LSMM
Landslide Susceptibility Model & Map

products

Messina (Sicily, Italy) Coloured areas show a landslide susceptibility zonation superimposed on a very-high resolution satellite image taken shortly after a destructive landslide event. Red areas are expected to be prone to landslides and green areas are not expected to be prone to landslides.

WHAT

A landslide susceptibility model and map (LSMM) predict where landslides are expected to occur or be more or less abundant based on terrain conditions, including the local morphological, geological, and land use settings. Using different colours, a landslide susceptibility map shows the predicted levels of landslide susceptibility in a region. LAMPRE has developed specific software to model landslide susceptibility and to produce the associated maps using statistical modelling tools.

WHERE

Software developed by LAMPRE allows preparing landslide susceptibility models and maps at various geographical scales and for areas ranging from very small (a few slopes) to much larger (entire catchments or regions), provided sufficient geographical information on the location of landslides and on the local morphological, geological and land use setting is available.

WHEN

Using software developed by LAMPRE, LSMMs can be prepared whenever new landslides or environmental (e.g., morphological, geological, land use) data is available for a region of interest. When a new event inventory map is prepared after a landslide-triggering event, existing LSMMs can be updated.

WHO

Civil Protection authorities use LSMMs in landslide regional or national early warning systems, and to improve their response capacity.

Planning & development authorities use LSMMs to identify landslide prone areas and to zone a territory accordingly.

Transportation authorities & utility managers use LSMMs to predict the potential impact of landslides on transportation or utility network, and for improved maintenance strategies.

Agricultural & forest agencies use LSMMs to identify landslide prone areas, for improved agricultural and forest management.

Scientists use LSMMs to predict the expected climate and environmental changes on landslide abundance and activity.

SPECIFICATIONS

LAMPRE prepares LSMMs at scales ranging from 1:100,000 (smaller scale) to 1:25,000 (larger scale) in periods from hours to days after the landslide inventory and terrain (e.g., morphological, geological, land use) data become available. The quality of the landslide and terrain information controls the quality of the LSMMs. LAMPRE can use independent landslide information (e.g., an event landslide inventory map) to validate the LSMMs.

Copernicus Programme Taxonomy

	Land Monitoring			Emergency Management		
Relevant for rush						
Relevant for non rush						

Key References
Guzzetti et al. (2005) doi: 10.1016/j.geomorph.2005.06.002
Guzzetti et al. (2006) doi: 10.1016/j.geomorph.2006.04.007
Rossi et al. (2010) doi: 10.1016/j.geomorph.2009.06.020

LAndslide Modelling and tools for vulnerability assessment Preparedness and REcovery management

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APPLICATIONS IN LAMPRE TEST SITES

LAMPRE has prepared LSMMs for areas ranging from a few to several thousand square kilometres, including the Briga catchment (Messina, Italy), and the Umbria region (Italy). To prepare the LSMMs, LAMPRE adopts a statistical approach to landslide zonation.
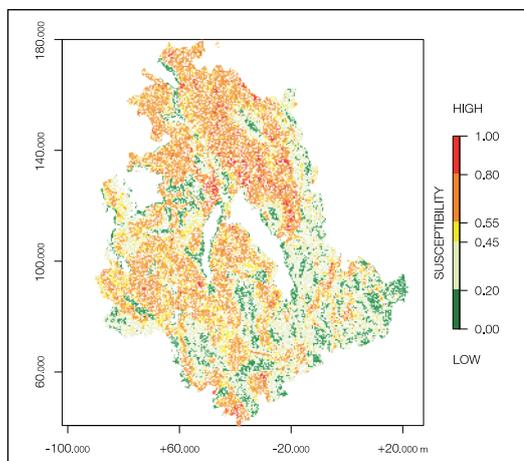

Fig. A - Landslide susceptibility map for the Umbria region.

Fig. B - Uncertainty in the landslide susceptibility classification map.

Landslides cover 10% of the hills and the mountains of **Umbria (Italy)**. Exploiting an existing landslide inventory map, and morphological, geological and land-cover information in a Geographical Information System (GIS), LAMPRE has prepared a landslide susceptibility model and the associated zonation map shown in Figure A. In the map, the different colours represent areas expected to be prone to (red, orange) or free of (light and dark green) landslides. Figure B shows the uncertainty associated with the landslide susceptibility zonation.

It is important to evaluate the quality of the susceptibility zonation by comparing it to observed landslide inventories. The map in Figure C shows the geographical location of the areas identified correctly and incorrectly as landslides using the susceptibility model. The four-fold plot shows the proportion of the territory that was classified correctly and incorrectly as landslide prone or landslide free. In the plot, correct predictions are: True Positives (TP) where landslides were predicted in the model and observed in reality, and True Negatives (TN) where landslides were neither predicted nor observed. Also shown is the proportion of the region classified incorrectly. False positives (FP) show the proportion of the area predicted as landslide prone where no landslides were observed, and False Negatives (FN) show areas where no landslides were predicted in the model but were observed in reality. Figure D shows a Receiver Operating Characteristic (ROC) plot used to evaluate quantitatively the performance of the landslide susceptibility zonation. In the ROC plot, the larger the red area under the curve, the better the susceptibility model and the associated terrain zonation.
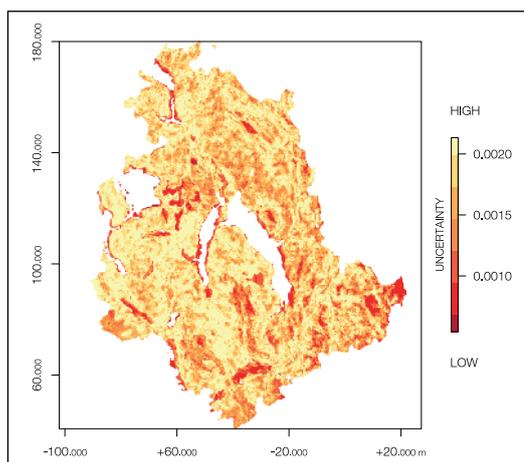
The combination of the susceptibility map (Figure A), the model uncertainty map (Figure B), and measures of the quality of the susceptibility model (Figures C and D), are useful for land planning and management. This combination helps to evaluate the potential impact of landslides, to do landslide early warning, and to construct scenarios of landslide abundance and activity in a changing climate.
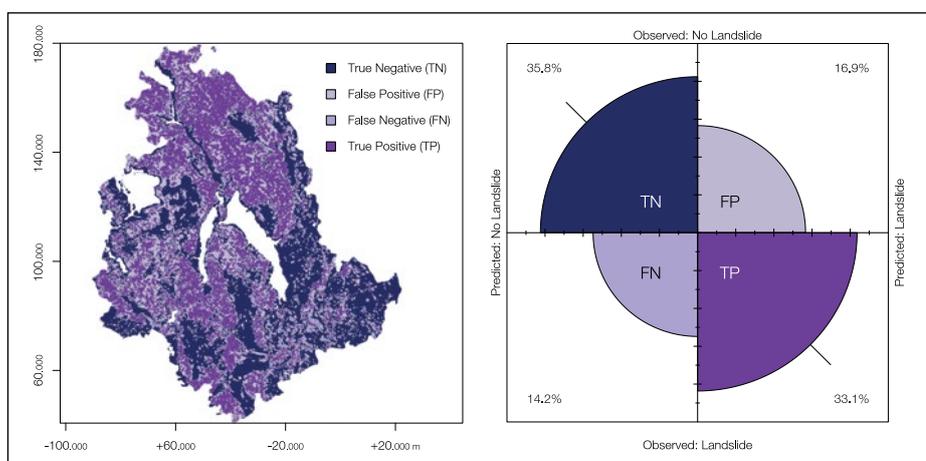

Fig. C - Areas classified correctly and incorrectly in the landslide susceptibility map. The fourfold plot shows the proportions of areas classified correctly and incorrectly.
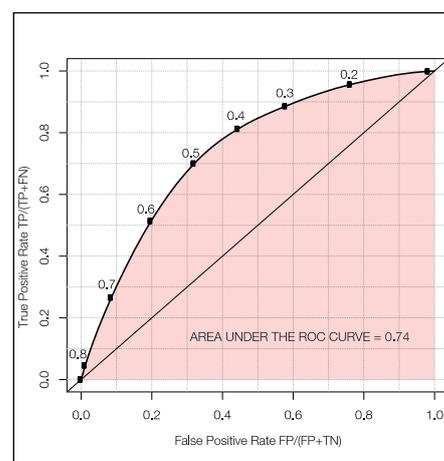

Fig. D - Receiver Operating Characteristic (ROC) plot for the landslide susceptibility model.

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