

Multi-temporal satellite DInSAR techniques for the monitoring of the built-up environment

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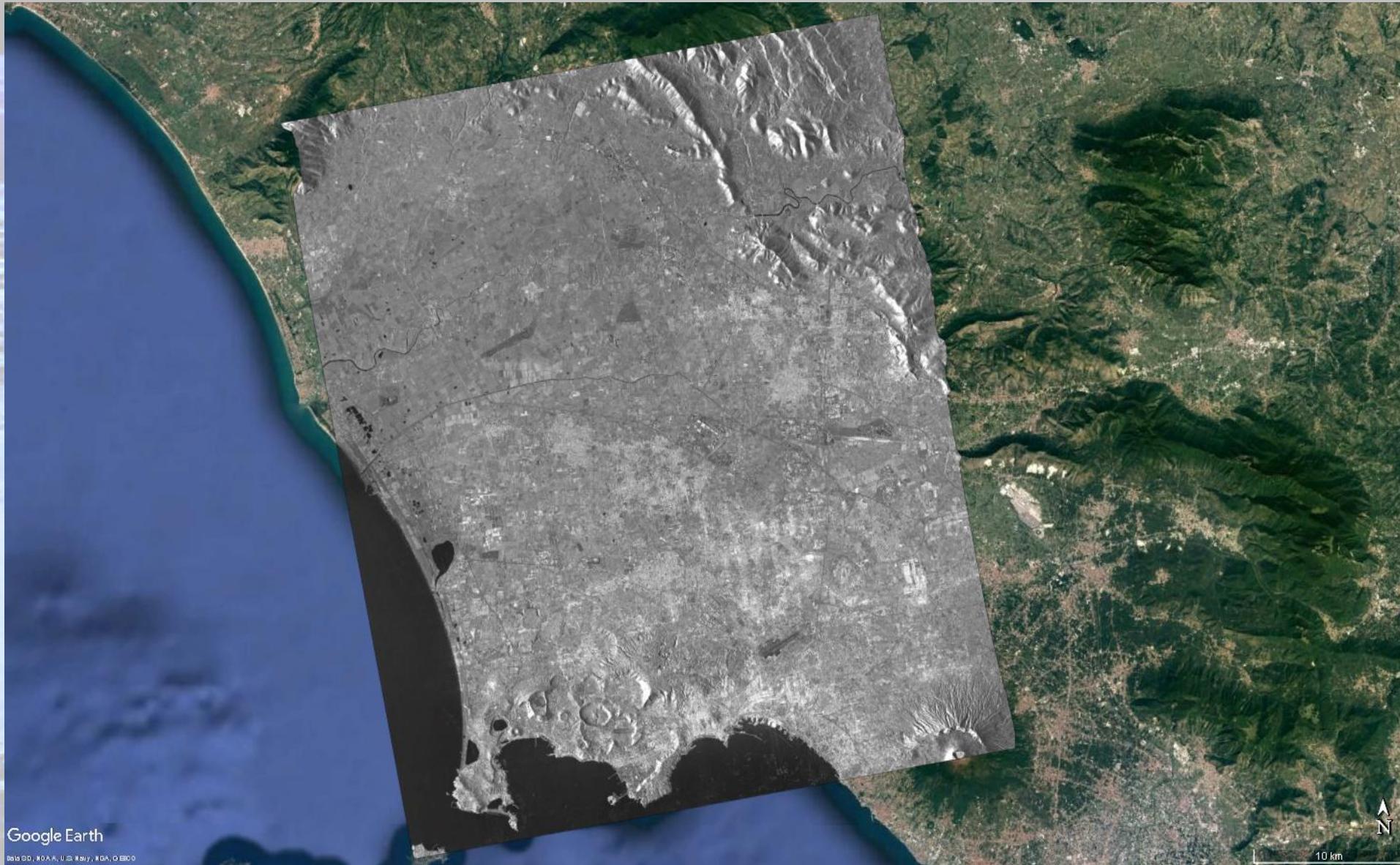
SAR: Microwave Imaging at high resolution



SAR: Microwave Imaging at high resolution



SAR: Microwave Imaging at high resolution

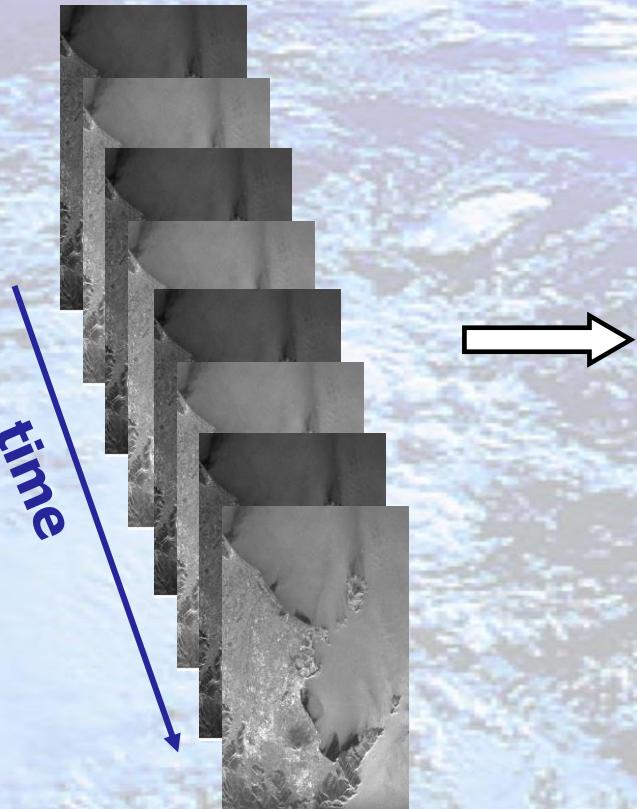


Google Earth

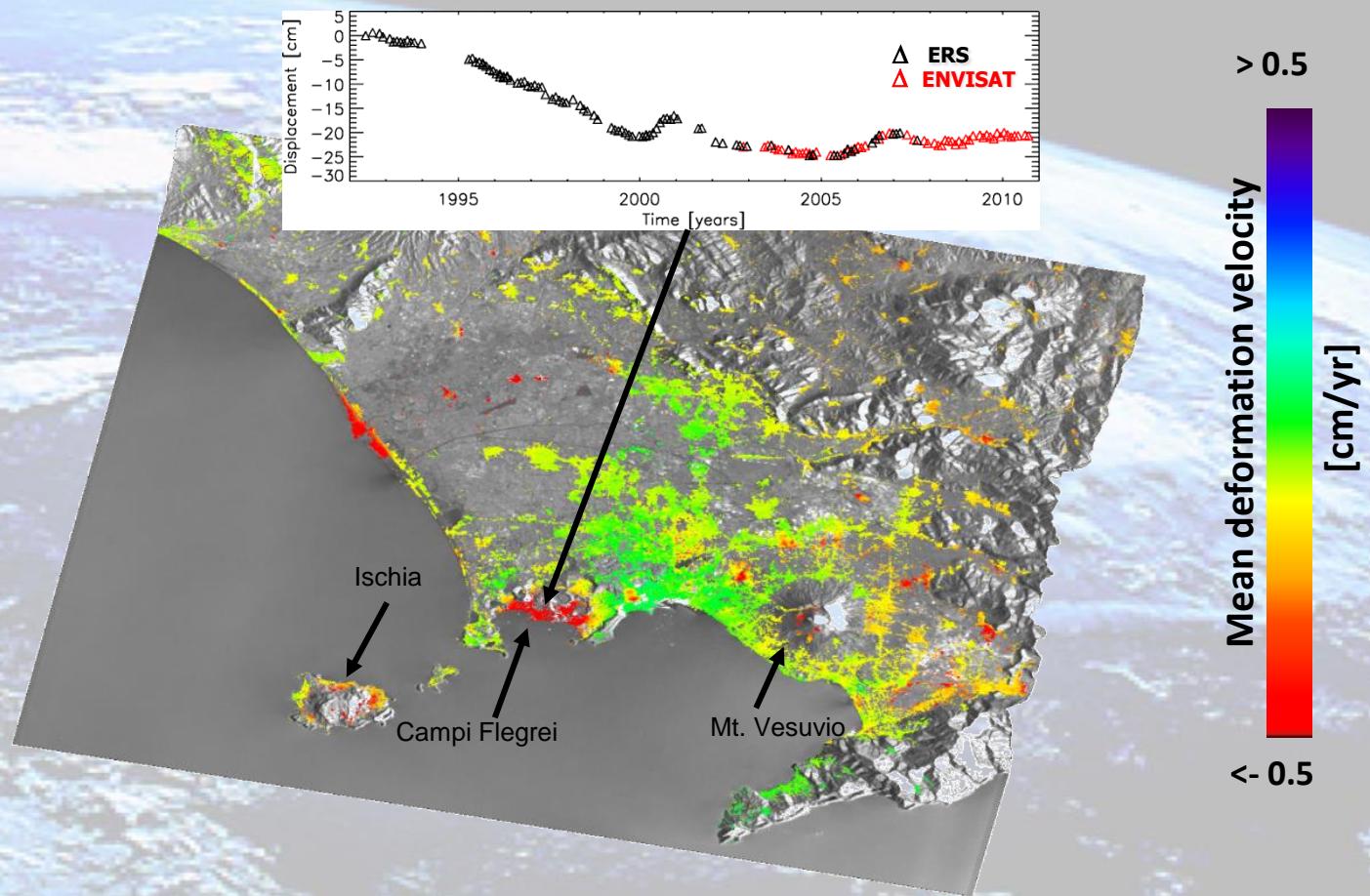
Basis: DO, NOAA, USGS, NGA, OGC, GIO

Advanced multi-temporal DInSAR techniques

SAR Images



ERS/ENVISAT images (1992 – 2010)



Berardino et al., 2002, IEEE Trans. Geosci. Remote Sens.

Lanari et al., 2004, IEEE Trans. Geosci. Remote Sens.

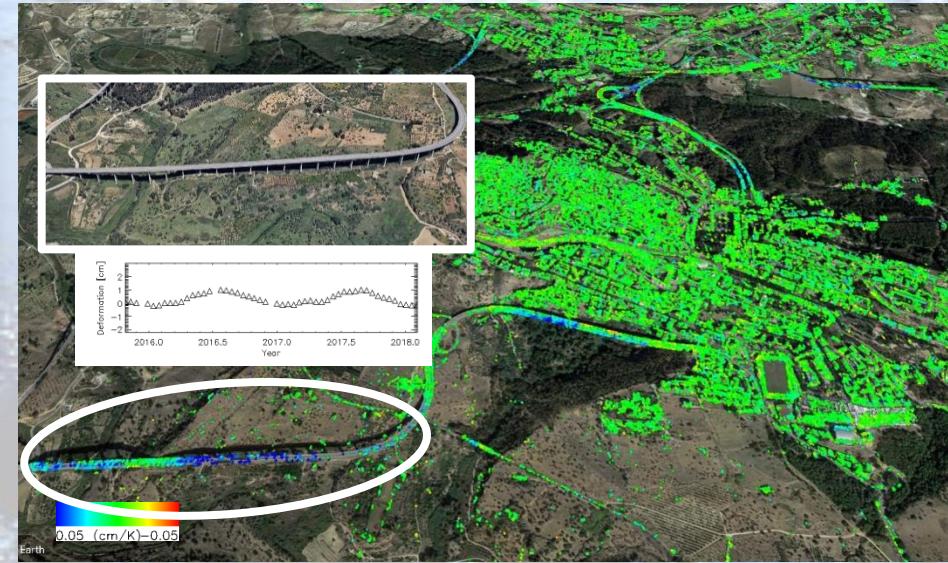
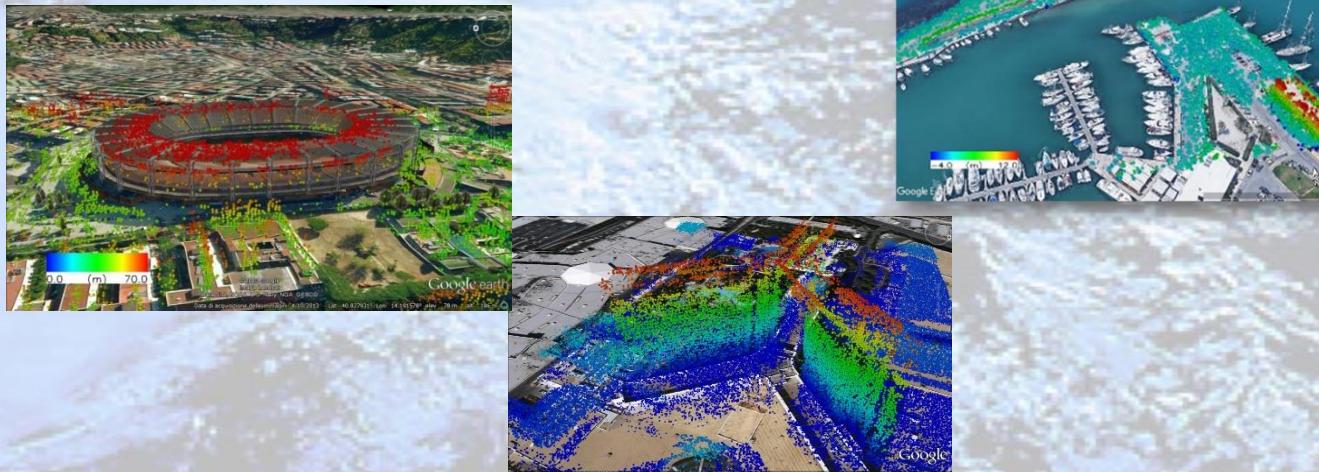
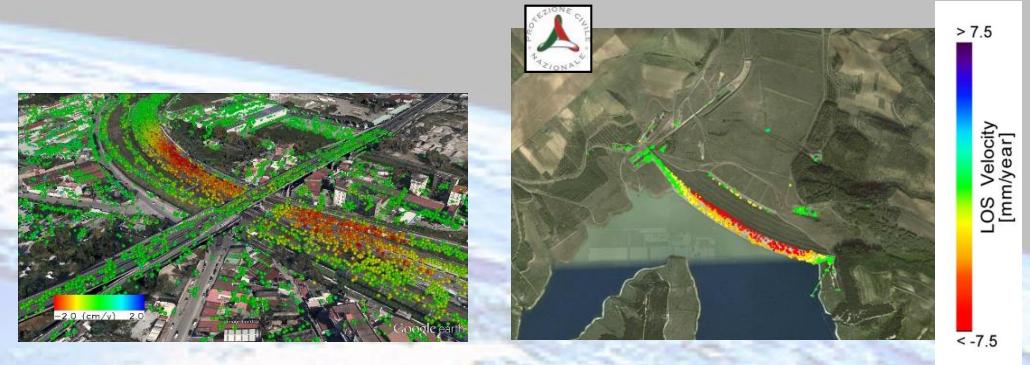
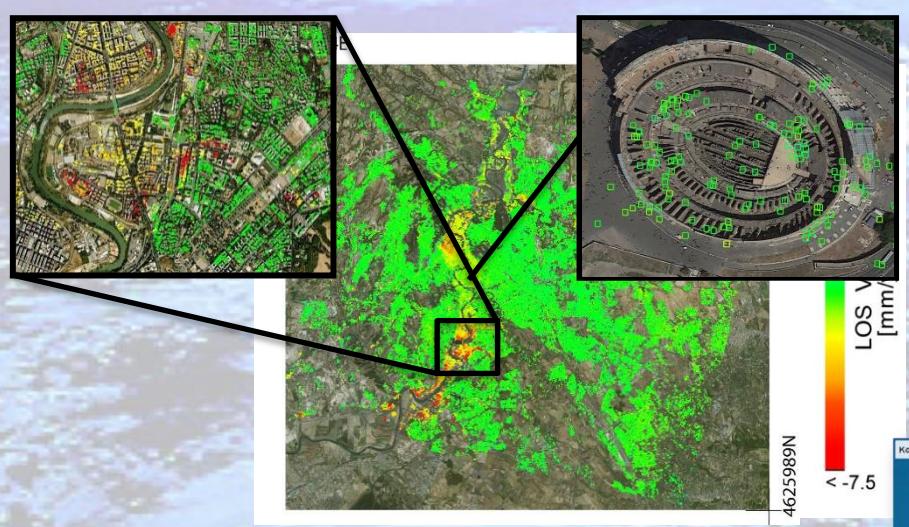
Bonano et al., 2012 Int. Jour. Remote Sensing

Fornaro et al. 2014, IEEE Signal Process. Mag.

Verde et al. 2018, ISPRS Journal of Photogr. and Remote Sens.

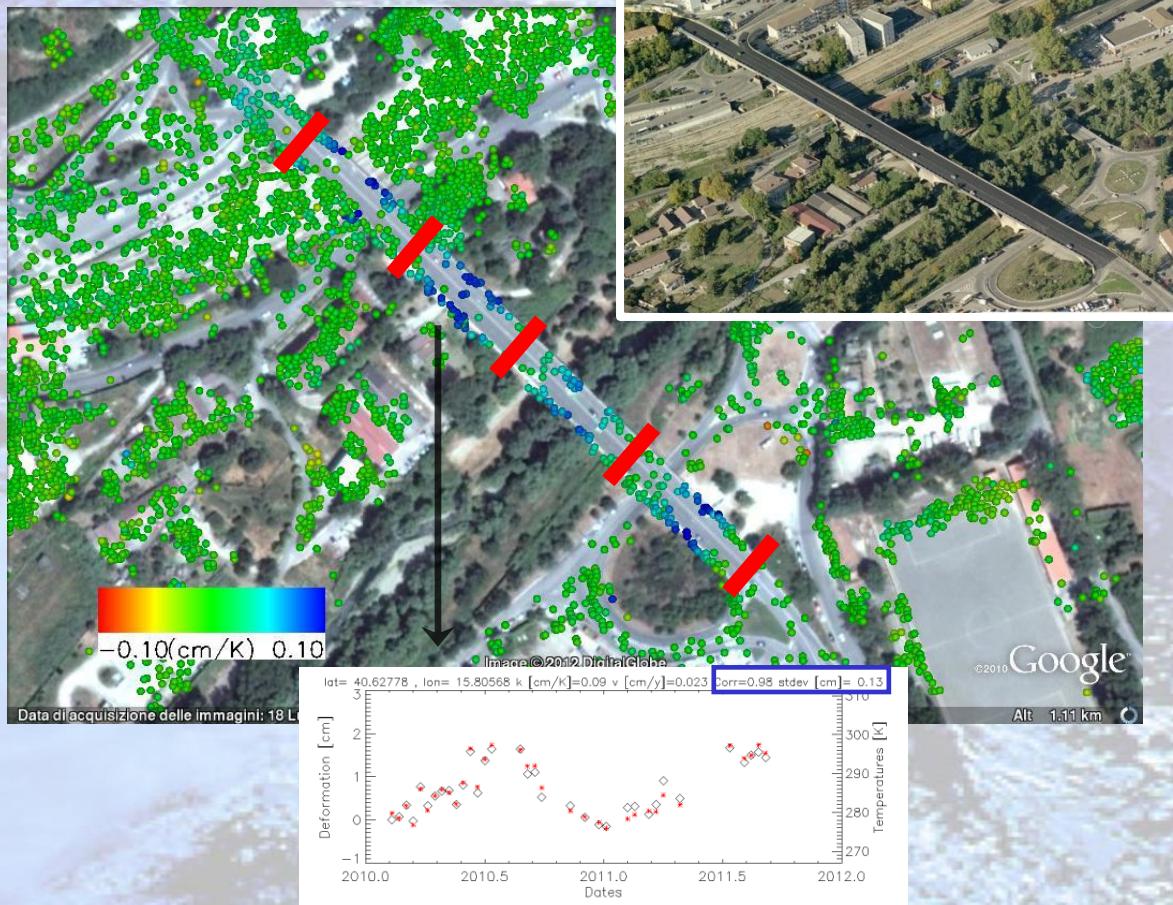
Advanced multi-temporal DInSAR techniques : APPLICATIONS

Built-up environment and infrastructures monitoring

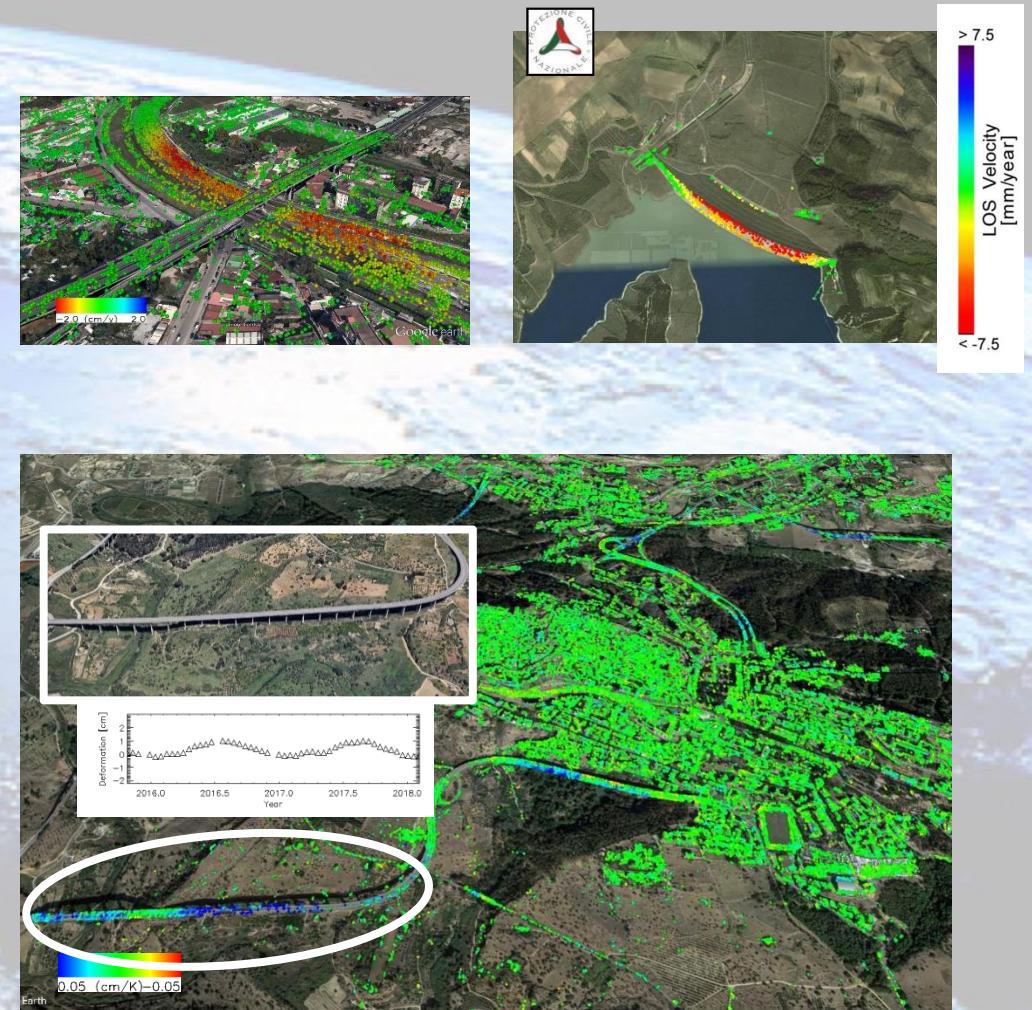


Advanced multi-temporal DInSAR techniques : APPLICATIONS

Built-up environment and infrastructures monitoring



Fornaro et al. 2013, IEEE Geosci. Remote Sens. Lett.



The Morandi bridge, Genova (Italy)

The New York Times (Wednesday, March 6, 2019):
Genoa Bridge Collapse Puts Harsh Light on a Fashion Family
The Benettons, famous for a global clothing empire, control a privatized road operator that managed the bridge that collapsed last year.
That company is now facing angry questions about big profits and lax regulation.

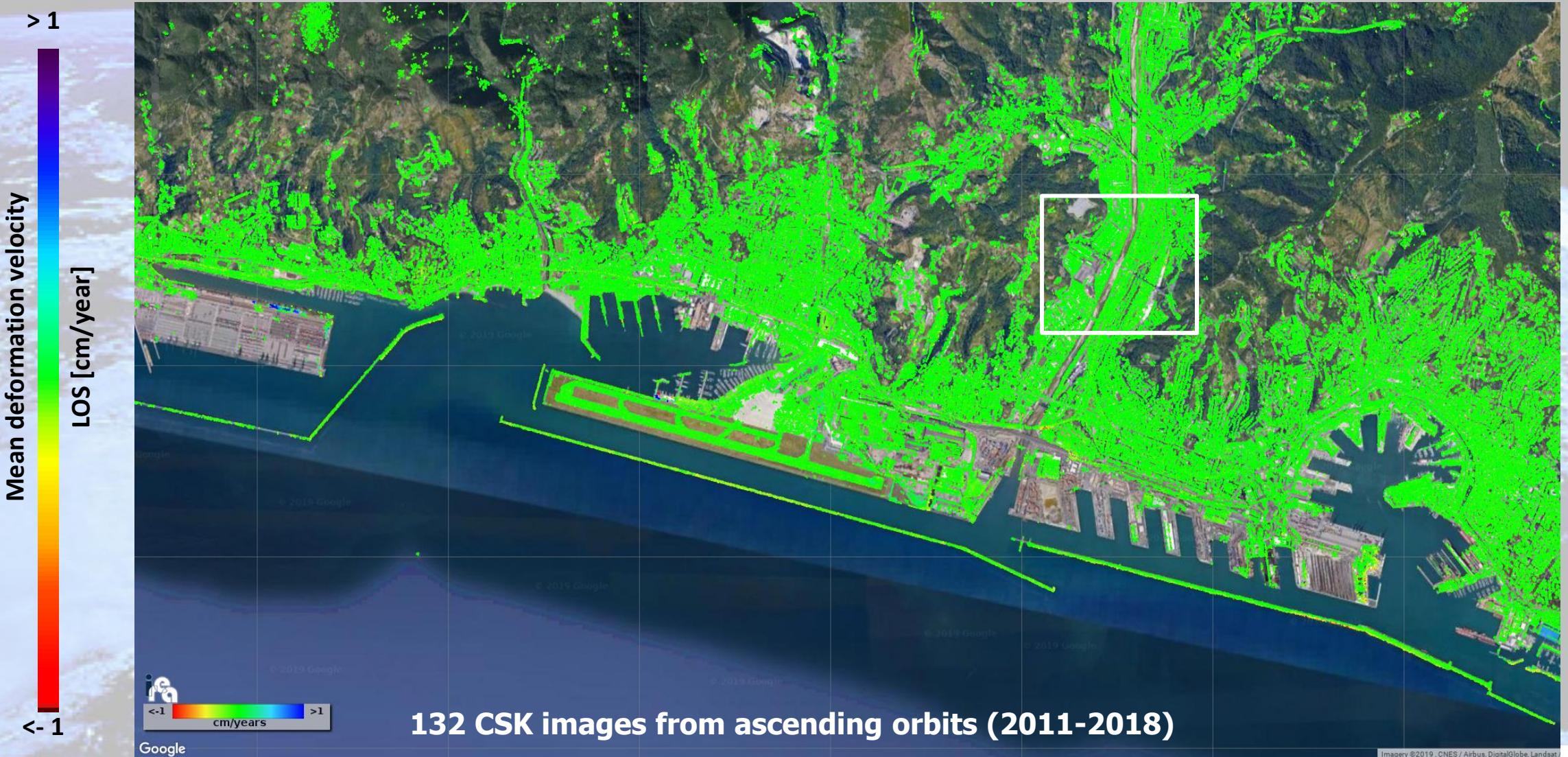
Bild (14.08.2018 - 13:19 UHR AKTUELLE NACHRICHTEN):
VIELE TOTE UND VERLETZTE!
AUTOBAHNBRÜCKE IN GENUA EINGESTÜRZT

Le Monde (INTERNATIONAL POLITIQUE SOCIÉTÉ ÉCO CULTURE IDÉES PLANÉTIQUE):
Gênes, en direct : au moins vingt-deux morts dans l'effondrement d'un viaduc autoroutier

O GLOBO (Desabamento de grande viaduto na Itália deixa mais de 20 mortos):
Desabamento de grande viaduto na Itália deixa mais de 20 mortos
O ministro dos Transportes disse que o colapso da estrutura na cidade de Gênova é uma 'enorme tragédia'

Washington Post (LIVE):
LIVE Genoa bridge collapse
3m Video of rescue operations
15m Aerial shot shows massive damage
In pictures: Bridge collapse

The Morandi bridge, Genova (Italy)

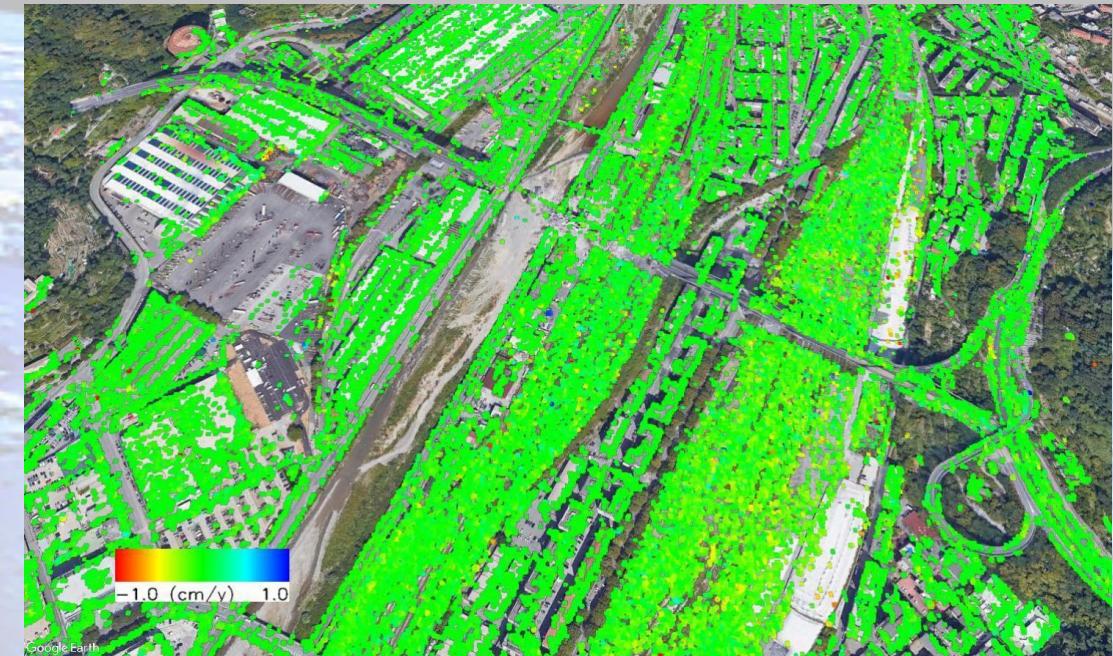
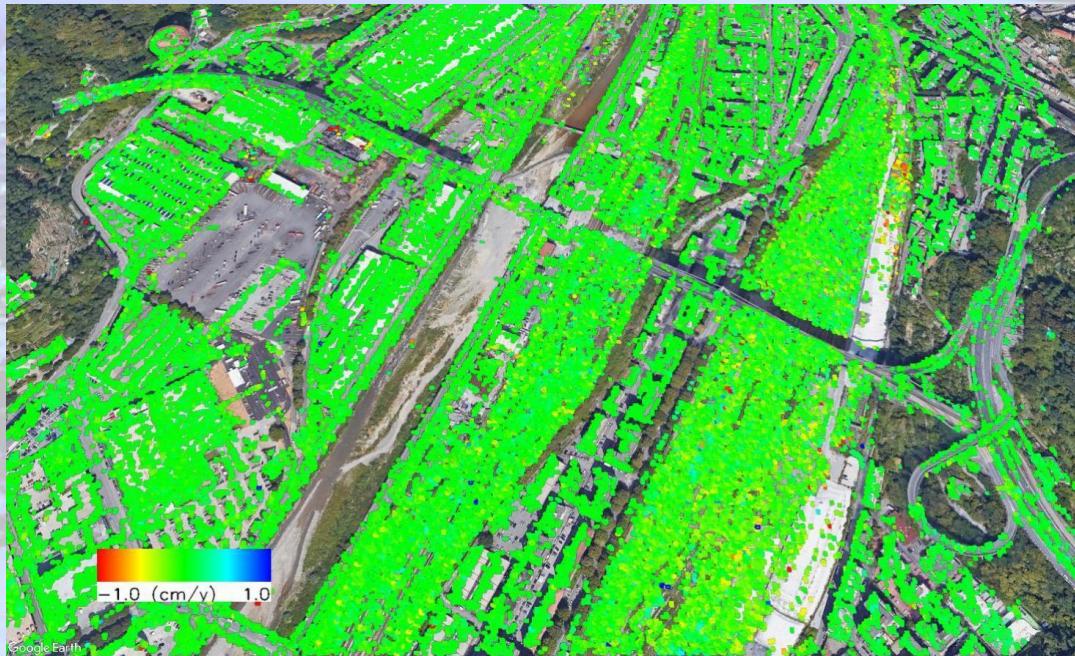


The Morandi bridge, Genova (Italy)

> 1

< -1

Mean deformation velocity
LOS [cm/year]



132 CSK images from ascending orbits (2011-2018) 134 CSK images from descending orbits (2011-2018)



remote sensing



Comment

Comment on “Pre-Collapse Space Geodetic Observations of Critical Infrastructure: The Morandi Bridge, Genoa, Italy” by Milillo et al. (2019)

Riccardo Lanari ^{1,*} , Diego Reale ¹ , Manuela Bonano ^{1,2} , Simona Verde ¹ , Yasir Muhammad ^{1,3}, Gianfranco Fornaro ¹ , Francesco Casu ¹ and Michele Manunta ¹

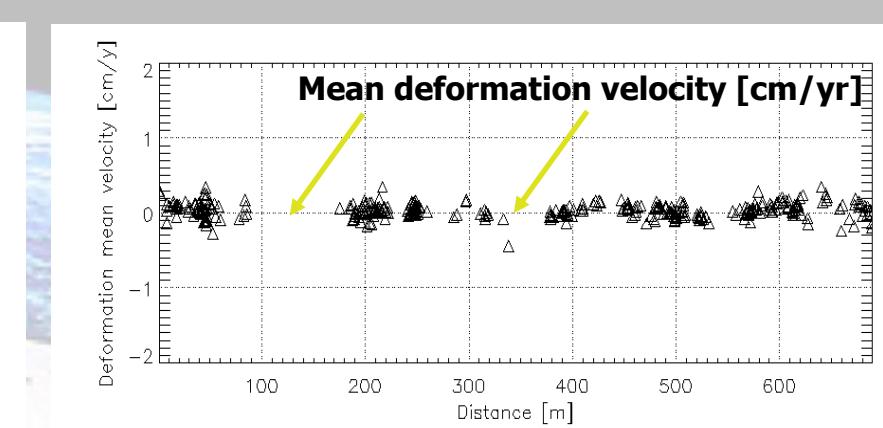
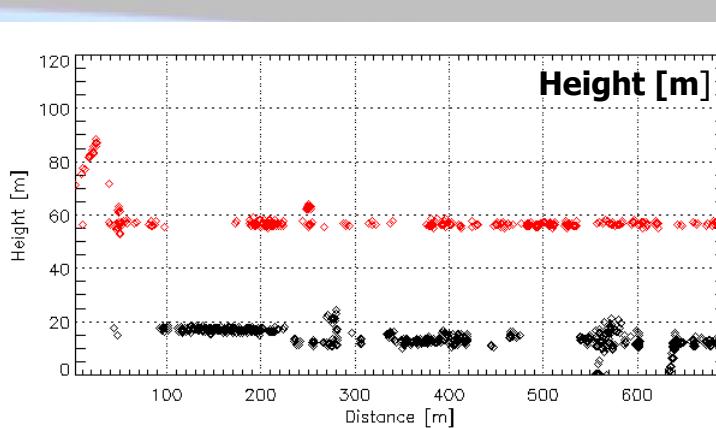
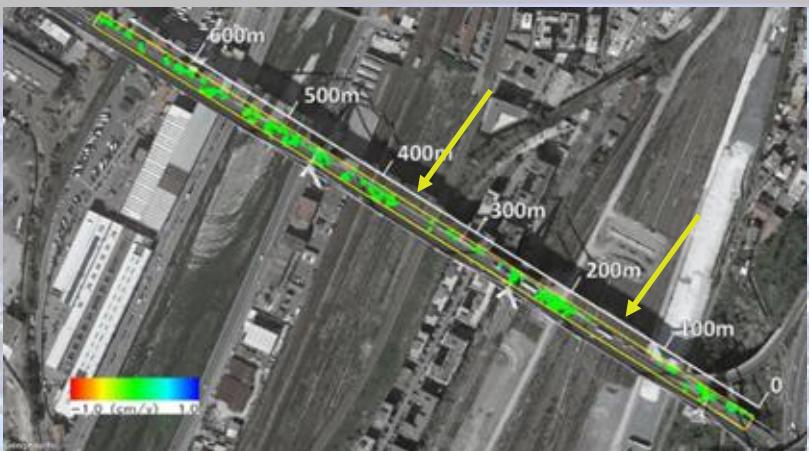


PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

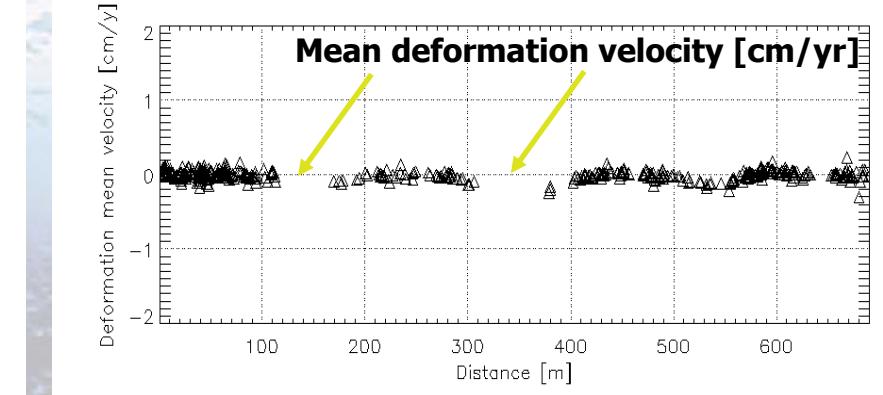
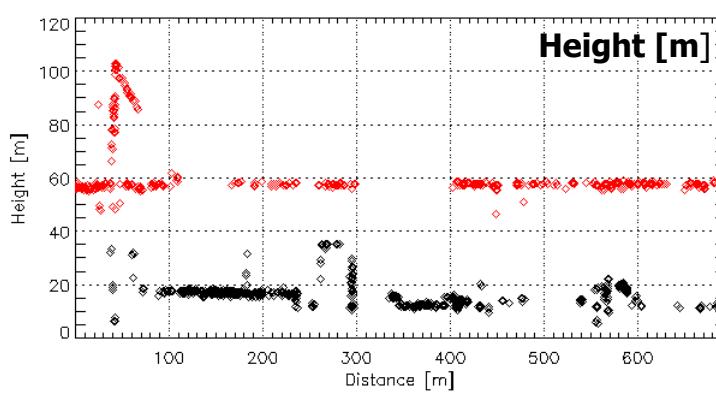
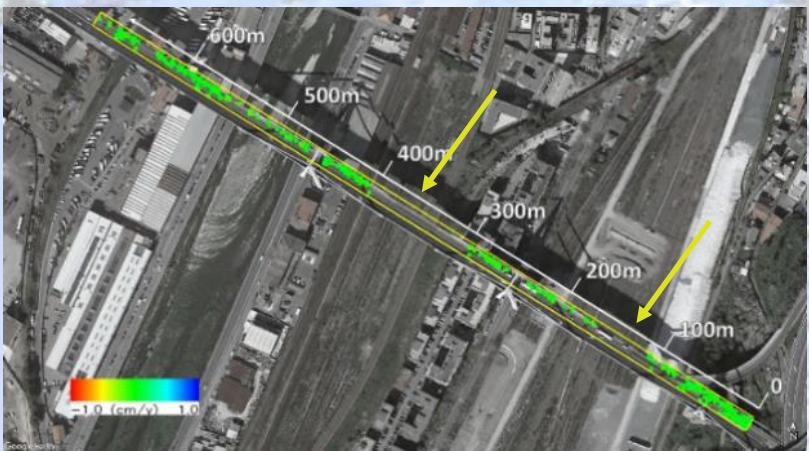


The Morandi bridge, Genova (Italy)

Northern roadway



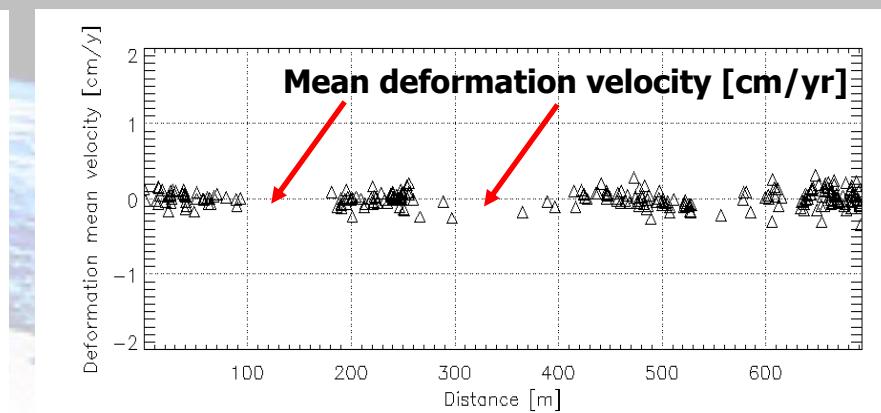
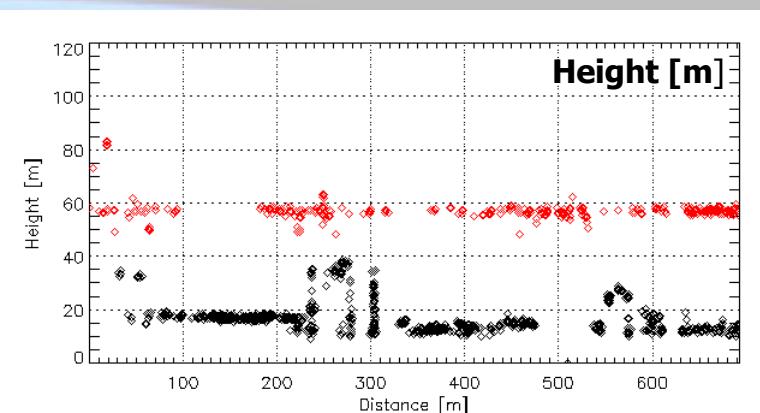
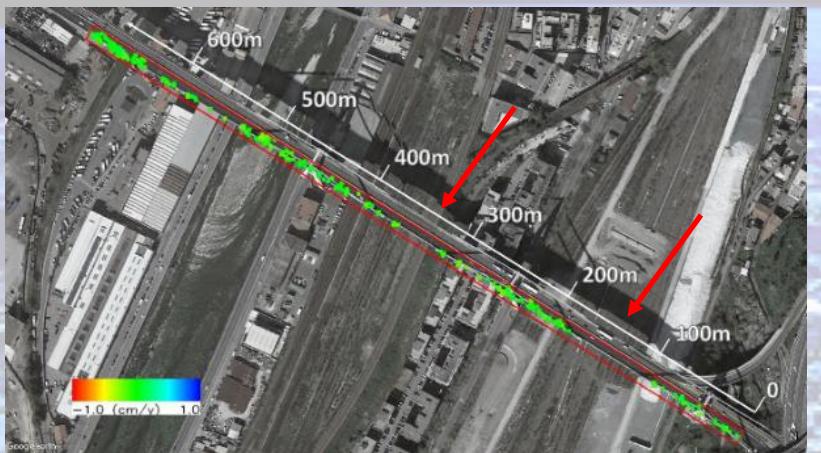
132 CSK images from ascending orbits (2011-2018)



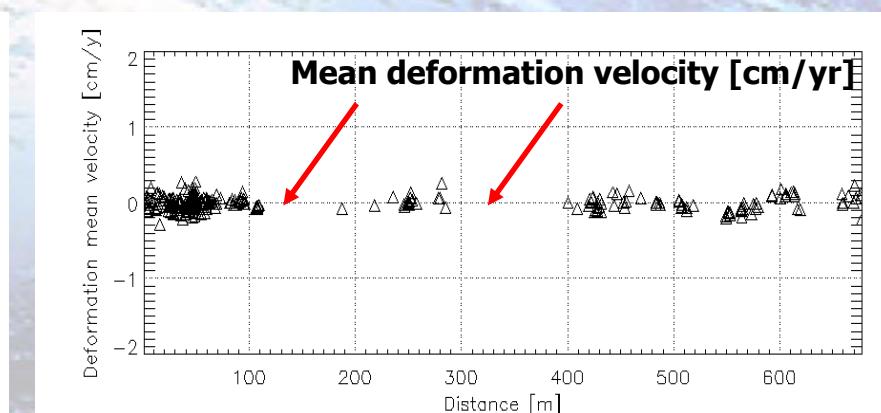
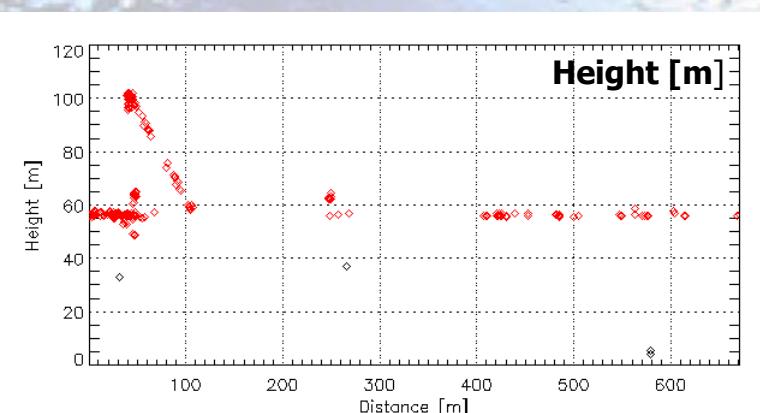
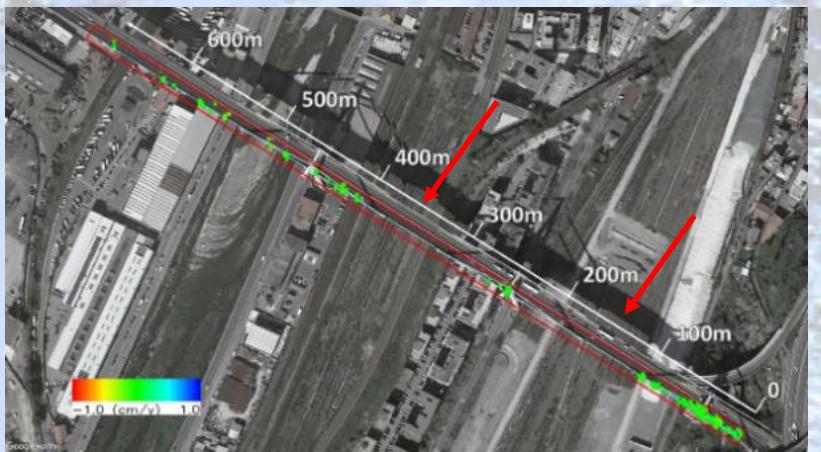
134 CSK images from descending orbits (2011-2018)

The Morandi bridge, Genova (Italy)

Southern roadway



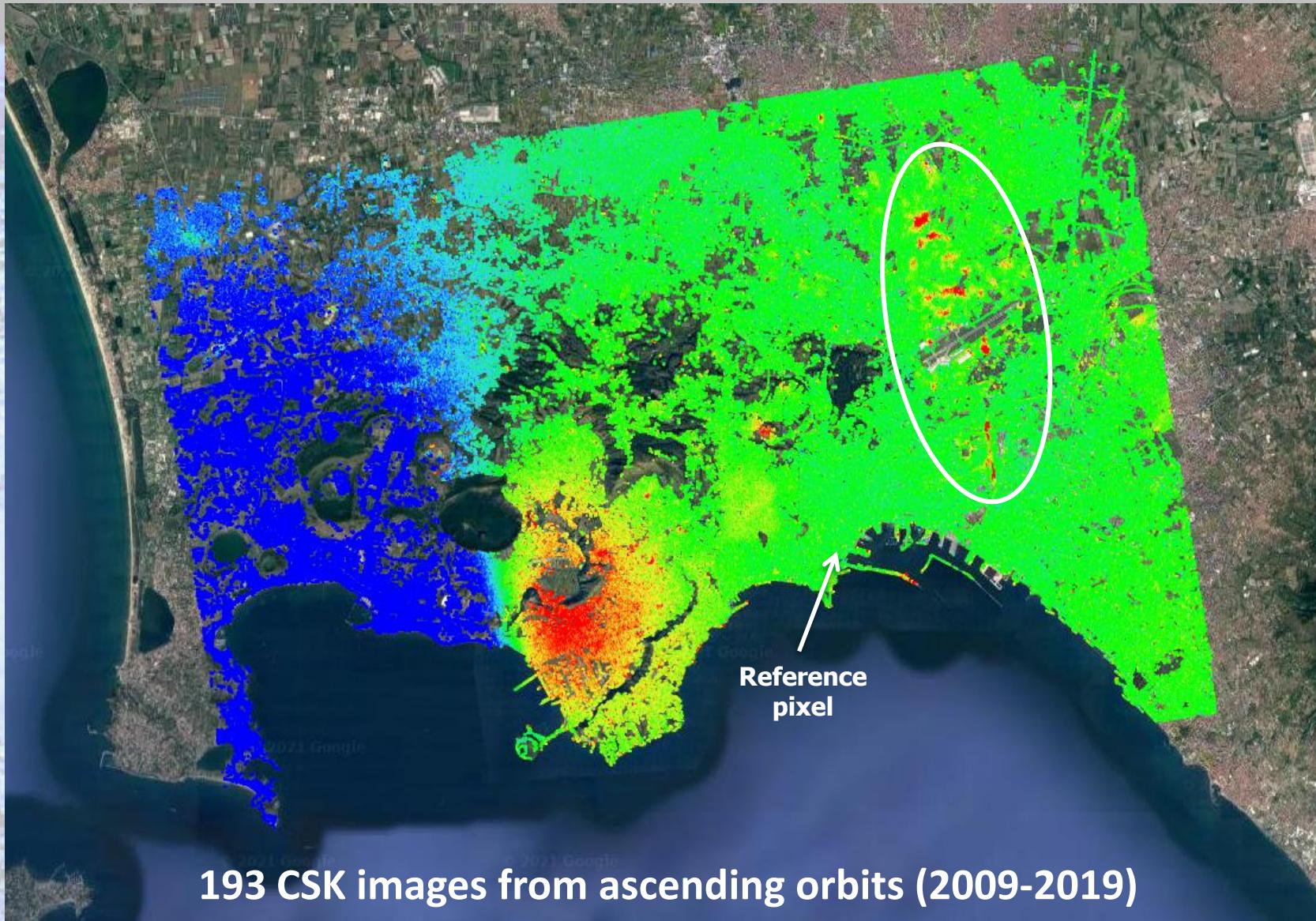
132 CSK images from ascending orbits (2011-2018)



134 CSK images from descending orbits (2011-2018)

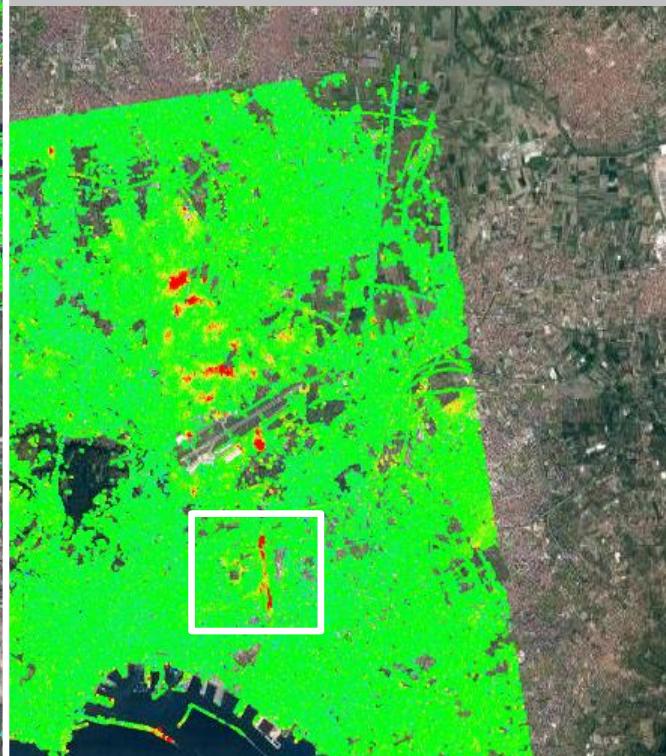
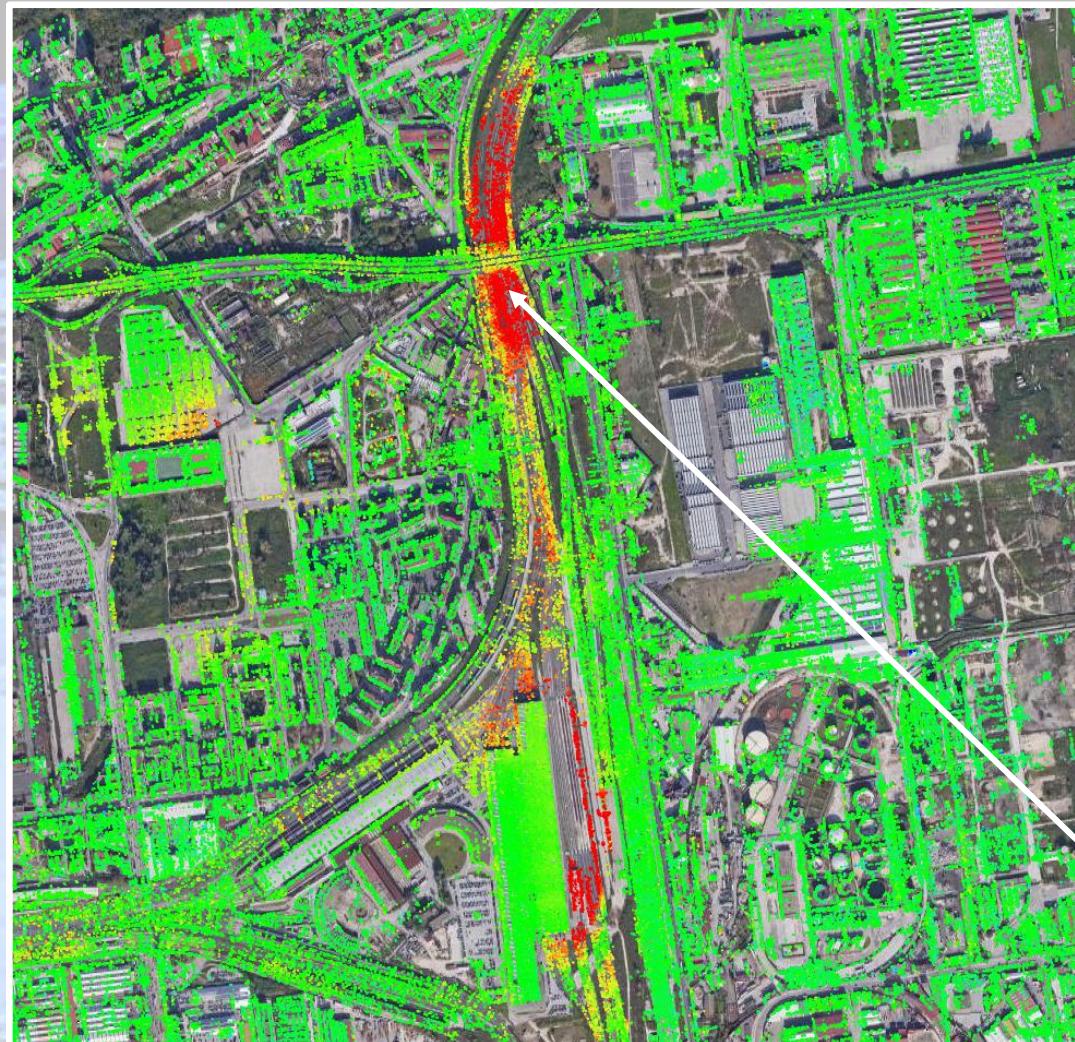
FR SBAS-DInSAR analysis of the built-up environment: the Napoli case study

> 0.5
[cm/year]
< -0.5



FR SBAS-DInSAR analysis of the built-up environment: the Napoli case study

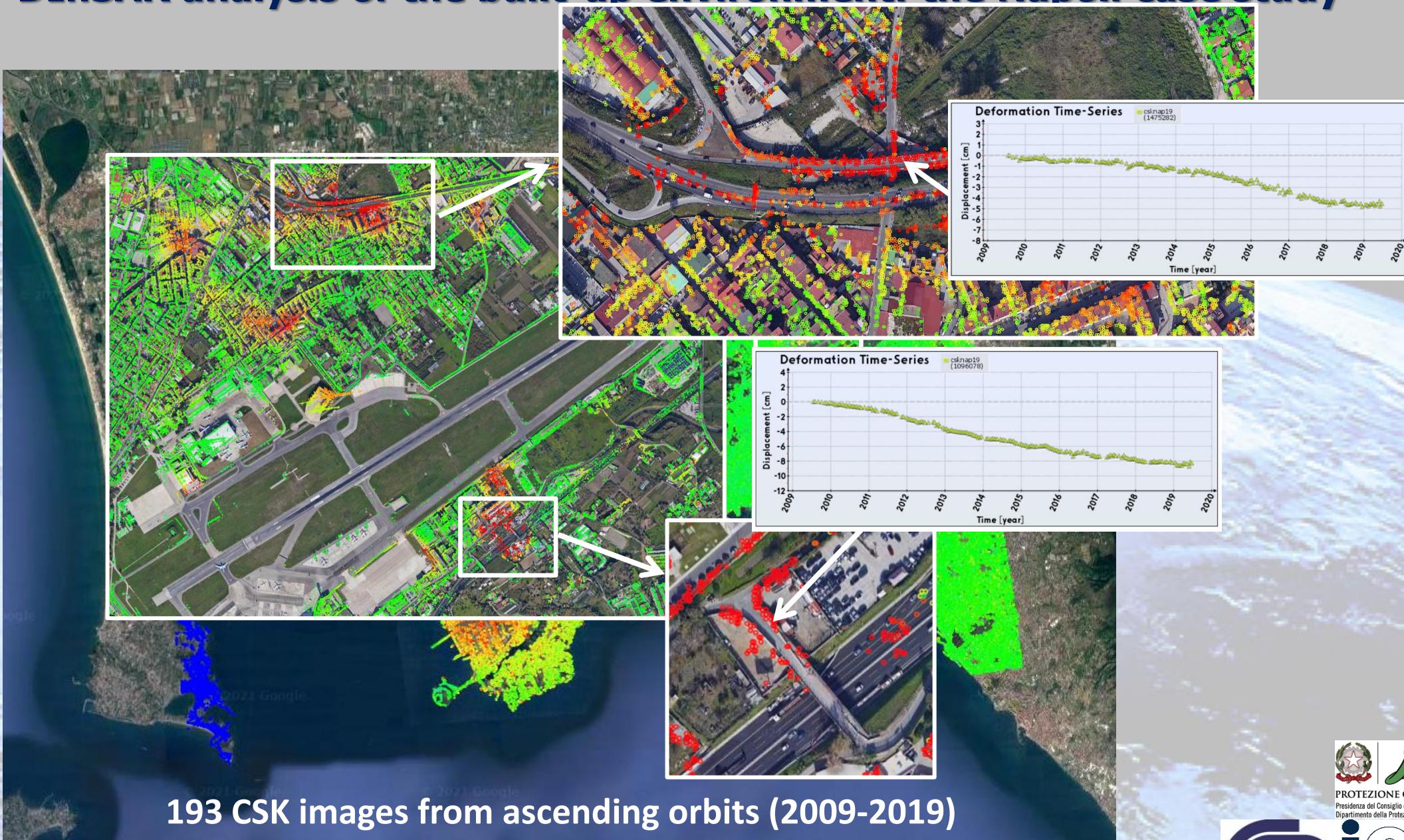
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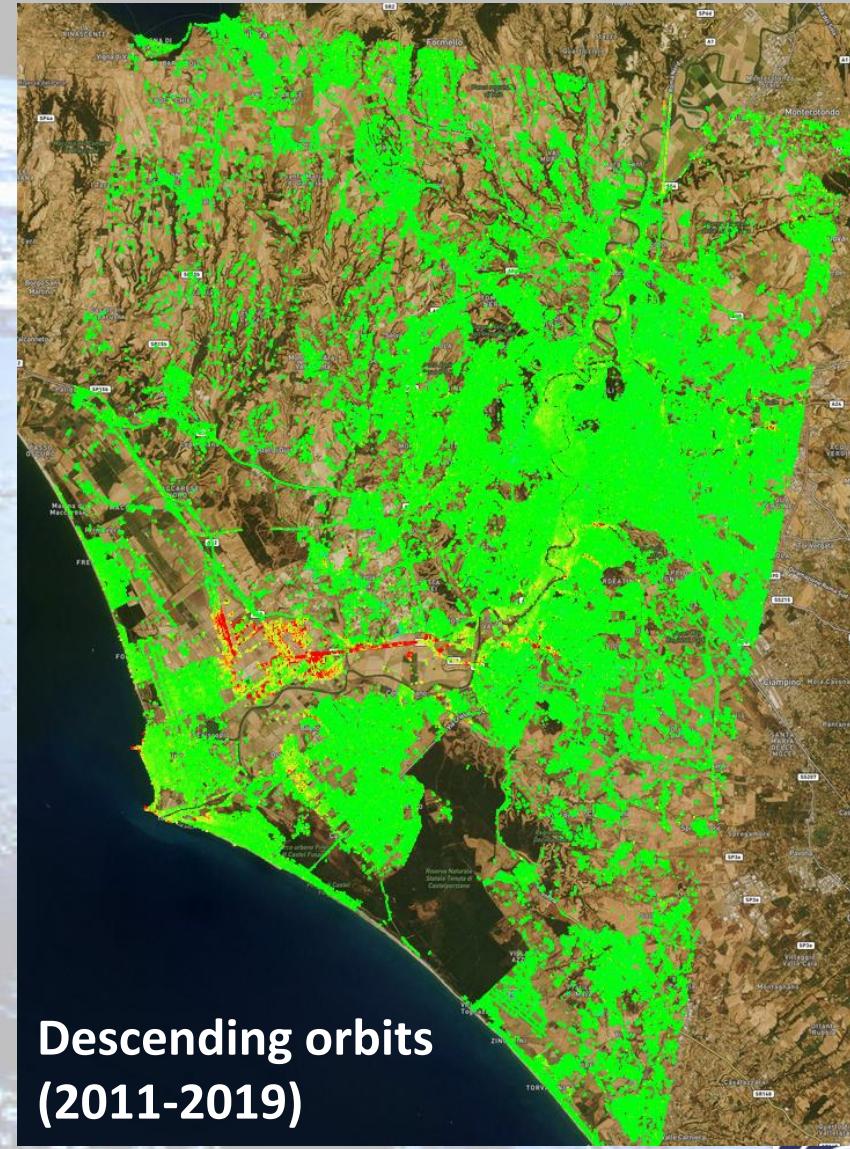
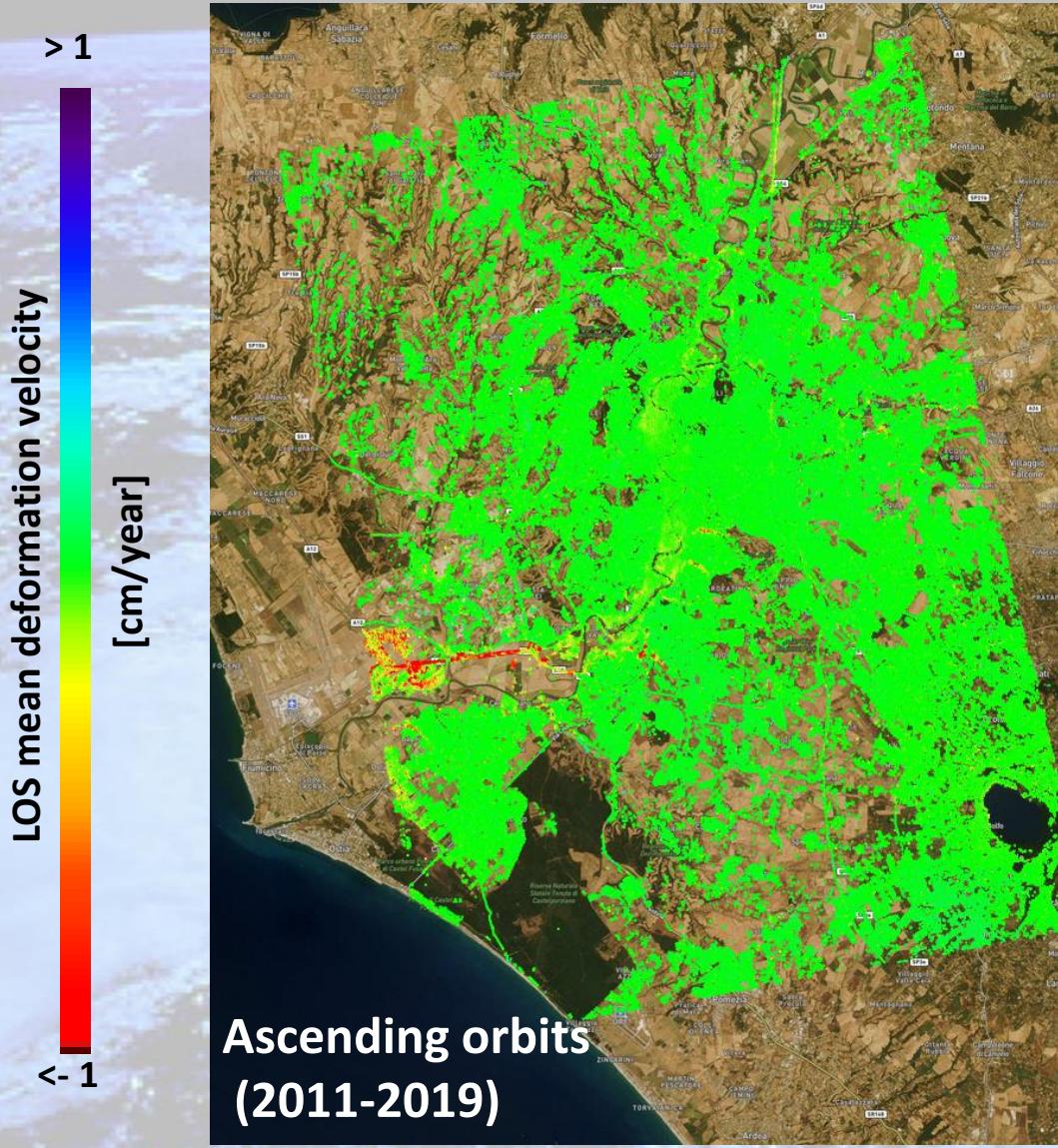
193 CSK images from ascending orbits (2009-2019)

FR SBAS-DInSAR analysis of the built-up environment: the Napoli case study

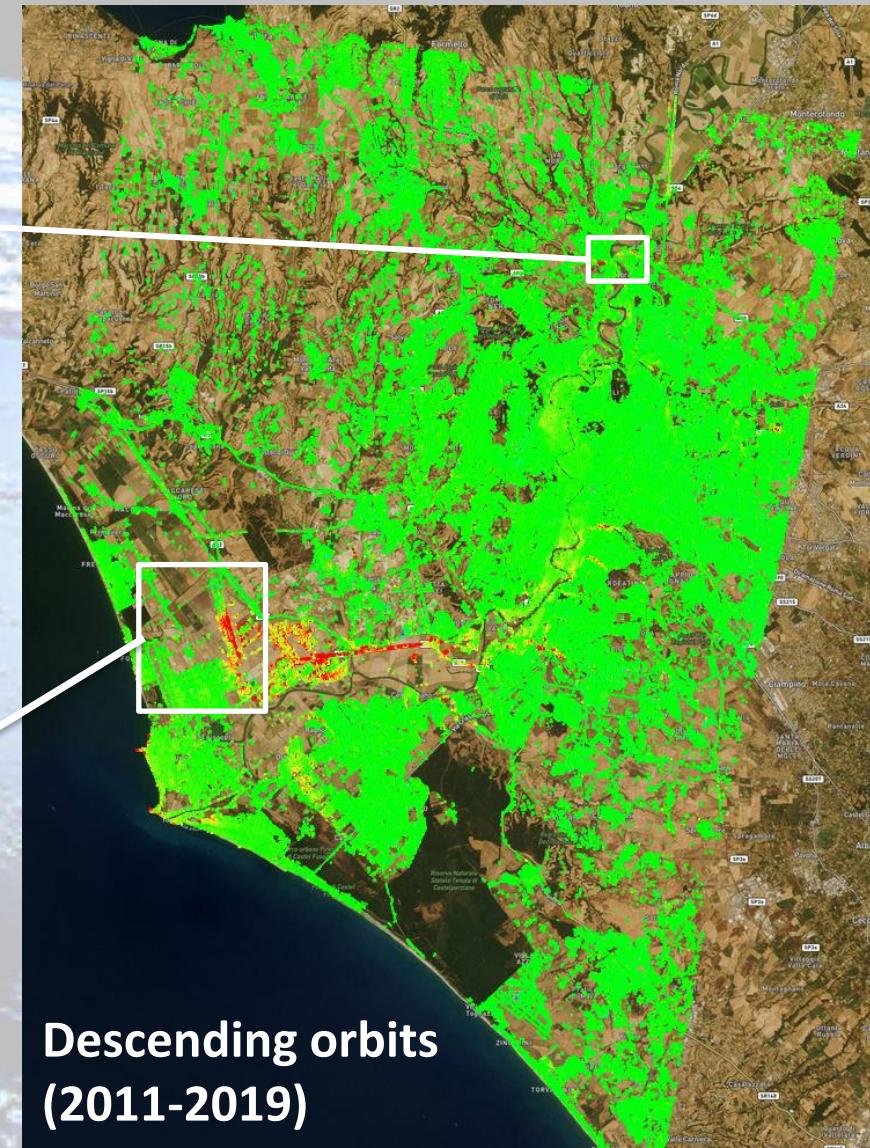
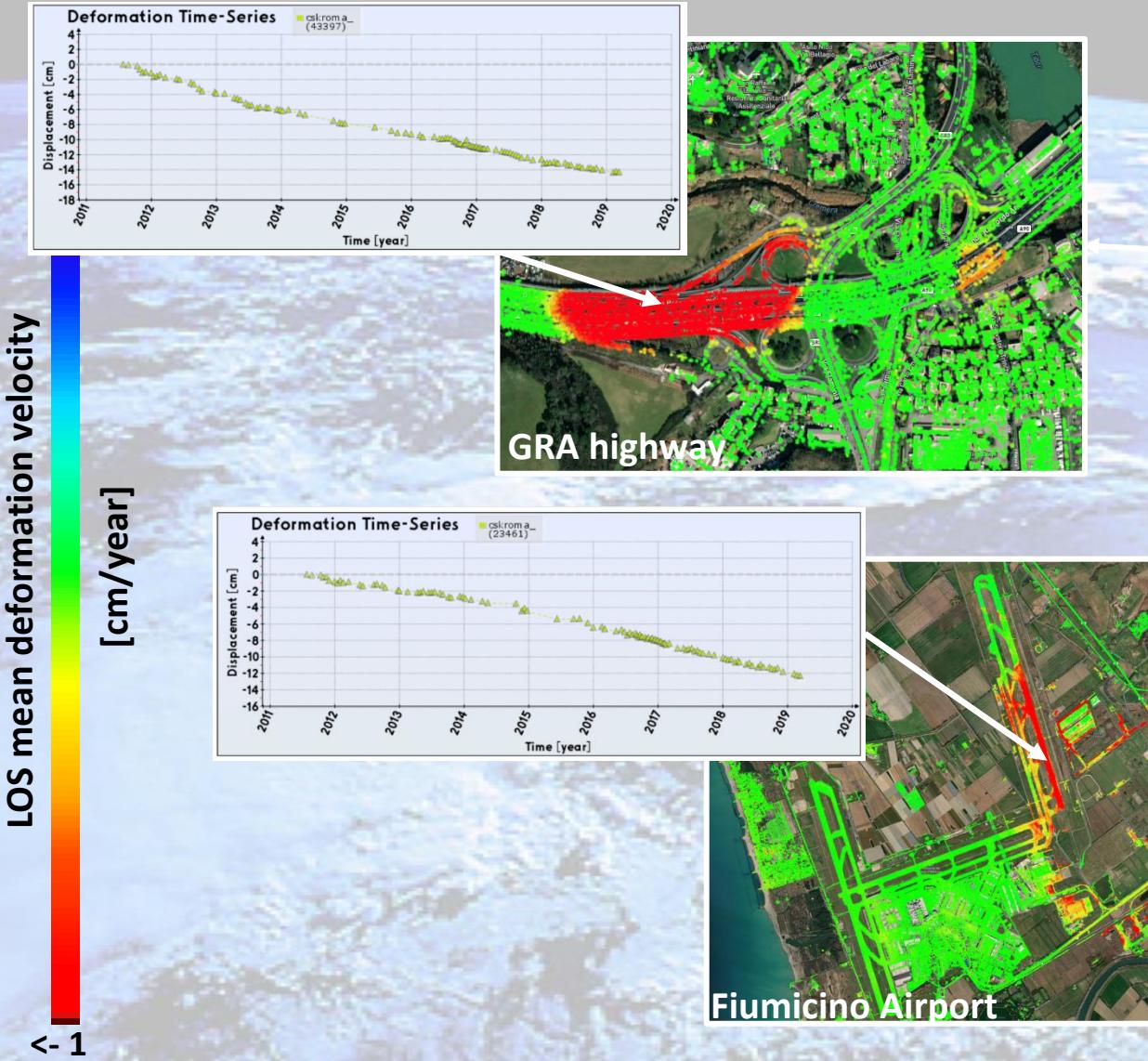
> 0.5
[cm/year]
< -0.5



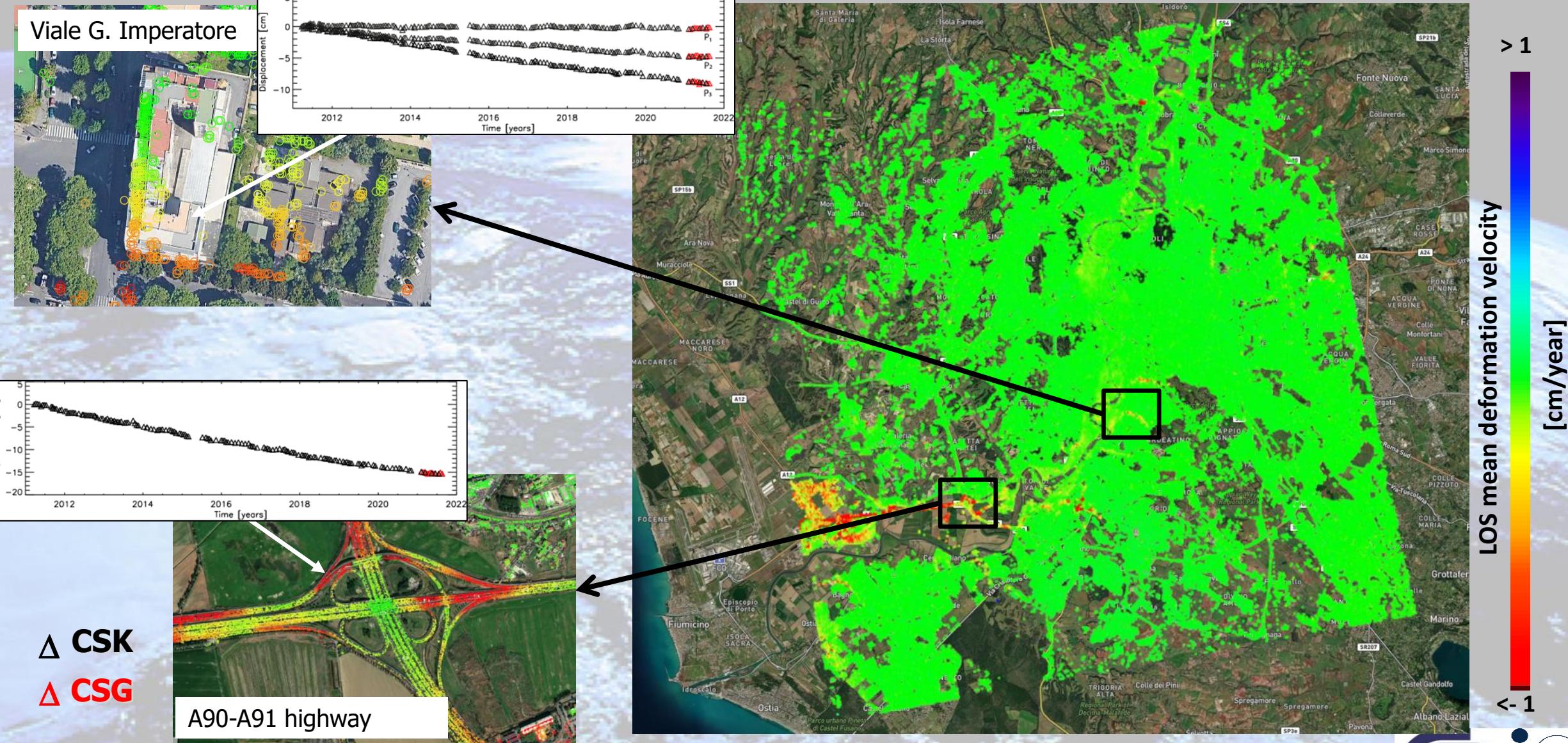
FR CSK SBAS-DInSAR analysis of the built environment: the Roma case study



FR CSK SBAS-DInSAR analysis of the built environment: the Roma case study



FR CSK-CSG SBAS-DInSAR analysis of the built environment: the Roma case study

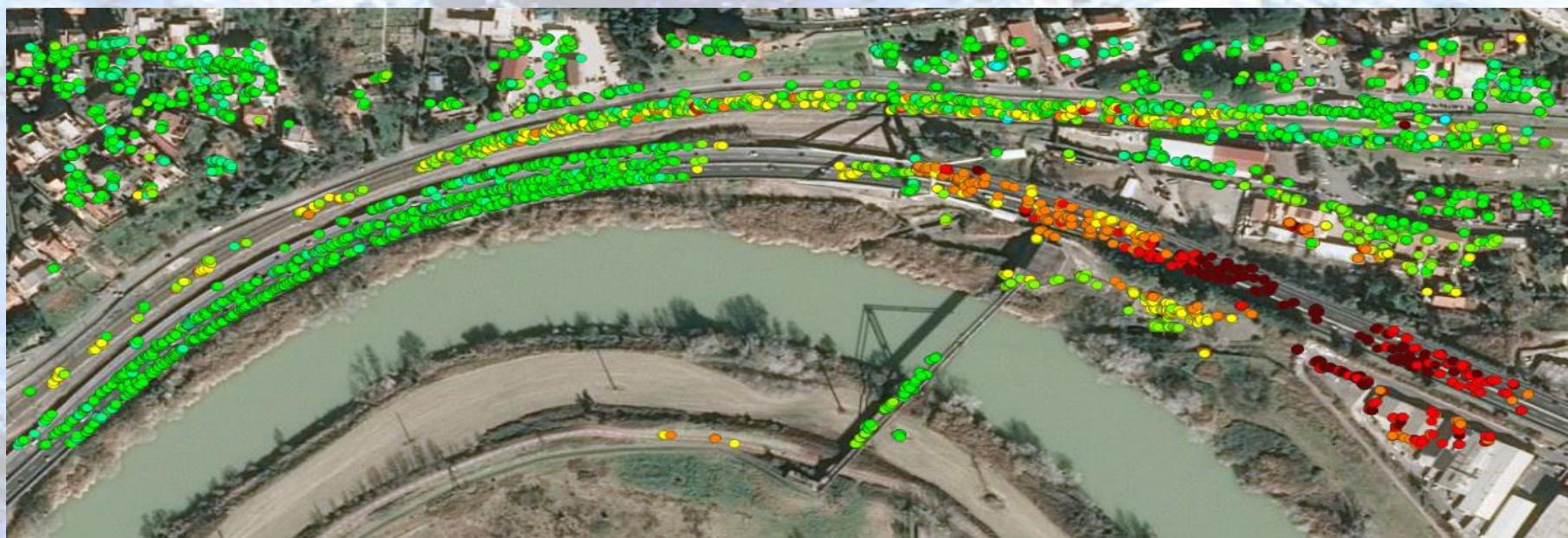


Deformation components of the single infrastructure: preliminary evaluations



ASC data
DESC data

Vertical component of the mean deformation velocity (about 2.5 mm/year)



- -6,1 - -4,5
- -4,5 - -3,5
- -3,5 - -2,5
- -2,5 - -1,5
- -1,5 - -0,5
- -0,5 - 0,5
- 0,5 - 1,5
- 1,5 - 2,5
- 2,5 - 3,5
- 3,5 - 4,5
- 4,5-6,0

- The multi-temporal satellite DInSAR techniques represent significant tools supporting the activities for the maintenance of critical infrastructures, suitable to investigate and monitor over time the deformation affecting man-made structures and built-up environment over large areas with sub-centimetric accuracy.
- The advanced DInSAR measurements, properly integrated with in-situ investigations and damage assessment models derived from structural engineering, may define a roadmap for identifying and preventing critical conditions of buildings and infrastructures, allowing to plan their maintenance and safety management.
- The CSK constellation has been collecting SAR images for more than 10 years, creating one of the most important data archives; in this framework, the new CSG constellation in continuity with CSK will allow the deformation monitoring over the built-up environment for the next 10 years.