URBAN RESEARCH AT BC3, BASQUE CENTRE FOR CLIMATE CHANGE

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BASQUE CENTRE
FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

www.bc3research.org

BC3, Basque Centre for Climate Change, is a Basque Excellence Research Centre (BERC) created in 2008 jointly by the Basque Government and the University of the Basque Country.

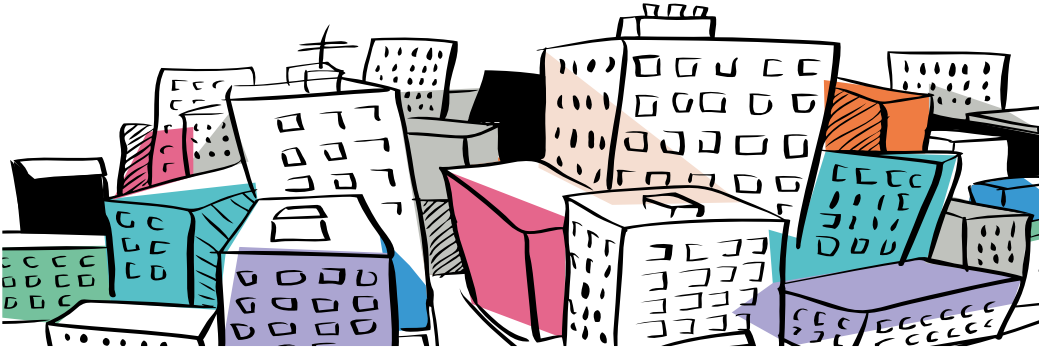
Led by one of the most recognised scientists in this field, Prof. Maria José Sanz, BC3 aims to contribute to long-term research on the causes and consequences of climate change.

In BC3, we work to provide scientific knowledge to inform decision making at the Basque, Spanish, and international level by integrating natural and social sciences to address the socio-economic implications of global climate change.

The centre has the primary objective of achieving excellence in Research, Training and Dissemination.

URBAN RESEARCH AT BC3

BC3 focuses its main research activities in four major areas: (1) Low carbon, (2) Climate and Natural Environment, (3) Health and Climate and (4) Climate policy. Urban research at BC3 interacts with these four research areas emerging as a multidisciplinary field that explores the contribution of cities to global warming and the ecological, political, social and economic implications of climate change at the local scale.



1

FLOOD-RISK ASSESMENT UNDER UNCERTAINTY: THE CASE OF BILBAO

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The Basque Country is an area with high-risk due to natural flood hazard, which is the result of a combination of natural and socio-economic drivers, but it also presents a high vulnerability, with most of its low-lying areas densely urbanised. The peninsula of Zorrotzaurre, once a heavy industrial area, is now planned to be the newest urban district of Bilbao and the risk of flooding represents a major challenge for this urban area. The adoption of the Special Urban Plan for Zorrotzaurre in 2007 included an **important initiative to reduce flood-risk: the opening of the Deusto Canal** which will turn Zorrotzaurre into an island. However, a great degree of uncertainty still exists about the timing (when will it occur) and extent of current and future flood-risk. This study develops a stochastic model that contains two risk factors: the frequency of extreme events, modelled with three Poisson processes, and the stochastic growth rate of the damage due to **climate and socio-economic effects under uncertainty.** The study calculates an analytical solution for the Net Present Value (NPV) of investment at a given time, and a binomial tree is used to study whether the best decision at present is to invest or to wait. **The study concludes that the opening of the canal can be considered a no-regret adaptation** measure and supports the decision of investing in adaptation to reduce current and future flood-risk.

ECONADAPT Project funded by the European Commission
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2

ENVIRONMENTAL AND ECONOMIC IMPACT OF THE SUSTAINABLE ENERGY ACTION PLAN OF THE CITY OF BILBAO

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Energy efficiency programs aim to rationalise energy consumption and reduce carbon emissions. In the last 10 years an increasing number of cities and regions have developed efficiency plans. Energy efficiency programmes typically require initial investment in new infrastructure and more efficient equipment which is compensated by lower energy costs. This study analyses the (direct and indirect) economic and environmental effects of an energy efficiency plan based on real case study of the city of Bilbao. The city of Bilbao joined the Covenant of Mayors in 2010 and submitted its Sustainable Energy Action Plan (SEAP) in 2012. The study developed by BC3 addresses the measures included in this plan and strives to **differentiate between new additional measures and those that would have been implemented anyway.** It also accounts for alternative uses of funds for the programme. These are critical issues to understand the real economic and environmental effects of these plans and thus avoid double counting of multiplier effects.

The results show that **one euro invested in SEAP** can be said to produce €1.27 in outcome and €0.18 in income. But, focusing solely on the additional measures, each euro of investment increases output by €0.26 and decreases income by €-0.02. Therefore, it can be said that the **Plan meets the objectives, provides economic benefits and reduces CO_2** emissions in the period, even when only the measures stemming directly from the plan are considered. In conclusion, these results highlight the importance of distinguishing, when assessing the plan, between actions determined by the plan itself and actions that would have been implemented anyway as the effects could be overvalued.

Study supported by REPSOL Foundation
Foundation through the Low Carbon Programme (www.lowcarbonprogramme.org)

3

ASSESSING THE BENEFITS OF EARLY WARNING FOR URBAN FLOOD RISK TO PEOPLE: THE CASE OF ZURICH

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This study develops a novel methodology to assess flood risk to people by integrating people's vulnerability and ability to cushion hazards through coping and adapting. The model is used to estimate the effect of **improving an existing Early Warning System.**

The proposed approach extends traditional risk assessments beyond material damages; complements quantitative and semi-quantitative data **with subjective and local knowledge**, improving the use of commonly available information; produces estimates of model uncertainty by providing probability distributions for all of its outputs.

Flood risk to people is modelled using a spatially explicit Bayesian network model calibrated on expert opinion. Risk is assessed in terms of: (1) likelihood of non-fatal physical injury; (2) likelihood of post-traumatic stress disorder; (3) likelihood of death. The study area covers the **lower part of the Sihl valley (Switzerland) including the city of Zurich**. Model results indicate that the potential benefits of an improved early warning in terms of avoided human impacts are particularly **relevant in case of a major flood event.**

KULTURisk Project funded by the European Commission
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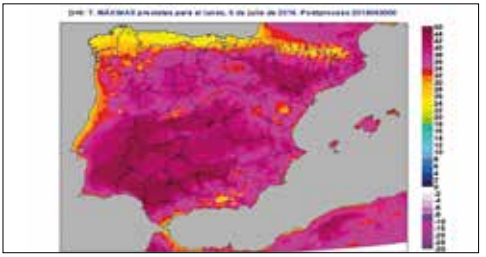

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HEAT HEALTH WATCH WARNING SYSTEMS AND THRESHOLD TEMPERATURE

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The frequency, intensity and duration of heat waves are expected to increase in the coming decades, as an effect of the changing climate, posing increased hazard to human health, particularly in urban settings and among vulnerable population groups, such as the elderly, people in poor health and children. In this context, **heat health watch warning systems (HHWWS)** have been established at city and national levels **to inform citizens** about possible ways to guard against excessive heat exposure **and to implement emergency plans.** A heat warning is issued when a critical threshold temperature is exceeded above which observed population mortality start to increase significantly, according to epidemiological evidence.

A case study carried out in the city of Madrid has shown that the incorrect setting of the threshold temperature may result in a significant increase in total costs associated with the implementation of the HHWWS and decreased effectiveness of the system to reduce heat-related health impacts. Final results suggest that a **periodical evaluation of the threshold temperature over time is essential** to deliver effective urban adaptation measures in a changing climate and that long term projections of heat wave impacts and adaptation measures need to take into account acclimatisation processes.

BASE Project funded by the European Commission
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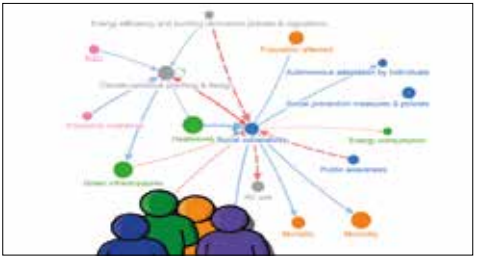

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INTEGRATED AND PARTICIPATORY CLIMATE ADAPTATION PLANNING

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Developing climate policies is a challenging issue. Cities are complex environments and climate change poses many challenges. Climate change impacts have a multilevel and cross-sectoral nature. This means that **impacts affect to different spatial levels in different ways and to different sectors**, which are interconnected. For this reason, accounting for information on-the-ground to plan urban management and planning interventions could improve the efficiency of urban policies and therefore, people's lives. In particular, participatory approaches that elicit stakeholders' and experts' knowledge and experience are useful to link sectors, institutions, stakeholders and population groups. **Using participatory approaches may reveal 'hidden' or less evident information** but not for that less important.

In the city of Madrid, a participatory cause-effect mapping approach was developed to collect information directly from key stakeholders and decision-makers working in different sectors presumably **impacted by heatwaves.** This **mapping approach allows generating scenarios** of the impact of potential climate adaptation interventions such as the deployment of green infrastructures or the performance of heat warning plans. Being multi-sectoral and expert-based, this becomes a very useful tool in integrated decision-making as it aggregates knowledge from various sources critical to plan the future of the city.

BASE Project funded by the European Commission
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6

SEA-LEVEL RISE AND EXTREME EVENTS: A FLOOD-RISK ANALYSIS IN PLENTZIA (BASQUE COUNTRY)

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A great part of the world population and major socio-economic infrastructures are located in coastal areas. Only in the last 40 years, the **population at risk of coastal extreme events has almost doubled.** This situation is expected to become worse for most coastal towns and cities around the world due to the effect of climate change and sea-level rise (SLR).

In this context, this study was designed to assess the **risk of coastal flooding in the town of Plentzia,** located in the Basque Country (Spain), considering different scenarios of SLR and its combined effect with maximum astronomic tides. Flood-risk maps were used to **identify the assets exposed and estimate the potential economic damages** under each scenario.

Results show significant impacts when astronomic tides are considered. Under the most pessimistic scenario, **some areas could be affected already by 2030** and damage costs could increase by 15 from 2030 to 2100 as shown in the map. Identifying those areas most at risk, as well as the potential timing of the impacts, can be a very relevant input for policy makers in order to design effective adaptation policies, especially those with a long-term time-span, such as urban planning.

Doctoral Dissertation ELISA SAINZ DE MURIETA
(University of the Basque Country, 2016).

7

GREEN ROOFS: A SOLUTION FOR URBAN ADAPTATION TO CLIMATE CHANGE?

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Green infrastructure is becoming an important concept in environmental and urban planning. **Nature-based solutions** in the urban context are presented as providing large services and benefits locally and globally to society. Among these nature-based solutions, extensive green roofs are particularly relevant as they are expected to provide various services: water runoff regulation, air quality regulation, energy savings, carbon sequestration, urban climate regulation, biodiversity conservation or aesthetic services.

In a study developed **in the city of Madrid, the social profitability of extensive green roofs has been tested.**

The estimated services are derived from energy savings for cooling, carbon footprint reduction, rain water retention and reduction of heat-wave related mortality, in a climate change context. This study emphasises that accounting for the urban-ecological processes like urban heat island regulation or epidemiological processes, is the most appropriate way to estimate the performance of green roofs **with the least possible bias**. Results highlight the **large uncertainty** in the deployment of green roofs as an urban strategy of adaptation to climate change.

BASE Project funded by the European Commission
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8

PROMOTING GREEN AREAS AND HUMAN HEALTH: PROGRAMS WITH MULTIPLE BENEFITS

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Nature is a foundation of human health, as clean water and air, healthy environment, healthy management of livestock are all crucial for public health. Moreover, direct contact with nature contributes to improve immune function, mood and concentration, while reducing stress and increasing the benefits of physical exercise. **Non-communicable diseases (NCDs**), such as heart disease, diabetes, cancer, and chronic respiratory illnesses, are now a global health epidemic. More than 36 million people die every year from NCDs, and this is projected to increase to 44 million by 2020, with **higher vulnerability in urban areas** and among economically disadvantaged groups.This vulnerability can be reduced by changes in lifestyles..

In this context, the ECOHEALTH project has analysed the co-benefits provided by green areas within a multi-sectorial approach in a context of climate change. The analysis has shown that **green spaces can be effective adaptation options** as they can provide a localised cooling effect, while decreasing the risk of flooding and improving water quality. At the same time, they provide other co-benefits, such as improving air quality by cutting particulate pollution, reducing traffic noise, **and improving human health, both physical and psychological,** offering opportunity for recreational activities and thus promoting more active lifestyles.

ECOHEALTH Project, funded by Fundación Biodiversidad
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FLOOD-RISK PREVENTION: THE IMPORTANCE OF THE SPATIAL ASSESSMENT OF THE RISK

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Flood-risk prevention measures are designed to reduce the adverse consequences associated with floods for humans, the environment, cultural heritage and economic activity, as per the EU Floods Directive. In this context, spatial hydro-economic approaches are widely used to estimate expected flood risks and present advantages for prevention.

Such approaches provide relevant information for flood prevention to policy makers such as: i) information necessary to prioritise locations and sectors and ii) information on the distribution of the expected risks, whether they originate from frequent floods with slight consequences or from exceptional floods with major consequences. **The spatial assessment reveals how the risk is distributed** between upstream and downstream cities. The case study developed in Zaragoza showed how flood infrastructural measures transferred the risks to downstream floodplains, which were originally less densely populated. In terms of flood risk prevention the spatial distribution of the risk implies **the coordination and the complementarity of institutional, infrastructural, environmental and socio-economic prevention measures** to effectively reduce the risk along the river catchment and prevent cascading effects.

Figure: Example of an index used to estimate the risk on humans. The Hazard Ratio (HR) considers flow velocity, water depth and the presence of debris. The higher HR, the higher the hazard humans are exposed to.

PREEMPT Project funded by the European Union DG Humanitarian Aid & Civil Protection (Grant Agreement 070401/2010/579119/SUB/C4).

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