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Climate services for tourism: An applied methodology for user engagement and co-creation in European destinations

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ABSTRACT

This article presents an exploratory methodology to co-create climate services for the tourism sector together with local stakeholders, emphasizing focus groups as an essential step for obtaining relevant data throughout the process. The article describes the user engagement for defining the optimal conditions for tourism in four different types of destinations in terms of tourist specialisation in Spain (Jacetania Council in the Aragon Pyrenees, the city of Calvià on the island of Majorca; the city of Barcelona and the Barcelona Coast) and Italy (Sila National Park) This methodology involves a sequence of steps to extract and validate such information through engagement, with destination stakeholders along the value chain (from accommodation managers to destination planners as well as final users). The process facilitates the design of numerical indices based on the information collected (from qualitative to quantitative data). Our methodology is suitable for application in other contexts and tourism activities where the subjective perception of weather and climate plays a role, as well as in other sectors.

Practical implications

Climate services (CS) aim to provide different kinds of users with usable and actionable information on climate variability, climate change impacts and their related risks, opportunities and uncertainties. The purpose of CS is to develop, translate and customise climate information to the various user needs, considering all related stakeholders. The production and systems of diffusion and use of CS, however, is a controversial issue. CS are based on the transformation of climate information from data to service to make it user-friendly and contextual to user needs. Research demonstrates that stakeholder participation in the production of CS is a necessary condition for the successful implementation of CS, and effective user engagement in the co-production of climate services is critical to guarantee its value and impact (Vincent et al., 2018; Bremer et al., 2021; Vollstedt et al., 2021; Mahon et al., 2019; Golding et al., 2017).

In this sense, we propose a novel methodology based on the co-creation process of climate services for the tourism sector with local agents. The research objective is to co-define, together with destination stakeholders:

A. Who are the potential users (of different types/spatial scales) of climate information for the tourist sector (at destination), and how could the availability of such data affect their decisions and business perspectives?
B. What value do these actors attach to the provision of specific climate information?
C. How should the climate services delivery model be designed for different types of activities according to the information collected through the co-creation process?

User engagement

Co-creation is an active, creative and social process based on collaboration between producers and users. The aim is to obtain

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information on the behaviour of the sector, determining the needs of users in terms of climate information and decision-making to adapt to the different activities of a destination.

In this case, the development of focus groups allows for achieving user engagement thanks to local and tourism agents who best know both the territory and the activities that take place in it. This methodology is applied in four European destinations with different tourism specialisations, such as snow tourism, sun and beach tourism, cultural tourism, outdoor activities, or meetings, incentives, conferences and exhibitions (MICE) tourism.

Users

There is a different range of users of climate services for tourism. Across these categories of end-users, effective decision-making and business planning require high-quality, personalised and contextualized climate information (Scott et al., 2011; Visscher et al., 2020). In this sense, we can distinguish between the following macro-categories of end-users.

- Users include tourist companies, like the hotel and restaurant sectors, cultural and natural attractions managers, guides, transport companies and intermediaries, etc. Tourism operators provide current observations (including webcams) and short-term forecasts to promote their location or event to tourists. Tourist companies need the information to have ideas for how to program their business. The emergence of specialised tourism weather and climate products from private meteorological companies represents significant progress. Still, these products thus far lack the transparency needed to properly evaluate their rigour and applicability to the international travel marketplace (Scott et al., 2011).
- Developers and promoters can use weather and climate information as reasons for developing new resorts. CS may provide developers and promoters with knowledge regarding how dependent the sorts of tourism and specific businesses are on weather. This information will allow them to develop facilities more carefully and with a cause.
- Government or private organisations in charge of destination planning, management, and marketing can also use these services. Some destinations have cultivated a destination image and marketing strategy around specific activities or experiences that are largely based on the local climate. Tourism strategic planning or future tourism developments have used historical climate information, and climate change projections are now being used to anticipate and adapt to market risks and opportunities at the business, destination and national level. Governments or private organisations in charge of destination planning, management and marketing need CS to have an overview of the places where they have competences. In this way, they could act to adapt and mitigate climate change.
- The local community and civic organisations (neighbourhoods associations, environmentalist groups, unions, etc.) need CS information to be less vulnerable and to make their daily operations easier and safe.
- It is also important to note here that the 'final users' of CS may well be the tourists themselves. Indeed, tourists take informed decisions regarding their travel based on weather forecasts and general knowledge of climatic conditions at the destination, which has been strongly improved by the availability of climate information in digital technologies. Although the tourists could hardly be considered 'decision-makers' in terms of future strategies informed by CS, they are nevertheless a subject in this equation whose behaviour needs to be predicted to anticipate future changes.

Addressing the gaps in designing climate services for tourism

Quality. The tourist sector needs accurate climate and weather information depending on the offered activities and market segment. The co-creation process with local agents developed in each study area allows for reaching consensus on the optimal conditions. When consensus is not possible because of the nature and reality of different tourist activities in the same destination, perceptions are listed regarding tourist activities/products. In this sense, a multiproduct destination needs to define a different range of values according to the specific product/activity.

Applicability. Co-creation methodology has a double dimension of applicability. On the one hand, the co-creation process can be applied for different geographical areas regardless of the tourist offer. On the other hand, qualitative information is obtained at the time of the workshop, making the information accessible and applicable by the participants. Also, this methodology could be applied in other sectors.

Decision-making. The developed workshops respond to the basic principle of CS and allow end-users to consensually plan adaptative actions in three temporal scales: short, medium and long timescales. Understanding adaptive actions as measures allows for managing meteorological or climatological conditions that benefit or constrain the specific tourism or leisure activity developed by each stakeholder.

Communication. The channel and format of the final product – the climate service – are tailored according to the needs defined by the participants.

It is expected that this co-creation methodology will improve the smart capacity of destinations, giving an easy-to-use tool to solve the problems of each stakeholder. Also, it is expected to generate synergies between stakeholders and users to face various challenges (from overtourism to the effects of climate change). Finally, it will be a tool for the destination to improve its market position in a post-COVID market characterized by digitalization.

Introduction

In the 21st century, the world's population is facing multifaceted challenges from climate variability and climate change. These require wise and well-informed decision-making at every level, from households to international forums. Parallel to the need to understand recent climatic changes and tendencies of extreme weather events, there is a need to know their impacts. Many recent examples of impact-based forecasts in different disciplines are either from the priority defined areas related to risk reduction strategy (Speight et al., 2021), agriculture (Malhi et al., 2021), health (Davis eet al., 2021), energy (Gil eet al., 2021), and water (Liu et al., 2021) or more specific topics as road accident probabilities due to weather conditions (Becker et al., 2021). In this sense, there is an increasing demand for customised climate-related tools, products and information that will enable climate-smart, strategic decisions at various levels for a wide range of end-users. Taken together, these reasons have led to the development of 'actionable' climate science and specific 'climate services' (Van den Hurk et al., 2018; European Commission, 2015; WCC-3, 2009).

Climate services (CS) aim to provide different kinds of users with usable and actionable information on climate variability, climate change impacts and their related risks, opportunities and uncertainties. In other words, the purpose of CS is to develop, translate and customise climate information according to various users' needs considering all related stakeholders such as academics, NGOs, decision-makers in enterprises and administrative bodies, policymakers from various levels, and citizens (JPI Climate, 2016; Lehoczky, 2017).

In this regard, stakeholders' participation is the basis for a productive and effective application of CS, where effective user engagement and the co-production of climate services are key. That has been a core recommendation of the Global Framework of Climate Services (GFCS) and several published studies. This application is not only used in priority areas of GFCS but also in the tourism sector (Turton et al., 2010; Moreno and Becken, 2009; Pandy and Rogerson, 2018; Hopkins, 2014; Morrison and Pickering, 2013). User-provider engagement is one of the most fundamental activities in the preparation, development and

application of climate information for decision-making. In addition, the collaboration between decision-makers, climate scientists and specialised academics offers an opportunity to leverage the expertise of all parties to better serve the problem-solving process (Briley et al., 2015; Golding et al., 2017).

Climate and meteorological information play an important role in global societies today. As Vincent et al. (2018) highlighted in echoing Williams et al. (2015), knowledge about future climate conditions is considered a key component of increasing societal capacities to adapt to both climate variability and climate change. Therefore, the use of this information can offer critical benefits to societies worldwide. According to the World Meteorological Organization (WMO, 2015), the effective use of up-to-date climate information has the potential to help stakeholders, including governments, avoid environmental problems and damages by reducing the impacts of hazardous natural events such as hurricanes, in addition to providing a wide range of societal benefits. For example, the use of CS can help avoid injuries or deaths, protect property and increase the safety and comfort of everyday life. Moreover, these benefits are both social and economic. Climate information allows companies to increase their profitability and productivity, which strengthens national economies by providing a more solid foundation for future planning.

Regarding this, there is real value associated with forecasts and climate services. According to Lee and Lee (2007), the economic value of forecasts is defined by additional profits a decision-maker can make by using a forecast compared to not using one. Demand-based methods assume that consumers of the services (which may be commercial producers who use the services as inputs) know the maximum amounts they would be willing to pay (WTP) for specific information services (Rollins and Shaykewich, 2003). Although it is difficult to put a number on the market price of CS, people may be willing to pay for services that have been demonstrated to be effective and applicable and that, thereby, create economic value (Clements et al., 2013; Lee and Lee, 2007; Rollins and Shaykewich, 2007). Potential clients and targeted users may have different willingness to pay and may alter the financial planning if not carefully prepared in advance (Larosa and Mysiak, 2020). Some services and climate indices have even been converted to stock-market products transformed into instruments such as weather derivatives, also generating economic value around them (see, for example, Alexandridis et al., 2020) and an insurance system concerning the activities these tools are measuring (see for example Boyd et al., 2020). Therefore, a product or service is priced when it explicitly demonstrates its value to users willing to pay for the advantageous information derived from it.

A clear understanding of the value and opportunities associated with CS can help national governments and organisations guide priorities and better manage the impacts of weather and climate across economic sectors (Clements et al., 2013). The valorisation of this information is defined in terms of not only the benefits it can offer but also the social, economic and environmental costs that may result from not having it.

As a result of their importance, value and benefits, CS currently exist at local, national, regional and international scales and in a range of different sectors, including agriculture, health, forestry, fisheries, transportation, energy, disaster risk reduction, water resources management and tourism (Vaughan and Dessai, 2014). In this sense, the focus of our attention is related to data extraction from tourism stakeholders to develop a co-created climate service.

The tourism sector is one of the world's largest economic sectors (World Travel and Tourism Council [WWTC], 2021). In the pre-COVID-19-time, international tourism growth continued to outpace the global economy; 1.5 billion international tourism arrivals were recorded in 2019 globally, a 4% increase on the previous year. UNWTO confirms that tourism is a leading and resilient economy sector; this calls for such growth to be managed responsibly to best seize the opportunities tourism can generate for communities around the world (UNWTO, 2018).

Without a doubt, tourism is an important economic activity in most countries worldwide, but any change in current atmospheric conditions could, indeed, have impacts of different kinds on this sector. The COVID-19 pandemic has revealed how fragile and volatile the tourism industry can be (Brouder, 2020). Nevertheless, the COVID-19 pandemic could be a starting point to transform it towards more sustainable tourism (Hall et al., 2020) and an opportunity for proximity tourism (Romagosa, 2020). Climate services can help reduce other sources of uncertainty, specifically those related to meteorological and climatic characteristics and fluctuations. Moreover, an effective climate service related to this reduction of uncertainty should help both in the management of the destination and its ability to generate a smarter destination, a key element for the future development of destinations. These climate services have a 'future' approach in snow tourism, as presented in the recent study by Morin (2021) and a previous study (Pons et al., 2014), but not are well defined for other types of tourism where 'past' approaches are more used (see Boqué and Aguilar, 2020; Mathews et al., 2021, among others). Reducing this uncertainty will better position the destination for its daily management and tourism-mobilities planning and adaptation to the post-pandemic situation and the increasing effects of climate change.

The climate determines the socioeconomic activities, including tourism, of any region, which are strongly influenced in a bidimensional relationship with the state of the atmosphere (Martínez-Ibarra et al., 2019). A climate service for tourism requires a daily-basis approach; it should be applied to a specific geographic area (tourism destination). Further, it depends on the type of tourism activity; for example, it will not be the same for snow tourism as for sun and beach tourism, surfing tourism, or cultural tourism. Those are key factors for continuing to design satisfactory and useful information for a climate service (Kovács and Unger, 2014; Martinez et al., 2019). Definitions of indices and tailored CS for specific tourism subsectors are in their early stages of development. Nevertheless, the first steps for developing CS for tourism subsectors can be found for surfing tourism where, thanks to developed indices, it is possible to determine the expected distribution of surfing days around the Iberian Peninsula's surf spots (Boqué and Aguilar, 2020).

Climate and weather, therefore, have to be understood as substantial factors of tourism that affect–directly and indirectly–the development of tourism activities, traveller satisfaction, repeat visits, economic performance, stakeholder management, destination planning and evolution for the future.

The literature (e.g. Gómez-Martín, 2005) suggests that climate can support tourist activities either as a basic resource or a necessary complement. At some destinations, together with geographic location, topography, landscape, and flora and fauna, weather and climate constitute the natural resource base for recreation and tourism (De Freitas, 2003). As Becken (2014) defended, it could be claimed that any type of tourism activity or product has 'ideal' atmospheric conditions that correspond to those providing the maximum level of comfort for visitors engaging in related activities. At the destination level, these conditions should be projected to different products over the year. For example, a mountain destination could offer ideal conditions for skiing in the winter and outdoor tourism in the summer, or a city on the coast could offer ideal conditions for sea and sand tourism in the summer and cultural tourism and events in colder seasons. Many destinations, however, are specialised in one tourism product; therefore, they typically should offer ideal conditions for such an activity during one peak season, while the other seasons are 'low season'. The key factor, then, will be the endowments related to climatic attributes that boost their competitiveness regarding other features, such as geographical, cultural or destination attractiveness.

Global climate change has the potential to alter the distribution of climate assets of destinations, with implications for tourism seasonality, demand and travel patterns and consumer behaviour, among others. Changes in the length and quality of tourism seasons have considerable implications for the long-term profitability of tourism enterprises and

competitive relationships between destinations (Scott et al., 2004).

While making sense of changing climate trends and extreme events is paramount to designing mitigation strategies and monitoring their implementation, there is also the need to understand and anticipate their impacts in view of adaptation. Accurate climate and meteorological information, therefore, play a fundamental role in societal well-being, and, as highlighted by Vincent et al. (2018) (echoing Williams et al., 1997), knowledge about future climate conditions is considered a key component of the capacity of society to adapt to both climate variability and climate change.

In the framework of the INDECIS Project (Integrated approach for the Development across Europe of user oriented climate indicators for GFCS high-priority sectors: agriculture, disaster risk reduction, energy, health, water and tourism), we conducted a series of workshops with stakeholders in four European tourism destinations. Three are located in Spain: Jacetania Council in the Aragon Pyrenees, the city of Calvià in Majorca, and Barcelona (city and coast); the fourth is in Italy: the Sila National Park. Each workshop was related to different geographic areas and different types of tourism: snow and high-mountain tourism in the Aragon Pyrenees; beach tourism in Majorca; mountain and natural tourism in Calabria; and MICE (Meetings, Incentives, Conferences and Exhibitions) and beach tourism in Barcelona. These workshops have the ultimate purpose of codeveloping climate services, considering the needs of different stakeholders and users in destinations perceived as highly vulnerable to weather fluctuations, climate variability and climate change. The need to cooperate with the tourism industry is twofold: on the one hand, this collaboration is necessary to understand industries' needs in terms of weather/climate services; on the other, tourism industry agents become providers of the sectoral data needed to develop and validate effective climate indicators and services.

Methods

According to Scott et al. (2007), there are three methodological approaches to extracting information about optimal conditions and tourist preferences for developing a tourism activity: (1) conducting tourist surveys, (2) analysing the relationship between tourist behaviour and meteorological conditions, and (3) interviewing local stakeholders and end-users, understood as the local administrations, private businesses and tourists. We propose a mixed methodology based on the second and third approaches, where the stakeholders, experts and users are the main actors who define the best meteorological conditions for developing tourism activities in a co-creation process.

The design of climate services for the tourism sector with local agents takes place in the context of the INDECIS Project, a project framed in the European Research Area for Climate Services program (ERA4CS). This article presents the different phases of the climate service co-creation process based on the participation of tourism destination stakeholders, focusing on workshops as a key phase for user engagement, and carried out to obtain qualitative data that will be transformed into a quantitative climate service.

Approach to user engagement

In the co-construction of climate service, a clear identification of stakeholders and the value proposition (advantages gained by users) is important, and the success of climate services will depend on the ability to engage users as equal and integral partners in the whole process (Bremer et al., 2019; Larosa and Mysiak, 2020; Stegmaier et al., 2020). The close involvement of users and stakeholders is essential to deliver a tailor-made service (Larosa and Mysiak, 2020). Users have quick and inexpensive access to relevant data and projections, making individual and collective decision-making processes more robust and objective (Visscher et al., 2020).

The methodology of user engagement implemented in this project pursued the creation of focus groups of local tourist stakeholders, including tourist businesses, destination managers, administration officials and potential users. The engagement was organised in a workshop composed of three steps through focus group discussions. The focus group is a qualitative technique of studying the opinions and attitudes of a given audience, a group interaction to produce data in relation to a common aim. Its value lies in part in minimizing researcher biases, offering the potential for unexpected insights to emerge, and participants can respond in their own words to reach an understanding or consensus about a topic (Eisenhauer and Nicholson, 2005, Newig et al., 2008).

In each focus group, the same issues were treated related to tourist activity and climate information; in this sense, the participants were divided into their tourist product specialisation. The resulting information and key issues are organised graphically using design thinking tools to facilitate the elicitation of positioning and opinions and their later elaboration.

To engage potential workshop attendees, each received a communication describing our objectives together with a call for participants. The communication contained the basic objectives of the workshop defined in three main axes:

1) A definition of potential users of climate information and how this information would affect business/activity decision-making;
2) The value this climate information would have for these actors; and
3) The climate service delivery channel, considering the specific context of each actor and, regarding the ability to understand the information, the definition of the best tool (newsletter, map, chart) for communicating climate information.

Each of the four workshops followed the same structure and procedure: The engagement sessions were preceded by 'keynote' talks from local government stakeholders, researchers and experts who presented the broader framework of the project and the specific issues of the region under scrutiny. This introductory session was then followed by the staging of focus groups, organised as subgroups of stakeholders representing a homogeneous group of products available at the destination (according to seasonality, market profile, spatial characteristics, e.g. sea and sand tourism, active and outdoor tourism, or ski tourism.

Co-creation process

The engagement of users is widely supported in the literature, although co-creation processes are still relatively rare in practice (Vaughan and Dessai, 2014). However, services are products of close and multiple interactions between providers and clients, implicit in the co-creation process (Xu et al., 2018).

The methodological model was specifically designed for the co-creation, analysis and valorisation of climate services with destination stakeholders. It includes a central workshop formed according to different steps taken before the workshops and during and after the workshops (Fig. 1).

The preliminary step consists of the identification of candidate locations to host the workshop and the entire co-creation methodology. Reasons for selection combine the scientific interest of a particular place according to the tourism typology and climate characteristics and the actual possibilities of engaging local workshop conveners and the key stakeholders of the area. The collection of statistical data becomes necessary in this step to define statistically significant associations between a climate dataset and a set of indicators on tourism performance (Hotel Occupation, Demand, Revenue, Revenue per Room [RevPar] and Average Daily Rate [ADR]). With all this, we can design and test the methodology of stakeholder engagement. In this step, scientists select potential stakeholders to participate in the different subsequent steps. The selection of participants is based on agreeing on a representation of different stakeholders (users) through discussion between local agents and project researchers. Local agents and local researchers make a proposal of participants that is validated by the research and dynamized

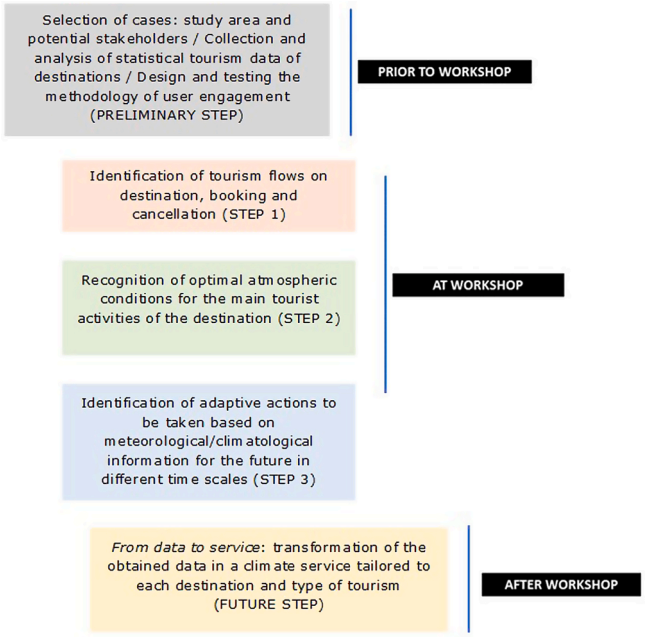

Fig. 1. Co-creation structure.

team of the focus groups.

The main steps of the methodology consist of developing the workshop; each one is a phase of the focus group and corresponds to a specific objective:

- Identification of tourism flows on destination, booking and cancellation (Step 1);
- Recognition of optimal atmospheric conditions for the main tourist activities of the destination (Step 2); and
- Identification of adaptative actions at different timescales (Step 3).

The step that follows corresponds to future research that consists of transforming the data collected so it becomes a useful climate service that includes identification, based on the information gathered at previous steps, of the most relevant end-users, channels and formats that will maximize the value of CS for destination stakeholders.

Conducting focus groups

The selected stakeholders (who accept the invitation to participate) are summoned to a specific place for the workshop. From this moment, the focus groups are structured, categorizing participants according to their affinity with their tourism/leisure activity. At this point, the co-creation process of climate service begins.

Information was collected using mental maps, which represent a multidimensional reality formed by the 'basic ordering of ideas' (Muñoz et al., 2014). This basic ordering idea is the key concept that generates a network of relationships between ideas. From this network, a structure that reflects the hierarchization and categorization of thoughts emerges (Ontoria et al., 2006). The mental map is a qualitative model that identifies the following characteristics: It is a descriptive process that collects descriptive data; it takes an interpretive humanistic and subjective approach; the observation is the main source of data, and the reflection is a thought-generating activity. The main objective of the mental map is to build a consensus around an issue (Flick et al., 2004; Muñoz, 2014; Muñoz and Serrano, 2014).

In this sense, a mental map is a collective output (González et al., 2014) and a graphic organiser where information is integrated using visualization techniques. One of the potentialities of mental maps is the construction of consensus based on subjective realities. In this sense, Reckien et al. (2013) studied these subjective realities for climate change, and the conclusion defined these maps as an effective tool for building socially sensible adaptation options. This tool presents important benefits for qualitative research. Thus, we created a new mental map framework for developing CS for the tourism sector. To build it, the moderator gave participants materials for writing and attaching their opinions to each frame of the work. Other experts guided the interaction between local stakeholders, experts and users. This engagement activity aimed to initiate dialogue between scientists and potential users of climate information. According to Vedeld et al. (2019), it was necessary to integrate stakeholders to analyse the determinants of vulnerabilities holistically and with consensus to enable the definition of multiple future scenarios.

The operative results of our co-creation process allow the extraction of three mental maps developed for each type of tourism depending on destination. Each consensual mental map responds to different steps with different objectives, as will be explained.

STEP 1. Identification of tourism flows on destination booking and cancellation.

The main objective is to characterize the tourism activity at the destination: main products, estimated performance in terms of revenue, occupation and employment; destination capacity, seasonal patterns and mobilities. The data are obtained as qualitative information, which helps in interpreting quantitative performance data and identifying their possible sources and databases. Table 1 shows the questions passed on to the participants and the information acquired from their answers.

STEP 2. Identification of optimal atmospheric conditions for the main tourism activities of the destination.

In this step, we analyse and describe the relationship between meteorological/climatological conditions and tourism products. The main objective is to identify and explain which atmospheric conditions harm or benefit the activities developed at tourism destinations (see Table 2). After defining the mental map from the consensus of participants, a matrix is built merging tourism activities and performance and climate and weather elements. Key information elicited directly from stakeholders is used to develop a table to graphically represent how such specific climatic conditions have a normal effect on tourism destination activity and performance. In this sense, the atmospheric conditions that affect the activities are ordered depending on the degree to which they affect the activity.

STEP 3. Identification of adaptative actions at different timescales.

Step 3 was designed to identify actions stakeholders would take when they had information in advance that would improve and adapt the destination and its activities in the future according to meteorological/climatological conditions defined in Step 2. In this sense, the objective is related to discovering the best adaptive actions for stakeholders to take and the best format to offer this information. Table 3 shows the questions asked and the data collected in this step.

Table 1
Questions and data achieved in Step 1.

Question	Acquired information
When are the periods with more and less tourism flows at the destination? Why are the periods that way?	Peak and valley periods of activity Reasons for seasonality described in the question
How long in advance do tourists book their activities/accommodation?	How long in advance users book the products
What are the reasons for last-minute cancellations?	Reasons for last-minute cancellations

Table 2
Questions and data achieved in Step 2.

Question	Acquired information
What atmospheric conditions benefit the tourism activity?	Optimal atmospheric conditions
What atmospheric conditions harm the tourism activity?	Negative situations for tourism activity
To what degree does each atmospheric conditions boost or constrain the tourism activity?	Degree of the dependence of the atmospheric conditions to the tourism activity

Table 3
Questions and data achieved in Step 3.

Question	Acquired information
What adaptive actions would you take if you had information regarding the conditions that boost your activity?	Adaptive actions related to boosters in different timescales (immediate, short-term, seasonal, five years, and ten years)
What adaptive actions would you take if you had information regarding the conditions that constrain your activity?	Adaptive actions related to constraints in different timescales (immediate, short-term, seasonal, five years, and ten years)
In which format and by which channel would you like to receive the information?	Channels and formats for receiving the climate service

In the first action for defining a mental map, adaptive actions were defined in different temporal scales: from nowcasting until a long term based on 30 years. This process posits defining adaptive actions for the immediate future (the next day) as well as thinking about strategic actions for the whole destination. In the second action, participants discuss in which format and channel they would like to acquire the information for developing the actions needed to implement defined adaptive actions.

This point also allows for the verification of how different actors value the utility of the climate information and which model of delivery they would prefer: questions about the channel (e.g. app, web, bulletin), the frequency (e.g. hourly, daily, seasonally) and the economic value (e.g. if they are willing to pay for the information; how much they would pay) are asked. This last point is a key factor in the whole methodological process insofar as climate services need to ensure their value to end-users. Customisable communication of the information is the key point in the co-creation method of climate services because it assures the method of compression and transmission of the information for the end-users.

However, for a final definition of this step, it will be interesting to develop a post-workshop survey after climate services have been applied. Application of climate services will have three steps more before the survey application: Firstly, it is necessary to define and build a numerical index (a first approach for snow tourism index was presented in conference [Olano et al., 2020]); secondly, when the index will be defined and calculated, the statistical relationships with the tourism performance variables collected in the preliminary step (Occupancy, Demand, RevPar or ADR); and, thirdly, the climate service will be presented with the key points and the mode defined in the last step of the workshop. This survey can define quantitative estimates and how the stakeholders use this information to take action themselves. Also, we will ask final users if climate and meteorological conditions in tourist origin place affect their destination election, a research area that is gaining attention and less explored (Mathews et al., 2021).

Furthermore, this process could focus the attention of the administration, policy organisations, destination-management organisations or lobbies on developing adaptive actions for the whole destination or simply to inform consumers and tourists.

Limitations of focus groups

One of the strongest advantages of the proposed method is that it relies on a flat hierarchy approach. However, this might introduce some distortion derived from the diverse perceptions, experiences, and needs of participants. Thus, the process must be clearly defined as cooperation and co-creation dynamics before starting it. In this sense, egalitarian cooperation is only achieved when all the participants are allowed to speak and be listened since the initial phases. Moreover, researchers have to realize that participants are actors who may have incoherent and sometimes even conflicting interests. This is the most important methodological issue to handle and, for this reason, it is necessary to let participants speak and listen with full attention as far as researchers can only identify these qualitative and subjective dimensions when analyzing the comments and reactions of actors during the workshop. As shown in the following sections four and five of the article, procedures deployed by researchers have ensured satisfactory management of this issue.

Study areas

The case study locations aimed to include different 'exemplary' destinations in terms of climate types and vulnerability of the principal tourist product typologies offered (Table 4); however, they were based primarily on adequacy and opportunity (contacts with local administrations and industry leaders). In this section, we briefly present these four destinations and their main tourism activities. The participant stakeholders at the four workshops held in 2019 at these destinations (April 25 in the Aragon Pyrenees, May 9 in Majorca, May 30 in Sila National Park, and June 27 in Barcelona) were predominantly tourist operators, destination manager organisations, and regional climate organisations.

Jacetania Council is a mountain tourism destination located in the Spanish province of Huesca in the Aragon Pyrenees (Spain). Snow tourism, cultural tourism and outdoor activities are the main activities in the Jacetania, of which Jaca is the capital. Jaca could hardly be considered a world-class destination; however, it has national importance as it offers all the activities related to snow, such as alpine and cross-country skiing. Cultural tourism involves visits to places of historical, heritage or ethnological interest and related events. Outdoor activities include physical and sports activities in the open air such as climbing, walking, biking, or canoeing.

Calvià, a coastal city on the island of Mallorca in the Balearic Islands (Spain), is a popular resort town in one of the most celebrated and popular summer destinations of the Mediterranean. The main activities at this destination are sun and beach tourism and outdoor activities. The former includes activities related to the beach, such as sunbathing and swimming, while the latter, as already noted, includes physical activities in the open air. In the coastal and inner areas of Calvià, these include cycling, golf, nautical trekking, diving courses and competitive events.

Sila National Park is one of the most outstanding natural reserves in Italy and is located in the southern region of Calabria (Italy). The main

Table 4
Case study destination and tourist market.

Tourist Market	Place	Destination
Beach	Majorca	Coast of Calvià
	Barcelona	Coast of Barcelona
Snow and high-mountain tourism	Calabria	Sila National Park
	Aragon Pyrenees	Jaca
Outdoor tourism	Majorca	Calvià
	Calabria	Sila National Park
	Aragon Pyrenees	Jaca
Cultural tourism	Aragon Pyrenees	Jaca and Jacetania County
	Barcelona	Barcelona
MICE	Barcelona	Barcelona

tourism activities offered there are snow tourism, lake tourism, and other outdoor activities, including trekking, cycling, the observation of flora and fauna, and gastronomic and cultural events.

Another case study location was the coastal region of Barcelona and the city of Barcelona. The coast of Barcelona is not as popular as other Catalan or Spanish coastal destination regions because the urbanization process has developed other, non-tourism uses as a result of metropolitan residential expansion (Olano, 2019; Olano et al., 2017). However, it has a regional and national interest and, because of its proximity to Barcelona, one of the most popular tourist cities in Europe, it stands out as offering access to a large number of unique natural, cultural and urban amenities. The reason for the focus on the coast was that it is an area vulnerable to climatic conditions, characterized, for instance, by severe beach erosion and frequent flooding. The city of Barcelona is one of the most celebrated urban destinations in the world and, thus, was an obvious part of this discussion. The main tourism activities identified in this area are sun and beach tourism; meetings, incentives, conventions and exhibitions (MICE) and cultural tourism.

In a preliminary stage, the research team, together with workshop organisers/conveners, identified the key stakeholders at each destination related to specific products or with the destination as a whole (including local governments) to be engaged in the process (see Table 5). The stakeholders were directly related to tourism activity at each destination. They were chosen for their predisposition to participate and think about the future of their destinations. In this sense, those who participated in the workshops were stakeholders with ideas for improving the destination and users' experiences. In each workshop, about 25 stakeholders participated, including those involved in public administrations (i.e. town councils, counties), destination-management organisations (e.g. tourism offices, Sila National Park Authority), conservation organisations (e.g. the Mallorca Preservation Fund), research groups (e.g. the Pyrenees Climate Change Observatory [OPCC]), private consulting services and tourism entrepreneurs (e.g. hotels, adventure parks, consultancies, restaurants, guides). Table 5 shows the full list of stakeholders who participated in each workshop and the total count of attendees.

Results

In this section, the information gathered at the workshops is briefly presented. Results for all destinations are shown through graphics and summary tables.

Optimal conditions for each tourism activity

One common finding in all our workshops is the confirmation of the strong relationship between climate and tourism. Beyond what data could show, this relationship is strongly internalized in the perception of key stakeholders and decision-makers at the destinations. The perceptions and anticipation regarding how climate conditions will change in the future are currently driving the most important decisions affecting the evolution of businesses at these destinations.

However, much of the 'replanning' of activities is based on short-term weather forecasts that are available in an erratic and poorly contextualized way or are not tailored to the needs of end-users. Furthermore, as frequently mentioned in the focus groups, the 'response tactics' of individual businesses or subsectors of the tourism industry are often fragmented and hardly supported by adaptation strategies at the scale of destination implemented in the long term. Not all types of tourism activities and products depend on weather and climate in the same way, and the more diverse a destination is, the greater its capacity to compensate for losses on one side with gains on another (Fig. 2).

According to the responses of the stakeholders at each destination, all the types of tourism analysed are influenced by certain weather or climatic conditions that compromise or even impede their realization. Conditions that affect each activity are represented on a simple traffic-light scale: green for optimal conditions; orange and red for adverse conditions (Fig. 2). These meteorological conditions/variables are categorized according to the activity in a very general way; however, all of them have nuances. For example, the average temperature at a ski resort in the Pyrenees is not the same as at a sun and beach area in the Mediterranean or a ski resort in the Alps or an Atlantic Coast sun and beach destination; therefore, the temperature needed to develop each activity is different. Some situations are clearly without debate; if the mountains do not have snow, it is impossible to develop ski activities. There are situations such as in MICE tourism where the meteorological conditions (unless very extreme) do not lead to tourists' cancellations, but they do affect the perception of their satisfaction. For this reason, the determination of variables and intervals in a more detailed manner is necessary as well as the creation of indicators for each type of tourism and geographic area to create tailored information. All this will be explained in the next step.

In the case of sun and beach or snow tourism, conditions such as extreme wind, rain, storm or snow directly and completely affect the realization of this type of tourism. Otherwise, when the weather is completely cloudy, it reduces the number of sun and beach tourists, but it is not an excluding factor. The best conditions are – according to the workshops and the participation of the stakeholders – sun, partially cloudy, and medium–high temperatures. In the case of snow tourism, as expected, low temperatures are required to produce snow, and snowfall when performing the activity is also a very positive condition. If the day is sunny and with average temperatures (neither too cold nor too hot for skiing) at the ski station, tourism is favoured, while the rest of the conditions, available in the table, are negative for snow tourism.

Outdoor tourism (i.e. hiking, climbing, canoeing) and outdoor cultural tourism (i.e. cultural routes, outdoor concerts) follow practically the same dynamics as snow tourism, which is affected by conditions that do not favour the practice of sports and tourism in the outdoors (i.e. rain, wind, fog and high or low temperatures, especially extreme), including, in this case, snow as a negative factor. Indoor cultural tourism is favoured when conditions outside are considered poor (e.g. not sunny, rainy, extreme temperatures, heavy winds) and do not allow outdoor activities. However, if conditions are very extreme, cultural tourism may not benefit because of tourists' lack of willingness to go to certain places (e.g. if there is a very strong snowstorm or a hurricane, tourists probably

Table 5
Type and number of organizations by workshops.

	Local Policy Makers	Local Tourism Offices	Research Centres/ Universities	Conservation Organizations	Private Tourism Entrepreneurs	Private Consultancies	Number of Attendees
Jaca, Huesca (Spain), 25 April 2019	4	2	2	0	3	0	26
Calvià, Balearic Islands (Spain), 9 May 2019	3	1	1	2	3	0	24
Sila National Park, Calabria (Italy), 30 May 2019	4	0	2	0	9	0	36
Coast of Barcelona (Spain), 27 June 2019	4	1	3	0	2	3	25

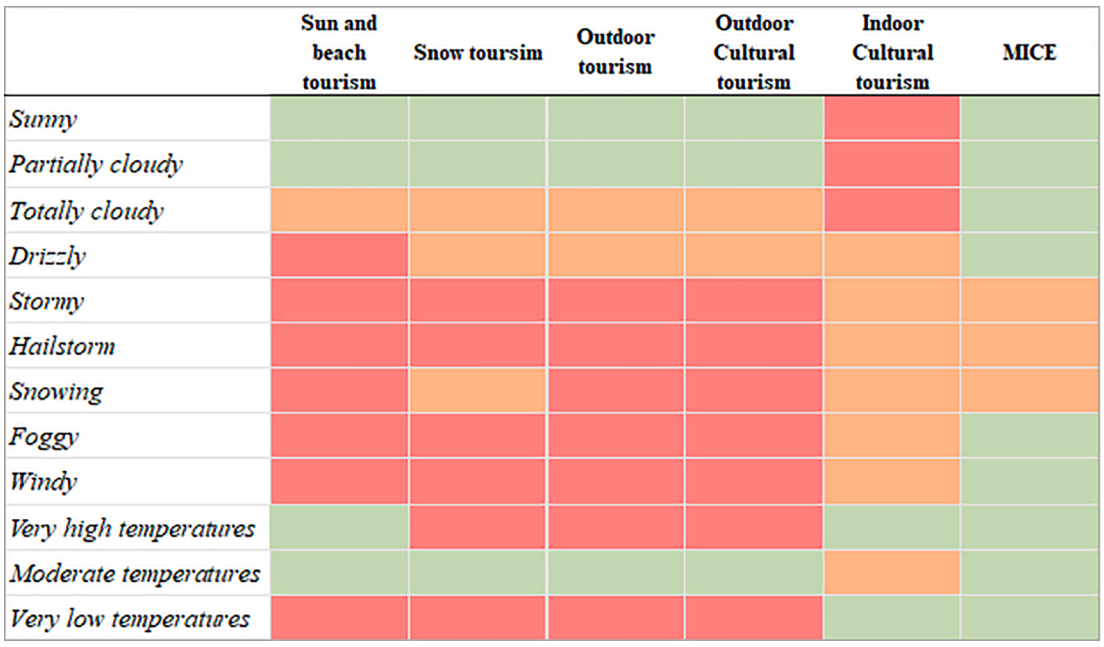

Fig. 2. Meteorological conditions and their relationships to different types of tourism activities. In green the optimal conditions; in red.

shelter in place at their accommodation).

Finally, in the case of congress tourism or MICE, we see a very different pattern. Normally, tourists book these activities and trips well in advance, and unless dangerous weather conditions force flight cancellations, they do not cancel the activity because it is work-related tourism. For that reason, the cancellation of MICE due to meteorological conditions rarely, if ever, occurs.

Our workshops facilitate an understanding of which climate conditions are especially adverse or favourable for key typologies of exemplary destinations of the Mediterranean Arc, one of the areas of highest tourist intensity and economic dependency on the tourist sector.

Adaptive actions for tourism destinations

It is well-known that climate change will affect this region's tourism future considerably; however, in this research, we wanted to focus on more specific situations and the diversity of responses on a local scale. We also looked at the ways and channels through which climate sensibility is 'transferred' from the ultimate customers to decision-making at the business and destination scale and the range of adaptive actions that could inform adaptation strategies. In this sense, the following figures show the main decisions about the weather and meteorological conditions that benefit (Fig. 3) and hurt (Fig. 4) tourism activities. Decisions and actions are, indeed, somewhat different for each destination and type of tourism activity, but the differences among them are minimal. On the contrary, the temporal scale of meteorological prediction is the factor that determines stakeholders' decisions to follow one course of action or another.

Considering the main decisions of the tourism sector in regard to conditions that benefit tourism activities, Fig. 3 shows them in three sections. The first is about the tourist offer, and if weather conditions are favourable, this can be reinforced, especially for short-term predictions, through powered-up programming and offers of tourist complements (e.g. alternative activities, additional services, more 'perks'). For long-term predictions, the decision to change the tourism policy according to the meteorological/climatic changes that are expected to occur consists of a plan of adaptation to be ready to face such new situations. The second section is marketing; all stakeholders decided that if conditions are very favourable, more and better destination promotion has to be done, especially with the inclusion of weather forecasts in event promotion and boosted social networking promotions. For the seasonal forecast, they agreed that there is a necessity for more investments in both online and offline promotions. In any case, it will be important to carry out a change in promotional planning according to changes in weather conditions (5–30-year prediction). The third section is about the economy and prices. The price of tourism products and services can be increased if the short-term prediction for tourism is good. However, this implies an increase in employees and services as well, based on tourist demand. With the benefits obtained, this information it can be considered a plan of investments for the destination, such as infrastructure, transport and services.

In contrast, Fig. 4 shows the main decisions of the tourism sector considering the conditions that hurt tourism, and the price is shown with the opposite effect (price reduction, employee reduction, service reduction), implying a diversification of the economy considering a long-term prediction. In the case of the tourist offer, the first decision considering a short-term prediction is rescheduling, postponing, or cancelling programmed activities, such as outdoor events, concerts or sports competitions. For this reason, it is important to have a 'plan B' of alternative activities and tourist products for customers. In this sense, communication and marketing for tourists must be direct and updated, especially to avoid booking cancellations. With a seasonal forecast, stakeholders can diversify the tourist offer, and the tourist model must be reconsidered and changed according to a long-term prediction through a new tourism strategy and promotional planning. However, because of previous actions and decisions, the participants agreed that an emergency plan must be applied for the short term, and a more detailed and complete plan must be created for the adaptation to and mitigation of climate changes. Thus, the collaboration of all stakeholders is essential.

Communication: channels and format

Many sources of weather and climate data or information (measured or modelled) are available to the public. Therefore, in agreement with Matzarakis et al. (2004), climate-relevant information can be implemented by tourism demands.

In a general way, for the formats and channels seen as more useful for receiving climate/meteorological information for the tourist activities mentioned in this research (beach, snow and mountain tourism, outdoor

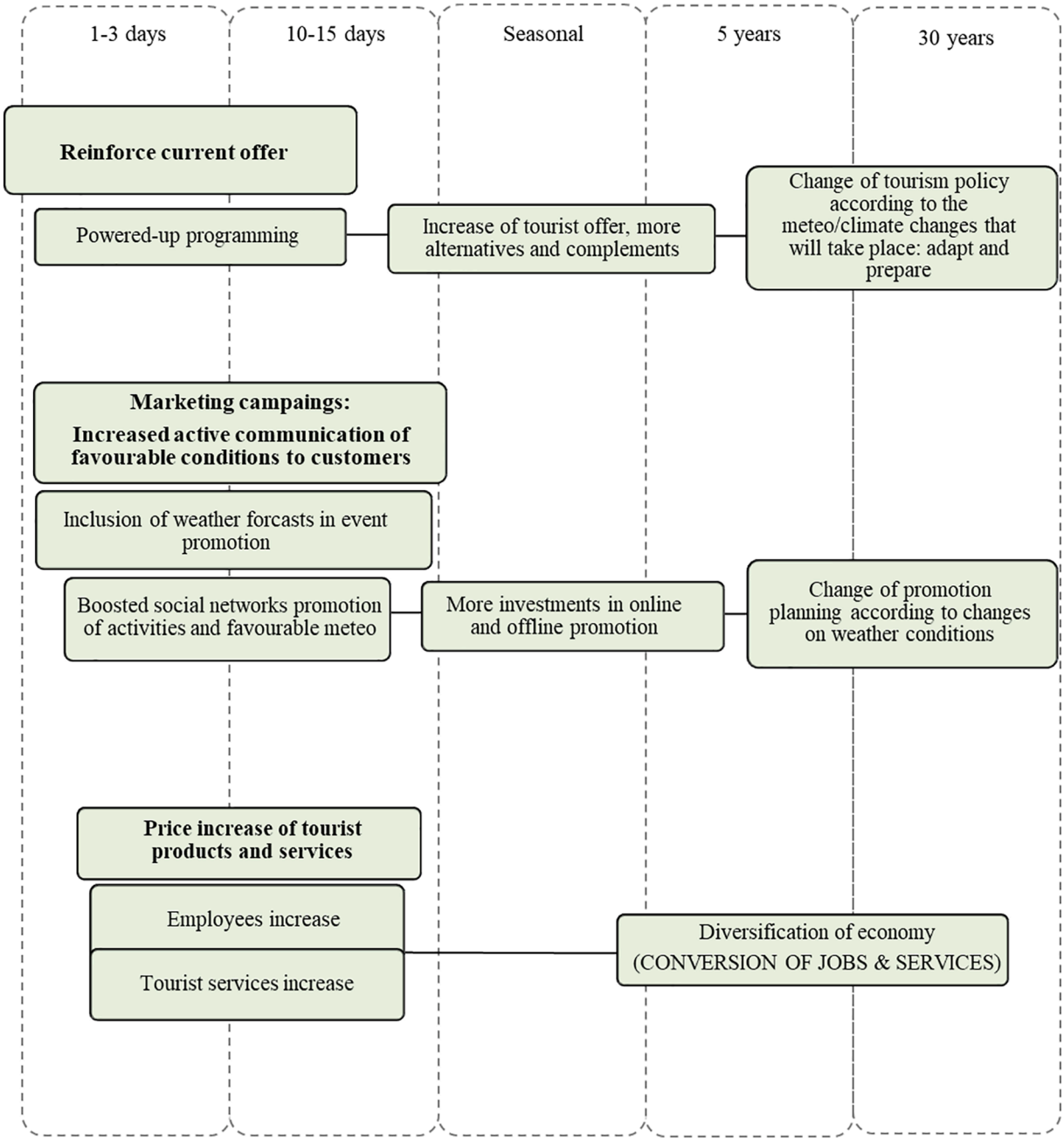

Fig. 3. Summary of adaptive reactions to beneficial conditions that stakeholders would undertake at different timescales if reliable meteorological/climatological information.

tourism, cultural tourism and MICE tourism), participants agreed that they prefer a visual format, for example, using emoticons or green/red colours to see easily and quickly if the conditions are favourable for the practice of the activity. They would also like the format to be customisable and the data to be represented with drawings and graphics. They also stated that, in the first instance, the information must be simple to understand, but that it should also be possible to access more in-depth and detailed information based on one's interests. Likewise, participants were interested in receiving information not only about their own destination but also about the broader region and competing destinations. They would also like to access and store the information history, and the most desirable channels are websites, mobile phone apps and social networks.

Discussion and conclusions

This paper presents the first step in building co-created climate services with local stakeholders for tourism destinations. This methodology, based on qualitative information, builds the consensus of stakeholders to define the main characteristics of the destination (flows, optimal meteorological conditions, and information transmission and value). This methodology is the main contribution of the paper because it proposes a fundamental revision of the methods to analyse ideal climatic and meteorological conditions and inform adaptive actions at the local level. Until recently, the most popular tool used in the tourism literature to pinpoint the relationship between climate and tourism competitiveness has been the 'Tourist Climatic Index' (TCI) and other derivate indices (such as HCIs).

The index to be built in the following steps must overcome the usual

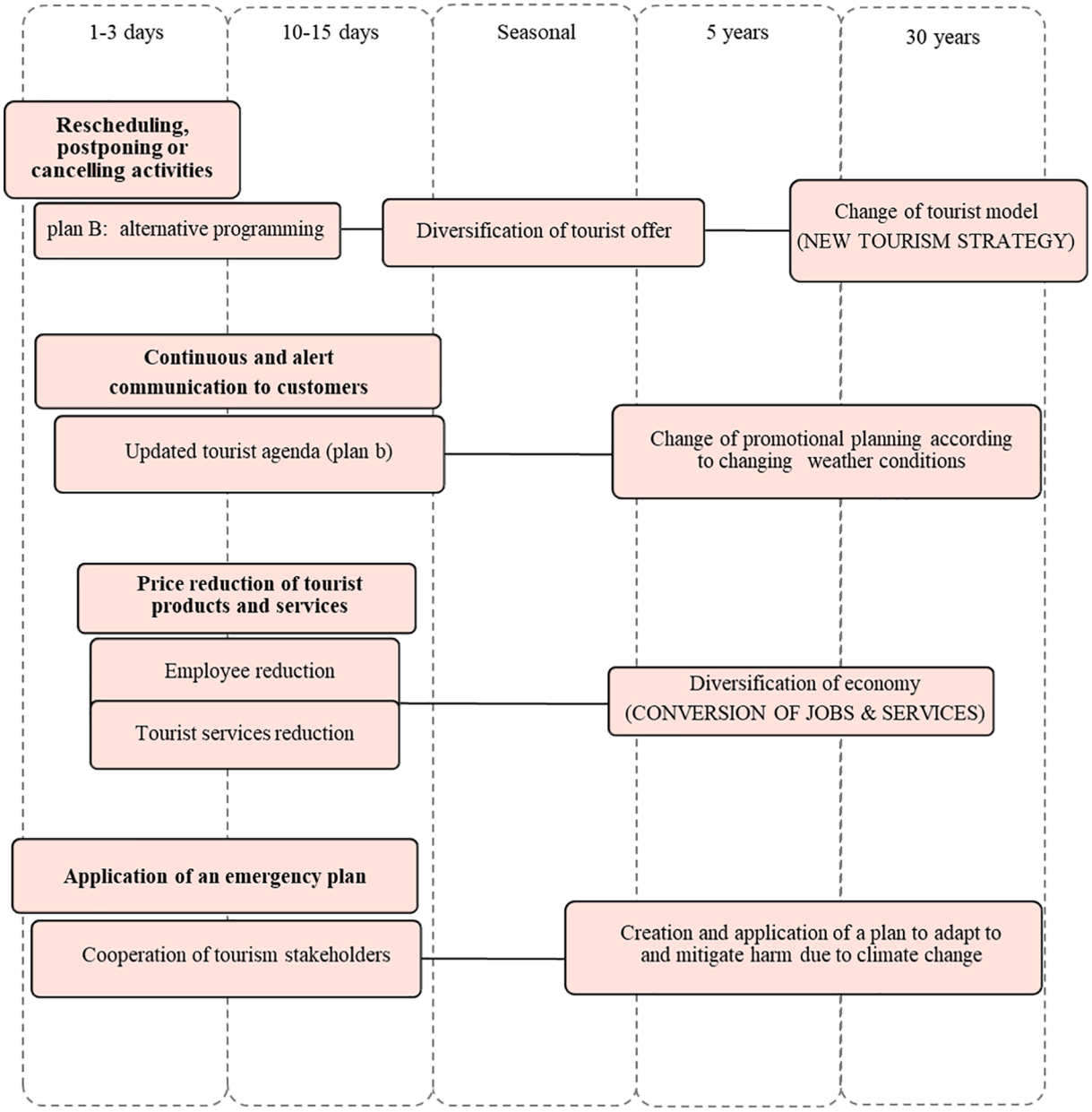

Fig. 4. Summary of adaptive reactions to damaging conditions that stakeholders would undertake at different timescales if reliable meteorological/climatological information.

criticisms made of the TCI and some of its derivatives: the subjective nature of the variable ranking schemes and the component weighting (Mathews et al., 2021). Also, this methodology proposes, as Scott et al. (2016), a daily level data and a tailored information system based on requested information for different types of tourism activities.

Another main contribution of this new approach is that it is the local agents of the place that define both, which are the important meteorological and climatic variables as well as their optimal conditions. Applying this methodology provides a local approach to optimal conditions of tourism activity. The variables playing a role in the snow index are the same in Jaca, Saint Moritz or Calgary; however, the optimal conditions (the intervals where variables are defined) could be different. The same occurs for the sun and beach tourism index, and the cultural index differs from MICE tourism. This methodology's similar role is the main reason for co-creation with local agents: Each place has the optimal conditions to develop a tourism activity, and each destination needs to develop its own adaptive strategies in order to evolve in the face of the effects of weather and climate changes. In this way, another criticism of the TCI and its derivatives is overcome since it will allow the construction of territorialized indexes based on the place.

In addition, another point to highlight about this methodology is that, with the help of the scientists who co-create the index, local agents propose adaptive strategies in the face of the effects of climate change and the changing weather conditions, something missing in other approaches.

In this sense, local tourism systems depend to a large extent on climatic conditions in terms of what can be offered to their customers, how, and when. The increasing variability of meteorological conditions, which is a characteristic of climate change, may require introducing innovations in governance and management as a 'safety net' to make the destination and the products it features less vulnerable to conditions that hinder their performance. In the longer run, local tourism systems need to cope with changing climatic conditions, which may spur changes in product specialisation, seasonal programming, infrastructure

development, market orientation, stakeholder management and destination planning. In all such cases, destination managers and governments who need to provide adequate conditions for such transitions need information and a good part of such information, and a good part of such information, especially for what regards the sensitiveness of specific products on climate, can only to some extent be gauged by 'objective' predictive models, but can be obtained through mechanisms eliciting 'collective intelligence' at local level.

Thereby, when we ask about the best way to receive the information, the last of the inherent characteristics of a climate service is fulfilled: that the end-user obtains the information in an understandable way that allows better decision-making.

The results show that this co-creation methodology can be useful for this tailored climate information to adapt the action to be applied in different types of tourism destinations, regardless of their offers and tourist specialisations (e.g. sun and beach destinations, cities, national parks and snow destinations). Thus, the key question is not the type of tourism but rather the end-user's engagement and the creation of consensus to define the characteristics and strategic adaptive actions of the destination. The sample of end-users employed for this research is representative of the tourist destination stakeholders. To ensure it, we selected and organized local players considering the different tourist's products and activities in each destination. All in all, using a bigger number of attendants or doing a second round of focus group workshops could enhance the co-creation process and so the results gathered from it. Obviously, a future objective for the co-development of the climate services would be to keep alive the focus groups and ensure the participation of all the key stakeholders.

We proceeded to extract the variables and optimal conditions for developing tourism activities according to the nature of the tourism developed at each destination.

In further steps, semi-automated indices will be developed thanks to the information gathered from the different workshops. These indices will be based on the information provided by the stakeholders who participated in the focus groups. Subsequently, we will extract the variables and optimal conditions for developing tourism activities according to the nature of the tourism developed at each destination. The main aim of these indices is to provide easily understandable climatic information to tourism stakeholders, thus fulfilling the basic needs of climate services for tourism to be timely, regular and developed for specific geographic areas and specific types of tourism (Kovács and Unger, 2014; Martinez et al., 2019). In this sense, the first tests for the INDECIS Snow Tourism Index (INSTIN) using this methodology have been developed through the case study of Jacetania's County – the Aragon Pyrenees (Olano et al., 2020). The numeric index may open the door for research to reanalyse climate data, relating it to the economic performance of different destinations. Additionally, it may propose predictions and projections to assist both in understanding the long-term effects of climate change and in making seasonal predictions that can aid in destinations' natural resilience.

Aligned with this, the defined co-creation methodology allows for knowledge about the necessary provision of climate information to assist decision-making. In this way, the service can respond to users' needs, thanks to the previous engagement between users and providers. Thus, because of the information extracted from different workshops, it is possible to go from data to service. Also, there appears the possibility to apply this data to service flow in other activities where there is a certain subjective perception of weather conditions because it enables the creation of a consensus with stakeholders around the activity.

Finally, this methodology gives stakeholders a useful tool for developing a smarter tourism destination, thus allowing better positioning for tourism recovery following the COVID-19 crisis.

CRediT authorship contribution statement

Alba Font Barnet: Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Resources, Formal analysis. **Anna Boqué Ciurana:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Formal analysis. **Jon Xavier Olano Pozo:** Conceptualization, Writing - original draft, Writing - review & editing, Formal analysis. **Antonio Russo:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Formal analysis, Supervision. **Roberto Coscarelli:** Methodology, Writing - review & editing, Formal analysis. **Loredana Antronico:** Methodology, Writing - review & editing, Formal analysis. **Francesco De Pascale:** Methodology, Writing - review & editing, Formal analysis. **Òscar Saladié:** Conceptualization, Methodology, Writing - review & editing, Formal analysis. **Salvador Anton-Clavé:** Conceptualization, Methodology, Writing - review & editing, Formal analysis, Supervision. **Enric Aguilar:** Conceptualization, Methodology, Writing - review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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