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Detection and monitoring of hydrothermal alteration by Principal Component Analysis applied on UAS derived optical data, Vulcano Island - Italy

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Modern UAS (unmanned aircraft system), light weight sensor systems and new processing routines allow us to gather optical data of volcanoes at a high resolution. However, due to the typically poor colorization, our ability to investigate and interpret such data is limited. Further, the information stored in the red, green and blue channel (RGB) is correlated. This makes any analysis a 3 dimensional task. Principal Component Analysis (PCA) helps us to overcome these problems by decorrelating the original band information and generating a variance representation of the original data. Therefore PCA is a suitable tool to detect optical anomalies, as might be caused by volcanic degassing and associated processes.

Applied in a case study at La Fossa Cone (Vulcano Island - Italy), the PCA showed a high efficiency for the detection and pixel based extraction of areas subject to hydrothermal alteration and sulfur deposition. We observed a broad alteration zone surrounding the active fumarole field, but also heterogeneities within, indicating a segmentation. Systematic variations in color and density distribution of sulfur deposits have implications for structural controls on the degassing system.

Combining the efficiency of PCA with the high resolution of UAS derived data, this methodology has a high potential to be employed in the spatio-temporal monitoring of volcanic hydrothermal systems and processes at surface.