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300 ans d'hydrographie

IMPROVING STORM SURGE AND WAVE FORECASTS FROM REGIONAL TO NEARSHORE SCALES

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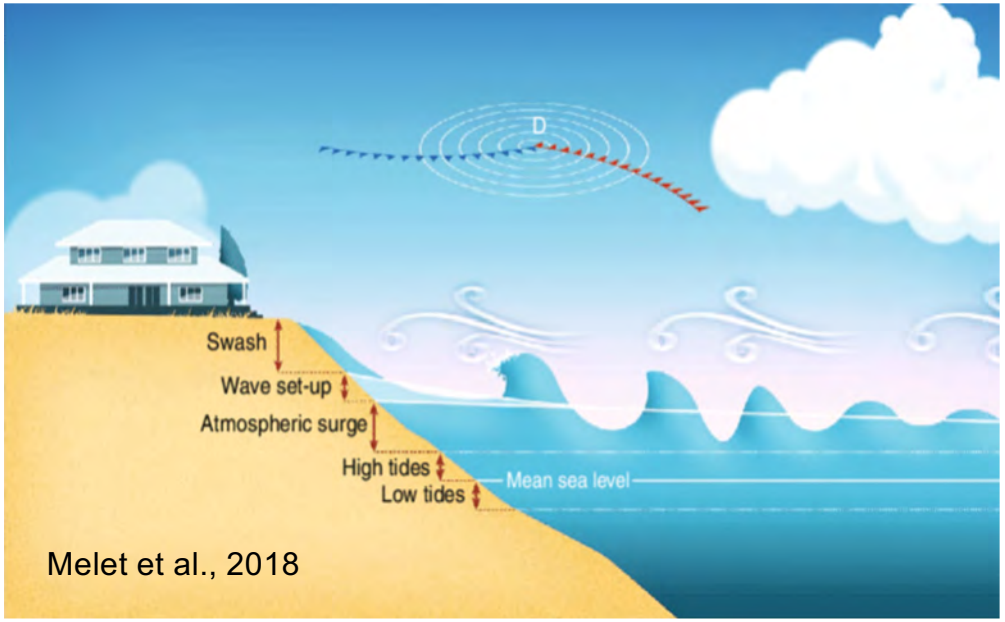
The challenge of marine flooding forecast

Marine flooding processes



Melet et al., 2018

Shom expertise for marine risk assessment

Ocean observations

- Tidal operational networks and databases
- Field campaigns

Bathymetry

- Bathymetry acquisition and DEMs production

R&D and operational modelling capacities

- 2D/3D circulation models (Hycom, Croco)
- specific tides, surge and currents models (Hycom,Tolosa)
- Wave spectral models (Wavewatch III - WW3)

Tides and extreme levels analyses

- Expertise in tidal signal analysis
- Extreme levels statistics (Storm events, long hindcasts analysis, Sea level rise)

Its mission of support to coastal public policies in flooding risk prevention :

- Regional (HOMONIM/VVS, NIVEXT,...)
- Local initiatives (PAPI Saint-Malo, VIMERS…)

How to improve well-proven and operated tools to multiscale submersion forecast ?

Well proven numerical tools and observations

Example of Atlantic coast capacities

Numerical modelling

HR regional configurations

- Wavewatch III ® and Hycom2D
- storm surge: curvilinear grid at ~500m/1km
- wave: unstructured grid at ~200/400 m nearshore, forced by current/elevation

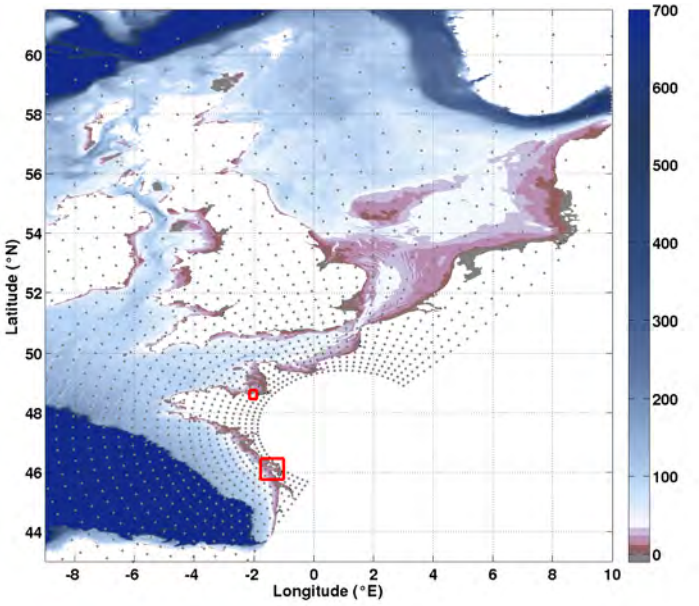
THR local configurations

- coupled Wavewatch III ® and Hycom2D at ~30m

HR configuration & bathymetry with locations of THR grids (in red)

Simulations

- 40-years hindcast (HR-ERA5)
- Storm events (HR-MF, THR-Charentes and THR-Malo)



Observations

Sea Level network

RONIM : permanent digital coastal tide gauge network on the French coast

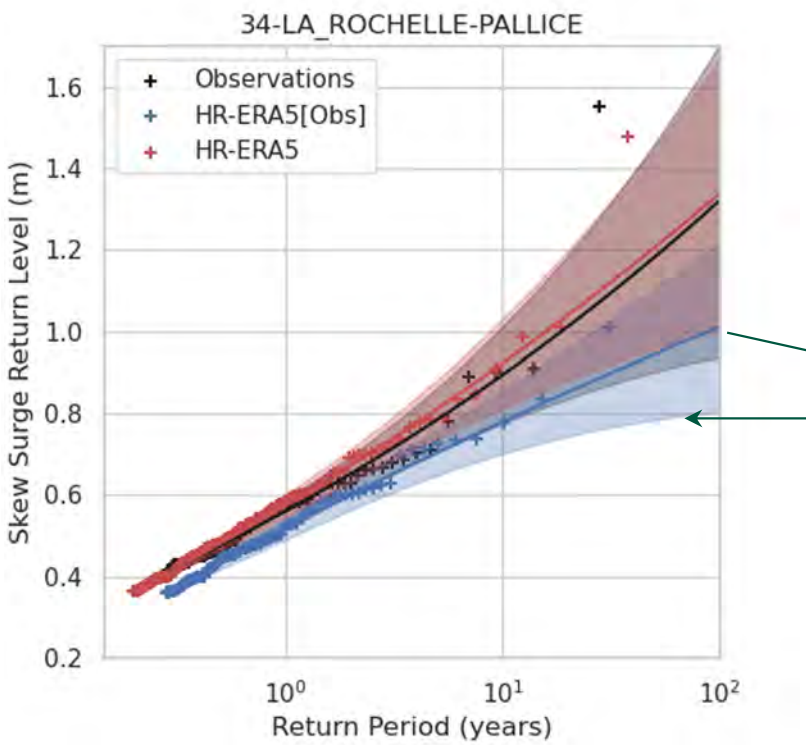
Wave network

CANDHIS : French National Wave Data Centre (CEREMA)

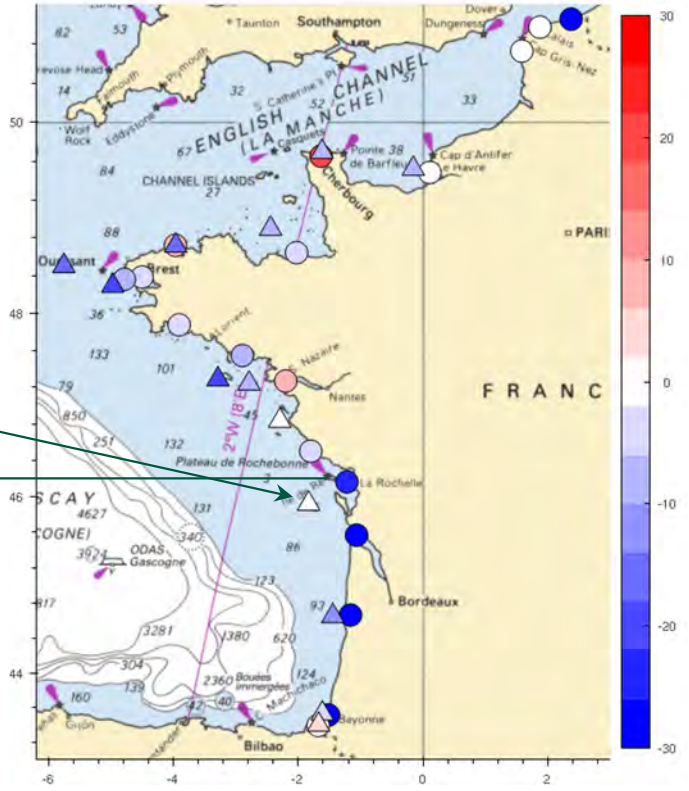
Networks of tide gauges (black circles) and wave buoys (blue triangle) (only instruments with more than 10 years of data are represented)

Storm Surge and Wave 40 years hindcast at regional scale

Skew surge return level in function of the return period at the tide gauge of La Rochelle



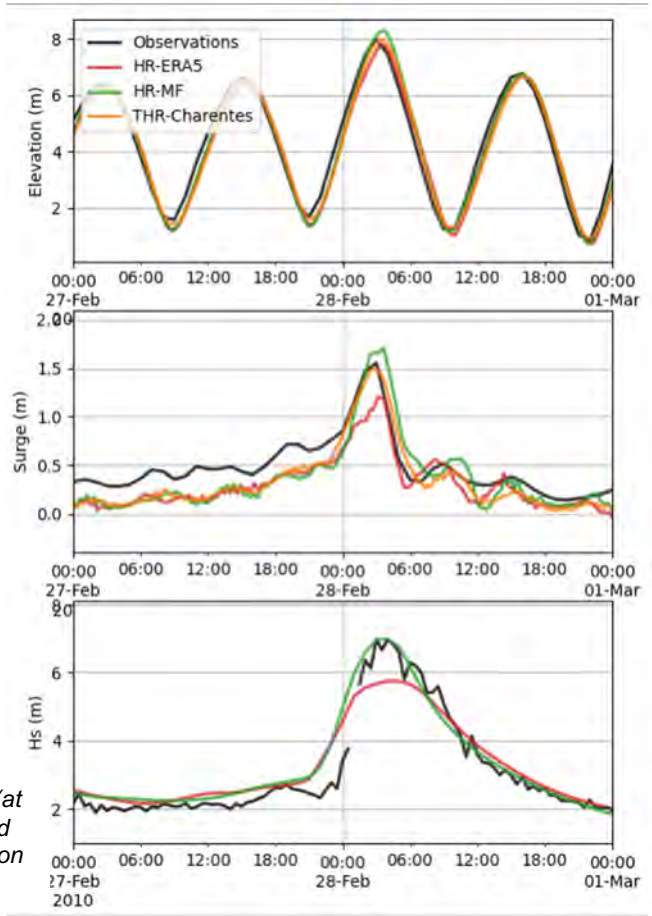
Difference (in %) on the Hs (in triangle for wave buoys) and skew surge (in circle for tide gauge) between simulation and observation for the calculation of the 100 years return period



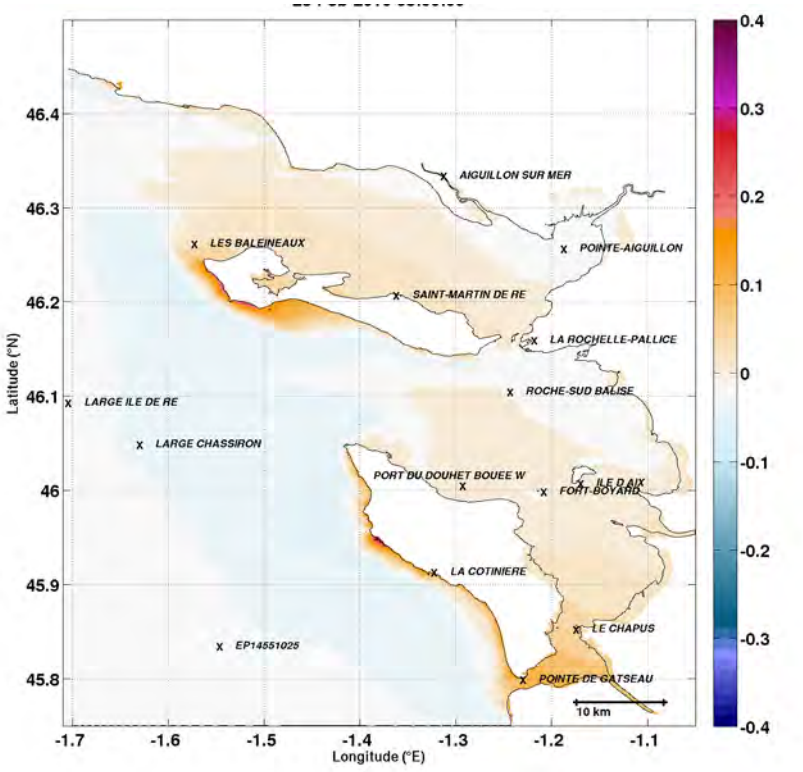
In : 40 years of regional Storm Surge and Wave Hindcasts : Application to coastal flood risks along the Atlantic French coast. Seyfried et al. (in progress)

Storm Surge and Wave modelling from regional to local scale

Xynthia storm in Pertuis Charentes (2010/02)



Time series of elevation and surge (at La Rochelle Pallice tide gauge) and Hs at Oleron Buoy (west of the Oleron Island)

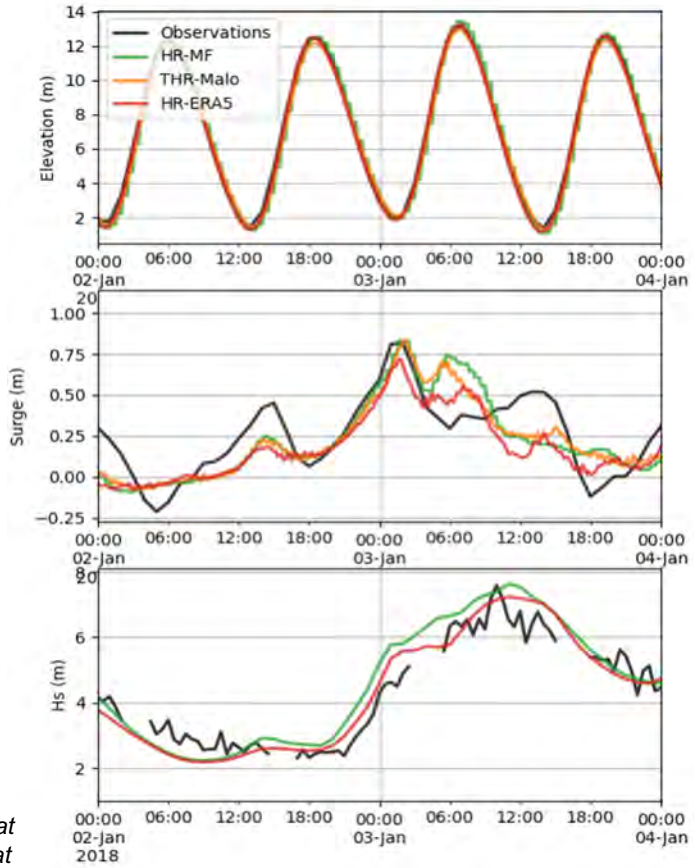


Wave setup (m) at the storm apex (28 Feb 2010 3:00) for the THR Hycom simulation

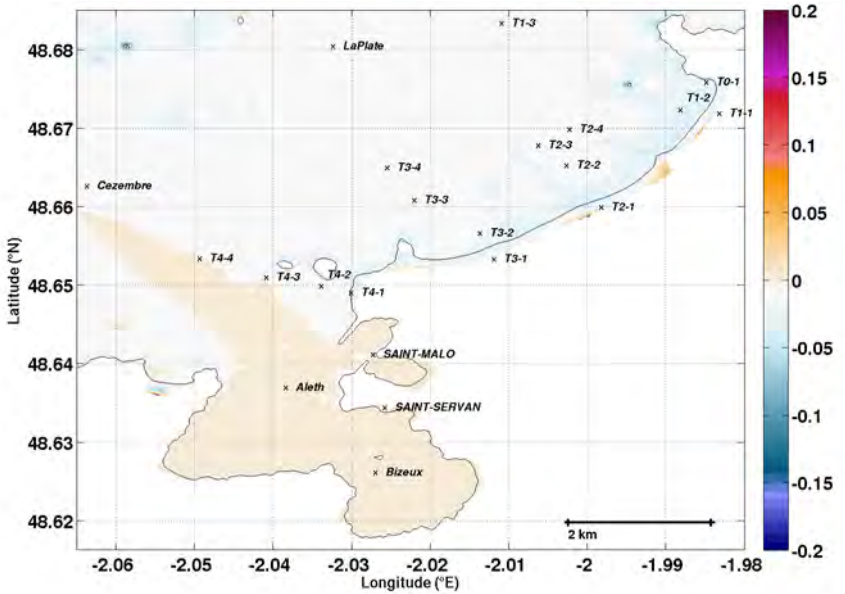
Described in Michaud et al., WHF 2015

Storm Surge and Wave modelling from regional to local scale

Eleanor storm in St Malo (2018/01)

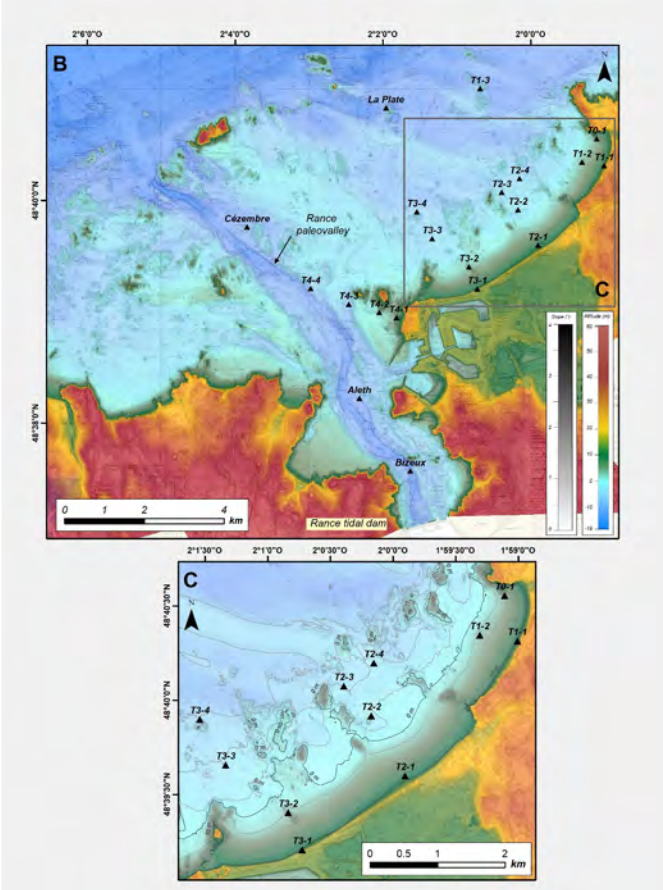


Time series of elevation and surge (at St Malo tide gauge) and Hs at Bréhat buoy 02204 (north of St Malo)



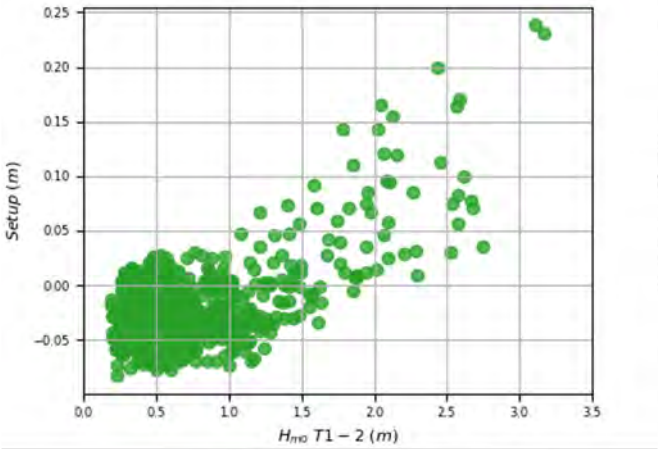
Wave setup (m) at the storm apex (3 Jan 2018 7:00 AM high tide)

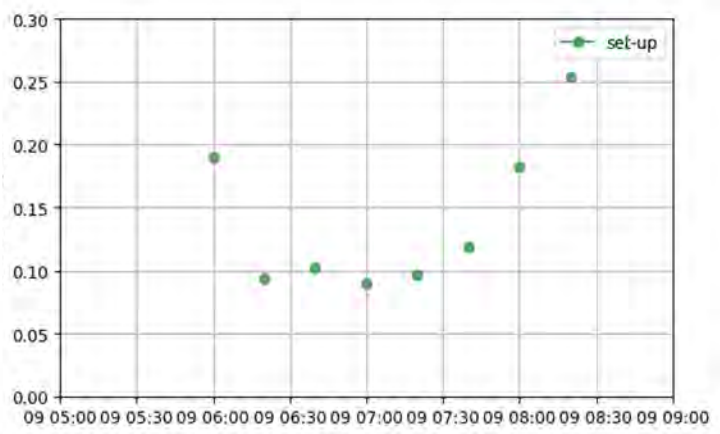
Improving processes knowledge at local scale

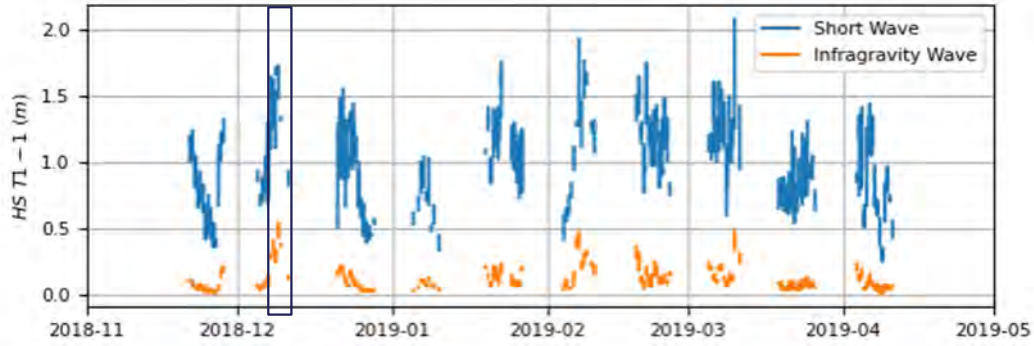


Morpho-bathymetry and moorings positions in the Saint-Malo bay

s at T1-1 wave pressure gauge







In: Topo-bathymetric and oceanographic datasets for coastal flooding risk assessment : French Flooding Prevention Action Program of Saint-Malo. Seyfried et al. (in progress)

Perspectives : From flooding risk forecast to actual flooding assessment...

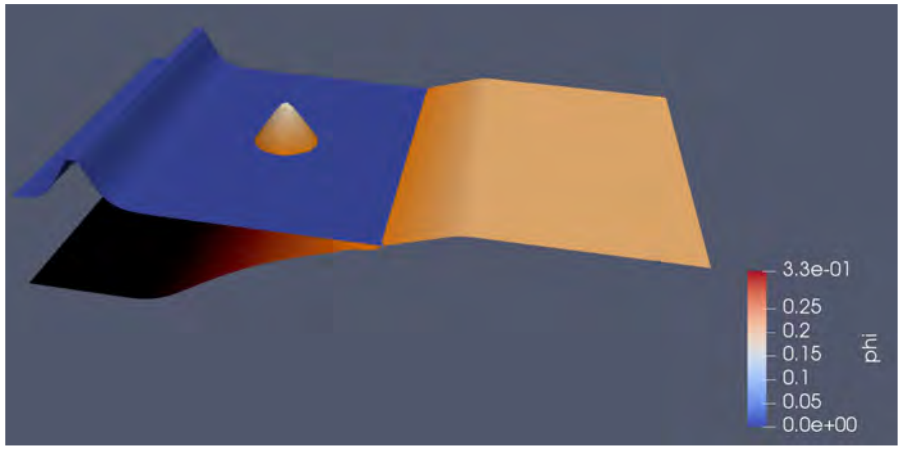
Ultra high resolution modelling

Improve nearshore processes modelling (IG waves, overflows, set-up/run-up, wave breaking ...)

TOLOSA : non structured shallow water model (Duran et al., 2020)

with a non-hydrostatic module (Richard, 2020) for explicit wave modelling

- UHR modelling at nearshore scales
- 2D/1D and river/sea dynamics (estuaries modelling)
- Overflow modelling with available topo/bathy data



Perspectives : From flooding risk forecast to actual flooding assessment...

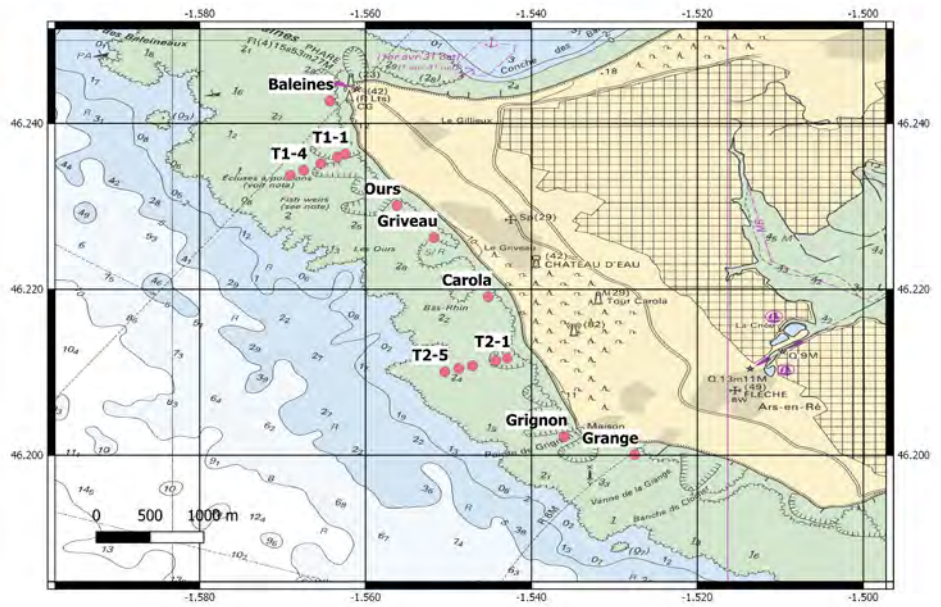
The need of observations

Importance of in situ data :

- to calibrate/validate models but also
- to improve knowledge of the physical processes

As for numerical modelling, the need is at HR and THR scales :

- Dedicated in situ campaign
- Need of an “operational” densified network adapted for the surge measurements



The RiCoRé campaign (winter 2020-2021) at Ré Island (Moorings of some of the 32 pressure sensors installed on Ars en Ré beach are in red circles). In collaboration with GLADYS, LEGOS, LIENSs universities

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THANK YOU !