

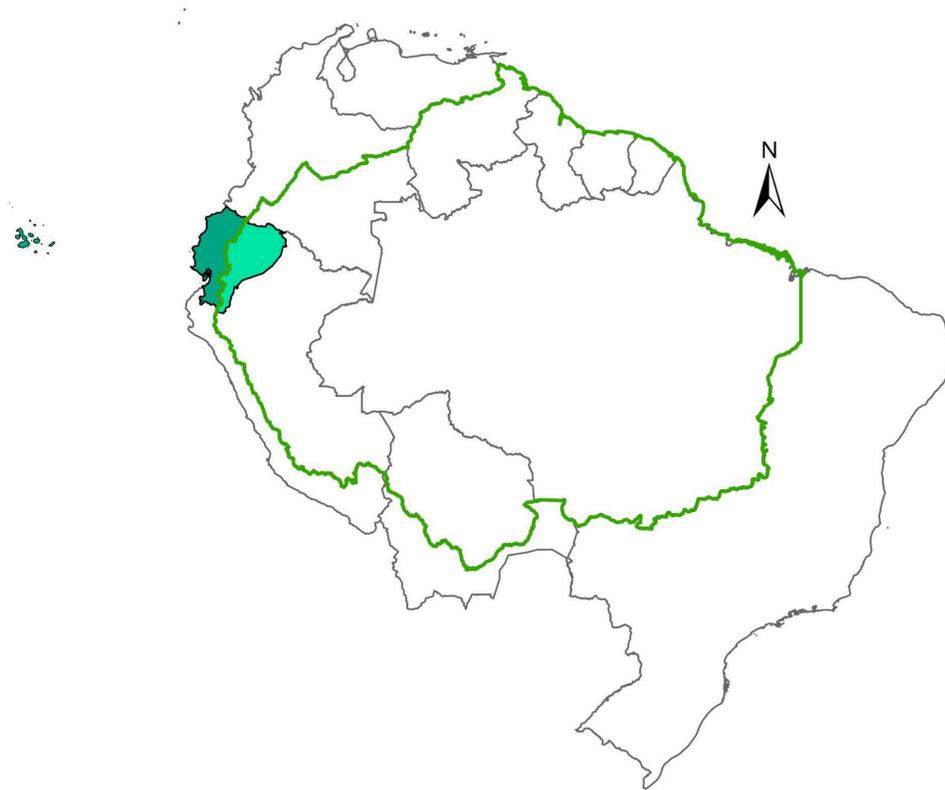
# MAPBIOMAS

ECUADOR

**Algorithm Theoretical Basis Document (ATBD)**

**Collection 3.0**

**Version 1.0**



**October 2025**

## **MapBiomias Ecuador Team**

### ***Technical Coordinator of MapBiomias in Ecuador***

Wagner Holguín

### ***Mapping Specialists***

Wagner Holguín

Cristina Aguilar

Katherine Terán

Fabrizio Garcés

Cristina Cabrera

Stephany Cevallos

### ***Interpretation Assistants***

Fernando Villacis (*transversal minería*)

### ***Executive Director of Fundación Ecociencia***

Carmen Josse

## **Institution**

Ecociencia Foundation for Ecological Studies



Lizardo García E10-80 y 12 de Octubre.

Edificio Alto Aragón, Oficina 5C

Quito-Ecuador

+593 2 2523 066

<http://ecociencia.org>

## **How to cite**

W. Holguín, C. Aguilar, K. Terán, F. Garcés, C. Cabrera & S. Cevallos. (2025). Algorithm Theoretical Basis Document (ATBD) MapBiomias Ecuador Collection 3.0, Ecuador Appendix.

# Index

List of Tables.....	4
List of Figures.....	4
1. Introduction.....	6
2. General Characteristics of the Country.....	6
2.1. Description of Ecuador.....	6
2.2. Biomas de Ecuador.....	7
2.2.1. Tropical Humid Forest of the Pacific Biome.....	9
2.2.2. Equatorial Dry Forest Biome.....	9
2.2.3. Andes Biome.....	10
2.2.4. Amazon Biome.....	11
2.2.5. Galápagos Biome.....	12
3. National-Scale Land Cover and Land Use Mapping Initiatives.....	13
4. Methodological details applied during MapBiomas Ecuador Collection 3.0.....	15
4.1. Generation of annual mosaics.....	15
4.1.1 Feature Space.....	20
4.2. General Map Classification.....	20
4.2.1 Classification regions.....	22
4.2.2 Leyend.....	24
4.2.3 Classification routines.....	26
4.2.4 Classification parameters.....	28
4.3 Post-classification.....	32
4.3.1 Gap-filling filter (GapFill).....	32
4.3.2 Temporal filter.....	35
4.3.3 Spatial filter.....	39
4.3.4 Frequency filter.....	40
4.3.5 Order of filter application by region in Ecuador.....	44
4.3.6 Masks.....	46
Rock outcrop (ID 29).....	46
Silviculture (ID 9).....	47
Aquaculture (ID 31).....	48
Remapping of rice fields to agriculture and/or pasture mosaic (ID 21).....	49
Remapping of beaches, dunes, and sands (ID 23).....	50
Remapping of other non-vegetated natural areas (ID 68).....	50
4.3.7 Adjusted temporal filter.....	51
4.3.8 Adjusted frequency filter.....	51
4.4 Classification of cross-cutting themes.....	52
4.5 Integration.....	53
4.5.1 National integration.....	53

5. References.....	57
6. Annexes.....	58
Annex 1: Reference Maps.....	58
6.1 Ecosystem Map of Continental Ecuador, scale 1:100,000.....	58
6.2. Land Cover and Land Use Map, scale 1:25,000.....	58
6.3 Land Cover and Land Use Map and Agricultural Production Systems of Continental Ecuador (version edited by the Ministry of Agriculture and Livestock in 2020) at a 1:25,000 scale.....	59
6.4 Land Cover and Land Use (CUT) Maps of Continental Ecuador at a 1:100,000 scale.....	60
6.5 Galapagos Ecosystems Map.....	62
6.6 Collection 1 of Annual Land Use and Land Cover Maps 2000–2017 of the Amazon Region.....	62
6.7 Collection 2 of Annual Land Cover and Land Use Maps 1985–2018 of the Amazon.....	62
6.8 Collection 3 of Annual Land Cover and Land Use Maps 1985–2020 of the Amazon.....	63
6.9 Collection 4 of Annual Land Cover and Land Use Maps 1985–2021 of the Amazon.....	64
6.10 Collection 5 of Annual Land Cover and Land Use Maps 1985–2022 of the Amazon.....	65
6.11 Collection 6 of Annual Land Cover and Land Use Maps 1985–2023 of the Amazon.....	66
6.12 Collection 1 of Annual Land Use and Land Cover Maps 1985–2022 of Ecuador.....	67
6.13 Collection 2 of Annual Land Use and Land Cover Maps 1985–2023 of Ecuador.....	67
Annex 2: Legend of the Ecosystems Map of Ecuador.....	68
Annex 3: Legend of the Land Cover and Use Map of Continental Ecuador.....	70
Annex 4: Feature space of the MapBiomias Amazonia Collection 3.0.....	71
Annex 5: Ecosystems of the Ecuadorian Amazon grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.....	72
Annex 6: Land Use Categories of Ecuador grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.....	74
Annex 7: Native Ecosystem Categories of Galápagos grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.....	75

# List of Tables

Table 1. Biomes as Part of the MapBiomias Ecuador Project. Areas Measured Using the SIRGAS 2000 Coordinate Reference System (Prepared by EcoCiencia).....	8
Table 2. Existing Vegetation Cover and Land Use Cartographic Data for Ecuador (Prepared by EcoCiencia).....	13
Table 3. Number of annual mosaics processed by region for the area within the RAISG boundary (Prepared by EcoCiencia).....	16
Table 4. Number of annual mosaics processed for the area outside the RAISG boundary (Prepared by EcoCiencia).....	17
Table 5. Number of Landsat satellite images that have captured data over Ecuador up to 2024 (Prepared by EcoCiencia).....	19
Table 6. Classification regions defined in Ecuador. Areas measured using the Sphere Sinusoidal coordinate reference system (Prepared by EcoCiencia).....	23
Table 7. Sampling parameters and number of decision trees used by classification region (Prepared by EcoCiencia).....	28
Table 8. Most significant variables identified by classification region (Prepared by EcoCiencia).....	29
Table 9. GapFill filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	33
Table 10. Temporal filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	35
Table 11. Spatial filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	40
Table 12. Frequency filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	42
Table 13. Order of filter application by classification region in MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	45

# List of Figures

Figure 1. Study Area in Ecuador Collection 3.0 (Prepared by EcoCiencia).....	7
Figure 2. Biomes of Ecuador: Regions Used for MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	8
Figure 3. Photo: Tropical Humid Forest of the Pacific Biome. Photo by Jorge Vinueza.....	9
Figure 4. Equatorial Dry Forest Biome.....	10
Figure 5. Andes Biome.....	11
Figure 6. Amazon Biome.....	12
Figure 7. Galápagos Biome.....	13
Figure 8. Maps for the RAISG boundary (Prepared by EcoCiencia).....	16
Figure 9. Annual mosaics 1985–2024 of the MapBiomias Ecuador Collection 3.0 within the RAISG boundary (Prepared by EcoCiencia).....	16
Figure 10. PathRows No RAISG Ecuador (Prepared by EcoCiencia).....	17
Figure 11. Annual mosaics 1985–2024 of the MapBiomias Ecuador Collection 3.0 outside the RAISG boundary (Prepared by EcoCiencia).....	18
Figure 12. Effect of applying a reducer to an image collection to compose a mosaic (composite) (Google, 2020).....	19
Figure 13. Complete processing chain of the General Map of MapBiomias Ecuador Collection 3.0 (Prepared by Gaia Amazonas).....	21
Figure 14. Classification regions of Ecuador for the MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	22
Figure 15. Mapped classes in the MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).....	26
Figure 16. Example of training sample point selection for a classification region in the Ecuadorian Amazon. a) Boundary of classification region 40201 “Low Amazon 1.” b) Stable-pixel map used for sample point selection. c) Sample points selected within region 40201 (Prepared by EcoCiencia).....	28

Figure 17. Functionality of the GapFill filter in MapBiomias Ecuador Collection 3.0 (Prepared by MapBiomias).....	33
Figure 18. Functionality of the temporal filter in MapBiomias Ecuador (Prepared by MapBiomias).....	35
Figure 19. Functionality of the spatial filter in MapBiomias Ecuador Collection 3.0 (Prepared by MapBiomias).....	39
Figure 20. Functionality of the frequency filter in MapBiomias Ecuador (Prepared by MapBiomias).....	41
Figure 21. Exclusion geometries (hidden). a) Pre-filter classification. b) Post-frequency filter classification. c) Landsat mosaic for the year 2022. d) Exclusion zone in white (Prepared by MapBiomias).....	41
Figure 22. Rock outcrop mask (ID 29). a) Original classification (before applying the mask). b) Application of the rock outcrop mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).....	47
Figure 23. Silviculture mask (ID = 9). a) Original classification (before applying the mask). b) Application of the silviculture mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).....	48
Figure 24. Aquaculture mask (ID = 31). a) Original classification (before applying the mask). b) Application of the aquaculture mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).....	49
Figure 25. Rice field mask (agriculture and/or pasture mosaic, ID = 21). a) Original classification (before applying the mask). b) Application of the rice field mask. c) Landsat mosaic, year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).....	50
Figure 26. Adjusted temporal filter for the class of non-vegetated natural areas (ID = 68). a) Original classification (before filter application). b) Classification after filter application. c) Pre-filter time series. d) Post-filter time series (Prepared by Ecociencia).....	51
Figure 27. Adjusted frequency filter for the class of non-vegetated natural areas (ID = 68). a) Original classification (before applying the filter). b) Classification after applying the filter. c) Pre-filter time series. d) Post-filter time series (Prepared by Ecociencia).....	52
Figure 28. Methodological scheme applied by legend class in Ecuador (Prepared by Ecociencia).....	53
Figure 29. Prevalence rules used during the national integration phase of the MapBiomias Ecuador Collection 3.0. The letters “G” (General Map) and “T” (Cross-cutting Theme) next to each class name indicate the data source (Prepared by Ecociencia).....	54
Figure 30. Example of the effect of layer integration for an area in the Ecuadorian Amazon (region 40201). a) Classified result of the 2021 General Map; b) Classified result of the 2021 cross-cutting theme “flooded forest”; c) Final map showing the result of the “flooded forest” theme integrated into the 2021 general map result; d) Google Earth Engine base map (undated high-resolution image); e) Landsat mosaic for the year 2021; (Prepared by Ecociencia).....	54
Figure 31. Example of the effect of layer integration for an area in the Ecuadorian Pacific (region 40904). a) Classified result of the 2022 General Map; b) Classified result of the 2022 cross-cutting theme “mangrove”; c) Final map showing the result of the “mangrove” theme integrated into the 2022 general map result; d) Google Earth Engine base map (undated high-resolution image); e) Landsat mosaic for the year 2022; (Prepared by Ecociencia).....	55
Figure 33. Wall map of Land Cover and Land Use mapping for the year 2024 (Prepared by Ecociencia).....	56

# 1. Introduction

MapBiomás Ecuador is an initiative focused on monitoring land use changes throughout the entire national territory. This multitemporal mapping approach allows for tracking pressures on natural ecosystems and the expansion of anthropogenic land uses.

The MapBiomás Network Project involves a collaborative network of specialists from each member country in areas such as land use, remote sensing, GIS, and programming. It employs cloud processing and automated classifiers, developed and operated on the Google Earth Engine platform, to generate a historical series of annual maps of land cover and land use for the Amazon region.

By 2025, under the leadership of EcoCiencia, Ecuador produced the third collection of national land use change maps and updated the third collection of surface water body monitoring maps across the entire country as part of the regional initiative MapBiomás Agua.

The map collections 1 to 6 (published between 2019 and 2023) of the MapBiomás Amazonía initiative only considered the area of Ecuador within the RAISG boundary, corresponding to the portion of continental Ecuador that forms part of the Amazon Basin. This area was defined based on the watershed boundary derived from official cartographic information provided by SENAGUA (2014) and CONALI (2016). This territory covers a total area of 132,292 km<sup>2</sup>, equivalent to 53% of the country and 1.6% of the Amazon Basin (Figure 1).

For this collection, the study area encompasses the entire Ecuadorian territory, including the Galápagos Islands, totaling 256,579 km<sup>2</sup>. The boundary was defined using official cartographic information provided by CONALI (2021). Therefore, this series of annual land cover and land use maps constitutes MapBiomás Ecuador Collection 3.0.

## 2. General Characteristics of the Country

### 2.1. Description of Ecuador

Ecuador is located in the northwestern corner of South America. It borders Colombia to the north, Peru to the east and south, and the Pacific Ocean to the west. The country's political and administrative division consists of 24 provinces, 221 cantons, 396 urban parishes, and 799 rural parishes. The national territory, including the Galápagos Islands, covers a total area of 256,579 km<sup>21</sup>.

According to official figures, as of 2020, 48.97% of Ecuador's continental territory is covered by native forest, equivalent to an area of 12,191,585 hectares. Of this area, the largest proportion (75%) is located in the Amazon region (politically and administratively defined), approximately 14% in the Coastal region, and 11% in the Highlands (MAATE, 2020).

---

<sup>1\*</sup> The international and internal territorial boundaries correspond to those defined by the National Committee of Internal Boundaries (CONALI, 2021), as modified by the EcoCiencia Foundation (2023), at a scale of 1:50,000. Additionally, the analysis area considered by the MapBiomás Ecuador initiative excludes certain islets that, due to their small size, cannot be analyzed using the spatial resolution of satellite imagery.

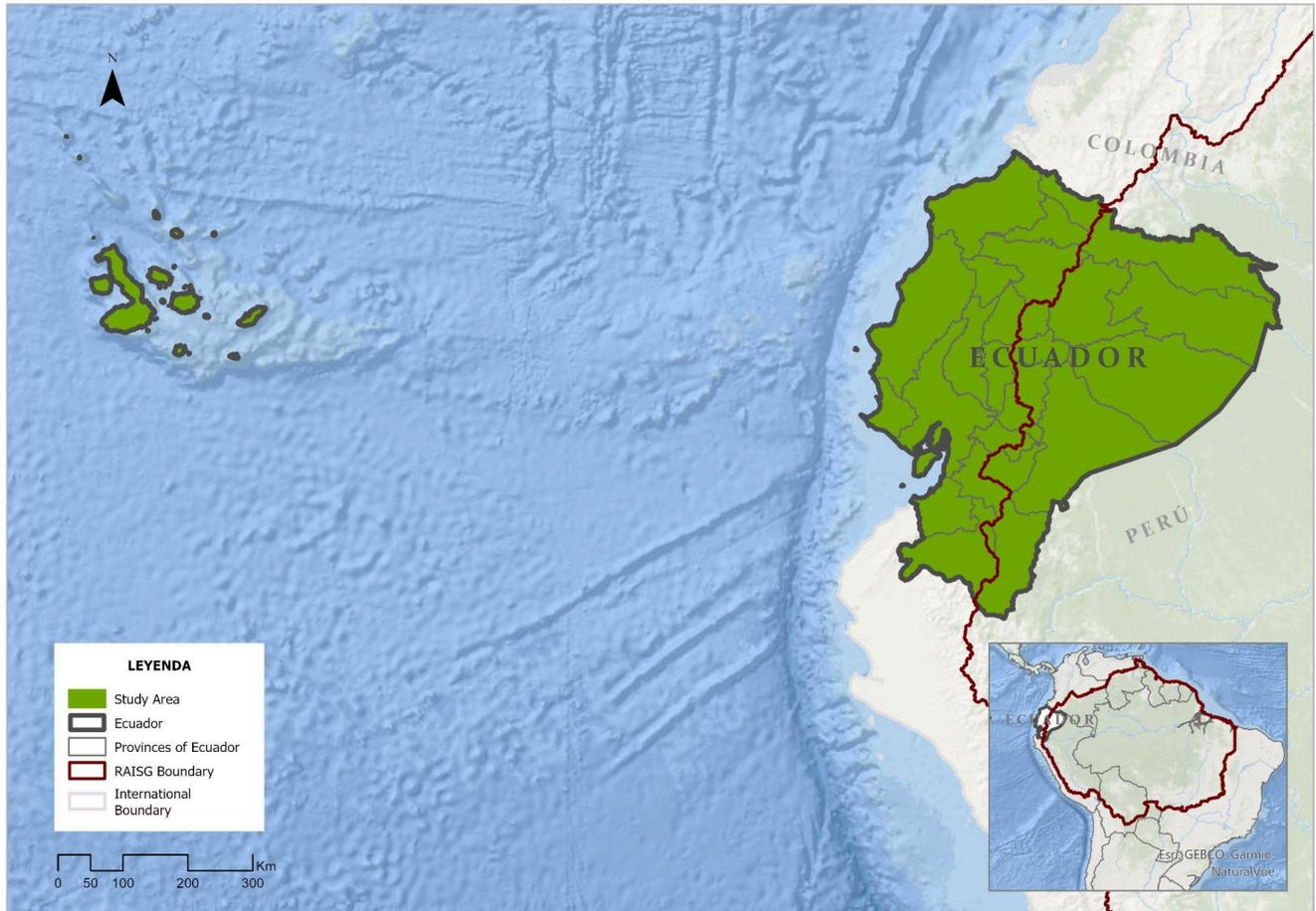


Figure 1. Study Area in Ecuador Collection 3.0 (Prepared by EcoCiencia).

## 2.2. Biomas de Ecuador.

The MapBiomias project defined five ecoregions for Ecuador, referred to within the project as “biomes”: Tropical Humid Forest of the Pacific, Equatorial Dry Forest, Andes, Amazon, and Galápagos (Figure 2, Table 1).

The delimitation of these ecoregions was carried out based on technical criteria regarding the distribution of ecosystems, using the following national maps as references:

- Biogeographic Sectors<sup>2</sup> (MAATE, 2013b)
- Ecosystems of Continental Ecuador (MAATE, 2013a)
- Ecosystems of the Northern and Central Andes (Josse et al., 2009)
- SRTM 90 m Digital Elevation Model (Jarvis et al., 2008)
- Ecoregions Map (Dinerstein et al., 2017)
- Ecological Systems of Latin America and the Caribbean (Josse et al., 2003)
- Land Cover, Land Use, and Agricultural Production Systems Map of Continental Ecuador (MAG, 2021)
- Availability of Cloud-Free Landsat Images

<sup>2</sup> Defined by MAATE as: “A representation of the biogeography of continental Ecuador, this map allows us to explain the distribution areas of species according to patterns that help identify their centers of origin and dispersion, as well as to understand the spatial patterns of biological diversity. These units are based on vegetation physiognomy, landscape criteria, climatic conditions, and floristic components.”

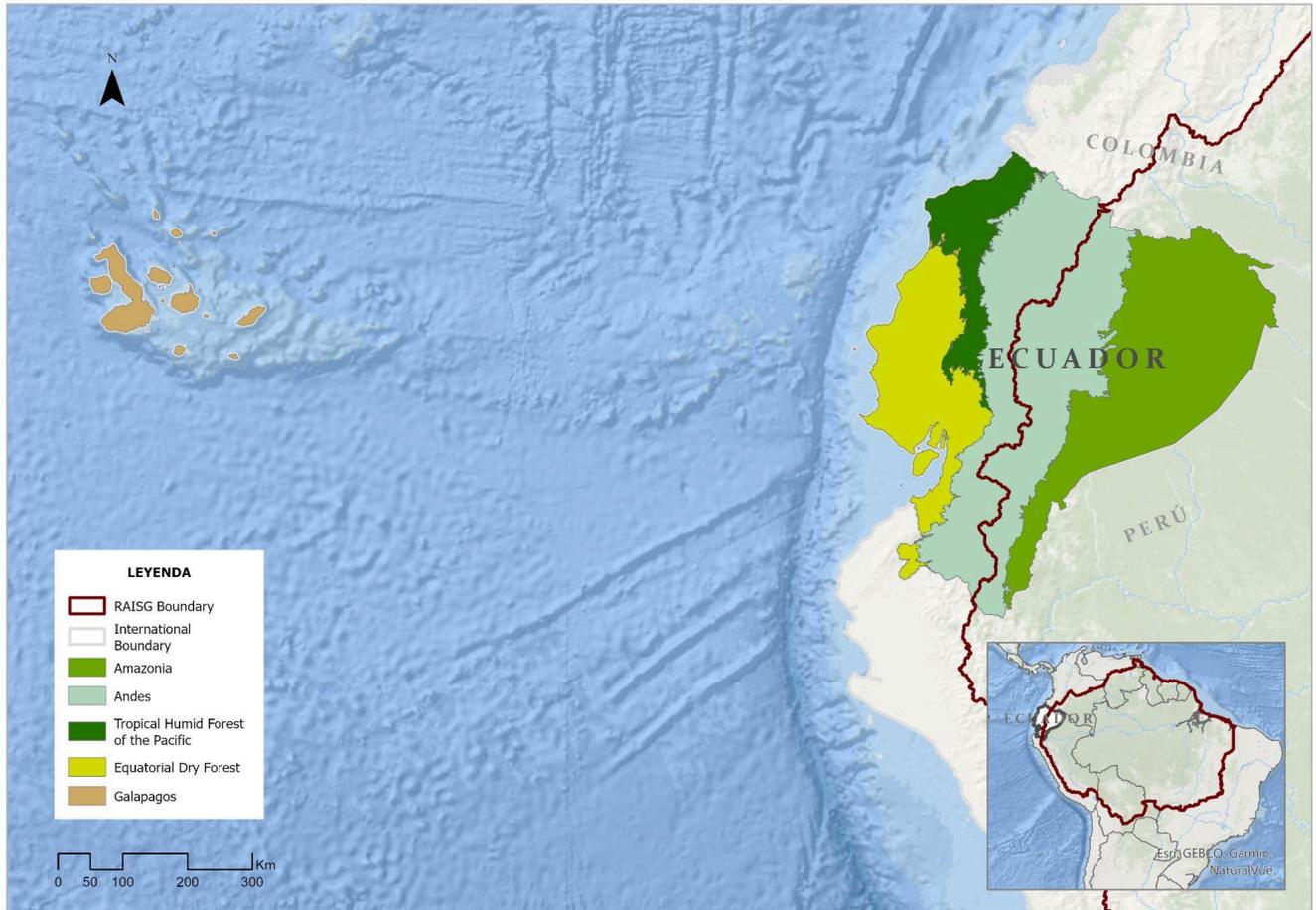


Figure 2. Biomes of Ecuador: Regions Used for MapBiomias Ecuador Collection 3.0 (Prepared by EcoCiencia).

Table 1. Biomes as Part of the MapBiomias Ecuador Project. Areas Measured Using the SIRGAS 2000 Coordinate Reference System (Prepared by EcoCiencia).

Biome	Km <sup>2</sup>	%	Provinces That Are Part of Each Biome (Totally or Partially)
Amazonia	81.482	32	Orellana, Napo, Morona Santiago, Pastaza, Zamora Chinchipe, Sucumbios
Andes	101.367	40	Azuay, Bolívar, Orellana, Cañar, Guayas, Chimborazo, Imbabura, Loja, Napo, El Oro, Pichincha, Los Ríos, Morona Santiago, Santo Domingo de los Tsáchilas, Tungurahua, Cotopaxi, Pastaza, Zamora Chinchipe, Carchi, Sucumbios, Esmeraldas
Tropical Humid Forest of the Pacific	22.050	9	Bolívar, Guayas, Imbabura, Manabí, Pichincha, Los Ríos, Santo Domingo de los Tsáchilas, Cotopaxi, Carchi, Esmeraldas
Equatorial Dry Forest	43.709	17	Azuay, Bolívar, Cañar, Guayas, Chimborazo, Loja, Manabí, El Oro, Los Ríos, Santa Elena, Esmeraldas
Galapagos	7.992	3	Galápagos
<b>Total</b>	<b>256.605</b>		

### 2.2.1. Tropical Humid Forest of the Pacific Biome

The Tropical Humid Forest of the Pacific biome covers an area of 22,050 km<sup>2</sup>, equivalent to 9% of the study area (Figure 2). It is found at elevations ranging from 0 to 300 meters and is characterized by warm and humid conditions.

This biome includes closed-canopy forests with trees that can reach up to 30 meters in height and an understory dominated by ferns and plants of the Araceae family. Tree diversity is high (with more than 100 species per hectare), although lower than in the Amazon biome.

Anthropogenic habitat degradation in this ecoregion is among the highest in Ecuador; nearly 75% of the forest has been destroyed by human activities. This biome is absent in the lowlands of southwestern Ecuador, where dry conditions prevail.



Figure 3. Photo: Tropical Humid Forest of the Pacific Biome. Photo by Jorge Vinueza.

### 2.2.2. Equatorial Dry Forest Biome

The Equatorial Dry Forest biome covers an area of 43,709 km<sup>2</sup>, equivalent to 17% of the study area (Figure 2). It is characterized by a combination of warm and extremely dry conditions. The average annual rainfall may not exceed 60 mm (in the westernmost locality, Salinas, Guayas Province). It is found mainly along the coastal margins in central Ecuador. In some areas, introduced herbaceous species used for livestock have replaced the native vegetation. In the driest habitats, cacti and other thorny plants dominate.

This biome also includes coastal deciduous forests, which are characterized by drier conditions and lower tree density compared to evergreen forests. Trees are generally less than 20 meters tall, and the understory can be dense with abundant herbaceous plants. Some tree species, such as ceibos, shed their leaves during the dry season. Human impact in this region has been severe. It is estimated that more than 60% of its area has been destroyed by human activities, especially agriculture and livestock grazing.



Figure 4. Equatorial Dry Forest Biome.

### 2.2.3. Andes Biome

The Andes biome includes the regions known as “Andes” and “Upper Amazon,” covering an area of 101,367 km<sup>2</sup>, equivalent to 40% of the study area (Figure 2). This biome extends from approximately 300 meters above sea level on the Pacific slope and from 400 meters on the Amazonian side. It encompasses the montane, upper montane, high montane, subnival, and nival bioclimatic zones (MAATE, 2013c), with altitudes ranging from 2,300 to 5,800 meters above sea level. Temperatures in this region rarely exceed 25°C. The terrain is characterized by mountain ranges and ridges, with valleys of glacial and/or tectonic origin, forming a landscape composed of mountain peaks, calderas, craters, lava deposits, and high hills interspersed with plains and extensive valleys. The melting of glaciers that cover the summits of several volcanoes forms systems of lagoons, wetlands, and small bodies of water that constitute the headwaters of Andean-origin basins of the Amazon Basin.

This region, locally known as the “Sierra” (to distinguish it from the “Coastal” and “Eastern” regions), is characterized by the presence of montane forests and other non-forest ecosystems such as shrublands and natural grasslands, commonly referred to as “páramos.” Many of these have lacustrine, flood-prone, or subnival characteristics, with phenologies ranging from evergreen to seasonally evergreen and semi-deciduous (MAATE, 2013c). The zones bordering the Amazon receive high humidity and maintain continuous forest cover. As elevation increases, vegetation height and physiognomy change, eventually becoming absent in areas such as sand fields, exposed rock, volcanic scars, and glaciers.

In the northern part of the country, the Andean range divides into eastern and western branches, with densely populated inter-Andean valleys located between them. Both branches have a high concentration of volcanoes. Moving from north to south, this pattern changes — the maximum elevation of the range decreases, and the western massif loses significant height near the Gulf of Guayaquil, marking the division between the Northern Andes to the north and the Central Andes to the south, which have different geological origins (Cuesta et al., 2009).

The slopes of the inter-Andean valleys experience alternating dry and wet periods, strongly influenced by the rain shadow effect.

The Andean region of Ecuador has been extensively transformed by urban development, infrastructure, and — due to the quality of its soils — the expansion of agricultural and livestock activities. In some of these transformed areas, forests of introduced species have been established for commercial or aesthetic purposes, mainly eucalyptus (*Eucalyptus* spp.) and pine (*Pinus* spp.).



Figure 5. Andes Biome.

#### 2.2.4. Amazon Biome

The Amazon biome includes the “Lower Amazon” region, which covers an area of 81,482 km<sup>2</sup>, equivalent to 32% of the study area (Figure 2). It encompasses the foothills of the Andean range and transitional zones toward the lowlands of the Amazon, where the piedmont, lower montane, and montane bioclimatic zones (MAATE, 2013c) are found, at altitudes ranging approximately from 700 to 2,300 meters above sea level. Its relief consists of foothills and mountain ranges characterized by steep slopes and deep ravines. Due to this topography, the soils of the foothills are prone to frequent landslides, which are worsened by anthropogenic processes such as deforestation and soil erosion.

These are hyper-humid zones characterized by intense and nearly constant rainfall, permanent cloud cover, and low temperatures. Due to the orographic influence of the area, these ecosystems capture large volumes of moisture from fog accumulation (a phenomenon known as horizontal precipitation or fog drip), which has led to the forests of this ecoregion—also referred to as the “montane forests of the Northern Andes” (Cuesta et al., 2009)—being known as “rain forests,” “cloud forests,” or “fog forests.” The average height of these forests ranges between 20 and 30 meters, and their phenology is evergreen. Humidity levels decrease latitudinally in the Upper Amazon region, reaching their lowest levels near the border with Peru, where remnants of seasonally evergreen forests with restricted distribution are found. In some parts of this region, montane evergreen shrublands and grasslands also occur, especially at higher altitudes along Andean ridges or the summits of Amazonian mountain ranges.

The ecosystems of this biome play an especially important role in regulating water flow, both locally and regionally. In addition, this ecoregion hosts some of the most biodiverse forests on the planet. However, it is also home to some of the most fragile ecosystems,

which are at risk of disappearing due to the ongoing and increasing conversion of forests into pastures, croplands, and settlements as a result of human occupation. In Ecuador, some portions of these ecosystems fall within protected areas; however, where such conservation designations do not exist, the degree of transformation is so high that forests remain only on steep slopes or on soils unsuitable for agriculture.

The Lower Amazon region includes the lowland bioclimatic zone of the Ecuadorian Amazon (MAATE, 2013c), at altitudes between approximately 700 and 100 meters above sea level. Its relief includes peri-Andean piedmont, peneplains, and plains, with topography ranging from plateaus and medium hills to flatlands and terraces. Due to the combination of topography and abundant rainfall, this region is prone to flooding, either seasonally or permanently. It is characterized by the predominance of dense, evergreen tropical lowland forests, some of which are floodable or permanently inundated. These forests often exceed 30 meters in height and are accompanied by lacustrine–riparian grasslands.



**Figure 6.** Amazon Biome

### **2.2.5. Galápagos Biome**

The Galápagos biome covers an area of 7,992 km<sup>2</sup>, equivalent to 3% of the study area (Figure 2). It is located in the Pacific Ocean, 972 km off the continental coast of Ecuador, with elevations ranging from 345 to 1,707 meters above sea level. It is composed of the Galápagos Archipelago, which consists of 13 volcanic islands and has a total surface area of 8,010 km<sup>2</sup> (Governing Council of the Special Regime of Galápagos, 2015).

The climate of the Galápagos Islands is determined almost entirely by ocean currents, which are in turn influenced by the trade winds that drive them. There is a warm season between January and April, with temperatures ranging from 26°C to 28°C, and a cool season during the rest of the year, with temperatures below 24°C, reaching as low as 14°C in some western locations (Governing Council of the Special Regime of Galápagos, 2015).



Figure 7. Galápagos Biome

### 3. National-Scale Land Cover and Land Use Mapping Initiatives

The most recent national initiatives, both official and non-official, for mapping vegetation cover and land use in Ecuador are summarized in Table 2 and detailed in Annex 1.

Table 2. Existing Vegetation Cover and Land Use Cartographic Data for Ecuador (Prepared by EcoCiencia).

Map	Reference	Description	Escale	Mapped Year
Ecosystem Map of Continental Ecuador	MAATE, 2013	Spatial distribution of remaining ecosystems in continental Ecuador as of 2012 for areas with natural cover.	1:100.000	2012
Land Cover and Land Use Map	MAGAP, SIGTIERRAS, IEE 2009-2015	Detailed information on production systems, land cover, plot size, and crop seasonality.	1:25.000	Between 2009 and 2015, depending on the canton.
Land Cover and Land Use (LCUL) Maps of Continental Ecuador	MAATE, MAGAP, 2016 MAATE, MAGAP, 2017 MAATE, MAGAP, 2019 MAATE, MAGAP, 2023 MAATE, MAGAP, 2023	At the first level, it maps the six classes defined by the IPCC (forest, agricultural land, shrub and herbaceous vegetation, water bodies, anthropic areas, and other lands). At the second level, it provides a more detailed classification with 16 land cover and land use categories.	1:100.000	1990, 2000, 2008, 2014, 2016, 2018, 2020, 2022
Land Cover, Land Use, and Production Systems Map	MAG, 2021	Detailed information on production systems, land cover, plot size, and crop seasonality. Edited version by the Ministry of Agriculture and Livestock in 2020.	1:25.0000	Between 2009 and 2015, edited in 2020.

Methodology for Mapping Native and Invasive Vegetation Cover in Archipelagos: An Example from the Galápagos Islands.	Rivas et al., 2018, Universidad San Francisco de Quito.	Detailed information on the methodology for mapping vegetation and assessing species invasion in the Galápagos National Park. Identification of native ecosystems and invasive species. Highlights the vulnerability of deciduous forests and the threats faced by high mountain ecosystems.	1:75.000	2015 y 2016
Collection 1 of Annual Land Cover and Land Use Maps (2000–2017) of the Amazon Region.	MapBiomias Amazonía, 2019	Annual land cover and land use maps of the Amazon for the period 2000 to 2017, generated from Landsat satellite images classified using empirical decision trees.		Anual, 2000 a 2017
Collection 2 of Annual Land Cover and Land Use Maps (1985–2018) of the Amazon Region.	MapBiomias Amazonía, 2020	Annual land cover and land use maps of the Amazon for the period 1985 to 2018, generated from Landsat satellite images classified using the Random Forest algorithm in Google Earth Engine.		Anual, 1985 a 2018
Collection 3 of Annual Land Cover and Land Use Maps (1985–2020) of the Amazon Region.	MapBiomias Amazonía, 2021	Annual land cover and land use maps of the Amazon for the period 1985 to 2020, generated from Landsat satellite images classified using the Random Forest algorithm in Google Earth Engine.		Anual, 1985 a 2020
Collection 4 of Annual Land Cover and Land Use Maps (1985–2021) of the Amazon Region	MapBiomias Amazonía, 2022	Annual land cover and land use maps of the Amazon for the period 1985 to 2021, generated from Landsat satellite images classified using the Random Forest algorithm in Google Earth Engine.		Anual, 1985 a 2021
Collection 5 of Annual Land Cover and Land Use Maps (1985–2022) of the Amazon Region.	MapBiomias Amazonía, 2023	Annual land cover and land use maps of the Amazon for the period 1985 to 2022, generated from Landsat satellite images classified using the Random Forest algorithm in Google Earth Engine.		Anual, 1985 a 2022
Collection 6 of Annual Land Cover and Land Use Maps (1985–2023) of the Amazon Region.	MapBiomias Amazonía, 2024	Annual land cover and land use maps of the Amazon for the period 1985 to 2023, generated from Landsat satellite images classified using the Random Forest algorithm in Google Earth Engine.		Anual, 1985 a 2023
Collection 1 of Annual Land Cover and Land Use Maps (1985–2023) of Ecuador	MapBiomias Amazonía, 2023	Annual land cover and land use maps of Ecuador for the period 1985–2023, generated from Landsat satellite imagery classified using the Random Forest algorithm in Google Earth Engine (GEE).		Anual, 1985 a 2023

## 4. Methodological details applied during MapBiomias Ecuador Collection 3.0

The MapBiomias Ecuador Collection 3.0 of Annual Land Use and Land Cover Maps was generated using a standardized methodology shared across the entire MapBiomias network.

## 4.1. Generation of annual mosaics

The first step in generating land cover and land use maps is the construction of annual mosaics, created from satellite images captured by the Landsat project. For this purpose, the MapBiomás Ecuador initiative used two methods:

1. For the area within the RAISG boundary, the mosaics were processed based on a uniform grid derived from the International Map of the World at a scale of 1:250,000, where each unit covers an area of 1°30' longitude by 1° latitude. According to this division, 16 map units encompass the Ecuadorian Amazon. However, due to the seasonality of the land cover types being mapped, it was necessary to subdivide certain map units using the boundaries of the Andes, Upper Amazon, and Lower Amazon regions (Figure 8), resulting in a total of 27 units or “map-regions” (Table 3).

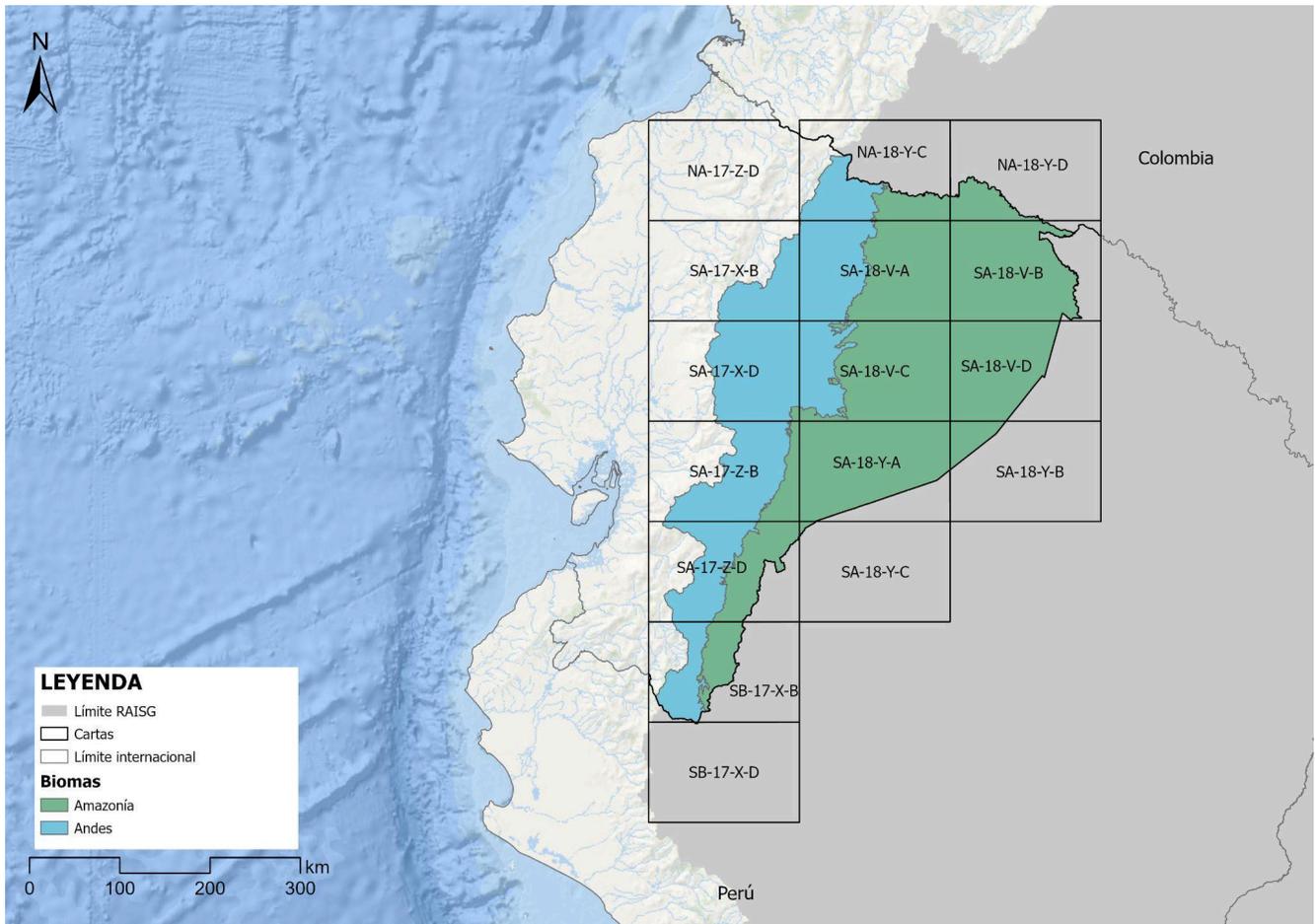


Figure 8. Maps for the RAISG boundary (Prepared by Ecociencia).

Table 3. Number of annual mosaics processed by region for the area within the RAISG boundary (Prepared by Ecociencia).

Country	Región	Maps by region	Parameterized and processed mosaics for the 1985–2024 time series
	Andes	8	294
Ecuador	Amazonía Alta	10	430
	Amazonía Baja	9	321
<b>Total</b>		<b>27</b>	<b>1045</b>

### Mosaicos Colección 3 (Landsat C3) - Mapbiomas Amazonía - Ecuador



Figure 9. Annual mosaics 1985–2024 of the MapBiomas Ecuador Collection 3.0 within the RAISG boundary (Prepared by Ecociencia).

2. For the area outside the RAISG boundary, the reference unit used for the construction of the mosaics was the path and row grid. The entire Ecuadorian territory, both continental and insular, is covered by 17 path and row scenes. Table 4 summarizes the corresponding quantity by region.

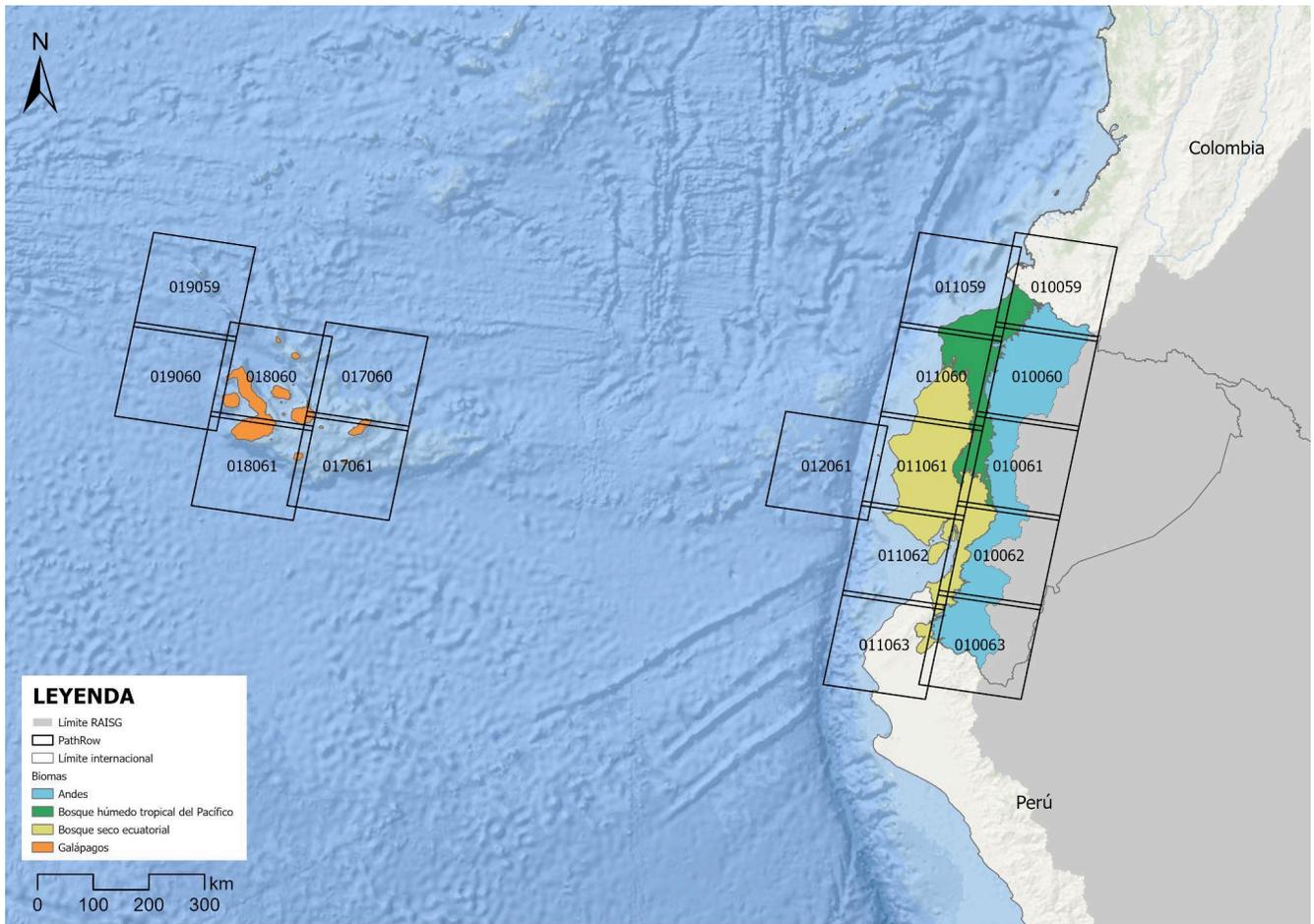


Figure 10. PathRows No RAISG Ecuador (Prepared by Ecociencia)

Table 4. Number of annual mosaics processed for the area outside the RAISG boundary (Prepared by Ecociencia).

Country	Biome	Scenes by biome	Parameterized and processed mosaics for the 1985–2024 time series
Ecuador	Andes, Tropical Rainforest of the Pacific, and Equatorial Dry Forest	11	398
	Galapagos	6	186
<b>Total</b>		<b>17</b>	<b>584</b>

Mosaicos Colección 3 (Landsat C3) - Mapbiomas Pacífico - Ecuador

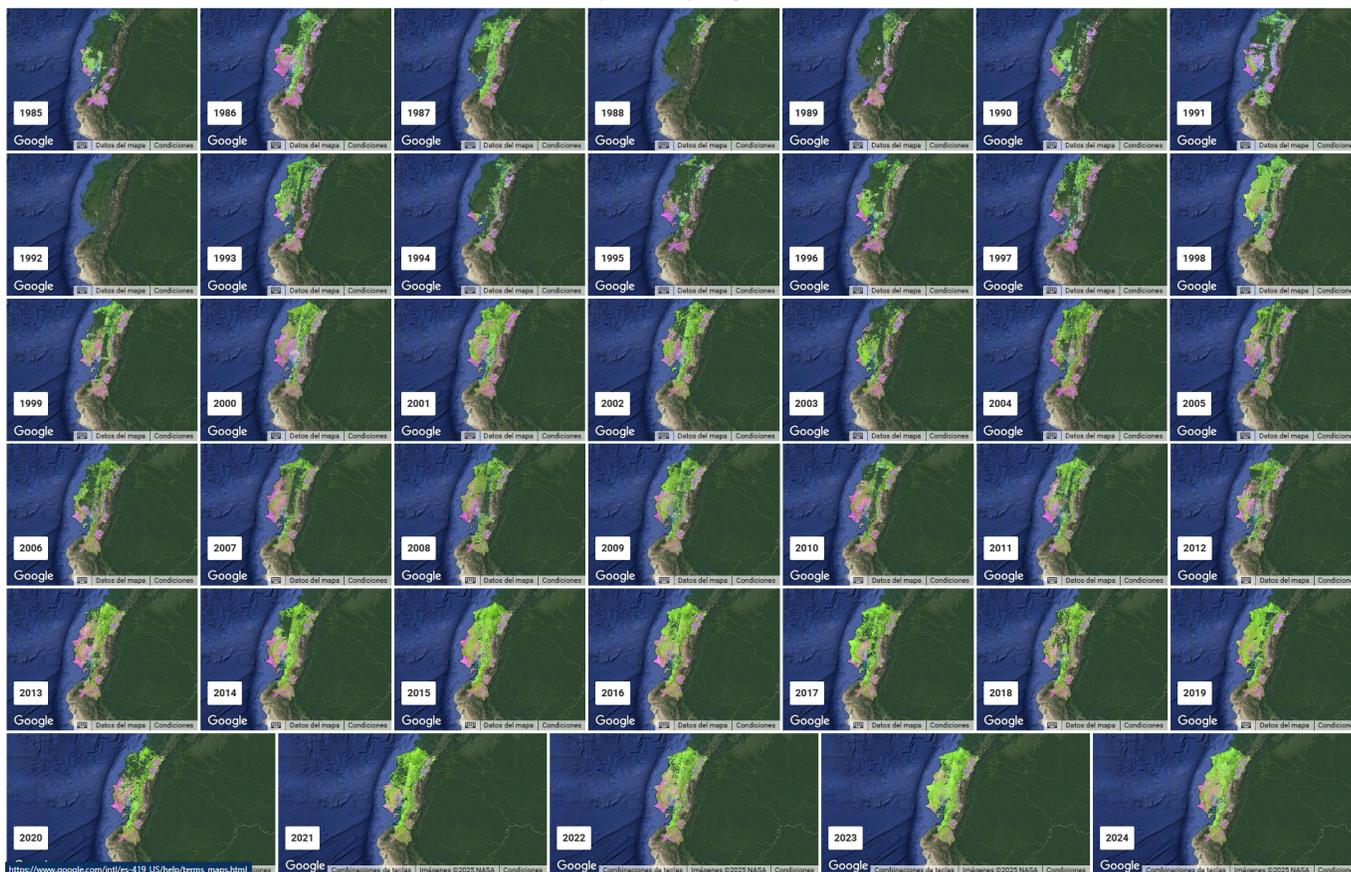


Figure 11. Annual mosaics 1985–2024 of the MapBiomas Ecuador Collection 3.0 outside the RAISG boundary (Prepared by Ecociencia).

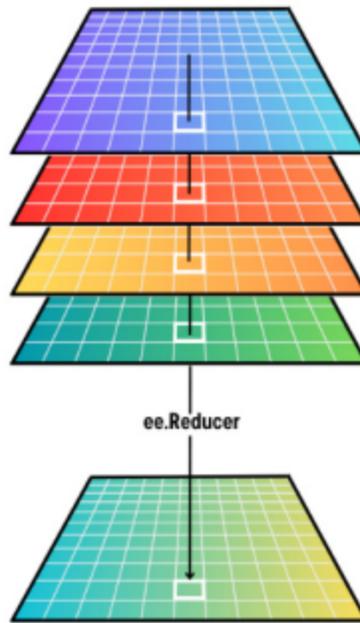
Both inside and outside the RAISG boundary, each satellite image acquired during the 1985–2024 period and available in the Landsat Collection 2 image catalog was visually assessed using Google Earth Engine. This image collection was filtered using parameters individually defined for each map sheet, including: cloud cover thresholds, data search periods (temporal windows), and the exclusion of specific images of insufficient quality due to excessive cloud cover, sensor malfunctions, preprocessing errors, among other factors. The images selected per year were reduced to a single composite image, or annual mosaic, using statistical reducers available in Google Earth Engine (Figure 12).

Median Mosaic: For each map sheet and each year, a mosaic of Landsat images from series 4, 5, 7, 8, and 9 was created. Each mosaic consists of at least two images, where the value assigned to each pixel per band in the composition is obtained using the median value from the set of selected images. This operation was applied to the visible red, near-infrared, and mid-infrared bands, as illustrated in Figure 12.

In this way, the pixel used for classification corresponds to the median value of the time series. For example, if the final mosaic for a given map sheet is composed of images acquired between October and December, with a maximum cloud cover threshold of 30%, remaining clouds or shadows were first masked, and then the statistical median reducer was applied to construct the final interpretation mosaic.

Each map sheet was processed individually using the median value from the selected images for each year in the 1985–2024 time series. Figure 11 shows the mosaics for the continental area of Ecuador.

Due to the lack of information in the Landsat collections or high cloud coverage, data gaps persist throughout the time series. These information gaps appeared temporarily, most notably during the early years (1985–1988 and 1992–1996), especially in high mountain areas such as páramos and glaciers, as well as the Chocó biogeographic region. This situation affected the results in areas with high land cover dynamics, where the method's ability to compensate for these data gaps was limited.



**Figure 12.** Effect of applying a reducer to an image collection to compose a mosaic (composite) (Google, 2020).

In total, specific parameters were defined for each of the 40 years in the 1985–2024 period, for each of the 27 “map-region” units and 27 Landsat scenes. However, due to data gaps in the catalog, a total of 1,045 mosaics were processed (Tables 3 and 4) for the area within Ecuador’s RAISG boundary and 584 mosaics for the area outside the RAISG boundary. The parameterization made it possible to construct annual mosaics with the highest possible quality, the greatest coverage of useful data, and the least amount of clouds or interference (Figure 11). This collection used data from Landsat 4, 5, 7, 8, and 9.

Within Ecuador, and as shown in Table 5, there is a total of 11,805 Landsat Surface Reflectance (SR) satellite images from Collection 2 that have captured data over the country since 1985. These images amount to more than 10 terabytes of information and are analyzed, filtered, or processed as part of the generation of annual mosaics. It is worth noting that this collection includes Landsat 9, a relatively new satellite whose data are already available on Google Earth Engine.

**Table 5.** Number of Landsat satellite images that have captured data over Ecuador up to 2024 (Prepared by Ecociencia).

	Lt4	Lt5	Lt7	Lt8	Lt9	Total
1980-1989	109	371	0	0	0	480
1990-1999	30	1048	90	0	0	1168
2000-2010	0	406	1956	0	0	2362
2010-2019	0	53	2461	2293	0	4807
2020-2023	0	0	946	1275	685	2906
2024	0	0	0	41	41	82
<b>Total</b>	<b>139</b>	<b>1878</b>	<b>5453</b>	<b>3609</b>	<b>726</b>	<b>11805</b>

Despite efforts to recover the largest possible amount of high-quality usable data, the resulting mosaics are not free from information gaps. Ecuador is a country where the availability of satellite data from optical sensors such as Landsat for the 1985–2024 period has been largely affected by:

- The continuous presence of clouds, which limits the number of usable pixels (cloud-free observations), with the Tropical Rainforest of the Pacific, Equatorial Dry Forest, Andes, and Upper Amazon regions showing the greatest limitations;
- Failures in the data reception and recording equipment for low-orbit satellites within the coverage range of the “Cotopaxi” Station antenna, which permanently affected data recording during the 1991–1995 period. As a result, it was not possible to generate mosaics for most map sheets during those years.

### 4.1.1 Feature Space

For each pixel with usable data in each annual mosaic, 151 variables were calculated to form the feature space, which consists of reflectance bands, indices derived from spectral bands, spectral fractions obtained through spectral mixture analysis, and indices derived from these spectral fractions (Annex 4). These variables serve as the main input for the classification algorithm.

The following statistical reducers were applied to the variables to obtain:

- *Median*: Calculation of the median applied to all available pixels in the annual mosaic at that location.
- *Dry-season median*: Statistical median calculated using pixels from the quartile with the lowest NDVI values (proxy for the dry season).
- *Wet-season median*: Statistical median calculated using pixels from the quartile with the highest NDVI values (proxy for the wet season).
- *Amplitude*: Range of variation among all available pixels in the annual mosaic.
- *Standard deviation*: Standard deviation of the values of all available pixels in the annual mosaic for a given location.
- *Minimum*: Lowest value among all available pixels in the annual mosaic at a given location.
- *Maximum*: Highest value among all available pixels in the annual mosaic at a given location.
- *Dry-season minimum*: Lowest value among all available pixels from the images in the quartile with the lowest NDVI values (proxy for the dry season).
- *Wet-season minimum*: Lowest value among all available pixels from the images in the quartile with the highest NDVI values (proxy for the wet season).
- *Dry-season maximum*: Highest value among all available pixels from the images in the quartile with the lowest NDVI values (proxy for the dry season).
- *Wet-season maximum*: Highest value among all available pixels from the images in the quartile with the highest NDVI values (proxy for the wet season).
- *Dry-season QMO*: The highest value of the band in the EVI2 index during the dry season.
- *Wet-season QMO*: The highest value of the band in the EVI2 index during the wet season.

Each variable constitutes a band in the final annual mosaic. Additionally, variables such as slope, elevation, shadow, flood potential, among others, were included, resulting in final annual mosaics composed of 151 bands (the complete list of bands is provided in Annex 4).

## 4.2. General Map Classification

The classification of the base map, or general land cover and land use map of Ecuador, was developed following a regionally standardized methodological protocol (MapBiomass methodology), which is based on the use of the Random Forest supervised classification algorithm at the pixel level. The entire process was executed within the cloud-based geoprocessing environment Google Earth Engine (GEE), following an iterative sequence of steps that are repeated as many times as necessary until achieving a high-quality classification product (Figure 13).

The complete processing chain for generating the general map of the MapBiomass Ecuador Collection 3.0 is summarized in Figure 13.

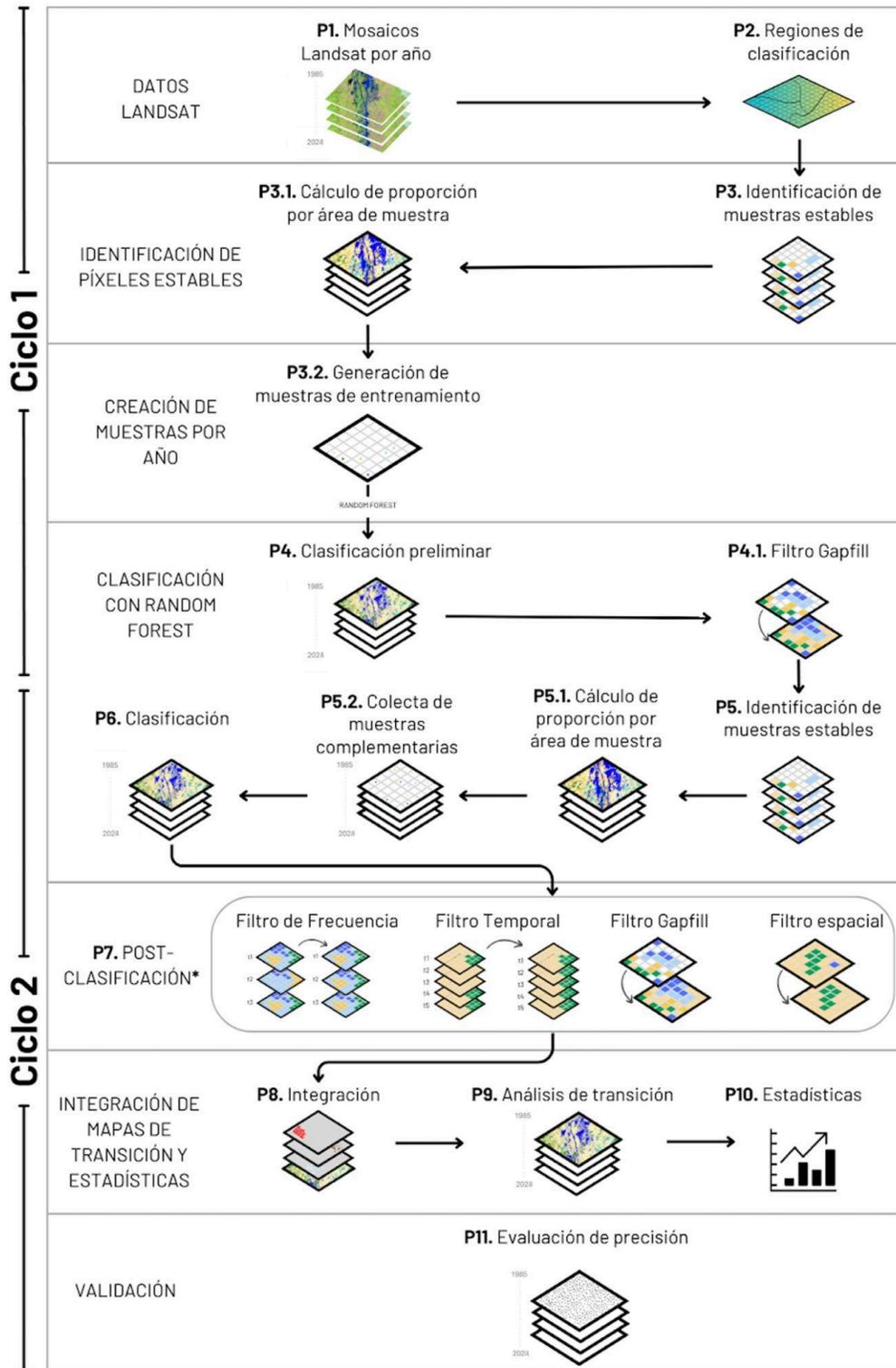


Figure 13. Complete processing chain of the General Map of MapBiomás Ecuador Collection 3.0 (Prepared by Gaia Amazonas).

In our experience, the determining factors in the quality of the classification were:

- Training and classification based on the use of mapping units that follow criteria related to the spatial distribution of land cover and land use types (referred to as classification regions),
- The balanced distribution of training samples, both geographically and among classes (where the least represented or most spatially restricted class accounts for about 12% of the total samples for a region),

- The identification of an optimal threshold or number of trees allowed (although increasing the number of trees yields better results, beyond a certain point accuracy decreases),
- The number of iterations (each additional round strengthens the final product. With each iteration, the stable pixel map—used to draw training samples—becomes more accurate, progressively generating a set of spectrally less ambiguous samples),
- The evaluation and selection of the variables that most contribute to class distinction (although our annual mosaics are composed of 151 bands, better results were obtained when excluding those bands whose values—classification variables—contribute less to the classifier; this adjustment was performed individually for each classification region).

#### 4.2.1 Classification regions

The sequence of classification steps is applied independently to each mapping unit or classification region. In Ecuador, twenty-nine (29) classification regions were defined (Figure 14, Table 5), following criteria based on the spatial distribution of land cover and land use types<sup>3</sup>.

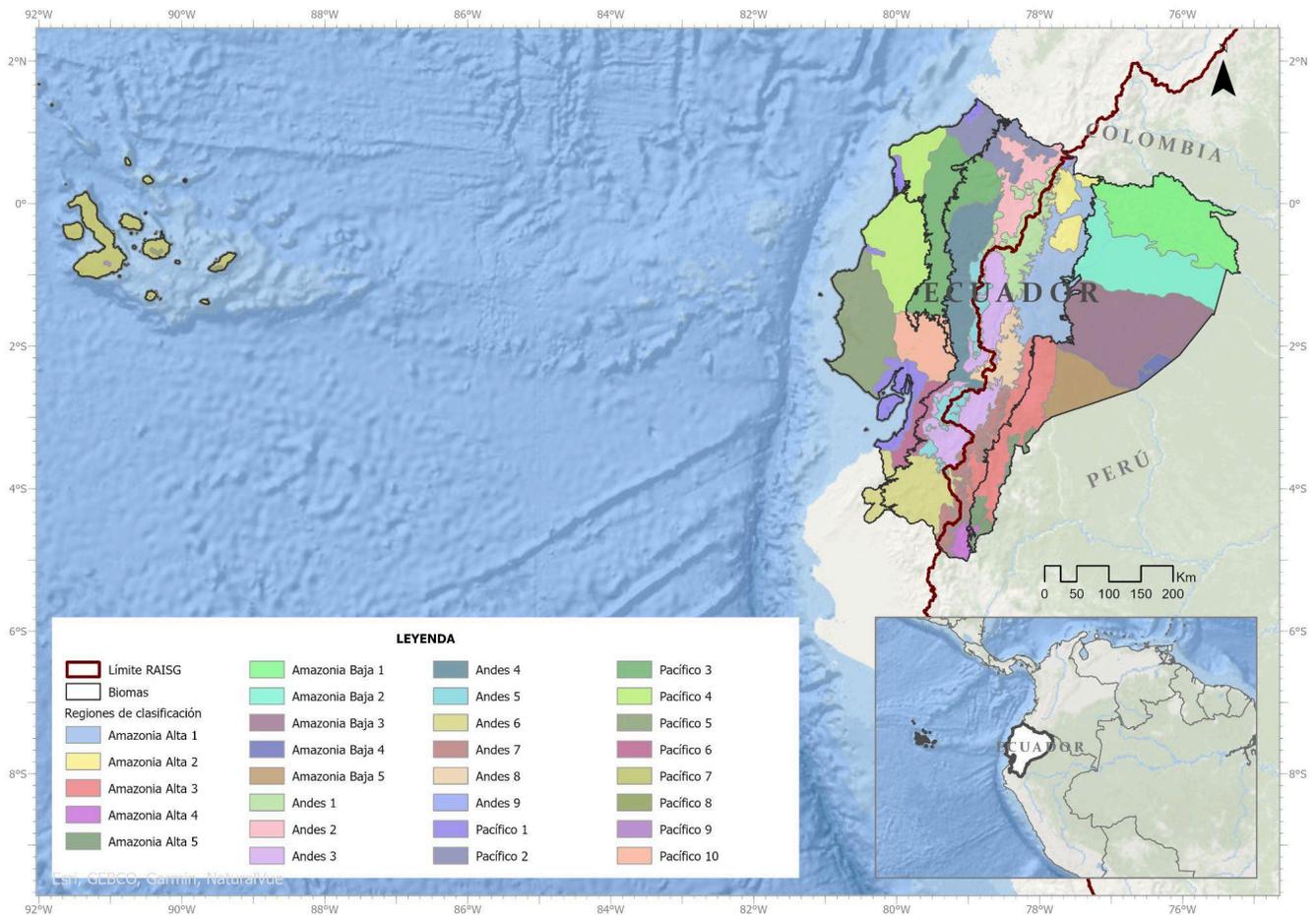


Figure 14. Classification regions of Ecuador for the MapBiomias Ecuador Collection 3.0 (Prepared by Ecociencia).

The reasons for dividing the country into classification regions are as follows:

- **Andes:** Its conditions of greater seasonality and constant cloud cover determine a temporal period for mosaic construction different from that of the Amazon. The mapping aimed to strengthen the identification of formations specific

<sup>3</sup> Las regiones de clasificación fueron definidas siguiendo criterios de unidades ecológicas e hidrológicas basados en Mapa de Ecosistemas de Ecuador (MAATE, 2013) junto con la presencia o ausencia de intervención antropogénica y lecciones aprendidas en Colecciones pasadas.

to this region (glaciers, páramos) and to avoid confusion (given the spectral similarity) between natural non-forest covers dominated by herbaceous species and land-use areas such as agriculture and planted pastures.

- Upper Amazon: Its constant cloudiness and resulting data gaps make it necessary to establish broader temporal parameters for annual mosaic construction. Due to its topography and cloud cover, there is an increase in shadows that hinder the classification of forests in shaded areas and narrow water bodies.
- Lower Amazon: Its physiography of plains and gently rolling hills facilitates the mapping of its evergreen forests, wide water bodies, and agricultural and livestock areas.
- Pacific Basin and Galápagos: As this is the first collection for these regions, the criteria for separating classification regions were based on secondary reference maps (mainly ecosystem distribution and land-use maps). Based on the lessons learned and mapping results from this first collection, classification regions will be refined as a strategy to strengthen mapping in future collections.

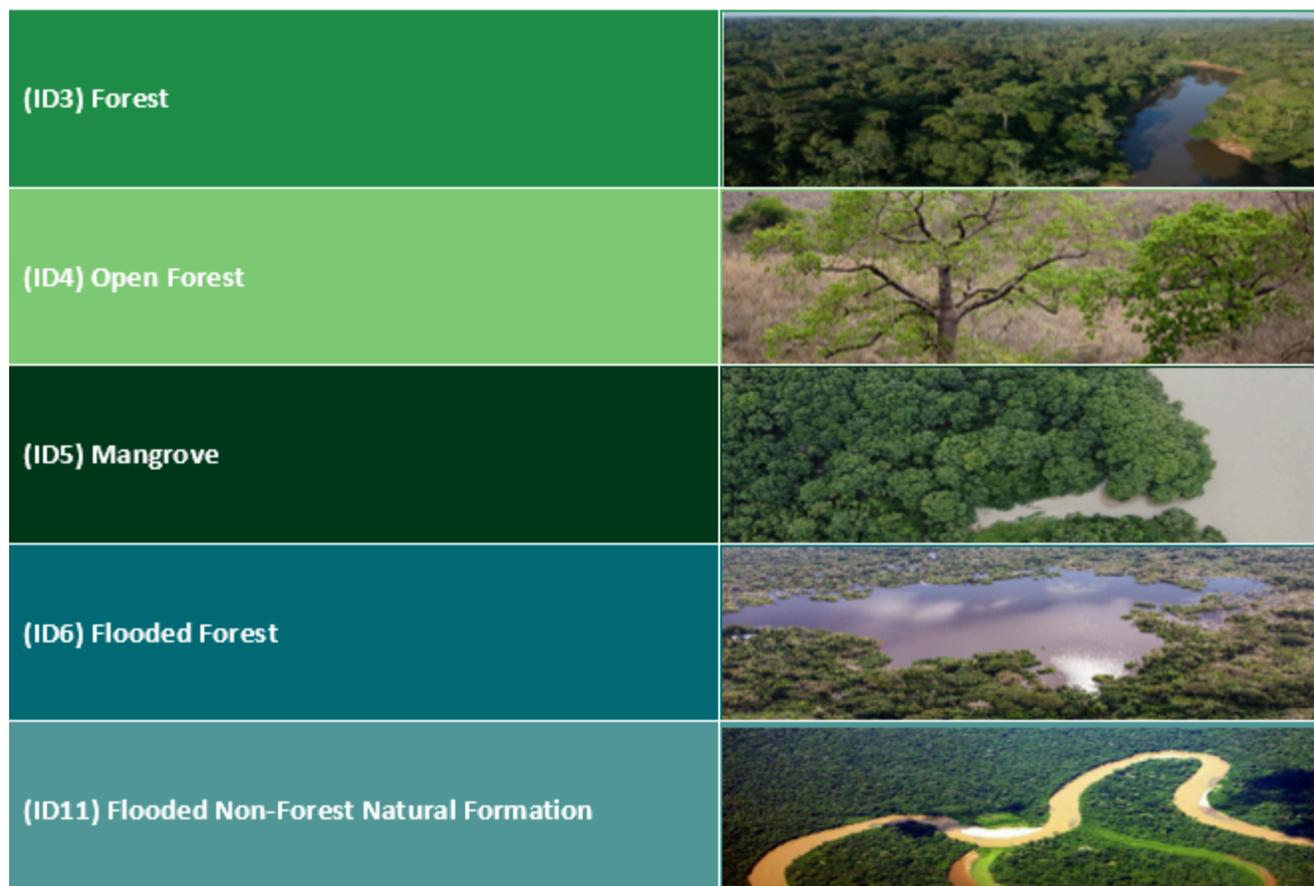
**Table 6.** Classification regions defined in Ecuador. Areas measured using the Sphere Sinusoidal coordinate reference system (Prepared by Ecociencia).

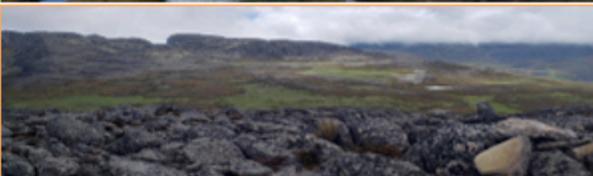
Nro,	Code	Classification region	Area (km2)	%	Mosaic region
1	40101	Amazonía Alta 1	14058,34	5,36%	Amazonía
2	40102	Amazonía Alta 2	4596,82	1,75%	Amazonía
3	40103	Amazonía Alta 3	14410,30	5,49%	Amazonía
4	40104	Amazonía Alta 4	1815,47	0,69%	Amazonía
5	40105	Amazonía Alta 5	2590,40	0,99%	Amazonía
6	40201	Amazonía Baja 1	18886,06	7,20%	Amazonía
7	40202	Amazonía Baja 2	17766,97	6,77%	Amazonía
8	40203	Amazonía Baja 3	23756,79	9,05%	Amazonía
9	40204	Amazonía Baja 4	1215,02	0,46%	Amazonía
10	40205	Amazonía Baja 5	7111,02	2,71%	Amazonía
11	40601	Andes 1	8437,38	3,22%	Andes
12	40602	Andes 2	6816,68	2,60%	Andes
13	40603	Andes 3	12807,03	4,88%	Andes
14	40604	Andes 4	12021,39	4,58%	Andes
15	40605	Andes 5	5917,19	2,25%	Andes
16	40606	Andes 6	10980,95	4,18%	Andes
17	40607	Andes 7	6182,68	2,36%	Andes
18	40608	Andes 8	4819,77	1,84%	Andes
19	40609	Andes 9	289,34	0,11%	Andes
20	40901	Pacific 1	8397,56	3,20%	Pacific
21	40902	Pacific 2	7542,49	2,87%	Pacific

22	40903	Pacific 3	16434,79	6,26%	Pacific
23	40904	Pacific 4	17556,55	6,69%	Pacific
24	40905	Pacific 5	15189,03	5,79%	Pacific
25	40906	Pacific 6	4019,16	1,53%	Pacific
26	40907	Pacific 7	10690,86	4,07%	Pacific
27	40908	Pacific 8	285,92	0,11%	Pacific
28	40909	Pacific 9	87,93	0,03%	Pacific
29	40910	Pacific 10	7723,87	2,94%	Pacific

## 4.2.2 Leyend

MapBiomass uses a common legend for all its initiatives, from which Ecuador employs a subset of classes corresponding to those occurring within the country. The operational definition of each class can be found on our website. The classes mapped in Ecuador (Figure 15) for the MapBiomass Ecuador Collection 3.0 are: Forest (ID = 3), Open forest (ID = 4), Mangrove (ID = 5), Floodable forest (ID = 6), Floodable non-forest natural formations (ID = 11), Grassland (ID = 12), Andean grasslands and shrublands (ID = 81), Floodable Andean grasslands (ID = 82), Other non-forest natural formation (ID = 13), Rocky outcrop (ID = 29), Mosaic of agriculture and pasture (ID = 21), Silviculture (ID = 9), Banana (beta) (ID = 74), Urban infrastructure (ID = 24), Mining (ID = 30), Beach, dune, or sandbank (ID = 23), Other anthropic area without vegetation (ID = 25), Other natural area without vegetation (ID = 68), Rivers, lakes, or ocean (ID = 33), Aquaculture (ID = 31), Glaciers (ID = 34), and Not observed (ID = 27).



<b>(ID12) Grassland</b>	
<b>(ID81) Andean Grasslands and Shrublands</b>	
<b>(ID82) Flooded Andean Grasslands</b>	
<b>(ID29) Rock Outcrop</b>	
<b>(ID13) Other Non-Forest Natural Formation</b>	
<b>(ID9) Silviculture</b>	
<b>(ID21) Mosaic of Agriculture and Pastures</b>	
<b>(ID74) Banana (beta)</b>	
<b>(ID24) Urban Infrastructure</b>	
<b>(ID30) Mining</b>	



**Figure 15.** Mapped classes in the MapBiomias Ecuador Collection 3.0 (Prepared by Ecociencia).

The legend classes of the MapBiomias Ecuador Collection 3.0 group together the vegetation formations from the Ecosystems Map of Ecuador (MAATE, 2013a), the Land Cover and Use Map (MAATE, 2014), and the Ecosystems of Galápagos (Rivas et al., 2018). Annexes 5, 6, and 7 show their (spatial and/or conceptual) correspondence.

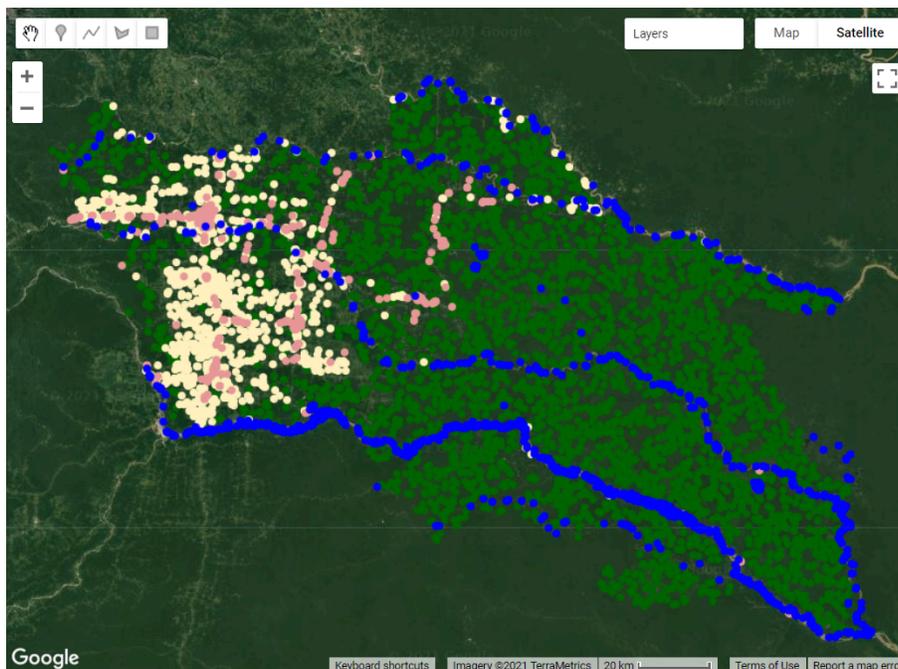
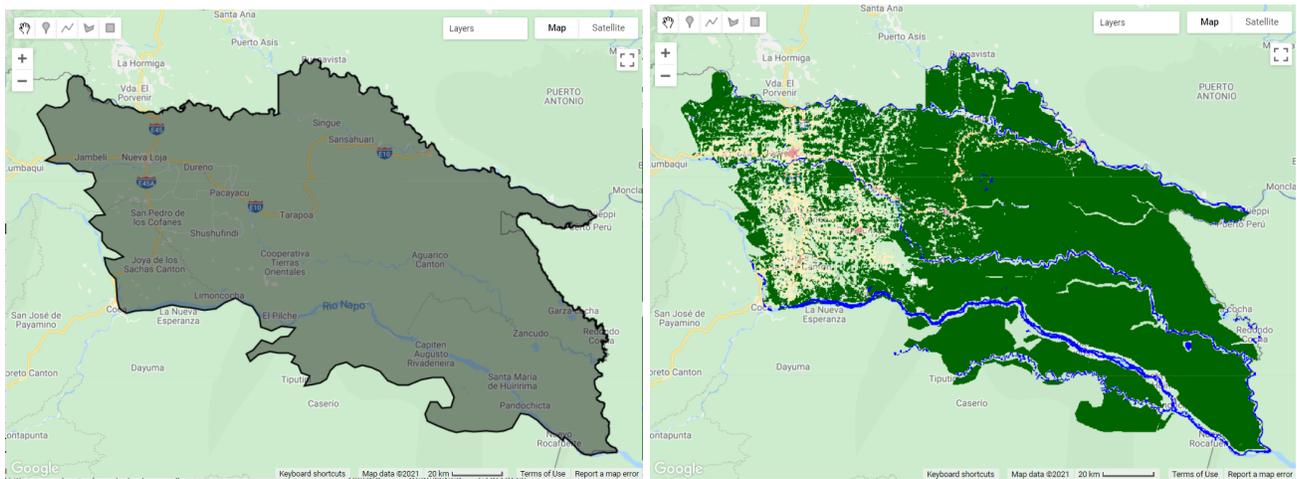
### 4.2.3 Classification routines

The following sequence of steps describes the routines that make up the classification method. The sequence was implemented in JavaScript and executed in the Google Earth Engine (GEE) processing environment.

For this third collection, since information from previous collections was available for the national territory—both within and outside the RAISG boundary (the Amazon Basin)—the following routine was applied separately to these two regions, as described below:

For regions within the RAISG boundary, mapping data from MapBiomias Amazonia Collections 1 to 6 was used, while for areas outside the RAISG boundary, mapping data from Collection 2 was used. These served as inputs for generating this map. Therefore, the sequence—repeated independently for each classification region—consisted of the following steps, with parameter adjustments made until achieving a satisfactory classification quality.

1. Pixels that consistently maintained the same class throughout the 39-year series (1985–2023) were identified in the maps from MapBiomass Amazonia Collection 6 and MapBiomass Ecuador Collection 3. Based on this information, a stable-pixel map was generated for each class in the legend. The map was then visually inspected and manually corrected. The manual correction included: (1) the exclusion of pixels that, upon visual inspection of Landsat images, were determined to be unstable, and (2) the reassignment (reclassification) of incorrectly labeled pixels.
2. Within the extent of the stable-pixel map, training points (Figure 16c) or sample locations were randomly generated. For each point, the values of all variables comprising the feature space were extracted (151 values per location, one for each variable; see Section 4.1 \*Generation of Annual Mosaics\* and Section 4.1.1 \*Feature Space\*). These values spectrally describe the land cover types to be classified and therefore represent the samples used to train the supervised classification algorithm Random Forest.
3. From the total set of stable pixels, a random sample of points was drawn. The sampling was balanced and stratified to ensure that the number of samples per class was proportional to the known extent of each class (estimated \*a priori\* for each region). At this stage, the interpreter evaluated the correct spatial distribution of samples, the class-wise distribution of points, and adjusted the parameters (Table 6) to ensure balanced sampling. After several rounds of evaluation, it was determined that the best results were achieved when between 10% and 15% of the total sample consisted of points from the least abundant class. When necessary, additional samples—referred to as “complementary samples”—were collected to strengthen the classification of underrepresented classes or those requiring improved classification accuracy.



**Figure 16.** Example of training sample point selection for a classification region in the Ecuadorian Amazon. a) Boundary of classification region 40201 “Low Amazon 1.” b) Stable-pixel map used for sample point selection. c) Sample points selected within region 40201 (Prepared by Ecociencia).

4. Another element that determines the quality of the classification is the number of trees used by the classifier to solve the classification. After several tests, it was determined that 120 trees was the optimal number, which was standardized for all regions (Table 6). Lower values resulted in reduced classification accuracy, while higher values did not improve quality and only increased processing demands.
5. A classification was generated for each year in the time series (1985–2024). The resulting classification represents the final product of the classification round, ready to proceed to the post-classification phase (see Section 3.4.4) and subsequently to the integration phase (see Section 3.6).
6. Although the classification process can be iterated (repeated) as many times as the interpreter deems necessary to achieve a satisfactory product, for the current Collection we adopted the strategy of correcting steps 1 and 2 as many times as needed, thereby reducing the number of intermediate products requiring physical storage.
7. An additional step that enhances classification quality should be highlighted: based on an analysis of the contribution of the 151 variables to class separability, the number of variables available to the classifier was filtered so that, in the final training, only the most relevant variables were used (i.e., those contributing most to class separability). This dimensionality reduction of the feature space allowed the use of the most significant variables suited to the specific natural formations and land-use types of each region. The variables selected for each region are detailed in Table 7.
8. This collection also relied on the use of Planet imagery to inspect and improve map quality, as well as canopy height data derived from GEDI (Dubayah, 2021; Potapov et al., 2021) to exclude areas with a low probability of being forests. In several regions, the strategy of using corrected maps from Collections 1 and 2 was adopted to exclude areas that had already been corrected in previous collections. These corrections improved the training data pool.

#### 4.2.4 Classification parameters

**Table 7.** Sampling parameters and number of decision trees used by classification region (Prepared by Ecociencia).

Biome	Region code	Number of iterations	Parameters for stratified sampling			Muestras estables exportadas		Number of trees (Random Forest)
			Iteration	Maximum sample	Minimum sample	Sample of the least represented class	Final sample size	
Amazonia	40101	1	1	3000	500	500 (10,10%)	4950	120
	40102	1	1	2100	350	350 (7,52%)	4653	120
	40103	1	1	3000	400	400 (16,30%)	2454	120
	40104	1	1	1000	200	200 (10,79%)	1853	120
	40105	1	1	1200	150	150 (13,27%)	1130	120
	40201	1	1	3500	550	550 (12,26%)	4487	120
	40202	1	1	4000	1000	1000 (13,15%)	7605	120
	40203	1	1	6000	1000	1000 (16,85%)	5935	120
	40204	1	1	1150	120	120 (9,55%)	1256	120
	40205	1	1	4000	200	200 (4,21%)	4750	120
Andes	40601	1	1	2000	450	450 (10,95%)	4109	120
	40602	1	1	2100	500	500 (11,97%)	4177	120

	40603	1	1	1000	150	150 (9,72%)	1543	120
	40604	1	1	6000	900	900 (10,55%)	8532	120
	40605	1	1	1000	200	200 (9,29%)	2154	120
	40606	1	1	1000	200	200 (11,02%)	1815	120
	40607	1	1	1000	200	200 (10,91%)	1833	120
	40608	1	1	1500	500	500 (11,73%)	4261	120
	40609	1	1	1500	500	500 (14,86%)	3365	120
	40901	1	1	1800	600	600 (17,83%)	3365	120
	40902	1	1	4000	500	500 (8,78%)	5697	120
	40903	1	1	3000	500	500 (12,56%)	3980	120
Pacific	40904	1	1	4000	200	200 (4,67%)	4281	120
	40905	1	1	3000	150	150 (12,69%)	1182	120
	40906	1	1	4000	200	200 (4,82%)	4153	120
	40910	1	1	2000	250	250 (13,39%)	1867	120
	40907	1	1	300	120	120 (14,94%)	803	120
Galapagos	40908	1	1	250	150	150 (14,29%)	1050	120
	40909	1	1	120	100	100 (20%)	500	120

**Table 8.** Most significant variables identified by classification region (Prepared by Ecociencia).

Biome	Region code	Selected variables
	40101	red_dry_max', 'evi2_wet', 'nir_wet_qmo', 'nir_wet', 'hallcover_median', 'nir_dry', 'ndvi_median', 'swirl1_median', 'mndwi_max', 'swirl1_dry_qmo', 'ndsi_median', 'blue_median', 'ndgb_median', 'ndgb_wet', 'nir_min', 'nir_median', 'ndmi_dry', 'nir_dry_qmo', 'ndmi_median', 'ndwi_gao_wet_qmo', 'ndwi_gao_wet_min', 'ndvi_stdDev', 'ndmir_wet', 'ndsi_min', 'pri_median', 'ndsi2_dry', 'ndsi2_max', 'pri_dry', 'ndsi2_min', 'red_dry', 'ndfi_wet', 'textG_median', 'swirl2_wet_qmo', 'swirl2_wet_max', 'swirl2_wet', 'swirl2_min', 'swirl2_median', 'swirl2_dry_qmo', 'swirl1_wet_qmo', 'swirl1_wet_max', 'swirl1_min', 'swirl1_dry_max', 'swirl1_dry', 'soil_median', 'shade_median', 'sefi_median', 'savi_median', 'savi_dry', 'red_wet', 'red_dry', 'red_dry_qmo', 'ndgb_dry', 'wefi_wet', 'gcvl_wet', 'gcvl_dry', 'ndbi_median', 'gli_max', 'gcvl_wet', 'gcvl_dry', 'green_wet_qmo', 'fns_stdDev', 'mndwi_dry', 'mndwi_median', 'fns_dry', 'mndwi_wet', 'ndbi_max', 'gli_min', 'evi2_median', 'green_dry_qmo', 'ndfi_dry', 'green_min', 'green_dry', 'gvs_median', 'ndbi_min', 'green_median',
	40102	red_median', 'nir_median', 'savi_median', 'swirl1_median', 'swirl2_median', 'ndvi_median', 'swirl2_dry_qmo', 'evi2_median', 'savi_dry', 'swirl1_wet', 'swirl2_wet_max', 'gcvl_wet', 'ndsi_median', 'ndvi_wet', 'savi_wet', 'nir_dry_qmo', 'mndwi_max', 'swirl1_wet_qmo', 'swirl1_dry', 'ndsi_min', 'swirl2_dry_min', 'evi2_wet', 'swirl2_dry', 'ndvi_dry', 'swirl1_dry_qmo', 'swirl1_min',
Amazonia	40103	mndwi_dry', 'ndsi2_dry', 'swirl2_median', 'swirl2_dry_min', 'ndbi_dry', 'swirl1_median', 'ndwi_mcfeters_median', 'textG_median', 'cai_max', 'ndvi_wet', 'ndwi_gao_wet_min', 'mndwi_median', 'ndbi_max', 'ndwi_gao_wet_qmo', 'ndbi_median', 'ndbi_min', 'ndwi_gao_wet_max', 'ndwi_gao_dry_min', 'ndfib_amp', 'ndfib_median', 'shade_median', 'ndwi_gao_amp', 'swirl1_dry', 'sefi_dry', 'ndmir_wet', 'blue_median', 'ndvi_dry', 'ndsi2_max', 'red_min', 'red_wet', 'ndvi_median', 'ndmir_stdDev', 'ndwi_mcfeters_amp', 'savi_dry', 'ndmir_median', 'ndmir_max', 'savi_median', 'red_dry_max', 'ndmi_dry'
	40104	NA
	40105	blue_median', 'green_dry', 'green_median', 'green_min', 'red_dry', 'red_median', 'red_min', 'red_wet', 'nir_dry', 'nir_median', 'nir_min', 'nir_stdDev', 'nir_wet', 'swirl1_dry', 'swirl1_median', 'swirl1_min', 'swirl1_wet', 'swirl2_dry', 'swirl2_median', 'swirl2_min', 'swirl2_wet', 'ndfi_dry', 'ndfi_median', 'ndfi_wet', 'ndfib_amp', 'ndfib_dry', 'ndfi_min', 'ndfi_max', 'ndfi_stdDev', 'gvs_dry', 'gvs_median', 'gvs_wet', 'shade_median', 'fns_dry', 'gcvl_dry', 'gcvl_wet', 'gcvl_dry', 'pri_dry', 'pri_min', 'pri_max', 'pri_stdDev', 'evi2_amp', 'evi2_dry', 'evi2_min', 'evi2_max', 'evi2_stdDev', 'evi2_wet', 'ndvi_amp', 'ndvi_dry', 'ndvi_min', 'ndvi_max', 'ndvi_stdDev', 'ndvi_wet', 'ndsi_dry', 'ndsi_min', 'ndsi_max', 'ndsi_stdDev', 'ndwi_gao_amp', 'ndwi_gao_dry', 'ndwi_gao_min', 'ndwi_gao_max', 'ndwi_gao_stdDev', 'ndwi_mcfeters_amp', 'ndwi_mcfeters_min', 'ndwi_mcfeters_max', 'ndwi_mcfeters_stdDev', 'savi_dry', 'savi_min', 'savi_max', 'savi_stdDev', 'savi_wet', 'sefi_dry', 'sefi_min', 'sefi_max', 'sefi_stdDev', 'wefi_dry', 'wefi_min', 'wefi_max', 'wefi_stdDev', 'hallcover_median', 'textG_dry', 'textG_min', 'textG_max', 'textG_stdDev', 'gli_dry', 'gli_min', 'gli_max', 'gli_stdDev', 'mndwi_dry', 'mndwi_min', 'mndwi_max', 'mndwi_stdDev', 'mndwi_wet', 'ndbi_dry', 'ndbi_min', 'ndbi_max', 'ndbi_stdDev', 'ndbi_wet', 'ndbi_min', 'ndbi_max', 'ndbi_stdDev', 'ndgb_dry', 'ndgb_min', 'ndgb_max', 'ndgb_stdDev', 'ndgb_wet', 'ndmi_dry', 'ndmi_min', 'ndmi_max', 'ndmi_stdDev', 'ndmi_wet', 'ndmi_min', 'ndmi_max', 'ndmi_stdDev', 'ndmir_dry', 'ndmir_min', 'ndmir_max', 'ndmir_stdDev', 'ndmir_wet', 'ndmir_min', 'ndmir_max', 'ndmir_stdDev',

		Dev','ndmir_wet','ndrb_min','ndrb_stdDev','ndrb_wet','ndsi2_dry','ndsi2_median','ndsi2_max','ndsi2_min','ndsi2_wet','cloud_median','cai_wet_min','green_dry_qmo','green_wet_min','green_wet_qmo','ndwi_gao_dry_min','ndwi_gao_wet_max','ndwi_gao_wet_min','ndwi_gao_wet_qmo','nir_dry_qmo','nir_wet_qmo','red_dry_max','red_dry_min','red_dry_qmo','red_wet_max','swirl_dry_max','swirl_dry_qmo','swirl_wet_max','swirl_wet_min','swirl_wet_qmo','swir2_dry_min','swir2_dry_qmo','swir2_wet_max','swir2_wet_qmo'
		nir_wet','swirl_min','ndvi_wet','mndwi_max','ndsi2_median','evi2_wet','ndbi_median','gcvi_dry','swir2_min','ndmir_wet','ndsi2_dry','ndmi_median','nir_dry','ndwi_mcfeters_median','ndwi_gao_wet_qmo','ndwi_gao_wet_max','ndwi_gao_wet','nir_dry_min','ndwi_gao_amp','ndvi_stdDev','ndsi2_median','ndsi2_wet','nir_median','ndmir_max','ndsi2_max','ndmir_min','ndmir_stdDev','nir_dry_qmo','nir_min','sefi_median','wefi_stdDev','swir2_dry_qmo','swirl_wet_qmo','swirl_wet_min','swirl_wet_max','swirl_wet','swirl_dry_max','swirl_dry','shade_median','sefi_stdDev','savi_wet','nir_stdDev','savi_stdDev','savi_median','red_wet_max','red_wet','red_median','red_dry_min','red_dry_max','red_dry','nir_wet_qmo','ndgb_dry','ndmi_max','ndsi2_min','wefi_wet','evi2_dry','mndwi_median','mndwi_dry','evi2_median','evi2_stdDev','hallcover_median','gvs_median','gcvi_median','gv_amp','gv_amp','gcvi_wet','green_wet_min','green_min','green_median','gli_min','mndwi_wet','green_dry_qmo','cai_wet_min','cai_median','ndfi_stdDev','cai_min','ndfib_amp','ndfi_median'
	40201	ndbi_dry','ndrb_wet','evi2_stdDev','swir2_wet_qmo','textG_median','ndmi_median','ndsi_min','ndsi2_median','ndsi2_max','ndgb_median','ndrb_stdDev','ndrb_min','ndmir_wet','ndmir_max','shade_median','ndmir_stdDev','ndvi_dry','ndmir_min','ndmir_median','ndvi_amp','savi_wet','ndvi_median','red_dry_max','pri_median','pri_dry','red_dry_qmo','red_min','nir_wet_qmo','nir_wet','nir_stdDev','nir_min','nir_median','nir_dry_qmo','nir_dry','ndwi_mcfeters_median','ndwi_mcfeters_amp','red_wet','ndwi_gao_wet_min','ndwi_gao_wet_max','ndwi_gao_wet','red_wet_max','savi_dry','savi_wet','ndvi_wet','ndgb_dry','red_dry_min','evi2_dry','gcvi_wet','evi2_wet','fns_dry','swirl_wet_min','swirl_wet_qmo','swir2_dry','gcvi_dry','swir2_dry_qmo','swir2_median','swir2_min','gcvi_median','swir2_wet','green_median','green_dry_qmo','green_dry','gli_min','swir2_wet_max','gli_max','evi2_median','gli_dry','ndbi_max','cai_median','swirl_min','mndwi_dry','mndwi_max','cai_wet_min','mndwi_wet','hallcover_median','ndbi_median','cai_max','ndbi_min','swirl_dry_qmo','swirl_dry'
	40202	
	40203	NA
	40204	fns_dry','nir_median','nir_dry_qmo','swir2_median','ndvi_median','green_wet_min','green_min','nir_wet','nir_min','wefi_wet','gli_dry','green_median','ndbi_median','ndfi_dry','hallcover_median','gli_median','gli_min','blue_median','green_dry_qmo','green_dry','evi2_median','cai_min','nir_dry','ndwi_mcfeters_median','red_dry','red_wet_max','swirl_dry_qmo','red_dry_max','swirl_median','textG_median','swir2_min','swir2_wet_qmo','swir2_wet_max','swirl_wet','gvs_median','mndwi_dry'
	40205	evi2_dry','evi2_median','shade_median','swir2_median','mndwi_median','mndwi_max','gv_median','nir_dry','nir_median','red_wet_max','evi2_wet','gcvi_dry','gli_max','green_dry_qmo','ndbi_min','gli_min','green_dry','fns_dry','cai_min','cai_wet_min','blue_median','cai_max','swirl_wet_min','red_dry','swirl_min','swirl_dry_qmo','swir2_wet_max','swir2_wet','swirl_median','swir2_dry_qmo','ndfi_dry','ndbi_max','green_wet_qmo','gvs_wet','green_wet_min','hallcover_median','ndwi_gao_dry','ndsi2_max','ndsi2_median','ndsi2_dry','ndsi_min','ndsi2_median','ndvi_median','ndvi_dry'
	40601	gvs_wet','ndfib_median','ndvi_dry','savi_wet','swirl_median','evi2_wet','swirl_wet','ndmi_dry','ndmi_median','savi_dry','ndwi_gao_wet_qmo','ndwi_gao_wet_min','ndwi_gao_wet_max','ndvi_median','ndwi_gao_wet','ndwi_mcfeters_median','ndwi_gao_dry_min','ndwi_gao_dry','ndwi_gao_amp','ndvi_wet','nir_dry','nir_dry_qmo','ndsi2_wet','blue_median','ndsi2_median','ndsi2_max','ndsi2_dry','ndrb_min','ndmir_wet','ndmir_stdDev','ndmir_min','ndmir_median','ndsi_min','nir_wet','nir_median','nir_min','swir2_wet_qmo','swir2_wet_max','swir2_wet','swir2_min','swir2_median','swir2_dry_qmo','swir2_dry_min','swirl_wet_min','swirl_min','swirl_dry_max','swirl_dry','shade_median','sefi_median','savi_median','red_wet_max','red_wet','red_min','red_median','red_dry_qmo','red_dry_min','red_dry_max','pri_median','pri_dry','ndmi_max','wefi_wet','ndgb_wet','ndbi_median','gvs_median','hallcover_median','gv_amp','ndgb_stdDev','evi2_median','green_wet_qmo','mndwi_median','mndwi_wet','ndbi_max','evi2_dry','ndbi_dry','green_min','green_dry','gcvi_wet','ndgb_max','gli_median','gli_min','ndfi_wet','ndbi_min','cai_median','green_dry_qmo','ndfi_median','ndfi_dry','green_median','gcvi_median'
Andes	40602	gv_amp','swirl_wet_max','nir_median','ndwi_gao_amp','shade_median','swirl_dry','nir_stdDev','gcvi_dry','mndwi_wet','swir2_wet_max','ndsi2_median','ndmir_min','ndmir_median','nir_dry','ndwi_mcfeters_amp','ndwi_gao_wet_qmo','ndwi_gao_wet_max','ndwi_gao_wet','ndwi_gao_dry_min','ndwi_gao_dry','ndvi_wet','ndsi2_wet','ndmir_wet','ndvi_stdDev','ndrb_min','ndrb_wet','ndvi_dry','ndvi_amp','ndsi2_max','nir_min','nir_wet','swirl_dry_qmo','wefi_stdDev','wefi_amp','swir2_wet_qmo','swir2_min','swir2_dry_qmo','swir2_dry_min','swir2_dry','swirl_wet_min','swirl_wet','swirl_median','nir_wet_qmo','sefi_dry','savi_wet','savi_stdDev','savi_dry','red_wet_max','red_wet','red_min','red_median','red_dry','ndgb_wet','ndmi_dry','ndsi2_min','wefi_wet','evi2_median','green_wet_qmo','green_median','green_dry_qmo','green_dry','green_dry','gli_median','hallcover_median','gli_dry','ndbi_max','fns_dry','evi2_wet','evi2_stdDev','mndwi_median','ndfi_wet','cai_min','evi2_dry','evi2_amp','cai_max','ndfi_dry','ndgb_dry','cai_median'
	40603	NA

		green_median', 'savi_wet', 'nir_wet_qmo', 'ndvi_wet', 'ndvi_median', 'ndsi_median', 'wefi_wet', 'cai_min', 'evi2_median', 'pri_median', 'nir_wet', 'nir_min', 'nir_median', 'nir_dry_qmo', 'nir_dry', 'ndwi_gao_wet', 'ndwi_gao_dry', 'ndwi_gao_amp', 'cai_wet_min', 'ndvi_amp', 'ndsi_min', 'ndsi2_max', 'ndrb_min', 'ndmir_wet', 'ndmir_min', 'ndmir_median', 'ndmir_max', 'ndmi_median', 'cai_median', 'red_dry', 'ndmi_dry', 'red_dry_max', 'wefi_amp', 'textC_median', 'swir2_median', 'swir2_dry_min', 'swir2_dry', 'swirl_wet_qmo', 'swirl_wet', 'swirl_dry_qmo', 'swirl_dry_max', 'sefi_dry', 'cai_max', 'savi_stdDev', 'savi_median', 'red_wet_max', 'red_min', 'red_median', 'red_dry_min', 'ndmi_max', 'ndvi_dry', 'ndsi2_min', 'gcvi_median', 'green_wet_qmo', 'green_wet_min', 'green_min', 'evi2_dry', 'hallcover_median', 'mndwi_dry', 'gli_median', 'mndwi_wet', 'gli_max', 'gcvi_wet', 'gv_median', 'gcvi_dry', 'ndfi_median', 'ndbi_median', 'evi2_wet', 'fns_dry', 'ndfi_wet', 'ndfi_amp'
	40604	
	40605	NA
	40606	NA
	40607	NA
	40608	green_median', 'nir_wet_qmo', 'ndwi_gao_wet_min', 'ndvi_wet', 'ndvi_dry', 'ndbi_max', 'green_wet_min', 'ndsi2_min', 'cai_wet_min', 'ndmi_dry', 'cai_median', 'ndwi_gao_wet_max', 'ndwi_gao_wet', 'ndwi_gao_median', 'ndwi_gao_dry_min', 'ndwi_gao_dry', 'cai_min', 'ndvi_median', 'evi2_wet', 'ndsi_min', 'ndsi_median', 'ndsi2_wet', 'blue_median', 'ndsi2_median', 'ndsi2_dry', 'ndrb_wet', 'ndrb_min', 'ndmir_wet', 'ndmir_median', 'ndmir_max', 'ndmi_dry', 'ndwi_gao_wet_qmo', 'ndwi_mcfeters_median', 'nir_dry_qmo', 'savi_wet', 'swir2_min', 'swir2_dry_min', 'swir2_dry', 'swirl_wet_min', 'swirl_wet_max', 'swirl_min', 'swirl_dry_qmo', 'soil_median', 'sefi_median', 'savi_stdDev', 'nir_min', 'savi_median', 'red_wet', 'red_min', 'red_dry_min', 'red_dry_max', 'red_dry', 'pri_median', 'cai_max', 'nir_wet', 'ndmi_max', 'wefi_wet', 'mndwi_median', 'gli_dry', 'mndwi_max', 'mndwi_dry', 'gli_max', 'gvs_wet', 'ndbi_dry', 'gvs_median', 'gvs_dry', 'gli_min', 'green_wet_qmo', 'green_dry', 'evi2_dry', 'green_min', 'mndwi_wet', 'evi2_median', 'ndbi_median', 'ndbi_min', 'gcvi_median', 'gcvi_wet', 'ndfi_dry'
	40609	N/A
	40901	N/A
	40902	evi2_wet', 'ndvi_median', 'savi_wet', 'evi2_median', 'gv_median', 'shade_median', 'swirl_dry_qmo', 'evi2_dry', 'nir_wet', 'savi_median', 'nir_wet_qmo', 'nir_dry_qmo', 'swirl_dry', 'ndvi_wet', 'savi_dry', 'ndvi_dry', 'gcvi_median', 'swirl_min', 'ndwi_mcfeters_median', 'wefi_wet', 'hallcover_median', 'nir_min'
	40903	shade_median', 'swirl_wet_max', 'swirl_wet', 'ndvi_wet', 'ndsi_median', 'green_wet_min', 'ndwi_mcfeters_median', 'ndsi2_max', 'swir2_dry_min', 'mndwi_median', 'ndvi_dry', 'green_median', 'hallcover_median', 'red_wet_max', 'evi2_median', 'nir_dry', 'nir_min', 'swir2_wet_max', 'swirl_dry_qmo', 'mndwi_max', 'swirl_wet_qmo', 'ndbi_max'
	40904	green_min', 'green_median', 'hallcover_median', 'gcvi_wet', 'red_min', 'swir2_min', 'red_wet_max', 'gcvi_median', 'nir_median', 'ndrb_wet', 'swir2_median', 'red_dry_qmo', 'mndwi_dry', 'swirl_wet_min', 'ndvi_wet', 'evi2_median', 'swirl_median', 'green_dry_qmo', 'evi2_dry', 'cai_wet_min', 'green_wet_min', 'green_wet_qmo', 'ndvi_median', 'mndwi_wet', 'gli_max', 'evi2_wet', 'red_wet', 'swirl_dry_max', 'ndvi_dry', 'ndmi_dry', 'green_dry', 'swir2_wet', 'red_median', 'swir2_wet_max', 'cai_median', 'ndwi_gao_wet_max'
Pacific	40905	green_median', 'nuaci_median', 'nir_min', 'red_median', 'swir2_dry', 'green_dry', 'nir_dry_qmo', 'savi_dry', 'red_wet_max', 'ndsi_median', 'green_wet_min', 'ndwi_mcfeters_median', 'ndsi2_max', 'nir_dry', 'shade_median', 'swir2_dry_qmo', 'red_dry_min', 'ndvi_median', 'swirl_dry_max', 'green_min', 'red_dry_max', 'nir_median', 'ndsi_min', 'gcvi_dry', 'red_dry_qmo', 'gcvi_median', 'cai_max', 'ndvi_dry', 'hallcover_median', 'red_dry', 'savi_wet', 'swirl_median', 'green_dry_qmo', 'swirl_dry_qmo', 'green_wet_qmo', 'gcvi_wet', 'mndwi_dry', 'ndvi_wet', 'ndmir_median', 'red_min', 'mndwi_median', 'swir2_median', 'evi2_dry', 'evi2_median', 'swir2_dry_min', 'red_wet', 'ndbi_max', 'swirl_wet', 'swir2_min', 'ndmi_dry', 'savi_median', 'swirl_wet_min', 'swirl_dry', 'ndsi2_median', 'ndsi2_dry', 'ndbi_dry', 'evi2_wet', 'swirl_wet_max', 'ndmi_median', 'ndwi_gao_wet_min', 'ndbi_median', 'ndsi2_wet', 'mndwi_max', 'ndrb_min', 'nir_wet_qmo', 'cai_median', 'textC_median', 'ndwi_gao_median', 'ndmi_max', 'swir2_wet', 'blue_median', 'ndwi_gao_dry_min', 'ndmir_max', 'ndgb_median', 'ndwi_gao_dry', 'nir_wet', 'cai_min', 'ndmir_min', 'swir2_wet_max', 'mndwi_wet', 'fns_dry', 'swirl_min', 'cai_wet_min', 'ndbi_min'
	40906	red_min', 'nir_wet_qmo', 'evi2_dry', 'ndvi_dry', 'mndwi_median', 'savi_wet', 'gcvi_dry', 'shade_median', 'textC_median', 'savi_dry', 'gcvi_median', 'red_dry_qmo', 'hallcover_median', 'red_wet_max', 'swirl_dry', 'ndvi_wet', 'evi2_median', 'ndmi_dry', 'green_median', 'swir2_dry_min', 'swir2_wet_qmo', 'ndmir_min', 'swirl_wet_min', 'swir2_median', 'ndrb_wet', 'ndsi2_wet', 'green_min', 'mndwi_max', 'green_dry_qmo', 'cai_min', 'red_wet', 'ndmir_wet', 'swirl_wet', 'wefi_wet', 'swirl_dry_qmo', 'swirl_min', 'swirl_dry_max', 'swirl_median'
	40910	savi_dry', 'ndvi_wet', 'ndvi_median', 'gcvi_dry', 'ndsi_median', 'ndwi_mcfeters_median', 'mndwi_median', 'red_median', 'ndsi_min', 'evi2_wet', 'swirl_wet', 'gcvi_median', 'ndvi_dry', 'swir2_wet_qmo', 'red_wet_max', 'nir_median', 'cai_min', 'evi2_dry', 'cai_max', 'ndrb_min', 'nuaci_median', 'gcvi_wet', 'hallcover_median', 'green_min', 'ndmir_max', 'swirl_dry_qmo', 'nir_dry', 'savi_median', 'mndwi_dry', 'ndmir_wet', 'evi2_median', 'ndmi_max', 'ndrb_wet', 'ndmi_dry', 'swir2_min', 'savi_wet', 'mndwi_max', 'swir2_wet', 'wefi_wet', 'ndmir_median', 'ndbi_max', 'red_dry_qmo', 'nir_wet_qmo', 'mndwi_wet', 'red_dry', 'ndsi2_wet', 'swir2_dry_min', 'ndwi_gao_wet_max', 'red_dry_max', 'cai_wet_min', 'red_min', 'green_wet_qmo', 'nir_dry_qmo', 'ndwi_gao_wet_min', 'pri_median', 'ndwi_gao_wet', 'ndwi_gao_median', 'swirl_median', 'ndsi2_median', 'swirl_wet_min', 'ndwi_gao_wet_qmo', 'swirl_min', 'ndbi_median', 'ndgb_median', 'shade_median', 'ndsi2_dry', 'ndgb_dry', 'gli_max', 'swir2_dry', 'cai_median', 'pri_dry', 'nir_min', 'swirl_dry_max', 'swirl_dry', 'gli_median', 'nir_wet', 'ndsi2_min', 'blue_median', 'ndmir_min', 'green_wet_min', 'ndbi_min', 'swirl_wet_qmo'

	40907	N/A	
	40908		swirl_median', 'savi_dry', 'gcvl_wet', 'ndvi_dry', 'nir_median', 'cai_min', 'evi2_median', 'nir_dry_qmo', 'swir2_dry_min', 'swirl_dry_max', 'swir2_median', 'hallcover_median', 'mndwi_median', 'swirl_wet', 'ndwi_mcfeters_median', 'ndbi_min', 'ndvi_median', 'swirl_wet_qmo', 'savi_wet', 'red_median', 'ndvi_wet', 'nir_dry', 'textG_median', 'nir_wet_qmo', 'swir2_wet', 'red_min', 'gcvl_median', 'swirl_wet_max', 'swirl_min', 'swirl_dry_qmo', 'swir2_wet_max', 'mndwi_dry', 'ndsi_min', 'swirl_wet_min', 'nir_min', 'cai_max', 'evi2_wet', 'evi2_dry', 'ndmir_wet', 'red_dry', 'nir_wet', 'green_min', 'shade_median', 'ndsi2_dry', 'wefi_wet', 'green_wet_qmo', 'mndwi_wet', 'red_wet_max', 'cai_median', 'savi_median', 'swir2_min'
Galapagos	40909		swirl_median', 'savi_dry', 'gcvl_wet', 'ndvi_dry', 'nir_median', 'cai_min', 'evi2_median', 'nir_dry_qmo', 'swir2_dry_min', 'swirl_dry_max', 'swir2_median', 'hallcover_median', 'mndwi_median', 'swirl_wet', 'ndwi_mcfeters_median', 'ndbi_min', 'ndvi_median', 'swirl_wet_qmo', 'savi_wet', 'red_median', 'ndvi_wet', 'nir_dry', 'textG_median', 'nir_wet_qmo', 'swir2_wet', 'red_min', 'gcvl_median', 'swirl_wet_max', 'swirl_min', 'swirl_dry_qmo', 'swir2_wet_max', 'mndwi_dry', 'ndsi_min', 'swirl_wet_min', 'nir_min', 'cai_max', 'evi2_wet', 'evi2_dry', 'ndmir_wet', 'red_dry', 'nir_wet', 'green_min', 'shade_median', 'ndsi2_dry', 'wefi_wet', 'green_wet_qmo', 'mndwi_wet', 'red_wet_max', 'cai_median', 'savi_median', 'swir2_min'

## 4.3 Post-classification

The post-classification phase consists of applying different types of filters designed to reduce data gaps or inconsistencies and to ensure the comparability of maps across the different years of the time series. All filters are applied to the classification output from the process described above (no filters are applied to the Landsat mosaics).

Four different types of filters were used. The process was carried out by applying the filters in a specific order according to the needs and conditions of each region, at the interpreters' discretion, with the option to use a filter more than once. This flexibility represented a methodological improvement and reduced sources of error identified in previous collections. It was also possible to exclude specific classes and years from the effects of any filter, as determined by the interpreters.

A description of each tool is presented below:

### 4.3.1 Gap-filling filter (GapFill)

According to the MapBiomass legend, pixels lacking information due to observation limitations at the time of satellite image acquisition are classified as "unobserved" (ID = 27). This filter is particularly useful in regions such as Ecuador, which are severely affected by the persistent presence of clouds that hinder data acquisition from optical remote sensing sensors such as Landsat.

The gap-filling filter (GapFill) replaces these data gaps in the time series so that pixels without a classification value assume the temporally closest known value (i.e., the most recent observation with a valid class). As a result, the classification produced by this filter is practically free of gaps (Figure 17). Persistent gaps may still occur when no valid observation was obtained throughout the entire time series.

Additionally, for Ecuador, efforts were made to exclude years that introduced excessive noise into the classification—that is, years that were not used to propagate pixel values to nearby years. Similarly, class exclusions were also implemented, creating a blocking mechanism to prevent the propagation of certain errors present in pre-filter classifications.

This filter was applied in all regions within the Ecuadorian study area, and the parameters used are summarized in Table 9.

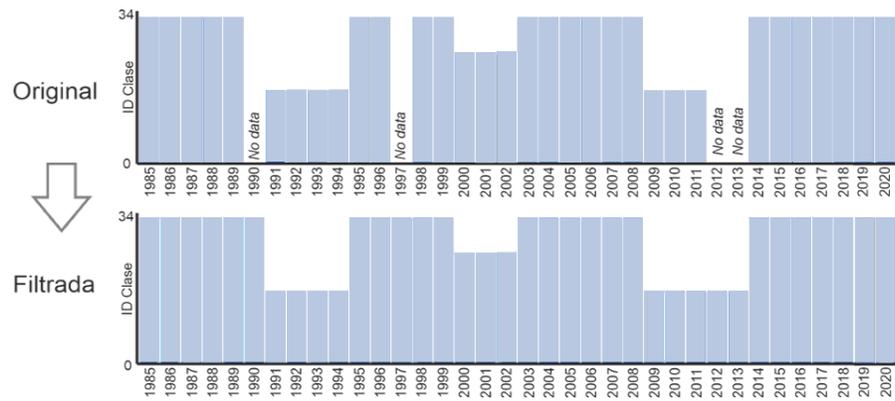


Figure 17. Functionality of the GapFill filter in MapBiomias Ecuador Collection 3.0 (Prepared by MapBiomias).

Table 9. GapFill filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by Ecociencia).

Biome	Region code	Number of iterations	Order	Excluded classes	Excluded years	Reason for repeated application
AMAZONIA	40101	1	t0tn_tnt0	NA	NA	
	40102	2	tnt0_t0tn	NA	1986, 1987, 1988, 1991, 1996, 2006, 2007, 2017, 2020	Year exclusion
			t0tn_tnt0	NA	NA	
	40103	1	t0tn_tnt0	NA	NA	
	40104	2	t0tn_tnt0	NA	1986, 1987, 1989, 1996, 1997	Year exclusion
			t0tn_tnt0	NA	NA	
	40105	2	t0tn_tnt0	21,33	1988, 1990, 1992	Exclusion of years and classes
			t0tn_tnt0	NA	NA	
	40201	1	t0tn_tnt0	NA	NA	
	40202	1	t0tn_tnt0	NA	NA	
	40203	2	t0tn_tnt0	NA	1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994	Year exclusion
			t0tn_tnt0	NA	NA	
	40204	1	t0tn_tnt0	NA	NA	
	40205	2	t0tn_tnt0	NA	1986, 1996, 1998, 1999, 2003, 2005, 2008	Year exclusion
			t0tn_tnt0	NA	NA	
ANDES	40601	2	t0tn_tnt0	33	NA	Class exclusion
			t0tn_tnt0	NA	NA	
	40602	2	t0tn_tnt0	33	NA	Class exclusion
			t0tn_tnt0	NA	NA	
	40603	2	t0tn_tnt0	33	NA	Class exclusions
			t0tn_tnt0	NA	NA	
	40604	2	t0tn_tnt0	33	NA	Class exclusion
			t0tn_tnt0	NA	NA	

		t0tn_tnt0	11, 13, 12	1988, 1992, 1994, 1995, 1985, 1986, 1987, 1989, 1990	Exclusion of years and classes	
	40605	3	t0tn_tnt0	11	NA	Class exclusion
			t0tn_tnt0	NA	NA	
	40606	1	t0tn_tnt0	NA	NA	
			t0tn_tnt0	NA	1996, 1997, 1998, 1999	Year exclusion
	40607	2	t0tn_tnt0	11	NA	Class exclusion
			t0tn_tnt0	33	NA	Class exclusion
	40608	2	t0tn_tnt0	NA	NA	
			t0tn_tnt0	33	NA	Class exclusion
	40609	2	t0tn_tnt0	NA	NA	
			t0tn_tnt0	NA	1987, 2008	Year exclusion
	40901	2	t0tn_tnt0	NA	NA	
			t0tn_tnt0	NA	2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025	Year exclusion
	40902	3	t0tn_tnt0	NA	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004	Year exclusion
			t0tn_tnt0	NA	NA	
	40903	1	tnt0_t0tn	NA	NA	
			tnt0_t0tn	11	NA	Class exclusion
	40904	3	t0tn_tnt0	11	NA	Class exclusion
			t0tn_tnt0	NA	NA	
	40905	2	tnt0_t0tn	NA	NA	
			t0tn_tnt0	NA	NA	
			tnt0_t0tn	11	NA	Class exclusion
	40906	3	tnt0_t0tn	11	1988, 1989, 2005, 2007, 2020, 2022	Exclusion of years and classes
			tnt0_t0tn	NA	NA	
	40910	1	t0tn_tnt0	NA	NA	
			tnt0_t0tn	33	1989, 1990, 1991, 1992, 1993, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018	Exclusion of years and classes
	40907	2	t0tn_tnt0	NA	NA	
			t0tn_tnt0	NA	1990, 1991, 1996, 2000, 2002, 2004, 2007, 2011, 2015, 2018	Year exclusion
	40908	2	t0tn_tnt0	NA	NA	
			t0tn_tnt0	NA	1991, 1993, 1997, 1998, 1999, 2000, 2001, 2002, 2004, 2005, 2006, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2021, 2022	Year exclusion
	40909	2	t0tn_tnt0	NA	NA	

### 4.3.2 Temporal filter

This filter aims to reduce information gaps, temporal inconsistencies, noise, or classification errors by using the historical record based on three types of rules (Figure 18):

- General rules (GR): These aim to correct the value of the central year (T) based on the pixel values of preceding (T-1, T-2) and succeeding years (T+1, T+2). This rule modifies classification values for the years 1986 to 2024. Time windows of three, four, or five years can be applied.
- First-year rules (FR): Corrects the value of the first year (1985) using the values of the next two consecutive years.
- Last-year rules (LR): Corrects the value of the last year (2024) based on the values of the two preceding years.

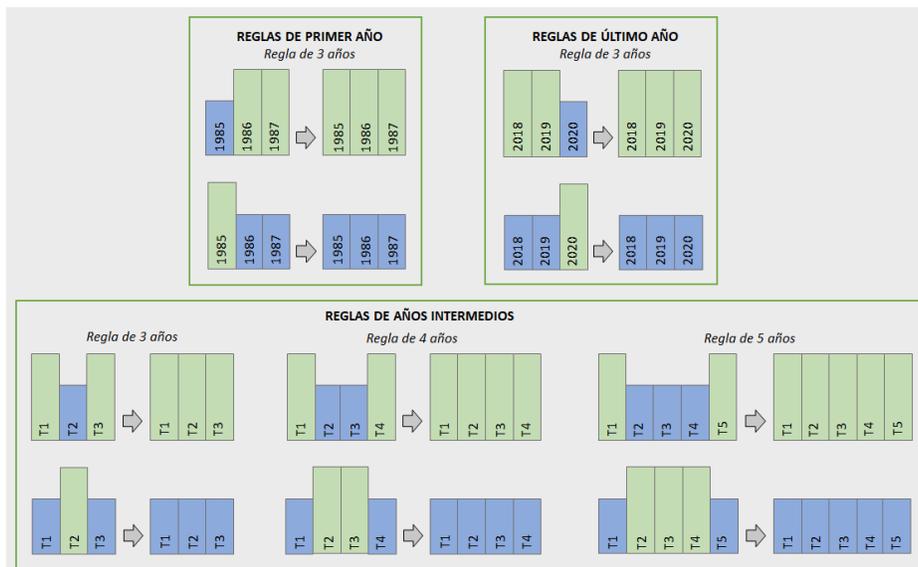


Figure 18. Functionality of the temporal filter in MapBiomias Ecuador (Prepared by MapBiomias).

In Ecuador, temporal filters were applied in all classification regions. The parameters for each rule were defined according to the needs of each region (Table 10):

- first3: execution order of classes for the first-year rule.
- last3: execution order of classes for the last-year rule.
- middle3: execution order of classes for the 3-year intermediate rules.
- middle4: execution order of classes for the 4-year intermediate rules.
- middle5: execution order of classes for the 5-year intermediate rules.

Table 10. Temporal filter parameters defined for each classification region in MapBiomias Ecuador Collection 3.0 (Prepared by Ecociencia).

Biome	Region code	Rule order	Execution order	Excluded classes/years
AMAZONÍA	40101	3, 4, 3, 5, 4, 3, Last, First, 3	var ordem_exec_first = [25,33,21,13] var ordem_exec_last = [21,33,13,25] var ordem_exec_middle = [21,3,33,25,13]	NA
	40102	first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 21] var ordem_exec_last = [21, 25] var ordem_exec_middle = [33, 21, 3, 13, 25]	NA

		var ordem_exec_first = [13, 3, 33,25, 11] var ordem_exec_last = [13, 21, 25,33, 13, 11] var ordem_exec_middle3 = [13,21, 3,25,33,11] var ordem_exec_middle4 = [13, 21, 3, 33, 25,13, 11] var ordem_exec_middle5 = [13, 21, 3, 33, 25,13, 11]	NA
40103	middle3,middle4,middle5,last3,first,middle3	var ordem_exec_first = [13, 3, 33,25, 11] var ordem_exec_last = [13, 21, 25,33, 13, 11] var ordem_exec_middle3 = [13,21, 3,25,33,11] var ordem_exec_middle4 = [13, 21, 25,3, 33, 13, 11] var ordem_exec_middle5 = [13, 21, 25, 3, 33, 13, 11]	NA
40104	first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 21] var ordem_exec_last = [21,25,3] var ordem_exec_middle = [21, 25, 3,33]	NA
	first,3,4,3,5,4,3,last	var ordem_exec_first = [13, 3, 25, 33] var ordem_exec_last = [13,25,33,3] var ordem_exec_middle = [13, 3, 25, 33]	21
	first,3,4,3,5,4,3,last	var ordem_exec_first = [13, 3, 25, 33] var ordem_exec_last = [13,25,33,3] var ordem_exec_middle = [13, 3, 25, 33]	21
40105	first, 3,5,4,3,4,3,last	var ordem_exec_first = [25,21] var ordem_exec_last = [25,21] var ordem_exec_middle = [25,21]	NA
	first, 5,4,3,4,3,3,last	var ordem_exec_first = [13, 3, 25, 21,33] var ordem_exec_last = [13,25,21,33,3] var ordem_exec_middle = [13, 25, 21,3,33]	NA
	3, 4, 3, 5, 4, 3, Last, First	var ordem_exec_first = [25,33,21,13] var ordem_exec_last = [21,33,13,25] var ordem_exec_middle = [21,3,33,25,13]	NA
40201	3,4,3,5,4,3,last,first	var ordem_exec_first = [3, 33, 13, 11] var ordem_exec_last = [25,33,21,13] var ordem_exec_middle = [21,33,13,25]	NA
	First	var ordem_exec_first = [3, 33, 13, 11]	NA
	First	var ordem_exec_first = [3, 33, 13, 11]	1985,1986
40202	First	var ordem_exec_first = [3, 33, 13, 11]	1985
	3,4,3,5,4,3,first,last	var ordem_exec_first = [3, 33, 13, 11] var ordem_exec_last = [21,33,13,11] var ordem_exec_middle = [21,3,33,25,13,11]	NA
	first,3,4,3,5,4,3,last	var ordem_exec_first = [21,25,3,33,13] var ordem_exec_last = [25, 21,3,13] var ordem_exec_middle = [21, 25, 3, 13,33]	NA
40203	5,4,3,3,4,3,last	var ordem_exec_last = [13,11,25,21,33,3] var ordem_exec_middle = [13,11,25,21,33]	NA
	first,Middle3,4,5,last	var ordem_exec_first = [13,25,3] var ordem_exec_last = [13,25,3] var ordem_exec_middle = [13,25,3]	NA
40204	first,Middle3,4,5,last	var ordem_exec_first = [13,25,3] var ordem_exec_last = [13,25,3] var ordem_exec_middle = [13,25,3]	NA
	last,middle5,4,3,middle3	var ordem_exec_last = [13,21,25,33] var ordem_exec_middle3 = [13,21,25,33,3] var ordem_exec_middle5 = [13,21,25,33,3]	1985,1986,1987,1988, 1989,1990,1991,1992, 1993,1994,1995, 1996,1997,1998,1999, 2000, 2001,2002,2003,2004, 2005,2006,2007,2008,2009, 2010,2011,2012,2013,2014

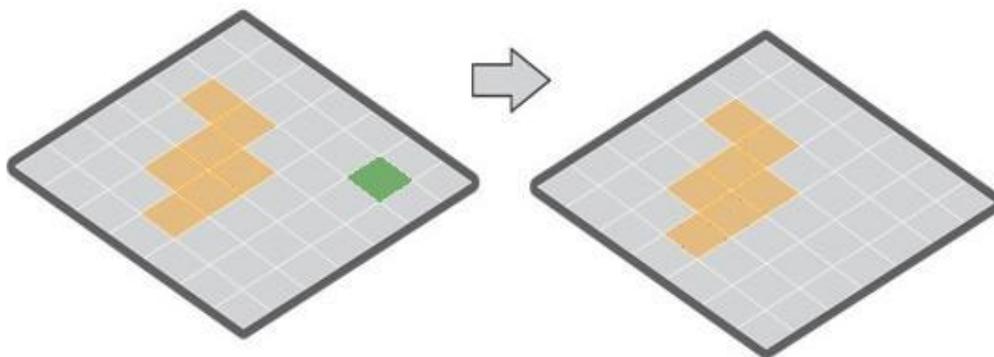
		first,middle3,middle4,middle5,last	var ordem_exec_first = [13, 21,25,33,3] var ordem_exec_last = [13, 21,25] var ordem_exec_middle3 = [13, 21,25,33,3] var ordem_exec_middle4 = [13, 21,25,33] var ordem_exec_middle5 = [13, 21,25,33]	1985,1986,1987,1988, 1989,1990,1991,1992, 1993,1994,1995, 1996,1997,1998,1999,2000, 2001,2002,2003,2004, 2005,2006,2007,2008,2009, 2010,2011,2012,2013,2014
		first	var ordem_exec_first = [3, 33, 12, 11, 13,34]	NA
40601		3,4,3,5,4,3,last,first	var ordem_exec_first = [3, 33, 12, 11, 13,34] var ordem_exec_last = [21,33,12,13,11,34] var ordem_exec_middle = [21, 33, 11, 3, 12, 13, 34, 25]	NA
		last	var ordem_exec_last = [21,33,12,13,11,34,25]	2025
40602		3,4,3,5,4,3,last,first	var ordem_exec_first = [3,12,11,21,25] var ordem_exec_last = [21,33,12,13,11] var ordem_exec_middle = [21, 33, 3, 12, 13,11, 25]	NA
40603		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 13, 12, 21, 25, 33] var ordem_exec_last = [3, 13, 12, 21, 25, 33] var ordem_exec_middle = [3, 13, 12, 21, 25, 33]	NA
40604		first,3,4,3,5,4,3,last	var ordem_exec_first = [11,13,3, 12,21,33,25] var ordem_exec_last = [11,13,12,21,25,3,33] var ordem_exec_middle = [11,13,12,21,3,25,33]	NA
		first,3,4,3,5,4,3,last	var ordem_exec_first = [11,13,3, 12,21,33,25] var ordem_exec_last = [11,13,12,21,33,25,3] var ordem_exec_middle = [11,13,12,25,21,3,33]	NA
ANDES		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 12, 13, 11, 25, 21] var ordem_exec_last = [3, 12, 13, 11, 25, 21] var ordem_exec_middle = [3, 12, 13, 11, 25, 21]	NA
40605		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 12, 13, 11, 25, 21,33] var ordem_exec_last = [3, 12, 13, 11, 25, 21,33] var ordem_exec_middle = [3, 12, 13, 11, 25, 21,33]	NA
		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 13, 4, 21, 25] var ordem_exec_last = [21,25,3, 13, 4] var ordem_exec_middle = [25,21,3,13,4]	NA
40606		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 13, 4, 21, 25] var ordem_exec_last = [21, 25, 3, 13, 4] var ordem_exec_middle = [25,21,3,13,4]	NA
40607		first,3,4,3,5,4,3,last	var ordem_exec_first = [3, 4, 13, 12, 11, 21, 25] var ordem_exec_last = [3, 4, 13, 12, 11, 21, 25] var ordem_exec_middle = [3, 4, 13, 12, 11, 21, 25]	NA
		3,4,3,5,4,3,first,last	var ordem_exec_first = [3, 33, 13,12, 11] var ordem_exec_last = [21,25,33,13,12,11,3] var ordem_exec_middle = [21,3,33,25,12,13,11]	NA
40608		3,4,3,5,4,3	var ordem_exec_middle = [3]	NA
40609		3,4,3,5,4,3,first,last	var ordem_exec_first = [3, 33, 13,12, 11] var ordem_exec_last = [21,25,33,13,12,11,3] var ordem_exec_middle = [21,3,33,25,12,13,11]	NA
		first,3,4,3,5,4,3,last	var ordem_exec_first = [13,11,4,3,25,21] var ordem_exec_last = [13,11,4,21,3,25] var ordem_exec_middle = [13,11,4,3,21,25]	33
PACIFIC	40901	5,4,3,first,last	var ordem_exec_first = [13,11,4,3,33,25,21] var ordem_exec_last = [13,11,4,3,33,25,21] var ordem_exec_middle = [13,11,4,3,33,25,21]	1985,1986,1987,1988, 1989,1990,1991,1992, 1993,1994,1995, 1996,1997,1998,1999, 2000,2001,2002,2003,2004, 2005,2006,2007,2008,2009, 2010,2011,2012,2013,2014,

			2015
	5,4,3,first,last	var ordem_exec_first = [13,11,4,3,33,25,21] var ordem_exec_last = [13,11,4,3,31,33,25,21] var ordem_exec_middle = [13,11,4,3,33,25,21]	NA
	3,4,3,fist,last	var ordem_exec_first = [21,3,12,33,25,11] var ordem_exec_last = [21,3,12,33,25,11] var ordem_exec_middle = [21,3,12,33,25,11]	NA
40902	5,4,3,first,last	var ordem_exec_first = [21,12,3,33,25,11] var ordem_exec_last = [12,21,3,25,33,11] var ordem_exec_middle = [12,21,3,25,33,11]	NA
	3,4,2003	var ordem_exec_middle = [11,33,25]	NA
	first,3,4,3,5,4,3,last	var ordem_exec_first = [33,11,3,25,21] var ordem_exec_last = [33,11,3,25,21] var ordem_exec_middle = [33,11,3,25,21]	NA
40903	5,4,3,4,3,3	var ordem_exec_middle = [12,33,11,3,21,2]	25
	5,4,3,4,3,3	var ordem_exec_middle = [11,33,21]	12,3,25
40904	first, 3,4,3,5,4,3,last	var ordem_exec_first = [ 3, 31, 25, 21, 33] var ordem_exec_last = [3, 31, 21, 33, 25, 11] var ordem_exec_middle = [31, 3, 25, 21, 33, 11]	NA
	first, 5,4,3,4,3,3,last	var ordem_exec_first = [4,3, 13, 33] var ordem_exec_last = [21, 25, 4, 13, 3, 33,] var ordem_exec_middle = [21,25]	NA
40905	first	var ordem_exec_first = [4,3, 13, 33]	1985
	first	var ordem_exec_first = [13,3,4,33]	NA
	first, 5,4,3,4,3,3,last	var ordem_exec_first = [3, 4, 21,25,33] var ordem_exec_last = [25,21,4,3,33] var ordem_exec_middle = [3, 4, 21,25,33]	11 / 2009, 2010,2011,2012,2013,2014, 2015,2016,2017,2018, 2019,2021,2022, 2023,2024,2025
40906	first,5,4,3,4,3,3,last	var ordem_exec_first = [11,33,21,25,3,45] var ordem_exec_last = [11,33,21,25,3,4] var ordem_exec_middle = [11,33,21,25,3,4]	1985,1986,1987,1988, 1989,1990,1991,1992, 1993,1994,1995, 1996,1997, 1998,1999, 2000,2001,
	4,3,5,4,3,fist,last	var ordem_exec_first = [3,4,3,4] var ordem_exec_last = [3,4,3,4] var ordem_exec_middle = [3,4,3,4]	NA
	4,3,5,4,3,fist,last	var ordem_exec_first = [3,4] var ordem_exec_last = [21,33,25] var ordem_exec_middle = [21,33,25,3,4]	NA
	first	var ordem_exec_first = [4]	1985,1986,1987,1988,1989
40910	3,4,3,5,4,3,first	var ordem_exec_first = [4] var ordem_exec_last = [4] var ordem_exec_middle = [4]	1985,1986,1987,1988
	first	var ordem_exec_first = [4]	1985,1986,1987
	first	var ordem_exec_first = [4]	1985,1986

	first	var ordem_exec_first = [4]	1985
	first, 3,4,4,3,5,3	var ordem_exec_first = [4,3] var ordem_exec_last = [21,33,25] var ordem_exec_middle = [4,3,33,21,25]	NA
40907	first,3,4,3,5,4,3,last	var ordem_exec_first = [11,12,13, 3,4,33,25] var ordem_exec_last = [11,13,12,25,3, 4, 33] var ordem_exec_middle = [11,13,3,12,4,25,33]	NA
	first,3,4,3,5,4,3,3,last	var ordem_exec_first = [11,12,13, 3,4,33,25] var ordem_exec_last = [11,13,12,25,3, 4, 33] var ordem_exec_middle = [11,12,13, 3,4,33,25]	NA
GALÁPAGOS	first,3,4,3,5,4,3,last	var ordem_exec_first = [12,13,33,25] var ordem_exec_last = [12,13,33,25] var ordem_exec_middle = [12,13,33,25]	3,4,21
40908	first,3,4,3,5,4,3,3,last	var ordem_exec_first = [11,3,12,13,21,4,25,33] var ordem_exec_last = [11,21,3,12,13,4,25,33] var ordem_exec_middle = [11,3,12,13,21,4,25,33]	NA
	first,3,4,3,5,4,3,last	var ordem_exec_first = [12,13,33,25] var ordem_exec_last = [12,13,33,25] var ordem_exec_middle = [12,13,25,33]	3,4,21
40909	first,3,4,3,5,4,3,3,last	var ordem_exec_first = [12,3,4,13,21,33,25] var ordem_exec_last = [12,13,21,3,4,25,33] var ordem_exec_middle = [12,3,4,21,33,25]	2005,2006,2007,2008,2009, 2010,2011,2012,2013,2014, 2015,2016,2017,2018,2019, 2020,2021,2022,2023,2024
	5,4,3,3,4,3	var ordem_exec_middle = [12,21,4,3,33,25]	1985,1986,1987,1988,1989, 1990,1991,1992,1993,1994, 2021,2022,2023,2024

### 4.3.3 Spatial filter

The spatial filter aims to reduce the number of isolated and/or discontinuous pixels (Figure 19). Groups of pixels that do not meet the equivalent of the minimum mapping unit ( $\approx$  half a hectare; about 5 pixels) are identified using neighborhood rules and reclassified (they assume the value of the surrounding class).



**Figure 19.** Functionality of the spatial filter in MapBiomass Ecuador Collection 3.0 (Prepared by MapBiomass).

In the Ecuadorian Amazon, a spatial filter was applied in all classification regions, with parameters adjusted according to each region. These parameters are detailed in the following table.

**Table 11.** Spatial filter parameters defined for each classification region in MapBiomass Ecuador Collection 3.0 (Prepared by Ecociencia).

Biome	Region code	Number of iterations	Minimum number of connected pixels	Excluded classes/years	
AMAZONIA	40101	1	5	NA	
	40102	1	5	NA	
	40103	1	5	NA	
	40104	1	5	NA	
	40105	2	5	33,25	
				5	NA
	40201	1	5	NA	
	40202	1	5	NA	
	40203	1	5	NA	
	40204	2	5	33,25	
				5	NA
	40205	1	5	NA	
ANDES	40601	1	5	NA	
	40602	1	5	NA	
	40603	1	5	NA	
	40604	2	5	33,25,23,11	
				5	NA
	40605	1	5	NA	
	40606	1	5	NA	
	40607	1	5	NA	
	40608	1	5	NA	
	40609	1	5	NA	
PACIFIC	40901	1	5	33,25,13	
	40902	1	5	NA	
	40903	1	5	NA	
	40904	1	5	NA	
	40905	1	5	NA	
	40906	1	5	NA	
		40910	1	5	NA
GALAPAGOS	40907	1	5	NA	
	40908	1	5	NA	
	40909	1	5	NA	

#### 4.3.4 Frequency filter

This filter considers the frequency of occurrence of natural classes (IDs 3, 4, 6, 11, 12, 13, 29, 33, 34) throughout the entire time series. Classes that occur sporadically over time are replaced by the most frequently occurring (temporally dominant) class, provided that this dominant class meets a stability criterion across the time series. This filter helps reduce temporal oscillations associated with natural dynamics that are mistakenly classified as a different class or as a class change. The application of this filter

results in a more consistent classification of natural classes by reducing the frequency of false positives related to natural dynamics while preserving consolidated trajectories.

Each pixel, evaluated across the historical series, must meet two criteria simultaneously for the filter to be applied: the occurrence of a single natural class must exceed a minimum percentage throughout the series (indicating relative stability), and the dominant class must surpass a minimum occurrence percentage to prevail as the definitive class. Based on the class value that meets this latter percentage, “temporally isolated” pixels with a high probability of being classification errors are updated (Figure 20).

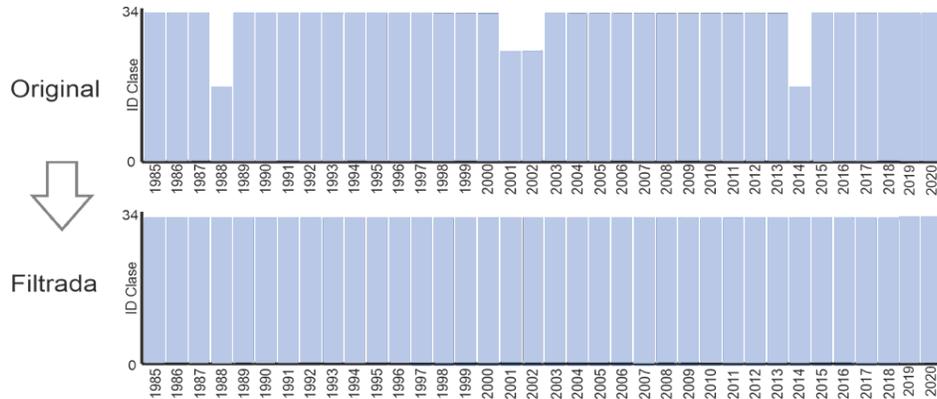


Figure 20. Functionality of the frequency filter in MapBiomás Ecuador (Prepared by MapBiomás).

In addition, and to meet the specific needs of the Ecuadorian territory, the adaptation and implementation of the possibility to generate inclusion or exclusion geometries was developed. These refer to specific or localized areas where the filter was either applied or intentionally omitted. These geometries were referred to as \*hidden areas\*, and an example of them can be observed in Figure 21.

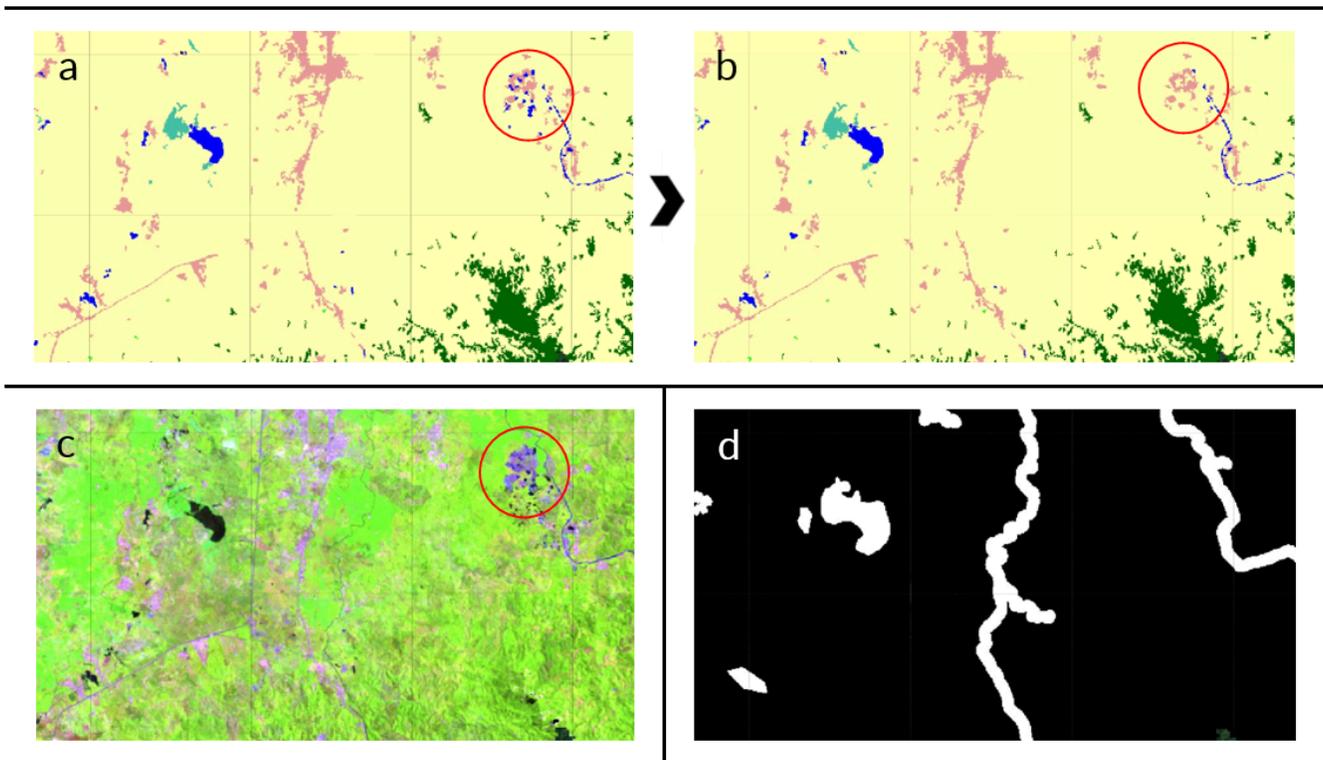


Figure 21. Exclusion geometries (hidden). a) Pre-filter classification. b) Post-frequency filter classification. c) Landsat mosaic for the year 2022. d) Exclusion zone in white (Prepared by MapBiomás).

In Ecuador, both criteria were adjusted according to the needs of each classification region and are summarized in Table 12.

**Table 12.** Frequency filter parameters defined for each classification region in MapBiomass Ecuador Collection 3.0 (Prepared by Ecociencia).

Biome	Region code	Number of iterations	Native vegetation			Excluded classes/years
			% native vegetation	% Majority class	Included classes	
AMAZONIA	40101	1	95	70	33,25	NA
	40102	4	40	60	21	NA
			10	10	21,25	NA
			10	10	21	NA
			50	50	N/A	N/A
	40103	2	50	60	NA	NA
			98	98	NA	NA
	40104	2	80	50	21,25	NA
			90	50	3	NA
	40105	3	95	95	NA	NA
			70	70	NA	NA
			50	50	25,21	N/A
	40201	1	90	60	NA	NA
	40202	1	83	60	NA	NA
	40203	2	90	90	NA	NA
			50	70	25,33	NA
	40204	5	60	60	33, 25	NA
			5	5	N/A	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017
			5	5	N/A	2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
			50	50	25, 13	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
44			50	25,13	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009	
40205	1	60	80	21,25	NA	

ANDES	40601	1	80	60	NA	NA
	40602	2	60	30	NA	NA
			80	50	NA	NA
	40603	2	50	50	NA	NA
			90	90	NA	NA
	40604	5	85	70	11,13,12,25	NA
			95	90	12,11,25	N/A
			50	40	12,11,33,3	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
			50	50	13,12,11,21	N/A
			60	60	11,13,12,3	N/A
	40605	5	50	50	NA	NA
			50	50	NA	NA
			50	50	NA	NA
			10	10	21,25	NA
			10	10	25	NA
	40606	3	10	50	21,25,33	NA
			10	90	25,33	NA
			10	50	NA	NA
	40607	3	40	40	NA	NA
			10	10	12	NA
90			40	NA	NA	
40608	2	60	20	NA	NA	
		80	40	NA	NA	
40609	2	70	40	NA	NA	
		70	40	NA	NA	
PACIFIC	40901	4	70	70	NA	NA
			90	90	NA	NA
			20	20	3,25,31	1985, 1986, 1987, 1988, 1989, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
	40902	1	75	85	NA	NA
			90	90	NA	NA
	40903	2	14	14	3,33,25	NA
			90	90	NA	NA

	40904	7	75	70	NA	NA
			70	70	NA	NA
			50	55	NA	NA
			65	65	NA	1985, 1986, 1987, 1988, 1989
			70	75	NA	NA
			65	70	NA	1985, 1986, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
			56	50	NA	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025,
	40905	1	65	60	NA	NA
	40906	2	90	90	NA	NA
			80	60	NA	1985, 1986, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
40910	1	90	70	NA		
GALÁPAGOS	40907	3	50	50	NA	NA
			25	30	NA	NA
			55	60	NA	1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
	40908	3	70	65	NA	1985, 1986, 1987, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025
			70	75	NA	NA
			40	40	NA	NA
	40909	4	40	40	NA	NA
			6	7	NA	NA
			60	60	21	NA
			60	60	NA	NA

#### 4.3.5 Order of filter application by region in Ecuador

According to the needs of each classification region, the order (Table 13) and the parameters of each filter (Tables 7 to 12) were adjusted.

**Table 13.** Order of filter application by classification region in MapBiomias Ecuador Collection 3.0 (Prepared by Ecociencia).

Biome	Region code	Filters	Mask
AMAZONIA	40101	GapFill, Temporal, Frecuencia, Espacial	mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40102	GapFill,GapFill,Temporal,Frecuencia,Frecuencia,Frecuencia,Frecuencia,Máscara1,Espacial	mascara_ID23_EC_col3
	40103	Gapfill, Temporal, Frecuencia,Frecuencia, Temporal, Máscara1, Máscara2, Espacial	mascara_ID68_EC_col3
	40104	Gapfill,Gapfill,Temporal,Frecuencia,Frecuencia,Máscara1, Mascara2, Espacial	mascara_ID68_EC_col3
	40105	Gapfill,Gapfill,Temporal,Temporal,Frecuencia,Frecuencia, Frecuencia,Temporal, Máscara1,Máscara2, Espacial	mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40201	GapFill, temporal, temporal, frecuencia	mascara_ID23_EC_col3
	40202	GapFill, temporal, temporal,temporal,temporal, frecuencia	mascara_ID23_EC_col3
	40203	GapFill, GapFill	mascara_ID23_EC_col3
	40204	GapFill	NA
	40205	GapFill, GapFill, Temporal,Temporal,Frecuencia, Espacial	mascara_ID23_EC_col3
ANDES	40601	Gapfill, Gapfill, Temporal, Temporal, Frecuencia, Temporal	mascara_ID29_EC_col3 // mascara_ID9_EC_col3 // mascara_ID23_EC_col3
	40602	Gapfill, Gapfill, Temporal, Frecuencia, Frecuencia	mascara_ID9_EC_col3 // mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40603	Gapfill,Gapfill,Temporal,Frecuencia,Frecuencia,Mascara1, Mascara2,Mascara3,Espacial	mascara_ID9_EC_col3 // mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40604		mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40605	Gapfill, Gapfill, Gapfill, Frecuencia,Temporal,Frecuencia,Frecuencia,Temporal,Frecuencia,Frecuencia,Mascara1,Mascar2,Mascara3,Espacial	mascara_ID9_EC_col3 // mascara_ID23_EC_col3 // mascara_ID68_EC_col3
	40606	Gapfill, Temporal, Frecuencia, Temporal, Frecuencia, Frecuencia, Mascara1, Mascara2, Mascara3, Espacial	mascara_ID23_EC_col3 // mascara_ID68_EC_col3 // mascara_ID9_EC_col3
	40607	Gapfill, Gapfill, Temporal, Frecuencia, Frecuencia, Frecuencia, Mascara1, Mascara2, Mascara3, Espacial	mascara_ID29_EC_col3 // mascara_ID23_EC_col3 // mascara_ID9_EC_col3
	40608	Gapfill, Gapfill, Temporal, Temporal, Frecuencia, Frecuencia	mascara_ID29_EC_col3 // mascara_ID9_EC_col3
	40609	Gapfill, Gapfill, Temporal, Frecuencia, Frecuencia,	mascara_ID29_EC_col3
PACIFIC	40901	Gapfill, Gapfill, Temporal, Frecuencia, Temporal, Temporal, Frecuencia, Frecuencia, Frecuencia,	mascara_IDbanano_EC_col3 // mascara_ID18_EC_col3 // mascara_ID31_EC_col3
	40902	Gapfill, Gapfill,Gapfill, Temporal, Temporal, Frecuencia, Temporal, Máscara 1, Máscara 2, Máscara 3, Espacial	NA
	40903	Gapfill, Frecuencia, Temporal, Temporal,Temporal,Frecuencia	mascara_ID31_EC_col3 // mascara_ID23_EC_col3
	40904	Gapfill, Gapfill, Máscara, Gapfill, Temporal, Frecuencia, Frecuencia, Frecuencia, Frecuencia, Frecuencia, Frecuencia	mascara_ID31_EC_col3 // mascara_ID23_EC_col3 // mascara_IDbanano_EC_col3
	40905	Gapfill, Gapfill, Temporal, Temporal, Temporal, Mask, Frecuencia	mascara_ID31_EC_col3 // mascara_ID23_EC_col3
	40906	Gapfill, Gapfill, Gapfill, Temporal, Temporal, Frecuencia,	mascara_ID31_EC_col3 // mascara_ID23_EC_col3 //

		Frecuencia	mascara_IDbanano_EC_col3
	40910	Gapfill, Temporal, Temporal, Temporal, Temporal, Temporal, Temporal, Temporal, Temporal, Frecuencia	mascara_ID31_EC_col3 // mascara_ID23_EC_col3
	40907	Gapfill, máscara, máscara, Gapfill, Temporal, Frecuencia, Temporal, Frecuencia, Frecuencia	mascara_ID23_EC_col3 // mascara_ID68_EC_col3
GALAPAGOS	40908	Gapfill, Gapfill, Temporal, Frecuencia, Frecuencia, Temporal, Frecuencia	mascara_ID23_EC_col3
	40909	Gapfill, Gapfill, Temporal, Frecuencia, Temporal, Frecuencia, Temporal, Frecuencia	mascara_ID23_EC_col3

### 4.3.6 Masks

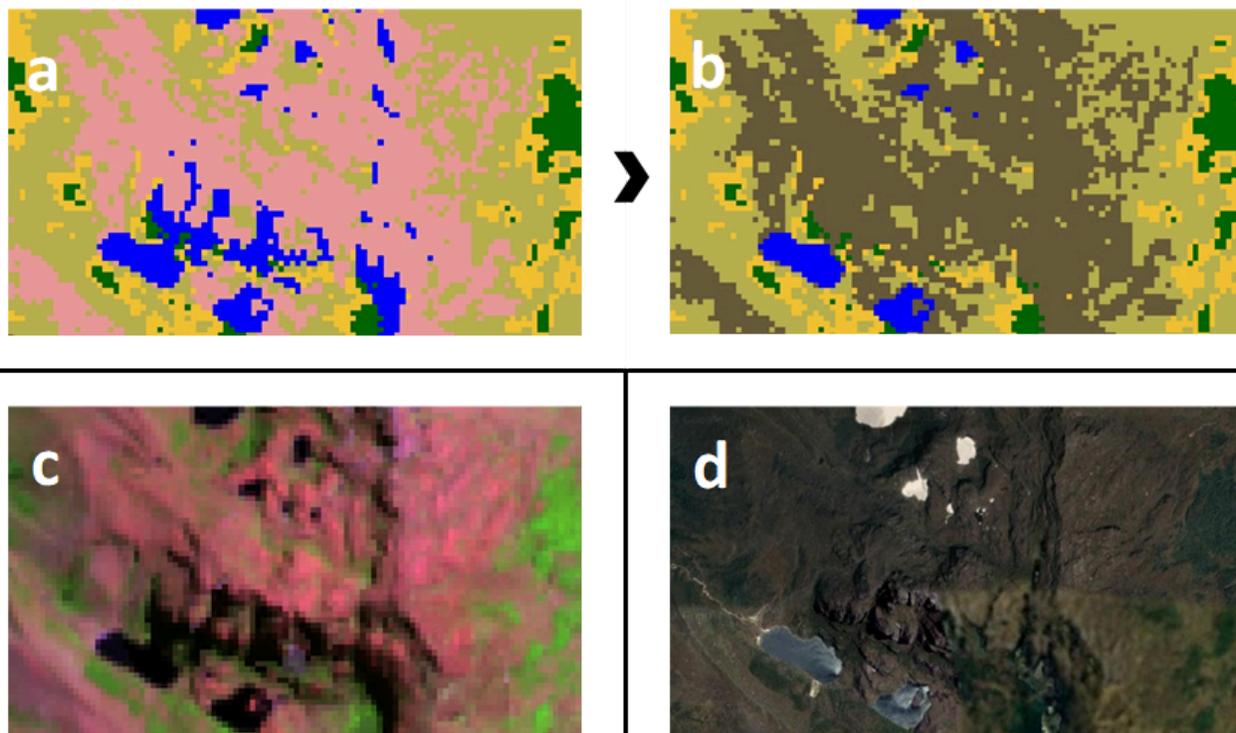
#### Rock outcrop (ID 29)

It should be noted that above a certain altitudinal threshold, vegetation becomes reduced and is affected by several factors, such as temperature and the amount of oxygen in the atmosphere. According to Holdridge's life zones<sup>4</sup>, Starting at 4,000 meters above sea level, the subalpine, alpine, and nival altitudinal zones are found, characterized by scarce or absent vegetation. Based on this understanding, various information sources were combined, including contour lines from the Military Geographic Institute at a 1:250,000 scale, the Land Use and Cover and Productive Systems Map from the Ministry of Agriculture and Livestock (MAG), and satellite imagery.

By applying spatial analysis and visual interpretation techniques to all these inputs, it was consistently determined that rock outcrops occur above the 4,000-meter elevation threshold. Consequently, a mask was created from this altitude to remap pixels categorized as non-vegetated areas to the rock outcrop class.

However, during this analysis, it was also identified that on the slopes of the Sumaco and Reventador volcanoes, rock outcrops occur at lower altitudes. Therefore, for these two cases, the elevation criteria were set at 2,400 meters for Sumaco and 2,000 meters for Reventador. This adjustment was applied exclusively in the "High Amazon 2" classification zone (ID 40102). This process was carried out only in specific mapping regions (see Table 13).

<sup>4</sup> The Holdridge life zones system is a model that divides land into life zones organized according to latitudinal region, altitudinal belt, and humidity. Different zones are defined based on mean annual precipitation, mean annual temperature, and altitude.



**Figure 22.** Rock outcrop mask (ID 29). a) Original classification (before applying the mask). b) Application of the rock outcrop mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).

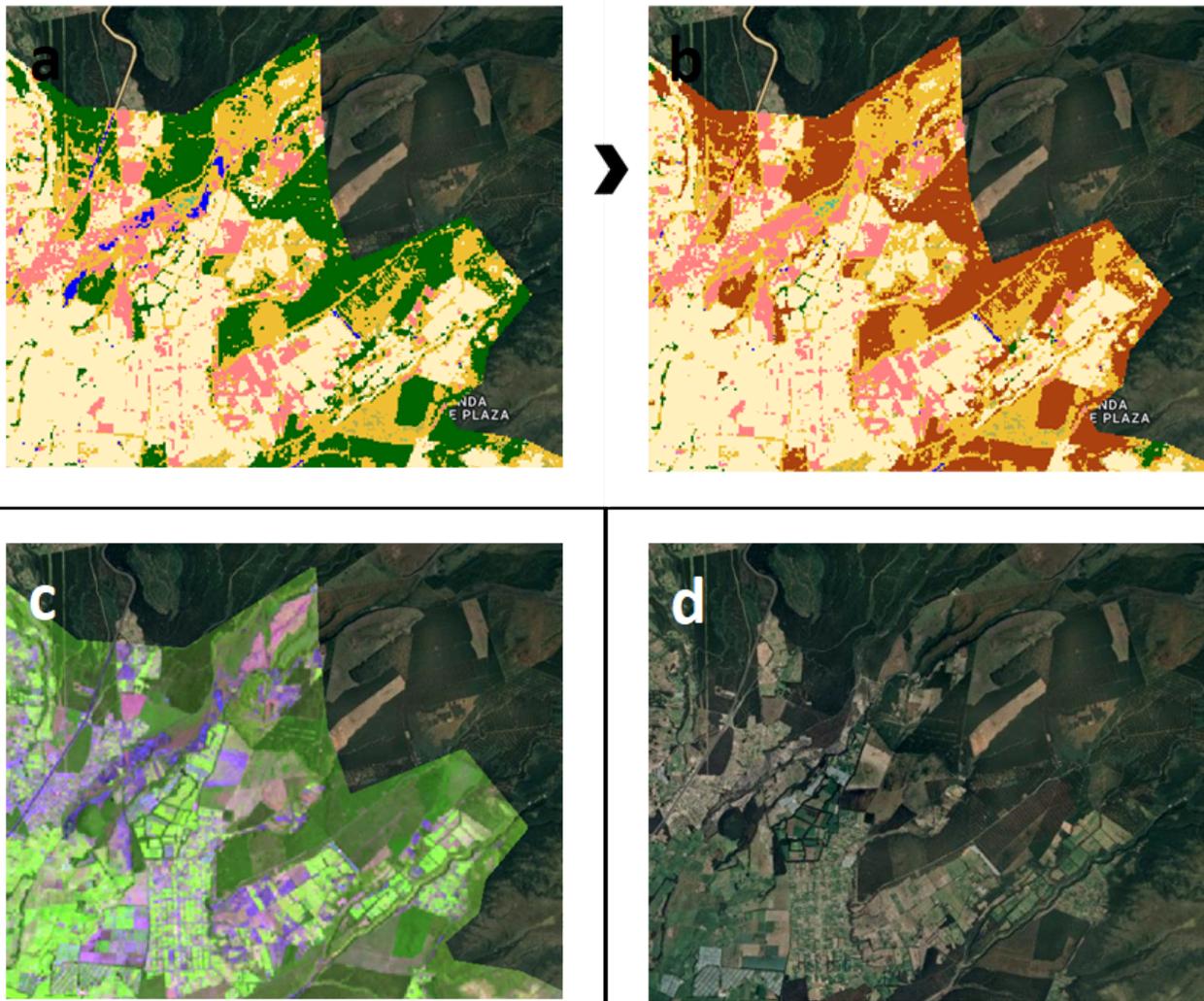
### Silviculture (ID 9)

The mapping of silviculture is based on assigning the corresponding value (ID = 9) to pixels that were classified as one of the forest categories within the polygons provided by the Ministry of Agriculture and Livestock (MAG):

- [Map of Incentivized Forest Plantations in Ecuador, Scale 1:5,000, Year 2020](#)

This layer defines forest plantations as “tree-covered areas established artificially through the planting of native or exotic species that share the same age and are evenly spaced. Their purpose is the production of timber and non-timber products.” This layer can be accessed at: [<http://geoportal.agricultura.gob.ec>](<http://geoportal.agricultura.gob.ec>)

This process was carried out only in specific mapping regions (see Table 13).



**Figure 23.** Silviculture mask (ID = 9). a) Original classification (before applying the mask). b) Application of the silviculture mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Eciociencia).

### Aquaculture (ID 31)

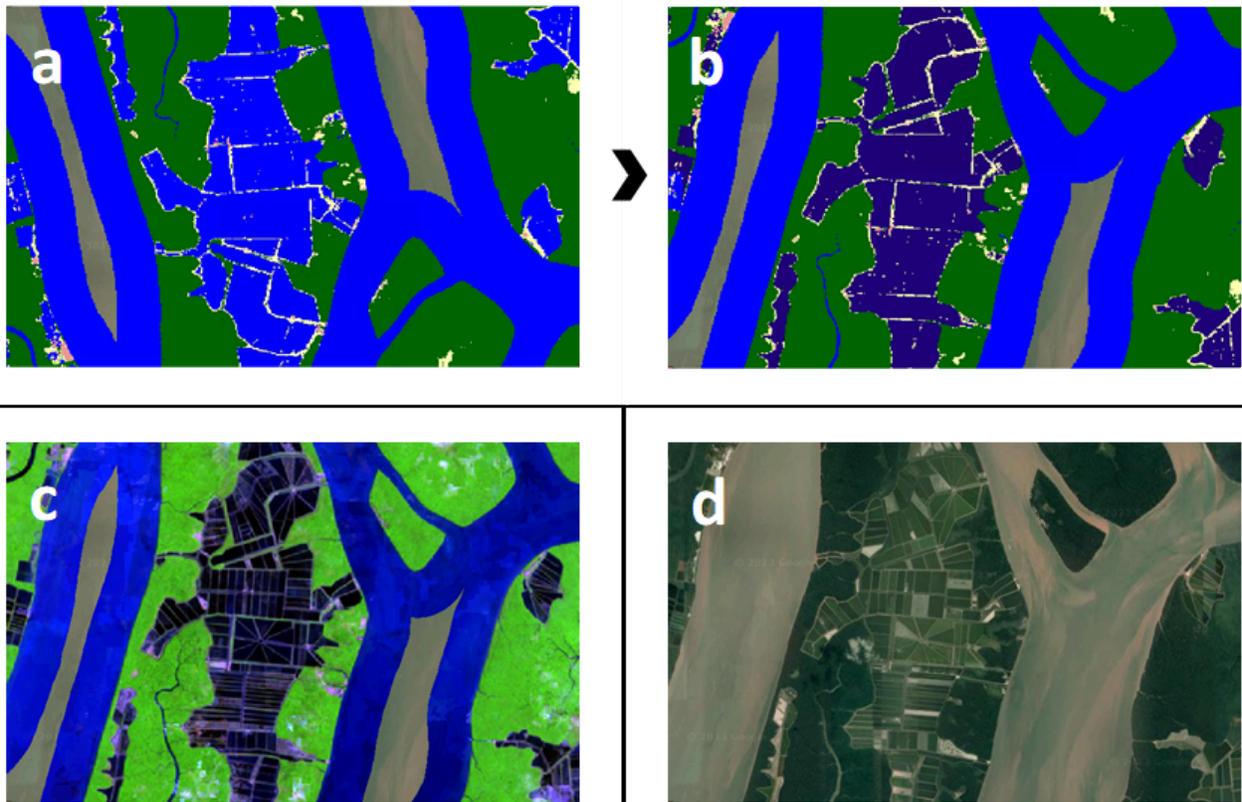
The aquaculture mapping is based on assigning the corresponding value (ID = 31) to pixels that were previously classified as water (ID = 33) within the polygons provided by the Ministry of Agriculture and Livestock (MAG).

- [Map of Land Cover, Land Use, and Agricultural Production Systems of Continental Ecuador \(version edited by the Ministry of Agriculture and Livestock in 2020\). Scale 1:25,000. Years 2009–2015](#)

It is important to note that from this reference, only the polygons classified under the “land use” category with the description “aquaculture” were selected.

This dataset can be accessed at: [<http://geoportal.agricultura.gob.ec>](<http://geoportal.agricultura.gob.ec>).

This process was carried out only in specific mapping regions (see Table 13).



**Figure 24.** Aquaculture mask (ID = 31). a) Original classification (before applying the mask). b) Application of the aquaculture mask. c) Landsat mosaic for the year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).

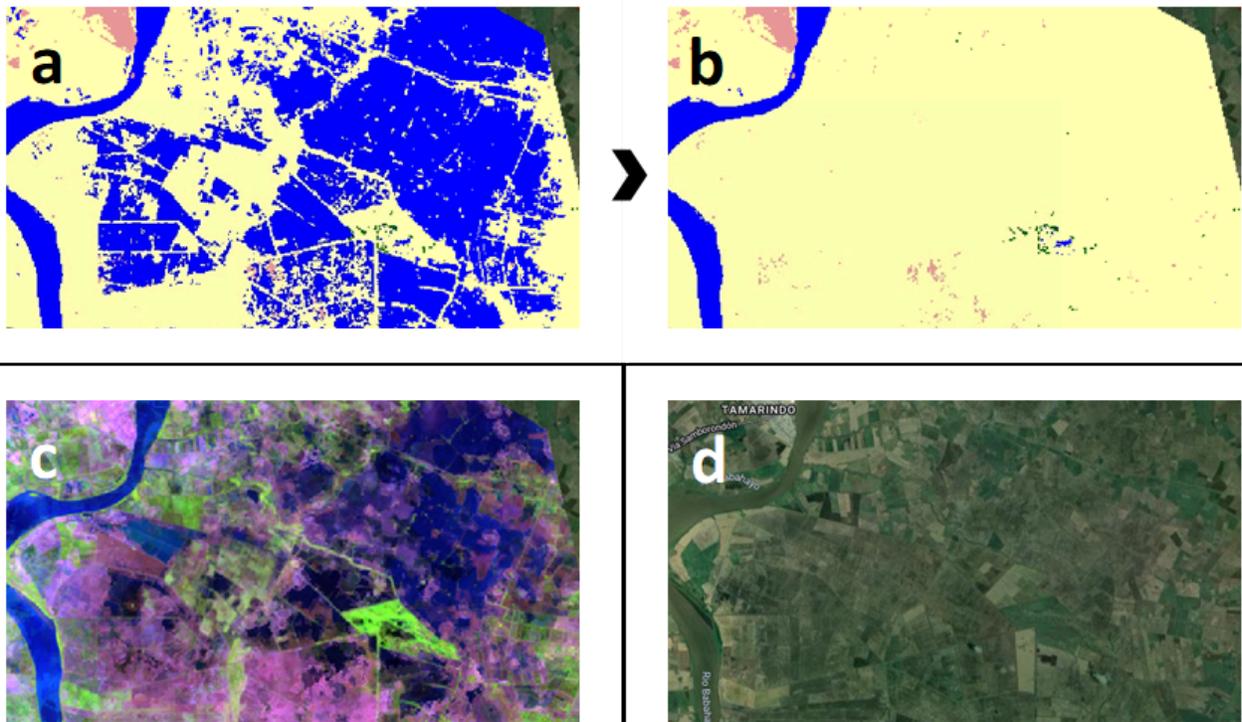
#### Remapping of rice fields to agriculture and/or pasture mosaic (ID 21)

The mapping of crops—specifically rice fields—that are characterized by permanent or temporary flooding regimes is based on reassigning the value corresponding to the agriculture and/or pasture mosaic class (ID = 21) to pixels that were classified as water (ID = 33) within the polygons provided by the Ministry of Agriculture and Livestock (MAG).

- [Map of Estimated Sown Area of Rice, Yellow Hard Maize, and Soybean in Priority Provinces, Scale 1:25,000, First/Second/Third Planting Period, Various Years](http://geoportal.agricultura.gob.ec)

It is important to note that from this reference, only those polygons whose "crop name" category corresponded to the description "rice" were selected. This layer can be accessed at: [<http://geoportal.agricultura.gob.ec>](<http://geoportal.agricultura.gob.ec>).

This process was carried out exclusively in certain mapping regions (see Table 13).



**Figure 25.** Rice field mask (agriculture and/or pasture mosaic, ID = 21). a) Original classification (before applying the mask). b) Application of the rice field mask. c) Landsat mosaic, year 2022. d) High-resolution Google Earth image (Prepared by Ecociencia).

#### Remapping of beaches, dunes, and sands (ID 23 )

For the generation of the mask for beaches, dunes, and sandbanks, the reference used was the “2009–2015 - Land Use and Cover Map and Agricultural Productive Systems of Continental Ecuador,” edited by the Ministry of Agriculture and Livestock (MAG) in 2020. This layer, at a scale of 1:25,000, covers the period from 2009 to 2015.

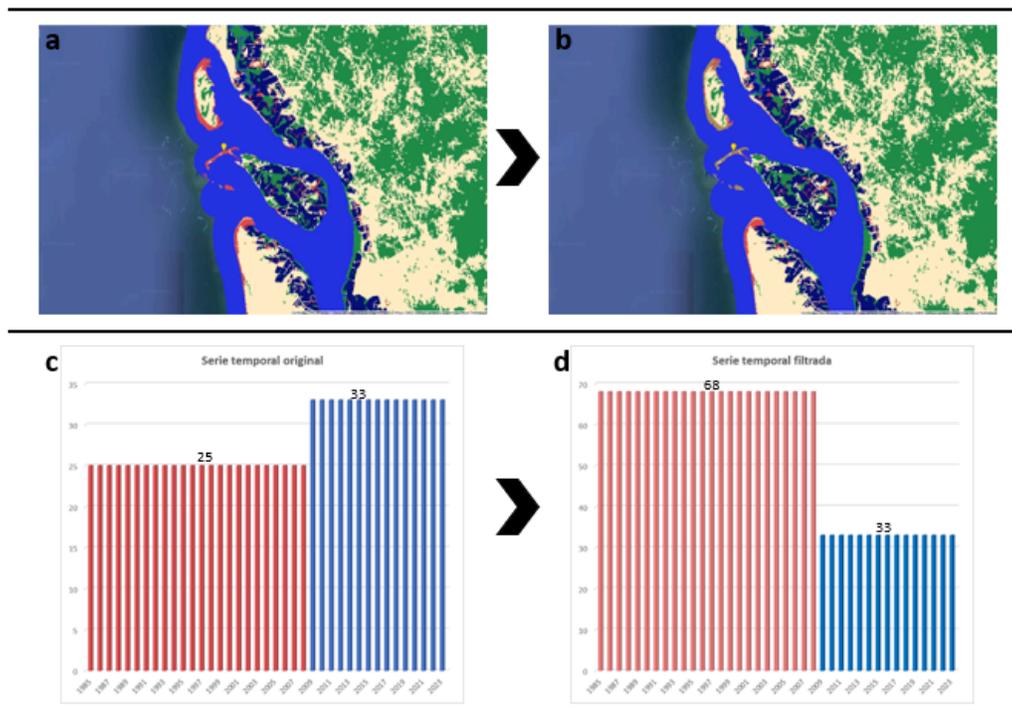
Within this layer, the attributes corresponding to level 3 were selected, which include the specific categories of sandbanks and beaches. Subsequently, a spatial analysis was carried out using the “Select by Location” tool, employing a double rivers shapefile as a reference. This process allowed for the identification and delineation of the relevant areas associated with ID 23 within the generated mask.

A manual-visual digitization was then performed using Planet Explorer base maps to refine and more accurately delineate these areas. The combined approach of spatial analysis and manual digitization ensured precision and reliability in defining the areas of interest.

#### Remapping of other non-vegetated natural areas (ID 68 )

In order to detect natural non-vegetated areas, once the generated map is integrated, the following adjusted filters are applied, which modify the pixel values only in areas with non-vegetated anthropogenic cover (ID 25):





**Figure 27.** Adjusted frequency filter for the class of non-vegetated natural areas (ID = 68). a) Original classification (before applying the filter). b) Classification after applying the filter. c) Pre-filter time series. d) Post-filter time series (Prepared by Ecociencia).

#### 4.4 Classification of cross-cutting themes

In cases where there are limitations in differentiating certain classes, specific methodologies have been developed to overcome these challenges. These methodologies are referred to as “cross-cutting themes” because they map information for these classes independently from—or transversally to—the general map. Each methodology focuses exclusively on the class of interest.

For the MapBiomás Ecuador Collection 3.0, six classes were mapped transversally (Figure 28): mangrove, flooded forest, urban infrastructure, mining, glaciers, and—introduced in this collection in a beta phase—banana cultivation. This information was incorporated into the final map during the “integration” stage. Each cross-cutting methodology is described in its respective thematic ATBD.

Below is a summary indicating which classes were mapped following the General Map methodology and which were addressed as cross-cutting themes (Figure 28).

ID	COLLECTION 3	TYPE	GENERAL MAP	CROSS-SECTI ON MAP
<b>1</b>	<b>1. Forest Formation</b>			
3	1.1. Forest	COVERAGE	X	
4	1.2. Open Forest	COVERAGE	X	
5	1.3. Mangrove	COVERAGE		X
6	1.4. Flooded Forest	COVERAGE		X
<b>10</b>	<b>2. Non-Forest Natural Formation</b>			
11	2.1. Flooded Non-Forest Natural Formation	COVERAGE	X	
12	2.2. Grasslands	COVERAGE	X	

81	2.3. Andean Grasslands and Shrublands	COVERAGE	X	
82	2.4. Flooded Andean Grasslands	COVERAGE	X	
29	2.5. Rock Outcrop	COVERAGE	X	
13	2.4. Other Non-Forest Natural Formation	COVERAGE	X	
<b>14</b>	<b>3. Agriculture and Silviculture</b>			
9	3.1 Silviculture	USE	X	
21	3.2 Mosaic of Agriculture and/or Pastures	USE	X	
74	3.3. Banana (beta)	USE		X
<b>22</b>	<b>4. Área sin vegetación</b>			
24	4.1. Urban Infrastructure	USE		X
30	4.2. Mining	USE		X
23	4.3. Beach, Dune, or Sandbank	COVERAGE	X	
25	4.4. Other Non-Vegetated Anthropogenic Area	USE	X	
68	4.5. Other Non-Vegetated Natural Area	COVERAGE	X	
<b>26</b>	<b>5. Cuerpo de agua</b>			
33	5.1 River, Lake, or Ocean	COVERAGE	X	
34	5.2 Glacier	COVERAGE		X
31	5.3 AcuaculturE	USE	X	

Figure 28. Methodological scheme applied by legend class in Ecuador (Prepared by Ecociencia).

## 4.5 Integration

### 4.5.1 National integration

This phase integrates all the results obtained for each mapping region into a single national product. This process involved merging the classified outputs from the 28 classification regions that make up the General Map, along with the results from the cross-cutting themes. To achieve this, specific rules (Figure 28) were defined to establish an order of precedence, determining which class prevails in the integrated map when more than one value is possible for the same pixel due to the overlap of resulting layers.

<b>PACIFICO</b>	MAPA	ID	PREVALENCIA	<b>ANDES</b>	MAPA	ID	PREVALENCIA
Glaciar	T	34	1	Glaciar	T	34	1
Glaciar	G	34	2	Glaciar	G	in 24 / out 29	2
Infraestructura Urbana	T	24	3	Agricultura	G	18	3
Minería	T	30	4	Infraestructura Urbana	T	24	4
Formación Campestre o Sabana	G	12	5	Formación Campestre o Sabana	G	12	5
Otra Formación Natural No Forestal	G	13	6	Otra Formación Natural No Forestal	G	13	6
Plantación forestal	G	9	7	Afloramiento rocoso	G	29	7
Acuicultura	G	31	8	Minería	T	30	8
Manglar	T	5	9	Río, Lago u Oceano de MB agua	T	33	9
Bosque Inundable	T	6	10	Plantación forestal	G	9	10
Formación Natural No Forestal Inundable	G	11	11	Río, Lago u Oceano	G	33	11
Río, Lago u Oceano	G	33	12	Pastos	T	15	12
Afloramiento rocoso	G	29	13	Formación Natural No Forestal Inundable	G	11	13
Mosaico de Agricultura y/o Pasto	G	21	14	Agricultura	T	18	14
Bosque abierto	G	4	15	Palma	T	35	15
Formación Forestal	G	3	16	Mosaico de Agricultura y/o Pasto	G	21	16
Río, Lago u Oceano de MB agua	T	33	17	Bosque Inundable	T	6	17
PLaya dunas y arenas	G	23	18	Otra Área Natural Sin Vegetación	G	68	18
Otra Área Natural Sin Vegetación	G	68	19	Otra Área Sin Vegetación	G	25	19
Otra Área Sin Vegetación antropica	G	25	20	Bosque abierto	G	4	13
No observado	G	27	21	Formación Forestal	G	3	20
				No observado	G	27	21

	MAPA	ID	PREVALENCIA
Glaciar	T	34	1
Glaciar	G	in 24 / out 29	2
Infraestructura Urbana	T	24	3
Formación Campestre o Sabana	G	12	4
Otra Formación Natural No Forestal	G	13	5
Afloramiento rocoso	G	29	6
Plantación forestal	G	9	7
Minería	T	30	8
Río, Lago u Oceano	G	33	9
Pastos	T	15	10
Formación Natural No Forestal Inundable	G	11	11
Palma	T	35	12
Bosque Inundable	T	6	13
Formación Forestal	G	3	14
Otra Área Natural Sin Vegetación	G	68	15
Agricultura	T	18	16
Agricultura	G	18	17
Otra Área Sin Vegetación	G	25	18
Mosaico de Agricultura y/o Pasto	G	21	19
No observado	G	27	20

Figure 29. Prevalence rules used during the national integration phase of the MapBiomás Ecuador Collection 3.0. The letters “G” (General Map) and “T” (Cross-cutting Theme) next to each class name indicate the data source (Prepared by Ecociencia).

The prevalence rules result from the evaluation of layer overlap for each classification region.

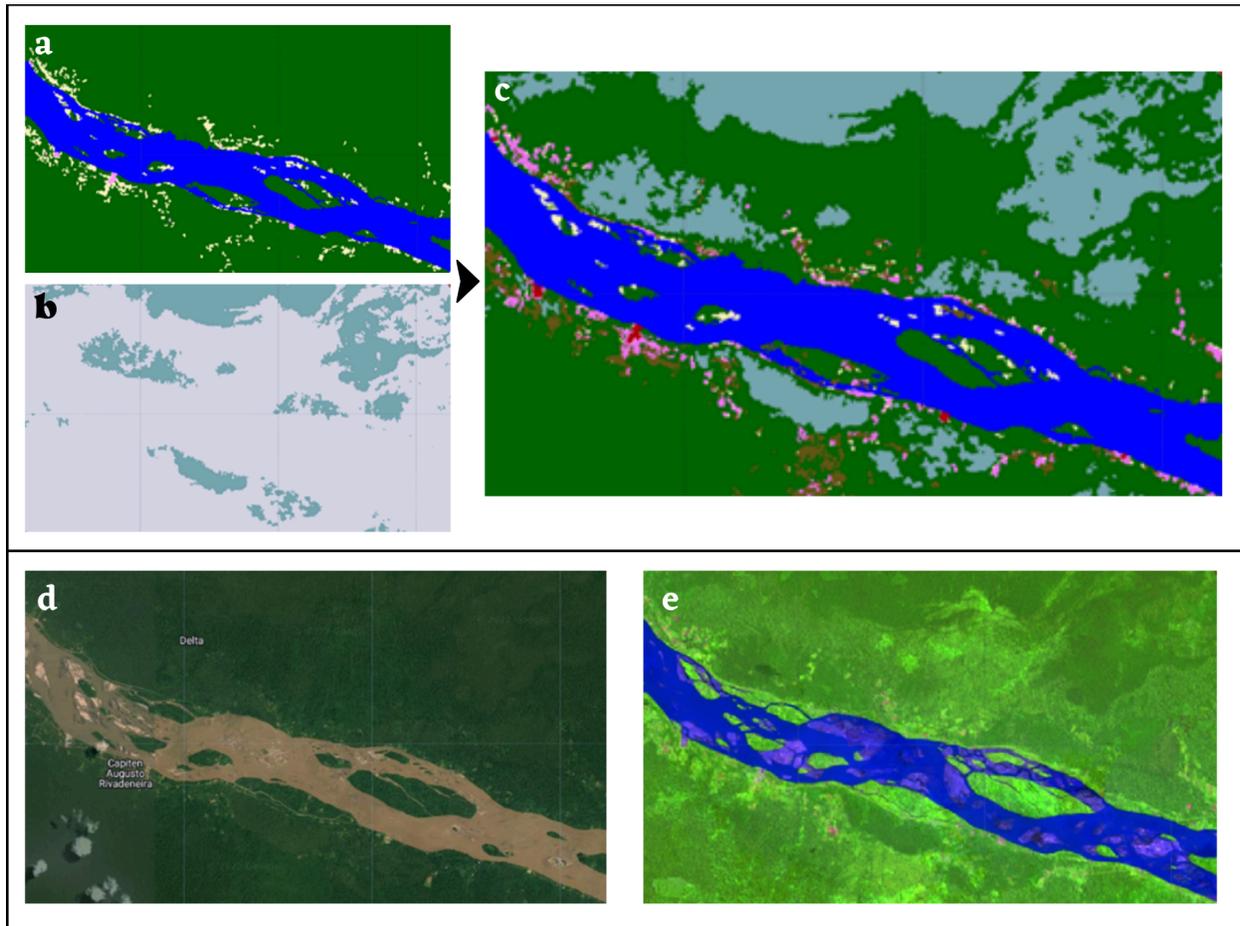
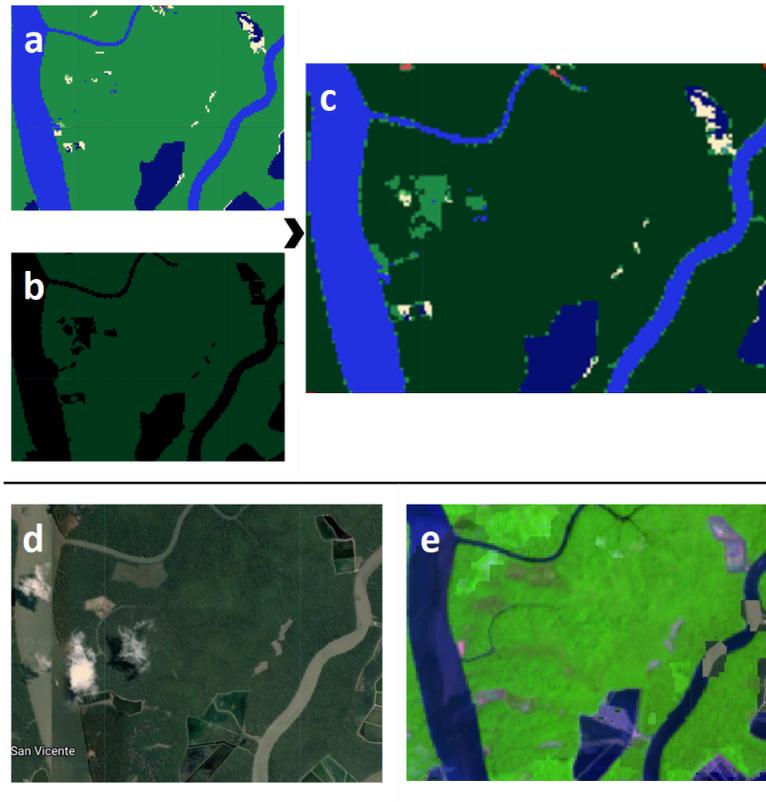


Figure 30. Example of the effect of layer integration for an area in the Ecuadorian Amazon (region 40201). a) Classified result of the 2021 General Map; b) Classified result of the 2021 cross-cutting theme “flooded forest”; c) Final map showing the result of the “flooded forest” theme integrated into the 2021 general map result; d) Google Earth Engine base map (undated high-resolution image); e) Landsat mosaic for the year 2021; (Prepared by Ecociencia).



**Figure 31.** Example of the effect of layer integration for an area in the Ecuadorian Pacific (region 40904). a) Classified result of the 2022 General Map; b) Classified result of the 2022 cross-cutting theme "mangrove"; c) Final map showing the result of the "mangrove" theme integrated into the 2022 general map result; d) Google Earth Engine base map (undated high-resolution image); e) Landsat mosaic for the year 2022; (Prepared by Ecociencia).

The result of this phase is a single national product. Below is the complete time series (1985–2024) for Ecuador:



**Figure 32.** Annual maps 1985–2024 resulting from the national integration of Ecuador (Prepared by Ecociencia).



## 5. References

- Comité Nacional de Límites Internos - CONALI (2016). Organización Territorial del Estado.
- Cuesta F., M. Peralvo and N. Valarezo. 2009. Los Bosques Montanos de los Andes Tropicales. Quito: Biblioteca Asocam. 74 pp.
- Dubayah, R., Hofton, M., Blair, J., Armston, J., Tang, H., Luthcke, S. (2021). GEDI L2A Elevation and Height Metrics Data Global Footprint Level V002 [Data set]. NASA EOSDIS Land Processes Distributed Active Archive Center. Accessed 2023-11-27 from [https://doi.org/10.5067/GEDI/GEDI02\\_A.002](https://doi.org/10.5067/GEDI/GEDI02_A.002)
- Eric Dinerstein, David Olson, Anup Joshi, Carly Vynne, Neil D. Burgess, Eric Wikramanayake, Nathan Hahn, Suzanne Palminteri, Prashant Hedao, Reed Noss, Matt Hansen, Harvey Locke, Erle C Ellis, Benjamin Jones, Charles Victor Barber, Randy Hayes, Cyril Kormos, Vance Martin, Eileen Crist, Wes Sechrest, Lori Price, Jonathan E. M. Baillie, Don Weeden, Kierán Suckling, Crystal Davis, Nigel Sizer, Rebecca Moore, David Thau, Tanya Birch, Peter Potapov, Svetlana Turubanova, Alexandra Tyukavina, Nadia de Souza, Lilian Pintea, José C. Brito, Othman A. Llewellyn, Anthony G. Miller, Annette Patzelt, Shahina A. Ghazanfar, Jonathan Timberlake, Heinz Klöser, Yara Shennan-Farpón, Roeland Kindt, Jens-Peter Barnekow Lillesø, Paulo van Breugel, Lars Graudal, Maianna Voge, Khalaf F. Al-Shammari, Muhammad Saleem, An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm, *BioScience*, Volume 67, Issue 6, June 2017, Pages 534–545, <https://doi.org/10.1093/biosci/bix014>
- Jarvis, A., H.I. Reuter, A. Nelson, E. Guevara, 2008, Hole-filled SRTM for the globe Version 4, disponible de la base de datos de CGIAR-CSI SRTM 90m (<http://srtm.csi.cgiar.org>).
- Josse, C., G. Navarro, P. Comer, R. Evans, D. Faber-Langendoen, M. Fellows, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of Latin America and the Caribbean: A Working Classification of Terrestrial Systems. NatureServe, Arlington, VA.
- Josse, Carmen & Cuesta, Francisco & Navarro, Gonzalo & Barrena, Víctor & Cabrera, Edersson & Chacón-Moreno, Eulogio & Ferreira, Wanderley & Peralvo, Manuel & J. y Tovar A., Saito. (2009). Ecosistemas de los Andes del Norte y Centro. Bolivia, Colombia, Ecuador, Perú y Venezuela.
- Rivas-Torres Gonzalo. Benítez Fátima L. Rueda Danny. Sevilla Christian. Mena Carlos (2018). Metodología para mapear la cobertura de vegetación nativa e invasora en archipiélagos: Un ejemplo de las Islas Galápagos.. Colegio de Ciencias Biológicas y Ambientales, Universidad San Francisco de Quito. Quito, Ecuador.
- Ministerio del Ambiente, Agua y Transición Ecológica. (2013a). Mapa de Ecosistemas del Ecuador Continental. Escala 1:100000. Quito - Ecuador. Disponible en: <http://ide.ambiente.gob.ec/mapainteractivo/>
- Ministerio del Ambiente, Agua y Transición Ecológica. (2013b) Mapa de Sectores biogeográficos, Proyecto Mapa de Vegetación del Ecuador Continental. Quito. Disponible en: <http://ide.ambiente.gob.ec/mapainteractivo/>
- Ministerio del Ambiente, Agua y Transición Ecológica. (2013c). Metodología para la Representación Cartográfica de los Ecosistemas del Ecuador Continental. Subsecretaría de Patrimonio Natural. Quito.
- Ministerio de Agricultura y Ganadería. (2017). Mapa de Cobertura y Uso de la Tierra del Ecuador Continental. Escala 1:25.000. Disponible en: <http://geoportal.agricultura.gob.ec/>
- Ministerio del Ambiente, Agua y Transición Ecológica, (2016). Mapa De Cobertura y Uso De La Tierra Del Ecuador Continental año 2000, 2008, 2014. Quito - Ecuador. Disponible en: <http://mapainteractivo.ambiente.gob.ec/portal/>
- Ministerio del Ambiente, Agua y Transición Ecológica, (2017). Mapa De Cobertura y Uso De La Tierra Del Ecuador Continental año 2016. Quito - Ecuador. Disponible en: <http://ide.ambiente.gob.ec/mapainteractivo/>
- Ministerio del Ambiente, Agua y Transición Ecológica, (2019). Mapa De Cobertura y Uso De La Tierra Del Ecuador Continental año 2018. Quito - Ecuador. Disponible en: <http://mapainteractivo.ambiente.gob.ec/portal/>
- Potapov, P., X. Li, A. Hernandez-Serna, A. Tyukavina, M. Hansen, A. Kommareddy, A. Pickens, S. Turubanova, H. Tang C. Silva, J. Armston, R. Dubayah, B. Blair, M. Hofton. (2021) . Mapping global forest canopy height through integration of GEDI and Landsat data. *Remote Sensing of Environment*, vol. 253, p. 112165. DOI: 10.1016/j.rse.2020.112165
- SENAGUA (2014) Unidades hidrográficas del Ecuador, nivel 5, escala 1:50000

## 6. Annexes

### Annex 1: Reference Maps

#### 6.1 Ecosystem Map of Continental Ecuador, scale 1:100,000

The ecosystem map (Figure 1) was developed in 2013 by the Ministry of Environment, Water, and Ecological Transition of Ecuador at a 1:100,000 scale (MAATE, 2013a). This map provides detailed information on the characterization, location, and spatial distribution of remaining ecosystems in continental Ecuador as of 2012, focusing on areas with natural cover. It distinguishes between natural forest and non-forest formations and human-modified areas.

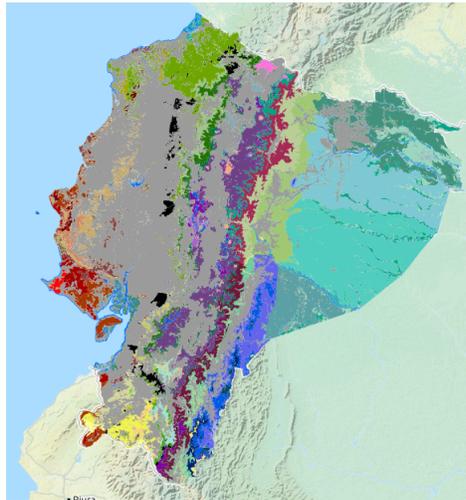
The methodology employed a biophysical model based on relevant biotic and abiotic environmental factors influencing ecosystem distribution, supported by land cover data derived from the interpretation of satellite imagery. The map presents a nested hierarchical classification system and defines 87 ecosystems for the entire continental territory, whose details can be reviewed in Annex 1 of this document.

MAATE describes it as follows:

“This layer represents the characterization, location, and distribution of ecosystems in Continental Ecuador as of 2012. It was developed at a 1:100,000 scale using biophysical modeling, interpretation of satellite images (2010–2012), and field validation. It serves as a baseline input for explaining the state of biodiversity through various analyses and as a tool to facilitate management and the creation of policies consistent with the sustainable use of natural resources.”

These data are available for download at:

[<http://ide.ambiente.gob.ec/mapainteractivo/>](<http://ide.ambiente.gob.ec/mapainteractivo/>)



**Figure 1.** Official Map of the Ecosystems of Continental Ecuador. The legend details can be found in Annex 1 of this document. Image taken from the SUIA Environmental Interactive Map.

#### 6.2. Land Cover and Land Use Map, scale 1:25,000

The Land Cover and Land Use Map at a 1:25,000 scale (Figure 2) is a national product developed between 2009 and 2015 through a collaborative effort among the Ministry of Agriculture and Livestock (formerly MAGAP), SIGTIERRAS, the Ecuadorian Space Institute (IEE), and SENPLADES (2017). The information was generated at the cantonal level, with different update periods for each canton during the mentioned timeframe.

This map provides detailed information on productive systems, land cover, plot size, and crop seasonality. In 2017, the Ministry of Agriculture standardized the cantonal information to produce a national Land Cover and Land Use Map.

These data are available as a geoservice at:

[[http://www.geoportalmg.gob.ec/p\\_afc/ows?service=wms&version=1.3.0&request=GetCapabilities](http://www.geoportalmg.gob.ec/p_afc/ows?service=wms&version=1.3.0&request=GetCapabilities)]([http://www.geoportalmg.gob.ec/p\\_afc/ows?service=wms&version=1.3.0&request=GetCapabilities](http://www.geoportalmg.gob.ec/p_afc/ows?service=wms&version=1.3.0&request=GetCapabilities))

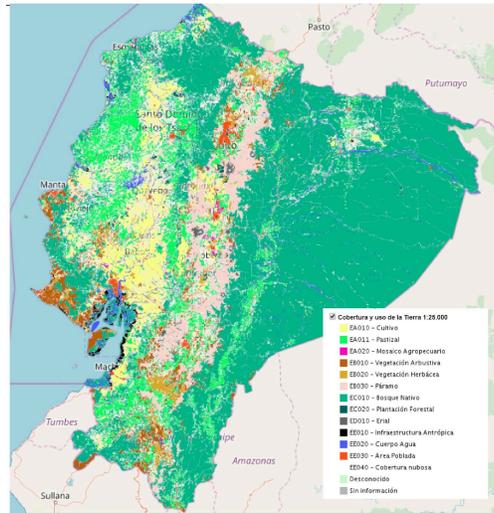


Figure 2. Official Land Cover and Land Use Map of Ecuador. The legend details can be found in Annex 2 of this document. Image taken from the Geoportal of the Ministry of Agriculture and Livestock.

### 6.3 Land Cover and Land Use Map and Agricultural Production Systems of Continental Ecuador (version edited by the Ministry of Agriculture and Livestock in 2020) at a 1:25,000 scale

The Land Cover and Land Use and Agricultural Production Systems Map of Continental Ecuador (version edited by the Ministry of Agriculture and Livestock in 2020) was developed by the Ecuadorian Space Institute (IEE) and the Ministry of Agriculture and Livestock (MAG) through the National System of Rural Land Information and Technological Infrastructure (SIGTIERRAS program). In the 2015 product, inconsistencies were identified, which led to corrections of certain variables in 2020.

This map identifies the different types of land cover and determines how each area is used by humans, characterizing the production system. The working scale is 1:25,000, meaning the map data should not be used for studies requiring more detailed scales, since the Minimum Mappable Unit (MMU) established is 1.0 hectare.

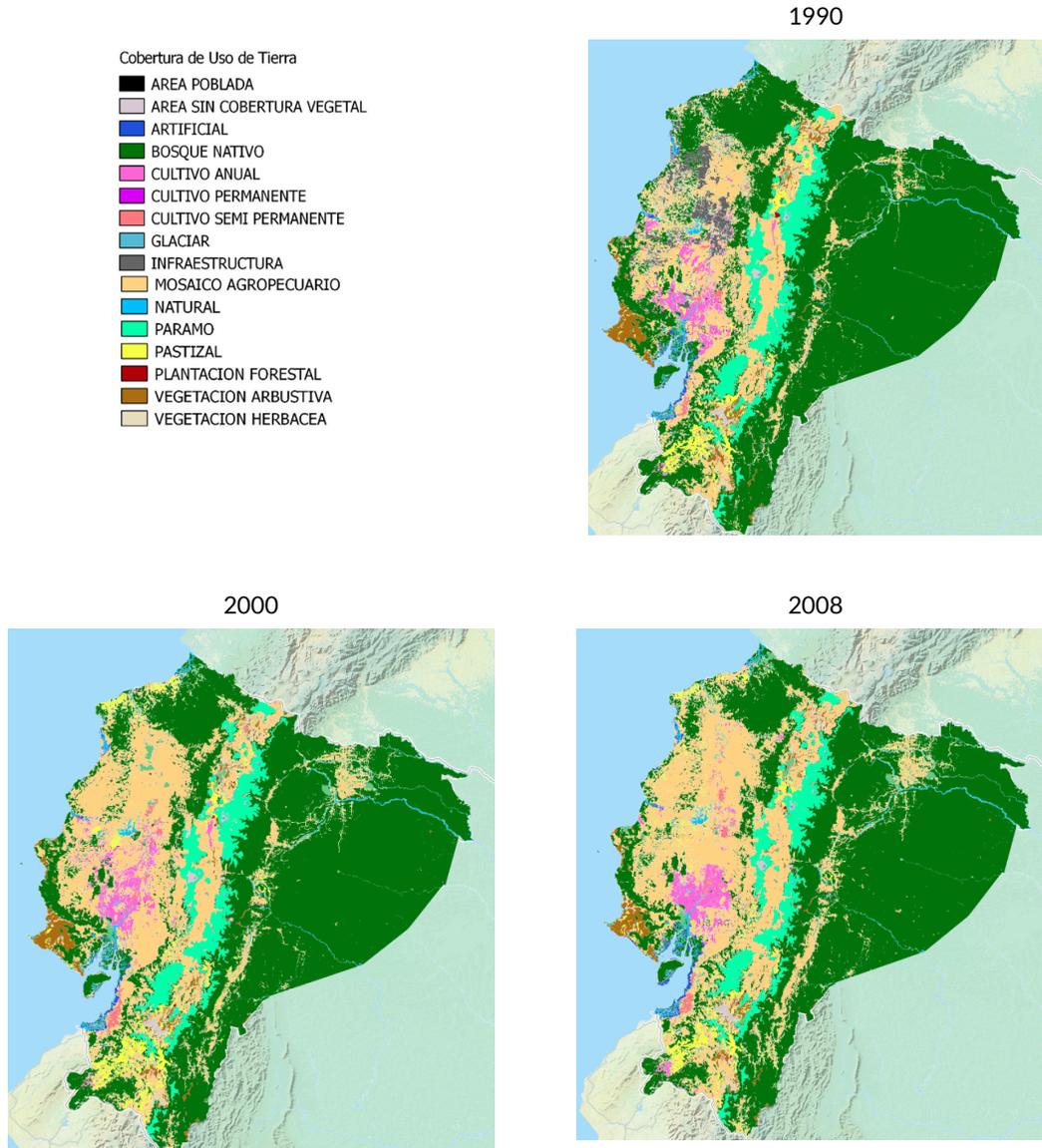
The data are available for download at: [<http://geoportal.agricultura.gob.ec/>](<http://geoportal.agricultura.gob.ec/>)



Figure 3. Official Map of Land Cover, Land Use, and Agricultural Production Systems of Continental Ecuador. Image taken from the Geoportal of the Ministry of Agriculture and Livestock.

## 6.4 Land Cover and Land Use (CUT) Maps of Continental Ecuador at a 1:100,000 scale

The land cover and land use maps generated by the Ministry of Environment, Water and Ecological Transition and MAGAP (2014) for the years 1990, 2000, 2008, 2014, 2016, 2018, and 2020 at the national continental level (Figure 4) identify units with common characteristics, including forests, agricultural zones, and transformed areas, at a 1:100,000 scale. The generated maps include two levels of detail: a) Level I corresponds to the six classes defined by the IPCC (Intergovernmental Panel on Climate Change); and b) Level II corresponds to 16 more detailed classes agreed upon in intersectoral dialogue tables. Available for download at: [<http://ide.ambiente.gob.ec/mapainteractivo/>](<http://ide.ambiente.gob.ec/mapainteractivo/>)



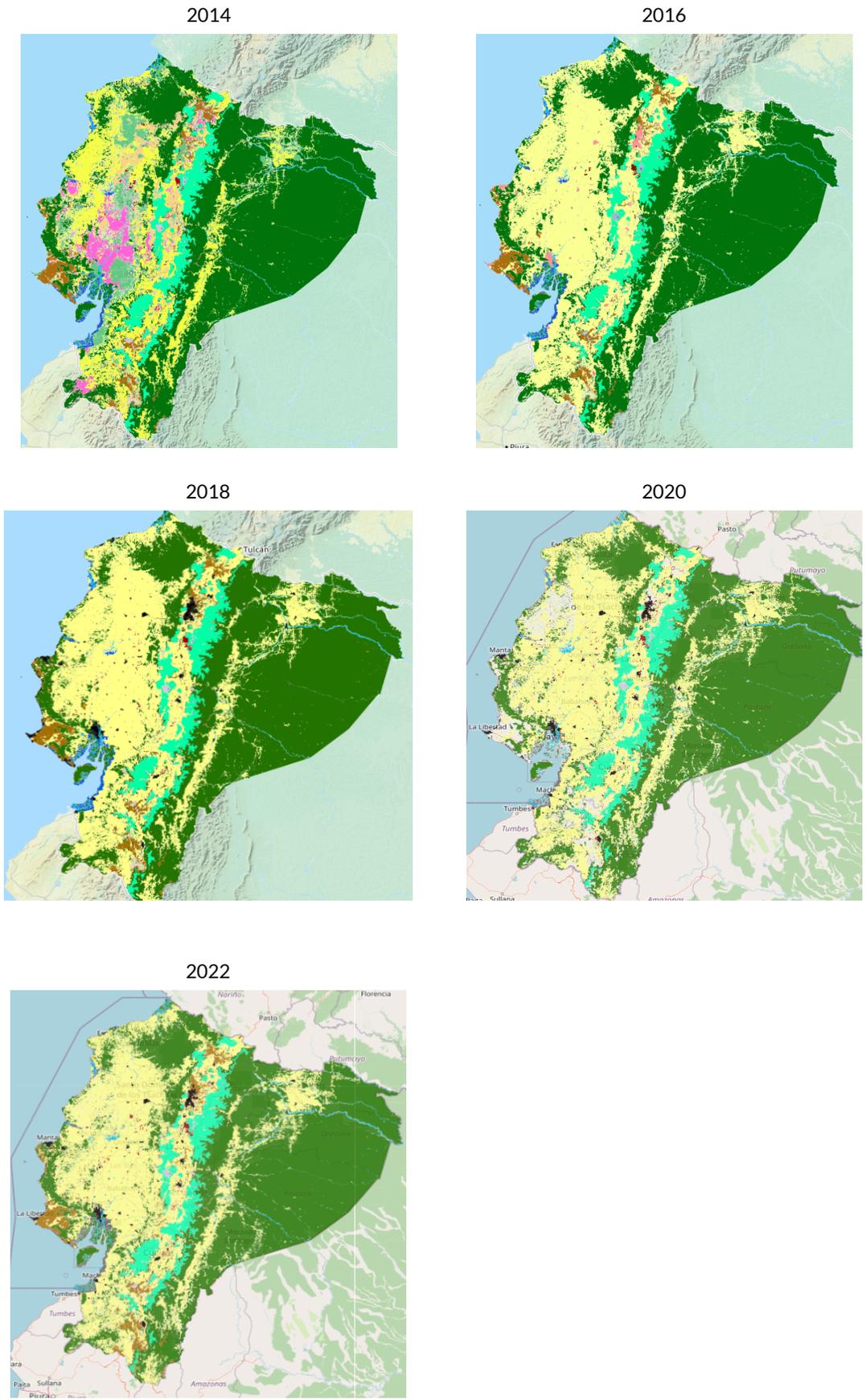
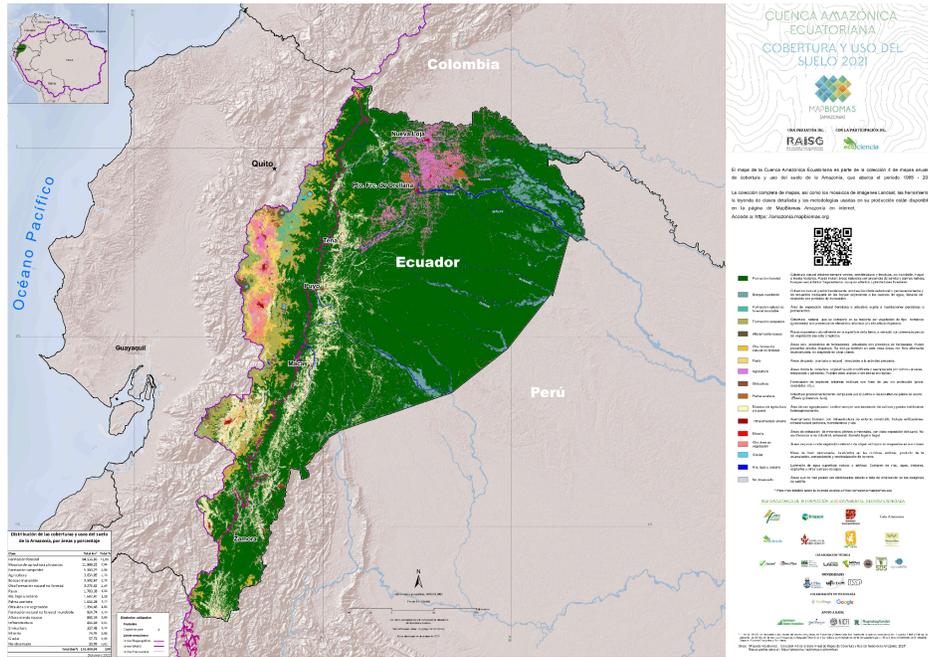


Figure 4. Official land cover and land use maps of Ecuador for the years 1990, 2000, 2008, 2014, 2016, 2018, 2020, and 2022. Images taken from the SUIA Environmental Interactive Map.









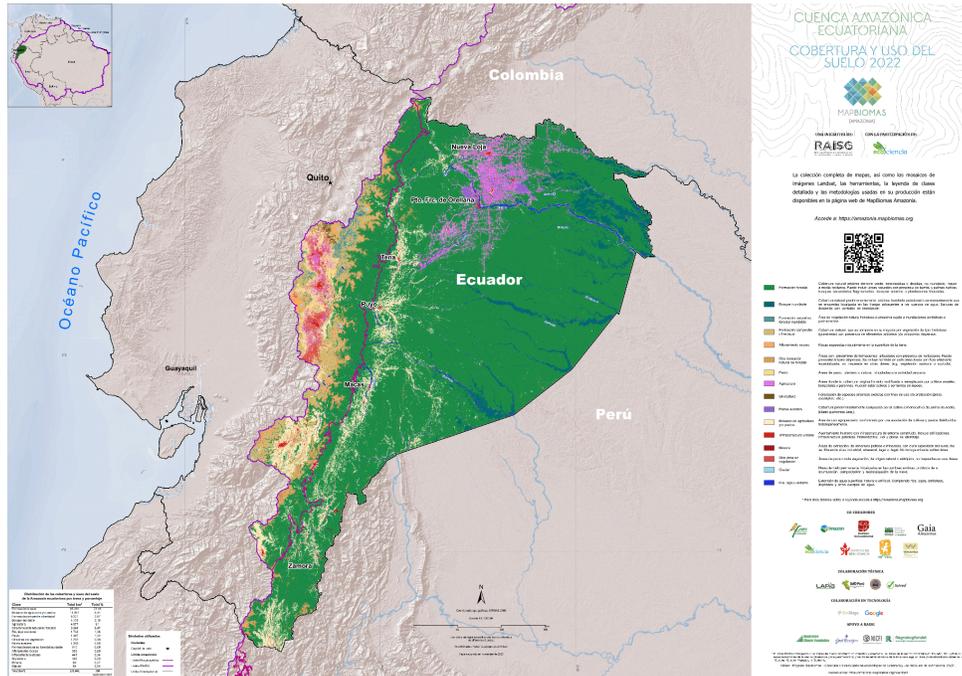
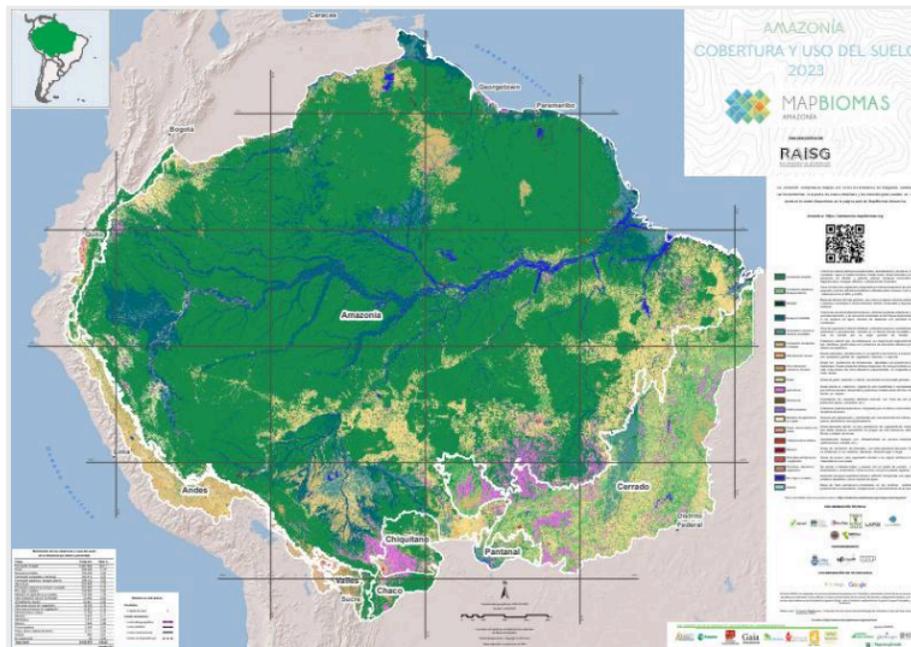


Figure 13. Wall map (year 2022) of Ecuador from Collection 5 of MapBiomás Amazonía (RAISG, 2023).

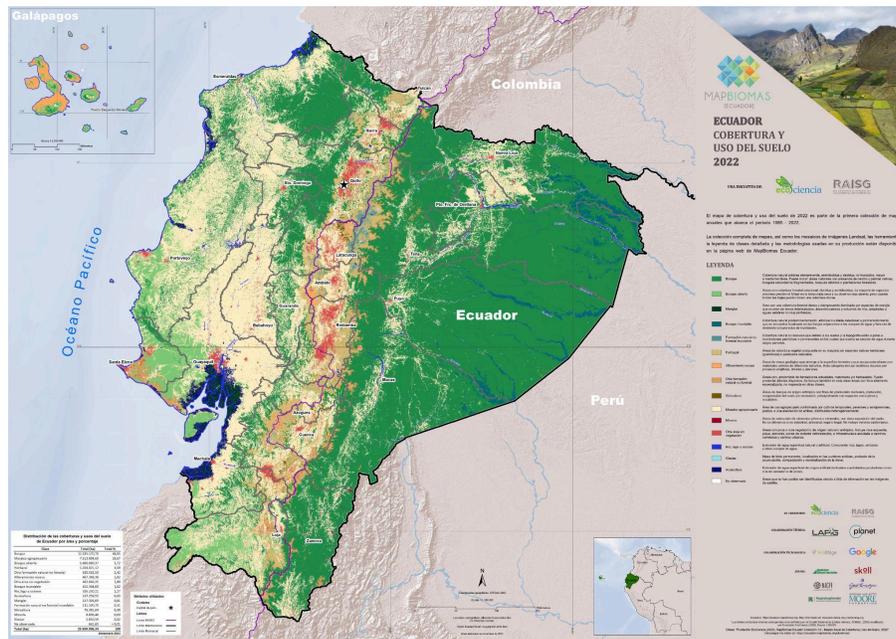
### 6.11 Collection 6 of Annual Land Cover and Land Use Maps 1985–2023 of the Amazon

In 2024, RAISG presented the sixth collection of annual land cover and land use maps of the Pan-Amazon region. This updated map covers the years from 1985 to 2023. The maps were generated through the classification of Landsat satellite imagery using the Random Forest algorithm, with scripts implemented entirely on the Google Earth Engine platform.



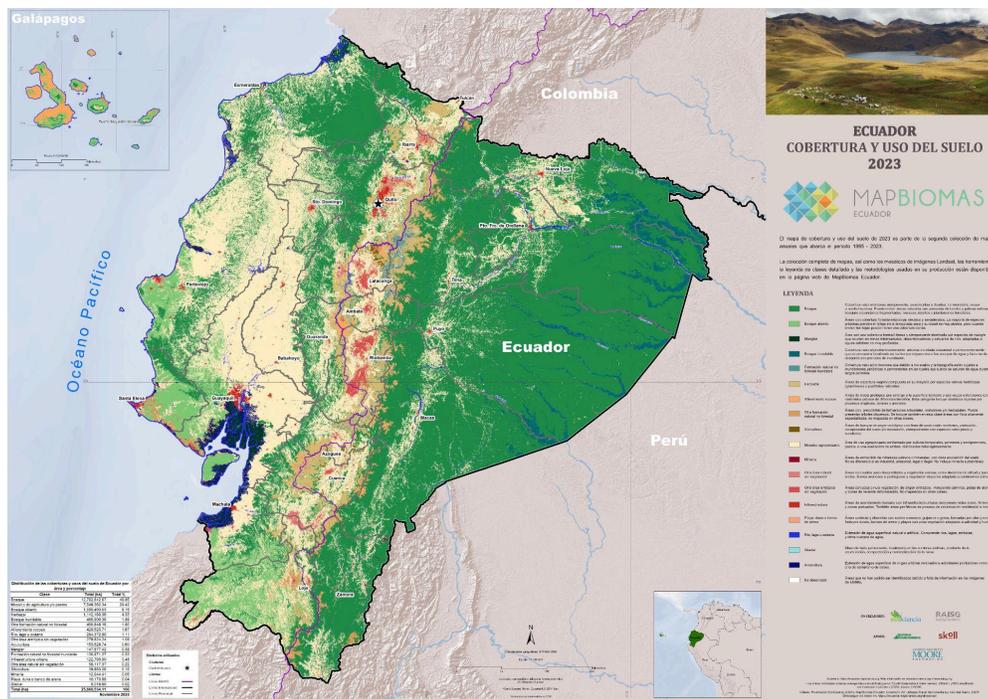
## 6.12 Collection 1 of Annual Land Use and Land Cover Maps 1985–2022 of Ecuador

In 2023, MapBiomias Ecuador released the first collection of annual land use and land cover maps for Ecuador. This updated dataset covers the years from 1985 to 2022. The maps were generated through the classification of Landsat satellite images using the Random Forest algorithm, with scripts implemented entirely on the Google Earth Engine platform.



## 6.13 Collection 2 of Annual Land Use and Land Cover Maps 1985–2023 of Ecuador

In 2024, MapBiomias Ecuador released the second collection of annual land use and land cover maps for Ecuador. This updated dataset covers the years from 1985 to 2023. The maps were generated from the classification of Landsat satellite imagery using the Random Forest algorithm, with scripts fully implemented on the Google Earth Engine platform.



## Annex 2: Legend of the Ecosystems Map of Ecuador

### Ecosistemas

- Agua
  - Arbustal decíduo y Herbazal de playas del Litoral
  - Arbustal desértico de tierras bajas del Jama-Zapotillo
  - Arbustal desértico del sur de los Valles
  - Arbustal semidecíduo del sur de los Valles
  - Arbustal siempreverde montano alto del Páramo del sur
  - Arbustal siempreverde montano del norte de los Andes
  - Arbustal siempreverde montano del sur de los Andes
  - Arbustal siempreverde ripario de la Cordillera Oriental de los Andes
  - Arbustal siempreverde y Herbazal del Páramo
  - Arbustal siempreverde y Herbazal montano de la cordillera del Cóndor
  - Bosque bajo y Arbustal decíduo de tierras bajas del Jama-Zapotillo
  - Bosque decíduo de Cordillera Costera del Pacífico Ecuatorial
  - Bosque decíduo de tierras bajas del Jama-Zapotillo
  - Bosque decíduo montano bajo del Catamayo-Alamor
  - Bosque decíduo piemontano del Catamayo-Alamor
- 
- Bosque inundable de la llanura aluvial de los ríos de origen amazónico
  - Bosque inundable de la llanura aluvial de los ríos de origen andino y de Cordilleras Amazónicas
  - Bosque inundable de llanura intermareal del Chocó Ecuatorial
  - Bosque inundable y vegetación lacustre-riparia de aguas negras de la Amazonía
  - Bosque inundado de la llanura aluvial de la Amazonía
  - Bosque inundado de llanura aluvial del Chocó Ecuatorial
  - Bosque inundado de palmas de la llanura aluvial de la Amazonía
  - Bosque semidecíduo de Cordillera Costera del Pacífico Ecuatorial
  - Bosque semidecíduo de tierras bajas del Jama-Zapotillo
  - Bosque semidecíduo montano bajo del Catamayo-Alamor
  - Bosque semidecíduo piemontano del Catamayo-Alamor
  - Bosque semidecíduo piemontano del Sur de la Cordillera Oriental de los Andes
  - Bosque siempreverde de tierras bajas con bambú de la Amazonía
  - Bosque siempreverde de tierras bajas del Abanico del Pastaza
  - Bosque siempreverde de tierras bajas del Aguarico-Putumayo-Caquetá
- 
- Bosque siempreverde de tierras bajas del Chocó Ecuatorial
  - Bosque siempreverde de tierras bajas del Napo-Curaray
  - Bosque siempreverde de tierras bajas del Tigre-Pastaza
  - Bosque siempreverde del Páramo
  - Bosque siempreverde estacional de tierras bajas del Chocó Ecuatorial
  - Bosque siempreverde estacional de tierras bajas del Jama-Zapotillo
  - Bosque siempreverde estacional inundable de llanura aluvial del Jama-Zapotillo
  - Bosque siempreverde estacional montano bajo de Cordillera Costera del Pacífico Ecuatorial
  - Bosque siempreverde estacional montano bajo del Catamayo-Alamor
  - Bosque siempreverde estacional piemontano de Cordillera Costera del Chocó
  - Bosque siempreverde estacional piemontano de Cordillera Costera del Pacífico Ecuatorial
  - Bosque siempreverde estacional piemontano de Cordillera Occidental de los Andes
  - Bosque siempreverde estacional piemontano del Catamayo-Alamor
  - Bosque siempreverde montano alto de Cordillera Occidental de los Andes
  - Bosque siempreverde montano alto del Catamayo-Alamor

- Bosque siempreverde montano alto del Norte de la Cordillera Oriental de los Andes
- Bosque siempreverde montano alto del Sur de la Cordillera Oriental de los Andes
- Bosque siempreverde montano bajo de Cordillera Costera del Chocó
- Bosque siempreverde montano bajo de Cordillera Occidental de los Andes
- Bosque siempreverde montano bajo de Galeras
- Bosque siempreverde montano bajo de las cordilleras del Cóndor-Kutukú
- Bosque siempreverde montano bajo del Catamayo-Alamor
- Bosque siempreverde montano bajo del Norte de la Cordillera Oriental de los Andes
- Bosque siempreverde montano bajo del Sur de la Cordillera Oriental de los Andes
- Bosque siempreverde montano bajo sobre mesetas de arenisca de las cordilleras del Cóndor-Kutukú
- Bosque siempreverde montano de Cordillera Occidental de los Andes
- Bosque siempreverde montano de las cordilleras del Cóndor-Kutukú
- Bosque siempreverde montano del Catamayo-Alamor
- Bosque siempreverde montano del Norte de la Cordillera Oriental de los Andes
- Bosque siempreverde montano del Sur de la Cordillera Oriental de los Andes
- Bosque siempreverde montano sobre mesetas de arenisca de la cordillera del Cóndor
  
- Bosque siempreverde piemontano de Cordillera Occidental de los Andes
- Bosque siempreverde piemontano de Galeras
- Bosque siempreverde piemontano de las cordilleras del Cóndor-Kutukú
- Bosque siempreverde piemontano del Catamayo-Alamor
- Bosque siempreverde piemontano del Norte de la Cordillera Oriental de los Andes
- Bosque siempreverde piemontano del Sur de la Cordillera Oriental de los Andes
- Bosque siempreverde piemontano sobre afloramientos de roca caliza de las Cordilleras Amazónicas
- Bosque siempreverde piemontano sobre mesetas de arenisca de las cordilleras del Cóndor-Kutukú
- Bosque siempreverde sobre mesetas de arenisca de la cordillera del Cóndor en la baja Amazonía ecuatoriana
- Bosque y Arbustal semideciduo del norte de los Valles
- Bosque y Arbustal semideciduo del sur de los Valles
- Herbazal del Páramo
- Herbazal húmedo montano alto superior del Páramo
- Herbazal húmedo subnival del Páramo
- Herbazal inundable del Páramo
- Herbazal inundable ripario de tierras bajas del Chocó Ecuatorial
- Herbazal inundable ripario de tierras bajas del Jama-Zapotillo
  
- Herbazal inundado lacustre del Pacífico Ecuatorial
- Herbazal inundado lacustre-ripario de la llanura aluvial de la Amazonía
- Herbazal lacustre montano bajo del Sur de la Cordillera Oriental de los Andes
- Herbazal ultrahúmedo subnival del Páramo
- Herbazal y Arbustal siempreverde del Páramo del volcán Sumaco
- Herbazal y Arbustal siempreverde subnival del Páramo
- Intervención
- Manglar del Chocó Ecuatorial
- Manglar del Jama-Zapotillo
- Otras áreas
- Rosetal caulescente y Herbazal del Páramo (frailejones)
- Sin información
- Otros

### Annex 3: Legend of the Land Cover and Use Map of Continental Ecuador

Level I	Level II	Operational Definition	Source
Forest	Native Forest	Tree-based ecosystem, either primary or secondary, regenerated through natural succession; characterized by the presence of native tree species of various ages and sizes, with one or more canopy strata.	MAE (2016)
	Forest Plantation	Tree mass established anthropogenically with one or more forest species.	MAE (2011)
Shrub and Herbaceous Vegetation	Shrub Vegetation	Areas with a substantial component of native non-tree woody species. Includes degraded areas in transition toward a dense canopy cover.	MAE (2011)
	High Andean Moorland	High Andean tropical vegetation characterized by dominant non-tree species, including fragments of native forest typical of the region.	MAGAP - IEE (2012)
	Herbaceous Vegetation	Areas composed of native herbaceous species with spontaneous growth, not receiving special care, used for occasional grazing, wildlife habitat, or protection.	MAGAP - IEE (2012)
Agricultural Land	Annual Crop	Lands dedicated to agricultural crops with a seasonal growing cycle, which may be harvested one or more times per year.	MAGAP - IEE (2012)
	Semi-permanent Crop	Lands dedicated to agricultural crops with a growing cycle lasting between one and three years.	MAGAP - IEE (2012)
	Permanent Crop	Lands dedicated to agricultural crops with a growing cycle longer than three years, providing several harvests during that period.	MAGAP - IEE (2012)
Agricultural Lands	Grassland	Herbaceous vegetation dominated by introduced grass and legume species, used for livestock purposes and requiring cultivation and management for their establishment and maintenance.	MAGAP - IEE (2012)
	Agricultural Mosaic (Association)	<b>Groups of cultivated species found mixed together</b> , which cannot be individually identified; they may exceptionally be associated with natural vegetation.	MAGAP - IEE (2012)
Water	Natural	Surface and associated volume of static or flowing water.	MAGAP - IEE (2012)
	Artificial	Surface and associated volume of static or flowing water related to anthropogenic activities and water resource management.	MAGAP - IEE (2012)
Anthropic Zone	Populated Area	Areas mainly occupied by housing and buildings intended for communities or public services.	MAGAP - IEE (2012)
	Infrastructure	Civil works for transportation, communication, agro-industrial, or social purposes.	MAGAP - IEE (2012)
Other Lands	Area without Vegetative Cover	Areas generally lacking vegetation, which, due to edaphic, climatic, topographic, or anthropogenic limitations, are not suitable for agricultural or forestry use, though they may have other uses.	MAGAP - IEE (2012)
	Glacier	Snow and ice located on the summits of Andean highlands.	MAGAP - IEE (2012)



**Annex 5: Ecosystems of the Ecuadorian Amazon grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.**

LEGEND		BIOME	ECOSYSTEMS (MAATE, 2013a)
LEVEL 1	LEVEL 2		
FOREST FORMATION	Forest (ID = 3)	Amazon	Montane Evergreen Forest of the Cóndor–Kutukú Ranges Lower Montane Evergreen Forest of the Cóndor–Kutukú Ranges Foothill Evergreen Forest of the Cóndor–Kutukú Ranges Lowland Evergreen Forest of the Pastaza Fan Lowland Evergreen Forest of the Aguarico–Putumayo–Caquetú Lowland Evergreen Forest of the Napo–Curaray Lowland Evergreen Forest of the Tigre–Pastaza
	Forest abierto (ID = 4)	Andes	Upper Montane Evergreen Forest of the Western Andes
Lower Montane Evergreen Forest of the Southern Eastern Andes			
Upper Montane Evergreen Forest of the Northern Eastern Andes			
Lower Montane Evergreen Forest of the Western Andes			
Montane Evergreen Forest of the Southern Eastern Andes			
Montane Evergreen Forest of the Western Andes			
Foothill Evergreen Forest of the Western Andes			
Lower Montane Evergreen Forest of the Northern Eastern Andes			
Montane Evergreen Forest of the Northern Eastern Andes			
Northern Foothill Evergreen Forest of the Eastern Andes			
Equatorial Dry Forest		Jama–Zapotillo Mangrove	
		Lowland Deciduous Forest of Jama–Zapotillo	
		Semi-Deciduous Forest of the Equatorial Pacific Coastal Range	
		Lowland Semi-Deciduous Forest of Jama–Zapotillo	
		Lowland Seasonal Evergreen Forest of Jama–Zapotillo	
		Lower Montane Seasonal Evergreen Forest of the Equatorial Pacific Coastal Range	
Tropical Humid Forest of the Pacific		Lower Montane Evergreen Forest of the Equatorial Chocó Coastal Range	
		Lowland Seasonal Evergreen Forest of the Equatorial Chocó	
	Foothill Seasonal Evergreen Forest of the Equatorial Chocó Coastal Range		
		Bosque siempreverde de las tierras bajas del Chocó Ecuatorial → Lowland Evergreen Forest of the Equatorial Chocó	
Forest abierto (ID = 4)	Andes	Southern Valley Semi-Deciduous Shrubland	
		Lower Montane Deciduous Forest of Catamayo–Alamor	
		Southern Valley Semi-Deciduous Forest and Shrubland	
		Foothill Deciduous Forest of Catamayo–Alamor	
		Foothill Seasonal Evergreen Forest of Catamayo–Alamor	
		Lower Montane Semi-Deciduous Forest of Catamayo–Alamor	
	Equatorial Dry Forest	Foothill Semi-Deciduous Forest of Catamayo–Alamor	
		Lowland Desert Shrubland of Jama–Zapotillo	
		Lowland Seasonal Evergreen Forest of Jama–Zapotillo	
		Foothill Semi-Deciduous Forest of Catamayo–Alamor	
		Foothill Deciduous Forest of Catamayo–Alamor	
		Lower Montane Seasonal Evergreen Forest of the Equatorial Pacific Coastal Range	
		Deciduous Forest of the Equatorial Pacific Coastal Range	
		Foothill Seasonal Evergreen Forest of the Equatorial Pacific Coastal Range	

				Semi-Deciduous Forest of the Equatorial Pacific Coastal Range	
				Lowland Semi-Deciduous Forest of Jama-Zapotillo	
				Lowland Low Forest and Deciduous Shrubland of Jama-Zapotillo	
				Lowland Deciduous Forest of Jama-Zapotillo	
			Tropical Humid Forest of the Pacific	Lowland Semi-Deciduous Forest of Jama-Zapotillo	
				Lowland Seasonal Evergreen Forest of the Equatorial Chocó	
				Lowland Evergreen Forest of the Equatorial Chocó	
			Mangrove (ID = 5)	Equatorial Dry Forest	Jama-Zapotillo Mangrove
				Tropical Humid Forest of the Pacific	Flooded Forest of the Alluvial Plain of the Equatorial Chocó Equatorial Chocó Mangrove
			Forest inundable (ID=6)	Amazon	Floodplain Forest of Rivers of Amazonian Origin
					Lowland Evergreen Forest of the Aguarico-Putumayo-Caquetú
					Lowland Evergreen Forest of the Pastaza Fan
					Lowland Evergreen Forest of the Tigre-Pastaza
					Floodplain Forest of Rivers of Andean and Amazonian Range Origin
					Flooded Forest of the Amazonian Alluvial Plain
Flooded Palm Forest of the Amazonian Alluvial Plain					
Andes	Floodplain Forest of Rivers of Andean and Amazonian Range Origin Northern Foothill Evergreen Forest of the Eastern Andes				
FORMACIÓN BOSCOSA	NATURAL	NO	Formación natural no forestal inundable (ID=11)	Amazon	Flooded Forest of the Amazonian Alluvial Plain
					Lowland Evergreen Forest of the Napo-Curaray
					Floodplain Forest of Rivers of Amazonian Origin
					Lowland Evergreen Forest of the Tigre-Pastaza
					Floodplain Forest of Rivers of Andean and Amazonian Range Origin
				Andes	Subnival Humid Grassland of the Páramo
					Causlescent Rosette and Grassland of the Páramo (Frailejones)
					Upper Montane Humid Grassland of the Páramo
					Evergreen Shrubland and Grassland of the Páramo
					Flooded Grassland of the Páramo
					Subnival Evergreen Grassland and Shrubland of the Páramo
				Páramo Grassland	
				Equatorial Dry Forest	Lowland Riparian Flooded Grassland of Jama-Zapotillo
					Jama-Zapotillo Mangrove
Lowland Low Forest and Deciduous Shrubland of Jama-Zapotillo					
Tropical Humid Forest of the Pacific	Equatorial Chocó Mangrove				
	Flooded Forest of the Alluvial Plain of the Equatorial Chocó				
Grassland (ID=12)	Andes	Southern Valley Semi-Deciduous Shrubland			
		Upper Montane Humid Grassland of the Páramo			
		Causlescent Rosette and Grassland of the Páramo (Frailejones)			
		Subnival Evergreen Grassland and Shrubland of the Páramo			
		Evergreen Shrubland and Grassland of the Páramo			
Páramo Grassland					
Equatorial Dry Forest	Lowland Semi-Deciduous Forest of Jama-Zapotillo				
	Lowland Low Forest and Deciduous Shrubland of Jama-Zapotillo				
	Lowland Seasonal Evergreen Forest of Jama-Zapotillo				
	Foothill Seasonal Evergreen Forest of Catamayo-Alamor				
Tropical Humid Forest of the Pacific	Lowland Seasonal Evergreen Forest of the Equatorial Chocó				
Rock Outcrop (ID=29)	Andes	Subnival Humid Grassland of the Páramo			
		Upper Montane Humid Grassland of the Páramo			
		Evergreen Shrubland and Grassland of the Páramo			
		Subnival Evergreen Grassland and Shrubland of the Páramo			

	Other Non-Forest Natural Formation (ID=13)	Amazon	Subnival Ultra-Humid Grassland of the Páramo
			Páramo Grassland
		Andes	Montane Evergreen Shrubland and Grassland of the Cordillera del Cóndor
			Montane Evergreen Forest on Sandstone Plateaus of the Cordillera del Cóndor
			Northern Andean Montane Evergreen Shrubland
			Southern Andean Montane Evergreen Shrubland
			Lower Montane Semi-Deciduous Forest of Catamayo-Alamor
			Northern Montane Evergreen Forest of the Eastern Andes
			Southern Upper Montane Evergreen Forest of the Eastern Andes
			Northern Upper Montane Evergreen Forest of the Eastern Andes
			Southern Valley Semi-Deciduous Shrubland
			Evergreen Shrubland and Grassland of the Páramo
		Páramo Grassland	
Equatorial Dry Forest	Lowland Deciduous Forest of Jama-Zapotillo		
	Lowland Low Forest and Deciduous Shrubland of Jama-Zapotillo		
	Lowland Desert Shrubland of Jama-Zapotillo		
Tropical Humid Forest of the Pacific	Lowland Evergreen Forest of the Equatorial Chocó		
WATER BODY	Aquaculture (ID=31)	Equatorial Dry Forest	Jama-Zapotillo Mangrove
			Lowland Deciduous Forest of Jama-Zapotillo
		Tropical Humid Forest of the Pacific	Equatorial Chocó Mangrove
			Lowland Seasonal Evergreen Forest of the Equatorial Chocó
			Lowland Evergreen Forest of the Equatorial Chocó

**Annex 6: Land Use Categories of Ecuador grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.**

LEGEND		REGION	LAND COVER AND LAND USE CLASSES ACCORDING TO MAATE, 2019	
LEVEL 1	LEVEL 2			
FOREST FORMATION	Forest (ID = 3)	Amazon Andes	-	Native forest
	Open forest (ID = 4)		-	Native forest
	Mangrove (ID = 5)		-	Native forest
	Flooded forest (ID = 6)	Amazon	-	Native forest
NATURAL NON-FOREST FORMATION	Floodable non-forest natural formation (ID = 11)	Amazon Andes	-	Páramo Herbaceous Vegetation
	Grassland (ID = 12)	Andes	-	Páramo Herbaceous Vegetation
	Rock outcrop (ID= 29)	Amazon Andes	-	Non-vegetated area Shrubland
	Other non-forest natural formation (ID = 13)	Amazon Andes	-	Shrubland

AGRICULTURE AND FORESTRY	Silviculture (ID= 9)	Amazon Andes	- Forest plantation
	Agriculture and/or pasture mosaic (ID= 21)	Amazon Andes	- Agricultural mosaic - Pasture - Annual crop - Semi-permanent crop - Permanent crop
AREA WITHOUT VEGETATION	Urban infrastructure (ID = 24)	Amazon Andes	- Populated area - Infrastructure
	Mining (ID = 30)	Amazon	- Non-vegetated area
	Other non-vegetated area (ID = 25)	Amazon Andes	- Non-vegetated area - Populated area - Infrastructure
WATER	River, Lake, or Ocean (ID = 33)	Amazon Andes	- Natural water body - Artificial
	Aquaculture (ID = 31)		- Artificial
	Glacier (ID = 34)	Andes	- Glacier

## Annex 7: Native Ecosystem Categories of Galápagos grouped according to the equivalent land cover and land use classes of the MapBiomias Ecuador legend.

LEGEND		BIOME	LAND COVER AND LAND USE CLASSES ACCORDING TO Rivas et al., 2018
LEVEL 1	NIVEL 2		
FOREST FORMATION	Forest (ID = 3)	Galápagos	- Humid beach forest and shrubland - Deciduous forest - Seasonally evergreen forest - Evergreen forest and shrubland - Humid grassland
	Open forest (ID = 4)	Galápagos	- Humid beach forest and shrubland - Deciduous forest - Seasonally evergreen forest - Evergreen forest and shrubland - Deciduous shrubland - Mangrove - Humid grassland - Deciduous grassland
	Mangrove (ID = 5)	Galápagos	- Humid beach forest and shrubland - Deciduous forest
NON-FOREST NATURAL FORMATION	Grassland (ID = 12)	Galápagos	- Deciduous grassland - Deciduous shrubland - High-altitude deciduous grassland - Deciduous forest - Seasonally evergreen forest
	Rock Outcrop (ID= 29)	Galápagos	- Old lava - Recent lava
	Other Natural Non-Forest Formation (ID = 13)	Galápagos	- Evergreen forest and shrubland - Deciduous grassland - Deciduous shrubland - Deciduous forest
WATER	River, Lake, or Ocean (ID = 33)	Galápagos	- Mangrove - Water - Old lava - Recent lava