

Supplementary Materials

Table S1. Characteristics of the existing native vegetation maps covering the entire Brazilian Cerrado and produced by semi-automatic methods and visual interpretation of varying remote sensing data.

Reference	Period mapped	NV classes mapped	Sensor	Spatial resolution (m)
Sano et al. (2010)	2002	Forestland, shrubland, and grassland	Landsat	30
INPE (2015)	2013	Woodland and grassland	Landsat	30
FBDS (2019)	2013	Woodland and grassland	RapidEye	5
MCTI (2015)	1994, 2002, and 2010	Forest and grassland	Landsat	30
IBGE (2017)	2000, 2010, 2012, and 2014	Forest, wetland, and grassland	MODIS	250

Table S2. Scripts used in the initial and final statistical decision tree classification of the native Cerrado vegetation.

Collections	Link to the scripts
Initial SDT Classification 2000-2016	https://code.earthengine.google.com/86886767242e9163a32ed709765cef03
Final SDT Classification 1985-2017	https://code.earthengine.google.com/f66091f3709acde232b0b6baef174466

Table S3. Spectral metrics, indexes, and other variables used to train the Random Forest SDT classification.

Number	Variable	Initial SDT Classification	Final SDT Classification
		2000 - 2016	1985 - 2017
1	Blue		x
2	Blue dry season		x
3	Blue wet season		x
4	Green		x
5	Green dry season		x
6	Green wet season		x
7	Red		x
8	Red dry season		x
9	Red wet season		x
10	Near infrared (NIR)		x
11	NIR dry season		x
12	NIR wet season		x
13	Shortwave infrared-1 (SWIR-1)		x
14	SWIR-1 dry season		x
15	SWIR-1 wet season		x
16	Shortwave infrared-2 (SWIR-2)		x
17	SWIR-2 dry season		x
18	SWIR-2 wet season		x
19	EVI2		x
20	EVI2 dry season		x
21	EVI2 wet season		x
22	GV	x	x
23	GVS	x	x
24	GVS dry season		x
25	GVS wet season		x
26	NPV	x	x
27	Soil	x	x
28	Shade	x	x
29	NDFI		x
30	NDFI dry season		x
31	NDFI wet season		x
32	NDVI		x
33	NDVI dry season		x
34	NDVI wet season		x
35	NDWI		x
36	NDWI dry season		x
37	NDWI wet season		x
38	SAVI		x
39	SAVI dry season		x
40	SAVI wet season		x
41	SEFI	x	x
42	SEFI dry season		x
43	SEFI wet season		x
44	Delta SEFI	x	x
45	SEFI entropy		x
46	Slope	x	x

Table S4. Rules of the temporal filters applied to classify native Cerrado vegetation. RG = General Rule; RP = First Year Rule; RU = Last Year Rule; FF = Forest; SV = Savanna; GL = Grassland; AG = Mosaic of Agriculture and Pasture; AR = Rocky Outcrop; WB = Water; and NO = Non-Observed.

ID	Rules	ID	Rules	ID	Rules
1	FF-NO-FF	32	GL-GL-NO	63	FF-GL-FF
2	FF-FF-AG-FF-FF	33	GL-GL-AG-GL-GL	64	RO-RO-NO
3	FF-FF-GL-FF-FF	34	GL-GL-AG-AG-GL	65	RO-RO-SV-RO-RO
4	FF-FF-SV-FF-FF	35	GL-GL-FF-FF-GL	66	RO-RO-FF-RO-RO
5	FF-FF-AG-AG-FF	36	GL-GL-SV-SV-GL	67	RO-RO-FF-RO-RO
6	FF-GL-FF	37	GL-GL-RO-GL-GL	68	WB-NO-WB
7	SV-NO-SV	38	GL-GL-SV-GL-GL	69	WB-NO-AG
8	SV-NO-AG	39	GL-GL-FF-GL-GL	70	WB-NO-FF
9	SV-NO-FF	40	GL-GL-FF-AG-AG	71	WB-NO-GL
10	SV-NO-GL	41	FF-NO-NO	72	WB-NO-NO
11	SV-NO-NO	42	AG-NO-AG	73	WB-NO-RO
12	SV-NO-RO	43	AG-NO-FF	74	FF-NO-WB
13	SV-NO-WB	44	AG-NO-GL	75	WB-NO-SV
14	FF-NO-AG	45	AG-NO-NO	76	WB-WB-NO
15	SV-SV-NO	46	AG-NO-RO	77	NO-FF-FF
16	SV-SV-AG-SV-SV	47	AG-NO-SV	78	NO-SV-SV
17	SV-SV-FF-SV-SV	48	AG-NO-WB	79	NO-GL-GL
18	SV-SV-GL-SV-SV	49	AG-AG-NO	80	NO-AG-AG
19	SV-SV-RO-SV-SV	50	AG-AG-FF-GL-GL	81	NO-WB-WB
20	SV-FF-SV	51	FF-NO-RO	82	NO-RO-RO
21	SV-GL-SV	52	AG-AG-RO-AG-AG	83	AG-AG-FF-FF-AG
22	GL-NO-GL	53	AG-AG-SV-AG-AG	84	FF-FF-NO
23	GL-FF-GL	54	AG-AG-FF-AG-AG	85	AG-AG-GL-GL-AG
24	GL-SV-GL	55	RO-NO-RO	86	FF-FF-GL-GL-FF
25	GL-NO-AG	56	RO-NO-AG	87	FF-FF-SV-SV-FF
26	GL-NO-FF	57	RO-NO-FF	88	SV-SV-AG-AG-SV
27	FF-NO-GL	58	RO-NO-GL	89	SV-SV-GL-GL-SV
28	GL-NO-NO	59	RO-NO-NO	90	SV-SV-FF-FF-SV
29	GL-NO-RO	60	RO-NO-SV	91	AG-AG-SV-SV-AG
30	GL-NO-SV	61	RO-NO-WB	92	FF-FF-RO-FF-FF
31	GL-NO-WB	62	FF-SV-FF		

Table S5. Confusion matrix of NV classes at level 2. Other land cover classes include agriculture and pasture fields and non-vegetated areas. UA = user's accuracy; PA = producer's accuracy.

Level 2		Reference						
		Forest	Savanna	Grassland	Other	Water	Total	UA (%)
Classification	Forest	3011	925	46	416	14	4412	68%
	Savanna	785	3559	533	1072	11	5960	60%
	Grassland	36	995	923	540	4	2498	37%
	Other	157	324	210	7420	6	8117	91%
	Water	8	1	3	5	58	75	77%
	Total	3997	5804	1715	9453	93	21062	
PA (%)		75%	61%	54%	78%	62%		71%

Table S6. Omission and commission errors of the 33 classified maps.

Classes	Omission error (%)			Commission error (%)		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Forest	24.6	23.7	25.1	31.6	29.9	33.5

Savanna	38.5	36.9	42.5	40.4	34.6	43.7
Grassland	45.9	41.7	52.3	63.0	61.6	64.0

Table S7. State-level distribution of native vegetation (NV) and NV net loss from 1985 to 2017.

State	State's Area Covered by the Cerrado biome (ha)	NV (1985) (ha)	NV (2017) (ha)	NV (2017) (%)	NV Net Loss (1985 – 2017) (ha)	Total NV Net Loss (1985 – 2017) (%)	Total Net Loss Rate	Net Loss Rate per Year
MT	35,245,731	27,121,518	21,049,814	19	6,071,705	25	22	0.68
TO	25,222,680	22,527,443	19,449,123	18	3,078,321	13	14	0,41
MA	20,315,832	19,168,968	16,666,214	15	2,502,754	10	13	0,40
MG	33,554,556	17,390,472	15,489,956	14	1,900,515	8	11	0.33
GO	33,163,828	17,410,844	13,182,362	12	4,228,483	17	24	0.74
BA	15,096,665	11,677,023	10,026,809	9	1,650,214	7	14	0.43
MS	21,963,621	10,903,381	6,687,333	6	4,216,047	17	39	1.17
PI	9,636,163	5,014,028	4,460,708	4	553,320	2	11	0.33
SP	7,760,034	1,208,720	1,123,028	1	85,692	0	7	0.21
DF	578,028	331,761	305,918	0	25,844	0	8	0.24
PR	372,040	88,964	120,465	0	31,501	0	-35	-1.07
PA	39,043	18,742	18,569	0	173	0	1	0.03
RO	15,642	15,499	14,114	0	1,385	0	9	0.27
TOTAL	202,963,863	132,877,365	108,594,413	100	24,282,952	100	18	0.55

Table S8. Distribution of the native Cerrado vegetation (NV) inside protected areas (indigenous lands and conservation units) from 1985 to 2017.

Classes	Area (ha) (1985)	Area (ha) (2017)	Percentage (%) (1985)	Percentage (%) (2017)
Forest	6,988,356	6,594,120	14	17
Savanna	4,603,747	4,722,051	7	9
Grassland	4,624,902	4,878,857	19	22
Total	16,217,005	16,195,028	12	14

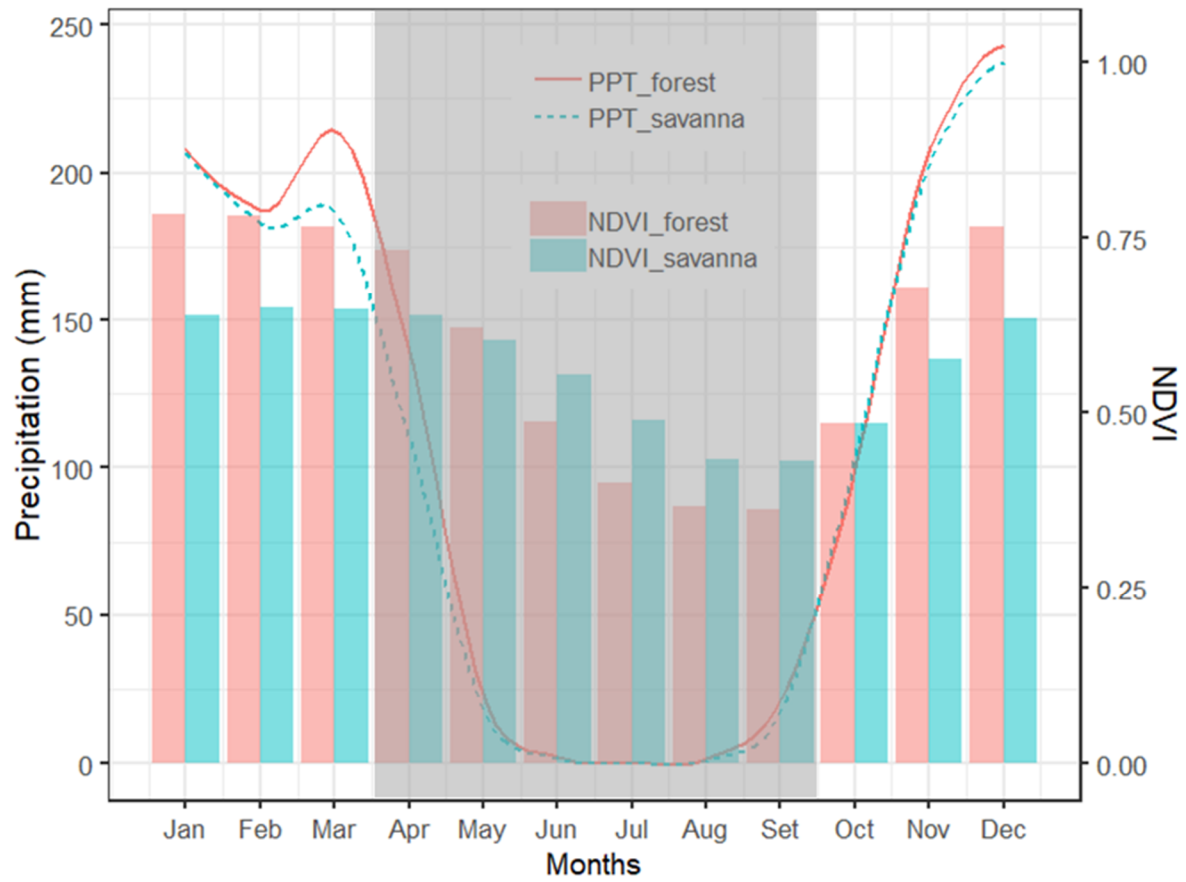


Figure S1. Mean monthly precipitation and Normalized Difference Vegetation Index (NDVI) data from forest and savanna vegetation. Gray rectangle corresponds to the six-month optimum period for deriving the Landsat mosaic of the Brazilian Cerrado.

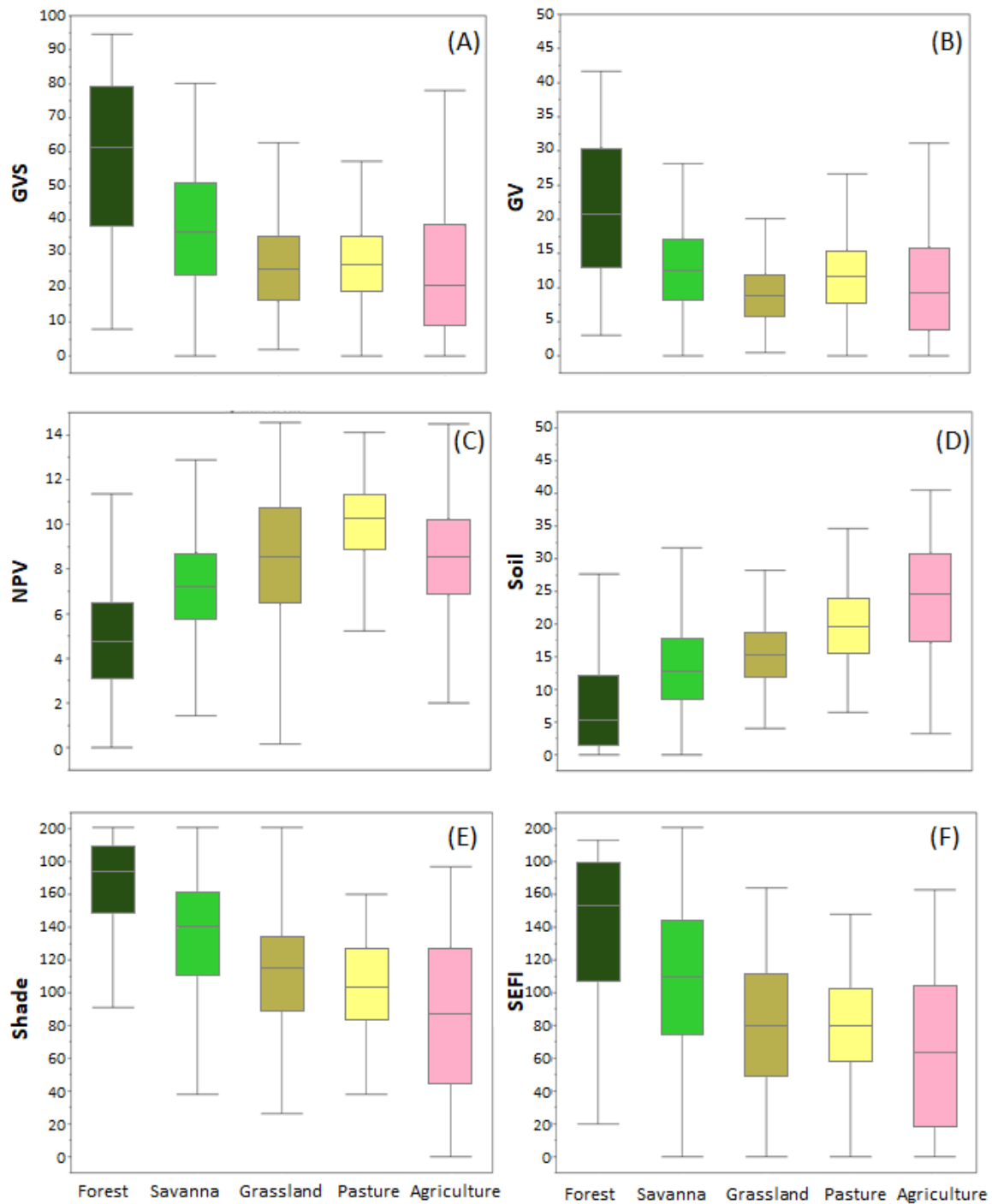


Figure S2. Boxplots representing the distribution of the dominant land cover classes of the Brazilian Cerrado over six spectral metrics included in the empirical decision tree classification. GVS = Green Vegetation and Shade; GV = Green Vegetation; NPV = Non-Photosynthetic Vegetation; SEFI = Savanna Ecosystem Fraction Index.

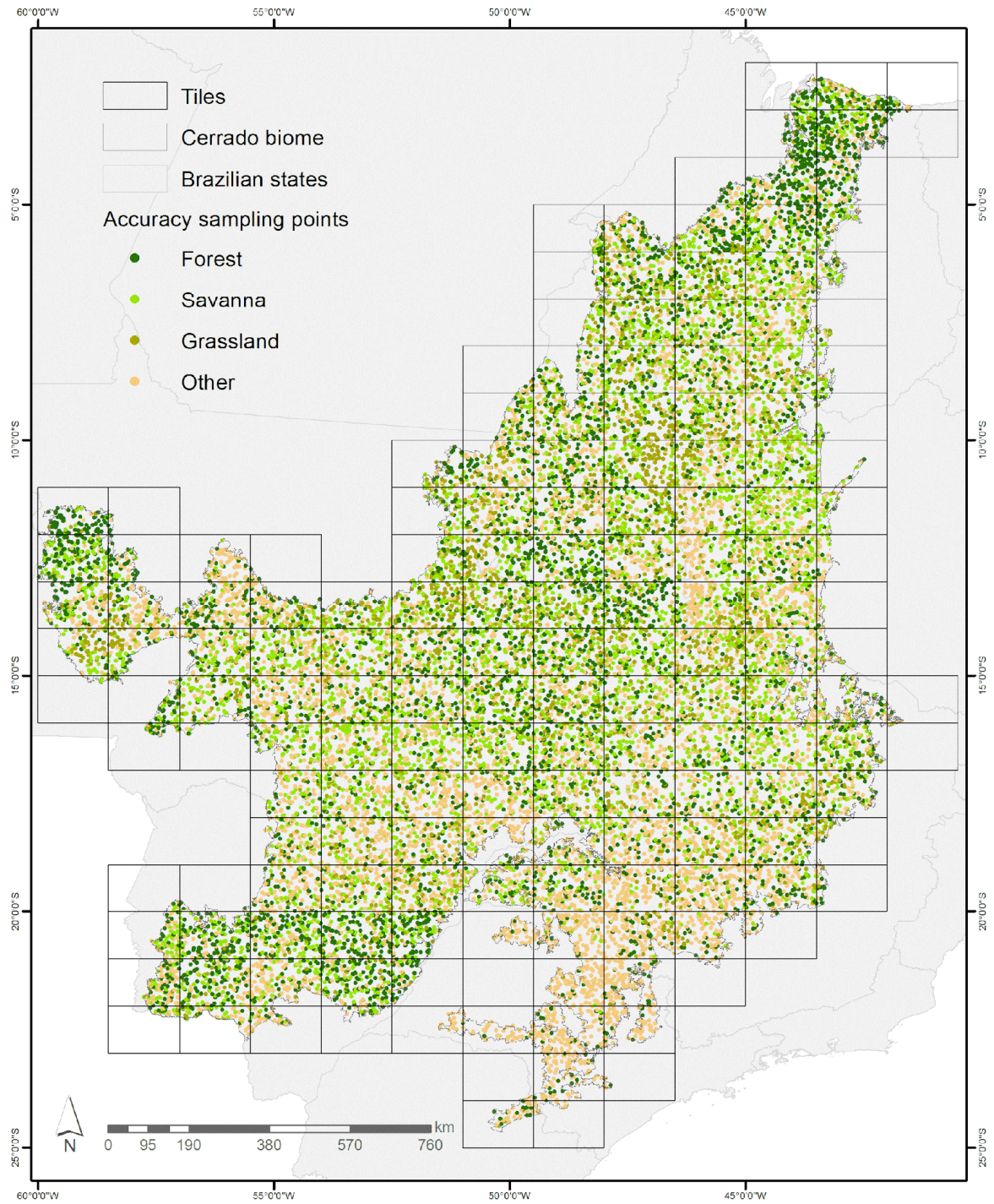


Figure S3. Location of 21,000 sampling points used for accuracy assessment. Other = water, non-vegetated, agriculture, and pasture fields.

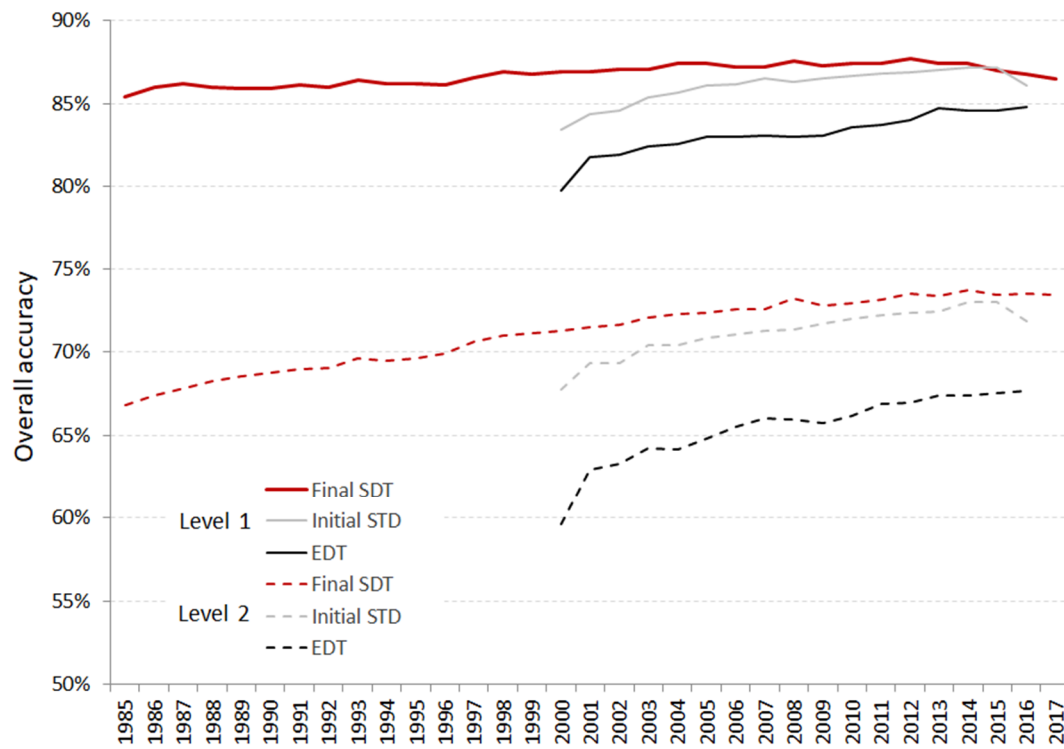


Figure S4. Overall accuracy for the three classifications [empirical decision tree (EDT), initial statistical decision tree (SDT), and final SDT], considering the aggregated legend.

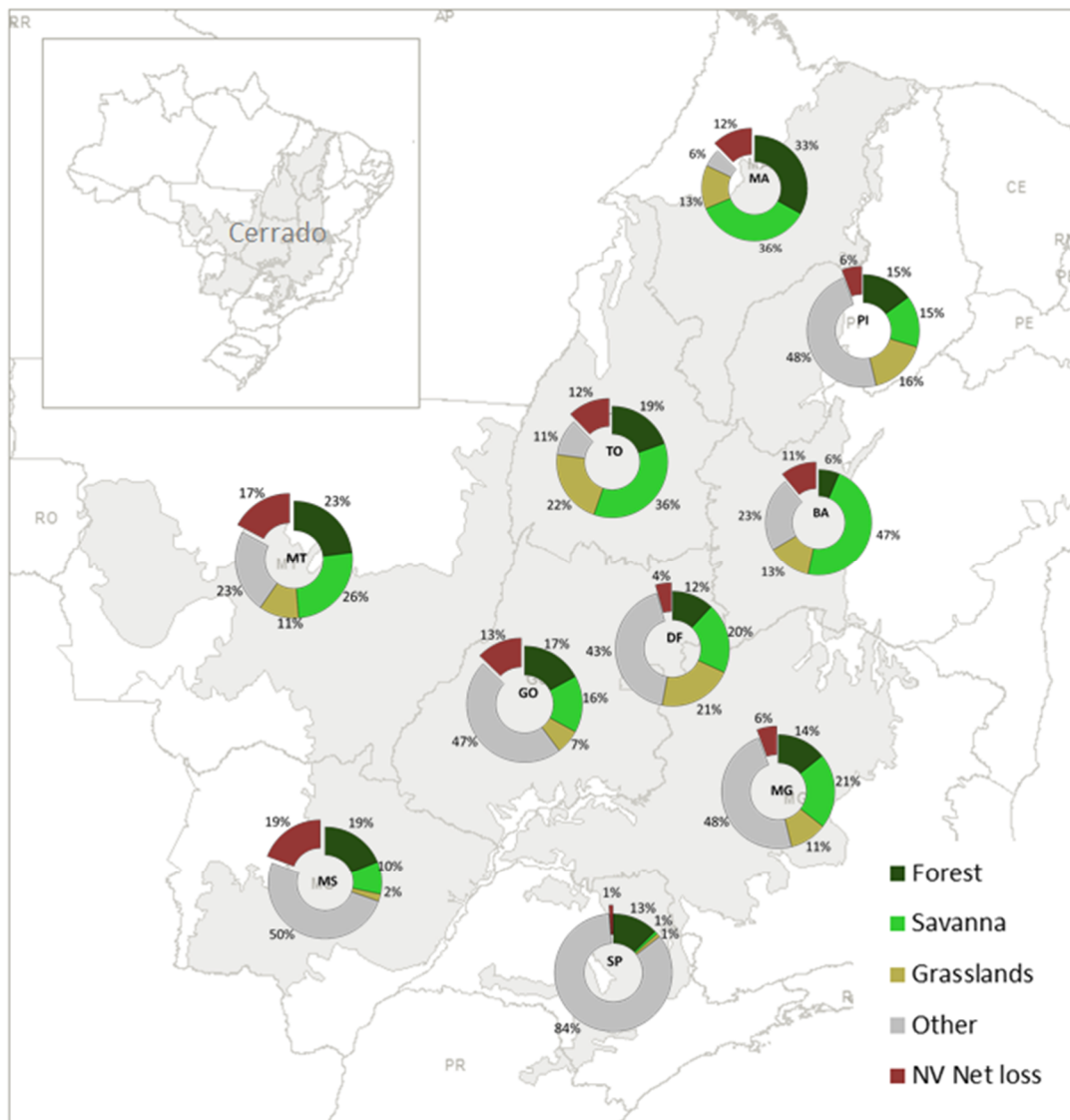


Figure S5. State-level proportion of native vegetation (NV) in 2017, other non-NV land cover types in 2017, and NV net loss from 1985 to 2017. MS - Mato Grosso do Sul, GO - Goiás, MT - Mato Grosso, TO - Tocantins, MA - Maranhão, MG - Minas Gerais, BA - Bahia, PI - Piauí, SP - São Paulo, and DF – Federal District.

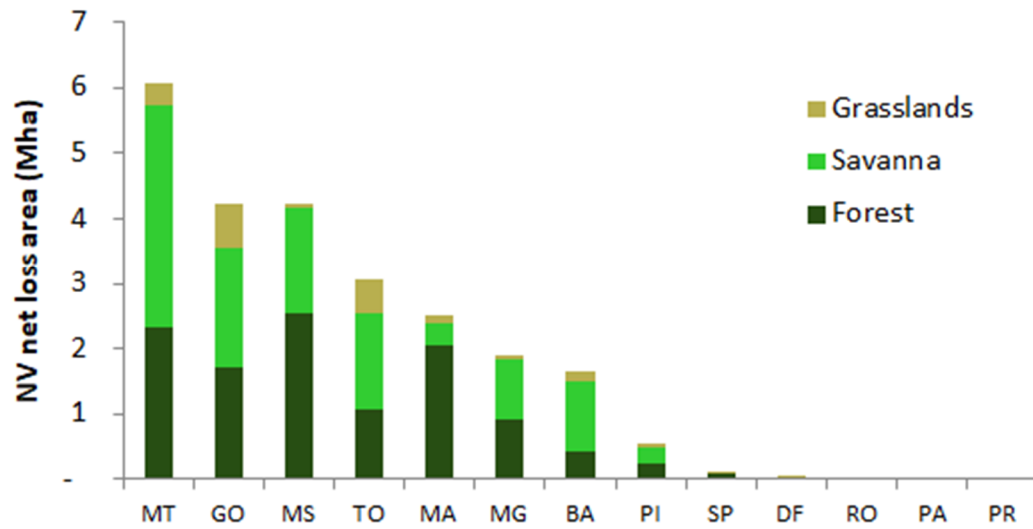


Figure S6. State-level net loss of native vegetation (NV) from 1985 to 2017. Mha = million hectares. See Fig. S6 for state identification.

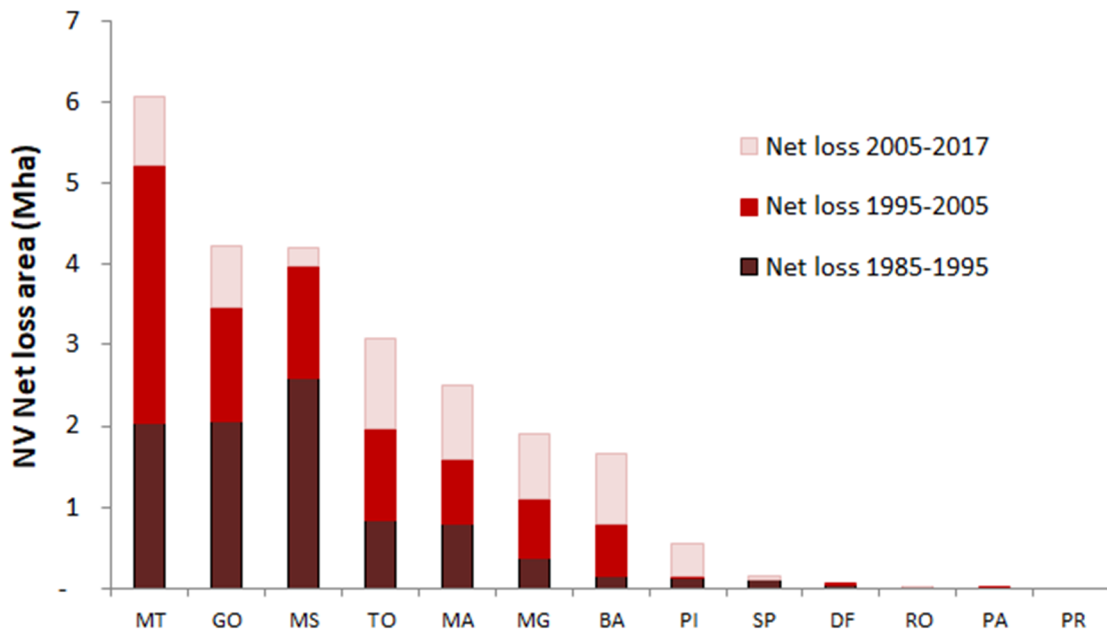


Figure S7. State-level native vegetation (NV) net loss in three different periods: 1985-1995, 1995-2005, and 2005-2017. M ha = million hectares. See Fig. S6 for state identification.