



The environment of risk: Case studies of interdisciplinary objects

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Introduction: The human and social dimensions of environmental risks



- Lisbon earthquake and fire (1755): controversy between Voltaire and Rousseau ; philosophical issues about disasters and the role of humans
- Flood plains, USA, populations come back after floods in spite of public authorities' orders. White (1945) pioneering study (human geography) led to the development of risk perception (Slovic, 2000) in psychology
- Climate change: Major threat for humanity ; anthropocene: new geological age resulting from human influence...

Case studies of interdisciplinary objects



- Heat wave 2003, France: What happens when the intricate association of natural and social factors is underestimated (i.e. ignored as an interdisciplinary object)
- Storm on the Noirmoutier Island 2030: Learnings from Scenario development and Stakeholder reasoning
- Radiofrequencies ; Fukushima: globalized information as an intermediary variable within the relation between environment and health



Heat wave 2003, France

Interdisciplinary question

“What are the socio-psychological factors behind the acknowledgment and management of a risk?”

Poumadère, M., Mays, C., Le Mer, S., & Blong, R. (2005). The 2003 heat wave in France: Dangerous climate change here and now. *Risk Analysis*, 25, 1483–94. doi:10.1111/j.1539-6924.2005.00694.x

Climate change and natural hazards



- 95% of the human casualties in natural hazards are due to extreme temperatures (CRED)
- In the US and Australia, heat waves kill more than hurricanes, tornadoes, lightning and flood combined (Posey, 1980; Blong, 2005)
- Human activities more than doubled the risk of heat waves (Stott et al., 2004)
- Increase in frequency and intensity of heat waves (IPCC, 2014)

Heat wave definitions

- Period of 3 consecutive days with temperatures above 32,2°C (AMS, 2000).
- A 4°C increase in 30-year average temperature for the same place and month (UK).
- Period with maximum temperatures beyond 30°C, acknowledging that other factors may influence the heat stress (France).

What happened in the summer of 2003 in France fits any of the heat wave definitions above.

Heat wave in France

■ Heat wave → from 4th – 18th August

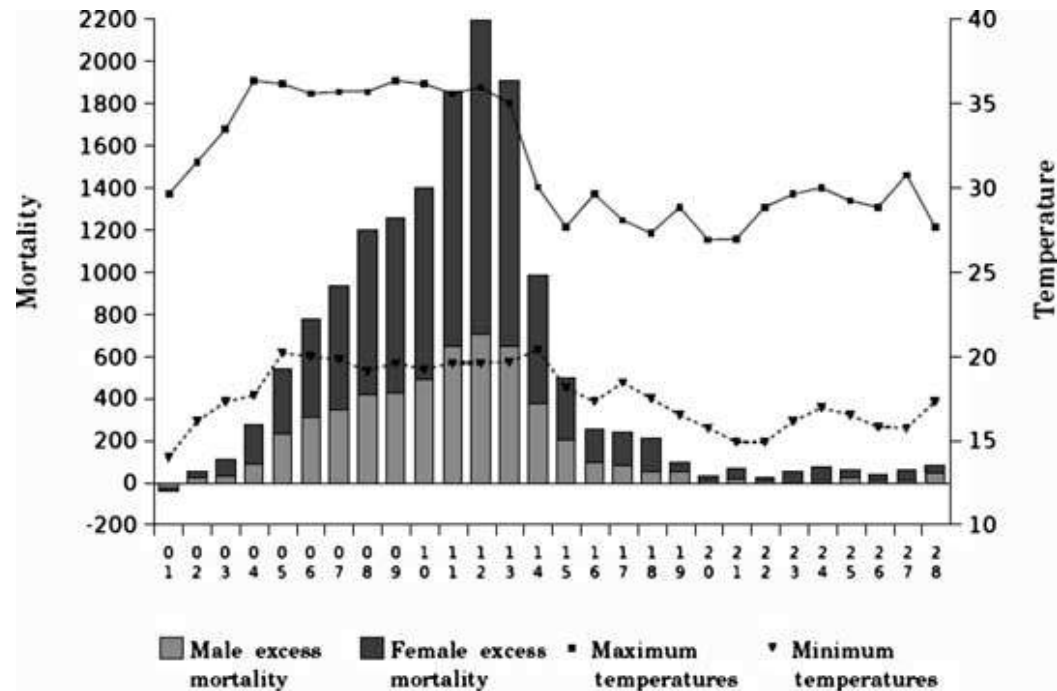
- 1-5 Aug: ↑ to a high of 37°C (normal average of 24°C).
- 5-11 Aug: excessively high temperatures (between 36° and 37°)
- 11-12 Aug: situation is worsen by ↓ winds and ventilation and ↑ air pollution



Impact on Mortality



- Cumulative death rates:
 - 400 by Aug 4
 - 10.600 by Aug 12
 - 14.800 by Aug 20



- Deaths proportional to the number of consecutive days of heat superior to 35°C
- 82,5% of fatalities correspond to the age group **above 75 years**

Social attenuation of heat related risks



- Technological vs. natural risks (Slovic, 2000)
- Heat waves can be perceived as a normal part of the summer
- Most vulnerable groups: elderly, isolated, sick, poor
- French people high levels of trust and fatalism towards health risks (Slovic et al., 2000)
- Before 2003, it was rare to attribute the primary cause of death as heat wave effects
- Reluctance of French administration to share information

First, attenuation

- Unreported death toll
- Official counts of fatalities soon lagged behind alarming reports from undertakers
- Rationalization: “Harvest effect”

Then, amplification

- When the catastrophe became evident, blame was placed upon ‘others’: absence of practitioners, lack of solidarity, reduction of working week...
- Shift in media coverage of usual summer events
- Public perception of the risk associated to the heat wave and consequent government response



A failure of imagination?

- Dangers exist even where governments **are not able to imagine**
- Example of the ignored 2014 heat waves in Brazil (Bertoldo, 2014). A failure of public politics, or of perception?
- Lack of previous experience (social memory) with yet unknown risks
- Climate change and the increase in heat related natural disasters





Storm on the Noirmoutier Island 2030

Interdisciplinary question

How will decision-making potentially increase or reduce the vulnerability of certain parts of the French coast to the risk of marine submersion?

Poumadère, M., Bertoldo, R., Idier, D., Mallet, C., Oliveros, C., & Robin, M. (2015). Coastal vulnerabilities under the deliberation of stakeholders: The case of two French sandy beaches. *Ocean & Coastal Management*, 105, 166–176. doi:10.1016/j.ocecoaman.2014.12.024

Vulnerability and human factor



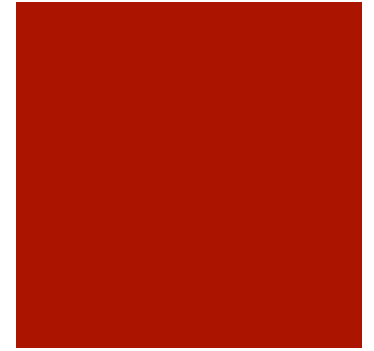
- Decision-making → increase or reduce the vulnerability of the French coast to the risk of erosion/marine submersion?
- Different types of socio-economical coastal regions were taken into account
 - Data from La Tresson (Île de Noirmoutier)
- Future perspective/scenario: 2030 horizon

Uncertainty and decision-making



- Uncertainties about greenhouse gas emissions are responsible for half of the uncertainties about the evolution of climate changes at the 2100 horizon
- Considering the fact that these emissions are largely dependant on *human activities* (e.g. economy growth and mitigation actions) **treating the climate system as only a physical dynamic would be a rough simplification** (Dupuy, 2008)
- Human decisions → what should be protected or not
 - cultural aspects, social memory, real state issues

Procedure (1/2)



1st phase: 2030 Scenario construction

- **Physical scenario:** direct physical measures of the four sites (by BRGM and other partners)
- **Socio economical scenario:** individual interviews with stakeholders (public service representatives, elected bodies, associations, managers of camping sites, farmers and fishermen)

Procedure (2/2)



2nd phase: Stakeholders Workshop

1. Presentation of research data and of the proposed '**worst case**' **scenario (in 2030)**
 - **Physical scenario:** description of future trends and the characteristics of the storm
 - **Socio-economical scenario:** presentation of the crisis situation and the reactions of the community through a forged newspaper article (dated 2030)
2. Mission of the stakeholder group: act as an advisory group to the decision-makers, i.e. make concrete proposals to cope with the situation
3. Group discussion (moderated by Marc)
4. Debriefing: collective evaluation of the activity, feedback of project partners

27/04/2030 - Vendée Infos

Noirmoutier séparée par la tempête

La tempête Victor a durement frappé sur l'île de Noirmoutier, séparée en deux pendant quelques heures quand l'océan a franchi la dune de la Tresson. Premières impressions sur place.

Les Noirmoutrins se souviendront longtemps de la nuit du 25 avril 2030. Selon les témoignages des riverains, l'océan a franchi la dune en face du camping municipal de la Guérinière. Ensuite, une fois la brèche ouverte chaque vague un peu grosse s'engouffre, poussant la précédente et préparant le terrain pour la suivante, entraînée par des rafales de vent d'ouest à 180 km/h. C'est vite un flot torrentiel qui a traversé le camping à une vitesse grandissante. Submergeant rapidement la rue de la Tresson avant de s'en prendre aux installations en dur et avancer vers le rond-point du Bonhomme. La route nationale fut vite franchie et l'eau entrée par l'ouest pouvait rejoindre l'eau passée par dessus les digues de l'est. En quelques heures, l'île de Noirmoutier était devenue deux îles.

Le recul du trait de côte fragilise cette bande de terre large de moins de 800 mètres, composée pour moins de 300 mètres du



Les dunes ont reculé de plusieurs mètres en arrière des enrochements censés les consolider.

cordons dunaires et pour le reste de polders culminant à peine au niveau des hautes mers derrière les digues. Le cordon dunaire y est d'une importance capitale car il sert de digue mais les tempêtes de moins en moins exceptionnelles ne laissent pas l'interaction plage-dune s'opérer correcte-

ment. Là, ce sont tous les aménagements, ganivelles, couvertures de branchages au sol qui ont été emportés par l'océan.

UN TRAVAIL SANS FIN

«C'est décourageant», explique Virginie Draveil, en charge de la sécurité des populations contre

la mer, *en quelques heures, c'est le travail des deux dernières années qui a été anéanti. Régulièrement, à l'issue d'une tempête et d'une grosse marée, il y a des dégâts mais cette année le bilan est lourd : l'intégralité des aménagements a disparu et, en plus, par endroit la dune a fait un bond en arrière de 15 mètres. Pour cette saison, il va falloir tout de même réaménager un sentier piéton et limiter les passages près de la dune, dans cet état, cela peut être dangereux.»*

Un passant lui objecte que c'est sur les défenses en dur qu'il aurait fallu mettre plus de moyens. Or, les ouvrages en pierre n'ont pas mieux résisté. Le compte-rendu des témoins des effets de la tempête sur les enrochements n'est pas plus réjouissant. La dune, qui ressemble plus à une falaise, est plusieurs mètres derrière les rochers. Ceux-ci disparaissent par endroit dans le sable.

A la mairie de la Guérinière, transformée en PC pour centraliser les informations et coordon-

ner les secours, on fait état d'une deuxième brèche dans la dune un peu plus à l'est, aux Villages de la Tresson. Quelques maisons sont inondées et la plage a bien reculé là-bas aussi. Du côté de la plaine, les surfaces submergées se comptent en dizaines d'hectares.

Le risque d'une séparation régulière entre le nord et le sud de l'île de Noirmoutier devient plus crédible à chaque épisode de surcote ; alors depuis le matin, l'action est de mise. Les pelleteuses s'affairent déjà à barrer le passage à la prochaine marée haute.

A la Tresson, la dune et la digue, la pierre et le sable sont d'égale importance, ce qui oblige à ouvrir l'éventail des choix entre méthodes de protection dures et douces. Cette vision des choses prévaut à Noirmoutier, une île gagnée en grande partie sur la mer. Une île qui n'a plus beaucoup de terres à rendre ayant bien suivi son programme de dépoldérisation. La ronde infinie du réensablement n'est pas prête de s'achever.

Noirmoutier – La Tresson



- Physical characteristics: erosive system, protected by a dune
- Socio-economical characteristics: the main economical activity in the island changed over the last years from agriculture to tourism (importance of stopping the erosion of the beach)
 - Polderized island: inhabitants share a risk culture
- **What are the decisions favoured by stakeholders?**
 - What areas will be protected? Why?
 - What types of protection measures would they favour?
 - What is the weight of real state issues in the decision about what areas are protected or not?





Le Passage du Gois







Material provided to Stakeholders Scenario Workshop Noirmoutier

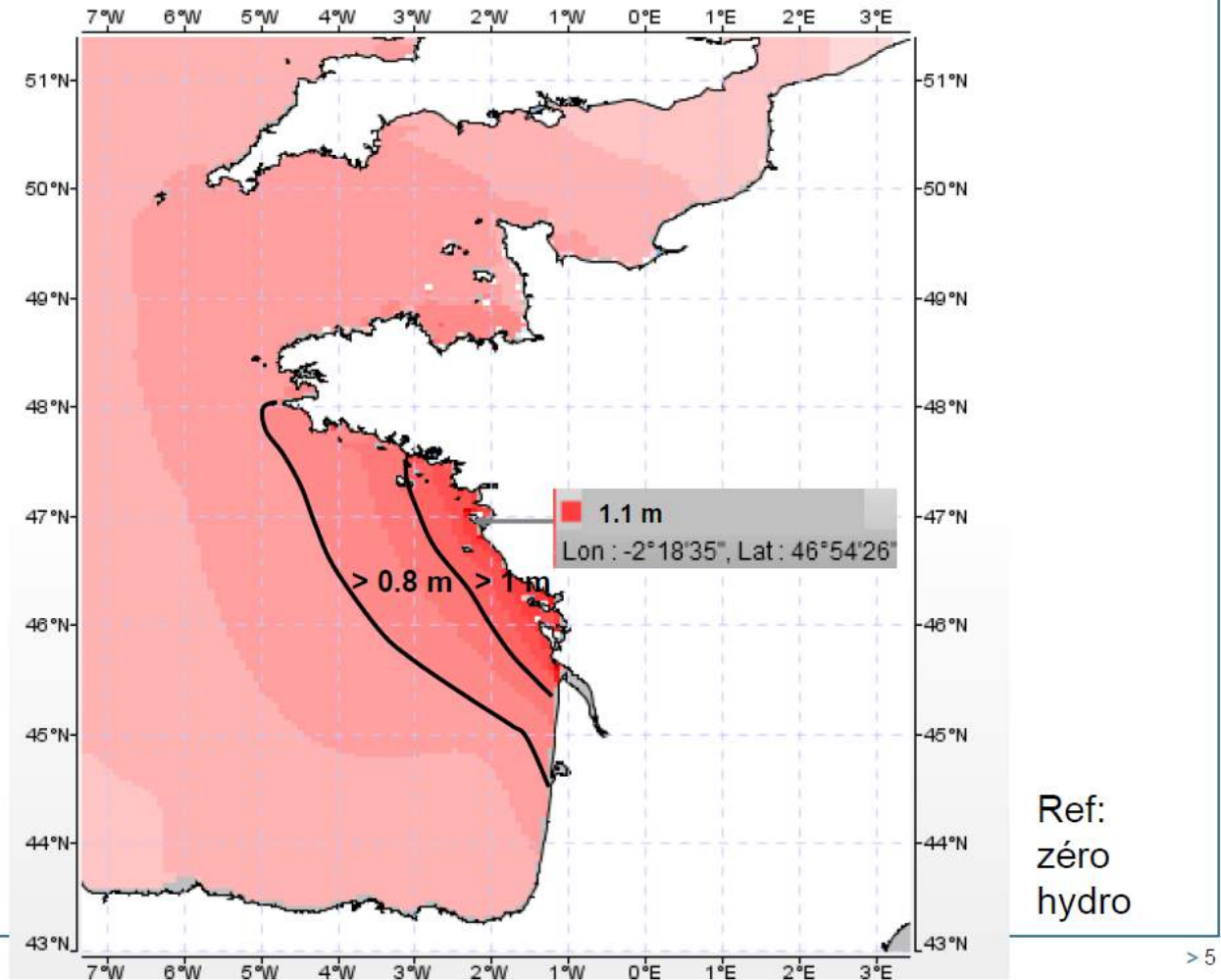
- Before the 2030 storm
- During the storm
- After the storm (including a newspaper article)
- Material used for discussion/decision making
- In addition, stakeholders could ask (3) written questions to the scientists (e.g. other extreme events before 2030 ?)

Before the storm



Storm of April 25, 2030: Maximum positive surge (storm set-up)

Le 10/05/2030 04:00

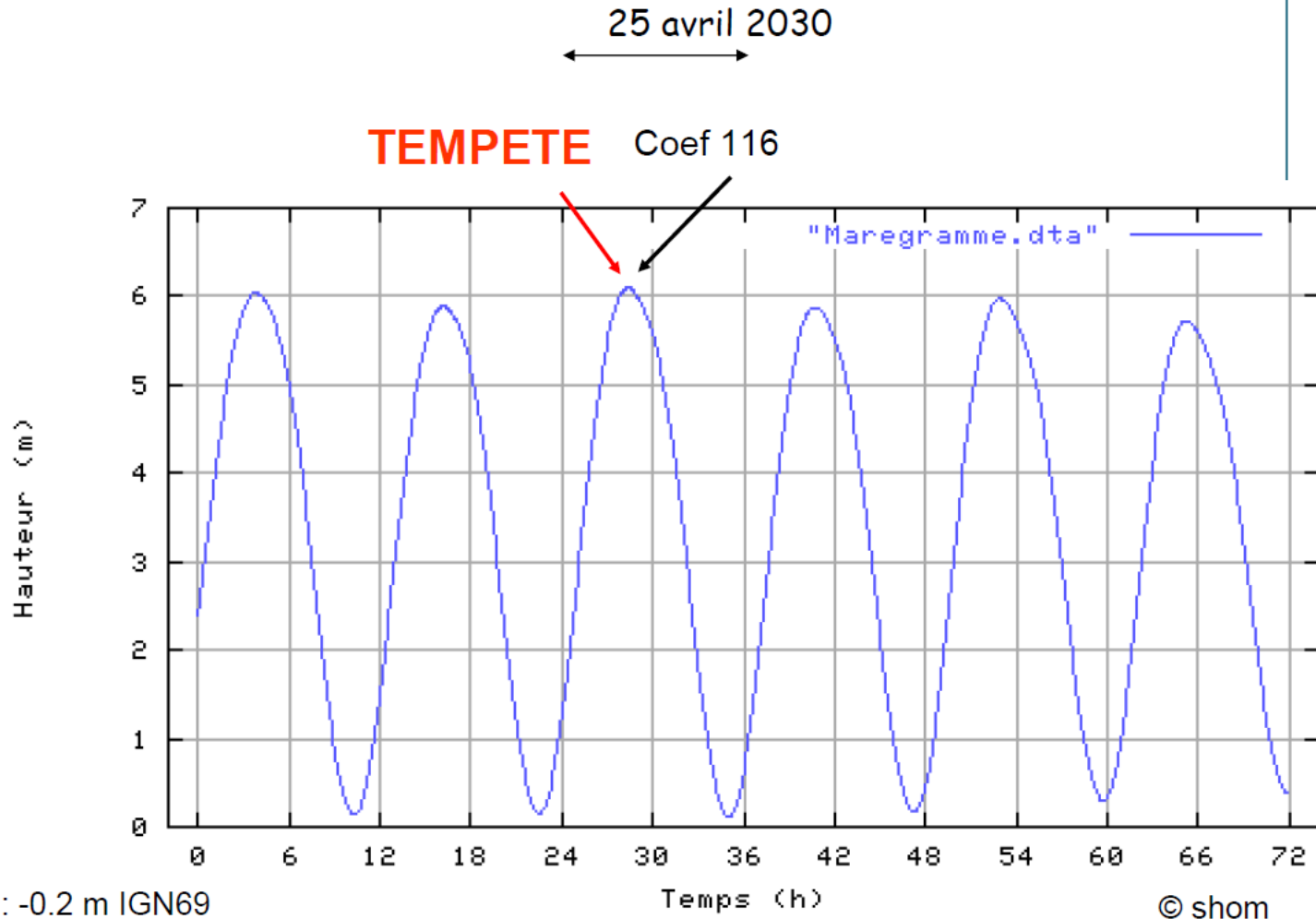


During the storm...

> Wind gusts of 180 km/h



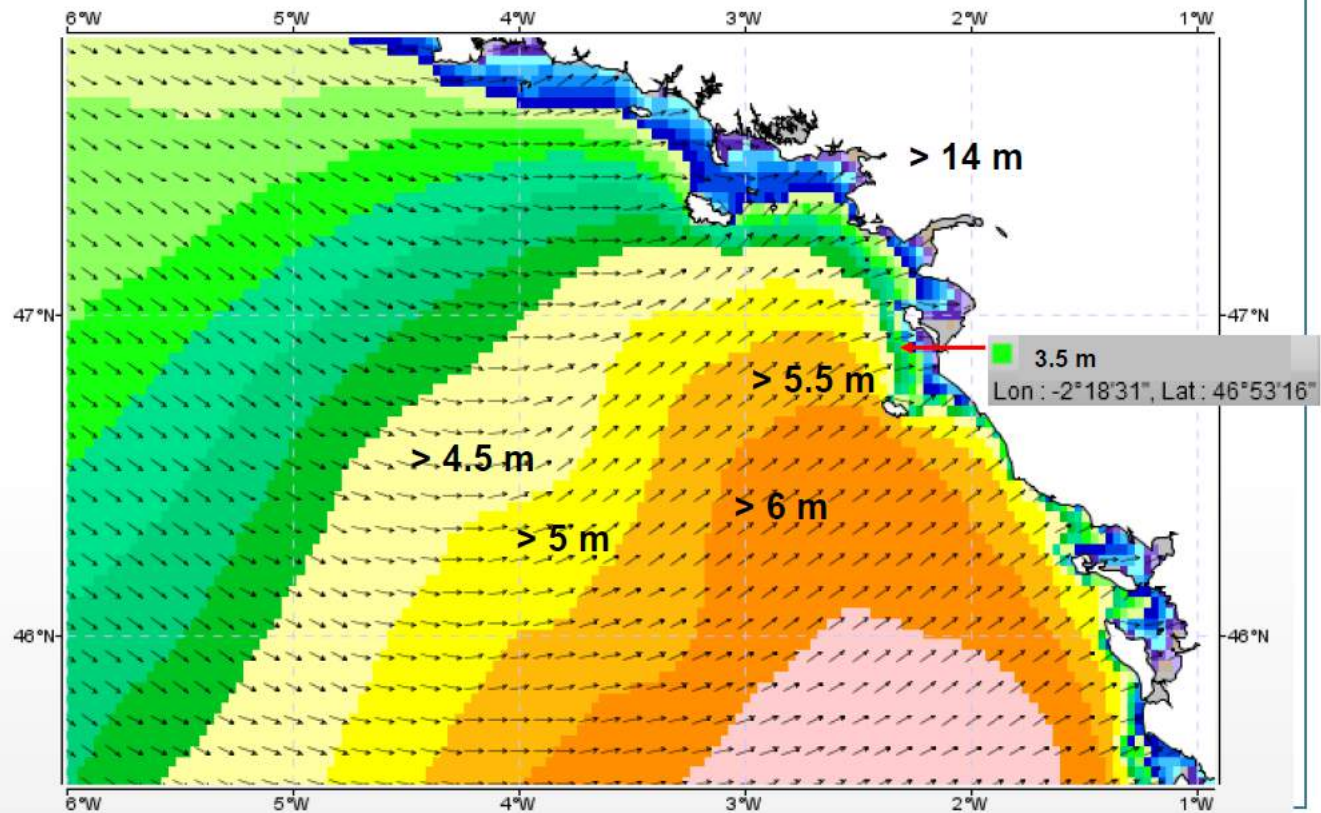
Storm April 25, 2030: Predicted tide level at Herbaudière



Storm April 25, 2030: Waves heights

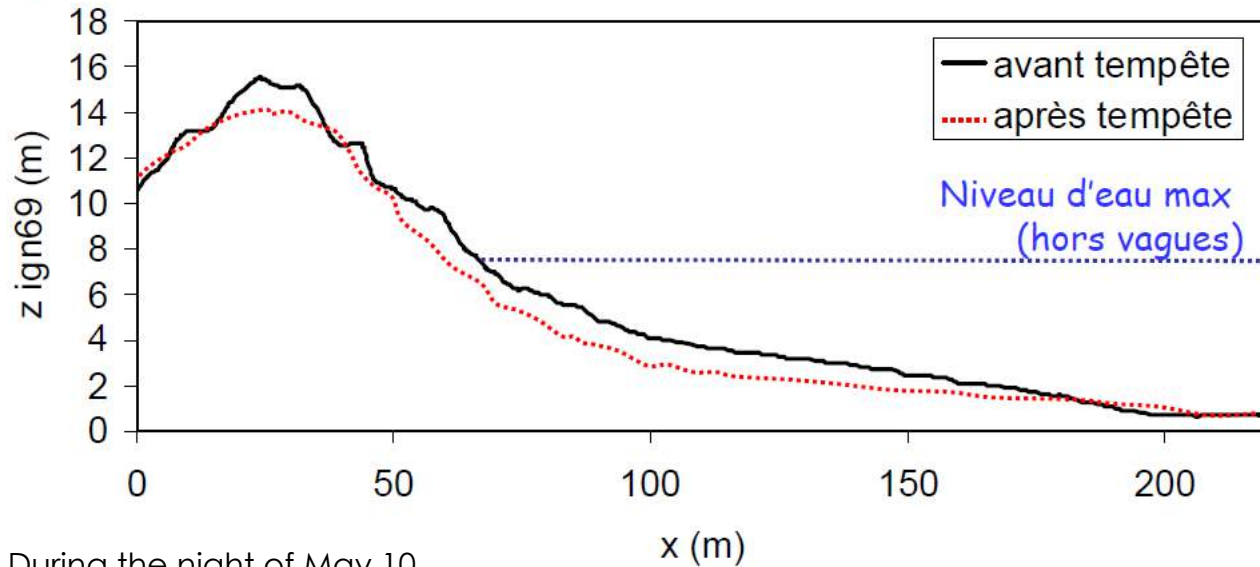
Le 10/05/2030 04:00

Bouée Gascogne : Hs= 10.8 m



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After the storm... On the Tesson site

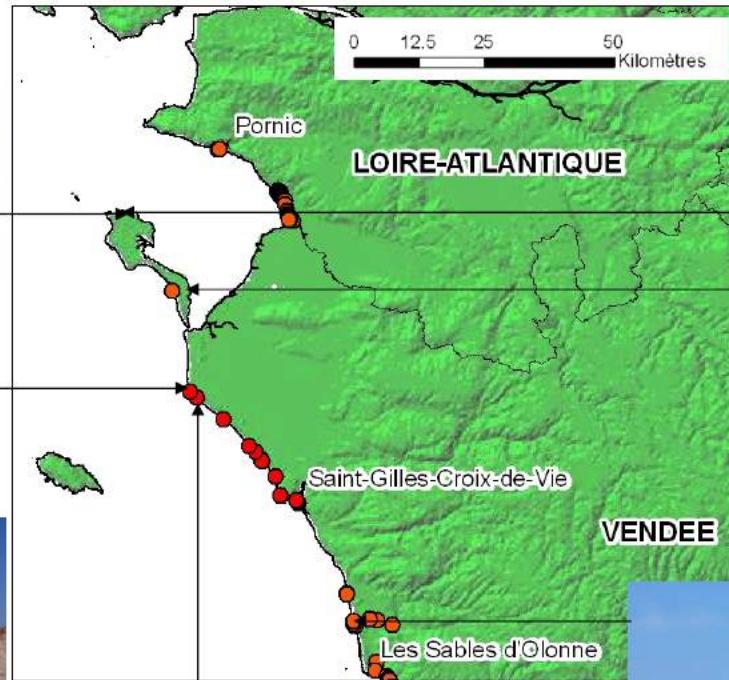


During the night of May 10,

- 15 m recess of the sand dune base
- Forming of breaches and blow out basins (*caoudeyres*)
- Flooding of the slack (*depression between lines of shore dunes*)



After the storm... Regional impact



After the storm... In the vicinity of La Tresson

Severe breach in the dune ridge on the north of La Tesson with flooding up to the four-lanes main road which is cut-off. Camping behind the dune ridge is devastated. An erosion basin (*ombilic*) is formed at the dune ridge level, allowing sea water penetration inland at each high tide.



Noirmoutier – La Tresson



Crisis management

- with the help of the army, a provisional bridge could be built to connect the two halves of the island, “to let the people from the north pass, before filling the gap”.

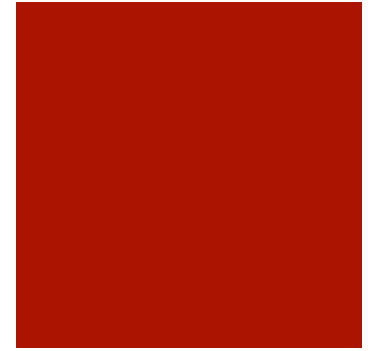
Strategic management (for the ‘future’)

- letting ‘nature take its course’ would be economically mortal to the island
- areas in risk of inundation would be exclusively used for farming and leisure activities.
- areas off risk would be more densely inhabited: « ... ne pas construire dans les zones inondables, mais sur les champs de patate »
- Emotional response: it was particularly difficult for this group to be faced with the bad news of the storm's impacts.





Radiofrequencies & Fukushima: The role of globalized information



Interdisciplinary question

“How can the media interfere/influence the social construction of a risk issue?”

Poumadère, M., & Perrin, A. (2011). Exposition socio-cognitive et évaluation des risques : le cas de la téléphonie mobile. *Radioprotection*, 46 (1) pp. 59-73



Table : Biological responses searched, epidemiology research and symptoms communly attributed to radiofrequencies

Biological and clinical effects (Radiofrequencies)	Epidemiology (Antennas, mobile phone handset)	Attributed Symptoms (Exposure to electromagnetic fields)
<ul style="list-style-type: none"> • Genetic expression and protein synthesis • Oxidative stress and production of free radicals • Genetic material (DNA) • Apoptosis • Development of cancer in the animal • Immunological system • Nervous system • Development • Reproduction • Hearing • Ocular system • Cardiovascular system • Melatonin • Cellular proliferation • Erythropoiesis in the rat • Stem cell precursors in the mouse • Ornithine decarboxylase (ODC) activity • Endocytosis • Mitosis 	<ul style="list-style-type: none"> • Aggregates of cancer cases (antennas) • Temporal trends of impact and of mortalities from brain tumors • Brain tumors linked to proximity of DECT base stations • Glial tumors • Meningiomas • Acoustic neuroma • Parotid tumors • Pituitary gland tumors • Testicular cancer • Breast cancer in men • Ocular melanoma 	<ul style="list-style-type: none"> • Cutaneous symptoms (face) • Fatigue • Palpitation • Headaches • Difficulties concentrating • Sleep disorders • Nervousness • Osteomuscular pain • Respiratory disorders • Balance disorders • Tinnitus • Hearing disorders • Vision disorders • Cutaneous signs (general) • Numbness in head • Memory disorders • Irritation • Agitation • Intestinal spasms • Restless legs

Hypothesis: Sociocognitive exposure



- Sociocognitive exposure = chronic exposure of populations to potentially worrying information when various health consequences are evoked in the literature and by the media.
- Information thus becomes an intermediary variable in the relationship between environment and health
- This approach leads to a redefinition of: vulnerable populations, extreme situations, and protective measures

Nuclear accidents: Proximity principle and beyond



- "Whenever there is a lot of energy in one place and a lot of people in the same place, there is a potential for disaster" (E. Wigner/R.Wilson, 2012)
- Proximity principle applies to nuclear: an immediate set of potential victims is to be found first among operators, rescue personnel, and the neighbouring population
- But nuclear accidents also give a new meaning to "proximity". Airborne radiation is a vector of exposure far from the source; according to meteorological conditions, radioactive material can travel across continents

Radiactivity: In the air for you and me ?

<https://www.youtube.com/watch?v=hhBG1ilB3ao>

- Using a concentric zones extending up to 1,200 km, distance does not offer “much of a protection” for most of the world's population. (Butler, 2011)
- However, a 30 km radius was considered pertinent for the evacuation or sheltering of people living in the vicinity of the Fukushima Daiichi plant.
- In the study of populations around French NPPs to consider evacuation planning , zones of 30, 75 and 150 km are used



Nuclear accidents: The removal of distances



- The "Fukushima cloud" was expected and monitored in France (about 10,000 km from Japan). *Le Parisien*, 23 March 2011 reported an NGO considering that the French Institute for Radiological Protection and Nuclear Safety (IRSN) underestimated the radiation level
- A nuclear accident attracts attention worldwide and is among the most widely media covered events

Nuclear accidents: circulation of news and radiations



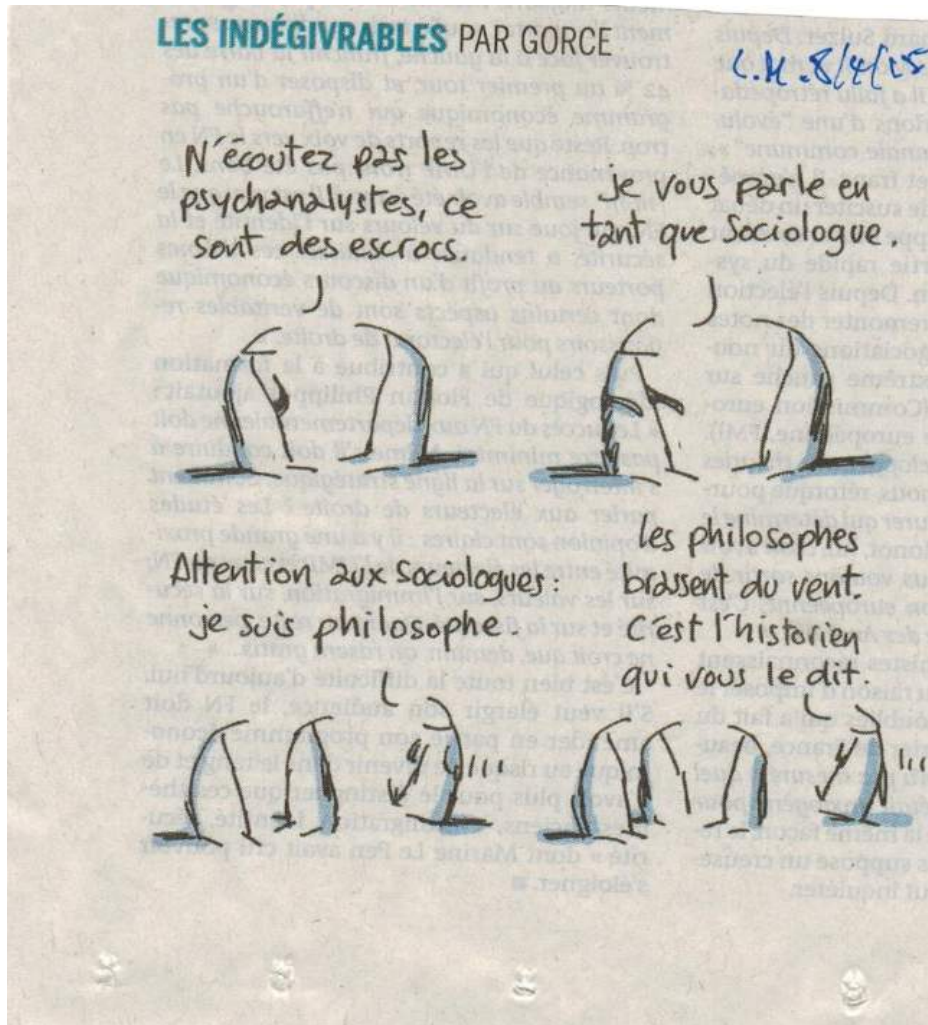
- Global and continuous exposure to the news of a nuclear accident can make it difficult for populations to differentiate risk and concern
- World Health Organization (2013) estimates that the risk to the general public inside and outside Japan from the Fukushima nuclear accident is minimal with no anticipated increases in cancer rates

Nuclear accidents: Contrast



- Difficulty to generate and communicate reliable information on possible health risks associated to low dose exposure over time, as the estimated doses seem too small (Boice, 2012)
- This reasoning (WHO, *Radiation epidemiology*) contrasts sharply with the representations and expectations of the public
- Likely this contrast contributes to the *social disruptions* impacting local populations and, maybe, populations far away

Discussion/Conclusions 1



Discussion/Conclusions 2



- The risks of doing interdisciplinary research: identity and recognition issues (considering the partitioning/division of scientific disciplines and of social roles)
- Interdisciplinary openness and trust: Trust colleagues and open to knowledge from other disciplines

Discussion/Conclusions 3



- Interdisciplinary research + Stake holders: to generate and integrate knowledge from their everyday life experience and involvement
- Conceptual “Models”: Hedgehog vs. Fox ; Co-construction ; Action-research ; Empowerment ; Transfer of concepts and methods ; Scenario and workshop ; “Amateur research”
- Maybe generate interdisciplinary concepts: “removal of distances” (physical, psychological, social) ; “sociocognitive exposure” (in addition to established exposure models)...

EU goals and Interdisciplinary research



- EU supports decentralized, voluntary multi-stakeholder partnerships between public authorities and agencies and/or public authorities and civil society (e.g. for disaster risk reduction)
- EU supports horizontal cooperation and collaboration ; as well as inclusive governance and territorial cooperation
- Interdisciplinary research can play a central role to help reach these EU goals

Published case studies:

- Bertoldo, R., Mays, C., Poumadère, M., Schneider, N., Svendsen, C. (in press) Great deeds or great risks? Scientists' social representations of nanotechnologies. *Journal of Risk Research*, Vol. 18
- Poumadère, M., Bertoldo, R. B., Idier, D., Mallet, C., Oliveros, C. & Robin, M. (2015) Coastal vulnerabilities under the deliberation of stakeholders: The case of two French sandy beaches. *Ocean & Coastal Management* 105: 166-176. <http://dx.doi.org/10.1016/j.ocecoaman.2014.12.024>
- Poumadère, M., Mays, C. (2014) Fukushima for you and me ? Contending with the social disruption caused by a nuclear accident, *Journal of Nuclear Research and Development*, N°8 (3-10)
- Poumadère, M., Mays, C., Le Mer, S. and Blong, R. (2005), The 2003 Heat Wave in France: Dangerous Climate Change Here and Now. *Risk Analysis*, 25: 1483–1494. doi: 10.1111/j.1539-6924.2005.00694.x]
- Poumadère, M., & Perrin, A. (2011). Exposition socio-cognitive et évaluation des risques : le cas de la téléphonie mobile. *Radioprotection*, 46 (1) pp. 59-73

Thank you for your attention

