Multi-Volcanic Hazards in Auckland

- Conceptual framework designed using scenarios
- Scenarios were developed based on past AVF eruptions, worldwide analogous eruptions, expert elicitation and stakeholder engagement (Hayes et al., 2018).

Waitemata Port Scenario

- 286,436 buildings impacted.
- 87.7% residential,
- 39.6% are impacted by more than 1 hazard.
- Waitemata Port destroyed, airport disrupted.

Experimentation

- Experimental structure designed to represent the largest typology of buildings in the Auckland region.
- Structure is designed to current New Zealand building code and includes roofing and ceiling components.
- Experiments designed to test the vulnerability of components when impacted by tephra fall and ballistic projectiles.
- Testing variables include: tephra, volcanic gas, ground deformation, shock wave, tephra fall, base surge/pyroclastic density currents, volcanic ballistic projectiles, lava flows, fire, fountains, edifice construction.

Research Questions

- Will your house be habitable after an Auckland Volcanic Eruption?
- What are the possible orders of hazards in a volcanic eruption?
- What impacts are caused to residential buildings when considering multiple hazards?
- Can multiple hazards interact to both increase and reduce impacts to residential buildings.

This Research

- Interaction of volcanic ballistic projectiles and tephra fall.
- Assessment of hazard sequences and multi-volcanic hazard framework development.
- Focus on residential buildings with timber-framed construction and sheet metal roof cladding.
- Empirical experimentation to quantify results.

The Auckland Volcanic Field

- Basaltic, monogenetic volcanic field which erupts infrequently with small magma volumes.
- 53 volcanic centres ~500km².
- Oldest eruption ~200ka, youngest eruption ~500 years ago.
- Most commonly produces phreatomagmatic eruptions.

Habitability

- Residential buildings are required to protect residents from inclement weather, structural hazards and disease.
- The impacts of volcanic hazards can influence the habitability of residential buildings.
- It is possible that the order and timing of hazards has a direct relationship with habitability.
- Structural integrity of the building will be the focus of this research.

Conceptual Framework

- Develop a conceptual framework to assess the cumulative impact of multiple volcanic hazards.
- Use scenarios to understand sequences of hazards, hazards that commonly occur together.
- Use literature to identify observed hazard interactions.
- Identify gaps in knowledge and conduct laboratory experimentation.

Unified impact state designed to describe building functionality when impacted by multiple hazards with different damage mechanisms.

Building functionality can be used to assess many impact metrics (economic loss, structural damage, building habitability).

Model of conceptual framework