

Supplementary Materials: Classification of tree species in diverse African agroforestry landscape using imaging spectroscopy and laser scanning

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Table S1. List of narrowband vegetation indices. Full citations are found in Roberts et al. (2011)[1].

Index	Equation	Category	Reference
NDVI	$(R_{750} - R_{679}) / (R_{750} + R_{679})$	Structure	Rouse et al. (1973)
SR	R_{750} / R_{679}	Structure	Jordan (1969)
EVI	$2.5 \times (R_{860} - R_{646}) / (R_{860} + 6 \times R_{646} - 7.5 \times R_{472} + 1)$	Structure	Huete et al. (1997)
WBI	R_{902} / R_{969}	Structure	Peñuelas et al. (1997)
ARVI	$(R_{860} - [R_{646} - y \times (R_{472} - R_{646})]) / (R_{860} + [R_{646} - y \times (R_{472} - R_{646})])$	Structure	Kaufman & Tanré (1992)
SAVI	$[(R_{860} - R_{646}) / (R_{860} + R_{646} + L)] \times (1 + L)$	Structure	Huete (1988)
VARI	$(R_{549} - R_{670}) / (R_{549} + R_{670} - R_{481})$	Structure	Gitelson et al. (2002a)
VI _{green}	$(R_{549} - R_{670}) / (R_{549} + R_{670})$	Structure	Gitelson et al. (2002a)
VI700	$(R_{698} - R_{670}) / (R_{698} - R_{670})$	Structure	Gitelson et al. (2002a)
SIPI	$(R_{800} - R_{445}) / (R_{800} - R_{680})$	Pigments	Peñuelas et al. (1995)
PSSR	(R_{800} / R_{675})	Pigments	Blackburn (1998a)
PSND	$[(R_{800} - R_{675}) / (R_{800} + R_{675})]$	Pigments	Blackburn (1998b)
PSRI	$(R_{680} - R_{500}) / R_{750}$	Pigments	Merzlyak et al. (1999)
CARI	$(R_{700} - R_{670}) - 0.2 \times (R_{700} - R_{550})$	Chlorophyll	Kim (1994)
MCARI	$[(R_{700} - R_{670}) - 0.2 \times (R_{700} - R_{550})] \times (R_{700} / R_{670})$	Chlorophyll	Daughtry et al. (2000)
CI _{red edge}	$R_{788} / R_{698} - 1$	Chlorophyll	Gitelson et al. (2006)
ARI	$(1/R_{549}) - (1/R_{698})$	Anthocyanins	Gitelson et al. (2001)
mARI	$[(1/R_{549}) - (1/R_{698})] \times R_{788}$	Anthocyanins	Gitelson et al. (2006)
RGRI	R_{670} / R_{549}	Anthocyanins	Gamon & Surfus (1999)
ACI	R_{549} / R_{788}	Anthocyanins	Van den Berg & Perkins (2005)
CRI1	$(1/R_{510}) - (1/R_{550})$	Carotenoids	Gitelson et al. (2002b)
CRI2	$(1/R_{510}) - (1/R_{700})$	Carotenoids	Gitelson et al. (2002b)
PRI	$(R_{531} - R_{570}) / (R_{531} + R_{570})$	LUE	Gamon et al. (1997)

R = reflectance, L = user defined value in SAVI (set to default of 0.5), LUE = light use efficiency

Table S2. McNemar's score and statistical significance of difference in overall accuracy between support vector machine and random forest classifiers for different feature sets.

	Refl.	NVI	MNF	ALS	Refl.+ALS	NVI+ALS	MNF+ALS
McNemar's score	10.6	25.6	1.7	0.4	0.0	0.2	3.4
p-value	0.00	0.00	0.19	0.54	1.00	0.66	0.07

Table S3. McNemar's score (lower triangular part) and statistical significance of difference in overall accuracy (upper triangular part) between different feature sets using support vector machine.

	Refl.	NVI	MNF	ALS	Refl.+ALS	NVI+ALS	MNF+ALS
Refl.		0.00	0.00	0.01	0.01	0.01	0.00
NVI	12.0		0.00	0.00	0.20	0.31	0.00
MNF	43.9	17.9		0.00	0.00	0.00	0.02
ALS	6.5	31.5	69.4		0.00	0.00	0.00
Refl.+ALS	6.1	1.6	23.3	26.1		0.77	0.00
NVI+ALS	6.4	1.0	19.2	29.3	0.1		0.00
MNF+ALS	61.4	28.5	5.1	101.4	41.7	44.5	

Table S4. McNemar's score (lower triangular part) and statistical significance of change in overall accuracy (upper triangular part) between different feature sets using random forest.

	Refl.	NVI	MNF	ALS	Refl.+ALS	NVI+ALS	MNF+ALS
Refl.		0.04	0.00	0.68	0.00	0.00	0.00
NVI	4.3		0.00	0.04	0.00	0.00	0.00
MNF	58.6	43.3		0.00	0.00	0.00	0.08
ALS	0.2	4.3	59.9		0.00	0.00	0.00
Refl.+ALS	32.7	9.5	12.4	32.9		0.40	0.00
NVI+ALS	29.8	15.2	9.1	37.3	0.7		0.00
MNF+ALS	80.4	62.3	3.0	85.0	29.0	22.4	

Table S5. Change in overall accuracy and Kappa after feature selection.

Feature set	Support vector machine		Random forest	
	Accuracy	Kappa	Accuracy	Kappa
Refl.	2.2	-1.1	-2	-2.6
NVI	-2.8*	-3.9	0.3	0.9
MNF	0.8	1.7	0.2	0.1
ALS	-0.8	-0.5	-0.5	-1
Refl.+ALS	0.2	-0.2	0	0
NVI+ALS	0.8	-0.4	0.4	-0.2
MNF+ALS	0.4	0.5	-0.8	-0.8

* Statistically significant change ($p < 0.05$)

- [1] Roberts, D. A, K. . L. Roth, and R. L. Perroy, "Hyperspectral vegetation indices," in *Hyperspectral Remote Sensing of Vegetation*, P. S. Thenkabail, P. S. Lyon, and J. G. Huete, Eds. CRC press, 2011, pp. 309–328.