ANEMOC-3

Assessment of storm events in the north-eastern Atlantic ocean with ANEMOC-3 hindcast numerical wave database

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4TH INTERNATIONAL WORKSHOP ON WAVES, STORM SURGES, AND COASTAL HAZARDS

Incorporating the 18th International Waves Workshop

Wave hindcast numerical database: a real need

The knowledge and understanding of usual and **extreme sea states** is essential:

- Coastal protection design
- Offshore Wind Turbines design and operation
- Morphodynamical processes, as erosion and deposition
- Energy resources identification
- Offshore industry.

➔ *In situ* (e.g. wave buoys) and satellite measurements are essential, but not sufficient to fulfil all our needs

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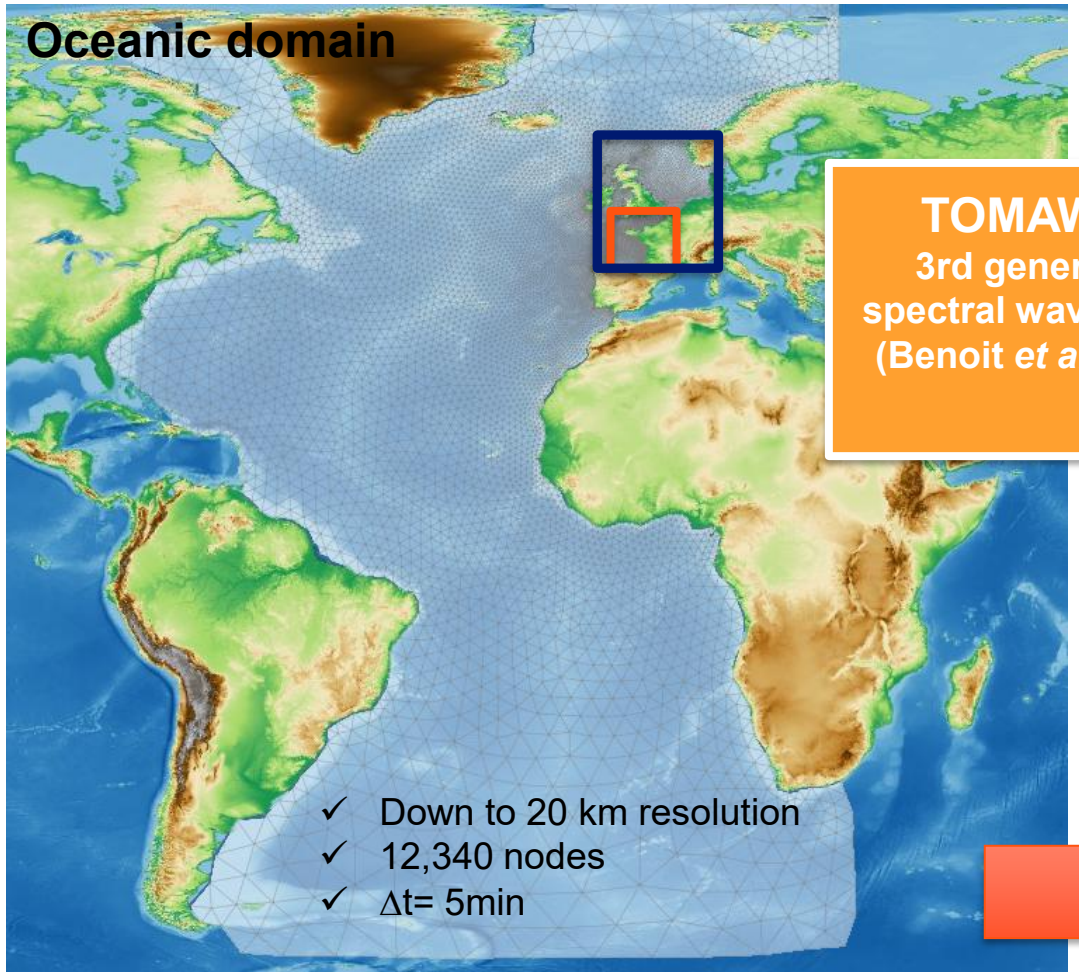
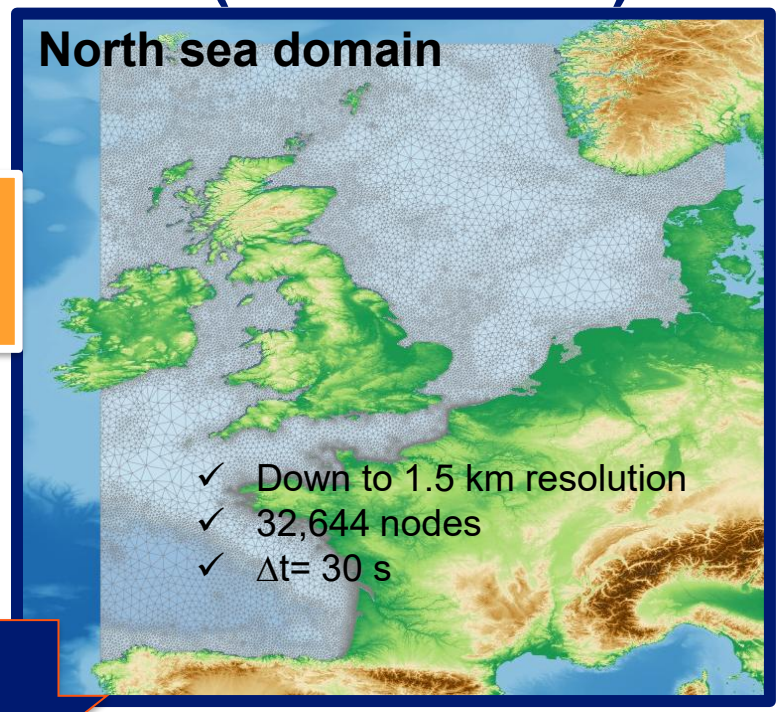
ANEMOC-3 hindcast wave numerical database

ANEMOC-3: Oceanic, North Sea and Coastal domains (1979 -2024)



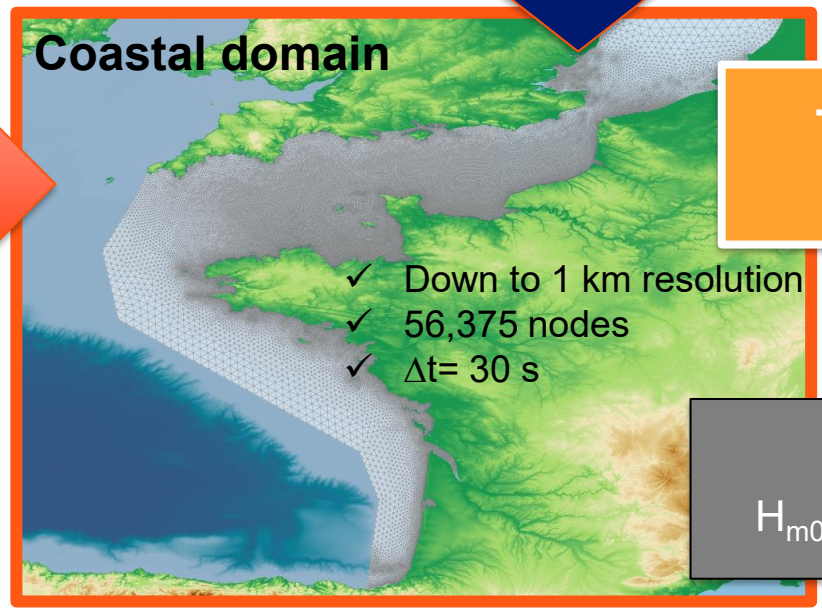
TOMAWAC
3rd generation spectral wave model (Benoit *et al.*, 1996)

TELEMAC-2D



Water levels and currents each 15 min

Wave spectra each hour



TELEMAC2D ➔ TOMAWAC

All domains:

Bathymetry: GEBCO + LEGOS (near the coast)

CFSR & CFSv2 re-analysis wind and pressure

30 min output:
H_{m0}; T_p; T_{m01}; T_{m02}; Dir_m; σ

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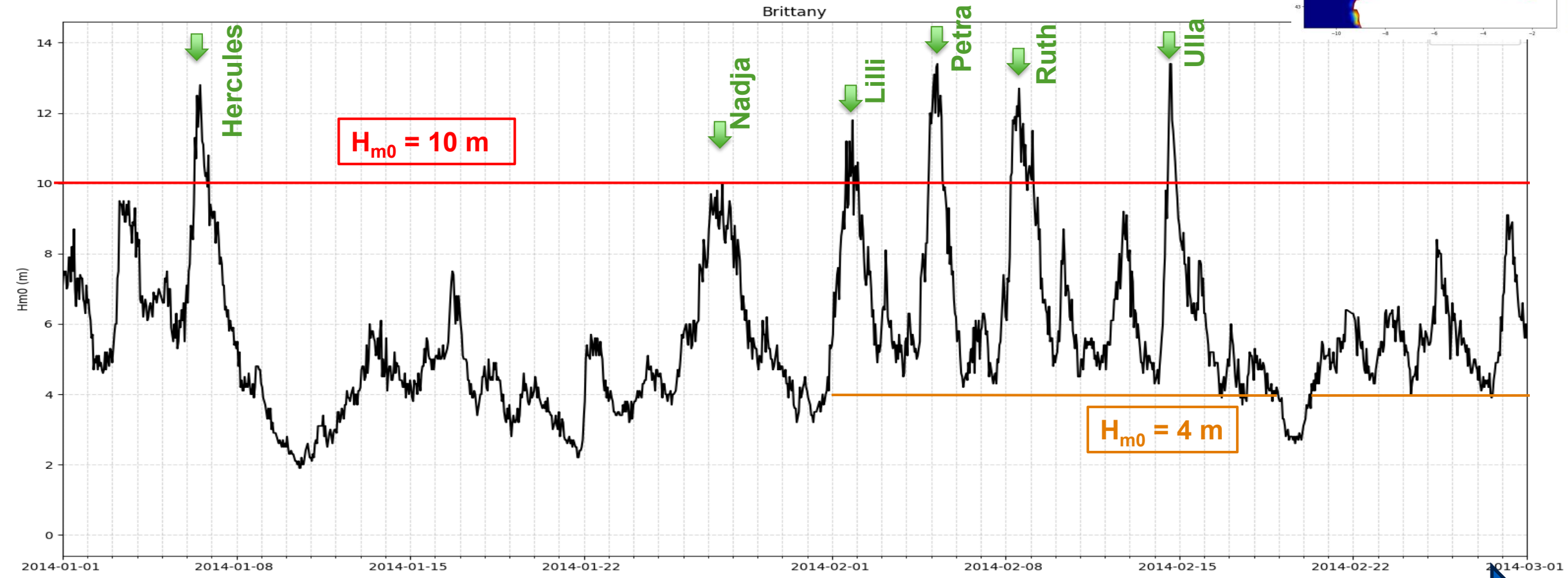
2013-2014 winter storms

2013-2014 winter storms

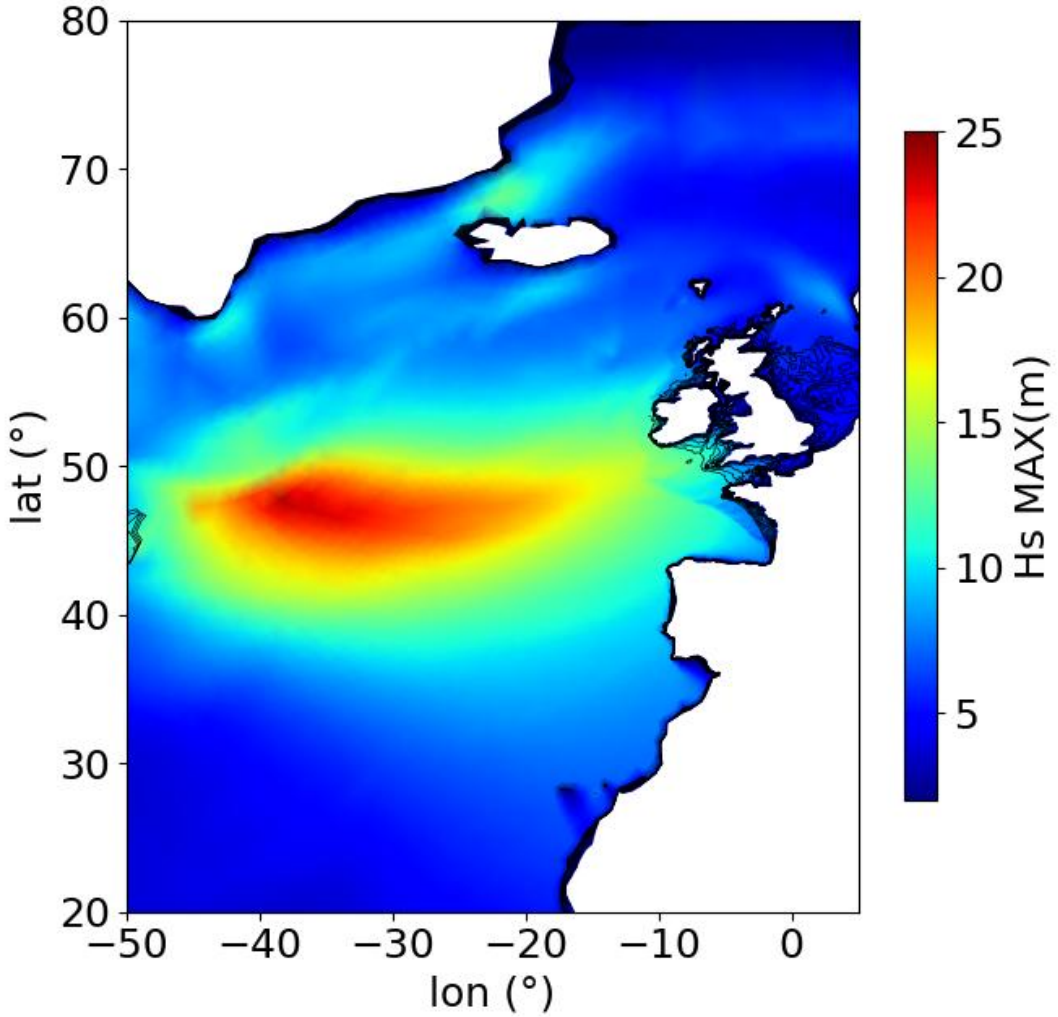
(Blaise et al. (2015); Masselink et al. (2016); Ruju et al. (2020))

Brittany buoy (62163)

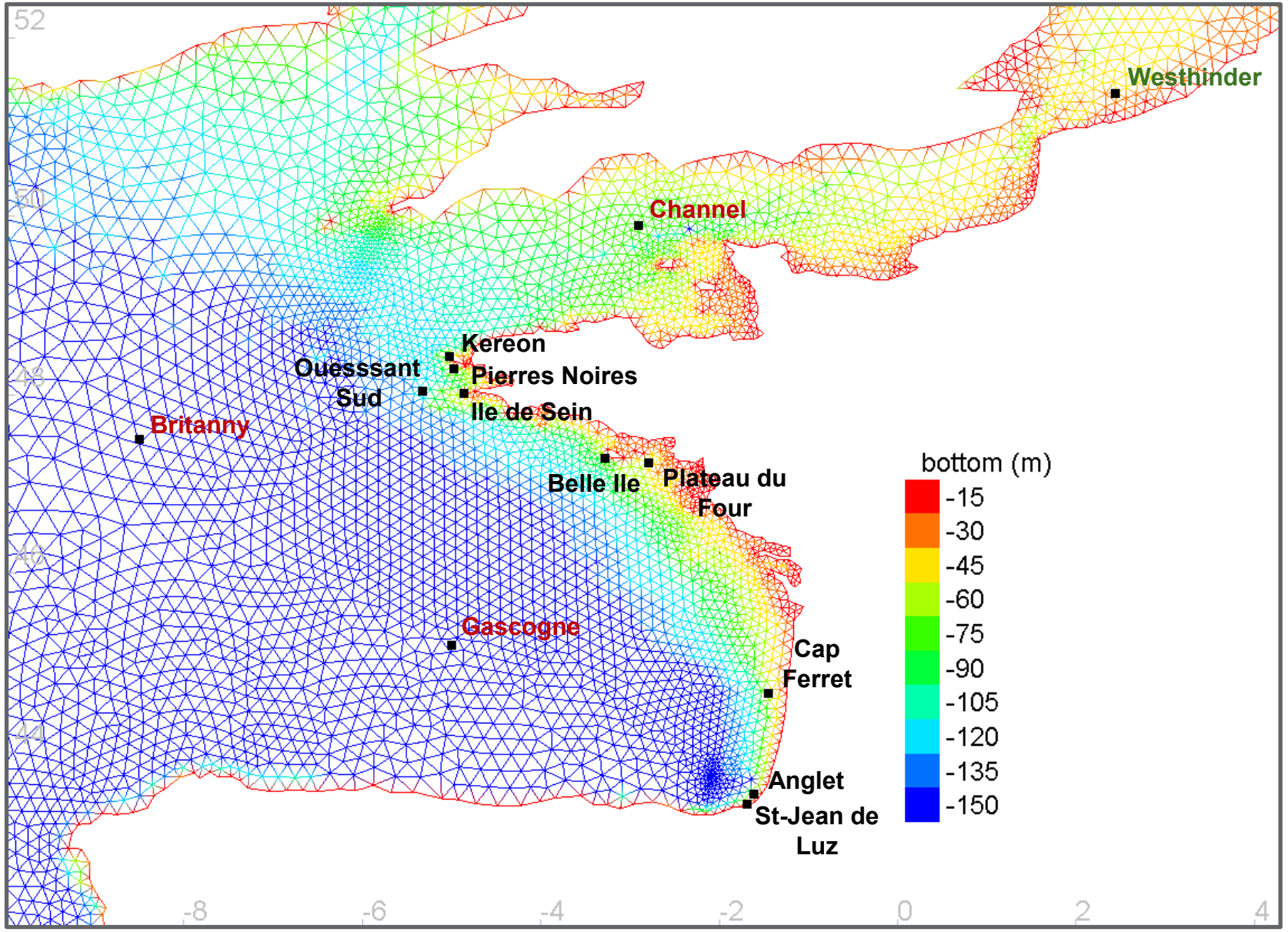


January and February 2014

2013-2014 winter storms :
Max Hm0 ANEMOC-3 over 3 days during Hercules storm



In situ measurements



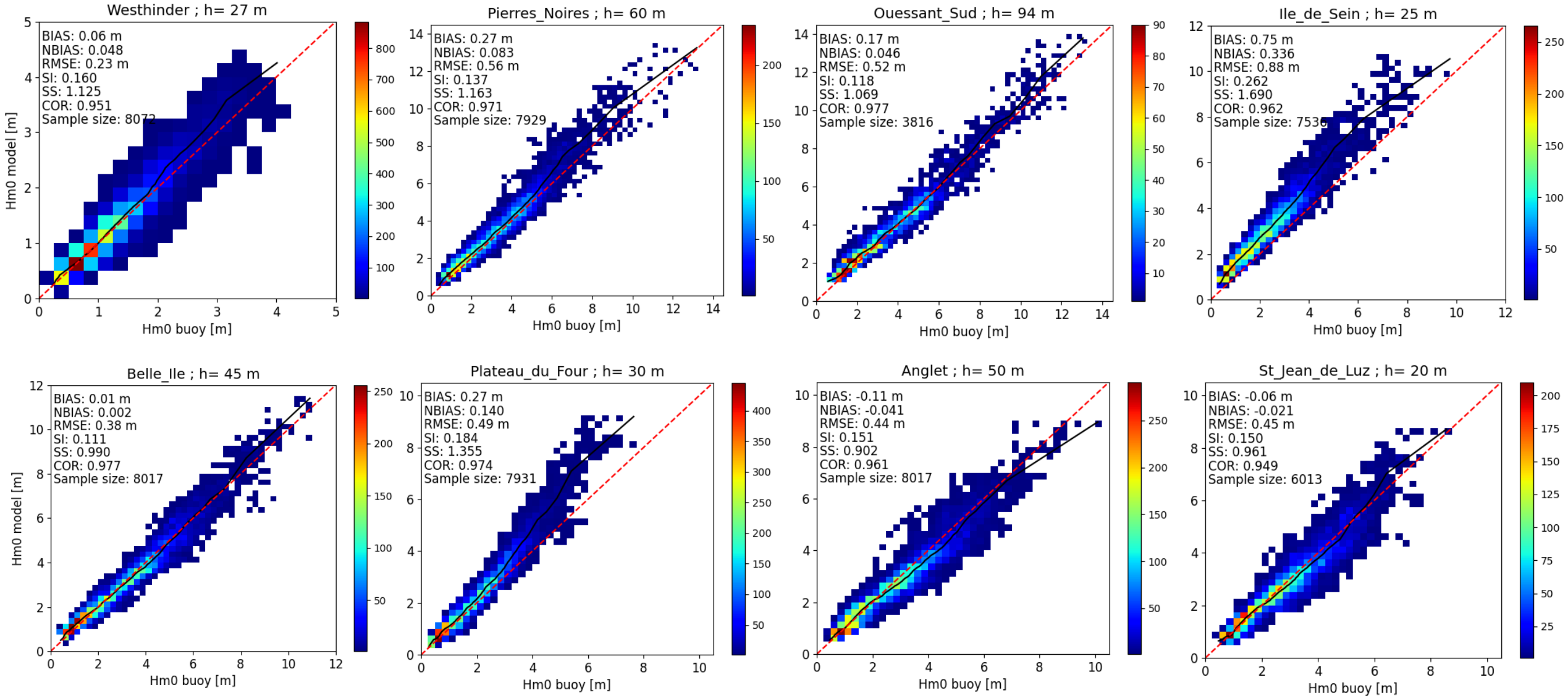
Different sources of data:

UKMO buoys
https://www.metoffice.gov.uk/weather/specialist-forecasts/coast-and-sea/observations

CANDHIS buoys
https://candhis.cerema.fr/

Belgium buoys
https://meetnetvlaamsebanken.be

2013-2014 winter storms comparisons



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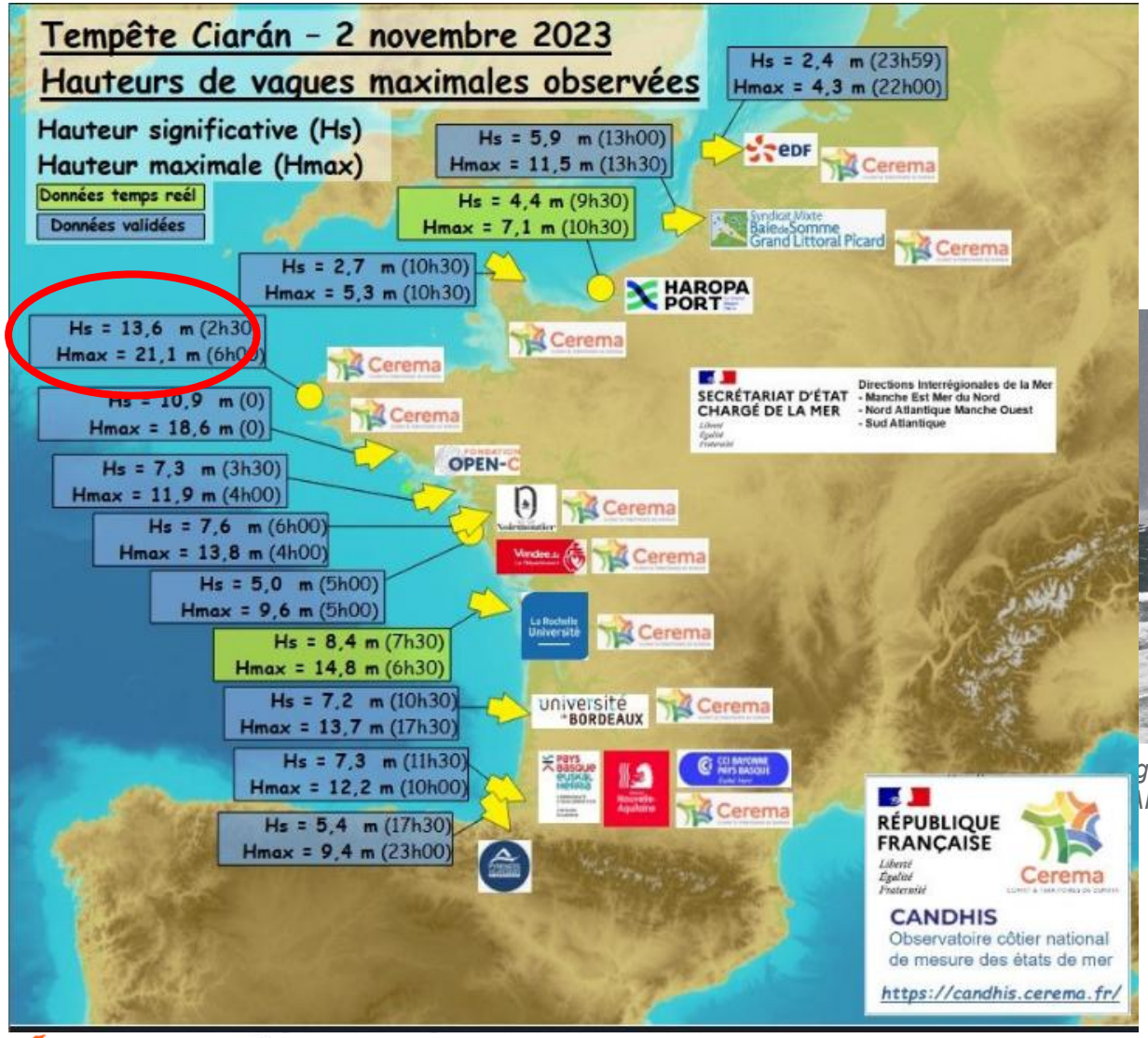
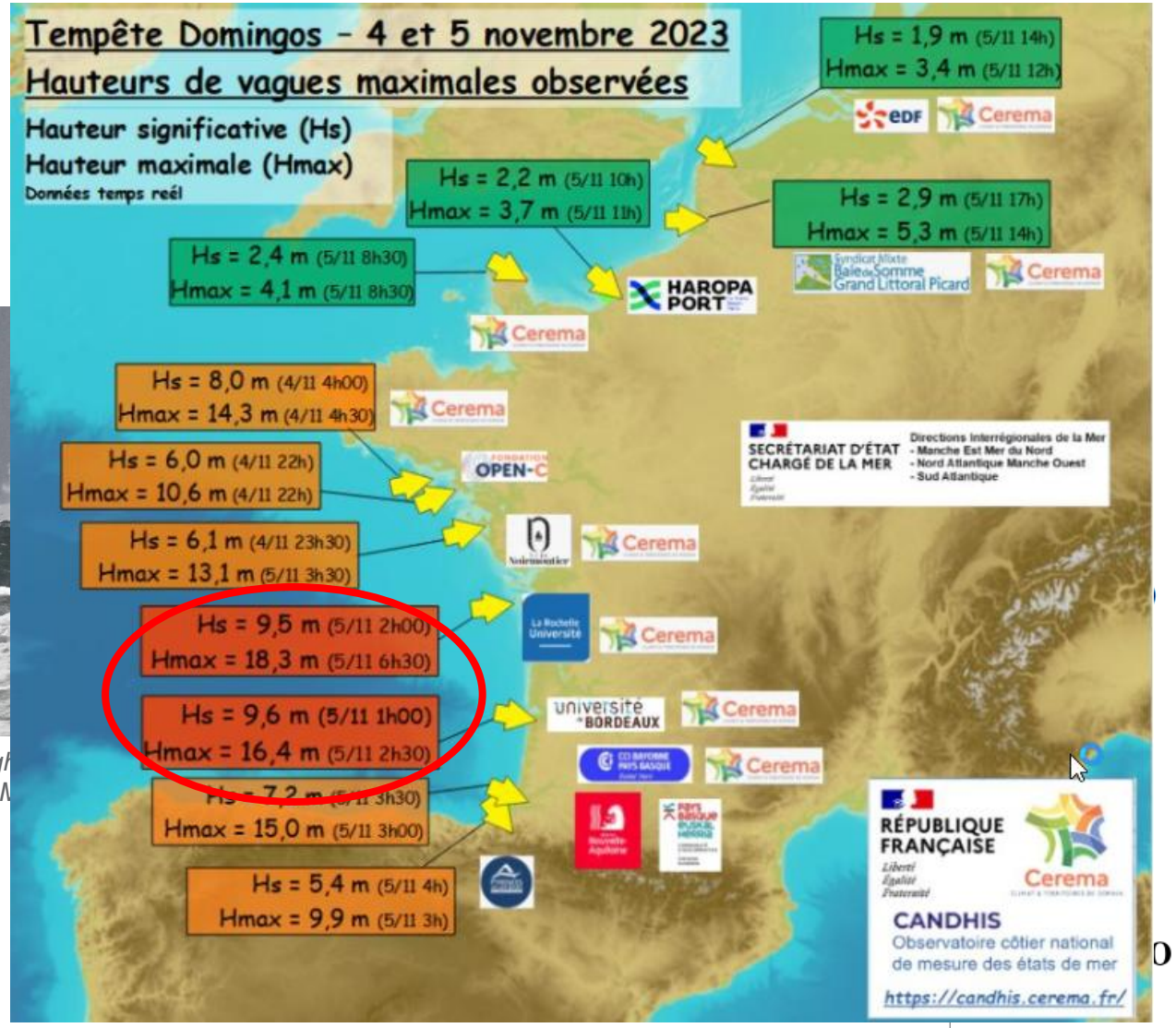
Ciaran and Domingos winter storms (November 2023)

Ciaran and Domingos 2023 winter storms

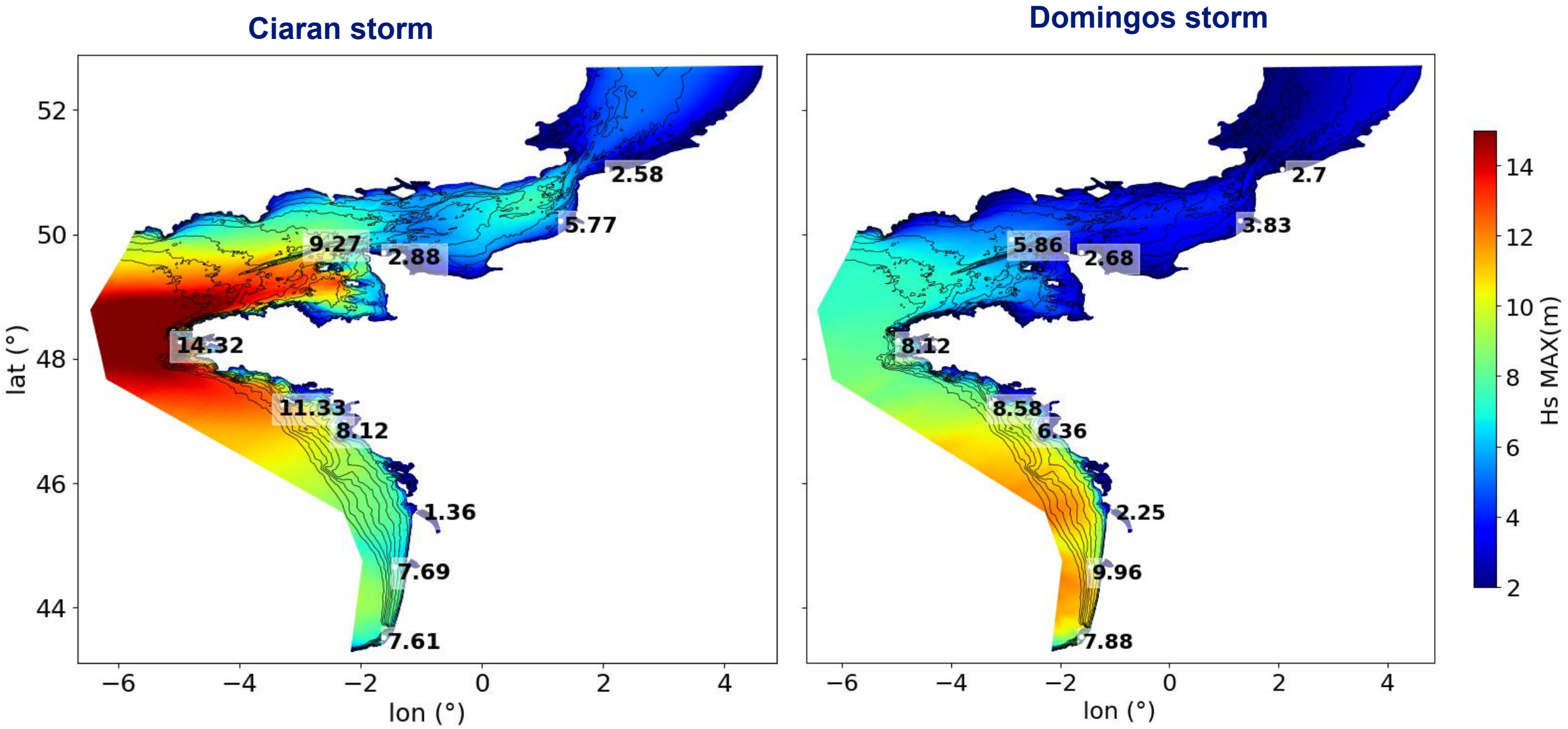
CEREMA, CANDHIS network



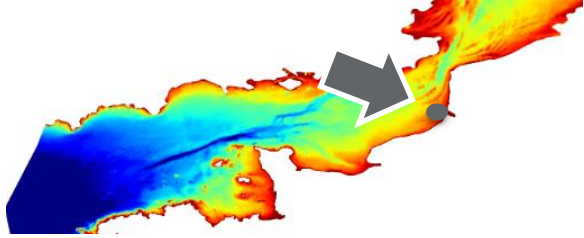


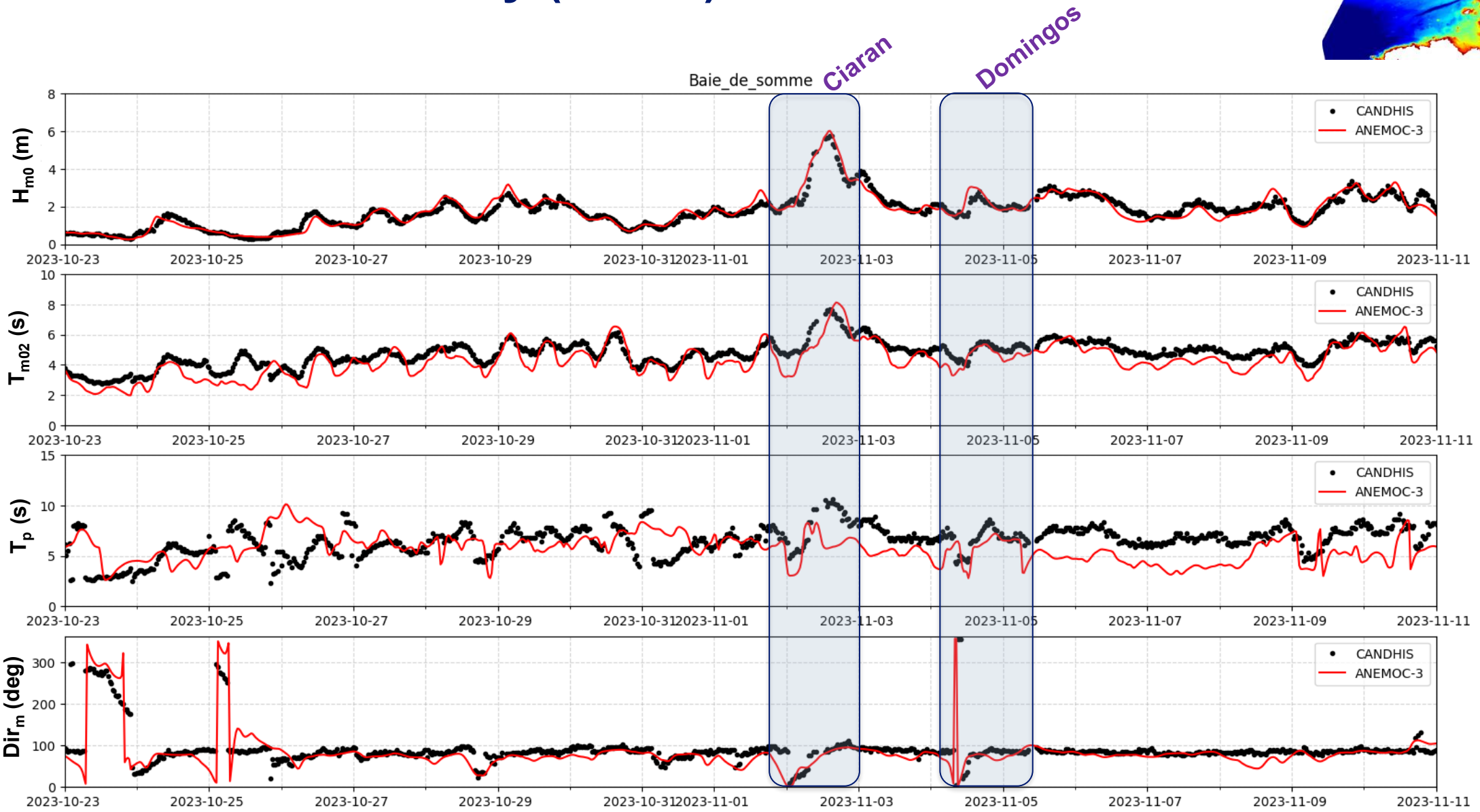
Ciaran and Domingos 2023 winter storms :

Max Hm0 ANEMOC-3 vs CANDHIS buoys

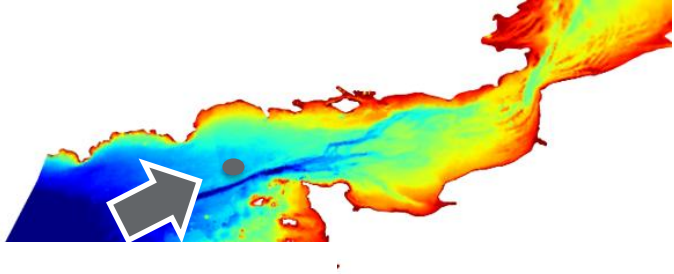


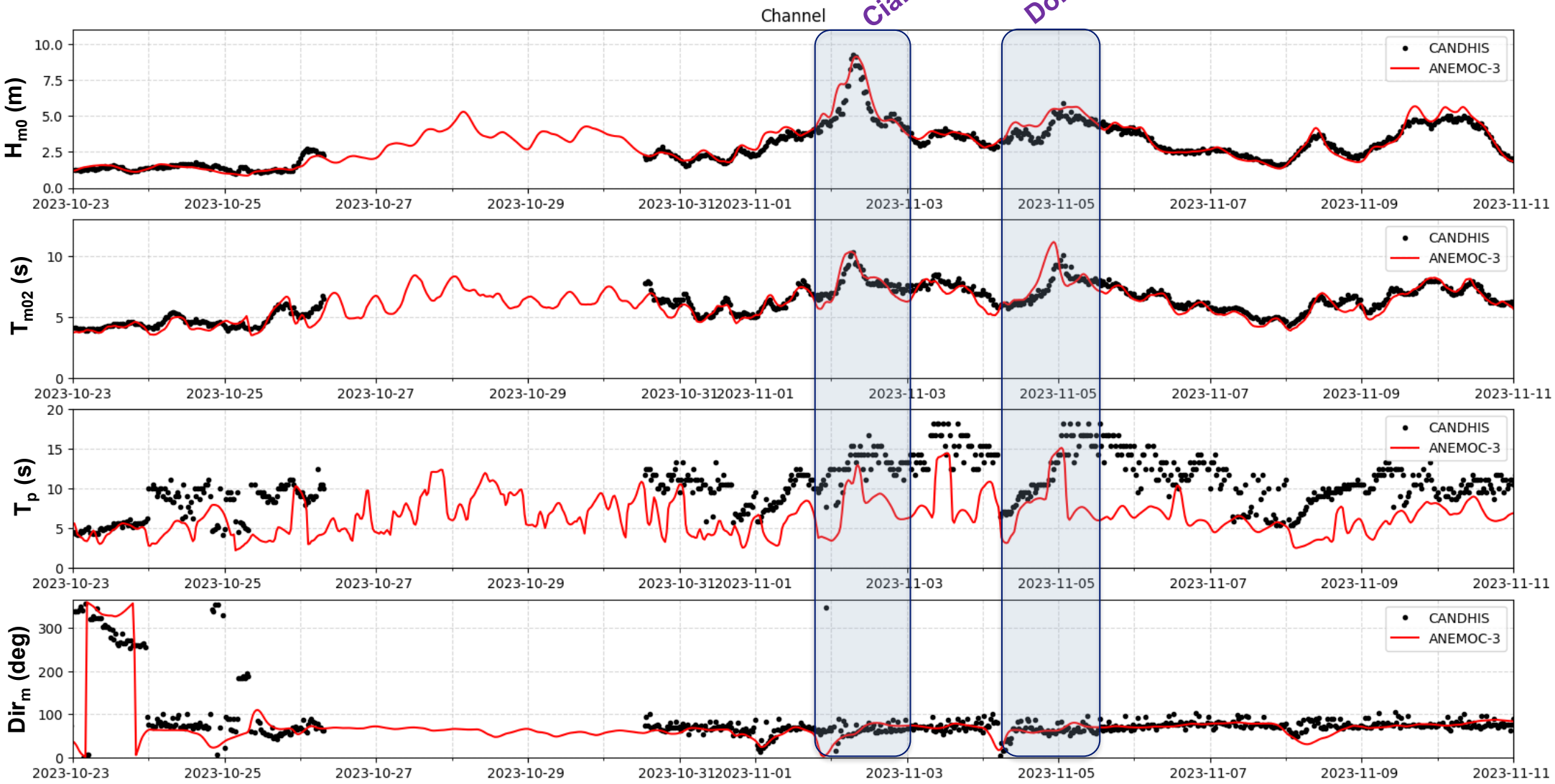
Baie de Somme buoy (08002) h ~ 15 m



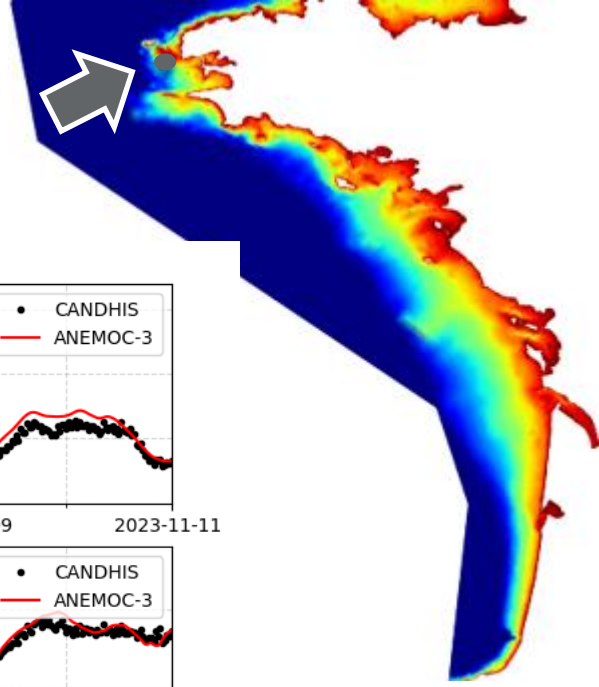


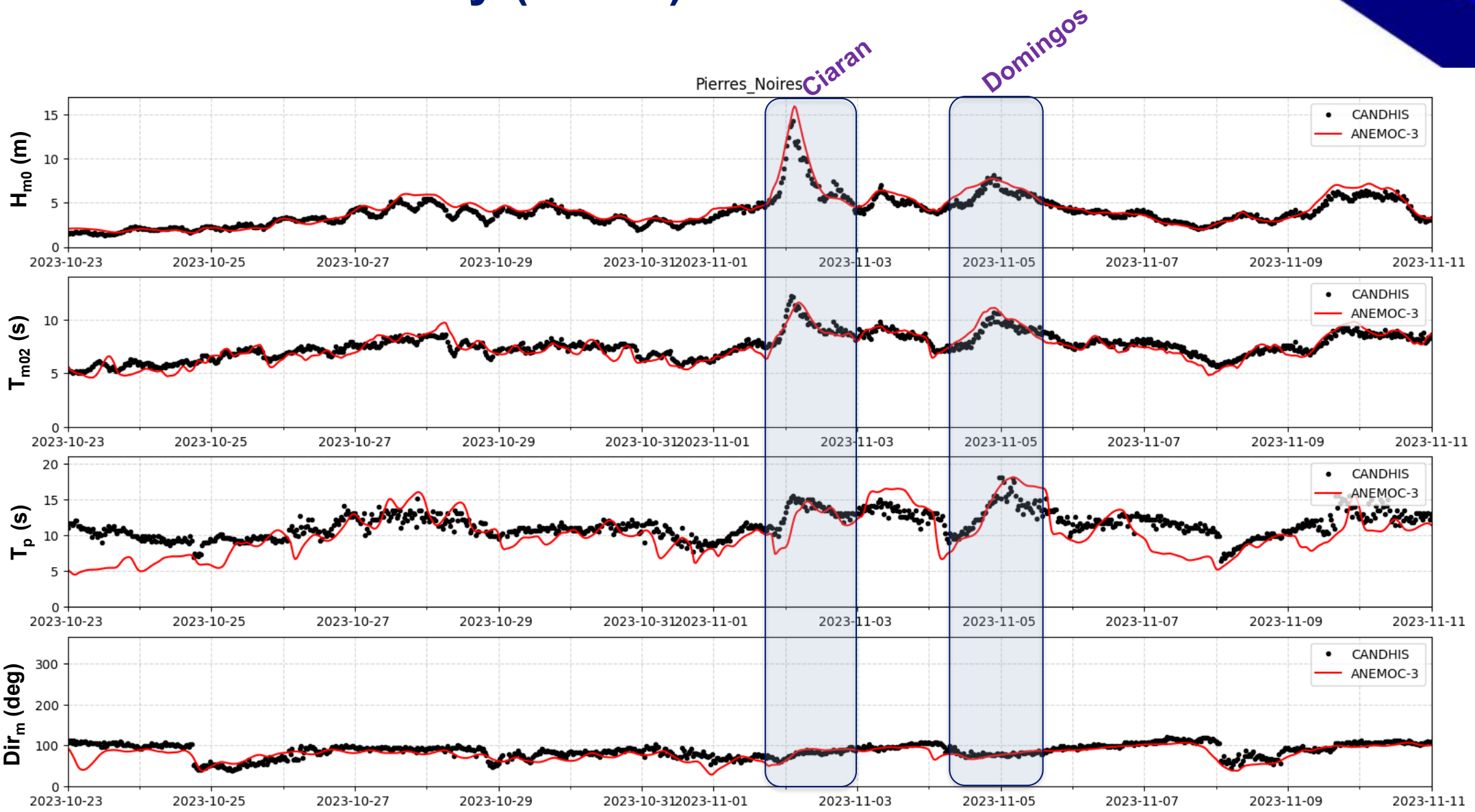
Channel buoy (62103) h ~ 70 m



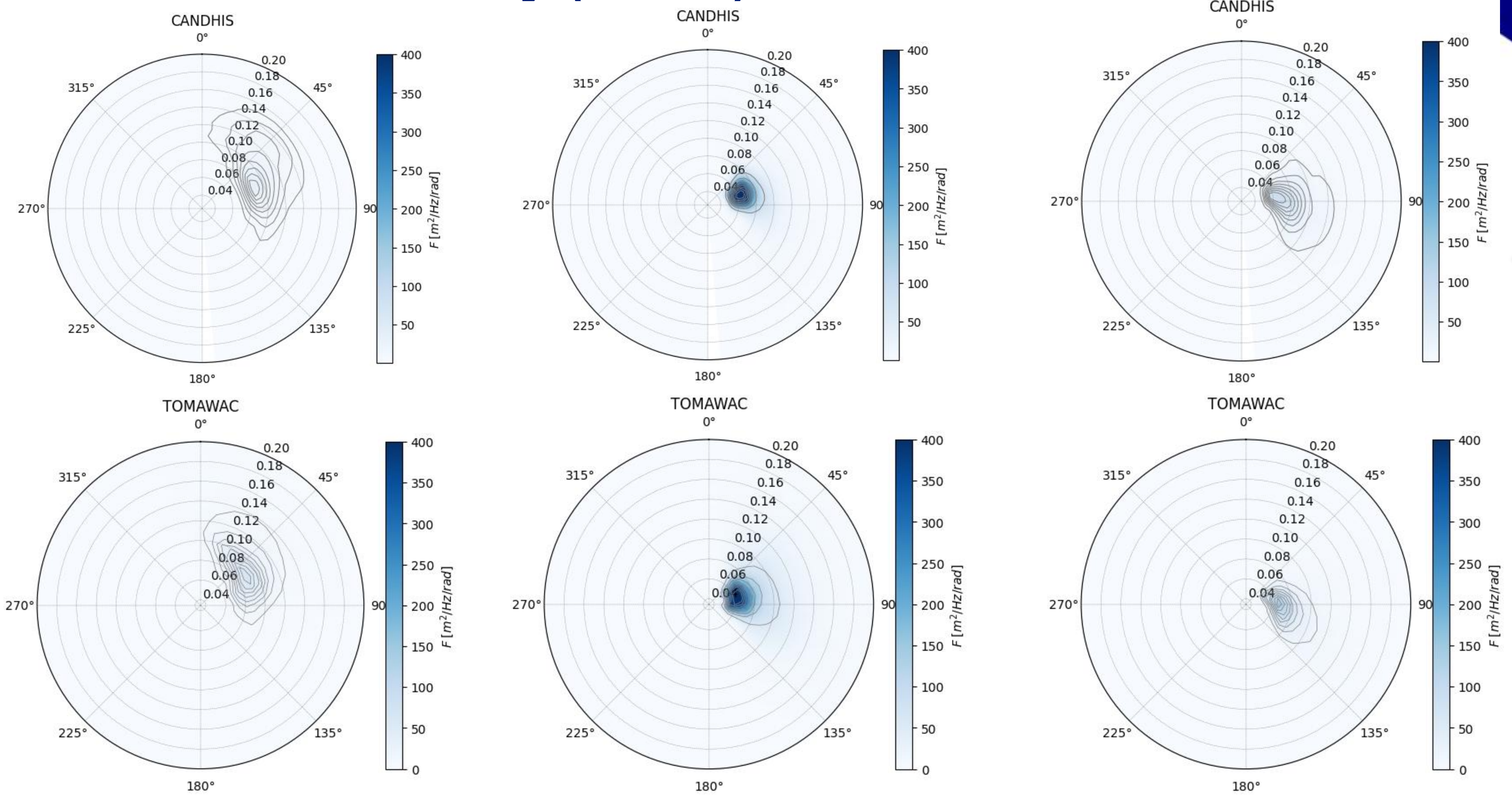


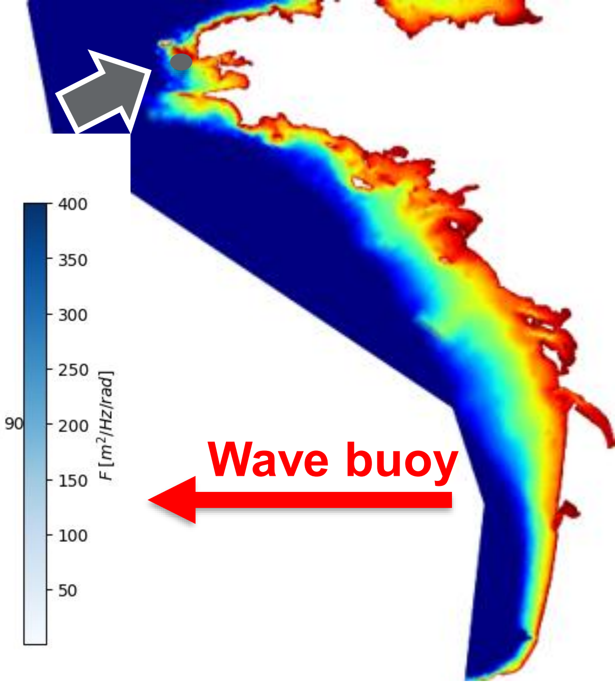
Pierres Noires buoy (02911) h ~ 60 m





Pierres Noires buoy (02911) h ~ 60 m





Wave buoy

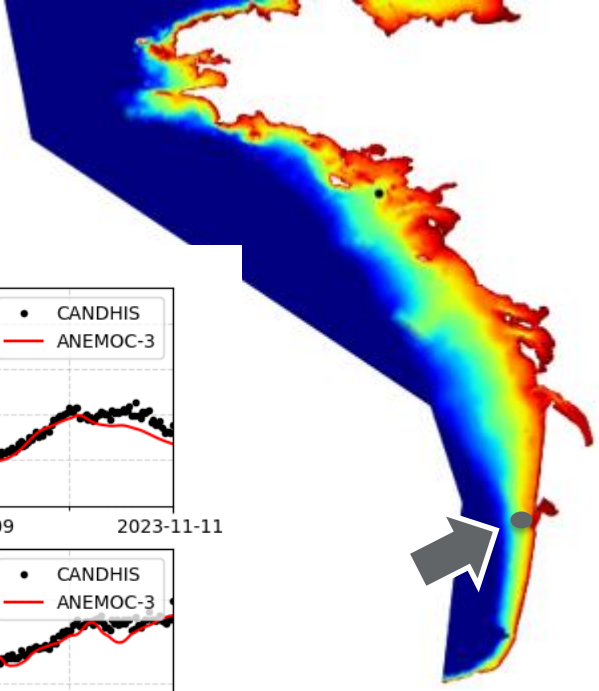
ANEMOC-3

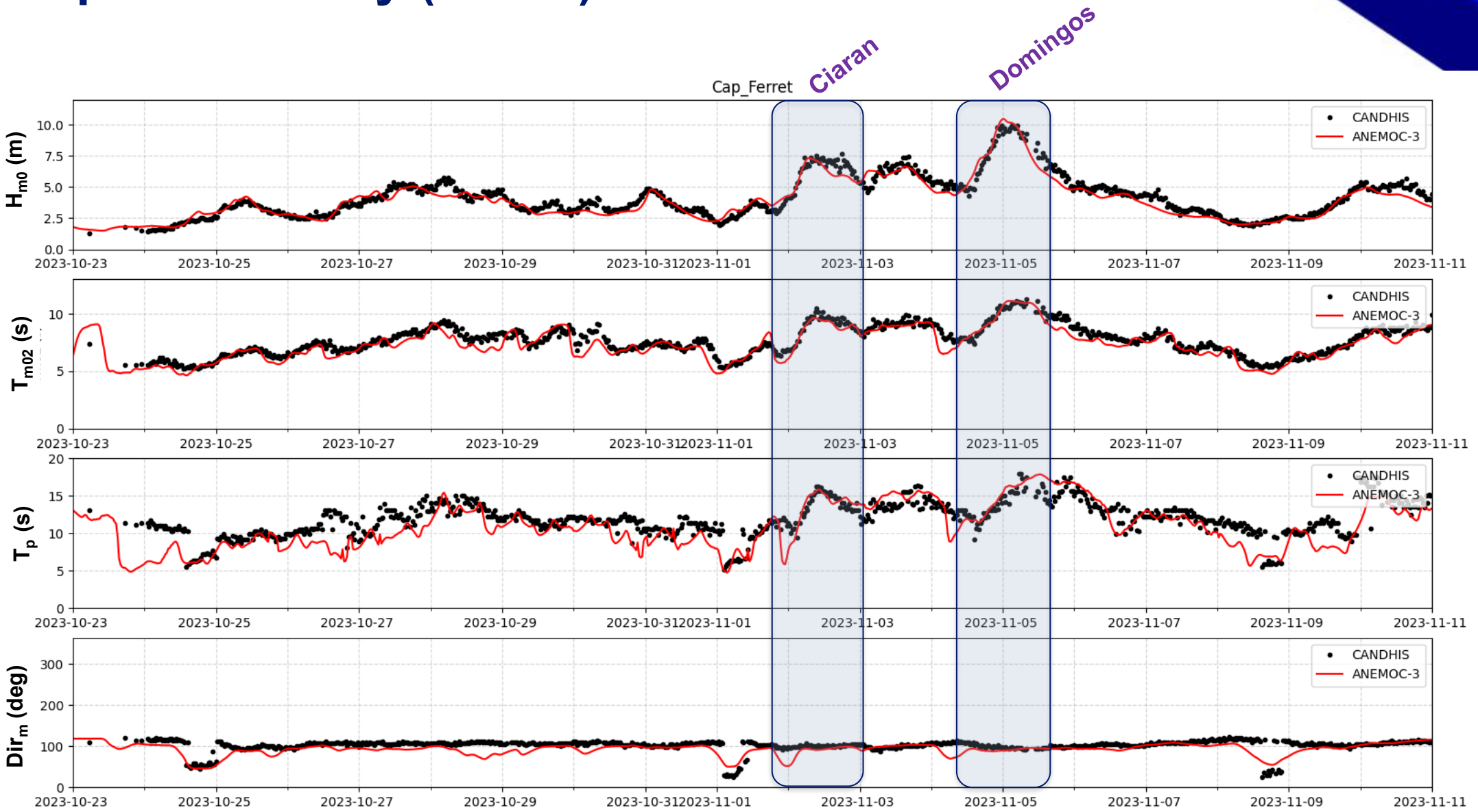
01/11 8:30pm UTC

02/11 2:30am UTC

02/11 8:30am UTC

Cap Ferret buoy (03302) h ~ 54 m





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Conclusions and further work

Conclusions

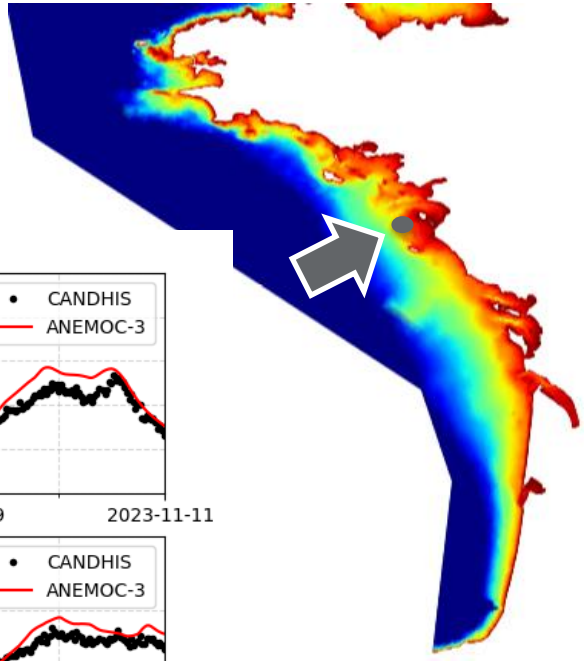
- Extension of the ANEMOC-3 database (1979-2024, 46 years).
- Improvements on the most energetic events.
- Wave hindcast improved after inclusion of effects of tidal water levels and currents.
- Calibration and validation of storm events against buoy measurements (wave parameters and spectra).

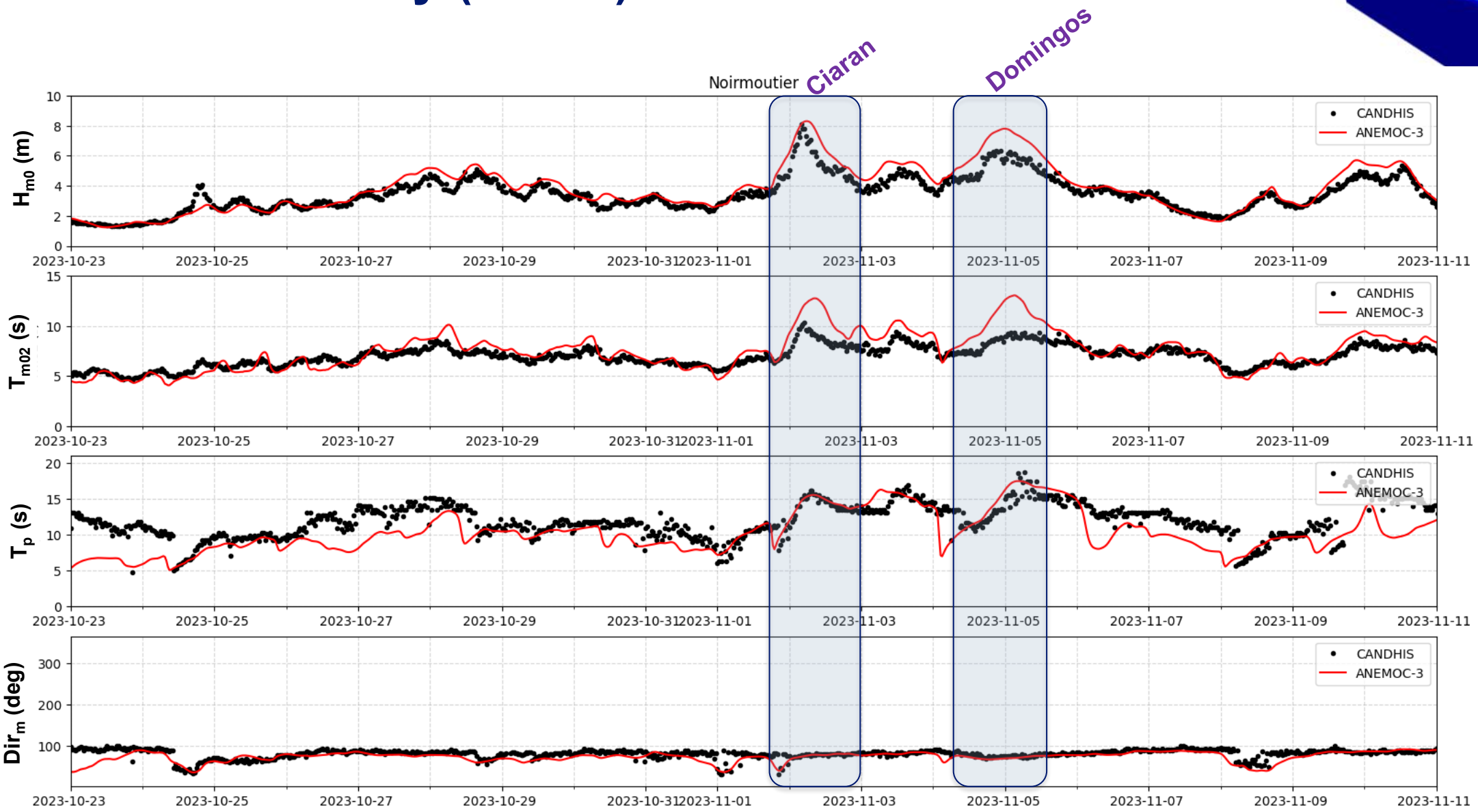
Ongoing and further work

- Comparisons with satellite data (Hs and spectra).
- Data assimilation for calibration of Hs (Goeury *et al*., 2023 ; Fouquet *et al*., 2024).
- Sensitivity tests regarding wind forcing fields.
- Sensitivity tests with other parameterizations (dissipation term ST4 (Ardhuin *et al.,* 2010) + bottom friction).
- Sensitivity tests to mesh resolution near the coastal waters.
- Study of wave climate evolution under climate change scenarios *(cf. pres. By Maxime Canard earlier today).*
- Study of waves induced by typhoons.

Thank you!

Noirmoutier buoy (08505) h ~ 15 m





Anglet buoy (06402) h ~ 50 m