Megalopolis: An Assay for the Identification of the World Urban Mega-structures

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The 20th Century. Century of the urbanization

From suburbanization (end of the XIX Century) to metropolitanization

The worldwide spread of the automobile, improving communication infrastructures (road networks) and the endless growth of the peripheries (peri-urbanization) brought the generalization of urban sprawl

The extension of the urbanization process to the developing world: a change in the geography of the urbanized world

The oil crisis and changing production model of Fordism

The counter-urbanization of Berry (1976), the desurbanization of Leo van der Berg (1982), the sprawling city of Indovina (1990), rurbanization, etc.

A crisis of urbanization in the last quarter century?
World Renaissance: Changing roles for people and places

Desurbanization or ....
World Renaissance: Changing roles for people and places

... change in the geography of the urbanized world?

<table>
<thead>
<tr>
<th>Percentage urban</th>
<th>1950</th>
<th>1975</th>
<th>2000</th>
<th>2030</th>
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<td>37.9</td>
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<table>
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<th>1975</th>
<th>2000</th>
<th>2030</th>
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<table>
<thead>
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<th>Urban population</th>
<th>1950</th>
<th>1975</th>
<th>2000</th>
<th>2030</th>
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<td>0.75</td>
<td>1.54</td>
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<table>
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<th>Development group</th>
<th>1950</th>
<th>1975</th>
<th>2000</th>
<th>2003</th>
<th>2030</th>
<th>Rate of urbanisation (%)</th>
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<tr>
<td></td>
<td>1950-</td>
<td>1975-</td>
<td>2000-</td>
<td>2030-</td>
<td></td>
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<tr>
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<td>37.1</td>
<td>38.7</td>
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<td>54.5</td>
<td>1.47</td>
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<td>Europe</td>
<td>51.2</td>
<td>66.0</td>
<td>72.7</td>
<td>73.0</td>
<td>79.6</td>
<td>1.02</td>
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<td>Latin America and the Caribbean</td>
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<td>61.2</td>
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<td>76.8</td>
<td>84.6</td>
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<td>73.8</td>
<td>79.1</td>
<td>80.2</td>
<td>86.9</td>
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<td>Oceania</td>
<td>60.6</td>
<td>71.7</td>
<td>72.7</td>
<td>73.1</td>
<td>74.9</td>
<td>0.67</td>
</tr>
</tbody>
</table>
In 1915, in Cities in evolution, Geddes anticipated the concept of megalopolis:

‘The expectation is not absurd that the not very distant future will see practically one vast city-line along the Atlantic Coast for five hundred miles, and stretching back at many points; with a total of . . . many millions of population’

Geddes used the term conurbation to refer to the future city, but in a previous work, in 1904, he had already suggested the term megalopolis.

Mumford was the first to use the term 'megalopolis' repeatedly. The 4th chapter of The Culture of Cities (1938), for example, is titled 'The rise and fall of Megalopolis' and he develops his thesis on the six stages of urban development: from the 'Eopolis' (village) to the 'polis' (association of villages) thereof to the 'Metropolis' (the capital city emerges), the 'megalopolis' ('the beginning of the decline'), the 'tyrannopolis' (the overexpansion of the urban system based on economic exploitation) and finally to the 'Nekropolis' (war and famine, city abandoned)
The concept of Megalopolis

Gottmann

It is certainly Gottmann (1957, 1961) to whom we owe the original work on the change of scale occurred in the urbanization. Gottmann in his book Megalopolis: The Urbanized Northeastern Seaboard of the United States, opened the systematic study of urban mega-regions. In the words of Gottmann:

“In 1950, on the basis of the new census, the Bureau of the Census prepared a map, later published as an illustration to a booklet of statistics on State Economic Areas, which showed clearly the continuity of an area of "metropolitan" economy from a little north of Boston to a little south of Washington (...). This seemed to be a first statistical demonstration on the map of the existence of a continuous stretch of urban and suburban areas, the main NE-SW axis of which was about 600 miles long, and within the frame of which dwelt even in 1950 some 30 million people. (...)The super-metropolitan character of this vast area, the greatest such growth ever observed, called for a special name. We chose the word Megalopolis, of Greek origin”
The concept of megalopolis: a complex and polemic concept

Peter Hall

(1973) A physical and functional reality or an analysis tool?

P. Hall recognized that only five superstructures on a global scale deserve the name of megacities:

- Northeastern Urban Complex (the east coast of the United States),
- Great Lakes (Chicago, Detroit and Cleveland),
- The Japanese Megalopolis (Tokyo, Yokohama, Nagoya and Osaka -Kobe),
- The North-West European Megalopolis (the Randstad and the Rhine-Ruhr),
- The area called England Megalopolis

Phenomenon, all of them in the developed world
Identification of Megalopolis

First approach: geographical and functional approach

His approach was functional, qualitative, as juxtaposition of metropolitan areas (which came as defined by the Census functional areas of daily commuting residence / work). The notion of contact, coalescence and overlap (Clawson, 1971; Hall et al, 1973) functional metropolitan areas, is therefore the primary factor that allows identification of Megalopolis.
Definition of Megalopolis

Second approach to the definition of megalopolis is the analysis of the spatial patterns of density of the human settlements.

Morrill (2006), updated the work of Gottmann through the consideration of the Urbanized Areas of the USA Census Bureau, which shows the evolution of the megalopolis of Boston-Washington between 1950 and 2000. The work allows to see how the criterion density is not an efficient mechanism for defining megacities. Not only because of the discontinuity of densely populated areas, but the proliferation from the 70's of the phenomenon of ex-urban sprawl.
Definition of Megalopolis

The third of the methodologies developed in the literature is the **morphological approach**, which emphasizes continuity of development, materialized mainly from structural axes of communication.

This methodology is inspired by the first criteria that were developed for the definition of the urban phenomenon in the era of metropolitan growth. Conurbations, once gone beyond the administrative borders of the central city, came to be defined under strictly **physical criteria**.

Contiguity of urban growth is presented as well as the decisive factor for the distinction between the city and its rural surroundings.
World Renaissance:
Changing roles for people and places

Megalopolis
This approach, which is certainly the most used in the literature, does not respond to specific quantitative methodology, but responds to an intuitive vision, based on the professional knowledge of urban planners. From this approach, the Lincoln Institute of Land Policy, together with the Regional Planning Association and the Pennsylvania School of Design, developed in 2004, the proposal called Toward an America Spatial Development Perspective, which proposed a qualitative change in the territorial management of United States that exceeds the merely local (place, county) and even metropolitan proposing megalopolis as basic territorial ambit of planning.
Our Methodology

The present study parts from the satellite images, especially those derived from the night lights, represents the most useful contribution to the delimitation of megalopolis.

The delimitation of the megalopolis on a global scale has been made by analyzing the image of night lights that in 2013 NASA has published and called Black Marble.

This new image of the Earth at night is a composite assembled from data acquired by the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite over nine days in April 2012 and thirteen days in October 2012.
First: we analyzed the file supplied by NASA, which offers, in the visible spectrum, three images (RGB) differentiated from night lights.

Then we proceed to the composition of a single image in conventional greyscale palette (0-255)
Methodology

Second: The image conversion from greyscale to elevations allows developing contours at different intensity levels, capable of identifying different hypothesis of global cities.

In this regard, we’ve been tried different alternatives, which have led to adopt the level curve on the intensity 64 (¼ of the light intensities analyzed 256).

Source: Self prepared from NASA (2013).
Methodology

This light intensity (64 of 256) allows a better identification of megalopolitan structures than alternative thresholds. For example, the intensity of light reflected by the ice at the poles is around 40, and very close to the light intensity of 38 is the reflection of the sandy deserts.

The analysis of these results, contrasted from the local knowledge has led to consider the threshold of 64 the best for the delimitation of the global megalopolis.

Source: Self prepared from NASA (2013).
Methodology

The contours of light (2012) with intensity equal to or greater than 64 have allowed to identify the lighted urban continuum, which have been aggregated into larger structures when there contiguity per vertex, or separation of one pixel at most, as can be seen in the image, where the agglomerations are shown, Boston (in white) and New York (in red).

Source: Self prepared from NASA (2013).
World Renaissance: Changing roles for people and places

Methodology

Finally, we’ve estimated the population of the continuing intensity contours of 64 or higher by overlapping the information of population (2008) of the LandScan database developed by the Oak Ridge National Laboratory, USA.

LandScan allows to analyze the population structure of different environments in the urbanized planet, with a close approximation to the reality.

Spatial distribution of the human population for Calcutta

Source: Self prepared from LandScan (2008).
Overlapping the lighted contours with intensity of 64 and the LandScan database has allowed to calculate the population of the same area, identifying planetary megalopolis (2008-12).
### World Renaissance: Changing roles for people and places

#### Results

Following the work begun by Florida et al (2008), using the methodology of nighttime satellite images as a method for the delimitation of the megalopolis, our analysis allows:

- The worldwide identification of 444,502 populated areas illuminated with sufficient intensity (64 on a scale of 256) for consideration of urban nature.
- 433 of these illuminated areas reach a population of over one million inhabitants, concentrating 2,537 million inhabitants, 37.8% of the population of the planet.
- 92 over 5 million represent the seeds of megalopolitan structures.
- And 30 structures, that we call proto-megas, exceed 15 million, reaching a population of 1,298,757,300 inhabitants, placing as strong candidates to be characterized as megalopolis.

#### Population (intensity 64)

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<tr>
<th>Population Range</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Accumulate</th>
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<td>&gt; 20,000,000</td>
<td>24</td>
<td>.005</td>
<td>0</td>
</tr>
<tr>
<td>10,000,000-20,000,000</td>
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<td>0</td>
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<td>5,000,000-10,000,000</td>
<td>45</td>
<td>.010</td>
<td>0</td>
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<td>1,000,000-5,000,000</td>
<td>341</td>
<td>.077</td>
<td>1</td>
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<td>500,000-1,000,000</td>
<td>366</td>
<td>.082</td>
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<td>.523</td>
<td>7</td>
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<td>.552</td>
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<td>10,000-50,000</td>
<td>12,325</td>
<td>2,773</td>
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<tr>
<td>5,000-10,000</td>
<td>12,371</td>
<td>2,783</td>
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<td>1,000-5,000</td>
<td>57,357</td>
<td>12,904</td>
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<td>100-1,000</td>
<td>133,982</td>
<td>30,142</td>
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<tr>
<td>&lt; 100</td>
<td>222,892</td>
<td>50,144</td>
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<tr>
<td>TOTAL</td>
<td>444,502</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Results

26 megacities with a population exceeding 20 million, concentrating 1,374,291,094 people in their environment.

These megalopolis are distributed throughout the entire planet.

Asia highlights the presence of 18 large agglomerations: 2 transnational (India-Pakistan and India-Bangladesh), 5 in India, 6 in China (5 in the continent and one in Taiwan), and 1 in Japan, Indonesia, Korea, Philippines and the Middle East.

America (4 megalopolis)

Europe (3 agglomerations)

Africa (1 agglomeration)

It demonstrates the global extent of the geography of the megalopolis. Only Oceania is free of such urban agglomerations.

Source: Self prepared from LandScan (2008).
## World Renaissance:
### Changing roles for people and places

<table>
<thead>
<tr>
<th>Megalopolis</th>
<th>Population</th>
<th>Area</th>
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<tbody>
<tr>
<td>Indian-Pakistani</td>
<td>228,482,082</td>
<td>232,063,48</td>
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<tr>
<td>Java Island</td>
<td>97,818,609</td>
<td>44,643,43</td>
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<tr>
<td>Yang Tse Delta</td>
<td>83,378,386</td>
<td>61,635,58</td>
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<tr>
<td>Hokaido</td>
<td>82,274,578</td>
<td>44,337,03</td>
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<tr>
<td>Nil River</td>
<td>80,651,862</td>
<td>62,816,61</td>
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<td>Beijing</td>
<td>78,835,106</td>
<td>63,641,85</td>
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<td>Central Europe</td>
<td>59,742,557</td>
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<tr>
<td>Zhengzhou-Xian</td>
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<td>40,309,40</td>
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<td>Pearl River</td>
<td>52,078,700</td>
<td>27,233,41</td>
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<tr>
<td>NY-Boston-Washington</td>
<td>49,685,899</td>
<td>85,170,18</td>
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<td>South Korea</td>
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<td>50,657,30</td>
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<td>Calcutta</td>
<td>42,878,107</td>
<td>18,984,73</td>
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<td>Uttar Pradesh</td>
<td>42,072,613</td>
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<td>England</td>
<td>38,782,052</td>
<td>43,635,51</td>
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<td>35,554,545</td>
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<td>15,221,38</td>
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<td>28,727,901</td>
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<tr>
<td>Ahmedabad-Silvassa</td>
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<td>24,455,59</td>
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<td>26,066,431</td>
<td>5,035,99</td>
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<tr>
<td>Dhaka</td>
<td>21,729,747</td>
<td>6,114,48</td>
</tr>
</tbody>
</table>

Source: Self prepared from LandScan (2008).
World Renaissance: 
Changing roles for people and places

Results

Six megalopolis stand out for its extraordinary population size, with a population exceeding 75 million.

These megalopolis are what might be called the premier league of world urban agglomerations.

All of them located in Asia, with the exception of an African: the Indian-Pakistani, Java Island, Yangtze Delta, the island of Hokkaido, the Nile and Beijing agglomeration.

No European or American megalopolis between these giants.
World Renaissance: Changing roles for people and places

Results

The large conurbation of Central Europe, which stretches from Brussels Dutch Randstad, the Rhine-Ruhr, Strasbourg and Stuttgart.

London to Cardiff and Bristol

Birmingham, Sheffield, Manchester, Liverpool and Leeds, on the fourteenth place,

The vast agglomeration of northern Italy, which it extends from Milan to Venice, in the twenty-first.

The American megalopolis par excellence, the US Northeast (Boston - New York - Philadelphia - Baltimore - Washington), does not appear until the tenth place ranking, preceded by the two large Chinese structures Zhengzhou - Pearl River Xian.

The rest of American megalopolis is reduced to other giant, the large urban agglomeration around Mexico City, which only appears in the fifteenth place,

Sao Paulo - Santos, on seventeenth

Los Angeles - San Diego - Tijuana (Southern California), which is the penultimate of the 26 megacities obtained in the present study.

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Conclusions

We can concluded that megacities are a new form of urban settlement that affects the entire planet.

This fact is not a phenomenon exclusive of the first world versus what the pioneering work of Geddes, Mumford and Gottmann seemed to suggest.

Latin America, Africa and especially Asia, are also protagonists of these new forms of occupation of space.

Emerging urban territories seem to make out a new economic and social order in Europe.

North America will no longer have the unique role of protagonists.
Thanks for your attention!

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