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CHARACTERISATION AND REANALYSES OF VOLCANIC CINDER CONE MORPHOMETRY EXPLOITING ADVANCES IN REMOTE SENSING : THE CASE OF MAUNA KEA SHIELD' S CONE FIELD

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Cinder cones are the most common volcanic landform on Earth and are also found on other planets. Thus understanding controls on cone eruptions, cone morphology and cone fields is essential. One approach to gain understanding and to assess hazards is to develop a capability of inverting cone shape and size information to derive key eruption parameters. Porter (1972) and Wood (1980) proposed morphometric relationships. However, the data set is biased as only a few cone fields have been considered. Riedel & al. (2003) presented new modelling and experiments accounting for the average shape of cones. They noted the potential of learning from analyses of the variability in cone morphometric parameters. However, this type of analysis has not yet been carried out. It is a focus of the present work. Documentation of features such as parasitic cones and multiple vent constructs is a second focus. Another dimension is that topographical maps and aerial photos, such as those used by previous workers, are not readily available for remote areas or in developing countries. Since the Porter and Wood studies, the spatial resolution of satellite imagery has dramatically improved and a key aspect of our work is to assess to what extent satellite imagery can be used as a substitute for other data sources when these are lacking or too difficult to obtain. We also explore to what extent spectral information can be used in automated classification of image regions as an automated geological mapping tool, for example to discriminate between lava and pyroclastic formations. Here, Landsat

ETM+, topographic map and aerial photo data were analysed to assess their respective capabilities including for retrieving accurate quantitative and descriptive morphological parameters. Satellite imagery proved invaluable in deriving essential data on vent spatial distribution, size distribution, W$_{cr}$/W$_{co}$ ratio, elongation axes, and breaching and parasitic cone locations. Cloud and vegetation coverage as well as the shadow effect due to the illumination angle appear as the chief methodological limitations. We found that H$_{co}$/W$_{co}$ for fresh cones has an upper limit of 0.2 and that variability is a defining feature of this ratio, which significatively decreases with cone aging. W$_{cr}$/W$_{co}$ ranges from 0.15 to 0.57 and is a record of contrasting eruption conditions; we discuss how the average and extrema values can be accounted for. Implications for future data collection and analyses and hazard assessment are also considered.