

I satelliti per l'osservazione della Terra: contare i danni e controllare gli edifici

Credits: ESA/NASA



Ing. Silvia Scifoni
Survey Lab



I satelliti **EO monitorano il pianeta e** raccolgono
Informazioni sul suo stato di **salute**

A satellite with large solar panels is shown in orbit above the Earth. A green laser beam is directed from the satellite towards the ground. The Earth's surface is visible, showing clouds and landmasses.

Le **osservazioni da satellite**
offrono risposte
precise, affidabili, sostenibili

SINOTTICITÀ



I satelliti offrono una **rapida visione d'insieme**

AGGIORNABILITÀ



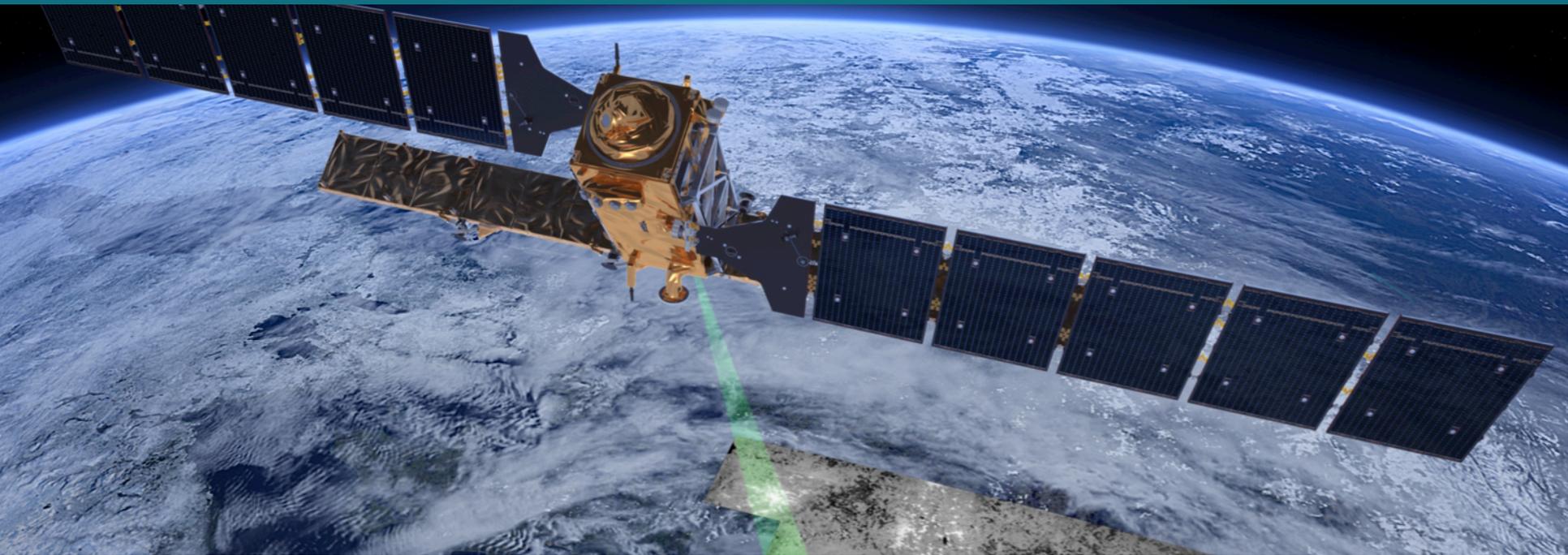
Gli elementi raccolti, oltre a costituire una **banca dati** di informazioni riguardanti il pianeta, si **aggiornano costantemente**

AGGIORNABILITÀ



Esistono **archivi di dati** satellitari che coprono tutta la Terra a partire dagli anni 90

RIPETIBILITÀ



Raccolgono informazioni nel tempo
che possono essere **confrontate e integrate**

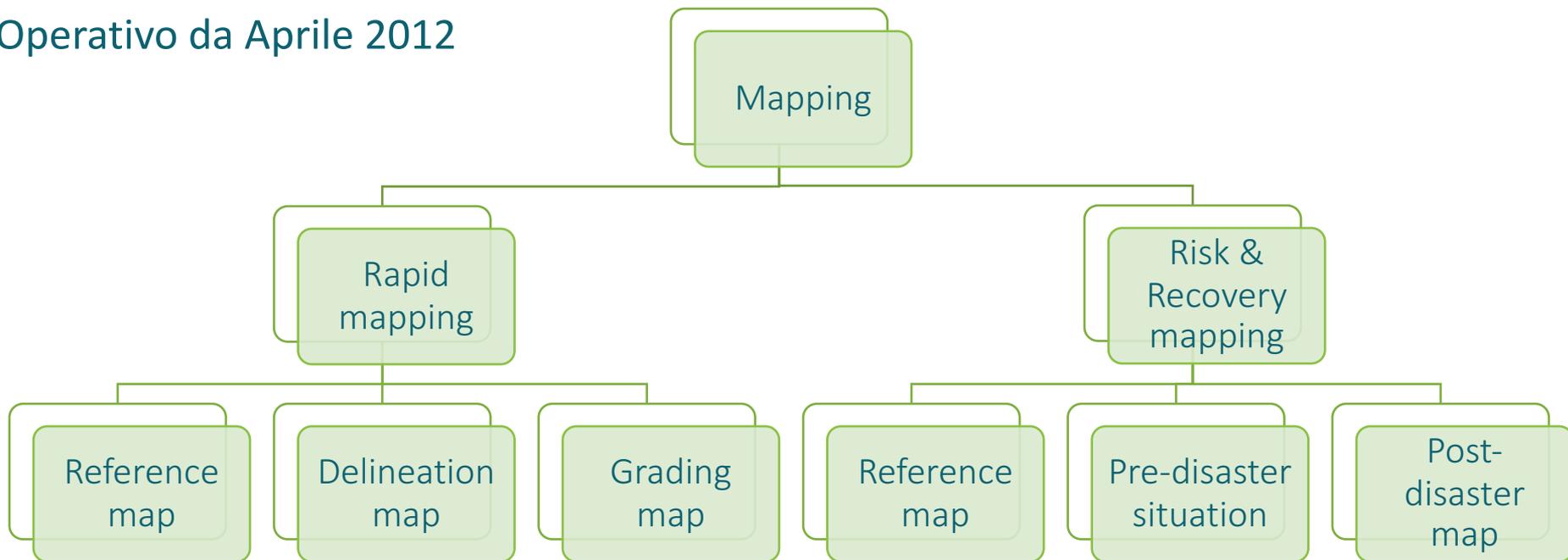
IL PROGRAMMA COPERNICUS



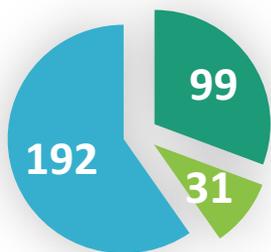
Copernicus
Europe's eyes on Earth

SERVIZIO MAPPING DEL COPERNICUS EMS

Operativo da Aprile 2012



Attivazioni totali 12



■ Ref. Maps ■ Delin. Maps ■ Grading Maps

Attivazioni in Italia 3



Earthquake



■ Ref. Maps ■ Grading Maps

LE SENTINELLE

Radar (04/2014)



sentinel-1



sentinel-6



sentinel-5

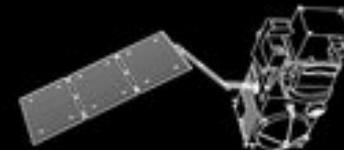


Ottico (06/2015)

sentinel-2



sentinel-sp



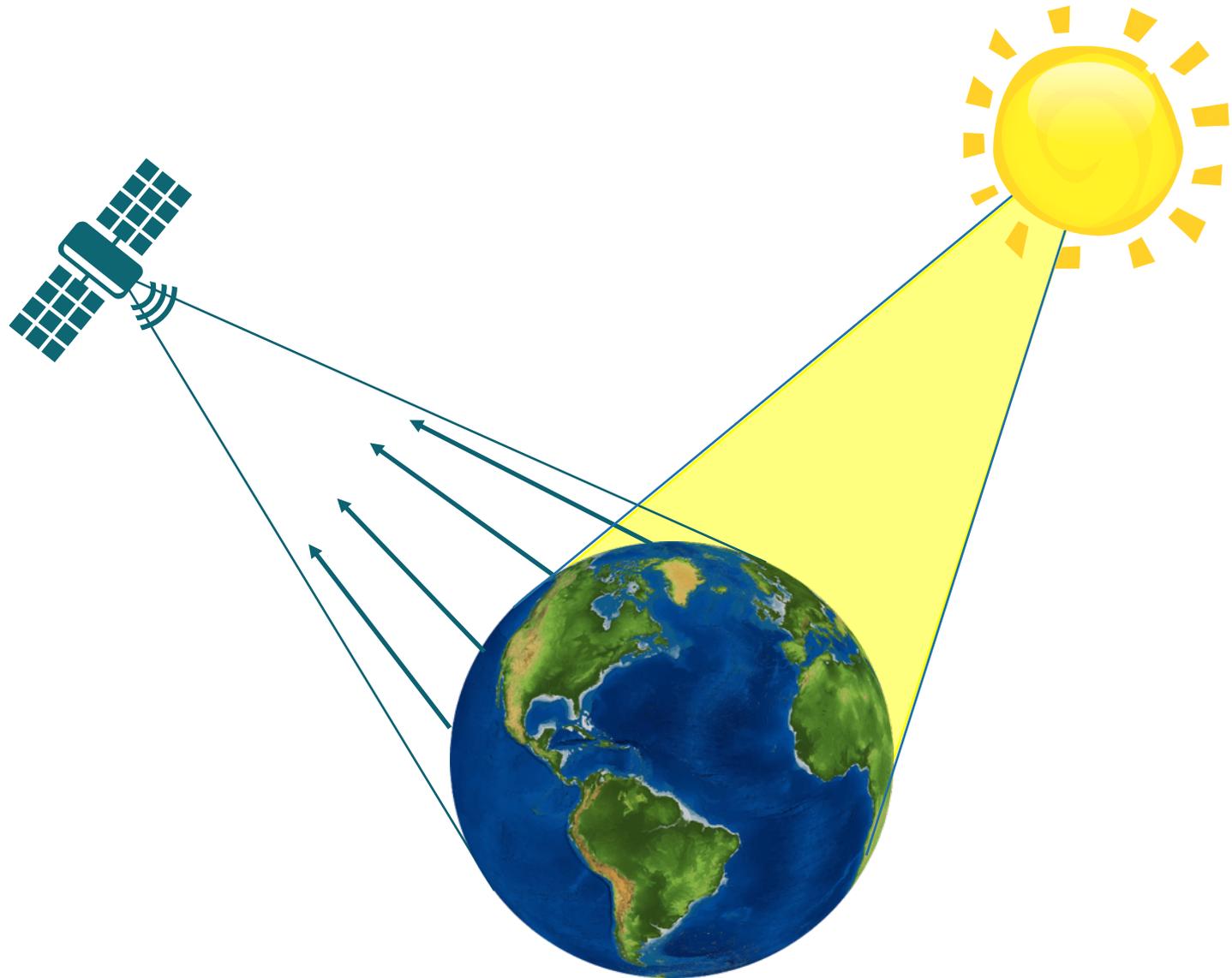
sentinel-3



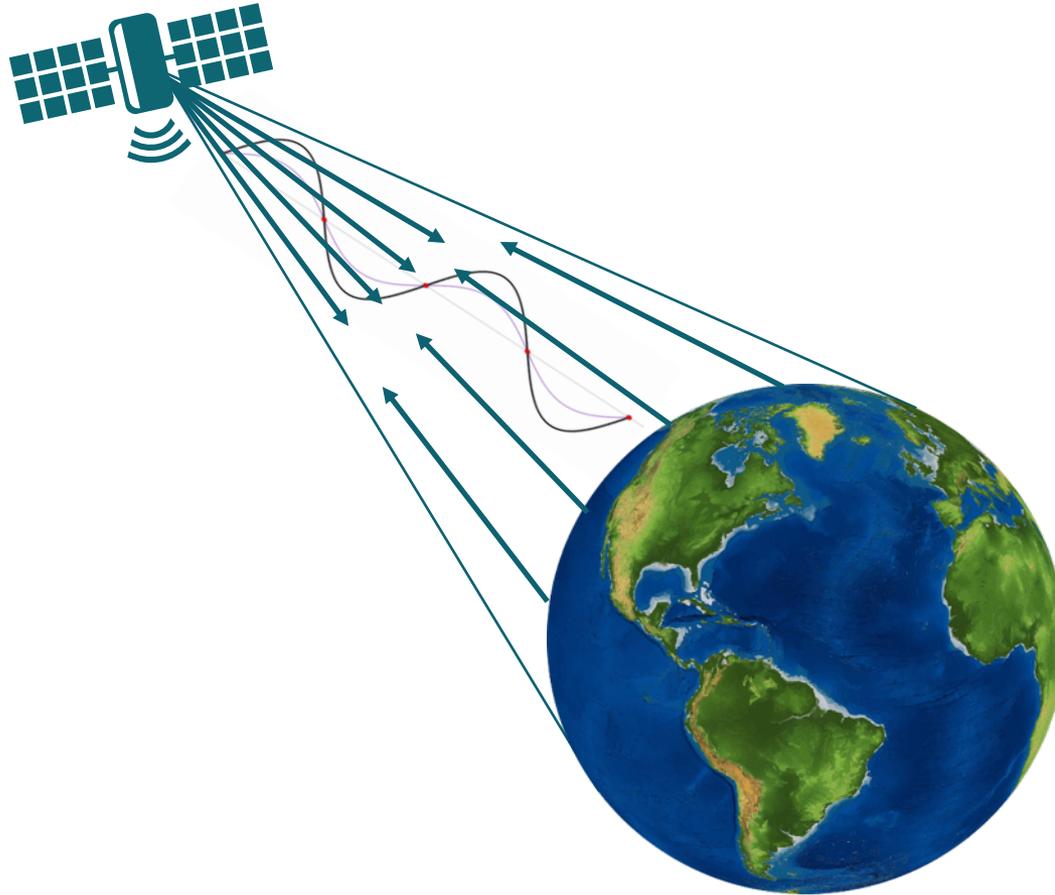
sentinel-4



I SENSORI OTTICI



I SENSORI RADAR



An aerial satellite image of a city, likely Rome, showing a dense urban grid and a prominent river (the Tiber) winding through the center. A semi-transparent white rectangular box is overlaid on the lower-left portion of the image, containing text. The text is in a sans-serif font, with the word 'ottica' in a bold, dark blue color.

Differenze: un'immagine **ottica**
(sensore passivo) e...

The image is a high-contrast, black and white aerial radar scan of a city. The radar returns create a complex, textured pattern where different urban features are highlighted. A prominent, dark, winding line represents a river or canal, meandering through the city's grid. The surrounding areas show a dense network of streets and buildings, with varying intensities of gray and black indicating different surface compositions and structures. The overall appearance is that of a detailed, top-down view of an urban environment captured using active radar technology.

... un'immagine **radar** (sensore attivo)
della stessa area

RAPID MAPPING

GLUE number: EG-2016-00095-PLA Activation ID: EMGR177
 Project N. 15AAMATRICWEST - 03_Engleng
Amatrice west - ITALY
Earthquake - Situation as of 25-08-2016
Grading Map - Moni01



Cartographic Information
 1:11000 Full color ISO A3, low resolution (100 dpi)
 Grid: WGS 1984 UTM Zone 33N map coordinate system
 Tick marks: WGS 84 geographical coordinate system

Legend

Circle Information	Settlements	Transportation
● Dams	● Population Point	● Secondary Road
● Gathering of People	● Hydrology	● Local Road
Building Grading	● Dam	
■ Damaged	■ Damaged	
■ Height Damaged	■ Damaged	
■ Intensity Damaged	■ Damaged	
■ Ineligible to slight damage	■ Damaged	
Infrastructure Grading	Land use - Land Cover	
■ Road Height Damaged	■ Forest (incl. water area)	
■ Road Intensity Damaged	■ Forest (incl. water area)	
■ Road Ineligible to slight damage	■ Forest (incl. water area)	
General Information	Physiography	
■ Area of interest	■ Forest (incl. water area)	

STATISTICAL DATA BY ZONE

Zone	Area (ha)	Population	Damaged	Intensity	Height	Ineligible	Total
Amatrice	1000	1000	1000	1000	1000	1000	1000
Amatrice (C)	1000	1000	1000	1000	1000	1000	1000
Amatrice (D)	1000	1000	1000	1000	1000	1000	1000
Amatrice (E)	1000	1000	1000	1000	1000	1000	1000
Amatrice (F)	1000	1000	1000	1000	1000	1000	1000
Amatrice (G)	1000	1000	1000	1000	1000	1000	1000
Amatrice (H)	1000	1000	1000	1000	1000	1000	1000
Amatrice (I)	1000	1000	1000	1000	1000	1000	1000
Amatrice (J)	1000	1000	1000	1000	1000	1000	1000
Amatrice (K)	1000	1000	1000	1000	1000	1000	1000
Amatrice (L)	1000	1000	1000	1000	1000	1000	1000
Amatrice (M)	1000	1000	1000	1000	1000	1000	1000
Amatrice (N)	1000	1000	1000	1000	1000	1000	1000
Amatrice (O)	1000	1000	1000	1000	1000	1000	1000
Amatrice (P)	1000	1000	1000	1000	1000	1000	1000
Amatrice (Q)	1000	1000	1000	1000	1000	1000	1000
Amatrice (R)	1000	1000	1000	1000	1000	1000	1000
Amatrice (S)	1000	1000	1000	1000	1000	1000	1000
Amatrice (T)	1000	1000	1000	1000	1000	1000	1000
Amatrice (U)	1000	1000	1000	1000	1000	1000	1000
Amatrice (V)	1000	1000	1000	1000	1000	1000	1000
Amatrice (W)	1000	1000	1000	1000	1000	1000	1000
Amatrice (X)	1000	1000	1000	1000	1000	1000	1000
Amatrice (Y)	1000	1000	1000	1000	1000	1000	1000
Amatrice (Z)	1000	1000	1000	1000	1000	1000	1000

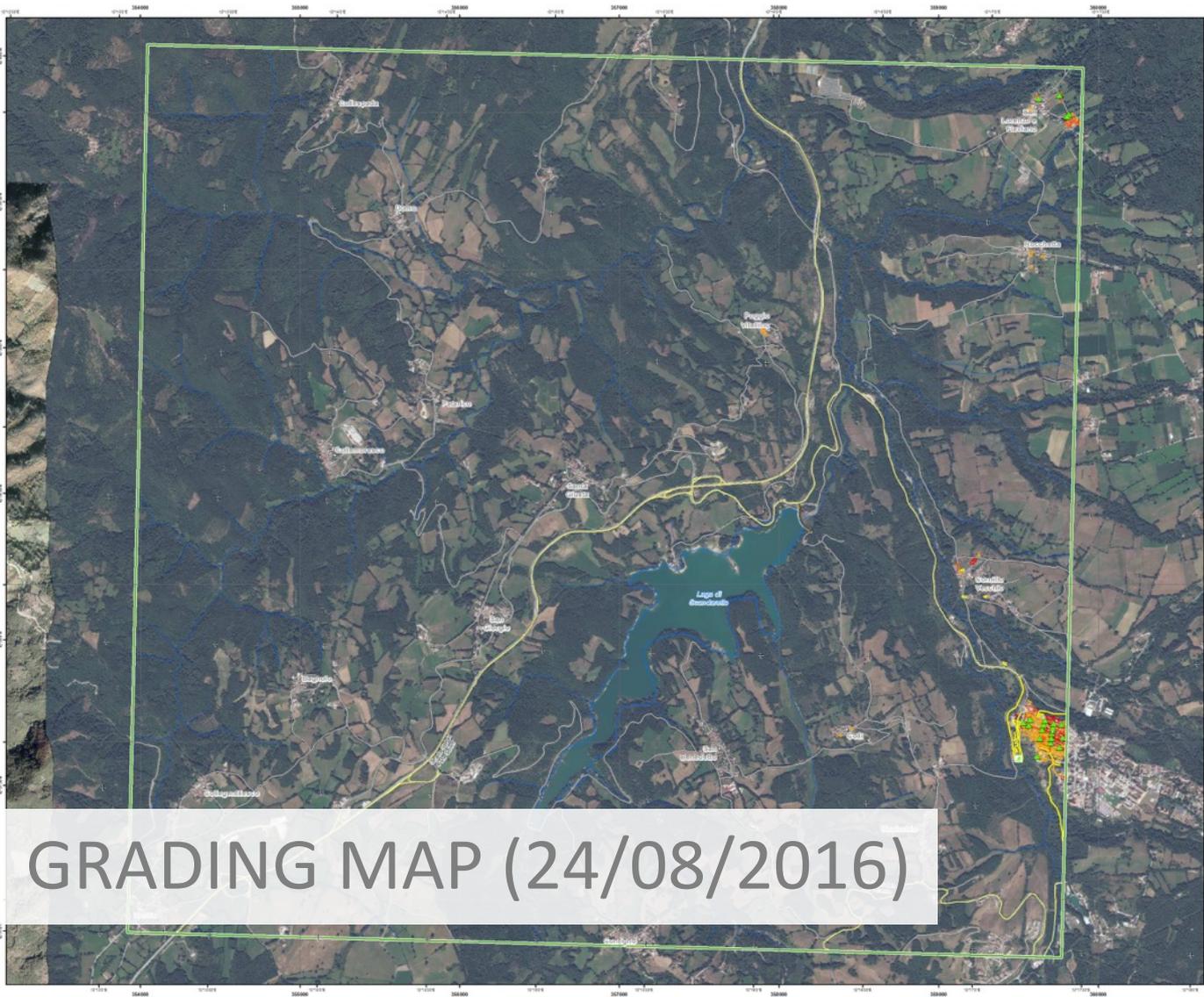
Map Information
 In the last week of 24th August 2016 an earthquake occurred in the centre of Italy causing a wide area of damage including several villages, towns, cities and infrastructure. The map shows the main roads which were affected in the area producing significant damage to structures and infrastructure. The map is a product of the Rapid Mapping activity and has been produced to provide damage information on the affected areas.
 The present map shows the earthquake damage grade assessment in the area of Amatrice (Italy). The present map has been derived from ground truth data to assess the extent of damage. The map is a product of the Rapid Mapping activity and has been produced to provide damage information on the affected areas.
 The present map shows the earthquake damage grade assessment in the area of Amatrice (Italy). The present map has been derived from ground truth data to assess the extent of damage. The map is a product of the Rapid Mapping activity and has been produced to provide damage information on the affected areas.

Relevant data records

Event	Date	Production	Map production
Amatrice	24/08/2016	EG-2016-00095-PLA	EG-2016-00095-PLA

Data Sources
 Present map: Copernicus Rapid Mapping (RM) 2014 (1:11000) 1km format by e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A.
 Present map: Rapid Mapping (RM) 2014 (1:11000) 1km format by e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A.
 Present map: Rapid Mapping (RM) 2014 (1:11000) 1km format by e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A.
 Present map: Rapid Mapping (RM) 2014 (1:11000) 1km format by e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A. - e-GEOS S.p.A.

Disclaimer
 Products delivered in the Copernicus RM Rapid Mapping activity are related to the best available data and are not intended for use in legal proceedings or for any other purpose. The map and the information contained therein are provided as a service to the user and the user is responsible for the use of the information. The user is responsible for the use of the information. The user is responsible for the use of the information. The user is responsible for the use of the information.



GRADING MAP (24/08/2016)

RAPID MAPPING



Legend

Crisis Information



Debris

Building Grading



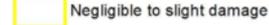
Destroyed



Highly Damaged

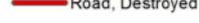


Moderately Damaged



Negligible to slight damage

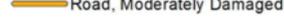
Transportation Grading



Road, Destroyed



Road, Highly Damaged



Road, Moderately Damaged

General Information



Area of Interest



Clouds

Administrative boundaries



Municipality

Settlements



Populated Place

Land use - Land Cover

Features available in vector data

Physiography

Features available in vector data

Hydrology



River



Stream



Lake

Transportation



Primary Road



Local Road

Performance under the AID									
Indicator	Target	Actual	Variance	Weight	Score	Weighted Score	Score	Weighted Score	Score
Population	100,000	100,000	0	10	100	1,000	100	1,000	100
Infrastructure	50,000	50,000	0	10	50	500	50	500	50
Healthcare	20,000	20,000	0	10	20	200	20	200	20
Education	10,000	10,000	0	10	10	100	10	100	10
Environment	5,000	5,000	0	10	5	50	5	50	5
Total	190,000	190,000	0	50	190	1,900	190	1,900	190

Map Information
This map was created using satellite imagery from 2016. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image.

The project map shows the satellite imagery grade assessment in the area of interest. The satellite imagery has been processed from satellite imagery to create a map representation. The satellite imagery accuracy is 5 to 10m or better. The map is a composite of several images and is not a single image.

Historical data records			
Year	Resolution	Resolution	Resolution
2016	10m	10m	10m
2015	10m	10m	10m
2014	10m	10m	10m

Data Sources
The project map uses satellite imagery from 2016. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image.

The project map uses satellite imagery from 2016. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image.

The project map uses satellite imagery from 2016. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image.

The project map uses satellite imagery from 2016. The map is a composite of several images and is not a single image. The map is a composite of several images and is not a single image.

Disclaimer
This map is intended for informational purposes only. It is not intended for use in any legal or financial transaction. The map is a composite of several images and is not a single image.

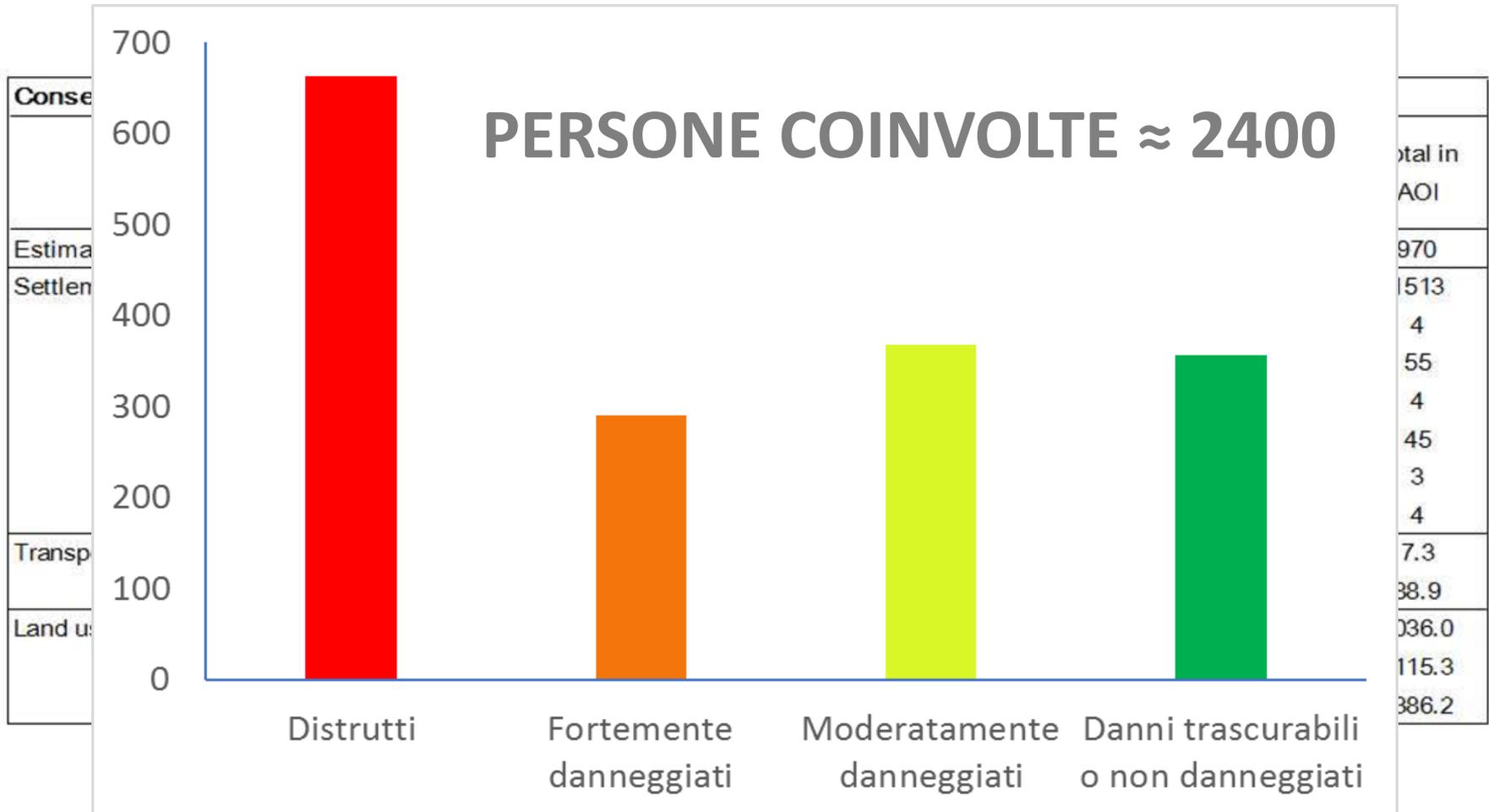
This map is intended for informational purposes only. It is not intended for use in any legal or financial transaction. The map is a composite of several images and is not a single image.

This map is intended for informational purposes only. It is not intended for use in any legal or financial transaction. The map is a composite of several images and is not a single image.

GRADING MAP (24/08/2016)

RAPID MAPPING

PERSONE COINVOLTE ≈ 2400



DATI STIMATI PER L'EVENTO DEL 24/08/2016

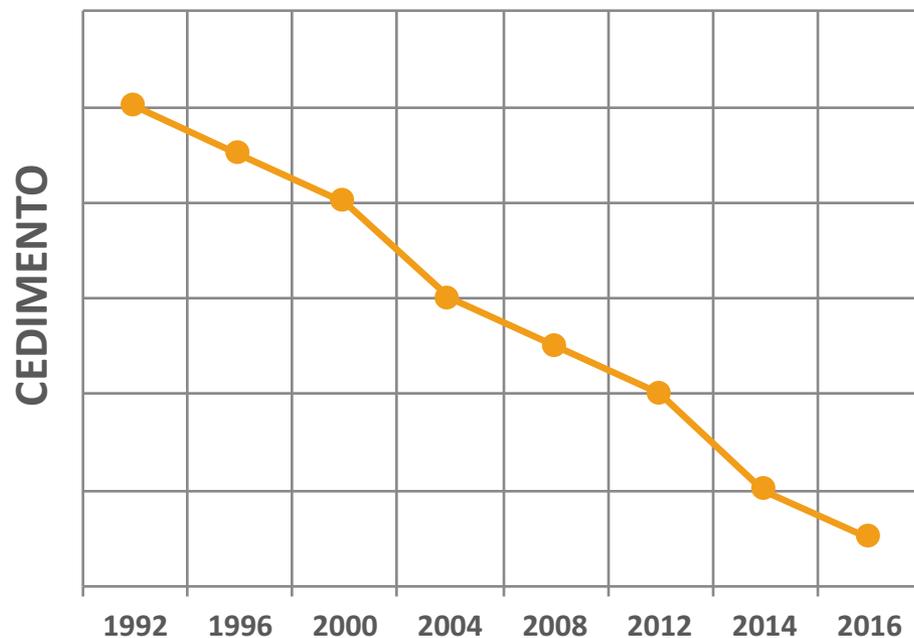
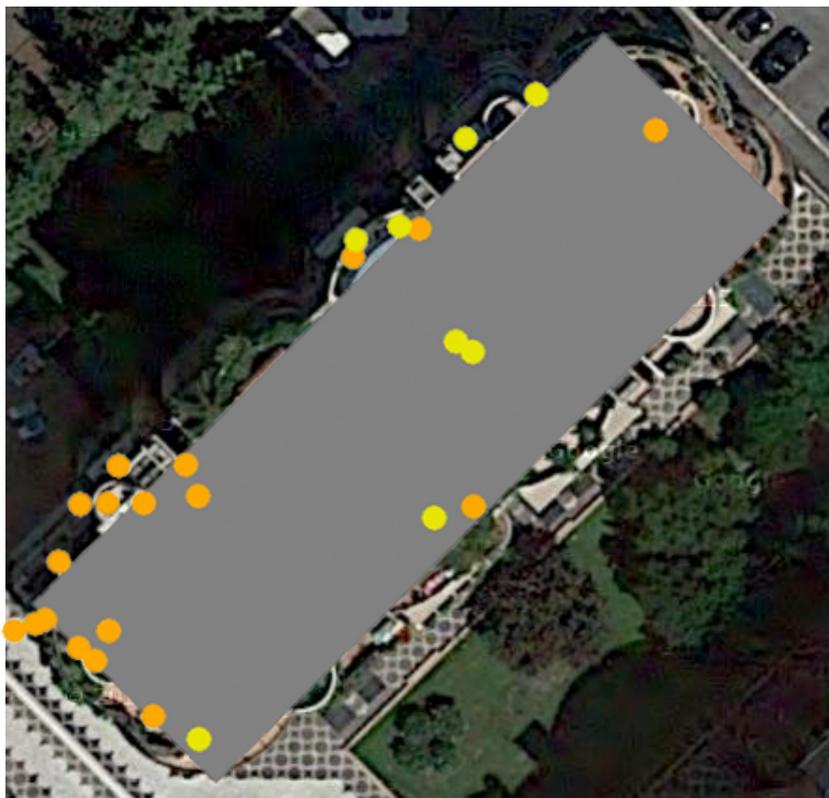
Tecnica **satellitare DInSAR** che utilizza un segnale radar in grado misurare **spostamenti** con precisione elevata





SPOSTAMENTO

Confrontando i dati satellitari nel tempo può essere misurato lo **spostamento di singoli edifici**



STABILITÀ

SICUREZZA

La **stabilità degli edifici**
è strettamente collegata alla
sicurezza della popolazione

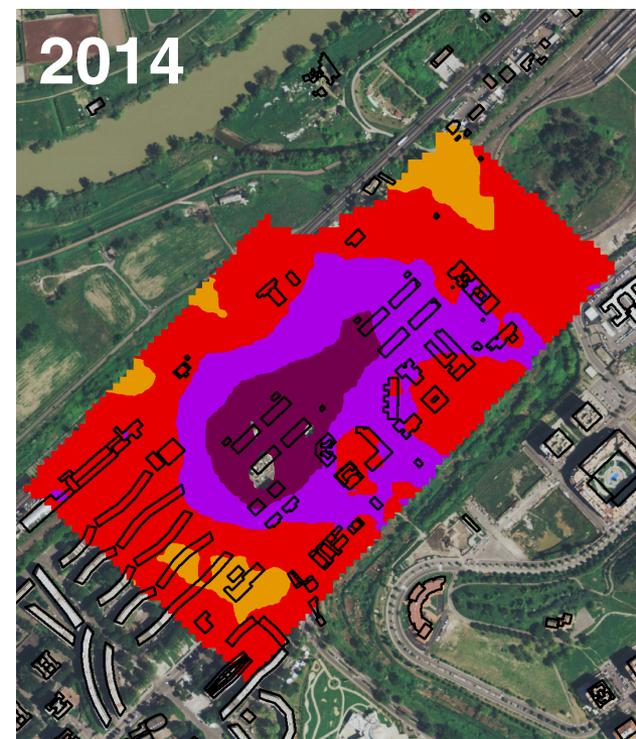
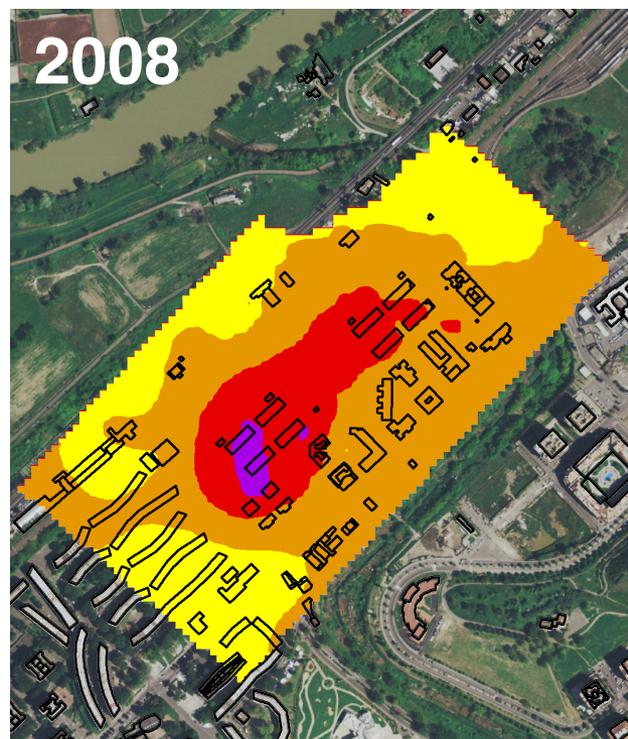
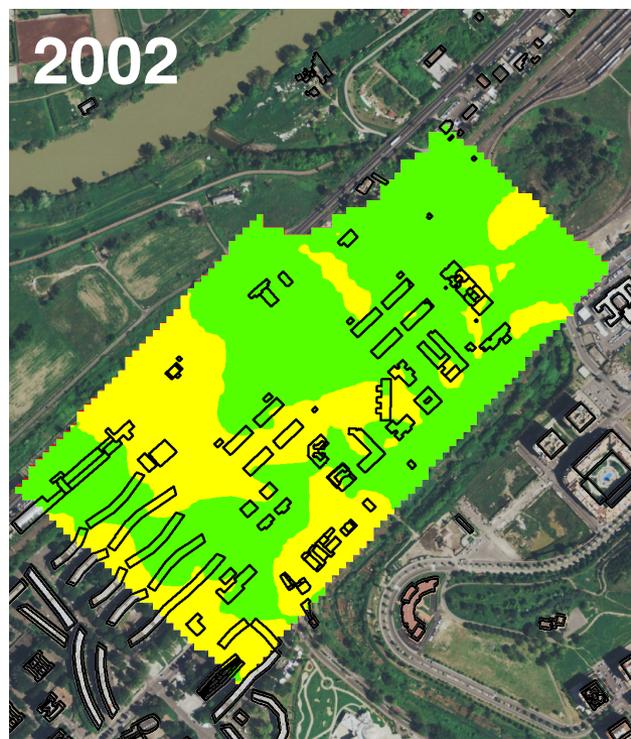


MONITORAGGIO

MANUTENZIONE

Il **monitoraggio** è fondamentale per programmare interventi di **manutenzione** e **messa in sicurezza**

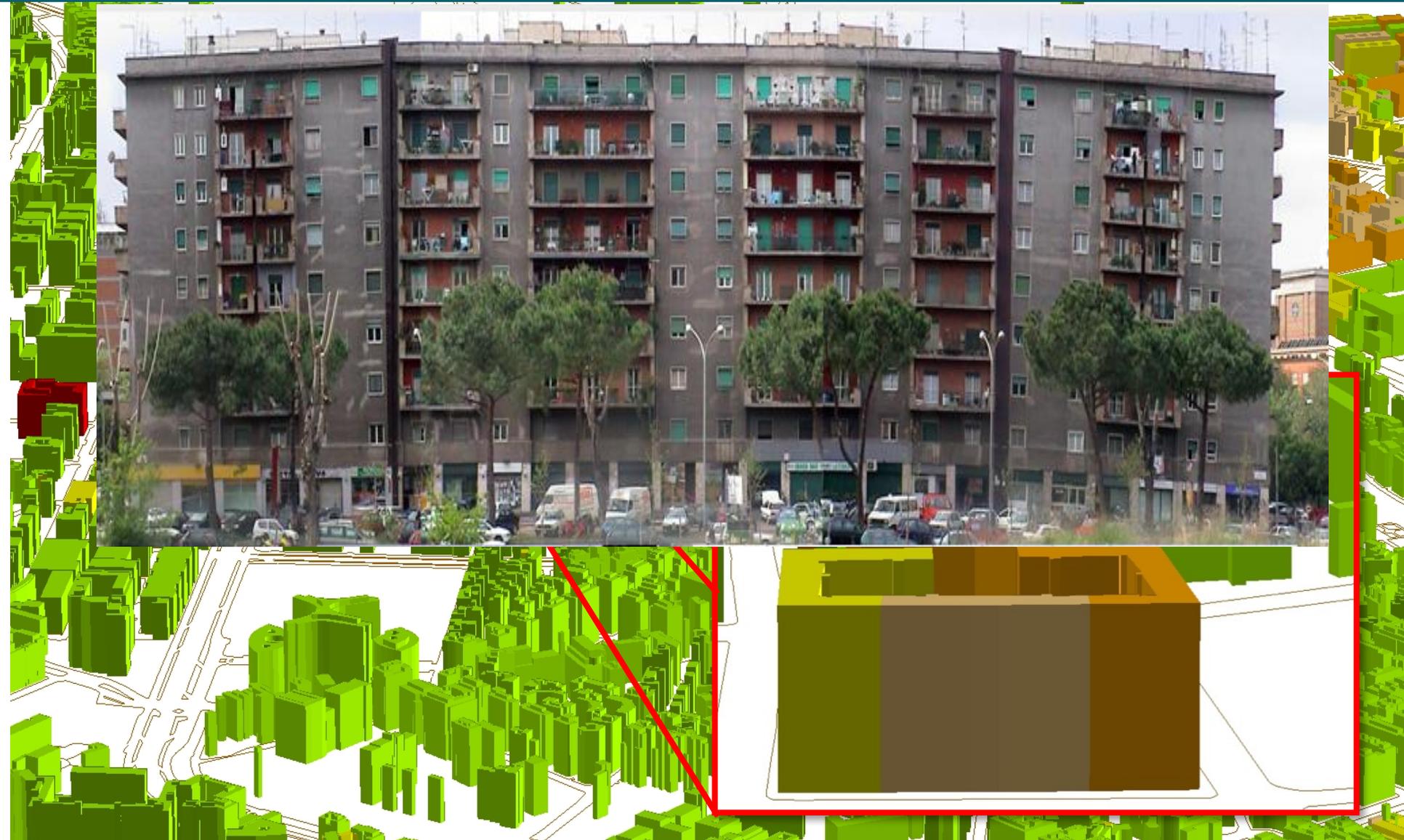




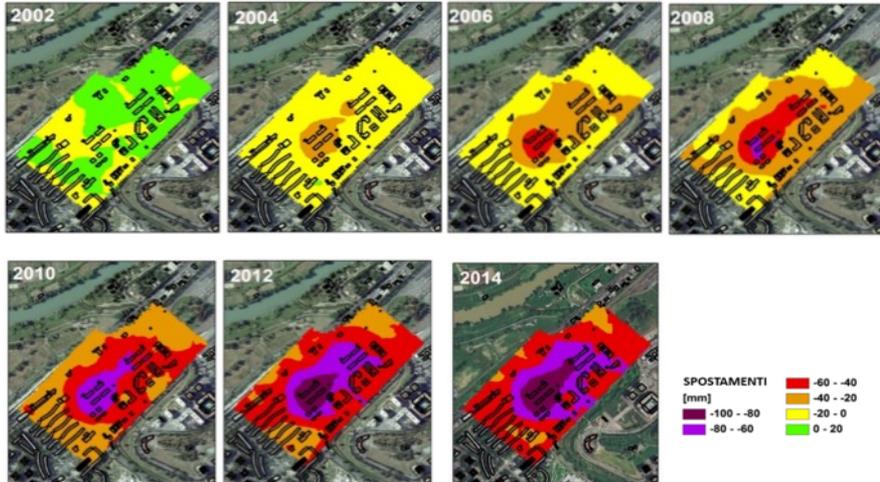
Analisi a ritroso 2002-2014

MAPPE INTERPOLATE

MAPPA DI CLASSIFICAZIONE DEGLI EDIFICI

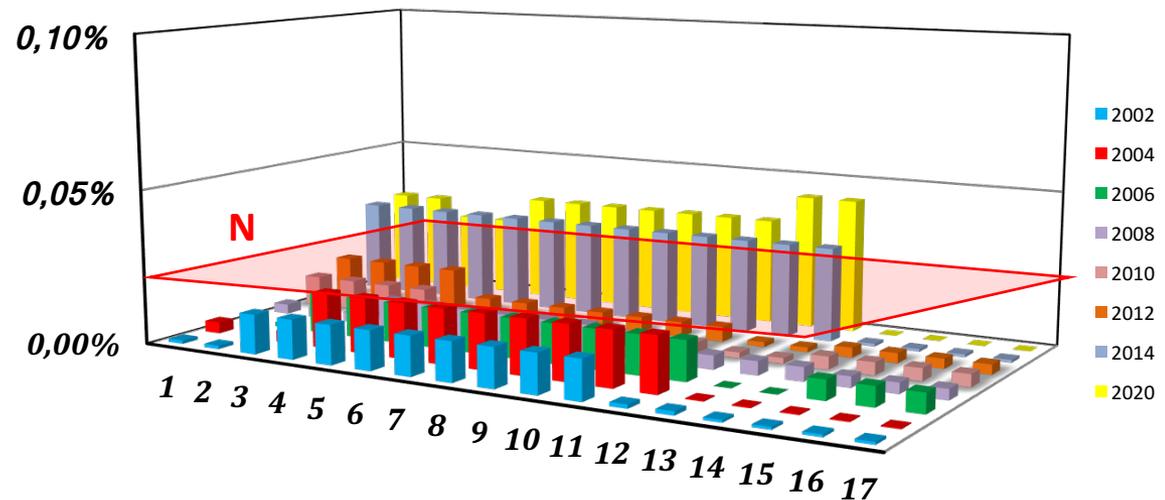


ANALISI SINGOLE STRUTTURE ATTRAVERSO MODELLI SEMI-QUANTITATIVI DELLO STATO DI DANNEGGIAMENTO



Classificazione del danno strutturale
Estensione delle fratture e deformazione a trazione associati alle varie categorie di danno (Burland, 1977; 1995).

Categoria di Danno	Grado di Danneggiamento	Limite deformazione a trazione ε%
0	Trascurabile - N	0.000 – 0.025
1	Molto leggero- VS	0.025 – 0.0375
2	Leggero - S	0.0375 – 0.075
3	Moderate - M	0.075 – 0.15
4 a 5	Grave - Molto Grave - SE	>0.015



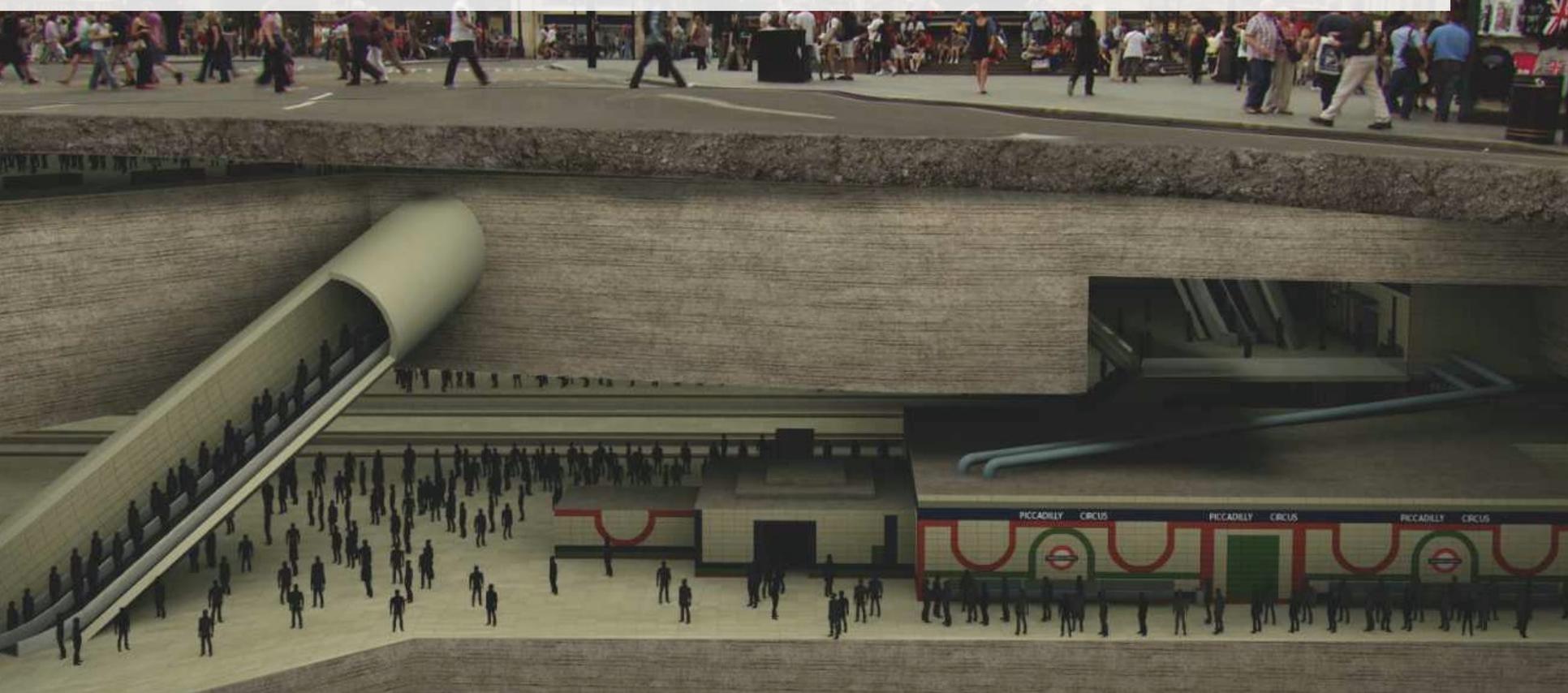


Evidenza **comportamenti anomali**
rispetto al contorno



Permette di andare **indietro** (e avanti) nel tempo

Permette una **analisi a grande scala** tenendo conto del **contesto geologico** e **infrastrutturale**



H2020 - SME Instrument Phase 2

This project has received funding from
the European Union's Horizon 2020
research and innovation programme
under grant agreement No 720121

“The innovation aims new market opportunities
addressing EU/global challenges”

Grazie per l'Attenzione!

esa



0 days 00 hours 00 minutes
Sentinel-2 constellation:
summer solstice