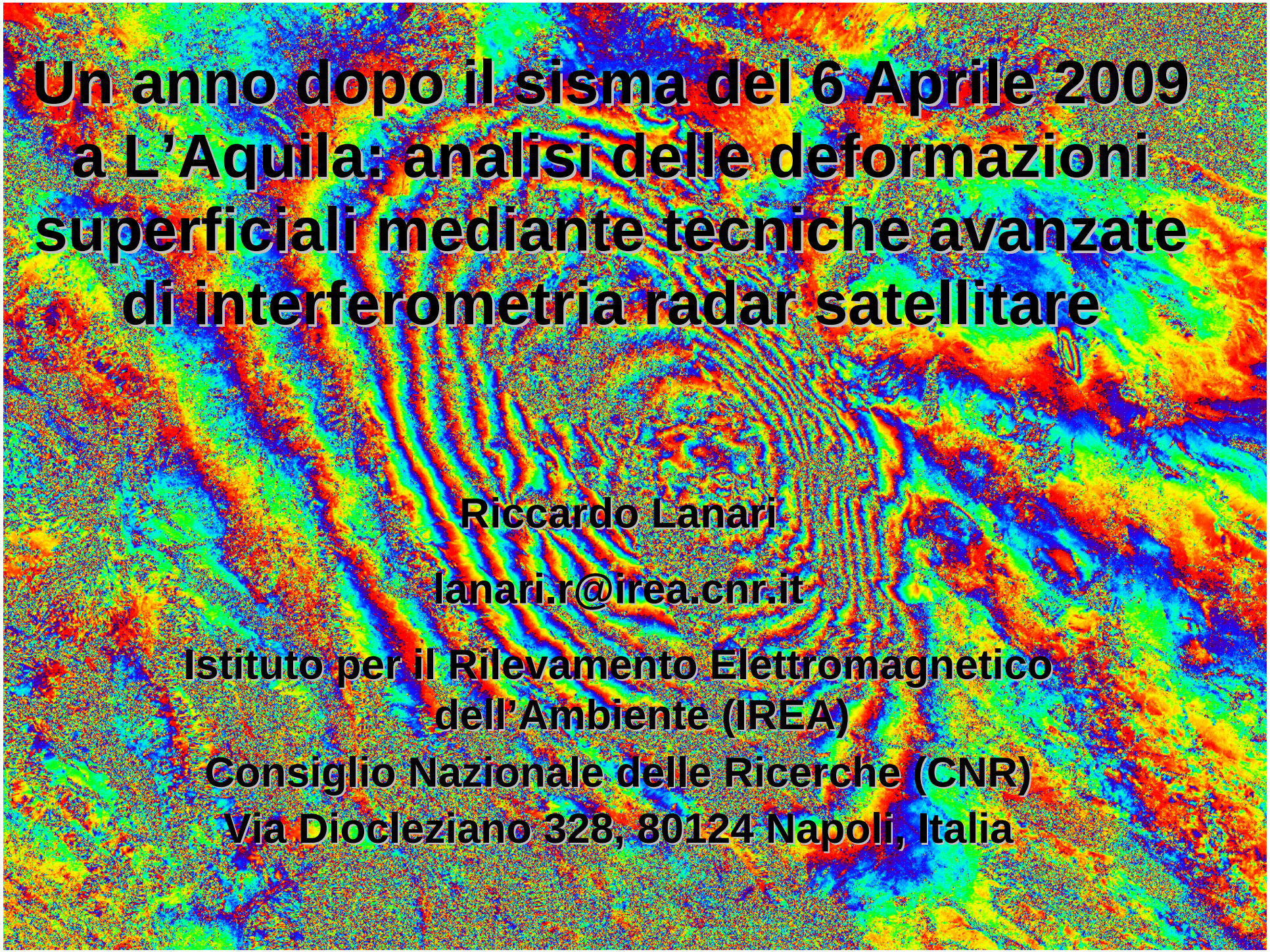

Un anno dopo il sisma del 6 Aprile 2009 a L'Aquila: analisi delle deformazioni superficiali mediante tecniche avanzate di interferometria radar satellitare

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Summary

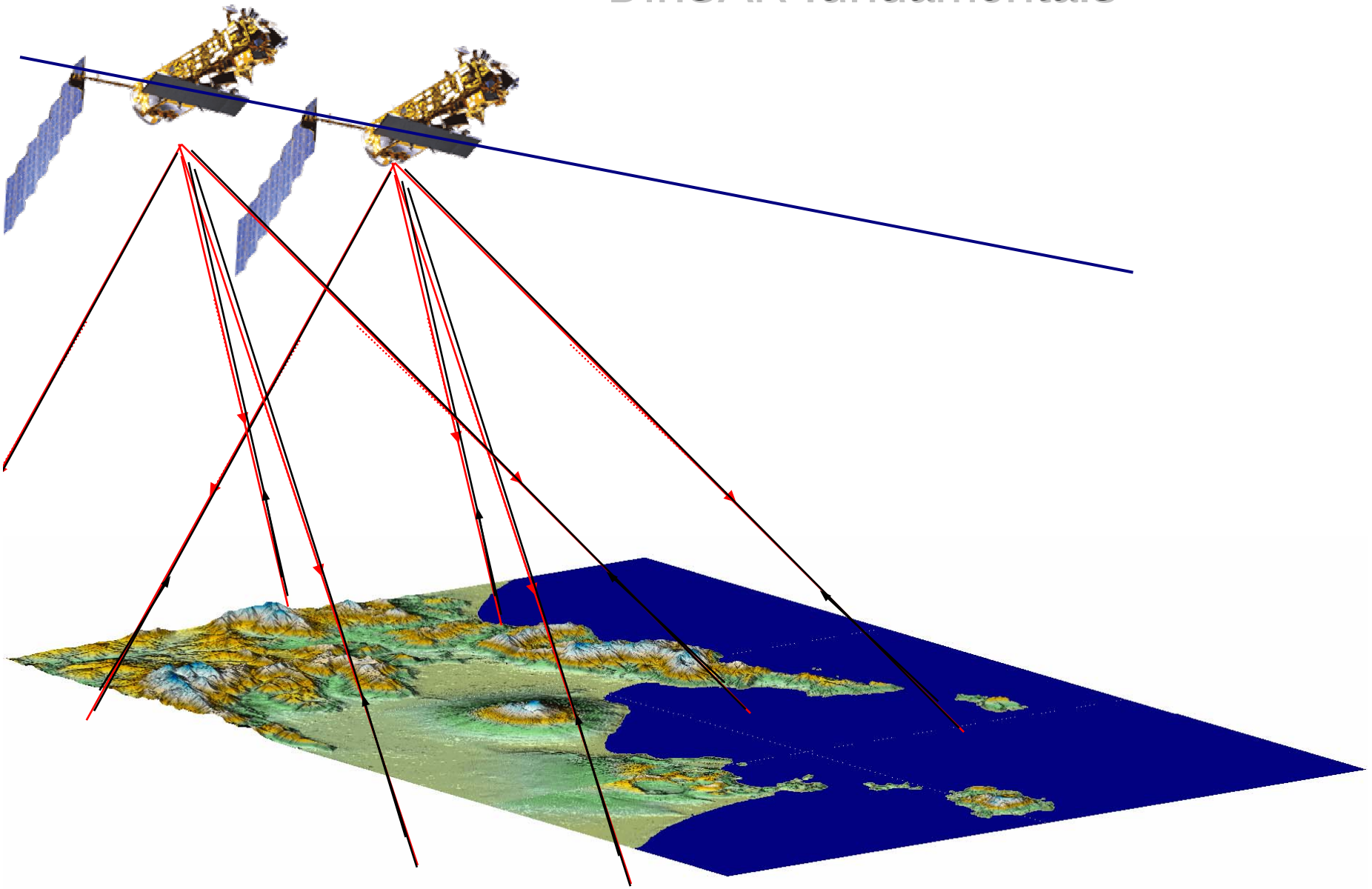
- Briefly summarize the rationale of the conventional differential SAR interferometry (DInSAR) technique and introduce the basic idea of the SBAS algorithm which is an advanced DInSAR approach applied for generating deformation time-series.

- Present the DInSAR results relevant to the co-seismic deformation pattern retrieved immediately after the event by processing SAR data acquired by different sensors.

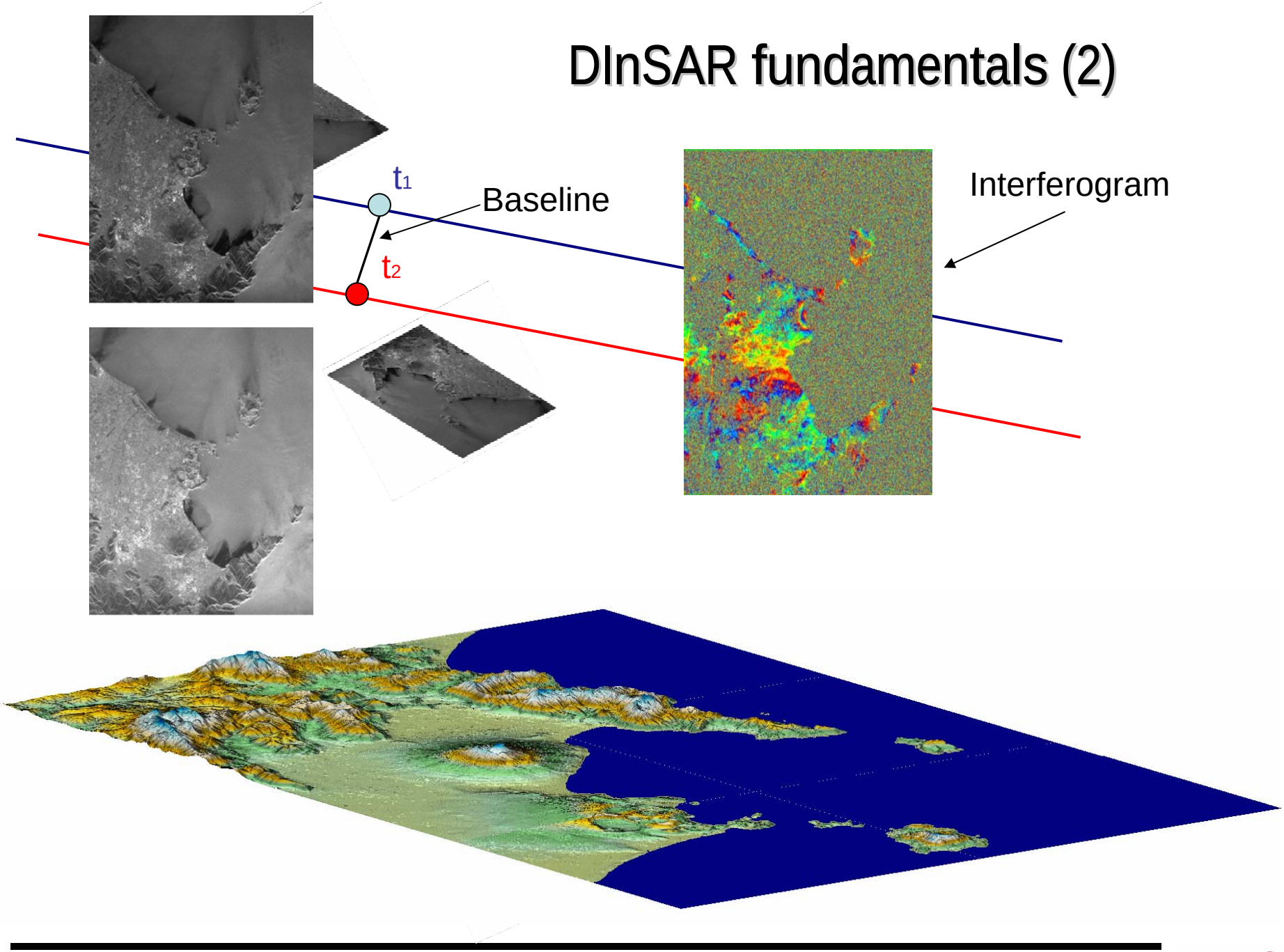
- Show some key results achieved by exploiting time-series of ENVISAT and COSMO-SkyMed images.

- Shortly discuss some conclusive remarks.

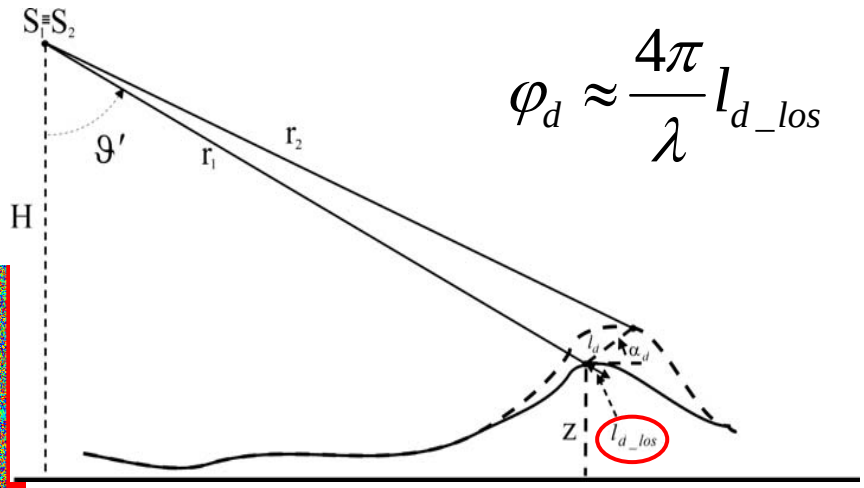
DInSAR fundamentals



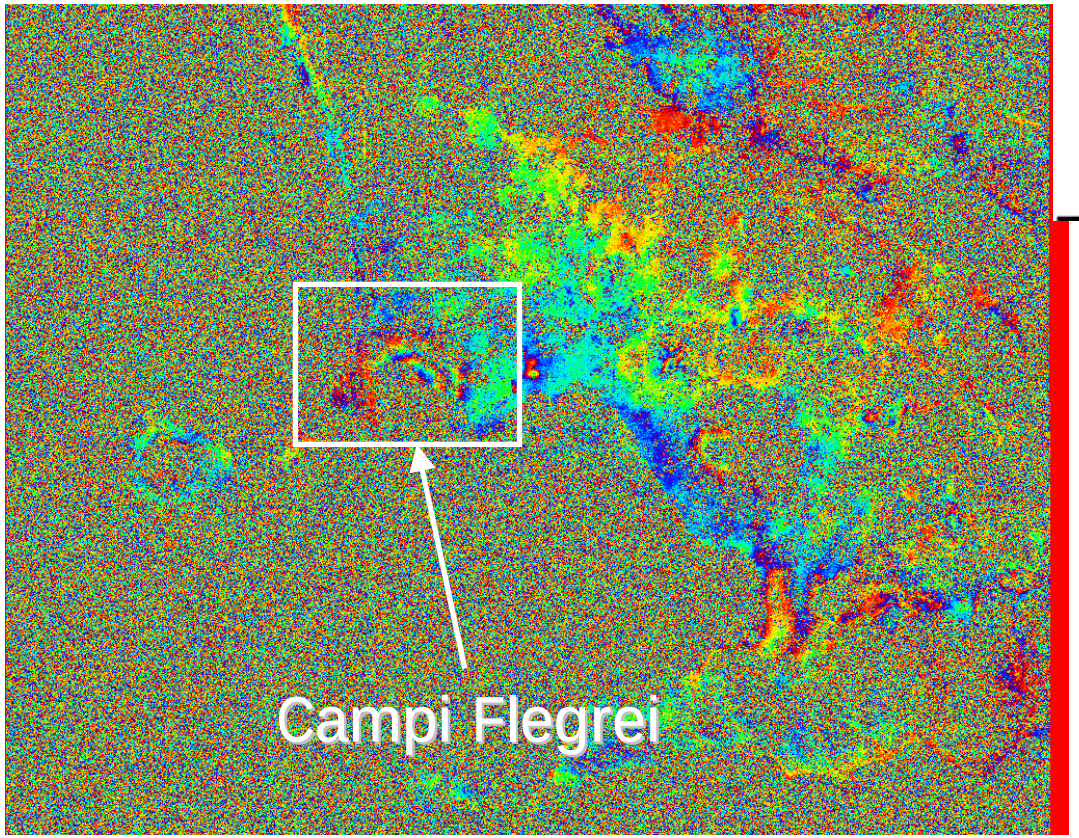
DInSAR fundamentals (2)



DInSAR fundamentals (3)

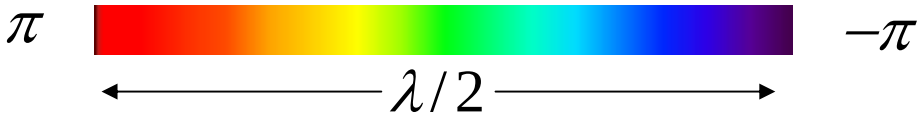


$$\varphi_d \approx \frac{4\pi}{\lambda} l_{d\_los}$$

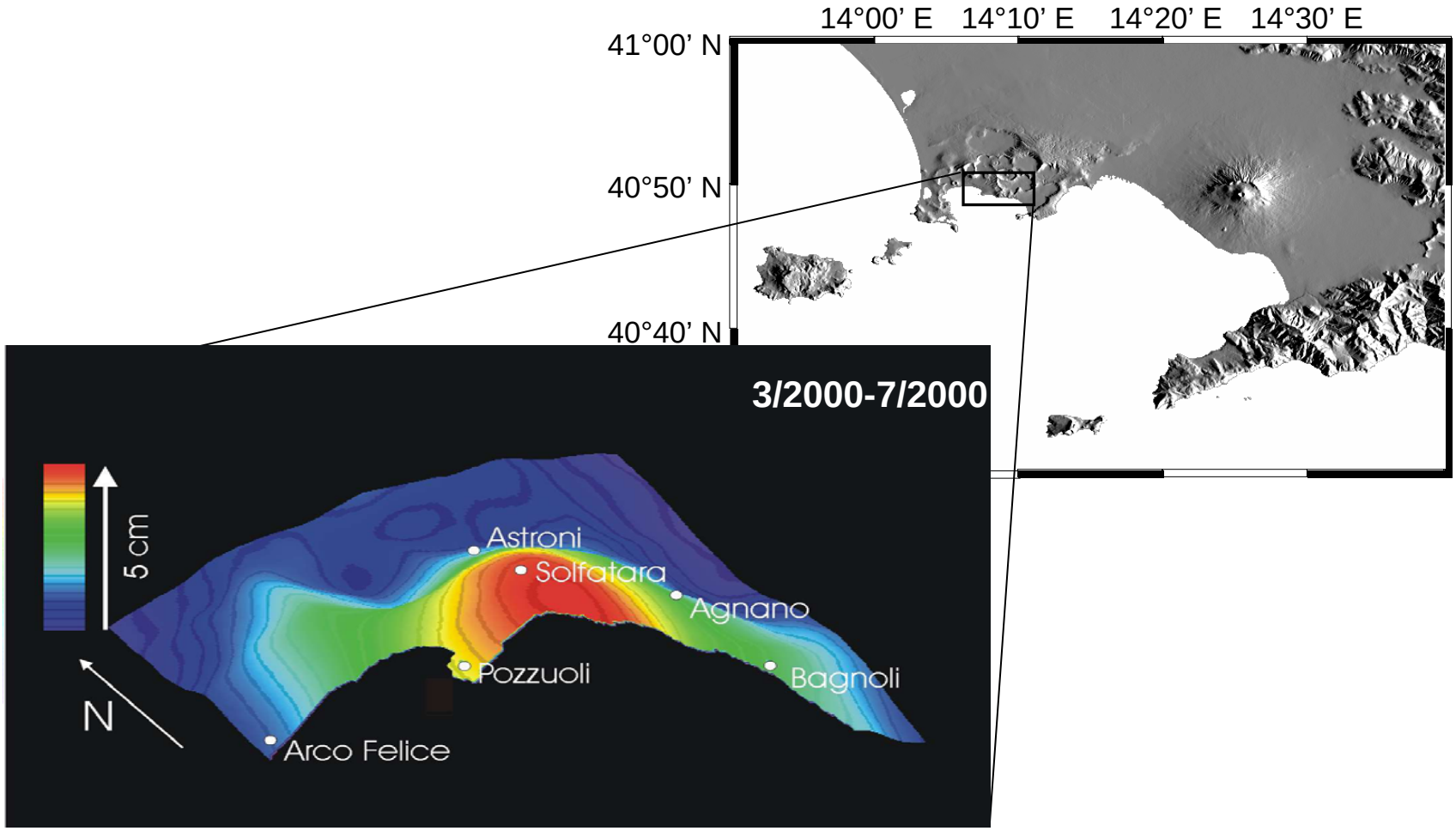


$$\varphi_d = 2\pi \rightarrow l_{d\_los} \approx \frac{\lambda}{2}$$

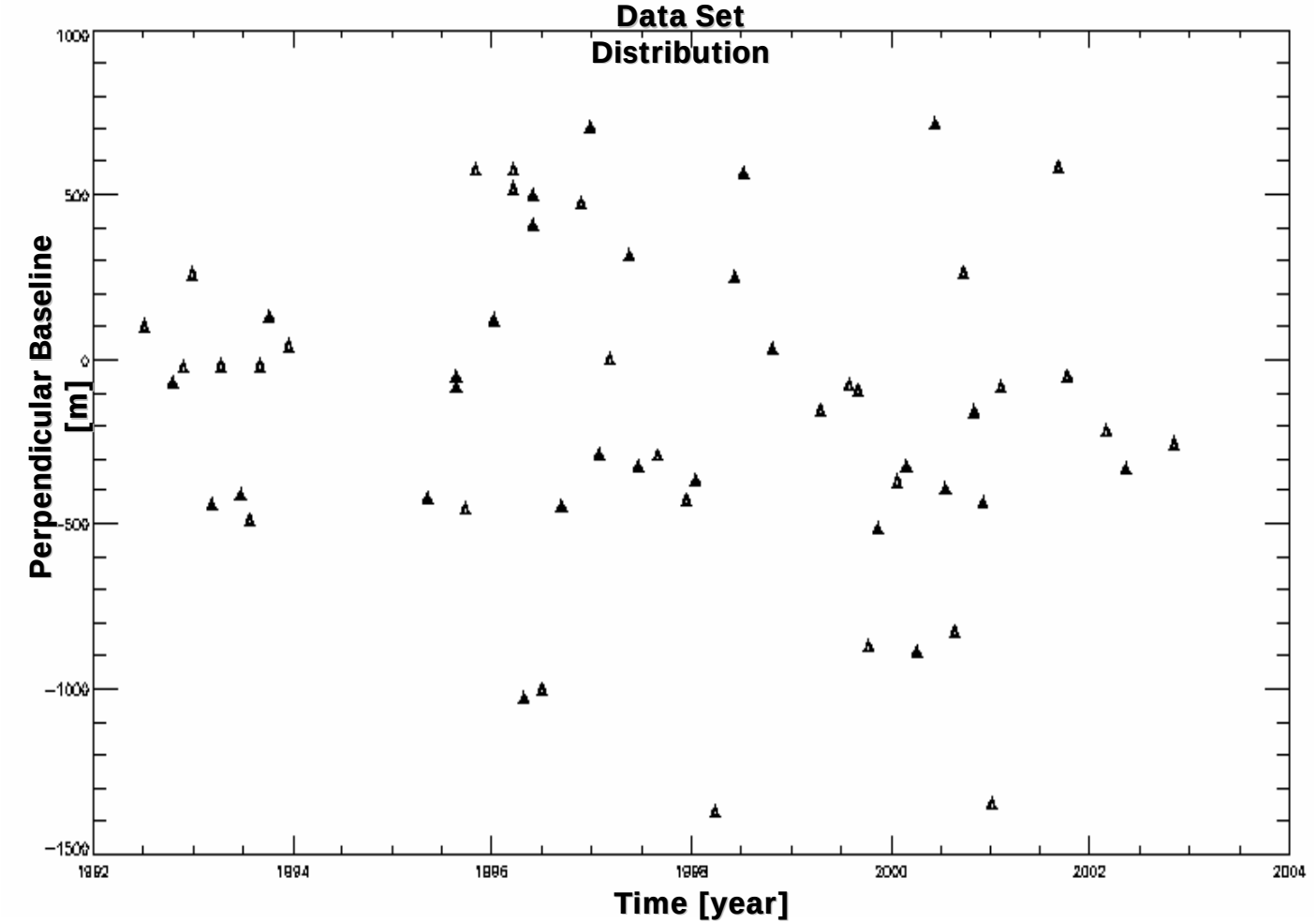
Centimetric displacements can be measured in “coherent” areas!



DnSAR fundamentals (4)



ERS data availability: Napoli bay (Italy) example



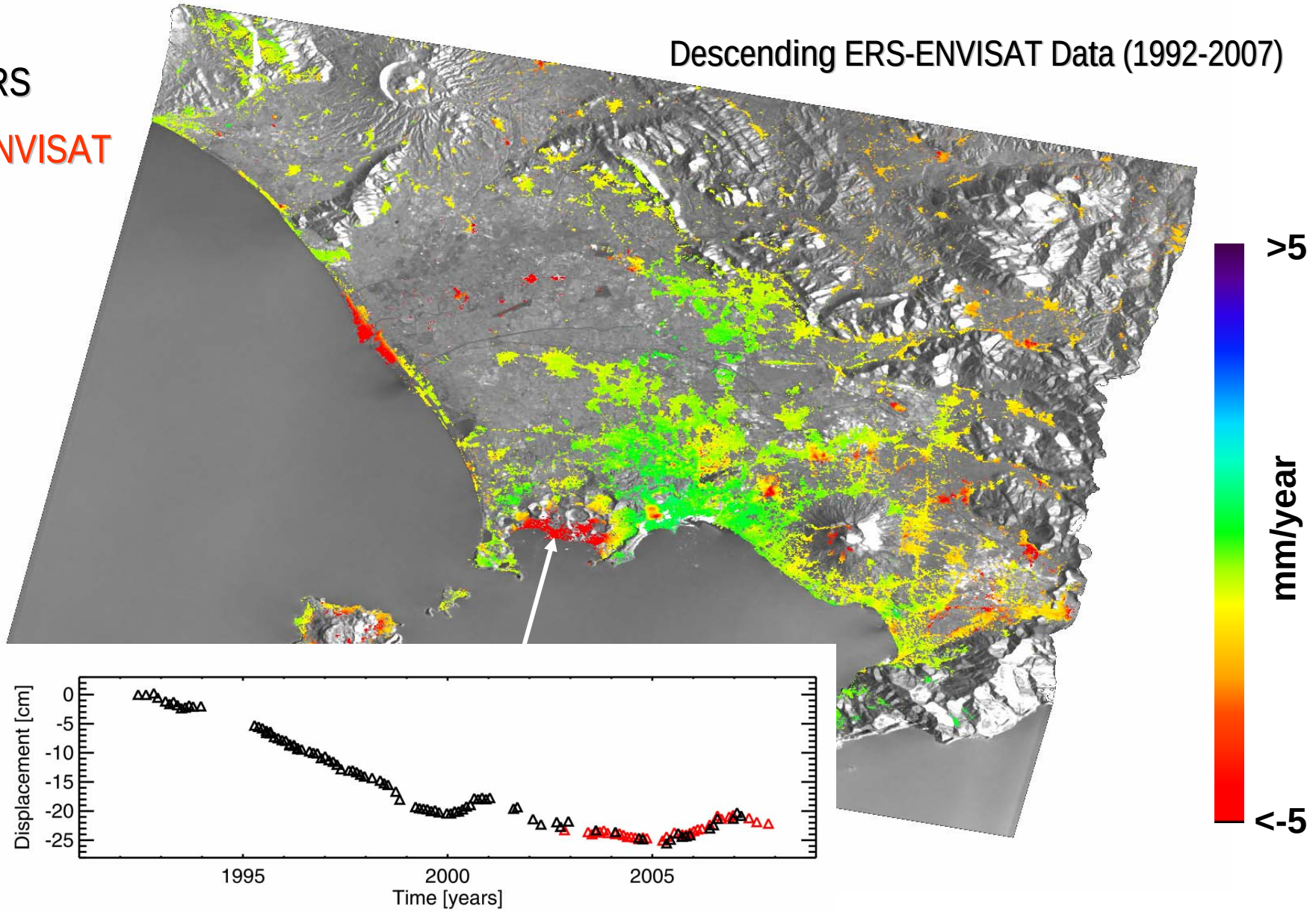
We can move from the analysis of single deformation events to the generation of time-series

Napoli Bay Area

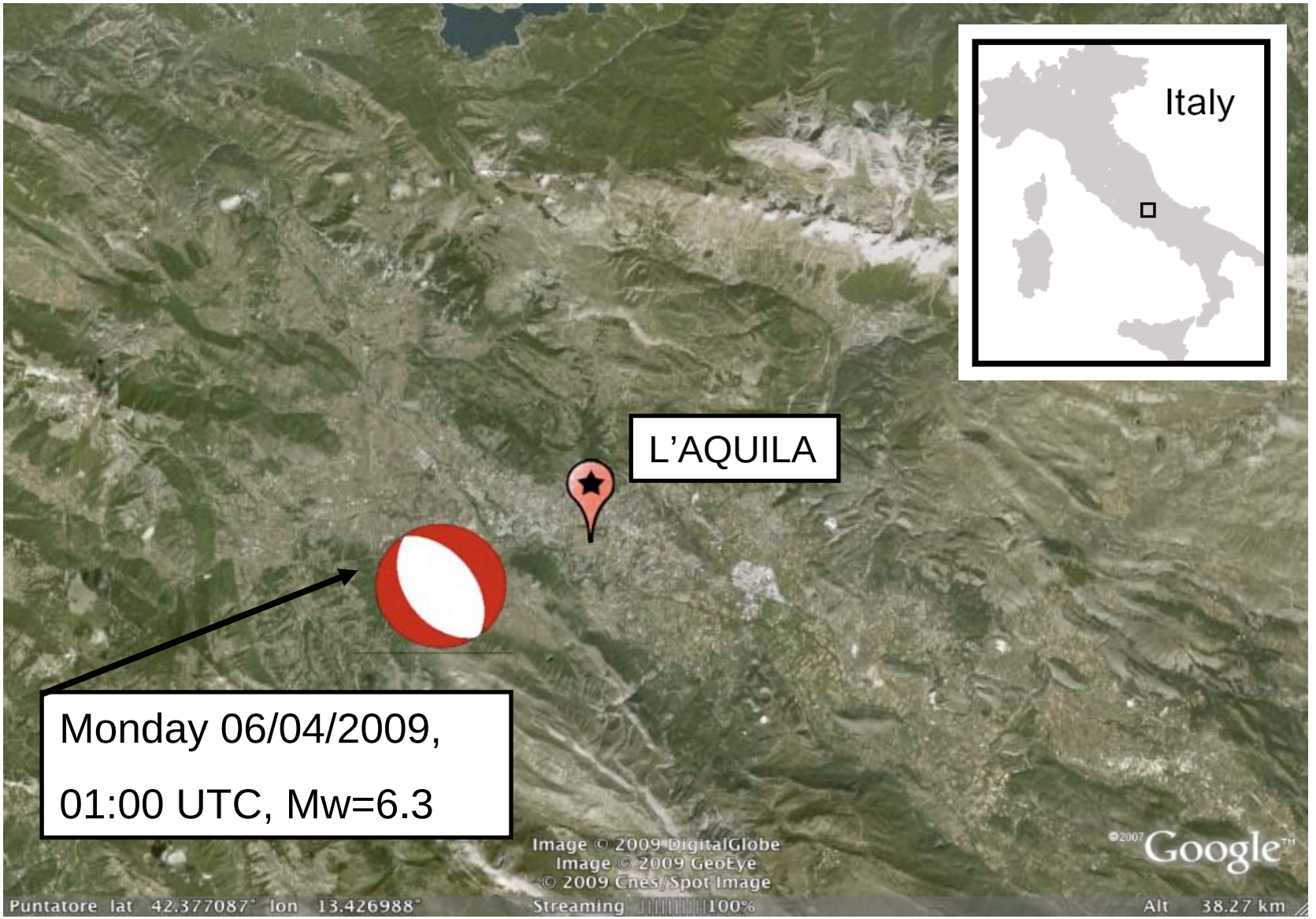
Δ ERS

Δ ENVISAT

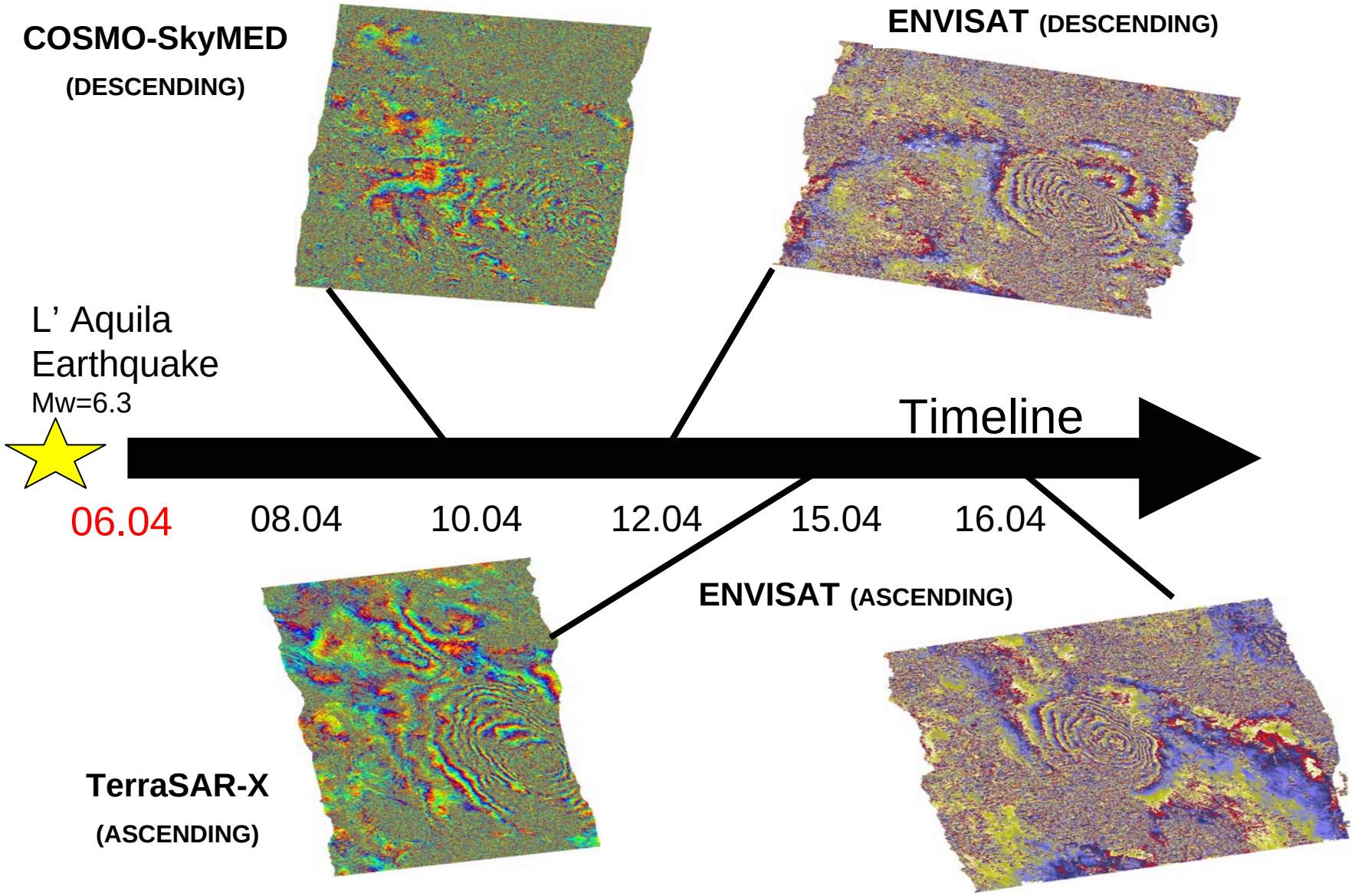
Descending ERS-ENVISAT Data (1992-2007)



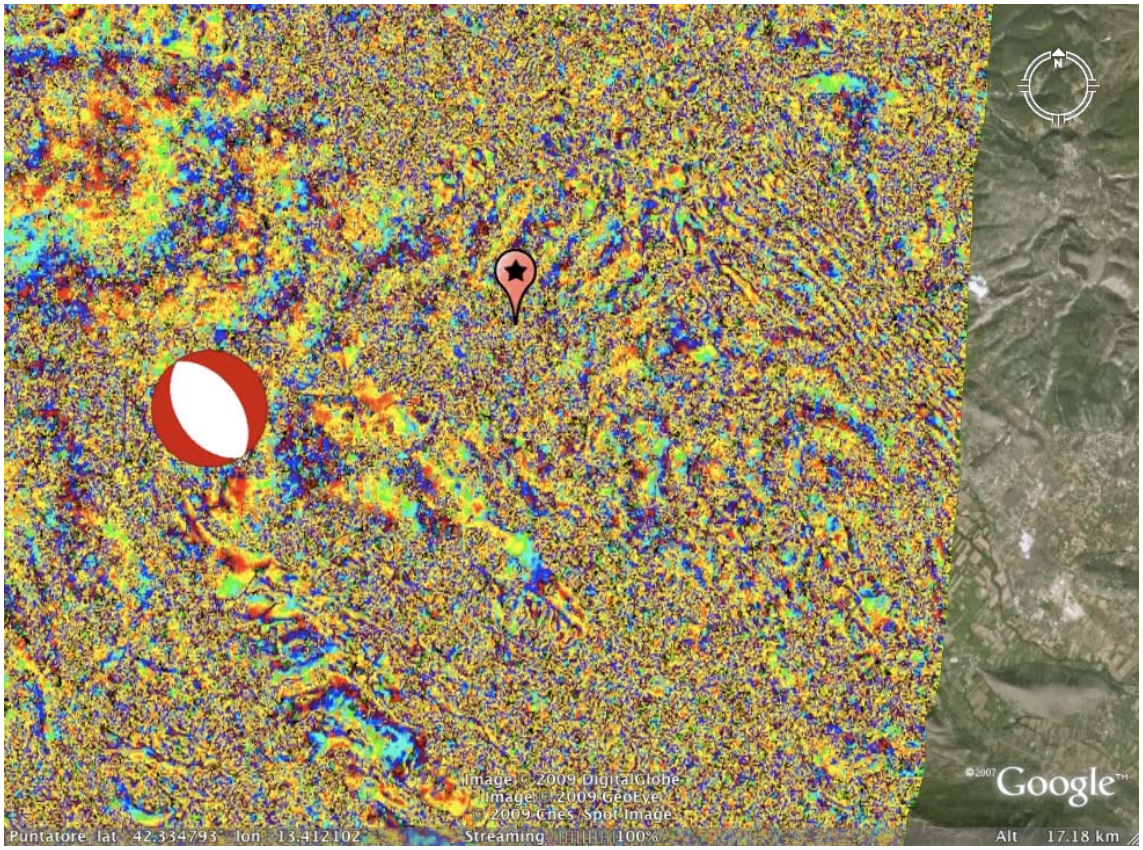
L’Aquila earthquake scenario



DInSAR analysis



COSMO-SkyMED results



Data pair= 23/03 - 08/04

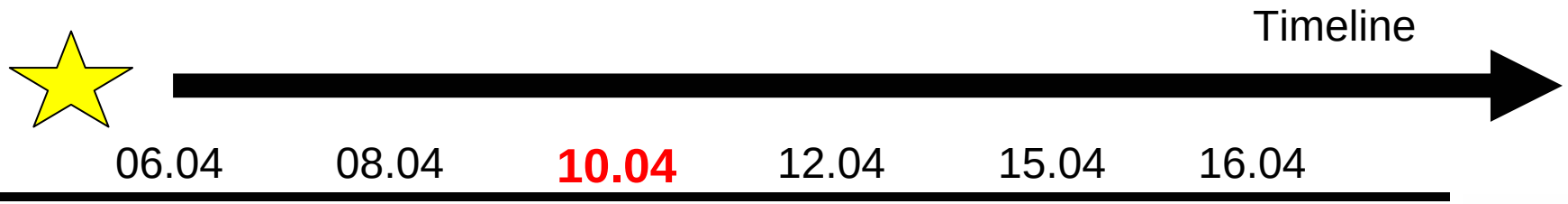
X-band (1 fringe = 15mm)

Descending orbit

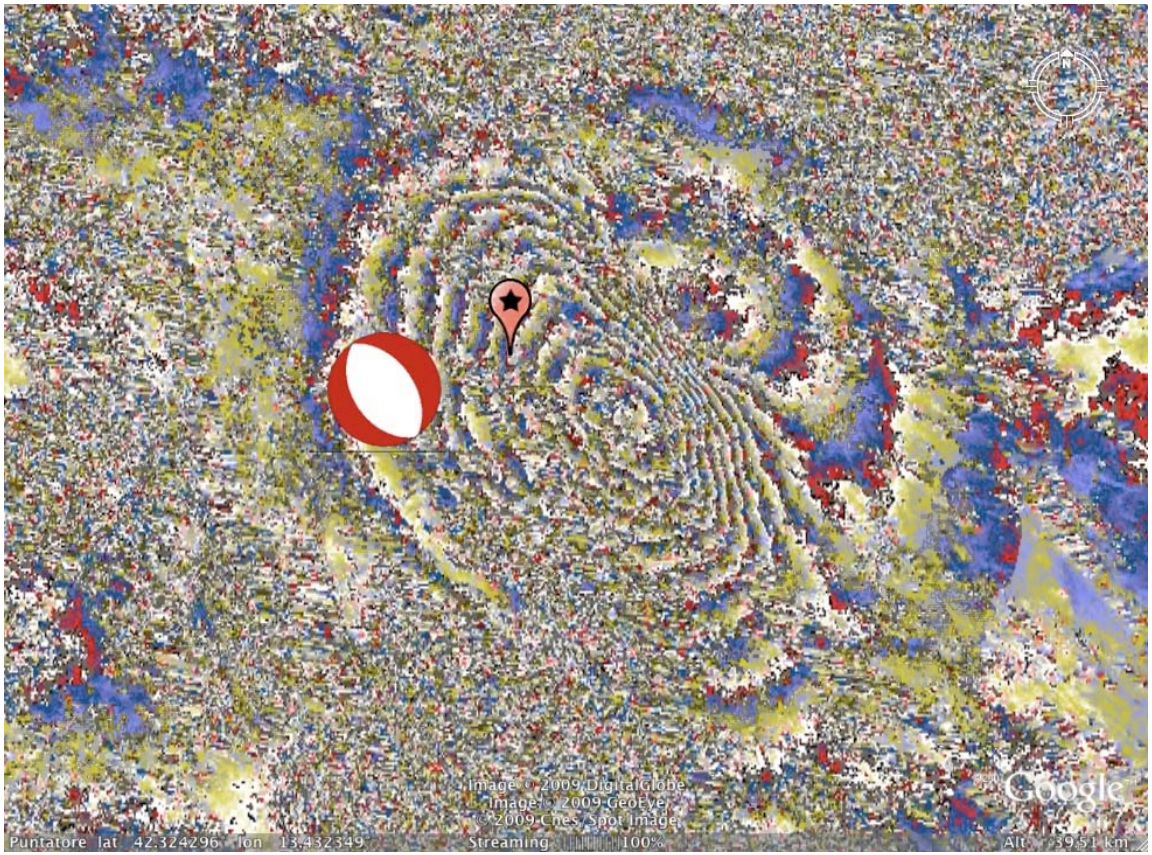
51° look angle

16 days temporal baseline

848m perpendicular baseline



ENVISAT results



Data pair = 01/02 - 12/04

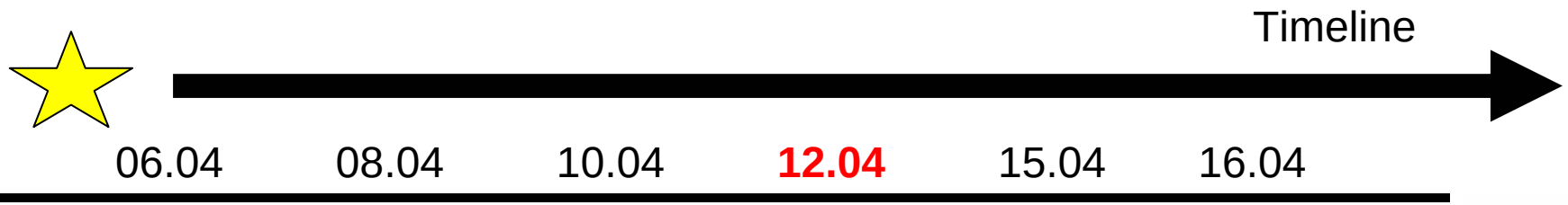
C-band (1 fringe = 28mm)

Descending orbit

23° look angle

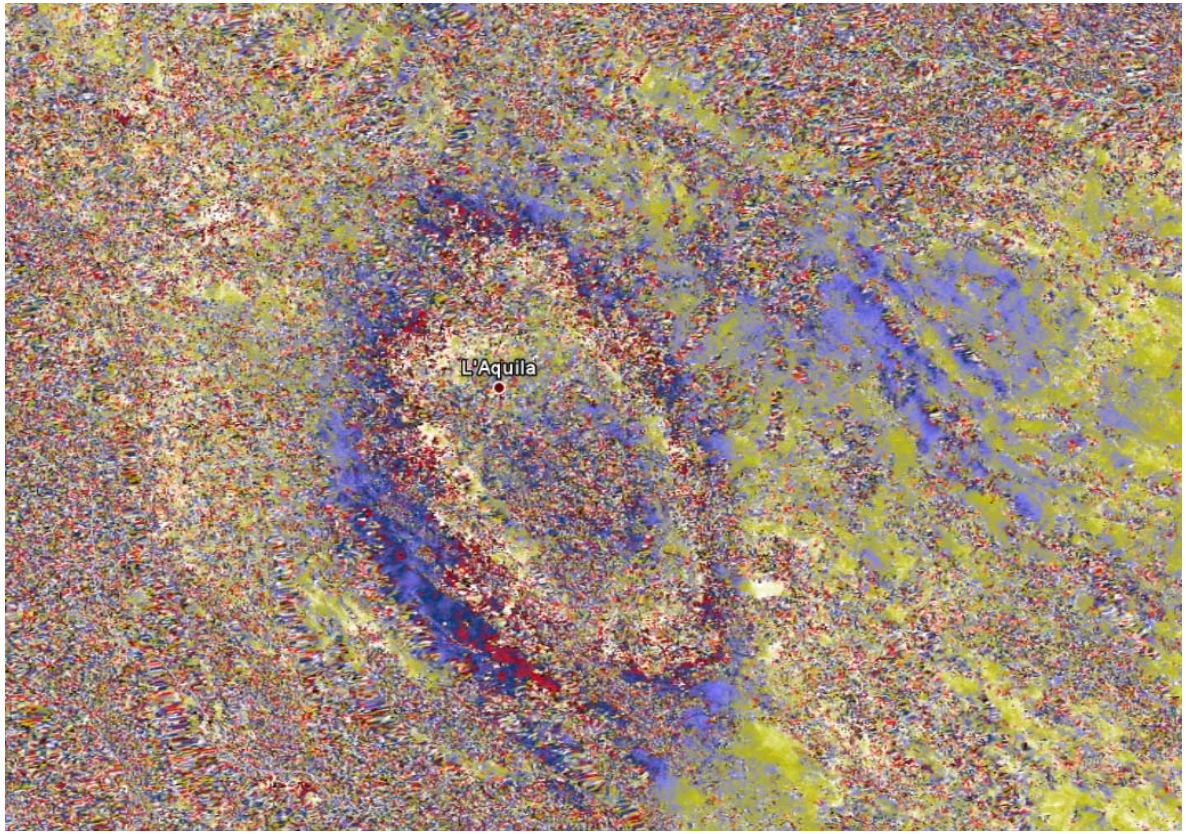
70 days temporal baseline

154m perpendicular baseline



ALOS results

Data pair = 02/04/2008 - 02/05



L-band (1 fringe = 11.5cm)

Ascending orbit

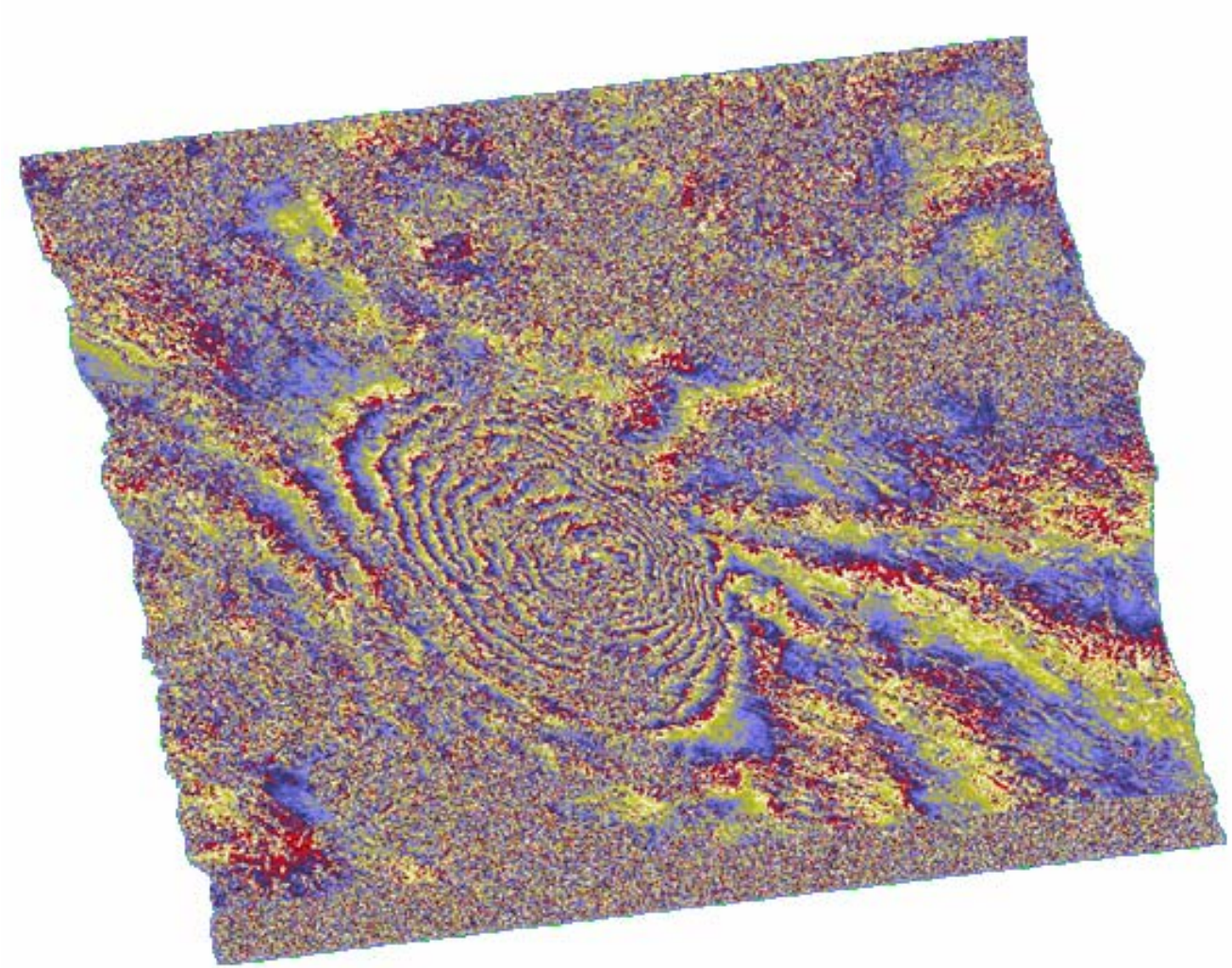
39.6° look angle

414 days temporal baseline

3600m perpendicular baseline

New COSMO-SkyMED results

Data pair= 04/04 - 12/04



ɔand (1 fringe = 15mm)

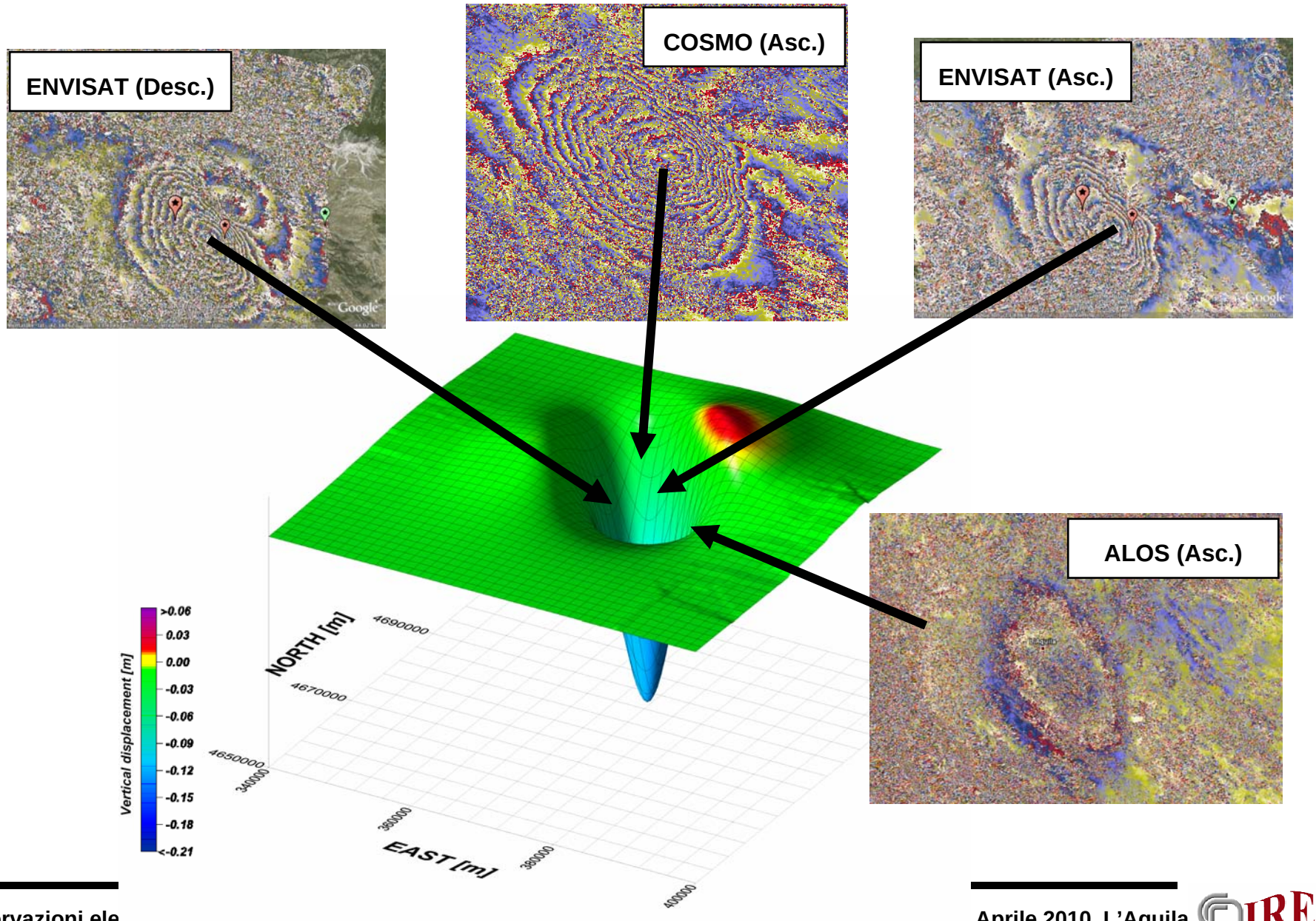
cending orbit

.9° look angle

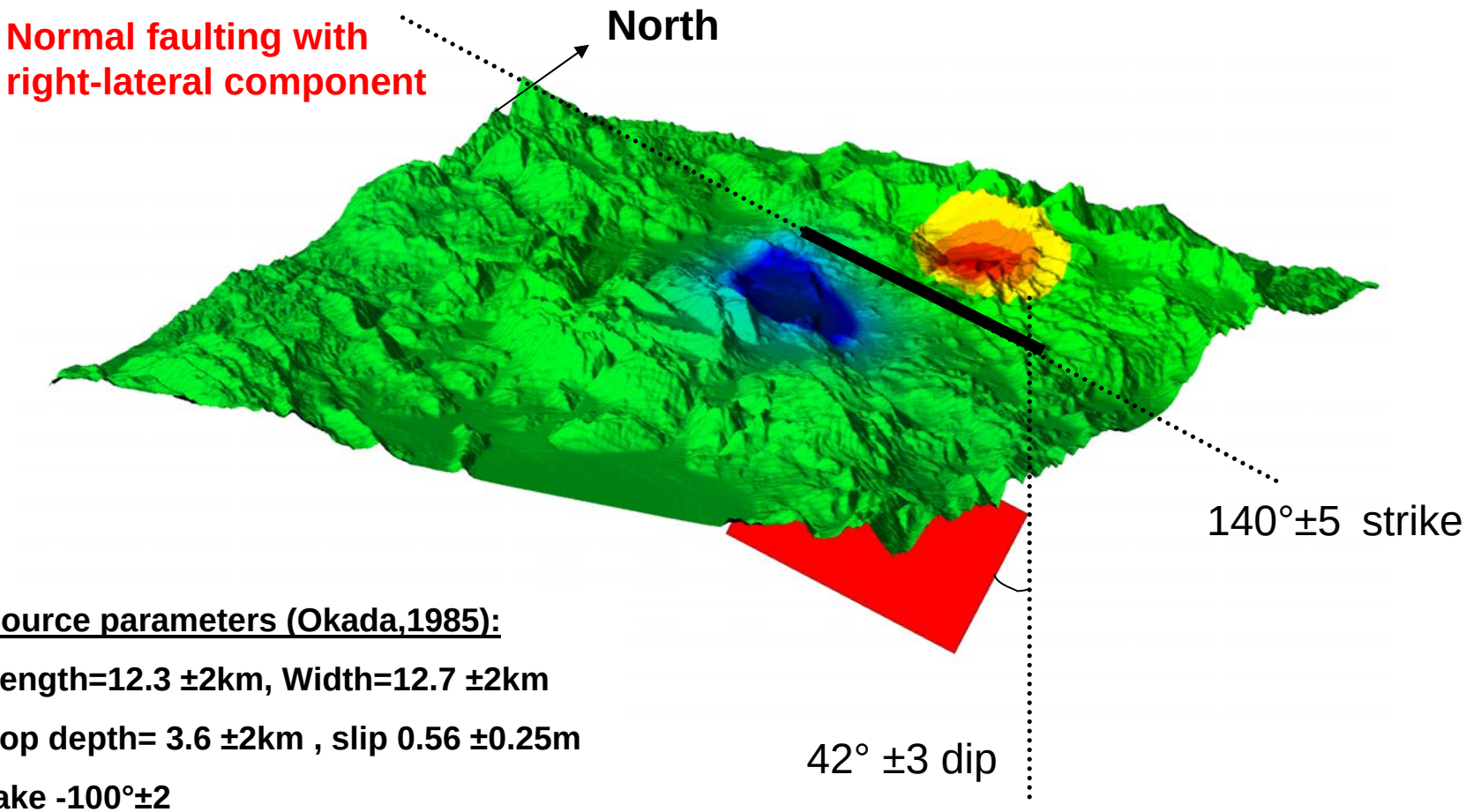
lays temporal baseline

2m perpendicular baseline

Co-seismic deformation analysis



Results of co-seismic interferograms modelling



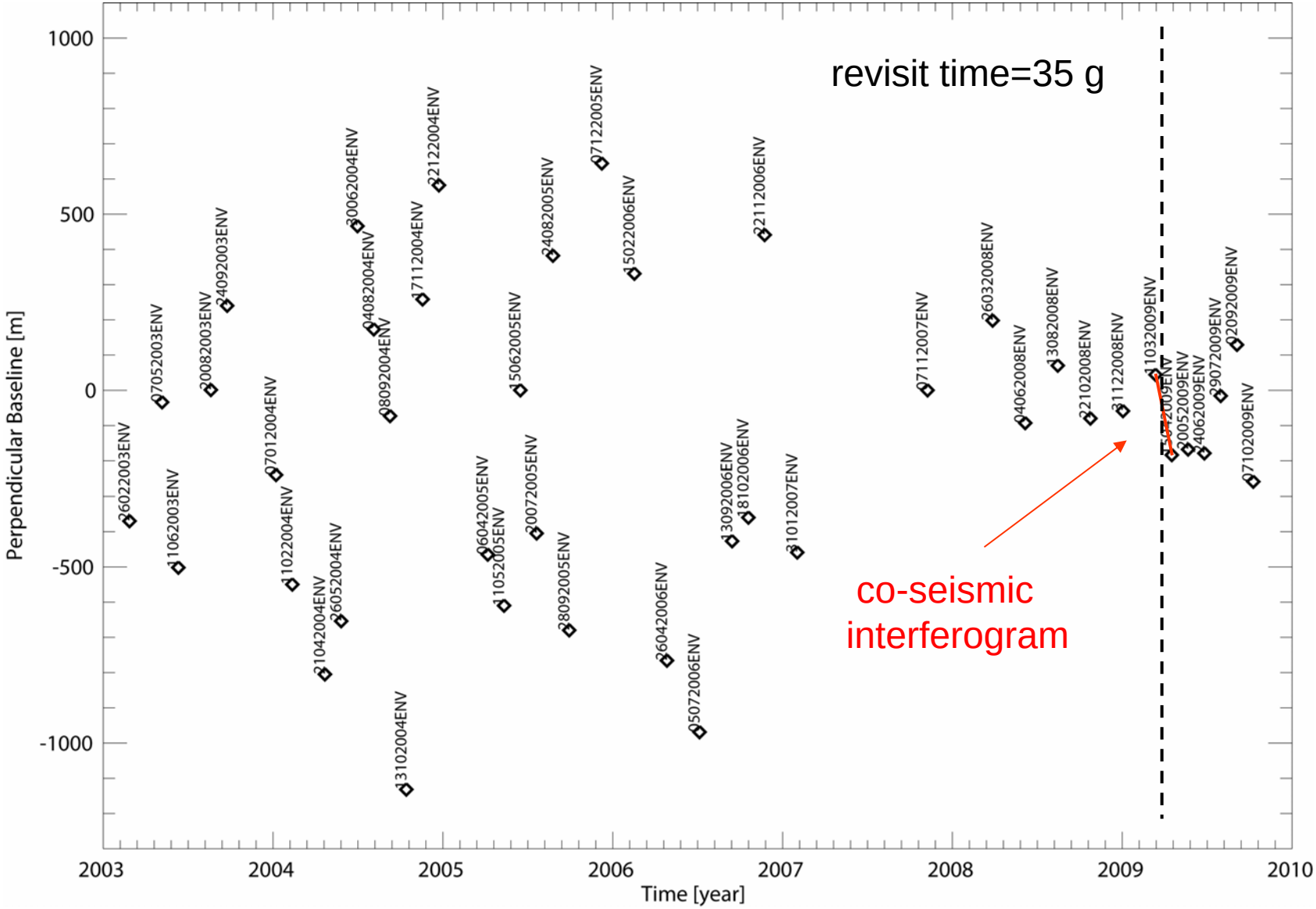
Source parameters (Okada,1985):

Length=12.3 ±2km, Width=12.7 ±2km

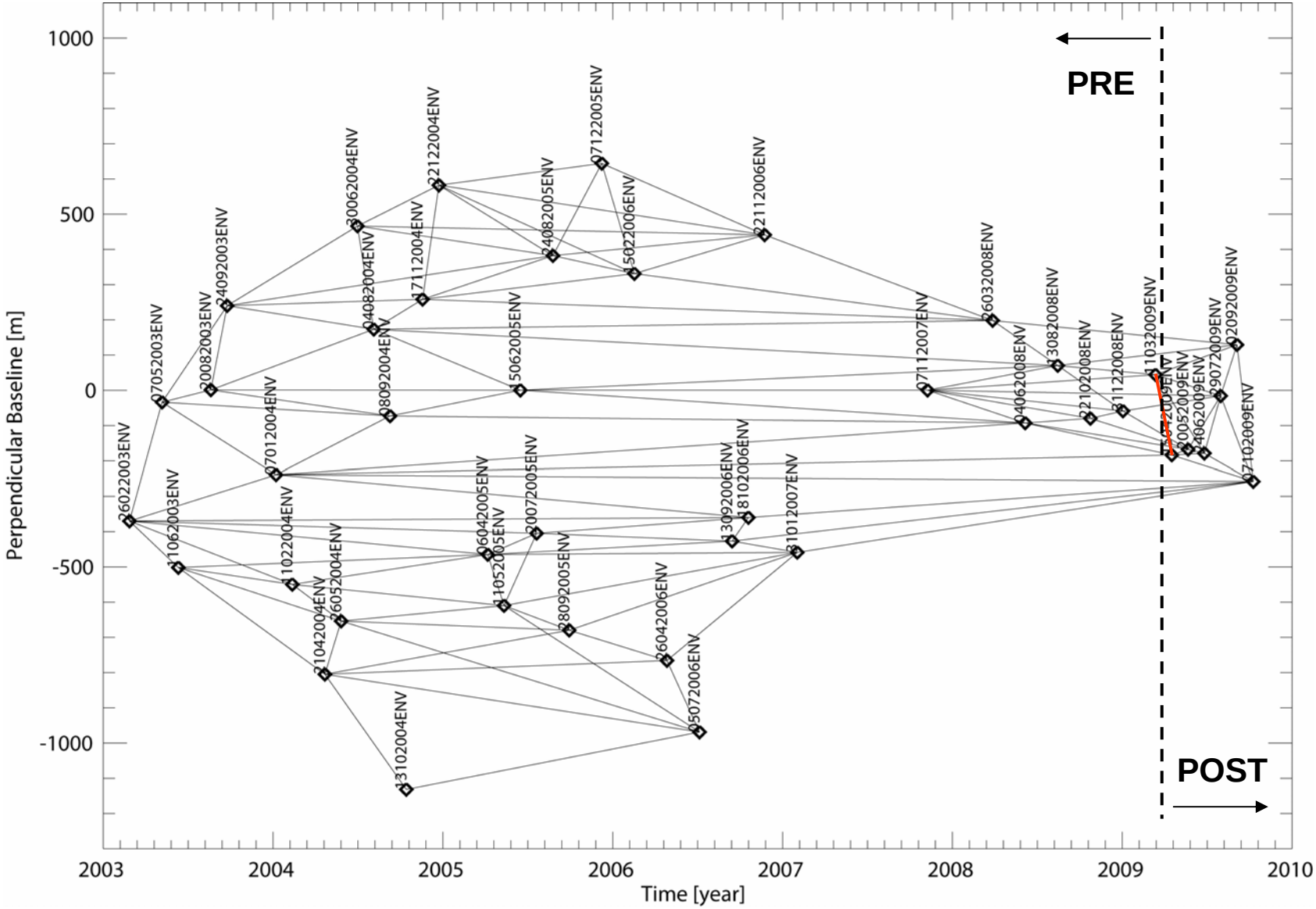
Top depth= 3.6 ±2km , slip 0.56 ±0.25m

rake -100°±2

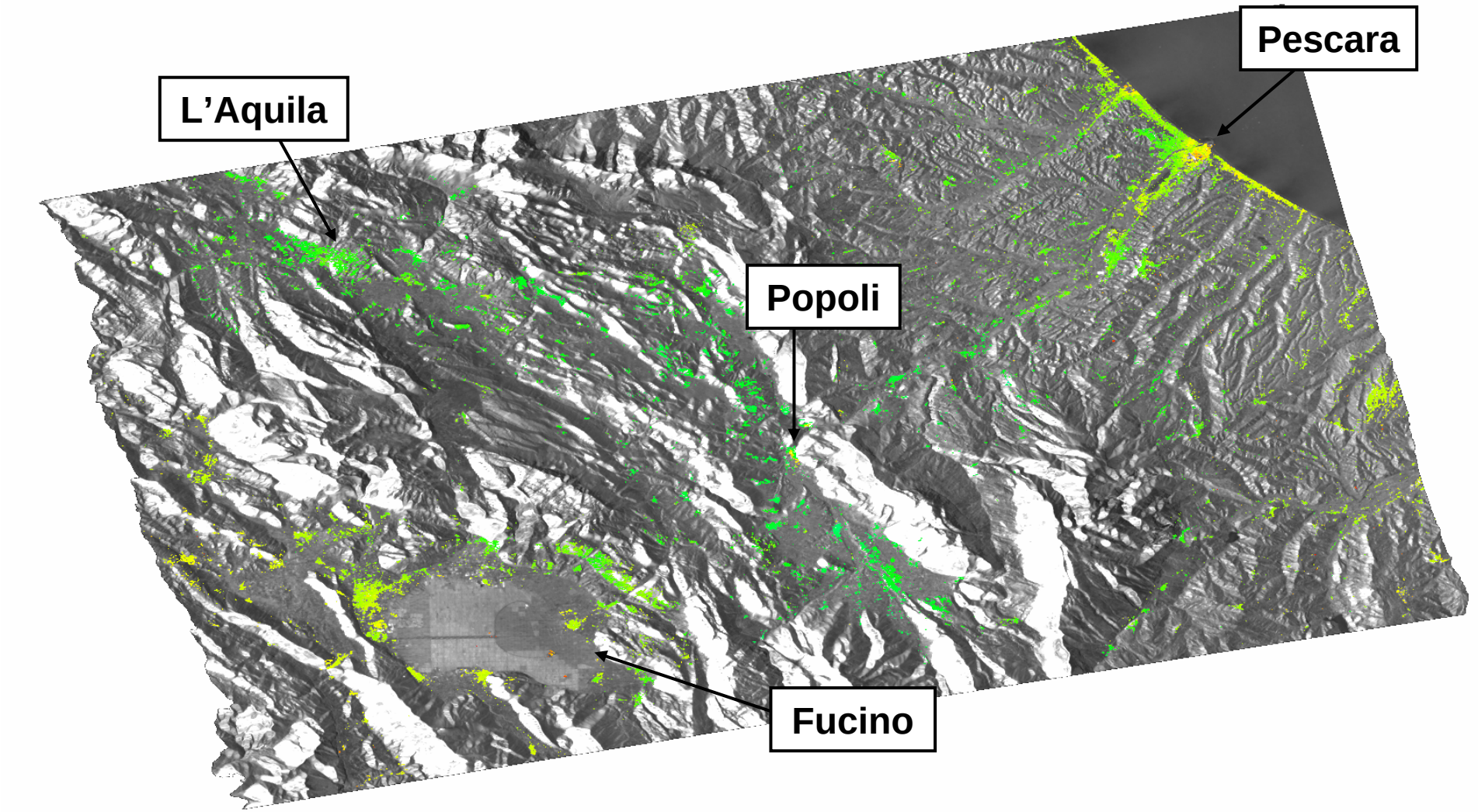
Ascending ENVISAT SAR data: 42 acquisitions (revisit time=35 g)



We can compute a sequence of interferograms and retrieve the deformation time-series



Pre-seismic mean deformation velocity map

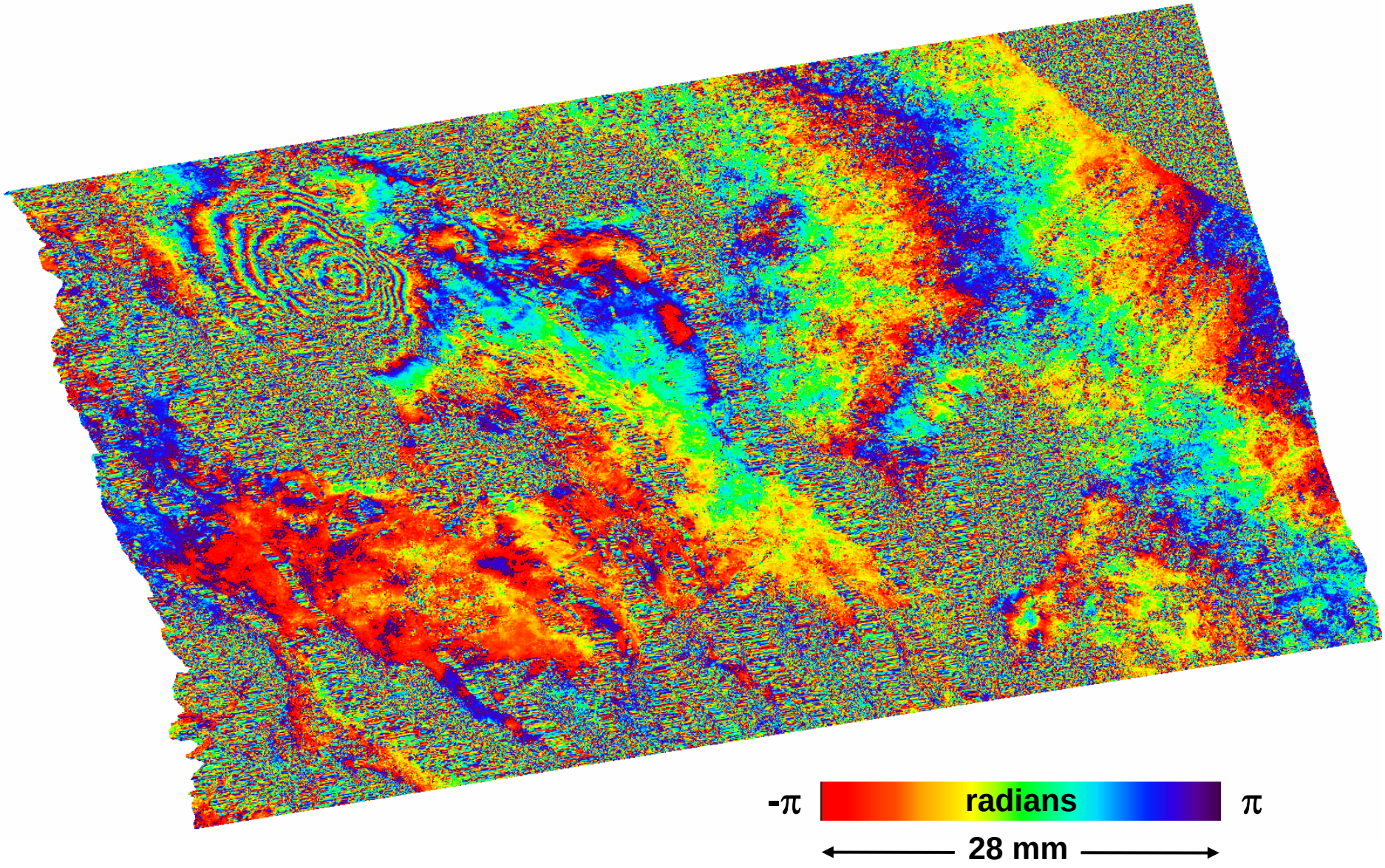


26 February 2003 – 11 March 2009

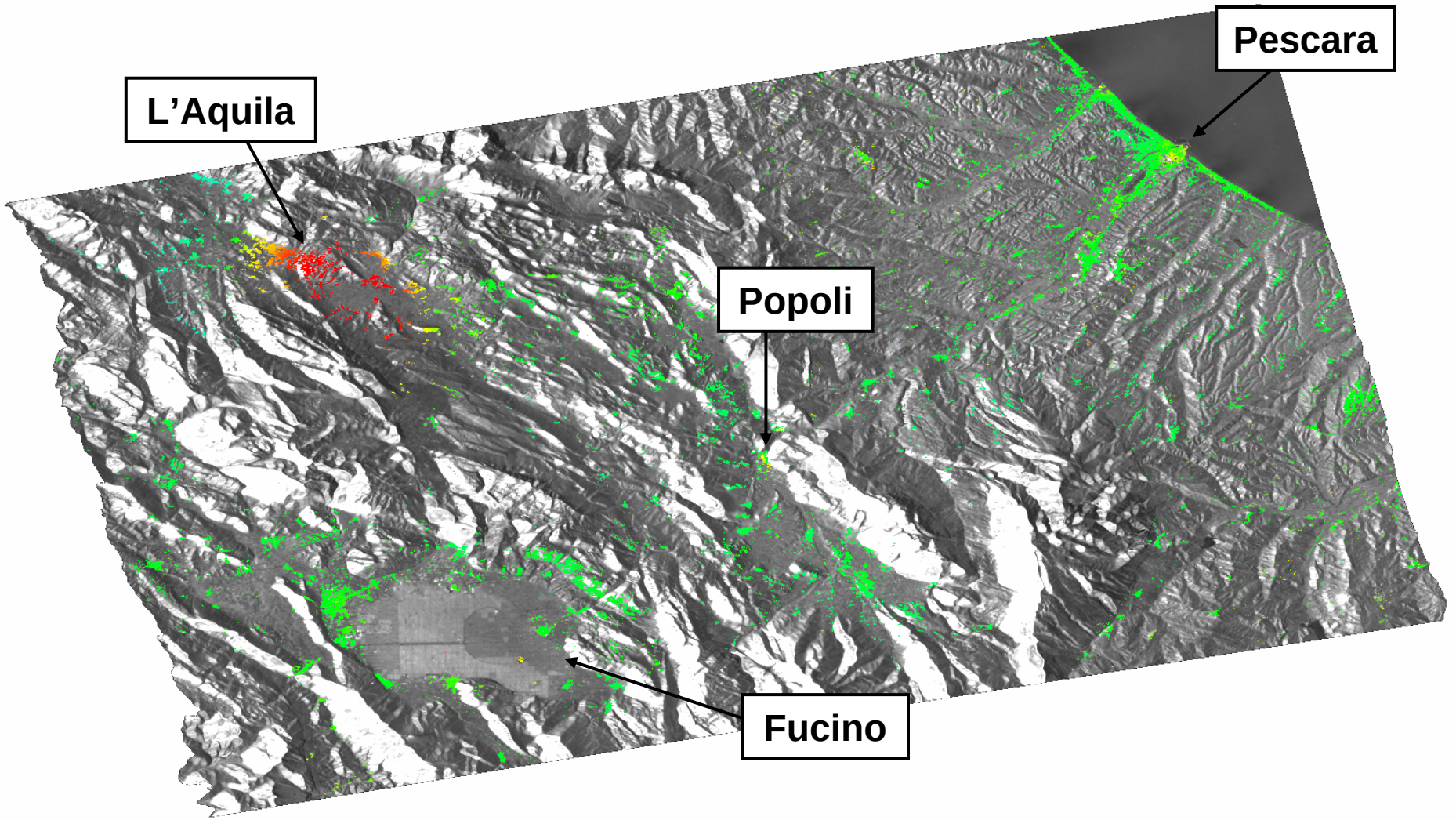
Mean deformation velocity

< -1.5 cm/year **> 1.5**

Co-seismic differential interferogram: 11 March 2009 – 15 April 2009



Pre-co-post seismic mean deformation velocity map

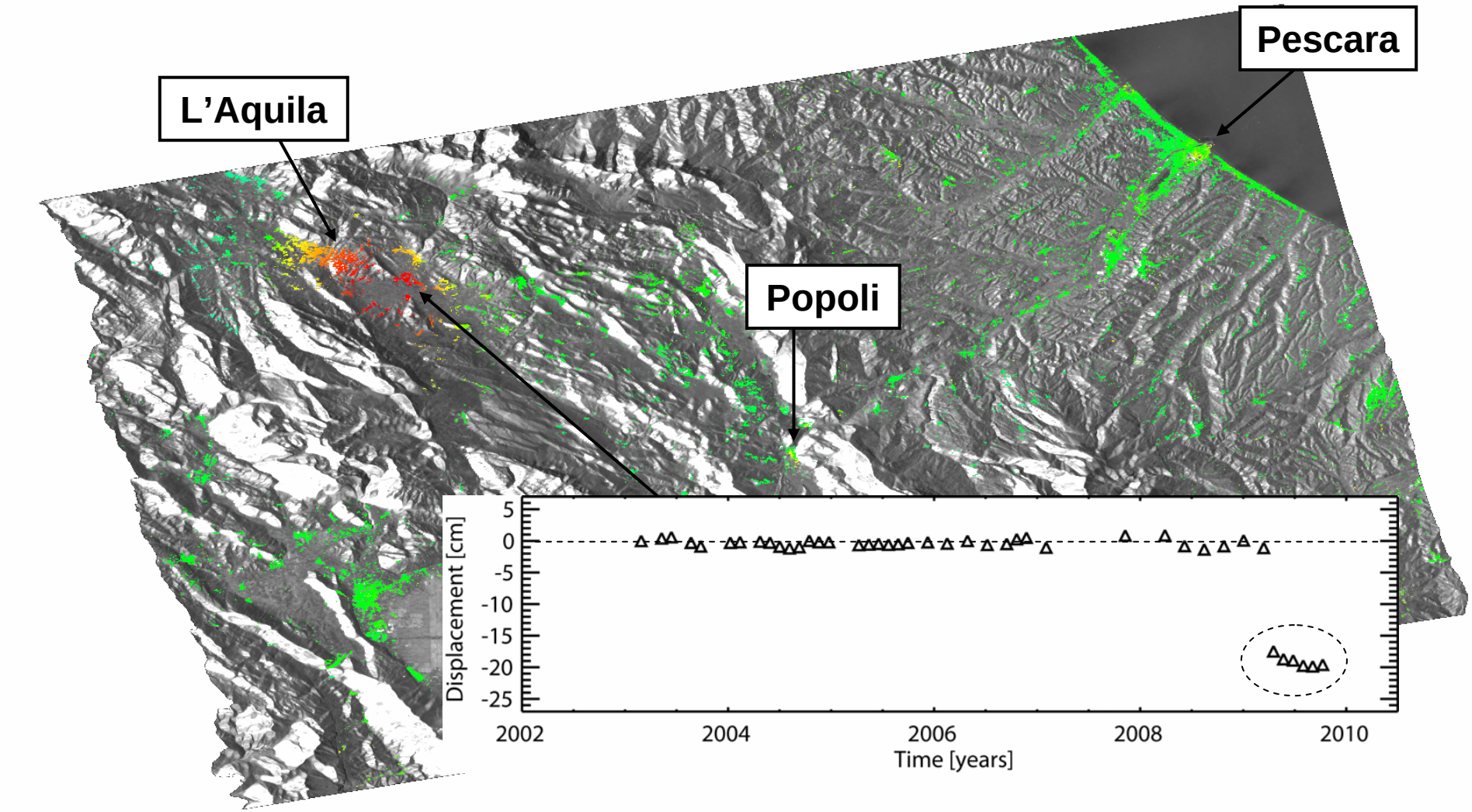


26 February 2003 – 7 October 2009

Mean deformation velocity

< -1.5 cm/year **> 1.5**

Pre-co-post seismic mean deformation velocity map

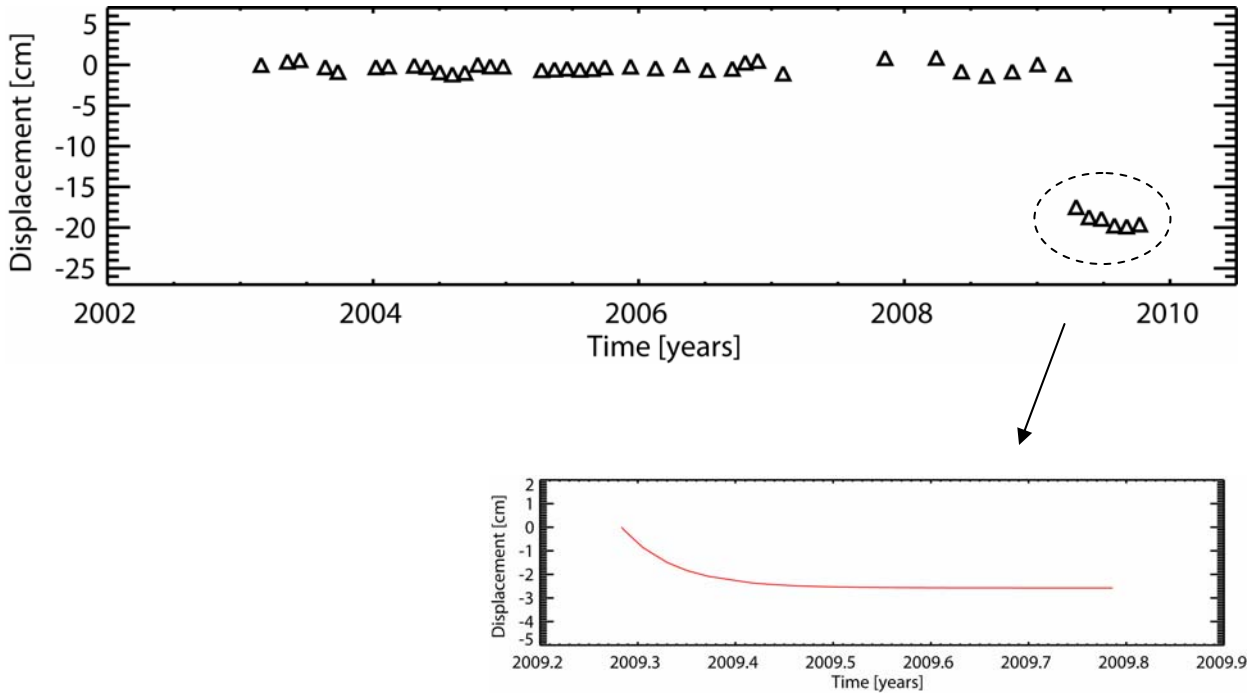


26 February 2003 – 7 October 2009

Mean deformation velocity

< -2 **cm/year** **> 2**

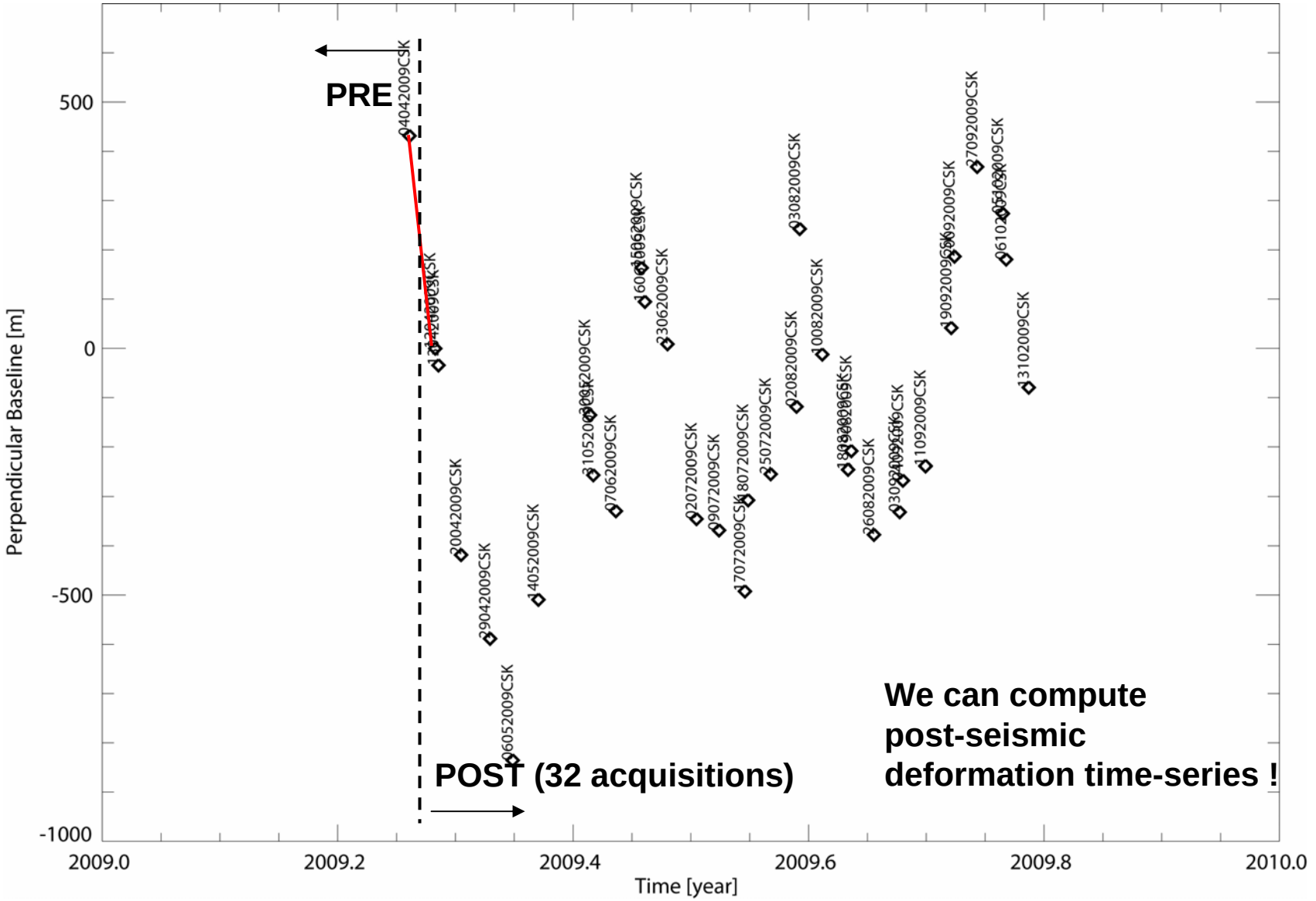
Post-seismic deformation analysis



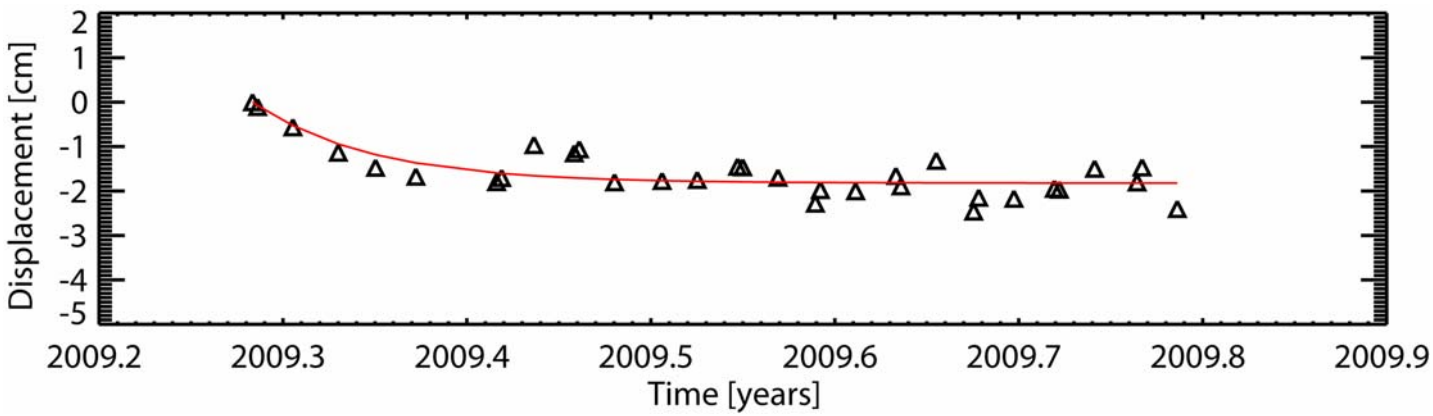
$P(t)=A\,[1-\exp(-t/\tau)]$

- t= time since the earthquake
- tau= relaxation time
- A= deformation at infinite time

Ascending COSMO-SkyMED SAR data: 33 acquisitions (revisit time=8 g)



Advanced post-seismic deformation analysis

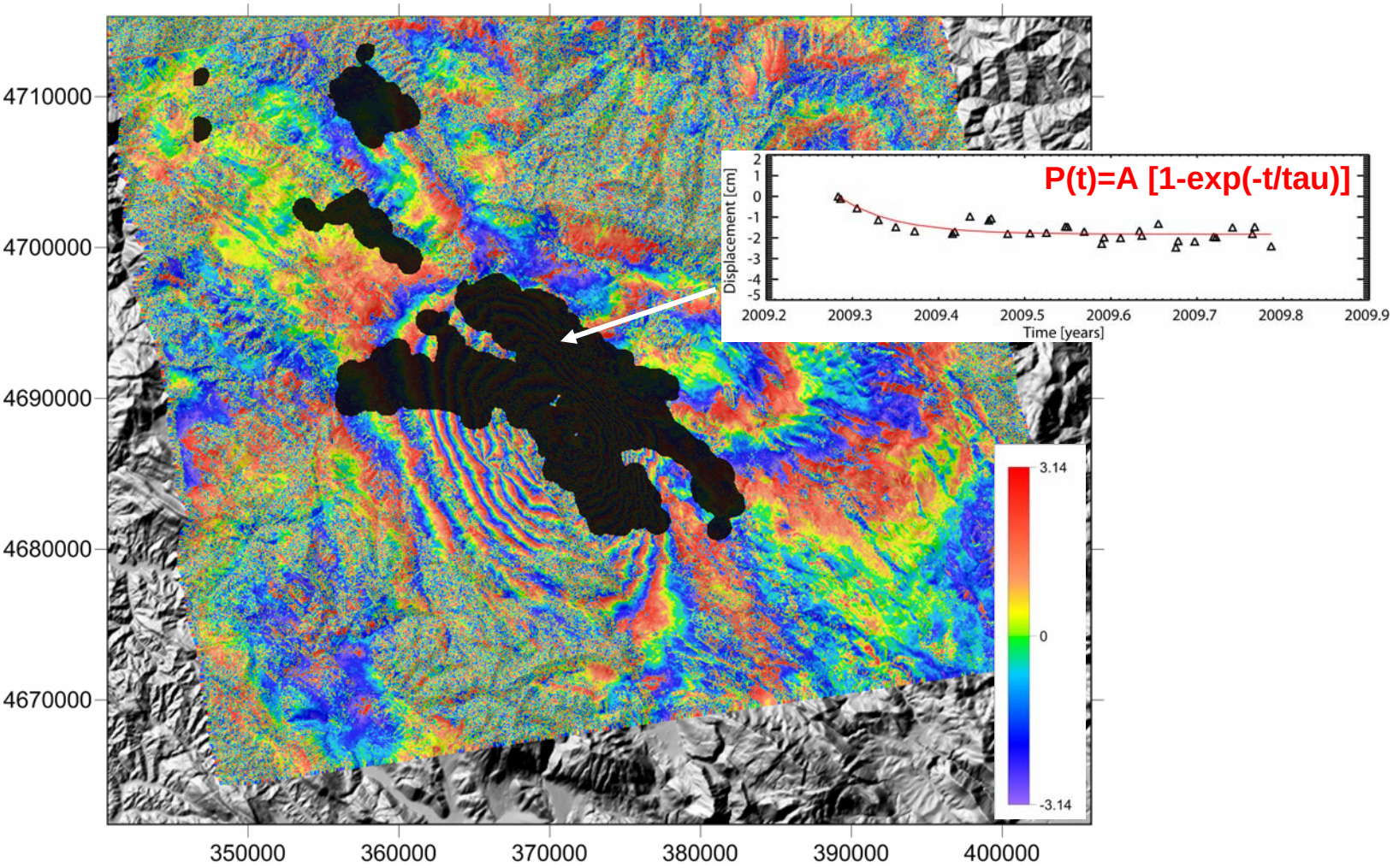


$P(t)=A\,[1-\exp(-t/\tau)]$

- t= time since the earthquake
- tau= relaxation time
- A= deformation at infinite time

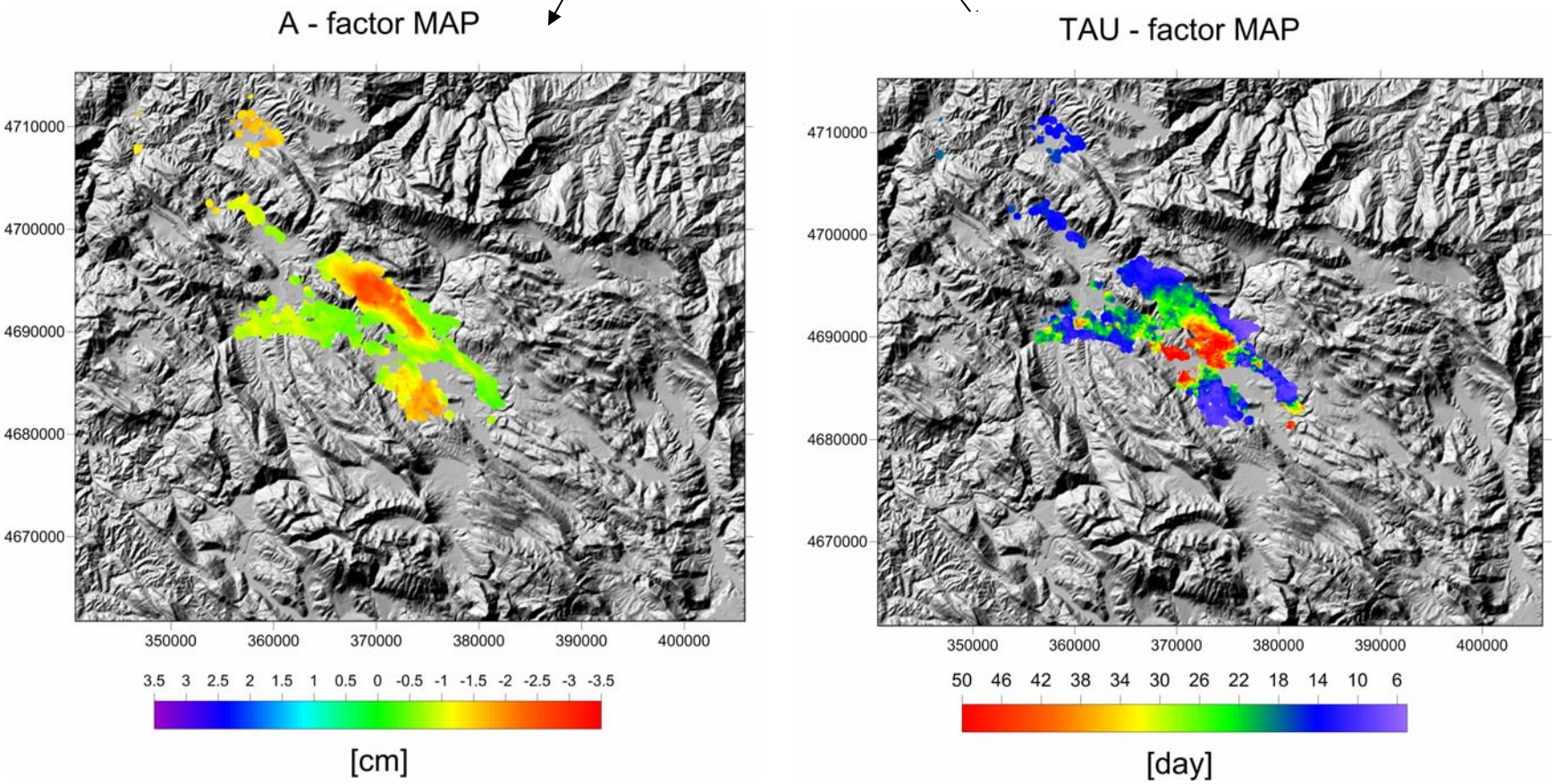
We may identify the areas with post-seismic deformation time series in agreement with P(t).

Advanced post-seismic deformation analysis (2)



Advanced post-seismic deformation analysis (3)

$$P(t) = A\,[1 - \exp(-t/\tau)]$$



Conclusive remarks

- **An extensive analysis on the L'Aquila 2009 earthquake, based on conventional and advanced differential SAR interferometry techniques, has been presented.**

- **The DInSAR results provide key information on the pre- ,co- and post-seismic deformations affecting the investigated area.**

- **The role of the short revisit time of the COSMO-Skymed constellation was essential to retrieve the space-time characteristics of the post-seismic displacements.**

- **The possibility to benefit of the short revisit time of the COSMO-Skymed constellation is foreseen in order to analyze possible pre-seismic displacements in future seismic events.**

- **The joint analysis of surface displacements and seismic information is worth for future analysis as well as the comparison with GPS measurements.**

Grazie !