Institution: The University of Manchester		
Unit of Assessment: 13 (Architecture, Built Environment and Planning)		
Title of case study: The Climate Just Mapping Tool: Supporting Planners in Understanding Social and Spatial Vulnerability to Climate Change		
Period when the underpinning research was undertaken: 2000 – 2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Richard Kingston	Professor of Urban Planning & GISc	2003 – present
Period when the claimed impact occurred: 2015 – 2020		
Is this case study continued from a case study submitted in 2014? Yes		

1. Summary of the impact

The Climate Just mapping tool is a web-based publicly available Geographic Information System (GIS) developed from University of Manchester research. The tool helps users explore how vulnerability to climate change varies between different neighbourhoods across Great Britain, supporting local planning and policy responses to a changing climate. The tool has been:

- used at a city-regional level, aiding economic development and spatial planning policy developed by Greater Manchester Combined Authority;
- incorporated in evidence issued by the Committee on Climate Change, the statutory body established under the Climate Change Act 2008;
- included in climate adaptation guidance issued jointly by the Royal Town Planning Institute (RTPI) and Town and Country Planning Association (TCPA); and
- incorporated in guidance published by the European Environment Agency (EEA).

2. Underpinning research

The underpinning scientific research sits within the domain of Public Participation GIS [1], which emerged in response to criticisms of the inaccessibility of GIS technology in the 1990s. GIS was deemed a powerful tool whose use was limited beyond professional and technical elites. The UN's Aarhus convention (UNECE, 1988) sought to remedy this fundamental problem by broadening access to information and facilitating enhanced public participation in decision-making in environmental matters. Addressing this concern, Richard Kingston has spent the past 20 years developing methods and tools to make GIS more accessible. This has led to the development of web-based GIS tools that range from EU-wide [2], to the national [3] and local scales [1].

It is acknowledged that climate change impacts, such as the increased susceptibility to flooding or the raised frequency and intensity of heatwaves, are unevenly distributed in both social and geographical terms. However, practitioners lacked the tools to bring together climate change research with an understanding of social and spatial vulnerability. The Climate Just mapping tool was developed to provide this capacity.

The Climate Just mapping tool stems from Kingston's research over the past decade, which focuses on the role of Information and Communication Technologies in supporting the planning and development process. Kingston's work on the use of mapping tools to advance understandings of climate vulnerability and disadvantage began with the EU-FP7 funded project *Green and Blue Space Strategies for Climate Change Adaption in Urban Areas* (GRaBS) (2008-11). GIS data on climate change generated as part of the project was used to create a mapping tool covering 13 European cities [2,4,5]. GRaBS won the EU DG RegioStars Awards 2012 for projects relating to sustainable growth and eco-system services.

In 2014, building on the GRaBS project, Kingston began development of a new mapping tool for the Climate Just project, funded by the Joseph Rowntree Foundation (with colleagues Lindley (Geography) and O'Neill, (Philosophy)). This more recent work was intended to raise

awareness about climate disadvantage among local authorities (and others) and inform their decision-making.

The success of the Climate Just mapping tool lies in our development of a participatory approach, employing a User Needs and Requirements Analysis to inform both functional and technical specification for the mapping tool. This approach puts the users at the heart of the development of software, ensuring the mapping tool meets their needs and requirements.

3. References to the research

1. **Kingston, R.**, Carver, S., Evans, A., & Turton, I. (2000) Web-based public participation geographical information systems: An aid to local environmental decision-making, *Computers, Environment and Urban Systems*, *24*(2), 109-125. DOI: 10.1016/S0198-9715(99)00049-6
2. Cavan, G., & **Kingston, R.** (2012) Development of a climate change risk and vulnerability assessment tool for urban areas, *International Journal of Disaster Resilience in the Built Environment*, *3*(3), 253-269. DOI: 10.1108/17595901211263648
3. Evans, A. J., **Kingston, R**., & Carver, S. (2004). Democratic input into the nuclear waste disposal problem: The influence of geographical data on decision making examined through a Web-based GIS, *Journal of Geographical Systems*, *6*(2), 117-132. DOI: 10.1007/s10109-004-0128-1
4. Cavan, G., Butlin, T., Gill, S., **Kingston, R.** & Lindley, S. (2015) Web-GIS Tools for Climate Change Adaptation Planning in Cities, Leal Filho, W (ed) in *Handbook of Climate Change Adaptation.* Springer, Berlin, pp. 1-27.
5. **Kingston, R.** (2015) Public Participation in Geocomputation, in Brunsdon, C and Singleton, A (eds) *Geocomputation: A Practical Primer.* Sage, London, pp. 301-319.

4. Details of the impact

Pathways to impact

The free-to-use Climate Just resource (www.climatejust.org.uk) provides evidence, guidance and case studies supporting the development of more socially-aware responses to climate change. Its datasets facilitate in-depth assessments of social vulnerability and climate disadvantage which move beyond traditional exposure-based analyses.

Since its 2015 launch, Climate Just has attracted more than 38,000 users. The mapping tool is the second most popular page of the Climate Just website (after the home page) and the technical user guide to the maps is the most downloaded item [A]. In 2015, the Scottish Government commissioned data updates, including the co-development of new indicators [B]. The mapping tool was further updated in 2017-18, utilising new data on climate change, flood risk and social vulnerability [C] and an ESRC Impact Acceleration Account grant to support training workshops and other dissemination activities amongst urban planning and climate resilience practitioners. Climate UK and the Environment Agency were also involved in the update of the website and the new mapping tool through user testing workshops and dissemination and promotion of the website. Around 600 people have been directly engaged through 30 face-to-face events. The National Flood Forum, and the Town & Country Planning Association and Royal Town Planning Institute (TCPA/RTPI) ran additional events to engage planning professionals [D].

The spatial data used in the mapping tool is made available on an open access basis, which allows any user to download it into their own Geographical Information System software such as ArcGIS and QGIS. This means that external organisations can integrate data used in the Climate Just mapping tool within their own mapping applications such as the Greater Manchester Combined Authority's (GMCA) infrastructure map [E] and the Climate Ready Clyde GIS [F]. Kit England, Climate Ready Clyde Manager, states: "*Climate change does not affect everyone equally, so social factors need to be taken into account, alongside physical factors, to ensure that social justice is incorporated into our climate change adaptation plans. Assessing these factors and compiling and aggregating them into*

actionable information normally comes at a cost that is far beyond the reach of city and region budgets for adaptation. The fact that the spatial data used in the mapping tool is made available on an open access basis has been strategically important to overcome this barrier, and has been a key part of helping us assess social vulnerability to climate change, and target adaptation action towards those who need and deserve it the most". [F].

The impacts of the mapping tool have been two-fold:

1. Raising awareness of the concept of climate disadvantage among planners and other policy actors in the UK and across Europe

Climate change and extreme weather-related events like floods do not affect everyone equally. Yet decision-making often relied on understanding only the physical exposure of people and places. The mapping tool, and the key concept of climate disadvantage that underpins it, have helped to shift understanding, highlighting that not only physical risk but also social vulnerability is crucially important in decision-making.

Initially, participation in the training workshops helped to change the ways that policymakers and practitioners think about climate change adaptation by encouraging them to consider the role of social and spatial disadvantage in determining variable levels of climate risk across different groups and areas. For example, Simon Williams (Civil Contingencies Lead at the Association of Directors of Adult Social Services and the Association of Directors of Children's Services) said that: "*as the Climate Just research demonstrates…we … need to* [identify] *factors such as whether someone lives alone, income levels or housing quality. Local authorities working with partners could work to these criteria. The Climate Just website provides compiled maps to assist with this work*" [G].

This shift in understanding is further evidenced by the inclusion of social vulnerability in practitioner guidance from the European Environment Agency and UK professional planning bodies. Guidance for local authorities on climate change adaptation, published by the TCPA and the RTPI, cites the Climate Just mapping tool as a *"powerful way of mapping the relationship between social exclusion and the impacts of climate change, offering the opportunity to tailor policy to meet the needs of those likely to be most vulnerable to climate change*" [H, pp 5-6]. The guidance document refers specifically to the mapping tool to "*help to consolidate map-based data on risks and vulnerabilities to illustrate the impacts on communities and communicate them to wider audiences*" [H pp. 24]. As stated by Hugh Ellis, Policy Director at the TCPA, "*this represents a new addition to the guidance on climate change adaptation issued to planning professionals, which in its previous iteration made no reference to the concept of climate justice*" [D].

Similarly, a technical paper produced by the European Environment Agency (EEA) European Topic Centre (ETC) on Climate Change impacts, vulnerability and Adaptation (CCA) highlights Climate Just as *'the most comprehensive and detailed tool currently existing in Europe for the planning and implementation of socially just urban adaptation*' [I, p. 34]. The EEA has previously tended to take an environment-centred approach, attaching little weight to social or spatial inequality when advising on climate change adaptation; the work of Climate Just has therefore provided conceptual and empirical evidence to refocus the EEA's approach.

Under the 2008 Climate Change Act, the UK government is required to provide a UK-wide climate change risk assessment every 5 years. The Climate Just mapping tool informed the 2017 UK Climate Change Risk Assessment Evidence Report, produced by the Committee on Climate Change [J]. As well as including the climate disadvantage maps for England, Scotland and Wales, the CCRA drew on Climate Just to highlight, for the first time, social equity as an influence on susceptibility to climate change risk. This was a new addition to the Committee's previous evidence report, and it was informed specifically by Climate Just, referenced as a resource to support risk assessment and inform adaptation planning [J].

2. Informing planning and decision-making relating to climate change and disadvantage

The mapping tool has informed decision making by providing a practical mechanism to measure climate disadvantage and identify affected groups and areas.

The mapping tool has been used to assist GMCA in decision-making in respect of economic development and spatial planning:

- *Economic development*: GMCA incorporated data from Climate Just in their bespoke interactive mapping system, MappingGM (https://mappinggm.org.uk/) for their staff: *"because we took and downloaded that data from the Climate Just website we were able to incorporate it in the background of our website"* [E].
- *Spatial planning*: mapping tool data was used by GMCA to assess the climate vulnerability of over 1,000 potential development sites considered for inclusion in the Greater Manchester Spatial Framework (GMSF) in 2017-18. Mapping tool data has also been imported into the Greater Manchester Open Data Infrastructure Map, which was used in the development of the GMSF. Using the Climate Just data, GMCA *"were able to identify what proportion of each submitted site was within each MSOA* [Middle Layer Super Output Area]*, and the likely vulnerability of those sites to climate change. The combination of all these spatial queries allows the GM planners to properly assess the submitted sites and give an overview of their likely use as employment or housing sites"* [E].

The maps of climate disadvantage have been used by the Environment and Climate Change strategic advisor at Hull City Council [K] to support engagement with the Housing, Transport, Waste Management, Parks and Open Spaces departments, and inform their service risk assessments. "*The maps enabled these services to obtain a better understanding of the location of vulnerable customers and facilitated a discussion about the implications of this for services' current demands*". In addition to the city's awareness raising work and engagement of services, "*the Council has taken steps to increase surface water flood management at both large and small scales. It has invested in large engineering projects to stem and slow the flow of water into the City sewage network. Further work has been undertaken at the community level to provide water attenuation in parks to prevent run off into residents' homes…. These solutions are a direct result of… property and community level social vulnerability*" [K].

Following the Scottish Government-commissioned data updates, including the co-development of new indicators [B], the mapping tool was used to inform the Scottish Climate Change Adaptation Programme [F]. The tool "*shows the most flood disadvantaged neighbourhoods and their underlying flood vulnerability to help us better understand the social impacts of flooding at a neighbourhood scale*" [F, pp.74]. The tool has also been used by Climate Ready Clyde and Aberdeen Adapts to inform their adaptation strategies. Kit England writes: "*we have been able to integrate data used in the Climate Just mapping tool within our own Geographic Information System, and particularly into the Climate Ready Clyde Climate Risk and Opportunity Assessment, which has in turn formed our Adaptation Strategy and Action Plan…The tool has informed other adaptation strategies in Scotland, such as the Aberdeen Adaptation Strategy (by Aberdeen Adapts), recognising that socially vulnerable neighbourhoods are over-represented in areas prone to flooding*" [F].

5. Sources to corroborate the impact

A. Knox, K. (2018) *Climate Just Impact and Legacy Report*. Simon Industrial and Professional Fellowship report.
B. Kazmierczak, A., Cavan, G., Lindley, S. & Connelly, A. (2015) *Mapping Flood Disadvantage in Scotland 2015: Main Report*. http://www.gov.scot/Resource/0049/00490788.pdf
C. Sayers, P., Penning-Rowsell, E.C. & Horritt, M. (2018) Flood vulnerability, risk, and social disadvantage: current and future patterns in the UK. *Regional Environmental Change*, 18, 339–352. https://doi.org/10.1007/s10113-017-1252-z

D. Testimonial from Policy Director, Town and Country Planning Association. Received February 2021.
E. Transcript of interview with GMCA New Economy Spatial Data Analyst (November 2019)
F. Testimonial from Climate Ready Clyde Manager (Received February 2021); Climate Ready Scotland: Climate Change Adaptation Programme 2019-2024. https://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/
G. Williams, S. (2015) 'How adult social care can protect the vulnerable from extreme weather', *Local Government Chronicle*, 30th April. https://www.lgcplus.com/5084172.article
H. TCPA and RTPI (2018) *Rising to the Climate Crisis A Guide for Local Authorities on Planning for Climate Change.* https://www.rtpi.org.uk/media/3568/rising-to-the-climate-crisis-1.pdf
I. Breil, M., Downing, C., Kazmierczak, A., Mäkinen, K. and Romanovska, L. (2018) *Social vulnerability to climate change in European cities: State of play in policy and practice. ETC/CCA Technical Paper, ETC/CCA 2018-1*. European Environment Agency. https://www.eionet.europa.eu/etcs/etc-cca/products/etc-cca-reports/tp_1-2018
J. Committee on Climate Change (2017) *Climate Change Risk Assessment: Evidence Report. Chapter 8: Cross-Cutting Issues*. The Stationery Office, London. https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/ccra-chapters/cross-cutting-issues/
K. Testimonial and case study from Environment and Climate Change Strategic Advisor, Hull City Council (Received February 2019)