Table S1. Table of rotated component matrices.

Variant	1	2	3	4	5	6	7	8	9	10
SUM-NPP-VIIRS	0.964									
SUM-GDP	0.903									
SUM-人口	0.796									
SUM-NDVI				0.913						
NDVI-1to7				0.783						
NDVI-8				0.851						
NDVI-9				0.827						
NDVI-10								0.668		
NDVI-11							0.940			
NDVI-12						-0.740				
NDVI-13	0.878									
NDVI-14			0.936							
NDVI-15		-0.979								
NDVI-16		0.973								
NDVI-17							0.755			
NPP-VIIRS-1to7					0.514					
NPP-VIIRS-8					0.892					
NPP-VIIRS-9										
NPP-VIIRS-10								0.858		
NPP-VIIRS-11										0.580
NPP-VIIRS-12						-0.683				
NPP-VIIRS-13	0.965									
NPP-VIIRS-14			0.752							
NPP-VIIRS-15		0.983								
NPP-VIIRS-16		0.989								
NPP-VIIRS-17	0.763									

Table S2. Subsumption of carbon emission independent variables on land classification.

Variables	Encodings	Land Type	Variables	Encodings	Land Type
forestland	1	evergreen	-	10	grasslands

Variables	Encodings	Land Type	Variables	Encodings	Land Type
grasslands	1	coniferous forest	-	10	cropland
	2	evergreen broad-leaved forest	-	11	permanent wetland
	3	deciduous-coniferous forest	farmland	12	cropland
	4	deciduous broad-leaved forest		14	Farmland and natural vegetation mosaics
	5	mixed forests	urban	13	urban built-up area
	6	closed shrubbery	-	15	snowfields
	7	brushwood	-	16	bare ground
	8	wooded grassland	water	17	water
	9	savanna			

Table S3. Correlation analysis of initially screened independent variables.

Variables	VIF	Variables	VIF
SUM-GDP	12.146	NDVI-13	5.785
SUM-人口	7.517	NDVI-17	1.193
SUM-NDVI	5.859	NPP-VIIRS-1to7	2.104
SUM-NPP-VIIRS	34.727	NPP-VIIRS-8to9	3.330
NDVI-1to7	2.830	NPP-VIIRS-12and14	3.853
NDVI-8to9	4.838	NPP-VIIRS-13	32.825
NDVI-12and14	2.769	NPP-VIIRS-17	2.245

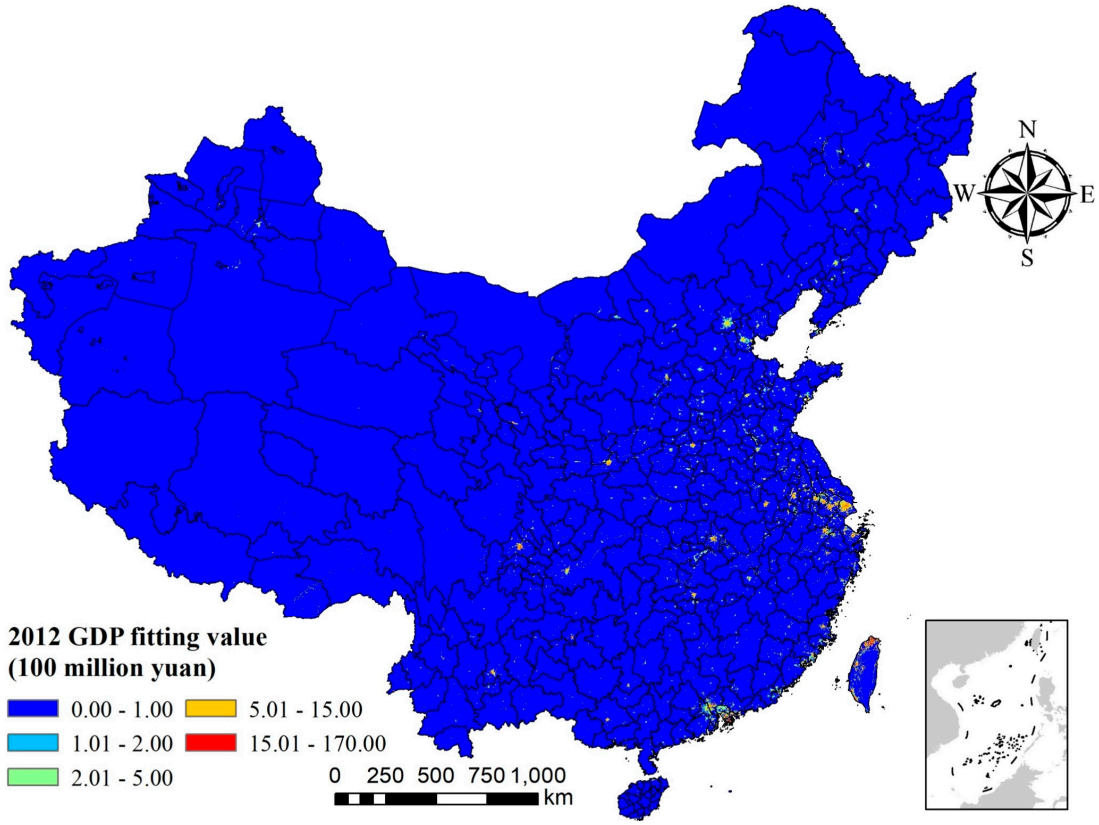
SUM-NPP-VIIRS denotes the sum of NPP-VIIRS, and the rest is the same; NDVI-1to7 denotes the NDVI of the merged land classes 1 to 7, and the rest is the same.

Table S4. Parameter table of provincial SLM regression coefficients for 2021.

Variables	regression coefficient[a]	standard error[a]	regression coefficient[b]	standard error[b]
W_carbon	0.740	0.000	0.984	0.000
CONSTANT	0.013	0.000	-0.002	0.000
SUM-GDP	-0.009	0.001	-0.001	0.000
NDVI-L_1	-0.008	0.001	-0.002	0.000
NDVI-L_3	0.059	0.001	0.003	0.000

Variables	regression coefficient[a]	standard error[a]	regression coefficient[b]	standard error[b]
NDVI-L_4	0.120	0.005	0.011	0.000
SUM-NDVI	0.040	0.001	0.007	0.000
NPP-VIIRS-L_1	0.015	0.002	0.005	0.000
NPP-VIIRS-L_2	0.000	0.000	0.000	0.000
SUM-NPP-VIIRS	0.003	0.000	0.001	0.000

a: provincial data, b: municipal data



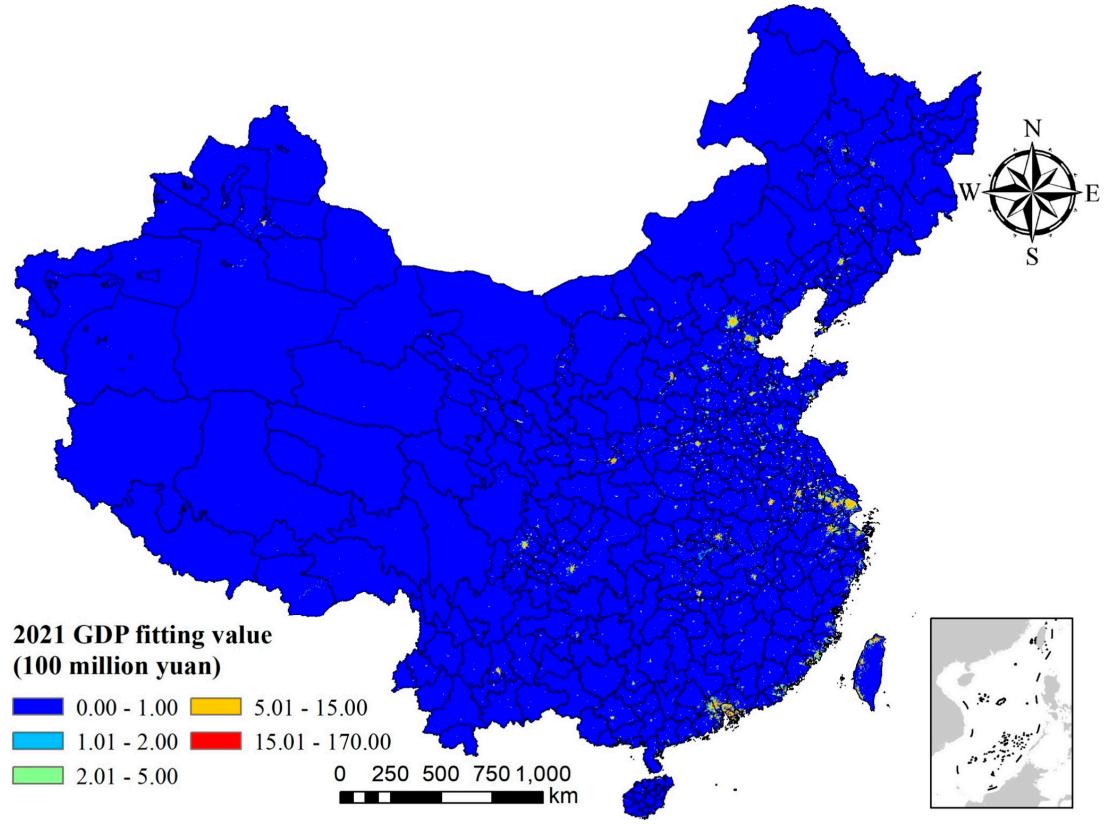
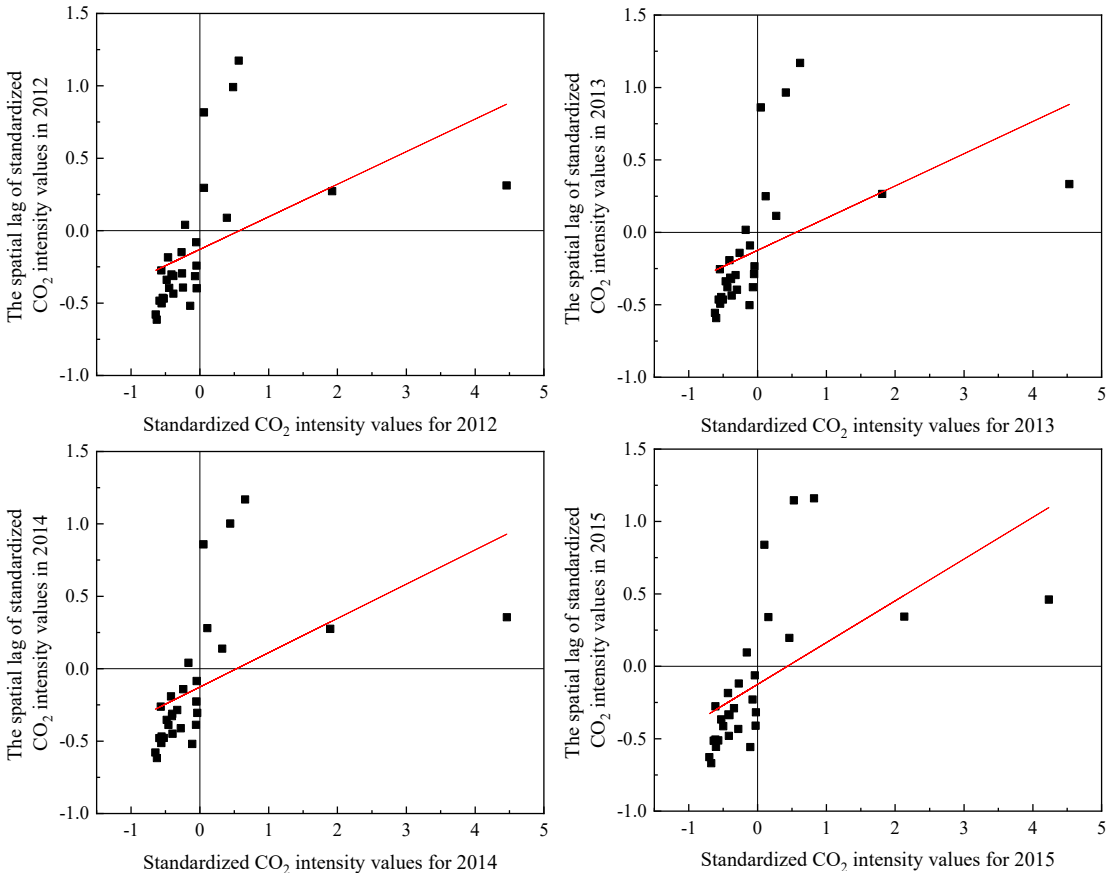


Figure S1. Fitted value of our 1-kilometer GDP in 2012 and 2021.



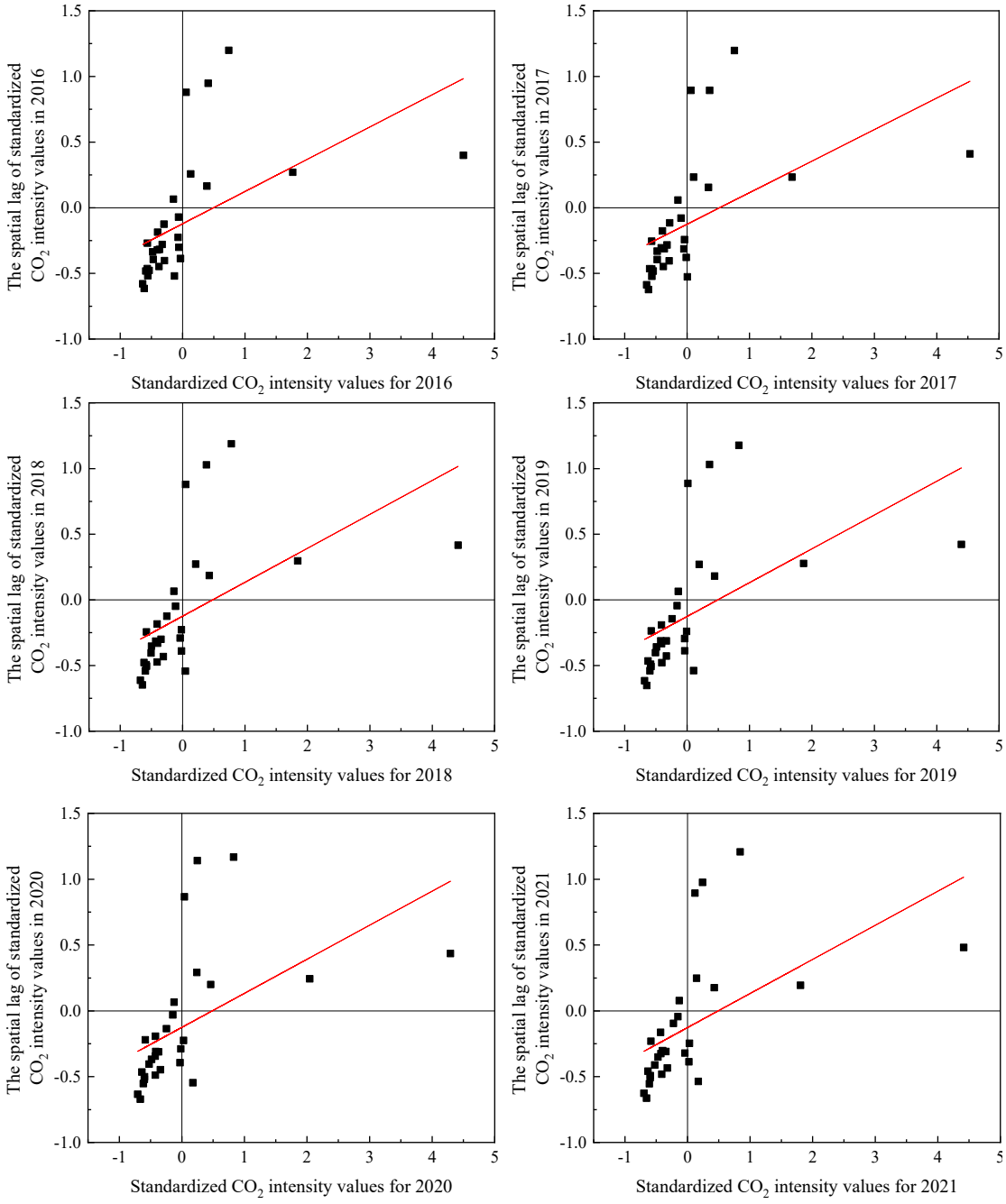
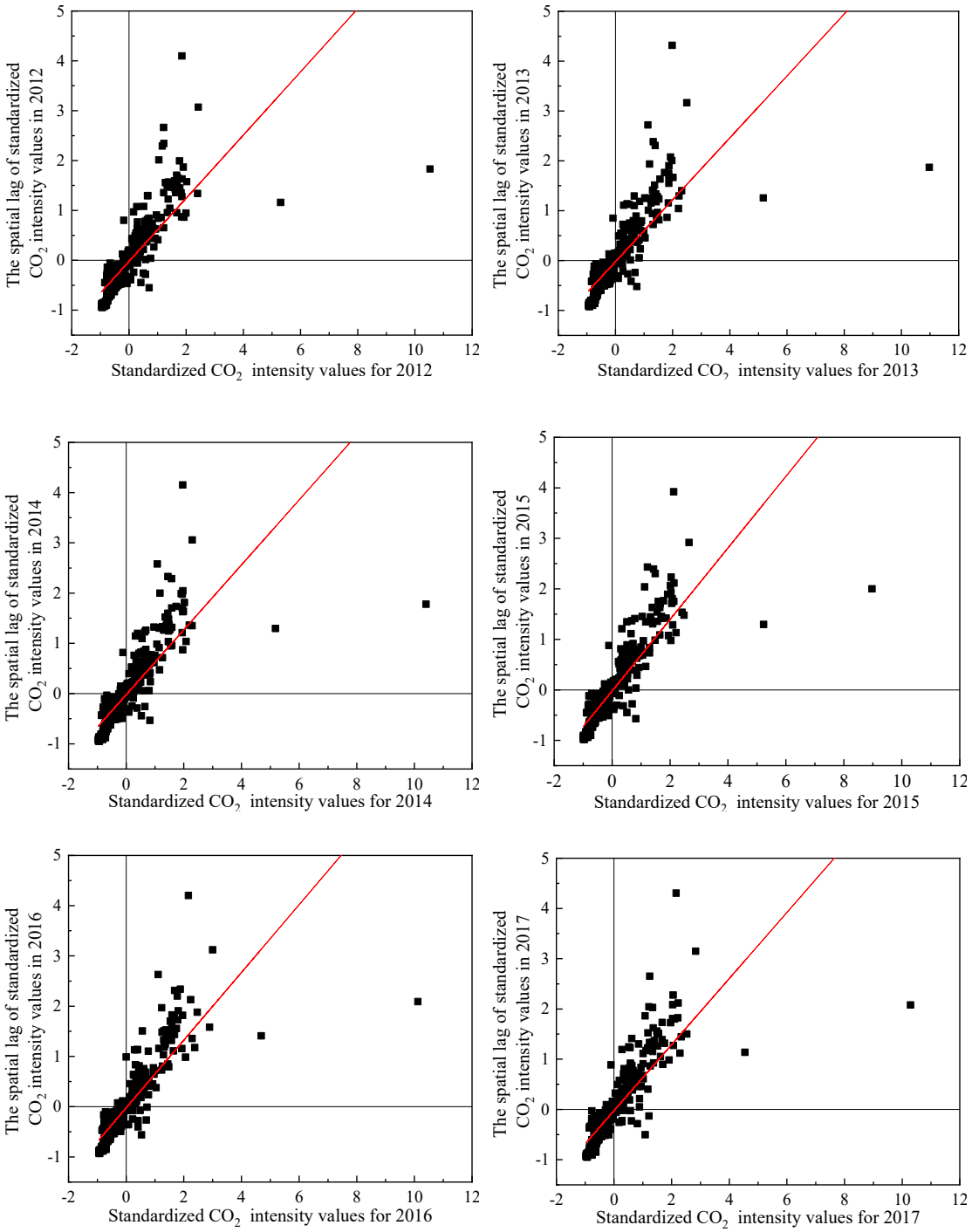


Figure S2. Moran scatterplot of provincial scale carbon emissions.


The spatial lag of standardized CO2 intensity values in 2012
Standardized CO2 intensity values for 2012
The spatial lag of standardized CO2 intensity values in 2013
Standardized CO2 intensity values for 2013
The spatial lag of standardized CO2 intensity values in 2014
Standardized CO2 intensity values for 2014
The spatial lag of standardized CO2 intensity values in 2015
Standardized CO2 intensity values for 2015
The spatial lag of standardized CO2 intensity values in 2016
Standardized CO2 intensity values for 2016
The spatial lag of standardized CO2 intensity values in 2017
Standardized CO2 intensity values for 2017

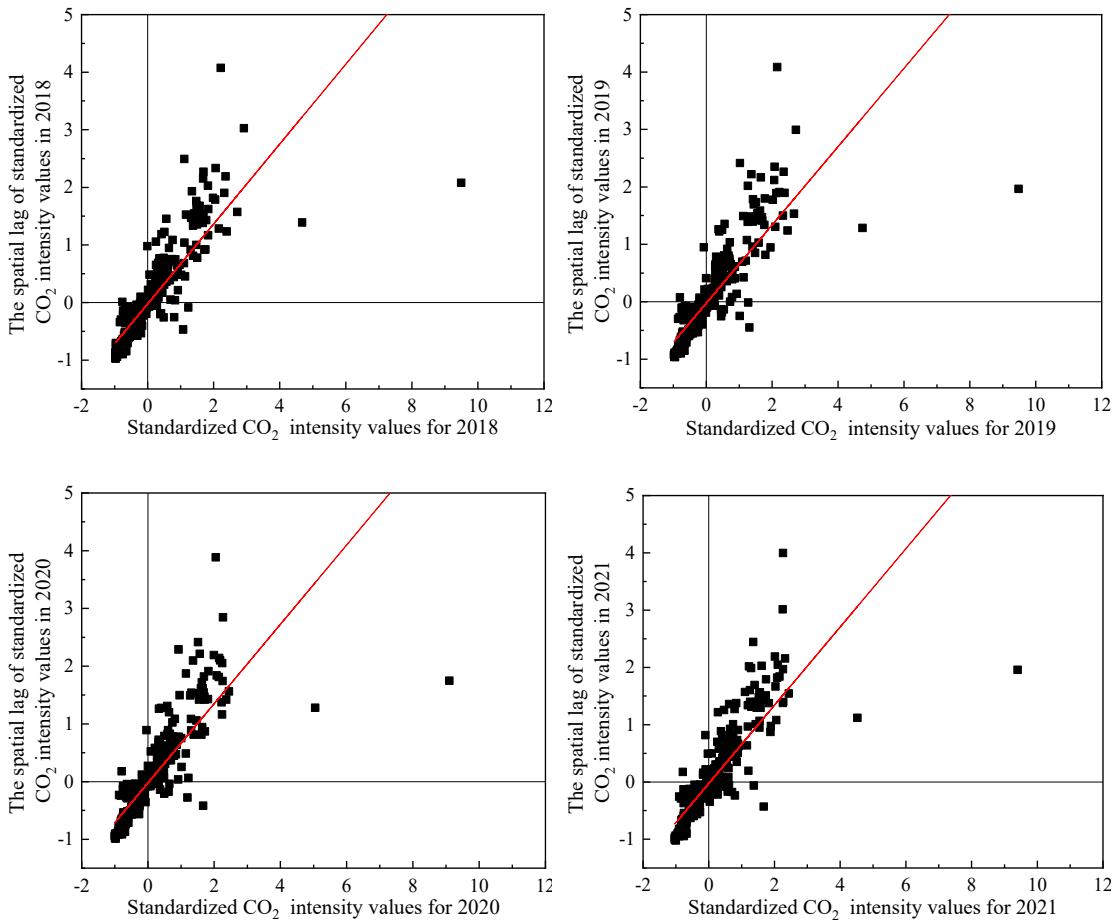


Figure S3. Moran scatterplot of carbon emissions at municipal scale.