Design for Climate Change with Satellites?

Emanuele Naboni

Present Positions

emanuele_naboni_climate

Environmental Sustainability Module - **SOS School of Sustainability** - with Mario Cucinella
Since 2021
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Affiliated Associate Professor of Sustainable Design. Institute of Architectural Technology
The Royal Danish Academy. Since 2010 (half time since 2022)

Associate Professor of Climate Change and Regenerative Architecture. **UNIPR**
Since 2021

Visiting Professor, **Norwegian University of Science and Technology**, Department of Civil and Environmental Engineering. Faculty of Engineering
Since 2022

Adjunct Professor, **University of New South Wales**
March 2023 to October

Visiting Professor, Architectural and science researcher at **CBE UC Berkeley**, College Of Environmental Design
Since 2023

Norman Foster Foundation
Academic

Past Position

Invited Professor at **ETH**. Future Cities Lab Singapore
2019

Researcher at **EPFL**
2016, 2017

Invited Professor at **Architectural Association**
2013

Visiting Professor at **The University of Nottingham**
2015

Adjunkt at **UC Berkeley**, CED, College Of Environmental Design
2012

Post Doc Rsearcher at **LBNL**
2006 - 10 + 2011

Sustainable Design Tools Development Consultant for **Autodesk**
2010 – 2012

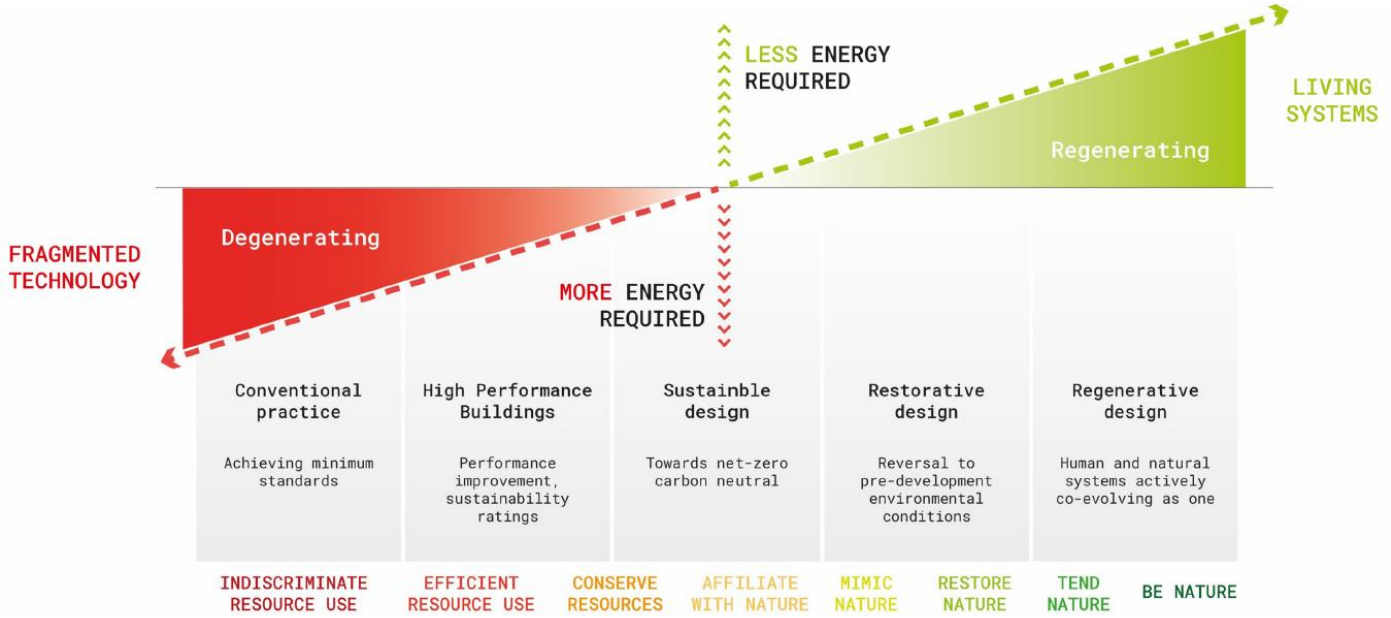
Sustainable Design Specialist at **SOM** (Skidmore Owings and Merrill, Llp)
2006 – 2010

Sustainable Design Specialist **William McDonough** and Loisos + Ubbelohde
2005

Phd Building Science, **Politecnico di Milano + University of California**
Awarded 2005

2021 - 23 projects: consultancies and research

What is the climatic ambition of our future design?



Future Research: Leveraging Climate Change for achieving Co-benefits

Ecology
Increase biodiversity
Urban Agriculture
Restorative Green, Blue Spaces
Water Flow

Health
Increase Outdoor Thermal Comfort
Increase Air Quality
Achieve biophilia

Decarbonization
Create Microclimate for Operations
Energy Positive Solutions
Maximize Existing Spaces Activation

Climate Change

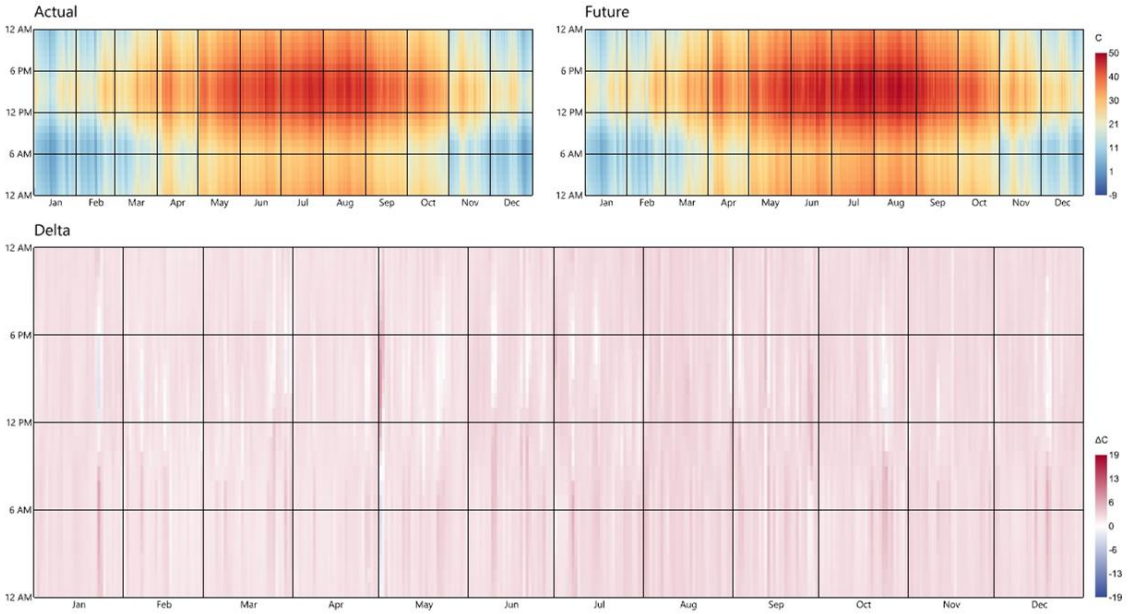
Satellites and Climate Change

Satellite Missions/Programs	*Imaging Type Description*	***Specific Measurement***	*Units*	*Climate Change Variable*	***Adaptation Measures for Buildings and Urban Spaces***
Orbiting Carbon Observatory-2 (OCO-2), Greenhouse Gases Observing Satellite (GOSAT)	Spectroscopy for atmospheric carbon dioxide levels.	**Carbon Dioxide (CO2) Concentration**	Parts per million (ppm)	Atmospheric Gases	Developing **urban greenery and carbon capture technologies** to reduce atmospheric CO2 levels.
Clouds and the Earth's Radiant Energy System (CERES)	Radiometry for Earth's energy budget and cloud properties.	**Outgoing Longwave Radiation, Albedo**	Watts per square meter (W/m^2)	**Earth's Energy Budget**	Designing buildings and urban layouts to face **new radiation charges**
Global Precipitation Measurement (GPM)	Microwave imaging for precipitation patterns and intensity.	**Precipitation Rate**	Millimeters per hour (mm/h)	**Precipitation Patterns**	Enhancing urban drainage and **stormwater management with greeneries** and water open tanks to prevent flooding and accommodate more frequent extreme precipitation events.
Moderate Resolution Imaging Spectroradiometer (MODIS), Visible Infrared Imaging Radiometer Suite (VIIRS)	Spectral imaging for land surface temperature and vegetation health.	**Land Surface Temperature, Normalized Difference Vegetation Index (NDVI)**	Degrees Celsius (°C), Index (0-1)	**Temperature and Vegetation Health**	Utilizing **systems that protect vegetation** and green roofs to reduce urban heat islands and improve thermal comfort in response to rising temperatures and vegetation stress.
Soil Moisture Active Passive (SMAP)	Radar and microwave for global soil moisture.	**Soil Moisture Content**	Cubic meter per cubic meter (m^3/m^3)	**Soil Moisture**	**Incorporating permeable surfaces** and green infrastructure to enhance soil moisture retention and support urban agriculture under drought conditions.
Landsat, Sentinel-2	Optical and infrared for land use changes and deforestation.	**Land Cover, Deforestation**	Type, Square kilometers (km^2)	**Land Use Changes**	Planning for **resilient urban expansion and reforestation** projects to counteract deforestation and support biodiversity in urban settings.

CLIMATE CHANGE ANALYSIS

AIR TEMPERATURE

Hourly chart. IPCC 8.5 2050

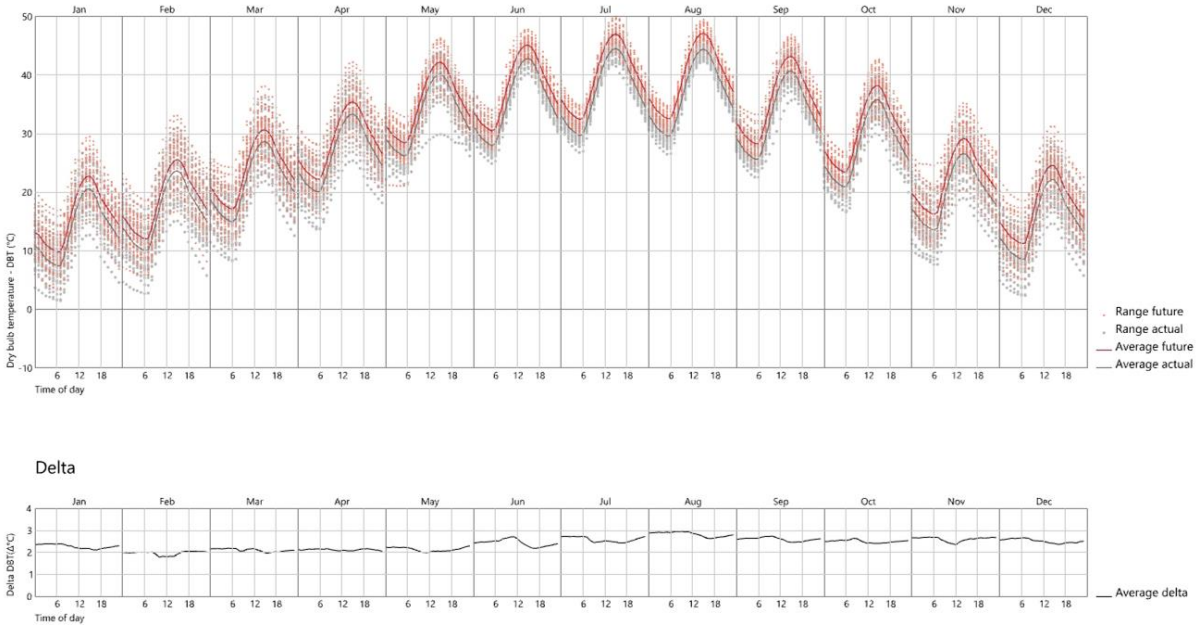


By 2050, there will be an increase of about 5°C compared to the current period.

CLIMATE CHANGE ANALYSIS

AIR TEMPERATURE

Daily chart. IPCC 8.5 2050



The average temperature increase in 2050 will be uniform across the hours of the day and will be about 1°C higher in summer than in winter.

What happens to the Ecosystem?

with 2 degrees more

Effects of Temperature Increase on Ecosystems	Factor of Degradation
Biodiversity Loss	**High**
Altered Species Interactions	Moderate
Changes in Distribution and Habitat Loss	High
Increased Stress on Ecosystems	Very High
Changes in Productivity and Nutrient Cycling	**High**
Changes in Water Availability	Very High
Altered Phenology	Moderate
Changes in Ecosystem Resilience	High
Disruption of Ecological Processes	Very High
Increased Invasive Species	**High**
Altered Carbon Cycling	Moderate

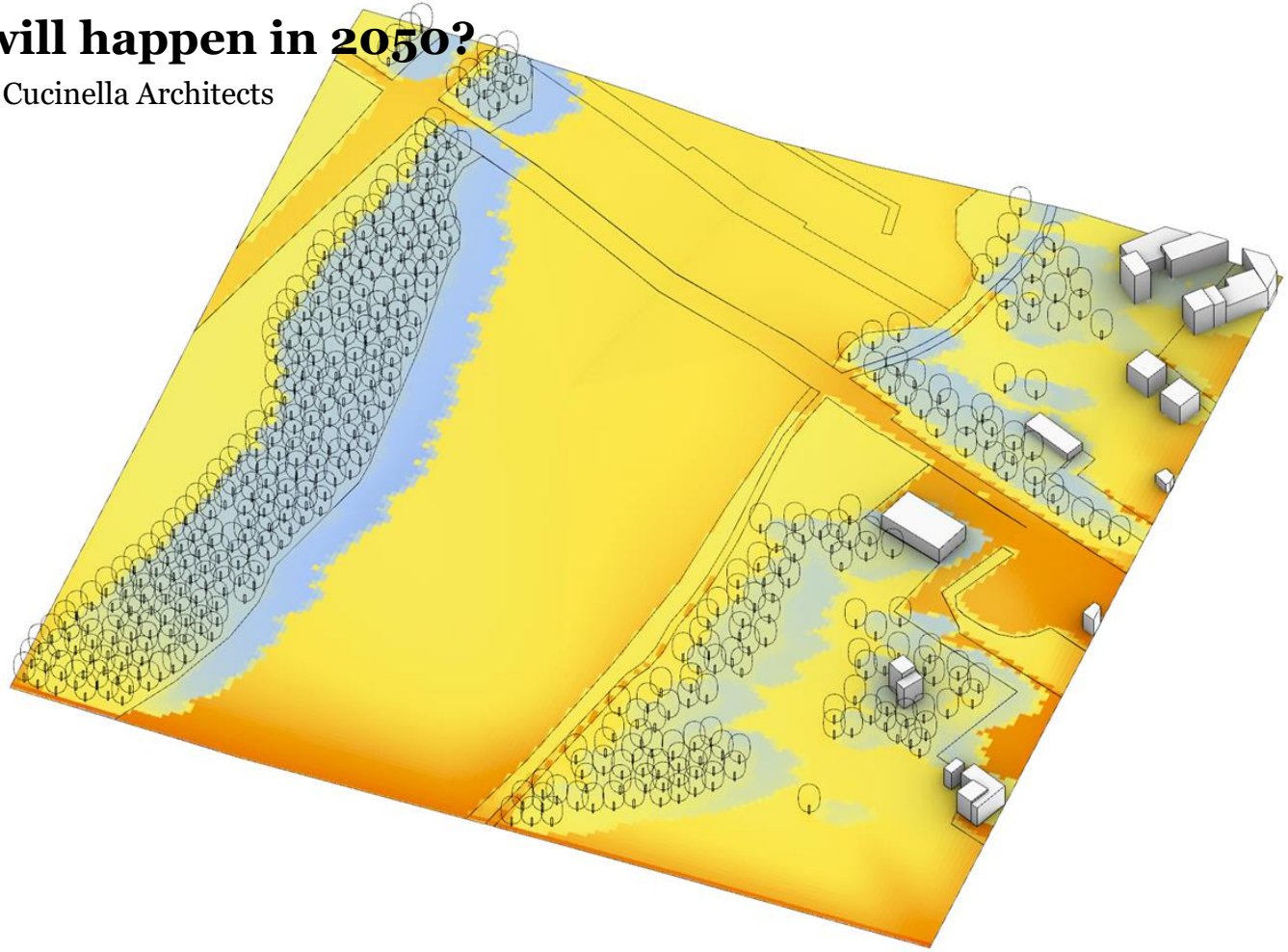
What in 2050?

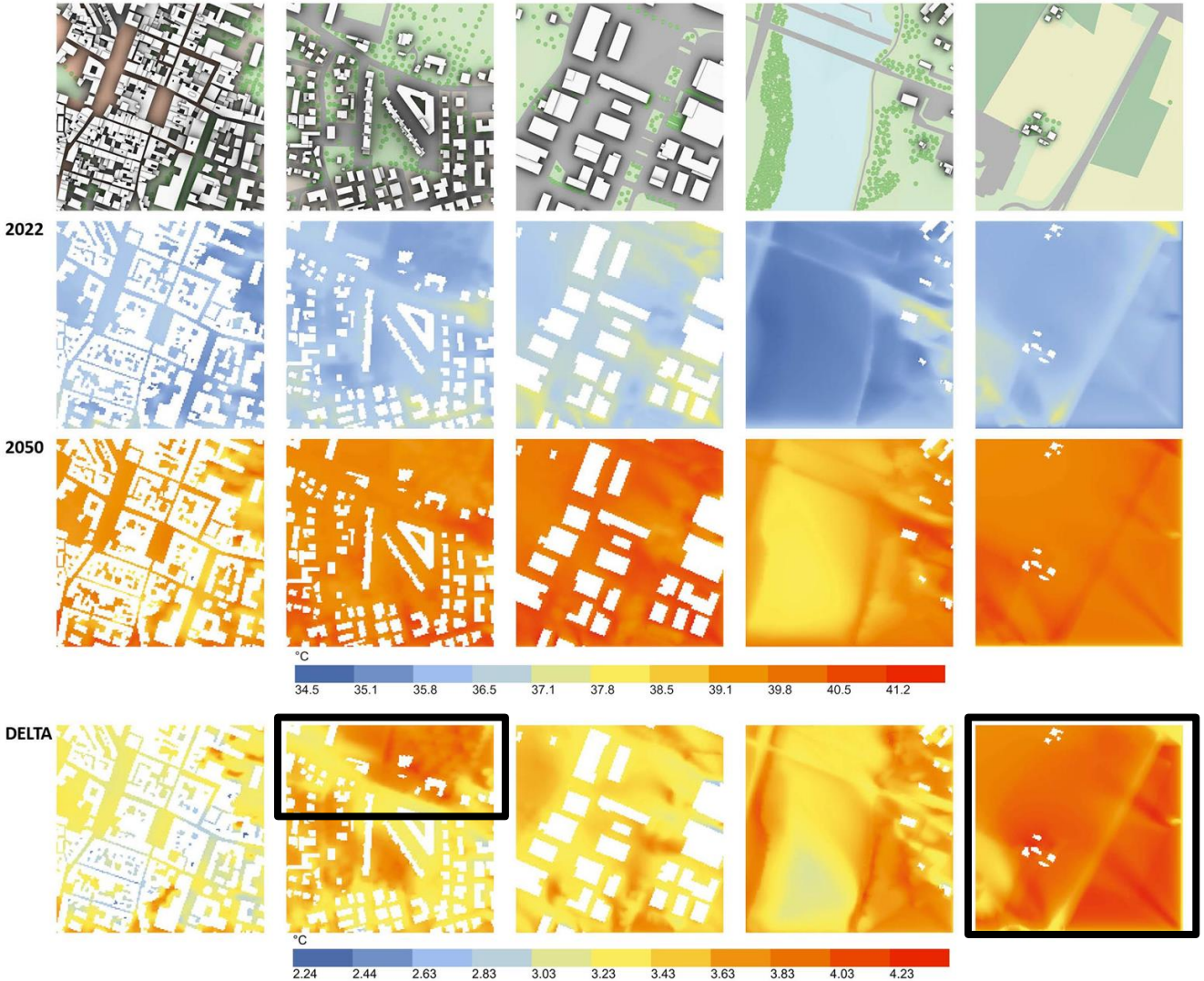
With Mario Cucinella Architects

modelling buildings and spaces

What will happen in 2050?

With Mario Cucinella Architects




2022
2050
°C
34.5 35.1 35.8 36.5 37.1 37.8 38.5 39.1 39.8 40.5 41.2
DELTA
°C
2.24 2.44 2.63 2.83 3.03 3.23 3.43 3.63 3.83 4.03 4.23

NEW MURABBA

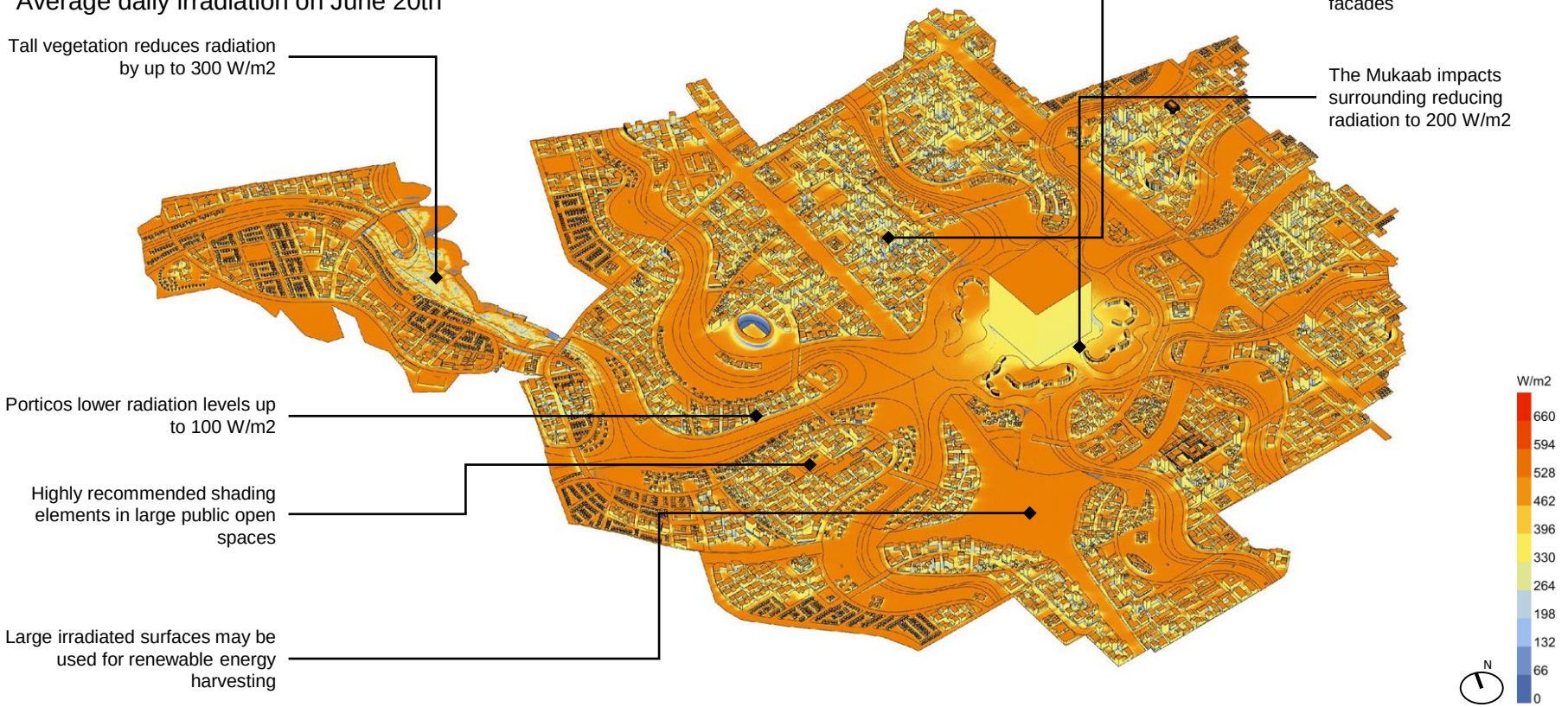
DETAILED MASTER PLAN
MICROCLIMATE

AtkinsRéalis

SOLAR RADIATION

SUMMER SCENARIO

Average daily irradiation on June 20th



OUTDOOR COMFORT - UTCI

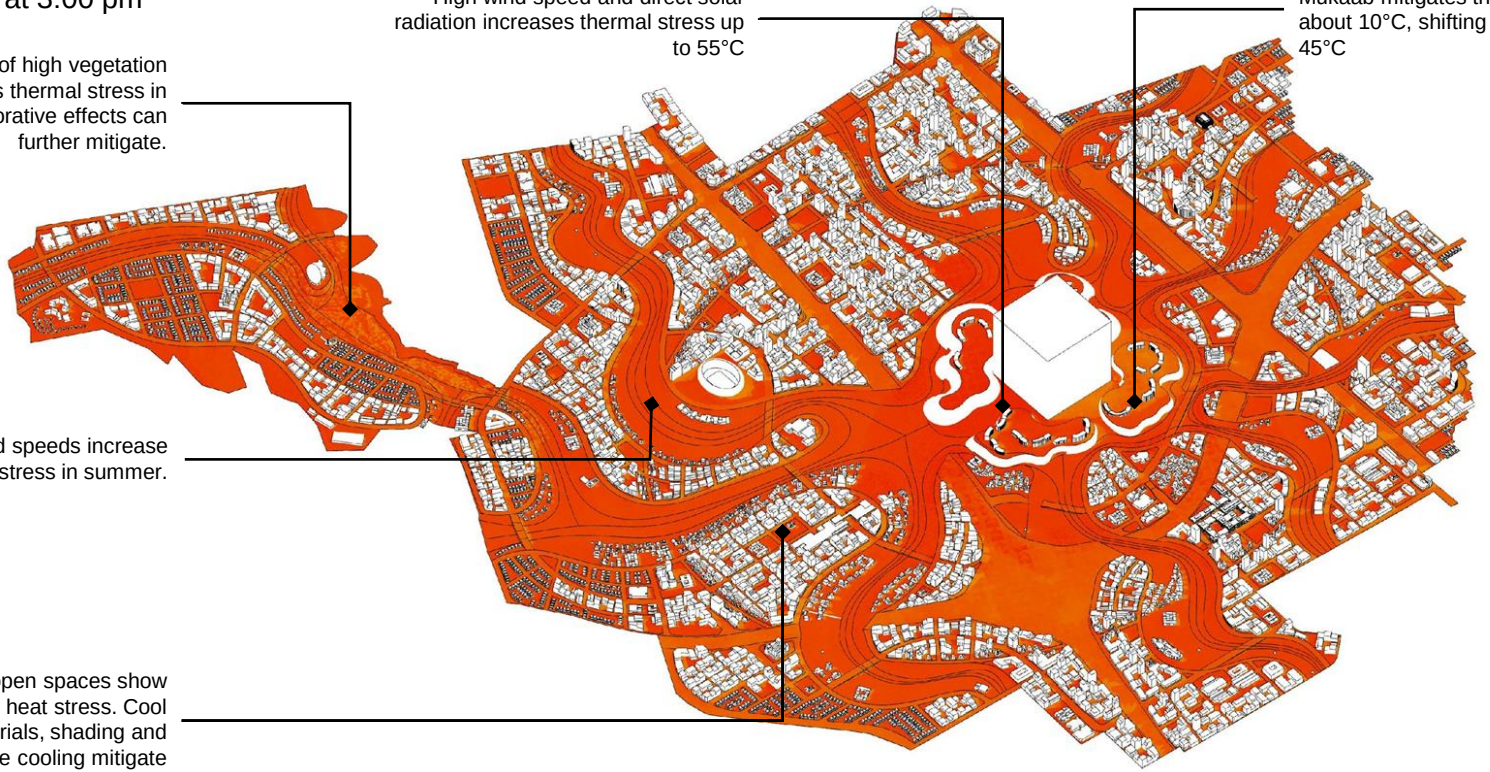
SUMMER SCENARIO

June 20th at 3:00 pm

The use of high vegetation decreases thermal stress in Summer. Evaporative effects can further mitigate.

High wind speed and direct solar radiation increases thermal stress up to 55°C

The shading provided by the Mukaab mitigates thermal stress by about 10°C, shifting from 55°C to 45°C



Higher wind speeds increase thermal stress in summer.

Fully exposed open spaces show extreme heat stress. Cool materials, shading and evaporative cooling mitigate overheating.

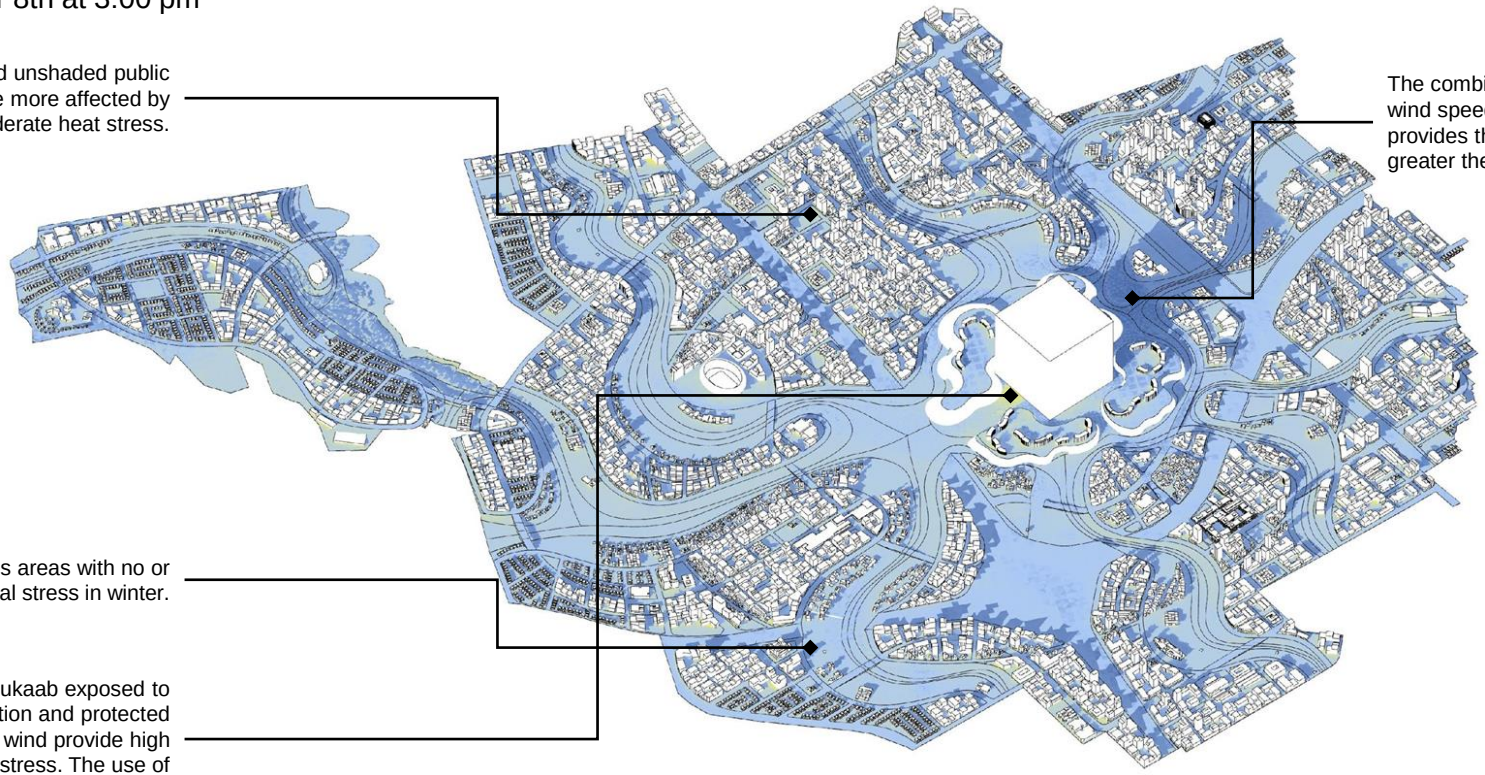
OUTDOOR COMFORT - UTCI

WINTER SCENARIO

December 8th at 3:00 pm

Unventilated and unshaded public spaces are more affected by moderate heat stress.

The combination of higher wind speed and shading provides the areas with greater thermal comfort

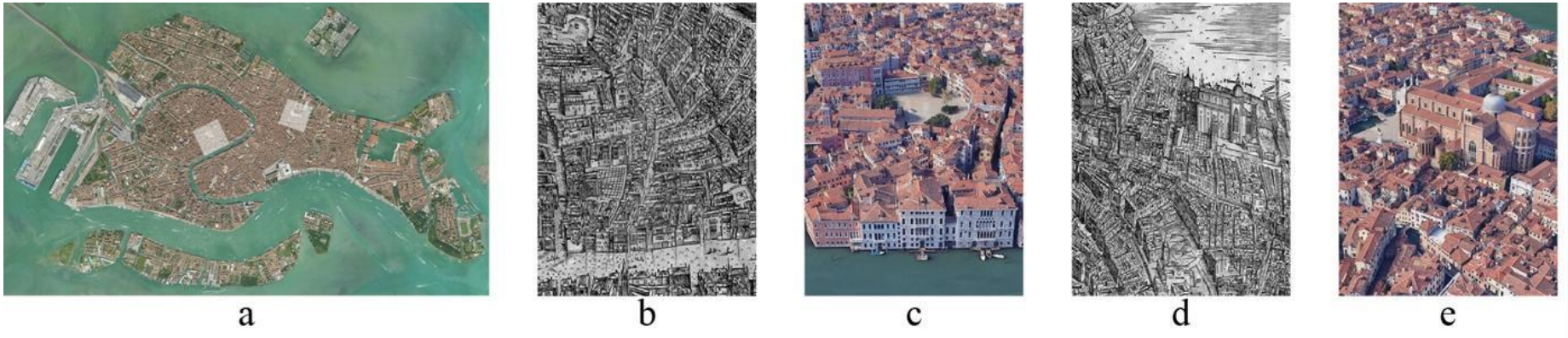


Shading provides areas with no or moderate thermal stress in winter.

Areas around Mukaab exposed to direct radiation and protected from the wind provide high thermal stress. The use of waterfeatures and shading is recommended..

Venetian Campi Resilience to Climate Change

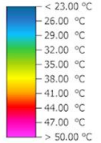
Complex case. Geometrically and Thermodynamically



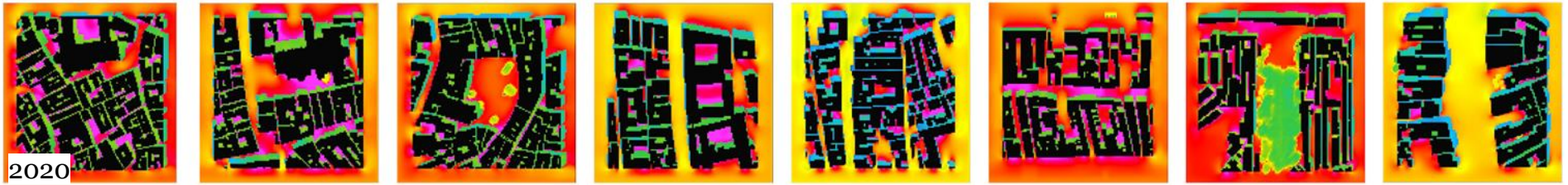
Aerial view of Venice (a); San Polo in de' Barbari illustration (1541) (b); view of San Polo (c); SS. Giovanni e Paolo in de' Barbari (1541) illustration (d); view of SS. Giovanni e Paolo (c).

Venice Microclimatic Studies 2020 + 2050 (with TU Delft)

Hotter Summer Day at 13:00

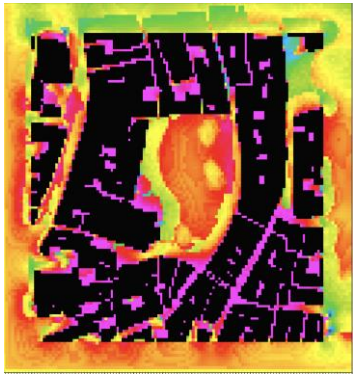


2020

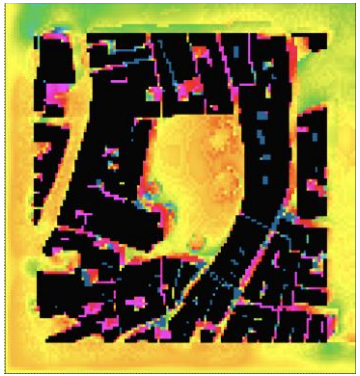


2050

Thermal Resilience: Current (2020) and projected scenario (2050) PET delta



San Polo PET h:10



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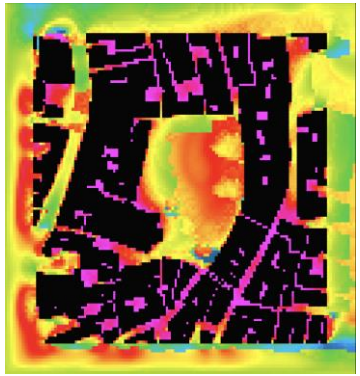

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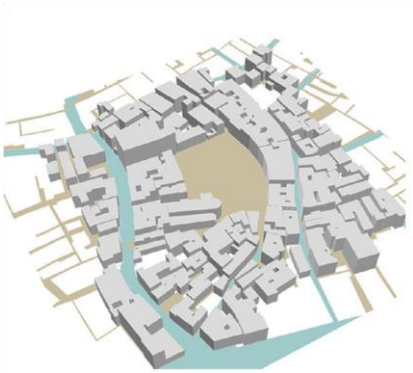
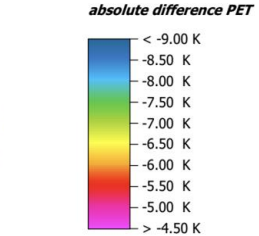
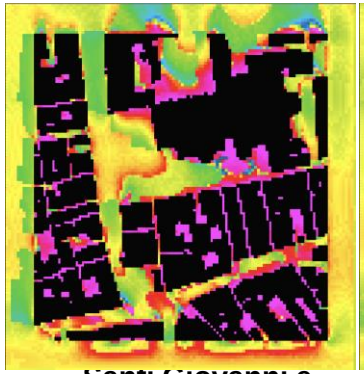
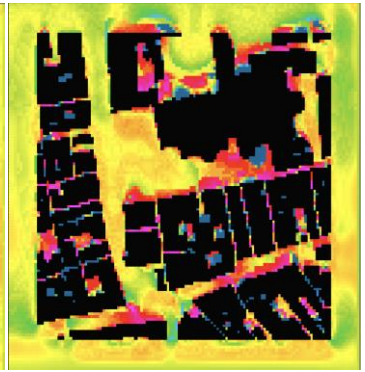






Santi Giovanni e Paolo PET h:10



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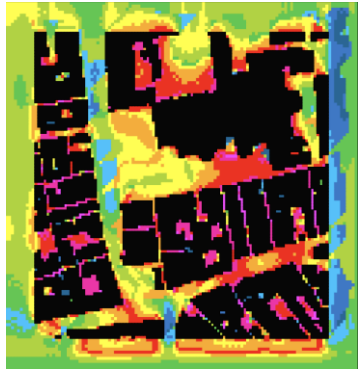

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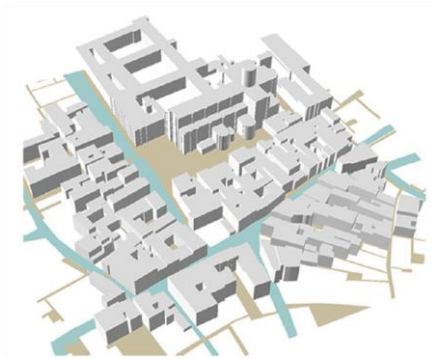
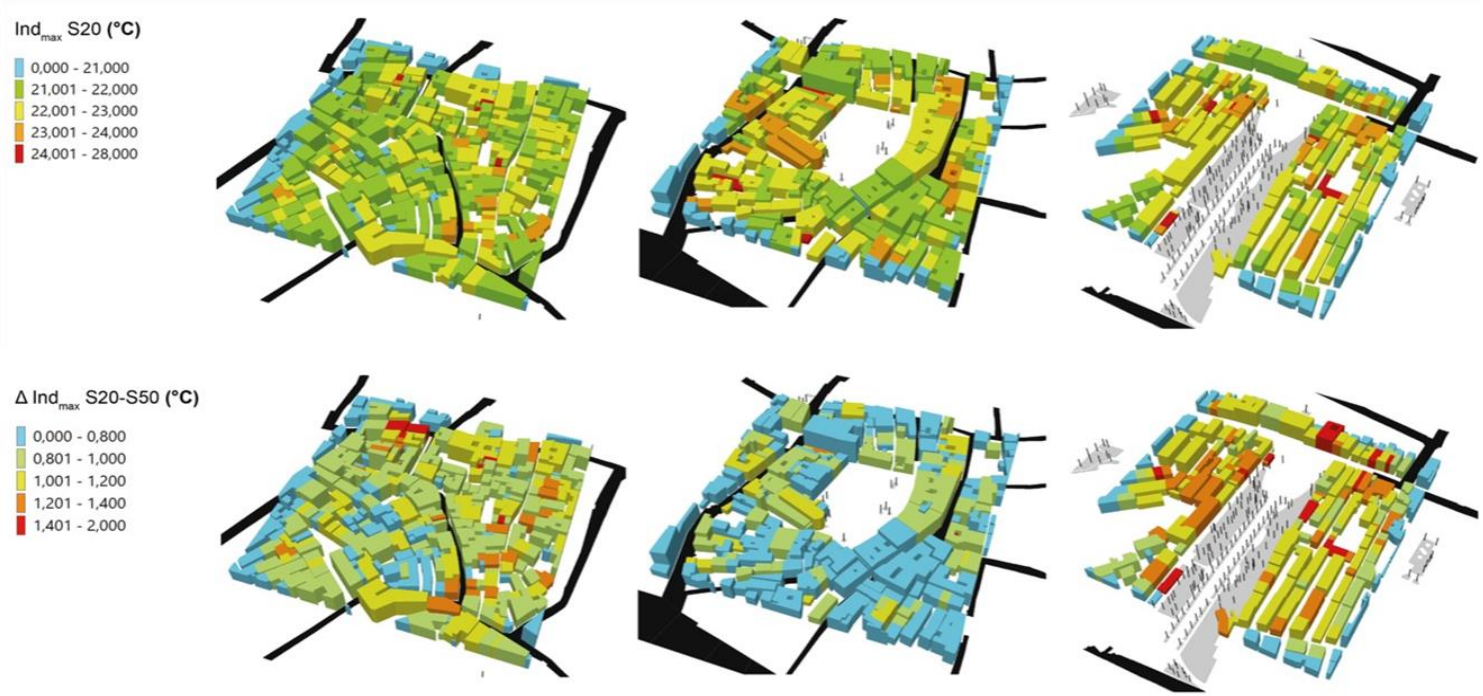


Climate Resilience

average outdoor temperatures in 2050 (avg. 6°C)
the higher the urban fabric compactness, the lower the frequency of high indoor temperatures



Ecology

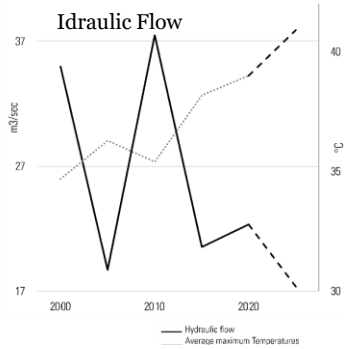
Satellites and Ecology

Satellite Missions/Programs	*Imaging Type Description*	*Specific Measurement*	*Units*	*Ecological Variable*	*Applications in Building Design and Urban Space Planning*
Landsat, Sentinel-2	Visible and near-infrared light for vegetation health and land use.	**Normalized Difference Vegetation Index (NDVI), Land Cover**	Index (0-1), Type	**Vegetation and Land Use**	Incorporating NDVI data into urban planning to **enhance green infrastructure**, optimizing building placement and landscaping to improve microclimates and biodiversity.
Moderate Resolution Imaging Spectroradiometer (MODIS), Sentinel-2	Multiple spectral bands for crop health and agriculture.	**Leaf Area Index (LAI), Crop Type**	Index (0-1), Type	**Urban Agriculture**	**Utilizing LAI data in the design of urban agriculture projects, integrating rooftop gardens and vertical farming into buildings** to promote local food production and reduce urban heat islands.
Soil Moisture Active Passive (SMAP), Sentinel-1	Radar and microwave for soil moisture and composition.	Soil Moisture Content, Soil Texture	Cubic meter per cubic meter (m^3/m^3), Type	Soil Moisture and Composition	Designing **water-efficient landscapes and irrigation systems** for urban areas based on soil moisture data, enhancing the resilience of green spaces to drought conditions.
Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS), Landsat	Infrared for soil temperature and health.	**Surface Temperature, Evapotranspiration**	Degrees Celsius (°C), Millimeters (mm/year)	Soil Temperature and Health	D**esigning bio-receptive surfaces** with soil temperature data.
Sentinel-2, MODIS	Visible and near-infrared for vegetation stress.	**Photochemical Reflectance Index (PRI), Water Stress Indicator**	Index (0-1), Index (0-1)	**Vegetation Health and Stress**	**Managing urban vegetation health with stress indicators.**

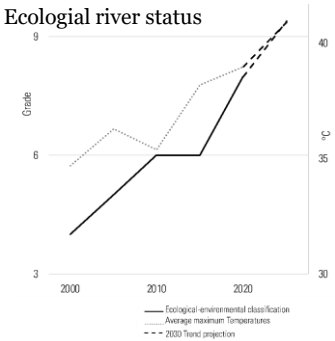
ECOSYSTEM HEALTH

SATELLITE DATA + ARPAE

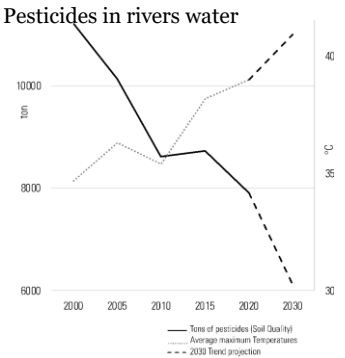
Idraulic Flow



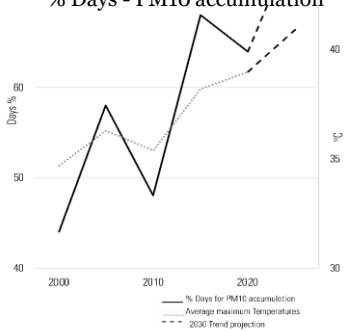
Ecologial river status



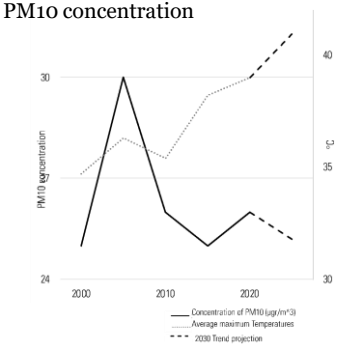
Pesticides in rivers water



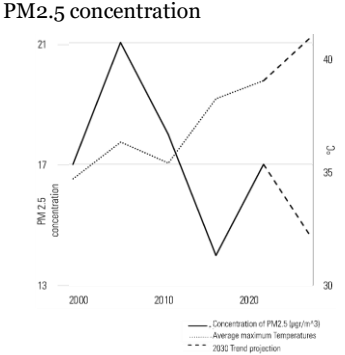
% Days - PM10 accumulation



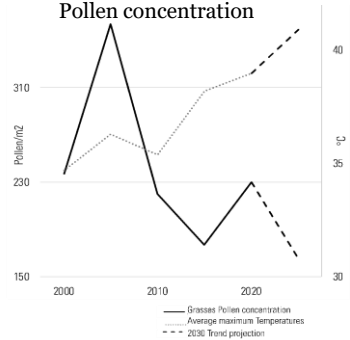
PM10 concentration



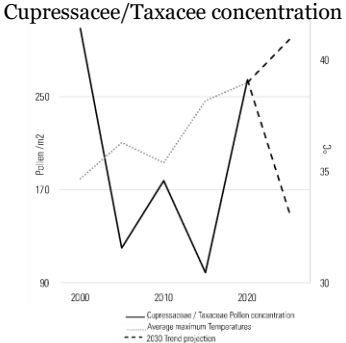
PM2.5 concentration



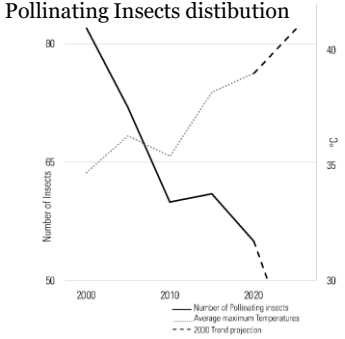
Pollen concentration



Cupressacee/Taxacee concentration



Pollinating Insects distibution



Microclimate Creation

Green Type	Temperature Reduction (°C)
Trees	2-8°C
Shrubs	1-4°C
Grass and Lawns	1-2°C
Vines and Climbers	1-3°C
Groundcover Plants	1-2°C
Urban Green Spaces	2-6°C
Rooftop Gardens	2-8°C
Vertical Gardens	1-4°C
Deciduous Trees	**2-6°C**
Evergreen Trees	1-4°C
Green Roofs	2-6°C
Floating Wetlands	1-3°C
Forested Areas	2-8°C
Native Plant Landscaping	1-4°C
Green Walls	1-3°C

What are the maximum tolerated temperatures?

	Maximum Effective Air Temperature (°C)
Trees	40°C and below
Shrubs	34°C
Grass and Lawns	28°C
Vines and Climbers	30°C
Groundcover Plants	28°C
Urban Green Spaces	36°C
Rooftop Gardens	38°C
Vertical Gardens	**32°C**
Deciduous Trees	**35°C**
Evergreen Trees	32°C
Green Roofs	38°C
Floating Wetlands	36°C
Forested Areas	40°C and below
Native Plant Landscaping	34°C
Green Walls	32°C

Greenery Type	Water Requirements (per year per square meter)	Rainwater Contribution in Torino (%)
Trees	300-500 liters	50-70%
Shrubs	200-400 liters	50-70%
Grass and Lawns	800-1,200 liters	80-90%
Vines and Climbers	200-400 liters	50-70%
Groundcover Plants	200-400 liters	50-70%
Urban Green Spaces	500-1,000 liters	60-80%
Rooftop Gardens	500-1,000 liters	60-80%
Vertical Gardens	500-1,000 liters	60-80%
Deciduous Trees	300-500 liters	50-70%
Evergreen Trees	300-500 liters	50-70%
Green Roofs	500-1,000 liters	60-80%
Floating Wetlands	500-800 liters	60-70%
Forested Areas	300-500 liters	50-70%
Native Plant Landscaping	300-500 liters	50-70%
Green Walls	500-1,000 liters	60-80%

4) OUTDOOR SPACES

4.a water events as a resource to sustain microclimate

4.b don’t change the design, change the program

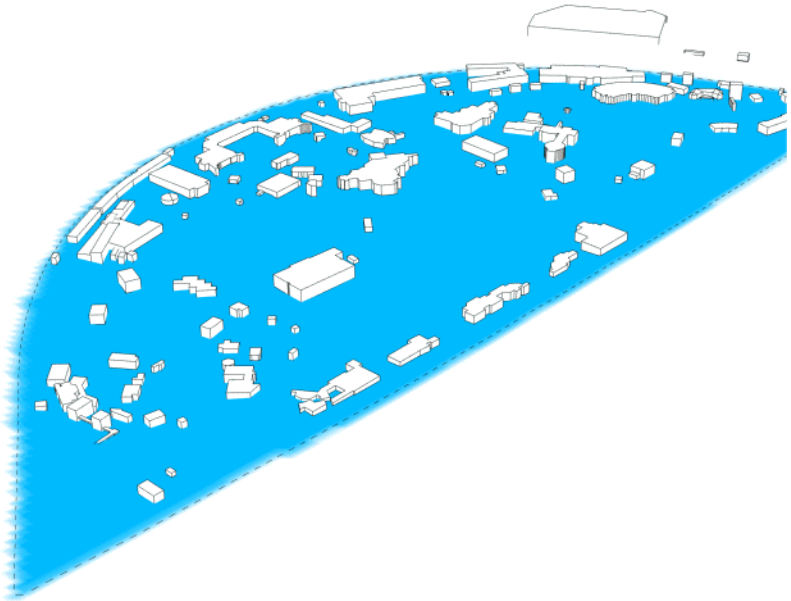
Climate Change and Water

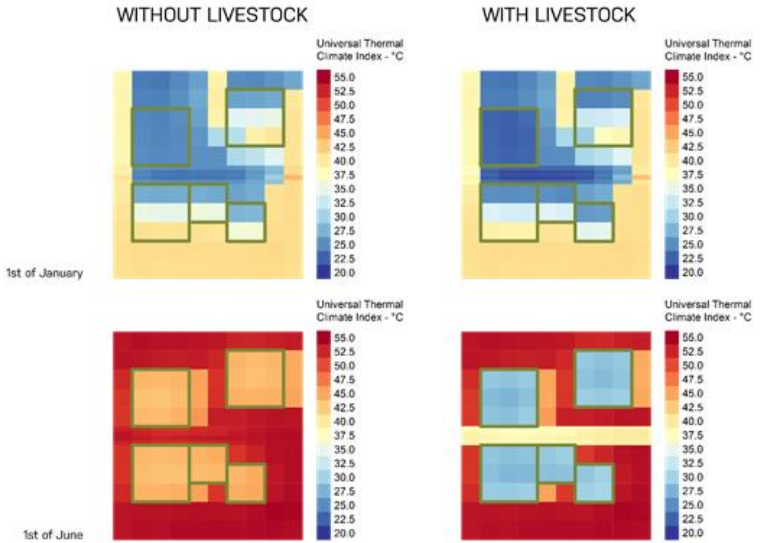
Tasinge Square

Comfort in 2050 -

Water is essential

modelling Living system is critical

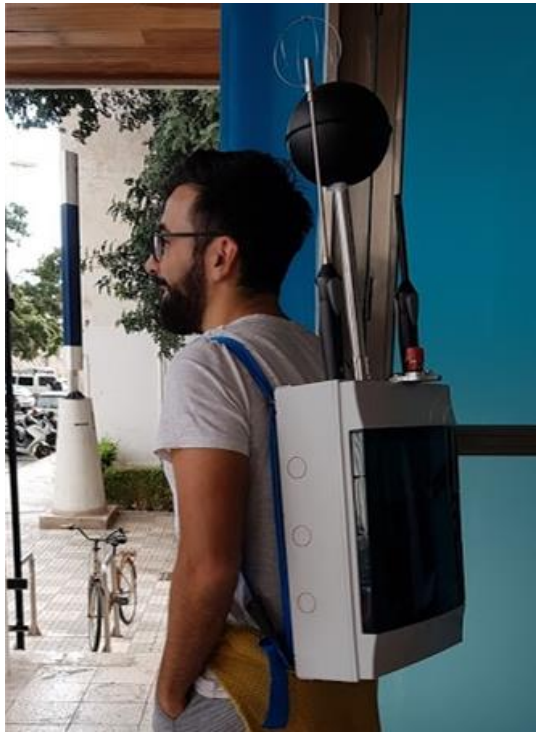


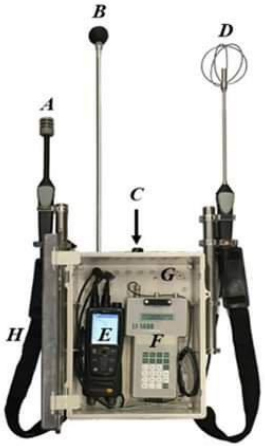


How to get information for climatic design

With TU Munich and TU Delft

Sensing Microclimates trough combined measurements and modelling





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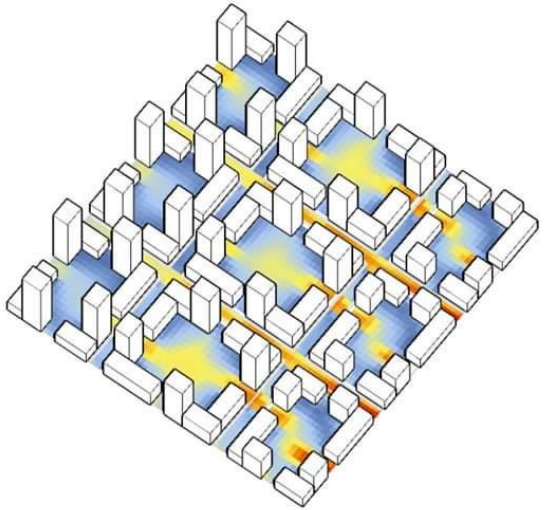
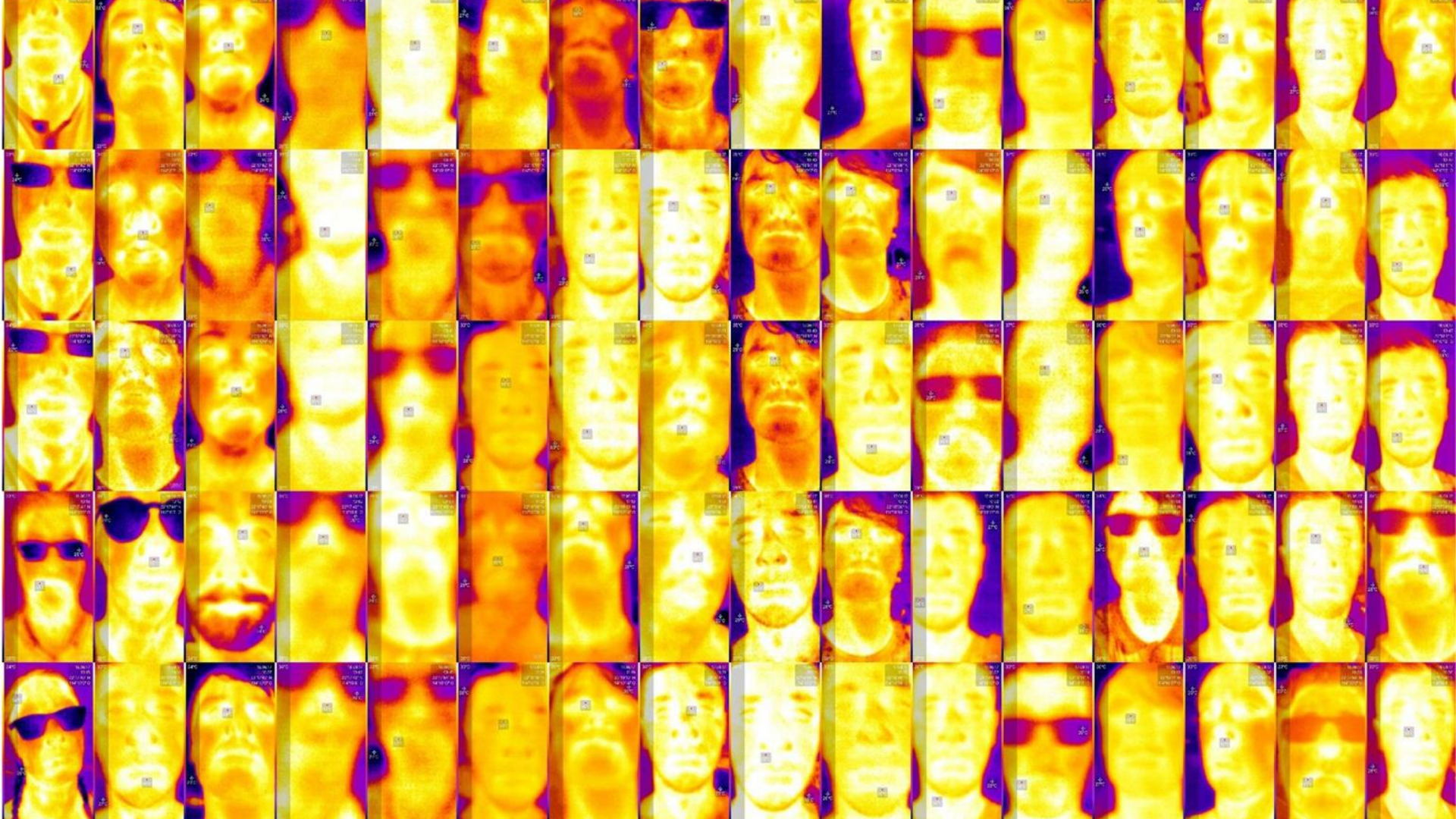
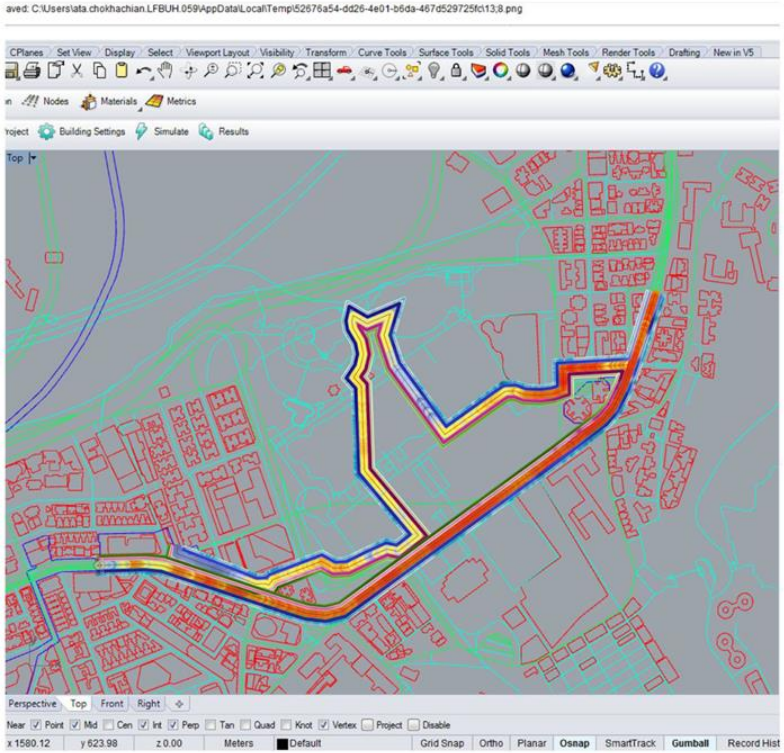
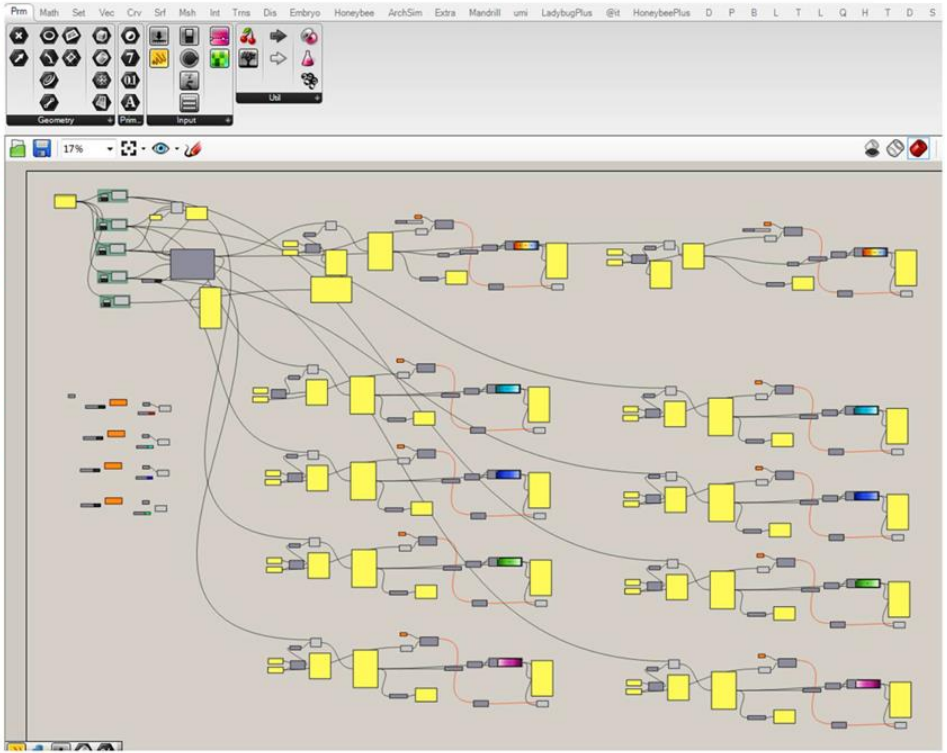




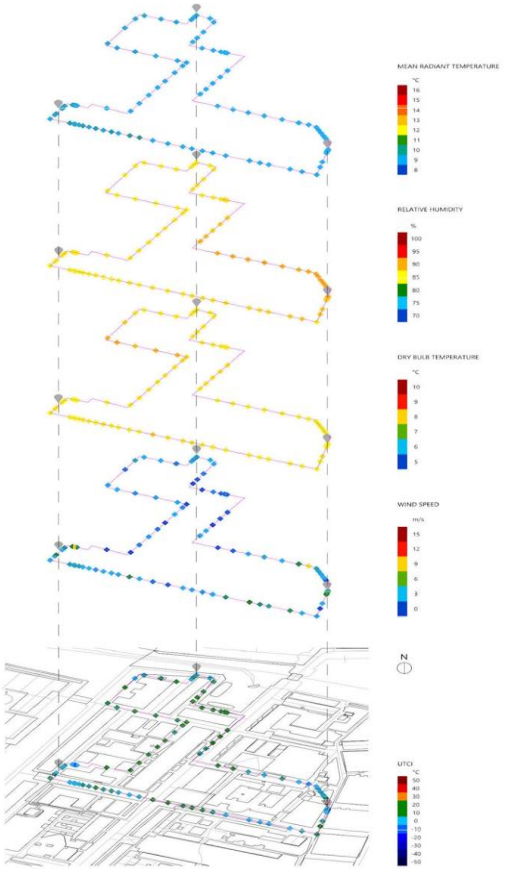
Information Visualization and Workflow

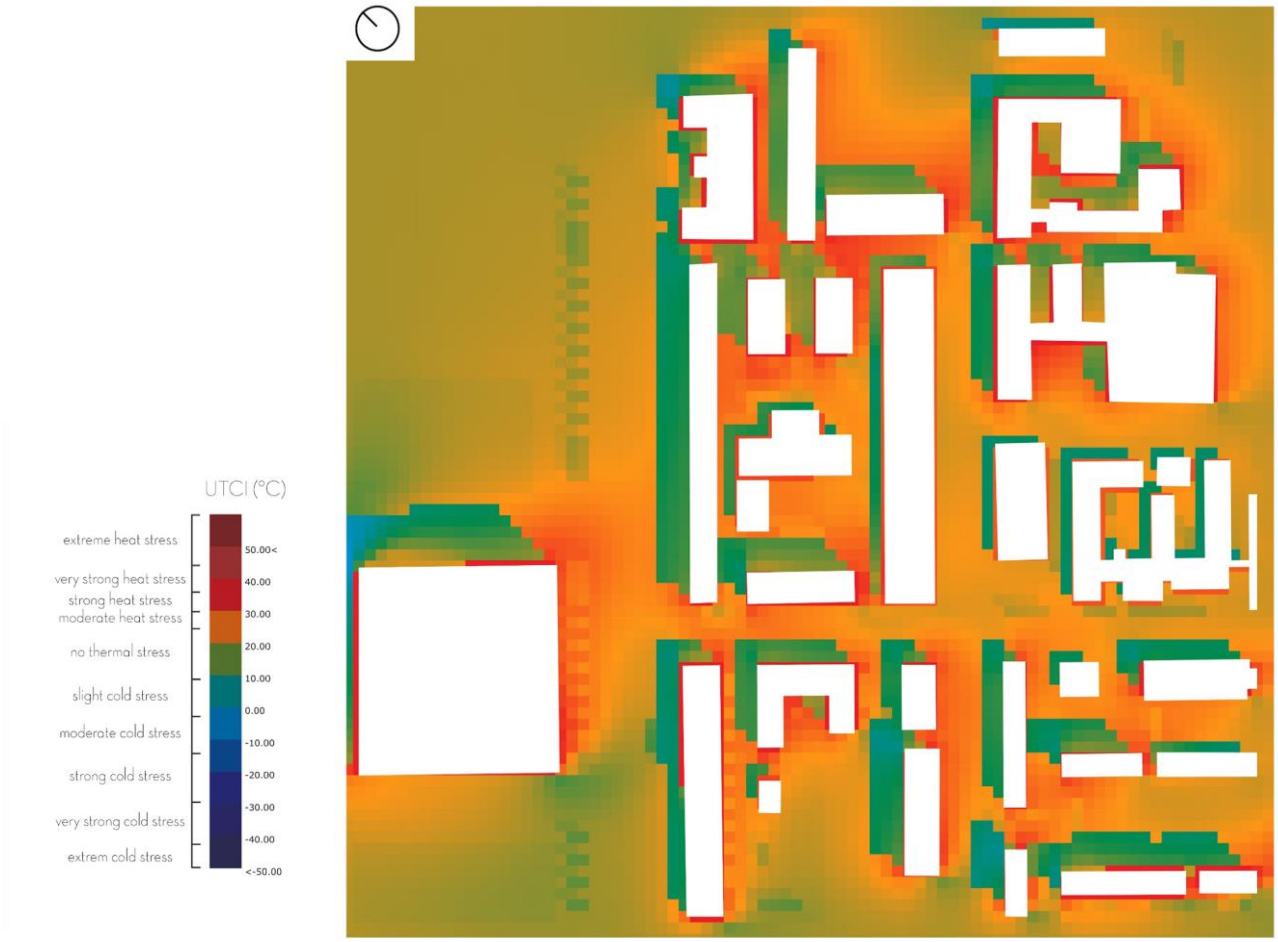





KADK Area
TAKKELOFTVEJ
START
PER KNUTZONS VEJ
PHILIP DE LANGES ALLÉ
DANNESKIOLD-SAMSØES ALLÉ
Cycling Path
Walking Path

Climate Cycling in Copenhagen




UTCI (°C)
extreme heat stress
very strong heat stress
strong heat stress
moderate heat stress
no thermal stress
slight cold stress
moderate cold stress
strong cold stress
very strong cold stress
extrem cold stress
50.00<
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
<-50.00


UTCI (°C)
extreme heat stress
very strong heat stress
strong heat stress
moderate heat stress
no thermal stress
slight cold stress
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strong cold stress
very strong cold stress
extrem cold stress
50.00<
40.00
30.00
20.00
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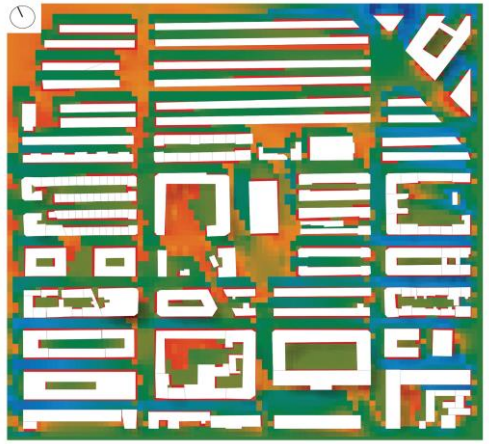
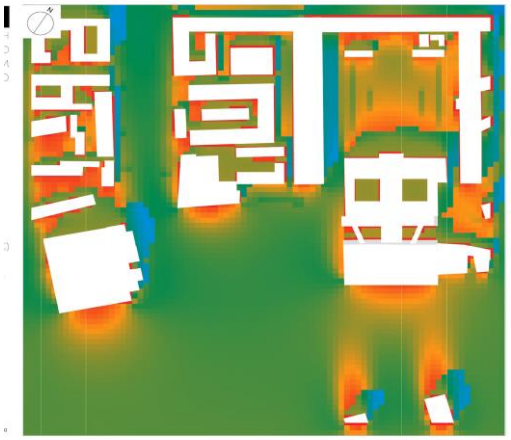
0.00
-10.00
-20.00
-30.00
-40.00
<-50.00





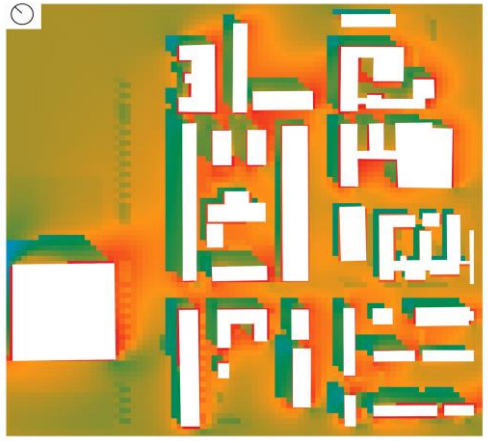



EXHIBIT
FIRST SEMESTER WORK 2015/16
THE AMAZON
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 12th
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2017/18
TANZANIA
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 23rd
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2016/17
THE GOBI
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 10th 15:00
ARCHITECTURE
AND EXTREME
ENVIRONMENTS

architecture and extreme environments

Created playlists

2018 ALASKA

VIEW FULL PLAYLIST

2015 THE AMAZON

VIEW FULL PLAYLIST

2016 THE GOBI

VIEW FULL PLAYLIST

2014 THE ARCTIC

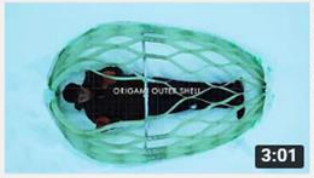
VIEW FULL PLAYLIST

2017 TANZANIA

VIEW FULL PLAYLIST

Uploads

PLAY ALL



AEE, ALASKA: DEPLOYABLE EMERGENCY STRUCTURE

891 views • 9 months ago

AEE, ALASKA: XYLEM FILTRATION

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AEE, ALASKA: THERMAL PROPERTIES OF EELGRASS

82 views • 9 months ago

AEE, ALASKA: FISH WASTE

74 views • 9 months ago

AEE, ALASKA: LOCAL TILE PRODUCTION

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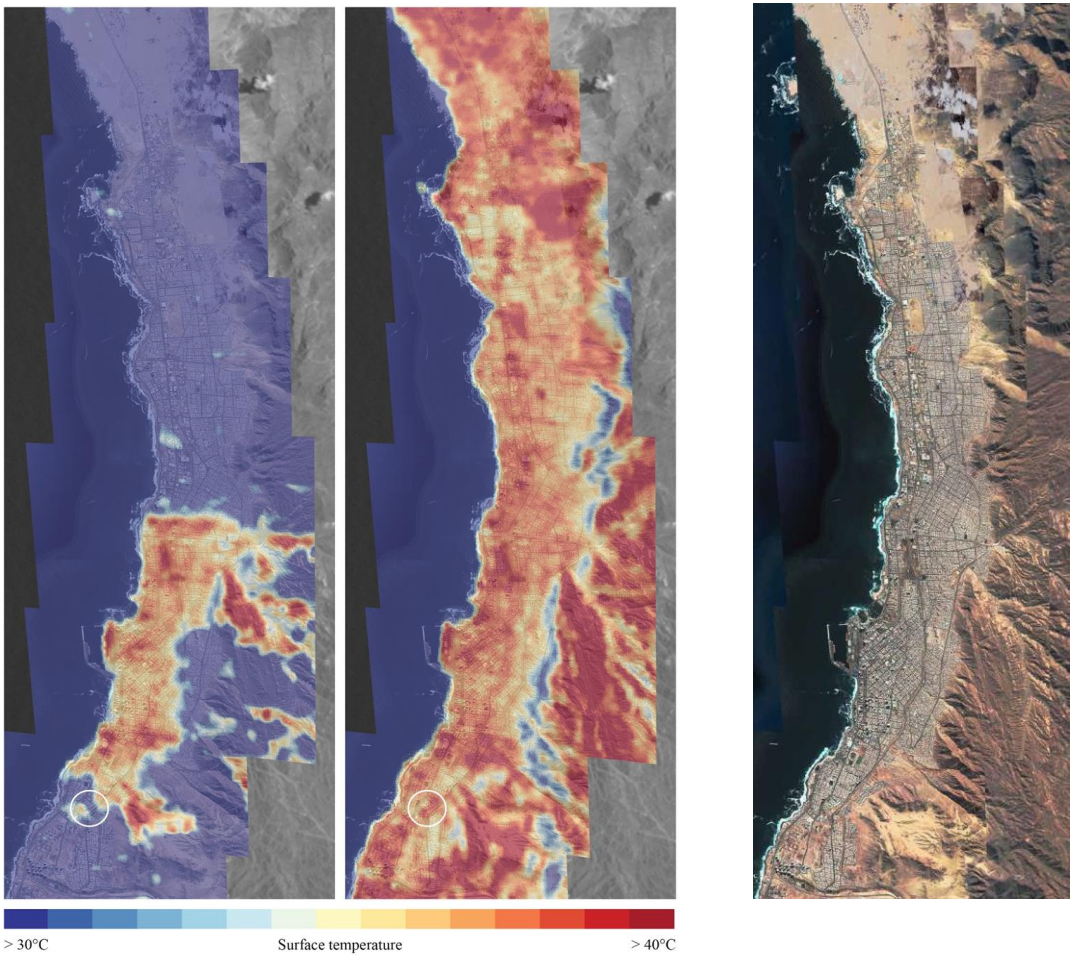
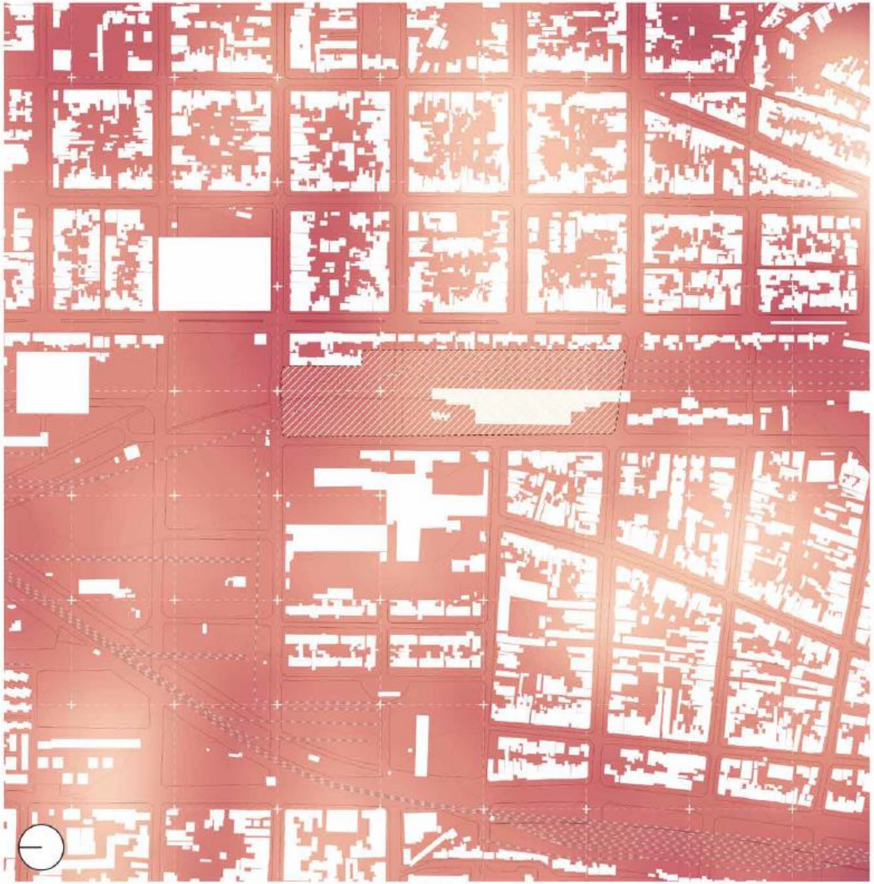
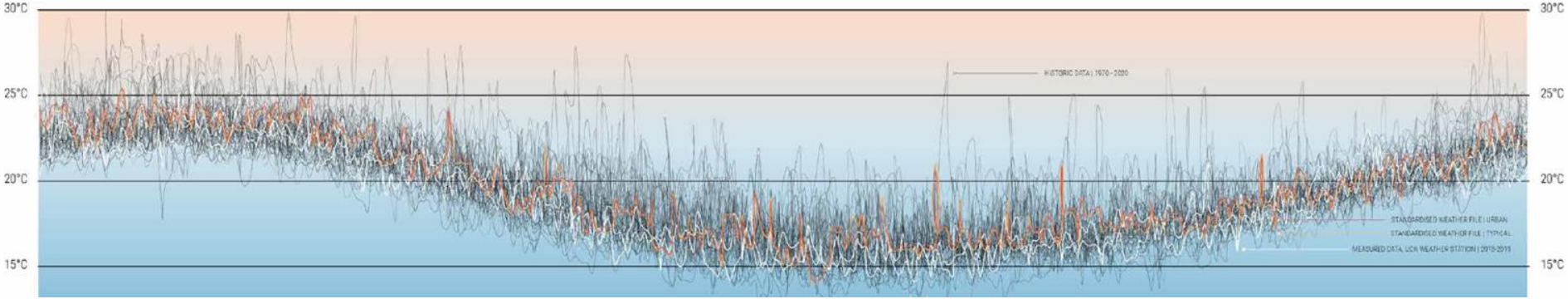
Aftamagosta (Atacama Desert Chile)

with Aimee Desert, David Garcia

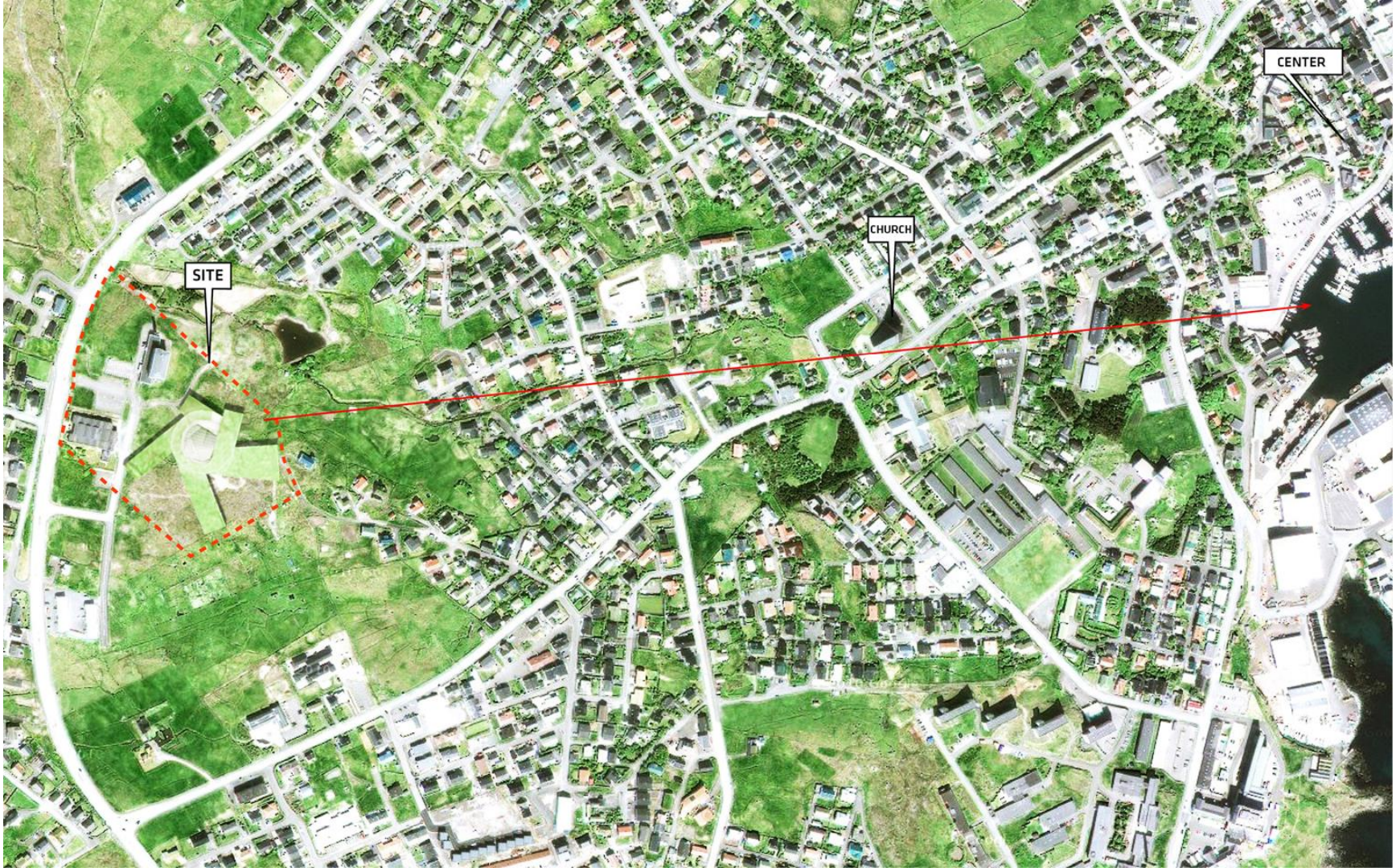

> 30°C
Surface temperature
> 40°C




30°C
25°C
20°C
15°C
HISTORIC DATA | 1970 - 2020
STANDARDISED WEATHER FILE | URBAN
STANDARDISED WEATHER FILE | TYPICAL
MEASURED DATA, UCK WEATHER STATION | 2019-2019

Playing with new climatic extremes

BIG – FarOer Educational Center


CENTER
CHURCH
SITE

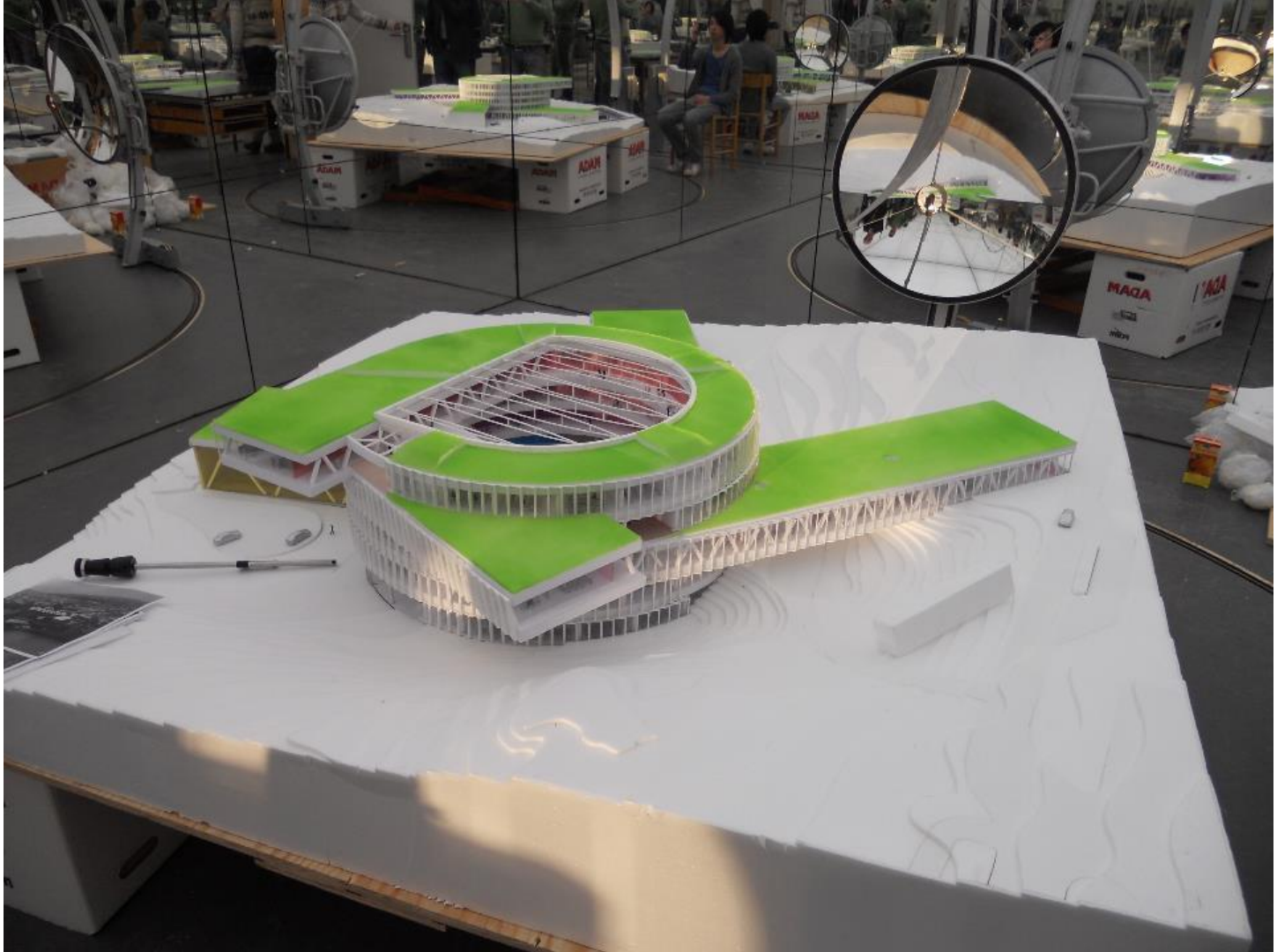

ADAM
MAGA


EXHIBIT
FIRST SEMESTER WORK 2014
THE ARCTIC
OPENING AND REFRESHMENTS
BYG. 68 - OPGANG A
FRIDAY march 6th 15:00
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2017/18
TANZANIA
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 23rd
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2018/19
ALASKA
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
THURSDAY January 31st 16:00
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2015/16
THE AMAZON
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 12th
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2016/17
KANGERLUSSUAQ
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 10th 15:00
ARCHITECTURE
AND EXTREME
ENVIRONMENTS


EXHIBIT
FIRST SEMESTER WORK 2016/17
THE GOBI
OPENING AND REFRESHMENTS
KADK campus - BUILDING 68 - ENTRANCE A
FRIDAY february 10th 15:00
ARCHITECTURE
AND EXTREME
ENVIRONMENTS

architecture and extreme environments

Created playlists

2018 ALASKA

VIEW FULL PLAYLIST

2015 THE AMAZON

VIEW FULL PLAYLIST

2016 THE GOBI

VIEW FULL PLAYLIST

2014 THE ARCTIC

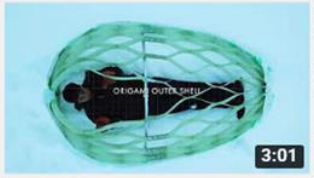
VIEW FULL PLAYLIST

2017 TANZANIA

VIEW FULL PLAYLIST

Uploads

PLAY ALL



AEE, ALASKA: DEPLOYABLE EMERGENCY STRUCTURE

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AEE, ALASKA: FISH WASTE

74 views • 9 months ago

AEE, ALASKA: LOCAL TILE PRODUCTION

84 views • 9 months ago


PHOTOBIOREACTORS

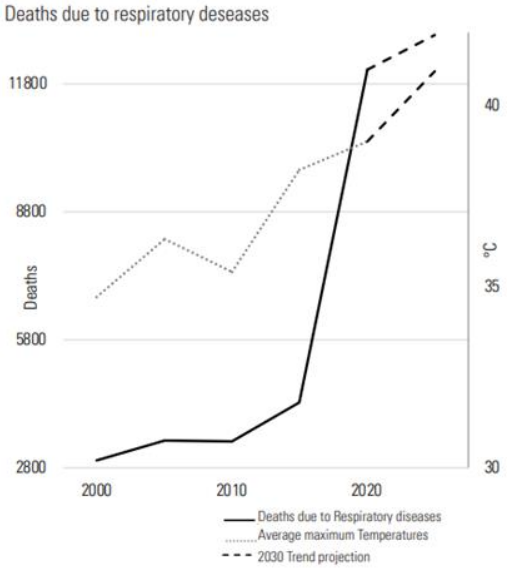
Health

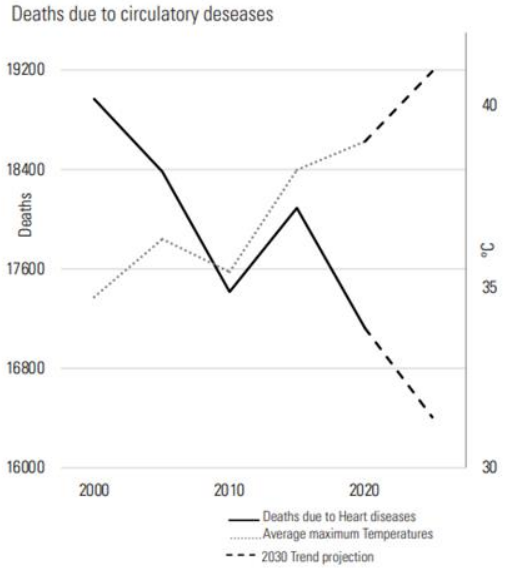
Satellites and Health

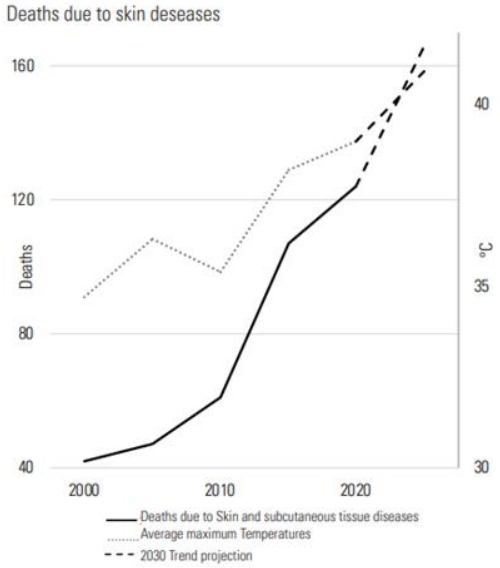
Satellite Missions/Programs	*Imaging Type Description*	*Specific Measurement*	*Units*	*Outdoor Comfort Variable*	*Applications in Urban Planning and Building Design*
Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS)	**Infrared for urban heat islands and evapotranspiration.**	Surface Temperature, Evapotranspiration	Degrees Celsius (°C), Millimeters (mm/year)	**Urban Heat Islands**	**Identifying hot spots for targeted cooling strategies in urban areas.**
Clouds and the Earth's Radiant Energy System (CERES)	Radiometry for sunlight exposure and cloud cover.	**Sunlight Exposure, Cloud Cover**	Watts per square meter (W/m^2), Percentage	**Sunlight and Cloud Cover**	Optimizing building orientation and **shading** for sunlight control.
Orbiting Carbon Observatory-2 (OCO-2)	Spectroscopy for atmospheric pollutants and CO2 levels.	**Carbon Dioxide (CO2) Concentration, Air Quality**	Parts per million (ppm), Index	**Air Quality**	**Implementing pollution reduction strategies for healthier urban environments.**

Human Health

Parametric Modelling



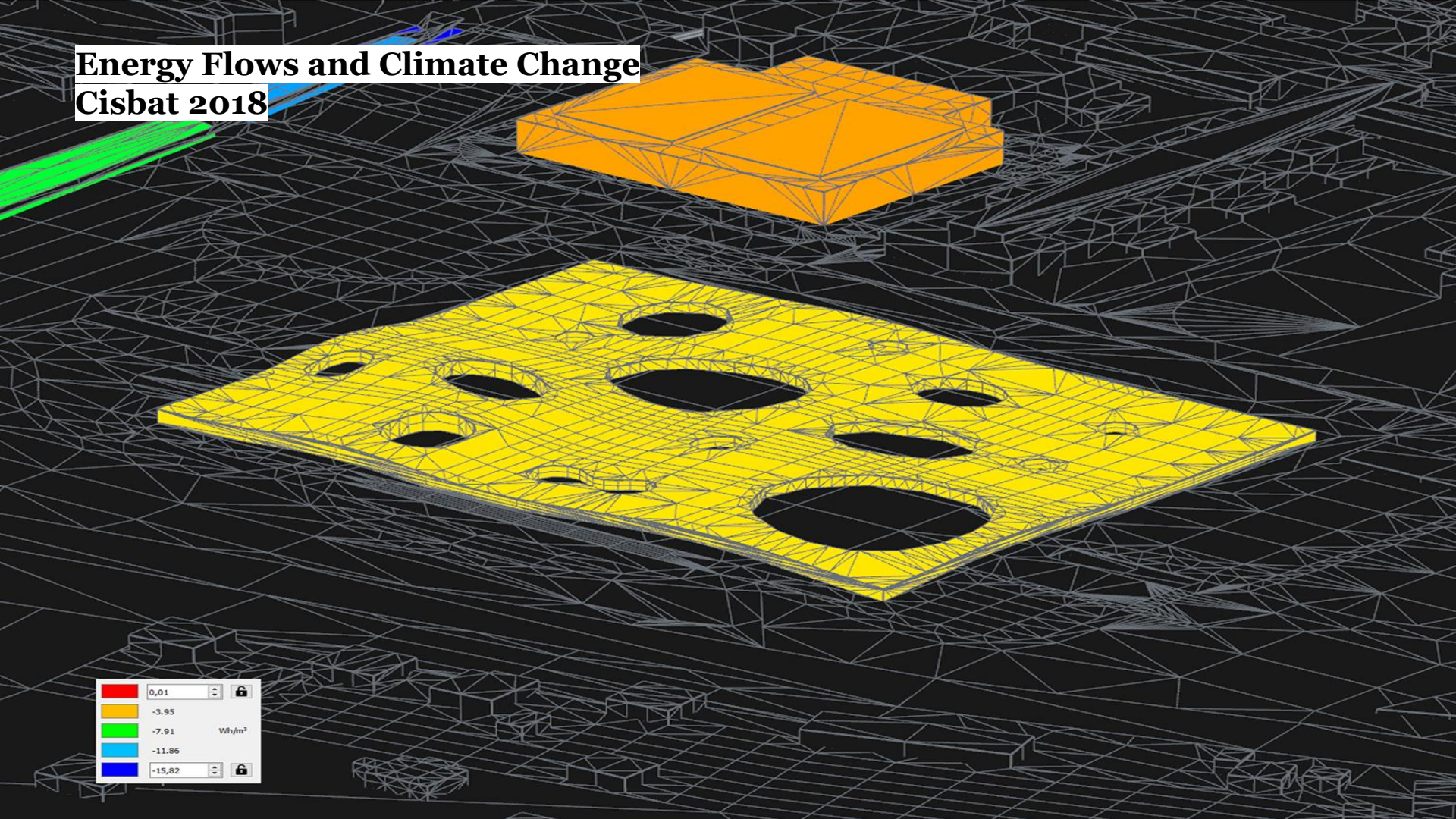




EPFL Campus

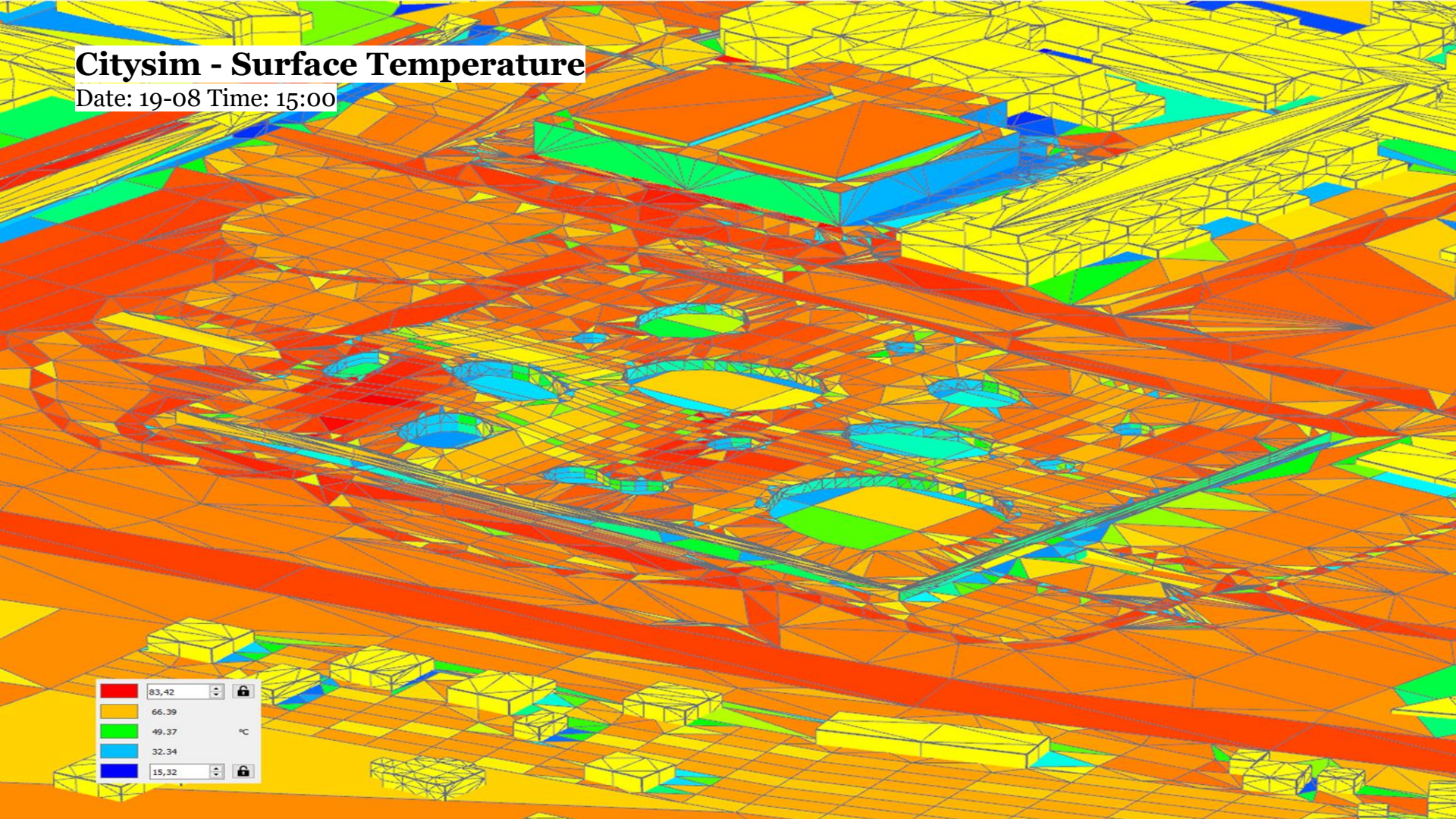
Complex case. Geometrically and Thermodynamically

Energy Flows and Climate Change
Cisbat 2018



Citysim - Surface Temperature

Date: 19-08 Time: 15:00

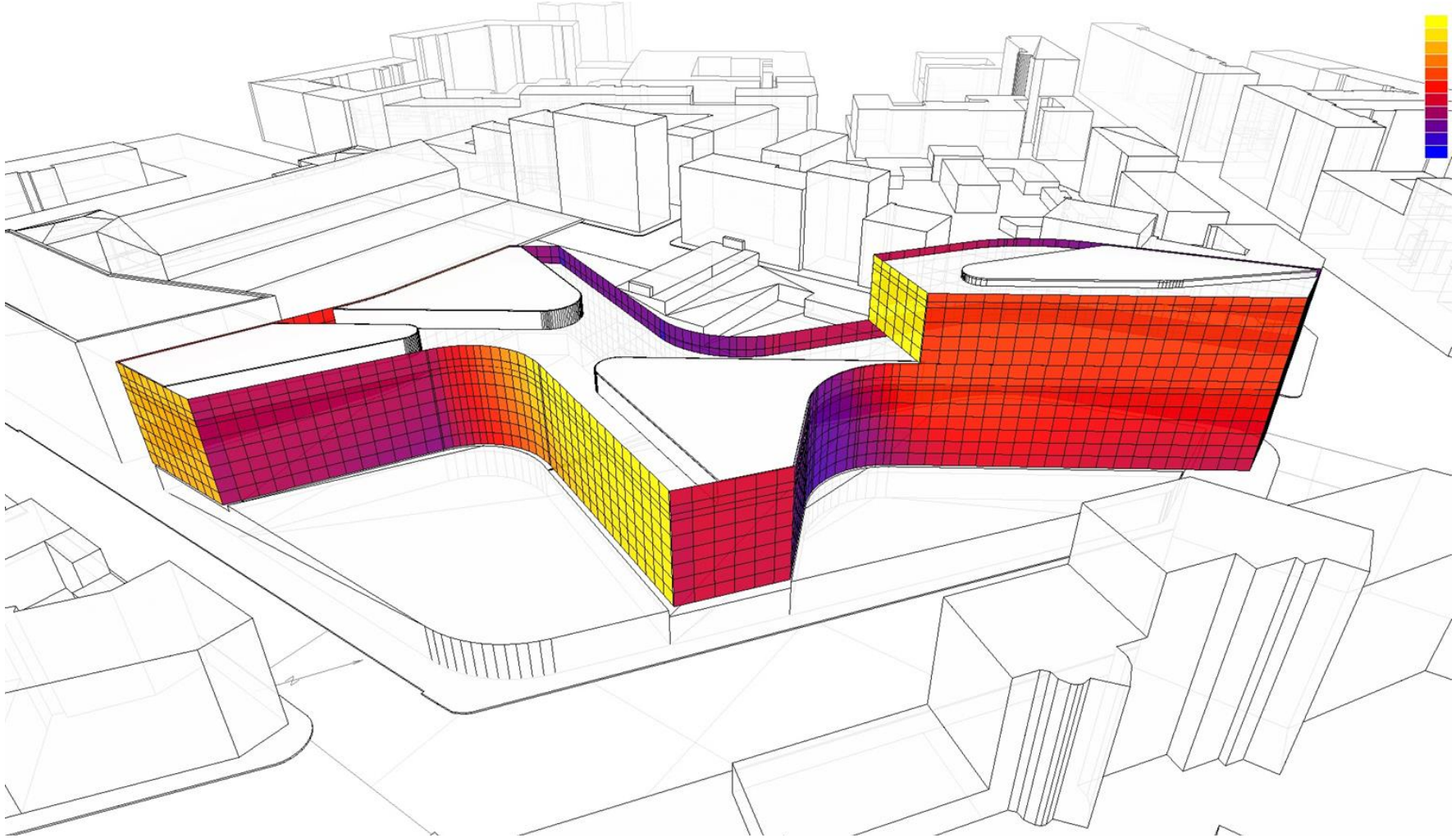


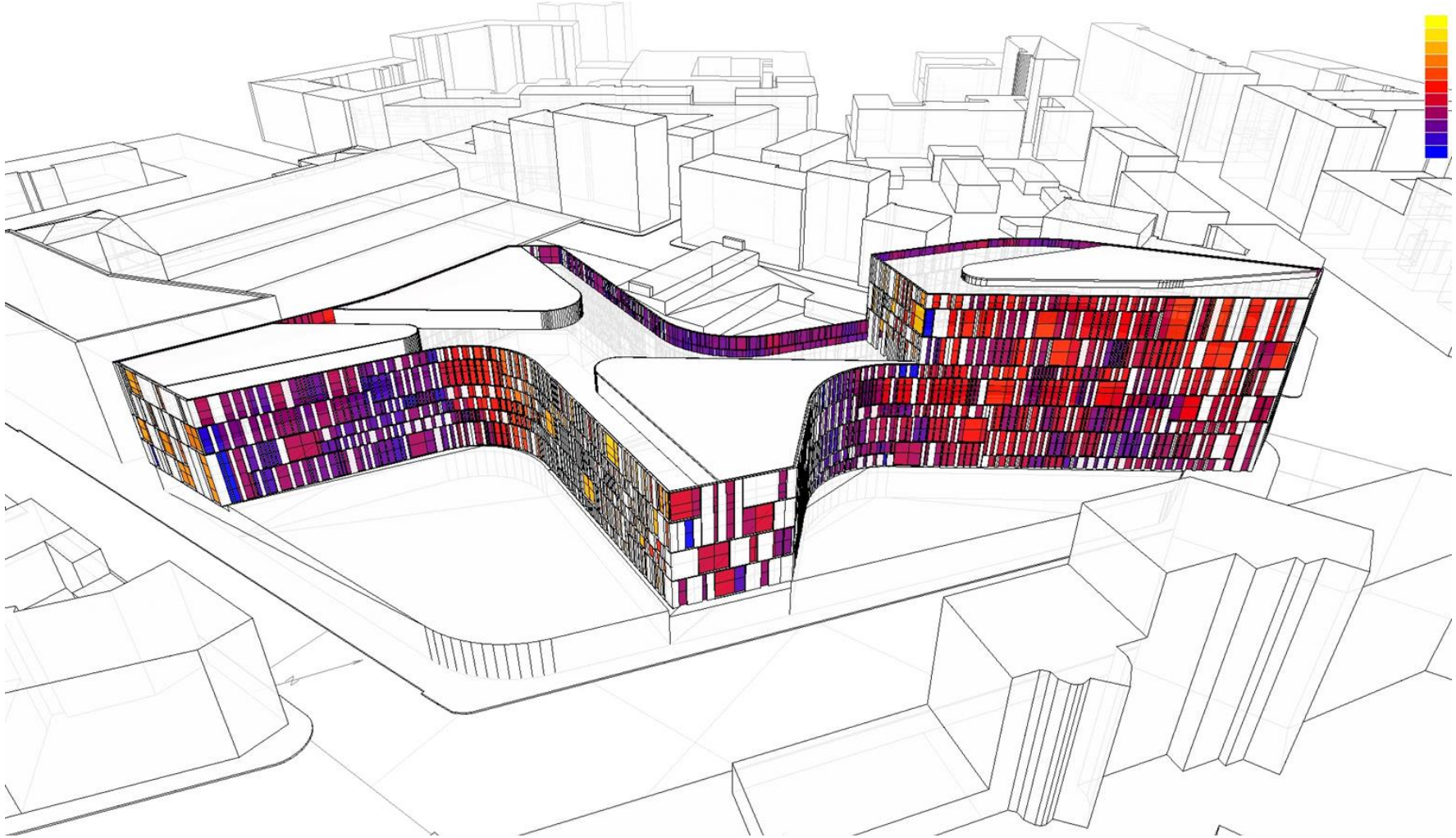
Issue of Surfaces

Material Type	Current Avg. Summer Temp. (°C) Exposed to Sunlight	Projected Temp. in 2050 (°C) Under RCP 8.5 Scenario
Asphalt	50 - 70	55 - 80
Concrete	30 - 50	35 - 60
Brick	30 - 50	35 - 60
Steel	40 - 60	45 - 70
Sand	35 - 55	40 - 65
Soil	25 - 45	30 - 55
Grass	20 - 35	25 - 45
Wood	30 - 50	35 - 60

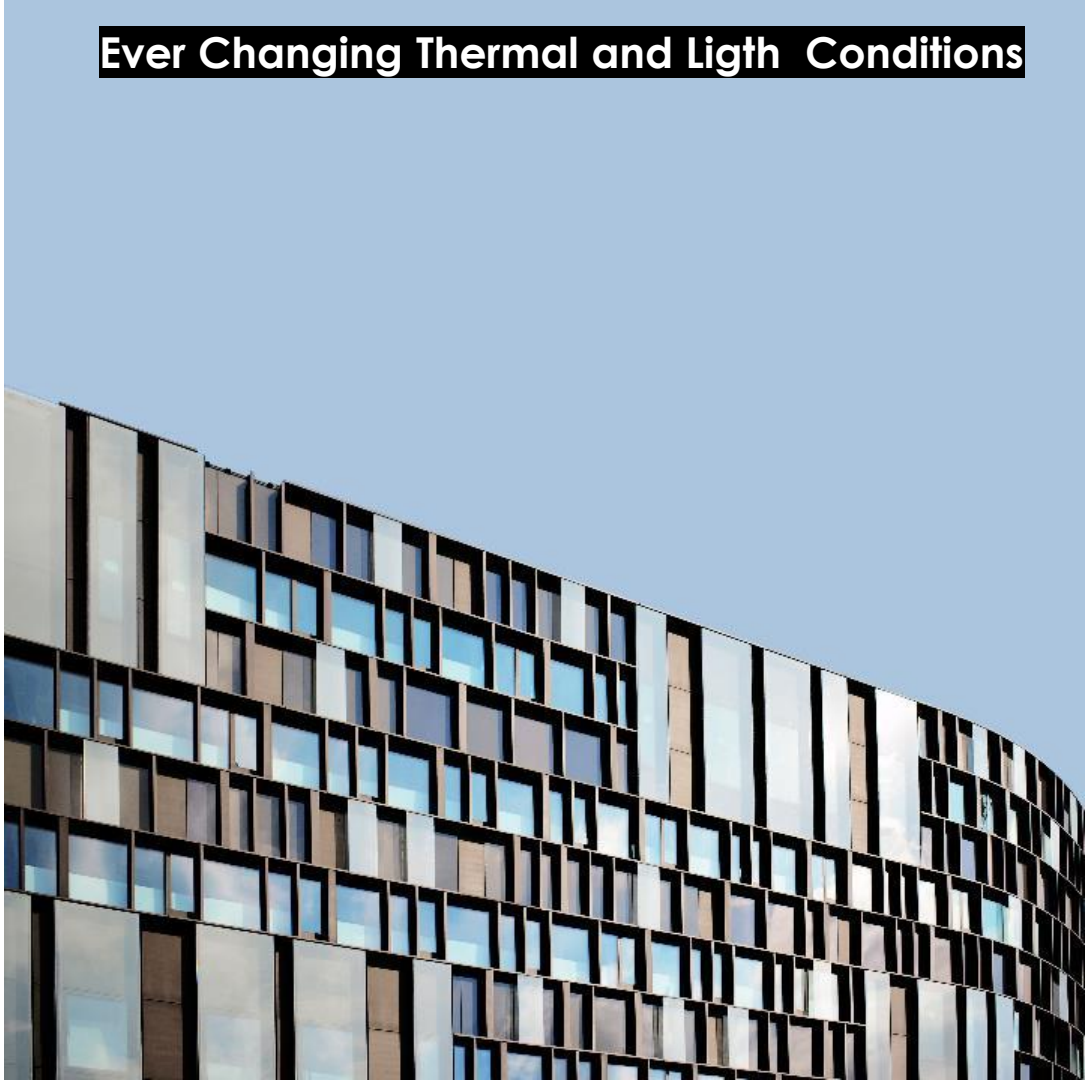
Issue with Insulation in Summer Daytime at 14 (peak)

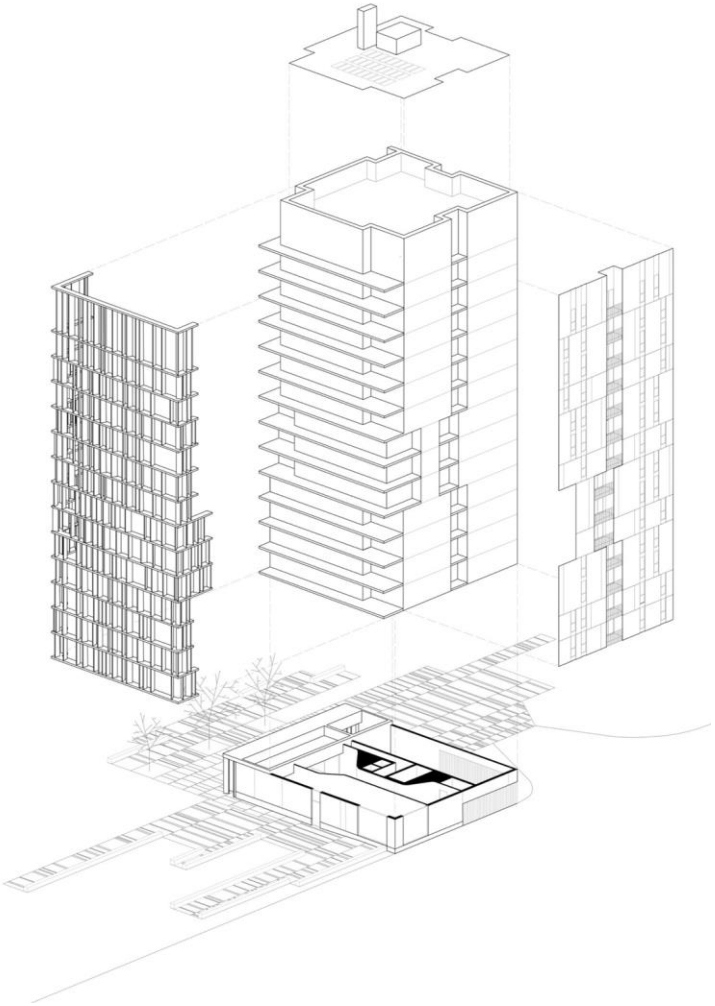
Season	Temp. in Lausanne Now (°C at 14:00)	Isolated Material Now (°C at 14:00)	Non-Isolated Material Now (°C at 14:00)	*Outdoor Temp. in Lausanne in 2050 (°C at 14:00)*	*Isolated Material in 2050 (°C at 14:00)*	*Non-Isolated Material in 2050 (°C at 14:00)*
Winter	2 - 6	2 - 4	1 - 3	*4 - 8*	*4 - 6*	*3 - 5*
Spring	10 - 16	12 - 17	11 - 15	*12 - 20*	*14 - 21*	*13 - 19*
Summer	**22 - 30**	**26 - 34**	**24 - 32**	***27 - 35***	***31 - 40***	***28 - 34***
Autumn	12 - 18	13 - 19	12 - 17	*14 - 21*	*16 - 23*	*15 - 21*

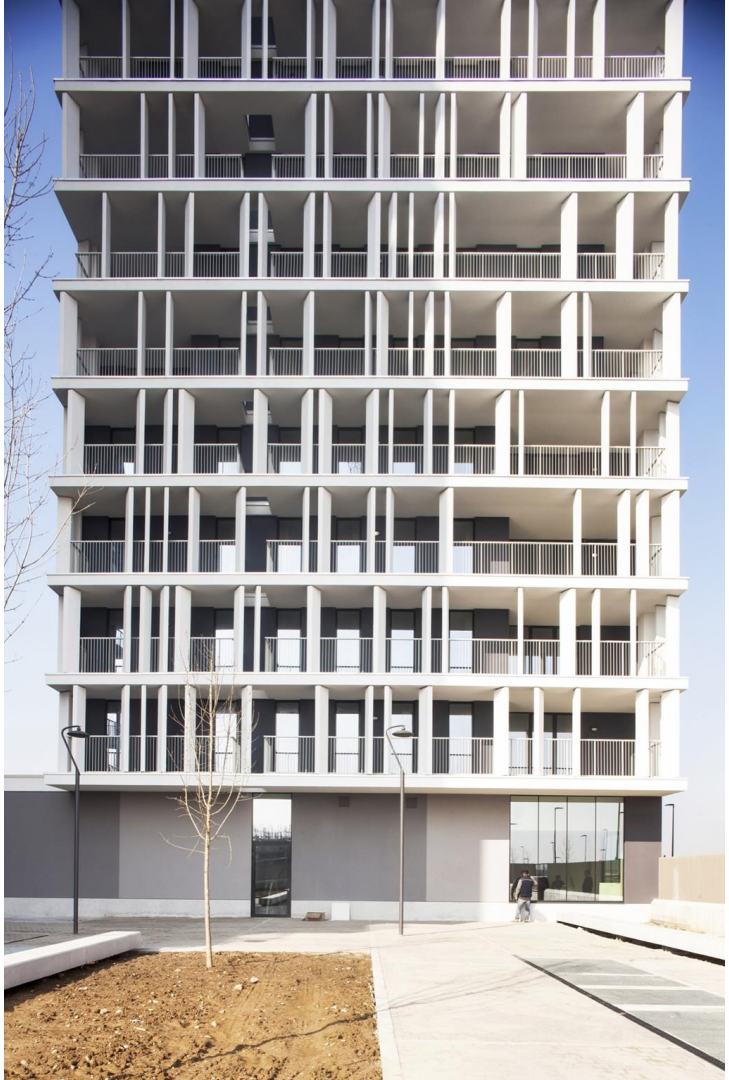




Ever Changing Thermal and Ligth Conditions







Decarbonization

Satellites and Decarbonization

Satellite Missions/Programs	*Imaging Type Description*	*Specific Measurement*	*Units*	*Decarbonization Focus*	*Applications in Decarbonization of Spaces and Buildings*
Moderate Resolution Imaging Spectroradiometer (MODIS), Landsat	Spectral imaging for land use and albedo.	**Albedo, Land Cover Changes**	Percentage, Type	**Operational Energy**	**Designing urban layouts and building orientations that maximize natural lighting and heating, reducing the need for artificial climate control and lowering energy consumption.**
Soil Moisture Active Passive (SMAP), Sentinel-1	Radar and microwave for soil moisture.	Soil Moisture Content	Cubic meter per cubic meter (m^3/m^3)	**Decarbonization**	Informing the selection of sustainable landscaping and green infrastructure materials based on local soil conditions to **enhance carbon sequestration** in urban environments.
Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS)	Infrared for evapotranspiration and thermal properties.	Surface Temperature, Evapotranspiration	Degrees Celsius (°C), Millimeters (mm/year)	**Operational Energy**	Guiding the correct use of materials in building design to naturally regulate temperature, reducing the need for mechanical heating and cooling.
Orbiting Carbon Observatory-2 (OCO-2), Greenhouse Gases Observing Satellite (GOSAT)	Spectroscopy for atmospheric CO2 concentration.	**Carbon Dioxide (CO2) Concentration**	Parts per million (ppm)	**Atmospheric Gases (CO2 levels)**	**Developing carbon-absorbing building materials** and green spaces, designing urban forests and parks as carbon sinks to mitigate CO2 levels, informed by atmospheric CO2 data.

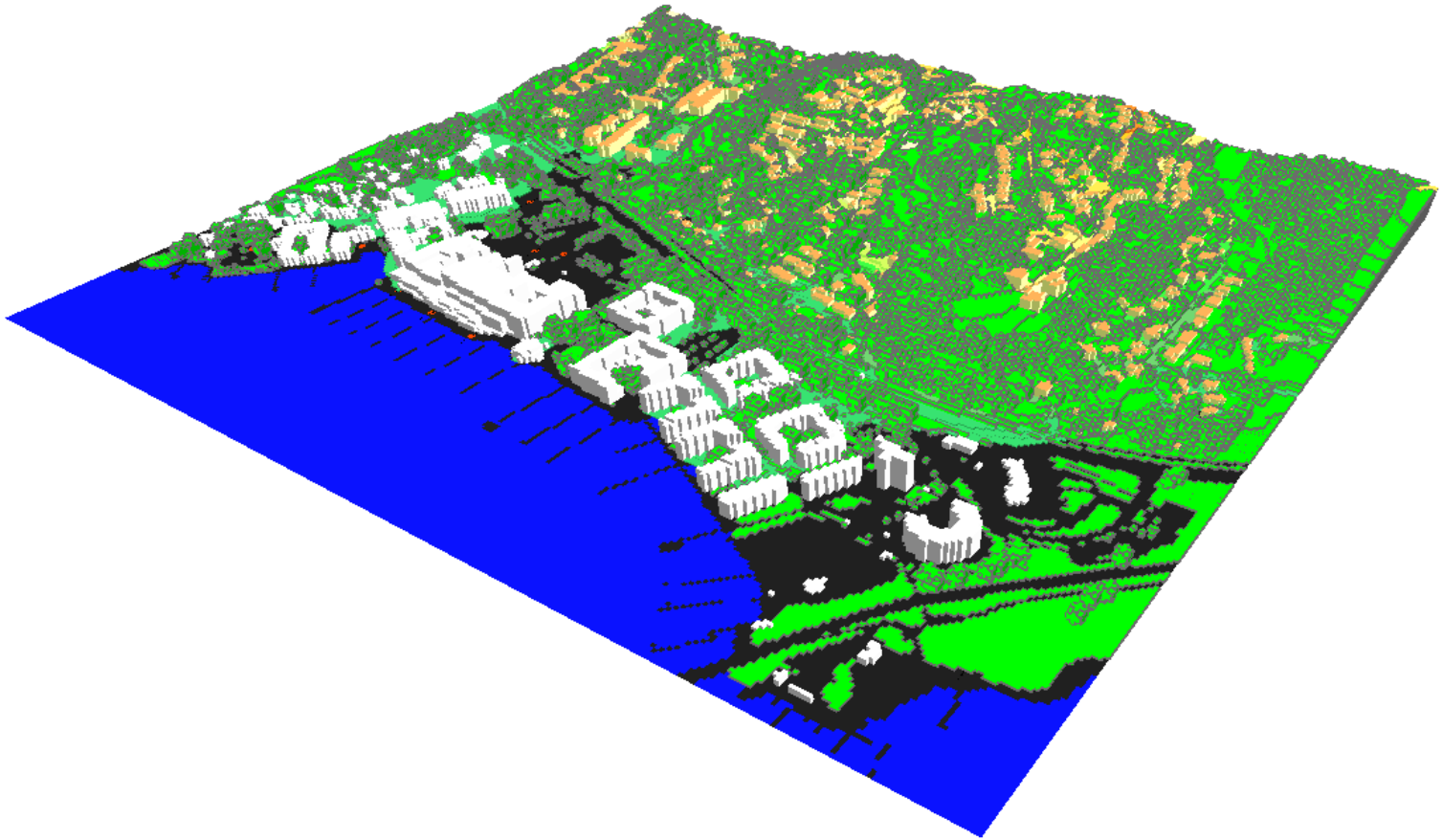
Gotemburg Climate Adaptation Plan.

With Antonello di Nunzio, Graziano Marchesini


avgT_fac
23,82 - 25,16
25,16 - 26,51
26,51 - 27,85
27,85 - 29,19
29,19 - 30,54
30,54 - 31,88
31,88 - 33,23
33,23 - 34,57
srfT_14
19,850 - 23,527
23,527 - 27,203
27,203 - 30,880
30,880 - 34,556
34,556 - 38,233
38,233 - 41,909
41,909 - 45,585
45,585 - 49,262
OpenStreetMap
Enestigen
Granstigen
Egnahemsvägen
Janssons Väg
Nytorpshöjdsvägen
Kristinedalskyrkan
qgis2web · Leaflet · QGIS

Stenungsund Climate Adaptation Plan

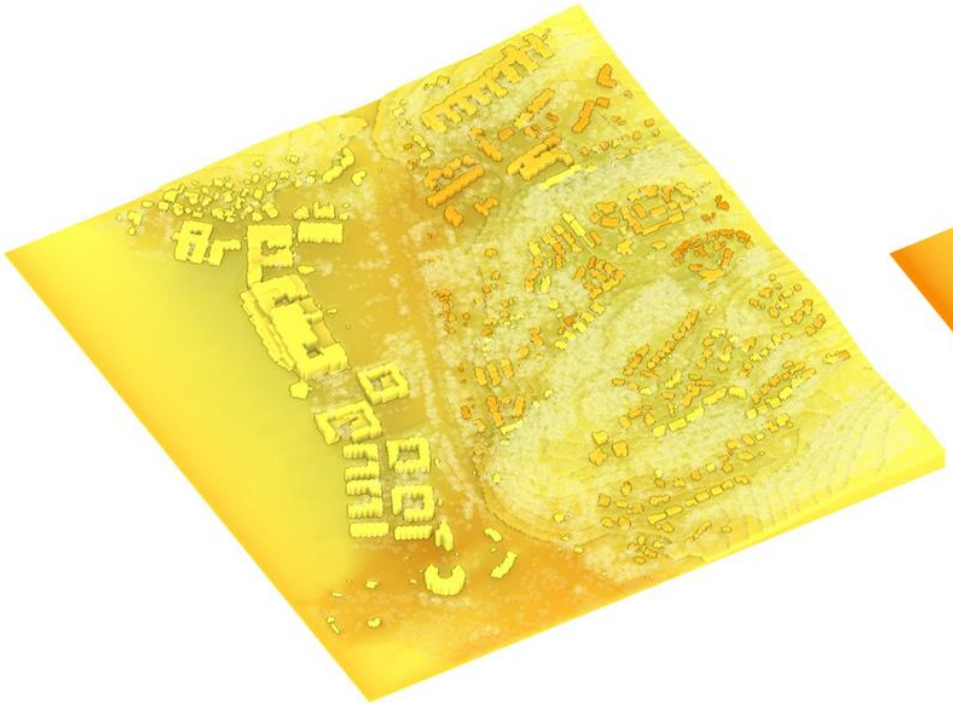
Microclimate Creation

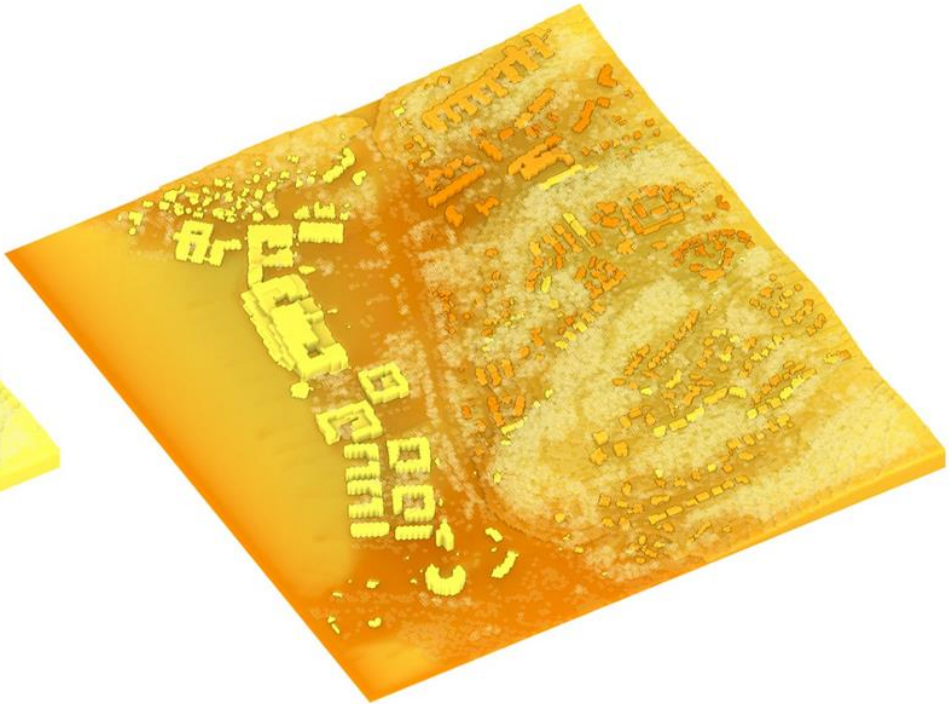



small deciduous
decidous
conifer

Summer scenario 27.07.2018 15.00

Summer scenario 27.07.2050 15.00

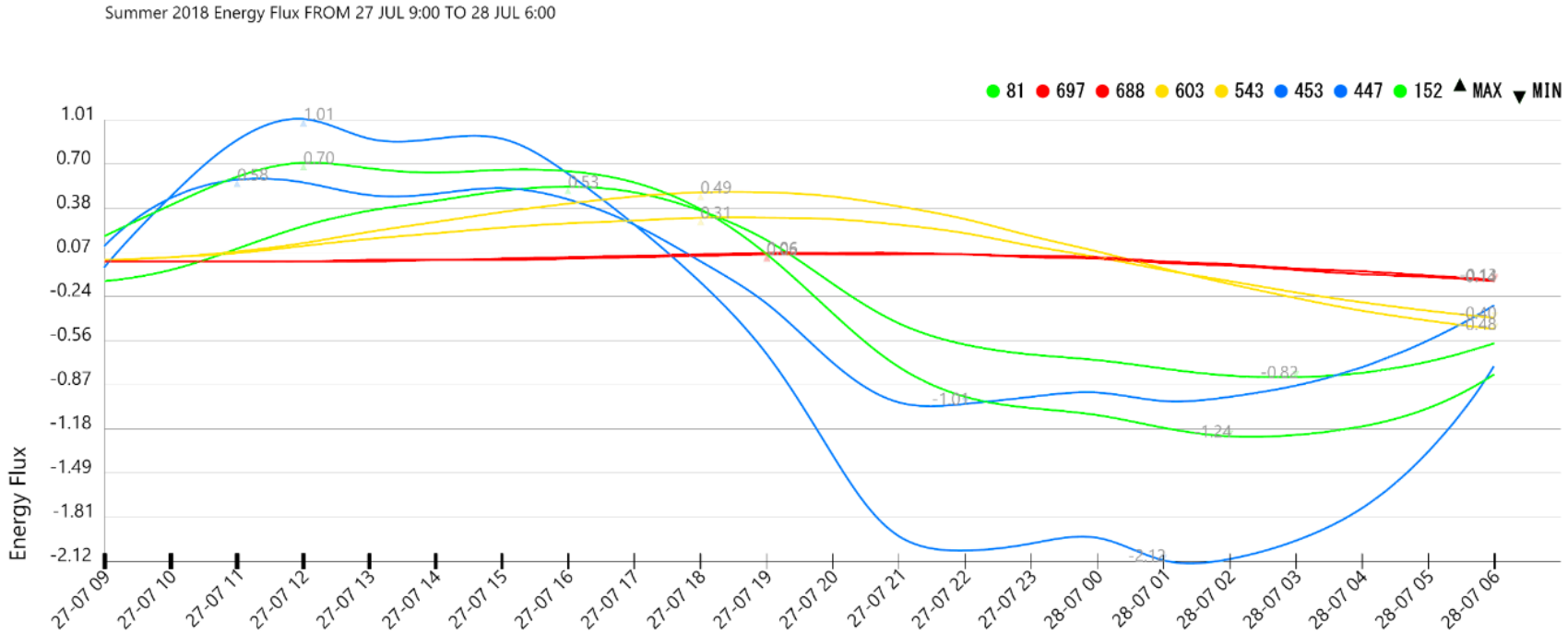




Potential Air Temperature (°C)
Building: Temperature of building (inside) (°C)
Air Temperature at Vegetation (°C)

15 18 20 23 25 28 30 33 35 38 40

Indoor building temperature



Takeouts

From controlling climate change, to play with it

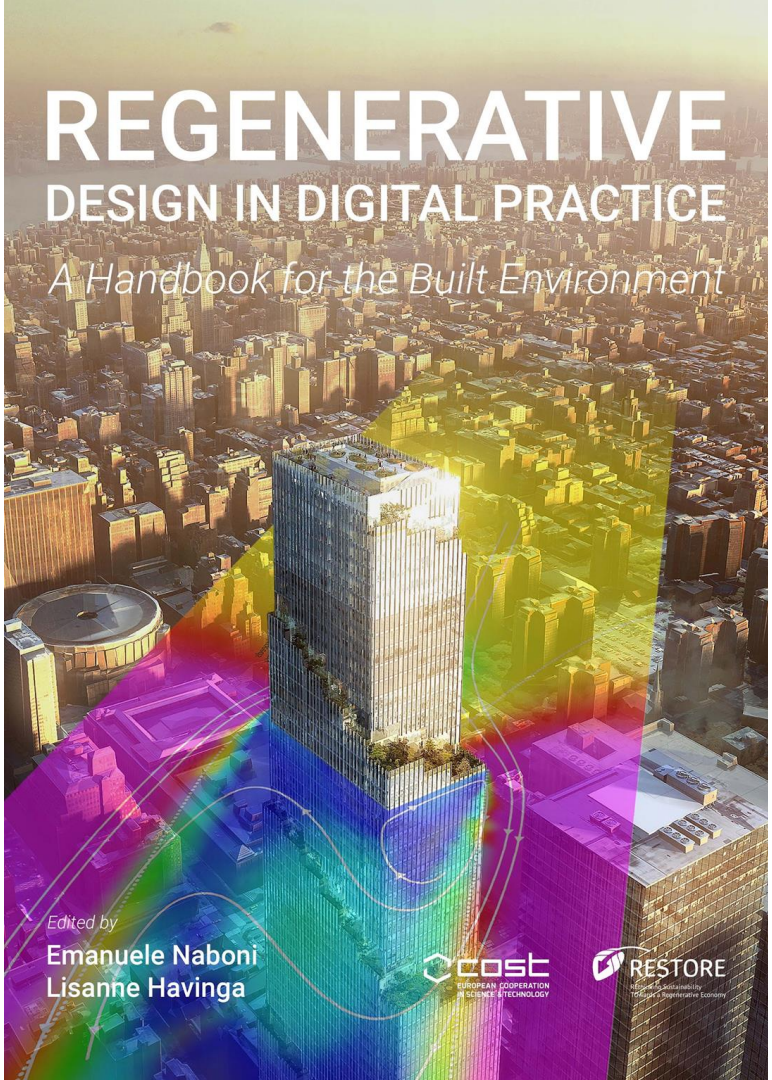
Expanding targets to support **ecology, decarbonization and health implies of of Satellites**

(Living) Materiality and Forms / Satellites

Urban and Building Metabolism / Satellites

Time for better integration macro - micro

Solutions are yet to be found, time for multi-domain collaborations



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Let's be in touch!

instagram:
emanuele_naboni_climate

or email:
emanuele.naboni@gmail.com