



UNIVERSITY OF  
AUCKLAND  
Waipapa Taumata Rau  
NEW ZEALAND

ENGINEERING

# Tsunami Research

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22 November 2022



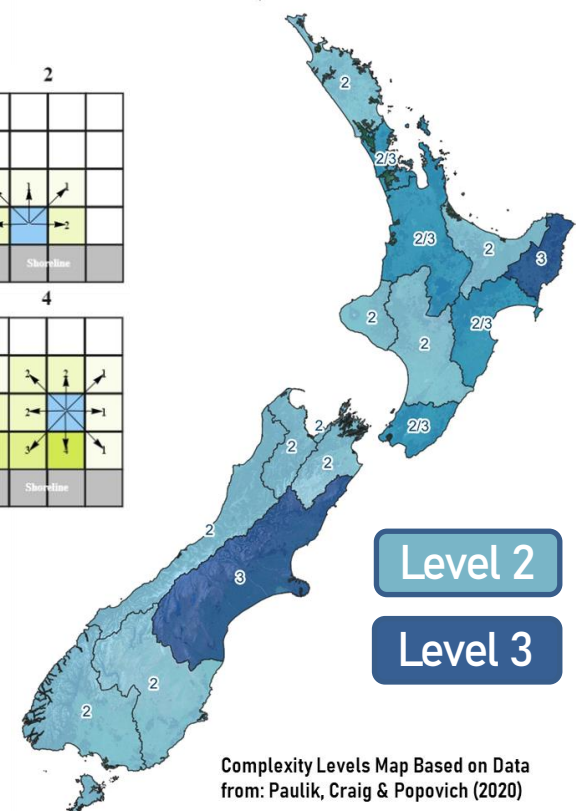
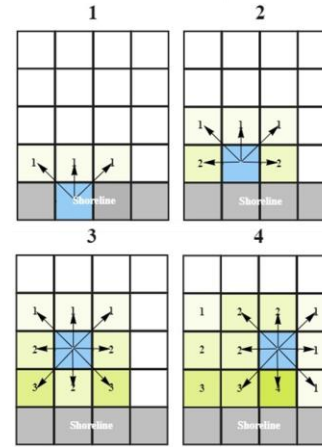
# Outline

- Tsunami inundation
- Physical modelling of tsunami impacts
- Volcanic tsunami hazard
- Outlook

# Tsunami inundation

PhD student: Tate Kimpton

- Level 2: Rule-based attenuation (1D transects interpolated)
- Level 3: Hydrodynamic model (NB roughness)
- “Level 2.5”: 2D GIS-based method.
- Adopt similar approach to Smart et al. (2015), 2D partitioned equation.
- Inputs: Tsunami height, DEM, land cover, tidal data (MHSW used)

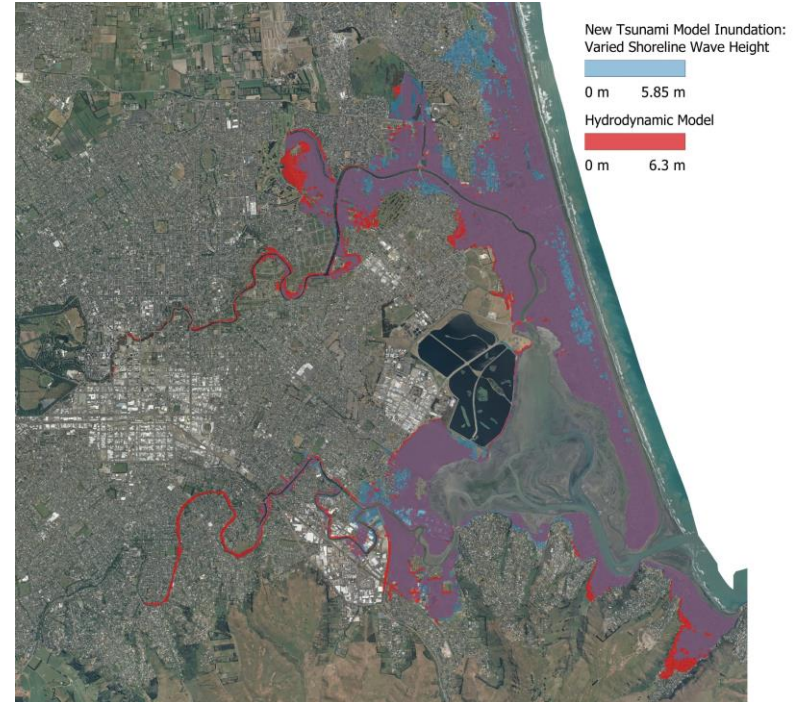


Complexity Levels Map Based on Data from: Paulik, Craig & Popovich (2020)

# Tsunami inundation

*PhD student: Tate Kimpton*

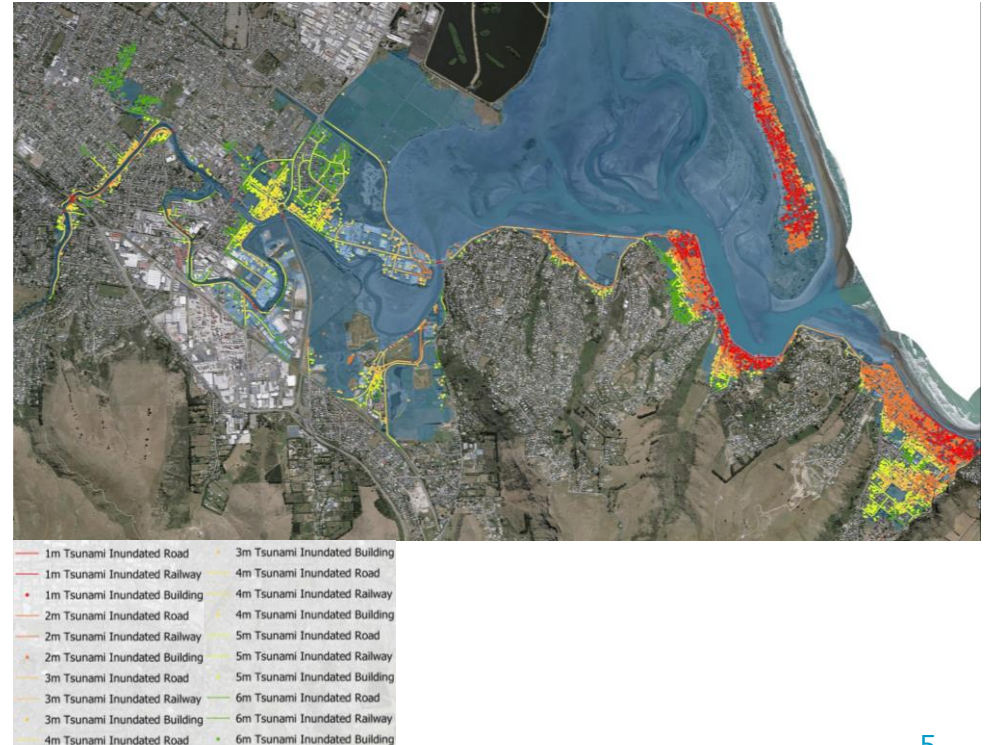
- Comparison with hydrodynamic model results for Christchurch.
- Tsunami heights from Power et al. (2022) 500-year ARI, 50<sup>th</sup> percentile.
- Varying roughness from land cover classification.
- Entire runtime: 3 mins 30 s. Inundation runtime: 1 min 30 s. F1 score: 88%.



# Tsunami inundation

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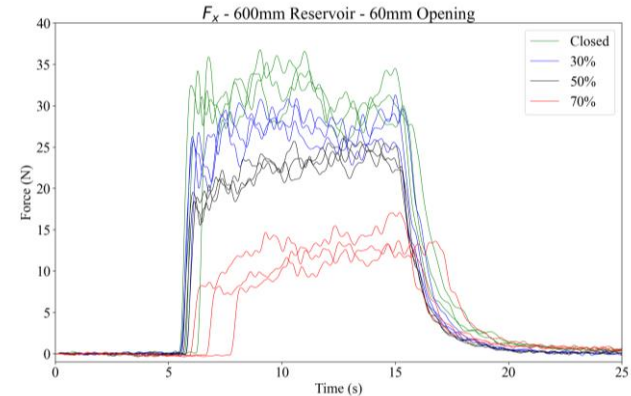
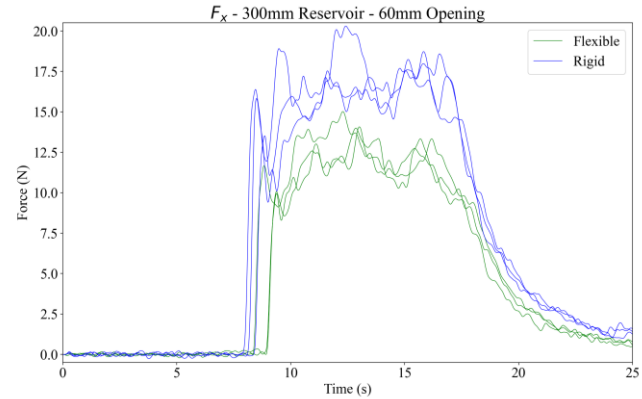
- Rapid inundation results to inform decision making
- Can run multiple wave heights for scenario testing
- Determine vulnerable infrastructure, communities, access



# Tsunami impacts on structures

PhD student: Henry Till

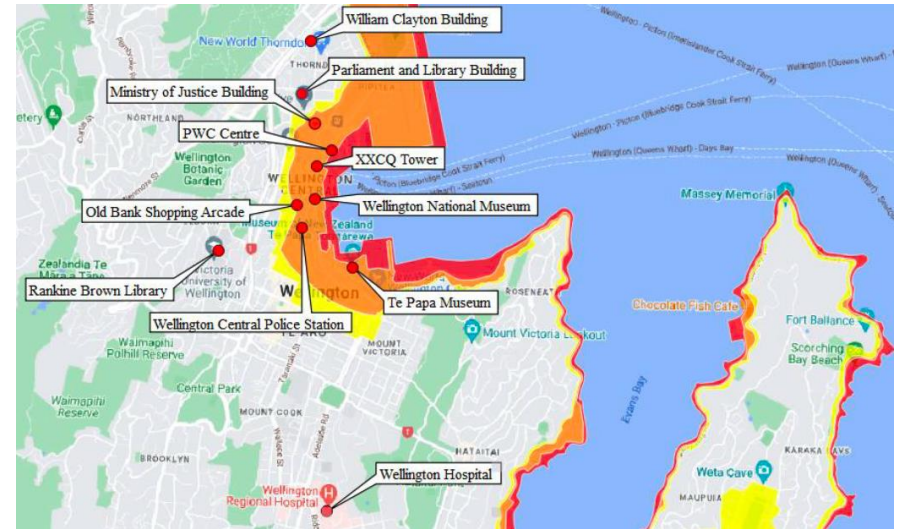
- Physical experiments of tsunami bore impacts on buildings, including effects of openings, flexibility, orientation
- Extended using advanced numerical methods



# Tsunami impacts on structures

*PhD student: Henry Till*

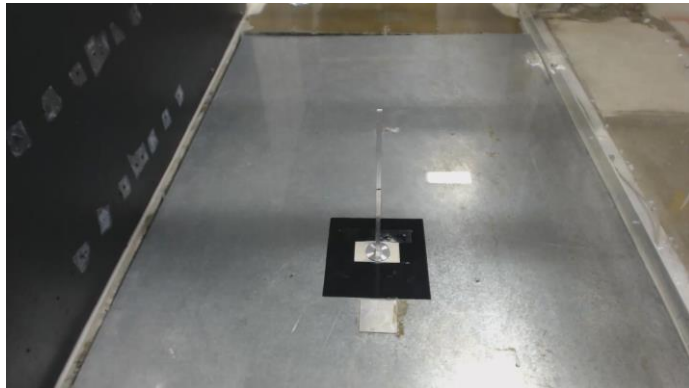
- Physical experiments of tsunami bore impacts on buildings, including effects of openings, flexibility, orientation
- Extended using advanced numerical methods
- Evaluating loading standards for new buildings, developing analysis procedures for existing buildings



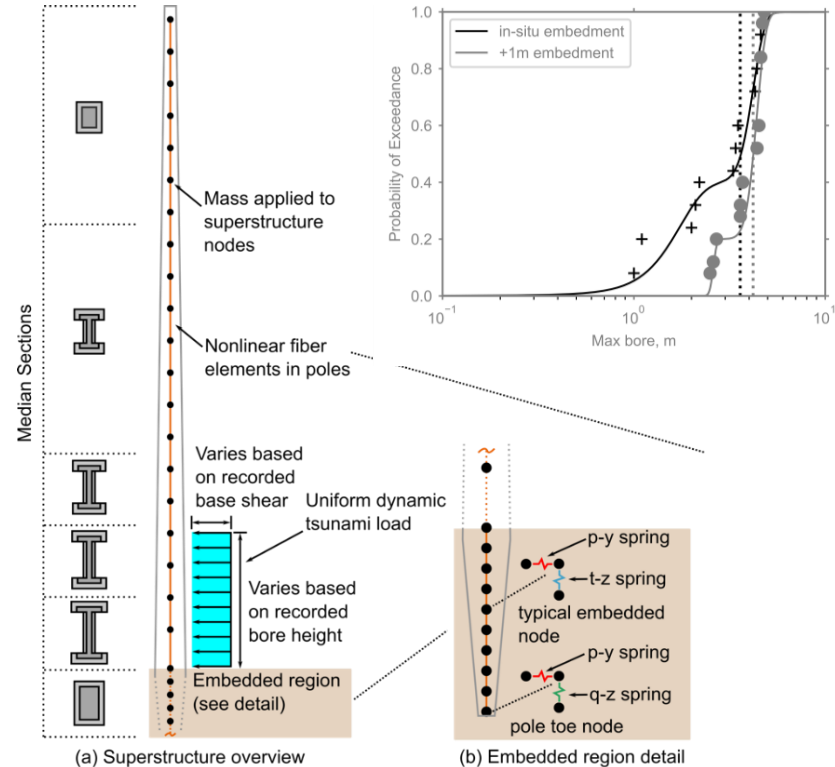
*Base isolated buildings in inundation zones*

# Tsunami impacts on power poles

- Building on previous bridge pier experiments
- Experimental measurements of forces and moments on simple structures
- Apply loadings within a numerical model, including embedment effects
- Towards probabilistic tools



*Flume experiments*



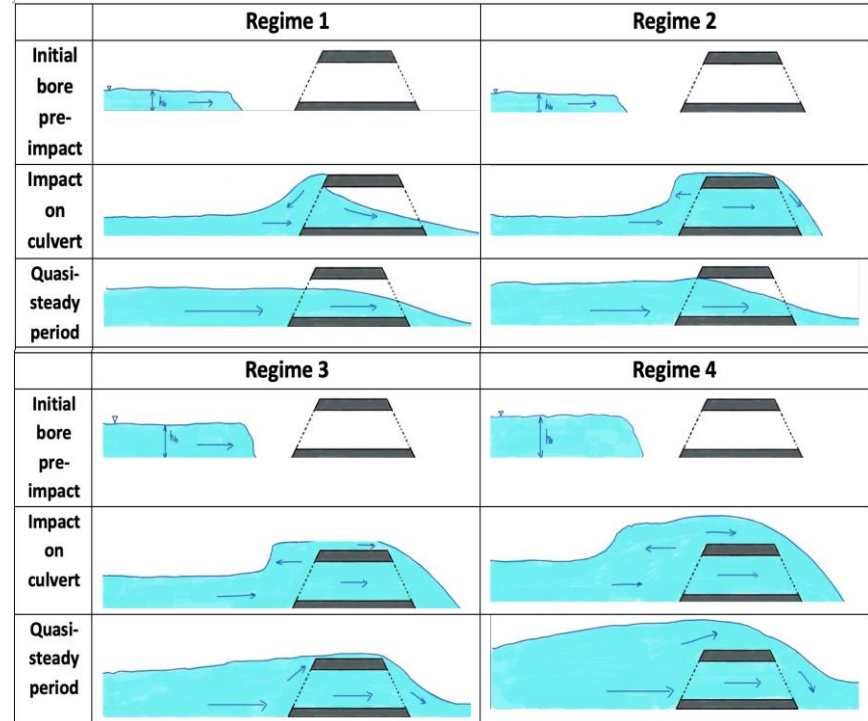
*Numerical modelling*



# Tsunami impacts on culverts

Summer student: Xuanrui (Rebecca) Liao

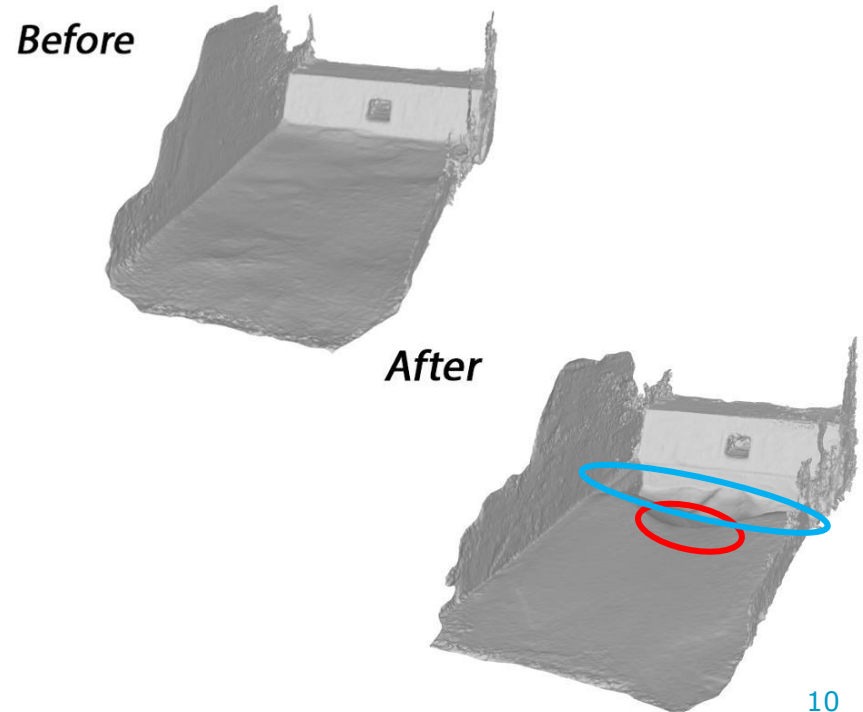
- Culverts as predictor of severe road damage under tsunami impact
- Failure mechanisms unclear
- Experimental study of tsunami interactions with an idealised culvert
- Identification of different interaction regimes



# Tsunami impacts on culverts

Part 4 students: Samuel Dean, Ali Tariq

- Culverts as predictor of severe road damage under tsunami impact
- Failure mechanisms unclear
- Experimental study of tsunami interactions with an idealised culvert
- Identification of different interaction regimes
- Scour caused by high-velocity culvert flow and overtopping flow



# Volcanic tsunami

*Aligned PhD student: Matty Hayward*

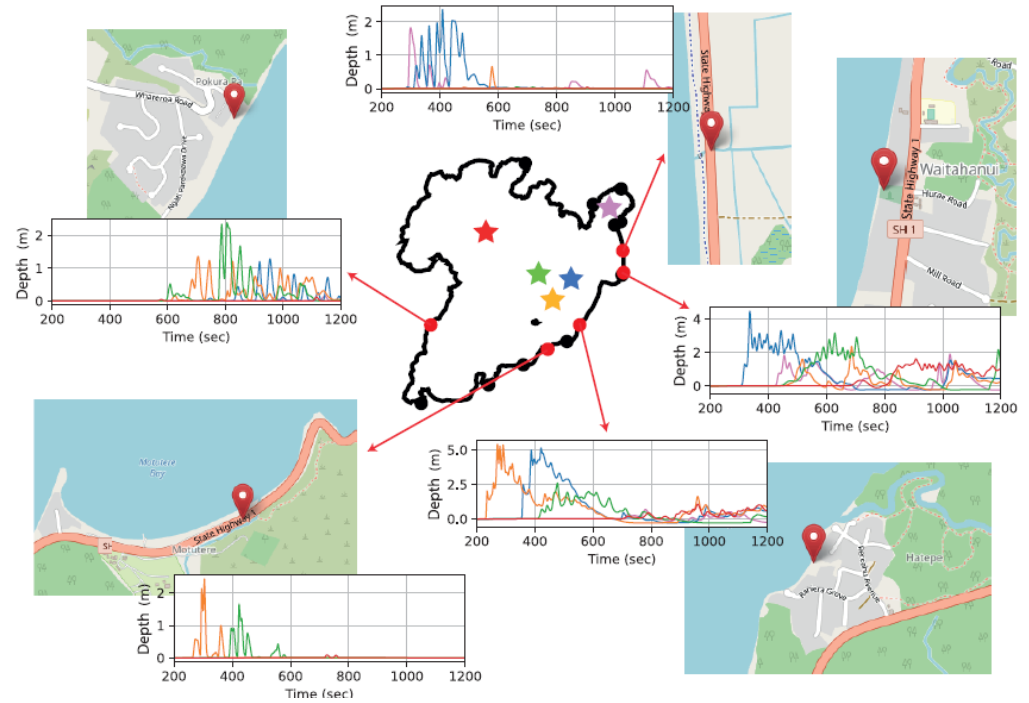
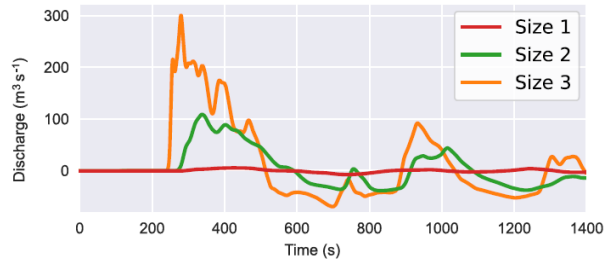
- Scenario-based modelling of waves generated in Taupō eruption
- Potential impacts on infrastructure



# Volcanic tsunami

Aligned PhD student: *Matty Hayward*

- Scenario-based modelling of waves generated in Taupō eruption
- Potential impacts on infrastructure



# Outlook

- Validation and application of inundation model
- Physical and numerical modelling to improve component-based fragility
- Synthesis





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