

# Climate Sensitivity Assessment at the Regional Scale for Spatial Planning: A Case Study in Italy

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## ABSTRACT

The aim of this research is the quantitative characterization of climate risk, in order to support spatial planners in choosing resilient adaptive actions at the urban and territorial scale. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, climate risk is the combination of hazard, exposure, and vulnerability parameters. Vulnerability is a function of the climate sensitivity and the adaptive capacity. From the planners' point of view, climate sensitivity expresses the degree to which the study area is influenced by the climate variability. In this regard, the authors have implemented a GeoDataBase to quantify the climate sensitivity over a southern Italian region, analyzing long-term measured meteorological data (air temperature and precipitation) and subsequently generating synthetic maps by interpolating data. As a result, the authors present climate sensitivity maps of the Calabria region, providing useful physical and data-based identification of priority areas for planning purposes.

## KEYWORDS

Spatial Planning, Mapping, Priority Areas, Climate Change, IPCC, Precipitation, Temperature, Calabria Region

## INTRODUCTION

Climate change is a global systemic phenomenon (Centeno et al., 2015) defined as a climate state affected by changes in average and varied properties over an extended period of time (Xue et al., 2021).

Spatial planning research combined with climate factor research has received increased attention in recent years (Hurlimann & March, 2012; Isinkaralar, 2023; Jiang et al., 2017; Nadin et al., 2021; Pacala & Socolow, 2004; Wilson, 2006). Therefore, the literature recognizes that although planners are concerned with climate issues, the use of climate information is too often unsystematic (Briley et al., 2015; Eliasson, 2000; Kauffman & Hill, 2021; Measham et al., 2011; Meerow & Woodruff, 2020). According to Manigrasso (2013), a new approach must be adopted in the discipline when searching for new ways of planning to accommodate local vocations and integrate the climate issue.

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This study aims to incorporate climate knowledge into the planning languages, supporting spatial planners in identifying solutions to current and future environmental challenges.

Thus, the research activities of planners and climate specialists are often disjointed. Therefore, the ambition and innovation of the proposed work is to promote integration between these two research approaches in order to plan appropriate risk reduction policies. To this end, a research group was set up through an agreement between the authors' institutions, namely the Department of Civil Engineering of the University of Calabria and the Institute of Atmospheric and Climate Sciences of the National Research Council of Italy. This joint research aims to promote integrated knowledge of climate parameters, with specific reference to precipitation and temperature data; the research designs and implements a GeoDataBase (GDB) to facilitate climate risk assessment at the regional scale. Specifically, it aims to develop domains of climate sensitivity and digital mapping for the area of application coinciding with the Calabria region, which is considered a climate hot-spot. Furthermore, we hope that the expected results can produce successful climate change impact management and further provoke local communities' commitment towards achieving sustainable development goals (Cobbinah et al., 2019).

In light of these assumptions, our contribution is organized as follows. The second section describes the current state of spatial planning in the context of climate change in Italy. The third section summarizes the authors' analysis of the state-of-the-art and presents the design and methods of the research. The fourth section outlines the main results obtained in the context of the trial. The last section discusses the results obtained.

## **THE CURRENT STATE OF SPATIAL PLANNING ON THE CONTEXT OF CLIMATE CHANGE IN ITALY**

Adaptation and mitigation strategies are equally crucial for reducing the adverse impacts of climate change (Hossain et al., 2024). However, as stated by Musco and Fregolent (2014), the international scientific community has repeatedly highlighted the steady progression of climate change and its impacts. It is evident the insufficiency of mitigation policies if not associated with appropriate actions to adapt to the new climate scenario the urban and territorial systems, increasingly affected by extreme and variable weather phenomena. According to the technical summary (Pörtner et al., 2022) of the intergovernmental panel on climate change, adaptation refers to adjustment, moderation, or changes to social and ecological systems to avoid or recover from the effects of climate change. Therefore, planners must define adaptive strategies to be implemented within the framework of planning and management, signaling a new culture of urban design (Musco & Zanchini di Castiglionchio, 2014). Thus, by placing climate change policies at the center of urban policies (Musco & Magni, 2014), researchers in this field can identify the most appropriate ways to design and manage the city in the face of changing climates.

The integration of climate change issues into planning activities is also recognized by the 2030 Agenda under the Sustainable Development Goal 13, which mentions that to achieve a sustainable society, climate change measures need to be integrated into national policies, strategies and planning. However, progress towards this sustainable development objective is still not satisfactory. As stated by Wamsler et al. (2013), current climate adaptation practices do not yet seem to adequately exploit their potential to reduce and adapt to the growing urban risk. To this end, the authors highlight how integrating cutting-edge theoretical and practical knowledge can lead to more comprehensive and appropriate models for adaptation planning. In this sense, planning is an appropriate tool to manage climate impacts (Cobbinah et al., 2019).

The European commitment to making member states resilient to climate change appears intense, as confirmed by the adoption in 2013 and subsequent update in 2021 of the European Union strategy on adaptation to climate change (Ledda et al., 2023). Above all, this priority is related to the promotion and the support of adaptation actions at local levels. Over time, the European Union has focused its

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