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Developing volcanic ash fragility functions for surface transportation using field and laboratory data

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Volcanic ash falling or remobilising on surface transportation (i.e. road, rail, maritime and airport) networks and infrastructure during and following eruptions often compromises visibility, covers road markings and reduces skid resistance, all of which can be detrimental to safety. However, disruption is often complex, with the severity of impacts affected by many parameters including ash characteristics (e.g. particle size, deposit thickness), meteorological conditions, pavement characteristics, and mitigation actions. Fragility functions are used in volcanic risk assessments to express the probability of impact given a range of hazard intensities. Most existing fragility functions for volcanic ash adopt ash thickness as the sole metric to assess impact, mainly because thickness is the most commonly measured variable in the field and hence most frequently modelled, so generally forms the basis of thresholds for functional loss. To refine such thresholds, we apply results from a series of recent laboratory experiments in the Volcanic Ash Testing Laboratory (VAT Lab) at the University of Canterbury, New Zealand, which investigate skid resistance and marking coverage on roads. We also use empirical data obtained from experiments of visibility in airborne volcanic ash to establish new fragility thresholds and functions, using ash-settling rate as an alternative hazard intensity metric to thickness. Our results highlight the importance of considering ash-settling rate, in addition to ash thickness, to best characterise hazard intensity for surface transportation. However, other metrics, especially particle size, are crucial to consider for comprehensive impact assessment to surface transportation. We present our findings on the relative importance of numerous metrics. Future datasets, obtained from both post-eruption field studies and additional laboratory experimentation, will provide fresh opportunities to further refine fragility functions.