

Volcanic Impact Study Group (VISG*) update



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* VISG is a subcommittee of the Auckland Lifelines Group



NZ volcanic impact research

- **Yesterday Tom Wilson provided overview of NZ volcanic impacts research**
 - Context: NZ leads way, but we are decades behind earthquake engineering
 - Partnerships with endusers critical (e.g., Transpower)
 - Tools: literature review, impact trips, lab experiments, modelling
- **VISG promotes & facilitates communication, engagement & collaboration between researchers and lifelines**

Available resources

- Ash impact posters
 - ALG website and GNS website
- USGS/GNS ash impacts website
 - <http://volcanoes.usgs.gov/ash/>
- International Volcanic Health Hazard Network
 - <http://www.ivhhn.org/>
 - Includes information on best practice face masks, health considerations for staff
- Recently published review paper on volcanic impacts (ash, lava, PDC, lahar) on lifelines

IMPACTS ON WASTEWATER COLLECTION AND TREATMENT SYSTEMS

SYSTEM COMPONENT IMPACTS OF VOLCANIC ASH FALL

SYSTEM COMPONENT	IMPACTS OF VOLCANIC ASH FALL
Sewerage pumping network	<ul style="list-style-type: none">Ash may form impermeable crusts in sewer lines and manholes which may cause blockages and overflows.Ash in sewer lines will cause accelerated damage to pump impellers (grinding and chipping of metal).Ashfall may cause sewer overflows which will affect pumping stations without backup generation. Lack of pumping can lead to overflows if storage capacity is exceeded.
General effects on plant	<ul style="list-style-type: none">Excess accumulated water and ash on pump components (impellers, motors, seals, etc).Ash may damage comminators and gas cleaners.
Pre-treatment equipment	<ul style="list-style-type: none">Coarse (1-1 mm) ash is likely to block mechanical screening equipment, including screens and gear trains.Mechanical gas production equipment is highly vulnerable to damage from ash. Lower flow sewage. To a lot reduce sludge, consider bypassing treatment plant.
Primary settling tanks	<ul style="list-style-type: none">Coarse ash will increase volume of sludge for disposal.Ash will change the proportion of organic in biogenic matter entering the plant.
Secondary treatment	<ul style="list-style-type: none">Ash will cause pump overflows and cause flow disruption for the main system to settle to through the sewer lines.This ash effect is likely to be reduced (subject to ash accumulation on such screens) other than treatment with forced aeration.Sludge treatment with digestion is difficult.Ash related very fine silt may increase suspended solid load of effluent, which may require disinfection.
Tertiary treatment	<ul style="list-style-type: none">Expect an increased residual content of sludge.
Sludge treatment	<ul style="list-style-type: none">Expect an increased residual content of sludge.

CASE STUDY: CITY OF YAKIMA, WASHINGTON STATE, USA

Volcanic ash can cause serious damage to wastewater treatment plants. The City of Yakima, Washington State, USA, experienced 1000 tonnes of volcanic ash fall damage to the plant following the 1982 eruption of Mt. St. Helens in October which triggered approximately 10 feet of ashfall over the city. The ash was primarily due to changes in the meteorologically measured fall rate and gas content.

RECOMMENDED ACTIONS

Use the best practice of ashfall, as an ashfall may cause pump stop or flow disruption to the extent of an operational engineer.

DO NOT:

- Use ashfall as a cover for manholes.
- Use ashfall as a cover for manholes.
- Use ashfall as a cover for manholes.

DO:

- Use ashfall as a cover for manholes.
- Use ashfall as a cover for manholes.
- Use ashfall as a cover for manholes.

UCoG **Life Lines** **Massey University**





Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Journal of Volcanology and Geothermal Research

journal homepage: www.elsevier.com/locate/jvolgeores



Review

Volcanic hazard impacts to critical infrastructure: A review

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- **Most comprehensive review since 1984**
 - *Technical, dense*
- **Open access (free)**
- **Many informative diagrams, plots, and tables**



Review

Volcanic hazard impacts to critical infrastructure: A review



G. Wilson ^{a,*}, T.M. Wilson ^a, N.I. Deligne ^b, J.W. Cole ^a

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- Sector diagrams, indicating vulnerable points
- Historical impacts
- First attempt to systematically quantify thresholds

A – Wastewater network

A Critical infrastructure - PDC damage

Table 11
Proposed disruption and damage levels for expected impacts to critical infrastructure as a function of tephra fall thickness (mm).

	Level	Level 0	Level 1
	Description	No damage	Cleaning required
Electrical supply	Threshold (mm)	<3	3–10
	Damage	No damage	Possible abrasion to some moving parts, infiltration of tephra into substation gravel.
Water supply network	Disruption	No disruption	Temporary disruption to service repair.
	Threshold (mm)	<1	1–20
	Damage	No damage	Possible clogging of filters and some abrasion to moving components.
	Disruption	No disruption	Normal operation with increased frequency of filter cleaning and

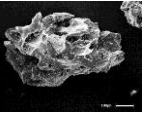
... and much more

Next: 3 sample ongoing research projects

- **Modelling electrical network outages**
 - Grant Wilson, PhD student
 - Building on previous research, modelling
- **Ash & road traction**
 - Daniel Blake, PhD student
 - VATLab
- **Ash clean up**
 - Josh Hayes, MS student
 - Literature review, (modelling)

Grant Wilson: electrical network vulnerability

Modelling (work in progress)



Proba
volc
sourc

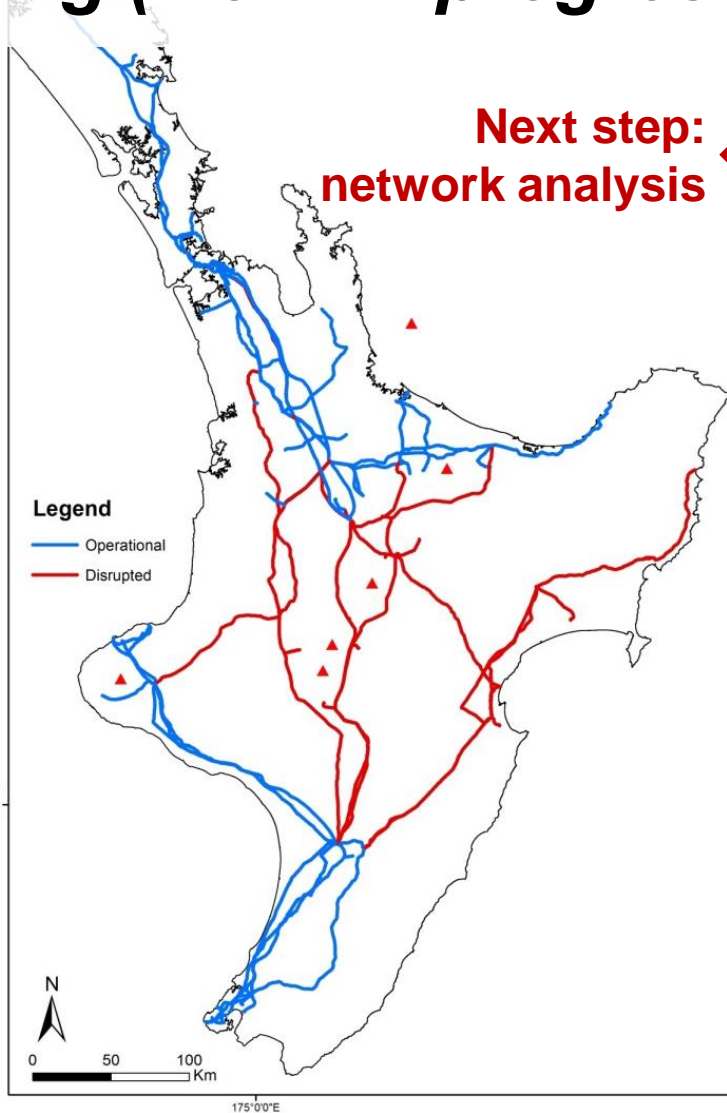


Transr

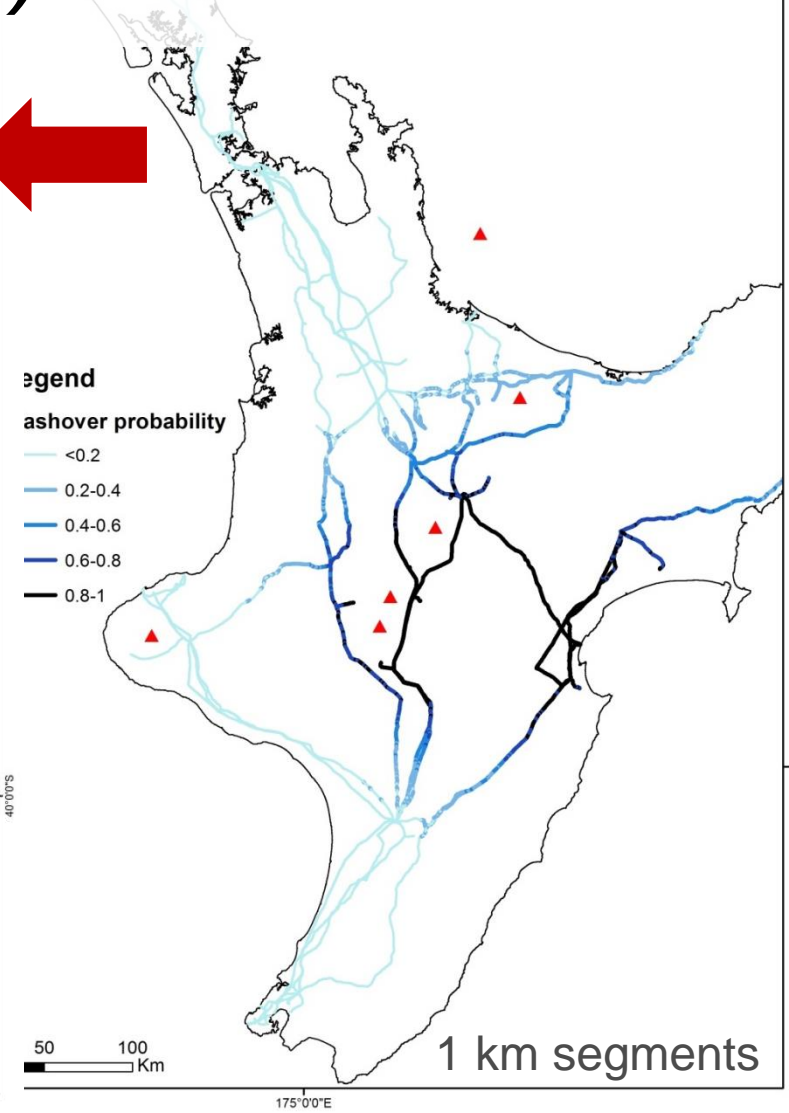
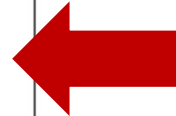


Prob
giv

Proba
5

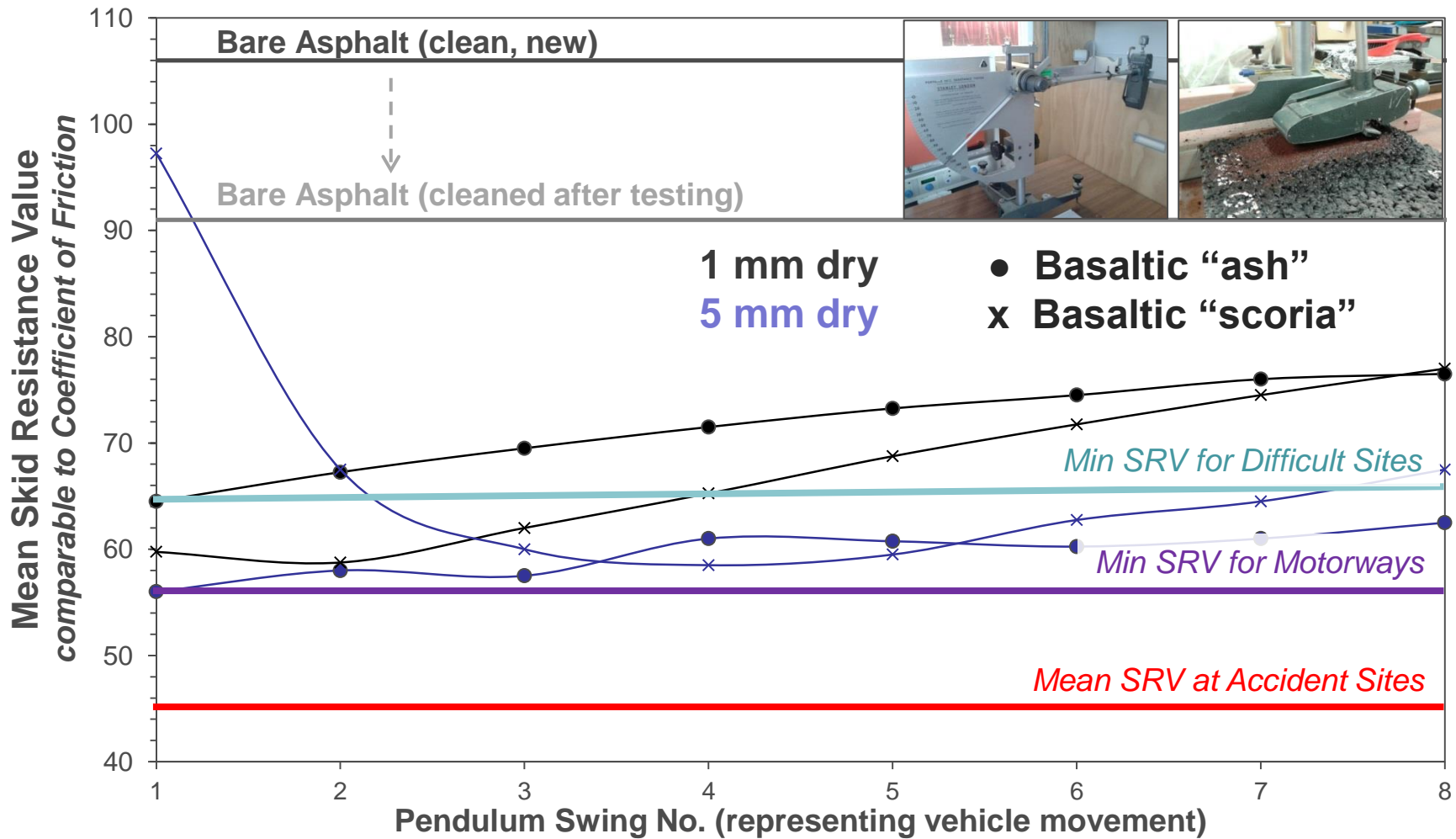


Next step:
network analysis



Daniel Blake: road traction testing

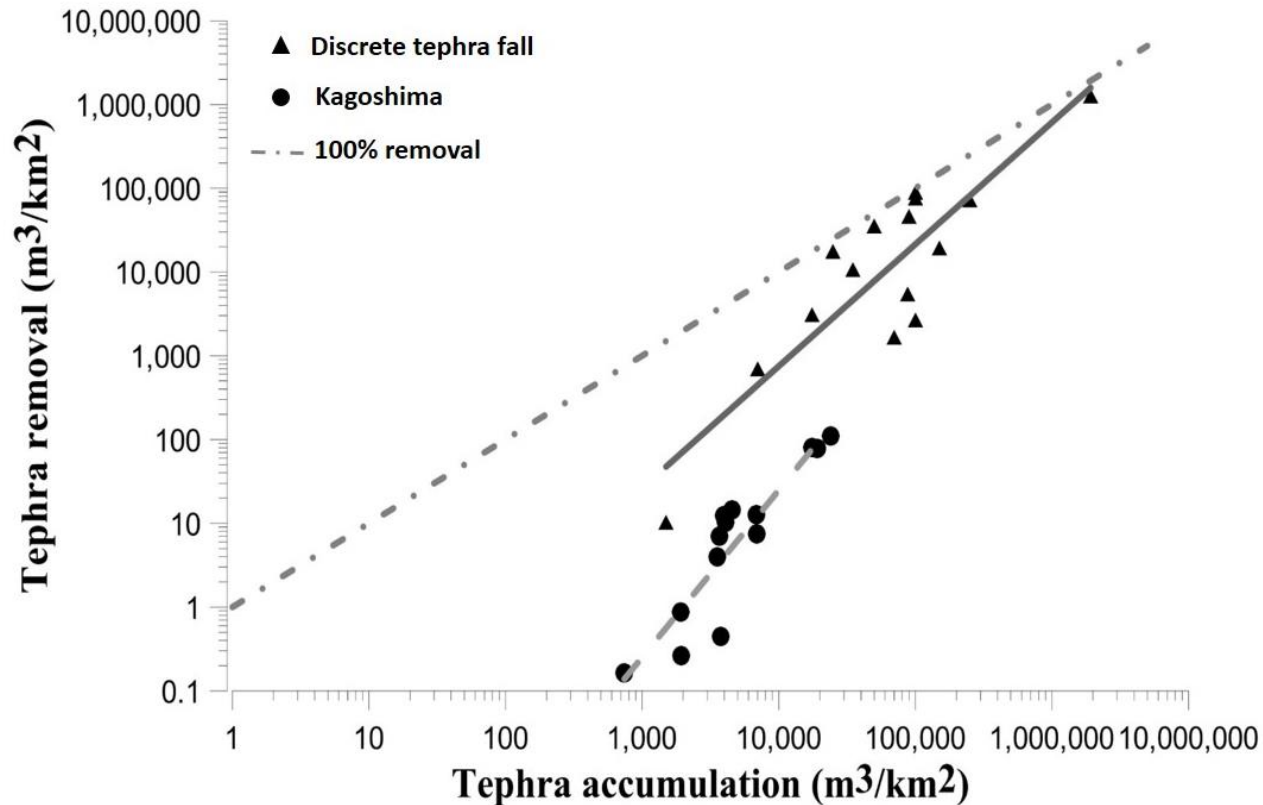
Lab experiments (work in progress)



Josh Hayes & urban ash clean-up

Literature review (work nearly complete)

1. How much?

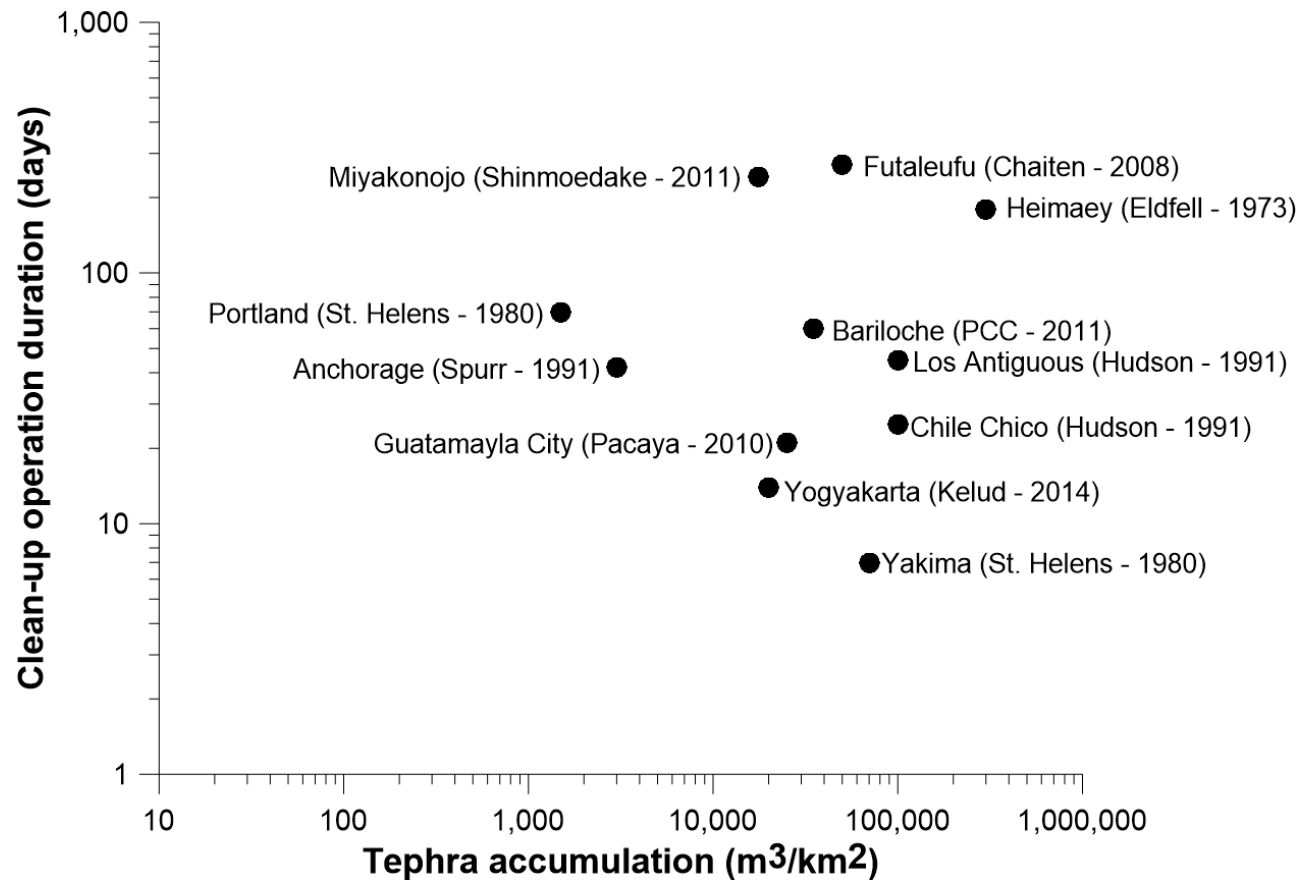


➤ The smaller the eruption, the less is cleaned up

Josh Hayes & urban ash clean-up

Literature review (work nearly complete)

1. How much?
2. How long?

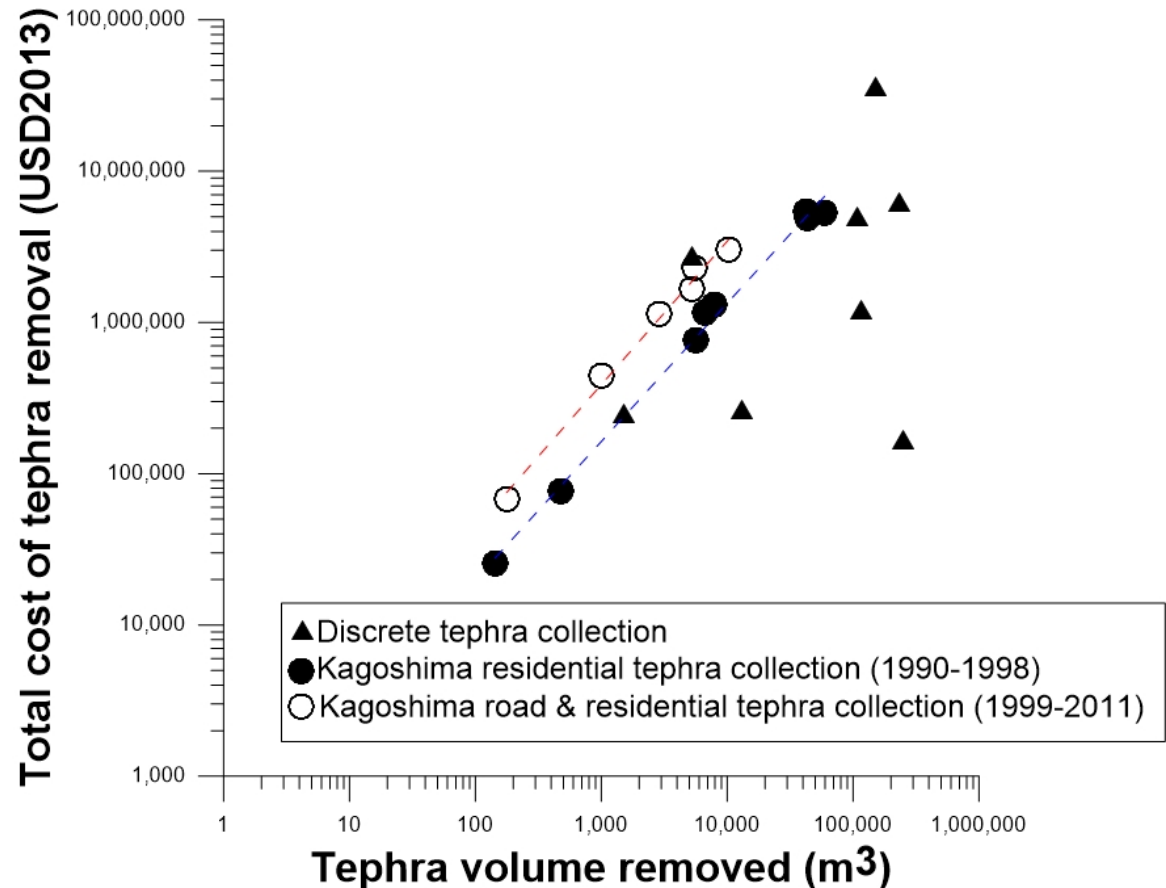


➤ No obvious relationship between amount and clean up duration

Josh Hayes & urban ash clean-up

Literature review (work nearly complete)

1. How much?
2. How long?
3. Cost?



➤ Positive correlation; predictable if experienced

Kīlauea, Hawai'i



- **Pu‘u ‘Ō‘ō (Kīlauea) has been erupting since 1983**
- **“June 27th flow” has been on course to threaten settlement since late August, first structure destroyed last week**
 - Agonising for community, great uncertainty as to what will be impacted when
- **Lifeline sectors concerned: power, water, transport**

Kīlauea, Hawai'i

- **Power**
 - Attempt to protect wooden pole
 - Initially worked, but since appears might be burning from below
- **Water**
 - Unclear how buried water pipes, particular at junctions, will fare
- **Roads**
 - One road crossed already
 - Threatens key transportation corridor
- **Redundancies added, contingency plans developed**



Prospects for coming year

Planned research

- **More work on infrastructure networks**
- **Start consideration of ballistics impacts**
- **Suite of fragility functions**

Lifeline engagement

- **Help us help you**
 - Develop research projects, reality check, model parameter setting
- **Impact trip?**
- **Other ideas?**