

Coastal Observations, Applications, Services and Tools – Virtual Constellation (COAST-VC)

Terms of Reference (March 15, 2024)

Mission Statement and Objectives

Mission Statement: *There is a broad spectrum of coastal needs, issues, and challenges for CEOS to address, and diverse stakeholders to engage. The CEOS COAST Virtual Constellation focuses on the user-driven value chain to facilitate targeted work and engagement on priority coastal observations and applications within CEOS, addressing the identification, extension/expansion, integration and transformation of multi-sensor observations into fit-for-purpose information supporting existing and emerging stakeholder requirements. Users of COAST-VC products are local, regional, and global and typically focused on land and sea interactions. User requirements and needs surround new coastal product development or application of the existing land/ocean product requirements within the complex coastal zones (which have been masked from land/ ocean products).*

Coastal zones are extraordinarily important from a societal and economic perspective. They are home to much of the global population, amongst the most productive ecosystems on Earth, and crucial to the emerging Blue Economy as essential sites of commerce, transportation, food security, and recreation.

There are significant risks and threats to human health and safety, as well as abundant ecosystem resources from these regions. Coastal hazards such as flooding and inundation, as well as water quality and associated impacts (e.g., eutrophication, hypoxia, harmful algal blooms, sediment loadings and coral reef et al. habitat degradation) to ecosystem health and productivity, represent particularly great challenges for society to address.

Further, within coastal zones, there is dynamic coupling of terrestrial, aquatic and atmospheric domains; complex, episodic and often ephemeral physical and biological/biogeochemical processes; and finally, the overarching challenge of integrating environmental sciences with social sciences. Our ability and, more so, capacity to address changes in these regions is still relatively limited, particularly in the developing world.

There is a compelling need to better observe, understand, manage, and predict changes in coastal regions for societal benefit and sustainable development. COAST VC seeks to address a gap in meeting coastal user needs by:

- encouraging broader utilization of space-based Earth observations and other CEOS capabilities for societal benefits within coastal zones (e.g., high-latitude observations, Blue Carbon; SDGs);
- demonstrating specific opportunities and mechanisms for CEOS to engage, particularly through linkages with GEO;
- facilitating technology transfer to developing nations and user communities worldwide; and
- Building capabilities and capacity with an eye toward scaling up from individual demonstration activities at national and regional levels to full global implementation.

Measurement and Data Collection Scope

Coastal zones are extraordinarily important from a societal and economic perspective. They are home to much of the global population, amongst the most productive ecosystems on Earth, and crucial to the emerging Blue Economy as essential sites of commerce, transportation, food security, and recreation. In both developed and developing nations, including small Island Nations and Territories, coastal zones continue to grow, diversify and are equally vulnerable to climate change. In this regard, there is a compelling need to better observe, understand, manage, and predict changes in these regions in support of sustainable development. However, the ability and capacity to address changes in these regions is still relatively limited, particularly in the developing world.

Coastal zones are characterized by complex processes, with rapidly changing and evolving conditions that can be challenging to observe effectively in both time and space, due particularly to their inherent transboundary and transdisciplinary nature. Within coastal zones there is dynamic coupling of terrestrial, aquatic and atmospheric domains; complex, episodic and often ephemeral physical and biological/biogeochemical processes; and finally, the overarching challenge of integrating environmental sciences with social sciences.

Focusing on this user-driven value chain, the COAST AHT facilitates targeted work and engagement on priority coastal observations and applications within CEOS, addressing the identification, extension/expansion, integration and transformation of multi-sensor observations into fit-for-purpose information supporting existing and emerging stakeholder requirements. In order to ensure a more permanent place for this work within the CEOS structure, it is thus appropriate for COAST to be a 'Virtual Constellation', leveraging CEOS Agency efforts and CEOS VC and WG expertise to achieve far more than the sum of disparate or disconnected activities.

This virtual constellation with a coastal focus will help bridge land and aquatic observations within CEOS, and given its cross cutting nature, it will continue to integrate across multiple CEOS entities and domains, both thematic and technical. COAST will leverage the CEOS Analysis Ready Data (CEOS-ARD) framework, which has already been extended to coastal and inland waters; best practices arising from WGCapD; and to the extent feasible, utilize the CEOS Systems Engineering Office Analytics Lab for product development. The strategic approach and priorities of the COAST-VC will be to:

- Maintain a CEOS perspective and ensure a clear focus on the "upstream" end of the value-chain by engaging downstream stakeholders on product needs and use cases, i.e., observations to data to products, addressing issues such as fit-for-purpose/analysis ready data; new/improved, higher resolution, integrated products et al.
- Co-design and co-develop specific, tractable high priority pilot projects and related activities in geographical areas that resonate with regional and global stakeholders/users in GEO, UN, GOOS, et al., particularly technology transitions toward broader global implementation
- Identify, leverage and integrate appropriate CEOS capabilities and capacities across CEOS Agencies, VCs, and Working Groups (WGs)
- Identify and articulate exactly what the novel contribution is from CEOS relative to other existing and planned community activities, ensuring complementarity and avoiding redundancy
- Collaboratively work with stakeholders to ensure pilot products meet existing and emerging user needs, that their evolution is co-designed, and that a path forward for longer term implementation is identified
- Develop a viable strategy to identify and acquire the necessary resources (human, Internet Technology capacity, et al.) from CEOS members to successfully execute the Phase 2 implementation plan.

- The COAST-VC’s primary reporting path is to the SIT Chair (as for all CEOS VCs), with a secondary reporting path to the CEOS Chair, if so delegated by the SIT Chair. COAST-VC reporting to CEOS SIT Chair will emphasize progress towards the achievement of these outcomes and deliverables, as well as issues and obstacles for SIT Chair attention.

Timeline	3-year horizon	5-year horizon and beyond
Space Segment	e.g., PACE, SWOT, NISAR, OS3/3A, S-1C/D, S-3C/D, S6B	e.g., GEO-XO, GLIMR, CIMR, S2-NG, S3-NG, S3-NGTopo, CRISTAL, CHIME, LSTSR, ROSE-L, SBG, TRISHNA
Group Segment and Information Systems	NOAA, ISRO, Geoscience Australia, ESA, and COAST members using the CEOS Analytics Laboratory for product development	COAST members leveraging CEOS Analysis Ready Data (ARD) in the cloud and CEOS Analytics Laboratory
Products and Services	Deliver and improve Application Knowledge Hub. Product Development - Global: Shorelines, physical oceanography products. Product Development Pilot areas: Coastal Flooding, satellite derived bathymetry, Coastal Habitat, per grid-cell trend-rates in ocean parameters (SST, Chl-a, SLA, Windspeed)	Product Development: Coastal Eutrophication AI Anomaly, Blue Carbon products, Refined products for polar regions.

Agencies Involved

Agencies involved (as of March 2024): CSIRO (AquaWatch Australia), ESA (CIMR, Sentinel 2 c/d), Geoscience Australia, ISRO (NISAR, OS3/3A), CNES (SWOT), NASA (PACE, GLIMR, SWOT and NISAR), NOAA (GEO-XO), USGS (Landsat 9). We will collaborate within the CEOS Analytics Lab for product development where possible, and we have historically worked successfully within other data cube environments (e.g., Digital Earth Africa).

Activities, Outcomes, and Deliverables

As noted in the *CEOS Governance and Processes Document* (ref. Page 7) in relation to Virtual Constellations, the COAST-VC primary reporting path is to the SIT Chair (as for all CEOS VCs), with a secondary reporting path to the CEOS Chair, if so delegated by the SIT Chair.

Within the VC framework, specific activities, outcomes and deliverables of the COAST-VC are to:

- Strategically utilize CEOS assets and bodies to engage with users and advance capabilities for COAST pilot project implementation, and also generally for future COAST planning and activities.
 - o Identify and analyze opportunities for new and emerging satellite-based observations and

- derived capabilities to support coastal needs, challenges and opportunities at all latitudes (e.g., new methods, new data, new products)
 - o Provide feedback to CEOS Agencies on the existing or potential future gaps in the satellite-based observations in addressing critical coastal applications.
- Enhance COAST pilots and supporting infrastructure
 - o Engage in co-design of products, tools and services with both internal and external entities (e.g., GOOS, GEO, WMO, UN Ocean Decade - including CoastPredict) and other relevant authoritative stakeholders (including under-represented and indigenous people) which meet coastal needs and issues.
 - working together on pilot project implementation
 - building partnerships to transfer operational control and sustain COAST deliverables
 - identify new pilot regions
 - o Make the CEOS Analytics Lab more robust as a development forum accessible to COAST members for methodological development. Within CEOS, promote its tools and platforms for discovery and accessibility to high priority global/regional data sets
- Enable easy, open-source user access to COAST products and other open-source coastal data sets through the continued improvement of an Applications Knowledge Hub
- Serve as a Communication Forum sharing best practices and approaches across CEOS and the broader international community in support of COAST activities and priorities

Implementation and Coordination Issues to be Addressed

COAST has been successfully coordinating over the last four years, first as a Study Team and then as an Ad Hoc Team. It is anticipated this coordination will continue smoothly as a VC. COAST-VC will not be in competition with the other Ocean VCs, but will instead complement them by supporting their direct application in coastal regions impacted by climate change and connecting them with downstream stakeholders and their applications. This includes impacts to biodiversity, disasters, understanding direct consequences of changes in the hydrological cycle, etc. Linkages with other CEOS VCs and WGs must be successfully established and maintained for COAST to achieve its objectives.

Schedule

Product development within COAST should endure through the end of key international programs such as the UN Ocean Decade (2030) and the International Decade for Action, "Water for Sustainable Development" (2028), the UNSDG (and in particular Goal 14 about coastal eutrophication), and Nippon Foundation-GEBCO Seabed 2030 Project. Product development and stakeholder engagement will continue in the 3-5 year timeframe, especially in the new theme of Blue Carbon and Arctic pilot region. COAST has also identified potential collaborations with other CEOS entities across the work plan. On the 5-7 year horizon, the COAST will continue to support its main external effort in the UN Ocean Decade and within the CEOS, it will exploit data from new missions and sensors. More detail is found in the COAST Implementation Plan (included in this package).

Leadership and Membership

Participation in the COAST-VC will be open to all CEOS Agencies willing to support and contribute to activities that are in scope with the COAST-VC mission and objectives. Agencies that are not already part of the COAST-VC and are interested in participating are encouraged to contact the Co-leads directly for integration into its activities. Similarly, CEOS Agencies that wish to sponsor one or more contributors from a university or institute in their country (invited partners) are encouraged to contact the COAST-VC Co-leads.

The COAST-VC will have three Co-Leads from CEOS Agencies representing different geographical regions

and with complementary interests and areas of expertise. Consistent with the *CEOS Governance and Processes Document* (Section on CEOS VCs; page 7): “Every two years, the Co-Leads will be reviewed by the Constellation membership with a decision to either maintain current leadership or transition to new leadership, as outlined in the CEOS Virtual Constellation Process Paper. It is recommended that only one VC Co-Lead change at one time.” In the interest of stability and continuity of activities, it is recommended that the sponsoring CEOS Agency Contact and the COAST-VC be informed in advance if a co-lead plans to step down.

The following CEOS Agencies are actively involved in COAST-VC at adoption of these Terms of Reference:

- NOAA - Co-Lead and Secretariat Host
- ISRO - Co-Lead
- CNES - Co-Lead
- CEOS SIT Chair
- CEOS Executive Officer
- CEOS Systems Engineering Office (SEO)
- CEOS VCs: SST-VC, OST-VC, LSI-VC, OCR-VC
- CEOS WGCapD
- CEOS-CGMS WGClimate
- CEOS WGCV
- CEOS WGISS
- CEOS WGDisasters
- SDG Coordination Group
- CSIRO
- ESA
- EUMETSAT
- European Commission
- GEO AquaWatch Initiative
- GEO Blue Planet Initiative
- Geoscience Australia (GA)
- JAXA
- NASA
- USGS

Resources

The COAST-VC will seek to leverage missions, data, expertise, and infrastructure from CEOS Agencies, mostly by participants in the COAST member agencies, VCs and WGs. CEOS Agency resources (e.g., tools, knowledge bases, available algorithms, in situ and satellite data applicable to coastal data product development) will be sought or augmented. COAST uses, requesting on a best-effort basis, the CEOS Analytics Laboratory and its available data sets (within pilot region boxes) for a development space. Resource support for these activities currently comes from various sources in the USA, India, Australia, and Europe, including limited deliverable-based resources within NOAA, ISRO, CNES, Geoscience Australia, ESA, and others. Should externally funded project opportunities (for which CEOS COAST is eligible to apply) become available that could advance parts of the CEOS COAST effort in a pilot region or thematic area, to the extent practicable, they will be pursued by the principals leading that work. The COAST-VC will make best efforts to engage new and existing CEOS members in its activities. Product development and co-design with stakeholder activities will continue, as well as for training and outreach.