



World Conference on
Drowning Prevention



Using machine learning to predict drownings in surf beaches of southwest France

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Some context

Should France be your next vacation destination 🌞 ?

Southwest France : The place to be 😊



OCEAN ATLANTIQUE
Côte d'Argent

Saint

Vieux-Bou



Anglet, Adour

Some (scary 🤨) numbers



Castelle et al. (2019)

- One of the most dangerous coasts in the world ([Castelle et al. 2019](#)) : heavy rip current (Baïnes), shore break
- Surveillance mainly during summer : Thousands of rescues each year
- 20 to 30 fatal drownings each year (👊0 between the flags)
- About 1/2 of swimmers bathe outside of the surveillance zone ([Dehez and Lyser 2021](#))

Can we prevent
drownings ?



Can we prevent
predict drownings ?



Goal of this work

- Same philosophy as previous work (**Tellier et al. 2021**) : Daily emergency calls prediction based on weather and beach crowd
- Better (and cleaner) data
- New statistical methods
- **The SWYM Project**



Predicting drownings using Machine Learning



Predictors and outcome

$$\text{Risk} = \text{Hazard} * \text{Exposure}$$



OUTCOME

- Water inhalation & respiratory impairments which lead to emergency calls

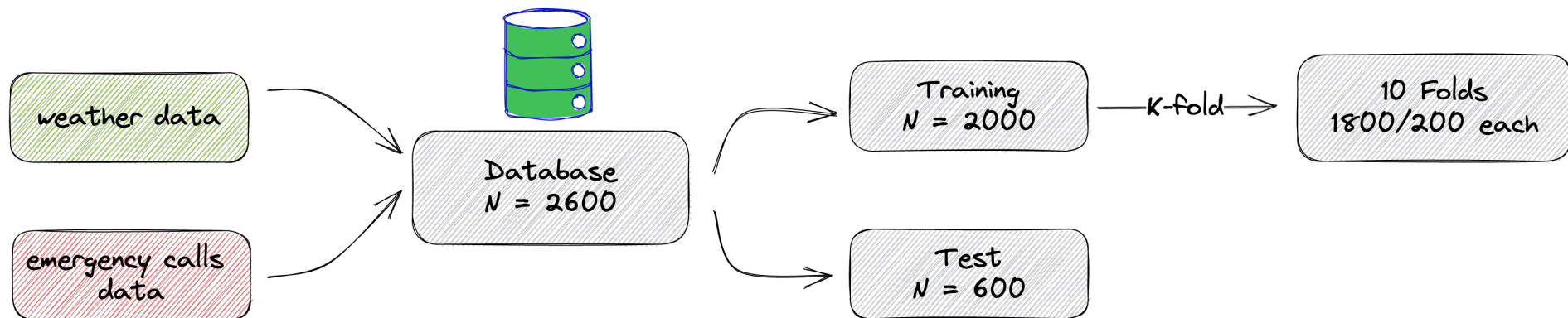
*Binary daily data
2011-2022*



PREDICTORS

- Wave Incidence Factor (cos4h)
- Wave Factor (HsTp)
- Air temperature
- Day (ex : 6 for 6th of July)
- Month
- Wday (ex : 1 for Monday)

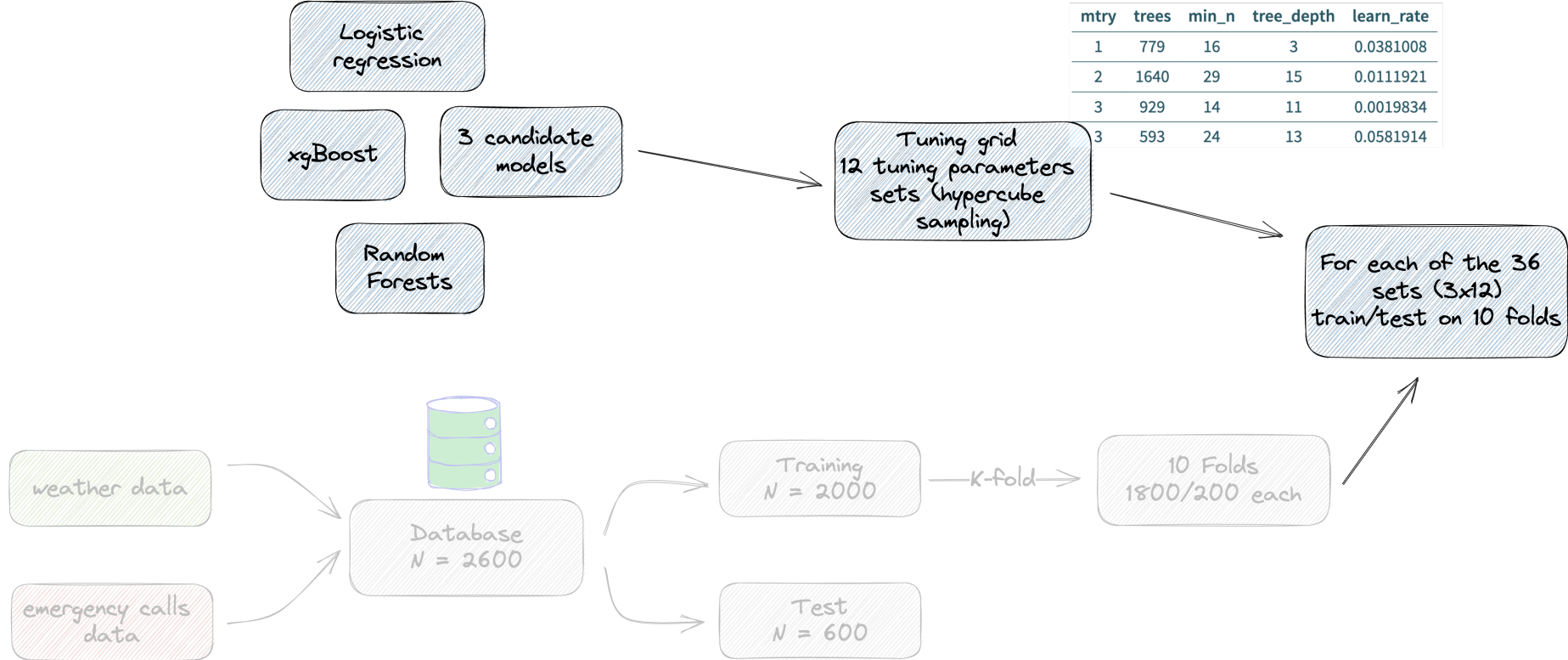
Modelling workflow



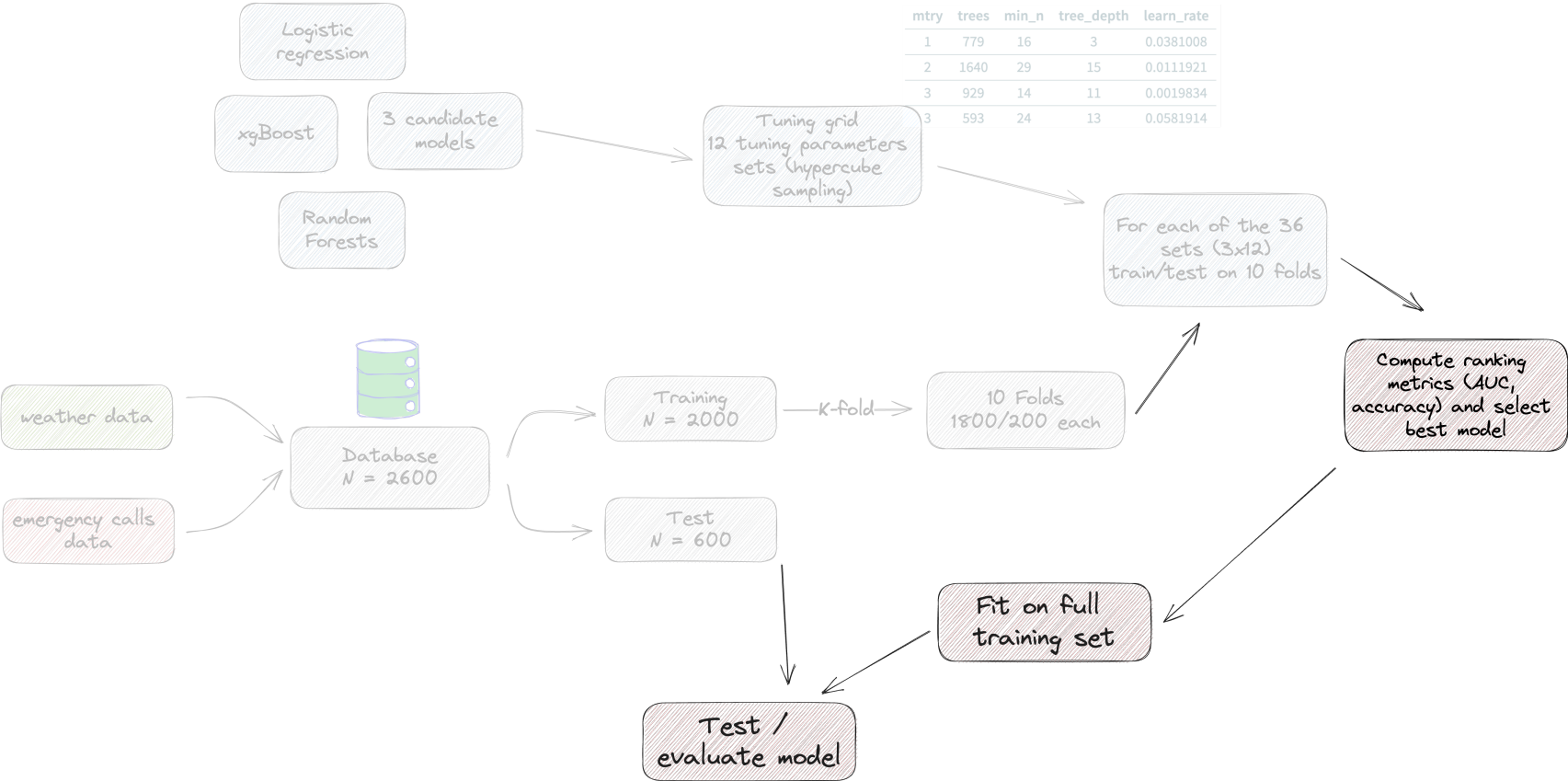
Data pre-processing

- Centering, [scaling](#), dummy-coding
- **S**ynthetic **M**inority **O**ver-sampling **T**Echnique ([SMOTE](#)) (Chawla et al. 2002) for the outcome

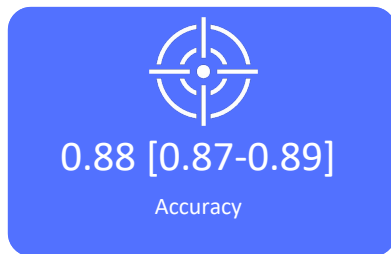
Modelling workflow



Modelling workflow



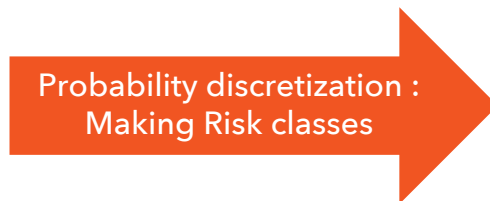
Our winner : XGBoost



Reality

		Reality	
		Drown	No drown
Model	Drown	True Pos = 58	False Pos = 60
	No drown	False Neg = 23	True Neg = 522

Confusion matrix



Risk class	# of Drownings	# of "No Drownings"	Total
1	31	502	533
2	20	44	64
3	4	20	24
4	16	11	27
5	7	8	15

N = 663 testing set

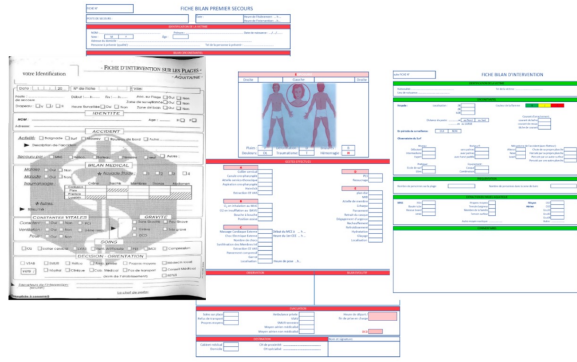
Discussion

“all models are wrong, but some are useful”

George Box

- **What is the best drowning prediction model ?** Lowering false negatives *or* false positives ? → Risk management and political decisions
- Low improvements over previous models → dataset limitation ?
- Emergency call database only covers a **minority** (👮) of all rescues

Perspectives



Majority of rescues

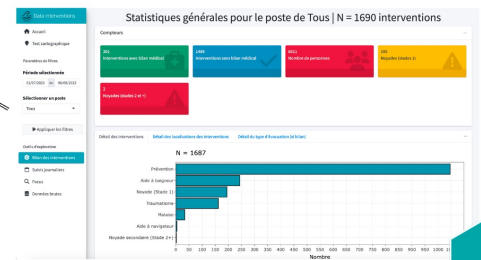


iPad data collection
offline mode available

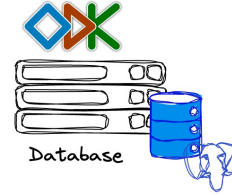
Summer 2023
experiment



New Model !



Monitoring Dashboard



Thank you !

Want to try this at home ?

Interested in the technical stuff ?

Contact us :

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References

Castelle, Bruno, Tim Scott, Rob Brander, Jak McCarroll, Arthur Robinet, Eric Tellier, Elias de Korte, Bruno Simonnet, and Louis-Rachid Salmi. 2019. “Environmental Controls on Surf Zone Injuries on High-Energy Beaches.” *Natural Hazards and Earth System Sciences* 19 (10): 21832205.

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Sacks, Jerome, William J. Welch, Toby J. Mitchell, and Henry P. Wynn. 1989. “Design and Analysis of Computer Experiments.” *Statistical Science* 4 (4). <https://doi.org/10.1214/ss/1177012413>.

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