

Supplementary Information

Trends and ENSO/AAO Driven Variability in NDVI Derived Productivity and Phenology alongside the Andes Mountains. *Remote Sensing* 2013, 5, 1177–1203

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This supplemental material supports the main manuscript with supplementary tables (Tables S1–S3).

Table S1. Summary of the areal coverage (km²) for each of the major land cover types per country within the study area.

	Argentina	Bolivia	Brazil	Chile	Falkland Islands	Paraguay	Peru	Uruguay
Closed evergreen tropical forest	69,783	377,019	737,876	0	0	32,538	292,031	5,328
Semi deciduous tropical forest	66,471	131,472	82,427	0	0	65,026	4,593	3,987
Mangroves	1,746	7,676	18,136	0	0	11	1,637	0
Closed deciduous forest	368,459	100,356	188,608	46,231	0	134,777	2,492	11,540
Open temperate deciduous forest	24,905	0	0	82,140	1,497	0	0	0
Forest plantations	0	13	160	0	0	0	0	0
Temperate mixed evergreen broadleaf forest	3,080	0	0	123,304	0	0	0	0
Closed shrubland	598,517	65,230	81,799	104,454	315	29,177	55,398	1,759
Grass savannah	114,180	133,940	114,572	110,265	6,866	9,556	125,472	67,477
Shrub savannah	70,661	9,350	226,412	605	0	31,718	1,567	30,942
Open steppe grasslands	1,199,354	88,602	26,648	170,187	4,039	6,484	78,669	1,035
Periodically flooded savannah	128,186	35,553	64,433	7,278	3,192	37,013	796	4,022
Agriculture-intensive	336,860	19,959	677,616	27,525	81	23,539	2,313	47,661
Mosaic agriculture / degraded forests	70,926	22,019	227,335	14,059	631	35,946	10,310	31,362
Mosaic agriculture / degraded vegetation	217,021	35,063	79,420	26,613	0	31,324	29,178	2,699
Desert	153,181	111,620	650	183,812	147	125	81,335	155
Water bodies	52,569	13,369	28,676	21,788	1,657	6,535	6,635	47,41
Permanent Snow/ice	4,920	514	0	27,437	0	0	1,812	0
Urban	1,867	603	152	601	0	14	1,042	78
Total	3,482,686	1,152,358	2,554,920	946,299	18,425	443,783	695,280	212,786

Table S2. Summary of the NDVI, SOS and LOS for the sampled major land cover types within the study area (include the regression results the mean, COV and slope and r^2 and p-values). A comparative bar graph showing mean and standard deviation for each of these sample areas is shown in Figure 4.

Lat (°)	Long (°)	Landcover (LC)	NDVI				Slope	Start of Season (SOS-days)				Slope	Length of Season (LOS-days)				Slope
			mean	cov	p	r^2		mean	cov	p	r^2		mean	cov	p	r^2	
-14.69	-62.17	Closed evergreen tropical forest	8,133	2.78	0.03	0.15	10.29	108.3	105.5	0.49	0.02	1.98	224.9	44.6	0.23	0.06	2.25
-11.31	-59.89	Closed evergreen tropical forest	7,817	3.60	0.16	0.07	8.49	59.9	117.4	0.94	0.00	-0.15	214.7	33.9	0.74	0.00	-0.46
-17.12	-60.01	Semi deciduous transition forest	7,436	4.87	0.00	0.25	-20.89	259.9	28.4	0.08	0.11	1.02	299.1	28.9	0.09	0.10	-1.31
-18.10	-59.39	Semi deciduous transition forest	7,789	3.55	0.77	0.00	1.81	249.2	36.8	0.05	0.14	2.83	301.7	31.1	0.75	0.00	-0.54
-24.81	-62.13	Closed deciduous forest	6,568	2.73	0.09	0.10	-6.44	292.8	5.5	0.83	0.00	0.08	280.8	9.3	0.82	0.00	-0.13
-21.24	-62.38	Closed deciduous forest	6,725	7.73	0.00	0.38	-37.21	306.2	6.7	0.00	0.36	1.42	277.1	11.0	0.42	0.02	-0.55
-44.15	-71.62	Montane forests 500–1,000 m—open temperate deciduous	6,225	4.33	0.34	0.03	5.56	252.5	5.7	0.37	0.03	-0.28	265.1	6.4	0.25	0.05	0.43
-45.42	-71.75	Montane forests > 1,000m—open temperate deciduous	5,603	5.73	0.69	0.01	-2.84	276.6	4.8	0.52	0.01	0.19	239.3	7.5	0.76	0.00	0.12
-37.58	-73.30	Temperate mixed evergreen broadleaf forests	8,442	2.83	0.64	0.01	2.43	197.4	48.4	0.84	0.00	0.34	255.9	40.5	0.07	0.12	-3.16
-39.96	-72.31	Montane forests 500–1,000 m—temperate mixed	8,395	4.10	0.02	0.19	17.45	199.2	31.2	0.80	0.00	-0.28	291.0	33.5	0.63	0.01	0.89
-35.31	-67.92	Closed shrublands	3,521	9.13	0.09	0.10	11.82	82.9	146.1	0.78	0.00	-1.04	188.9	64.2	0.20	0.07	2.95
-29.90	-70.99	Closed shrublands	3,483	10.47	0.03	0.16	-16.80	182.1	28.7	0.08	0.11	-1.52	225.2	31.9	0.23	0.05	-1.55
-33.82	-71.34	Open montane grasslands	5,894	5.20	0.86	0.00	-1.17	156.9	17.1	0.61	0.01	0.30	241.5	17.1	0.79	0.00	0.24
-30.75	-67.14	Open montane grasslands	3,800	9.68	0.42	0.02	6.43	308.7	27.8	0.04	0.15	3.04	216.3	24.5	0.14	0.08	1.70
-30.66	-56.69	Closed steppe grasslands	6,530	3.71	0.94	0.00	-0.39	110.4	99.3	0.21	0.08	3.31	231.1	70.4	0.28	0.05	-3.72
-11.73	-75.32	Closed montane grasslands	3,911	5.35	0.00	0.27	12.57	221.5	63.4	0.89	0.00	-0.37	246.1	34.8	0.91	0.00	0.18
-13.07	-51.35	Shrub savannah	5,642	4.25	0.46	0.02	3.88	279.2	24.9	0.67	0.01	0.44	308.1	10.8	0.87	0.00	-0.12
-31.78	-58.88	Shrub savannah	6,716	3.63	0.03	0.15	-10.89	155.4	68.1	0.40	0.03	-1.85	243.4	47.1	0.02	0.19	-5.09

Table S2. Cont.

Lat (°)	Long (°)	Landcover (LC)	NDVI				Slope	Start of Season (SOS-days)				Slope	Length of Season (LOS-days)				Slope
			mean	cov	p	r ²		mean	cov	p	r ²		mean	cov	p	r ²	
-48.55	-69.67	Open steppe grasslands	1,965	5.63	0.11	0.09	3.79	220.3	40.3	0.75	0.00	0.39	222.5	42.7	0.06	0.14	2.68
-42.09	-67.16	Sparse desertic steppe shrub/grasslands	2,420	9.61	0.02	0.18	-11.34	119.8	46.5	0.31	0.04	1.14	244.6	38.6	0.32	0.04	1.67
-28.18	-57.00	Periodically flooded savannah	6,445	4.64	0.24	0.05	7.64	181.1	77.1	0.04	0.17	-5.69	248.0	32.1	0.22	0.05	-1.75
-18.02	-56.22	Periodically flooded savannah	6,193	3.99	0.90	0.00	0.68	268.9	19.2	0.70	0.01	0.11	310.7	20.0	0.57	0.01	0.29
-22.06	-50.43	Agriculture-intensive	6,053	3.18	0.36	0.03	3.85	288.0	8.6	0.04	0.15	1.09	295.5	10.6	0.50	0.02	-0.46
-32.92	-62.60	Agriculture-intensive	5,688	4.28	0.54	0.01	-3.26	235.1	15.2	0.96	0.00	-0.04	258.8	14.1	0.22	0.05	-0.97
-36.00	-59.91	Agriculture-intensive	6,541	4.87	0.43	0.02	5.51	234.2	7.2	0.62	0.01	-0.18	275.9	9.5	0.55	0.01	-0.34
-36.96	-61.31	Mosaic agriculture/degraded forests	6,600	2.93	0.29	0.04	-4.47	181.2	51.0	0.43	0.03	1.29	237.2	45.2	0.17	0.07	-2.91
-33.03	-53.73	Mosaic agriculture/degraded forests	6,857	3.80	0.06	0.12	10.53	222.9	36.8	0.64	0.01	-0.65	247.9	29.9	0.01	0.23	-3.40
-35.65	-64.05	Mosaic agriculture/degraded vegetation	5,977	5.11	0.70	0.01	-2.62	190.8	53.9	0.36	0.03	1.79	249.0	42.7	0.18	0.07	-2.52
-36.40	-61.23	Mosaic agriculture/degraded vegetation	6,399	3.25	0.75	0.00	1.43	239.7	6.5	0.88	0.00	-0.05	272.4	7.4	0.77	0.00	-0.13
-21.50	-69.60	Desert	781	5.45	0.02	0.17	-2.04	161.6	30.7	0.07	0.11	-1.93	276.2	27.5	0.07	0.11	2.92
-26.63	-67.47	Barren/bare soil	533	6.21	0.00	0.30	-2.09	167.5	68.0	0.03	0.18	-4.65	202.5	61.3	0.17	0.07	-3.64
-30.57	-62.54	Water bodies	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
-41.17	-72.85	Water bodies	1,818	22.04	0.00	0.50	-32.70	235.5	28.3	0.93	0.00	0.10	254.8	37.3	0.32	0.04	1.84

Table S3. The significant ($p \leq 0.05$) positive and negative changes in the annual mean NDVI and the area associated per land cover type and country. The changes are represented by the slope of the annual mean NDVI values from 1982 to 2011 ($\Delta y/\Delta x = dNDVI/dt$). Negative changes are in red and positive changes in black. A slope of 16.7 means a 5% change in the annual NDVI (the NDVI was scaled by a factor 10,000) over a 30 year period (5% of 10,000 = 500; 500/30 = 16.7). The spatial distribution of these data is presented in Figure 8.

	Argentina				Bolivia				Brazil				Chile			
	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$	km ²	$\Delta y/\Delta x$
Closed evergreen tropical forest	130	-15.67	61	13.18	95	-14.64	938	15.17	407	-14.31	1,041	14.91				
Semi deciduous tropical forest	97	-13.63	80	11.46	370	-16.49	51	14.50	39	-13.95	169	14.38	16	-13.23	7	20.91
Mangroves	5	-9.58	0		1	-13.62	13	15.37	15	-14.84	31	17.13				
Closed deciduous forest	1508	-15.96	91	13.95	479	-20.74	21	15.83	128	-14.52	366	15.48	70	-16.19	120	19.92
Open temperate deciduous	80	-14.94	12	18.76									82	-14.31	192	17.84
Temperate mixed ever-green broadleaf forests	4	-22.74	4	16.91									75	-18.39	384	20.35
Closed shrublands	2649	-13.52	116	11.95	178	-17.61	76	11.16	25	-13.92	203	13.82	242	-8.53	130	25.52
Grass savannah	375	-13.07	69	18.86	52	-14.14	395	13.38	33	-14.34	298	13.44	100	-14.71	249	26.87
Shrub savannah	62	-16.76	63	12.74	19	-16.56	5	15.48	88	-15.57	711	14.54				
Open steppe grasslands	5809	-11.10	242	12.39	138	-14.04	131	6.36	10	-15.56	79	15.60	655	-7.11	136	26.77
Periodically flooded savannah	250	-14.21	126	15.84	14	-16.11	135	17.09	13	-14.22	178	16.27	15	-10.43	9	13.61
Agriculture-intensive	625	-16.01	105	14.23	108	-23.29	3	13.53	706	-15.46	1,351	14.68	6	-14.48	74	15.02
Mosaic agriculture/degraded forests	142	-13.52	23	10.51	29	-18.16	44	17.45	137	-14.26	628	12.96	8	-15.21	43	20.69
Mosaic agriculture/degraded vegetation	400	-15.43	46	13.02	116	-18.70	19	13.41	55	-16.04	156	13.55	28	-12.78	90	20.69
Desert	704	-6.31	78	7.26	247	-5.42	113	24.62	1	-8.30	2	14.66	1196	-4.15	61	22.86
Water bodies	154	-18.04	96	61.55	15	-20.58	44	40.03	47	-23.45	75	25.34	30	-16.92	51	34.35
Permanent Snow/ice	20	-6.36	8	82.89	1	-3.58	4	13.63					71	-5.94	106	82.66
Urban	15	-16.48	2	19.48	1	-8.00	1	12.39					2	-9.75	1	3.70

Table S3. Cont.

	Falkland Islands				Paraguay				Peru				Uruguay			
	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx	km ²	Δy/Δx
Closed evergreen tropical forest					33	-14.10	27	11.42	78	-13.96	955	19.05	1	-19.94	9	13.44
Semi deciduous tropical forest					174	-16.77	49	12.06	2	-15.17	13	21.82	1	-12.42	7	15.80
Mangroves									0		5	26.91				
Closed deciduous forest					974	-20.96	34	12.74	0		6	20.05	3	-11.79	9	14.39
Open temperate deciduous																
Temperate mixed ever-green broadleaf forests	6	-10.98	1	11.53												
Closed shrublands	21	-11.29	3	9.45	235	-20.47	4	10.93	30	-10.24	141	16.24	0		6	11.88
Grass savannah					4	-13.05	21	10.12	35	-9.08	361	11.57	11	-11.64	43	15.21
Shrub savannah	17	-11.57	2	9.06	26	-18.30	40	9.95	0		7	18.40	1	-17.53	25	15.19
Open steppe grasslands	11	-12.26	4	10.96	57	-20.38	2	10.89	87	-8.84	219	34.96	1	-16.50	2	11.74
Periodically flooded savannah					76	-19.17	29	12.27	3	-14.89	6	31.36	0		5	12.99
Agriculture-intensive	2	-10.67	0		79	-21.40	17	10.27	1	-14.19	12	20.35	16	-11.69	24	12.89
Mosaic agriculture/degraded forests					43	-15.93	28	9.63	0		39	19.94	7	-11.22	27	14.49
Mosaic agriculture/degraded vegetation					188	-23.08	12	9.88	9	-8.54	101	11.24	1	-12.17	3	13.76
Desert	10	-15.30	8	8.51					246	-6.82	324	88.98				
Water bodies					14	-18.01	11	13.85	9	-9.93	23	66.28	6	-16.66	1	14.50
Permanent Snow/ice									2	-7.03	5	15.04				
Urban									2	-25.05	3	37.24				