Time series of Landsat images to determine burned area

in the context of the Latin-American Network of Forest Fires (RedLatIF).

Jesús Anaya

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Background

- Important ecosystems subject to fire are not represented in global BA maps
-There are high commission and omission errors and is important to understand the cause of the error.
-There may not be one perfect index for mapping BA.
-The last meeting of the network was on INPE, San Jose dos Campos, BR, where we agree to work on the identification of BA using Landsat data.

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Objectives:

-Evaluate time series and different indices to improve BA detection and thresholds using Landsat
-Generate reference information by each network member following protocols (Roy, Bochetti)
-Evaluate the possibility of generating a regional product using these methods
-Enhance regional collaboration using GEE

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Study area:

Bolivia	Bosque seco Chiquitano
Colombia, Caribe	Magdalena-Urabá bosque húmedo
México, Baja California	Matorral costero y chaparral
Colombia, Sur	Bosque húmedo tropical
México, Sierra Madre	Bosques de pino y roble
Argentina	Chaco seco
Argentina	Chaco seco

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Methods:

-Calculate TOA reflectance for Landsat and mask:

* Clouds, with GEE function
* Water bodies, based on NDWI
* Shadows, based on SWIR1

Methods:

-Calculate Normalized Burn Ratio:

$$NBR = (R4 - R7) / (R4 + R7)$$ (Key & Benson 2006)

$$*dNBR = (NBRprefire - NBRpostfire)$$

$$* RdNBR = (NBRprefire - NBRpostfire)/(NBRprefire)$$
(Miller & Thode, 2007)

* dNBR, where NBRprefire f(time series: maximum)

* dNBR, where NBRprefire f(time series: maximum) & Soil Mask

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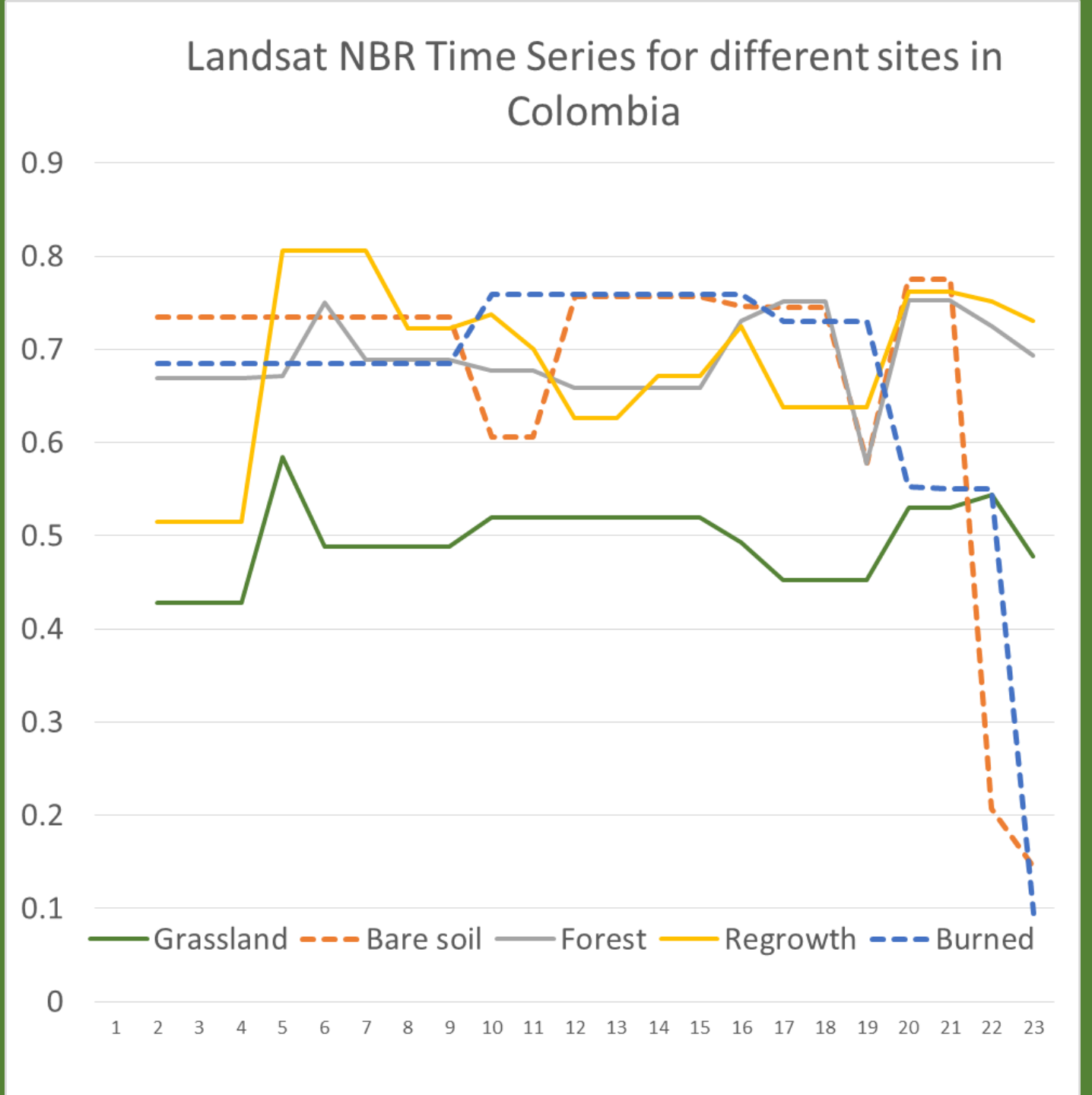
Methods:



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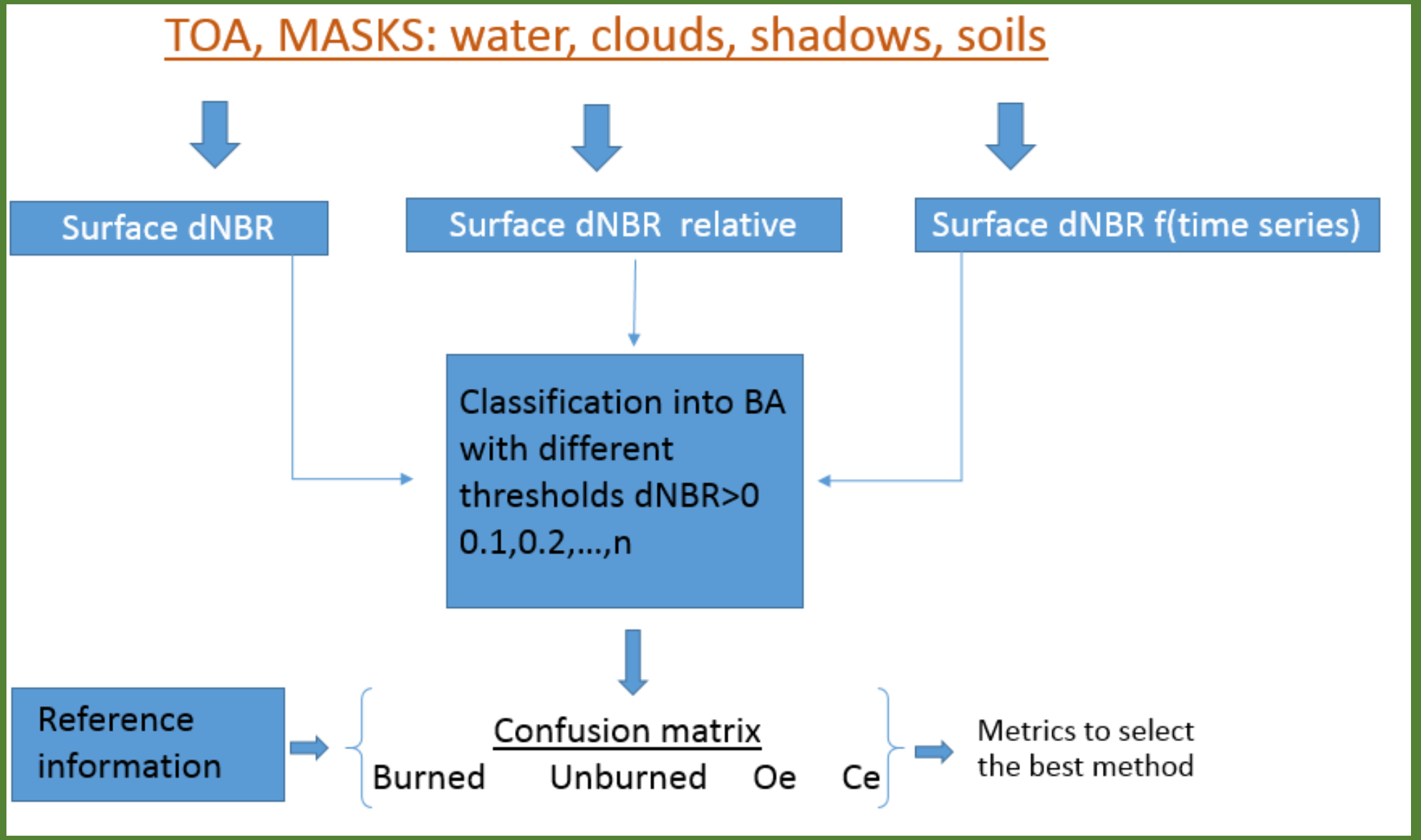
Methods:



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Methods:

-Metrics to select the best method:

* Minimum value of: Oe + Ce, for best threshold: (0,1, 0,2, … n)

* Maximum value of : BA agreement/Ce, for best index:

dNBR
RdNBR
dNBR f(TS)

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Preliminary results:

Selection of thresholds for RdNBR based on minimum Ce + Oe

“Burned” agreement increase as Ce increase.

Units are pixels

Site	Oe	Unburned	Burned	Ce	Threshold RdNBR
CO_008_059	21623	10077741	12366	19758	0.7
	25317	10088112	8672	9387	0.8
	28605	10091790	5384	5709	0.9
	31287	10094310	2702	3189	1.0
	32910	10095797	1079	1702	1.1
CO_009_054	9549	10107330	8998	16950	0.6
	11838	10117158	6709	7122	0.7
	13851	10121046	4696	3234	0.8
	18116	10124231	431	49	0.9
	18188	10124254	359	26	1
BO_230_070	267541	9614118	713011	328354	0.0
	369005	9746025	611547	196447	0.1
	473554	9819883	506998	122589	0.2
	566736	9859640	413816	82832	0.3
	646360	9881991	334192	60481	0.4
AR_229_078	239477	9619139	164527	140409	1.5
	249052	9630718	154952	128830	1.6
	258156	9640514	145848	119034	1.7
	267259	9648732	136745	110816	1.8
	276398	9655838	127606	103710	1.9
AR_229_082	147401	9135851	650726	172933	1.2
	159804	9152722	638323	156062	1.3
	172937	9166116	625190	142668	1.4
	186695	9177873	611432	130911	1.5
	200431	9188254	597696	120530	1.6
MX_039_038	102717	8886847	72364	45845	4.6
	105394	8889212	69687	43480	4.7
	108019	8891225	67062	41467	4.8
	110301	8893376	64780	39316	4.9
	112590	8895379	62491	37313	5.0
MX_035_039	113578	9838914	194008	58610	1.7
	123796	9847848	183790	46976	1.8
	133789	9855257	173797	42267	1.9
	143229	9861299	164357	36225	2.0
	152678	9865815	154908	31709	2.1

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Preliminary results:

Method	Oe	Unburned	Burned	Ce	Threshold	Bare Soil	BA/Ce	Oe + Ce	Country
dNBR	25549	10081533	8440	15966	0.5	no	0.53	41515	CO
dNBR	29212	10093630	4777	3869	0.6	no	1.23	33081	CO
dNBR	32289	10096333	1700	1166	0.7	no	1.46	33455	CO
dNBR	33845	10097313	144	186	0.8	no	0.77	34031	CO
RdNBR	20184	10077364	13805	20135	0.7	no	0.69	40319	CO
RdNBR	24115	10088326	9874	9173	0.8	no	1.08	33288	CO
RdNBR	27720	10092093	6269	5406	0.9	no	1.16	33126	CO
RdNBR	30808	10094615	3181	2884	1	no	1.10	33692	CO
dNBR, TS	14215	10008249	26000	83024	0.4	no	0.31	97239	CO
dNBR, TS	21267	10056288	18948	34985	0.5	no	0.54	56252	CO
dNBR, TS	27265	10081229	12650	9974	0.6	no	1.27	37239	CO
dNBR, TS	33661	10087280	6554	3993	0.7	no	1.64	37654	CO
dNBR, TS	38605	10090111	1610	1162	0.8	no	1.39	39767	CO
dNBR, TS, SM	9954	10078847	30261	12426	0.3	yes	2.44	22380	CO
dNBR, TS, SM	15865	10085370	24350	5903	0.4	yes	4.13	21768	CO
dNBR, TS, SM	22722	10088398	17493	2875	0.5	yes	6.08	25597	CO
dNBR, TS, SM	28365	10089905	11580	1368	0.6	yes	8.46	29733	CO
dNBR, TS, SM	34328	10090656	5887	617	0.7	yes	9.54	34945	CO

Units are pixels
CO_008_059

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Preliminary results:

Method	Oe	Unburned	Burned	Ce	Threshold	Bare Soil	BA/Ce	Oe + Ce	Country
dNBR	214123	9495992	189881	263556	0.1	no	0.72	477679	AR
dNBR	250447	9650590	153557	108958	0.2	no	1.41	359405	AR
dNBR	318389	9717048	85615	42500	0.3	no	2.01	360889	AR
dNBR	385403	9748237	18601	11311	0.4	no	1.64	396714	AR
RdNBR	254768	9686078	149236	103470	1.4	no	1.44	358238	AR
RdNBR	262397	9665851	141607	93697	1.5	no	1.51	356094	AR
RdNBR	270701	9674259	133303	85289	1.6	no	1.56	355990	AR
RdNBR	278814	9681583	125190	77965	1.7	no	1.61	356779	AR
RdNBR	286861	9687501	117143	72047	1.8	no	1.63	358908	AR
RdNBR	295196	9692800	108808	66748	1.9	no	1.63	361944	AR
dNBR, TS	169575	8682570	234429	1076978	0.7	no	0.22	1246553	AR
dNBR, TS	278298	9172061	125706	587487	0.8	no	0.21	865785	AR
dNBR, TS	363457	9739385	40547	20163	0.9	no	2.01	383620	AR
dNBR, TS	400756	9758625	3248	923	1	no	3.52	401679	AR
dNBR, TS, SM	209038	8475331	194966	1284217	0.4	yes	0.15	1493255	AR
dNBR, TS, SM	225476	9617174	178528	142374	0.5	yes	1.25	367850	AR
dNBR, TS, SM	250231	9737786	153773	21762	0.6	yes	7.07	271993	AR
dNBR, TS, SM	282156	9747849	121848	11699	0.7	yes	10.42	293855	AR
dNBR, TS, SM	324843	9754220	79161	5328	0.8	yes	14.86	330171	AR
dNBR, TS, SM	376746	9758078	27258	1470	0.9	yes	18.54	378216	AR

Units are pixels
AR_229_078

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Conclusions

-Large agreement of burned areas increase commission errors.
-It is important to identify and remove Commission Errors by ecoregions
-We found that the accuracy was increased when “prefire” was replaced by the “maximum NBR” from a time series.

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Thanks

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