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Imaging volcanic SO_2 plumes with UV cameras

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Ultraviolet (UV) cameras allow the two-dimensional imaging of SO_2 distributions at temporal resolutions on the order of 1Hz. Optical bandpass filters that selectively transmit only UV wavelengths at which SO_2 absorption occurs (or, for reference, wavelengths at which absorption is negligible) are positioned in the camera's optical system, thus providing selective sensitivity to SO_2. As SO_2 is one of the main volatile species associated with high-temperature volcanic degassing, UV camera systems are increasingly being applied to volcanic environments for monitoring and research purposes. The relatively high frame rate of these cameras allows the retrieval of SO_2 emission fluxes on time scales comparable to those on which other geophysical parameters (e.g. seismicity, deformation) are recorded, thus making an integrated evaluation possible. While impressive imagery of a volcanic plume's extent is readily obtained, lingering challenges include obtaining an accurate SO_2 column density calibration, correcting for complex radiative transfer in and around volcanic plumes (which are often visually opaque), and deriving accurate flux measurements truly representative of volcanic activity and not overly biased by atmospheric turbulence and other secondary effects. Here, these issues are addressed, innovative solutions are presented, and example measurements from Kilauea Volcano (Hawaii) are shown. Although time-averaged SO_2 emission rates were typically below 10 kg/s ($\sim$900 t/d) during measurements in September and October 2011, the high-resolution camera measurements revealed short-period (order of seconds) peaks of more than twice that value. Measurements were taken from different locations between 2 and 7 km distance from the summit vent, thus giving different perspectives of the gas plume. Where possible, links between SO_2 emissions and other monitored parameters are identified and interpreted in regard to their connection to physical processes occurring in the volcanic system.