INVESTIGATIONS OF BORE-BORE CAPTURE ON A MACROTIDAL BEACH

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The aim of better understanding the mechanisms of extreme runup events has led to increasing interest into bore-bore capture statistics and drivers. Bore-bore capture occurs when a broken wave (bore) travels over the front of another broken wave on approach to the shore (Figure 1). A similar but distinct process is shoreline capture which is where a broken wave travels over an uprush swash lens (therefore located in the swash zone), Bore-bore capture events occur in the surf and outer swash zones and have been shown to greatly influence runup statistics on natural beaches (Stringari and Power, 2020). Garcia-Medina et al. (2017) investigated bore-bore capture on a dissipative beach using numerical modelling and found that bore-bore capture was correlated to the largest runup events. Stringari and Power (2020) expanded on this by investigating bore-bore capture on 7 different beaches and found that bore-bore capture was responsible for over 97% of extreme shoreline maximas. The exact mechanisms behind bore-bore capture which result in extreme runup events in the form of energy transfer, however, are yet to be investigated. Whilst the relationship between infragravity energy at the shoreline and the probability of bore capture has been identified (Stringari and Power, 2020), the influence of infragravity energy on runup elevations resulting from captured and non-captured waves is yet to be fully quantified.

This research uses LiDAR data obtained from a gently sloping macrotidal beach located at Saltburn-by-the-Sea, UK (Figure 1) to investigate runup statistics with respect to bore-bore and shoreline capture and infragravity energy. Bores are identified and tracked through the surf and swash zones to investigate capture statistics such as wave height and water depth at capture, as well as the cross-shore location of capture and proximity to shoreline (Figure 2). In combination with runup statistics, these data are used to identify the key characteristics of captures that result in higher magnitude runup maximas. Furthermore, investigations are made on the relationship between bore capture and infragravity phase with respect to occurrence of capture and the resulting magnitude of runup maximas (Figure 3).

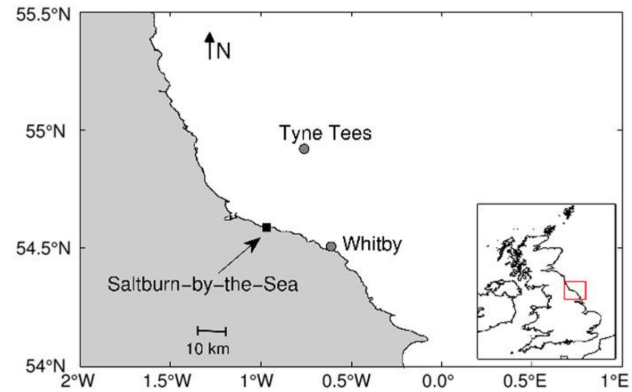

Figure 1 – Location map of Saltburn-by-the-Sea where LiDAR data was collected, and nearshore (Whitby) and offshore (Tyne Tees) wave buoys. Inset map indicates location on UK coastline. Source: Martins et al., 2018.

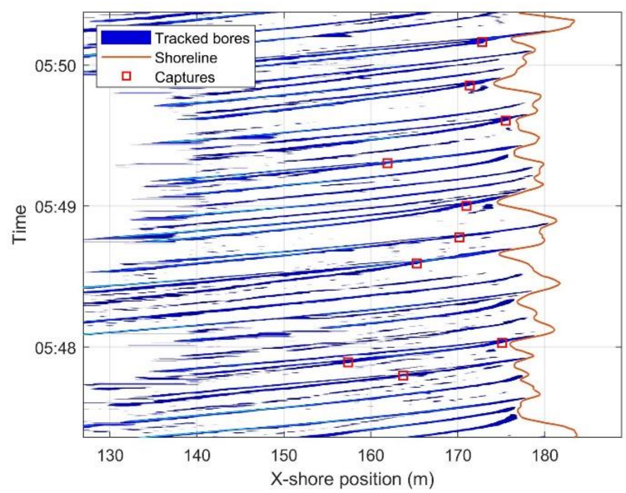

Figure 2 – Example of bore tracking from LIDAR data using water surface gradients to identify bore fronts with bore capture events shown by red squares.

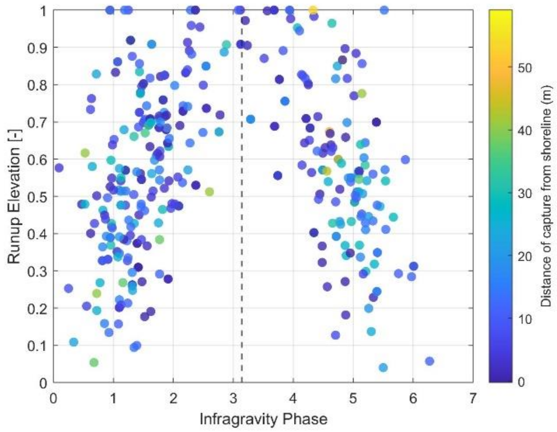

Figure 3 – When bore-bore captures occur with respect to infragravity waves (dashed line representing boundary between rising and falling) and the resulting runup elevation. Capture events that occur during the peak of the infragravity phase resulting in higher runup elevations.

This research also investigates the relationship between bore-bore and shoreline capture and runup statistics. The incorporation of this phenomenon into empirical runup models has the potential to improve the accuracy of empirical runup predictions on multiple beach types under a broad range of conditions.

REFERENCES

Garcia-Medina, Ozkan-Haller, Holman, Ruggiero (2017): Large runup controls on a gently sloping dissipative beach, Journal of Geophysical Research: Oceans, vol. 122, pp. 5998 - 6010.

Martins, K., Blenkinsopp, C. E., Deigaard, R. & Power, H. E. 2018. Energy Dissipation in the Inner Surf Zone: New Insights From LiDAR-Based Roller Geometry Measurements. Journal of Geophysical Research: Oceans, 123, JC013369.

Stringari, Power (2020): Quantifying Bore-Bore Capture on Natural Beaches, Journal of Geophysical Research: Oceans, vol. 125, ec019JC015689