Multi-proxies approach of morphological sandy-beach changes to energetic events.

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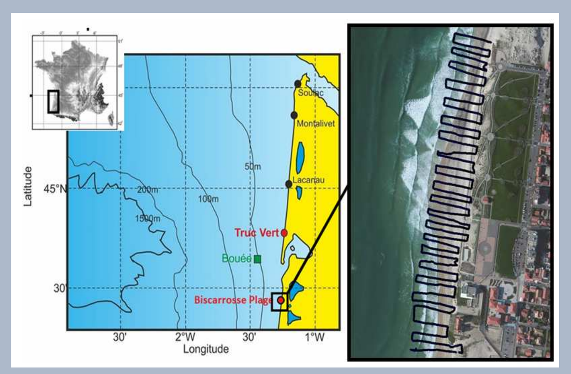
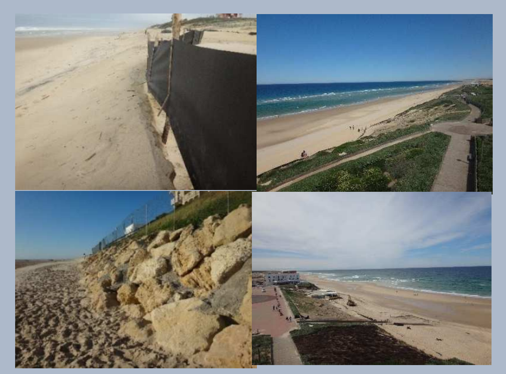
Introduction

Understanding storm impacts and sediment exchanges at different timescales is a key component to predict the shoreline evolution and vulnerability in a context of climate change. Many studies followed the morphological seasonal variations of beaches but only a few take into account the impact of each energetic event on beach/dune systems. This work trends towards a better understanding of the impact of short scale dynamics on the seasonal variations by including not only erosive events (e.g. storms or cluster of storms) but also calmer periods (relative to storms) generally considered in the literature as being 'post-storm recovery' periods.

Field Site

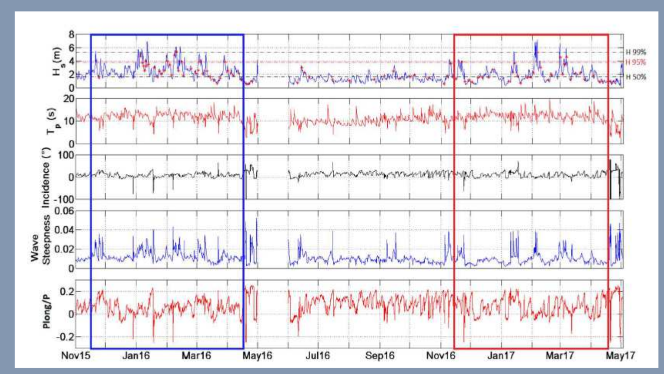
Biscarrosse beach, South West of France, is a meso to macrotidal double-barred open sandy beach with a morphology driven by both cross-shore exchanges and a north to south oriented longshore drift.
Different management strategies are deployed on the beach: the back dune is covered by grass, the southern part of the shoreline is fixed by seawalls and the northern part of the dune is protected by windbreakers.
The shoreline evolutions at Biscarrosse are driven at 52% by seasonal timescale variations and at 28% by short term events.

Methods

From November 2015 to October 2017, at least two DGPS surveys a week are recorded, covering 700m of longshore beach, to access the beach and dune variability at short scales, as storm event.
Different isocontours were extracted from interpolated topographic data corresponding to: the dune top (z=9m), the dune foot (z=4.5m), the supratidal beach and the berm (z=2m), the intertidal beach (z=0.85m) and the inner bar (z=0.45m).

Results & Discussions

- Hydrodynamic conditions and Storm activity



- ➢ Strong seasonality
- ➢ Same winter period from November to April
- ➢ Higher waves conditions in 2015/2016 (by a factor near to 1.4)

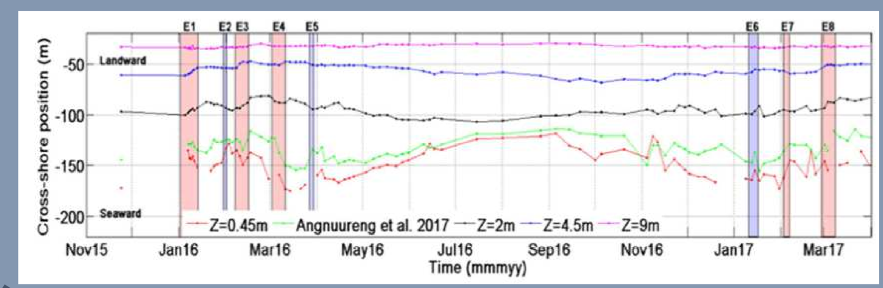
	Winter 2015/2016	Winter 2016/2017
Hs mean (m)	2,56	1,89
H50% of Hs (m)	2,37	1,71
H95% of Hs (m)	4,91	3,90
Mean Energy (J)	9893	5987
Cumulated Energy (J)	$3{,}61.10^{7}$	$2{,}17.10^{7}$
Total Energy Flux (W/m)	$4{,}54.10^{8}$	$2{,}73.10^{8}$
Number of Storms	10	5
Maximum Storm Duration (hrs)	81	44

- ➢ Higher cumulated energy too (by a factor nearly equals to 1.6)
- ➢ Double number of storms and maximum storm duration

➢ **Winter 2015/2016 way more energetic than the next one**

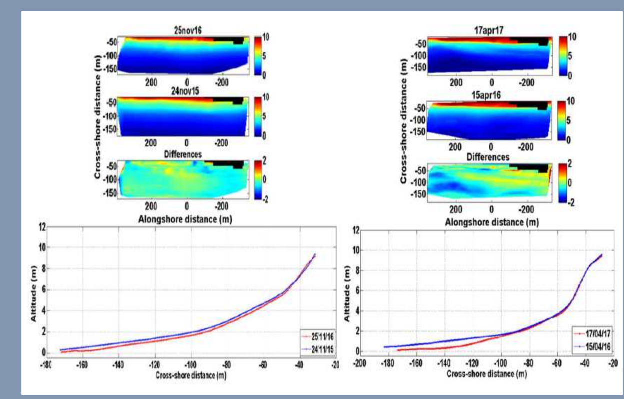
- Isocontours: dune, supra/intertidal beach

- ➢ Seasonal patterns:
  - ➢ Dune foot and supratidal beach erosion in winter
  - ➢ Inner bar offshore migration in winter: downstate transition
  - ➢ Same cross-shore amplitude for both winters
- ➢ Short-term evolutions: same magnitude than seasonal
  - ➢ Storm/post-storm signal in 2015/2016 (erosion/recovery) but not in 2016/2017
  - ➢ Visible cross-shore sediment exchanges in 2015/2016



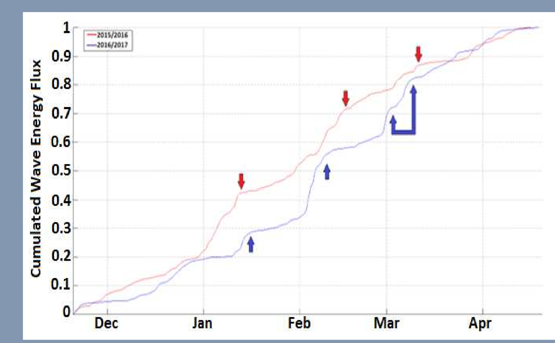
➢ E1 to E8: energetic events

- Total volume rate and cumulated energy flux

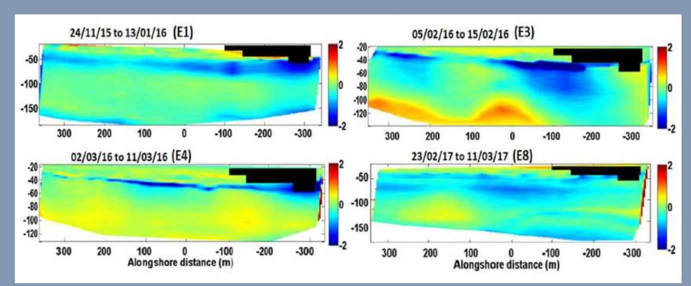
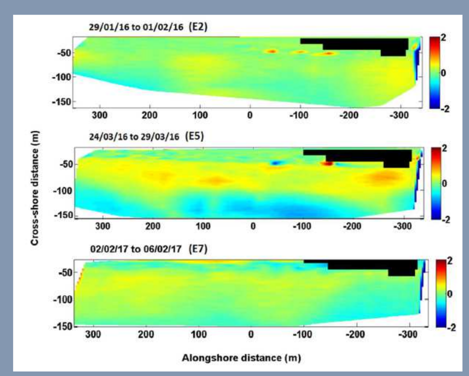


- ➢ Same pre-winter morphologies ($\Delta z<0.2m$)
- ➢ Same pre-storm mean profiles
- ➢ Different post-storm morphologies: longshore contrasting evolution
- ➢ Seasonal volume variation rate: $\approx$ -26 m^3/m

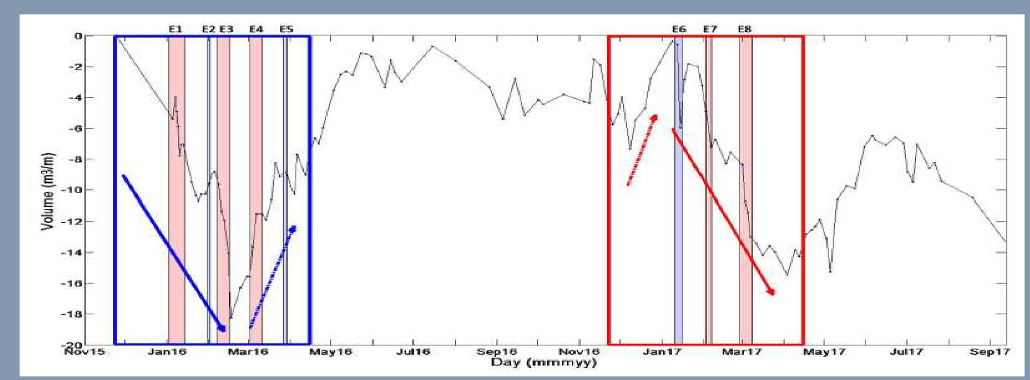
- ➢ Winter 2015/2016 (red):
  - ➢ Early first event accounting for 20% of the total energy
  - ➢ Overall increase energy
- ➢ Winter 2016/2017 (blue):
  - ➢ Later first event accounting for 20%
  - ➢ Energetic events with weak waves in between



- Erosive vs. Recovery events: sequencing

- ➢ Erosive events: always clusters
- ➢ Erosion of the supratidal beach and dune foot retreat
- ➢ Intertidal accretion (E3, E1)
- ➢ Intertidal erosion (E3, E4)
- ➢ Some energetic events could be characterized as recovery events
- ➢ E7: most energetic event of the winter 2016/2017 but not erosive
- ➢ Recovery of the upper beach, variable response of the intertidal beach



- ➢ Both winter experienced recovery events
- ➢ Winter 2015/2016:
  - ➢ First one between two erosive ones
  - ➢ Second ending the season
  - ➢ Erosion until February, followed by recovery
- ➢ Winter 2016/2017:
  - ➢ Just one event, opening the season
  - ➢ Recovery until January, then erosion

➢ **No post-storm recovery during the second winter: extremely weak conditions not efficient for beach reconstruction**

- Tide

- ➢ Spring tide:
  - ➢ High water level
  - ➢ Access to the upper beach, supratidal beach erosion
  - ➢ Reduced sediment export distance, possible intertidal accretion
  - ➢ Under high waves conditions: dune foot retreat
  - ➢ Under calmer conditions: no recovery
- ➢ Neap tide:
  - ➢ Low water level, reduced access to the upper beach even under storm conditions

Conclusions

- Higher hydrodynamic conditions in 2015/2016
- Same pre-winter profiles, and same erosion total volume rate
  - ➢ Overall increase in wave conditions in winter 2015/2016 while during the second winter, it only results from energetic events with very calm conditions in between.
- Different post-winter morphologies and mean profiles
  - ➢ Different processes involves: mainly cross-shore sediment exchanges during the winter 2015/2016
- Influence of post-storm recovery and sequencing
- Influence of tide

Perspectives

- Impact on seasonal recovery?
- Still high frequency data acquisition
- Including beach and dune evolutions of the winter 2017/2018

Acknowledgements

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