Ultraviolet SO₂ imaging systems allow insights into degassing processes occurring on short timescales at Kilaeua’s summit.

**Introduction**

Ultraviolet (UV) cameras allow the two-dimensional imaging of SO₂ distributions at temporal resolutions on the order of 1Hz. Optical band-pass filters that selectively transmit only UV wavelengths at which SO₂ absorption occurs (for reference, the sensitivity at which absorption is negligible is positioned in the camera’s optical system, thus providing selective sensitivity to SO₂). As SO₂ 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.

**Dealing with optically thick plumes**

Ultraviolet (UV) imaging systems allow insights into degassing processes occurring on short timescales at Kilaeua’s summit.

** deriving a high resolution SO₂ emission rate**

Since the UV camera system measures the SO₂ concentration integrated along the line of sight (VSO₂), the emission rate \( \Phi \) can be derived by integrating \( VSO₂ \) along a cross-section through the plume and multiplying by the plume velocity \( v \):

\[
\Phi = v \int VSO₂ dx \cdot \sin(\theta)
\]

The \( \Phi \) function ensures that only the velocity component perpendicular to the integrated cross-section is used (\( \theta \) is the angle between \( \mathbf{v} \) and \( \mathbf{x} \)). The plume velocity \( v \) can also be obtained directly from the image. For this we plot the distribution of SO₂ along the plume axis (shown in Fig 3a) as a function of time (Fig 3b). The slope of the structure in this image (bottom left to top right) is a measure of plume speed.

**Linking seismicity and gas emissions**

The lava level at Kilaeua’s summit has been observed to fluctuate between two seemingly stable levels, one approximately 10–20 m above the other. During lava low stand, SO₂ emissions are significantly higher than during periods of high stand. High-frequency (HF > 1Hz) seismicity appears well correlated to SO₂ emission rate. In fact, besides the obvious change in HF amplitude between high and low stand, a correlation between the HF seismic energy and SO₂ emission rates is often observed on much shorter timescales of seconds to minutes as well.

**References**