

Can wave processes be seen in SWOT HR data? – A first look

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Coastal Processes
Research Group



- For the SPLASH project a wave overtopping prediction model for Penzance (figure 1) was developed (McGlade et al., 2025) using data from a wave buoy in the bay (CCO, 2025), the tide gauge at Newlyn (BODC, 2025) and the Wirewall overtopping system (figure 2)
- However, would wave processes between the wave buoy and shore affect the model? And can these be resolved in satellite data?

The SWOT satellite mission (figure 3) provides 2D water surface height measurements for the first time from space. The HR PIXC data product, though designed for rivers and inshore water bodies, should be able to detect near shore features in water level at about 30 m resolution. Though SWOT will also detect intertidal and beach areas, mistaking them for water.

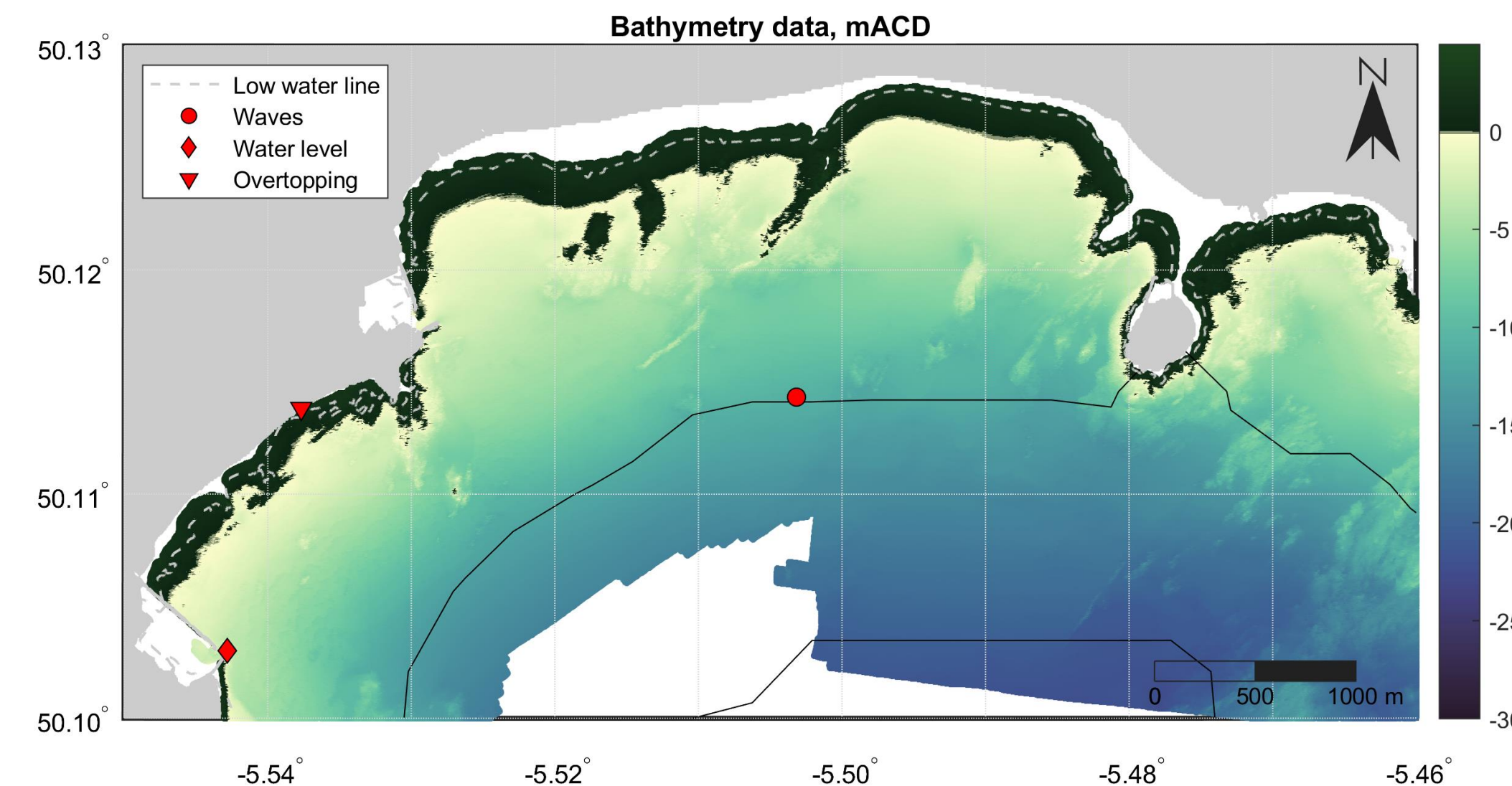


Figure 1: Bathymetry of the Penzance area. CCO high resolution bathymetry (colour scale), GEBCO bathymetry shown for comparison (contour lines, 10 & 20 m), Coastline and low-water line: Office for National Statistics licensed under the Open Government Licence v.3.0 Contains OS data © Crown copyright and database right 2025.

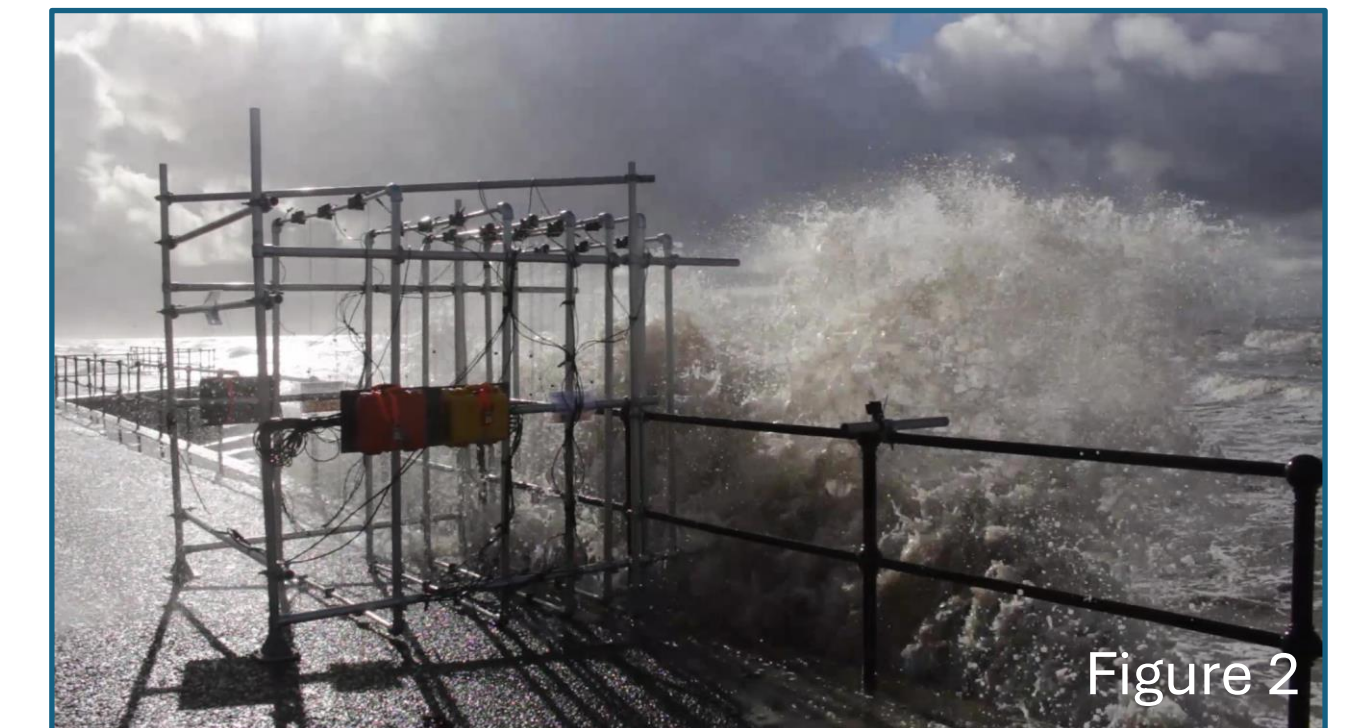


Figure 2



Figure 3

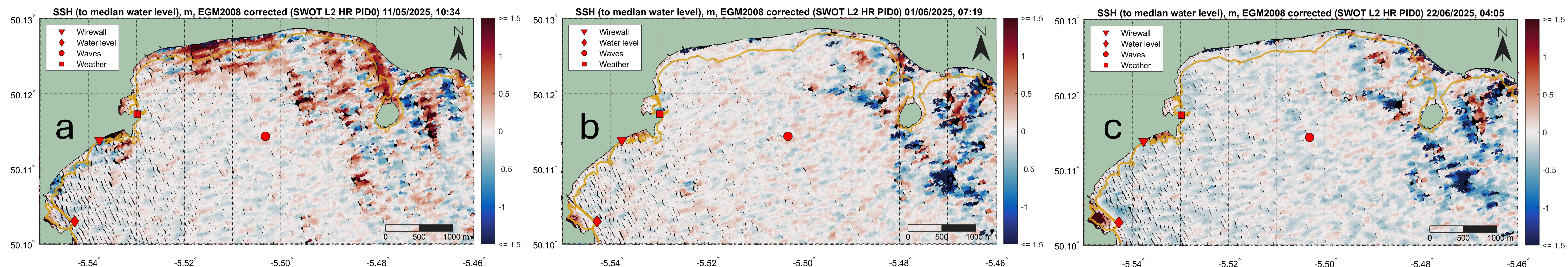


Figure 4a, b & c: Sea surface height for the Penzance area at a) low-water, b) high-water & c) mid-water ebb, metres, corrected to geoid (EGM2008) and the median water level. SWOT L2 HR PIXC product (version PID0). The locations of Wirewall (overtopping), Newlyn tide gauge (water level), Penzance wave buoy and Penzance weather station are shown. Missing data and gaps between SWOT measurements are shown in black. The colour scale has been adjusted to ± 1.5 m to highlight the wave affects. The low-water line is shown in light orange. Coastline and low-water line: Office for National Statistics licensed under the Open Government Licence v.3.0 Contains OS data © Crown copyright and database right 2025.

- The sea surface height map from 11 May, low-water, shows lines of higher water level near the shore to the north of the bay and by the Wirewall deployment at Penzance (figure 4a), which would be expected for depth limited wave breaking. Along the low-water line, areas of higher and lower water level can be seen.
- In the east of the bay persistent features (figure 4a, b & c) suggest circulation patterns caused by the coastal morphology, but this would need to be verified.

References

BODC (2025) https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/uk_tide_gauge_network/processed/
Channel Coastal Observatory (2025) <https://coastalmonitoring.org/realtimedata/>
McGlade et al. (2025) Investigating Appropriate Artificial Intelligence Approaches to Reliably Predict Coastal Wave Overtopping and Identify Process Contributions. Ocean Modelling, V194,102510.