making space for sand

UNIVERSITY OF PLYMOUTH

How does a Tromino survey work?

Background

Tromino surveys have been undertaken at the 40 Making Space for Sand (MS4S) sites to estimate the depth of sediment at each beach. Surveys were completed along fixed cross-shore profiles extending from the back of the dune system to approximately Mean Low Water Spring (MLWS). These same profiles are routinely surveyed by the South West Coastal Monitoring (SWCM) Programme to monitor changes in beach elevation (topography) over time. By improving our understanding of how much sediment is stored within the beach and nearshore system, the surveys help inform how coastlines may respond to future sea-level rise and coastal change. This document provides an overview of what Tromino surveys are, how the surveys were undertaken, and how to interpret the survey outputs for each beach location.

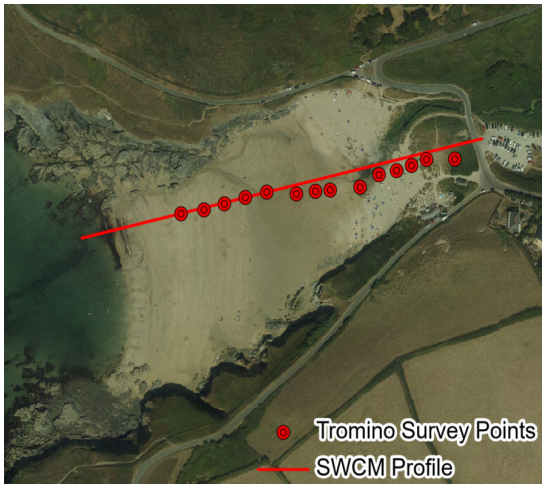


What is a Tromino Survey?

A Tromino is a small, portable instrument (see above image) that measures tiny natural vibrations in the ground caused by waves, wind, and even traffic. These vibrations are affected by the materials beneath the surface, meaning sand, gravel, clay, and rock each produce different vibration patterns. By analysing these patterns, it is possible to estimate the depth and shape of buried layers beneath the beach. Because the technique uses naturally occurring vibrations, no excavation or artificial energy source is required. By repeating measurements at multiple locations along a profile, a picture can be built up of how conditions beneath the beach vary from place to place. The method is quick to deploy, causes minimal disturbance to the environment, and can be used to survey large stretches of coastline efficiently.

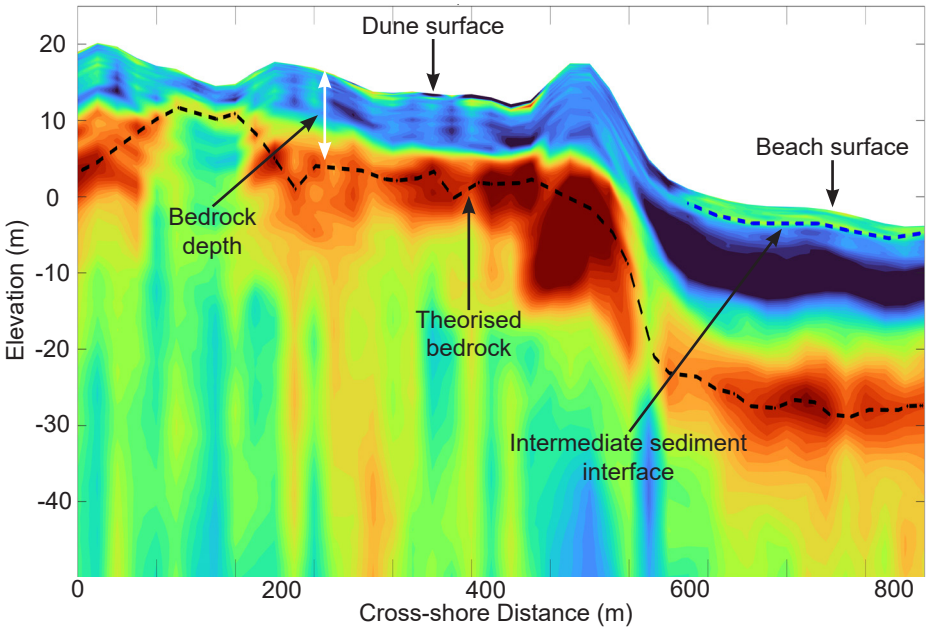
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Data Analysis

The processed data were analysed using specialist software to identify changes in vibration frequency, which commonly occur where there is a change in the stiffness of the material beneath the beach. By analysing the frequency of these signals, it is possible to estimate the depth of buried layers and map how they vary across the profile (see opposite data output at Holywell Beach). When similar patterns are observed at neighbouring survey points, the position of these layers can be traced along the beach. Ground elevation was also measured at every survey point using GPS equipment, allowing the interpreted layers to be referenced to a common height system known as Ordnance Datum Newlyn (ODN).

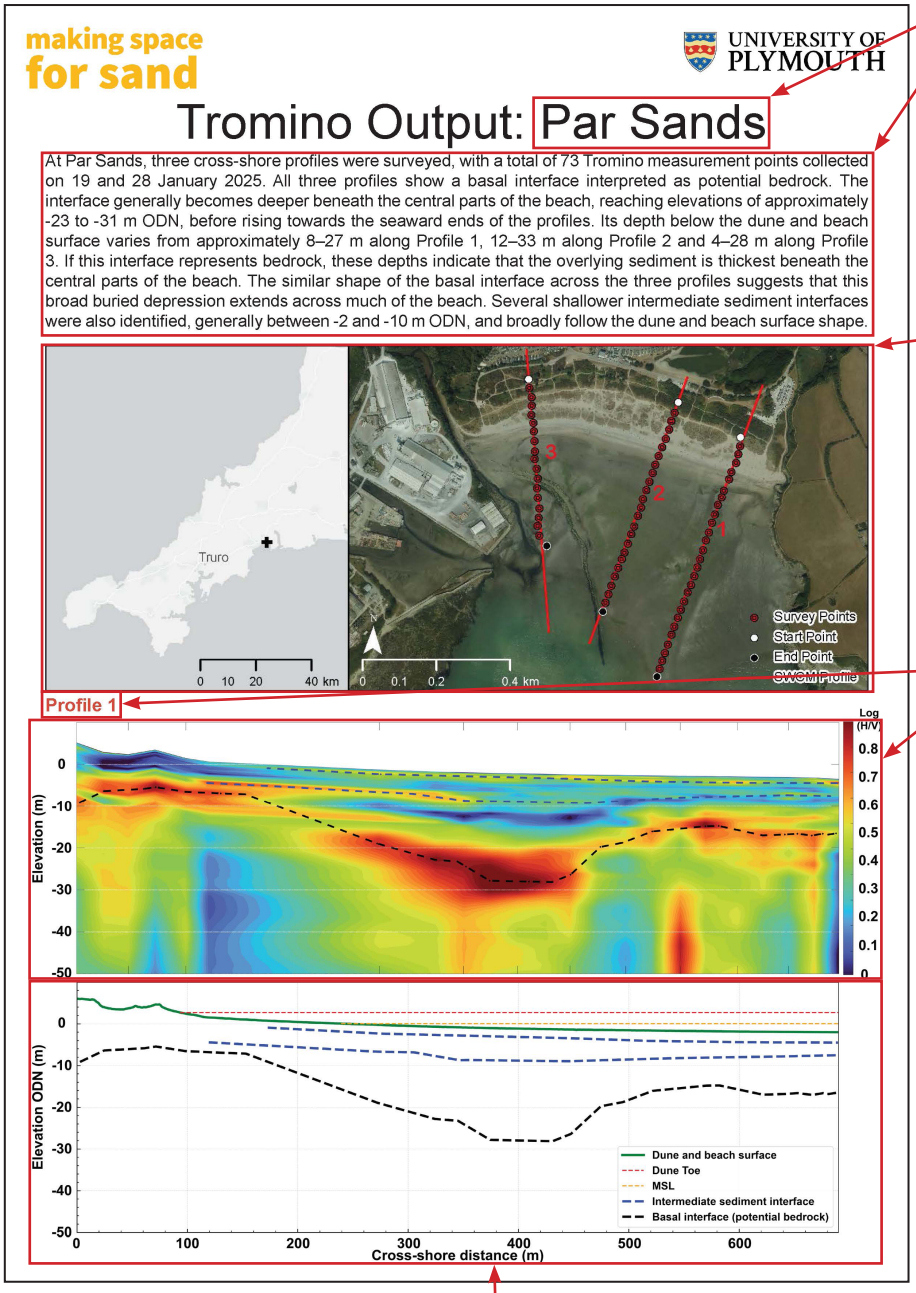


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Interpreting the results

The below section details how to interpret the Tromino output documents available for each beach location.



Beach Location

Site Description and Interpretation
A small paragraph detailing the number of Tromino survey points surveyed across the total number of SWCM profiles for the site. A short description of the primary interfaces between sediment/rock layers, identified at each profile is also included.

Location Map
The location map to the left indicates the position of the beach relative to Cornwall. The location map to the right indicates the aerial image of the beach, overlain on which is the SWCM profiles used for Tromino surveys, as well as each of the Tromino points that were surveyed. The start and end point of each Tromino measurement is also indicated

Profile Number

Tromino Output
Tromino output showing changes in subsurface conditions beneath a beach profile. The horizontal axis shows distance along the survey profile going from the dune on the left to the lower beach on the right, while the vertical axis shows beach elevation. The dashed lines represent different interfaces between sediment or rock units. Plot colours indicate the strength of the Tromino response, with warmer colours (red-yellow) representing stronger contrasts between subsurface layers and cooler colours (blue-green) representing weaker responses. The peak of the warmer colours represents the interpreted position of a layer boundary.

Interpreted Subsurface Elevations
Interpreted subsurface elevations extracted from the Tromino survey profile. The horizontal axis shows distance across the survey profile, while the vertical axis shows elevation relative to mean sea level. The solid green line represents the beach and dune surface topography. The dashed black line shows the interpreted elevation of a deeper subsurface boundary, representing the basal interface or potential bedrock. Dashed blue lines indicate shallower intermediate sediment interfaces, for example a transition from sand to gravel. Together, these interpreted layers help show how sediment thickness varies across the beach profile. Dune toe and mean sea level (MSL) elevations are also shown.

How will the results be used?
The Tromino survey results will be used to improve understanding of sediment thickness and beach volume at each site, helping quantify how much sediment is stored within the coastal system. At several locations, the Tromino profiles have also been aligned with offshore sub-bottom geophysical surveys, which use acoustic methods to map sediment layers beneath the seabed. Combining these datasets provides a more complete picture of sediment distribution from the dunes to the offshore zone. The interpreted subsurface information will then be used within ShoreTrans coastal evolution modelling to help predict how beaches may respond to future sea level rise and changing wave conditions, supporting long-term coastal management and adaptation planning.

For more information on the MS4S project and Tromino Surveying, visit our Website