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# Detection of volcanic ash through depolarisation of scattered ultraviolet sunlight

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Ash-rich volcanic eruptions can severely impact a range of human activities, including transport, agriculture, building structural stability, electricity networks and water quality. Aircraft jet engines are particularly vulnerable to ingestion of ash particles, which melt and then accumulate on cooler parts of the rotor, leading to engine failure. The mitigation strategy for this risk is avoidance, leading to closure of enormous volumes of airspace during ash-rich eruptions, with expensive impacts due to delayed or cancelled flights. Ash detection systems are therefore essential, to allow risk managers and stakeholders to make optimal decisions on when to close airspace. Additionally, the presence of ash impacts the accuracy of volcanic sulphur dioxide ($SO_2$) retrievals. Measuring $SO_2$ flux is one of the primary methods for volcano monitoring, and so identifying when ash contaminates measurements is important to ensure that volcanic gas fluxes are accurate.

Existing remote sensing systems able to detect volcanic ash include radar, LiDAR and infrared imagery. Ground based ultraviolet imagery has been used in the past to determine the effect of particulate matter on atmospheric $SO_2$ retrievals (e.g. with the UV SO¬2 camera), however these did not detect ash - only calculate its impact when it was already known to be present. Ground based ultraviolet measurements could offer a cheap and simple ash detection system that would be easily integrated into existing volcano monitoring infrastructure.

Here, we use ground-based ultraviolet measurements of volcanic ash to demonstrate a new ash detection method that uses the depolarisation of sunlight due to scattering from non-spherical ash particles. We present a combination of spectroscopic and imaging techniques to investigate the possibility of using depolarisation of sunlight to detect volcanic ash, using data taken from two field studies – Stromboli, in Italy, and Santiaguito, in Guatemala. This new ash detection method will provide risk managers with improved data quality on the critical question of where ash is located, minimising the economic and societal impacts of ash-rich volcanic eruptions, as well as improving the quality of volcanic gas flux measurements. This system will provide ash location information during daylight hours, complementing existing ash detection techniques to provide a powerful ash detection network.