

Supplementary Materials: Research on temporal and spatial resolution and driving forces 2 of ecological environment quality in coal mining areas considering topographic correction *Remote Sensing* 2021, x, Article No.

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Table S1. Landsat remote sensing image used in this study.

Data	Sensor	Path/row	Azimuth angle	Elevation angle	Data	Sensor	Path/row	Azimuth angle	Elevation angle
1987-09-17	TM	124/34	137.51°	46.87°	2007-08-14	TM	125/34	131.56°	59.01°
1987-09-24	TM	125/34	140.36°	44.88°	2007-09-15	TM	125/34	145.34°	50.60°
1988-09-26	TM	125/34	142.44°	44.48°	2008-09-01	TM	125/34	136.96°	53.36°
1989-09-13	TM	125/34	135.64°	47.62°	2009-08-27	ETM	125/34	136.34°	55.38°
1990-09-16	TM	125/34	134.95°	46.01°	2010-09-23	TM	125/34	147.42°	47.70°
1991-08-02	TM	125/34	116.82°	56.30°	2011-08-09	TM	125/34	127.79°	59.32°
1991-08-18	TM	125/34	123.26°	53.48°	2011-09-19	TM	124/34	145.30°	48.84°
1991-09-19	TM	125/34	137.33°	45.83°	2012-09-04	ETM	125/34	141.92°	53.87°
1992-09-05	TM	125/34	131.14°	49.06°	2013-08-06	ETM	125/34	129.09°	60.80°
1992-09-30	TM	124/34	141.18°	42.16°	2013-08-15	ETM	124/34	132.98°	58.97°
1993-09-24	TM	125/34	139.07°	44.08°	2013-08-31	ETM	124/34	140.14°	55.06°
1994-09-27	TM	125/34	138.28°	42.46°	2013-09-07	ETM	125/34	143.19°	53.11°
1996-09-16	TM	125/34	134.74°	45.70°	2014-08-10	OLI/TRIS	124/34	132.53°	60.77°
1997-09-03	TM	125/34	133.37°	51.15°	2014-09-18	OLI/TRIS	125/34	149.02°	50.51°
1998-09-06	TM	125/34	136.69°	51.33°	2015-08-04	OLI/TRIS	125/34	129.86°	61.97°
1999-08-17	TM	124/34	127.18°	55.88°	2015-09-14	OLI/TRIS	124/34	147.43°	51.65°
1999-08-24	TM	125/34	130.25°	54.34°	2016-09-07	OLI/TRIS	125/34	145.01°	53.57°
2001-08-21	ETM+	125/34	133.07°	56.63°	2017-08-10	ETM	124/34	133.64°	61.08°
2001-09-06	ETM+	125/34	140.14°	52.53°	2017-09-18	ETM	125/34	150.07°	50.49°
2002-09-01	TM	125/34	132.93°	51.92°	2018-08-28	OLI/TRIS	125/34	140.25°	56.43°
2004-09-22	TM	125/34	145.25°	47.23°	2018-09-29	OLI/TRIS	125/34	152.83°	46.72°
2005-09-17	ETM	125/34	144.79°	49.33°	2019-08-15	OLI	125/34	134.64°	59.75°
2006-09-05	TM	124/34	141.48°	53.52°	2019-09-25	OLI	124/34	151.63°	48.18°
2006-09-12	TM	125/34	144.45°	51.51°	2020-09-18	OLI	125/34	149.37°	50.18°

Table S2. Land cover area of the study area (km²).

Year	Water	Vegetation	Construction land	Bare land
1987	27.31	1414.13	124.69	171.32
1998	17.26	1432.2	139.36	148.63
2010	20.35	1492	219.43	5.67
2020	18.29	1447.88	249.38	21.9

Table S3. Classification accuracy of land cover data.

Year	Overall accuracy (%)	Kappa coefficient
1987	94.02	0.88
1998	97.13	0.94
2010	97.69	0.91
2020	97.54	0.91

Table S4. Percentage change of ecological environment quality level within the boundaries of mineral rights from 1987 to 2020.

Type	Level	1987–1998		1998–2010		2010–2020		1987–2020	
		Level percent (%)	Sub-total (%)	Level percent (%)	Sub-total (%)	Level percent (%)	Sub-total (%)	Level percent (%)	Sub-total (%)
Improved	4	0.09		0.06		0.09		0.94	
	3	1.90		1.65		0.54		9.80	
	2	23.09	74.24	20.17	74.01	3.55	41.44	30.94	76.11
	1	49.16		52.13		37.26		34.43	
Unchanged	0	0.62	0.62	0.51	0.51	0.71	0.71	0.31	0.31
Degraded	-1	21.44		20.57		47.54		17.41	
	-2	3.35		3.21		7.84		5.00	
	-3	0.31	25.13	1.42	25.48	2.07	57.85	1.05	23.58
	-4	0.03		0.28		0.40		0.11	

Table S5. The mean value and standard deviation (SD) of each ecological environment index before and after SCS + C correction.

Sensor	Correction Model	Statistics	NDVI	Wet	NDBSI	LST	RSEI
TM	Original image	Mean	0.5253	-0.0906	-0.1765	24.5585	0.6558
		SD	0.1630	0.0325	0.0881	1.9361	0.2357
	SCS + C	Mean	0.5247	-0.0902	-0.1758	24.5221	0.6715
		SD	0.1625	0.0303	0.0863	1.7426	0.2326
ETM+	Original image	Mean	0.6137	-0.1014	-0.1111	22.5444	0.6391
		SD	0.1957	0.0261	0.1051	2.7139	0.2510
	SCS + C	Mean	0.6129	-0.1010	-0.1104	22.5125	0.6486
		SD	0.1949	0.0246	0.1041	2.5803	0.2507
OLI/TIRS	Original image	Mean	0.5940	-0.0073	-0.2229	24.8868	0.6496
		SD	0.1982	0.0233	0.1057	2.0667	0.2548
	SCS + C	Mean	0.5929	-0.0071	-0.2218	24.8569	0.6600
		SD	0.1973	0.0228	0.1040	1.9373	0.2538

Table S6. The contribution and load of the four variables to the first principal component (PC1) before and after SCS + C correction.

PC Analysis	Original image			Image corrected by SCS + C		
	TM PC1	ETM+ PC1	OLI/TIRS PC1	TM PC1	ETM+ PC1	OLI/TIRS PC1
NDVI	0.5619	-0.5958	0.5833	0.5807	0.6012	0.5947
Wet	0.4136	-0.3262	0.4248	0.4075	0.3118	0.4050
NDBSI	-0.5611	0.5681	-0.5576	-0.5667	-0.5734	-0.5622
LST	-0.4453	0.4646	-0.4104	-0.4189	-0.4611	-0.4077
Eigenvalue	0.1576	0.1742	0.1886	0.1536	0.1723	0.1825
Percent eigenvalue (%)	78.87	80.18	82.61	79.56	80.73	83.01

Table S7. Pearson correlation coefficient between climate variables and the mean of RSEI. * Indicates that the correlation is significant at the 0.05 level.

Study area	Average annual temperature	Average temperature in August and September	Annual precipitation	Precipitation in August and September
Yangquan Coal Mine	0.127	-0.271	0.361*	0.380*
M1	0.320	0.075	0.173	0.099
M2	0.255	0.009	0.215	0.177
M3	0.280	0.020	0.228	0.182
M4	0.279	0.173	0.176	0.194
M5	0.223	-0.063	0.177	0.130
M6	0.273	-0.044	0.207	0.164
D1	0.128	0.174	0.277	-0.143
D2	-0.221	-0.178	0.014	0.207
D3	-0.112	-0.026	-0.125	0.115
D4	-0.069	-0.115	0.132	0.352
D5	-0.185	0.108	0.031	0.135
D6	-0.104	-0.364*	0.061	0.346

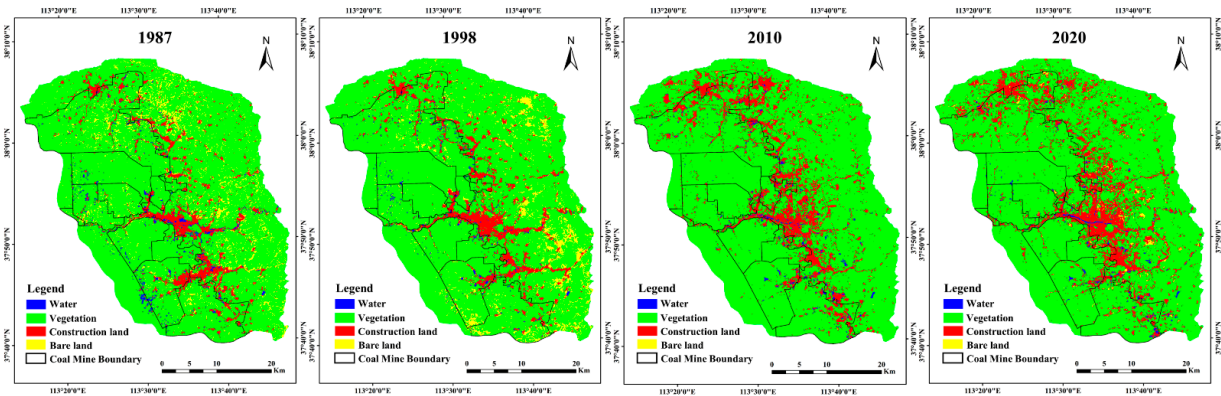


Figure S1. Land cover maps of the study area.

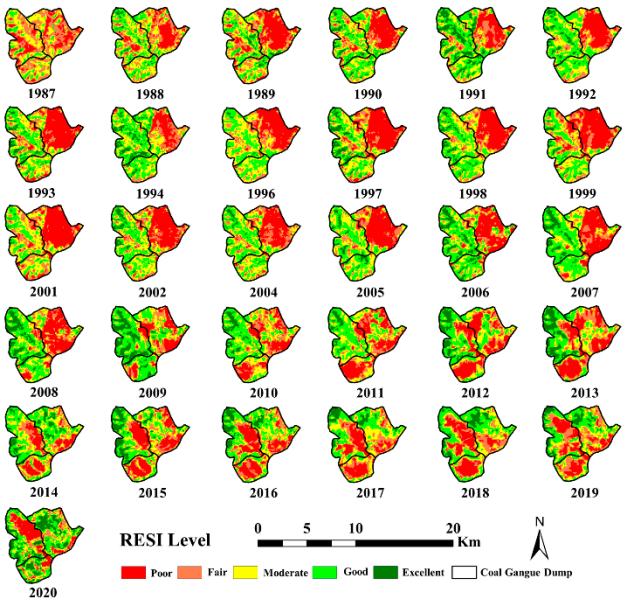


Figure S2. Spatial distribution of RSEI grades of D1, D2 and D3 coal gangue dumps from 1987 to 2020.

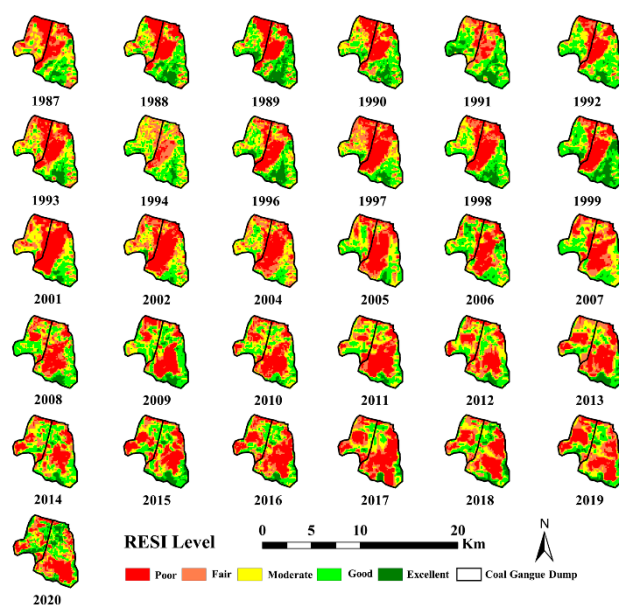


Figure S3. Spatial distribution of RSEI grades of D4 and D5 coal gangue dumps from 1987 to 2020.

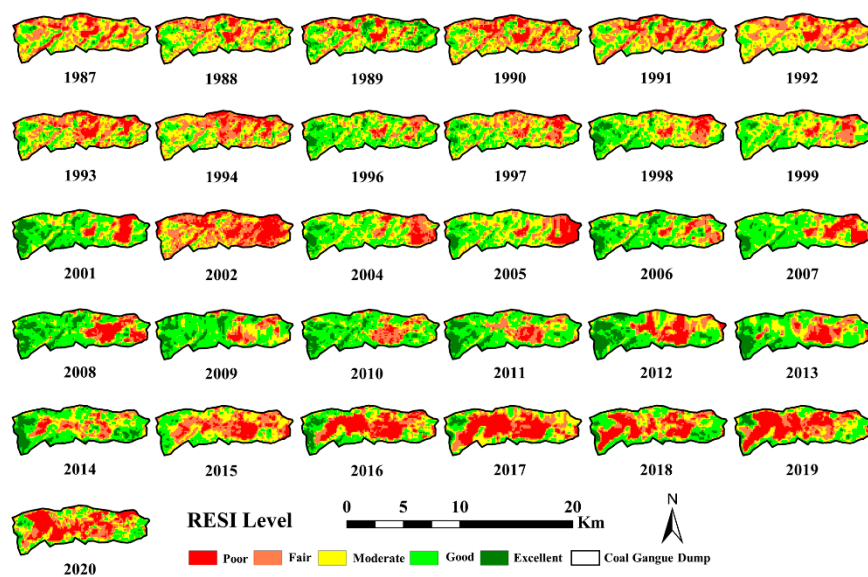


Figure S4. Land cover maps of the study area.

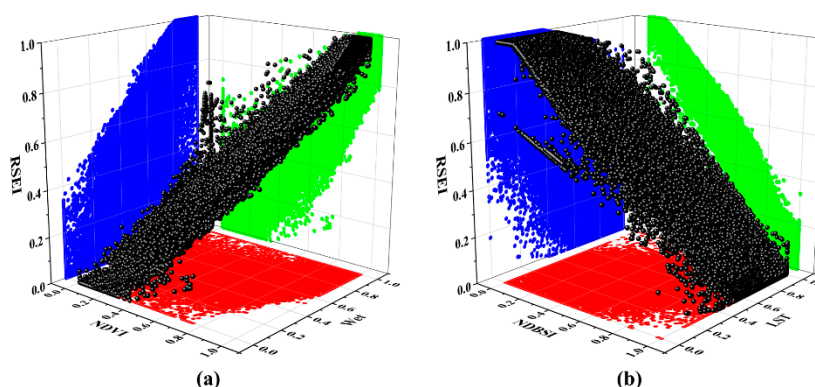


Figure S5. Three-dimensional scatter plots of NDVI, Wet, NDBSI, LST and RSEI. (a) Three-dimensional scatter plots of NDVI, Wet and RSEI, (b) Three-dimensional scatter plots of NDBSI, LST and RSEI. The top of the scatter plot represents an area with better ecological environment quality, where the vegetation coverage is higher, the surface humidity is higher, the density of buildings and bare soil is lower, and the surface temperature is lower. The bottom of the scatter plot represents areas with worse ecological environment quality, where vegetation coverage is lower, surface humidity is lower, the density of buildings and bare soil is higher, and the surface temperature is higher.

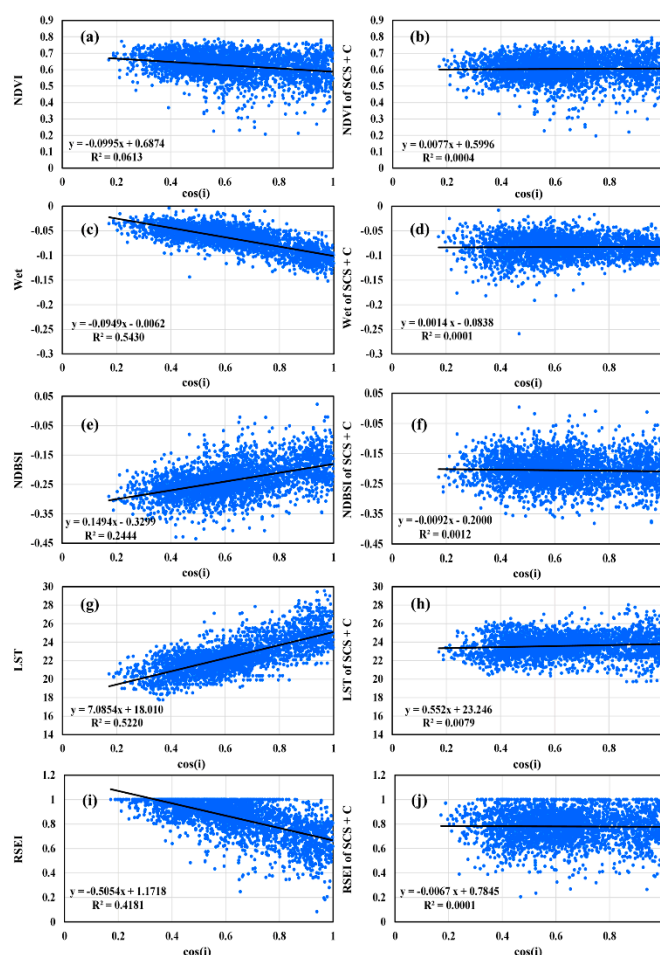


Figure S6. Scatter plots and fitted lines of ecological environment index values and $\cos(i)$ before and after SCS + C correction. (a) scatter plot and fitting line of NDVI and $\cos(i)$ before SCS + C correction, (b) scatter plot and fitting line of NDVI and $\cos(i)$ after SCS + C correction, (c) scatter plot and fitting line of Wet and $\cos(i)$ before SCS + C correction, (d) scatter plot and fitting line of Wet and $\cos(i)$ after SCS + C correction, (e) scatter plot and fitting line of NDBSI and $\cos(i)$ before SCS + C correction, (f) scatter plot and fitting line of NDBSI and $\cos(i)$ after SCS + C correction, (g) scatter plot and fitting line

of LST and cosi before SCS + C correction, (h) scatter plot and fitting line of LST and cosi after SCS + C correction, (i) scatter plot and fitting line of RSEI and cosi before SCS + C correction, (j) scatter plot and fitting line of RSEI and cosi after SCS + C correction.

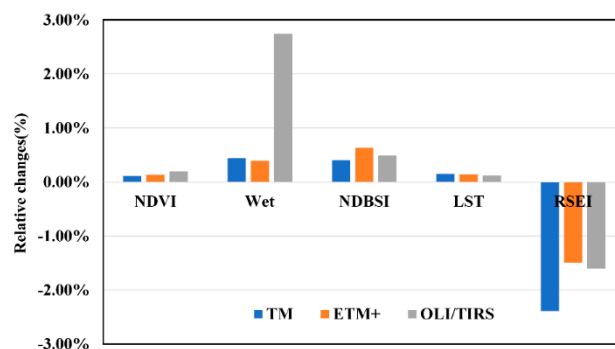


Figure S7. The relative change rate of the mean value of each ecological environment index before and after topographic correction.