

Supplementary Materials:

Table S1. Area of various land use types in Wuhan Urban Agglomeration in 2000.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	61.94	72.92	5248.58	635.34	801.17	1749.19
Huangshi	10.09	210.79	1746.87	238.03	1895.13	482.10
Ezhou	35.15	37.16	852.74	137.60	152.67	380.67
Xiaogan	17.02	6.01	6136.17	408.48	1709.00	627.73
Xiantao	0.00	0.00	1829.91	281.21	16.18	410.69
Xianning	31.32	556.65	2961.06	154.57	5331.12	717.28
Tianmen	7.03	2.01	2056.19	313.55	28.14	215.07
Qianjiang	4.06	0.00	1583.28	224.59	24.39	167.68
Huanggang	54.30	551.00	7600.45	601.28	7621.56	1028.61
Wuhan Urban Agglomeration	220.91	1436.55	30015.25	2994.65	17579.36	5779.03

Table S2. Area of various land use types in Wuhan Urban Agglomeration in 2005.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	56.94	66.93	5120.71	769.21	791.18	1764.18
Huangshi	11.09	204.74	1728.71	252.15	1893.11	493.20
Ezhou	34.15	34.15	823.61	142.63	151.67	409.80
Xiaogan	21.02	6.01	6088.12	419.49	1707.00	662.77
Xiantao	0.00	0.00	1738.87	281.21	15.17	502.74
Xianning	41.42	559.62	2919.34	175.77	5318.45	737.41
Tianmen	9.04	2.01	2055.19	314.56	27.13	214.06
Qianjiang	4.06	0.00	1572.10	227.63	24.39	175.81
Huanggang	49.27	543.97	7554.20	617.37	7620.56	1071.85
Wuhan Urban Agglomeration	227.00	1417.43	29600.85	3200.01	17548.65	6031.82

Table S3. Area of various land use types in Wuhan Urban Agglomeration in 2010.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	27.07	65.16	5077.53	837.07	790.95	1771.37
Huangshi	11.09	207.77	1715.60	263.24	1887.06	498.24
Ezhou	34.15	33.15	817.59	149.66	151.67	409.80
Xiaogan	21.02	6.01	6068.09	433.51	1707.00	668.78
Xiantao	0.00	0.00	1718.64	285.26	15.17	518.93
Xianning	42.43	555.58	2900.14	201.02	5315.42	737.41
Tianmen	6.03	2.01	2048.15	320.59	26.13	219.09
Qianjiang	4.06	0.00	1555.84	237.80	28.45	177.84
Huanggang	49.27	544.97	7529.06	643.51	7612.51	1077.88
Wuhan Urban Agglomeration	195.13	1414.65	29430.65	3371.64	17534.36	6079.34

Table S4. Area of various land use types in Wuhan Urban Agglomeration in 2015.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	56.94	62.94	4865.97	1042.92	778.20	1762.18
Huangshi	11.09	206.76	1692.40	298.54	1878.99	495.21
Ezhou	34.15	33.15	787.45	186.82	148.65	405.78
Xiaogan	21.02	5.01	5929.93	579.68	1695.98	672.79
Xiantao	0.00	0.00	1698.41	304.48	14.16	520.95
Xianning	32.37	425.41	4492.21	206.54	4034.43	561.04
Tianmen	5.02	2.01	2007.96	343.70	22.11	241.20
Qianjiang	4.06	0.00	1517.23	265.24	28.45	189.02
Huanggang	19.10	538.94	7429.52	801.37	7569.28	1098.99
Wuhan Urban Agglomeration	183.77	1274.20	30421.08	4029.29	16170.26	5947.16

Table S5. Land use carbon emissions in Wuhan Urban Agglomeration in 2000.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	677.76	9.10	668.66
Huangshi	252.82	12.28	240.55
Ezhou	145.38	1.86	143.52
Xiaogan	449.47	11.52	437.95
Xiantao	297.54	1.13	296.40
Xianning	173.26	32.91	140.35
Tianmen	331.83	0.71	331.12
Qianjiang	238.23	0.57	237.66
Huanggang	654.51	47.00	607.50
Wuhan Urban Agglomeration	3220.79	117.07	3103.72

Table S6. Land use carbon emissions in Wuhan Urban Agglomeration in 2005.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	814.42	9.08	805.35
Huangshi	267.22	12.29	254.93
Ezhou	150.38	1.93	148.46
Xiaogan	460.53	11.60	448.93
Xiantao	297.08	1.36	295.72
Xianning	194.79	32.89	161.91
Tianmen	332.86	0.70	332.16
Qianjiang	241.30	0.59	240.71
Huanggang	670.78	47.10	623.67
Wuhan Urban Agglomeration	3429.36	117.53	3311.84

Table S7. Land use carbon emissions in Wuhan Urban Agglomeration in 2010.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	883.81	9.09	874.72
Huangshi	278.53	12.27	266.26
Ezhou	157.57	1.93	155.64
Xiaogan	474.81	11.61	463.19
Xiantao	301.13	1.40	299.73
Xianning	220.60	32.87	187.73
Tianmen	339.01	0.71	338.30
Qianjiang	251.64	0.62	251.03
Huanggang	697.47	47.07	650.39
Wuhan Urban Agglomeration	3604.57	117.56	3487.00

Table S8. Land use carbon emissions in Wuhan Urban Agglomeration in 2015.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	1093.91	9.00	1084.91
Huangshi	314.62	12.21	302.41
Ezhou	195.53	1.90	193.64
Xiaogan	624.05	11.56	612.49
Xiantao	320.75	1.40	319.34
Xianning	234.17	24.95	209.22
Tianmen	362.52	0.74	361.78
Qianjiang	279.59	0.64	278.95
Huanggang	858.89	46.87	812.02
Wuhan Urban Agglomeration	4284.03	109.27	4174.76

Table S9. Area of various land use types in Wuhan Urban Agglomeration in 2017.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	326.54	187.42	2277.47	1878.15	1860.41	2039.16
Huangshi	225.03	140.88	794.96	761.36	1999.63	661.15
Ezhou	40.04	21.54	412.75	346.56	285.97	489.12
Xiaogan	358.23	101.09	3939.15	1133.95	2317.46	1054.53
Xiantao	24.22	27.66	1422.07	317.92	66.58	679.56
Xianning	387.16	226.56	1097.91	853.49	6203.88	983.00
Tianmen	54.94	5.51	1948.50	313.56	61.04	238.44
Qianjiang	38.22	20.71	1262.36	253.31	32.02	397.39
Huanggang	1182.89	531.92	2748.22	2323.41	9184.25	1486.50
Wuhan Urban Agglomeration	2637.26	1263.30	15903.41	8181.72	22011.22	8028.84

Table S10. Area of various land use types in Wuhan Urban Agglomeration in 2018.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	343.63	187.53	2106.85	1952.40	2089.84	1888.91
Huangshi	144.48	78.55	644.91	831.38	2292.69	590.99
Ezhou	37.74	34.18	347.66	384.17	380.65	411.61
Xiaogan	309.54	65.93	4402.95	1274.87	1917.73	933.38
Xiantao	10.69	22.92	1568.80	341.54	30.59	563.46
Xianning	202.29	149.86	1023.33	905.82	6606.10	864.61
Tianmen	20.75	8.13	1832.60	474.33	34.87	251.32
Qianjiang	10.18	5.30	1043.49	325.32	23.90	595.80
Huanggang	866.61	186.15	2539.79	2454.79	10172.36	1237.49
Wuhan Urban Agglomeration	1945.91	738.56	15510.37	8944.62	23548.75	7337.56

Table S11. Area of various land use types in Wuhan Urban Agglomeration in 2019.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	202.67	330.96	1715.76	2047.73	2150.62	2121.41
Huangshi	103.14	132.83	675.84	876.12	2083.04	712.03
Ezhou	17.86	58.70	317.16	370.88	308.66	522.75
Xiaogan	309.24	107.89	2959.66	1425.39	3170.95	931.28
Xiantao	3.21	38.68	1314.22	346.17	194.69	641.02
Xianning	148.94	246.98	951.96	1006.80	6518.39	878.93
Tianmen	12.31	31.67	1746.77	455.18	177.51	198.56
Qianjiang	7.25	20.30	1278.13	335.42	127.40	235.50
Huanggang	522.65	375.27	2713.01	2970.99	9243.95	1631.33
Wuhan Urban Agglomeration	1327.27	1343.28	13672.51	9834.68	23975.21	7872.81

Table S12. Area of various land use types in Wuhan Urban Agglomeration in 2020.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	405.86	173.24	1503.73	1975.92	2319.24	2191.15
Huangshi	210.49	79.92	573.29	814.17	2222.70	682.44
Ezhou	39.77	23.14	292.83	362.42	384.86	492.98
Xiaogan	563.44	166.00	2472.52	1413.43	2923.27	1365.73
Xiantao	23.26	18.68	1206.42	358.98	87.76	842.90
Xianning	362.04	120.23	885.64	972.19	6471.62	940.28
Tianmen	68.43	12.71	1662.76	462.18	109.74	306.19
Qianjiang	21.48	17.76	1193.33	326.47	71.81	373.15
Huanggang	1314.32	331.54	2230.99	2583.80	9474.05	1522.49
Wuhan Urban Agglomeration	3009.10	943.22	12021.51	9269.56	24065.05	8717.32

Table S13. Area of various land use types in Wuhan Urban Agglomeration in 2021.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	139.72	448.79	847.73	2004.92	2781.27	2346.72
Huangshi	71.74	168.03	344.49	761.53	2586.77	650.43
Ezhou	21.53	67.59	128.78	344.13	529.62	504.35
Xiaogan	295.70	387.80	2822.19	1322.20	2749.84	1326.68
Xiantao	16.51	98.30	1186.80	367.89	62.48	806.03
Xianning	108.92	219.38	545.24	960.68	6985.07	932.71
Tianmen	44.39	25.70	1772.46	483.39	25.30	270.76
Qianjiang	16.73	13.94	1026.59	336.23	15.66	594.85
Huanggang	518.04	680.49	1501.05	2432.40	10781.82	1543.42
Wuhan Urban Agglomeration	1233.53	2109.82	10178.54	9013.51	26515.91	8974.44

Table S14. Area of various land use types in Wuhan Urban Agglomeration in 2022.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	233.14	172.01	1633.76	2170.23	2391.45	1968.56
Huangshi	157.01	70.53	556.78	864.68	2343.49	590.52
Ezhou	49.27	15.09	286.78	398.16	418.05	428.65
Xiaogan	399.97	202.50	3097.61	1533.75	2546.37	1124.21
Xiantao	16.94	31.67	1306.34	429.26	122.61	631.18
Xianning	223.09	138.12	994.21	1084.43	6547.03	765.13
Tianmen	71.56	15.88	1625.49	559.25	94.00	255.82
Qianjiang	14.43	10.37	1177.14	396.09	117.80	288.18
Huanggang	861.26	175.17	2548.92	2771.56	9861.90	1238.40
Wuhan Urban Agglomeration	2026.66	831.33	13227.01	10207.40	24442.70	7290.65

Table S15. Land use carbon emissions in Wuhan Urban Agglomeration in 2017.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	1937.74	16.02	1921.72
Huangshi	784.88	13.33	771.55
Ezhou	357.52	2.91	354.62
Xiaogan	1182.67	16.17	1166.50
Xiantao	333.16	2.11	331.04
Xianning	880.88	38.60	842.28
Tianmen	331.31	0.96	330.34
Qianjiang	266.09	1.20	264.89
Huanggang	2396.78	57.29	2339.49
Wuhan Urban Agglomeration	8471.03	148.60	8322.43

Table S16. Land use carbon emissions in Wuhan Urban Agglomeration in 2018.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	2013.05	16.98	1996.07
Huangshi	855.95	14.84	841.11
Ezhou	395.77	3.26	392.51
Xiaogan	1329.52	13.53	1315.99
Xiantao	358.11	1.61	356.50
Xianning	934.19	40.61	893.58
Tianmen	495.63	0.84	494.79
Qianjiang	338.87	1.65	337.22
Huanggang	2530.50	62.31	2468.18
Wuhan Urban Agglomeration	9251.58	155.63	9095.95

Table S17. Land use carbon emissions in Wuhan Urban Agglomeration in 2019.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	2108.88	17.94	2090.94
Huangshi	901.99	13.94	888.06
Ezhou	381.98	3.13	378.85
Xiaogan	1476.73	20.82	1455.92
Xiantao	361.60	2.76	358.84
Xianning	1037.40	40.15	997.25
Tianmen	475.56	1.54	474.02
Qianjiang	350.39	1.34	349.05
Huanggang	3060.83	57.94	3002.89
Wuhan Urban Agglomeration	10155.38	159.56	9995.82

Table S18. Land use carbon emissions in Wuhan Urban Agglomeration in 2020.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	2034.17	19.08	2015.10
Huangshi	837.94	14.67	823.27
Ezhou	373.19	3.49	369.70
Xiaogan	1462.05	20.50	1441.55
Xiantao	374.20	2.65	371.56
Xianning	1001.58	40.02	961.56
Tianmen	482.32	1.42	480.90
Qianjiang	340.79	1.37	339.42
Huanggang	2661.29	59.03	2602.26
Wuhan Urban Agglomeration	9567.53	162.22	9405.31

Table S19. Land use carbon emissions in Wuhan Urban Agglomeration in 2021.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	2060.66	22.20	2038.46
Huangshi	782.81	16.71	766.10
Ezhou	353.61	4.37	349.24
Xiaogan	1370.21	19.43	1350.78
Xiantao	383.24	2.42	380.81
Xianning	988.08	42.99	945.09
Tianmen	504.62	0.84	503.78
Qianjiang	349.97	1.60	348.37
Huanggang	2502.37	66.72	2435.65
Wuhan Urban Agglomeration	9295.75	177.27	9118.48

Table S20. Land use carbon emissions in Wuhan Urban Agglomeration in 2022.

City (10000 tons)	Carbon Source	Carbon Sink	Carbon Emission
Wuhan	2234.13	18.92	2215.21
Huangshi	889.67	15.13	874.53
Ezhou	409.82	3.52	406.30
Xiaogan	1588.56	17.70	1570.86
Xiantao	446.79	2.32	444.47
Xianning	1117.25	40.01	1077.23
Tianmen	581.70	1.20	580.50
Qianjiang	412.12	1.42	410.70
Huanggang	2855.45	60.51	2794.94
Wuhan Urban Agglomeration	10535.47	160.73	10374.74

Table S21. Land use carbon emissions in Wuhan Urban Agglomeration in 2035 under natural development scenario.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	334.71	155.34	1332.07	1541.49	3103.83	2101.70
Huangshi	224.29	136.95	627.82	598.50	2326.59	668.86
Ezhou	39.22	19.03	249.80	269.64	514.39	503.91
Xiaogan	372.63	88.66	1661.33	1297.33	4286.69	1197.77
Xiantao	24.05	22.24	995.91	498.95	236.62	760.24
Xianning	386.89	226.03	1030.17	866.35	6248.91	993.65
Tianmen	54.30	4.85	828.04	1099.24	367.24	268.33
Qianjiang	37.39	13.53	837.36	521.00	129.82	464.91
Huanggang	1226.36	403.56	1390.25	1421.12	11494.34	1521.58
Wuhan Urban Agglomeration	2699.83	1070.20	8952.75	8113.61	28708.43	8480.95

Table S22. Land use carbon emissions in Wuhan Urban Agglomeration in 2035 under low-carbon development scenario.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	316.28	167.68	1260.48	1401.95	3333.30	2089.47
Huangshi	221.91	138.44	620.47	562.79	2372.36	667.03
Ezhou	38.48	19.81	243.15	238.17	555.92	500.46
Xiaogan	342.40	99.50	1500.01	1060.19	4731.92	1170.39
Xiantao	24.08	22.85	969.55	444.47	333.67	743.38
Xianning	386.92	226.31	1021.77	861.97	6263.72	991.32
Tianmen	54.58	5.03	785.13	989.18	526.44	261.65
Qianjiang	37.97	13.94	817.18	488.87	198.84	447.21
Huanggang	1113.35	461.35	1284.70	1205.47	11878.20	1514.13
Wuhan Urban Agglomeration	2537.37	1155.30	8493.95	7248.81	30208.27	8382.07

Table S23. Land use carbon emissions in Wuhan Urban Agglomeration in 2035 under economic development scenario.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	323.66	175.10	1445.29	1847.19	2674.07	2103.84
Huangshi	224.30	138.69	644.00	700.45	2206.43	669.13
Ezhou	39.64	20.03	264.32	339.43	428.48	504.11
Xiaogan	355.82	103.84	1964.58	1756.81	3518.31	1205.06
Xiantao	24.19	23.18	1036.66	564.53	128.20	761.24
Xianning	387.15	226.57	1038.51	872.95	6233.12	993.69
Tianmen	54.84	5.23	895.39	1212.22	185.09	269.23
Qianjiang	38.12	14.21	863.07	557.03	64.68	466.89
Huanggang	1164.56	476.19	1510.70	1884.88	10895.79	1525.09
Wuhan Urban Agglomeration	2613.76	1183.45	9654.14	9731.44	26347.82	8495.15

Table S24. Land use carbon emissions in Wuhan Urban Agglomeration in 2035 under cropland protection scenario.

City (Square kilometers)	Unused Land	Grassland	Cropland	Built-up Land	Forestland	Water
Wuhan	314.82	173.30	2172.73	1863.60	2009.64	2035.08
Huangshi	221.54	139.56	772.12	756.92	2033.01	659.86
Ezhou	38.18	20.37	394.22	343.94	311.21	488.07
Xiaogan	339.87	94.83	3683.70	1174.75	2551.58	1059.67
Xiantao	23.65	24.53	1407.70	330.18	68.75	683.19
Xianning	386.65	226.14	1093.60	852.34	6210.56	982.70
Tianmen	52.97	5.11	1875.98	379.18	70.85	237.92
Qianjiang	36.94	18.04	1266.28	263.48	32.40	386.85
Huanggang	1119.11	476.72	2605.32	2239.19	9547.92	1468.94
Wuhan Urban Agglomeration	2535.16	1178.97	15260.73	8203.85	22847.20	7999.86