

3rd SIIW Winter School – Moena, Italy

“Pavement Assessment and management
towards Smart and Safer mobility”

*Smart and safety mobility:
my research view*

Actual framework, main concepts, novel tools and
challenging perspectives

Andrea Benedetto





Short outline

the perspective and the stage of Research

thinking on Research in our field

the actual context

smart and safe roads: the new paradigm

a visionary route

» *Which role for Research...*

Research & Life Life & Research

«in depth» investigation...

«wideness» of knowledge...



» *Social priorities and needs
and visionary perspective...*

Life Society Quality

...new trends and strong positive social
pressing towards high standards of quality of
life...

do not forget that TRANSPORTATION and MOBILITY
impact enormously on social life and well being





» *Consciousness of new paradigms
and tools... and in the meanwhile...*

Smart working

Digital literacy

Connectivity enhancement

... a Covid «positive» legacy...
... probably the unique



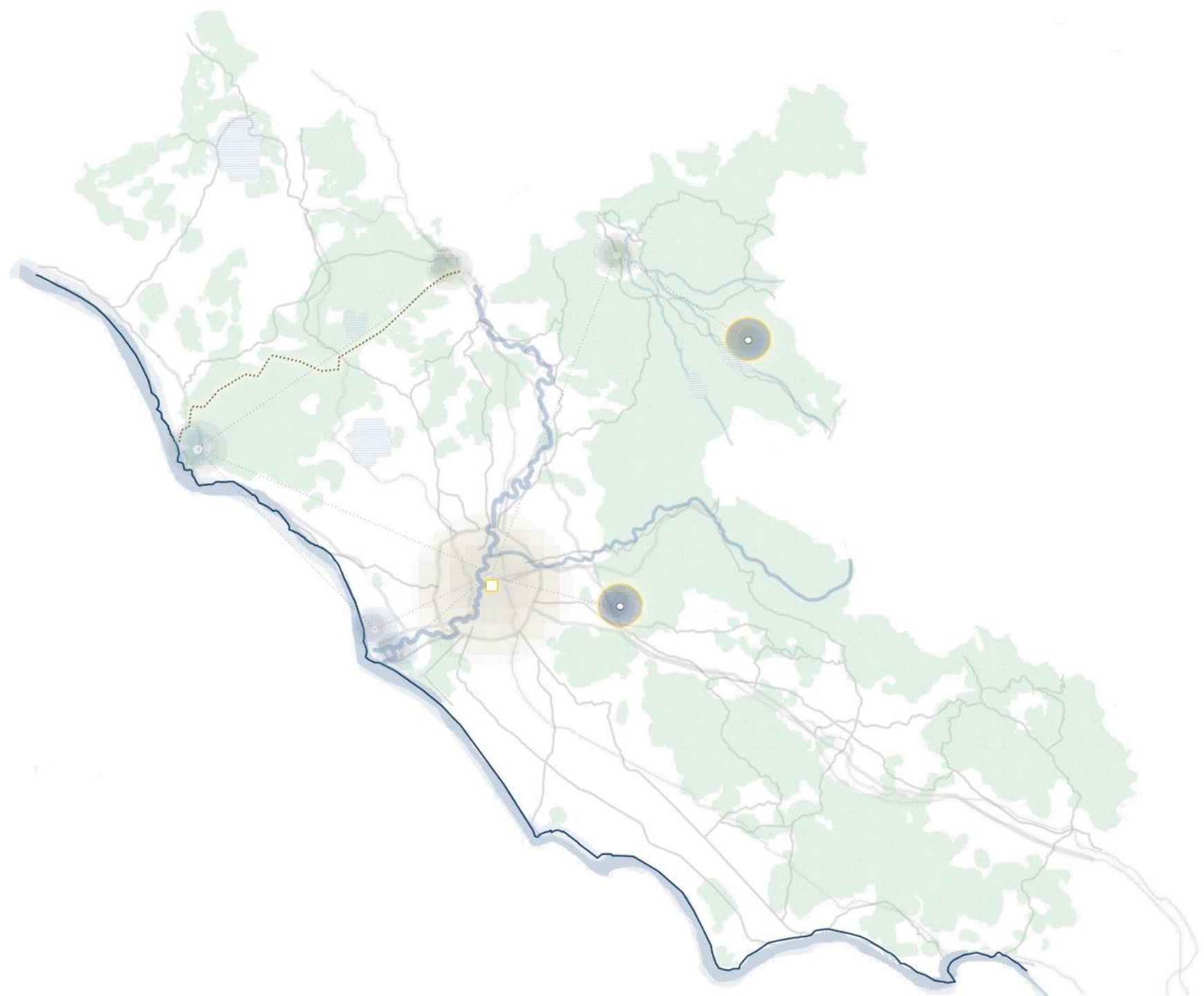
» *Material and immaterial assets
and cultural heritage...*

... growth of the economy of minor historical towns and cultural heritage...

History
Culture
Nature
Beauty

different and heterogeneous environments

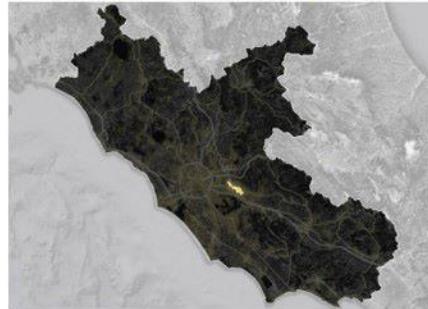
inadequate infrastructures, lack and deficit of maintenance, defects and damages



» *Classification...*

» *Cases...*

Zagarolo



ZAGAROLO

Petrella Salto



PETRELLA SALTO

Ferrovia dismessa
Civitavecchia - Orte



FERROVIA DISMESSA CIVITAVECCHIA - ORTE

Il tratto costiero
Ostia - Civitavecchia



IL TRATTO COSTIERO FIUMICINO - CIVITAVECCHIA



ZAGAROLO

Analisi e Dati

DATI E GRAFICI RELATIVI AL SISTEMA AMBIENTALE

Rischio da Frana

	Città	Provincia	Regione
di attendere PAV - AA	6	42.439	104.823
a pericolosità frana PAV moderata - P1	132	6.068	31.537
a pericolosità frana PAV media - P2	71	1.471	9.787
a pericolosità frana PAV elevata - P3	258	5.803	15.782
a pericolosità frana PAV molto elevata - P4	12	17.672	73.599

DATI E GRAFICI RELATIVI AL SISTEMA DEMOGRAFICO E INSEDIATIVO

Andamento popolazione residente

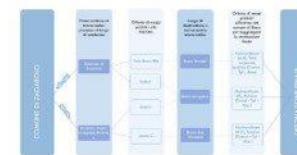


DATI E GRAFICI RELATIVI AL SISTEMA RELAZIONALE

Spostamenti e direzioni



Grafico degli Spostamenti



Territorio regionale



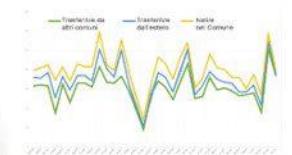
Territorio provinciale



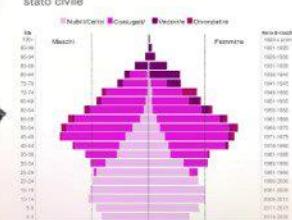
Variazione percentuale della popolazione



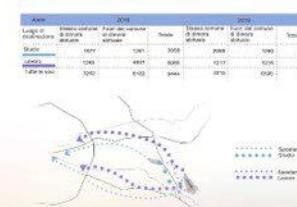
Variazione demografica e provenienze



Popolazione distribuita per età e stato civile



Spostamenti quotidiani della popolazione residente

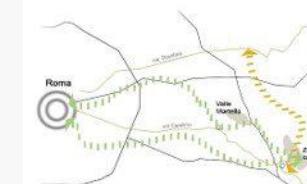


» *in depth...*

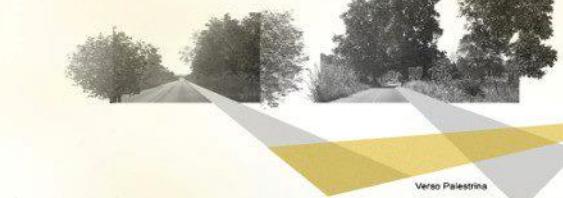
ZAGAROLO

Strategie di rigenerazione

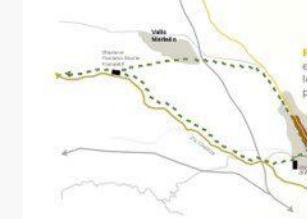
Strategie di rigenerazione a scala provinciale



Potenziare le connessioni con la Capitale e i principali centri abitati



Strategie di rigenerazione a scala comunale



Ricucire il tessuto urbano esistente e riconnettere le aree insediative con le principali infrastrutture

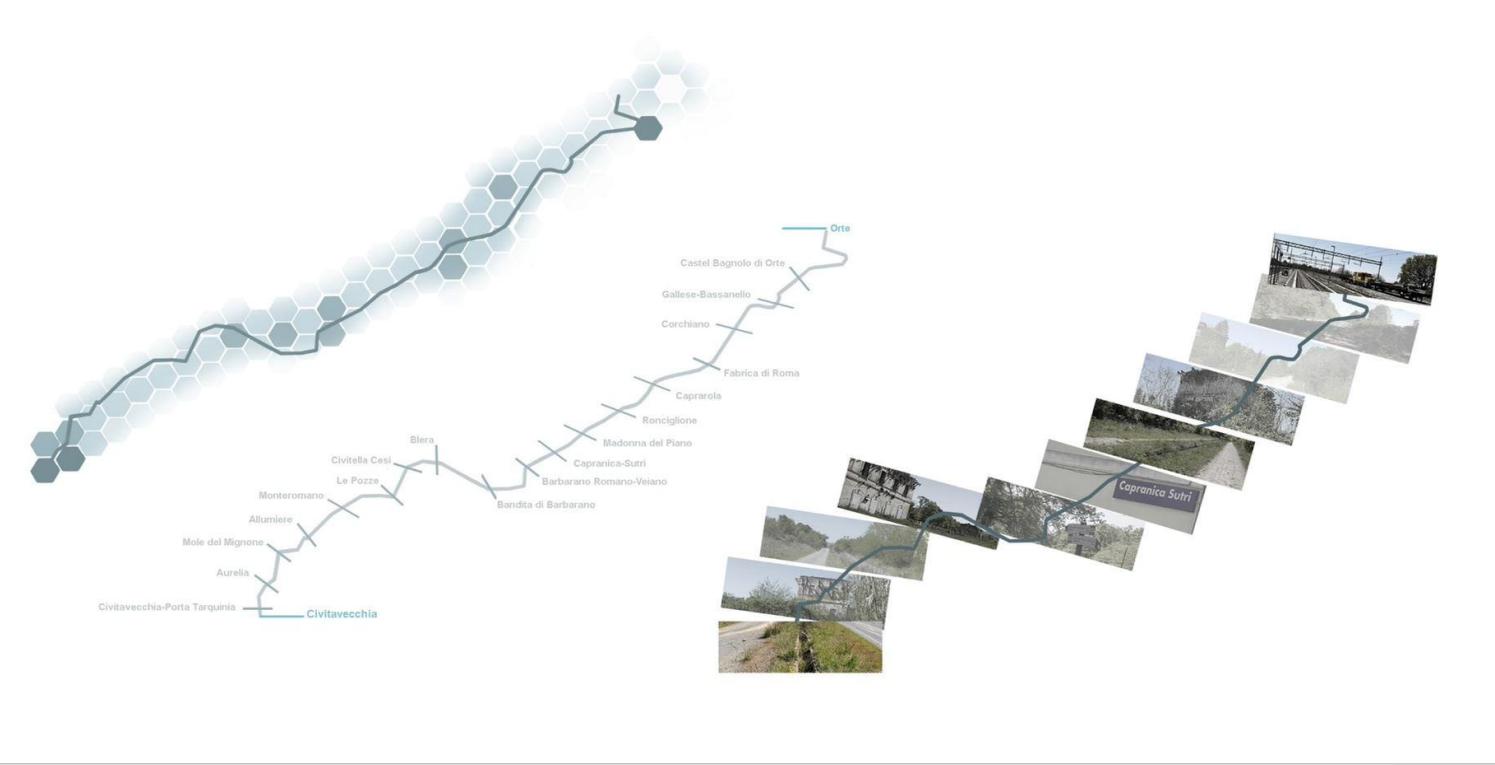


Strategie di rigenerazione a scala locale

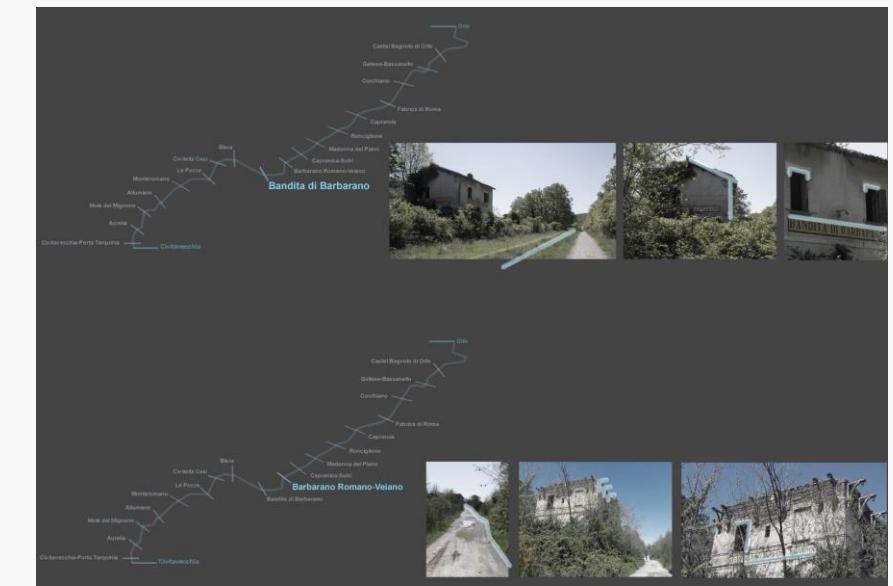
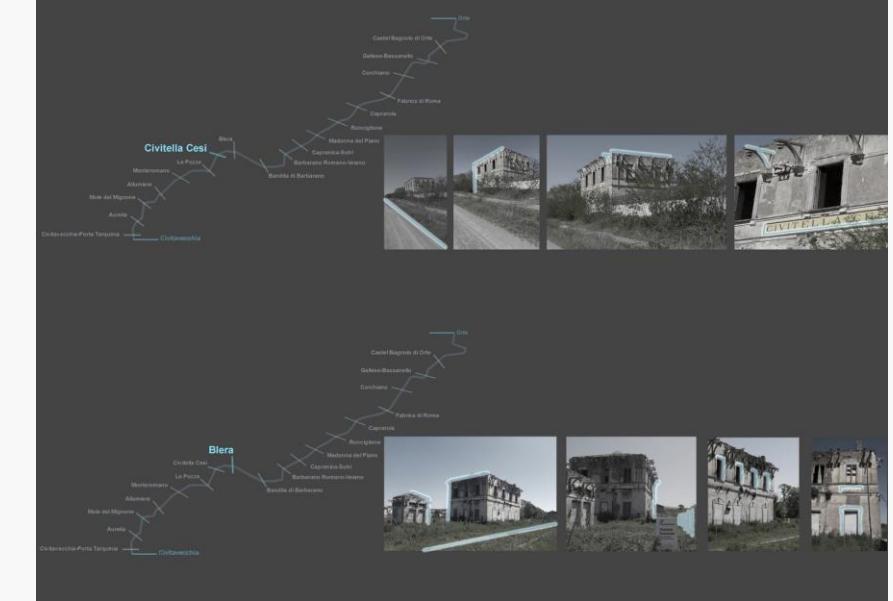


Metterizzare le peculiarità della città attraverso la realizzazione di percorsi e aree tematiche





» in depth...



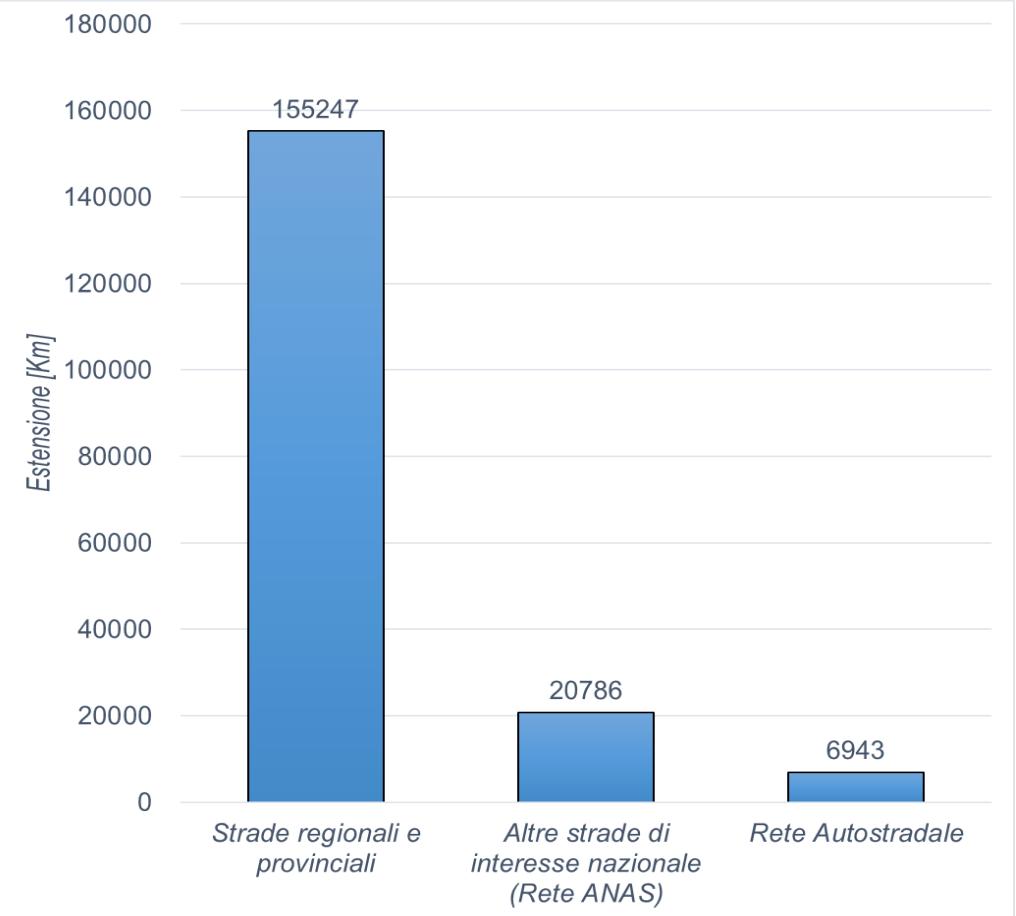


» *Which asset without investment?*

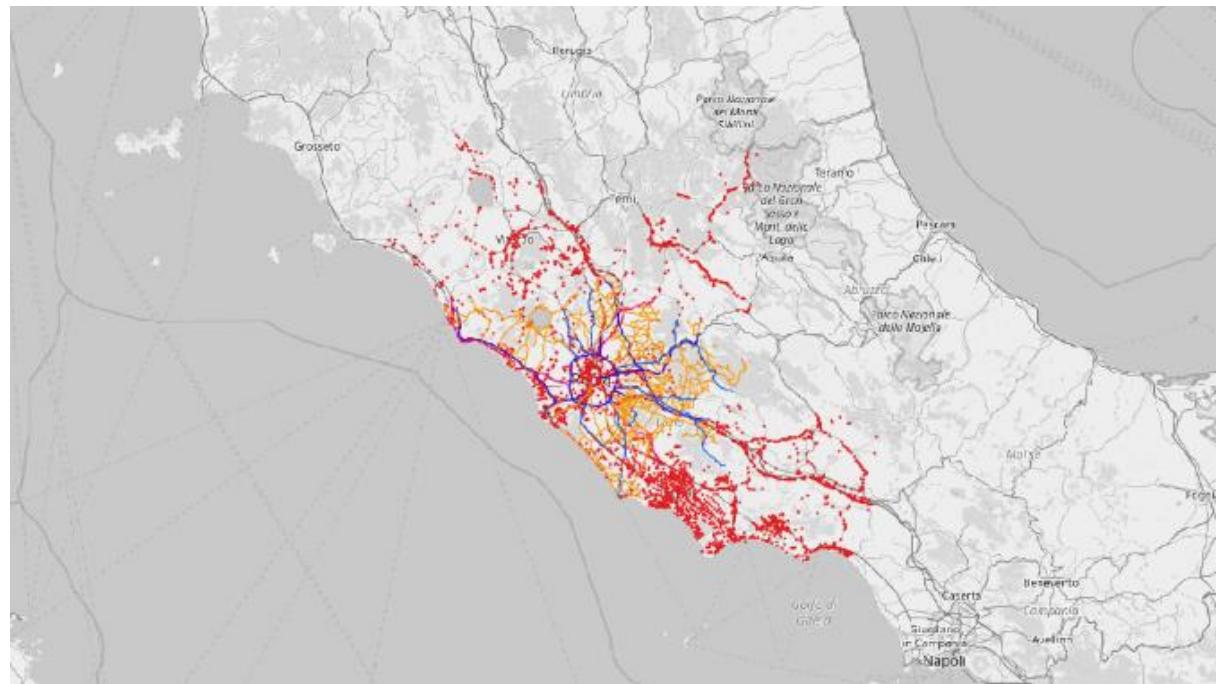
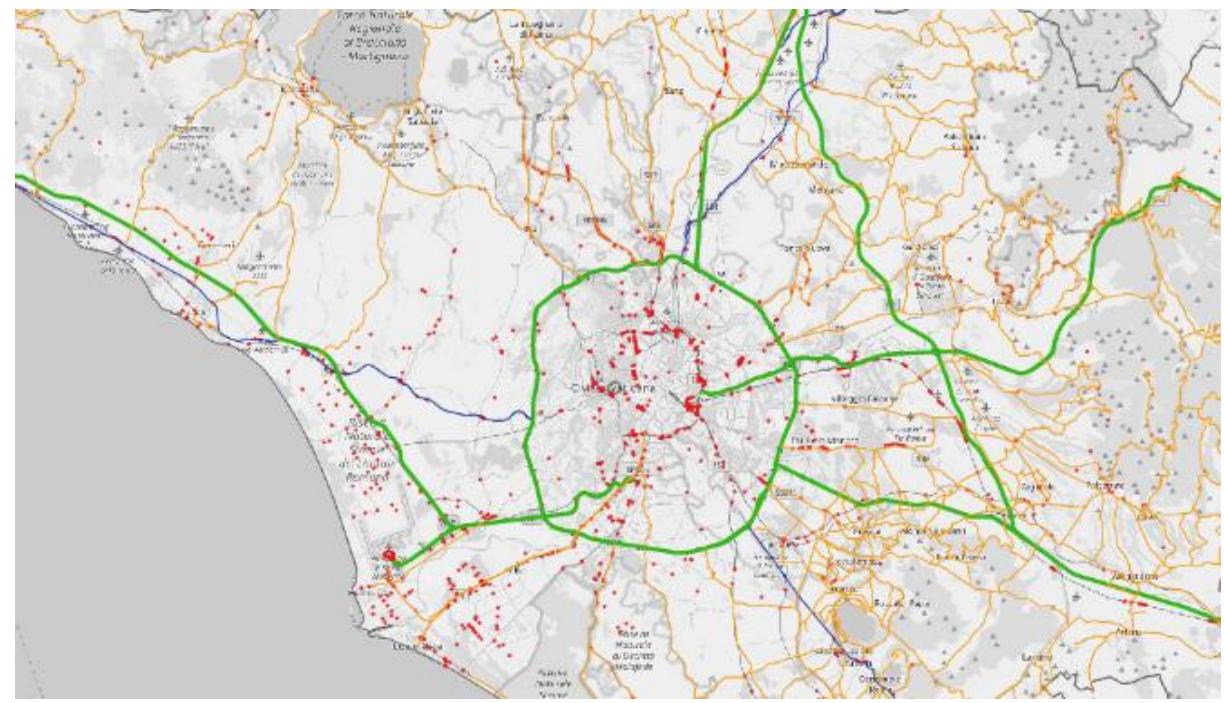
The dimension of the networks

The allocated resources

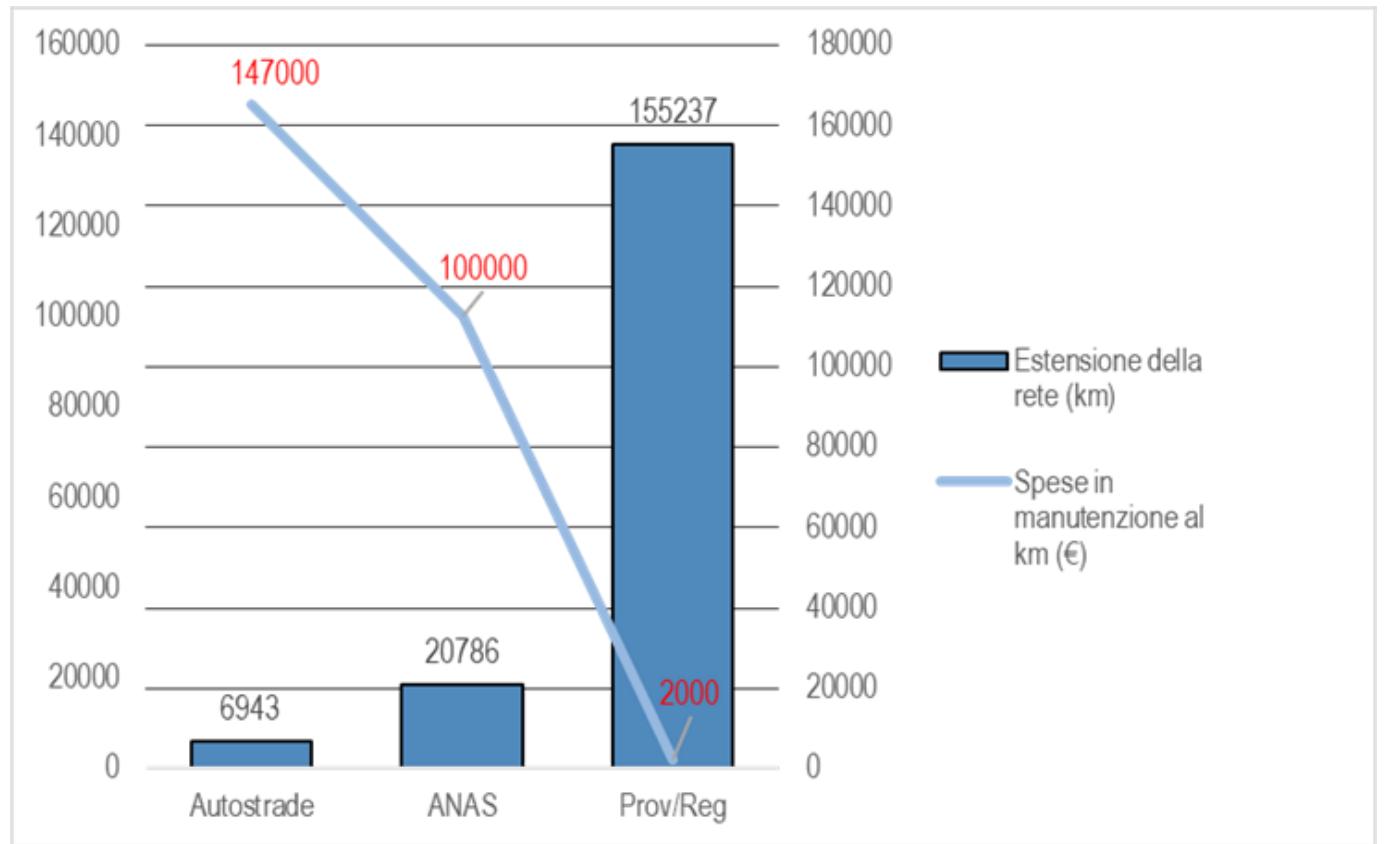
...between uncertainties and bias



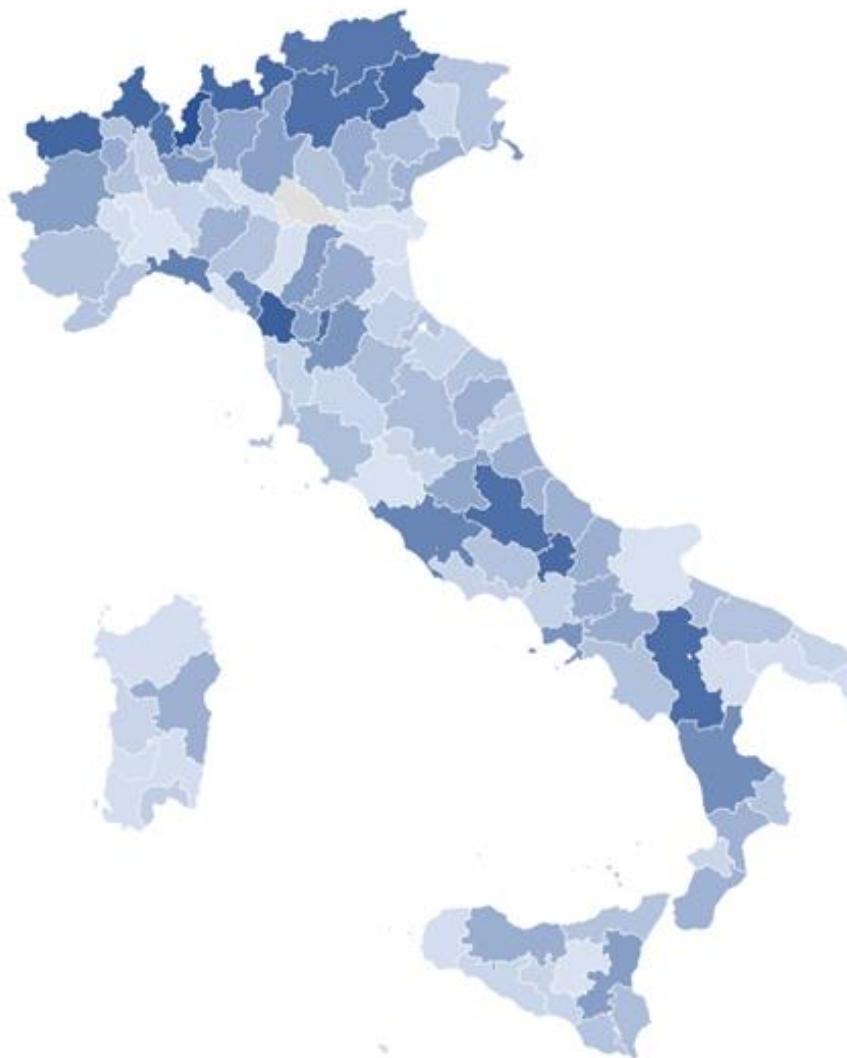
» *Networks extent*



» *Bridges and tunnels*



» *Uneven spending*



Costo Annuo Complessivo €/KM



» *real needs... a tremendous gap*

Smart & Safe Roads

new and novel concepts...



A capillary road network (paved)

*it is an extraordinary and unique
resource... a great potential towards
the green transition*

*distributed
sustainable
inclusive
equal*

» *The start point of strength...*



Aging & deficit of maintenance

defects and damages impact on

- *operative life*
- *safety*

» *The start point of weakness...*





Resilience

...not only ordinary decay and declining

» *The start point, opportunity and threat...*



» *The green strategy... the green road*

Capillary network
Aging and maintenance
Resilience

...need of knowledge
- observation of large areas
- observation of details



» *Large areas from space*

Satellite

Earth observation

Sentinel 1 (A e B) mission – C-Band

- *Sentinel-1 is a space mission of the European Space Agency (ESA "European Space Agency") included in the Copernicus program.*
- *C-Band, wavelength equal to 5.6 cm, frequency 5.405 GHz.*
- *The first satellite, Sentinel-1A was launched on April 3, 2014.*
- *The revisiting time of the same scene is 12 days*

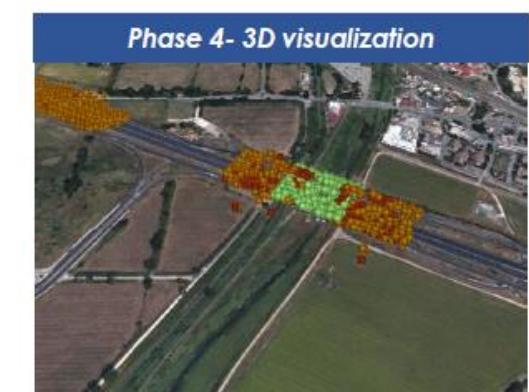
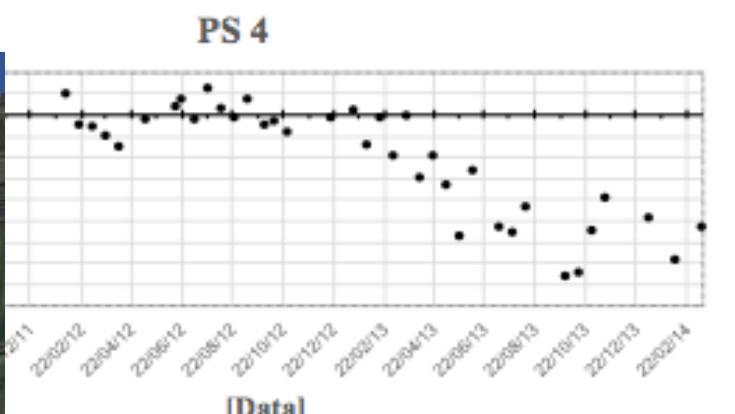
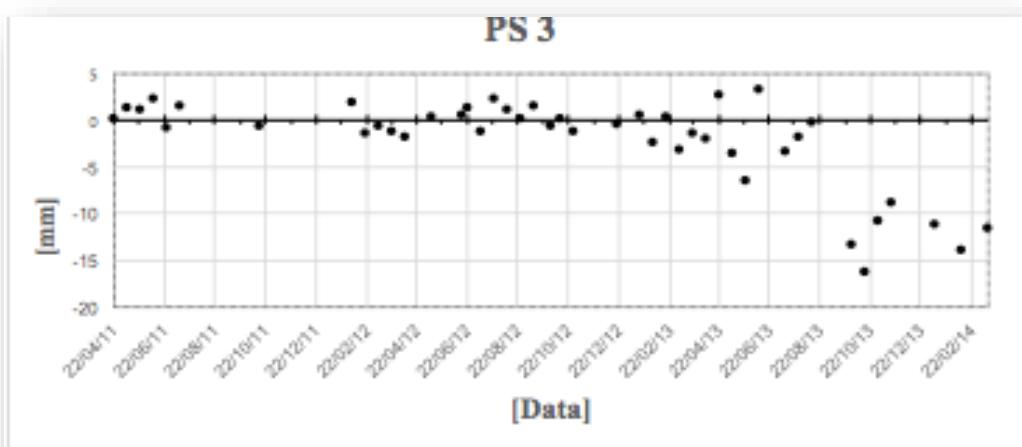
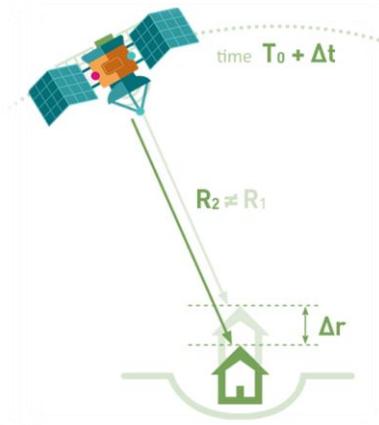
COSMO-SkyMed – X-Band

- *Developed by the Italian Space Agency (ASI) in cooperation with the Ministry of Defense, COSMO-SkyMed is based on a constellation of four identical satellites,*
- *Synthetic Aperture Radar (SAR) working in the X (wavelength 3 cm; frequency 9.6 GHz).*
- *Ground Resolution cell 3m x 3m. Revisiting time varies from 16 days (for one satellite only) to 4 days (full constellation).*

» *Large areas from space*

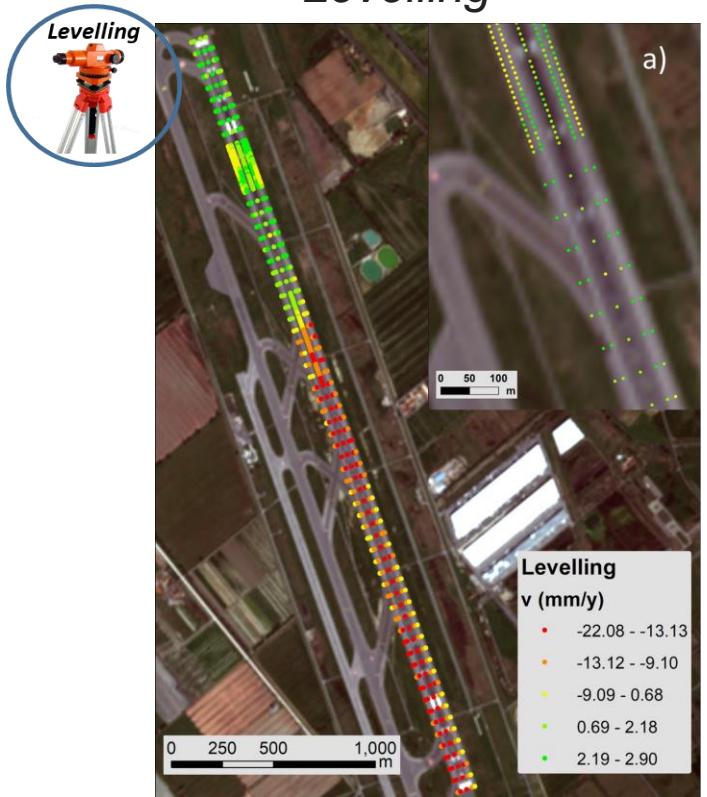
Satellite



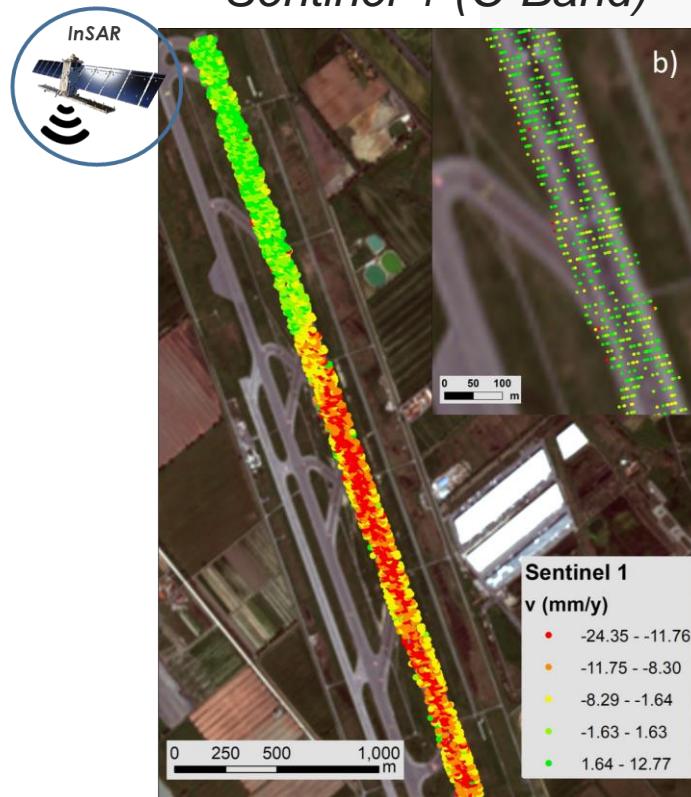


» *Data processing*

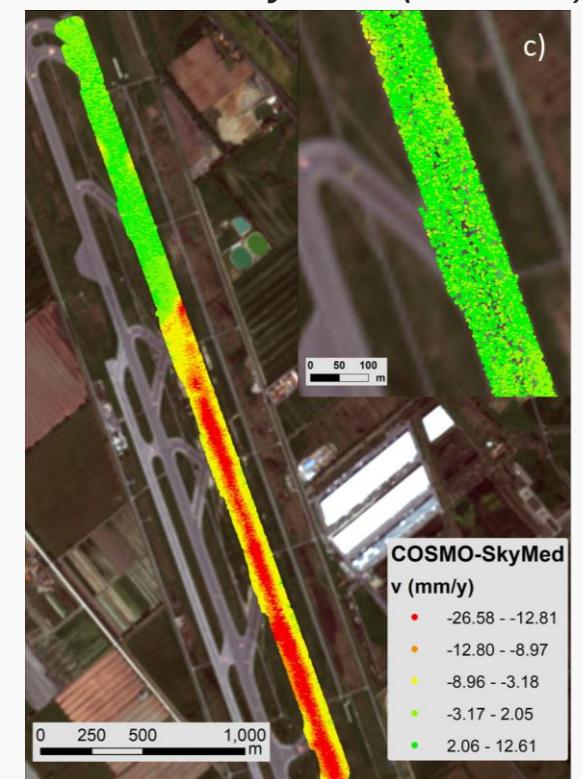
Levelling

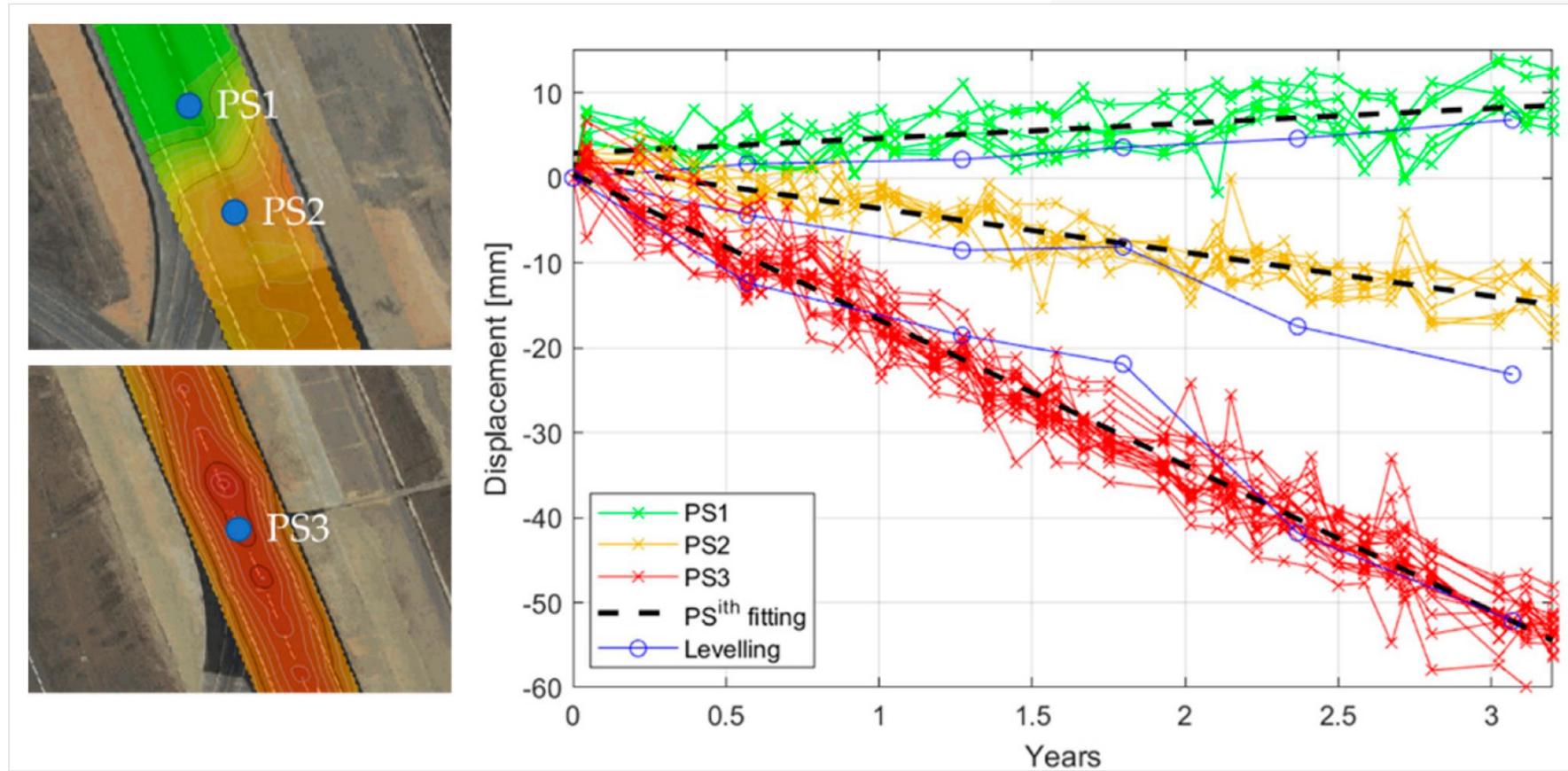


Sentinel-1 (C-Band)



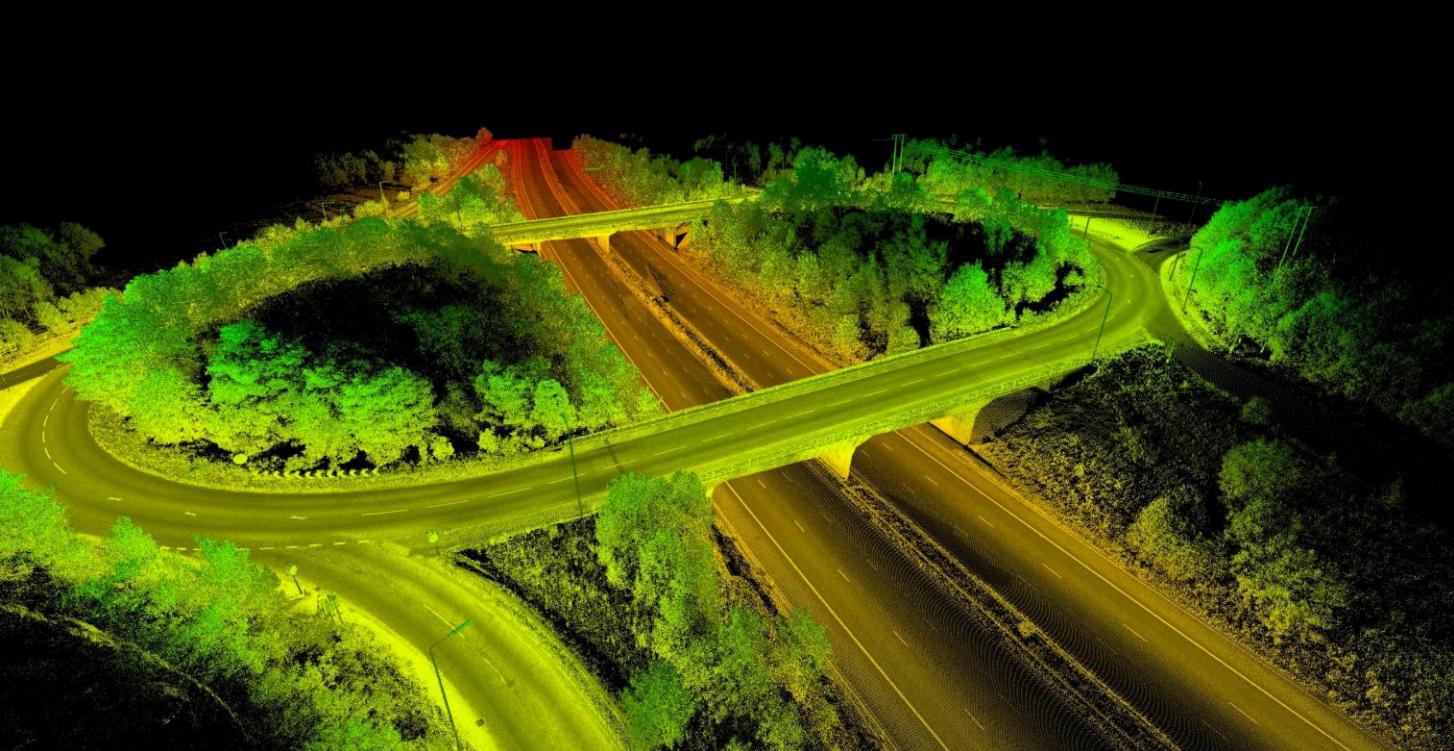
COSMO-SkyMed (X-Band)





Surveyed Point	Displacement Velocity by Levelling (mm/yr)	Displacement Velocity by InSAR (mm/yr)	RSME (mm)
PS1	1.68	1.76	2.4659
PS2	-6.21	-5.16	4.9875
PS3	-16.93	-17.16	3.9101

» *quasi-continuous data in time and space*



Lidar UAV

*aerial and ground based
observations*



» *Details from ground and air*

UAV application



Lidar
UAV

• • •

» *Details from ground and air*

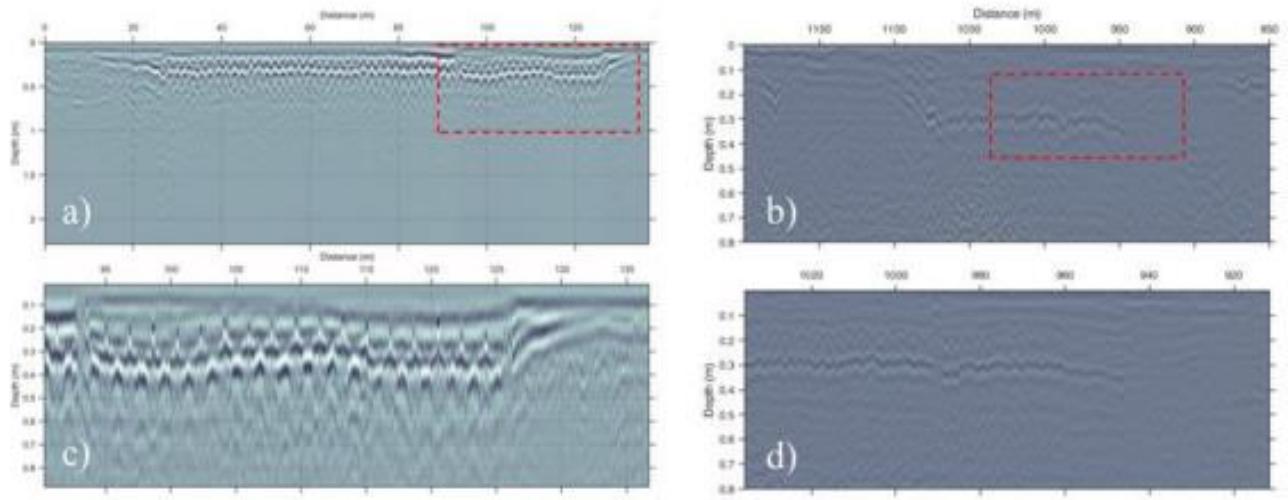
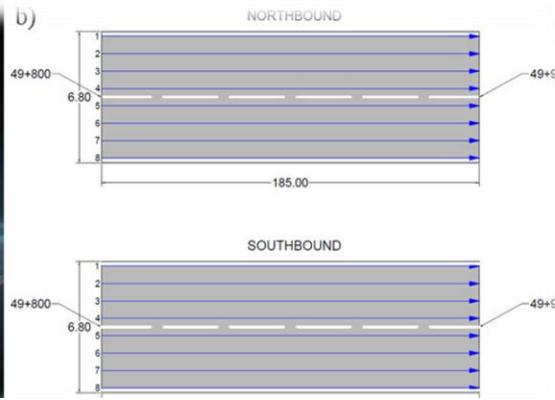
UAV application



» *Details from ground and air*

Lidar UAV





GPR

pavement, bridges and tunnels

» Radargrams from underground...

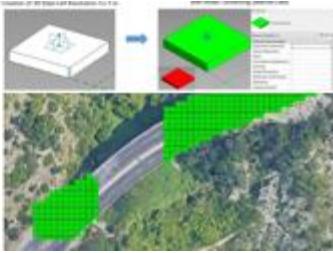
» Radargrams from underground...



GPR

construction elements

InSAR Data



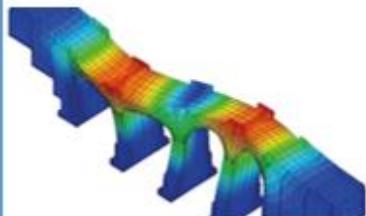
Laser Scanner



Damages evaluation



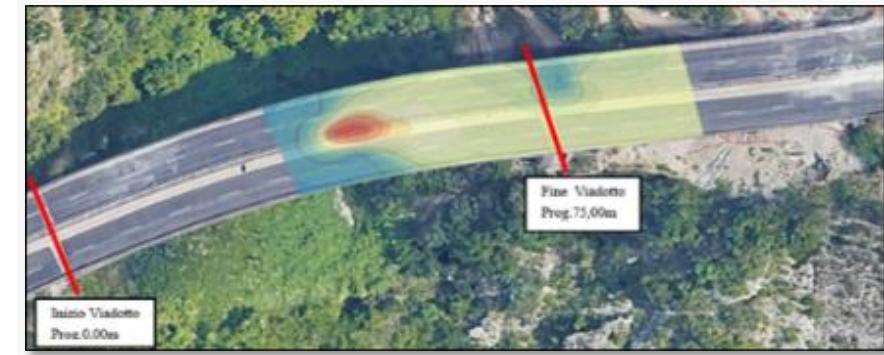
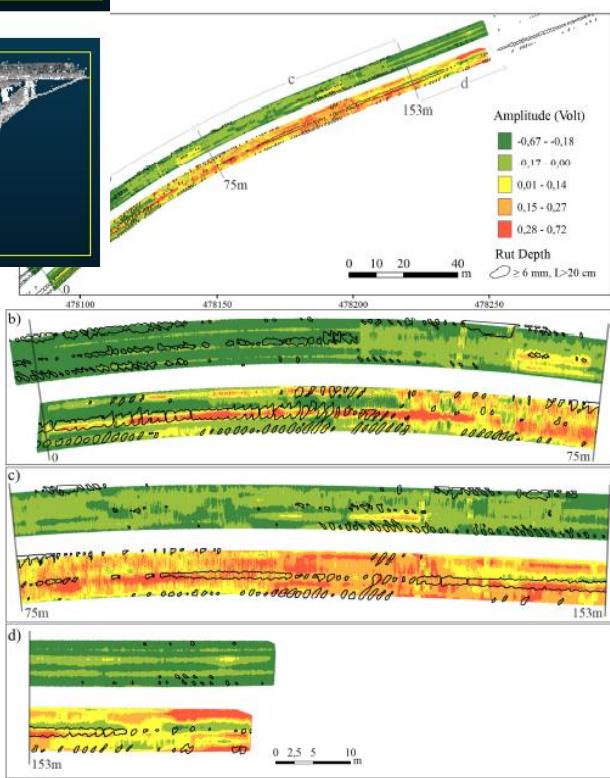
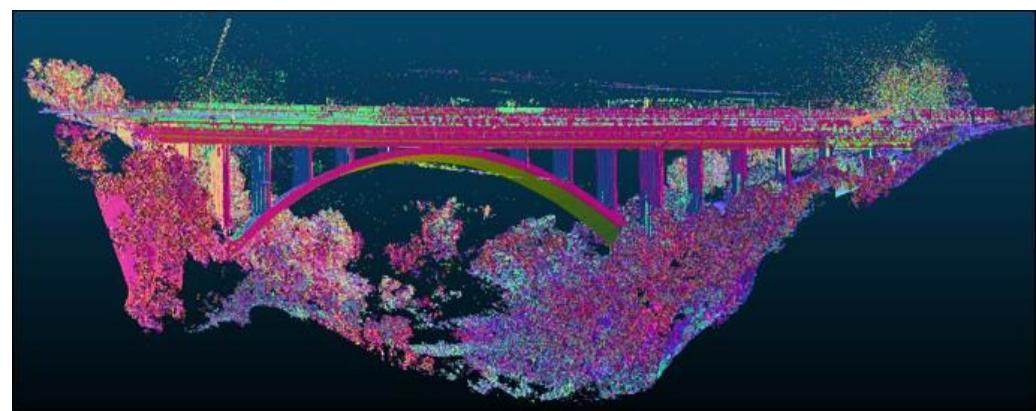
FEM analysis



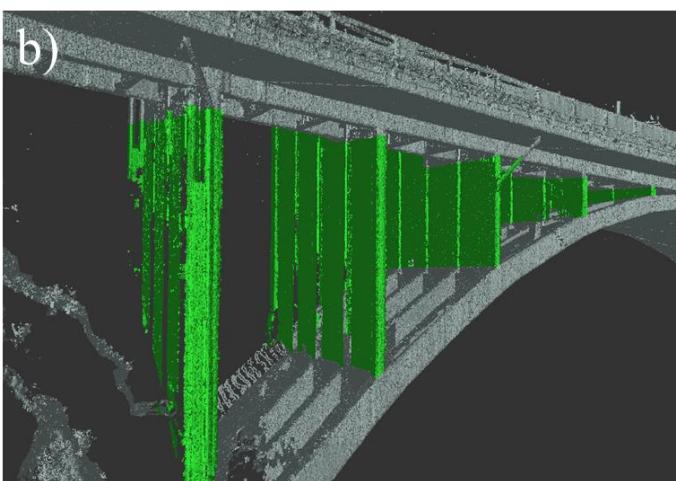
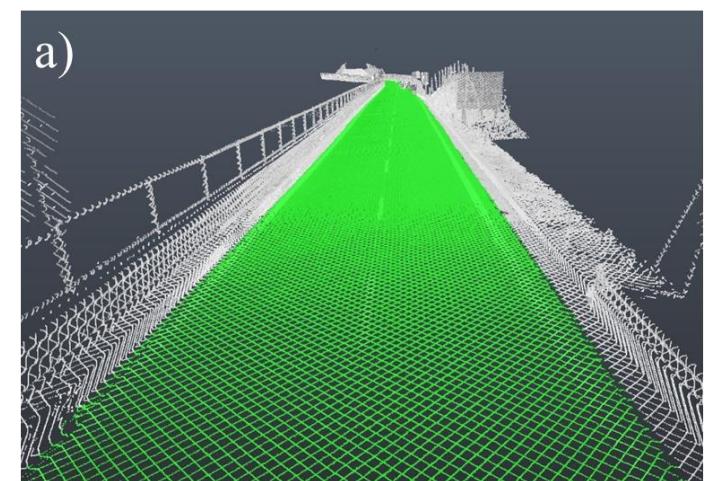
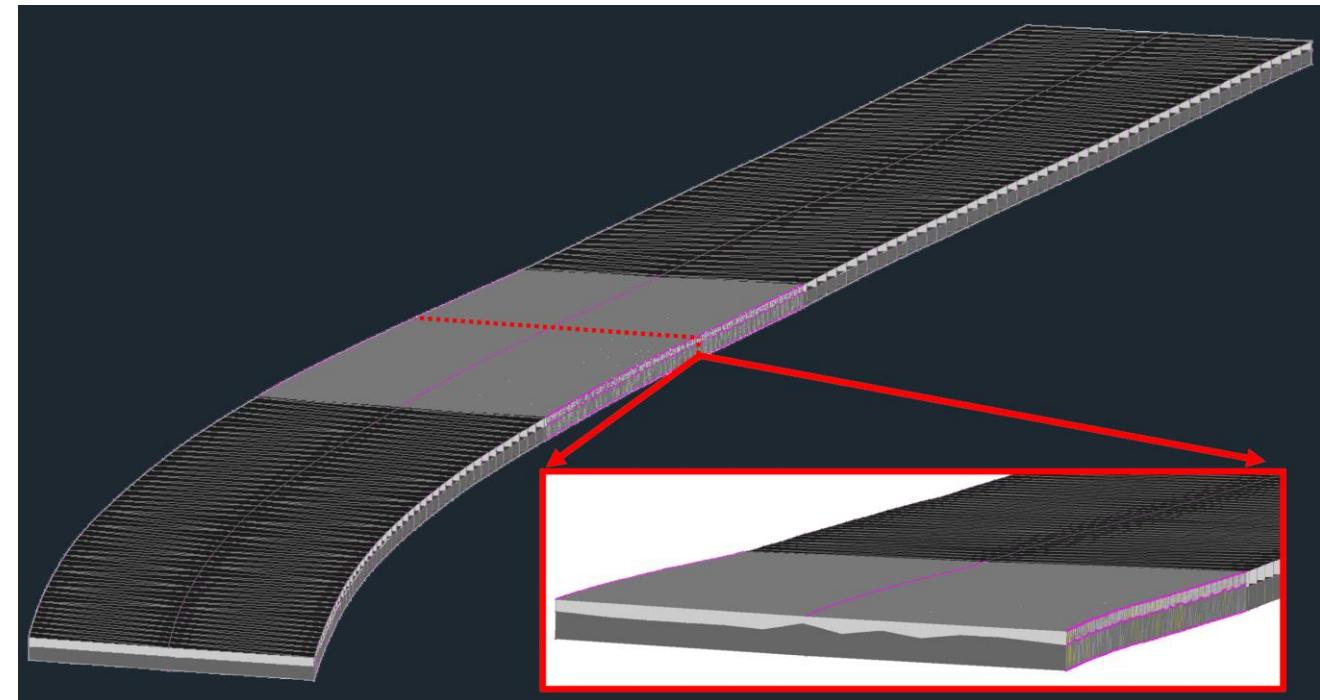
» *Fusion...*

Data Fusion BIM

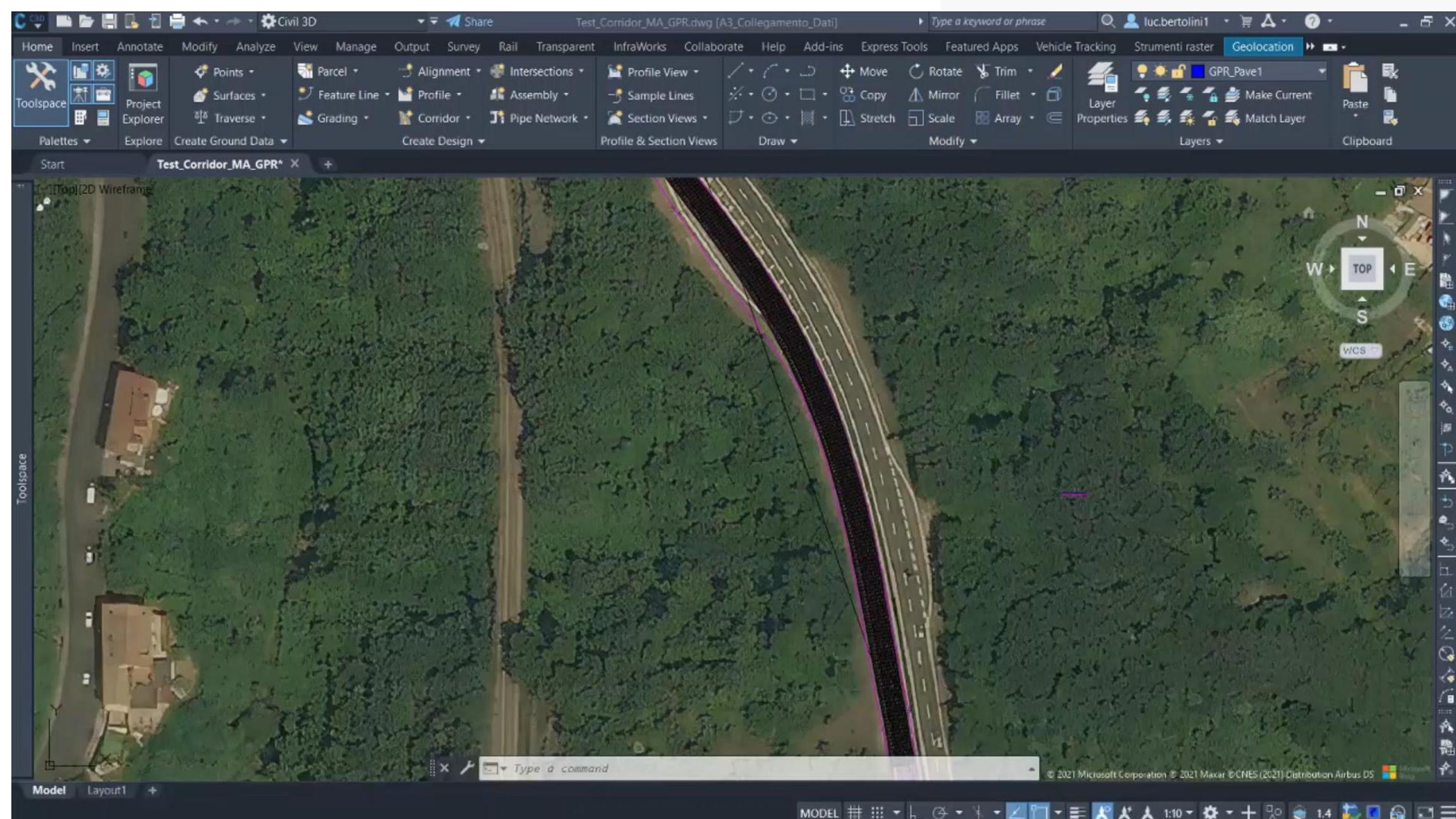




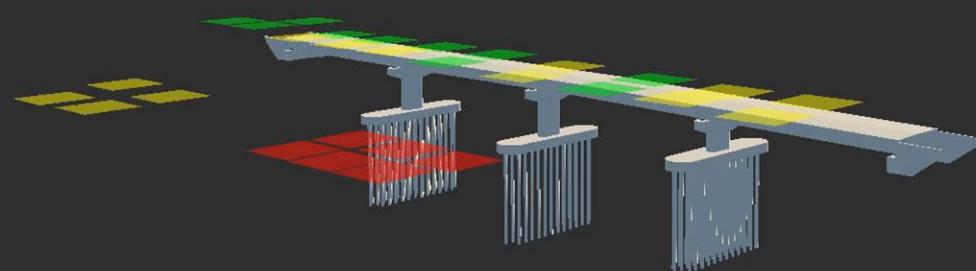
» *Fusion...*



» *From fusion to the Digital Twin*



» *Digital Twin processing...*



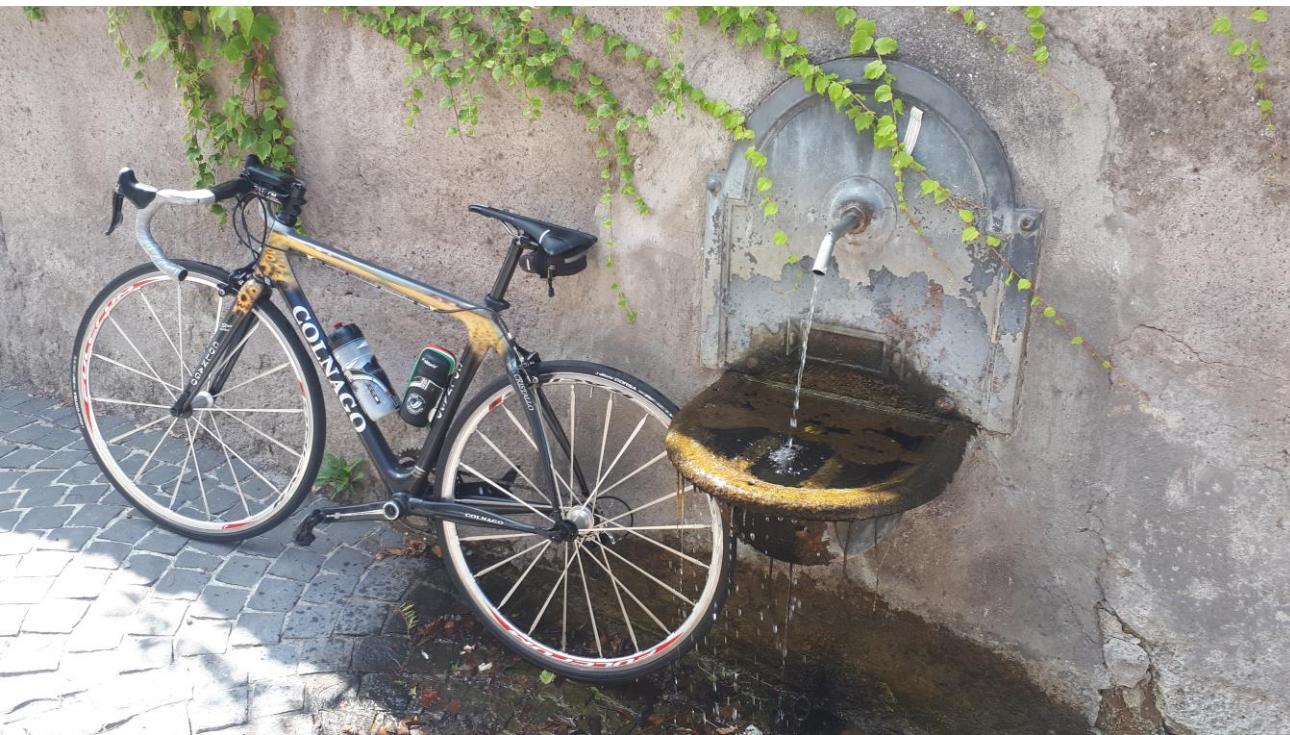
» *Where are we going?*

From the Digital Twin to
the Augmented Reality



» Now I do not know which the future could be

...probably bike... I have eleven... the top 3!



Thank you