

Supplementary File 1: List of vegetation indices used in this work.

Vegetation indices used in the study (adapted from (Agapiou, Hadjimitsis, & Alexakis, 2012; Lehnert, Meyer, & Bendix, 2016; Main et al., 2011; Odilbekov, Armoniené, Henriksson, & Chawade, 2018))

No	Abbr	Name	Formula	Reference
1	ARI	Anthocyanin Reflectance Index	$(1/R_{550}) - (1/R_{700})$	(A. A. Gitelson, Merzlyak, & Chivkunova, 2001)
2	ARI2	Anthocyanin Reflectance index 2	$R_{800}(1/R_{550}) - (1/R_{700})$	(A. A. Gitelson et al., 2001)
3	BGI	Blue Green Pigment Index	R_{450}/R_{550}	(P. Zarco-Tejada et al., 2005)
4	SB703/Boochs	Single Band 703 Boochs	D_{703}	(Boochs, Kupfer, Dockter, & Kühbauch, 1990)
5	SB720/Boochs2	Single Band 720 Boochs 2	D_{720}	(Boochs et al., 1990)
6	BRI	Browning Reflectance Index	R_{450}/R_{690}	(P. Zarco-Tejada et al., 2005)
7	CAI	Cellulose Absorption Index	$0.5 * (R_{2000} + R_{2200}) - R_{2100}$	(Nagler, Inoue, Glenn, Russ, & Daughtry, 2003)
8	CARI	Chlorophyll Absorption Ratio Index	$R_{700} * \text{abs}(a * R_{670} + R_{670} + b) / R_{670} * (\alpha^2 + 1)^{0.5}$ $\alpha = (R_{700} - R_{550}) / 150$ $b = R_{550} - (550 * \alpha)$	(Kim, Daughtry, Chappelle, McMurtrey, & Walthall, 1994)
9	Ctr	Carter	R_{695}/R_{420}	(Carter, 1994)
10	Ctr2	Carter 2	R_{695}/R_{760}	(Carter, 1994)
11	Ctr3	Carter 3	R_{605}/R_{760}	(Carter, 1994)
12	Ctr4	Carter 4	R_{710}/R_{760}	(Carter, 1994)
13	Ctr5	Carter 5	R_{695}/R_{670}	(Carter, 1994)
14	Ctr6	Carter 6	R_{550}	(Carter, 1994)

15	CI	Coloration Index	$R_{675} * R_{690} / R_{683}^2$	(P. J. Zarco-Tejada, Pushnik, Dobrowski, & Ustin, 2003)
16	CI2	Coloration Index 2	$R_{760} / R_{700} - 1$	(A. A. Gitelson, Gritz, & Merzlyak, 2003)
17	CIInt	-	$\int_{600nm}^{735nm} R$	(Oppelt & Mauser, 2004)
18	CRI	Carotenoid Reflectance Index	$(1/R_{510}) - (1/R_{550})$	(A. A. Gitelson, Zur, Chivkunova, & Merzlyak, 2002)
19	CRI1	Carotenoid Reflectance Index 1	$1/R_{515} - 1/R_{550}$	(A. A. Gitelson et al., 2003)
20	CRI2	Carotenoid Reflectance Index 2	$1/R_{515} - 1/R_{770}$	(A. A. Gitelson et al., 2003)
21	CRI3	Carotenoid Reflectance Index 3	$1/R_{515} - 1/R_{550} * R_{770}$	(A. A. Gitelson et al., 2003)
22	CRI4	Carotenoid Reflectance Index 4	$1/R_{515} - 1/R_{700} * R_{770}$	(A. A. Gitelson et al., 2003)
23	D1	Derivative index	D_{730} / D_{706}	(P. J. Zarco-Tejada, Pushnik, et al., 2003)
24	D2	Derivative index	D_{705} / D_{722}	(P. J. Zarco-Tejada, Pushnik, et al., 2003)
25	Datt	Datt	$(R_{850} - R_{710}) / (R_{850} - R_{680})$	(B. Datt, 1999)
26	Datt2	Datt 2	R_{850} / R_{710}	(B. Datt, 1999)
27	Datt3	Datt 3	D_{754} / D_{704}	(B. Datt, 1999)
28	Datt4	Datt 4	$R_{672} / (R_{550} * R_{708})$	(Bisun Datt, 1998)
29	Datt5	Datt 5	R_{672} / R_{550}	(Bisun Datt, 1998)
30	Datt6	Datt 6	$R_{860} / (R_{550} * R_{708})$	(Bisun Datt, 1998)
31	Datt7	Datt 7	$(R_{860} - R_{2218}) / (R_{860} - R_{1928})$	
32	Datt8	Datt 8	$(R_{860} - R_{1788}) / (R_{860} - R_{1928})$	
33	DD	Double Difference Index	$(R_{749} - R_{720}) - (R_{701} - R_{672})$	(le Maire, François, & Dufrêne, 2004)

34	DDn	New Double Difference Index	$2 * (R_{710} - R_{660} - R_{760})$	(le Maire et al., 2008)
35	DPI	Double Peak Index	$(D_{688} - D_{710})/D_{697}^2$	(P. J. Zarco-Tejada, Pushnik, et al., 2003)
36	DWSI1	Disease water stress index 1	R_{800}/R_{1660}	(Apan, Held, Phinn, & Markley, 2004)
37	DWSI2	Disease water stress index 2	R_{1660}/R_{550}	(Apan et al., 2004)
38	DWSI3	Disease water stress index 3	R_{1660}/R_{680}	(Apan et al., 2004)
39	DWSI4	Disease water stress index 4	R_{550}/R_{680}	(Apan et al., 2004)
40	DWSI5	Disease water stress index 5	$(R_{800} + R_{550})/(R_{1660} + R_{680})$	(Apan et al., 2004)
41	EGFN	Edge green first derivative normalized difference	$(\max(D_{650:750}) - \max(D_{500:550})) / (\max(D_{650:750}) + \max(D_{500:550}))$	(Peñuelas, Gamon, Fredeen, Merino, & Field, 1994)
42	EGFR	Edge green first derivative ratio	$\max(D_{650:750}) / \max(D_{500:550})$	(Peñuelas et al., 1994)
43	EVI	Enhanced Vegetation Index	$2.5 * ((R_{800} - R_{670}) / (R_{800} - (6 * R_{670}) - (7.5 * R_{475}) + 1))$	(A.R. Huete, Liu, Batchily, & Van Leeuwen, 1997)
44	GDVI2	Green Difference Vegetation Index 2	$(R_{800}^2 - R_{680}^2) / (R_{800}^2 + R_{680}^2)$	(W. Wu, 2014)
45	GDVI3	Green Difference Vegetation Index 3	$(R_{800}^3 - R_{680}^3) / (R_{800}^3 + R_{680}^3)$	(W. Wu, 2014)
46	GDVI4	Green Difference Vegetation Index 4	$(R_{800}^4 - R_{680}^4) / (R_{800}^4 + R_{680}^4)$	(W. Wu, 2014)
47	GI	Greenness Index	R_{554}/R_{677}	(Smith, Adams, Stephens, & Hick, 1995)
48	-	Gitelson	$1/R_{700}$	(A. A. Gitelson, Buschmann, & Lichtenthaler, 1999)
49	-	Gitelson 2	$(R_{750} - R_{800}) / (R_{695} - R_{740}) - 1$	(A. A. Gitelson et al., 2003)
50	GMI1	Gitelson and Merzlyak Index 1	R_{750}/R_{550}	(A. A. Gitelson & Merzlyak, 1998)
51	GMI2	Gitelson and Merzlyak Index 2	R_{750}/R_{700}	(A. A. Gitelson & Merzlyak, 1998)
52	Green NDVI	Green Normalized Difference Vegetation Index	$(R_{800} - R_{550}) / (R_{800} + R_{550})$	(A. A. Gitelson, Kaufman, & Merzlyak, 1996)

53	GVI	Greenness Vegetation Index	$(R_{682} - R_{553}) / (R_{682} + R_{553})$	(Gandia, Fernández, García, & Moreno, 2004)
54	LIC	Lichtenthaler indices	R_{440} / R_{690}	(Lichtenthaler, Lang, Sowinska, Heisel, & Miehe, 1996)
55	LRDSI1	Leaf Rust Disease Severity Index 1	$6.9 * (R_{605} / R_{455}) - 1.2$	(Ashourloo, Mobasheri, & Huete, 2014)
56	LRDSI2	Leaf Rust Disease Severity Index 2	$4.2 * (R_{695} / R_{455}) - 0.38$	(Ashourloo et al., 2014)
57	LWVI1	Normalized Difference 1094/983 Leaf water VI 1	$(R_{1094} - R_{983}) / (R_{1094} + R_{983})$	(Galvão, Formaggio, & Tisot, 2005)
58	LWVI2	Normalized Difference 1094/1205 Leaf water VI 2	$(R_{1094} - R_{1205}) / (R_{1094} + R_{1205})$	(Galvão et al., 2005)
59	-	Maccioni	$(R_{780} - R_{710}) / (R_{780} - R_{680})$	(Maccioni, Agati, & Mazzinghi, 2001)
60	MCARI	Modified Chlorophyll Absorption in Reflectance Index	$((R_{700} - R_{670}) - 0.2 * (R_{700} - R_{550})) * (R_{700} / R_{670})$	(Daughtry, Walthall, Kim, De Colstoun, & McMurtrey Iii, 2000)
61	MCARI1	Modified Chlorophyll Absorption in Reflectance Index 1	$1.2(2.5(R_{790} - R_{670}) - 1.3(R_{790} - R_{550}))$	(Haboudane, Miller, Pattey, Zarco-Tejada, & Strachan, 2004)
62	MCARI2	Modified Chlorophyll Absorption in Reflectance Index 2	$((R_{750} - R_{705}) - 0.2 * (R_{750} - R_{550})) * (R_{750} / R_{705})$	(Haboudane et al., 2004)
63	MCARI2/OSAVI2		MCARI2/OSAVI2	(C. Wu, Niu, Tang, & Huang, 2008)
64	MCARI/OSAVI		MCARI2/OSAVI	(Daughtry et al., 2000)
65	mNDVI	Modified NDVI	$(R_{800} - R_{680}) / (R_{800} + R_{680} - 2 * R_{445})$	(Sims & Gamon, 2002)
66	mNDVI2	Modified NDVI 2	$(R_{750} - R_{705}) / (R_{750} + R_{705} - 2 * R_{445})$	(Sims & Gamon, 2002)
67	MPRI	Modified Photochemical Reflectance Index	$(R_{515} - R_{530}) / (R_{515} + R_{530})$	(Hernández-Clemente, Navarro-Cerrillo, Suárez, Morales, & Zarco-Tejada, 2011)
68	mREIP	Modified Red-Edge Inflection Point	Modified REIP with inverted Gaussian fit on reflectance	(Miller, Hare, & Wu, 1990)
69	mSAVI	Modified Soil Adjusted Vegetation Index	$0.5 * (2 * R_{800} + 1 - ((2 * R_{800} + 1)^2 - 8 * (R_{800} - R_{670}))^{0.5})$	(Qi, Chehbouni, Huete, Kerr, & Sorooshian, 1994)
70	MSI	Moisture Stress Index	R_{1600} / R_{817}	(Hunt Jr. & Rock, 1989)

71	mSR	modified Simple Ratio	$(R_{800}-R_{445})/(R_{680}-R_{445})$	(Sims & Gamon, 2002)
72	mSR2	modified Simple Ratio 2	$(R_{750}/R_{705}) - 1/(R_{750}/R_{705} + 1)^{0.5}$	(Jing M Chen, 1996)
73	mSR3	modified Simple Ratio 3	$(R_{800}/(R_{670} - 1)) / (R_{800}/(R_{670} + 1))^{0.5}$	(Jing M. Chen & Cihlar, 1996)
74	mSR705	modified Simple Ratio 705	$(R_{750} - R_{445})/(R_{705}-R_{445})$	(Sims & Gamon, 2002)
75	MTCI	MERIS Terrestrial Chlorophyll Index	$(R_{754} - R_{709})/(R_{709} - R_{681})$	(Dash & Curran, 2004)
76	mTVI	modified Triangular Vegetation Index	$1.2 * (1.2 * (R_{800} - R_{550}) - 2.5 * (R_{670} - R_{550}))$	(Haboudane et al., 2004)
77	MVSR	Modified Vegetation Stress Ratio	R_{723}/R_{700}	(White, Williams, & Barr, 2008)
78	NDVI4	Narrow-Band Normalised Difference Vegetation Index	$(R_{850} - R_{680})/(R_{850} + R_{680})$	(Cao et al., 2015)
79	NDLI	Normalized Difference Lignin Index	$(\log(1/ R_{1754}) - \log(1/ R_{1680})) / (\log(1/ R_{1754}) + \log(1/ R_{1680}))$	(Serrano, Peñuelas, & Ustin, 2002)
80	NDNI	Normalized Difference Nitrogen Index	$(\log(1/ R_{1510}) - \log(1/ R_{1680})) / (\log(1/ R_{1510}) + \log(1/ R_{1680}))$	(Serrano et al., 2002)
81	NDVI	Normalized Difference Vegetation Index	$(R_{800} - R_{680})/(R_{800} + R_{680})$	(Tucker, 1979)
82	NDVI2	Normalized Difference Vegetation Index 2	$(R_{750} - R_{705})/(R_{750} + R_{705})$	(A. Gitelson & Merzlyak, 1994)
83	NDVI3	Normalized Difference Vegetation Index 3	$(R_{682} - R_{553})/(R_{682} + R_{553})$	(Gandia et al., 2004)
84	NPCI	Normalized Pigment Chlorophyll Index	$(R_{680} - R_{430})/(R_{680} + R_{430})$	(Peñuelas et al., 1994)
85	NPQI	Normalized Difference 415/435 Normalized Phaeophytinization Index	$(R_{415}-R_{435})/(R_{415}+R_{435})$	(P. J. Zarco-Tejada, Miller, Noland, Mohammed, & Sampson, 2001)
86	NRI	Nitrogen Reflectance Index	$(R_{570} - R_{670})/(R_{570} + R_{670})$	(Cao et al., 2015)
87	OSAVI	Optimized Soil Adjusted Vegetation Index	$(1 + 0.16) * (R_{800}-R_{670})/(R_{800} + R_{670} + 0.16)$	(Rondeaux, Steven, & Baret, 1996)
88	OSAVI2	Optimized Soil Adjusted Vegetation Index 2	$(1 + 0.16) * (R_{750}-R_{705})/(R_{750} + R_{705} + 0.16)$	(C. Wu et al., 2008)
89	RARS	Ratio Analysis of Reflectance Spectra	R_{746}/R_{513}	(Chappelle, Kim, & McMurtrey, 1992)
90	PhRI	Physiological Reflectance Index	$(R_{550} - R_{531})/(R_{550} + R_{531})$	(Cao et al., 2015)
91	PRI	Photochemical Reflectance Index	$(R_{531} - R_{570})/(R_{531} + R_{570})$	(Gamon, Serrano, & Surfus, 1997)

92	PRI2	Photochemical Reflectance Index 2	$(R_{570} - R_{539}) / (R_{570} + R_{539})$	(Iolanda Filella, Amaro, Araus, & Penuelas, 1996)
93	PRI*CI2		PRI*CI2	(Garrity, Eitel, & Vierling, 2011)
94	PRI_norm	normalized PRI	$PRI * (-1) / (RDVI * R_{700} / R_{670})$	(P. J. Zarco-Tejada et al., 2013)
95	PSND	Pigment specific normalised difference	$(R_{800} - R_{470}) / (R_{800} + R_{470})$	(Blackburn, 1998)
96	PSRI	Plant Senescence Reflectance Index	$(R_{678} - R_{500}) / R_{750}$	(Merzlyak, Gitelson, Chivkunova, & Rakitin, 1999)
97	PSSR	Pigment specific simple ratio	R_{800} / R_{635}	(Blackburn, 1998)
98	PWI	Plant Water Index	R_{900} / R_{970}	(Peñuelas, Pinol, Ogaya, & Filella, 1997)
99	RDVI	Renormalized Difference Vegetation Index	$(R_{800} - R_{670}) / \text{SQRT}(R_{800} + R_{670})$	(Roujean & Breon, 1995)
100	REP	Red-Edge Position	$700 + 40((R_{670} + R_{780}) / 2 - R_{700}) / (R_{740} - R_{700})$	(Guyot, Baret, & Major, 1988)
101	REP_LE	-	Red-edge position through linear extrapolation	(Cho & Skidmore, 2006)
102	REP_Li	-	$R_{re} = (R_{670} + R_{780}) / 2$ $700 + 40 * ((R_{re} - R_{700}) / (R_{740} - R_{700}))$	(Guyot & Baret, 1988)
103	RGI	Red/Green Index	R_{690} / R_{550}	(P. Zarco-Tejada et al., 2005)
104	SAVI	Soil Adjusted Vegetation Index	$(1 + L) * (R_{800} - R_{670}) / (R_{800} + R_{670} + L)$	(A. R. Huete, 1988)
105	SIPI	Structure Intensive Pigment Index	$(R_{800} - R_{445}) / (R_{800} - R_{680})$	(Peñuelas, Filella, Lloret, Muñoz, & Vilajeliu, 1995)
106	SIPI2	Structure Intensive Pigment Index 2	$(R_{800} - R_{440}) / (R_{800} - R_{680})$	(Pen Uelas, Filella, Lloret, MUN- OZ, & Vilajeliu, 1995)
107	SIPI3	Structure Intensive Pigment Index 3	$(R_{800} - R_{445}) / (R_{800} - R_{650})$	(Peñuelas, Baret, & Filella, 1995)
108	SPVI	Spectral Polygon Vegetation Index	$0.4 * (3.7 * (R_{800} - R_{670}) - 1.2 * ((R_{530} - R_{670})^2)^{0.5}$	(Vincini, Frazzi, & D'Alessio, 2006)
109	SR	Simple Ratio	R_{800} / R_{680}	(Jordan, 1969)
110	SR1	Simple Ratio 1	R_{750} / R_{700}	(A. A. Gitelson & Merzlyak, 1997)

111	SR2	Simple Ratio 2	R_{752}/R_{690}	(A. A. Gitelson & Merzlyak, 1997)
112	SR3	Simple Ratio 3	R_{750}/R_{550}	(A. A. Gitelson & Merzlyak, 1997)
113	SR4	Simple Ratio 4	R_{700}/R_{670}	(McMurtrey, Chappelle, Kim, Meisinger, & Corp, 1994)
114	SR5	Simple Ratio 5	R_{675}/R_{700}	(Chappelle et al., 1992)
115	SR6	Simple Ratio 6	R_{750}/R_{710}	(Zarco-Tejada & Miller, 1999)
116	SR7	Simple Ratio 7	R_{440}/R_{690}	(Lichtenthaler et al., 1996)
117	SR705	Simple Ratio 705	R_{750}/R_{705}	(Castro-Esau, Sanchez-Azofeifa, & Rivard, 2006)
118	SR8	Simple Ratio 8	R_{515}/R_{550}	(Hernández-Clemente, Navarro-Cerrillo, & Zarco-Tejada, 2012)
119	SR9	Simple Ratio 9	R_{690}/R_{655}	(P. J. Zarco-Tejada, Pushnik, et al., 2003)
120	SR10	Simple Ratio 10	R_{685}/R_{655}	(P. J. Zarco-Tejada, Pushnik, et al., 2003)
121	SRPI	Simple Ratio Pigment Index	R_{430}/R_{680}	(J Peñuelas et al., 1995)
122	SRWI	Simple Ratio 850/1240	R_{850}/R_{1240}	(P. J. Zarco-Tejada, Rueda, & Ustin, 2003)
123	Sum_Dr1	-	$\sum_{i=626}^{795} D1i$	(Elvidge & Chen, 1995)
124	Sum_Dr2	-	$\sum_{i=680}^{780} D1i$	(I. Filella & Penuelas, 1994)
125	SWIR FI	Shortwave-infrared	$((R_{2133})^2 / R_{2225}) * (R_{2209})^3$	(Levin, Kidron, & Ben-Dor, 2007)
126	SWIR LI	Shortwave-infrared	$3.87 * (R_{2210} - R_{2090}) - 27.51 * (R_{2280} - R_{2090}) - 0.2$	(Lobell, Asner, Law, & Treuhaft, 2001)
127	SWIR SI	Shortwave-infrared	$-41.59 * (R_{2210} - R_{2090}) + 1.24 * (R_{2280} - R_{2090}) - 0.64$	(Lobell et al., 2001)
128	SWIR VI	Shortwave-infrared	$37.72 * (R_{2210} - R_{2090}) + 26.27 * (R_{2280} - R_{2090}) + 0.57$	(Lobell et al., 2001)

129	TCARI	Transformed Chlorophyll Absorbtion Ratio	$3 * ((R_{700} - R_{670}) - 0.2 * (R_{700} - R_{550}) * (R_{700}/R_{670}))$	(Haboudane, Miller, Tremblay, Zarco-Tejada, & Dextraze, 2002)
130	TCARI2	Transformed Chlorophyll Absorbtion Ratio 2	$3 * ((R_{750} - R_{705}) - 0.2 * (R_{750} - R_{550}) * (R_{750}/R_{705}))$	(C. Wu et al., 2008)
131	TCARI2/OSAVI2	-	TCARI2/OSAVI2	(C. Wu et al., 2008)
132	TCARI/OSAVI	-	TCARI/OSAVI	(Haboudane et al., 2002)
133	TGI	Triangular greenness index	$-0.5 * (190 * (R_{670} - R_{550}) - 120 * (R_{670} - R_{480}))$	(Hunt et al., 2013)
134	TVI	Transformed Vegetation Index	$0.5 * (120 * (R_{750} - R_{550}) - 200 * (R_{670} - R_{550}))$	(Broge & Leblanc, 2001)
135	Vog	Vogelmann indices	R_{740}/R_{720}	(Vogelmann, Rock, & Moss, 1993)
136	Vog2	Vogelmann indices 2	$(R_{734} - R_{747})/(R_{715} + R_{726})$	(Vogelmann et al., 1993)
137	Vog3	Vogelmann indices 3	D_{715}/D_{705}	(Vogelmann et al., 1993)
138	Vog4	Vogelmann indices 4	$(R_{734} - R_{747})/(R_{715} + R_{720})$	(Vogelmann et al., 1993)
139	VS	Vegetation Stress ratio	R_{725}/R_{702}	(White et al., 2008)
140	WI	Water Index	R_{900}/R_{970}	(Peñuelas, Filella, Biel, Serrano, & Save, 1993)

R_x - reflectance at wavelength x nm.

D_x - derivative of the reflectance spectrum at wavelength x nm.

- No original index name or abbreviation found

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