# Ensemble-Based Storm Surge Forecasting System for the French Atlantic Coast

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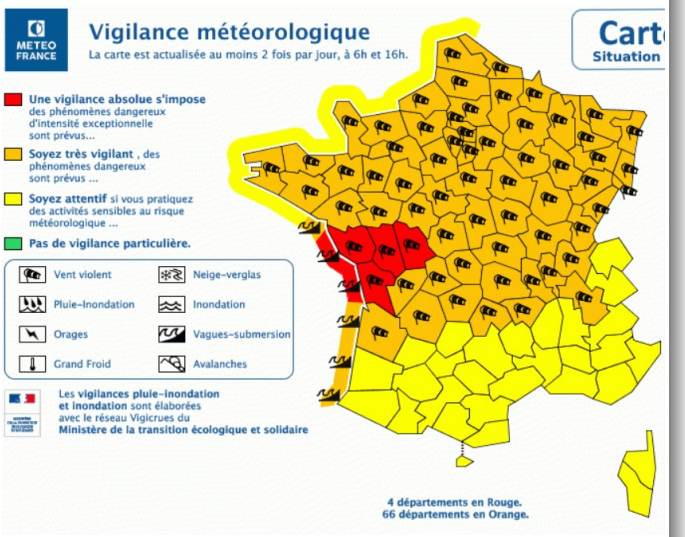
## Introduction

- The HOMONIM project, led by SHOM and Météo-France, aims to improve storm surge and wave forecasts to enhance the marine submersion warning system.
- As part of this project, a new operational storm surge ensemble forecasting system was launched for the French Atlantic coast (Nov 2024).
- The ensemble forecasting system is based on the TOLOSA-sw.



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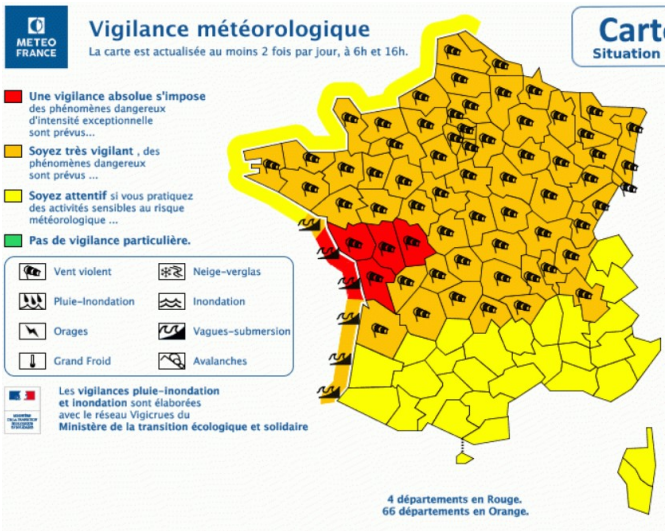
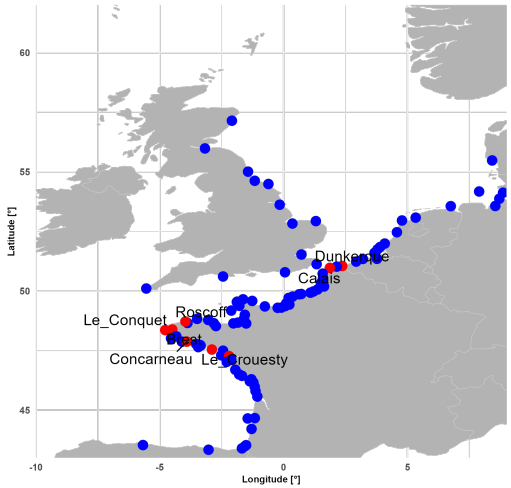
- The ensemble forecasting system is based on the TOLOSA-sw.
- Atmospheric forcing: 10 m wind and mean sea level pressure from PEARP (35 members)
- Outputs: Forecasts up to 102 hours lead time, with a 10-minute temporal resolution, for 102 sites along France's Atlantic coast.
- Update frequency: 00h, 06h, 12h, and 18h.



**Goal 1:**

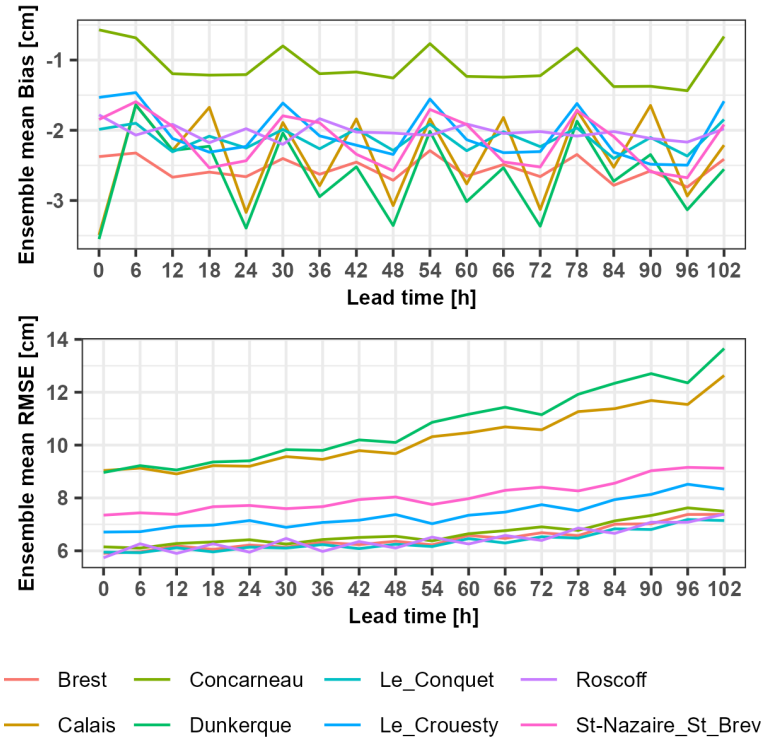
- Assessment of the performance of the ensemble storm surge forecasting system

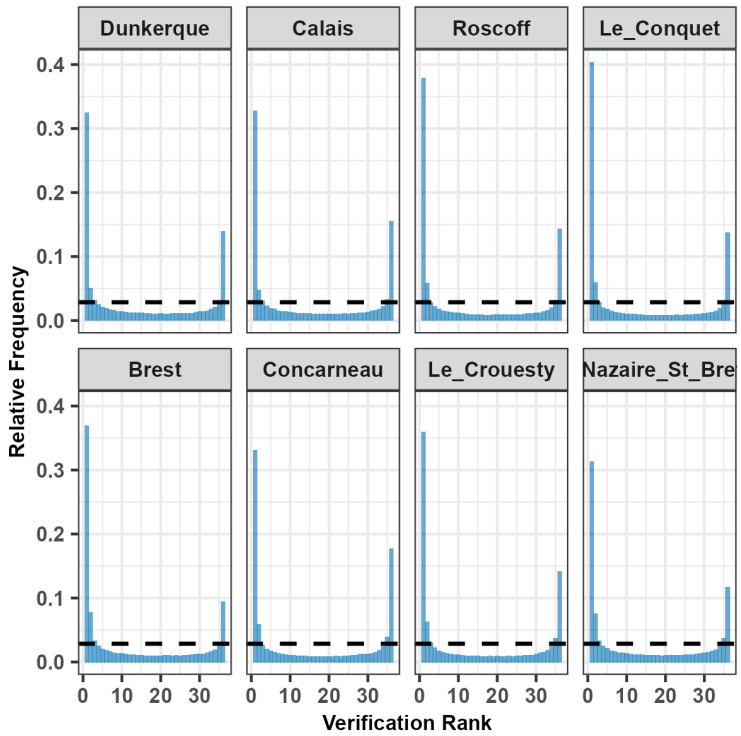
**Data**

- 4-year simulation of ensemble storm surge forecasts (2021-2024).
- Tide gauge data from eight stations, provided by SHOM.

## Raw Ensemble Forecast Assessment

- RMSE increases with forecast lead time, with larger errors on the eastern coast of the English Channel (Dunkerque and Calais).
- Rank histograms show underdispersion (U-shape), with observations often either below or slightly above all ensemble members.



**Goal 2:**

- Post-processing of raw ensemble forecasts with the aim of reducing biases and improving dispersion.

**Additional Data (predictors)**

- Wave parameters from the WW3 model
- Mean sea level pressure and 10-m wind from Météo France deterministic atmospheric model (ARPEGE)
- The dataset is partitioned with the 2021–2023 period for training and validation, while 2024 is reserved as an independent test set

**Methods**

- Ensemble Model Output Statistics (EMOS)
- Distributional Regression Networks (DRN)
- Quantile Regression Forests (QRF)

## Results

- PIT diagrams indicate that calibration, regardless of the method, improves dispersion and reduces bias at Calais, a trend observed at other sites as well.