

Tidal measurements for coastal resilience and survey

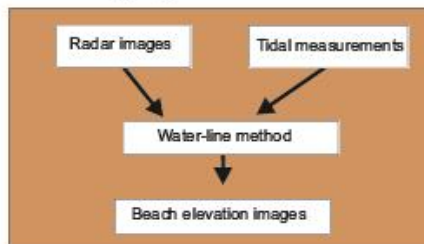
Phil Knight, Andy Plater & Cai Bird*, University of Liverpool, *Marlan Maritime Technologies, philip.knight@liverpool.ac.uk

Aim: to develop an effective sensor deployment to monitor tidal levels that then improve the accuracy of **radar-based mapping** of intertidal beach and tidal flat morphology.

The water-line method, developed by Bell, Bird & Plater (2015) generates spatial and temporal beach elevation data from X-band marine radar images by using local tidal data for calibration.

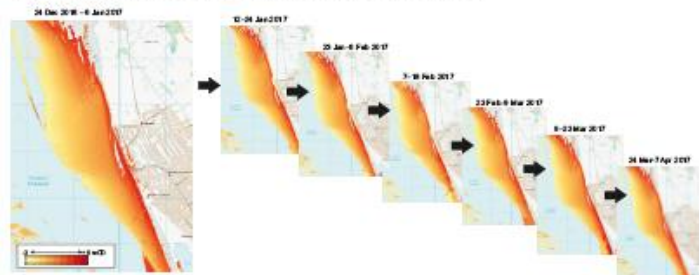
The **challenge** for many areas where the radar is likely to be installed is the **provision of good quality tidal data**; at some survey locations there will be no local tide gauges and using traditional methods to measure tidal levels will be difficult.

Radar-based mapping



Beach elevations from Crosby case study site

Composite beach elevation images generated from the X-band radar at Crosby and using tidal data from Gladstone Lock at Liverpool. Vertical datum to Ordnance Datum (OD).



Tidal measurements

Low-cost methods are being explored to measure tidal signals (with an added requirement for near-real time data); to supplement existing tidal data, and as an alternative and/or to provide data within the radar foot print.

from GPS signals

Measurement of vertical sea surface heights using a GPS fitted to a buoy, and correcting for errors by using Post Processing Kinematic methodology with data from a nearby static GPS (e.g., at the radar installation site).

Previous research (Morales Maqueda et al. 2016) has shown that sea surface heights can be successfully derived from a floating base (e.g., wave glider) to a few centimetres using dual frequency GPS receivers. These receivers typically cost around £6K for the receiver development board and a geodetic antenna.

However, the proposed initial investigation has concentrated on using low cost single frequency receivers (Ublox M8T GPS receiver, < £200), which might be able to deliver cm accuracy in the vertical (Ublox white paper, 2016).

from pressure sensors

Measurement of pressure using a sensor fitted to a Arduino MKR FOX 1200. Experiments have been planned to attach such a device to navigation structures at low water. It is currently at the bench testing stage.

Experimental hardware setup

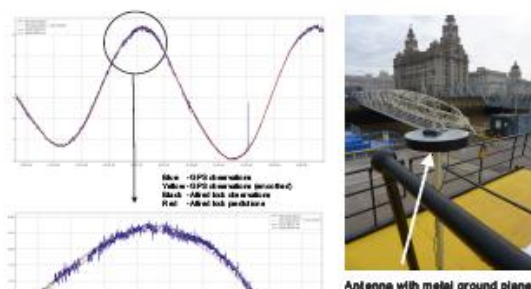
Two experiments were conducted to evaluate the low cost Ublox GPS receiver. The first, at the floating landing stage at the Pier Head, Liverpool, where an Ublox M8T GPS evaluation kit was used with an external 4Gb capacity logger, and a Ublox antenna. The second, on a moored boat in the Dee Estuary using an Emild Reach, consisting of a Ublox M8T GPS embedded onto an Edison Intel board with 2Gb internal memory, and a Tallysman multi GNSS antenna.

The Arduino MKR FOX 1200 has been set up with two sensors measuring, water pressure & temperature, and air pressure and air temperature, and has near-real time connectivity to the internet via the SigFox wireless network.



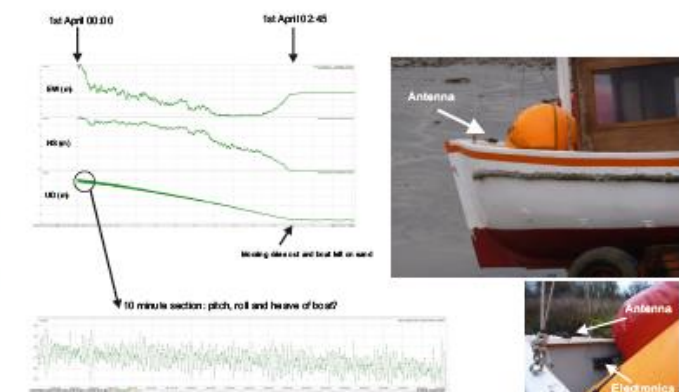
Pier Head

The GPS receiver was set up on the landing stage at the Pier Head, Liverpool. The GPS data were recorded at 1Hz between 31Oct and 1Nov 2017. The vertical solution was computed using RTKlib open source GPS software together with GPS data from the nearby geodetic GPS station at Darabury. The results were compared with a tide gauge located 1km away at Alfred Lock.



Dee Estuary

The GPS receiver was set up on a moored boat within the Dee Estuary, and where the location dried out towards low water. The GPS data were recorded at 4Hz between 31Mar and 1Apr 2018. The vertical solution was computed using RTKlib together with GPS data from a geodetic GPS station at St Asaph.



References

Bell, Bird & Plater (2015). A temporal waterline approach to mapping intertidal areas using X-band marine radar, <https://doi.org/10.1016/j.coastaleng.2015.09.009>

Morales Maqueda, Perma, Williams, Foden, Martin & Pugh (2016). Water surface height determination with a GPS Wave Glider: A demonstration in Loch Ness, Scotland. Journal of Atmospheric and Oceanic Technology 2016, 33(6), 1159-1168, <http://dx.doi.org/10.1175/JTECH-D-15-0162.1>

Ublox white-paper (2016). Achieving Centimeter Level Performance with Low Cost Antennas, 21 July 2016: <https://www.u-blox.com/en/white-papers>