A METHODOLOGICAL APPROACH TO COMPARE PROS AND CONS OF DELOCALIZING VILLAGES: SOCIO-ECONOMIC AND TECHNICAL ISSUES

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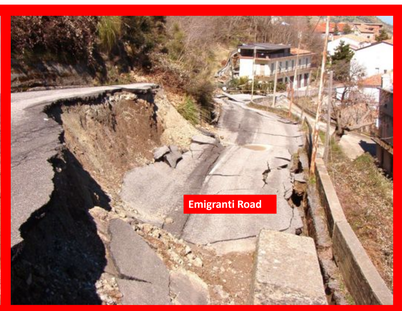
ABSTRACT

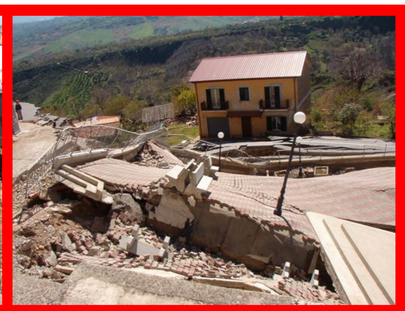
- On 7th March 2005, after prolonged rainfalls and snowfalls, a rock slide involved about five cubic meters of terrains and partially destroyed Cavallerizzo, a village of 581 people located in Calabria (Southern Italy).
- A basic monitoring of the phenomenon was carried out, even with the contribution of the inhabitants. This allowed that, when the landslide collapsed, all the people living in the villages were safe and sound.
- Even because of a long history of landslide damage affecting the buildings of the area since the XVIII century, the National Department of Civil Protection decided to transfer the village. Thus, between 2007 and 2011 the "new town" was realized.
- Despite this decision was undertaken in order to improve the security conditions of the village, part of the people did not accepted the decision to move from the old settlement and they started a series of protests partially still active.

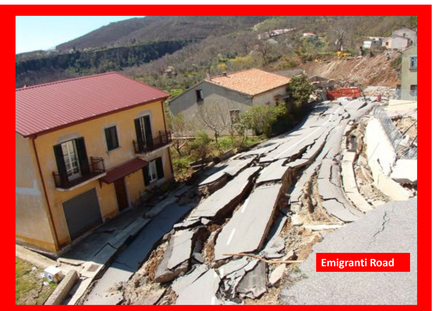
THE STUDY AREA

- Calabria region is frequently affected by landslides, especially during autumn-winter season. During the past century, several villages had to be relocated because of landslides.
- The sector affected by Cavallerizzo landslide belongs to a deep-seated gravitational deformations located along the western edge of the Crati Graben. Three faults systems are distinguished: 1) NE-SW to N-S thrusts, 2) E-W left strike-slip sub vertical faults; 3) a N-S master system of normal faults that cuts the slope just west of Cavallerizzo: the village is located along the wide cataclastic zone belonging to this faults system.
- The tectonic superposition of terrains, whose permeability strongly decreases with depth, combined with the lateral confinement produced by both N-S master faults and E-W structures, represent a strong predisposing factor with respect to slope instability.

THE 7TH MARCH 2005 LANDSLIDE







The Cavallerizzo landslide: panoramic view and damage caused to roads and buildings

HISTORICAL LANDSLIDES IN CAVALLERIZZO

N	Year	Month	Day	Buildings	Roads	Other
1	1635	?	?	X		
2	1720	?	?	X		
3	1758	02	19	X		
4	1827	02	28	X		
5	1903	10	30	X		X
6	1917	02	21	X		
7	1929	11	?	X		
8	1933	12	?	X		
9	1935	03	09	X		
10	1940	02	20	X	X	X
11	1941	03	31	X		
12	1941	?	?			X
13	1944	?	?	X		
14	1946	?	?	X		
15	1953	11	21	X		
16	1953	12	09			
17	1959	11	24	X		
18	1963	02	20	X		
19	1970	01	?	X		
20	1973	02	09			X
21	1973	04	24		X	
22	1974	01	07	X		
23	1980	02	?	X	X	
24	1987	01	11		X	
25	1999	03	?	X	X	

MAP: sites historically damaged by the landslides listed in the table. Green: Cavallerizzo village; grey: area affected by the 2005 landslide.TABLE: historical landslides dates and damaged elements.

THE CHRONOLOGY OF THE LANDSLIDE

- **Before 2005.** CNR-IRPI started irregular measurements at inclinometers and piezometers located in the area of the prospective landslide, for scientific purposes.
- **First decade of February 2005.** Premonitory evidences: a) landslide activations on the slopes, and downslope of Emigranti Road and along S. Nicola Torrent; b) increase of discharge at springs; c) increase of piezometric levels; d) inaccessibility of some inclinometers; e) worsening of damage to buildings and roads.
- **End of February 2005.** A warning was issued by the mayor (acting as authority for Civil Protection).
- **March 1st.** Punctual velocities reached 0.8 cm/day. A team, made of municipal technicians and volunteers was charged of monitoring the opening of cracks at pre-fixed lapses of time.
- **March 5th.** Measurements were performed more frequently and an infrared distance-measuring equipment (AGA-12) was installed on a building outside of the area. An inhabitant of the same building was charged to perform one measure every 4 hours.
- **March 5th, 8:00 p.m.** Crack opening accelerated up to 1.2 cm/day. The mayor ordered the partial evacuation of the village, while most of the people was already moving away spontaneously.
- **March 6th**, only few people were still in the area. Highly-variable readings at AGA-12 (5.2 cm/day at 18:00), coupled with a crack opening velocity of 4 cm/day clearly indicated that warning conditions had been established: in the late evening, remaining inhabitants were forced to move away.
- **March 7th, 3 a.m.** One inhabitant who was still in the area for monitoring purposes, having noticed a rapid increase of displacements (ca. 6 cm/day), gave the alarm by ringing the church bells, thus allowing any people still remaining in the area to escape. Almost instantly through a series collapses, the southernmost part of the village was destroyed. Activity slackened during the following weeks.

REFERENCES

- Petrucci O. (2013) The assessment of damage caused by historical landslide events. NHESS, 13: 755–761.
- Petrucci O., Gullà G. (2009) *A Support Analysis Framework for mass movement damage assessment: applications to case studies in Calabria (Italy).* NHESS, 9, 315–326.
- Iovine G., Petrucci O., Rizzo V., Tansi C. (2006) *The March 7th 2005 Cavallerizzo (Cerzeto) landslide in Calabria* - Southern Italy. 10th IAEG Congress: Nottingham, U.K. 6-10 September 2006. CDRom, Paper 785
- Guadagno E. (2014) *Dove la nostalgia diventa un bene comune.* Lo Squaderno, 30, 55-57.

THE DAMAGE

- **A relative damage assessment** was performed by Petrucci and Gullà (2009) by using a simplified procedure (Petrucci, 2013) assessing *Direct*, *Indirect* and *Intangible* damage in three levels (L4: very high; L3: high; L2: medium, L1: light)
- **Direct damage.** The buildings along the main scarp were heavily damaged (L4), as was the road connecting the hamlet to nearby villages (L4), and the municipal and country roads located in the landslide area (L4). A school and a church suffered high (L3) and medium (L2) damage. Damage suffered by commercial, handicraft, farming activities, aqueduct and drainage system was L4, while electric and telephone lines suffered damage of level L2.
- **Indirect damage.** The main indirect public costs were related to both the construction of the new town (L4) and the accommodation of 329 people for a prolonged period, some of them until the end of new town construction (L4). Further costs were necessary to modernize an old municipal road to bypass the landslide area (L2).
- **Intangible damage.** Some of the inhabitants suffered temporary shock conditions (L3), while the entire group of evacuated people suffered because of the separation from home (L4), and stress conditions related to the systematic use of a longer way to home.

THE "NEW TOWN"

- The new Cavallerizzo was born in the village of Pianette downstream of the originating country.
- According to Civil Protection, the new town was planned taking into account the suggestions of Cavallerizzo inhabitants.
- The project followed the traces of the old village, trying to create an urbanized structure organized in five surroundings arranged according to the shape of the petals of a flower.
- The national government funded the construction of 260 dwellings in order to house 560 people. The houses were projected according to people requests.
- The Decree n. 3427/2005 organized the compensation for homeless and displaced.
- The Decree foresees a single contribution for each economic activity, for an amount of 70% of the declared income of the previous year.
- Each family touched by the event was helped with 5.000€ once and 400€ each month, to rent another place, independently from the dimension of the house and of the number of people in the household.

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