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Semiautomatic inventory of the landslides triggered in the 2014 event in Ribeira Valley using Remote Sensing Data

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In the last two decades several studies have applied automatic and semiautomatic methods to produce landslide inventories using high resolution Earth Observation products such as satellite imagery and Digital Elevation Models (DEMs). In Brazil, inventory maps for large areas are not systematic and the application of automated and semiautomated methods for landslide detection is unusual. In January 2014 intense rainstorms (200mm/2h) occurred in the Ribeira de Iguape river Valley (São Paulo State, Southeast Brazil), triggering landslides and a debris flows that caused 25 deaths and damage to urban, transportation and energy infrastructures. In the following years, a few event-based inventories were produced for small subbasins affected in 2014, by the means of empirical methods and freely available images. To the best of our knowledge there are no large-scale event-based inventories for the whole area affected by landslides in the 2014 event. In this study, we tested a combination of unsupervised classification of high-resolution orbital images, visual interpretation and DEM analysis to map landslides triggered in 2014 event. The landslide inventory was produced for an area of 110 km². The ISODATA algorithm from SAGA GIS was used to clusterize a NDVI difference layer derived from RapidEye (5m) pre-event and post-event orhorectified mosaics. The resulting clusters were checked and corrected through visual interpretation. Finally, we used a TanDEM-X DEM (12m) to identify valley bottoms and separate the inventory in two classes: landslide scars and landslide deposits. Our results shows that an area of 5.48 km² (approximately 5% of the total area) was affected by landslides in 2014, with 4.04 km² classified as landslide scars and 1.44 km² as landslide deposits. A total of 2089 landslide scars were detected, with mean area of 1.926 m², minimum of 25 m², maximum of 91.100m² and median of 800 m². Given the scarcity of detailed geographical information about the landslides in the area, the inventory presented here may improve future susceptibility and hazard studies, especially regional scale statistically based models. This inventory can also be used as labeled sample for the application of Machine Learning and Deep Learning algorithms aiming to detect landslide scars and the timing of ruptures using satellite imagery time series, as well to launch a systematic mapping of such phenomena in Brazil.