

Appendix IV Global Innovation Index science and technology cluster methodology

Since 2016, the Global Innovation Index (GII) has sought to identify science and technology (S&T) clusters using a bottom-up approach. This approach disregards administrative or political borders and instead pinpoints those geographical areas that show a high density of inventors and scientific authors. The resulting clusters often encompass several municipal districts, sub-federal states and sometimes even two or more countries. Two innovation metrics are employed in the compilation of the top 100 GII S&T clusters worldwide: location of inventors listed on published patent applications and authors listed on published scientific articles.

For patents, this method relies on applications under WIPO's Patent Cooperation Treaty (PCT). PCT patents offer a useful basis for analyzing patents globally. The PCT system applies a single set of procedural rules and collects information based on uniform filing standards. This reduces potential biases that could arise from using data collected from multiple national sources. The patents selected were published over the most recent five-year period available, between 2018 and 2022, to minimize the effects of volatility that can occur between years.¹

To widen the range of innovation included, scientific publications from the Web of Science's Science Citation Index Expanded (SCIE) are incorporated. The SCIE provides detailed coverage of the world's most impactful academic journals. For the analysis presented here, science and technology fields are the focus, while articles from the fields of social sciences and humanities are disregarded. In addition, scientific publications are limited solely to articles of original research. This excludes other published items, such as meeting abstracts, conference summaries or paper briefs. As with PCT filings, the most recent five-year period according to data availability was also used for the SCIE – publication years 2017 to 2021.

The WIPO PCT patent data set consists of approximately 1.3 million patent applications published between 2018 and 2022, containing 3.9 million inventor addresses. For the SCIE, the data set comprises 7.6 million articles published between 2017 and 2021, containing 25.1 million listed author addresses.

The process for geocoding of addresses for this report is as follows. PCT inventor addresses were geocoded using the Environmental Systems Research Institute (ESRI) ArcGIS World Geocoder service.² In cases where the ESRI address matches proved either ambiguous or insufficiently accurate, the city name in the address string was extracted and matched using records in the city-level data set from the GeoNames Gazetteer database.³ This latter database gives the geolocation of cities around the globe and contains 48,000 geocoded cities. This same city-matching approach was applied to all SCIE author addresses.

Overall, 97.6 percent of inventor addresses were geocoded at either the city level or a more accurate level, while 95.7 percent of scientific author addresses were geocoded at the city level. Appendix Table 5 provides a summary of the geocoding results for the top 20 countries, which together account for the majority of inventor and scientific author addresses. As shown in the table, the coverage of geocoded PCT inventor addresses across all 20 countries is typically above 98 percent, only falling below 98 percent in one instance. Coverage of scientific author addresses is also high, above 90% in all but one instance. All of the 20 countries had at least 95 percent of their PCT applications and Scientific articles contain at least one inventor or author with a geocoded address, only falling below 95 percent in one instance.

Addresses were clustered by applying the density-based spatial clustering of applications with noise (DBSCAN) algorithm. This algorithm requires predefined radius and density parameters. As in previous years, a radius of 15 km and a density of 4,500 listed inventors/authors was applied. Equal weight was given to inventors and authors by expressing data points as a share of total inventor and author addresses, respectively. Given that the number of scientific articles far exceeds the number of patents, cluster identification based on the raw data points would have resulted in clusters shaped predominantly by the scientific author landscape.

The result was an initial list of 248 clusters. After review, neighboring clusters were merged if the edge of one cluster was within 3–5 km of another and where the co-author/co-inventor

relationships were higher than for any other relationship with any other cluster or non-cluster points. A total of 22 clusters met these criteria, with mergers reducing the overall number of clusters identified to 237.⁴

The remaining 237 clusters were then ranked by counting the number of patents and scientific articles in a given cluster. Numbers were aggregated using fractional counting, in which counts reflect the share of a patent's inventors and an article's authors present in a particular cluster. In addition, mirroring the equal weighting approach described above, fractional counts are relative to the total numbers of patents and scientific articles.

To produce an intensity ranking, the European Commission's Global Human Settlement Layer (GHSL) population distribution data were matched geographically to the top 100 clusters identified in the overall ranking.⁵ Just as with inventor/author geocoded locations, these population data allowed us to define the total population of a cluster using a bottom-up approach. We chose to define a cluster's area as all the space within 0.05 degrees of each inventor/author location. Overlaying the resultant cluster polygons on top of the population data and aggregating all points which lay within each polygon gave a total population estimate for each cluster.⁶ The clusters were then ranked by dividing the total S&T share by population.

Appendix Table 3 Top 100 S&T clusters, 2023

Rank	Cluster name	Economy	PCT applications	Scientific publications	Share total PCT filings (%)	Share of total pubs (%)	Total	Previous rank ^a	Rank change ^a
1	Tokyo–Yokohama	JP	127,418	115,020	10.1	1.5	11.7	1	0
2	Shenzhen–Hong Kong–Guangzhou	CN/HK	113,482	153,180	9.0	2.1	11.1	2	0
3	Seoul	KR	63,447	133,604	5.1	1.8	6.8	4	1
4	Beijing	CN	38,067	279,485	3.0	3.7	6.8	3	-1
5	Shanghai–Suzhou	CN	32,924	162,635	2.6	2.2	4.8	6	1
6	San Jose–San Francisco, CA	US	47,269	58,575	3.8	0.8	4.6	5	-1
7	Osaka–Kobe–Kyoto	JP	38,413	51,948	3.1	0.7	3.8	7	0
8	Boston–Cambridge, MA	US	18,184	76,378	1.4	1.0	2.5	8	0
9	San Diego, CA	US	23,261	20,928	1.9	0.3	2.1	11	2
10	New York City, NY	US	13,838	74,849	1.1	1.0	2.1	9	-1
11	Nanjing	CN	7,143	113,488	0.6	1.5	2.1	12	1
12	Paris	FR	15,176	61,692	1.2	0.8	2.0	10	-2
13	Wuhan	CN	6,250	89,756	0.5	1.2	1.7	15	2
14	Hangzhou	CN	10,755	62,924	0.9	0.8	1.7	14	0
15	Nagoya	JP	17,736	16,091	1.4	0.2	1.6	13	-2
16	Los Angeles, CA	US	11,556	44,058	0.9	0.6	1.5	16	0
17	Washington, DC–Baltimore, MD	US	5,525	76,039	0.4	1.0	1.5	17	0
18	Daejeon	KR	12,275	25,552	1.0	0.3	1.3	20	2
19	Xi'an	CN	1,786	86,937	0.1	1.2	1.3	21	2
20	London	GB	5,981	59,068	0.5	0.8	1.3	18	-2
21	Seattle, WA	US	11,472	20,322	0.9	0.3	1.2	19	-2
22	Munich	DE	10,248	24,239	0.8	0.3	1.1	22	0
23	Qingdao	CN	7,286	39,745	0.6	0.5	1.1	29	6
24	Chengdu	CN	2,046	67,334	0.2	0.9	1.1	27	3
25	Cologne	DE	7,466	34,286	0.6	0.5	1.1	23	-2
26	Amsterdam–Rotterdam	NL	4,230	52,864	0.3	0.7	1.0	25	-1
27	Taipei–Hsinchu	TW*	3,907	52,752	0.3	0.7	1.0	26	-1
28	Houston, TX	US	8,475	24,636	0.7	0.3	1.0	24	-4
29	Stuttgart	DE	9,342	14,874	0.7	0.2	0.9	28	-1
30	Tel Aviv–Jerusalem	IL	7,268	24,219	0.6	0.3	0.9	31	1
31	Moscow	RU	2,036	55,086	0.2	0.7	0.9	32	1
32	Chicago, IL	US	5,763	32,343	0.5	0.4	0.9	30	-2
33	Singapore	SG/MY	4,861	36,803	0.4	0.5	0.9	35	2
34	Tehran	IR	249	63,113	0.0	0.8	0.9	33	-1
35	Philadelphia, PA	US	5,390	32,309	0.4	0.4	0.9	34	-1
36	Tianjin	CN	1,267	53,680	0.1	0.7	0.8	36	0
37	Changsha	CN	1,149	52,768	0.1	0.7	0.8	39	2
38	Stockholm	SE	6,069	19,984	0.5	0.3	0.8	37	-1
39	Minneapolis, MN	US	6,625	15,375	0.5	0.2	0.7	38	-1
40	Hefei	CN	2,549	38,974	0.2	0.5	0.7	53	13
41	Eindhoven	NL	7,982	5,339	0.6	0.1	0.7	40	-1
42	Melbourne	AU	2,126	40,056	0.2	0.5	0.7	41	-1
43	Berlin	DE	3,624	30,464	0.3	0.4	0.7	42	-1
44	Chongqing	CN	1,651	41,412	0.1	0.6	0.7	49	5
45	Frankfurt am Main	DE	5,410	18,590	0.4	0.2	0.7	43	-2
46	Sydney	AU	2,539	33,695	0.2	0.5	0.7	44	-2
47	Raleigh, NC	US	3,057	30,206	0.2	0.4	0.6	45	-2
48	Madrid	ES	1,580	38,849	0.1	0.5	0.6	46	-2
49	Zürich	CH	3,759	24,437	0.3	0.3	0.6	50	1
50	Milan	IT	2,578	31,077	0.2	0.4	0.6	51	1
51	Brussels–Antwerp	BE	3,079	27,659	0.2	0.4	0.6	48	-3

Appendix Table 3 Continued

Rank	Cluster name	Economy	PCT applications	Scientific publications	Share total PCT filings (%)	Share of total pubs (%)	Total	Previous rank ^a	Rank change ^a
52	Toronto, ON	CA	2,756	28,967	0.2	0.4	0.6	54	2
53	Harbin	CN	251	42,974	0.0	0.6	0.6	55	2
54	Barcelona	ES	2,431	29,851	0.2	0.4	0.6	52	-2
55	Jinan	CN	1,638	34,308	0.1	0.5	0.6	57	2
56	Bengaluru	IN	4,342	15,579	0.3	0.2	0.6	60	4
57	Denver, CO	US	3,084	21,910	0.2	0.3	0.5	59	2
58	Changchun	CN	376	37,310	0.0	0.5	0.5	63	5
59	Istanbul	TR	2,144	26,230	0.2	0.4	0.5	47	-12
60	Montréal, QC	CA	2,235	25,406	0.2	0.3	0.5	58	-2
61	Copenhagen	DK	3,123	18,911	0.2	0.3	0.5	62	1
62	Heidelberg–Mannheim	DE	3,941	13,849	0.3	0.2	0.5	61	-1
63	Shenyang	CN	716	32,840	0.1	0.4	0.5	68	5
64	Delhi	IN	1,111	30,443	0.1	0.4	0.5	65	1
65	Cambridge	GB	3,146	17,751	0.3	0.2	0.5	64	-1
66	Rome	IT	960	29,642	0.1	0.4	0.5	67	1
67	Portland, OR	US	4,769	6,705	0.4	0.1	0.5	56	-11
68	Atlanta, GA	US	1,844	23,550	0.1	0.3	0.5	66	-2
69	Dalian	CN	1,089	27,534	0.1	0.4	0.5	69	0
70	Nuremberg–Erlangen	DE	3,619	9,491	0.3	0.1	0.4	71	1
71	Dallas, TX	US	3,458	10,093	0.3	0.1	0.4	73	2
72	São Paulo	BR	763	25,815	0.1	0.3	0.4	70	-2
73	Helsinki	FI	2,841	13,367	0.2	0.2	0.4	74	1
74	Busan	KR	2,314	16,194	0.2	0.2	0.4	75	1
75	Zhengzhou	CN	740	25,472	0.1	0.3	0.4	82	7
76	Vienna	AT	1,589	20,160	0.1	0.3	0.4	76	0
77	Cincinnati, OH	US	3,460	7,753	0.3	0.1	0.4	72	-5
78	Pittsburgh, PA	US	1,869	17,051	0.1	0.2	0.4	79	1
79	Oxford	GB	1,583	18,437	0.1	0.2	0.4	77	-2
80	Xiamen	CN	1,947	16,127	0.2	0.2	0.4	85	5
81	Ann Arbor, MI	US	1,266	19,984	0.1	0.3	0.4	78	-3
82	Lanzhou	CN	464	23,368	0.0	0.3	0.4	93	11
83	Chennai	IN	1,133	19,367	0.1	0.3	0.4	88	5
84	Mumbai	IN	1,606	16,203	0.1	0.2	0.3	84	0
85	Vancouver, BC	CA	1,586	16,167	0.1	0.2	0.3	83	-2
86	Kanazawa	JP	3,687	3,441	0.3	0.0	0.3	80	-6
87	Ankara	TR	739	20,308	0.1	0.3	0.3	86	-1
88	Lyon	FR	2,123	12,050	0.2	0.2	0.3	81	-7
89	Zhenjiang	CN	928	18,948	0.1	0.3	0.3	104	15
90	Warsaw	PL	446	21,602	0.0	0.3	0.3	89	-1
91	Daegu	KR	1,837	13,061	0.1	0.2	0.3	91	0
92	Austin, TX	US	2,320	9,917	0.2	0.1	0.3	90	-2
93	Wuxi	CN	2,110	10,906	0.2	0.1	0.3	106	13
94	Fuzhou	CN	678	19,405	0.1	0.3	0.3	102	8
95	Ottawa, ON	CA	1,898	11,986	0.2	0.2	0.3	92	-3
96	Phoenix, AZ	US	2,364	9,051	0.2	0.1	0.3	87	-9
97	Basel	CH/DE/FR	2,556	7,774	0.2	0.1	0.3	96	-1
98	Göteborg	SE	2,078	10,329	0.2	0.1	0.3	95	-3
99	Hamburg	DE	1,765	11,479	0.1	0.2	0.3	99	0
100	Brisbane	AU	1,129	15,233	0.1	0.2	0.3	97	-3

Source: WIPO Statistics Database, May 2023.

Notes: ^a This column represents the previous year's rankings, which have been adjusted to align with the updated methodology. The codes given in the tables in this appendix are the ISO alpha-2 country codes, with the following addition: TW* = Taiwan, Province of China.

Appendix Table 4 Ranking of S&T intensity

Rank per capita	Cluster name	Economy	Estimated cluster population	PCT applications per capita ^a	Scientific publications per capita ^a	Total S&T share per capita ^a	Rank change ^b
1	Cambridge	GB	477,995	6,582	37,136	1.02	0
2	San Jose–San Francisco, CA	US	6,262,908	7,547	9,353	0.73	0
3	Oxford	GB	539,483	2,934	34,176	0.69	0
4	Eindhoven	NL	1,031,903	7,735	5,174	0.69	0
5	Boston–Cambridge, MA	US	4,232,444	4,296	18,046	0.58	1
6	Daejeon	KR	2,348,673	5,226	10,879	0.56	–1
7	Ann Arbor, MI	US	659,586	1,920	30,297	0.56	0
8	San Diego, CA	US	3,835,826	6,064	5,456	0.56	0
9	Seattle, WA	US	2,526,151	4,541	8,045	0.47	0
10	Munich	DE	2,767,781	3,702	8,757	0.41	4
11	Kanazawa	JP	881,092	4,184	3,905	0.39	1
12	Raleigh, NC	US	1,772,830	1,724	17,038	0.37	3
13	Göteborg	SE	841,183	2,470	12,279	0.36	3
14	Beijing	CN	19,292,327	1,973	14,487	0.35	4
15	Stockholm	SE	2,159,150	2,811	9,255	0.35	2
16	Helsinki	FI	1,232,664	2,305	10,844	0.33	3
17	Zürich	CH	1,933,135	1,945	12,641	0.32	3
18	Tokyo–Yokohama	JP	36,197,318	3,520	3,178	0.32	3
19	Basel	CH/DE/FR	1,020,380	2,505	7,619	0.30	6
20	Copenhagen	DK	1,670,776	1,869	11,319	0.30	2
21	Nuremberg–Erlangen	DE	1,384,238	2,615	6,857	0.30	2
22	Stuttgart	DE	3,195,495	2,923	4,655	0.30	2
23	Minneapolis, MN	US	2,699,170	2,454	5,696	0.27	3
24	Pittsburgh, PA	US	1,395,595	1,339	12,218	0.27	3
25	Seoul	KR	26,436,274	2,400	5,054	0.26	4
26	Heidelberg–Mannheim	DE	2,003,186	1,968	6,914	0.25	2
27	Ottawa, ON	CA	1,255,368	1,512	9,548	0.25	3
28	Nanjing	CN	8,632,198	827	13,147	0.24	7
29	Hangzhou	CN	7,021,090	1,532	8,962	0.24	4
30	Osaka–Kobe–Kyoto	JP	15,704,848	2,446	3,308	0.24	2
31	Qingdao	CN	4,883,232	1,492	8,139	0.23	7
32	Shenzhen–Hong Kong–Guangzhou	CN/HK	49,538,901	2,291	3,092	0.22	5
33	Washington, DC–Baltimore, MD	US	6,958,796	794	10,927	0.21	3
34	Portland, OR	US	2,258,229	2,112	2,969	0.21	–3
35	Xi'an	CN	6,290,985	284	13,819	0.21	6
36	Cincinnati, OH	US	1,857,103	1,863	4,175	0.20	–2
37	Changsha	CN	3,997,004	288	13,202	0.20	6
38	Wuhan	CN	8,839,629	707	10,154	0.19	8
39	Nagoya	JP	8,964,894	1,978	1,795	0.18	0
40	Paris	FR	11,217,166	1,353	5,500	0.18	2
41	Vancouver, BC	CA	1,920,504	826	8,418	0.18	3
42	Frankfurt am Main	DE	3,813,326	1,419	4,875	0.18	3
43	Lyon	FR	1,874,163	1,133	6,429	0.18	–3
44	Denver, CO	US	3,072,747	1,004	7,130	0.18	5
45	Sydney	AU	3,839,713	661	8,775	0.17	3
46	Philadelphia, PA	US	5,076,519	1,062	6,364	0.17	4
47	Vienna	AT	2,406,439	660	8,377	0.16	5
48	Houston, TX	US	6,128,063	1,383	4,020	0.16	–1
49	Berlin	DE	4,275,066	848	7,126	0.16	2
50	Atlanta, GA	US	2,841,151	649	8,289	0.16	3

Appendix Table 4 Continued

Rank per capita	Cluster name	Economy	Estimated cluster population	PCT applications per capita ^a	Scientific publications per capita ^a	Total S&T share per capita ^a	Rank change ^b
51	Austin, TX	US	1,967,860	1,179	5,039	0.16	3
52	Melbourne	AU	4,529,662	469	8,843	0.16	3
53	Amsterdam–Rotterdam	NL	6,953,571	608	7,602	0.15	3
54	Montréal, QC	CA	3,507,450	637	7,244	0.15	3
55	Changchun	CN	3,624,328	104	10,294	0.15	5
56	Brussels–Antwerp	BE	4,254,045	724	6,502	0.14	2
57	Brisbane	AU	2,049,367	551	7,433	0.14	2
58	Milan	IT	4,470,896	577	6,951	0.14	4
59	Jinan	CN	4,262,386	384	8,049	0.14	8
60	Chengdu	CN	7,789,484	263	8,644	0.14	13
61	Rome	IT	3,501,527	274	8,465	0.14	3
62	Toronto, ON	CA	4,493,449	613	6,446	0.14	1
63	Hefei	CN	5,429,701	469	7,178	0.13	18
64	New York City, NY	US	16,134,372	858	4,639	0.13	1
65	Chicago, IL	US	6,900,333	835	4,687	0.13	-4
66	Harbin	CN	4,649,090	54	9,244	0.13	6
67	Dalian	CN	3,559,819	306	7,735	0.13	8
68	Tehran	IR	6,771,866	37	9,320	0.13	-2
69	Warsaw	PL	2,547,547	175	8,480	0.13	0
70	Lanzhou	CN	2,761,553	168	8,462	0.13	7
71	Tel Aviv–Jerusalem	IL	7,215,450	1,007	3,357	0.13	-3
72	London	GB	10,204,869	586	5,788	0.12	-2
73	Los Angeles, CA	US	12,262,007	942	3,593	0.12	1
74	Shanghai–Suzhou	CN	39,290,672	838	4,139	0.12	8
75	Hamburg	DE	2,435,222	725	4,714	0.12	-4
76	Barcelona	ES	5,060,158	480	5,899	0.12	0
77	Singapore	SG/MY	7,629,733	637	4,824	0.12	1
78	Daegu	KR	2,828,895	650	4,617	0.11	2
79	Cologne	DE	9,636,503	775	3,558	0.11	0
80	Zhenjiang	CN	3,107,637	299	6,097	0.11	n.a.
81	Xiamen	CN	3,575,564	545	4,510	0.10	6
82	Madrid	ES	6,430,213	246	6,042	0.10	2
83	Phoenix, AZ	US	3,160,779	748	2,864	0.10	0
84	Busan	KR	4,108,717	563	3,941	0.10	1
85	Tianjin	CN	8,503,650	149	6,313	0.10	3
86	Dallas, TX	US	4,264,360	811	2,367	0.10	0
87	Taipei–Hsinchu	TW*	11,351,789	344	4,647	0.09	2
88	Shenyang	CN	5,926,243	121	5,541	0.08	2
89	Fuzhou	CN	3,788,203	179	5,123	0.08	n.a.
90	Chongqing	CN	8,587,433	192	4,822	0.08	1
91	Zhengzhou	CN	5,355,743	138	4,756	0.07	2
92	Wuxi	CN	4,557,289	463	2,393	0.07	n.a.
93	Ankara	TR	4,858,391	152	4,180	0.07	-1
94	Moscow	RU	14,055,141	145	3,919	0.06	0
95	Istanbul	TR	12,694,255	169	2,066	0.04	0
96	Bengaluru	IN	14,805,929	293	1,052	0.04	0
97	Chennai	IN	10,687,599	106	1,812	0.03	0
98	São Paulo	BR	18,356,410	42	1,406	0.02	0
99	Delhi	IN	28,458,701	39	1,070	0.02	0
100	Mumbai	IN	21,112,341	76	767	0.02	0

Source: WIPO Statistics Database, May 2023.

Notes: ^a Per capita figures refer to 1,000,000 of population. ^b This column represents the previous year's rankings, which have been adjusted to align with the updated methodology. n.a. indicates not applicable. The codes given in the tables in this appendix are the ISO alpha-2 country codes, with the following addition: TW* = Taiwan, Province of China.

Appendix Table 5 Summary of geocoding results

Country	Scientific publications			PCT applications				
	Number of addresses	City-level address accuracy (%)	Publications covered (%)	Number of addresses	Block-level address accuracy (%)	Sub-city-level address accuracy (%)	City-level address accuracy (%)	Applications covered (%)
China	5,709,166	99.0	99.5	899,931	83.0	0.0	16.9	99.8
United States	6,926,084	97.0	98.3	945,562	96.0	3.7	0.2	99.9
Japan	1,292,914	92.2	95.5	621,999	32.9	23.6	41.4	98.4
Germany	1,512,886	97.6	98.4	272,949	97.3	0.7	1.9	99.9
Republic of Korea	858,760	96.5	98.1	293,886	30.3	0.6	69.0	99.9
United Kingdom	1,541,130	96.9	97.9	87,833	54.8	39.5	5.4	99.7
France	1,137,986	93.3	95.5	107,561	92.6	3.9	2.4	99.1
Italy	1,282,423	95.9	97.3	46,693	93.3	4.8	1.6	99.7
India	899,463	92.4	95.0	48,458	34.7	53.3	11.1	99.4
Canada	973,115	98.3	99.0	47,255	96.9	2.8	0.3	99.8
Spain	972,255	97.5	98.6	27,806	85.2	11.3	2.8	99.7
Netherlands (Kingdom of the)	549,403	97.5	98.6	50,507	85.1	0.3	14.0	99.4
Brazil	742,852	98.5	99.6	10,818	89.3	9.3	1.1	99.7
Australia	941,612	86.2	90.4	21,683	91.1	5.2	3.4	99.8
Switzerland	368,966	90.8	92.5	43,048	92.2	1.3	6.2	99.7
Russian Federation	430,319	99.0	99.2	16,506	94.3	3.9	1.4	99.7
Sweden	324,003	98.0	98.4	46,067	94.9	0.7	4.0	99.6
Türkiye	423,747	96.5	96.6	17,814	59.6	27.8	10.9	98.8
Israel	176,686	92.5	96.8	32,813	70.7	4.1	18.6	96.2
Belgium	270,683	95.6	97.2	19,179	98.2	0.9	0.7	99.8
World Total	25,138,682	95.7	98.6	3,932,217	73.2	7.0	17.4	97.8

Source: WIPO Statistics Database, May 2023.

Note: This list includes the top 20 countries that account for and ordered by the highest combined shares of patents and scientific articles. PCT inventor addresses were geocoded to the highest level of detail. Due to their much larger volume, scientific author addresses were geocoded to the city level only.

Notes

- 1 In previous editions, PCT publications years were aligned with SCIE publication years, as SCIE data is available with a one-year lag. This year we decided to change to “most recently available data” in order to more accurately reflect the most recent innovation.
- 2 ESRI ArcGIS World Geocoder service: www.esri.com/en-us/arcgis/products/arcgis-world-geocoder.
- 3 GeoNames: <http://geonames.org>.
- 4 The mergers involved the following clusters: Aurora with Chicago; Baltimore with Washington DC; Boulder with Denver; Cheonan-si with Seoul; Irvine with Los Angeles; Jerusalem with Tel Aviv; Matsudo with Tokyo-Yokohama; Rotterdam with Amsterdam; Suzhou with Shanghai; Wilmington with Philadelphia; Worcester with Boston-Cambridge, MA.
- 5 See Schiavina *et al.* (2023).
- 6 See Bergquist and Fink (2020: 61–63) for a more detailed description of how population data were matched to clusters.

References

Bergquist, K. and C. Fink (2000). The top 100 science and technology clusters. In Dutta, S., B. Lanvin and S. Wunsch-Vincent (eds), *The Global Innovation Index 2000: Who Will Finance Innovation?* Ithaca, NY, Fontainebleau and Geneva: Cornell University, INSEAD and World Intellectual Property Organization. Available at: www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf.

Schiavina M., S. Freire, A. Carioli and K. MacManus (2023). GHS-POP R2023A – GHS population grid multitemporal (1975–2030). Brussels: European Commission, Joint Research Centre (JRC). Available at: <http://data.europa.eu/89h/2ff68a52-5b5b-4a22-8f40-c41da8332cfe>.