSS week in conjunction with GEOGLAM. Sponsorships for course material and trainers were provided by ESA and Marie-Josée Bourassa from the Canadian Space Agency. Courses included basic introduction to SAR, pre-processing and general view of the application of SAR in the monitoring of agriculture. The second session of SAR (25 students)

Working Group on Calibration and Validation (WGCV)

The CEOS WGCV looks back on a fruitful period with the highlight being the 40th WGCV plenary at CSIRO's Black Mountain site in Canberra hosted by CSIRO and Geoscience Australia. One day of the four-day meeting was dedicated to a combined session with WGISS at Geoscience Australia discussing cooperation between both groups. It is worth noting that special attention was given to a diversity of topical sessions including the CEOS Chair's initiatives, CEOS Carbon action items, and interactions with other CEOS bodies.

The audience encompassed around 40 attendants and several remote participants.

The WGCV plenary included the agencies' and subgroups' reports and dedicated sessions. A broad overview on the evaluation and validation of Atmospheric products for several missions were presented emphasizing upcoming missions. Attention was given to the validation of GOSAT and OCO-2 calibration activities. The presentation of the CEOS Chair NMA study opened a new view of future challenges regarding combined GEO/LEO applications.

Another topic of interest was the interaction with LSI-VC on future cooperation including a discussion about ARD definition. The WGCV agreed to a principal strategy for handling Carbon action items and break-downs of those actions into sub-tasks were presented. The project team of RADCALNET presented its promising

beta-version with plans for intensive testing of the beta-version, a schedule to become officially available in 2017, and inclusion of additional test sites. It is also worth noting that interaction with VC-SST on a comparison campaign of radiometer reference measurements is progressing very well.

We had also the opportunity to intensively discuss the implementation road map of the task team "Atmospheric Correction Model Inter-comparison Exercise" (ACIX) which is led by ESA and NASA. The effort encompasses around 14 correction models from several entities and defined their comparison baseline during a fruitful workshop. It is expected that they will have their first results the end of October and will finalize their comparison during 2017 which is well on schedule.

During summer time, a series of subgroup meetings have been carried out beginning with the LPV, MWSG, and IVOS. This series will end with the SAR subgroup meeting in combination with the coming WGCV plenary in Tokyo early September 2016.

Finally, the working group finalized

**Albrecht
von Bargaen,**
DLR, WGCV Chair



new ToRs for approval during the coming CEOS plenary. In combination with that, a new internal work plan will be drafted as a rolling repository. The outreach of the WGCV activity will also be re-shaped in a new website concept.



CEOS WGCV welcomed during its plenary in Canberra not only new members from several agencies but also some additional special guests representing typical fauna and moving calibration targets. (plenary group photo see WGISS)

Global Forest Observation Initiative (GFOI)

Dear CEOS colleagues, it has been a steep learning curve catching up on the many components and activities of the Global Forest Observations Initiative since being confirmed as the CEOS Lead for the Space Data Component late last year. I am pleased to report that GFOI continues to develop and evolve thanks to the shared vision and energy of the various partners. I would like to report a few, select highlights for your reference:

- GFOI organised a side event at the UNFCCC Climate Change Conference in Bonn in May, where the free and open data policy of our core data was very much appreciated. Data distribution and access remains a challenge in developing countries, where modern solutions like data cubes, analysis ready data and cloud processing are investigated by SDCG in pilot countries.
- In June, the US Secretary of State (John Kerry) and the Norwegian Minister of the Environment (Vidar Helgesen) signed an agreement supporting conservation of tropical forest and REDD+. GFOI was cited in the agreement as potential way to enhance this bilateral cooperation (<http://www.state.gov/r/>

pr/ps/2016/06/258502.htm)

- The GFOI International Collaboration Forum in DC in late June included attendance from US Aid, World Bank, and WRI to explore opportunities for collaboration among their relevant goals and programs.
- GFOI has launched **REDDcompass** - a web application to help countries develop national forest monitoring systems and procedures to measure, report and verify associated greenhouse gas emissions. REDDcompass guides users through the core themes, concepts and actions involved in the development of national forest monitoring systems for measurement, reporting and verification (<https://www.reddcompass.org/frontpage>).

To succeed, we need to see GFOI mainstreamed within the forest-related programmes of FAO, World Bank and the major development aid donors such as Norway, USA, Germany and UK. With this in mind, a briefing day for relevant government agencies has been arranged just before SDCG-9, in London on 6th September. SDCG-9 will be hosted by the UK Space

Masanobu Shimada, JAXA

Agency and National Centre for Earth Observations in Reading that same week. The meeting includes a special session dedicated to closer cooperation with the strong technical sector in the UK.

Our SDCG has been hard at work to conclude their Global Data Flows report in time for discussion at SIT Technical Workshop. Many of the conclusions have much broader consequences for CEOS and its agencies than just forest monitoring. Consultation with countries has revealed that the new generation of land surface imaging satellites has, ironically, reduced the number of countries able to apply satellite data, due to the data volume and complexity. CEOS must compensate with measures to ensure new data architectures can accommodate these users and others like them.

Loss of Australian funding for the SDCG Secretariat in late 2016 will have a significant impact on the operation of our group for GFOI. SDCG Exec will be studying various options in order to mitigate this loss and ensure continued effective operation of this dynamic CEOS team.

I am available as required to answer questions from the CEOS community in relation to GFOI.

GEOGLAM

GEOGLAM Coordination Supports Policy Action and Decision Making

GEOGLAM was mandated in 2011 by the G20 in to lever Earth observations (EO) to provide transparent, timely, and accurate information on global crop conditions and outlooks for production to combat market volatility. Because of GEOGLAM's considerable efforts and successes, the **G20 Agricultural Ministers** restated their commitment to the implementation of GEOGLAM again in 2016: http://www.g20.org/English/Documents/Current/201606/t20160608_2301.html

Since mid-2013, GEOGLAM has been providing monthly consensus, multi-source reports on crop conditions of the four main commodity crops (wheat, rice, maize, and soybean) to the Agricultural Market Information System (AMIS), via its **Crop Monitor for AMIS** (CM4AMIS). As a testament to GEOGLAM's value to the success of AMIS, in June 2016, the GEOGLAM Secretariat was unanimously confirmed by AMIS as a member of its Steering Committee and Secretariat. This strong relationship exemplifies the power of international and interdisciplinary coordination around issues of pressing global

concern.

Building off of this success, GEOGLAM launched its **Crop Monitor for Early Warning** (CM4EW) in early 2016 (Figure 1). The CM4EW focuses on countries at risk of food insecurity as well as their relevant crops and drivers, providing early warning of crop shortages and failures. The CM4EW's timely and accurate reporting of the devastating southern African drought assisted in [developing food policy responses](#). Led by the GEOGLAM Secretariat, key contributors include World Food Programme (WFP), Famine Early Warning System Network (FEWS NET), European Commission Joint Research Centre (EC-JRC), Asia-RiCE, and the Agricultural Research Council (ARC) of South Africa. More information on both initiatives can be found at: www.cropmonitor.org.

Linkages with CEOS: The relationship between GEOGLAM and CEOS has expanded and flourished, with GEOGLAM now collaborating with both the Working Group on Capacity Development (WGCapD) on training workshops and "best practices" for capacity development, as well as with the Land Surface Imaging Virtual Constellation (LSI-VC) on EO requirements characterization and analyses of gaps in potential and actual coverage. Further,

GEOGLAM's characterization of its EO data needs have fed into requirements gathering for the next generation Copernicus space segment (Brussels, June 2016).

Rangeland and Pasture Productivity (RAPP):

The 4th international RAPP workshop was held in South Africa (city of Tshwane, Pretoria), in late June 2016, co-organized by the South African National Space Agency (SANSA) and Commonwealth Scientific and Industrial Research Organisation (CSIRO), strongly supported by the South African Department and Science Technology and the City of Tshwane in South Africa (Figure 2). The focus was mainly on linking the pasture cover/biomass modelers and remote sensing practitioners with livestock productivity experts, with a focus also on RAPP's EO requirements and pilot site establishment. The RAPP Map (global rangeland monitoring system) is now online, but still under development with new features coming soon. <http://map.geo-rapp.org>

Regional Networks Launched: Following the successful example of Asia-RiCE under JAXA's leadership, GEOGLAM is launching two additional regional networks: GEOGLAM Latinoamerica (led by Instituto Nacional de Tecnología Agropecuaria-Argentina) and AfriGAM (African Global Agricultural Monitoring, led by ARC-South Africa). GEOGLAM Latinoamerica held its first workshop in Bogota, Colombia in June 2016, while AfriGAM will be formally launched in October.

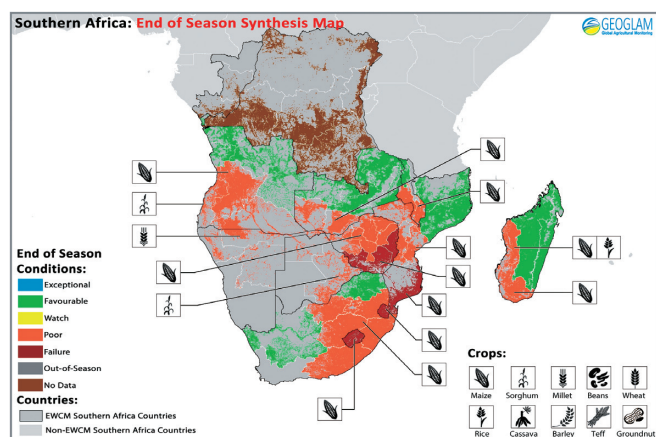


Figure 1: End of season crop condition map synthesizing information over the main growing regions in southern Africa. Crop conditions are based on a combination of inputs including remotely sensed data, ground observations, field reports, and national and regional expert reports. Crops that finished the season in other than favorable conditions are labeled on the map.



Figure 2: GEOGLAM RAPP workshop group photo in Pretoria

CEOS Water Constellation Feasibility Study

Climate changes have significant impacts on regional precipitation patterns and water availability. People are concerned about increasing severity and frequency of floods and droughts in the world. Improved observation, modeling and prediction of the changing water cycle are required.

GEO issued the GEO Water Strategy in 2014 which contains recommendations for improvements of existing observation system capabilities. CEOS Water Strategy Implementation Study Team (WSIST) established by the 28th CEOS

Plenary, prepared its responses. The 29th CEOS Plenary, in Kyoto in Nov 2015, endorsed the responses and decided to extend WSIST for a year to implement the responses including the Water Constellation feasibility study;

(GEO Water Strategy 2014 C1 recommendation)

"The feasibility of developing a Water-Train satellite constellation should be assessed. This suite of satellites would be modelled after the A-Train, providing a space segment of an observation system that would capture all fluxes and stores of the water cycle using a

Chu Ishida, WSIST lead

diverse suite of platforms and instruments. This system would operate as a Virtual Water Cycle Constellation."

The FS aims to provide an assessment of the value and feasibility for a constellation that could provide measurements of all components of the water cycle that are synchronized in time

(to be continued on page 7)

Future Data Access and Analysis Architecture

The CEOS strategy to optimize the societal benefit of EO is taking its member agencies closer to users through GEO/CEOS initiatives like GEOI and GEOGLAM. These support societal needs globally and the value is being recognised by Governments, aid agencies, and other key people.

With new missions increasing the spatio-temporal resolution and variety of sensors, the massively increasing data volume is matched only by the number of new applications that are being conceived. Combined with Big Data infrastructures from organisations like Amazon and Microsoft, the potential for economic and societal benefit through innovative EO businesses and applications is unprecedented, and so is the expectation that CEOS will assist in this realisation by reducing barriers to not only access, but use of EO data.

A key question then is what barriers exist and what can CEOS do?

The CEOS Future Data Access and Analysis Architectures (FDA) study seeks to answer this

question. Drawing on experience of agency and CEOS initiatives at the frontier of user engagement the study is exploring responses to these major shifts and the pressure on EO architectures. Significant applications potential remains consigned to test-beds, unable to scale or move into operations due to high costs and inefficiencies. This will worsen as data volumes increase and for a significant number of countries the combination of changes effectively excludes them due to limited bandwidth or the complexity of managing new EO datasets.

The FDA study has identified potential solutions that can remove many of the barriers. Data Cube technology as demonstrated in the Australian Geoscience Data Cube and the CEOS SEO Kenya and Colombia Cubes, provides easier access to analysis without the need to transport large volumes of data to end users. The use of Analysis Ready Data (ARD), data that is already calibrated, geospatially corrected and ready for application greatly reduces the technical expertise required to apply EO data with limited impact on potential applications. These are just some of the options

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being analysed.

Such changes are not isolated and it is important to understand what the impacts are. Data Cubes are predicated on treating EO data as a temporal volume of spatio-spectral observations, not as scenes or files. Discovery interfaces and Metadata may need to move from being "about files" to being "about observations" with seamless access. The variety of data and its integration requires common access methods to reduce operational inefficiencies. All of this points towards changes in architecture and an increase in interoperability not only for data discovery, but for integrated data analysis across CEOS.

The FDA study will report key findings and recommendations on a way forward for CEOS and its agencies and how CEOS priorities might benefit from the proposed data architectures.

Non-meteorological Applications for Next Generation Geostationary Satellites Study

The Non-meteorological Applications (NMA) for Next Generation Geostationary Satellites Study Team is undertaking a systematic survey of non-meteorological applications for current and planned Geostationary (GEO) missions including their synergistic use with Low-Earth Orbiting (LEO) satellites. The study will result in a report that will provide comprehensive and pragmatic guidance in line with the activities of the Coordinating Group for Meteorological Satellites (CGMS) on how to progress key non-meteorological applications for a quasi-global GEO constellation.

During initial teleconferences held in February/March feedback from all 17 agencies involved in the NMA study was requested on the scope and proposed outline of the report. After the

assignment of chapter lead authors the report was then progressed in the background within a smaller focus-team consisting of the study co-leading agencies ABoM (Ian Grant), NOAA (Satya Kalluri), EUMETSAT (Kenneth Holmlund) and CSIRO, in addition to the USGS (Thomas Cecere) and the DLR (Albrecht von Bergen). Since then the team took several opportunities to meet face-to-face to discuss and review study progress e.g. at the March CEOS WGCV-40 plenary meeting in Canberra, Australia and the April SIT-31 Technical Workshop in ESRIN, Italy. In order to coordinate the NMA study with CGMS, and to take into account already on-going or planned future activities by CGMS agencies, the CGMS secretariat initiated a joint CGMS/CEOS side-event that was held in June at the CGMS-44 plenary in Biot, France.

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Presentations from the CGMS/CEOS side meeting are available at: <http://cgms.eumetsat.int/CWPT/Views/agendas.xhtml?sessionId=4b1ceeb28adb9eaa698a1c2a1e>.

A first draft report will be circulated for comments to the wider NMA study team, CEOS Working Groups and Virtual-Constellations by end of August. Another NMA side meeting is being organized at the SIT Technical Workshop to be held in Oxford, UK, in September when draft recommendations will be provided for consideration by CEOS. The report will then be refined and finalized based on feedback for presentation to the CEOS Plenary in early November.

(continued from page 6)

and space. It also provides an assessment of the options for providing this integrated capability. At present the measurements for the water cycle are taken from different platforms widely varying measurement techniques at different intervals and resolutions and sampling strategies making their synergistic use very difficult.

The WSIST agreed on focusing on 6 high

priority variables associated with the water cycle including: precipitation, soil moisture, evaporation/evapotranspiration, river run-off, surface water storage and ground water. It undertook a gap analysis of individual observations systems for these parameters and this combined observation system. The goal of the FS is to address all the 6 parameters and optimize this integrated observation system. Given the complexity of assessing the interactions between all six variables, WSIST proposed a step-wise approach

to start with the precipitation-soil moisture case study and then expand to other variables.

Preparations of draft reports on the precipitation-soil moisture case study and the CEOS Water Constellation feasibility study are under way. Many experts in water communities and space agencies are collaborating for these documents and the goal is to submit the feasibility study report to the 31st CEOS Plenary, on Nov 1-2, in Brisbane.

CEOS Chair Updates & 30th CEOS Plenary

Welcome Message



*Dr. David Williams,
CSIRO,
2016 CEOS Chair*

Dear CEOS Colleagues and Friends,

This continues to be an exciting and busy year for CEOS, and I thank all leads and members of our Working Groups, virtual constellation teams, special Ad-Hoc initiative teams and their home agencies for their valuable time and inputs. It is the collective efforts that make this such a vibrant and successful organisation.

CSIRO as the CEOS Chair, in close collaboration with Geoscience Australia and the Australian Bureau of Meteorology, has continued the key CEOS activities and initiatives identified by the Plenary. These include GCOS GFOI, GEOGLAM, GEO Disasters, GEO Water and GEO Blue Planet. This year, we have also addressed how Earth observation and CEOS can best assist UN agencies and the national governments

responsible for implementation of monitoring programs associated with key indicators under the UN Sustainable Development Goals (SDG) process, as a way to enhance the routine use of EO data by governments for UN-level reporting.

Work has also continued on the two initiatives that Australia introduced at the 2015 Plenary - one on tackling new challenges around big data, future data processing and delivery architectures that help bring Earth observation data to many more users worldwide; and a second looking into how best to leverage the new generation geostationary weather satellites for applications that would benefit from the high temporal frequency of observations that these systems provide. Both teams are making very good progress and we hope to receive solid recommendations at the CEOS Plenary in Brisbane – Australia, later this year.

In this regard, I would like to invite you to join our 30th Plenary from the 1st to the 2nd of November 2016 at the Brisbane Exhibition and Convention Centre in Brisbane, Australia. Online meeting registrations are open via the links on the CEOS website: <http://ceos.org/meetings/30th-ceos-plenary/>.

The continued engagement of agencies is critical to the success of CEOS and we sincerely hope that you will join us in October/November.

We look forward to seeing you in tropical Brisbane!

Meeting Calendar

As of August 2016

Activities	2016					
	July	August	September	October	November	December
CEOS Plenary and CEOS SIT (Strategic Implementation Team)			▲13-15 SIT Technical WS Oxford, UK		▲10/31-11/2 CEOS 30th Plenary Brisbane, Australia	
CEOS VCs and CEOS TFs (Virtual Constellations and Task Forces)		▲20-22 LSI-VC-2 Los Angeles, USA	▲7-9 SDCG-10 Reading, UK		▲10/31-11/4 OSIST Mtg & OST-VC La Rochelle, France	
CEOS WGs			▲6-8 WGDisasters-6 Vancouver, USA ▲5-9 WGCV-41 Tokyo, Japan ▲19-23 WGISS-42 Frascati, Italy			
GEO related Activities (Group on Earth Observations)	▲6-7 GEO ExCom Geneva, Switzerland		▲7-8 GEO Programme Board Geneva, Switzerland		▲8-10 GEO XIII Plenary & ExCom St. Petersburg, Russia	
Others	▲10-15 IGARRS 2016 Beijing, China	▲7/30-8/7 41st COSPAR Istanbul, Turkey	▲26-30 IAC 2016 Guadalajara, Mexico		▲7-18 COP-22 (including SBSTA-44) Marrakech, Morocco ▲14-18 APRSAT-23 Manila, The Philippines	

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

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