# Why landslide susceptibility maps should change over time


Jalal Samia[1], Arnaud Temme[2], Arnold Bregt[1], Jakob Wallinga[1], Fausto Guzzetti[3], Francesca Ardizzone[3], Mauro Rossi[3]

[1]Wageningen University & Research, Droevendaalsesteeg 3, 6708 PB Wageningen, the Netherlands

[2]Kansas State University, 950 N17th Street, Manhattan, KS, 66506, United States

[3]CNR-IRPI, via Madonna Alta 126, I-06128 Perugia, Italy


WAGENINGEN UNIVERSITY & RESEARCH

irpi Istituto di Ricerca per la Protezione Idrogeologica

## Objective:

Quantifying the effect of history of landslides in susceptibility modelling

Time-variant landslide susceptibility modelling (Samia et al, 2016, Landslides):

$$\text{Susceptibility}_{s,t} = f(\text{conditioning attributes}_s, \text{previous landslides}_{s,t})$$

## Study area, data and inspiration

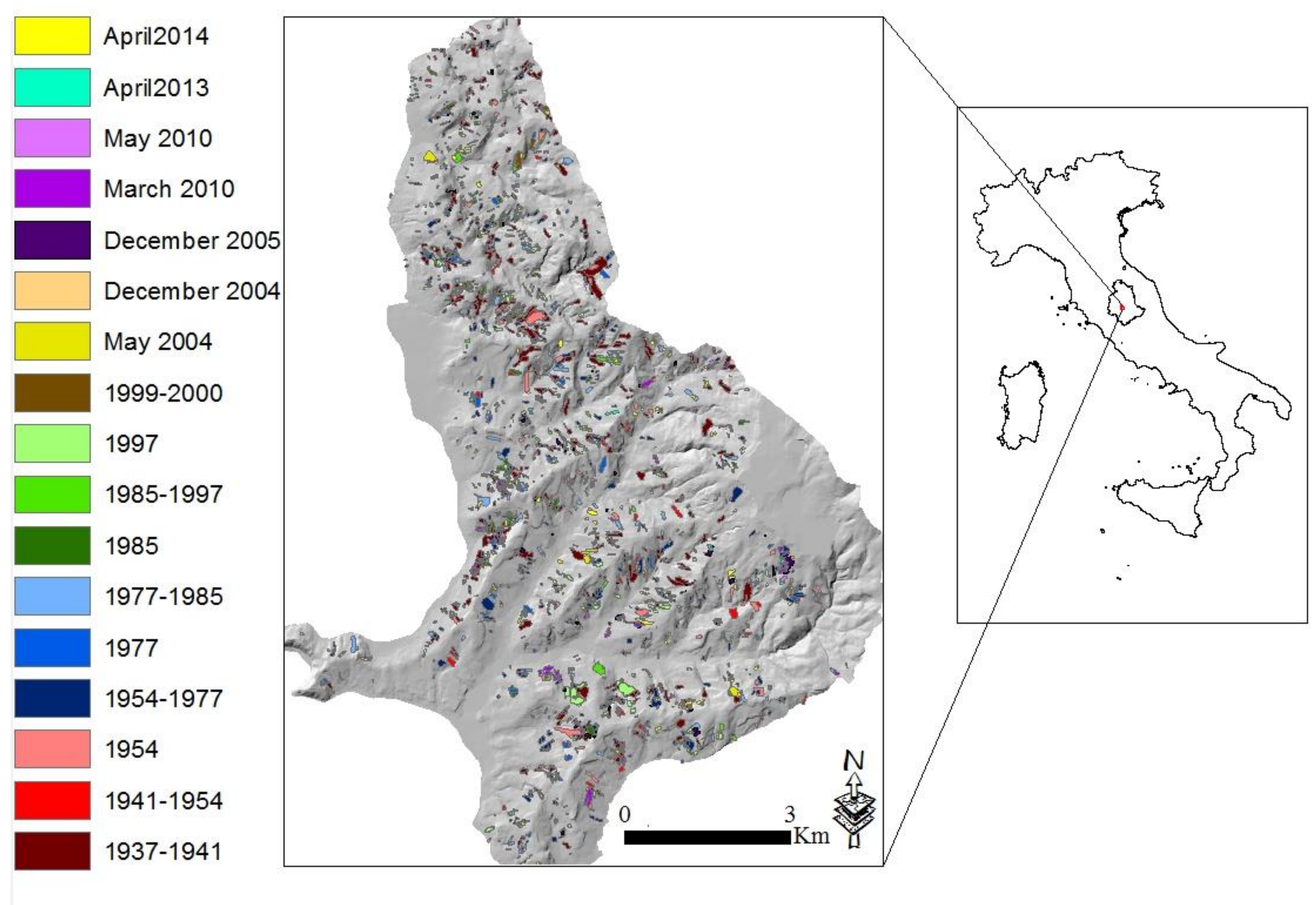


**Figure 1.** Multi-temporal landslide inventory of Collazzone study area in central of Italy

**Figure 2.** Inspiration of the work: many overlapping landslides

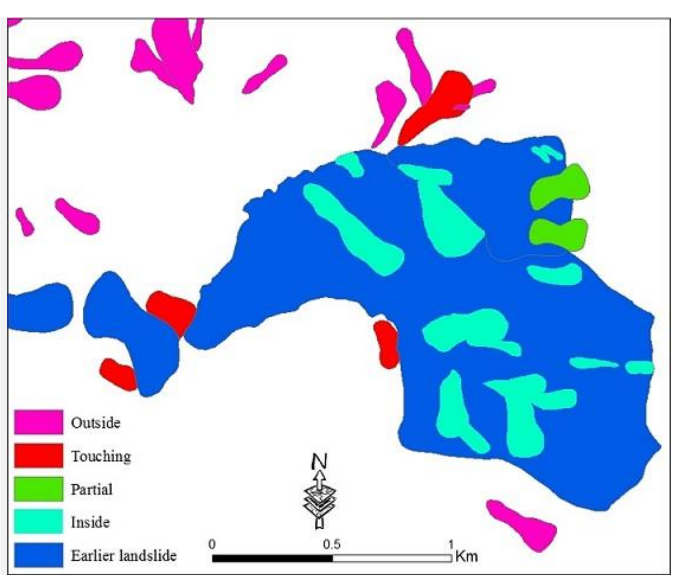


**Figure 3.** Spatial association between landslides

## Results

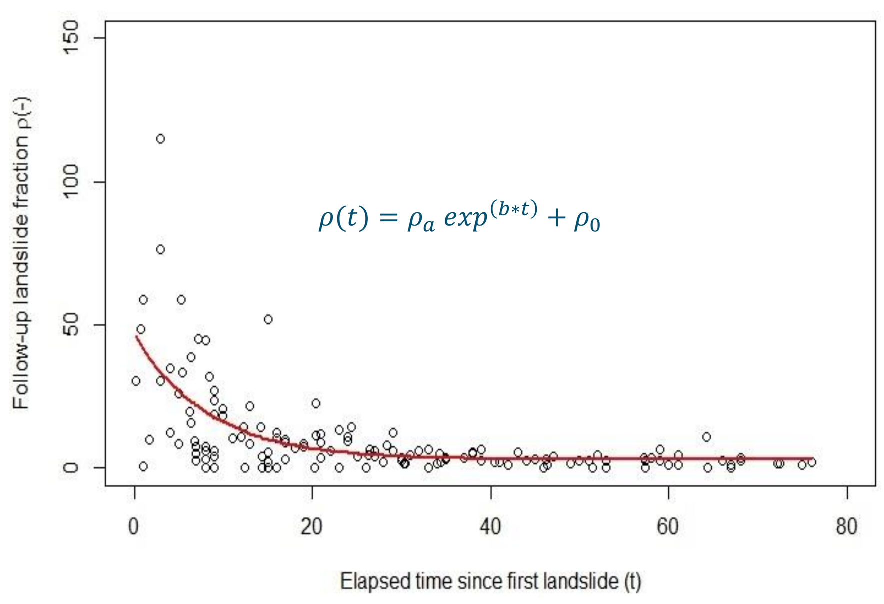


**Figure 4.** Temporal behaviour of landslide path dependency with an exponential decay

Landslide susceptibility temporarily increases by a factor of 15 following a landslide, and then decreases gradually over time

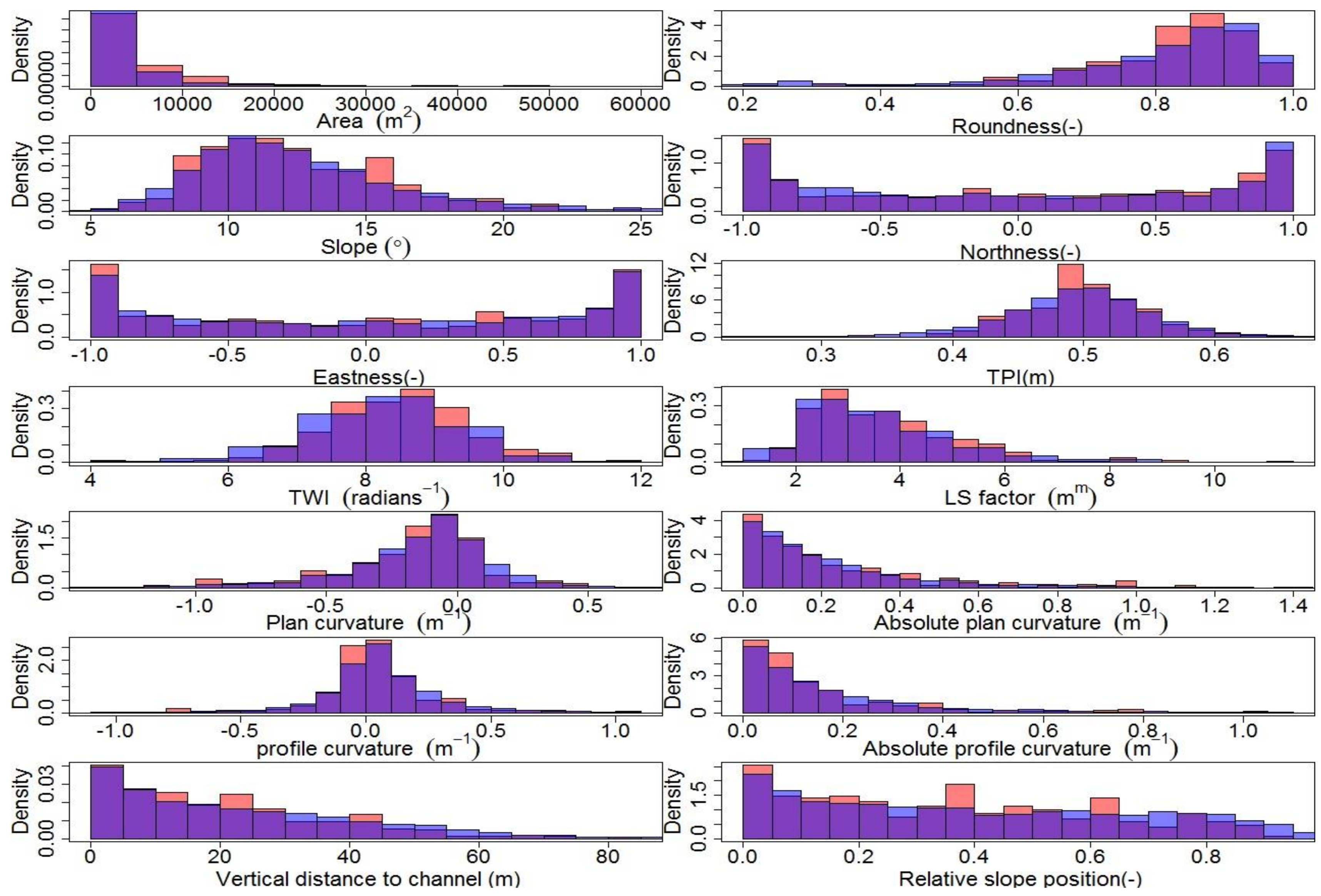


**Figure 5.** Histograms of geometric and topographic attributes of landslides with (red) and without (blue) follow-up landslides.

ANOVA

Mean of size, roundness, TWI, absolute profile curvature, relative slope position and vertical distance to channel network between landslides with and with out follow-up landslides are significantly different

| Set of variables | Variables available for logistic regression | AUC calibration | AUC validation |
|---|---|---|---|
| Geometry | 2 | 0.60 ± 0.01 | 0.55 ± 0.03 |
| Topography | 12 | 0.57 ± 0.03 | 0.56 ± 0.05 |
| Geometry + topography | 14 | 0.64 ± 0.02 | 0.58 ± 0.04 |

**Table 1.** Logistic regression models implemented to predict occurrence of follow-up landslides

## Conclusion

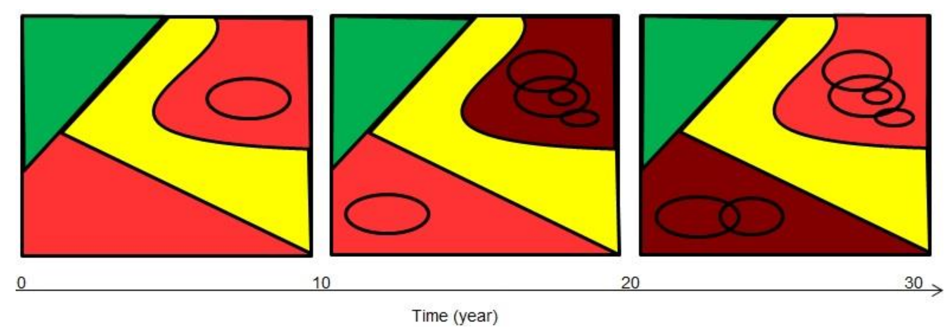


**Figure 6.** Example: Time-variant landslide susceptibility modelling reflected as clustering of landslides after a first landslide happens within a time scale of about 10 years.

Landslides clearly depend on the history of landsliding, therefore dynamic landslide susceptibility maps are necessary


## Acknowledgements

This work is part of JS PhD project at Wageningen university and research, Financed by ministry of science, research and technology of Iran



Wageningen University & Research
Laboratory of Geo-information Science and Remote Sensing, Droevendalsesteeg 3, 6708 PB Wageningen
Contact: jalal.samia@wur.nl
+ 31 (0)317 419000