



Terrafirma Extension Tectonic Theme

6th Terrafirma Workshop

ESA-ESRIN, December 1st, 2010



Summary

- Service Prospectus Presentation
- The Terrafirma Extension Tectonic Theme (TFX-TT)
- Greek Task Force Service Test Case (SAA)
- Service delivery status (SLAs, volumes planned, user list)
- Related projects (SAFER, EPOS etc)
- Service delivery planning

Tectonic Theme Service Prospectus

- Objectives:
 - providing services for seismic hazards
 - delivering services based on users needs
 - answering to major TFX requirements:
 - 1. *European level of services***
 - 2. *PSI exploitation for wide area coverage***

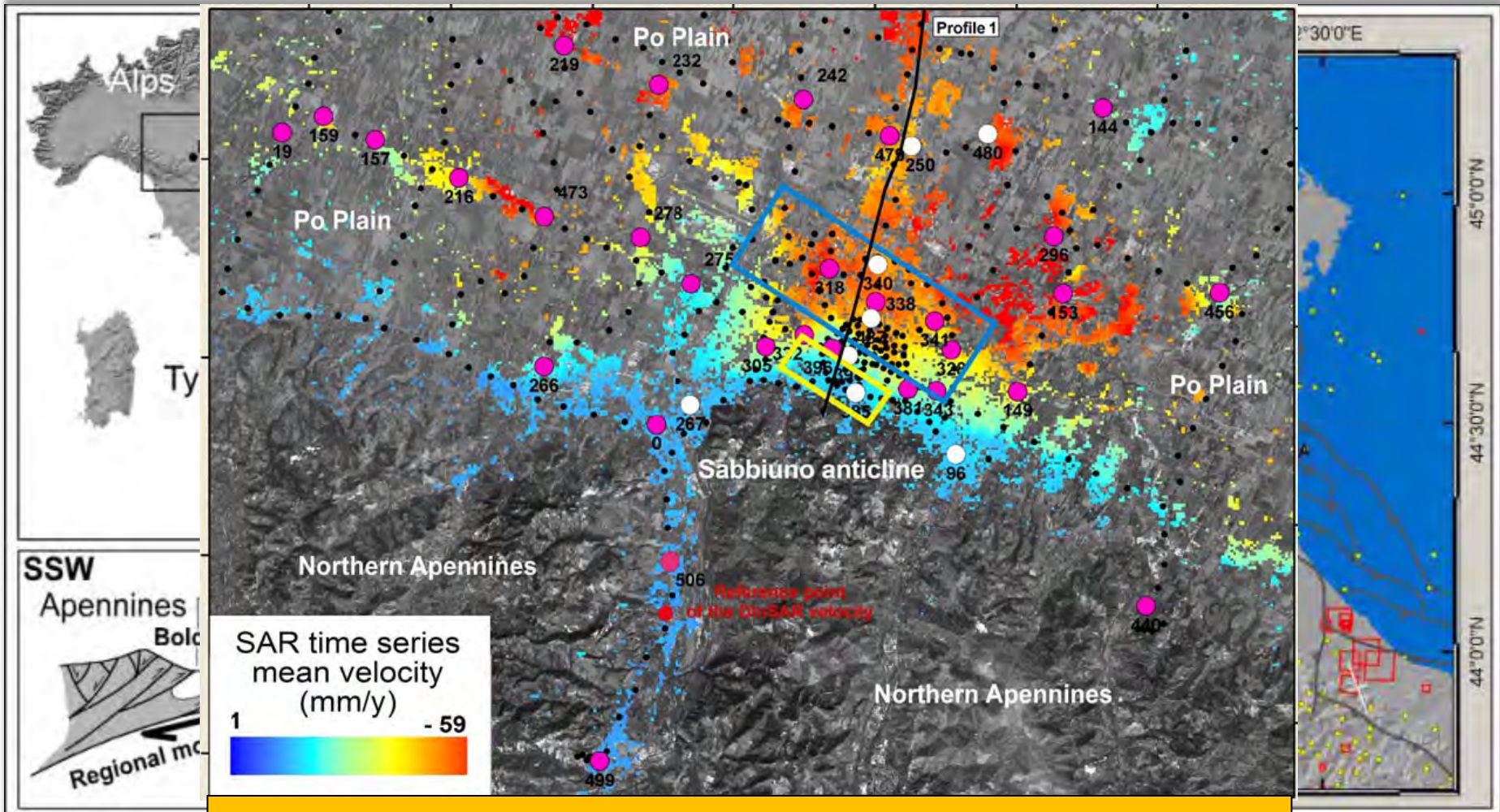
Tectonic Theme Service Prospectus

- Two macro services are envisaged:

A. CRUSTAL BLOCK BOUNDARIES service

- composed by sub-services:
 - ✓ Major and local fault investigation
 - ✓ Earthquake cycle investigation
 - ✓ Vertical deformation source in urban areas

B. SOIL VULNERABILITY MAPS service



Example of Bologna city: surface mean velocity map and leveling benchmarks (black dots, fuchsia and white circles)

Seismotectonics recorded by the Istituto Nazionale di Geofisica e Vulcanologia (INGV) between 1992 and 2002 (circles, squares, stars). Historical events are indicated by red squares. White crosses represent the orientation of horizontal stress

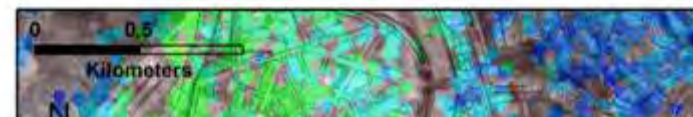
Crustal Block Boundaries

- Earthquake cycle monitoring

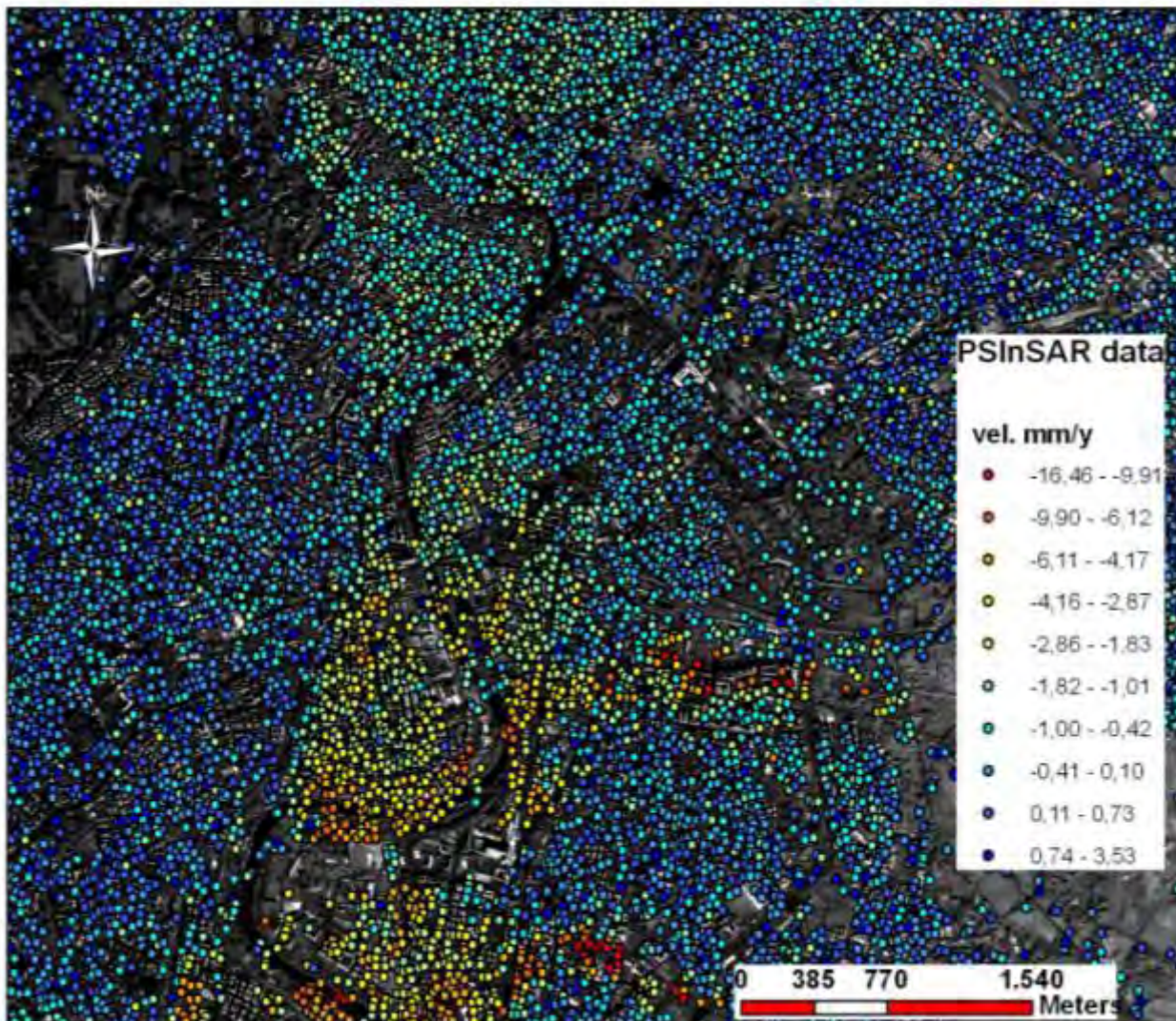
Exploitation of PSI for measuring surface deformation along the overall earthquake cycle: pre- co- and post-seismic phases

- ✓ Co-seismic phase is well know by Differential InSAR
- ✓ By filling the information gap on pre- and post- phases (inter-seismic phase) using PSI techniques
- ✓ To allow the estimate of seismic hazard

Output to end user: GIS project with raster and vector data



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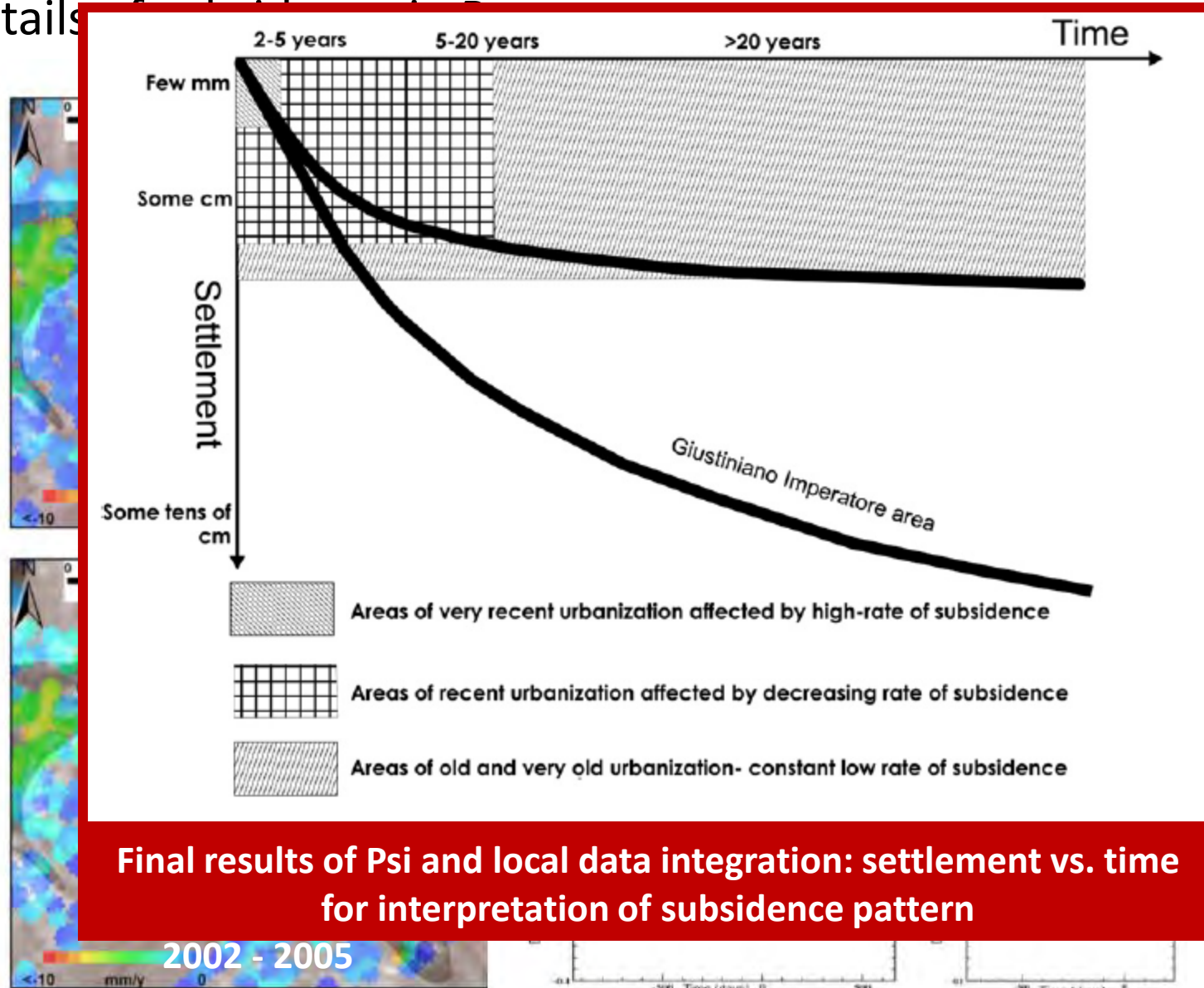


Example - PSI map of Rome: most surface movements are along Tiber river and tributaries valley

Tiber

Product example

- Details



Final results of Psi and local data integration: settlement vs. time for interpretation of subsidence pattern

2002 - 2005

Soil Vulnerability Maps

- Exploit the very dense PSI data as input to additional local measurements and observations to provide vulnerability maps
 - ✓ Full resolution PSI are needed being the vulnerability targets single building and single infrastructures
 - ✓ Building inventory is needed: construction type, numbers of storey and construction date ... Available for Istanbul test site (24 different type of buildings are identified)
 - ✓ Geological maps with soil classification and properties are also needed for vulnerability analysis

Output to end user: GIS project with raster and vector

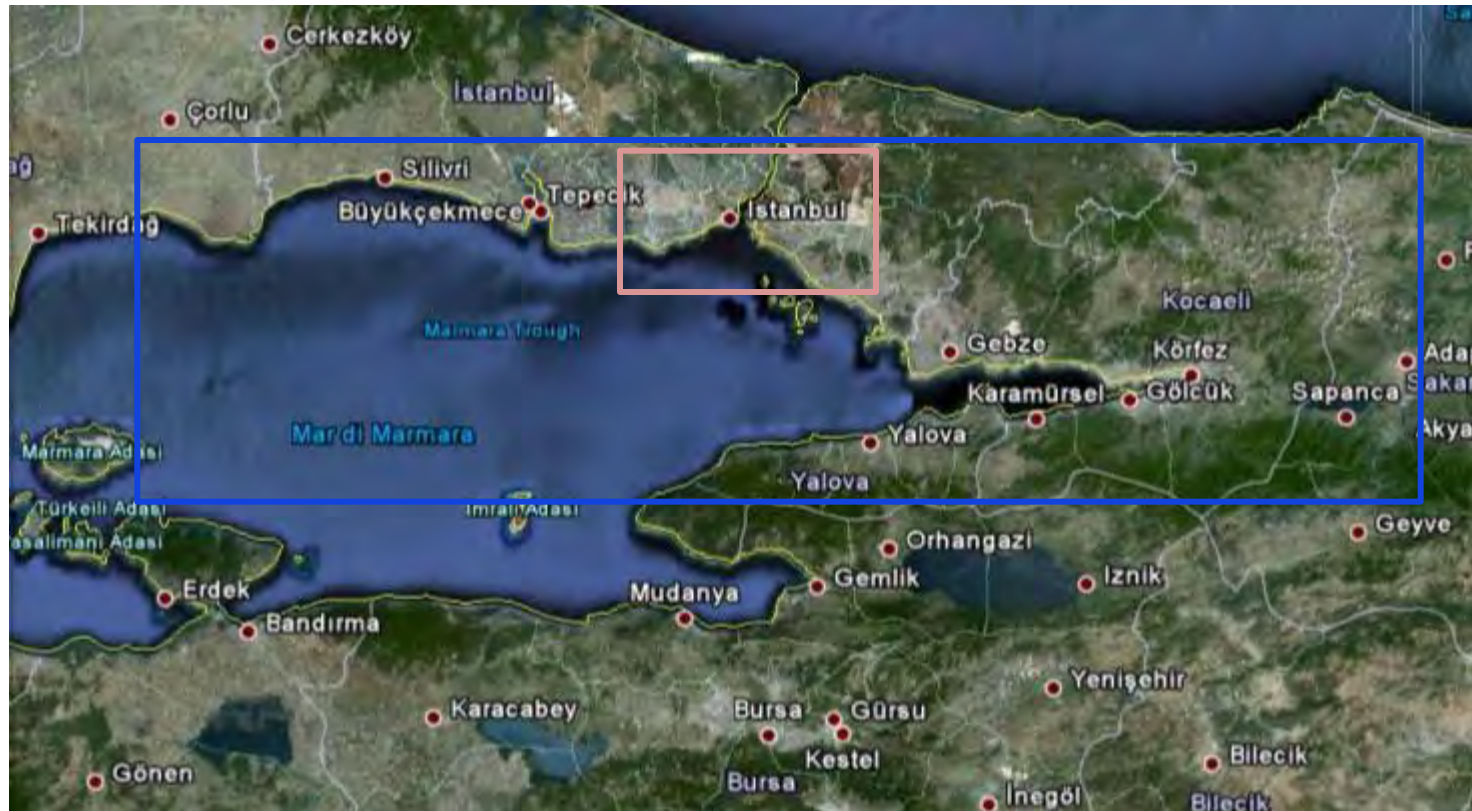
The Tectonic Team Theme

The TFX-TT is composed by:

- INGV – Istituto Nazionale di Geofisica e Vulcanologia (Team Leader)
- KOERI (Kandilli Observatory and Earthquake Research Institute of Bogazici University)
- NOA (National Observatory of Athens)
- Harokopio University of Athens
- Stamatopoulos & Associates Co.
- NKUA (National Kapodistrian University of Athens)
- IMM (Istanbul Megacity Municipality) Department of Earthquake Risk Management and Urban Development
- EPPO (Earthquake Protection and Planning Organization)

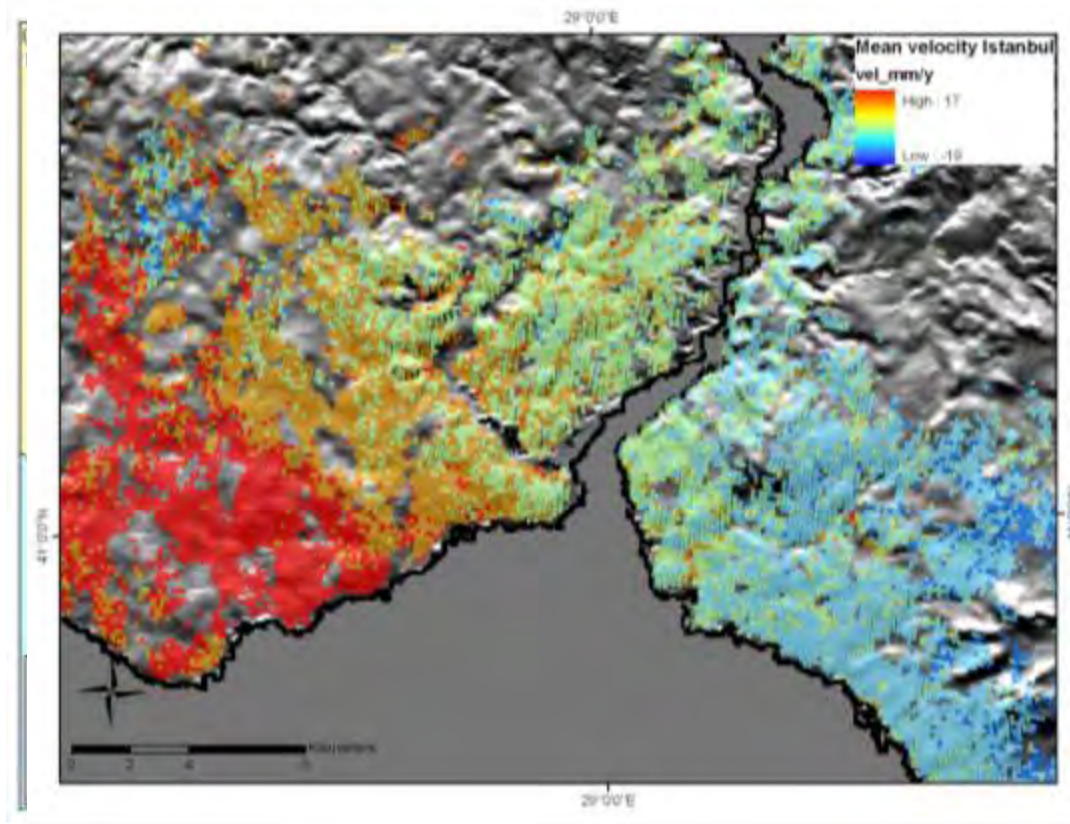
Selected site areas: Turkey

- Crustal Blocks Services: [North Anatolic Fault System – NAFS](#)
- Vulnerability Maps: [Istanbul metropolitan area](#)



Istanbul metropolitan area

- Istanbul has a long history of earthquakes related the North Anatolian Fault
- Eight earthquakes $M_w > 7$, have occurred in the last 500 years in this seismic prone area
- Extensive micro-zonation project of Istanbul metropolitan area has been accounted by the local Municipality

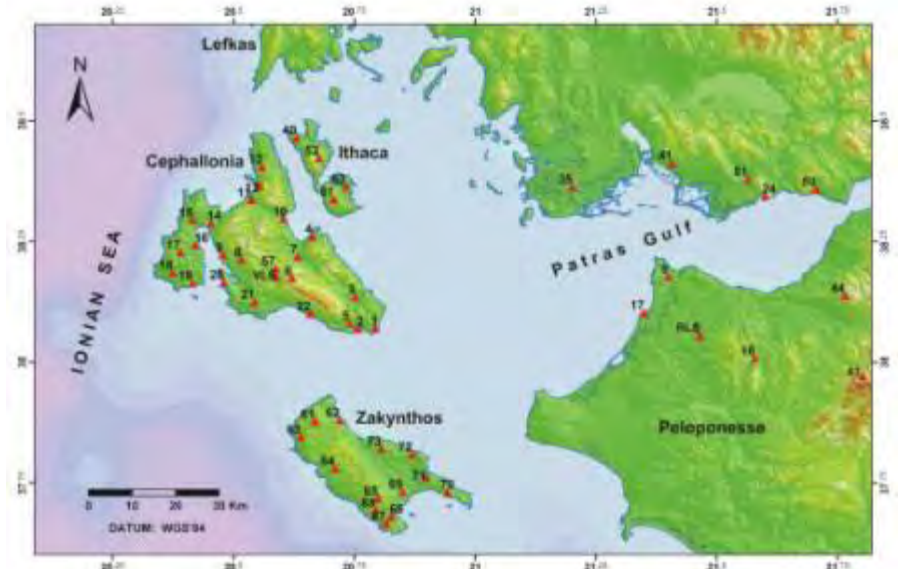


Istanbul building inventory for evaluating element at risk

PSI map: western sector mostly affected by subsidence; eastern sector mostly stable

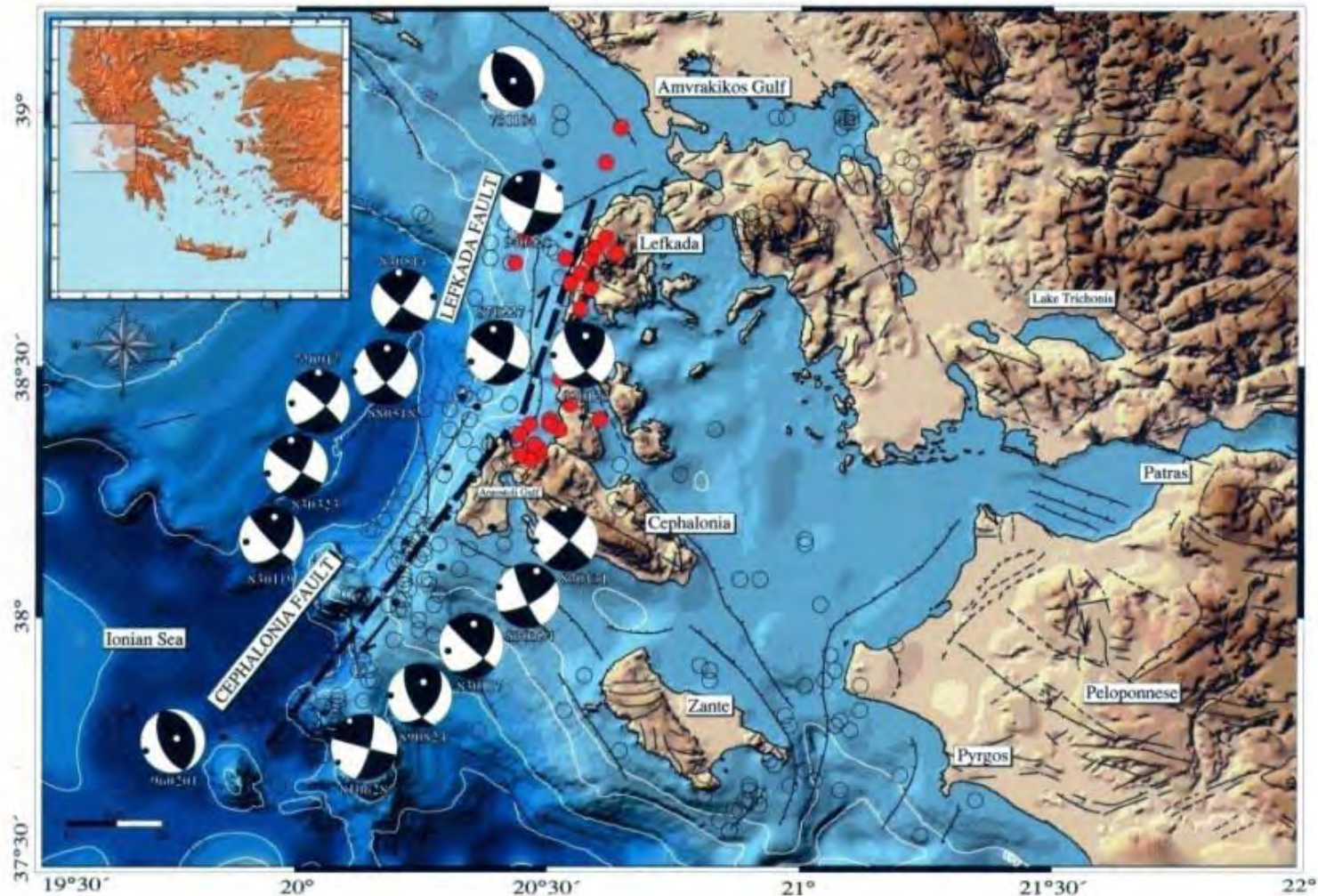
Selected site areas: Greece

- Crustal Blocks Services: Cephalonia – Zakynthos
Value Adding NOA
- Vulnerability Maps: Lefkada
Value Adding NKUA



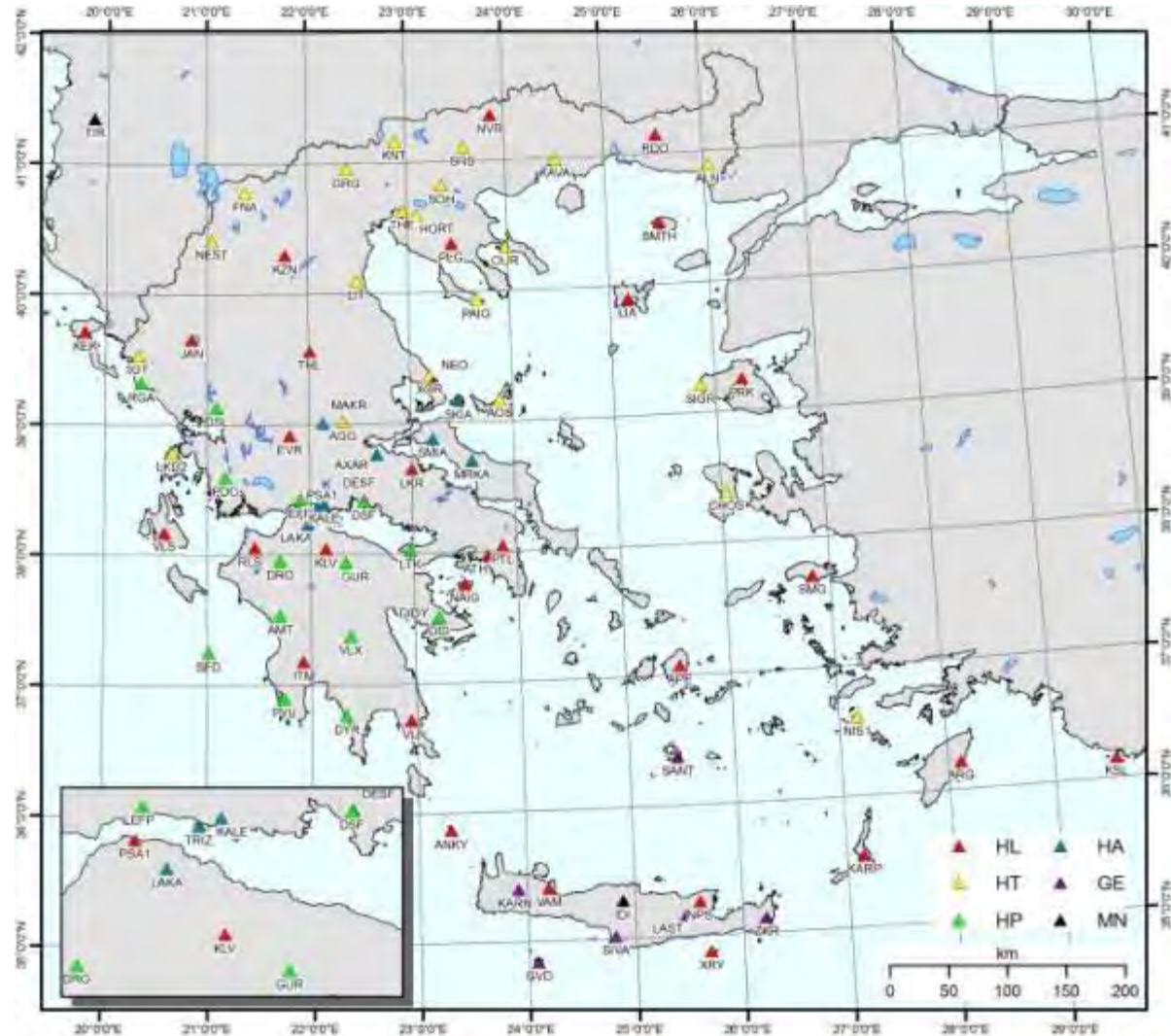
TFX – TT NOA test cases in Greece

120 km long strike-slip fault – high seismicity



Hellenic Unified Seismological network – 2010 picture

Two existing stations in Lefkada - Cephalonia



Greek task force

Partners:

- Stamatopoulos and Associates Co (Pr.-Contractor):
- Harokopio University of Athens

Users

- EARTHQUAKE PLANNING AND PROTECTION ORGANIZATION OF GREECE (EPPO)
- GREEK INSTITUTE OF GEOLOGY & MINERAL EXPLORATION (IGME)

Case studies for Greek task force



Previously selected sites were:

1. Thessaly basin

2. Rio-Antirio Bridge and the broader area
(this is the case study for Tectonics)

3. Messinia

...but ...

According to users' needs and interest of
Greek Task Force:

✓ **Confirmed: Rio-Antirio Bridge**

✓ **Added: Region east of Aegion city –
Nikoleika, Valimitika, Rizomilos
(funding dependent)**

Rio-Antirio Bridge: TECTONIC SOIL VULNERABILITY MAPPING

- The Rio-Antirio bridge crosses the Corinth strait near the city of Patras, connecting Peloponnese with mainland Greece.
- The bridge is one of the most challenging engineering structures in Europe and the longest cable stayed bridge in the world with a continuous deck of 2,250 meters.
- The bridge was under monitoring by the provider Harokopio University of Athens, in the frame of a previous project. It is necessary to continue the project of the Rio-Antirio Bridge in order to enrich the data set of ENVISAT scenes, and thus improve the result of the interferometric processing in terms of validation and accuracy.
- As the construction of the bridge finished in 2004, less than 30 ENVISAT scenes have been used. This number of scenes is not sufficient for reliable analysis.
- A number of earthquake occurred near the bridge. Thus, the case will illustrate the response of the bridge under earthquakes occurring near the structure, of considerable magnitude. Of special interest is the response of the foundation, that rests on very soft soil.



Related projects (SAFER, EPOS etc)

- Progress in establishing links and common activities with parallel projects (e.g EPOS, SubCoast, DORIS)

EPOS European Plate Observing System

Research Infrastructure and e-science for Data and Observatories on Earthquakes, Volcanoes, Surface Dynamics and Tectonics



Related projects (SAFER, EPOS etc)

EPOS is a long-term integration plan that aims to create a single sustainable, permanent and distributed infrastructure that includes:

- geophysical monitoring networks
- local observatories (including permanent in-situ and volcano observatories)
- experimental laboratories in Europe

EPOS will give open access to geophysical and geological data and modelling tools, enabling a step change in multidisciplinary scientific research into different areas

-EPOS is now closing the negotiation phase (June 2010)

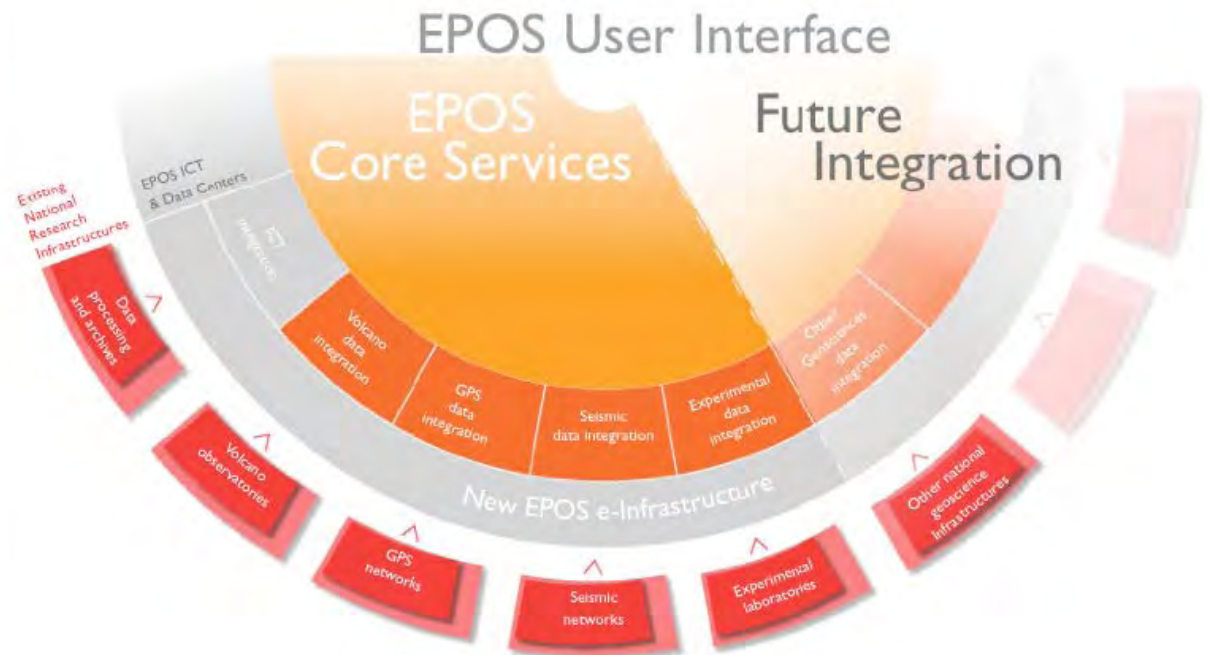


Related projects (SAFER, EPOS etc)

The existing national research infrastructures are integrated into the EPOS Data Centres, which represent community specific services for data archiving and mining having their own computational resources.

Community specific data centres are integrated by the EPOS Core Services, representing the infrastructure layer consisting of common data services.

The EPOS core service infrastructure will be designed taking into account the requirements of different user communities.



Related projects (SAFER, EPOS etc)

EPOS
European Plate Observing System



- Timeline: 2009 - 2048
- Total budget: 500 M€
- Budget source: National
- Project Leader: INGV
- Partners: ETHZ, GFZ, CNRS, NERC...
- Research Infrastructure and e-science for Data and Observatories on Earthquakes, Volcanoes, Surface Dynamics and Tectonics

- TF can be considered as one of the community specific data centres to be integrated by the EPOS Core Services. This year, TF has agreed to open its datasets to third parties at no cost.
- TF – Tectonic Theme can be the *space infrastructure* and deliver PSInSAR products to be combined with outcomes from in situ data
- Spatial data integration in EPOS needs a dedicated WP for such activities

EPOS will give open access to geophysical and geological data

Related projects (SAFER, EPOS etc)

EPOS
European Plate Observing System



TF – EPOS road map

“The opportunity for Terrafirma Extension to become the “space service provider” for the EPOS multidisciplinary Community is a real chance. Indeed the scope of TFX, “A Pan-European ground motion information service”, is to provide a support to the policies for geohazard mitigation.”...

“Terrafirma delivers geo-information services based on PSInSAR maps, carrying on adding value activities leading to geo-interpreted and modeled products”...

“In the EPOS Data Centres, representing a network of community service providers, Terrafirma is the space component. Taking into account the requirements of the different user communities Terrafirma provides PSInSAR maps to EPOS by sharing its database of surface velocity maps.

Later on Terrafirma will add PSInSAR maps to the EPOS Core Services to allow the full integration with other data (GPS, leveling, etc)”.

Related projects (SAFER, EPOS etc)

GEM

A uniform independent standard to calculate earthquake risk



- Timeline: 2009 - 2013
- Total budget: 35 M€
- Budget source: Private companies - Public
- Project Leader: Insurance companies
- Partners: UNESCO, World Bank, IAEE
- GEM's overarching goal is the establishment of a uniform and independent standard to communicate earthquake risk worldwide, to support earthquake risk reduction policies and actions

- TF-Tectonics is suitable to provide a support to calculate earthquake risk uniformly worldwide.
- PSInSAR maps of seismic regions worldwide can be used for seismic hazard estimation for GEM's purposes

Products accessible to basic and expert users

Related projects (SAFER, EPOS etc)

SHARE

Seismic Hazard Harmonization in Europe



- Timeline: 2009-2012
- Total budget: 4.14 M€
- Budget source: EC
- Project Leader: ETHZ
- Partners: INGV, GFZ, NERC, NOA, NIEP, KOERI
- SHARE will create a unified framework and computational infrastructure for seismic hazard assessment and produce an integrated European probabilistic seismic hazard assessment (PSHA) model and specific scenario based modeling tools.

- TF-Tectonics is suitable to provide a support to calculate earthquake risk uniformly at European scale.
- PSInSAR maps of seismic regions in Europe can be used for seismic hazard estimation for GEM's purposes

Build a framework for integration across disciplines

Related projects (SAFER, EPOS etc)

SAFER

Services and Applications For Emergency Response



- Timeline: 2009 - 2011
- Total budget: 40 M€
- Budget source: EC/FP7
- Project Leader: SPOT Infoterra, DLR, e-GEOS (TPZ)
- Partners: INGV, NILU, EUSC, DPC, JRC, ...
- The SAFER project objective is to implement and to validate a pre- operational version of the GMES Emergency Response Core Service (ERCS).

- TF capabilities exploited to generate the reference maps (PSInSAR products)
- TF can provide support to the prevention phase, the pre crisis and the post crisis

Integration between scientific teams, service providers and users

Service delivery planning

Service will be delivered for the following areas:

- 1 – Kephallonia-Zakynthos islands
- 2- NAFS
- 3- Istanbul metropolitan area
- 4- Lefkada island
- 5- Rio-Antirio bridge (Harokopio University/Stamatopoulos)

SLA progress on year 1 (processing started) and year 2

Year 1 PSInSAR processing: schedule

- 1 –Kephalonia-Zakynthos islands (from TRE OSP)
- 2- NAFS (from TRE OSP)
- 3- Rio-Antirio bridge (Harokopio University)

Year 2

- 1- Istanbul metropolitan area (from TRE OSP, already completed)
- 2- Lefkada island (from TRE OSP)

SLA progress on year 1 (processing started) and year 2

KOERI

- 1 – SLAs completed and properly signed
- 2- PSInSAR processing completed for Istanbul and Kephalaria-Zakynthos
- 3- PSInSAR processing NAFS in progress

NOA

- 1- SLA completed and signed

NKUA

- 1- SLA completed and signed

Harokopio University

- 1- SAR data selection and download for Rio-Antirio bridge (STA signed)

SLA progress on year 1 (processing started)
and year 2

SqueeSAR™ analysis over
Istanbul Area

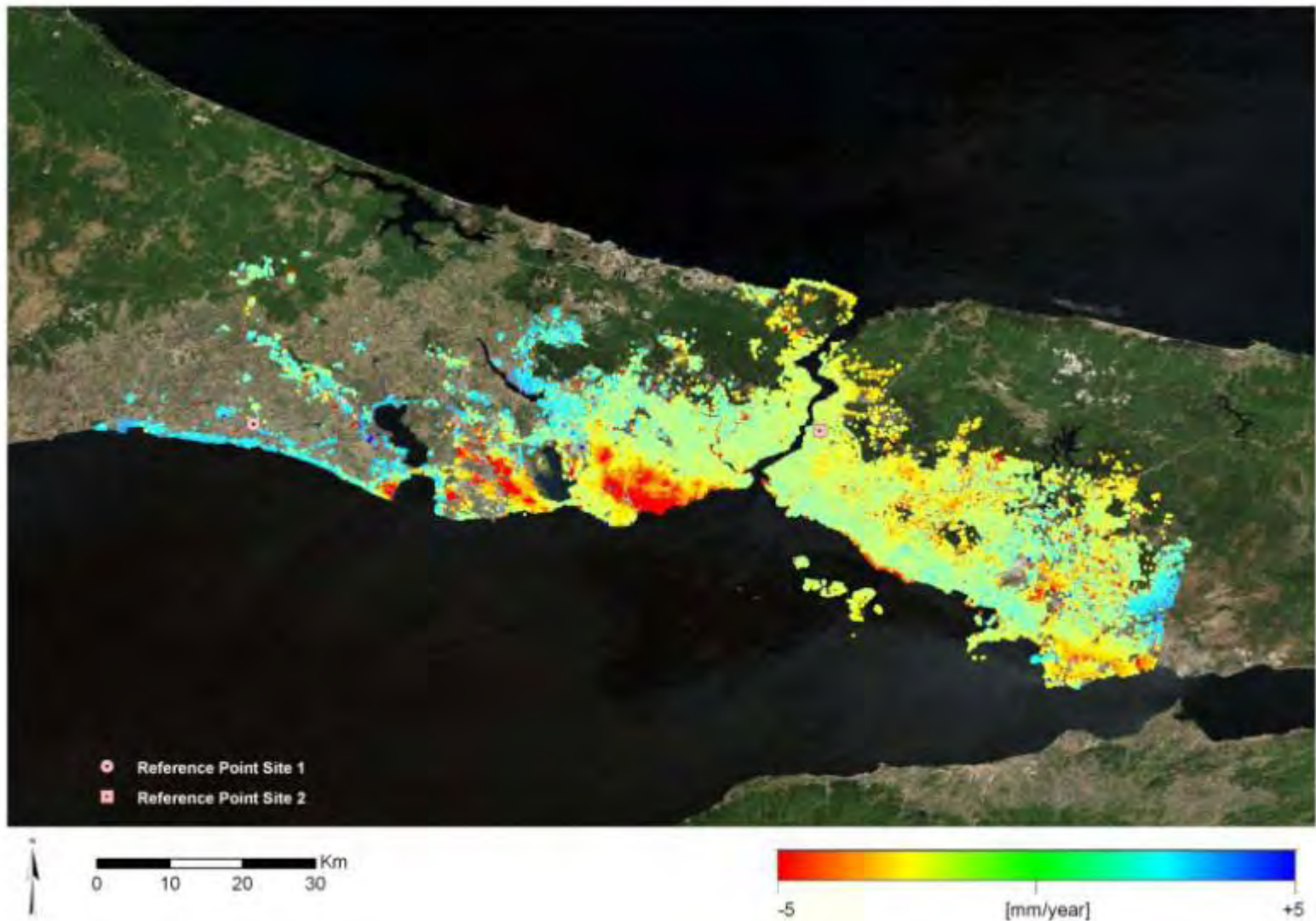
Area of interest



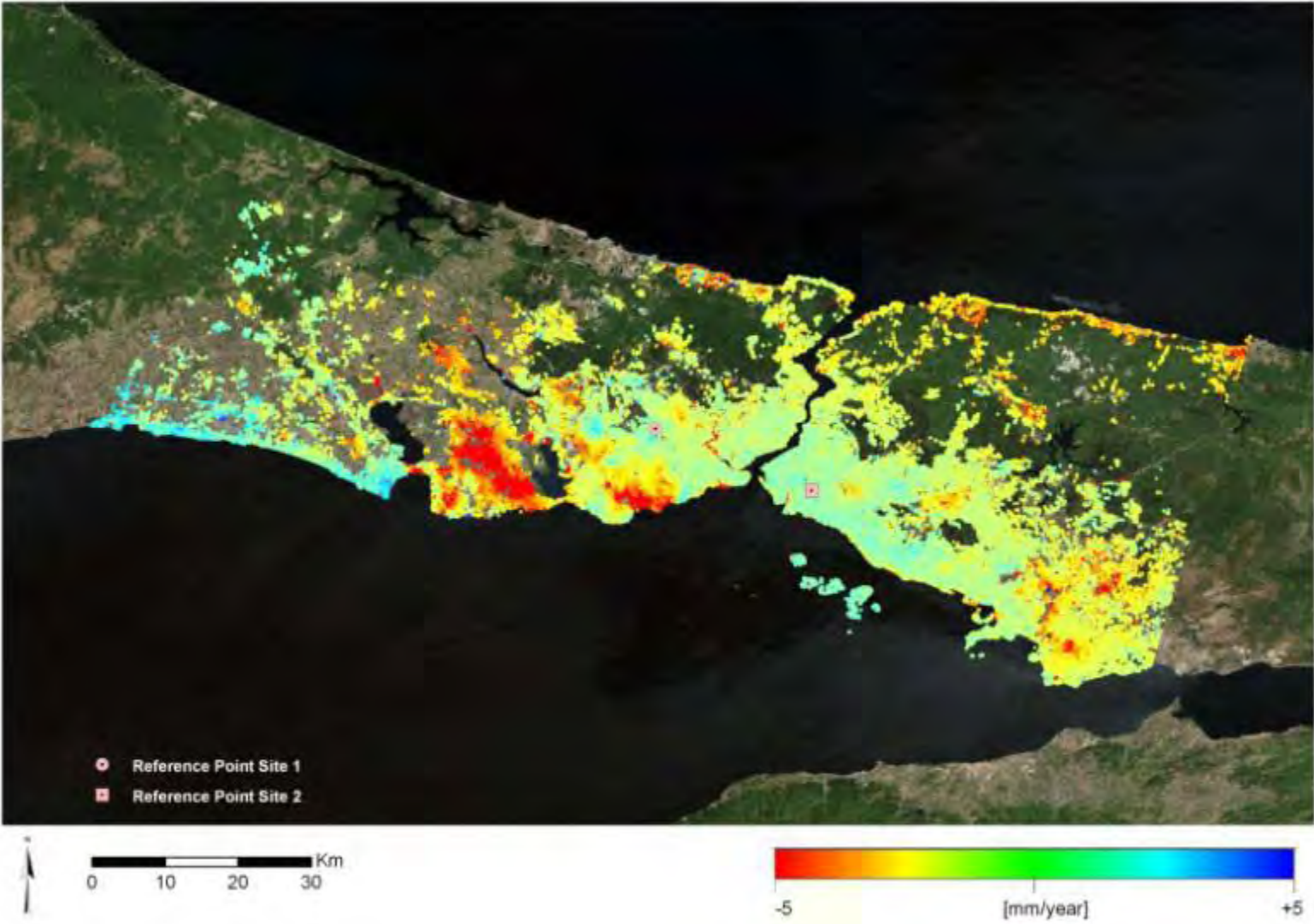
Available Data

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	336	40	1992-2000
ENVISAT DESCE	107	27	2003-2010
	336	28	2003-2010
ENVISAT ASCE	200	23	2003-2010
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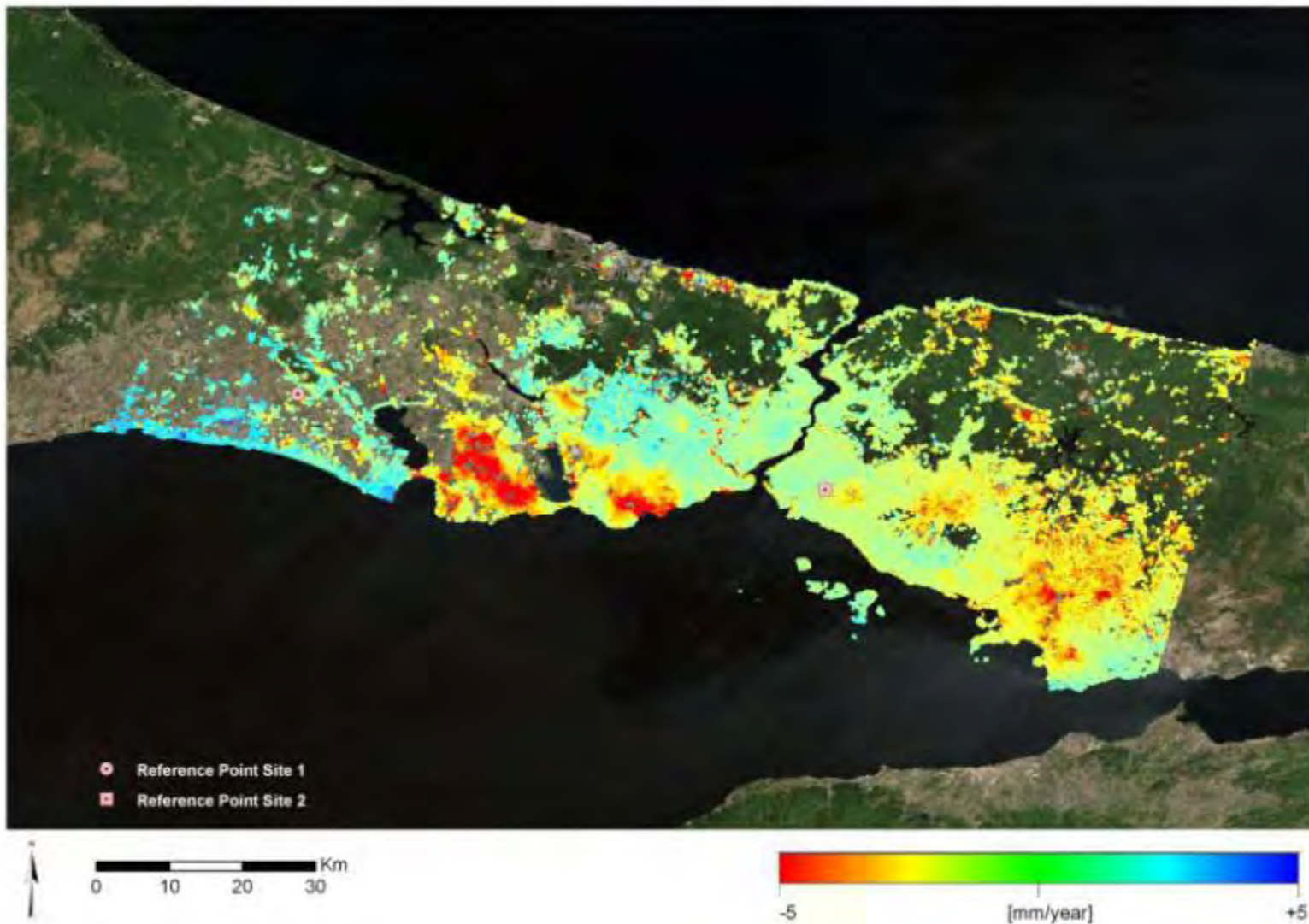
ERS Descending Geometry



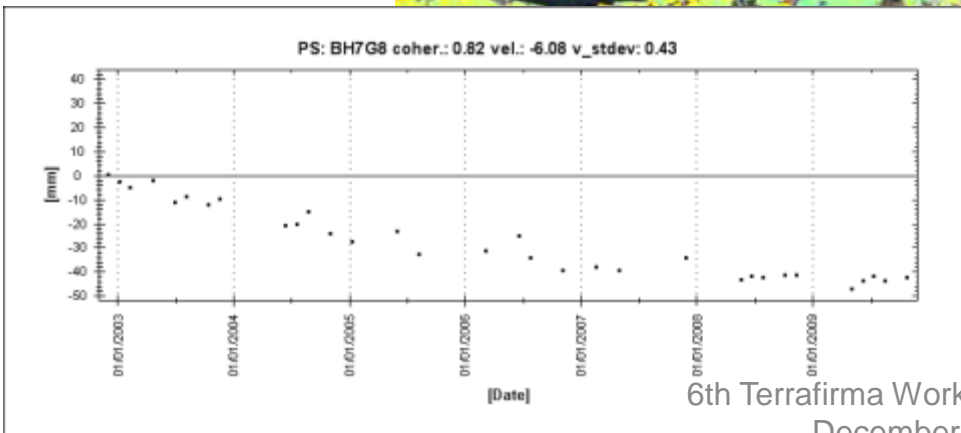
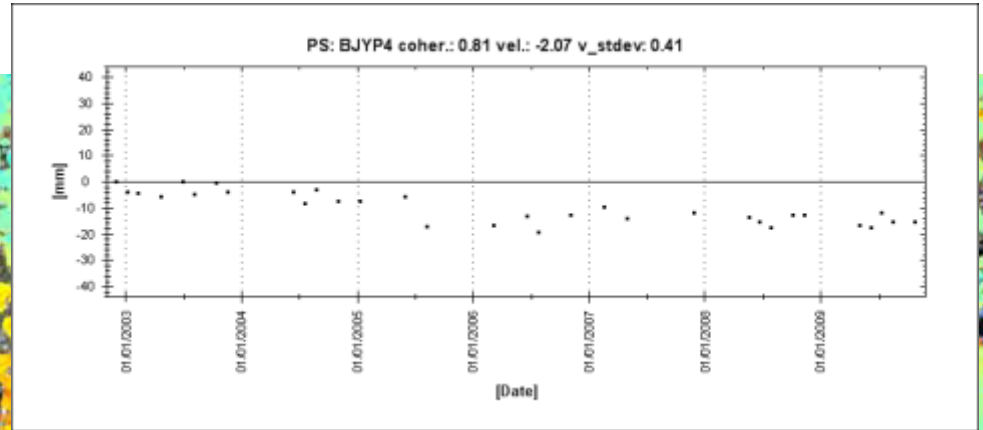
ENVISAT Descending Geometry



ENVISAT Ascending Geometry



Close up - Envisat Ascending Geometry



Close up - Envisat Descending Geometry

