



## **A tool for the estimation of the distribution of landslide area in R**

M. Rossi (1,2), M. Cardinali (1), F. Fiorucci (1,2), I. Marchesini (1), A.C. Mondini (1,2), M. Santangelo (1,2), S. Ghosh (3), D.E.L. Riguer (4,5), T. Lahousse (6), K.T. Chang (6), and F. Guzzetti (1)

(1) Consiglio Nazionale delle Ricerche, Istituto di Ricerca per la Protezione Idrogeologica, Perugia, Italy (mauro.rossi@irpi.cnr.it, +39 075.5014420), (2) Dipartimento di Scienze della Terra, Università degli Studi di Perugia, Italy, (3) Geological Survey of India, Kolkata, India, (4) Philsaga Mining Corporation, Agusan del Sur, Philippines, (5) Department of Earth Systems Analysis and the UNU-ITC School for Disaster and Geo-information Management, The Netherlands, (6) Department of Geography, National Taiwan University, Taipei, Taiwan

We have developed a tool in R (the free software environment for statistical computing, <http://www.r-project.org/>) to estimate the probability density and the frequency density of landslide area. The tool implements parametric and non-parametric approaches to the estimation of the probability density and the frequency density of landslide area, including: (i) Histogram Density Estimation (HDE), (ii) Kernel Density Estimation (KDE), and (iii) Maximum Likelihood Estimation (MLE). The tool is available as a standard Open Geospatial Consortium (OGC) Web Processing Service (WPS), and is accessible through the web using different GIS software clients. We tested the tool to compare Double Pareto and Inverse Gamma models for the probability density of landslide area in different geological, morphological and climatological settings, and to compare landslides shown in inventory maps prepared using different mapping techniques, including (i) field mapping, (ii) visual interpretation of monoscopic and stereoscopic aerial photographs, (iii) visual interpretation of monoscopic and stereoscopic VHR satellite images and (iv) semi-automatic detection and mapping from VHR satellite images. Results show that both models are applicable in different geomorphological settings. In most cases the two models provided very similar results. Non-parametric estimation methods (i.e. HDE and KDE) provided reasonable results for all the tested landslide datasets. For some of the datasets, MLE failed to provide a result, for convergence problems. The two tested models (Double Pareto and Inverse Gamma) resulted in very similar results for large and very large datasets (> 150 samples). Differences in the modeling results were observed for small datasets affected by systematic biases. A distinct rollover was observed in all analyzed landslide datasets, except for a few datasets obtained from landslide inventories prepared through field mapping or by semi-automatic mapping from VHR satellite imagery. The tool can also be used to evaluate the probability density and the frequency density of landslide volume.