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Identification and mapping of landslides using lidar technology

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We describe the preliminary results of an experiment aimed at testing lidar technology for the identification and mapping of new or reactivated landslides. The Collazzone area, which extends for about 79 square kilometres in central Umbria, was selected for the experiment. For this test area, detailed lithological and landslide information is available through field mapping and analysis of multiple sets of aerial photographs. In April 2004, rainfall episodes produced numerous landslides in Umbria. In the Collazzone area, through reconnaissance field surveys we mapped a total of 70 landslides, for a total landslide area of 0.27 square kilometres. Most of the landslides occurred in cultivated or barren areas, and were classified as soil slides, slides, and slide-earth flows. Landslides were identified and mapped directly in the field using 1:10,000 scale topographic maps. Mapping of the landslides was aided by monoscopic and pseudo-stereoscopic digital photographs taken with hand-held cameras. The area of the individual landslides ranged from about 100 to more than 31,900 square meters (average 3811 square meters). Vertical alterations in topography produced by the landslides - mostly in the scarp area, and subordinately in the deposit and at the landslide toe - ranged from a few centimetres to several decimetres. On 3 May 2005, the Dornier 228 aircraft operated by the Airborne Research and Survey Facility (ARSF) of the UK National Environment Research Council (NERC) flew an Optech Airborne Laser Terrain Mapper (ALTM) 3033 over the Collazzone area, and performed an airborne lidar swath mapping (ALSM). The high-accuracy laser rangefinder mounted on the aircraft collected and average of 33,000 laser observations per second from an average

flying height of 2800 meters. The instrument recorded first pulse, last pulse, and intensity data. On October 2005, the lidar data were processed by the Unit of Landscape Modelling (ULM) of the Cambridge University. GPS post-processing was performed using Applanix PosPac version 3.02 software, and laser data post-processing was performed using Optech REALM version 3.03d software. Digital terrain elevation data were delivered in the UTM coordinate system (Datum WGS84) and covered an area of 238.90 square kilometres, with an average point density of 2.1 m (55.73 millions elevation points). We compare the results of the landslide mapping performed in the field with the digital elevation data obtained by the airborne lidar swath mapping a few weeks after the landslides occurred, and when the morphology of the slope failures was still evident on the ground. Preliminary results indicate that the medium to large size landslides triggered by rainfall in April 2004 left morphological features (e.g., scarps, lateral ridges, frontal lobes) that are visible in the digital representation of the terrain captured by the lidar. Landslide features are best seen on open and planar slopes covered by grass. Small landslides and landslides in areas covered by chaparrals or mixed vegetation cannot be easily identified from the lidar elevation data.