

Mapping Coastal Wetlands and Their Dynamics in the Yellow River Delta over Last Three Decades: Based on a Spectral Endmember Space

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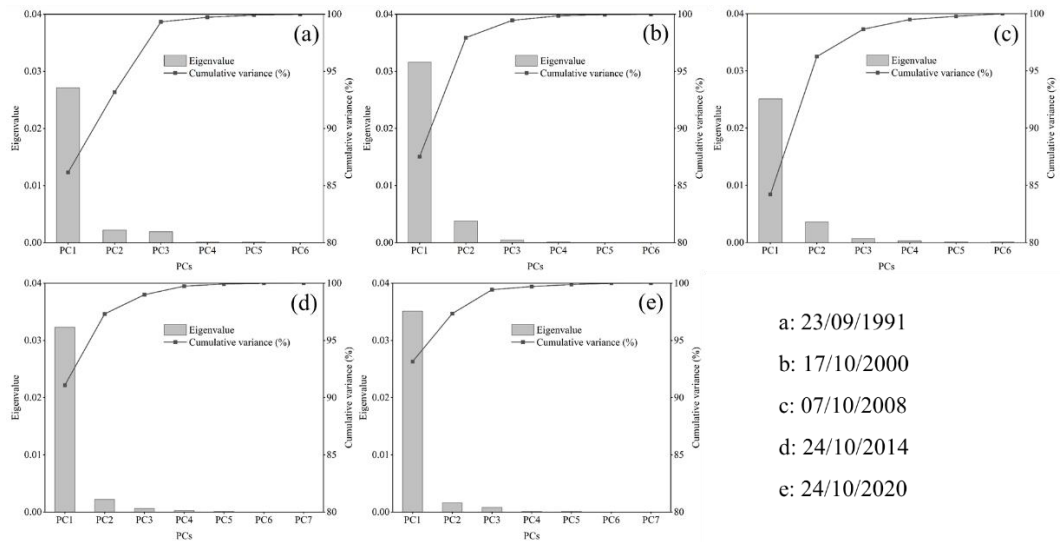


Figure S1. Eigenvalues ordered highest to zero, and cumulative PC variance (%). The cumulative variance of the three primary PCs (PC1 to PC3), was greater than 98%, meaning nearly all the image parameter information can be represented by these PCs.

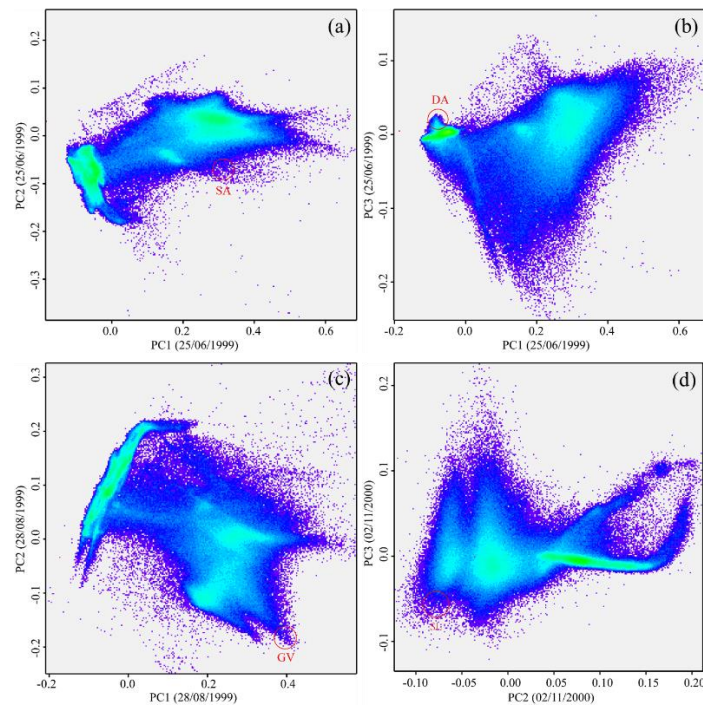


Figure S2. Scatter plot for TM endmember spectral extraction.

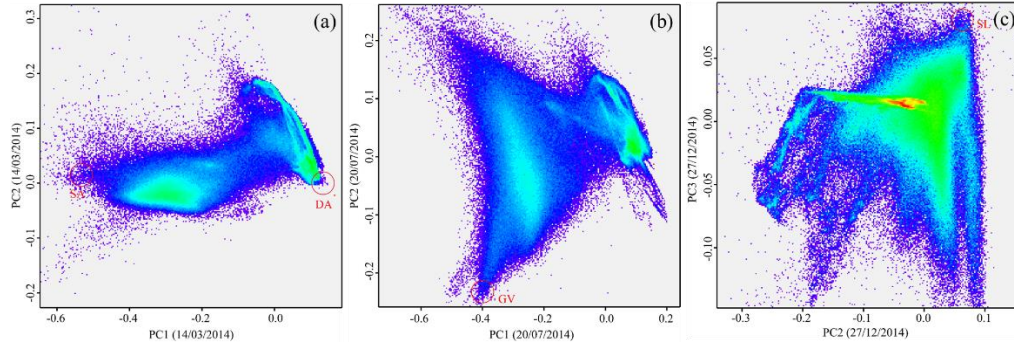


Figure S3. Scatter plot for OLI endmember spectral extraction.

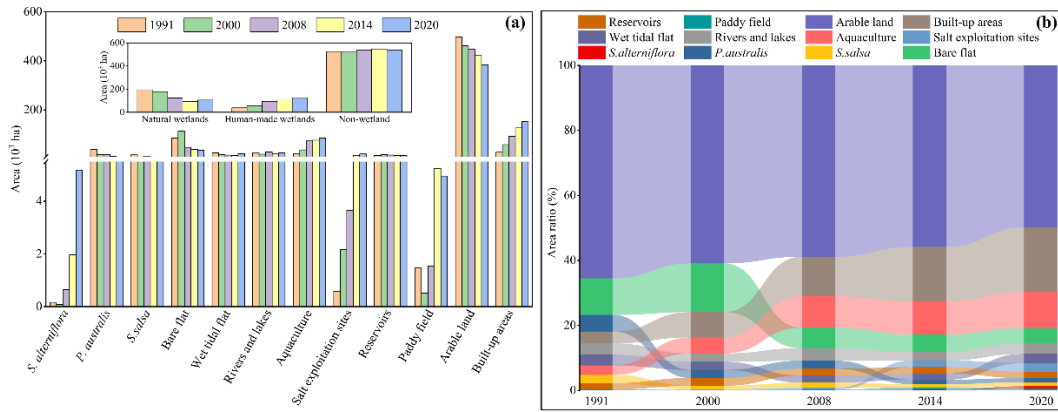


Figure S4. Area and proportion of coastal wetlands in the YRD from 1991 to 2020.

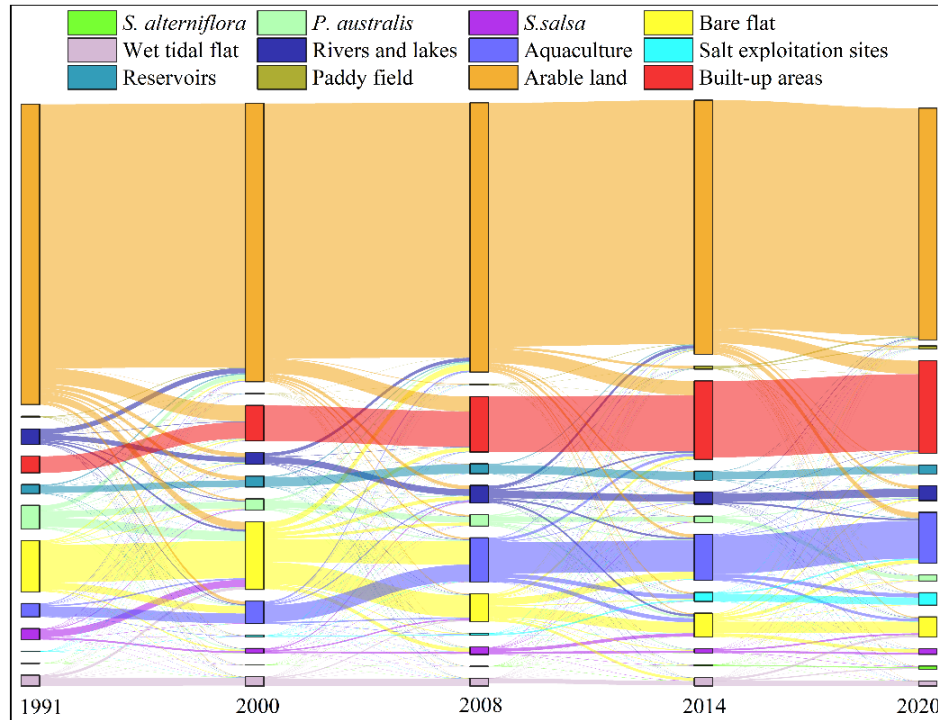


Figure S5. The transitions of coastal wetlands in the YRD from 1991 to 2020.

Table S1. List of remote sensing image data.

Image	Mapping year	Acquisition date	Path/row	Spatial resolution
Landsat-5 TM	1991	18/05/1991	121/034	30 m
		07/09/1991	121/034	
		23/09/1991	121/034	
	2000	25/06/1999	121/035	
		28/08/1999	121/035	
		17/10/2000	121/034	
		02/11/2000	121/034	
		03/07/2008	121/035	
		07/10/2008	121/035	
		19/05/2009	121/035	
Landsat-8 OLI	2014	14/03/2014	121/034	
		20/07/2014	121/034	
		24/10/2014	121/034	
		27/12/2014	121/034	
	2020	14/03/2020	121/034	
		15/04/2020	121/034	
		01/05/2020	121/034	
		20/07/2020	121/034	
		24/10/2020	121/034	

Table S2. Training and validation samples (pixels) for coastal wetlands during the period of 1991-2020.

Classes	1991		2000		2008		2014		2020	
	Training	Validation	Training	Validation	Training	Validation	Training	Validation	Training	Validation
SA	12	30	7	24	44	31	26	26	90	58
PA	130	73	218	84	228	106	86	94	89	91
SS	161	79	86	63	131	98	71	56	135	111
BF	161	69	442	147	267	107	190	113	191	165
WF	75	44	124	70	70	47	33	55	65	63
RL	152	75	198	97	235	113	121	74	186	145
AQ	110	72	235	127	287	116	219	125	327	193
SE	10	33	37	45	73	41	70	66	67	73
RE	90	53	90	55	124	46	92	55	80	72
PF	29	30	36	25	46	23	114	71	125	77
AL	338	215	522	137	448	169	226	182	398	246
BR	90	95	343	114	148	113	171	128	181	173

* *S. alterniflora* (SA), *P. australis* (PA), *S. salsa* (SS), Bare flat (BF), Wet tidal flat (WF), Rivers and lakes (RL), Aquaculture (AQ), Salt exploitation sites (SE), Reservoirs (RE), Paddy field (PF), Arable land (AL), Built-up areas (BR).

Table S3. Accuracy assessment of coastal wetlands classification during the period of 1991-2020.

Year	Accuracy	SA	PA	SS	BF	WF	RL	AQ	SE	RE	PF	AL	BR
1991	PA(%)	97.67	97.26	98.73	98.51	97.73	96.15	98.61	97.14	96.23	96.55	97.21	94.68
	UA(%)	97.67	95.95	97.50	97.06	95.56	99.01	97.26	97.14	96.23	96.55	96.76	97.80
	OA(%)	97.14											
	KC	0.97											
2000	PA(%)	100.00	98.70	98.39	97.22	97.10	95.88	97.40	97.73	96.36	96.00	96.35	94.74
	UA(%)	95.83	96.20	96.83	95.89	95.71	97.89	97.40	96.83	94.64	92.31	99.25	97.30
	OA(%)	96.90											
	KC	0.97											
2008	PA(%)	97.50	98.17	97.73	97.06	97.83	96.46	98.28	96.23	95.65	95.65	95.86	96.46
	UA(%)	97.50	96.40	98.85	94.29	95.74	97.32	95.80	98.08	97.78	91.67	98.78	97.32
	OA(%)	96.95											
	KC	0.97											
2014	PA(%)	96.08	97.70	98.41	97.25	96.36	95.95	96.32	98.44	96.36	95.83	96.70	95.31
	UA(%)	98.00	96.59	93.94	96.36	94.64	93.42	99.37	95.45	98.15	98.57	96.17	96.83
	OA(%)	96.65											
	KC	0.96											
2020	PA(%)	97.06	97.75	97.50	97.50	96.83	96.55	98.45	97.26	95.83	97.40	97.97	95.95
	UA(%)	95.65	95.60	99.15	96.89	98.39	97.22	97.44	95.95	98.57	98.68	98.77	94.86
	OA(%)	97.30											
	KC	0.97											

* Producer's Accuracy (PA), User's Accuracy (UA), Overall Accuracy (OA), Kappa Coefficient (KC). *S. alterniflora* (SA), *P. australis* (PA), *S. salsa* (SS), Bare flat (BF), Wet tidal flat (WF), Rivers and lakes (RL), Aquaculture (AQ), Salt exploitation sites (SE), Reservoirs (RE), Paddy field (PF), Arable land (AL), Built-up areas (BR).

Table S4. Landscape-level indices for coastal wetlands during the period of 1991-2020.

Year	NP	PD	LPI	LSI	PAFRAC	SHDI	SHEI	AI
1991	23964.00	3.15	35.10	49.73	1.29	1.32	0.53	96.78
2000	37824.00	5.00	28.83	68.82	1.30	1.37	0.55	95.49
2008	47102.00	6.21	29.35	85.47	1.32	1.46	0.59	94.33
2014	32204.00	4.27	27.27	74.54	1.29	1.50	0.60	95.07
2020	33356.00	4.33	23.76	78.70	1.29	1.62	0.65	94.81

* Number of Patches (NP), Patch Density (PD), Largest Patch Index (LPI), Landscape Shape Index (LSI), Perimeter-Area Fractal Dimension (PAFRAC), Shannon's Diversity Index (SHDI), Shannon's Evenness Index (SHEI), and Aggregation Index (AI).

Table S5. Class-level indices for coastal wetlands during the period of 1991-2020.

Classes	Year	NP	PD	LPI	LSI	PAFRAC	AI
<i>S. alterniflora</i>	1991	27.00	0.00	0.01	6.52	1.26	86.53
	2000	22.00	0.00	0.01	4.64	1.20	87.38
	2008	159.00	0.02	0.02	11.43	1.26	87.54
	2014	41.00	0.01	0.15	5.91	1.16	96.65
	2020	94.00	0.01	0.26	9.48	1.21	96.45
<i>P. australis</i>	1991	2574.00	0.34	1.08	34.51	1.27	94.89
	2000	3194.00	0.42	0.79	39.86	1.29	91.47
	2008	2539.00	0.33	0.67	39.57	1.30	91.53
	2014	627.00	0.08	0.62	17.73	1.25	95.13
	2020	488.00	0.06	0.31	19.52	1.24	94.32
<i>S. salsa</i>	1991	2894.00	0.38	0.40	53.49	1.33	88.57
	2000	839.00	0.11	0.33	33.51	1.35	89.12
	2008	2458.00	0.32	0.30	52.70	1.34	86.06
	2014	273.00	0.04	0.47	15.26	1.26	94.94
	2020	266.00	0.03	0.48	17.19	1.27	94.97
Bare flat	1991	2934.00	0.39	2.65	44.77	1.32	95.51
	2000	6907.00	0.91	2.74	54.63	1.34	95.22
	2008	6225.00	0.82	0.63	75.48	1.36	89.74
	2014	3491.00	0.46	1.40	46.54	1.31	93.11
	2020	2983.00	0.39	1.64	46.72	1.32	92.72
Wet tidal flat	1991	277.00	0.04	1.33	13.07	1.24	97.72
	2000	229.00	0.03	0.64	10.21	1.23	97.99
	2008	432.00	0.06	0.69	11.93	1.26	97.39
	2014	132.00	0.02	0.50	10.01	1.20	97.72
	2020	88.00	0.01	1.37	8.86	1.20	98.40
Rivers and lakes	1991	4899.00	0.64	1.00	75.68	1.34	86.16
	2000	5464.00	0.72	0.65	84.35	1.36	82.04
	2008	8369.00	1.10	0.75	94.88	1.35	83.48
	2014	2638.00	0.35	0.39	55.22	1.28	88.66
	2020	3902.00	0.51	0.61	60.95	1.29	88.70
Aquaculture	1991	2397.00	0.32	0.42	31.54	1.23	93.84
	2000	4220.00	0.56	0.68	50.20	1.26	92.34
	2008	4112.00	0.54	1.74	38.50	1.29	95.85
	2014	1819.00	0.24	4.46	33.21	1.27	96.51
	2020	2748.00	0.36	4.68	38.01	1.25	96.19
Salt exploitation sites	1991	67.00	0.01	0.03	6.64	1.14	92.92
	2000	395.00	0.05	0.07	11.42	1.18	93.25
	2008	219.00	0.03	0.09	12.37	1.15	94.32
	2014	1728.00	0.23	0.53	33.09	1.27	92.19
	2020	765.00	0.10	0.53	21.91	1.23	95.63

Reservoirs	1991	226.00	0.03	0.70	10.02	1.11	97.77
	2000	256.00	0.03	0.60	11.56	1.11	97.64
	2008	238.00	0.03	0.60	11.55	1.12	97.52
	2014	101.00	0.01	0.60	9.99	1.13	97.78
	2020	88.00	0.01	0.62	10.11	1.15	97.75
Paddy field	1991	795.00	0.10	0.01	28.26	1.24	78.39
	2000	455.00	0.06	0.01	21.69	1.22	71.98
	2008	940.00	0.12	0.01	32.09	1.23	75.91
	2014	663.00	0.09	0.13	25.44	1.21	89.83
	2020	648.00	0.08	0.04	28.13	1.22	88.38

* Number of Patches (NP), Patch Density (PD), Largest Patch Index (LPI), Landscape Shape Index (LSI), Perimeter-Area Fractal Dimension (PAFRAC), and Aggregation Index (AI).

Table S6. Classification system based on GlobeLand30 for comparison.

GlobeLand30	YRD
Wetland	<i>S. alterniflora</i>
	<i>P. australis</i>
	<i>S.salsa</i>
	Bare flat
	Wet tidal flat
Water bodies	Rivers and lakes
	Aquaculture
	Salt exploitation sites
	Reservoirs
Cultivated land	Paddy field
	Arable land
Artificial surfaces	Built-up areas