Supplemental material

The dynamic driving mechanisms of wetland change from an asynchrony-spatiotemporal perspective: A a case study in Pearl River Delta, China

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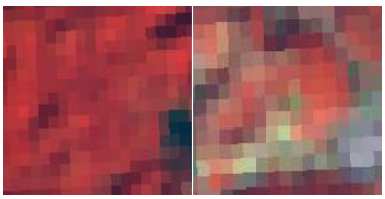
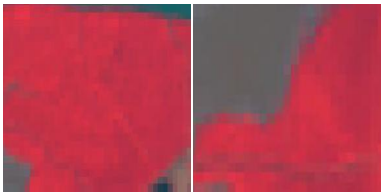
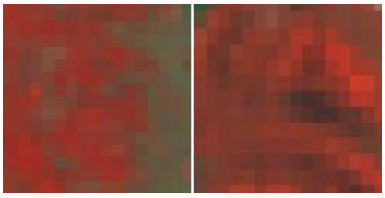
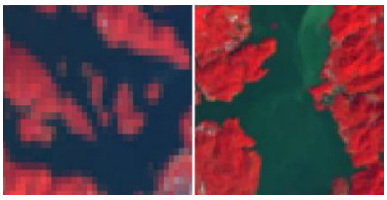
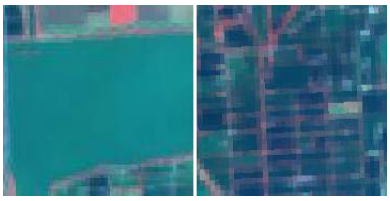
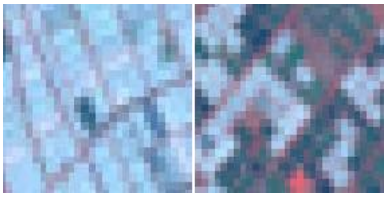
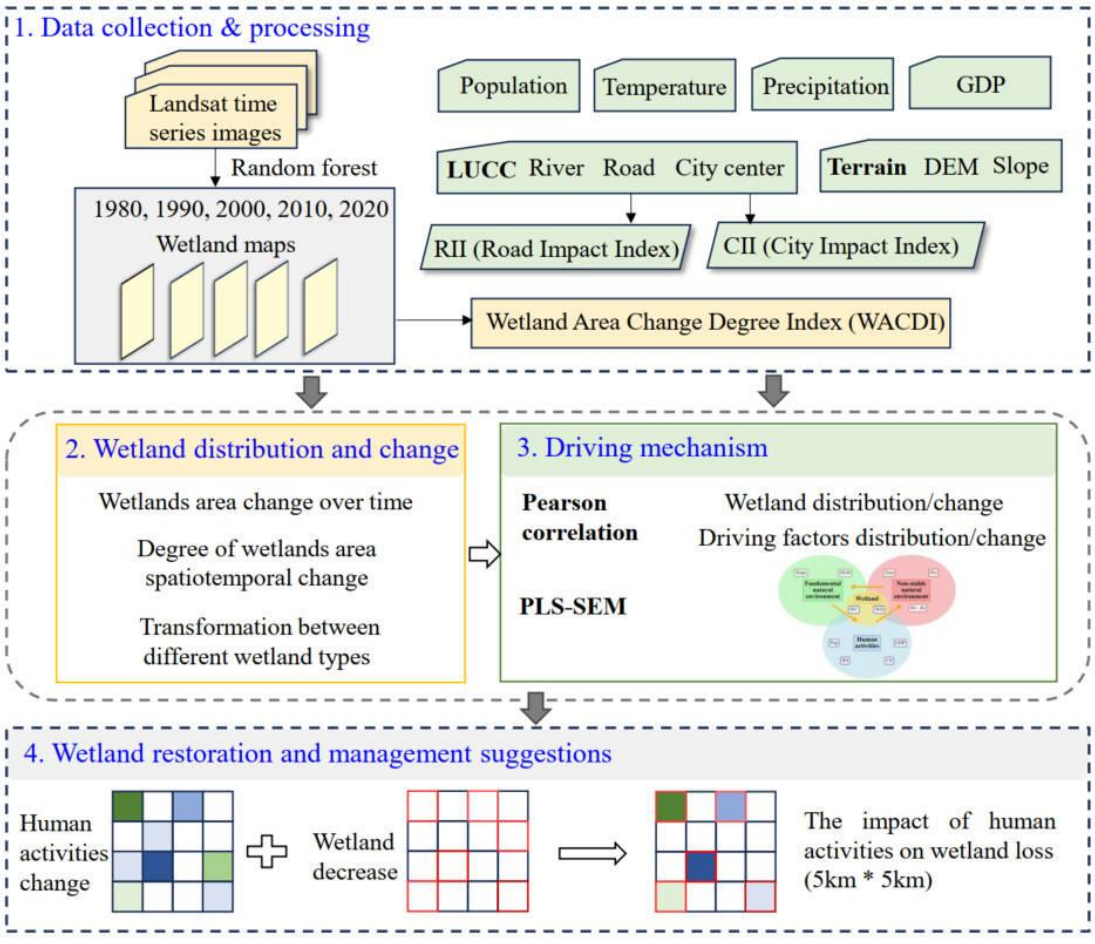
Table S1. Wetland satellite remote sensing interpretation indicators based on Landsat series data

Weland type	Characteristics	Standard false color image
Marsh	It is Dark red and light red patches with dark patches of water, and large bodies of water such as lakes and rivers often appear in the adjacent area. The texture is relatively rough and the color gamut is uneven.	
Forested wetlands	It is dark red with dark black stripes or spots. The texture is relatively smooth and the shape is relatively regular. It is mainly distributed in the coastal zone mudflat area, and mainly mangroves.	
Shrub swamps	It is dark red in color. The shape is relatively irregular, and the texture is also rough, with obvious granular shape.	
Lake	It is brown in color, with smooth texture and natural boundaries.	

Reservoir and ponds	Mainly including artificially excavated water bodies or artificially managed drinking water sources areas. The texture of excavated water bodies is relatively rough, with darker colors and obvious regular patches. The artificially managed drinking water sources areas has a smooth texture, but the surrounding boundaries are relatively regular.	
River	Including rivers, beaches and mudflat. The texture is relatively smooth. The water color is dark blue, and the beach and mudflat are dark gray with scattered red spots.	
Paddy field	The color is pale and accompanied by small brown patches. The texture is relatively rough and has a regular grid like pattern. Distributed in areas with abundant water sources such as rivers, reservoirs, and ponds.	



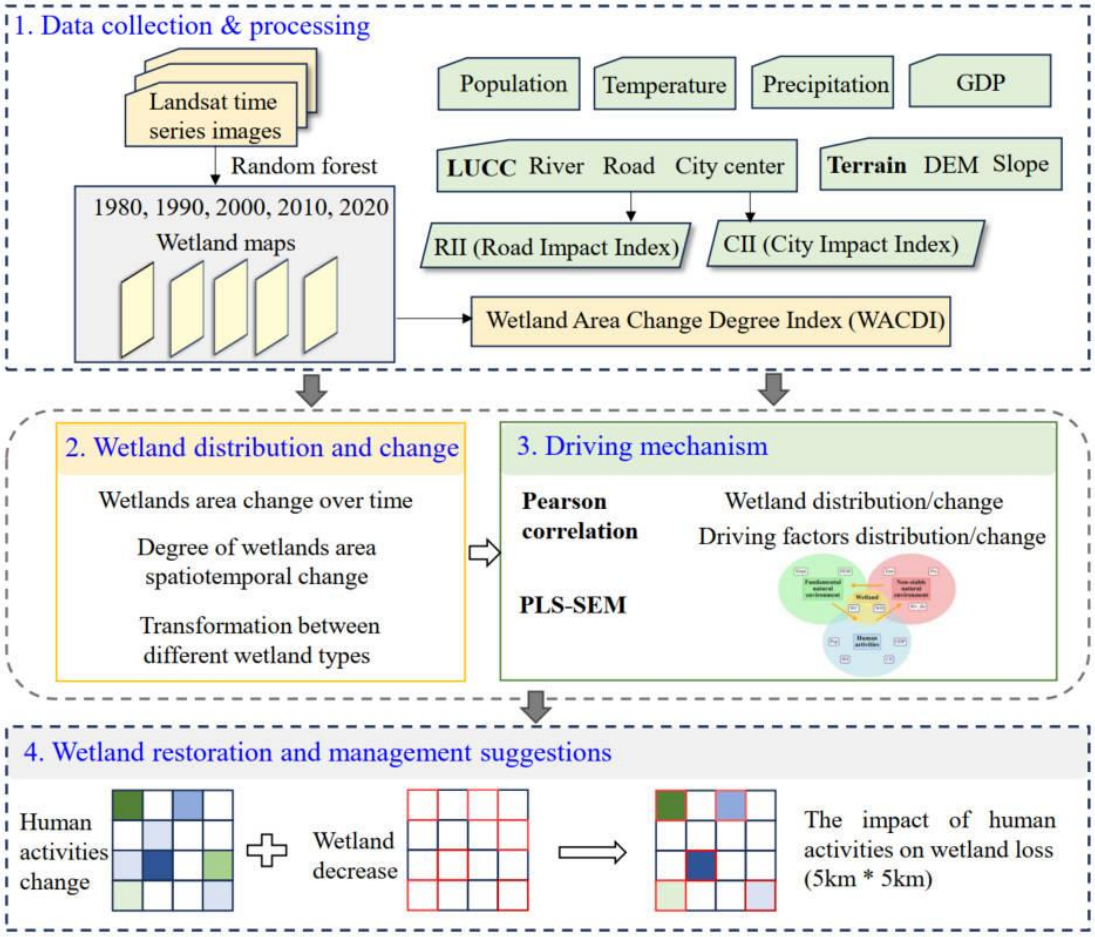


Figure S1 The technical flowchart of this study

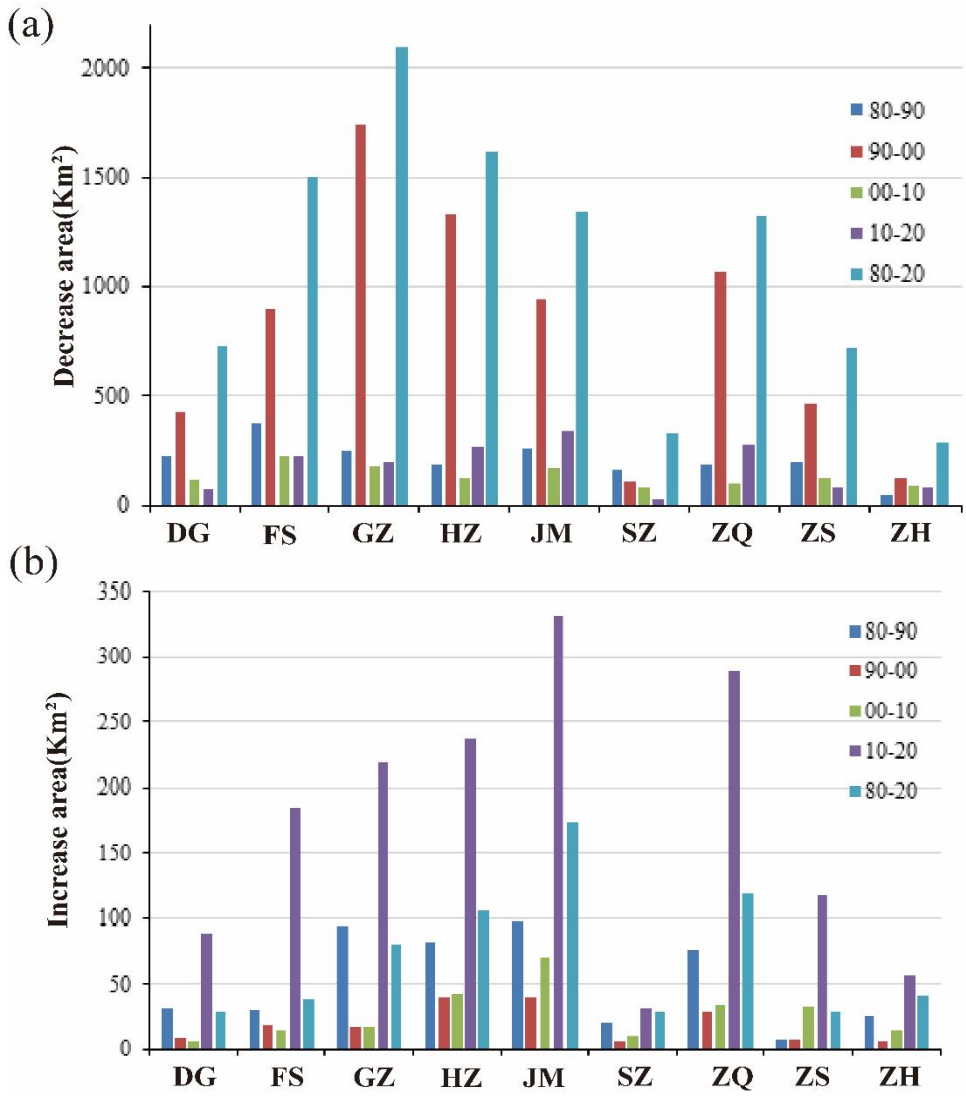


Figure S2. (a) Decreased area and (b) Increased area of wetlands in PRD cities from 1980 to 2020

Table S2. Reliability and validity of PLS-SEM between wetland distribution and driving factors

Indices	CR			AVE		
Latent factors	FNE	NNE	HA	FNE	NNE	HA
1980	0.957	0.818	0.769	0.917	0.700	0.532
1990	0.957	0.799	0.869	0.917	0.665	0.625
2000	0.957	0.844	0.879	0.918	0.731	0.644
2010	0.957	0.688	0.886	0.917	0.561	0.661
2020	0.950	0.620	0.821	0.905	0.529	0.540

Table S3. VIF of PLS-SEM between wetland distribution and driving factors

Variables	1980	1990	2000	2010	2020
Tem	1.323	-	1.273	-	1.070
Pre	1.323	1.122	1.273	1.042	1.070
Slope	3.312	3.296	3.330	3.302	2.919
Dem	3.312	3.296	3.330	3.302	2.919
Riv_dis	-	1.122	-	1.042	-
RII	1.125	1.380	1.504	1.502	1.465
Pop	1.174	5.774	6.896	1.982	5.951
Gdp	-	5.621	6.377	3.191	5.305
CII	1.257	1.473	1.759	2.320	1.676
Wetland	1.000	1.000	1.000	1.000	1.000

Table S4. Reliability and validity of PLS-SEM between wetland increase and changes in driving factors from 2010 to 2020

Indices	CR		AVE	
Latent factors	FNE	NNEC	FNE	NNEC
2010-2020	0.955	0.737	0.915	0.591

Table S5. VIF of PLS-SEM between wetland increase and driving factor changes from 2010 to 2020

Variables	PreC	Slope	Dem	Riv_disC	CII	WetlandC
2010-2020	1.043	3.215	3.215	1.043	1.000	1.000

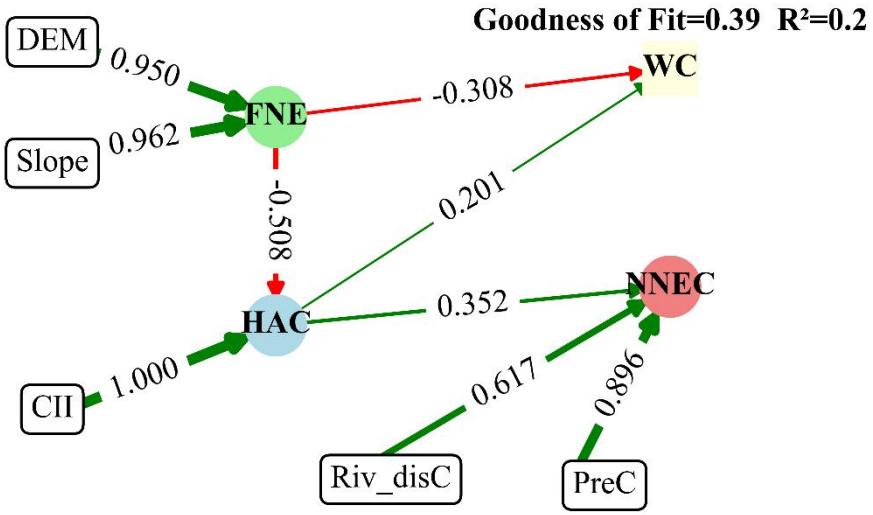


Figure S3. PLS-SEM diagram relationship between each variable and the increase of wetlands during 2010-2020.

Note：The red arrow represents negative impact, while the green arrow represents positive impact. The significance level of all path coefficients is less than 0.001

Table S6. Reliability and validity of PLS-SEM between wetland changes and driving factor changes (wetland decrease from 2010 to 2020)

Indices	CR			AVE		
Latent factors	FNE	NNEC	HAC	FNE	NNEC	HAC
1980-1990	0.957	-	0.810	0.917	-	0.683
1990-2000	0.957	0.774	0.822	0.918	0.614	0.607
2000-2010	0.957	0.789	0.781	0.918	0.575	0.547
2010-2020	0.959	0.693	0.669	0.921	0.558	0.551

Table S7. VIF of SEM between wetland changes and driving factor changes (wetland reduction from 2010 to 2020)

Variables	1980-1990	1990-2000	2000-2010	2010-2020
TemC	-	3.347	1.774	1.026
PreC	1.000	3.351	1.844	1.026
Slope	3.291	3.335	3.344	3.436
Dem	3.291	3.335	3.344	3.436
Riv_disC	-	1.004	1.054	-
RIIC	-	-	-	-
PopC	-	1.452	1.150	-
GdpC	1.162	1.286	1.254	1.041
CII	1.162	1.337	1.233	1.041
WetlandC	1.000	1.000	1.000	1.000

Table S8. The direct, indirect and total effects among Fundamental Natural Environment (FNE), Non-stable Natural Environment Change (NNEC), Human Activity Change (HAC) and wetland increase based on the statistically significant SEM paths (2010-2020)

Path			2010-2020
Effect on HAC	Direct	FNE-HAC	-0.508
	Indirect	-	-
	Total	FNE~HAC	-0.508
Effect on NNEC	Direct	HAC-NNEC	0.352
	Indirect	FNE-HAC-NNEC	-0.179
	Total	HAC~NNEC	0.352
		FNE~NNEC	-0.179
Effect on WC	Direct	HAC-WC	0.201
		FNE-WC	-0.308
	Indirect	FNE-HAC-WC	-0.102
	Total	HAC~WC	0.201
		FNE~WC	-0.410

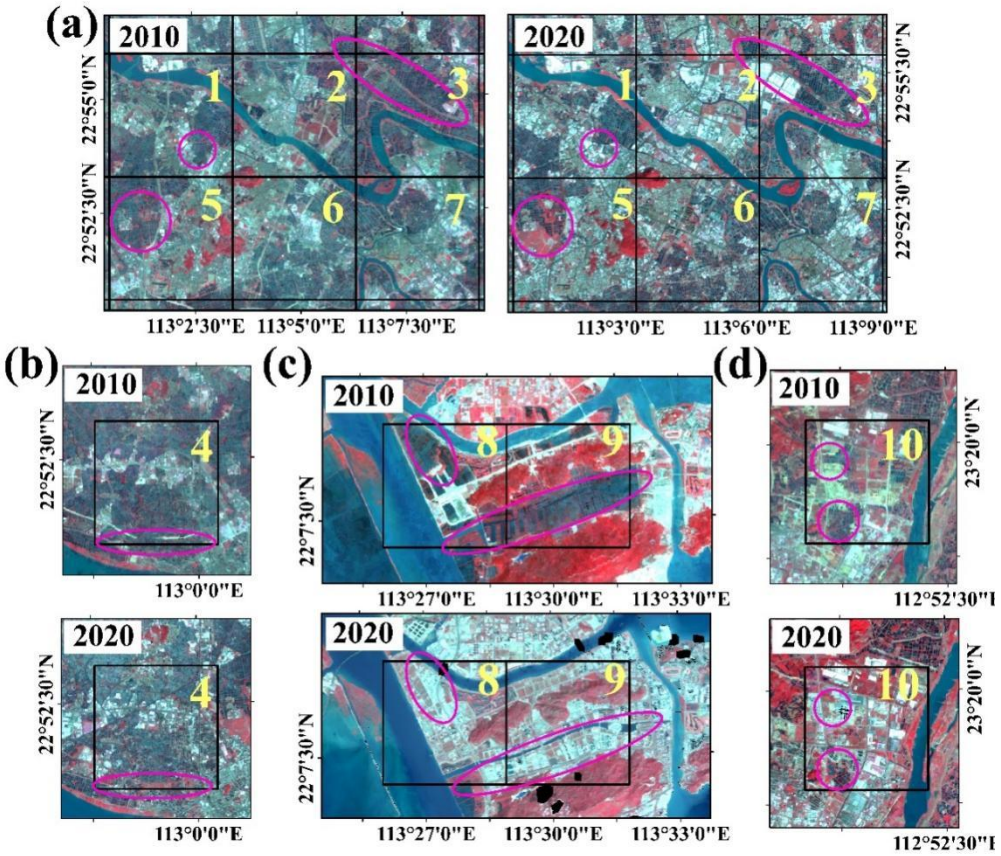


Figure S4. Comparison of typical regional images of human activity changes and wetland loss during 2010-2020 (a) Regions I, 1, 2, 3, 5, 6, 7, (b) Regions I, 4, (c) Regions II, 8, 9 (d) Regions III, 10

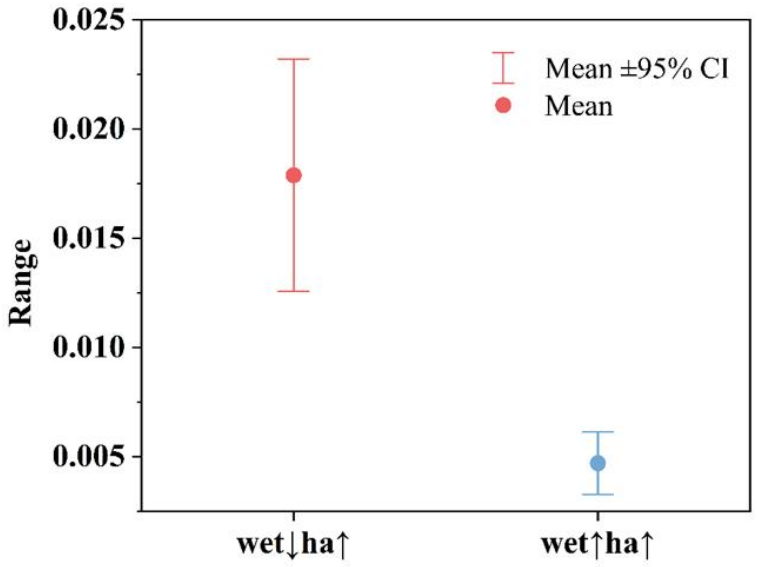


Figure S5. Interval map of human activity range during 2010-2020 estimated by PLS-SEM. Red indicates a decrease in wetland area and an increase in human activity (wet↓ha↑); blue indicates an increase in wetland area and an increase in human activity (wet↑ha↑)