

# CEOS Analysis Ready Data Strategy 2021

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## Outline

CEOS ARD Strategy 2021 (the Strategy) provides direction for the next stage of CEOS activity on ARD. The focus for the Strategy is to ensure that CEOS data is as impactful as possible, and that such impact is sustained, including via an increased scope of the CEOS ARD concept beyond the land domain.

Leadership, governance and accessibility and utilisation of CEOS ARD emerge as pillars of the strategy, building on the success of CEOS Analysis Ready Data Strategy v1.0, which was presented at the 2019 CEOS Plenary and has given direction and focus to CEOS Analysis Ready Data (ARD) for the last two years.

## Background

CEOS ensures international coordination of civil space-based Earth observation programs and promotes exchange of data to optimize societal benefit and inform decision making for securing a prosperous and sustainable future for humankind.

The rapidly evolving domain of information technology has led to greatly enhanced computational capability and much increased expectations of a broadened user community familiar with Big Data systems and the benefits of cloud storage and computing, machine learning, and artificial intelligence. Satellite data is now just one of many sources of information available to results-driven users and data hungry, automated systems.

Additionally, Earth observation missions are no longer the sole domain of government programs and space agencies. Miniaturization, standardization and innovation have led to significant new Earth observation and data access capabilities in the commercial 'Space 2.0' sector. This new presence poses a challenge for CEOS Agencies to identify and communicate the distinct role for government-funded missions and to strategically shape the EO landscape to include and leverage the rapidly emerging capabilities of the commercial sector.

Earth observation data from CEOS Agencies have several distinctive characteristics which ensure their ongoing relevance. Those features include:

- Highly superior platforms and instrumentation, allowing accuracy of observations that are not possible with systems that are developed with orders of magnitude less cost;
- Robust calibration and validation;
- Long-term data records and measurement continuity;
- Their potential to be free and open for all of society, allowing benefits to be delivered over many end users;
- The authority of trusted and respected government agencies.

For these benefits to continue to be realised however requires that agencies adapt their methods of operation to ensure that data is easy to access – preferably in locations already favoured by the established IT and user community – and ready to use with minimal additional processing.

One of the measures proposed to support the objective of simplified data handling was the pursuit of CEOS Analysis Ready Data (ARD) – which involves data suppliers removing many of the fundamental data correction and processing tasks from the users, so that more users and more uses of the data are possible.

## CEOS Analysis Ready Data Strategy v1.0 – Key Outcomes

There was great progress on the development of Product Family Specifications (PFS) over the past two years. The current collection of CEOS ARD for Land PFS has continued to grow, and now includes:

- Surface Reflectance
- Surface Temperature
- Normalised Radar Backscatter
- Polarimetric Radar

Each of which have continued to evolve and progress to meet needs and address feedback from the community.

In addition, the portfolio of CARD4L PFS is expected to grow substantially, with the following PFS at varying stages of completion:

- Aquatic Reflectance
- Nighttime Lights Surface Radiance
- Geocoded Single-Look Complex (GSLC, SAR)
- Interferometric Radar (INSAR, SAR)
- LiDAR Terrain and Canopy Top Height

CEOS Agencies have responded positively to the availability of CARD4L PFS, with a number of assessments underway.

The proliferation of PFS, and increasing interest in PFS for new domains, stimulated development of a clear governance framework for CEOS ARD, formalising existing arrangements and broadening the framework to explicitly include domains beyond land. The CEOS Virtual Constellations have been identified as the most appropriate entities to oversee the framework.

CEOS ARD Strategy v1.0 also saw numerous outreach activities taking place to raise awareness of the CEOS ARD concept. This included representation at various community meetings and events, as well as CEOS' own online webinars.

## **CEOS ARD Strategy 2021 – Objectives**

As CEOS ARD has matured from an idea to a firm concept with deliverables and impacts, so too have the objectives evolved. Some objectives have been met, some continue, and some new objectives emerge.

### **Overarching objectives that continue from version 1.0:**

- a) Ensure continued value to users of public EO programme data and information, leveraging the availability of all relevant CEOS Agency missions to meet user needs for information;
- b) Remain flexible and adaptable to the evolving expectations of the user base, which is increasingly non-technical and more accustomed to simplicity in geospatial data sourcing, integration and application; thus to support the mainstreaming of EO data in society through removal of user burden and data complexity;
- c) Engage and collaborate with the three key stakeholder groups: EO data providers (both public and private); Big Data hosts and aggregators who stage increasing amounts of CEOS Agency free and open data; and data users;
- d) Establish a broad understanding of, and participation in, CEOS' efforts to define, produce, apply, and promote ARD in support of societal needs.

### **Emerging, new objectives to be supported by the Strategy:**

- e) Continued oversight and maintenance of CEOS ARD ensuring that CEOS' ARD work continues to be coordinated and guided by an appropriate governance framework.
- f) Ensure the suitability of CEOS ARD for the machine-to-machine processes employed for the application of remote sensing data and propose changes as necessary to the CEOS ARD Framework, definition or specifications to ensure continued relevance and utility of CEOS ARD.
- g) Continued evolution of the concept of CEOS ARD, where necessary and appropriate.

- h) Continue investigating further opportunities for the CEOS ARD concept to streamline user uptake of satellite Earth observation data, including new thematic domains and applications.

## Strategy Pillars

The headline focus for CEOS Analysis Ready Data Strategy 2021 is the *accessibility and utilisation of CEOS ARD*. To achieve this the forward strategy is based on three pillars: Visible Leadership; Governance and Support; Accessibility and User Needs.

### Visible Leadership

- Leadership of the EO ARD concept
  - Participation in key forums, conferences, webinars, etc.
  - Engagement with the wider community including the private sector, GEO, etc.
- Visibility of CEOS ARD
  - CEOS Agency products
  - [Website](#)

### Governance, Monitoring and Evaluation

- Coordination CEOS ARD efforts
- Maintenance of specifications and advisory notes
- Reporting of CEOS ARD production
- Assessing the demand for, and benefits of, CEOS ARD

### Accessibility and Utilisation

- Interoperability
- Discoverability
- Open license
- Technical advisory notes
- Web/Cloud accessibility
- Sustained access – global archives

## CEOS ARD Strategy 2021 – Activities

The following activities are seen as necessary to achieve the objectives listed above, and the overall theme of increasing accessibility and utilisation of CEOS ARD:

Activity	Description
<b>1. Visible Leadership</b> <i>Continued visible CEOS leadership within the Earth observation community of the concept of analysis-ready data, and its implementation as exemplified by CEOS ARD data flows.</i>	
<b>1.1: CEOS web and other outreach efforts</b>	<ul style="list-style-type: none"> <li>● Maintain and expand <a href="http://ceos.org/ard">ceos.org/ard</a></li> <li>● Increased social media presence.</li> </ul>
<b>1.2: CEOS ARD Webinars</b>	<ul style="list-style-type: none"> <li>● Continue the webinar series.</li> </ul>
<b>1.3: Increase involvement of those outside CEOS (including the private sector) in the development</b>	<ul style="list-style-type: none"> <li>● Through the VCs and WGs.</li> <li>● Increasing involvement increases likelihood of uptake by others.</li> <li>● Increased relevance and convergence.</li> </ul>

<b>and refinement of the CEOS ARD concept and PFS</b>	
<b>1.4: Integrate CEOS ARD in early mission planning phases – with a view to having CEOS ARD as a standard product type</b>	<ul style="list-style-type: none"> <li>Having agencies produce CEOS ARD directly is the ideal scenario (reduces duplication and necessary external effort; maximises potential impact).</li> </ul>
<b>1.5: Participation in community activities</b>	<ul style="list-style-type: none"> <li>Examples include: VH-RODA, JACIE, and ARD2x.</li> </ul>
<b>2. Governance and Support</b> <i>The implementation and further maturation of CEOS internal governance structures supporting CEOS ARD, including monitoring progress and where possible gathering evidence of demand and impact.</i>	
<b>2.1: Establish and maintain a strong CEOS ARD Oversight Group</b>	<ul style="list-style-type: none"> <li>Maintain the CEOS ARD Governance Framework.</li> <li>Serve as a forum for VCs and others to coordinate and collaborate, particularly with a vision toward increased commonality and interoperability across the land, oceans, and atmosphere domains.</li> <li>Oversee PFS collection (VCs will be responsible for the individual PFS).</li> <li>Future CEOS ARD Strategy development.</li> </ul>
<b>2.2: Sufficiently resource VC representatives to undertake CEOS ARD work, as detailed in the Governance Framework</b>	<ul style="list-style-type: none"> <li>Continued PFS development, including new thematic domains/applications.</li> </ul>
<b>2.3: Sufficiently resource the WGCV peer review group to ensure timely CEOS ARD assessments</b>	<ul style="list-style-type: none"> <li>Burden has been cut down significantly by recent streamlining.</li> </ul>
<b>2.4: Continue to optimise processes around CEOS ARD</b>	<ul style="list-style-type: none"> <li>Appropriate streamlining to maintain rigour whilst ensuring that processes can be supported in practice and that turn-around times are acceptable.</li> </ul>
<b>3. Accessibility and User Needs</b> <i>Activities that continue to progress the practical accessibility and utility of CEOS ARD, including in anticipation of machine-to-machine operations, and also to ensure continued accessibility of data through work with user-facing communities such as GEO.</i>	
<b>Accessibility</b>	
<b>3.1: Increase visibility of and access to CEOS ARD datasets via a comprehensive inventory / catalogue</b>	<ul style="list-style-type: none"> <li>This is both a promotional and technical task.</li> <li>A <a href="#">comprehensive inventory and catalogue</a> (with access capability) of all CEOS ARD.</li> <li>Including linkages with the <a href="#">CEOS MIM Database</a>.</li> </ul>
<b>3.2: Ensure maximum machine-to-machine compatibility of CEOS ARD</b>	<ul style="list-style-type: none"> <li>Machine-to-machine is the future, not individual downloads and processing.</li> <li>Critical to success of CEOS ARD data and concept.</li> <li>Continued strong WGISS relationship.</li> </ul>

<b>3.3: Advisory Notes</b>	<ul style="list-style-type: none"> <li>● Provide additional technical guidance to the user community without compromising the nature of CEOS ARD, e.g., on STAC, COGs, HDF5/netCDF, Zarr.</li> </ul>
<b>3.4: Increase efficiency in the distribution of CEOS ARD across data platforms / the cloud</b>	<ul style="list-style-type: none"> <li>● Increased efficiency if agency driven, rather than relying on third parties.</li> <li>● Reduce duplication.</li> <li>● Ensure consistency and accuracy.</li> <li>● Inventory comprehensively.</li> <li>● Increase connections with cloud data and platform providers.</li> <li>● Minimise duplication of effort by dealing with data aggregators and platforms.</li> </ul>
<b>User Needs</b>	
<b>3.5: Increase understanding of user needs and value of CEOS ARD</b>	<ul style="list-style-type: none"> <li>● CEOS R&amp;D / demonstrator activities and thematic community connections.</li> <li>● Where possible consider integrating CEOS ARD into R&amp;D / demonstrator / pilot activities of CEOS (e.g., as done by COAST).</li> <li>● Direct feedback on CEOS ARD specifications.</li> <li>● Surveying of community needs for ARD.</li> <li>● Engagement in community events.</li> </ul>
<b>3.6: Capture the value and benefits of CEOS ARD</b>	<ul style="list-style-type: none"> <li>● Leverage studies conducted by CEOS agencies and partners including GEO, Digital Earth Africa and others to communicate the value of CEOS ARD.</li> </ul>
<b>3.7: Explore further evolution of the concept of CEOS ARD</b>	<ul style="list-style-type: none"> <li>● CEOS ARD is a point on the interoperability spectrum and the strategy should reflect from time to time on the evolution of interoperability techniques and technical readiness.</li> </ul>