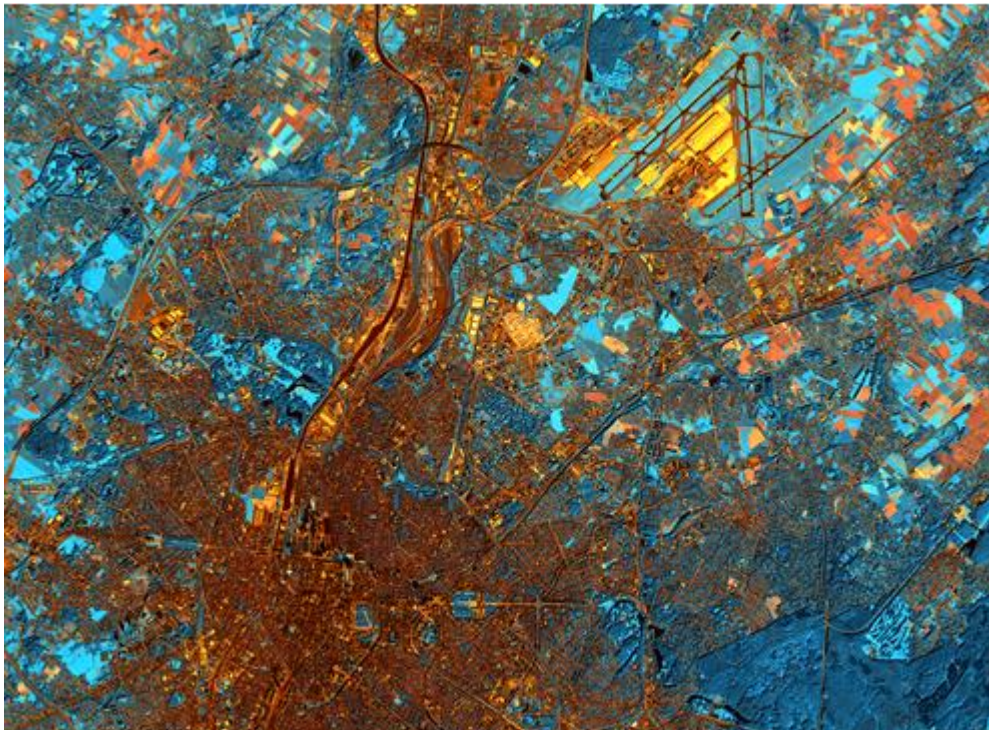


June 2020

COPERNICUS FOR URBAN RESILIENCE IN EUROPE

IN THIS ISSUE

Editorial

by Nektarios Chrysoulakis

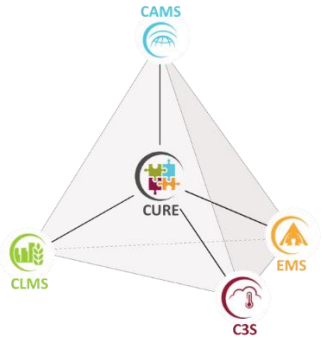
CURE (Copernicus for Urban Resilience in Europe) is one of the three projects that were funded from the H2020-Space call on Copernicus evolution (LC-SPACE-04-EO-2019-2020). It is a joint effort of 10 partners that synergistically exploit Copernicus Core Services to develop a DIAS (Data and Information Access Services) based umbrella application for urban resilience (CURE system). It consists of 11 individual cross-cutting applications for climate change adaptation/mitigation, energy and economy, as well as healthy cities and social environments, at several European cities.

Copernicus, as the means for the establishment of a European capacity for Earth Observation (EO), is based on its continuously evolving Core Services. However, a major challenge for the EO community is the innovative exploitation of the Copernicus products in dealing with urban sustainability towards increasing urban resilience, because due to the multidimensional nature of urban resilience, information from more than one Copernicus Core Services is needed to meet this objective.

Furthermore, to address urban resilience, the urban planning community needs spatially disaggregated environmental information at neighbourhood and city scales. Such information is not yet directly available from the Copernicus Core Services, while several datasets and products from contemporary satellite missions comprise valuable tools for retrieving urban environmental parameters at local scale.

Towards encountering these challenges, CURE is bringing together scientific leading organizations linked to EO, or other relevant environmental, or socioeconomic fields. Specifically, CURE team is formed by partners from nine countries, experienced in applied research - FORTH, DLR, UWE, ApHER, TECNALIA, PIK, VITO, UNIBAS - and consultancy work – GEOVILLE and GISAT. Also, CURE includes several stakeholders from nine European cities: four front runner and five follower cities are involved in the project from the beginning.

This Newsletter will be published every 6 months, to inform on the activities, progress and achievements of the project; and to initiate an open dialogue between the CURE team and all the potential users relevant to EO science, urban planning practice and downstream services development.



Project Overview

CURE provides the means to cope with the Earth Observation data in the domain of sustainable and resilient urbanization, combining products of different Copernicus Core Services and developing a system, integrating complementary individual cross-cutting applications.

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Copernicus Core Services

CURE exploits four Copernicus Core Services - dedicated to atmosphere (CAMS), land (CLMS), climate change (C3S) and emergency (EMS) - to develop cross-cutting applications for climate change adaptation/mitigation, energy and economy, as well as healthy cities and social environments.

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Project Overview

Urban resilience has become an important necessity for cities, in order to properly preserve their functions and to adapt/transform their systems in the face of climate change. In this context, the European Union promotes urban sustainability and resilience, as they are outlined in the New Urban Agenda and the European Green Deal. At local level, city administrations are prompted to embed climate change mitigation and adaptation in both urban planning and development. However, in most approaches, only an adjustment to physical climate change is taken into account. Less emphasis is given to integration of the wider socioeconomic, administrative, demographic and political transformation processes. In addition, projects, conducted under the heading of urban resilience, are often established in parallel to existing formal planning tools. Hence, a full integration of latest concepts of urban resilience, based on dynamic city-atmosphere interactions in formal planning approaches, is lacking.

CURE will contribute to this direction by developing applications that deal with city-atmosphere interactions, by combining information provided by Copernicus Core Services. Towards this objective, CURE team consists of world-leading experts in the fields of EO, climate change, science communication, energy systems modelling, urban planning, socioeconomics, software engineering, technology and innovation. CURE links the respective diverse scientists in a novel way aiming to develop, test, and apply cross-cutting applications that consider both urban form (physical structure of cities) and urban function (heat, CO_2 and pollutants emissions); smoothing the disciplinary divisions and incorporating integrated data and information sources (both Copernicus and third-party).

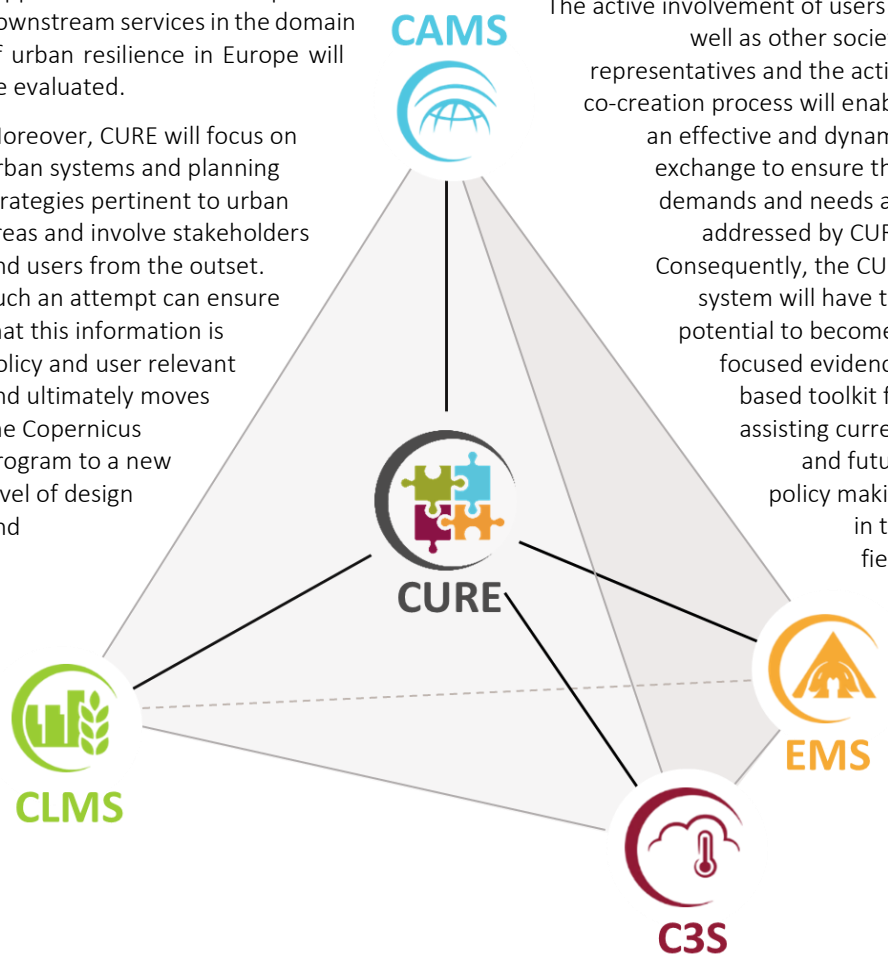
In this context, four front runner (Berlin, Copenhagen, Heraklion and Sofia) and five follower (Bristol, Basel, Munich, Ostrava and San Sebastian) cities of different magnitude and typologies – i.e. highly urbanized, as well as typical central, western, northern and eastern European medium size cities, and a Mediterranean city with dynamic urbanization - have been selected in CURE as case studies. Copernicus Core Services products will be combined with existing geospatial data to deliver information on urban form and function in these cities. This task will support the development of an umbrella application in the domain of urban resilience across the Land Monitoring Service (CLMS), the Atmosphere Monitoring Service (CAMS), the Climate Change Service (C3S) and the Emergency Management Service (EMS).

Given that the DIAS technology is mature enough to develop the CURE system, the 11 cross-cutting applications will be built in front runner cities, integrated in the CURE system, and transferred and tested to the follower cities. In this way, the transferability and upscaling potential of CURE will be assessed and its potential to support the development of downstream services in the domain of urban resilience in Europe will be evaluated.

Moreover, CURE will focus on urban systems and planning strategies pertinent to urban areas and involve stakeholders and users from the outset. Such an attempt can ensure that this information is policy and user relevant and ultimately moves the Copernicus program to a new level of design and knowledge implementation. The collection, co-creation, and sharing of scientific knowledge and accurate data needs to be significantly improved, in order to allow more stakeholders to be part of the information source and information receiver.

Therefore, CURE interaction activities aim to reinforce multi-stakeholder collaboration in defining and developing the system. Specifically, CURE will bring key resilience partners together, including the private sector, the insurance industry, climate scientists, and community leaders; in order to understand their needs and opinions about active urban resilience policies and integrate them into its framework. Participants will explore the growing challenges of Copernicus Big Data for cities and regions and discuss on the incremental and transformative changes required to advance on the resilient development pathway.

The active involvement of users as well as other societal representatives and the active co-creation process will enable an effective and dynamic exchange to ensure that demands and needs are addressed by CURE. Consequently, the CURE system will have the potential to become a focused evidence-based toolkit for assisting current and future policy making in the field.



Copernicus Core Services

by Tomas Soukup

Copernicus Core Services can be defined as a geospatial intelligence system, providing timely and reliable information to a growing community of users in Europe and worldwide. For this knowledge generation activity, the data acquired within the Copernicus programme are processed and transformed into appropriate products available for the end-users and distributed through the individual services. Based on both space-borne and in-situ observations, the Copernicus Core Services generate timely and reliable geo-information products along defined and agreed processes, in some cases involving significant data assimilation and modelling efforts. Each of the six provided services responds to specific environmental or security-related themes identified as key in Europe. Within the CURE project, four of these six services are considered.

Land Monitoring Service (CLMS)

CLMS provides geographical information on land cover and its changes, land use, vegetation state, water cycle and earth surface energy variables in the field of environmental terrestrial applications. It provides products on global, pan-European and local scale and supports applications in a variety of domains; such as spatial and urban planning, forest management, water management, agriculture and food security, nature conservation and restoration, rural development, ecosystem accounting and mitigation/adaptation to climate change. CLMS portfolio includes five main products categories (both already operational and upcoming): Land Cover and Land Use Mapping, Hot-spot Monitoring, Biophysical Parameters, Imagery, In Situ and Reference Data and European Ground Motion Service. CLMS is jointly implemented by the European Environment Agency and the European Commission DG Joint Research Centre (JRC) on behalf of the European Commission. The service is operational since 2012.

Atmosphere Monitoring Service (CAMS)

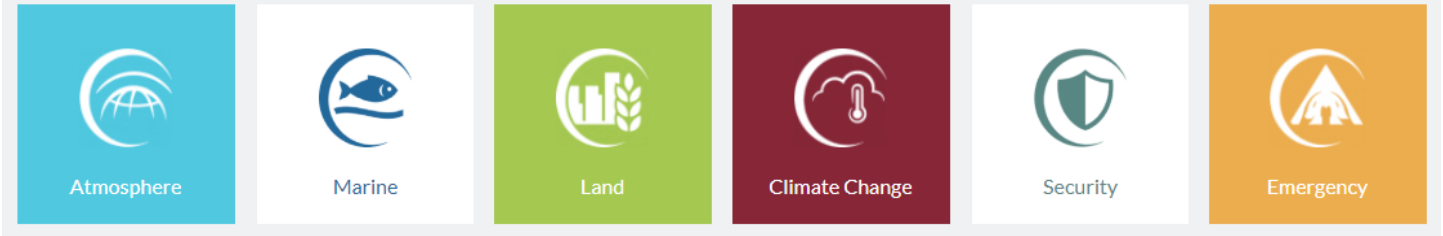
CAMS provides continuous data and information on atmospheric composition. The service describes the current situation, forecasts the situation a few days ahead, and analyses consistently retrospective data records for recent years. The CAMS supports many applications in a variety of domains including health, environmental monitoring, renewable energies, meteorology and climatology. The service focuses on five main areas: Air quality and atmospheric composition, Ozone layer and ultra-violet radiation, Emissions and surface fluxes, Solar radiation and Climate forcing. CAMS is implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF) on behalf of the European Commission - an independent intergovernmental organisation serving its Member and Co-operating States and the broader community. The service is operational since 2015.

Climate Change Service (C3S)

C3S provides information about the past, present and future global climate. The C3S mission is to support adaptation and mitigation policies of the European Union by providing consistent and authoritative information about climate change. C3S users include scientists, consultants, planners and policy makers, the media and the public. C3S offers free and open access to climate data and tools based on the best available science, helping users and endeavours to meet their goals about the impacts of climate change. C3S relies on climate research carried out within the World Climate Research Programme (WCRP), responds to user requirements defined by the Global Climate Observing System (GCOS) and provides an important resource to the Global Framework for Climate Services (GFCS). Like CAMS, C3S is implemented by the ECMWF on behalf of the European Commission and is operational since 2019.

Emergency Management Service (EMS)

EMS provides actionable information for emergency response regarding different types of disasters, i.e. meteorological hazards, geophysical hazards, deliberate and accidental man-made disasters and other humanitarian disasters; as well as prevention, preparedness, response and recovery activities. It has a worldwide coverage and emergency response actors community - mainly Civil Protection Authorities and Humanitarian Aid Agencies. The Copernicus EMS consists of a mapping and an early warning and monitoring component. The on-demand mapping component provides rapid maps for emergency response, as well as risk and recovery maps for prevention and planning. The early warning and monitoring component of the Copernicus EMS consists of three different systems: The European Flood Awareness System (EFAS), the European Forest Fire Information System (EFFIS) and the European Drought Observatory (EDO); providing historical, early-warning and forecast information. The Copernicus EMS is implemented by the European Commission DG JRC and is operational since 2012.

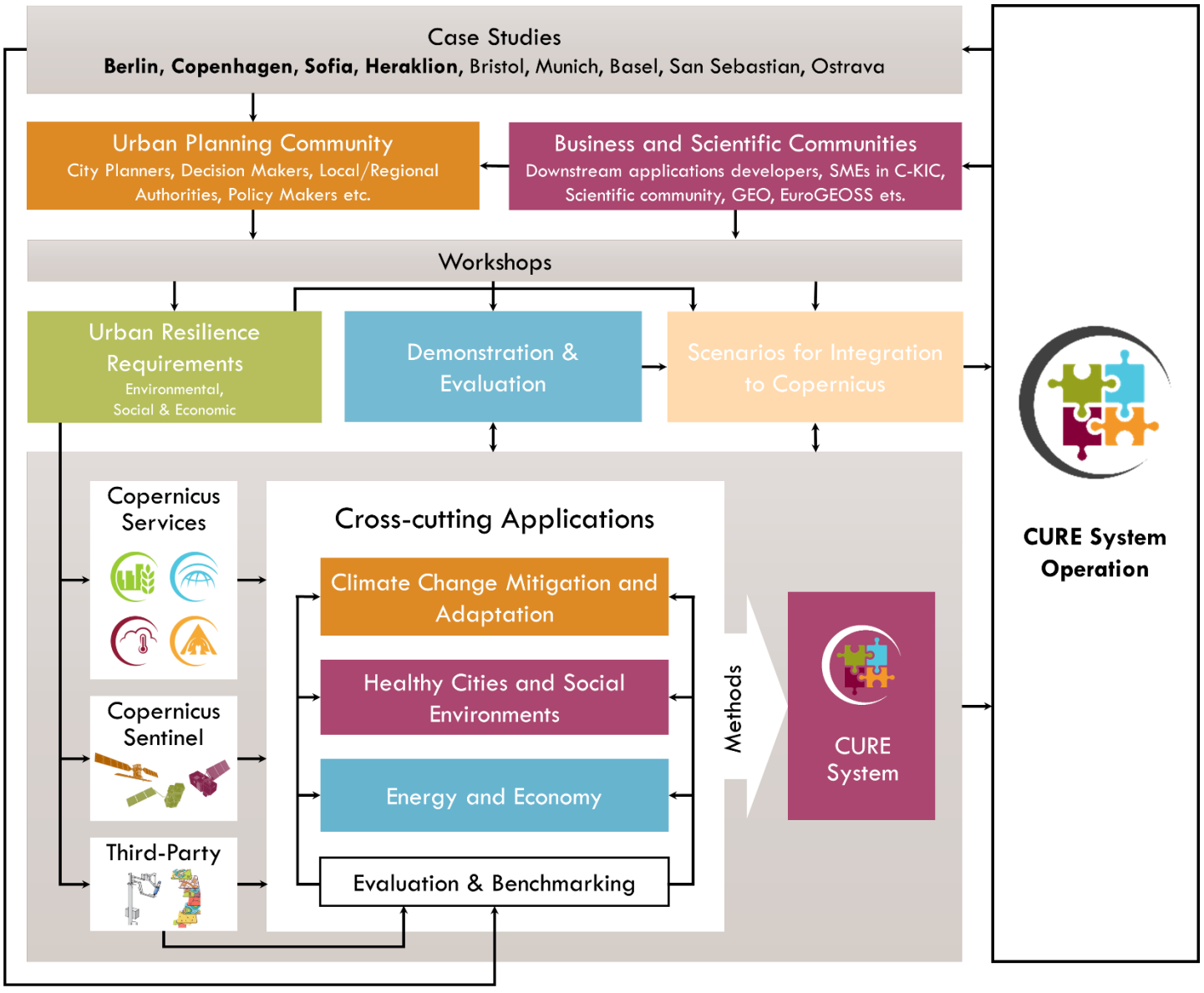


CURE Methodology

The overall CURE approach is shown in the following figure, which depicts the cross-cutting process of the continuous interaction with the users. In this framework, urban resilience related user requirements will be captured focusing on where in the policy process the CURE products can be of use and under what conditions (e.g. scale, precision, timeliness, costs). The increase in mutual understanding will be monitored and evaluated.

CURE will be developed around two pillars: the first is related to the proof of concept of Copernicus cross-cutting applications by developing and benchmarking cross-cutting applications related to the different dimensions of urban sustainability (climate change mitigation and adaptation, healthy cities and social environments, energy and economy), based on four Copernicus Core Services products (CLMS, CAMS, C3S and EMS); the second concerns the CURE system development, using methods and sample data from each cross-cutting application, as well as the evaluation of its urban resilience potential and its economic feasibility. Use case scenarios will be developed to specify user requirements and therefore data requirements for cross-cutting applications development. Also, a roadmap for potential integration of CURE to Copernicus architecture will be delineated.

Regarding data exploitation, Copernicus core data will be analysed for identifying urban forms and functions, as well as EO-based methods will be implemented to assess urban resilience. Beyond Copernicus core products, third-party data will be used, such as in-situ measurements from networks of meteorological stations, flux towers for direct measurements of heat and CO_2 emissions by means of Eddy Covariance approaches (available long time series in both Basel and Heraklion), health profiles (available in several cities), as



well as energy consumption, traffic and population data (available at all cities). The evaluation and benchmarking of the different approaches will be supported by auxiliary spatial datasets (available in all case studies), whereas in-situ observations will be used to downscale Copernicus-derived city scale atmospheric parameters, needed to force CURE models and to verify model outputs.

The performance of the CURE system will also be evaluated and demonstrated in the framework of two demonstration events that will be organized. During these events, the results will be interpreted in an open discussion to address questions such as: what do the visual images mean; how certain or uncertain are the results; how can downstream services be developed in the future based on CURE outcomes? The synergistic use of different Copernicus Core Services will enable the development of a highly automated process and the standardization of the CURE final products. CURE outcomes will be relevant to both Copernicus/developers and urban planning communities, since urban resilience products and scenarios for their potential integration to Copernicus will be provided, as well as guidelines on how CURE can be used to support the development of downstream services; focusing on sustainable urban planning, with emphasis on climate change adaptation and mitigation. Furthermore, the users workshops will be used to develop a network of SMEs and/or large enterprises, which could be interested in CURE and will be outlined based on the respective discussions.

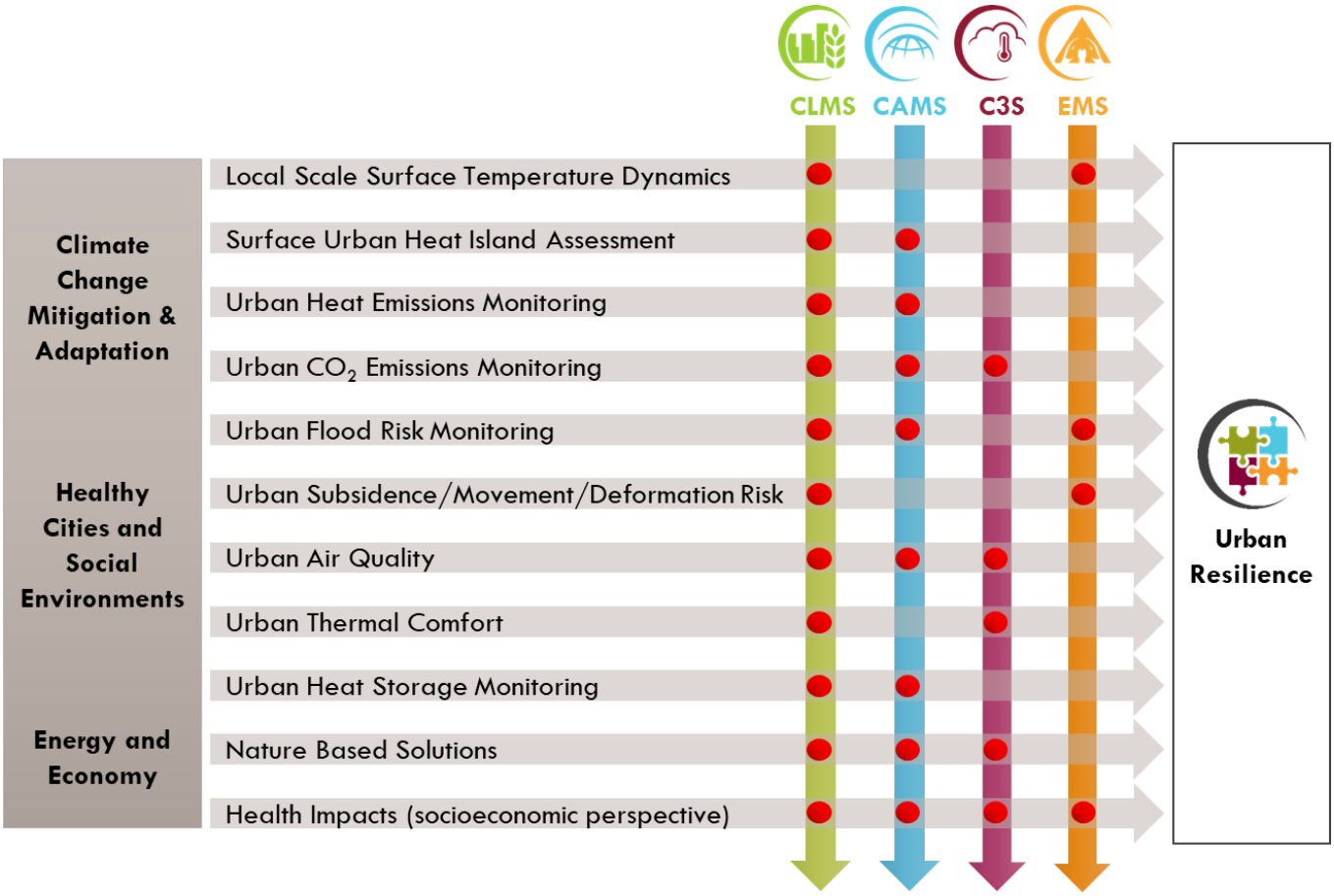
CURE objectives

- Providing a proof-of-concept that enhancing urban resilience in Europe can be supported by Copernicus Core Services.
- Improving EO-based methods about urban environmental parameters, considering uncertainties and evaluating them.
- Organising workshops for users from several cities, on the basis of an active co-creation process.
- Providing a benchmarked selection of concurring methodological approaches to build cross-cutting applications.
- Exploiting DIAS capabilities to develop a platform (the CURE system), integrating the developed cross-cutting applications.
- Developing scenarios about the potential integration of CURE into the existing Copernicus service architecture, addressing also its economic feasibility.
- Standardising and disseminating the outputs, enhancing their use by urban planners, decision makers and scientists.
- Developing synergies with the EuroGEOSS (European component of the Global Earth Observation System of Systems) Urban Action Group to highlight the added value of CURE results for the Group of Earth Observations (GEO).
- Developing synergies with the Climate-KIC (Knowledge and Innovation Community) towards using CURE outcomes in downstream services at local scale in cities.
- Supporting sustainable urban planning strategies relevant to climate change mitigation and adaptation towards enhancing urban resilience in Europe.

CURE System & Applications

by Giorgos Somarakis

The CURE System will be developed in DIAS and its data products will be open and available via the CURE data repository (hosted on DIAS) for demonstration and evaluation, including web-based exploration and analytical capabilities. The CURE system will consist of 11 individual cross-cutting applications, concisely described next.



Local Scale Surface Temperature Dynamics

The surface temperature is one of the most important parameters in the physical processes of urban surface energy, water balance and the land-atmosphere exchanges. Thence, it constitutes a valuable information source for the understanding of the natural and human components of the Earth system. In this context, the anticipated application will be utilized in all urban areas involved in the project, leading to frequent local scale surface temperature estimations, which are essential data for other CURE applications too, i.e. the Surface Urban Heat Island (UHI) Assessment application, the Urban Heat Emissions Monitoring application and the Urban Heat Storage Monitoring application.

Surface Urban Heat Island assessment

An UHI occurs, when a city experiences much warmer temperatures than nearby rural areas. Warmer air caused by UHI increases the heat load stress of urban residents, as well as the energy consumption and associated greenhouse gas emissions. Hence, properly identifying UHIs can contribute to the effective evaluation of potential heat risk. In this framework, the intended CURE application aims at assessing the UHI intensity through remote sensing data, as well as tracking its trend over time and detecting hotspots. This will assist urban planners in understanding the significance of the phenomenon, monitoring its evolution, and taking suitable decisions.

Urban Heat Emissions Monitoring

Urban heat emission refers to the turbulent sensible heat flux, i.e. the heat exchange between the urban surface and the atmosphere. The sensible heat flux defines the amount of energy that is available for heating the urban atmosphere, which is strongly modified by the properties of the surface and the input of heat by human-related activities. The localization of hotspots of high heat emissions will help urban planners to optimize their adaptation strategies, considering also heat stress, urban green space and building development. Focusing on CURE, the expected application will estimate sensible and latent heat fluxes in urban environments, pinpointing the above-mentioned hotspots.

Urban CO2 Emissions Monitoring

The total urban CO_2 emissions have spatial dimension due to the heterogeneous nature of urban land use/cover and urbanization in general. In this CURE application, the CO_2 emissions are partitioned into an anthropogenic (traffic, heating/cooling) and a biogenic component (urban green space). Spatial planning strategies have an influence on the urban form, and consequently affect CO_2 emissions through changes in traffic patterns, energy consumption, and location and extent of urban green areas. Knowing the portion of the anthropogenic and the biogenic part of CO_2 emissions in a high spatial resolution (neighbourhood scale) will provide urban planners with an additional decision support tool for developing emission reduction strategies.

Urban Flood Risk

Floods are the natural hazard with the highest frequency and the widest geographical distribution worldwide. Due to societal assets concentration in cities, flooding can cause major disruptions and lead to significant impacts on people, economy and environment. Thus, potential flood risk has to be taken into consideration seriously, especially under the ongoing climate change. CURE proposes a solution, which (i) captures the multi-scale aspect of flood risk assessment providing relevant information and (ii) contributes to rapid flood monitoring. Therefore, this service aims to support urban planners both during city preparedness and climate adaptation activities, as well as during emergency situations with information support to city response activities.

Urban Subsidence, Movements and Deformation Risk

Ground and construction movements are responsible for hundreds of deaths and billions of Euros lost annually. In a more and more urbanized world, the threats of urban subsidence, slope instability and building or infrastructure deformations are also deteriorating due to (i) the large increase in the number of extreme events related to climate change and (ii) the sub-optimal building and infrastructure maintenance. CURE proposes a solution to detect up to millimetre displacements. The service is utilized for subsidence risk assessment, coupling hazard monitoring with up-to-date assets information. The provided accurate assessment of threats and vulnerabilities is critical for urban planners to understand and manage the subsidence risk to the actual city assets.

Urban Air Quality

Air pollution is one of the main environmental issues in urban areas and urban air quality is a multi-scale issue, since pollutant concentrations at street-level scale are influenced by regional (rural) background concentrations. Urban increments arise from local industrial and traffic sources, as well as an additional contribution comes from recirculation in street canyons. CURE proposes a solution capturing the multi-scale aspect by incorporating several models into an integrated model chain. The application provides street-level maps of NO_2 concentrations for entire urban areas, which allow stakeholders to identify pollution hotspots in the urban metropolitan region. Additionally, the model chain allows the assessment of pollution reduction measures (low emission zones, pedestrian streets, etc.).

Urban thermal comfort

Heat stress is an increasing problem in many European cities, having a negative impact on sleep, productivity, health and mortality of urban residents. Urban population experiences higher levels of heat stress than people in rural areas due to higher air temperatures, lower wind speeds and higher levels of solar and thermal radiation. This CURE application will quantify and map human thermal comfort at a very high resolution for entire urban areas. This will allow urban planning and development stakeholders to identify hotspots and give them insight into the local variation of heat stress. Furthermore, the application will allow users to upload different land use scenarios and assess the effectiveness of adaptation measures.

Urban Heat Storage Monitoring

Observations of global temperature evolution indicate a pronounced air temperature warming, since an increase in the occurrence of heat waves and the UHI effects tends to exacerbate such warming. Among all the effects caused by the substitution of natural ecosystems for urban land-use, the most pronounced is the increase in the amount of energy stored in the urban canopy, which is much larger than in non-urban canopies. The slow release of this energy causes the UHI effect and it is therefore related to the energy efficiency and consumption in cities. In this framework, the CURE application will deploy various earth observation and in-situ data towards monitoring urban heat storage.

Nature-Based Solutions

Nature-Based Solutions are gaining relevance for the enhancement of urban sustainability and resilience, given the increased evidence about a wide range of multiple environmental, climate and socioeconomic related co-benefits, which they provide. Specifically, green roofs could improve performance of single buildings, while generating at the same time important positive effects in public spaces at city scale. This application will allow urban planners to quantify maximum potential deployment of green roofs by assessing at city scale key enabling conditions for installation. Alongside, benefits related to key resilience challenges will be modelled and evaluated. Both outputs will inform local decision making by benchmarking alternative scenarios of green roofs potential.

Health Impacts (Socioeconomic Perspective)

The enhancement of human health and the increase of human resilience through improved city planning are key challenges. Substantial health economic benefits can be achieved by creating healthy cities, where air quality remains below critical levels and health promoting aspects (such as walkability, bikeability and access to green areas) are prioritised in urban planning. In general, there is increasing evidence that these aspects have a positive effect on the disease profile of cities. CURE has the potential to support the above prioritisations through this application, which uses health data (e.g. mortality, illness, demographic data) and links them with city living conditions.

Project activities

Kick-off Meeting

CURE kicked off in Brussels on the 27th of January thanks to the Project Officer that organized the meeting. During the meeting, information about H2020-Space, project vision and partners, objectives and methodologies of WPs and cross-cutting applications was presented, as well as discussions among CURE partners were held.

CURE presentation in EGU2020

The European Geophysical Union General Assembly 2020 - EGU2020 (egu2020.eu) was held virtually in response to the new coronavirus pandemic from 4th to 8th of May. During this event, Nektarios Chrysoulakis presented the CURE project concept and idea in the session "Urban climate, urban biometeorology, and science tools for cities" through a recorded presentation and responded to questions.

Users' Workshops

The CURE team values the users' needs and it is interested in analysing and consolidating the user requirements regarding the CURE applications and the CURE prototype. CURE follows a Collaborative Requirements Engineering and Stakeholder Engagement (CoReS) approach, where dedicated workshops and interviews with the city partners from Berlin, Sofia, Copenhagen, Heraklion, Bristol, Ostrava, Basel, Munich and San Sebastian and representatives from the Climate-KIC community play an important role in developing business canvas for the CURE products. An in-person Users' Workshop event was originally scheduled to take place in Bristol, UK in April 2020. Due to the COVID-19 situation, the CURE team organized Virtual Users' Workshops in June 2020, where details on the CURE idea and applications were discussed, in order to assess the technical and operational feasibility and the expected output products for each specific application.

All activities of the CURE project are available through the project's web-site: http://cure-copernicus.eu/news.html.

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CURE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870337.