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Environmental controls on summer surf zone hazards, beach crowds, and resulting life risk at a high-energy sandy beach in southwest France

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World Conference on Drowning Prevention

4-7 December, 2023



The southwest Coast of France



- 250 km of sandy beaches
- Popular destination
- Summer-mean wave height > 1 m
- Max tide range ~5m





31% of SZI

Castelle et al. (2018, Nat. Haz.)



31% of SZI



45% of SZI

Castelle et al. (2018, Nat. Haz.)



31% of SZI



45% of SZI

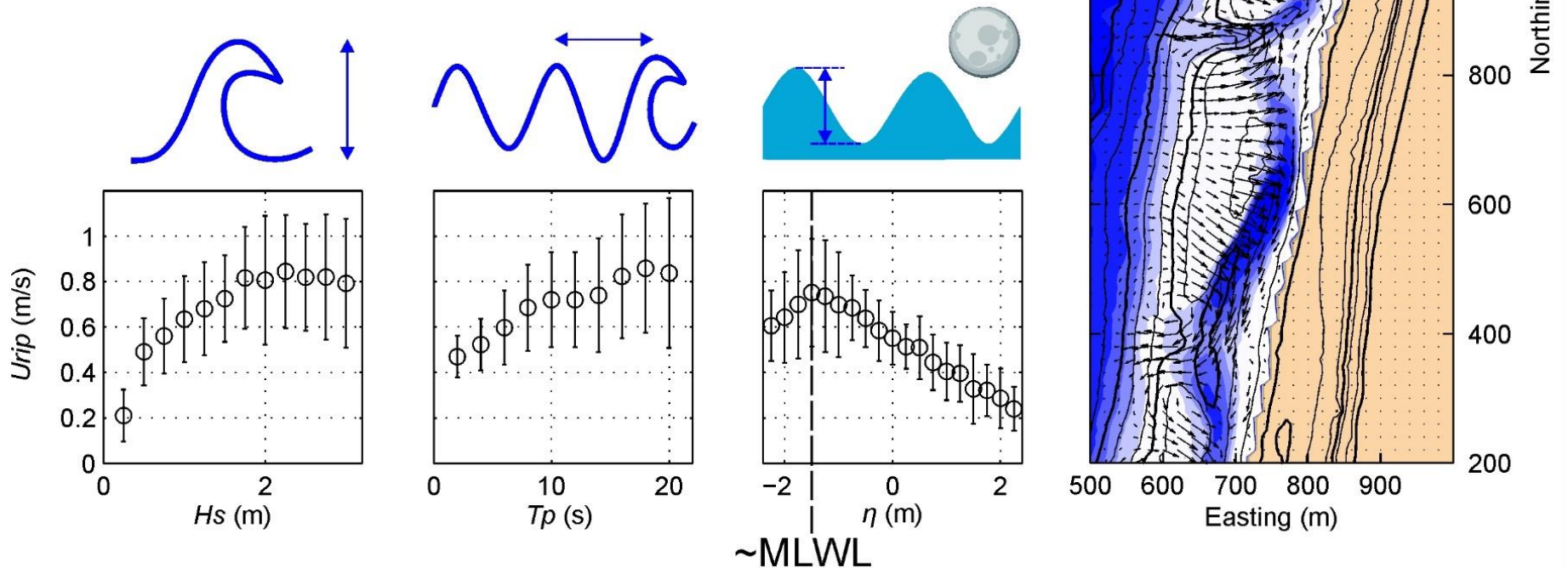


9% of SZI

Castelle et al. (2018, Nat. Haz.)

✓ Rip current dynamics and hazards

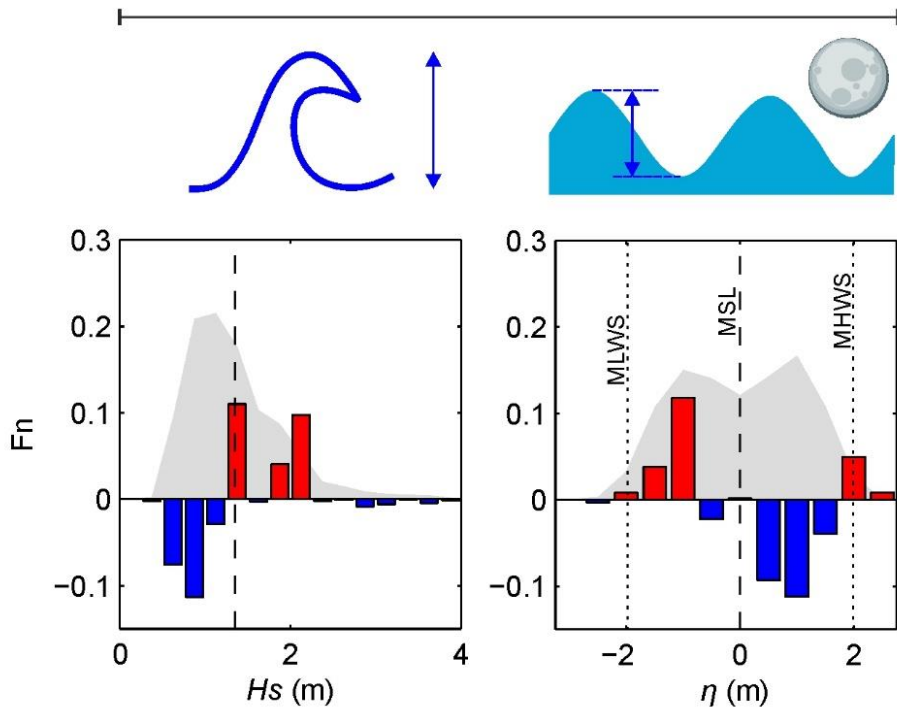
[e.g. *Castelle et al., 2006 Cont. Shelf Res.*; *Bruneau et al., 2011 J. Geophys Res.*]



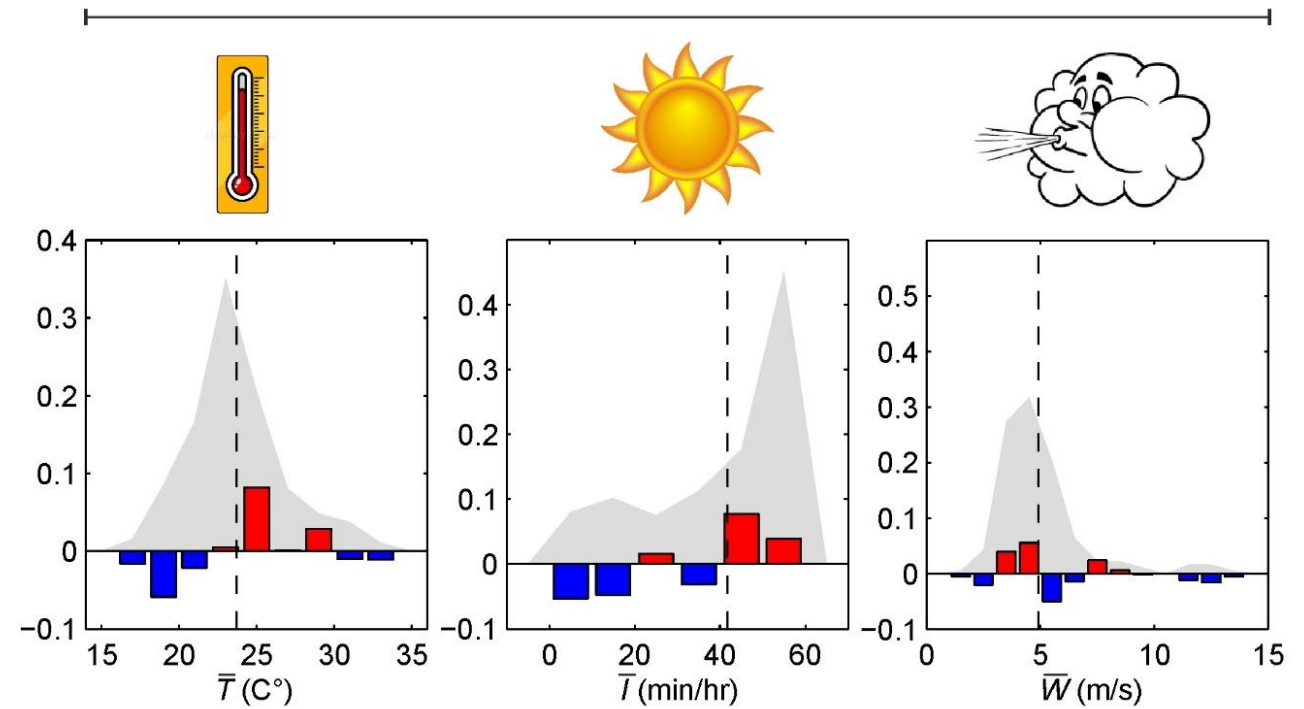
✓ Rip current dynamics and hazards
 [e.g. *Castelle et al., 2006 Cont. Shelf Res.*; *Bruneau et al., 2011 J. Geophys Res.*]

✓ Environmental controls on SZIs
 [e.g. *Castelle et al., 2019 Nat. Haz. Earth Syst. Sc.*; *de Korte et al., 2021 Nat. Haz. Earth Syst. Sc.*]

HAZARD



EXPOSURE

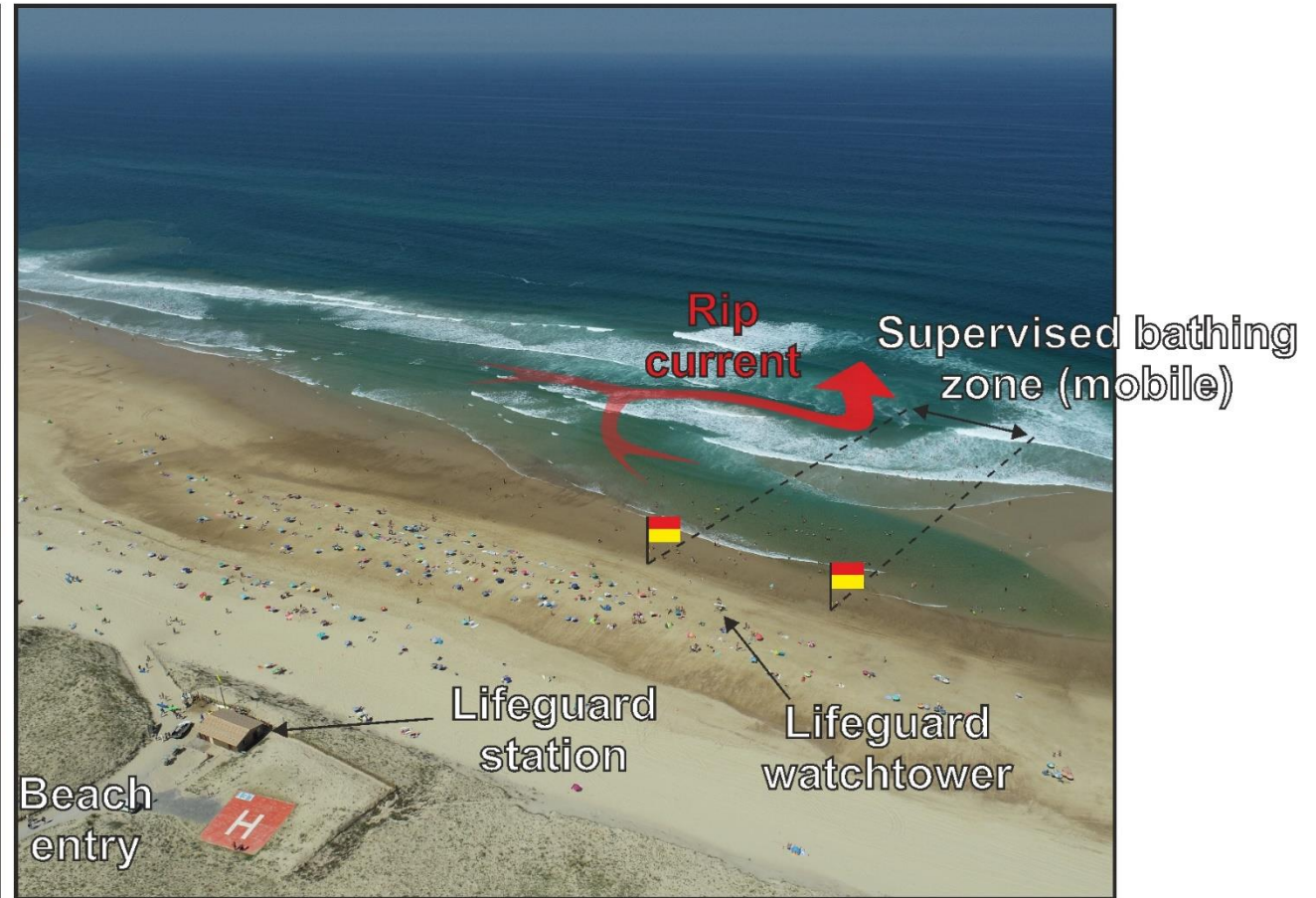
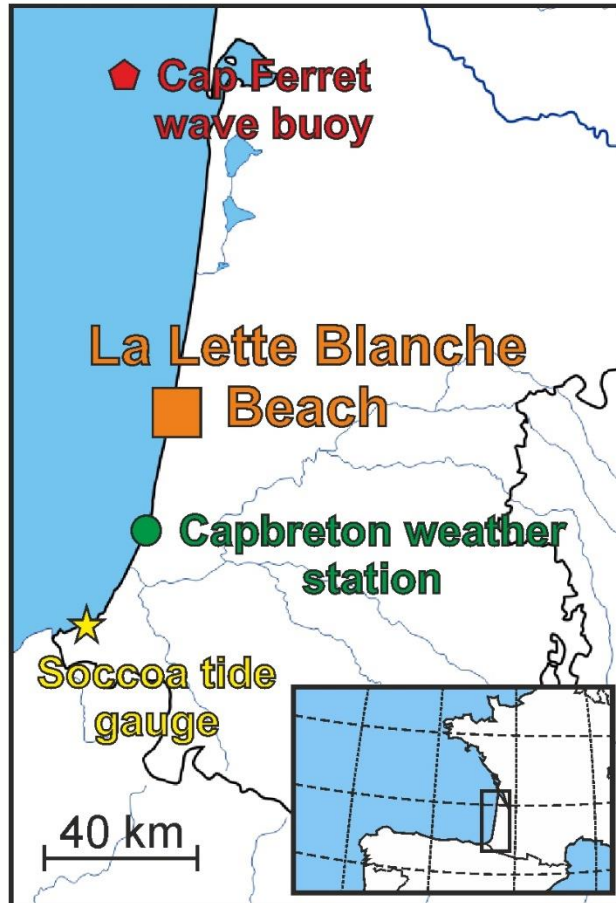


Jeoffrey Dehez
RESCUE 7 : Coastal Safety

Life risk = Hazard x exposure x vulnerability

After *Stokes et al. (2015, Ocean & Coast. Management)*

- Can lifeguards be a valuable source of (hazard and exposure) data ?
- What are the respective contributions of hazard and exposure to risk ?
- Can this provide better insight into the environmental controls ?
- Can we ultimately predict life risk at the beach ?





Experiment (July-August 2022, La Lette Blanche)



Lifeguard data

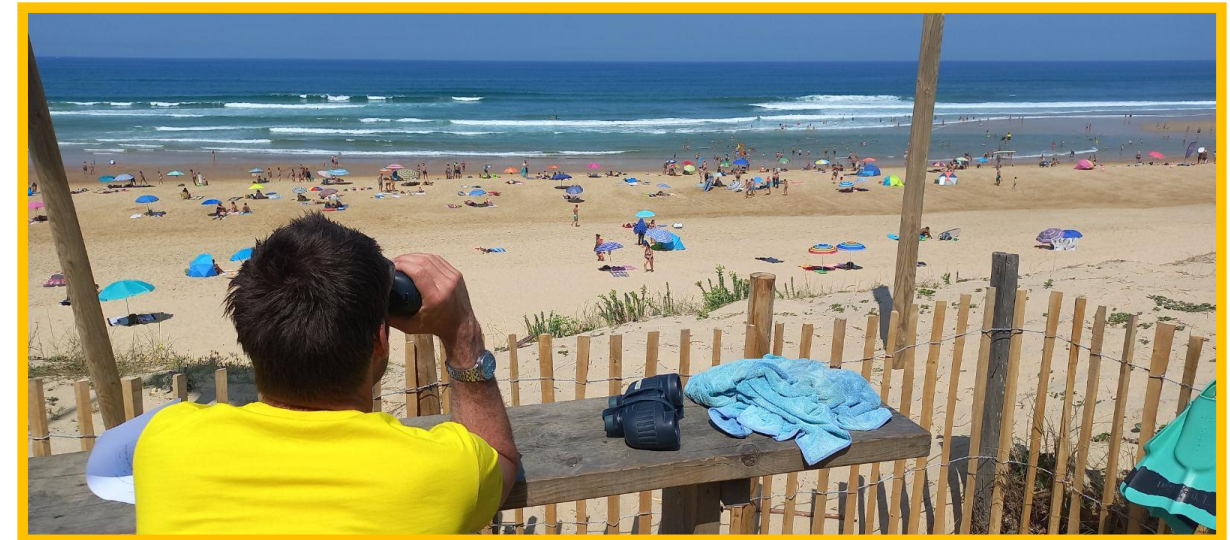
- Hourly estimate of beach crowd and rip-current and shore-break-wave hazards (from 0 to 4)

Dayhour	Rip current hazard	Shore-break wave hazard	Beach crowd
11AM	2	0	50
12AM	3	0	200
1PM	2	0	400
...
6PM	0	3	450
7PM	0	3	400

Lifeguard data

- Hourly estimate of beach crowd and rip-current and shore-break-wave hazards (5-level scale from 0 to 4)

Dayhour	Rip current hazard	Shore-break wave hazard	Beach crowd
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Lifeguard data

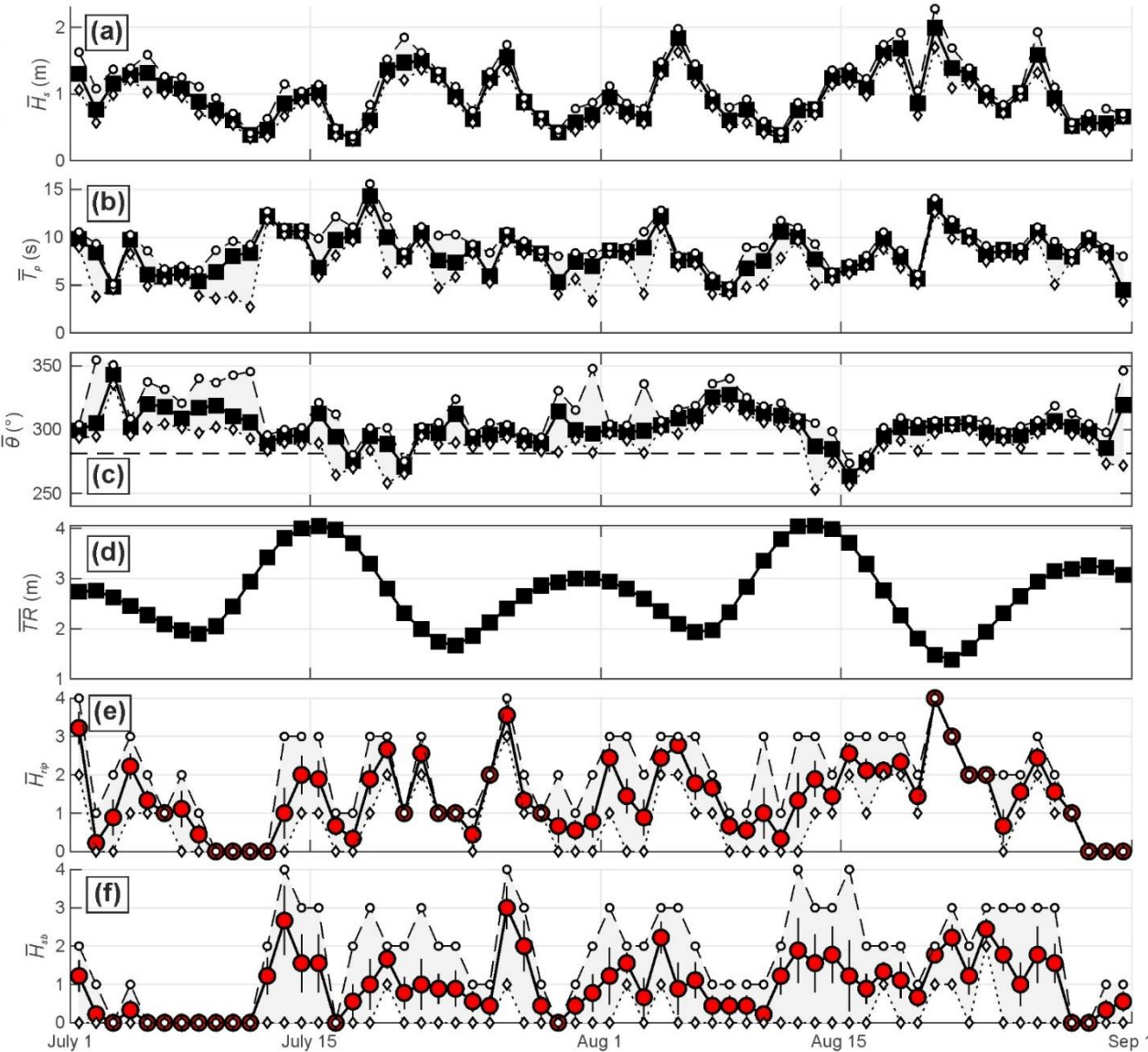
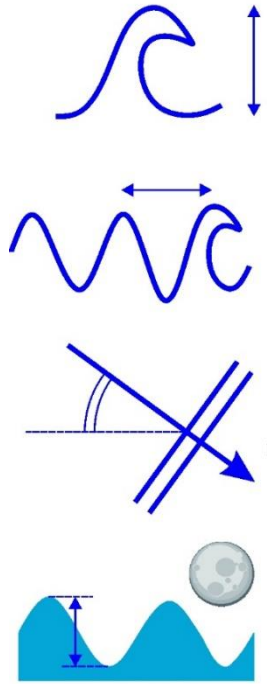
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Results & Discussion

Daily-averaged hazard data



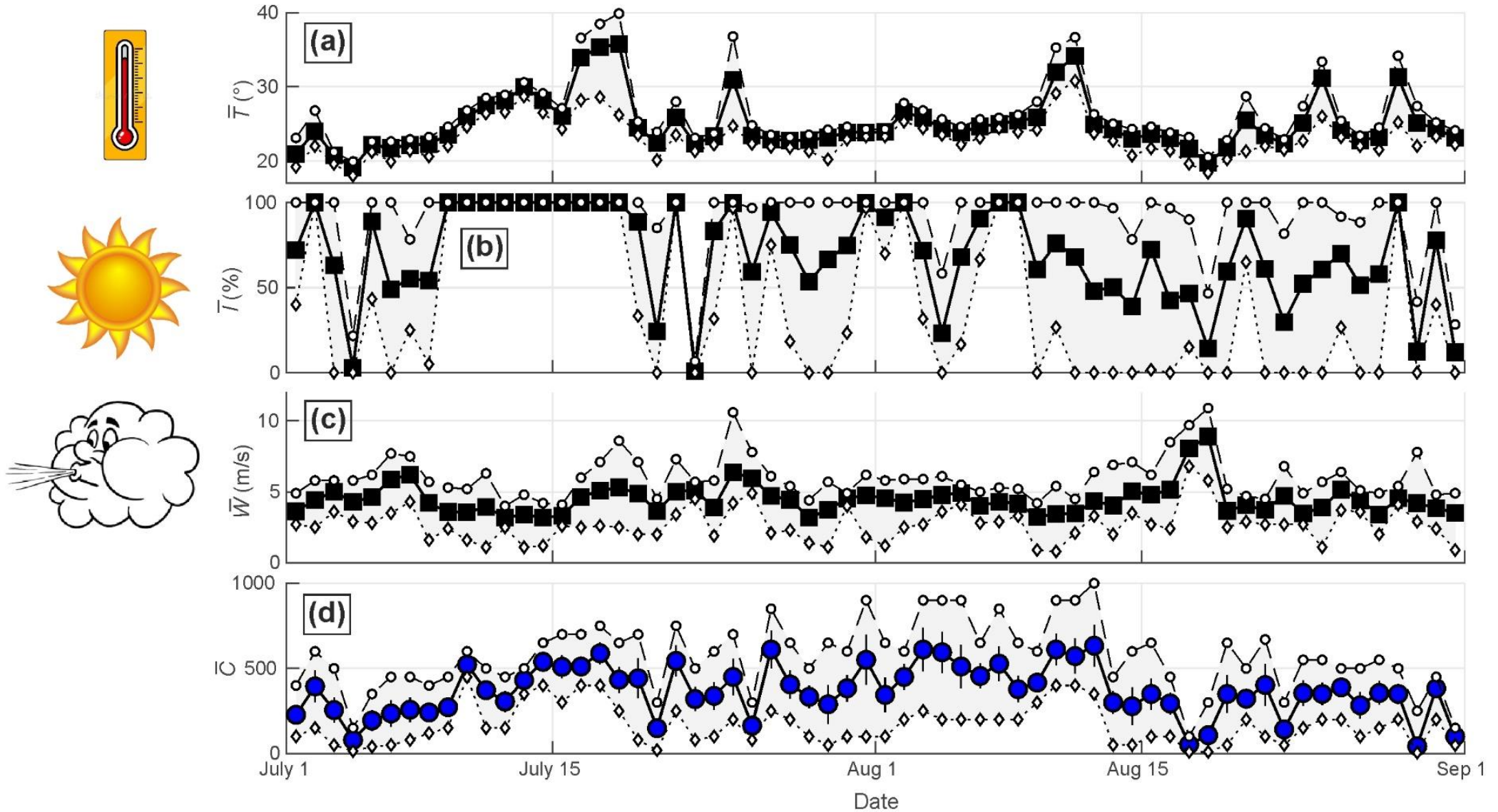
Rip current hazard

Shore-break wave hazard

$R = 0.60$ ($p\text{-value} < 0.02$)

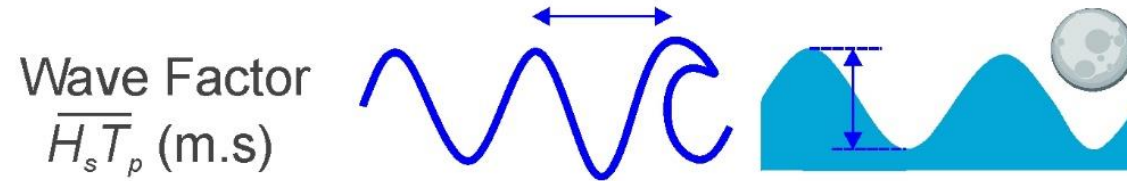
Results & Discussion

Daily-averaged exposure



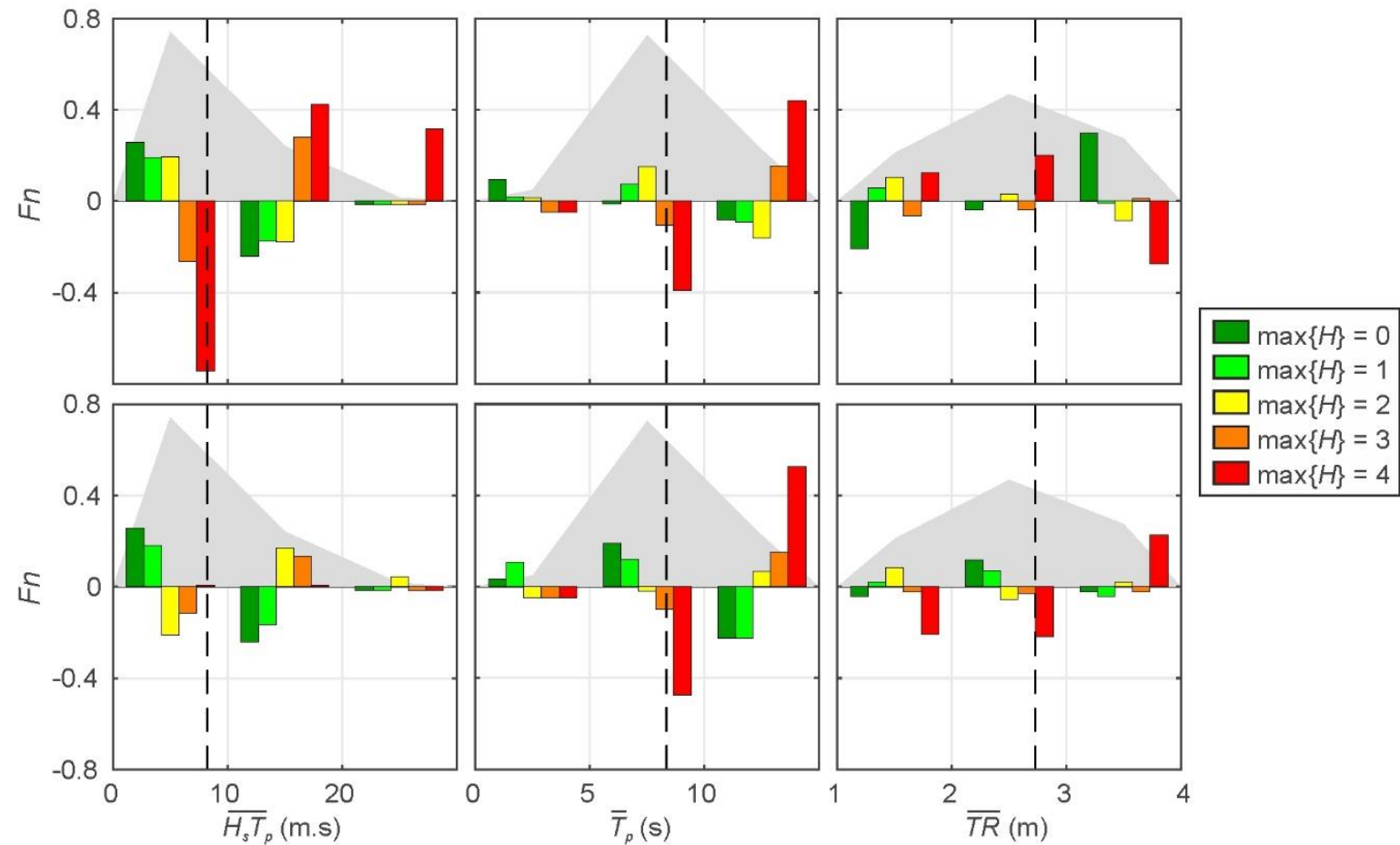
Daily-averaged data : correlation with environmental conditions

	\bar{H}_s	\bar{T}_p	$ \overline{\cos 2(\theta - \theta_c)} $	$\overline{H_s T_p}$	\overline{TR}	\bar{T}	\bar{I}	\bar{W}
\bar{H}_{rip}	0.80*	0.36*	0.24	0.83*	- 0.21	- 0.29*	- 0.08	0.22
Max{ H_{rip} }	0.62*	0.33*	0.23	0.67*	0.00	- 0.15	0.01	0.20
Min{ H_{rip} }	0.82*	0.36*	0.23	0.86*	- 0.37*	- 0.33*	- 0.15	0.23*
\bar{H}_{sb}	0.41*	0.51*	0.41*	0.57*	0.09	0.00	- 0.03	- 0.07
Max{ H_{sb} }	0.37*	0.47*	0.45*	0.48*	0.23	0.06	- 0.01	- 0.03
Min{ H_{sb} }	0.34*	0.32*	0.17	0.47*	- 0.27	- 0.07	- 0.03	0.05
\bar{C}	- 0.27*	0.25*	0.03	- 0.10	0.23	0.54*	0.57*	- 0.27*
Max{ C }	- 0.20	0.14	- 0.05	- 0.09	0.16	0.42*	0.47*	- 0.20
Min{ C }	- 0.38*	0.32*	- 0.01	- 0.15	0.37*	0.73*	0.55*	- 0.32*



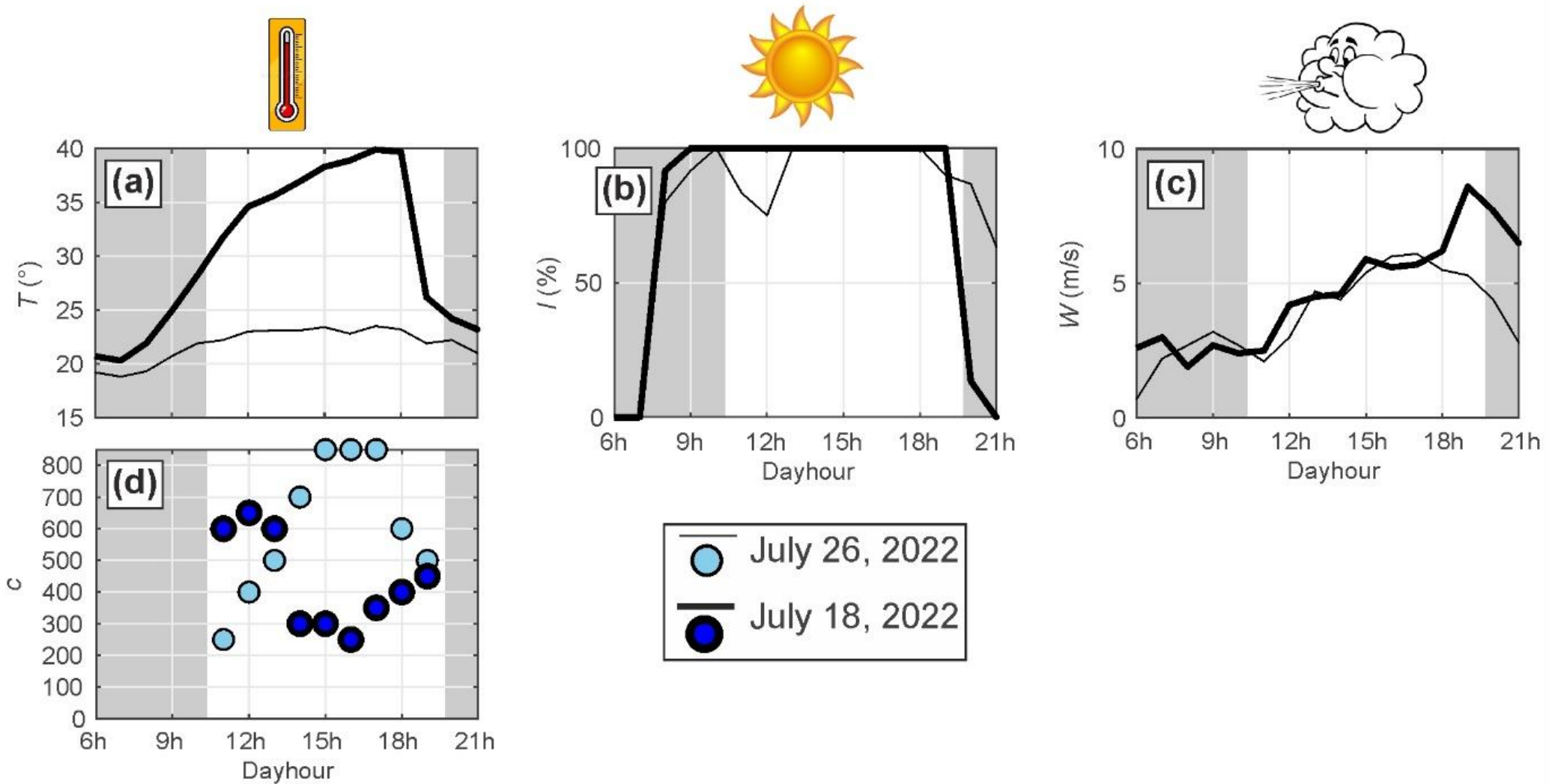
Rip current hazard

Shore-break wave hazard



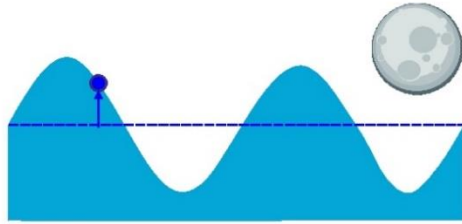
Results & Discussion

Hourly data : heat wave influence



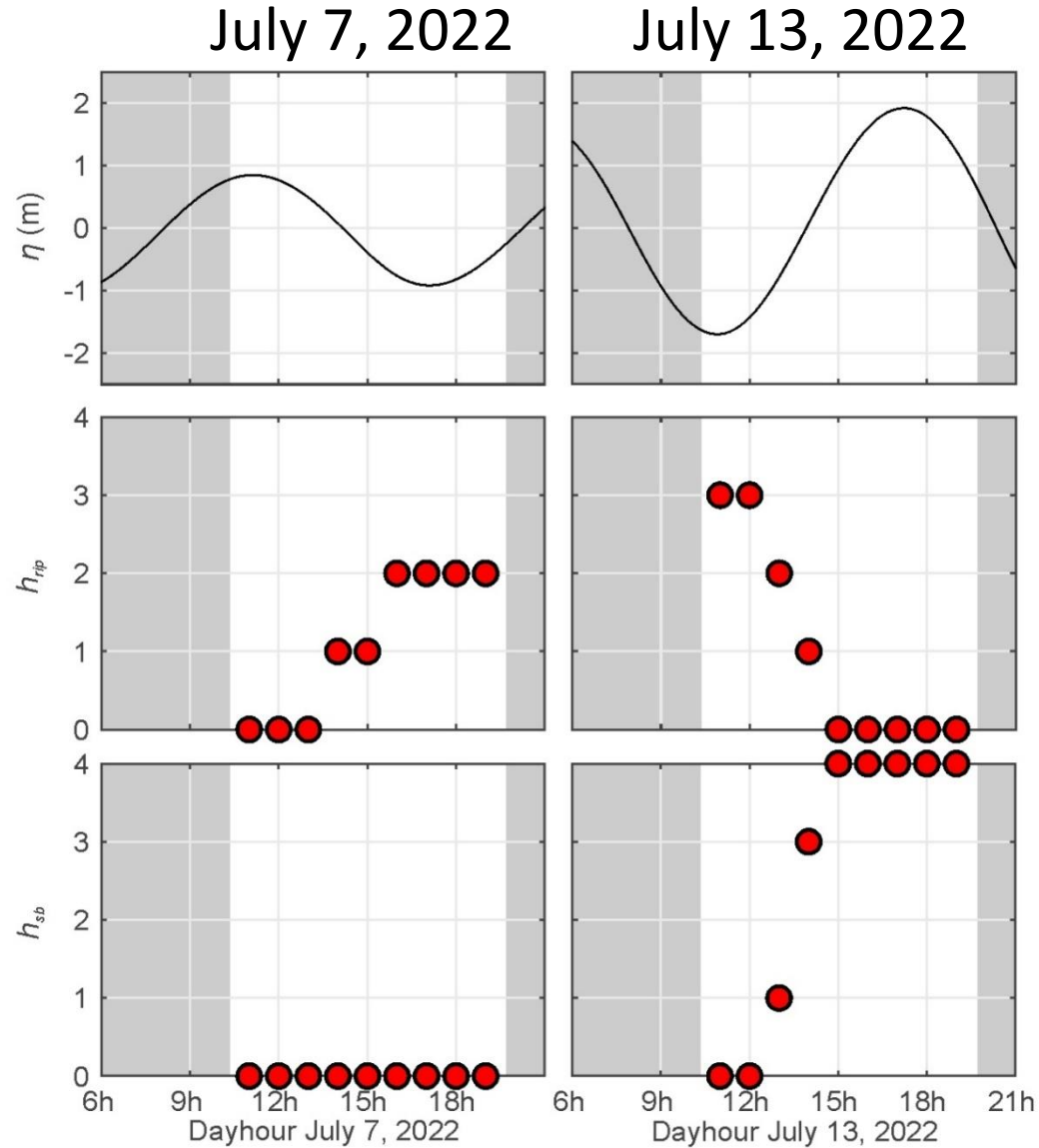
Results & Discussion

Rip-current hazard *versus* shore-break-wave hazard ($H_s \approx 1$ m)



Rip current hazard

Shore-break wave hazard





CONCLUSIONS



- *Can lifeguard be a valuable source of (hazard and exposure) data ?*

YES – Links with environmental conditions in line with previous work

- *Can it provide better insight into the environmental controls ?*

YES – e.g. Heat wave influence on beach crowd, role of wave period on shore-break hazard

- What are the respective contributions of hazard and exposure to risk ?

Hard to say – Needs more data (more beaches, more years)

- Can we ultimately predict life risk at the beach ?

Work in progress – Combining physics-based and AI models

Do not miss the talks of:

David Carayon (RESCUE 6 - AI) & Jeffrey Dehez (RESCUE 7 - Coastal Safety)

Thank you for your attention !



More in :

Castelle, B., Dehez, J., Savy, J.-P., Marieu, V., Lyser, S., Bujan, S., Carayon, D., Brander, R.W. (2023). Environmental controls on lifeguard-estimated surf-zone hazards, beach crowds, and resulting life risk at a high-energy sandy beach in southwest France, *Natural Hazards*, <https://doi.org/10.1007/s11069-023-06250-0>.

Funding :

Project **SWYM** (Surf zone hazards, recreational beach use and Water safety Management in a changing climate) funded by Région Nouvelle-Aquitaine and the French government in the framework of the University of Bordeaux's IdEx "Investments for the Future" program/RRI Tackling Global Change