

# Science for Environment Policy

## Mapping the vulnerability of European cities to climate change

**A new study has assessed the vulnerability of 571 European cities to heatwaves, droughts and flooding caused by climate change.** The causes of vulnerability differ across Europe and the researchers say the results could be used to design policies to mitigate the impacts.

**Over 75% of the EU's population lives in urban areas (this figure is expected to rise to over 80% by 2050).** Cities contain large populations, important infrastructure and are centres of economic activity. Understanding how cities may be vulnerable to the effects of climate change is, therefore, crucial in planning for the future.

In this study, which was supported by the [EU Project RAMSES](#)<sup>1</sup>, researchers carried out an indicator-based vulnerability assessment (IBVA) for 571 European cities. IBVAs try to break down the different factors that lead to vulnerability to climatic hazards. The Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability is "the propensity or pre-disposition to be adversely affected,"<sup>2</sup> by climate change and this also encompasses the lack of capacity to cope with and adapt to the effects of [climate change](#).

The IBVA used a set of indicators to assess urban vulnerabilities to climate stressors and their consequences: (i) [heatwaves on human health](#); (ii) drought on water planning, and; (iii) the socio-economic impact of [flooding](#), including fluvial (river), pluvial (rainfall) and coastal flooding. Fluvial flooding occurs when river systems cannot contain excessive rainfall; pluvial flooding occurs when drainage systems cannot cope with heavy rainfall.

The indicators were developed from a review of published literature to identify the climate threats most relevant to European cities and were classified into five broad categories, comprising: (i) human capital; (ii) socio-economic conditions; (iii) built environment; (iv) natural and ecosystem services; and (v) governance and institutions. Data for the 571 cities assessed by the IBVA were mostly taken from the [Urban Audit database](#), which has been used previously for other climate-change vulnerability assessments. In addition, new indicators based on big data were also produced to assess different aspects related to adaptive capacity – in particular, awareness of the main climate stressors. Coastal-flooding vulnerabilities were assessed for the 92 coastal cities within the database. The fluvial-flooding assessment was completed on the 365 cities with water bodies with a catchment of at least 500 square kilometres.

The researchers grouped the cities into seven different clusters according to their relative degree of vulnerability to each of the three climate stressors. Cities that showed higher vulnerability to heatwaves were predominantly located in the central areas of the EU and in the southern regions of new Member States and the Baltic republics. This was in part linked to elderly populations, higher pollution levels and small dwelling size, which, in combination, increase the urban sensitivity to heatwaves. Surprisingly many of the cities with lower vulnerabilities to heatwaves were located in some of the warmest areas of Europe, which is likely due to raised awareness of heatwaves in these regions. Cities more vulnerable to droughts, such as Brussels, Ludwigshafen am Rhein and Marseille, were found across Europe, without a clear spatial distribution pattern. Overall higher vulnerabilities are explained by comparatively less diversified economies, growing populations and less efficient water-management systems (i.e. higher resource consumption at greater water costs).

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1. This research received funding from the EU's Seventh Programme for Research, Technological Development and Demonstration under Grant Agreement No. 308497 ([Project RAMSES](#)).

2. IPCC (2014): [Climate Change 2014: Synthesis Report](#). Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, [Annex II: Glossary](#).

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Flooding vulnerabilities were also found across Europe, although lower vulnerability was found in the British Isles and Scandinavian countries, compared to high vulnerability scores in the Mediterranean countries, Bohemian and Danubian regions. The factors influencing flooding vulnerability included socio-economic conditions (e.g. income levels and employment rates), physical features, such as the extent of [soil sealing](#) and the awareness of citizens and the commitment to adaption of the cities' governing institutions. For coastal flooding, cities over the Atlantic coasts, western Mediterranean and Baltic showed higher vulnerability than the Italian Peninsula, the UK and the Scandinavian countries, which were shown to have a higher capacity to adapt, as well as higher awareness and commitment to addressing coastal flooding.

The study results demonstrate the challenges different European cities will face due to climate change, with a large number of cities across Europe vulnerable to the effects of either floods, heatwaves or droughts. For each city, the causes of vulnerability to the consequences of climate change are dependent on the specific geographical and socioeconomic conditions. The researchers therefore emphasise the importance of city-level assessments, particularly for cities identified as vulnerable to one or more of hazards in this assessment, in order to inform adaption planning. They also say that the IBVA used here could be developed to include the adaptation measures already established in European cities, in order to understand whether these measures have reduced a city's vulnerability to potential climate hazards.

Cities comprise a range of social systems, buildings, infrastructure and natural features, which makes planning for the future difficult. The researchers say that the assessment can be used by city planners and can contribute to the development of EU policies to adapt to climate change. They say the results enable comparison across European cities, because the definitions and indicators are consistent for all the cities assessed. The researchers highlight that, compared to other areas of risk, vulnerability is most directly linked to social conditions and that tackling these issues could lead to policy interventions that have win-win scenarios for both urban resilience and socioeconomic issues.

