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Application of a low-cost ultraviolet camera solution for permanent sulphur dioxide measurements at six volcanoes worldwide.

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Ultraviolet (UV) cameras provide advantages in spatial and temporal resolution for the measurement of sulphur dioxide (SO_2) emission rates, when compared to the more common differential optical absorption spectroscopy (DOAS) instruments. Up to this point, however, most instances of UV camera usage are restricted to discrete campaigns, rather than permanent installations. Notable exceptions include Stromboli, Etna, and Kīlauea (2013-2018). The reasons for this are largely related to cost, with commercially available UV cameras often being prohibitively expensive, and also to the challenges associated with developing robust algorithms for automated retrieval of emission rates from the collected imagery. The PiCam, developed at the University of Sheffield, is a new UV camera system designed for permanent installation in the field and provides automatic measurements of SO_2 emission rates (for full details see Wilkes et al., 2023, doi: 10.3389/feart.2023.1088992). The PiCam is currently installed at six volcanoes globally: Kīlauea (USA), Cotopaxi and Reventador (Ecuador), Lascar and Lastarria (Chile), and Merapi (Indonesia). Each location has unique requirements and setup, for instance the UV cameras at Reventador and Lastarria operate autonomously but require user visits for data download. Those at Kīlauea and Merapi are integrated within existing telemetry solutions, while at Lascar and Cotopaxi we have begun to integrate Starlink satellite data telemetry alongside our cameras. We present some early results from measurements at Kīlauea where emission rates are compared to more traditional measurements using DOAS. Since the PiCam installation in 2022, the system has recorded multiple styles of activity, from low-level degassing during periods of quiescence to syn-eruptive emissions exceeding 10,000 t/d. Our work highlights continuing challenges of processing of UV camera data, where automated protocols and real-time processing for reliable emission rate retrievals are still in their infancy.