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Where Waves Matter Most
A Case Study of Significant Wave Height from Offshore to Onshore

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Where Waves Matter Most
An ONGOING Case Study of Significant Wave Height from Offshore to Onshore

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Location

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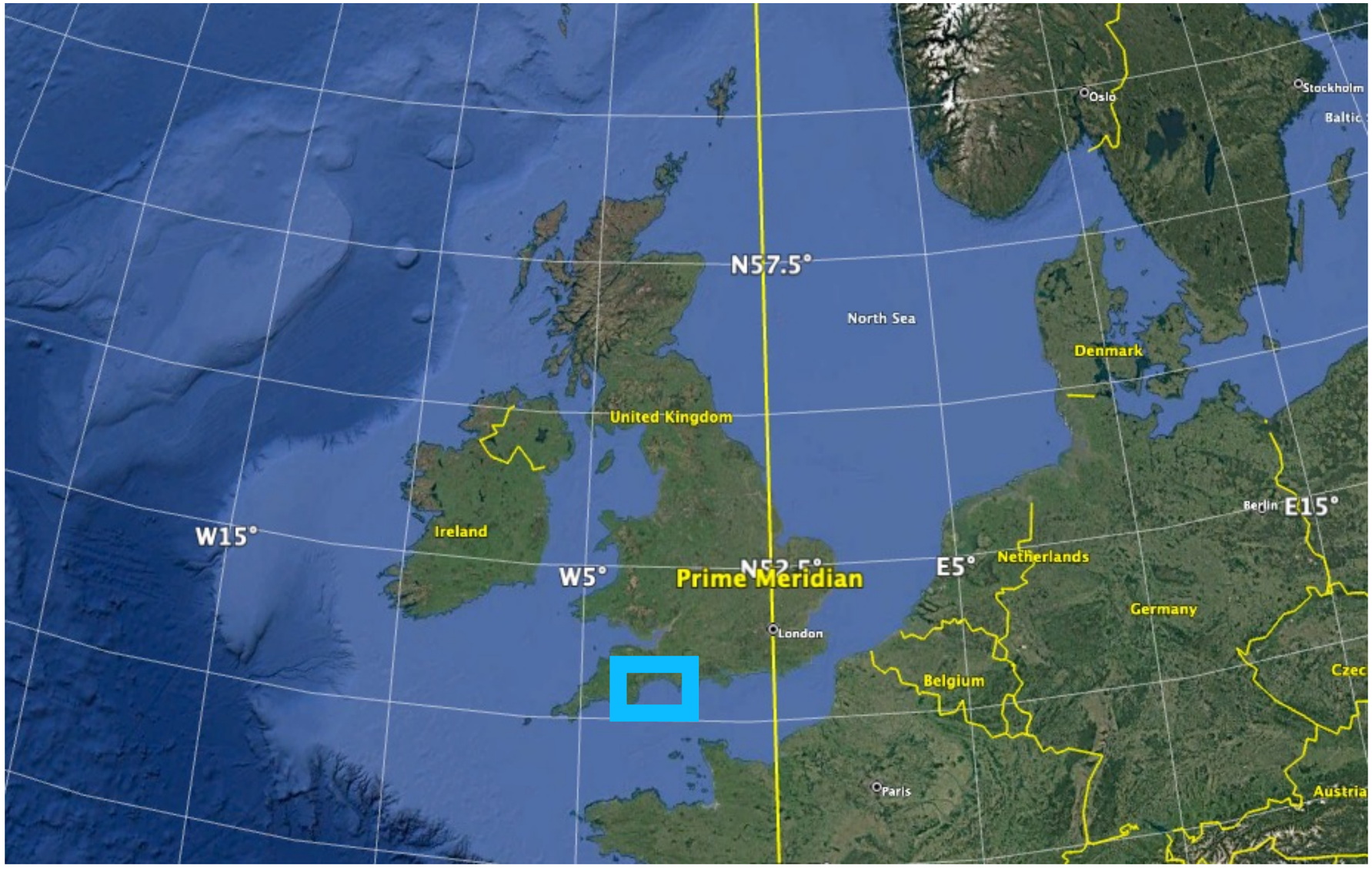

Sentinel 6
(Image: JPL)

Repeat ~10 days

Image: EMU Limited

EU | ESA
sentinel-3
COPERNICUS

Repeat ~27 days

Repeat ~369 days (30-day-sub-cycle)

CRYOSAT

Buoy versus Satellite: Spatial Variability

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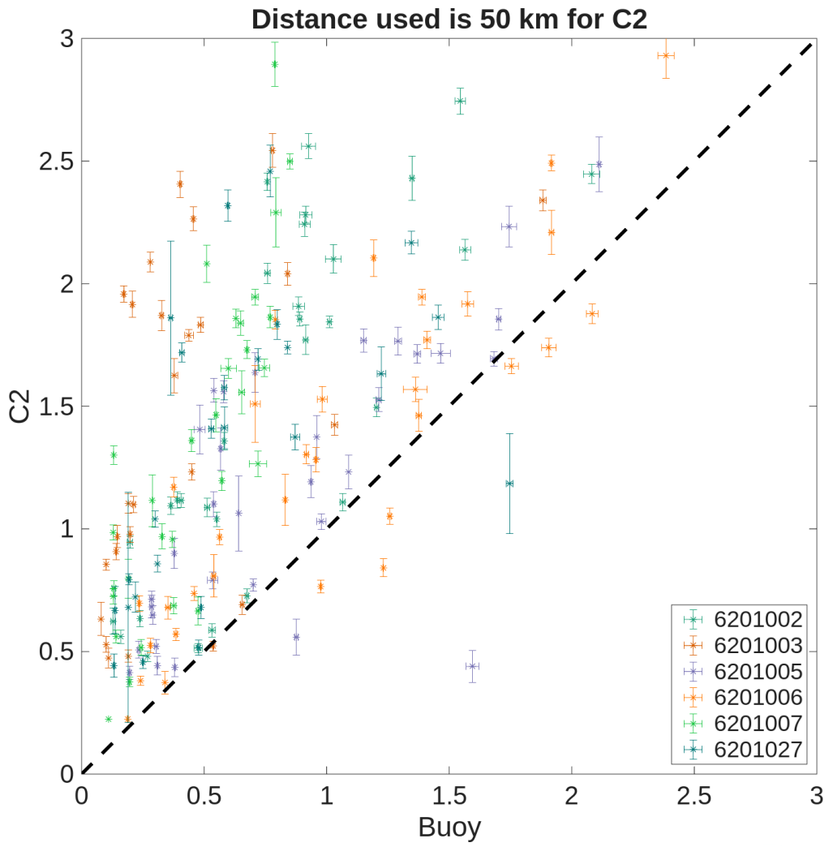
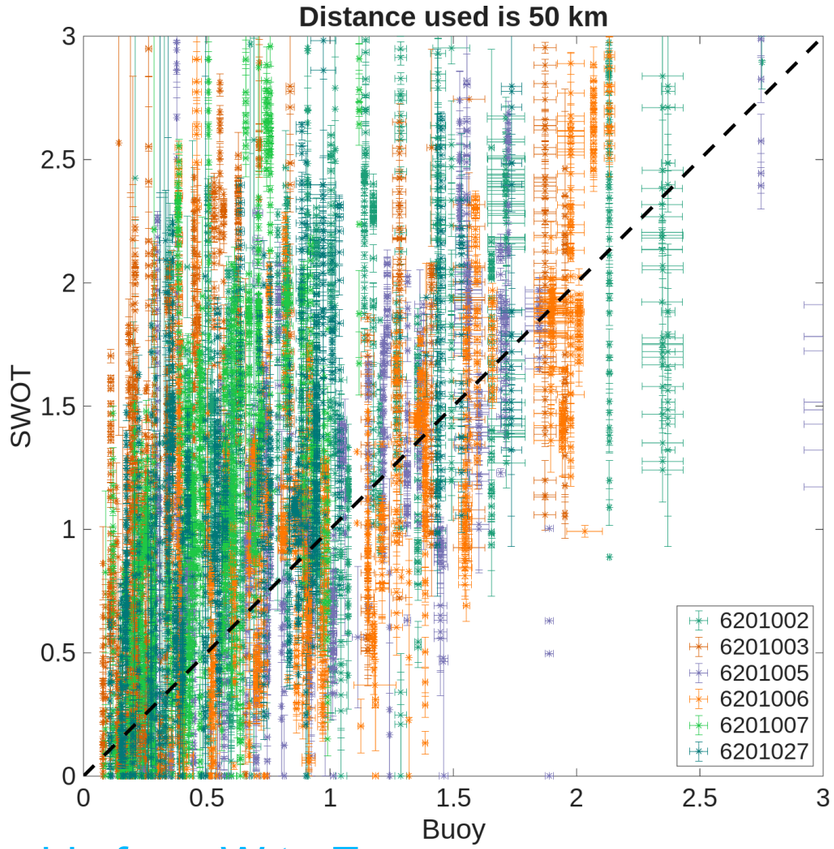
- Sentinel 3A and 3B, Sentinel 6, CryoSat-2, SWOT within study region during 2024
- 6 wave buoys (Weymouth/6201007 outside bay)
- 2 GNSS-IR locations
- Average data within 30 minutes of satellite pass within given radius

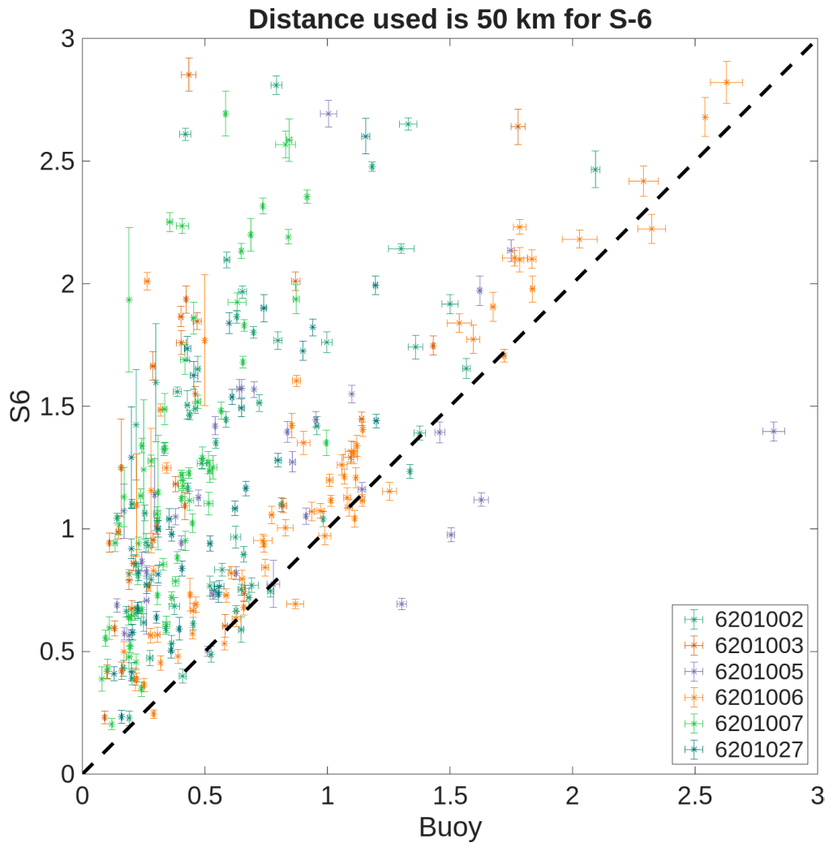
CryoSat-2



SWOT

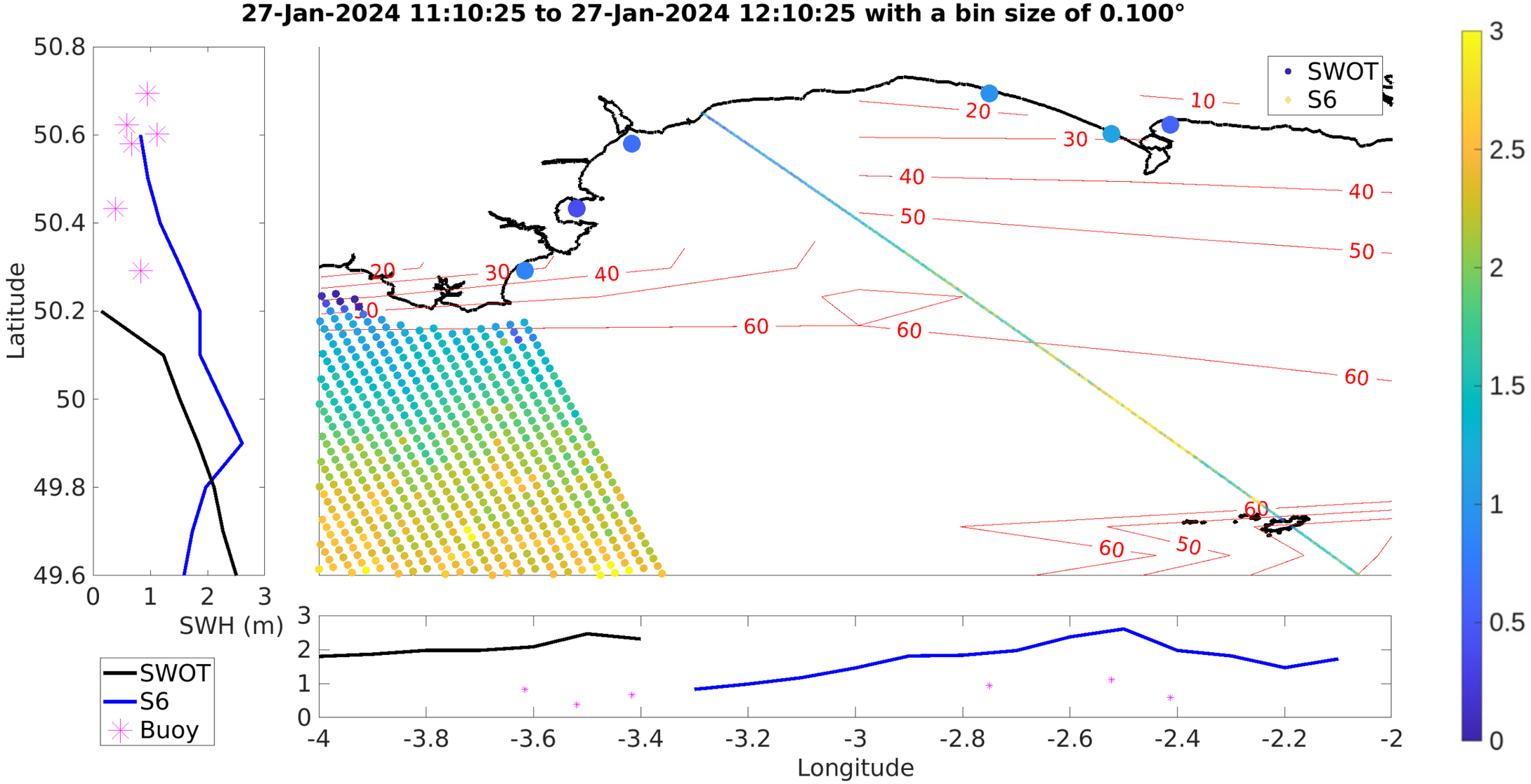


S-6



Buoy ids from W to E
6201002 Start Bay
6201003 Tor Bay
6201027 Dawlish
6201005 West Bay
6201006 Chesil
6201007 Weymouth

SWOT Matchup with Sentinel 6



SWOT Matchup with CryoSat-2

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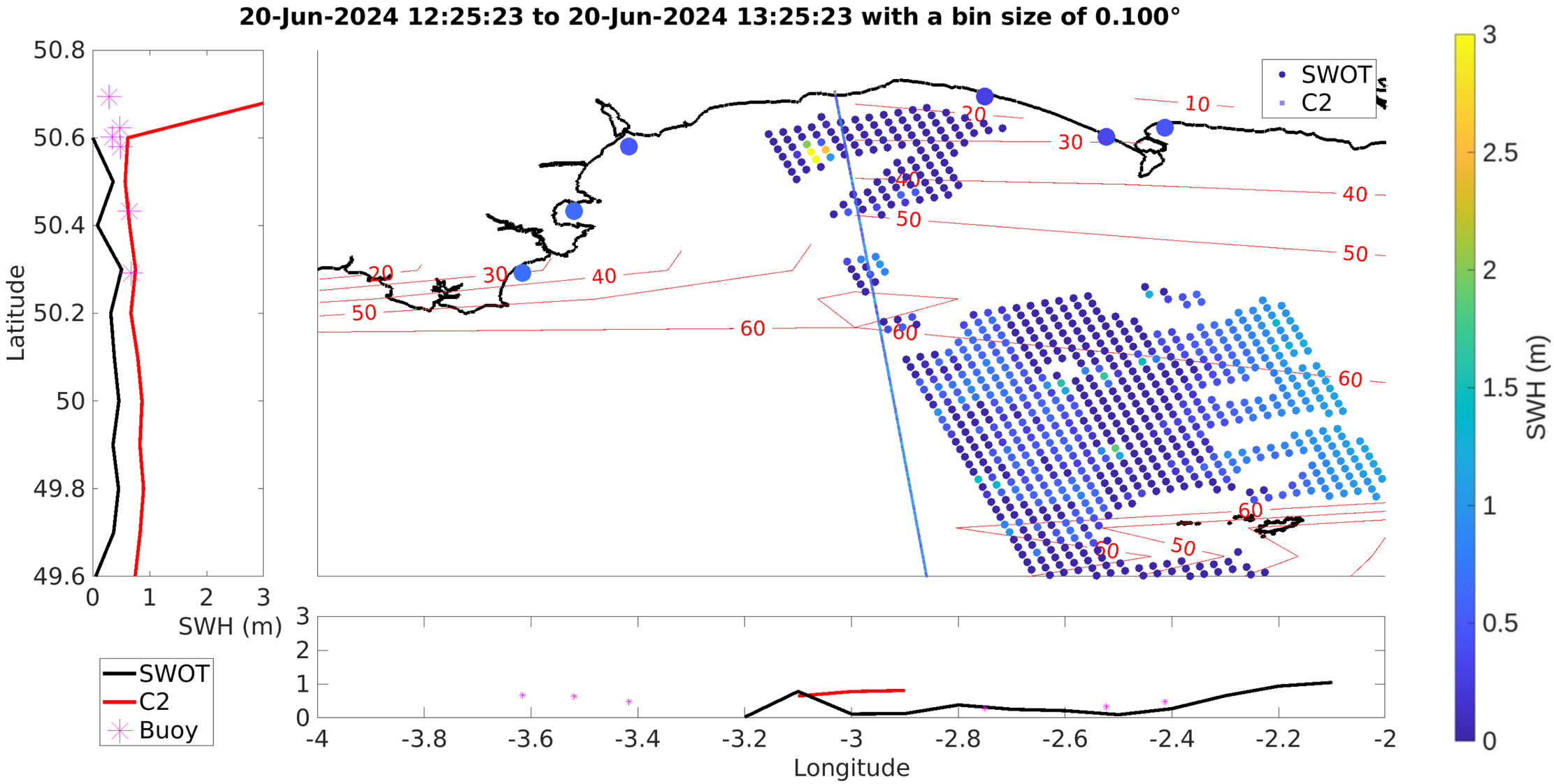
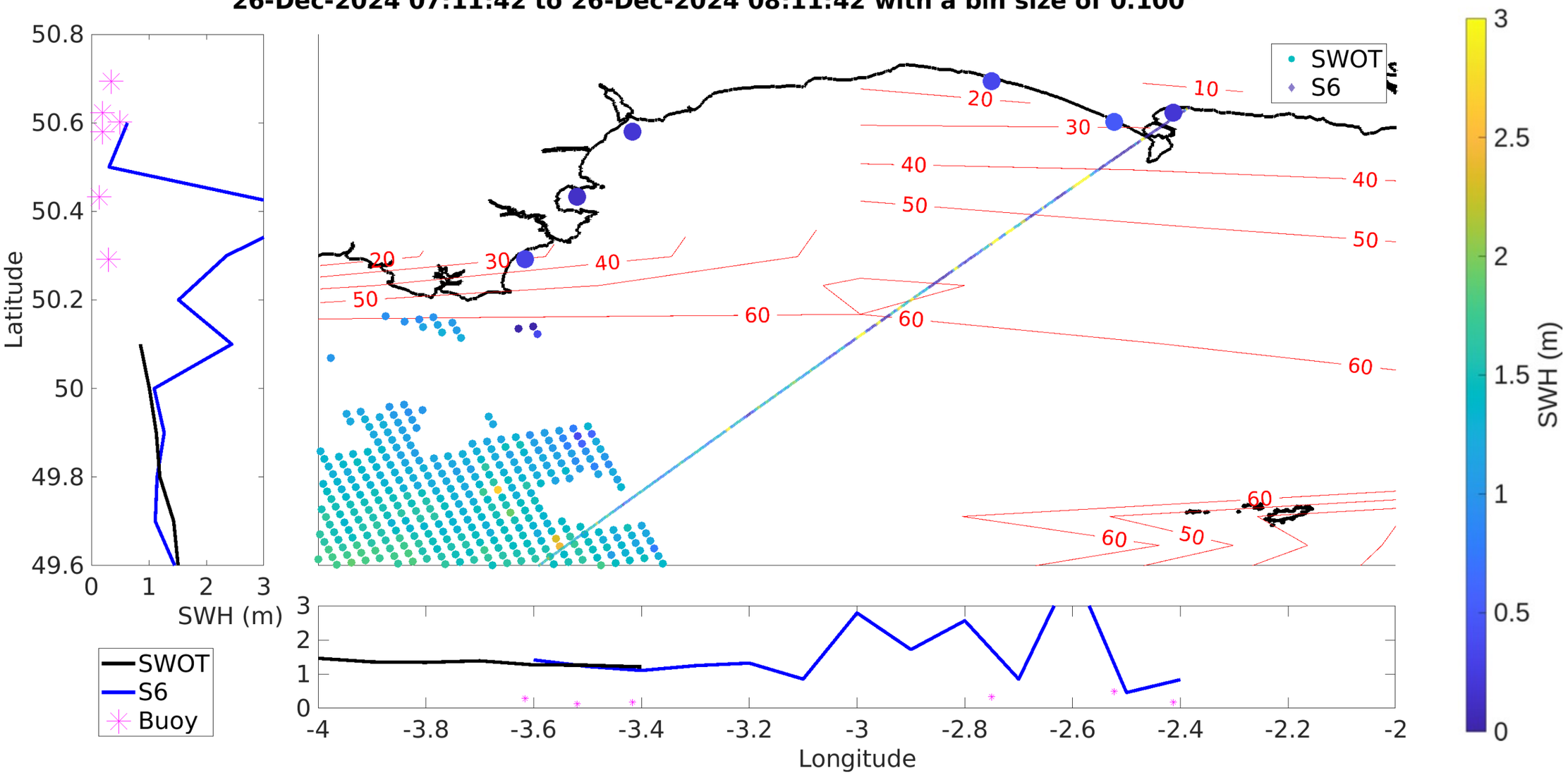


SWOT Matchup with Sentinel 6



Other Data Sources

- Sentinel 1 SAR
- High resolution Model?

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GNSS-IR for SWH

MULTIPATH: POSITIONING NIGHTMARE.

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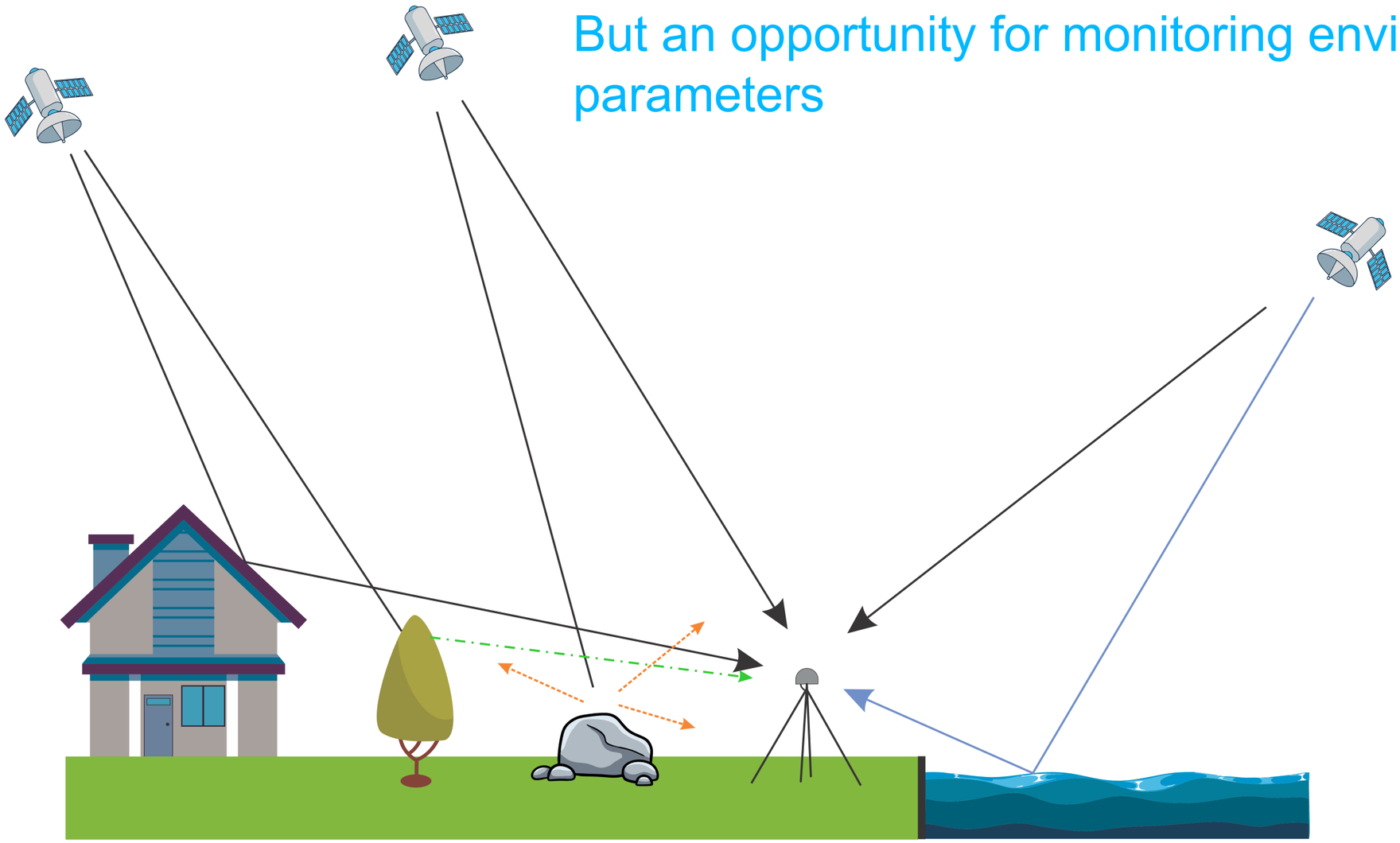
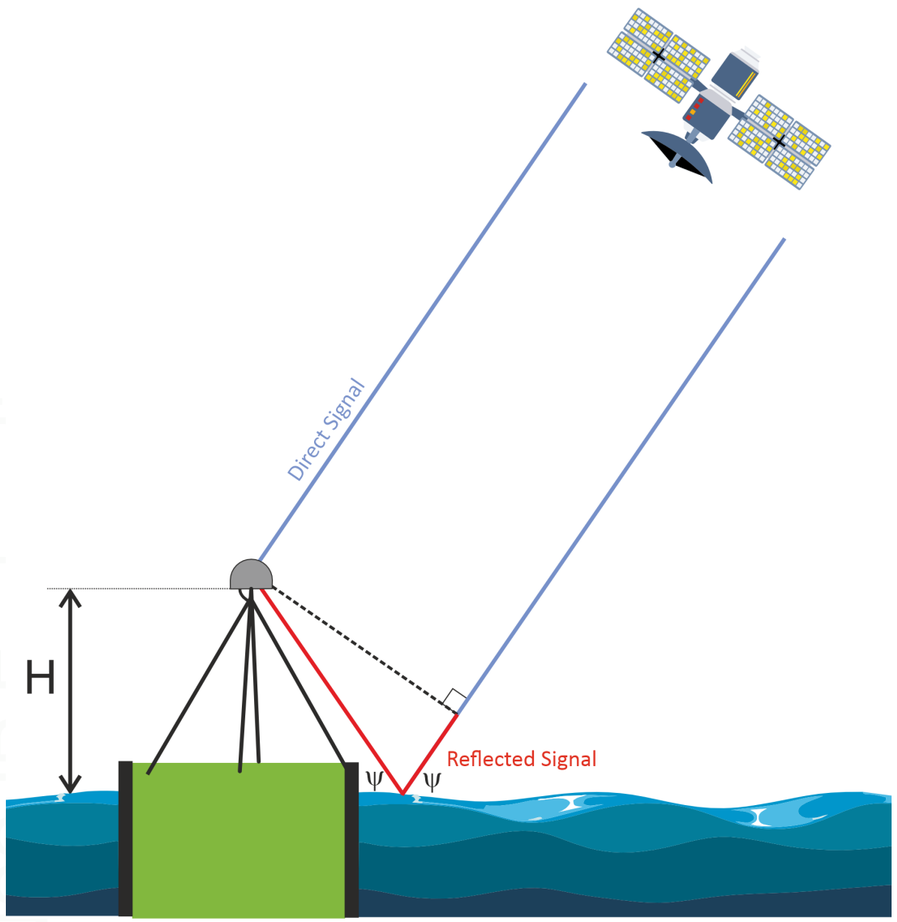
But an opportunity for monitoring environmental parameters

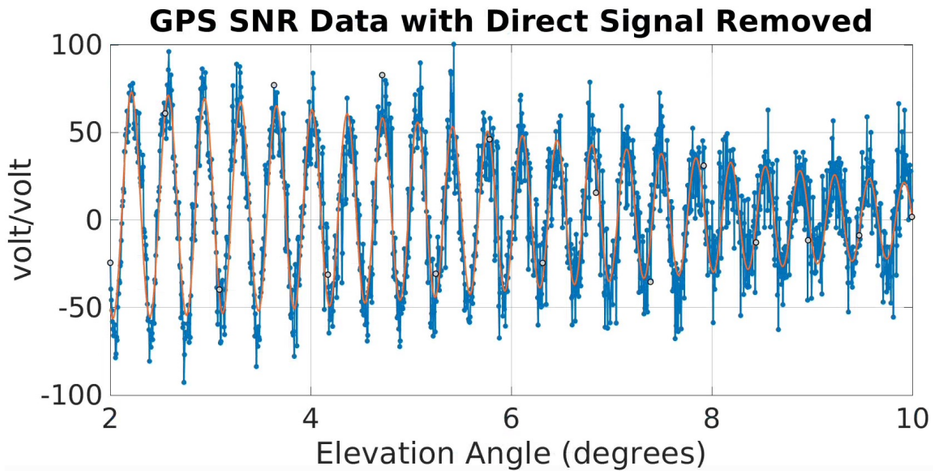


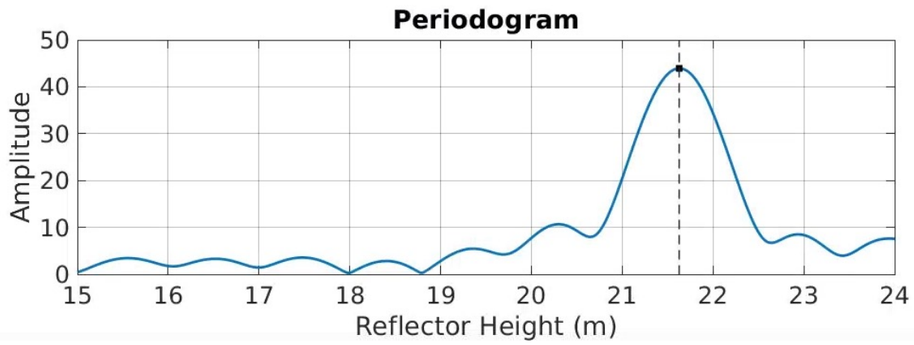
IF THAT SURFACE HAPPENS TO BE “FLAT” SUCH AS THE SEA SURFACE……



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

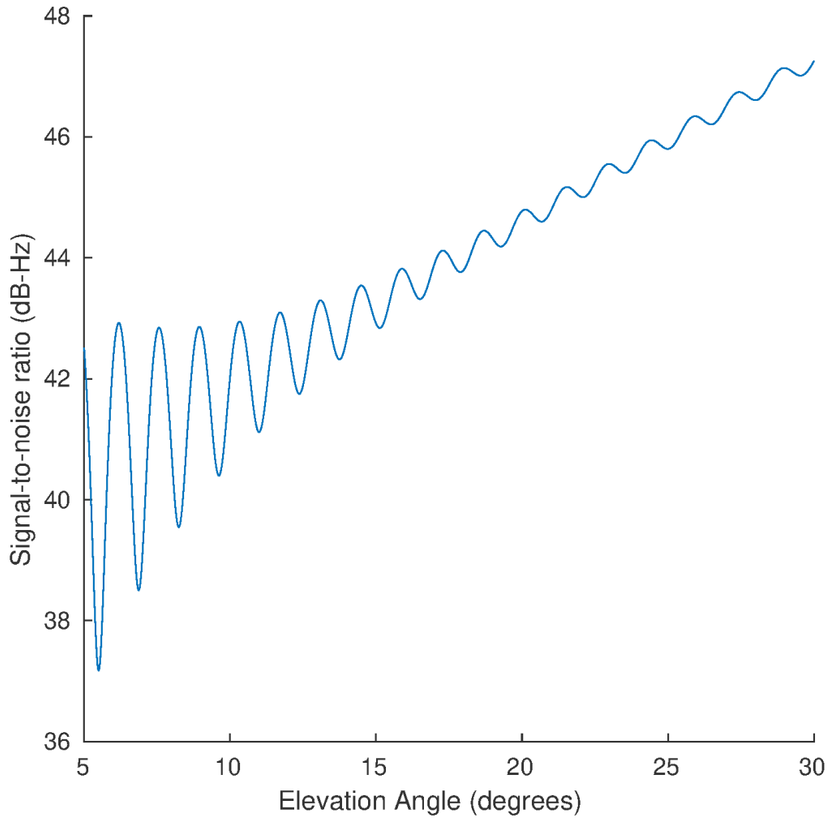
and the elevation angle

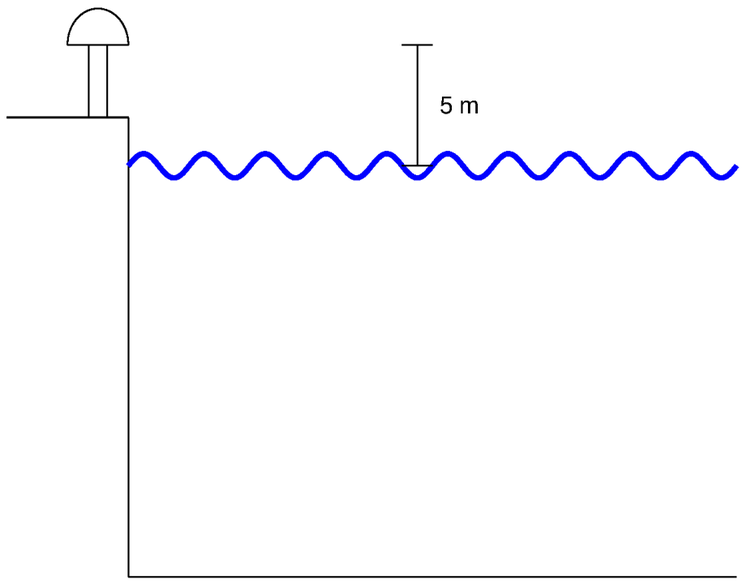




The reflections create oscillations in the SNR data (top). The frequencies of these oscillations are estimated using a periodogram (below)

HOW SNR CHANGES WITH SEA LEVEL HEIGHT





The plot of the signal-to-noise ratio as the GNSS satellite passes overhead changes as the height of the water changes. Lower water levels means the reflected signal has to travel further, resulting in greater frequency modulation. The water level can be extracted from this (see Larson et al., 2013)

EPL1, NORTH SEA, EUROPLATFORM, NETHERLANDS

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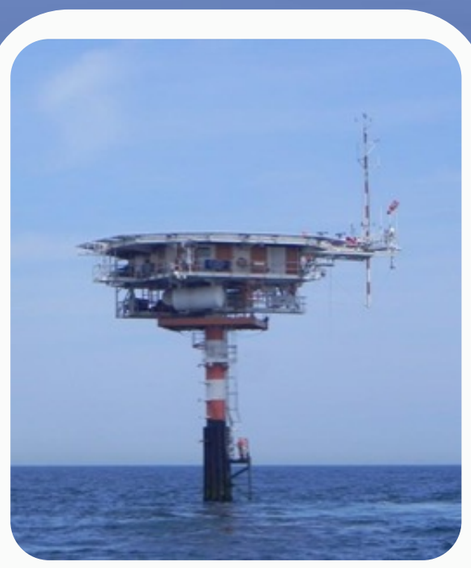

EPL1

EPL1

SEA STATE : THE BASIC IDEA…

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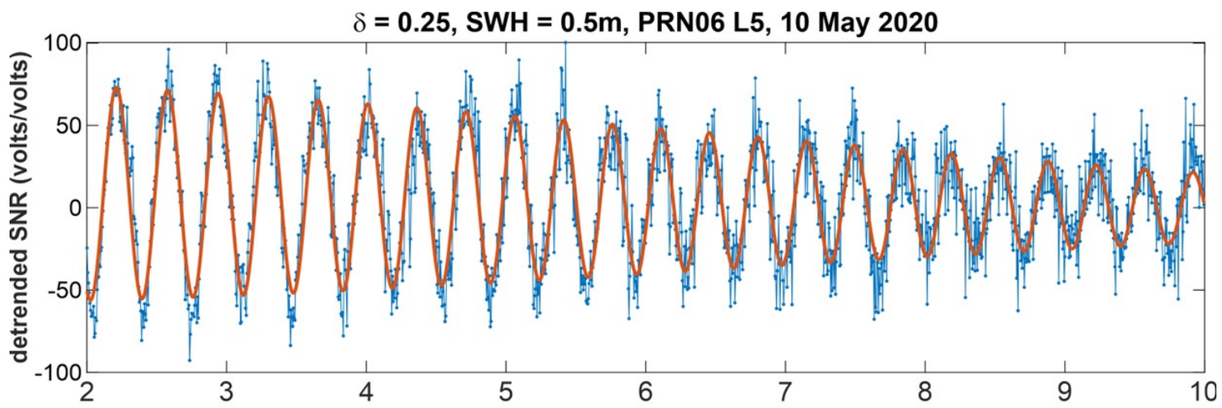

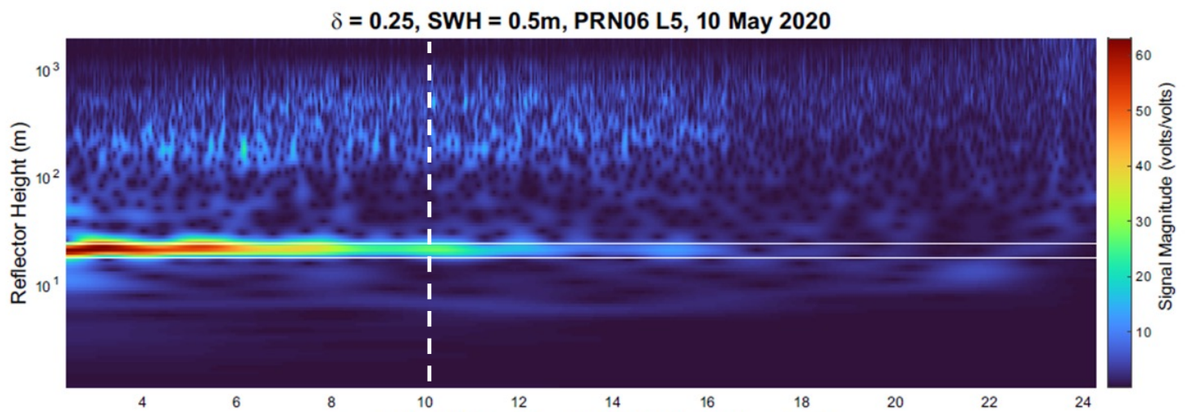

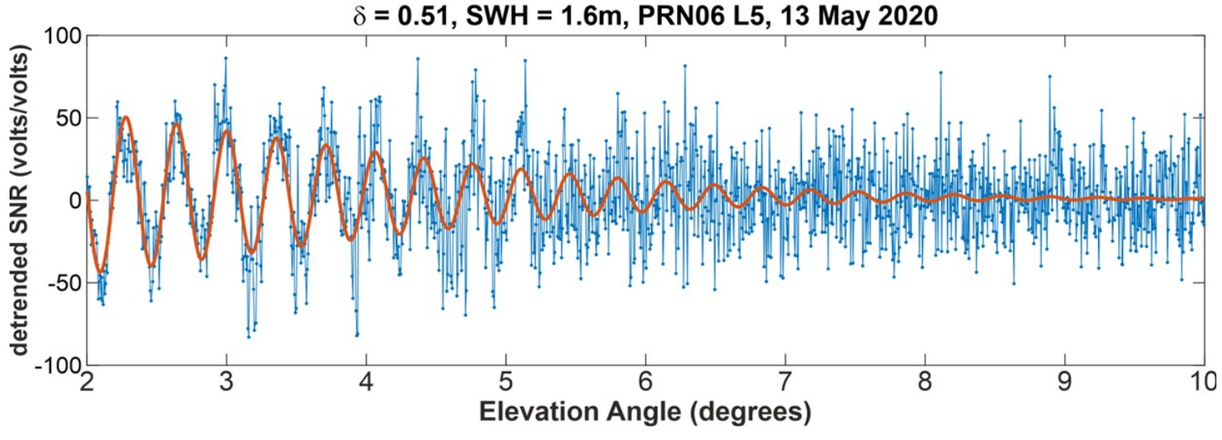

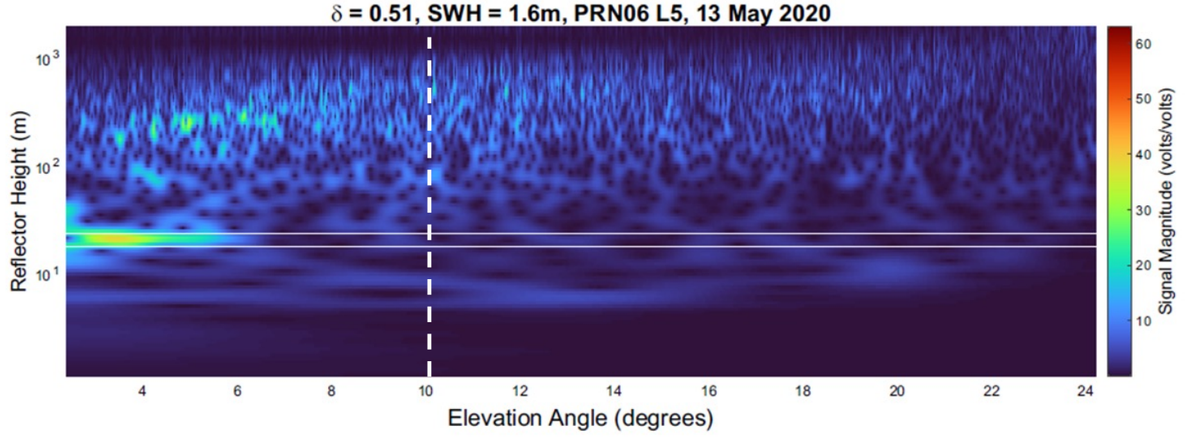

Site Europlatform (EPL1), South North Sea

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

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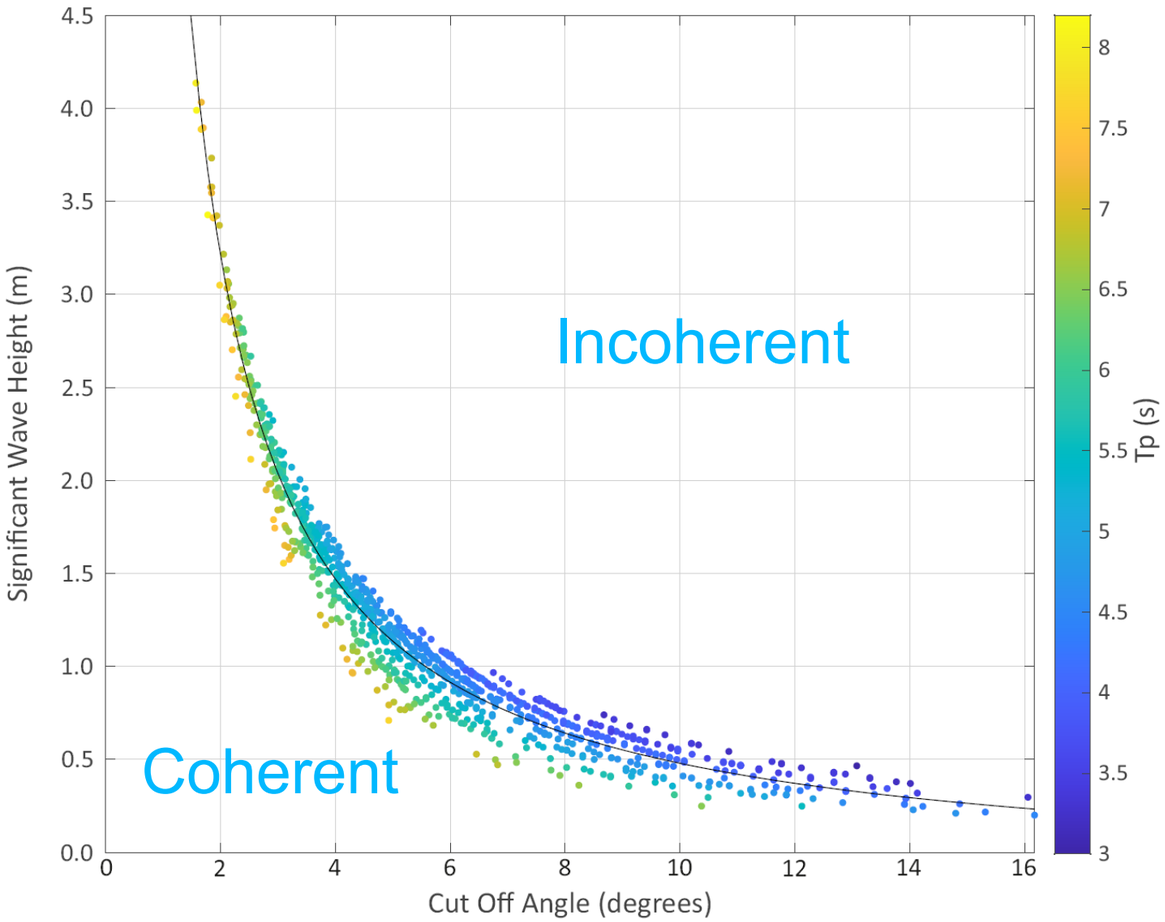

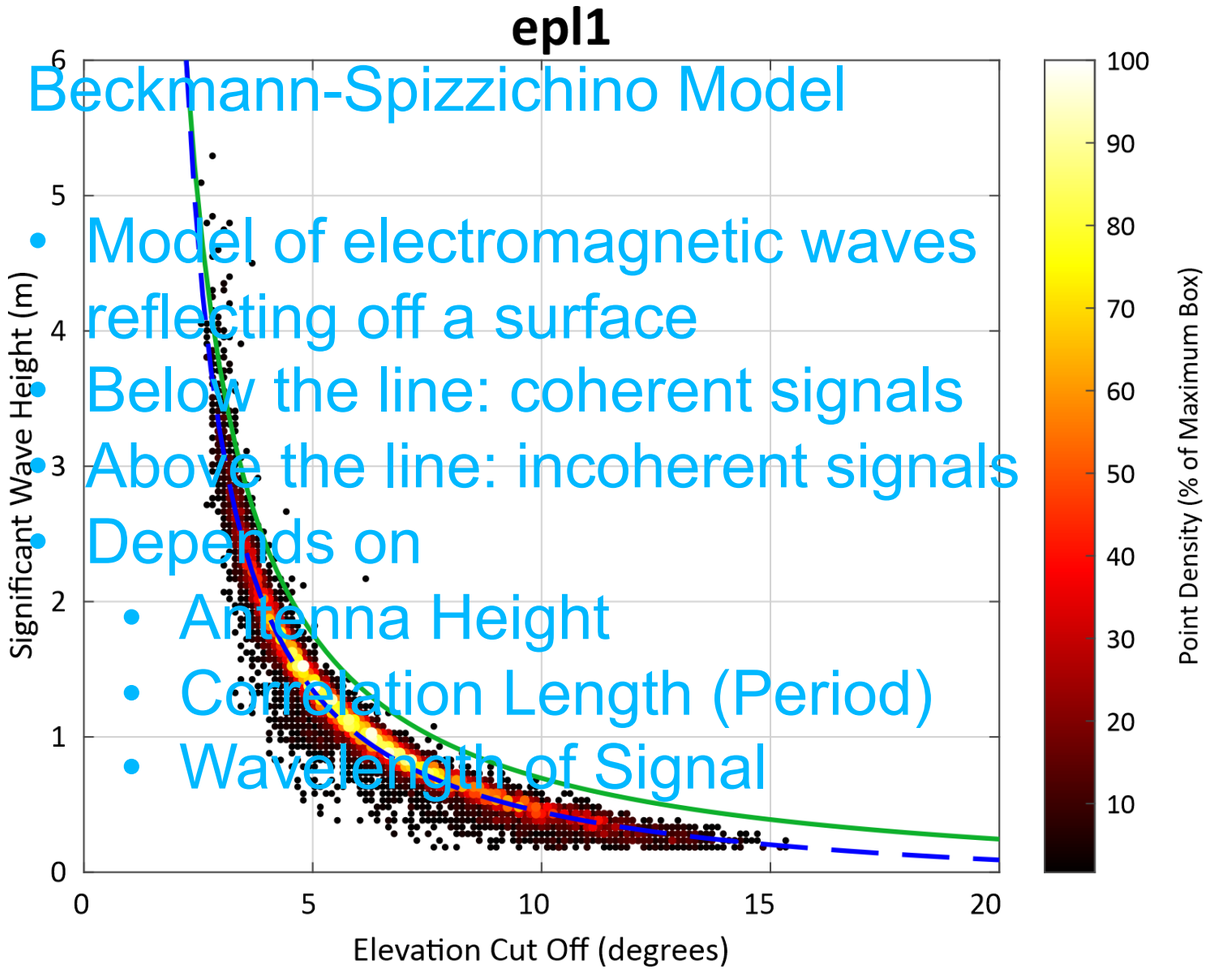

EPL1, NORTH SEA, EUROPLATFORM, NETHERLANDS

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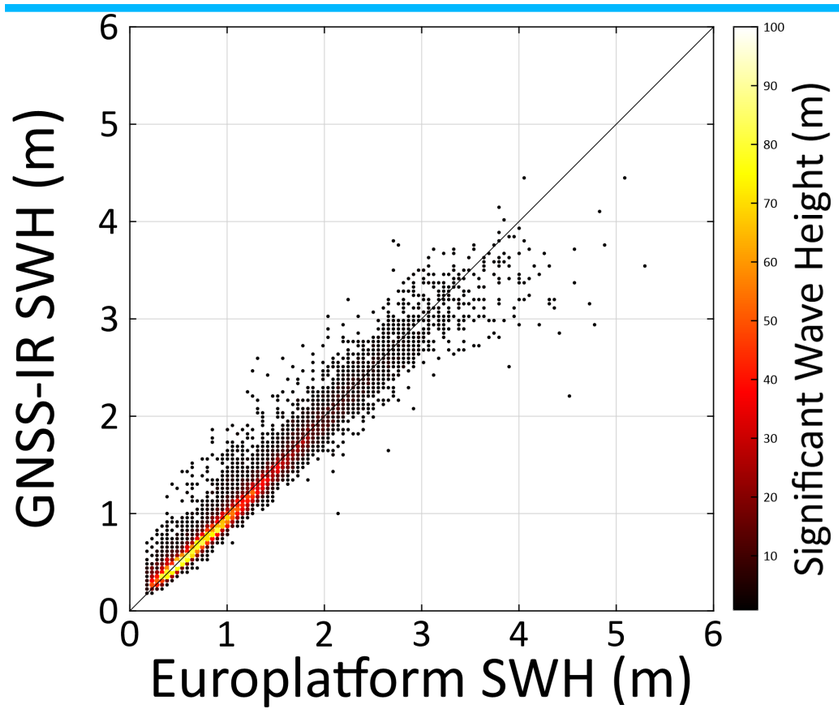

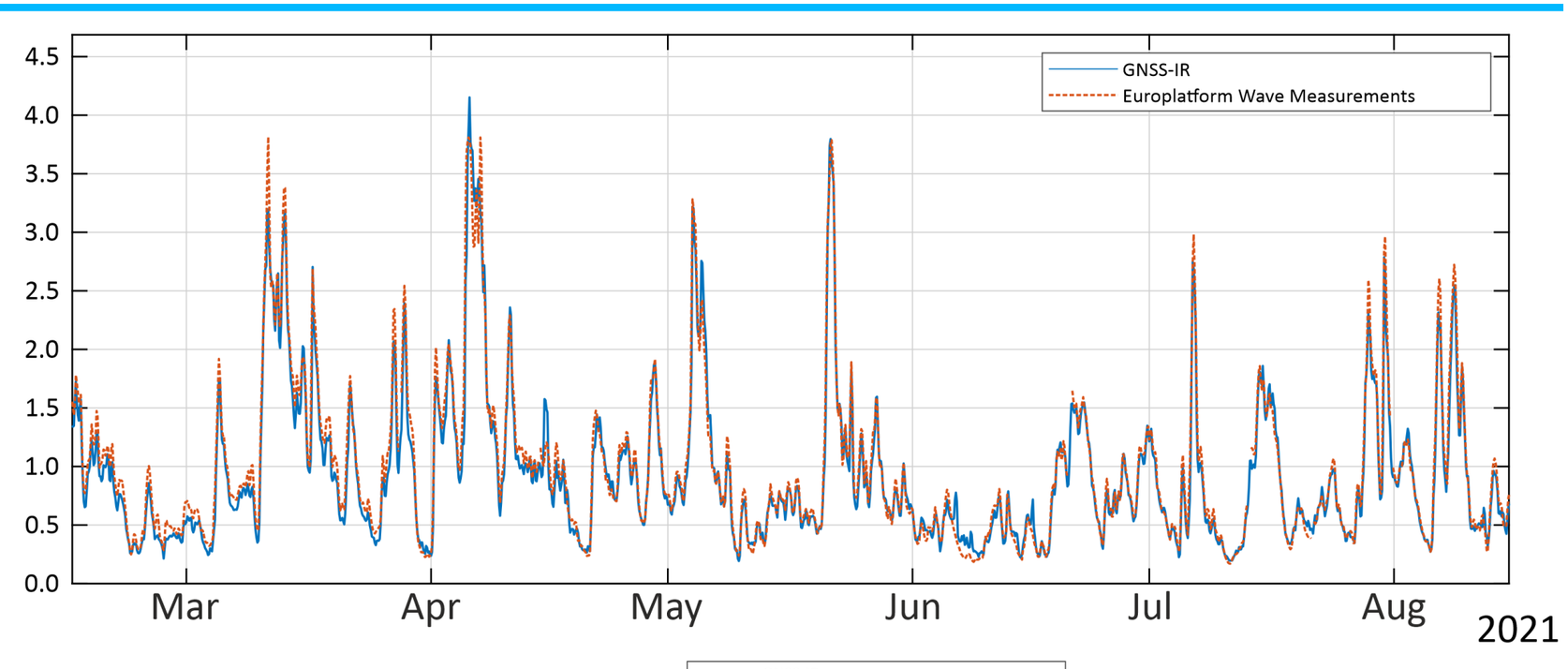

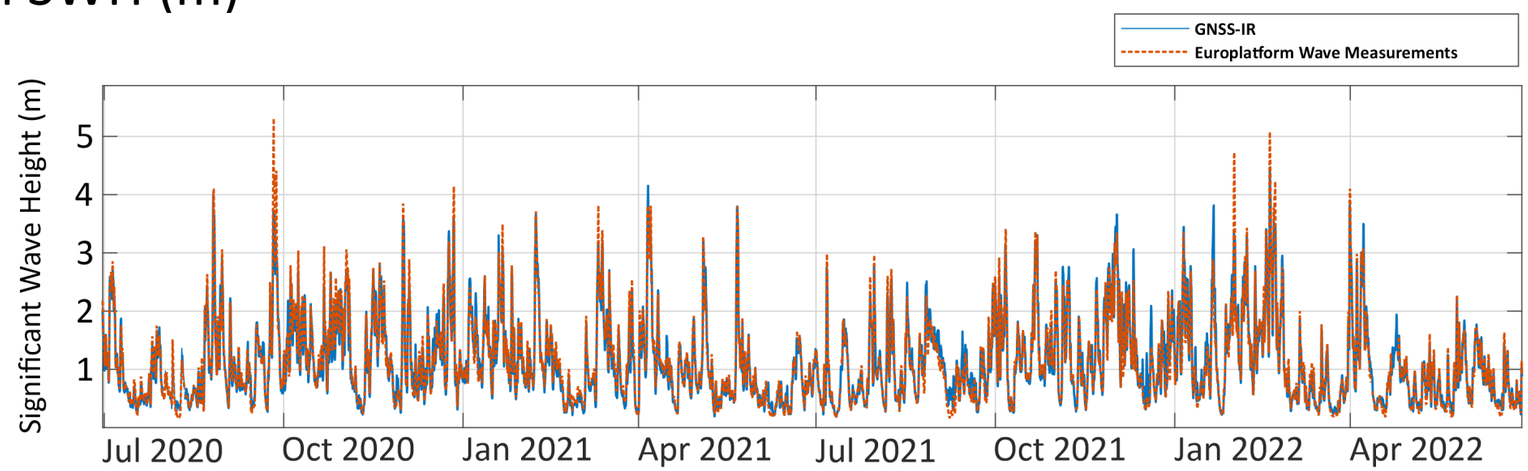

EUROSEA LOW COST SYSTEM IN BARCELONA FOR WAVES

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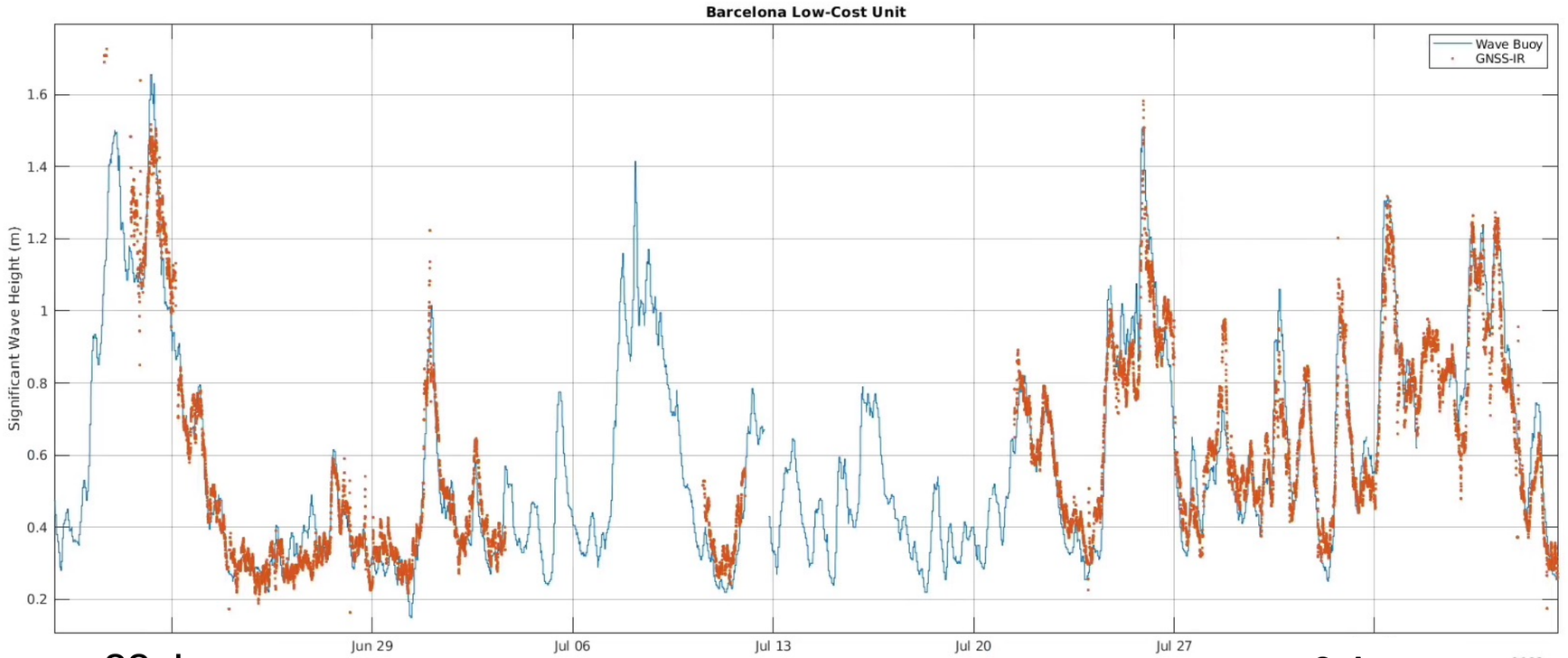
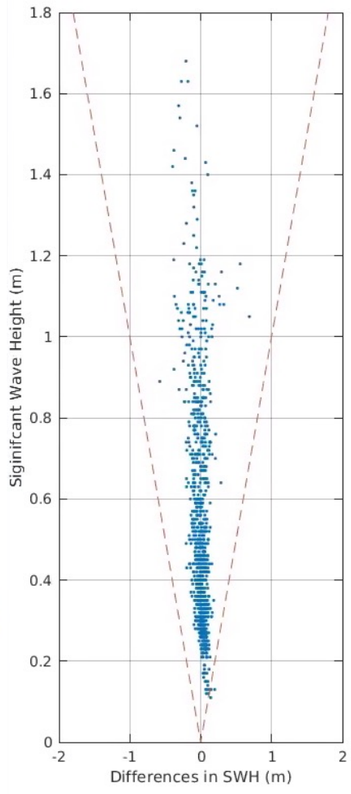
Blue line Buoy
Red GNSS-IR



22 June 2023

3 Aug 2023



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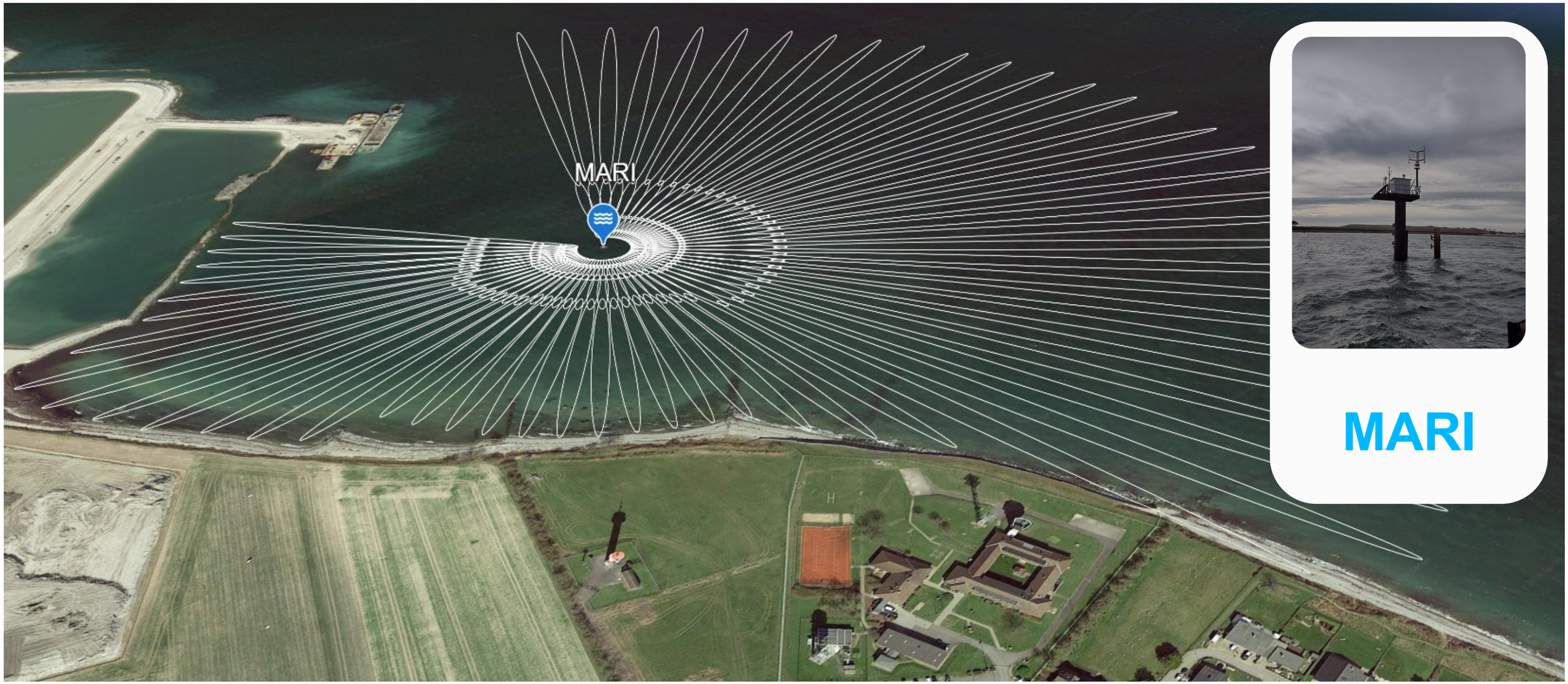

MARI

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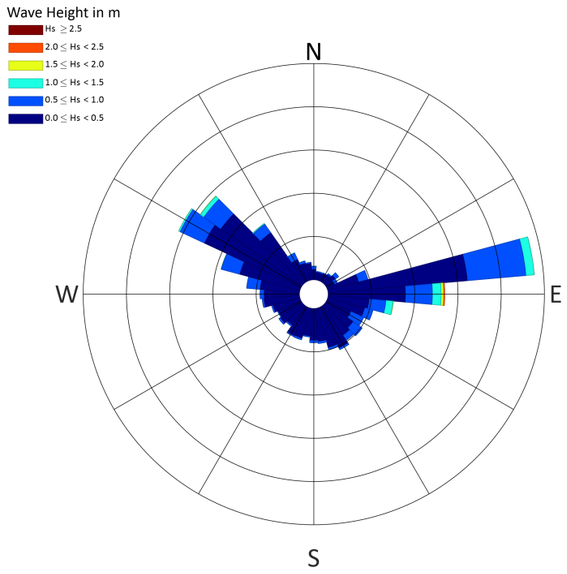

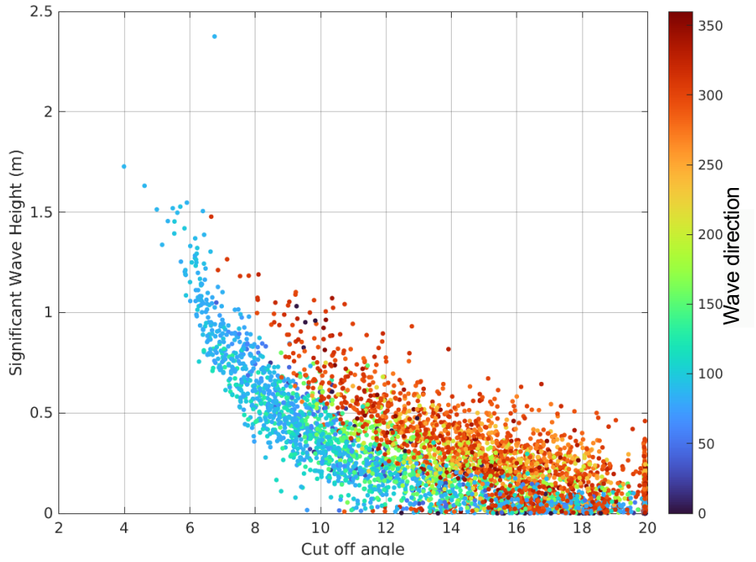

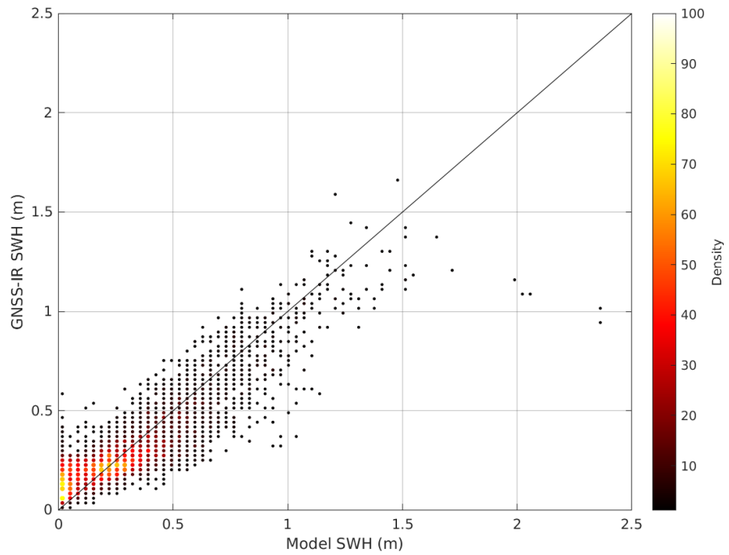

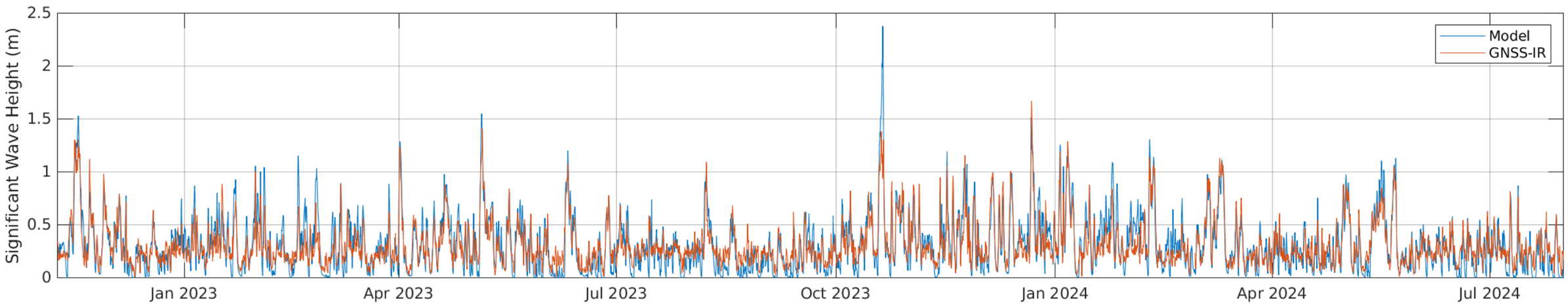

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FINAL POINTS

- 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?

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