University of Victoria

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Wave runup on a highly dissipative beach

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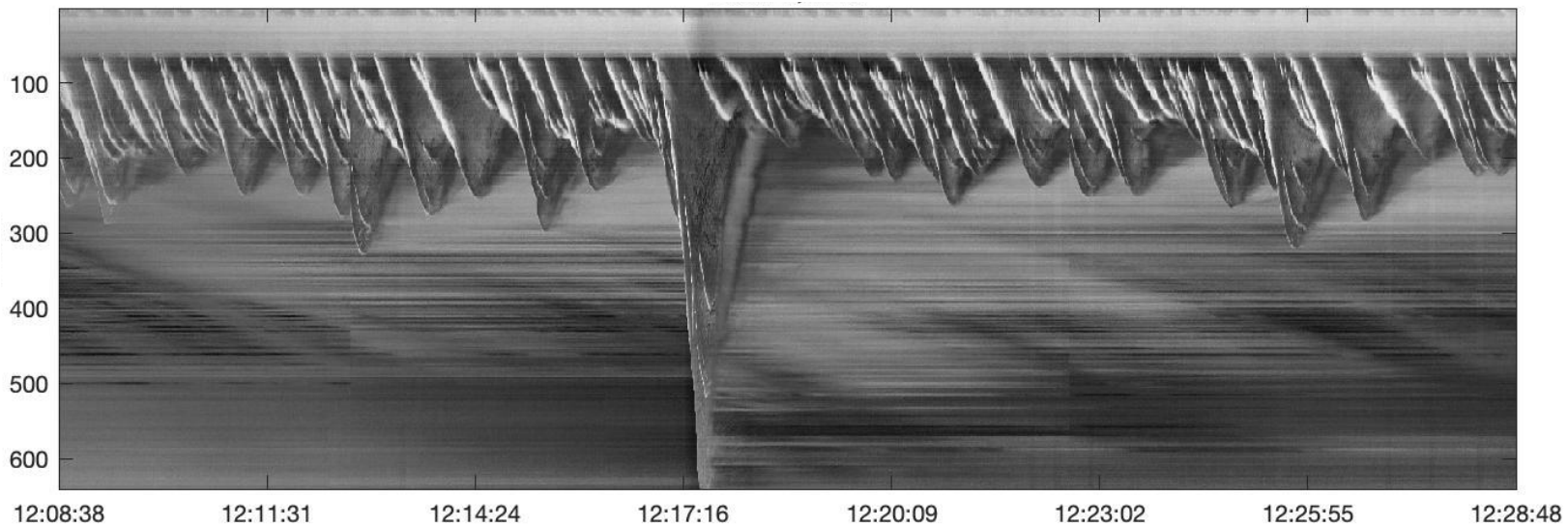
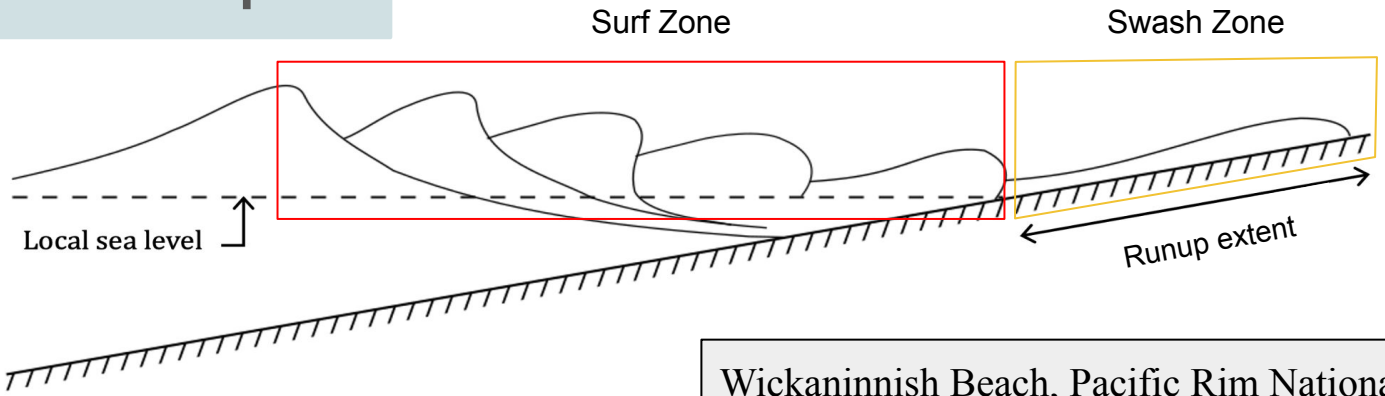
University of Victoria

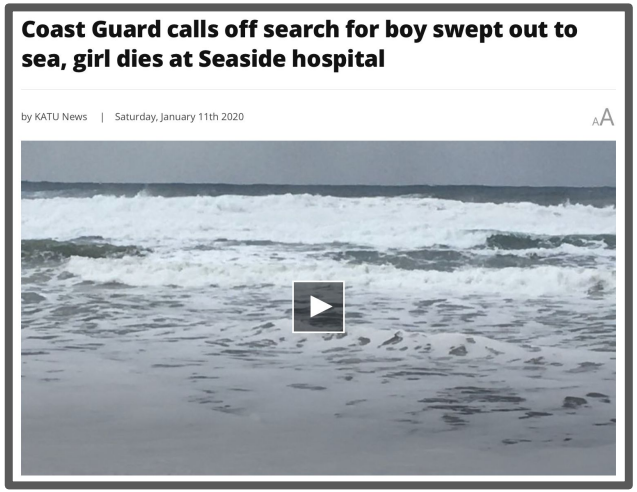


What is wave runup?



Wickaninnish Beach, Pacific Rim National Park
Tofino, B.C.

Societal Impacts



Outcomes of this project:

- Develop tools for local risk managers to use in predicting wave hazards through Parks Canada

What factors or mechanisms affect wave runup?

1. Offshore conditions

2. Wave transformation processes in the surf zone (i.e. bore-bore capture)

Data Collection

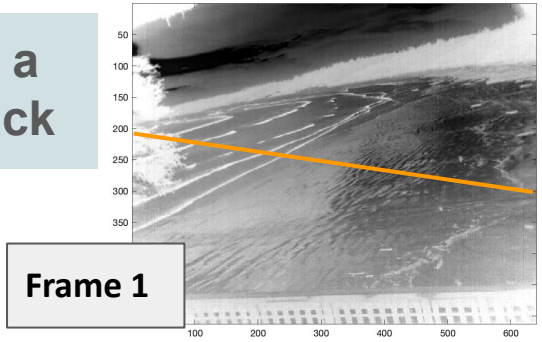
Record video of
run-up on beach

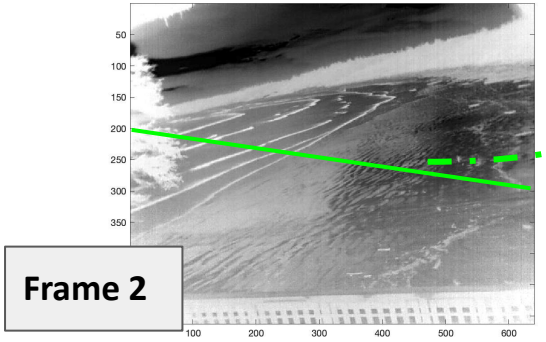
Infrared Camera
Mounted at KWISITIS Visitor Centre
Recording rate of 5 frames per second

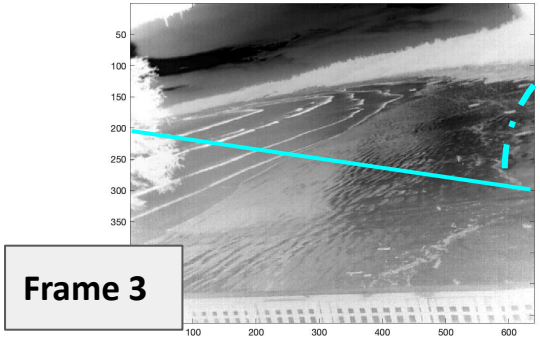
Making a timestack

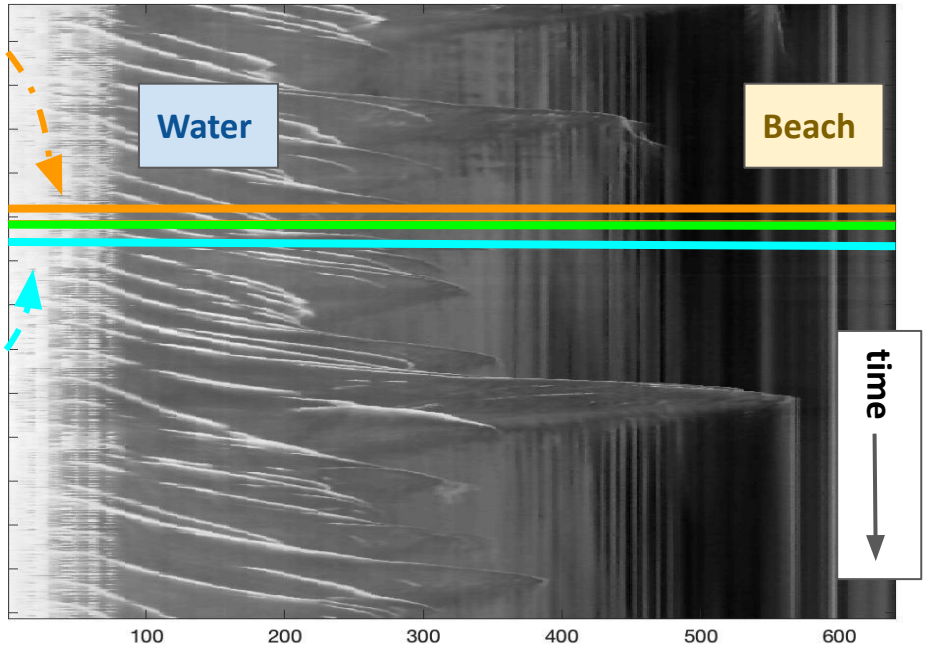
Record video of runup on beach

Extract timestacks from IR footage









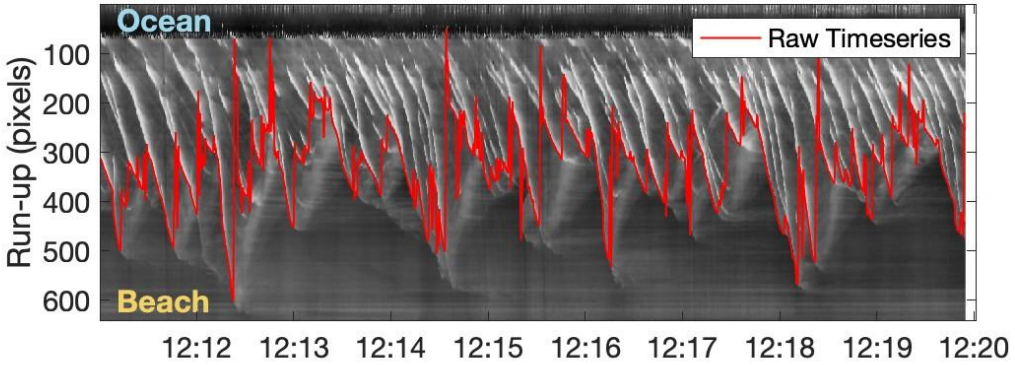
Get runup time-series

Record video of runup on beach

Extract timestacks from IR footage

Trace interface between water and sand

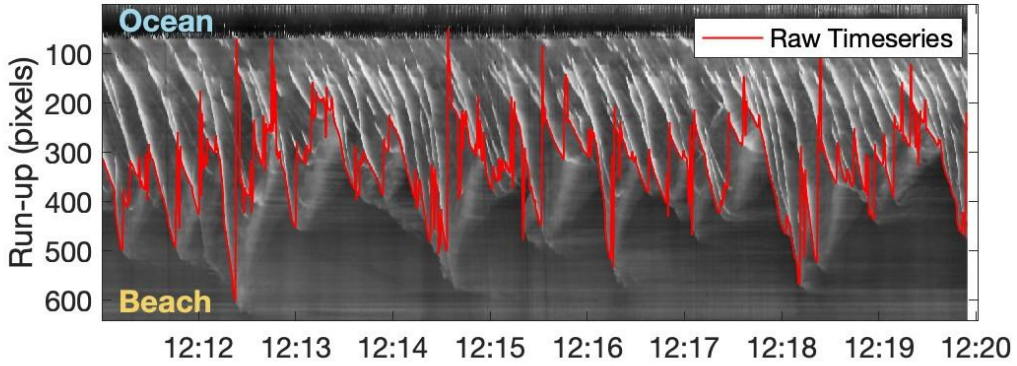
- Program uses thresholding technique on timestacks to find interface between water and sand



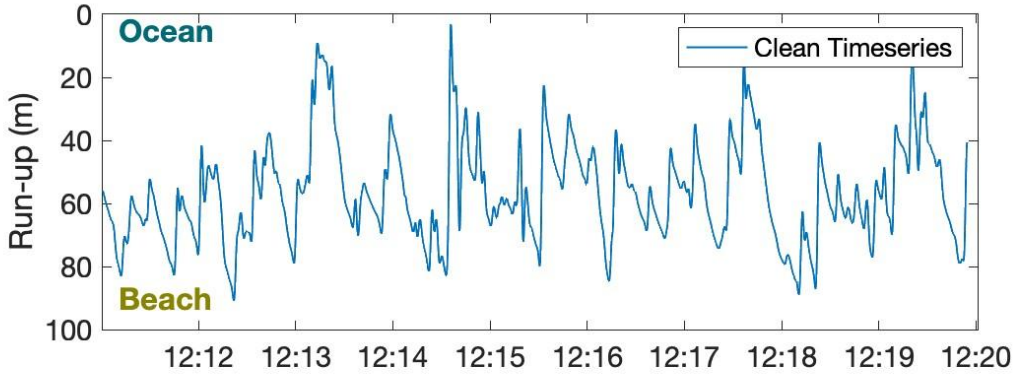
Get runup time-series

Record video of runup on beach → Extract timestacks from IR footage → Trace interface between water and sand → Convert from pixels to real-world units

- Program uses thresholding technique on timestacks to find interface between water and sand

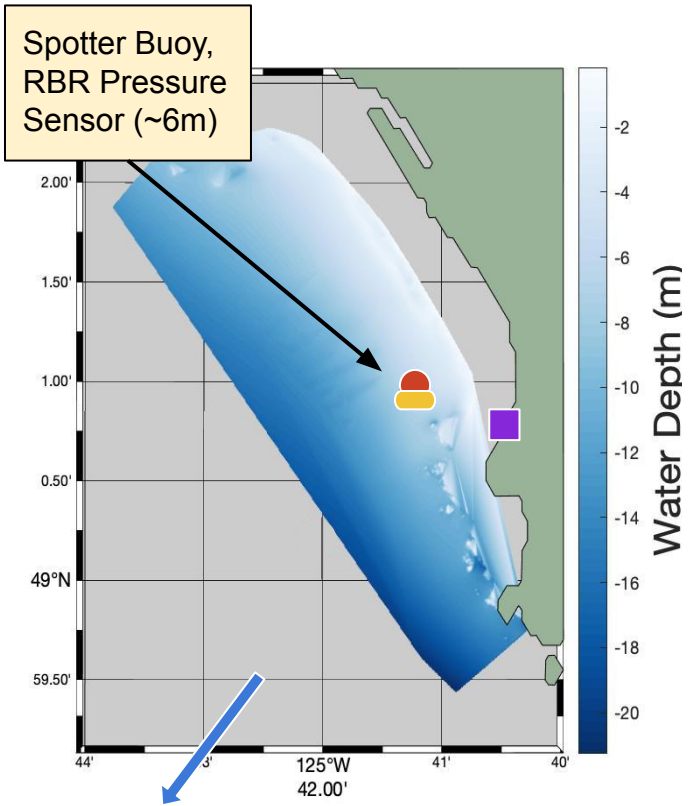


- Time-series is converted to georeferenced runup

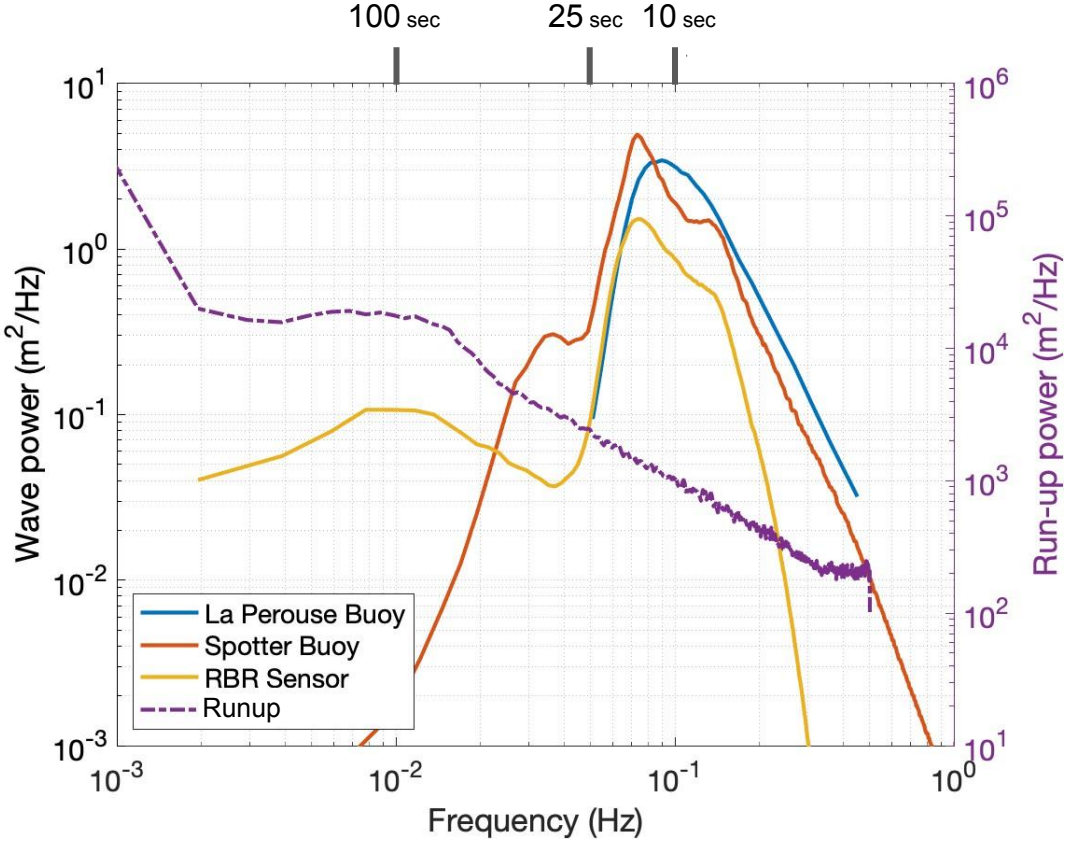


Spectral Analysis

1. **Runup periods peak in the infragravity frequency range, much longer than wind-wave periods**

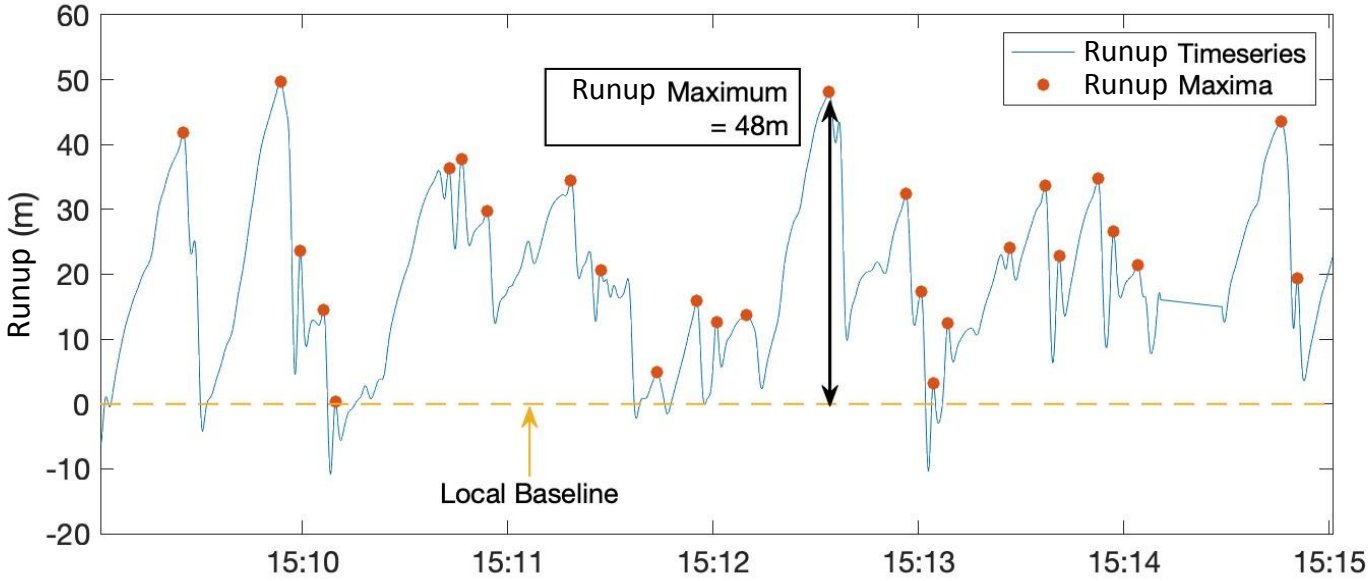


La Perouse Bank (deep water wave buoy, offshore)



Swash Statistics

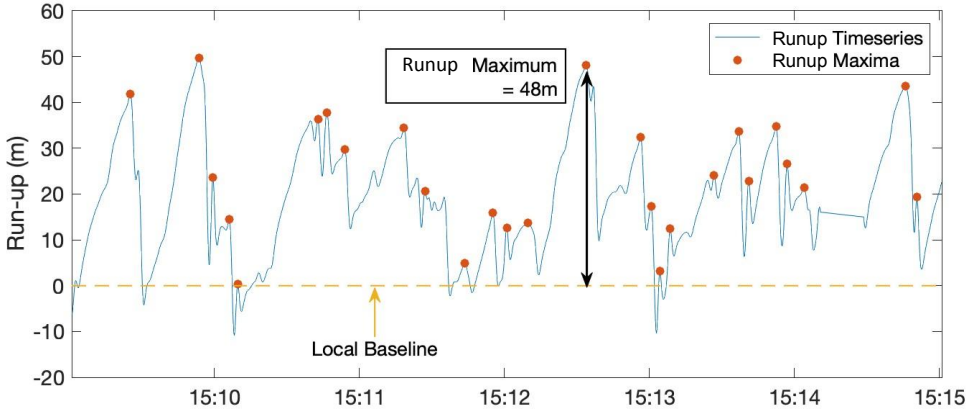
- Runup maxima extracted from time-series:

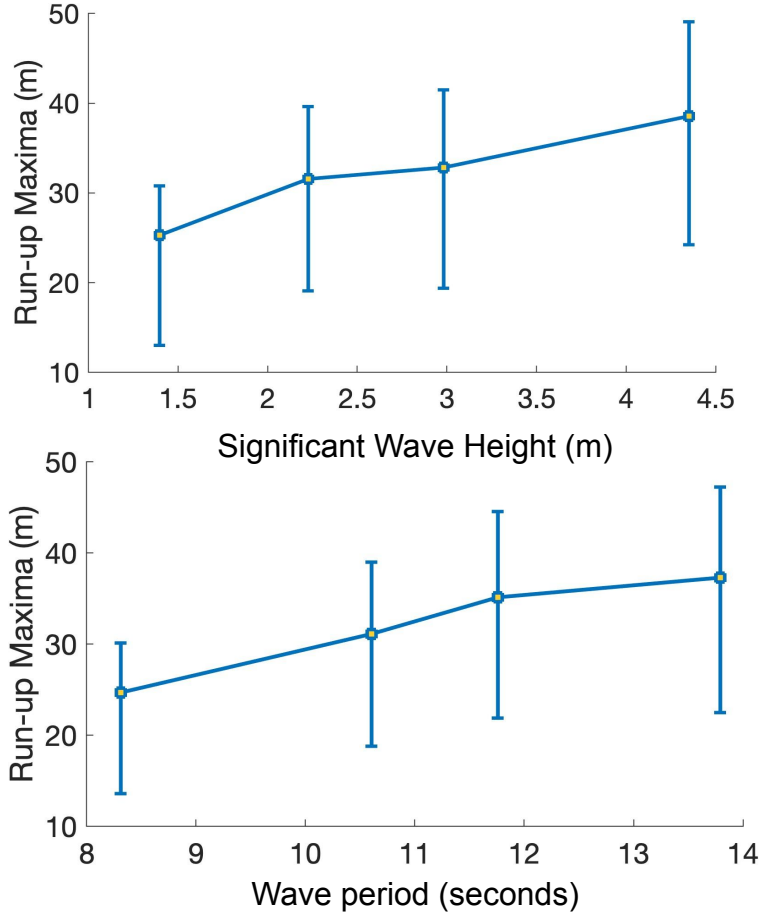


Swash Statistics

2. Larger, more variable, runup during energetic sea-states

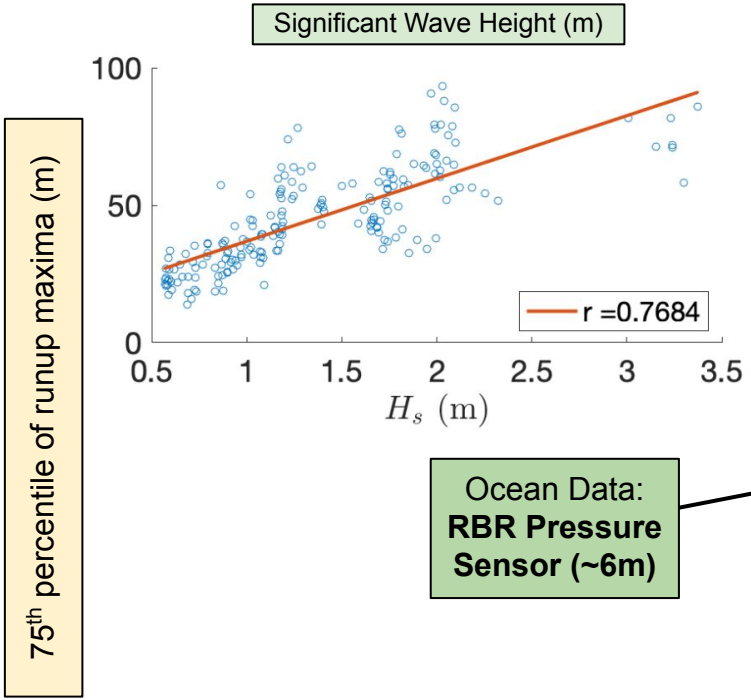
- Runup maxima extracted from time-series:





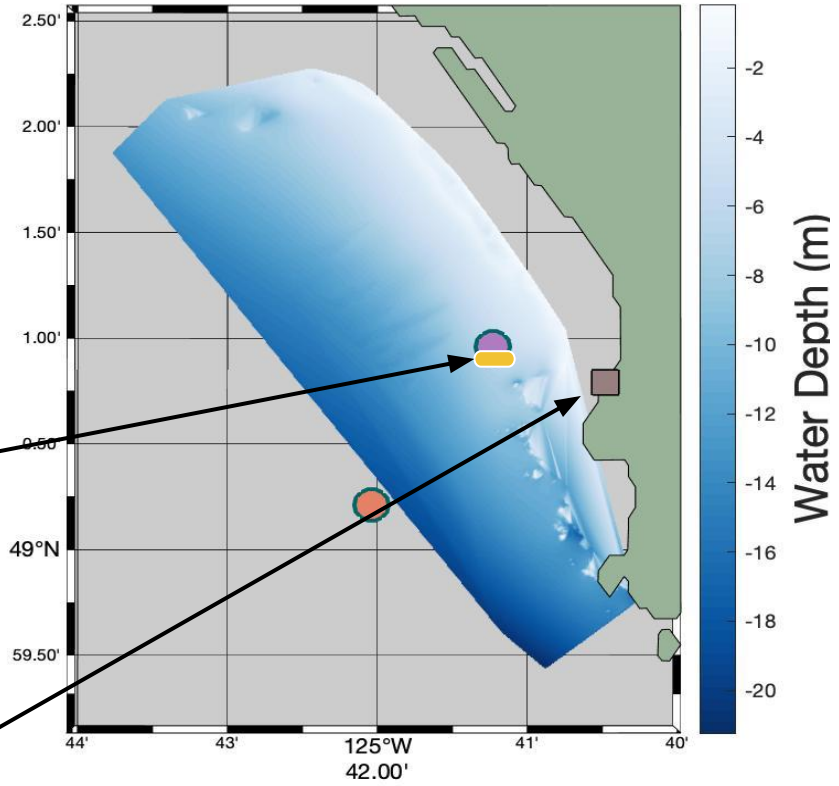
- Look for trends with corresponding sea-state variables from offshore wave buoy

Swash Statistics: Case study from October 2021



Ocean Data:
RBR Pressure Sensor (~6m)

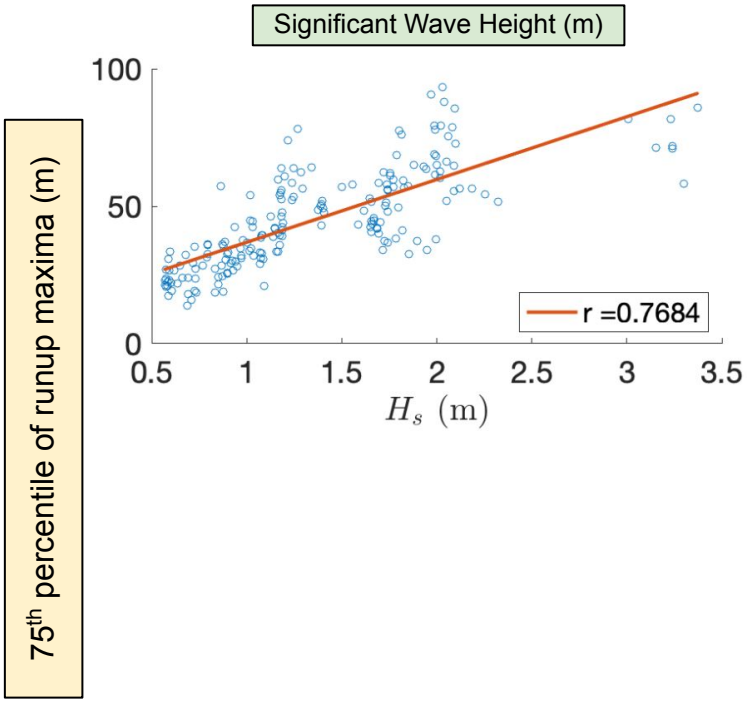
Runup Data:
Beach Imagery

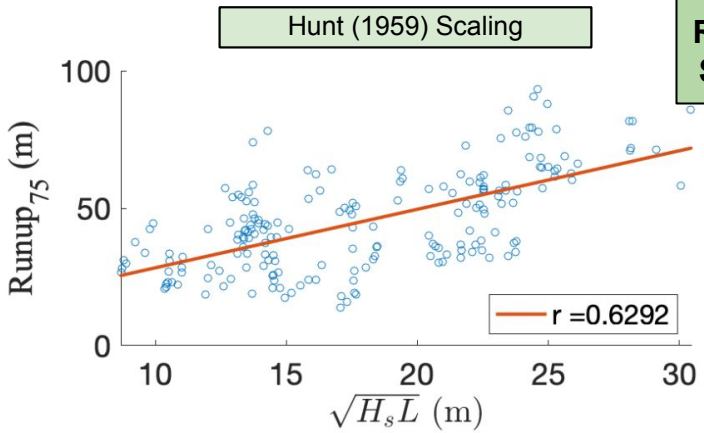


Swash Statistics: Case study from October 2021

Runup Data: **Beach Imagery**

Ocean Data: **RBR Pressure Sensor (~6m)**

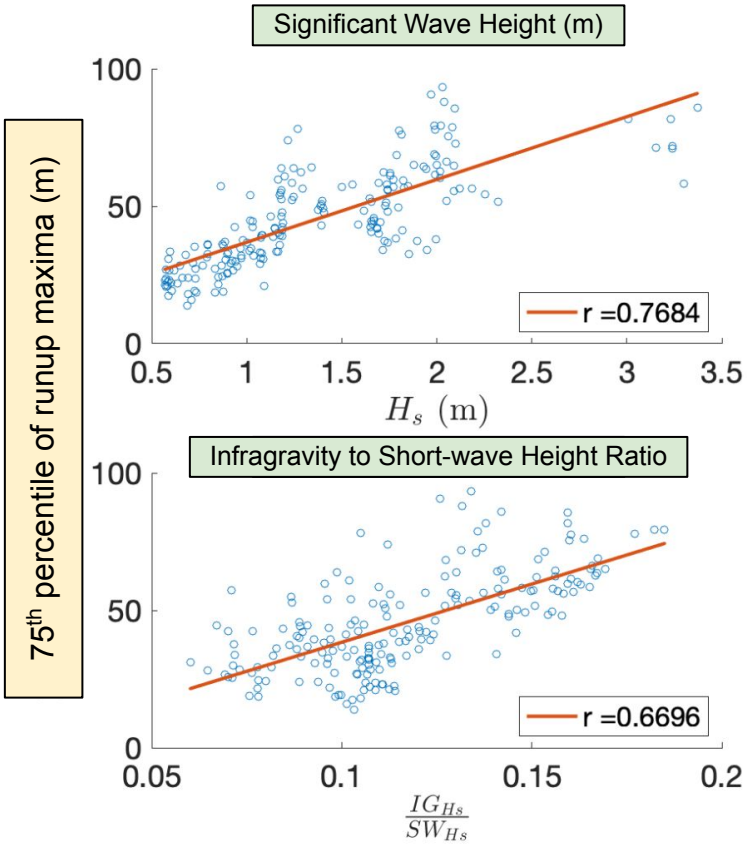


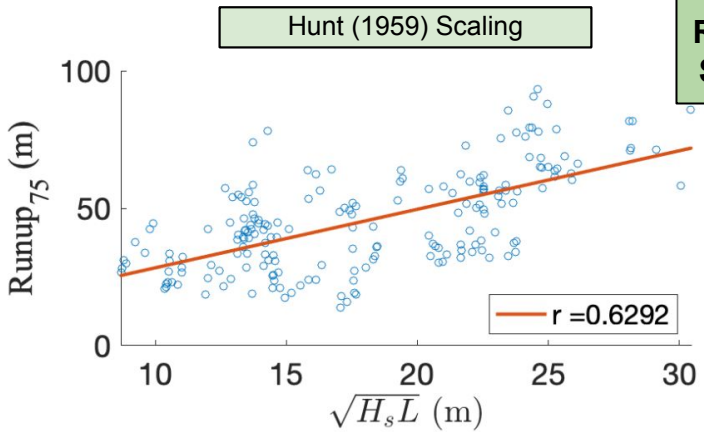


Swash Statistics: Case study from October 2021

Runup Data: **Beach Imagery**

Ocean Data: **RBR Pressure Sensor (~6m)**

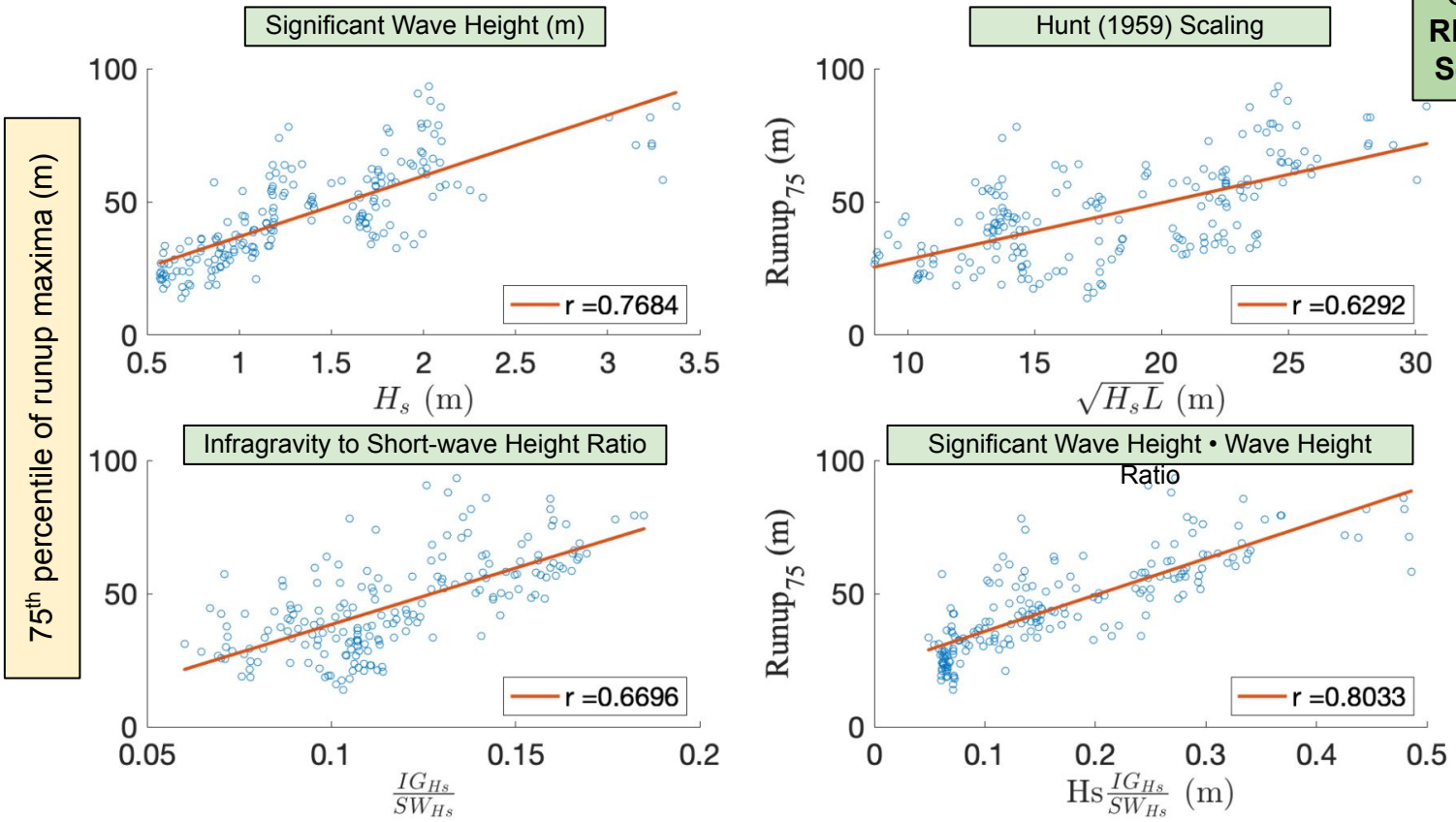




Swash Statistics: Case study from October 2021

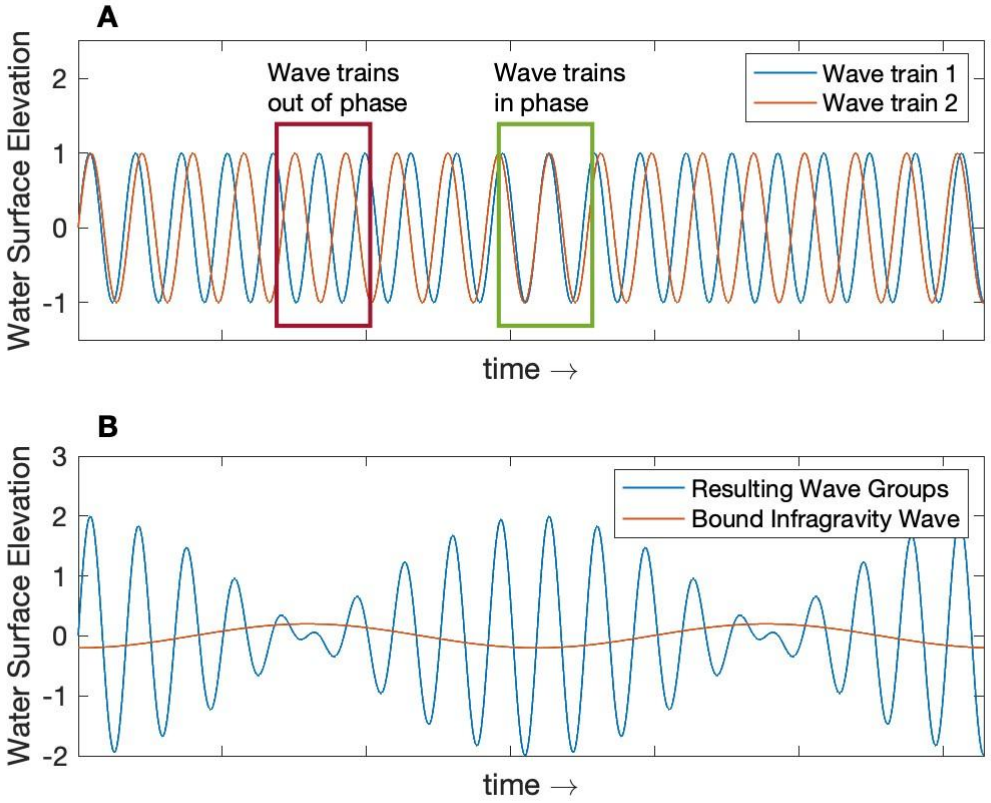
Runup Data: **Beach Imagery**

Ocean Data: **RBR Pressure Sensor (~6m)**



Generation of IG waves

1. “Bound wave” mechanism

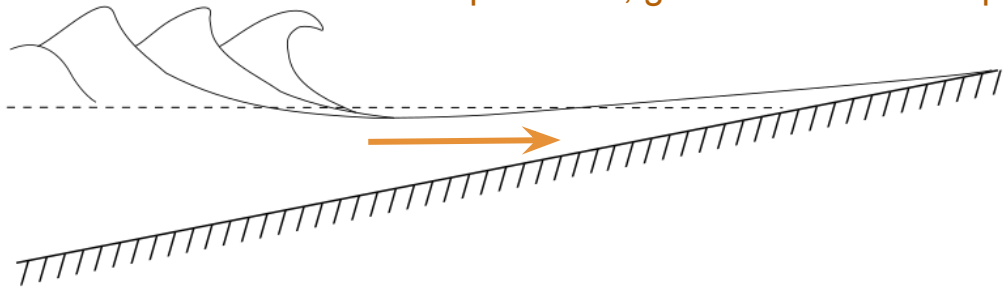


Generation of IG waves

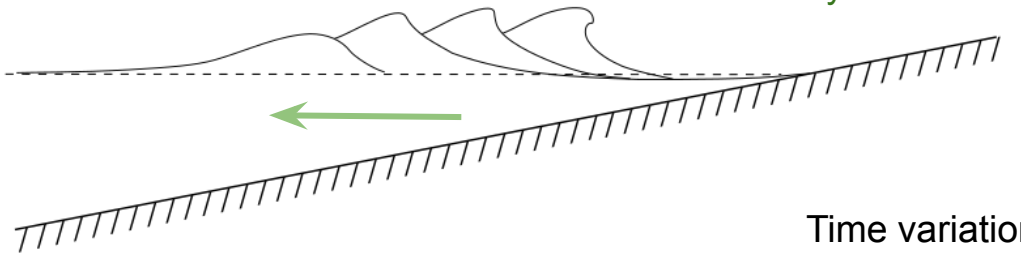
1. “Bound wave” mechanism

2. **Varying breakpoint Mechanism**
   Typically associated with steeper beaches, not highly dissipative beaches as studied here

Large waves in the group break in deeper water, generate wave set-up



Small waves in the group break closer to the beach, wave set-up is balanced by radiation stress



Time variation in radiation stress leads to a signal in the spectrum in the infragravity frequency range

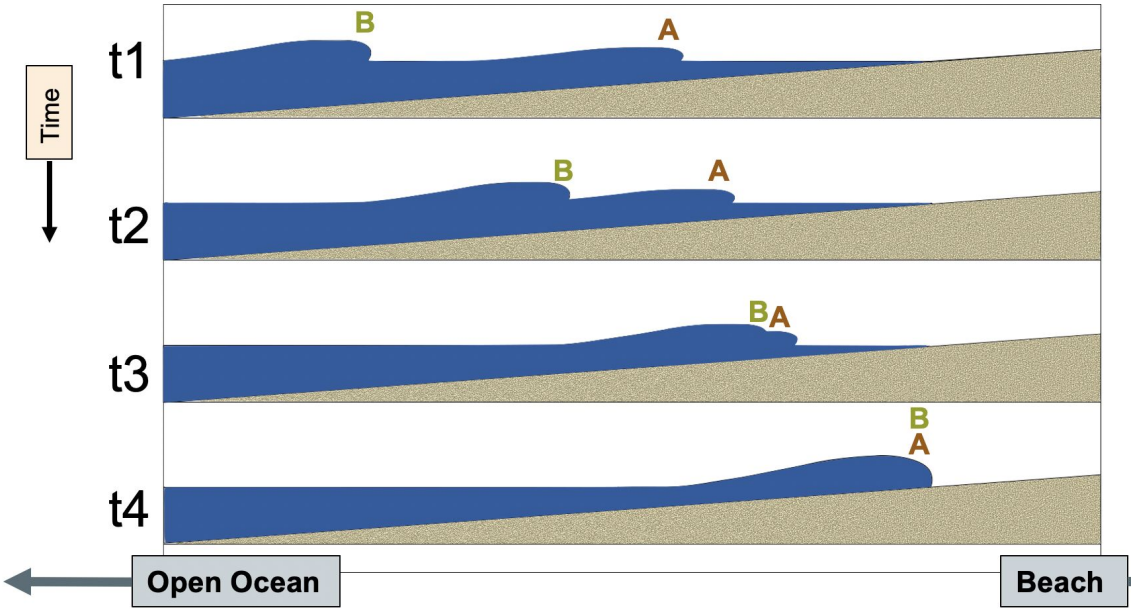
Generation of IG waves

1. “Bound wave” mechanism

2. Varying breakpoint Mechanism
   Typically associated with steeper beaches, not highly dissipative beaches as studied here

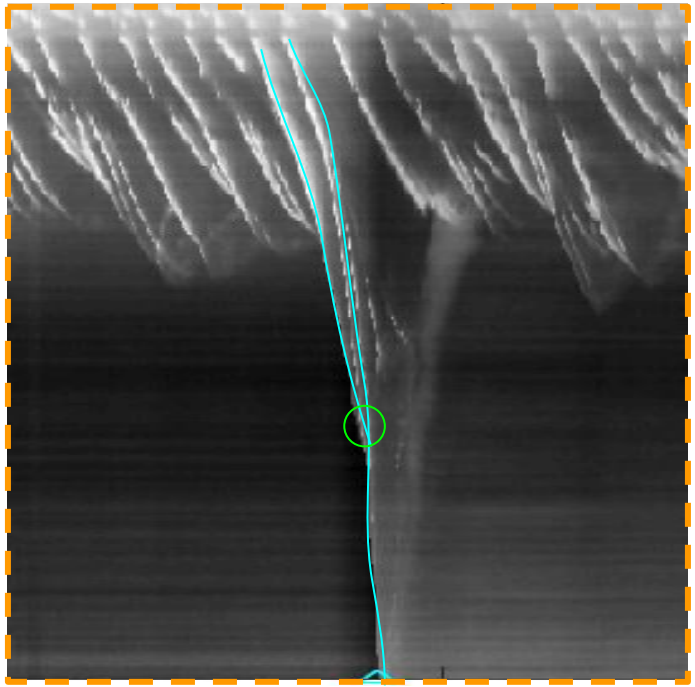
3. Bore-bore capture

When two waves propagate towards the beach at different speeds, the lead bore can be overtaken by next bore



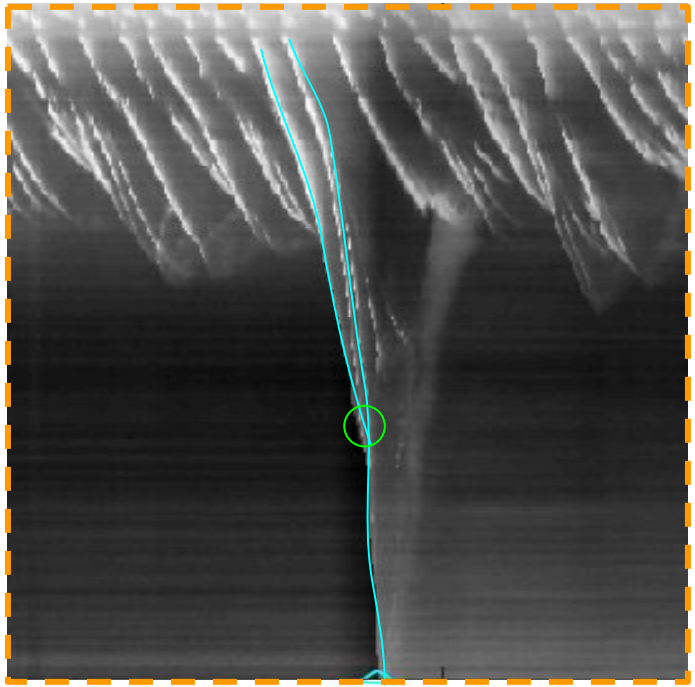
$$c \approx \sqrt{g(d+H)}$$

Generation of IG waves: Bore-bore capture



Example showing bore-bore capture in a timestack

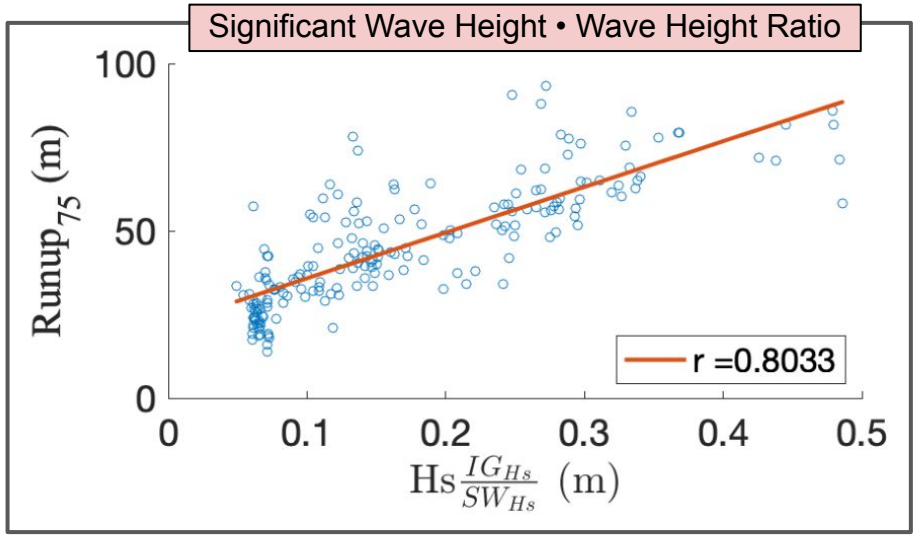
Generation of IG waves: Bore-bore capture



Example showing bore-bore capture in a timestack

Why might more relative IG energy in the incoming wave spectrum result in higher runup?

IG waves contribute to variability in the speed and relative depth of bores approaching the shore, increasing the potential for captures to occur



RBR Pressure Sensor (~6m)

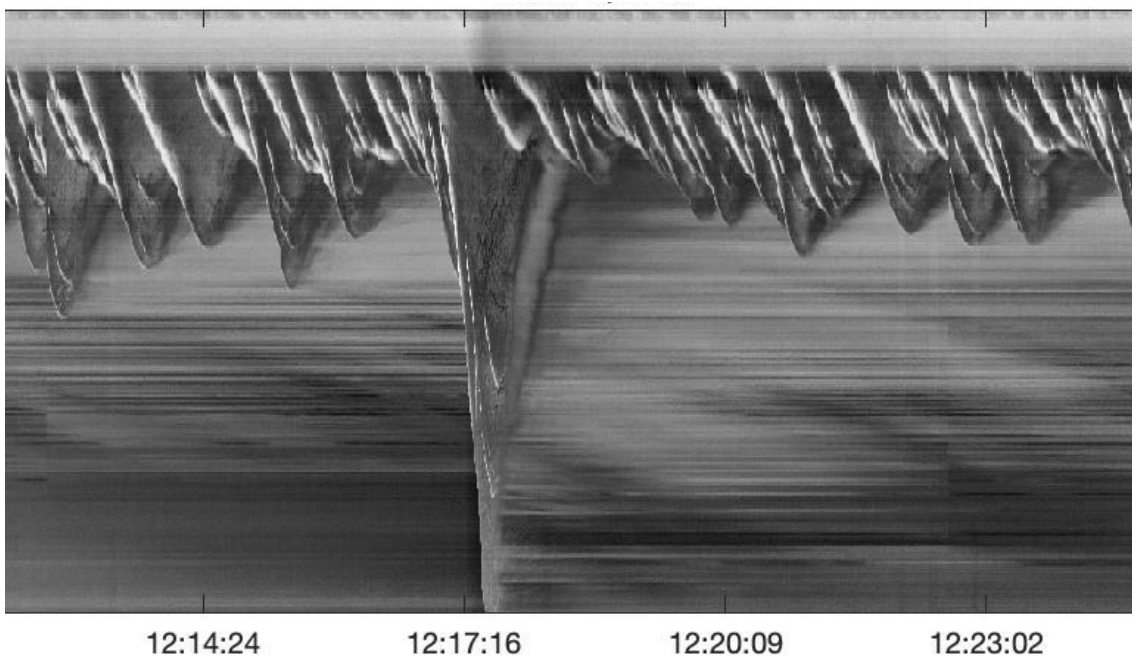
Summary

1. **Run-up periods peak in the infragravity frequency range, much longer than wind-wave periods**

2. **Larger, more variable, runup during energetic sea-states**

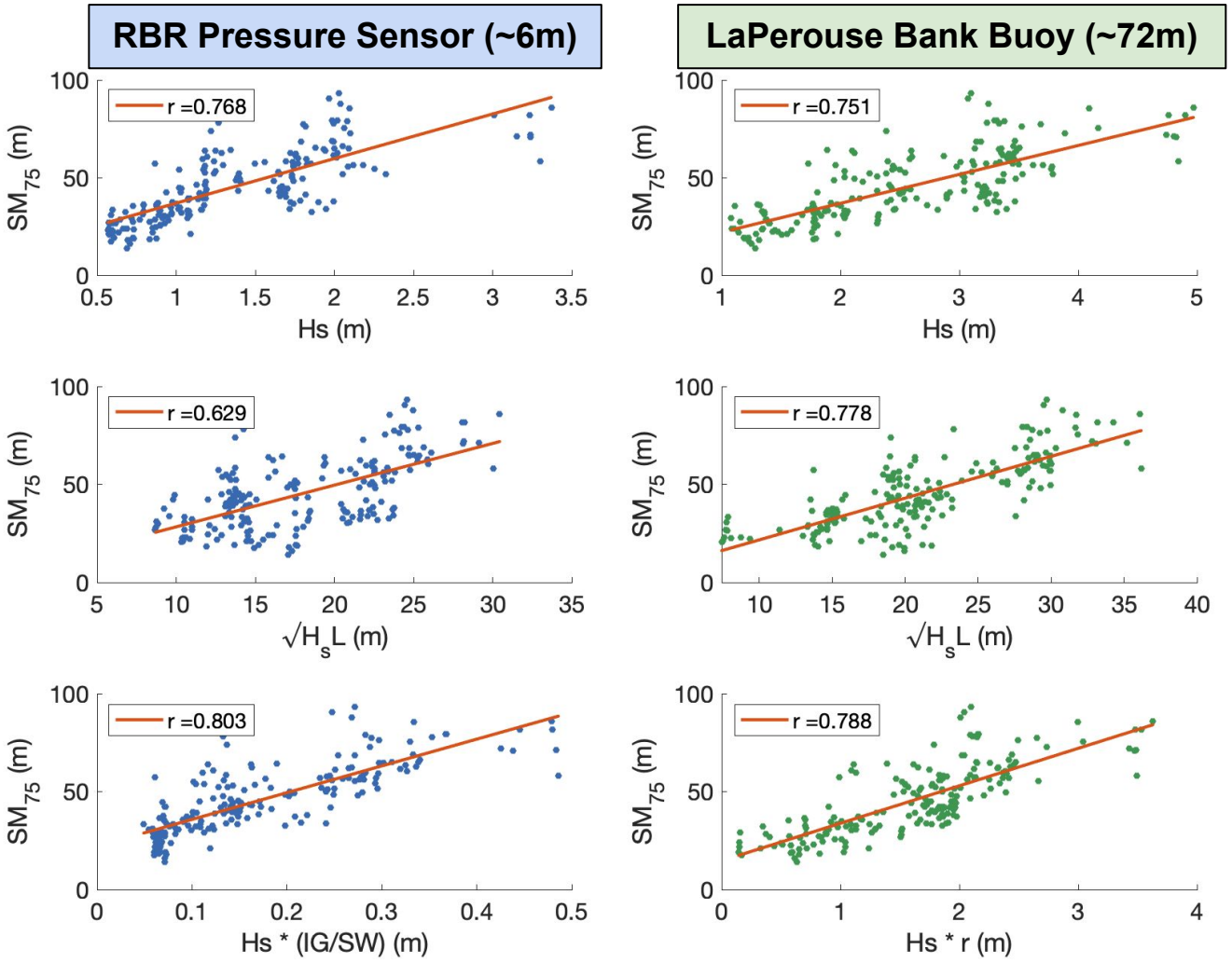
3. **Significant correlation between relative incoming IG energy and runup on the beach**

Bore-bore capture strongly influences runup behaviour on highly dissipative beaches



Questions?

Supplementary slide 1



Supplementary slide 2