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

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

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

## 1. Introduction

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

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

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

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

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

**2. Russian cities: peculiarities of the urban context**

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

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

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

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

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

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

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

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

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

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

After the end of the USSR, the soviet urban system was transformed enormously: many traditional links between cities were broken because of the new independent states building and the emergence of constraining international borders. Most cities that were in the center of the USSR turned out to be on 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.

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

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

3. The Russian urban concept

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

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

3.1 Urban localities

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

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/)

			<div><div>- Have the right to establish their state languages along with Russian, and also have the capital;</div><div>- Ethnic principle of formation.</div></div>
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	<div><div>- They do not have a right to establish their local state languages;</div><div>- Ethnic principle of formation for indigenous peoples of the North;</div><div>- 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).</div></div>

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

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

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

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

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

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

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

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

### 3.2 Urban agglomerations or urban units

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

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

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

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

### 3.3 Urban regions

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

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

The methods applied in USSR or Russia can be divided into two categories: case-study based 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#>

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### 3.4 Polynuclear urban regions, or conurbations

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

## 4. The need for a new urban delineation

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

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

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

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

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

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

## 5. General method

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

### 1. Units of aggregation

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

### 2. Identification of the core cities

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

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

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

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

<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/>

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

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

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

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

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

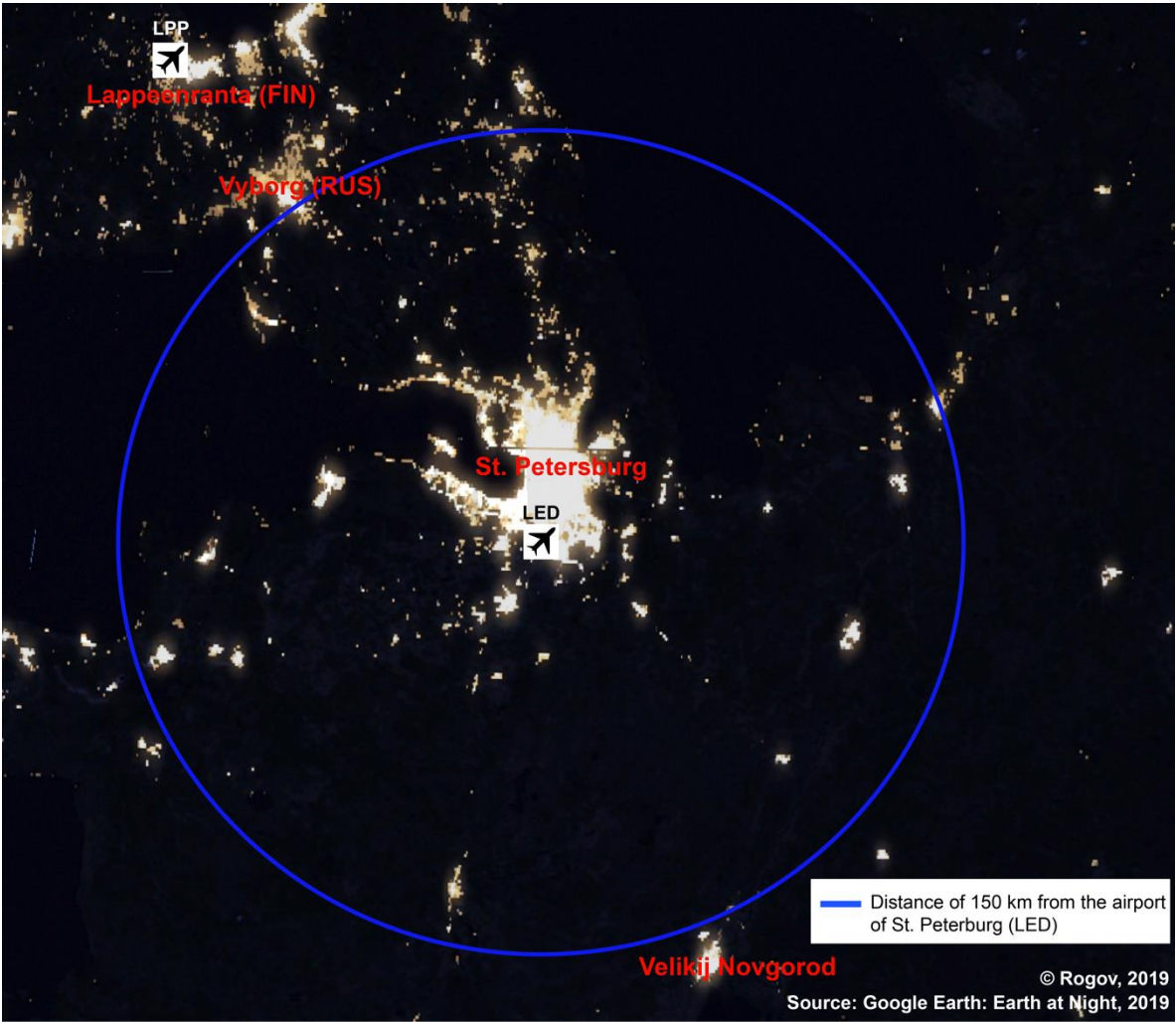
### 6.1 Two case studies of delineation of Large Urban Areas in Russia

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

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

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

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



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

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

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



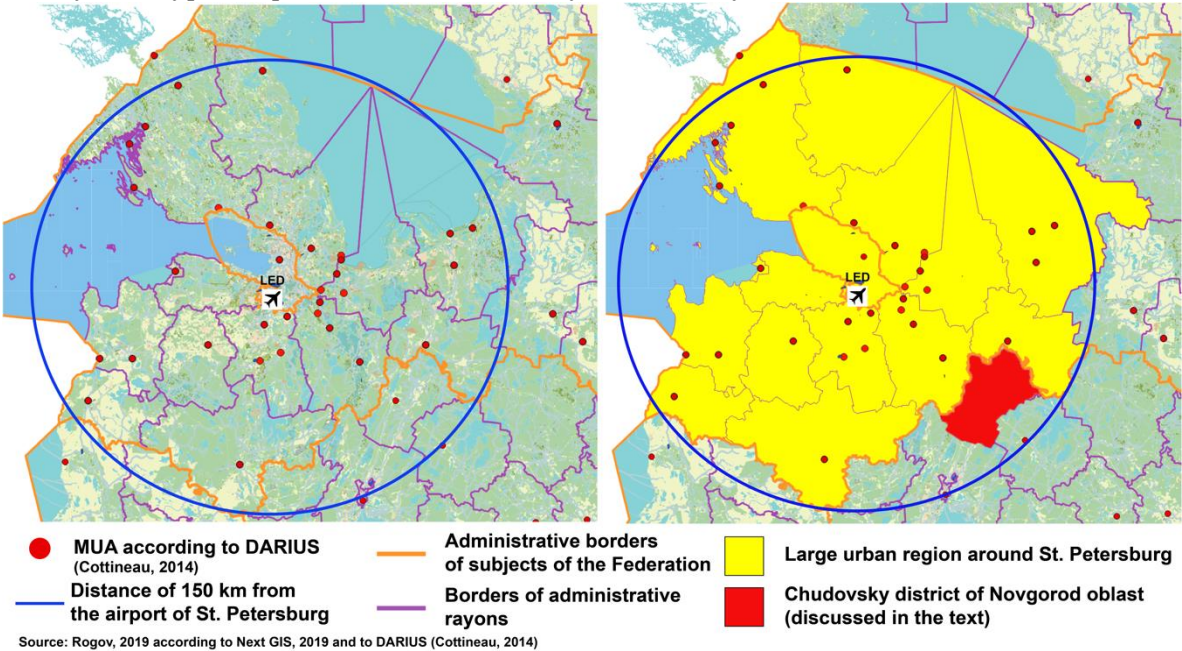
**Figure 2.** Road networks and MUA around St. Petersburg

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).

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



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

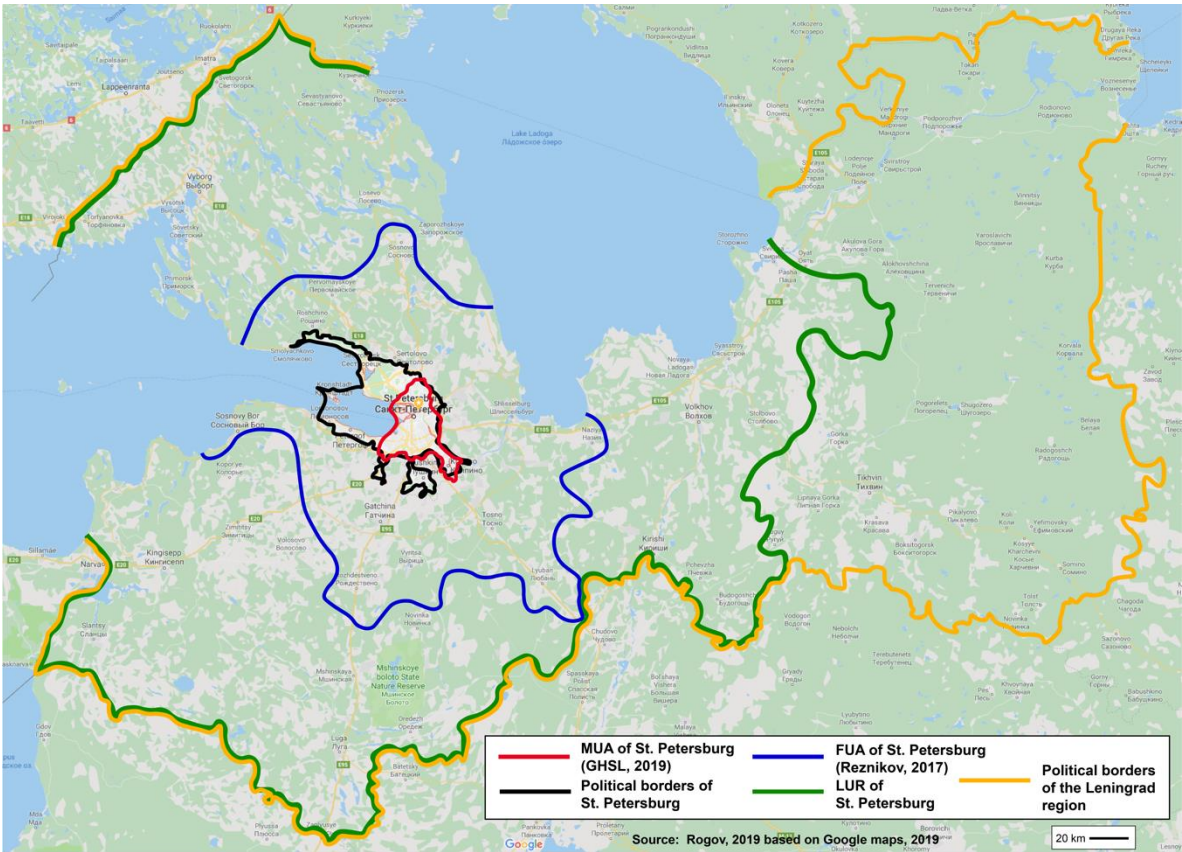
In the figure 3 we represent the region around St. Petersburg, with the borders of administrative districts and the borders of the Leningrad oblast. On the right side of the picture we highlighted, in yellow, the selected districts we propose to aggregate as LUR around St. Petersburg. We follow several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

- 1) an equal maximum distance radius from the principal airport (Pulkovo, LED): we selected a zone of 150 km;
- 2) inclusion of districts with MUA: in this case they all encompass several MUAs;
- 3) we respect the borders of the subject of the Federation, because economically they differ very much, which is of crucial importance for business.

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

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

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



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

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

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

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

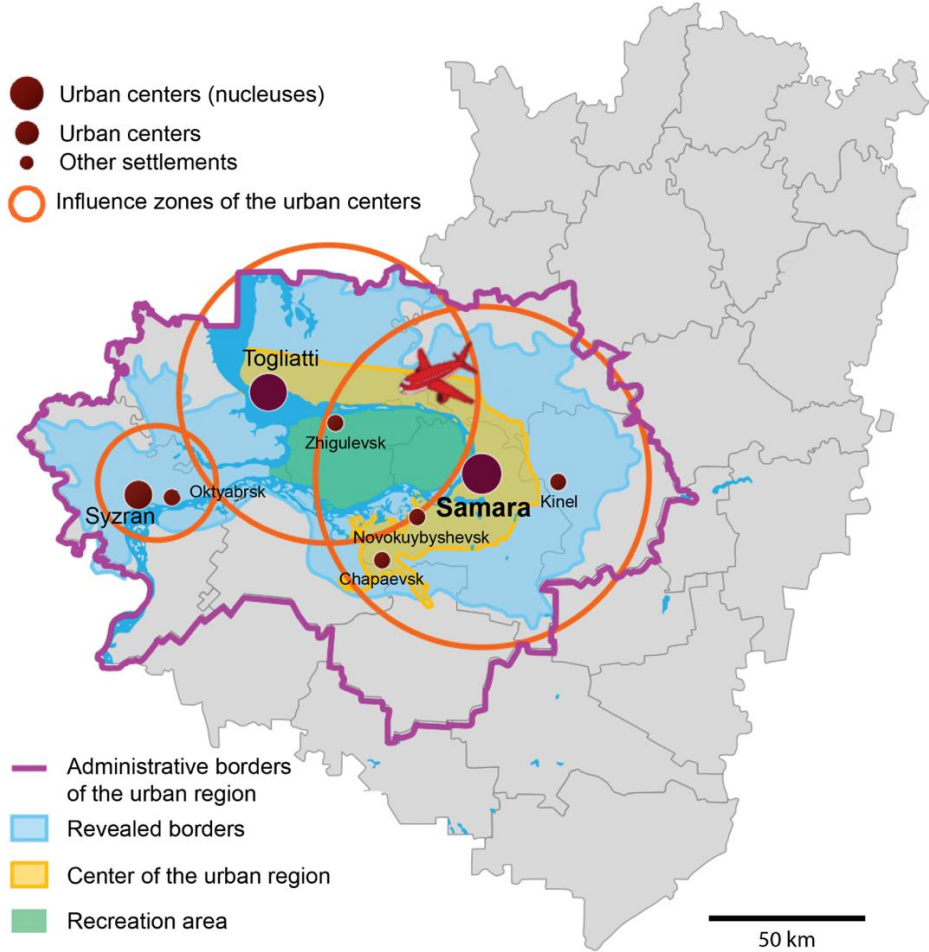
Therefore, LUR is the largest urban concept that includes the whole region around the St Petersburg core city. To construct the LUR, we aggregate administrative units, ideally on the smallest level (municipality), but in the Russian context, because of the data availability, we took the level of a municipal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

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

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

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

### Samara - Togliatti Urban Region



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

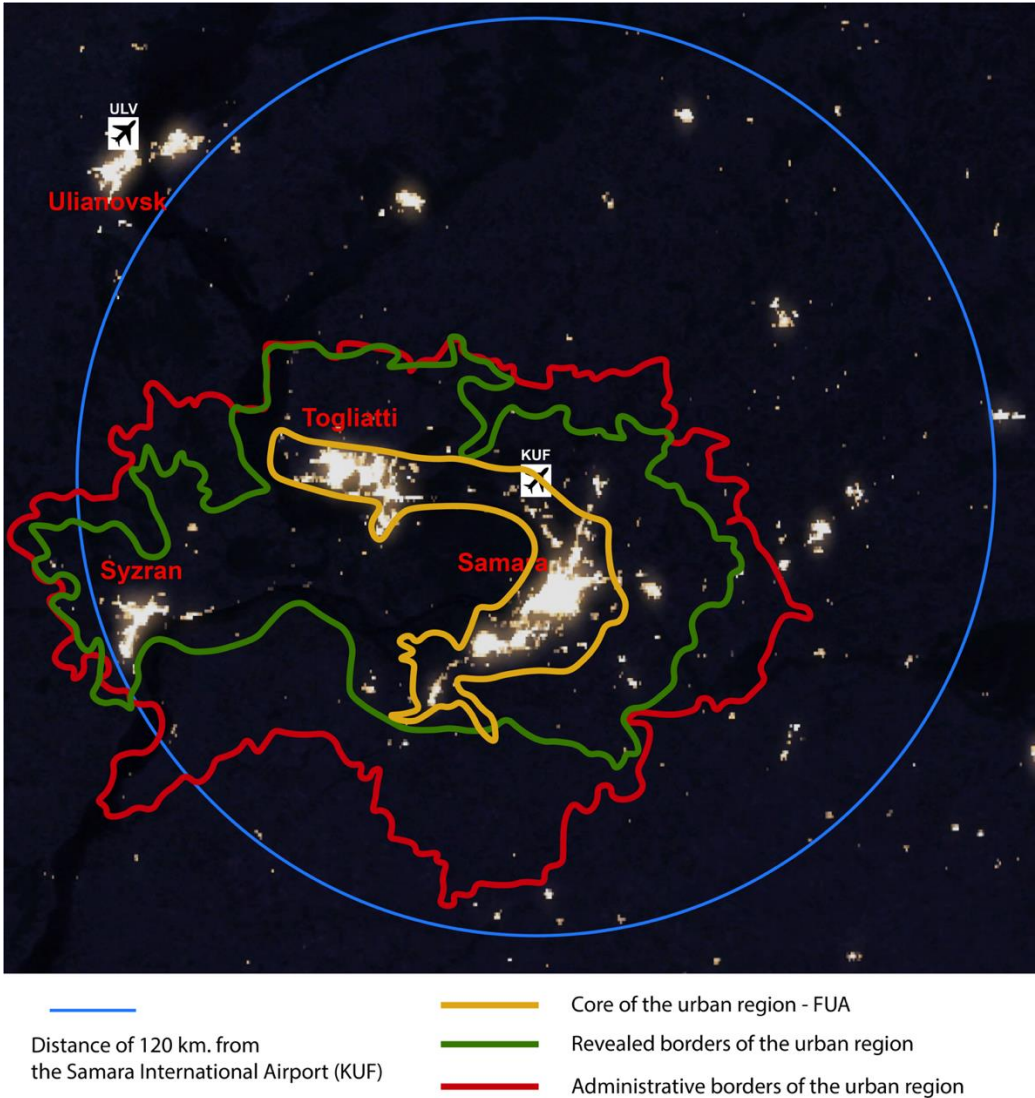
**Figure 5.** Samara – Togliatti Urban Region for strategic development.

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

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

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



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.

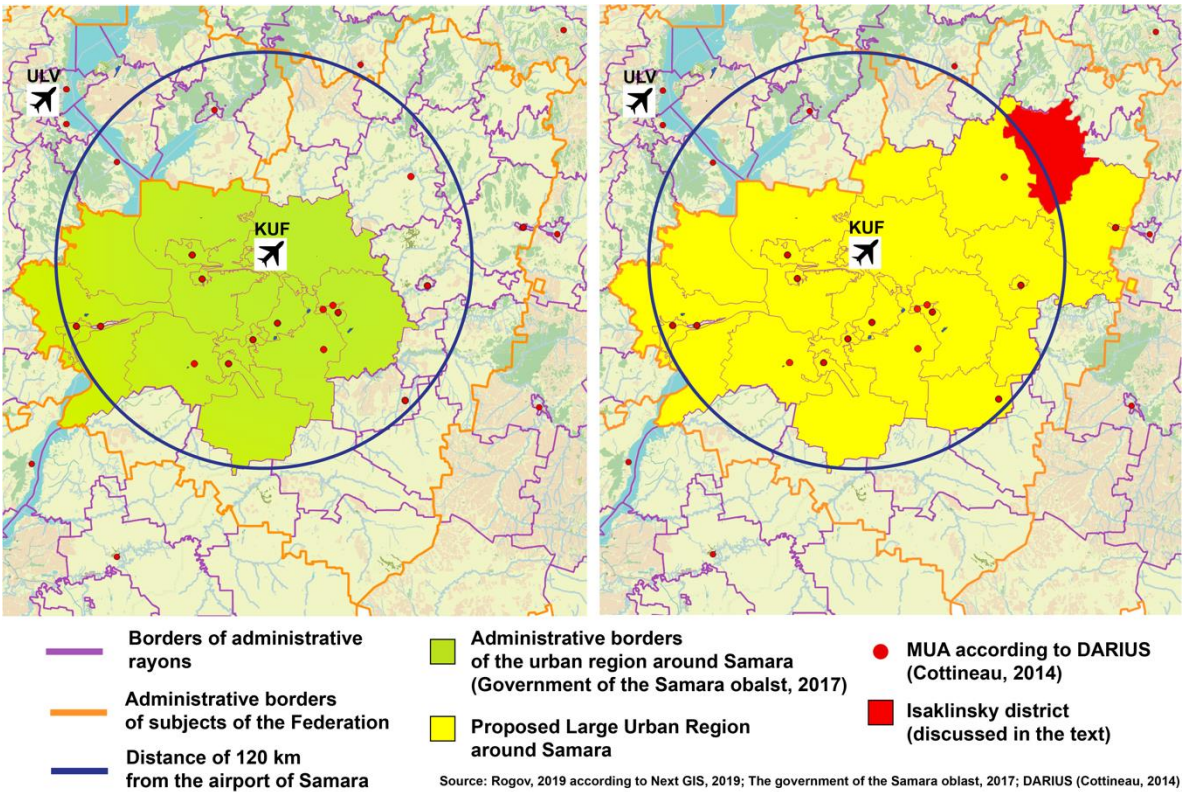
The principal airport (and the only one) of the whole region is KUF and is situated between the two defined cores: Samara and Togliatti. Therefore, due to its central position, it allows us to consider it as a central point for the potential LUR. Then, to include Syzran we should use a distance threshold

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



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

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.

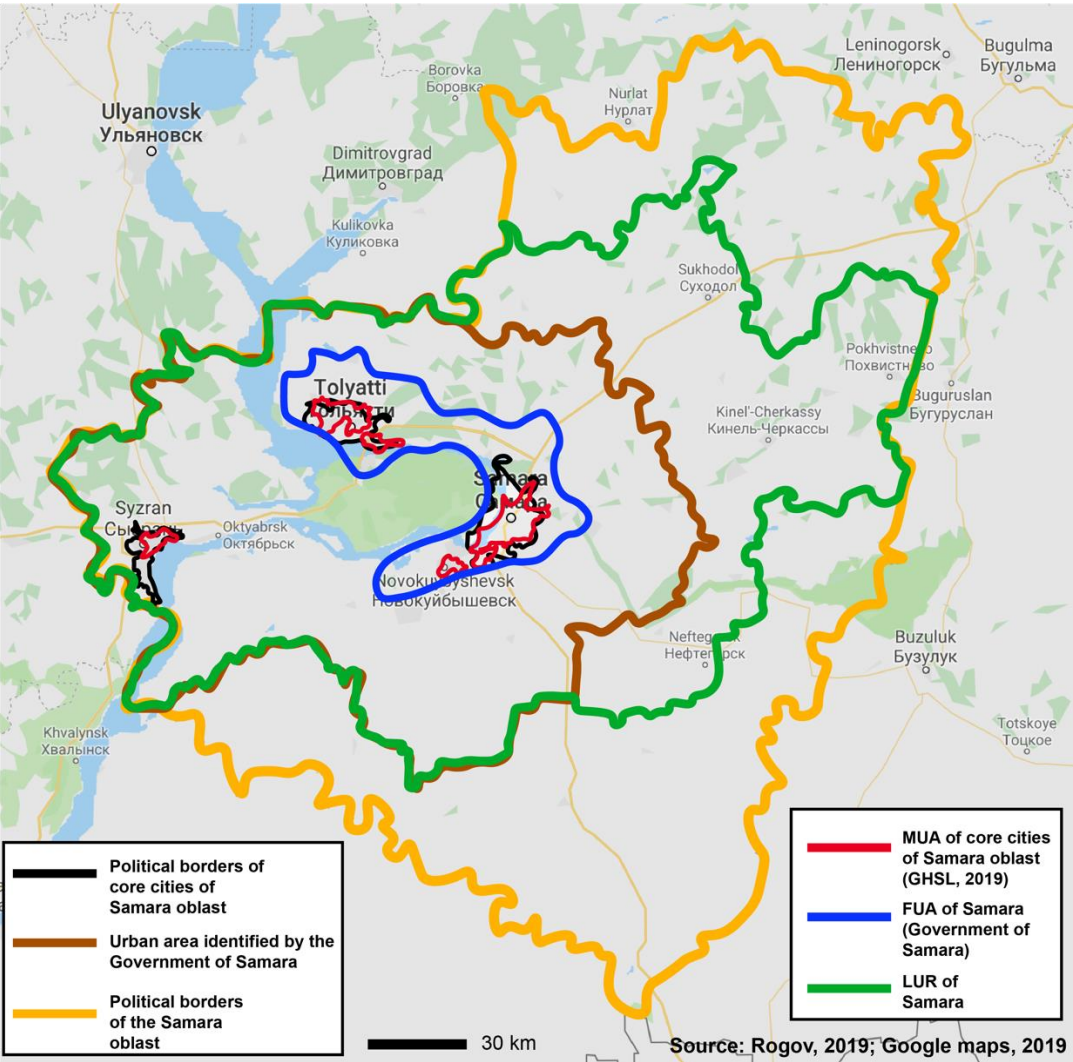


**Figure 8.** Resulting LUR of Samara compared with other delineations.

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

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



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

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

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

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

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

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

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

## 7. Resulting LURs in Russia

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

	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	OVV	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

\* Political borders; data source: Rosstat, 2018

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

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

To construct LURs we aggregated different types of the municipal formations<sup>9</sup> in Russia. All of these municipal formations have an official code OKTMO<sup>10</sup>, which has the following format: OKTMO is a code AA BBB CCC DDD, where AA is a code of a subject of the Federation; BBB is a code for a municipal district (munitsipalnyi rayon) or urban neighbourhood (gorodskoy okrug); CCC is a code for rural settlements (selskoe poselenie) or urban settlements (gorodskoe poselenie), which are continuous municipalities, and DDD is a code for a single settlement inside a municipality. In LUR 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).

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

#### 1. Municipality

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

#### 2. Functional Urban Areas

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

#### 3. Large Urban Regions

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

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

## 8. Conclusion

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

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

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

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

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

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## Appendix A

DATABASE: RUSSIAN LUR\_V1\_2019

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### *Keywords*

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

### *Theme*

Urban studies, regional studies

### *Language*

English, names of municipalities are also written in Russian

### *Spatial coverage*

The Russian Federation

### *Temporal coverage*

- Time lapse: 2018
- Publication date: July 2019
- Latest update: July 2019

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

*File's format:* .xlsx

*Creation date:* July 2019

*Dataset creator*

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

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*Responsible organization and person*

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*Type of spatial representation*

Controlled list limited to the following values:

- text table (textTable): Text or tabular data

*Spatial resolution (scale or minimum cartographic unit)*

Urban settlement (gorodskoe poselenie), rural settlement (selskoe poselenie), inter-settlement territories (mezhselennye territorii), and urban neighborhoods (gorodskoy okrug), which we all consider as municipalities.

*Geographic extension*

All Russian territory

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