**Initial Proposal and Terms of Reference for a**

**CEOS Biodiversity Virtual Constellation**

**Draft for discussion at the CEOS SIT Technical Workshop**

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This document follows the format for a VC Terms of Reference that is outlined in

Annex 3 of the [CEOS Virtual Constellation Process Paper](https://ceos.org/document_management/Publications/Governing_Docs/Virtual-Constellations_Process%20Paper_rev1-2019.pdf)

**TERMS OF REFERENCE FOR THE CEOS**

**BIODIVERSITY VIRTUAL CONSTELLATION**

**DRAFT VERSION 1.3a**

**25 August 2025**

**Introduction**

Space-based Earth Observations (EO) provide global, periodic data that give them a unique perspective of Earth. As a result, EO plays an essential role for understanding and monitoring biodiversity and for supporting decisions by the biodiversity and conservation communities. The value of EO is expected to further increase as new sensors are deployed and as advances in science and technology enable the generation of innovative and higher quality EO data products (e.g., see the [CEOS Ecosystem Extent Task Team White Paper](https://ceos.org/document_management/Publications/Publications-and-Key-Documents/Cross-Cutting/EETT%20White%20Paper%20V1.1%202023-12-04.pdf)). EO-based products are needed and utilized by a range of key stakeholders, including international agreements such as the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands of International Importance, and the Convention to Combat Desertification, as well as by governments at all levels.

Coordinating the instruments, activities, and expertise provided by multiple agencies can form a Virtual Constellation whose impact is greater than the sum of the individual efforts. With such coordination in mind, this Terms of Reference document outlines the mission, objectives, activities, and overall scope of the Biodiversity Virtual Constellation.

**CONSTELLATION NAME:** CEOS Biodiversity Virtual Constellation (B-VC)

**MISSION STATEMENT AND OBJECTIVES:**

**Mission Statement:** The mission of the CEOS Biodiversity Virtual Constellation is to enhance utilization of space-based Earth observations and data products to improve biodiversity understanding, monitoring, and conservation for the benefit of society.

Objectives: The B-VC has three inter-related objectives that form the top-level drivers behind its activities.

1. **Maximize Impact**: Maximize the societal benefit of space-based Earth observation and derived data products for biodiversity understanding, monitoring, and conservation.
2. **Engage Users**: Maintain active dialogue with biodiversity stakeholders to ensure a continued understanding of evolving user needs for space-based EO biodiversity data products and to tailor activities accordingly.
3. **Foster Coherence**: Facilitate alignment and connectivity across CEOS Agency missions, observations, data products, services, and related activities, as well as with the activities of other CEOS entities.

**CHARACTERISATION OF THE MEASUREMENTS AND DATA COLLECTIONS WITHIN SCOPE:**

Understanding and monitoring biodiversity requires measurements from a variety of types of sources: on the ground, in the air and/or in space. These measurements complement each other and enhance our understanding of the biosphere. Supporting the biodiversity community to better utilize the EO elements of this complex and diverse data landscape is one of the main objectives of the B-VC, which will address biodiversity in terrestrial, freshwater, coastal and marine ecosystems.

**CHARACTERISATION OF THE SPACE SEGMENT CONCERNED:**

Many space-based Earth observing instruments operated by CEOS Agencies can characterize the land surface and the marine environment, track their changes over time, and measure their organic and inorganic components. These capabilities, spanning both active and passive sensors, fall within the scope of the B-VC. Observations from existing missions already have proven ability to help address many of the identified user needs. However, forthcoming CEOS missions should greatly increase the degree to which these needs can be met, and the role of the B-VC is to track these developments.

**ACTIVITIES, OUTCOMES, AND DELIVERABLES:**

1. Identify priority gaps in data products such as biodiversity indicators and facilitate development of solutions to fill critical gaps
2. Facilitate enhancement of data processing and utilization tools needed to increase utilization of EO for biodiversity applications
3. Enhance existing CEOS biodiversity demonstrators, and explore possibilities for new ones, to provide useful exemplars and facilitate development and testing of needed EO capabilities
4. Prioritize and implement capacity building initiatives through close collaboration with CEOS WGCapD
5. Actively seek to increase biodiversity community engagement with EO and its applications for biodiversity understanding, monitoring, and conservation
6. Coordinate with GEO BON and its Global Biodiversity Observing System (GBiOS) concept to facilitate the wider use of space-based EO

|  |  |  |
| --- | --- | --- |
|  | **3-year horizon** | **5-years or more horizon** |
| **Space Segment** | * Develop plan to utilize forthcoming hyperspectral, L-band, and Lidar missions
 | * Update plans based on emerging experience
 |
| **Ground Segment & Information Systems** | * Identify and facilitate filling priority data product gaps
* Coordinate with GEO BON and GBiOS concept development
 | * Address additional data product gaps
* Guide GEO BON as it implements GBiOS
 |
| **Products and Services** | * Facilitate enhancement of end user utilization tools
* Engage with the biodiversity community
 | * Ongoing tool enhancement and community engagement
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**IMPLEMENTATION AND COORDINATION ISSUES TO BE ADDRESSED BY SIT:**

Achievement of B-VC objectives will benefit from CEOS leadership’s attention to the following implementation and coordination issues:

1. CEOS Agency participation in and support for B-VC membership and leadership
2. CEOS Agency support for development of new or enhanced product algorithms
3. CEOS Agency participation in and support for generation of biodiversity data products
4. CEOS Agency support for demonstrator development activities
5. Increased adoption by CEOS agencies of recommended data product standards and other recommendations

**SCHEDULE:**

The proposed schedule for the B-VC activities is as follows, recognizing that the detail and timeframe may evolve over time in accordance with CEOS Agency priorities and stakeholder needs:

| **Activity Topic** | **Milestones** | **Timeframe** |
| --- | --- | --- |
| Data product gaps | Prioritize needed products to fill product gaps | Year 1 |
| Develop plan and methods to fill gaps | Years 1-3 |
| Implement product gap-filling plan (incremental, with partners) | Years 2-5+ |
| Data utilization tools | Assess current tools and identify and prioritize enhancements | Years 1-3 |
| Develop plan and methods for enhancements | Years 2-4 |
| Implement tool enhancements (incremental, with partners) | Years 2-5+ |
| Demonstrator development | Continue development of the three Ecosystem Extent Task Team demonstrators (Hudson Bay—ECCC; Costa Rica—CNES; Great Western Woodlands—CSIRO) and seek new demonstrator options | Years 1, 2-5 |
| Capacity building | Work with WGCapD to prioritize and enhance capacity building | Continuous |
| Stakeholder engagement | Outreach and engagement via informational webinars, brochures, and other means | Continuous |
| Space arm of GBiOS | Identify needs, gaps, and challenges (jointly with GEO BON) | Years 2-3 |
| Integrate space-based EO into the GBiOS concept and architecture (jointly with GEO BON) | Years 3-7+ |

**MEMBERSHIP AND LEADERSHIP:**

The B-VC’s official membership consists of representatives of CEOS Agencies and their designees. Participation is open to all CEOS Agencies and (at the discretion of the co-leads) other organizations that are willing to support and contribute to the priorities of the B-VC.

To ensure smooth operation, the B-VC operates with a team of co-leads who are biodiversity experts selected from CEOS Agencies that concretely contribute to the outcomes of the B-VC. To promote membership diversity, the B-VC aims to attract membership across geographic regions. In the case where a co-lead or member, for any reason, cannot continue to serve in the VC, their Agency will have the first option to fill the position with an alternate. If the Agency chooses not to name or designate an alternate, the B-VC will seek biodiversity expert members from other CEOS Agencies that are actively contributing to the B-VC.

**RESOURCES:**

Three categories of support will provide the resources to enable the B-VC’s activities and to meet its objectives.

**B-VC team members.** As Biodiversity Study Team membership shows there is significant interest in Biodiversity across CEOS. Member time and associated resources will be supported by their sponsor Agencies in a manner similar to that for the BST. Additionally, certain activities will benefit from support from other CEOS entities that have the needed expertise.

The B-VC and its members largely focus on planning and facilitating biodiversity-relevant activities to increase utilization of space-based EO. While this will be supported by CEOS Agency involvement, the BST will invite members of the outside research and applied biodiversity communities such as those at universities, institutes, and other organizations to participate in the B-VC and to support its activities. Many BST members and several key Agencies already heavily engage with outside organizations through existing projects and other activities; this engagement will continue. Additional, in-kind participation is expected where there is alignment with an activity such as development of a product (product development is a common activity at universities, often by a graduate student under the guidance of their professor).

**Agency Research and Development Programs.** Some of the B-VC’s planned activities, such as algorithm and product development and the “demonstrators”, align with Agency research and development programs that already support these types of activities, often by soliciting proposals. Universities, institutes, and NGOs have focused on EO utilization for biodiversity for many years, as exemplified by the many proposals that space agencies have funded. The exceptionally high interest in ESA’s BioSpace25 conference (February 2025; many attendees had to be turned away as capacity was exceeded) is an example of the level of interest in this topic. It is noted that each of the three Ecosystem Extent Task Team Demonstrators was funded by a CEOS member Agency. Demonstrators such as those have components that support all of the B-VC’s planned activities and are a valuable tool for users seeking to enhance their use of space-based EO to meet their needs.

**External Support.** Another source of support for B-VC activities is proposals submitted to non-CEOS Agency organizations by B-VC external partners. For example, a national science agency or an agency within an Environment Ministry may solicit proposals for work relevant to the B-VC’s activities, such as development of a product or tool for which a biodiversity expert at a university then submits a proposal. An important role of the B-VC is to continue engagement with such external partners so they are aware of, and encouraged, to engage with potential B-VC activities.

1. Jet Propulsion Laboratory, California Institute of Technology [↑](#footnote-ref-1)