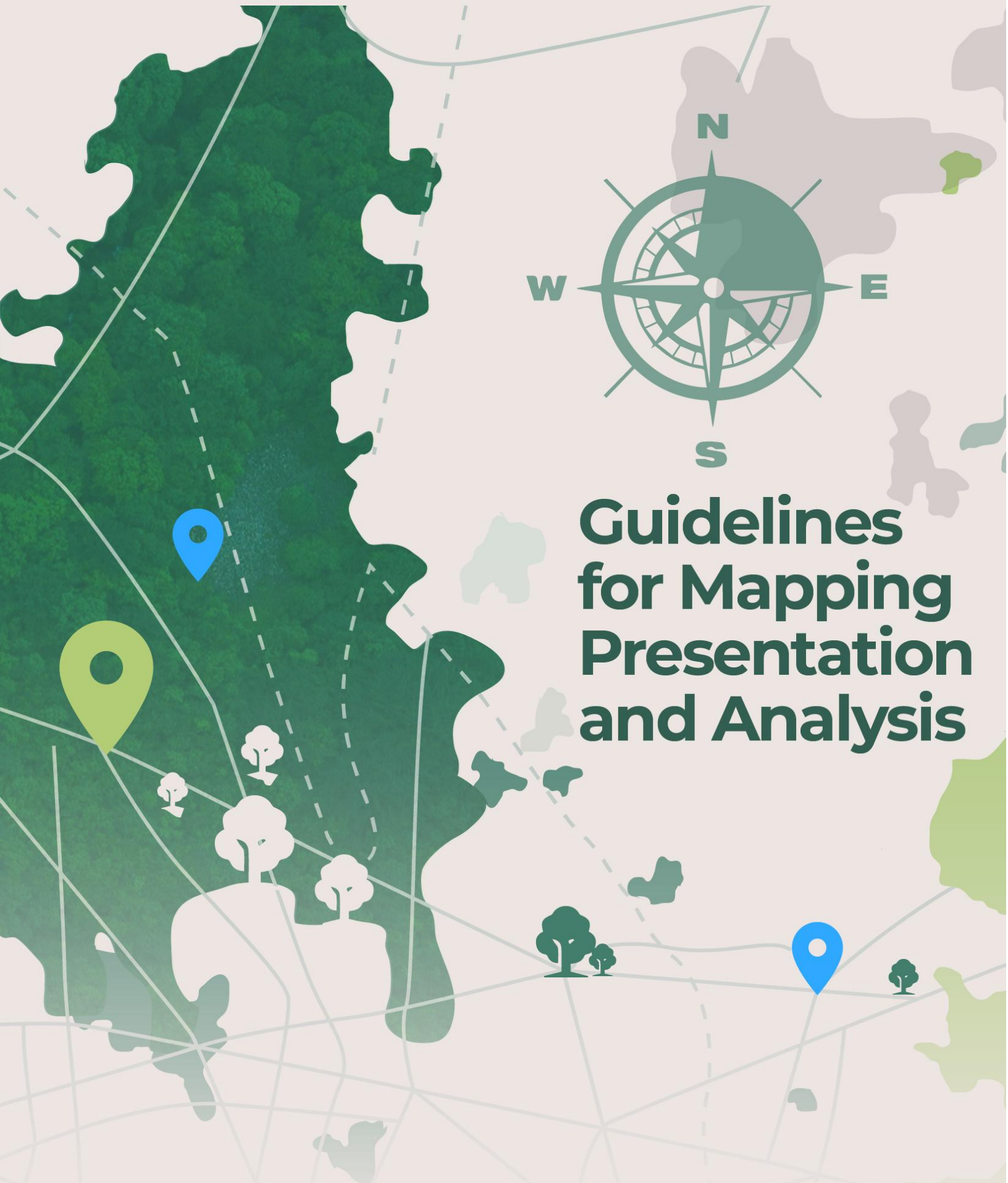

Guidelines for Mapping Presentation and Analysis

CERCARBONO
Certified Carbon Standard

CERCARBONO
Certified Carbon Standard

Guidelines for mapping presentation and analysis

Version 1.1

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Acronyms and abbreviations

AGD	Australian Geodetic Datum
CGRS	Constrained Gauss Reference System
CRS	Coordinate Reference System
ETRS	European Terrestrial Reference System
FCCB	Fondo Cooperativo para el Carbono de los Bosques
FREL	Forest Emissions Reference Level
GCF	Green Climate Fund
GCS	Geographic Coordinate System
GHG	Greenhouse gases
GIS	Geographic Information Systems
GPS	Geographic Positioning System
PDD	Project Description Document
REDD+	Reduction of Emissions from Deforestation and Forest Degradation and other actions in this sector
REM	REDD Early Movers
SIRGAS	Geodetic Reference System for the Americas
SPCS	State Plane Coordinate System
UNFCCC	United Nations Framework Convention on Climate Change
UTM	Universal Transverse Mercator
VVB	Validation and Verification Body

Terms and definitions

The terms and definitions contained in the document ***Terms and Definitions of the Voluntary Certification Programme of Cercarbono***, available at www.cercarbono.com, section: Documentation. For the purposes of this guidelines in particular, the following terms apply:

- **Area:** land extension or surface where a program or project is developed.
- **Coordinate reference system:** coordinate system referred to the earth's surface through a geodetic datum using one or more numbers (coordinates) to uniquely determining an object's position.
- **Dataset:** geospatial data group as small as a single property or property attribute contained within a larger dataset, existing in the mapping of programs or projects.
- **Dron:** device that allows imaging of different types of land and land coverage that facilitates the assessment and monitoring of activities performed in the land use sector.
- **Mapping:** graphical representation of the surface or area where a program or project is developed.
- **Mapping record:** catalog of geospatial data sets which includes information on their origin, content, quality, and other relevant metadata. This record can be used to manage and access the geospatial data sets used for the mapping of programs or projects.
- **Multi-polygon:** cartographic representation allowing modeling of geographical areas with complex boundaries and of internal structures, by grouping individual polygons present in programs or projects.
- **Geographic coordinate system:** system based on a reference spheroid such as the Earth, uses latitude and longitude to identify a certain point's position. Latitude is measured in degrees north or south of the equator, while longitude is measured in degrees east or west of the Greenwich meridian; units are normally expressed in terms of degrees, minutes, and seconds.
- **Geographic datum:** location-implicit/explicit information, related to the earth's surface within the mapping registered in Cercarbono.
- **Global Positioning System:** United States of America radio navigation system that provides reliable positioning, navigation, and timing services with free, uninterrupted access to civilian users worldwide. The system consists of satellites, ground stations and receivers. The area location and calculation of a given place is generated through a receiver that can have an accuracy range of millimeters to meters.
- **Overlap:** intersection of the areas included in a program or project registered in Cercarbono with another(s) registered in either Cercarbono or other standards.
- **Orthophoto:** high-resolution aerial or satellite photography geographically corrected to eliminate the effects of terrain relief and camera tilt, allowing accurate measurements of parameters such as distances and areas.
- **Polygon:** plane, flat, two-dimensional and closed geometric figure representing geographic areas on maps related to programs or projects; it displays associated

attributes describing specific features of the represented area, such as surface or perimeter, among others.

1. Introduction

Mapping is a valuable tool that allows visually identification of areas where programs or projects registered in Cercarbono are located. Its submission is one of the essential requirements of the certification process, highlighted both in Cercarbono's regulatory and technical framework and in the methodologies selected by them.

It is therefore necessary to standardize the way they are presented, so that it allows individualized and comparative analysis during the certification cycle in compliance with Cercarbono's principles, such as no double accounting, integrity, and transparency, among others.

Therefore, the spatial limits of each program or project will be precisely identified, allowing, among other objectives, providing certainty about the geographical scope in which the results of the activities pertaining to them will occur, as well as overlaps' identification and assessment, providing quantitative elements enabling their resolution.

The aim of this guidelines is the standardization of the mapping information of programs and projects registered in Cercarbono, thus supporting transparency of their actions in a spatial and temporal context, available to actors involved in the certification process and to society in general.

2. Scope

Application of this guidelines is mandatory for all programs or projects registered with Cercarbono, especially those related to land uses, including biodiversity conservation and restoration, registered in Cercarbono.

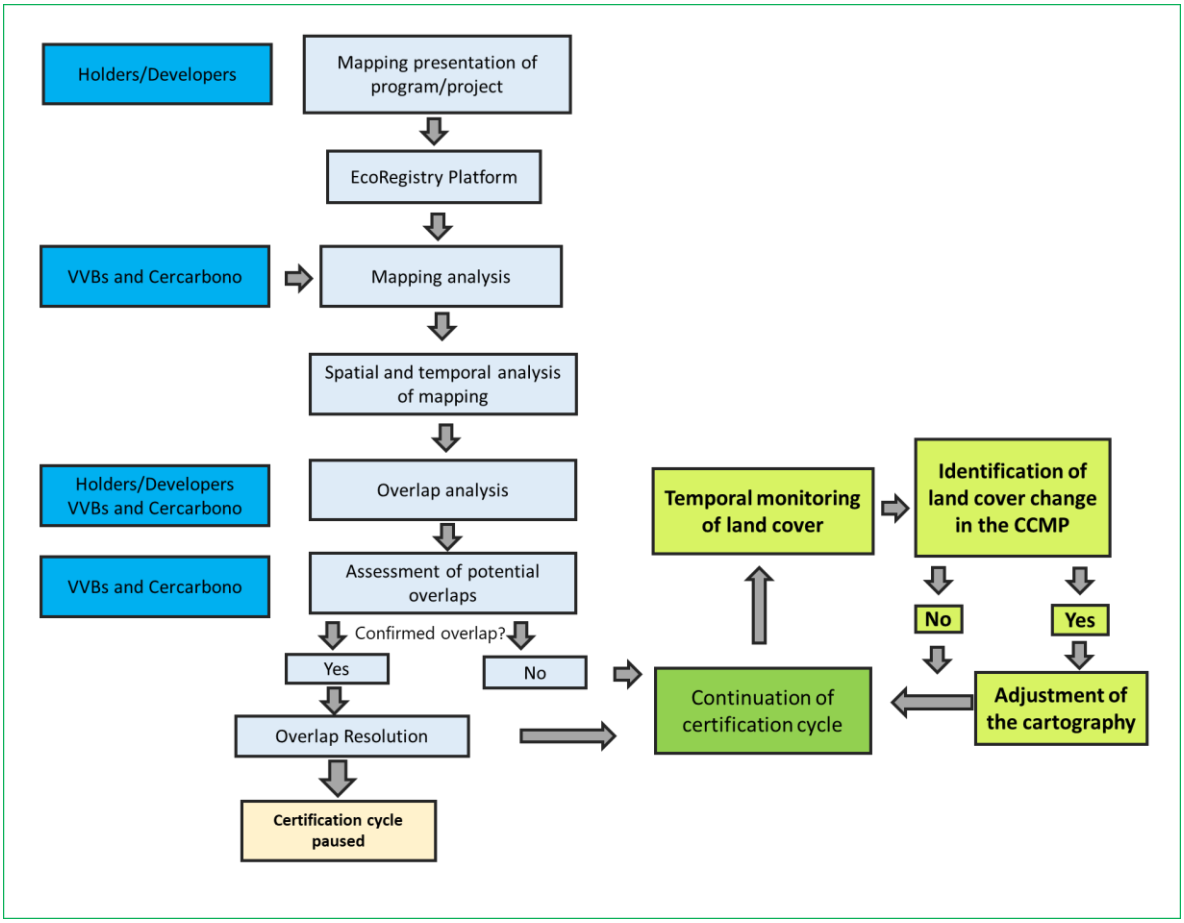
It is aimed to allow holders, developers and Validation and Verification Bodies (VVBs) providing guidance to the staff in charge of the preparation, presentation, and analysis of mapping information of these programs or projects.

Program and project activities included in such scope are:

- GHG removal.
- GHG emissions reduction.
- Materials' reduction and recycling.
- Conservation and restoration of biodiversity.
- Other activities requiring mapping information.

The key elements of this guideline are presented in **Figure 1**, including those responsible for each one of them.

Figure 1. Mapping presentation and analysis.



3. Mapping presentation

Holders and developers shall ensure that the areas established in the programs and projects registered with Cercarbono are identifiable, comparable, and measurable. Likewise, they shall independently verify that these areas are not a part of other initiatives with the same scope as that of the methodology(s) selected for their implementation; In addition, they shall ensure areas' compatibility according to the type of activity to be carried out, to avoid incurring in double counting events or situations of incompatible spatial or temporal area or facilities overlap[1].

Sections 3.1 to **3.5** present the elements holders and developers of programs or projects registered in Cercarbono shall consider for their mapping presentation. **Section 3.6** describes the form designed for such purpose.

[1] There are instances where the very nature of the mapping information (e.g., a point at which a facility is defined) causes several activities in that facility to be defined with the same geographic reference, which does not necessarily implies an overlap. In other situations, such as those in which leaks are monitored, overlaps of their reference areas would not present an incompatibility between projects sharing them.

3.1 Historical record for mapping

Programs or projects shall record the historical reference (day.month.year)[2] of the mappings presented at different stages of the certification cycle, especially when they are modified due to change requests or revisions in the validation, verification or certification stages.

3.2 Location data for programs and projects

It refers to the geographical representation of the surface, facility, or process unit where the activities of programs or projects registered in Cercarbono are carried out.

3.2.1 Area location

Programs and projects that are not implemented within a specific commercial or industrial building, facility or process unit shall describe its total area(s) in its mapping presentation.

Programs and projects in which a geographical description of the area representing them is required, such as those implemented in the land use sector (including those focused on biodiversity), shall consider as a minimum, the total and the eligible areas, represented in hectares (**Figure 2**).

In the case of CCMPs registered in the energy sector that involve photovoltaic parks or require surfaces larger than one hectare to carry out their activities, the cartography of the area must be presented as a polygon.

These programs or projects shall submit their mapping in the format established in **Section 3.4** by uploading it to EcoRegistry, as indicated in **Section 3.6**.

- **Total project area**

This area encompasses the total area of a given program or project, including eligible and ineligible areas (which also include, where applicable, leakage monitoring areas considered by some programs or projects in the land use sector). Therefore, holders and developers shall generate the cartographic survey and present it as one or more polygons, in which those areas are clearly identified.

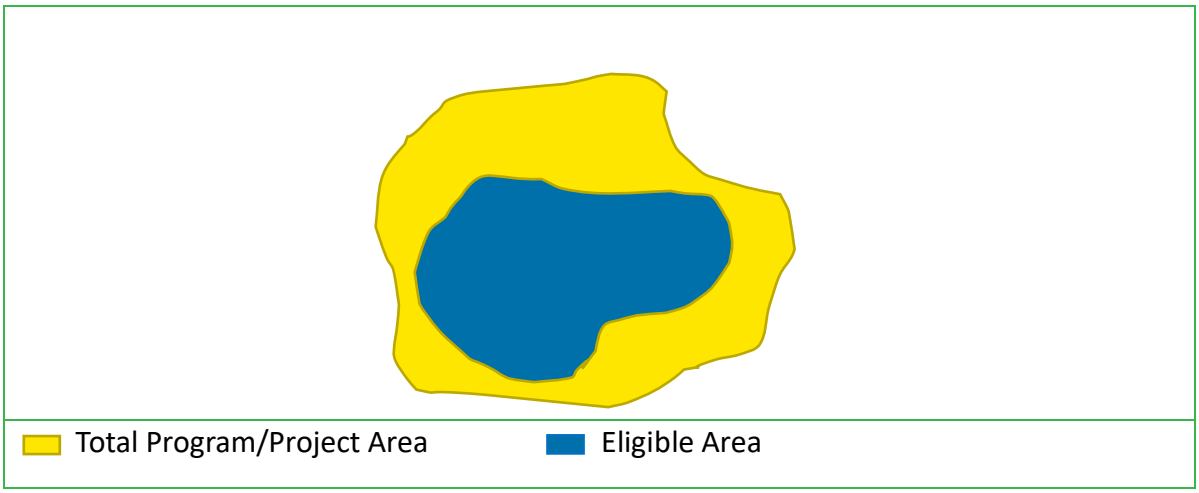
- **Eligible area**

It is the land surface, where the program or project certifiable activities are carried out. Such areas shall comply with the following:

- Have clearly established their geospatial boundaries.
- Comply with criteria established as per in selected methodologies.
- Identify, delimit, and represent through polygons the areas related to the eligible tree cover according to the activity and methodology developed, as is the case in some land-use sector projects, where they are classified as *stable forest*, *non-stable forest*, and *non-forest*.

[2] Both that for the mapping generation and the one corresponding to its registration in EcoRegistry platform, as established in **Section 3.6**.

Figure 2. Distribution of areas of programs and projects.



- **Non-eligible area**

It is the land area that does not meet the eligibility criteria; this area is part of the total area of the program or project and it is not necessary to represent it in the mapping, since its existence within it is implicit when identifying and representing the total area and the eligible areas, established in line with the selected methodology(s), being clearly delimited and defined by difference between the two.

3.2.2 Location data for commercial or industrial facilities or process units

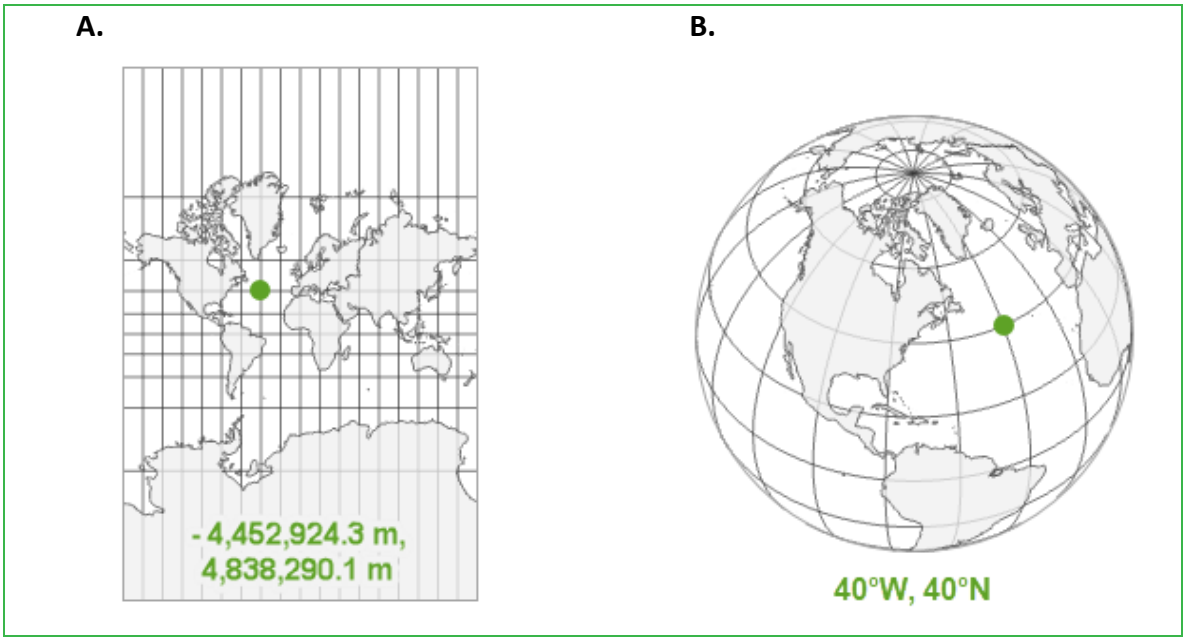
Programs and projects whose activity is carried out exclusively in buildings, industrial facilities or process units, may present their location (coordinates) as a fixed point in the geography in the forms established in **Section 3.4** and their upload shall be made into EcoRegistry as indicated in **Section 3.6**.

3.3 Coordinate Reference System

Coordinate Reference Systems (CRS) allow any point on the earth's surface to be defined primarily as coordinates (latitude and longitude values). They are divided into projected/planar and geographic coordinate reference systems (**Figure 3**).

Programs and projects registered in Cercarbono shall use the projected/ planar coordinate reference system in their mapping.

Figure 3. Representation of coordinate reference systems: A. Planar coordinate system. B. Geographic coordinate system.



Source: Image adapted from Esri, 2023.

3.3.1 Projected Coordinate System

Projected (or planar) coordinate systems are used to represent the Earth's curvature on a two-dimensional plane, allowing for a more accurate representation of distances and areas. These coordinate systems (see **Table 1**) are based on a specific mapping projection, which is a mathematical transformation of the Earth's spherical surface to a plane (Morales, 2024).

Table 1. Available planar coordinate systems.

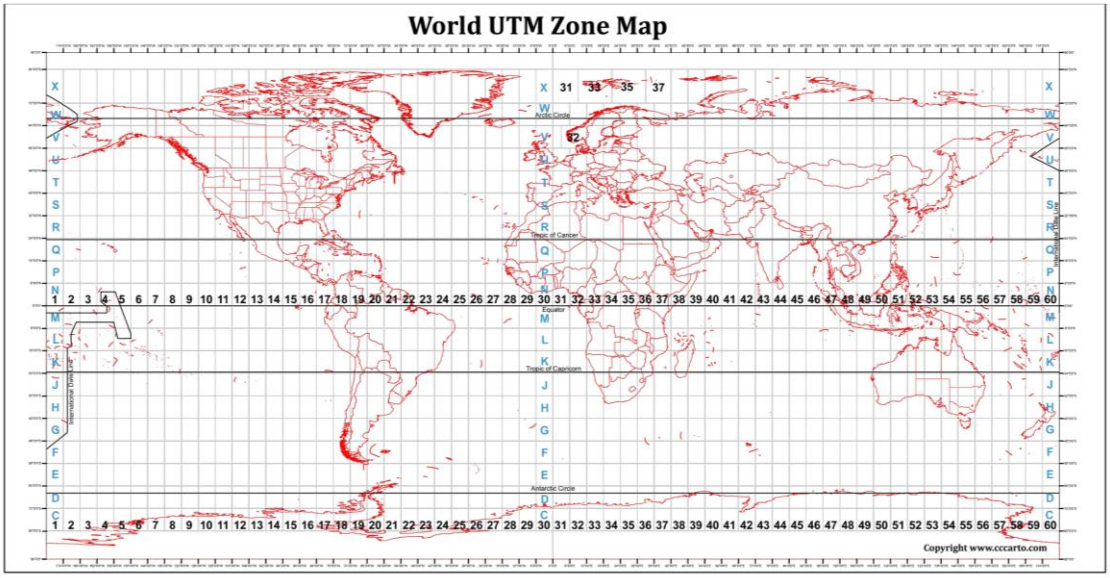
Region	Coordinate Reference System	Countries
Globally	UTM (Universal Transverse Mercator)	All countries.
Africa	Albers Equal Area Conic	Egypt and some Northern Africa regions
	Lambert Conformal Conic	Morocco and Tunisia
	Gauss-Krüger	South Africa and Angola
	Plane Rectangular Coordinate System	South Africa, Keny, and Nigeria
	Cassini-Soldner	Algeria, Tunisia, and Morocco
America	Versions for each country of origin within SIRGAS (Geocentric Reference System for the Americas) framework	All American continent countries

Region	Coordinate Reference System	Countries
	Gauss-Krüger	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela
	State Plane Coordinate System (SPCS)	United States
	CGRS (Constrained Gauss Reference System)	Brazil
Asia	Plane Rectangular Coordinate System	Japan, South Korea, Singapore, Taiwan, China, Indonesia, Malaysia, Thailand, among others.
	Gauss-Krüger Coordinate System	China, India, Russia, and South Korea.
	Local Coordinate System	Japan, South Korea, and Singapore
Europe	Versions for each country of origin within the European Terrestrial Reference System (ETRS) framework	Germany, France, Spain, Italy, United Kingdom, Sweden, Norway, among others.
	Gauss-Krüger *Coordinate System*	Germany, France, Spain, Italy, United Kingdom, Sweden, Norway, among others.
	Lambert Conic Conformal Projection	France, Belgium, Luxembourg, Netherlands, Spain, among others.
Oceania	Australian Geodetic Datum (AGD)	Australia, New Zealand, Papua New Guinea, and Pacific Islands.
	Plane Rectangular Coordinate System	Australia, New Zealand, Papua New Guinea, Fiji, and Vanuatu.

Source: independent research by Cercarbono.

Internationally, the UTM (*Universal Transverse Mercator*) coordinate system is used to reference any point on the Earth's surface, employing a particular type of cylindrical projection that represents the Earth on a grid-based plane. The UTM system divides the earth into 60 spindles of 6 degrees in length that complete its 360 degrees. The spindles are listed in ascending order toward the East (**Figure 4**).

Figure 4. UTM coordinate system.

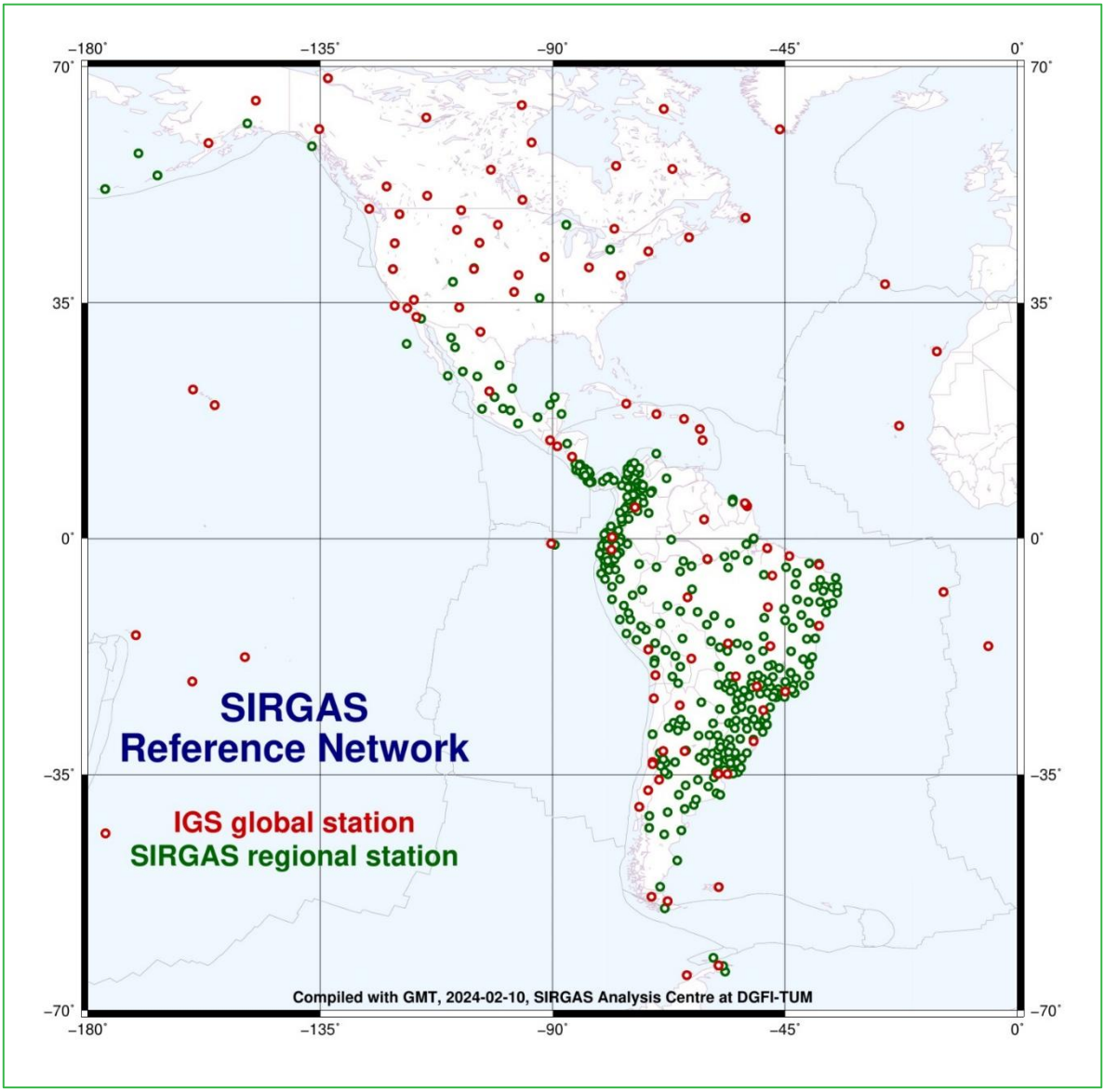


Source: Mavink, 2024.

For countries located in Europe, Russia, and China, in addition to the UTM, they mainly use the *Gauss-Krüger* coordinate system, featuring zones of 3 and 6 degrees wide, which differs from the UTM in some of its parameters such as the scale factor and sometimes the false East.

Meanwhile, for countries located in the three regions of America (North America, Central America, and South America), since 2001 and following the recommendation of the 7th United Nations Cartographic Conference for the Americas, it was established to adopt the Geodetic Reference System for the Americas (SIRGAS) as a reference system. Although this system implements a geocentric system, it is used to generate the flat projections of the reference systems in countries of the regions of the Americas, such as "SIRGAS 2000 Brasil Mercator", or "MAGNASIRGAS/Origen-Nacional", among others (**Figure 5**).

Figure 5. SIRGAS coordinate system in America.



Source: SIRGAS, 2024.

Based on the above descriptions, holders and developers shall select and specify the planar coordinate system used in the mapping of the program or project registered in Cercarbono, either selecting the UTM system (specifying the area in which the cartography is based), or the one officially adopted by the country where the program or project is located, as in the different countries of America adopting the SIRGAS coordinate system.

3.4 Format for mapping presentation

The mapping of programs and projects for the land use sector and other sectors requiring demonstration that their activities are carried out in specific areas shall be submitted in

shapefile [3] format (.shp)[4] with their auxiliary files under projected/planar coordinates, as set out in **Section 3.6**. These files shall be integrated as a compressed folder in Zip format (.zip), then uploaded into EcoRegistry.

For programs or projects implementing activities exclusively in buildings, industrial facilities, or process units (**Section 3.2.2**), their location data shall be uploaded into EcoRegistry in Shapefile format (.shp).

3.5 Quality of mapping

The mapping information submitted by the holders or developers of programs and projects shall consider the following guidelines specified in ISO 19157-1:2023 Standard:

- Understand and incorporate the concepts of mapping data's quality and measurement. Establishing the foundations needed to define and understand the factors that influence the quality of geospatial data, such as positional accuracy, thematic accuracy, and temporal accuracy. By understanding these factors and their implications, practitioners can develop effective strategies to measure and improve the quality of geographic data in their projects and applications.
- Define data quality conformance levels in the data product specifications. This involves establishing the criteria and metrics that will be used to assess the quality of the data and determine whether they meet the requirements set forth for the geospatial data in terms of positional accuracy, thematic accuracy, completeness, consistency, and other quality factors identified in the standard.
- Specify quality aspects in application schemas. This may include specific quality criteria that geospatial data shall comply with to meet the needs of the project or organization, as well as procedures for assessing and ensuring data quality throughout the data lifecycle.
- Evaluate and report on data quality. To do this, GIS experts should systematically assess by following the steps below:
    - Establish quality criteria.
    - Select assessment methods.
    - Collect quality data.
    - Perform quality analysis.
    - Generate the quality report and,
    - Present the findings.

Compliance with mapping quality shall be highlighted in the Project Description Document (PDD).

3.5.1 Sources of information

The holder or developer of the CCMP must present the cartography and provide evidence of cartographic surveying based on reliable and verifiable information sources with medium

[3] Geospatial vector data format used in *geographic information systems (GIS)* software.
[4] This type of format has been selected among others, due to the fact it supports a wide range of advanced functionalities and capabilities in GIS software, as well as for its robust structure to store attributive data associated with geospatial features in a reliable and accurate way.

or high spatial resolution, proportional to the scale of the CCMP as specified in **Section 3.5.3**. **Table 2** presents some of the sources used in the generation of CCMP cartography.

Table 2. Sources of information used in the construction of cartography.

Remote sensor type / technology	Derived product	Source of capture	Format	Applications and technical considerations
Multispectral optical satellite	Multispectral images (RGB, NIR, SWIR)	Satellites (Landsat, Sentinel-2, WorldView, Planet) and multispectral drones	GeoTIFF, JP2	Suitable for land-cover classification, change monitoring, and NDVI/NBR analysis.
Hyperspectral optical satellite	Hyperspectral images	Satellites (PRISMA, EnMAP) and hyperspectral drones	GeoTIFF, HDF5	Greater spectral detail, useful for identifying species and vegetation condition.
Synthetic Aperture Radar (SAR)	Radar images	Satellites (Sentinel-1, ALOS PALSAR, RADARSAT)	GeoTIFF, HDF5	Useful in cloudy areas; detects structure and moisture.
LiDAR (Light Detection and Ranging)	3D point clouds, Digital Elevation Models (DEM/DSM)	Satellites (ICESat-2, GEDI), aircraft, drones, terrestrial vehicles	LAS, LAZ, ASCII XYZ, GeoTIFF (derived)	Allows estimation of vegetation height, relief, and structures; highly accurate.
GNSS (Global Navigation Satellite Systems) (e.g., GPS, GLONASS, Galileo, BeiDou)	Precise georeferenced coordinates	Portable GNSS receivers or those integrated into drones/mobile devices	CSV, shapefile, GPX	Fundamental for georeferencing and quality control in cartography.
Orthophotography	Georeferenced orthophotos	Satellites, aircraft, drones	GeoTIFF, JPEG2000	Geometrically corrected image for precise distance and area measurement.

To generate adequate and precise collection of cartographic information, the minimum mappable area (see **Section 3.5.2**), understood as the minimum unit of interpretation of cartographic sources and corresponding to the working scale, must be equal to the minimum size established in the forest definition of the country where the CCMP is implemented.

For land-cover classification (stable forest, non-stable forest, and non-forest), orthophotos must be implemented, which may be constructed or downloaded from free or paid geospatial data portals. In addition, methodologies, spatial scales, and minimum area measurement units generated by the forest monitoring entities of the country where the CCMP is located must be applied.

3.5.2 Minimum mappable area unit

It is understood as the minimum unit of interpretation of cartographic sources, corresponding to the scale of work used (**Section 3.5.3**). It shall be equal to the minimum unit established in the context in which the program or project is developed, according to

the selected methodology or applicable guidelines, such as those established by some countries in their “forest” definition.

For CCMPs that develop agricultural activities, the minimum unit will be designated as the plot (woody crop activity) or the stand (reforestation or forest restoration activity, which may be a continuous unit or made up of several polygons that may be smaller than the minimum forest area defined by the country where the CCMP is located). These may be separated by a land feature (power line, forest road, water network, protection zones, among others), as long as such separation does not exceed 20 meters between the nearest points. If the separation distance exceeds 20 m, the CCMP holder or developer must justify it, considering landscape conditions in line with applicable national or subnational environmental regulations.

Identification and monitoring images must have high spatial resolution, accepting images from 10 cm to 5 m per pixel, and must cover a minimum area of 0.25 ha. In addition, the following conditions must be met:

- The CCMP holder or developer must provide evidence—through cartography, remote sensing images, or field verification—that demonstrates that the separated stands are ecologically connected and belong to the same management unit, despite the physical separation.
- Any separation greater than 20 meters must be duly justified from a technical standpoint, demonstrating that the ecological continuity of the intervention is maintained and that the separated stands continue functioning as a coherent management unit.
- Separations caused by roads or operational corridors must be demonstrably necessary for the proper establishment, maintenance, monitoring, and harvesting of the stands, without causing significant ecological fragmentation.
- Spatial separation must not be used as a mechanism to artificially increase the figures of emission reductions or removals of the CCMP.

3.5.3 Minimum forest area unit

For cartographic purposes, the minimum forest unit shall correspond to the smallest continuous forest cover unit that can be identified, measured, and audited. In this regard, a general reference area of 1 ha is adopted, unless a different unit is officially established by the country where the CCMP is being implemented.

3.5.4 Mapping Scale

The holder or developer must ensure that the scale of the cartography is proportional to the program or project area, allowing for adequate analysis. In this sense, the scale

generated by the official cartographic authority and adopted by the country where the CCMP is developed must be used (**Table 3**).

Table 3. Scale and area covered in a cartography in some of the countries where CCMPs are registered in Cercarbono.

Country	Entity (Institution)	Scale (min–max)	Minimum area covered per sheet (ha)	Maximum area covered per sheet (ha)
Colombia	IGAC - Instituto Geográfico Agustín Codazzi	1:500 - 1:500000	14,6	6000000
México	INEGI - Instituto Nacional de Estadística y Geografía	1:1000 - 1:250000	4	150000
Honduras	DGGM/INETER - Dirección de Geografía y Cartografía	1:10000 - 1:50000	100	2500
El Salvador	IGCN - Instituto Geográfico y del Catastro Nacional	1:5000 - 1:50000	25	2500
Nicaragua	INETER - Dirección General de Geodesia y Cartografía	1:10000 - 1:250000	100	150000
Dominican Republic	ICM/SGN - Instituto Cartográfico Militar	1:5000 - 1:100000	25	10000
Panamá	IGN - Instituto Geográfico Nacional	1:1000 - 1:100000	4	10000
Ecuador	IGM - Instituto Geográfico Militar	1:1000 - 1:1000000	4	6000000
Perú	IGN - Instituto Geográfico Nacional	1:1000 - 1:500000	4	6000000
Brasil	IBGE - Instituto Brasileño de Geografía y Estadística	1:1000 - 1:1000000	4	6000000
Chile	IGM - Instituto Geográfico Militar	1:5000 - 1:250000	25	150000
Argentina	IGN - Instituto Geográfico Nacional	1:10000 - 1:500000	100	6000000
Bolivia	IGM - Instituto Geográfico Militar	1:10000 - 1:250000	100	150000

Country	Entity (Institution)	Scale (min–max)	Minimum area covered per sheet (ha)	Maximum area covered per sheet (ha)
Costa Rica	IGN - Instituto Geográfico Nacional	1:5000 - 1:200000	25	40000
Paraguay	IGM - Instituto Geográfico Militar	1:10000 - 1:100000	100	10000
Ghana	SMD - Survey & Mapping Division	1:2500 - 1:50000	625	2500
Ethiopia	GSE - Geological Survey of Ethiopia	1:10000 - 1:250000	100	150000
Turkey	GDM - General Directorate of Mapping	1:1000 - 1:1000000	4	6000000
India	SoI - Survey of India	1:10000 - 1:1000000	100	6000000
Nepal	DoS - Department of Survey	1:10000 - 1:250000	100	150000
Bangladesh	SoB - Survey of Bangladesh	1:10000 - 1:250000	100	150000
Laos	NGD - National Geographic Department	1:10000 - 1:100000	100	10000
Vietnam	DMA - Defence Mapping Agency	1:2000 - 1:100000	4	10000
Indonesia	BIG - Badan Informasi Geospasial	1:1000 - 1:250000	4	150000
Malaysia	JUPEM - Jabatan Ukur dan Pemetaan Malaysia	1:1000 - 1:500000	4	6000000
Egypt	ESA - Egyptian Survey Authority	1:5000 - 1:1000000	25	6000000

3.5.5 Spatial resolution

Programs or projects with areas larger than one hectare may use high scale and medium-low resolution satellite images (see **Table 3***),* depending on the sensor consulted (e.g., images taken from sensors in the Landsat constellation).

Meanwhile, programs or projects (especially grouped ones) featuring polygons with areas less than one hectare shall use images captured by unmanned vehicles (drones) which ensure a high resolution of such areas with pixels smaller than 10 cm.

The following describes the spatial resolutions allowed by Cercarbono:

- **Medium-low spatial resolution:** information with a spatial resolution of 10 m to 30 m, which allows the definition of working scales of less than 1:50,000, from spectral sensitivity systems or satellite images such as Sentinell, Landsat, SPOT, ALOS, AVNIR-2, ASTER and IRSS.
- **High spatial resolution:** information with a spatial resolution of less than 5m, which allows the definition of working scales greater than 1:50,000, from spectral sensitivity systems, satellite, or aerial images such as RapidEye, orthophotos and LiDar.

3.6 Mapping information filling out

The information required for the correct analysis of the cartography present in the program or project shall be filled out and uploaded into EcoRegistry by the holder or developer of the program or project registered in Cercarbono, according to the certification cycle stage of the requiring it.

For this procedure, a form with related directions will be displayed in EcoRegistry, as per in **Figure 6**.

Figure 6. Form available at EcoRegistry for mapping presentation.

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Form for the submission of mapping to Cercarbono by a programa or project

Date uploaded into EcoRegistry	Mapping creation date	File	Country	Location	Total project area (ha)	Eligible project area (ha) (As applicable)	Coordinate system	Comments

4. Cartography analysis

4.1 Mapping quality assessment

Once the holders and developers of programs or projects registered with Cercarbono have submitted their mapping, it shall be audited during the validation and verification events as well as subsequently reviewed in the certification process, assessing:

- The coordinate system used in the mapping of the areas, which shall follow a flat/projected coordinate system as specified above.
- The polygon(s), including the specific point or total area and eligible areas (as applicable) of the program or project[5]. They can be set by layers or multi-polygons.

[5] For REDD+ programs or projects, verify that they are aligned with the Forest Emissions Reference Level (FERL) of the country in which it is implemented, and that the ecological divisions established therein (such as biomes, ecotypes, among others) are considered.

- The specific location point or total eligible area (where applicable), against information supported in the Project Description Document (PDD) of each program or Project.
- That mapping is considered only for the scope of activity established in a given program or project (especially in the land use sector). This point is further explained below.

4.2 Mapping spatial and temporal assessment

In the validation and verification processes, the areas included in each program or project shall be subjected to analysis/review to ensure they are not in an overlap situation, especially for programs or projects in the land use sector; to this end, following actions shall be carried out as a minimum:

- Review the cartographies of the programs and projects registered in Cercarbono (EcoRegistry platform), with overlap potential according to the subject project or program location.
- Consult national registry(ies) of environmental initiatives in the country in which the program or project is being developed (as available). This information shall be included in the validation or verification report (including an access link).
- Consult information repositories on national or subnational environmental programs in the country where the programs or projects are implemented.
- Consult the records of other standards supporting activities related to the subject program or project activity.
- Consult REDD+ programs or projects in the information repository of NREFs submitted to UNFCCC or the results-based payment programs of the Forest Carbon Partnership Facility (FCCB), Biocarbon Fund, REDD Early Movers (EMR) Program, GCF (Green Climate Fund) and on the pages reporting on climate action of the governments of Germany, Norway, and the United Kingdom, among others.
- Consult the Ecosystem Market Place project database.

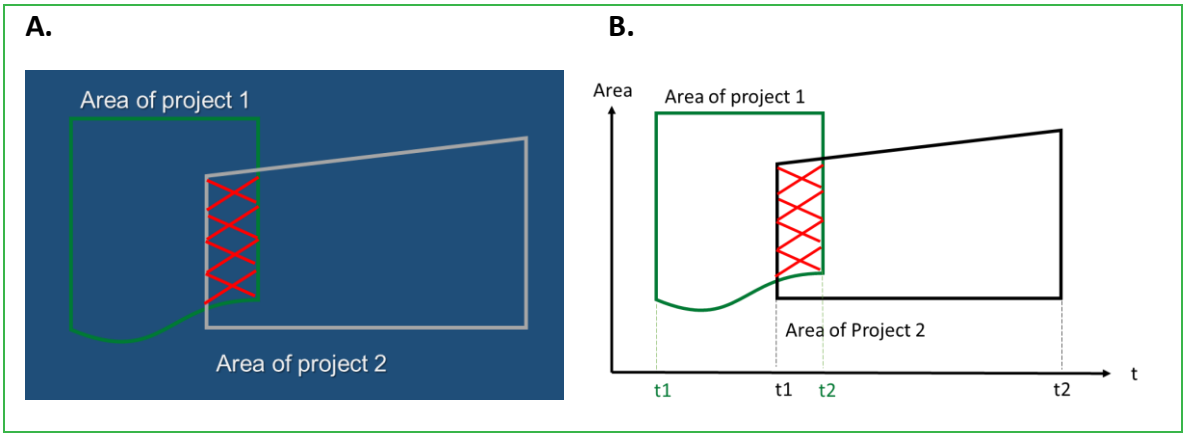
4.3 Overlap assessment

In the validation, verification, and certification processes, and after the general review of the cartography, an overlap analysis shall be carried out that will allow:

- Preventing or detecting double counting events.
- Identify potential area intersections involving different programs or projects.
- Identify potential temporal intersections between different programs or projects.
- Ensure transparency in the validation, verification, and certification processes.

The overlap of a program or project registered in Cercarbono with another(s) registered either in Cercarbono or in other standards can be of following types: spatial or temporal (**Figure 7**).

Figure 7. Spatial (A) or temporal (B) overlap between programs or projects.



- **Spatial overlap**

It occurs when two or more programs or projects have a partial or total overlapping common area.

- **Temporal overlap**

It occurs when two or more programs or projects, in addition to a spatial overlap, present an overlap in the registration period before a standard and/or in the Crediting period granted by the standard.

If there is an overlap, it should be considered they could be:

- **Compatible:** Simultaneous overlapping of the "partial or total" area, where two or more programs or projects can coexist, provided the activities and final results are different from each other. Therefore, mainly the spatial overlap is reviewed and analyzed.
- **Non-compatible:** simultaneous overlapping of the “partial or total” area, the registration or crediting period, and the activity of the programs or projects. Therefore, two or more programmes or projects cannot coexist, considering the above characteristics. Therefore, spatial and temporal overlaps are reviewed and analyzed.

4.3.1 Systematized identification of overlaps

In the formulation, validation, verification, and certification processes, for the identification of possible overlaps between two or more programs or projects, the holders/developers, VBBs and Cercarbono may use and combine various ways of doing so, either using available automated tools such as the one developed by EcoRegistry or using their own internal procedures to identify them.

EcoRegistry's GeoCarbon tool is available to holders/developers and OVVs authorized by Cercarbono, which allows identifying whether there are possible geographic overlap situations, generating an automated report on the program or project under analysis.

4.3.2 Confirmation of identified overlaps

In the validation, verification, and certification processes, once potential overlaps have been identified, either using automated tools or by means of internal procedures, the cartography is analyzed to either corroborate the overlap or clarify the subject areas are not in an overlap situation, as follows:

4.3.2.1 Compilation and homogenization of cartography with possible overlaps

Cartographies of each of the programs or projects with potential overlapping are compiled to be analyzed using Geographic Information Systems (GIS) *specialized software*.

To ensure cartography homogeneity, it should be checked all mappings share the same coordinate systems. Otherwise, they will be projected into a single type of planar coordinate system. The planar coordinate system selected will depend on the country in which the program or project is developed as set out in **Section 3.3.1**.

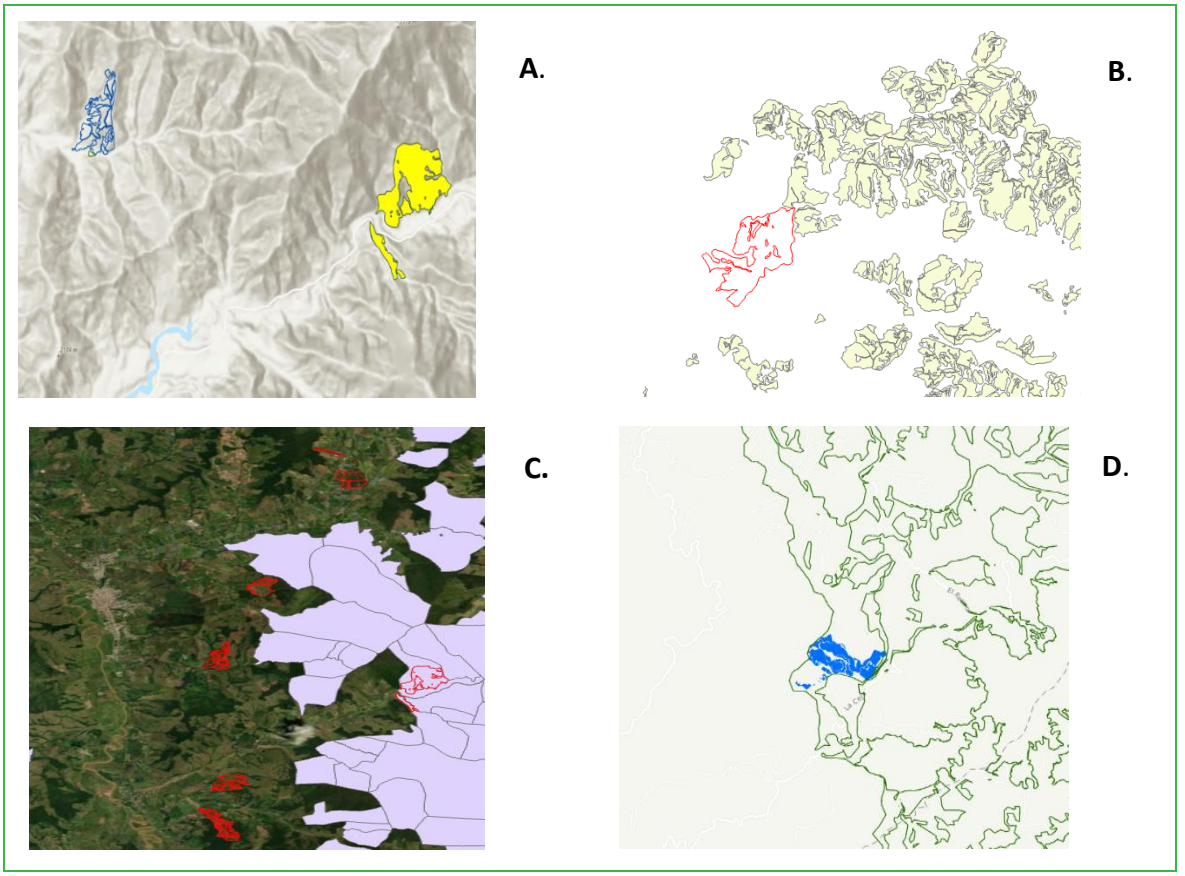
For this step of the overlap analysis, specialized GIS software shall be used, in the case of Cercarbono, ArcGIS pro®. There are other software packages that provide the same type of geographic information analysis, the selection of which will depend on technical considerations of the organization performing the overlap analysis.

4.3.2.2 Analysis of possible overlapping areas

Once the cartography of the programs or projects with possible overlap has been compiled and homogenized, as applicable, following steps shall be carried out:

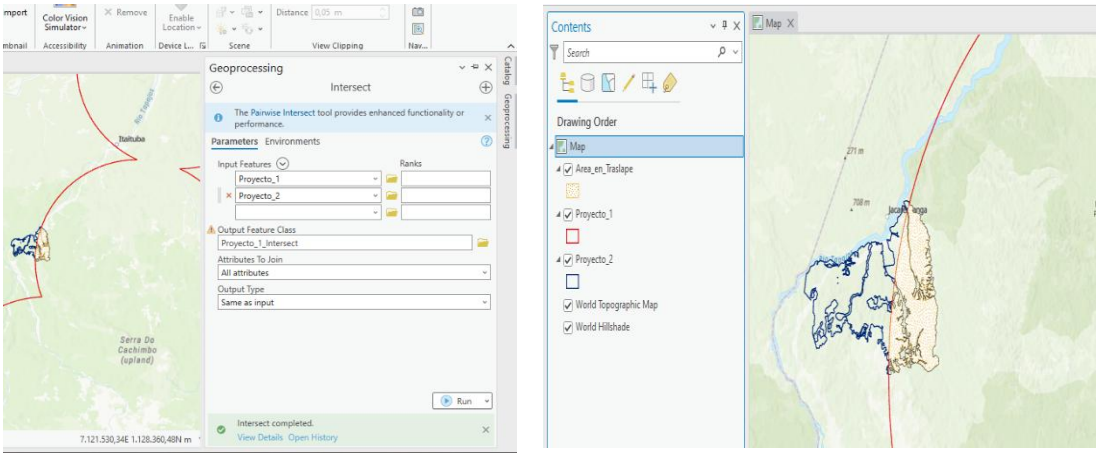
1) Visual assessment of the areas comprised in the programs or projects with possible overlap to identify if their areas are overlapping (see **Figure 8**).

Figure 8. Visual assessment of possible overlaps. Figures A and B correspond to programs or projects without overlapping areas. Figure C, partial overlap between program/project areas and D. total area overlap of program and/or project.



2) Analysis of areas using the GIS tool, once it has been visually identified that areas of the programs or projects are overlapping. This is performed to calculate geometric intersections between the polygons that make up the areas of the programs or projects; Cercarbono implements the "Intersect" tool available in ArcGIS Pro® software, which creates a polygon with the overlapping areas (see ***F*igure 9)**.

Figure 9. Assessment of overlapping areas using the "Intersect" tool available in ArcGIS Pro®.



3) Once the polygon with the overlapping areas has been created, an estimate of the area present in the overlap polygon is generated (see **Figure 10**), using this general process:

   a) Open the polygon attribute table.
   b) Create a specific column for the polygon areas to verify the units in the polygon are hectares.
   c) Calculate the area of the polygon using the "Calculate Geometry" tool.
   d) Finally, the total area of the polygon is calculated using the "Statistics" tool.

Figure 10. Generation of the area estimate for the overlap polygon.

4.2.3.3 Overlapping areas report

Once the assessment on potential overlapping areas between two or more programs or projects has been performed, a report is generated, concluding if there is any overlap.

In the validation or verification process, this report shall be delivered to the program or project by means of a request (either a clarification- or a corrective request), which shall be included and shall appear as resolved in the final validation or verification report.

In the certification process, the final report is sent to the program or project holder, developer or VVB, attached to the corresponding change request through the EcoRegistry platform.

4.3.3 Resolution of overlaps identified in the certification cycle

Once the overlapping areas in the programs or projects registered with Cercarbono have been identified, it is necessary to consider in which certification cycle stage they are:

- **At the registration and certification stages:**

Cercarbono, through EcoRegistry platform, will send the final reports on potential overlaps identified to the holders/developers of programs or projects that are in these stages, which shall review the eligibility criteria of the selected methodology and shall perform pertinent adjustments.

The holders/developers shall make independent or Cercarbono-mediated (per parties request only), approaches with the holders/developers of involved programs or projects either those registered in Cercarbono or those registered in other standards for the resolution of the overlap situation.

If the programs or projects do not reach a consensus, they should refer the matter to the competent authorities to settle the differences or put the situation on hold, in which case the certification cycle of the program or project in an overlapping situation will be paused until a voluntary or legal resolution is reached.

Additionally, following steps shall be followed according to the particular scenario:

- ***If there is a compatible overlap:***

The holder/developer in these stages shall demonstrate that the activities to be developed in the areas have a different scope than those for the program/project already registered or implemented either in Cercarbono or in other standards.

- ***If there is a non-compatible overlap:***

The holder/developer at these stages shall assess/remove the overlapping areas considering:

– If the registration and crediting periods for the overlapping projects or programs are the same, an analysis should be carried out on the ownership of the property and its

participation in the program or project activity. The holder is the one who chooses in which program or project he//she/it will participate, eliminating the areas of the program or project that do not have his//her/its endorsement.

- If the registration and crediting periods are different, the first program or project registered in the national registration system of the country (if any) where the program or project is or will be implemented will be supported. Subsequently, and supplementary to this, the first program or project registered or certified by Cercarbono6 or another standard will be supported.
- If the program or project has generated carbon credits, Cercarbono will activate the procedures corresponding to post-certification adjustments or facts discovered after certification established in its regulatory framework. Such credits will continue to be considered valid until otherwise determined, however, they may be blocked preventatively (if available) until the overlapping situation is resolved.

- **In the validation or verification stages:**

It will be directly the VVBs who shall generate the identified overlap reports and make the respective requests to each program or project.

5. Monitoring of land cover

CCMPs registered under methodologies in the land-use sector, such as REDD+ or Agroforestry, shall include within the total and eligible area the following classification in relation to their land cover, according to the activity being developed (Figure 2):

I. Areas of stable forest.
II. Non-stable forest.
III. Non-forest.
IV. Settlements.

For the generation of land-cover monitoring, the following steps shall be followed:

1. **Preliminary analysis**: this allows the establishment of a region in which the cover of stable forest and the changes it has undergone (non-stable forest or non-forest—the latter applicable if it corresponds to other land-use categories) are analyzed over a period equal to or greater than ten years. The preliminary analysis confirms eligible and non-eligible areas, as well as the program or project activities that the CCMP will implement.

The documentation used for the analysis must consider the entirety of the area to be included in the CCMP, and the existing land covers at the date of the analysis must be substantiated. The cartographic interpretation must be complemented to support the land covers (and their classification) as of the start date of the CCMP and those at the time of legal support.

[6] As it complies with the guidelines as per in the certification cycle established in Cercarbono's protocol.

2. **Use and analysis of images**: images from sensors such as CBERS, RapidEye, ASTER, Sentinel-2, Sentinel-1, LiDAR, among others, may be used. The images must have cloud cover lower than 10%. To achieve this cloud-cover threshold, mosaics of images from a period of less than one year may be generated. The images must be geometrically and radiometrically corrected to eliminate distortions or use orthophotos that already include these corrections.

To identify and classify the land covers present in the CCMP area, structural or spectral indices may be implemented, depending on their applicability and availability (Table 4).

Table 4. Spectral or structural indices implemented in tree-cover analysis.

Index	Type of index	Data source	Formula / Calculation method	Description
NDVI (Normalized Difference Vegetation Index)	Spectral (optical)	Multispectral satellites (Landsat, Sentinel-2, Planet), multispectral drones	(NIR − Red) / (NIR + Red)	Differentiates vegetation / non-vegetation
EVI (Enhanced Vegetation Index)	Spectral (optical)	Multispectral satellites	2.5 × (NIR − Red) / (NIR + 6×Red − 7.5×Blue + 1)	Differentiates dense forests / low vegetation / non-vegetation
GNDVI (Green Normalized Difference Vegetation Index)	Spectral (optical)	Multispectral satellites and drones	(NIR − Green) / (NIR + Green)	Separates crops / grasslands / forests according to chlorophyll content
SAVI (Soil Adjusted Vegetation Index)	Spectral (optical)	Multispectral satellites and drones	[(NIR − Red) / (NIR + Red + L)] × (1 + L), L ≈ 0.5	Classification in arid areas or with high soil influence
NDWI (Normalized Difference Water Index)	Spectral (optical)	Multispectral satellites	(Green − NIR) / (Green + NIR)	Separates water covers vs. vegetation or soil
Hmax (Maximum canopy height)	Structural (LiDAR)	Satellite LiDAR (GEDI, ICESat-2), airborne LiDAR, LiDAR drones	Maximum return height	Distinguishes tall forest, low forest, shrubland, grassland
Hmean (Mean canopy height)	Structural (LiDAR)	Satellite, airborne or drone LiDAR	Average of returns' height	Refines classification of vegetation types

Index	Type of index	Data source	Formula / Calculation method	Description
Canopy Cover	Structural (LiDAR)	LiDAR, 3D photogrammetry	% of returns above a threshold	Determines presence of forest vs. open areas
RVI (Radar Vegetation Index)	Structural (SAR)	Polarimetric SAR (Sentinel-1, ALOS PALSAR, RADARSAT)	(4 × HV) / (HH + VV)	Estimates biomass and vegetation density
VH/VV Ratio	Structural (SAR)	Dual-pol SAR (Sentinel-1)	VH / VV	Differentiates vegetation vs. hard surfaces or water
HH/HV Ratio	Structural (SAR)	Polarimetric SAR	HH / HV	Differentiates dense forest vs. crops/grasslands
Entropy (H)	Structural (SAR)	Polarimetric SAR (Cloude-Pottier decomposition)	Measure of scattering randomness	Differentiates cover types according to scattering
Alpha angle (α)	Structural (SAR)	Polarimetric SAR	Mean scattering angle	Differentiates volumetric vegetation vs. double bounce

Once the indices have been calculated, the characteristic ranges for each land cover must be defined and validated/verified in the field. **Table 5** presents typical ranges of indices that may be used in land cover classification. It is recommended to combine at least one spectral index and one structural index in order to improve mapping accuracy.

Table 5. Typical ranges of indices used in land cover classification.

Index	Typical range	Interpretation	Probable land cover
NDVI	< 0.1	Very low or no vegetation	Water, bare soil, infrastructure
	0.2 – 0.5	Low or sparse vegetation	Grassland, young crops
	> 0.6	High vegetation biomass	Dense forest
EVI	< 0.2	Sparse vegetation	Bare soil or sparse grass
	0.3 – 0.5	Moderate vegetation	Shrubland, crops
	> 0.5	High vegetation density	Forest
NDWI	> 0.3	High water presence	Rivers, lakes, wetlands
	< 0.1	Low surface moisture	Dry vegetation, soil
Hmax (m)	< 1	No tree structure	Grassland, low crops
	1 – 5	Shrubland or regeneration	Shrub, secondary vegetation
	> 15	Tall forest	Primary or mature secondary forest

Index	Typical range	Interpretation	Probable land cover
Hmean (m)	0.5 – 3	Low vegetation	Grassland, shrubland
	> 8	Tall vegetation	Mature forest
Canopy Cover (%)	< 20%	Very low cover	Open areas, crops
	20 – 70%	Medium cover	Shrubland, sparse forest
	> 70%	High cover	Closed forest
VH/VV ratio	< 0.2	Smooth surfaces or water	Water, bare soil
	0.3 – 0.6	Low or medium vegetation	Grassland, shrubland
	> 0.6	Volumetric vegetation	Dense forest

To carry out the land cover classification, "supervised" and "unsupervised" classification methods may be used through the different tools available in specialized GIS software:

a) **Supervised method**. Requires training data and algorithms such as Random Forest, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), or Convolutional Neural Networks, among others, may be used.
b) **Unsupervised method**. Generated through clustering by spectral similarity, with the most widely used methods being K-Means and ISODATA.

3. **Temporal analysis of land cover**: Prior to each verification process, a temporal analysis must be carried out to identify and quantify the changes or persistence of land cover within the project area, comparing the most recent information with previous periods to detect significant variations in their extent or condition.

Other methodological proposals related to the classification of areas (stable forest, non-stable forest, and non-forest) or sub-classification may be accepted, provided that they are technically justified and supported. Therefore, a methodology must be applied that allows the classification of the areas present in the CCMP in a clear manner.

6. Validity and transitional regime

This document enters into force on the day of its publication, and in case of discrepancy, it prevails over any provision that may be found in other Cercarbono normative documents, with respect to the topics herein included.

The guidelines expressed herein apply to programs or projects registered with Cercarbono, considering:

- Its full adoption of new programs or projects registered with Cercarbono at the time of publication.
- For projects and programs already registered, the cartography will be updated in line with this guide at each new verification event.

7. References

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8. Document history

Version	Date	Comments or changes
1.0	20.03.2024	Initial version.
1.1	07.11.2025	The cartographic scale and the presentation of coordinates of infrastructures of CCMPs registered in the energy sector are adjusted. Additionally, Figure 2 is updated, and clarification is made regarding the different land cover categories harmonized with the Cercarbono methodologies (REDD+ and Forestry-Agricultural). Likewise, the information sources and the minimum mapping unit are updated, and Section 5 “Land Cover Monitoring” is incorporated.