Supplementary Material

Projections for Mexico's tropical rainforests considering ecological niche and climate change

SM1: Structural valuation indices used to complement the selection of the most ecologically important species in the tropical rainforest

To select the most ecologically important species from the *Selva alta perennifolia* (SAP) or Tropical rainforest (TR), the Importance Value Index (IVI) and the Forest Value Index (FVI) were calculated at the plant community level. For which data from the National Forest and Soil Inventory (NFSI) edition 2004 to 2007 (CONAFOR & UACh, 2009) spatially delimited with a Geographic Information System (GIS) were used; that according to the area occupied by the plant community in climax state of the INEGI's 2005 annual report on Land Use and Vegetation (INEGI, 2005), which was used as a basis to collect such original data. Those data are shown in the Figure 1. Only woodland data (individuals with a normal diameter >7.5 cm) were analyzed. These data are made up of the following and other records: identity of the specimen, measurements of its most common dasometric attributes (eg normal diameter, height, canopy diameter) and characteristics of the soil and vegetation. All specimen data is referred to the X and Y coordinates of the sampling site. The sampling design is conglomerates (Primary Sampling Unit, PSU) with 4 sampling sites (Secondary Sampling Unit, SSU) each one with an area of 400 m^2, for more details see CONAFOR (2000).

The calculations were made under the assumption that data absences at the SSU level indicated absence of trees in the field.

The IVI was developed by Curtis & Mclntosh (1951), it is a synthetic index that is used to rank the dominance of the species in mixed or incoetaneous forests; it is the average of the density, dominance and frequency (all relative) of the species (equations 2 to 4).

$$\textbf{Relative component} = \frac{\text{Absolute component of the i-th species}}{\text{Absolute component of all species}} \tag{1}$$

Where the component can be density, dominance or frequency.

$$\textbf{Absolute density} = \frac{\text{number of individuals of the i-th species in the PSU}}{\text{Species sampling area}} \tag{2}$$

Where PSU: Primary Sampling Unit, Species sampling area: total area of the PSUs where the species occurs. PSU sampling area = 0.16 ha.

$$\textbf{Absolute dominance} = \frac{\text{Basal area of the i-th species}}{\text{Species sampling area}} \tag{3}$$

Where Basal area $= \frac{\pi}{4}$Normal diameter^2.

$$\textbf{Absolute frequency} = \frac{\text{Number of SSUs where the i-th species occurs}}{\text{Total of SSUs in the PSUs where the species occurs}} \tag{4}$$

Where SSU: Secondary Sampling Unit, SSU number for each PSU = 4.

The FVI evaluates the two-dimensional structure (vertical and horizontal) of the species (Corella et al., 2002); it is the mean of relative normal diameter (lower stratum in the horizontal plane), relative coverage (upper stratum in the horizontal plane) and relative height (lower and upper stratum in the vertical plane). Equations 5 to 7 show those formulas.

Equation 1 was used to obtain the **relative component**. In this case component refers to normal diameter, coverage or height .

$$\textbf{Absolute normal diameter} = \frac{\text{Normal diameter of the i-th species}}{\text{Species sampling area}} \tag{5}$$

$$\textbf{Absolute coverage} = \frac{\text{Canopy area of the i-th species}}{\text{Species sampling area}} \tag{6}$$

Where Canopy area $= \frac{\pi}{4}$Canopy diameter^2.

$$\textbf{Absolute height} = \frac{\text{Height of the i-th species}}{\text{Species sampling area}} \tag{7}$$

Finally, 26 species with the highest percentage values of each index were taken. For the above species with reduced number of individuals (<6) were omitted; likewise, the scientific names of said species were updated based on current taxonomic information, or failing that, basinonyms data were regrouped. The processing results are shown in Table 1 and Figure 2. Additionally, the information on the components of both indices for the species selected is shown in Figure 3, it has been included in order to highlight the components with the highest contribution.

Table 1: Summary information used for obtan the structural indices

Index	**Type**	**Descrption**	**Total**	**26 species considered**
General	PSU	Primary Sampling Unit	315	ND
	SSU	Secondary Sampling Unit with data	1 075	ND
	S	Species number	536	26
IVI	Dominance	Absolute (Sum of basal area)	1 279.8 m^2	840.8 m^2
		Relative	100%	65.9%
	Density	Absolute (number of individuals)	14 893	6 831
		Relative	100%	45.9%
	Frecuency	Absolute (number of SSU)	6 939 SSU	3 261 SSU
		Relative	100%	47.0%
	IVI	Importance Value Index	100%	**53.1%**
FVI	n	Number of individuals	14 893	6 905
	Normal diameter	Absolute (sum of normal diameter)	3 782.9 m	2 068.1 m
		Relative	100%	54.7%
	Coverage	Absolute (sum of canopy areas)	284 779.7 m^2	145 592.5 m^2
		Relative	100%	51.1%
	Height	Absolute (sum of heights)	171 312.33 m	82 675.87 m
		Relative	100%	48.3%
	FVI	Forest Value Index	100%	**51.4%**

ND: No data.

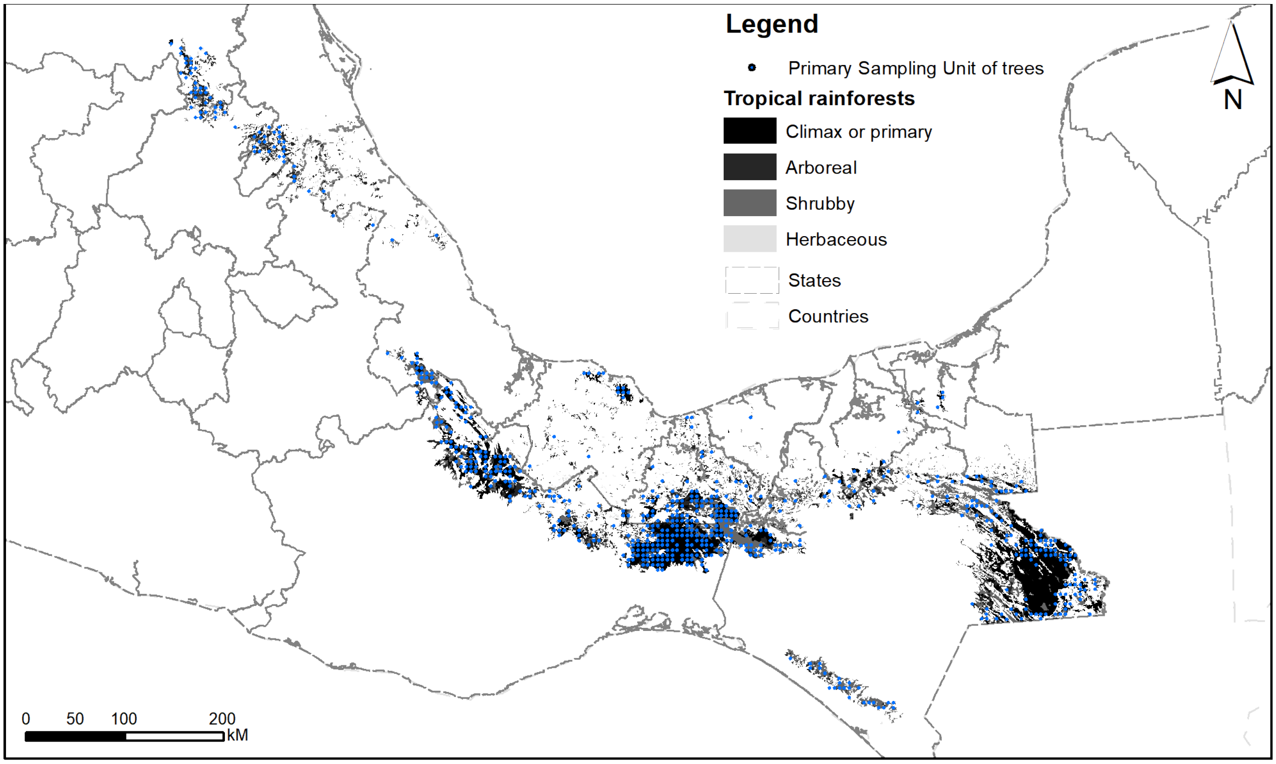

Figure 1: Primary Sampling Units (PSUs) used for calulating the structural importance of Tropical rainforests species in Mexico

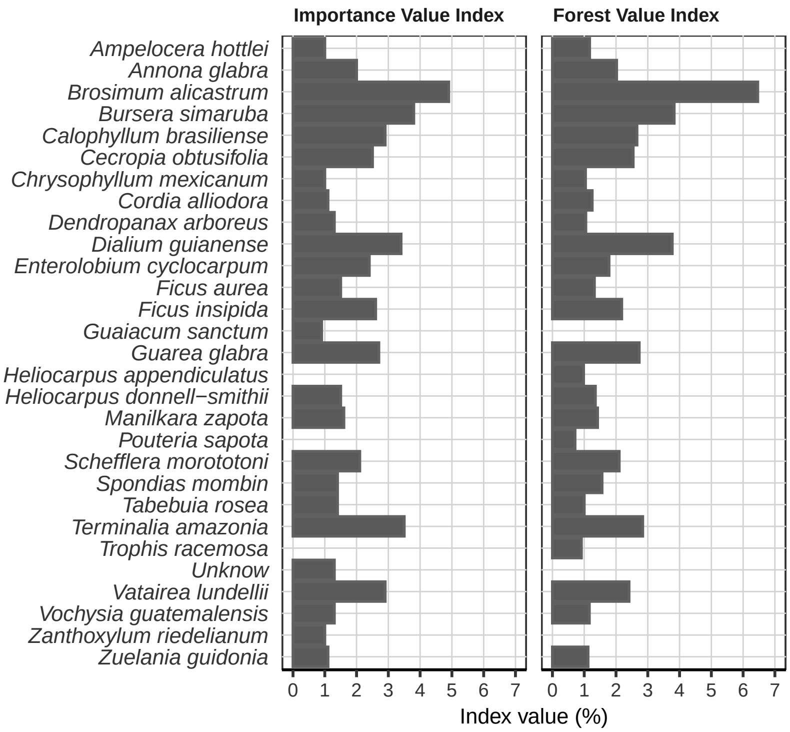

Figure 2: Tropical rainforest species with high structural valuation indices calculated from official data. The magnitude between both indices in these species is about proportional. The species with higher values are consistent in both indices while the species with the lowest values are variable, some of these unknown. The truth is that the species with the highest values are *Brosimum alicastrum, Bursera simaruba, D. guianense, T. amazonia, G. glabra and V. lundellii.*

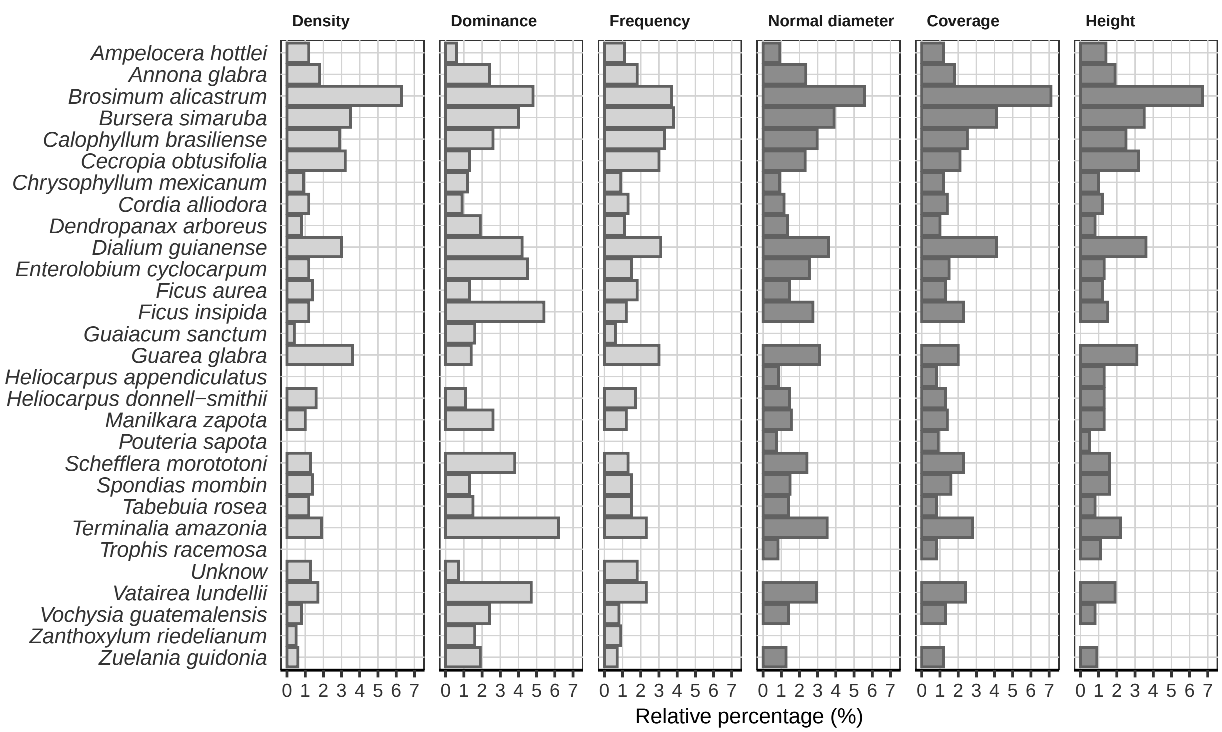

Figure 3: Relative components of structural valuation indices of tropical rainforest species with higher value. The light gray color indicates the components of the Importance Value Index, the other color indicates the components of the Forest Value Index.

References

CONAFOR [Comisión Nacional Forestal] & UACh [Universidad Autónoma Chapingo]. (2009). Inventario Nacional Forestal y de Suelos 2004-2009. México.

CONAFOR [Comisión Nacional Forestal]. (2009). Metodología del Inventario Nacional Forestal y de Suelos 2004 – 2009. Retrieved from https://www.conafor.gob.mx/biblioteca/Inventario-Nacional-Forestal-y-de-Suelos.pdf.

SM2: Supplements related to geographic records

GBIF's geographic records references

A part of geographic records used in the work were downloaded from Global Information Facility (GBIF), this references are listed in the Table 2. The other data soruce was the National Forest and Soil Inventory (NFSI) of Mexico (CONAFOR & UACh, 2009).

Table 2: References of the GBIF's geographic records

Species	References
Annona glabra L.	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.f1stn1
Aspidosperma megalocarpon Müll. Arg.	GBIF.org (04 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.bey5ex
Brosimum alicastrum Sw.	GBIF.org (08 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.kfx4ut
Bursera simaruba (L.) Sarg.	GBIF.org (04 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.oz4ynm
Calophyllum brasiliense Cambess.	GBIF.org (04 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.3ntst0
Cecropia obtusifolia Bertol.	GBIF.org (25 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.w11hj8
Dialium guianense (Aubl.) Sandwith	GBIF.org (08 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.5zzeoe
Enterolobium cyclocarpum (Jacq.) Griseb.	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.9p52qr
Guarea glabra Vahl	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.uiarge
Guatteria anomala R.E. Fr.	GBIF.org (04 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.28bmi7
Heliocarpus donnell-smithii Rose ex Donn.Sm.	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.omurum
Licania platypus (Hemsl.) Fritsch	GBIF.org (06 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.uryxkd
Magnolia mexicana DC.	GBIF.org (11 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.j2p0vm
Manilkara zapota (L.) P. Royen	GBIF.org (08 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.ebpr7v
Pouteria campechiana (Kunth) Baehni	GBIF.org (09 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.v6fmwr
Spondias mombin Jacq.	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.nlibyr
Swietenia macrophylla King	GBIF.org (08 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.i75pxx
Tabebuia rosea (Bertol.) Bertero ex A.DC.	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.2vzwhd
Terminalia amazonia (J.F.Gmel.) Excell	GBIF.org (28 September 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.2vzwhd
Vatairea lundellii (Standl.) Killip ex Record	GBIF.org (08 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.3mqopx
Vochysia guatemalensis Donn. Sm.	GBIF.org (09 August 2019). GBIF Occurrence Download. https://doi.org/10.15468/dl.epychv

Geographic records details

In a Geographic Information System (GIS), the geographic records (GR) were cleaned or refined by removing data with strange locations as indicated by the literature. Then, these GR were randomly thinned to reduce sampling bias with the use of a grid (thinning grid). These data were divided or splitted into three groups for training, testing and final evaluation of the models with the ENMeval package (Muscarella et al. 2014) from RStudio (ver. 3.6.3) (R Core Team 2019). After cleaning, thinning and split, the GR shown on the Table 3 were obtained. The data percentage destined to each process phase is also detailed.

Only *Bursera simaruba*, *Cecropia obtusifolia*, *Enterolobium cyclocarpum*, *Heliocarpus donnell-smithii*, *Manilkara zapota*, *Spondias mombin* and *Tabebuia rosea* were thinned with a 10 km grid, in the other species a 5 km grid was used.

Table 3: Geographic records used in this study

Species	**Geographic records**	**Train (%)**	**Test (%)**	**Ind (%)**
Annona glabra	223	68	22	10
Aspidosperma megalocarpon	340	59	30	11
Brosimum alicastrum	1 546	58	31	11
Bursera simaruba	2 607	72	18	10
Calophyllum brasiliense	389	57	31	11
Cecropia obtusifolia	693	68	22	10
Dialium guianense	249	60	29	11
Enterolobium cyclocarpum	597	69	21	10
Guarea glabra	554	69	21	10
Guatteria anomala	85	58	32	11
Heliocarpus donnell-smithii	634	67	23	10
Licania platypus	127	69	20	10
Magnolia mexicana	130	61	28	12
Manilkara zapota	1 007	68	22	10
Pouteria campechiana	1 074	60	30	10
Schefflera morototoni	153	69	21	10
Spondias mombin	1 002	69	21	10
Swietenia macrophylla	444	59	32	10
Tabebuia rosea	616	68	22	10
Terminalia amazonia	300	58	31	11
Vatairea lundellii	201	69	21	10
Vochysia guatemalensis	235	57	31	11

"Ind" refers to the data that was used in the final evaluation of the best models.
This data were included in the Figure 4.

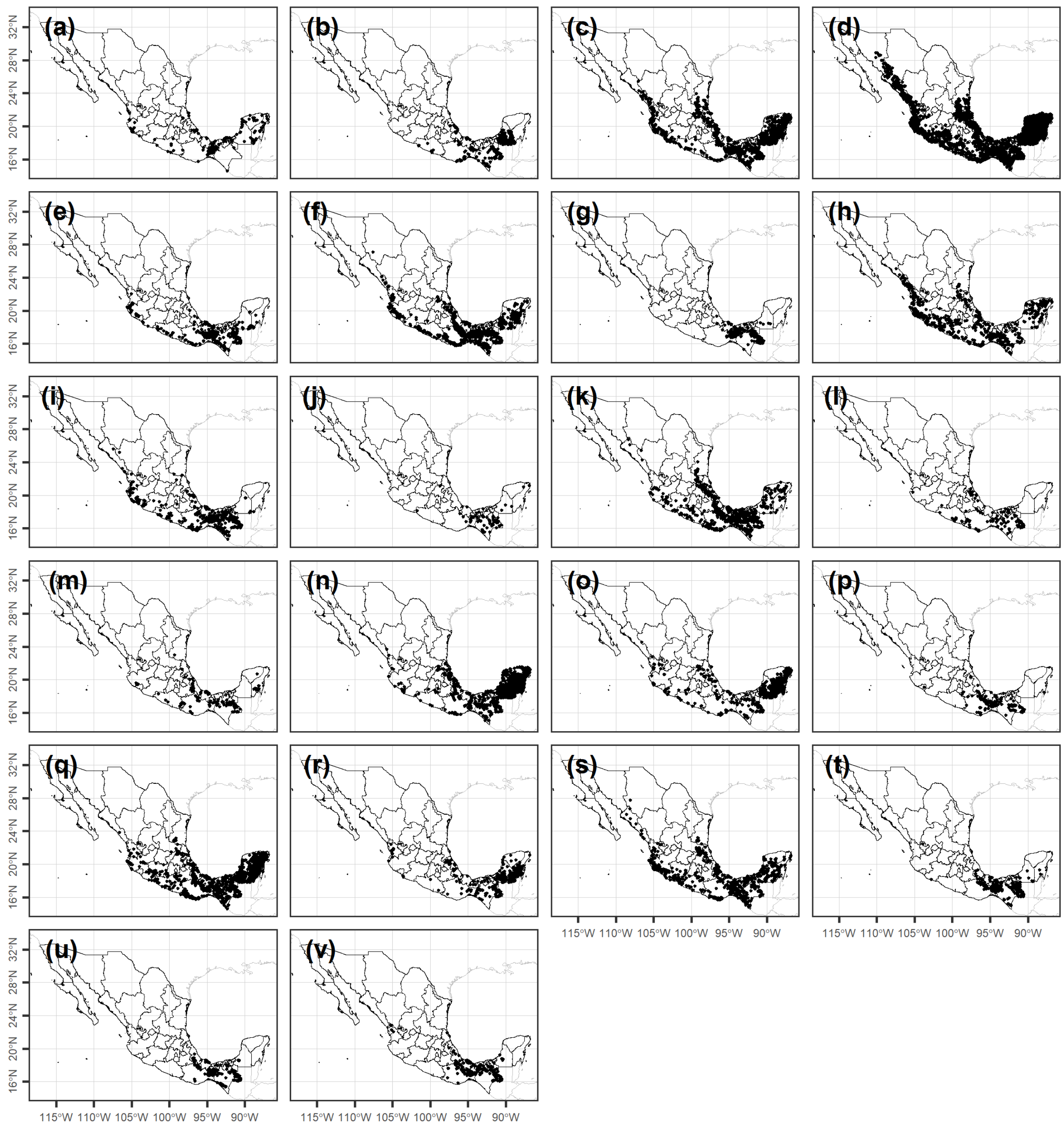

Figure 4: Geographic records obtained after cleaning and thinning. (a) *Annona glabra*, (b) *Aspidosperma megalocarpon*, (c) *Brosimum alicastrum*, (d) *Bursera simaruba*, (e) *Calophyllum brasiliense*, (f) *Cecropia obtusifolia*, (g) *Dialium guianense*, (h) *Enterolobium cyclocarpum*, (i) *Guarea glabra*, (j) *Guatteria anomala*, (k) *Heliocarpus donnell-smithii*, (l) *Licania platypus*, (m) *Magnolia mexicana*, (n) *Manilkara zapota*, (o) *Pouteria campechiana*, (p) *Schefflera morototoni*, (q) *Spondias mombin*, (r) *Swietenia macrophylla*, (s) *Tabebuia rosea*, (t) *Terminalia amazonia*, (u) *Vatairea lundellii* and (v) *Vochysia guatemalensis*.

SM3: Defined M areas and preselected groups of bioclimatic variables

Bioclimatic variables

The bioclimatic variables used were those suggested by O'Donnell and Ignizio (2012), which are combinations of temperature and precipitation throughout the year (Table 4). Both the bioclimatic variables of the current scenario and those of the climate change scenarios were processed with the methodology of O'Donnell Ignizio (2012) and Gómez et al. (2008). Variables corresponding to the current scenario were downloaded from WorldClim (2015). The applied climate change scenarios considered: the general circulation models (GCM) HADGEM2_ES (England) and GFDL_CM3 (United States), which were obtained and processed on the UNITAMOS platform (Fernández Eguiarte, Zavala Hidalgo, Romero Centeno 2009); a Receptive Concentration Patway (RPC) at 8.5 Wm^{-2} (energy released to the atmospheric system); its projection to the far horizon (2075-2099). In this way, the climate change scenarios HADGEM2_ES RCP 8.5 and GFDL_CM3 RCP 8.5 to the far horizon (2075-2099) were obtained.

The methodology of Gómez et al. (2008) was used to obtain a higher level of detail in the environmental layers. This is based on climatic influence areas, that is, areas with homogeneous temperature and precipitation. This methodology is useful when meteorological information is scarce. Thus, bioclimatic variables with a national coverage and a pixel size of 500 m were generated.

M areas

In the definition of the accessible area (M area), terrestrial ecoregions of Mexico were taken as a reference (INEGI, CONABIO, & INE, 2008) e). Then, bioclimatic variables were delimited to the M area. The six defined M areas are briefly mentioned in the Table 5 and are shown in the Figure 5.

Preselected group of bioclimatic variables

Prior at the application to Maxent software, bioclimatic variables were preselected as a recommendation from Elith et al. (2011). The above through the analysis of Pearson's correlation coefficients of the 19 variables of the current scenario, for which those variables that were highly correlated ($r \geq 0.8$) were omitted as long as they were reported in the literature as of minor importance for the species distribution.

Table 4: Bioclimatic variables analyzed in this study

Name	Meaning
BIO1	Annual Mean Temperature
BIO2	Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3	Isothermality (BIO2/BIO7) (100)
BIO4	Temperature Seasonality (standard deviation 100)
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO7	Temperature Annual Range (BIO5-BIO6)
BIO8	Mean Temperature of Wettest Quarter
BIO9	Mean Temperature of Driest Quarter
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO12	Annual Precipitation
BIO13	Precipitation of Wettest Month
BIO14	Precipitation of Driest Month
BIO15	Precipitation Seasonality (Coefficient of Variation)
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter

Soruce: WorldClim (2015).

Table 5: M areas used in this study

M area	Area (km^2)	Brief and aproximated description
1	253 134.99	Limited to Selvas Cálido-Húmedas
2	391 169.29	Limited to Selvas Cálido-Húmedas and deciduos tropical forest
3	771 421.09	Limited to Selvas Cálido-Húmedas, Selvas Cálido-Secas and others
4	794 412.74	Limited to Selvas Cálido-Húmedas, Selvas Cálido-Secas and others
5	577 230.14	Limited to Selvas Cálido-Húmedas and Selvas Cálido-Secas
6	623 570.76	Limited to Selvas Cálido-Húmedas and Cálido-Secas

Selvas Cálido-Húmedas refers to warm and wet jungles, Selvas Cálido-Secas to weat and dry jungles. Species included in different M areas are explained below:

1. **M area 1** included *Dialium guianense* and *Vatairea lundellii*
2. **M area 2** included *Aspidosperma megalocarpon*, *Guatteria anomala* and *Terminalia amazonia*.
3. **M area 3** included *Brosimum alicastrum*, *Bursera simaruba*, *Guarea glabra* and *Vochysia guatemalensis*.
4. **M area 4** included *Cecropia obtusifolia*, *Enterolobium cyclocarpum*, *Heliocarpus donnell-smithii*, *Spondias mombin* and *Tabebuia rosea*.
5. **M area 5** included *Calophyllum brasiliense*, *Magnolia mexicana*, *Manilkara zapota*, *Pouteria campechiana* and *Swietenia macrophylla*.
6. **M area 6** included *Annona glabra*, *Licania platypus* and *Schefflera morototoni*.

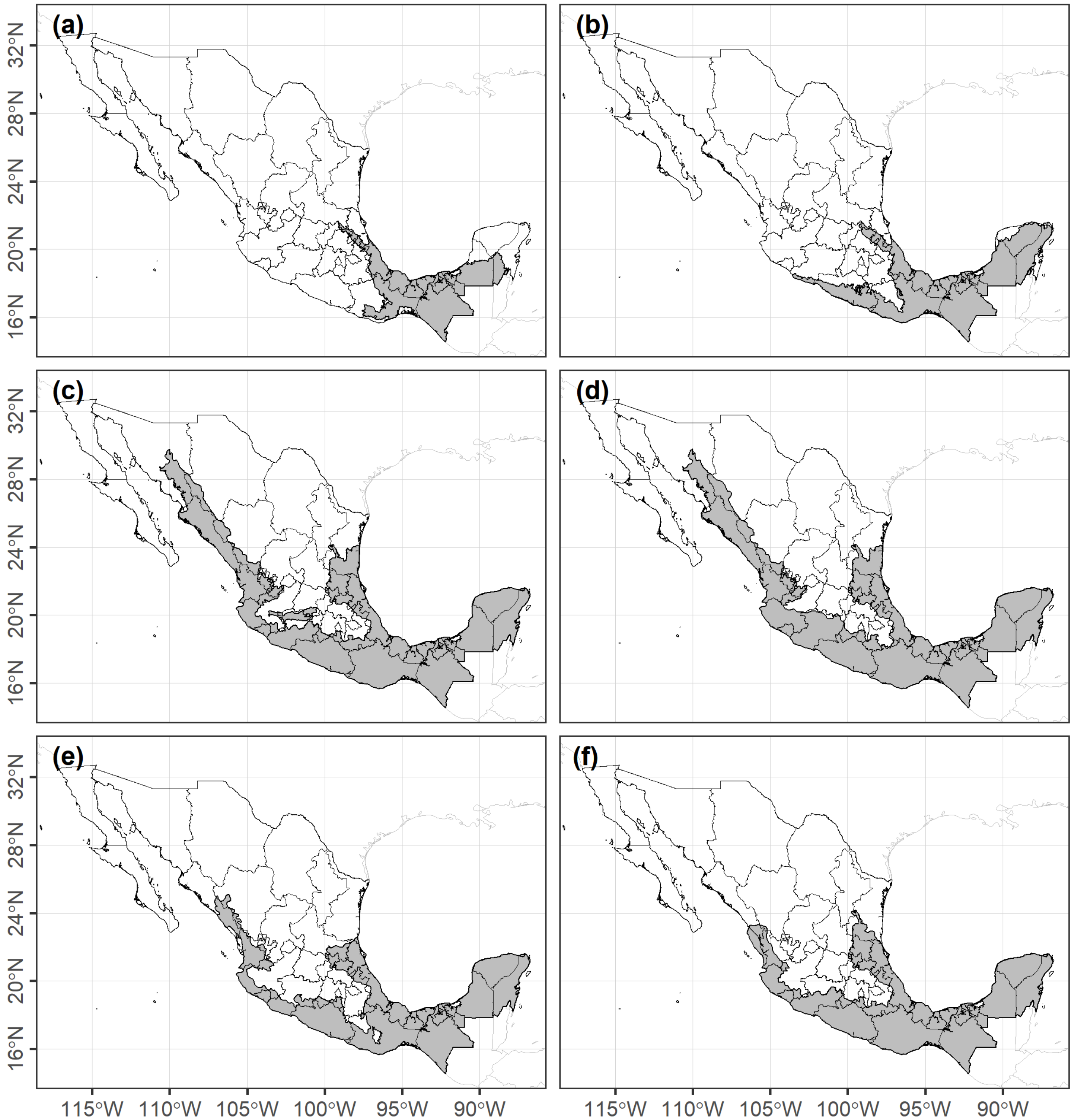

Figure 5: M areas. (a) 1, (b) 2, (c) 3, (d) 4, (f) 5 and (g) 6.

The Pearson's correlation coefficient matrix of all environmental layers to detect collinearity between them and to select the most representative bioclimatic variables of each area M were included in the Tables 6 to 11.

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Table 6: Pearson's correlation coefficient matrix of M area number 1

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.09	1																	
3	-0.27	0.68	1																
4	0.26	-0.47	-0.84	1															
5	0.96	0.04	-0.3	0.31	1														
6	0.92	-0.33	-0.27	0.22	0.86	1													
7	0.14	0.68	-0.08	0.2	0.35	-0.18	1												
8	0.99	-0.13	-0.36	0.38	0.96	0.9	0.18	1											
9	0.96	-0.11	-0.22	0.16	0.91	0.92	0.05	0.93	1										
10	0.99	-0.16	-0.4	0.41	0.95	0.91	0.17	1	0.93	1									
11	0.97	0.04	-0.06	0	0.91	0.9	0.1	0.92	0.95	0.91	1								
12	-0.08	-0.53	-0.3	0.13	-0.16	0.06	-0.42	-0.09	0.01	-0.05	-0.12	1							
13	-0.11	-0.49	-0.24	0.05	-0.19	0.03	-0.43	-0.13	-0.03	-0.09	-0.13	0.98	1						
14	-0.01	-0.54	-0.48	0.43	-0.06	0.08	-0.25	0.03	0.08	0.07	-0.12	0.87	0.79	1					
15	-0.18	0.36	0.53	-0.64	-0.18	-0.18	-0.03	-0.26	-0.27	-0.27	-0.01	-0.41	-0.28	-0.72	1				
16	-0.11	-0.52	-0.25	0.04	-0.2	0.04	-0.45	-0.13	-0.02	-0.1	-0.13	0.98	0.99	0.78	-0.28	1			
17	-0.01	-0.56	-0.48	0.4	-0.06	0.09	-0.29	0.03	0.08	0.06	-0.12	0.89	0.8	0.99	-0.7	0.8	1		
18	-0.11	-0.33	-0.19	0.13	-0.17	-0.05	-0.24	-0.1	-0.1	-0.08	-0.15	0.85	0.86	0.71	-0.26	0.84	0.71	1	
19	0	-0.56	-0.45	0.34	-0.06	0.11	-0.32	0.03	0.11	0.06	-0.1	0.89	0.81	0.97	-0.68	0.81	0.98	0.66	1

Table 7: Pearson's correlation coefficient matrix of M area number 2

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.06	1																	
3	-0.12	0.62	1																
4	0.18	-0.41	-0.82	1															
5	0.95	0.08	-0.18	0.24	1														
6	0.93	-0.28	-0.09	0.09	0.86	1													
7	0.04	0.66	-0.17	0.27	0.28	-0.26	1												
8	0.99	-0.09	-0.21	0.3	0.95	0.9	0.08	1											
9	0.98	-0.07	-0.08	0.11	0.92	0.93	-0.01	0.95	1										
10	0.99	-0.13	-0.26	0.34	0.95	0.91	0.09	1	0.95	1									
11	0.97	0.05	0.08	-0.07	0.9	0.92	-0.02	0.93	0.96	0.92	1								
12	-0.1	-0.56	-0.4	0.2	-0.16	0.01	-0.32	-0.09	-0.04	-0.06	-0.15	1							
13	-0.14	-0.52	-0.31	0.09	-0.21	-0.02	-0.36	-0.15	-0.1	-0.12	-0.17	0.98	1						
14	0.03	-0.53	-0.58	0.54	-0.01	0.05	-0.11	0.08	0.07	0.12	-0.11	0.84	0.73	1					
15	-0.24	0.26	0.56	-0.72	-0.26	-0.15	-0.2	-0.33	-0.28	-0.34	-0.06	-0.32	-0.16	-0.71	1				
16	-0.15	-0.54	-0.32	0.09	-0.22	-0.02	-0.38	-0.16	-0.11	-0.13	-0.18	0.98	0.99	0.72	-0.15	1			
17	0.02	-0.55	-0.58	0.52	-0.02	0.06	-0.15	0.07	0.07	0.11	-0.11	0.86	0.75	0.99	-0.68	0.75	1		
18	-0.04	-0.31	-0.17	0.14	-0.12	0	-0.21	-0.03	-0.06	-0.02	-0.08	0.79	0.81	0.64	-0.19	0.79	0.64	1	
19	0.03	-0.56	-0.55	0.47	-0.01	0.09	-0.19	0.07	0.1	0.11	-0.09	0.86	0.75	0.96	-0.66	0.75	0.98	0.59	1

Table 8: Pearson's correlation coefficient matrix of M area number 3

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.32	1																	
3	0.02	0.1	1																
4	-0.15	0.36	-0.73	1															
5	0.81	0.16	-0.21	0.26	1														
6	0.88	-0.62	0.22	-0.45	0.53	1													
7	-0.29	0.85	-0.44	0.74	0.26	-0.67	1												
8	0.92	-0.15	-0.23	0.24	0.89	0.67	0.01	1											
9	0.96	-0.34	0.17	-0.32	0.72	0.91	-0.4	0.81	1										
10	0.93	-0.15	-0.24	0.23	0.9	0.69	0.01	0.99	0.83	1									
11	0.94	-0.39	0.29	-0.49	0.63	0.93	-0.51	0.73	0.96	0.74	1								
12	0.1	-0.59	-0.05	-0.25	-0.16	0.32	-0.51	-0.03	0.18	-0.01	0.16	1							
13	0.07	-0.58	0	-0.29	-0.2	0.31	-0.52	-0.06	0.14	-0.05	0.15	0.98	1						
14	0.21	-0.63	-0.23	-0.13	-0.04	0.37	-0.45	0.12	0.27	0.13	0.21	0.85	0.77	1					
15	-0.31	0.44	0.37	-0.15	-0.17	-0.32	0.21	-0.34	-0.33	-0.33	-0.2	-0.38	-0.26	-0.73	1				
16	0.05	-0.56	0.01	-0.3	-0.21	0.29	-0.51	-0.09	0.13	-0.08	0.14	0.98	0.99	0.75	-0.22	1			
17	0.19	-0.6	-0.25	-0.09	-0.04	0.34	-0.42	0.11	0.25	0.13	0.18	0.87	0.78	0.99	-0.71	0.77	1		
18	0.02	-0.32	-0.07	0	-0.13	0.11	-0.24	0.04	-0.01	0	0.01	0.69	0.73	0.48	-0.14	0.71	0.5	1	
19	0.14	-0.5	-0.28	0.01	-0.02	0.25	-0.31	0.11	0.2	0.12	0.1	0.86	0.76	0.93	-0.66	0.76	0.96	0.53	1

Table 9: Pearson's correlation coefficient matrix of M area number 4

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.09	1																	
3	-0.27	0.68	1																
4	0.26	-0.47	-0.84	1															
5	0.96	0.04	-0.3	0.31	1														
6	0.92	-0.33	-0.27	0.22	0.86	1													
7	0.14	0.68	-0.08	0.2	0.35	-0.18	1												
8	0.99	-0.13	-0.36	0.38	0.96	0.9	0.18	1											
9	0.96	-0.11	-0.22	0.16	0.91	0.92	0.05	0.93	1										
10	0.99	-0.16	-0.4	0.41	0.95	0.91	0.17	1	0.93	1									
11	0.97	0.04	-0.06	0	0.91	0.9	0.1	0.92	0.95	0.91	1								
12	-0.08	-0.53	-0.3	0.13	-0.16	0.06	-0.42	-0.09	0.01	-0.05	-0.12	1							
13	-0.11	-0.49	-0.24	0.05	-0.19	0.03	-0.43	-0.13	-0.03	-0.09	-0.13	0.98	1						
14	-0.01	-0.54	-0.48	0.43	-0.06	0.08	-0.25	0.03	0.08	0.07	-0.12	0.87	0.79	1					
15	-0.18	0.36	0.53	-0.64	-0.18	-0.18	-0.03	-0.26	-0.27	-0.27	-0.01	-0.41	-0.28	-0.72	1				
16	-0.11	-0.52	-0.25	0.04	-0.2	0.04	-0.45	-0.13	-0.02	-0.1	-0.13	0.98	0.99	0.78	-0.28	1			
17	-0.01	-0.56	-0.48	0.4	-0.06	0.09	-0.29	0.03	0.08	0.06	-0.12	0.89	0.8	0.99	-0.7	0.8	1		
18	-0.11	-0.33	-0.19	0.13	-0.17	-0.05	-0.24	-0.1	-0.1	-0.08	-0.15	0.85	0.86	0.71	-0.26	0.84	0.71	1	
19	0	-0.56	-0.45	0.34	-0.06	0.11	-0.32	0.03	0.11	0.06	-0.1	0.89	0.81	0.97	-0.68	0.81	0.98	0.66	1

Table 10: Pearson's correlation coefficient matrix of M area number 5

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.17	1																	
3	-0.06	0.44	1																
4	0.04	-0.15	-0.78	1															
5	0.9	0.1	-0.14	0.14	1														
6	0.9	-0.43	0.04	-0.15	0.75	1													
7	-0.15	0.76	-0.24	0.41	0.2	-0.49	1												
8	0.98	-0.18	-0.18	0.22	0.89	0.84	-0.07	1											
9	0.96	-0.17	0.05	-0.13	0.86	0.92	-0.23	0.91	1										
10	0.98	-0.18	-0.21	0.23	0.91	0.84	-0.05	0.99	0.91	1									
11	0.96	-0.11	0.16	-0.23	0.85	0.91	-0.24	0.89	0.97	0.89	1								
12	-0.01	-0.54	-0.25	-0.02	-0.15	0.15	-0.42	-0.04	0.06	-0.02	-0.02	1							
13	-0.05	-0.51	-0.19	-0.08	-0.19	0.12	-0.42	-0.08	0.01	-0.07	-0.04	0.98	1						
14	0.11	-0.59	-0.42	0.2	-0.01	0.23	-0.35	0.12	0.17	0.13	0.04	0.84	0.74	1					
15	-0.27	0.43	0.44	-0.39	-0.18	-0.27	0.16	-0.33	-0.31	-0.31	-0.14	-0.37	-0.23	-0.74	1				
16	-0.07	-0.5	-0.19	-0.09	-0.2	0.11	-0.42	-0.11	0	-0.09	-0.05	0.98	0.99	0.72	-0.19	1			
17	0.1	-0.58	-0.43	0.21	-0.02	0.21	-0.33	0.11	0.16	0.12	0.02	0.86	0.76	0.99	-0.71	0.75	1		
18	-0.03	-0.25	-0.13	0.15	-0.13	0	-0.17	0.03	-0.06	-0.01	-0.07	0.68	0.72	0.46	-0.12	0.7	0.48	1	
19	0.08	-0.53	-0.41	0.22	-0.02	0.18	-0.29	0.1	0.15	0.11	0.01	0.86	0.76	0.94	-0.66	0.76	0.97	0.51	1

Table 11: Pearson's correlation coefficient matrix of M area number 6

BIO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1	1																		
2	-0.23	1																	
3	-0.1	0.47	1																
4	0.11	-0.24	-0.8	1															
5	0.9	0.05	-0.16	0.17	1														
6	0.91	-0.45	0	-0.08	0.77	1													
7	-0.18	0.75	-0.22	0.35	0.17	-0.5	1												
8	0.98	-0.26	-0.22	0.29	0.89	0.86	-0.12	1											
9	0.96	-0.21	0.03	-0.08	0.85	0.93	-0.27	0.9	1										
10	0.98	-0.25	-0.25	0.29	0.91	0.86	-0.08	0.99	0.91	1									
11	0.96	-0.14	0.13	-0.17	0.85	0.92	-0.26	0.89	0.97	0.89	1								
12	0.03	-0.55	-0.25	0.01	-0.12	0.18	-0.44	0.02	0.1	0.02	0.02	1							
13	0	-0.52	-0.19	-0.04	-0.15	0.15	-0.44	-0.02	0.06	-0.02	0	0.98	1						
14	0.12	-0.59	-0.44	0.23	0	0.22	-0.34	0.14	0.18	0.14	0.04	0.84	0.74	1					
15	-0.26	0.47	0.46	-0.43	-0.16	-0.26	0.18	-0.33	-0.28	-0.3	-0.12	-0.39	-0.25	-0.74	1				
16	-0.02	-0.5	-0.18	-0.07	-0.16	0.14	-0.43	-0.05	0.05	-0.04	-0.01	0.98	0.99	0.72	-0.21	1			
17	0.11	-0.59	-0.44	0.24	-0.01	0.21	-0.33	0.13	0.17	0.14	0.03	0.86	0.76	0.99	-0.72	0.75	1		
18	0.06	-0.32	-0.14	0.18	-0.08	0.09	-0.25	0.12	0.02	0.07	0	0.71	0.75	0.51	-0.19	0.73	0.52	1	
19	0.11	-0.55	-0.4	0.23	-0.01	0.21	-0.33	0.13	0.18	0.13	0.03	0.87	0.77	0.95	-0.67	0.77	0.97	0.54	1

The preselection of variables is shown briefly in the Table 12. It is important to mention that when the bioclimatic variables of the climate change scenario were not available, those of the current scenario were taken.

Table 12: Preselected bioclimatic variables

M area	**2** $*$	**3**	**4**	**5** $*$	**6**	**7**	**13**	**14**	**15**	**18**
1	✓	✓	✓		✓	✓	✓		✓	✓
2	✓	✓	✓		✓	✓	✓		✓	✓
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	
4	✓	✓	✓		✓	✓	✓		✓	✓
5	✓		✓	✓	✓	✓	✓		✓	
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

$*$ Bioclimatic variables available only in the current scenario.

SM4: Details of species distribution and ecological niche modeling

Both Ecological Niche Modeling (ENM) and Species Distribution Modeling (SDM) were developed with the Maxent software (version 3.4.0) and the Kuenm package (Cobos, Peterson, Barve, & Osorio-Olvera, 2019) from RSutdio. In the model calibration, candidate models were created and evaluated with current scenario data to identify the species niche (ENM). As a result of these processes, the best models were selected. Then using replicates, the best models were created and projected to future scenarios to obtain the geographical space (SDM) where the species niche would be located in the future and under climate change conditions. Finally, the best models were evaluated with independent data. Such information is detailed below.

Creation of candidate models. 493 Maxent candidate models were created from the combination of the set of preselected bioclimatic variables, 17 regularization multipliers (from 0.1 to 1.0 each 0.1; from 2 to 6 and from 8 to 10 each 1) and the 29 possible combinations of five feature classes (l: linear, q: quadratic, p: product, t:threshold and h: hinge).

Evaluation of candidate models. The best models was chosen based on: (1) statistical significance with the partial Receiver Operating Characteristic (partial ROC) by bootstrapping with 100 iterations and 50% of data; (2) predictive power with omission rates at 5% (E$\leq$5%); (3) complexity with the delta Akaike Information Criteria corrected by the sample (delta AICc) $\leq$2. The partial ROC indicates if the model is better than one given by randomness, the omission rates refer to the percentage of GR that does not include the model and the AICc measures the amount of missing relative information by varying the model. Specifically, the AICc delta are differences are obtained from the AICc values of each model respect to the lower AICc value.

Creation and final evaluation of the best models. The best models were created with the GR to model training and testing and the selected parameterizations using 10 replicates by bootstrap with logistical outputs for transfer to the considered scenarios, that using clamping extrapolation (EC). The best models were evaluated with the final evaluation data using the partial ROC and omission rates criteria (E$\leq$5%).

Although it is true that the number of models that met the three criteria was variable for each species, most of them were significant. We studied the *Ficus insipida* distribution with the same methodology but it was left aside when we noted that it was very general distribution since there were several non-significant models (105), which is appreciated in the Figure 6 (a), while that in most cases a condition similar to that shown in Figure 6 (b) was observed.

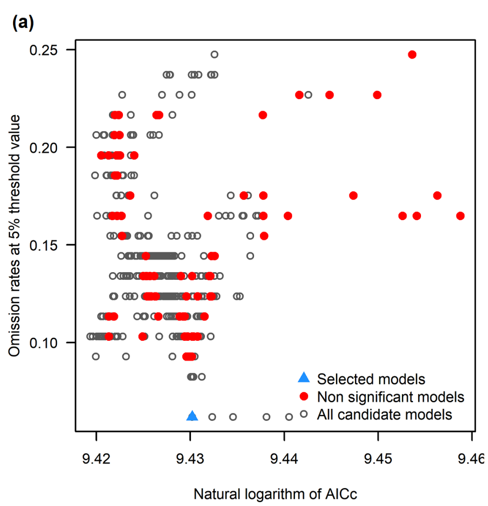

Figure 6: Examples of calibration figures. (a) *Ficus insipida* and (b) *Annona glabra*.

It seems that the size of the thinning grid has a direct and positive relation with the number of best models that were obtained with the Kuenm package. The number of best models have been included in the Table 13. When the species were thinned with a 10 km grid, a greater number of best models have been obtained (except *Cecropita obtusifolia* and *Busera simaruba*), while in the other species predominantly obtained one best model (only *Guatteria anomala* had 2). Although the above did not result in a generality, for example in the *Terminalia amazonia* case in which did not meet the omission rate criteria, a 10 km grid was applied but no improvement in results was noted.

Table 13: Best models resulted from model calibration

Species	n	Best model	AUC ratio	pval	Omission rate at 5%	AICc	delta AICc	np
Annona glabra	1	M_2_F_pt	1.314	0	0.04	5 439.5	0	26
Aspidosperma megalocarpon	1	M_4_F_qpt	1.138	0	0.049	8 206.3	0	20
Brosimum alicastrum	1	M_2_F_lqh	1.298	0	0.05	38 589.8	0	28
Bursera simaruba	1	M_3_F_pth	1.164	0	0.05	127 571.2	0	44
Calophyllum brasiliense	1	M_2_F_lpth	1.347	0	0.049	9 404.7	0	28
Cecropia obtusifolia	1	M_0.6_F_lqp	1.321	0	0.04	17 653.0	0	22
Dialium guianense	2	M_2_F_qth	1.385	0	0.028	5 618.6	0	22
Enterolobium cyclocarpum	2	M_4_F_lph	1.178	0	0.048	15 558.2	0	11
Guarea glabra	1	M_2_F_h	1.373	0	0.034	13 656.4	0	40
Guateria anomala	2	M_5_F_qh	1.204	0	0.037	2 075.8	0	11
Heliocarpus donnell-smithii	3	M_1_F_lq	1.173	0	0.056	16 233	1.94	10
Licania patypus	1	M_2_F_t	1.516	0	0	3 127.5	0	19
Magnolia mexicana	1	M_2_F_lqth	1.384	0	0.028	3 024.5	0	19
Manilkara zapota	4	M_0.3_F_lqp	1.191	0	0.05	25 177.9	0	18
Pouteria campechiana	1	M_3_F_t	1.314	0	0.04	26 159.0	0	24
Schefflera morototoni	1	M_2_F_t	1.532	0	0.031	3 665.9	0	25
Spondias mombin	2	M_2_F_lqpth	1.255	0	0.043	25 675.4	0	29
Swietenia macrophylla	1	M_0.2_F_qh	1.439	0	0.036	8 176.3	0	101
Tabebuia rosea	3	M_2_F_qth	1.22	0	0.037	16 035.3	1.49	30
Terminalia amazonia	1	M_3_F_qpt	1.271	0	0.109	6 943.2	0	27
Vatairea lundellii	1	M_0.6_F_qp	1.422	0	0.048	4 652.7	0	26
Vochysia guatemalensis	1	M_0.8_F_pt	1.497	0	0.041	5 542.9	0	54

n: numer of best models, AUC: area under the curve, pval (p-valor) refers to partial ROC (partial Receiver Operating Characteristic), AICc: Akaike Information Criteria corrected by the sample, np: number of parameters. The Models column contains the optimal parameterization of the Maxent models: numbers refer to regularization multiplier, which control the amount of information the model can contain; letters refer to feature classes so, l: linear, q: quadratic, p: product, t:threshold and h: hinge.

The contribution of the bioclimatic variables was obtained (Figure 7), these explain the variability of environmental conditions where the species live.

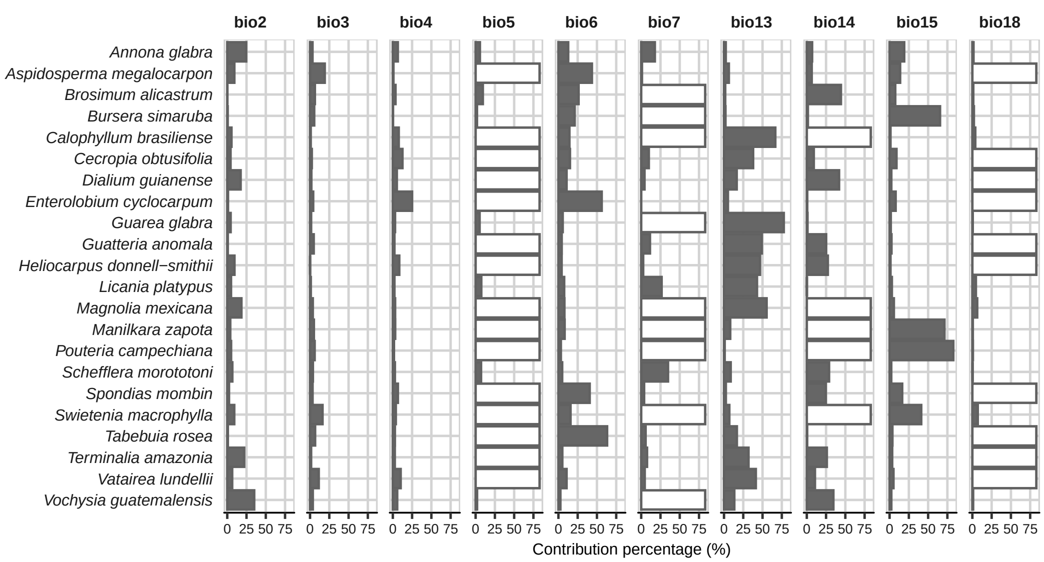

Figure 7: Contribution of the bioclimatic variables to each best model

Summary information of the best models

We summarize geographic information produced by selected Maxent models, which were created by 10 bootstrapping replicates with 50% of the data using the Kuenm package (Cobos et al., 2019). We obtained Pearson's correlation coefficients of the layers produced by the replicates as well as the average and standard deviation layers.
A boxplot wrapped were prepared with Pearson correlation coefficients of the 45 paired combinations of all replicates (Figure 8).

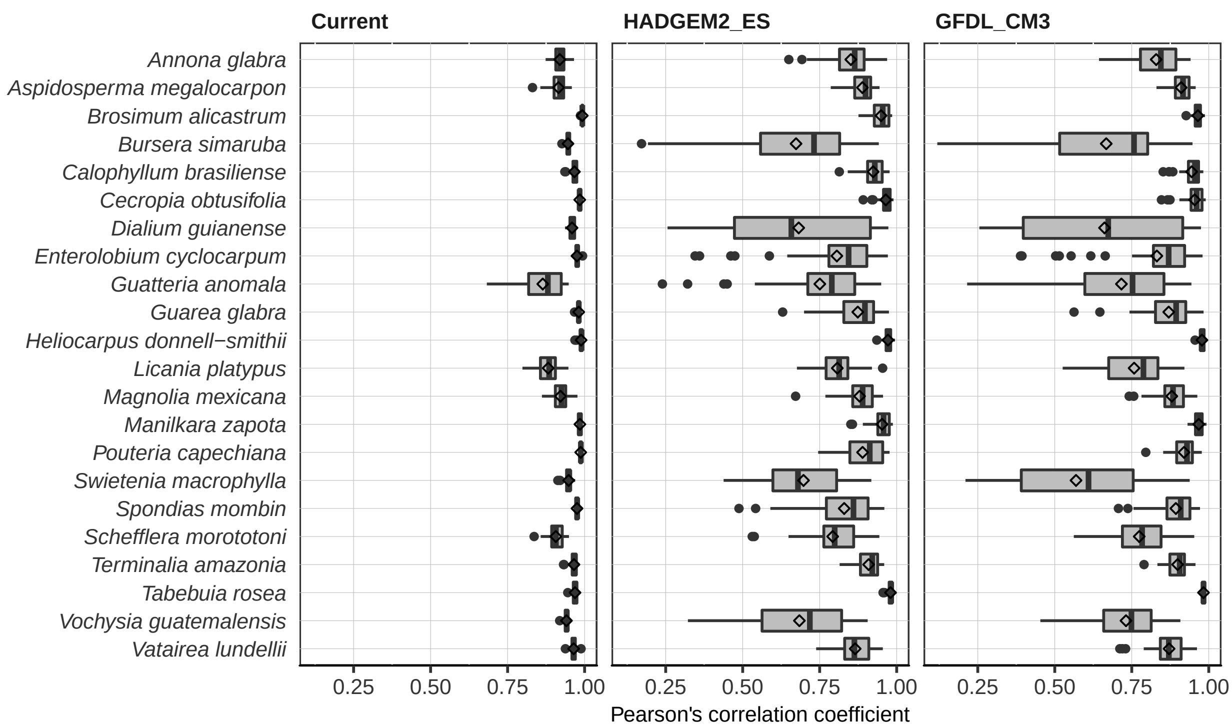

Figure 8: Pearson's correlation coefficients of the 10 replicates

Summary distribution models (maps) for each species and scenario considered are enlisted in alphabetic order (Figures 9 to 30). An averange map and standard deviation map of the 10 replicates is included. We take the logistic output of the model as a measure of climatic suitability for the species. This suitability go continuously from 0 to 1, where 0 is not situable and 1 is the ideal maximum. In each case, in (a) is shown in the averange map of the current scenario and in (b) its standard deviation map; in (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and in (d) its standard deviation map is illustrated; in (e) GFDL_CM3 RCP 8.5 climate change scenario mean map and in (f) its standard deviation map is observed. Their respective histograms are included under each figure, remember that the pixel size was 500 m.

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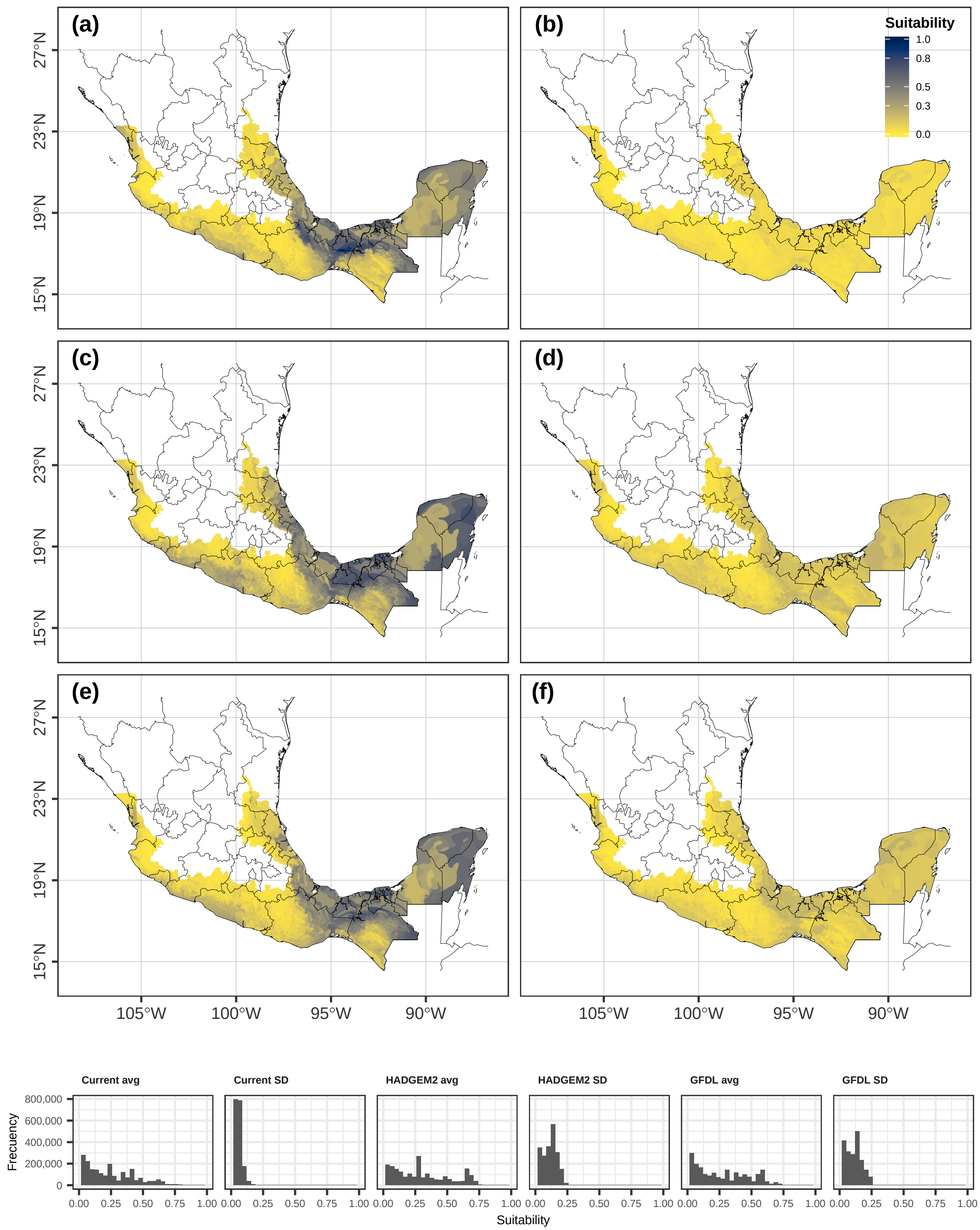

Figure 9: *Annona glabra* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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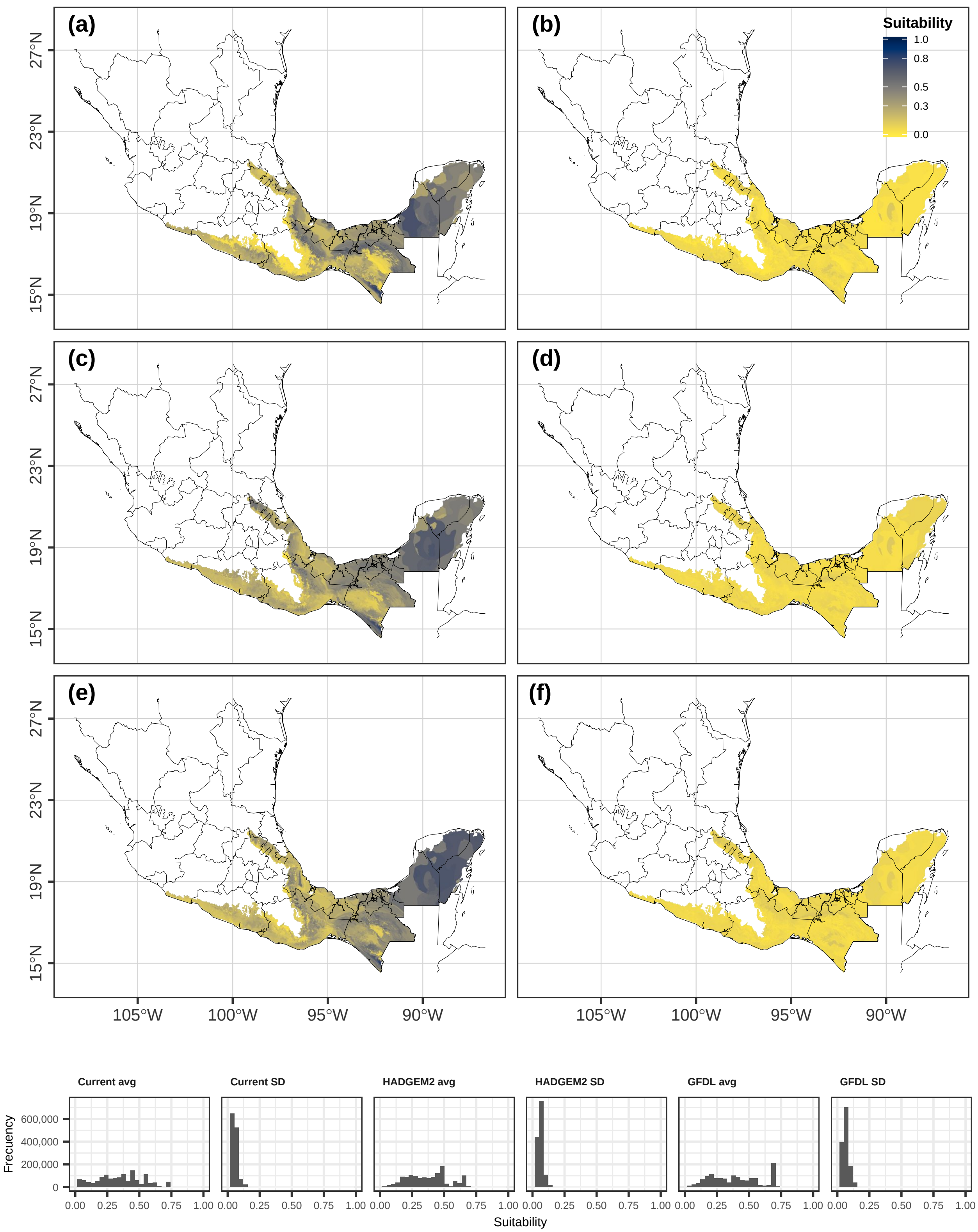

Figure 10: *Aspidosperma megalocarpon* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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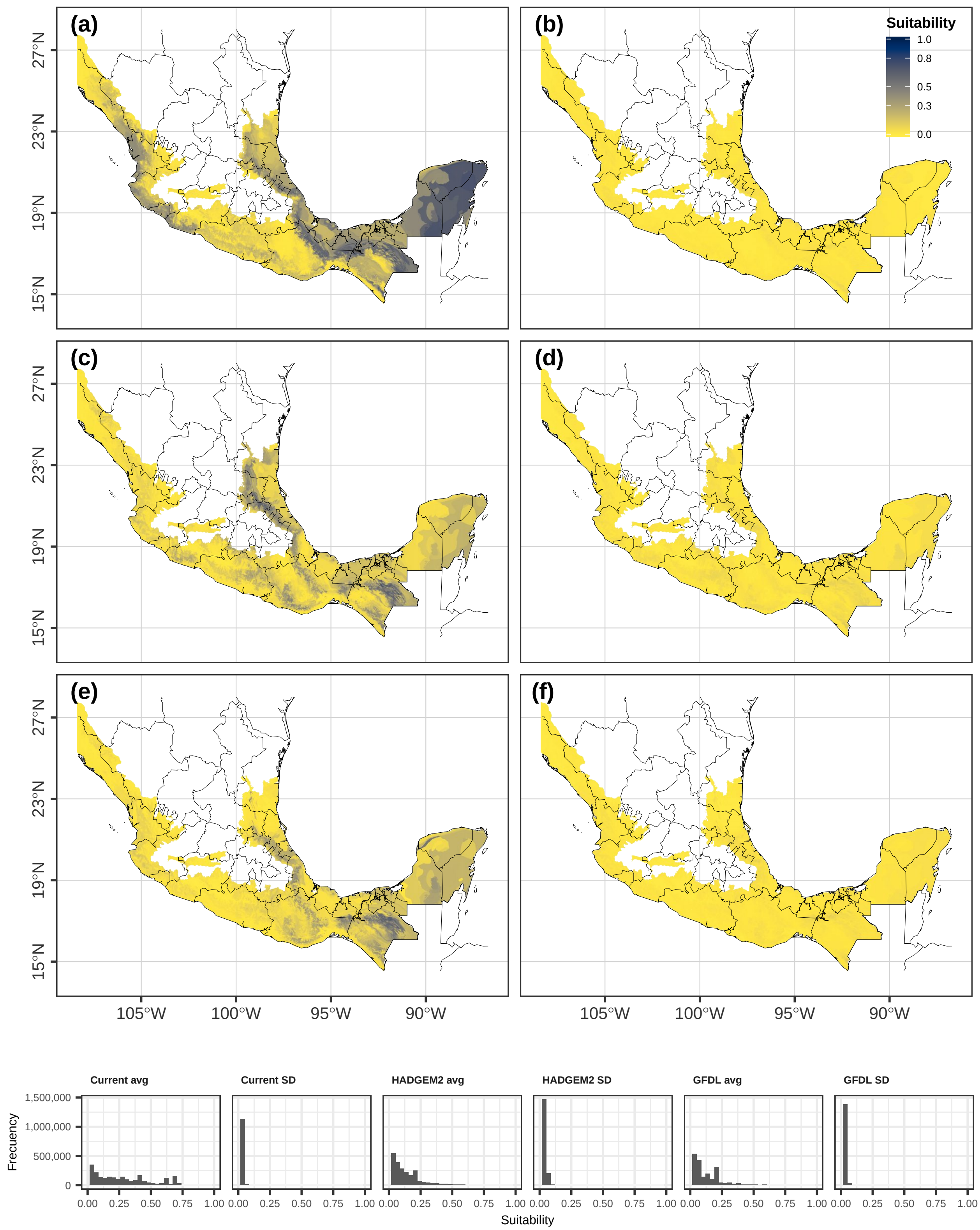

Figure 11: *Brosimum alicastrum* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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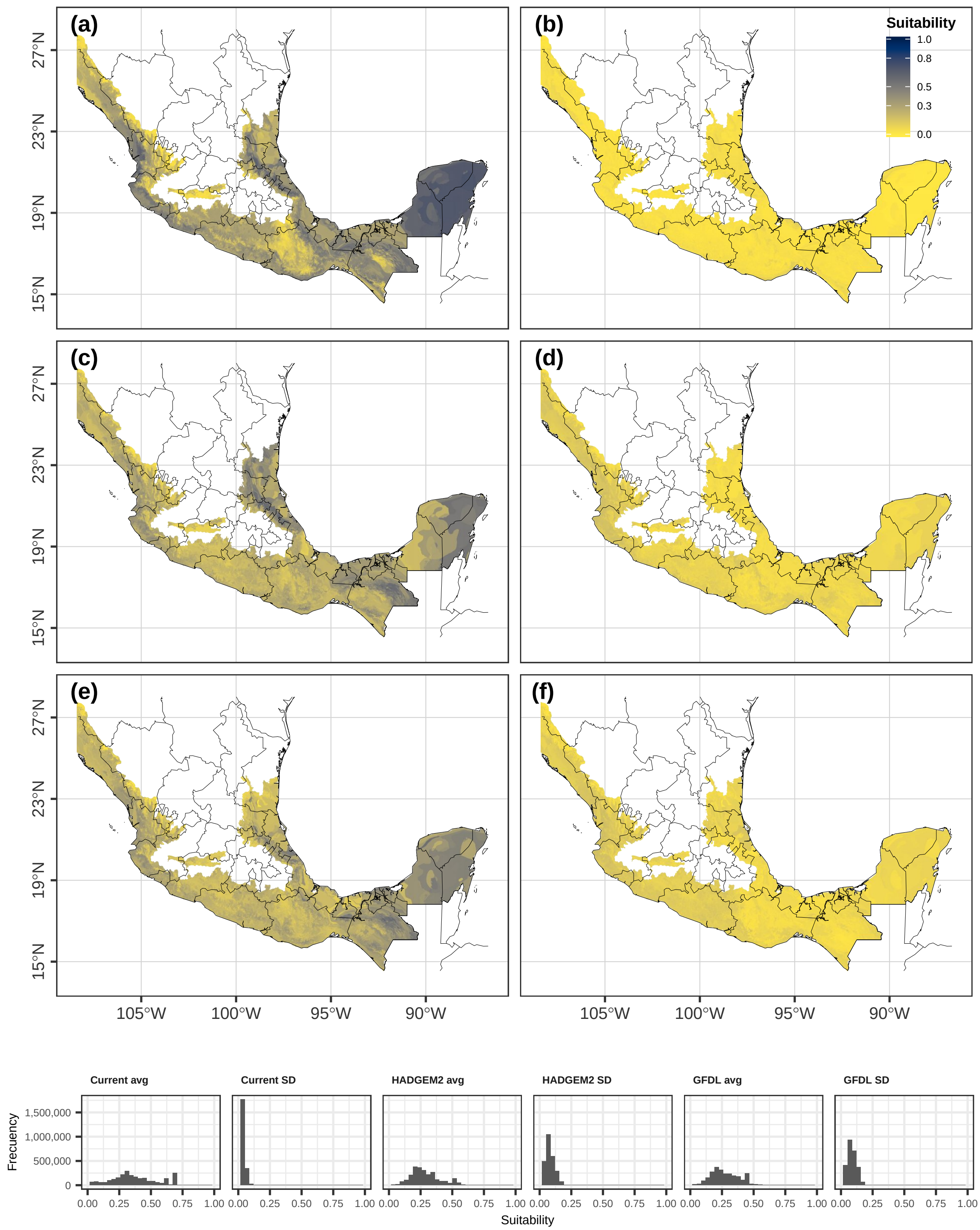

Figure 12: *Bursera simaruba* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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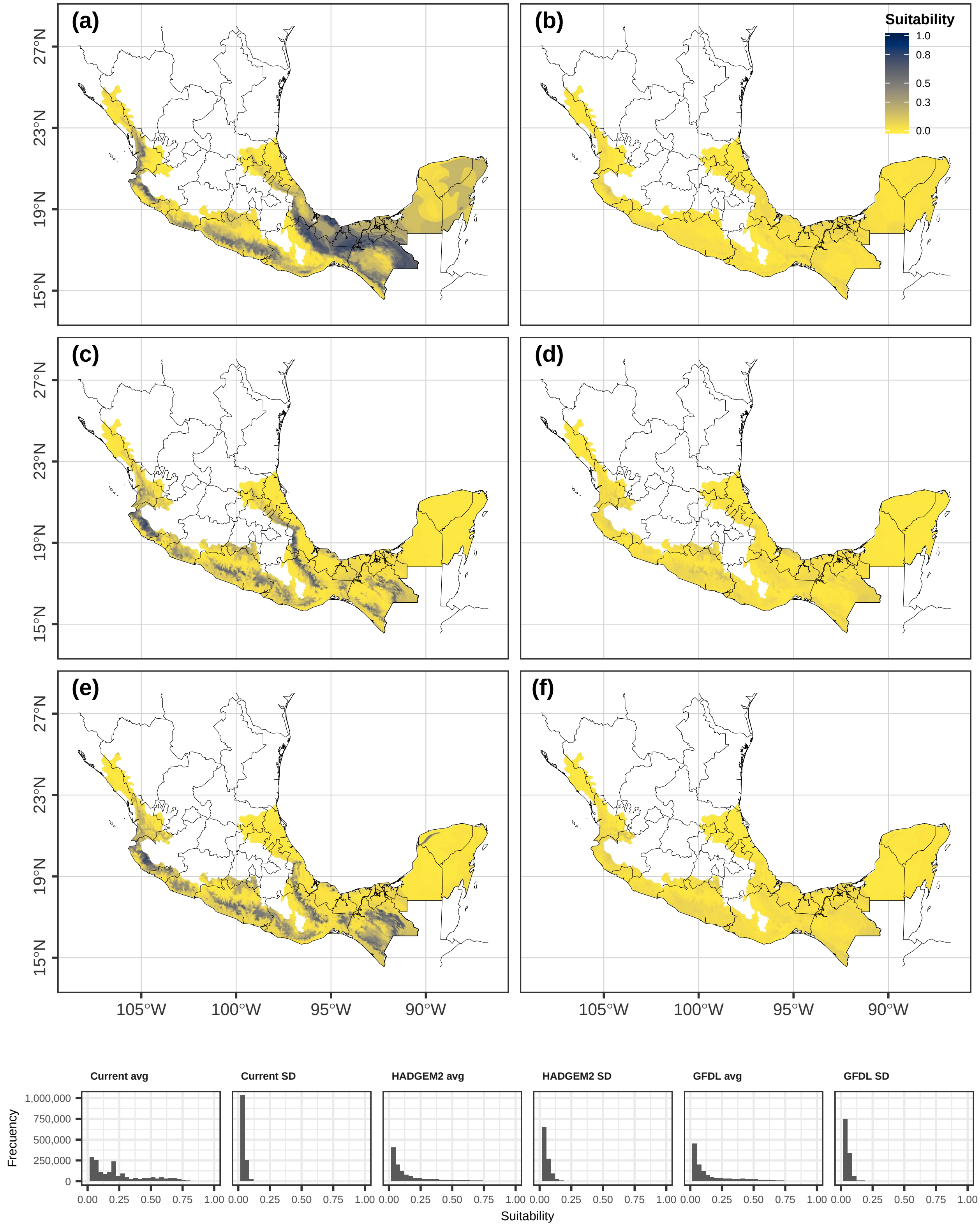

Figure 13: *Calophyllum brasiliense* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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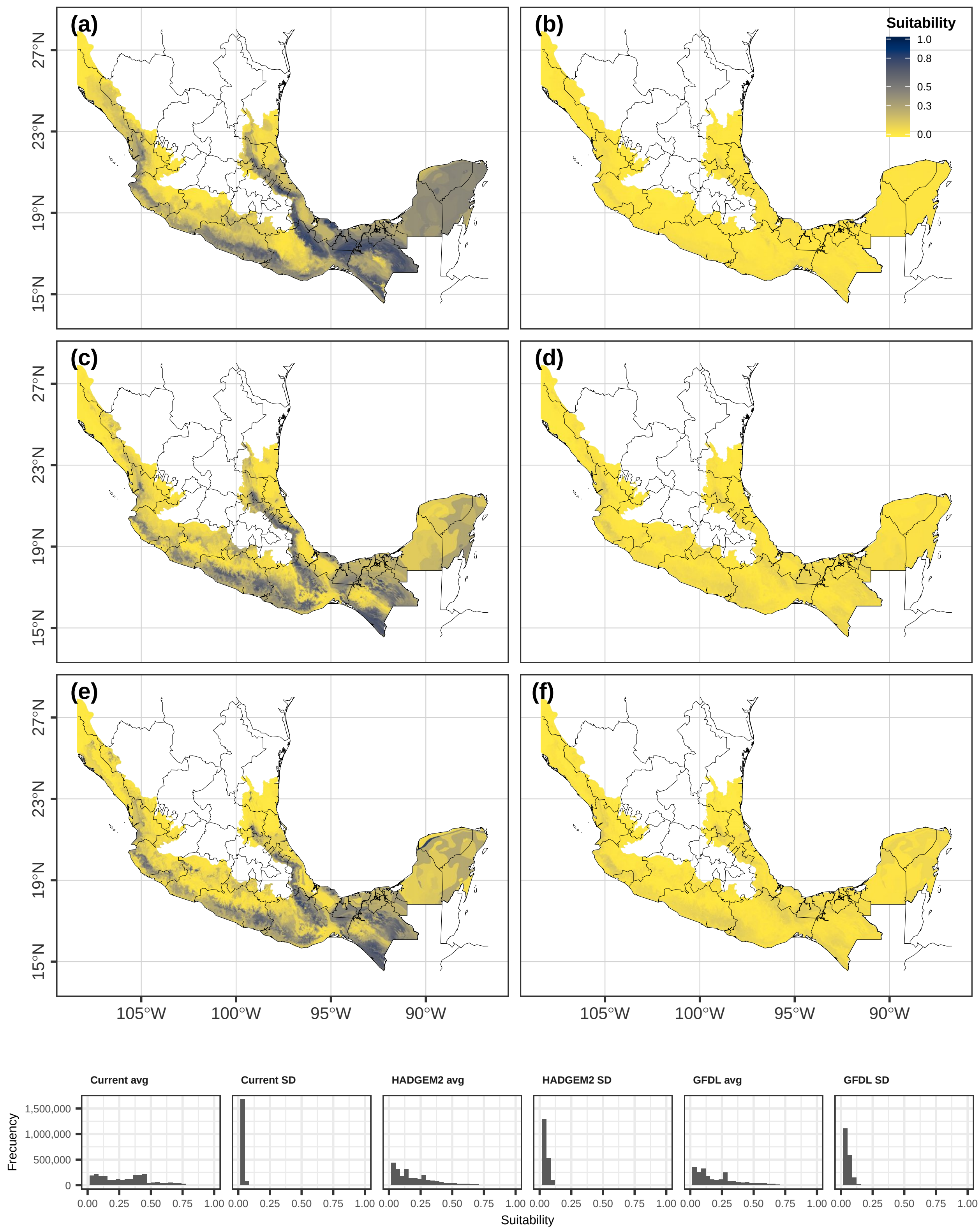

Figure 14: *Cecropia obtusifolia* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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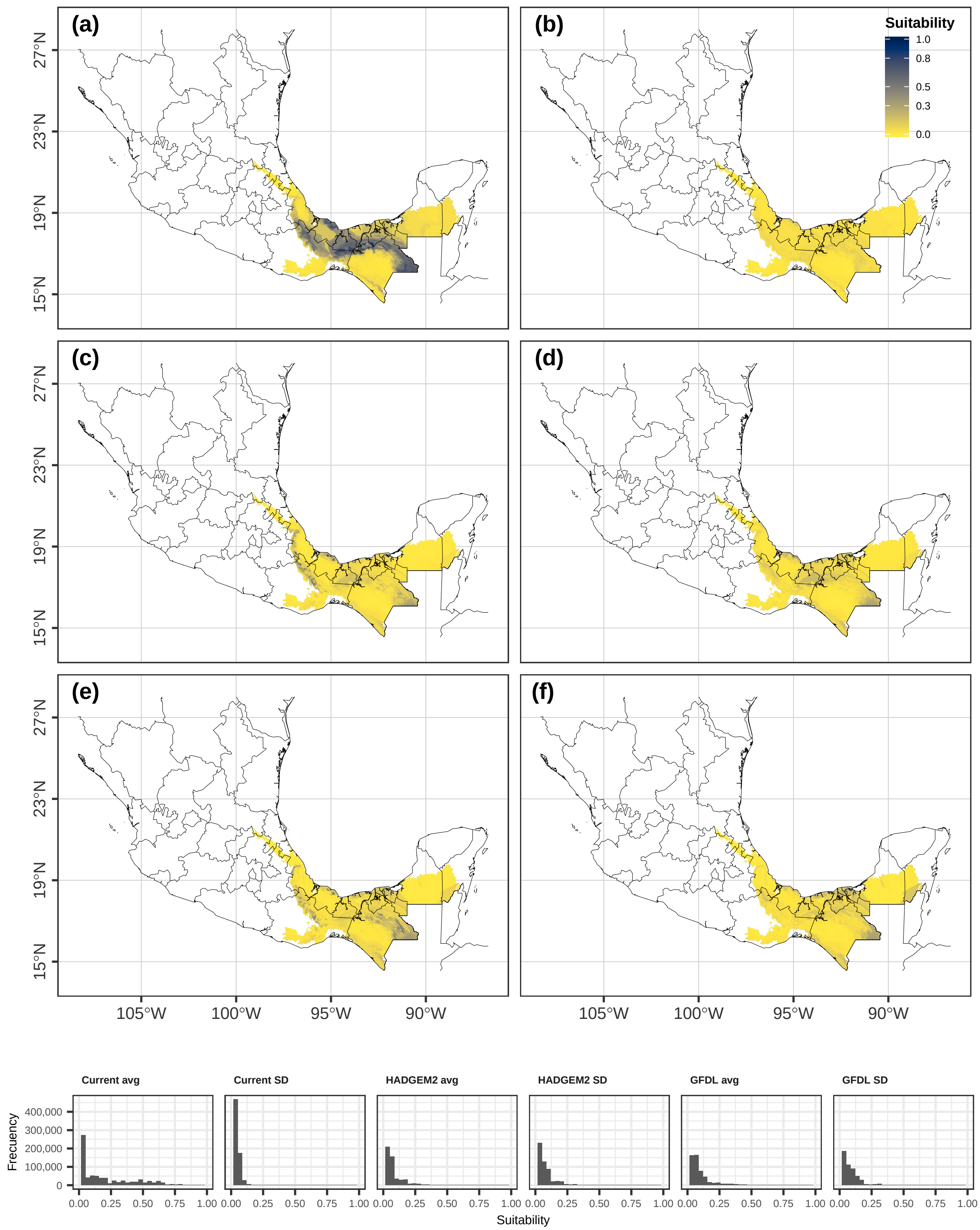

Figure 15: *Dialium guianense* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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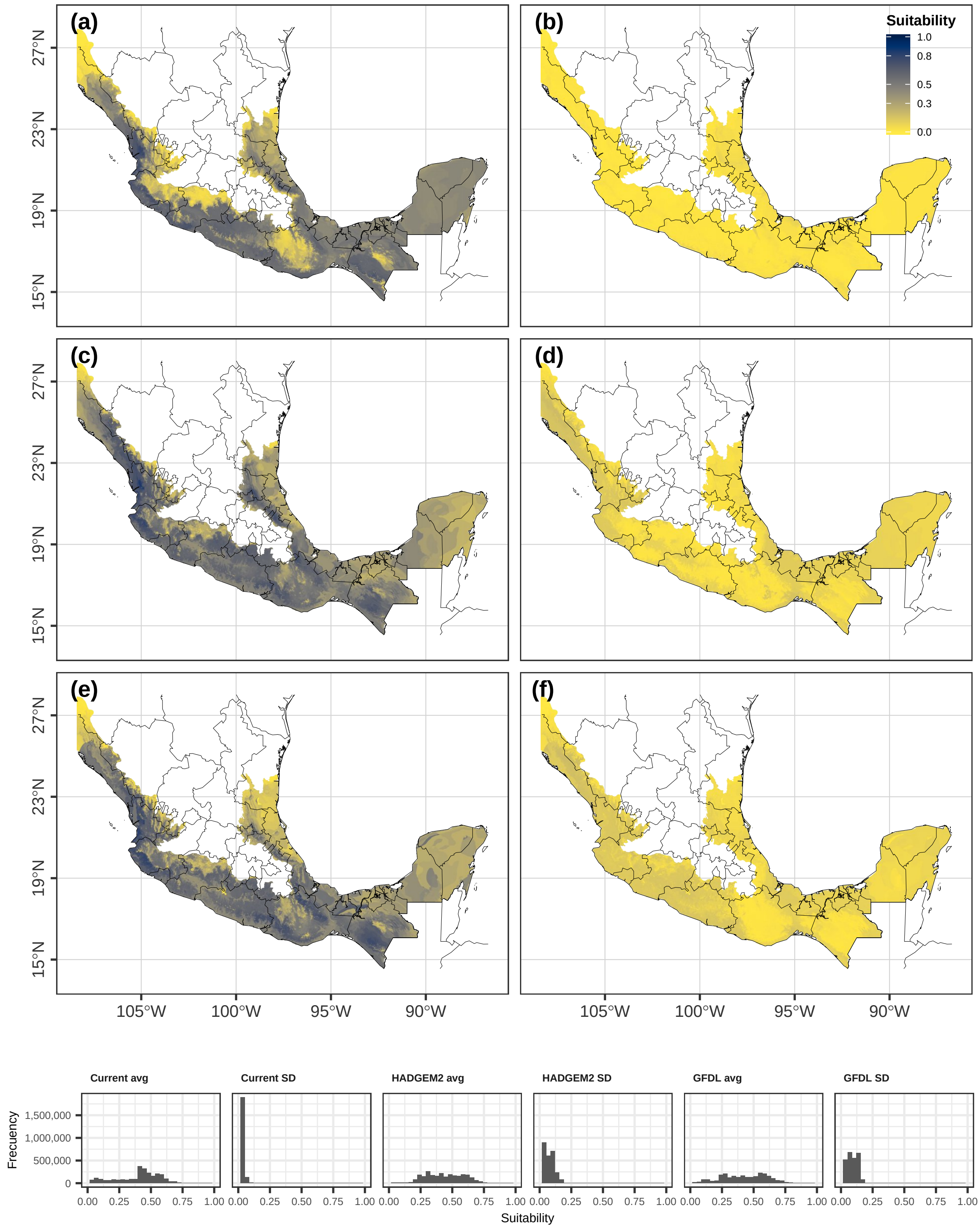

Figure 16: *Enterolobium cyclocarpum* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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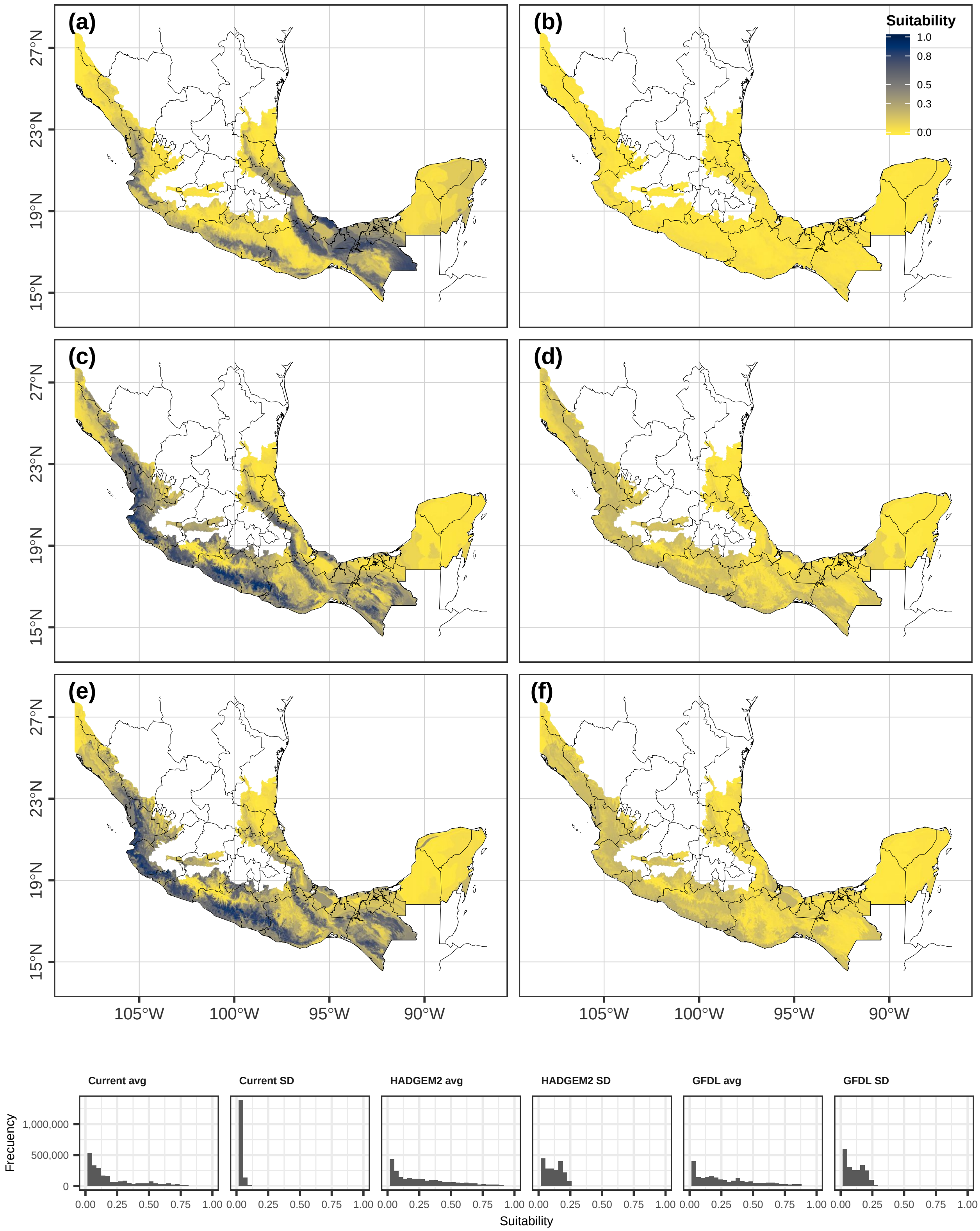

Figure 17: *Guarea glabra* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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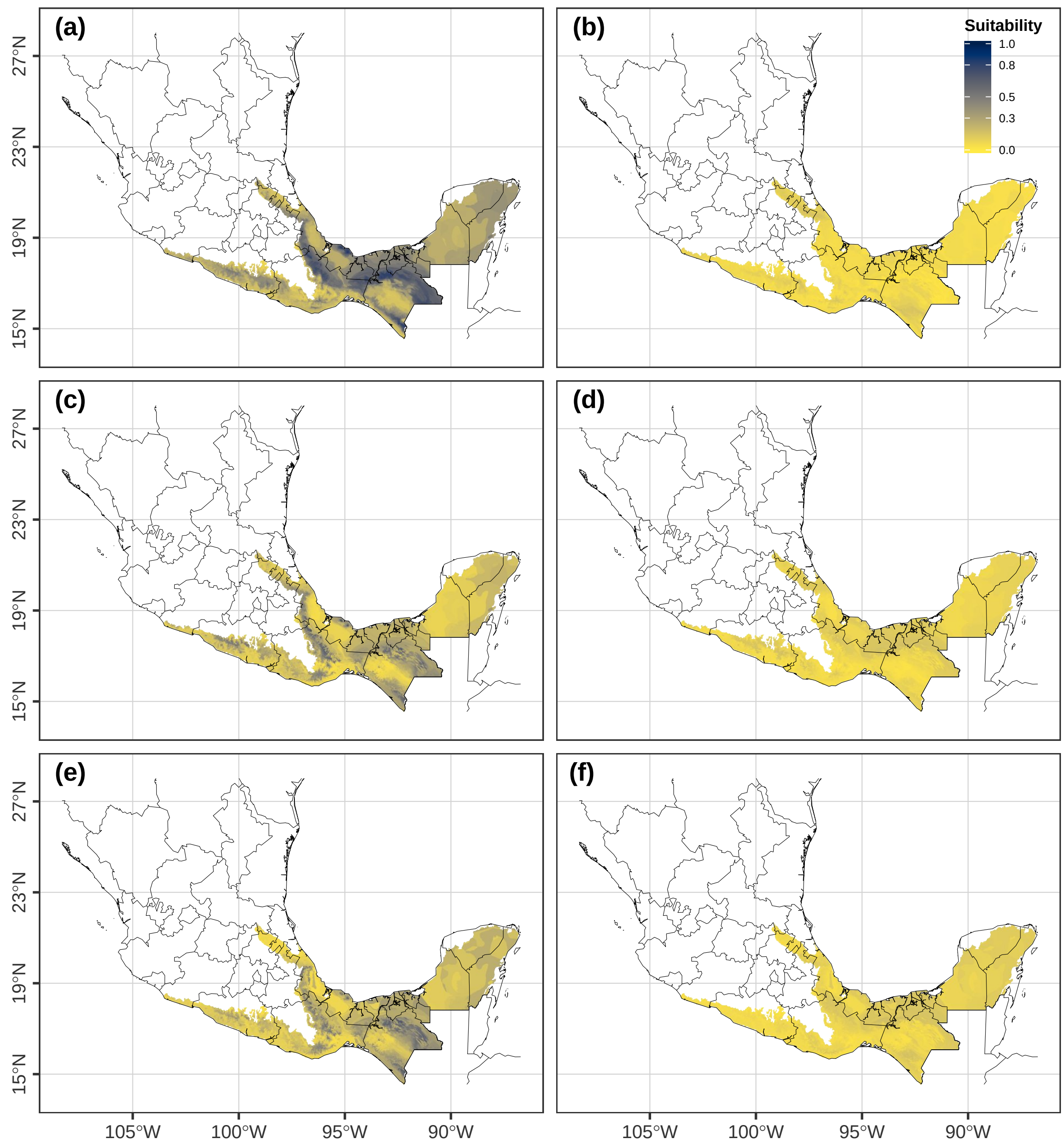

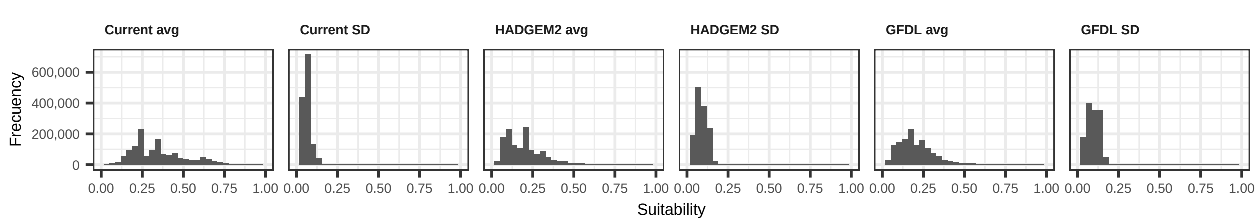

Figure 18: *Guatteria anomala* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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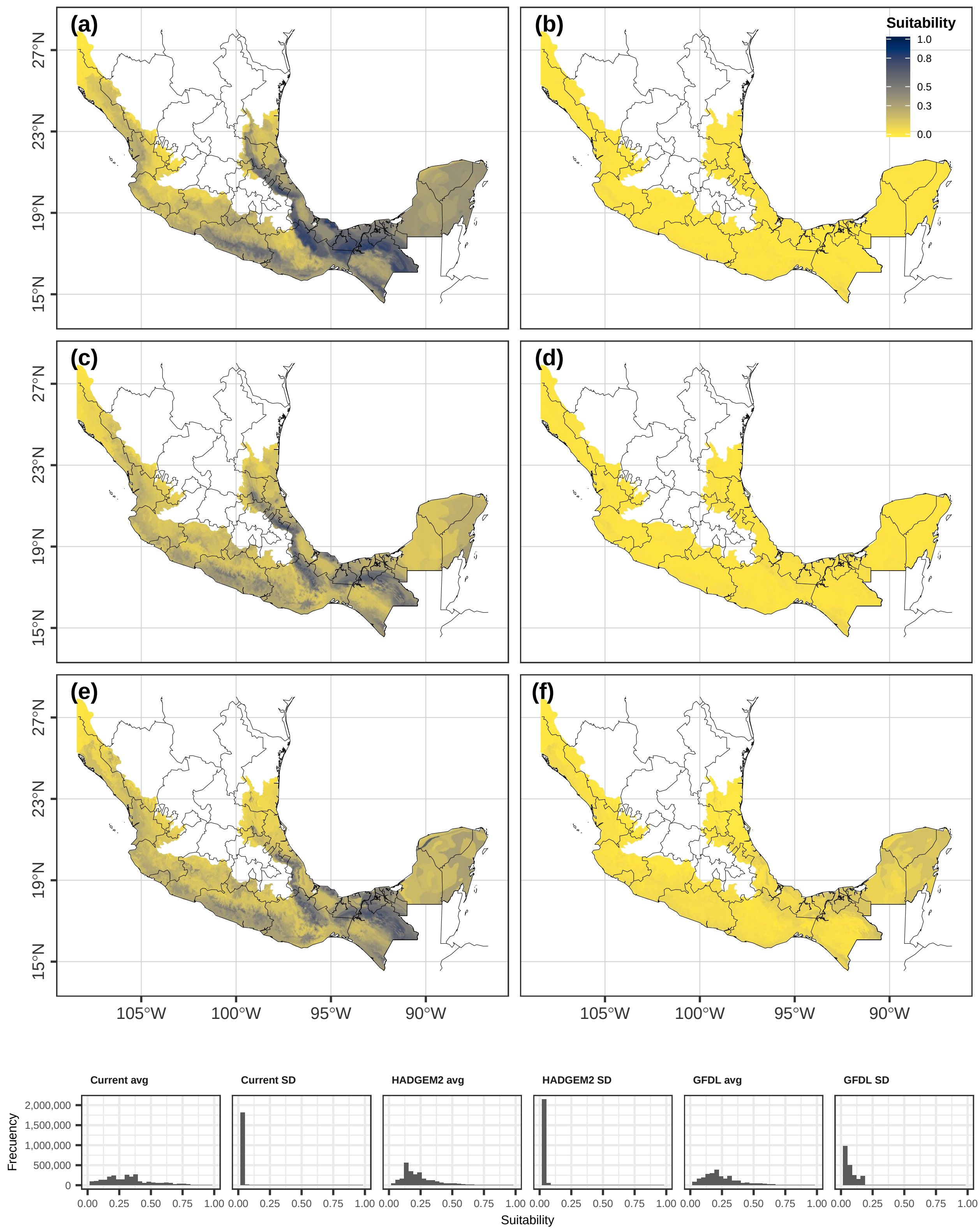

Figure 19: *Heliocarpus donnell-smithii* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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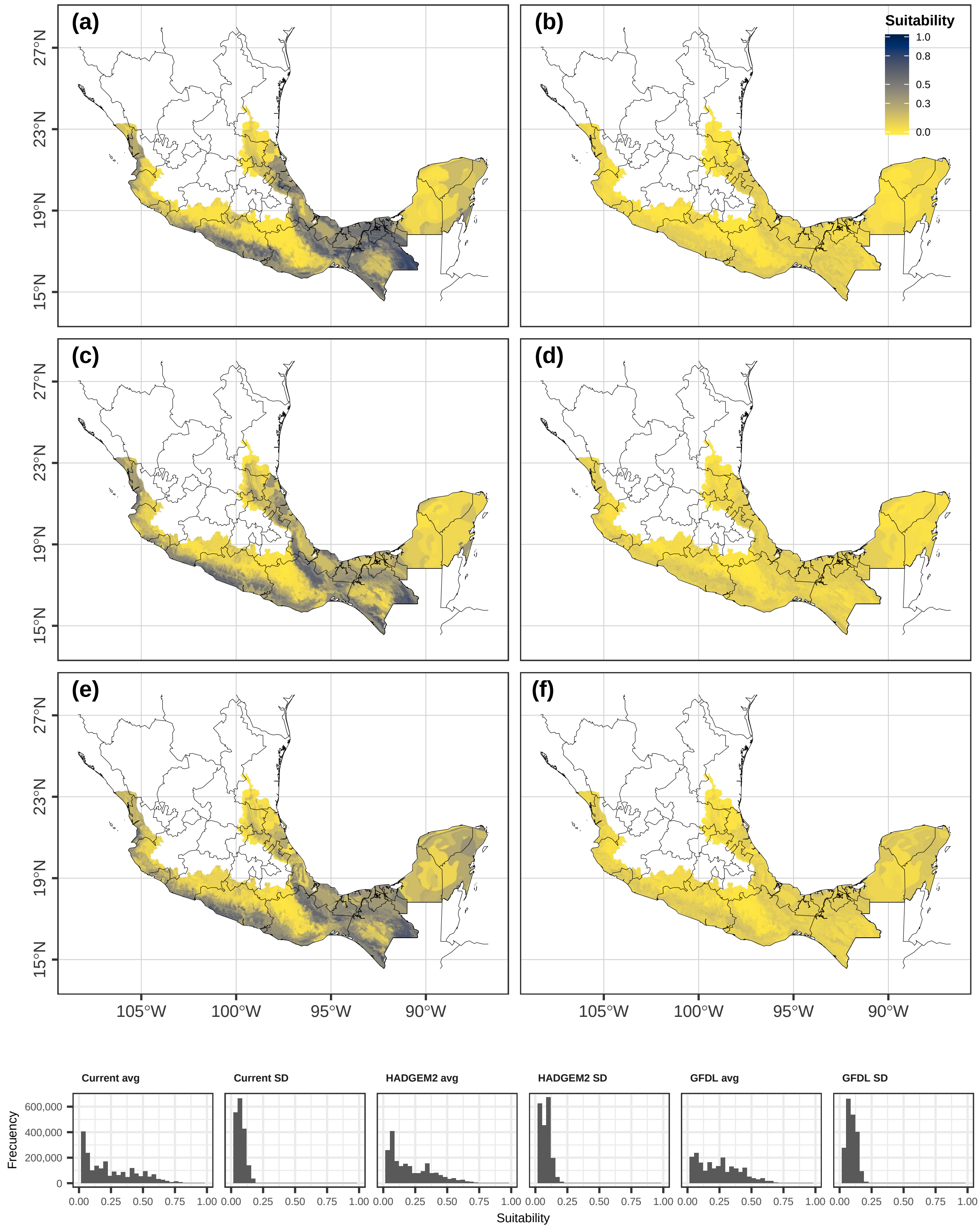

Figure 20: *Licania platypus* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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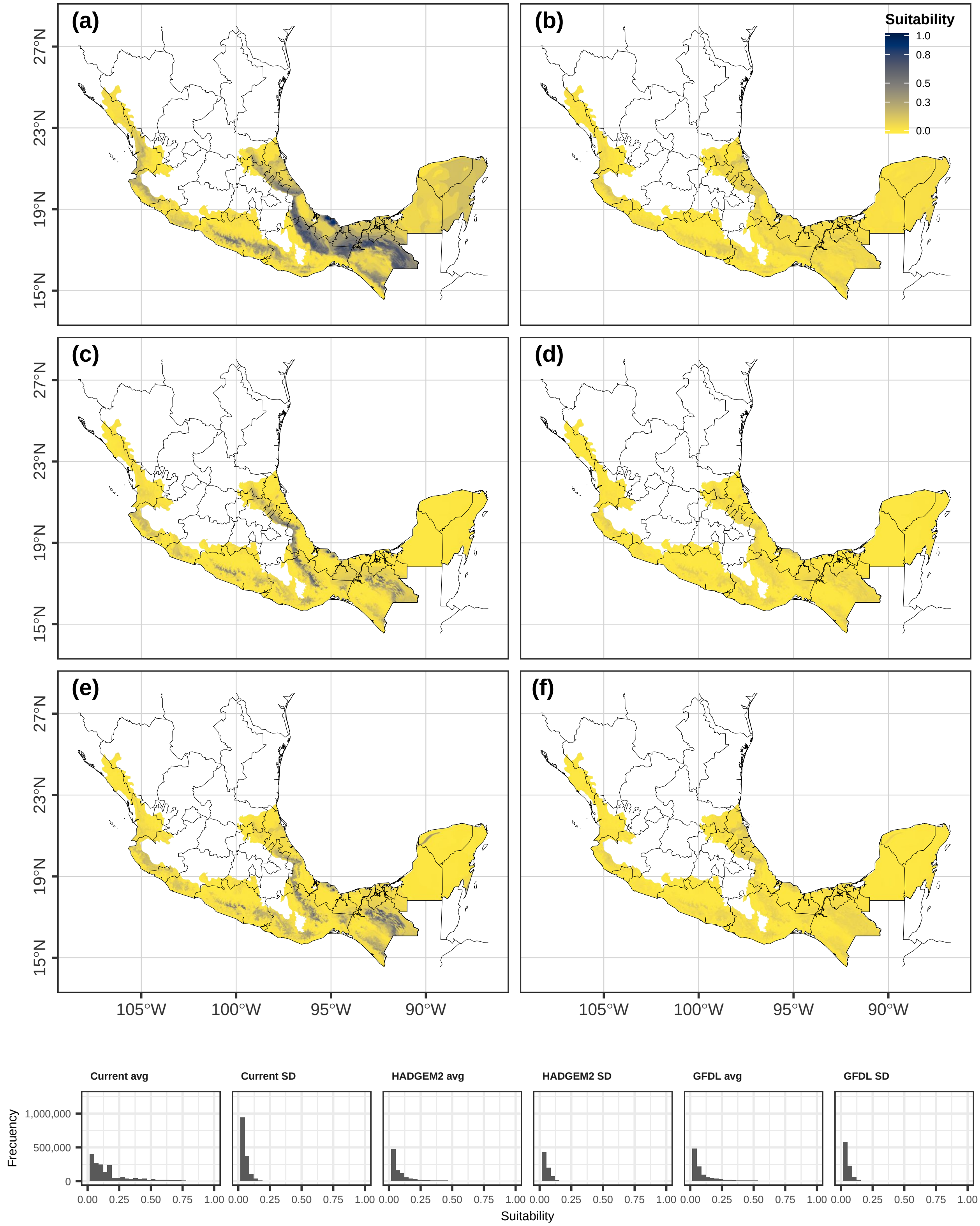

Figure 21: *Magnolia mexicana* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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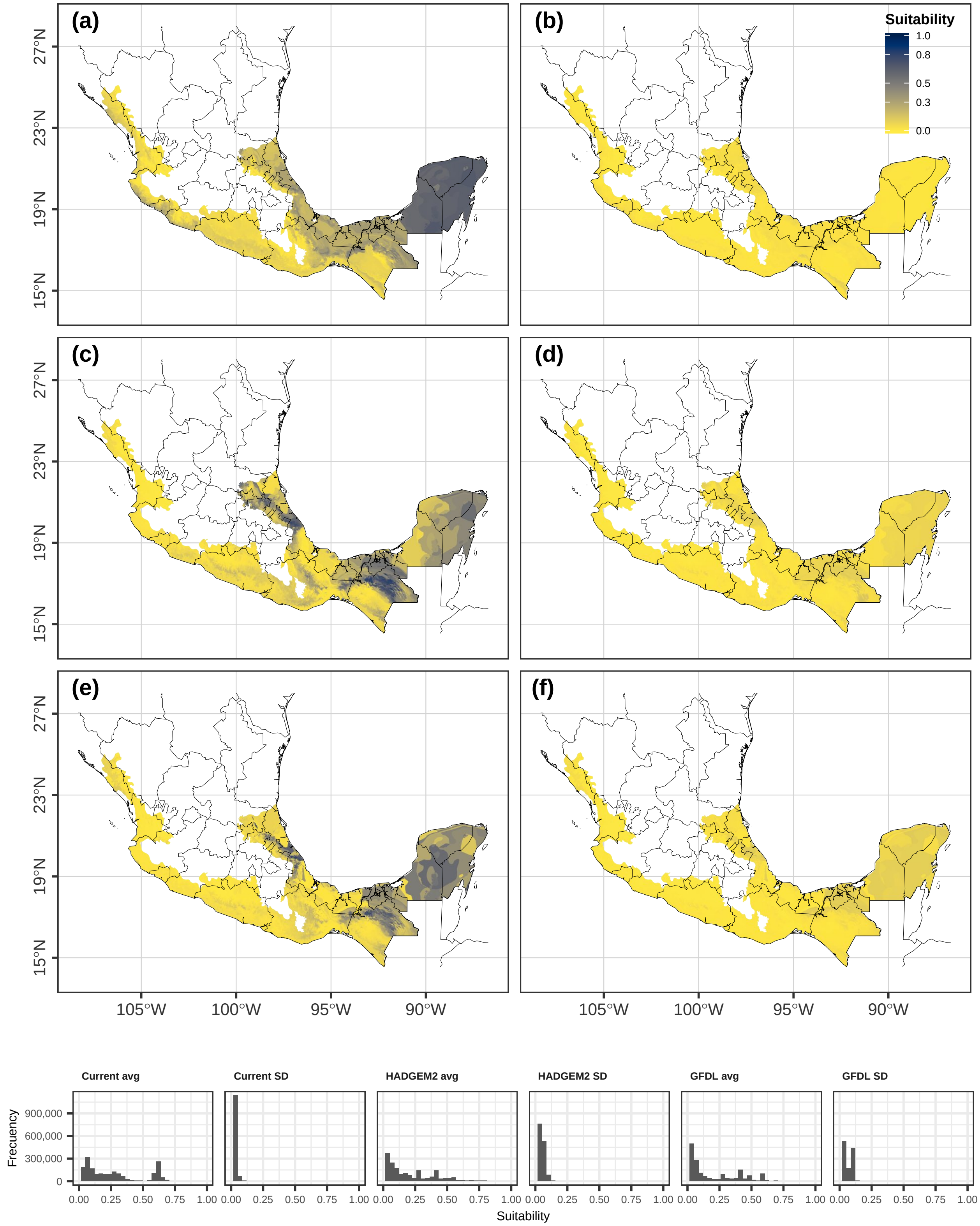

Figure 22: *Manilkara zapota* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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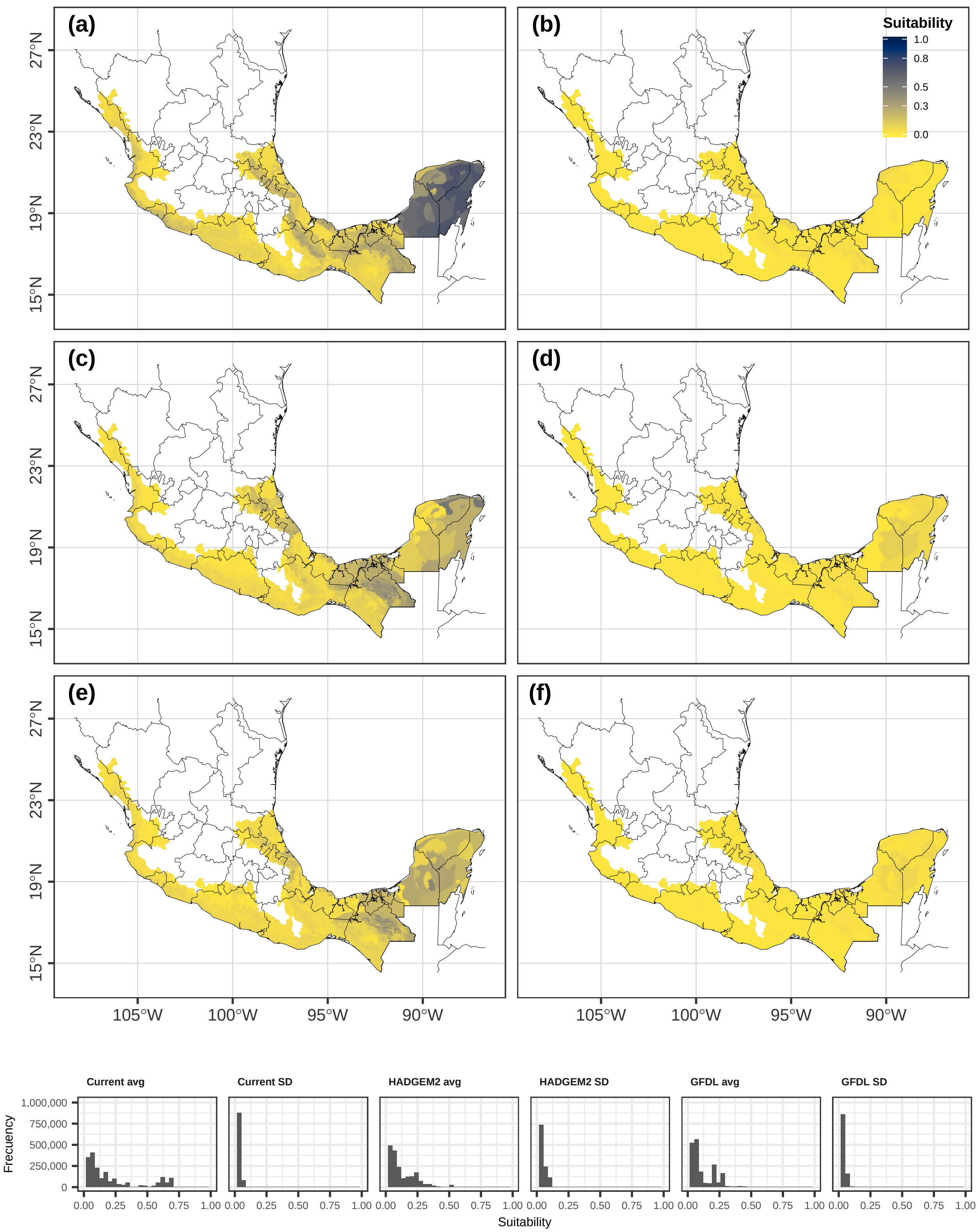

Figure 23: *Pouteria campechiana* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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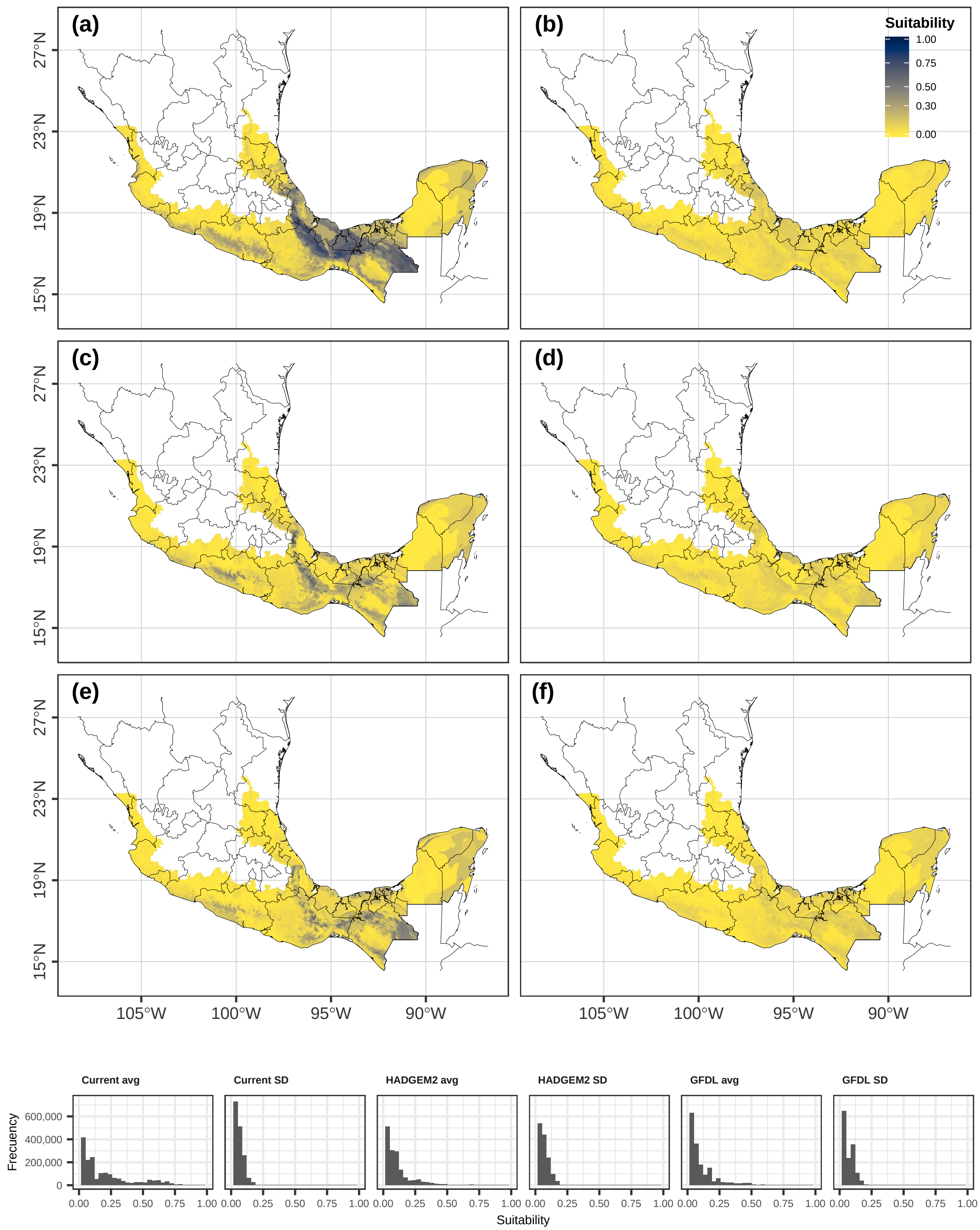

Figure 24: *Schefflera morototoni* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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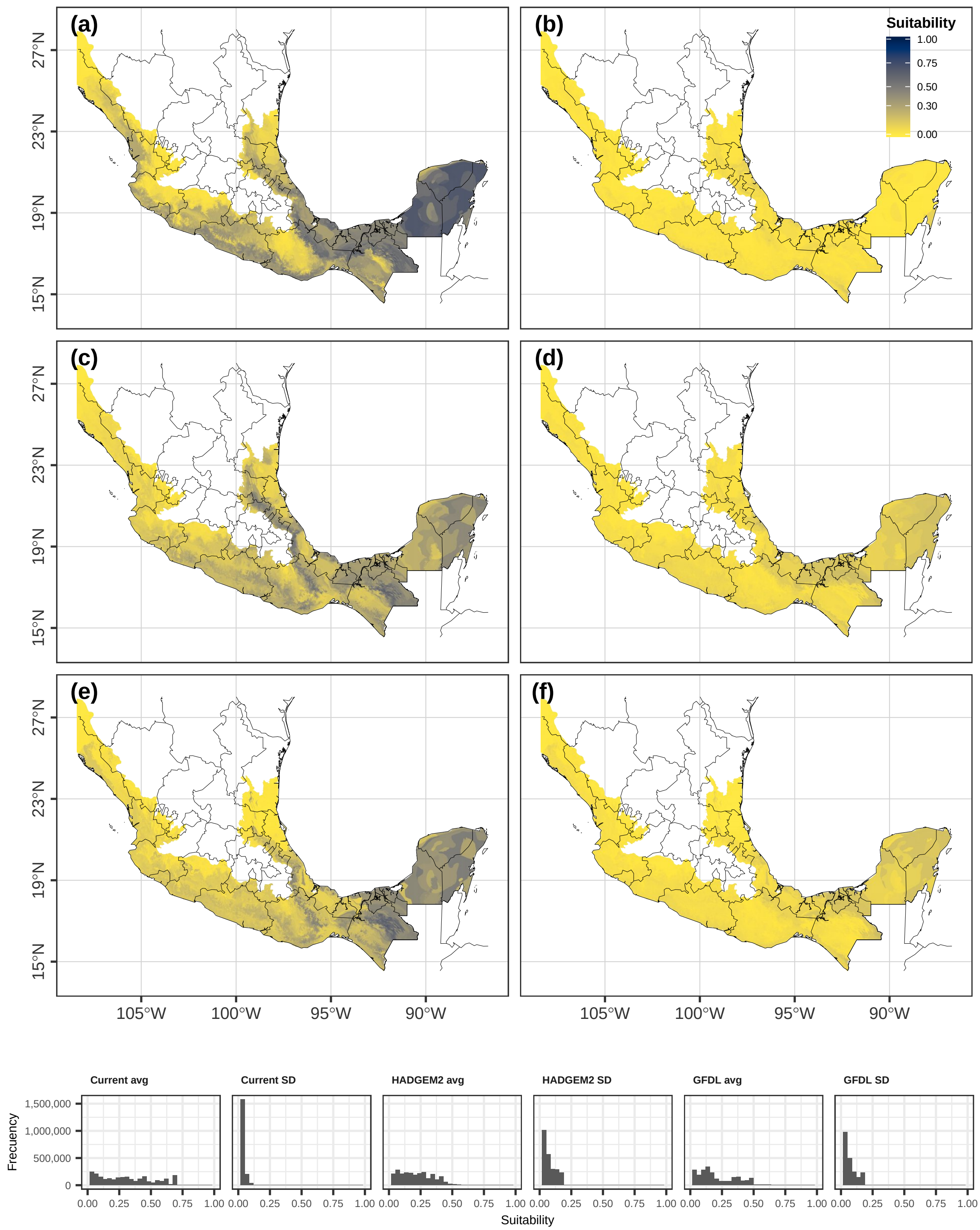

Figure 25: *Spondias mombin* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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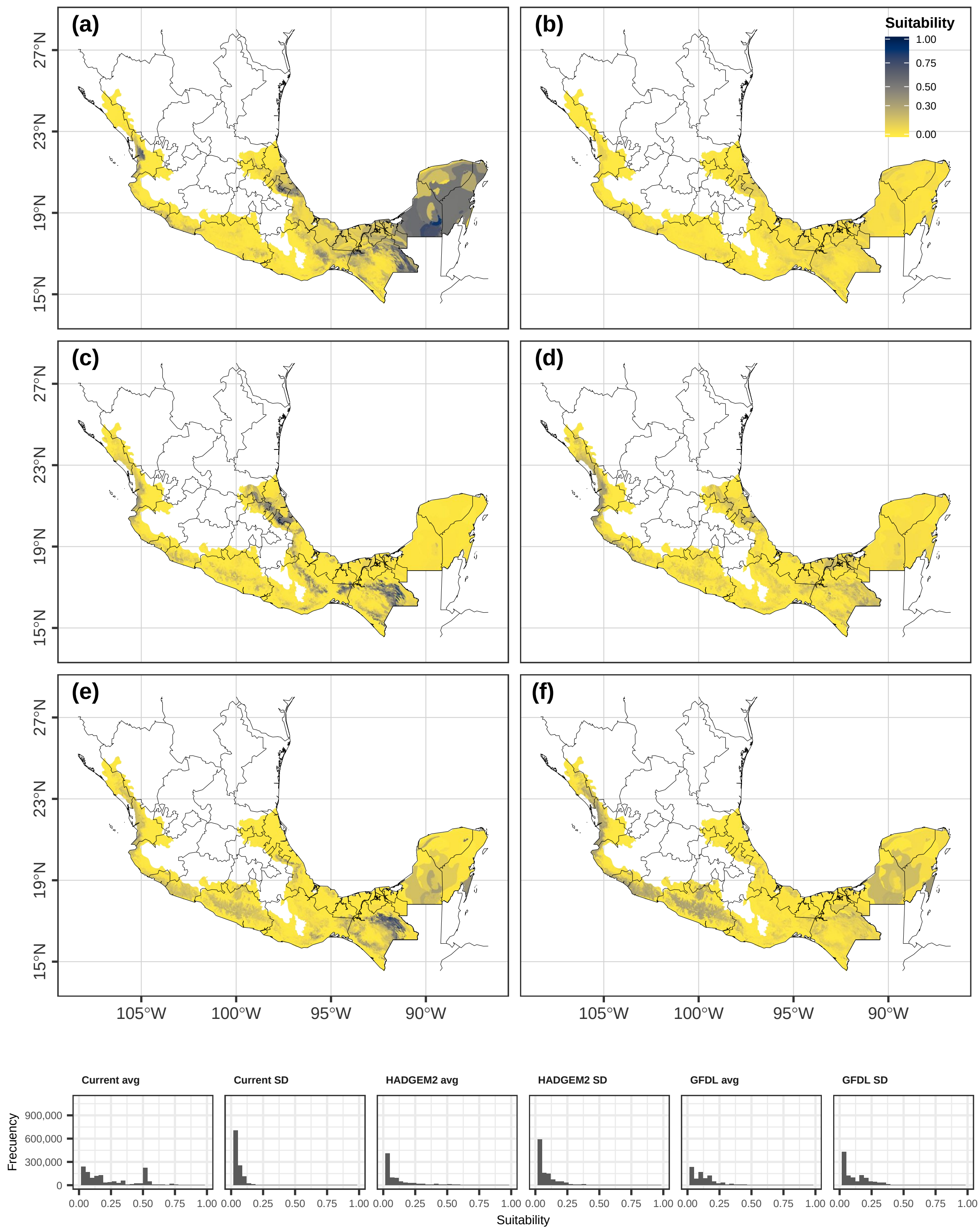

Figure 26: *Swietenia macrophylla* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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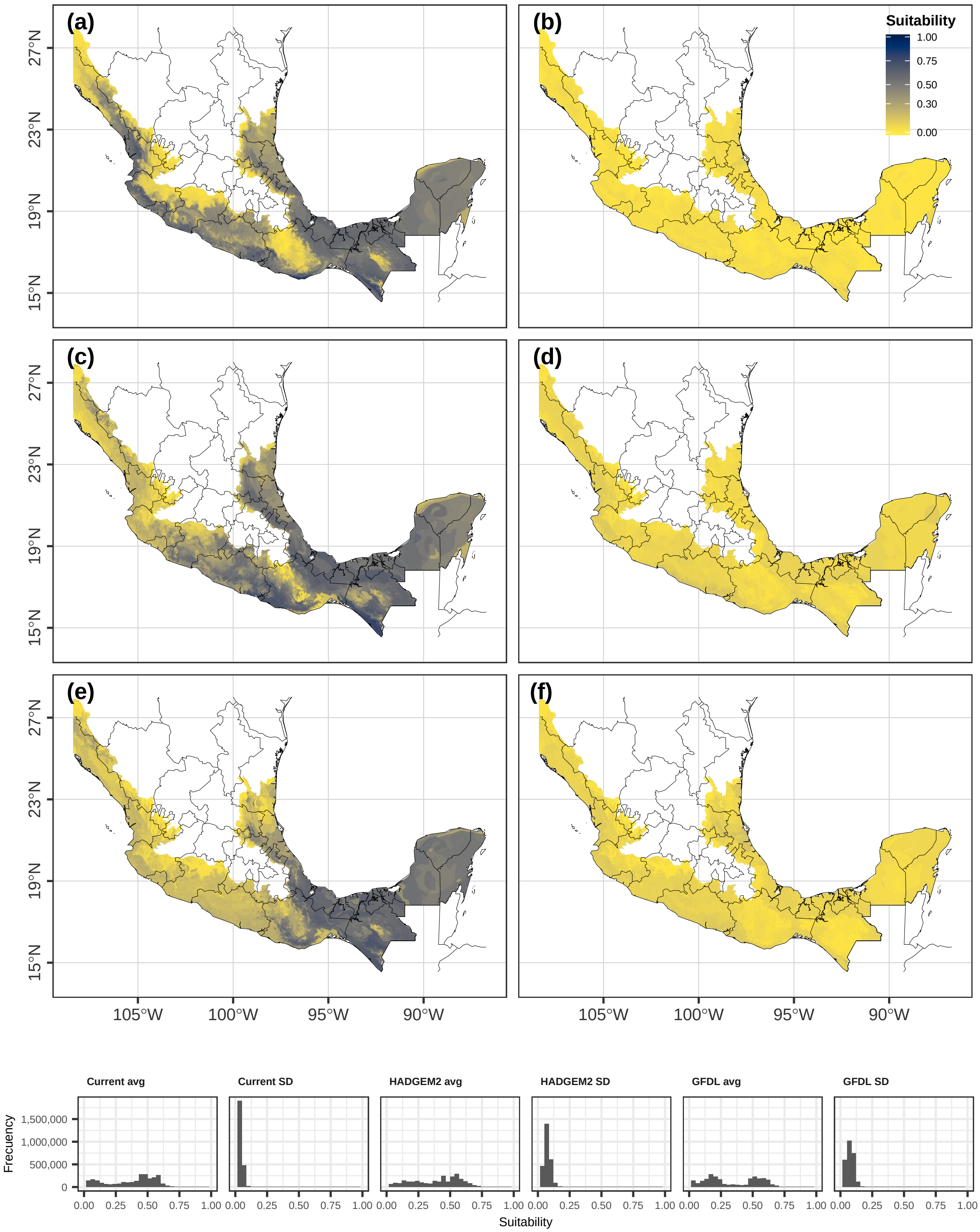

Figure 27: *Tabebuia rosea* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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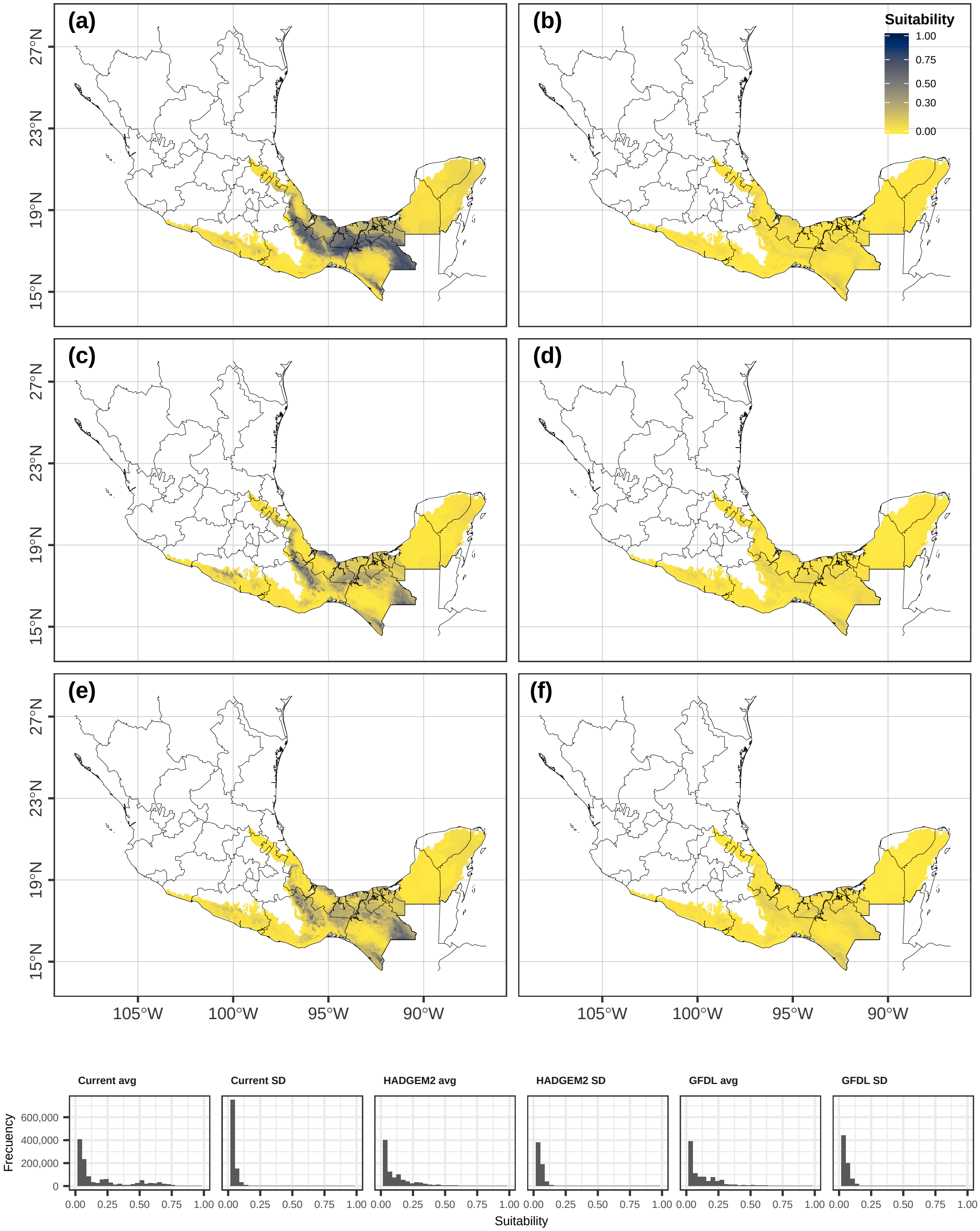

Figure 28: *Terminalia amazonia* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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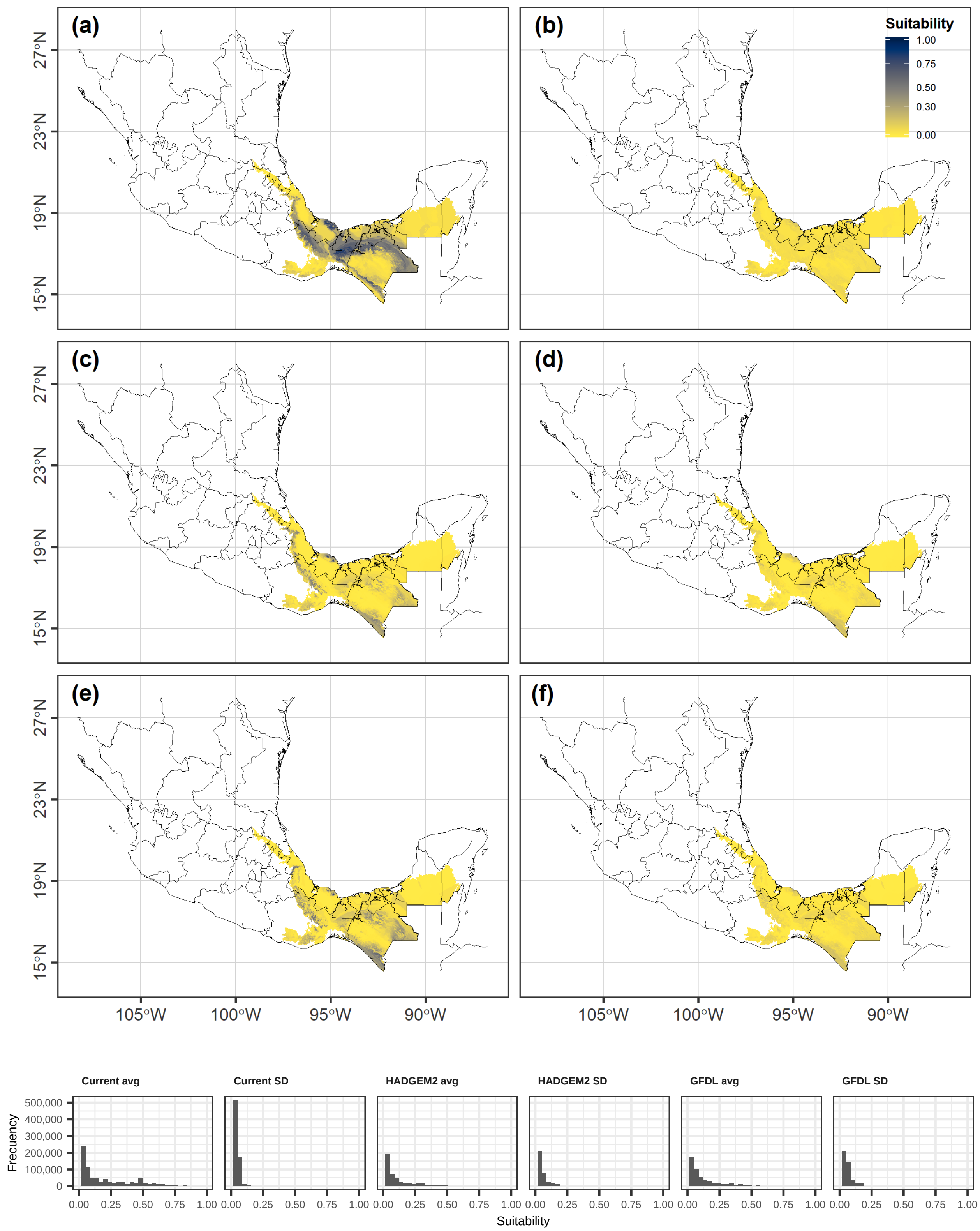

Figure 29: *Vatairea lundellii* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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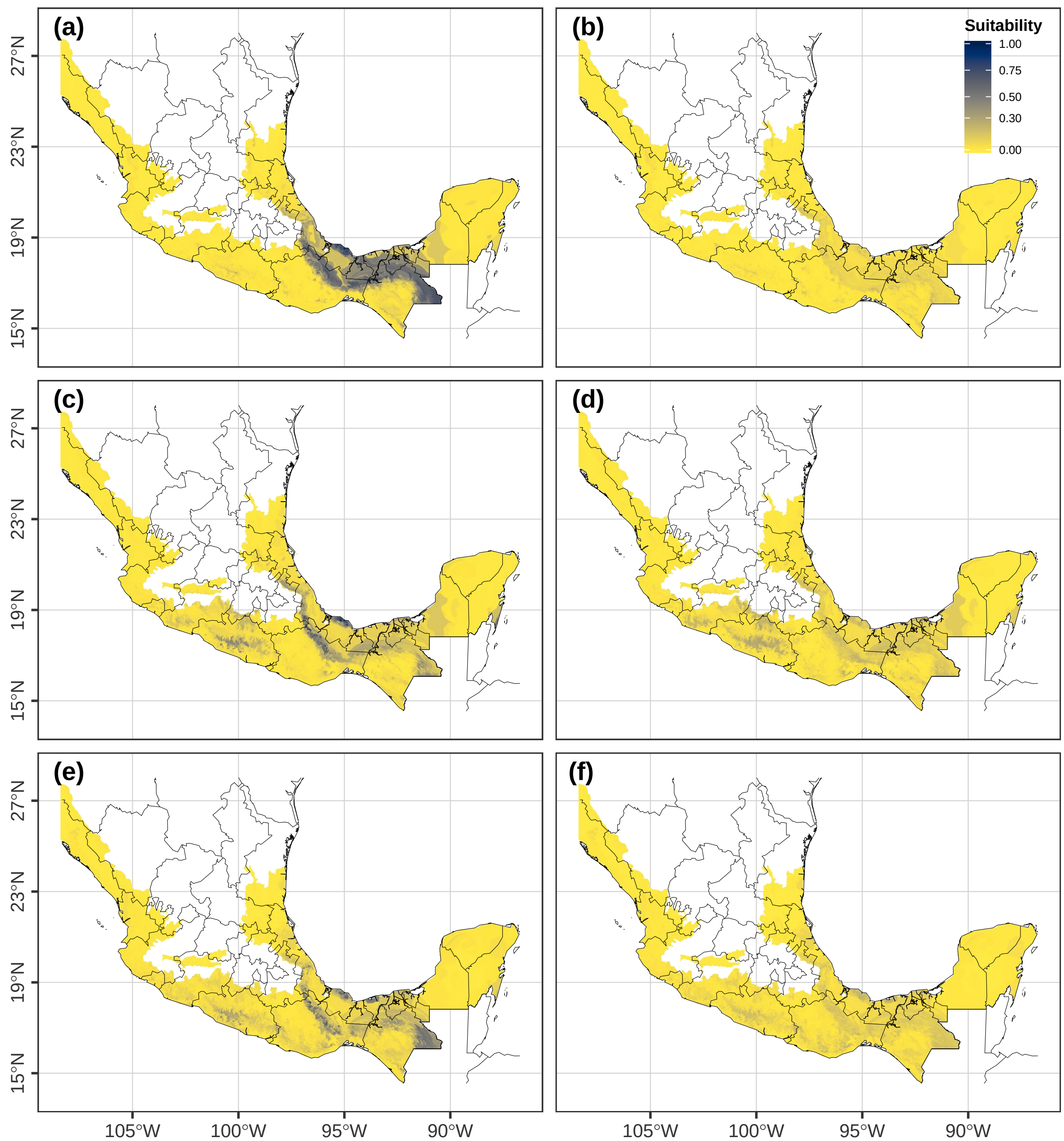

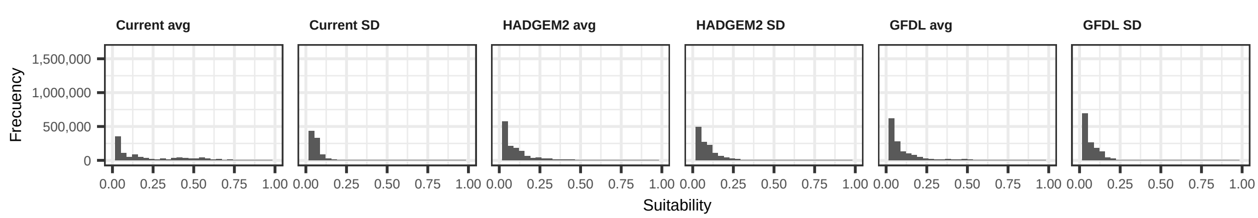

Figure 30: *Vochysia guatemalensis* distribution models. (a) Current scenario averange map and (b) its standard deviation map. (c) HADGEM2_ES RCP 8.5 climate change scenario averange map and (d) its standard deviation map. (e) GFDL_CM3 RCP 8.5 climate change scenario averange map and (f) its standard deviation map. Their respective histograms are included below.

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Final evaluation of the best models

Finally, we show the final evaluation of the best models of each species (Table 14). Statistical significance was excellent for all models (partial ROC=0). However, in several cases the permissible omission rates were exceeded, mostly in *Annona glabra*, *Licania platypus* and *Vochysia guatemalensis*; only in 6 cases not were exceeded.

Table 14: Final evaluation of the best models

Species	**AUC ratio**	**pval**	**Omission rate at 5%**
Annona glabra	1.168	0	0.182
Aspidosperma megalocarpon	1.193	0	0.026
Brosimum alicastrum	1.241	0	0.088
Bursera simaruba	1.154	0	0.056
Calophyllum brasiliense	1.399	0	0.023
Cecropia obtusifolia	1.318	0	0.072
Dialium guianense	1.610	0	0
Enterolobium cyclocarpum	1.148	0	0.068
Guarea glabra	1.347	0	0.073
Guateria anomala	1.719	0	0
Heliocarpus donnell-smithii	1.203	0	0.063
Licania platypus	1.303	0	0.154
Magnolia mexicana	1.433	0	0.133
Manilkara zapota	1.223	0	0.059
Pouteria campechiana	1.343	0	0.047
Schefflera morototoni	1.413	0	0.2
Spondias mombin	1.282	0	0.06
Swietenia macrophylla	1.388	0	0.068
Tabebuia rosea	1.231	0	0.082
Terminalia amazonia	1.291	0	0.152
Vatairea lundellii	1.245	0	0.15
Vochysia guatemalensis	1.448	0	0.154

AUC: area under the curve, pval (p-valor) refers to partial ROC (partial Receiver Operating Characteristic).

SM5: Complements to Mapping the potential distribution and percentage changes

Remember that the threshold used to delimiting the distributional area of the species was used a 0.3 presence likelihood from the Maxent model obtained with the Kuenm package.

Relation betwen distribution area and area under the curve

We noted that mean of the Area Under the Curve (AUC) from the 10 replicates had a interesting relation with the defined species distribution area. For that, we included the Table 15 and the Figure 31 to illustrate this condition.

Table 15: Mean AUC and current potential distribution area.

Species	**mean AUC**	**SD of AUC**	**CPDA (km^2)**
Annona glabra (-)	0.796	0.037	
Annona glabra (+)	0.850	0.015	211 320
Aspidosperma megalocarpon	0.804	0.022	226 230
Brosimum alicastrum	0.826	0.005	270 830
Bursera simaruba	0.785	0.002	460 760
Calophyllum brasiliense	0.865	0.006	134 890
Cecropia obtusifolia	0.806	0.004	353 300
Dialium guianense	0.883	0.011	65 660
Enterolobium cyclocarpum	0.730	0.006	550 400
Guarea glabra	0.873	0.006	170 430
Guatteria anomala	0.810	0.030	212 250
Heliocarpus donnell-smithii	0.775	0.008	389 490
Licania platypus	0.884	0.017	220 230
Magnolia mexicana	0.894	0.009	95 180
Manilkara zapota	0.805	0.008	210 010
Pouteria campechiana	0.860	0.005	134 890
Schefflera morototoni	0.924	0.007	120 100
Spondias mombin	0.801	0.003	351 590
Swietenia macrophylla	0.880	0.005	137 850
Tabebuia rosea	0.749	0.008	517 950
Terminalia amazonia	0.900	0.006	82 010
Vatairea lundellii	0.865	0.014	65 930
Vochysia guatemalensis	0.952	0.002	90 110

AUC: area under the curve. SD: Standard deviation. CPDA: current potential distribution area. We include an example without using of Kuenm package (-) to note that it improves the mean AUC when this is used (+).

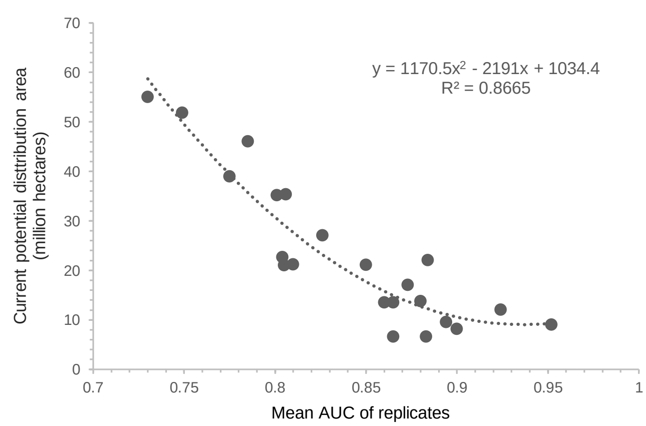


Figure 31: Mean AUC and currente potential distribution area.

Comparation betwen this and other study (Pennington y Sarukán, 2005)

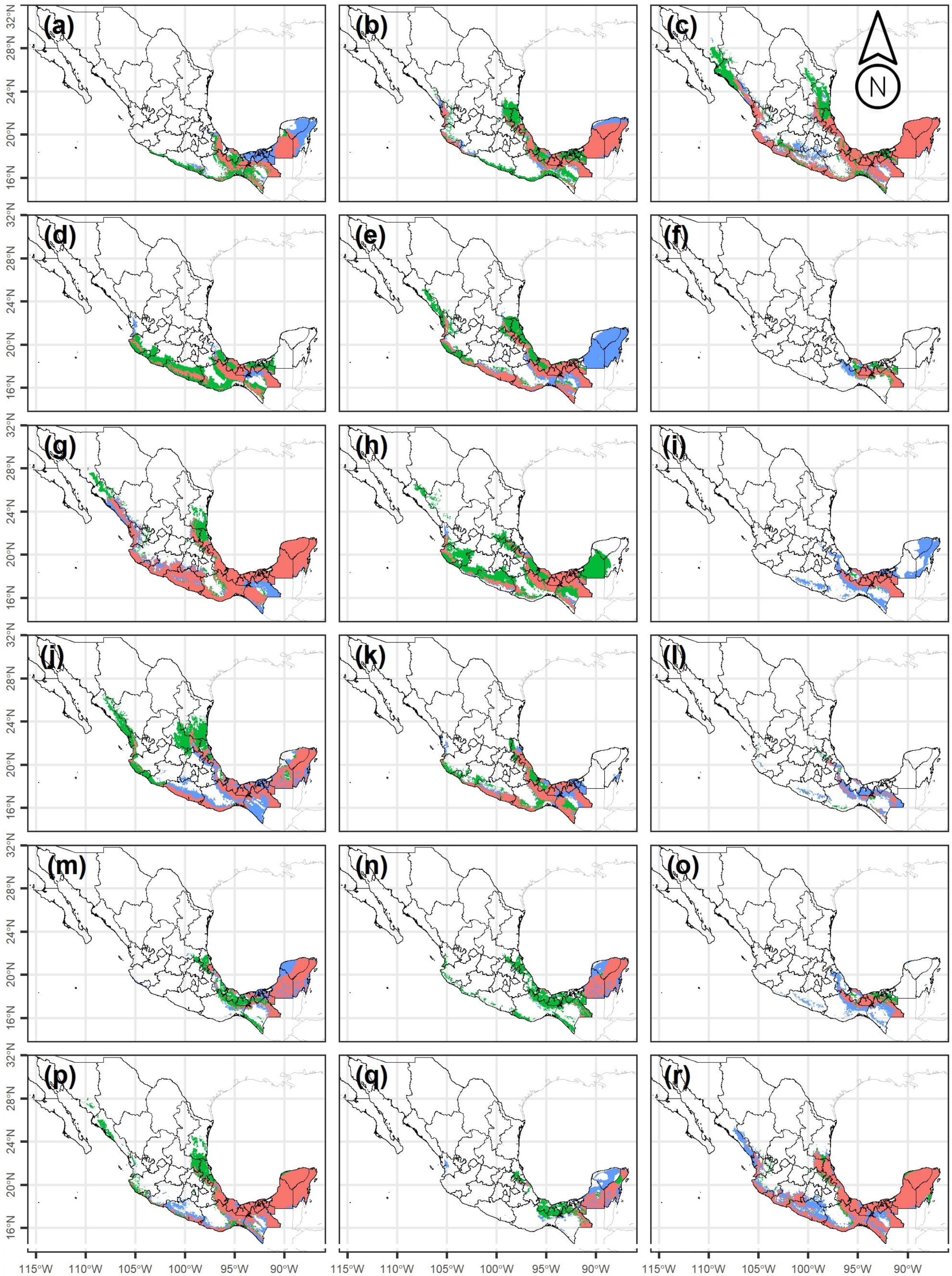
Figure 32: Comparative one

Species	CPDA in this study (km²)	CPDA in PyS (2005) (km²)	% Indicated in this study /Coincidence	% Indicated in PyS (2005) /Coincidence
Aspidosperma megalocarpon	226,227	202,465	78.8	60.0
Brosimum alicastrum	270,835	359,354	21.4	61.1
Bursera simaruba	460,765	522,891	20.9	37.2
Calophyllum brasiliense	134,888	273,668	21.5	146.4
Cecropia obtusifolia	353,304	300,209	96.4	66.9
Dialium guianense	65,663	66,562	44.1	46.1
Enterolobium cyclocarpum	550,402	529,113	22.1	17.4
Guarea glabra	170,426	411,564	11.5	169.2
Guatteria anomala	212,249	83,901	163.0	3.9
Heliocarpus donnell-smithii	389,493	393,664	62.6	64.4
Licania platypus	220,228	236,910	38.5	49.0
Magnolia mexicana	95,182	36,784	254.3	36.9
Manilkara zapota	210,010	206,226	55.9	53.1
Pouteria campechiana	134,887	225,563	42.8	138.8
Schefflera morototoni	120,104	71,266	122.9	32.3
Spondias mombin	351,594	378,907	23.7	33.3
Swietenia macrophylla	137,850	136,609	88.3	86.6
Tabebuia rosea	517,953	414,633	36.5	9.3
Terminalia amazonia	82,014	63,116	83.8	41.5
Vatairea lundellii	65,925	84,873	28.9	65.9
Vochysia guatemalensis	90,106	84,925	39.5	31.4

CPDA: current potential distribution area

Figure 33: Comparative two

Species	Coincidence in both (km²)	Only indicated in this study (km²)	Only indicated in PyS (2005) (km²)	%Variation in this study	% Variation in PyS (2005)
Aspidosperma megalocarpon	126,527	99,700	75,938	44.1	37.5
Brosimum alicastrum	223,067	47,767	136,287	17.6	37.9
Bursera simaruba	381,109	79,656	141,782	17.3	27.1
Calophyllum brasiliense	111,056	23,832	162,612	17.7	59.4
Cecropia obtusifolia	179,871	173,433	120,338	49.1	40.1
Dialium guianense	45,555	20,108	21,007	30.6	31.6
Enterolobium cyclocarpum	450,706	99,697	78,407	18.1	14.8
Guarea glabra	152,871	17,555	258,694	10.3	62.9
Guatteria anomala	80,717	131,532	3,184	62.0	3.8
Heliocarpus donnell-smithii	239,499	149,994	154,165	38.5	39.2
Licania platypus	158,971	61,256	77,939	27.8	32.9
Magnolia mexicana	26,861	68,321	9,923	71.8	27.0
Manilkara zapota	134,673	75,337	71,553	35.9	34.7
Pouteria campechiana	94,446	40,441	131,117	30.0	58.1
Schefflera morototoni	53,888	66,216	17,379	55.1	24.4
Spondias mombin	284,286	67,308	94,620	19.1	25.0
Swietenia macrophylla	73,197	64,652	63,412	46.9	46.4
Tabebuia rosea	379,413	138,540	35,220	26.7	8.5
Terminalia amazonia	44,616	37,398	18,500	45.6	29.3
Vatairea lundellii	51,159	14,766	33,714	22.4	39.7
Vochysia guatemalensis	64,610	25,497	20,316	28.3	23.9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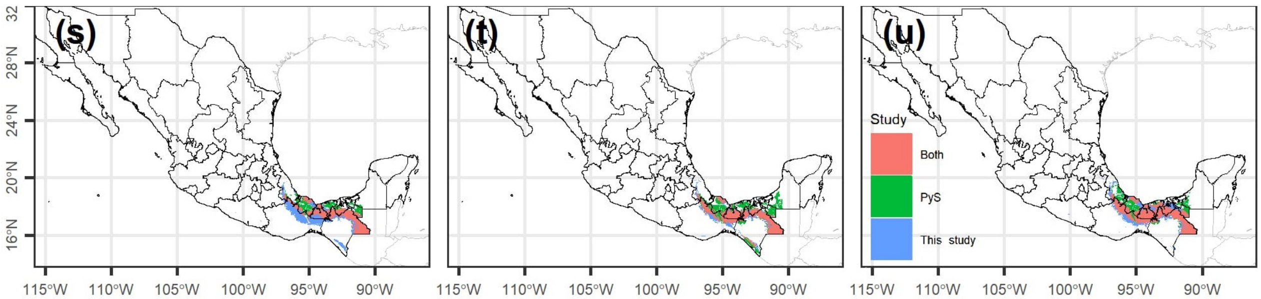


Figure 34: Figura 22. Comparation of the potential distribution of 21 species considered in this study vs Pennington y Sarukhán (2005). (a) *Aspidosperma megalocarpon*, (b) *Brosimum alicastrum*, (c) *Bursera simaruba*, (d) *Calophyllum brasiliense*, (e) *Cecropia obtusifolia*, (f) *Dialium guianense*, (g) *Enterolobium cyclocarpum*, (h) *Guarea glabra*, (i) *Guatteria anomala*, (j) *Heliocarpus donnell-smithii*, (k) *Licania platypus*, (l) *Magnolia mexicana*, (m) *Manilkara zapota*, (n) *Pouteria campechiana*, (o) *Schefflera morototoni*, (p) *Spondias mombin*, (q) *Swietenia macrophylla*, (r) *Tabebuia rosea*, (s) *Terminalia amazonia*, (t) *Vatairea lundellii* y (u) *Vochysia guatemalensis*. Observe that *Annona glabra* is not included because those autors not consider it in their study.

What are in the current potential distribution area of Tropical rainforest now?

We merge the assembly map with the land use and vegetacion map of Mexico (INEGI, 2016) to examinate what are in the area where at least 14 species can live (Table 16). Rememerber that *selva alta perennifolia* refers to the Tropical rainforest, *bosque mesófilo de montaña* refers to the cloud forest.

Table 16: What are in the area of potential distribution of the species of the Tropical rainforest?

Class of land use and vegetation type	All class (km^2)	1 a 7 spp. (km^2)	8 a 13 spp. (km^2)	14 a 22 spp. (km^2)	14 a 22 spp. (%)	Reached (% class)
Pastizal cultivado	133152.8	32407.3	33828.8	30573.4	35.1	23.0
Selva alta perennifolia	12248.9	49.3	234	11930.7	13.7	97.4
V.s. arbórea de selva alta perennifolia	9406.5	373.9	776.7	8249.2	9.5	87.7
V.s. arbustiva de selva alta perennifolia	8706.7	1359.1	1362.2	5972	6.9	68.6
Agr. de temporal permanente	14784.4	4392.2	4664.9	3860.4	4.4	26.1
Agr. de temporal anual	175310.6	34375.3	10867.8	2813.8	3.2	1.6
Agr. de temporal semipermanente	8223.5	3283.8	2078	2731.3	3.1	33.2
V.s. arbustiva de B.M.M.	4911.7	1717.2	1308.3	1773.5	2	36.1
Agr. de temporal anual y permanente	16879.8	6812.8	2383.1	1582.8	1.8	9.4
Agua	1101689.3	4111.5	1754	1560.5	1.8	0.1
B.M.M.	8241.4	2901.6	3019.2	1553.7	1.8	18.9
Agr. de temporal anual y semiperma.	8211.8	4666.1	1011.8	1411.1	1.6	17.2
V.s. arbórea de bosque de pino-encino	14353.7	4191.2	1979.6	1377.6	1.6	9.6
V.s. arbórea de B.M.M.	4721.4	1593	1643.6	1368.7	1.6	29
Agr. de temporal semipermanente y per.	3062.7	777.7	1005.3	1203.3	1.4	39.3
Bosque de pino-encino	52163.2	6589.3	4844.8	1064.1	1.2	2
Urbano construido	21846.6	3655.3	2394.6	869.5	1	4
Tular	9278.5	1130	6972.8	845.6	1	9.1
V.s. arbustiva de bosque de pino-encino	19539.6	5990.5	3009.3	758	0.9	3.9
Popal	1516.6	27.4	827.1	657.7	0.8	43.4
Pastizal inducido	57476.6	12956.8	2941.6	656.5	0.8	1.1
Agr. de humedad anual	1174.1	53	129.1	453.7	0.5	38.6
Sabana	1454.6	125.4	945.2	382.7	0.4	26.3
V.s. herbácea de B.M.M.	519.9	152.2	174	193.7	0.2	37.2
Remaining	**270373.1**	**166543.2**	**125640.9**	**3304.6**	**3.8**	**1.2**
Total	**1959248**	**300235.4**	**215796.9**	**87148**	**100**	**4.4**

V.s.: *Vegetación secundaria* is the secondary vegetation referred to the earlier successional stage respect to the old-growth, climax or primary vegetation. Agr.: *Agricultura* = Farming or agriculture. B.M.M.: *Bosque mesófilo de montaña* refers to the cloud forest vegetation.

Expected changes in the potential distribution in the HADGEM2_ES and GDFL_CM3 climate change scenarios at the species level are in the Figures 35 and 36 respectively.

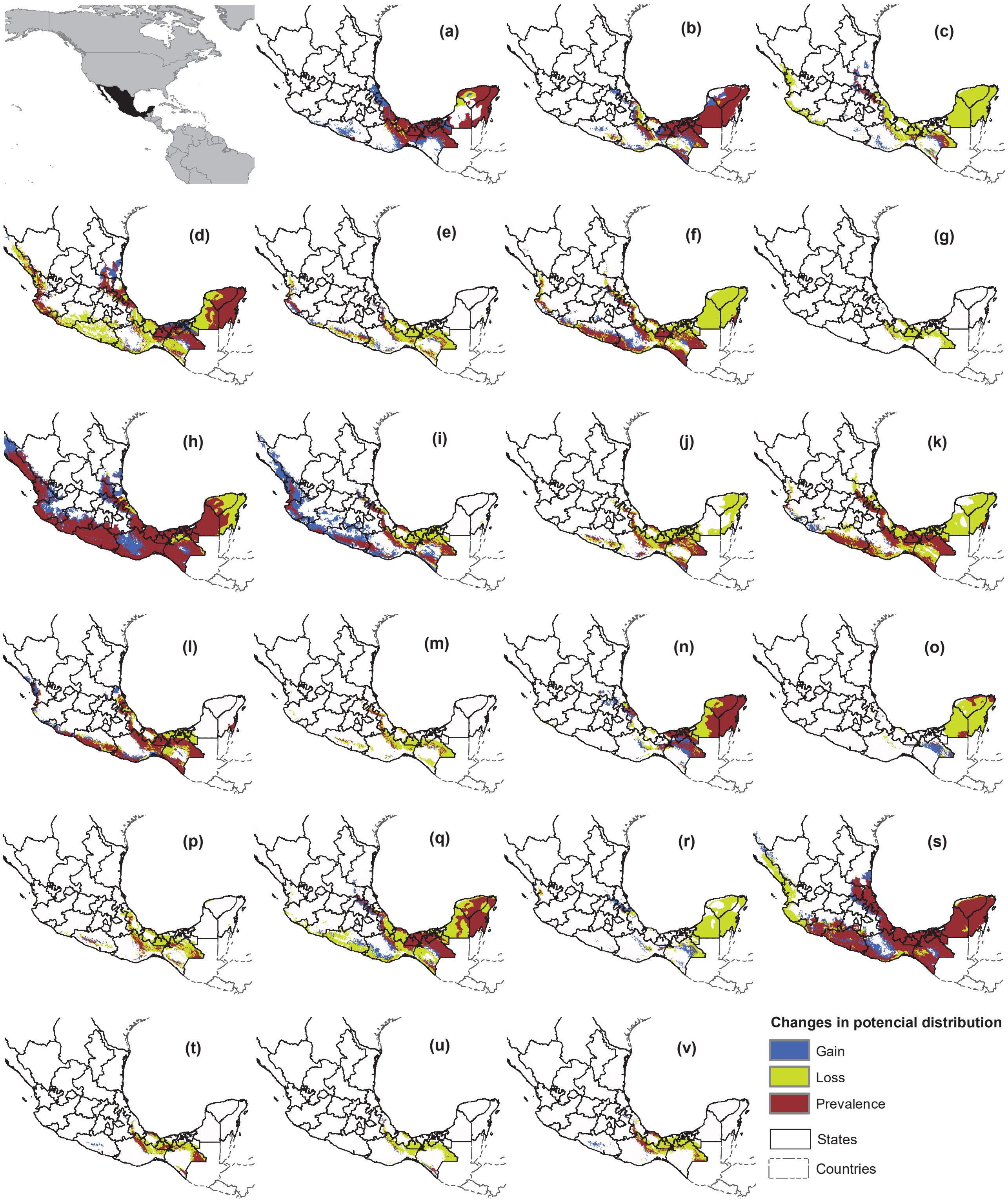


Figure 35: Expected changes in the species potential distribution in the HADGEM_2 RCP 8.5 climate change scenario. (a) *Annona glabra*, (b) *Aspidosperma megalocarpon*, (c) *Brosimum alicastrum*, (d) *Bursera simaruba*, (e) *Calophyllum brasiliense*, (f) *Cecropia obtusifolia*, (g) *Dialium guianense*, (h) *Enterolobium cyclocarpum*, (i) *Guarea glabra*, (j) *Guatteria anomala*, (k) *Heliocarpus donnell-smithii*, (l) *Licania platypus*, (m) *Magnolia mexicana*, (n) *Manilkara zapota*, (o) *Pouteria campechiana*, (p) *Schefflera morototoni*, (q) *Spondias mombin*, (r) *Swietenia macrophylla*, (s) *Tabebuia rosea*, (t) *Terminalia amazonia*, (u) *Vatairea lundellii* and (v) *Vochysia guatemalensis*.

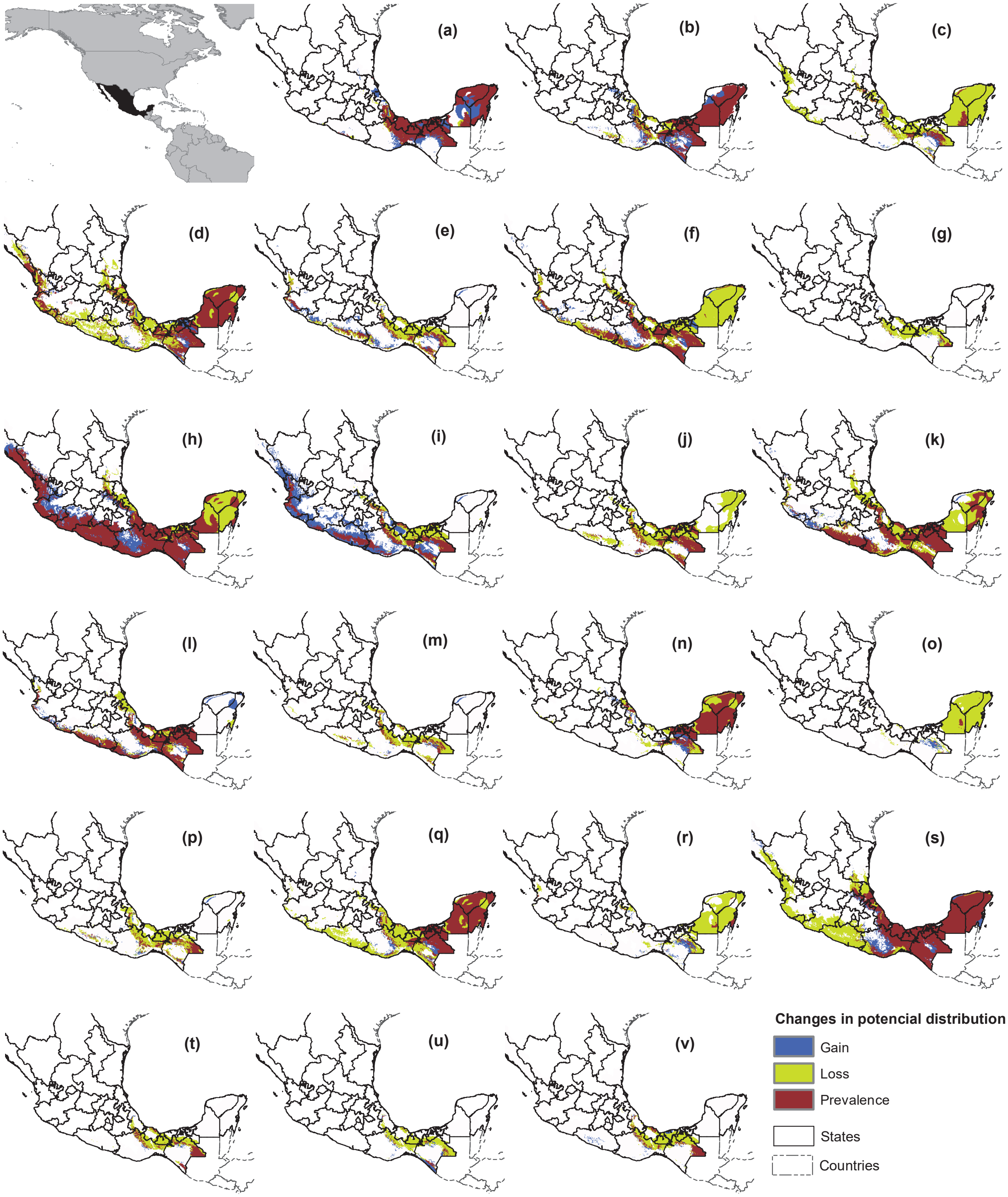


Figure 36: Expected changes in the species potential distribution in the GFDL_CM3 RCP 8.5 climate change scenario. (a) *Annona glabra*, (b) *Aspidosperma megalocarpon*, (c) *Brosimum alicastrum*, (d) *Bursera simaruba*, (e) *Calophyllum brasiliense*, (f) *Cecropia obtusifolia*, (g) *Dialium guianense*, (h) *Enterolobium cyclocarpum*, (i) *Guarea glabra*, (j) *Guatteria anomala*, (k) *Heliocarpus donnell-smithii*, (l) *Licania platypus*, (m) *Magnolia mexicana*, (n) *Manilkara zapota*, (o) *Pouteria campechiana*, (p) *Schefflera morototoni*, (q) *Spondias mombin*, (r) *Swietenia macrophylla*, (s) *Tabebuia rosea*, (t) *Terminalia amazonia*, (u) *Vatairea lundellii* and (v) *Vochysia guatemalensis*.

Table 17: Coincident areas (km^2) of the current potential distributions with respect to the HADGEM2_ES climate change scenario.

	Current			
HADGEM2_ES	1 to 7 species	8 to 13 species	14 to 22 species	**Sum**
1 to 7 species	27 7988.68 (46.13 %)	191 119.68 (31.72 %)	21 515.76 (3.57 %)	**490 624.12 (81.42 %)**
8 to 13 species	19 581.56 (3.25 %)	18 761.85 (3.11 %)	47 629.95 (7.90 %)	**85 973.37 (14.27 %)**
14 to 22 species	2 177.31 (0.36 %)	5 801.71 (0.96 %)	17 991.26 (2.99 %)	**25 970.28 (4.31 %)**
Sum	**299 747.56 (49.75 %)**	**215 683.24 (35.79 %)**	**87 136.97 (14.46 %)**	**602 567.76 (100 %)**

Table 18: Coincident areas (km^2) of the current potential distributions with respect to the GFDL_CM3 climate change scenario.

	Current			
GFDL_CM3	1 to 7 species	8 to 13 species	14 to 22 species	**Sum**
1 to 7 species	284 519.69 (47.22 %)	169 571.83 (28.14 %)	34 524.77 (5.73 %)	**488 616.30 (81.09 %)**
8 to 13 species	13 210.20 (2.19 %)	41 999.27 (6.97 %)	33 701.81 (5.59 %)	**88 911.27 (14.76 %)**
14 to 22 species	2 017.40 (0.33 %)	4 111.93 (0.68 %)	18 910.39 (3.14 %)	**25 039.72 (4.16 %)**
Sum	**299 747.29 (49.75 %)**	**215 683.03 (35.79 %)**	**87 136.97 (14.46 %)**	**602 567.29 (100 %)**

Table 19: Coincident areas (km^2) of the future potential distributions: by two climate change scenarios.

	HADGEM2_ES			
GFDL_CM3	1 to 7 species	8 to 13 species	14 to 22 species	**Sum**
1 to 7 species	194.84 (1.2 %)	379.36 (2.2 %)	187.47 (1.1 %)	**761.67 (4.5 %)**
8 to 13 species	425.38 (2.5 %)	3 983.86 (23.6 %)	1 169.17 (6.9 %)	**5 578.41 (33.1 %)**
14 to 22 species	8.27 (0 %)	2 698.32 (16.01 %)	7 815.76 (46.4 %)	**10 522.35 (62.4 %)**
Sum	**628.49 (3.7 %)**	**7 061.54 (41.9 %)**	**9 172.40 (54.4 %)**	**16 862.43 (100 %)**

Expected changes in the potential distribution of the species of coincident area

Expected changes in the potential distribution of the geographically coincident species within the current distribution area of Tropical rainforest are shown in the Figure38. Some similar information is shown in the Figures 37 and 39.

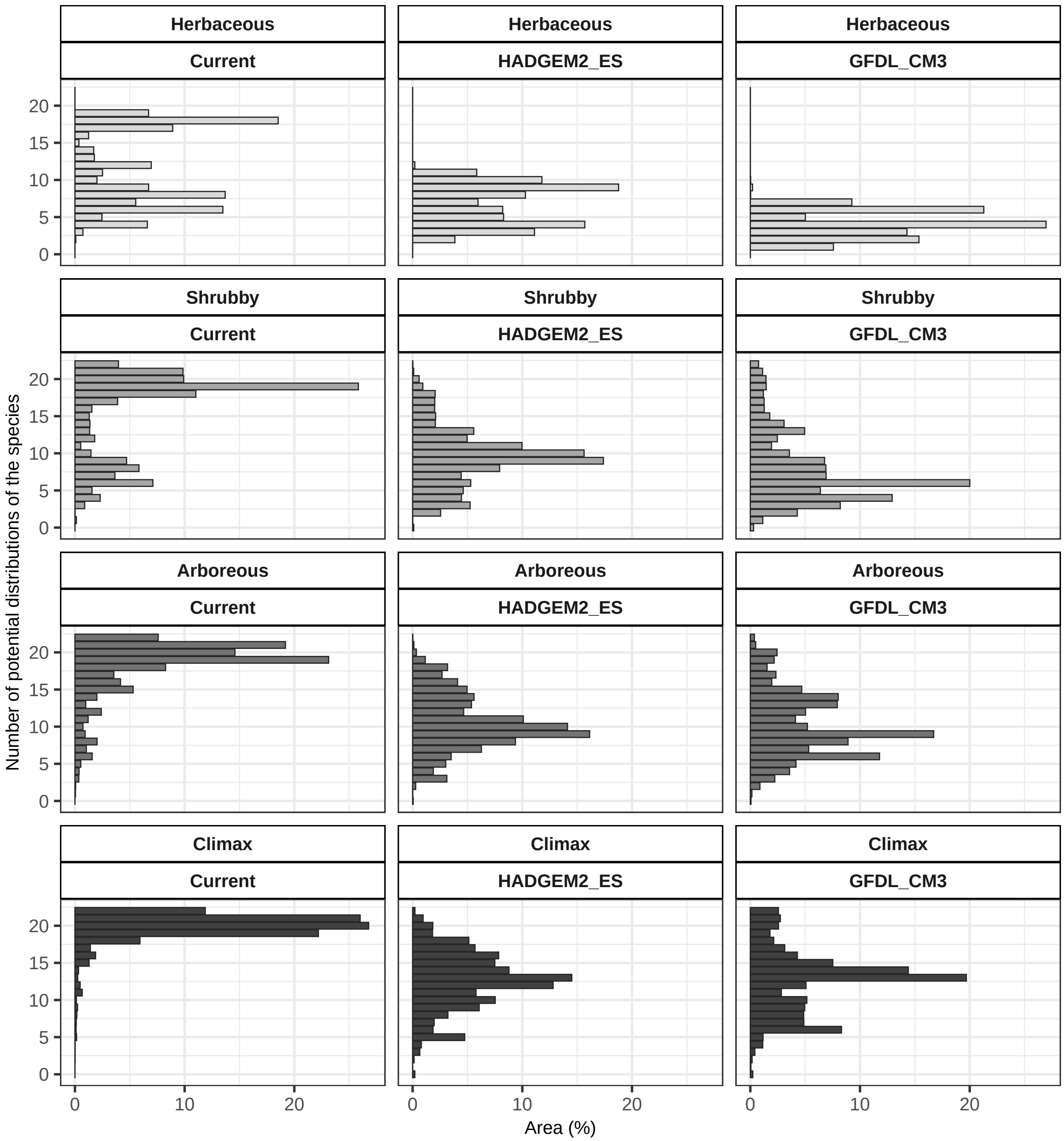


Figure 37: Percent (%) of potential distributions of the studied species within the areas of the successional stages of the Tropical rainforest in each scenario.

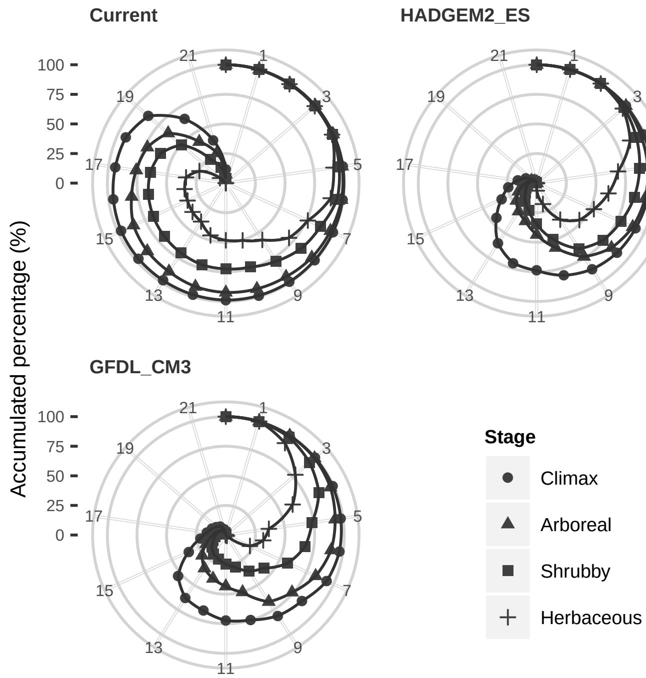
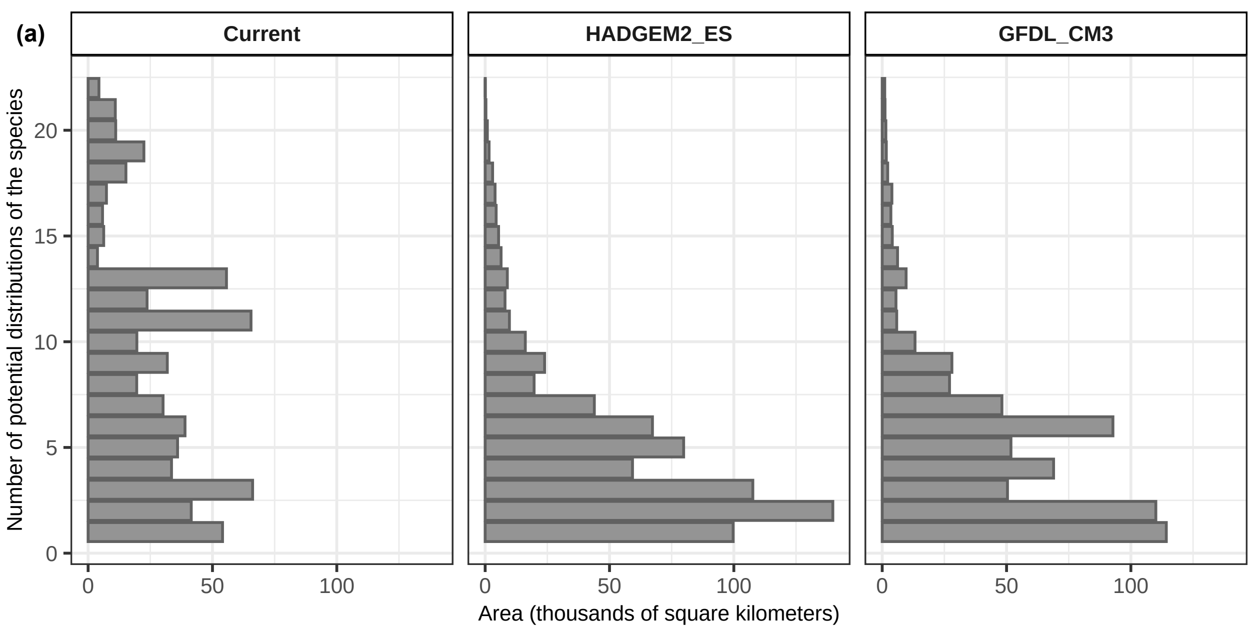


Figure 38: Expected changes (%) in the potential distribution of the studied species within the current distributional area of Tropical rainforest in Mexico. *Here, we show the accumulated percent of areas by successional stage and scenario. In the axis ticks of the radar plot is found the matching (geographically) potential distributions.* That is, what changes are expected in the PDs within the area that the TR occupies in 2016. To obtain these graphs, the assembles of each scenario were clipped based on the current TR, its geodetic area was calculated and then the accumulated percentage by successional stage was obtained.



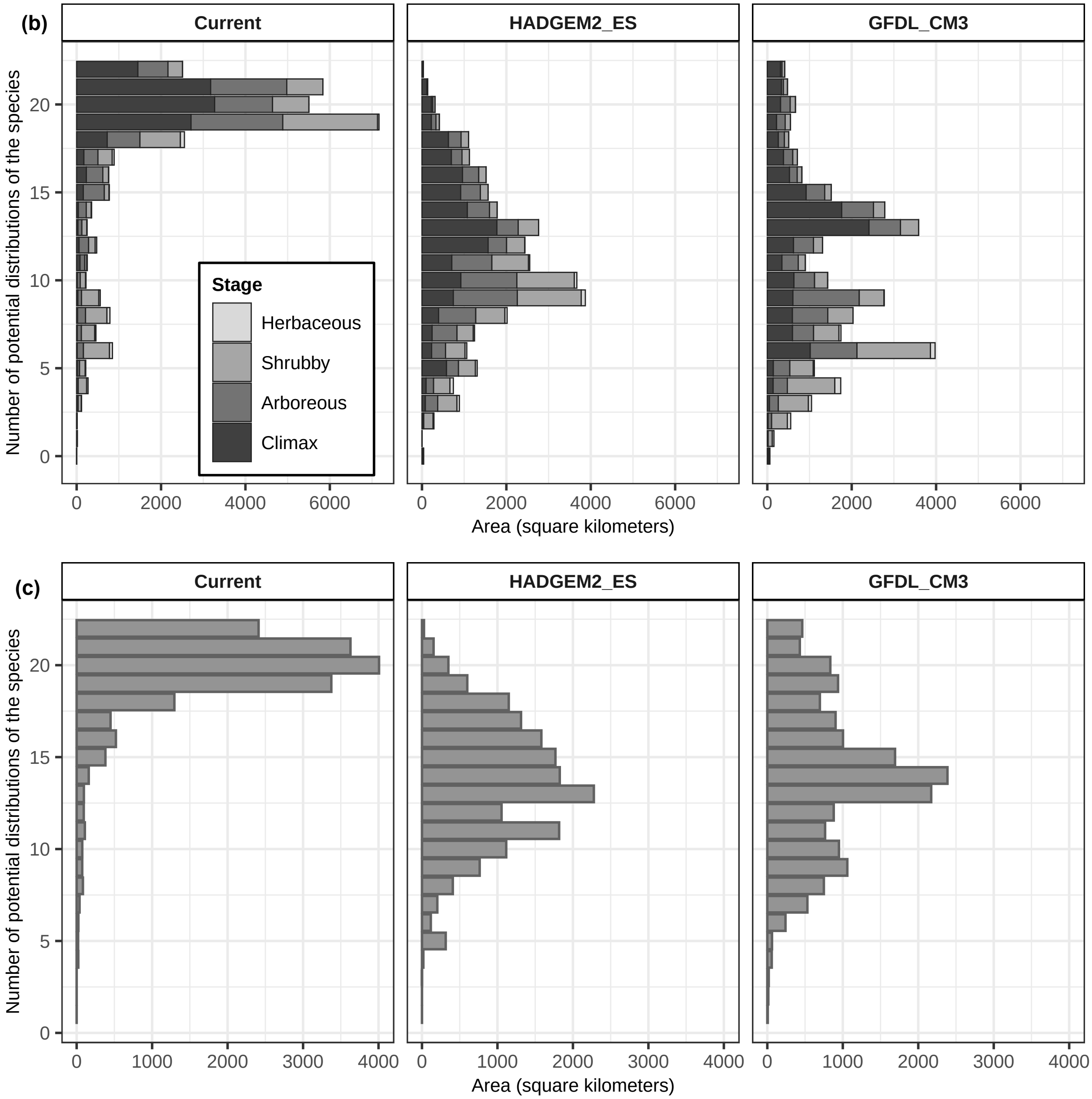


Figure 39: Potential distributions of the species. Within (a) All country, (b) Tropical rainforest and (c) Proposed areas for conservation

In addition to what is shown in the previous figure (Figure 39 (c)), there is the following figure (Figure 40) where the same information is observed (areas of common distribution of the species within the conservation proposal) but in a percentage way.

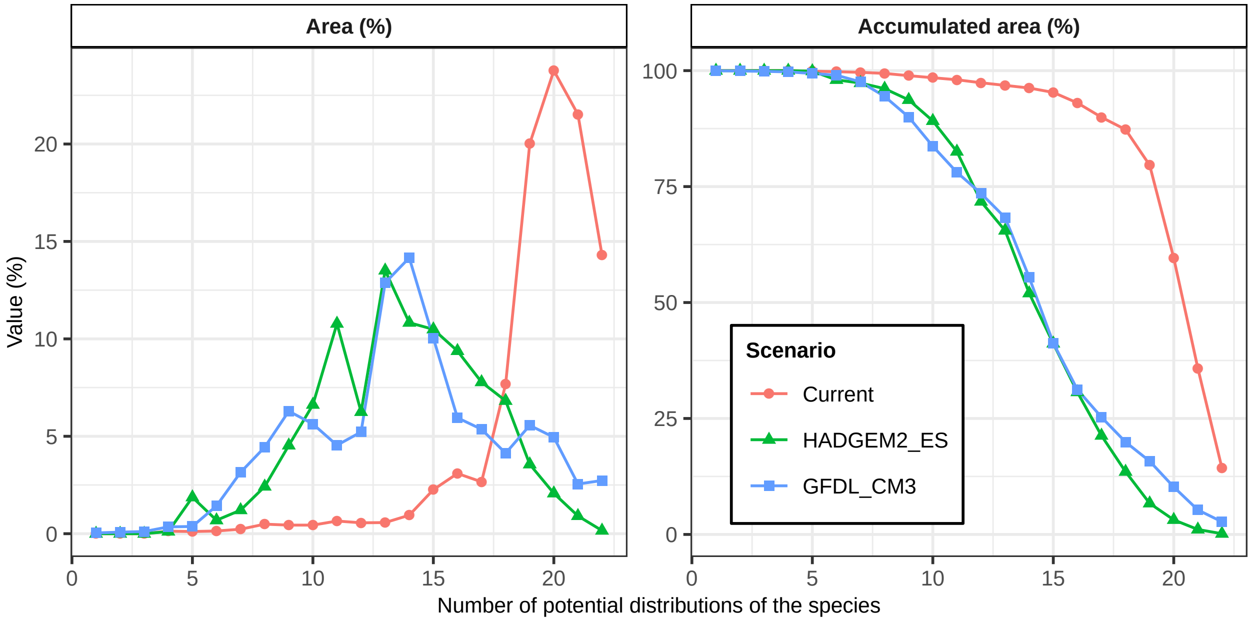


Figure 40: Potential distributions within the proposed areas for Tropical rainforest conservation

Table 20: Class of land use and vegetation type within the proposed areas for Tropical rainforest conservation.

Class of land use and vegetation type	Area (km^2)	Area (%)	Accumulated area (%)	All class (km^2)	Reached (% of class)
Selva alta perennifolia	5 122.62	30.4	30.4	12 248.9	41.8
V.s. arbórea de selva alta perennifolia	3 290.06	19.5	49.9	9 406.5	35
Pastizal cultivado	2 898.74	17.2	67.1	133 152.8	2.2
V.s. arbustiva de selva alta perennifolia	1 627.49	9.7	76.8	8 706.7	18.7
B.M.M.	769.68	4.6	81.4	8 241.4	9.3
Agr. de temporal permanente	677.18	4	85.4	14 784.4	4.6
Agr. de temporal anual y permanente	610.07	3.6	89	16 879.8	3.6
Agr. de temporal anual	546.1	3.2	92.2	175 310.6	0.3
V.s. arbórea de B.M.M.	313.49	1.9	94.1	4 721.4	6.6
V.s. arbustiva de B.M.M.	285.19	1.7	95.8	4 911.7	5.8
Agr. de temporal semipermanente y permanente	159.34	0.9	96.7	3 062.7	5.2
Pastizal inducido	112.79	0.7	97.4	57 476.6	0.2
Agua	70.42	0.4	97.8	1 101 689.3	0
Agr. de temporal semipermanente	57	0.3	98.1	82 23.5	0.7
Urbano construido	49.66	0.3	98.4	21 846.6	0.2
Agr. de temporal anual y semipermanente	41.52	0.2	98.6	8 211.8	0.5
Bosque de pino	41.46	0.2	98.8	49 471.5	0.1
Bosque de encino-pino	35.06	0.2	99	29 679.6	0.1
Bosque de pino-encino	32.15	0.2	99.2	52 163.2	0.1
Agr. de humedad anual y semipermanente	26.49	0.2	99.4	279.2	9.5
V.s. arbórea de bosque de pino-encino	17.15	0.1	99.5	14 353.7	0.1
V.s. arbustiva de bosque de encino	10.43	0.1	99.6	40 681.6	0
V.s. arbórea de bosque de pino	9.73	0.1	99.7	14 353.7	0.1
V.s. arbustiva de bosque de pino-encino	9.15	0.1	99.8	19 539.6	0
V.s. arbórea de selva mediana subperennifolia	9.09	0.1	99.9	33 056.6	0
Sabana	6.56	0.04	99.94	1 454.6	0.5
Tular	6.01	0.04	99.98	9 278.5	0.1
V.s. arbórea de bosque de encino	5.35	0.03	100	8 191.6	0.1
V.s. arbórea de bosque de encino-pino	5.09	0.03	100	4 097.7	0.1
V.s. arbustiva de selva mediana subperennifolia	4.84	0.03	100	7 071.8	0.1
Selva mediana subperennifolia	2.7	0.02	100	14 322.1	0
Sin vegetación aparente	1.87	0.01	100	9 710.8	0
Total	**16 854.48**	**100**			

V.s.: *Vegetación secundaria* is the secondary vegetation referred to the earlier successional stage respect to the old-growth, climax or primary vegetation. Agr.: *Agricultura* = Farming or agriculture. B.M.M.: *Bosque mesófilo de montaña* refers to the cloud forest vegetation. All categories are the corresponding with INEGI (2016).
References that appear in supplementary material are found in the main text.