

Current Status of the NOANET GNSS network 2006-2014

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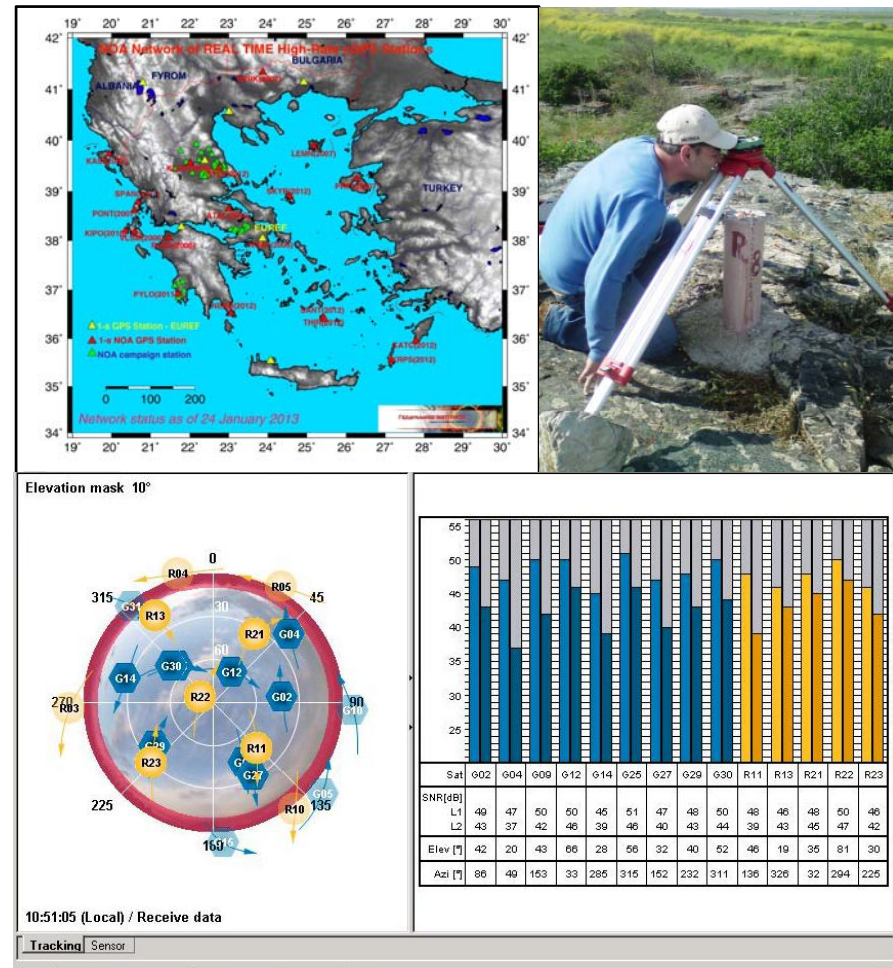
NOA GPS Project <http://www.gein.noa.gr/gps.html>

Hemus NET Project <http://www.hemus-net.org/>

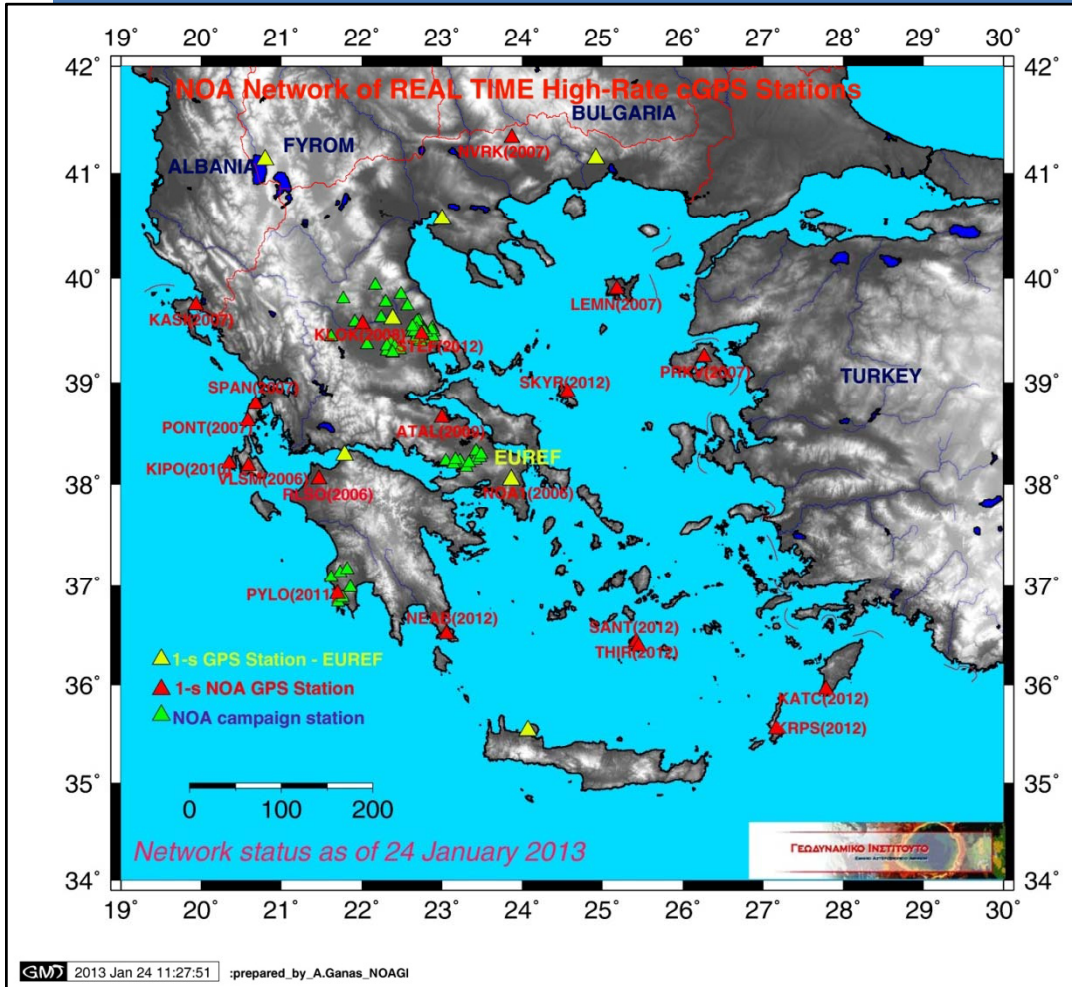
NOA Faults http://194.177.194.200/services/GPS/GPS_DATA/1_NOAFaults/

Outline of presentation

- Infrastructure
- Research
- Services
- Projects – Funding
- Vision



NOA GPS & GLONASS network: NOANET (2006-2014)



following the EUREF
(Regional Reference Frame Sub-Commission for Europe)
Permanent Network standards
22 stations at 1-s 24/7
12 stations co-located at 1-10m with seismometers and strong-motion sensors
55 benchmarks

NOA GPS & GLONASS network: (2006-2013)

Data:

Type (e.g., *binary, ascii, solutions - station velocities*)

Raw GPS + GLONASS observations at 1-s intervals

Format: (*international standard*)

Formats include MDB, Rinex, Compact Rinex, .zip, RTCM v3,X, .Z

field instrumentation: type of data transmission

Internet (SYZEFXIS / VODAFONE/ leased lines from Greek Telecom – OTE)

Data archiving

Current Data volume (Gbytes)

1292 Gbytes

Data Volume Growth rate (GBytes/year)

192 Gbytes/year

NOANET acquisition software: LEICA GNSS Spider

Implement UNAVCO GSAC <http://194.177.194.238:8080/noanetgsac>

NOA GPS & GLONASS network: Geodetic Equipment



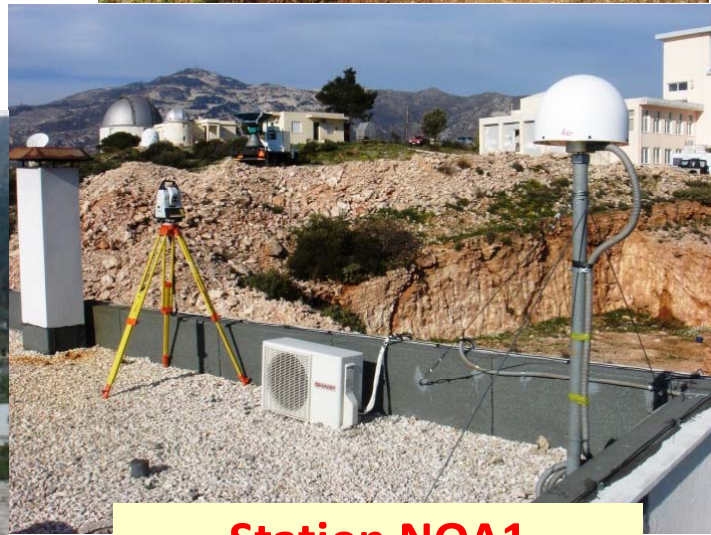
**Campaign station
Trimble**



**Station KLOK
NOA-INGV**



**Station ATAL
NOA-NTUA**

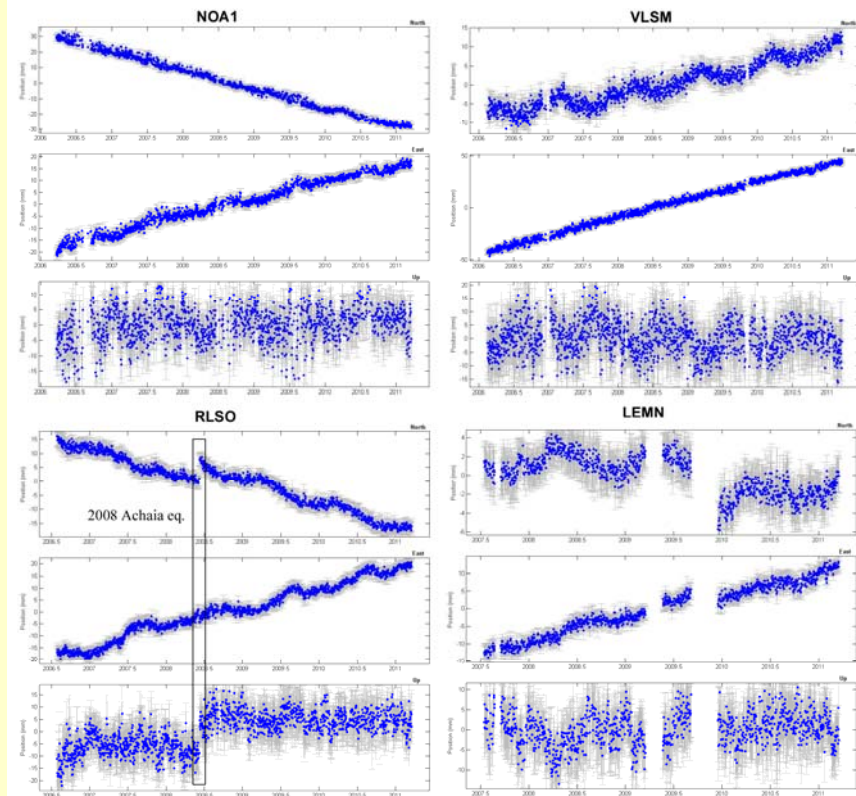


**Station NOA1
EUREF since 2006**

Infrastructure

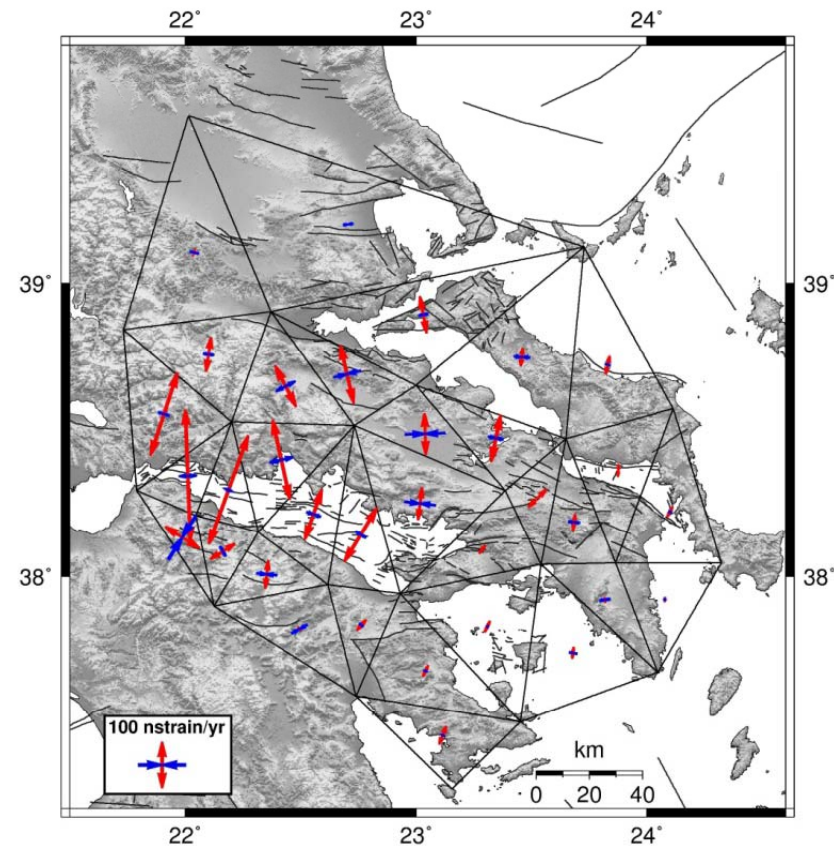
1 Hz & 30-s Data Processing - Analysis

- Processing
- Data analysis using the open-source software GAMIT/GLOBK software package (Version 10.4; Herring et al., 2010)
- Mean Daily positions and 1- σ deviations on each component
- Real-time PPP processing of 1-s data using IGS clocks
- First measurement of co-seismic deformation in Greece using GPS observations (station RLSO, June 8, 2008)
- Derivation of GPS velocity field that can be used for geodynamics and geophysical applications

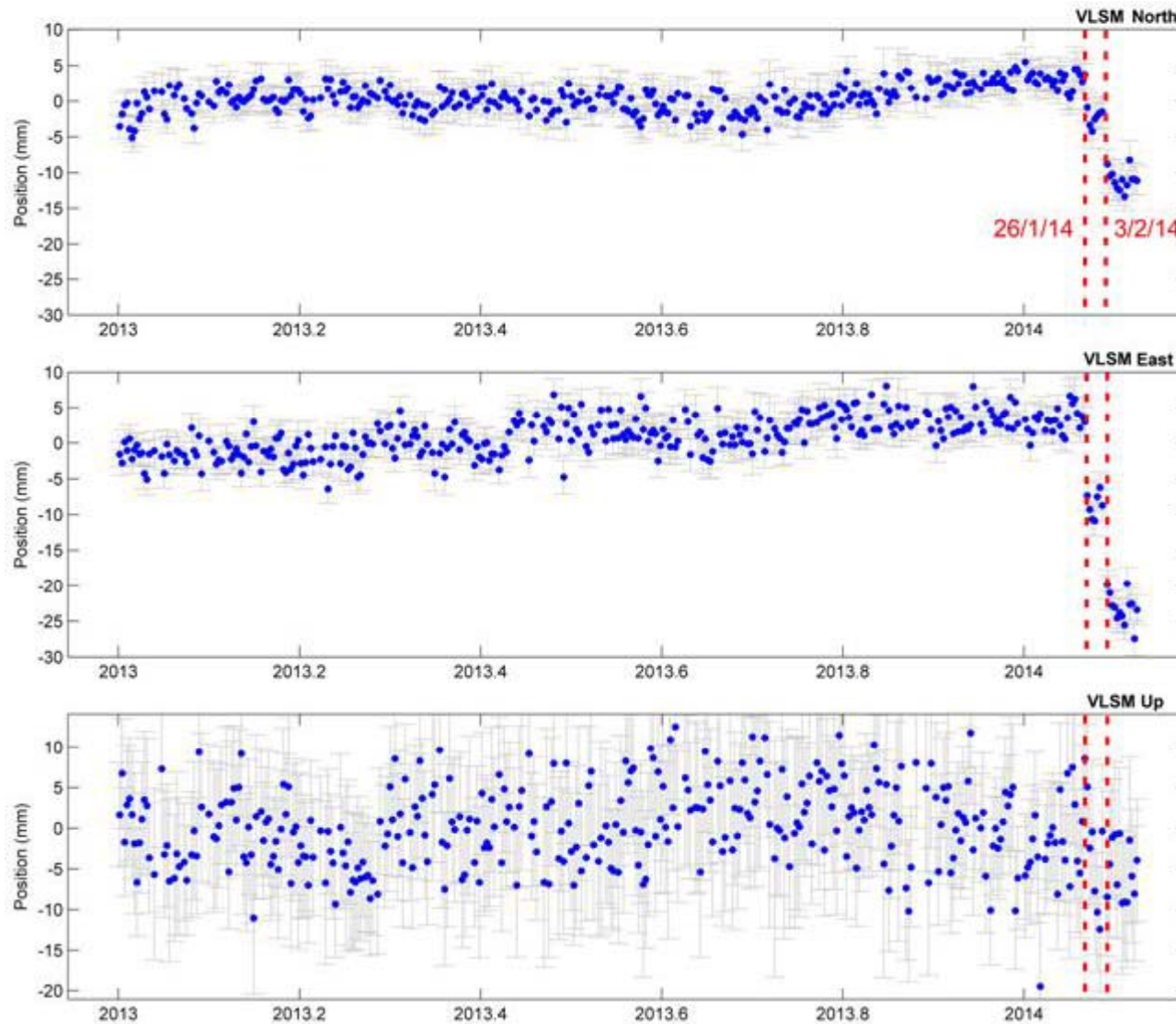


Science: Tectonic strain using 30-s data

- Data input from 33 stations
- Principal axes of the 2-D strain rate tensor. Convergent arrows (blue) denote contraction while divergent arrows (red) denote extension.
- Strain rate ranges from 10 nstrain/yr up to 270 nstrain/yr.
- Large NNW-SSE extension is obtained across the Corinth & Sperchios rifts.
- Internal extension across rigid areas:
 - a) Small rate across Attica and
 - b) larger across northern Peloponnese.
- Currently analysing data from 99 stations

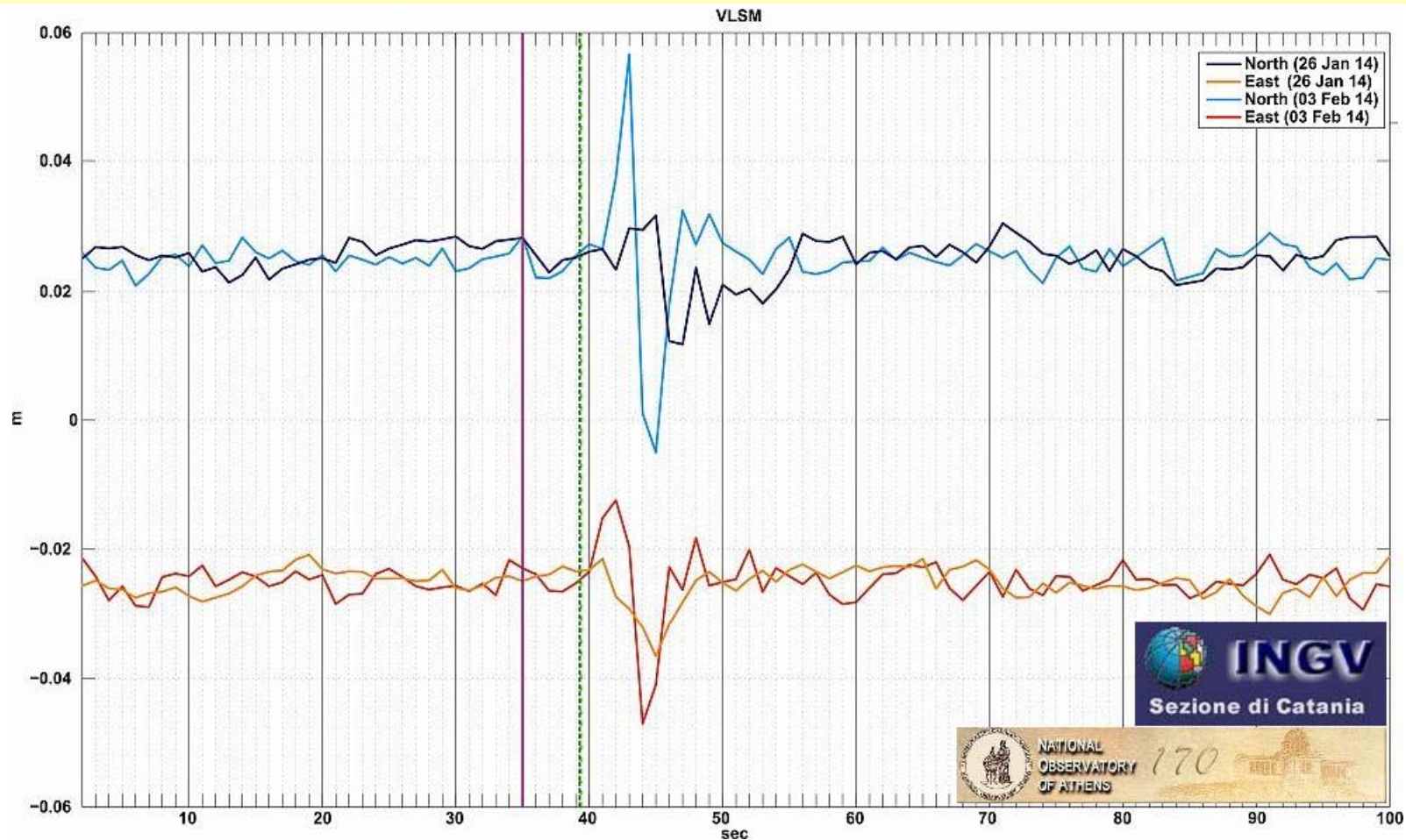


Science: Co-seismic offset using 30-s data



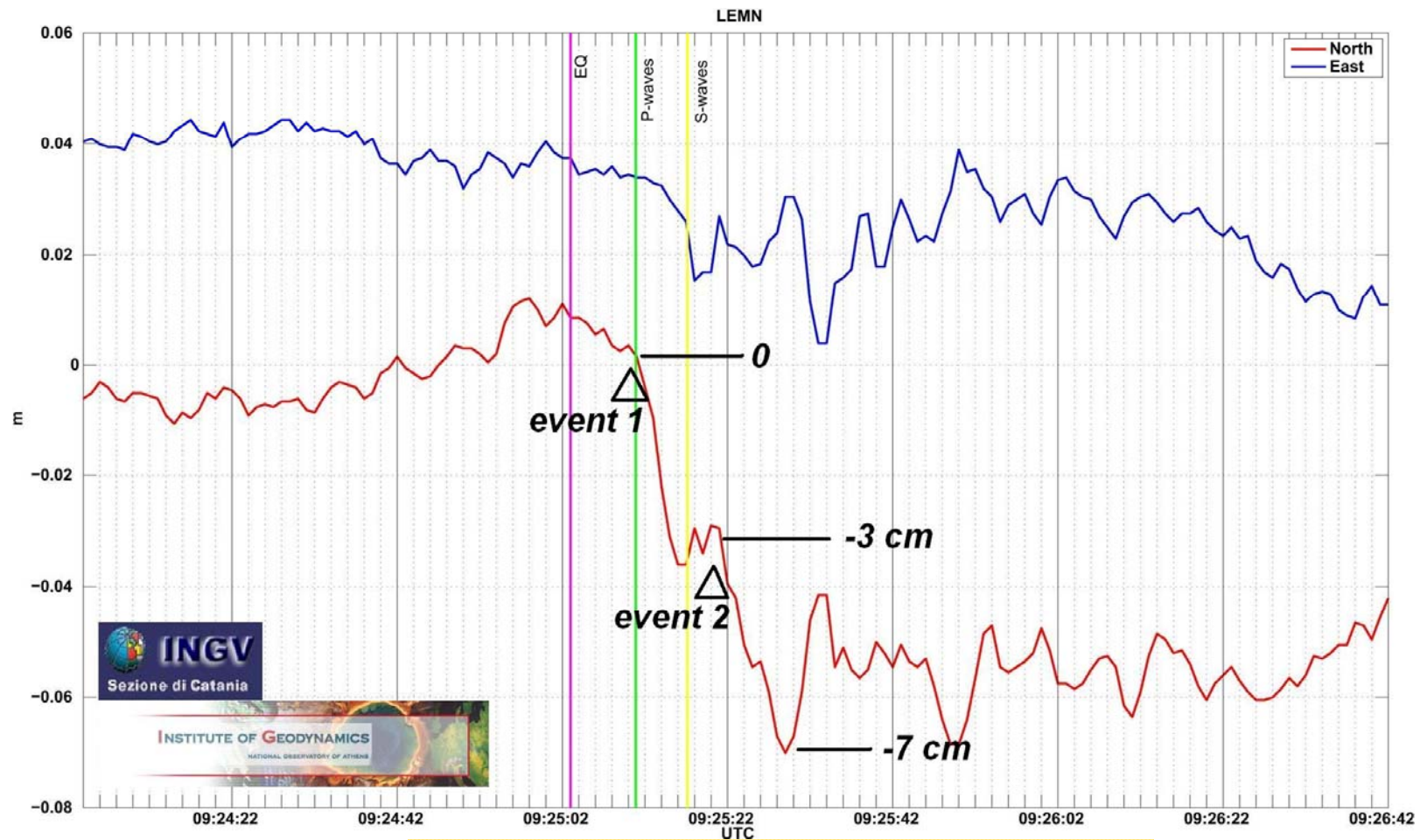
Science: Seismogeodesy (seismic offsets using 1-Hz data)

Cephalonia earthquakes Jan & Feb 2014 GNSS seismology – displacement waveforms for NOA station VLSM



Science: Seismogeodesy (seismic offsets using 1-Hz data)

Samothraki earthquake May, 24 2014
GNSS seismology – displacement waveforms for NOA station LEMN



Other GEO Research supported with GPS

Geomorphometry using ASTER and SRTM data > assess long term uplift

Fault growth relations for active faulting using field data > local networks

Paleoseismology > constrain fault slip rates from geology vs GPS models

Stress transfer (STROP and STROOP models incorporating fault-slip models) > constrain stress directions for optimal failure

Earth Observation (thermal remote sensing for monitoring Greek volcanoes) > provide support for ground campaigns (etc Santorini, 2012)

Earth Observation (hyperspectral remote sensing for mineral exploration and alluvial fan differentiation)

Selected GPS Publications

Chousianitis K., Ganas A., Gianniou M., 2013. Kinematic interpretation of present-day crustal deformation in central Greece from continuous GPS measurements. Journal of Geodynamics, 71, 1– 13.

Ganas, A., Marinou A, Anastasiou D., Paradissis D., Papazissi K., Tzavaras P., Drakatos G. 2013. GPS-derived estimates of crustal deformation in the central and north Ionian Sea, Greece: 3-yr results from NOANET continuous network data. Journal of Geodynamics, 67, 62– 71.

Ganas Athanassios, Chousianitis Kostas, Batsi Evaggelia, Kolligri Maria, Agalos Apostolos, Chouliaras Gerassimos, Makropoulos Kostas, 2013. The January 2010 Efpalio earthquakes (Gulf of Corinth, Central Greece): earthquake interactions and blind normal faulting. Journal of Seismology, 17 (2), 465-484.

Ganas, A., Serpelloni, E., Drakatos, G., Kolligri, M., Adamis, I., Tsimi, Ch. and Batsi, E., 2009. The Mw 6.4 SW Achaia (Western Greece) Earthquake of 8 June 2008: Seismological, Field, GPS Observations, and Stress Modeling, Journal of Earthquake Engineering, 13:8, 1101 — 1124.

Ganas A, Bosy J, Petro L, Drakatos G, Kontny B, Stercz M, Melis NS, Cacon S, and Kiratzi A, 2007. Monitoring active structures in eastern Corinth Gulf (Greece): The Kaparelli fault. Acta Geodynamica et Geomaterialia, 4 (1), 67-75.

Services

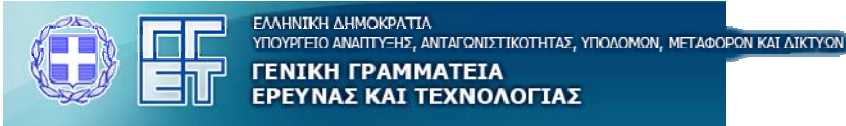
- Open data policy (30-s data) for Solid Earth applications
www.gein.noa.gr/gps.html
- Network Products: Station velocities of 30-s positions at ITRF2008 reference frame (N, E, U).
- Implementation of the GSAC web-service of UNAVCO
- Use of GPS velocities to validate / calibrate InSAR PS data (TERRAFIRMA etc)
- Studies of active faults/subsidence for EPPO, local municipalities
- Provision of GNSS quality control services to the private sector

GPS/Deformation Projects & Funding (2006-2013) P.Is Ganas, Drakatos

1. National Funds (Direct funding)	40.000,00 Euros
2. GSRT competitive funding	200.000,00 Euros
3. EU+EEA+ESA competitive funding	520.000,00 Euros
4. NATO (SfP) competitive funding	60.000,00 Euros
5. Private Sector (METRICA SA, JGC)	40.000,00 Euros
6. Services to EPPO	30.000,00 Euros

Total funding 890.000,00 Euros

Funding acknowledgements



Authorized Leica Geosystems Distributor



Data access at: <http://www.gein.noa.gr/gps.html>

2020 Vision for Geodynamics – Active Tectonics

1. Expand the network to 50-60 stations
2. Get permanent national funding for network maintenance 20kE
3. Hire qualified scientists, technicians
4. Produce tectonic strain maps on annual basis using 200+ stations
5. Operate Early Warning based on GPS: Seismogeodesy
6. Estimate coupling along the Arc
7. Measure slip rates and locking depths of active faults using block-modeling
8. Expand the range of services to third parties: ground motion maps, data quality control
9. Participate to major EU - ESFRI initiatives: EPOS etc

Thanks for your attention!

