Indecis

Sectorial Climate Services

Integrated approach for the **d**evelopment across **E**urope of user-oriented **c**limate **i**ndicators for GFCS high-priority **s**ectors: Agriculture, disaster risk reduction, energy, health, water and tourism

Work Package 7

Deliverable 7.2

Document Business Cases Study for the Delivery of Climate Services in the Tourism Sector

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1. INTRODUCTION

1.1. Approach to Climate Services for tourism in the INDECIS project

In the 21st Century, the world's population is facing multi-faceted challenges from climate variability and climate change. This requires wise and well-informed decision making at every level, from households to international fora. While making sense of changing climate trends and extreme events is paramount to design mitigation strategies and monitor their implementation, there is also the need to understand and anticipate their impacts in view of adaptation. 'Good' climate and meteorological information thus plays a fundamental role for societal wellbeing, 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 this sense, there is an increasing demand for customized climate-related tools, products and information that will enable climate-smart, strategic decisions at various levels for a wide range of end-users. All these reasons have led to the development of "actionable" climate science, and this in turn is now becoming concrete "climate services" (European Commission, 2015; Van den Hurk et al., 2018; WCC3, 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 customize climate information to the various user needs, considering all related stakeholders, such as academics, NGOs, decision-makers in enterprises and administrative bodies, policy makers at various levels of government, and citizens (JPI Climate, 2016; Lehoczky, 2017). A proficient use of this information is reputed to offer important benefits to society. According to WMO (2015), an effective use of climate information has the potential for reducing the effects of natural hazards, as well as a wider range of societal benefits, like the avoidance of injury or loss of life, the protection of property, or increasing safety and comfort of everyday life. Moreover, these benefits are both social and economic. Climate information allows companies to increase their profitability and productivity, and therefore strengthen national economies by providing a more solid base for future planning.

A clear understanding of the value and opportunities associated with CS can help national governments and organizations to define priorities and better manage the impacts of weather and climate across economic sectors. In fact, the valorization of this information is not only in terms of the benefits it can offer, but also in terms of the social, economic and environmental costs that may result from not having it (Clements, et al., 2013; Quiroga, S., 2018). In relation to this, there is value associated with climate services. Although CS may have no market price, individuals and organizations may be *willing to pay* for such services, and therefore create an economic value.

The production and the systems of diffusion and use of CS however is a controversial issue. On one hand, Climate Services as seen above are based on an elaboration of climate information to make it user-friendly and contextual to user needs: only in this way, their societal value will be maximised. On the other hand, the definition of user needs, let alone the specification of what really matters in terms of user needs for specific sectors of activity, is not a trivial issue. This is especially the case when climate and meteorological information is highly technical, and when the relevant time horizon for sectorial decision-making requires good forecasts and 'bundling' several climate indicators and conditions, and besides this must be available at a reasonably geographical scale. Hence, increasingly, the translation of Climate Information into valuable Climate Services requires sectorial knowledge as well as technical climatological knowledge, and could be seen as an iterative process by which the availability of one influence the depth of the other.

In this regard, user-provider engagement is considered one of the most fundamental elements in the preparation, development and use of climate information as CS for decision-making; and the collaboration between decision-makers and climate scientists is seen as key to leverage expertise from both parties to better serve problem solving (Briley et al., 2015; Golding, et.al, 2017). Research demonstrates (Bruno et.al, 2018; Golding et. al., 2017) that stakeholders' 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 key to guarantee their value and impact.

The societal relevance, value and expected benefits from CS currently is shown by the fact they do exist at local, national, regional, and international scales and are implemented towards a range of different sectors including agriculture, healthcare, forestry, fisheries, transportation, energy, disaster risk reduction, water resources management, or in the tourist sector (Vaughan & Dessai, 2014). However, there is no universal operational framework or standard methodology for such collaboration along the value-chain of CS production and use, and less so consolidated examples of CS cocreation within the policy domain of the EU.

Climate determines to some extent – even in some cases fundamentally – the viability and competitiveness of socio-economic activities of any territory for many sectors, like those earmarked as priority areas in the Global Framework for Climate Services (GFCS). Yet, although the tourist sector is not one of those, the INDECIS project[1] (an integrated approach for the development across Europe of user-oriented climate indicators for GFCS high-priority sectors) does include it, and indeed, it is the main focus of this work-package.

[1] INDECIS is part of ERA4CS, an ERA-NET initiated by JPI Climate, and funded by FORMAS (SE), DLR (DE), BMWFW (AT), IFD (DK), MINECO (ES), ANR (FR) with co-funding by the European Union Grant 690462) (2017-2020).

In fact, this project acknowledges that tourism is one such activities that is sensitive to climatic conditions to a high degree. Furthermore, it is one of those that may resent more, at least at local level, from climate change. Tourism is also one of the largest and fastest growing global industries; it is based to a large extent on long-haul mobility, which is known as a net contributor to gas emissions, a determinant of climate change (Lenzen, et. al., 2018); and it is a sector characterized by complex and highly fragmented organizational and governance structures, which makes it particularly difficult to take breakthrough decisions related to adaptation and mitigation. This is the reason why more focus is required to bring about a successful framework for the production of valuable CS for the tourist sector as a key prerequisite for adaptation and resilience to the very least.

In the framework of INDECIS, researchers have been carried out different workshops for co-designing with stakeholders climate services in five European tourism destinations: Alcañiz (Spain), Jaca (Spain), Calvià (Spain), Calabria (Italy) and Barcelona (Spain). The destination cases have the purpose of responding to the design of climate services taking into account the participation of different stakeholders and user engagement in vulnerable destinations to Climate Change.

The aim of this report is to introduce the relationships between tourism, climate and societal wellbeing, as well as the factors and processes that are found to frame the creation and communication of climate services for tourism. In order to test these conceptual arguments and move to an operational level, we then present our method of research, its implementation and the main results achieved. Finally, we generalize these findings, illustrating the contribution that this exploratory work could provide to the broader WP7 and the whole INDECIS project.

1.2. Tourism, weather and climate: dynamic relationships

The tourist sector is one of the largest and fastest growing global industries and is a significant contributor to national and local economies around the world (Scott, et. al, 2011). As shown in the latest Tourism Highlights Report (UNWTO, 2018), the year 2017 has seen the highest growth in international tourist arrivals in seven years since 2010, with a total of 1,326 million international displacements (+7% than 2016) and US$ 1,342 billion of total international tourism receipts (+5% than 2016).

The industrial organisation of tourism is highly complex, operating across geographical scales that range from the global to the very local level, and bundling different subsectors which provide distinct services in the field of mobility, hospitality services and access to attractions, with global and regional intermediaries as the ‘glue’ that channels demand towards supply and ‘distributes’ travel services. This system is configured as a global *value chain* that connects global operations like travel, intermediation and hotel and restaurant franchises to territories or *destination regions* which have specific attributes, and where such global operations get

articulated into - or feed - local enterprises, government services and natural or cultural attractions. From an economic / productive viewpoint, destinations are understood as *L*ocal *T*ourist *S*ystems (LTSs) – the local end of global value chains; however, in a geographical sense, they involve a specific (mostly regional) *space* and a system of representation (brand images, values, identities), hinting at different types of leisure activities, which ultimately are what attract tourists to those spaces.

The viability and competitiveness of such LTSs, as well as of their basic product components, depend to some degree to climatic and meteorological conditions, on top of geographical and anthropic features. Thus, sea and sand tourism is possible not only where there is a coastline, local capital and entrepreneurs, and links with distribution channels at various scales, but also in certain climatic conditions, and so do active and outdoor tourism, or mountain tourism; to some extent, also urban and cultural tourism depend on 'good weather'. It is crucial though to recognise that:

- the influence of climate conditions on destination performance should be 'isolated' from other equally important factors, like, as mentioned before, the uniqueness of topographical features and the institutional and organisational arrangements that drive destination development;
- that LTSs at different scales with similar product orientations compete between them for the attraction of tourists, so that one destination will also resent from the influence of climatic conditions on its operations but also on those of its competitors, and on the way their competitors adapt to change and innovate.

An initial literature review on the relationships between climate and tourism at different scales is summarised in Figure 1, organised in specific areas of interest in this research: tourist climatic index (1), weather climate and tourism (2), Climate Change Impacts for tourism sector (3), Tourism adaptation to CC (4), Decision making (5), Climate services for tourism (6), Socioeconomic benefits (7), Valorization (8) and User Engagement (9). The most important contributions are picked up in this and the next sections.

Figure 1. Main contributions on climate & tourism. Own elaboration

Topic	Main contributions	Author
Weather, climate and tourism	The influence of weather and climate on recreation and tourism is studied. Climate change and the distribution of climatic resources for tourism are analysed. Is researched the nature of the influence that climate has on tourism and recreation.	Smith, K. (1993) Scott, D et al (2004) Gómez, B. (2005)
Climate Change Impacts for tourism sector	Impacts of CC on Winter Tourism are presented. The impacts of global warming related to skiing are evaluated. The implications of 2ºC global warming in European summer	Koenig, U. et al (1997) Breilling, M. et al (1999) Grillakis, M.G. et al (2016)

	tourism are shown.	
Tourism adaptation to Climate Change	Snowmaking as a technical adaptation is considered. Climate Change and sustainable tourism in the 21st century is studied. Ski Resorts and their Response to Climate Change is evaluated.	Scott, D. et al (2003) Scott, D. (2006) Bicknell, S. et al (2006) Pickering, C.M et al (2010)
Decision Making	In the field of Tourism Climatology: environmental information for decision making and business planning is evaluated. Barriers of co-production of climate information for decision-making are shown.	De Freitas, C. R (2003) Briley, L. et al (2015)
Climate Services for tourism	Is studied which is the panorama related to Weather and climate information for tourism. Climate services are presented for supporting sustainable tourism and adaptation to Climate Change.	Scott, D. et al (2010) Scott, D. et al (2011)
Socioeconomic benefits	Economic and social benefits as a result of using meteorology and climatology information. Economic Tools and Methods for the Analysis of Global Change Impacts.	Frei, T. (2010) Cerdá, E.; Quiroga, S; Martínez, P. (2018)
Valorisation	Is presented the value of Climate Services across economic and public sectors. The Value of Meteorological Information.	Clements, J. et al (2013) Quiroga, S. (2018)
User engagement	Is published an effective engagement for climate services – case study in China-. The official tourism promotion websites as a source of information.	Golding, N. (2017) Gómez-Martín, M.B et al (2017) Vincent, K. et al (2018)
Tourism Climatic Index	A method of evaluating world climates for tourism is created.	Mieczkowski, Z. (1985)

The literature (e.g. Gómez, 2005) suggests that climate can support tourist activity either as a basic resource or a necessary complement. At some destinations, together with geographical location, topography, landscape, flora and fauna, weather and climate constitute the natural resource-base for recreation and tourism (De Freitas, 2003). As Becken (2014), defends it could be claimed that any type of tourism activity or product has "ideal" atmospheric conditions, which correspond to those providing the maximum level of comfort for visitors engaging in such activities, for the longest period of time. At destination level, these conditions should be projected to different products along the year, i.e. a mountain destination could offer ideal conditions for skiing in the winter and for outdoors tourism in the summer; a city on the coast could offer ideal conditions for sea and sand tourism in the summer and for cultural tourism and events in cold seasons; and so on. Many destinations, however, are specialized in one tourist

product, thus they typically can offer ideal conditions for such activity in one season, while the other seasons are 'dead periods'.

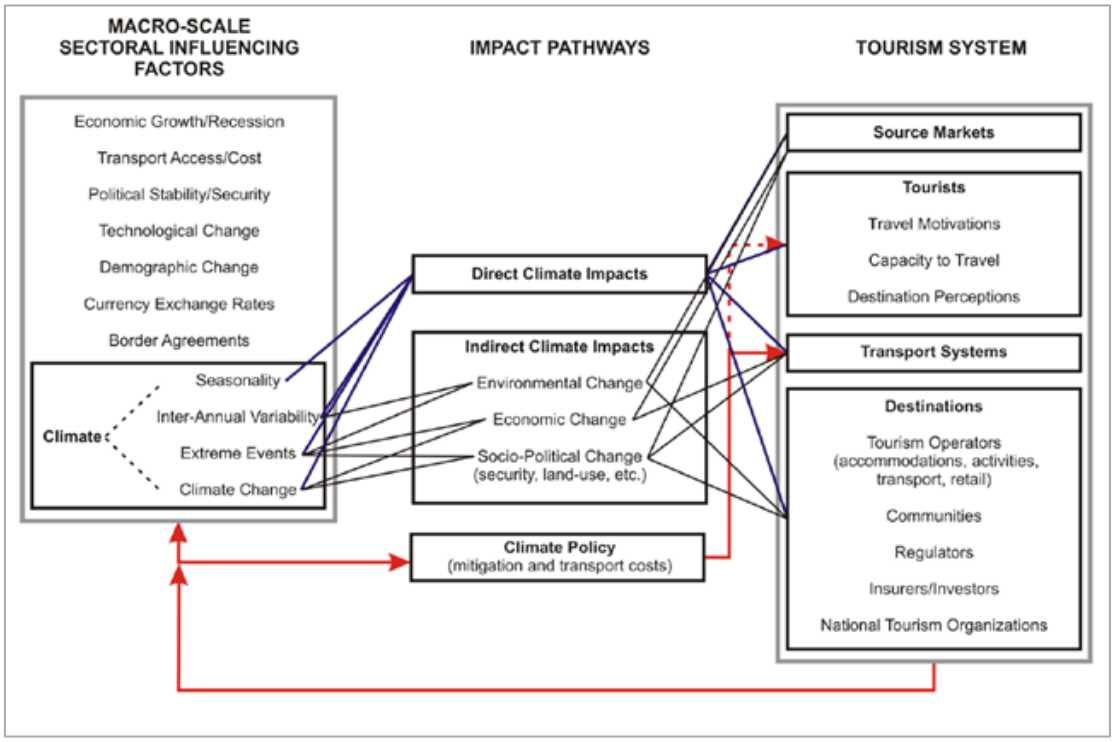
The key issue, thus, will be the endowments with climatic attributes that boost their competitiveness on top of other (geographical or anthropic/organizational) features. Global climate change has the potential to alter the distribution of climate assets among destinations, with implications for tourism seasonality, demand and travel patterns, and consumer behavior among others (figure 2). Changes in the length and quality of tourism season have considerable implications for the long-term profitability of tourism enterprises and competitive relationships between destinations (Scott, et. al, 2004).

It is important, however, to consider the scale of concern. On one hand, increased societal and political concerns for the environmental costs of mobility may eventually alter the cost of leisure-related mobility (for instance with an increased fiscalization and regulation of travel operations), which may have the overall effect of diminishing the willingness to travel (people would travel less frequently, closer to home, or using non-contaminating transport means).

We recognize that the need of an emissions-neutral planet no later than 2040 (IPCC, 2018) might severely affect the global tourist exchange, and we consider as a future constraint the provision of mobility services and the cost of long-haul mobility, irrespectively of changing climatic conditions. But, as it might be argued that people travel and will continue to travel in the future, we keep as our main concern the local effects of global climate change trends. What *is* subject to change with the uneven effects of climate change on different types of regions at different latitudes, is the geographical distribution of leisure-related mobility (the specific spaces which are chosen as destinations), the seasonal patterns of such inbound travel, the range of activities demanded in such places and the value attributed to them (and thus, the competitiveness and long term viability of such spaces as destinations). All these factors will be to some extent determined by current and future climatic conditions, and more specifically by a set of climate-related variables that are known to be susceptible of long-term changing shifts.

Climate and weather, therefore, have to be understood as substantial determinants of tourist demand at local level that affect – directly or indirectly – the development of supply, traveller satisfaction, visits or attendance numbers, value perceived, among other factors. Then, given the growing importance of the tourism economy for a wide range of places – bordering in some cases on dependency –, understanding, measuring, anticipating changing climate conditions and adapting destinations (and the range and modality of activities offered to visitors) to climate change become keys to guarantee socioeconomic resilience.

Figure 2. Climate influences on the tourism sector. Source: Scott & Lemieux, 2009



Although some forms of tourist activity are more sensitive and dependent to climate and meteorological conditions than others (e.g. outdoors, snow-based, rural tourism, etc.), all tourist destinations are at least to some extent climate-sensitive, resenting for instance on weather, intra/inter-annual climate variabilities, or extreme meteorological phenomena. These factors influence competitiveness and sustainability in both the short- and long-term (Gómez-Martín, et. al., 2017). More in general, research has addressed extensively the issue of how travel behavior is influenced by weather and climatology. The tourist market is not homogenous – for that reason there are different markets and visitor segments; the focus of scrutiny for climate studies is closely related to the type of tourist activities practiced in the destination (sun and beach tourism, hiking tourism, cultural tourism…). In this sense, the following table (Fig. 3) illustrates a hierarchy of factors that influence the behaviour of demand in relation to specific tourist forms, like temperature, insulation, absence of precipitation and absence of strong wind. In the table, it is shown that depending on the activity, these variables may be hierarchically organised in different ways. At the same time, it is suggested that not only the type of tourism affects the hierarchy, but also the specific characteristics of the study region. For urban tourism, which depends on a large extent on man-made, indoor attractions, the hierarchy is at the most homogeneous across the different study regions. Moreover, it is observed that the variable that plays not a such important role in almost all cases is the absence of strong wind.

Figure 3. Hierarchy of variables for the tourist. Source: Scott, Hall and Gössling, 2012

Tourist segments	Study region	Temperature	Insolation	Absence of precipitation	Absence of strong wind	Author/s
Sun and beach	United Kingdom, Mediterranean	3	2	1	4	Morgan et alt. (2000)
	Canada, New Zealand and Sweden	2	1	3	4	Scott, Gössling and the Freitas (2008)
	North Europe	3	1	2	4	Rutty and Scott (2010
	France	2	1	3	4	Credoc (2009)
	Belgium and Holland	2	3	1	4	Moreno (2010)
Urban	Canada, New Zealand, Sweden	1	3	2	4	Scott, Göosling and de Freitas (2008)
	North Europe	1	3	2	4	Rutty and Scott (2010)
	France	1	3	2	4	Credoc (2009)
Mountain (summer)	Canada, New Zealand, Sweden	1	3	2	4	Scoot, Gössling and de Freitas (2008)
	France	2	3	1	4	Credoc (2009)
Mountain/ ski	USA	5	4	1	3	Scott and Vivian (2012)*

*Clear visibility ranked second

For example, tourism in ski resorts depends on snow cover, which is expected to decline with climate change (Pickering, 2011). Research has focused on the impacts on ski season length and the economic viability of existing supply structures (Breiling & Charamza, 1999; Koenig & Abegg, 1997); however more recently it has also tackled adaptation strategies like artificial snowmaking and the examination of snowmaking potentials (Pickering & Buckley, 2010; Scott, et. al, 2007; Scott, et. al, 2003). Damm et. al (2017) quantified the risk due to weather variability and assess the potential impacts of climate change under 2ºC on losses in overnight stays. An important finding of these authors is that the sensitivity of overnight stays towards snow conditions might have changed over the years due to the introduction and expansion of artificial snowmaking. Thus, 'ideal' climatic conditions may be becoming harder to provide for many ski resorts, or for shorter periods of the year, or at higher costs, which may hinder their competitive capacity for tourism, or straightforwardly make ski tourism not viable anymore in the longer term. These conditions, if known well in advance in their local, contextualized effects, call for adaptation strategies on the long and the shorter run.

As a counter example, some destinations take advantage of climate conditions that may be seen as more adverse by other destinations of the same class or latitude. In the case of Tarifa (Spain), a coastal destination, tourists are not attracted by high temperatures, such as in the majority of sun and beach destinations, but by strong wind bursts that allow the practice of windsurfing. In this case, what is generally seen as a threat for the sun-beach tourism is an opportunity to enhance sport such as windsurfing and kite surfing. This case illustrates the importance of

adaptation and product specialization to specific climatic conditions, which, in its turn, is highly dependent on entrepreneurial capacity to turn to a niche activity (a group of entrepreneurs prepared to offer wind-related products and services, and the existence of a viable visitor market and distribution channels to tap into). Not always, though, this reorientation is easy to implement; the possibility to estimate the added value and related costs of reorienting a destination in the face of certain oncoming climatic conditions could be key to endorse such strategy at destination level.

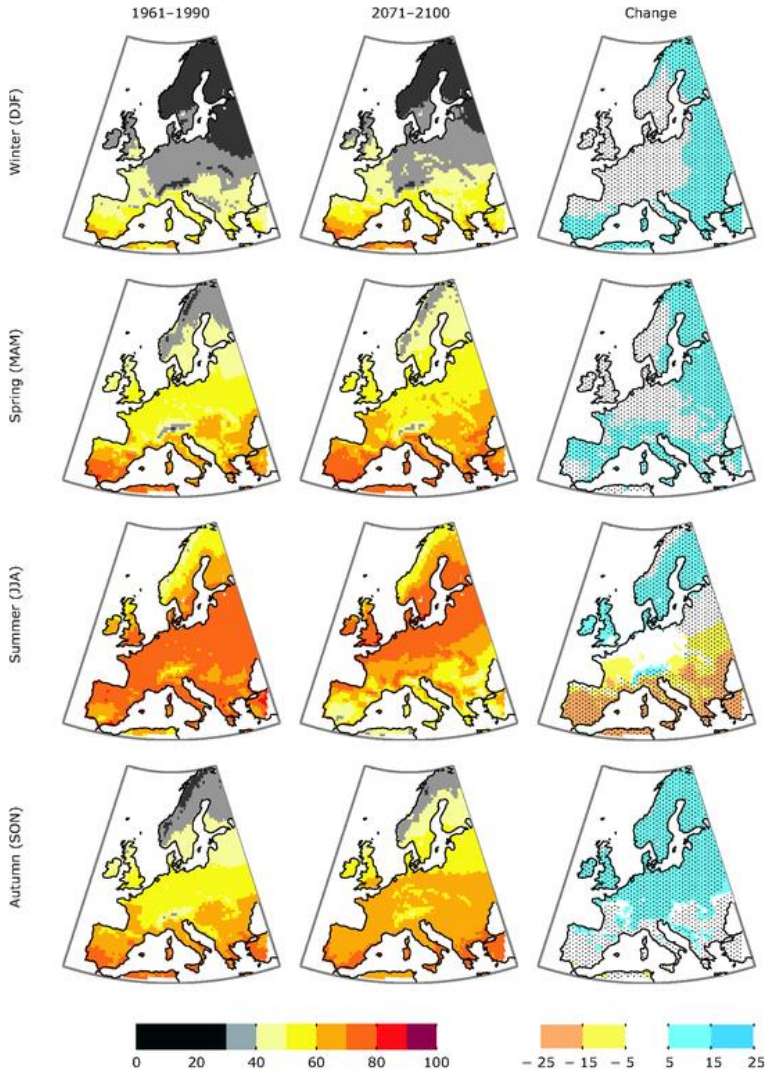
Similarly, increasing temperatures and sunlight exposure of regions traditionally seen as emissary of tourists towards warmer countries are progressively becoming more competitive for summer tourism. A popular tool to monitor these shifts in 'advantages' offered by climatic conditions is the Tourism Climatic Index (TCI), which summarizes and combines seven climate variables (Mieczkowski, 1985) and it has been used in a huge number of studies. This index was conceived to examine the climate favorability for outdoor tourism. Furthermore, different tourism activities impose different climatic requirements – sunbathing, skiing and surfing – all require specific and different conditions (Grillakis, et. al, 2016). Research based on the use (and 'mapping') of this index and its forecasted value across EU regions show that the change in climate will positively affect central and northern Europe, increasing the potential of further economic development in this direction. Mediterranean countries are likely to lose in favorability during the hot summer months whereas will tend to become more favorable in the early and late summer seasons. Considering that the two degrees' period is focused between 2031 and 2060 the estimated shifts in climate favorability of Mediterranean countries indicate a need in early adaptation strategies (Grillakis et al., 2016).

However strong critiques could be levied to the TCI (and the whole approach is subsuming) as a piece of 'climate information' (let alone a Climate Service) useful to take decisions locally in view of adaptation.

As said before, one of the economic activities that can be more affect due of climate change effects is tourism. In this line, tourism is a vulnerable activity in a variable exposition depending on the kind of tourism located in a specific place (Olcina, 2012). Moreover, the relationship between tourism and climate change is bidirectional. That postulates that tourist activity is possible due of the existence of specific resources in a territory. These resources explain the displacement of the human being in the research of experiences, evasion pleasure or enjoy (Tuan, 2003). However, at the same time, there are changes in the territorial resources into the climate change scenario. In this context it is known that, especially due to thermic and pluviometry conditions (Olcina, 2012), climate change will modify tourist flows and travel patterns both in terms of visited places and seasonality, and therefore will affect the current configuration of the tourist marketplace. This relationship has been integrated into analyses of the dependence of tourism performance on climatic conditions. As presented before, Mieczkowski (1985) created a method for evaluating world climates and their bearing on tourist attractiveness. The method consists in calculating the Tourist Climatic Index (TCI). This index is one of the most

widespread within climate studies applied in tourism. This is because the combination of various meteorological parameters which directly influence to the human well-being. In detail, TCI uses a combination of seven parameters that can be obtain from weather station data. Three of these parameters are independent (precipitation, wind and insolation) and two come from a bioclimatic combination: hourly comfort index and daily comfort index. In that way the maps (Fig. 4) represent the TCI for different periods around Europe: 1961-1990 period, 2071-2100 period. At the end, the change of TCI between periods is shown.

Figure 4. Tourism Climatic Index (TCI) for four seasons in the present period (1961–1990, left), under future climate change (2071–2100, middle), and change between present and future period (left). Future climate conditions are based on the SRES A2 scenario and derived from the ensemble mean of five regional climate models (RCMs) that participated in the PRUDENCE project. Source: European Environment Agency, 2019.



Since then, several scholars have used this index in the analysis of specific tourist destinations. Amiranashvili et al (2008) have used this approach to evaluate climate in the Georgian resort town in Batumi. In this case data from the hydrometeorological department of Georgia were used for the TCI calculations. The results determine the climatic potential of tourism to Batumi. It is also found that, like New Orleans, Charleston, New York, St. Louis or Tbilisi, Batumi belongs to the category of bimodal-shoulder peak TCI distribution. Therefore, the first peak of TCI falls on May and June, and the second on September and October (Amiranashvili et al, 2008). The TCI was also used to analyse the vulnerability to climate change of the Mediterranean as a destination region by Amelung et al (2007), also suggesting that there is a need for stakeholders in tourism, to explore vulnerability of their own businesses and policies to climate change.

Other studies have extended the use of TCI to other variables. For instance, Scott et al (2016) produce a different index, the Holiday Climatic Index (HCI), and compare their use with the TCI in Europe. They argue that while much research has been devoted quantifying optimal or unacceptable climate conditions – both generally or for specific tourism segments or activities – over the last 10 years, this knowledge is not incorporated in the TCI. Harydai et al (2019) calculate the TCI and correlate it with the number of visitors in Samosir district at North Sumatra Province, finding no correlation between climate comfort and the number of visitors. Similarly, Russo et al (2012) analyse climate resources as one of many 'territorial capital endowments' which could explain migration flows, using an index based on an elaboration of the TCI, the difference between values of the TCI in 'warm' and 'cold' month. It is found that the relationship with migration flows is significantly strong and negative (Europeans tend to migrate where climate conditions are less uneven according to the season, and this behaviour is more accentuated for the 25-49 age cohort), and it is also known from the literature that the mobility behaviour between at least 'lifestyle mobility' and tourism are quite similar (Cohen. et. al, 2015); however, the statistical relation performed with tourism movements is found to be non-significant.

In the field of urban studies, Roshan, G., et al. (2016) correlate metropolitan sprawl with climate comfort in Teheran and find that sprawl has a negative effect on the TCI. In the line of cross-analysing TCI with other variables, Hossein (2015) conducts a risk assessment of precipitation through a mathematical approach to the tourism climate risk, using different probabilities of excessive precipitation. Another example of evolution in uses of TCI is the combination of two climate change scenarios with the TCI (Amelung et al, 2007). As a result, it is found that the location of climatically 'ideal' conditions is likely to shift poleward under projected climate change.

Some scholars did engage with the limitations presented by the TCI approach. For instance, Gómez-Martín et al. (2017) identify two main limitations. On one hand, the index does not refer to any particular geographic or socio-demographic segment. On the other, the index has a low empirical contrast: the hierarchy of variables and the establishment of favourable and unfavourable thresholds have been determined based on the author's own judgment, without being referenced to the behaviour or to the atmospheric preferences of tourists. These limitations are found to have prompted uncorrected interpretations of research results.

New tools have been created, probably as a result of these limitations. Thus Matzarakis (2007) introduced a Climate Tourism Information Schemes (CTIS) as an assessment method for climate and tourism based on daily data. The innovative aspect of the CTIS is that it takes into account different parameters depending on specific regions or specific tourism uses. Other authors thoroughly redefine the TCI. Kovács et al (2014) modified the TCI in two ways: on the one hand, physiologically equivalent temperature (PET) is apply instead of effective temperature (ET). On the other hand, the TCI is adjusted to a ten-day scale and not in monthly averages of climatic parameters as in the original TCI. Tang et al (2012) implemented a new Tourism Climate Suitability Index (TCSI) to evaluate the tourism climate suitability in Qinghai Province, China. Climate suitability index is construct using different impact factors: temperature and humidity, wind chill, solar radiation, atmospheric oxygen and barrier weather. Results found that there is a clear distributional characteristic of spatial-temporal variability of TCSI values in Qinghai Province, tourism climate suitability has significant seasonal and regional differences and the key factor, which influences regional differences in tourism climatic suitability, is atmospheric oxygen. In addition, the key factors that influence seasonal differences are temperature and humidity, the wind chill factor, and barrier weather (Tang et al, 2012).

Other researchers tackle the relationship between climate and tourism but without taking into account the TCI. For instance, Álvarez- Díaz et al (2010) present the statistical relationship between the North Atlantic Oscillation (NAO) and tourism movement, corroborating the result that NAO has a significant effect on the number of tourists arriving in the Balearic Islands. Martínez et al (2019) adopt a different approach in their study of the climatic preferences for trekking tourist in Spain, which is based on a survey aimed to gauge the weight of different atmospheric elements on aspects such as enjoyment, comfort, health and risk. Morgan et al (2000) have created their own index in order to evaluate the relationship between climate and in this case beach tourism based on the preferences of users in terms of climate and bathing water temperature. In the same vein, Ren (2004) created the human body comfort-index in order to evaluate the comfortableness in the framework of tourism climate in Wuati Mountain. The results of application of this index suggest that the comfortableness of human body varies with different months according to the analysis and assessment of the tourism climatic comfortableness of each month. While Matzarakis et al (2004) introduced a Climate Index for Tourism (CIT) relying on actual observations rather than on average data. In that way, the index rates the climate resource activities that are highly climate/weather sensitive such as beach holidays, resort tourism, water-based sporting holidays… The same author introduced 'A second generation climate index for tourism' in which he uses the application of this index (De Freitas et al, 2008).

Hamilton et al (2005) created a model of international tourist flows from 207 countries to 207 countries. The matrix of bilateral tourism flows is perturbed with scenarios of population growth, economic growth and particularly climate change. It was found that climate change would imply that the currently dominant group of international tourists – sun and beach lovers form Western Europe – would stay closer to home, with an altogether small decrease of total international tourist numbers and distances travelled.

In front of this framework is going to be proposed a new approach to the co-construction of climate services.

1.3. The use and value of climate services for tourism

As mentioned above, climate services are understood as the transmission of processed information from meteorological and climatological data in a way that becomes useful for the end-user in the decision-making process. This can apply both for the short, medium and long term, and should be useful to trigger actions that **adapt** tourism activity to long-term trends and sudden changes of the competitive context, or else **mitigate** the effects that tourism generates on climatic conditions.

Mitigation actions are generally conceived as promoting sustainable tourism (tourism which contributes to - or at least does not hinder - sustainable development goals, at different scales); thus, they derive from shifts in tourism production and organization processes which diminish the pressure on non-renewable physical, anthropic, economic resources, according to different conceptions of sustainability and contextual factors as in Hunter (1993).

Conversely, **adaptive actions** could be framed in the broader concept of resilience, and more specifically in resilience planning (Lew, 2014). While the Sustainable Development approach looks to mitigate or alert about change, keeping (or regulating) the resources to an acceptable level, the Resilience approach looks for the adaptation to change, promoting the capacity to go back to a desired state following ‘disruptions’, both anticipated and abrupt. This is an alternative approach to ‘planning for sustainability’, that has been criticised (Espiner et al., 2017) for not been able to generate consensus either on the aims or on the methods and practices of tourist planning in a context of global change trends and ‘crisis’ of tourist places, of social, economic and environmental nature. Besides, planning for sustainability faces the usual problem is the scale of action: mitigation hardly produces ‘local’ gains, so it is hard to enforce actions at local level to induce wider territorial or global transitions.

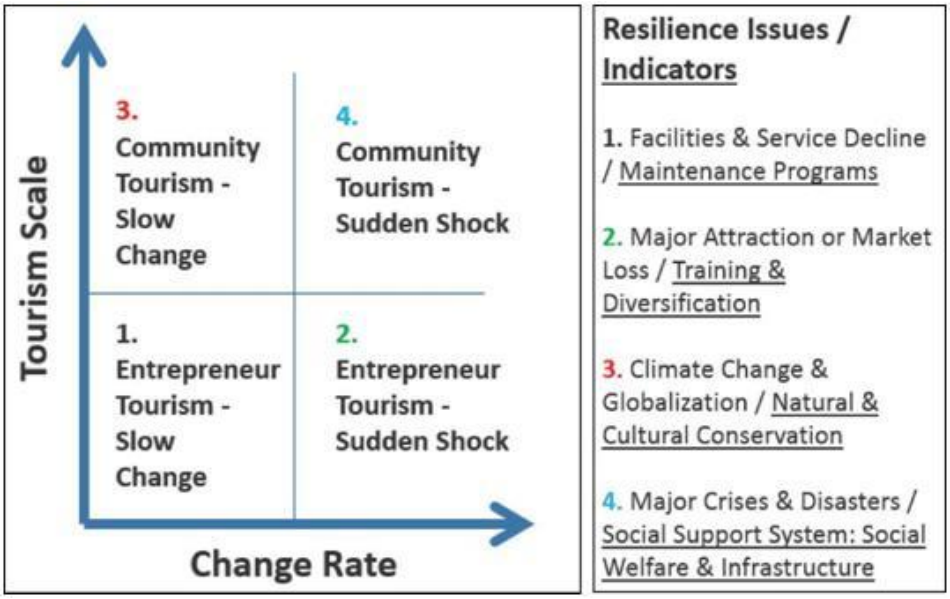
Resilience is a systemic frame in psychology (the capacity to overcome situations of stress) and in economics (the capacity to regenerate an economic system after a disruptive event: crisis, disaster, technological change, etc.), which can be applied to socioeconomic or socio-ecological systems. It has recently turned into a reference framework in territorial and tourist planning, It assumes that the change and the adaptation to exogenous elements of alteration of the competitive conditions of a destination are a constant, and stability / balance is an illusion. It is associated to the concept of ‘evolutionary economics’, complex environments in which stakeholders are in an interrelationship with physical and technological elements, and looks for an adaptation of the local socioeconomic system to slow but constants changes of the socioeconomic, environmental and even cultural conditions.

The contexts in which it has been applied to tourism planning are:

- Recovery of conditions of competitiveness (companies and tourist movement) after a sudden change of the conditions, for example after a crisis, epidemics (the SARS in Asia), natural disasters, etc. – e.g. population support systems, model or product changes, etc.
- Activation of new paths and models of growth or competitive strategies that adapt to slow but constant changes (e.g. climate change, cultural change of the travelers, migrations, etc.) – for instance in ski resorts, coastal destinations based on reef diving, etc.

Lew et al's (2014) SCR model (scale - change - resilience) proposes 4 distinct orientations of tourist planning according to the change pattern and the scale of agents and processes (public or private) affected (see Figure below).

Figure 5. SCR model. Source: Lew, 2014



Some contemporary problems that the concept of resilience and the SCR model allows to challenge are related to destinations and companies confronting a wide range of pressure factors pushing change, among which the environmental (changes in the natural resources, climate change), social (changes in the cultural resources) and economic (changes of the competitive economic / conditions).

The pressures for change take place according to distinct speeds, some slow and predictable, other sudden, requiring flexible and urgent answers. Both have linear and non-linear patterns and may take place at different social and geographic scales, some affecting mainly individual actors (companies) and other whole communities or social group. The most frequent changes that demand an answer in terms of planning to level of destination include the transformation, erosion and deterioration, or complete decline of Services and tourist infrastructure, Natural and cultural

resources, Markets, or Qualified workforce. In this scale, Climate Change as a pressure factor is positioned as 'slow change' that affects mostly the destination and community as whole. Resilience planning in that case recommends an increased emphasis in the preservation of natural resources and in the adaptation of economic activity. However, it has been pointed out that climate change also involved sudden 'shocks' deriving from increased weather turbulence and variability. In that case, resilience planning also hints at actions that reinforce welfare support systems at community scale and the development of diversification and related training activity at product level.

Among possible actions for adaptation to climate change, decision makers at such different scales can decide to cease activities, change the range activities offered to tourists, promote new tourist products, introduce new management strategies for existing products and resources, or respond to shorter-term conditions with the rescheduling of activities. In all those cases, the capacity of response with climate-aware strategies equates to added value for the destination or individual business with respect to a situation in which the capacity to respond effectively is scarce. The collection, elaboration and transmission of correct climate information could thus be seen a key factor for defending the competitiveness of the tourist sector and in this way support the current levels of welfare at destinations.

The provision of Climate Services must thus be understood as a necessary dimension of destination planning for resilient communities, that allow adaptation to climate change, among other challenges. Reliable and ready-to-use information on weather, water and climate allows individuals, households, organizations, businesses and governments to make informed and aware decisions, maximising gains from current and future climate conditions (Golding et al., 2017; Gómez, 2005; Vincent et al., 2018). Furthermore, accurate geographically specific meteorological information is essential for tourism operations. This means that each location has its specifically conditions and for that reason there is a need of a creation of CS focused on the reality of the territory. In this line, reliance on general regional forecasts, which may differ substantially from the specific conditions of destinations that are often characterised by unique weather/climate microclimate, could lead to 'wrong' courses of action and therefore damage the destination. So, producing CS at the correct, often 'tailor-made' geographical scale (which may overcome administrative and even geographical boundaries, or be restricted to a few stations) is also a key component of their value.

However, embracing CS as part of destination planning requires demonstrating to society and tourism stakeholders that their production and use will lead to socioeconomic benefits. The **valorisation process** of CS thus involves both the production and transmission of climate information that is seen as 'valuable' by stakeholders, informing due adaptation strategies; and the demonstration of their potential effect as a planning instrument and decision support system that produces tangible benefits both across the range of stakeholders involved, and at the level of the destination and community as a whole.

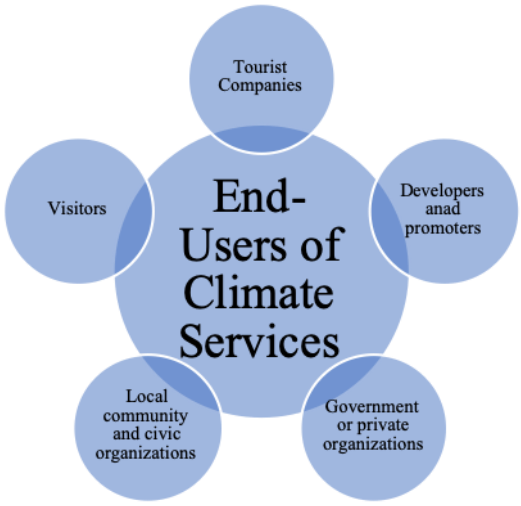
There is today widespread acknowledgement that weather and climate change affect tourism destinations and local and regional economies. Thus, the demand for detailed and accurate climate data is continually increasing as tourism destinations wish to minimize associated risks and capitalize upon new opportunities posed by climate change. However, the key to innovative research about this topic is how tourism should be adapted in present strategies and future planning. According to Scott et al. (2011), there is also a lack of research on studies about the financial or non-market benefits of specialized products for tourism, or the previously mentioned *'willingness to pay'* – in this case – climate information among tourists and tourism operators. Besides, the information available to tourism end-users from major providers varies considerably from nation to nation and even within nations. There have been very limited evaluations of the use of climate information or assessments of the climate-services needs within the tourism sector (Altalo & Hale, 2002; De Freitas, 2003; Scott, 2006).

As a consequence of the above points, the pathways to valorisation of CS for the tourist industry remain largely uncharted territory, and although this information may be potentially useful, in practice it is seldom used by decision-makers. In this sense, a first necessary step forward is to identify the various major user segments of CS, featuring very different climate sensitivities and information requirements, and considering that types of tourist destinations (and activities offered therein), their ideal climate conditions, and their inner organization, may differ considerably, and so will both strategies and 'end users' informed by CS and deriving value form them.

For this reason, it is necessary to take into account that CS do not generate economic and social value on their own. For having value, the most important point is that users benefit from decisions as a result of the information provided - even if the services are of the highest quality- (WMO, 2015). So, the aim of CS is to further increase them in view of their growing value and impact, and the usefulness of weather, climate and water knowledge for social and economic benefits (Frei, 2009; Cerdá, et. al., 2018)

There is a different range of users of Climate Services (Fig.6), this range is composed by: tourist companies (1), developers and promoters (2), Government or private organizations in charge of destination planning, management and marketing (3), the local community and civic organizations (4) and visitors (5).

Figure 6. End Users of Climate Services. Source: own elaboration, 2019



Depending on the segment of end-user the value of CS will be probably in someway different. For this reason, it is important to know which are the correct methods of production, transmission and valorisation for doing that.

We can, in this sense, distinguish between the following macro-categories of end-users:

- **Tourist companies** (end producers), like the hotel and restaurant sectors, managers of cultural and natural attractions, guides, transport companies and intermediaries, etc. Nowadays, tourism operators use real-time observations and near-term weather forecasts for marketing purposes as exposed before (Scott et al., 2011). Tourism operators provide current observations (including webcams) and short-term forecasts to promote their location or event to tourists. An example of this usage is the emergence of flash selling in the lodging industry, where hotel operators utilize massive email distribution lists generated by customer and loyalty program databases or prearranged internet marketing arrangements, targeting last minute and short lead-time bookings. Private-sector service providers offer specialized weather reports and climate indices for several recreation and tourism sub-sectors as well as a range of forecast products tailored to recreation and tourism sector operations. The emergence of new specialized tourism weather and climate products from private meteorological companies represents important progress, but thus far lacks the transparency needed to properly evaluate their rigor and applicability to the international travel marketplace. Private sector climate service providers have been innovators in the use of emerging communications technologies to deliver specialized climate information to their customers and other tourism-sector-end-users, for skiing (iSki App, The North Face Snow Report, SkiResort and SnoCountry), boating (TideApp), surfing (Oakley Surf Report), and fishing (Fishing Calendar) (Scott et al., 2011). Tourist companies need the information in order to have an idea

about how to programme their business. In this sense, for example in a place where snow tourism is realized, knowing the forecast, will be useful to predict the amount of skiers that are going to come, by next could be possible to recruit more workers. In that way tourist companies could be able to know where to trust and invest. The information given to this kind of end user should probably need to be given taking into account the different sorts of tourism.

- **Developers and promoters.** Altalo & Hale (2002) found that weather and climate were not usually cited as reasons for development of new resorts relative to other macro-level factors. Source markets, land ownership, and coastal access, were used far more extensively in engineering, construction planning, property design and maintenance, and other post-development decisions. Moreover, knowledge of just how dependent different tourism sub-sectors and specific businesses are on weather is still relatively unexplored and is hampering development of weather risk-sharing financial products within the tourism sector. Tourism operators and organizations that promote tourism to specific destinations typically use historical climate information for two purposes: (1) marketing the destination and (2) assisting travelers to prepare for a safe and comfortable travel experience (Scott et al., 2011). Developers and promoters can use weather and climate information for being reasons of developing new resorts. If climate services provide, to developers and promoters, knowledge of how dependent are the sorts of tourism and specific businesses on weather, they will have an opportunity to develop more carefully and with a cause.

- **Government or private organizations in charge of destination planning, management and marketing**. It has been claimed that some destinations have cultivated a destination image and marketing strategy around certain activities or experiences that are largely based on the local climate. Historical climate information has been used for strategic planning of future tourism developments. In addition, climate-change projections are now also being used to anticipate and adapt to market risks and opportunities at the business, destination, and national level. While the use of climate-change information by tourism developers, operators, and destinations remains isolated to date, it is necessity for successful climate-change adaptation. Government or private organizations in charge of destination planning, management and marketing need climate services in order to know an overview in the place where they have competences. In that way they could take actions in order to adapt and mitigate Climate Change. At the same time, they will be able to manage the economic activities by knowing the specific meteorological/climatological characteristics that they are going to have. In this way, they will need the information exposed having in reference the potentials that they have in the territory. So, climate services not only have to regard to the territorial potential, but also have to relate to the climatic/meteorological variables that booster or constraint each activity.

- **The local community and civic organizations** (neighborhood associations, environmentalist groups, unions, etc.). Local community and civic organizations need climate services

information in order to be less vulnerable and make their daily life easier. Moreover, the given instructions should be focused with specific methods on how to react to possible hazards that could happen in the places where they life. There is not a huge necessity of explaining the general intrinsic of the place, because they have already known it. The channel to reach local community will be different depending on the kind of the community. For an urban area, probably giving the information in an app is correct, but for a rural area it is not, due of the possibility of lack to internet connection. In that way, it would be better to reach the local community by sending SMS or via radio, giving the information in their own language.

- **Visitors**. 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 – including choice of destinations, travel period, travel carrier, activities to realize at destination, budget, etc. – based on weather forecasts and general knowledge on climatic conditions at destination, which, in fact, 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 anyway a subject in this equation whose behavior needs to be predicted in order to anticipate future changes. In fact, weather conditions experienced at the destination have important influence on travel and holiday satisfaction (Bicknell & McManus, 2006; Carmichael, 1996; Koenig & Abegg, 1997; Scott, 2006; Smith, 1993; Williams, et. al, 1997). However, the motivations and characteristics of travelers are different. Weather and climate have broad significance to tourist decision-making and the vacations experience. Tourists require different forms of information during the different phases of their travel and tourist experience. Concretely, information that matches their needs and is provided with sufficient accuracy and detail to let them know, for example, what the weather will be like at a certain place at a certain time. Weather and climate represent a push and pull factor for tourists as a prominent influence on tourist decision-making and their travel experience. It is consciously or implicitly thought of during travel planning, a central motivator to travel and a factor that influences travel satisfaction (Gómez-Martín et al., 2017; D. Scott & Lemieux, 2010). Thus, DMOs and tourism business can be providers of climate and weather information, facilitating relationships between tourists and businesses. In this sense, adding value to customer services is becoming a differentiating factor by DMOs, playing an information management role in which climate information is a component (Altalo & Hale, 2002).

Across these categories of end-users, effective decision making requires high quality, personalised and contextualised climate information. This information in a variety of forms is now widely available especially via internet, but information generation without further treatment and personalisation is not sufficient for business planning and decision-making and therefore has little value. Moreover, end-users must have the incentive, technical skill and intellectual capacity to effectively use the information (De Freitas, 2003).

For this reason, the National Meteorological and Hydrological Services (NMHSs) and central and regional governments, among other actors involved, must know the value of the socioeconomic benefits that CS bring to the population, as well as the costs involved in maintaining the operations and benefits of said services, in order to consider them within the framework of public policies aimed at improving the welfare of the population and the development of the country (SENAMHI & MeteoSwiss, 2018). As stated by Gómez-Martín et al. (2017), providing climate and weather information in the tourism context means disseminating data and adapting the information to the different potential users: tourists, tourism operators, DMOs, government agencies, etc.

In order to meet the needs of the tourism industry and destination communities for adaptation to climate variability and change, the following four gaps –shown and explained below- in climate services for tourism need to be addressed: quality and applicability, decision-making, social benefits and communication (Scott et al., 2011).

In relation to **quality and applicability,** it is known that tourist activity patterns and operations are highly localized, often in microclimate conditions. In the review of types of climate information provided by destinations or tourism operators, it was observed that in a number of cases, the climate station used by operators or destination promoters was located >100 km away from the destination. Therefore, due to the lack of sufficient weather stations and availability of adequate data reduces the potentials application for weather-risk reduction through weather risk-sharing products like derivatives and weather index insurance

In relation to **decision-making,** knowledge about the process of how end-users integrate weather and climate information into specific decisions remains very limited. Climate information is typically embedded with other relevant information. Disentangling the role of climate and its relationship to other situational factors in major decision-making processes in tourism remains an important objective for future research. In other words, the complexities of tourist climate preferences are only beginning to be examined.

The production of climate information needs specific treatment for travel or business planning and decision-making. There is a need of **communication**, but there has been almost no evaluation of what sources of climate information tourist or tourism operators utilize, nor of the effectiveness of different communication pathways and formats. Tourist can be particularly vulnerable to natural hazards. At the same time, they may have limited familiarity with the places that they are visiting. For this reason, it is important to understand that tourist will probably need more specific information than residents because of their lack of knowledge of the possible natural hazards to which they are exposed.

To conclude, we claim that the research and policy community have yet to evaluate how the revolution in climate information and information communications technologies could be translated into enhanced decision-making for the tourist sector. There is no systematic evaluation

of the extent and nature of climate-information use in any tourism or specific destination region, and, as a result, there is limited understanding of the role of climate information in specific decision processes within the tourist sector.

Taking into account the recommendations made by Scott & Lemieux (2010), enhancing collaboration between the tourism sector, NMHs, meteorological companies, researchers and governments is essential to ensure appropriate communication of climate information in a global tourism marketplace, according to the needs of travellers and the tourism sector. As Bruno et al., (2018) also recommend, the uptake of climate information in the context of CS development in Europe needs to be understood and operationalized as a network of different actors within processes of co-production so as to better shape the service based on the wide variety of users' needs.

Knowing the complexity of Climate Services nature, that is to say, Climate Services can be addressed to different sectors. Moreover, in each sector Climate Services have an amount of different end-users. Each one of them needs the information – coming from Climate Services- in a specific customizable way and for different purposes as well. In this line, in the next sections of the present document is going to be present a specific study about co-construction of Climate Services for the Tourist sector.

2. CO-CONSTRUCTION OF CLIMATE SERVICES FOR THE TOURIST SECTOR. METHODOLOGICAL APPROACH

2.1 Global approach

The shortcomings in the definition, value attribution, production and dissemination of Climate Services identified in the previous section has been tackled in this project through a complex methodology which included a process of engagement with stakeholders at four exemplary destinations (specialised in different tourist forms or range of products), aimed at the co-construction and verification of user needs for climate information and ensuing decision-making in view of adaptation and destination resilience (Fig. 7). Specifically, the research design involved the following steps:

1) Selection of exemplary case studies of destinations that can be characterised as vulnerable to specific climate conditions and approach to local government, tourist industry, and other destination stakeholders
2) Design and testing of a methodology of stakeholder engagement
3) Workshops at selected case study destinations aimed at the elicitation of sensible information about tourism performance and operations in relation to climate conditions, adaptive tactics

and information needs to orient future strategic action at the scale of operators and destination as a whole

4) Collection and elaboration of statistical data: a subset of climate data and indicators from the INDECIS database which the literature relates to tourism performance, and a set of indicators on tourism performance (hotel occupation tax, daily rates, revenue etc.) from a privately-owned source, which would be cross-correlated to identify significant climate factors influencing destination performance

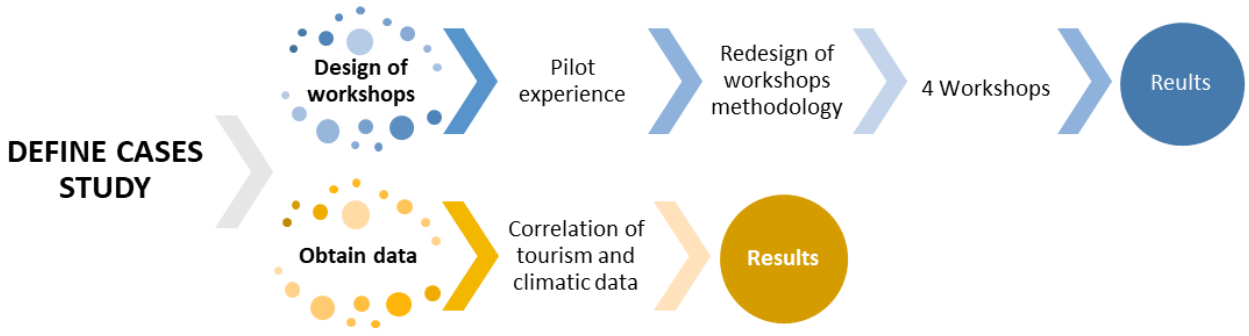
5) Estimation, on the basis of the results of step 3) and 4), of the economic value attached to disposing of CS at destination level. It must be underlined that steps 3) and 4) are interrelated: on one hand, locally elicited information serves to calibrate the model of estimation of climate influence on tourism. On the other, these estimates serve to validate local perceptions and expectations on the value of CS.

6) Identification, based on the information gathered at previous steps, of the most relevant end-users, channels and formats which maximise the value of CS for destination stakeholders.

7) Generalisation of the insights form previous steps for a wider range of destinations across Europe.

It must be noted that this report does not cover all these analytic steps, and focuses mainly on the strategy of engagement of stakeholders. It does, however, present the basis for the subsequent steps, the results of which will be disseminated over the course of project life in the form of scientific papers and will feed other deliverables in this Work Package.

Figure 7. Methodological scheme. Source: own elaboration, 2019



Following from this structure, the overall workshop methodology has been the following.

STEP 0. In a preliminary stage, the INDECIS team together with workshop organisers/convenors have identified case study locations and key stakeholders therein related with specific products or with the destination as a whole (including local governments) to be engaged in this research process.

STEP 1. Description of tourism activity at the destination (products 1…n), including estimates of performance (revenue, associated occupation rates, employment, etc.), seasonal patterns, capacity thresholds, etc.

Figure 8. Description of tourism activity at the destination. Source: own elaboration, 2019

	Descriptor (indoor/outdoor, season, capacity, etc.)	Performance Indicator 1	Performance Indicator 2	Performance Indicator …	Performance Indicator M
Product 1					
Product 2					
Product …					
Product N					

This first step attributes to each different product offered at the destination (to be described in terms of main features, seasonal patterns, potential dependence on climate, capacity thresholds, etc.), a number of indicators defining performance. While it's useful to keep them separated, because different tourism products / forms will relate differently to climate conditions, it might not be possible operationally to measure performance by product, in order to test this assumption.

These indicators monitor tourist activity (demand or expenditure, by markets) in the geographical area delimited, and on daily or monthly bases. The local availability of these data was explored with workshop organisers, however eventually for the sake of homogeneity and comparability the privately-owned source (SRT database) was acquired for the purpose.

So ideally it could be possible to define 'a priori' which indicators or conjunct of indicators (for which data exist) could proxy the performance of a specific tourist product or of the destination as a whole.

STEP 2. Creation of a matrix of performance measures / and climate and weather elements.

Figure 9. Matrix of performance measures and climate weather elements. Source: own elaboration, 2019

	Constraints and boosters	INDECIS indicator 1	INDECIS indicator …	INDECIS indicator Y	Other indicators
Performance product 1					
Performance product 2					
Performance product ….					
Performance product N					

At this stage, we related each product performance indicator (or of the destination as a whole) with

- Constraints and boosters that define ‘good months/days’ and ‘bad months/days’ in relation to specific products and/or markets, based on prior experience and literature
- INDECIS climate indicators, relevant to the product in question
- Other indicators which might be relevant and are not included in the INDECIS DB

As an experiment prior to the workshop, we filled up this matrix with the largest number of climate indicators and performance indicators available at the destination concerned and at benchmark destinations, to analyse which subset of INDECIS indicators could be maintained and brought to the attention of stakeholders. This test would

- Flag significant correlations between climate indicators and (lagged) performance indicators allowing to identify a subset of CI that could be significantly related to performance of specific products or of the destination as a whole
- Identify significant associations between ‘extraordinary’ climate events and ‘extraordinary’ performance (at the destination or at benchmark destinations) to be used for discussion / demonstration at the workshops
- Possibly also build a model (e.g. a logit model) of performance depending on selected climate- and weather-related variables

At the workshop, this information would be used to engage the debate with stakeholders, ‘demonstrating’ how we value the impact of climate (different indicators) on product/destination performance. Key information to this respect elicited directly from stakeholders was:

1. to validate this information based on their own experience
2. to fill in the ‘constraints and boosters’ columns – how such specific climatic conditions have abnormal effects on their performance (we will produce a first draft prior to the workshop)
3. to evaluate how variability and change of the climate and weather indicators specifically affect their decision-making (what would they do if they could know that certain climatic condition would be present in order to improve their performance):
    a. (operators): reschedule activity / diversify product / price strategy / customer relation
    b. (destination managers): customer relation / product diversification / seasonal programming / infrastructure works / etc.

<u>STEP 3. Create a matrix crossing meteorological and climatological scales and activities.</u>

Each cell in the table below would include adaptative actions resulting from having information at that particular scale, and expresses the forecasted value of this information (how much they save / earn if they can dispose of the information of sufficient quality and time).

Figure 10. Matrix of crossing meteorological and climatological scales and activities. Source: own elaboration, 2019

	1-3 days forecast	10-15 days forecast	Seasonal Forecast	Climate projection	Climatology
Product 1					
Product 2					
Product …					
Product N					

At the workshops, the focus groups would provide the information needed to fill in this table. When it is not possible to have an estimate (however sloppy), '+++'s and '++'s has been used and ex-post estimations proposed based on available data.

This step would also verify:

- How different actors value the utility of the Climate Information and which model of delivery they would prefer (by which channel and format / with what frequency / if they are prepared to pay for it, and how much). It is likely that quantitative estimates could be completed could be obtained through a post-workshop survey done with participating stakeholders.
- How they would use this information (do something themselves / bring it to the attention of collective bodies or DMO / inform their clients)

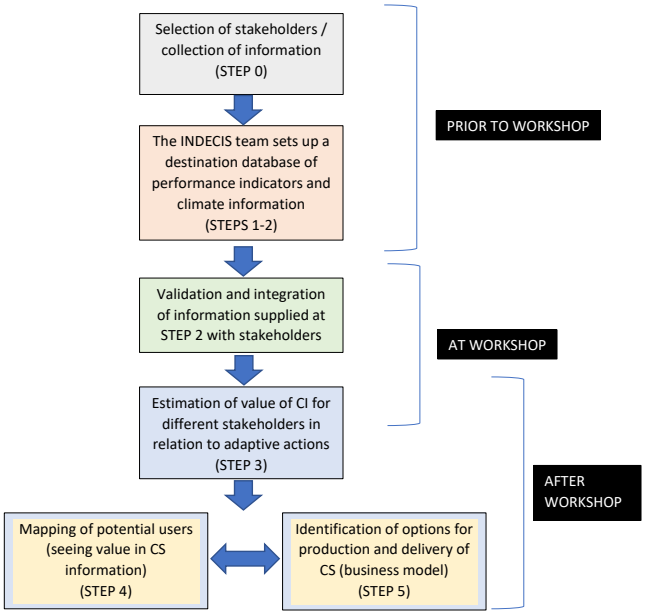
STEP 4. Identify relevant users and providers and an 'ideal' valorisation model by destinations.

As a result of the exercise in Step 3, we will, for each destination, have a map of the

- stakeholders that are potential 'buyers' of climate information as 'final users' (that could carry out adaptive actions and see a value in it)
- climate information that for them has sensible value
- formats, channels, type of CI that is demanded
- destination managers or other bodies / public authorities / research centres that could have a key function and the technical capability to 'package' the climate information and offer it from case to case to final users (at viable economic conditions, e.g. upon subscription of the community of users, or using public subsidies, income from tourist taxes, etc.).

Whatever could not be done in this sequence at the workshop itself, would be done ex-post. Summing up, our model of analysis of valorisation of climate services for destination stakeholders is represented in the following Figure 11.

Figure 11. Model of analysis of valorisation of Climate Services for destination stakeholders. Source: own elaboration, 2019



2.2 Selection of case study locations and engagement of stakeholders

The selection of case study locations has been mostly based on opportunity (contacts with local administrations and industry leaders) however it cared to cover a sufficiently wide range of 'exemplary' destinations in terms of climate types and vulnerability of the principal tourist products offered to climate change. Thus, the four cases selected have been:

- **Jaca**, a mountain tourism destination located in the Spanish province of Huesca, in the Aragonese Pyrenees. **Snow tourism, cultural tourism** and **outdoor activities are the main tourism activities** in the Jacetania county, of whose Jaca is capital**.** Jaca could hardly be considered a world-class destination; however, it has national importance and attracts especially international tourists from across the nearby French border. The first one includes all the activities related with the snow, such as skiing and cross-country skiing. Cultural tourism involves visits to places of patrimonial or ethnological interest and events. Outdoor activities comprise physical and sports activities in the open air, such as climbing, walking, biking, or canoeing.
- **Calvià**, a coastal city of the island of Mallorca, in the Balearic Islands (Spain). Calvià is an upscale resort town in one of the most celebrated and popular summer destinations of the Mediterranean. The main activities in this destination are **sun and beach tourism** and **outdoor activities.** The former includes activities related with the beach as sunbathing or swimming**,** while the latter as already seen involves physical activities in the open air, which

in the coastal and inner areas of Calvià include cycling, golf, nautical trekking, diving courses, competitive events, etc.

- The **Sila National Park**, one of the most outstanding natural reserves in Italy, located in the southern region of Calabria. The main tourism activities offered there are **snow tourism, water and lake tourism** and **other outdoor activities,** including trekking, cycling and the observation of flora and fauna**,** and **gastronomic and cultural events.**
- The **coastal region of Barcelona**. The coast of Barcelona is not as popular as other Catalan or Spanish coastal destination regions, yet it has regional and national interest, and due to its proximity with the capital city, it stands out as offering access to a unique combination of natural and urban amenities. The focus on the coast was due to the fact that this is a more vulnerable area to climatic conditions, characterised for instance by strong beachline erosion and frequent flooding. The city of Barcelona as regional capital and one of the most celebrated urban destinations in the world was nevertheless 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 this section, we briefly present these four destinations and their main tourism activities (figure 13).The participant stakeholders at the four workshops in these destinations (held, respectively, on April 25, May 9, May 30 and June 27 of 2019; fig.13) were pre-eminently tourist operators, DMOs and regional climate - see annex 1 showing the types and number of assistants for each workshop.

Figure 12. Touristic segment in each destination. Source: own elaboration, 2019

Tourist market	Destination
Sun and beach	Coast of Calvià
	Coast Barcelona
Snow tourism	Sila National Park
	Pyrinees (Jacetania)
Outdoor tourism	Calvià
	Sila National Park
	Pyrinees (Jacetania)
Cultural tourism	Jaca city
	Barcelona city
MICE	Barcelona city

Figure 13. Workshops- Co-Creating Climate Services for Tourism. Source: own elaboration, 2019

These workshops have been preceded by a pilot experience to test the engagement methodology, carried out in the first year of the INDECIS project in Alcañiz, on 22nd-23rd January 2018. This destination, located in the province of Teruel (Spain), was chosen as an emergent destination for ***rural tourism, birdwatching*** and ***outdoor activities***, in which climate is a key dimension for the definition of their products. This workshop has been a good opportunity to revise and fine-tune the different steps of the process of engagement, the engagement methodologies, the format of the workshop as well as the data needs to derive valuable results. In this pilot, firstly, stakeholders were divided in groups of 5-6 people focusing on a specific tourism product offered in Alcañiz. Concretely, three groups according to the most representative offer: **birdwatching, outdoor activities** and **cultural tourism**. The work of the focus groups was based on four questions aiming at knowing how climate services could be used to inform strategies of upgrading and valorisation of these products:

1. How do weather and climate affect concrete activities/products of the destination? (Periods, optimal conditions, suboptimal conditions, demand satisfaction)

2. How can we adapt these activities/products to suboptimal conditions?

3. How to use weather/ climate information for the marketing of concrete activities/products and to enhance their competitiveness?

4. Which information about weather and climate can be useful for increasing visitor satisfaction in relation to concrete activities?

After this pilot experience, the research group decided to change the methodology with some adaptations: from four questions to three steps, and employing 'manual thinking tools'.

Thus, the final revised methodology of stakeholder engagement at workshops foresaw the creation of homogeneous groups of stakeholders in terms of product specialisation, also including destination managers with a special interest in those products as well as administration officials. The engagement was organised in a sequence of steps as three 'debate areas', where specific issues were treated. The resulting information and key issues organised graphically to as to facilitate the elicitation of positioning and opinions, and their posterior elaboration.

The objective of the workshop was set as follows, and so it was communicated to perspective participants:

Co-define, together with destination stakeholders:

A. What are potential users (of different types / spatial scales) of climate information for the tourist sector (at your destination) and how could the availability of such data affect their decisions and business perspectives.

B. The value that these actors attach to disposing of specific climate information.

C. The model of delivery of Climate Services (of different types, to be defined better in the course of the workshop) which better fit their specific context – the actors who have the technical and financial capacity to 'package' climate data into information (numbers, texts, maps, tools, etc.) for specific classes final users.

Each of the 4 workshops followed the same structure and steps. Concretely, the engagement sessions were preceded by 'keynote' speeches of local government stakeholders, researchers and experts presenting 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 with subgroups of stakeholders representing a homogeneous group of products available at destination (according to seasonality, market profile, spatial characteristics, etc.), e.g. sea and sand tourism, active and outdoor tourism, ski tourism, etc. (see Annex 1).

A first stage of stakeholder engagement at the focus groups had the objective of characterizing the activities and obtaining qualitative information, which would help to interpret the quantitative performance data and to identify the possible sources and databases of performance data. Therefore, five rounds of questions were presented for this objective:

- which are the periods of lowest and highest activity in their own sphere (company, subsector, or destination level);
- which are the reasons for this seasonality
- how long in advance customers plan for their activities and make bookings.
- which are the main reasons of last-minute cancellations.

Figure 14. Example of Step 1. Source: own elaboration, 2019

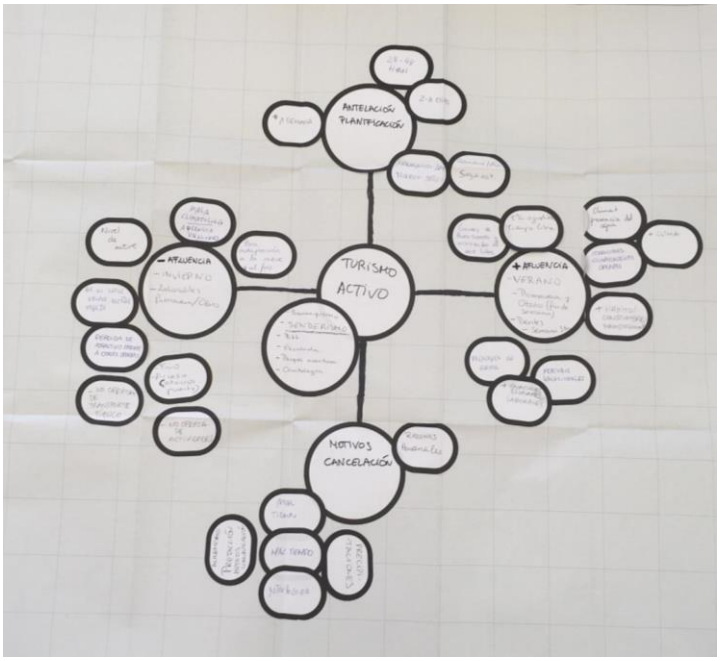


Figure 14 shows one of the examples of the use of manual thinking tool. In this case, is represented the results of step 1 related to active tourism. In the framework is defined all the activities that compose that kind of tourism in the specific area of study. Moreover, there are exposed the periods of less and more affluence, the reasons of cancellation and the anticipation time of planning the activity.

The second stage had as main objective to identify the activity boosters and constraints, in the way of assisting in calibrate the models of estimation of tourist performance data. Two questions have been brought to discussion to this aim.

- the assistants should explain which climatic conditions are the most harmful for their activity, specifying whether such conditions impede the activity at all, or they just limit their market pull.
- then they should identify and explain those that are most beneficial for their activity.

The third stage set the two objectives of, firstly, getting the stakeholders to illustrate their own 'adaptation tactics', in the face of harmful or beneficial climate conditions, at different temporal scales. Secondly they were asked to specify their best options for receiving information to inform their responses or adaptation strategies; or in other words, which kind of weather and climate information, in which format and on which channels, at which spatial and temporal scale they would need in order to have the best options to reduce damage from adverse climatic or to use the favourable conditions.

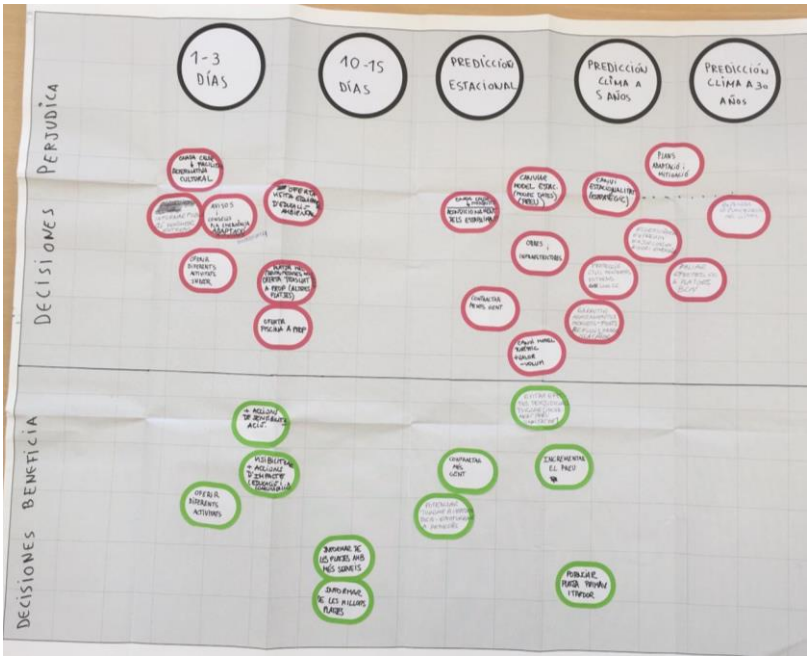
All the information was collected in the three 'spreadsheets' collecting and positioning the information and opinions obtained from different (but homogeneous) stakeholders in an ordered way.

Figure 15 is an example of the working process in step 2. In these stages is expected to know which factors constraint (in red colour) the activity and which are the ones which booster it (in green colour). Moreover, there is a difference into boosters and constrains, in order which boosters more (going in the + axis) and which boosters lees (going in the – axis). It is done the same in the constraints in order to know the degree in which constrain the activity.

Figure 16 it is an example of Step 3. In that way are represented which decisions are supposed to do in order to the predefined boosters and constraints in the step 2. For doing that, is asked to the assistants to take into account the temporal scale (1-3 days, 10-15 days, stational forecast, climate projection for 5 years, climate projection in 30 years).

Figure 15. Example of Step 2. Source: own elaboration, 2019

Figure 16. Example of Step 3. Source: own elaboration, 2019



The results from this procedure in the different workshops are going to be illustrated in the next section.

2.3 Data collection and elaboration

As for the second step of the overall methodology introduced above, on one hand we have selected a subset of climate data which the literature and business and policy reports flag out as having an influence on various aspects of destination performance (seasonality, movement, hotel occupation, revenue, etc.) as well as on each of its products or sectors of activity. These datasets include daily values of **Tmax, Tmin, Precip, cloud cover, sunshine duration** and **wind speed, and relative humidity** for all studied regions. Tmax refers to maximum temperature, Tmin refers to minimum temperature, precip corresponds to the accumulated precipitation, cloud cover responds to sky conditions – estimated in terms of how many eights of the sky are covered in cloud, ranging from 0 oktas (completely clear sky) through to 8 oktas (completely overcast). Sunshine duration is the time-period since and until incident short wave radiation from sun at surface is higher than 120 Wm ^{2} wind speed is also included as variable of evaluation.

On the other, we have collected datasets related to tourism performance. For practical reason, we adopted two simplifications. Firstly, it is hardly possible to obtain homogeneous and high-quality data regarding specific products, as these are mostly private data which are unfrequently made public, and are also generally subject to large degrees of inaccuracy in collection. For this reason, we resorted to hotel performance as a general indication of success of the destination, pooling the results from different products, but also involving a meta-management factor which is an

important addition to explain the success of destinations. The case studies treated are good examples of moderately to highly specialised destinations (at least on a seasonal basis) in one sector of tourist activity, therefore the performance of hotels proxy relatively well that of activities which resent of certain climatic conditions. If the weather forecasts or the climatic trends play against the comfort for certain activities, it is likely that the hotel sector at that destination will resent with fewer booking, cancellations and revenues; conversely, when weather and climate are exceptionally good, hotel performances will tend to be boosted. Obviously, hotel performance depends on many other business-related, organisational and human factors, however the influence of climate could to some extend be 'isolated' through statistical treatment. The exception is that of the Barcelona coast, a destination in the proximity of a year-round multi-product destination like Barcelona, for which climate influence on different sectors of activity may vary considerably and the overall effect could be to a large extend 'masked' by the fact that what for instance is bad weather for visiting heritage sites and museums could be good weather to stay at the beach. Secondly, the precise geographical scale of tourist demand at destinations is not easily captured by public statistics, which are notoriously offering data only at regional level, not at a sufficiently fine periodical scale to capture short-term variations possibly due to climatic events. Hence cross-analysing climate data, which we have available at the fine scale of meteorological stations on 0.1 lat/lon grid and in daily or monthly time series, with tourism performance data at the correct geographical scale, is hardly possible.

For these reasons, we recurred to hotel performance data provided by the SRT Share centre, which collects premium global data, benchmarking, analytics and insights for the hotel sector using a large sample of hotels from all around the world. A total of 17 trend reports and census databases for areas/markets were requested covering the 4 selected case study locations (mostly a larger region with a sufficient sample to allow disclosure) as well as 13 benchmark cases organised in groups that are comparable to our set of case studies and offer more data about seasonal and short-term trends (see figure 16). The trend reports for each case include hotel performance data such us Occupancy (%), Average daily rate (ADR), Revenue Per Available Room (RevPAR), Supply andDemand, from 2005 to 2017.

Figure 17. Case study and benchmarks. Source: own elaboration, 2019

CASE STUDIES	SPAIN - Jaca	SPAIN - Calvià	ITALY - Sila Park	SPAIN – Barcelona
BENCHMARKS	FRANCE - Departement de Jura	CYPRUS - Paphos district	AUSTRIA - District of Kirchdorf	GREECE - Athens
	GERMANY - Region Allgau	ITALY - Province of Olbia-Tempio	CZECH REPUBLIC - Hradec Králové Region	
	ITALY - Province of Trento	PORTUGAL – Algarve	GREECE - Region of Kastoria	

	SLOVENIA - Region Gorenjska	SPAIN - Province of Málaga	PORTUGAL - District of Guarda	

In the present deliverable all the analysis of this data is not presented. All the results related to quantitative data are going to be present in the different papers expected to be published.

As suggested by the illustration of the methodology above, these data will be used to

1. contrast to what extent the perceptions and estimation of the tourist operators at case study destinations are correct in predicting the influence of specific climate conditions, and climatic events and long-term trends on the performance of the destination and their own field of activity
2. use field information from workshops to assist in setting up and 'calibrating' a model of estimation of the influence of climate conditions on tourist sector performance, as for instance, time lags to be used, groups of dependent variables to be clustered, seasonal breaks to be included, 'noise' factors, etc.
3. use the estimation in 2. to produce an assessment of the economic impact of climate conditions and events in specific types of destinations, which would then feed an analysis of the socioeconomic value of disposing of state-of-the-art Climate Services to inform reactive and adaptive actions.

3. INSIGHTS AND RESULTS FROM THE WORKSHOPS

In this section, the information gathered at the workshops is presented. Following the structure in three steps of engagement illustrated above, results for each destination are shown through comparative graphics and summary tables.

3.1 Jaca

In Step 1, participants were asked about periods of highest and lowest activity for their field of activity, the booking behaviour of visitors and the most frequent reasons for cancellations. Thus, **the periods of highest activity** for snow tourism are in long weekends (such as *El Puente de la Purísima*, 8th of December), in February during a week of school holidays, the Christmas holidays, and the Easter holidays (the latter, depending on the time in the year, which is variable). These periods are characterised by favourable weather for ski activities, good snow quality, a 'winter mentality' of the customers (they want to ski because it is winter). Marketing and tourist dynamics also influence this scheduling. For cultural tourism, the best periods are August, the Christmas Holidays and Easter. Secondary periods are July and long weekends, together with weekends all year round as other Spanish and local holiday breaks like San Fermín in the nearby Pamplona. During scholar holidays in France, there is a presence of international tourism (caravanning) and presence of second homes. Outdoor activities perform well in the

summer, spring and autumn, on long weekends or weekends in general, and especially for Easter, when there are generally optimal weather conditions, watercourses are full, the temperature is pleasant. The **periods of least affluence for snow tourism** are the summer and working days. Certain adverse meteorological conditions also hinder the activity in top periods, and it was highlighted that misplaced weather alarms affect the activity too. A period of generally **low activity for cultural tourism** is November, which has no long weekends. In that period, the majority of restaurants and hotels are closed and services to visitors are reduced to a minimum. Other bad periods for cultural tourism are the winter as well as working days in the autumn and spring, when snow and cold weather hinder the mobility between different attractions and generally outdoor activities except ski. Stakeholders claimed that they have no marketing strategy for cultural tourism in those conditions offer.

Regarding the **planning and booking for snow tourism**, participants stated that this depends on the profile of the skier. They identify two different types of skiers: the 'tripper-skier' and the 'weekend warrior'. The latter are used to plan their activity with 1- or 2-days advance. Tripper-skiers are holidaymakers who are hardly affected by weather forecasts for their decisions and plan their activities one or two weeks in advance. Two main reasons for cancellations were identified: adverse weather (wind and rain) and road alerts. For **cultural tourism**, two main trends were identified: anticipation (1-3 months) in high reason, and last-minute booking (considering weather prediction and prices) in low season. The cancellations of cultural tourists are known to be due to bad weather (usually due to meteorological alerts from the TV or other channels, which sometimes reveal to be incorrect). Finally, **outdoor activities** are planned with 1 or 2 days' advance, up to one week, depending on the type of activity. For example, for canoeing, they plan one day in advance, while trekking activities are planned with months of advance. Reasons for cancellations are bad weather, and especially rain, besides personal circumstances.

In step 2, more specific questions regarding the influence of climate and meteorological conditions that affect their activity the most (in negative or positive terms) were asked. **The climate/meteorological conditions that hurt snow tourism** the most are foggy weather, which impedes skiing, and thunderstorms, as ski stations must be closed for dangers of electric interferences. Even so, there is no consensus on the degree to which the fog hurts, since some participants say that ski is performed even with poor visibility, and rescue missions of skiers who get lost because of the fog are frequent. The other conditions that damage the activity are strong winds, blizzards and rain. In the case of **cultural tourism**, a rainy weather and excessive heat are negative factors. It was stated that recurrent storms may heavily affect the summer tourist season. Frost rather than snow make especially the senior visitors give up cultural tourism activities. For **outdoor activities**, the most harmful conditions are rain, wind, snow and storms, while fog and extreme temperatures also could negatively affect the activity.

The climate/meteorological conditions that benefit snow tourism, from the highest to lowest degrees, are sunny weather, low temperatures (needed for snow), and moderate and continuous snowfall. When these conditions are not met, it is more likely that **cultural tourism** and shopping activities receive a boost as a counterpoint: visitors who give up skiing engage in these other activities offered in towns and villages ("what is not spent on the ski pass is spent on attractions or gastronomy"), and vice versa. Participants also claimed that they benefit from bad weather in France, as they can generally offer better conditions. The boosters for outdoor activities are sun, moderate temperatures and clear skies.

In step 3, participants were asked which adaptive actions and 'response strategies' they could develop with good advance information on meteorological events and climate trends.

In the 1-3-day time horizon, the lowering the prices of ski-passes is seen as a good response strategy in the face of adverse forecasts. Conversely, expected exceptionally good weather conditions (also comparatively in respect to neighbouring resorts, e.g. the nearby French mountain destinations) would lead to a greater communication effort. In the 10-15-day horizon, cultural events and packages that are alternatives to ski in conditions of adverse weather could be promoted. Adverse seasonal predictions (expected climate for the next seasons) but also for the 10-15 days forecast could inform actions to supply artificial snow and better managing the snow stock, while favourable predictions would inform customer loyalty campaigns. For the 30-year climate prediction, investments would be made to develop certain alternative products to ski tourism, a conversion of the population's jobs, and a diversification of the economy. Conversely favourable 5-year or 30-year climate trends would drive development investments and a strategy of customer acquisition from the more vulnerable resorts.

Adverse short-term predictions for cultural tourism could be used to propose alternatives, re-route visitors or reschedule/change the setting of cultural events from outdoors to indoors. It is generally the case that participants are sceptical about the possibility to obtain reliable climate predictions with a 10-15 day advance, however if available it could inform the planning of alternatives. Favourable seasonal predictions could lead to the planning and budgeting of new events, while a favourable 5-year would drive the reinforcement of the existing offer, and reliable predictions on the 30-year time horizon would inform an altogether new approach to tourism development policy and possibly drive the development of new technologies in tourism operations.

Finally, as for the **formats and channels** seen as more useful to receive the climate/meteorological information for different activities, participants in different field of activity agree that they prefer a visual format, for example, using emoticons or green / red colours. In addition, they would like the format to be customizable and the data to be represented with drawings and graphics. They also defend that, in the first instance, the information must be simple to understand, but in the case of interest, it should be possible to access more in-depth and

detailed information. Likewise, participants are interested to receive information not only on their own destination but also on the broader region and competing destinations; they would like to access and store the information history, and claimed to be willing to pay if valuable information would be offered. The most desirable channels are websites or mobile phone apps or social networks.

3.2 Calvià

In the case of Calvià, the main tourism activities that have been analysed thorough the focus group work were ***sun and beach tourism*** and ***outdoor activities.***

Following the steps structure, in Step 1 it was gathered that **the period of highest activity for sun and beach tourism** is from May to October, especially on weekends and July and August, when the weather is particularly favourable and air connections to Mallorca are very good. There is also a peak of tourists at Easter, depending on the period of the year (an early Easter, in March, does not produce such a substantial peak as one at the end of April). On the contrary, the peak period for outdoor tourism is from November to April (until Easter). Sport events are generally organised outside of the high season in order to avoid mass tourism, meaning hotels tend to fill up, and excessively hot climate conditions. It should be noted that specific tourist segments have different visitation behaviour, for instance Nordic tourists coming in the winter to play golf. Nautical tourism is the exception, because sunny weather and high temperatures are required, thus the high season for this starts at Easter and finishes in October.

The **periods of least affluence** are from May to October for outdoor tourism and from November to April for sun-beach tourism. In the case of sun-beach tourism, this least period can be explained for the following reasons: bad weather/climatology, dwindling air connections, poor complementary offer (hotels, apartments, shops...), badly-kept beaches from tourist uses (a lot of *posidonia* on the sand, related to sea storms), and adverse household economy in January. In the case of outdoor tourism, the high summer season is too hot and there are too many tourists to carry out sports activities in a comfortable way.

Regarding the **planning and booking behaviour** of sun-beach tourism, participants stated that it depends on the booking channel. If they book the accommodation from a tour operator, they will do it with 6-7 months' advance, yet individual bookings tend to be realized with 2-3 months' advance. They also agree that the trend is towards a relative increase of individual bookings. Last minute bookings are generally the choice of local tourists, that decide during the week whether they'd go somewhere in the island itself on weekends. About outdoor activities, tourists usually plan their visits with large anticipation, especially in the case of nautical tourism in the high summer season, due to the high price of air tickets. Nevertheless, tourists who travel for doing the rest of outdoor activities do not plan so much because it is not in high season. With the exception for *Imserso's* tourists (subsidised social tourism packages for national senior tourists),

that are packaged with large advance, and major events. The sports/competition tourism, that it is being mostly scheduled in the low season, requires more advanced planning to ensure that there are sufficient hotel beds for teams and public.

In any case, tourists do not normally buy **cancellation insurances** for their flights, so there is no high risk of cancellation. However, there are contextual factors (being an island) that influence the decision of changing the holidays or cancelling the trip, such as airline strikes, or the perception of insecurity (e.g. the period following the jihadist attacks in Barcelona in 2017). For sun-beach tourism, the prediction of adverse weather conditions in the short term is one of the reasons of cancellation. Conversely, tourists who come to do outdoor activities are trained for any weather condition. Thus, they do not usually cancel their trip because of adverse weather forecasts. In any case, they might switch to indoor activities once they are in the island.

Regarding Step 2**, the climate/meteorological conditions that hurt** sun-beach tourism are (from the highest to the lowest degree): storms and important precipitations, sultry weather, cloudy skies, excessively high temperatures and wind. These conditions make sun-beach activities unpleasant for the tourist and it affects the beach quality (sand erosion, rise of sea level, jellyfishes and seaweed on the beach, etc.). In the case of outdoor activities, the constraints are extreme temperatures, floods, excessive solar radiation, and lack or excess of wind. These conditions are affecting sports events, tourist satisfaction as well as the ecosystems. Some conditions, such as significant temperatures or high sea level temperatures, can be a constraint and a limiting factor at the same time in both activities, depending on the preferences of specific markets.

The climate/meteorological conditions that benefit both tourism activities are sunny skies and an adequate and comfortable temperature, without extreme conditions. The tourist brand of the Balearic Islands is "300 days of sunshine per year" and there is undoubtedly a commitment and belief in this brand.

In Step 3, and in relation with **adaptive decisions** following from reliable 1-3 days or 10-15 predictions, it is considered that it would be interesting to offer more services and cultural opportunities off-season and to increase the public transport offer in the face of favourable conditions, or to reduce the price to attract visitors in the face of adverse conditions. Especially for outdoor tourists, alternatives could be offered switching from outdoor to indoor activities if the scheduling cannot be changed or the activity cancelled.

In relation to unfavourable seasonal predictions, participants defend the diversification of the tourist supply focusing on cultural, gastronomy, congresses and indoor sportive events. For the 5-year climate prediction, participants stated that it would be interesting to create indoor beaches in case they do not want to change the model, protect and conserve existing beaches (i.e. build dykes, posidonias' regeneration), and eventually implement a transition towards a higher quality sea-beach tourism model. The outdoor tourism focus group agreed that a solution to

unfavourable medium-term trends lies in the development of new tourist products, risk prevision and better adaptation strategies. Moreover, for the 30 years' climate prediction they defend that these could generate momentum to replan urbanizations and roads, and to define new planning and land use strategies. Favourable 1-3 days' and 10-15 days' prediction could be used to boost the promotion of the commercial, active and gastronomy supply through last-minute packaging, 'happy hours' etc., contracting more workers or offering incentives to work longer hours for the existing workforce, extending the reinforce workers, and launch ad hoc promotional campaigns. Decisions following from favourable seasonal predictions include the increase of prices, the increase of air connections and of local public transport, and the creation of promotional campaigns for the next season. For favourable climate predictions in the 5-year and 30-year horizon, participants said that they could use it to support the de-seasonalization of tourism and to change the tourism planning strategy.

They would like to receive Climate Information through mobile apps or website, and it need to be dynamic, visual and graphical.

3.3 Parco Nazionale della Sila

The workshop at National Park of Sila (Italy) was organised with three focus groups related to the following tourism activities: ***snow tourism, water and lake tourism*** (i.e. canoeing), and ***other outdoor activities –earth tourism-*** (i.e. trekking or wildlife and nature watching).

Following the Step 1, **the influx period of most affluence** for **water (lake) tourism** are the following: July to August (canoeing, sport events and some outdoor activities), December to March (some outdoor activities), all Sundays, from August to mid-September (water boat), Christmas holidays. The general period of affluence for this activity goes from 15th of July to 15th of September (hotels occupation). Moreover, the periods of affluence but not the most, the participants highlight October weekends - due of traditional fairs and events-, Christmas holidays (Snow activities), all seasons for cultural and environmental tourism, Autumn for gastro tourism (food itineraries, events, mushrooms) and Sundays for the restaurant activity related with water tourism. For the **snow tourism, the periods of most affluence** are Christmas holidays (from 27th of December to 6th of January for ski and ski lessons) and all the winter Saturdays (especially for Italians). Furthermore, the old little Sila train is sold out in any Season.. February is also good for snow tourism. Besides **earth tourism**, the periods of most affluence are December to February (winter outdoor, snow trekking), from July to October with peak in August (trekking and mountain bike), from May to October (environmental education, trekking, mountain bike), end of September (cultural and gastronomic events). In particular, snow trekking goes from Christmas holidays in a specific peak and from 20th of December to February for the general period. August has nature tourism and wellness on weekends, while September and October are the months of most affluence for wine and gastronomy tourism. The other periods of high

affluence but not the most for earth tourism, are April and May for school groups, from July to September, December to April (winter outdoor and restaurant), August (leisure park).

The **influx period of low affluence** for **water tourism** goes from November to April and in the school periods. For the canoeing activity, the low affluence is in the whole winter. Referring the water boat activity, kayak and canoeing it goes from May to October. For the hotels and water tourism, the period of less affluence goes from March to June and in the month of November. The main month of less affluence for restaurants is on November. The periods of low affluence for **Snow tourism** are 10^{th} – 20^{th} of March due to scarce motivation to ski (most ski plats are closed) and scarce promotion (not seen as holiday periods, except by few foreigners). Spring is one of the periods of least affluence for snow tourism because visitors are more interested in outdoor activities in that period.

Regarding the **planning and booking** of **water-lake tourism**, the assistants said that the visitors plan the activities in a short-term for everything except for sport and traditional events. They also said that they plan it in a longer term for summer holidays, Christmas and October events. For **snow tourism**, the participants exposed that the visitors plan in 6 months in advance for important events, 1-2 months for holidays stays, 4 days before for ski weekends, 2 days for other activities and 1 day for ski lessons. Moreover, for **earth tourism** the reservations are made in an advance of: 1-2 months for excursions and overnight stays, 1 month for school groups, 2-3 weeks for winter outdoor activities, 2 weeks for summer outdoor activities, 7- 10 days for mountain bike, trekking, winter trekking and 7 days for general visits.

The reasons of **cancellation** for **water tourism** are due to the weather that influences the duration of the stay (in particular, by means of the TV news about bad weather expectations). Furthermore, for **snow tourism**, no snow means plants closed so this is one of the reasons for cancellations, but forecasts of too much snow or rain are as well reasons of cancellation. Being sick is another reason to cancel the planned activity. To the end, for **earth tourism**, the reasons of cancellation identified are alarmist weather forecasts, bad weather for summer outdoor, bad weather and closed plants for winter outdoor, sickness or family problems and serious impediments for excursionists.

Regarding Step 2**, the climate/meteorological conditions that hurts lake tourism** are (from least to most hurt): strong snow during weekends (activities undoable), strong wind, rain in summer, low temperatures in May, long rainfall events and storms-humidity in September and October. For **snow tourism**, the hurter conditions are fog in high season, hail, wind, storms, excessive cold (for hotel management costs), excessive storms, rainfall events for several days (for outdoor winter activities), variable weather and extreme temperatures. In the case of **earth tourism**- , the conditions that harm are storms and violent storms (all activities), rain (for visits to natural reserves and all outdoor activities), storms (guided tours, leisure parks), hail (for

guided tours), rain and wind (leisure parks), strong wind, fog (trekking routes), snow (visits to natural reserves), rain (hotels) and high temperatures (visits to natural reserves).

On the contrary, **the meteorological and climatic conditions that benefits lake tourism** are snow during the weekends, sun in the summer, rigid temperatures in winter, heat in the summer and rain in September (for mushrooms tourism). For **snow tourism**, the best conditions are sun and snow in the winter, not excessively cold temperatures (for outdoor winter activities),. In addition, some conditions that benefit although less than the previous are cloudy in other places and coast (for outdoor activities), moderate temperatures, or strong snow over the course of more days and too cold and cloudy. In the case of **earth tourism**, the conditions that benefit are sun for summer outdoor activities and visits to natural reserve, heat (for leisure parks and hotels occupation in general), and snow for winter outdoor activities.

Following Step 3, the assistants are asked about which decisions they would do regarding to the climatological or meteorological conditions (both negative and positive conditions). Regarding the **decisions about what it harms** for **water tourism**, rescheduling or change of schedule of sport events would be done (10-15 days). For the seasonal prediction, they would do a better programming of the supply, to offer more indoor activities and to stabilise programming in good days to loyal the customer. For the prediction of 5 years, they will adapt the products towards costumers that are less sensitive to climate variability. For **snow tourism** in the scale of 1-3 days prediction, they will re-schedule winter outdoor activities, offer alternatives to outdoor activities, make alerts to customers regarding clothing, offer alternative programmes, shift of outdoor events to indoor or cancel of booking for specific activities that are undoable. Moreover, for 10-15 days predictions the participants will change the tourist offer to be negotiate with costumers, they will re-schedule winter outdoor activities, they will change the prices, redesign the packages, re-schedule activities in general, re-schedule of the main events. Referring to seasonal prediction, participants say that skiers think that if the snow does not come, they will go to the snow wherever it is. They would probably do differentiated programming/promotion. Besides 5 years prediction, they probably do water treatment and air conditioning as well invest to support differentiation activities. To the end, having 30-year prediction, investments on more efficient energy sources and diversification of activities will be done. For **earth tourism** and having predictions of 1-3 days, the activities would be cancelled, they would make alternative solutions; proposals of indoor activities and offer restaurants. Participants said that rescheduling of bookings would also probably be done. For prediction of 10-15 days, rescheduling activities and events and propose indoor cultural itineraries would be expected. For seasonal prediction, it would be an opportunity to better programming events and activities and realize specific promotions. Towards 5 years prediction they will probably focus on diversification of activities, planning for new activities, planning based on new conditions and de-seasonalise activities. To the end, regarding to 30 years prediction it would be done: investments in a new pioneer's destination project, development in a new destination model – alternative to the existing one-,

exploration of new activities that adapt to the new climate conditions and investments in alternative activities for planning a product change.

Related to the **decisions about what benefits,** for **water (lake) tourism** having 1-3 days prediction, if there are forecasts of excessive heat in cities and on the coast, they will do promotional actions to attract customers. Regarding 10-15 days predictions, they will promote hotel offers with packages of activities that are doable. Besides seasonal prediction, the participants said that it would be important to communicate the customer that 'even when it is hot, you can sleep well at night here'. They also said that it would be a good idea to extend season and programme for September. Personalised communication campaigns with good weather conditions could be realised like 'when you will come, the weather will be fantastic'. In the case of seasonal prediction, they also support networking with different territorial agencies and institutions for better programming. For prediction of 5 years, the participants defend investment decisions.

For **snow tourism**, the actions that would be take in 1-3 days term are better organization of daily schedules, increase of direct publicity, and extension of programmed activities and renewal of promotions. For 10-15 days predictions the participants expose to make greater promotional activities to incentive other markets, increase of activities programmed, diversification of activities and increase it in offer (more courses, i.e ski lessons, more reservations). Besides seasonal prediction, the actions that would be done are increase prices, powered-up programming, and diversification of the proposed activities, investing on outdoor activities and hire more professionals, investing in infrastructure. For the prediction of 5 years, reorganisation of activities and planning shuttles would be expected. Programming of new investments in the sector would probably be done as decision for this timescale. For **earth tourism** and the decisions about what it benefits, for 1-3 days prediction they would increase active communication of favourable conditions to customers, include weather forecasts in event promotion and extend the proposed activities. For 10- 15 days prediction, the actions to do are boosted social networks promotion of activities and favourable meteorological conditions, increase of events offer (programming of activities), more investments in online and offline promotion. Furthermore, for seasonal prediction, participants thought about four decisions: 1)the creation of new packages with more diversified activities; 2) focussing on events and educational labs in periods of foliage and blooming; 3) detailed and accurate programming for niche tourists; 4) identification of doable activities. For the predictions of 5 years, the participants think to increase the offer of particular activities; to invest in infrastructure works and in new events to attract more customers. They think that could also be done a better programming and budgeting as well more targeted investments. In that way, programming of new activities could be done. Regarding 30 years predictions, almost all the actions are related to investment. For example, investing in new outdoor infrastructure to increase the offer versatility and investing in

enhancements to infrastructure and tourist information systems. In the same way, programming of new activities could be prepared.

3.4 Coast of Barcelona

The tourism activity in Barcelona is analysed by two focus groups related to the following tourism activities: ***cultural and MICE – Meetings, Incentives, Conferences, and Events – tourism and sun and beach tourism.***

Following the Step 1, **the influx periods of most affluence** for **MICE tourism** are on autumn and spring.

For **cultural tourism** in general – including local tourism and non-local tourism- the period is between spring and autumn. Into this period there are some peaks such as in Holy Week (for international tourism, not for local people who go abroad), long weekends (for national tourism such as from Madrid, Zaragoza, etc.). For cultural tourism, there is as well a peak on spring, related to the schooler's travels. Another peak of most affluence is on Christmas for cultural tourism in general. Regarding this panorama, the time when more fairs and events are plan in spring season in order to deseasonalize. For **sun and beach tourism,** the period of most affluence goes from June to September, with three different peaks: weekends, mornings until 4pm and scholar holydays period.

The **influx periods of least affluence** for **MICE tourism** go from July to August and there is a period of low affluence on Holy Week. Related to **cultural tourism**, the period of least affluence is on winter for Barcelona's coast and on February for Barcelona city. Besides **sun and beach tourism**, the periods of less affluence are on November, December, January and February. The working days are the period when there is not so much affluence.

Regarding the **planning and booking** for **MICE and cultural tourism** the participants said that for local cultural tourism they do not plan the activity having a lot of time in advance. For fairs and events, they plan the activity almost without anticipation – 2 days-. For **MICE tourism**, some tourists plan in 1 month in advance, there are other tourists that they do with more time in advance. Related to the people who comes in order to do long holidays they plan in three of four months in advance. For scholars travel they plan six months or one year in advance. Moreover, for **sun and beach tourism** they plan the activity between one and three months in advance. The participants also said that the time that they plan the activities depends on the tourist profile. They also defend that the infrastructures allow the tourist to plan with little anticipation.

The reasons of **cancellation** for **cultural and MICE tourism** are intense rain, personal disease and transport strikes. The participants also say that the cancellations depend on the economic value of cancellation. Going in that direction, for **sun and beach tourism**, the main reasons for cancellation are having job or health problems. Other problems that can motivate cancellation are

economic problems, meteorological difficulties such as rain and pollution, loss of beach sand, terrorism, political instability and epidemics.

Regarding Step 2**, there are different climate/meteorological conditions that hurts/benefits** the cultural or MICE activities. First, it is important to distinguish between indoor cultural activities, outdoor cultural activities and MICE. Rain and extreme temperatures are conditions that hurts **outdoor cultural tourism** while these conditions benefit the **indoor cultural tourism** (museums, i.e.). On the contrary, a good weather (sun and good temperatures) causes that people prefer to do **urban tourism/outdoor activities**. In the case of **MICE**, the conditions must be too extremes for hurting the correct development of the activity, such as snowfall or floods. Participants highlighted that the economic cost for **MICE activities** will be very high. In all cases, the Mediterranean climate is a condition that benefits both activities, as well as TV's/Apps alarms and extreme conditions are elements that hurts them. For **sun and beach tourism**, the conditions that hurts this activity are the following (from more to less importance): 1) jellyfishes, 2) torrential rains (with consequences of lack of sand, sea pollution and floods), 3) strong waves, 4) extreme wind, 5) heat waves, 6) low temperatures, 7) clouds all day, and 8) poor quality of the air. On the contrary, the conditions that benefits sun and beach tourism are: 1) sun, 2) pleasant temperatures (not extreme), 3) little wind and 4) low UVA rays. In any case, the prediction must be correct and no-alarmist for the client satisfaction.

Regarding Step 3, the assistants explain which decisions would do regarding to the climatological/meteorological conditions that it harms and what it benefits. In line, **the decisions about what it harms** for **MICE and cultural tourism**, for 1-3 days predictions they will cancel the event or the activity. For prediction of 1-3 days and 10-15 days they will offer a plan B in this way they will communicate to the customer designing an agenda in which will appear all the different options to do, they will also promote that agenda via Instagram. Having prediction for 5 years, 30 years they will try to diversify the offer.

Related to the **decisions about what it benefits for MICE and cultural tourism**, they will do promotion by having seasonal prediction. For prediction in 5 years and 30 years, they will probably redistribute the tourist season. The assistants of MICE and cultural tourism also identify transversal actions (regarding to conditions that harm or benefit), for 10-15 days, they will probably decide or cancel the day of a fair or event. For seasonal prediction, they will do a readjustment of schedules.

Related to the **decisions about what hurts, for sun and beach tourism** and having 1-3 days or 10-15 days prediction, the solutions could be to offer different indoor activities, especially cultural tourism, to create an "emergency/adaptation plan", to offer environmental education guides, and to propose to the tourist a transfer to nearby beaches or swimming pools. On the one hand, for seasonal prediction, the decisions are: to offer establishments with air conditioning, to contract less employees, to change seasonal models (move dates of the season) and tourist

models (more quality, less massive), and to improve infrastructures. On the other hand, for the prediction of the climate, it will be necessary to make a change of tourist seasonality as well as to have adaptation plans for mitigation and energy eco-efficiency. In the long term (30 years), the coast will have to be rethought, while in the short term (1-5 years) the protection of civilians must be guarded against extreme phenomena and guarantee the provision of services according to extreme conditions.

Related to **decisions about what conditions benefit sun and beach tourism**, it is also important to offer different tourism activities and to carry out actions of environmental education and sensitization in 1-3 days predictions. If the prediction is on 10-15 days, the decision is to inform about the best beaches (quality and services). For seasonal prediction, the decisions are to contract more employees and to promote other types of tourism near Barcelona (ecotourism in Penedès region). For climate prediction on 5 years, the participants said that the price of products and services could increase but annoying effects to local people (housing price), and to promote beach activities in spring and autumn.

Related to the **format and the channels** for receiving the information, participants said that they would pay for the information in case it is reliable. The channel to receive the information will be Twitter, Facebook, Instagram, App and SMS (for companies). However, participants said that with all these channels, old people would probably be displace due of the technological gap. The format that they would like to see the information should be in a simple map and in a not alarmist way.

3.5 Comparative analysis and discussion

One key transversal result of all the workshops carried out is a confirmed relationship between climate and tourism. Beyond what data could show, this relationship is strongly interiorized in the perception of key stakeholders and decision makers at destinations: not only the programming of activities and 'seasons' is influenced by local, mostly tacit, knowledge on visitors' sensibility to climatic conditions, but perceptions and anticipations on how climate conditions will change in the future, is today driving the most important decisions affecting the evolution of business at the destination. However, much of the 're-planning' of the activities is based on short-term weather forecasts that are available in an erratic and poorly contextualised way or tailored to the needs of end-users. Furthermore, as was frequently commented in the realised focus groups, the 'response tactics' of individual business or subsectors of the tourist industry are often fragmented and hardly supported by adaptation strategies at the scale of destination implemented in the long term. Not all types of tourist activities and products resent in the same way on weather and climate, and the more diverse a destination is, the greater the capacity to compensate losses on one side with gains on another (See fig.18).

All the types of tourism analysed are influenced by certain weather or climatic conditions that diffuse or even impede their realization. The following table shows the conditions which affect each activity on a simple traffic light scale (green, orange, and red). However, these meteorological conditions/variables are categorized according to the activity in a very general way but all of them have nuances, for example, it is not the same as an average temperature in a ski resort in the Pyrenees that in a sun and beach area in the Mediterranean, that means that the temperature needed to develop each activity is different. 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 geographical area; in order to create tailored information. All this will be detailed explained in the next step.

Figure 18. Degree of weather sensitivity by type of tourism. Source: own elaboration, 2019

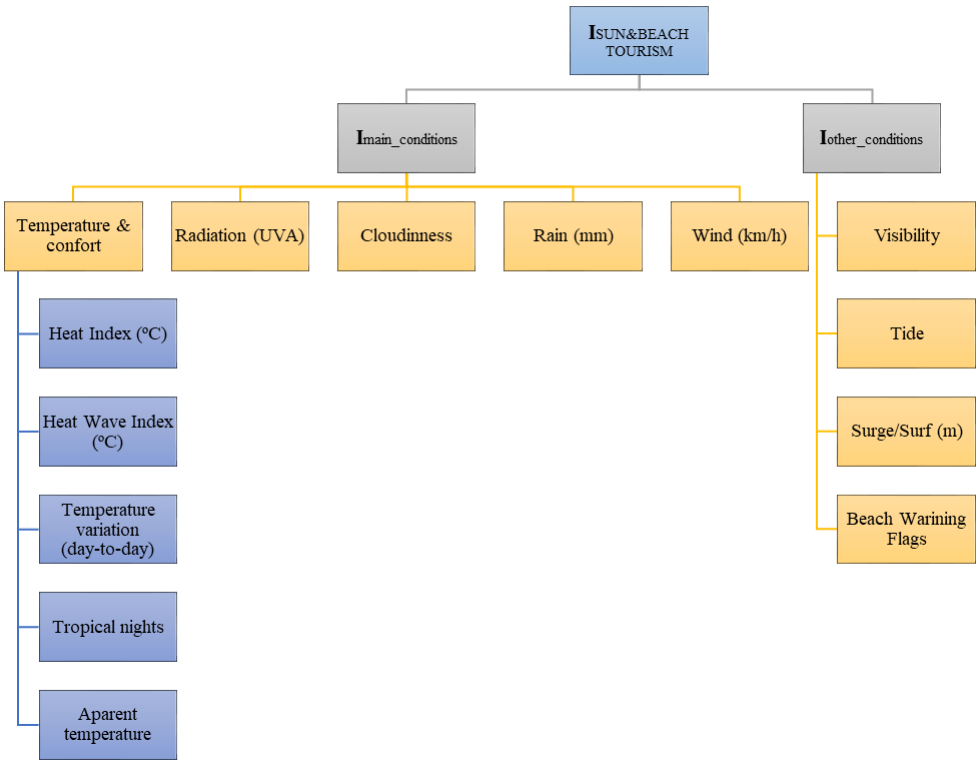
	Sun and beach tourism	Snow toursim	Outdoor tourism	Outdoor Cultural tourism	Indoor Cultural tourism	MICE
Sunny						
Partially cloudy						
Totally cloudy						
Drizzly						
Stormy						
Hailstormy						
Snowing						
Foggy						
Windy						
Very high temperatures						
Medium temperatures						
Very low temperatures						

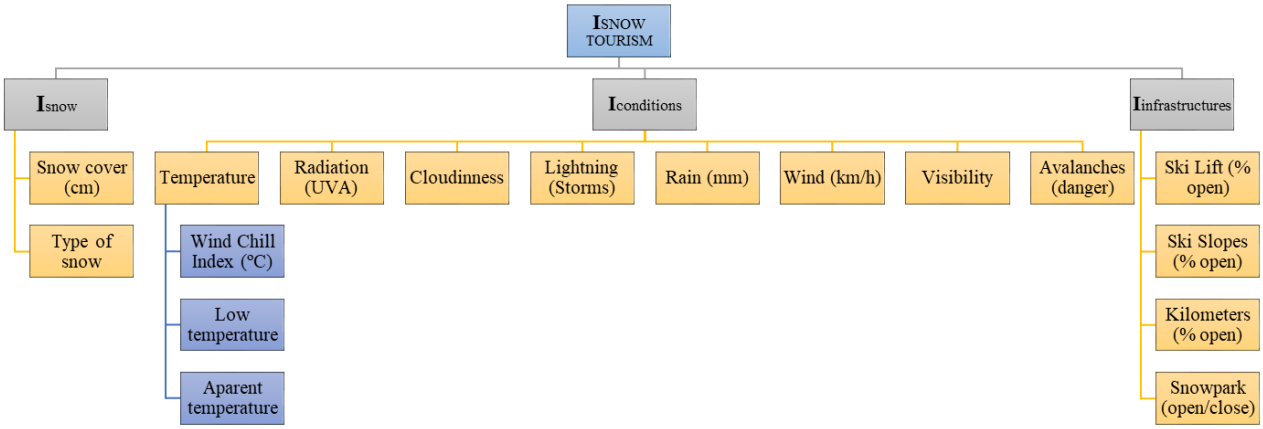
Following the mentioned table, in the case of sun and beach, conditions such as extreme wind, rain, storm or snow directly and completely affecting the realization of this type of tourism. Otherwise, when the weather is completely cloudy, it is reducing the number of tourists who want to do sun and beach tourism, but it is not a totally 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, logically it is a determining factor that temperatures must be low to produce snow and that 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 conditions, available in that the table, are negative for the snow tourism. Outdoor tourism (i.e. hiking, climbing,

canoeing) and outdoor cultural tourism (i.e. cultural routes, outdoor concerts) follows practically the same dynamics as snow tourism, which is totally affected by convictions that do not favour the practice of sports and tourism in the outdoors (i.e., rains, wind, fog, high and low temperatures, especially extreme), including in this case the snow as a negative factor. The indoor cultural tourism is favoured when conditions abroad are considered bad (not sunny, rain, extreme temperatures, etc.) and do not allow outdoor activities. However, if the conditions are very extreme, cultural tourism may not be benefiting because of willingness of access to certain places (i.e, if there is a very strong storm or hurricane, tourists probably will not move to a museum). Finally, in the case of congress tourism or MICE, this follows a very different pattern according to what the stakeholders indicated. Normally tourists book these activities and trips well in advance and, if it is not very extreme weather conditions that forces the cancellation of flights, they do not cancel the activity because it is work tourism. That is why the cancellation of MICE due to meteorological conditions practically does not occur.

As mentioned above, the determination of variables and intervals in a more detailed manner for each type of tourism and destination is necessary, that it can be shown in a way of indicators that allowed it. Indicators that allow to calculate how affected the tourism will be in a destination according to certain variables. As example, the figure 19 shows the variables that composes sun and beach tourism indicators and snow tourism according to the stakeholder's perception.

Fig.19 Indicators disaggregated by variables. Source: own elaboration, 2019





On the other hand, we have seen cases where excess specialisation in one product or 'season' would require a strong commitment to transition to more resilient models. These efforts though should be sustained by all stakeholders and use long-term investments and planning efforts by governments at multiple scales. Neither adaptation strategies not eventually mitigation policies should be left to chance or to the initiative of power-scarce individual operators, but big decisions require good, reliable, personalised information; our project, if anything, has brought up the urgency of this need. In this line, the co-construction of climate information with stakeholders becomes an important step to flesh out Climate Services which are useful and valuable.

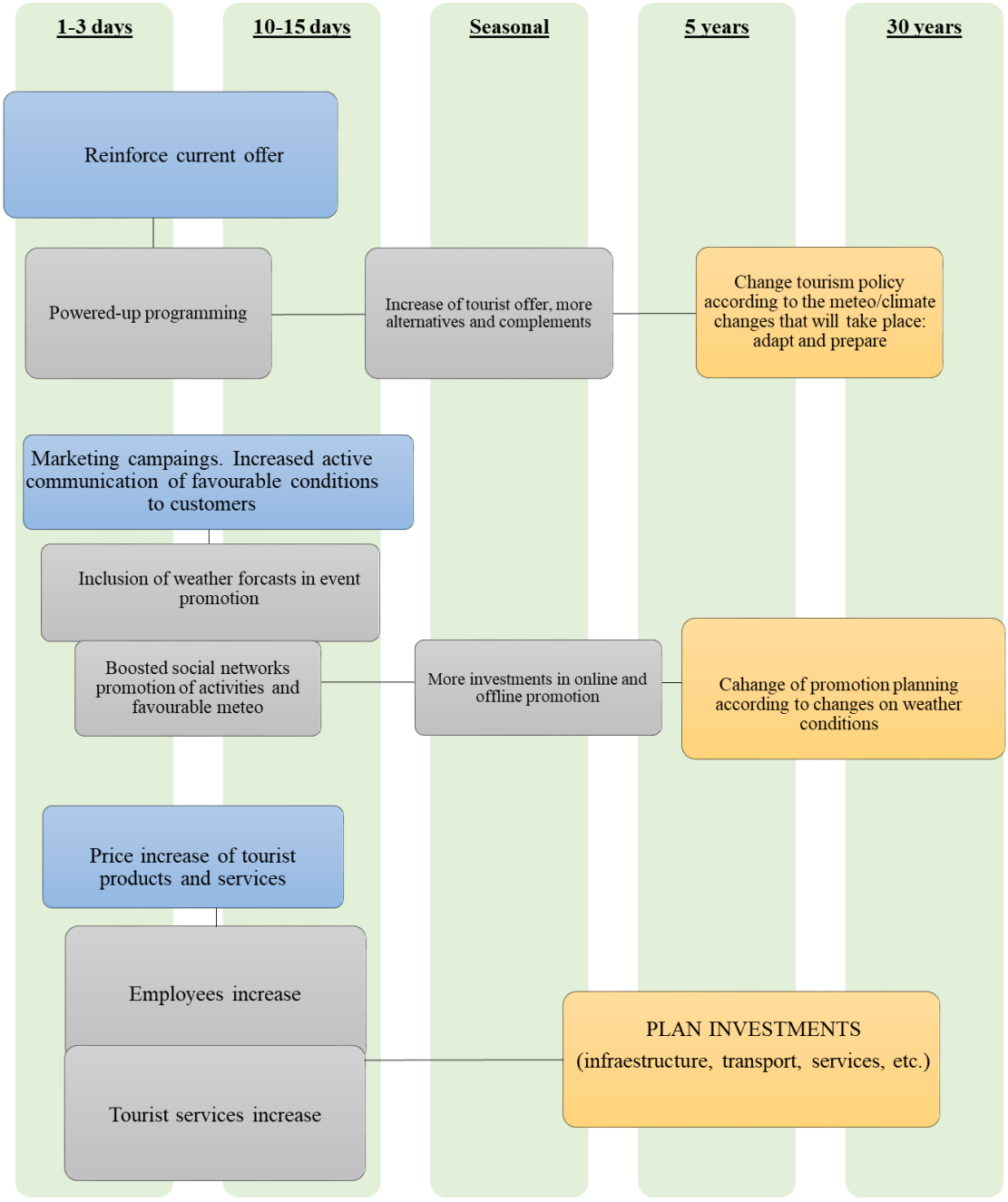
Our workshops allowed to understand especially which are adverse and favourable climate conditions for key products in exemplary destinations of the Mediterranean arc, one of the areas of highest tourist intensity or in other words economic dependency on the tourist sector.

It is well known that climate change will affect this region's tourist future considerably, however in this research task we wanted to bring more specific situations and the diversity of responses at the very local scale. We also looked at the ways and channels through which climate sensibility is 'transferred' from the ultimate customers to decision making at business and destination scale, and at the range of adaptive actions which could inform adaptation strategies. In this sense, the following figures show the main decisions about weather and meteorological conditions that benefit (fig.20) and hurts (fig,21) the tourism activity.

It is true that decisions and actions are somewhat different in each destination and type of tourism activity, but the difference among them is minimal. On contrary, the temporal scale of meteorological prediction is the factor that determines the decision of stakeholders to decide one action or another, as the mentioned workshops confirmed.

Considering, the main decisions of tourism sector about conditions that benefit tourism activity, the figure 20 shows them in three sections. The first one is about the tourist offer, and if the weather conditions are favourable, it can be reinforced, especially for short-term prediction through a powered-up programming and an offer of tourist complements (more services, more packs, etc.). For long-term prediction, the decision is to change the tourism policy according to the meteo/climate changes that will take place, it consists on a plan of adaptation for being ready in order to face this new situation.

Fig.20. Decisions of tourism sector about conditions that benefit tourism activity. If weather/climate conditions could be anticipated at different time-scales. Source: own elaboration, 2019



The second one section is marketing, all stakeholders reached the decision that if the conditions are very good, more and better promotion of the destination has to be done, especially with the inclusion of weather forecasts in event promotion and the boosted of social networks promotion. For season prediction, they agreed that there is a necessity of more investments in online and offline promotion. In any case, it will be important to carry out a change of promotion planning according to changes on weather conditions too (5-30 years prediction).

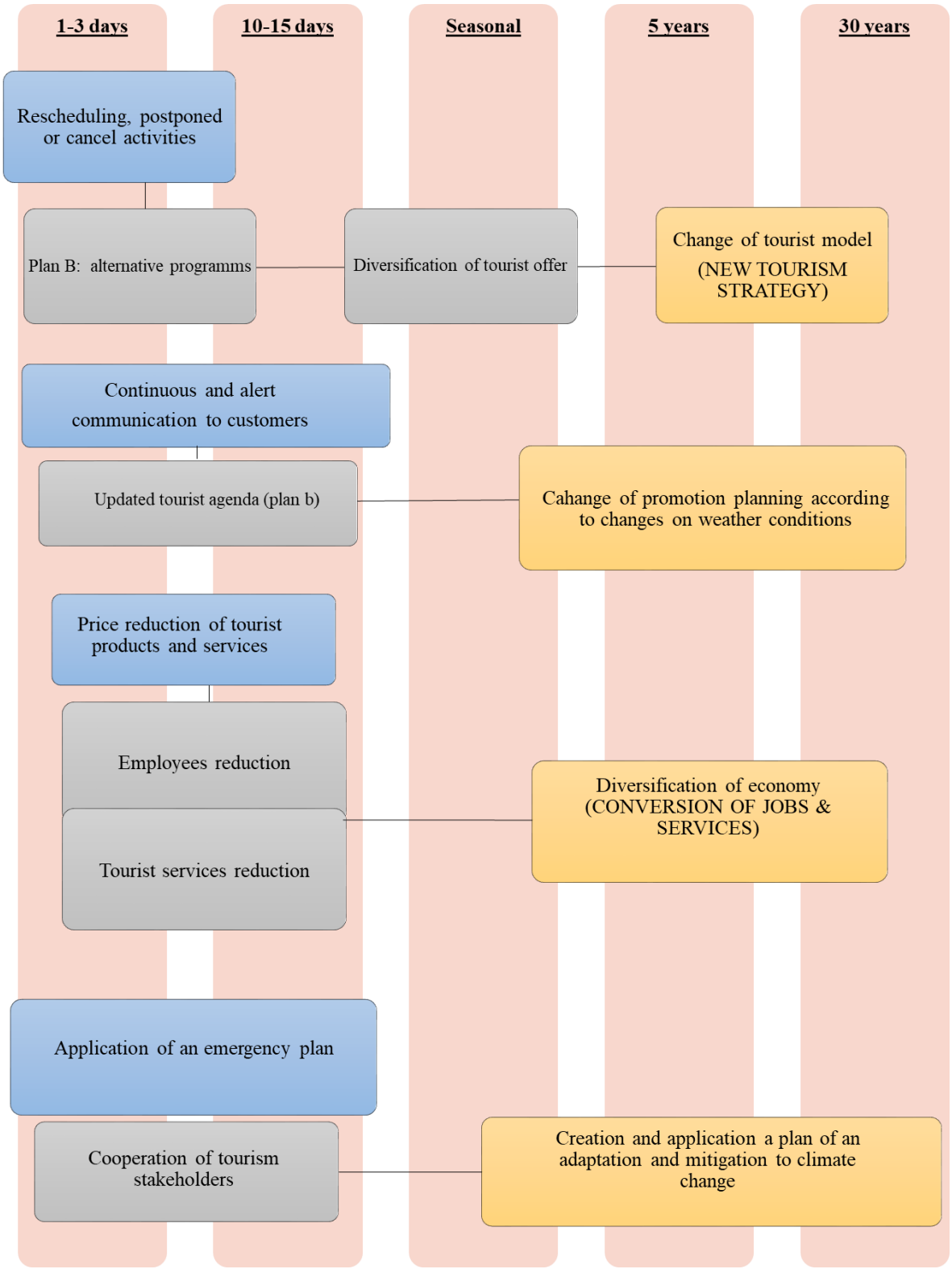
The third section is about economy and prices. The price of tourist products and services can be increased if the short-term prediction is good for the practice of tourism. However, this implies an increase of employees and services according, also, to the tourist demand. With the benefits obtained, it can be considered a plan of investments for the destination, such as infrastructures, transport, services, etc. On the contrary, figure 21 shows the main decisions of tourism sector considering the conditions that hurts the tourism, and the price is shown with an opposite effect (price reduction, employees' reduction, services reduction) implying a diversification of economy considering long-term prediction.

In the case of the tourist offer, the first decision considering short-term prediction is rescheduling, postponed or cancel the programmed activities, such us outdoor events, concerts or sports race. For this reason, it is important to have a "plan b" of alternative activities and tourist products for customers. In this sense, the communication and marketing for tourists must be directly and updated, especially for avoiding the cancelation of bookings. With seasonal prediction, the stakeholders can diversify the tourist offer and the tourist model must be rethought and changed according to long-term prediction through a new tourism strategy and new promotion planning.

However, and as a result of joining previous actions and decisions, the participants agree that an emergency plan must be applied to the short term and a real and complete plan must be created on adaptation and mitigation to climate change. The collaboration between stakeholders is essential.

Furthermore, stakeholders at different destinations seem to agree about the format and channels in which they would like to receive Climate Information: graphical, dynamic, and customizable, as interactive web or mobile app. They have shown to be mistrustful about the information they receive currently – mostly because of 'false alerts' on weather events have affected their business – and claim that often standard meteorological information does not meet their needs. Besides, they have expressed scepticism regarding the possibility to receive reliable and useful seasonal predictions or information on longer-term trends that can have value to orient their strategic choices. However, they do value the fact that good climate information in this sense would make a difference for the adaptation of tourist operation in the face of changing climate.

Fig.21. Decisions of tourism sector about conditions that hurt tourism activity. If weather/climate conditions could be anticipated at different time-scales. Source: own elaboration, 2019.



In the next section, we will inform about how to spend these insights in the broader framework of the INDECIS project and of the type of scientific outputs that will follow from them.

4. CONCLUSIONS AND FURTHER STEPS

The process and results illustrated in Sections 2 and 3 allow a first approach to the collaborative construction and valorisation of Climate Services for the tourist sector. Yet, as mentioned above, the contribution of this stream of research to the definition and valorisation of CS in the broader framework of the INDECIS project is not concluded with this report, and the results presented here have to be understood as 'intermediate' and exploratory in nature. In the following, we explain which next steps have to follow from this analysis.

Towards a 'business model' for the valorisation of CS

As illustrated in Section 2 of this document, the work and insights with stakeholder workshops at 4 case study destinations are a first step of the process towards the valorisation of CS. The rest of the methodology introduced above foresees an iterative process by which the models of estimation of climate influence on tourism performance are corroborated and calibrated according to the knowledge extracted at workshops. In Section 2.3 we illustrated the design of this task. The next step will be to develop such models of estimation and achieve results that could shed more light on how specific climate conditions, meteorological events and future climate trends affect tourist destinations, and could allow estimating the economic value of such incidences. This value is then to be then contrasted with the value attributed by stakeholders (to be elicited through further direct engagement in focus groups or surveys) to the provision of strategic information as Climate Service which would serve to adapt operations or the 'tourist model' of destinations altogether in anticipation of such expected losses or potential gains at different time scales. The detailed statistical methodology for this task is complex and will be the object of further scientific elaboration as illustrated below.

Towards INDECIS CS standards

One key aspect of the valorisation of Climate Services and the identification of a model framework for their delivery to sectors of interest has to do with the channel and formats of such information. This aspect is the bulk of research to be undertaken under Deliverable 7.4. The work presented in this document D7.2 has provided a first exploration in this sense for the tourist sector, and has highlighted the potential role of intermediary CS agencies that 'wrap up' data provided by international and national meteo service centres (like AEMET) and provide valuable, tailored Climate Information 'on demand' to operators at the local scale.

A key aspect in this sense is the quality and functionality of the root services of central data provision and forecasts. In this sense, INDECIS sets up a formidable dispositive, however the modalities of 'channelling' of information and their format towards the sectors is still in

progress. In particular, a key aspect that needs to be developed in a veritable 'product design' is the way in which weather forecasts and climate predictions are stored and transmitted to the sector in a valuable and 'useful' format, an aspect to be especially treated in Deliverable 7.3.

Towards scientific outputs regarding CS for the tourist sector

The intermediate results presented in this document and the expected final results from this stream of research lend themselves for packaging as scientific outputs for dissemination towards the academic and policy community, in a format which is of necessity different from the one presented here.

Specifically, we aim at developing three main scientific papers, which cover different sections of the methodology and research work presented in this document; these papers are highly interrelated and by no means have to be intended as sequential, as they feed one another.

- The first one presents a conceptual revision of the relationship between climate and tourism for informing adaptive actions at destination level. This paper will start with a fundamental critique of the concept and operationalisation of 'Tourist Climatic index' and move towards a framework of co-construction of climate services within the broader analysis of destination competitiveness and resilience in a context of complexity and multi-scale interrelatedness.
- The second one treats the information already presented in this document, to illustrate the value of stakeholder engagement in the process of co-construction of Climate Services for the tourist sector, using the case studies and research process presented here.
- The third one will present the construction and testing of a model of analysis of the influence of climate and specific climatic conditions and meteorological events on the performance of the tourist sector, using the specifications already presented above, towards an estimation of the economic value of Climate Services through stakeholder engagement.

It is foreseen that these three papers will be elaborated and sent to relevant academic journals for publication within the timeline of this project.

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Annex

Table 1. Contacted stakeholders for INDECIS' Workshops

	CONTACTED STAKEHOLDERS	Nº atendees
Pilot experience to involve tourism stakeholders on climate services co-creation in Bajo Aragón (Spain). Alcañiz (Spain). *Organized by GRATET/C3/URV*. 22nd - 23rd January 2018	- Environmental & tourism department, Municipality of Alcañiz - Tourism department, Comarca del Bajo Aragón - Guided tour in Alcañiz - Calanda Tourist office, Comarca del Bajo Aragón - The Meteorological Agency State of Aragón (AEMET – Aragón) - Rural Hotels (i.e. Casa de la Fuente) - Maestrazgo cultural park - Tourism outdoor activities company (Geoventur experiences) - BTT experts (Club Ciclista 5C) - Birdwatching experts - Association "Friends of Natural Areas & Rivers of Alcañiz" (Asociación de amigos del río y de los espacios naturales de Alcañiz) - School of Nature Activies – Maestrazgo (EANA Maestrazgo) - Cultural Association of Alcañiz (Oceano Atlántico)	**21**
Adaptation strategies of tourist destinations to climate change. Participation sessions of social agents from Jaca, Huesca (Spain). *Organized by Ecounion asociation & C3/GRATET/URV* 25th April 2019	- The Pyrenees Climate Change Observatory (OPCC) - Comarca de la Jacetania: Environmental & tourism department - Comarca de Sobarbe: Promotion department - Aragon Government - Tourism department - Aragon Government - Rural development, sustainability & climate change department - Tourism office of Hecho - Tourism office of Jaca - Tourism Business Association: Western valleys tourist entrepreneurs - Mountain Guides (i.e. Val d'Echo Activa SL) - Hotels (i.e. Jolio Jaca's Hotel) - INTURPYR Project: Tourism innovation for a unique destination in the heart of the Pyrenees	**26**
Adaptation strategies of tourist destinations to climate change. Participation sessions of social agents from Calvià and Balearic Islands (Spain). *Organized by Ecounion asociation & C3/GRATET/URV* 9th May 2019	- Municipality of Calvià: Tourism & environmental department - Municipality of Alcúdia: Tourism department - Belaric Islands Governement: Tourism department - Belaric Islands Governement: Energy & climate change department - The Meteorological Agency State of Balearic Islands (AEMET – Mallorca) - Interdisciplinary Laboratory on Climate Change (LINCC /University of Balearic Islands) - Mallorca Preservation Fund (MAPF) - Ecologist Association "Amics de la Terra de Mallorca" - Hotels & Clubs-Resort (i.e. Meliá Claviá Beach or Robinson Club Cala Serena) - FEHM: Hotels Federation of Mallorca	**24**
Creation and communication of climate services for tourism sector of Sila National Park, Calabria (Italy).	- Tourism Department of Calabria region - Tourism department of Cosenza Province - Sila National Park Authority - Municipality of Spezzano della Sila - Hotels (i.e. Park Hotel 108, Hotel Biafora) - Restaurants (i.e. Agriturismo Lorica Parco Natura) - Adventure parks	**36**

Organized by CNR/IRPI & C3/GRATET/URV. 30th May 2019	- Outdoor activties (i.e. Il Chiosco Rosso-Bike Point, Centro Sportivo Lorica, Centro Fondo Carlo Magno, Cammina Sila) - Nature tourism guides (i.e. Fondo Ambientale Italiane)	
Adaptation strategies of tourist destinations to climate change. Participation sessions of social agents from the coast of Barcelona (Spain). *Organized by Ecounion asociation & C3/GRATET/URV* 27th June 2019	- Generalitat de Catalunya: Tourism Department - Catalan office of Climate Change - University of Barcelona - University of Girona - Municipality of Barcelona: Culture and Environmental Strategies - Municipality of Barcelona: Tourism Department - Municipality of Barcelona: Ecology, Urban Planning and Mobility Department - Barcelona Regional (Urban development agency) - Barcelona activa Muncipality of Calella - Municipality of Sitges - Costa del Maresme: Tourism Promotion - Gaiàlia: Sustainable onsultory - CINESI; Mobility and Transport Consultory - Winery Mas Rodó - Cultruta S, L.	**25**

Source: own elaboration (2019).