CARES / Climate heAlth RESearch, mitigation and early-adaptation strategies for Europe

LC-CLA-03-2018 / Climate change impacts in Europe: Climate change impacts on health in Europe

RIA Research and Innovation Action

1. Excellence

The negative effects of climate change have begun to be noticed in Europe: the average increase of temperature above pre-industrial levels was 1.45-1.59°C for 2006-2015[1] and European regions have started to experience the increase in temperature extremes, droughts and heavy precipitation events. The European Environmental Agency warns[1] that "climate change is already contributing to the burden of disease and premature deaths in Europe", especially the deaths and injuries due to extreme weather events, changes in the distribution of climate-sensitive diseases and changes in environmental and social conditions.

The Paris Agreement was adopted in 2015 by United Nations Framework Convention on Climate Change (UNFCC) parties to limit global warming below 2°C, ideally at 1.5°C. The EU is already implementing the Agreement with mitigation policies to transit to a low carbon, resource-efficient economy[2]. In parallel with efforts devoted to stabilize greenhouse gas concentrations, Europe is starting to implement early-adaptation strategies to minimize the negative impacts of climate change in a range of sectors, but particularly on human health, both at the continental and urban levels. Cities are key for an effective implementation of global climate change adaptation measures, by means of sustainable urban adaptation solutions strengthening local government and community adaptation capacity[3].

1.1. Objectives

To overcome these challenges, the CARES project will follow up an integral action plan structured in three main areas, with the overarching aim of providing public health authorities and key stakeholders with enhanced knowledge, optimized strategies and dedicated solutions to face the human health dimension of climate change:

- ★ **Benchmarking activities.** During the first year of the project, CARES will review the current state-of-the-art on the effects of climate change upon human health, including mitigation and early adaptation measures and prediction tools to better understand and anticipate needs, perform research and design strategies.
  - To review the state-of-the-art on the following topics: temperature-related morbidity and mortality, extreme weather events, air quality and urban pollution, UV radiation, vector-borne diseases, water-related illness, food safety, nutrition and distribution and mental health.
  - To identify at least two knowledge gaps per topic, as well as the main vulnerable groups.
  - Interact with the key stakeholders and decision makers and gather information about their

[1] European Environment Agency, "Climate change, impacts and vulnerability in Europe 2016: An indicator-based report" (2017)

[2] European Commission, "Communication from the Commission to the European Parliament and the Council: The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris agreement adopted under the United Nations Framework Convention on Climate Change", COM(2016) final

[3] Revi, A., D.E. Satterthwaite, F. Aragón-Durand, et al., 2014: Urban areas. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 535-612.

needs.
    - To state the current public health best practices in early-adaptation and mitigation measures regarding climate health risks in Europe and other regions (legislative, administrative, operational, financial, evidential/data aspects).
- ★ **Research activities**. The benchmark will provide a reference for the development of research actions to better understand the effects of climate change on health through 6 representative urban case studies (Rome, Antwerp, Istanbul, Izmir, Genova and Barcelona/Catalonia), which will be circumscribed within the framework of a continental-wide case study for European regions. These cities have been chosen as representative cases with regard to their socioeconomic characteristics and their different vulnerability and adaptive capacity.
    - To improve current methodological approaches, either based on observations or numerical models, for the description and assessment of extreme events and other climate change related hazards and risks on human health, with particular emphasis on the most vulnerable population groups.
    - To quantify the potential environmental, economic and health impacts up to 2100 under different emissions scenarios, both at the urban and regional levels.
    - To empower citizen-based operational capacity to minimise the negative social impacts of climate change through innovative ICT tools, such as early warning systems, solidarity based networks, neighbour watching tools or risk mapping.
- ★ **Outreaching activities**. The project will provide a set of outputs valuable to public health authorities, decision-makers and the general population through a two-way engagement approach. A dissemination plan will be defined to identify the key stakeholders and their needs, and coordinate the dissemination of data, knowledge and products resulting from the project.
    - To reach at least 200 public health stakeholders, publish more than 20 academic papers and participate in 10 workshops and events, including training and dissemination workshops.
    - To involve 20 different experts in the domains of climate and public health within the project's Advisory Board, and at least 2 citizens' organisations per case study (including the public health authorities of the consortium countries).
    - To elaborate at least 1 climate change and health roadmap per country of the consortium (France, Italy, Turkey, Spain, Belgium).
    - To create a report with recommendations for a Strategic Research and Innovation Agenda (SRIA). One focus workshop to this end will be held in collaboration with the EC.
    - To define a shared budget with the other funded projects of the LC-CLA-03-2018 call to coordinate strategic common actions that enhance the impact of the projects.

1.2 Relation to the work programme

The CARES project gives answer to the topic LC-CLA-03-2018 "Climate change impacts in Europe" and its subtopic A "Climate change impacts on health in Europe".

"Climate change is likely to make it harder to address inter alia poverty, disease, food and water insecurity in Europe. (...) Moreover, the inherent uncertainty of climate impacts is likely to increase risks for the business and financial sectors."

The overarching aim of CARES is to improve knowledge and capacity to better cope with climate change-related risks on human health, particularly for the most vulnerable groups and in urban areas, where multiple intersectorial risks interact (urbanization, lack of green and blue spaces, road traffic, noise, unemployment, job displacement, poverty, social isolation)[3]. Through a set of valuable documents, the project will establish an EU-wide evidence-based framework to guide policy, R&D and regional/local decision-makers in the implementation of strategies and actions to enhance overall resilience in Europe.

"Actions should review, report and progress on the current state-of-the art knowledge on the links between climate change and impacts on human health in Europe that have thus far been poorly addressed or understood."

The consortium will offer a comprehensive review of the current state of the art on climate change effects on health. For every health related risk, a systematic literature review will be conducted with completeness, applicability and quality of evidence and implications for practice and for research. Research gaps will be identified with the contribution of sectoral experts.

"Actions should also identify associated costs and suggest effective adaptation strategies, quantify health co-benefits from mitigation and early adaptation, target research actions to address key issues and identified research gaps and prioritise those that are of significance for Europe."

The systematic literature review will also cover the range of mitigation and early adaptation solutions that have already been implemented in cities and regions. The identification of the best practices in mitigation and adaptation will be considered for the modelling and estimation of future environmental, socioeconomic and health impacts under different scenarios of greenhouse gas and pollution emission until 2100. A European-wide case study will be used as a framework for the six cities here considered. Several ICT adaptation tools will be developed to help citizens and decision-makers to cope with the climate change effects on health based on a grassroots approach.

"Actions may, where appropriate, cluster with activities of global collaborative research actions (e.g. Belmont Forum) on climate change and health. Applicants are encouraged to seek synergies with relevant actions under Societal Challenge 1."

The consortium will tailor and execute an ambitious Dissemination, Communication and Exploitation plan which will establish communication and common actions with existing and future projects (from SC1 but also SC5 in order to fully exploit the synergies of the two H2020 pillars and health and environmental sciences fields) and organisms (Belmont Forum, the European Climate Adaptation Platform, the US Center for Climate Change & Health, the WHO Regional Office for Europe, ECDC, etc.).

1.3 Concept and methodology

1.3.1 Concept

A) Overall concept

The overall concept of the project CARES (see Figure 1) is based on the development of evidence-based European strategies/tools to tackle the climate change effects on health. For that purpose, CARES will gather information, perform research and disseminate knowledge across a range of disciplines (environmental sciences, health, climate prediction, air quality modelling) and through a range of methodologies (grassroots approach, stakeholder engagement).

To generate the aforementioned strategies, the project will undertake activities within the areas of health research, impact estimations and predictions, mitigation and adaptation measures towards health risks.

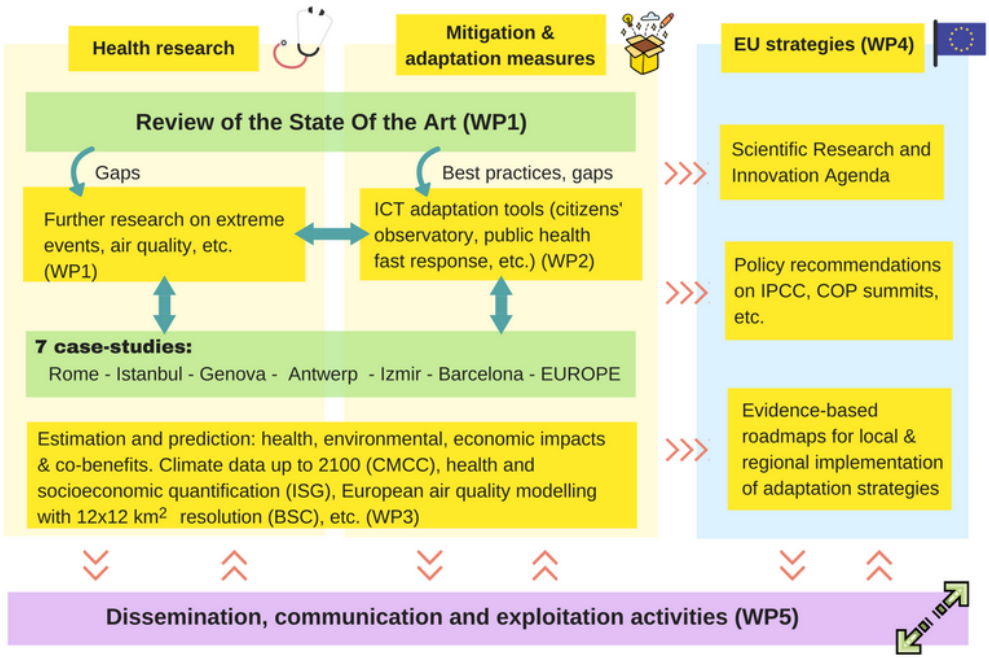

Figure 1. CARES project concept

Health research

The project consortium will build upon previous knowledge and expertise in the different fields involved, reinforced thanks to the benchmarking activities and the Advisory Board experts' insight. The health-focused institutions will advance in the health topics of extreme weather events and air quality with a special focus on vulnerable groups of population, which are some of the main health-relative exposures in the EU region[4]. This work will be supported by the systematic literature review and the development of a continental-wide and six city-level case-studies. Exposure-response risk functions and analysis of individual vulnerability factors will be carried out for selected climate change related risks. The aim is to quantify risks in middle income and vulnerable areas for which poor background information are available, and to identify vulnerability subgroups within high-income urban areas.

The research aims will be area-specific, according to the existing evidence-base, population vulnerabilities, main climate change threats and other environmental risks. Studies will address multiple components including climate risks on health according to vulnerability dimensions (age, sex, socioeconomic level), and vulnerability to extreme temperature according to individual and environmental factors. In the systematic literature review the effects of climate change on health both due to the long term trend and to changes in variability of different climate variables, and the associated environmental, economic and social systems affected by it (altered sea levels, freshwater and food availability, property loss, tourism, ecosystem and infrastructure damage, human conflicts and migratory movements, etc.) with both direct and indirect health impacts will be considered[5]. Thanks to the sound systematic review methodology, epidemiological advances and the multidisciplinary Advisory Board, a critical assessment of state-of-the-art knowledge for climate-related health hazards will be identified. This will provide the EU and national and local public health authorities with an adequate knowledge base that can be further translated into better decision-makers' strategies.

Mitigation and early-adaptation strategies

The EU has different mandates (Paris Agreement, Sendai Framework on Disaster Risk Reduction, UN SDG 2030 Agenda, Ostrava and Parma Declarations, etc.) that urge the development of public strategies tackling climate change exacerbation of health threats. Public health priorities must be reshaped in order to address the changes in the main climate, environmental and socioeconomic determinants of human health, and particularly regarding the main weaknesses of the health protection system (e.g. ageing European populations)[1].

Building community-based, grassroots movements is essential for any public health initiative. Research[6] has uncovered a direct link between local policy campaigns and healthy social norms. Since local governments are strongly engaged in community-based initiatives, CARES will contribute to existing and develop new strategies for a more effective citizen-oriented impact of public resources.

CARES will aim at localizing climate change related public health adaptation strategies and develop both behavioural and ICT tools to favour the engagement of local communities and local governments[7] [8]. The environmental, health and population data from the research partners and the case-studies, as well as the estimations and prediction models and health signals from extreme weather events, will be used for the development of these tools and actions.

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[4] WHO presentation, "Climate change and health: WHO European Region perspective" (2017)
[5] McMichael, A. J., "Globalization, climate change, and human health", New England Journal of Medicine 368(14), 1 335–1 343 (2013)
[6] Mowery, P.D.; Babb, S.; Hobart, R.; Tworek, C.; MacNeil, A.; "The Impact of State Preemption of Local Smoking Restrictions on Public Health Protections and Changes in Social Norms", Journal of Environmental and Public Health (2012)
[7] Balaji, V., Meera, N. and Dixit, S., 2007. ICT-enabled knowledge sharing in support of extension: addressing the agrarian challenges of the developing world threatened by climate change, with a case study from India. *Journal of SAT Agricultural Research*, *4*(1), pp.1-18.
[8] Solanas, A., Patsakis, C., Conti, M., Vlachos, I.S., Ramos, V., Falcone, F., Postolache, O., Pérez-Martínez, P.A., Di Pietro, R., Perrea, D.N. and Martinez-Balleste, A., 2014. Smart health: a context-aware health paradigm within smart cities. *IEEE Communications Magazine*, *52*(8), pp.74-81.

The ICT tool (target at TRL 5) developed is aimed at assessing the risk associated with heatwaves, the urban heat island (UHI) effect and the exposure to air pollution to selected vulnerable populations. The new ICT tool will include interactive GIS maps for the visualization climate data (UHI and air pollution) and historical observations (from meteorological stations and satellites), census records, sociodemographic estimations and ancillary health data in a range of spatiotemporal scales. Differences between cities and countries will be identified, and this comparison will be used to infer differences in current vulnerability and the effectiveness of early adaptation measures. The climate hazards and risk assessment models for vulnerable populations will be integrated into the ICT tool, which uses artificial intelligence algorithms as described in Keramitsoglou (2013)[9]. The software represents an outstanding visualization tool of scientific data for research, communication and dissemination purposes[10].

This interactive map-based ICT tool will also be the instrument for defining and executing the grassroots approach. The user interface of the tool will be designed for smartphones and web portals, and will pave the way for the creation of operational, real-time maps using the GPS location of social volunteers and selected vulnerable population groups. This platform will provide climate services to the health care community. The tool will store, aggregate, homogenize and visualize all data coming from third party devices, and monitor the health situation of selected vulnerable population groups, access to volunteers and health workers, and coordinate their locations. Furthermore, interactive neighbour reach-out strategies may be established such as linking with existing social networks, providing directions to working or vulnerable people outside during heat waves or extreme air pollution hazards to recommended cool zones[11] provided by local governments.

Impacts and co-benefits quantification and prediction

In parallel to the health research and the development of adaptation and mitigation public health strategies and tools (and also supporting them), the climate modelling experts of the consortium will work together to bring ground-breaking health, environmental and socioeconomic impact estimations and predictions in Europe. Quantifying and predicting these impacts as well as the possible benefits thanks to the implementation of mitigation and adaptation measures is crucial to reach the commitment of decision-makers and investors. The aim is to provide evidence to decision-makers about the impacts of urban and European adaptation or mitigation scenarios that might be related to the greatest health co-benefits in urban areas such as green spaces and urban transportation[12]. The case study cities include high-income and middle-income settings, with different degrees of motorisation, green and blue spaces, air quality levels and regulations, heat adaptation plans and public health expenditure.

CARES will explore past climate trends (health related indicators such as extreme events of precipitation, heat waves or perceived temperature) by means of observational station networks and high-resolution datasets (e.g. JRA-55, ERA-5, ECA&D, E-OBS, COSMO-REA6). For future climate scenarios, high-resolution (~10 km in longitude and latitude) simulations up to 2100 from EURO-CORDEX[13] will be considered under different emission scenarios. Because air pollution significantly affects health and climate change can alter the dispersion and formation of air pollutants, CARES will also use ~10 km resolution air quality modelling at European scale[14] to explore the combined effect upon health of climate and air pollution changes under different emissions scenarios up to 2100. Moreover, the additional continental case study will use an unprecedented database of daily human mortality by

[9] Keramitsoglou, I., Kiranoudis, C.T., Maiheu, B., De Ridder, K., Daglis, I.A., Manunta, P. and Paganini, M., 2013. Heat wave hazard classification and risk assessment using artificial intelligence fuzzy logic. Environmental monitoring and assessment, 185(10), pp.8239-8258.
[10] Jedlovec, G., Crane, D. and Quattrochi, D., 2017. Urban heat wave hazard and risk assessment. Results in physics, 7, pp.4294-4295.
[11] https://slco.org/aging-adult-services/cool-zone/
[12] Cheng, J.J. and Berry, P., 2013. Health co-benefits and risks of public health adaptation strategies to climate change: a review of current literature. International journal of public health, 58(2), pp.305-311.
[13] CORDEX is the climate change projection downscaling programme endorsed by the WCRP-WMO.
[14] http://www.bsc.es/caliope/?language=en

sex and age groups available from 1998 to 2012 for 166 NUTS2 regions in 16 European countries representing around 420 million people[15] [16]. This database provides the most complete and comprehensive description of human mortality in Europe with around 60 million counts of death, which will be used as the best available benchmark for the development of the urban case studies.

Finally, by using the resulting knowledge and the climate data and air quality data based on dataset and prediction models, CARES will generate an European scale model that will transform the climate change predictions into future expected health, environmental and socioeconomic impacts, as well as the co-benefits brought by the implementation of certain mitigation and early adaptation strategies. The main impacts of climate change that will be modelled and assessed will be extreme events, temperature anomalies (heat waves, cold spells and influenza-like illnesses) and atmospheric pollution.

B) Research and innovation activities linked to the project

The project will build on prior state-of-the-art contained in the literature, previous projects and initiatives and the owned knowledge of the project consortium. The CARES project is multidisciplinar, and therefore multitude of past and ongoing projects are linked to it. A brief list of relevant projects where CARE partners have participated in is shown in Table 1.

Table 1. Research projects linked to CARES

Project	Title/Description	Partner
INTARESE (FP6) 2005-2011	The project provided for the first time a framework of tools for the Integrated Assessment of Health Risks from Environmental Stressors in Europe	Azienda Sanitaria Locale Roma
CIRCE (FP6) 2007-2011	The project provided the assessment of climate change impacts on environment, ecosystems and human health in the European and other countries surrounding the Mediterranean basin	
URBAN GREEN UP(H2020) 2017-2022	Urban renaturing project involving NBS implementations and its effects on public health, especially urban heat island effect, air quality assessments etc..	Demir Enerji, Bitnet
Covenant of Mayors Sustainable Energy and Climate Adaptation Action Plans -SECAP's - for Turkish cities	SECAP's involve adaptation plans for cities which involves identifying, measuring, monitoring and preparing for climate change induced public health challenges	Demir Enerji
Northern Africa-Middle East-Europe (NA-ME-E) Regional Center. The Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) programme at WMO	The SDS-WAS Regional Center provides user communities access to forecasts, observations and information and build capacity of relevant countries to utilize SDS observations, forecasts and analysis products for meeting societal needs. The mineral dust model is integrated in the CALIOPE system.	BSC
BlueHealth (H2020) 2016-2020	BlueHealth is a pan-European research initiative investigating the links between environment, climate change and health.	Centro Euro-Mediterraneo sui Cambiamenti Climatici
ICARUS (H2020) 2016-2020	ICARUS is an initiative intersecting research areas related to the climate and the environment and their interactions with health and wellbeing.	
Pan-European Urban Climate Service (PUCS, H2020) 2017-2019	PUCS is a demonstration project creating new urban climate services for European cities. ISGlobal is in charge of the health sector.	ISGlobal
SECTEUR (Copernicus C3S) 2016-2017	SECTEUR explored and compiled the current end-user needs in terms of climate information in a range of relevant sectors. ISGlobal was in charge of the health sector.	

[15] Ballester J, Robine JM, Herrmann FR, Rodó X. Long-term projections and acclimatization scenarios of temperature-related mortality in Europe. Nature Communications 2, 358 (2011)
[16] Ballester J, Rodó X, Robine JM, Herrmann FR. European seasonal mortality and influenza incidence due to winter temperature variability. Nature Climate Change 6, 927-930 (2016).

1.3.2. Methodology

A) Overall methodology

The project consortium is composed of 11 partners which cover the different capabilities needed for the execution of the different activities within the project. It is properly balanced in terms of type of organisation regarding a RIA project (4 research centres and universities, 4 SMEs and 3 non-profit associations and public institutions).

The project will have a duration of 48 months and will be divided into three different phases. In an horizontal way, the stakeholders (especially those representing vulnerable groups of population) will have a key role to assess and co-participate in the work carried out by the consortium via the Advisory Board.

- **Phase 1 (M1 to M12), Benchmarking activities.** Within the first year, the systematic review will be conducted and the main gaps in current research, end-user needs and early adaptation identified. For that purpose, a participatory approach will be adopted to engage and gather the insight of the different stakeholders (scientists, decision-makers, local authorities and citizens, with particular emphasis on the most vulnerable population groups). In addition to public health authorities, we will also engage representative end-users from the private sector, such as insurance companies, hospitals, clinics, retirement homes or farmers.
- **Phase 2 (M1 to M48), Research activities.** Also within the first year, data will be collected, homogenized and standardized by means of dedicated protocols. Based on these procedures, the consortium partners will proceed with the above-mentioned research activities (see the Overall concept section), to increase the knowledge-base on the main health risks, impacts of mitigation and early adaptation strategies, and to develop a vulnerability tool and different ICT early adaptation tools. The research, including impacts and co-benefits quantification and prediction, will be performed for 6 representing cities pivoting around the European-wide case study.
- **Phase 3 (M1 to M48), Outreaching activities.** These activities will structured and described in the dissemination and exploitation plan, and will be put in practice during the project in order to identify stakeholders and their needs, to develop dissemination methods and tools and to tailor project assessment reports for European decision-makers.

The project will be divided in 6 work packages:

- **WP1. Understanding climate change impacts on health, well-being and socio-economics.** The objective of this assessment will be (i) to provide a comprehensive report about how climate change is affecting and will affect human health and well-being in the EU and the associated social and economic costs, and (ii) to carry out further research on the health topics (extreme weather events, heat waves, cold spells, air pollution events, human mortality, etc.) and associated risks, both at the continental and urban scales, and particularly for the most vulnerable population groups.
- **WP2. Prevention and early-adaptation measures: developing and testing.** The aim of this WP is to (i) identify the existing measures already implemented in Europe, including the main national public health plans, (ii) evaluate and compare the effectiveness of early adaptation strategies, and (iii) develop and test specific adaptation tools to empower citizen-based operational capacity and enhance societal resilience to climate change through volunteer, solidarity based networks, operationalize early warning, neighbour-watch, grassroots community-help platforms.
- **WP3. Prediction of climate change impacts on human health and quantification of socio-economic costs.** In this WP, both the positive and negative impacts of climate change on health will be quantified and predicted for different scenarios of greenhouse gas and pollution emissions and levels of adaptation interventions. The output will be used as a powerful resource to guide future policy-making in Europe for the design of mitigation and early-adaptation roadmaps.
- **WP4. EU strategies on scientific research, policy guidelines and implementation of actions.** Research and modelling actions performed by the consortium will be transformed into effective guidelines for the design of the next generation of policies and interventions by European decision-

makers: identification and prioritisation of knowledge gaps to build a Strategic Research and Innovation Agenda within the context of international (future Katowice COP24 and COP25, Sixth Assessment Report of the IPCC, etc.) and European roadmaps for the implementation of regional to local measures.

- **WP5. Dissemination, communication and exploitation plan.** Through this WP, the project will create an effective and strong Dissemination and Exploitation plan to maximise the impacts of the project beyond its ending date. Additionally, a multidisciplinary European community of stakeholders (scientists, citizen associations, politicians) will be created to maintain and keep boosting the project's objectives on climate and health beyond the project itself.
- **WP6. Project management.** The WP will be dedicated to project technical and administrative management, and to undertake the communication actions with the EC.

B) Gender dimension

The WHO[17] states that "Preparations for, and responses to, climate change need to be sensitive to gender dimensions of health care (including mental) and health-seeking behaviours". The European Parliament has recently adopted a Resolution on women, gender equality and climate justice (2017/2086(INI))[18] recognising that "climate change impacts exacerbate gender inequalities" and calls on the Commission and the Member States to take action on the issue. The CARES project, therefore, will adopt a gender approach (reflected in the specific studies on vulnerable groups of population and the involvement of gender and climate experts in the Stakeholder Advisory Board) to ensure the adequate inclusion of the gender dimension. This will be for example addressed by analysing if, where and to which extent early adaptation measures are effectively reducing the gender gap in vulnerability, and which are the most realistic scenarios that can be expected in the near future under future warming conditions. Internally, the consortium will look for a gender-balanced approach when hiring new employees and building the working teams.

1.4. Ambition

The ambition of the CARES project is to create regional and local adaptation and mitigation strategies to cope with the effects of climate change on health in Europe by identifying the current state-of-the-art basis and gaps, establishing and extending the necessary knowledge base about health research, public strategies and impacts/co-benefits quantification and prediction.

Advance beyond the state-of-the-art and innovation potential

Regarding climate change effects on health studies on the general state-of-the-art, several articles and reports have covered it partially at a EU level (the EEA report[1] on climate change indicators in 2017, the joint EEA-JRC report on environment and human health[19] in 2013, the WHO report on vulnerability and adaptation[20], etc.). The CARES project will advance by generating a thorough report assessing specifically the climate change effect (excluding other environment aspects) on health, identifying knowledge gaps, EU strategies and appropriate recommendations in line with the U.S. Global Change Research Program report[21].

The project is innovative in that it focuses on areas most vulnerable to the specific health risks (higher urbanization, lack of adaptation) or less studied (low-middle income, vulnerable groups). Thanks to heterogeneity of participating countries, adaptation best practices will be tested and evaluated in different socioeconomic and health contexts by improving their transferability and information base on cost-effectiveness. A capacity building activity will be done in Turkey from Italy and Belgium to improve organizational resources (in terms of skills, expertise) for epidemiological studies as well as resources for trainings in preparedness and emergency response to extreme weather events.

[17] WHO "Gender, Climate Change and Health" (2014)
[18] European Parliament resolution of 16 January 2018 on women, gender equality and climate justice (2017/2086(INI))
[19] European Environment Agency, "Environment and human health, Joint EEA-JRC report No 5/2013 " (2013)
[20] World Health Organisation, "Protecting health from climate change, Vulnerability and adaptation assessment" (2010)
[21] USGCRP, "The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment" (2016)

The grassroots approach and other community-based strategies like citizens' observatories have been applied previously to many disciplines. The CARES project will apply this approach in the development of public health response strategies led collaboratively by public authorities and citizens. What is more, the ICT tool developed will use in an innovative way the environmental, health and population data, integrated within GIS-based tools to put together the academia, decision makers and citizens in the design and execution of adequate adaptation strategies to work on heat waves and pollution episodes joint response.

The integration of different expertise in the area of climate change, air quality and health impacts modelling and prediction will build a novel approach to be developed at the city (micro) and regional (macro) scales. Several projects addressed this issue of the attribution of health and cost impacts to climate change in the early 2000s (Climate-TRAP, cCASHh, CIRCE, PESETA II, IMPACT2C, RAMSES), but a general framework at the continental scale coherently covering a large ensemble of cities and regions is still missing. The CARES project will mount on these initiatives and conduct applied research based on urban case studies within the framework of a much wider and generalized European case study. For that purpose, the project will use unprecedented observational and simulated databases covering the continent to address open research questions and provide health outcomes for the quantification of present-day and future impact/co-benefit estimations.

2. Impact

2.1. Expected impacts

1. "To improve the capability in assessing impacts of climate change"

The CARES project will go further in the currents State of the Art of climate change effects on health: quantification and prediction of health, socioeconomic and environmental indicators; health-related morbidities and mortality better understood; public system and citizenship coping strategies, etc. It will be of special interest the construction of new models linking climate data, adaptive capacities (green areas, air quality models, vulnerabilities of population, etc.) with health and economic indicators at the urban and continental levels. This will enable other countries to carry out their assessment of impacts using models developed within the project.

2. "To enable evidence-based decision making through better understanding of mitigation and adaptation costs and co-benefits, and of potential new climate-related pressures on the EU"

The EU launched in 2013 its Adaptation Strategy with the aim of promoting action by Member States (guidance and funding for national strategies), better informed decision making (addressing knowledge gaps and developing the platform Climate-ADAPT) and adaptation in key vulnerable sectors (making them more resilient and prepared).

The CARES project will generate in WP4 several reports and tools useful for different levels of decision-makers in the EU, contributing to the EU Adaptation Strategy. While doing this, the dissemination and communication activities will involve key stakeholders (including the EU authorities) to build on existing knowledge and initiatives. Hence, the platform Climate-ADAPT, as the main information point for climate adaptation in the EU, will be a key asset where transfer this knowledge. Specifically, the different roadmaps built for different countries of the consortium will use evidence-based data obtained from the project activities to show regional and local decision makers the potential negative effects on health, environment and public health system costs as well as the potential co-benefits brought by the implementation of the most adequate mitigation and adaptation strategies. It will also build links with the potential funding sources and regulations to support the implementation.

3. "To enhance the information base relevant for the 2023 global stocktake exercise under the UNFCCC"

The Paris Agreement states that each 5 years, starting in 2023, it will be released a Global Stocktake (GST) to assess the collective progress and to inform further individual actions by Parties. It has to be created an information basis to: "recognize adaptation efforts of developing country Parties; enhance the implementation of adaptation action; review the adequacy and effectiveness of adaptation and support

provided for adaptation; and review the overall progress made in achieving the global goal on adaptation". Building on synergies among the Paris Agreement, the UN SDG agenda for 2030 and the Sendai Framework on Disaster Risk Reduction, the CARES project will contribute to the information base relevant for the 2023 GST. It will feed information to achieve the two main outcomes sought by the UNFCCC with the GST: (i) provide information that countries need to identify opportunities for enhanced action by highlighting the best adaptation and mitigation strategies on the climate change and health sector and improving the scientific knowledge base; and (ii) inform the delivery of support and technical assistance needed to realize these opportunities by identifying main barriers to implementation and also suggesting unlocking actions to overcome them.

4. "To inform major international scientific assessments such as the IPCC reports and the IPBES, as well as to EU and national adaptation strategies and plans"

The scientific outputs of CARES, detecting the knowledge gaps, best mitigation and adaptation strategies and quantifying health, environmental and socioeconomic impacts and co-benefits, will be valuable information to be used by the EU representatives in the coming climate change related forums. What is more, the clustering activities of the project will seek for the generation of common reports with other H2020 and national projects to offer coherent and unified guidelines. The project action plan (further detailed in 2nd stage), will try to link up with the preparation periods such as the 6th IPCC assessment cycle (2018-2022). On the other hand, the aforementioned roadmaps will be useful to update the national strategies and plans of Member States with a renewed and assessed health-related dimension (objective of national mid-century strategies in 2020).

5. "To contribute to cohesive European resilience to climate change"

The EC adopted in 2013 the EU Strategy on adaptation to climate change aiming to make Europe more climate resilient. It is intimately linked with the Cohesion Policy, which supports adaptation measures for present and future impacts. The variety of regional effects, exposure paths, vulnerability and coping capacities in the EU makes necessary to establish integrated approaches from the EU authorities. The heterogeneity of participating countries included in the CARES project will contribute to successful transferability of proposed local and regional adaptation strategies to cope effects on health in different settings and also in EU candidate countries as Turkey. The inclusion of vulnerable groups of population and different public health systems in the different study areas will allow to enhance efficiency of the proposed best practices. In addition, the adoption of the grass-roots approach when developing innovative ICT tools will represent a model to promote the local empowerment to face climate change effects in European urban areas where public systems are not sufficiently effective.