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Change detection and characterization of volcanic activity using ground based low-light and near infrared cameras to monitor incandescence and thermal signatures

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Knowledge and understanding of precursory events and thermal signatures are vital for monitoring volcanogenic processes, as activity can often range from low level lava effusion to large explosive eruptions, easily capable of ejecting ash up to aircraft cruise altitudes. Using ground based remote sensing techniques to monitor and detect this activity is essential, but often the required equipment and maintenance is expensive. Our investigation explores the use of low-light cameras to image volcanic activity in the visible to near infrared (NIR) portion of the electromagnetic spectrum. These cameras are ideal for monitoring as they are cheap, consume little power, are easily replaced and can provide near real-time data. We focus here on the early detection of volcanic activity, using automated scripts, that capture streaming online webcam imagery and evaluate image pixel brightness values to determine relative changes and flag increases in activity. The script is written in Python, an open source programming language, to reduce the overall cost to potential consumers and increase the application of these tools across the volcanological community. In addition, by performing laboratory tests to determine the spectral response of these cameras, a direct comparison of collocated low-light and thermal infrared cameras has allowed approximate eruption temperatures and effusion rates to be determined from pixel brightness. The results of a field campaign in June, 2013 to Stromboli volcano, Italy, are also presented here. Future field campaigns to Latin America will include collaborations with INSIVUMEH in Guatemala, to apply our techniques to Fuego and Santiaguito volcanoes.