WAVES'N SEE
from wave to shore

Wave Overtopping by videomonitoring

Soutenu par

MINISTÈRE
DE LA TRANSITION
ÉCOLOGIQUE
Liberté
Égalité
Fraternité

GREENTECH
INNOVATION

METEO
FRANCE

About us

- Startup created from **French public research** (IRD – Institut de Recherche pour le Développement)
- Based in **Meteo France** headquarters
- **SCOP** (société coopérative => corporate governance independent from external investors)

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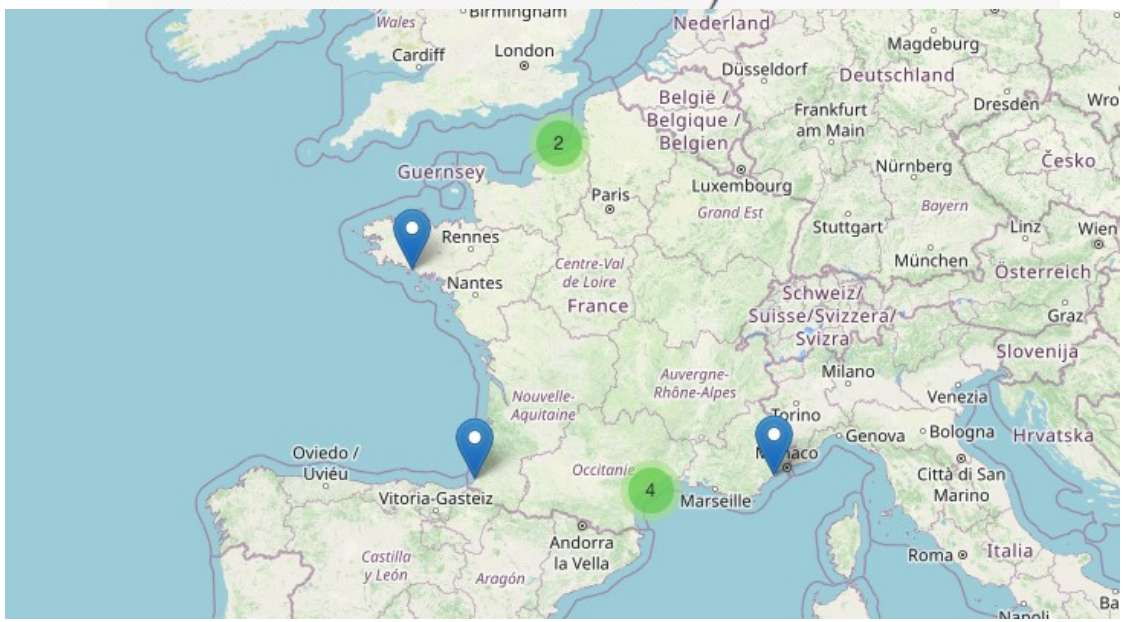
GREENTECH INNOVATION

METEO FRANCE



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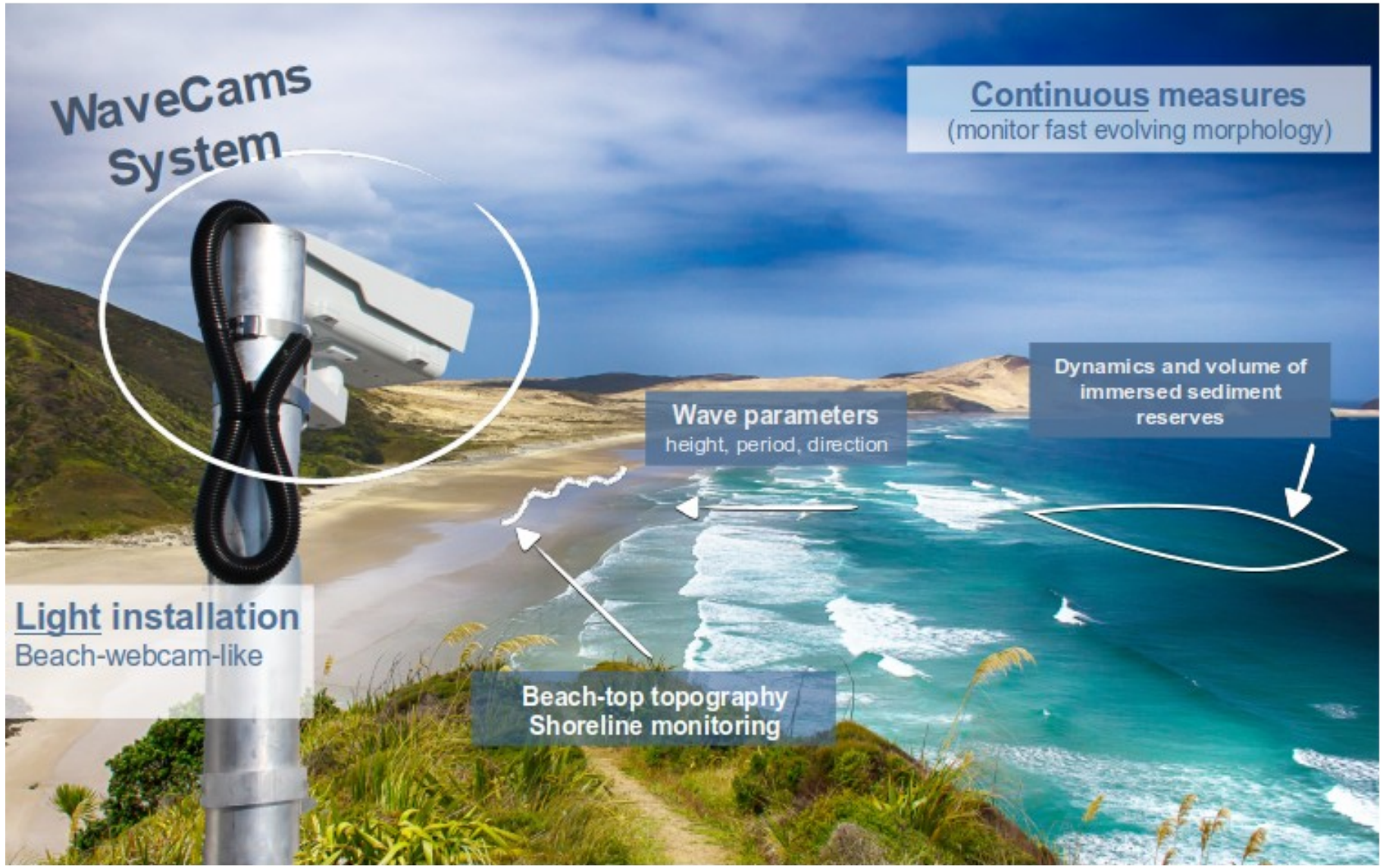
Video monitoring by WaveCams

Key points

Coastal videomonitoring : continuous monitoring of a complete set of parameters



Complete beach profile

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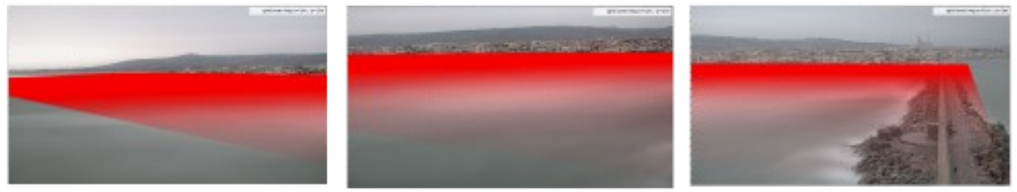
Secondary images

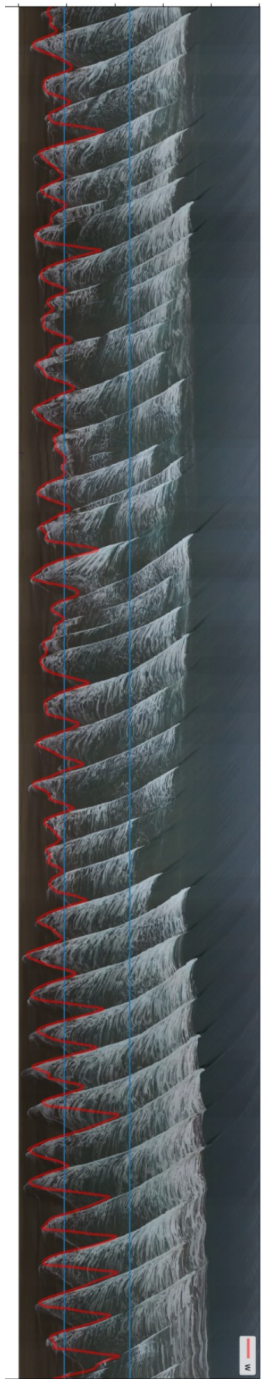
Snapshots

Average



Orthorectification process

← Integrate images into geovisualization tools.



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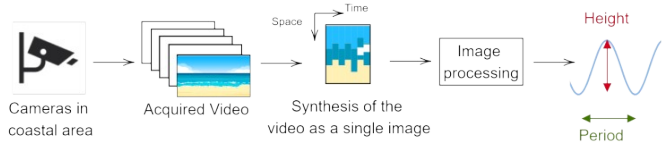
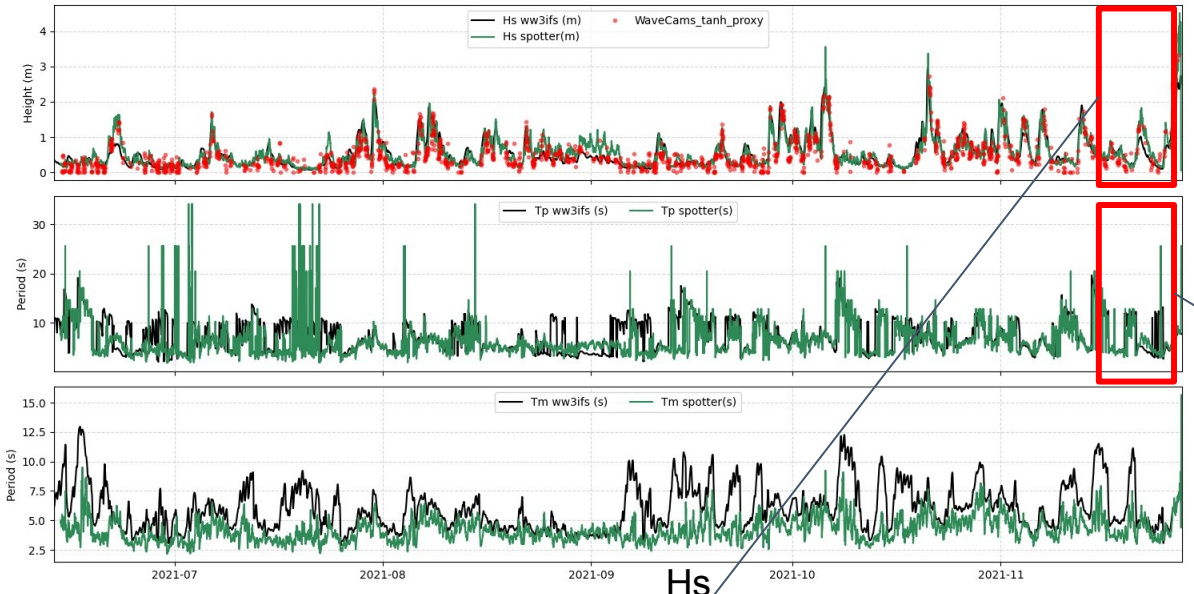
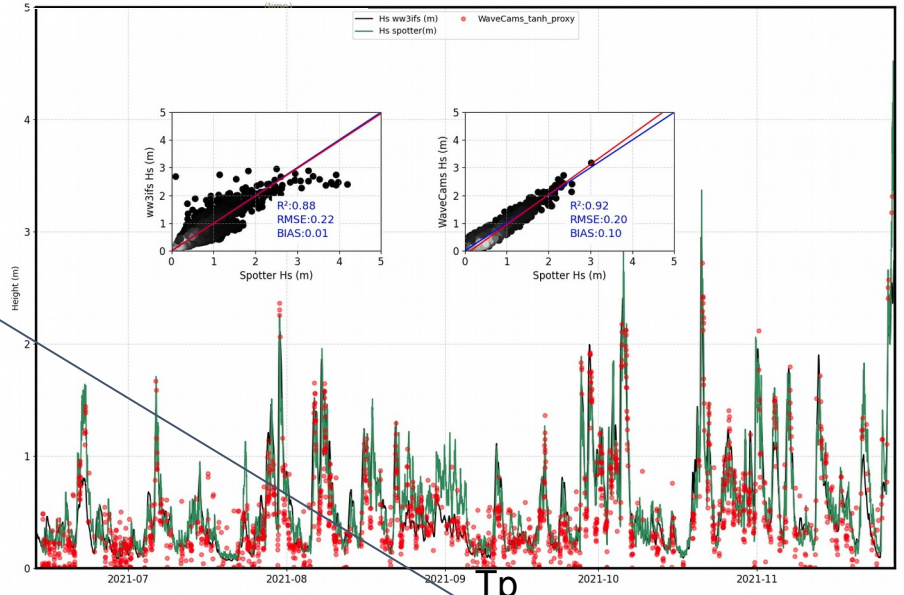
Data sources - Analysis - Wave Conditions - MF ww3 offshore v/s Spotter (and WaveCams)



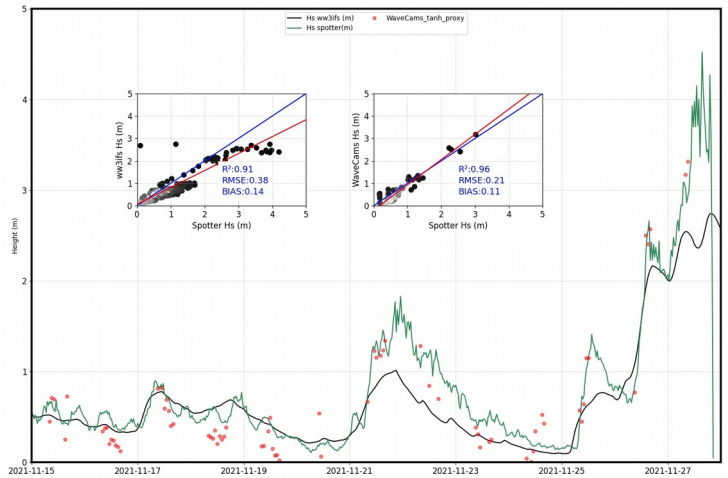


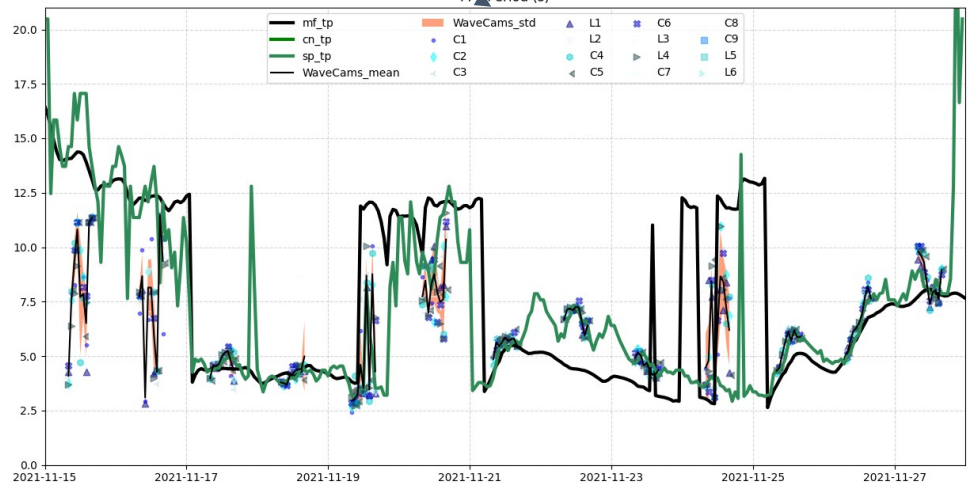
Hs



Tp

FFT Period (s)





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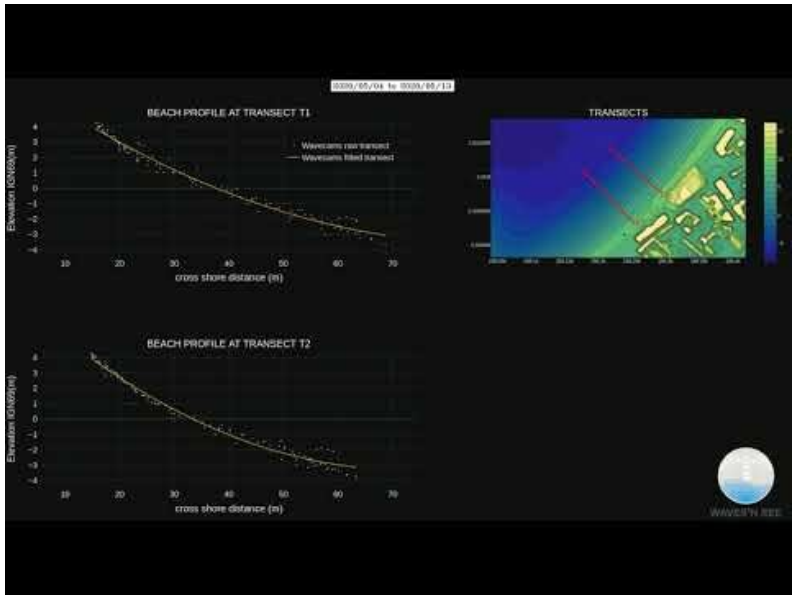
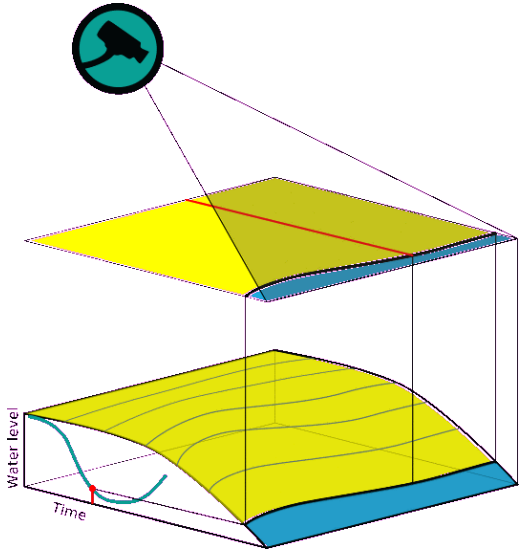
Waterline detection





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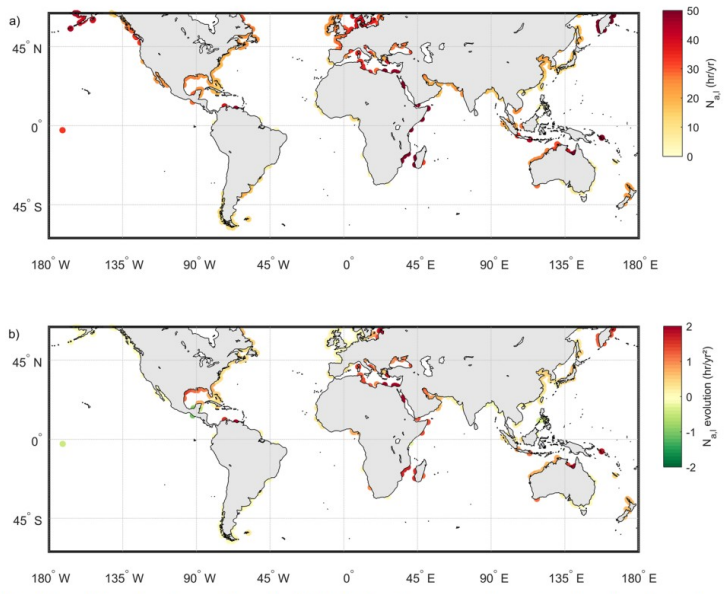
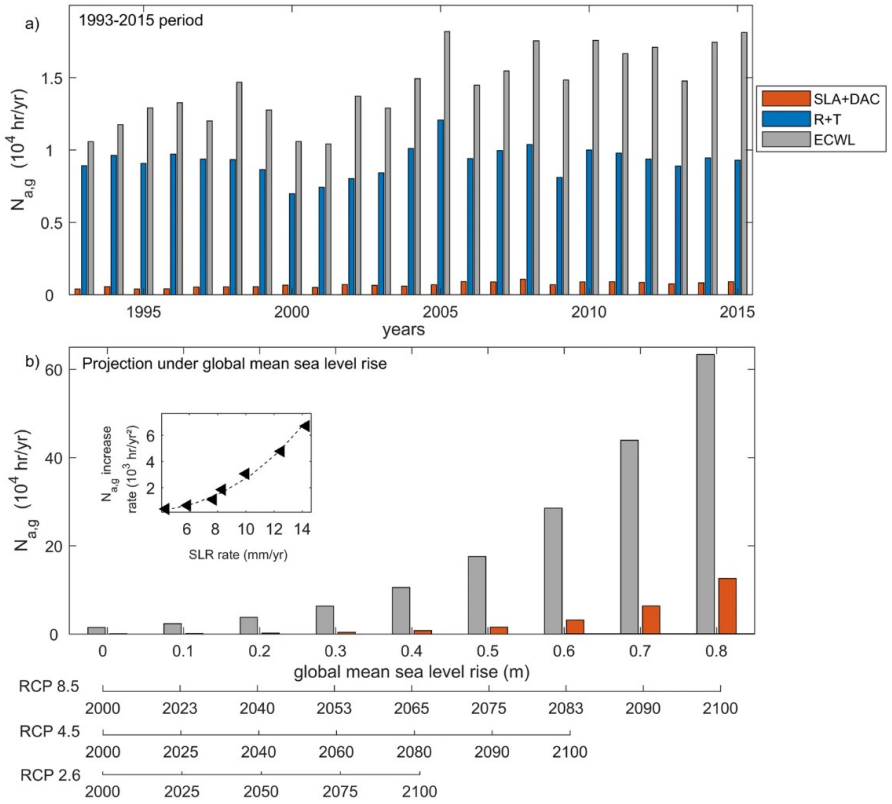
Context

Context - Overtopping global context

A global analysis of extreme coastal water levels with implications for potential coastal overtopping

Rafael Almar, Roshanka Ranasinghe, Erwin W. J. Bergsma, Harold Diaz, Angelique Melet, Fabrice Papa, Michalis Vousdoukas, Panagiotis Athanasiou, Olusegun Dada, Luis Pedro Almeida & Elodie Kestenare





- <u>Main outcomes:</u>

- ECWLs and their impacts have increased over the last two decades, regionally affecting the west coast of Europe and the east coast of the United States, among many other parts of the world.

- Detailed information on local topography at high frequency is needed to assess impacts directly.

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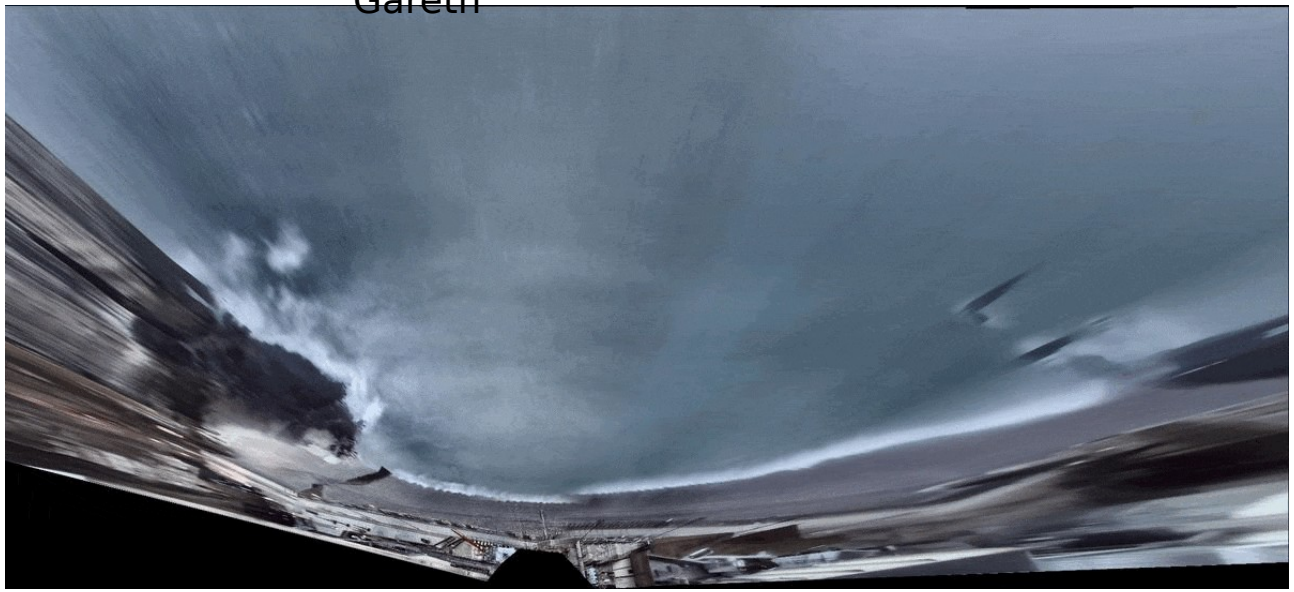
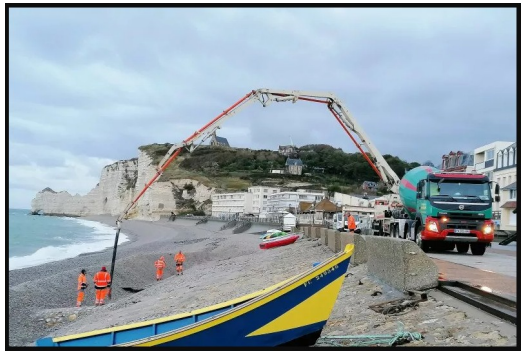
Context - Study case

201903 10-15 Tempête Gareth





SYNDICAT MIXTE DU LITTORAL DE LA SEINE-MARITIME

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First questions and main objective

- Can video cameras apport quantitative overtopping information?
- Can cameras helps to identify primary environmental conditions that drive overtopping?
- Can cameras helps to classify overtopping events?
- Can this information be useful for scientific and engineering studies?

Then, the main objective for now is establish a first approach for validation of video overtopping metrics

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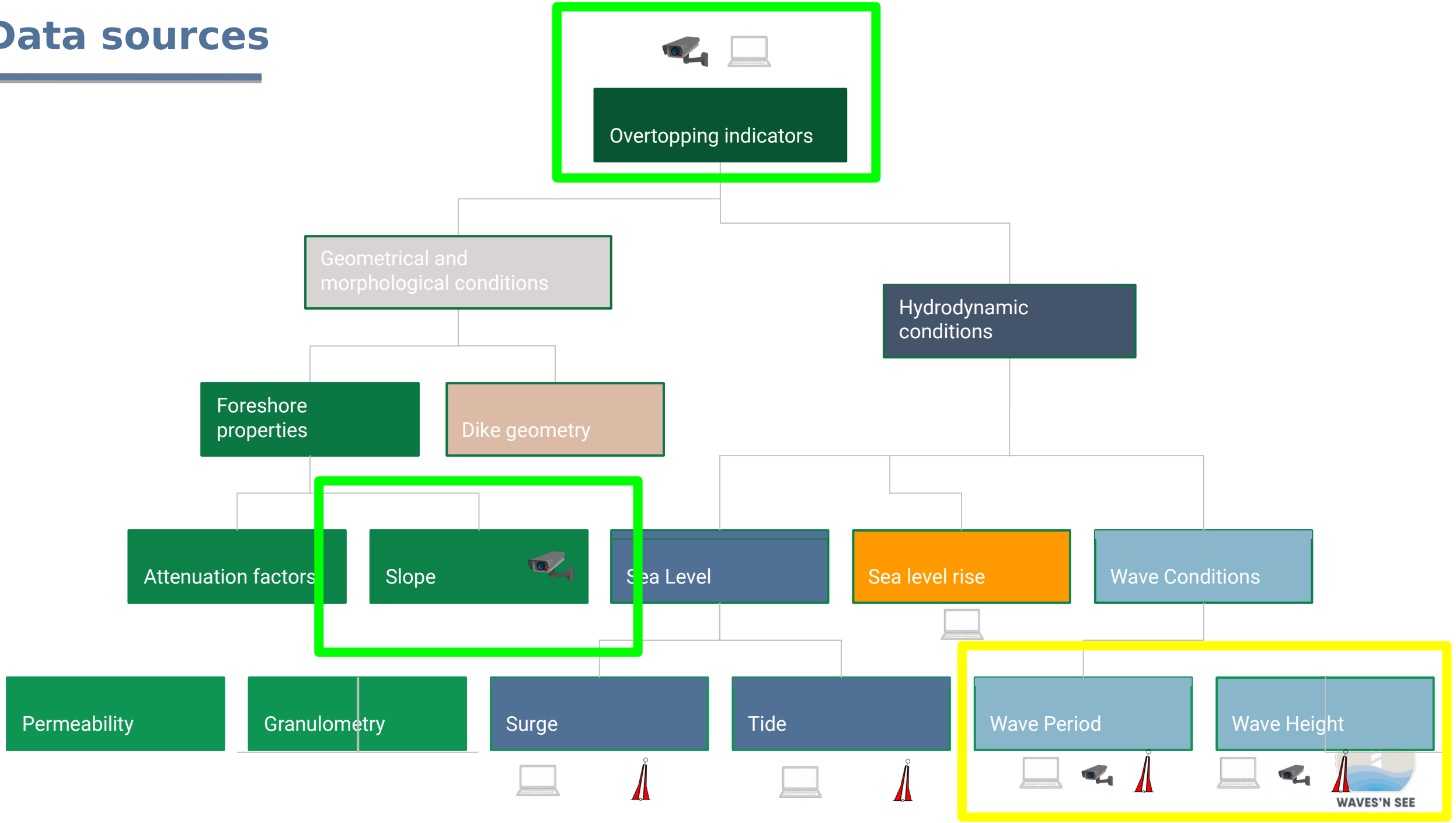
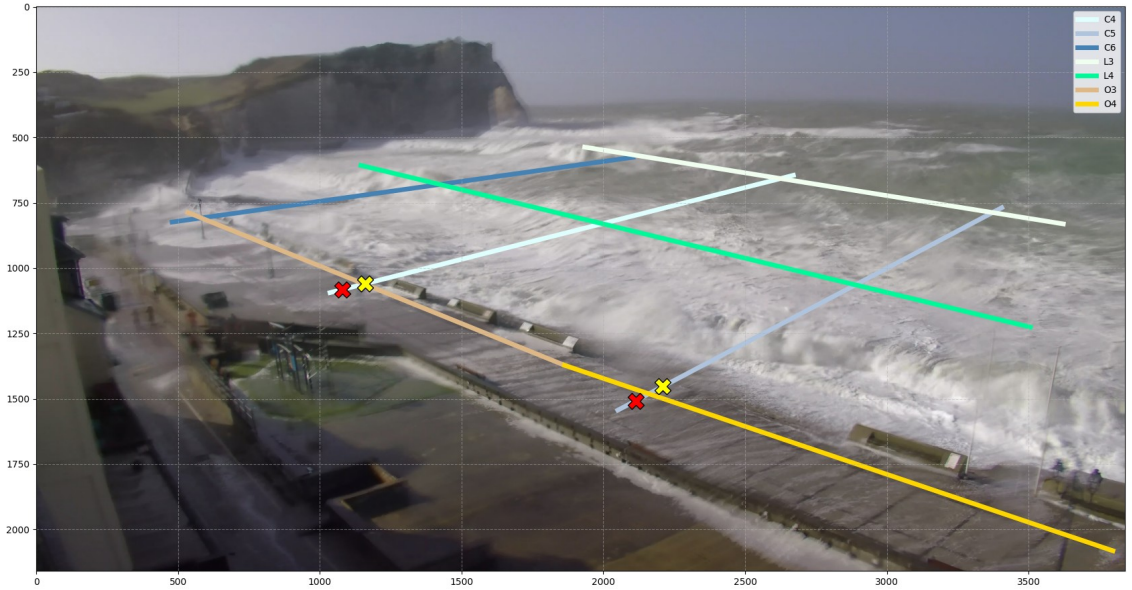
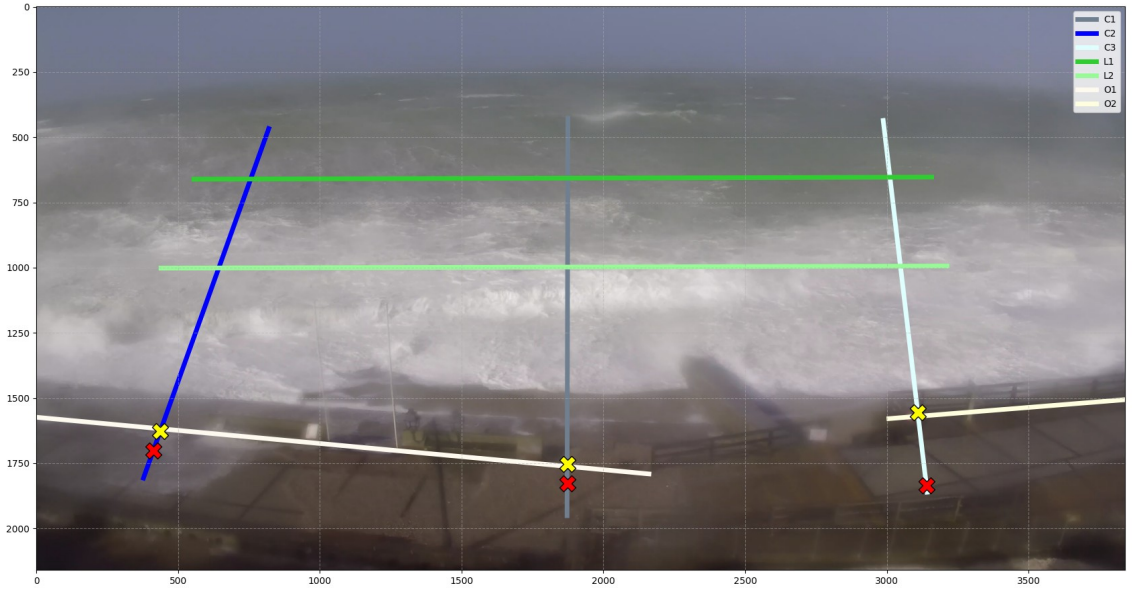
Methods

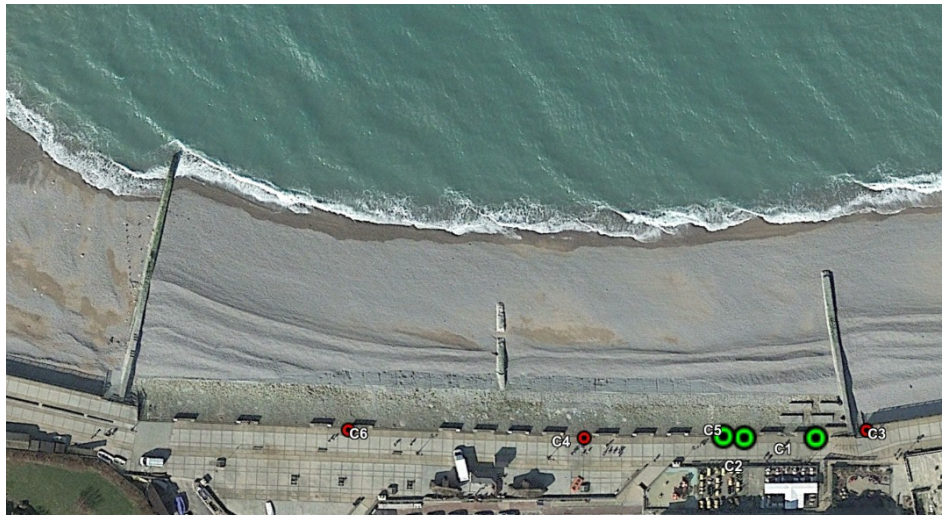
Data sources

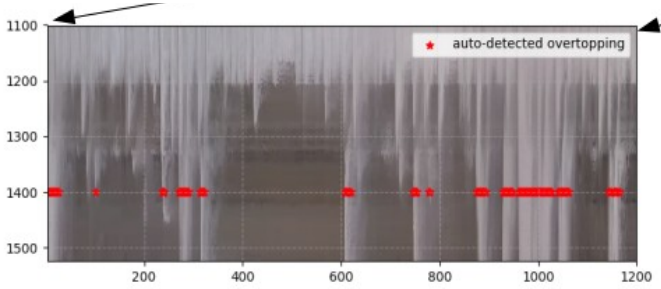


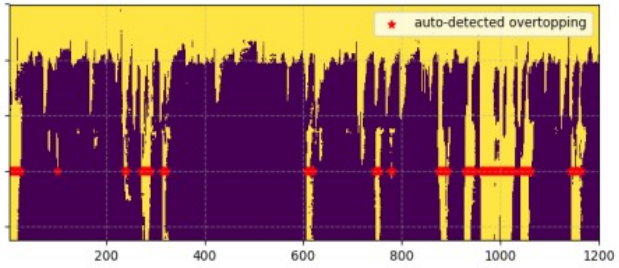
Methodology











Main products:

- Overtopping counts <u>at least</u> every hour.
- Pixel counts → Submerged time.
- Overtopping waves, time series.

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Overtopping variables definitions - Empirical approach

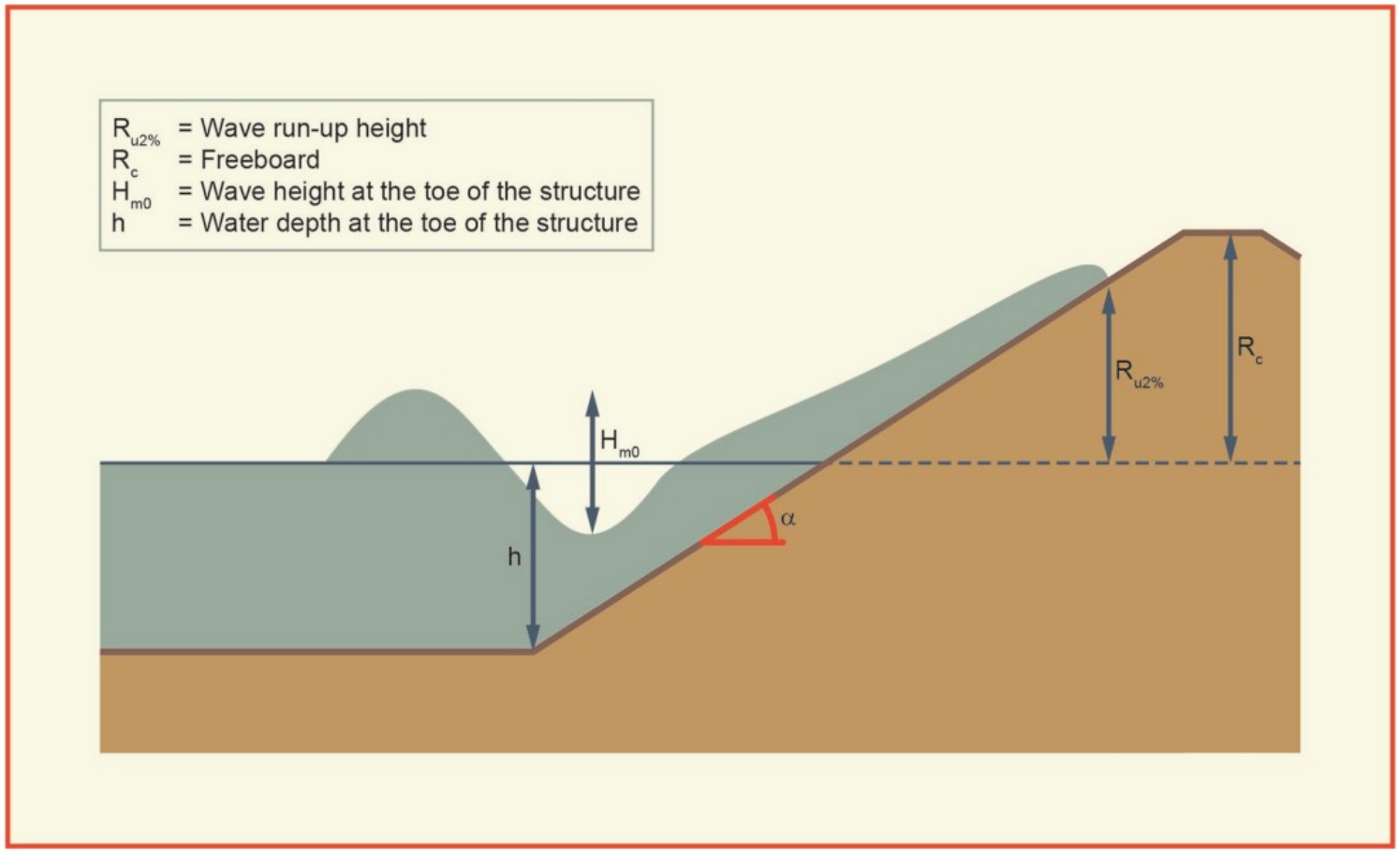

Figure 5.4: Definition of the wave run-up height $R_{u2\%}$ on a smooth impermeable slope

Eurotop 2018: Relatively gentle, impermeable slopes without permeable foreshore

For breaking waves ($\xi_{m-1,0} < 2$)

$$\frac{q}{\sqrt{gH_{m0}^3}} = \frac{0.023}{\sqrt{\tan\alpha}} \cdot \xi_{m-1,0} \cdot \exp\left[-\left(2.7 \frac{R_c}{\xi_{m-1,0} \cdot H_{m0} \cdot \gamma_f}\right)^{1.3}\right]$$

For non-breaking waves ($\xi_{m-1,0} > \sim 2$) a maximum value of

$$\frac{q}{\sqrt{gH_{m0}^3}} = 0.09 \cdot \exp\left[-\left(1.5 \frac{R_c}{H_{m0}\,\gamma_f}\right)^{1.3}\right]$$

$$\xi_{m-1,0} = \frac{\tan\alpha}{\sqrt{\frac{H_{m0}}{L_{m-1,0}}}}$$

$$T_{m-1.0}\left(= \frac{gT_{m-1,0}^2}{2\pi}\right) \qquad T_p = 1.1\, T_{m-1,0}$$

$$P_{ov} = \frac{N_{ow}}{N_w}$$

$$\frac{R_{u2\%}}{H_{m0}} = 1.65\, \xi_{m-1,0}$$

$$P_{ov} = \exp\left[-\left(\sqrt{-\ln 0.02}\, \frac{R_c}{R_{u2\%}}\right)^2\right]$$

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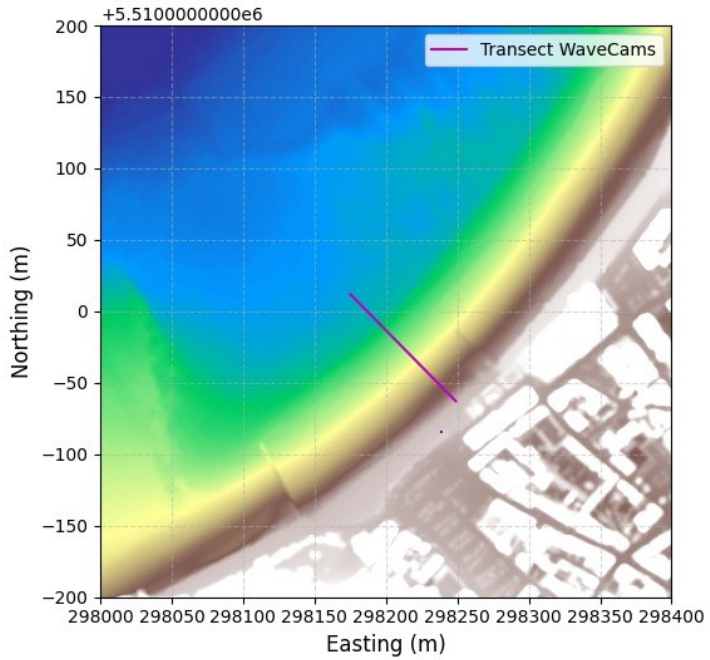
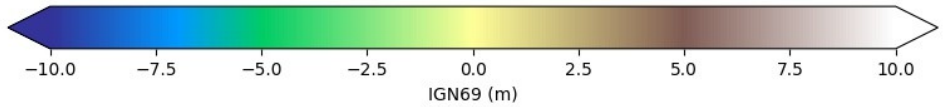
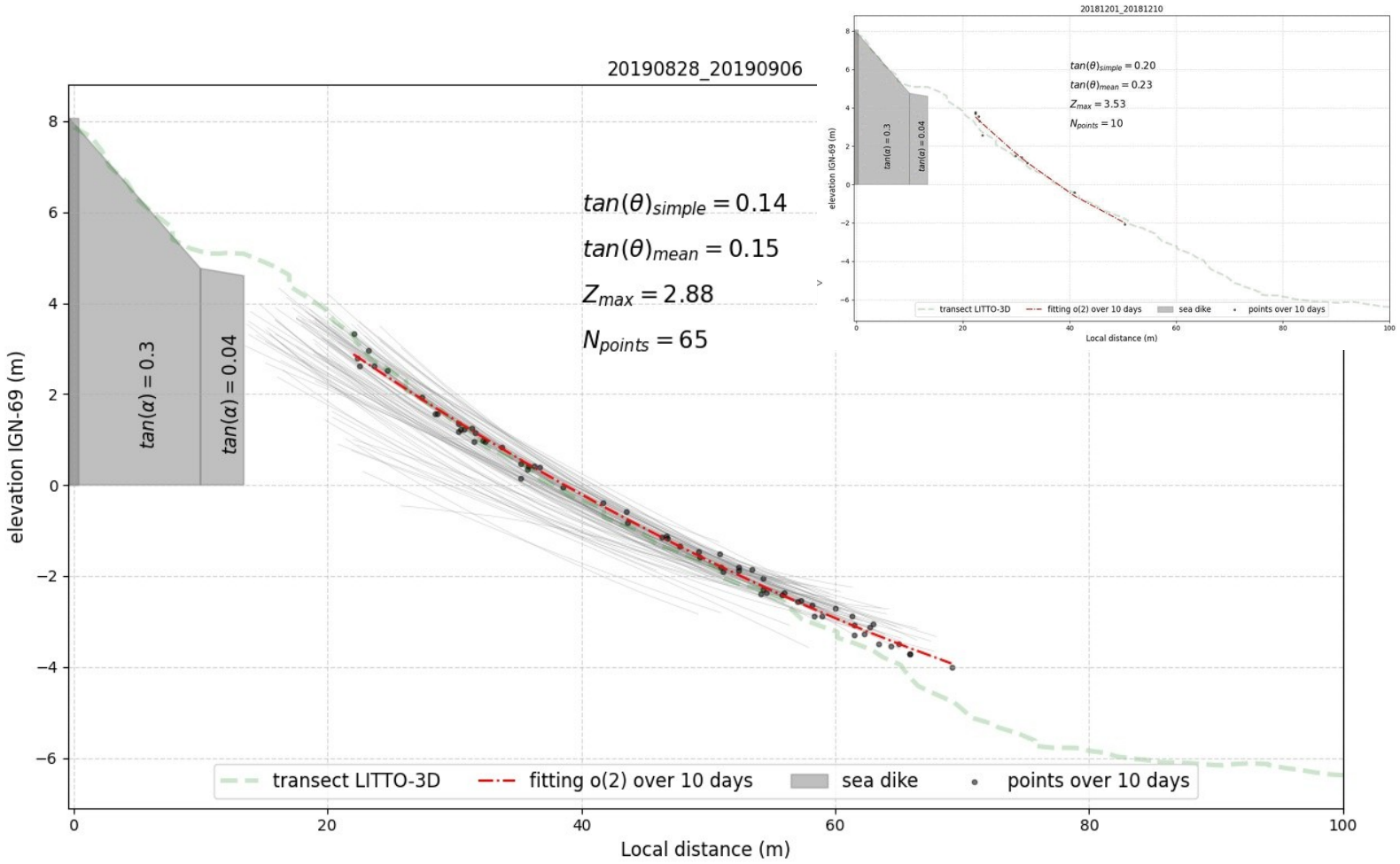
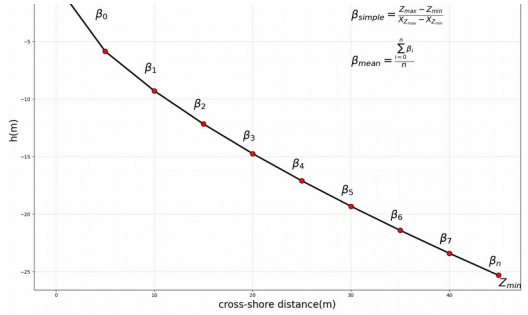
Overtopping variables definitions - Constant foreshore slope?









Camera beach slope, input for modelling

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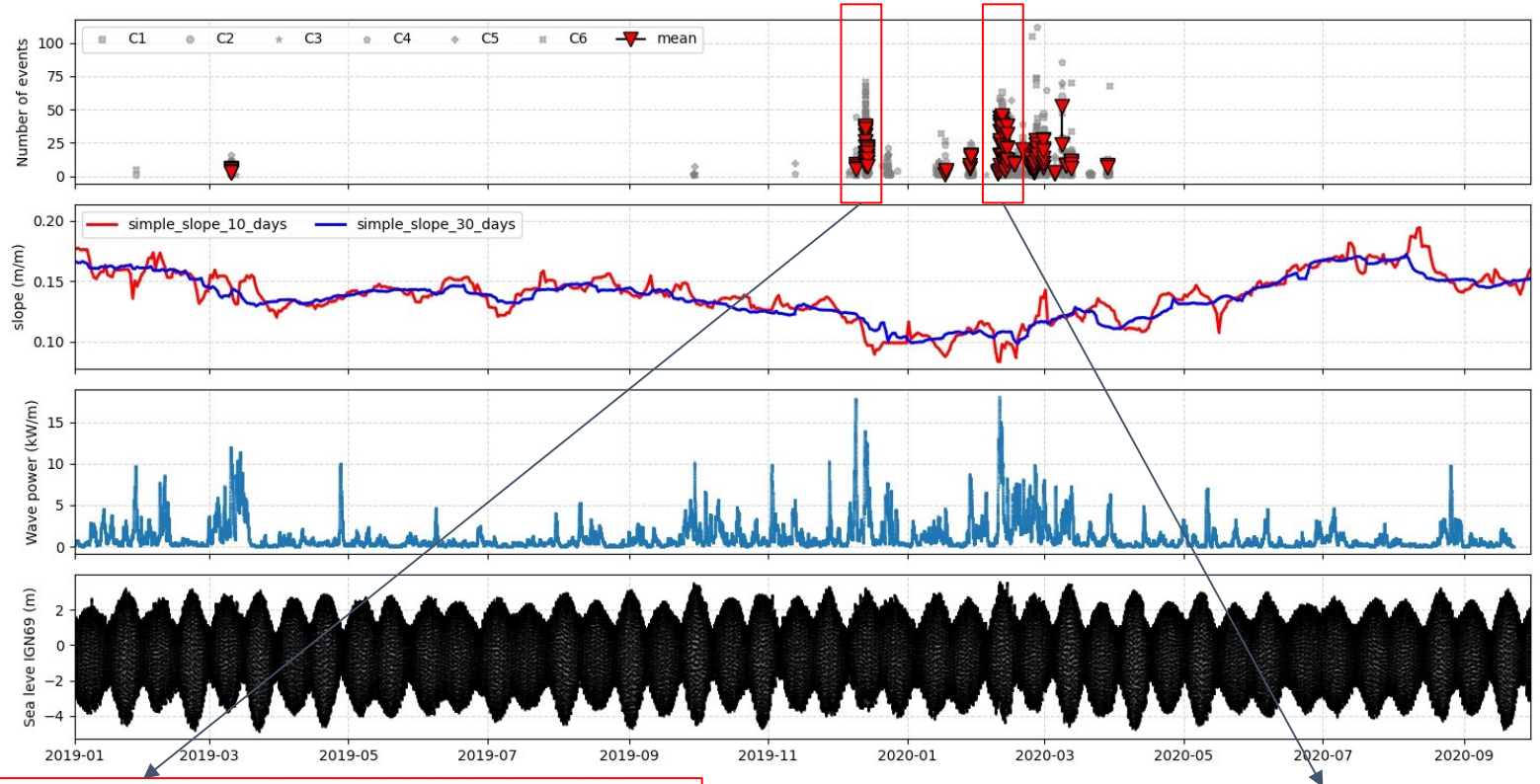
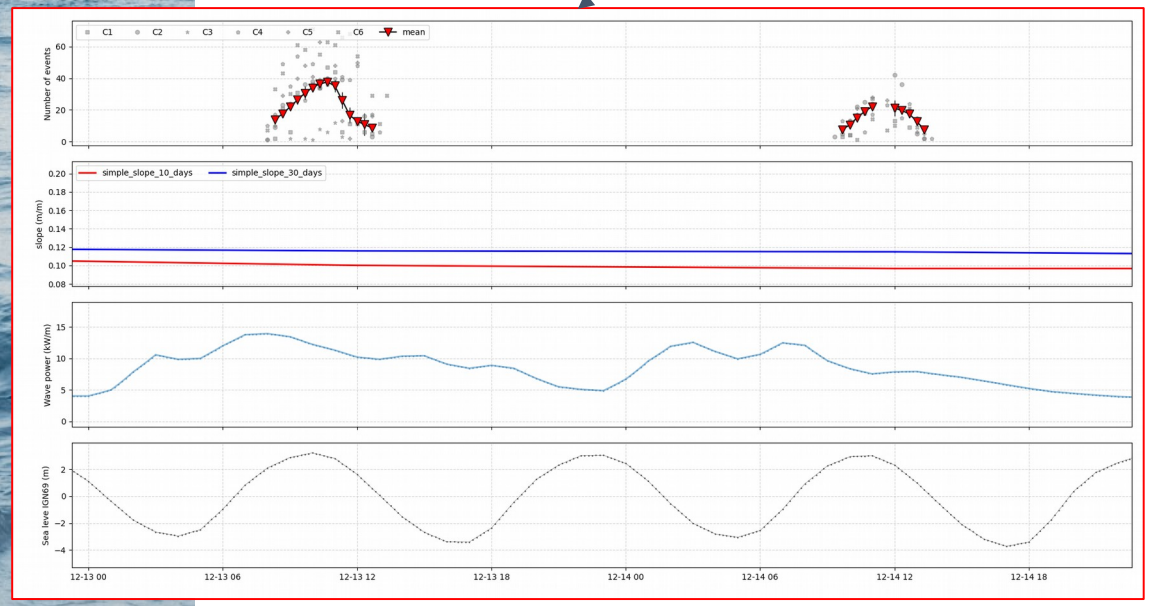
Results

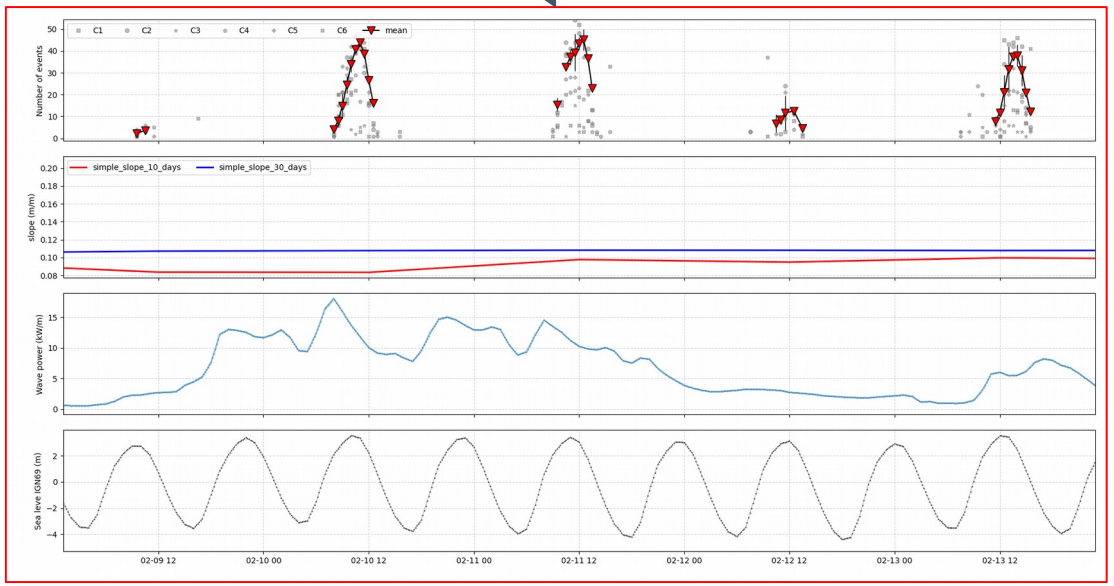
4 years of constant monitoring



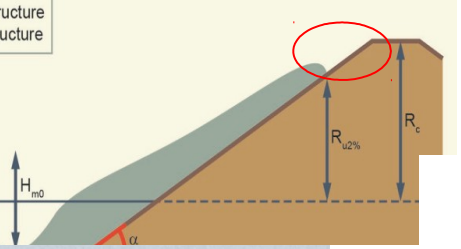
Atiyah-storm



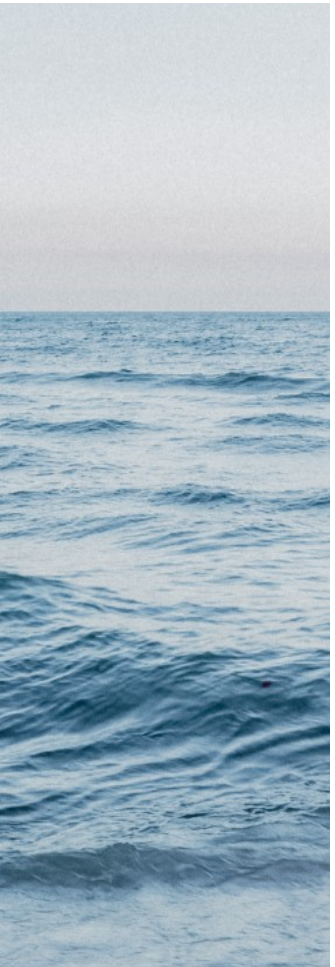
Ciara-storm



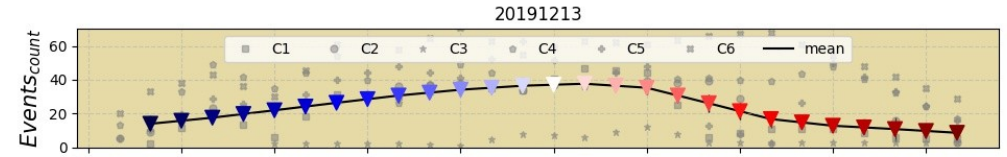
Atiyah-storm

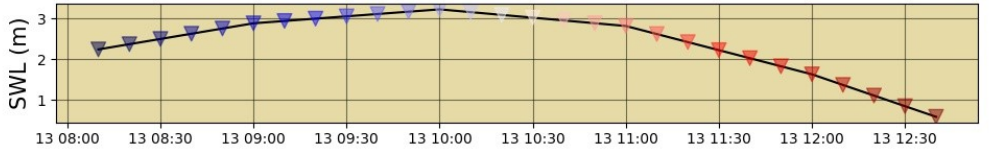


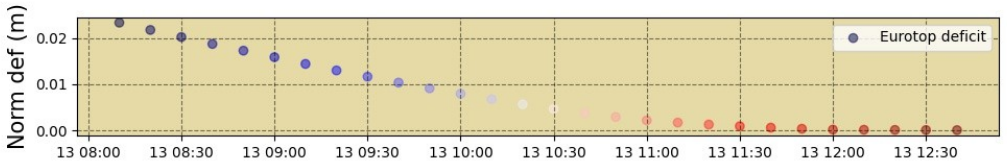
$$R^* = \frac{R_{def}}{R_{2\%}} = \frac{R_{2\%} - z_c}{R_{2\%}},$$

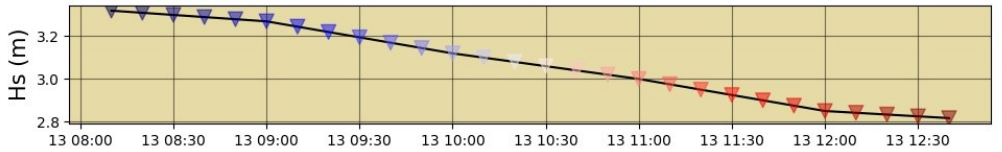


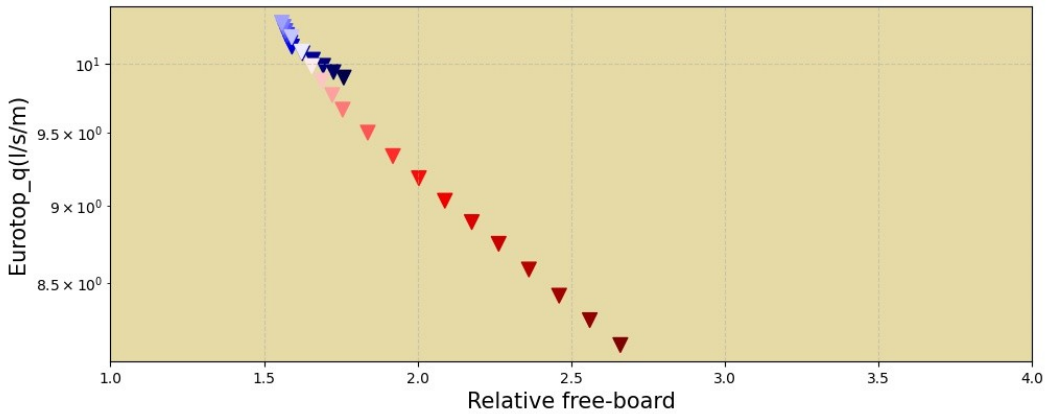
~4 hrs

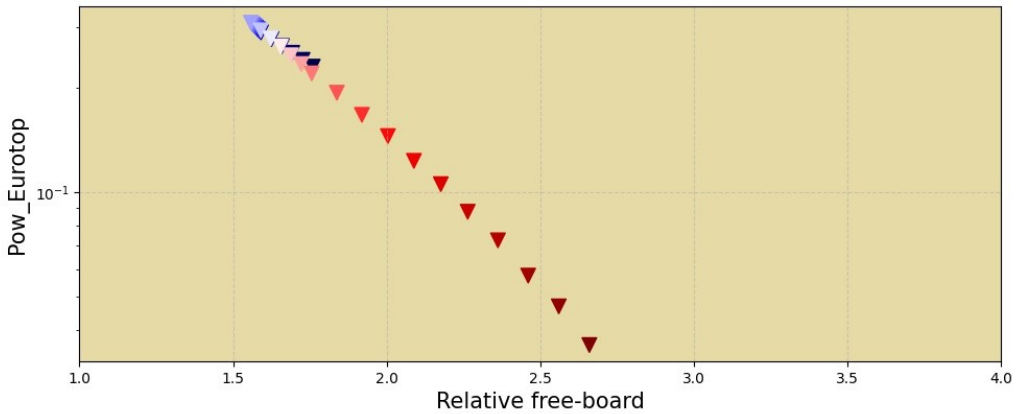


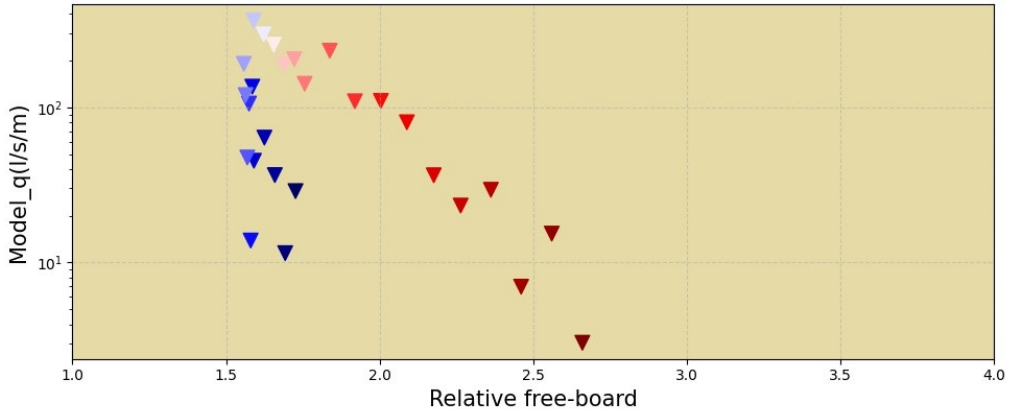


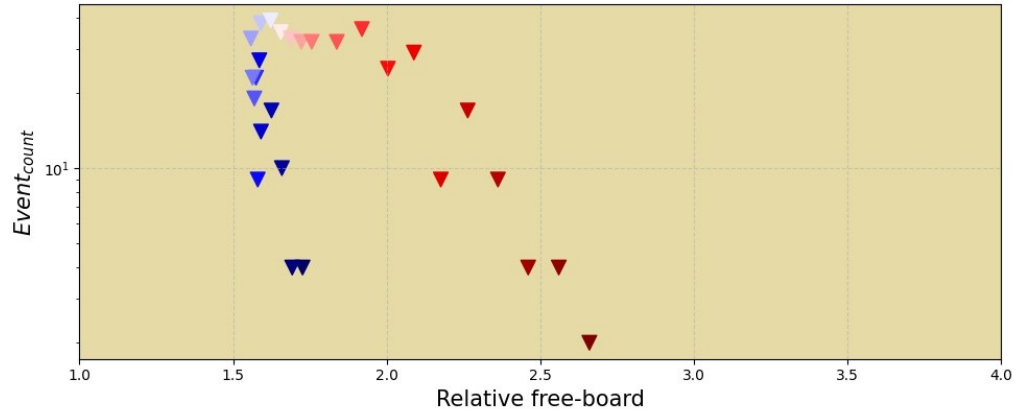




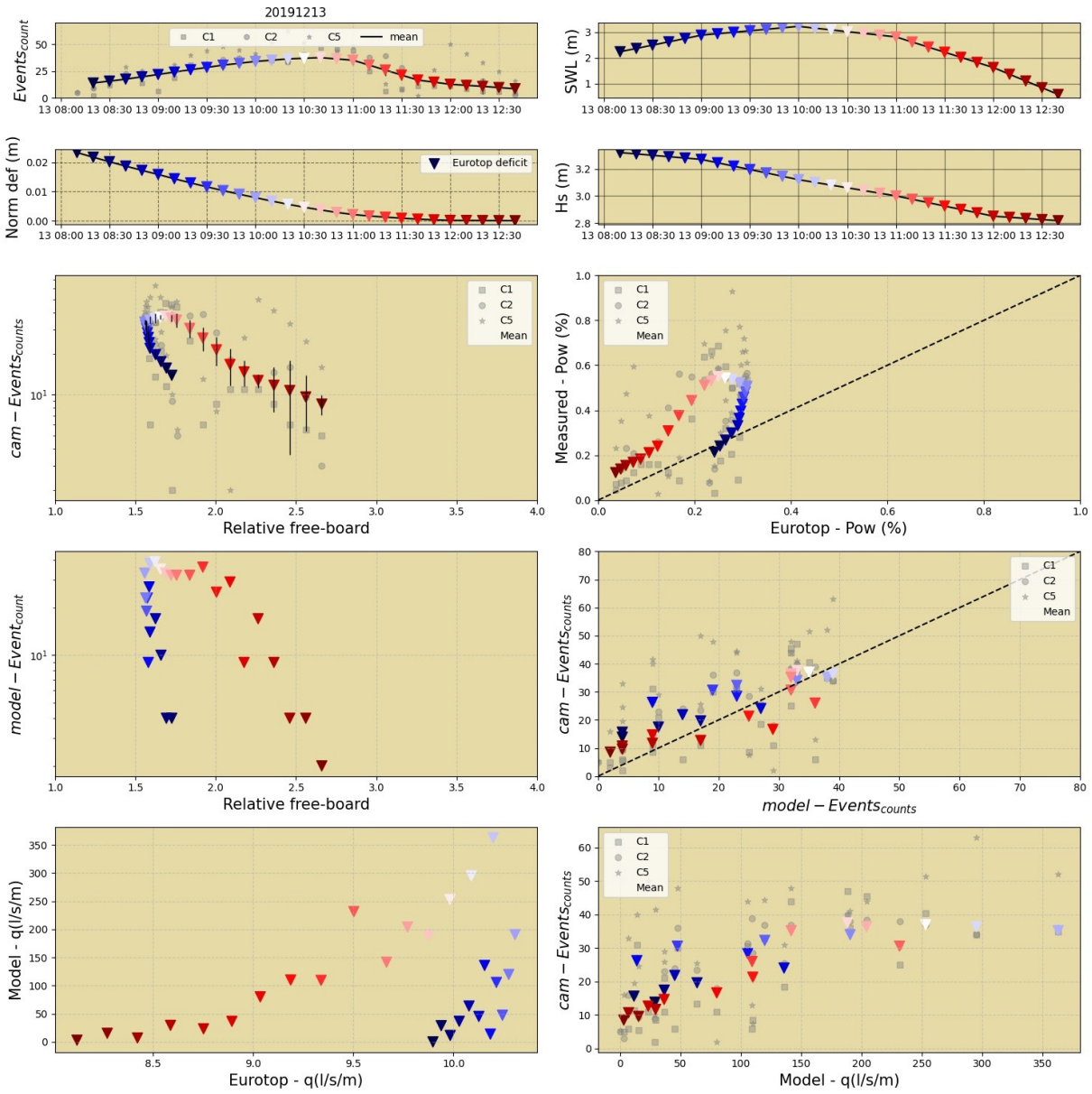




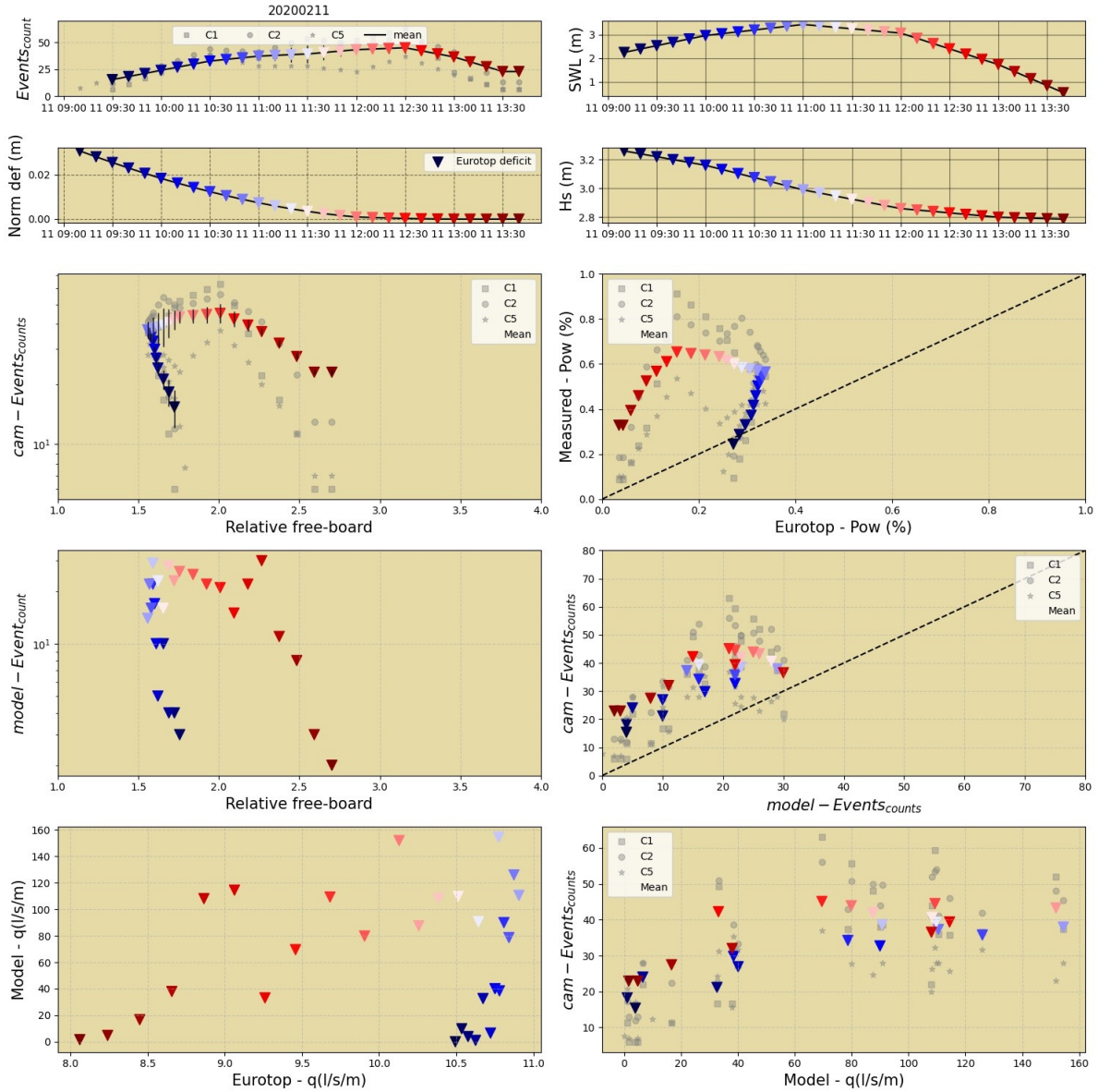




Atiyah-storm



Ciara-storm



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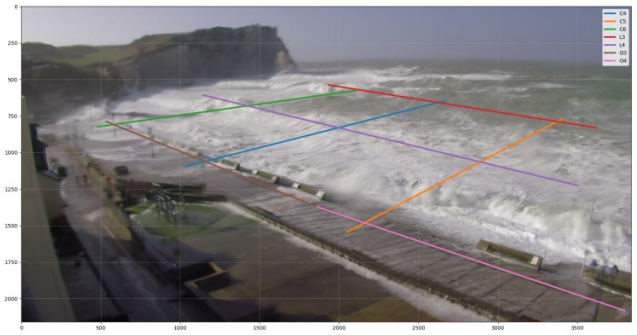
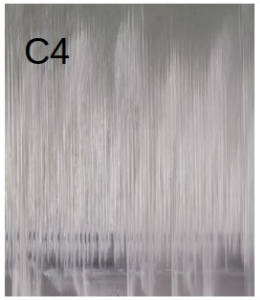
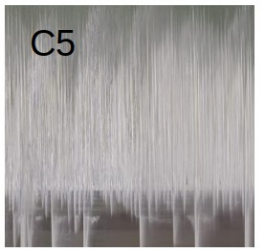


Spatial variability of overtopping



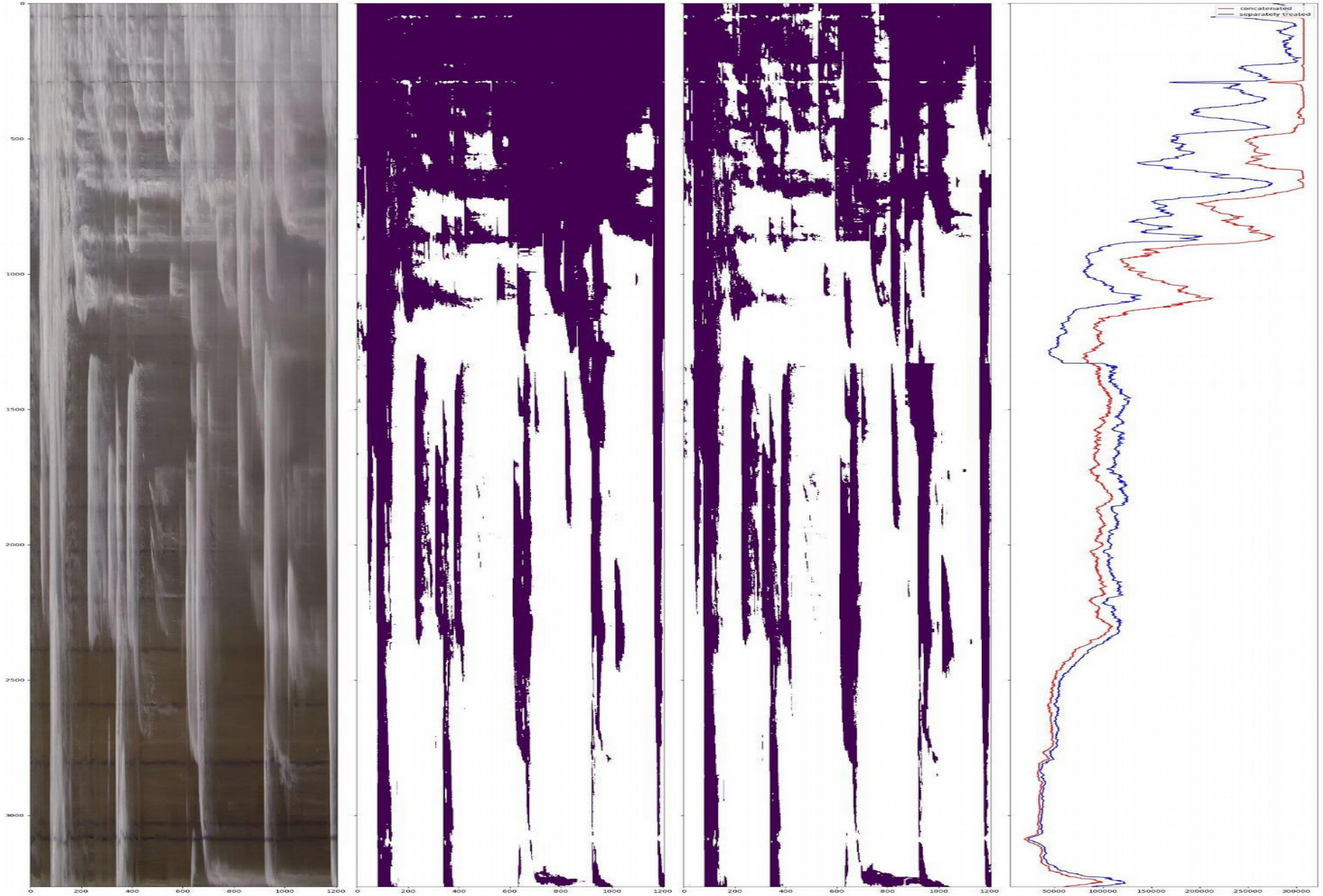


Sud

O3

O4

Nord



What’s next - PhD thesis?

- Improve video overtopping detection.
- Make in situ measurement at the same time of video acquisition.
- Capture local spatial variability over the dike.
- Can cameras helps to arise awareness about morphological environmental conditions leading overtopping events?
- Can this information be useful for scientific and engineering studies?....

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