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Accuracy of MODIS on Kilauea eruption temperatures

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Spectral radiances obtained through NASA'S MODerate resolution Imaging Spectroradiometer (MODIS) satellite and run through MODVOLC, a new algorithm developed by the HIGP, show two-temperature fits to single-pixel brightness temperatures can yield actual eruption temperatures with believable areal limits on Kilauea, with some error. Calculated temperature accuracy was determined by comparison with temperatures measured on-site using a thermocouple, optical pyrometer, and digital camera.

Calculations used two-temperature fits of the form $T_b = T_h(f) + T_c(1-f)$, where T_b is average pixel brightness temperature calculated from satellite spectral radiance, T_h is eruption temperature measured on location, T_c is average temperature of all cooling surfaces, and (f) is fractional area of eruption-temperature material in the 1 km^2 pixel. In this study, eruptive material covered $\sim$1% of the pixel, as determined on the eruption site. Believable average cool temperatures $T_c$of 10-20 degrees below the brightness temperature resulted. Since error in high temperature values can be large for small fractional pixel values, we determine a fractional area $\sim$ 10 % is needed for accurate temperature results, based on our model and MODIS observations only (no ground truth). Future satellite missions with thermal imaging goals should account for similar limits. Based on field observations, variations seen in brightness temperatures could be due to the volcanic feature. While lava flows are broad, they are below-eruption temperatures. Skylights are small but at eruption temperatures. The two are difficult to differentiate at the MODIS pixel resolutions.

Research significance is in determining eruption style and lava composition on other planets, as eruption temperatures and spatial and temporal variations are indicators of composition and volcanism style. This work can be applied to other terrestrial and comparative planetary studies of volcanic features in order to better understand active volcanism through remote sensing.