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Empirical parameterization of wave runup and dune erosion during storm conditions on a natural macrotidal beach

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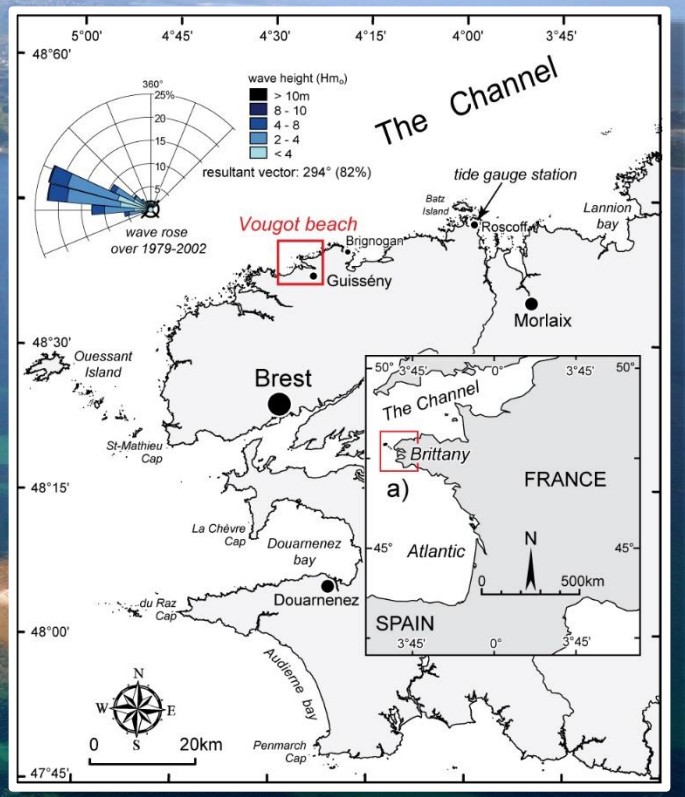
1. Context

Vougot beach



erosion

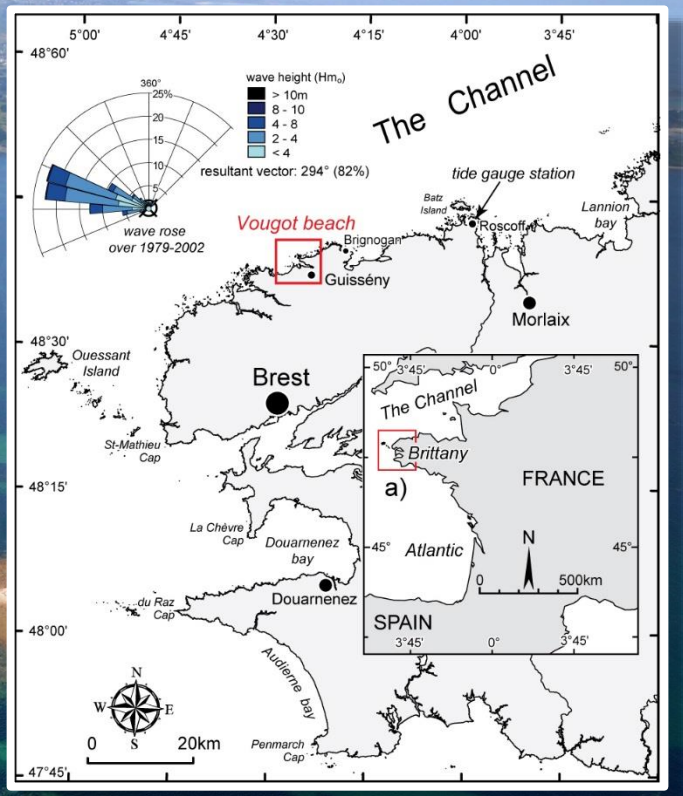
erosion

1. Context

Vougot beach

survey since 2004

- beach/dune profile at monthly time scale observation
- shoreline at annual time scale observation
- topographic and bathymetric (3D) at 3 to 5-years time scale observation
- hydrodynamic conditions (wave and water level) since 2012



1. Context

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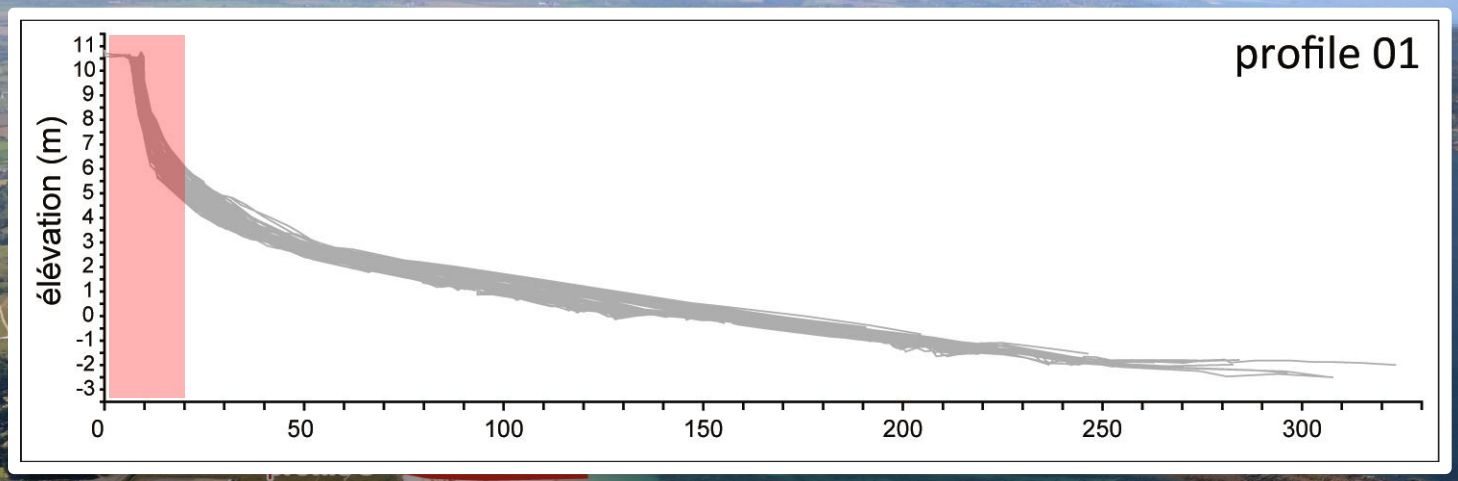
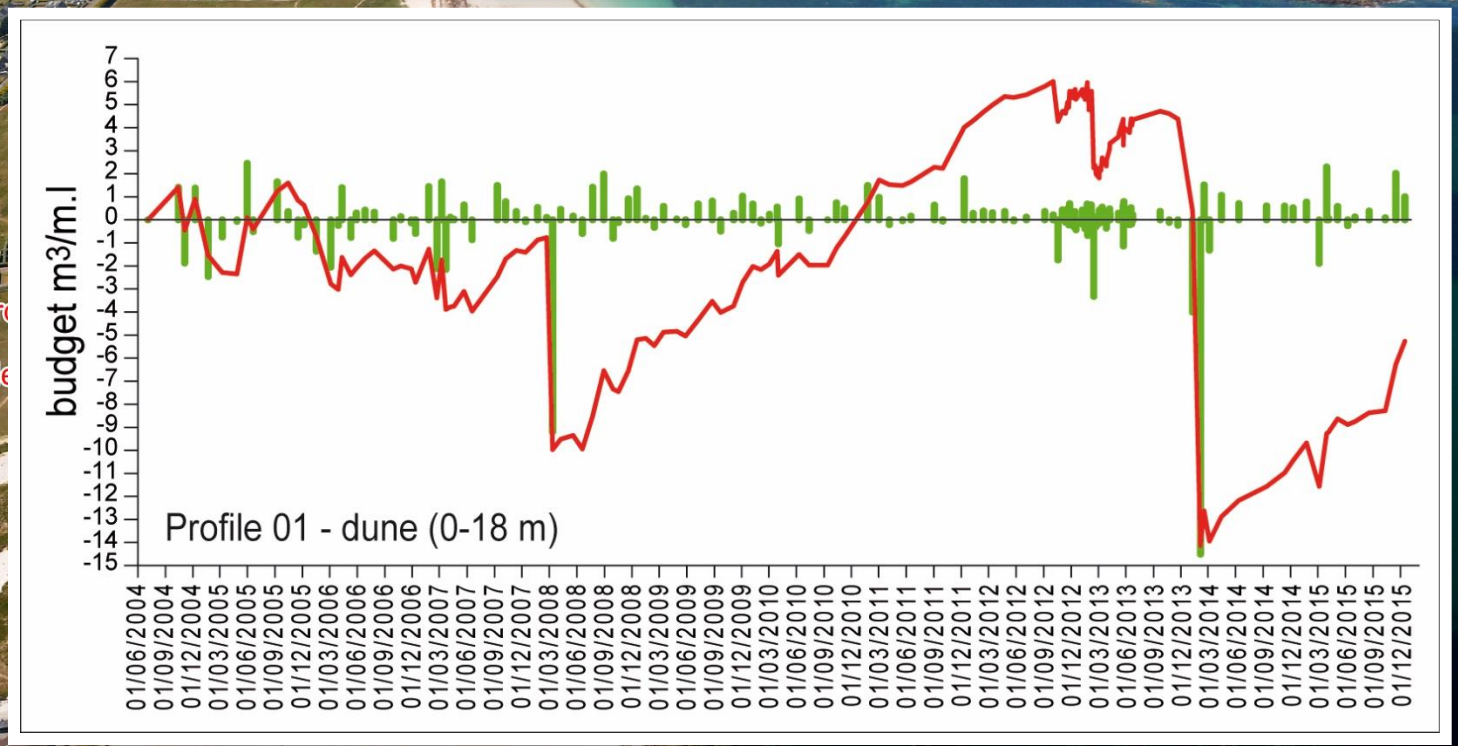

profile 01
élévation (m)
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
0
50
100
150
200
250
300


budget m3/m.l
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
Profile 01 - dune (0-18 m)
01/06/2004
01/09/2004
01/12/2004
01/03/2005
01/06/2005
01/09/2005
01/12/2005
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01/12/2014
01/03/2015
01/06/2015
01/09/2015
01/12/2015


01/02/2014 – 19h05

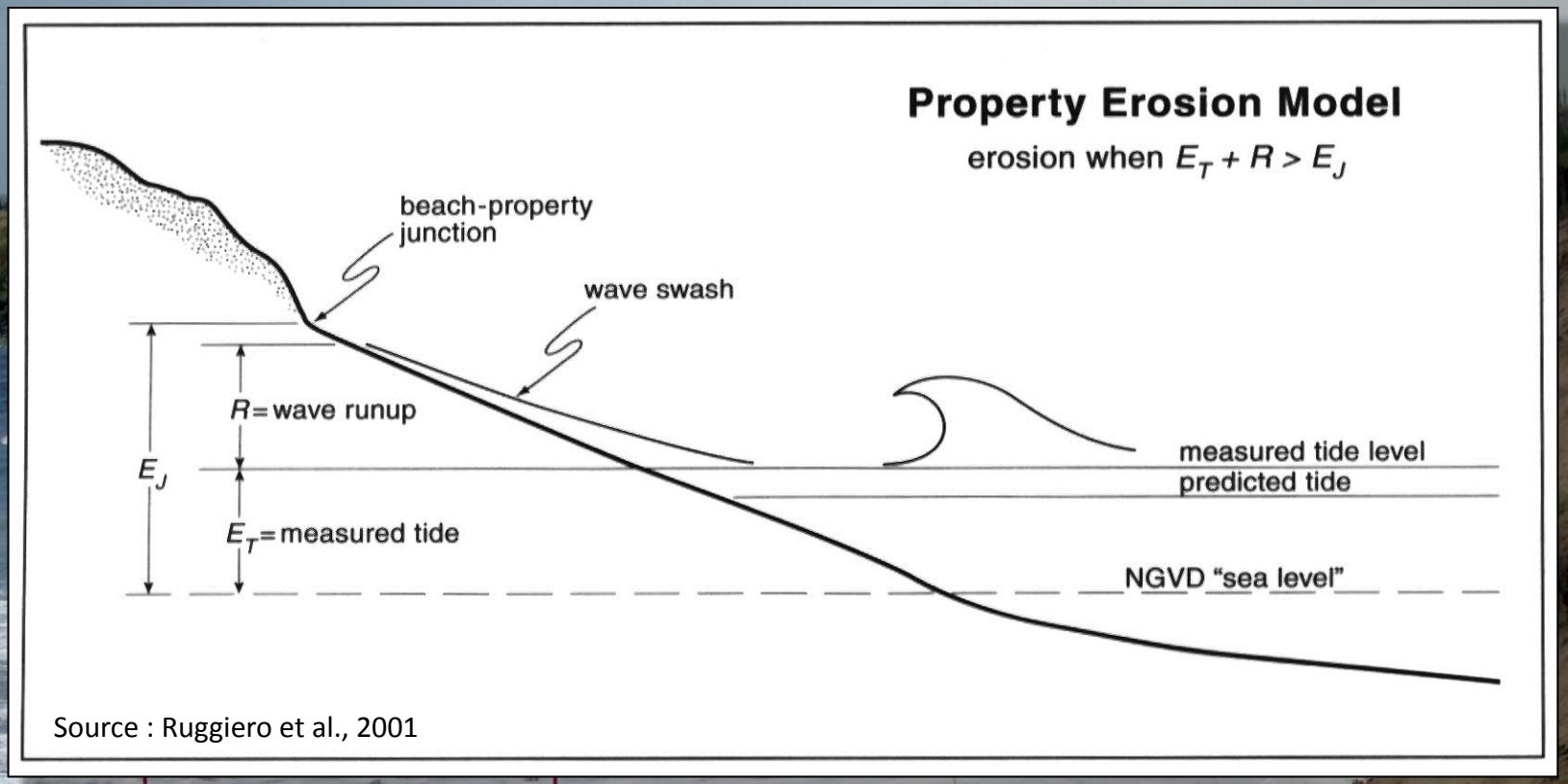

10/03/2008 – 19h20


03/03/2014 – 18h50

élévation (m)
budget m3/m.l
Profile 01 - dune (0-18 m)

2. Objectif

2. Objectif



Source : Ruggiero et al., 2001

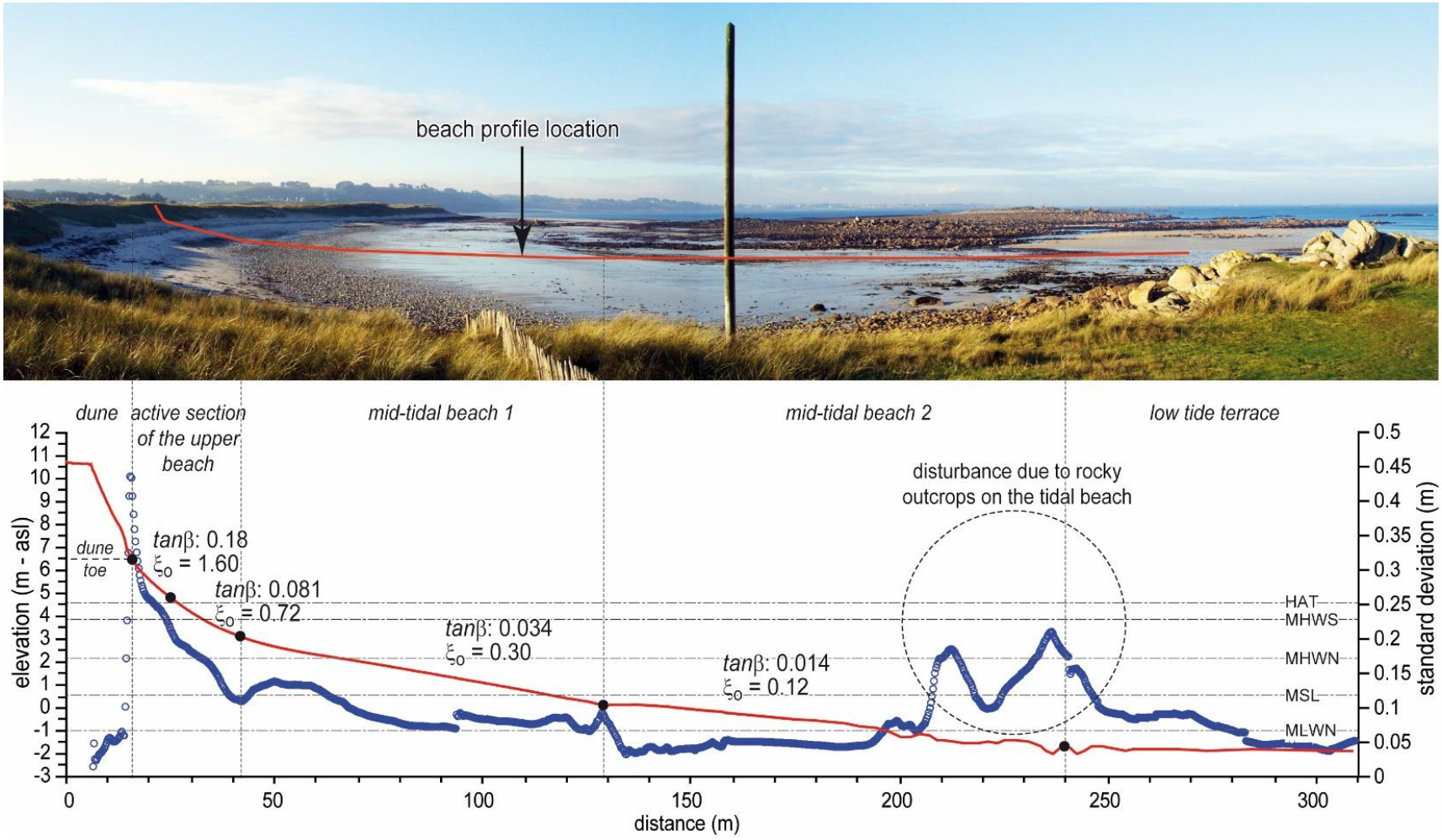
use of Battjes eq. derived from Hunt (1959) eq. including Iribarren number

$$\frac{R_T}{H_o} = C\xi_o \Rightarrow \xi_0 = \frac{\tan\beta}{(H_o/L_o)^{1/2}}$$

R_T : *runup*
H_o : wave height
C : constante
ξ_0 : Irribaren number

tanβ : beach slope
H_0 : wave height
L_0 : wave length

2. Objectif



complexity of defining the best slope when the beach exhibits composite-slope and/or a concave profile in a macrotidal environment (7 m tidal range)

$\Rightarrow$ different morphodynamic contexts depending on the water level at high tide

3. Methods

Method and data (see Cariolet and Suanez - *Coastal Engineering*. 2013, 74).

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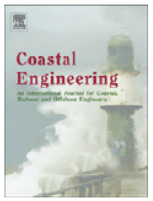

Runup estimations on a macrotidal sandy beach

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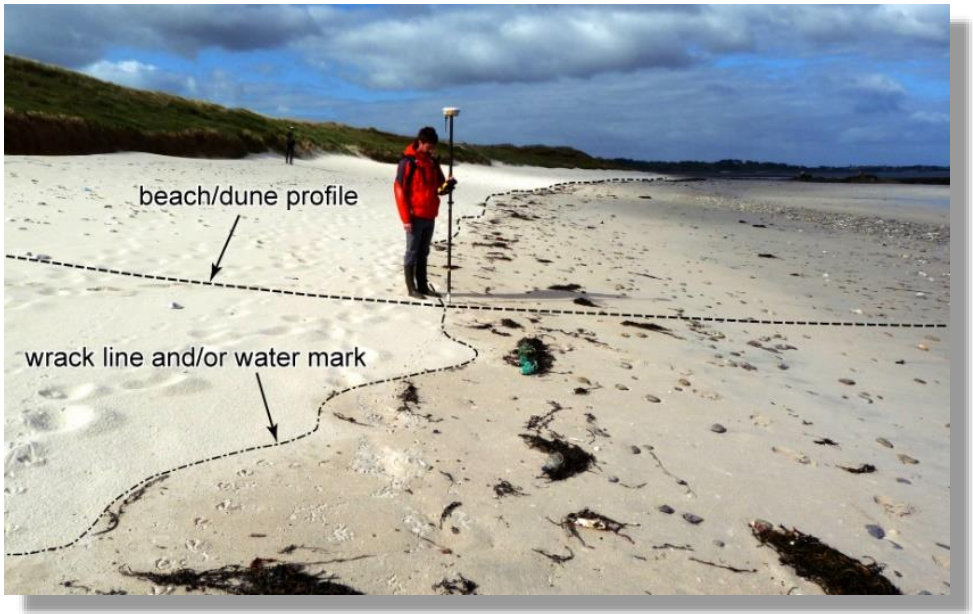
ABSTRACT

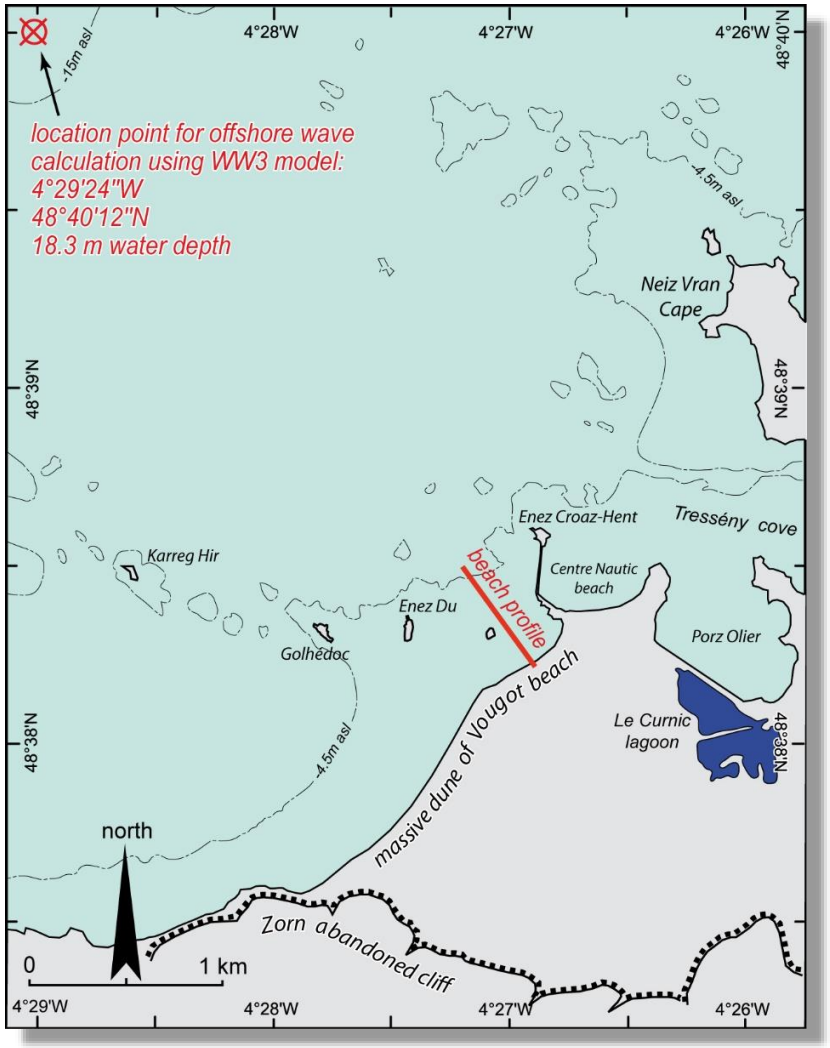
This paper presents a methodological approach to calculate runup from the analysis of morphodynamic conditions on a macrotidal sandy beach. The method is based on measurements of the elevation of high-tide deposits and on the analysis of morphological and hydrodynamic changes. A series of measurements has been carried out on the beach of Vougot (Brittany, France) under different wave conditions. This allowed to assess runup formula effectiveness on a macrotidal sandy beach and to determine the best slope parameters to estimate runup. The results suggest that on that macrotidal sandy beach the slope of the active section of the upper beach should be used instead of the entire slope of the foreshore, the latter resulting in an underestimation of runup elevations when used in predictive equations from the literature. Results obtained with widely used equations are relatively well correlated with observed values ($r^2 = 0.63$). An analysis of the relationship between observed runup elevations and various variables has enabled the establishment of a runup estimation formula with a relatively good fit to the study site ($r^2 = 0.86$).

3. Methods

Method and data (see Cariolet and Suanez - *Coastal Engineering*. 2013, 74).



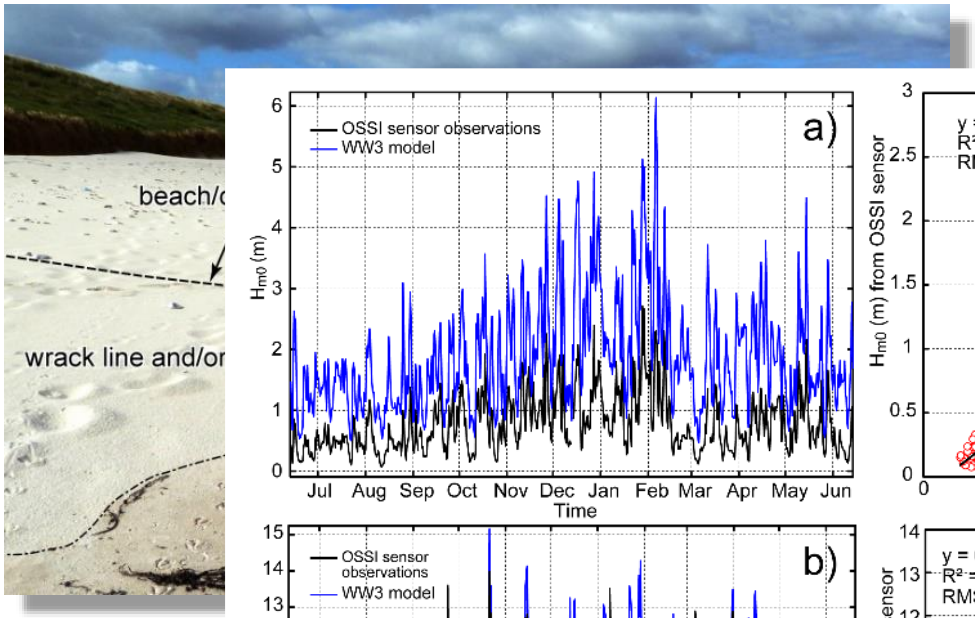
- measurement of beach profile + debris line and/or water mark as field runup limit



- offshore wave (H_0 and T_{pic}) using WW3 model

3. Methods

Method and data (see Cariolet and Suanez - *Coastal Engineering*. 2013, 74).

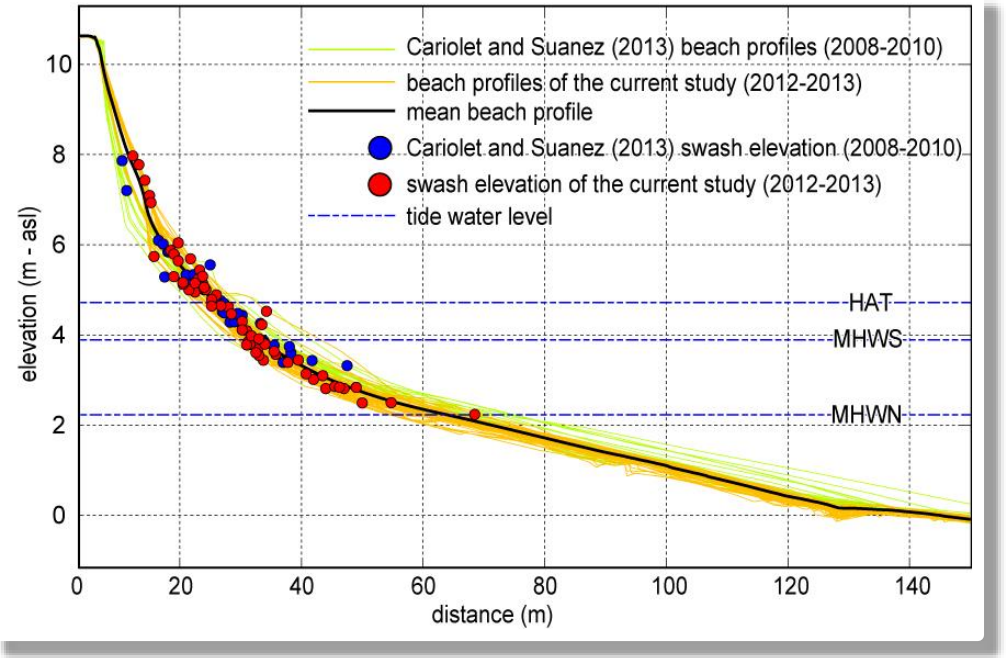


- measurem
  water mar

- offshore wave (H_0 and T_{pic}) using WW3 model

3. Methods

- tide level from field measurements + data obtained from tide gauge station of Roscoff (located at 30 km from Vougot beach) corrected for the study site ⇒ offset of 0.18 m

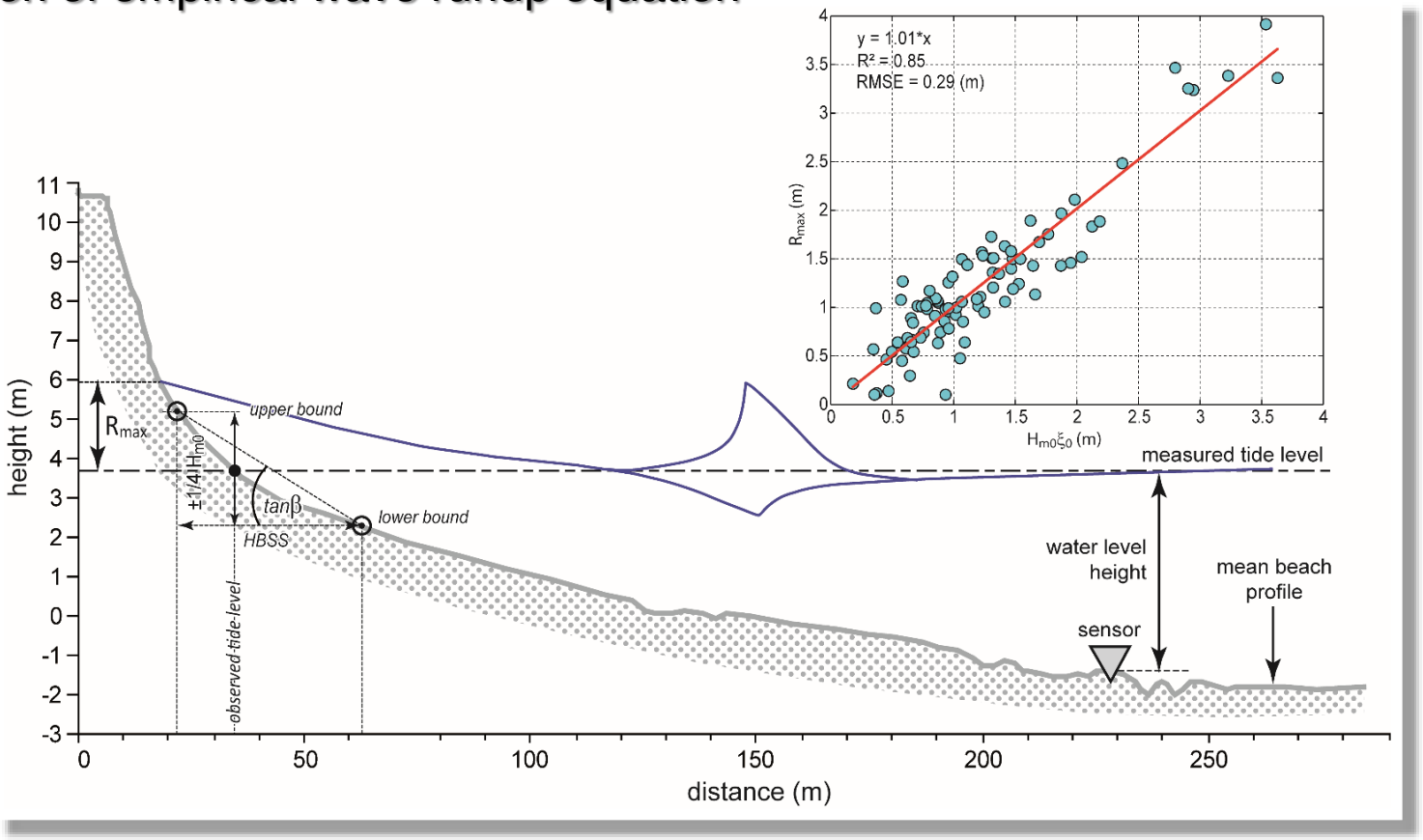


two set of data were used:

- 1rst campain between 2008-2010 (Cariolet and Suanez, 2013)
- 2nd campain achieved between 2012-2013 (current data)

4. Results

Calibration of empirical wave runup equation



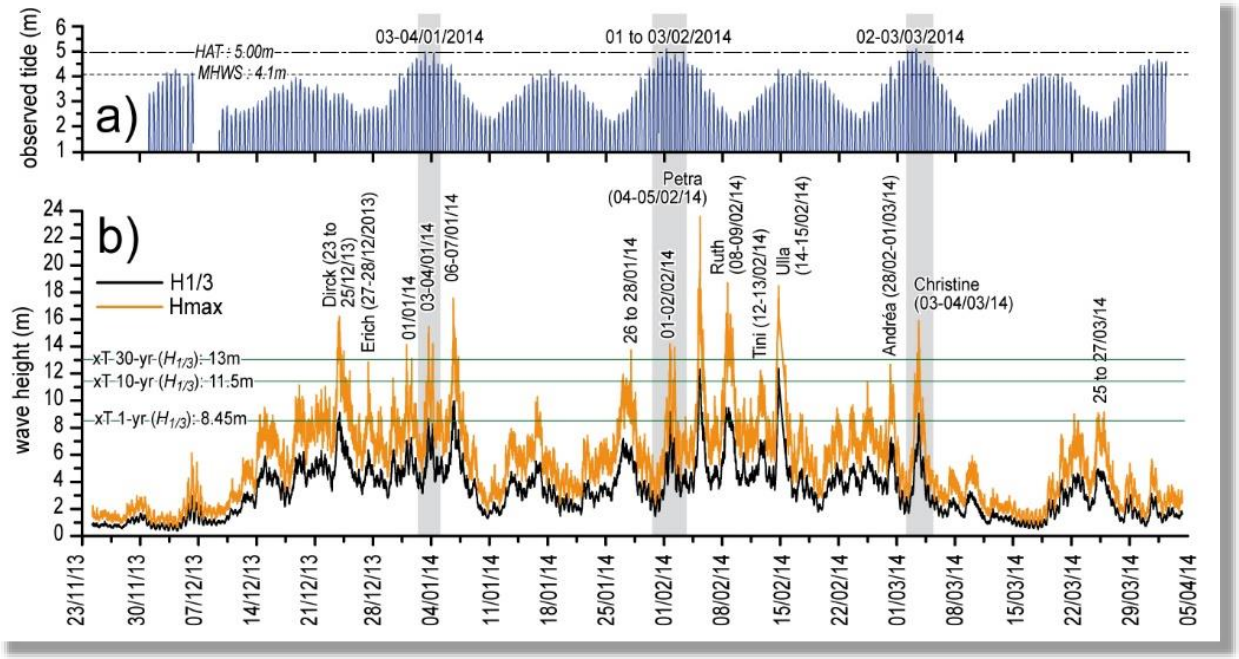
best fit for $R_{max} = 1.01\ H_0\xi_0$ where beach slope is calculated on a beach width section (Horizontal Beach Slope Section) limited by:

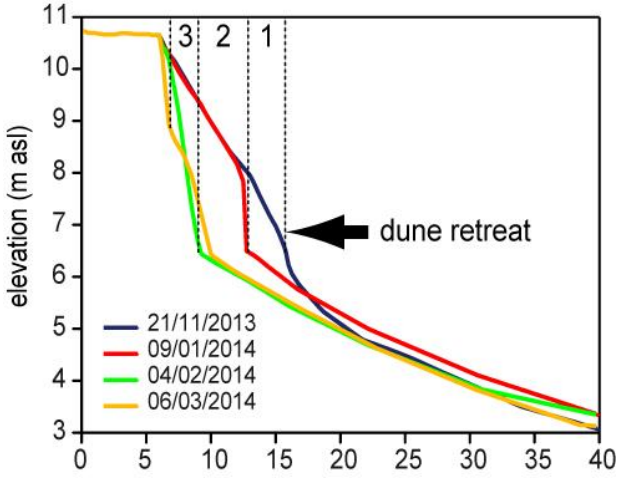
$$Bound_{up\ and\ low} = HTWL \pm \frac{1}{4}H_0$$

where $HTWL$ is High Tide Water Level, and H_0 is offshore wave height

4. Results

Winter Storm 2013-2014 test case

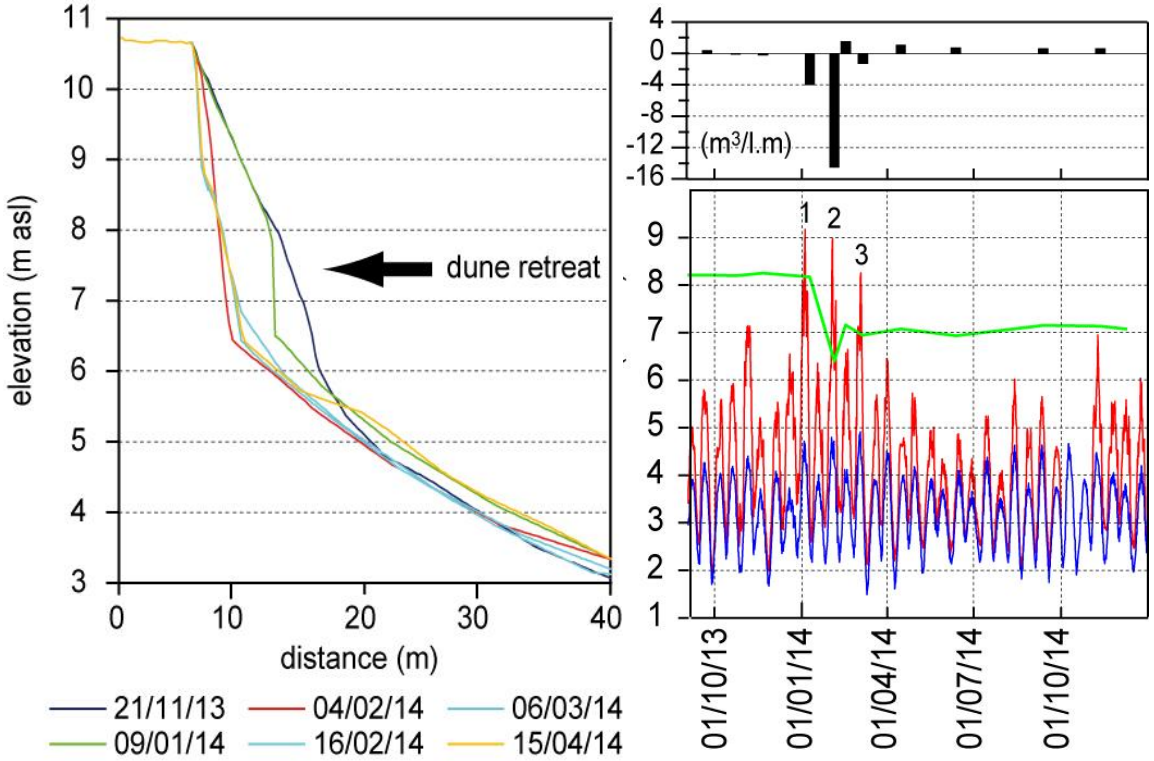




1 : storm event 3-4 January
2 : storm event 1-3 February
3 : storm event 2-3 March

Blaise et al. (2015)

Winter Storm 2013-2014 test case



1 : storm event 3-4 January
2 : storm event 1-3 February
3 : storm event 2-3 March

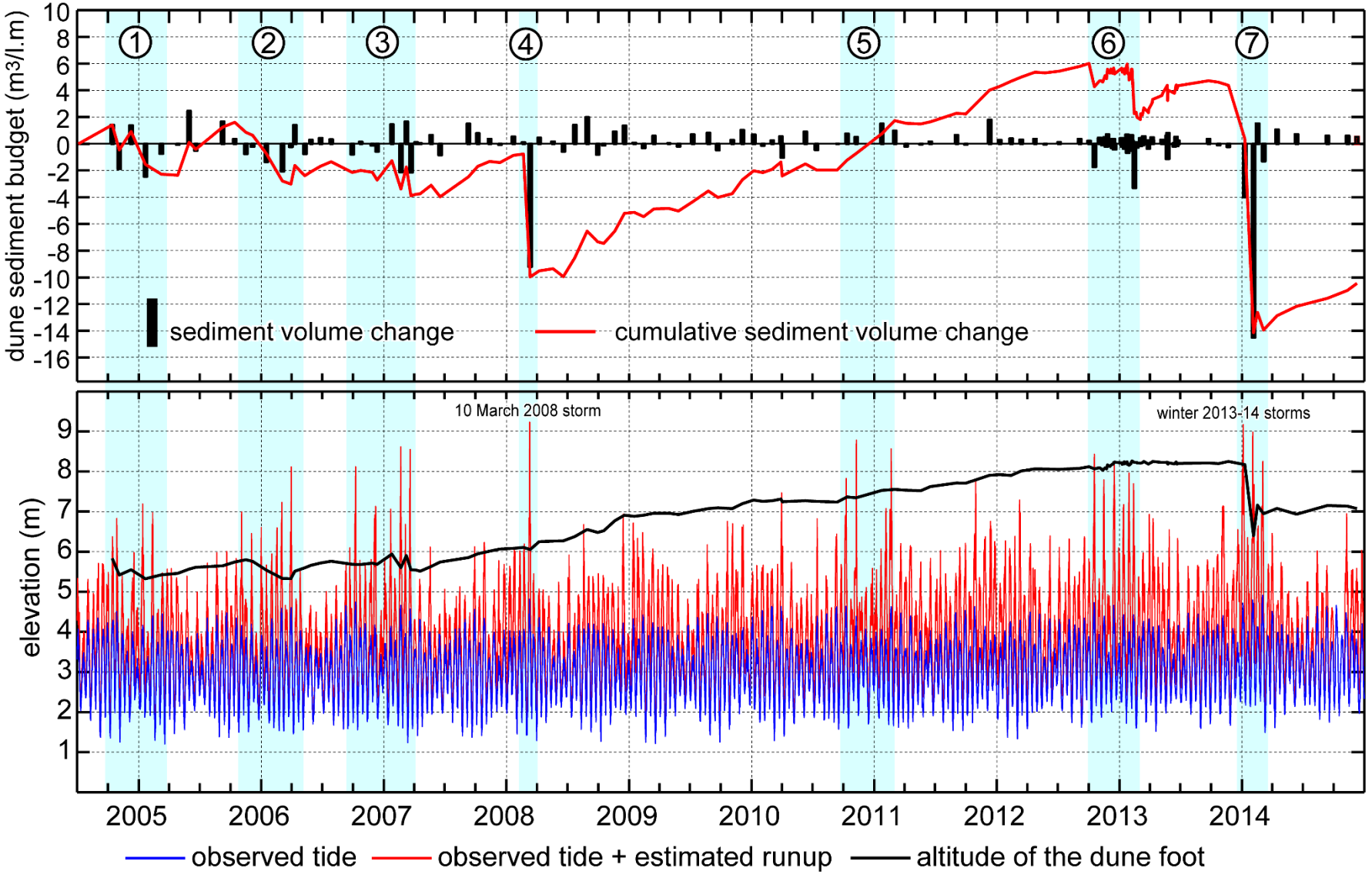
: dune foot height

: observed tide

: observed tide + runup (extreme water level)

5. Perspectives

Long-term observation




Thank you for your attention
Christine storm event
of 3 March, 2014