Title: Comparison between Sentinel–2 and WorldView–3 sensors in mapping wetland vegetation communities of the Grassland Biome of South Africa, for monitoring under climate change.

Type: Original Research Paper

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Supplementary material I: Spectral bands of the Sentinel–2 and WorldView satellites

Table I.1. Spectral bands and associated wavelength ranges of the optical Sentinel–2A and –2B images (ESA, 2019b; https://eos.com/sentinel-2/). Spectral bands 1, 9 and 10 at 60 m spatial resolution were not used in the analysis and are therefore shaded gray in the table. MSI - Multispectral Imagery, NIR - Near infrared, SWIR - shortwave infrared

Sensor	Band no.	Band name	Sentinel–2A		Sentinel–2B		Resolution (meters)
			Central wavelength (nm)	Bandwidth (nm)	Central wavelength (nm)	Bandwidth (nm)	
MSI	1	Coastal aerosol	443.9	27	442.3	45	60
MSI	2	Blue	496.6	98	492.1	98	10
MSI	3	Green	560.0	45	559	46	10
MSI	4	Red	664.5	38	665	39	10
MSI	5	Vegetation Red Edge	703.9	19	703.8	20	20
MSI	6	Vegetation Red Edge	740.2	18	739.1	18	20
MSI	7	Vegetation Red Edge	782.5	28	779.7	28	20
MSI	8	NIR	835.1	145	833	45	10
MSI	8a	Narrow NIR	864.8	33	864	32	20
MSI	9	Water vapour	945.0	26	943.2	27	60
MSI	10	SWIR – Cirrus	1373.5	75	1376.9	76	60
MSI	11	SWIR1	1613.7	143	1610.4	141	20
MSI	12	SWIR2	2202.4	242	2185.7	238	20

Table I.2. Spectral bands and associated wavelength ranges of the optical images of WorldView–2 (WV2) and –3 (WV3)

Sensor:	**WV2**			**WV3**		
Range of the electromagnetic spectrum	**Band**	**Spectral range, center wavelength (nm)***	**Ground sampling distance**	**Band**	**Spectral range, center wavelength (nm)***	**Ground sampling distance**
Visible to near infrared	Panchro-matic	450–800, 625	46 cm	Panchro-matic	450–800, 649.4	31 cm
Multispec-tral bands	Coastal blue	400–450, 427	1.8 m	Coastal	400–450, 427.4	1.24 m
	Blue	450–510, 478		Blue	450–510, 481.9	
	Green	510–580, 546		Green	510–580, 547.1	
	Yellow	585–625, 608		Yellow	585–625, 604.3	
	Red	630–690, 659		Red	630–690, 660.1	
	Red edge	705–745, 724		Red edge	705–745, 722.7	
	Near Infrared 1 (NIR–1)	705–745, 831		NIR–1	770–895, 824.0	
	NIR2	770–895, 908		NIR–2	860–1040, 913.6	
Shortwave-infrared (SWIR)	N.A.	N.A.	N.A.	SWIR–1	1195–1225, 1209.1	3.7 m
				SWIR–2	1550–1590, 1571.6	
				SWIR–3	1640–1680, 1661.1	
				SWIR–4	1710–1750, 1729.5	
				SWIR–5	2145–2185, 2163.7	
				SWIR–6	2185–2225, 2202.2	
				SWIR–7	2235–2285, 2259.3	
				SWIR–8	2295–2365, 2329.2	

** The band ranges and centers of WV2 was obtained from https://earth.esa.int/web/eoportal/satellite-missions/v-w-x-y-z/worldview-2; band ranges for WV3 from https://earth.esa.int/eogateway/missions/worldview-3, and band centres for WV3 from the image.*

Supplementary material II: Fieldwork surveys undertaken

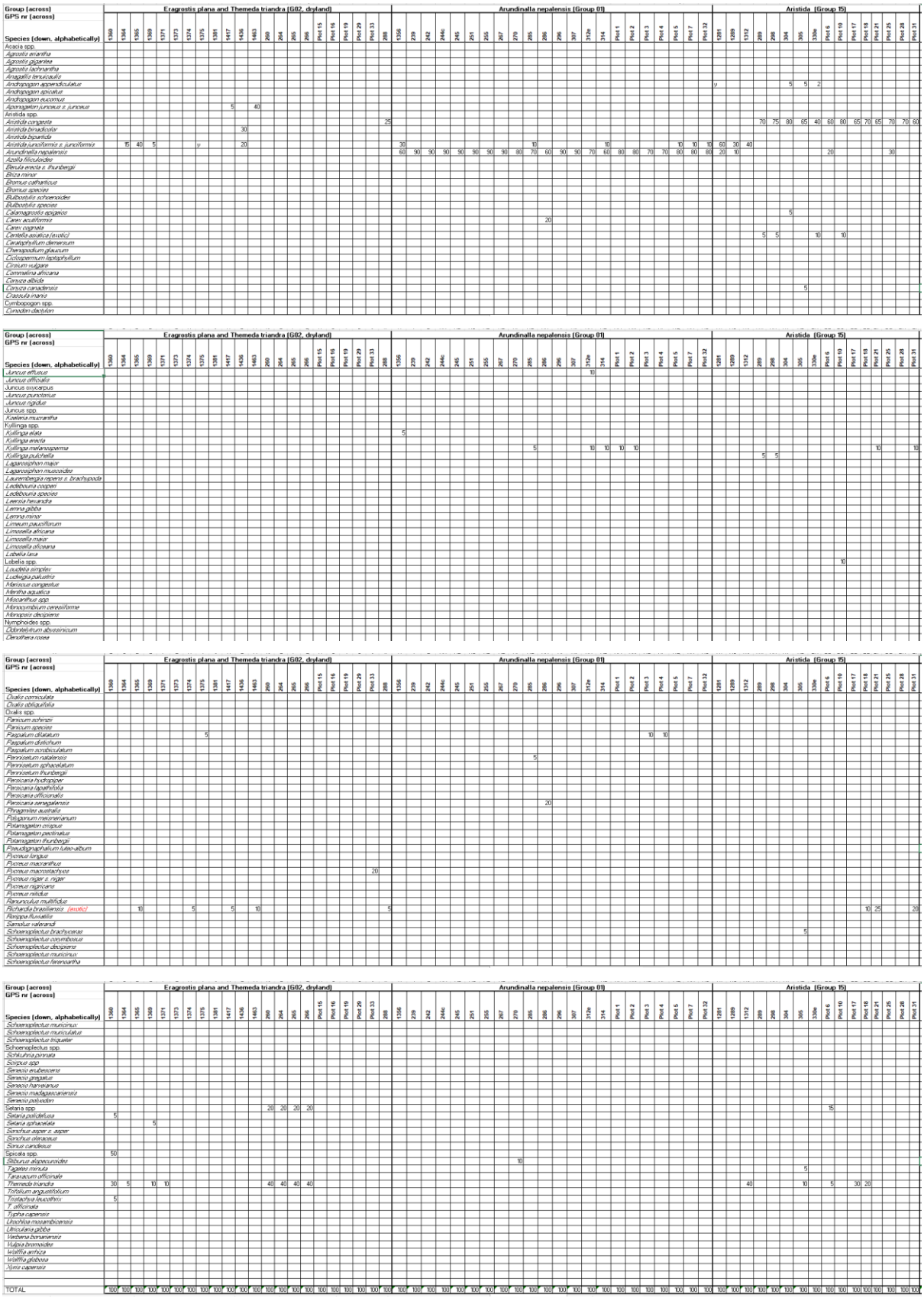


Figure II.1. Example of field surveys mapping percentage cover of species for each sample point.

Supplementary material III: Vegetation communities identified of the Hogsback and Tevredenpan study areas

The approach to identify dominant communities that could potentially be detected by satellite images was developed and executed on the following criteria:

i. Identify large homogeneous patches of wetland vegetation that are at least 10x10 m to match the S2 sensor, or alternatively at least 3x3 m for WV3. Ideally homogeneous patches should be at least 30x30 m for the Sentinel sensor, to minimize the edge effect and obtain a central pure pixel; however, this was not always possible for all communities, so patches with minimum sizes of 10x10 m and 3x3 m were also considered.
ii. Some vegetation communities were easy to identify, such as *Phr. australis* and *Carex* spp. in both study areas, since they extended over large areas, were primarily a single species that dominated the canopy, and had generally low spectral variability except for their density and subsequent background reflectance from varying soil saturation and inundation levels. For such homogeneous patches, fewer points were visited since we had a higher confidence in their homogeneity.
iii. Other grass and sedge communities showed high heterogeneity, and for these areas more sample points were obtained. Structurally and visually similar patches were identified within the size criteria, a center Global Positioning System (GPS) point taken with a Garmin GPSMAP 62S, and the species for the patch identified from a remote sensing perspective. For larger patches, the center point and some of the edges were taken, while the center and multiple edge points were taken for small and irregularly-shaped patches. This approach ensured that only pixels which fall predominantly within the extent of the points were selected as representative areas of interest. Background information was also recorded as a percentage of the total cover of the area of a patch, which is often not recorded in floristic sampling approaches.
iv. Within each patch, the percentage cover of each species was estimated and recorded as the average cover within the patch, and estimations adjusted to add up to a 100% (Supplementary material II, Figure II.1).
v. Following the first field campaign for each site, the repetitiveness of species patches was considered, as well as the percentages of dominant species within these patches, and species groups were developed based on thresholds of dominance for the group.
vi. In the second field-campaign, at least a third of the points were revisited to confirm groupings and edge-points also taken particularly for smaller patches of species groups.

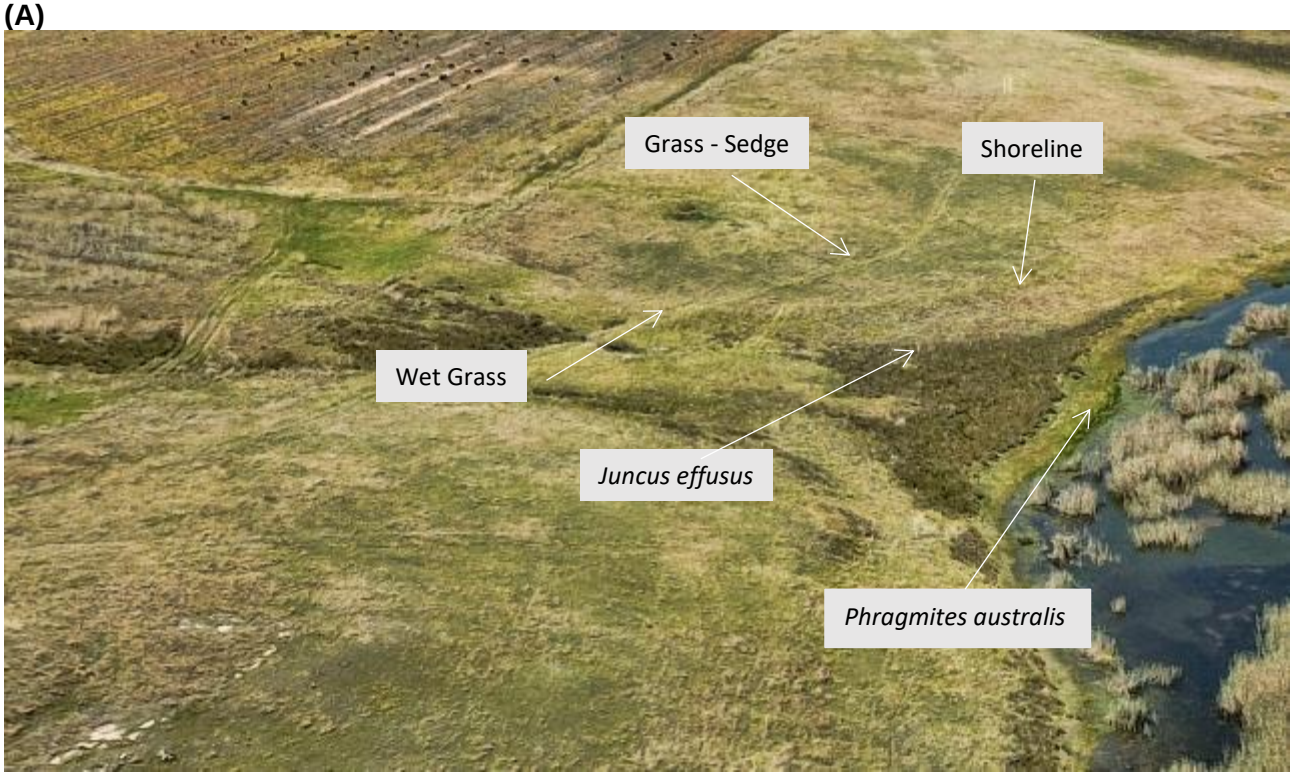
In collecting GPS points, edge points were also collected in addition to the center points, especially for smaller patches, to ensure that the selection of pixels from the images would be fully representative of these areas. The number of GPS points reported for this study included only center points and not edge points.

Table III.1. Categories and types of vegetation communities identified through floristic sampling (relevé) information for the Hogsback and Tevredenpan study areas in the South African National Wetland Vegetation Database (Sieben et al., 2014)

Site	Community Group (CG)	Community	Vegetation community types
Hogsback	Montane grassy wetlands	CG5.1	*Merxmuellera* macowanii* community
		CG5.2	*Isolepis angelica* community
		CG5.4	*Fingerhuthia sesleriiformis* community
		CG5.9	*Juncus inflexus* community
		CG5.11	*Haplocarpha nervosa* community
		CG5.14	*Festuca caprina* community
			Merxmuellera drakensbergensis* community
		CG5.15	*Aristida junciformis – Tristachya leucothrix* community
	Temperate grassy wetlands	CG6.2	*Carex acutiformis* community
		CG6.4	*Juncus effusus* community
		CG6.6	*Arundinella nepalensis* community
Tevredenpan	Grass lawn wetlands	CG7.13	*Bidens bipinnata - Cynodon dactylon* community
	Inland saline wetlands	CG9.1	*Schoenoplectus decipiens* community
		CG9.2	*Cynodon transvaalensis* community
		CG9.5	*Schoenoplectus triqueter* community
	Montane grassy wetlands	CG5.3	*Gunnera perpensa* community
			Limosella africana community
			Limosella maior community
	Submerged wetlands	CG8.1	*Azolla - Lemna minor* community
		CG8.3	*Stuckenia pectinata* community
		CG8.5	*Limosella maior - Lim. grandiflora* community
			Potamogeton nodosus community
	Subtropical wetlands	CG3.2	*Axonopus affinis - Centella* community
		CG3.8	*Pycreus nitidus* community
	Temperate grassy wetlands	CG6.1	*Eleocharis dregeana* community
			Leersia hexandra community
		CG6.3	*Aristida junciformis - Helichrysum* community
		CG6.4	*Juncus effusus* community
			Schoenoplectus brachyceras community
			Schoenoplectus corymbosus community

** Genus name is now 'Tenaxia'.*

(A)



(B)

Figure III.1. Views of wetland vegetation classes on the north-eastern side of Tevredenpan: (A) Oblique view of the different vegetation patterns relating to wetland vegetation classes viewed in a south-easterly direction (Oblique aerial photo taken by Anton Linström); (B) Horizontal photo taken in a northerly direction, with grass-sedges in the front, *Juncus* spp. to the right and *Phragmites australis* to the left.

Supplementary material IV: Number of pixels collected for each Region of Interest class and optical sensor for the Hogsback and Tevredenpan study areas

Table IV.1. Vegetation community classes used for the remote sensing classification of the Hogsback study area (first six classes listed). Seven additional classes (last seven classes) were added for image classification. S2A = Sentinel–2A; WV3 = WorldView–3

Type	Vegetation community (first set) or sub-category of cover type (second set)	CODE	Approximate average percentage of species observed within patches	Number of pixels per sample for WV3 / S2A	Number of samples for WV3 / S2A	Total number of pixels for WV3 / S2A
Terrestrial*	*Eragrostis* spp., *Themeda* spp., *Andropogon* spp.	ET	> 60% *Eragrostis plana*; *Themeda triandra; Andropogon appendiculatus* (dominant species).	±210 / 25	30 / 30	6 253 / 750
Palustrine	*Carex* spp. (>70%)	CA	*Carex* spp. (> 70%).	±45 / ±5	30 / 30	1 278 / 144
Palustrine*	*Ficinia* spp.	FS	*Ficinia nodosa* and *F. indica* species.	4 / 1	30 / 30	126 / 30
Palustrine*	*Merxmuellera macowanii*	MM	Predominantly *Merxmuellera macowanii* species, see the mixed grass community in Table 2 for more information.	4 / 1	30 / 30	120 / 30
Palustrine*	*Phragmites australis***	PA	> 90% *Phragmites australis.*	±81 / 9	30 / 30	2 387 / 270
Palustrine*	Sedge-dominant	SE	See the mixed sedge community in Table 2 for more information.	36 / ±4	30 / 30	1 198 / 117
Natural	Bare soil	BA	Harvested croplands and roads.	9 / 1	20 / 20	180 / 20
Modified	Cropland	CR	Owing to the wide variety of reflectance values that were present, resulting from different types of crops and their growth stages, a wider range of pixels were used to represent this class.	±210 / 25	50 / 50	10 732 / 1 250
Modified	Invasive tree species (woody)	RS	*Rubus* spp.	9 / 1	14 / 14	126 / 14
Natural (lacustrine)	Open water	OW	Including both natural and artificial inundated systems.	81 / 9	30 / 30	2 396 / 270
Natural (terrestrial)	Mountain slopes	MS	The southern slope of the mountain in the north mapped as a separate class to avoid prediction of palustrine wetlands in this area.	±64 / 9	30 / 30	1 952 / 270
Modified	Plantations	PL	Commercial plantations in full growth.	±169 / 55	30 / 30	5 456 / 750
Modified	Plantations felled	PLF	Commercial plantations felled.	196 / 25	30 / 30	5 950 / 750

** Dominant in the landscape.*

Table IV.2. Vegetation community classes used for the remote sensing classification of the Tevredenpan study area (first nine classes listed). Four additional classes (last four classes) were added for image classification. S2A = Sentinel–2A; WV3 = WorldView–3

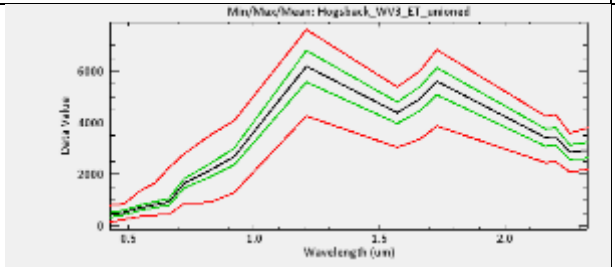
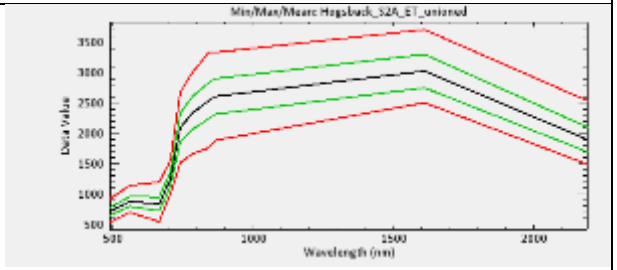
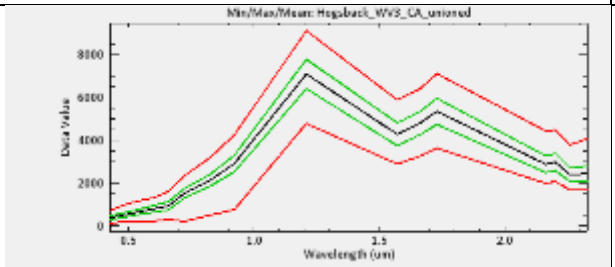
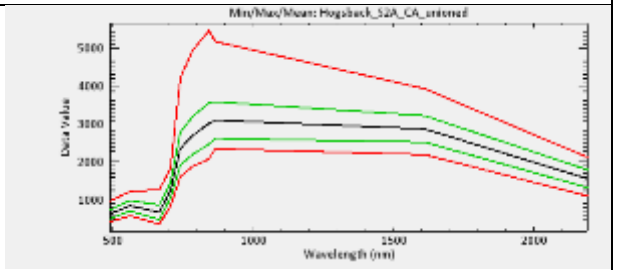
Type	Vegetation community (first set) or sub-category of cover type (second set)	CODE	Approximate average percentage of species observed within patches	Number of pixels per sample for WV3 / S2A	Number of samples for WV3 / S2A	Total number of pixels for WV3 / S2A
Terrestrial*	*Eragrostis plana* and *Themeda triandra*	ET	> 60% *Eragrostis plana* and *Themeda triandra.*	±323 / 4	55 / 55	16 685 / 220
Palustrine*	*Arundinella nepalensis* (>50%)	AN	*Arundinella nepalensis* (> 50%).	64 / 1	25 / 25	1 600 / 25
Palustrine*	*Aristida* spp.	AR	> 40% *Aristida* spp.	64 / 1	30 / 30	1 920 / 30
Palustrine	*Carex* spp. (>70%)	CA	*Carex* spp. (> 70%).	±72 / 1	25 / 25	1809 / 25
Palustrine*	Grass-sedge communities	GS	*Aristida junciformis* (±10%); *Arundinella nepalensis* (±20%); *Calamagrostis epigejos* (±20%); *Commelina africana* (±25%); *Cyperus denudatus* (±10%) and *Paspalum dilatatum* (±5%).	±72 / 1	50 / 50	3 761 / 50
Palustrine	*Juncus effusus* (>50%)	JE	> 50% *Juncus effuses.*	±56 / 1	40 / 40	2 633 / 40
Palustrine*	*Phragmites australis***	PA	> 90% *Phragmites australis.*	±1 221 / 16	30 / 30	37 357 / 480
Palustrine*	Sedge dominant (>20%)	SE	± 80% *Eliocharis dregreana*; ±16% *Leersia hexandra* and < 6% open water.	±72 / 1	40 / 40	2 944 / 40
Palustrine*	Wet-grass communities	WG	±70% *Cymbopogon validus with* < 10% of *Cyperus haematocephalus; Cyperus denudatus*; *Kylinga erecta*; *Leersia hexandra* and *Pennisetum thunbergi.*	±80 / 1	70 / 70	5 657 / 70
Natural	Bare soil	BA	Harvested croplands and roads.	±81 / 4	25 / 25	1 906 / 100
Modified	Cropland	CR	Owing to the wide variety of reflectance values that was present, resulting from different types of crops and their growth stages, a wider range of pixels were used to represent this class.	±7 876 / 20	65 / 70	511 924 / 1400
Modified	Invasive tree species (woody)	IS	*Acacia dealbata, Acacia mearnsii, Eucalyptus grandis,* and *Salix babylonica.*	±323 / 4	30 / 30	9 842 / 120
Natural (lacustrine)	Open water	OW	Including both natural and artificial inundated systems.	±1 292 / 16	30 / 30	38 027 / 480

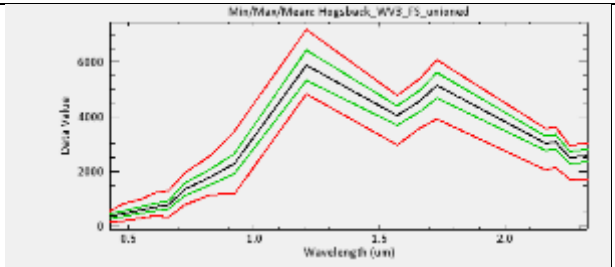
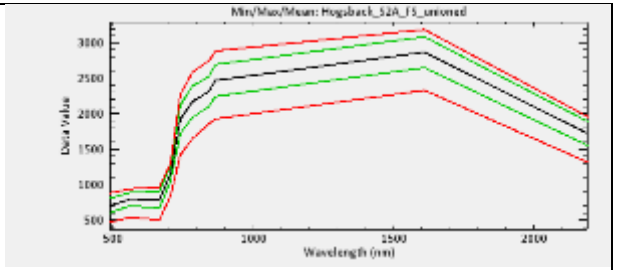
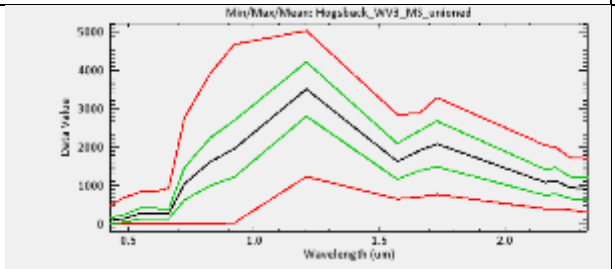
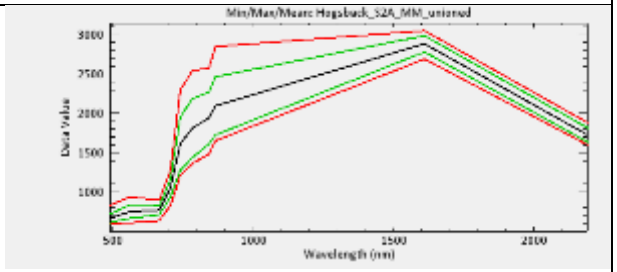
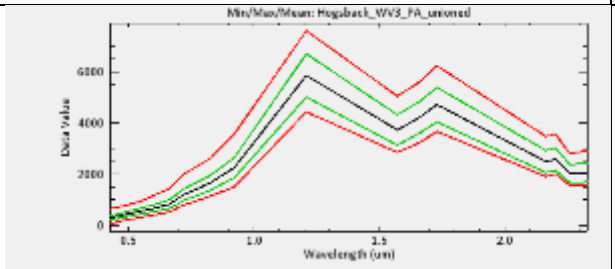
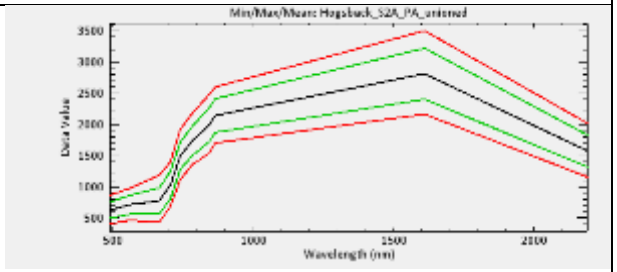
** Dominant in the landscape.*

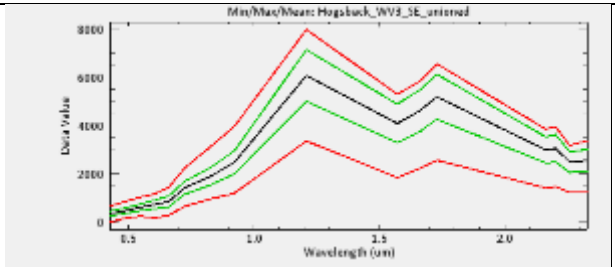
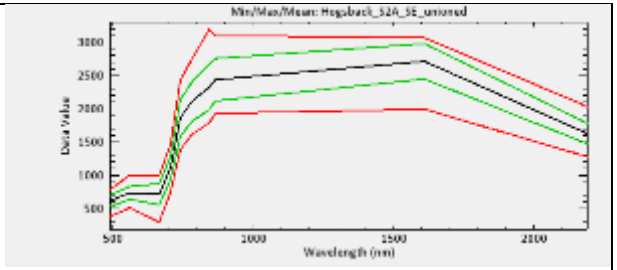
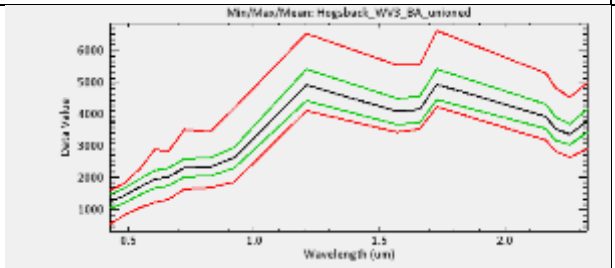
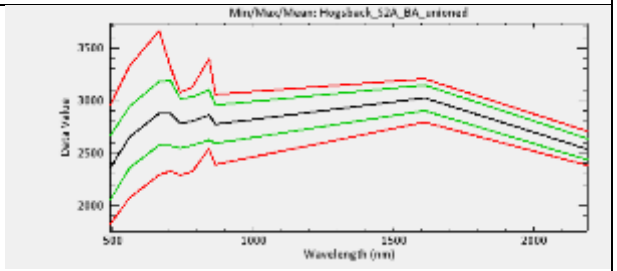
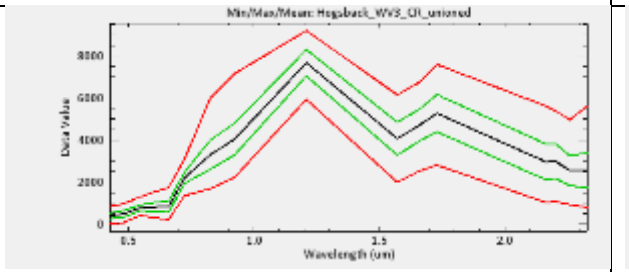
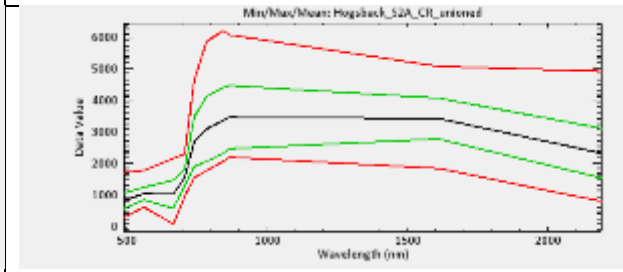
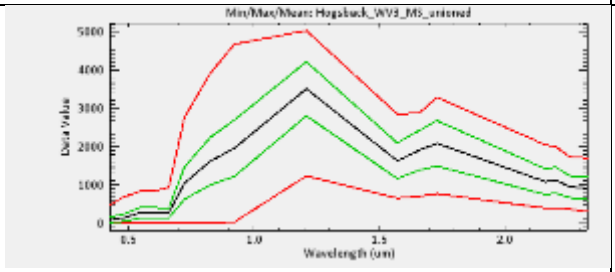
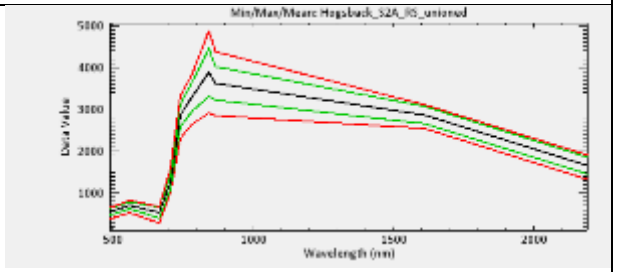
*** Emergent vegetation, which was not always accessible on foot, and therefore canopy spectra were extracted at a desktop level.*

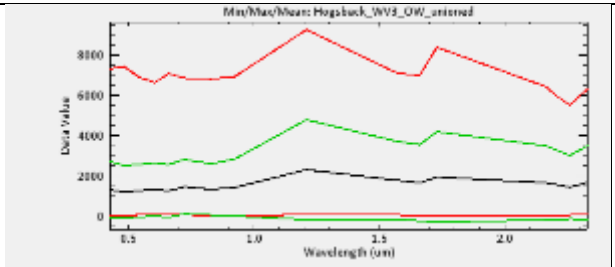
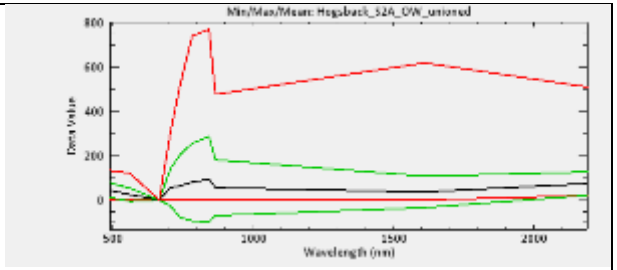
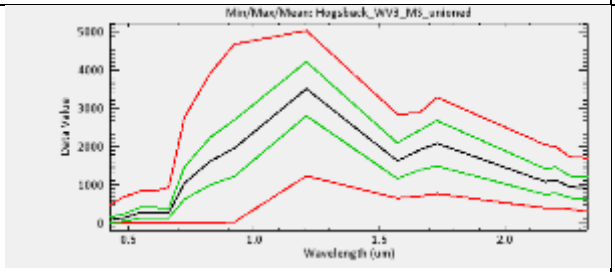
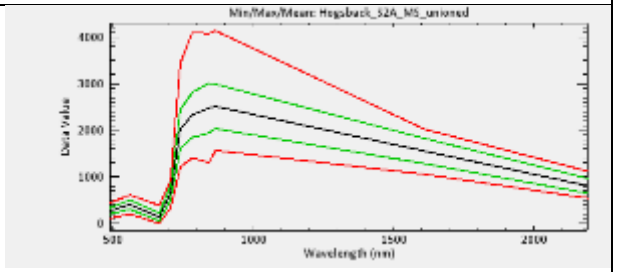
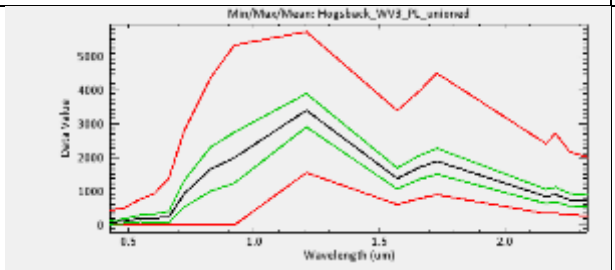
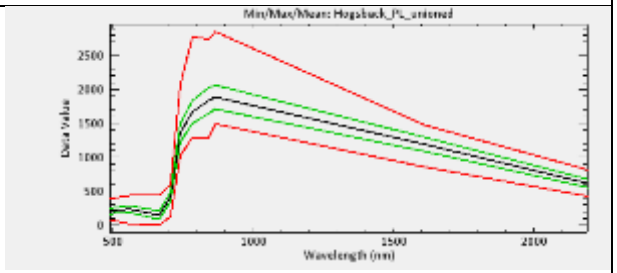
Supplementary material V: Reflectance spectra of classes used in the remote sensing classification

Figure V.1. Photographs and average spectra of the Hogsback vegetation communities for WorldView-3 (WV3) in micrometres (µm) and Sentinel-2 (S2A) in nanometers (nm). Red lines indicate the minimum and maximum range, black the mean and green the first standard deviation of the distribution of the data. VNIR = visible to near infrared region; SWIR = shortwave infrared region.

Photograph taken in the field	Average spectra from WV3 (VNIR-SWIR)	Average spectra from S2A (VNIR & SWIR)
Eragrostis spp, Themeda spp., *Andropogon* spp 		
Carex spp 		

Ficinia spp. 		
Merxmuellera macowanii 		
Phragmites australis (no photo taken)		

Sedge-dominant 		
Bare soil (no photo taken)		
Cropland 		
Invasive tree species (woody) – *Rubus* spp. 		

Open water 		
Mountain slopes (no photo taken)		
Plantations 		

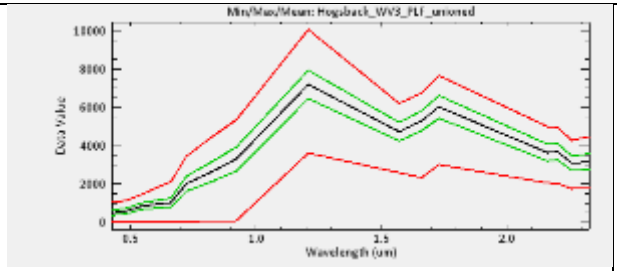
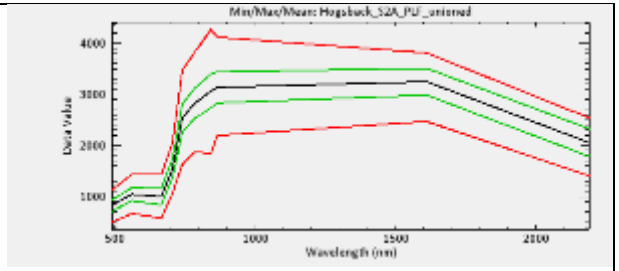
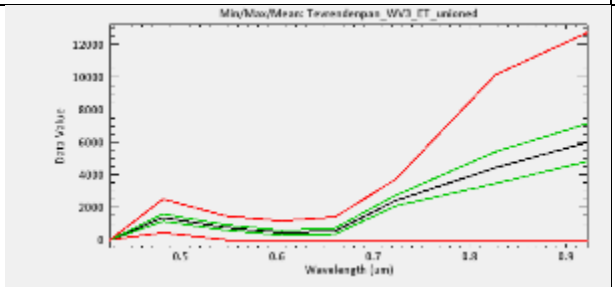
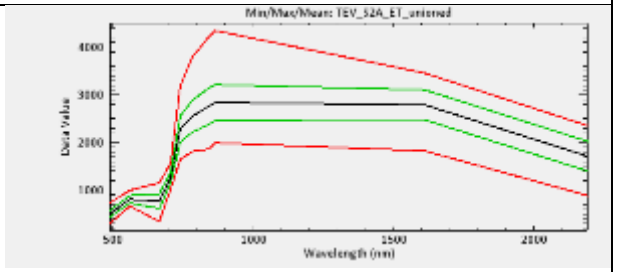
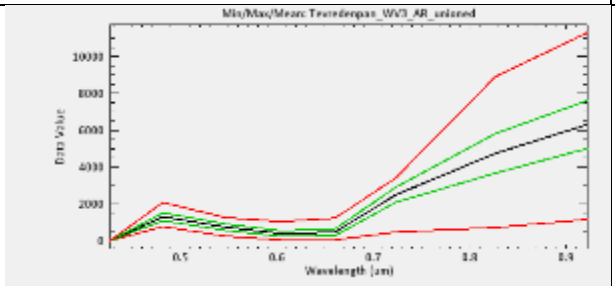
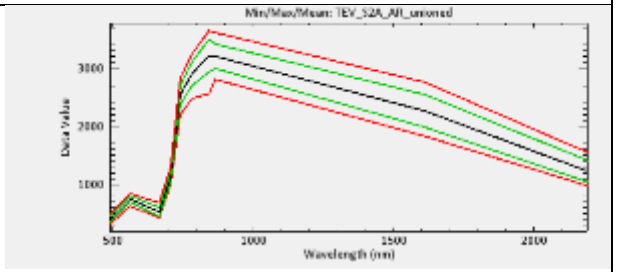
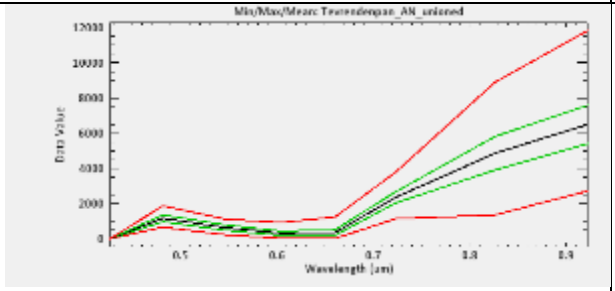
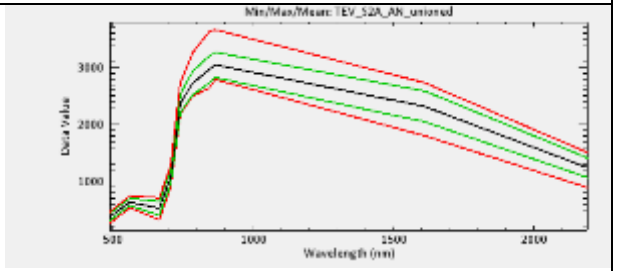
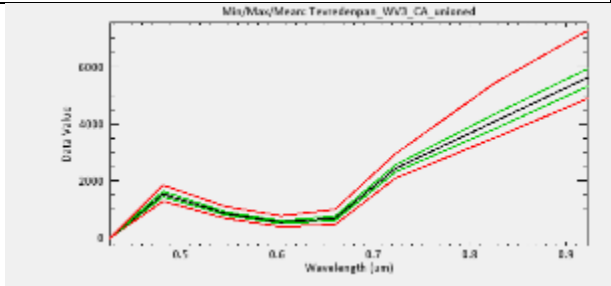
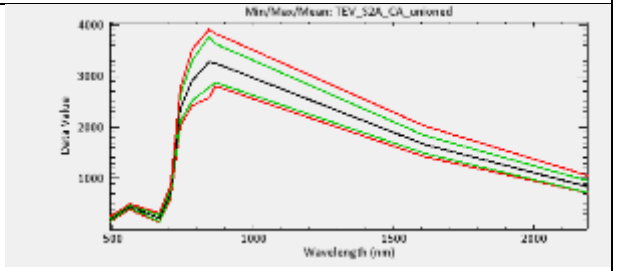
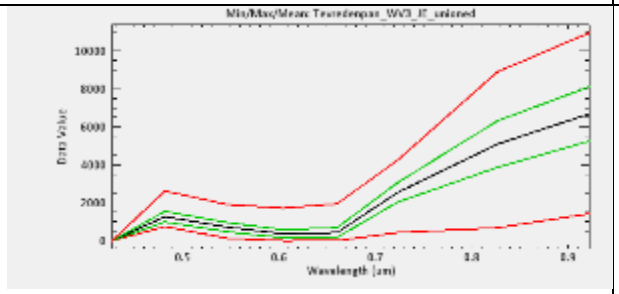
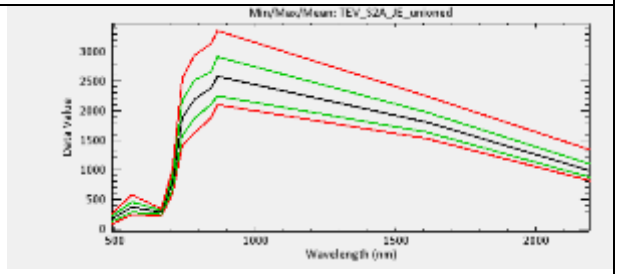
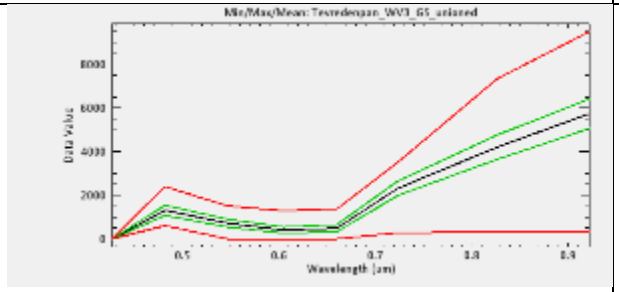
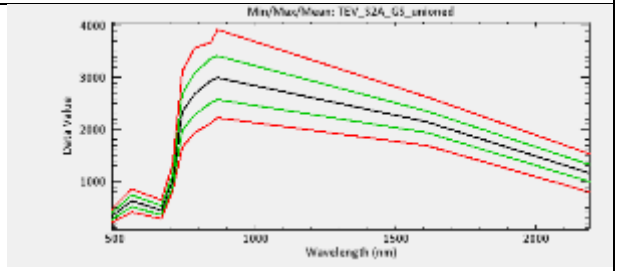
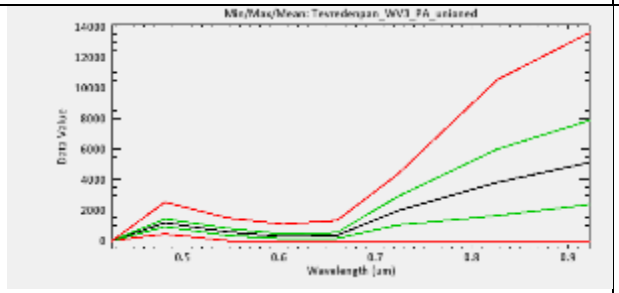
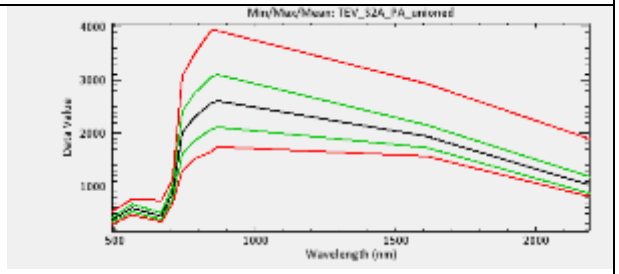
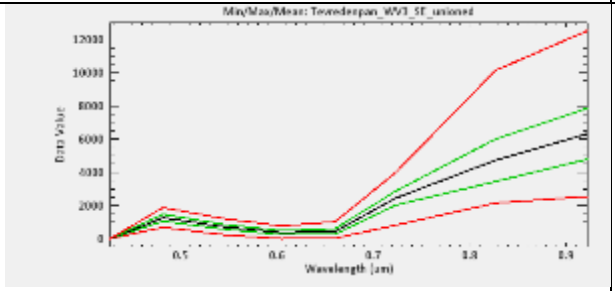
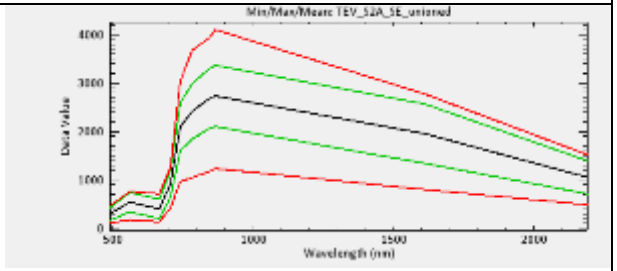
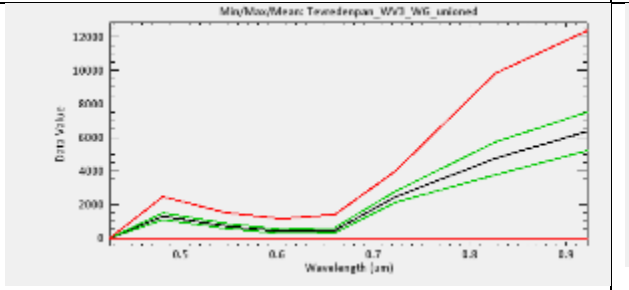
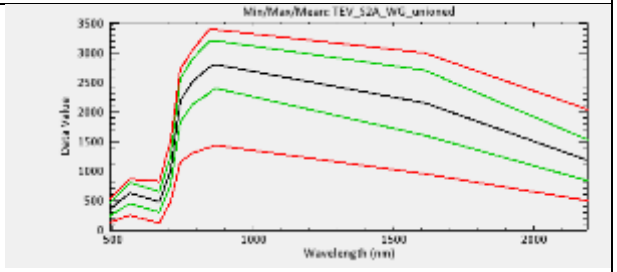
Plantations felled 		

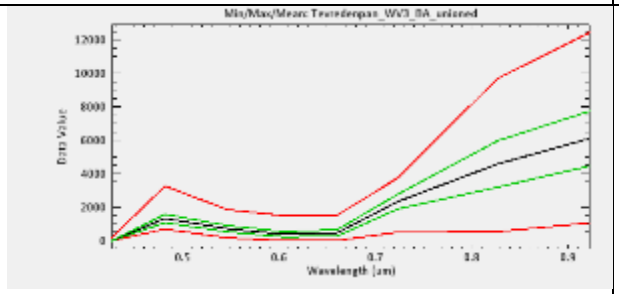
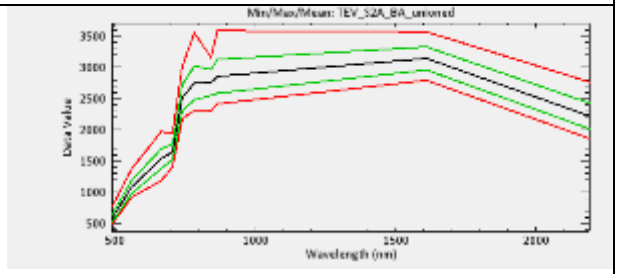
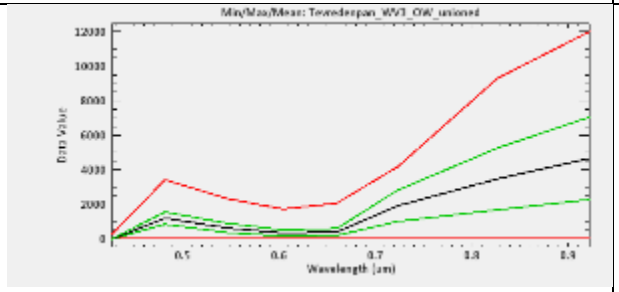
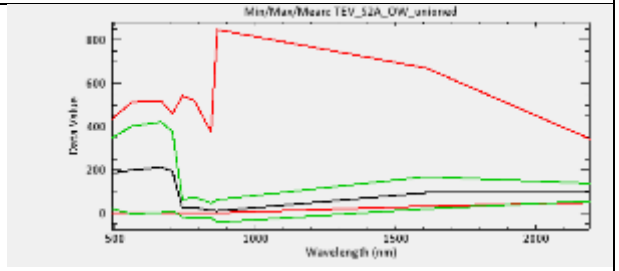
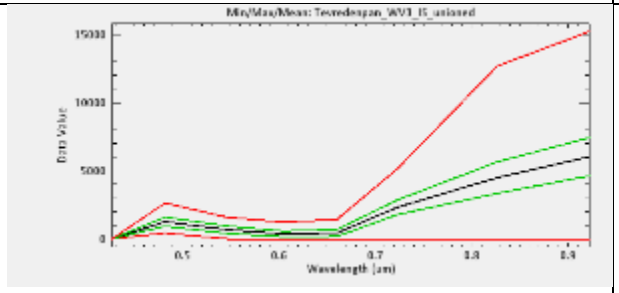
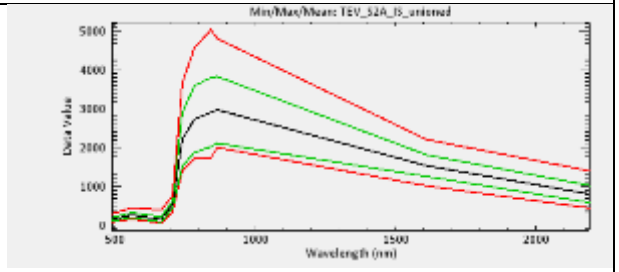
Figure IV.2. Photographs and average spectra of the Tevredenpan vegetation communities for WorldView-3 (WV3) in micrometres (µm) and Sentinel-2 (S2A) in nanometers (nm). Red lines indicate the minimum and maximum range, black the mean and green the first standard deviation of the distribution of the data. VNIR = visible to near infrared region; SWIR = shortwave infrared region.

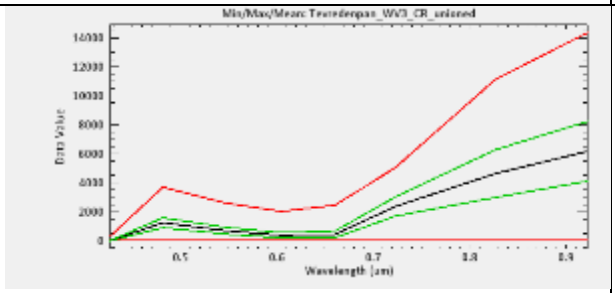
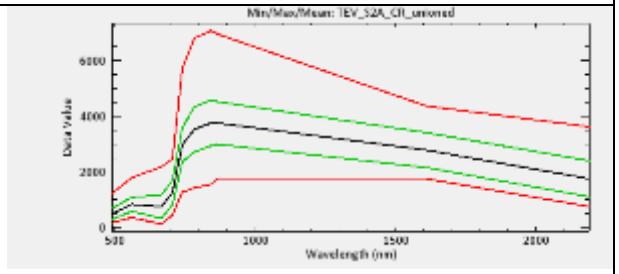
Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Eragrostis plana* and *Themeda triandra 		
***Aristida* spp.** 		

Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Arundinella nepalensis 		
***Carex* spp** 		

Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Juncus effuses (see Figure I.2A)		
Grass-sedge communities 		
Phragmites australis  (see also Figure I.2A)		

Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Sedge dominant 		
Wet-grass communities 		

Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Bare soil (no photo taken)		
Inundation / open water 		
Invasive tree species (woody) 		

Photograph taken in the field	Average spectra from WV3 (VNIR)	Average spectra from Sentinel-2A (VNIR & SWIR)
Cropland 		

Supplementary material VI: Confusion matrices of the optimal classification scenarios per study area and sensor, prior to the adjustment for area bias as per the best-practise guideline of Olofsson et al. (2013;14)

Table V.1. Confusion matrix resulting from the optimal classification scenario of the Sentinel–2A image (bands and ancillary data) for the Hogsback study area. Classes indicated in red text show the class confusion of > 10% and the lowest individual producer's and user's accuracies. Values in bold indicate sub-totals. Abbreviations: BA = Bare soil; CA = *Carex* spp; CR = cropland; ET = *Eragrostis* spp. and *Themeda* spp; FS = *Ficinia* spp.; MM = *Merxmuellera macowanii*; MS = mountain slope; OA = average overall accuracy; OW = open water; PA = *Phragmites australis*; PA_ = Producer's accuracy; PL = plantations; PLF = plantations felled; RS = *Rubus* spp.; SE = Sedge dominant; UA = User's accuracy

	BA	**CA**	**CR**	**ET**	**FS**	**MM**	**MS**	**OW**	**PA**	**PL**	**PLF**	**RS**	**SE**	**Sub-totals:**	**Original UA**	**Total extent of predicted areal extent (ha)**	**Fraction of cover**
BA	20	0	0	0	0	0	0	0	0	0	0	0	0	20	100.0	3.9	0.000
CA	0	16	5	2	2	0	0	0	0	0	1	1	3	30	60.0	418.4	0.059
CR	0	2	45	0	0	0	0	0	0	0	2	1	0	50	92.0	1 144.2	0.141
ET	0	0	3	23	0	1	0	0	0	0	0	0	3	30	76.7	2 627.2	0.340
FS	0	1	0	0	19	4	0	0	0	0	0	0	6	30	53.3	523.8	0.057
MM	0	0	0	1	6	22	0	0	0	0	0	0	1	30	66.7	386.2	0.045
MS	0	0	0	0	0	0	30	0	0	0	0	0	0	30	100.0	818.1	0.096
OW	0	0	0	0	0	0	0	30	0	0	0	0	0	30	100.0	26.5	0.004
PA	0	0	0	0	0	0	0	0	30	0	0	0	0	30	100.0	97.2	0.007
PL	0	0	0	0	0	0	0	0	0	30	0	0	0	30	96.7	450.0	0.051
PLF	0	2	1	2	0	0	0	0	0	0	24	0	1	30	76.7	729.1	0.079
RS	0	1	0	0	0	0	0	0	0	0	1	12	0	14	85.7	197.8	0.023
SE	0	2	0	4	3	5	0	0	0	0	0	0	16	30	53.3	919.9	0.097
Sub-totals:	20	24	54	32	30	32	30	30	30	30	28	14	30	**384**		**8 342.2**	
Original PA_	100.0	66.7	83.3	71.9	63.3	68.8	100.0	100.0	100.0	100.0	85.7	85.7	53.3			**Original OA = 82.6%**	

Area-adjusted PA_	100.0	54.4	74.3	90.5	62.7	47.7	100.0	100.0	100.0	100.0	88.8	82.2	52.4			**Area-adjusted OA =78.2%**

Table V.2. Confusion matrix resulting from the optimal classification scenario of the WorldView–3 image (bands and ancillary data) for the Hogsback study area. Classes indicated in red text show class confusion of > 10% and the lowest individual producer's and user's accuracies. Values in bold indicate sub-totals. Abbreviations: BA = Bare soil; CA = *Carex* spp; CR = cropland; ET = *Eragrostis* spp. and *Themeda* spp; FS = *Ficinia* spp.; MM = *Merxmuellera macowanii*; MS = mountain slope; OA = average overall accuracy; OW = open water; PA = *Phragmites australis*; PA_ = Producer's accuracy; PL = plantations; PLF = plantations felled; RS = *Rubus* spp.; SE = Sedge dominant; UA = User's accuracy

	BA	**CA**	**CR**	**ET**	**FS**	**MM**	**MS**	**OW**	**PA**	**PL**	**PLF**	**RS**	**SE**	**Sub-totals:**	**UA**	**Total extent of predicted areal extent (ha)**	**Fraction of cover**
BA	20	0	0	0	0	0	0	0	0	0	0	0	0	20	100.0	27.3	0.004
CA	0	24	0	0	2	0	0	0	0	0	0	0	4	30	80.0	659.7	0.107
CR	0	0	46	1	0	0	0	0	1	0	2	0	0	50	92.0	1 235.6	0.200
ET	0	0	0	28	0	0	0	0	0	0	2	0	0	30	93.3	635.3	0.103
FS	0	2	0	1	19	4	0	0	0	0	0	1	3	30	63.3	398.7	0.064
MM	0	1	0	0	3	25	0	0	0	0	0	0	1	30	83.3	268.5	0.043
MS	0	0	0	0	0	0	28	0	0	2	0	0	0	30	93.3	814.0	0.131
OW	0	0	0	0	0	0	0	30	0	0	0	0	0	30	100.0	41.6	0.007
PA	0	0	0	0	0	0	0	0	30	0	0	0	0	30	100.0	140.9	0.023
PL	0	0	0	0	0	0	2	0	0	28	0	0	0	30	93.3	303.4	0.049
PLF	0	1	1	7	0	0	0	0	0	0	20	0	1	30	66.7	709.7	0.115
RS	0	1	1	0	4	0	1	0	0	0	0	7	0	14	50.0	227.5	0.037
SE	0	2	1	0	1	2	0	0	0	0	0	0	24	30	80.0	730.3	0.118
Sub-totals:	20	31	49	37	29	31	31	30	31	30	24	8	33	**384**		**6 192.7**	
Original PA_	100.0	77.4	93.9	75.7	65.5	80.6	90.3	100.0	96.8	93.3	83.3	87.5	72.7			**Original OA = 85.7%**	
Area-adjusted PA_	100.0	81.0	94.6	74.4	61.2	68.7	95.4	100.0	85.1	83.9	83.8	89.5	78.5			**Area-adjusted OA =83.3%**	

Table V.3. Confusion matrix resulting from the optimal classification scenario of the Sentinel–2A image (bands and elevation data) for the Tevredenpan study area. Classes indicated in red text show class confusion of > 10% and the lowest individual producer's and user's accuracies. Values in bold indicate sub-totals. Abbreviations: AN = *Arundinella nepalensis*; AR = *Aristida* spp; BA = bare soil; CA = *Carex* spp; CR = cropland; ET = *Eragrostis* spp and *Themeda* spp.; GS = grass-sedge communities; IS = invasive species; JE = *Juncus effusus*; OA = average overall accuracy; OW = open water; PA = *Phragmites australis*; PA_ = Producer's accuracy; SE = Sedge dominant; UA = User's accuracy; WG = Wet-grass

	AN	**AR**	**BA**	**CA**	**CR**	**ET**	**GS**	**IS**	**JE**	**OW**	**PA**	**SE**	**WG**	**Sub-totals:**	**UA**	**Total extent of predicted areal extent (ha)**	**Fraction of cover**
AN	14	0	0	0	0	0	4	0	0	0	0	3	4	25	56.0	236.9	0.031
AR	0	20	0	0	0	0	3	0	0	0	0	2	5	30	66.7	367.2	0.048
BA	0	0	22	0	2	1	0	0	0	0	0	0	0	25	88.0	36.7	0.005
CA	0	0	0	25	0	0	0	0	0	0	0	0	0	25	100.0	108.6	0.014
CR	0	0	1	0	57	6	2	1	0	0	0	0	3	70	81.4	1 901.6	0.247
ET	0	1	0	0	5	42	1	0	0	0	0	2	4	55	76.4	1 831.3	0.238
GS	4	3	0	0	2	0	36	0	1	0	0	1	3	50	72.0	764.7	0.099
IS	0	0	0	0	0	0	1	28	0	0	0	0	1	30	93.3	127.7	0.017
JE	1	0	0	0	0	0	1	0	38	0	0	0	0	40	95.0	109.8	0.014
OW	0	0	0	0	0	0	0	0	0	30	0	0	0	30	100.0	145.7	0.019
PA	1	2	0	0	1	1	0	0	0	0	24	0	1	30	80.0	411.6	0.053
SE	1	0	0	0	1	0	2	0	0	0	0	35	1	40	87.5	146.7	0.019
WG	1	2	0	0	2	5	1	0	1	0	0	2	56	70	80.0	1 511.1	0.196
Sub-totals:	22	28	23	25	70	55	51	29	40	30	24	45	78	**520**		7 699.5	0.031
Original PA_	63.6	71.4	95.7	100.0	81.4	76.4	70.6	96.6	95.0	100.0	100.0	77.8	71.8			**Original OA = 82.1%**	
Area-adjusted PA_	56.3	62.0	54.3	100.0	85.6	83.0	73.5	81.4	73.9	100.0	100.0	41.9	76.0			**Area-adjusted OA =78.6%**	

Table V.4. Confusion matrix resulting from the optimal classification scenario of the WorldView–3 image (visible to near-infrared bands and ancillary data) for the Tevredenpan study area. Classes indicated in red text show class confusion of > 10% and the lowest individual producer's and user's accuracies. Values in bold indicate sub-totals. Abbreviations: AN = *Arundinella nepalensis*; AR = *Aristida* spp; BA = bare soil; CA = *Carex* spp; CR = cropland; ET = *Eragrostis* spp and *Themeda* spp.; GS = grass-sedge communities; IS = invasive species; JE = *Juncus effusus*; OA = average overall accuracy; OW = open water; PA = *Phragmites australis*; PA_ = Producer's accuracy; SE = Sedge dominant; UA = User's accuracy; WG = Wet-grass

	AN	AR	BA	CA	CR	ET	GS	IS	JE	OW	PA	SE	WG	Sub-totals:	UA	Total extent of predicted areal extent (ha)	Fraction of cover
AN	12	0	0	0	1	0	5	0	1	0	0	0	6	25	48.0	274.9	0.036
AR	0	18	0	0	0	2	2	0	0	0	0	0	8	30	60.0	270.8	0.035
BA	0	0	25	0	0	0	0	0	0	0	0	0	0	25	100.0	89.7	0.012
CA	0	0	0	25	0	0	0	0	0	0	0	0	0	25	100.0	40.1	0.005
CR	0	0	1	1	45	6	4	1	0	0	0	0	7	65	69.2	1 778.3	0.231
ET	0	0	0	0	3	45	2	0	0	0	0	1	4	55	81.8	1 901.6	0.247
GS	2	2	0	0	1	0	34	0	1	0	2	4	4	50	68.0	744.9	0.097
IS	0	0	0	0	1	0	0	28	0	0	0	1	0	30	93.3	232.7	0.030
JE	0	0	0	0	0	0	1	0	39	0	0	0	0	40	97.5	180.1	0.023
OW	0	0	0	0	0	0	0	0	0	30	0	0	0	30	100.0	181.7	0.024
PA	2	0	0	0	0	1	0	0	0	0	25	0	2	30	83.3	394.3	0.051
SE	0	1	0	0	3	0	1	0	0	0	0	29	6	40	72.5	276.2	0.036
WG	0	6	0	0	1	1	1	0	4	0	7	5	45	70	64.3	1 330.9	0.173
Sub-totals:	16	27	26	26	55	55	50	29	45	30	34	40	82	**515**		**7 696.3**	
Original PA_	75.0	66.7	96.2	96.2	81.8	81.8	68.0	96.6	86.7	100.0	73.5	72.5	54.9			**Original OA = 77.7%**	
Area-adjusted PA_	70.2	51.9	76.6	59.5	87.4	87.9	64.2	88.8	63.3	100.0	66.9	50.4	59.0			**Area-adjusted OA = 73.8%**	