Metropolitan Cartography: An Inventive Practice Tool for Caring Metropolitan Landscapes

Antonella Contin[1] **, Valentina Galiulo**[12] **, Domingo Sánchez Fuentes**[2]

[1]Politecnico di Milano, Milano, IT
[2]Escuela Técnica Superior de Arquitectura de Sevilla, Sevilla, SP

ABSTRACT: To focus on issues of the resilient city on the metropolitan scale, it is important to understand the metropolitan city as a system that uses complementary actions to work with local projects for maintenance to preserve, improvement to increase, and transformation to grow, increasing the scale of local projects. Metropolitan City is a system that allows places to relate to each other in order to implement and care for metropolitan landscapes and their resources. To outline and give a spatial image to these relationships, the maps of Metropolitan Cartography are projects that identify the spatial components that make the landscapes dynamic, order spatial categories according to a new taxonomy for mapping the urban-rural interdependence of spaces, and structure gradients of tonal rhythms of landscapes that can be reprogrammed for new inventive patterns of land-use.
Metropolitan Cartography (MC) is therefore a methodology capable of interpolating spatial data in a new synthetic map for digital design practices. With MC maps, it is possible to spatialize new land-use patterns from the global to local scales by mapping open-source data obtained through data mining, data setting, and data graphic semiology following the metropolitan architecture design process. In particular, the Metropolitan Cartography experiment allows us to contextualize qualitative and quantitative open-source data, finding and highlighting implicit relationships between heterogeneous informative layers which help to characterize the state of care and neglect of metropolitan landscapes at 'southern latitudes'.
Thus, the operational findings of Metropolitan Cartography maps for caring Metropolitan Landscapes are outlined as methodological steps that make visible spatial relationships not yet detectable on the ground, which can be shaped by interpolating geographical, social, and economic factors.
The maps allow for stages of project design and practices through repeatable and scalable open-data processing, which grants and supports sequences of logical choices for metropolitan architecture projects.

KEYWORDS: Metropolitan Cartography, Caring Metropolitan Landscapes, Digital Design, Inventive Practice, Open-data Processing

INTRODUCTION

Uncoupling the word 'resilience' from the metropolitan project

To focus on issues of the resilient city on the metropolitan scale, is important to start by analysing the concept of the metropolis.
A metropolis is a system that uses complementary actions to work with local projects for maintenance to preserve, improvement to increase, and transformation to grow, boosting the scale of local projects. It is a system that allows places to relate to each other in order to implement and protect the territory and its resources. This is why we have introduced the 'metropolitan discipline'.

The metropolitan discipline addresses the complexity of the metropolis according to its physical, social, economic, and governance dimensions, understood and described in a theoretical framework called Metropolitan General Principles and Issues (MGIP). We define the conditions for dialogue and mutual understanding between different disciplines with the MGIP (common premises) and Glossary (common language). Using these, TELLme (an educational proposal under an Erasmus EU co-financed project) frames methodological steps, from Metro-dology to Metropolitan Cartography (Contin, Galiulo, 2020), for applying the MGIP to concrete metropolitan contexts. Metropolitan Cartography is used to establish relationships among selected elements and to refer simple data to the concepts of the discipline and digital tools such as TELLme Hub, where the maps are visualized (Contin et al, 2021).

Metro-dology is also at the core of the TELLme project. It is the base used to build the pilot training experiences and training programme guidelines within the framework of the transverse competencies and management skills it aims to develop. Since the discipline is conceived as a theory built on practice, the influence of the tools predominates. The most relevant for training and cartography is the MGIP/Glossary, a software prototype deeply tied to project outputs.

In order to define a metropolitan architecture project, we argue that the interaction between the morphological, material, and discursive dimensions shapes the sense of corpo-reality as a structure of the habitat. In the context of bigness (Koolhaas, 1995), the imagined and desired sensory dimension produced from the spatial practice and experience of a society composed of bodies consubstantiates the act of inhabitation.
Beyond constituting the hinge of the metropolitan structure between green and grey infrastructure, the task of the metropolitan architecture project is to construct the affective scene, the new form of metropolitan urbanism, and strengthen a feeling of adequacy between the places and inhabitants. This achievement will increasingly consider the metropolitan landscape as a value, and economically important, understood as cultural built heritage and natural capital, one of the most critical elements for understanding the profound meaning of metropolitan public goods.

This question relates to the possibility of resilience for cities in 'southern latitude' countries, which are growing by 5% or more every year (Un-Habitat,2020). Obviously, the future tense posed by the radical problem of the cities' rate of growth indicates that the metropolitan architecture project cannot be reduced to the past, except as the past of the future. Resilience is not an antidote to the fear of climate change; the fear of loss remains as it is. Instead, we need to understand its reality (herein lies the meaning of our risk maps), which also includes transforming the city into a metropolis through predictive technologies and the algorithms of metropolitan managers and climate experts. However, the metropolis will not be realized as anticipated in the algorithm.
This is the problem of the future. What does the algorithm that plans and manages our future and that of cities look like, so that we can fix the certainty of today? Fixing the proper terms of the algorithm today provides certainty about the future. This is the value of the tool that we have called Metropolitan Cartography. Before executing the works of what has been managed through an algorithm, we create a deep understanding of 'where' to recognize what cannot be erased (also using the Glossary software with keywords and related concepts).

1.1 What is the value we want to preserve for the near future?

For people emerging from a tribal phase, the practices of their remote past are the 'values'. The problem lies in the gap between values that are 'inadmissible' due to modernity, yet are present in the practices and 'values' now shared on a global level, which are the opposites of these practices. This problem is expressed in the question: How can endemic populations tune the 'other' values brought by globalization? This is the problem behind resilience.

In these contexts, the world's large banks finance infrastructure projects that will shortly be promoted and preserved as a memory of today because such projects, as new epicentres of the metropolitan city, are necessary for the metropolis to exist.
The problem, then, is that in cities with this annual growth rate, we can go from no city to metropolis, and this will happen tomorrow.
However, the word 'metropolis' does not precisely fit today's cities, which are instead explosions towards the metropolis.
The study of the metropolitan architecture project must therefore be left to scientists questioning what this very rapid transition from zero city to metropolis should be like today. This corresponds to an equally radical shift from tribal populations to somewhat technically equipped populations. Who will be the new citizens and how will revised tribal practices and state-of-the-art techniques fit together? That is the question lying at the heart of research concerning Metropolitan Cartography.

Our goal is to recode the model of city and territory on the metropolitan scale, which constitutes the pertinent horizon of the system of discourse and signification between all phases to construct the metropolis. Methodologically speaking, however, it will be challenging to find intellectual coherence between the different cultural perspectives, even if only through assonance.
The city that serves as a model for everyone today is the smart city. Therefore, the initial question is why this model is not admissible in the 'southern latitudes' of metropolitan landscapes? To argue this, we would have to show that it is not permissible due to their cultural basis, territorial exposure, and sensitivity.

It may happen that a tribal country finds itself at a global conjuncture so powerful that it creates a metropolis even if the context lacks such preconditions, which now belong to the sphere of new techniques and technologies. A city can therefore remain tribal but know how to use the necessary techniques to make the metropolis function well or poorly. The city's functioning through techniques affects the behaviour of inhabitants and is therefore a powerful vehicle in the path towards assimilating non-sustainable behaviours.

1.2 Metropolitan expansion. Other cities and their knowledge

The cultural framework must be clarified if we consider today's 'non-plan' city as a different city from the mainstream metropolitan idea, indeed, if we consider true 'southern latitude' cities where norms and practices coexist. Is this difference related to use? Ownership? Access? Is it historical? In short, we need to understand the matrix that holds

different cities together today. What directs us in the search for a code of mediation between the cities (Fig.3,4) are today's construction and planning practices, which are scaled in time between practices that date back to the pre-colonial, colonial, and post-colonial phases.

We also need to include an analysis of areas of the city called 'urban extension' (Simone et al, 2017). These places evidence a sense of the multiplicity of logic, agreements, and constellations of power and the possibilities that have made and could make/form the processes of urbanization of metropolitan landscapes in the 'southern latitudes'.

According to A. Simone, the majority of these 'cities within the city' live and operate in spaces beyond the traditional settlements of what is conventionally understood as an urban core. These extensions say something uncertain and different about urbanization and living itself, its sensibilities, and its politics. They are places where thinking about the urban area and urbanity (Choay,1965) is used to consider how practices and spaces can continuously prefigure the variable mathematics of evaluation and emancipation from the dominant culture of globalization. Here, liminal spaces open in the absence of a consensual development plan, and incompleteness allows various projects to emerge from the 'bottom' as changing times and speeds amid which it is difficult for anything to take hold. The extensions now pose critical questions about relationships, scales, temporality, the incipience of differences without the need for physical separation. How will new metropolitan epicentres that will act as nodes be structured with these extensions?
This will only be possible if they are multipolar and situated in a variety of flows. It is a process that reaffirms the fundamental instability of the inter-connectivity of these metropolitan territories and a potential space from which the resistance of tradition and illicit or 'informal' uses might emerge. It therefore requires the ability to anticipate instability and prevent disruptions by studying past data.
However, these places of possibility expand into the metropolitan issue of places where different instances meet; this possibility of different people meeting is a behavioural problem.
We must also encounter in these places the project of metropolitan centralities negotiated by global multilateral agreements.

2.1 Methodological context: Heterotopia as a different metropolitan rhythm

Our research concerns the great metropolises in explosively developing countries of the 'southern latitudes', where we study the influence of the surrounding context on metropolitan governance. Here, the relationships between times and values are never linear or mechanical but change with shape. There are no absolute scenarios but proportions to be taken care. Different relationships among the elements of Metropolitan Cartography section strategies across the pre-colonial, colonial, and post-colonial city thresholds establishing:
1) resonance [1];
2) plot;
3) growth.

There is a functional integration of the past and vibration, a feeling of common belonging. The map projects in Metropolitan Cartography, which are used to support design choices in metropolitan architecture projects, must trigger relevant relationships (even fragile ones) moving through a shared value and vision to be realized. The visions must be projected to manage metropolitan complexity.
Through Metropolitan Cartography, our interpretation of the concept of heterotopia (Shane, 2005) is related to mapping different metropolitan rhythms, or gradients of formality, within different attributes that can be identified along a section of virtual landscape running through the historical nucleus, colonial city, and city expansion.
In particular, from the metropolitan city centre to middle-sized municipalities in the metropolitan region, the design strategies of Metropolitan Cartography aim to discern collective values, recognizable planning, and construction practices. With a view to a diachronic reading of inheritance, we identify the cultural transformation of change.
We consider two approaches to metropolitan urban design. The first is the 'deep structure' type, which consists of principles referring to basic structural features such as the appearance of streets and other transport systems, the way buildings relate to them, pedestrian access, and the ability of the built form to adapt over time. These shape the collective memory of a place. The second is the 'superstructure' type, in which each new era — each urban generation — brings new values to the visual character and new demands for the functions of the built environment.
This is why it is crucial to work with a vertical narrative, or rather, a process of inclusion and deconstruction to read multiple identities, their meaning, and their representation, avoiding the cognitive redundancy of traditional governance. Narrative infrastructure therefore forms a bridge between the physical and virtual heritage of places, which Metropolitan Cartography aims to communicate by means of synthetic and scalable cartographic models relying on an experimental method for caring Metropolitan Landscapes.

2.2 Metropolitan Cartography: Data for transformation, data for Innovation

We are now in a transitional phase between the IoT (Internet of Things) and IoE (Internet of Everything), in which knowledge and awareness of the relationships between places and objects is conveyed by the Internet and computer mediators that facilitate connection to hyper-planetary connectivity. This is understood as necessary for the construction of new connections, not only between devices, but also between users and people through increasingly intelligent networks capable of learning and returning information with greater security (Cisco, 2014). We are in the deep dimension of the meta-city (Shane, 2014).

In the scientific debate between technical and humanistic disciplines, however, there is a clear need to transfer and inform the narrative infrastructure of city places through inventive pedagogical approaches supported by technology. With Metropolitan Cartography (MC), a methodological and technological tool, it is possible to construct an image of the narrative architecture of the metropolitan territory by manipulating and spatially representing open-source data, from global data to the modelling and verification of local data.
However, Metropolitan Cartography is also a tool for modelling and designing the backbone of cartographic information packages (through the relationship Glossary and Metropolitan Data Set for Geographic Information Systems). The MC is a tool that uses maps to recount the affective image of a ground project (Secchi, 1986) and the long-lasting evolution of the complex metropolitan territorial and urban system, as well as the involvement of metropolitan citizens in map-making practices. The experimental application of the MC methodology in heterogeneous metropolitan contexts has therefore not only enabled the construction of cartographic products, but has also allowed us to consolidate systemic, multidisciplinary knowledge aimed at ensuring the spatialization of new relationships between metropolitan lines/life stratigraphy (Boano, 2021) and modelling times. For our research, the term ‘inventive’ (Naveh, 1994) emphasizes a research approach committed to analysing, interpreting, and reacting to critical environmental and social problems in order to achieve a research path for the transformation and innovation of metropolitan planning on the urban scale through metropolitan architecture projects (Contin,Galiulo, 2020).

Thus, the Metropolitan Cartography maps define the characteristics of the ‘deep structure’ of metropolitan landscapes through the relationship Glossary and Map (Contin,Galiulo, 2020), since they must not only be recognized, protected, and governed, but also redesigned for the near future. A new approach to the design of metropolitan places must not only go beyond a merely adaptive approach; it must also be able to move towards a projective design proposal through cartographic maps. Moreover, through the methodological experimentation of Metropolitan Cartography and the construction of cartographic projects in GIS systems, the research includes the possibility of detecting, imagining, and modelling new spatial relationships between landscape spaces (Galiulo, 2021) through data mining, data setting, and data semiotics in open-access map-making.

2.3 Methodology: Data mining, data setting, and data graphic semiology following the metropolitan Architecture design process

Metropolitan Cartography maps also allow us to assess and interpret the limits beyond which the vulnerability of the metropolitan territory reaches an unsustainable threshold, enabling planners to develop a prevention and transformation project compatible with these limits. Each Metropolitan Cartography map is created using a semantic package containing keywords and related concepts (Fig.2) that articulate the territorial components related to a spatial condition inherent in the physical dimension of the territory. The relationship between the parts (keywords, related concepts, informative levels, metadata) in the Metropolitan Cartography methodological system follows a simple cause/effect principle that represents the current complexity because it crosses the four dimensions of the metropolitan city addressed by Metropolitan Cartography and TELLme. This cognitive process produces a second set of maps which is called a set of dynamic maps in Metropolitan Cartography because it is capable of presenting the dynamics of metropolitan processes occurring in the territory, implicitly conveying a strategic project forecast (Fig.3).

It is here that the three methodological phases of MC — *data mining, data setting, and data graphic semiology* — come into play to construct cartographic projects for the knowledge of ‘southern latitude’ Metropolitan Landscapes. Data mining finds and unearths the primary associations, the recurring information patterns (geographical information patterns), and also anomalies in the information that might be received in open-source data from international, national, regional, and even local geoportals of the metropolitan city under study. Although manual, this preliminary phase of data selection and critical analysis allows information essential for configuring the invariant and tectonic structure of the territory to be discerned in the network system of open-access information. According to the design principles of the metropolitan architecture project supported by Metropolitan Cartography, the dissemination of inventive and strategic knowledge occurs by planning a metropolitan database that makes multidisciplinary information explicit according to a dimensional, textual, multimedia association of ‘hybrid’ data, which obtain an ordered, clustered, shareable, and reliable configuration and collocation in the data setting phase. It is therefore an initial phase of Knowledge Discovery in Databases (KDD) (Fayyad et al, 1996) (Fig.1), which does not end with the choice of data, but continues with their spatialization and verification in the ‘map space’ of the data design considering categories of data validity and reliability.

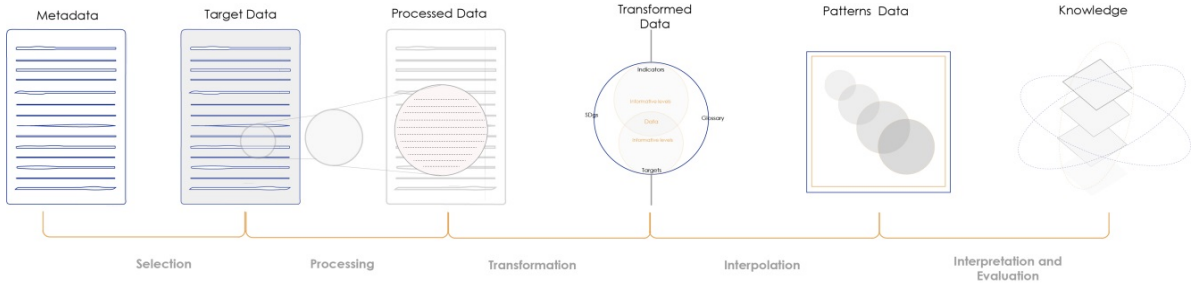

Figure 1: Data mining process in Metropolitan Cartography for KDD. Source: Galiulo, 2021

To support the data search phase, Metropolitan Cartography allows for the selection of connectivity relationships necessary for representing a specific ground phenomenon through multi-scale maps. Metropolitan Cartography guides the planner through the phases to acquire and filter data to facilitate the construction of a replicable, comparable, and scalable model in heterogeneous metropolitan contexts. The digital design processes of MC advise the planner in modelling the data following an initial analysis and interpretation of the information layers with respect to scalar relationships and the programmatic purpose of the map. Thus, to support the design choices of metropolitan architecture projects, the criteria guiding the process of selection, critical analysis, and spatialization of the data (data mining), cataloguing, cleaning, pre-processing, and connection of the data with the Glossary (data setting), and modelling and dressing of the data (data graphic semiology) are:

- identification of the purpose of the research in relation to the project map, which is independent of the design objective;

- pre-selection of the data to achieve it according to an initial classification based on the geographic dimension of the application (XXL; XL; L; M; S) and scale of representation (1:500000; 1:250000, 1: 100000, 1:50000, 1:25000);

- identification of a sequence of historical data (time series) that enables a series of interrelationships between evolving physical variables to be identified, ordering them with respect to the dynamics expressed in a given phenomenon;

- categorization of the concept and data, from the semantic package to the map, through the use of ISO 37120: 2014 standards, indicators for urban services and quality of life for sustainable development defined by the United Nations Member States (Sustainable Development Goals), as set out in the 2030 Agenda for Sustainable Development;

- data cleaning and pre-processing: further classification of attributes in the data necessary to represent the phenomenon spatially, choice of how to deal with incomplete or empty fields, final selection of key information for the ideal reference model;

- data dressing and modelling: transformation of the original data format and modelling of the data by means of data cleaning, filtering of GIS geoprocessing and sémiologie graphique rules (Bertin, 1967) for Metropolitan Cartography (Galiulo, 2021);

- interpretation of the preliminary results, categorized and ordered according to a new explanatory taxonomy of the metropolitan phenomenon under study, and their visualization according to a scalar and dimensional relationship consistent with the purpose of the project.

It follows that in spatial data mining, the criteria capable of extracting implicit knowledge from data and information patterns are determined by the need for research and knowledge of the territory. Therefore, it is necessary to define spatial rules through which the usefulness of global or local data for cartographic representation can be compared and understood according to a trans-scalar proposal of metropolitan dimensions: the physical, social, economic, and governance of the metropolitan territory. The spatial data analysis is crucial for investigating the properties of the selected information, so spatial analysis always requires mapping the spatial attributes of the information levels and also the quantitative levels related to the economy, in order to guarantee their communicative efficiency in the decision-making process through scale-data relationships (XL-L-M). From this research, it can be deduced that drafting a Metropolitan Cartography project allows experts to become familiar with the territory by understanding its structure, identifying events and causes, whether in progress or evolving, that trigger factors of development and critical regression of the metropolitan context according to a resilient, inventive, and therefore transformative approach.

3.1 Findings: Metropolitan Cartography as design strategy tools for technological implementation

The preliminary research findings, which were tested in European and ‘southern latitude’ metropolitan cities, allowed us to highlight the potential of Metropolitan Cartography as a design strategy tool for technological implementation across the metropolitan and urban-rural scales.
First, Green-Grey infrastructure Protocol Maps from the XXL, XL, L to the M, S, XS scales of the metropolitan region provide spatial information according to a large- and small-scale design purposes: an integrated green infrastructure system through the spatial continuity principle. Nevertheless, the intention of the design strategy is to highlight the infrastructural discontinuity between the metropolitan centrality and medium and small cities in the metropolitan network system. Starting with the structure of the semantic package taxonomy, the open-source maps represent:

- The relationship between the spatial components of Green infrastructure as a descriptive network system in the existing ecological framework of the territory;

- Grey infrastructure to depict anthropogeographic (Gregotti, 1967) spatial components that constitute the structural link between the metropolitan city and possible new small and medium-sized centralities in the network of metropolitan landscapes;

- Blue infrastructure exemplifying the water systems and apparatus in the metropolitan region according to its definition on a hyperlocal scale;

- Physiography representing the lithological and topographical components of the soil on which the metropolitan infrastructure is built;

- Cultural heritage, which describes the pre-existence and socio-environmental permanence of the metropolitan landscapes in transformation and innovation.

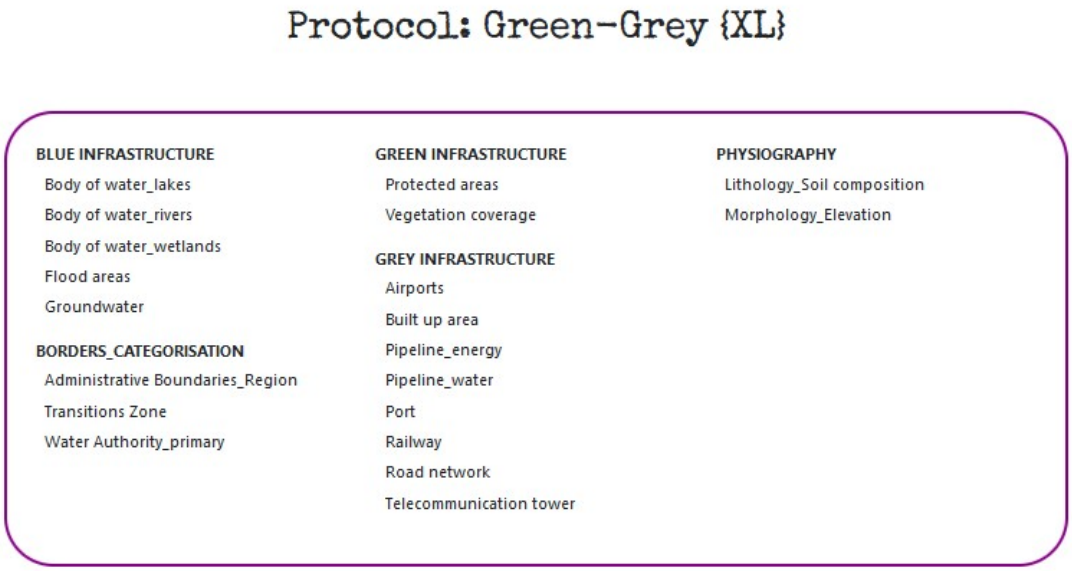

Figure 2: Green-Grey Protocol maps XL Semantic Package. Source: Galiulo,Contin, Sánchez Fuentes 2020

The Green-Grey infrastructure Protocol XL map makes it possible to observe the territory through the representation of green, grey, and blue infrastructure, which constitutes the main structural layer for the formation of the ecological armatures of the Net City (Shane, 2005). Therefore, to understand the importance of the metropolitan revolution on local territories, it is necessary to analyse the impact that the network of intermediate cities must bear due to changes that have occurred at the heart of national economic structures and the changes in morphological and geological adaptation. The main operation when managing explosive growth consists of territorial reinforcements or linear systems that ensure the continuity of the infrastructure network and landscape units. The aim of Green-Grey infrastructure is to develop an image of spatial growth, allowing for accessibility and regulating growth in areas with strong natural risks and a loss of environmental resources. To achieve these objectives, ecological reinforcements must lead to a system of predominantly open spaces to be protected through specific uses, strengthening environmental regeneration and ensuring the robustness of the system to allow the structure to transform under conditions of green-grey infrastructure continuity. The entire system operates as a landscape hub that interacts in different ways, such as through protection, renaturalization, and reconnection. This creates a possible ecosystem infrastructure, which provides ecological services, i.e. benefits provided by the goods and services in an ecosystem. These are considered inalienable common goods for the metropolitan dimension of the city and the ecosystem approach should form the basis of a metropolitan strategy that integrates the management of land, water, and living resources and promotes conservation and sustainable use more fairly through metropolitan architecture projects (Fig.4).

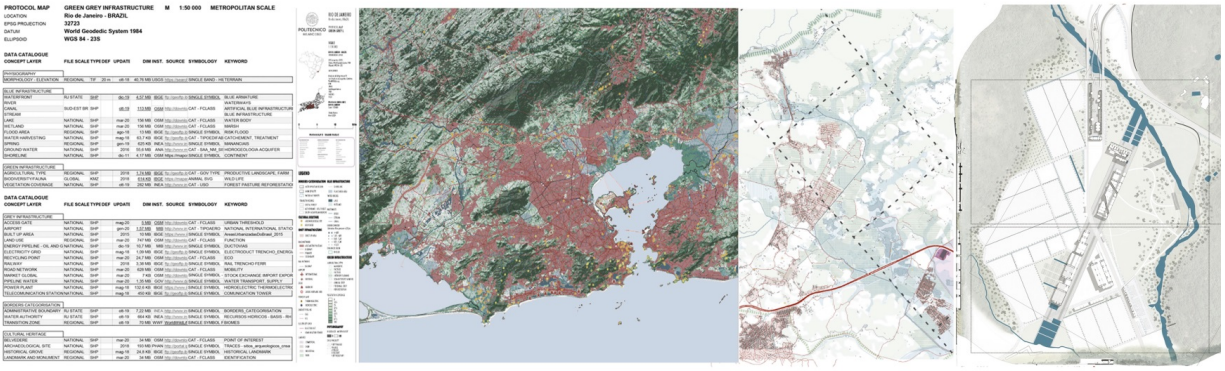

Figure 3: Rio de Janeiro – Southern latitude metropolis. From data mining and setting, Green-Grey Protocol Map L, Green-Grey Protocol Map M, towards a metropolitan architecture project. Demonstrating how data research and the composition of the Metropolitan Cartography map project must follow the objective of the project on an architectural scale. Source: Contin,Galiulo, 2021

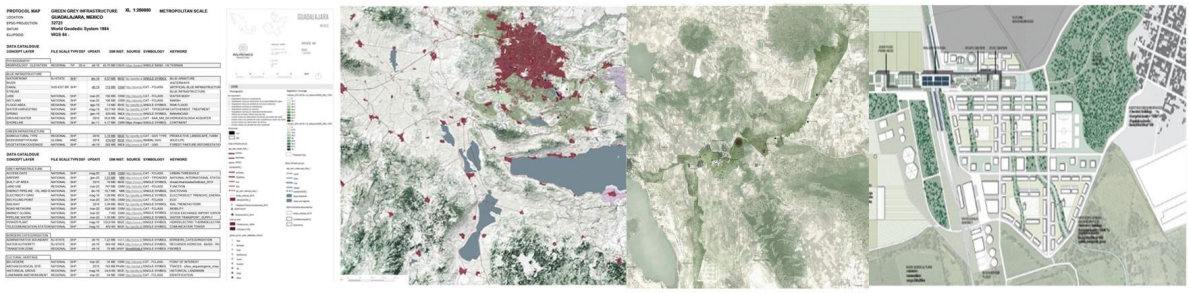

Figure 4: Guadalajara – 'Southern latitude' metropolis. From data mining and setting, Green-Grey Protocol Map L, Green-Grey Protocol Map M, towards a metropolitan architecture Project. Demonstrating how data research and the composition of the Metropolitan Cartography map project must follow the objective of the project on an architectural scale. Source: Contin,Galiulo, 2021

CONCLUSION

The disciplinary issue related to metropolitan 'nature'. Caring metropolitan cities through maps

In the context of these new metropolitan epicentres, is there a real space that cares for territorial elements? What of the past must be made to resist? These questions present a new phase of the city that must be managed with new tools towards a new vision of sustainability.

Care for our territories is therefore not only the result of social and economic evolutionary processes, but can be understood as the active reaction to a system of physical and environmental gradient inequalities in the urban-rural context. If society in the cities of the future were to organize itself according to a new awareness of caring for the anthropic and non-anthropic components of the city, it would be possible to operationally redefine the concepts of sustainability and resilience, which would no longer be tied only to resistance to the metabolic evolution of the city, but above all to inventive knowledge about the environment in which it is rooted. Therefore, the research of Metropolitan Cartography for caring Metropolitan Landscapes, explained through map projects on different scales, could be supported and implemented through new connections among spatial information that can activate design predictions related to the future habitability of hybrid spaces in extremely vulnerable metropolitan territories.

Metropolitan Cartography maps therefore contribute to communicating the need for a new metropolitan vision with a multidisciplinary perspective that moves away from the traditional objective of functional efficiency and the economic prosperity of the city. Metropolitan Cartography maps also support the evolution of the spatio-temporal image of fragile territories so that they can be understood as new possible spaces to achieve the equitable well-being of inhabitants living in the metropolitan area. The maps support a qualitative assessment that is not limited to the construction of functional efficiency parameters in the urban-rural structure. Our perspective is based on the interpolation of different levels of information discretized according to the relationships between physical, social,

economic, and health dimensions in the contemporary metropolis. Metropolitan Cartography for caring metropolitan landscapes then becomes a practice of territorial knowledge, collective urban and architectural knowledge for a new operational perspective. MC maps are qualitative tools to visualize spatial relationships that are not yet detectable on the ground but can be shaped by interpolating geographical, social, and economic factors and also through open-source mapping, which sustains and supports logical project choices, from the preliminary urban design phase to the architectural design, through metropolitan architecture projects.

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ENDNOTES

[1] Resonance: In chemistry, the concept of resonance expresses the fact that a molecule always simultaneously presents the properties of various structures, due to which it can be considered a hybrid.