SUSTAINABLE DEVELOPMENT
CROSSING BORDERS, BREAKING STEREOTYPES

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Eje cafetero *(Coffee belt, Colombia) – houses that once belonged to coffee plantation owners are converted into guesthouses and hotels. This zone is often visited by foreign tourists.*

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Megacity Buenos Aires and its most recent conurbation impact

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Introduction

Nowadays, the world has 33 megacities – urban areas which surpass 10,000,000 inhabitants (United Nations, 2018) – and six of them are located in Latin America: São Paulo, Brazil (21,650,000); Mexico City, Mexico (21,580,000); Buenos Aires, Argentina (14,967,000); Rio de Janeiro, Brazil (13,293,000); Bogotá, Colombia (10,574,000); and Lima, Peru (10,391,000).

From a physical point of view, they are the largest constructed urban areas. They are urban agglomerations of thousands of km^2, with physical structures that make an orientation towards global markets possible. Moreover, they are significantly influenced in an international manner: from a political point of view, through deregulation; from a social point of view, through socio-spatial polarisation; and from an ecological point of view, through the highest risk probability (Borsdorf, Coy, 2009).

One of the aspects which have been the centre of attention as regards the spatial evolution of megacities in Latin America is their large fringes. Firstly, the physical extension of the central city is considered; secondly, the conurbation process, which physically merges the city with neighbouring cities; and finally, the improvement in communication which favours its further extension by means of the creation of gated communities, aimed at social groups devoted to economic activities of the CBD (Central Business District) as the top of the interurban centre hierarchy. Finally, some megacities develop *outer cities* within the peripheral urban structure that are semi-autonomous urban spaces, which causes the fragmentation of their outer area into closed polygons that concentrate services and job positions in the tertiary and quaternary sectors of the economy.

Within this context, the aim of this work is to analyse the last great expansion of the Megacity Buenos Aires at the beginning of the 21st century. It underwent a lengthy conurbation process on the farthest fringes when it merged with five cities which were originally separated. Thus, the area of the Megacity Buenos Aires was expanded, and the number of inhabitants grew significantly both in quality and quantity.

This evolution was initially shaped by the leading role that the spatial evolution of the *grey infrastructure* in the area played; the visual empirical evidence was obtained through aerial photography survey for a previous investigation project (Buzai, Lanzelotti, 2019), which was ultimately proven through geo-informatics techniques.

The creation of a raster database in Geographical Information Systems (GIS) made it possible to capture and analyse the logistic growth of the agglomeration between 1869 and 1991, and the digital processing of satellite images of Earth at night allowed for the broadening of the study oriented to the determination of the most recent conurbation process of the megacity. On the maximum expansion axis, the outer border is 90 km from the CBD.

In the following section, the study area is presented, as well as methodological considerations, and cartographic and numerical results of the spatial evolution towards the formation of the current Megacity Buenos Aires. Thus, the spatial distribution and evolution of the agglomeration becomes an empirical spatial manifestation which presents, at a spatial level, contextual aspects corresponding to the incorporation of Argentina into the international economic context.

Study area

The majority of the studies aimed at spatially addressing the main urban area of Argentina are based on the concept of Gran Buenos Aires (GBA) (INDEC, 2003), which includes the Autonomous City of Buenos Aires (CABA) as a central city and 24 municipalities of the Province of Buenos Aires which surround it and constitute a broad conurbation area. Taking into consideration its functional relations with nearby urban areas, but separate from the continuous urban area, the *Dirección Provincial de Ordenamiento Urbano y Territorial* (DPOUyT, 2007) broadens the spatial determination of the INDEC by adding 16 municipalities. Therefore, they consider a greater extension that is formed by the functional entity that comprises 41 spatial units of an urban mosaic.

As the spatial structure, due to being on the coastline of the Río de la Plata, creates semi-circles around CABA as a central city, the concept of *rings* is used. In this sense, the model shows that GBA covers three rings and eight growth areas in urban expansion axes (Buzai, Marcos, 2012). Its most recent

conurbation took place on a fourth ring, although the considerable distance shows that the spatial development occurs mainly in sectors.

Taking into consideration the greater extent of the urban contiguity, Figure 1 shows the study area in full, highlighting the municipalities that correspond to GBA and those that are added and cover the outer area, which as a whole is called *Región Metropolitana de Buenos Aires* (RMBA) as an addition of municipalities that comprise the agglomeration of the Megacity Buenos Aires.

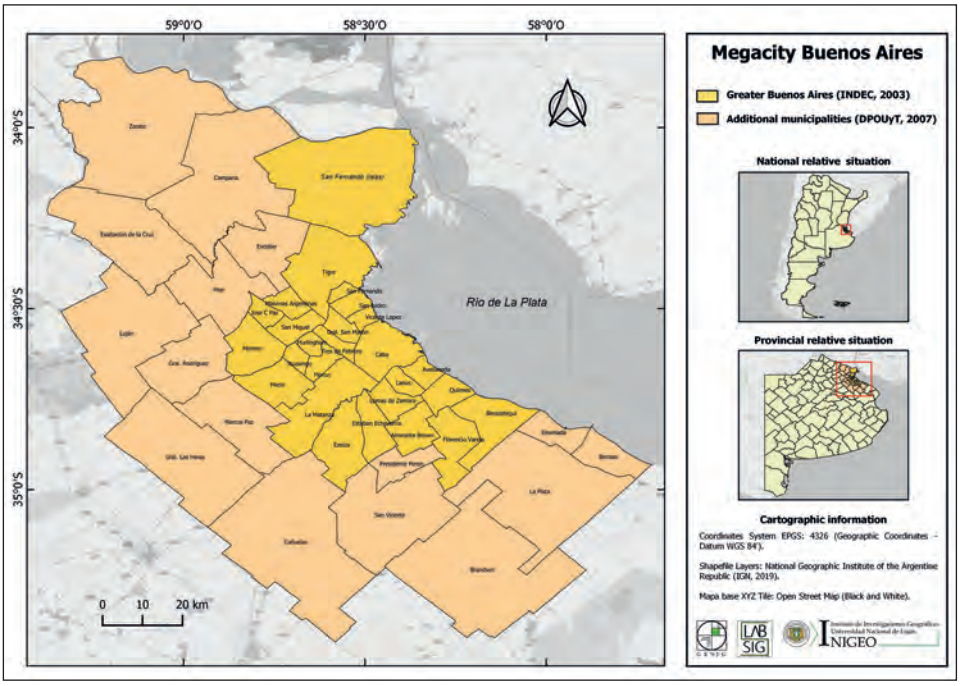

Figure 1. Megacity Buenos Aires. Spatial units (municipalities)

Source: The authors

Methodology

Studying the spatial evolution of GBA involves analysing the concept of agglomeration, i.e., the city as a physical entity which develops on the surface of various contiguous municipalities as a result of its expansion process.

Between 1869 and 1991, eight national population censuses were carried out in Argentina (1869, 1895, 1914, 1947, 1960, 1970, 1980 and 1991), which became a primary source of information along with cartographic contributions from Randle (1969, 1981), Torres (1975), Kollmann (1982), Clarín (1992),

Esso (1992), and Vapñarsky (1998, 2000). A unified database in GIS was created based on these works, which allowed for a cartographic comparison of all the aforementioned years.

The physical analysis of the city leads to the consideration of *adapted space* and *flow system* (Lynch, Rodwing, 1958) as operational concepts of cartographic representation, which are precursors of what nowadays is referred to as *grey infrastructure*.

The creation of thematic raster layers was focused on the flow system when it produced basic territorial units for the construction of adapted space and each 640 metre cell was classified according to the following categories: 1 or 0 depending on whether it belonged or not to the agglomeration each year. Each thematic layer shows the spatial distribution, and the overlay cartographic modelling makes it possible to determine its expansion.

The recent update of the agglomeration, which was complete in 2002 and 2012, was based on the processing of satellite images of Earth at night analysing the brightness based on its grey infrastructure. An extensive documentary and methodological revision as well as the detailed information regarding the sources of the satellite images used can be found in Buzai and Montes Galbán (2020) and Montes Galbán (2020).

On the basis of the said images, the spatial determination of urban coverage for the last period was achieved, considering a brightness threshold which would bring the area closer to the year 1991 as a reference year. The agglomeration was spatially determined in 1992, 2002 and 2012 with the aim of expanding and updating the database, which would allow for the in-depth study of the last two decades.

Spatial distribution and evolution of the megacity

During almost three decades, the spatial growth and configuration of the agglomeration of Buenos Aires has been studied, up to its development into the current megacity as a manifestation of economic, social, and demographic processes (Buzai, 1993, 1994; Buzai, Baxendale, 1998, 2011; Baxendale, Buzai, 2006; Baxendale et al., 2012, 2016) with significant environmental consequences (Baxendale, Buzai, 2006; Buzai, 2007; Morello et al., 2000, 2001).

Counting raster locations in each thematic layer gave rise to the possibility of producing quantitative information corresponding to the area of the agglomeration; the map overlay allowed for the observation of the growth between years; and the national censuses provided the total population by adding municipalities surrounding the central city, which is the Autonomous City of Buenos Aires (CABA) (Table 1).

Figure 2 shows on the left (A) the real time evolution, between 1869 and 2012, by means of a line chart based on the area in km^2 and, on the left (B),

Table 1. Quantitative information

Year	Area (km²)	Population	Period	Increment (km²)	Average annual increase (km²)
1869	33.21	187,126(1)			
1895	86.92	672,983(2)	1869–1895	53.71	2.07
1914	141.49	1,914,450(3)	1895–1914	54.57	2.87
1947	567.44	4,659,768(4)	1914–1947	425.95	12.91
1960	1,282.07	6,758,058(5)	1947–1960	714.63	54.97
1970	1,977.02	8,485,110(6)	1960–1970	694.95	69.49
1980	2,139.79	9,984,104	1970–1980	162.77	16.28
1991	2,317.32	11,271,049	1980–1991	177.53	16.14
2002	3,553.77	12,875,325(7)	1991–2002	1,236.45	112.40
2012	4,078.45	14,756,128(8)	2002–2012	524.68	52.47

Source: The authors

(1) CABA, (2) incorporates Avellaneda, (3) incorporates La Matanza, Lanús, Lomas de Zamora, Moreno, San Fernando, General San Martín, San Isidro, Tigre, Tres de Febrero and Vicente López, (4) incorporates Almirante Brown, Berazategui, Esteban Echeverría, Florencio Varela, Merlo, Morón and Quilmes, (5) incorporates General Sarmiento generating the GBA (initially CABA + 19 municipalities) and General Rodríguez, (6) incorporates Escobar, Marcos Paz and Pilar, (7) incorporates Gran La Plata, Luján, Presidente Perón and San Vicente – census data 2001 – y (8) incorporates Zárate-Campana – census data 2010.

the extent of the growth between the reference years by means of a bar chart which represents the expansion in km². The former allows for the determination of four periods based on the change of the gradient of the line, and the latter shows the extent of the growth between the said years.

Figure 2A shows a logistic growth in three stages between 1869 and 1991 and, a significant increase in its area due to the most recent conurbation between 1991 and 2012. Figure 2B allows for its confirmation based on the magnitude of the last two bars.

The spatial distributions and associations that led to the formation of the Megacity Buenos Aires are presented in Figure 3. In it, a vertical sequence on the left is included, as well as the maps of urban expansion of the agglomeration grouped in three defined periods between 1869 and 1991. This sequence shows a moderate growth in the initial period (1869–1947), an exponential growth in the second period (1947–1970), and a slow balanced growth in the third period (1970–1991). The representations obtained through the use of satellite images of Earth at night are also included for the fourth period (1992–2012). These images represent, in a vertical

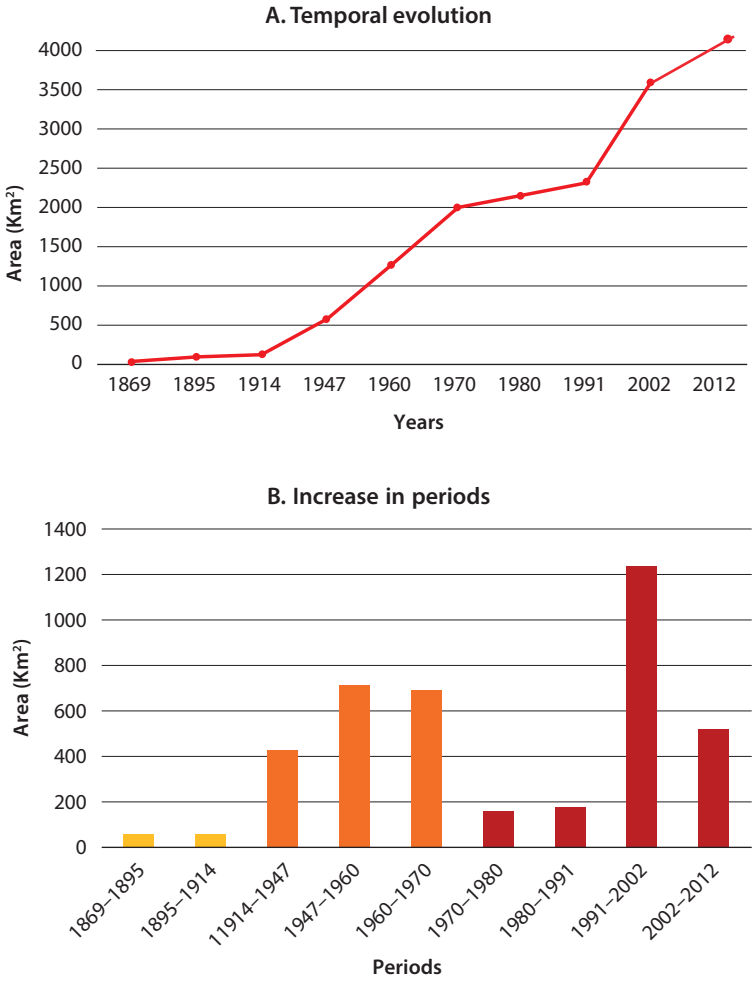

Figure 2. Megacity Buenos Aires. Representation of quantitative evolution (1869–2012)

Source: The authors

manner and on the right of the figure, the most recent conurbation process of the megacity.

The satellite image of Earth at night taken in 2002 shows a conurbation of three axes: 1) Gran La Plata, located in the Southeast as a conurbation area that consists of La Plata, Berisso and Ensenada, and which has 694,253 inhabitants; 2) Luján, located in the West as an intermediate size city which has 67,266 inhabitants, axis mapped in detail by Humacata (2015), and 3) San Vicente-Alejandro Korn, an agglomeration of two cities located in the South which has 56,818 inhabitants. In the image taken in 2012, a fourth axis is added to these conurbation sectors: 4) Zárate-Campana, an agglomeration of two cities located in the Northwest which has 206,058 inhabitants.

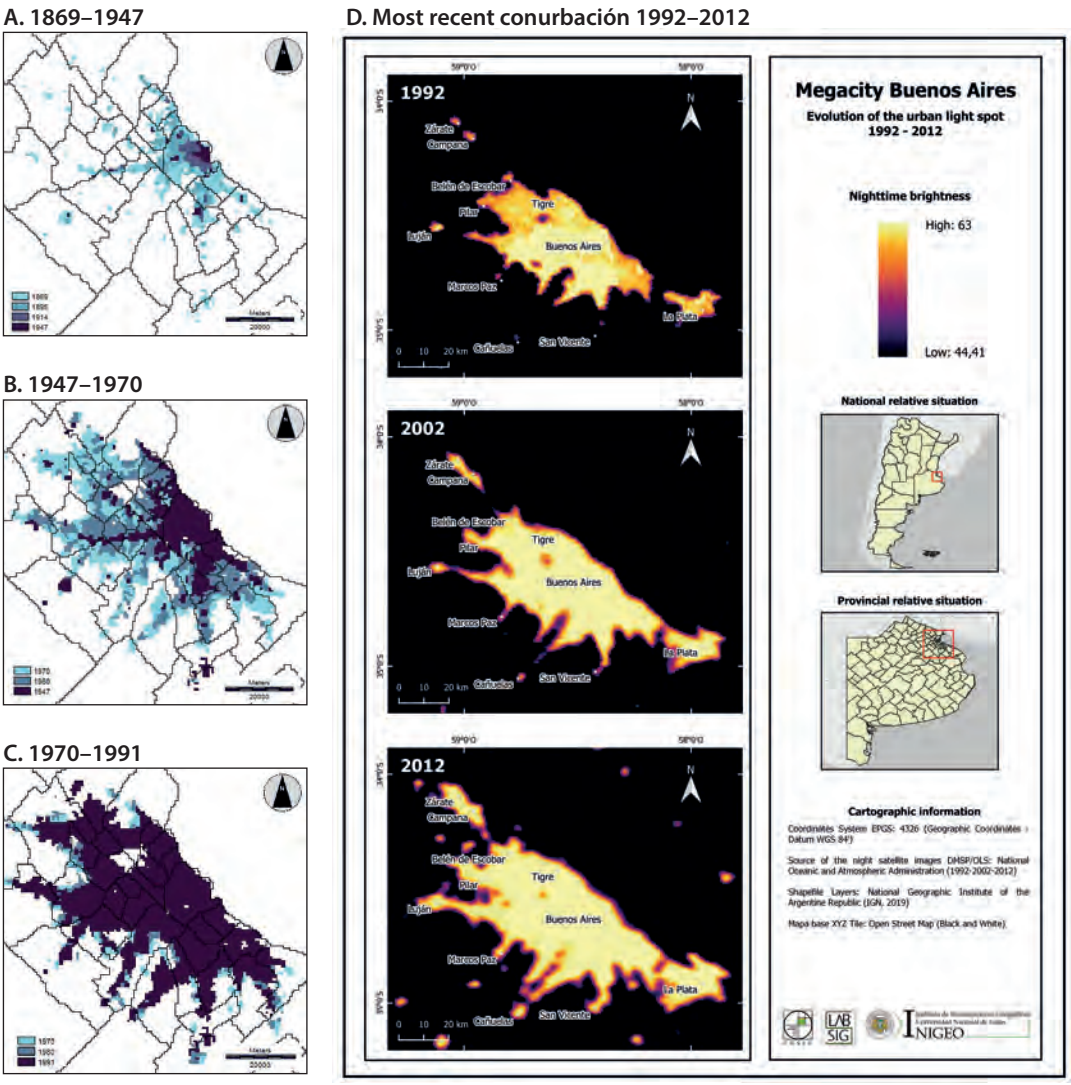

Figure 3. Megacity Buenos Aires. Spatial evolution 1869–2012

Source: The authors

Figure 4 illustrates a summary of the most recent conurbation. Within this figure, the distance of each growth axis in kilometres of each city incorporated to the CBD in CABA is shown. The average distance is 63.75 kilometres, and the maximum distance is 82 kilometres, which is as far as the city of Zárate.

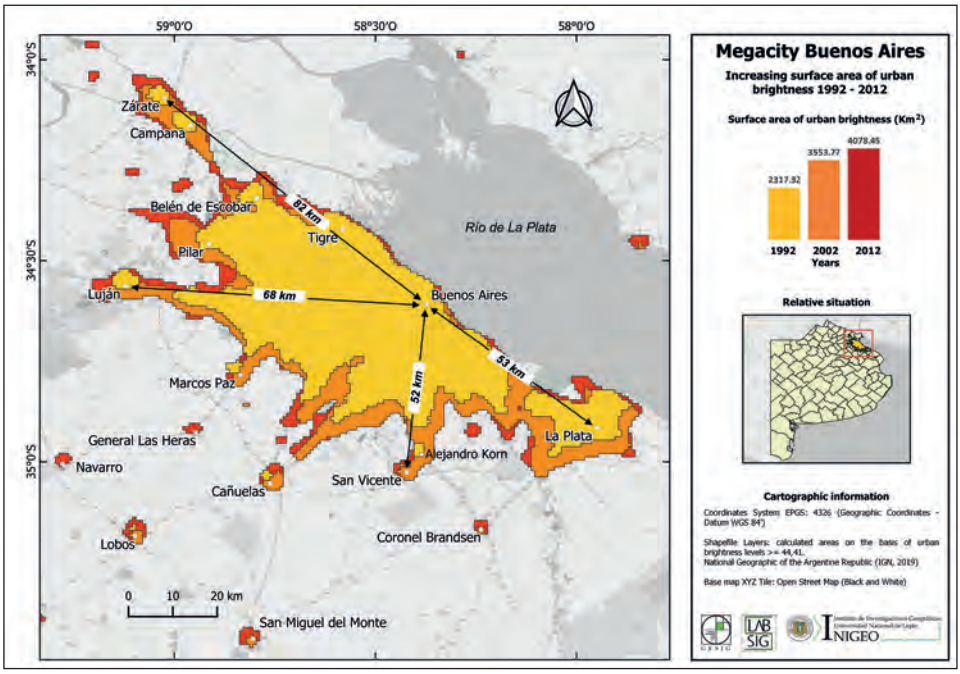

Figure 4. Megacity Buenos Aires. Most recent conurbation

Source: The authors

Interpretation of each period

Spatial Evolution between 1869 and 1991

In the first period, the initial, moderate growth that took place between 1869 and 1947 is the result of a major European migration and of the implementation of the railway and port infrastructure that incorporated the country into the new international division of labour as a primary producer, mainly producing leather, wool and, subsequently, meat and wheat. Highly fertile soils turned the Pampas into a geographical area of great worldwide value (Morello et al., 2001).

Within this period of 78 years, two sub-periods may be highlighted since, between 1869 and 1914, the radial urban growth began to take shape towards the port of Buenos Aires, where the CBD was located, following the main traffic lanes. There, a continuous agglomeration was determined towards the municipalities that bordered the central city, and the first sub-urbanisation process occurred (Torres, 1975) due to the extension of transport and the instalment sale of peripheral lands. Between 1914 and 1947, the spatial configuration of the agglomeration was characterised by the structured blocks that covered a high percentage of the surface of the central city, and the urban expansion reached,

in growth axes, a distance of 40 kilometres. In the aftermath of World War I, the economic crisis of 1930 and World War II, international trade was constantly reduced, and an emerging process of industrialization for consumption goods occurred in industries located in Buenos Aires, which continued to grow.

In the second period, the accelerated growth between 1947 and 1970 is the result of the deepening of the industrialisation process that began in the previous period. In this case, it focused on the manufacture of goods and industrial machinery in the heavy industry (including steel, chemical, petrochemical, and electronic industries). Multinational companies provided a significant international capital (Rofman, Romero, 1997) and, from a spatial perspective, the consolidation of Buenos Aires as a great source of employment was enhanced, thus receiving major migrations from the inland regions and neighbouring countries.

Even though CABA reached a demographic balance with nearly three million inhabitants, which remains stable to this day, municipalities that include the Gran Buenos Aires agglomeration had the largest population growth rate in their history, with 6% between 1945 and 1960 (Lattes, Rechini, 1992). By the end of this period, the municipalities of Vicente López, San Isidro, Tres de Febrero, Morón, Hurlingham, Ituzaingó, Lanús, and Lomas de Zamora became part of the agglomeration. The continuous urban area developed from the axes created by the railways and they extended to, on average, 50 kilometres from CABA.

In the third period, the slowdown in urban growth observed between 1970 and 1991 is related to the last stage of evolution of a logistic growth in which the urban sprawl reaches a growth limit. This took place within the context of a generalised economic depression caused by the competition against national industry that stems from the economic liberalisation (Kosacoff, Aspiazu, 1989).

Internal migrations slowed down along with the growth of the municipalities of Gran Buenos Aires. The growth of cities of intermediate size (50,000 and 1,250,000 inhabitants), which increase their percentage in the population distribution of the country from 24.84% to 33.28% (Sánchez, 1993), can be observed at a national level.

Despite this generalised tendency, during the 1980s, a new process of residential suburbanisation took place, mainly within the upper classes, in the form of peripheral closed polygons which are connected to CABA through highways. These undertakings were generically called gated communities, and created enclaves mainly located in the Northwest growth axis that fragmented the urban structure.

Most recent conurbation between 1992 and 2012

The 1990s is a period characterised by neo-liberal economy in which state-owned public utility companies were privatised. Argentina was definitely incorporated into the globalisation process due to the convertibility plan (1 Argentine *peso* = 1 American dollar) and the labour market flexibility.

Amid this situation, at an urban level, fragmented territorial configurations emerged and were strengthened as a result of the increasing social division. Soja (2000) analysed this as a tendency which is characteristic of the post-Fordist cities oriented to an economy based on financial services. From a spatial perspective, it shows enclosed and guarded spaces as a result of the construction of gated communities (*Carcereal Archipelagos*), the emphasis on socio-spatial differences in local spaces (*Fractal City*), and the emergence of new centralities mainly in highway crossroads (*Edge cities*), which, according to Tella (2001), represent the change from suburbs to post-periphery.

After the 2001 crisis, and a necessary political stabilisation in 2005, it is deemed that an expanding economic activity began with the overcoming of the fiscal deficit after the end of the convertibility plan amidst devaluation and the *pesification* of the economy, which began in 2002. Argentina produced a commercial surplus, and this placed the country as a primary producer again, mainly due to the demand for soy from China and nations of Southeast Asia.

Nationalist measures were introduced, which led to the government regaining control over privatised companies and over subsequent economic, social, and civic advances. In this context of shrinkage and closing of the economy, there were important corporate groups with benefits for large producers, such as the so-called *sowing pools* (Romero, 2019).

At a geographical level, the images show in which manner the interstices were completed between the main axes of the railway and road transport of a radial concentric design at the same time in which the agglomeration merged with outer cities. According to Vidal-Koppman (2014), the tentacle pattern becomes an insular pattern of strong demographic segregation and territorial fragmentation.

The growth of the agglomeration, which strengthens the current Megacity Buenos Aires, matches the models developed for the large cities of Latin America by Jurgen Bärh, Axel Bordorf, Larry Ford, and Günter Mertins during the 1980s and the 1990s, and specifically, with the model of *city of islands* presented by Michael Janoschka in 2002 (Buzai, 2016). During this last period, the foundation for these models can be determined as structures of a new geography of the urban structure processes of the megacities of Latin America (Buzai, 2020).

The Megacity Buenos Aires incorporates four cities of intermediate size to its continuous urban area with the most recent conurbation. Between 1991 and 2002, it incorporated Gran La Plata, Luján, and San Vicente-Alejandro Korn, and between 2002 and 2012, Zárate-Campana. This adds 1,213,905 inhabitants, resulting in a population of nearly 15 million inhabitants, which consolidates the city as the third megacity of Latin America.

Final considerations

This work represents a contribution to the spatial analysis of the Buenos Aires agglomeration since the first national population census in Argentina.

Delimiting the urban sprawl for each year allowed for the definition of four characteristic periods of the urban structures regarding general national, economic, and political context.

The study considers a spatial focus within a complex system formed by different levels of analysis and representation (García, 2006). Within this framework, spatial distributions and their evolution are provided in four periods in relation to wider contexts with specific characteristics.

The confluence of theory, methodology, and techniques of spatial analysis made it possible to obtain a new confirmation as regards the recent spatial evolution of the Megacity Buenos Aires. At the turn of the century, it was determined that its last growth occurred as a result of conurbation, which incorporated into the agglomeration five urban areas that surrounded its fringes, whose distances from the CBD were between 42 km and 82 km.

The satellite images of Earth at night made it possible to get a new perspective of the agglomeration as they clearly show the adapted space and the flow system as *grey infrastructure*. These images allowed for the update of the size of the Megacity Buenos Aires regarding the surface, extension, and population, in addition to the dynamism amid mixed urban growth that arose as a result of the joint evolution of the growth fragmented due to the closed urbanisations in the interstices and the merging of urban areas from the far peripheries.

The Megacity Buenos Aires is an important example of urban development in one of the largest urban areas of Latin America within the social, economic, and political framework of the current globalisation.

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Abstract

Megacity Buenos Aires and its most recent conurbation impact

Some three decades of work have allowed us to analyze the spatial trends of the Buenos Aires agglomeration in order to define its shape and distinctive phases of expansion as indicators of the economic and socio-demographic history of Argentina. We consider urban geometry a spatial manifestation of multiple processes; its modelling was carried out from census data, from 1869 to 2001. In this lapse of time it is possible to define distinct periods: Argentina as agro-exporter (1869–1914); initial industrial development of consumer goods (1914–1947); development of base industries based on international capital (1947–1970); de-industrialization processes and financial modifications (1970–1991); deepening of neoliberal policies, convertibility and crisis (1991–2001); and the turn to the nationalist and populist left (2001–2015). The presentation focuses on the latest expansion of the Buenos Aires agglomeration, a conurbation process which integrates intermediate-sized cities of contiguous municipalities. The expansion process developed along five axes that incorporate different cities of the metropolitan region to the urban area at a median distance from the main center (the CBD, Central Business District) of 61 km. The development of the grey infrastructure, as an urban continuum, made it possible to capture its current configuration via the analysis of night-time satellite images. Based on this structure, the megacity Buenos Aires exceeds approximately 15 million inhabitants in an urban area of some 4,000 km^2, consolidating itself as the third largest metropolitan area in Latin America.

Keywords: Buenos Aires, megacity, urban sprawl, conurbation, socio-spatial periodization

Thousands of pages have already been written on sustainable development. However, the subject is still relevant. Processes occurring in the environment, especially the climate change, only emphasize the need for further research and discussion on the subject. In this monograph we return to the issue of understanding and implementing the idea of sustainable development in Poland and Latin America. We also join the discussion on sustainable urban development and governance. Finally, by presenting a few examples, we address the issue of the conflicting nature of sustainable development policies in some countries and regions. The book also introduces the reader to the issue of education on sustainable development.

This publication is a continuation of the topics discussed in earlier monographs, which were the result of joint research of Polish and Latin American geographers within many projects dedicated to urban issues. Academics of the Faculty of Geography and Regional Studies of Warsaw University have been lecturers at doctoral studies in urban and regional sustainable development and post-doctoral studies in Earth and Environmental Science at the University of Manizales in Colombia (Doctorado en Desarrollo Sostenible y Posdoctorado en Ciencias de la Tierra y el Medio Ambiente). Doctoral students and lecturers from the University of Manizales have visited Poland many times in joint symposia and workshops. In 2017 a Polish-Colombian monograph in Spanish was published in Colombia and in 2018 two scientific monographs, both in Spanish and English, were brought out by the University of Warsaw Press. This volume is the second of the two published in 2021 and contains only English texts on sustainable development, risk and local development in Poland, Colombia and some other Latin American countries.

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