Committee on Earth Observation Satellites

2026-2031 CEOS-ARD Strategy

Earth Observation for Everyone



Authored by the CEOS-ARD Oversight Group

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For the 2026 CEOS Plenary

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1: Background

The CEOS-ARD Oversight Group is tasked with maintaining a high-level strategy for CEOS-ARD development. In 2025, CEOS undertook a community engagement campaign to connect with satellite data producers and users – particularly those outside of CEOS – to help us understand exactly how CEOS-ARD needs to evolve.

The overarching questions posed to the community were:

- *What are the opportunities to make CEOS-ARD better?*
- *How can we make CEOS-ARD more effective and impactful?*

The CEOS-ARD team compiled its findings into a consultation paper and was subsequently tasked by the 2025 CEOS Plenary to produce an updated CEOS-ARD Strategy for 2026.

Guiding principles in developing the 2026 CEOS-ARD Strategy are:

- "Earth Observation for Everyone"
- Enabling users to address their questions significantly faster.

Overall, CEOS-ARD will be effective and impactful when it is trusted, interoperable, scalable, and indispensable — supporting science discovery and applications, operations, markets, and Artificial/Super Intelligence with clear evidence of fitness, quality, and impact.

2: Future of CEOS-ARD Themes

The 2025 Future of CEOS-ARD concept note identified 14 priority themes for further development:

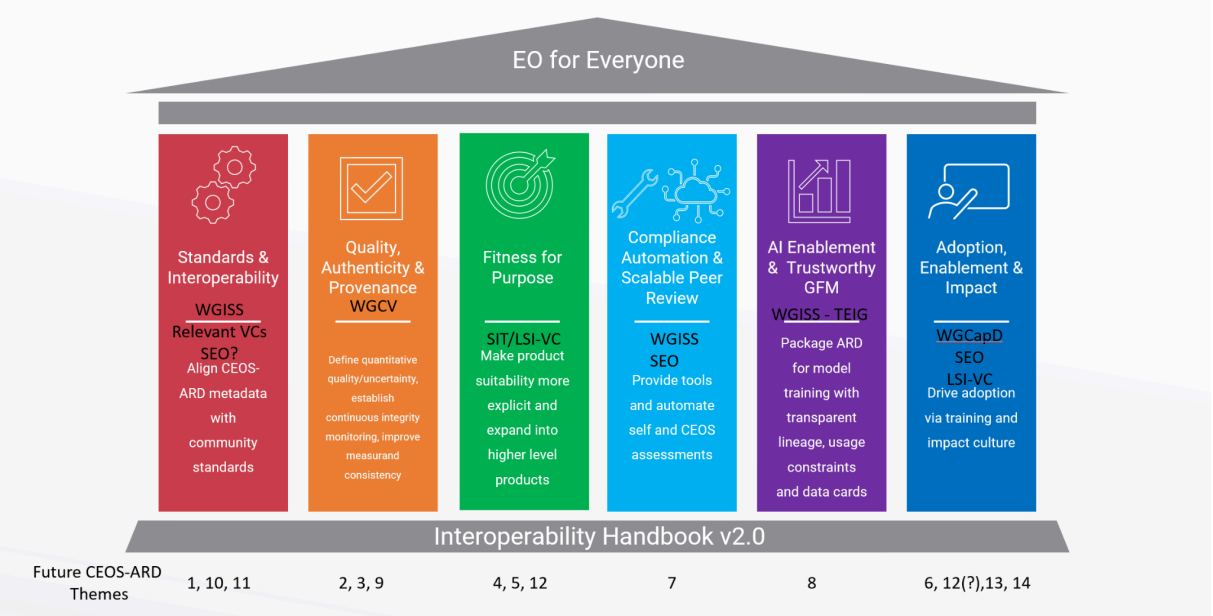
1. Consistent and Enhanced Metadata Specifications
2. Data and Metadata Quality
3. Ongoing Quality Assurance and Integrity Monitoring
4. Fitness for Purpose
5. Increased Support to Scientific Applications and Environmental Adaptation and Resilience
6. Solidifying the Business Case and Increasing Commercial Relevance
7. Tools to Aid Compliance Assessments and Peer Reviews
8. Supporting Opportunities and Reducing Risks Related to Artificial/Super Intelligence
9. Measurand Consistency and Algorithm / Application Resilience
10. Alignment with the Software Ecosystem
11. Analysis Ready Data Standards
12. Thematic and Higher level CEOS-ARD Products
13. Training and Outreach
14. Capturing Use and Impact

3: Strategic Pillars

In order for CEOS-ARD to be more impactful and broadly adopted, we propose future work be categorised under six strategic pillars as follows:

1. Standards and Interoperability where CEOS-ARD datasets work seamlessly across mainstream geospatial tools and platforms.
2. Quality, Authenticity & Provenance where trust in the CEOS-ARD label is based on evidence.
3. Fitness for Purpose where all users of Earth observation select CEOS-ARD products with confidence.
4. Compliance Automation & Scalable Peer Review where CEOS-ARD can scale while maintaining rigour and integrity.
5. Artificial/Super Intelligence Enablement & Trustworthy Geospatial Foundation Models (GFM) where CEOS-ARD is referenced as a trusted and high-quality baseline for Artificial/Super Intelligence research and operational deployment.
6. Adoption, Enablement & Impact where CEOS-ARD success is measured by use and impact.

These pillars encompass the 14 themes from the 2025 concept note. The Strategy is underpinned by the principles of the [CEOS Interoperability Handbook 2.0], which was endorsed by CEOS in 2025. Each pillar is described in detail in the following sections.



CEOS-ARD will manage the competing demands of increased evidence requirements and lower assessment burden through tiered maturity levels. Requirements will be introduced only where they provide demonstrable value for interoperability, quality, fitness for purpose, or user trust.

1: Standards and Interoperability

Foundation. Focus on ensuring CEOS-ARD metadata and data structures are interoperable across existing global standards.

Success Criteria:

- CEOS-ARD metadata is consistently implemented across all Product Family Specifications (PFS), with a STAC-first, machine-readable and human-interpretable specification supported by OGC/ISO crosswalks.
- CEOS-ARD data and metadata are natively understood by mainstream software tools (e.g., GDAL, QGIS, ArcGIS, cloud catalogues) without custom adapters.
- CEOS-ARD is recognised as the *de facto* global community standard for satellite Analysis Ready Data, with a clear, endorsed roadmap toward formal standardisation.
- Agencies, commercial providers, and distributors treat CEOS-ARD requirements as default interoperability baselines, not bespoke CEOS artifacts.
- PFS are machine-interpretable, composed from reusable building blocks which are supported by registers making them discoverable, traceable, and trustworthy.

Outcome Signal: CEOS-ARD datasets work seamlessly across mainstream geospatial tools and cloud-based processing environments. This means:

- CEOS-ARD metadata and data work out-of-the-box in mainstream tools and cloud workflows.
- Users don't need custom scripts or manual schema mappings to use CEOS-ARD.
- CEOS-ARD is seen as ready-to-use.

2: Quality, Authenticity & Provenance

Trust. Addresses the need for measurable, transparent, and continuously verifiable data quality.

Success Criteria:

- CEOS-ARD products are accompanied by quantitative, consistent, and comparable quality and uncertainty information, not just descriptive compliance statements.
- Ongoing integrity monitoring and reporting is routine, enabling early detection of degradation or loss of compliance. *Note: Integrity means continuous, verifiable*

confidence that CEOS-ARD data remains accurate, consistent, authentic, and traceable across its entire lifecycle.

- Provenance, authenticity, versioning, and lineage of data are machine-readable and human-interpretable, and traceable across all mirrors, cloud platforms, and reprocessing cycles.
- If a user is building a time series or multi-mission analysis, they can swap or mix CEOS-ARD products with no hidden biases or artifacts being introduced.
- The CEOS-ARD label guarantees harmonized measurands, within specified uncertainties (note: not homogenised).
- CEOS-ARD PFS for higher-level product families are based on requirements from and ensure consistency with, the appropriate WGCV Subgroup validation protocols or other community-agreed validation protocols.

Outcome signal: Trust in CEOS-ARD is evidence-based.

3: Fitness for Purpose

Utility. CEOS-ARD products are clearly classified for their suitability across different applications, supporting both non-expert and expert users.

Success Criteria:

- Users can clearly identify what each CEOS-ARD product is fit for, including limitations, uncertainty bounds, and appropriate application types.
- CEOS-ARD supports long-term, stable, bias-aware data records suitable for long-term scientific applications.
- Fitness-for-purpose distinctions help non-expert users avoid misuse, while giving providers clear pathways to improve product maturity.
- CEOS-ARD products are increasingly cited as authoritative inputs to global frameworks, indicators, and assessments.

Outcome Signal: Users can select CEOS-ARD products with confidence.

4: Compliance Automation & Scalable Peer Review

Scale. Reducing the burden of compliance assessments for data providers and assessors, enabling CEOS-ARD to scale across a growing number of providers.

Success Criteria:

- CEOS-ARD assessments are largely automated, repeatable, continuous, and embedded in provider pipelines.
- Peer review scales sustainably without relying on manual document checks.

- Providers experience lower effort and faster turnaround for CEOS-ARD endorsement.
- CEOS-ARD governance shifts from gatekeeping to continuous assurance.
- Contribute to commercial ecosystem enhancement by enabling independent third parties to undertake compliance assessments.

Outcome Signal: CEOS-ARD can scale to many more providers without slowing down and third parties emerge to provide commercial compliance services.

5: Artificial/Super Intelligence Enablement & Trustworthy GFM

Utility. Position CEOS-ARD as the gold standard reference for Artificial/Super Intelligence applications, including Geospatial Foundation Models (GFMs).

Success Criteria:

- CEOS-ARD products are widely used as trusted training and benchmarking data for geospatial Artificial/Super Intelligence (including foundational models).
- CEOS-ARD defines product specifications for GFM-derived products, including embeddings, ensuring they carry the same quality and provenance guarantees as the source data.
- Artificial/Super Intelligence users understand dataset limitations through clear provenance, uncertainty information, and data cards[1].
- CEOS-ARD helps reduce Artificial/Super Intelligence risk, by discouraging use of poorly characterised data in high-impact applications.
- CEOS agencies are recognised as stewards of high-quality training data.

Outcome Signal: CEOS-ARD is referenced as a quality baseline in Artificial/Super Intelligence research and operational deployment.

6: Adoption, Enablement & Impact

Impact. Maximize CEOS-ARD adoption across public procurement, commercial markets, and end-user communities.

Success Criteria:

- CEOS-ARD is routinely referenced in procurement, funding calls, and operational requirements as a baseline expectation.
- CEOS-ARD is recognised as community-driven, being co-developed by CEOS and the broader community.

[1] A data card is a transparency artifact that documents key facts and explanations about a dataset. It captures not just metadata, but also the *context*, *rationales*, and *human decisions* that shaped the dataset throughout its lifecycle. (The Data Cards Playbook - Data Cards Playbook)

- Derivative and thematic CEOS-ARD products directly support priority user communities (e.g., agriculture, biodiversity, disasters).
- Commercial providers see CEOS-ARD endorsement as a market differentiator, not a compliance burden.
- Training, outreach, and documented case studies clearly demonstrate real-world impact and return on investment.
- Growing number of CEOS-ARD compliant datasets and a growing annual volume of CEOS-ARD compliant datasets across common 'data distributor' platforms based on a 2026 baseline.

Outcome Signal: CEOS-ARD success is measured by use and impact including through increased citations in the scientific and general literature.

4: Development Pathway

A series of initiatives and tasks have been identified to achieve the success criteria and outcome signals for each of the pillars. These are detailed in Section 6 and broadly fit into three time horizons:

Horizon 1 (2027-2028): Foundations and Pathfinders

Horizon 1 Initiatives seek to build the foundations of an evolved CEOS-ARD, including activities that will increase trust across the community. Key outcomes for Horizon 1 are improved technical foundations such as common, machine-readable metadata requirements, improved governance to ensure scalability, and streamlined assessment capabilities. Horizon 1 will establish the technical and governance foundations and also deliver a small number of operational end-to-end workflows.

Standards and Interoperability pillar tasks will focus heavily on ensuring consistency between CEOS-ARD specifications and other geospatial community frameworks like those under OGC/ISO. Discoverability and accessibility of CEOS-ARD datasets will also be enhanced through adoption of WGISS principles and metadata specifications aligned with STAC and OGC/ISO standards. Engagement with the standards community will continue, with a formal roadmap developed to guide CEOS-ARD from a community-driven framework to an internationally recognized standard, reassuring stakeholders of its stability and longevity.

Steps will be taken to increase trust in CEOS-ARD by integrating quality, authenticity and provenance metrics into the framework, leveraging WGCV's extensive cal/val networks and best practices. The Joint ESA-NASA-USGS Quality Assessment Framework will be

adopted as criteria for CEOS-ARD assessments, alongside other recommendations from the CEOS Interoperability Handbook Quality Factor.

The broader user community will be engaged to co-develop fitness for purpose metrics, as well as use cases and impact studies that demonstrate the value of CEOS-ARD.

Horizon 2 (2029-2030): Scaling and Integration

Tasks focus on scaling CEOS-ARD and further integrating it into the broader geospatial community. Key outcomes for the second Horizon are scalable implementation, improved interoperability, enhanced provenance information, and evolved tools and interconnected catalogues of datasets. Horizon 2 will also extend successful pathfinders across providers, product families and user communities, supported by increasingly automated assessment and monitoring.

Compliance automation and scalable peer review are essential to support data providers and avoid bottlenecks associated with manual assessments. CEOS tools and frameworks will be enhanced such that they can underpin both scalable compliance assessments and continuous quality and integrity monitoring.

Work will continue on fitness for purpose metrics, ensuring users can identify CEOS-ARD products that are right for their needs. Assessments and product characterisation will be refined, to allow categorisation based on uncertainty and performance metrics. Support for thematic, higher-level products will also be enhanced, for use cases such as agriculture, land degradation and wildfires.

Horizon 3 (2031+): Operationalisation and Mainstream Adoption

Tasks focus on operationalisation of CEOS-ARD, including formal adoption as a community standard and integration into operational workflows. Following Horizon 3, CEOS-ARD will be an internationally recognised, procurement-relevant ecosystem and standard, with a high level of trust ensured by a robust quality assessment framework and continuous integrity monitoring.

Horizon 3 will also see the more complete enablement of Artificial/Super Intelligence and development of trustworthy geospatial foundation models (GFMs). Improved formats and data packaging will be developed to support Artificial/Super Intelligence, and benchmark tasks and evaluation protocols will be published to guide Artificial/Super Intelligence developers and ensure robust performance.

CEOS-ARD will be promoted as a procurement baseline to eliminate duplication of assessment effort and reduce risk for agencies and vendors. CEOS-ARD training and outreach programs will continue, supported by multilingual documentation and other materials, to build capacity and awareness globally.

5: Work Themes

Each of the six pillars of the CEOS-ARD Strategy are broken down into common work themes, detailed below.

Pillar 1: Standards and Interoperability

Alignment with broader geospatial standards and conventions: CEOS-ARD is an amalgamation of various concepts across areas like metadata, pre-processing, data quality, interoperability, etc. In recognition of the fact that we are not operating in isolation, and build upon work that has come before, ensuring complete alignment of CEOS-ARD and existing standards and conventions will increase adoption and provide leverage opportunities.

This work theme covers tasks such as the development of CEOS-ARD metadata specifications aligned with STAC and OGC/ISO standards, a community profile that maps CEOS-ARD to existing ISO and other standards, and a CEOS-ARD STAC Extension v2.0.

Robust and consistent specifications and framework: CEOS-ARD has evolved in an *ad hoc* fashion since its inception. In order to scale and enable community adoption, the Framework needs to be internally consistent and robust.

This work theme includes efforts to resolve issues and fill gaps in the current specifications, and harmonising requirements across domains. A CEOS-ARD UML (Unified Modeling Language) diagram will be developed to aid standards development, and terminology used in the CEOS-ARD Specifications will be harmonised with the CEOS EO Glossary. A clear hierarchy/typology for CEOS-ARD specifications will also be developed. The CEOS-ARD building block paradigm will be progressed and tools developed to ease specification development and ensure ongoing consistency.

A strategy will also be agreed for addressing the emergence of concepts such as 'decision ready data', linking these to the CEOS Data Value Chain and processing level harmonisation activities.

Discoverability and accessibility: If data is not able to be found or used, it is inherently not 'analysis-ready'. This work theme recognises that CEOS-ARD must connect with existing infrastructure and systems to enable discovery and accessibility by users.

This work theme focuses on the establishment of a resolvable keyword Uniform Resource Identifier (URI) mechanism to enable keyword discovery and WGISS

Connected Data Asset (IDN/FedEO) endpoints for CEOS-ARD products. Goals for this work theme are the development of a new, dynamic, interconnected catalogue of CEOS-ARD datasets for ceos.org/ard built off the WGISS CDA end points and development of cross linkages to other CEOS assets like the CEOS MIM Database.

Pillar 2: Quality, Authenticity & Provenance

Continuous integrity monitoring: CEOS-ARD Specifications include requirements and metrics intended to build trust in products, such as those related to data quality and uncertainty. However, to date, compliance assessments are just a snapshot in time. Trust in products will be enhanced by continuously assessing them against trusted reference measurements.

This work theme covers both the integration of internationally recognised CEOS WGCV assets and cal/val networks into the CEOS-ARD Framework, and in Horizon 3 automated monitoring pipelines and dashboards will be implemented, where possible, to continuously assess CEOS-ARD compliance and data quality, replacing periodic or one-off assessments.

Consistency and downstream quality: Provenance and lineage requirements will be developed to capture version history and chain-of-custody information to build trust and reproducibility for CEOS-ARD datasets. Findings from WGCV studies will be implemented with a view to increasing harmonisation and the potential for homogenisation.

Quality assessment frameworks: Recognising that extensive work has already been done in the frame of CEOS and beyond regarding data quality, we seek to avoid reinventing the wheel and instead directly leverage the substantial work of WGCV and others and build these into the CEOS-ARD Framework.

Under this work theme, all products will eventually be required (at the Threshold level) to include documented uncertainty statements and evidence supporting quality claims, following QA4EO principles, and the Joint ESA-NASA-USGS Quality Assessment Framework will be adopted as core criteria for CEOS-ARD. These frameworks and requirements will provide the basis for ongoing quality and consistency monitoring of CEOS-ARD.

Pillar 3: Fitness for Purpose

Refined assessments and product characterisation: The binary Threshold and Goal model for CEOS-ARD assessments will be reconsidered to provide a more detailed view of product fitness for purpose and relative performance. As an interim measure, partial Goal compliance assessments will be reintroduced, followed by the development of a maturity matrix grading approach, with intermediate levels of compliance. Classifications of quality/fitness for purpose of CEOS-ARD products will be implemented to allow categorisation based on common use cases, uncertainty ranges, and performance metrics.

User guidance and suitability assessment: A CEOS-ARD Product Selection Framework and fitness for purpose profiles will be developed, allowing users to determine which CEOS-ARD datasets are suitable for their specific use cases. This will include development of application-specific guidance to help users select appropriate CEOS-ARD datasets.

Pillar 4: Compliance Automation & Scalable Peer Review

Improved product assessments and supporting tools: Broader adoption of CEOS-ARD requires a compliance process that scales and supports data providers. The CEOS-ARD Strategy will seek to streamline the process through the development of new tools and software, with a view towards more complete automation in the later Horizons. Maintaining the rigour of assessments is paramount.

Automated validation tools will be developed to check metadata and technical compliance against CEOS-ARD specifications, and compliance-as-code, online self-assessment, and other peer review workflows will be implemented to improve efficiency and transparency.

Data provider support: Clear guidance, templates, and examples will be published that support data providers in meeting requirements.

Pillar 5: Artificial/Super Intelligence Enablement & Trustworthy GFM

Artificial/Super Intelligence community engagement and support: The first step to Artificial/Super Intelligence enablement is to engage with research communities and platform providers to promote adoption of CEOS-ARD and understand best practices/requirements. Following this, in Horizon 3, benchmark tasks and evaluation protocols will be published to guide Artificial/Super Intelligence developers and ensure robust performance.

Artificial/Super Intelligence support via improved formats and data packaging: To ensure CEOS-ARD is Artificial/Super Intelligence ready, a number of enhancements to the CEOS-ARD specifications will be made. These include requirements for chunkable, cloud-optimized formats, improved traceability and versioning, and guidance on packaging CEOS-ARD datasets for Artificial/Super Intelligence model training. Such guidance may include considerations for consistent tiling schemes, training/validation/test dataset splits, and licensing clarity where appropriate. Additional recommendations will include the use of Data Cards and Model Cards to improve transparency, reproducibility, and usability of Artificial/Super Intelligence datasets and models.

Pillar 6: Adoption, Enablement & Impact

Supporting the commercial sector: While there has been strong reception from the private sector, specific hurdles to full adoption remain. Constraints unique to the commercial sector include the inability to disclose proprietary information, as well as issues related to very high resolution data. In the near term, tasks will seek to resolve these specific issues, as well as continue to build and document the business case.

Demonstrating value: Case studies and impact metrics will be documented, alongside the development of communications materials, to solidify the value proposition of CEOS-ARD.

Meeting thematic and higher level needs: The CEOS-ARD Framework will be expanded to accommodate thematic and higher-level products to meet evolving user needs and demands from other CEOS entities, in areas such as biodiversity, agriculture, etc.

Data procurement: CEOS-ARD will be promoted as a procurement baseline, reducing duplication of effort and providing an open and transparent benchmark.

> **Capacity building and training**: CEOS-ARD training and outreach programs will be developed to increase capacity and awareness globally.

6: Initiatives and Tasks

The initiatives and tasks identified to achieve the success criteria and outcome signals for each of the pillars are detailed below.

ID	Work Theme	Initiative / Task	Lead Entity	Horizon
1: Standards and Interoperability				
2026-0001	Alignment with broader geospatial standards and conventions	Engage with the emerging OGC API for ordering and tasking satellite or airborne sensors (Sensor Tasking API) and ensure alignment with CEOS-ARD and future ARD standards where applicable.	WGISS, SEO	3
2026-0002	Robust and consistent ARD specifications and framework	Develop the CEOS-ARD Building Block Editor Tool for the current CEOS-ARD Framework.	CEOS SEO	1
2026-0065	Robust and consistent ARD specifications and framework	Evolution of the Building Block Editor Tool to work with future ARD standards.	CEOS SEO	2
2026-0003	Discoverability and accessibility	Implement WGISS Connected Data Asset (IDN/FedEO) endpoints for CEOS-ARD to enhance discoverability and accessibility of CEOS-ARD datasets	WGISS	1
2026-0020	Discoverability and accessibility	Establish a resolvable keyword Uniform Resource Identifier (URI) mechanism / framework for CEOS-ARD and incorporate the update of the list of CEOS-ARD URIs in the approval process for a new or updated PFS, and maintain the WGISS DAIG Guidance to Enable Discoverability of Specialised Datasets.	WGISS, SEO	1
2026-0004	Discoverability and accessibility	Develop a new, dynamic, interconnected catalogue of CEOS-ARD datasets for ceos.org/ard built off the WGISS CDA end points	WGISS, CEOS MIM Database team, CEOS-ARD	2

		and ensure cross linkages to other CEOS assets like the CEOS MIM Database.	Secretariat, SEO	
2026-0005	Alignment with broader geospatial standards and conventions	Develop CEOS-ARD metadata specifications (vNext or v2) that will align specifications with STAC and OGC/ISO standards, providing JSON and XML schemas for validation.	LSI-VC, SAR-VC, SEO, CEOS-ARD Oversight Group	1
2026-0006	Robust and consistent ARD specifications and framework	Harmonize optical specification metadata to match the maturity of SAR metadata specification, and reduce inconsistencies across product families.	CEOS-ARD Oversight Group, LSI-VC, OCR-VC, SAR-VC	1
2026-0007	Alignment with broader geospatial standards and conventions	Prepare a formal roadmap to guide CEOS-ARD from a community-driven framework to a recognized standard, reassuring stakeholders of its stability and longevity.	CEOS-ARD Oversight Group	1
2026-0011	Alignment with broader geospatial standards and conventions	Develop a community profile that maps CEOS-ARD to existing ISO and other standards.	LSI-VC	1
2026-0008	Alignment with broader geospatial standards and conventions	Publish reference implementations (of a community profile that is compliant) and conformance test suites to accelerate adoption and reduce integration friction.		3
2026-0009	Robust and consistent ARD specifications and framework	Introduce a clearer delineation of metadata, processing steps/corrections, and quality aspects in the CEOS-ARD specifications.	CEOS-ARD Oversight Group	1
2026-0010	Alignment with broader geospatial standards and conventions	Adoption of CEOS-ARD as an OGC Community Standard	CEOS-ARD Oversight Group	3
2026-0013	Robust and consistent ARD specifications and framework	Define and maintain a CEOS-ARD UML (Unified Modeling Language) diagram to aid standards development	CEOS-ARD Oversight Group	1

2026-0014	Alignment with broader geospatial standards and conventions	Create a mapping between CEOS-ARD requirements and STAC	SEO	2
2026-0015	Robust and consistent ARD specifications and framework	Achieve alignment of terminology used in the CEOS-ARD Specifications with the CEOS EO Glossary.	CEOS-ARD Oversight Group	1
2026-0016	Robust and consistent ARD specifications and framework	Define a clear hierarchy/typology for CEOS-ARD specifications, considering levels of products, sensing technology, etc.	CEOS-ARD Oversight Group, LSI-VC	1
2026-0017	Alignment with broader geospatial standards and conventions	Ensure full compliance of GDAL libraries with CEOS-ARD.		3
2026-0018	Robust and consistent ARD specifications and framework	Update the CEOS-ARD Framework to accommodate constellations and composite/mosaic products, working with WGCV to define best practices on validating products that are derived from a constellation of observing platforms (likely using per-satellite uncertainty to drive weightings). This will also have implications for the hierarchy/typology for CEOS-ARD specifications.	CEOS-ARD Oversight Group, WGCV	2
2026-0021	Robust and consistent ARD specifications and framework	Resolve inconsistent absolute geolocation accuracy requirement to facilitate the assessment of high-resolution products against the CEOS-ARD Specifications, thereby increasing relevance for the commercial sector.	LSI-VC	1
2026-0022	Discoverability and accessibility	Consider incorporating specific requirements for fully streaming capable, cloud-native formats.	CEOS-ARD Oversight Group	1
2: Quality, Authenticity & Provenance				
2026-0025	Continuous integrity monitoring	Implement requirements for passive optical CEOS-ARD sample datasets to include acquisitions over CEOS Product Validation Platform (PVP) sites and to engage with the PVP framework to enable repeatable,	CEOS-ARD Oversight Group, WGCV	1

		automated assessment against trusted reference measurements.		
2026-0026	Continuous integrity monitoring	Implement, where possible, automated monitoring pipelines and dashboards to continuously assess CEOS-ARD compliance and data quality, replacing periodic one-off assessments.	WGCV	3
2026-0027	Consistency and downstream quality	Develop provenance and lineage requirements to capture version history and chain-of-custody information to build trust and reproducibility for CEOS-ARD datasets.	WGISS	2
2026-0028	Continuous integrity monitoring	Integrate the use of a minimal set of WGCV validation platforms and cal/val networks into CEOS-ARD requirements to support quality assurance and continuous verification.	CEOS-ARD Oversight Group, WGCV	1
2026-0032	Continuous integrity monitoring	Introduce requirements for documented optical pre-flight sensor characterisation and calibration evidence of key characteristics, dependent on application, within CEOS-ARD specifications.	WGCV	2
2026-0067	Quality assessment frameworks	Adopt the Joint ESA-NASA-USGS Quality Assessment Framework as criteria for CEOS-ARD requirements across optical and SAR product families, replacing qualitative interpretation with measurable thresholds.	CEOS-ARD Oversight Group, WGCV	1
2026-0069	Quality assessment frameworks	Incorporate QA4EO principles into CEOS-ARD specifications by requiring all products to include documented uncertainty statements at the Threshold (mandatory) level and evidence supporting quality claims.	WGCV	1
2026-0070	Continuous integrity monitoring	Implement the CEOS Interoperability Handbook V2.0 Cal/Val Recommendations, including those pertaining to the mandatory traceability of measurand and uncertainty, and quality indicators to enable fitness for purpose assessments.	WGCV	1
2026-0071	Consistency and downstream quality	To increase harmonisation and the potential for homogenisation where desired, between surface reflectance CEOS-ARD, follow the WGCV Surface Reflectance Quality and Consistency Guidelines in the development of CEOS-ARD	WGCV	1

		requirements for atmospheric correction algorithms; BRDF normalisation and topographic correction; validation and uncertainty quantification; and machine learning.		
3: Fitness for Purpose				
2026-0034	Refined assessments and product characterisation	Implement classifications of quality/fitness of CEOS-ARD products to allow categorisation based on use cases, uncertainty ranges, and performance metrics derived from the EDAP and JACIE system characterization frameworks/systems (e.g., Exploratory, Research, Operational, Science)	CEOS-ARD Oversight Group	2
2026-0035	User guidance and suitability assessment	Develop application-specific guidance to help users select appropriate CEOS-ARD datasets for tasks.	CEOS Virtual Constellations and Working Groups	2
2026-0037	Refined assessments and product characterisation	Expand the binary Threshold and Goal CEOS-ARD assessment process into a maturity matrix (MM) grading approach with intermediate levels of compliance, building on the EDAP review of the CEOS-ARD Surface Reflectance PFS. Consider if compliance to the PFS could be implemented through the creation/adaptation/expansion of a MM as developed for QA.	WGCV	2
2026-0038	Refined assessments and product characterisation	Reintroduce partial Goal compliance assessments until the maturity matrix approach is implemented.	CEOS-ARD Peer Review Team under WGCV	1
2026-0039	User guidance and suitability assessment	Develop the CEOS-ARD Product Selection Framework and fitness for purpose profiles that will allow users to determine which CEOS-ARD datasets are suitable for their use cases.	CEOS-ARD Oversight Group, LSI-GEOGLAM, LSI-VC F&B/GFOI, Biodiversity VC, GEO LDN, KCEO, LSI-VC Wildfire subgroup, etc.	1

2026-0040	User guidance and suitability assessment	Develop new CEOS-ARD PFS for higher level wildfire products, such as active wildfires (based on the ST PFS as a basis) and burned area mapping (built on the SR PFS).	LSI-VC Wildfire Subgroup	2
2026-0041	Robust and consistent ARD specifications and framework	Agree a strategy for addressing the emergence of concepts such as ‘decision ready data’, 'application ready data', 'interpretation ready data', etc. and linking these to the CEOS Value Chain and processing level harmonisation activities.	CEOS-ARD Oversight Group	1
4: Compliance Automation & Scalable Peer Review				
2026-0042	Continuous integrity monitoring	Implement ongoing Artificial/Super Intelligence-assisted monitoring of CEOS-ARD product quality.		3
2026-0043	Improved product assessments and supporting tools	Develop automated validation tools to check metadata and technical compliance against CEOS-ARD specifications, configured to work with individual building blocks and referring to PFS manifests.	WGCV CEOS-ARD Peer Review Team, SEO	2
2026-0044	Improved product assessments and supporting tools	Develop compliance-as-code to allow providers to integrate checks directly into their production pipelines, ensuring continuous adherence.	WGCV CEOS-ARD Peer Review Team	2
2026-0045	Improved product assessments and supporting tools	Develop online self-assessment and peer review workflows to replace static Word/PDF forms with structured web submissions, improving efficiency and transparency.	CEOS SEO	1
2026-0046	Improved product assessments and supporting tools	Implement scalable peer-review processes that include shared decision logs and reviewer training to handle higher submission volumes without compromising rigour.	WGCV CEOS-ARD Peer Review Team	3
2026-0047	Data provider support	Publish clear guidance, templates, and examples that support data providers in meeting requirements.	CEOS-ARD Oversight Group	2

2026-0048	Continuous integrity monitoring	Develop an efficient approach for dealing with specific requirements, particularly at Goal level, that are not amenable to automation of compliance review (i.e., those that require expert review, e.g., traceability, uncertainty).	WGCV CEOS-ARD Peer Review Team	2
2026-0049	Continuous integrity monitoring	Enhance the CEOS MIM Database such that it can serve as the authoritative source underpinning scalable CEOS-ARD compliance assessments and continuous quality and integrity monitoring.	CEOS MIM Database Team	2
5: Artificial/Super Intelligence Enablement & Trustworthy GFM				
2026-0050	Artificial/Super Intelligence support via improved formats and data packaging	Enable scalable Artificial/Super Intelligence training with CEOS-ARD by making recommendations for chunkable, cloud-optimized formats (e.g., Zarr, COG) and other related requirements related to metadata, APIs, etc.	WGISS TEIG	3
2026-0051	Artificial/Super Intelligence support via improved formats and data packaging	Implement increased traceability and versioning in the CEOS-ARD Framework and PFS to support reproducibility and explainability.	WGISS TEIG	3
2026-0053	Artificial/Super Intelligence support via improved formats and data packaging	Improve packaging of CEOS-ARD datasets for Artificial/Super Intelligence model training through guidance on dataset organization, including considerations for tiling schemes, training/validation/test splits, and licensing clarity where appropriate.	WGISS TEIG	3
2026-0054	Artificial/Super Intelligence support via improved formats and data packaging	Implement Data and Model Cards to provide structured documentation on provenance, limitations, biases, and permissible uses to mitigate risks in Artificial/Super Intelligence workflows.	WGISS TEIG	3
2026-0055	Artificial/Super Intelligence community engagement and support	Publish benchmark tasks and evaluation protocols to guide Artificial/Super Intelligence developers and ensure robust performance.	WGISS TEIG	3

2026-0056	Artificial/Super Intelligence community engagement and support	Engage with Artificial/Super Intelligence research communities and platform providers to promote adoption of CEOS-ARD and understand best practices/requirements.	CEOS-ARD Oversight Group	1
6: Adoption, Enablement & Impact				
2026-0057	Meeting thematic and higher level needs	Expand the CEOS-ARD Framework to accommodate thematic and higher-level products to meet evolving user needs in areas like agriculture, biodiversity, land degradation, forestry, wildfires, etc.	CEOS-ARD Oversight Group, LSI-GEOGLAM, LSI-VC F&B/GFOI, Biodiversity VC, GEO LDN, LSI-VC Wildfire, etc.	2
2026-0059	Data procurement	Promote CEOS-ARD as a procurement baseline to eliminate duplication of assessment effort and reduce risk for agencies and vendors.	CEOS-ARD Oversight Group, LSI-VC	3
2026-0060	Supporting the commercial sector	Adapt requirements for very-high-resolution data and constraints related to the disclosure of proprietary information, increasing inclusivity of the commercial sector in particular.	CEOS-ARD Oversight Group, LSI-VC	1
2026-0061	Capacity building and training	Develop and conduct CEOS-ARD training and outreach programs, supported by multilingual documentation to build capacity and awareness globally.	WGCapD	3
2026-0062	Demonstrating value	Systematically capture and document case studies and impact metrics that demonstrate CEOS-ARD's value	CEOS-ARD Oversight Group, LSI-VC	1
2026-0063	Demonstrating value	Develop communications materials to clarify the business case for CEOS-ARD.	CEOS-ARD Oversight Group, CEOS Comms Team	1
2026-0064	Demonstrating value	Implement SMART quantitative measures of success for the Adoption, Enablement & Impact pillar.	CEOS-ARD Oversight Group	1

7: Measuring Success and Tracking Implementation

Success will be measured through a combination of adoption, capability and impact indicators. The Strategy intentionally defines qualitative Success Criteria and Outcome Signals, while Initiative 2026-0064 will establish SMART measures and baselines during Horizon 1. This allows us to adapt the metrics as the ecosystem evolves while maintaining a clear strategic direction.

For CEOS-ARD, impact is defined as demonstrable use of CEOS-ARD to reduce barriers to Earth observation uptake and enabling better scientific, operational, commercial and policy outcomes. Impact is therefore not limited to the number of datasets assessed, but must include evidence that CEOS-ARD is influencing decisions, enabling new applications, reducing duplication, supporting procurement processes and increasing interoperability across the community.

Commercial adoption will be demonstrated through increased participation of commercial providers in the CEOS-ARD ecosystem, successful assessment of commercial products, alignment of CEOS-ARD requirements with commercial needs, and evidence that CEOS-ARD endorsement provides value as a recognised market differentiator.

8: Conclusion

The 2026–2031 CEOS-ARD Strategy provides a comprehensive roadmap designed to evolve CEOS Analysis Ready Data into a robust and agile framework that encourages broad geospatial community participation and adoption, promotes data quality, streamlines assessments, and implements ongoing monitoring and assurance.

Realisation of the strategy will fully address community feedback from the consultation effort undertaken in 2025, ensuring CEOS-ARD is responsive, trusted, scalable, and indispensable — supporting science discovery and applications, operations, markets, and Artificial/Super Intelligence with clear evidence of fitness, quality, and impact.

Annex I: CEOS-ARD Strategy for Water

Context and Vision

This annex represents a contribution from the NASA Strategic Implementation Team (SIT) Chair team under its primary thematic focus: *Water Planet – Seeing Earth's Water from Space*.

The overarching goal of the Water Planet priority is to advance the global understanding of Earth's water cycle by seamlessly monitoring terrestrial waters, coastal regions, and oceans from space. By integrating the capabilities of past, present, and future missions, the SIT Chair aims to transform this observational knowledge into actionable insights. This effort directly aligns with NASA's Earth Science to Action (ES2A) strategy, which emphasizes accelerating the application of Earth science data to solve real-world challenges.

A core objective of this annex is to close the critical usability gap between observation capture and archive, and when they are operationalized by end-users. By shifting the burden of fundamental data processing away from the user, we can dramatically accelerate the transition from raw observation to impactful water decision-making.

These insights are essential to enhance water use efficiency, improve water quality, and build global resilience to water-related hazards.

To achieve this, CEOS relies on its collective strength to enable a multi-source, integrated data approach, including with private sector data providers. This annex directly supports the key outcomes of the Water Planet priority, specifically:

- Accessible and Interoperable Water Data Products
- User-Centric Solutions for Water Challenges
- Coordinated Water Observations

The Legacy of CEOS-ARD in the Water Domain

CEOS-ARD has an established and active history in the water domain. First published in 2022, the original Aquatic Reflectance (AR) Product Family Specifications (PFS) provided guidance for satellite data products focused on inland and nearshore coastal, and optically shallow waters, with an additional emphasis on high-resolution sensors. Open oceans were initially excluded from this PFS due to a lack of community consensus, along with the challenge of consolidating kilometre-scale open ocean pixels and sub-hundred metre coastal pixels without a common geolocation referencing system.

However, increased interest from the ocean community led the CEOS Ocean Colour Radiometry and Land Surface Imaging Virtual Constellations (OCR-VC and LSI-VC), in collaboration with the International Ocean Colour Coordinating Group (IOCCG), to

update the specification to accommodate the breadth of aquatic reflectance applications.

In mid-2024, the update was initiated to define a single AR PFS covering all aquatic domains, with new requirements for general and per-pixel metadata, as well as products, algorithms, and geometric corrections. The effort saw the creation of new metadata requirements, including for 'Geometric Correction and Orthorectification', in recognition of the loss of terrestrial reference systems over open oceans. In parallel, many existing Threshold and Goal metadata requirements were updated. Where applicable, these changes are planned to propagate through other optical PFS, ensuring consistency.

Version 2 of the Aquatic Reflectance PFS was endorsed by OCR-VC, LSI-VC, and IOCCG in May 2025. The PFS applies to data collected with multispectral and hyperspectral imaging sensors operating in the VIS/NIR/SWIR wavelengths over water bodies including oceans, seas, coastal zones, and inland waters. These typically operate with ground sample distance and resolution in the order of 1-4000 metres; however, the specification is not inherently limited to these resolutions.

Alignment with the Broader CEOS-ARD Strategy

The vision for the Water Planet priority closely mirrors that of the broader CEOS-ARD Strategy and its guiding principle: *"Earth Observation for Everyone."* For CEOS-ARD to be widely embraced by the water community, it must enable users to address their specific questions and use cases.

While existing foundational specifications, such as the Aquatic Reflectance PFS, provide a critical baseline, engagement with the water management and research communities has indicated that these often do not go far enough along the value chain for end-users. A water resource manager, for example, rarely seeks raw reflectance data; rather, they require derived, thematic variables such as Chlorophyll-a concentrations, soil moisture, or snow water equivalent. This is feedback that is echoed in agriculture, biodiversity, and other domains, and has led to calls for an expansion of the CEOS-ARD Framework to consider higher-level products.

Therefore, to fulfill the "User-Centric Solutions" outcome of the Water Planet priority, this annex seeks to establish a roadmap to expand the CEOS-ARD Framework for the water domain, with the goal of expanding beyond strictly foundational data to define PFS for higher-level, thematic products. This annex outlines the steps required to bridge the gap between data producers and the water management community, ensuring that CEOS-ARD is fundamentally "fit for purpose" from catchment to coast.

This roadmap also aligns with the COAST-VC, which is chartered to provide cross-domain application and integration perspectives for the coastal component of this strategy.

COAST-VC will work with measurement-focused VCs and the CEOS-ARD Oversight Group to translate coastal user requirements into thematic product requirements, support development and assessment of coastal higher-level products, identify common building blocks, demonstrate integrated multi-source products in pilot regions, and document user impact.

Framing CEOS-ARD for Water: Essential Water Variables

Strategies for addressing water data product needs must recognize two primary client groups: researchers focusing on water cycle variables for macroscale hydrological research, and operational users focusing on variables essential for day-to-day water resources management.

Therefore, to define a holistic vision for CEOS-ARD for water, we seek a framework driven by applications and user needs. In 2014, the Group on Earth Observations (GEO) released the Global Earth Observation System of Systems (GEOSS) Water Strategy Report, outlining a list of proposed Essential Water Variables (EWVs).

The GEOSS report formally defines EWVs as parameters that address user-defined critical requirements for:

1. Observational monitoring of key elements of the global, regional, and local water cycle.
2. Inputs required by land surface/hydrological prediction models to generate derived products.
3. Variables required by users for inter-disciplinary decision support systems and tools.

Table I. Essential Water Variables, adapted from GEOGLOWS Essential Water Variables and Observations <https://www.geoglows.org/pages/123730e2d8d24dfa9fb7c134e3d8f1cb>

Primary EWVs	Supplemental EWVs
Precipitation	Surface Meteorology
Evaporation	Surface and Atmospheric Radiation Budgets
Evapotranspiration	Clouds
Snow	Aerosols
Soil Moisture	Land Cover
Soil Temperature	Vegetation
Groundwater	Land Use

Runoff/Streamflow/River Discharge	Elevation/Topography
Lake/Reservoir Levels and Aquifer Volumetric Change, Terrestrial Water Storage	Geological Stratification
Water Use/Demand	
Water Quality	

The concept of EWVs is grounded in the well-established Essential Climate Variables (ECVs) first proposed by the Global Climate Observing System (GCOS), which demonstrated the value of focusing Earth observation efforts on a targeted set of critical parameters.

As well as EWVs, there are also ECVs of relevance, including Ocean Colour (Chlorophyll-a Concentration; Water Leaving Radiance) and Lakes (Lake Water Level; Water Extent; Lake Surface Water Temperature; Lake Ice Thickness; Lake Ice Cover; Lake Water-Leaving Reflectance), among others.

Various sub-disciplines within the water domain have sought to define their own critical parameters. For example, to support the Ramsar Convention on Wetlands, practitioners are actively developing Essential Wetland Variables (EWetVs) to monitor the critical interface between groundwater, land, and the atmosphere. Furthermore, CSIRO under its Aquawatch program has initiated efforts to define Essential Water Quality Variables (EWQVs).

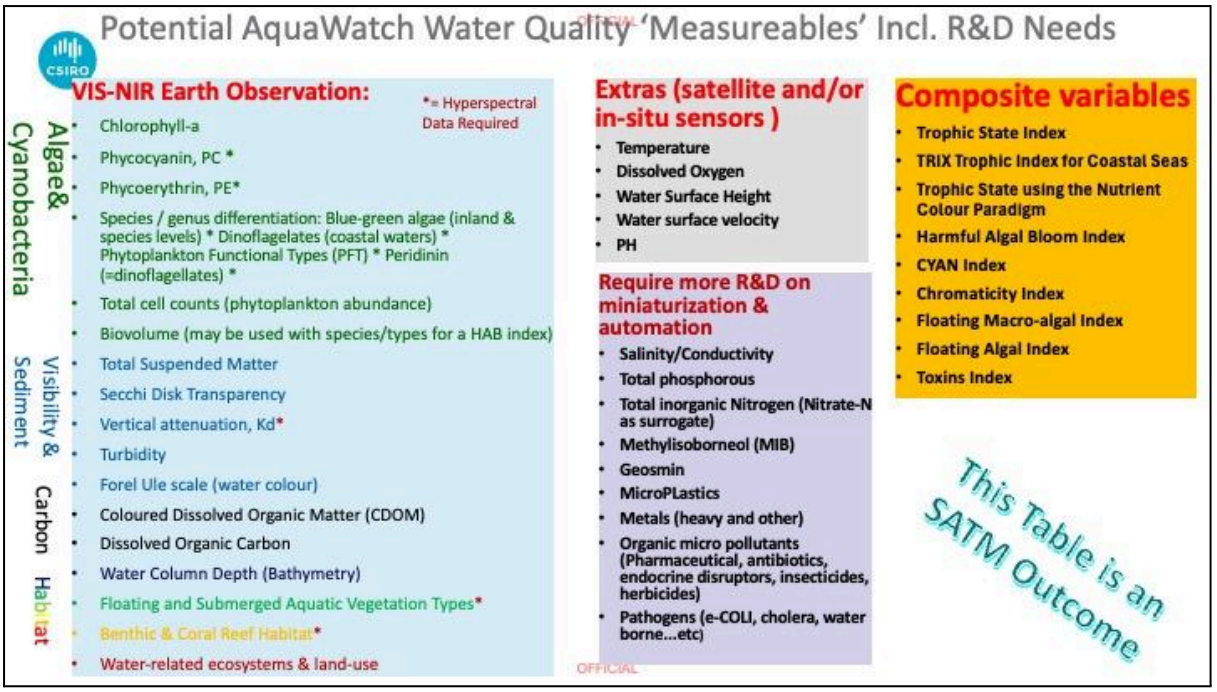
As these various thematic frameworks continue to mature, it is critical to ensure cohesion across them at the outset. While these lists provide a strong conceptual foundation, transitioning them into concrete Earth observation strategies requires careful harmonization. Some variables are defined broadly (e.g., the GEOSS list includes "Water Quality" as a single EWV) and will require disaggregation to be functionally useful for satellite product specification. Furthermore, overlapping domains—such as where a water quality parameter also serves as a wetland indicator—highlight the need to avoid redundant or competing specification efforts.

Ultimately, the long-term vision for CEOS-ARD for the water domain is to systematically identify which variables provide the most utility as fundamental building blocks for those working on critical water issues.

Essential Water Quality Variables

Throughout 2026, NASA and CSIRO have collaborated on a shared priority of water quality, seeking to understand the requirements for comprehensive catchment-to-coast

satellite Earth observations. Past work by CSIRO under the Aquawatch program has yielded a candidate set of Essential Water Quality Variables – achieved through a comprehensive Science and Applications Traceability Matrix assessment, intended to ensure the AquaWatch program is driven by end user requirements informed by science.



While this should be considered a preliminary step towards formal Essential Water Quality Variables, these findings provide a useful initial deconstruction of the singular 'Water Quality' Primary EWV noted above.

Identifying Essential Water Quality Variables (EWQVs) will provide a scientifically agreed and user-focused set of measurements critical for monitoring water quality along the catchment-to-coast system. These are characterised as the most important indicators of water quality, which have significant impact on ecosystem health, water security and human well-being. Improving consistency, interoperability and comparability of water quality observations will enable more effective tracking of water conditions, support development of early warning and forecasting systems, as well as guide future mission planning, technology development and investment in observation systems to ensure that the most important water quality information remains available, consistent and fit for purpose over the long term. Aligning CEOS-ARD with EWQVs will further enable this.

Wetlands in the Water Cycle

Wetlands constitute an integral part of the water cycle at global, regional and local scales. They store large amounts of surface water, regulate water flows and evapotranspiration rates, and replenish groundwater aquifers. Wetlands also constitute

biodiversity hotspots for terrestrial, avian and aquatic life, and consequently for the livelihood of people. Where there are wetlands, there is life.

The role of wetlands in the hydrological cycle is identified as a Priority Task in the Ramsar Convention STRP (Scientific and Technical Review Panel) Workplan for 2025-2028 (Tasks 2.2 and 3.3). The Tasks are set out to improve understanding of how wetlands influence hydrological processes between ground water, land and the atmosphere, including how regional evapotranspiration and precipitation patterns are influenced by terrestrial moisture recycling, and to define and develop Essential Wetland Variables (EWetVs) to support wetland monitoring and reporting.

The Ramsar Convention on Wetlands explicitly mentions Earth observation as a key technology to the implementation of the Work Plan and in supporting Contracting Parties to meet their reporting requirements. To realize this goal, access to analysis-ready information products will be critical.

Addressing the Water Cycle Holistically

To date, CEOS-ARD specifications have not been developed in a fashion that considers the needs of a whole thematic user domain. Rather, they have been developed *ad hoc*, in response to the specific needs or motivations of lead authors and end users. The CEOS-ARD Strategy for Water Observations will serve as a case study in attempting to address a thematic domain systematically and holistically. The goal for the next five years is to undertake the engagements, studies, and planning that will put us on a path to ensure CEOS-ARD comprehensively serves the needs of the whole water community.

As with the rest of the CEOS-ARD Framework, water focused efforts will adopt the same modularization / building blocks approach. Modularization serves as the structural mechanism by which we can identify foundational water requirements that act as common "building blocks." By defining these core modules once, they can be utilized across multiple higher-level Product Family Specifications (PFS), harmonizing efforts across EWVs, EWQVs, EWetVs, and any other related initiatives/frameworks.

Given this overarching vision and structural framing, we propose a strategy to accomplish the following objectives:

- Evaluate the existing suite of Essential Variables to determine which are most applicable for initial CEOS-ARD development, in consideration of existing CEOS-ARD Product Family Specifications (PFS) that can be used as a basis and satellite products and capabilities.
- Disaggregating broad categories (such as water quality) into specific, actionable parameters that can be targeted for CEOS-ARD PFS.
- Determining the specific PFS required to operationalize these refined variables.

- Identifying the critical satellite missions capable of providing data that can be assessed as CEOS-ARD for these variables.
- Engaging the necessary expert groups, both within CEOS and the broader community, to collaboratively develop these PFS.
- Establishing a definitive roadmap for further PFS development that is based on a coherent typology/hierarchy grounded in user needs and frameworks.

The following initiatives have been identified as initial waypoints. To ensure alignment with the broader 2026-2031 CEOS-ARD Strategy, these initiatives are categorized according to the core strategic pillars and time horizons. Additionally, to foster immediate collaboration and accountability, the specific CEOS Virtual Constellations (VCs) and relevant partner groups anticipated to lead or support these efforts have been identified, where possible.

CEOS-ARD Water Initiatives by Pillar

1: Standards and Interoperability

Update the Synthetic Aperture Radar (SAR) Product Family Specification (PFS) to address findings from the SWOT self-assessment

The SWOT self-assessment has highlighted necessary refinements within the current SAR PFS. Addressing these is critical to ensure the specification remains robust for water applications.

- Lead: NASA SWOT team (Mission Applications Lead)
- Support required from: SAR-VC, NASA SIT Chair Team, COAST-VC
- When: Horizon 1

Update the Aquatic Reflectance (AR) PFS to address findings from PACE and Landsat aquatic reflectance product self-assessments

Recent self-assessments have highlighted areas for improvement within the current AR PFS. This foundational specification must be updated to effectively serve as a baseline for further derivative product specifications.

- Lead: NASA PACE team (Mission Applications Lead)
- Support required from: NASA SIT Chair Team, USGS AR team, OCR-VC, LSI-VC, COAST-VC
- When: Horizon 1

Explore a derived PFS for Chlorophyll from the updated AR PFS

Develop this thematic specification and undertake a self-assessment. This effort will consider coastal ocean versus inland water chlorophyll, directly supporting the catchment-to-coast vision. To be undertaken after PACE and Landsat aquatic reflectance product self-assessment findings are reflected in the AR PFS.

- Support required from: CSIRO Water Quality team, NASA SIT Chair Team, OCR-VC
- When: Horizon 1

Explore a derived PFS for Soil Moisture

Develop a specification for soil moisture retrievals from microwave sensors and undertake a product self-assessment. This will serve as a critical thematic pathfinder for land-water interface variables.

- Lead: SAR-VC
- Support required from: NASA NISAR representatives, NASA SIT Chair Team, COAST-VC
- When: Horizon 1

Explore a derived PFS for Evapotranspiration

Develop a specification for evapotranspiration retrievals from combined thermal and optical sensors and undertake a product self-assessment. This will serve as a critical thematic pathfinder for monitoring agricultural water demand, drought conditions, and land-atmosphere water fluxes.

- Lead: LSI-VC GEOGLAM (Agriculture) Subgroup
- Support required from: NASA SIT Chair Team, relevant thermal mission representatives (e.g., Landsat, ECOSTRESS), NASA, EC, ESA, USGS
- When: Horizon 1

Study into potential higher-level altimetry-based CEOS-ARD products aligned with EWVs

Following completion of the initial SWOT product self-assessment, undertake a study on potential higher-level, altimetry-based derivative products related to EWVs such as Runoff/Streamflow/River Discharge and Lake/Reservoir Levels and Aquifer Volumetric Change, Terrestrial Water Storage.

- Lead: NASA SWOT Team
- Support required from: NASA SIT Chair Team
- When: Horizon 2

Precipitation CEOS-ARD user needs analysis and specification development

Continue early efforts to understand user needs regarding a CEOS-ARD precipitation product and define the appropriate level of product. Once user demand is confirmed, progress to defining a precipitation PFS.

- Lead: P-VC
- Support required from: NASA SIT Chair Team, Takuji Kubota (JAXA, P-VC Co-Lead)
- When: Horizon 1

Identify the Essential Variables necessary for a comprehensive water observation system consistent with CEOS-ARD user demand and map out the required PFS in a consistent typology/hierarchy

Determine where all current and planned PFS fit within a hierarchy. This includes identifying which products serve as derivatives, data levels, and sensing technologies to establish clear development dependencies and priorities. Establishing a clear typology will facilitate the identification of foundational water requirements that act as common "building blocks" across variables.

- Lead: NASA SIT Chair Team
- Support required from: CEOS-ARD Oversight Group, SAR-VC, LSI-VC, OCR-VC, COAST-VC
- When: Horizon 2

Identify common building blocks across necessary PFS to address EWVs

Leverage the CEOS-ARD modularization approach to identify foundational elements that can be shared across multiple water-thematic specifications.

- Lead: NASA SIT Chair Team
- Support required from: CEOS-ARD Oversight Group, SAR-VC, LSI-VC, OCR-VC
- When: Horizon 2

Explore a CEOS-ARD PFS for Sea Surface Temperature that is consistent with GHRSST Data Specification Version 3

Ensure interoperability and structural alignment with this complementary standard.

- Lead: SST-VC (Misako Kachi, JAXA; Ed Armstrong, NASA)
- Support required from: CEOS-ARD Oversight Group
- When: Horizon 2

2: Quality, Authenticity & Provenance

Ensure appropriate representation of the water domain in CEOS WGCV

Explore whether a dedicated water group in the Working Group on Calibration and Validation (WGCV) might be needed to support peer review of water-focused self-assessments.

- Lead: NASA SIT Chair Team
- Support required from: WGCV
- When: Horizon 1

Alignment of quality requirements of CEOS-ARD for water with WGCV cal/val networks

Ensure that the quality metrics defined in the water-thematic specifications leverage established WGCV cal/val networks, frameworks, and protocols.

- Lead: NASA SIT Chair Team
- Support required from: WGCV, CEOS-ARD Oversight Group
- When: Horizon 2

3: Fitness for Purpose

Develop water-specific guidance for dataset selection

Create documentation to help users select appropriate datasets for specific water-related tasks, including guidance on the use of multiple integrated datasets. Consider a decision matrix to map water management questions to EWVs and appropriate CEOS-ARD datasets.

- Support required from: COAST-VC, WGCV, CEOS-ARD Oversight Group
- When: Horizon 2

Contribute water-thematic profiles to the CEOS-ARD Product Selection Framework

Integrate water-specific variables into the broader framework to improve discoverability of relevant CEOS-ARD for end-users.

- Support required from: WGCV, CEOS-ARD Oversight Group
- When: Horizon 2

6: Adoption, Enablement & Impact

Engage stakeholder communities to capture case studies and impact metrics

Work with relevant communities to document and demonstrate the operational value of CEOS-ARD for water management.

- Support required from: COAST-VC, GEO water communities, WGCapD
- When: Horizon 2

Annex II: Acronyms and Abbreviations

AR	Aquatic Reflectance
ARD	Analysis Ready Data
CEOS	Committee on Earth Observation Satellites
COAST-VC	Coastal Observations, Applications, Services, and Tools Virtual Constellation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ECV	Essential Climate Variable
ES2A	NASA Earth Science to Action Strategy
EWetV	Essential Wetland Variable
EWV	Essential Water Variable
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOGLOWS	GEO Global Water Sustainability
GEOSS	Global Earth Observation System of Systems
GFM	Geospatial Foundation Models
GHRSST	Group for High Resolution Sea Surface Temperature
IOCCG	International Ocean Colour Coordinating Group
JAXA	Japan Aerospace Exploration Agency
LSI-VC	Land Surface Imaging Virtual Constellation
NASA	National Aeronautics and Space Administration
NISAR	NASA-ISRO Synthetic Aperture Radar
OCR-VC	Ocean Colour Radiometry Virtual Constellation
OG	Oversight Group (e.g., CEOS-ARD OG)
PACE	Plankton, Aerosol, Cloud, ocean Ecosystem
PFS	Product Family Specification(s)
P-VC	Precipitation Virtual Constellation
SAR	Synthetic Aperture Radar
SAR-VC	Synthetic Aperture Radar Virtual Constellation
SIT	Strategic Implementation Team
SST	Sea Surface Temperature
SST-VC	Sea Surface Temperature Virtual Constellation
STRP	Scientific and Technical Review Panel (Ramsar Convention)
SWIR	Short-Wave Infrared
SWOT	Surface Water and Ocean Topography

USGS	United States Geological Survey
VC	Virtual Constellation
VIIRS	Visible Infrared Imaging Radiometer Suite
VIS/NIR	Visible and Near-Infrared
WGCV	Working Group on Calibration and Validation