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climate conference:

MAKING CLIMATE SERVICES A REALITY IN EUROPE

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Urban climate services are needed to translate the global climate information to the local urban scale.

Dirk Lauwaet, *Senior Researcher at VITO*

Climate change presents new challenges for public and private organisations to overcome, but also opportunities to exploit. Climate services give valuable information on how climatic events can negatively or positively affect various aspects of urban life, such as tourism, mobility, and health.

If Europe aims to become the first carbon-neutral continent in the world by 2050, cities will have a major role to play in reaching this goal. Two thirds of the global population will live in cities by 2050 reports the UN[1]. By then, cities should be not only carbon neutral or even carbon negative, but also resilient to climate change. It is therefore imperative for climate researchers, policy makers, businesses, and industry experts to have accurate information about how shifting weather patterns will affect them.

The TIC Council, an international association representing businesses, emphasises that although businesses have "high confidence in risk management, new risks loom". Thus, the emerging impacts of climate change on global supply chains can create new situations that may blindside companies and endanger their production, supply chain or reputation.

Climate data is an important factor when taking decisions about the present and future of cities. As Stijn Vermoote, Section Head Copernicus Contract Management ECMWF, shares: "We need to make sure that we build climate services for citizens where it matters. So, we need to understand how data and information are transformed into knowledge and wisdom, so that citizens and policy makers can make better decisions."

A lot of the climate services described here use the Climate Data Store provided by the **Copernicus Climate Change Service (C3S).** Implemented by the European Centre for Medium Range Weather Forecasts (ECMWF) on behalf of the European Commission, C3S acts as a quality assured and consistent source of data and information on past, present and future climate.

As an **operational service**, C3S is an **enabler of downstream climate services**, by providing or brokering high quality and sector relevant climate data and indicators, good practices, tools and by supporting compelling use cases. Training, user engagement and support, and communication are all an integral part of the service.

"With our one-stop Climate Data Store, we provide an infrastructure for **open and free access** to climate data, the tools needed to use the data and information on sectoral impacts," clarifies Stijn Vermoote, Section Head Copernicus Contract Management ECMWF.

To help city stakeholders combat the effects of climate change, this brochure presents a selection of solution-oriented climate services projects for cities.

[1] www.cnbc.com/2018/05/17/two-thirds-of-global-population-will-live-in-cities-by-2050-un-says.html

Mobility

Urban mobility is a sector that not only influences the climate but is also highly impacted by it. Extreme weather conditions cause road damages, public transport breakdown and also create obstacles for cyclists and pedestrians. Europe's transport infrastructure is already struggling to cope with such events.

Active mobility for more liveable cities

Cycling is an urban mobility solution which tackles both climate change adaptation and mitigation. To make cycling attractive to more people, it is necessary to understand how active mobility works. This could be achieved through using data to understand better how cyclists behave, which types of infrastructure they prefer and which they avoid. A data analysis is then necessary to estimate cyclists' behaviour and how changing weather conditions may influence this.

→ **www.bikecitizens.at**

> **Resilience is not just about infrastructure, it is also about individuals, communities and institutions.**
>
> **Dr Adewole Adesiyun**, *Deputy Secretary-General Forum of European National Highway Research Laboratories*

Tailored bicycle traffic planning

Within the Climate-fit.city project, a service has been developed that provides climate information tailored to bicycle traffic planning, with the purpose to help improving the comfort and climate resilience of urban cycling. The provided information allows answering questions such as:

- which regions of a city show the highest bicycle traffic variations due to climatic variability;
- which regions of a city show the highest exposure to climatic conditions unfavourable for cycling; and
- how is a city's climate attractiveness towards cycling expected to change in the future.

→ **www.climate-fit.city**

Is cycling always healthy?

With increasing levels of pollution and changes in weather conditions, people have a reason to wonder about the risks of cycling in cities. Within the FP7 PASTA project, case studies from seven European cities compared positive and negative health impacts of urban cycling.

The results demonstrate that in the studied cities, positive impacts on health outweigh negative ones. Such insights highlight the importance for cities to provide more sustainable and active modes of transport. Accidents are the most important negative health impact. This presents decision makers with an opportunity to mitigate the risk and improve the conditions for cyclists in their cities.

→ **www.pastaproject.eu**

What to do with our ageing infrastructure?

With 40% of Active Member State's budgets going towards transport infrastructure, the cost of not adapting roads to the effects of climate change could cost countries between 100 to 250 billion euros.

The FEHRL's Resilient Roadmap is a climate service developed to give a step by step guide on how to achieve a climate resilient transport system. The goal is to reduce the impacts of disasters and to maintain an ageing infrastructure.

→ **www.fehrl.org**

Conclusion

Due to reinforcing feedback loops between climate change and the mobility sector, planning for climate-related risks will need to involve both climate adaptation and mitigation strategies.

Future cities

How will climate change impact cities? The answer is still unclear due to cities' particular nature. Dense populations, urban heat island effect, large critical infrastructure networks, and often a proximity to water bodies, make the urban environment particularly vulnerable to changes in weather patterns.

• Urban Models

The Urban planning service developed within Climate-fit.city gives outputs such as high-resolution urban maps for climate impact studies, assessment of uncertainties and impacts, and evaluation of adaptation strategies.

The UrbClim model developed by VITO provides urban heat maps of current and future climate adaptation scenarios for any city in the world. These maps show possible impacts of climate change on various sectors such as active mobility, building energy, cultural heritage, tourism, climate-health, emergency planning and urban planning.

By combining different data, valuable information on energy consumption from mobility and from buildings, as well as the water-energy-land nexus in cities, can be extracted.

→ **www.climate-fit.city**

Urban climate services make cities more resilient in several ways. For instance, by raising awareness for citizens and for the local governments. Also, by providing guidance on adaptation measures and providing scientific bases on how to use specific adaptation measures.

Dirk Lauwaet, *Senior Researcher at VITO*

• Adaptation toolkit for cities

Land, water and energy infrastructures are critical to the everyday functioning of a city. Understanding how resilient such infrastructures are to climate-related risks is crucial.

The GERICS adaptation toolkit for cities aims to facilitate the planning of adaptation measures without putting additional pressure on city administrations. The flexible structure of the toolkit makes it easy to implement the measures within the specific environmental and administrative frameworks of each city.

This toolkit allows decision makers to plan tailored climate mitigation and adaptation strategies for different sectors, for example, for critical infrastructure based on city-specific constraints.

→ **www.climate-service-center.de**

Conclusion

In the face of the complexity and uncertainty of the effect of climate change on cities, not only do decision makers need to address current issues, but also need to plan for the future.

Climate adaptation and mitigation strategies will require tailored solutions, as each city possesses its own context-dependent set of constraints but also opportunities. Climate services can help decision makers navigate this complexity and smartly invest their limited resources as they prepare their cities to face the future.

Tourism

Globalisation has allowed tourism to become more accessible to a higher number of people. While tourism can bring positive socio-economic impacts to cities, it is strongly influenced by weather patterns. Understanding how the industry is impacted by climate change is critical for stakeholders who wish to maintain the attractiveness of tourist destinations.

Manage your snow

For winter economic viability, many towns rely on ski tourism and more precisely, on skiing installations. Therefore, ensuring the availability and quality of snow is crucial. PROSNOW® is a modelling tool that addresses such challenges. The tool displays predictions for snow height and other variables in a map-based interface meant for ski resorts.

Combining different forecast data, PROSNOW® provides predictions for future conditions throughout the season. The tool allows resorts to optimise their snow management, while avoiding depletion of water resources and reducing their energy consumption.

→ **www.prosnow.org**

Climate services for zoos

This service developed within the H2020 Climate-fit.city project helps zoos manage their animal collections, energy and water consumption. It also provides insights about visitor attendance while taking into account detailed and state-of-the-art climate data.

The service has been used so far by the Antwerp Zoo and, amongst other benefits, has facilitated long term investments and animal collection planning.

→ **www.kmda.climate-fit.city**

Busy, crowded and heated historic cities

Crowds and people flow planning in touristic cities has always been a challenge. In the tourism industry it is important to provide good information about touristic flows, opening and closing time of monuments and services available on site.

Within the Climate-fit.city project, we developed a web system to address such issues. With the new system, stakeholders can better predict health hazards for visitors, such as heat strokes, and review comfort conditions. The service leads to a better information service that can minimise impacts on tourists' health and is available as a mobile app or a web platform for a PC.

Using a weather forecast system, the application gives information on heat, air quality, pollen and weather across a period of 5 days.

→ **https://climate-fit.soprintendenzaspecialeroma.it/area**

City planning for tourism

A series of examples from Austria demonstrate how monitoring and forecasting of weather and climatic conditions can help with city planning for tourism. For example, WEATHERPARK studies wind patterns and comfort in urban areas and provides wind protection measures to optimise comfort in outdoor dining areas. WEDDA (WEather Driven Demand Analysis) provides forecasting, monitoring and risk evaluation for recreation businesses, such as outdoor swimming pools.

→ **www.weatherpark.com**
→ **www.wedda.at**

Conclusion

The above case studies demonstrate that the tourism sector would benefit from climate services. The use of weather services, especially publicly available and tailored forecasts, is already quite common in the tourism sector. This is less the case, however, for climate services which could benefit from better communication, design, user-friendliness and integration in already operational systems. It also appears that overall, tourism stakeholders show higher interest in short-term and seasonal services than in long-term projections.

Energy

Energy production and demand are heavily dependent on meteorological conditions. Both renewable energy sources and traditional energy production are affected by heat waves, droughts and storms. With this in mind, we need to develop future energy systems that are climate robust.

• Forecasting a hydropower system in the Alps

Hydropower is facing considerable challenges associated with changes in energy market and hydrology, for example variations in water availability and frequency of extreme weather events.

Within the H2020 IMPREX project, Politecnico di Milano in collaboration with the Swedish Meteorological and Hydrological Institute developed a machine-learning based procedure for a more efficient management of the system and water resources. The analysis, based on a hindcast model, shows that seasonal hydrological forecasts added € 1.4 million annually to the average profit of an Alpine hydropower company. This value expected to increase under projected climate scenarios.

→ **www.imprex.eu**

• More energy to be needed for cooling our homes

Quantifying the influence of climate change on energy consumption for heating and cooling of different building types can provide valuable information for planning engineers and energy managers.

Climate change will influence indoor comfort which will influence power demands. How the buildings are configured, whether they are new or old, and whether they possess heating and cooling infrastructure will also influence indoor comfort. In Southern cities for example, air conditioning will become essential, predicting a rise in energy consumption.

Within the Climate-fit.city project, the urban heat island effect was combined with climate change data to predict energy demands and indoor comfort levels for different buildings for different scenarios.

→ **www.climate-fit.city**

Conclusion

The energy sector is strongly linked to weather and climate conditions, both on the short term and on the long term. Climate services could play a big role for this sector, which is heavily regulated and controlled. As such, the introduction of climate services for cities should be addressed through legislation and rules.

Agriculture

The 2019 IPCC Special Report on Climate Change and Land stresses the fact that out of all sectors, agriculture is going to be the one most impacted by climate change.[2]

Reliable agricultural systems are crucial for food, political and economic stability, but the rise in strength and occurrence of extreme weather events due to climate change is increasingly challenging crop production.

Farmers therefore require more than ever tools to help them not only tackle current challenges, but also to allow them to plan for future shifting weather patterns.

• Making a smart agriculture system

Climalert is a web and phone application which uses smart technologies to provide tailored climate information for farmers and water managers.

Amongst other things, the service can assist with precision agriculture, crop yield forecasting, and the design of smart agricultural systems.

→ **www.climalert.eu**

• Watch your potatoes

WathITgrow is an online platform for the Belgian potato sector to monitor and increase potato yields in a sustainable way. WatchITgrow allows potato growers, traders and processors to access data and information on the growth of their potato crops.

WatchITgrow is the first such platform to combine several types of data. Through the combination of satellite and drone images, weather and soil data and yield prediction models, the potato sector can consult, in a quick and efficient way, the correct information on one or multiple potato fields.

WatchITgrow is a beautiful example of how research can be turned into a user-friendly platform to support the industry.

→ **www.watchitgrow.be**

• Crops, crops, crops

The Global Agriculture Sectoral Information System (SIS) project has developed a toolbox of climate services in support of decision-making in the context of climate change. It gives information on crop-specific requirements, water resource indicators, crop productivity, and historic agricultural impacts of climate change.

→ **www.wur.nl**

Conclusion

GreenYard, a world leader in fruit and vegetable production and distribution, highlights the need for reliable climate data and decision-support tools.

Currently most prediction models used by farmers are short term (seasonal). Although this type of information is crucial as it allows "timely decision-making in terms of quality specifications, promotions, and emergency sourcing", long-term information is also essential to allow for long-term planning such as strategic sourcing.

[1] www.ipcc.ch/site/assets/uploads/sites/4/2019/12/02_Summary-for-Policymakers_SPM.pdf

Water

Recent hydrological extreme events demonstrate the vulnerability of our society to water-related natural hazards. There is strong evidence that climate change will worsen these events in the coming years.

Decision-makers in both public and private arenas need accurate information on flood and drought risks to assess strategic decision-making on risk reduction and climate adaptation in the short-term as well as in the long-term.

• Internet of Water Flanders

A broad range of sectors depend on water availability and quality. Internet of Water Flanders is an ambitious innovation project that aims to measure the water quality in Flanders and to process the associated data for a period of over 4 years.

Imec City of Things and its partners, VITO, VLAKWA, VMM, de Watergroep and Aquafin, are researching how to set up cheap "Internet of Water" sensors in Flanders for real-time monitoring of water-quality, allowing for real time monitoring of water quality in surface water systems such as streams, rivers, lakes, and reservoirs. The data can then be processed and converted into usable information to inform sustainable water policies.

→ www.internetofwater.be

• Climate service and urban flood management

Between 2000 and 2012 pluvial flooding have cost globally an estimated amount of 4.9 Billion euros per year. This is predicted to increase to 23.5 billion per year by 2050[3].

Urban and emergency planners benefit from understanding how future floods will impact their cities. Within the Climate-fit.city project, KU Leuven created urban flood hazard maps for current and future climate conditions. They combine models of extreme precipitation with models of city infrastructure, mobility and demographic data.

The flood hazard maps have been used by the city of Antwerp to assess local risks and revise the Emergency Planning of the city. An online viewer has been developed that allows the risks to be communicated to the different emergency planners.

→ www.climate-fit.city

• Do you have a Water Plan?

Climate services on urban rain flooding were also used in Antwerp to see how it could be transformed into a "water sensitive city". The project developed a large-scale vision of what this could mean, combining short- and long-term practical solutions to mitigate the risks of droughts and floods.

Better integration of water in the city spatial planning makes cities more resilient to changes in hydrological extremes such as drought, flooding, and water pollution. Better water integration for Antwerp came in the form of blue-green macro networks and street gardens which act as water buffers and infiltration zones for rainwater.

This urban water plan elaborates a large-scale vision in combination with very practical short- and long-term solutions to reduce flood and drought hazards and to raise water awareness in the city.

→ www.antwerpenmorgen.be/projecten/waterplan/over (in Dutch)

Conclusion

Climate change impacts both availability and quality of water. Integrating measures for the resilience of water systems within urban planning is crucial, because of the impact on other sectors such as energy (hydropower), health (dealing with heat waves), agriculture (irrigation) and tourism (water-based recreational activities).

Climate services for the water sector will therefore be essential for setting up adaptation strategies that will benefit all sectors of city life.

[3] www.climateservices.biz

Health

The physical environment, including natural factors such as climate and geography, is a key determinant of population health and health inequalities. Understanding how climate conditions such as heat waves directly or indirectly impact human lives drives the development of health strategies and action plans.

How cities can deal with heat inequalities

Health inequalities are usually to be seen in big cities, where population differences in terms of place of living, salaries, etc. are most tangible. The so-called urban heat island effect that is a result of human activities in metropolitan areas causes temperatures to rise in cities. It is also known to worsen the effects of heat on population health. In view of that, cities should support the health sector in designing strategies and emergency plans.

The Climate-fit.city's urban climate service is made to provide cities with the necessary information to achieve this goal. Our tool describes comprehensively the associations between the urban environment, the local climate, the daily mortality registers and the socio-demographic profiles of city neighbourhoods. It helps identify the main vulnerable population groups by studying the role of age, sex and the different causes of death associated with heat. It also provides assessments and projections based on socio-demographic and urban data to better understand the role of climate change and non-climate factors.

→ Barcelona case
→ London case

Heat Alarms

The number of heat waves have been increasing in Antwerp. Due to the urban heat island effect, citizens living in the city can experience temperatures nearly 10°C higher than in rural areas during a heat wave.

In order to protect vulnerable people, a climate service was set up to forecast and communicate about heatwaves, giving information about when they would occur, their intensity, and tips on how to protect themselves from their effects.

→ www.hitteverklikker.antwerpen.be

Heat to spread diseases

Globalisation in tandem with climate change has been favouring the spread of infectious diseases spread by spiders, mites, mosquitoes, and other invertebrate animals.

A climate service using Geospatial Information Systems (GIS) developed methods to map information about the weather conditions that facilitate the spread of such diseases and about the diseases themselves. Such maps can help determine which areas are the most vulnerable to the spread of bacteria, allowing for timely decision making to stop it or manage its impacts.

→ www.avia-gis.com

Belgian Mortality Monitoring

To support public health policymaking in the face of an increasing number of heatwaves, the Be-MOMO model was developed. The service aims to provide exhaustive and (almost) real-time information about mortality rates so that policymakers can quickly identify and measure the impact of harmful climate events.

→ www.epistat.wiv-isp.be

Conclusion

Socio-economic and demographic factors play in combination with climate change to render populations that are already at risk even more vulnerable to impacts of shifting weather patterns such as heat waves.

At the moment most climate data is at regional scale, but we need data at local scale for climate-related health policies to target the right people and be effective.

Urban areas shape their own climate which amplifies climate extremes

As global populations continue to grow and an increasing number of people are moving to urban areas, cities will be placed at the center stage of strategic actions for climate change mitigation and adaptation.

Cities can present particular challenges though, as they are impacted differently by climate change than the broader regions in which they evolve. Indeed, urban areas shape their own climate, locally amplifying climate extremes such as excessive heat and flooding. Furthermore, they present different needs, challenges, but also opportunities.

Making cities resilient to climate change impacts while also maximising their potential will require timely, relevant and usable information for decision makers. Climate services can provide such information.

It appears though that stakeholders do not yet fully appreciate the value of climate services. Only through effective communication of the key role of climate services will we be able to make climate-fit cities a reality in Europe.

Mobility

- A service to support climate-resilient bicycle traffic planning and design
- The Resilient Road
- BikeCitizens: GPS-data on tracked trips & analytics tool
- Active Mobility and Health: is urban cycling healthy or not?

Future cities

- GERICS adaptation toolkit for cities concept and application case studies
- Tools for Climate-Smart Future Cities
- Climate-fit.City Urban Climate Data and Services overview
- Climate-fit.City Urban planning tools: How the cities can exploit the service
- Urban climate services from the URCLIM project

Tourism

- The market for climate services in the tourism sector: Results from an Austrian case study
- Sectoral Case: Cultural Heritage climate changes and Roma historical sites
- Climate services for the Zoo of Antwerp
- From the forecast to the decision: C3S & Prosnow, 2 examples of Climate Services

Energy

- Impact of urban und future climate conditions on energy consumption and indoor climate comfort in buildings (a Climate-fit.City demonstration)
- Building energy use case - Climate Part
- Adaptation challenges and opportunities for the European energy system – key findings from a new EEA report

Agriculture

- Climate Services towards Water and Agriculture Sustainability
- Greenyard: Adapting to climate change - a 'fresh' perspective
- Climate change adaptation in the agriculture sector in Europe - key findings from a new EEA report
- Copernicus Climate Change Services: SIS global agriculture

Water

- Water plan Antwerp: Towards a water-sensitive city: Ronny Van Looveren, City of Antwerp, Ronny.VanLooveren@antwerpen.be
- Climate-fit.City Urban Pluvial Flood Hazard Analysis: Patrick Willems, KU Leuven, patrick.willems@kuleuven.be
- Internet of water: Koen Triangle, Imec, koen.triangle@imec.be
- Beyond adaptation: Emergency planning in times of climate change: Erik De Bruyn, City of Antwerp, erik.debruyn@antwerpen.be

Health

- Forecasting and communicating urban heat waves in Antwerp
- The contribution of climate data for mapping the risk of vector-borne diseases
- Belgian Mortality Monitoring
- Climate-fit.City Health service: ISGlobal, Barcelona Institute for Global Health - Campus Mar

→ Barcelona case
→ London case

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