IAEG XII Congress
15 – 19 September 2014 - Turin (IT)
Engineering Geology for Society and Territory

6.3 APPLIED GEOLOGY FOR INFRASTRUCTURE PROJECTS

THE ROLE OF GEOLOGICAL ANALYSIS IN THE DESIGN OF INTERVENTIONS FOR THE SAFETY OF THE ROAD ASSET. SOME EXAMPLES.

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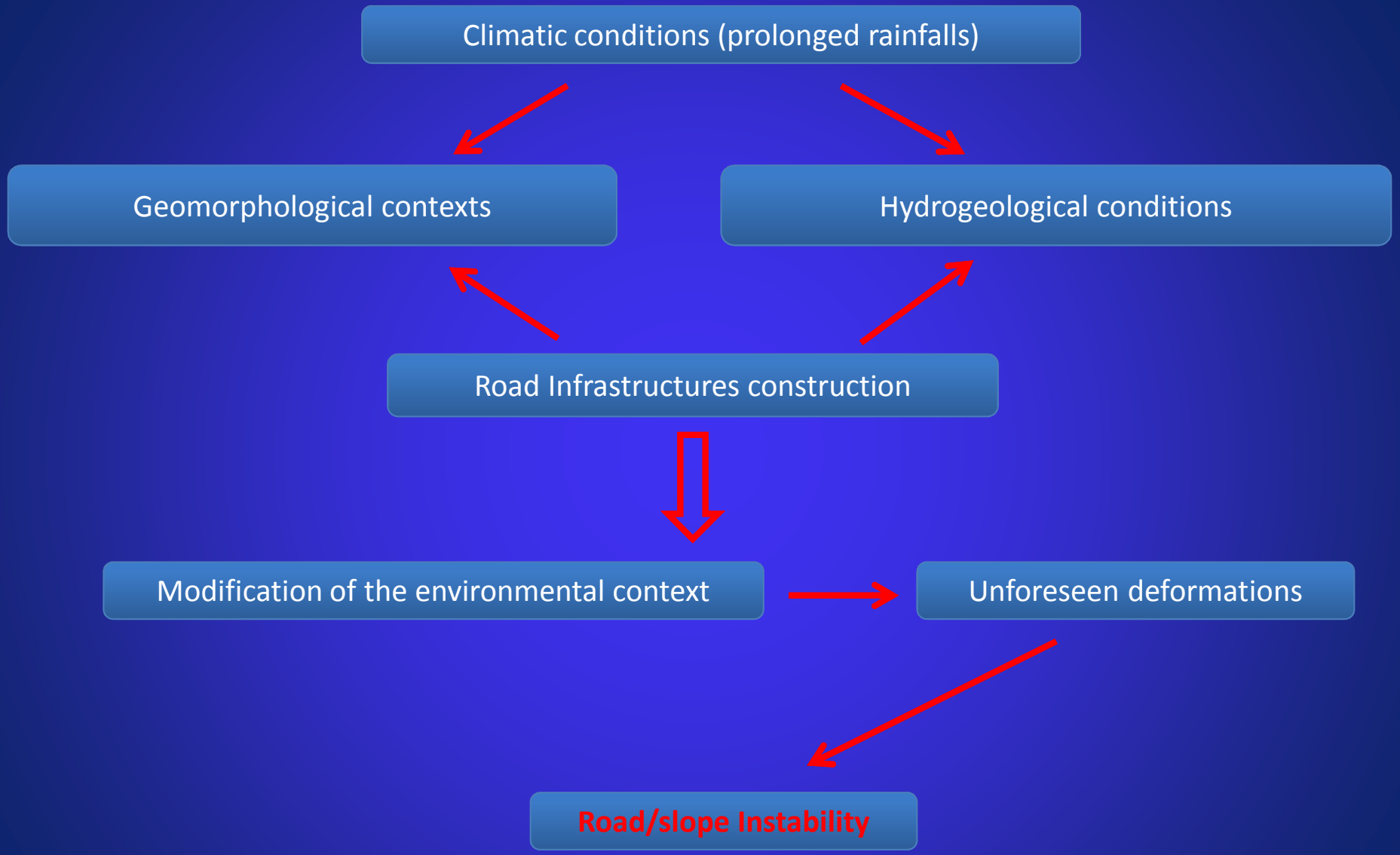
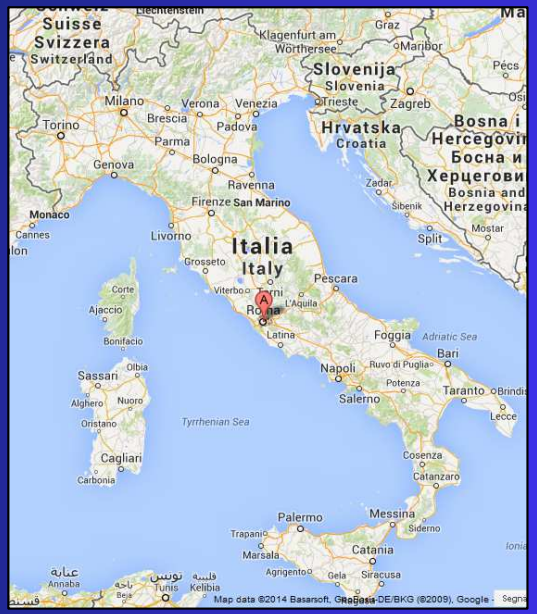
INTRODUCTION



CASE HISTORIES

2 EXAMPLES

Rome Hinterland



Damages inside earth-reinforced embankments

Liguria (Northern Italy)

Two different environmental and climatic context

But in both events

Main factor of damage is the rainfall inside the slope of the road body

INTRODUCTION

Intervention Methodology

I° PHASE

- Identifing the causes and the mechanisms of instability evolution in act
- Reconstruction of the Geological Reference Model
- Proposing preliminary stabilization solutions

II° PHASE

- Refinement of the Geological reference model
- Plan of site investigation campaigns
- Plan of instrumental and monitoring survey

III° PHASE

- Establishing the project interventions in order to consolidate the road body

Rome Hinterland

Causes → *Consequencens*

Prolonged rainy period

Deformation phenomenon inside a earth-reinforced embankment

Overview of the deformed roadway

Water flood rising from the foot of the embankment

Damages and tension cracks along the roadway

Rome Hinterland

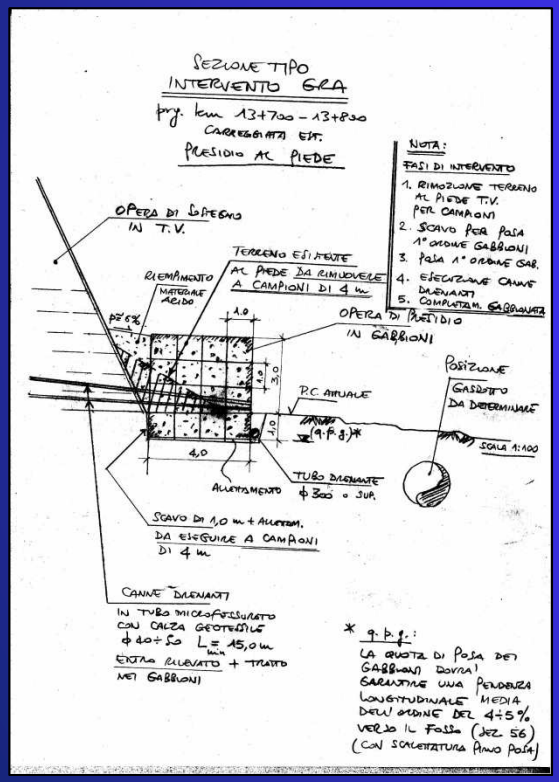
I° - Emergency phase

Provisional safety intervention by:

- Drainage system
- Metal gabions

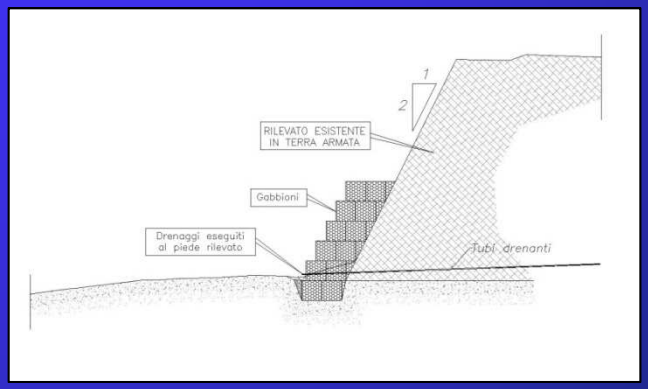
to

- Lower the pore pressure
- Create an overload to the foot of the slope



Gabions

Horizontal drains



schematic cross-section of provisional interventions

Rome Hinterland

II° - Geological study

Site investigation campaign consisting of:

- n. 13 boreholes

Instrumental monitoring composed by:

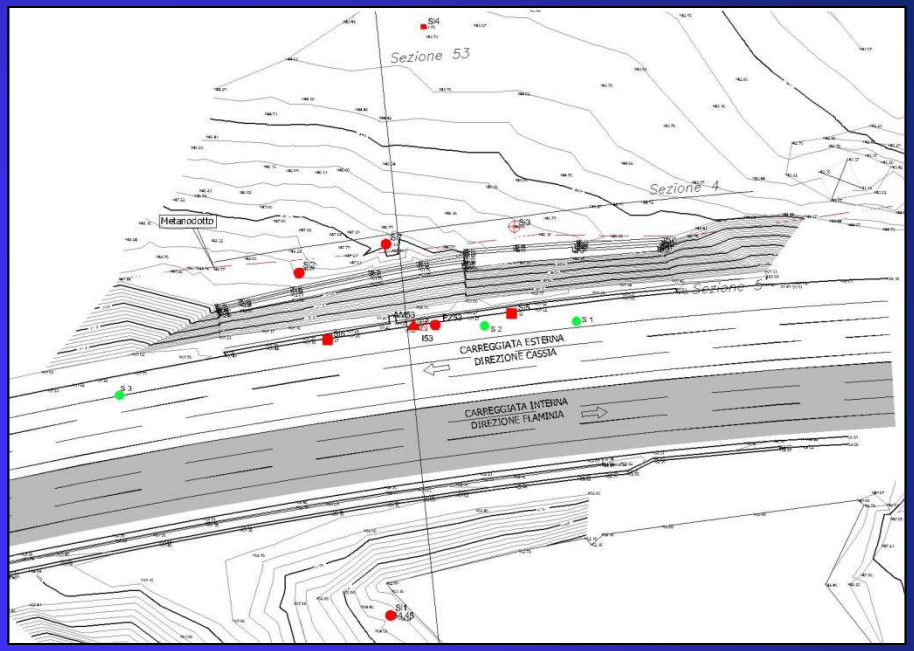
- n. 3 piezometers
- n. 1 inclinometer
- n. 1 assestimeter

Topographical monitoring

to

- Define a very detailed Geological Reference Model;
- Monitor the evolution of the instability

Location of the site-investigations



Rome Hinterland
Geological Reference Model

1. Prevulcanic sedimentary sequence:

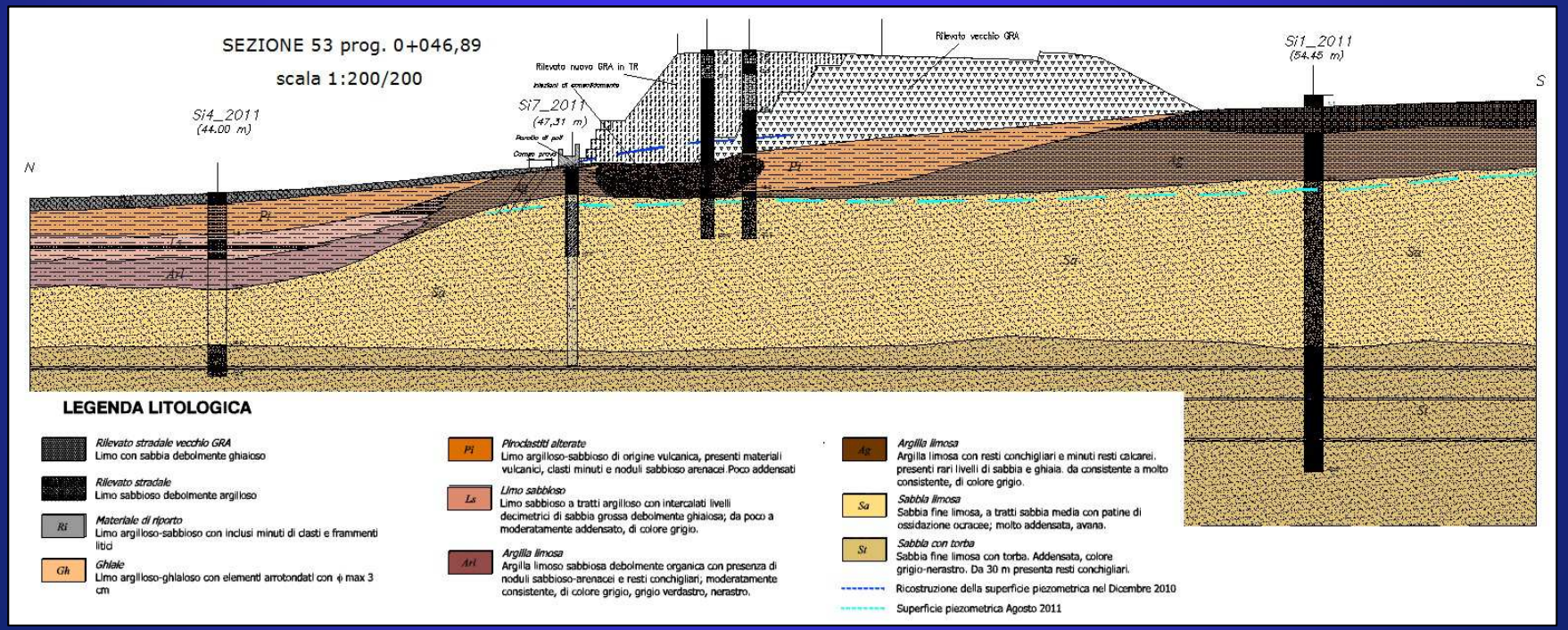
- Beach unit
- Infralittoral unit
- Fluvial and brackish unit

Sands and gravel with clay and silty levels, oxidized horizons and peaty levels

2. Pyroclastic materials:

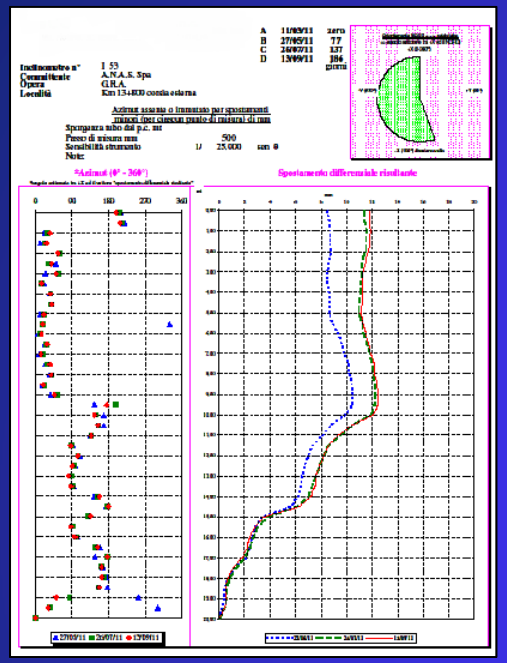
Cineritic matrix with pumice. Slag and lithic lava and volcaniclastic reworked levels

Sabatini Mounts volcano

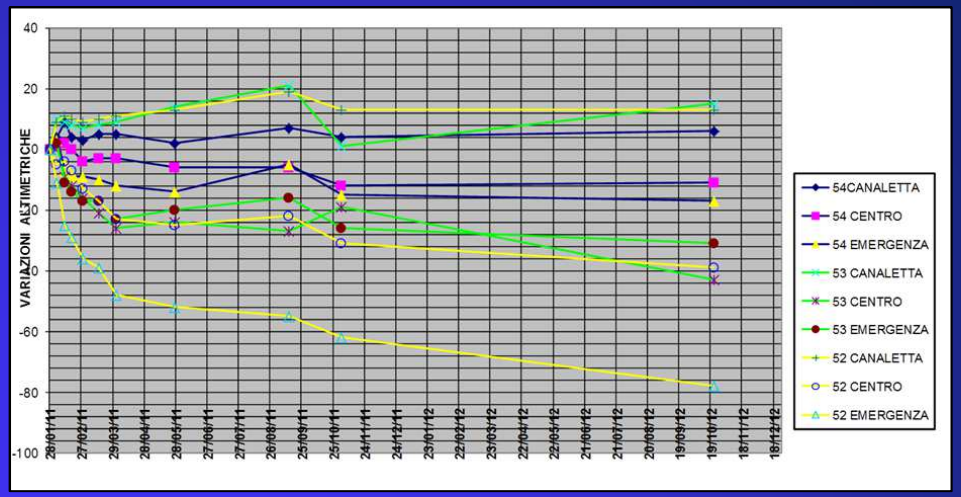


Geological cross-section in the damage site

Rome Hinterland
Instrumental and Topographic Monitoring

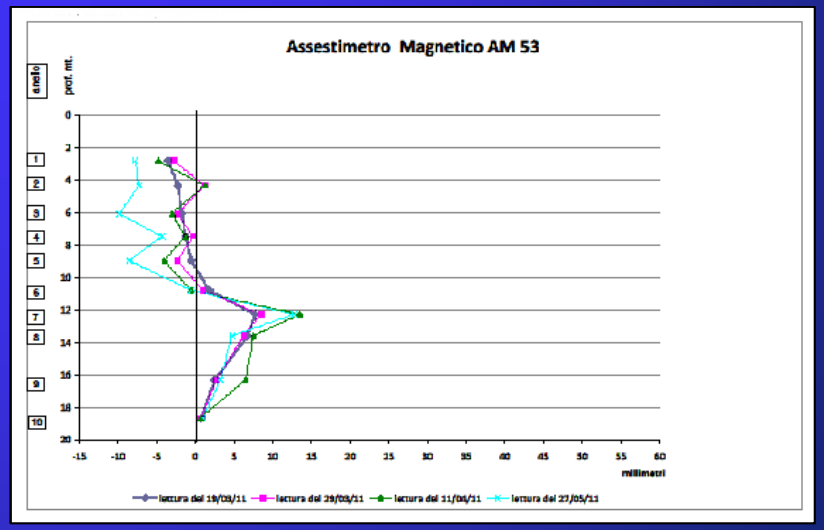


Inclinometric monitoring



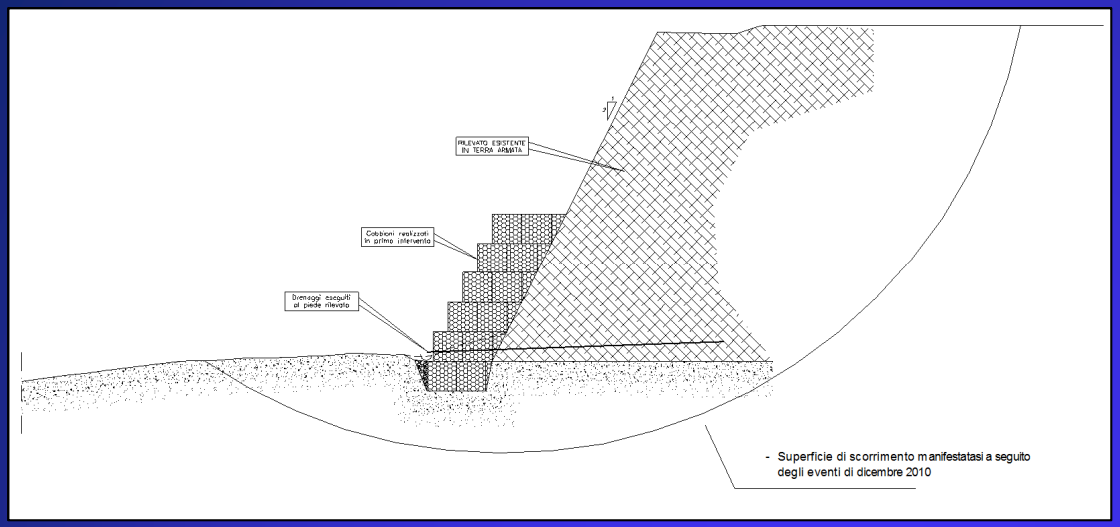
Altimetric monitoring

Sensibility to pore pressure



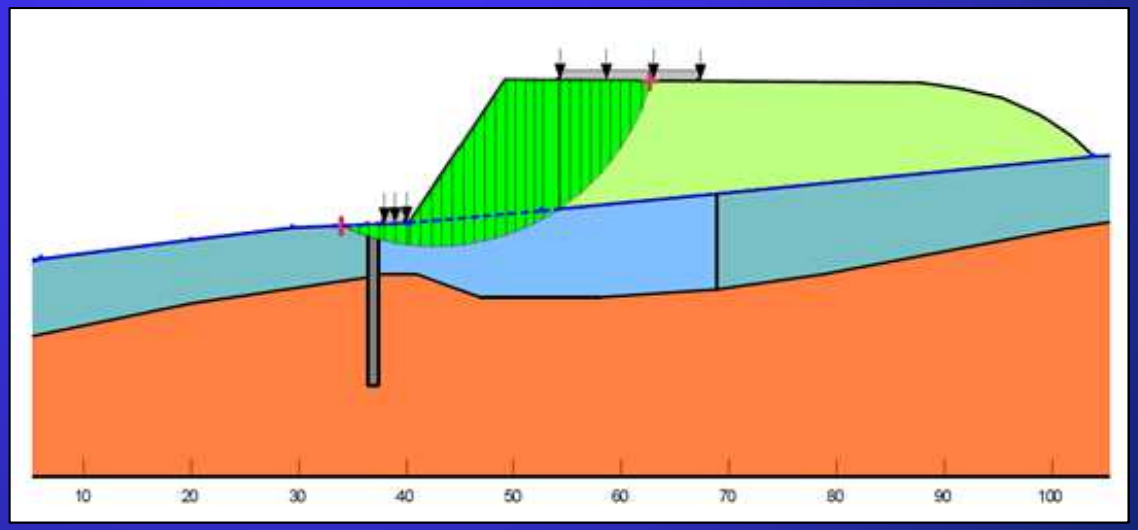
Assestimetric monitoring

Rome Hinterland
Slope Stability analysis



Illustrative section of the assumed sliding surface

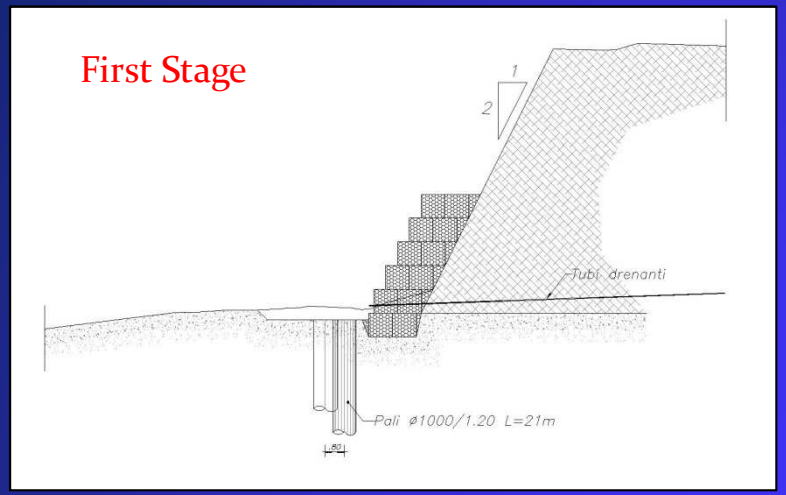
Post intervention slope stability analysis in dynamic conditions



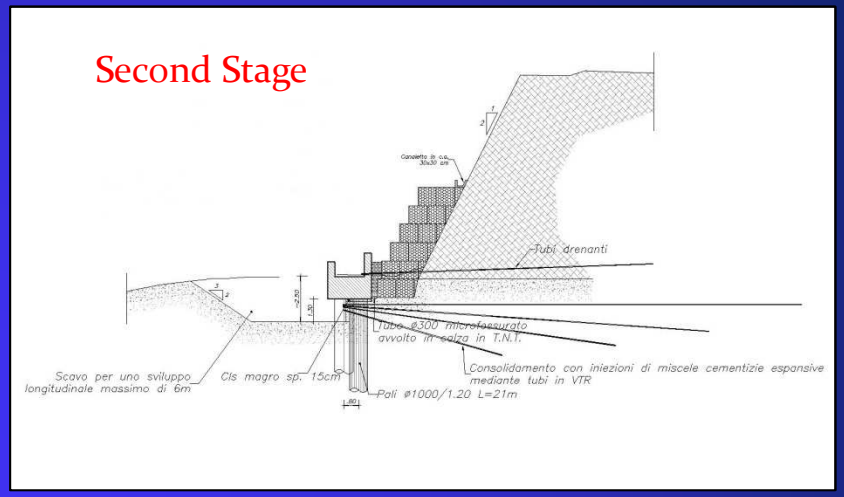
Rome Hinterland

III° - Final Safety

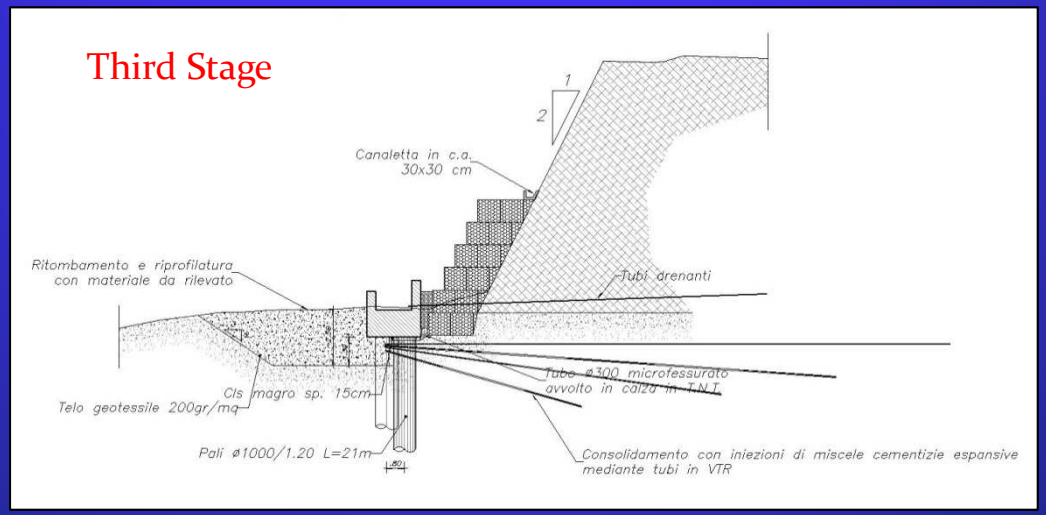
First Stage



Second Stage



Third Stage

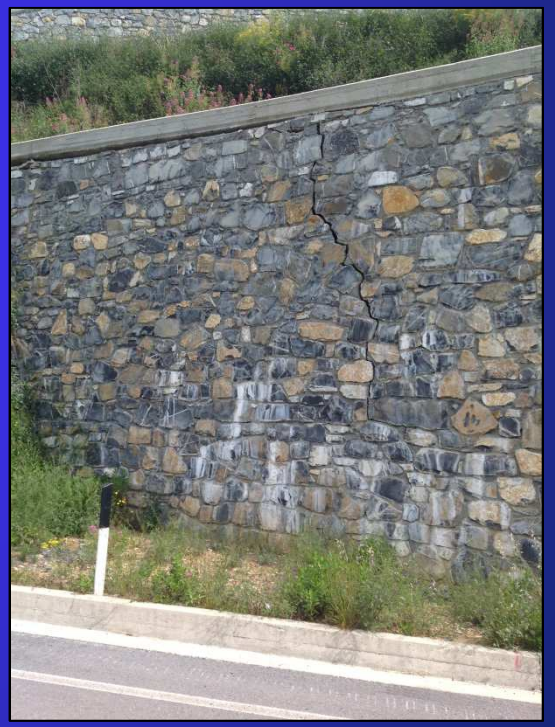


Liguria (Northern Italy)

Causes → *Consequences*

Intense rainfall events

Instability signs of a section of road interchange



Liguria (Northern Italy)

I° - Emergency phase

Provisional safety intervention by:

- Sub-horizontal drains

Liguria (Northern Italy)

II° - Geological study

Site investigation campaign composed by:

- n. 12 boreholes

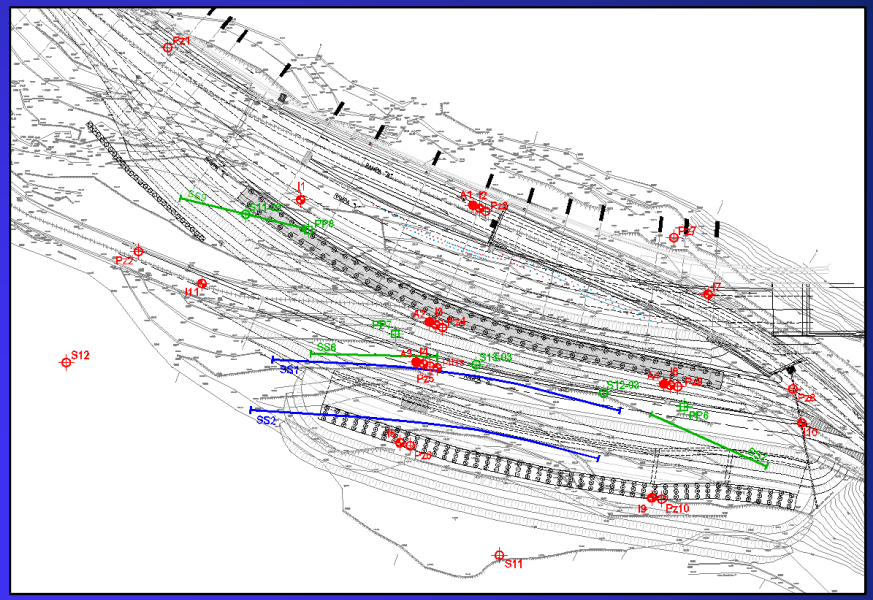
Instrumental and topographical monitoring composed by:

- n. 10 piezometers
- n. 11 inclinometers
- n. 4 multipoint assestimetric sections
- n. 7 mecchanic fessurimeters
- Interferometric monitoring

↓ *to*

- Define a very detailed geological reference model
- Monitor the evolution of the instability

Location of the site-investigations

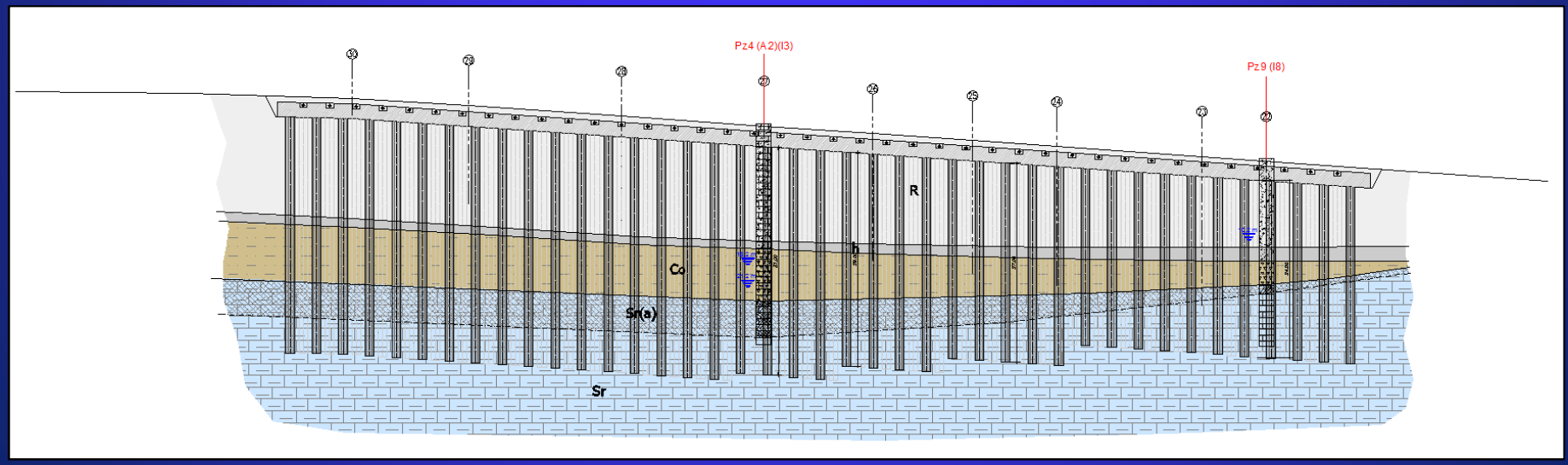


Liguria (Northern Italy)
Geological Reference Model

Semplified stratigraphic succession:
(from the oldest)

- Calcareous-marly substrate
- Eluvial-colluvial deposits
- Anthropogenic filling material

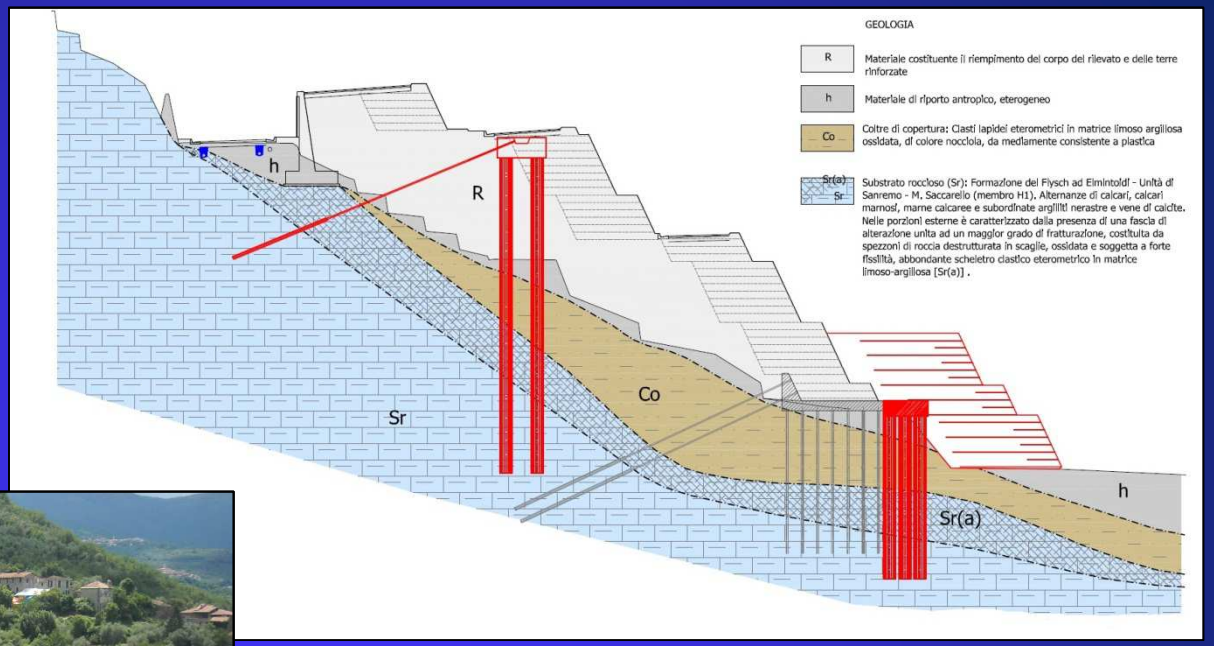
R	Materiale costituente il riempimento del corpo del rilevato e delle terre rinforzate
h	Materiale di riporto antropico, eterogeneo
Co	Coltre di copertura: Clasti lapidei eterometrici in matrice limoso argillosa ossidata, di colore nocciola, da mediamente consistente a plastica
Sr(a) Sr	Substrato roccioso (Sr): Formazione del Flysch ad Elmintoidi - Unità di Sanremo - M. Saccarello (membro H1). Alternanze di calcari, calcari marnosi, marne calcaree e subordinate argilliti nerastre e vene di calcite. Nelle porzioni esterne è caratterizzato dalla presenza di una fascia di alterazione unita ad un maggior grado di fratturazione, costituita da spezzoni di roccia destrutturata in scaglie, ossidata e soggetta a forte fissilità, abbondante scheletro clastico eterometrico in matrice limoso-argillosa [Sr(a)] .



Geological longitudinal section in the damage site

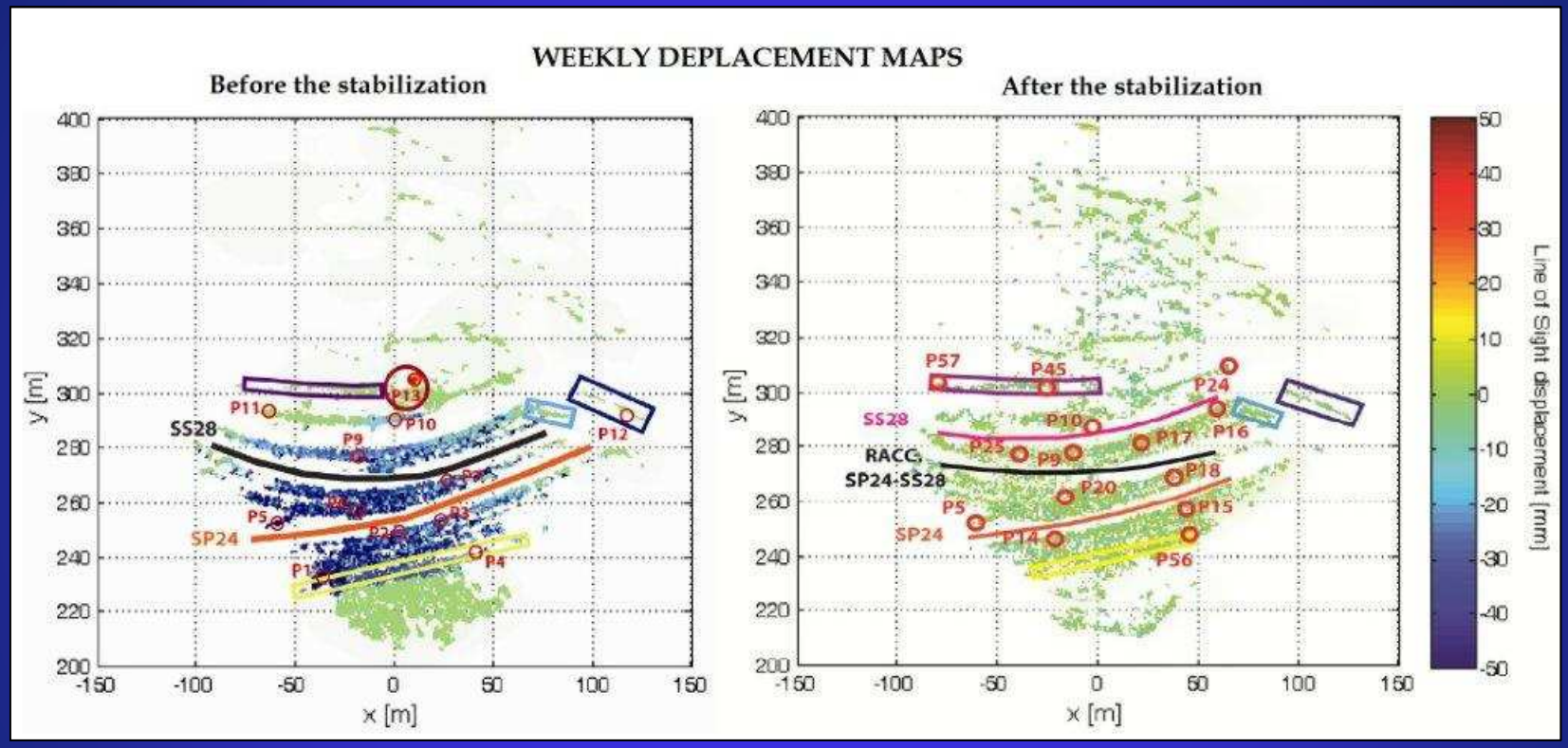
Liguria (Northern Italy)

III° - Final Safety



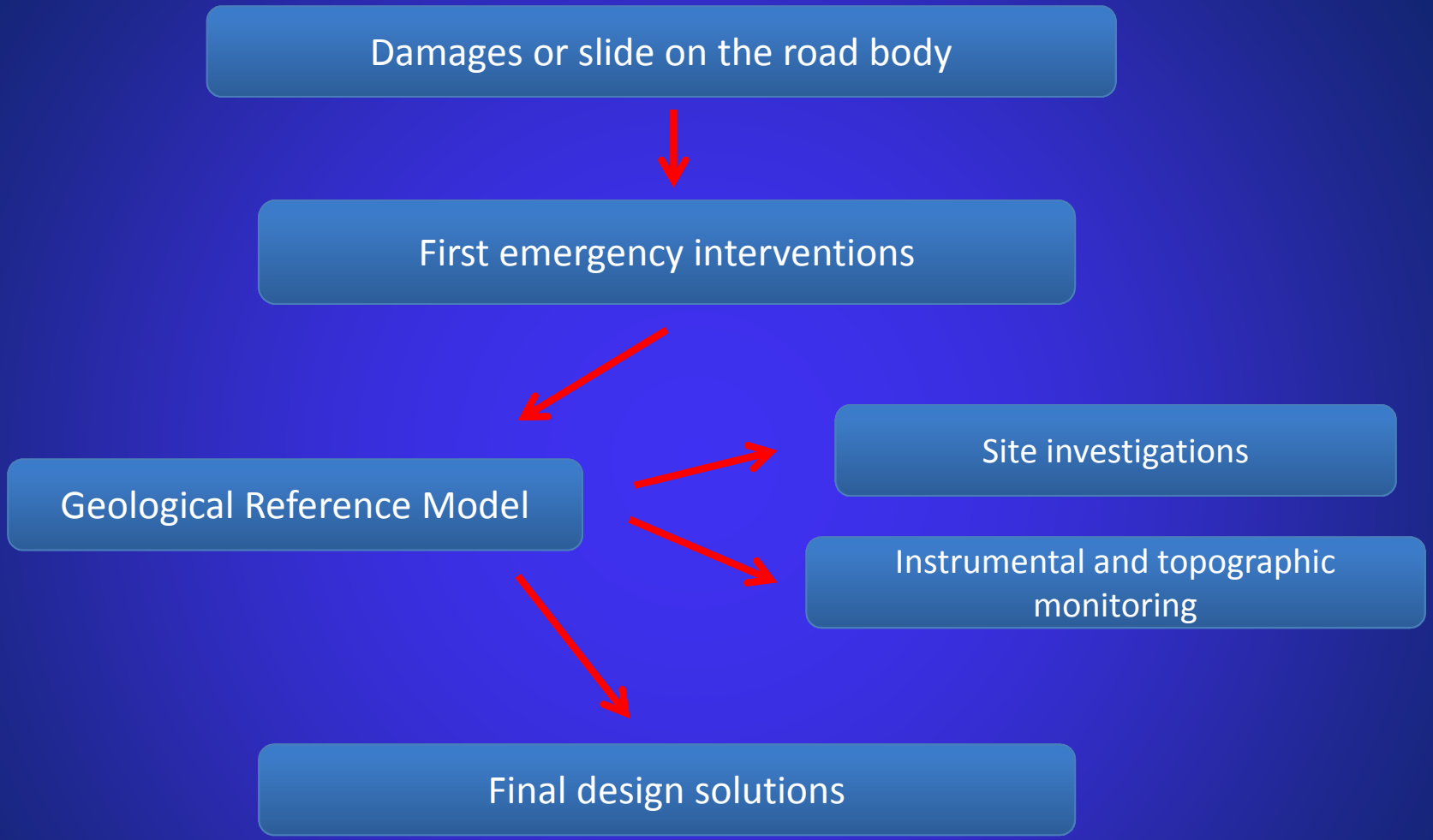
Geological cross-section, completed with the designed stabilization works

Liguria (Northern Italy)
Interferometric Monitoring



Shift TInSAR map before and after the stabilization works
(courtesy of Nhazca - spin-off of La Sapienza University)

CONCLUSIONS



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THANKS FOR THE ATTENTION

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