



Workshop CNR IRPI

50 Anni di Attività



Istituto di Ricerca per la Protezione Idrogeologica

# SPARSE DATA ON LANDSLIDE FATALITIES: WHAT THEY SAY AND WHY TO USE

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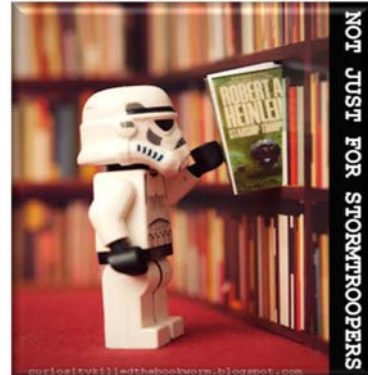
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## Data collection ..... it a long story of multidisciplinary



<https://it.pinterest.com/Lailahashtag/lego-in-real-life/>



<https://bluesyemre.com/2013/08/29/the-library-in-lego-form/>



We have compiled a **catalogue** of more than **7640 landslide and flood events** that have caused **damage to the population** in Italy from **589** to **yesterday**

For each event in the catalogue, **information includes**: the precise or approximate **date** and **location** of the event; the **type** of event and the known or inferred **trigger**; the **temporal** and **spatial evolution** of the event; the exact or approximate **number** of **deaths**, **missing** persons, **injured** and **homeless** people.

## Why it is important

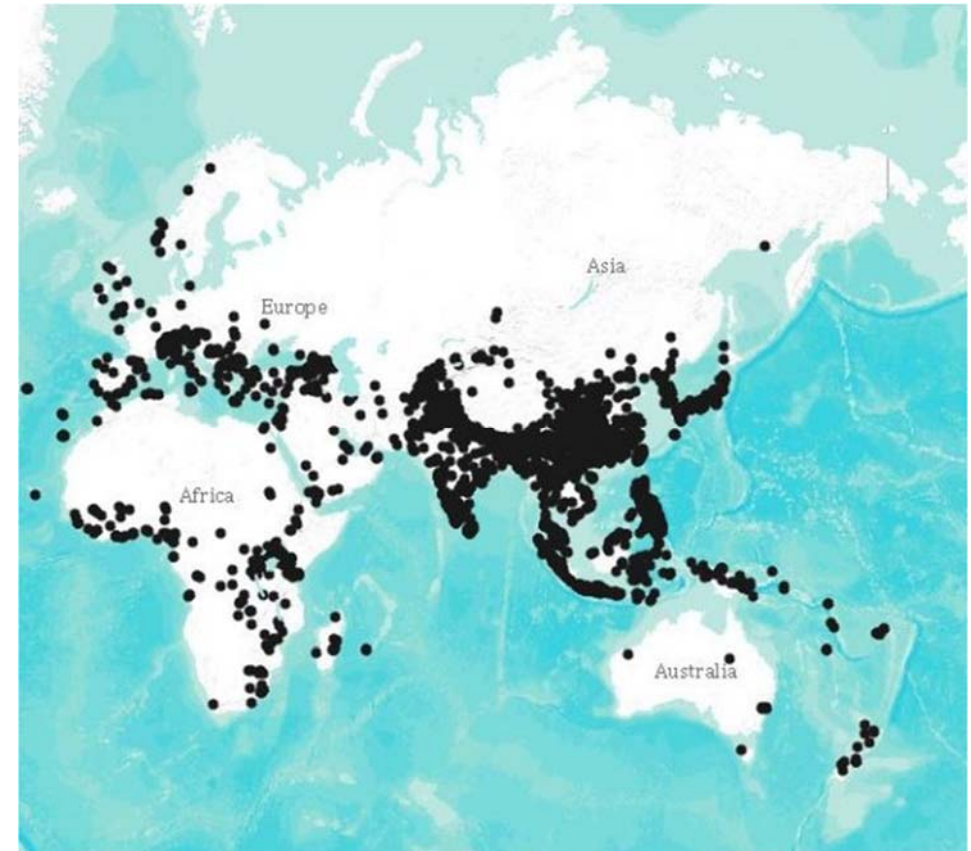
- ❑ Quantify the **impact on people**
- ❑ Identify **vulnerable groups** of people by age and gender
- ❑ Evaluate the **expected impact** on people and assess **quantitative risk levels**
- ❑ **Improve** people **safety** and to increase community **resilience** to landslides using **communication strategies**

## Landslide fatalities in the world 2004 to 2017

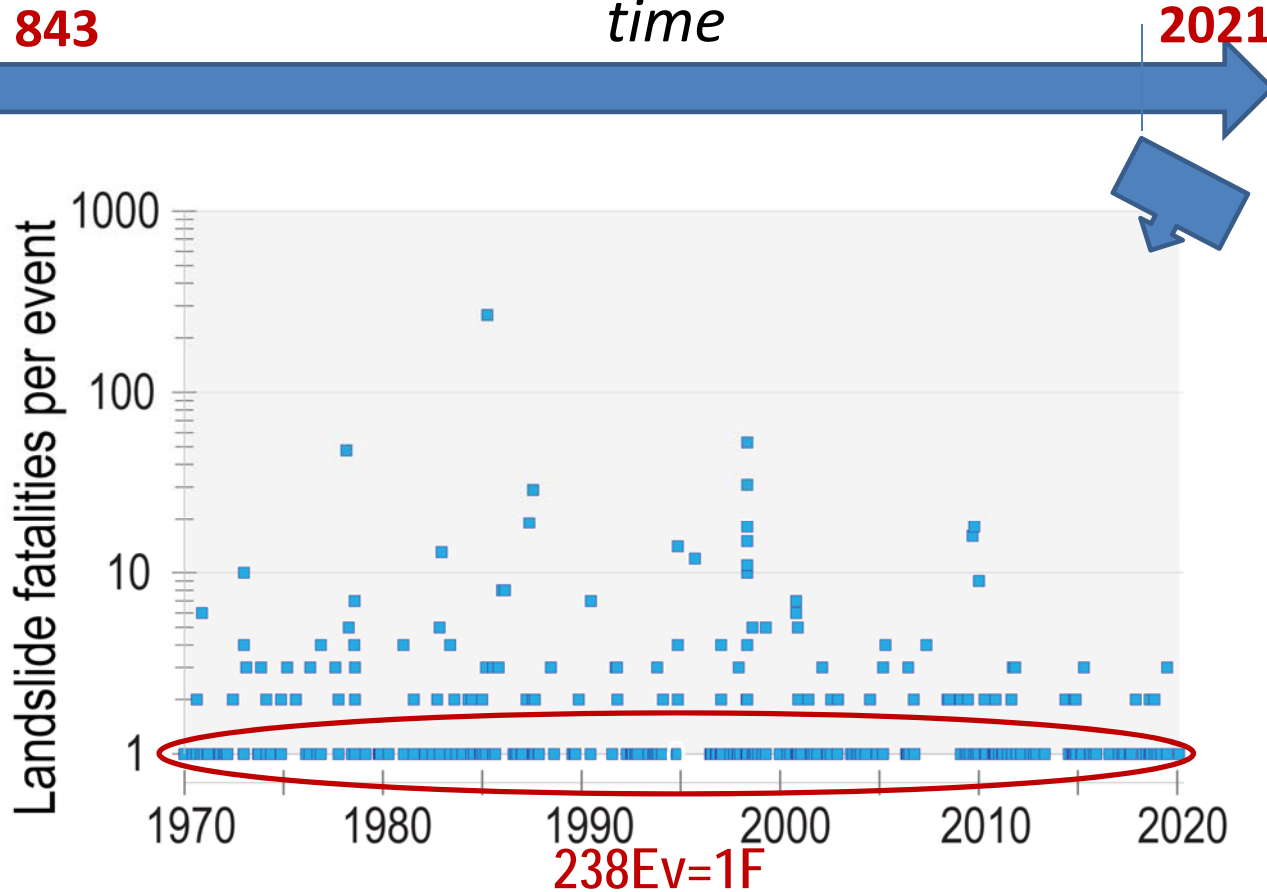
Landslides are frequent and **destructive** geo-hydrological events that **cause harm to people** every year in **Italy** and **worldwide**

*The Global Fatal Landslide Database  
from the Landslide Blog*

<https://blogs.agu.org/landslideblog/2019/06/18/global-fatal-landslide-database-1/>



# Landslide fatalities in Italy 1970-2020








## Landslide fatalities in Italy 1970-2020

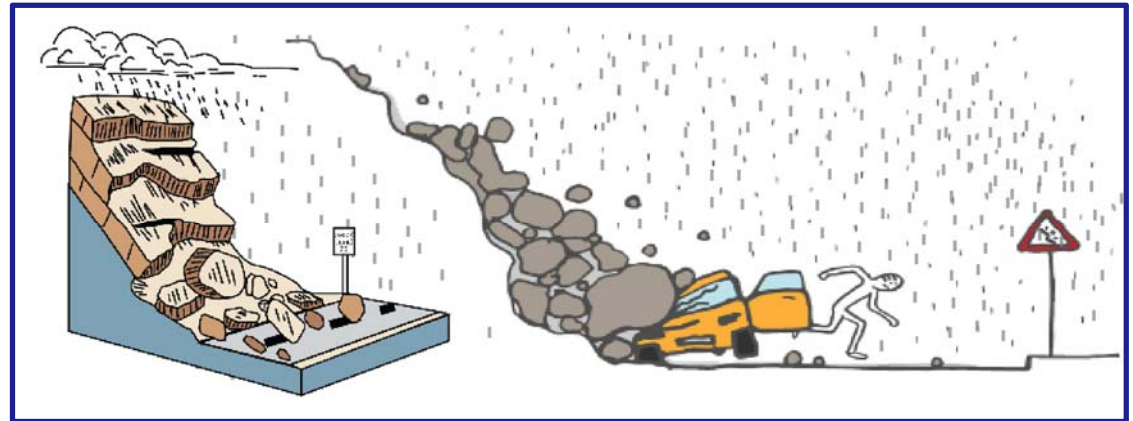
- ❑ The recognition of the **circumstances** in which people **lost their life** are fundamental to improve **people safety and to increase community resilience to landslides**
- ❑ To understand the **general conditions** in which people **lost their life** during landslide events we searched more detailed data on the **gender**, the **age**, the **place** and the **light conditions** at the time of the landslide covering the period of 50-year period **1970-2020**



## Place and circumstances by gender and age

|                     |   |           |
|---------------------|---|-----------|
| Road/Highway 167:   |    | M/F= 3    |
| Mountain/Hill 82:   |    | M/F = 4.1 |
| Railways 65:        |    | M/F = 2.6 |
| Rocky beach 18:     |   | M/F = 1   |
| Proximity house 18: |  | M/F = 1,6 |

**OUTDOOR 364: MALE 271 - FEMALE 93**

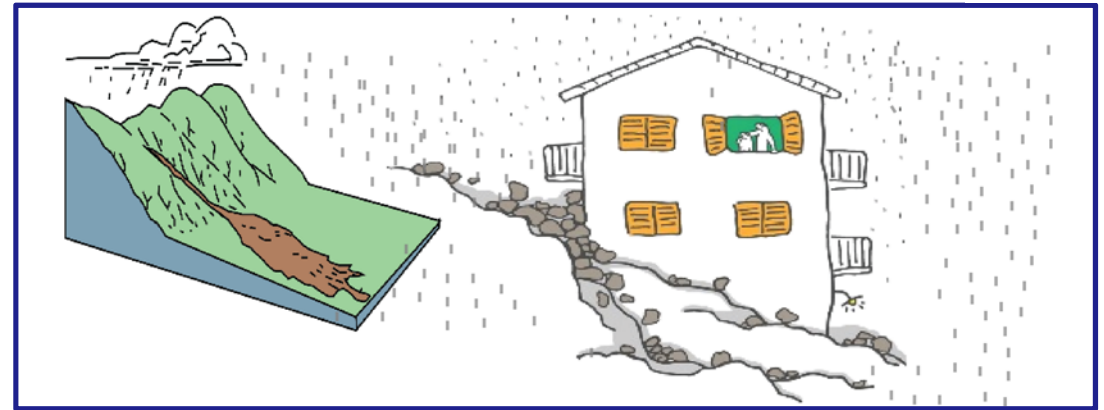
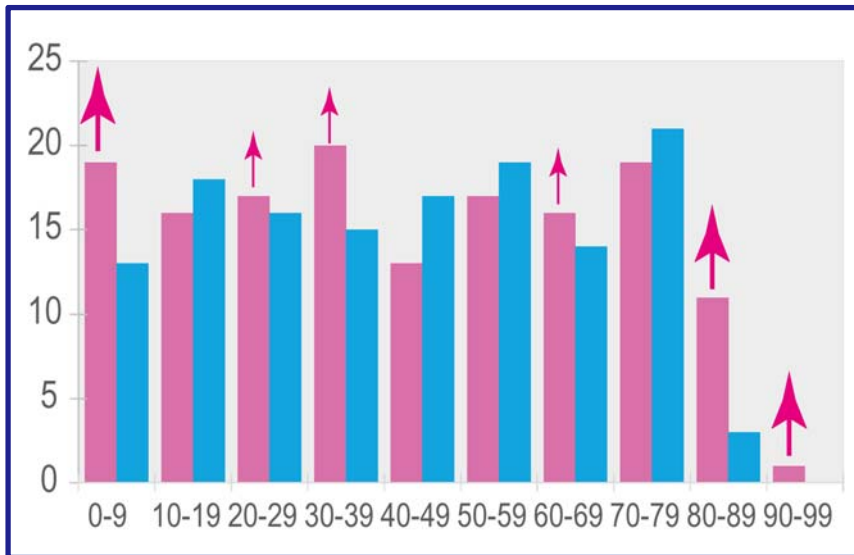


The majority (74,5%) of the road – related fatalities were male

## Place and circumstances by gender and age

Public and private building:  M/F = 0.9

**INDOOR 285: MALE 136 - FEMALE 149** 

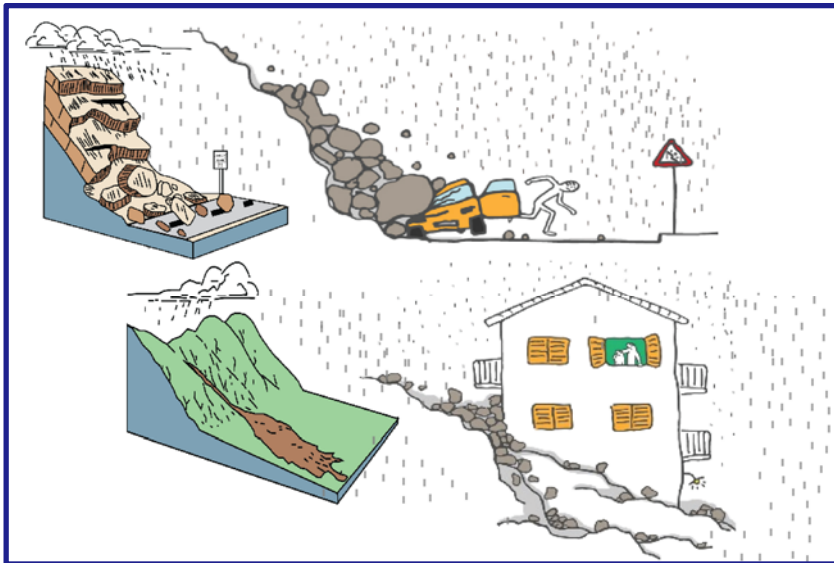
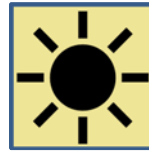


- ❑ The indoor – related fatalities ratio was near 1
- ❑ Large difference between gender exist for very young and very old persons

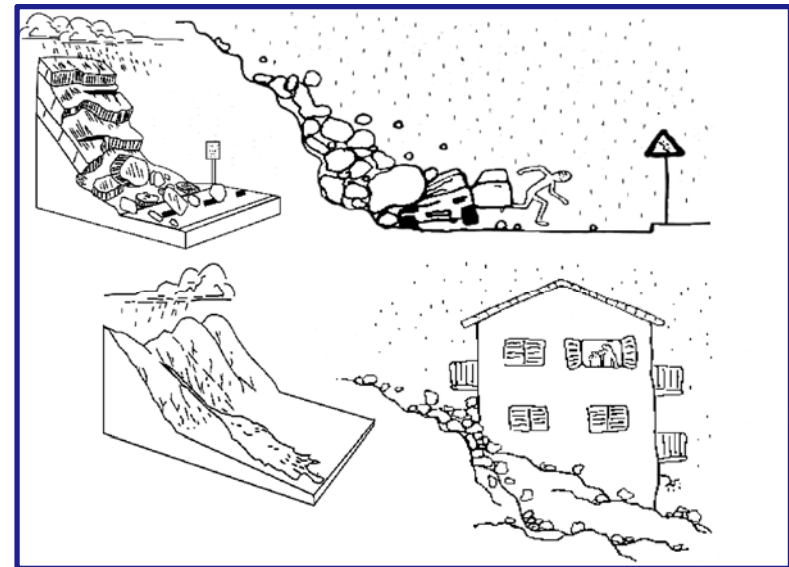


# Times of the day by gender and age

**BY DAY** 682: MALE 376 – FEMALE 306



**BY NIGHT** 305: MALE 171 - FEMALE 134



MALE / FEMALE 1.22

DAY / NIGHT = 2

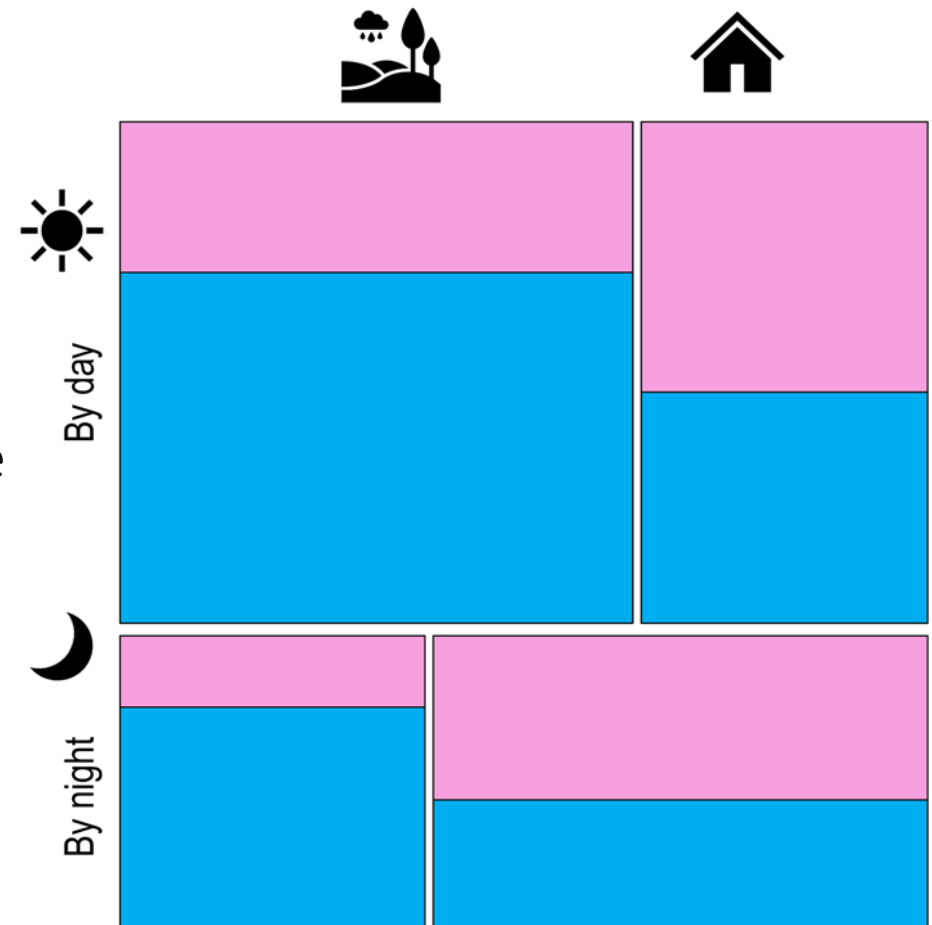
MALE / FEMALE 1.3



□ **By-day** fatalities were double of those **by-night**

## Mosaic plot Times of the day by place and gender

- ❑ **MOSAIC** plot to visualize the co-occurrence of multivariate categorical data
- ❑ The **majority** of both males and females lost their lives **during the daylight** hours.
- ❑ **Males** lost their life mostly **outdoor**, while **females indoor**
- ❑ **Men** who lost their lives **outdoor** by **night** are **three times** the number of **women**



Salvati et al., 2021

## Expected fatalities by gender and age

It is legitimate to ask if the **observed differences** are **significant** and **representative** considering **the small number of fatalities** (few tens to a few hundred) **compared to the size of the population** (tens to hundreds of thousands)

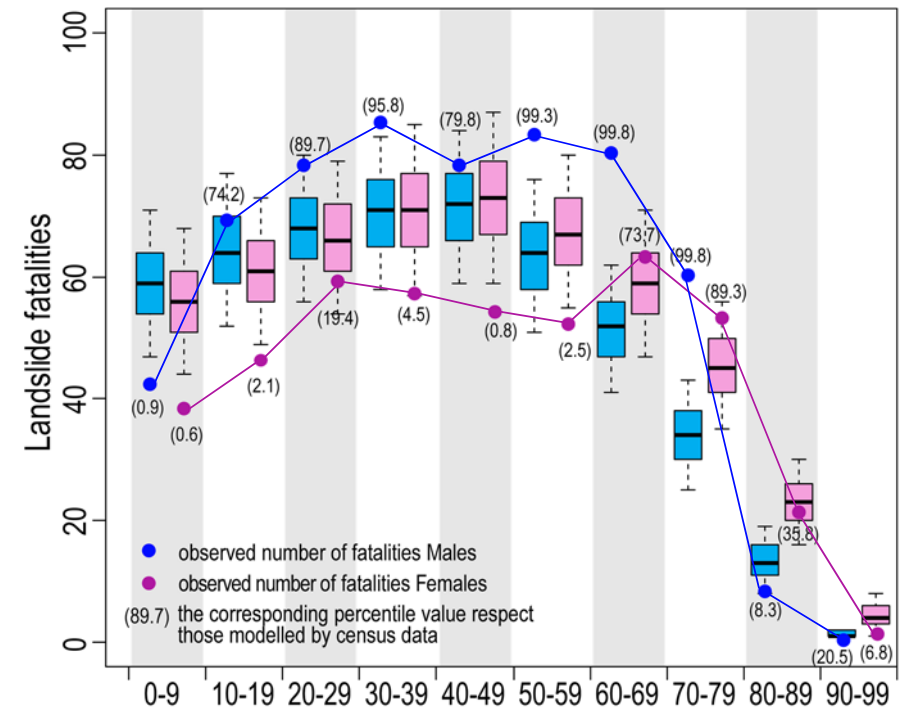


## Expected fatalities by gender and age

Using a **statistical approach**, we **compare** the number of **observed fatalities** with the **distribution** by **age** and **gender** of the **national population data** using the national census data carried out from 1971, to 2011 by ISTAT

□ We estimated the **multinomial probability mass function** of the **expected** fatalities by gender and age, as reported by national census data, and we **compared** it with the **observed** landslide fatalities

□ **Comparison** of the **expected** fatalities – the **box plots** – with the **observed** landslide fatalities – the **dots** – **identify** the gender and age categories **over** or **under represented** than those expected by **census data**



Salvati et al., 2018

## Landslide Risk to people

**Risk Analysis** aims to determine the probability that a specific hazard will cause harm, and it investigates the relationships between the frequency of damaging events and the intensity of their consequences

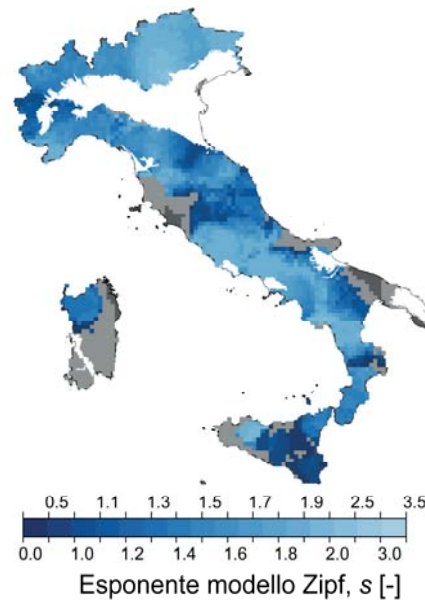
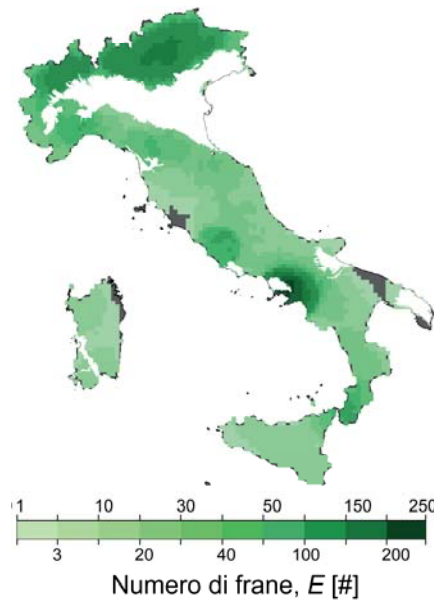
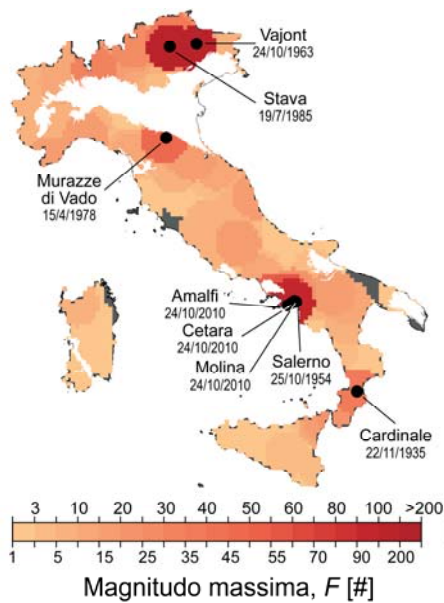
**Historical data** were fundamental to build **frequency/intensity** (**frequency/magnitude**) curves (**F/M**)

- ❑ **Individual risk** is the risk posed by a hazard to any identified individual
- ❑ **Societal (or collective) risk** is the risk imposed by a hazard on society as a whole

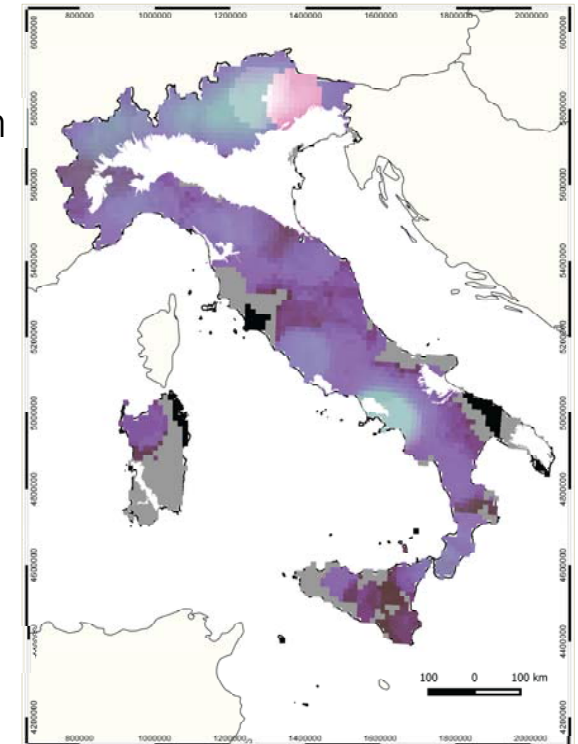
*(Fell & Hartford, 1997; Guzzetti et al., 2005, Salvati et al., 2010; 2016 )*

# Landslide Societal Risk in Italy

Recently we propose a novel approach to evaluate the spatial and temporal distribution of societal landslide risk in Italy using different territorial subdivision.



high  
low

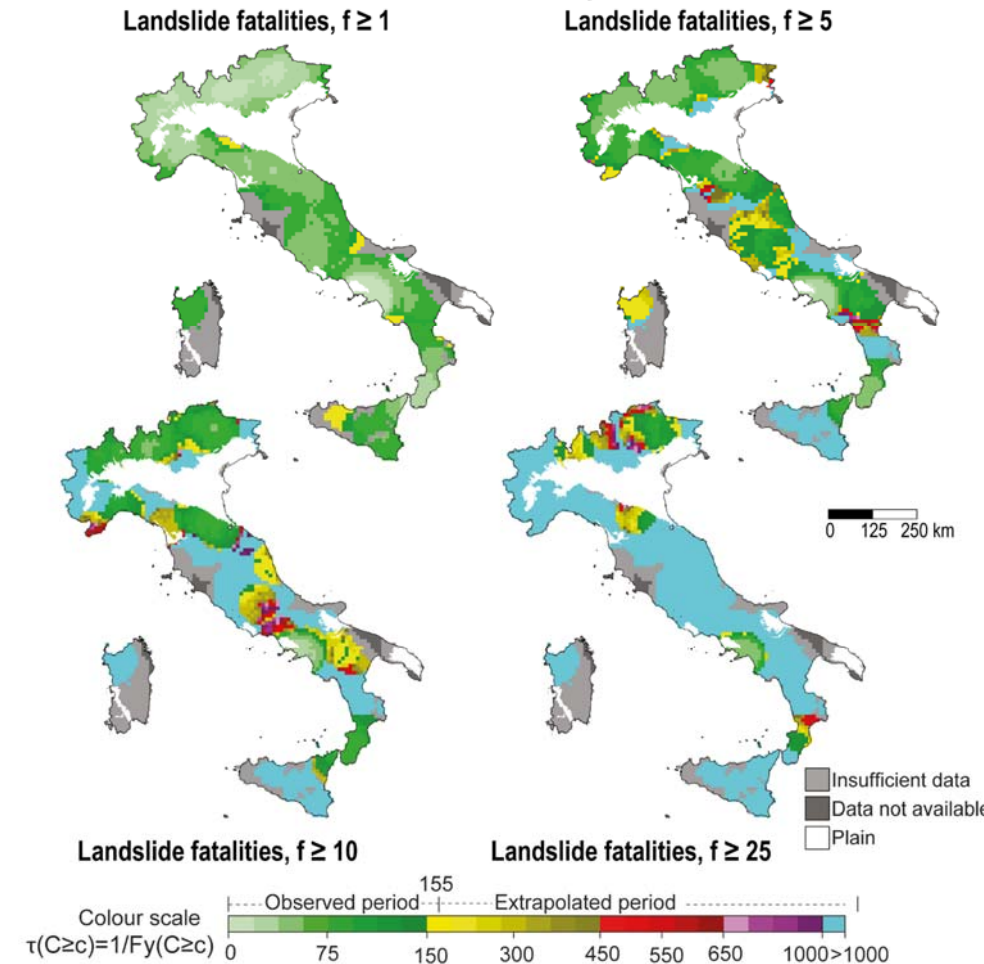


Rossi et al. 2019



## Expected return period of fatal landslides in Italy

- Expected fatal landslides return period for different magnitude with  $f \geq 1$ ,  $f \geq 5$ ,  $f \geq 10$  and  $f \geq 25$  fatalities
- Very short return period  $\tau < 30$  years are expected for low magnitude events ( $f = 1$ ) in large areas of the Italian territory

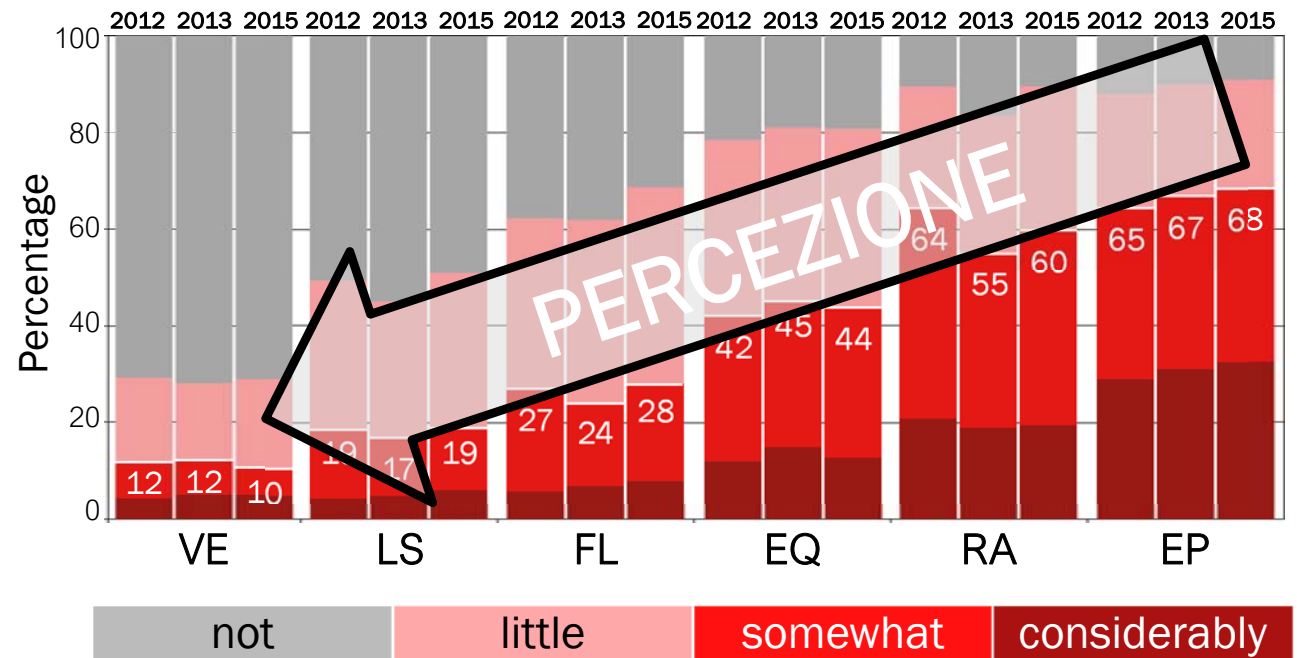


Rossi et al. 2019

Sala Convegni CNR, Roma 25-26 novembre 2021

## Risk Perception in Italy

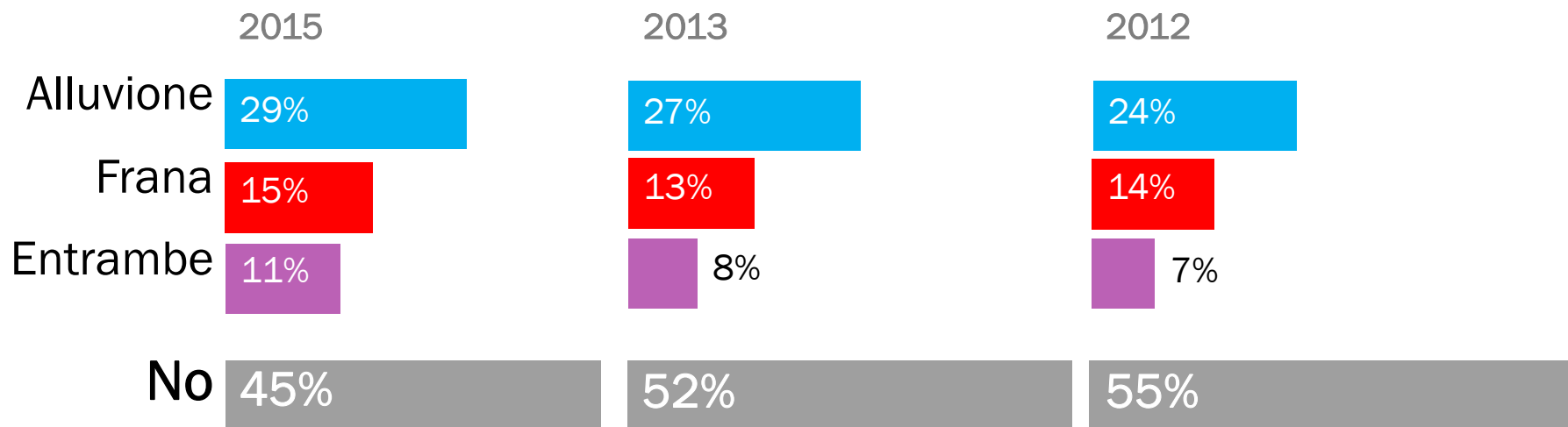
How much do you feel exposed to each of these risks:  
 (a) **landslide - LS**, (b) **flood - FL**,  
 (c) **earthquake - EQ**, (d) **volcanic eruption VE**, (e) **road accident - RA**, (f) **environmental pollution - EP**?  
 Possible answers: (1) considerably exposed, (2) somewhat exposed, (3) little exposed, (4) not exposed.



Salvati et al. 2014

## Risk Perception in Italy

Do you have **direct knowledge**, because **involved**, or **indirect information** of a landslide or a flood occurred in the **municipality** where you live, or nearby?



Salvati et al. 2014

# Risk Communication

THE **SCIENTIFIC LITERATURE ON RISK COMMUNICATION** IS LARGE AND IT CAN BE CLASSIFY IN TWO CATEGORIES:

- ❑ THE LONG TERM RISK COMMUNICATION “**IN TIME OF PEACE**”
- ❑ AND THE RISK COMMUNICATION “**IN TIME OF EMERGENCY**”

NEL 1999 KEYS RIPORTA:

*“It has been apparent for some time that creating community awareness of floods and storms is not easy, (...) **Most of the time, people are not particularly interested in them**”*

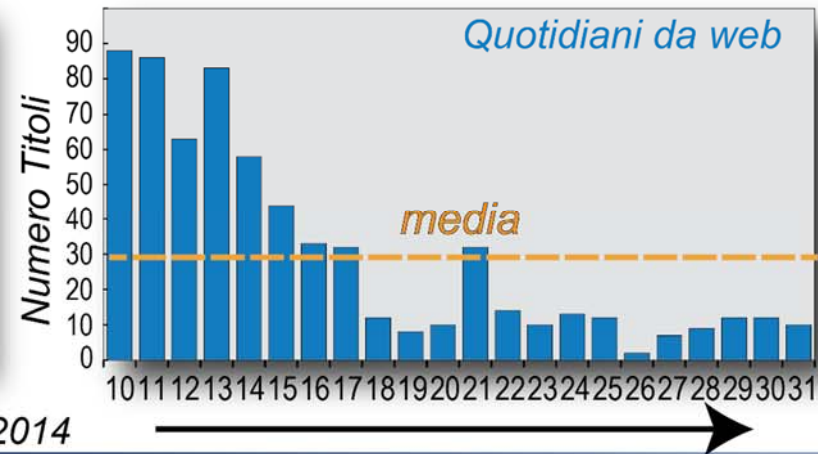
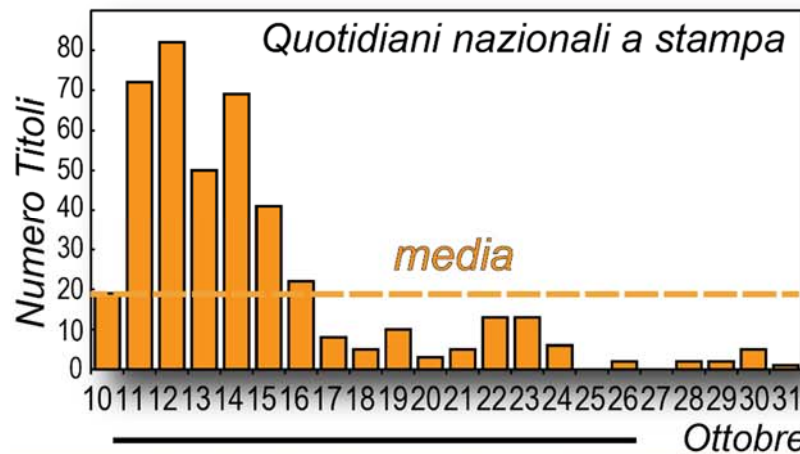
BUT DURING AN EVENT, THE INTEREST OF BOTH CITIZENS AND THE MEDIA INCREASES

Salvati et al. 2016

# Communication problem



1080 articles published between 10 and 31 October 2014 were analyzed of which: il 39,8% (n = 430) relating to national press, il 19,9% (n = 215) relating to national web newspapers and 40.3% (n = 435) related to local web newspapers



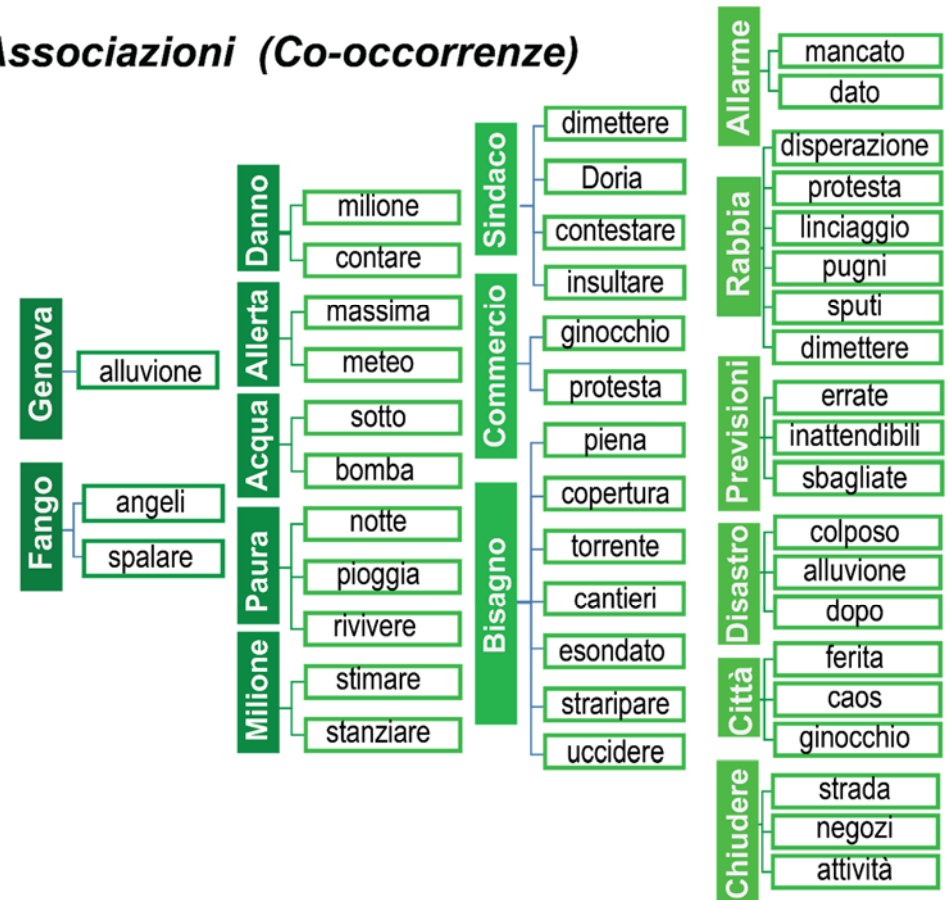
# Communication problem

THE **MOST FREQUENT GROUPS** OF WORDS HIGHLIGHT A **FEELING OF NEGATIVITY** AND VERY STRONG **CONTROVERSY STATEMENTS**

THE **MOST FREQUENT WORDS** RELATED TO **ANGER** ARE **DISPERAZIONE, PROTESTA LINCIAGGIO, PUGNI SPUTI, DIMETTERE**

THE **MOST FREQUENT WORDS** RELATED TO **FORECAST** ARE: **UNRELIABLE, MISTAKES, WRONG**

## Associazioni (Co-occorrenze)





# Some Possible Communication Channels

**polaris** Popolazione a Rischio da Frana e da Inondazione in Italia. Consiglio Nazionale delle Ricerche Istituto di Ricerca per la Protezione Idrogeologica

REPORT SEI PREPARATO? PERICOLOSITÀ EVENTI DI RILIEVO FOCUS BLOG

SEI PREPARATO? VIEWER ZONE DI ALLERTA ULTIMO REPORT

**eventi di rilievo**

ALLUVIONE IN SARDEGNA 18 NOV 2013 ALLUVIONE IN PUGLIA 06-08 OTT 2013 FRANE MAR - A

accadde **oggi** 11 luglio

Il giorno 11 luglio 1992 un evento meteoroclimatico di forte intensità colpì la provincia di Lucca causando frane ed inondazioni. Quattro morti nei comuni di Seravezza e Borgo a Mozzano.

**Firmati 12 contratti per le assunzioni nel CNR**  
Stabilizzazione articolo 20, comma 1, del D.Lgs. 75/2017

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WE WORK TO MAKE SAFE YOUR WORLD WE WANT TO HELP YOU TO MAKE THE BEST CHOICE WE CAN PROTECT YOU FROM RISKS WE USE LATEST GENERATION TECHNOLOGIES

Elenco degli eventi di frana, inondazione e allagamento con vittime nel periodo 1 gennaio - 30 giugno 2017

| data     | comune / località e/o prossimità                   | provincia | regione | morti | dispersi | ferti |
|----------|--|-----------|---------|-------|----------|-------|
| 18/01/17 | Campotosto / Ortolano, lungo la SS 80              | AQ        | ABR     | 1     | -        | -     |
| 22/01/17 | Castronovo di Sicilia / SS 189 al km 15            | PA        | SIC     | 1     | -        | -     |
| 04/02/17 | Trento / Valsorda                                  | TN        | TAA     | -     | -        | 1     |
| 18/03/17 | Cannobio / SS 34 del Lago Maggiore al km 30        | VB        | PIE     | 1     | -        | 2     |
| 17/04/17 | Sirolo / M. Conero, lungo il sentiero del Passo... | AN        | MAR     | -     | -        | 2     |
| 19/04/17 | Arco / Attacco della via ferrata Colodri           | TN        | TAA     | 1     | -        | -     |
| 29/04/17 | Resiutta / Lungo la SP 42                          | UD        | FVG     | -     | -        | 1     |
| 25/05/17 | Realmondo / Scala dei Turchi di Realmondo          | AG        | SIC     | -     | -        | 1     |
| 03/06/17 | Voltago Agordino / Fedarola                        | BL        | VEN     | -     | -        | 1     |
| 25/06/17 | Ovaro / SR 355, poco prima dell'abitato di Ovaro   | UD        | FVG     | -     | -        | 2     |

Quali cause devono satellitare e mapp Impatto climatici

Frana Inondazione Allagamento

FACEBOOK FEED

ULTIMO REPORT