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Lidar-based digital terrain analysis of an area exposed to the risk of lava flow invasion: the Zafferana Etnea territory, Mt. Etna (Italy)

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Areas exposed to volcanic risk need to be monitored continuously to reduce the impact of volcanic eruptions by establishing early warning systems, mapping areas exposed to volcanic hazards and taking timely preventive measures. Correct land-use planning is fundamental in minimizing loss of life and damage to property, and to protect the natural and urban landscape in case of volcanic disaster. In this context, up-to-date and accurate topographic data are a fundamental resource for volcanological research, risk mitigation efforts and modelling volcanic flows. The airborne Lidar (Light detection and ranging) technology has become one of the most promising tools in topographic analyses. Compared with traditional methods, it produces, in short time and with moderate-to-low cost, high density and accuracy spatial data of the investigated territory. Subsequent elaboration allows to extract detailed 3D high resolution models of different features as ground, vegetation cover (forest) and urban areas. This contribution presents the results obtained from a September 2005 Lidar survey flight on Mt Etna (Italy). This volcano occupies a large area (˜1,200 km2), which is exposed to the risk of lava flow invasion capable of damaging or destroying human property such as buildings, lifelines, and cultivated land. In this work we present qualitative and quantitative 3D Lidar analysis data in a sample area of the municipality of Zafferana Etnea, on the eastern slope of the volcano. The outskirts of this town have repeatedly been reached and damaged by lava flows in the past few centuries, most recently in 1992. The Zafferana Etnea area is characterized by three different landscape typolo-

gies: a) the western sector is occupied by the Valle del Bove depression, and it is characterized by relatively flat but rough morphologies of recent and historical lava flows; b) the northern sector is dominated by a rugged topography with deeply incised valleys and the southeastern entry to the Valle del Bove, and c) the southern and eastern sector mostly occupied by the urban texture of Zafferana town and surrounding forested/agricultural areas. Our analysis aims at identifying the probable parcourse of future lava flows (based on the present-day morphology) and its possible modification due to the presence of man-made structures and vegetation and investigate whether such obstacles could significantly alter the evolution of a lava flow. Repeated surveys and analysis of this kind will allow to monitor ongoing man-made and natural changes to the urban and natural morphology, and to furnish an up-to-date topographic base to authorities involved in land-use planning and scientists running numerical simulations of lava flows.