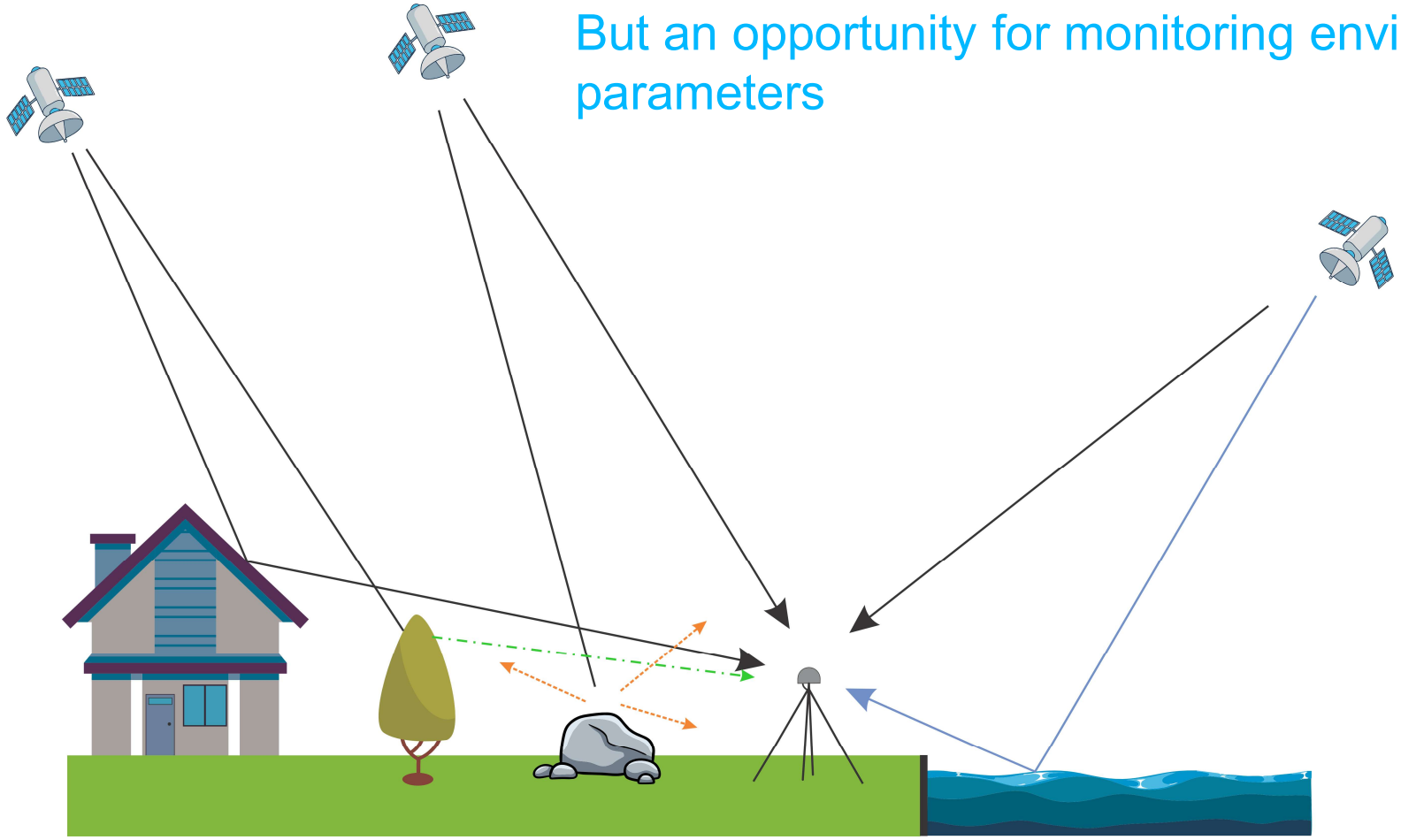
National Oceanography Centre

SIGNIFICANT WAVE HEIGHT FROM GNSS-IR

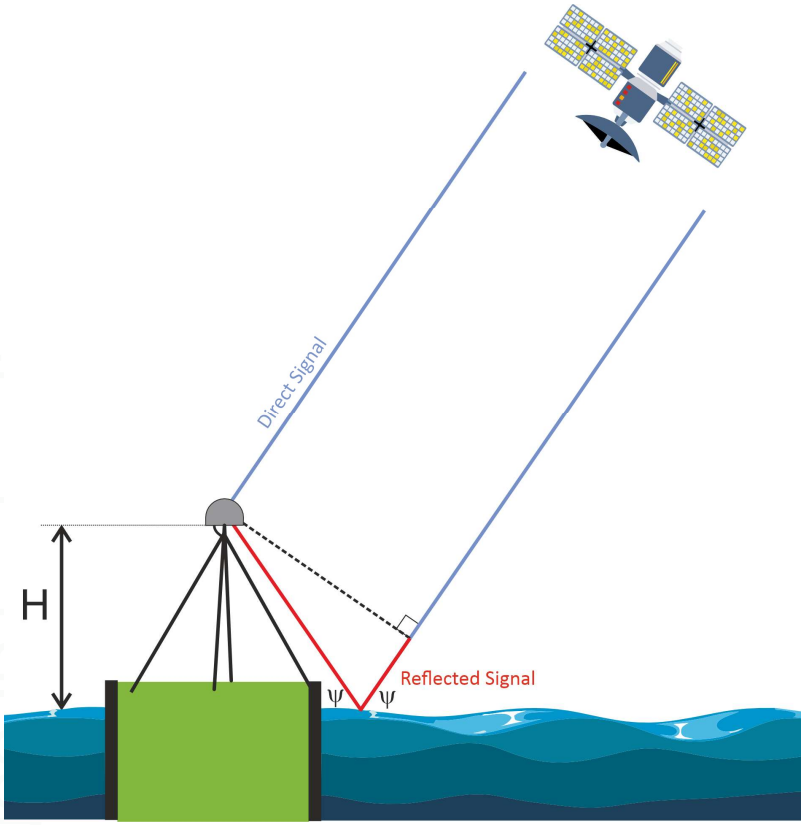
MULTIPATH: POSITIONING NIGHTMARE.

National Oceanography Centre

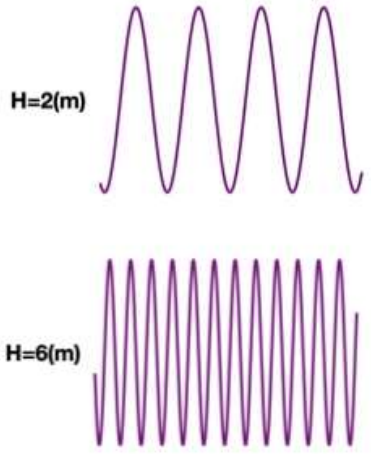
But an opportunity for monitoring environmental parameters



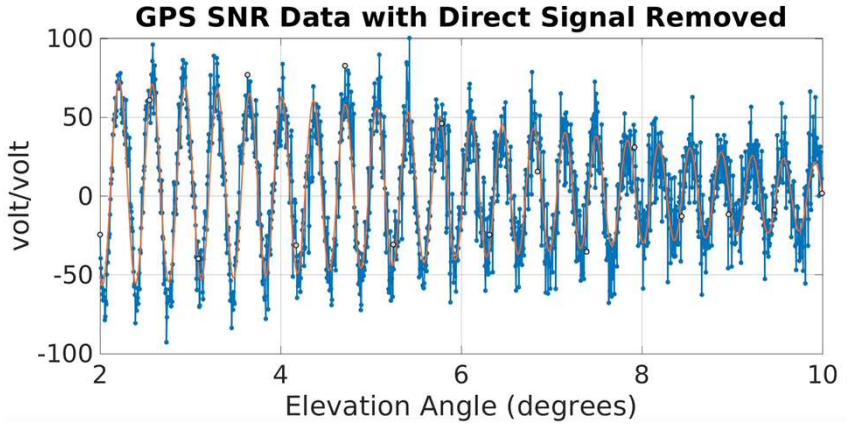
IF THAT SURFACE HAPPENS TO BE “FLAT” SUCH AS THE SEA SURFACE……

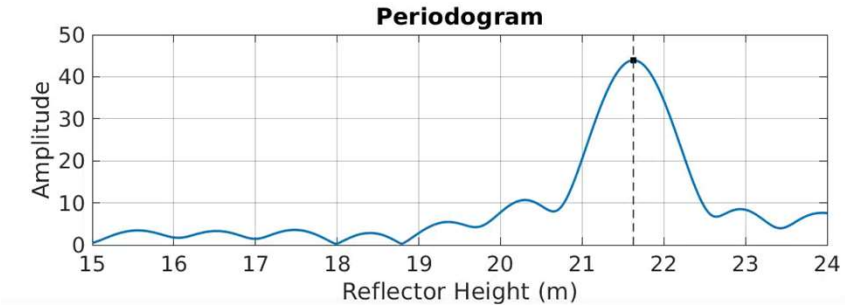


The frequency of the interference pattern created by the direct and reflected GNSS signals depends on H and the GNSS wavelength.



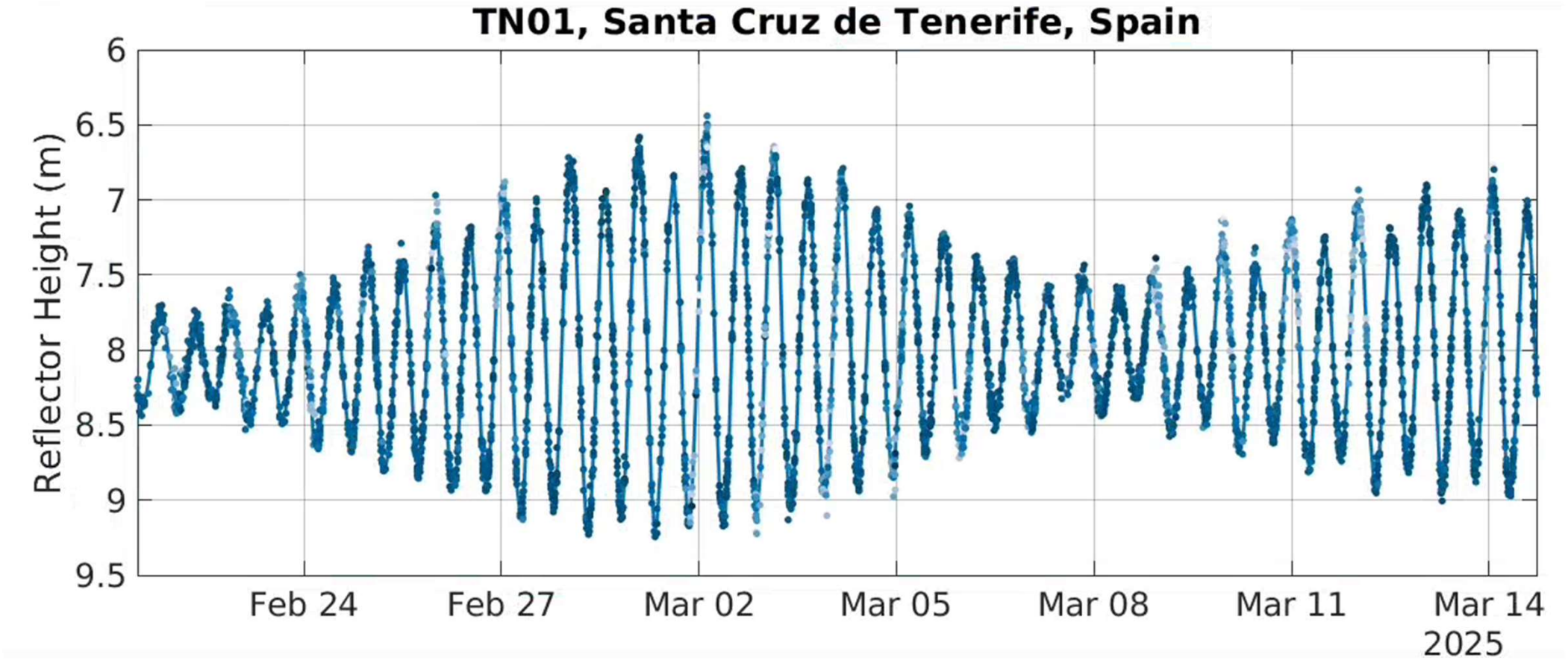
and the elevation angle



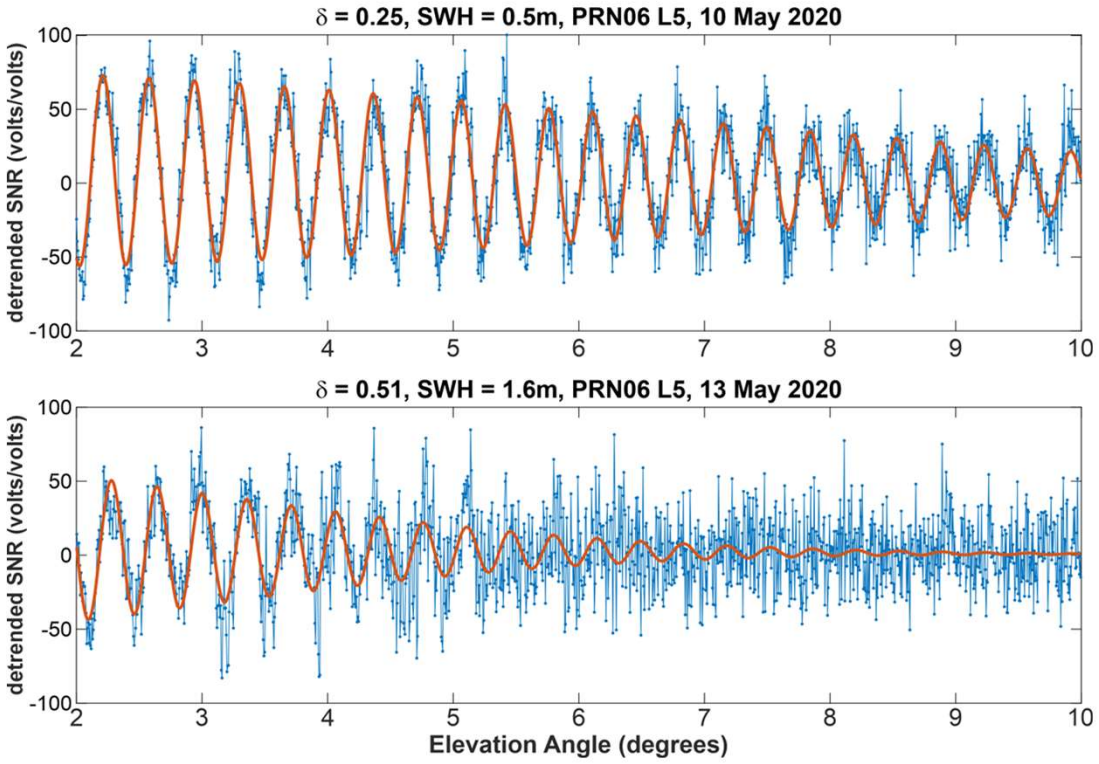


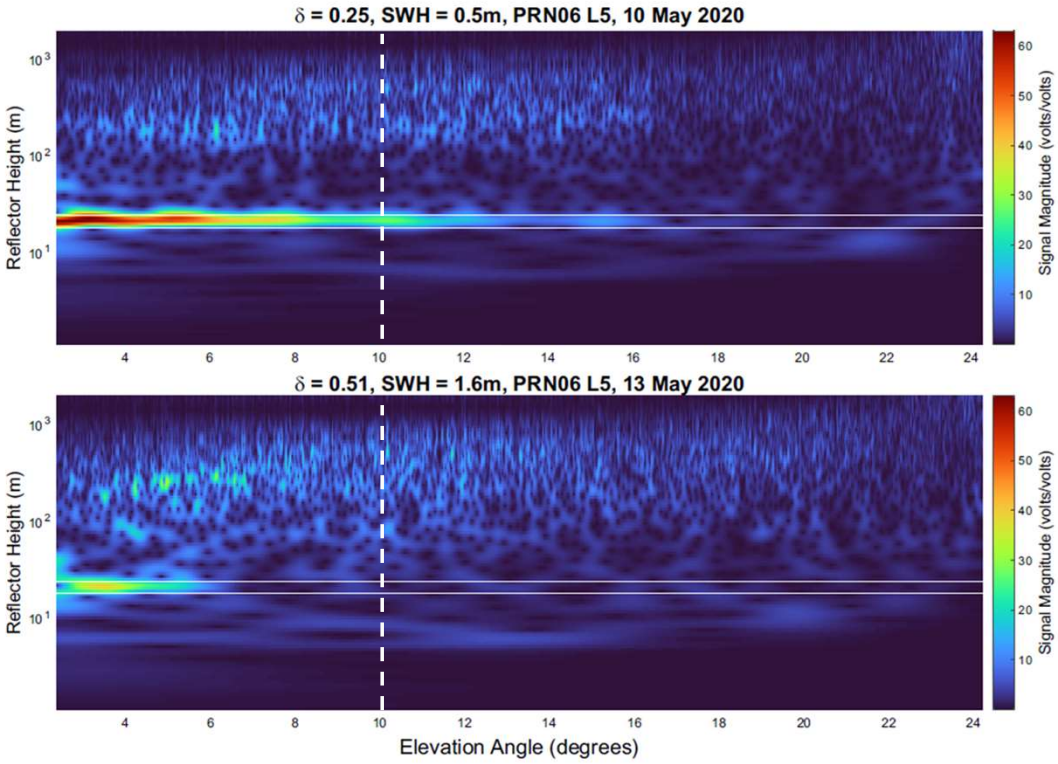
The reflections create oscillations in the SNR data (top). The frequencies of these oscillations are estimated using a periodogram (below)

TYPICAL REFLECTOR HEIGHT RESULTS



SEA STATE : THE BASIC IDEA…

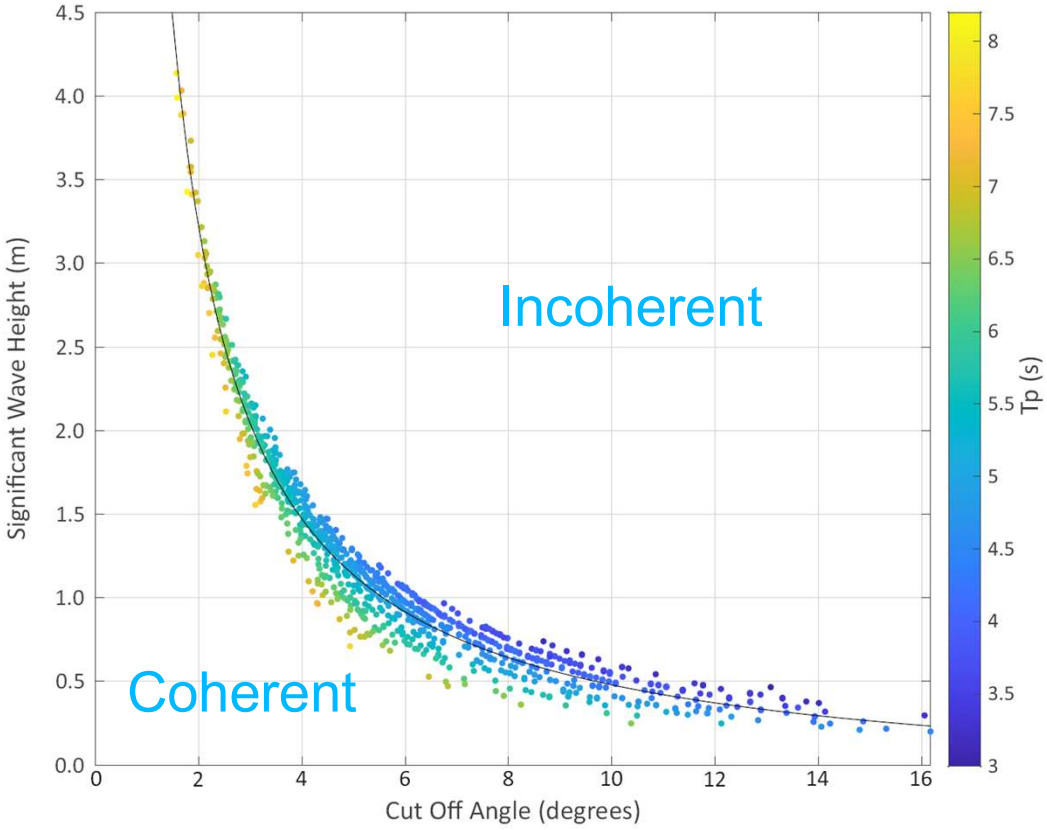


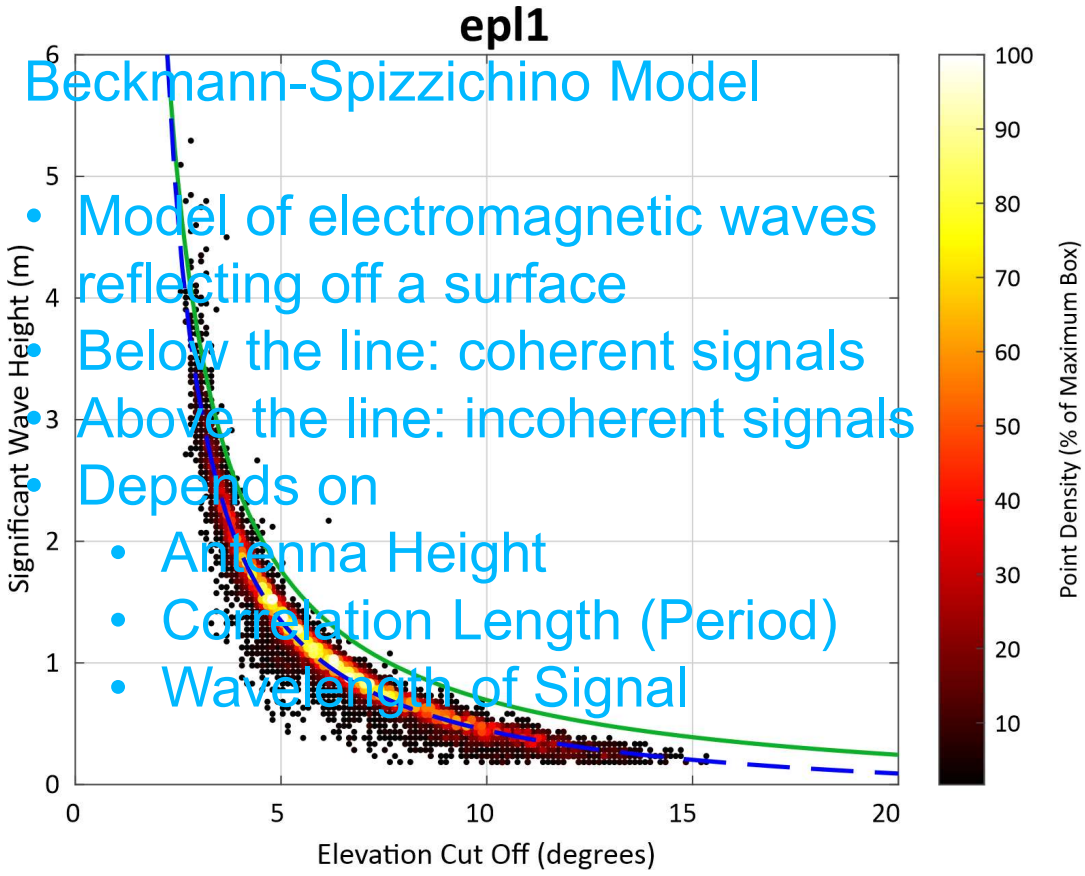


Site Europlatform (EPL1), South North Sea

DO WE KNOW THE RELATIONSHIP BETWEEN CUT-OFF ANGLE AND SIGNIFICANT WAVE HEIGHT?

National Oceanography Centre





Beckmann-Spizzichino Model

- Model of electromagnetic waves reflecting off a surface
- Below the line: coherent signals
- Above the line: incoherent signals
- Depends on
  - Antenna Height
  - Correlation Length (Period)
  - Wavelength of Signal

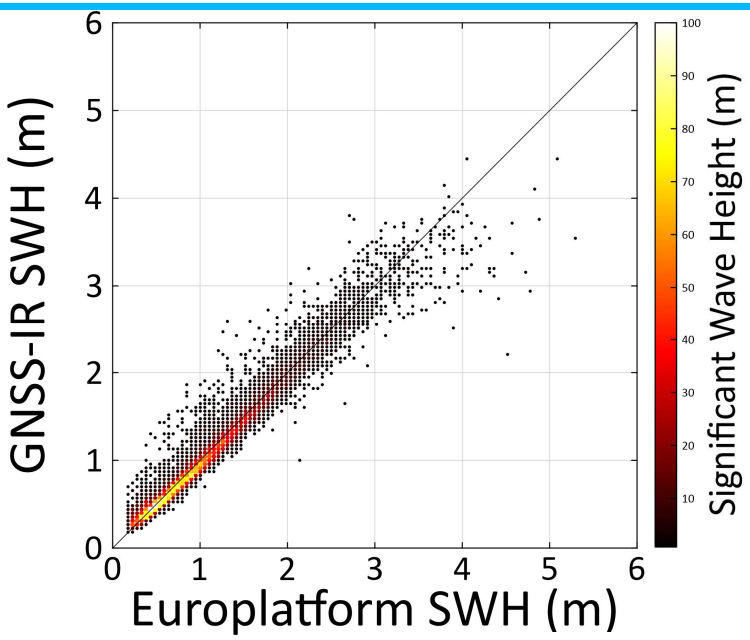
EPL1, NORTH SEA, EUROPLATFORM, NETHERLANDS

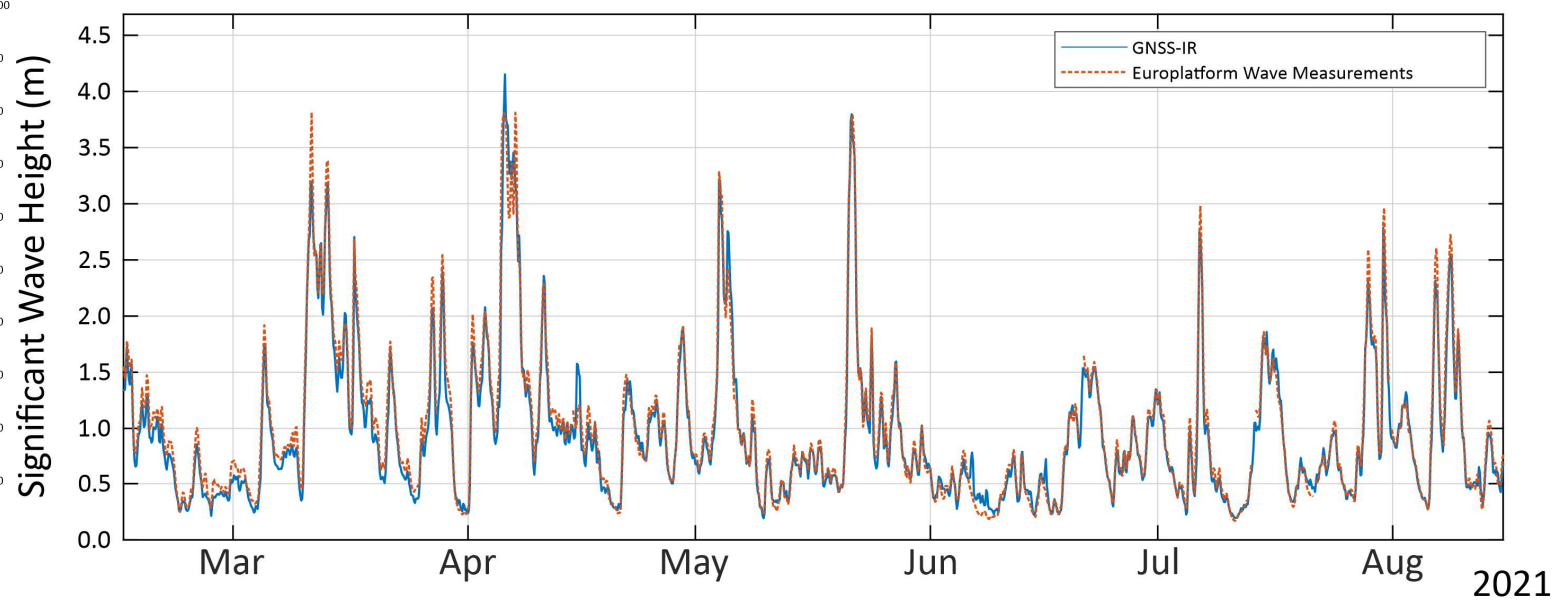
National Oceanography Centre

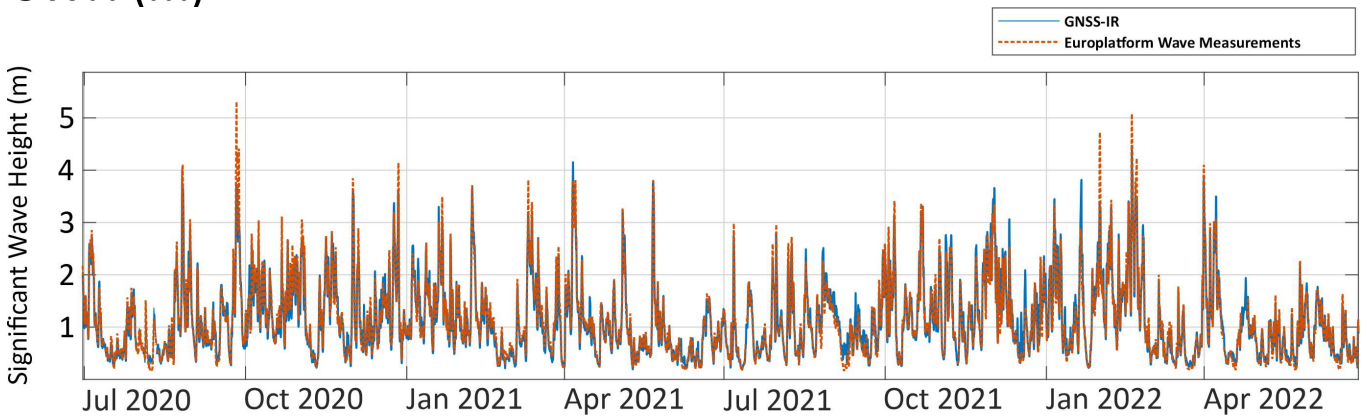
EPL1

EPL1

EPL1, NORTH SEA, EUROPLATFORM, NETHERLANDS

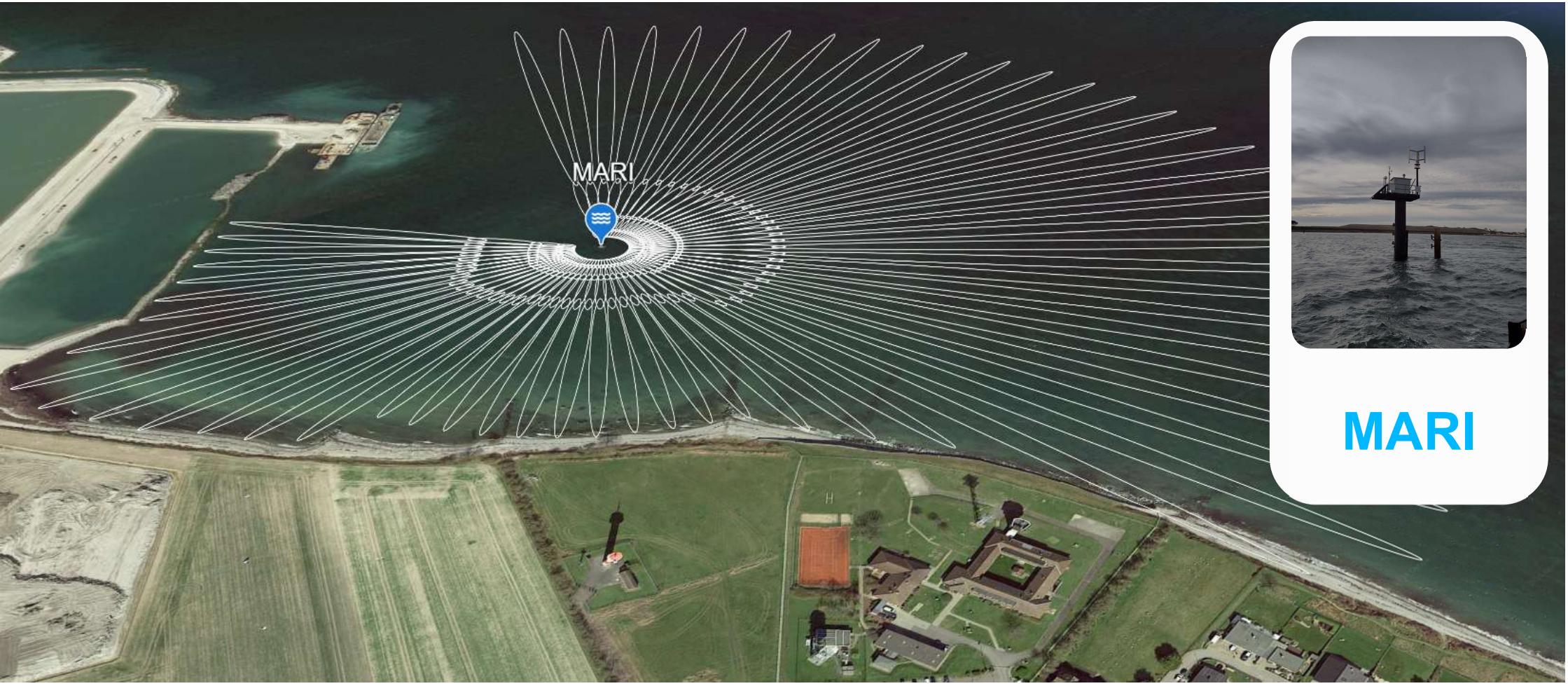






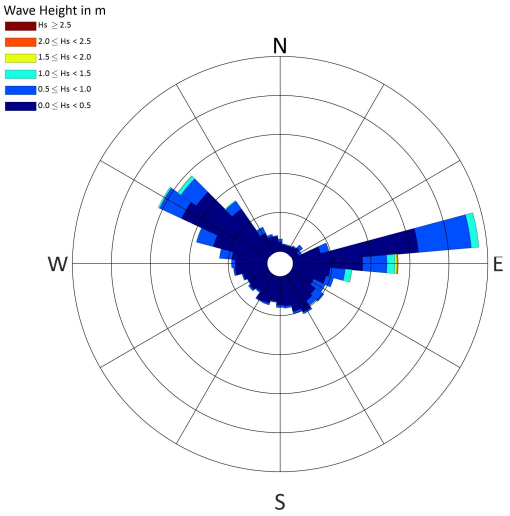
MARI, TIDE GAUGE MARIENLEUCHTE, PUTTGARDEN, GERMANY

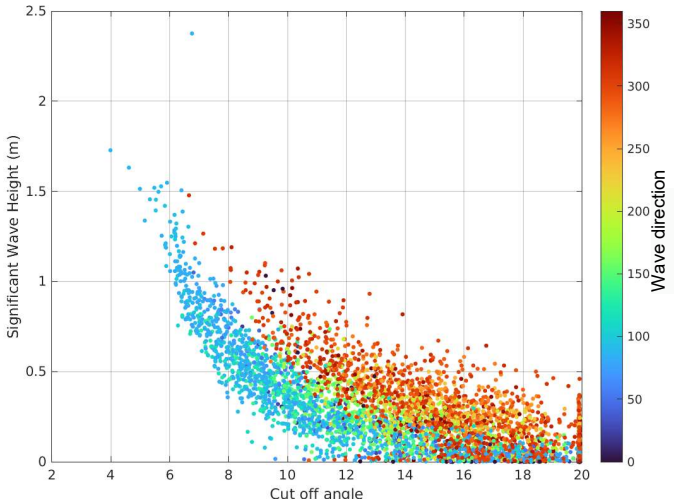
National Oceanography Centre

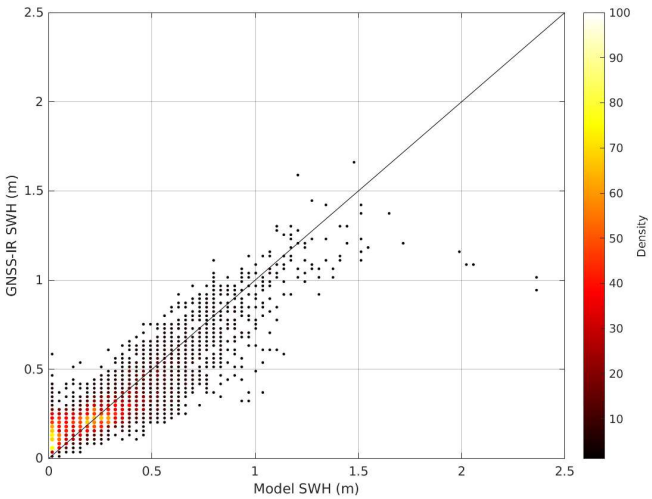


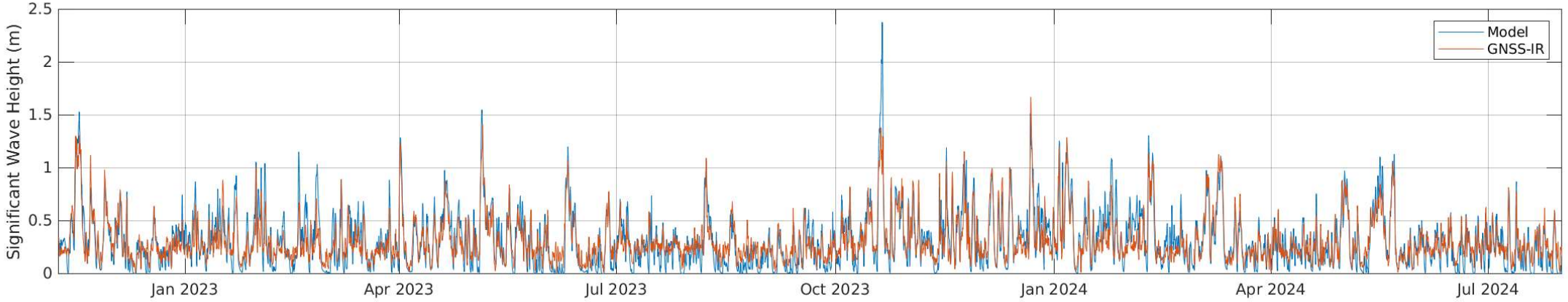
MARI, TIDE GAUGE MARIENLEUCHTE, PUTTGARDEN, GERMANY

National Oceanography Centre



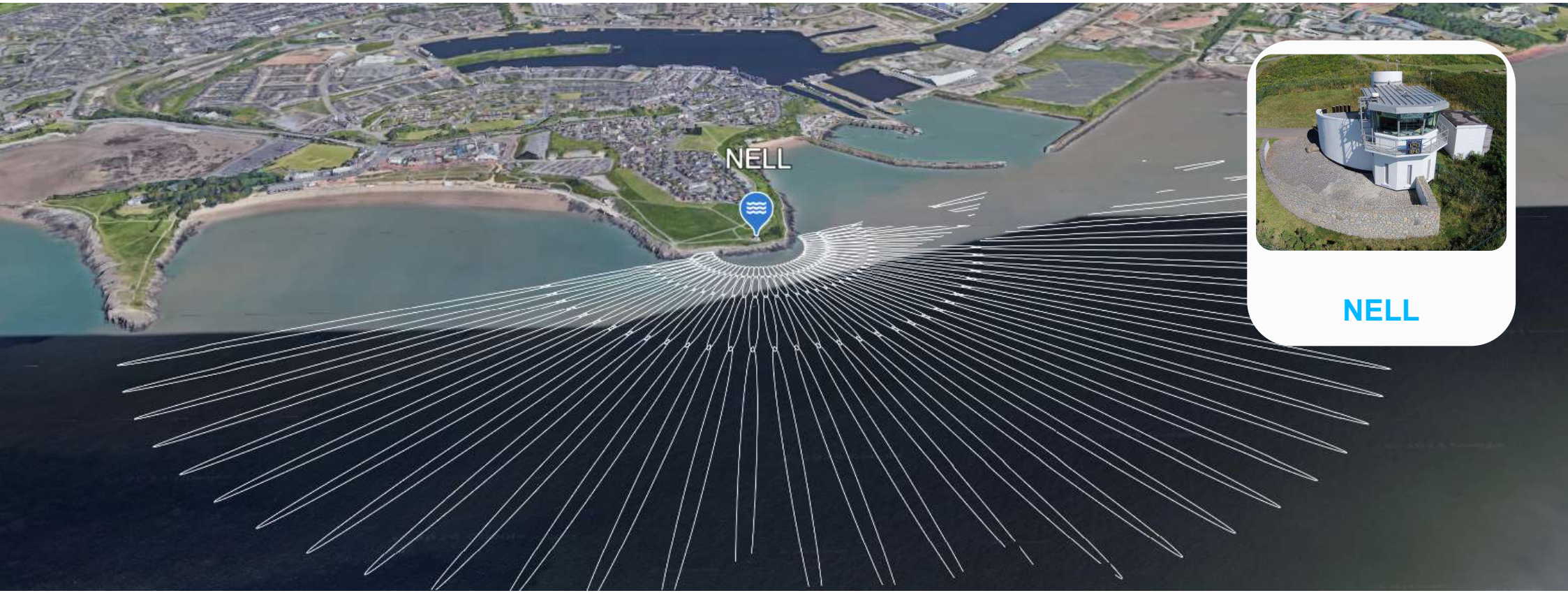




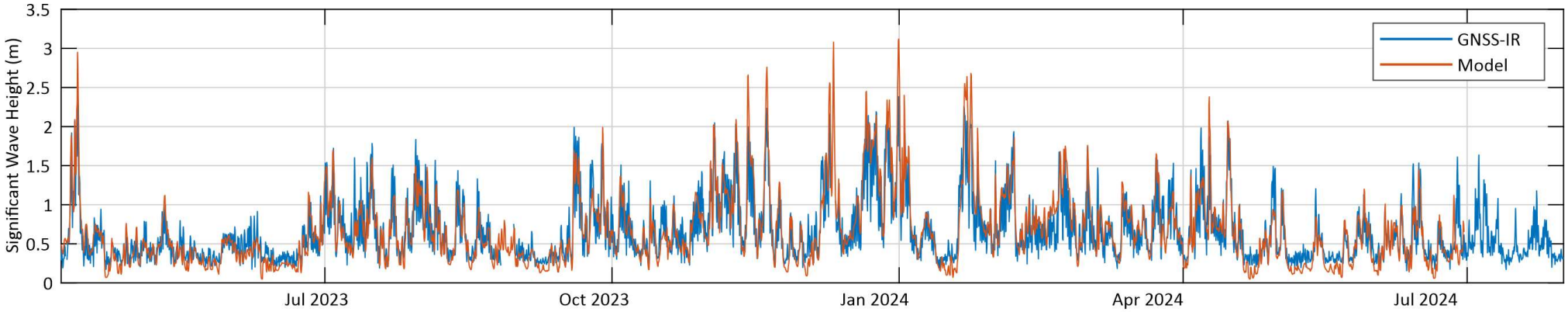


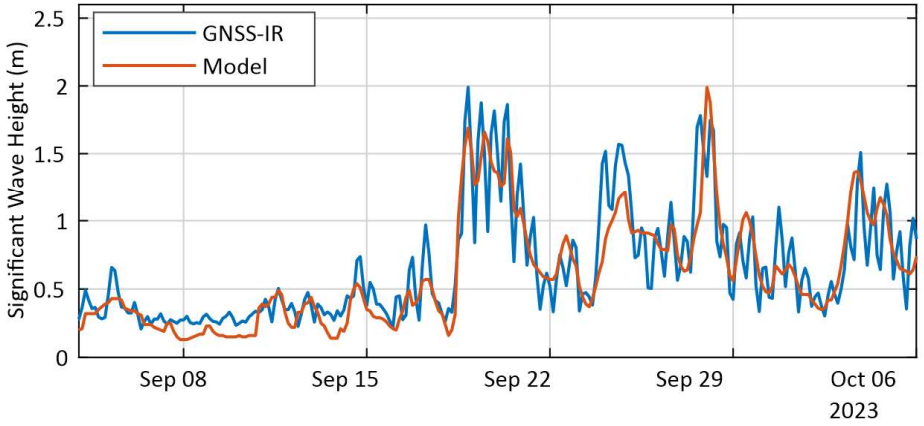
NELL, NELLS POINT, BARRY, SOUTH WALES

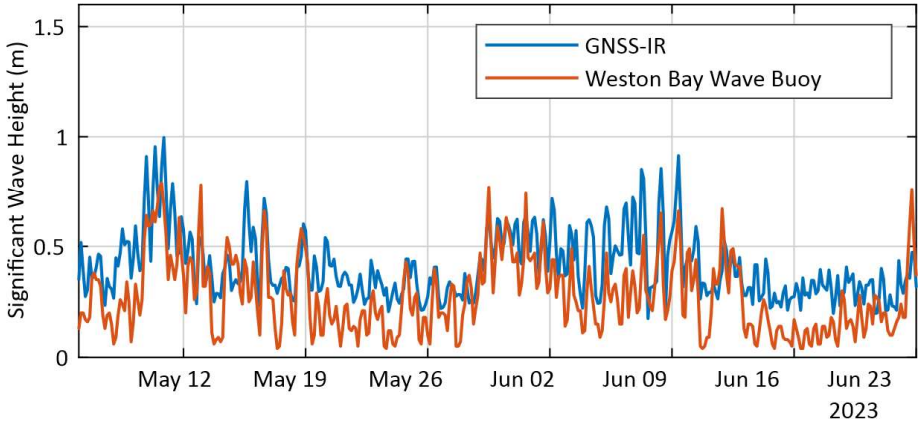
National Oceanography Centre



NELL, NELLS POINT, BARRY, SOUTH WALES

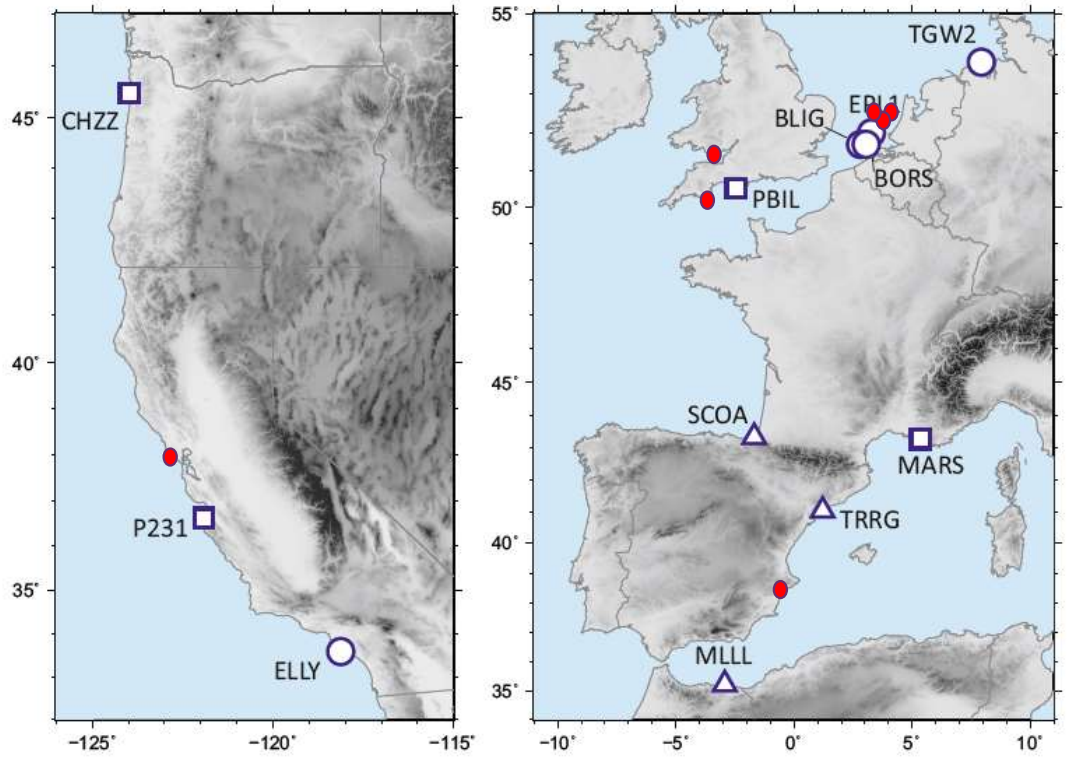






SWOT-UK NERC Grant NE/V009168/1

SOME SITES USED SO FAR…



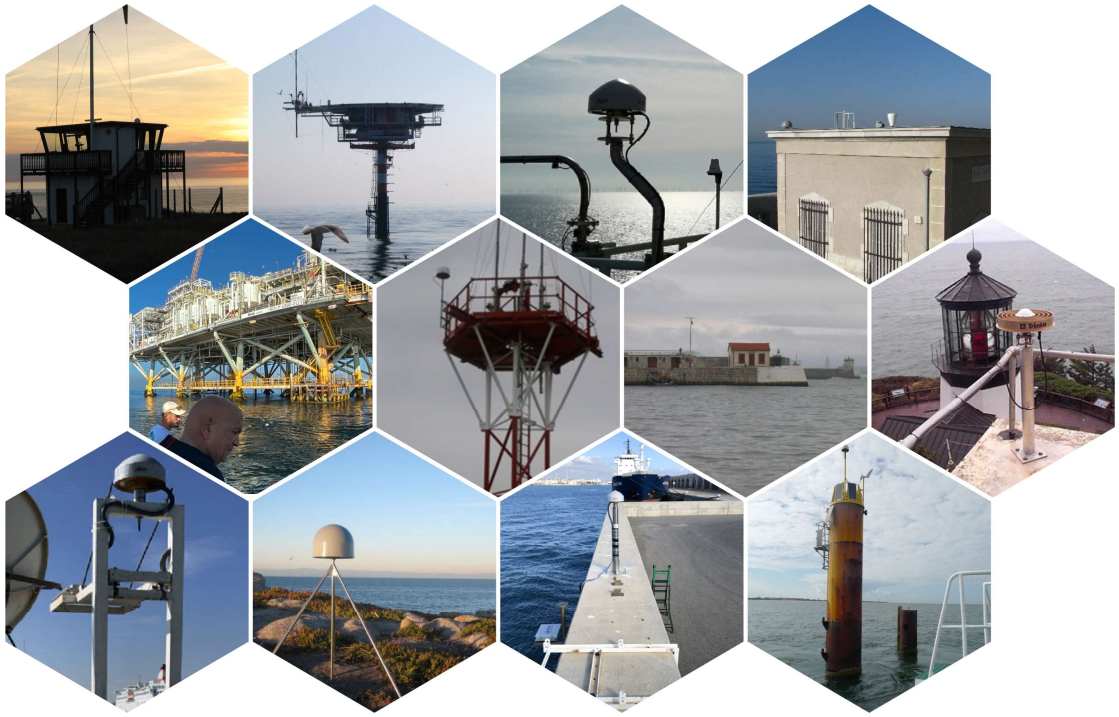
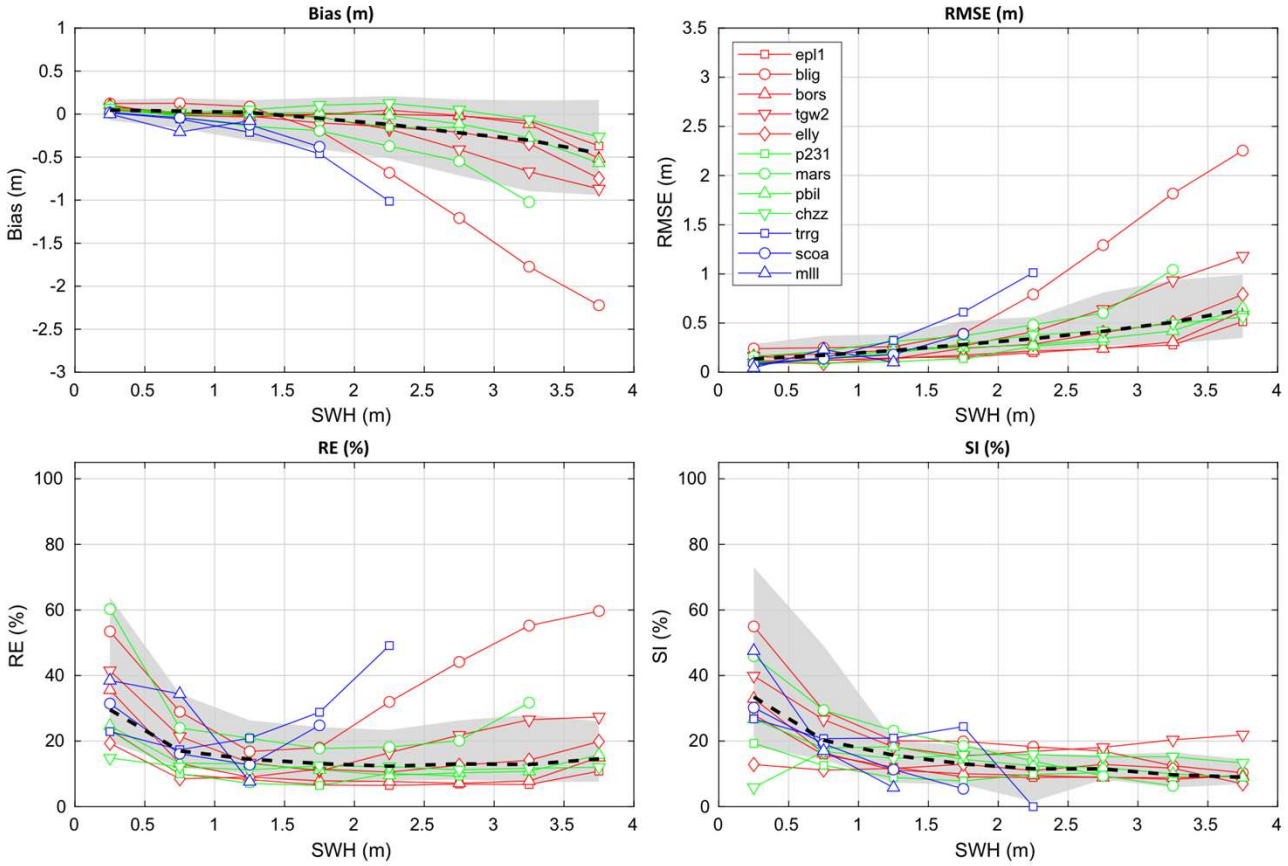


Fig. 9 Location of the GNSS sites used in this study. Platform sites are marked with circles, coastal sites with squares and harbour sites with a triangle.

Not all of these sites were chosen because they were the best. Just that they showed some indication of SWH and they were indicative of a typical location : platform, harbour, natural

QUALITY INDICATORS



Relative Error

Scatter Index

- BIAS: tends to underestimate at high SWH
  - Blig is bad because it doesn't record data at low elevation angles
  - Harbour sites partially due to lack of sampling of high SWH events
- RMSE: increases with increasing SWH
  - Best sites sub 25cm
  - "new method" (not shown) better but only works for the best sites

National Oceanography Centre

FINAL POINTS

- Not as simple as measuring water level
- Best sites tend to have
  - Clean elevation and azimuthal view (no clutter)
  - Large azimuthal range
  - All GNSS systems and frequencies (to increase the number of measurements)
  - High-rate data
  - Elevation angles down to at least 2 degrees
- Low-cost units are just as good as the geodetic quality receivers. Will it encourage more people to deploy them?

QUESTIONS

Can it measure Wave Period? 

Can it measure Wave Direction? 

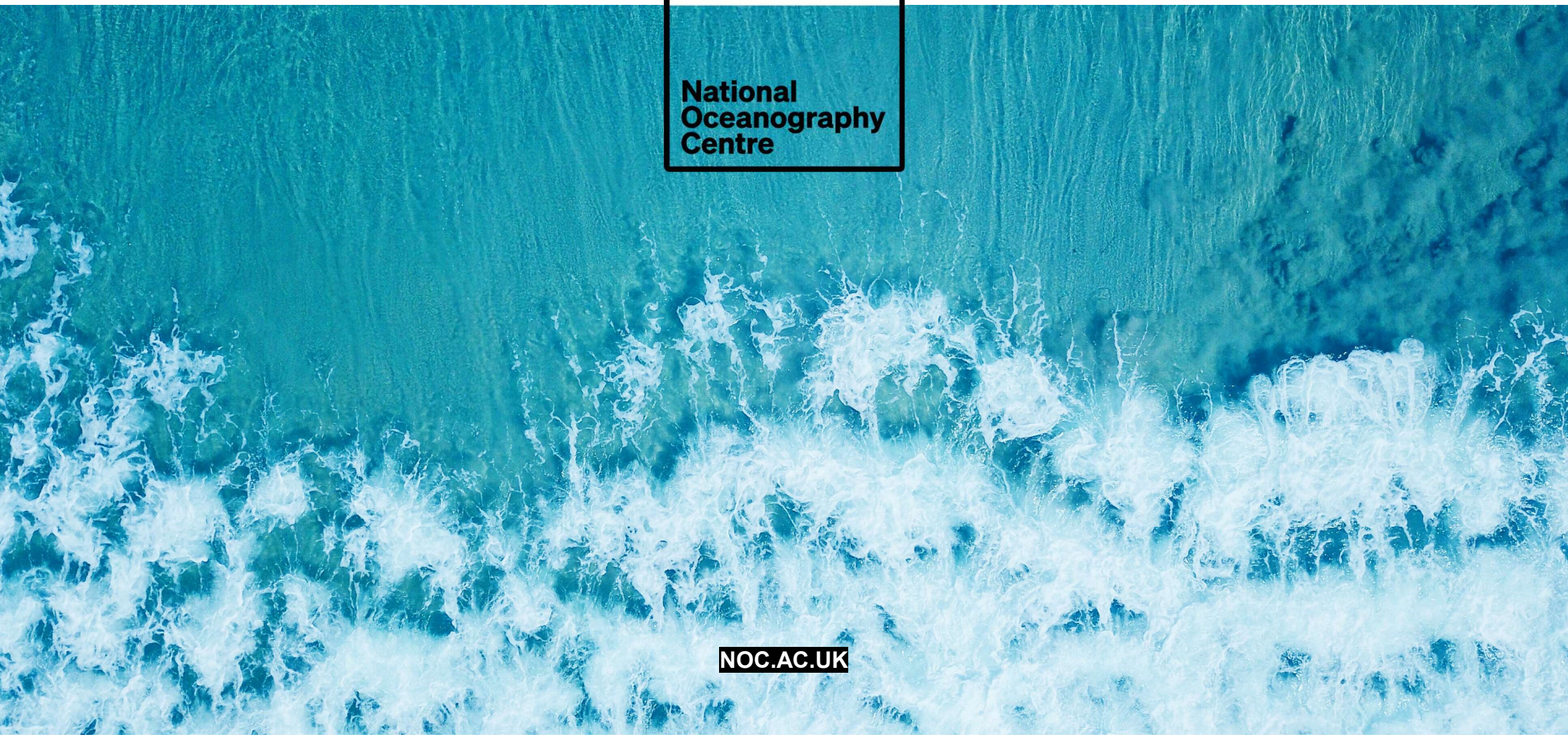
There is a paper claiming this and you can distinguish some direction information for example MARI, but not generally using the current methods

Calibration?

Cut-off method shouldn't need calibration according to the physics but there is also a dependence on the antenna gain. So yes at the moment it needs calibration.

Why?

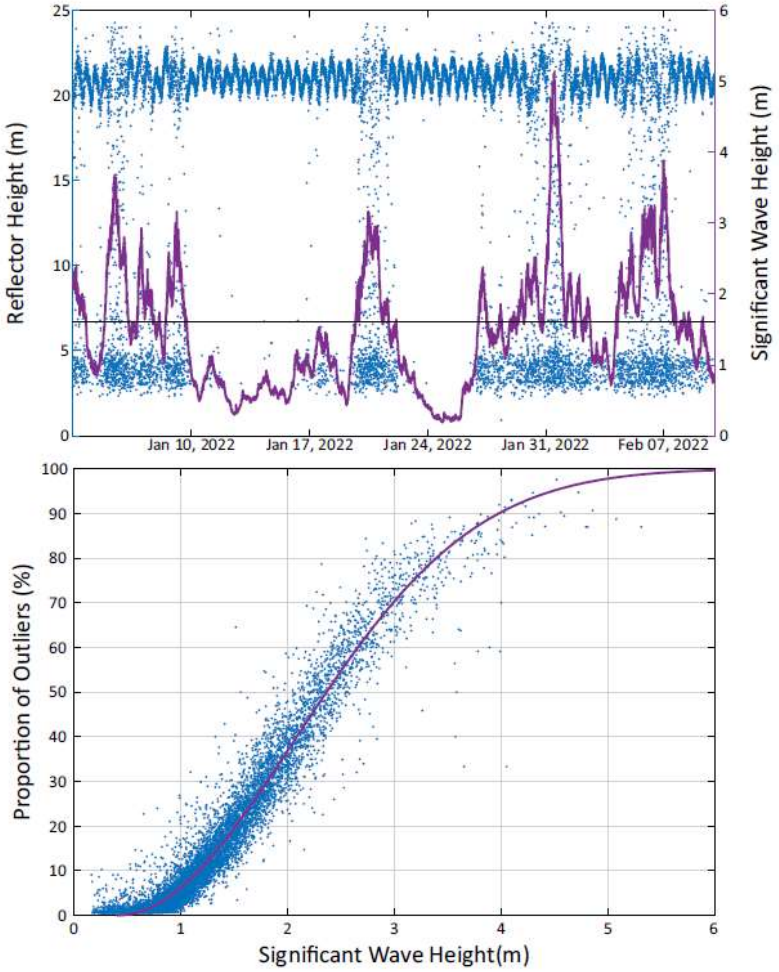
Cheap alternative that can supplement traditional systems and be installed in locations not necessarily practical for those systems


National
Oceanography
Centre
NOC.AC.UK

TGHM, HOROMATANGI REEF, LAKE TAUPO, NEW ZEALAND

National Oceanography Centre

OTHER PROXIES FOR SWH



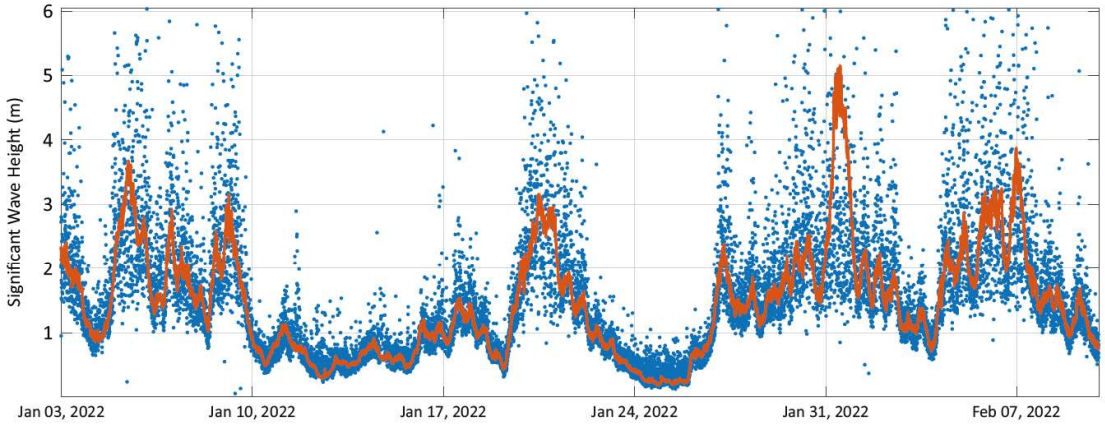


Fig. 8 Scaled reflector height uncertainties at site EPL1 in the North Sea compared with significant wave heights from colocated wave measurements.