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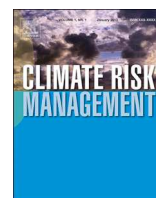
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Adaptation planning in France: Inputs from narratives of change in support of a community-led foresight process

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ABSTRACT

In France, integrating adaptation to climate change into planning policies is a prerogative that has recently been delegated to municipalities. There are also various injunctions to engage the local population in this decision-making process. How can municipalities co-construct an adaptive future with their citizens? This article critically describes a community-led foresight process, based on the mapping, analysis and interpretation of narratives of change. Based on empirical results, we explore and discuss the role past, present and future narratives may play in the process of outlining incremental scenarios and how these might enable the identification of pathways and hinge points. The role of design in supporting the process by proposing an innovative foresight workshop is also discussed. We then highlight how these narratives stimulated reflections through an art, design and science foresight experiment.

1. Introduction

Adaptation planning for climate change seeks to help human-environmental systems to adjust in response to actual or expected climatic stimuli so as to minimize damage caused by and to them and to exploit beneficial opportunities (IPCC, 2007). In France, top-down national and European Union (EU) strategies have initially guided local climate policy and adaptation planning (Bertrand, 2013; Reckien et al., 2014; Richard, 2016). In parallel, climate planning at city level became compulsory from 2012¹ and was

Abbreviations: ADEME, French Environment & Energy Management Agency; B.P, before present; EU, European Union; IDEO, American Design Institute; INSEE, French national institute for statistical and economic studies; IPCC, Intergovernmental Panel on Climate Change; NGO, Non-governmental organization; ONERC, National Observatory of global warming effects; PAR, Participatory Action Research; PCAETs, Territorial Climate, Air, and Energy Plans; PNR, Natural Regional Park; RCP, Representative Concentration Pathway; UVSQ, University of Versailles Saint-Quentin-en-Yvelines

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¹ Law on the National Commitment for the Environment (Loi n°2010-788 du 12 juillet 2010 portant engagement national pour l'environnement) followed by the Law on the Energy Transition for Green Growth (Loi n°2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte).

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assigned to municipalities by requiring them to adopt a sequence of climate-related planning documents – the last one being the Territorial Climate, Air, and Energy Plans (PCAETs). Despite the absence of binding directives on adaptation, formal injunctions to “consider” the effects of climate change anticipated the generalization of citywide reflection on how to tackle adaptation (Richard, 2014).

In addition, the climate planning methodology of the ADEME (French Environment & Energy Management Agency) suggests that municipalities should conduct a co-construction process to define climate mitigation and adaptation actions to be taken (ADEME, 2016). This should be understood within the framework of the history of community participation in policy-making in France (Bertrand, 2013) linked to international injunctions to engage local populations, including civil society, public and private sectors, elected officials, NGOs, and governmental agencies in planning and decision-making processes (Brown et al., 2011; Füssel, 2007; Gagnon-Lebrun and Agrawala, 2006; ONERC, 2016; Smit and Wandel, 2006; Snover et al., 2007). Since the 1990s, France has offered a way of dealing with contention (e.g. challenges to territorial zoning and development projects) by way of institutionalized citizen participation with policies of proactive consultation with the community (e.g., Bouchardeau and Barnier Laws²).

In this context, how can municipalities with limited human and financial resources (especially small and mid-size towns and cities) construct a future in cooperation with their citizens? Nowadays, there is a need to create policies that support more community and industry engagement in the climate adaptation planning process (Lioubimtseva and da Cunha, 2020). We developed a co-constructed foresight process, based on the mapping, analysis and interpretation of narratives of change. Our motivation was to help municipalities in the Gulf of Morbihan improve their thinking about their future while engaging the population.

The involvement of local actors in the generation of climate plans through discussions and contributions as well as in the implementation of adaptation actions is believed to improve the quality and success rate of adaptation plans (Richard, 2014). This led researchers to adopt a reflective approach and work toward the transformation of reality through Action Research, a non-traditional approach to conducting science (Goyette and Lessard-Héber, 1987; Lewin, 1946). Participatory Action Research (PAR), a type of action research, aims to ensure the appropriation of scientific knowledge by society and decision-makers not through the conventional processes of research valorization but by co-construction with relevant stakeholders (Buchy and Ahmed, 2007; Gonzalez-Laporte, 2014).

This interaction between non-academic actors and researchers thus generates collective and individual learning, as well as transformation at the level of local institutions reinforcing the change towards sustainable behavior (Finger and Verlaan, 1995; Reason and Bradbury, 2006). The goal is to empower all actors, giving them a voice and an authentic role in the dynamics of the co-construction of knowledge. It relies on the commitment of stakeholders from all sectors, local and scientific knowledge, as well as mutual learning (learning from contact with each other and from how other modes of action function) (Guillemot et al., 2008; Plante et al., 2015). It allows the definition of new modes of governance and unique adaptation strategies to face climate and environmental changes based on the co-construction of knowledge, tools, strategies and actions.

PAR relies on a diverse and evolving range of application methods and practices (Kemmis et al., 2013; Mehra et al., 2002; Ozanne and Saatcioglu, 2008). We chose to implement a community-led process to outline incremental scenarios and enable the identification of pathways, hinge points and current and future needs (Martinez-Emin et al., 2011; Vanderlinden, 2015). We started by mapping narratives of change and defining chronotopes as an entry point.

Narratives are firstly linguistic instruments that structure events and actions (Wittmayer et al., 2019) and can exist in written, oral or non-verbal forms such as maps, visualizations, or other media representations (Krauß et al., 2018b). They are dynamic, dialogic and often contested, and they denote a set of values and meanings relative to internal and external events over time. Moezzi et al. (2017) argue that narratives are mobilized in social sciences as non-fictional representations of a general discourse, usually defined and communicated more formally than private individual stories (although these may sometimes be called narratives in the field of psychology).

Within narrative theory, Michael Bakhtin introduced the term ‘chronotope’ for the representations of specific configurations in time and space in discourse and literature. Thus, chronotopes are ‘points in the geography of a community where time and space intersect and fuse. Time takes on flesh and becomes visible for human contemplation; likewise, space becomes charged and responsive to the movements of time and history and the enduring character of a people’ (Bakhtin, 1981, p.7). Chronotopes were an interesting concept for our co-constructed foresight process as they ‘stand as monuments to the community itself, as symbols of it, as forces operating to shape its members’ images of themselves’ (Bakhtin, 1981, p7) and refer to the fusion of spatial and temporal signs into an intelligible and concrete whole (Aron et al., 2017).

The use of narratives and chronotopes in climate change research follows a change of methodological approach seeking an alternative to unsatisfactory representations of scientific information as unequivocal “truths”. By encompassing the subjectivity of human emotions and eventual uncertainties related to data into sense-making tools, narratives help “balance the presence of multiple interpretations with the need for collective action” (Moezzi et al., 2017, p1).

This paper consists of five sections, including this introduction. In Section 2, the methods and data are outlined to explain how the co-construction process, supported by design, was set up. The results presented in Section 3 start with an overview of the changes the territory is undergoing, followed by four narratives of change over time and two chronotopes directly resulting from this work. In

² The Bouchardeau Law mandates public inquiry when developments are likely to affect the environment (Loi n°83-630 du 12 juillet 1983 relative à la démocratisation des enquêtes publiques et à la protection de l'environnement). The Barnier Law broadens the participation of the public and associations in all major projects by creating the National Commission of Public Debate (CNDP) (Loi n° 95-101 du 2 février 1995 relative au renforcement de la protection de l'environnement).

Section 4, we describe how these narratives influenced the long-term vision emerging from the foresight workshop, and stimulated reflections in art, design and science foresight experimentation. In **Section 5**, we discuss the results and in the last section, conclusions are drawn.

2. Methods and data

The CoCliServ project aims to establish a collaborative relationship between climate science outputs and local communities in five case studies representative of northwestern Europe, including the Gulf of Morbihan, a natural harbor in the south of Brittany (Morbihan, France – [Fig. 3](#) in Results). Dotted with many islands and islets, it is a popular tourist destination with a multi-thousand-year history. Its natural and cultural riches make it a special place whose balance is fragile and threatened by different pressures, including climate change.

Our co-constructed foresight process is rooted in the articulation of an academic consortium (researchers from the social and climate sciences) with local teams (Clim'actions Bretagne Sud and Natural Regional Park (PNR) of the Gulf of Morbihan) along with a local designer and artists, constituting a hybrid site-governance group³. The innovative way used to conduct the co-construction process comes from the embedded way of thinking, the methodology and the organization of the fieldwork. The interviews and foresight workshop were conducted in cooperation with the social and climate scientists, the local partners, as well as the local designer. As in any interdisciplinary research work, the concepts and terminology needed to be agreed upon. The goal was to consider the context jointly and directly share the various points of view and understandings so that a common interpretation could be formed.

To start with, we pooled a series of data supplied by the local partners and a preliminary academic literature review focused on the Gulf of Morbihan. In February 2018, we collected additional information through exploratory interviews (4 life stories – see [Appendix 1](#)) and site exploration. The purpose of the life stories and site exploration was to gather an understanding of past, present and future changes in the Gulf of Morbihan. We wanted to better understand the changes of the primary sector in the context of tourism development, so we firstly contacted actors involved in major traditional activities in the Gulf. Conducting interviews with different categories of economic actors allows us to gather a diversity of views and issues. The first question related to their activities: “I would like to talk to you about what it's like to be an oyster farmer / farmer / salt worker in the Gulf today?” This prompt was followed by the same question with reference to the past and the future. If this was not naturally raised by the respondents, we asked them to give us their point of view on any changes they may have observed over the past 20 years, if they felt these changes were linked to climate change, and finally if they feel they need more information about these changes. In this way, we wanted to explore the characteristics of the geographical site to identify community priorities and gaps to be filled.

Secondly, between February and May 2019, twenty-eight individual semi-structured interviews were carried out (see [Appendix 1](#)). This second series of interviews has allowed us to broaden the spectrum of issues to the administrative, political and civic sphere. The interviews were structured to better understand the stakeholders' feelings and their link with the territory (what does the Gulf of Morbihan represent for you today?), to identify their activities and relevant actions, to enrich our dataset about changes in the Gulf (past, present and future) associated with trades/activities and, finally, to better understand their vision for the future of the territory.

Analysis was done based on grounded theory, a methodology for generating theories from field data using inductive reasoning. It aims to group the data into categories and then to deduce theories and extract meaning from a situation so that the various elements can be linked ([Glaser and Strauss, 1967](#); [Paillé, 1994](#)). The first corpus – the existing information on the future of the Gulf of Morbihan and the exploratory interviews – was analyzed to identify climate-related storylines, practices, community priorities, forms of governance and notions related to foresight. The semi-structured interviews, the second corpus, were transcribed and treated using the qualitative data analysis software, Atlas.ti. In this process, text quotes were classified according to a set of codes, defined from the first corpus and complemented using inductive reasoning as relevant elements arose from the transcripts themselves.

Then, we changed our point of view when analyzing the same data and interrogating narratives from the Gulf of Morbihan. We took Braudel's three-tiered chronology of historical time (1949): very long time, medium time, and short time, and redefined this typology according to timescale and to the physical markers that distinguish them ([Krauß et al., 2018a](#)). As a result, we defined four narratives of change for the Gulf of Morbihan (geo-social, historical, seasonal and climatic effects), as well as two chronotopes: the coastal pathway and the Megaliths of Er Lannic.

These narratives of change and chronotopes helped to outline incremental scenarios and enabled the identification of pathways and hinge points, while design supported the process by guiding an innovative foresight workshop. Our intention was to understand the perceptions of citizens about climate change, the impacts and the adaptation alternatives, so that we could build a long-term vision of the territory and define the trajectory to move towards this desired future. The foresight workshop, organized in March 2019, gathered together twenty local stakeholders to collectively reflect on a long-term vision for a particular part of the Gulf, the Rhuis Peninsula. To facilitate this exercise, we devised specific tools to encourage participants to consider multiple alternatives for the territory and, finally, defined desired scenarios.

A creative exercise named Poker Design was devised⁴. This type of ideation exercise, called “Design Thinking”, prioritizes stakeholders' needs in the elaboration of a product or a concept and finds its origins in the work of Robert [McKim \(1972\)](#) and Rolf [Faste \(1995\)](#). It has been widely publicized by Tim [Brown \(2008\)](#), founder of IDEO (American Design Studio). The local designer and the team from the University of Versailles Saint-Quentin-en-Yvelines together developed the poker design exercise, which consisted of a

³ Some of the local partners are co-authors of this article.

⁴ The process and the visual materials is fully described in Deliverable 2.2 - Incremental scenario case studies on the CoCLiServ project website.

Table 1
Examples of poker design cards, relating the four narratives of change and the three poker design categories.

Poker design categories	Narratives of change			
	Geo-social	Historical	Seasonal	Climatic effects
Climatic changes and hazards	<ul style="list-style-type: none"> ● Submersion ● Flooding ● Erosion 	<ul style="list-style-type: none"> ● Drying soils ● Sea level rise ● Ocean acidification 	<ul style="list-style-type: none"> ● Warmer summer and spring periods ● Colder winters 	<ul style="list-style-type: none"> ● Storms ● Heat waves ● Droughts
Infrastructure and territory	<ul style="list-style-type: none"> ● First nautical mile ● Subsidence ● Beaches 	<ul style="list-style-type: none"> ● Oyster farms ● Coastal pathway ● Salt mines 	<ul style="list-style-type: none"> ● Second homes ● Ports ● Water treatment systems 	<ul style="list-style-type: none"> ● Historical sites ● Urban areas ● Routes
Resources and actors	<ul style="list-style-type: none"> ● Island owner ● Intra-gulf nautical transport network 	<ul style="list-style-type: none"> ● Oyster farmers and farmers ● Direct selling ● Tourists 	<ul style="list-style-type: none"> ● Office of Tourism ● Retired population ● Seasonal workers 	<ul style="list-style-type: none"> ● Measuring instruments ● Scientific community

series of three categories of cards visually representing key elements of the narratives of change and their context, as shown in Table 1. By randomly combining cards from each category, participants, in groups of four, were encouraged to imagine how these unlikely combinations could work.

Adopting 2200 as a time horizon was a choice driven by the geo-social narrative. A physical scenario was presented taking 1 mm per year of local subsidence, 6.5 °C of mean temperature rise and a conservative (yet realistic) simulation of 2.5 m sea level rise (mean value of the Kopp-2017 model K14 – RCP 8.5). The “Climate Central’s Surging Seas” simulator was used to represent the sea level rise compared to current local infrastructure and a map of the territory was designed by the designer using Illustrator® to encourage the stakeholders to think about the future of the peninsula (Fig. 1). Additionally, a small series of factsheets summarizing current and future societal, environmental, economic and demographic trends provided the context for reflection.

Finally, an innovative media to collate and present the ideas was conceived: a note-taking support allowed the participants to represent the created scenarios on a map of the territory so that they could imagine how they might fit in their social, economic and environmental context. Then, they evaluated how innovative and desirable the various propositions were.

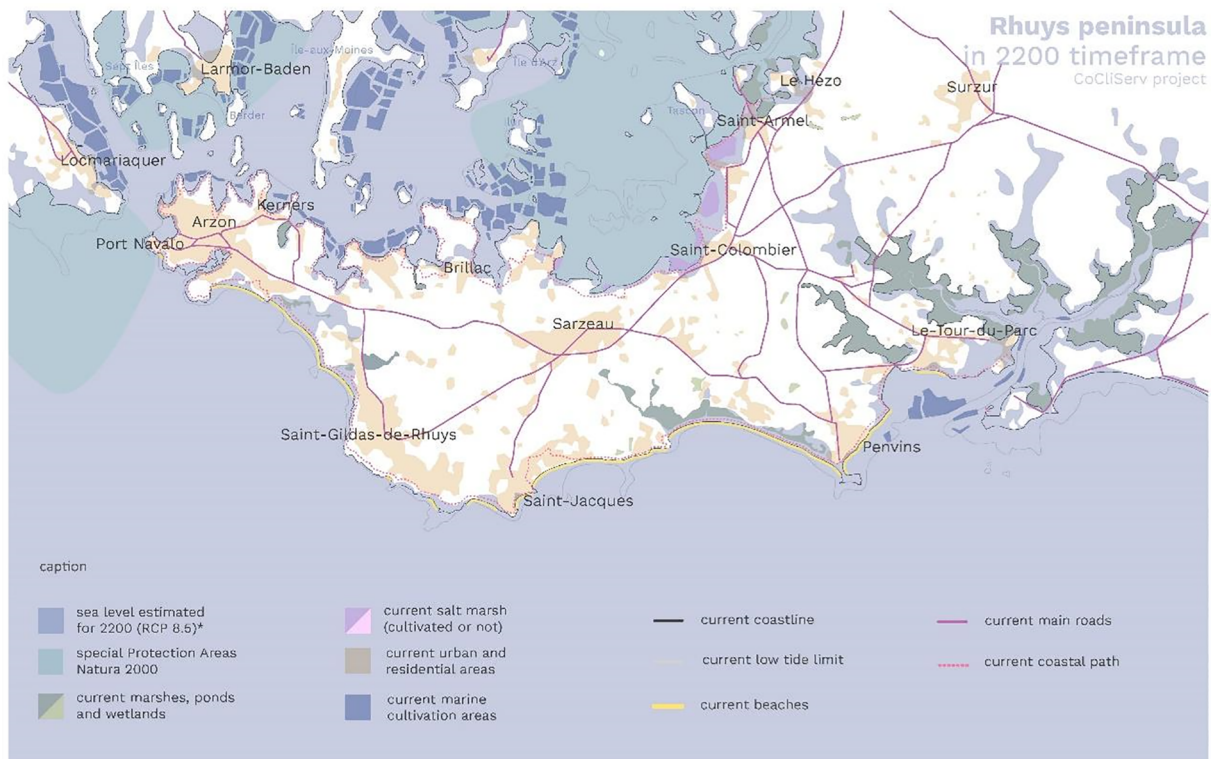


Fig. 1. 2200 physical scenario map of the Rhuy peninsula.

3. Narratives of changes, rethinking the territory

This section presents the narratives of change and the chronotopes. This allowed us to think about our data in terms of timescale and of the physical markers that distinguish them, but, above all, it influenced how we approached the foresight workshop, and the art, design and science foresight experimentation, as explained in [Section 4](#).

3.1. *The Gulf of Morbihan, a changing territory*

Located in the southern part of Brittany, the Gulf of Morbihan, with its small enclosed sea, enjoys a microclimate, often mentioned in the interviews, with high levels of sunshine between May and October and a dry summer. Additionally, large tidal flats, very attractive for bird wintering (duck, terns, various waders and other shorebirds), are protected under Marine Habitats of European Interest ([Direction départementale des territoires et de la mer du Morbihan, 2019](#); [Gélinaud et al., 2002](#)), thus preserving a landscape much appreciated by both locals and visitors. The Gulf of Morbihan is also protected since the 1970's from building outside existing villages ([Office National de la Chasse et de la Faune Sauvage, s.d.-c](#)), a protection that was progressively extended after 1986 to the whole sea-shore with the enactment of the Coastal Act.

The area was a major center of civilization during the megalithic period, occupied by a population that left behind large megalithic ensembles and started shaping the landscape through deforestation for crops and livestock ([Visset et al., 1996](#)). In modern history, the Gulf of Morbihan was a typical rural area with traditional and adapted agricultural activities, mainly oyster and poly-culture farming ([Observatoire Départemental de l'Environnement du Morbihan, 2010a](#)), with a manufacturing hub around Vannes, which originally developed around the port activity in the Middle Ages ([Ville de Vannes, s.d.](#)). Some of the most iconic activities in the Gulf are oyster farming which started in the 19th century ([Le gars, 1988](#), p8), and salt marshes, dating back to the 12th century ([Fustec and Nicolas, 2017](#)), then almost disappearing after the 1960s due to the reduction of salt requirements for the conservation of food ([Ouest France, 2017](#)). Both of these activities have coexisted alongside the development of tourism, which started with sea-side resorts along the Brittany coast in the 19th century ([Danielo, 2008](#), p. 122).

Nowadays, the main agricultural activities are dairy production and poultry farming ([Observatoire Départemental de l'Environnement du Morbihan, 2010a](#)), oyster farming and, to a lesser extent, fishing and salt production from two salt marshes recently restored. Tourism is currently a major economic resource ([Tourisme, 2018](#)), mostly along the coast, developing significantly in the years 1960–1980 and characterized by second homes owned by visitors from Rennes, Nantes and Paris. The social and economic contrast between the littoral and inland regions is one of the major characteristics of the Gulf of Morbihan. The economy associated with tourism has caused coastal towns to thrive commercially while small, inland towns suffer from decaying industry and declining agriculture, which has an influence not only on the social and professional life but also on political choices.

The need to attenuate this contrast is, in large part, the justification for the creation of the PNR in 2014. It works to protect and enhance the natural, cultural and human heritage of its territory by implementing an innovative policy of land-use planning including mitigation and adaptation actions, and economic, social and cultural development, especially of a tourism respectful of the environment ([Parc naturel régional du Golfe du Morbihan, s.d.](#)).

3.2. *Narratives of change*

The existing information on the future of the Gulf of Morbihan and the narrative experience of stakeholders documented in the interviews were linked to define four narratives of past, present and future changes in the territory: geo-social, historical, seasonal and climatic effects narratives. Despite being categorized, these narratives are imbricated and complement each other and these interconnections are shown in [Appendix 2](#).

3.2.1. *Geo-social narrative: from estuary to an expanding small sea*

The Gulf of Morbihan used to be a small estuary joining three small rivers (Vannes, Auray et Noyal), which has been persistently inundated (Flandrian transgression) since 10,000BP (Before Present) ([Créquer, 2010](#); [Office National de la Chasse et de la Faune Sauvage, s.d.-b](#)), with frequent oscillations in the sea level along the Morbihan coastline ([Bos and Quélenec, 1988](#)). Nowadays, it is a bay 25 km in diameter, with access to the Atlantic ocean through a narrow entrance, that hosts around 40 emerged islands and islets and is surrounded by a coastal pathway, called the “The Customs Trail” (GR34) ([Golfe du Morbihan Vannes Tourisme, s.d.-a, s.d.-b](#)). Hence, there is potential for a first geo-social narrative of submersion during the megalithic period (see chronotope of Er Lannic).

Since 3000BP, the sea level has been stable. Nowadays, the Gulf, its inhabitants and its economic activities will undergo a new geo-social narrative, as it is exposed to increasing risks of storms, flooding, submersion, as well as coastline modifications ([Bamber et al., 2019](#); [Observatoire Départemental de l'Environnement du Morbihan, 2010b](#)). On the Rhuys peninsula which faces the ocean, winds, tides, currents and climatic events such as the Xynthia storm in 2010 are eroding the fore dunes in some places and are forming mudflats in others ([Dubois et al., 2014](#)). Along the gulf coastline, erosion provoked by natural drivers is aggravated by the consequences of human activities, such as the construction of hydrodynamic barriers for oyster farming, soil impermeabilization due to the development of urban infrastructure and soil compaction resulting from heavy circulation on the coastal footpaths ([Office National de la Chasse et de la Faune Sauvage, s.d.-a](#)).

3.2.2. *Historical narrative: from an economy based on agriculture and oyster farming to one based on tourism*

The more recent historical narratives of the Gulf of Morbihan result from the development of tourism, which currently represents

over 1.5 billion euros in annual revenue brought by almost 5 million tourists (Tourisme, 2018). This has reshaped the territory, in terms of economic activities, land-use and everyday lifestyle.

Many second homes have appeared on the outskirts of coastal villages with prices double those of the hinterland (Observatoire Départemental de l'Environnement du Morbihan, 2010a). The Gulf has turned into a boater's paradise, mainly in Vannes, Auray, and Arzon. The port of Crouesty (Arzon), built in the 1980s near the old Port-Navalo, in a swampy area, is a large seaside resort that can accommodate 1500 pleasure boats (Morbihan Tourisme, s.d.-b) and the thalasso-therapy center, "Le Miramar", is located there. Housing and infrastructure are mostly near the sea and some are located in flood risk areas, protected only by dikes and dunes. More will become endangered as the sea level rises. The expanded construction has caused inappropriate river management, generating overflows during heavy rains. Here, we question the perception of the risks by people and decision-makers, who undertake to build and live in risky areas.

Tourism has led to an increase of direct sales by organic farmers, oyster farmers and salt workers. On the other hand, it has led to conflicts with oyster farmers about the use of tidal zones and is liable, along with agricultural devitalization, to cause occupation and maintenance problems for the rural area. Access to fresh water is becoming progressively more difficult, especially during the summer tourist season.

3.2.3. Seasonal narrative: wintertime versus peak season

The year in Europe is generally marked by four distinct seasons and changes in the weather are as significant to the local populations as the scientific news about climate change (Krauß et al., 2018a). The difference between the autumn-winter and the spring-summer seasons is obvious in the Gulf of Morbihan. When travelling around the region in winter during the week, the number of closed houses is a striking indicator of this difference. For instance, at one extreme, 79.7% of the houses in Arzon are second homes. In summer, the population increases tenfold. Visitors spend a lot of time on the sandy beaches and walking along the numerous natural trails.

This upper-class tourism has also led to the construction of an infrastructure that is often out of step with the needs of residents. Sailing and motorboats are a strong attraction, with the presence of several large sailing harbors and shipbuilders. The interviews highlighted flagrant examples of questionable development: dry ports for the storage of boats that might only venture out three times a year, a professional-standard soccer field built for the French national team who occasionally stay at a luxury local resort, etc.

This situation does not facilitate a balanced development of the territory for residents who feel invaded during summer by secondary residents who do not invest themselves in the locality. This phenomenon is coupled with soaring land prices, which prevents people working in service jobs to remain in place throughout the year. A large fraction of the permanent coastal residents are seniors (57.6% of residents in Arzon are retirees), as young people cannot find work outside of the holiday season and are not wealthy enough to live locally year round (INSEE Bretagne, 2016, 2018).

3.2.4. Climate effect narrative: impacts on economic activities and the socioeconomic profile of the region

Strong impacts of climate change are already being felt in the Gulf of Morbihan. Communication with local stakeholders' points to personal experiences of climate change perceived, more or less strongly, through the lens of professional activities. When asked about their work nowadays, oyster farmers spontaneously evoked climate hazards and rising water temperatures. The future is worrisome for the next generations due to the rapid and negative shift in the activity, and oyster farmers have to adapt their practices by diversifying to ensure their income (algaculture, adding value to products and offering activities to tourists). The tides, the sun and the wind determine the rhythm of the salt workers, while seasonal changes, water scarcity and drying soils are the main concerns for agricultural activities. To varying degrees, climate change is perceived through a shift in the timing of the seasons, weather disturbance, and longer and hotter summers.

Tourism in the Gulf of Morbihan is directly affected by the rise in temperature and seasonal changes happening locally and in other regions. Locally, the summer weather starts earlier and ends later than before, extending the duration of the peak tourist season from July-August to June-September. Even though longer summers bring economic opportunities, they lead to usage conflicts with other activities, mostly primary ones, within marine and terrestrial zones.

Regarding the profile of the tourists, nine out of ten people visiting the region are French, the largest proportion comes from the Parisian region (28%), (Tourisme, 2018) who choose the destination for vacations as well as for retirement. This level of attraction is shared with the Côte d'Azur region on the French Mediterranean shore, known for its warm weather and well-off, aging population. The Côte d'Azur region is also facing the effects of climate change with temperature rise being of particular concern. A heat wave there in July 2019 set a new national temperature record of 45.9 °C (HuffPost, 2019). Given its milder temperatures and well-developed touristic infrastructure, many stakeholders, including tourism and regional planning experts, indicate that the Gulf of Morbihan could progressively replace the Côte d'Azur as the residence of choice for retired people. If confirmed, this phenomenon would represent a further demographic shift, deepening the socioeconomic gap already flagrant in the Gulf of Morbihan thus accentuating the need to implement housing policies and other initiatives to incentivize better social and generational mix.

3.3. Chronotopes and sea level rise

As we developed narratives, we came to identify two important chronotopes. Megaliths are clearly chronotopes, representative of a period of time and noticeable from far away, so marking a point in space and time. They are immemorial landmarks of a place and its history (Goldhahn, 2015; Joyce and Preucel, 2002). The Gulf of Morbihan was a major civilization center during the megalithic period, with thousands of cairns and menhirs, richly sculptured walls and precious jadeite jewels found in burial cairns (Audouard, 2014). The sea level rise at this time partly submerged certain megaliths, including the iconic one of Er Lannic (Fig. 2). The monument stands as two circles in the shape of horseshoes made of raised stones, erected on the slight slope descending from the



Fig. 2. Illustrated aerial view of the double cromlech of Er Lannic, a geo-social chronotope ((Thomas, 2015) – © 2015 IGN/Géoportail, modified to show the location of submerged parts (Burl, 1995, p. 256)).



Fig. 3. The coastal pathway (GR34) around the Gulf of Morbihan© (Morbihan Tourisme, s.d.-a).

center of the island to the southern shores. Today, only the northern circle is still visible although it is partly submerged at high tide while the southern one is totally under water. Several theories have been put forward to explain the presence of the two stone circles. The northern one could have been built during the rising of the waters, partially reusing menhirs from the southern one as it was being immersed. Alternatively, the southern hemicycle could have been a symbolic bulwark against the ocean to ward off the rising waters (Mohen, 2009; Sévère and Lorin, s.d.). Anyway, this cromlech clearly illustrates the rise in sea level during the Neolithic period, and acts as a symbol for the forthcoming increase.

Only recently, it has become possible to walk easily along almost the entire coastline of the Gulf of Morbihan. In addition to the traditional passageways (the customs officers trail), this is in particular because of the implementation of the law regulating the long coastal right-of-way (SPPL⁵), resulting in the creation of the national walking trail, GR34. This coastal pathway (Fig. 3) is an interesting second chronotope, as it visually underlines erosion. In French law, the coastal pathway corresponds to a 3 m-wide right of way on private property along the shoreline. Most owners tend to fence their property, and so they erect this close to the trail. Erosion can thus be clearly seen in the changing width of the trail. Erosion of the banks has led, in consequence, to the erosion of private land, forcing homeowners to move back their fences to respect the right of passage.

⁵ The easement of passage of pedestrians of the littoral (SPPL) is the result of a land use planning amendment (Loi n°76-1285 du 31 décembre 1976 portant réforme de l'urbanisme) and was reinforced by the "Coastal Law", allowing the creation of a transversal servitude to reach the shore.

Table 2
Top 5% most frequent code combinations referring to the past, present and future.

Issues	Future changes	Past or ongoing changes	Related narratives
Regional planning/Urbanization	30	22	Geo-social; Historical
Primary activities	20	25	Geo-social; Historical; Seasonal; Climatic effects
General climatic and environmental changes	15	15	Seasonal; Climatic effects
Tourism and recreational activities	14	14	Geo-social; Historical; Seasonal; Climatic effects
Sustainable mobility	14	NA*	Geo-social; Historical;
New economic models	14	NA*	Geo-social; Historical; Seasonal
Demographic rebalancing	10	12	Geo-social; Historical; Seasonal
Biodiversity and environmental protection	NA*	12	Historical; Climatic effects; Seasonal

NA*: code combination outside of the top 5% range.

4. Link narratives of changes with foresight process

4.1. Long-term visions and issues, a significant link with elements of the narratives

The narratives of change have been used at different levels to lead the co-constructed foresight process. Specifically, the foresight process and narratives of change have fueled each other. The pre-existing local data and the interviews allow definition of narratives of change. They were used to design the foresight workshop and reciprocally narratives of change have been reviewed and evolved following the workshop toward the final version presented in this article.

For the workshop, we chose 2200 as a future time frame so as to design a very long-term physical scenario with visible climate change impacts and to avoid the preferences of stakeholders for short-term issues. This desire was driven by the geo-social narrative, which questioned the impact of the rise in sea level during the Flandrian transgression. To illustrate this coastline evolution, we used maps, conceived by geologists portraying this 90-meter sea level rise over the past 15,000 years (Meunier, 2018). These maps show that Vannes was several tens of kilometers inland and Belle-Île-en-Mer, the emblematic island, was once an inland hill. We also used regional climatic forecasting to establish what the forthcoming geo-social narrative might be, followed by a map of the projected sea level in 2200. The use of these narratives and chronotopes, the hindsight maps and locally targeted climate data were a powerful means of communicating climate change to the participants (see Section 5).

Then, the places, concept, actors and issues used for the poker design cards representing key elements of the narratives and their context, as shown in Table 1. By means of the poker design tools, we could connect elements of the gathered narratives to the projection exercise to encourage participants to reflect more deeply about the territory and to use their creativity in proposing their visions for the future.

After the workshop, the results from interviews and the foresight workshop were articulated in order to define a long-term stakeholder-conceived vision and to identify preliminary actions to trace the trajectory that leads to the desired future outcome. Past, present and future changes, as well as desirable events, appear naturally among the most frequently mentioned issues, since the researchers directly raised them. The 5% most frequent code combinations are displayed in Table 2, highlighting the accuracy of the previously established narratives of change and show that these issues are the building blocks for future narratives built by the local stakeholders.

Stakeholders agree, at different levels, that there is a need to adapt at the local level and to prepare the territory to face the identified changes, including climatic ones. On the majority of the proposed issues, participants agree on a single long-term vision for the territory. On the other hand, definite oppositions arose concerning the coastline land use and the role of tourism in the region. Some participants evoked increasing the density of the current urban zones with taller buildings and, in parallel, recovering the original vegetation within an expanded coastal no-build zone, while others think that housing on the coast should be maintained, living with and/or under water by adapting habitats to become climate-resilient, submersible and innovative. The second area of opposition concerns initiating a drastic reduction in touristic activities versus incentivizing them once there has been a shift toward more sustainable practices, with enlargement of other local economic activities not linked to tourism.

This process is still ongoing, including our continued involvement in the field, keeping in mind the objective to help municipalities in the Gulf of Morbihan to improve their thinking about their future while engaging the population. We compiled twenty-five potential actions proposed by the participants as components of the trajectory between present and future, which can be linked to one or multiple local issues, and presented our initial results to local authorities. Our next step is to conduct a second foresight exercise, inspired by popular educational tools to reach a broader public, in collaboration with local associations. This will form part of the participatory arrangement of the short-term exhibition of the art, design and science foresight experimentation (see 4.2.). The challenge is twofold: the need to encourage the population to take charge of this question of climate change, which was the goal of the first foresight workshop, and then, to define the modalities of adaptation.

4.2. Art, design and science foresight experimentation inspired by narratives of change

Beyond the use of narratives of changes and chronotopes to shape the community-led foresight process, an innovative aspect of our methodology is to consider the role of art and design in planning for the future. We are developing another foresight experiment to galvanize local stakeholders into action by making connections between art, design and science within the territory. This art,

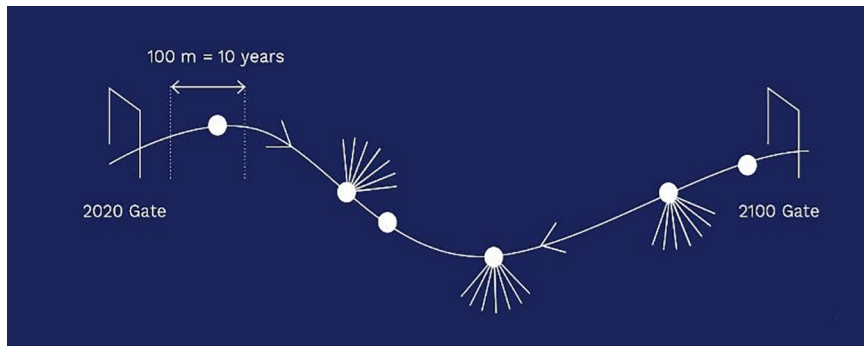


Fig. 4. The “Pathway of possibles” ©Marianne Cardon.

design and science experimentation is produced as a result of a genuine co-construction process involving artists, designer and researchers working together along the way inside an artistic committee. Building from the narratives of change, the interviews and the collective reflections emerging from the foresight workshop, this artistic intervention is conceived to convey the results of the co-construction process by displaying the artistic works along the coastal path, the “Pathway of possibles”, as it acts as a marker of the erosion of the coastline and the rise in sea level.

This “Pathway of possibles” finds its origin in the chronotope of the coastal pathway and the positive response of local stakeholders to this concept. It will propose an immersion exercise over a larger stretch of the coastal pathway, further developing its role as a chronotope since meters of terrain correspond to years into the future from 2020 to 2100 (Fig. 4). Taking the present as a starting point, the “possibles” represent a reflection, a chance to discern between what is likely to happen if the present situation follows its course and what outcome the people taking this path into the future would prefer.

After discussing the technical and financial possibilities, we chose to firstly install a short-term exhibition in a busy public space presenting the pre-project artistic works with an emphasis on an imaginary coastal path. Local people and visitors who discover the artistic work are invited to visualize how the future might be reflected in designated areas of their territory, in order to foresee potential impacts and to become accustomed with what bold adaptation solutions could look like. Participatory exercises will be conducted during this short-term exhibition taking several forms: a second foresight exercise and a long-term mechanism for collecting ideas about adaptation actions, thoughts about future directions – desirable or not, and maybe an artwork proposal for the “Pathway of possibles”.

5. Role of narratives and chronotopes in the foresight process, rethinking the communication with local actors

Our goal was to engage people so they could think about incremental scenarios and identify pathways and hinge points. The researchers co-constructed and adapted their methods, while the designer, following the principles of “design thinking”, reimagined her own working tools to adapt them to the specificities of the issues being addressed. A particularity of the design process is that designers may need to reinvent their methods completely to ensure they are best suited to the creative exercise goals used in foresight workshops, just as participative practices must be continuously recreated to better correspond to local specificities (Ostrom et al., 2007). The poker design method has not been implemented as a “one size fits all” recipe whose adoption in a standard iteration would suffice to lead to innovative ideas.

The poker design methodology successfully stimulated engagement by the participants and produced a lighthearted atmosphere during the session. These aspects were fundamental to facilitate collective work by the participants who, not only had never worked together before, but were reflecting on serious, long-term and potentially sensitive issues for their own environment and lifestyle. This allowed a relevant community-led strategy to be developed, involving a co-evolution of the team involved and maturing into an artistic proposal with strong links to the academic results on narratives and chronotopes.

Taking 2200 as the timeframe allowed the participants to overcome current restrictions. We presented this timeframe as a moment where either their children, grandchildren or great grandchildren will have died. Reactions to this proposal were mostly positive, although some of the interviewees considered this exercise as “too abstract” and the long-term nature of this reflection to be anxiety-inducing, since it moves beyond the timeframe of individual human-life (some participants reacted negatively to this timeframe, particularly the oldest⁶). This perception seems to have changed during the foresight workshop, which is likely linked to the collective dimension of the activity and to the elements offered as creative supports. The participants quickly integrated the principle and began to think long term, freeing themselves from the present. The 2100 timeframe may have the same impact on people as 2200 but choosing 2200 allows the climate change impacts to be visually displayed in a simulation based on the middle value from the model by Kopp et al. (2017).

The Poker Design tools were fundamental to allow participants to reflect on various issues such as living conditions; potential

⁶ Additional studies should be carried out to understand why the very long-term timeframe was less well accepted by the oldest participants: desire to see actions accomplished?, owner of a house along a coastal pathway?, etc.

changes in housing; mobility and transportation; work and the future of certain economic sectors; possible development paths for the territory; the evolution of their relationship with nature; among others. Therefore, past and present narratives have become an appropriate framework to develop new narratives of change for the future. The deductive analysis of semi-structured interviews based on narrative elements indicated the accuracy of our narratives of change and showed that these issues can constitute building blocks for future narratives conceived by the local stakeholders.

Then, it is important to understand what insights these narratives of change can bring to the foresight process, following a recent trend highlighted by Wittmayer (2019): “the field of study of the future has seen a surge in interest regarding the potential of narrative approaches to help in our thinking about the future (Burnam-Fink, 2015; Frittaion et al., 2010; Inayatullah, 2008; Miller et al., 2015; Raven and Elahi, 2015).”

The narratives of change and the chronotopes provide a new point of view to help to restructure our data. Following Braudel's guidelines (1949), we developed an analysis of specific configurations of time and space, confronting us with an exercise of thinking about geo-social, historical, seasonal and climatic effects relative to human lifetime (Krauß et al., 2018a). This approach allowed us to adopt a new perspective based notably on history and prehistory in an attempt to better understand the present. For instance, the geo-social narratives and the chronotope of Er Lannic have provided us with a new vision of the Gulf, a dynamic one whose current contours have their current aspect only in the present moment. Indeed, Er Lannic has raised interest as a symbol of the need for climate change adaptation and this has inspired interest in carrying out artistic work around this chronotope. At 6000 years BP, Er Lannic was on a hill and Neolithic people, seeing the sea level rise, were obliged to adapt. We can imagine that it was hard, at that time, to conceive of a flooded Gulf, as is also the case nowadays. During the foresight workshop, we showed maps and this visualization of the geo-social narratives put the (pre)historic sea level rise into perspective, thus rendering it more eloquent. The historical and seasonal narratives allowed us to better understand the socio-economic issues the Gulf of Morbihan faces, while the climatic effects narrative depicted the effects a changing climate is having on the ways people occupy and transform a territory.

The value of narrative and chronotope mapping in the context of planning for climate adaptation is that they give meaning to scientific data about climate and turn ‘matters of fact’ into ‘matters of concern’ (Latour, 2004). Thereafter, artists and designers are ideally placed to challenge existing narratives and to provoke the exploration of pioneering future narratives. Our approach is not a simple one of mediation through art. It aims to develop a strong connection between art and science to enable a re-articulation of the scientific description of the world (Latour, 2011). This reflects the role of art as a Distant Early Warning system, as proposed by the philosopher Marshall McLuhan, in which art “can be relied on to tell the old culture what is beginning to happen to it” (Buckland, 2012).

The artistic works devised from the art, design and science process are still under construction and their analysis will be the subject of a later publication. Nevertheless, collaborative by design, this construction of experiments at the intersection of art–science–policy could galvanize action to combat climate change and could support climate change adaptation. Artistic works resulting from interpretations of the collectively-built narratives of past, present and future change, will be converted into physical elements to allow people to follow the ongoing changes in the territory. Scientific researchers and artists analyze scientific information collectively to capture the spatial and temporal dimensions of current transformations, which are then communicated through artwork acting as markers, for instance, of expected sea level rise or estimated coastal erosion in the future. This “sneak-peek” into the future, as well as the ability to observe the speed of these changes through these new chronotopes, could inspire community-led transformative practices. Hence, the coastal path, turned out to have a fundamental role as an apt location for the artistic exhibition. Propositions such as the “Pathway of possibles” allow us to argue that artistic work can also become a chronotope itself.

6. Conclusion

A great challenge in the adaptation to climate change is the need to deal with perceptions of climate change, while also considering the modalities of adaptation. The objective of this paper was to show how the narrative of change and chronotopes influenced our community-led foresight process. Narratives facilitated the researchers' understanding of the local context, by making sense of a great deal of data, issues, history and stories, allowing them to better grasp the experience of people in the Gulf of Morbihan. Analyzing our data through the lens of narratives made it possible to highlight the salient points of the territory, to outline two incremental scenarios and hinge points, and to stimulate reflection within the art and science experimentation.

The goal of this participatory, community-led work was to stimulate the local population to take ownership of this question of climate change. The priority of the first foresight workshop was to encourage local stakeholders to appropriate the subject of climate change adaptation and to define collectively their priorities and the possible ways they could be achieved. This objective was achieved by means of “design thinking” practices and methods, conceived to respond to the specific requirements of this workshop. This work, which was based on past and present narratives, successfully culminated in locally-built, imbricated, future narratives that communicate mutual aspirations as well as conflicts and contradictions. The artistic dimension of the poker design mobilized the participants' creativity and undoubtedly contributed to the quality of the final result. Adding narratives as a way to capture both the scientific and non-scientific elements (values, fears, desires, etc.) of the discussion facilitated the dialogue between stakeholders. Idea exchange and, ultimately, the scenarization process, were facilitated because stakeholders were able to avail of shared references based on the local narratives of change regardless of disagreements about their versions of the desired future.

In addition, the collaboration between social and climate scientists allowed researchers to communicate a coherent vision of the issues at hand composed of climatic and socioeconomic dimensions to the participants. This set the tone of the collective discussions during the workshop and, as a result, the needs for climatic information started to emerge from the joint narratives/incremental scenarization approach, so that desirable visions and adaptative actions to get there could be co-developed.

In parallel, the first results indicate the advantage of taking an integrated art and science approach to culturally relevant co-construction processes for climate change adaptation. The development of artistic works is found to be an effective way to convey messages of future narratives and may also become chronotopes themselves with the integration of temporal and spatial dimensions of the territory allowing ongoing changes to be monitored. This experience in progress seeks to show that mobilizing art and science to establish future narratives of change and to interact with stakeholders in a territory undergoing transformation due to climate change can empower people and incentivize local action.

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Declaration of Competing Interest

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

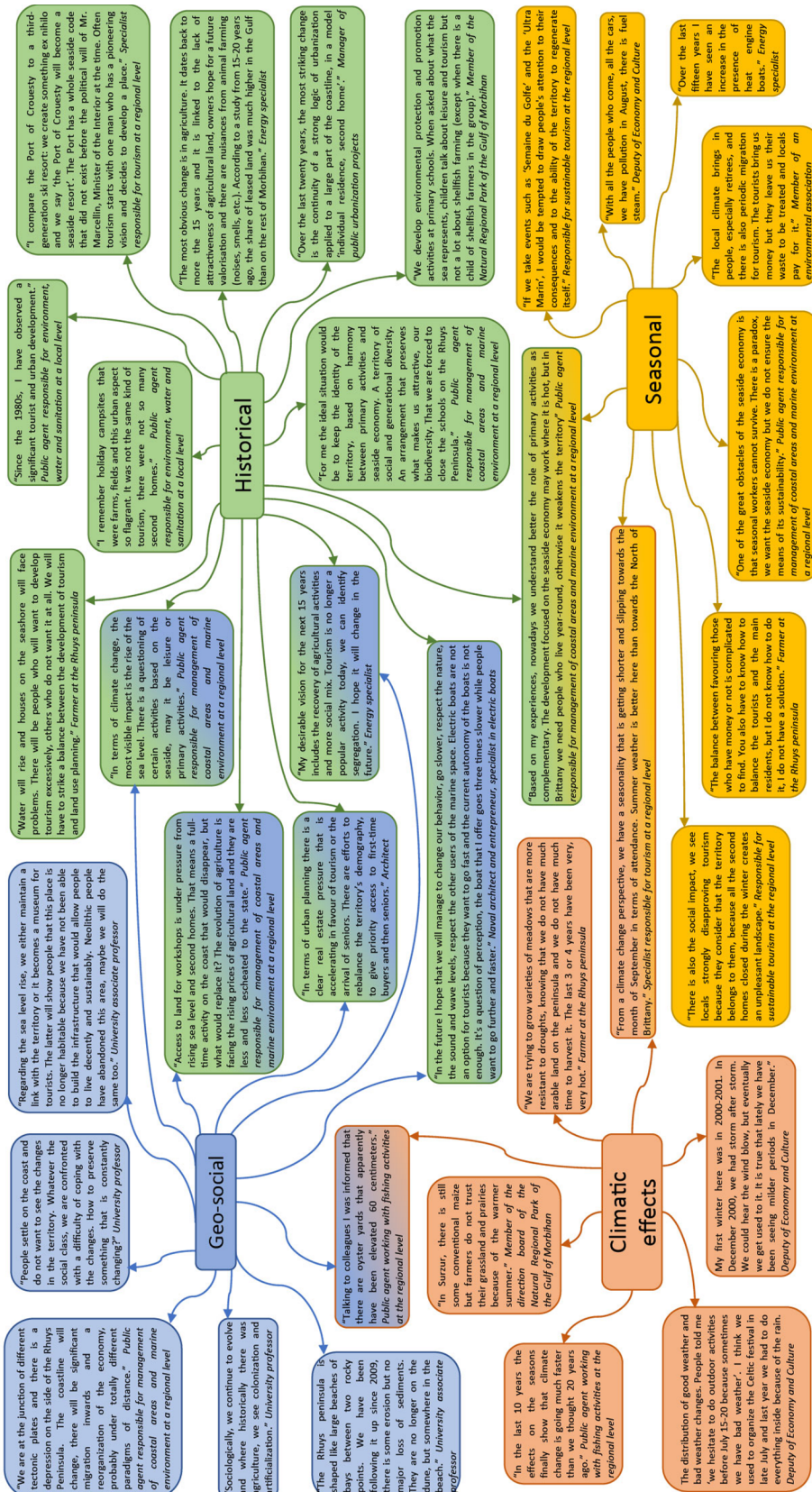
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Appendix 1. List of participants in the workshop and/or interviews.

Socio-professional category	Stakeholders
Elected officials and administrative staff	<ol style="list-style-type: none"> 1. Mayor of Sarzeau 2. Deputy for Culture and Economy, Sarzeau 3. Member of municipal council, Sarzeau 4. Regional Vice-president of environment, water and sanitation (Gulf of Morbihan – Vannes) 5. Manager of urban planning and development projects, Sarzeau
Public officers	<ol style="list-style-type: none"> 1. Deputy for scientific initiatives at the local Fishing and Aquaculture Departmental Committee (CDPMEM 56) 2. Project manager at the Regional/Departmental Sustainable Development Governmental Agency (DREAL) 3. Project manager at the PNR of the Gulf of Morbihan 4. Local-level facilitator at the Chamber of Agriculture 5. Deputy for organic agricultural practices at the Chamber of Agriculture 6. Deputy for Sustainable Development at the Departmental Committee of Tourism 7. Director of the Tourism Office of the Gulf of Morbihan – Vannes 8. Manager for Territorial Development at the Gulf of Morbihan Regional Natural Park (PNRGM) 9. Manager for communication and pedagogic activities at the PNR of the Gulf of Morbihan 10. Director of the PNR of the Gulf of Morbihan
NGO and Associations	<ol style="list-style-type: none"> 1. Member of Clim'actions 2. Member of Clim'actions 3. Member of a local environmental association (Eau et Rivières de Bretagne) 4. Entrepreneur in the Social and Solidarity Economy
Primary activities	<ol style="list-style-type: none"> 1. Oyster farmer (lifestory) 2. Oyster farmer and entrepreneur 3. Farmer (traditional farming) (lifestory) 4. Farmer (organic farming) 5. Salt mine worker (lifestory) 6. Local shop selling direct (lifestory)
Business and services	<ol style="list-style-type: none"> 1. Professional guide – fishing 2. Professional guide – aquatic sports 3. Administrator of an ecotourism facility 4. Naval architect and businessman 5. Architect
Academia	<ol style="list-style-type: none"> 1. Student (high school level) 2. Student (university level) 3. University associated professor 4. University professor

Appendix 2. Quotes from the narrative experiences of stakeholders.



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