

# Planning for more sustainable tourism destination in a context of climate change - the case study of Porto (Portugal)

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## 1 Main goals

- To assess the spatiotemporal dynamics of land surface temperature (LST) change and land occupation in tourism areas;
- To evaluate the thermal patterns of the critical areas and the influence on the bioclimatic comfort of tourists;
- To determine the influence of urban planning policies on the conditions for the enjoyment of urban space by tourists.

## 2 Methods

### Methodological triangulation (Figure 2):

Identification of tourism areas (or potentially) through processes based on **Big data and data from relevant institutions** since 2005 (analysis between January 2018 and December 2019 – WP3) (Figure 3 and Table 1)

Remote sensing analysis (LANDSAT and MODIS satellite images) between 2013 and 2019 (analysis between February 2018 and December 2019 – WP2) (Figure 4)

Application of **questionnaire surveys** to tourists (563 surveys) and **on-site measurements** (35 days) between July 2019 and August 2020 (analysis between October 2019 and April 2021 – WP4) (Figure 5)

Contributions based on citizen science – participation of institutions and professionals on the subject tourism, urban planning and climate change with **Delphi technique** (subdivided in 2 rounds with 47 (1<sup>st</sup> round) and 34 participants (2<sup>nd</sup> round) occurred between January and April 2021 (analysis between March and May 2021 – WP5) (Figure 6)

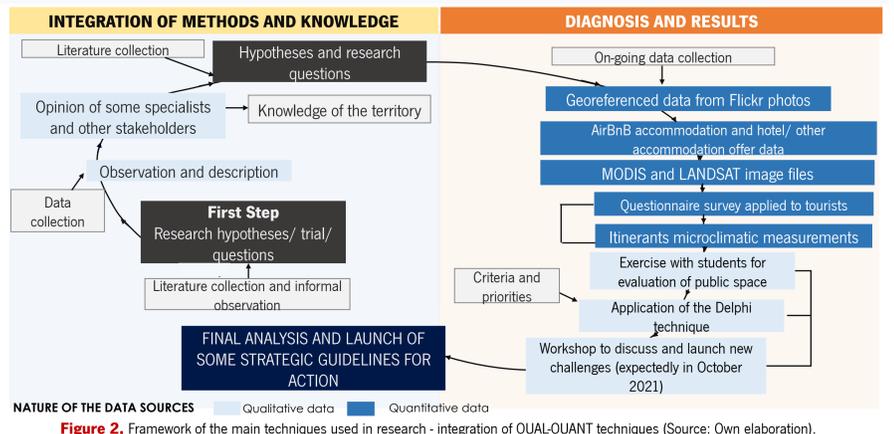


Figure 2. Framework of the main techniques used in research - integration of QUAL-QUANT techniques (Source: Own elaboration).

## 3 Some results

### WHERE DO WE HAVE MORE TOURISM ACTIVITY...?

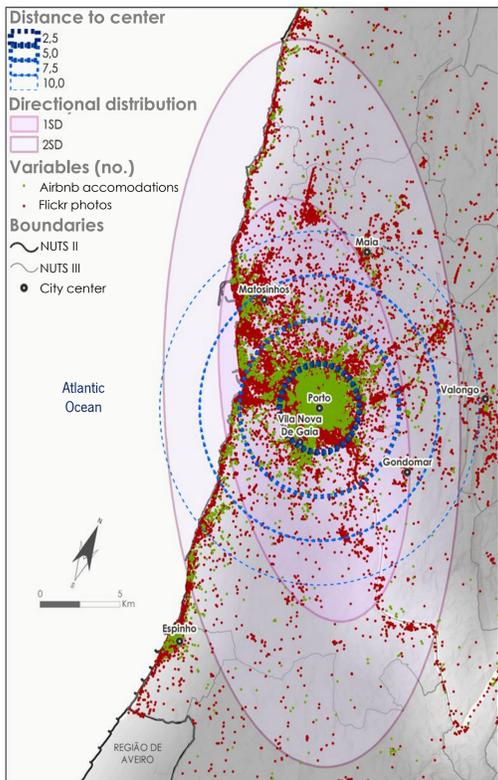


Figure 3. Directional distribution and distance to Porto city center from Flickr photos and Airbnb accommodation (Source: Own elaboration).

At the metropolitan level, the intensification of supply (through accommodation, namely Airbnb) and demand (namely visible through the posting of photographs by tourists) shows a large-scale spread of tourism activity.

The analysis of the mechanisms of direction of the patterns of tourism supply and demand confirm a stronger tendency relationship between the central areas, which most attract the tourism activity.

Table 1. Levels of development of tourism activity in the Porto Metropolitan Area (PMA)

Growth model	Typology	Configuration	Spatial relationship	Tourism consolidation areas and structures
Consolidated metropolitan group (Porto Metropolitan Area)	(1) Metropolitan area	Polynucleated - hierarchical (Porto - V.N.Gaia)	Center-Periphery Interdependence	Matosinhos – Maia – Porto – V.N.Gaia
	(2) Metropolitan Center	Dual Monocentric (Porto – Matosinhos – Maia)	Center – Periphery (complementarity trend)	
Transition areas	(3) Transition areas	Polynucleated (linear)	Interdependence - Complementarity	Póvoa de Varzim (with extension to Viana do Castelo) Trofa – Santo Tirso (with connection to Braga)
		Polynucleated (networked)		Urbanization in Paredes (Vale do Sousa subsystem) Espinho – Santa Maria da Feira – S. J. Madeira (extension to Aveiro)

Source: Own elaboration.

### IS THE CLIMATE OR WEATHER RELEVANT FOR TOURISTS WHO CHOOSE THE PORTO DESTINATION?

The relationship between the choice of tourist destination and the climate is fundamental. The results of the investigation do not disconnect this factor.

73.2% of respondents consider that the climate influences the choice of destination, 71.0% the choice of the season and 80.3% the planned activities. Just over half of the surveyed tourists planned their trip according to Porto's climate/weather (58.4%).



Figure 5. Opinions of Porto tourists about the importance of climate/weather (Source: Own elaboration, based on 563 responses).

### WHAT ARE THE LAND SURFACE TEMPERATURE (LST) PATTERNS IN URBAN AND TOURIST AREAS?

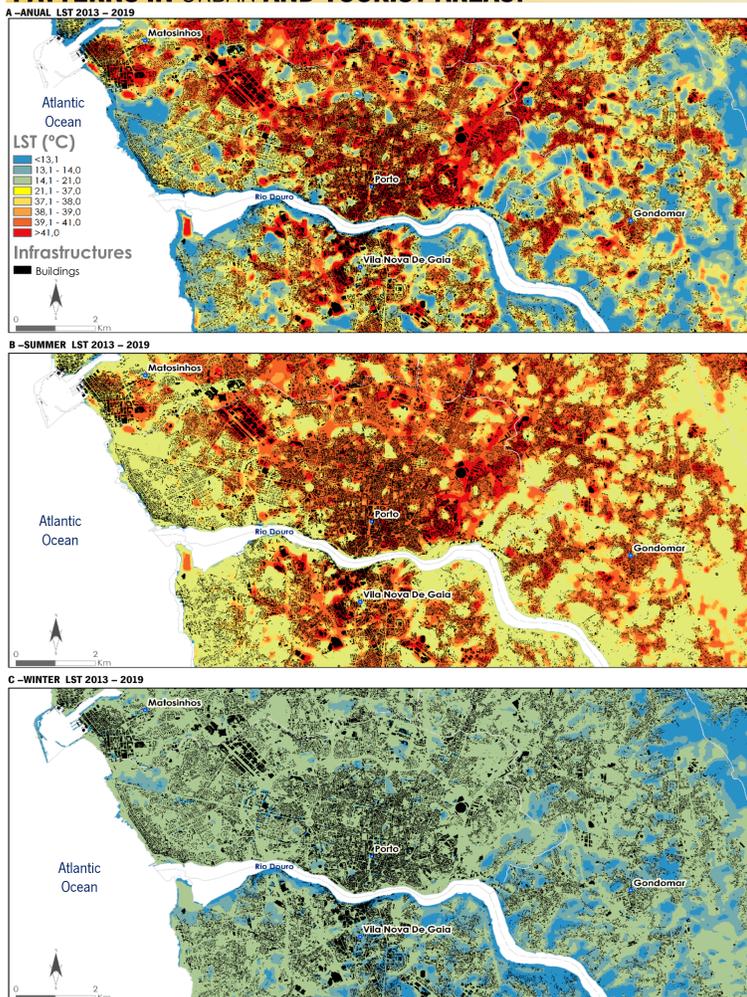


Figure 4. Mean Land Surface Temperature (LST) in Porto between 2013 and 2019: Annual (A), Summer (B) and Winter (C). (Source: Own elaboration).

### WHAT TO DO IN FRONT OF CLIMATE CHANGE SCENARIOS?

#### Scientific evidences points to:

- 1) Central areas with higher land surface temperatures (LST) identified, and, consequently, an urban surface heat island (UHI<sub>sup</sub>) more intense than the peripheral areas (e.g., Avenida dos Aliados area, extension to other contiguous areas - Industrial Area of Ramalde and Via de Cintura Interna (VCI);
- 2) In addition, tourists visiting these areas do not neglect these problems, and consider that the climate significantly influences the tourism enjoyment;
- 3) Among the main problems arising from climate change, there is a significant increase in the frequency of heat waves (which can be more than five times higher in the scenario RCP8.5) and an increase in its duration over time (which can even be twice as high in the RCP8.5 scenario). It is also expected an increase in the frequency of tropical nights (annual average), reaching 21 nights.

Stakeholders point out some measures to be implemented based on:

- i) energy sector solutions;
- ii) improvement and expansion of green infrastructures; and
- iii) increase in network participation, to be developed in the medium and long term.

## 4 Discussion and some conclusions

The use of collaborative practices in this investigation seeks to rethink spaces in view of the flows generated by the tourist activity, taking into account: (1) the functions of the built space (buildings, accommodation, equipment and infrastructure); (2) the generation and encouragement of sociability; and (3) the application of specific interventions, considering the dimension of thermal comfort and the ability to adapt the urban space to future climate change scenarios.

This case study applied to the municipality of Porto identifies the urban planning guidelines to improve the tourist enjoyment of the urban space under current climatic-meteorological conditions, as well as in a context of climate change.

This type of research is fundamental in the context of sustainable development goals (SDGs), where the use of research practices based on 'citizen science' should be valued.

## 5 References

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#### MAIN RESULTS OF DELPHI TECHNIQUE

- 1 ENERGY SECTOR SOLUTIONS
  - Energetic certification.
  - Prioritization of the use of renewable energies (e.g., use of energy sharing services, such as the Copernic program).
- 2 IMPROVEMENT AND EXPANSION OF GREEN INFRASTRUCTURES
  - Creation of green areas (additional areas), namely in the center of Porto.
  - Pedestrianization of central areas of the city.
- 3 TRAINING AND ADAPTATION OF TECHNICAL STAFF
  - Increase the availability of tools (through toolkits and strategic orientations) to assist planners (and companies) in developing adaptation responses.
- 4 NETWORK PARTICIPATION
  - Collaboration of several Stakeholders with relevance in tourism and urban planning subject.
  - Encourage co-responsibility.

Figure 6. Main strategic axes for the development of tourist activity in the context of climate change (Source: Own elaboration, based on two rounds of Delphi technique).