Perceived risks and its relation to bathing rate at a high energy surf beach in France

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Introduction – Water exposure = missing gap ?

- Beaches are some of the **most attractive** places in the word,
- But swimming and wading are also **risky activities** (drowning, wounds, contusions…)
- Can **numerical models** help to anticipate risky days? (Stokes et al. 2017, Tellier et al. 2019, De Korte et al. 2023)
- **Exposure** remains poorly understood

Risk = hazards X exposure

water users number

Beach attendance **X** % entering the water **?**

Introduction – what are the potential predictors of the individual decision ?

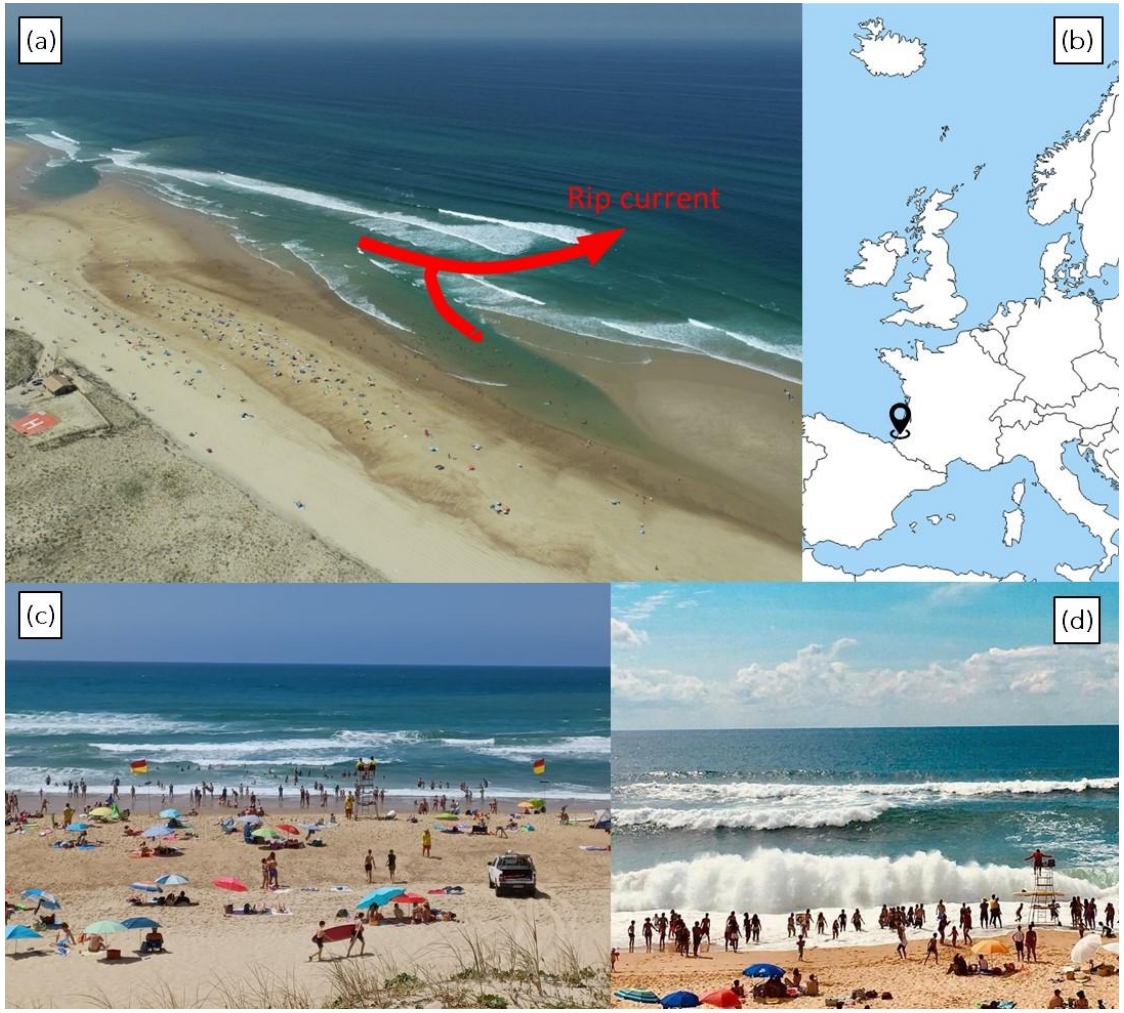
- Environmental factors
  - ✓ Weather (insulation, outdoor temp…)
  - ✓ Marine (waves heights, tide level…)

- Human
  - ✓ Sociodemographic (gender, age …)
  - ✓ Beach use activities
  - ✓ Swimming ability / confidence in the water
  - ✓ Risk concerns

Our questions

- What **proportion** of beachgoers enter the water once they arrive at the beach ?
- What (environmental and humans) **factors influence** the decision to enter the water at a high energy beach ?
- Can we model such a decision and use the models to **predict** the probability for a beachgoer to enter the water ?

Method – Our study site: la Lette Blanche in SW France



- Supervised beach: 01/07 – 31/08. Every days. 11h-19h
- Natural environment, few amenities: access, parking lots, surfing schools
- Hazards: rips, shore break waves, collisions…
- Daily-mean hourly beach attendance ~ 360 (max ~ 1,000)

Methods – Data Collection

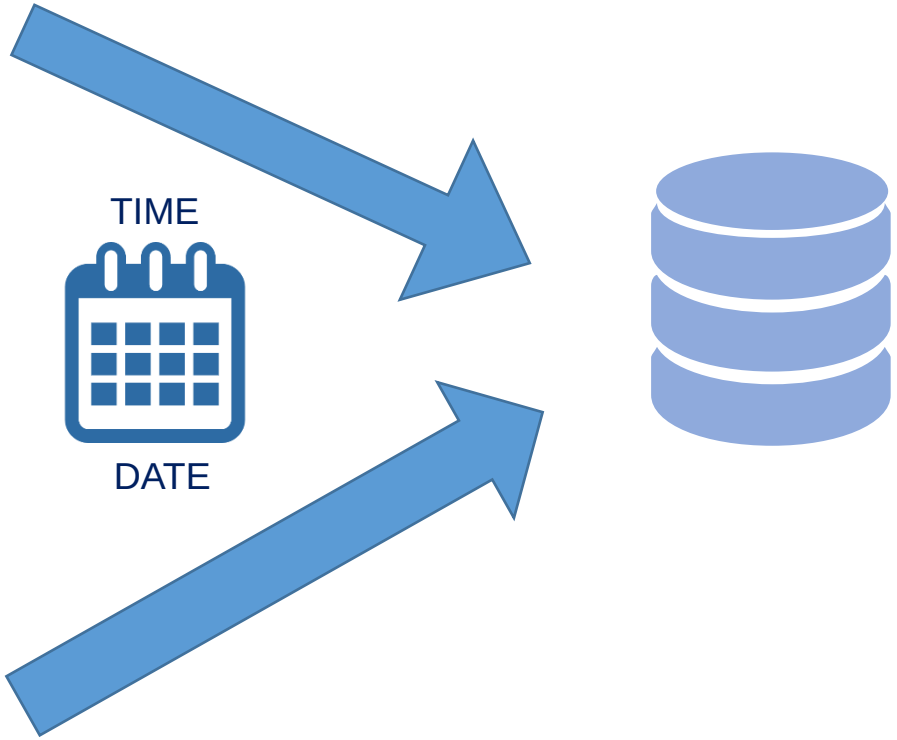
Unique multidisciplinary database (July-August 2022)

Data set 1: Human data- beachgoers survey

- ✓ Face to face interviews, 40 days, 722 questionnaires

Data set 2: Environmental data – weather stations

- ✓ Waves (2)
- ✓ Weather (3)
- ✓ Tide level



Methods – questionnaire

Variables	*Type*	*Modalities*
	Sociodemographic	
Gender	Dichotomous	Man/Woman
Age class	Ordinal	[18-24],[25-39],[40-54],[55-64],[65+]
Live in Landes area	Dichotomous	No/yes
	Participation in beach activities	
Define himself as a surfer	Dichotomous	No/yes
First visit at la Lette Blanche Beach	Categorical	First time, Sometimes, Often
	Surf beach swimming ability	
Self-assessed rip escape capability	Ordinal	Anxious, Uncertain, Confident
	Risk Concern	
Attitude toward risks	0-10 numeric rating scale	[0-10]
Perceived bathing risk	0-10 numeric rating scale	[0-4]
Time the survey was performed	Dichotomous	On arrival at the beach/leaving the beach
	Dependent variable	
Enter the water	Dichotomous	No/yes

Methods – beachgoers risks assessment

Monday July 11th 2022 | 11:30

H_s = 0,37 m
T_p = 8,35 s
θ = 307,7 °

Wind = 2,9 m.s^{-1}
Sun = 60 mn
Tide = +0,56 m

Saturday August 20th 2022 | 17:00

H_s = 2 m
T_p = 13,08 s
θ = 297,2 °

Wind = 4,2 m.s^{-1}
Sun = 39 min
Tide = -0,56m

*"Using a scale from **0 to 4**, do you think it is dangerous to enter the water ?"*

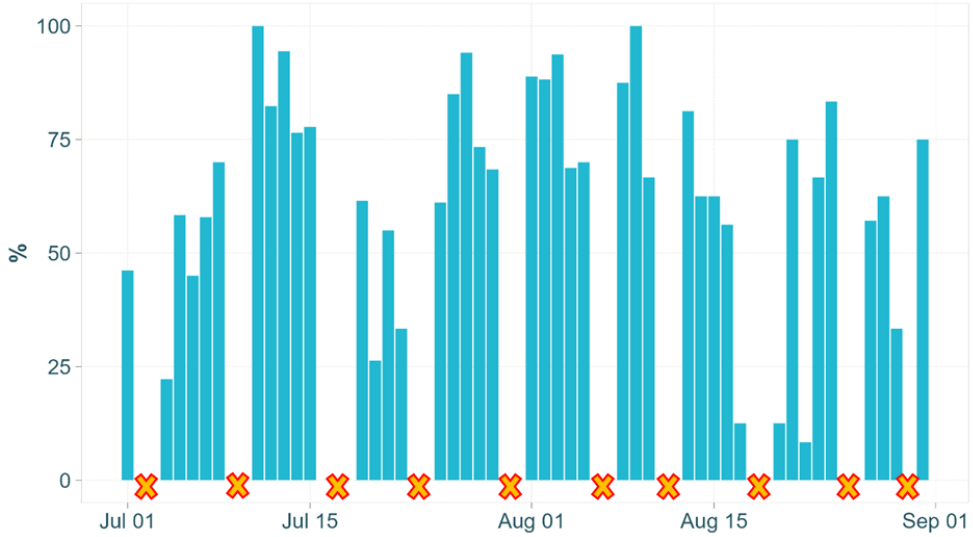
Will you enter the water today ? Have been in the water today ?

Methods – Data analysis

Method	
Frequency	describe sample, exploratory
Logistic (ordered) regression	Model individual risk assessment [0-4]
Logistic (binary) regression	**Model decision** to enter the water (Yes/no)
Prediction	Training and testing sample / accuracy and F score

Results – Sample statistics

Daily proportion of respondents which entered (or were intending to) the water in the sample



mean = 64%, min = 8%, max =100%

Variable	Category	%
Sociodemographics		
Gender	Female	53.8%
	Male	46.2%
Age (years)	15-29	25.0%
	30-44	30.0%
	45-59	24.6%
	60+	20.4%
Living in the Landes area	Yes	30,5%
Beach use/ recreational activities		
First Time at la Lette Blanche	Yes	25,6%
Surfer/bodyboarder/bodysurfer	Yes	26.6%
Swimming ability		
Concern about rip current escape	Very anxious or anxious	37.7%
	Uncertain	38.8%
	Confident or very confident	20.4%
Risk concerns		
Attitude toward risks	Mean score (Median)	4,7 (5)
risk perceptions	Mean score (Median)	2,04 (2)
Survey's timing	Upon arrival	61.1%
	Upon leaving	38.9%

Results – Ordinal logistic regression / dependent variable = individual perceived risks

Variables	Value	Std. Error	P value
0|1	-0.2583	0.5042	-0.512
1|2	1.4704	0.4975	2.956
2|3	3.4768	0.5094	6.826
3|4	5.7856	0.5459	10.598
Wave height	4.967***	0.441	<2e-16
Wave period	1.358***	0.371	0.000
Wind speed	0.544	0.494	0.270
Outdoor temperature	0.662	0.536	0.217
Insulation	-0.427*	0.212	0.044
Tide Level	-0.207	0.305	0.498
Gender (reference=man)			
Woman	0.201	0.148	0.176
Age (reference = [18-24])			
Age [25-39]	0.404	0.210	0.054
Age [40-54]	0.504**	0.213	0.018
Age [55-64]	0.407	0.244	0.096
Age [65 +]	0.309	0.263	0.240
Place of living (reference=outside of Landes area)	-0.169	0.163	0.298
First time at la Lette Blanche (reference=No)	-0100	0.169	0.552
Activity Surf (reference = no)	-0.119	0.175	0.495
Confident about rip current escape (ref = anxious)	-0.710***	0.210	0.000
Uncertain about rip current escape (ref = anxious)	-0.423**	0.167	0.011
On arriving on the beach (reference=leaving the beach)	-0.143	0.151	0.343

- **Statistical influence** of
  - ➢ Environmental predictors:
    - ✓ wave heights (+)
    - ✓ wave period (+)
    - ✓ insulation(-),
  - ➢ human predictors
    - ✓ age(+)
    - ✓ confidence in escaping a rip (-)

Significance level *5%, ** 1%, ***1‰

Results – logistic regression (training sample N=500) / decision to enter the water

	Environmental only			Environmental + Human		
	Coef	Std. Error	p value	Coef	Std. Error	p value
Intercept	0.841	0.524	0.108	0.596	0.650	0.359
Wave height	-1.786***	0.579	0.002	-1.103*	0.559	0.048
Wave period	-1.033	0.543	0.057	-0.355	0.476	0.456
Wind speed	-0.691	0.670	0.302	-0.761	0.614	0.215
Outdoor temperature	0.905	0.797	0.256	1.759*	0.722	0.015
Insolation	0.862**	0.292	0.003	0.825**	0.258	0.001
Tide level	0.892	0.458	0.0514	0.790*	0.402	0.049
Gender=woman				-0.051	0.193	0.790
Age25-39				-0.461	0.279	0.098
Age40-54				-0.243	0.282	0.390
Age55-64				-0.097	0.327	0.767
Age65 +				-0.621	0.330	0.060
Live in the Landes area=Yes				-.0337	0.207	0.104
First time at la Lette Blanche=Yes				-0.293	0.214	0.171
Surf=Yes				0.062	0.231	0.790
Rip escape Confident (Reference=Anxious)				0.804**	0.270	0.003
Rip escape Uncertain (Reference=Anxious)				0.526*	0.209	0.012
Willingness to take risk in general				0.712	0.425	0.094
individual perceived risk				-1.646***	0.404	4.74e-05
Survey timing						
On arrival at the beach=Yes				0.088	0.186	0.638

Significance level *5%, ** 1%, ***1‰

- **Statistical influence** of
  - ➢ Environmental predictors:
    - ✓ wave heights (-),
    - ✓ outdoor temperature (+),
    - ✓ insulation (+),
    - ✓ tide level (+)
  - ➢ human predictors:
    - ✓ self confidence in escaping a rip (+)
    - ✓ risk perception (-)
    - ✓ Appetite for risks (+)

Results – prediction (testing sample, N= 222)

- Environmental variables only
  - F score = 77%
  - Precision = 90%
  - Sensitivity = 68%

Reality

Prediction	Don't enter	Enter
Don't enter	23	59
Enter	14	126

- Environmental and personal variables
  - F score = 81%
  - Precision = 90%
  - Sensitivity = 73%

Reality

Prediction	Don't enter	Enter
Don't enter	37	45
Enter	14	126

Better prediction

Discussions

➢ Toward a better understanding of open water exposure

- ✓ Not everyone enter the water at the beach (in our sample: [8% - 100%])
- ✓ Environmental factors and human factors both influence the decision
- ✓ Environmental factors are crucial for prediction (F Score model 1 = 77%)
- ✓ Introducing personal factors allow a more comprehensive analysis (⇔ safety messages)

- **Perceived risks** as a social constructs
- Influence of **self confidence** (incl. those who are “uncertain”)
- Most are “unobservable” characteristics ⇔ increase **interactions** between lifeguards and beachgoers

Discussions – How to go further ?

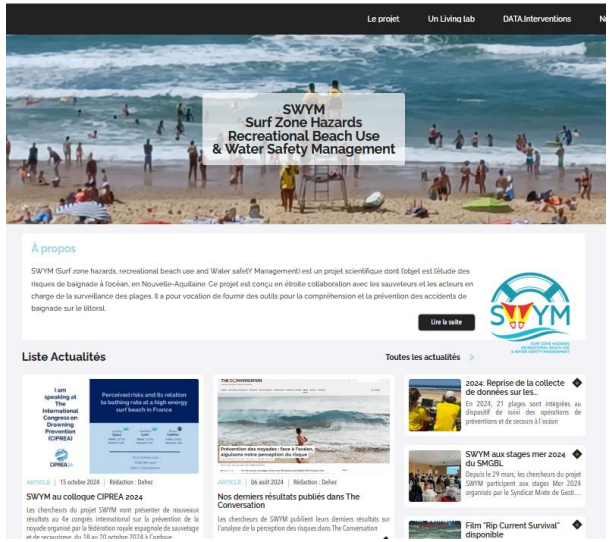
➢ Correct existing bias

- ✓ Better description of exposure (time spent in the water ? swimming location ?…)
- ✓ Survey bias (sample selection, intention-behavior gaps, social interactions…)
- ✓ Bathing is supervised ! (⇔ lower perceived risks ?)

⇨ **Replicate** on other (unsupervised and/or urban) beaches

➢ Combine with others models

- ✓ Beach attendance (Domingo et al. 2021)=> exposure
- ✓ Hazard (Castelle et al. submitted)=> Risks



More information :
https://www.projet-swym.fr/

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