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DOI: 10.20944/preprints201908.0070.v1

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1 Article

# 2 Globalization of Russian Cities: Towards a 3 Construction of Large Urban Regions

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8 **Abstract:** This study explores how to delineate Russian cities in order to make them comparable on  
9 the world scale. In doing so we introduce the concept of large urban regions (LUR) applicable to the  
10 Russian urban context. This research is motivated by a principal research question: how to construct  
11 a statistical urban delineation, which would allow first, to demonstrate integration of cities into  
12 globalization, and second, to make global urban comparative research. Previous studies on urban  
13 delineation in Russia have focused almost exclusively on functional urban areas, which have  
14 substantial limitations and are not suitable for global urban comparisons. Addressing this research  
15 gap, we propose a new definition of Large Urban Regions (LUR). In doing so, first, we introduce  
16 the context of Russian cities (2), then we discuss existing Russian urban concepts (3), and justify a  
17 need for a new urban delineation (4). Afterwards, we present a general method to delineate Large  
18 Urban Regions in Russian context (5.1), and illustrate it in the two case studies of St. Petersburg  
19 (polycentric region) and Samara (monocentric region) (5.2). In the last part (6), we discuss the 10 the  
20 largest urban regions in Russia and describe a constructed database including all Russian LURs.

21 **Keywords:** city, large urban regions, Russia, globalization, open database

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## 23 1. Introduction

24 Traditionally, cities in Russia are defined according to political borders and considered as  
25 administrative units. City in Russia is a legal status that is assigned by the government to a settlement  
26 that can be obtained or lost depending on different contextual factors. Interestingly, the population  
27 is not a major criterion for a city status: for example, Visotsk in Leningrad oblast, which has the status  
28 of “city”, has only 1,115 inhabitants (Rosstat, 2018), whereas Moscow has over 12 million (2018,  
29 Rosstat). The history and strategic position of a city sometimes is the main factor for considering a  
30 settlement as a city, but not always. Therefore, due to the huge size diversity of Russian cities, it is  
31 impossible to compare them both between each other and with other cities on the world scale.

32 The principal objective of this research is to propose a systemic approach to characterize Russian  
33 cities in their insertion in the globalization, which implies to link them to other cities of the world  
34 and, thus, to adopt an equivalent definition. Hence, the final goal of this delineation is to make cities  
35 comparable on the world scale.

36 In this paper, we discuss the construction of so called Large Urban Regions (LUR) [1] that are an  
37 aggregation of continuous statistical units around a core that are economically dependent on this core  
38 and linked to it by economic and social strong interdependences. Aggregating different districts  
39 (“rayons” in Russian) around a core city, using such criteria as population distribution, road  
40 networks, access to an airport, distance from a core, we construct a single large urban region, which  
41 allows to include all the area of economic influence of a core into one statistical unit. This leads to a  
42 delineation of monocentric as well as polycentric Large Urban Regions.

43 This article is structured as follows: in the beginning, we introduce the context of Russian cities,  
44 explaining their historical paths and current dynamics (2); In the next part we discuss existing  
45 delineations of Russian cities (3); afterwards, we propose a general method to delineate all Russian

46 Large Urban Regions (4.1) and illustrate it with two case studies: St. Petersburg (monocentric) and  
47 Samara (polycentric) (4.2). Based on the discussion of these two examples, we expose and discuss a  
48 resulting population of the 10 biggest Large Urban Regions in Russia (5).

## 49 2. Russian cities: peculiarities of the urban context

50 Studying Russian cities, it is important to provide some essential facts on their history that  
51 characterize the urban context. Russia considers its sovereignty since the 9th century, when Varangian  
52 Rurik was elected as a ruler (knyaz), in the capital Novgorod in 862. Twenty years later, in 882, due to  
53 the expansion to the South, the capital was moved to Kiev and it became the central city of Kievan Rus'  
54 until the late 13th century. We clearly see that from the very beginning of the Russian history, the  
55 country embraced a huge space and, consequently, one of the main features was the huge distances  
56 between different settlements.

57 Therefore, since medieval centuries, a very large part of Russian cities were founded as part of a  
58 network of a frontier defensive system [2,3,4] and until the 19th century cities had been created as  
59 fortresses. Garrisons are at the origin of the Russian cities' system: they are the best-connected nodal  
60 points [5]. Around 270 cities in modern Russia had been created as fortresses or garrisons [6]. Some  
61 examples are Torjok (Торжок), Porhov (Порхов), Ivangorod (Ивангород), Cola (Кола), Pskov (Псков).  
62 Originally many Russian cities were military outposts [4].

63 However, other factors also influenced Russian cities throughout their long-time history. A  
64 tremendous impact on their development was the so called Trade route from the Varangians to the  
65 Greeks that took place from 10th to 13th centuries. This trade route started in Stockholm, through the  
66 Finnish gulf, Ladoga lake, Ilmen lake and then through Dnepr to the Black sea, ending in the Byzantine  
67 capital Constantinople. Connecting the oldest Russian cities such as Ladoga, Novgorog and Kiev, this  
68 trade route was a spine of Kievan Rus' playing a crucial role in linking the whole country. However, as  
69 of 13th century trade flows between North and South moved to the West, partially because of the Tatar-  
70 Mongol invasion into Kievan Rus', or so called "Tatar yoke", that lasted until the 15th century and had  
71 a devastating effect on the development of Russian cities. Approximately two thirds of all the cities of  
72 Kievan Rus' were ravaged by this yoke and around one third of the cities were never recovered and  
73 disappeared [7]. This yoke was somehow a resilience test for Russian cities, and finally, Moscow, due  
74 to its economic-geographic location managed to centralize power and became a leader in the movement  
75 against the Tatar yoke, therefore, becoming a central node in the system of Russian cities.

76 The spatial expansion of the Tsardom of Russia also led to the creation of new cities. In the end of  
77 the 16th century the exploration of Siberia started and new cities were founded, most important  
78 amongst those that still exist are Tumen (1586), Tobolsk (1587), Pelim (1592), Obdorsl (1594),  
79 Krasnoyarks (1628), Yakutsk (1632) and Irkutsk (1686). These cities were founded as ostrog which are  
80 fortresses surrounded by a wooden fence built in order to protect settlements from wild animals.  
81 Therefore, Russian system of cities enlarged to the East continuing a tradition of a city as a fortress  
82 oriented to defense of country's borders.

83 In the beginning of the 18th century, the expansion of the Russian urban system continued in the  
84 same defensive context to the North (foundation of St. Petersburg (1703), Petrozavodsk (1703)), and to  
85 Ural, with the foundation of Ekaterinburg (1723) and Orenburg (1735). Later, in the end of 18th century,  
86 when Caucasus became a part of the Russian Empire, a defensive line of fortresses was created along  
87 the South border of the Empire that went from Black sea (Fanagoria) to Caspian Sea (fortress of Saint  
88 Cross).

89 During 1775-1785 Ekaterina the Great launched the administrative reform that predefined cities'  
90 development in Russia until now. The country was divided into 42 vice-regencies (namestnichestva),  
91 of which only eight were divided into provinces (oblast) that were 16 in total. All of the vice-regencies  
92 were divided into counties (uezd) that were the lowest administrative level and there were around 500  
93 counties in total. By reforming administrative divisions in Russia, Catherine the Great set up a planned  
94 hierarchy of central places [5] that lasted until the revolution of 1917 [3]. Based on this new approach,  
95 many villages were transformed into cities and the term of city clearly became a legal status appointed  
96 by the government. As a result of this reform, 165 new places received a city status and therefore, the

97 total amount of cities in Russia increased in 1.5 times from 282 cities before the reform to 447 cities after  
98 it. These cities appeared first of all as centers of new administrative divisions, but not because of  
99 economic needs or a historical path. However, they quickly became drivers of economic development  
100 of these administrative divisions and their central nodes to the whole surrounding area. The legal status  
101 of a city given by this reform defined the main economic nodes of Russia and its internal system of  
102 cities. Those cities, that later became economically weak, were transformed back into villages and lost  
103 their administrative functions and political power over the surrounding area. This approach to a city,  
104 as a legal status, is still in use in contemporary Russia and most of cities set by Catherine the Great as  
105 regional political centers now became capitals of the subjects of the Federation<sup>1</sup>.

106 Throughout the 19th century there was a rapid development of railroad networks, which became  
107 the new spine of the Russian system of cities. In 1916 the construction of the Trans-Siberian Railway  
108 linking Moscow to Vladivostok was finished and enormously facilitated growth and development of  
109 cities along this railway in Ural, Siberia and the Far East. During the first decade of the Soviet  
110 government (1917-1926), 182 settlements received a legal status of a city. However, at the same time,  
111 some cities were deprived of their city legal status and became again villages (like Berezovo in Siberia,  
112 Alexandrov and Kola in the North and many others) [7].

113 The Second World War (or to be more precise its part concerning USSR that is called Great Patriotic  
114 War from 1941 until 1945) had a devastating effect on the urban development in the Soviet Union:  
115 hundreds of cities in the European part of USSR were literally destroyed by the war, which was very  
116 dramatic for the whole Soviet urban system because more than 80% of all cities were situated in the  
117 European part of the country. During the war, many factories and large industrial enterprises were  
118 moved to Ural and Siberia, therefore, facilitating urban development there. Along with the  
119 development of already existing cities in Ural and Siberia, from 1942 to 1945 fifty five new cities were  
120 created, primarily in Ural (31), West Siberia (6), East Siberia (5), Volgo-Viatskiy region (5), European  
121 North (4), Volga region (2), Central region (1) and Far East (1) [7]. Most of the new cities were founded  
122 because of the discovery of new places for mineral extraction and also for gas and petrol extraction.  
123 Therefore, somehow during the war there was a process of re-hierarchization of Russian cities due to  
124 the growth of cities in the East and the decline of cities in the West.

125 After the Second World War there was the so-called Cold War, that also had specific consequences  
126 on the dynamics of the whole system of cities in the USSR. First of all, this system of cities became highly  
127 internal, what means that most of the linkages between cities in the USSR remained inside the country's  
128 borders. Secondly, as a consequence of the arms race, "Closed cities" (ZATO) appeared to concentrate  
129 research and development on military-industrial complexes, concerning production of guns, nuclear  
130 and chemical experiments and manufacture of space satellites. These cities were never listed in any  
131 official statistics and consequently, they were never mentioned on the maps, and entrance was  
132 forbidden to non-residents. Most often, they were satellites of a bigger industrial city and had the same  
133 name, however, adding a code number (for example, Krasnoyarsk-45 was a closed city-satellite of large  
134 city Krasnoyarsk). After a partial disclosure of these cities in 1994, there were more than 1 million people  
135 living in closed cities in the Russian Federation alone (not in the whole former Soviet Union) [8].  
136 Another specific type of satellites of large cities was the so called "scientific cities" (naukograd), which  
137 were the centers of fundamental science. These cities were specialized in different research and  
138 advanced development such as nuclear physics (Dubna, Moscow region), biotechnology (Koltsovo,  
139 Novosibirsk region), rocket and space industry (Korolev, Moscow region) and some other fields.  
140 Scientific cities were divided into two different groups: closed, which were similar to closed cities, and  
141 public, which people could visit. Currently in Russia there are still 13 scientific cities.

142 After the end of the USSR, the soviet urban system was transformed enormously: many traditional  
143 links between cities were broken because of the new independent states building and the emergence of  
144 constraining international borders. Most cities that were in the center of the USSR turned out to be on  
145 the edge of independent Russia and completely changed their economic and geographic situation. One

---

<sup>1</sup> Subjects of the Federation are the constituent entities of Russia, its top-level political divisions according to the Constitution of Russia.

146 soviet system of cities was divided into many local and national systems, which were gravitating  
 147 towards the Western countries. In the conditions of a huge economic decline in Russia in the 1990's,  
 148 many cities were drastically depopulating and a majority of people moved to Moscow to find a job and  
 149 to have access to a better life. At the same time, after the end of the Soviet Union, all post-soviet cities  
 150 started their integration into globalization and the world system of cities [9]. However, due to the deep  
 151 economic recession, it was more profitable to live in villages because people there could receive certain  
 152 benefits in taxation and in payment of utilities, also rural teachers and doctors had special financial  
 153 governmental support. Moreover, in villages, people could privatize more territories, which also  
 154 encourage them to move to a village. Therefore, in the 1990's there was so called "administrative  
 155 ruralization" [10], when some towns that had a legal status of a city were downgraded to the category  
 156 of villages, in order to have more government support (for example, only in Orenbourg region during  
 157 1990's, 16 towns received the status of village).

158 This specific urban development in Russia and the particular way the cities are defined, constitutes  
 159 a set of key characteristics of cities in contemporary Russia. Despite that 75% of the population in Russia  
 160 is considered as urban (Rosstat, 2019) due to a city as a legal status, many Russian settlements are only  
 161 officially "cities", whereas in terms of functions and lifestyle they still remain quite rural. In these terms,  
 162 some villages in the European Union are more urban than some cities in Russia. Besides this, as a  
 163 consequence of the end of the USSR and integration of Russian cities in globalization, there are  
 164 substantial changes in cities' centrality, economic-geographic position and diverse flows between them.  
 165 Another critical feature having its origin in the deep economic recession of the 1990's, is the incredible  
 166 growth of Moscow that caused a shrinkage, a stagnation or rarely a very slight growth of other cities in  
 167 Russia [11].

### 168 3. The Russian urban concept

169 In the time of the USSR and contemporary Russia, several different methods to delineate a city  
 170 have been developed depending on the purposes of geographic analysis. These initiatives aimed at  
 171 measuring the urban growth in a consistent way, while the legal status of a settlement could be gained  
 172 or lost within time and over the years criteria to obtain this urban status varied considerably from  
 173 census to census, which made urban comparative research over time quite difficult. Therefore, most  
 174 of the proposed alternative urban definitions have different terminologies for these spatial urban  
 175 entities, whereas the notion of city always refers exclusively to the legal status.

176 To organize the variety of different methods of city delineation applied in the Russian context,  
 177 we follow the *four principal urban concepts* introduced by Pumain et al. [12]. Each of these city concepts  
 178 corresponds to different types of research questions and presents different geographical borders of  
 179 a city. Below we introduce each of them and we provide examples of methods used in Russia  
 180 corresponding to each of the four concepts.

#### 181 3.1 Urban localities

182 Urban localities are defined by the town's administrative boundaries or by their status in law.  
 183 This is the delimitation most often used in economic research on Russian cities and regions (subjects  
 184 of Federation) because of the data availability: Rosstat<sup>2</sup> as a main source of statistical information  
 185 provides data only within administrative boundaries on the different levels (Tab.1):  
 186  
 187

Type of the subject of the Federation	In Russian	Quantity	Specificity
Republic	Республика	22	- Have their own constitutions and constitutional courts;

<sup>2</sup> Russian Federal State Statistical Service:  
[http://www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/en/main/](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/en/main/)



			- Have the right to establish their state languages along with Russian, and also have the capital; - Ethnic principle of formation.
Kray	Край	9	Different words are used because of the historical traditions of regions.
Oblast	Область	46	
City of federal significance	Город федерального значения	3	Used for the two biggest cities St. Petersburg and Moscow. As of 2014 Sevastopol is also considered as a city of federal significance.
Autonomous oblast	Автономная область	1	
Autonomous okrug	Автономный округ	4	- They do not have a right to establish their local state languages; - Ethnic principle of formation for indigenous peoples of the North; - Being an independent subject of the Federation, at the same time they can be included into oblast or kray (Examples: Nenets Autonomous Okrug is a part of Arkhangelsk oblast; Khanty-Mansi Autonomous Okrug is included into Tumen oblast).

188 **Table 1.** Types of subjects of the Russian Federation

189 The subjects of the Federation are top-level political divisions possessing equal rights, despite  
190 differences in terms of size of territory, population, and specific national languages. They have the  
191 same political power.

- 192 • 8 *Federal districts* (groupings of subjects of the Federation): Central, North West, South,  
193 North Caucasian, Volga, Ural, Siberian and Far East. The federal districts are not the  
194 constituent bodies of the country, but exist for convenience for operation of federal  
195 services.  
196 • 85 *subjects of the Federation* (constituent entities-states of the Russian Federation), namely:  
197 republics (22), krais (9), oblasts (46), cities of federal significance (3), autonomous oblast  
198 (1), autonomous okrugs (4).  
199

200 Inside subjects of the Federation there are *municipalities (munitsipalnie obrazovaniya)* (21,946):

- 201 ○ *Urban neighborhoods ("gorodskoy okrug" in Russian)* (588)  
202 ○ *Urban neighborhoods with internal divisions ("gorodskoy okrug s vnutrigorodskim*  
203 *deleniem" in Russian)* (3)  
204 These both types are used for the biggest cities in a region;  
205 ■ *Communes ("vnutrigorodskoy rayon" in Russian)* (19)  
206 Internal divisions of urban neighborhoods.  
207 ○ *Municipal districts ("munitsipalnyi rayon" in Russian)* (1,759), which consist of  
208 ■ *urban settlements (gorodskie poselenia)* (1,538)  
209 ■ *rural settlements (selskie poselenia)* (17,772)  
210 which are self-governing political divisions.  
211 ○ *Intra-city territories of cities of federal significance* (267)

- 212 Small municipalities inside St. Petersburg, Moscow and Sevastopol.  
 213 ○ *Inter-settlement territories ("mezhselennye territorii" in Russian) (80)*  
 214 Places with very low population density, which are governed by the municipal  
 215 district's administration to which they belong.  
 216

217 The difference between urban settlements and urban neighborhoods is mostly considering the  
 218 size of territory and its place in urban hierarchy: urban settlements are smaller in size and concern  
 219 places of local significance, whereas urban neighborhoods are larger and include cities of regional  
 220 significance. Also, there are so called inter-settlement territories (80 in total) that are governed by the  
 221 administration of municipal districts.

222 Therefore, in Russia there are 3 levels of statistical organization: federal districts (federal),  
 223 subjects of the Federation (regional) and municipalities (local level).

### 224 3.2 Urban agglomerations or urban units

225 This approach embraces "*continuously-built urban centers forming either part of one administrative*  
 226 *unit or a group of several*" [12, p. 5], and considers a territory of coherent and geographically continuous  
 227 entities. The empirical methodology for this approach was proposed by Pumain et al. [12] who  
 228 delineated cities as *Morphological Urban Areas (MUA)* in the European Economic Community,  
 229 followed by Moriconi-Ebrard [13], who systemized this approach at the world scale. For Russian  
 230 cities this methodology was more recently applied by Cottineau [14], who used the following steps  
 231 to delineate MUAs in the Russian contexts:  
 232

- 233 1) Identification of urban spots using satellite images or aerial photographs. The distance  
 234 threshold between two buildings to consider them as continuous is 500 meters;
- 235 2) Superimposition of the administrative mesh on these morphological entities. The  
 236 contiguous local units (municipalities) were integrated, where the majority of the area was  
 237 an intersection with the urban spot based on the satellite images.  
 238

239 It results a delineation of urban agglomerations based on the municipality level [14]. This  
 240 delineation permits to work on the population evolution of areas, but unfortunately, no data is  
 241 available for other kinds of themes like workers and industries by activity.

242 Another study on the morphological urban areas is provided by the *Global Human Settlement*  
 243 *Initiative*<sup>3</sup> on the world scale, that is based on built-up areas and identifies urban centers (cities), dense  
 244 and semi-dense urban cluster (towns and suburbs) and rural areas.

### 245 3.3 Urban regions

246 Urban regions definition "*comprises a nucleus town and its sphere of influence or employment*  
 247 *catchment area, which are frequently defined in terms of commuting*" [12, p. 5]. An urban region  
 248 includes all dormitory towns situated around an agglomeration and these towns are usually defined  
 249 by the estimation of people, who regularly go to the core city for work or study reason, creating  
 250 regular commuting flows. In other words, this definition illustrates functional borders of a city and  
 251 can be called Functional Urban Areas.

252 Based on the analysis of different methods used in the USSR or Russia to delineate so called  
 253 "urban agglomerations", the produced delineations embraced a whole zone of economic influence of  
 254 a city, including its towns-satellites and we can conclude that all of them correspond to the  
 255 understanding of a city as a functional urban area or urban regions. Despite that in the Russian  
 256 language, most of the authors refer to the term "urban agglomeration", we will translate it below  
 257 with the more consistent terms of "functional urban area" or "urban region".

258 The methods applied in USSR or Russia can be divided into two categories: case-study based  
 259 and universal methods. The case-study methods consider all the possible relevant factors to delineate

---

<sup>3</sup> Atlas available online, URL: <https://ghsl.jrc.ec.europa.eu/visualisation.php#>

260 an agglomeration around one single city. The case-study method to delineate cities is very common  
261 amongst both geographers and economists [for example, 15,16]. They are characterized by a more  
262 complex approach, notwithstanding, the resulting method is hardly applicable to delineate other  
263 agglomerations. For example, one of the first attempts to delineate urban agglomeration in the USSR  
264 was done by Vishnevskiy [17], who took Kharkiv (now in Ukraine) as a case-study and proposed the  
265 following criteria for inclusion of satellite-towns: 1) the proportion of those, who do not work in  
266 agriculture is not lower than 60%; 2) the proportion of working people of the core-city (Kharkiv) in  
267 the total urban region is not lower than 25%; 3) population growth in the satellite towns is at least  
268 10% over the selected period; 4) population density is not less than 70 people per square km.

269 Later, delineating the urban region of Sverdlovsk (now Ekaterinburg), Skutin [18] proposed the  
270 so called method of "total indicator of attributes", which is based on a large set of criteria  
271 characterizing urban region, for instance, an influence degree of an urban core on the surrounding  
272 territory; territorial concentration of population and settlements; spatial community of settlements,  
273 etc. The disadvantage of this method (as in a number of other methods) is the use of already specified  
274 administrative units (districts), which are certainly too large for a delimitation of an urban region.

275 Working on the municipality level, Burian [19] proposed another method to delineate the urban  
276 region of Chelyabinsk. Based on the analysis of the population distribution around a core and  
277 commuting patterns between the core and its satellites she identified the borders of Chelyabinsk  
278 agglomeration. According to Burian, the most complex criterion to delineate an urban region is time  
279 costs (or a distance from a central city), and accordingly, the method of isochronous is the most  
280 appropriate tool for urban region delimitation.

281 Amongst universal methods to delineate urban regions in the USSR and Russia, two principal  
282 ones could be mentioned. The first one is the method of the Institute of the Academy of Science of the  
283 USSR [described in 20-23]. It is one of the first attempts to define all Russian urban regions started in  
284 the early 1970's with the publication of the first census of 1959 [24]. The basis for determining urban  
285 boundaries was an internal spatial closure of a weekly life cycle of the population [25]. Existence and  
286 development of urban regions is founded on intra-urban relations in various fields such as  
287 production, social networks, environment, etc., which are concentrated in the central city and its main  
288 sub-centers. Basically, the method consisted of the following criteria:

- 289 1) Core population threshold: more than 250,000 people;
- 290 2) Time threshold to the core: boundaries of an urban region defined according to a two-hour  
291 (gross) isochrony transport accessibility to the city center, combined with a 0.5-hour travel  
292 time band from the big and medium cities in the periphery of urban area. Travel time from  
293 sub-centers on the periphery is considered because sometimes several functions of a core city  
294 were given to its satellites on the periphery, which led to an extension of functional linkages  
295 on the periphery;
- 296 3) Development threshold: coefficient of development is more than 1.  
297 The formula of the coefficient of development:  
298 
$$K_{dev.} = P (M*m+N*n)$$
  
299 P – population of the urban area;  
300 M and N are the number of official cities and urban-type settlements;  
301 m and n are their shares in the total population of the urban area.  
302

303 The authors highlight that cities with a population of more than 250,000 people have completely  
304 different agglomerating potential, and the existence of developed urban regions with population in  
305 a core less than 250,000 is possible. Using this method, 84 urban regions were identified in the USSR  
306 for the year 1979.

307 An alternative method was proposed by Listengurt [26] and was further applied by the *Central*  
308 *Scientific-Research and Design Institute for Urban Planning (ЦНИИП градостроительства)*. This  
309 approach focused not so much on the fixation of already existing urban regions, but on the  
310 identification of groups of interrelated settlements that can potentially become, in the future, the basis



311 for the formation of planned and regulated systems of settlements. Listengurt [26] formulated the  
312 following criteria:

- 313 1) Core population threshold: 100,000 people;  
314 2) Time threshold to the core: 2 hours;  
315 3) A share of the population of the outer zone of an urban region to its total population is  
316 not less than 10% (agglomerative index);  
317 4) A number of urban settlements in an urban region, in addition to its core, is at least  
318 three;  
319 5) The minimum value of the agglomerative coefficient is 0.1 (the latter is the ratio of the  
320 density of urban settlements per 1000 km<sup>2</sup> to the average shortest distance between the  
321 two nearest urban settlements within an urban agglomeration. According to the  
322 calculations of Listengurt, the values of this coefficient vary from 0.1 – a rare uniform  
323 network – to 4.3 – a dense and condensed network of urban settlements.  
324

325 According to this method, 193 urban regions were identified in the USSR [27].

326 These two previous approaches, that are very close methodologically, were the two principal  
327 ones in the USSR until 1988, when the group of researchers namely Polyán, Naimark and Zaslavskiy  
328 proposed the “standardized method of urban agglomeration delimitation” that again determined  
329 rather urban regions [27] embracing features of the two previous ones. We summarize this method  
330 in the Table 1.  
331

Stages of delimitation	Criteria	Urban region		
		Large	Big	
			Polycentric	Monocentric
1	Core city	Large city (250,000 people and more)	Two big cities (more than 100,000 people) with a distance between each other not more than 50 km.	Big city (more than 100,000 people)
2	Urban region boundaries	1,5 hours from a core city along with 0,5 hours from big and middle towns on the periphery	1 hour from a core city along with 0,5 hours from middle towns on the periphery	1 hour from a core city along with 0,5 hours from middle towns on the periphery
3	Satellite zone	Not less than 4 urban settlements	Not less than 6 urban settlements	Not less than 4 urban settlements
4	Development coefficient	1,0 and more	1,0 and more	2,0 and more

332 Table 1. Stages of the standardized method of urban region delimitation according to Polyán et al. [27]

333 This method is quite elaborated though it does not consider real interactions between a core city  
334 and its satellites, such as, commuting flows (that do not exist in the census). A last national  
335 delimitation of urban regions in Russia was undertaken by Polyán and Selivanova [24] based on this  
336 standardized method they identified 52 urban regions, 43 of which (or 83%) are situated in the  
337 European part of Russia. Eight urban regions are located in the regions of Siberia and only one in the  
338 Far East: Vladivostok. However, Siberia and Far East include most of the potential urban regions,  
339 such as Khabarovsk, Chita, Komsomolsk, Ulan-Ude etc. Therefore, we can conclude that the urban  
340 regions in these regions are still in the phase of formation and need to accumulate existing economic  
341 and human resources to complete this urbanization process.

342 According to this standardized approach, from 1989 to 2002, only one urban region around  
343 Grozny disappeared. In the list of the new urban regions of Russia, only one new urban region around  
344 Tyumen appeared [24]. Considering that only one new region has been formed in the last 13 years,  
345 Lappo argues that the formation process of urban regions' framework in Russia is almost complete

346 [8]. He argues, that today the development of urban regions in Russia goes towards the intensification  
347 of ties within the already formed urban regions, towards the contraction of the population in them  
348 and, as a consequence, to the increase in the development class of these urban regions.

349 Therefore, having shown several methods used to delineate urban regions in Russia, we can  
350 conclude that most of the scientific criteria for this type of delineation, both for a case-study approach  
351 and a universal one, can be separated into the following groups:

- 352 1) the criteria for the city-core (first of all - the number of its population);
- 353 2) boundary criteria - spatial, temporal or another radius;
- 354 3) the criteria of the satellite zone (the number and population of urban settlements in it, their  
355 relationship with the core, functional complementarity);
- 356 4) criteria for real interaction (intensity of various flows and connections, first of all  
357 commuters);
- 358 5) criteria characterizing urban region' integrity (population density, complexity,  
359 development, agglomerativeness, etc.). It is clear that the criteria of this group are control  
360 ones, since their values can be obtained only after a territory is delimited as an urban  
361 region.

362 An alternative definition to the Soviet approach to delineation of urban regions was proposed  
363 by Rowland [28], who researched internal urban population shifts in Russia during the entire 20<sup>th</sup>  
364 century. For his purpose, he needed to include all urban settlements, not only the largest ones (as in  
365 case of urban regions), and therefore he proposed his own definition of a city. As it was noticed  
366 before, a legal status of a city in Russia could be gained or lost depending on the current political and  
367 economic conditions, thus, for data harmonization purposes Rowland proposed a more comparable  
368 unit "metropolitan area" or "urban region" [28, 29]. Metropolitan area was defined as "an area with an  
369 urban population of one million or more people based on the summation of the population residing in a major  
370 central city and other urban centers of 15,000 and over within a 50-mile radius (straight-line distance) of that  
371 central city" [29, p. 272]. He explains further that "the criterion of 15,000 and over has been adopted, because  
372 this is the smallest population size for which data on individual urban centers are available in all Russian and  
373 Soviet censuses from 1897 to 1989 [...] the 50-mile zone has been further subdivided into three "concentric"  
374 internal zones in order to assess internal geographical patterns and shifts in such patterns. These include the  
375 main central city itself; the "inner suburbs," or urban centers of 15,000 and over beyond the central city out to  
376 a radius of 25 miles from the center of the central city; and the "outer suburbs," or those 15,000-plus centers in  
377 the 25- to 50-mile zone".

378 Unlike all the other soviet approaches to define urban regions as drivers of economic growth,  
379 the goal of Rowland's approach is to estimate urban population shifts, which explain differences in  
380 the methods.

381 More recently, following this series of different scientific methods of delimitation of urban  
382 regions in Russia, there is a state program supporting their development and functioning. In February  
383 2019 *The Strategy of Spatial Development of Russia until 2025*<sup>4</sup> was approved by the Russian government,  
384 which is currently the main document defining a forecasting vision of the development of urban  
385 regions in Russia. This document is mainly devoted to the spatial economic development of different  
386 territories, describing perspectives of economic specializations of territories inside Russia, centers of  
387 economic growth and urban centers as main drivers of regional economic development. Urban  
388 regions are understood as a set of compactly located settlements and inter-settlement territories,  
389 connected by the joint use of infrastructural facilities and united by intensive economic, labor, and  
390 social ties. In other words, urban regions are basically cities with zones of attraction to them, which  
391 include both rural areas and small and medium-sized cities, so the development of urban regions  
392 (and not cities in their administrative boundaries) allows to consider the diversity of settlements'  
393 types. Particularly, the authors introduce two types of urban regions: large (from 500,000 to 1,000,000  
394 people) and the largest (over 1,000,000 people). In total 41 urban regions were identified, despite that  
395 the method of delimitation was not precisely described in this Strategy and the authors did not

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<sup>4</sup> Available online (in Russian): <http://government.ru/docs/35733/>

396 provide any references to any external methods. According to Zubarevich [30], in the beginning of  
397 the development of this Strategy, around 20 urban agglomerations were delimited, leading in the  
398 final version approved by the Russian Government, to the amount of 41 urban regions. She argues  
399 that this increase from 20 to 41 is a consequence of the typical Russian lobbying system of regional  
400 authorities hoping to obtain additional funding. Considering that all these official urban regions  
401 receive strong additional governmental financial support for further development, this interpretation  
402 seems to be quite realistic.

### 403 3.4 Polynuclear urban regions, or conurbations

404 The last urban concept refers to polynuclear urban regions or conurbations that are defined as  
405 “continuously-built but comprise a number of centers polarizing human dealings” [12, p. 5]. Often, these  
406 urban forms are “the product of a number of urban agglomerations or regions which, though initially separate,  
407 have become merged as a result of their geographical spread” [12, p. 5]. In the Russian context a research on  
408 conurbations is almost missing, which can be explained by the dominancy of monocentric regions  
409 that are studied as urban regions. Lappo [31] notices that the number of conurbations in Russia is  
410 much lower than the number of urban regions. In his monograph, Lappo [31] describes 4  
411 conurbations: 1) Samara-Togliatti-Sizran; 2) Caucasian Mineral Waters; 3) Rostov; 4) Kuzbass. All  
412 these urban regions are polycentric, each of them including several cities of comparable size and,  
413 therefore, should be distinguished from a previous concept of urban region, where there is only one  
414 dominating core-city.

## 415 4. The need for a new urban delineation

416 Having shown the history of the Russian urban system and the main conceptual approaches to  
417 cities’ delineation, we can conclude that the mainstream of studies since Soviet times is focused on  
418 the urban regions approach (FUA), which is different from the morphological urban agglomeration  
419 approach spread amongst European studies. However, all the proposed methods of urban regions  
420 are quite limited, first of all because they are focused only on the largest cities with populations over  
421 100,000 or 250,000 people. Another serious limitation of these approaches is their normative method,  
422 delineating urban regions with the same criteria despite very different core city sizes. For example,  
423 when delineating urban agglomerations of a city with 100,000 inhabitants and with 12 million  
424 inhabitants (like Moscow), these methods use the same thresholds of commuting time. However,  
425 these two city sizes have incomparable influence on their surroundings. The approach of Rowland  
426 [28,29] is convenient for the retrospective population dynamics analysis, however, it also has the  
427 same limitation of the normative criterion of a distance from a core: regardless the core city size, the  
428 distance of 50 miles should be unchanged.

429 The MUA approach identifying physical borders of all settlements based on the built-up area  
430 incompletely encompasses the whole cities’ influence area. However, this MUA method can help to  
431 observe dense distribution of population around a core city that is an important factor to identify the  
432 higher influence zone of this core city (for example, the world atlas of the Global Human Settlement  
433 Initiative can be used). For different reasons, the first concept of a city within its administrative  
434 boundaries cannot be used for comparative studies: arbitrary denomination mostly based on political  
435 connivance has importance but cannot constitute a criterion to compare cities’ properties.

436 In this paper, we aim to propose a new method of city delineation that would be, on one side,  
437 *universal* as we apply it to all Russian cities using the same concepts and the same set of criteria (such  
438 as development of transport networks, population density, presence of an airport etc.), but on another  
439 side, *case-based* as we consider separately every city and we do not necessarily use the same thresholds  
440 (for example, we do not say that all core-cities must have at least 4 towns-satellites, but adjust it in  
441 every case). Based on this mixed approach, *our principal objective of this new city delineation is to make*  
442 *Russian cities comparable on the world scale in order to be able to study their integration in globalization.*

443 The role of cities in globalization is increasing and Russian cities are not an exception. After the  
444 end of the USSR, Russia started its integration in the world economy and the global market [9]. The  
445 first territories of globalization were the largest cities, such as Moscow and St. Petersburg, that

446 became actively involved in global processes since mid-1990 [32]; later on, after the economic crisis  
447 in Russia of 1998, smaller cities slowly started their integration into foreign markets, however mostly  
448 indirectly through the largest metropolises. Today, Russian economy is deeply integrated in the global  
449 processes that can be illustrated by the rapid economic decline in Russia in 2008-2009, as a  
450 consequence of the world economic crisis and the devastating effect of the drop-in oil prices, along  
451 with international economic sanctions against Russia in 2014 [33, 34].

452 Cities as centers of economic and political power are also the main attractors for multinational  
453 companies and, therefore, become crucial nodes in the global integration processes. Being central  
454 nodes in global economic networks, cities, as places of dense spatial interactions, become the main  
455 agents of globalization. These multilevel flows (local/global) coming through a city change an  
456 understanding of urban resilience, making it also multilevel dependent [35]. Besides a city itself, the  
457 influenced surrounding territory should be taken into consideration. Following a report of The World  
458 Bank, globalized world is the set of cities and territories around them [36] and thus, in this paper we  
459 discuss the concept of Large Urban Regions that include a city core and the territory of its influence  
460 that together become a comparable urban definition on the world scale.

## 461 5. General method

462 After having discussed the delineation of large urban regions based on the two quite different  
463 case studies – monocentric and polycentric cities – we can now propose a consolidated general  
464 method for delineating Russian Large Urban Regions.

### 465 1. Units of aggregation

466 Ideally, in order to construct LUR we should aggregate the smallest municipal units, which are  
467 in Russia urban neighborhoods (gorodskoy okrug), urban settlements (gorodskie poselenia), rural  
468 settlements (selskie poselenia), and intra-city territories of the federal cities<sup>5</sup>. However, first, due to  
469 the lack of economic data for urban and rural settlements (only population data is available) such as  
470 a number of employees, unemployment rate, data on industrial sectors, and second, due to the lack  
471 of political and economic power of these types of municipal formations, we decided to take municipal  
472 districts, which include urban and rural settlements. Instead of intra-city territories of the federal  
473 cities, we took the entire cities.

### 474 2. Identification of the core cities

475 The core city of a LUR can be identified with night satellite images provided, for example, by  
476 Google<sup>6</sup>. We also used as a starting point, the DARIUS database on morphological urban areas [37],  
477 which includes urban settlements with a population of more than 10,000 people and the zones  
478 defined by the Global Human Settlement Layer (GHSL, 2015).

### 479 3. Selection of aggregation units around the city cores

480 In order to select districts for potential borders of a LUR, we should first look at the distribution  
481 of towns and other urban settlements around a core city according to the satellite images and  
482 according to DARIUS. As a starting point for a distance measurement from a core, we propose to use  
483 the principal airport, which is particularly helpful in the case of polycentric urban areas, where an  
484 airport can be between cores (case of Samara-Togliatti, similarly to other cases in the world such as  
485 Bonn-Cologne in Germany). Then, we should check their connectivity with a core (road's networks  
486 and railroads), as well as to consider a distance criterion. A distance threshold varies in every case,  
487 mainly it depends on the size of a core city (the bigger a core city is, the bigger its influence zone is),  
488 on accessibility to urban settlements around a core, their sizes and economic importance, and on the  
489 relative density of the region.

490 Besides, particularly in the Russian context, we decided to respect political borders of the  
491 subjects of the Federation, because every subject differs substantially in terms of all economic  
492 indicators, governmental financial support and regional policies. Therefore, we assume that urban

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<sup>5</sup> For the explanation of different municipal formations in Russian please see the section 3.1 *Urban localities* of this article.

<sup>6</sup> Available online: <https://earth.google.com/>



493 settlement in every subject of the Federation gravitates towards its capital city, and not to a city  
494 belonging to another subject of the Federation (here we also take into consideration a strong hierarchy  
495 of urban settlements in Russia, set by Catherine the Great and working well still today). Selecting  
496 districts for LUR, we also avoided to include highly agricultural areas that might be within a set  
497 distance from a core, which are lacking urban activities (sometimes there are not even any towns  
498 there, only villages) and completely rural in their essence.

499 Following all these conceptual criteria, we aggregated districts around each core-city following  
500 the proposed method. Thus, we constructed cities according to the statistical concept that is called  
501 *large urban region* [1], which become comparable on the world scale and permit to evaluate their  
502 mutual relations and their insertion into global processes.

## 503 6. Redefinition of Russian cities through Large Urban Regions

504 A new urban definition is thus needed and can be used for *comparative economic analysis of cities*  
505 in the context of cities' economic globalization. Russia being now considered as an emerging market  
506 economy, is still in the process of global integration and it is far from being complete. Therefore, we  
507 propose the notion of Large Urban Regions (LUR), which is more adapted to compare Russian cities'  
508 insertion in globalization together with their economic trajectories [38].

509 We define Large Urban Region (LUR) as an aggregation of administrative local units around a  
510 core city, which are economically influenced by this core, meaning that they have important local  
511 interactions constructing a unique regional urban system. The area around a core is different for every  
512 city, depending on the economic power of the core city, the general density of the city location, the  
513 density of transport networks, the continuity of population density, the historical constitution of the  
514 cities and the administrative and political regional borders (Oblasts: subjects of the Federation). Also,  
515 a critical feature to define a core of LUR is the presence of an important airport, as a main gate to the  
516 whole region, through which all the aggregated local units can be accessed easily by visitors, but also  
517 that local economic actors can use for their global activity. After discussing a process of delineation  
518 of Large Urban Regions in Russia in two case studies, monocentric and polycentric, we will propose  
519 a generalization of the approach to delineate all LURs of Russia.

### 520 6.1 Two case studies of delineation of Large Urban Areas in Russia

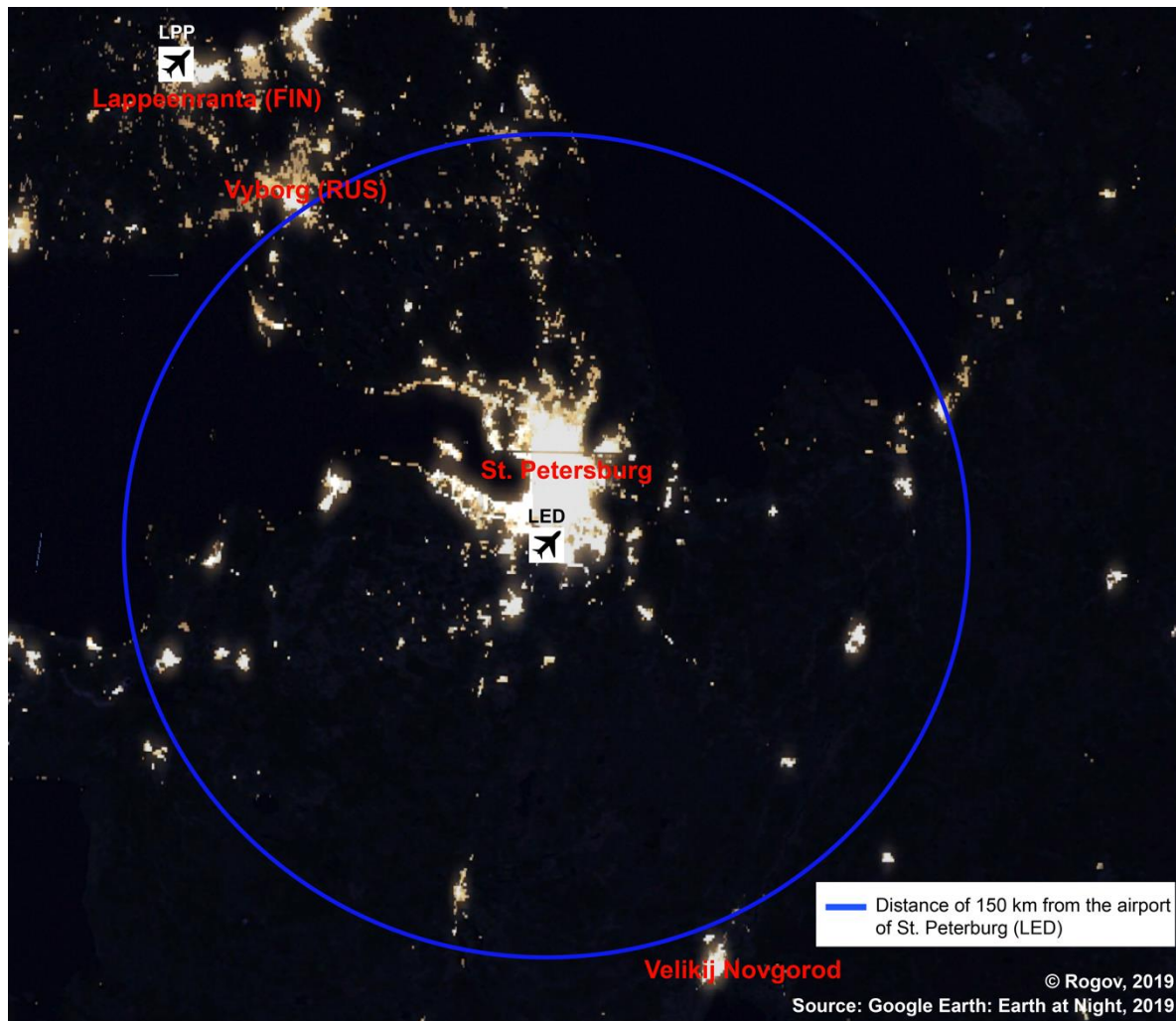
521 To illustrate the delineation of Large Urban Regions (LUR) we selected two examples: a) St.  
522 Petersburg, as the second city in Russia, in terms of population, economic and political power; and  
523 b) Samara oblast, that is characterized by its polycentric organization.

#### 524 6.1.A Example of St. Petersburg – monocentric LUR

525 St. Petersburg is developing a mostly monocentric urban region. It is the second largest city in  
526 Russia, with a population of 5,3 million inhabitants, in its administrative borders (Rosstat, 2018).  
527 The city is a separate subject of the Federation, with a population of 1,8 million inhabitants (Rosstat,  
528 2018), surrounded by the Leningrad oblast, which has international borders with Finland on the  
529 North (around 150 km. from the center of St. Petersburg) and Estonia on the West (around 130 km.  
530 from the center of the city). St. Petersburg is an important economic and industrial center of the  
531 country: according to the Gross Regional Product (GRP) it takes the third place in Russia, after  
532 Moscow and the Tyumen oblast, an oil-rich city bordering Kazakhstan (Rosstat, 2018).

533 In terms of urban geography, St. Petersburg is clearly a monocentric city, which is a core city for  
534 the whole surrounding region, as revealed by the satellite image at night (fig.1). To identify the  
535 borders of a large urban region around St. Petersburg, it is important to first understand the  
536 distribution of population and settlements around the core city.





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**Figure 1.** Population distribution around St. Petersburg

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The distribution of the population around St Petersburg's core goes most intensively to the North towards the boarder with Finland and to the West, towards the boarder with Estonia. Probably, because these two directions go along the Finnish gulf, and people prefer to live close to water. Secondly, the North is particularly famous due to its diverse and numerous water recourses: variety of lakes and rivers. Also, both of these directions lead to countries of the European Union: Finland and Estonia, which are very popular amongst local people for so called one day "shopping" tourism. Therefore, these two axes have great advantages of their economic-geographic situation, especially, the North because of Finland. The population distribution in the East and South is apparently mostly along roads and is more discontinuous.

As a core point we take the international airport of St. Petersburg (LED) Pulkovo, because we consider it to be a main gate to the whole surrounding region. At the same time, just next to the border between Finland and Russia (20 km from it) there is the international airport of Lappeenranta (LPP) that could also be a potential gate to Vyborg and other settlements in the Northern part of the region, because it is much closer than the airport in St. Petersburg (50 km instead of 150 km). However, we do not consider it as a principal gate because of two main reasons: 1) between Russia and Finland there is a visa regime, what makes the access to the airport in Lappeenranta more complicated; 2) the airport in Lappeenranta is quite small and provides only a few flights to the European Union and worldwide.

The road network around St. Petersburg (Fig.2) reveals the accessible morphological urban areas (MUA) identified by C. Cottineau in her database DARIUS [37]. Every MUA is an urban settlement that has either a legal status of a city (this way population does not matter), or an urban-type

560 settlement that has a population over 10,000 inhabitants<sup>7</sup>. With the transportation and the density of  
 561 MUAs defined by Cottineau [14,37], we observe that in the direction of Finland and Estonia the road  
 562 network is much denser and the number of MUAs is greater than in the South-East direction, which  
 563 corresponds to the population distribution shown in figure 1.



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**Figure 2.** Road networks and MUA around St. Petersburg

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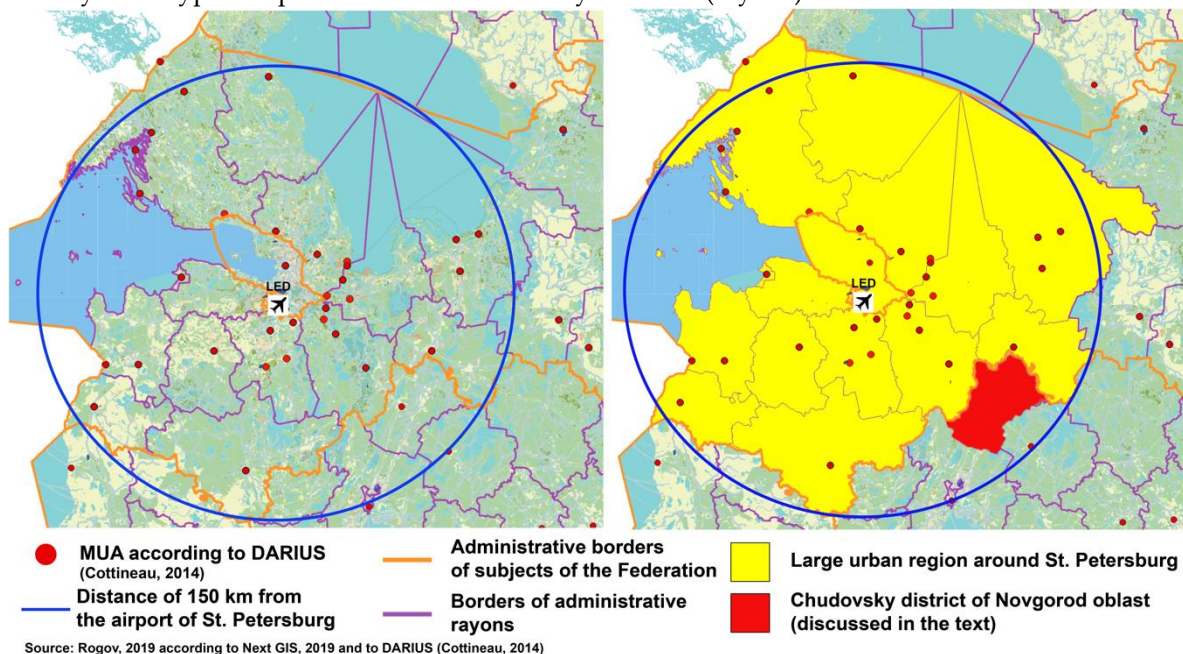
Since we assume that most of the economic activities take place in cities, we find it important to analyze the distribution of MUAs around a core city. LUR being an urban definition for studies on the economic integration of cities into global processes must include smaller regional economic sub-centers. Therefore, in order to delineate the LUR of St. Petersburg, we propose to include all the MUAs within 150 km from the airport LED as being better linked by transport network and respectively having a higher economic dependency from St. Petersburg.

To construct LUR as a large statistical unit, we should aggregate in a continuous way the smallest statistical units such as municipalities. However, since Rosstat provides only population data for municipalities, and not any economic indicators, such as employment and production data, we will aggregate entire administrative districts (“*rayon*” in Russian, which are sets of municipalities). It is reasonable to do so also because municipalities in Russia do not have a lot of political and economic

<sup>7</sup> In Russia there are two legal statuses of urban settlements: 1) city (there is no universal definition; strategic location/position and historical meaning are more important than a number of inhabitants); 2) urban-type settlement (intermediate position between a city and a village (English equivalent could be a “town”); usually more than 2,500 inhabitants; at least 2/3 of the population work in fields others than agriculture).



577 power to influence local economic processes, concerning firms' activities, investment attraction etc.,  
 578 usually these types of questions are addressed by districts' (rayons) administrations.



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**Figure 3.** Discussing the delineation of the Large Urban Region (LUR) around St. Petersburg.

581 In the figure 3 we represent the region around St. Petersburg, with the borders of administrative  
 582 districts and the borders of the Leningrad oblast. On the right side of the picture we highlighted, in  
 583 yellow, the selected districts we propose to aggregate as LUR around St. Petersburg. We follow  
 584 several principal criteria:

585 1) an equal maximum distance radius from the principal airport (Pulkovo, LED): we selected a  
 586 zone of 150 km;

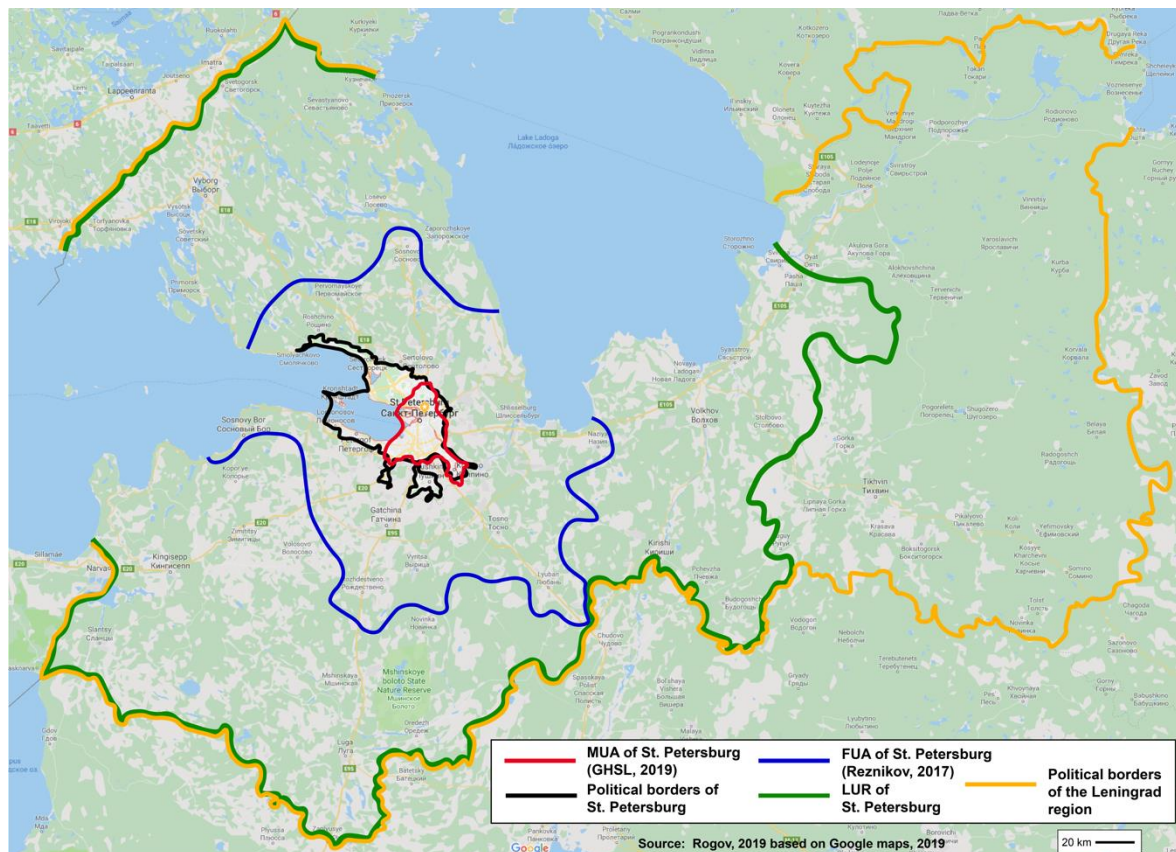
587 2) inclusion of districts with MUA: in this case they all encompass several MUAs;

588 3) we respect the borders of the subject of the Federation, because economically they differ very  
 589 much, which is of crucial importance for business.

590 The inclusion in the same subject of the Federation is the reason why we did not include some  
 591 districts of Novgorod oblast in this LUR and particularly, the Chudovsky district (in red in Figure 3),  
 592 which otherwise absolutely has to be integrated into this LUR, first, because it is completely within a  
 593 distance threshold of 150 km, and second, crossed by highways towards Moscow that means it is well  
 594 connected and accessible.

595 Four districts in the Eastern part of the Leningrad oblast were not integrated into LUR for the  
 596 following reasons: 1) they are too far from the core (more than 150 km, which would be equal to more  
 597 than two hours' drive by car); 2) these regions are very poorly populated: there are only 5 MUAs with  
 598 an average population of 26,000 inhabitants per MUA, out of 1,8 million citizens of the whole  
 599 Leningrad oblast (Rosstat, 2018).

600 Thus, we selected 14 districts (rayons) in the Leningrad oblast and the city of Saint-Petersburg  
 601 as forming a unique Large Urban Region that we will call Saint-Petersburg LUR. Based on the  
 602 analysis of population distribution and road networks we identified the territories around St.  
 603 Petersburg that gravitate towards it, and therefore are better connected and more easily accessible  
 604 than others. Also, we respected the political context and we did not aggregate districts of other  
 605 subjects of the Federation. Compared to the delimitation of urban agglomeration around St.  
 606 Petersburg, done by Reznikov [16], which is completely functional, the Saint-Petersburg LUR is much  
 607 bigger. Moreover, the Reznikov [16] delineation is not composed of entire municipalities or districts  
 608 and thus, statistics are difficult to collect). In figure 4 we illustrated four different delineations of St.  
 609 Petersburg: political definition, MUA, FUA and LUR.



610

611

**Figure 4.** Comparison of different delineation concepts applied on St. Petersburg

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Among these different concepts, the MUA, according to GHSL (2019) is the smallest one, within  
 613 the political borders of St Petersburg. The FUA defined by Reznikov [16] is larger, and the LUR is  
 614 even larger. To construct the LUR, all the other “smaller” delimitations can be nested inside. Along  
 615 with the territory, the population also changes according to different urban definitions (Tab.1).

616

Concept of city delineation	Population	Source and year
Political borders of St. Petersburg city	5,351,935	Rosstat, 2018
Morphological Urban Area (MUA)	4,300,867	The Global Human Settlement Layer (GHSL), 2015
Functional Urban Area	6,266,104	Reznikov [16]; Calculation by the authors, 2019 based on Rosstat, 2018
Large Urban Region (LUR)	6,987,987	Rosstat, 2018

617

Table 1: Comparison of population of St. Petersburg according to different city concepts

618

Therefore, LUR is the largest urban concept that includes the whole region around the St  
 619 Petersburg core city. To construct the LUR, we aggregate administrative units, ideally on the smallest  
 620 level (municipality), but in the Russian context, because of the data availability, we took the level of  
 621 a municipal district, which is an aggregation of smaller municipalities (and comparable to the US  
 622 counties that constitute SMAs). Then, we can consider this LUR as comparable to the Greater London  
 623 region or with the New York Combined metropolitan statistical area - CMSA [1].

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#### 4.1.B Example of Samara oblast – polycentric LUR

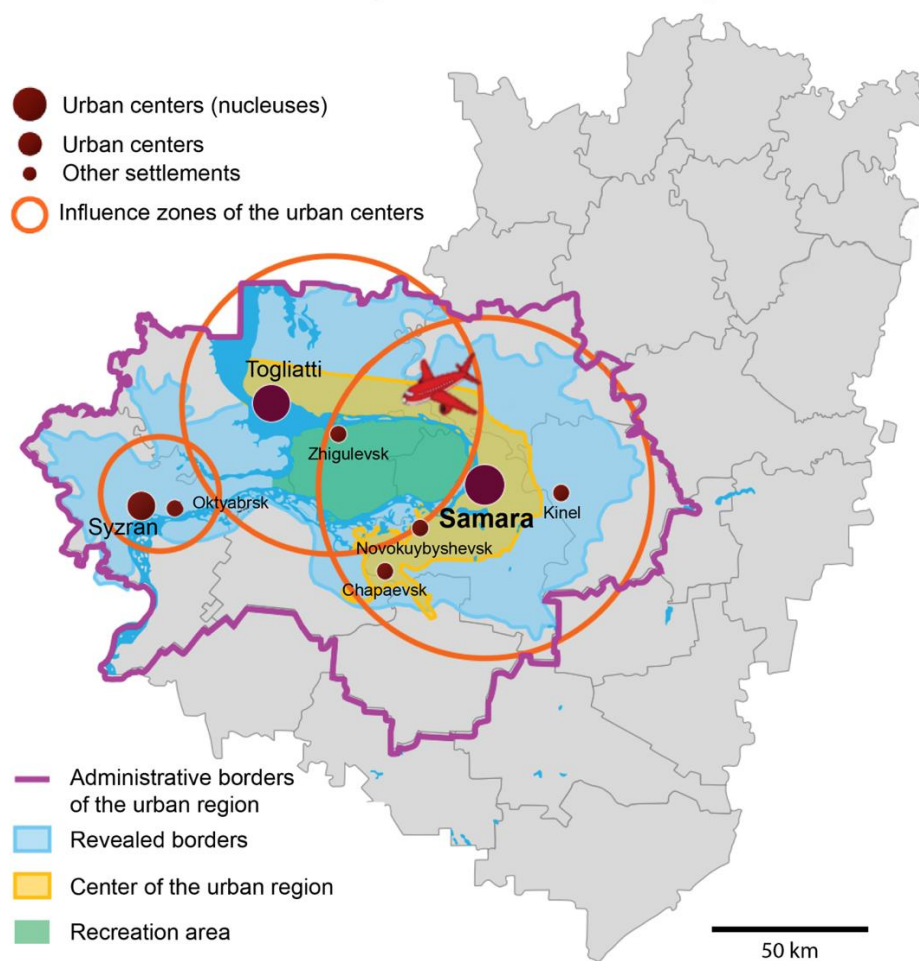
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In order to consolidate the methodology, we consider a second example, Samara, which will  
 626 lead to a construction of a polycentric LUR.



627 Samara is one of the largest industrial centers of Russia. Together with Togliatti city, it forms a  
 628 joint economic region, which is specialized, particularly, in mechanical engineering, car  
 629 manufacturing, metalworking, oil extraction and chemical industry (source). The biggest cities of  
 630 Samara oblast are situated along the Volga river, and two of the biggest ones (Samara and Togliatti)  
 631 around a peninsula formed by the Samara bend of the Volga river. Due to the proximity of these two  
 632 cities, their comparable big sizes and their high industrial development for a long time (the biggest  
 633 automobile manufacturer in the USSR and in the Eastern Europe "AvtoVAZ" was founded in  
 634 Togliatti in 1966), this urban region was well studied in terms of the economic geography perspective  
 635 (sources). Traditionally, it was considered as a two-core conurbation [8], despite the methods of  
 636 delimitation that varied from one study to another [39-41]. In addition, the local government accepted  
 637 an official strategy of development of Samara oblast that defined so called "Samara-Togliatti urban  
 638 region" that besides two cores – Samara and Togliatti – also includes several surrounding  
 639 administrative districts (Fig.5).

## Samara - Togliatti Urban Region



640 **Source:** The strategy of socio-economic development of the Samara region for the period up to 2030,  
 641 The government of the Samara oblast, 2017. Developed by Strategy Partners Group, 2014.

640

641 **Figure 5.** Samara – Togliatti Urban Region for strategic development.

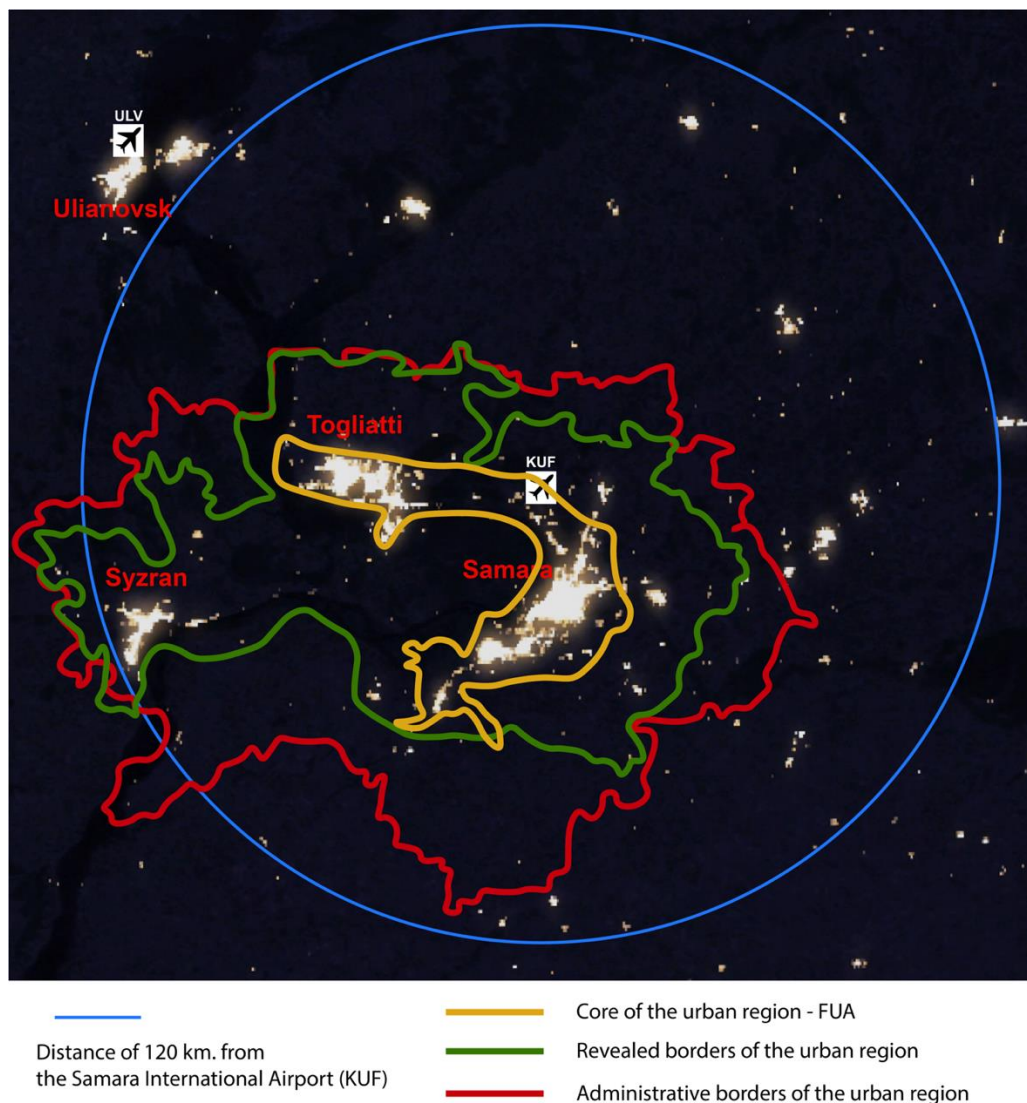
642 The Strategy of socio-economic development of the Samara oblast for the period up to 2030<sup>8</sup>  
 643 suggests that the Samara – Togliatti Urban Region is made of the largest cities (two cores and one  
 644 potential core) and surrounding towns gravitating towards them. In fact, the delineation of Samara  
 645 – Togliatti strategic urban region defined by the oblast government, includes two core cities and the

<sup>8</sup> Available online in Russian: [http://economy.samregion.ru/upload/iblock/82a/strategiya-so\\_2030.pdf](http://economy.samregion.ru/upload/iblock/82a/strategiya-so_2030.pdf)



646 main smaller cities that are situated in the influence zone of the cores. In terms of the urban concepts,  
 647 we can say that the center of the urban region (in orange in Figure 5) corresponds to the FUA  
 648 definition, whereas revealed borders, which include the influence zones, might correspond to the  
 649 LUR definition. What is particularly interesting, is the fact that the Strategy Partners Group defines  
 650 administrative borders of this conurbation, consisting of smaller statistical units such as districts, and  
 651 therefore, it becomes itself a single statistical unit, which is LUR finally should be. This urban region  
 652 is amongst the 41 urban regions included in the federal Strategy of Spatial Development of Russia  
 653 until 2025, and therefore, its defined political borders are officially recognized by the Russian  
 654 government as a type of delineation, however, without pre-defined specific power. Syzran, situated  
 655 at the western part, was not defined as a nucleus, however, the authors of the strategy admit, that in  
 656 the future, it will become one and the region will transform into three-cores conurbation. To verify  
 657 the relevance of this delineation, we redefine below this conurbation according to the criteria of LUR  
 658 as discussed in the example of St. Petersburg.

659 To understand the distribution of population around this urban region we look at the night  
 660 satellite image of Samara oblast, where we drew the official existing delineations (Fig.6).  
 661



Source: Rogov, 2019 based on Google Earth: Earth at Night, 2019. Delineations: The government of Samara oblast, 2017.

**Figure 6.** Population distribution around Samara and different delineations.

664 The principal airport (and the only one) of the whole region is KUF and is situated between the  
 665 two defined cores: Samara and Togliatti. Therefore, due to its central position, it allows us to consider  
 666 it as a central point for the potential LUR. Then, to include Syzran we should use a distance threshold

667 from this airport at least around 120 km that we can see on the picture. The use of this threshold  
 668 allows us to also include smaller industrial cities in the North and East in case they are well connected  
 669 to the cores by roads. To verify this we look at the map of a road network around these two cores,  
 670 where we also situated MUAs identified in the database DARIUS [37] (Fig.7).



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**Figure 7.** Road networks and MUAs around Samara.

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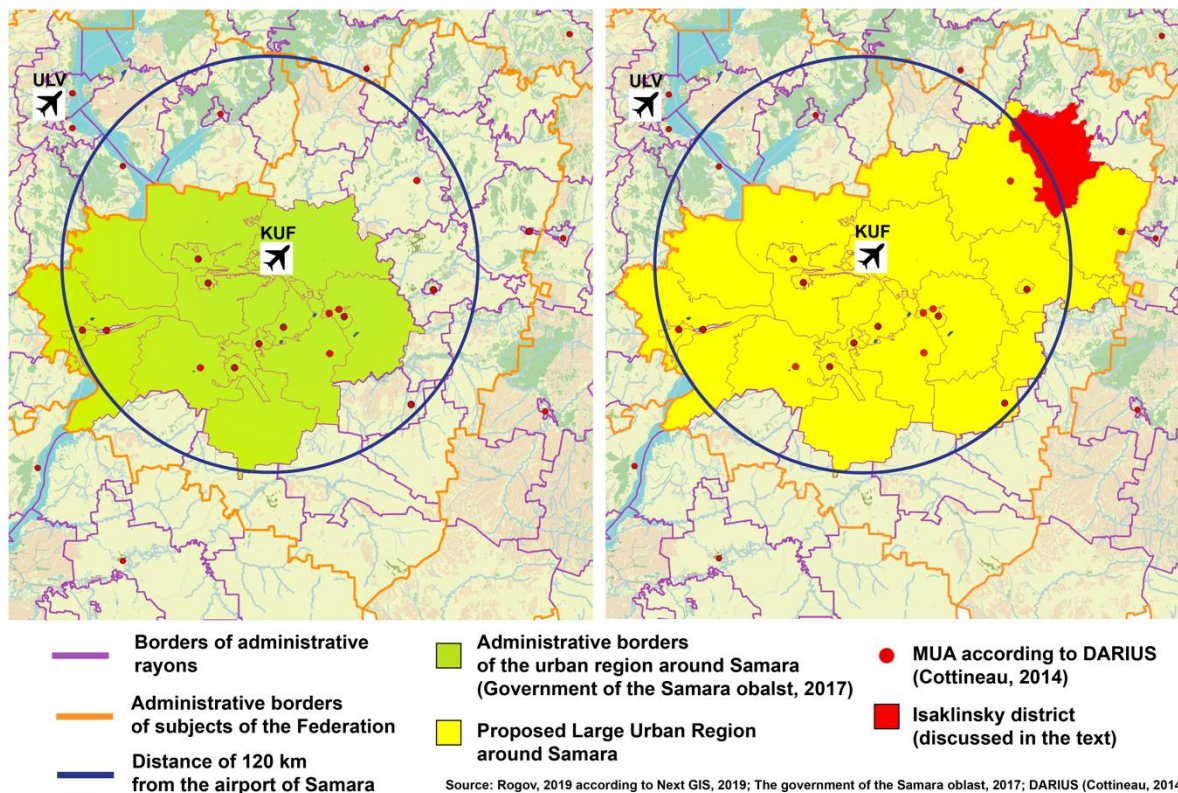
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We see that the road network is quite well developed in both the North and East, which links little industrial towns-satellites to the cores. Also, in these directions there is a railroad that serves as another link to the cores. Since in the North-West direction there is another large city, which is the center of Ulyanovsk oblast, that has its own public airport ULV, we assume that it creates its own LUR around itself and therefore, we would include smaller cities in the North-West in that LUR, and not in the Samara one. Another reason for this is the political borders of two different oblasts that we want to respect (see the figure 8). Thus, we propose to extend the official definition of Samara LUR and include more districts that first, are well connected to the cores, and second, have MUAs. In figure 8 below we compare different existing delineations.





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**Figure 8.** Resulting LUR of Samara compared with other delineations.

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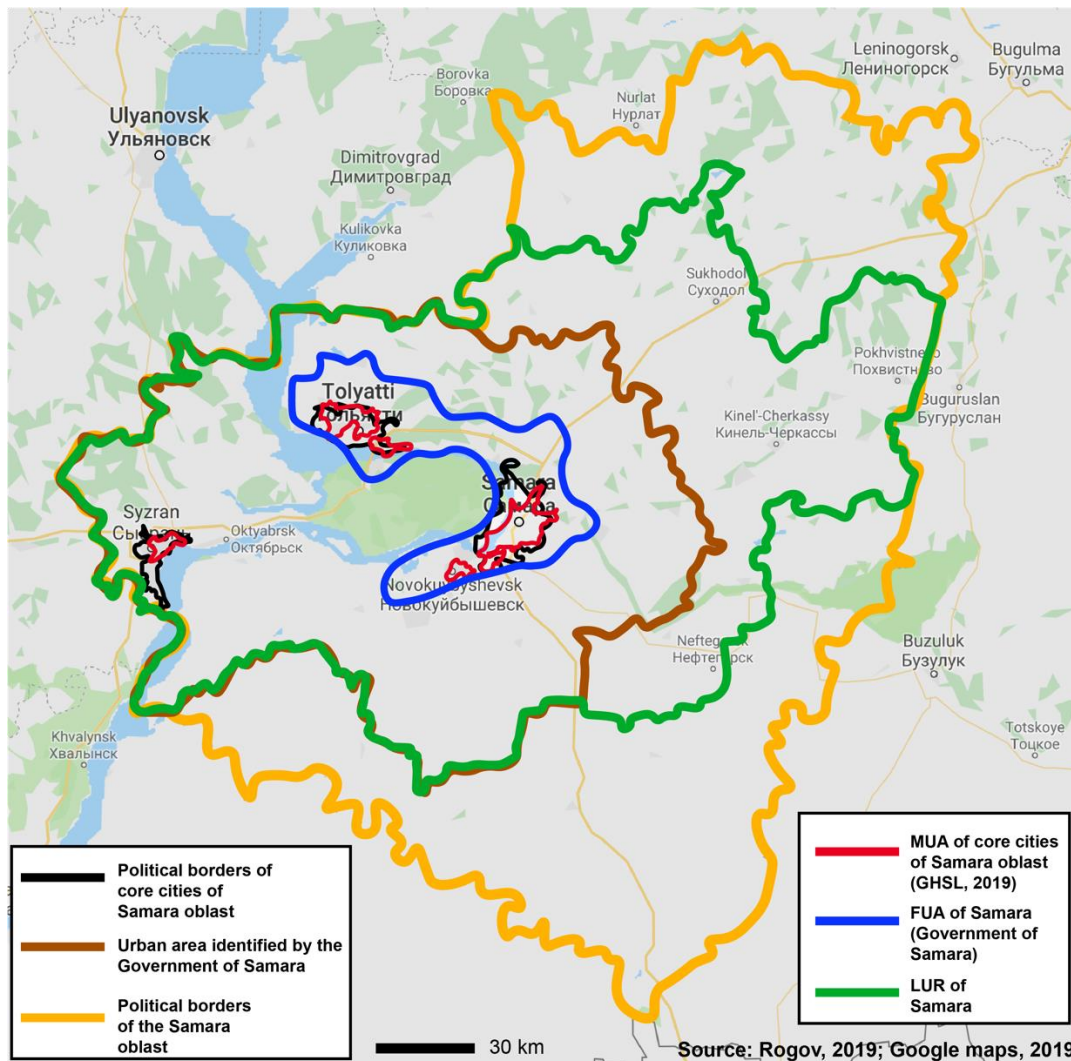
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Based on the accessibility criterion and distance from the airport, we finally decided to extend existing delineation to 6 districts in the East-North direction. The main criteria for this selection were: 1) proximity to the airport KUF; 2) presence of highways in districts (some of them are crossed by interregional roads); 3) presence of MUAs in districts; 4) continuity of districts. Also, before the inclusion of any districts in a LUR, we should pay attention to the industrial importance of a district, particularly if some of the main criteria are not met. In the case of Samara we hesitated about Isaklinsky district: it does not have any MUAs, it is not crossed by any major roads, however, for continuity reasons and because it is just on the border of 120 km threshold from the core we could include it. To take a decision, we explored the economy of this district and its importance for the oblast. It turned out that this district is completely agricultural and it does not have any petrol extraction enterprises or high-tech production, which means that, in its essence, the district remains rural. Therefore, we decided not to include it in the Samara LUR.

By extending the urban region of Samara and including more economic nodes (official cities) than the government of the Samara oblast suggested in 2017, we can better represent the economic power of the region on the world scale. The urban region delineation proposed by the government is quite good for identification of a zone, where most of the economic activities of Samara oblast take place. The fact that this delineation is included in the Federal Program of Spatial Development and the selected districts receive additional financial support, clearly leads to an acceleration of interactions between local economic agents and, therefore, for bolstering local economy, which is the principal objective of this delineation. Another goal of this official delineation is to support, so called, mono-cities-satellites by diversifying their economies and also to strengthen Syzran and make it the third core of this urban region, which might explain why this delineation goes clearly towards Syzran and not so much towards the East-North of the oblast. However, for a comparison of cities on the world scale, we find it important to include as many towns around a core as possible. Therefore, we decided to extend the existing delineation of Samara urban region and to include towns that are within a certain distance threshold and well connected to the cores. We did not include in Samara

710 LUR the periphery of the Samara oblast because these districts exceed the distance threshold, not  
 711 very well connected or have highly rural economy (mainly agriculture).  
 712 In figure 9 we map different existing urban concepts of Samara.



714 **Figure 9.** Comparison of different delineation concepts applied on Samara

715 All the existing delineations of Samara are nested one in another. Basically, we can divide them  
 716 into two different types:

- 717 1. Political delineations, which are state-financed and/or managed by local authorities, such as  
 718 administrative borders of the cities, the urban area defined by the government of the Samara  
 719 oblast and the oblast.  
 720 2. Scientific delineations (MUA, FUA, LUR), which are proposed by scientific institutions in  
 721 order to address specific research questions. There is not any political body that governs a  
 722 city in its conceptual borders and respectively a city in these borders is not state-financed  
 723 but one assumes that they constitute some consistent spatial systems that must be  
 724 considered for planning or for comparison with other cities.

725 For comparison of these different urban concepts we provide below a table with population  
 726 (Tab.2).

Concept of city delineation	Population	Source and year
Political borders Samara city	1,163,440	Rosstat, 2018
Urban area (Gov.) Samara oblast	2,825,975	Rosstat, 2018
	3,193,514	Rosstat, 2018

Morphological Urban Area (MUA)	900,591	The Global Human Settlement Layer (GHSL), 2015
Functional Urban Area (Gov.)	2,176,854	Calculation by the authors, 2019 based on Rosstat, 2018
Large Urban Region (LUR)	2,999,689	Rosstat, 2018

727 **Table 2.** Comparison of population of Samara according to different city concepts

728 The Morphological Urban Area (MUA) defined by the Global Human Settlement Layer (GHSL,  
729 2015) is more restricted than the political border of Samara. The Urban area defined by the Samara  
730 Oblast, including all the districts until Tolyatti and Sysran, double the population. Thus, the LUR,  
731 more widely delineated, adds more than 170,000 inhabitants. With the LUR, we can consider Samara-  
732 Tolyatti-Sysran as an urban region comparable to St Petersburg, for studying its capability to insert  
733 in the globalization. It is also comparable to other Large Urban Regions of the world. The criteria and  
734 thresholds are not necessarily strictly identical, but the conceptual approach is similar and adapted  
735 to the Russian regional contexts.

## 736 7. Resulting LURs in Russia

737 In this part we discuss the construction of Large Urban Regions for all Russian cities that was  
738 published in the database Russian LUR\_V1\_2019 (see Appendix A) [42]. In total we defined 113 Large  
739 Urban Regions in Russia: the principal criteria to define a core city of a LUR was a presence of an  
740 airport and then, we used an airport code as a universal code of the LUR, similarly to other LURs of  
741 the world (and for cities having different airports, we choose the code of the main airport) (Rozenblat,  
742 2019). Each LUR consists of several districts or Functional Urban Areas (FUA), which are composed  
743 from municipalities (local units). Table 3 shows the ten biggest LURs in Russia in terms of population.  
744

	Code LUR	LUR	ADMIN*	LUR**
1	SVO	Moscow	12,506,468	20,009,853
2	LED	St. Petersburg	5,351,935	6,935,418
3	OVB	Novosibirsk	1,612,833	2,659,799
4	SVX	Ekaterinburg	1,501,652	4,314,357
5	GOJ	Nizhny Novgorod	1,267,464	3,172,705
6	KZN	Kazan	1,243,500	2,178,655
7	CEK	Chelyabinsk	1,202,371	3,493,036
8	OMS	Omsk	1,172,070	1,905,803
9	KUF	Samara	1,163,440	3,023,365
10	ROV	Rostov-on-Don	1,130,305	4,036,617

745 \* Political borders; data source: Rosstat, 2018

746 \*\* Large Urban Regions; data source: Rosstat, 2018

747 **Table 3.** Population comparison of 10 largest Russian cities

748 To construct LURs we aggregated different types of the municipal formations<sup>9</sup> in Russia. All of  
749 these municipal formations have an official code OKTMO<sup>10</sup>, which has the following format: OKTMO  
750 is a code AA BBB CCC DDD, where AA is a code of a subject of the Federation; BBB is a code for a  
751 municipal district (munitsipalniy rayon) or urban neighbourhood (gorodskoy okrug); CCC is a code  
752 for rural settlements (selskoe poselenie) or urban settlements (gorodskoe poselenie), which are  
753 continuous municipalities, and DDD is a code for a single settlement inside a municipality. In LUR  
754 construction we did not use DDD level because of the non-continuity of settlements. Using the same

<sup>9</sup> For a detailed overview of different types of municipal units in Russia (municipal formations) please see the *section 3.1 Urban localities* of this article.

<sup>10</sup> Official Russian Classification of Territories of Municipal Formations OKTMO (as of January 1, 2014 OKTMO replaces OKATO - Russian Classification of Objects of Administrative Division).



755 set of criteria that were discussed earlier in this article, and based on the code of municipal units that  
756 we used for the LUR construction, we made the following assumptions:

757 1. *Municipality*

758 As local units or municipalities we consider municipal formations of the level C in the OKTMO  
759 code, namely *rural settlements (selskoe poselenie)*, urban settlements (*gorodskoe poselenie*) or *inter-*  
760 *settlement territories (mezhselennie territorii)* as a part of municipal districts. However, since *urban*  
761 *neighbourhood (gorodskoy okrug)* is not divided into smaller local units, we consider it both as  
762 municipality and functional urban area. For federal cities we consider their *intra-city territories*  
763 (*vnutrigorodskie territorii*) as municipalities.

764 2. *Functional Urban Areas*

765 As Functional Urban Areas (FUA) or districts we consider municipal formations of the level B in  
766 the OKTMO code, namely *municipal district (munitsipalnyy rayon)* or *urban neighbourhood (gorodskoy*  
767 *okrug)* as bigger continuous municipal units. For three federal cities, we consider the entire city  
768 territory as a functional urban area (FUA).

769 3. *Large Urban Regions*

770 To construct Large Urban Regions as single statistical units we aggregated FUAs.

771 Also, as it was mentioned before, we respected the political borders of the subjects of the federation,  
772 except the three federal cities that form the same LUR together with the surrounding region (St.  
773 Petersburg is joined with the Leningrad oblast; Moscow with Moscow oblast; Sevastopol with the  
774 republic of Crimea). In the database [42] we included the population data (Rosstat, 2018) for every  
775 municipal unit and in total for every LUR. The official codes OKTMO that we kept for every  
776 municipal formation, is convenient to collect other types of socio-economic data.

777 **8. Conclusion**

778 In this article we discussed the delineation of large urban regions in Russia as a new urban  
779 definition that aimed at making cities comparable on the world scale. The Russian context was chosen  
780 because Russia is now considered as an emerging economy becoming a part of the global market,  
781 with cities being centers of economic activity and, therefore, main agents of globalization and should  
782 be redefined to be able to better illustrate the insertion of the national urban system in the global  
783 market.

784 In doing so, we first described the urban context of Russia. We showed that historically in Russia  
785 a *city* is considered as a legal status that can be gained and lost within time, that a population size is  
786 not extremely important for this status, unlike a strategic position of a settlement or its history (Part  
787 1). Secondly, we described existing urban delineation of Russian cities and divided them into four  
788 urban concepts following the classification of Pumain [12]: urban localities, urban agglomerations,  
789 urban regions and conurbations (Part 2). We argued that each urban delimitation depends on the  
790 particular research question and none of the existing urban delineation of Russian cities is suitable  
791 for a global comparison of cities (Part 3).

792 Given this, we discussed the delineation of Large Urban Regions (LURs) based on the two cases  
793 of Russian cities: St. Petersburg, which is a monocentric region, and Samara, which is a polycentric  
794 region. Using a set of maps, such as night satellite images, densities, road and railroad networks and  
795 distribution of MUA around the cores, we proposed a delineation of these two large urban regions.  
796 In the end of every case we illustrated four urban concepts for each case on the same map and  
797 compared them in terms of population (Part 4.1). Afterwards, we proposed a general method for  
798 large urban region delimitation in the Russian context, where we described a step by step procedure  
799 (Part 4.2). Finally, in the last part, we provided a table including population data for 10 of the biggest  
800 Russian cities in their political borders and LUR borders, explaining the database on all LURs in  
801 Russia.

802 Therefore, large urban region (LUR) is a statistical definition of a city that aggregates statistical  
803 units (such as districts for the Russian urban context) including all their economic influence to make  
804 cities comparable on the national and the world scale. We argue that this new delineation will better

805 permit to study the socio-economic evolution of the Russian urban system and to evaluate the urban  
806 regions' insertion into globalization in a comparative way.

807 **Author Contributions:** M.R. made the original draft preparation of this paper. C.R. supervised  
808 conceptualization, review, methodology, interpretation and editing processes.

809 **Funding:** This research received no external funding.

810 **Acknowledgments:** The authors express their deep gratitude to Helen Schwager-Ivashkoff for her help with  
811 language editing and proofreading. Also, the authors would like to thank Andrea Ferloni and Mehdi Bida for  
812 the numerous discussions and their constructive advice.

813 **Conflicts of Interest:** The authors declare no conflict of interest.

814

## 815 **Appendix A**

816 DATABASE: RUSSIAN LUR\_V1\_2019

817 Available online: <https://doi.org/10.5281/zenodo.3354435>

818

### 819 *Keywords*

820 Large Urban Regions, Russia, cities, statistical urban definition, comparative urban research

821

### 822 *Theme*

823 Urban studies, regional studies

824

### 825 *Language*

826 English, names of municipalities are also written in Russian

827

### 828 *Spatial coverage*

829 The Russian Federation

830

### 831 *Temporal coverage*

832 - Time lapse: 2018

833 - Publication date: July 2019

834 - Latest update: July 2019

835

836 *Format name and version:* Excel file, Version 1

837 *File's format:* .xlsx

838 *Creation date:* July 2019

839 *Dataset creator*

840 Mikhail Rogov, University of Lausanne: mikhail.rogov@unil.ch

841 *Name and function developed by the person responsible for the resource*

842 Mikhail Rogov, PhD Student University of Lausanne: mikhail.rogov@unil.ch

843 *Responsible organization and person*

844 Mikhail Rogov, University of Lausanne: mikhail.rogov@unil.ch

845

846 *Repository location*

847 <https://zenodo.org/>

848

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 862 manner, but not in any way that suggests the licensor endorses you or your use863 - ShareAlike – if you remix, transform, or build upon the material, you must distribute your  
 864 contributions under the same license as the original

865

866 *Type of spatial representation*

867 Controlled list limited to the following values:

868 · text table (textTable): Text or tabular data

869

870 *Spatial resolution (scale or minimum cartographic unit)*871 Urban settlement (gorodskoe poselenie), rural settlement (selskoe poselenie), inter-settlement  
 872 territories (mezhselennye territorii), and urban neighborhoods (gorodskoy okrug), which we all  
 873 consider as municipalities.

874

875 *Geographic extension*

876 All Russian territory

877

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