MATTEO LOMAGLIO

ENCODED ECOLOGIES OF THE VENETIAN LAGOON

A MULTI-SCALAR DATA-DRIVEN COMPUTATIONAL APPROACH FOR DYNAMIC ENVIRONMENTS

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AHO -Oslo School of Architecture   -   Diploma Spring 2017

C O N T E N T S

"New ways of using technology to change behaviour and our system of production and consumption also offer the potential for supporting the regeneration and preservation of natural environments..."

Schwab, K. (2016) The Fourth Industrial Revolution. Geneva: World Economic Forum.

The research that underlies this project combines ecological and architectural scales in approaching the design and transformation of the environment of the Venetian Lagoon. This is done through advanced computational design and the proposed utilization of robotic technologies.

The project draws from a combined systemic and design approach and proposes a dynamic and varied attitude to landscape preservation and transformation. The complexity of the Venetian lagoon ecosystem is encoded into a set of generative data-driven algorithms that define computational methodologies with the aim to inform architectural strategies within and between different scales.

A multi-criteria analysis was undertaken based on available ecological, geological and hydrological data and information of the lagoon. The inherent complexity of this ecosystem necessitated an investigation into current and innovative technological developments that could underpin a diverse approach to ecological restoration of dynamic environments. This includes selective preservation and selective transformation in a dynamic and continual project for the lagoon, a proposed new botanical garden conceived as a terrain vague, and the architectures and technologies that are key provisions in a process of perpetual change. In this vision, the Venetian Lagoon becomes a 1:1 laboratory for research in advanced technologies and autonomous systems related to ecological and architectural developments, and through this a pioneering laboratory for ecological processes preservation.

The aim of the thesis is the research in the definition of complex systems of data-driven architectural strategies through the use computational tools. The research is focused on multiple cross-informed scales of the lagoon, considering "scale" as determined by both the spatial dimensions or resolution (as far as data is concerned) and time.

The research aims to initiate a new approach for collaboration between disciplines such diverse and interrelated as geography, ecology, urban planning, computer science, Statistics and Architecture.

500 M   2 KM
1 KM   5 KM
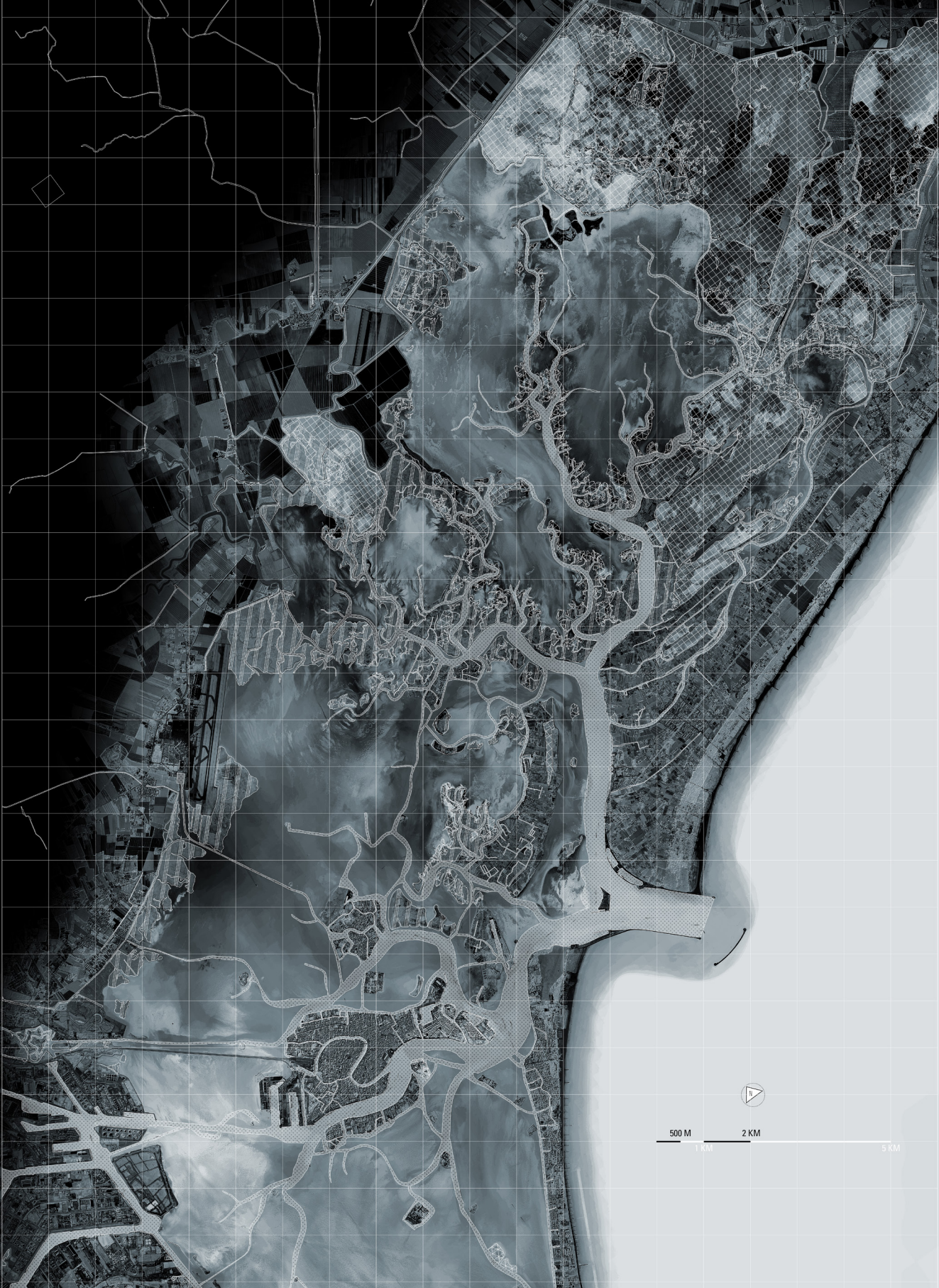
THE VENETIAN LAGOON
A DYNAMIC ECOSYSTEM

The Venetian Lagoon is a shallow coastal water body affected by a series of both anthropogenic and natural factors. To assess the significance of those factors in relationship to the lagoon ecosystem it is important to understand the extent of natural variability and spatial heterogeneity of this specific system. The Venice lagoon is a complex, heterogeneous, and dynamic system that evolves continuously in response to modifications by numerous different and correlated factors.

The city and islands of Venice emerged incrementally from its lagoon as the result of technological innovations that allowed people to build solid ground on marshy substrate. The relationship between the construction and the ephemeral morphology of the lagoon can be traced through the city's history as a sequence of different adaptations aimed at preserving this unique symbiosis. Starting from the 13th century until today, humans affected a continuous change in the morphology that brought about Venice's urban texture in terms of construction and techniques.

In this way Venice has become an historical example of the possibility of human adaptation to extreme environmental surroundings and, in turn adaptation of the environment to human needs. In the recent times sea level rise and climate change is placing the Venetian lagoon at a critical juncture in its existence and require the exploration of new techniques of adaptation to prevent dramatic failure of both the human and the natural environment.

In order to approach the impact on natural activities in the lagoon, it is important to understand the extent of its natural variability and spatial heterogeneity. In this process, collection and visualization of environmental data can yield strategic guidelines to evaluate the lagoon ecological condition, as well as new approaches to designing in and with such conditions.

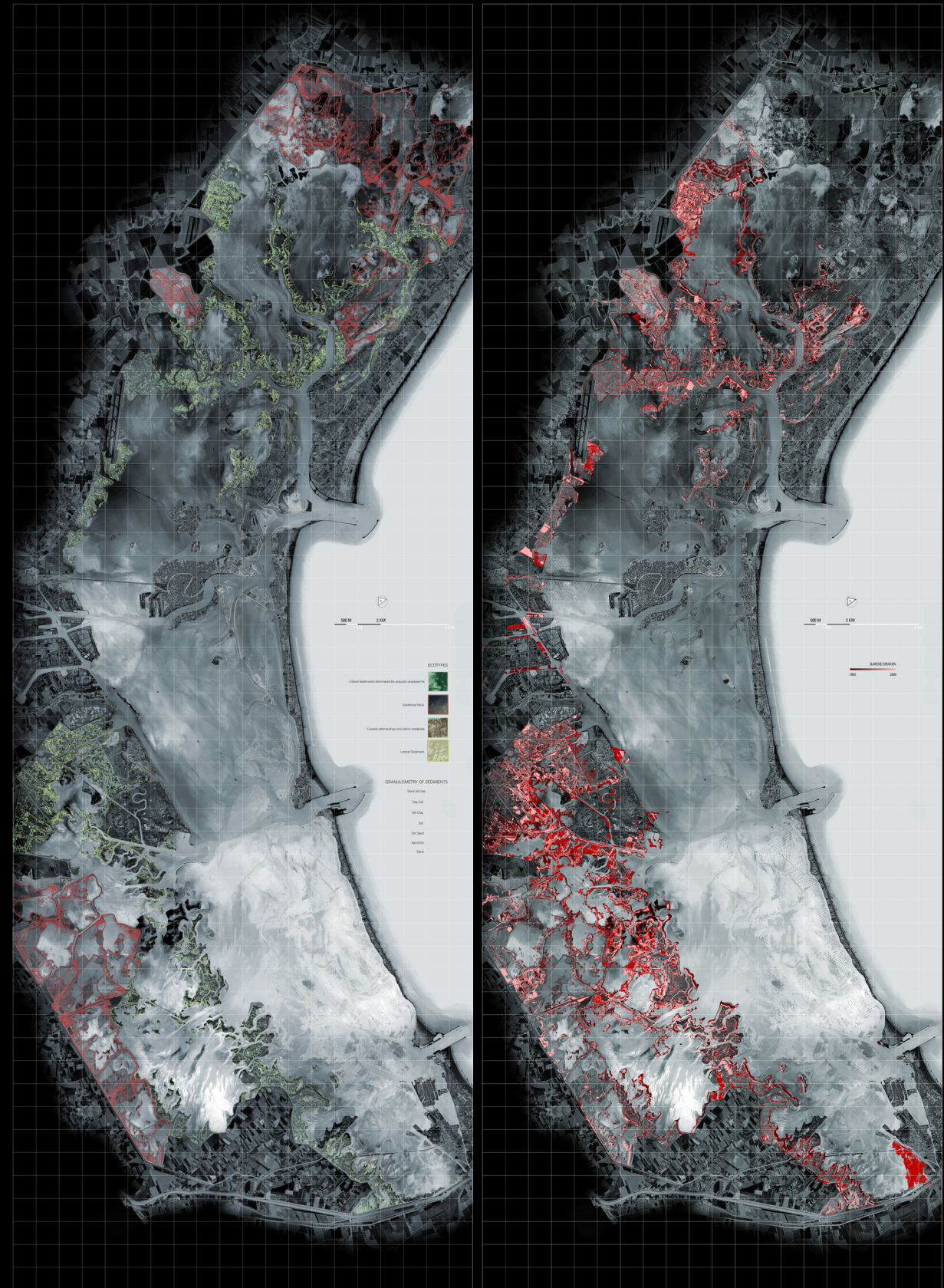*"Mapping is a cultural project creating and building the world as much as measuring and describing it. "*

Corner, J. (1999) 'The agency of mapping: speculation, critique and invention'. In: Cosgrove, D. E. Mappings. London: Reaktion. 213-233.
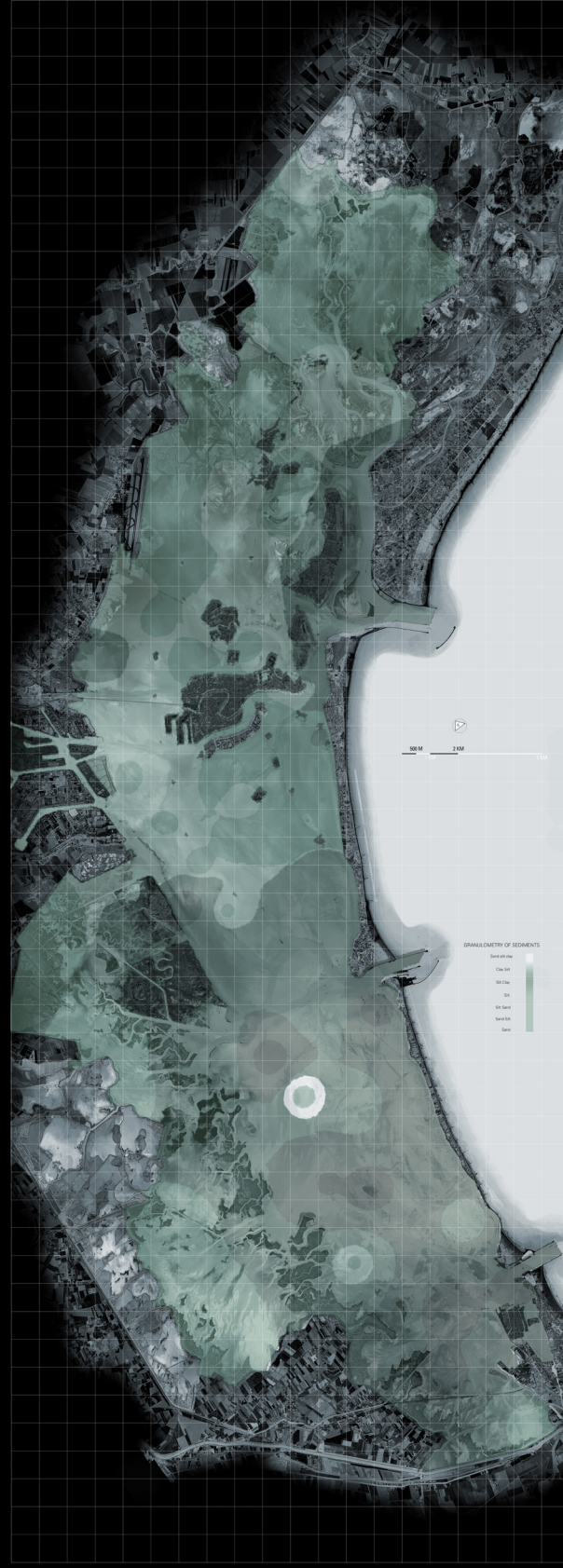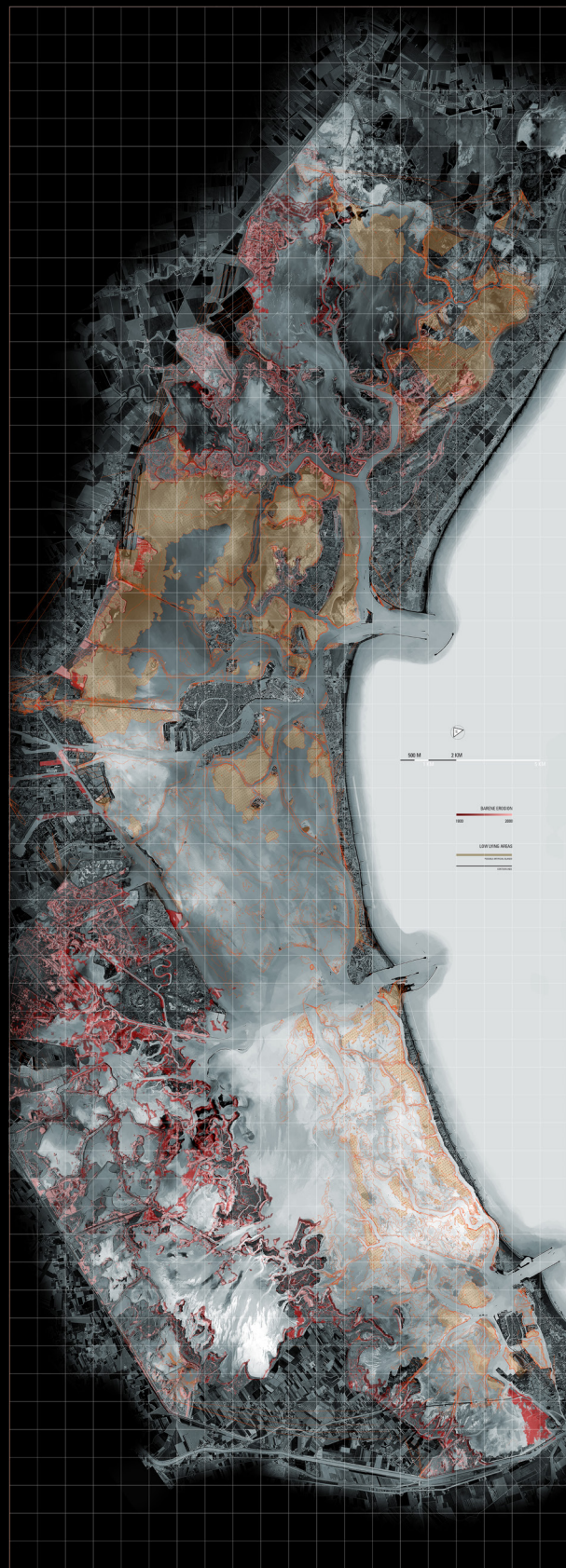
THE ACT OF MAPPING

In this project the development of mapping strategies for the different collected data of the lagoon is of great relevance. In this context mapping is not merely a question of visualization but, instead, the means by which a change in approach can be affected through the understanding of the agency and interaction between different constituents and forces that shape an ecosystem in interaction with human management of the environment. The representations go to the root of the determinant factors of the natural conditions of the environment. In other words, the process aims not only to interrogate data to extract information, but also to provoke a shift toward a different point of view and perspective regarding the complex natural landscape in which Venice is located. In this way, it proposes the act of mapping as an agent for developing a cultural process capable of giving a different experience and refocusing the attention to the whole ecosystem of the lagoon and not only on the main island of Venice.

DATA TO INFORMATION
The set of data used in this work has been collected from Open data Portal of the city of Venice. This provides the starting point for the elaboration of a complex system of data collection and interpretation by the proposed robotic system of drones and robots on which numerous actions are based. The main data set used regard ecotypes classification, type of sediments, bathymetry, erosion, water pollution, sediment pollution, granulometry, ecological state, waterflow and morphological classification. (file_Drawings/Renders)
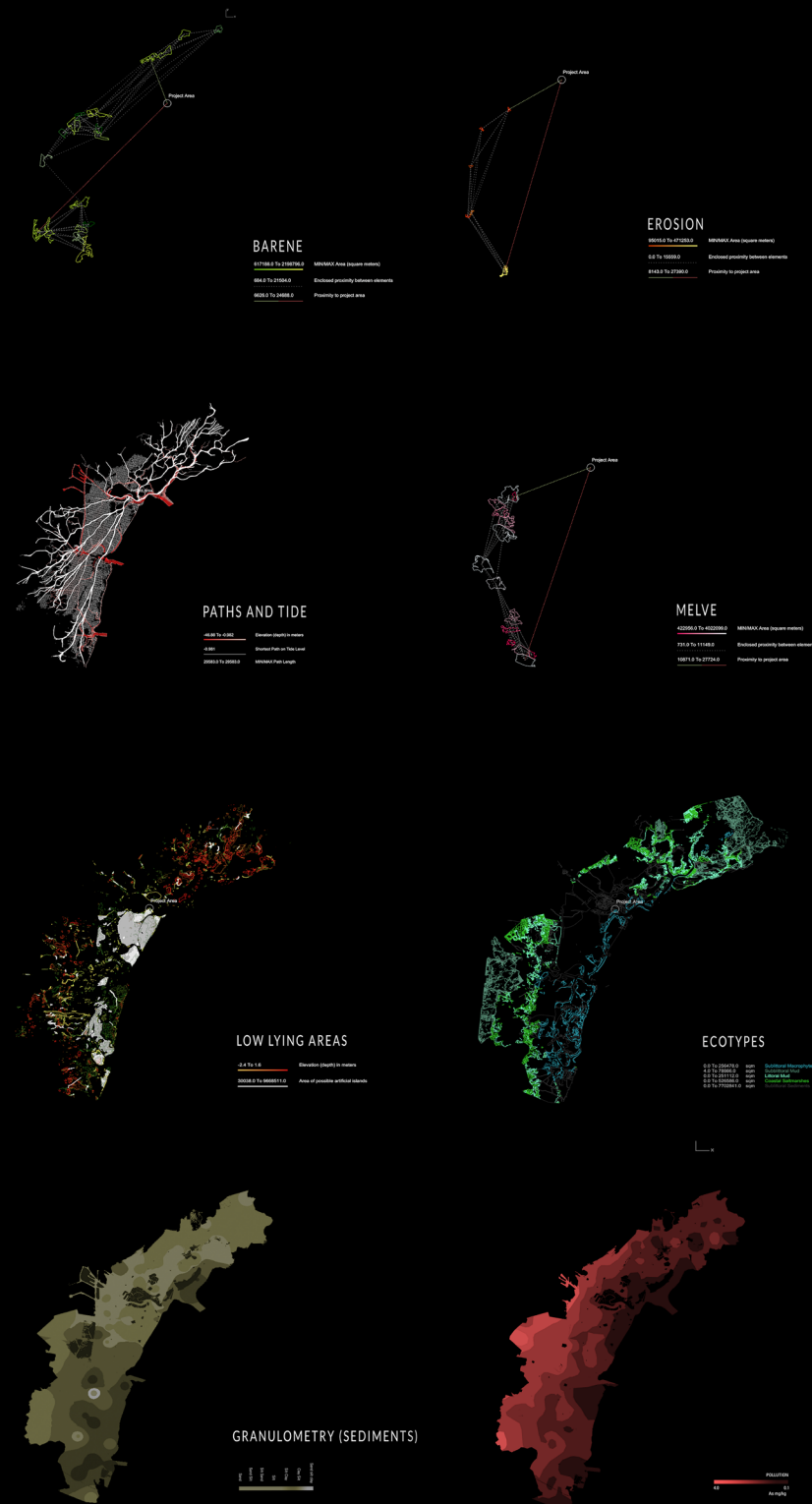
DATA/DRIVEN ALGORITHMS

The integration of the data trees collected into a unique computational model makes possible to translate them into a readable system that can be interrogated and sorted based on defined questions, parameters and conditions. At the same time, the possibility of combining and layering data leads to more complex readings of data. An integrative approach to data defines guidelines for the actuation of data-driven algorithms for the circulation of the proposed robotic agents into the lagoon ecosystem that are intended to both upkeep and transform the environment. For instance, robots will move based on the maximum speed level permitted in the specific location, finding the shortest path relative to real time tide levels, etc. Such set of rules permits the infrastructure to achieve effective performance. That is to say that the robotic system does not present a pre-defined set of systematic circulation paths but, instead, a real time data-driven network of information to inform their actions.
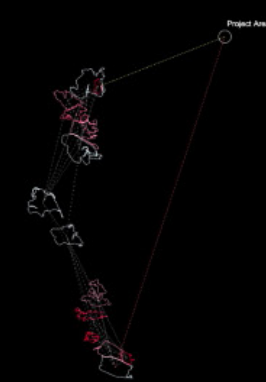
Movements are regulated by a hierarchical set of rules defined by the network of relationships between the collected data. For example the amount of terrain lost caused by the erosion process over a certain amount of square metres of a land, constituted by a specific type of sediment, defines a value of "attraction" for the robotic agents to choose where to move and how to act. Robots and drones are proposed to not only intervene physically in the environment, but also to continually collect new data to feed back into the system with the aim to track changes and transformation, and to evaluate the impact of interventions. (file_Data-driven Swarming)

BARENE

EROSION

PATHS AND TIDE

MELVE

LOW LYING AREAS

ECOTYPES

GRANULOMETRY (SEDIMENTS)

POLLUTION

BARENE

MESTRE

VENEZIA

Project Area

LIDO DI VENEZIA

MELVE
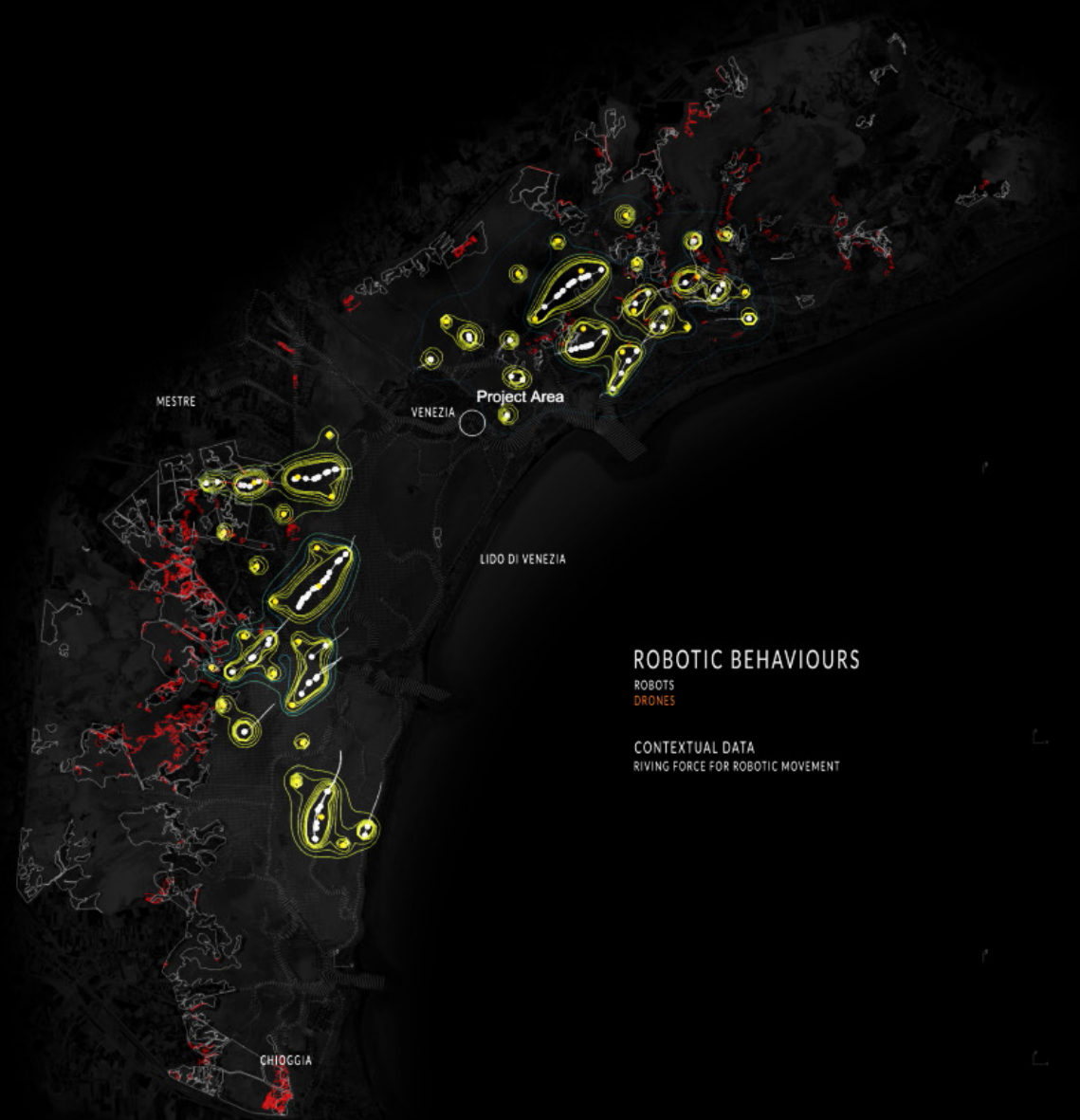
ROBOTIC BEHAVIOURS

ROBOTS
DRONES

CONTEXTUAL DATA
RIVING FORCE FOR ROBOTIC MOVEMENT

EROSION

CHIOGGIA
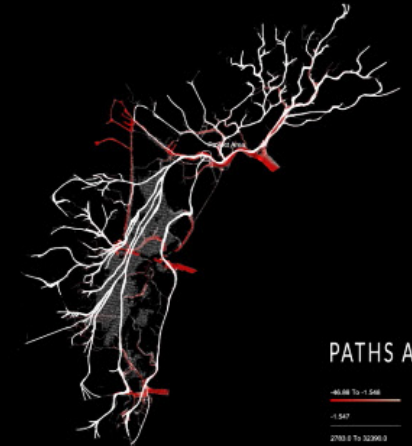
PATHS AND TIDE
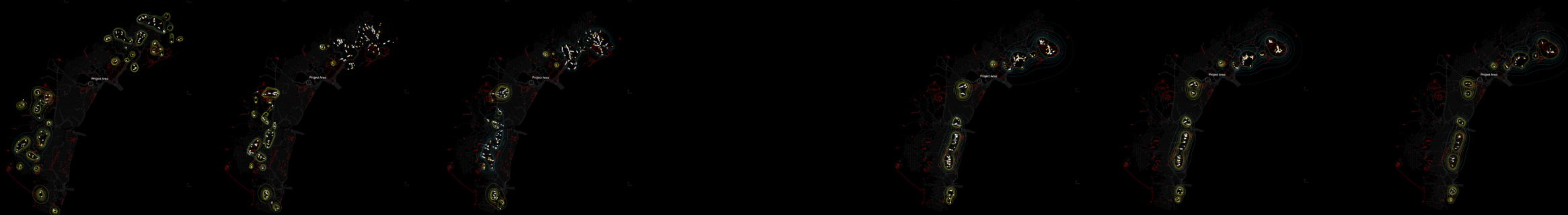
DYNAMIC RANGE ECOSYSTEMS

The definition of the modes of intervention and management of such complex situation needs to be built on a deep understanding of the complex and dynamic factors acting in the lagoon ecosystem. Effective management of the lagoon should hence be an outcome of an integrated vision of the intervening factors based on a fundamentally adaptive approach.

Non-linear behaviours in populations, communities, and ecosystems are widespread and occur at many different scales. Because of their natural inclination to be variable, the term equilibrium, used prevalently when ecosystems were still viewed as fairly static systems, is considered inadequate to define variable systems such as the Venetian lagoon. In fact, the word equilibrium implies a static character of a sort that ecosystems do not display outside of the meta-equilibrium of dynamic processes and change. Because the response of ecosystem patterns and processes to disturbance is rarely linear, a dynamic regime concept offers a more useful construct than linear models for understanding ecosystems.

Given the complex nature of how the ecosystem functions, the approach that informs effective interventions is proposed to be conducted through the integration of a new active robotic layer into this ecosystem, fundamental not only for the purpose of maintenance, but also for sustaining change and modification. This approach follows the shift in approach from sustaining unstable equilibrium to sustaining a stable disequilibrium, as proposed by the German Zoologist Josef Reichholf.

Approaching ecosystem management in a dynamic way is more difficult than using more simplistic, linear relationships. For this reason, the integration of robotic technology is fundamental for the identification of dynamic regimes and their correlations through the collection and analysis of large
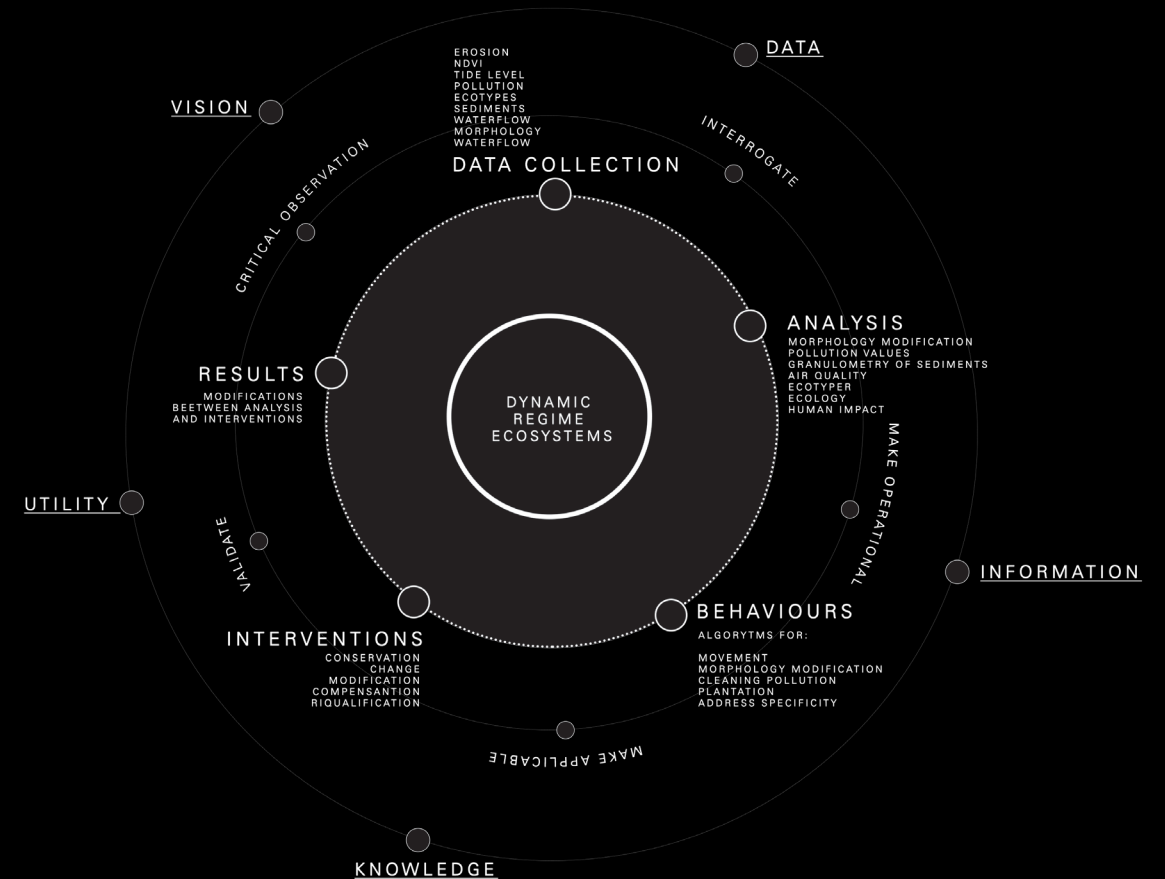
amounts of data on multiple temporal and spatial scales. Such a system might be able to intervene, evaluate and collect new information to feed back into the process, going from data to interventions, and back to data-analysis again. This includes processes of learning, development and optimization over parallel investigations done at the proposed research centre.
(file_Dynamic Range Ecosystems)

INTERVENTIONS
PRESERVATION
CHANGE
RIQUALIFICATION
RESTORATION

LAGOON INTERVENTIONS FLOW MAPS

RECOMPENSATE EROSION

DYNAMIC REGIME ECOSYSTEM

DISTURBANCES
MODIFICATION
CLASSIFICATION
INTERVENTIONS

ECOLOGICAL SUCCESSION
UNPREDICTABLE EVENTS
DYNAMICS
GEOLOGY
CHANGE
RIQUALIFICATION
DIVERSITY
GLOBAL WARMING
HUMAN IMPACT
RIQUALIFICATION
LAND USE CHANGE
FUNCTIONING
BIOLOGY
RESTORATION
BIOLOGY
BIOLOGICAL INVASION
STRUCTURE
MORPHOLOGY
CONSERVATION
FUNCTIONING
NATURAL EVENTS

ECOLOGICAL SUCCESSION
DIVERSITY
BIOLOGICAL INVASION
LAND USE CHANGE
BIOLOGY
STRUCTURE
HUMAN IMPACT
CONSERVATION
CHANGE
MORPHOLOGY
ECOLOGY
NATURAL EVENTS
RIQUALIFICATION
PRESERVATION
FUNCTIONING
GLOBAL WARMING

DISTURBANCES
BIOLOGICAL INVAISONS
ECOLOGICAL SUCCESSION
NATURAL EVENTS
LAND USE CHANGE
GLOBAL WARMING

TIDE LEVEL
-0.5 TO +2.00 METERS   SUBMERGED LAND
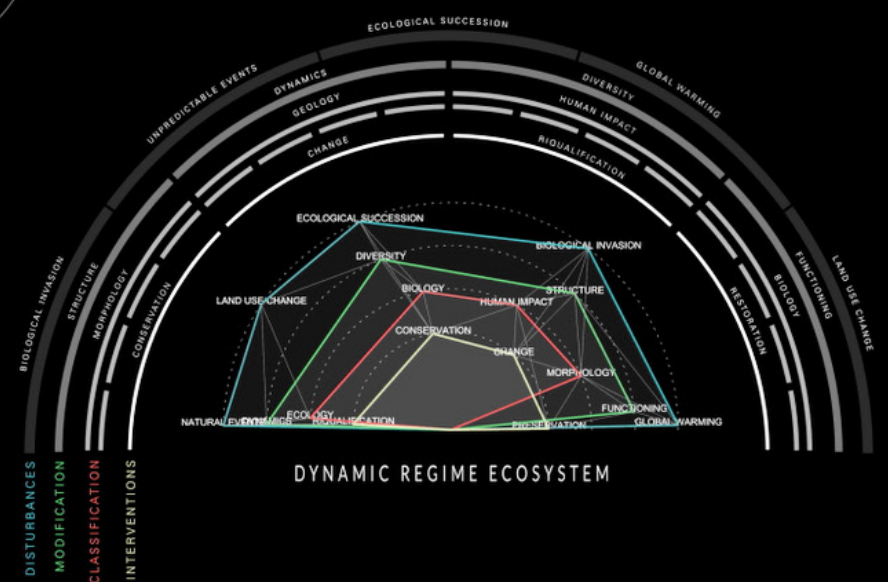
MODIFICATION
DYNAMICS
FUNCTIONING
STRUCTURE
DIVERSITY

ECOTYPES

0.0 To 7722.0   sqm   Sublittoral Macrophyte
4.0 To 7734.0   sqm   Sublittoral Mud
0.0 To 7326.0   sqm   Littoral Mud
0.0 To 10396.0   sqm   Coastal Saltmarshes
0.0 To 84141.0   sqm   Sublittoral Sediments

CLASSIFICATION
MORPHOLOGY
ECOLOGY
BIOLOGY
HUMAN IMPACT

EROSION

3761.0 To 132586.0

20   21

DATA COLLECTION
NDVI MAPS
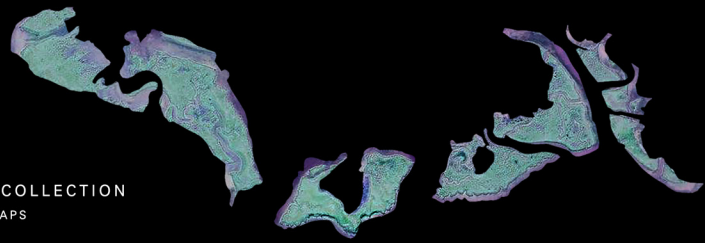
INTERVENTIONS
REPLANTATION
BARRIER CONSTRUCTION

ECOLOGY
MAPPING PLANTS
AND ORGANISM

EROSION
AREAS SUBJECTED TO EROSION

MORPHOLOGICAL SITUATION
3D SCAN OF THE TOPOGRAPHY

THE QUESTION OF THE SCALE

This integrated approach involves different scales, based on the understanding of the concept of "scale" as determined by two main components: dimension or resolution (as far as data are concerned) and period or extent. Resolution is usually determined by the smallest unit that is relevant to the system dynamics of interest.

However, the typical constraint in practice is the resolution determined by available data. For this reason the integration of new ways for collecting data, by way of drones for instance, can help obtain data at the scale of interest.

Time period or spatial extent is ruled by ecosystem boundaries and by the observer frame of reference, determined by the longest period over which the ecosystem can be defined or data is available. Scale becomes an important consideration when determining which monitored variables are external and which are internal to a particular ecosystem regime, making it possible to intervene toward specific goals. The proposal is to enable this important task by a robotic ecosystem layer, which can reduce limitations of the usual data-recording devices and human life span, and which may restrict the scale at which researchers can observe dynamic regimes and understand the shifts between them.
 (file_Dynamic range ecosystems)

ROBOT SIMULATION
LANDSCAPE/MORPOHOLOGY MODIFICATION
SOIL PLANTATION
DRONE/ROBOT COLLABORATION
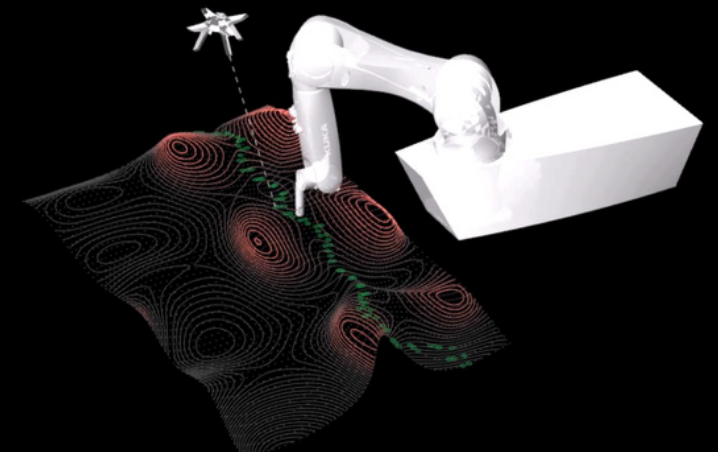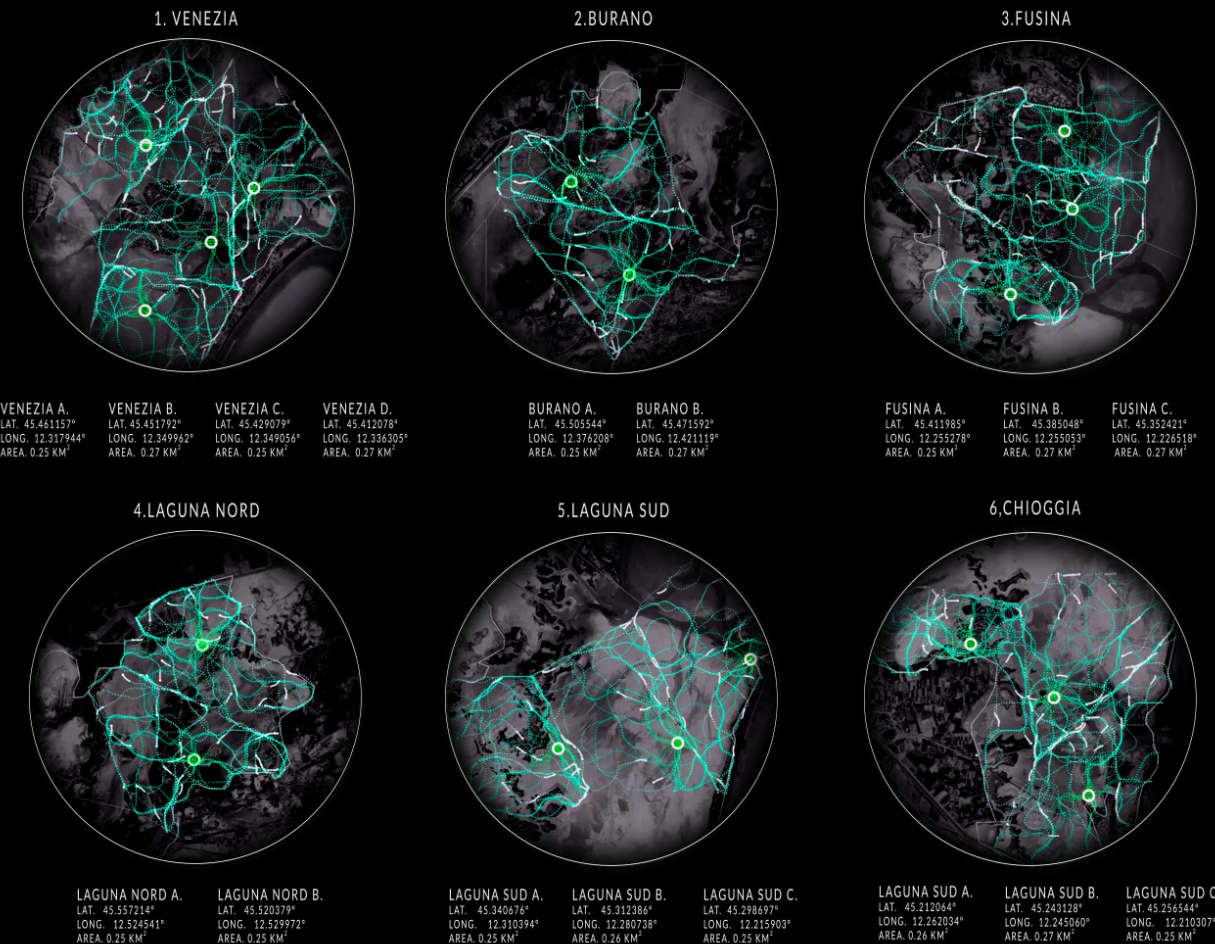
THE ROBOTIC INFRASTRUCTURE

This strategic view of advanced ecological management and preservation is based on a designed infrastructural network of robotic agents, data centres and charging stations.

The framework was developed based on an optimizing algorithm, as far as the coverage area and position are concerned. The entire lagoon is subdivided into 6 main areas and 17 stations for drone and robot recharge, data download and storage. Parameters, such as, distance from coast line, proximity in between the stations, bathymetry and accessibility have been taken into account to generate the coordinates of the stations through an evolutionary solver.

The optimization permits the robotic agents to always be in a specified range from each station and access another to download the data in case of system errors.

STIGMERGIC BEHAVIOURS

Each station is provided with a certain number of drones and robots that communicate and move in a swarm formation over the given area. Because of the number of agents involved, the agents will swarm based on a consensus network of coordination of stigmergic behaviours. In this way, it will not be necessary to give orders to each of the agent, but only to define a certain target of intervention, making the agents communicate between each other through traces, like insects. For example, ants exchange information by laying down pheromones (the trace) on their way back to the nest when they have found food. In that way, they collectively develop a complex network of trails, connecting the nest in the most efficient way to the different food sources. (file_ Robotic Infrastructure)

ROBOT STATIONS
COVERAGE AREA OPTIMIZATION

ROBOT STATIONS
SPECIFIC LOCATION
BASED ON CONTEXTUAL DATA
AREAS LESS SUBJECTED TO FLOOD
PROXIMITY TO BOUNDARY SEA/LAND

ROBOT STATIONS
OPTIMIZED DISTANCE FOR CHARGE/MANTEINANCE
AVERAGE ROBOT SPEED
DISTANCE IN BETWEEN THE STATIONS

ROBOT STATIONS
STYGMERGIC BEHAVIOUR
TRACE MAPS BASED ON CONTEXTUAL DATA

1. VENEZIA

VENEZIA A.
LAT. 45.461157°
LONG. 12.317944°
AREA. 0.25 KM²

VENEZIA B.
LAT. 45.451792°
LONG. 12.349962°
AREA. 0.27 KM²

VENEZIA C.
LAT. 45.429079°
LONG. 12.349056°
AREA. 0.25 KM²

VENEZIA D.
LAT. 45.412078°
LONG. 12.336305°
AREA. 0.27 KM²

2.BURANO

BURANO A.
LAT. 45.505544°
LONG. 12.376208°
AREA. 0.25 KM²

BURANO B.
LAT. 45.471592°
LONG. 12.421119°
AREA. 0.27 KM²

3.FUSINA

FUSINA A.
LAT. 45.411985°
LONG. 12.255278°
AREA. 0.25 KM²

FUSINA B.
LAT. 45.385048°
LONG. 12.255053°
AREA. 0.27 KM²

FUSINA C.
LAT. 45.352421°
LONG. 12.226518°
AREA. 0.27 KM²

4.LAGUNA NORD

LAGUNA NORD A.
LAT. 45.557214°
LONG. 12.524541°
AREA. 0.25 KM²

LAGUNA NORD B.
LAT. 45.520379°
LONG. 12.529972°
AREA. 0.25 KM²

5.LAGUNA SUD

LAGUNA SUD A.
LAT. 45.340676°
LONG. 12.310394°
AREA. 0.25 KM²

LAGUNA SUD B.
LAT. 45.313286°
LONG. 12.280738°
AREA. 0.26 KM²

LAGUNA SUD C.
LAT. 45.298697°
LONG. 12.215903°
AREA. 0.25 KM²

6,CHIOGGIA

LAGUNA SUD A.
LAT. 45.212064°
LONG. 12.262034°
AREA. 0.26 KM²

LAGUNA SUD B.
LAT. 45.243128°
LONG. 12.245060°
AREA. 0.27 KM²

LAGUNA SUD C.
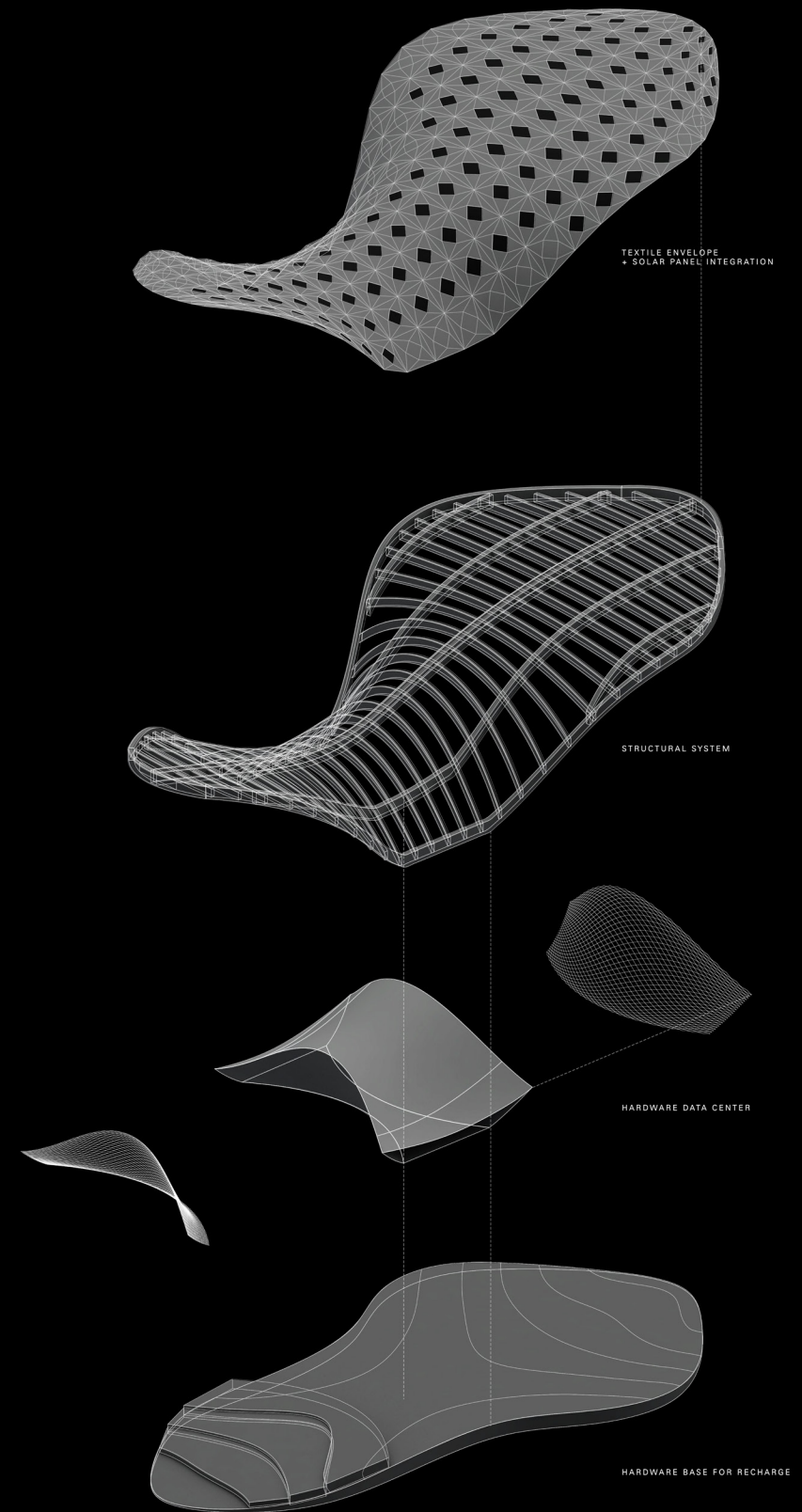LAT. 45.256544°
LONG. 12.210307°
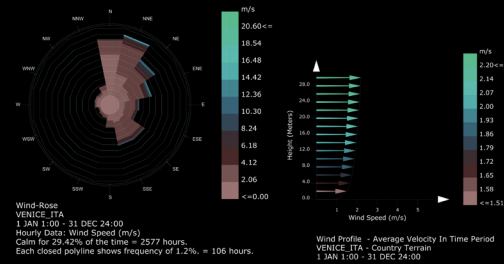AREA. 0.25 KM²

CHARGING STATIONS

The charging station design derives from a set of programmatic needs and contextual data.

The dimensions of the "users" (drones, robots and humans) have been integrated into the formalization of both a required covered area and a desirable height of the structure to define spatial arrangements for the data centre, the robots and the drones. The structural system and envelope is optimized based on solar radiation, wind data and energy production(solar cells).
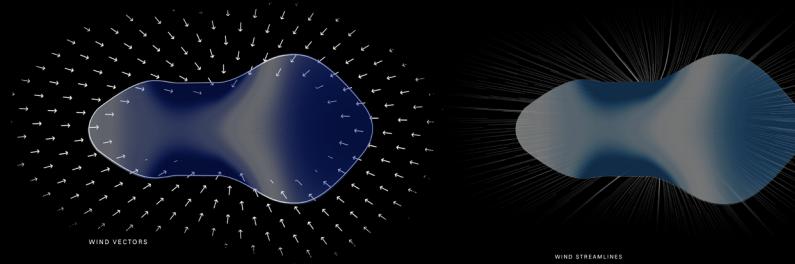
The central core of the data centre is a closed, protected module in which data are collected and stored. Lightweight structure and materials are chosen for the purpose of easy assembly and the building elements are optimized for robotic fabrication.
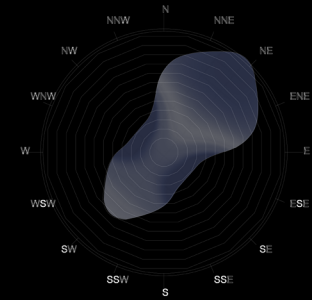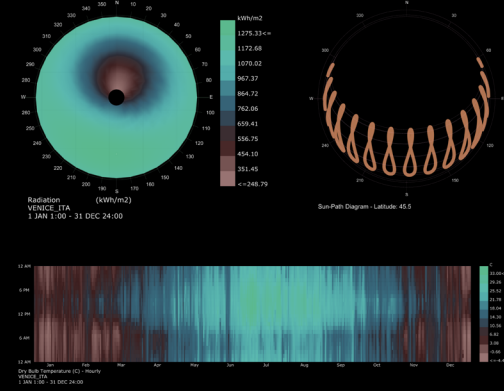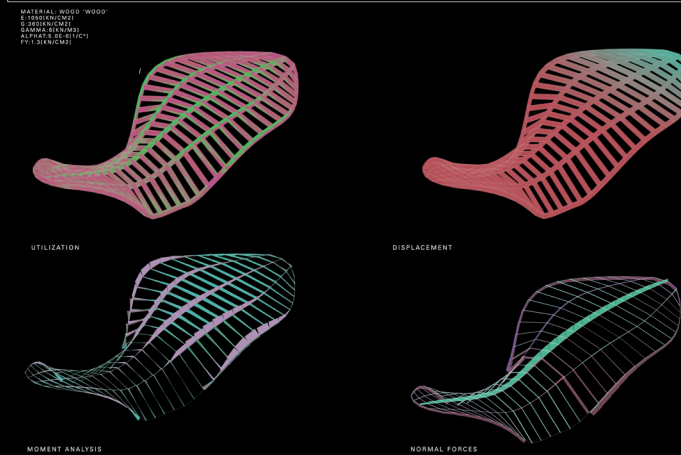

TEXTILE ENVELOPE
+ SOLAR PANEL INTEGRATION

STRUCTURAL SYSTEM

HARDWARE DATA CENTER

HARDWARE BASE FOR RECHARGE

WIND FLOW ANALYSIS

ORIENTATION

Wind-Rose
VENICE_ITA
1 JAN 1:00 - 31 DEC 24:00
Hourly Data: Wind Speed (m/s)
Calm for 29.42% of the time = 2577 hours.
Each closed polyline shows frequency of 1.2%. = 106 hours.

Wind Profile - Average Velocity In Time Period
VENICE_ITA - Country Terrain
1 JAN 1:00 - 31 DEC 24:00

WIND VECTORS

WIND STREAMLINES

NNW   N   NNE
NW   NE
WNW   ENE
W   E
WSW   ESE
SW   SE
SSW   S   SSE

ENVELOPE ORIENTATION TO MAXIMIZE SOLAR RADIATION
AND VENTILATION

SUN/TEMPERATURE DATA

STRUCTURAL ANALYSIS

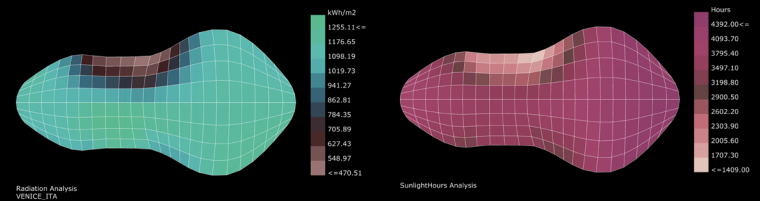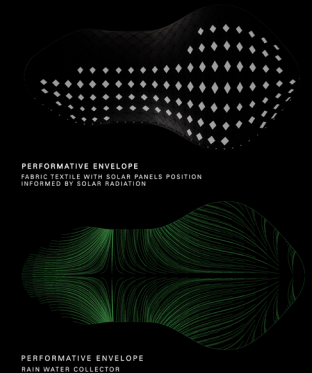MATERIAL: WOOD 'WOOD'
E: 1060[KN/CM2]
G: 260[KN/CM2]
GAMMA:0[KN/M3]
ALPHAT:5.0E-6[1/C°]
FY:1.3[KN/CM2]

SHAPE OPTIMIZATION

Radiation
VENICE_ITA
(kWh/m2)
1 JAN 1:00 - 31 DEC 24:00

Sun-Path Diagram - Latitude 45.5

UTILIZATION

DISPLACEMENT

MOMENT ANALYSIS

NORMAL FORCES

GEOMETRY DEFINITION
CHARGING POINTS
DATA TRANSFER TO DATA CENTER

Dry Bulb Temperature (C) - Hourly
VENICE_ITA
1 JAN 1:00 - 31 DEC 24:00

ENERGY PERFORMANCES

RADIATION/SUNLIGHT ANALYSIS

RAIN DATA

kWh/m2
1255.11<=
1176.65
1098.19
1019.73
941.27
862.91
784.35
705.89
627.43
548.97
<=470.51

Hours
4392.00<=
4093.70
3795.40
3497.10
3198.80
2900.50
2602.20
2303.90
2005.60
1707.30
<=1409.00

PERFORMATIVE ENVELOPE
FABRIC TEXTILE WITH SOLAR PANELS POSITION
INFORMED BY SOLAR RADIATION

Radiation Analysis
VENICE_ITA

SunlightHours Analysis

PERFORMATIVE ENVELOPE
RAIN WATER COLLECTOR

USERS

PROGRAM DEFINITION
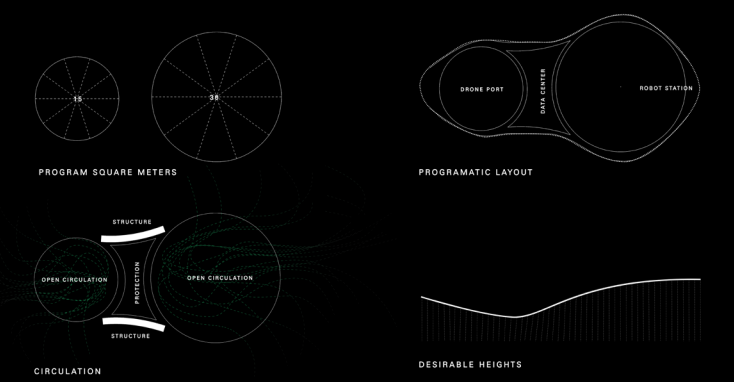
INFRASTRUCTURE
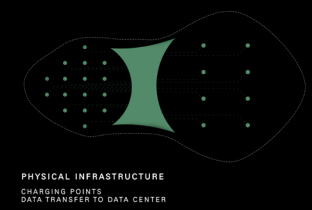
DRONE PORT   DATA CENTER   ROBOT STATION

HUMAN   DRONE   ROBOT

PROGRAM SQUARE METERS

PROGRAMATIC LAYOUT

STRUCTURE

OPEN CIRCULATION   PROTECTION   OPEN CIRCULATION

STRUCTURE

CIRCULATION

DESIRABLE HEIGHTS

PHYSICAL INFRASTRUCTURE
CHARGING POINTS
DATA TRANSFER TO DATA CENTER

THE BOTANICAL GARDEN

The new local Botanical garden arises from the sand banks formations in front of the main waterfront of the city. It is the result of the accumulation of sediments, which made this area not navigable over the last years. Because of these particular morphological conditions and their relationship with the tidal phenomena, the garden is conceived as a terrain vague, with indeterminate, blurred boundaries. In fact, the overall formal expression and programmatic layout depends on the variation of those conditions over time. For this reason final form is not a useful consideration but, instead, the constant modification of the terrain through the forces that shape it.

The changes in morphology and water conditions define different areas that are more or less subjected to tide conditions, water stagnation and slope variation. Together with the type of sediments, which constitutes the land, it is possible to analyse different settings for different local species of plants to grow. These rules are also informing the creation and modifications of the walkable paths that are built and modified by robots. Water run-off analysis informs the location of small water channels for controlled irrigation.

This scheme seeks to take the city back to its tidal roots to allow the visitor to experience the effect of the tide and other ecological involved factors over time. Thus the botanical garden becomes an ongoing register of time and ecological conditions. Moreover, it gives a closer experience to the citizens and tourist towards the dynamics that act upon the lagoon. It becomes a complementary element with the research centre to inform the scientific development of the strategic system for the lagoon. (file_Architectural Strategies)

OPEN THEATER
RESEARCH CENTRE
ACCESS SQUARE
STOP (VAPORETTO)
TIDAL GARDEN
TIDAL GARDEN
CENTRAL PARK
TIDAL GARDEN
TIDAL GARDEN
STAGNATION POOL
RECOLLECTION POOL
SHORELINE GARDEN
TIDAL GARDEN
EXPERIMENTAL STRUCTURES
TIDAL GARDEN
RECOLLECTION POOL
RECOLLECTION POOL
TIDAL GARDEN
LAGOON POV

SILT

CLAY

SAND

SEDIMENT   MORPHOLOGY   TIDE LEVELS

WATER RUNOFF   CONDITIONS   PROXIMITY

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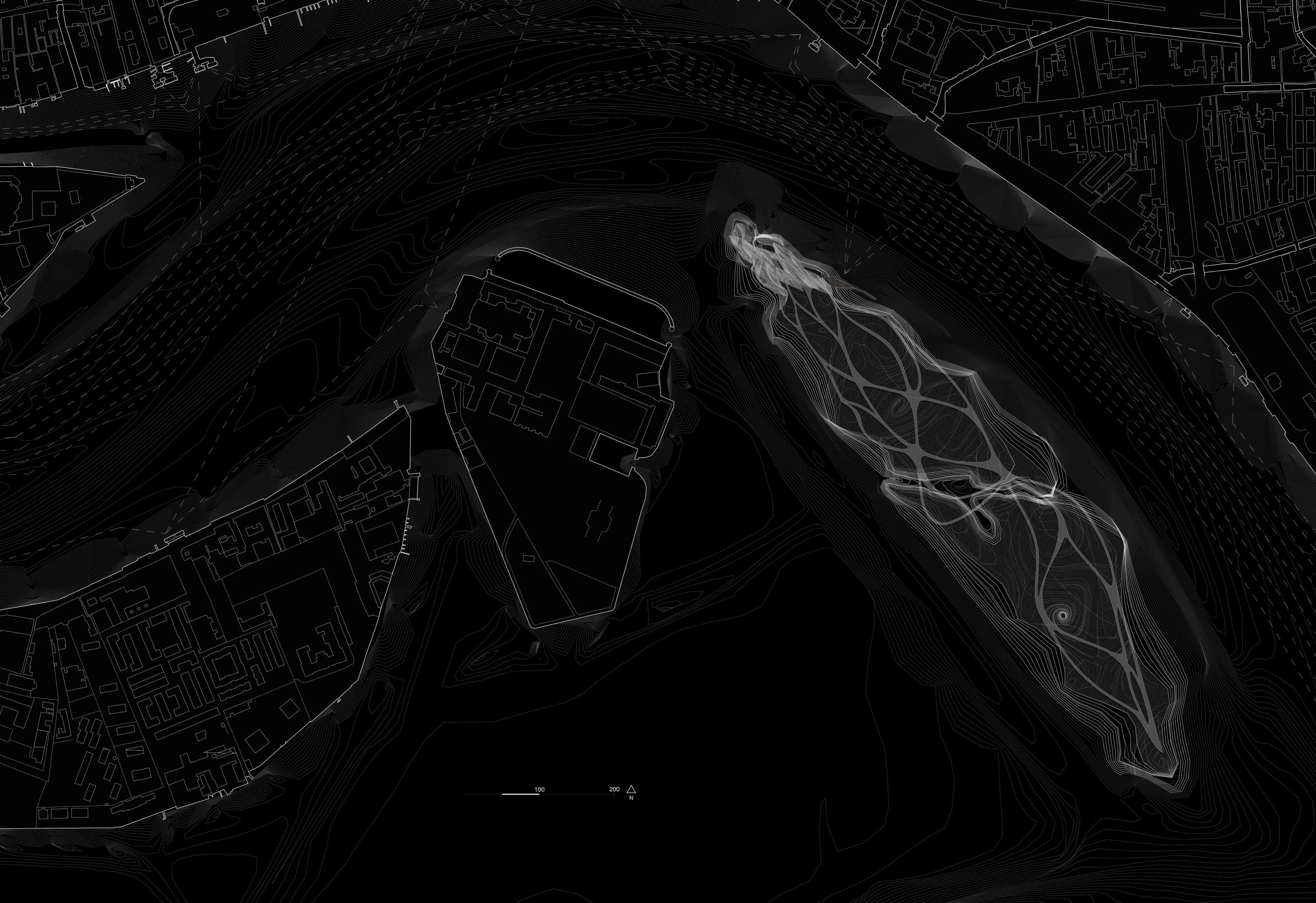
THE RESEARCH CENTRE

The architectural proposal for the research centre unveils the ancient and rooted relationship between the built and the natural environment of Venice and the lagoon. The symbiosis is displayed in the creation of volumetric land infill on the sand banks profiles.

The architecture is built into the landscape and unravels in a series of varying curvilinear profiles derived from interpolation of the morphological data and the program requirements. Bathymetry and land formation modifications are simulated based on the actual data of water-flow to analyse the movement of the sediments related to the tide levels. This informed the project in the definition of a certain degree of adaptability of the architectural volumes creating a dialogue between the land, the programs and the changing sea level.

Just as the lagoon is fragmented into island bodies, the architecture proposed has the ability to reveal itself or be partially concealed depending on the level of the tide and thus provide different experiences to the visitor and user. The programmatic layout is defined by space-syntax relationships between the different programs and synthesized in a vector field generated by degrees of privacy, visibility and size of each program. A series of generative curves defines the outline of the resulting volumes taking into account parameters such as desirable height, visibility, and views. The envelopes are generated by computational form-finding that involves the structural form, the relationship between the ground and the buildings, and defined views and comfort requirements. The use of the cusped vault system looks at the integration of the architecture in a new, symbolic, visible and recognizable element in the cityscape.
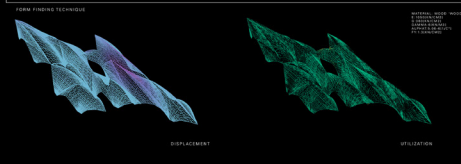
The project involves adaptability as a design characteristic, defining spatial, material and structural strategies, which allow the physical artefact a certain level of responsiveness to changing operational parameters over time and in adaptation to changing contextual situations. This involves the consideration of the physical constructions as objects whose main constituent elements are designed to address future functional, technological, and aesthetic metamorphosis in users' needs and context. (file_Architectural Strategies)

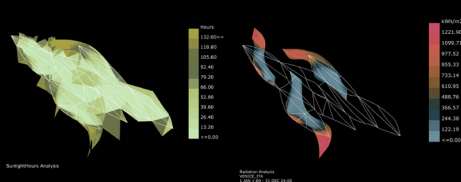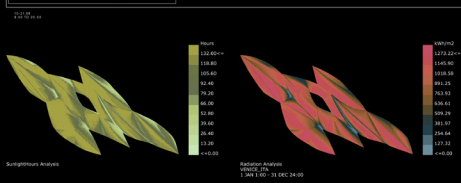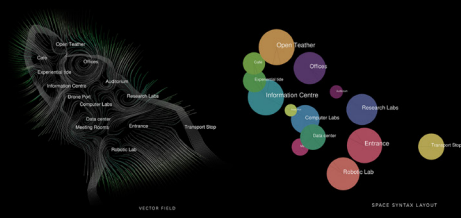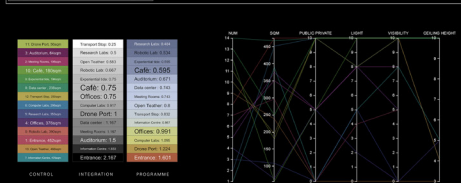MORPHOLOGICAL DATA

SITE LEVEL
BATHYMETRY/TERRAIN DATA

WATERFLOW/SEDIMENT MOVEMENT

STRUCTURAL ANALYSIS

FORM FINDING TECHNIQUE

MATERIAL, NODE MASS & DIRECTIONS DISPLACEMENT & DIRECTIONS FORCES/BENDING SUPPORTS/BRACKETS UTILIZATION

DISPLACEMENT

UTILIZATION

RADIATION SUNLIGHT ANALYSIS

Sunlighthours Analysis

Radiation Analysis VENICE, ITA 1 JAN 1:00 - 31 DEC 24:00

Sunlighthours Analysis

Radiation Analysis VENICE, ITA 1 JAN 1:00 - 31 DEC 24:00
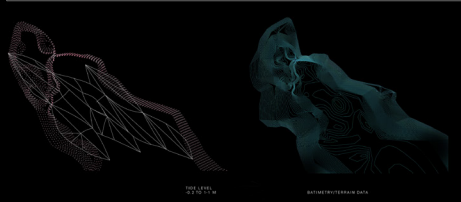
PROGRAMATIC DEFINITION

CONTROL   INTEGRATION   PROGRAMME

VECTOR FIELD

SPACE SYNTAX LAYOUT

SHAPE OPTIMIZATION

DIGITAL FORM FINDING

CURVATURE ANALYSIS

GENERATIVE SYSTEM

HEIGHT RELATIONSHIP TO THE GROUND

GENERATIVE LINES

VIEW ANALYSIS

PERFORMANCES

PERFORMATIVE ENVELOPE
MATERIALITY,
LIGHT CONDITIONS
ENERGY PRODUCTION

RAINWATER COLLECTION

COMFORT

COMFORT VALUES UNDER THE ENVELOPE
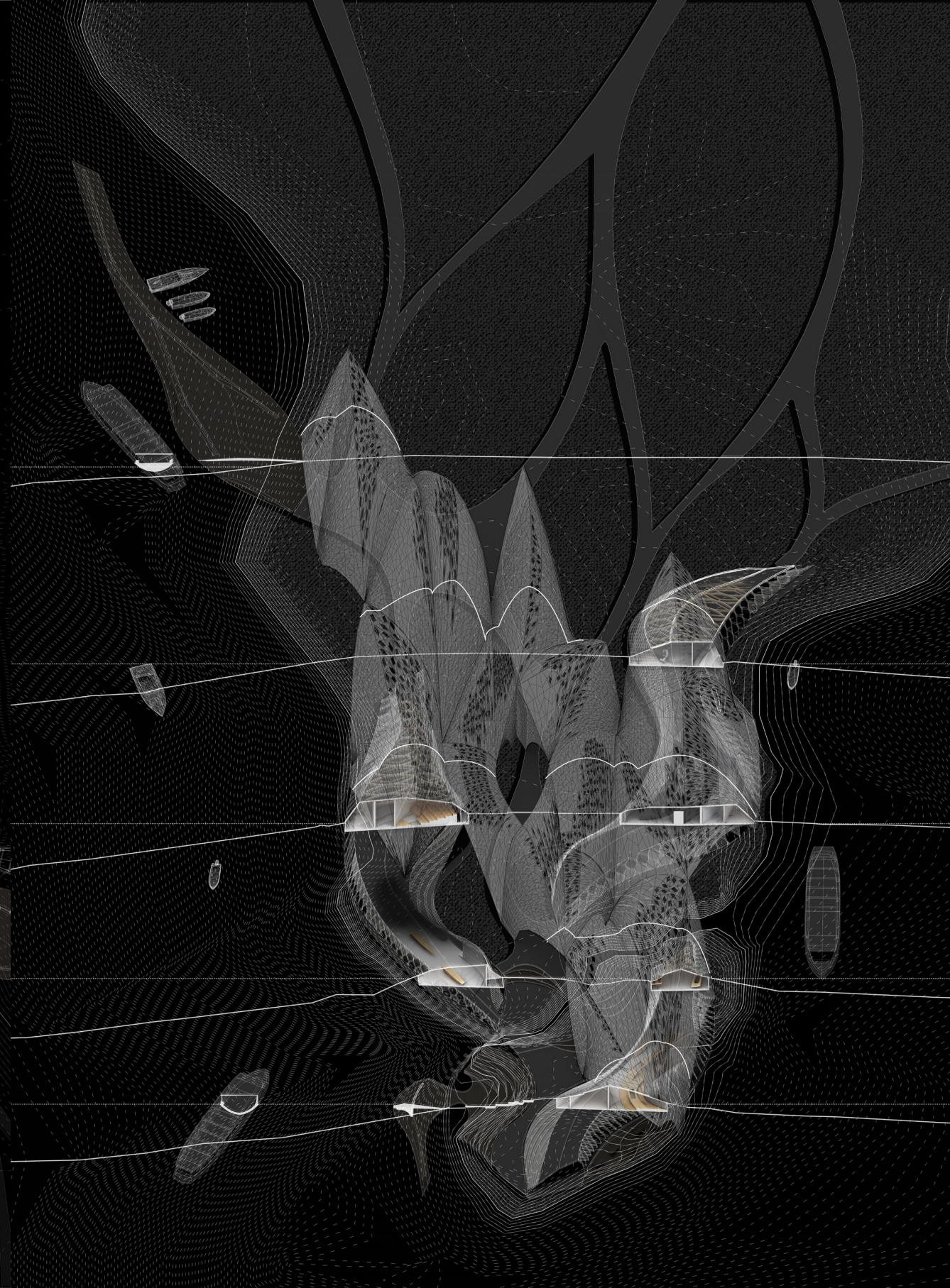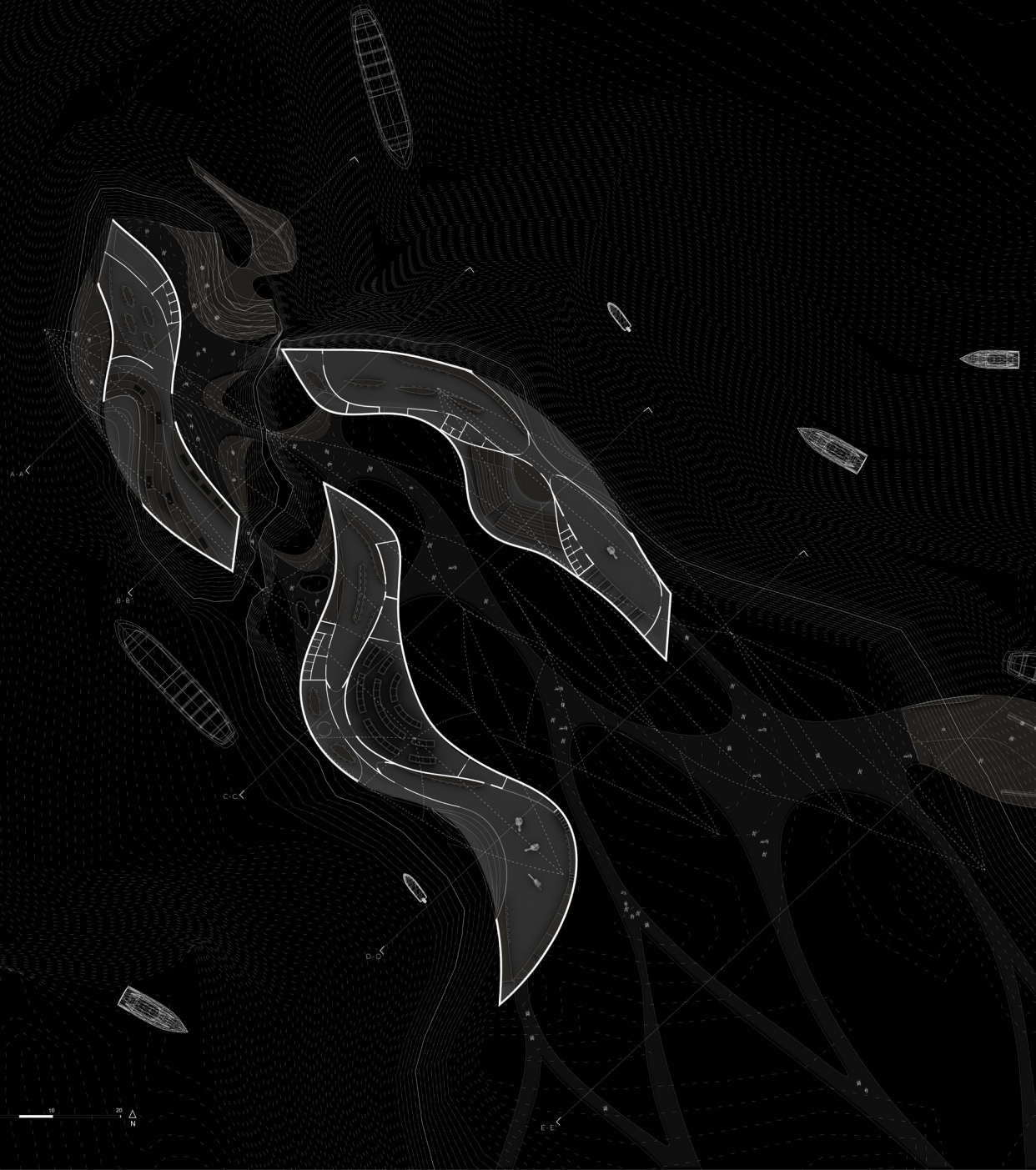FELT TEMPERATURE
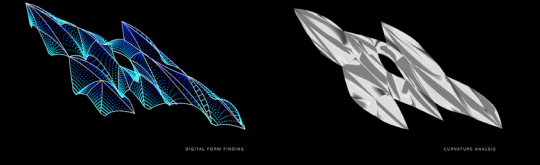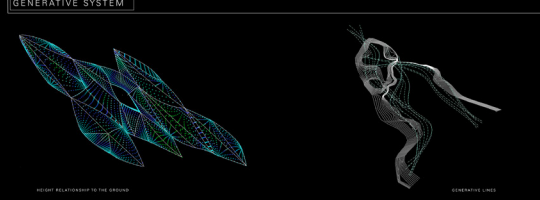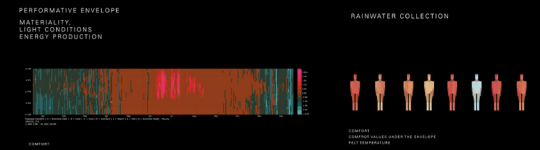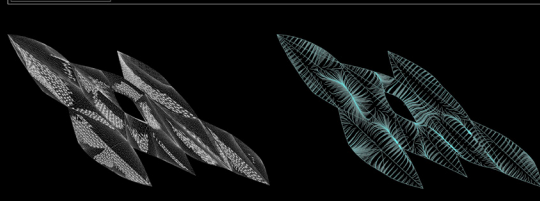
INTERIOR AND COMPOSITION

VOLUMES

STRUCTURAL SYSTEM

PUBLIC SPACE DEFINITION
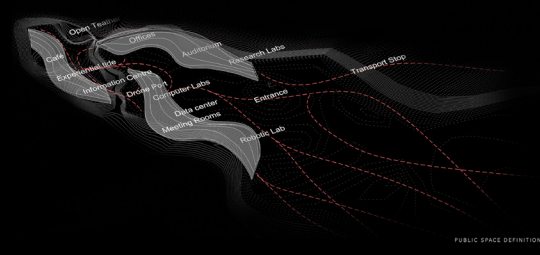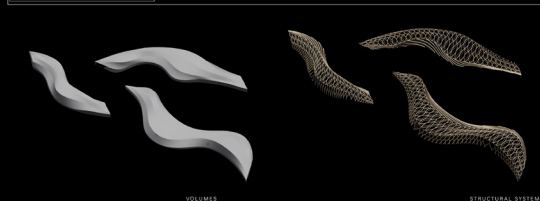
CONCLUSION

This research brings into the discussion the role of emergent technology towards a less anthropocentric and more ecol-centric vision and proposes an integrated approach to design at different scales. The integrated associative models and algorithms serve to ensure that all the complex factors involved can be taken in consideration as heterogeneous but jointed elements, so as to set out a vision for architecture that is informed by specific local conditions, transformations and diversifying needs of the users.

The possibilities given by the use of the latest technological developments enables the creation of networks of cross-referenced information to address complex dynamics. As a consequence, this re-defines the boundaries in which architects and designers are positioned at the moment and promote an interdisciplinary exchange in the time-specific creation of our environment.

At the same time, the introduction of autonomous agents in the ecosystem sets the vision for the near future collaboration between the species of the natural ecosystem, humans and robots.

Society is now speculating and evaluating how Artificial intelligence could fit within our civilization. Meanwhile it may have already found its place, automating certain types activities and service. However, as AI develops, its place within human society will become more complex. Society will need to have a framework for developing strategies for an integrative approach that correlates and co-involves species in the making of the environment that needs to sustain all.

Architecture will play a key role in this.
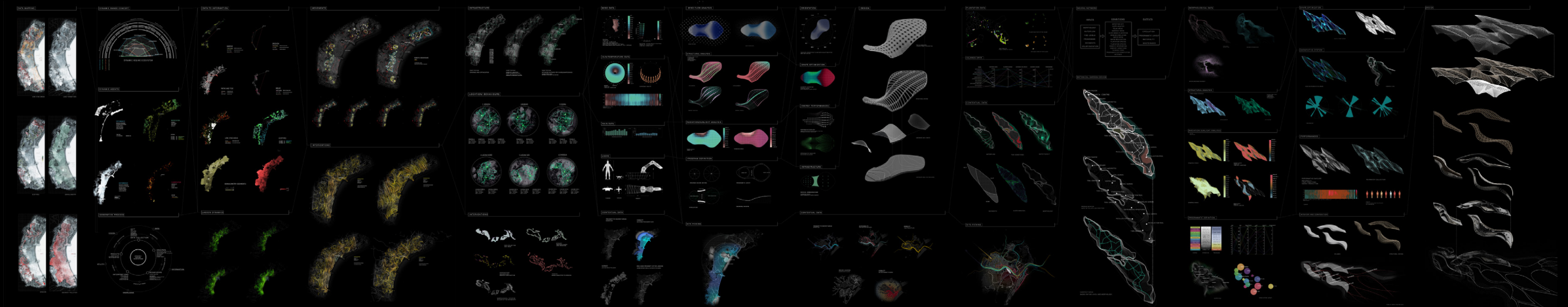
(file_Drawings and Renders)

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MATTEO LOMAGLIO

ENCODED ECOLOGIES OF THE VENETIAN LAGOON

A MULTI-SCALAR DATA-DRIVEN COMPUTATIONAL
APPROACH FOR DYNAMIC ENVIRONMENTS

Supervisors: Michael U. Hensel, Søren S. Sørensen
AHO -Oslo School of Architecture   -   Diploma Spring 2017