Optical Measurements for Tsunami Run-up

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Outline

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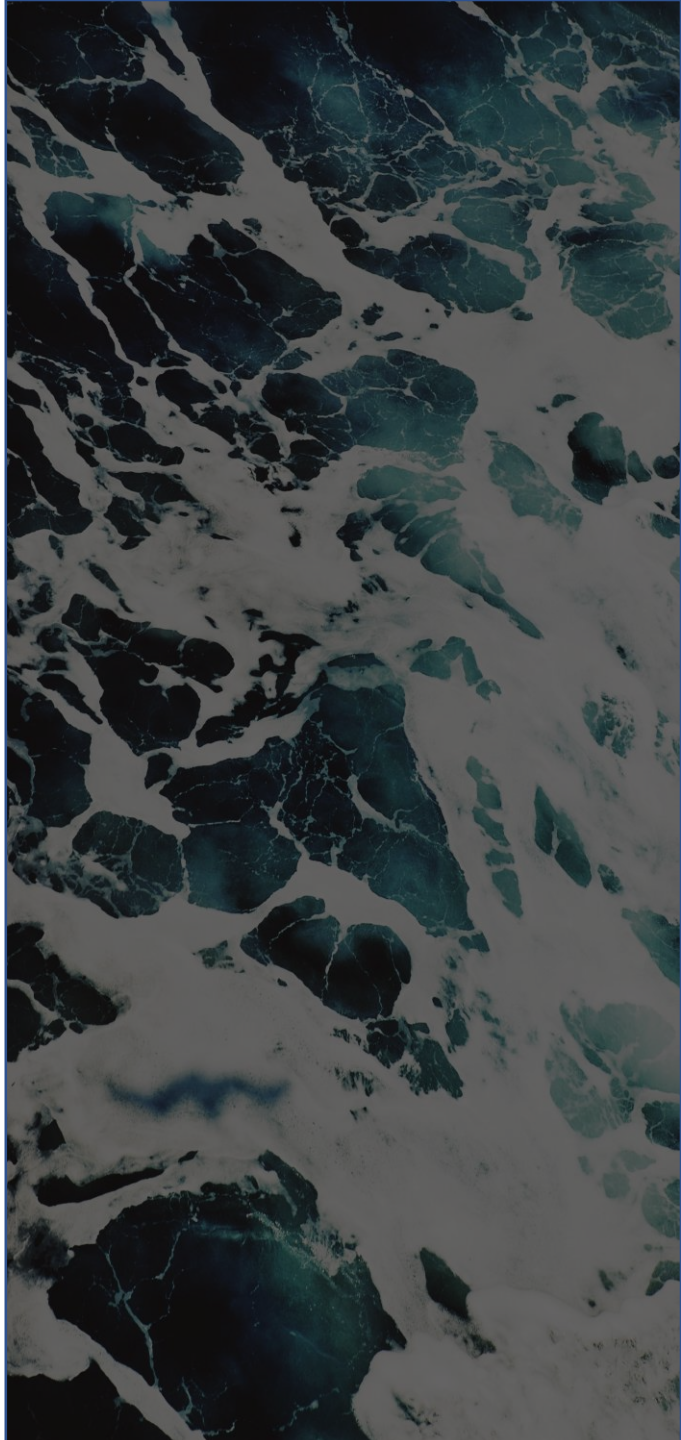
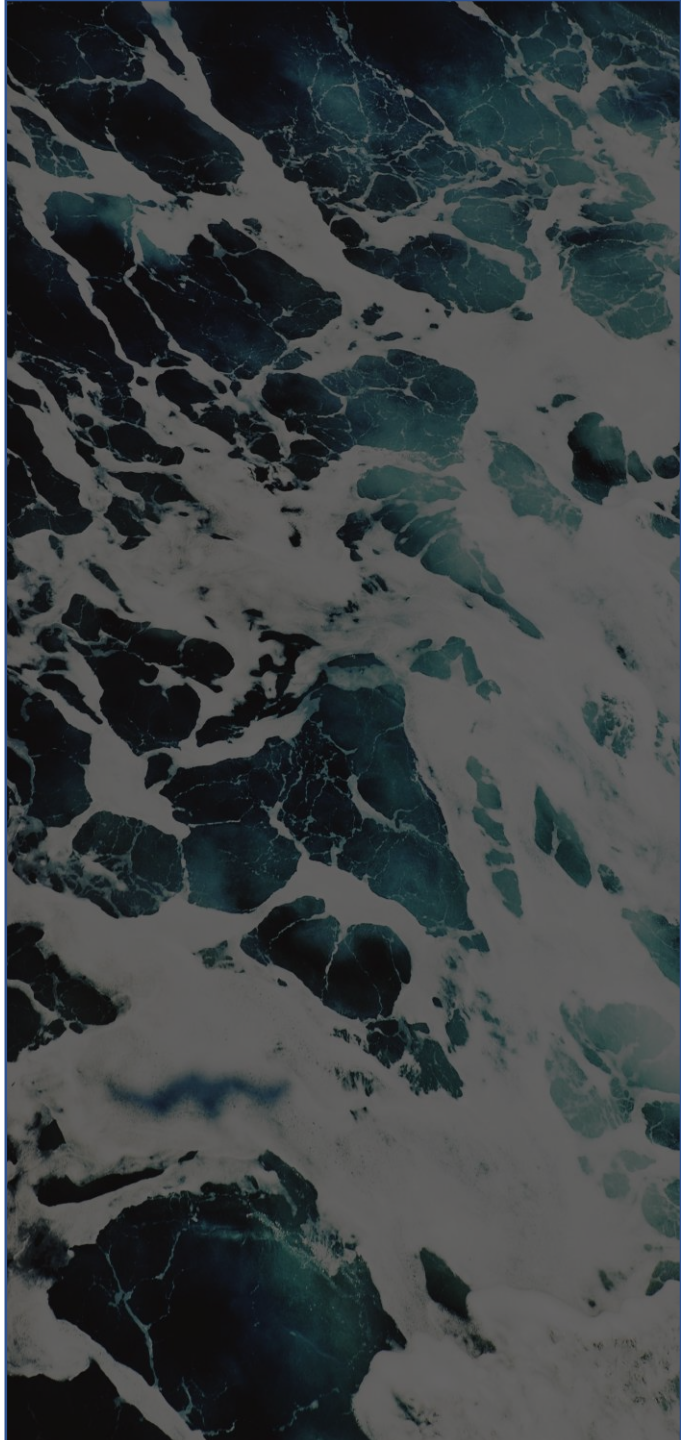


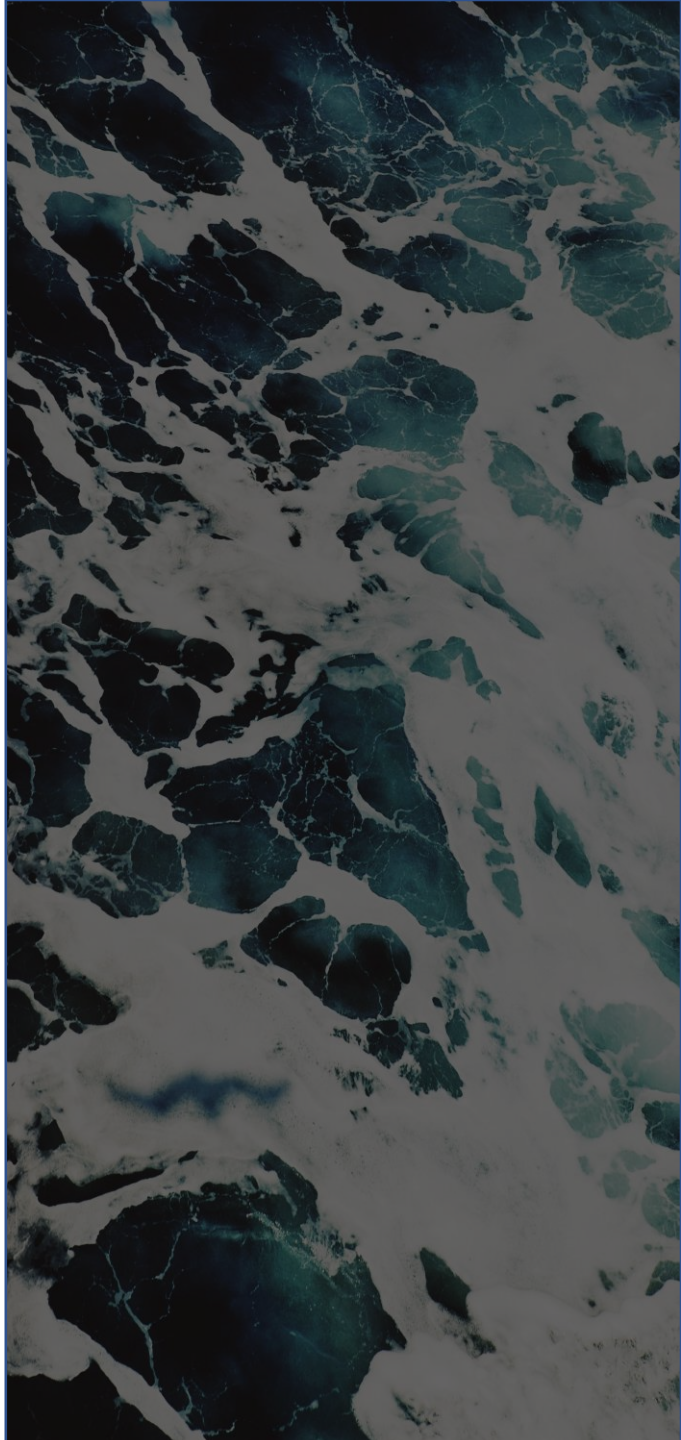
Motivation

Apply edge detection methods to obtain optical measurements of run-up on a planar beach to estimate inundation area, edge velocity and maximum run-up for a variety of wave types.



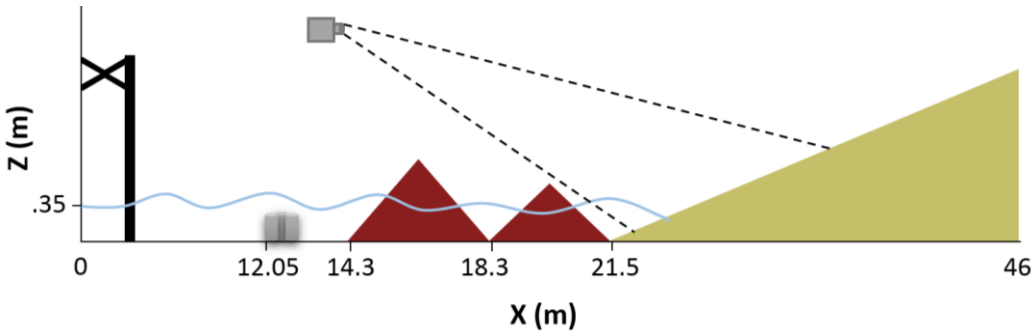
Background

- Performing precise run-up measurements along the entire shoreline can be difficult and time consuming. Rueben et al. (2011) developed and tested innovative optical measurement techniques to track the leading edge of long waves in physical model.
- In further work from Rueben et al., (2014) the bore edge was tracked on a frame to frame basis.
- We extend the approach from Reuben to a variety of wave forms.



Experiment Set-Up

- O.H. Hinsdale Wave Research Laboratory, Tsunami Wave Basin
- Two conical islands oriented in line with the wave propagation
- Concrete cylinders where used to model a reef with dimensions 2.9 m x 0.4 m x 0.3 m
- Two Panasonic AW-HE60 cameras
- The water level was maintained at approximately 0.35 m
- Two wave types, a solitary wave (0.20 m) and s-wave (5 sec)



Optical Run-Up Measurement Procedure

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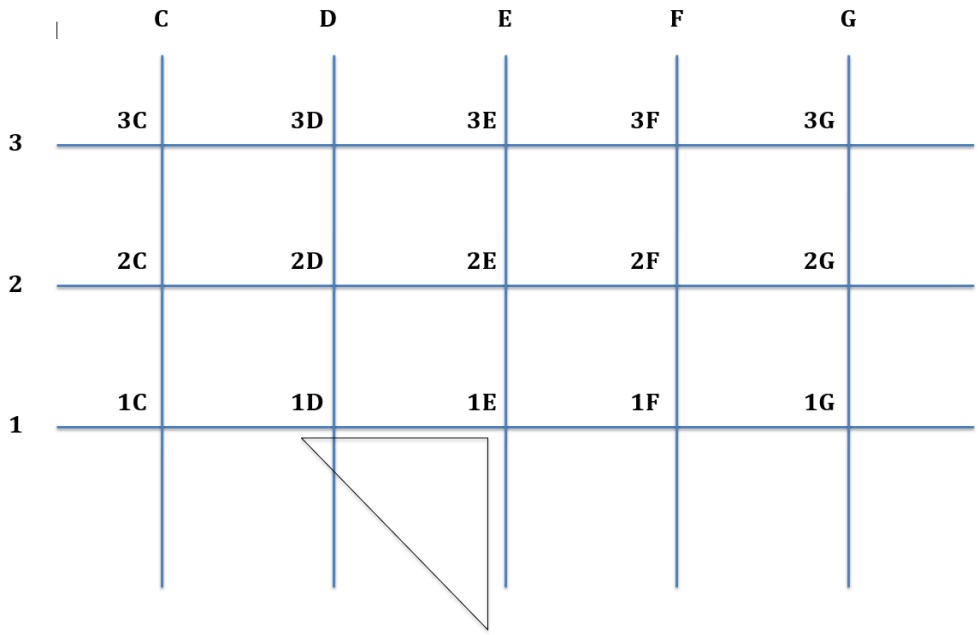
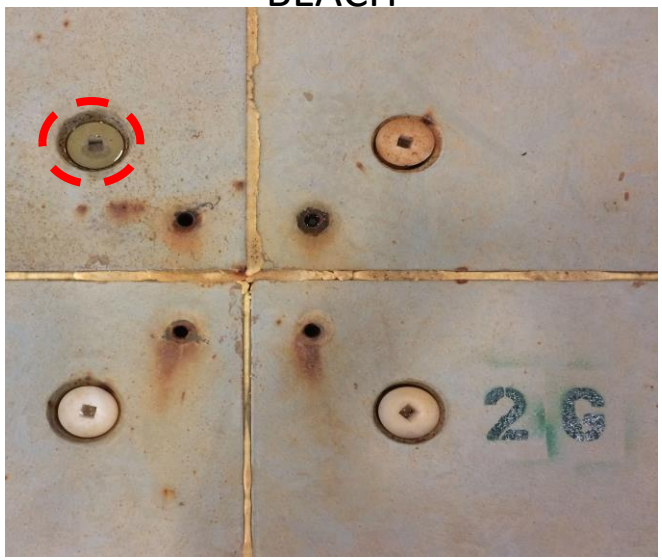
- Using a total station, ground control points where collected near the shoreline to rectify the images and obtain 'real world coordinates' from the videos.
- Using a projective geometric transform the images are rectified.



BEACH

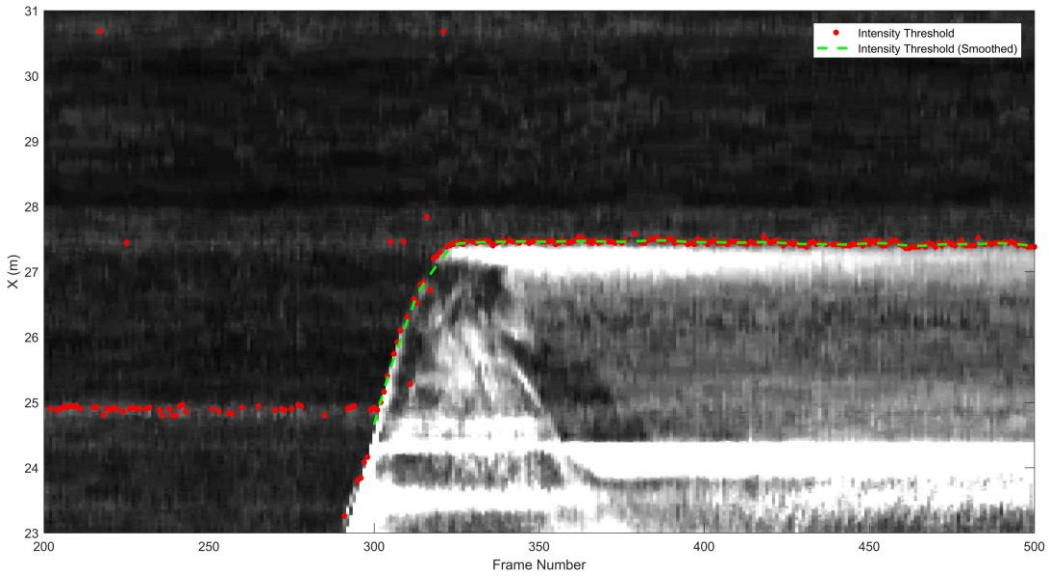


WAVEMAKER

Optical Run-Up Measurement Procedure

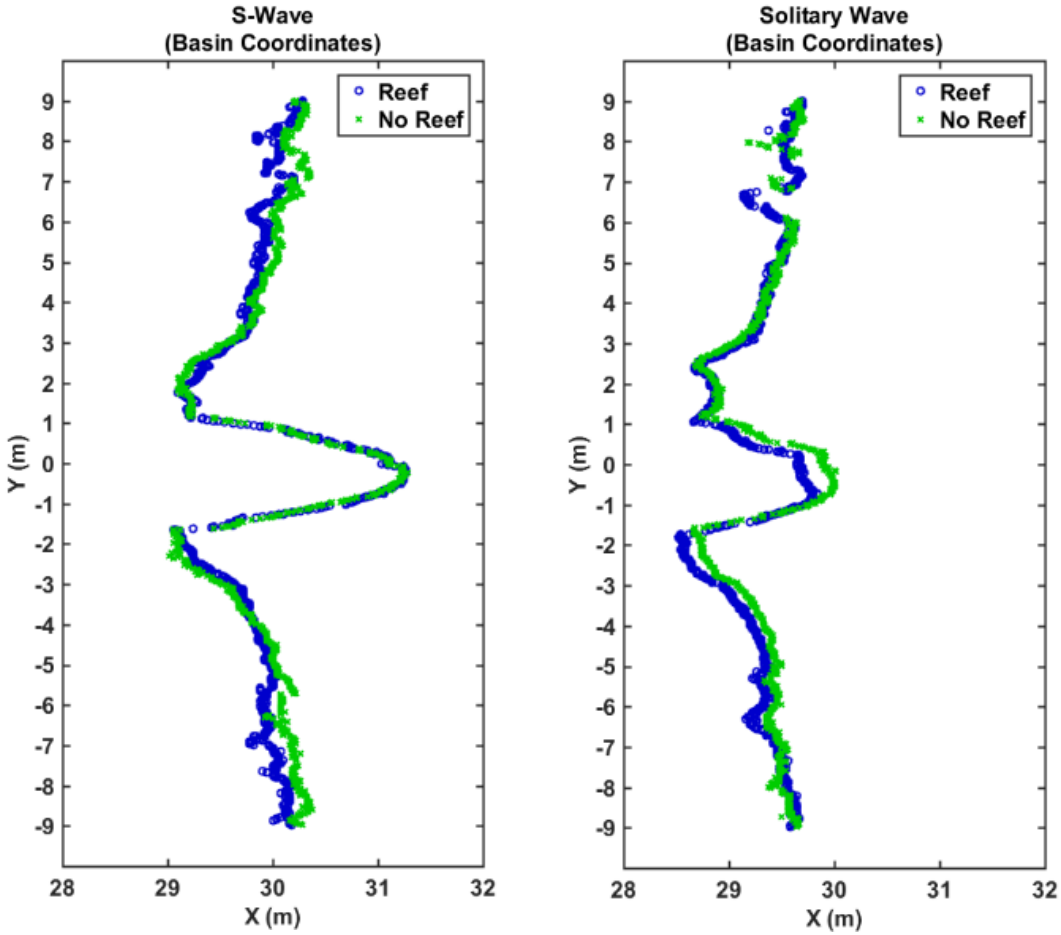
- To make up for lens distortion we obtain the camera parameters using the single camera calibration app from the MATLAB Image Processing Toolbox.
- Images are converted into intensity image and get filtered for noise. Analyzing the image as a matrix we track the bore edge through each column by detecting the change in color.

Results



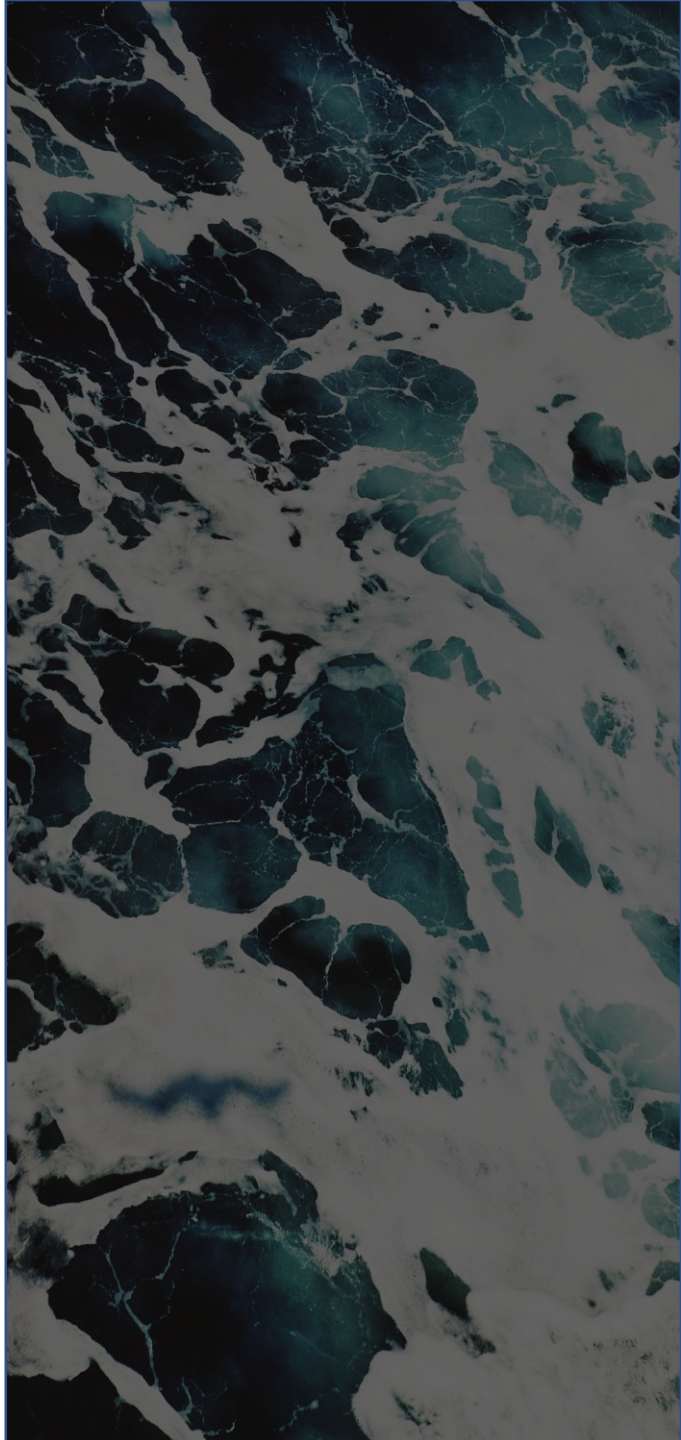
Reef	Wave Type	Max. Run-up(m)
Yes	Solitary Wave	29.84
		29.90
		29.92
	S-Wave	31.20
		31.26
		31.30
No	Solitary Wave	30.02
		29.98
	S-Wave	31.28
		31.28

Results


S-Wave
(Basin Coordinates)
Reef
No Reef
Y (m)
X (m)
Solitary Wave
(Basin Coordinates)
Reef
No Reef
Y (m)
X (m)

Conclusion

- With the given video resolution from the cameras we were able to obtain differences of up to two significant figures and a total of 900 points where measured along the shoreline, this indicates the cameras performed well and could be used to perform measurements.
- With some adjustments, the methodology to measure run-up could be applied to different scenarios in both laboratory or field.



Questions???

Thank you for your attention!

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