*The European Climate Change Adaptation Conference (**ECCA**) is the leading European forum for sharing the latest science, policy, and practice on climate adaptation.*

*As a leading research center on climate science and impacts, **CMCC** plays a key role at the European level. The following press brief is designed to provide journalists and media with themes, research, data, and tools to explore crucial aspects of the climate challenge and tell impactful stories connecting science, policy, and society.*

Preparing European cities for change

Urbanization rates in Europe are expected to increase to 84% by 2050, compared to 75% in 2020. At the same time, climate change will lead to an increase in **heat stress** and **flood events** in urban areas across the EU. Yet cities are not just victims of climate change, they also contribute to it, with the building sector being one **of the main drivers of global energy-related CO_2 emissions**. Which leads to the question: What is the future of European cities?

Urban areas heat up faster

Key messages

- **The 2003 European heatwave caused 70,000 excess deaths**, highlighting the health risks of rising urban temperatures. It is projected that annual fatalities from extreme heat could rise to approximately 30,000 or 50,000 by 2050, with 1.5°C or 2°C global warming, respectively.
- **Heatwaves in Europe are on the rise**, with **57% more people exposed** to them in the decade from 2010 to 2019 compared to the preceding ten year period.
- **Urban environments intensify climate risks**, especially **urban heat islands (UHI)**, whereby city centers are significantly warmer than surrounding rural areas due to heat-absorbing materials, lack of vegetation, and concentrated human activity.

- **The UHI effect** **disproportionately affects vulnerable populations** – elderly, low-income, and marginalized communities – who often live in less energy-efficient homes and have less access to green spaces or cooling infrastructure.

Story ideas:

- The heat divide: How European cities are failing the most vulnerable
- How urban design can make us safer and healthier
- Are cities prepared for the coming heatwaves?

The magnitude of heat-related health risks to which people in urban environments will be exposed is directly related to climate hazards, vulnerability, and the capacity for adaptation measures to create resilience. This reveals how **effective emission reductions and adaptation can significantly mitigate the negative health impacts of climate change**.

Cities can be up to +9°C warmer than vegetated surroundings due to the UHI effect with heatwaves leading to **almost 90,000 deaths in Europe between 2000 and 2020**.

The number of hot days and intensity and frequency of heatwaves is expected to rise under all future climate change scenarios, particularly for cities in the Mediterranean area and in Eastern Europe, where rising mean temperature increases will compound heat stress in urban areas.

Under such climate conditions, and without any adaptation measures, **annual fatalities from extreme heat could rise from 2,700 deaths per year now to approximately 30,000 or 50,000 by 2050**, with **1.5°C** or **2°C** global warming, respectively.

Urban heat islands: The Turin case study

Tackling heat related inequities involves implementing programs and policies that address historically marginalized and disadvantaged people to diminish their disproportionate vulnerability to heat-related risks.

Providing a reproducible and flexible methodology for risk assessment of the **heat-health nexus within the city of Turin**, Italy, is one of the main outcomes from an interdisciplinary study, led by CMCC and published in the Urban Climate journal.

The main objective of the study was to generate **climate risk assessment evaluations at the local scale that take social inequalities into consideration**, as this is a crucial element in the effective implementation of adaptation strategies.

“It’s not only greener or more urbanized areas that influence risk exposure. We should also consider the characteristics of buildings, proximity to hospitals and availability of public spaces with air conditioning, among others,” says CMCC and Politecnico di Torino researcher **Guglielmo Ricciardi,** co-author of the study. “The combination of different factors allows us to express the complexity of the concept of risk associated with UHIs.”

The study is just one example of the impact of urban environments on human health, a topic that is gaining growing relevance at a scientific level. **Climate change and the UHI effect are both phenomena that will continue to impact lives**, mutually reinforcing each other and compounding heat-related risks in the future.

High risk: Flooding and extreme precipitation events

Key messages

- Coastal and urban populations in Europe face **rising flood risks** due to sea level rise and more intense precipitation.
- In a rapid sea level rise scenario, **flood-exposed populations could increase** to 8.8 million in the Netherlands and 2 million in Germany.
- In 2023, floods in Europe affected **1.6 million people** and caused **81% of the year’s total climate-related economic damage**.
- The Emilia-Romagna region in Italy experienced **€10 billion in damage** in May 2023 after receiving six months’ worth of rain in just 1.5 days.
- Extreme rainfall events are **expected to increase in frequency and intensity** due to climate change.

Story ideas:

- Storm proofing Europe: Leaders in coastal adaptation
- How climate change is overwhelming Europe's infrastructure

- AI vs. water: The new frontline of climate defense

Europe's population is increasingly concentrated in coastal areas, many of which are exposed to risks related to sea level rise and storm surges. Although overall precipitation is expected to decrease in most of Europe, **extreme precipitation events are expected to become more frequent, leaving European cities, buildings and infrastructure more vulnerable to flooding**.

Many cities in the European Union have already been affected by intense short-term precipitation events that cause surface flooding. **In 2023 alone 1.6 million people were affected by flooding in Europe**, causing around 81% of the year's economic damage due to climate impacts in the region.

In Münster, Germany, 90 millimetres of rain fell in 7 hours, leading to €72 million euros in damages in 2014. In Copenhagen in 2011, 135 millimetres of rain in 2 hours caused losses for more than €800 million. In the Italian region of Emilia-Romagna, in mid-May 2023, 6 months' worth of rain fell in just 1.5 days. This led to the overflow of 23 rivers, over 400 landslides, and the displacement of over 50,000 people for total estimated damages exceeding €10 billion.

Frequency and intensity of brief precipitation events are expected to continue to increase resulting in more frequent and intense flood events.

Coastal adaptation: The future of Venice

Venice and its lagoon are among the most emblematic cases of how coastal and urban landscapes will be transformed by climate change. The city faces significant challenges in protecting its cultural and natural heritage whilst also safeguarding local communities, with risk assessment research in the area already playing a crucial role in developing effective adaptation strategies.

In the complex and multi-risk landscape of the Metropolitan City of Venice – where rising sea levels and subsidence amplify the impacts of extreme events which are then further intensified by strong winds like Bora and Scirocco that together contribute to the *Acqua Alta* phenomenon – CMCC researchers use **artificial intelligence and machine learning techniques to improve climate risk assessment and support regional adaptation**.

A prototype decision-support tool, developed to assess the physical and socio-economic impacts of extreme weather on the Veneto coastline, identifies key

drivers including daily precipitation, wind intensity, and sea surface height. Machine learning, climate models and satellite data are used together in a joint CMCC and Ca' Foscari University study that analyses **coastal erosion and water quality** in the Venice Lagoon. Results highlight **sea-level rise as a major factor behind worsening extreme events and coastal degradation**, especially under high-emission scenarios like RCP 8.5, with sea water velocity strongly influencing water quality.

Complementing this, multi-risk mapping tools developed by CMCC and Ca' Foscari visualize the distribution of climate hazards, mapping areas - particularly urban and coastal zones - most exposed to droughts, floods, and storm surges, and offering local authorities **a powerful resource for prevention and planning**.

CMCC forecasting systems such as MedFS and AdriFS, part of the Copernicus Marine Service, have already proven to be vital in **predicting Acqua Alta events up to four days in advance**, enabling better preparedness and response. Meanwhile, the *MoSe* system - Venice's primary defense against storm surges - was analysed in a CMCC study assessing its cost-effectiveness under various sea-level rise scenarios. While economically viable in the short term, the increasing need for closures may challenge its long-term sustainability, underlining the **urgency of integrated adaptation strategies that also consider ecological impacts**.

Building sustainable and resilient cities

Story ideas:

- What does it mean to build resilient cities?
- Who really benefits from urban greening?
- Which European cities are best prepared for heat?

Key messages

- The buildings and construction sector is responsible for approximately **39% of global energy-related CO_2 emissions** – this includes both operational emissions (from energy use in buildings) and embodied emissions (from construction and manufacturing of materials).

- Urbanization is accelerating: Over **55% of the world's population** now lives in cities, up from one-third in the 1960s, a share that continues to rise.
- Public policy is key: The **Italian Public Property Agency** manages around **43,000 properties** valued at **€62.5 billion**. **In partnership with CMCC**, they have developed a methodology to assess and improve the climate resilience of public property

The combined buildings and construction sectors account for approximately 39% of global energy-related CO_2 emissions, which places **urban areas at the forefront of global challenges related to climate change, inequality, and sustainability**. CMCC is advancing research to address these issues through cutting-edge tools, innovative projects, and collaborative initiatives that can turn cities into a source of sustainability and solutions.

Mitigating the UHI effect is not just a matter of technology but also urban design. Numerous studies confirm that green spaces – parks, urban forests, and innovative solutions can substantially reduce surface and air temperatures through shading and evapotranspiration. However, the benefits of urban greening are not distributed equally. **Vulnerable populations, often living in denser, less vegetated neighborhoods, are more exposed to heat and have limited access to cooling infrastructure or green space, compounding health risks and social inequities**.

This inequality is especially concerning as heatwaves – now **the deadliest natural disaster globally**, causing hundreds of thousands of casualties each year – are projected to become more frequent and severe, particularly in urban environments where the UHI effect amplifies their impact.

CMCC data supports adaptation policies

CMCC research demonstrates that effective urban climate action requires a combination of advanced modeling, high-resolution risk mapping, integrated urban and environmental planning, and attention to social equity.

A recent study by CMCC, CNR, and other leading European institutions, published in *Nature Cities*, reveals **widespread social inequality in access to green spaces across 14 major European urban areas**. These green areas, key to mitigating the health impacts of increasingly frequent and intense heatwaves, remain less accessible to vulnerable groups such as low-income residents, tenants, and immigrants. Using a mix of satellite data, simulations, and socioeconomic indicators, the study shows that wealthier and native populations benefit from better cooling provision, whereas

disadvantaged groups are more exposed to heat stress, highlighting a **critical environmental justice issue in urban climate adaptation**.

Another study by CMCC has led to the development of several key tools and datasets that support climate adaptation in Italy. The first high-resolution CMIP6-based dataset for Italy now provides daily projections of temperature, wind speed, humidity, and precipitation at a local scale, which is essential for assessing local climate hazards like heatwaves and heavy rainfall. The data is available via CMCC's Data Delivery System.

On the Dataclime platform, CMCC also introduced climate stripes – a visual tools based on 2.2 km resolution data – to highlight temperature changes in all Italian regions and provinces. In addition, Dataclime offers "Dataclime cards," a collection of maps and indicators (26 in total) showing how climate variables are projected to evolve, helping users – from experts to citizens and policymakers – better understand local climate risks and inform targeted adaptation strategies.

According to the new European Climate Risk Assessment (EUCRA), climate change is affecting Europe in different ways, with **Southern Europe facing more heatwaves and droughts, Central Europe experiencing more floods and storms, and Northern and Eastern Europe seeing rising water stress and extreme winter events**. Coastal areas are increasingly exposed to sea level rise and storm surges. In this complex context, understanding climate hazards is key to guiding adaptation strategies.

As part of the Horizon Europe MULTICLIMACT project, CMCC scientists analyzed the National Adaptation Plans (NAPs) of 11 European countries to identify priority climate hazards and planned adaptation measures. The analysis shows that floods, droughts, sea level rise, and changing temperature and rainfall patterns are among the most frequently addressed hazards. Common measures across countries include institutional coordination, early warning systems, risk mapping, and public awareness initiatives. Structural interventions are more widespread than nature-based or financial solutions, highlighting both progress and gaps in Europe's adaptation efforts.

Recognizing the urgent need for precise tools to understand and address these risks, CMCC researchers have advanced urban climate modeling by integrating the TERRA_URB parameterization into the ICON Earth system model. This integration, tested in cities like Rome and Milan, **significantly improves the simulation of urban heat islands and urban dry islands**, capturing localized temperature variations with high spatial and temporal detail.

As CMCC researcher **Angelo Campanale** explains, "This advancement positions ICON with TERRA_URB as a powerful tool for medium-scale climate simulations, enabling better analysis of urban heat dynamics and supporting adaptation strategies."

The enhanced modeling capacity allows scientists and policymakers to evaluate future climate scenarios, assess the impacts of extreme weather events, and develop data-driven adaptation plans tailored to the unique conditions of each city. **Paola Mercogliano**, principal scientist at CMCC, notes that these new datasets "will enhance impact studies, risk assessments, and adaptation planning at the local scale".

CMCC projects address these challenges by providing high-resolution urban climate data, supporting the design and implementation of nature-based solutions, and highlighting the need for equitable adaptation strategies. The work of CMCC researchers helps equip cities with the scientific foundation to create healthier, more resilient urban environments for all residents.

Energy poverty

According to an International Environmental Agency report, **10 new air conditioning (AC) units will be sold every second for the next 30 years**, bringing the number of installed cooling units worldwide to 5.6 billion by 2050.

However, in 2016 alone **more than 20% of EU households faced difficulties in keeping their homes cool during heatwaves**, with research showing that this was due to a combination of both energy poverty and poor housing quality. Furthermore, heatwaves also go hand in hand with high levels of air pollution in many European cities, which also leads to health impacts. In 2017, **almost 80% of the European population was exposed to levels of air pollution which exceeded WHO thresholds**.

As temperatures rise and AC becomes more readily available and affordable, this energy intensive cooling solution may end up being used in places where heat stress could instead be tackled via passive cooling alternatives.

The Cooling Solution is a CMCC led scientific project that uses photography and data-visualization to investigate how people of different socioeconomic backgrounds around the world adapt to high temperatures and humidity. It combines scientific findings with personal stories from Brazil, India, Indonesia, and Italy; offering a visual journey through people's lived experiences of ineffective and inefficient cooling, hypercooling, heat dumping, vernacular architecture, and cutting-edge cooling technologies.

CMCC experts are available to share their insights with interested parties, including journalists.

Contacts:

Mauro Buonocore, *Press Officer, CMCC*
mauro.buonocore@cmcc.it
tel. +39 0832 1902411 - mob. +39 3453033512

Marina Menga, *Press Office, CMCC*
marina.menga@cmcc.it
tel: +39 0832 1902411, ext. 303

www.cmcc.it