Improving the French storm surge prediction models by using Copernicus Marine Service products

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Background and Objectives

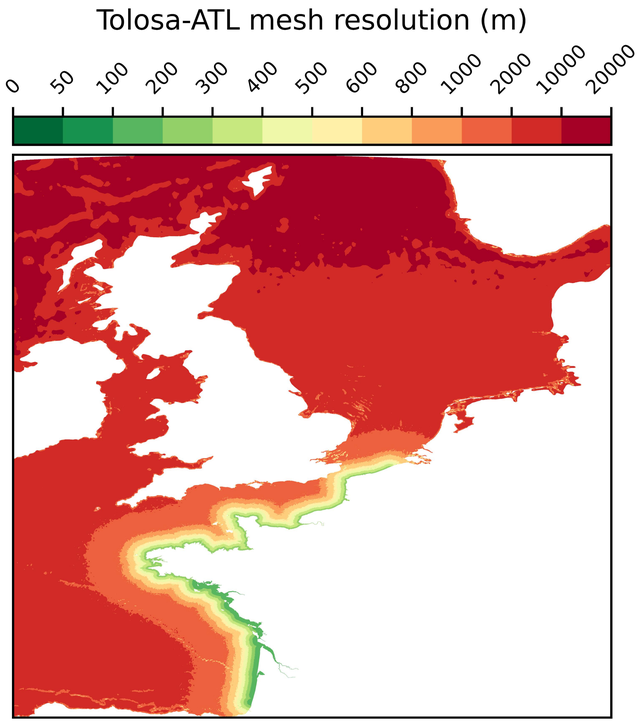
• Since autumn 2024, the French national surge system has been based on the shallow water configuration of the Tolosa toolbox (https://tolosa-project.com/) for the Atlantic French coast

→Waves and baroclinic effects not represented in the simulations

• Work ongoing in the FOCCUS project (https://foccus-project.eu/) to improve the forecasting system by using the Copernicus Marine Service products:

– GLO-ANFC, the global ocean analysis and forecast system

– IBI-ANFC, the regional system covering the Atlantic waters (Iberia-Biscay-Ireland)



Methodological Framework

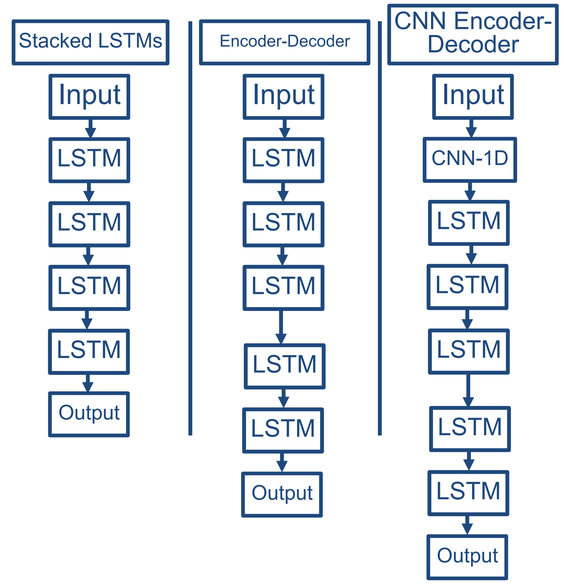
1. Development of a machine learning-based calibration method

Objective: correct surge bias through Machine Learning

- Gradient-Boosting Random Forests
- Long Short-Term Memory models (stacked LSTM, Encoder-Decoder LSTM, and CNN-Encoder-Decoder)

Features include

- 3D dynamics from Copernicus Marine Service IBI-ANFC system
- Meteorological data from Météo-France's ARPEGE atm. model
- Sea state data extracted from WW3 operated by Météo-France



Methodological Framework

2. Extraction of physical processes from large-scale CMS products

Objective: Filtering the low-frequencies in IBI or GLO systems

- Available in GLO-ANFC “sl-merged” product (hourly, 2D)

  ex: Dynamic sea level variations or steric sea level variations, excluding tides and atmospheric forcings

- Extracted from IBI-ANFC
  - FFT over the entire spatial domain in the IBI-ANFC system
  - Cutoff chosen by minimizing the bias of the reconstructed signal with surge “observations”

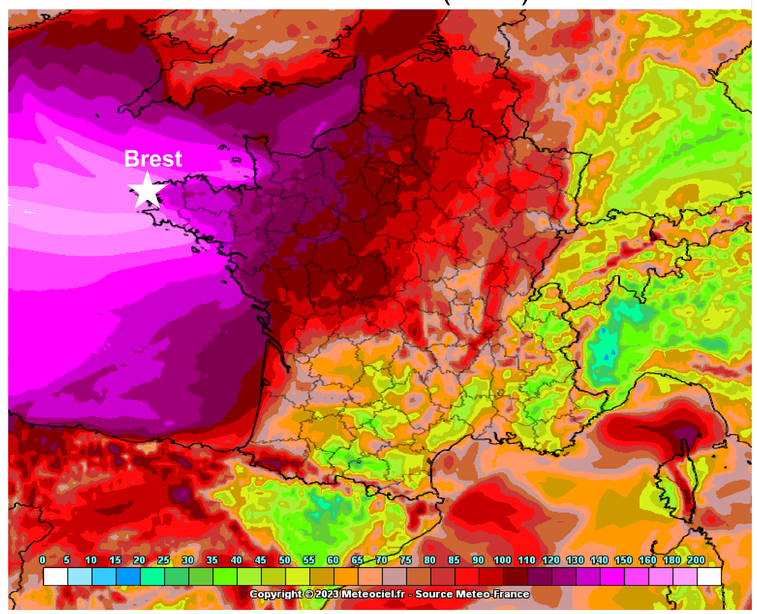
Methodological Framework

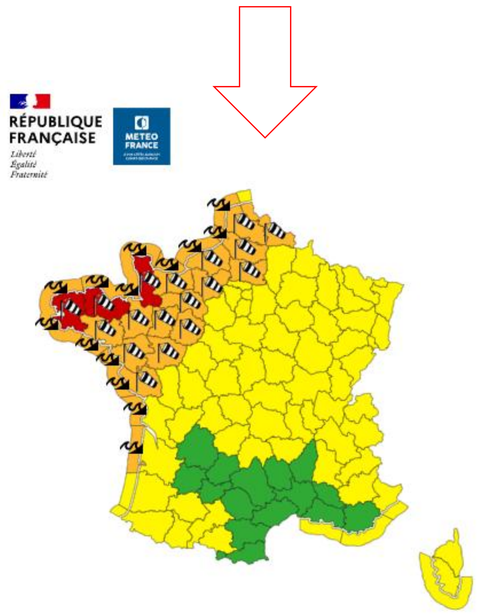
1. Development of a machine learning-based calibration method
2. Extraction of physical processes from large-scale CMS products

→ Comparison with 1D-observations from the RONIM network (https://data.shom.fr/donnees/refmar) to assess the results.

Focus on Brest, hit by several major storms during the winter of 2023 (Ciaran, Domingos, …)

CIARAN storm
ARPEGE winds forecast 0,1°
02/11/23 10:00 (+99h)





Warning issued on
01/11/23 by Météo-France