

Spatial Differentiation of Potential Drivers of Grassland Degradation Across Urban Functional Zones in Inner Mongolia

Yong Mei ^{1,2,3}, Batunacun ^{1,2,3,*}, Chang An ^{1,2,3}, Yunfeng Hu ⁴, Chunxing Hai ¹ and Ruifang Guo ¹

¹ College of Geographical Science, Inner Mongolia Normal University, Hohhot 010022, China; 20216019008@mails.imnu.edu.cn (Y.M.); 20060623@imnu.edu.cn (C.A.); hcxs@imnu.edu.cn (C.H.); rfguo@imnu.edu.cn (R.G.)

² Academician Expert Workstation for Ecological Security and Disaster Risk Reduction, Inner Mongolia Normal University, Hohhot 010022, China

³ Key Laboratory of Resources and Environmental Information Systems, Inner Mongolia Autonomous Region, Hohhot 010022, China

⁴ College of Resources and Environment, University of Chinese Academy of Sciences, Beijing 100049, China; huyf@reis.ac.cn

* Correspondence: 20210041@imnu.edu.cn

Table S1

The land use classification system of CLCD.

Classes	ID	Description
Cropland	1	Land for rice fields, greenhouse farming.
Forest	2	Land for broadleaf forests, needleleaf forests, Mixed forests and orchards.
Shrub	3	Land for closed to open shrubland (thicket).
Grassland	4	Land for herbaceous plants.
Water	5	Natural waterbodies and artificial waterbodies, including Lake, reservoir, pond, river and ocean.
Sonw/Ice	6	Including perennial snow, seasonal snow, perennial ice and seasonal ice.
Barren	7	Land for dry salt flats, sandy areas, bare exposed rock, bare herbaceous croplands and dry lake river bottoms,
Impervious	8	Including impervious rooftops covered by low albedo materials and impervious roads covered by high albedo materials.
Wetland	9	Natural and semi-natural aquatic or regularly flooded vegetation

Table S2

Input values for the hasse diagrams of GD drivers in resource-oriented cities from 2000 to 2023.

(a) Human disturbance driver group

County ID	PD 2000	SD 2000	PD 2023	SD 2023
11	0.05	0.42	0.02	0.35
12	0.00	0.26	0.00	0.42
13	0.18	0.02	0.12	0.13
14	0.09	1.00	0.05	1.00
15	0.03	0.25	0.02	0.46
16	0.82	0.28	0.59	0.38
17	1.00	0.69	1.00	0.42
18	0.12	0.02	0.08	0.12
19	0.62	0.00	0.49	0.16
32	0.02	0.43	0.02	0.43
33	0.04	0.19	0.09	0.41
34	0.02	0.18	0.02	0.46
35	0.00	0.17	0.00	0.46
36	0.00	0.20	0.00	0.31
37	0.03	0.33	0.02	0.27
38	0.07	0.13	0.07	0.52
39	0.00	0.36	0.00	0.68

40	0.00	0.34	0.00	0.51
72	0.49	0.12	0.30	0.00
73	0.29	0.04	0.31	0.02
74	0.08	0.42	0.04	0.20

(b) Climate driver group

County ID	PRE 2000	TEM 2000	PRE 2023	TEM 2023
11	0.52	0.00	0.69	0.00
12	0.55	0.17	0.71	0.16
13	0.38	0.64	0.59	0.57
14	0.18	0.40	0.14	0.35
15	0.25	0.11	0.47	0.06
16	0.27	0.57	0.38	0.52
17	0.34	0.57	0.62	0.53
18	0.16	0.46	0.33	0.41
19	0.23	0.58	0.22	0.53
32	0.10	0.63	0.12	0.55
33	0.10	0.56	0.19	0.47
34	0.01	0.61	0.09	0.54
35	0.64	0.84	0.59	0.79
36	0.75	0.79	0.74	0.74
37	0.27	0.63	0.32	0.56
38	0.11	0.48	0.18	0.38
39	0.30	0.93	0.16	0.88
40	0.00	0.87	0.00	0.82
72	1.00	1.00	1.00	1.00
73	0.99	0.95	0.99	0.94
74	0.90	0.97	0.88	0.96

(c) Economic development driver group

County ID	PI 2000	SI 2000	TI 2000	GDP 2000	PI 2023	SI 2023	TI 2023	GDP 2023
11	0.00	0.03	0.02	0.02	0.00	0.06	0.01	0.04
12	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00
13	1.00	0.10	0.09	0.11	0.81	0.77	0.08	0.09
14	0.10	0.02	0.04	0.03	0.20	0.17	0.02	0.04
15	0.11	0.01	0.01	0.01	0.17	0.00	0.00	0.00
16	0.11	0.49	0.62	0.52	0.74	0.67	0.45	0.43
17	0.13	1.00	1.00	1.00	0.65	1.00	1.00	1.00
18	0.73	0.01	0.06	0.04	1.00	0.00	0.01	0.02
19	0.12	0.22	0.51	0.27	0.89	0.18	0.26	0.22
32	0.08	0.01	0.01	0.01	0.10	0.07	0.02	0.05
33	0.08	0.13	0.59	0.13	0.00	0.05	0.14	0.10
34	0.07	0.01	0.01	0.01	0.10	0.06	0.02	0.04
35	0.02	0.00	0.00	0.00	0.03	0.01	0.00	0.01
36	0.05	0.00	0.00	0.00	0.09	0.00	0.00	0.00
37	0.19	0.01	0.01	0.02	0.36	0.01	0.01	0.01
38	0.07	0.07	0.07	0.07	0.04	0.08	0.13	0.11
39	0.04	0.00	0.00	0.00	0.07	0.00	0.00	0.00
40	0.05	0.00	0.00	0.00	0.09	0.01	0.00	0.01
72	0.33	0.17	0.24	0.19	0.26	0.24	0.11	0.19
73	0.15	0.11	0.25	0.15	0.30	0.15	0.15	0.16
74	0.10	0.04	0.05	0.04	0.14	0.06	0.02	0.05

(d) Urbanisatin driver group

County ID	D _{road} 2000	D _{urban} 2000	D _{rural} 2000	D _{mine} 2000	D _{road} 2023	D _{urban} 2023	D _{rural} 2023	D _{mine} 2023
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11	0.96	1.00	0.89	0.88	0.82	0.98	0.89	0.98
12	0.74	0.00	0.55	0.77	0.44	0.03	0.54	0.47
13	0.97	0.54	0.97	0.96	0.91	0.88	0.94	0.93
14	0.97	0.54	0.94	0.91	0.95	0.73	0.95	0.89
15	0.93	0.43	0.95	0.78	0.85	0.45	0.94	0.63
16	0.98	0.86	0.96	0.96	0.97	1.00	0.96	0.92
17	0.99	0.76	0.92	1.00	1.00	0.95	0.93	0.96
18	0.87	0.62	1.00	0.80	0.41	0.62	1.00	0.67
19	1.00	0.72	0.99	0.98	0.98	0.98	0.92	0.94
32	0.89	0.23	0.35	0.37	0.77	0.37	0.42	0.70
33	0.97	0.82	0.72	0.47	0.96	0.81	0.71	1.00
34	0.84	0.41	0.80	0.79	0.73	0.50	0.81	0.80
35	0.80	0.08	0.06	0.70	0.52	0.20	0.18	0.06
36	0.75	0.17	0.00	0.76	0.00	0.16	0.00	0.22
37	0.83	0.29	0.86	0.88	0.63	0.37	0.86	0.73
38	0.98	0.67	0.72	0.59	0.93	0.71	0.83	0.89
39	0.00	0.00	0.04	0.19	0.60	0.00	0.14	0.00
40	0.12	0.03	0.08	0.00	0.65	0.20	0.43	0.19
72	0.99	0.96	0.71	1.00	0.90	0.97	0.84	0.95
73	0.98	0.89	0.23	1.00	0.96	0.88	0.33	0.94
74	0.94	0.35	0.77	0.97	0.88	0.54	0.83	0.89

Table S3

Input values for the hasse diagrams of GD drivers in central service-oriented cities from 2000 to 2023.

(a) Human disturbance driver group

County ID	PD 2000	SD 2000	PD 2023	SD 2023
20	0.01	0.72	0.01	0.64
21	0.00	0.43	0.00	0.70
22	0.29	0.48	0.27	0.57
23	0.12	0.61	0.10	0.34
24	0.55	0.47	0.52	0.57
25	0.05	0.65	0.04	1.00
26	0.09	0.86	0.08	0.48
27	0.04	0.70	0.03	0.78
28	0.05	0.75	0.05	0.49
29	0.08	0.72	0.08	0.68
30	0.00	0.54	0.00	0.94
31	0.02	0.54	0.02	0.65
41	0.43	0.13	0.57	0.48
42	0.03	1.00	0.03	0.70
43	0.03	0.23	0.02	0.53
44	0.04	0.47	0.04	0.35
45	1.00	0.46	1.00	0.60
46	0.11	0.14	0.10	0.22
47	0.73	0.00	0.81	0.00
48	0.11	0.06	0.10	0.12
49	0.31	0.05	0.49	0.20

(b) Climate driver group

County ID	PRE 2000	TEM 2000	PRE 2023	TEM 2023
20	0.45	0.79	0.30	0.78
21	0.06	0.00	0.47	0.00
22	0.47	1.00	0.44	1.00
23	0.00	0.89	0.01	0.89
24	0.47	0.96	0.48	0.96
25	0.31	0.42	0.58	0.42

26	0.08	0.75	0.22	0.75
27	0.38	0.48	0.47	0.47
28	0.03	0.91	0.00	0.90
29	0.28	0.76	0.43	0.74
30	0.39	0.70	0.50	0.68
31	0.36	0.84	0.44	0.82
41	0.89	0.48	0.91	0.45
42	0.49	0.67	0.43	0.63
43	0.93	0.36	0.97	0.34
44	0.70	0.76	0.70	0.72
45	1.00	0.66	1.00	0.63
46	0.76	0.86	0.81	0.83
47	1.00	0.81	0.98	0.78
48	0.91	0.80	0.95	0.77
49	0.94	0.75	0.92	0.72

(c) Economic development driver group

County ID	PI 2000	SI 2000	TI 2000	GDP 2000	PI 2023	SI 2023	TI 2023	GDP 2023
20	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.46	0.37	0.16	0.27	1.00	0.21	0.05	0.12
23	0.33	0.03	0.02	0.04	0.39	0.02	0.01	0.02
24	0.48	0.14	0.22	0.20	0.61	0.48	0.23	0.35
25	0.15	0.02	0.01	0.02	0.12	0.01	0.01	0.01
26	0.11	0.02	0.01	0.02	0.18	0.02	0.01	0.02
27	0.09	0.01	0.01	0.01	0.13	0.01	0.00	0.01
28	0.16	0.01	0.01	0.01	0.21	0.00	0.00	0.01
29	0.18	0.01	0.01	0.02	0.34	0.02	0.02	0.02
30	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
31	0.10	0.00	0.00	0.01	0.13	0.00	0.00	0.00
41	0.16	0.47	0.59	0.53	0.10	0.24	0.58	0.57
42	0.17	0.02	0.01	0.02	0.05	0.02	0.01	0.01
43	0.11	0.01	0.01	0.02	0.03	0.00	0.00	0.00
44	0.19	0.01	0.00	0.02	0.24	0.10	0.02	0.05
45	0.34	1.00	1.00	1.00	0.06	0.49	1.00	1.00
46	0.56	0.06	0.05	0.08	0.59	0.14	0.03	0.08
47	1.00	0.71	0.47	0.61	0.46	1.00	0.71	0.91
48	0.64	0.07	0.02	0.06	0.54	0.12	0.03	0.07
49	0.70	0.29	0.23	0.28	0.80	0.78	0.40	0.58

(d) Urbanisatin driver group

County ID	D _{road} 2000	D _{urban} 2000	D _{rural} 2000	D _{mine} 2000	D _{road} 2023	D _{urban} 2023	D _{rural} 2023	D _{mine} 2023
20	0.41	0.07	0.50	0.14	0.44	0.06	0.46	0.42
21	0.06	0.00	0.00	0.15	0.00	0.00	0.00	0.00
22	0.94	0.56	0.83	0.99	0.91	0.66	0.82	0.95
23	0.78	0.53	0.66	0.74	0.70	0.48	0.66	0.15
24	0.95	0.89	0.90	0.96	0.93	0.82	0.90	0.86
25	0.70	0.38	0.66	0.26	0.80	0.34	0.67	0.20
26	0.87	0.59	0.74	0.72	0.76	0.54	0.73	0.15
27	0.00	0.20	0.61	0.00	0.70	0.19	0.58	0.20
28	0.71	0.35	0.85	0.50	0.72	0.33	0.83	0.47
29	0.61	0.07	0.65	0.69	0.50	0.12	0.64	0.46
30	0.51	0.12	0.75	0.18	0.68	0.11	0.74	0.15
31	0.53	0.22	0.62	0.49	0.47	0.20	0.62	0.20
41	0.95	0.79	0.88	0.92	0.91	0.78	0.87	0.88
42	0.85	0.65	0.80	0.64	0.81	0.60	0.80	0.78
43	0.86	0.68	0.98	0.72	0.80	0.64	0.97	0.81

44	0.85	0.65	0.96	0.64	0.85	0.63	0.95	0.89
45	1.00	1.00	0.66	1.00	0.98	1.00	0.73	0.89
46	0.79	0.80	1.00	0.63	0.90	0.75	0.98	0.89
47	0.99	0.95	1.00	0.99	1.00	0.98	1.00	1.00
48	0.90	0.80	0.97	0.77	0.87	0.79	0.95	0.89
49	0.97	0.75	0.99	0.95	0.92	0.78	1.00	0.97

Table S4

Input values for the hasse diagrams of GD drivers in agro-pastoral-oriented cities from 2000 to 2023.

(a) Urbanisatin driver group

County ID	D_{road} 2000	D_{urban} 2000	D_{rural} 2000	D_{mine} 2000	D_{road} 2023	D_{urban} 2023	D_{rural} 2023	D_{mine} 2023
4	0.92	0.78	0.99	0.38	0.64	0.75	0.99	0.69
5	0.82	0.59	0.62	0.41	0.68	0.57	0.53	0.73
6	0.95	0.75	1.00	0.60	0.77	0.73	1.00	0.74
7	0.39	0.00	0.28	0.60	0.01	0.00	0.13	0.48
8	0.69	0.60	0.92	0.80	0.81	0.64	0.90	0.73
9	0.00	0.20	0.80	0.65	0.62	0.21	0.76	0.68
10	0.93	0.79	0.99	0.37	0.85	0.76	0.99	0.71
64	0.91	0.78	0.95	0.71	0.91	0.77	0.93	0.78
65	0.71	0.66	0.91	0.35	0.68	0.63	0.89	0.42
66	0.95	0.99	0.92	1.00	0.94	0.96	0.88	1.00
67	0.66	0.74	0.93	0.12	0.59	0.71	0.91	0.44
68	0.72	0.66	0.83	0.65	0.64	0.64	0.80	0.57
69	0.77	0.70	0.86	0.60	0.55	0.67	0.83	0.49
70	0.81	0.75	0.94	0.28	0.77	0.73	0.93	0.44
71	0.76	0.78	0.92	0.72	0.75	0.75	0.90	0.61
75	0.95	0.87	0.96	0.58	0.89	0.88	0.96	0.95
76	0.71	0.67	0.97	0.37	0.72	0.67	0.96	0.83
77	0.90	0.77	0.91	0.80	0.72	0.77	0.93	0.64
78	0.95	0.79	0.97	0.69	0.84	0.78	0.97	0.69
79	0.89	0.80	0.98	0.07	0.70	0.80	0.97	0.77
80	1.00	1.00	0.99	0.49	1.00	1.00	0.98	0.98
81	0.38	0.45	0.72	0.48	0.00	0.47	0.67	0.53
82	0.94	0.88	0.97	0.66	0.82	0.85	0.97	0.78
83	0.87	0.86	0.97	0.24	0.83	0.83	0.97	0.66
84	0.83	0.78	0.96	0.40	0.70	0.79	0.95	0.86
85	0.94	0.84	0.93	0.00	0.88	0.82	0.96	0.54
98	0.65	0.60	0.89	0.44	0.66	0.58	0.87	0.66
99	0.67	0.67	0.93	0.47	0.40	0.66	0.90	0.71
100	0.72	0.53	0.78	0.73	0.77	0.55	0.77	0.58
101	0.70	0.66	0.00	0.64	0.44	0.63	0.00	0.00
102	0.72	0.63	0.93	0.52	0.54	0.70	0.91	0.24
103	0.82	0.66	0.77	0.83	0.64	0.67	0.75	0.76

(b) Human disturbance driver group

County ID	PD 2000	SD 2000	PD 2023	SD 2023
4	0.10	0.00	0.21	0.00
5	0.01	0.05	0.03	0.08
6	0.05	0.00	0.11	0.05
7	0.00	0.14	0.00	0.05
8	0.02	0.25	0.04	0.26
9	0.00	0.15	0.00	0.17
10	0.08	0.03	0.15	0.00
64	0.10	0.02	0.20	0.25
65	0.02	0.31	0.03	0.78
66	0.05	1.00	0.14	1.00

67	0.02	0.46	0.03	0.56
68	0.01	0.44	0.02	0.87
69	0.04	0.16	0.09	0.56
70	0.02	0.26	0.05	0.50
71	0.02	0.11	0.05	0.49
75	0.06	0.21	0.07	0.56
76	0.02	0.24	0.04	0.63
77	0.05	0.40	0.11	0.50
78	0.03	0.25	0.06	0.37
79	0.04	0.15	0.07	0.55
80	1.00	0.02	1.00	0.05
81	0.00	0.25	0.01	0.36
82	0.03	0.35	0.06	0.60
83	0.02	0.25	0.05	0.68
84	0.04	0.25	0.08	0.59
85	0.03	0.19	0.06	0.58
98	0.01	0.51	0.02	0.95
99	0.03	0.25	0.06	0.31
100	0.01	0.20	0.02	0.54
101	0.00	0.00	0.00	0.21
102	0.02	0.15	0.03	0.34
103	0.16	0.44	0.09	0.54

(c) Climate driver group

County ID	PRE 2000	TEM 2000	PRE 2023	TEM 2023
4	0.97	0.94	0.93	0.95
5	1.00	1.00	1.00	1.00
6	0.89	0.89	0.88	0.90
7	0.99	0.76	0.95	0.76
8	0.64	0.84	0.81	0.85
9	0.87	0.75	0.93	0.78
10	1.00	0.97	0.98	0.98
64	0.14	0.84	0.17	0.89
65	0.00	0.86	0.06	0.91
66	0.32	0.33	0.33	0.33
67	0.04	0.87	0.10	0.91
68	0.28	0.70	0.29	0.72
69	0.21	0.85	0.26	0.89
70	0.12	0.86	0.21	0.91
71	0.12	0.82	0.15	0.86
75	0.26	0.66	0.43	0.67
76	0.43	0.54	0.52	0.54
77	0.19	0.63	0.38	0.64
78	0.24	0.59	0.43	0.60
79	0.27	0.61	0.50	0.62
80	0.29	0.66	0.44	0.67
81	0.67	0.60	0.79	0.64
82	0.34	0.53	0.55	0.54
83	0.38	0.58	0.45	0.59
84	0.18	0.65	0.44	0.67
85	0.23	0.52	0.50	0.54
98	0.22	0.67	0.16	0.69
99	0.22	0.70	0.11	0.71
100	0.18	0.47	0.10	0.48
101	0.05	0.00	0.00	0.00
102	0.21	0.56	0.13	0.58
103	0.20	0.64	0.19	0.65

(d) Economic development driver group

County ID	PI 2000	SI 2000	TI 2000	GDP 2000	PI 2023	SI 2023	TI 2023	GDP 2023
4	0.69	0.10	0.05	0.09	1.00	0.12	0.18	0.19
5	0.13	0.02	0.01	0.01	0.13	0.02	0.01	0.02
6	0.47	0.02	0.01	0.03	0.54	0.02	0.06	0.06
7	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
8	0.17	0.02	0.01	0.02	0.22	0.02	0.02	0.03
9	0.02	0.00	0.00	0.00	0.03	0.00	0.01	0.00
10	0.76	0.04	0.03	0.06	0.93	0.04	0.08	0.09
64	0.70	0.15	0.05	0.10	0.47	0.06	0.14	0.11
65	0.12	0.00	0.00	0.01	0.15	0.00	0.01	0.01
66	0.17	0.14	0.05	0.08	0.36	0.86	0.20	0.51
67	0.07	0.00	0.00	0.01	0.15	0.00	0.02	0.01
68	0.06	0.00	0.00	0.00	0.09	0.01	0.01	0.01
69	0.38	0.02	0.01	0.03	0.42	0.01	0.03	0.04
70	0.12	0.01	0.00	0.01	0.16	0.01	0.02	0.02
71	0.12	0.00	0.00	0.01	0.20	0.00	0.01	0.02
75	0.25	0.03	0.02	0.03	0.19	0.05	0.03	0.04
76	0.15	0.01	0.00	0.01	0.13	0.01	0.01	0.01
77	0.22	0.06	0.01	0.03	0.15	0.06	0.03	0.05
78	0.17	0.01	0.00	0.01	0.14	0.01	0.02	0.02
79	0.18	0.01	0.00	0.01	0.13	0.01	0.02	0.02
80	1.00	1.00	1.00	1.00	0.64	1.00	1.00	1.00
81	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
82	0.13	0.02	0.01	0.01	0.11	0.05	0.04	0.04
83	0.12	0.01	0.00	0.01	0.15	0.03	0.01	0.02
84	0.15	0.01	0.00	0.01	0.14	0.02	0.02	0.02
85	0.13	0.01	0.00	0.01	0.11	0.03	0.02	0.03
98	0.03	0.00	0.00	0.00	0.09	0.00	0.00	0.00
99	0.17	0.01	0.00	0.01	0.22	0.02	0.01	0.02
100	0.04	0.00	0.00	0.00	0.12	0.01	0.01	0.01
101	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
102	0.10	0.00	0.00	0.01	0.20	0.00	0.01	0.01
103	0.37	0.20	0.10	0.14	0.19	0.06	0.06	0.07

Table S5

Input values for the hasse diagrams of GD drivers in ecology-oriented cities from 2000 to 2023.

(a) Urbanisation driver group

County ID	D_{road} 2000	D_{urban} 2000	D_{rural} 2000	D_{mine} 2000	D_{road} 2023	D_{urban} 2023	D_{rural} 2023	D_{mine} 2023
1	0.14	0.73	0.00	0.51	0.54	0.11	0.00	0.30
2	0.53	0.00	0.72	0.00	0.49	0.02	0.72	0.33
3	0.49	0.48	0.50	0.75	0.45	0.00	0.47	0.47
50	0.80	0.93	0.81	0.57	0.80	0.77	0.77	0.33
51	0.41	0.92	0.83	0.62	0.72	0.73	0.80	0.64
52	0.29	0.85	0.69	0.41	0.26	0.52	0.63	0.41
53	0.66	0.89	0.86	0.68	0.61	0.65	0.83	0.51
54	0.60	0.89	0.89	0.78	0.69	0.64	0.87	0.11
55	1.00	0.96	0.93	0.94	1.00	0.97	0.93	1.00
56	0.67	0.90	0.72	0.87	0.72	0.66	0.66	0.63
57	0.70	0.83	0.80	0.50	0.71	0.44	0.81	0.37
58	0.94	0.98	0.96	0.90	0.96	0.93	0.96	0.95
59	0.55	0.80	0.75	0.61	0.58	0.33	0.70	0.28
60	0.81	0.92	0.98	0.86	0.78	0.73	0.97	0.39
61	0.64	0.92	0.92	0.80	0.65	0.74	0.91	0.20
62	0.29	0.84	0.75	0.73	0.41	0.48	0.71	0.13
63	0.99	1.00	0.85	1.00	0.96	1.00	0.83	0.98
86	0.24	0.77	0.75	0.55	0.11	0.26	0.70	0.09

87	0.00	0.77	0.65	0.49	0.00	0.26	0.62	0.00
88	0.75	0.93	0.93	0.90	0.76	0.78	0.93	0.70
89	0.89	0.91	0.94	0.84	0.93	0.74	0.93	0.83
90	0.65	0.85	0.78	0.73	0.67	0.49	0.69	0.39
91	0.77	0.93	0.94	0.47	0.76	0.78	0.96	0.75
92	0.16	0.81	0.88	0.72	0.87	0.37	0.86	0.72
93	0.74	0.88	0.86	0.68	0.76	0.61	0.86	0.56
94	0.78	0.86	0.88	0.76	0.74	0.52	0.88	0.34
95	0.37	0.81	0.77	0.62	0.73	0.40	0.76	0.54
96	0.46	0.87	0.86	0.38	0.32	0.58	0.83	0.52
97	0.86	0.93	1.00	0.43	0.85	0.78	1.00	0.79

(b) Climate driver group

County ID	PRE 2000	TEM 2000	PRE 2023	TEM 2023
1	1.00	1.00	1.00	1.00
2	0.73	0.84	0.86	0.83
3	0.76	0.98	0.84	0.97
50	0.17	0.09	0.15	0.09
51	0.17	0.07	0.29	0.07
52	0.59	0.39	0.65	0.38
53	0.22	0.12	0.28	0.12
54	0.20	0.44	0.00	0.44
55	0.41	0.32	0.54	0.30
56	0.10	0.00	0.28	0.00
57	0.42	0.25	0.45	0.24
58	0.32	0.19	0.38	0.19
59	0.28	0.16	0.28	0.17
60	0.08	0.38	0.03	0.38
61	0.27	0.44	0.07	0.45
62	0.00	0.24	0.08	0.23
63	0.42	0.36	0.54	0.34
86	0.51	0.48	0.68	0.50
87	0.59	0.58	0.72	0.61
88	0.15	0.53	0.47	0.54
89	0.49	0.50	0.66	0.49
90	0.63	0.68	0.76	0.71
91	0.42	0.62	0.59	0.64
92	0.38	0.41	0.51	0.40
93	0.28	0.52	0.54	0.53
94	0.70	0.66	0.81	0.70
95	0.41	0.34	0.46	0.34
96	0.36	0.56	0.57	0.59
97	0.19	0.58	0.46	0.59

(c) Human disturbance driver group

County ID	PD 2000	SD 2000	PD 2023	SD 2023
1	0.00	0.14	0.00	0.12
2	0.00	0.28	0.00	0.06
3	0.01	0.31	0.01	0.24
50	0.05	0.09	0.04	0.15
51	0.01	0.07	0.01	0.28
52	0.00	0.42	0.00	1.00
53	0.01	0.13	0.01	0.56
54	0.10	0.00	0.09	0.06
55	1.00	0.26	0.65	0.27
56	0.03	0.00	0.02	0.01
57	0.01	0.25	0.01	0.65

58	0.57	0.43	0.72	0.67
59	0.02	0.16	0.02	0.47
60	0.09	0.00	0.10	0.04
61	0.08	0.00	0.08	0.06
62	0.02	0.00	0.01	0.00
63	1.00	0.52	1.00	0.86
86	0.00	0.54	0.00	0.52
87	0.00	0.41	0.00	0.37
88	0.08	0.83	0.10	0.35
89	0.03	0.50	0.05	0.50
90	0.01	0.35	0.01	0.22
91	0.02	0.61	0.02	0.51
92	0.01	0.39	0.01	0.39
93	0.02	0.58	0.03	0.48
94	0.30	0.09	0.08	0.16
95	0.00	0.35	0.01	0.46
96	0.04	1.00	0.04	0.58
97	0.19	0.53	0.19	0.42

(d) Economic development driver group

County ID	PI 2000	SI 2000	TI 2000	GDP 2000	PI 2023	SI 2023	TI 2023	GDP 2023
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.01
50	0.04	0.01	0.01	0.02	0.13	0.00	0.01	0.02
51	0.04	0.00	0.00	0.01	0.09	0.00	0.00	0.01
52	0.03	0.00	0.00	0.00	0.08	0.01	0.00	0.01
53	0.04	0.00	0.00	0.01	0.12	0.03	0.01	0.03
54	0.25	0.00	0.01	0.03	0.61	0.01	0.02	0.04
55	0.73	0.30	0.64	1.00	0.48	0.21	1.00	0.85
56	0.01	0.01	0.01	0.02	0.03	0.00	0.01	0.01
57	0.04	0.00	0.00	0.01	0.07	0.00	0.00	0.00
58	0.46	0.17	0.27	0.48	0.64	0.26	0.59	0.60
59	0.05	0.01	0.01	0.02	0.07	0.04	0.01	0.03
60	0.21	0.01	0.01	0.03	0.77	0.00	0.01	0.04
61	0.13	0.01	0.01	0.02	0.46	0.02	0.02	0.04
62	0.02	0.00	0.00	0.00	0.08	0.00	0.00	0.00
63	1.00	1.00	1.00	0.55	1.00	1.00	0.46	1.00
86	0.03	0.00	0.00	0.00	0.05	0.00	0.00	0.01
87	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00
88	0.17	0.01	0.01	0.03	0.37	0.04	0.03	0.06
89	0.05	0.04	0.01	0.05	0.18	0.07	0.05	0.08
90	0.02	0.00	0.00	0.01	0.03	0.00	0.00	0.01
91	0.04	0.00	0.00	0.01	0.12	0.01	0.01	0.02
92	0.07	0.00	0.00	0.01	0.11	0.04	0.01	0.03
93	0.07	0.00	0.00	0.01	0.12	0.02	0.01	0.03
94	0.04	0.11	0.41	0.56	0.12	0.04	0.20	0.17
95	0.03	0.00	0.00	0.00	0.05	0.00	0.00	0.00
96	0.05	0.00	0.00	0.01	0.15	0.02	0.01	0.02
97	0.27	0.02	0.02	0.06	0.59	0.03	0.04	0.07

Table S6

Ranking of all driver groups in RO from 2000 to 2023.

County	GD area	Human disturbance	Economic	Urbanisation	Climate factor	Dominant drivers
11	33.15	2	3	1	5	Urbanisation
12	248.62	4	7	4	4	Human, urbanisation, climate
13	82.13	3	1	1	4	Economic and urbanisation
14	10.83	1	2	2	7	Human,
15	191.41	2	3	2	5	Human and urbanisation
16	22.70	2	1	1	5	Economic and urbanisation
17	19.17	1	1	1	4	Human, economic, urbanisation
18	136.74	4	1	1	6	Economic and urbanisation
19	26.40	3	1	1	6	Economic and urbanisation
32	392.30	2	2	3	6	Human and economic
33	37.75	2	2	1	7	Urbanisation
34	442.95	3	3	3	7	Human, economic, urbanisation
35	1132.00	4	5	4	3	Climate
36	994.21	5	5	4	3	Climate
37	811.80	3	2	3	5	Economic
38	122.38	0	2	2	7	Economic and urbanisation
39	920.07	2	6	4	3	Human
40	899.11	3	4	4	4	Human
72	34.40	3	1	1	1	Economic, urbanisation, climate
73	73.47	3	1	1	2	Economic and urbanisation
74	135.16	2	2	2	2	All

GD area	6766.74	3259.61	2299.59	1606.41	2544.38	Human > Climate > Economic > Urbanisation
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Table S7

Ranking of all driver groups in CSO cities from 2000 to 2023.

Count y	GD area	Human disturbance	Economic	Urbanization	Climate factor	Dominant drivers
20	1270.04	2	6	5	2	Human and climate
21	873.708	3	7	6	7	Human
22	73.9134	1	1	2	1	Human, economic, Climate
23	475.814	1	3	3	2	Human
24	29.5875	1	2	2	1	Human and climate
25	154.925	1	4	5	5	Human
26	333.206	1	4	3	3	Human
27	349.864	1	5	6	6	Human
28	1102.21	1	4	4	2	Human
29	376.969	1	3	4	3	Human
30	748.848	2	6	5	5	Human
31	1122.02	2	5	5	2	Human and climate
41	63.8955	2	1	2	3	Economic
42	186.32	1	4	4	5	Human
43	159.672	2	5	3	2	Human and climate
44	419.853	2	3	3	3	Human
45	14.1921	1	1	1	1	ALL
46	159.79	2	2	2	1	Climate
47	15.3063	2	1	1	1	Economic, urbanisation, climate
48	198.961	3	2	2	2	Economic, urbanisation, climate
49	100.061	3	1	2	2	Economic
GD area	8229.16	7691.14	466.33	228.46	3043.48	Human > Climate > Economic > Urbanisation

Table S8

Ranking of all driver groups in APO cities from 2000 to 2023.

Count y	GD area	Human disturban ce	Econom ic	Urbanizati on	Climat e factor	Dominant drivers
4	229.66	2	1	1	3	Livelihood, Urbanisation
5	527.95	6	4	2	1	Climate
6	202.52	3	2	1	4	Urbanisation
7	2314.07	7	7	3	3	Livelihood
8	814.49	5	3	1	5	Urbanisation and climate
9	1420.33	6	7	2	4	Livelihood
10	183.30	0	1	1	2	Economic and urbanisation
64	273.15	1	2	1	6	Human and urbanisation
65	1497.41	2	6	3	5	Human
66	77.14	1	2	1	7	Human and urbanisation
67	685.48	2	5	3	4	Human
68	1003.11	3	6	2	6	Urbanisation
69	619.40	2	3	2	5	Human and urbanisation
70	1022.81	3	4	2	4	Urbanisation
71	745.52	4	5	1	7	Urbanisation
75	180.88	1	3	1	7	Human and urbanisation
76	148.44	3	5	2	6	Urbanisation
77	178.76	2	3	1	8	Urbanisation
78	291.68	3	4	1	8	Urbanisation
79	139.05	3	4	2	6	Urbanisation
80	73.88	1	1	1	6	Human, economic, urbanisation
81	507.64	4	8	3	5	Urbanisation
82	131.83	2	3	1	6	Urbanisation
83	89.87	2	4	2	6	Human and urbanisation
84	280.41	2	4	2	7	Human and urbanisation
85	44.15	3	4	2	7	Urbanisation
98	1275.40	2	7	2	7	Human and urbanisation
99	560.47	4	4	2	7	Urbanisation
100	1239.66	4	6	2	10	Urbanisation

101	303.29	6	9	2	11	Livelihood
102	855.71	4	6	2	9	Urbanisation
103	335.99	1	2	2	8	Human
GD area	18253.44	5389.01	486.84	15206.60	2842.02	Urbanisation > Human > climate > economic

Table S9

Ranking of all driver groups in EO cities from 2000 to 2023.

Country	GD area	Human disturbance	Economic	Urbanization	Climate factor	Dominant drivers
1	397.69	5	10	5	1	Climate
2	574.25	5	8	5	2	Climate
3	2891.50	4	7	4	2	Climate
50	997.66	4	4	2	11	Urbanisation
51	650.53	5	6	3	9	Urbanisation
52	295.23	1	6	4	5	Human
53	637.62	4	3	3	10	Economic and urbanisation
54	308.26	3	2	3	8	Economic
55	55.74	2	1	1	7	Economic and urbanisation
56	268.15	5	5	3	11	Urbanisation
57	533.53	3	7	4	7	Human
58	127.14	2	1	1	8	Economic and urbanisation
59	876.02	3	3	4	9	Human and economic
60	581.22	3	2	1	8	Urbanisation
61	347.82	4	3	3	7	Economic and urbanisation
62	2380.70	6	7	4	8	Urbanisation
63	18.65	1	1	1	6	Human, economic and urbanisation
86	197.40	2	7	5	5	Human
87	290.48	3	9	6	4	Human
88	186.31	1	2	2	6	Human
89	270.27	2	2	2	5	Human, economic and urbanisation
90	280.30	4	7	3	3	Urbanisation and Climate
91	38.72	2	5	2	4	Urbanisation
92	280.73	3	3	3	6	Human, economic and urbanisation
93	205.17	2	4	3	6	Human
94	106.29	3	2	3	3	Economic
95	475.07	3	8	4	7	Human

96	58.82	1	4	4	5	Human
97	104.44	1	2	1	5	Human and urbanisation
GD area	14435. 71	3550.12	2747.82	6758.97	4143.7 4	urbanisation > Climate > > Human > Economic