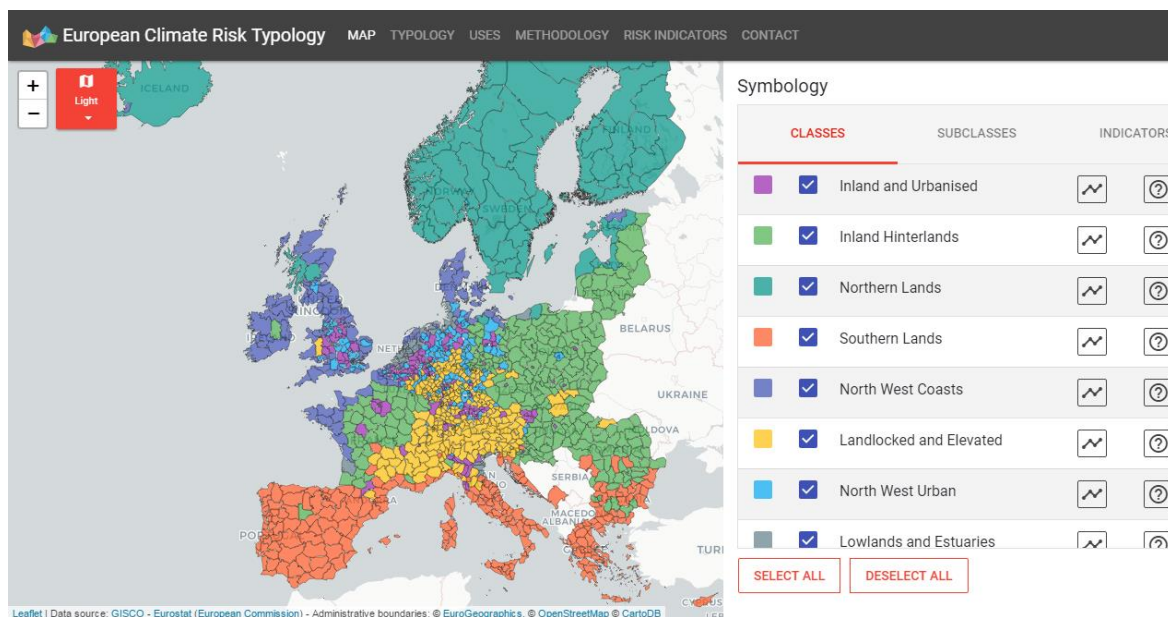


<b>Institution:</b> The University of Manchester		
<b>Unit of Assessment:</b> 13 (Architecture, Built Environment and Planning)		
<b>Title of case study:</b> Strengthening planning for urban climate change adaptation and resilience		
<b>Period when the underpinning research was undertaken:</b> 2015 – 2019		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Jeremy Carter	Senior Research Fellow	2004 – present
Stephen Hincks	Senior Lecturer	2007 – 2017
John Handley	Emeritus Professor; and Professor of Urban Planning	2010 – present; and 2004 – 2010
Angela Connelly	Research Associate	2011 – 2020
<b>Period when the claimed impact occurred:</b> 2016 – 2020		
<b>Is this case study continued from a case study submitted in 2014?</b> No		
<p><b>1. Summary of the impact</b></p> <p>The Horizon 2020 RESIN project, building on a 20-year programme of research at the University of Manchester, has improved planning and decision-making for climate change adaptation and resilience across Greater Manchester and Europe.</p> <p>(a) Our research has advanced the development and implementation of the <i>Manchester Climate Change Framework 2020-2025</i> and the <i>Climate Change and Low Emission Strategies: Whole Place Implementation Plan for Greater Manchester (2016-2020)</i>, by giving adaptation and resilience strategy greater prominence on the policy agendas of Manchester Climate Change Agency and the Greater Manchester Combined Authority.</p> <p>(b) Our online spatial decision support portal, the European Climate Risk Typology, has provided a practical tool for policymakers, advancing their understanding of climate risk and shaping policy development. The portal has: supported the European Investment Bank in the development of its climate risk model; improved the European Environment Agency's understanding and communication of climate risk; and informed the adaptation and resilience agenda advanced by the European Covenant of Mayors for Climate and Energy.</p>		
<p><b>2. Underpinning research</b></p> <p>Susceptibility to adverse impacts stemming from climate change varies significantly in form and extent between urban areas, depending on their location, socio-economic circumstances, and biophysical characteristics [1,2]. University of Manchester (UoM) research has demonstrated the need to differentiate cities according to their vulnerability to extreme weather and climate change hazards (e.g. floods and heat waves), so that effective, city and region specific responses can be developed [1,2]. There is also a need for collaboration between cities and regions with similar climate risk profiles, to share experiences and learning [2]. These goals can be supported via the development of climate risk typologies [1,2].</p> <p>The Climate Resilient Cities and Infrastructures (RESIN) project brought together 17 partners from eight countries. Beginning in 2015, RESIN's primary focus was to produce knowledge, tools and methodologies to support urban areas in becoming better adapted and more resilient to climate change. RESIN applied a risk-based framework for understanding climate change impacts and developing adaptation responses to reduce those impacts [3,4]. Three key outputs from the UoM RESIN research are:</p> <p><b>Output 1) The European Climate Risk Typology</b> [4,5]. Developed collaboratively by UoM with the input of RESIN project partners and end-users, the Typology is an interactive online portal to visualise, compare and analyse climate risk across European cities and regions (Figure 1). The Typology helps users to understand and assess climate change risks in their area. It also helps them to identify other European cities and regions with comparable climate risk characteristics, in order to develop links and share experience.</p> <p><b>Output 2) An online portal for new spatial datasets.</b> The data underpinning the Typology is freely available via an online portal [5]. These new spatial datasets, covering all of Europe, are</p>		

organised around the four climate risk themes of hazard, exposure, sensitivity and adaptive capacity [3]. This data can support climate change adaptation and resilience strategy in cities and regions across Europe by enhancing the development of evidence bases to help decision-makers identify their most pressing climate risks and thereby develop strategy accordingly.

**Output 3) An extended evidence base for Greater Manchester.** Alongside the Typology and data portal, our research has generated new datasets that identify climate change risks to critical infrastructure, and flood risk to transport infrastructure, in Greater Manchester [6]. These datasets have informed and supported the development and implementation of climate change adaptation and resilience strategies in Greater Manchester.



**Figure 1:** Screenshot of the European Climate Risk Typology  
Available at: <http://european-crt.org/map.html>

### 3. References to the research

1. **Carter, J, Connelly, A, Handley, J & Lindley, S** (2012) *European cities in a changing climate: exploring climate change hazards, impacts and vulnerabilities*. Centre for Urban and Regional Ecology, University of Manchester. Available: <https://climate-adapt.eea.europa.eu/repository/11156074.pdf/view> (accessed 20th December 2020).
2. **Carter, J, Cavan, G, Connelly, A, Guy, S, Handley, J & Kazmierczak, A** (2015) 'Climate change and the city: building capacity for urban adaptation', *Progress in Planning*, 95, 1-66. DOI: [10.1016/j.progress.2013.08.001](https://doi.org/10.1016/j.progress.2013.08.001)
3. **Connelly, A, Carter, J, Handley, J & Hincks, S** (2018) 'Enhancing the practical utility of risk assessments in climate change adaptation', *Sustainability*, 10(5), 1399. DOI: [10.3390/su10051399](https://doi.org/10.3390/su10051399)
4. **Carter, J, Hincks, S, Connelly, A, Vlastaras, V, Handley, J** (2018) *European Climate Risk Typology – Final Report*. Deliverable 1.4 RESIN project. Available: <http://european-crt.org/files/typology-final-report.pdf> (accessed 20th December 2020).
5. **Carter, J, Hincks, S, Vlastaras, V, Connelly, A & Handley, J** (2018) *European Climate Risk Typology*. Available: <http://european-crt.org/map.html> (accessed 20th December 2020).
6. The RESIN project website includes a page that houses research outputs focused on climate change adaptation and resilience in Greater Manchester, produced by UoM as part of the RESIN project: <https://resin-cities.eu/cities/tier1/> (accessed 20th December 2020).

### 4. Details of the impact

Our research has positively impacted on urban climate change adaptation and resilience planning in Greater Manchester and at the European level by strengthening knowledge and providing practical tools used by policymakers to inform climate risk modelling and support the development and implementation of climate change strategies and frameworks.

### **a) Strengthening Greater Manchester climate adaptation and resilience strategies and frameworks**

UoM researchers collaborated with the Greater Manchester Combined Authority (GMCA) and the Manchester Climate Change Agency to co-produce knowledge of local climate risks and support the development and implementation of climate change adaptation and resilience strategies and frameworks. The European Climate Risk Typology, launched in October 2018 (Output 1, [5]), and our extended evidence base for Greater Manchester (Output 3, [6]) were used to develop and implement local climate change adaptation and resilience strategies.

The *Climate Change and Low Emission Strategies: Whole Place Implementation Plan for Greater Manchester (2016-2020)* [A] is Greater Manchester's overarching climate change strategy [B]. As noted by GMCA's Assistant Director of Environment, "*Completion of the RESIN project itself represents the delivery of one of the first actions of the implementation plan. RESIN project outputs (including the European Climate Risk Typology and reports on climate risks to critical infrastructure) have acted as an overarching resource to inform and support the delivery of subsequent actions listed in the strategy. For example, a RESIN project report allowed us to identify the key risks to Greater Manchester's transport infrastructure posed by increased incidence of flooding, as part of our transport strategy and planning*" [B]. Collaboration between GMCA and the UoM RESIN project has also helped to establish Greater Manchester as one of four pilot areas to develop new approaches to the protection and enhancement of the natural environment, as part of the Department for the Environment, Food and Rural Affairs 25-year environment plan. RESIN research outputs have subsequently enabled Greater Manchester to advance its Urban Pioneer programme, which assesses new tools and methods for managing the natural environment [B,C].

The *Manchester Climate Change Framework 2020-2025* [D] was developed by the Manchester Climate Change Partnership. Comprising 60 members across ten sectors, the Partnership used RESIN research outputs to set Manchester's adaptation and resilience priorities and objectives. Citing RESIN research on climate change risks to critical infrastructure, the Framework states (p. 20): "*Floods and storms account for the highest risks, and these events stand out as priorities for adaptation and resilience planning and action*" [D]. The Framework also makes direct reference (p. 21) to the use of the RESIN European Climate Risk Typology to progress Manchester's adaptation and resilience objectives and "*... identify and then learn from cities and urban areas that have a similar climate risk profile as Manchester*" [D].

Summarising the impact of the RESIN project on the development of climate change adaptation and resilience in Manchester, the Programme Director of the Manchester Climate Change Agency noted that "*The RESIN project has made a valuable contribution to the evidence base on topics linked to climate change adaptation and resilience in Manchester and has developed tools to help drive forward progress. In doing so, the RESIN project has helped the City of Manchester to establish a formal policy commitment to address the challenges associated with the changing climate*" [E].

### **b) Impact on European institutions working to strengthen urban climate change adaptation and resilience knowledge and planning**

As a result of direct engagement with European agencies, the reach and impact of the RESIN project extends across Europe. Drawing on Google analytics data (which understates the totality of traffic to the website), the European Climate Risk Typology website (<http://european-crt.org/index.html>) was accessed during 1663 sessions (occasions where a user interacted with the website) by users from 87 countries, between February 2019 and October 2020 [F]. (Capture of Google data analytics on use of the typology website only began in February 2019, following its release in October 2018.) The Typology and associated datasets (Outputs 1 and 2, [4,5]) have directly supported European institutions working to strengthen urban climate change adaptation, and to improve the information they provide to cities and regions.

The European Investment Bank (EIB) is the lending arm of the European Union, the largest multilateral financial institution in the world and one of the largest providers of climate finance



[G]. EIB has developed a climate risk model to assess the climate risk of its counterparties. The model provides transparency regarding the EIB's exposure to climate risk, and enables it to meet the disclosure requirements of the European Central Bank [G]. The RESIN European Climate Risk Typology data "...provided valuable support to the development of the prototype of the EIB Climate Risk model" by delivering an "assessment of the physical risks arising from climate change at the level of European regions" [G]. EIB benefited from the Typology data which is "...provided in a consistent, well-structured and easily accessible way. Without the European Climate Risk Typology data, more time would have been needed to access and aggregate data on physical climate risk at the level of European regions" [G].

The European Environment Agency (EEA) is an agency of the European Union, whose task is to provide 32 member countries and six cooperating countries with robust information on the environment. The EEA used the Typology to inform their European Climate Adaptation Platform, Climate-ADAPT, an online resource which helps users to access and share data and information [H]. Climate-ADAPT incorporates an 'Urban Adaptation Map Viewer' which collates information to provide data on climate risk, using data from the UoM Resin Typology [H]. "The Typology has helped us to highlight the complex nature of climate risk at the European scale, and also to emphasise the importance of the exchange of experiences and learning between cities that share similar climate risk profiles" [H,I]. EEA has drawn on the Typology to inform their recent report, *Urban adaptation in Europe: how cities and towns respond to climate change* [I]. This report notes that the Typology "...emphasises that all of Europe's cities and NUTS 3 regions [areas of 150000-800000 inhabitants] are at risk from climate change, albeit for different reasons" [I]. The EEA has undertaken additional work, drawing on the Typology, to classify cities according to their size, climate change vulnerability and risk characteristics [H], concluding that "The Typology is a useful strategic decision-aid that supports more efficient and effective approaches to assessing and adapting to climate risks in European cities and regions" [H].

The Covenant of Mayors for Climate and Energy brings together over 10,000 local and regional authorities across 59 countries voluntarily committed to implementing climate change mitigation and adaptation objectives. Climate change risk and vulnerability assessments (RVAs) are required from all Covenant of Mayors signatories, and "...the Covenant of Mayors recommends the use of the European Climate Risk Typology to signatories in order to support their climate change adaptation work" and to develop their RVA [J]. As the Typology helps users to identify other regions with similar risk profiles, "this can help Covenant of Mayors signatories and their coordinators to find cities and regions that share their underlying climate risk characteristics, and to obtain and share knowledge with them and possibly develop exchange networks" [J].

The data underpinning the European Climate Risk Typology is of real value in light of the difficulties in accessing locally relevant climate risk data to inform climate change adaptation and resilience planning. Users can access a wide range of indicators in this database, covering different elements of climate risk, including new data produced within the RESIN project and data that was previously difficult for potential end users to access (Output 2 [5]). The Covenant of Mayors acknowledges this: "As data on climate change hazards, vulnerabilities and risks are not always readily available to European cities and regions", the Covenant of Mayors recommends the Typology as "a useful resource for aiding Covenant of Mayors signatories in meeting their commitments" [J].

## 5. Sources to corroborate the impact

- A. Greater Manchester Combined Authority (2016) *Climate Change and Low Emission Strategies: Whole Place Implementation Plan for Greater Manchester (2016-2020)*, Manchester, GMCA. Available at: <https://www.greatermanchester-ca.gov.uk/media/1273/climate-change-and-low-emission-implementation-plan.pdf>
- B. Testimonial from the Assistant Director of Environment, Greater Manchester Combined Authority. Received 7 December 2020.
- C. Greater Manchester Combined Authority (2018) *Greater Manchester chosen as green pioneer for the urban environment*, Manchester, GMCA. Available at:

<https://www.greatermanchester-ca.gov.uk/news/greater-manchester-chosen-as-green-pioneer-for-the-urban-environment/>

- D. Manchester Climate Change Partnership and Agency (2020) *Manchester Climate Change Framework 2020-2025*, Manchester, MCCA. Available at: <http://www.manchesterclimate.com/sites/default/files/Manchester%20Climate%20Change%20Framework%202020-25.pdf>
- E. Testimonial from the Programme Director, Manchester Climate Change Agency. Received 29 June 2020.
- F. Google Analytics data for the European Climate Risk Typology website (<http://european-crt.org/index.html>) from February 2019 – October 2020
- G. Testimonial from the Risk Management Department Structured Finance and Equity Division, European Investment Bank. Received 22 October 2020.
- H. Testimonial from Climate Change Adaptation Expert, European Environment Agency. Received 3 July 2020.
- I. European Environment Agency (2020) *Urban adaptation in Europe: How cities and towns respond to climate change*, Luxembourg, Publication Office of the European Union. Available at: <https://www.eea.europa.eu/publications/urban-adaptation-in-europe>
- J. Testimonial from Project Officer and Coordinator of the European Covenant of Mayors working group on climate change adaptation. Received 30 June 2020.