

Proposed CEOS Chair Initiative for 2016

Non-meteorological applications for next generation geostationary satellites Study

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Introduction

As the Chair agency for CEOS for 2016, CSIRO proposes to provide leadership on two new initiatives:

- A study of Future Data Access and Analysis Architectures
- A study of Non-meteorological applications for next generation geostationary satellites

This paper introduces the first topic, explains the purpose and objectives of the initiative, in support of a decision on the way forward for the effort at the Kyoto CEOS Plenary. The paper and proposed approach have been prepared in accordance with the *CEOS New Initiatives Process Paper*.

Context

The deployment over the next few years of a constellation of advanced meteorological geostationary (GEO) satellites, with their improved spectral, spatial and temporal resolution sensors, opens up a world of new possibilities for continuous monitoring of the high-temporal dynamics of the land, oceans and atmosphere, addressing a broad range of societal challenges, particularly in combination with moderate resolution low Earth orbit (LEO) observing satellites.

While the primary mission of the new GEO satellites is to support operational meteorological services, they offer opportunities for non-meteorological applications that can enhance and complement the LEO-based applications that have been the workhorse for monitoring of the broader environment. The characteristics of the advanced GEO sensors complement current moderate resolution LEO sensors, approaching the LEOs in spatial and spectral resolution while offering far greater temporal resolution, and complementary view and illumination geometries. GEOs can fill gaps in LEO coverage due to cloud. They are particularly well suited to monitoring rapid changes in the land surface (such as snow, burns and harvest), ocean (such as ocean color, including algal blooms and sediment plumes, and sea surface temperature), and non-meteorological characteristics of the atmosphere (such as aerosol, including smoke and dust events, ozone and potentially air quality).

Even further enhancements in observation capability can potentially come from applications that use data from both the advanced GEO and LEO sensors together, by exploiting their complementarity. Possibilities include merging the finer spatial resolution of the LEOs with the fine temporal resolution of the GEOs, or exploiting the availability of simultaneous observations with different view or illumination conditions, and the fusion of GEO and LEO products into global products that address sampling issues at high latitudes.

The development of meteorological applications of the advanced GEOs is well addressed by the meteorological community. The development of non-meteorological applications from the advanced GEOs, including in conjunction with LEOs, is a new area of EO application development that shows much promise but will benefit from a systematic survey of the potential applications, their benefits and capacity to meet societal needs, and their relationship to other EO applications.

Proposal

CSIRO, with support from the Australian Bureau of Meteorology, proposes a CEOS Chair's initiative, executed by an Ad-hoc Study Team for maximum flexibility, to assess the potential of these new technologies and approaches, and develop a report that identifies key issues and opportunities and propose a plan of action for consideration by CEOS. The subject of the study is non-meteorological applications, but careful consideration will be given to developing an

understanding of the work planned or underway within CGMS and on ensuring any way forward is planned in consultation with CGMS where appropriate.

The report would identify the potential non-meteorological applications of advanced GEOs, alone or in combination with LEOs, identify LEO applications that may serve as a basis for GEO application development, identify the benefits of applications, identify where the applications satisfy unmet requirements and fill data gaps, and identify opportunities for agency collaboration on application development. The report would make recommendations to promote the coordinated development, implementation and evaluation of non-meteorological applications by CEOS agencies, and recommendations for CEOS engagement with external stakeholders such as meteorological agencies and organisations.

It is suggested that the Study Team is co-led by volunteers from space agencies developing non-meteorological applications and space agencies that operate advanced GEO imagers, and include participants from a range of other CEOS Entities. An Ad-hoc Study Team is an appropriate mechanism for this CEOS Chair's initiative since:

- 1) The scope of the work is well defined and time-limited;
- 2) The nature of the topic is cross-cutting, and may require input from:
 - a. the Virtual Constellations (from the application technical perspective), in particular LSI-VC, OCR-VC, ACC-VC and SST-VC;
 - b. the Working Groups, in particular WGClimate and WGDisasters (from the perspective of requirements and application prioritisation), and WGCV (from the perspective of data consistency and compatibility);
 - c. Thematic groups (eg WSIST) as representatives of user groups whose activities could be enhanced by better applications.

The outcomes envisioned for the study are:

- 1) Identification of future mission and instrument plans of relevance to understand the scope and scale of the topic,
- 2) An inventory of relevant non-met algorithm and application initiatives and plans being undertaken by CEOS and related agencies. this can build on the Japan-Australia bilateral effort initiated in 2015 (see www.geoapplications.org) and consider whether further algorithms are required.
- 3) Assessment and prioritisation of the various applications and algorithms for coordination through CEOS.
- 4) A report on lessons from the early collaboration on algorithms resulting from the Japan-Australia bilateral efforts.
- 5) Identification of the key issues and opportunities, including in the specification of requirements for relevant future missions and instruments, and the implications for the production of ECVs in response to GCOS requirements.
- 6) Recommendations for the way forward for CEOS and its agencies.

Alignment with CEOS Strategic Goals

This initiative would support the following goals in the CEOS Strategic Guidance:

- **Close important observational gaps** – Opportunities for new measurements that are impossible or less capable from LEO alone.
- **Achieve better integration across the full range of Earth observations** – Exploit synergies in the EO satellite fleet, and increase coordination of meteorological and non-meteorological EO.

This initiative has the potential to contribute to the following CEOS Outcomes 2015-2017:

- **Climate Monitoring, Research, and Services** – Potentially develop new measurement strategies to enhance monitoring of CDRs and ECVs.
- **Observations for Agriculture** – Satellite derived products to support improved management of agricultural resources.

- **Observations for Water** – Land surface temperature from GEO satellites to map evapotranspiration in near-real-time.
- **Observations for Disasters** – Mapping natural hazards such as bush fires or spatial extent of flooding (standing water).

This initiative would support CEOS themes:

- **Blue Planet:** Focus on near-shore observations and effective use of current and future EO platforms and data-services to serve end-users.
- **CEOS engagement with the UN system** – through engagement with WMO.
- **CEOS-CGMS-GCOS coordination in support of UNFCCC** – Engagement with WMO's GCOS will support CEOS in its aim to promote the effective partnership between space agencies and GCOS in providing a structured and monitored response to the need for systematic observations.

This initiative aligns directly with the following from CEOS Strategic Guidance:

- **Opportunity: Identify Gaps and Promote Complementarity**–With this initiative CEOS would take the lead in identifying data gaps that can be filled with the new capability of advanced GEOs, as well as in systematically documenting the complementarity of GEO and LEO non-meteorological applications.
- **Strategic Direction: Optimize the Societal Benefit of Space-based Earth Observation**–This initiative will provide CEOS with opportunities to communicate its contributions for global societal benefit in meteorological forums such as WMO (a UN forum) and other global forums such as those coordinating observation networks including GEOSS, GCOS, etc.
- **Strategic Direction: Remain the Focal Point for International Coordination of Space-based Earth Observations**– This initiative supports CEOS in continuing in its role as the unique international forum coordinating the full spectrum of civil space-based Earth observing systems, particularly as meteorological agencies expand their scope to environmental regimes beyond meteorology. It aligns with the CEOS commitment to foster new measurement capabilities, innovative and integrated approaches to satellite data, and mission coordination for the global community.

Benefit to Internal & External Stakeholders

The initiative is of value both to CEOS agencies as data providers and to existing and prospective users of EO satellite data. Many CEOS agencies operate GEOs for meteorological applications and LEOs for non-met applications, or both. Agencies can get a better return on their existing substantial investments in GEO and LEO infrastructure and applications, by applying their infrastructure and expertise to non-meteorological GEO applications. This will strengthen the science and environmental monitoring that is the aim of their LEO programmes, and thereby deliver increased benefits to society. In implementing these new applications, agencies will further benefit from efficiencies and product improvements from collaboration and intercomparisons with other agencies.

This initiative will promote the alignment and engagement of CEOS agencies with meteorological agencies and the WMO. WMO's 'Vision of WIGOS 2040' plan recognises that emerging user requirements will drive meteorological agencies to broaden their range of environmental intelligence services. These agencies would receive and perceive increased benefit from Earth Observation with the development of new non-meteorological GEO applications, many of which will eventually be produced operationally within meteorological agencies. This will broaden the reliance on satellite Earth observation and support for its continuance, as well as spreading the benefits to broader sectors of society.

The roadmap to new applications that this initiative would produce also would be a valued contribution to GEO.

CEOS initiatives in areas such as disasters and forest monitoring have identified that the obstacles to uptake of EO satellite data are not always technical. User and intermediary awareness, understanding and capacity to exploit data are just as significant. The proposed studies should include substantial engagement with external stakeholders, including typical user groups, UN agencies, financing bodies such as World Bank, to ensure their perspective is fully understood and reflected as we plot the way forward. These bodies are where we hope the benefits will ultimately be realised and they should be engaged early and fully.

Feasibility & Affordability

The work proposed will draw on existing expertise in application development within the CEOS agencies. In particular, LEO technical teams are often engaged with development for the advanced GEOs. Notably the NOAA effort on GOES-R algorithms, by science teams that have developed expertise on LEO, is being applied to Himawari-8 through established collaborations with JMA and BoM.

Japan and Australia plan to initiate a bilateral study team under APRSAF and CSIRO proposes to broaden this to include all interested CEOS (and APRSAF) agencies as an initiative in 2016. Data and archive system challenges will be part of the remit and there will be links to the Future Data Architectures study that CSIRO is also proposing.

Engagement with the meteorological community can leverage the existing coordination mechanisms of that community (CGMS, APSDEU-NAEDEX, AOMSUC, the Rolling Review of Requirements) and relationships with CEOS.

Expected Duration

The initial activity period is for 1 year – the duration of the CSIRO CEOS Chairmanship, with a decision on the way forward, as appropriate, at the 2016 CEOS Plenary.

Next Steps

As required by the New Initiatives Process Paper, CSIRO has provided this paper for a decision at CEOS Plenary, after extensive outreach and consultation with relevant CEOS groups, including CEOS SEC and at the SIT Technical Workshop. The incoming CEOS Chair encourages active participation in the Study by the relevant CEOS groups and agencies and urges Principals to approve the establishment of the proposed Ad-hoc Study Team at the Kyoto Plenary.