

# ECONOMIC LANDSLIDE SUSCEPTIBILITY UNDER A SOCIO-ECONOMIC PERSPECTIVE: AN APPLICATION TO UMBRIA REGION (CENTRAL ITALY)

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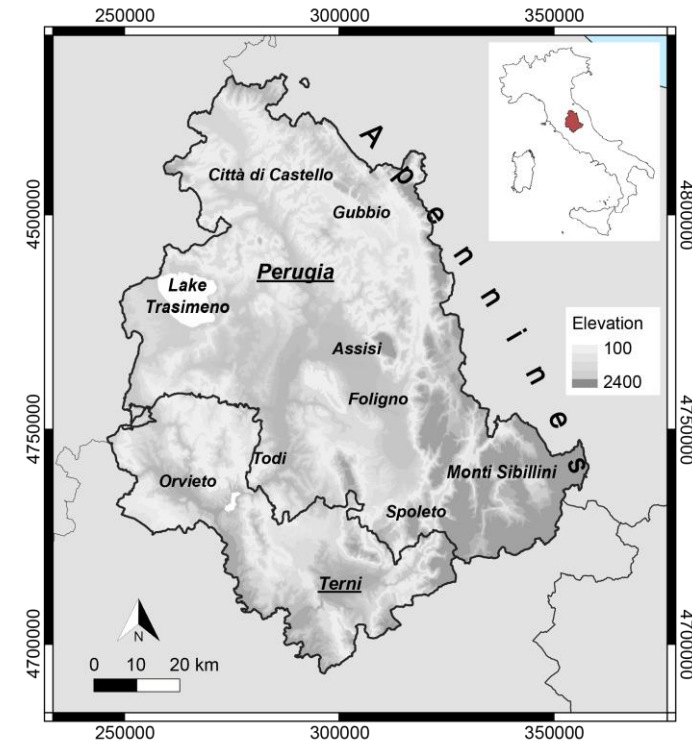
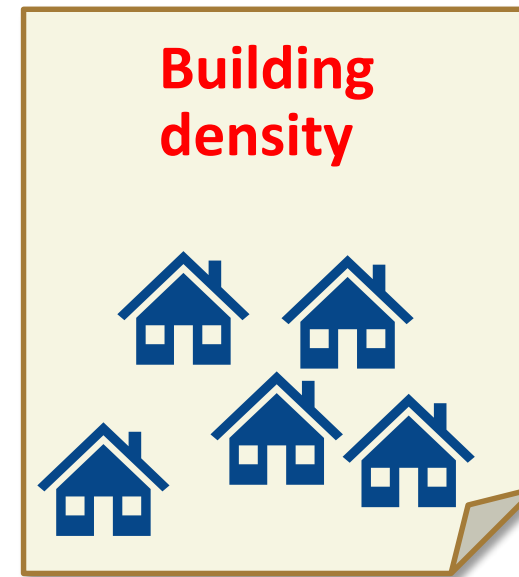
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# Economic landslide susceptibility. Some questions

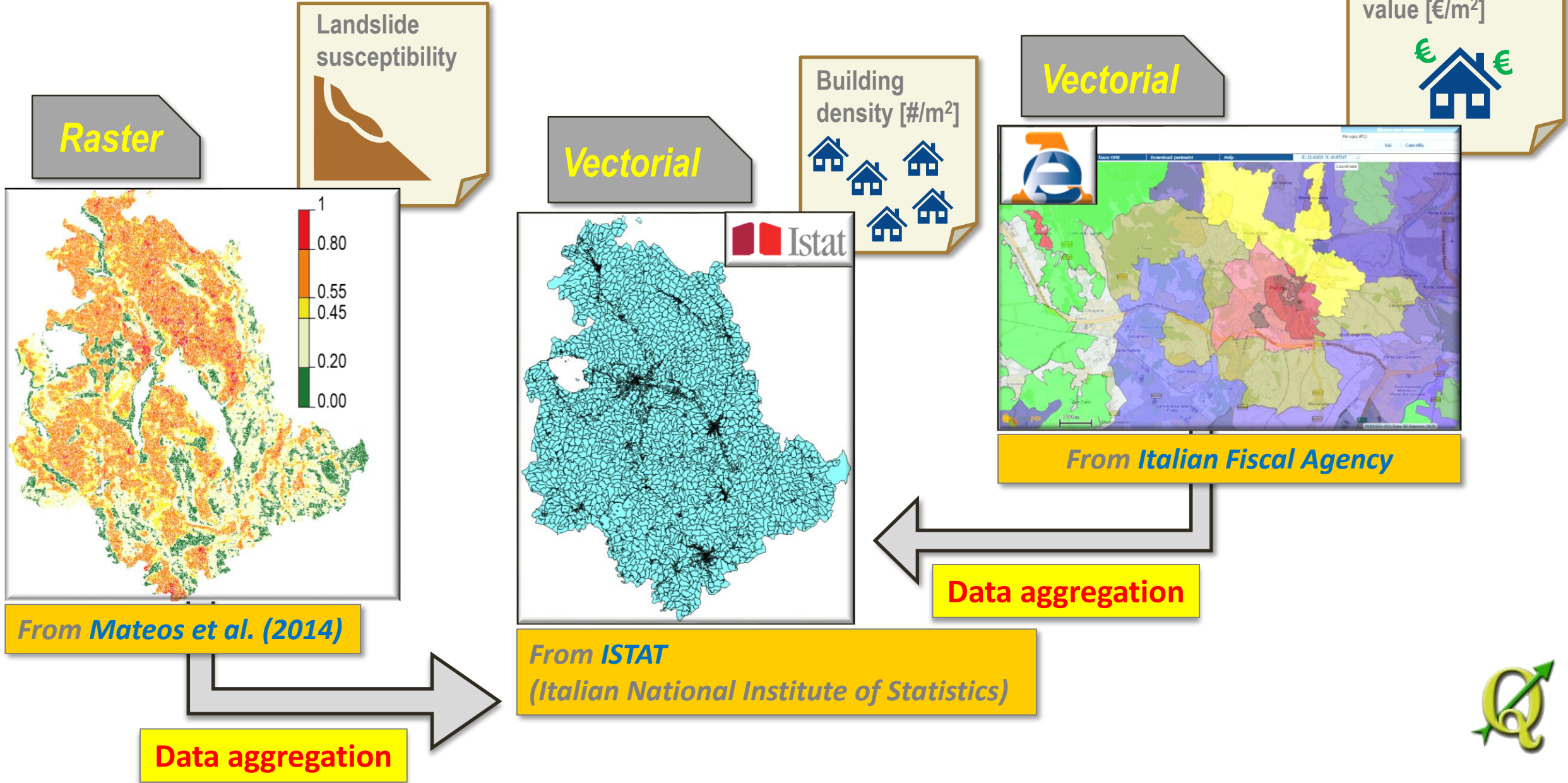
What is it? The **economic landslide susceptibility** is the **probability** of **landslide occurrence** in an area weighted for its **socio-economic exposure** in term of **real estate market value**.

How can I do it? The **economic landslide susceptibility** is estimated through a **pixel-based method** designed for large areas. The method needs the **maps** of:



Where did we realize it? We used **Umbria Region** (Central Italy) as test area. **Umbria** is **rich in historical cities, industrial plants** and **agricultural areas**.

*Economic landslide susceptibility. Umbria Region application*

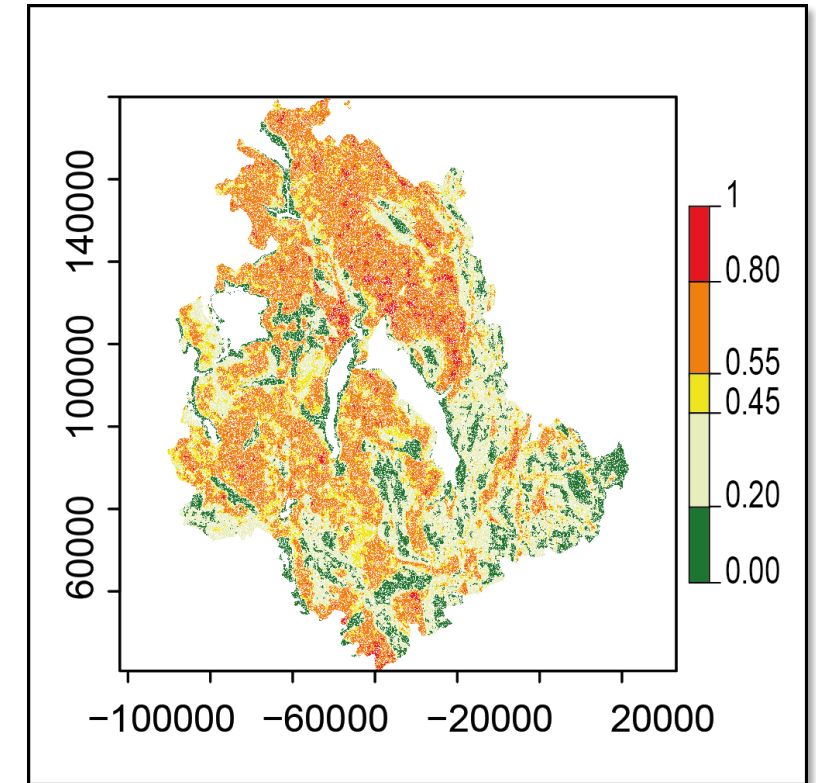


# Economic landslide susceptibility. Landslide susceptibility map

**Landslide susceptibility** is the **probability** of a **landslide occurring in an area** based on local terrain conditions (Brabb, 1984) expressing “**where**” **landslides could occur** (Guzzetti et al., 1999; 2005; 2006a; 2006b)

The **landslide susceptibility map** was realized using:

- the **landslide inventory map** of Umbria region (Antonini et al., 2002);
- **SRTM-DEM** version 2.1 (<http://dds.cr.usgs.gov/srtm/>);
- the **Corine Land Cover** 2006;
- the **Geological Map** of Italy (ISPRA);
- the **Soil map** of Italy (Mancini, 1966).



From Mateos et al. (2014)

**Landslide susceptibility** ranges from **0 (minimum susceptibility)** to **1 (maximum susceptibility)**



1° step - adaptation of ISTAT data with Italian Fiscal Agency data

Italian Fiscal Agency 

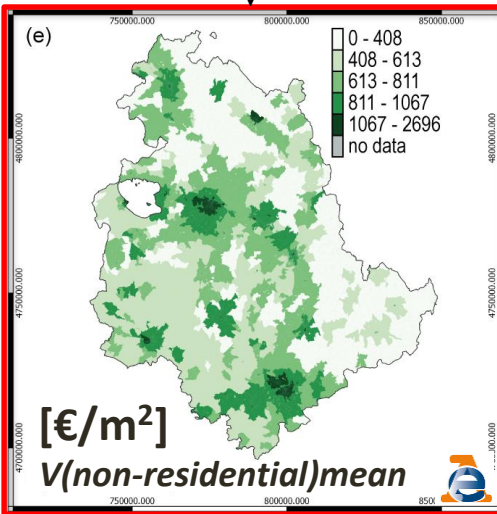
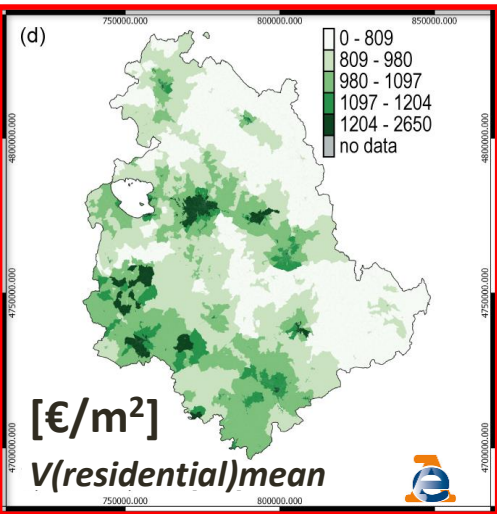
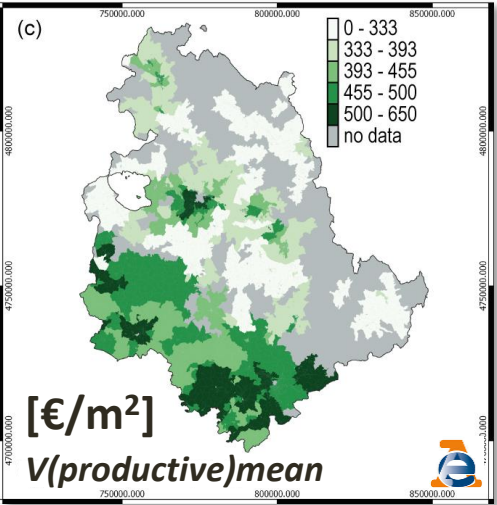
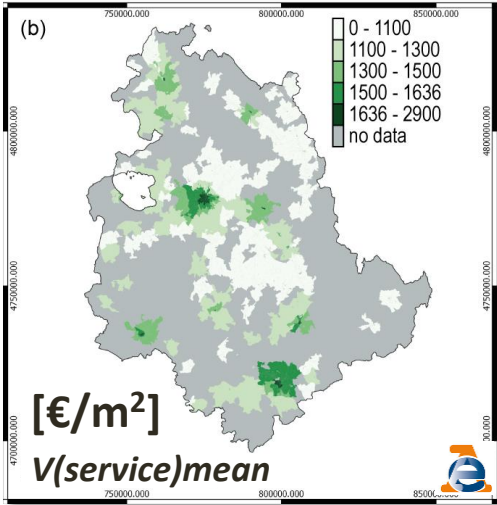
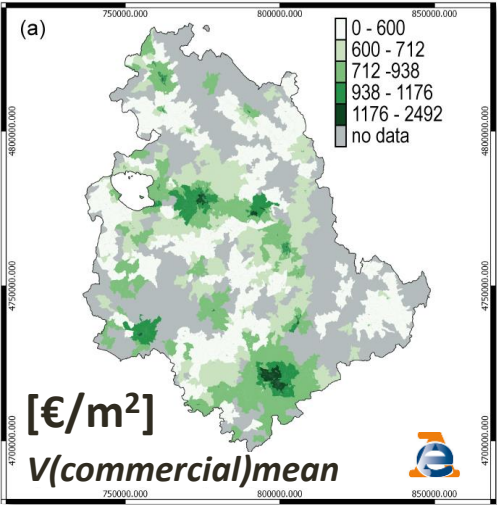
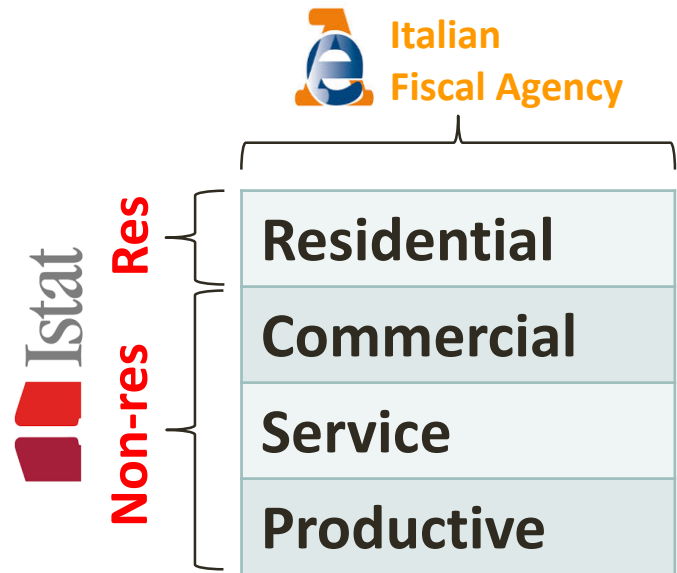
DATA ADAPTATION

Istat

Residential  
Non-residential

INTENDED USE CATEGORY	TIPOLOGY
Residential	Villa
	Refined house
	Residential unit
	Economical residential unit
	Box and garage
	Covered/uncovered parking
Commercial	Shop
	Shopping center
	Warehouse
Service sector	Office
	Structured office
Productive	Shed
	Industrial shed

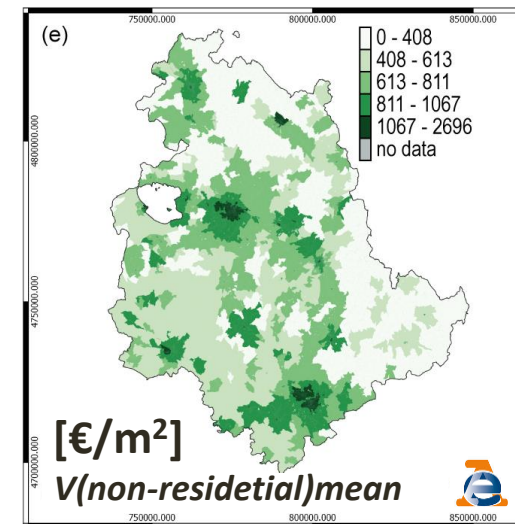
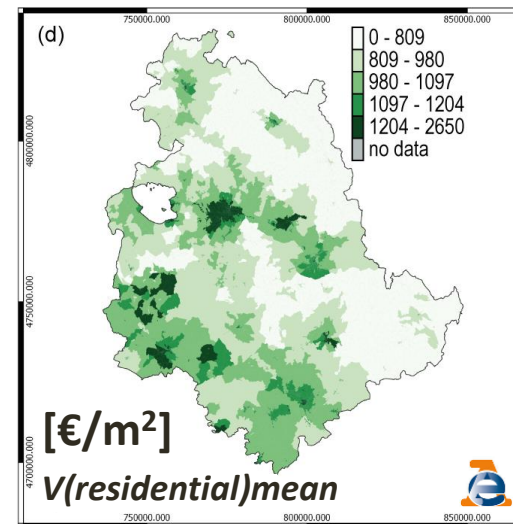
2° step – calculation of the mean real estate market values for residential and for non-residential buildings



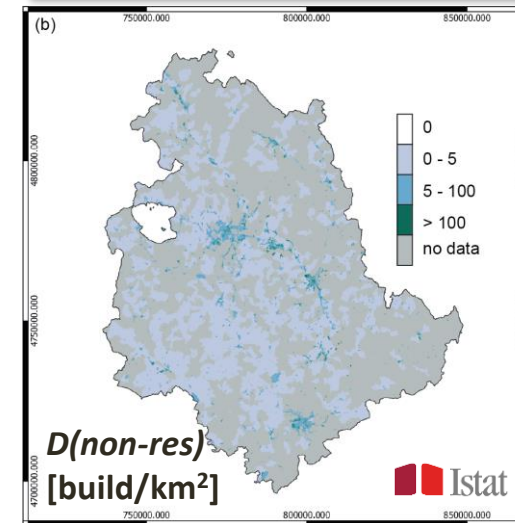
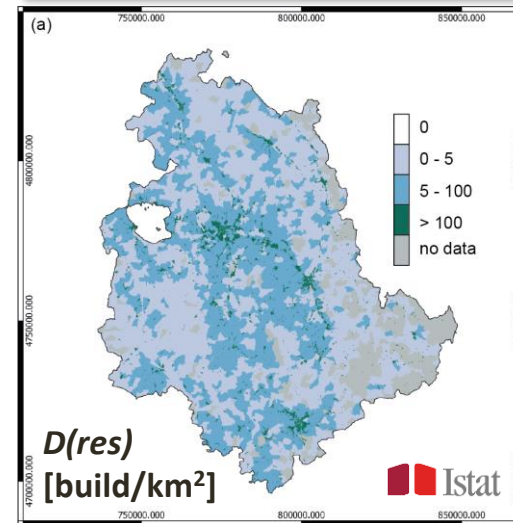
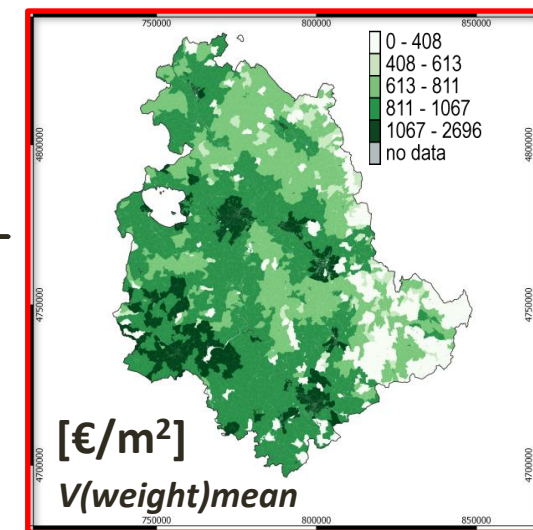
MEAN

$V(\text{res})_{\text{mean},i}$  ;  $V(\text{non-res})_{\text{mean},i}$  [€/m²]

3° step - the **mean real estate market values** for **residential** and for **non-residential** buildings were **weighted** for **residential** and **non-residential building density**

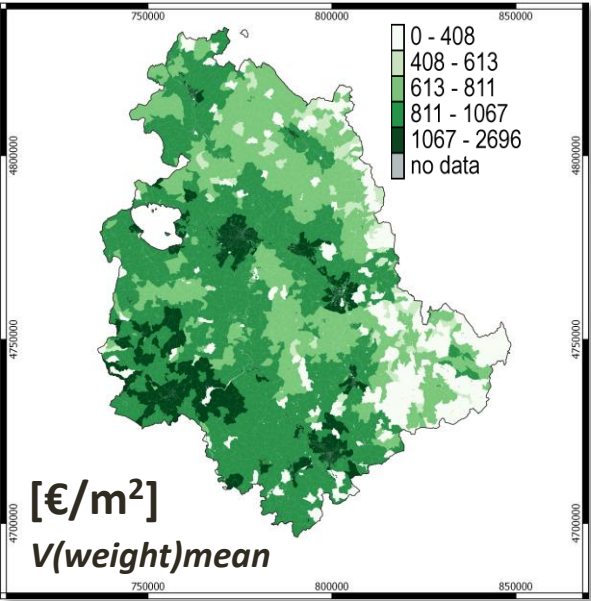


**WEIGHTED  
MEAN**

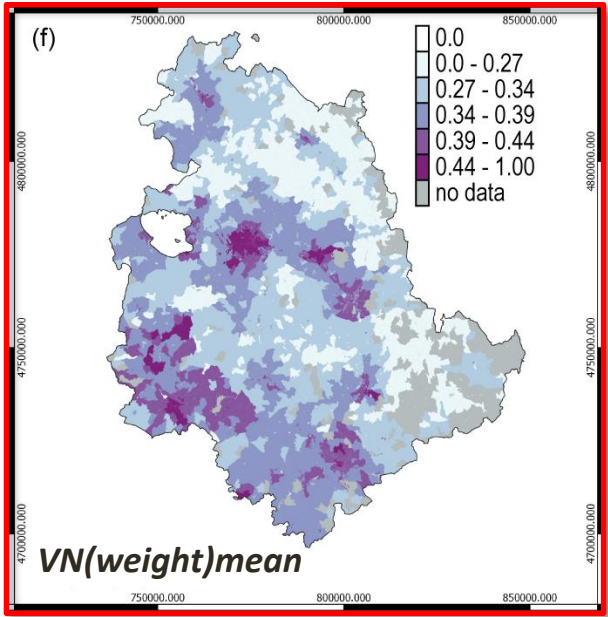


$$V(\text{weight mean})_i = \frac{[V(\text{res})\text{mean}_i \times D(\text{res})_i] + [V(\text{non-res})\text{mean}_i \times D(\text{non-res})_i]}{[D(\text{res})_i + D(\text{non-res})_i]} \quad [\text{€/m}^2]$$

4° step - the weighted mean real estate market values were normalized to obtain 0 to 1 values



**NORMALIZATION**



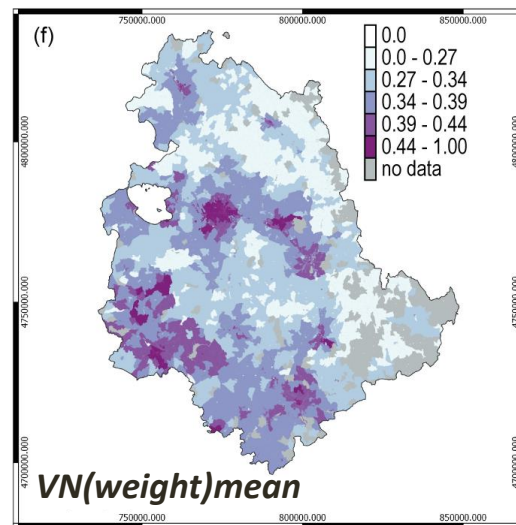
$$VN(\text{weight mean}),i = \frac{V(\text{weight mean}),i - V(\text{weight mean}),\min}{V(\text{weight mean}),\max - V(\text{weight mean}),\min}$$

[Normalized, unitless]

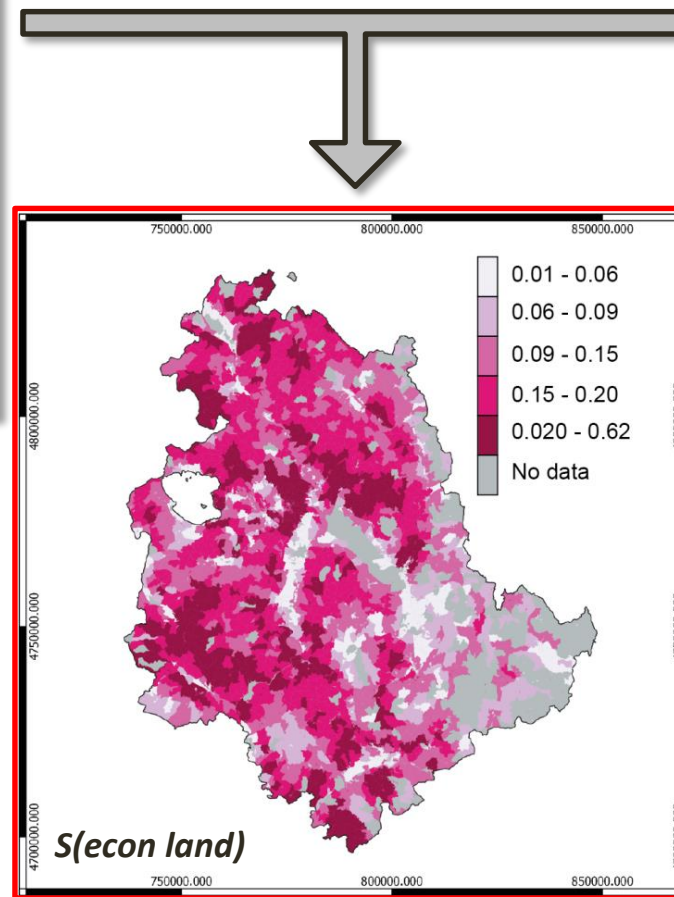


5° step - the **economic landslide susceptibility** comes from the combination of **normalized weighted mean real estate market values** and **landslide susceptibility**

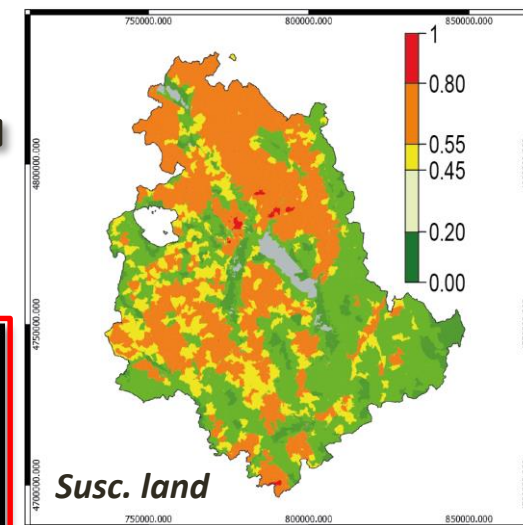
**ECONOMIC LANDSLIDE  
SUSCEPTIBILITY  
CALCULATION**



From 0 to 1



From 0 to 1



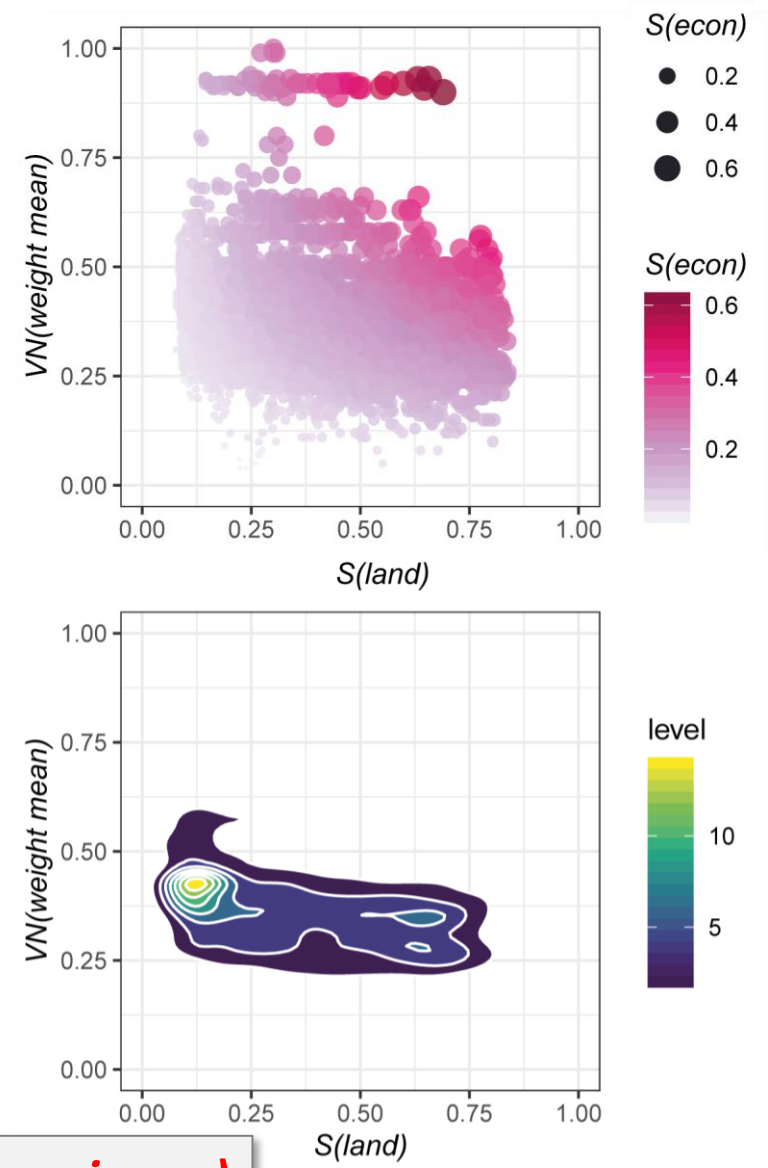
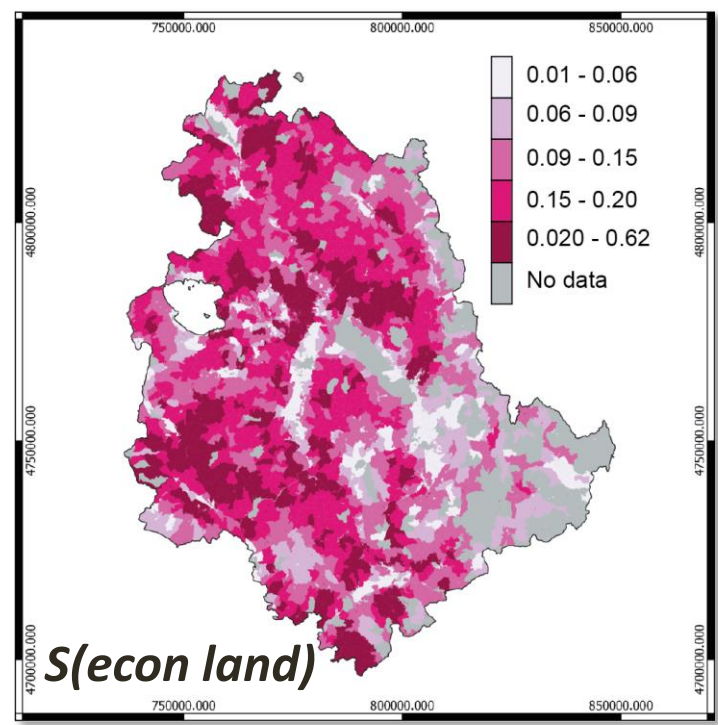
From 0 to 1

$$S(econ\ land)_i = VN(weight\ mean)_i \times S(land)_i$$

[Normalized, unitless]

*Economic landslide susceptibility. A combination of two «0 to 1» variables*

The **color** and the **sizes** of the **circles** in (a) represent the  **$S(econ)$**  values. The **contour lines** in (b) give a measure of the distribution of the  **$S(econ)$**  values.



*Economic landslide susceptibility ranges from 0 (minimum) to 1 (maximum)*

# References

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