

STRATEGIC DIRECTIONS AND PARTNERSHIPS FOR CEOS

DISCUSSION PAPER

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Introduction

As the new Chair of CEOS's Strategic Implementation Team (SIT), ESA would like the community to reflect on a number of issues to help shape how CEOS can best serve space agency needs and organise itself to capitalise on the significant opportunities before us for satellite Earth observations in the service of society.

These issues include:

1. **Future Partnerships** - understanding which partnerships are needed for CEOS and space agencies to promote uptake and application of government-sponsored EO programmes in support of key sectors such as forestry, food security, water resource management, climate, disaster risk reduction – amongst many.
2. **Thematic Observing Strategies** - how to move forward in managing the multitude of thematic observational strategies that CEOS finds itself presented with – in relation to carbon, water, forests, agriculture, disasters – consistent with the capacity available within CEOS and agencies, whilst recognising the opportunities that they represent.
3. **Opportunities** - reflecting on the opportunities arising for EO satellite data in support of major new initiatives. This meeting specifically addressing those resulting from: UN-WCDRR, the SDG process, and UNFCCC COP21. **New data opportunities:** How can agencies take advantage of new data architectures?
4. **Management** - reflecting on the need for adjustments in CEOS priorities and resources to respond to trends identified in the work of CEOS and the challenges and opportunities arising.

This paper is offered to CEOS Principals to stimulate discussion at SIT-31 in April 2016 on these issues and to help set directions and priorities for the coming two years of ESA's SIT Chairmanship term.

Future Partnerships

CEOS has always aimed to address a broad range of coordination activities in support of the EO satellite programmes of its members. Some could be considered to be space agency 'housekeeping' - internal business in relation to basic data formats, standards, interoperability and so on. This work is always executed with an awareness of global standards bodies etc but is essentially undertaken at the technical level between space agency experts, often within our Working Groups. As the EO satellite data sector has matured to penetrate more sectors, with more data being used for more purposes by more organisations, CEOS balance of effort has noticeably swung to place more emphasis on supporting the uptake and application of data – to the point where (eg through GFOI in 2015) CEOS is assisting individual government agencies with the processing and application of datasets for a specific purpose (forest monitoring in the case of GFOI). This generally reflects the way in which EO data has evolved since CEOS was established in the 1980s, but has significant implications for the nature of the partnerships that CEOS must explore and operate to be successful at this level.

The graphic below aims to summarise how CEOS partnerships have evolved over the three decades since its foundation in 1984. Recognising the potential of a new body such as CEOS for the coordination of major, global information needs of their programmes the major science programmes and UN bodies (WMO, FAO, others) sought a seat at the table with space agencies. The IGOS Partnership brought a welcome focus on a select number of high-priority themes

(water, cryosphere, atmospheric chemistry...) and was very successful in identifying the appropriate participants in the dialogue (limited in number), in establishing consensus on the nature of the requirements, and suitable observing strategies for space and in-situ. On the whole, these foci and communities were somewhat dispersed upon the establishment of GEO in 2005 and we have not generally seen effective continuity of much of this thematic work via the GEO Communities of Practice - for several understandable reasons, for example that they are not directly aligned with the IGOS themes. Perhaps in response to this trend, the SIT initiated new relations with thematic (usually science) communities in 2006 via the Virtual Constellations mechanism and this has proven to be useful in bringing more specificity to the coordination between CEOS Members active in selected areas of EO – such as sea level, atmospheric chemistry etc. User interaction varies significantly from group to group depending on their selected priorities.

Evolution of CEOS Partnerships for EO data uptake and benefits

- 80s**
 - Major science programmes as Associates: WCRP, IGBP etc
 - Major users gradually introduced as Associates – WMO, GCOS, FAO...
- mid 90s**
 - Broadened with thematic studies/alliances under IGOS-P umbrella – effective in establishing requirements and observing strategies in major areas
- mid 00s**
 - Alliances merged into GEO (2003+). Decreasing prominence of Communities of Practice
 - New relations with thematic science communities via VC mechanism
- mid 10s**
 - Mature partnership with GCOS in support of UNFCCC/Parties
 - IGOS tradition continued via new CEOS Water, Carbon Strategies
 - Extended reach to individual govts and key intermediaries through thematic programmes like GFOI and GEOGLAM – bringing CEOS and agencies closer to linking space data with societal benefits
 - Common role for UN agencies but complex in some cases
- late 10s?**
 - Future Data Architectures (Analysis Ready Data, Data cubes...) seeking to simplify connection between space agencies and even individual users
 - Financing institutions important partners (WB.ADB, IADB, AfDB,...)
 - Prospects for GEO into the future

Around the same time as the establishment of the VCs, the SIT pioneered the strengthening of the relationship with the Global Climate Observing System (GCOS) and this is now perhaps the best example of a successful partnership for CEOS - in that it clearly has the correct geometry, has established CEOS as the natural supplier of space data information to a major UN convention (UNFCCC/SBSTA) via an expert intermediary (GCOS), and continues to operate with a productive and supportive relationship between CEOS and GCOS. Having GCOS as part of the UN family (technically GCOS is jointly sponsored by WMO, UNESCO/IOC, FAO and ICSU), was essential to this success, and the neutrality and openness of the GCOS personnel in inviting CEOS to fulfil its natural role in this geometry was also key.

In the last five years, CEOS has taken great strides to further evolve its political, scientific and technical partnerships in support of the uptake and application of EO data, summarised as being on two fronts:

- by extending reach to individual governments and user agencies through thematic programmes like GFOI and GEOGLAM, as well as through WCDRR activities in support of WCDRR and its pilot projects;
- by continuing the tradition of thematic requirements and observation strategies in partnership with the user group reincarnation as GEO communities – for Carbon and Water. High quality, definitive references now exist to guide space agency coordination and planning observation strategies for these sectors.

CEOS has also been involved in the early stages of the development of a detailed approach to implementation of the SDGs, both via its agencies and through discussions with GEO.

Each of these efforts has involved significant investment in new relationships and partnerships to establish the geometry appropriate for the individual circumstances and communities involved. This is important work as it breaks new ground for CEOS and its agencies to service the needs of the recognised world leaders within the UN and beyond, into the responsible national authorities for the uptake and application of CEOS agency programme data in support of important societal applications. And each continues to involve significant challenges in terms of the functional partnerships required to realise the ambitions CEOS has, including:

- the GEO programmes of GFOI and GEOGLAM both count FAO as the major intermediary body within the UN responsible for helping CEOS deliver the observing programme results in support of the national policy goals – eg within the REDD+ programme and the significant capacity building and donor aid activities within the forestry sector; but the role of GEO – and perhaps programmes such as GFOI and GEOGLAM, and by association CEOS – has not been negotiated at a high-level within the UN system and its major agencies like FAO; initiatives like GFOI and GEOGLAM deliver in areas where the traditional lead with countries has been with UN agencies and it is important to ensure that they are integrated seamlessly into ongoing work and provide a wider, more effective framework for implementation. At the same time, we see organisations like Google pioneering high-profile strategic relationships with FAO in the same area, often using CEOS agency data but within their own computing platform and this challenges the role of government programmes versus the role of industry in areas that CEOS might consider its natural turf; it is also changing user expectations as to the way in which CEOS agency satellite data can/should be made available to meet user needs and limitations;
- UN agencies are often identified as important partners for CEOS, in areas where there is a clear mandate and natural role for CEOS and EO; yet even the most promising opportunities can be complicated by the complexity of the UN organisational structure and by the (sometimes competing) distribution of responsibilities among several UN agencies as demonstrated during the last UN-WCDRR, and moves to subsume what might be considered to be the CEOS role within their responsibilities;
- CEOS and space agency work can be disconnected from the major political and financial support directed at the very same sectors and we find ourselves in the frustrating situation of having to repeatedly promote and explain our activities to our own government departments given responsibility for substantial development aid budgets in forestry and agriculture; to succeed, CEOS and GEO together must give considerably more attention to greater integration of political and financial support for their initiatives aimed at data uptake, including in collaboration with the international donor bodies such as World Bank, Asian and African Development Banks, as well as the development agencies within our own governments.

With the promise of major requirements for satellite EO in support of the SDGs and COP21 agreements, it is an opportune time for CEOS to take stock of lessons learned in relation to the effective partnerships that will be needed to position CEOS and its members to help satellite EO realise its full potential in service of society. SIT-31 will feature discussions on these topics, including addressing the specific challenges and possible solutions facing each of our major initiatives.

Thematic Observing Strategies

CEOS has invested considerably in developing coordinated strategies in support of thematic requirements. First for Forestry (GFOI), then Carbon (GEO Carbon Strategy), Agriculture (GEOGLAM), Disasters (WGDisasters) and most recently Water (GEO Water Strategy). These efforts represent a natural evolution of CEOS efforts to provide a common framework for all space agencies to rally around to support the observing needs for one or more key sectors of science, society or industry. As the first of the new wave of strategies, the GFOI acquisition strategy has been the most enthusiastically embraced and supported by agencies with suitable programmes – with a well resourced coordination group pushing things forward. As the strategies have increased in number, so proportionally has the difficulty in understanding how to reconcile the new requirements with those that preceded them and the fear that there may be conflicting requirements. The net effect has been a guarded caution and inaction, even for initiatives such as GEOGLAM which in theory enjoy broad support across CEOS agencies. The challenge is further complicated by the fact that some of the requirements will require sustained and significant investment (eg in support of global carbon and water observing systems).

CEOS must reflect on the current situation which has involved significant investment in the development of multiple thematic observing strategies and uncertainty as to how to best handle their implementation – such that expectations are well managed within and beyond CEOS as to how our support for these strategies is going to proceed and at what pace and scale. These issues will be discussed at SIT-31, including a stock-take of the many and varied existing commitments, and a first look at possible tools and processes for better management across them all.

Opportunities in relation to COP21 and the SDGs

The CEOS Response to the GCOS IP has been cited as the most productive external relationship for CEOS in terms of global recognition for the role of CEOS in coordinating the application of space agency data to address societal needs. COP21 and its follow-up processes will likely raise new requirements for observations related to new dimensions to the UNFCCC, including the development of new national accounts and reports as obligations under legally-binding treaties. SIT will work with WGClimate and in collaboration with GCOS, to undertake an assessment of the implications for the observation needs of the Convention and will bring to SIT-31 a draft plan to consolidate the CEOS position in reporting the progress towards COP-21 follow-up, including the space component of the Global Climate Observing System. Depending on the exact nature of the agreements which flow from Paris and the follow-on discussions, CEOS might consider directing its thematic observation strategies for Carbon and for Water to become routine supplements to the periodic reporting to UNFCCC/SBSTA. There may be further opportunities to link in GFOI, WGDisasters and other significant investments. CEOS should look strategically at the influence of the political and financial commitments being directed towards post-COP21 activities and consider new paradigms and geometries to ensure that the essential role of satellite EO is recognised, supported and benefits from the support – becoming part of the mainstream conversation around implementation of the Convention in the years ahead. The convening power of GEO may be the most promising channel through which CEOS might pursue these new geometries, if GEO realises the promise communicated in the description of its next Phase. The CEOS-GCOS relationship will certainly continue to be the top priority and SIT Chair

will ensure GCOS features prominently in the SIT-31 agenda item on COP21 follow-up, including the GCOS 2016 IP, Satellite Supplement and Response processes.

In relation to the Sustainable Development Goals - at face value these would appear to have significant potential for the systematic application of satellite EO. Analyses have shown that a large fraction of the Goals (just like the ECVs) are largely measurable from space. CEOS should however reflect on the past experience with the Millennium Development Goals. We invested significant effort in promoting the role of the MDGs through the UNCED process at the Rio+10 meeting in South Africa in 2002. Some notable references to EO were accomplished in the declarations but ultimately the MDGs did not have the societal impact that many hoped. The SDGs may fare better, although ongoing discussions show that the agreed indicators are tending to focus on economic and statistical data – perhaps inevitable given the source of information responsible. CEOS should work however to ensure that the benefits of satellite data are fully recognised in developing the indicators, whilst staying alert to the challenges facing non-UN bodies in engaging in the process. Initiatives like the SDGs can sometimes serve as currency within the UN system, for use by various UN agencies, in dealing with each other and establishing territories and responsibilities.

SIT-31 will include agenda items in relation to opportunities arising from COP21 and the SDGs, as well as more strategic discussions regarding CEOS and GEO relations with the UN system and agencies.

New data opportunities: How can agencies take advantage of new data architectures?

There is now both an appetite and potential for a much wider use of satellite data among UN, and other, agencies and programmes. Many of these require direct land imagery or some variety of land cover, usually as a proxy for some other parameter, for example fragmentation of land cover as an indicator of habitat suitability for specific species. This suggests that space agencies should create an integrated dataset of land surface imagery which can have very broad utility among a wide group of, in scientific terms, not very sophisticated users. They represent a very broad but shallow (no offence intended) group of very important policy and programmatic users of satellite data. However, they are often and easily put off using such data by the complexities of access, storage, inter-comparison, compatibility, technical corrections and many other aspects of the data which make it much more difficult to use – and, as a consequence, not used. But if CEOS agencies can develop a more accessible and simpler means of accessing and manipulating space data these users represent an entire universe of new services to society which are as yet unexplored.

The appetite of CEOS agencies for coordination via CEOS in the uptake and application of EO satellite data in support of pressing global issues like food security, deforestation, and climate has been repeatedly confirmed through significant investment in activities in support of GEOGLAM, GFOI and GCOS, amongst others. It is assumed that the trend in this direction will only increase and that major changes in both space segment (with many and varied non-governmental participants) and ground segment, will have a significant impact on the expectations of data users for the contribution from CEOS and its space agencies. Multiple studies underway by CEOS groups (eg, the Global Data Flows work by SDCG, and the Future Data Architectures Team work) are highlighting the importance of removing the obstacles of data size and complexity from individual user agencies if CEOS agency EO programmes are to realise their full potential and achieve societal impact, particularly within developing countries. CEOS experience with GFOI and GEOGLAM has brought this firmly into focus also. For Land Surface Imaging applications such as these, optical data supply is no longer the point of anxiety - given the parallel operation of the Landsat and Sentinel series, amongst others. Instead, available capacity and resources can focus instead on the uptake, application and impact of the data.

The data volumes involved in new missions (such as Sentinel-2 and Landsat-8) mean that the old '*come and get it*' data system model are simply not sustainable and new paradigms are

required. This realisation is reflected in the Analysis Ready Data (ARD) strategy of USGS which will drive its entire Landsat ground segment design in future. It is also demonstrated in the provisional conclusions of the Global Data Flows work which advocates that considerably greater emphasis be placed on ARD and Future Data Architectures (such as the Data Cube) by CEOS as the peak EO coordination and standardisation body for civil space agencies. These developments are also seen as having the potential of reducing the dependence of CEOS and space agencies on third party partners, eg in relation to capacity-building. Significant new applications and users can be realised from the newly-achieved continuity and coverage of data supply, but only if 'interoperability' and interchangeability is achieved among the core data streams and data handling burdens are removed from users.

A number of questions in this direction will be put to CEOS Principals at SIT-31:

1. Given the potential of Analysis Ready Data and the importance of an effective coordination and standardisation approach at this early stage, might CEOS take measures to establish a strategic and top-down approach – directing all relevant subsidiary groups as necessary in support of common outcomes?
2. Noting the increasing role of commercial cloud storage and processing players (such as Amazon and Google) in the uptake and application of CEOS agency missions, does CEOS and its agencies need to consider the nature of future data architectures, and the impact on the nature and distribution of ground segment funding? These players may provide both their own satellite data sources and/or almost all data available from CEOS agency programmes – through what many users see as superior cloud storage and computing interfaces. User expectations of government-sponsored data provision are changing as a consequence. Do we need to consider novel partnerships to sustain CEOS pilot projects in this direction? The Future Data Architectures Team is due to report at CEOS Plenary 2016.
3. The SEO has brought essential prototyping development capacity to the collective ambitions expressed by space agencies active in CEOS. The SEO is pioneering pilot projects which are trialling the application of Analysis Ready Data and Future Data Architectures to the EO satellite data needs of individual countries. This geometry is new for CEOS, and is placing significant demands on the SEO as the user-facing prototype developer. In 2016, SEO capacity remains as a single-agency (NASA) contribution and is becoming the limiting factor in the progress of these pilot activities. CEOS might consider whether an expanded and distributed SEO capacity is more appropriate to seize the opportunities ahead and to handle the scale of the work involved?

Next Steps

This short paper has served to begin to raise matters central to the future success of CEOS and its space agencies to the consciousness of CEOS Principals – with a view to a robust and productive exchange of views at the next SIT meeting in April 2016. The SIT Chair Team will work to develop further material on each topic to support and stimulate the discussions. **CEOS agencies are invited to comment on the issues raised above and to suggest refinements and perspectives that can enhance the agenda for SIT-31.**