Trinational MapBiomas Pampa

Collection 5

Version 1

2026

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1 INTRODUCTION

1.1 Scope and content of the document

The objective of this document is to describe the theoretical basis, justification and methods applied to produce annual maps of land use and land cover (LULC) in the South American Pampa biome of Argentina, Brazil and Uruguay from 1985 to 2024 (Collection 5). The document indicates where detailed information about the satellite image processing, the feature inputs and the process, step by step, applied to obtain the annual classifications area are available.

Collection 5 updates Collection 4 by adding the year 2024, but with classification adjustments for all other years in the series. Furthermore, some data gaps detected along the borders between the three countries were corrected. The legend also underwent a minor adjustment: Class 36 Perennial crop, mapped only in Argentina in Collection 4, has now been incorporated together with annual crop into the current Class 18 - Annual and perennial crop. Consequently, Class 19 - Annual crop, used in Collection 4, also ceases to exist, now being integrated into Class 18.

1.2 Region of Interest

Trinational Pampa MapBiomas initiative was created to produce LULC annual maps for the Pampa biome corresponding to Argentina, Brazil and Uruguay territories. Other phytogeographic regions closed or interspersed with Pampa were partially added to allow a better regional delimitation. Thus, in Argentina, a neighboring area of *Espinal* phytogeographic province and Paranaense phytogeographic province were also included (**Figure 1**).

The total mapped area was 109.21 million hectares (Mha), being 83.81 Mha in the Pampa (77%), 23.15 Mha in the Espinal (21%) and 2.25 Mha in the Paraná river delta (2%).

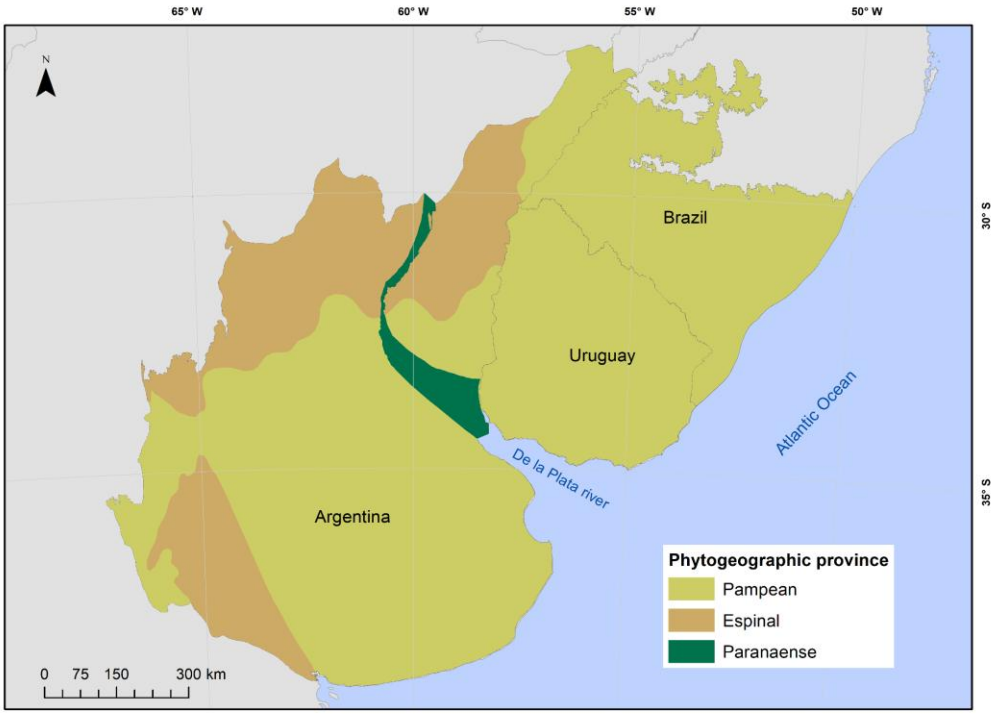

Figure 1. Region of interest mapped in the Trinational MapBiomas Pampa initiative (collection 5), including the typical areas of the Pampa, Espinal, and Parana river Delta.

1.3 Pampean region

The Pampa is mainly renowned for its vegetation, composed primarily of grasses and herbs, and for providing habitat for a diverse and specific biota typical of open ecosystems. It is part of the largest temperate grassland region in South America, covering the great plain of central-eastern Argentina, Uruguay and the south of Brazil.

The region's climate ranges from subtropical to temperate, characterized by marked seasonal temperature variations (cold winters and consistently warm summers) and the absence of a dry season (rainfall occurs throughout the year).

Livestock farming was the region's defining economic activity during the early centuries of European colonization—driven by the abundant natural forage—and exerted a strong influence on local customs and culture. However, over the last 200 years large tracts of native grasslands have been mainly replaced by sown pastures, crops, and tree plantations, placing these grasslands among the most altered ecoregions of the world (Baeza et al., 2022).

2 METHODS

The annual maps of Collection 5.0 result from the aggregation of maps from MapBiomas Pampa Argentina Collection 5 (integrating MapBiomas Argentina Collection 2), MapBiomas Brazil (Collection 10.1), and MapBiomas Uruguay (Collection 3), with adjustments for a common legend comprising nine classes, and with a transnational territorial boundary using the limits of the Pampa biome. The collection numbers for each country represent varying degrees of annual mapping updates and are linked to the year each country began publishing annually updated map collections. Although the collection numbers differ across the three countries, they all cover the same time period (1985–2024).

Methodological details regarding the classification and post-classification stages for each country are available in the corresponding ATBDs:

- ATBD MapBiomas Pampa Argentina Collection 5 (Argentina Collection 2)

http://argentina.mapbiomas.org/wp-content/uploads/sites/12/2026/02/ATBD_Collection_5_PampaArg.pdf

- ATBD Brazil (Collection 10.1)

https://drive.google.com/file/d/1iR_OJsUJFnFcJXQOYBXcefak2fapAKC-view?usp=drive_link

- ATBD Uruguay (Collection 3)

https://uruguay.mapbiomas.org/wp-content/uploads/sites/6/2025/11/ATBD_MapBiomas-Uruguay_Collection-3.pdf

2.1 Merged Map and Common legend

Each annual land cover and land use map from Collection 5 was obtained by clipping the individual country or regional maps to the areas corresponding to the boundaries of the Pampas region within each of the three countries, followed by reclassifying each country's detailed legend into a common legend with fewer classes.

Table 1 presents the map legends for each of the three countries and indicates how each class was retained or reclassified for the common nine-class legend of the Trinational Pampa annual maps.

The limitations inherent in the map harmonization process for the three countries can be considered minor. This is because the mapping activities carried out in each country share similar methodological characteristics—such as class definitions, training sample collection, remote sensing variables used, processing methods, and the application of post-classification filters—as can be observed in the corresponding ATBDs.

Table 1. Reclassification scheme for the original land cover and land use classes used in each country's map to produce the map of the Pampean region - Collection 5.

Pampa Trinational	Argentina	Brazil	Uruguay
1. Natural Woody vegetation			
Forest formation (3)	Closed forest (3) Flooded forest (6) Closed shrublands (66)	Forest formation (3) Wooded sandbank vegetation (49)	Forest formation (3)
Savanna Formation (4)	Open forest (4) Open shrublands (77)		
2. Natural herbaceous and shrub vegetation			
Wetland (11)	Wetland (11)	Wetland (11)	Wetland (11)
Grassland (12)	Grassland (12)	Grassland (12) Herbaceous sandbank vegetation (49)	Grassland (12)
3. Farming			
Annual and perennial crop (18)	Temporary crop (19)	Soybean (39) Rice (40) Other Temporary Crops (41)	Agriculture (19)
	Perennial crop (36)	Mosaic of uses (21)	
Pasture (15)	Pasture (15)	Pasture (15)	Pasture (15)
Forest Plantation (9)	Forest Plantation (9)	Forest Plantation (9)	Pinus plantation (79) Eucalyptus plantation (80) Other forestry uses (83)
4. Non-vegetated area			
Non- vegetated area (22)	Non vegetated area (22)	Urban Areas (24) Others non vegetated area (25) Rocky outcrop (29) Mining (30)	Non- vegetated area (22)

Pampa Trinational	Argentina	Brazil	Uruguay
5. Water body			
River, lake or ocean (33)	River, lake or ocean (33)	River, lake or ocean (33)	River, lake or ocean (33)

2.2 Pampa Legend

The classification for the Trinational Pampa MapBiomas initiative using Landsat mosaics included nine land use and land cover (LULC) classes (**Table 2**): Forest formation (3), Savanna formation (4), Wetland (11), Grassland (12), Pasture (15), Silviculture (9), Temporary and perennial crop (18), Non vegetated area (22) and River, lake or ocean (33). A full description of the legend is described in the document Legend Description available in the website (https://pampa.mapbiomas.org).

Table 2. Land cover and land use classes considered for the Pampean region - Collection 5.

Class	ID	Color
1.1 Forest formation	3	
1.2 Savanna formation	4	
2.1 Wetland	11	
2.2 Grassland	12	
3.1 Pasture	15	
3.2 Temporary and perennial crop	18	
3.3 Forest plantation	9	
4. Non vegetated area	22	
5. River, lake or ocean	33	

2.3 Special cases

The Brazil 10.1 collection does not include the "Pasture" class for the Brazilian portion of the Pampa region. To address this data absence, a specific classification for this class was conducted based on perennial pasture samples collected in the field, during 2025 and 2026, and the mapping results were superimposed on the original maps. This new classification replaces the previous one presented in Collection 4—which was based exceptionally on samples from Uruguay due to a lack of perennial pasture samples from southern Brazil, and the results of which were considered unsatisfactory. Methodological details regarding this classification are presented in the appendix.

3 VALIDATION STRATEGIES

Validation was performed for the classifications of the years 1986, 1991, 1996, 2001, 2006, 2012, 2018 and 2022 following the good practices recommendations proposed by Olofsson et al. (2014) for area and error estimation. A total of 2,330 samples were defined as necessary for the analysis. The number of samples for each class was proportional to the area of each class obtained from Collection 1 for the year 2010. Independent samples were raffled and class classified by visual interpretation of Landsat images, very high resolution images from Google Earth and time series of vegetation indices. Two interpreters evaluated each of the sample points generated from the stratified random design. In those sample points where discordance in class classification was detected among interpreters, a third interpreter defined the final class assignment. When a final class could not be defined by the three interpreters (e.g. three different class assignments), a final class was agreed by a team of interpreters. More details of the validation methodology are described in Baeza et al. (2022).

The average overall accuracy for the eight years evaluated was 79.84%. The average allocation disagreement was 12.89%, and the average quantity disagreement was 7.3%.

Further details on the results of the validation process for Collection 5 and a comparison with previous collections can be found at:

https://datastudio.google.com/reporting/d12af258-2608-4d48-8bee-5806c93d6d49/page/p5cJF?s=q2gCWwC0CcE

4 REFERENCES

Baeza, S., Vélez-Martin, E., De Abelleyra, D., Banchero, S., Gallego, F., Schirmbeck, J.& Hasenack, H. (2022). Two decades of land cover mapping in the Río de la Plata grassland region: The MapBiomas Pampa initiative. Remote Sensing Applications: Society and Environment, 28, 100834.

Olofsson, P., Foody, G. M., Herold, M., Stehman, S. V., Woodcock, C. E., & Wulder, M. A. (2014). Good practices for estimating area and assessing accuracy of land change. Remote sensing of Environment, 148, 42-57.

5 APPENDIX

The classification of Class 15 – Pasture in Brazil was carried out separately and exclusively to compose Collection 5 of the Trinational Pampa, ensuring that this class was covered for all the three countries that make up the Pampa. This class is not present in the Collection 10.1 maps for the Brazilian region of the Pampa, which was used to generate this collection. The result of this classification was overlaid with the annual maps of Brazil's Collection 10.1 prior to the reclassification and aggregation process of the maps from the three countries. The methodology used is detailed below:

5.1 Samples

Throughout 2025 and 2026, field expeditions were conducted exclusively to collect samples of perennial planted pastures only. Annual pastures are mostly winter pastures and are located in areas intended for planting summer crops, which are prioritized in the mapping. Therefore, these annual pastures are not the focus of the mapping.

From the field expeditions, a file was generated with delimited polygons within perennial pastures. Given the impossibility of obtaining samples for each year of the time series (1985-2024), an alternative strategy was adopted. 2,100 random points were generated within the polygons of the perennial pasture plots. These geometries were used to extract the values of the variables used in the classification for the years 2022, 2023, and 2024, assuming that in these years the pastures observed in the field were already established. This set of 6,300 observations was used as an interannual sample pool for use in the classifications of each year of the series. Samples for the agriculture and grassland classes were also generated (2,100 samples for each class) based on the stable areas of the Collection 10.1 mapping.

5.2 Mapping mask

Overlaying the perennial pasture sample polygons with the Collection 10.1 map for the year 2024 demonstrated that these areas are being mapped as agricultural areas, as mosaic of uses, or even grassland vegetation. Therefore, for each year of the 1985-2024 series, a mask was generated containing only a fraction of the map corresponding to the pixels of the agriculture, mosaic of uses, and grassland vegetation classes. This annual mask was generated for every year in the 1985-2024 series. Consequently, all pixels within this mask were classified using this methodology into three classes: pasture, agriculture, and grassland.

5.3 Feature space

Satellite images from Landsat 5 (1985-2001,2003-2010), 7 (2002, 2011-2012), 8 (2013-2024) were used. To harmonize measurements across sensors, the Landsat 5 and 7 images were harmonized to Landsat 8, following the approach proposed by Roy et al. (2016).

From the harmonized image collection, quarterly and annual composites were generated:

A) Quarterly composites:

● Median of reflective bands (B, G, R, NIR, SWIR1, SWIR2).

● Median of various spectral indices (NDVI, GNDVI, NDMI, NBR).

B) Annual composites (corresponding to an agricultural year: July–June):

● Median, maximum, minimum, standard deviation, and day of the year for reflective bands (B, G, R, NIR, SWIR1, SWIR2).

● Median, maximum, minimum, standard deviation, and day of the year for spectral indices (NDVI, GNDVI, NDMI, NBR).

A total of 81 bands of information were considered for the classification process.

5.4 Classification

A supervised approach using the Random Forest classifier was employed for the classification within the mapping mask containing the three mapped classes: pasture, agriculture, and grassland. However, only the pasture classification was used as the final product to be overlaid onto the annual maps of Collection 10.1, thus preserving the original agriculture and grassland classifications. For each year, the sample proportions among the three classes were manually adjusted to optimize the classification results.

5.5 Boundary adjustment

Pixel-by-pixel classification results in patches that spatially may have irregular shapes incompatible with the regular shapes generally observed in areas cultivated with perennial pastures, which indicates that part of the observed results correspond to classification errors, whether due to commission or omission. To circumvent this, the boundaries of the patches mapped in the pasture class were adjusted based on a support layer.

The support layer was annually defined by generating segments from the inspection of adjacent pixels using a spatial clustering algorithm called SNIC (Simple Non-Iterative Clustering). Based on the NDVI of the annual Landsat mosaics used in the classification, annual maps of patches expressing a homogeneous behavior of this variable in space were generated for each year. The average size of the patches was adjusted with the seedSize

variable, adopting the value of 10, through visual comparison with agricultural plots visible in test areas of the annual mosaics.

Finally, the annual classification maps of the pasture class and the annual maps of homogeneous patches were compared. For each patch, the percentage of coverage by the pasture class was calculated. In cases where the degree of coverage of the patch was less than 70%, the pasture pixels were disregarded in the mapping. In cases where the degree of coverage of the patch was equal to or greater than 70%, the pixels were kept and complemented by the remaining pixels of the same patch that had not originally been classified as pasture.