Urban Climate Change Research Network for Higher Education
Climate-Resilient Design, Planning and Governance of Cities

Co-funded by the Erasmus+ Programme of the European Union

UCCRN_edu Climate-Resilient Urban Planning, Design and Governance Toolkit

Project Results' Lead Partners: Universitá degli Studi di Napoli Federico II

UCCRN_edu — Climate-Resilient Urban Planning, Design and Governance Toolkit and Climate-Resilient City Game

Disclaimer
UCCRN_edu "Urban Climate Change Research Network for Higher Education: Climate-Resilient Design, Planning and Governance of Cities" is a project co-funded by the Erasmus+ programme of the European Union (proj. n. 2021-1-IT02-KA220-HED-29D94D03).
The content of the document is the sole responsibility of UCCRN_edu and the European Commission cannot be held responsible for any use that may be made of the information contained therein.

This work shall be cited as follows
Leone, M.F., Visconti, C., Tersigni, E., Nocerino, G., Addabbo, N., Verde, S., Mills, G., Pellegrino, M., Ruggiero, A., Koutra, S., Valentin, C., Lehmann, M., Raven, J. (2024).
Climate-Resilient Urban Planning, Design and Governance Toolkit. Available at: www.uccrn.education

Authors: Mattia Federico Leone, Cristina Visconti, Enza Tersigni, Giovanni Nocerino, Nicola Addabbo, Sara Verde, Gerald Mills, Margot Pellegrino, Angela Ruggiero, Sesil Koutra, Christian Valentin, Martin Lehmann, Jeffrey Raven.
Editing and proofreading: Mattia Federico Leone, Enza Tersigni, Valeria Granillo
Layout: Valeria Granillo
Images: Images provided by the UCCRN_edu Partners (credits in the caption)

This publication is the outcome of in-depth consultations undertaken by the Erasmus+ UCCRN_edu project team:

Project Partners

Universitá degli Studi di Napoli Federico II
Main coordinator: Mattia Leone
Key partners: Giulio Zuccaro, Pietro Nunziante, Enza Tersigni, Cristina Visconti, Maria Fabrizia Clemente, Sara Verde, Marion Perney, Daniele Campese, Giovanni Nocerino, Nicola Addabbo, Valeria Granillo

Université Gustave Eiffel
Local coordinator: Margot Pellegrino
Local partners: Bruno Barroca, Angela Ruggiero, Maria Baresch

Sorbonne Université
Local coordinator: Chantal Pacteau
Local partners: Christian Valentin, Loic Segalen, Jacques Gignoux, Emmanuel Gendreau, Pierre Lacaze, Hanna Hertwig, Séverine Maillet

Aalborg Universitet
Local coordinator: Martin Lehmann
Local partner: Astrid Dalum Bøgh Jensen

University College Dublin
Local coordinator: Gerald Mills
Local partners: Eve Brosseau

Universitat Internacional de Catalunya
Local coordinator: Lorenzo Chelleri
Local partners: Ernest Bisgrove, Allison Ahern, Raquel Guerra, Valeria Rijana, Maxime Pierson, Eloise Deshayes

Université de Mons
Local coordinator: Vincent Becue
Local partners: Sesil Koutra, Noémie Lago, Fabrice Sobcak

Università di Pisa
Local coordinator: Alfredo Fioritto
Local partners: Marco Lunardelli, Marco Bevilacqua, Gabriele Serra

IHE Delft Institute for Water Education
Local coordinator: Chris Zevenbergen
Local partners: William Veerbeek, Fred Toet

Associated Partners

Higher Education Institutions
COLUMBIA – Columbia University (USA)
DRX – Drexler University (USA)
PUC-RIO – Pontifícia Universidad Católica do Rio de Janeiro (Brazil)
AHMED – Ahmedabad University (India), and UCCRN South Asian European Hub
SCU – Southern Cross University (Australia), and UCCRN Australian Hub
NYIT – New York Institute of Technology

International Networks
UCCRN
UCCRN European Hub
UCCRN Latin American Hub
URNet
ICLEI
Climate Chance
Cité-ID – Gouvernance de la résilience urbaine
ACAN – Architects Climate Action Network

Local Authorities
Ethekwini Municipality (South Africa), and UCCRN African Hub

SME
Raven Architecture + Urban Design + Sustainability (USA)

Introduction

The project result presented in this document is a comprehensive toolkit, designed to be used within UCCRN_edu Intensive Study Programmes. It reflects the principles and methods to streamline climate-resilient governance, planning, and design by fostering the collaborative dimension proposed within the Urban Design Climate Workshops (UDCWs).

It includes the following:

- **Simulation tools for urban microclimate modelling** (GIS + parametric design tools) **and use guidance**
- **Facilitation tools**
  - Collaborative Mapping
  - City Visions and Local Needs Matching
  - A Day in The Life
  - 3D District Configurator

The UCDW methodology focuses on sequential and iterative phases that lead to the development of the project through a multidisciplinary and multi-scale approach: climate and microclimate analysis; site surveys, collaborative mapping and co-design; planning and design; post-intervention evaluation (Fig. 1), being implemented with the support of UCCRN_edu multidisciplinary experts and urban stakeholders. The toolkit's goal is to define an intervention model that combines knowledge-sharing and co-design actions with urban decision-makers and local communities and the development of simulations based on computational design tools to control the leading indicators that determine the performance of buildings and open spaces about climatic stress conditions.

- **The Climate/Microclimate Analysis Mapping phase** aims to identify the urban areas most affected by extreme events and seasonal variations, including local climate projections, as preliminary project information. To achieve this objective, historical climate data and Regional Climate Models (RCMs) are processed through simulation models integrated into different design tools: GIS systems for city/district-level

analyses, providing as output urban heat hotspots and flood zones; Algorithm Aided Design (AAD) 3D modelling tools (Rhinoceros and Grasshopper) for technical solutions assessment at the block/building scale, integrating climate-resilience aspects with other green building and environmental design criteria and benchmarks.

- **Site Surveys, Collaborative Mapping and Co-Design** aim to assess the quality of urban spaces and combine climate-related considerations with the needs and expectations of local communities. Innovative stakeholder engagement methods (e.g., collaborative mapping, gamification and co-design through the Climate-Resilient City Game) involving residents, local administrations, neighbourhood and category associations to allow a shared reading of the main critical aspects of the urban system about environmental, functional-spatial and socio-economic aspects. The synthesis of the results outlines a picture of shared needs and possible divergence elements between categories of stakeholders to integrate into the project.

- **The Planning and Design phase** is based on a critical review of the information collected to identify synergies and tradeoffs that can be implemented in the planning initiatives envisaged by the local authorities. Urban plans and building regulations define the limits to develop the most appropriate technical design strategies and solutions to achieve the objectives. Visual tools will link the multiple factors orienting local policies, transformative actions, and possible meta-design layouts to support the production of innovative solutions addressing climate change impacts while increasing environmental quality in cities.

- **The Post-Intervention Evaluation phase** is intended as a sequence of activities to evaluate the proposed solutions' benefits regarding microclimate, energy, and environmental performance and compliance with community priorities. The tools include instruments for simulation-driven/indicator-based scenario comparisons and gathering direct feedback from residents and local stakeholders.

The toolkit was developed by building on the consolidated knowledge of UCCRN_edu Partners. UNINA coordinated the activity, which was implemented jointly by all partners (including support from the UCCRN Associated Partners regarding the UCCRN ARC3 background).
The final version of the toolkit is released as a downloadable package, including guidance on designing an Urban Design Climate Workshop to implement urban microclimate modelling and simulations, the Climate-Resilient City Game, and other tools to support knowledge-sharing and co-design practices with local stakeholders and communities. Online tutorials facilitate the replication process.

Table of Contents

1.

Simulation Tools for Urban Microclimate Modelling

1.1 Background

The first version of the IT tools for microclimate modelling has undergone rigorous testing in numerous UNINA partner research activities and UCCRN activities. This testing was conducted with the invaluable support of the consolidated knowledge of UCCRN_edu Partners.
Today, the use of appropriate IT tools is essential for climate action in urban design. These tools play a crucial role in managing the complexity of the interconnected multidisciplinary knowledge domains, thereby streamlining climate-resilient planning, design, and governance practices.
The issue of climate resilience in urban areas requires the development of innovative design methods and supporting tools that can handle the complexity of the information and data needed to guide sustainable urban regeneration and retrofitting strategies.
Developing a climate-resilient design toolkit is a significant step towards integrating a comprehensive perspective in current planning and design practices. This toolkit, which incorporates original and analytical methodologies, specific process workflows, and design support tools, is aimed at measuring the multiple benefits of applying climate-adaptive and community-driven strategies to the local scale in the context of urban regeneration interventions.

Figure 1. Climate-Resilient Urban Planning and Design Process phases developed by the UCCRN ARC3.2 Urban Planning and Urban Design working group to facilitate integrated mitigation and adaptation in cities. © 2023 UCCRN European Hub.

1.2 Simulation Tools — Brief Description

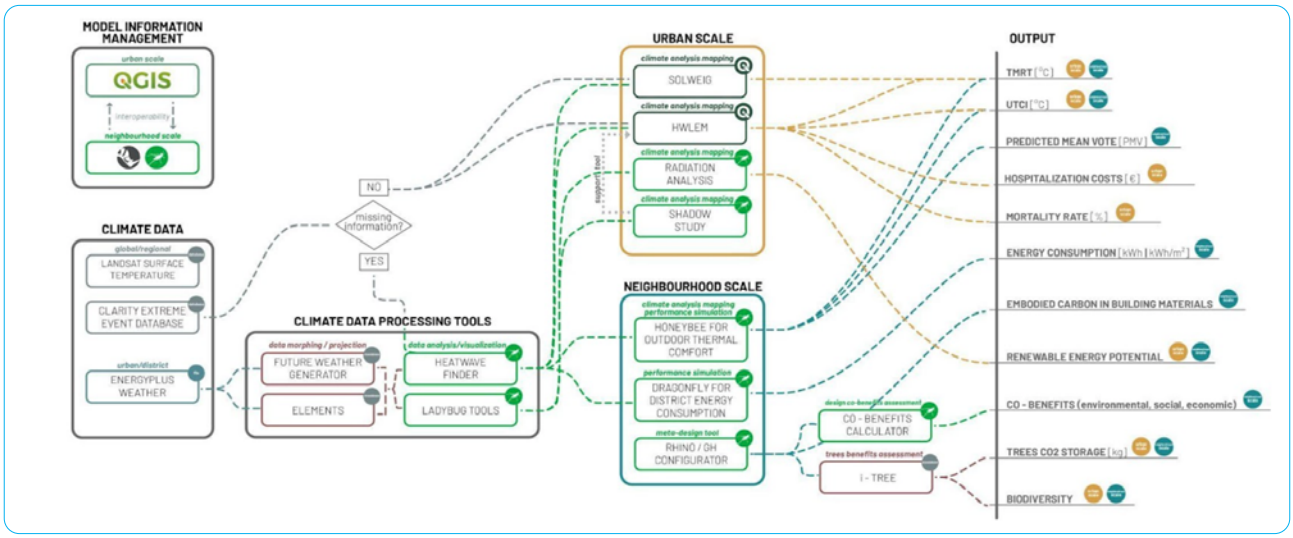
Regarding urban microclimate modelling, the toolkit is a comprehensive set of IT tools (standalone software, GIS tools, and 3D modelling algorithm-aided design tools) for heatwaves and flood hazard/impact modelling. It considers urban microclimate effects (morphology, land use and cover, building features, etc.) and operates at different scales, supporting each phase of the iterative workflow proposed by UCCRN, especially the Climate Analysis Mapping and the Post-Intervention Evaluation phases.

The main objectives can be summarised in the following points:

- streamlining climate modelling and climate resilient planning and design, bridging them with urban decision-makers and local communities
- generating simplified urban scenarios and assessing their behaviour according to several indicators, both qualitative and quantitative
- assessing climate-related risks
- evaluating planning and design solutions at different scales (urban, neighbourhood and building)

Depending on the specific type of output or indicator to be assessed, each tool can be classified into different categories: weather data projection and visualisation, performance simulation, climate analysis mapping and meta-design modelling tools.
The calculation models provided by the most sophisticated tools in the kit are based on the elaboration of climate projections downscaled to include urban microclimate conditions and simulate the impacts of heat-waves on population (mortality rate increase, hospitalisation, etc.) and the effect of seasonal temperature trends variation on energy demand for building heating/cooling, and impacts of floods on buildings and open spaces (direct and indirect damage to structure and content).
The tools can measure the climate benefits in terms of adaptation and mitigation measures through fully quantitative indicators, including a quantitative/qualitative assessment of social, economic, and environmental co-benefits associated with climate-resilient development strategies.

Figure 2. Simulation tools input/output scheme, showing how the different tools work at urban and neighbourhood scales considering inputs and outputs.



The results produced by the calculation models described above relate to the following indicators:

- Thermal Comfort Analysis Mapping
  - Universal Thermal Climate Index (UTCI) [°C]
  - Mean Radiant Temperature (TMRT) [°C]
  - Predicted Mean Vote [PMV]
  - Weather Data (air temperature, relative humidity, wind speed, etc.)

- Healthy Indicator for Impact Assessment Due to Heat Waves
  - Hospitalisation Costs [€]
  - Mortality Rate [%]

- Energy Consumption (for single building or neighbourhood scale)
  - End Use Intensity [kWh/m2]
  - Total Energy Consumption [kWh]

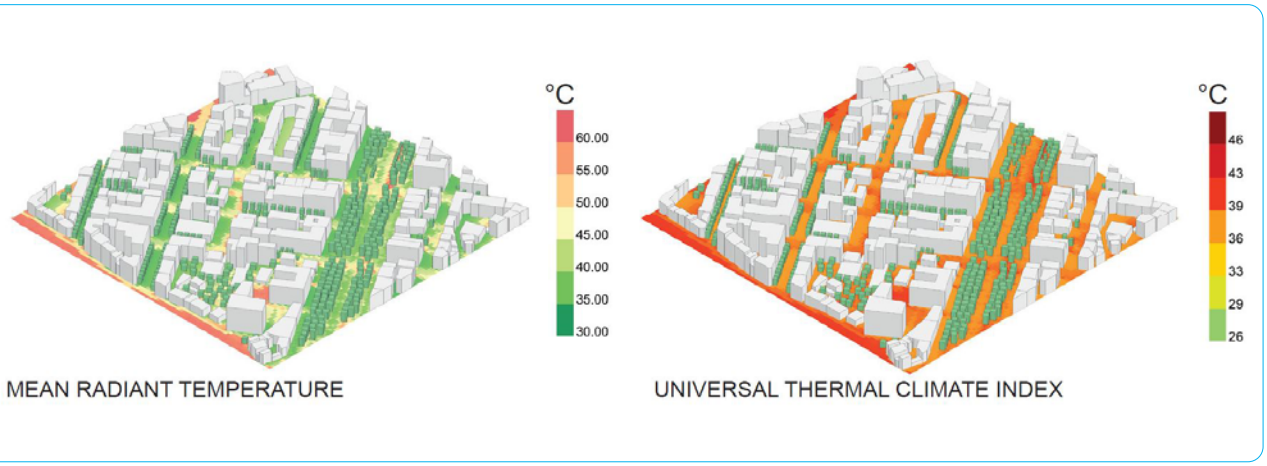
- Renewable Energy Production Potential
  - Annual Energy Production [kWh]

- Carbon Storage Potential (NBS and GBI)
  - End Use Intensity [kWh/m2]
  - Total Energy Consumption [kWh]

- Direct and Indirect Economic Impact of Floods on Buildings and Infrastructure
  - Building Damage (structure and content) [€]
  - Road Infrastructure Damage (cleaning and repairing) [€]

While our toolkit is designed with user-friendliness as a primary goal, it does require some specific skills for proper use. Operators should have technical knowledge in the fields of environmental design and sustainable planning, as well as adequate knowledge of 3D modelling, algorithm design, and GIS.

Figure 3. 3D modelling tool for the simulation of outdoor thermal comfort to analyze climate benefits of urban design stretegies. © 2023 UCCRN European Hub.



1.3 Simulation Tools — List

- **Future Weather Generator v. 0.5.3**
  - Main goal: projecting EPW weather data
  - Working environment: standalone tool (Java)
  - Detailed sheet: https://docs.google.com/document/d/1T2GYBXK3CQ2S11YE76O1wT5ehJOUha9W

- **Elements**
  - Main goal: morphing EPW weather data
  - Working environment: standalone tool
  - Detailed sheet: https://docs.google.com/document/d/1xs8U3L30O0kKtLz1GMxAfI2SFR1_TuBP

- **Clarity Extreme Event Database**
  - Main goal: characterising and projecting heat waves and rainfall events for a given location
  - Working environment: bundled tool (GIS)
  - Detailed sheet: https://docs.google.com/document/d/1BfXBOr_rhqOWKB6FMMOrXlNdB0pjakeD

- **Solweig**
  - Main goal: estimating urban heat stress
  - Working environment: bundled tool (GIS)
  - Detailed sheet: https://docs.google.com/document/d/1TjmHu-GD6VsusOfczbBjnTAA_Q9Mq-4e

- **Plinivs HWLEM**
  - Main goal: estimating urban heat stress and the impact of heat waves in terms of mortality and hospitalisation costs
  - Working environment: bundled tool (GIS)
  - Detailed sheet: https://docs.google.com/document/d/1S-EWu6Sc3NIOxx4R8ZBwVvGj5kbQHF7L

- **3D District Configurator_Simulation Tool**
  - Main goal: optimising and simplifying the district-scale modelling phase in order to explore different design solutions at the earliest design stages
  - Working environment: bundled tool (Rhinoceros and Grasshopper)
  - Detailed sheet: https://docs.google.com/document/d/1S7GihXt4vH8hsfig7YmLoavpcfGHOdiO

- **Honeybee for Outdoor Comfort Simulation**
  - Main goal: assessing the outdoor thermal comfort at the neighbourhood scale with different design

solutions at the earliest design stages
    - Working environment: bundled tool (Grasshopper)
    - Detailed sheet: https://docs.google.com/document/d/1iEjErdjzbI9sgcX7ZVC3FLoVf7JqoAmf

- **DRAGONFLY for District Energy Consumption**
    - Main goal: assessing total energy consumption at district scale
    - Working environment: bundled tool (Rhinoceros and Grasshopper)
    - Detailed sheet: https://docs.google.com/document/d/1ayKmxbWxrAAK8hsR4jvwzudzQQHV3PeX

- **HeatWave Finder**
    - Main goal: individuating the highest air temperature values in a .epw weather file
    - Working environment: bundled tool (Rhinoceros and Grasshopper)
    - Detailed sheet: https://docs.google.com/document/d/1XnWco96Jjf5iBvb2tfM2cX5A7j-Ko87N

- **Ladybug Tools**
    - Main goal: ClimaLadybug toolset data analysis and visualisation of different design solutions at the earliest design stages
    - Working environment: bundled tool (Rhinoceros and Grasshopper)
    - Detailed sheet: https://docs.google.com/document/d/18An_SPrtoThShcb3nVMWfucmw7H2I6Na

- **U-ZED. Urban-Zero Energy Districts**
    - Main goal: strategic decision-making for planning in a district from the early phase of its conception towards the zero-energy transition on an urban scale
    - Working environment: bundled tool (GIS, HOMEE, TRNSYS, Excel)
    - Detailed sheet: https://docs.google.com/document/d/1zvRCLdCJarAadaz7mWMCCr7q-Fx303PR

2.

Facilitation Tools for Urban Microclimate Modelling

2.1 Background

Facilitation tools are participatory resources supporting knowledge sharing and co-production in a multi-stakeholder context, facilitating communication about urban climate resilience topics and bridging complex and science-based inputs with tacit knowledge. The tools are conceived to foster the dialogue between experts and non-expert and to match urban design solutions for mitigation and adaptation with everyday practices and needs of citizens and as well with capacity building issues of public administrations and decision makers. The tools, that developed within the UCCRN_edu Urban Design Climate Workshops since 2018, have shown their adaptability in different geographical contexts (Naples, Paris, Durban, New York, Aalborg, Barcelona, Dublin, Rotterdam, Mons, Rio-De Janeiro) and with different city actors (local communities, city officials, third sector, practitioners).

Figure 4. Facilitation tools aim at collaboratively mapping both the critical elements of knowledge of the territory and the priorities for urban development considering key social, economic and environmental issues, based on insights from local communities, public and private stakeholders.

2.2 Facilitation Tools — Brief Description

The facilitation tools are a family of participatory tools that allow the engagement of different typologies of city actors (experts: decision makers, city officials, planning/design practitioners; and non-experts: third sector and citizens) in a co-created climate resilient design process.

The toolkit includes:

- **Collaborative Mapping** through analogic (boards/stickers) or digital (P-GIS Participatory Geographic Information System) tools (collaborative mapping with experts and non-experts)
- **City Visions and Local Needs Matching** (priority mapping/co-design exercise with non-experts)
- **A-day-in-the-life Exercise** (visioning exercise with experts and non-experts)
- **3D Neighbourhood Configurator Tool** (co-design exercise with experts)

The facilitation tools support the implementation of the site surveys, collaborative mapping, and co-design phases of the UDCW methodology. The toolkit can be used as a standalone (and its tools as standalone components for partial analyses) but provides significant additional outcomes if used in synergy with the UDCW simulation toolkit (see dedicated form).

The main objective is to create structured interactions with institutions, practitioners, and civil society, leveraging collective learning about climate-related issues and possible solutions. UCCRN experts play a crucial role in facilitating this process, bringing knowledge about climate-resilient design strategies and climate risks into the discussion and surveying the variety of knowledge that participants can bring to the collaborative exercises. This process helps contextualise design solutions by establishing local priorities for a specific territory's needs and opportunities. When used in synergy with the simulation tools, bottom-up data can be integrated into quantitative modelling of climate change impacts (heat and flood) and assessing mitigation/adaptation benefits and social, economic and environmental co-benefits of climate-resilient planning/design solutions.

The UDCW facilitation tools contribute to conducting workshops activities in which local authorities, stakeholders, students, practitioners and the community are engaged to collaboratively envision city transformation pathways, to identify common goals and divergence elements, to evaluate climate benefits and social, economic, and environmental co-benefits of possible technical solutions.

Thanks to the co-design tools and the methodology, the toolkit produces results concerning various indicators:

- stakeholder engagement to build a collaborative and inclusive climate-resilient governance
- surveys of the perspectives of different stakeholder groups or groups of the population
- an understanding of the local challenges related to climate mitigation and adaptation
- contextualisation of the climate-resilient solutions and the matching of them with local claims and opportunities

In the further implementation of the facilitation tools, UCCRN proposes to evaluate them through KPIs: the number of actions and activities developed after the UDCW, the number of stakeholders involved in the organisation of UDCW, the feasibility and effectiveness of the proposed actions; the number of participants in the workshops, the number of stakeholders reached through the dissemination of workshop materials, and the level of engagement and participation during the workshops.

2.3 Facilitation Tools — List

- **Urban Adaptation Tool (UGE)**
  - Main goal: address the critical challenges of urban adaptation and resilience in the context of climate change. This tool provides insights into how cities adapt, evolve, and respond to environ mental, social, and economic pressures
  - Methodology: The platform offers a structured and user-friendly interface with resources, including adaptable frameworks, methodologies, visual aids, and detailed case studies. It facilitates the exploration of urban dynamics, assessment of vulnerabilities, and identification of opportunities for transformative interventions. Through an integrated approach, users can bridge the gap between theoretical knowledge and practical application. Each section of the tool delivers detailed guidelines and strategic pathways, offering a variety of approaches, from immediate adaptation measures to long-term mitigation strategies. The tool is designed to address specific hazards within short-term scenarios while also identifying long-term risks that may significantly alter urban planning and design paradigms. By comparing strategies and evaluating solutions across green (vegetation-based), blue (water-focused), and gray (infrastructure-related) domains, the platform provides a holistic perspective on urban adaptation. It helps users identify effective solutions tailored to the unique challenges of their urban contexts.
  - Expert skills: basic knowledge on urban adaptation and resilience in the context of climate change
  - Detailed sheet: https://docs.google.com/document/d/1NRED_Io7lG199-UOl7zvlXYOTcl2r0AT

- **UCCRN Case Study Docking Station**
  - Main goal: inform research and practice by allowing cross comparisons of city case studies for a broad range of social, biophysical, cultural, economic, and political contexts. It includes over 100 city case studies covering a range of topics such as climate change vulnerability, hazards and impacts, mitigation and adaptation actions, and sector-specific themes such as wastewater and flood management. The case studies highlight climate change action, and both mitigation and adaptation, by cities all over the world.
  - Methodology: Research in the Case Studies portal by keyword, topic, location, city size, latitude range, and more details
  - Expert skills: online research and basic understanding of climate change action, and both mitigation and adaptation
  - Detailed sheet: https://docs.google.com/document/d/1ZCF9I3QQB6HHxaW3GmLhXGc9olwtaNn3

- **Climate Walk**
  - Main goal: Understanding the principles of urban microclimate outcomes using field experience

- Methodology: Through a neighbourhood walk participants encounter a variety of landscape types that illustrate not only types of micro-climates and their dynamic nature, but also how the diffeent spaces are used by citizens. The diversity of urban spaces (varying building heights, green spaces, tree cover, street geometry, etc.) has the potential to generate different microclimates that are proximate; this allows a person to walk through different ambient environments and observe changes in airflow, temperature and radiation. If the space is well occupied by people then it is possible to see how spaces are used at different times of the day. Of course, the other aspect of a good climate walk is the weather which modulates the distribution of solar energy at the surface and mixes the atmosphere, which erases small-scale influences. The ideal weather for a thermal walk has clear skies and weak winds – this maximizes the influences of surface types and minimises the mixing.
- Expert skills: basic understanding of energy exchanges associated with microclimate formation and with the thermal climates of humans
- Detailed sheet: https://docs.google.com/document/d/12GgHJgTboLItaot8IqixMfrE1YqI3daP

- **Collaborative Mapping**
  - Main goal: Co-production of data about climate risks, local issues and opportunities, quality of urban spaces, environmental pressures, social capital, socio-spatial issues, infrastructures and service availability, and everyday risks. Performed via analogic (boards/stickers) or digital (P-GIS Participatory Geographic Information System) tools. Final mapping integrated into a GIS format and used as complementary input in the UDCW simulation tools
  - Methodology: Experts develop physical or digital maps with baseline information that can include qualitative and quantitative data (e.g. data on climate-related risks and other environmental risks, the vulnerability of the population, building typologies, etc.). Through a focus group or a neighbourhood walk, the engagement of participants is triggered. They are invited to develop a mapping exercise on physical maps (with stickers) to collect bottom-up data. These data depend on the specific aim of the activity and on the specific local focus and issues to be interlinked with climate topics. Experts collect the data and implement digital maps with experts' and non-experts' data to deliver a public platform of knowledge sharing available for communities and decision-makers (see https://www.google.com/maps/d/viewer?mid=1KVELhy6wVgnD818VcRcVI8-JeTb9YXX5&ll=40.85688146844234% 2C14.334617259767919&z=14)
  - Expert skills: Use of P-GIS tools
  - Detailed sheet: https://docs.google.com/document/d/1MUTFZNii785GeIVP9MSdOjhioiOn_y2TKLp6ylv278o

- **City Visions and Local Needs Matching**
  - Main goal: Identification and visualization of local needs in terms of urban regeneration priorities (urban quality and essential services: housing, transportation, social services, etc.) and highlighting the opportunities to respond to them through climate-resilient strategies synthesized in city visions (e.g., Green and blue city, Circular city, Zero-carbon city, 15-minute city, Disaster-resilient city)
  - Methodology: Experts prepare posters and cards dedicated to city visions and potential design options. Local needs are surveyed through a focus group oriented to feed city visions with local perspectives while delivering knowledge about climate-resilient interventions to participants
  - Data: Potential solutions for the different city visions
  - Expert skills: Graphic and visualisation
  - Detailed sheet: https://docs.google.com/document/d/192Hj5S-cyBnQ8oc7LOeMRhj-xOiMG9RubMlnNmjSdPk

- **A-day-in-the-life Exercise**
  - Main goal: Visioning of desirable outcomes tailored to specific end-user personas (e.g. children, youth, women, elderly, etc.)
  - Methodology: Experts set persona options, developing a visioning exercise with non-expert participants to understand the potentialities of everyday sustainability practices and urban design options that can support them
  - Data: Potential users/target personas

- Expert skills: Graphic and visualisation
- Detailed sheet: https://docs.google.com/document/d/18x--t5hXr6p_226hkwrGPnq7zNyqlcLxCNdKmTfa94A

- **3D Neighbourhood Configurator Tool**
  - Main goal: Co-creation of design solutions based on digital simulations co-designed by experts, increasing knowledge and awareness about climate benefits and the social, economic, and environmental co-benefits of climate resilient governance, planning, and design measures. Design solutions integrated in a 3D model format and used as complementary input in the UDCW simulation toolkit (see dedicated form)
  - Methodology: Experts prepare a set of solutions that participants will combine. The activity is conducted by UCCRN experts in collaboration with local experts and is oriented to evaluating participants' preferences and co-benefits related to climate-resilient design solutions. The result is a digital co-design outcome
  - Data: Climate data; building typologies and materials; vector land cover based on provided layers' template; digital surface model; recurring building construction typologies; population data
  - Expert skills: Architectural digital modelling (IT background)
  - Detailed sheet: https://docs.google.com/document/d/1F4yPsx4ucTvX88ne-FSkxv9HkBZ7L5NTtE6PIQGjQjk

References

Clemente, M. F., Barroca, B., Pellegrino, M. (2022). *Urban Design Climate Workshops, Port du Montreuil*. https://www.uccrn.education/paris-udcw

Leone, M. F., Tersigni, E. (Eds.) (2018). *Climate-resilient urban design: Regenerating cities through adaptive mitigation solutions*. CLEAN. http://needlecrowd. com/wp-content/uploads/2019/01/Crud-Book-2018.pdf

Leone, M., Raven, J. (2018). *Multi-scale and adaptive-mitigation design methods for climate resilient cities*. TECHNE - Journal of Technology for Architecture and Environment, (15), pp. 299–310. https://doi.org/10.13128/Techne-22076

Leone, M. F., Zuccaro, G. (2021). *Climate-resilient urban transformation pathways as a multi-disciplinary challenge: The case of Naples*. TECHNE - Journal of Technology for Architecture and Environment, (2), pp. 159–164. https://doi.org/10.13128/techne-10702

Visconti, C. (2023). *Co-production of knowledge for climate-resilient design and planning in Naples, Italy*. Habitat International, p. 135, 102748. https://doi.org/10.1016/j.habitatint.2023.102748

UCCRN Climate Resilient Design International Workshop Naples https://www.youtube.com/

Urban Climate Change Research Network for Higher Education

Climate-Resilient Design, Planning and Governance of Cities

www.uccrn.education