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Assessing Vulnerability to Climate Change: An Approach Illustrated through Large Urban Scale Adaptation (Urb-ADAPT)

Authors: Roberta Paranunzio, Barry O'Dwyer, Paul J. Alexander, Marco Guerrini, Ned Dwyer and Jeremy Gault

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Rialtas na hÉireann
Government of Ireland

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

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- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
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- waste water discharges;
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- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
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- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

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Assessing Vulnerability to Climate Change: An Approach Illustrated through the Large Urban Scale Adaptation (Urb-ADAPT) Project

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Prepared for the Environmental Protection Agency

by

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Cover image: Dublin City from the air, looking east.

This report is based on research carried out/data from 2015 to 2019. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

Globally, climate change will have wide-ranging effects on all aspects of society, the environment and the economy. This is particularly the case for urban areas, which represent only a small fraction of the Earth's surface (less than 3%), but are where more than half of the global population resides and concentrations of assets and economic activities are found. While urban areas will generally experience the same exposure to climate change as their surrounding regions, climate change poses particular risks for urban areas. This is as a result of the process of urbanisation, which results in changes in land use, land cover and land surface characteristics that subsequently modify the local climate, moisture exchanges and ecosystem services, promoting heat trapping and storage.

Actions to adapt to our current and future climate need to be taken to manage climate change risk. Adaptation involves taking action to reduce the adverse impacts of climate change while taking advantage of any opportunities that these changes might bring. Planned adaptation actions in conjunction with ongoing mitigation strategies are essential. Furthermore, because of the enhanced vulnerability of urban areas, the adaptation of cities to climate change impacts is now considered a priority in developing adaptation strategies.

When planning for climate change adaptation, identifying and assessing vulnerability to climate change form a key component in the development of robust adaptation strategies in accordance with national adaptation policy and guidance. On the basis of the outputs of the Environmental Protection Agency-funded Large Urban Scale Adaptation (Urb-ADAPT) project, this report provides an overview of how to undertake a vulnerability assessment and illustrates the approach, with reference to the evolution of vulnerability to climate change in the Eastern and Midlands Region of Ireland, in relation to heat, pluvial flooding and coastal inundation over the coming decades.

1 The Issue

Climate change will have wide-ranging effects and this is particularly the case for urban areas, where more than half of the global population resides and concentrations of assets and economic activities are found. Coastal cities and urbanised regions that are sufficiently densely populated and of a spatial scale sufficient to influence their climate at a neighbourhood scale (about 1 km^2) are particularly vulnerable. In this context, in Ireland more than 50% of the population is concentrated in the coastal zone, with the majority located in five major urban centres, i.e. Dublin, Cork, Limerick, Waterford and Galway. Ireland's climate is changing in line with global trends and these changes are expected to continue and intensify into the future, resulting in higher average temperatures, an increased frequency of heatwave conditions, changes in patterns of precipitation and sea level rise (Dwyer, 2013; Nolan, 2015). Therefore, it is vital to develop robust strategies to make Ireland's urban areas more resilient to climate change. In developing these strategies, it is essential that the vulnerability of Ireland and its urban areas is accounted for. This report outlines how vulnerability to different climate hazards may be assessed; this is illustrated for three different hazards for the Eastern and Midlands Region of Ireland, with a focus on the Dublin area.

Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse climate change impacts (IPCC, 2007).

2 Vulnerability and Mapping

The terms “vulnerability” and “risk” are often used to describe the potential effects of climate change on ecosystems, infrastructure, economic sectors, social groups, communities and regions. Here, the integrative vulnerability concept, presented in the Intergovernmental Panel on Climate Change’s (IPCC’s) Third and Fourth Assessment Reports, and defined at the end of the previous chapter, is used. Defined in this way, vulnerability comprises three concepts: exposure, sensitivity and adaptive capacity (Figure 2.1). The first two (exposure and sensitivity) determine the potential impact of climate change based on its interaction with the system being considered, while adaptive capacity represents the ability of the system to respond.

- *Exposure* is the presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure, and economic, social or cultural assets in places and settings that could be adversely affected by significant climate variation, e.g. extreme events (IPCC, 2014). If a population is not exposed to a climate hazard, there would be no risk. Similarly, if it is exposed but has a sufficient ability to respond to climate change effects, it is not vulnerable to the risk.
- *Sensitivity* is the degree to which a system is affected, either adversely or beneficially, by climate change (IPCC, 2014).
- *Potential impact* is defined as a combination of exposure and sensitivity. However, even though a system can be considered highly exposed and/or sensitive to climate change, it does not necessarily mean that it is vulnerable. This is because neither exposure nor sensitivity accounts for the capacity of a system to adapt.
- *Adaptive capacity* is the ability of a system to adjust to potential impacts of climate change, to cope with its consequences or to take advantage of opportunities (IPCC, 2014).

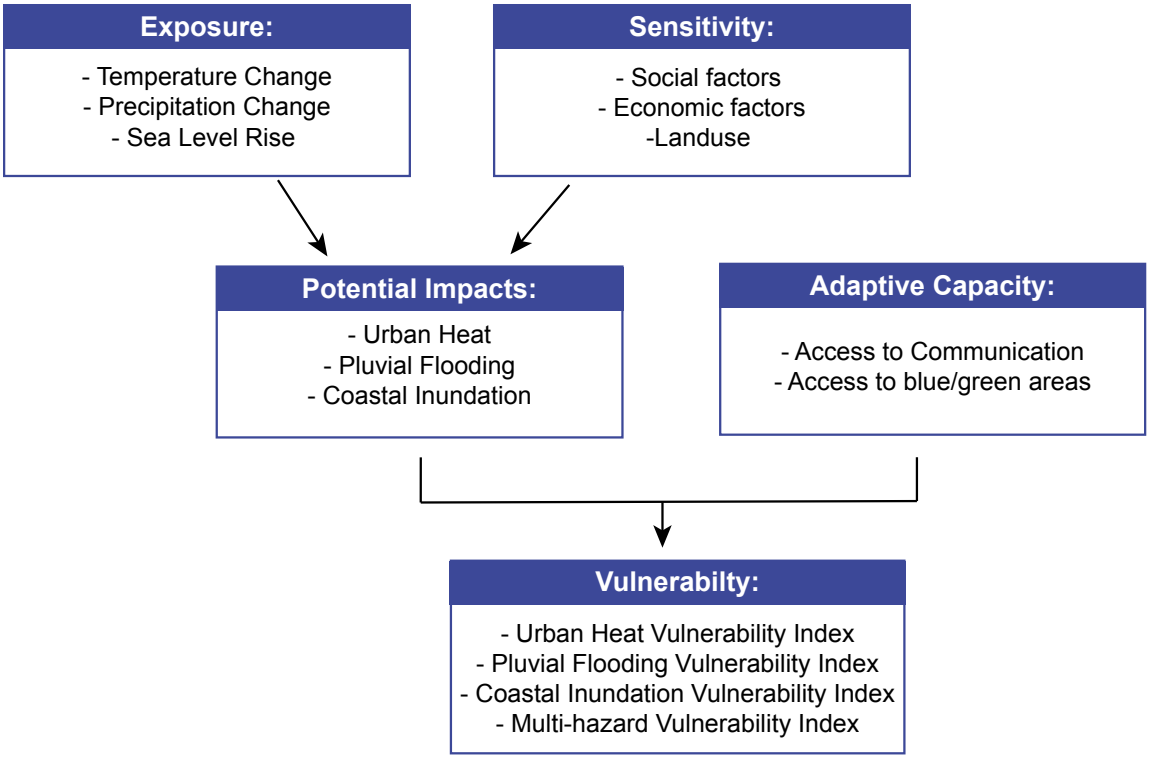

Figure 2.1. Schematic diagram of vulnerability including the five key concepts (exposure, sensitivity, potential impacts, adaptive capacity and vulnerability). Key factors considered for each of the key concepts as part of the Urb-ADAPT project are highlighted.

Vulnerability mapping entails the mapping of the key components of vulnerability (exposure, sensitivity and adaptive capacity), which are then aggregated into a vulnerability index. Vulnerability maps show the location of vulnerable areas, populations and assets and are important because they provide assessments of the individual and social impacts of a changing climate, which are more significant than the actual physical changes to the climate. Therefore, vulnerability mapping goes beyond considerations of changes to the climate itself and incorporates the sensitivity and adaptive capacity of societies, which can potentially be managed to influence the outcomes of the changes.

Assessing vulnerability forms a key step in planning for climate change adaptation and, in accordance with the requirements of the national adaptation policy (DCCAE, 2018a) and local and sectoral guidance (DCCAE, 2018b,c), this guidance adopts an adaptive management approach, is stepped and is iterative. Assessing vulnerability forms a key component of steps 2, 3 and 4 (Figure 2.2).

The aim of this report is to provide guidance on how to take vulnerability into account when developing climate adaptation plans for urban areas. It describes useful datasets that may be used, the methods for calculating exposure to climate hazards and the methods for determining the sensitivity and adaptive capacity of populations, and then shows how these can be combined to provide spatio-temporal maps of climate vulnerability to specific hazards. Case studies for the Eastern and Midlands Region and Dublin city illustrate the approach in relation to vulnerability to heat, pluvial flooding and coastal inundation.

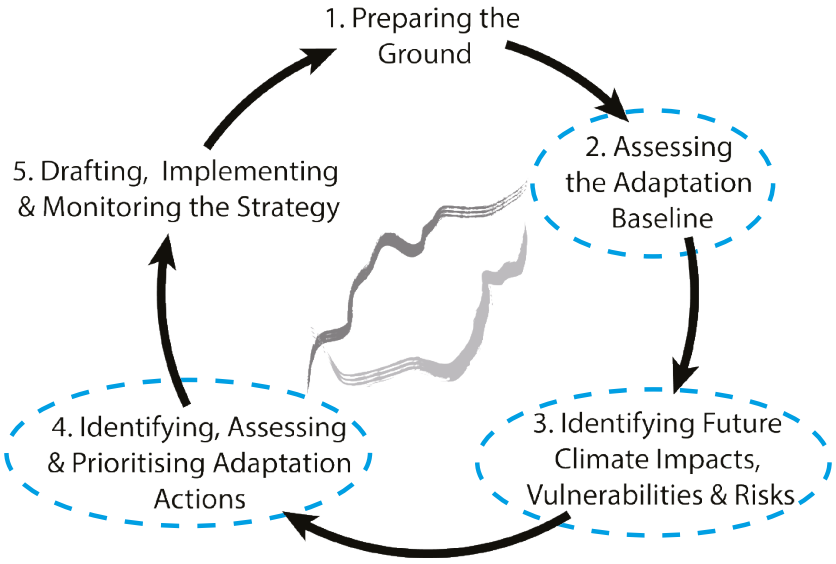

Figure 2.2. Schematic diagram of the adaptation strategy development process showing the five different steps (DCCAE, 2018b). The relevant steps for mapping vulnerability are highlighted in blue.

3 Determining Potential Impact

The potential impact of climate change is a combination of the physical exposure to a particular hazard and the sensitivity of the population based on socio-economic considerations, among others. The scale at which impact can be assessed may be national, regional or local. Here, the analysis is carried out for the Eastern and Midlands Region and at the Central Statistics Office (CSO) small-area scale.

3.1 Assessing Exposure

The goal of this step is to identify the environmental conditions that can have an impact on the levels of exposure of populations and infrastructure to climate changes (e.g. increasing temperatures). To support this identification, it can be helpful to look at how the climate has been evolving in recent decades. National tools such as the climate status report (Dwyer, 2013) can support this analysis. Although there are significant uncertainties as to how exposure will change, future climate scenarios provide a useful range of likely hypotheses. The Climate Ireland Platform[1] provides up-to-date information on future climate scenarios for Ireland. This report explores future changes relating to exposure to projected changes in heat, rainfall and sea level.

3.1.1 Future climate scenarios

Levels of climate change are dependent on current and future amounts of greenhouse gas (GHG) emissions. As a result, to estimate future changes in the climate, trajectories of the evolution of global emissions of GHGs are required. To achieve this, the IPCC (2014) has adopted four GHG concentration trajectories, i.e. representative concentration pathways (RCPs), which provide estimates of the radiative forcing of the atmosphere as a result of different levels of GHG emissions. For the purposes of modelling urban-scale changes in climate for Ireland, projected climate data for Ireland were sourced from published data (Nolan, 2015) for two RCPs – RCP 4.5 and RCP 8.5 (representing medium and high levels of GHG emissions, respectively) – and these data were further developed to account for the urban effect on climate by employing a finely resolved urban climate model (Figure 3.1). These models can be used to

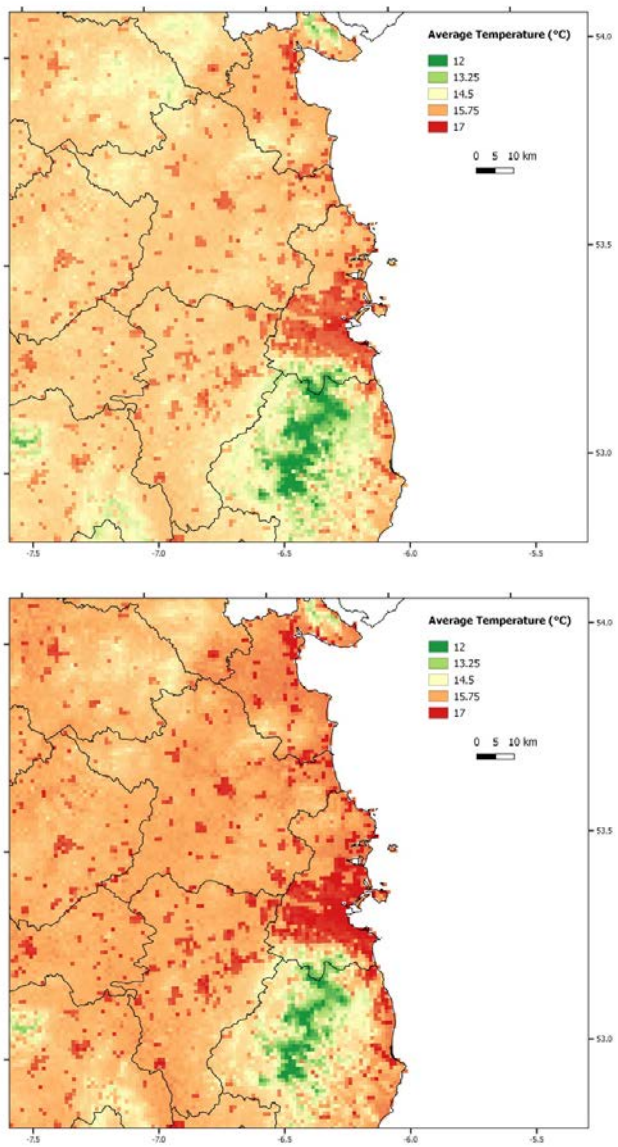

Figure 3.1. Monthly average temperature for the 2050s under RCP 4.5 (top) and RCP 8.5 (bottom), downscaled for Ireland in the month of July. The figure highlights the urban heat island effect in towns and cities, where warming is exacerbated by the built environment.

1 https://www.climateireland.ie (accessed 12 March 2020).

investigate exposure to climate changes as a result of changes in temperature, rainfall and sea level, among others, over future decades.

3.1.2 Climate hazard exposure indicators

Based on these projected changes, a range of climate hazard exposure indicators may be considered. These can range from indicators of heat stress or cold stress to people, to indicators of the requirement for additional heating or cooling of buildings, flooding depth or flood duration due to rainfall or river overflow, the duration and intensity of a drought, effects on flora and fauna in protected areas, etc.

For the purposes of the Large Urban Scale Adaptation (Urb-ADAPT) project, the Universal Thermal Climate Index (UTCI) was employed to quantify exposure to heat stress (Jendritzky *et al*., 2012; Pappenberger *et al*., 2015). The UTCI categorises heat stress into 10 categories ranging from “extreme heat stress” to “extreme cold stress”. Each category is defined by a specific range of UTCI values, and is representative of the load caused by physiological and thermoregulatory responses of the human body when responding to the actual environmental conditions.

Figure 3.2 illustrates the number of hours of exposure to conditions that would be conducive to strong heat stress on the population of the Eastern and Midlands Region during the month of July in 2050 and under RCP 8.5. Strong heat stress refers to a UTCI equivalent temperature from +32 to +38°C. As can be seen, the approach highlights the accentuating effects of urban areas on the thermal environment.

3.2 Assessing Sensitivity and Adaptive Capacity

The sensitivity and adaptive capacity of an area is dependent on a range of factors, including land cover, demographics and socio-economics. To assess the sensitivity and adaptive capacity of the Dublin area to climate impacts, land cover information and 2016 national census data from the CSO have been used.

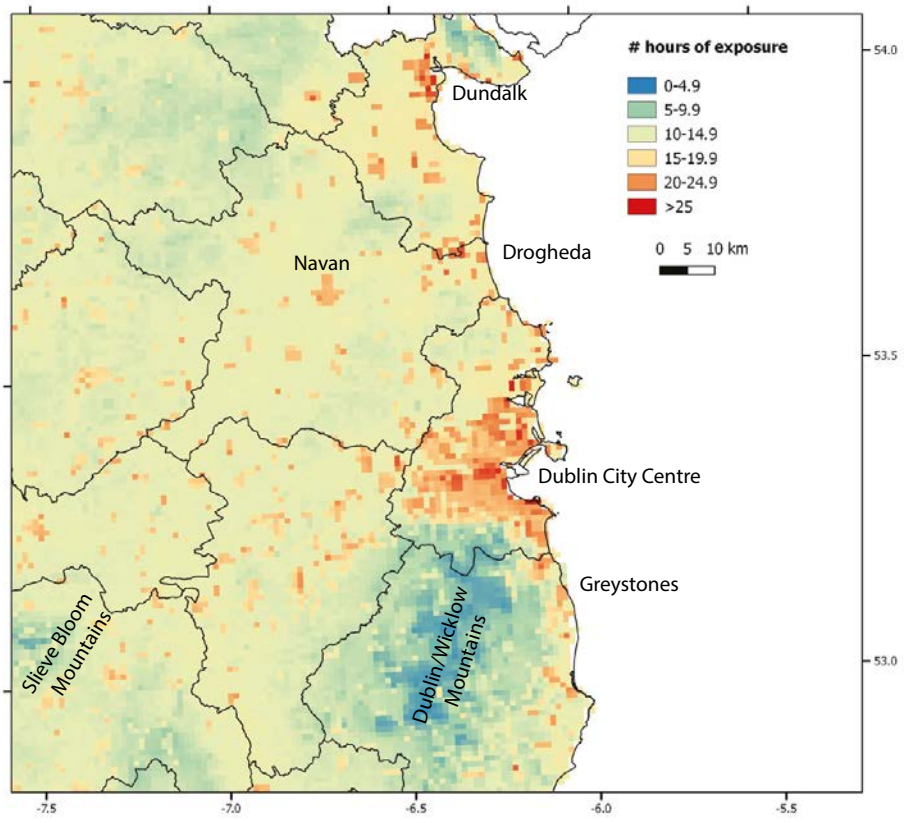

Figure 3.2. Exposure to heat in terms of strong heat stress based on the UTCI under RCP 8.5 for the 2050s in the month of July across the Eastern and Midlands Region.

3.2.1 Land cover

Different urban development scenarios could have significant impacts on local-scale climate conditions across a city during a typical climatological year. For example, differences in the land cover and surface morphology drive intra-urban variations in local and micro-scale air temperature and hydrology, in terms of run-off and subsequent landscape responses to extreme events. In order to account for the influence of land cover on the climate across the Eastern and Midlands Region, urban extent models for future decades were developed based on 2012 CORINE Land Cover (CLC) data and information garnered from consultation with planners in the Eastern and Midlands Region (Figure 3.3).

3.2.2 Demographic and socio-economic indicators

An indicator mapping approach allows exploratory analyses of climate change vulnerability. Although the selection of the specific demographic and socio-economic status indicators to be examined is subjective, they can be used to provide an estimate of a population's sensitivity and adaptive capacity to climate changes. The indicators developed through the Urb-ADAPT project were from the 2016 census records collected and held by Ireland's CSO and the CLC 2012 dataset (EEA, 2019) (Table 3.1). Calculation of future socio-economic scenarios was beyond the scope of this work, but it would be useful to investigate approaches such as shared socio-economic pathways in future iterations (O'Neill *et al*., 2014).

3.2.3 Sensitivity and adaptive capacity index

The above indicators were combined in a mathematical process to determine a sensitivity and adaptive capacity index. It was then possible to categorise this index from least sensitive to most sensitive and map it at the required scale (Figure 3.4).

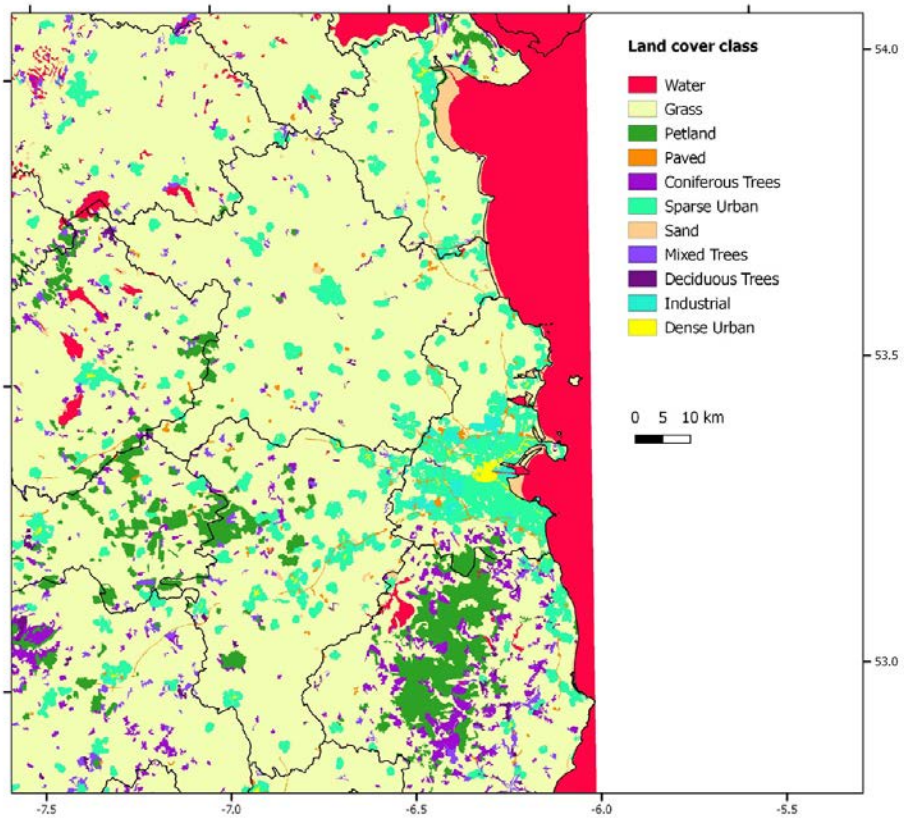

Figure 3.3. Modelled land cover for the Eastern and Midlands Region for 2050 at 30-m resolution according to 11 land cover classes. Four urban classes (dense urban, sparse urban, industrial and paved) and seven non-urban classes (water, peatland, coniferous trees, deciduous trees, grass, mixed trees and sand) are included.

Table 3.1. Indicators used to assess sensitivity and adaptive capacity

Domain	Data
Urbanisation	Population density
Employment/income	Persons unemployed
Housing	House ownership
	Year property built
Household composition	One-person households
Health	Persons with disability
	Persons with poor health
	Age < 15 years
	Age > 65 years
Education	Persons with less than a secondary school diploma
Travel	Households without a car
Information access	Households with internet access
	Persons with a low level of English
Physical environment	Land area with green/blue spaces

The physical environment data were sourced from the CLC 2012 dataset, with the remaining data coming from the CSO census 2016.

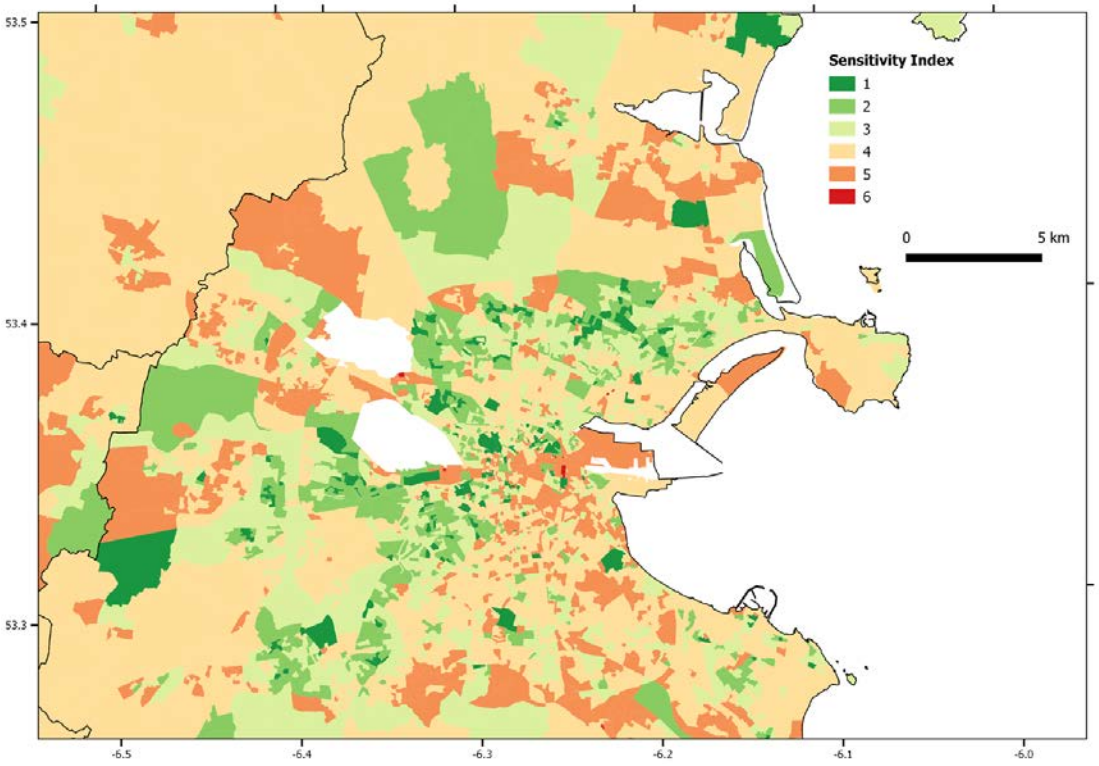

Figure 3.4. Sensitivity and adaptive capacity index map across Dublin city based on 2016 CSO data and current land cover. The index is displayed at the CSO small-area scale and ranges from 1 (least sensitive, green colour) to 6 (most sensitive, red colour).

3.3 Identifying Impacts and Vulnerabilities

Relevant stakeholders should be consulted in order to garner specific information in relation to validating vulnerability mapping, identifying impacts of climate change vulnerabilities and highlighting areas of particular concern (Table 3.2). Consultation can help identify specific needs and concerns, as well as identify preferred outcomes. Stakeholders can also contribute to the methodology employed in calculating vulnerabilities and provide feedback on map products and outputs.

3.4 Mapping Vulnerability

Vulnerability to climate change impacts is determined by exposure, sensitivity and adaptive capacity. For the purposes of developing indicators of climate vulnerability, data on exposure and sensitivity and adaptive capacity should be standardised on a spatial basis and then integrated to develop indicators of vulnerability for the climate hazard under investigation. Methods of integration can vary, as can the scale of analysis, the specific indicators incorporated, the weights applied, etc.

For the purposes of the Urb-ADAPT project, data on exposure to pluvial flooding and sensitivity and adaptive capacity have been standardised at the CSO small-area scale and then integrated to develop a flood vulnerability indicator. Figure 3.5 illustrates vulnerability to pluvial flooding in Dublin city and highlights the effects of sealed surfaces, located primarily in the city centre and surrounds, on exacerbating vulnerability to pluvial flooding impacts. Although a CSO small area is shown with a specific vulnerability, not all of the small area may be equally vulnerable, especially in the larger spatial areas.

Table 3.2. Some impacts of exposure to heat as identified by stakeholders engaged through the Urb-ADAPT project

Exposure	Sensitivity	Consequence
Hospitals, crèches, general practices, primary health-care centres (located in urban centres)	• Vulnerable populations (elderly and young) • Children's hospital in James Street • Maternity hospitals, such as the Coombe, Rotunda and Holles Street	• Provision of water/shaded areas • Ultimately, each hospital will need to devise a plan to address climate change based on the services it provides
Areas of planned development	• These areas are planned to include a mix of residential and commercial developments, and planned densities would be expected to exacerbate exposure to projected changes in temperature, potentially reflecting those levels projected for the urban core	• Building and neighbourhood design needs to account for heat-related effects
Older areas	• Older areas that are predominately paved	• Challenges with regard to retrofitting
Commercial operations	• Data centres • Business parks • Certain flagship business parks	• Implications of heat effects on operations • Currently sited on the basis of serviceable sites – may reach saturation or ability to provide sites may become compromised
Beaches/recreational areas	• Environmental conditions put at risk because of increased visitor numbers	• Implications for ecosystem/habitat health
Tree planting	• Existing tree types may not be suitable under future climatic conditions – right tree, right place, right time	• Costs of replacing trees and maintenance
City centre	• Becomes uncomfortable for tourists (and elderly residents) to walk around or use public transport	• Loss of income because of reduction in attractiveness as a visitor destination • Consider adequate provision for cooling/ shading/fountains/bicycles
Green – agricultural zones	• Located in the hinterlands of city	• Services they will be able to provide to city in terms of adaptation
Young population in city centre	• Access to relief areas (parks) and commutes to school	• Health and well-being implications

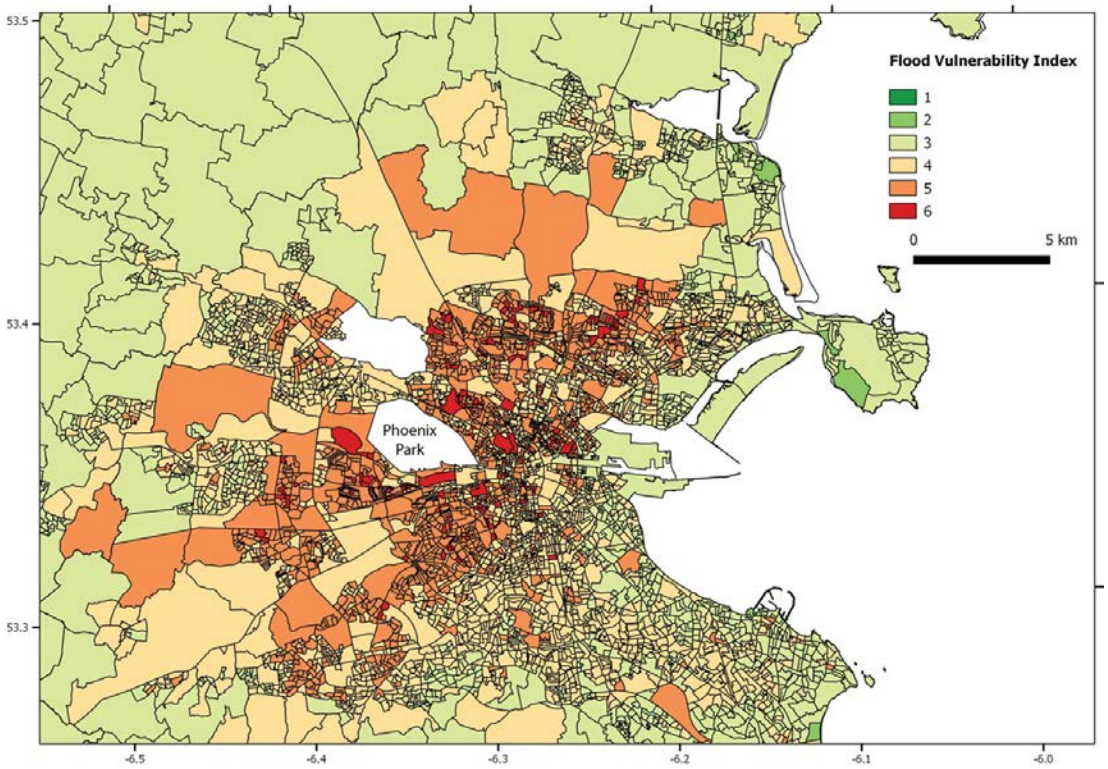

Figure 3.5. Vulnerability to pluvial flooding across Dublin city under RCP 4.5 for the 2050s. The vulnerability index is displayed at the CSO small-area scale and ranges from 1 (lowest, green colour) to 6 (highest, red colour). The small areas constituting Phoenix Park and green areas to the north of Phoenix Park have been removed from the calculations as their characteristics as large green areas with very low populations are inappropriate for this analysis.

4 Case Study: Heat

Projected changes in temperature will have implications for energy consumption, e.g. air conditioning for cooling on hot days. Cooling and heating degree days are typical indicators of household energy consumption, i.e. they are used to estimate heating and cooling energy requirements and performance. Cooling degree days can be used as a measure of population exposure to overheating. Based on this measure (Figure 4.1) and the sensitivity and adaptive capacity index (Figure 4.2), the vulnerability of populations across Dublin to heat can be assessed for different climate scenarios and future time periods (Figure 4.3).

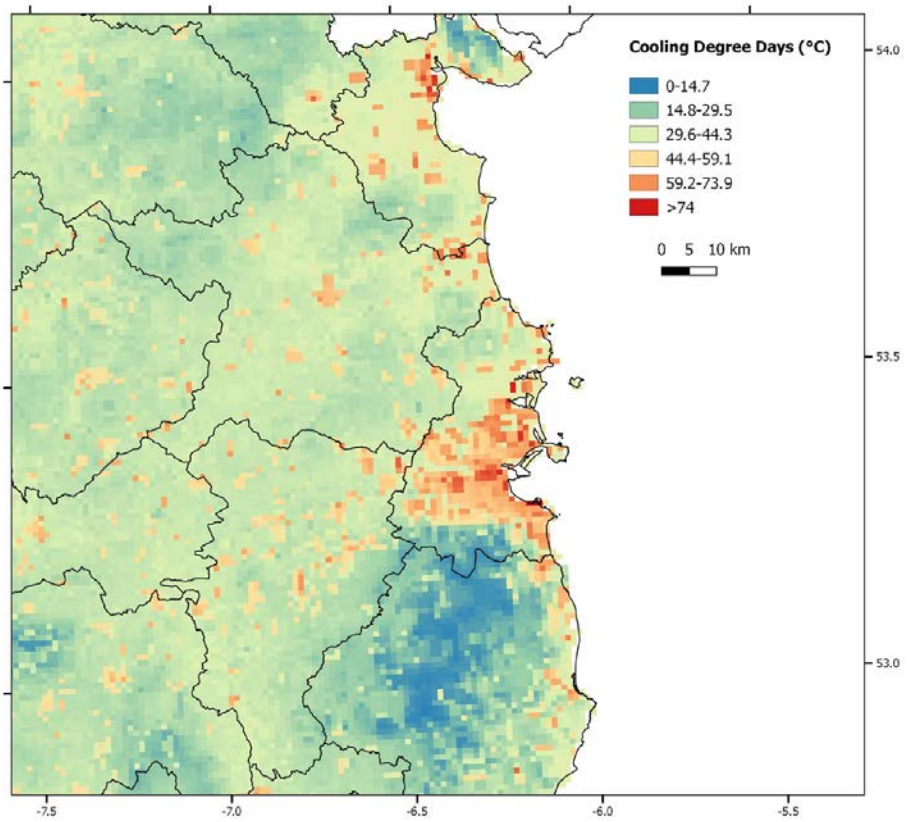

Figure 4.1. Exposure to heat in terms of cooling degree days under RCP 8.5 for the 2050s in the month of July across the Eastern and Midlands Region.

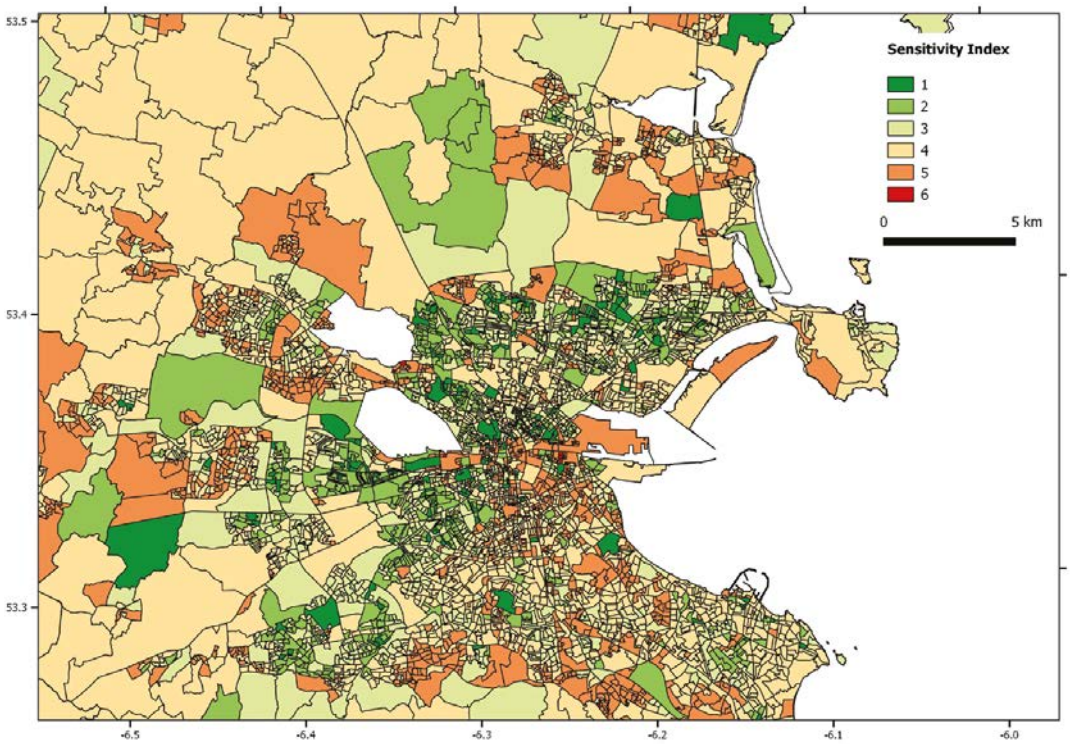

Figure 4.2. Sensitivity and adaptive capacity index map across Dublin city based on 2016 CSO data and 2012 CLC data. The index is displayed at the CSO small-area scale and ranges from 1 (least sensitive, green colour) to 6 (most sensitive, red colour).

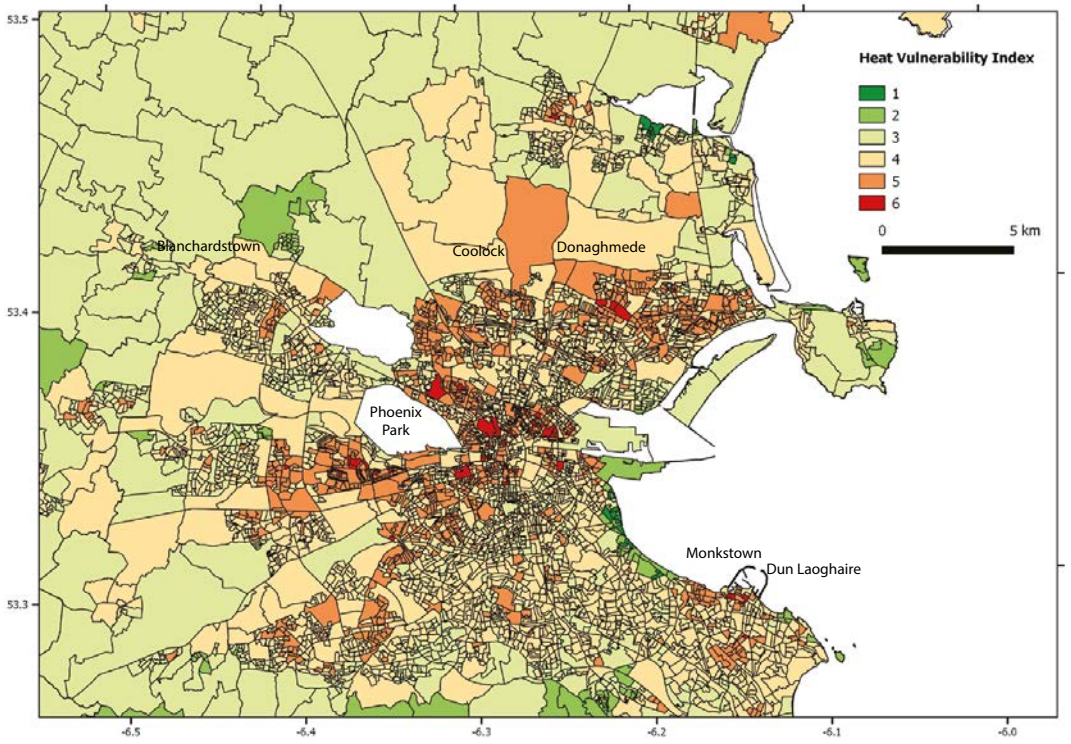

Figure 4.3. Vulnerability to heat based on cooling degree days across Dublin city under RCP 8.5 for the 2050s during the month of July. The vulnerability index is displayed at the CSO small-area scale and ranges from 1 (lowest, green colour) to 6 (highest, red colour). The city centre and surrounding areas, as well as Monkstown and Dún Laoghaire, are particularly affected by heat, along with zones in and around Donaghmede and Coolock.

5 Case Study: Pluvial Flooding

Projections of rainfall show ambiguous patterns worldwide, with lower confidence and larger uncertainties than is the case for temperature changes. It is also the case that change in pluvial flooding is essentially driven by changes in land cover and not changes in the climate per se. Figure 5.1 shows the probability of flooding across the Eastern and Midlands Region in the 2050s under projected climate and land use change. Figure 5.2 shows the sensitivity and adaptive capacity of the Dublin area to pluvial flooding and Figure 5.3 shows the vulnerability of the Dublin area to pluvial flooding.

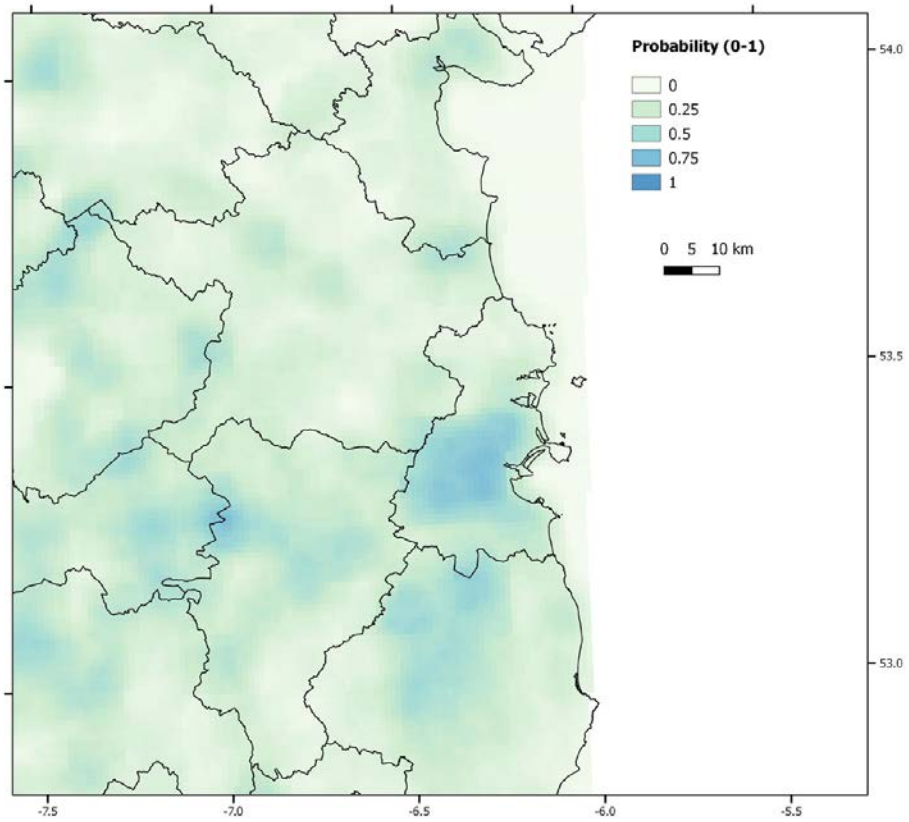

Figure 5.1. Modelled exposure to pluvial flooding in terms of the probability of a surface being flooded under RCP 4.5 for the 2050s across the Eastern and Midlands Region, based on a one in a 100-year event.

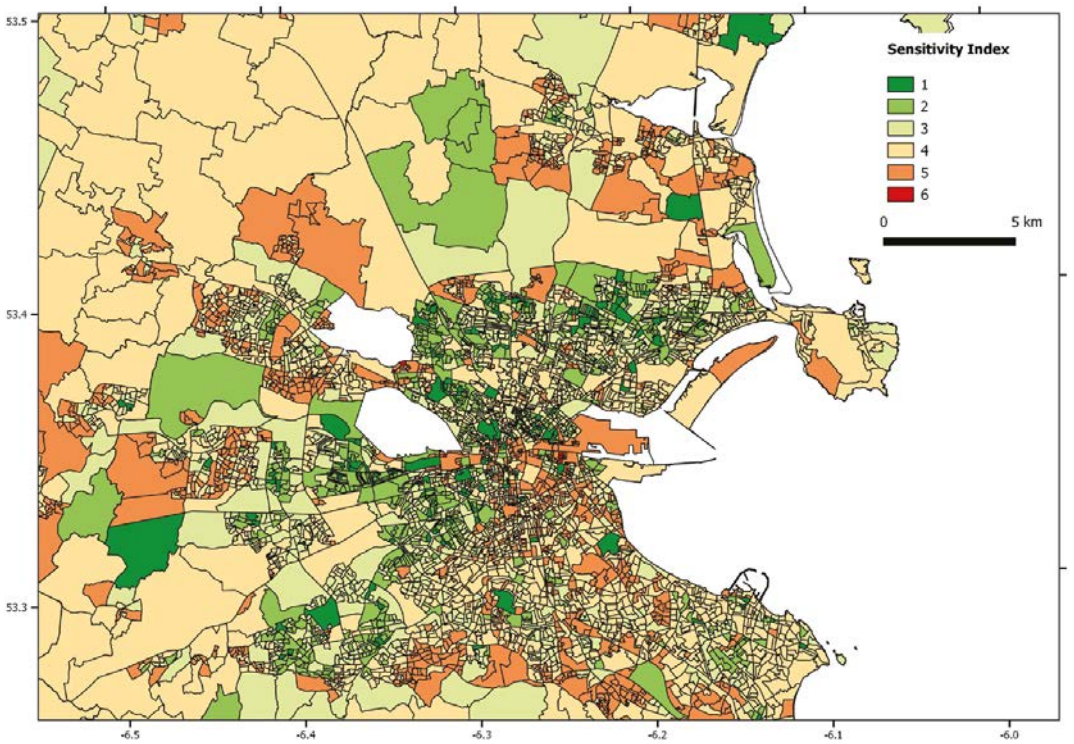

Figure 5.2. Sensitivity and adaptive capacity index map across Dublin city based on 2016 CSO data and 2012 CLC data. The index is displayed at the CSO small-area scale and ranges from 1 (least sensitive, green colour) to 6 (most sensitive, red colour).

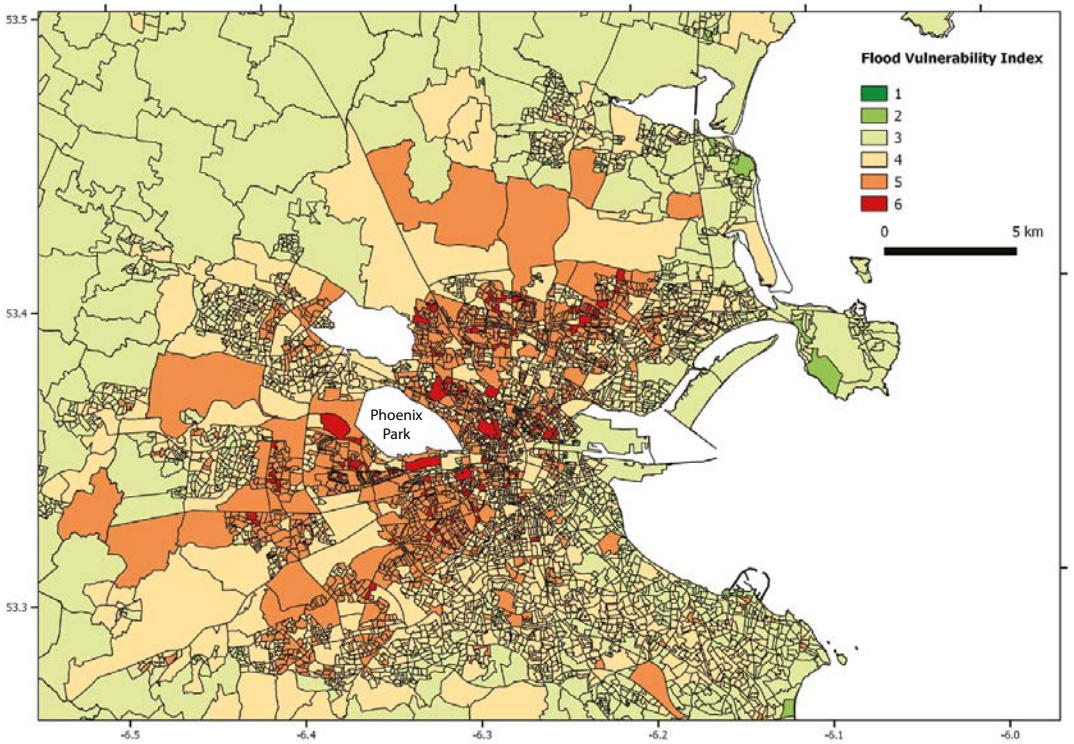

Figure 5.3. Vulnerability to pluvial flooding across Dublin city under RCP 4.5 for the 2050s. The vulnerability index is displayed at the CSO small-area scale and ranges from 1 (lowest, green colour) to 6 (highest, red colour). The highest vulnerability is predominantly found in the city centre and in the northern and western suburban areas. Almost all areas around Phoenix Park show high levels of vulnerability.

6 Case Study: Coastal Inundation

Coastal exposure is the cumulative result of a range of relevant factors, including climate-induced sea level rise, ocean currents and non-periodic water movement, such as storm surges, tidal variation and wave climate. Inundation depth is the exposure index calculated here, based on projecting a past surge event (Cyclone Xaver, 2013) under sea level rise (mean sea level rise) scenarios for 2100 (Figure 6.1). Focusing on Dublin city, Figure 6.2 illustrates the sensitivity and adaptive capacity indicator and Figure 6.3 illustrates the vulnerability of the area to sea level rise.

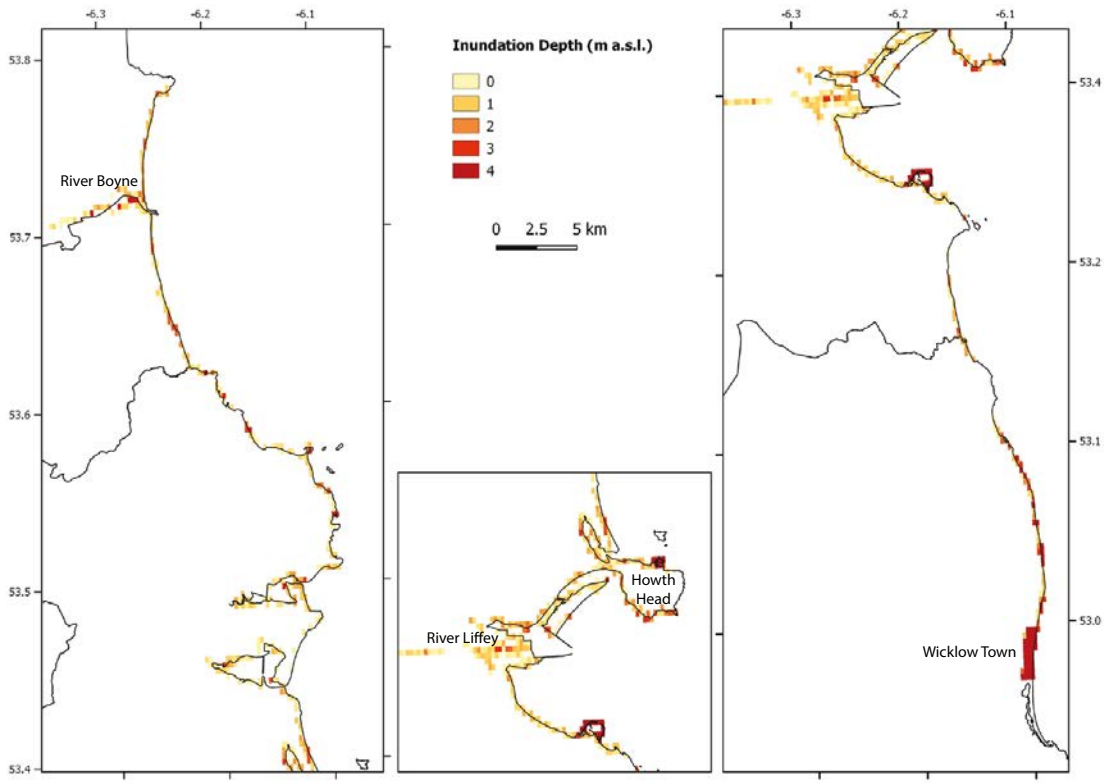

Figure 6.1. Exposure to coastal inundation in terms of inundation depth across the Eastern and Midlands Region for RCP 8.5 for 2100 (estimated sea level rise of 0.81 m). Left, area to the north of Dublin city; middle, Dublin city centre; and, right, areas to the south of Dublin city.

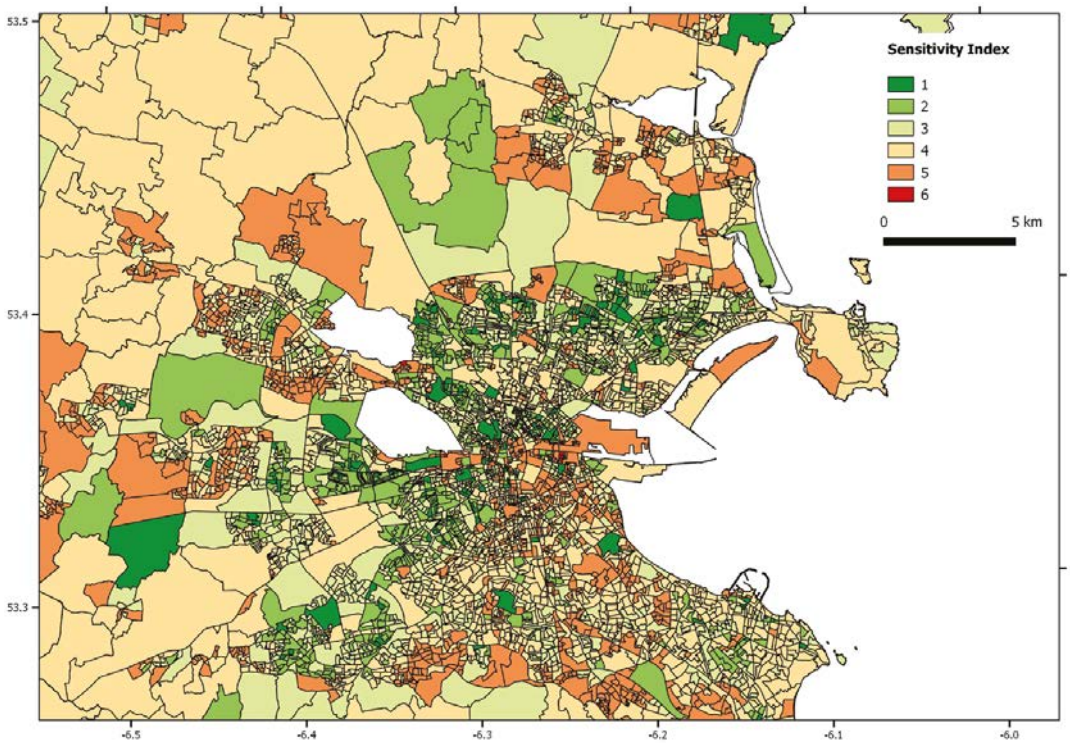

Figure 6.2. Sensitivity and adaptive capacity index map across Dublin city based on 2016 CSO data and 2012 CLC data. The index is displayed at the CSO small-area scale and ranges from 1 (least sensitive, green colour) to 6 (most sensitive, red colour).

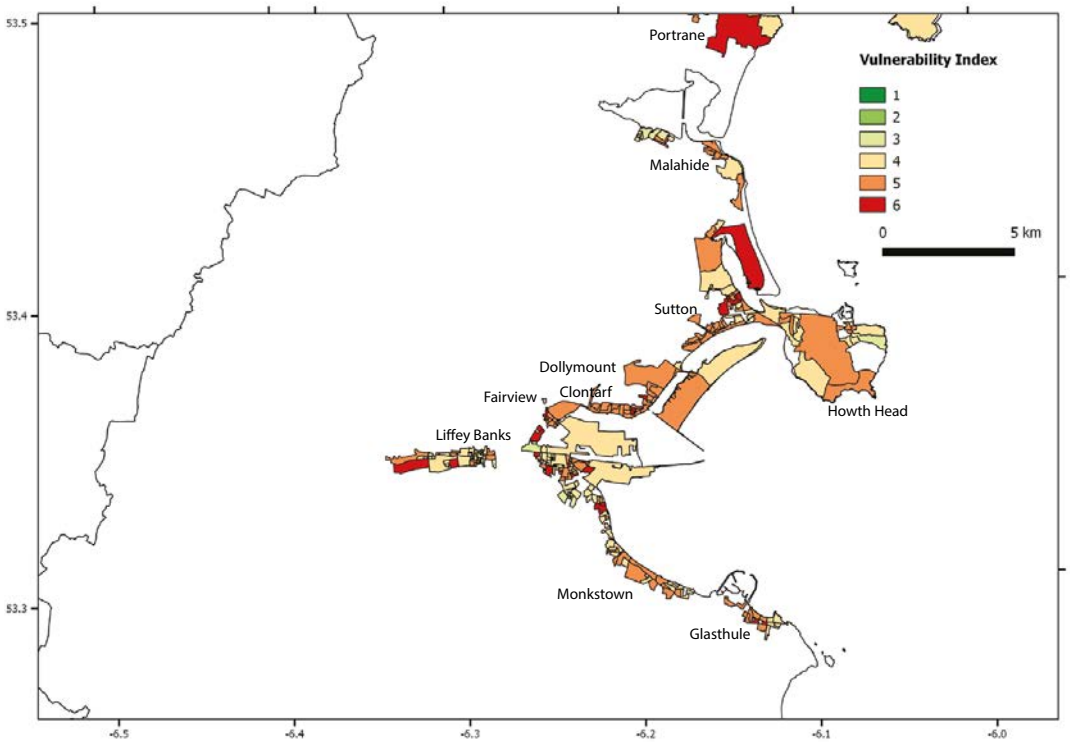

Figure 6.3. Vulnerability to coastal inundation across Dublin city under RCP 8.5 for 2100. The coastal inundation vulnerability index is displayed at the CSO small-area scale and ranges from 1 (lowest, green colour) to 6 (highest, red colour). The most vulnerable areas are to the north of the city centre, with high levels of vulnerability also identified for the Liffey estuary.

7 Conclusion

When planning for climate change adaptation, identifying and assessing vulnerability to climate change forms a key step in the development of robust adaptation strategies. This report provides an overview of how to undertake a vulnerability assessment and illustrates the approach with reference to the evolution of vulnerability to climate change in the Eastern and Midlands Region in relation to heat, pluvial flooding and coastal inundation over the coming decades. This approach provides spatially explicit information on vulnerability and uses internationally accepted IPCC future climate pathways (RCP 4.5 and RCP 8.5) to assess a range of possible climate change trajectories. As well as showing which areas will be exposed to specific climate changes, tailored indices are calculated to highlight the level of vulnerability to each climate hazard, both spatially and temporally. In addition, the approach highlights the importance of stakeholder engagement to validate vulnerability information and to provide inputs on the consequences of these vulnerabilities for local-scale planning and development.

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Abbreviations

CLC	CORINE Land Cover
CSO	Central Statistics Office
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative concentration pathway
Urb-ADAPT	Large Urban Scale Adaptation
UTCI	Universal Thermal Climate Index

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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Assessing Vulnerability to Climate Change: An Approach Illustrated through Large Urban Scale Adaptation (Urb-ADAPT)

Authors: Roberta Paranunzio, Barry O'Dwyer, Paul J. Alexander, Marco Guerrini, Ned Dwyer and Jeremy Gault

Identifying Pressures

Ireland's climate is changing in line with global trends and this trend is expected to continue and intensify into the future. Climate change will have wide-ranging effects on all aspects of Ireland's society, environment and economy, and this is particularly the case for Ireland's urban areas. This is because all of Ireland's major cities are located on the coast and are already at risk from sea level rise and extreme weather events. Although urban areas generally experience the same exposure to climate change as the surrounding regions, these areas are considered to be at particular risk (e.g. flooding, droughts and excess heat) because of processes of urbanisation. With urbanisation set to continue and intensify in terms of both density and extent, planned adaptation of these areas is now a priority.

Informing Policy

As a national policy objective, Ireland's National Planning Framework (Project Ireland 2040) aims to consolidate growth in Ireland's existing five cities and regional centres, thereby increasing the density of the existing urban footprint. Moreover, and reflecting the requirement of Ireland's National Adaptation Framework and Climate Action Plan, Project Ireland 2040 requires the consideration of climate change impacts in settlement strategies. For the Eastern and Midlands Region, which encompasses Dublin, its wider commuting catchment and its surrounding and nearby counties and towns, the Urb-ADAPT project combines climatic and socio-economic information to assess the vulnerability of the region to key urban climate impacts. Accounting for potential future urban development patterns, project outputs provide an assessment of the vulnerability of the region to projected increases in urban heat, pluvial flooding and coastal inundation. Such information supports decision-making in relation to appropriate mitigation and adaptation actions for existing built areas and planning for future development of the region through the National Development Plan by highlighting potential future impacts and vulnerability. In addition, the approach developed through Urb-ADAPT can be replicated on both a national and an international basis.

Developing Solutions

Adapting Ireland's existing and future urban areas to climate change impacts requires information on not only exposure to climate change and impacts but also the vulnerability of people and communities to these. In collaboration with the key stakeholder groups, Urb-ADAPT further develops the existing knowledge base on exposure to potential future climate change and impacts by developing spatially explicit information on the vulnerability of the Eastern and Midlands Region to potential future climate impacts. Through project workshops, this information has been employed to support local and regional decision-makers in understanding and assessing future climate impacts, vulnerabilities and risks for the region, which forms a key step in planning for climate change adaptation at local and sectoral scales.

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