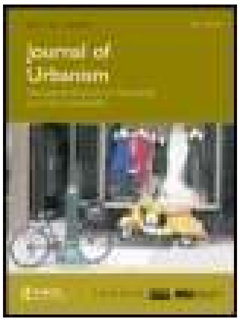

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Chiara Cavalieri

LOCI, Faculty of Architecture, Architectural Engineering and Urban Planning, Catholic University of Louvain (Uclouvain), Louvain La Neuve, Belgium

ABSTRACT

Water urbanism and more in general climate change adaptation are an essential part of urban transition processes. While sea level rising demands a re-evaluation of the new geography of extreme-cities, it emerges a temporal and conceptual gap between climate prediction, policies, adaptation strategies, and factual interventions. Consequently, the very same method of urban analysis needs to be reconsidered in light of this new horizon. This paper addresses extreme-cities as spaces of transition, and analyses the case of the Veneto Region via a multi-scalar process of mapping entailing: (i) zoning transition; (ii) mapping microtopography; (iii) sampling urban-topographical patterns; (iv) re-designing a territorial transect. The resulting representations disclose two types of information: (a) they suggest a set of rules for transitioning urban landscape in coastal areas according to different SRL scenarios; (b), they indicate the specificities of the same study area, disclosing a taxonomy of past and potential future elements of modification.

KEYWORDS

Water urbanism; city-territory; sea-level rise; horizontal metropolis; mapping; climate change adaptation strategies

1. Introduction

1.1. *Extreme-city-territories*

By the end of the century, sea-level rise (SLR) is liable to completely redraw the physical geography of our planet (Grinsted, Moore, and Jevrejeva 2010). Nowadays, this image is perceived as a geography of risk (Beck 2009), of extreme-cities (Fabian and Viganò 2010; Fabian 2012), where the word extreme refers to the extreme climate conditions while at the same time defining coastal areas as terminal parts – the extremities – of larger environmental regions. Extreme-cities are densely inhabited: almost 11% of the world population (and 13% of the world's urban population) lives within the first 10 m above sea level, which represents only 2% of the world's surface (McGranahan, Balk, and Anderson 2007); by 2060 these areas are expected to almost double their population density (Neumann et al. 2015). On the other hand, extreme-cities are also diversely urbanized (mega)cities are often constellated by an extended pattern of diffuse urbanization or agropolitan development (McGee 2017; East-West Environment and Policy Institute (Honolulu, Hawaii) 1991; Friedmann and Douglass 1975), while the notion of urban is being reconceptualized by considering urban both dense, diffuse, and *operational*

CONTACT Chiara Cavalieri chiara.cavalieri@uclouvain.be

landscapes (Brenner and Schmid 2015; Brenner 2017, 2019; Brenner and Katsikis 2020). As a consequence, the Urban Age (UN 2008; World Bank 2009; UN 2018) can be interpreted as the result of a double process: (a) that of densification or expansion of existing urban areas and (b) that of urbanization of agricultural lands. Following this line of thinking, extreme-cities hence become extreme-city-territories, where different kinds of urbanities coexist and climate change threatens a multitude of different land uses beyond the classical dense urban domain, such as natural ecosystems and agricultural production (Mukul et al. 2019). Within this context of extreme-city-territories, undergoing change due to the combined effect of processes of urbanization and consequences of climate change – this paper analyses the spatial impacts of SLR in a condition of diffuse urbanization.

1.2. SRL: a multiplicity of predictions

There is a general consent among the scientific community in recognizing: (i) that SLR increased over the last century (Church and White 2006); (ii) SLR will increase even further over the centuries to come, this as a combined effect of subsidence and eustacy (IPCC 2018). Nevertheless, among the consequences of climate change, SLR remains the most difficult to forecast (Pilkey and Pilkey-Jarvis 2009), both in terms of spatial quantification (meters of rise and thus land surface overwhelmed) and times (temporal horizons of different scenarios). And yet SLR is potentially able to redraw the whole planetary geography: for example, a SLR of up to 0,58 m will constantly affect 2,5 million people, while by 2080 20% of wetlands will have disappeared (Nicholls and Klein 2005). Over the last decades, different research studies worked on SLR scenario formulation. Already in 1989 indeed, EPA ran a state of the art of the different scenarios and concluded that by 2100 the sea may well have risen by between 0,5 m to 2 m (Titus and Narayanan 1996). One year later, the first IPCC report (IPCC 1990) declared 1 meter as the maximum range of SLR. Nowadays, the latest IPCC report (IPCC 2018) foresees a global mean SLR as projected to be a minimum 0.1 of meters with a global warming of 1.5°C. If considering the melting glaciers (i.e. Greenland) in the calculation, sea level rising might reach from 0.6 to 3 meters by the next centuries (Golledge et al. 2015). Other studies prove that the ongoing rate of SLR would considerably exceed IPCC predictions (Nicholls and Tol Richard 2006; Church et al. 2010).

Within this multiplicity of predictions, this paper analyses the spatial impact of SLR considering three scenarios, three hypothetical spatial configurations for the year 2100: (i) +1 m SLR, as the most likely result of both subsidence and eustacy (IPCC 1990); (ii) +3 m SLR, when considering the melting of glaciers (Golledge et al. 2015); (iii) +5 m SLR, as an extreme situation, a combination of SLR and extreme events.

1.3. An invisible transition

Despite scientific evidence of SLR and the magnitude of possible impacts on urban areas, adaptation strategies are, for multiple reasons, rarely implemented in current urban policies. In the first place, there emerges a paradox between the long-term nature of climate change scenarios −2050 or 2100- and the inability of existing planning tools to regulate the territory over such a long-term span: the current and available tools rather respond to a *hic et nunc* paradigm. SLR appears to be simply too far away in time to be actively included as part of planning practices. It is a matter of different time units between policies and ecologies: while policy tends to conform to the electoral cycle, ecology is normally a matter of centuries (Acot 2004, 224). Secondly, the given adaptation strategies for extreme-city-territories do not take into consideration the fact that SLR is a slow process that could be planned as a process: as the result of different short-term steps, whereas each step corresponds to a unique spatial configuration. As it is well known, for SLR-exposed (and more in general for floodable) urban areas, IPCC proposes a threefold adaptation strategy (Dronkers et al. 1990): (i) protection, (ii) accommodation, (iii) retreat, also defined as the *three R's* strategy (Carbonell, Zogran, and Sijmons 2016), where the words "protection" and "accommodation" are replaced by the two sides of a by now consolidated debate, that is the counterpoising of *resistant* and *resilient* approaches (Klein, Nicholls, and Thomalla 2003; McNeill 2001; Nicholls 2011). However, despite reflecting different attitudes towards water, none of these strategies takes into consideration the dimension of time, nor the dimension of transition. In other words, they portray futures that picture a water-transition that has already occurred while forgetting to portray the process itself: the strategies, as single images without context or process, fail to perceive the nexus between space and time that features a shifting rather than a static landscape (Cosgrove and Petts 1990).

Lastly, transition is not only absent in intervention strategies but also in representational ones. Common Mapping operations are unable to properly portray the dimension of risk as a temporal spatial process. In this sense, to draw a detailed geography of risk becomes the first and necessary step towards not only a collective consciousness of hazards, but also towards the systematisation of proper governance tools. From the strict perspective of representation, the continuous attempt to spatialise the area of SLR entails a contradiction in itself: what is represented as a static image is rather a dynamic one, a space under slow but continuous transition, one that requires other categories – other than the sole spatial one – in order to be described.

Rather than evaluating the space loss, this paper rather focuses on representing the space of SLR as a space of transition with the research hypothesis that transitional spaces, once properly visualized, will disclose unexpected paths for reorganizing the adaptation of extended spaces. The aim of this work is thus to spatialise the process of SLR (via three scenarios) in the case of extreme-city-territories. Worldwide, extreme city-territories are mainly concentrated around big river mouths while presenting diverse condition of urbanisation and population density within their same macro regions (Figure 2). This work is then a cartographic exploration that takes the Veneto Region (Figure 1) as a case for testing a mapping methodology. A case study where the main pattern of urbanization is that of diffusion (Indovina et al. 2009), and where, due to the presence of Venice and its lagoon, the issue of SLR has been at the forefront for many decades (Lee 1991).

2. Materials and methods

2.1. The case of the Veneto region

The methodology proposed here is a set of multi-scalar (100 km; 30 km; 2 km) mapping operations (from GIS-based software to interpretative mapping) that, processing the available spatial and geomorphological data, ultimately aims at engendering a new

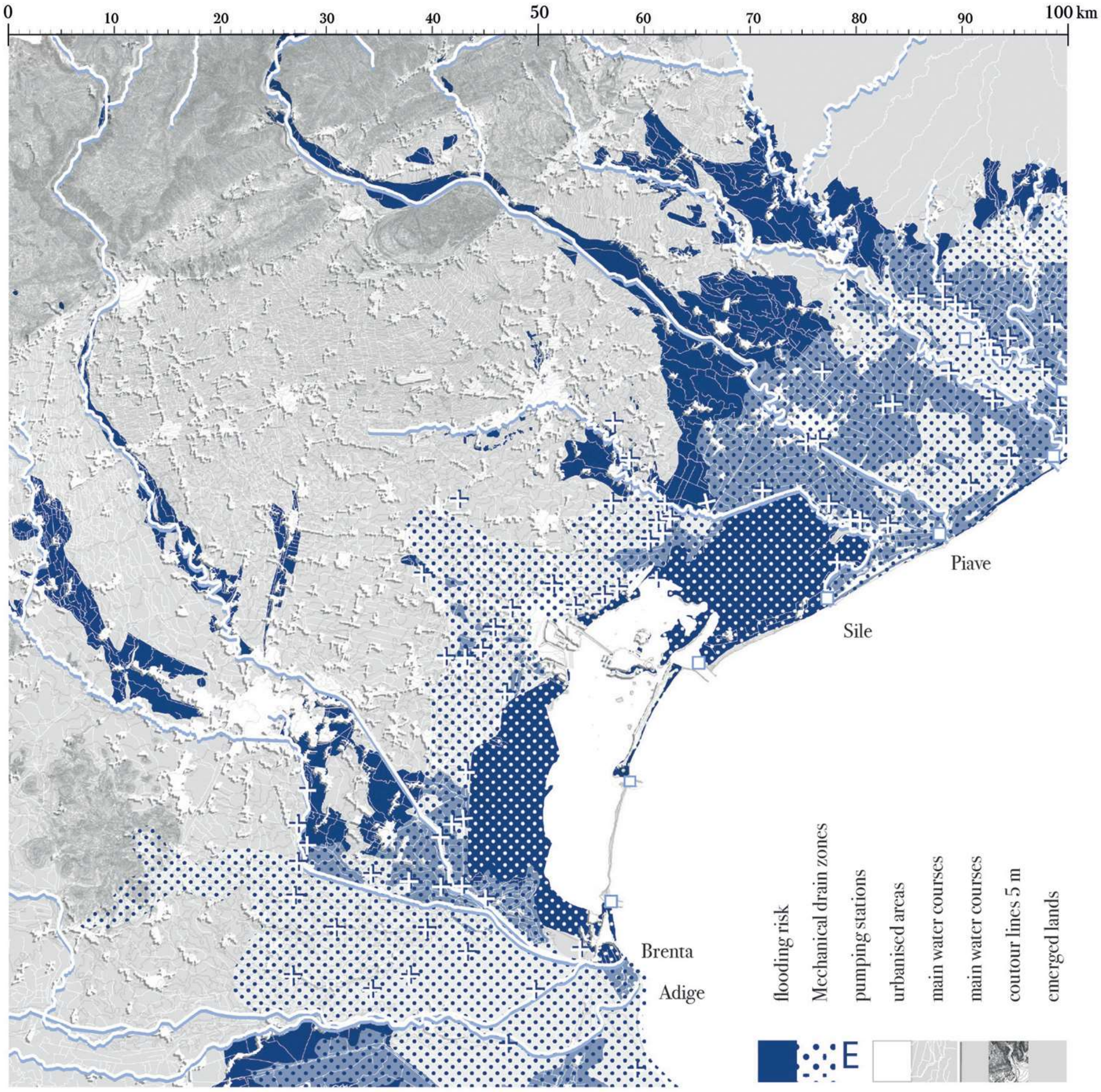

Figure 1. Veneto Region: big floods, low lands and urbanisation. 100x100km. elaborated by the author. Source of data: Regione Veneto LandCover (Uso Del Suolo) 2010, Regional Technical Map, 1:5000. (CTR) 2010; Water management Plan (Piano di Tutela delle Acque, PTA) 2010; Unione Veneta Bonifiche; Corine Land Cover 2006.

interpretation of the same space, capable of properly describing the spatial dynamic of SLR and ultimately of suggesting specific paths for political action.

The Veneto Region is one of those territories that, on a global scale, risks disappearing beneath the encroaching sea waters: indeed, in terms of surface, its lowlands can be compared (Aerts et al. 2009) with globally recognised extreme-city-territory. Furthermore, the area around Venice has historically had to learn to cope with SRL: the rate of subsidence of Venice was particularly severe in the last century (of about 15 cm of subsidence mainly due to groundwater pumping in the nearby industrial area of Porto Marghera and 10 cm of eustacy) (Lewis and Schrefler 1978). Nowadays the area is sinking between 0,7 and 0,9 mm per year due to natural subsidence, and up to 10 mm per year due to anthropogenic subsidence (Tosi, Teatini, and Strozzi 2013). Furthermore, current planning instruments – both at regional and on a local scale, does not consider SLR

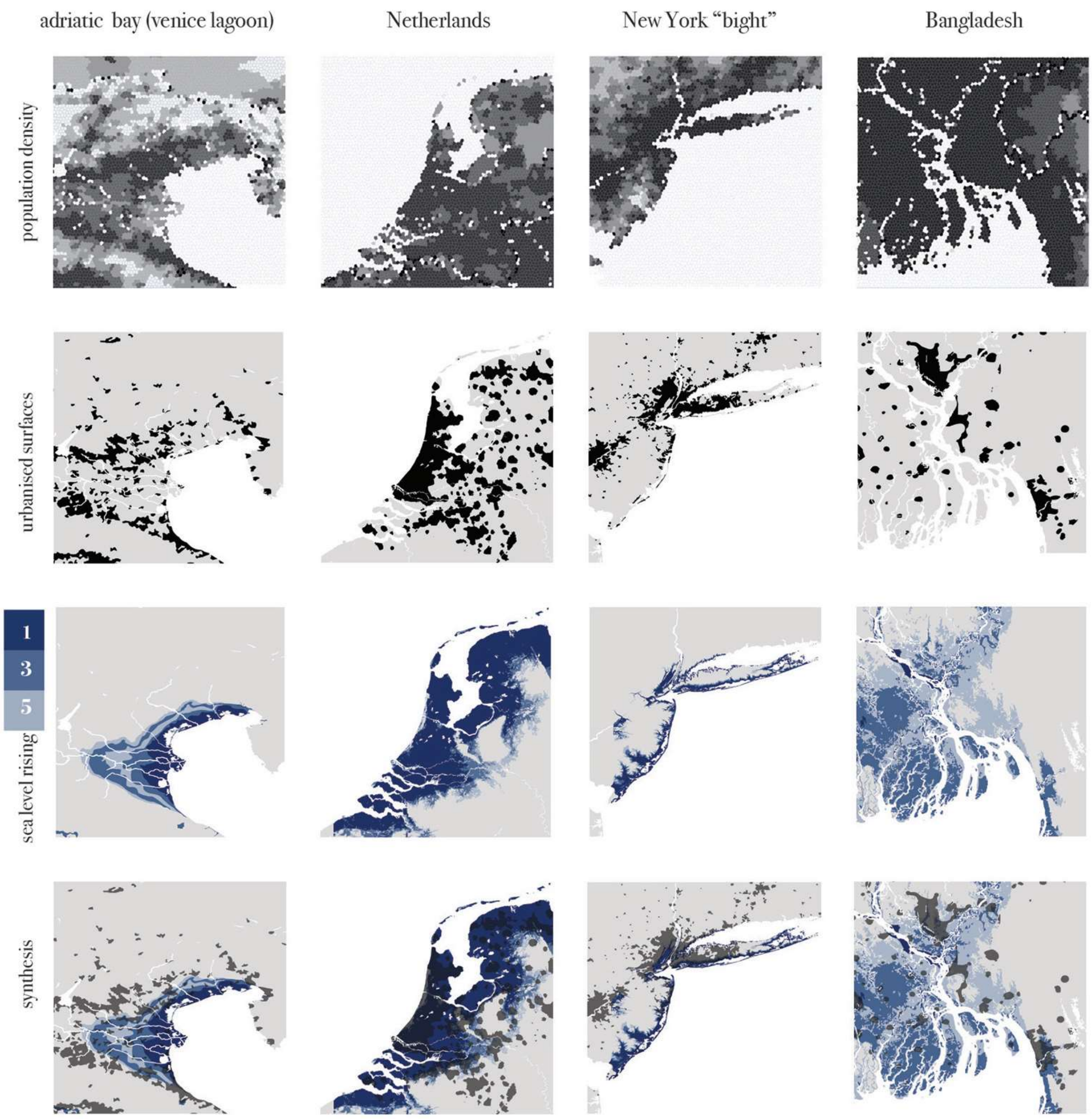

Figure 2. Extreme-cities-territory. The images compare the exposure to sea level rising in four different cases, by framing a space of 300 × 300 km: (from left) (a) Adriatic basin -to which the Veneto Region belongs-; (b) Netherlands; (c) New York region; (d) Bangladesh. The comparison reports data on population density, urbanization and degrees of exposure to sea level rising (1,3,5 meters). elaborated by the author. Source of data: NASA; Ciesin, Columbia University, IPCC 2009, Regione Veneto, SIT

a tangible threat: the plans rather refer to more traditional risks for coastal areas, such as flooding, erosion, subsidence and soil salinization, while never mentioning eustacy (Lee 1991; Cavalieri 2012), as the cause for concrete adaptation actions. At the same time, the Veneto is a region with a long tradition of water management (Lane 1973; Bevilacqua 1998; Bevilacqua and Rossi-Doria 1984) that, over the centuries, heavily modified and rationalised both the coastal and the internal geomorphology, for the main purpose of safeguarding the core of the region itself: the city of Venice and its lagoon. Over the centuries, the paradoxical result of these massive transformations is that of evermore exposing the hinterland to extreme events (i.e. the big floods of 1966; 2010, 2019). In order to tackle this increasing challenge, over the years, a combination of the three abovementioned strategies has occurred in this area: (a) retreat: after the big flood of 1966, some areas (Polesine, extreme south) have been abandoned; (b) accommodation: that collection of micro-strategies adopted by Venetian citizens for temporary adaptation to a high rise in water levels (from small door-to-door dams to the famous "passerelle" or raised walkways positioned across the flooded areas); (c) protection: the MoSe, – Electromechanical Experimental Module – the three dams designed to close the lagoon in case of extreme events. Following this line of thinking, the region of Venice can be somehow considered pioneer in exploring a diverse application and variety of adaptation strategies (see, "the three Rs"). However, those same implemented strategies have mainly been centred on – protecting – Venice and its lagoon, while neglecting surrounding areas as spaces of intervention. Indeed, barely estimating the impact on the areas surrounding the same lagoon, strategic actions hardly considered Venice as part of a larger system, that of an extreme city-territory. In this sense, this work looks *outside* Venice, whereas suddenly strategies and policies simply cease to exist. Besides, even if Venice will hypothetically be protected by the dams (MoSE), the exponential increasing of extreme events over the last decades start to reinforce the hypothesis that the unfinished protective works (still not in function during the last flooding of the fall 2019) are already obsolete and inadequate to face impending sea level rise scenarios (Pirazzoli 2002).

2.2. *Describing lands in transition: mapping operations*

In order to represent the spaces of SLR, to then build collective risk awareness, and ultimately to trigger policy-makers, this work proposes a multiscale set of analytical operations. SRL, and more in general climate change, is imposing a radical shift in traditional territorial and urban analysis that requires a renewed and detailed approach that shifts from space to process and from risk to transition. To perform this shift, this paper proposes a first mapping convention (2.2.1) and four inter-scalar mapping operations (2.2.2–2.25), that aim at: (i) codifying time in cartography; (ii) measuring the space of risk (100 km); (iii) mapping microtopography; (iv) sampling urban-topographical patterns (2 km); (v) reconstructing a territorial section (30 km).

2.2.1. *The scale of time*

In representing processes, the first necessary shift is to introduce the dimension of time within the bi-dimensional space of the map, where temporary elements are usually not recorded. Ironically, this absence of time in cartography is fully symbolised by the very same idea of coastline, at the same time an element of convention in mapping and an oxymoron in literature (Mathur and Da Cunha 2009). As an analogy, any map, in establishing a univocal relationship with the space of reality – by geographic coordinates and the metric scale – should also have precise coordinates identifying its time(s) along a temporal scale, that thus becomes an essential element in encoding and deciphering the drawing (Wood 1992, 125–130).

2.2.2. *SLR zoning*

The first mapping operation is that of linking space and time, as in Figure 3, where the different surfaces represent not only topographical zones, but also different timeframes within the long-term process of SLR. A 100 × 100 km portion of the Veneto Region is represented, covering the entire Venetian lagoon, up to the main river sources (Brenta;

Sile; Piave). The map presents four different SLR zones: (a) below and up to 0 m; (b) lands 0–1 m; (c) 1–3 m; (d) 3–5 m. These SLR zones are transitional surfaces, that are analysed according to different factors: the rate of built land; the rate of residential areas and ultimately the rate of buildable areas. As shown in Table 1, the different factors increase equally according to the increase in altitude, while newly buildable areas are equally present in the different zones, thus highlighting the mismatch between climate change forecasts and urban planning tools. This sort of zoning of transition describes dimensions, dynamics and the physical geography of SLR. However, observing this zoning discloses that: (a) the contour lines defining the areas represent – as well as the same coastline – contradictory spaces; (b) the scale of representation, being too large, fails to show the spatial link between specific dwellings and SRL, necessary for building risk awareness; (c) the map fails to provide a synchronic view of the same SLR process. The following mapping operations are thus oriented towards coping with these constraints.

2.2.3. *Microtopography: points vs contour lines*

The second mapping operation is thus that of detailing (micro)topography on a smaller scale, going beyond the contradiction of coastline by representing topography through punctual annotations rather than using contour lines: the denser the annotations, the

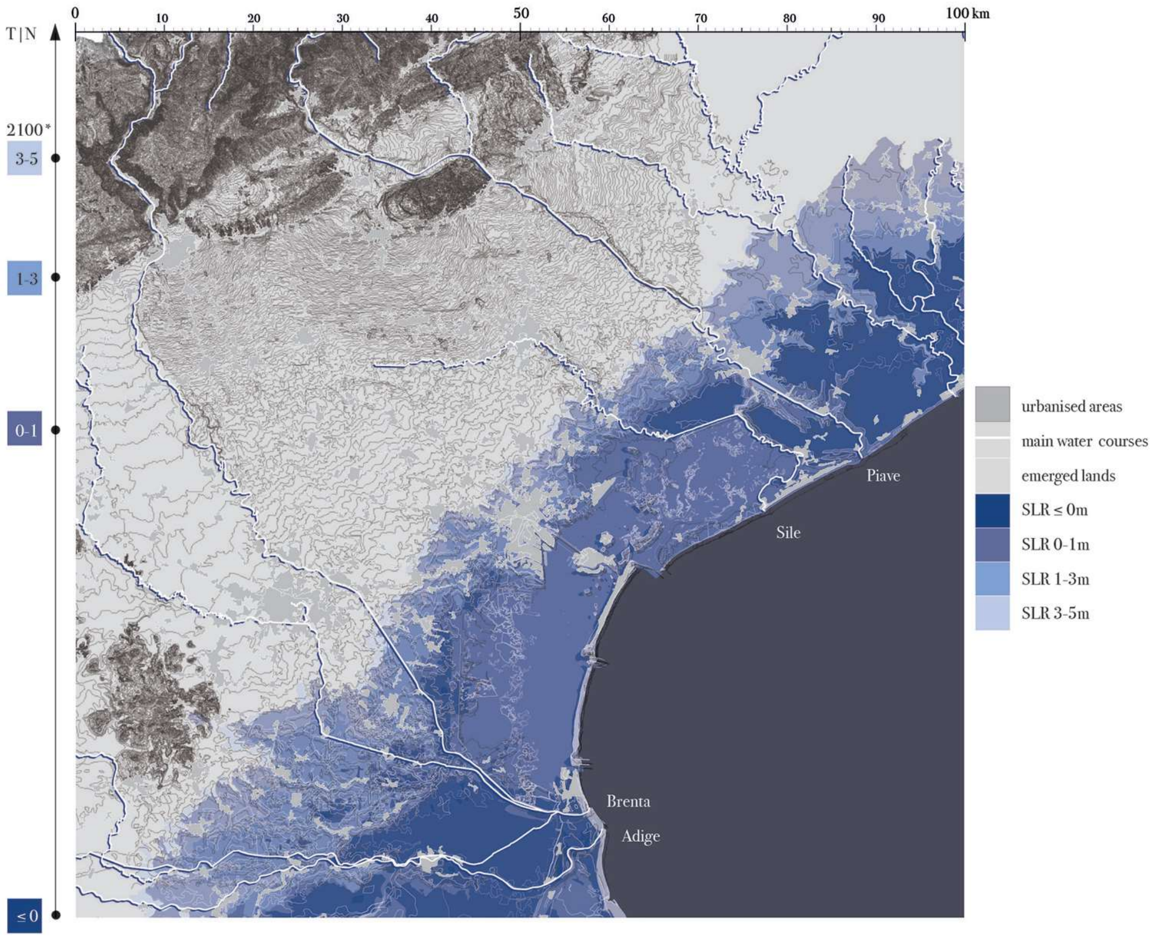

Figure 3. Zoning SLR. Sea level rising simulation. 100x100km. elaborated by the author. Source of data: Regione Veneto LandCover (Uso Del Suolo) 2010; Regional Technical Map, 1:5000 (CTR) 2010; Corine Land Cover 2006; EEA, 5 meter contour line 2010.

Table 1. Measuring SLR zones.

SLR zones	topography	built land[a]	residential area[a]	buildable land[a]
a	≤ 0 m	6593	4338	188
b	0–1 m	6740	4341	108
c	1–3 m	9561	6734	372
d	3–5 m	11,757	8391	532
Tot.	-	*34,651*	*23,804*	*1201*

[a]all surfaces are expressed in ha

more accurate the map. Figure 4 frames a 30 km coastal portion of the Veneto Region bordered by the courses of the rivers Sile and Piave, just north of the Venetian lagoon. In Figure 4, each ground height annotation – imported from topographic maps – translate with a point that, detailing the SRL zones (2.2.2), symbolises both a space at a certain altitude and a specific time: the blue represents the land below, while the greyscale represents the land above the current sea level. The map, based on the Regional Technical Map (CTR, scale 1:5000), has been processed using GIS software and it is and has been constructed by (a) collecting existing point-by-point ground height information for every single quadrant (about 40) of the area (30x30km); (b) merging the information into one unique database; (c) converting the text strings into quantities; (d) categorizing the results by quantities. The database obtained gathers the most detailed information available in

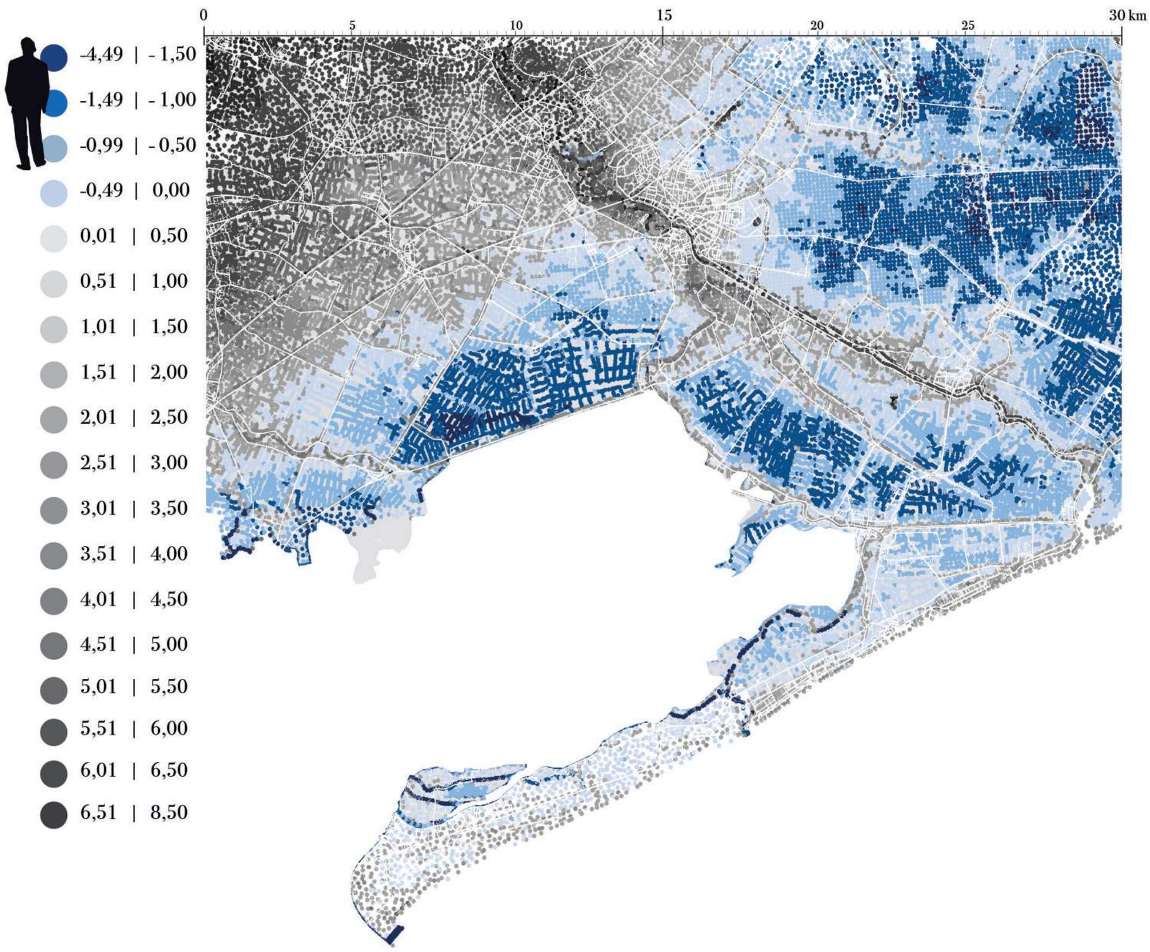

Figure 4. From lines to points: micropographies. 30x30km. elaborated by the author. Source of data: Regione Veneto, Regional Technical Map, 1:5000. (CTR), 2010

the area. Moreover, the new database has been added to the same CTR data collection and delivered to the *Regione Veneto*, as an *atlas of microtopography* (and risk) to be made available to all local users. More in general, the overall picture of topography depicts a complexity that testifies a palimpsest (Corboz 1983) of heavy modifications that occurred in this area over the centuries: from the diversion of the rivers Sile and Piave by the Venetian Republic (D'Alpaos 2010) to the several seasons of reclamations (Ciriacono 1994), all these traces are still readable while revealing an artificial topography that appears as a massive *ground project* (Secchi 1986).

2.2.4. Patterns of altitude

The third mapping operation is that of observing such a new image of topography (Figure 4) and of sampling different patterns of landscape and mapping them via a combination of plans and sections (Figure 5). The addition of sections indeed unfolds the third dimension of space which is key for discussing floods and SLR. Moreover, sections allows: (a) to represent with a unique line – that of the ground – altimetry (physical feature) and time (linked to altimetry by SLR scenarios), thus avoiding the aforementioned paradox of the coastline; (b) to synchronically visualise different levels of flooding and evaluate possible interventions (i.e., up to 3 m rising, resilient strategies such as freeing the ground floors of buildings, while probably over 3 m it is rather the case of envisioning actions of retreating); (c) to still consider already flooded areas as places under transition due to further variation of SLR, and thus as a shifting flooded geographies. Samples are circular surfaces of 1 km radius that have been selected according to different criteria: (i) each sample belongs to a different SLR zone, according to Figure 3; (ii) each sample is paradigmatic of a specific urban condition; (iii) each sample presents a different relation with water. From downstream to upstream, four prototypical situations are identified: (5.a) hyperbolic coast; (5.b) landscape of reclamation; (5.c) floodland; (5.d) diffuse city.

Starting the observation from the sea upstream, the very first specific situation is the continuous and rather compact urbanisation of the coast, an *hyperbolic coast* (a): indeed Jesolo Lido represents the perfect case of Italian "ransacking of the coast" (Cederna 1975). This "Miami of the upper Adriatic" – from the name given to the plan by Kenzo Tange (Lupo and Badiani 2011) was once a large wetland, protected by a dune ecosystem of great ecological value (Vallerani and Varotto 2005). From the beginning of the twentieth century until the institution of the coastal protection law (law n. 431, 1985, known as "Galasso law"), a 11 km strip of hotels was progressively built along the top of the dunes, at about 1 meter above sea level. The strip, despite the efforts of Tange's plan, symbolises an urbanisation without development and without infrastructure (Lupo and Badiani 2011). Moving further upstream, behind the right bank of the river Sile and just beyond the lagoon, lies a completely different landscape, that of *reclamation* (b), with its polder morphology mainly constituted by drainage systems and levees that, despite being distant from the coastline, lie about 3 m below sea level. Reclamation operations in this area date back to the eleventh century when, in order to afford the costs of defence from floods, individual landowners spontaneously started to form small consortia (Rosato and Stellin 2003) for draining – and then cultivating – specific portions of land. Later, between the fall of the Venetian Republic (1797) and the end of WWI, the reclamation process drew to a halt, to fully start up again, supported by new technologies, under the fascist regime (from the 1920s to WWII). The counter part of this

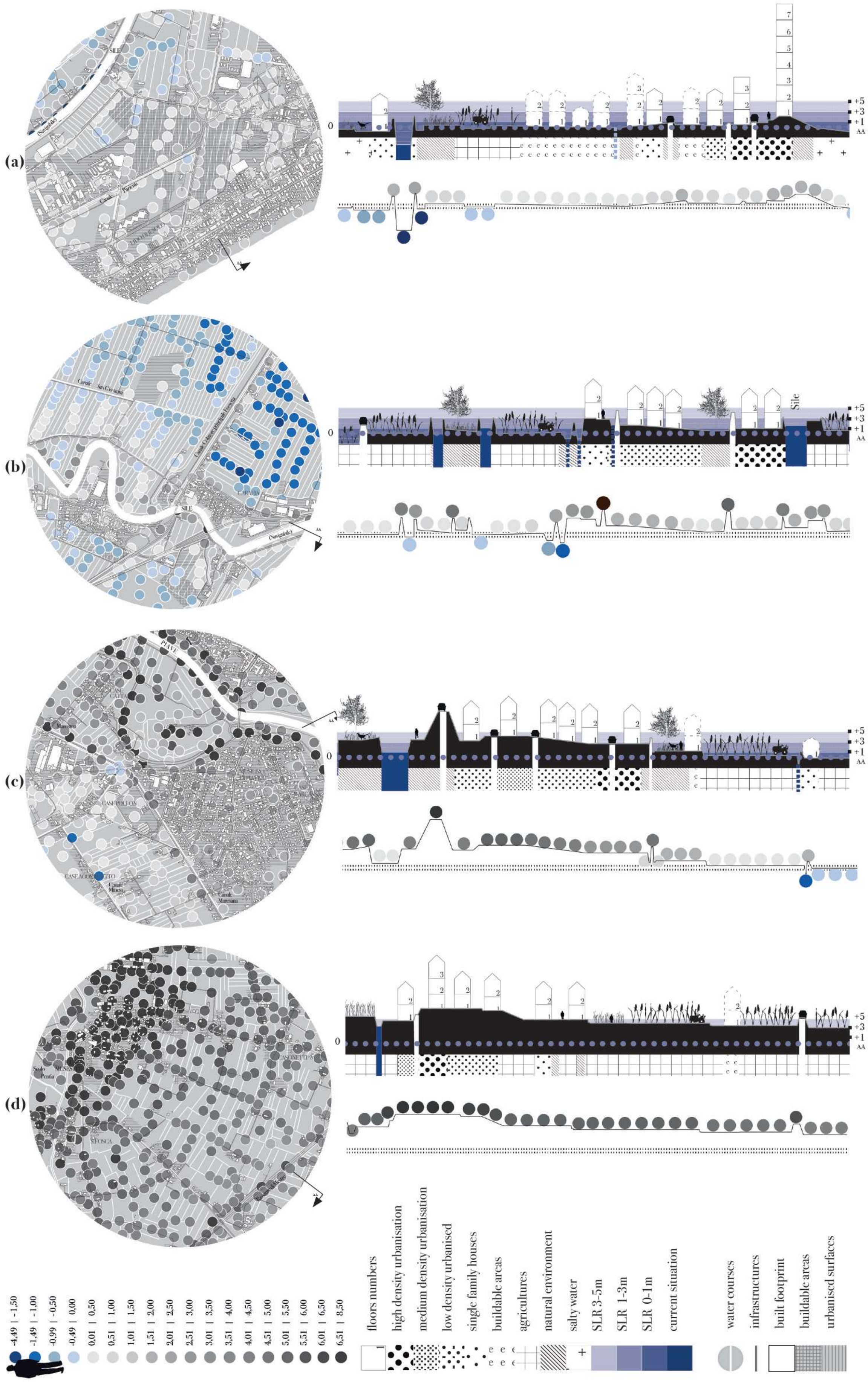

Figure 5. Sampling: 2 × 2 km: (5.a) hyperbolic coast; (5.b) landscape of reclamation; (5.c) flood land; (5.d) diffuse city. elaborated by the author. Source of data: Regione Veneto LandCover (Uso Del Suolo) 2010; Regional Technical Map, 1:5000 (CTR), 2010; Corine Land Cover 2006; Google.

landscape are the historical centres (c), located instead on higher areas, along the main rivers dikes, – about 4 m above sea level. Despite the relatively safe position concerning the sea level, the population of these villages has always had to struggle against water, because of the seasonal river *floods*, building and layering all types of embanking and deviating devices. The fourth landscape (d) is located more upstream, where such a massive manipulation of topography is reduced to the canalisation of water into drainage systems, and where to find that mixed use landscape typical of the *città diffusa* (Indovina 1990; Indovina et al. 2009). A landscape that, in being diffuse – as opposed to dispersed (Cavalieri 2018) – form a typically mixed-used landscape where city and countryside are intimately interrelated.

Overall, the representation of samples is a combination of a more detailed topographic map than Figure 4 and a section that combine topography, a three-dimensional landcover (highlighting the height of the different urban tissues) with the simultaneous view of three scenarios of SLR. This multiple representation not only combines plans and sections but it also offers a synchronic view of multiple elements such as (i) microtopography; (ii) land-use; (iii) the average number of storeys according to the different land uses; (iv) still buildable areas (according to the local plans).

2.2.5. A territorial sequence

The fourth mapping operation is then that of reconstructing a prototypical territorial transect, that reframes the samples into their large territorial system (that of coast and lowlands) and renders a synchronic reading of 30 km of spaces differently but consequentially exposed to the process of SLR. The drawing (Figure 6) intertwining these different situations is a combination of: (a) a section as the sum of the single sample sections (land-use, SLR, planning tools); (b) zoomed plans detailing a smaller scale SLR zoning (based on micro-topographical data overlapped and retraced on aerial pictures), delayered according to the three SLR scenarios. This ultimate mapping operation gathers all the information obtained in the previous steps while adding: (i) a large (30 km) but still detailed scale of observation (thanks to its being the result of the sampling operation); (ii) the systemic dimension of the watershed dynamics, where the relational positions of the single landscape matter; (iii) the reading across – rather than along – the depth of the coastal zone; (iv) the evidence of some prototypical urban landscape. To resume, by observing Figure 6 we can observe what it would happen to the spaces of the existing situation in case of either new everyday situations or during extreme events cause a – temporary or final SLR – of either 1,3, 5 meters. In this sense, this exploration portrays a detailed spatialisation of SLR scenarios, rather than a possible image of the future, that would require much more radical transformation and representation.

3. Results

3.1. Geographies of transition

Observing Figure 6 discloses two types of information: on the one hand it lays down a set of SLR transitioning rules in the Veneto urban landscape, while on the other the same emerging specificities of the study area disclose a taxonomy of past – and possibly future – elements of transformation. First of all, when observing SLR scenarios in Figure 6 it

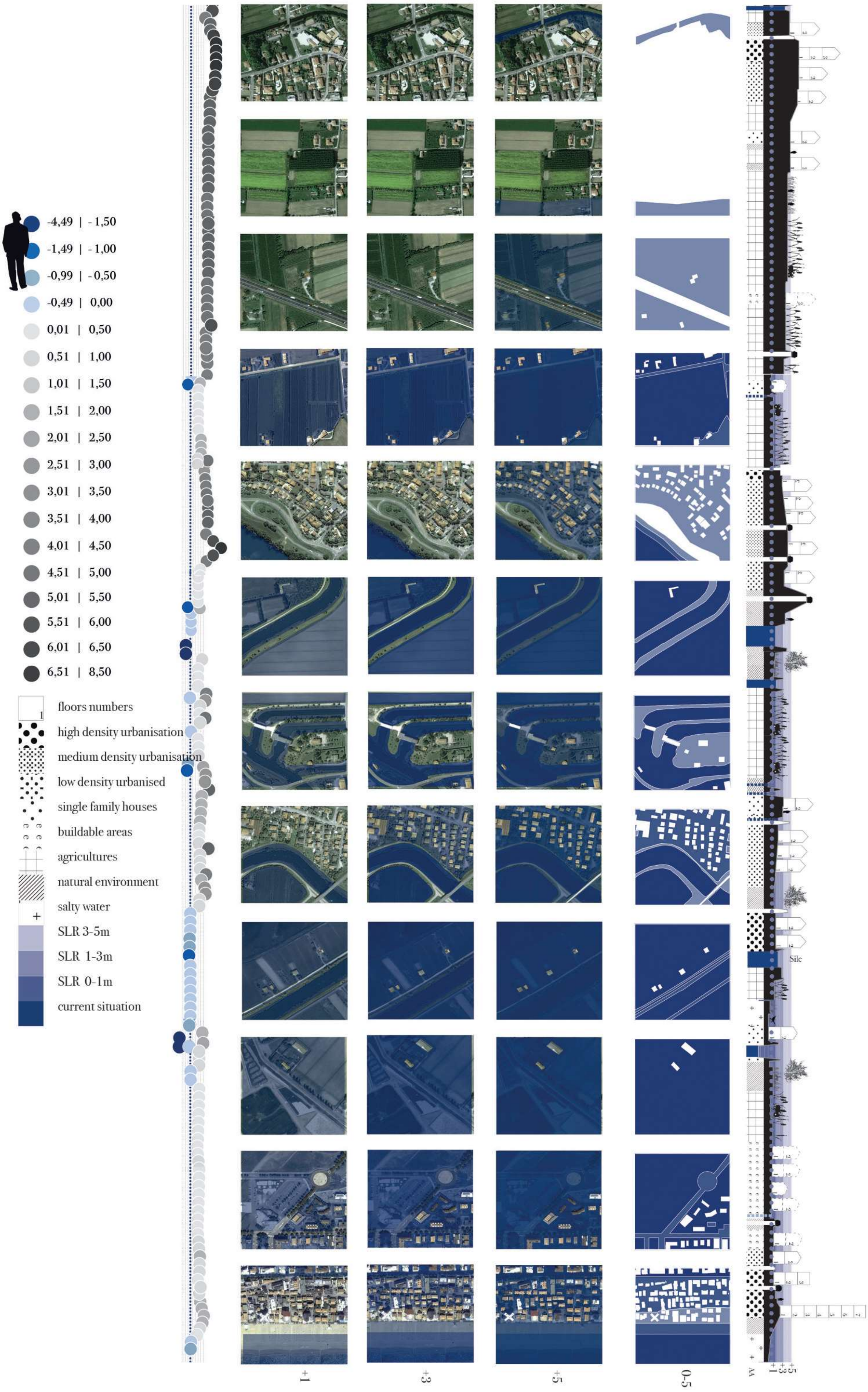

Figure 6. Synchronic view. 30 km. Scenarios of SLR 1-3-5 meters projected in the current spatial configuration. elaborated by the author. Source of data: Regione Veneto, Regional Technical Map, 1:5000 (CTR), 2010; Corine Land Cover 2006; Google.

becomes immediately evident that water rises in a non-linear way, i.e. overwhelming inner lands prior to coastal areas. Following SRL scenarios, the +1 m SLR scenario discloses a future where: (a_1) all traces of reclaimed land will be erased by SLR; (b_1) agricultural lowlands will subsequently disappear; (c_1) the coast will become a narrow strip island, where the ancient cordon of dunes will be evoked by a landscape of tall buildings and skyscrapers facing the sea, as a bastion of an economy that needs to be reconceived; (d_1) existing buildings will have to give up their ground floors and (e_1) new urbanisations (buildable areas) will have to be reconceived around main infrastructures.

Furthermore, observing the same spaces within the scenario +3 m SLR: (a_3) reclaimed lands will become consolidated water surfaces where productive landscapes (i.e. aquaculture; fishing) might be imagined; (c_3) the coastal hotel-line will have to either be protected by dikes or else have its ground floors invaded by seawater; (d_3) part of the built stock will have to be abandoned while (e_3) in face of the danger of flooding, those buildable areas placed in SLR zones need to be displaced elsewhere; at the same time, the same dynamics as described in (b_1,d_1,e_1) will affect other land higher up.

Lastly, the extreme scenario of +5 m SLR anticipates a far off future where: (f_5) the entire coastal zone will become a set of narrow peninsulas mainly located along riverbanks, where typically main roads and infrastructures run; (g_5) the sea shore will reach the limits of the reclaimed landscape, whereas (h_5) in the lower lying areas a new landscape of floating infrastructures and an archipelago of buildings without parcels of land will be visible, testimony to a recent past that can still be reconsidered.

At the same time, if imagining a journey from the lower to the upper lying areas in different moments of the future, the urban landscape encountered along the way will change, in space and time, in a non-linear manner, continuously alternating and intermingling pieces of sea and land, roads and water infrastructures, and thus reversing the paradigm of order and equilibrium that has historically guided the construction of this area.

3.2. A taxonomy of barriers

Moreover, according to this analysis, land morphology emerges as the element via which historical transformations can be analysed and future intervention imagined. While reading territorial forms and observe at the same time present and future of these places, the most appropriate term for describing this complex morphology is that of a large-scale *ground project* (Secchi 1986), where ground is revealed not only as the driver for both past and future territorial transformation but also as that element able to cross the traditional city borders, and thus the extreme city-territory support and main infrastructure. Indeed, the entire area can be pictured as an archipelago of lowlands surrounded by barriers (Figure 7), by a taxonomy of linear elements that emerge from the ground as the deposit of long-term rationalities, of hydraulic infrastructures and of a diffuse process of urbanisation. River dikes in particular, in all their hierarchies, types and dimensions, are the main elements around which infrastructures (and their related flows) such as mobility, water, waste and energy supplies have been organized. If observing the territory according to this interpretative lens, barriers become multiple elements to be observed, described and designed throughout spaces and times of transition. A design operation that will have to follow temporal shifts before spatial ones, and by doing so opens up a reflection on a project continuously adapting to the specificity of context rather than on absolute paradigms of intervention.

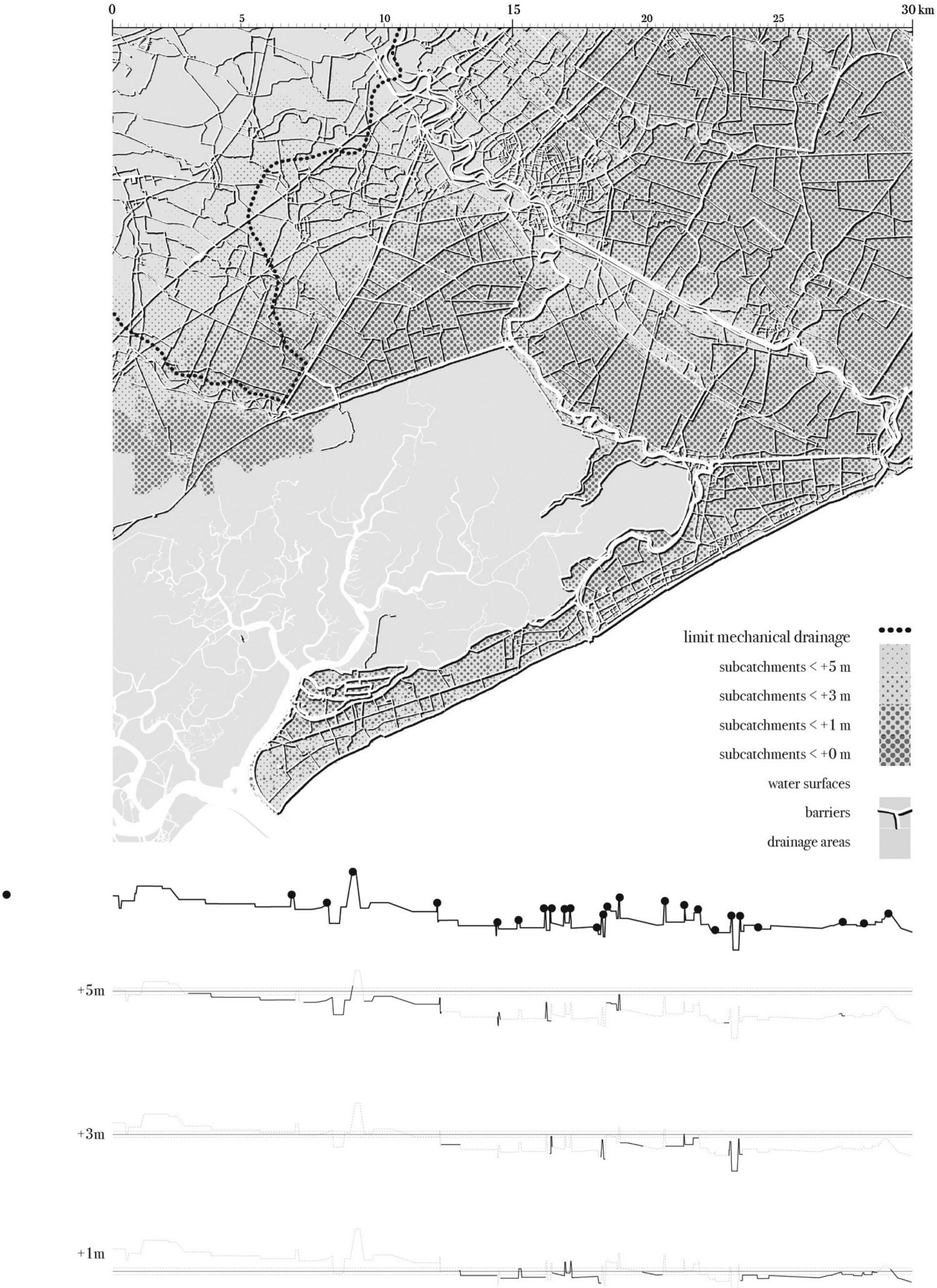

Figure 7. Geographies of barriers. 30x30km. Tscale: 2010. elaborated by the author. Source of data: Regione Veneto, LandCover (Uso Del Suolo) 2010; Regional Technical Map, 1:5000 (CTR), 2010, Consorzio di Bonifica Veneto Orientale.

4. Discussion

This paper addresses the consequences of climate change via a spatial and cartographical analysis that roots into the idea that representing transition is key for addressing climate-related dynamics. The methodology proposed unfolds a process of crossing -and representing- scales as a mean to break through the generic geography of risk, as a mean of considering topography as an element that will continuously redesign future boundaries. In this sense, the threefold operation here proposed (i. mapping microtopography as a vectorial device; ii. sampling and prototyping small-scale plans and sections; iii. building a territorial section, that is to say to re-contextualize the space of investigation) could be applied elsewhere, but on the other hand, different contexts of investigation, will certainly and inevitably underline different relations of spaces with past and future transformation and thus possibly modify the methodology itself.

More in general, this work is rooted in an alliance between water and urbanism that, over the last decades, due to the combination of the environmental crises and the worldwide growth in the process of urbanisation, has come to produce a consistent accumulation of research studies, design investigations and projects (Mathur and Da Cunha 2001; Gandy 2004; Shannon 2008; Feyen, Neville, and Shannon 2009; Hölzer, Wiethüchter, and Stiftung 2008; Mathur and Da Cunha 2009; Fabian and Viganò 2010; De Meulder and Shannon 2013; Viganò, Fabian, and Secchi 2016; Prominski et al. 2017). This accumulation proves the binomial (water-urbanism) to be a fruitful path and demonstrates a consistent shift of paradigm from resistance to resilience, from hard to soft infrastructures, from artificial to nature-based solutions. Categories such as water reuse, retainment, infiltration are progressively replacing those of channelling or evacuating and gradually entering into political agendas. However, today's conditions have changed: the future is upon us. The latest report on Climate Change (IPCC 2018) warns us that what was envisioned for the end of the century is actually expected for 2050, and that we need to move fast in implementing a radical transition of society and spaces: architects and urbanists thus need to once again re-question the research (by design) agenda for such extreme-city-territories. Following this line of thinking, this work discloses a threefold path via which to address the increasingly important interrelation of water and space. Firstly, it underlines the renewed need for images able to: increase collective risk awareness, while reinforcing the synergies between local and territorial scale for rethinking urban transformation; reveal local specificities, while disclosing local geo-morphological typologies as starting points for imagining the future. Secondly, via binding extreme-city-territories and extreme images, it suggests we conceive and analyse space within embracing the principles of "sensitive watershed design" (Romnée, Evrard, and Trachte 2015) and watershed solidarity (Ranzato 2017) (in the current debate, the notion of watershed is often mentioned to explain the mismatch between administrative and ecological units). Ultimately, this work argues that multiple scales are now even more increasingly required for coping with such themes: the tension between global and local testifies both the need to devise new long-term and large-scale designs and the urgency of experimenting locally based and on-site analysis, where the pattern of diffuse urbanisation, due do the different intertwining of built and open spaces, offers a different set of possibilities for imagining alternative adaptation paths.

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Notes on contributor

Chiara Cavalieri, architect and PhD Urbanism, (IUAV, University of Venice), is Professor of Urbanism and Territorial Management at the Université Catholique de Louvain (UCLouvain) and member of the executive committee of the Habitat Research Center (HRC) at EPFL. Over the last years, she has collaborated and taught in the field of architecture and urbanism at a number of different international schools, including IUAV Venice, GSD Harvard, EPFLausanne, ITMO St. Petersburg, and ENSAP Lille. She has participated and directed several projects, researches activities and international workshops (with Iuav Venice, Studio Secchi-Viganò; Lab-U, EPFL Lausanne; Studio Paola Viganò; UCLouvain). In 2016 she co-curated the exhibition "The Horizontal Metropolis: A radical Project", exhibited in 2016 at "La Biennale di Venezia, 15th International Architecture Exhibition" and in 2018 at Bozar, Brussels. She is currently developing water and landscape urbanism research throughout transboundary city-territories, with a particular focus in mapping and representing the related territorial dynamics.

ORCID

Chiara Cavalieri http://orcid.org/0000-0002-7023-6516

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