



→ INSARAP WORKSHOP

Technical Workshop on
Sentinel-1 TOPS interferometry

Preliminary scientific results: Fault locking near Istanbul

Thomas R. Walter

GFZ Potsdam, DLR, e-geos, INGV, LEEDS

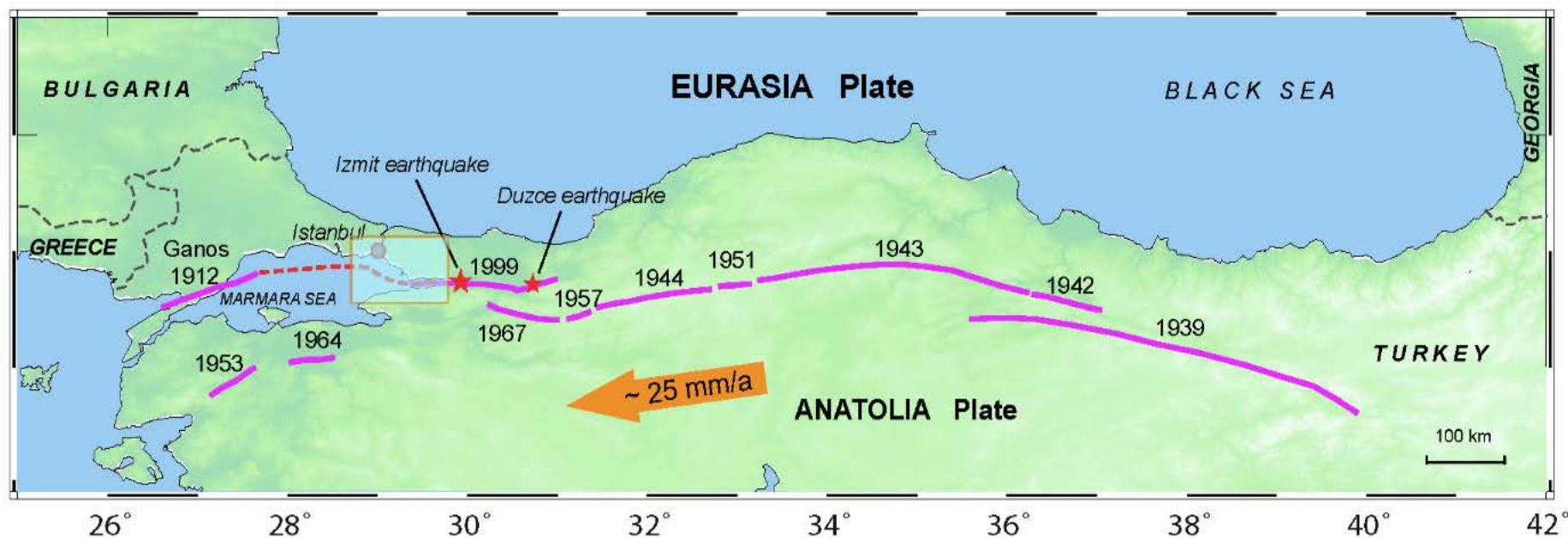
together with external partners:

IREA Napoli, Kandilli Observatory Istanbul, Wuhan University China



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Tectonic background near Istanbul

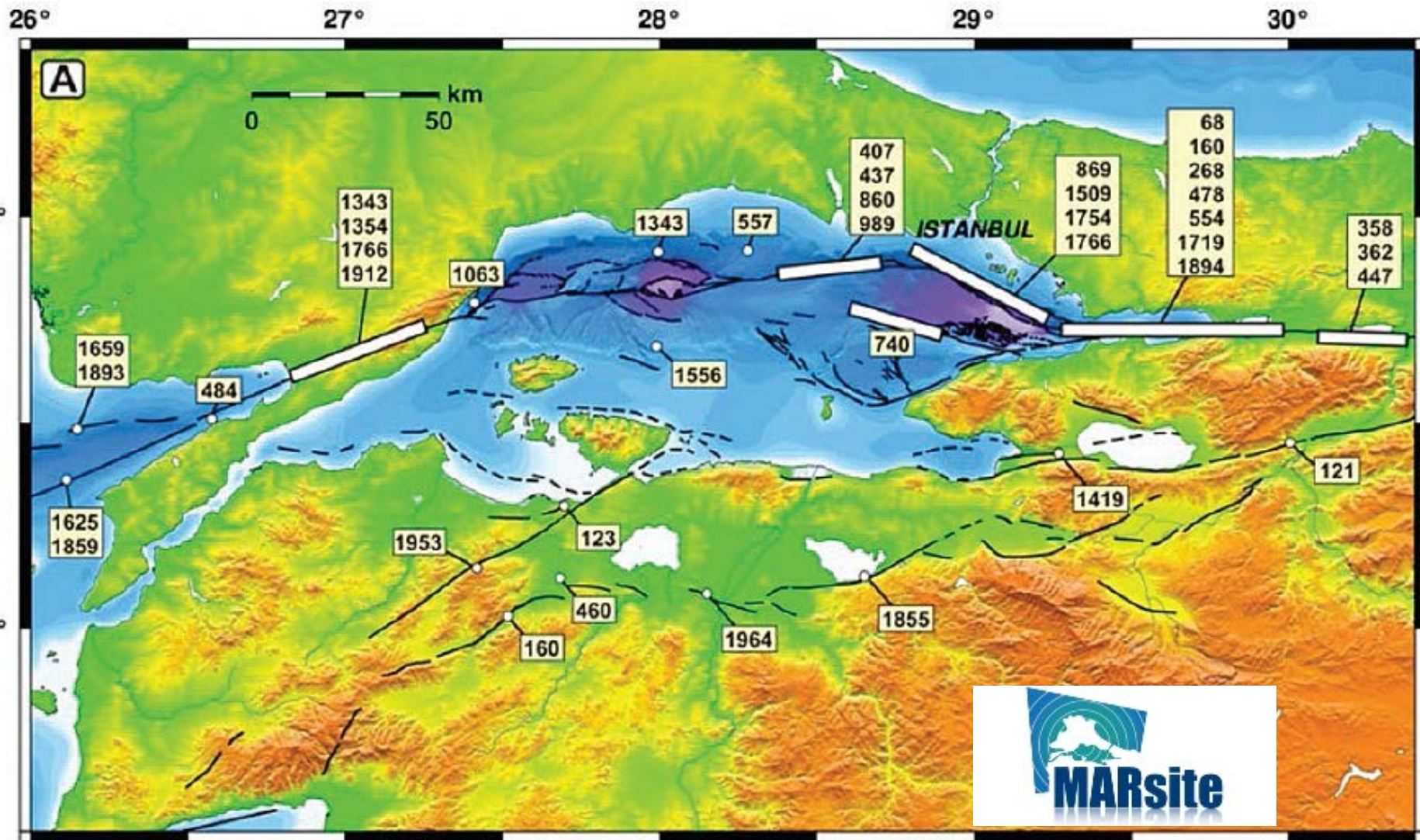


Seismic gap 10 km south of Istanbul- a mega city of >14 M people.
One of the fastest-growing metropolitan economies in the world.

Istanbul earthquake is anticipated.
Data access has been significantly improved
in the course of supersites project

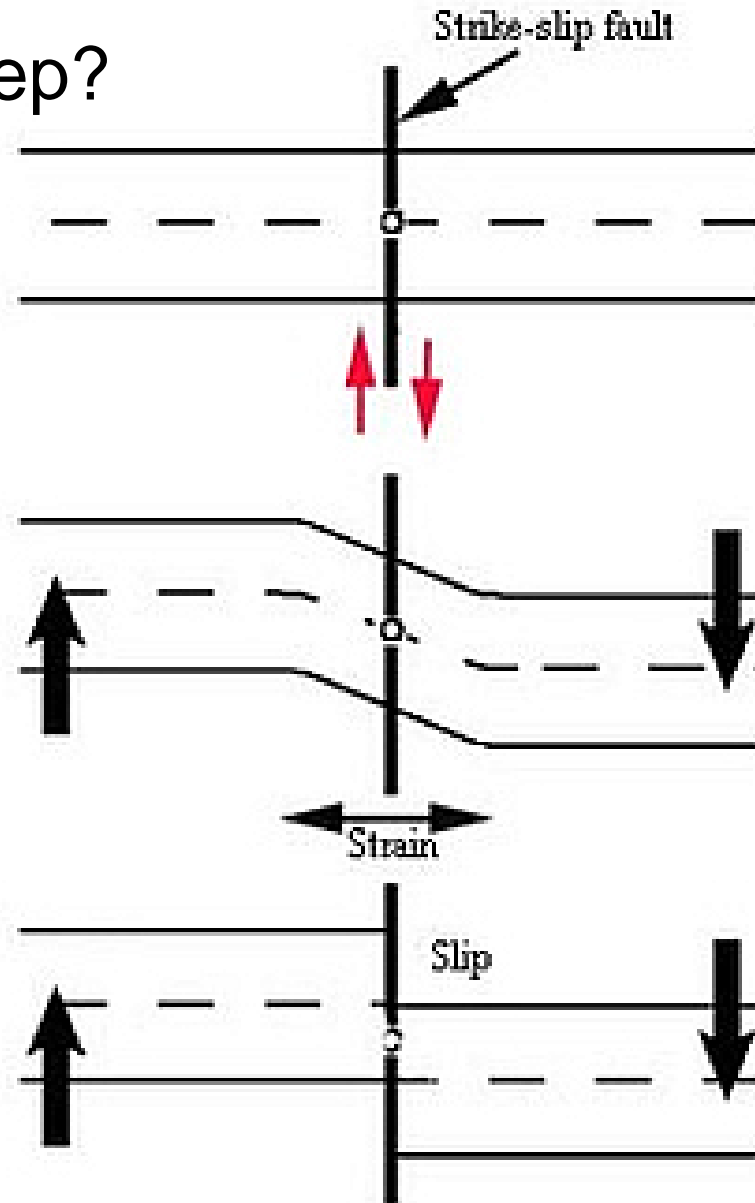


Tectonic background near Istanbul



Elastic rebound – or creep?

Illustration of elastic rebound theory (from top to bottom): original position of the road, strain builds up while the fault is locked, and then releases during an earthquake
(Source: Nature Educ.)





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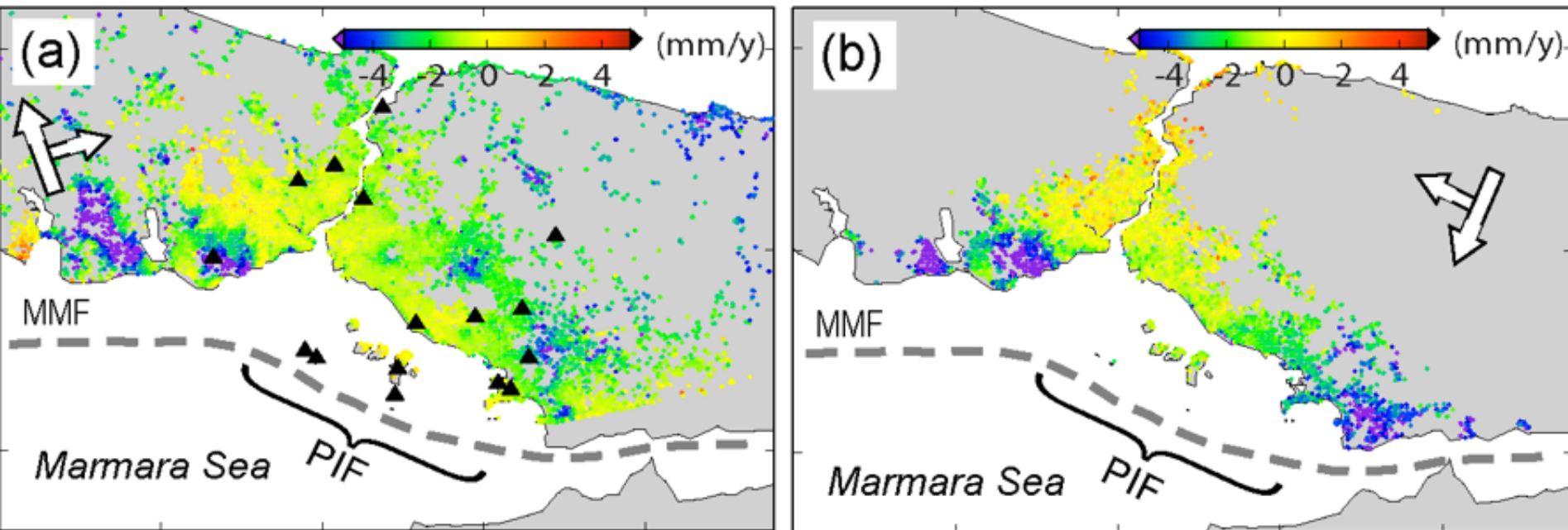
**together with Faqi Diao, Rongjiang Wang, Manuela Bonano, Giuseppe Solaro,
Mariarosaria Manzo, Semih Ergintav, Xiong Xiong, and Riccardo Lanari**

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Archived data (ERS1, ERS2, ENV)

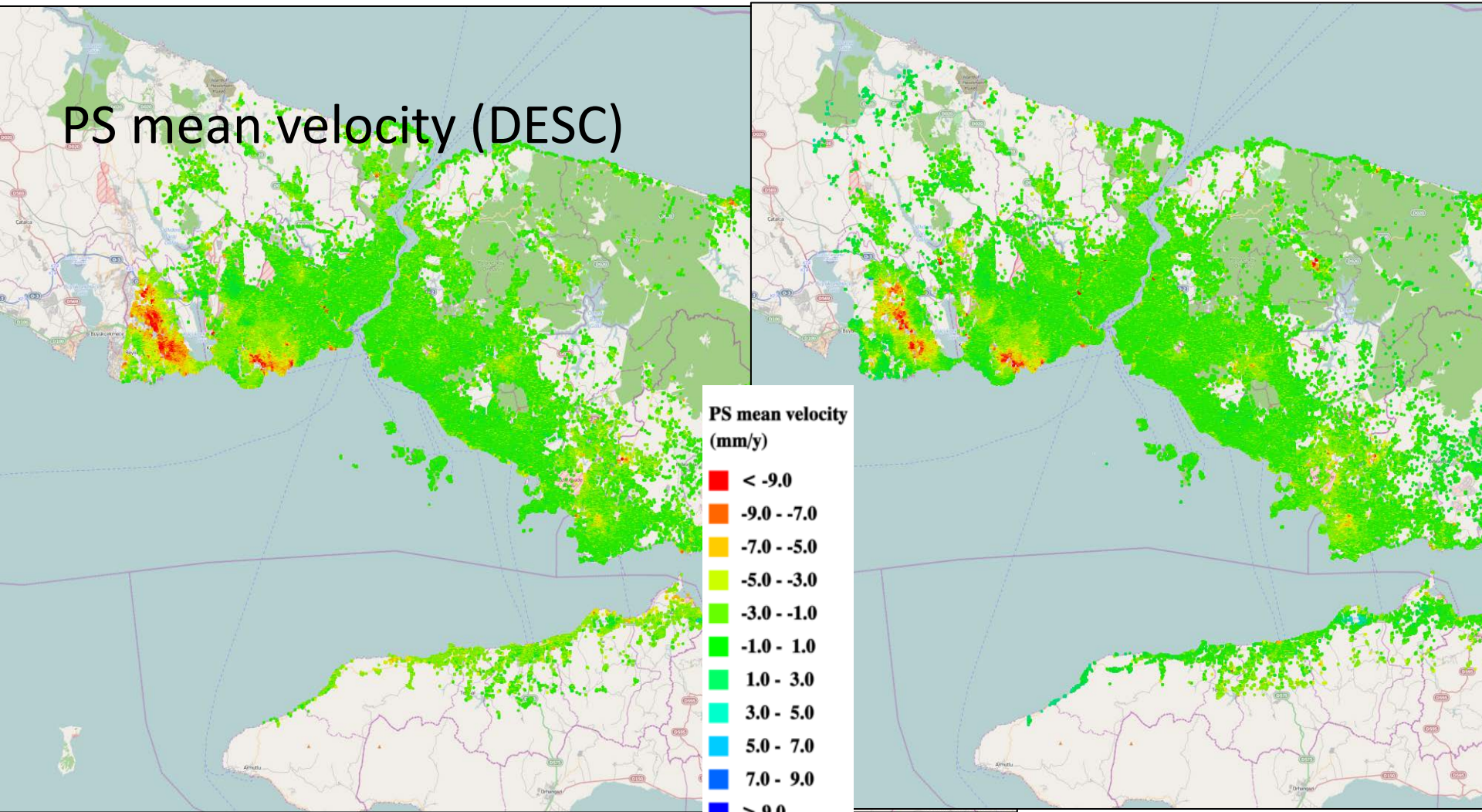


SBAS InSAR time series from 2002-2009: both ascending and descending

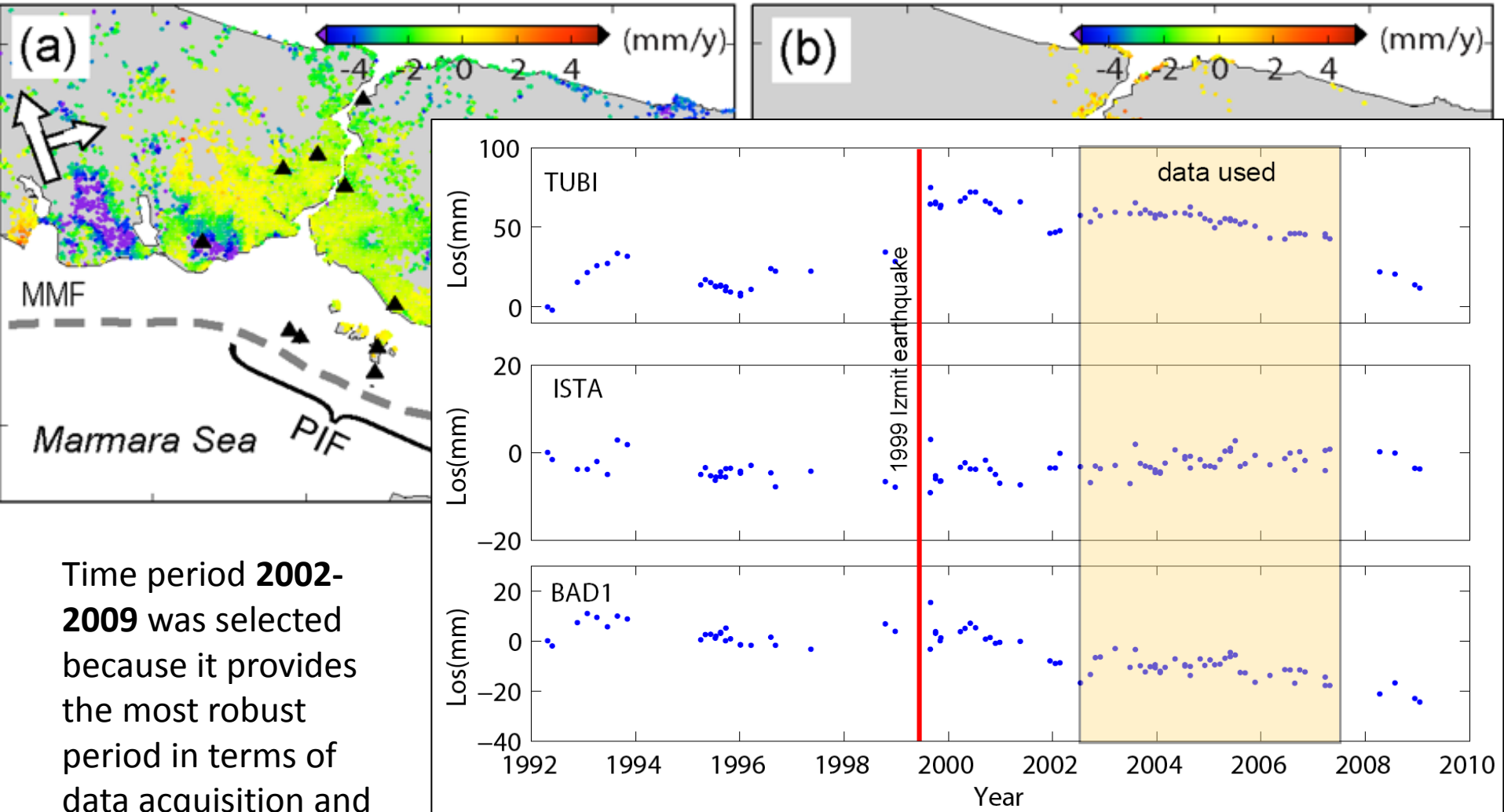
- The potential earthquake fault is located under sea.
- Deformation caused by aquifer compaction, landslides, man made activity, and postseismic and interseismic tectonic processes

Archived data (ERS1, ERS2, ENV)

PS mean velocity (DESC)

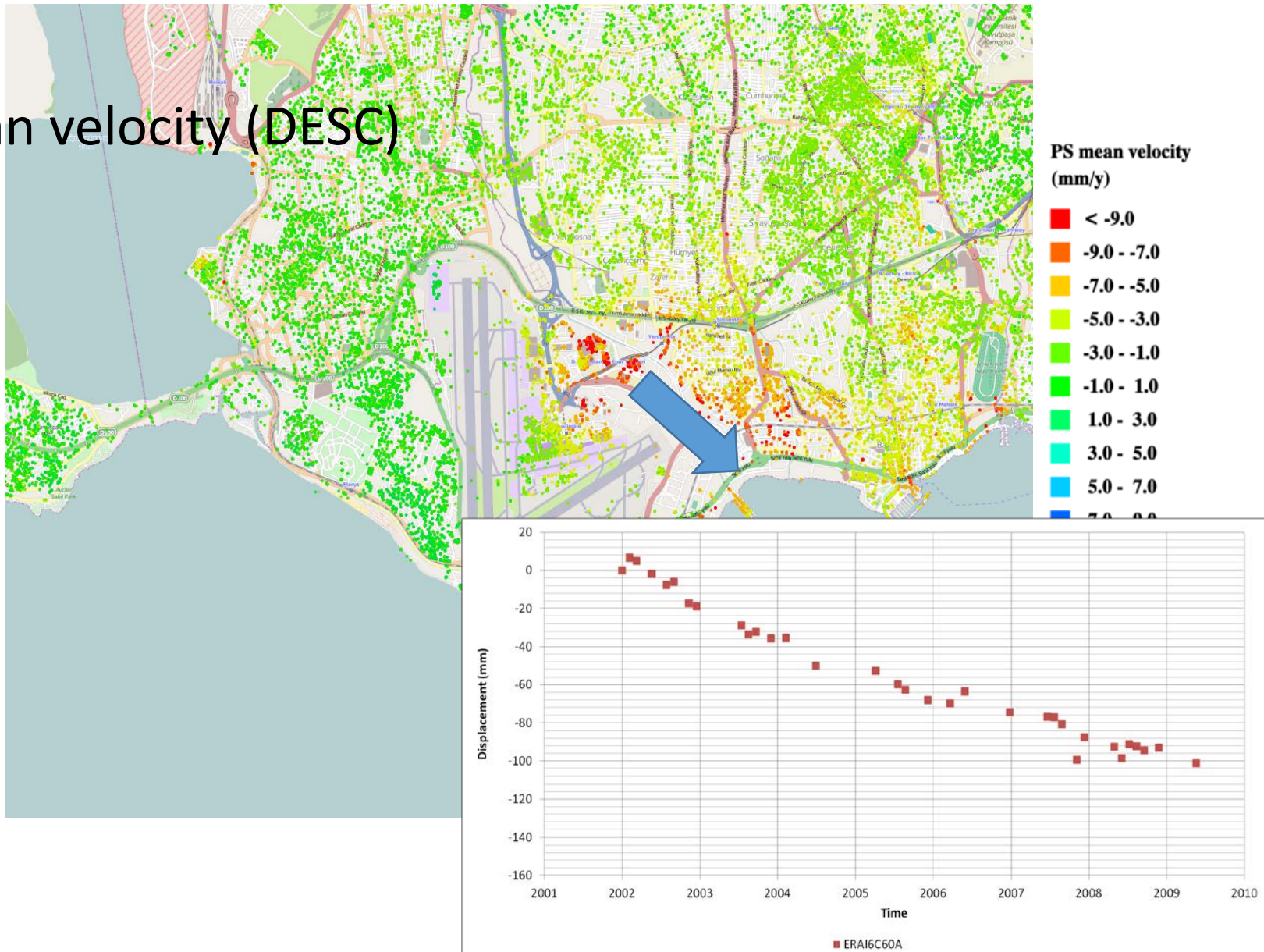


Archived data (ERS1, ERS2, ENV)



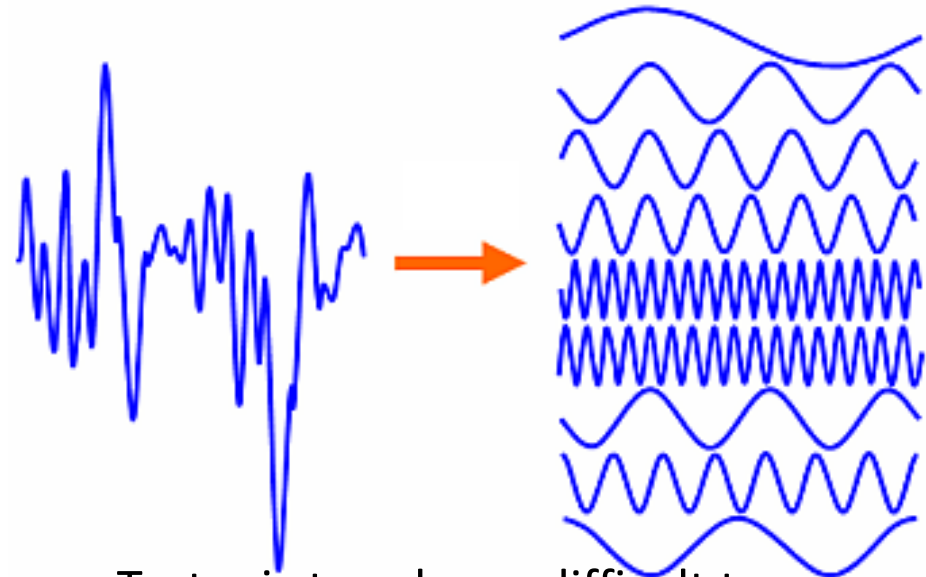
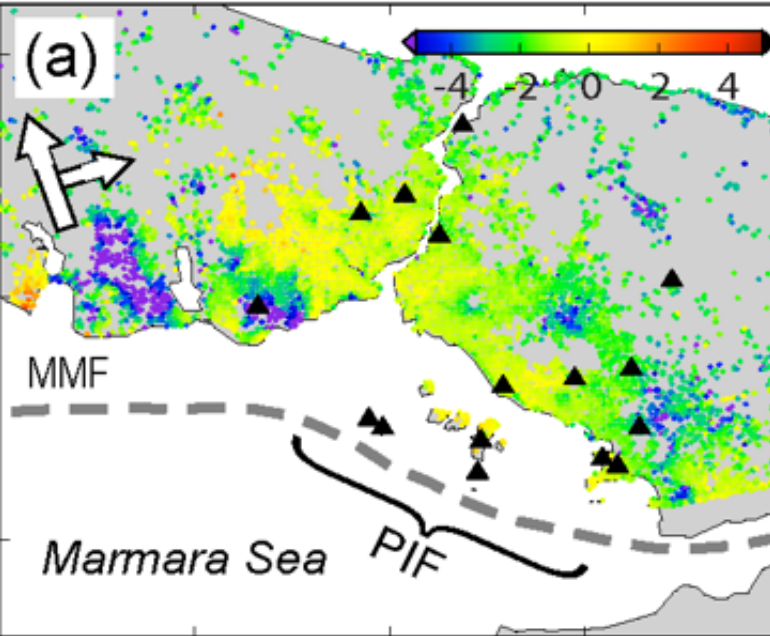
Archived data (ERS1, ERS2, ENV)

PS mean velocity (DESC)



Overlapping signals

How to obtain deformation directly related to fault movement ?



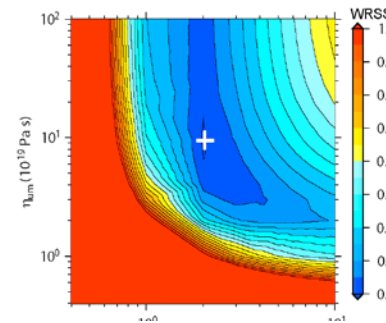
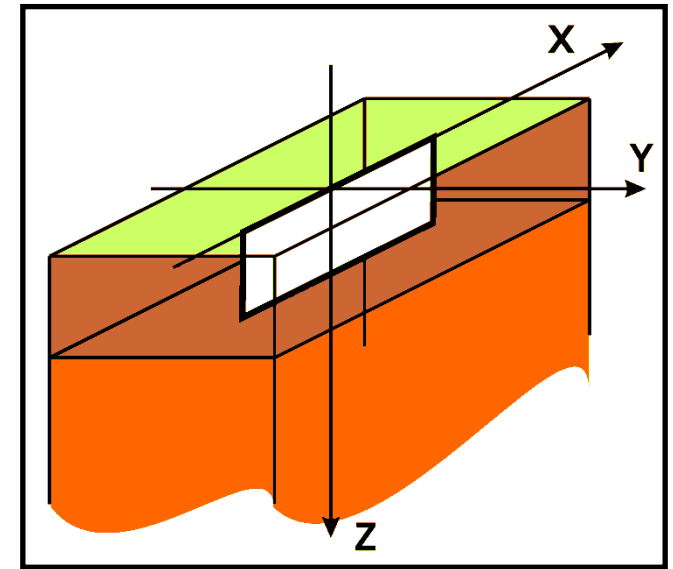
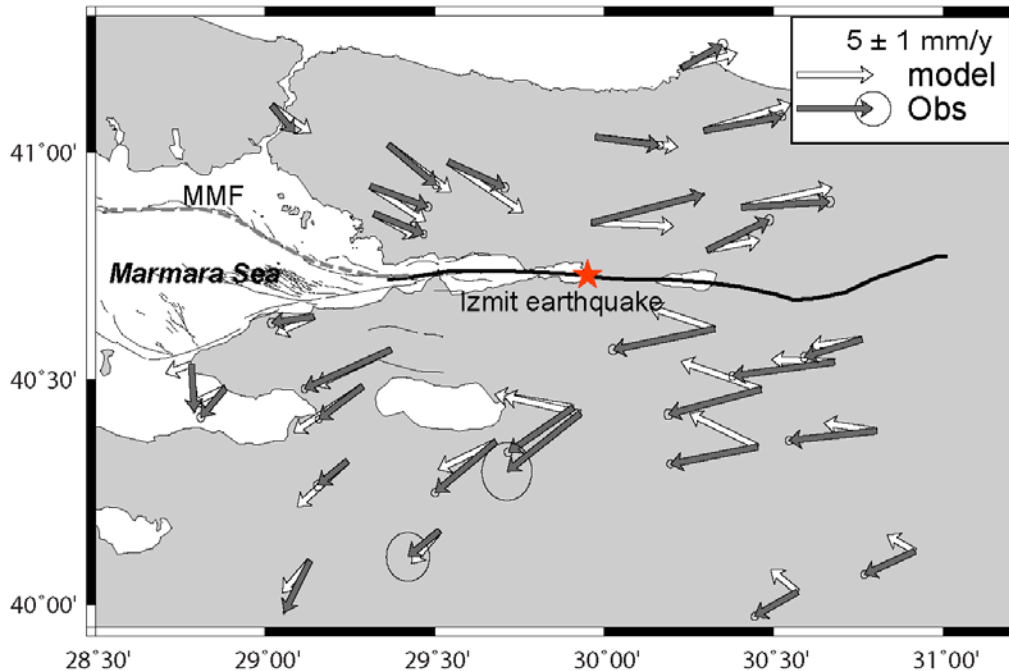
Signal decomposition:

Tectonic trends are difficult to determine in the frequency domain

- Postseismic viscoelastic relaxation
- Effect of locking/creep of adjacent fault

Overlapping signals

(1) Long wavelength signal: Viscoelastic relaxation effect following 1999 Eq constrained by GPS observation

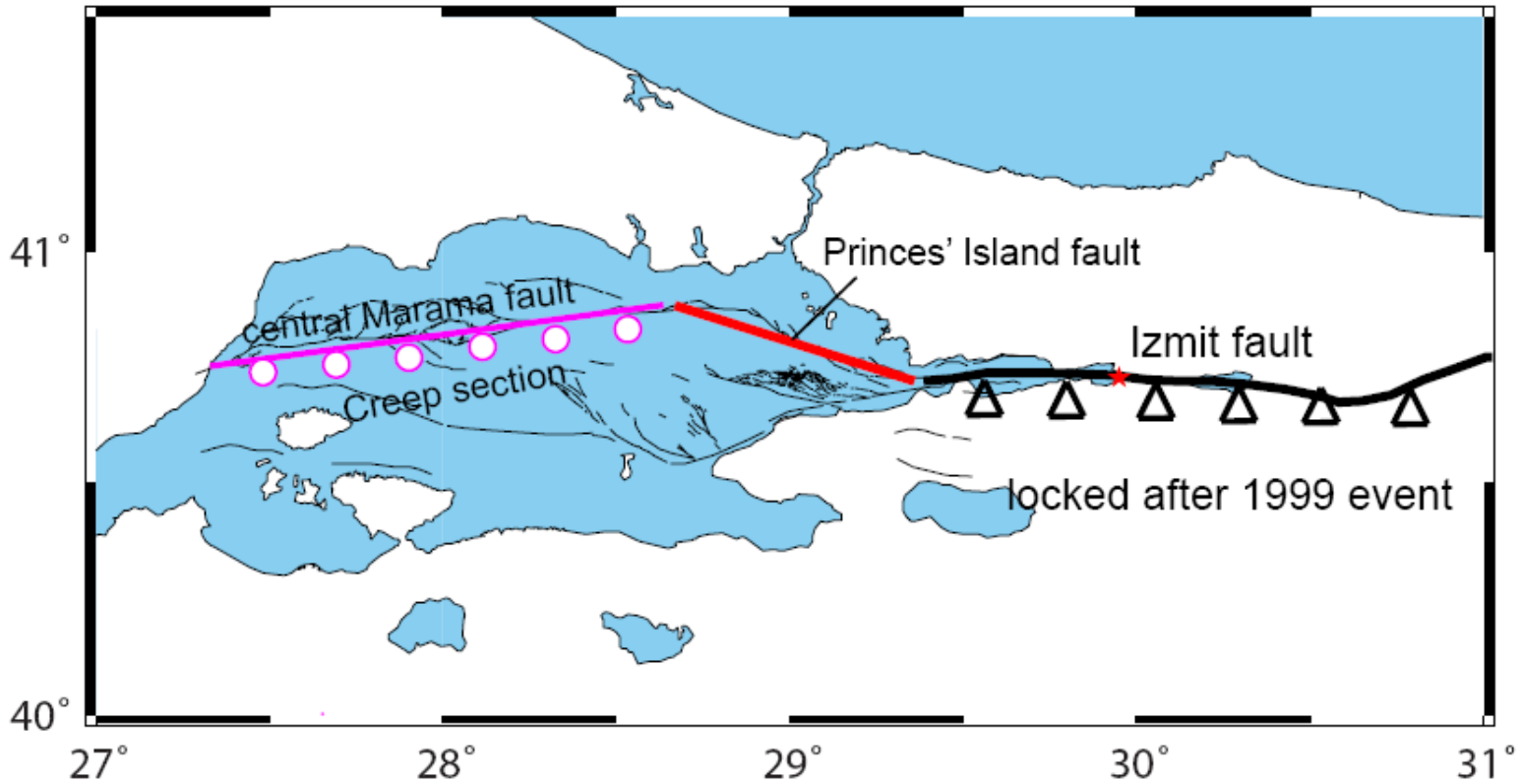


$$Misfit(\eta) = \sum_{i=1}^N \sum_{j=1}^M \left(\frac{Obs_{i,j} - Cal_{vis(\eta),i,j}}{\sigma_{i,j}} \right)^2$$

A grid search method was used to find the optimal viscosities of the lower crust and upper mantle.

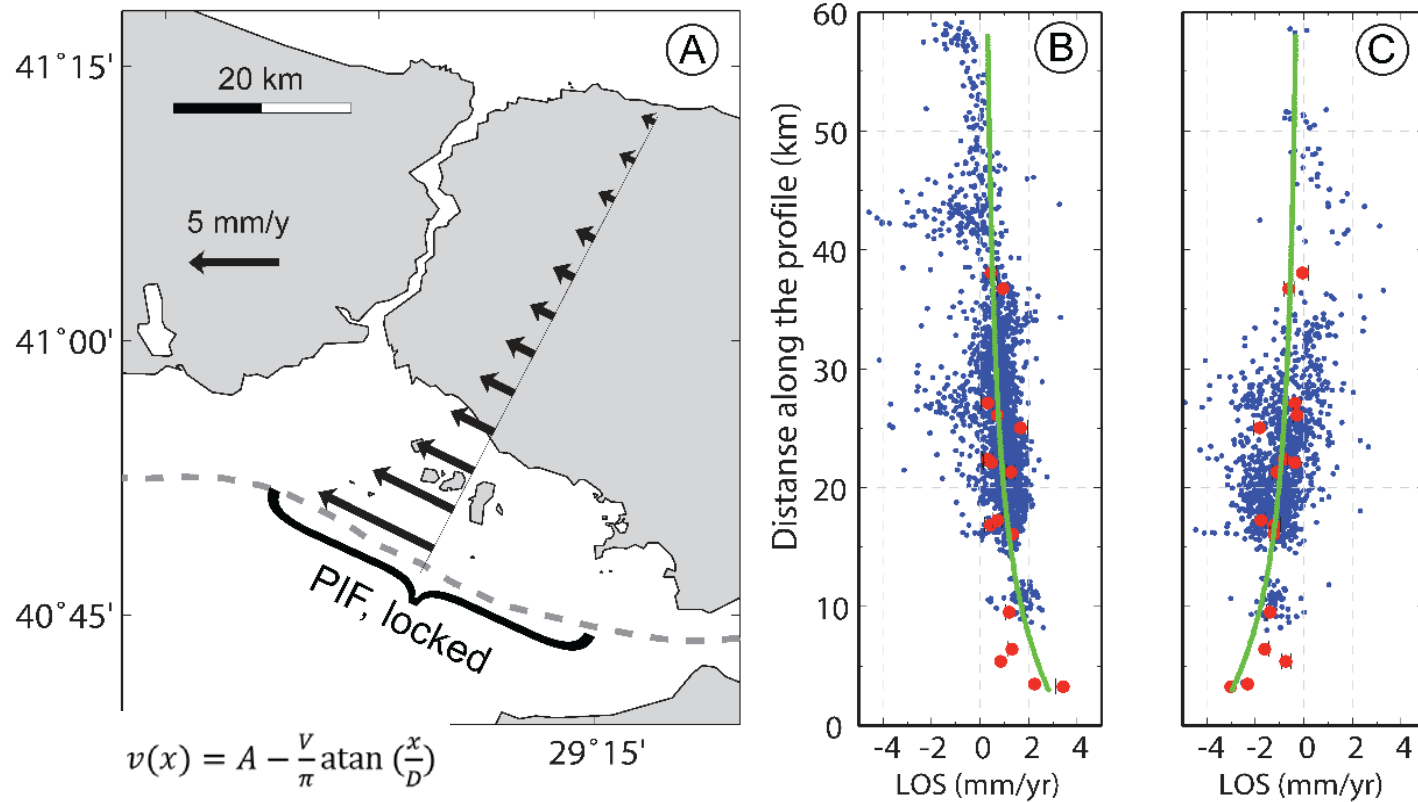
Overlapping signals

(2) Intermediate/short wavelength signal:
Effect of locking/creep of adjacent fault:



Forward calculating the effect based on layered dislocation model.

Signal decomposition of overlapping deformation processes



- Fault is in its high strain accumulating stage (before an earthquake)
- Assuming a uniform slip rate since the last rupture in 1776, the total accumulated slip deficit on this segment is up to 4.5 m ($M \geq 7$).



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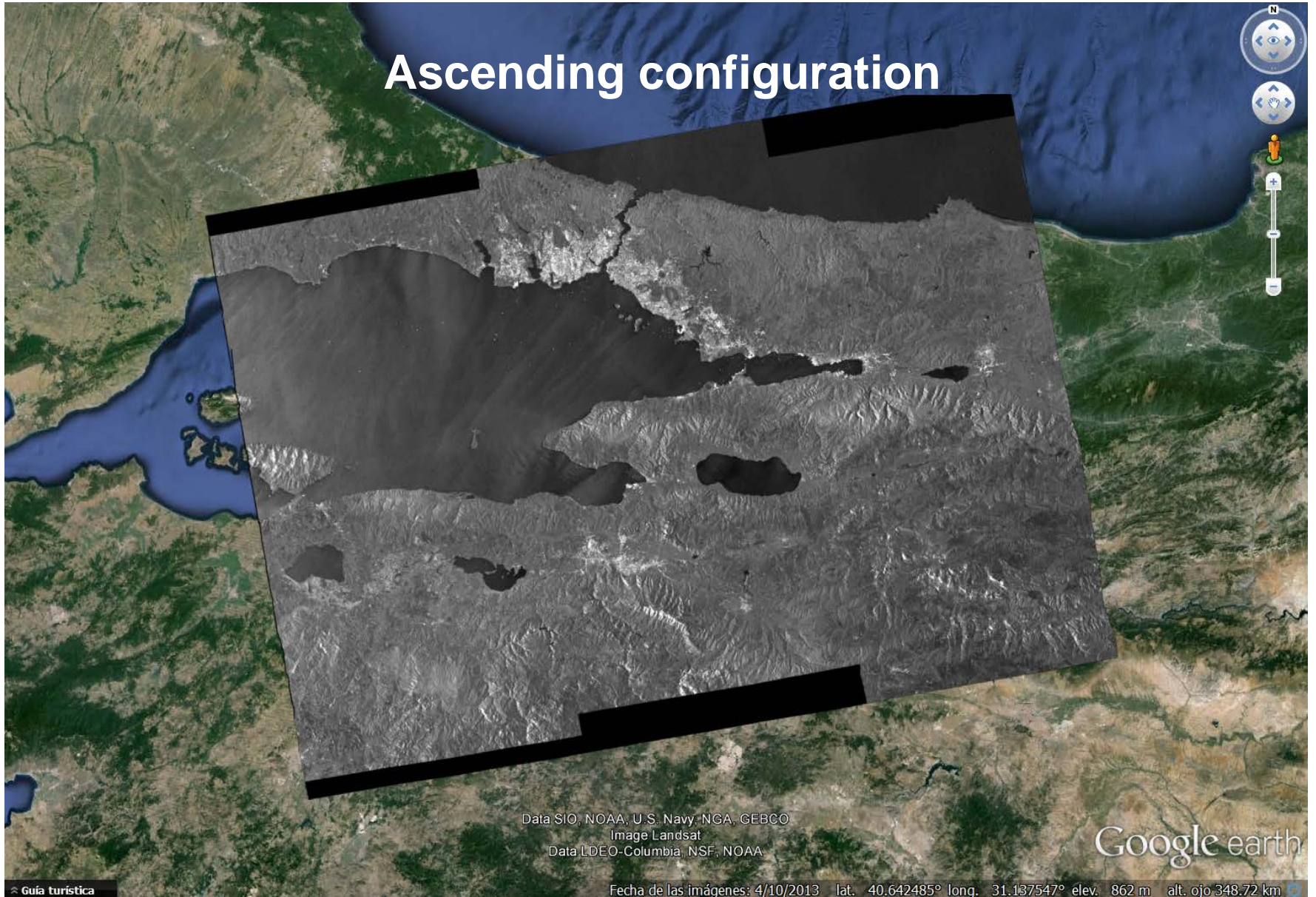
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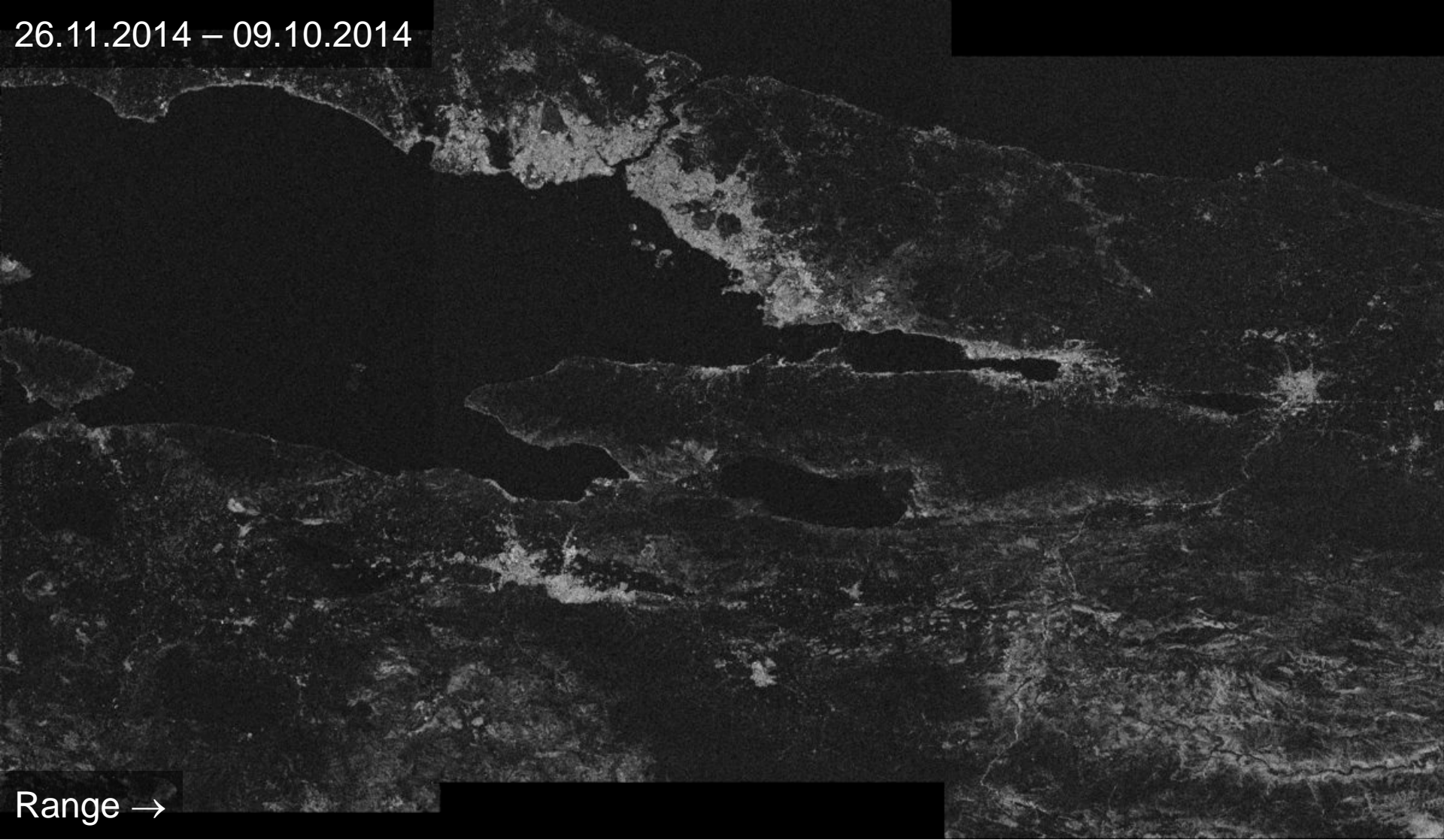
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Ascending configuration



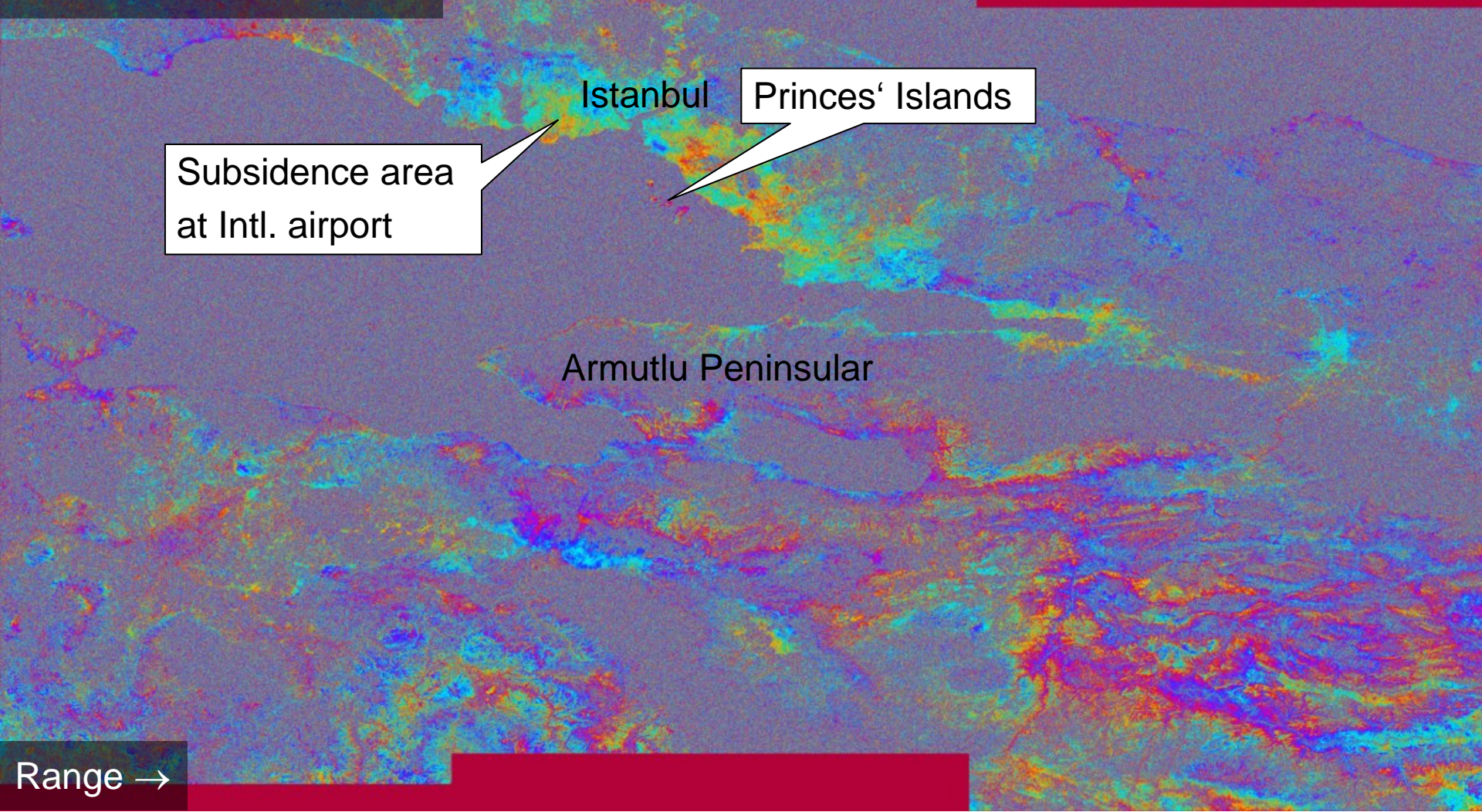
Interferometric Coherence

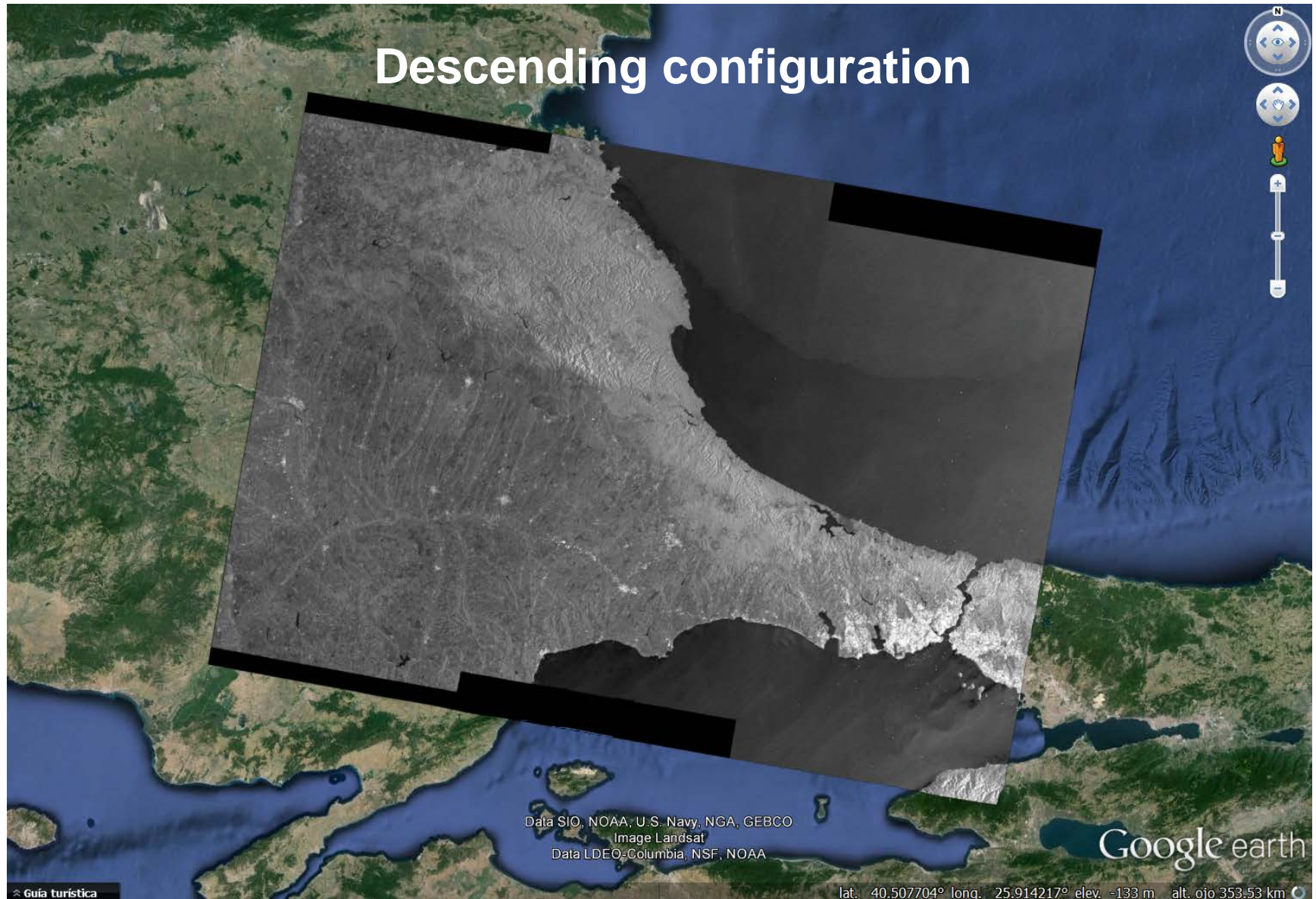
26.11.2014 – 09.10.2014



Flattened Phase

26.11.2014 – 09.10.2014





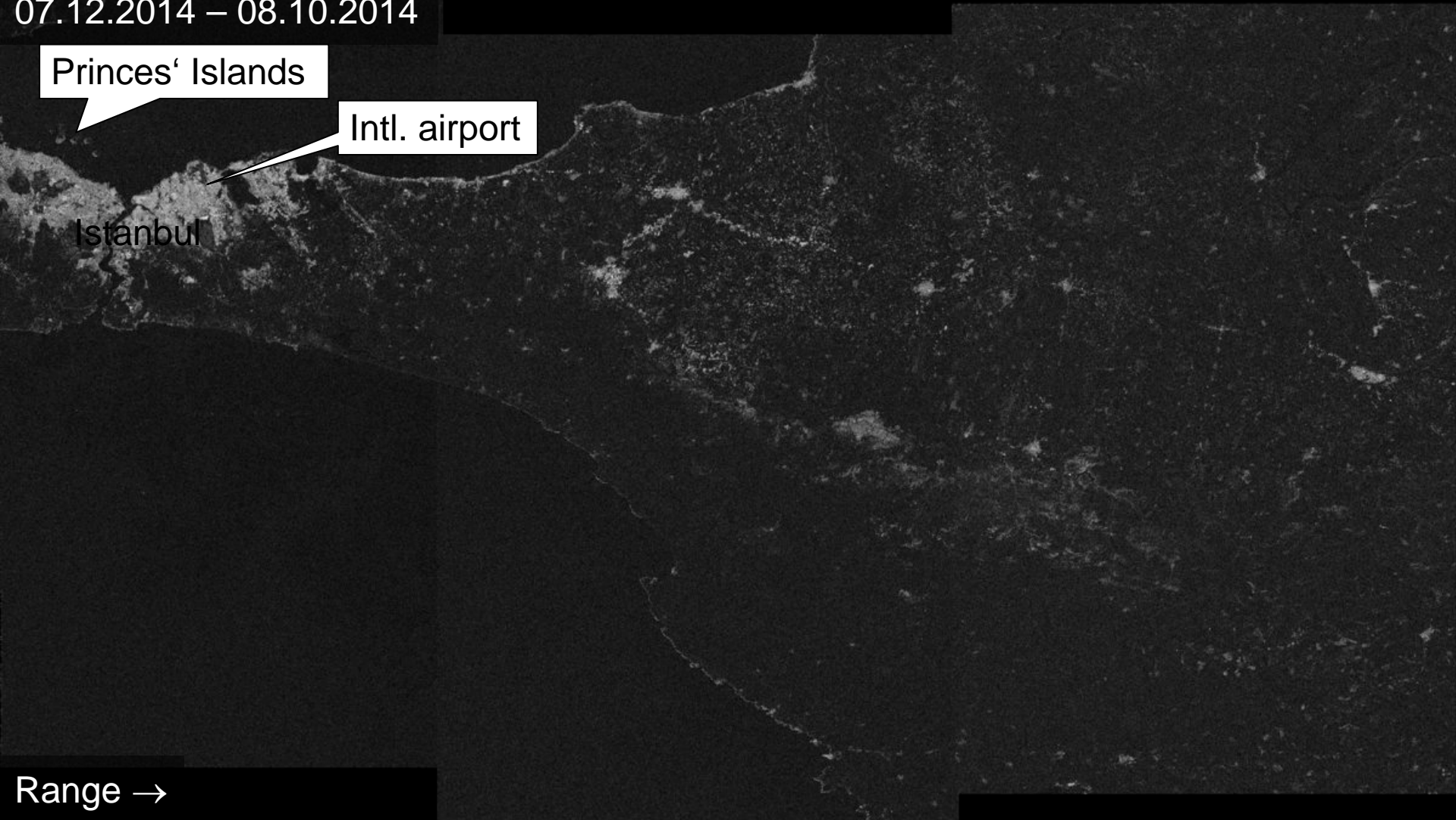
Interferometric Coherence

07.12.2014 – 08.10.2014

Princes' Islands

Intl. airport

Istanbul



Range →



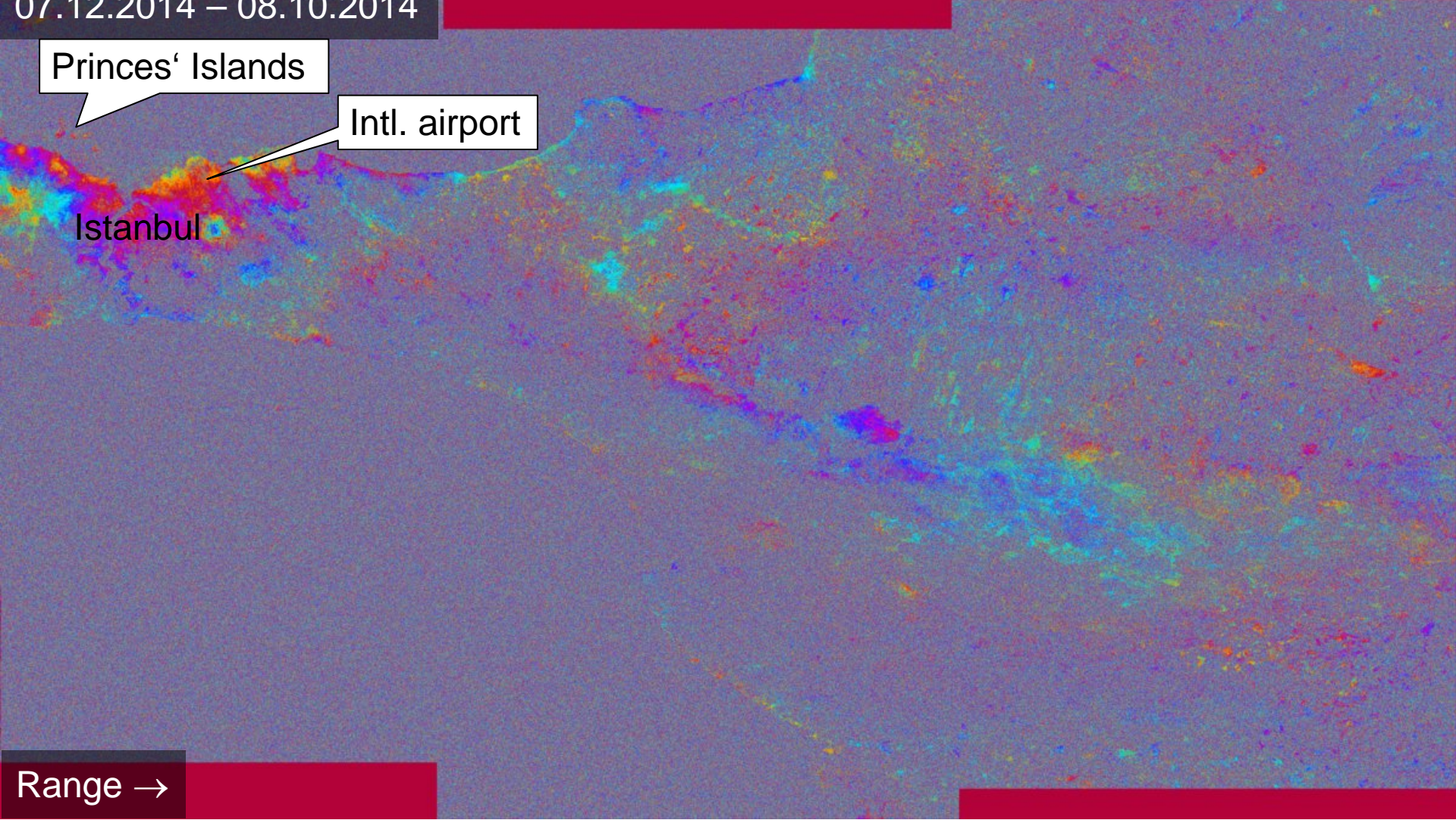
Flattened Phase

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