Climate Services to support urban resilient planning and design: the CLARITY methodology

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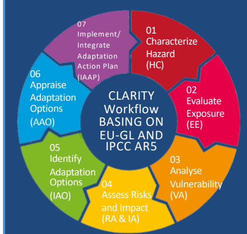
CLARITY H2020

The project is aimed to optimize the climate change adaptation planning process in order to make it easier, faster, lower cost.

1. Initial self-service screening of the relevant hazards, exposed elements at risk, vulnerabilities, resulting climate risks and relevant adaptations measures
2. Marketplace where project owners are offered relevant Expert Services and Solutions (mostly by third parties), based on result of the screening

The project allows end-users to explore climate resilience of their projects through alternative planning and adaption scenarios considering:

1. variable local context
2. expert-based climate intelligence
3. customized risk analysis
4. varying impact scenarios
5. flexible adaption and alternative options
6. integration of data and model results into action plans



The projects follows a two-tier board structure:

1. Screening data package, based on available open data (e.g. EURO-CORDEX, Urban Atlas), includes represesentative hazards, elements at risk, vulnerability functions. Heat waves hazard is already implemented,while the floods development is in progress
2. Local & expert data packages planned is the result of expert services. It is organized site-specific data (e.g. hazards, vulnerabilities…)

www.clarity-h2020.eu

www.myclimateservices.eu

Introduction

The intensity and impact of climate change induced extreme weather events, such as heat waves or floods, is to a large extent determined by the characteristics of built and natural environment. Urban resilience measures therefore need to be identified and designed locally to reduce impacts by altering the specific settlement characteristics and improving the microclimate conditions. To support urban planners in choosing the adequate adaptation options for specific urban infrastructure projects, climate projections should capture the variations at urban/district scale for key hazard indicators. Such refinement can be achieved by integrating the urban microclimate analysis in the conventional GCM-RCM (Global Climate Model - Regional Climate Model) downscaling approach.

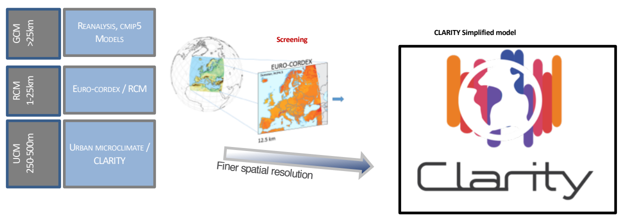


Fig. - Downscaling of climate information in relation to urban climate/microclimate

Methods

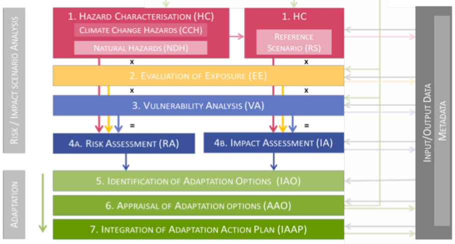


Fig. - CLARITY modelling workflow in relation to the 7 steps of the EU-GLs

Clarity methodology has been developed according to IPCC-AR5 approach, which reconnects the climate risk/impact modelling to the more consolidated modelling framework from DRR (Disaster Risk Reduction) domain. The AR5 report has shifted from a vulnerability-centred approach to a risk-based approach. In such science, Risk assessment and Impact Scenarios analysis are the aspects to be considered and integrated. The risk is the likelihood that a predetermined level of damage on elements at risk, caused by a certain event, will arise within a given time period in a certain geographic area. On the other hand, the scenario represents the probabilistic distribution, in a certain geographic area, of the damage caused by a single event with a probability of occurrence assigned (assumed as a reference scenario). Both risk (1) and scenario (2) involve three aleatory variables, Hazard (H), Exposure (E), and Vulnerability (V).

$$\text{Risk}_l = \int_m E_m \left[\int_i (H_i)\cdot(V_{l,i,m})\right] \quad (1)$$

$$\text{Scenario}_{l,i} = \int_m E_m \left[(H_i)\cdot(V_{l,i,m})\right] \quad (2)$$

Microclimate effects have been evaluated at European level, exploiting satellite earth observations (Copernicus datasets). Specific algorithms have been designed for extracting detailed information (base layers - key parameters) related to the urban morphology and surface type (e.g. albedo, emissivity, green fraction, runoff coefficient, etc.).

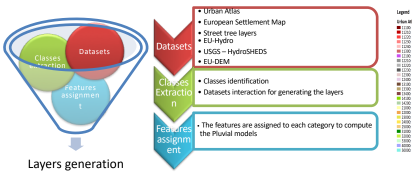


Fig. – Workflow of layers generation

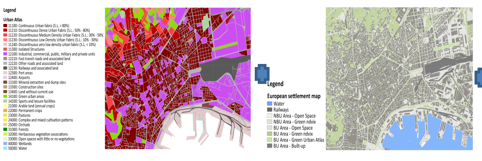


Fig. – Example of Albedo Map generation

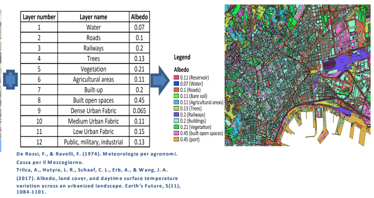


Fig. – Example of Albedo Map generation

Such basic information have been used as input for CLARITY Urban Microclimate Simplified Model to downscale the conventional GCM-RCM output, obtaining the Hazard local effect.

Elements at risk (e.g. population, buildings, infrastructure, etc.), their exposure to the climatic risks according to vulnerability classes and the corresponding vulnerability functions needs to be evaluated. All of these information have been set on the base of the availability of European open data and, in particular, on Copernicus Database.

Adaptation options are strongly connected to the impact model, thanks to their ability to reduce local effect intensity and/or vulnerability of elements at risk, as well as to modify the exposure (e.g. by modifying the spatial distribution of elements at risk).

Hazards	Element at risk	Classes	Unit
Heat Wave	Population	Age group 0-14	pop./km^2
		Age group 15-64	pop./km^2
		Age group >65	pop./km^2
Flood	Buildings	Continuous Residential	m^3/m^2
		Med-Hi Density Discontinuous Res.	m^3/m^2
		Low Density Discontinuous Res.	m^3/m^2
		Non Residential	m^3/m^2
Flood	Infrastructure	Roads	ml / m^2
		Railways	ml / m^2

Fig. - Description of elements at risk for each considered hazard

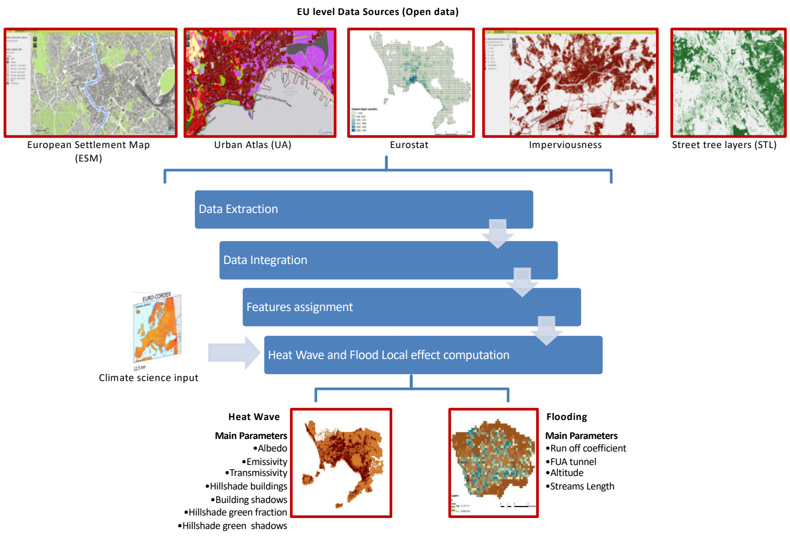


Fig. – Workflow of Heat Wav local effect

Results

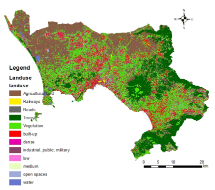


Fig. – Outcome of Basic generation

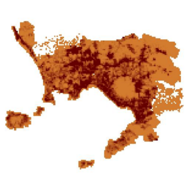


Fig. – Heat wave local effect on a grid of 500 x 500 m

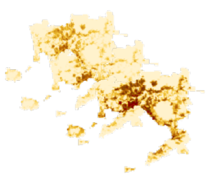


Fig. – Population exposure distribution on a grid of 500 x 500 m

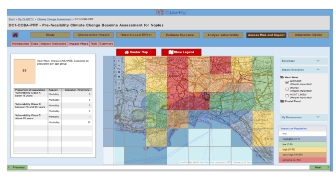


Fig. – Heat wave impact on population risk element on a grid 500 x 500 m

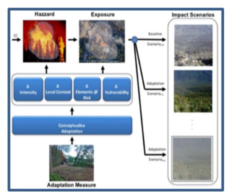


Fig. - Conceptualisation of Adaptation Scenarios modelling.