

CAT: the INGV Tsunami Alert Center

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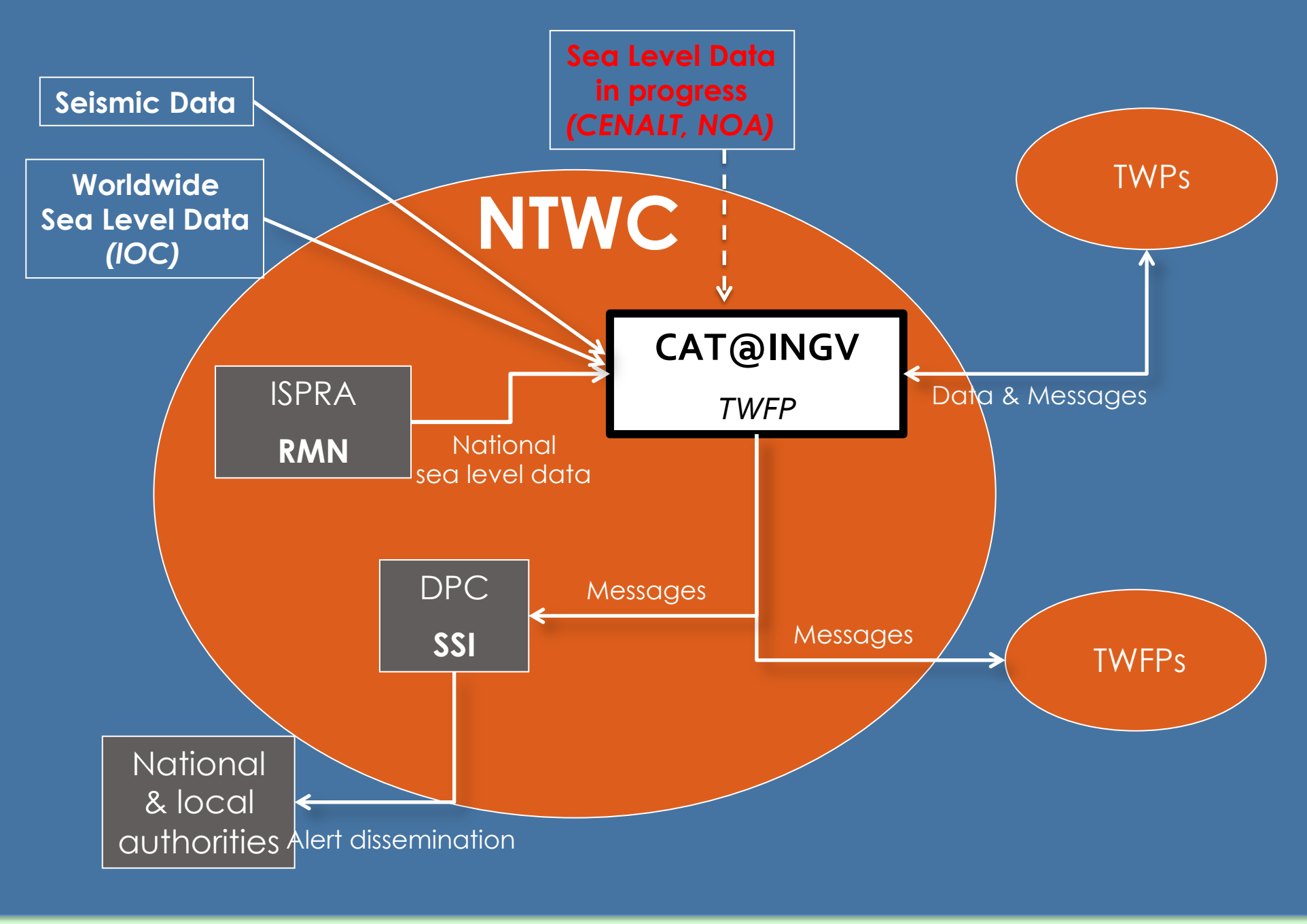
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Abstract

After the big 2004 Sumatra earthquake, the tsunami threat posed by large earthquakes occurring in the Mediterranean sea was formally taken into account by many countries around the Mediterranean basin. In the past, large earthquakes that originated significant tsunamis occurred nearly once per century (Maramai et al., 2014, Annals of Geophysics). The Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) received a mandate from the international community to coordinate the establishment of the ICG/NEAMTWS (<http://neamtic.ioc-unesco.org>) through Resolution IOC-XXIII-14. Since then, several countries (France, Turkey, Greece) have started operating as candidate Tsunami Watch Provider (cTWP) in the Mediterranean. Italy started operating as cTWP on October 1st, 2014. The Italian cTWP is formed by INGV (“Istituto Nazionale di Geofisica e Vulcanologia”), DPC (“Dipartimento di Protezione Civile”) and ISPRA (“Istituto Superiore per la Protezione e la Ricerca Ambientale”). INGV is in charge of issuing the alert for potentially tsunamigenic earthquakes, ISPRA provides the sea level recordings and DPC is in charge of disseminating the alert. INGV established the tsunami alert center (CAT, “Centro di Allerta Tsunami”) at the end of 2013. CAT is co-located with the INGV national seismic surveillance center operated since many years. In this work, we show the technical and personnel organization of CAT, its response to recent earthquakes, and the new procedures under development for implementation.

CAT - Infrastructure



- Data**
 - Seismic
 - GFZ, NOA, CENALT, IRIS, NEIC, INGV (MedNet+NSN), ORFEUS (~400 stations worldwide)
 - Sea level
 - Italian Sea level Network (ISPRA-RMN), IOC
- Seismic Detection/Location/Magnitude/ (Discriminants)**
 - Early-Est
- DBs integrated with seismic monitoring system**
- JET (Java Estimate Tsunami interface)**
- Alert messages issued by Email, GTS, and FAX**

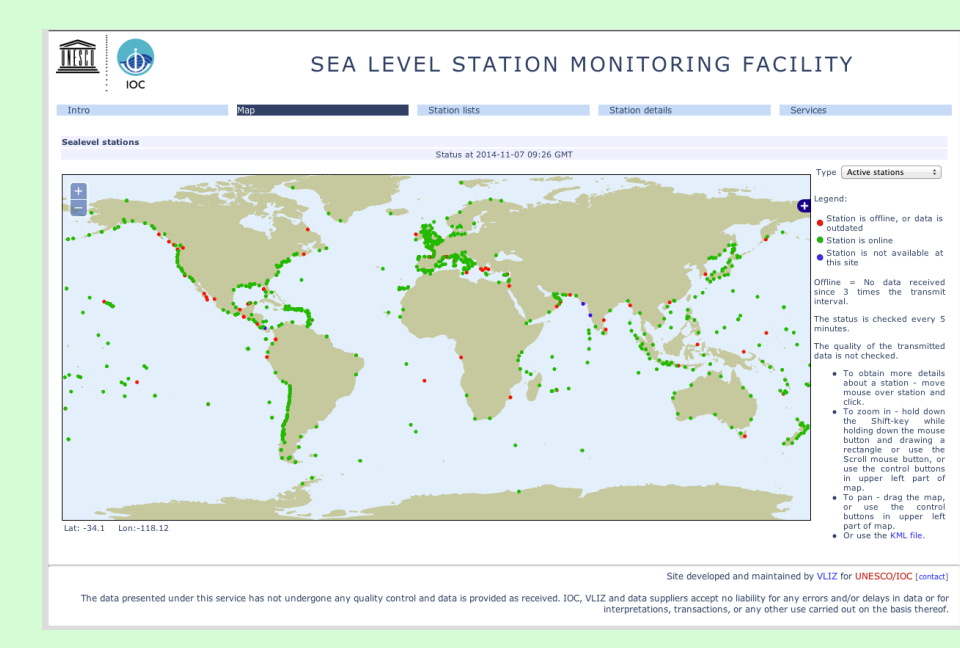
INGV Seismic Center

- Integration between Seismic surveillance and Tsunami alert
- Personnel in seismic room (7/24)
 - 2 seismologists + 1 engineer
 - 1 “tsunamist” (seismologist/geophysicist)
- Personnel on call
 - Senior seismologist in charge (weekly) of the center operations
 - 2 technicians (operation s/w & network)
- Seismic and Tsunami monitoring training
- Continuous worldwide tsunami monitoring (for training and system-checking purposes)
- Monthly Communication tests

Sea level monitoring



ISPRA-RMN

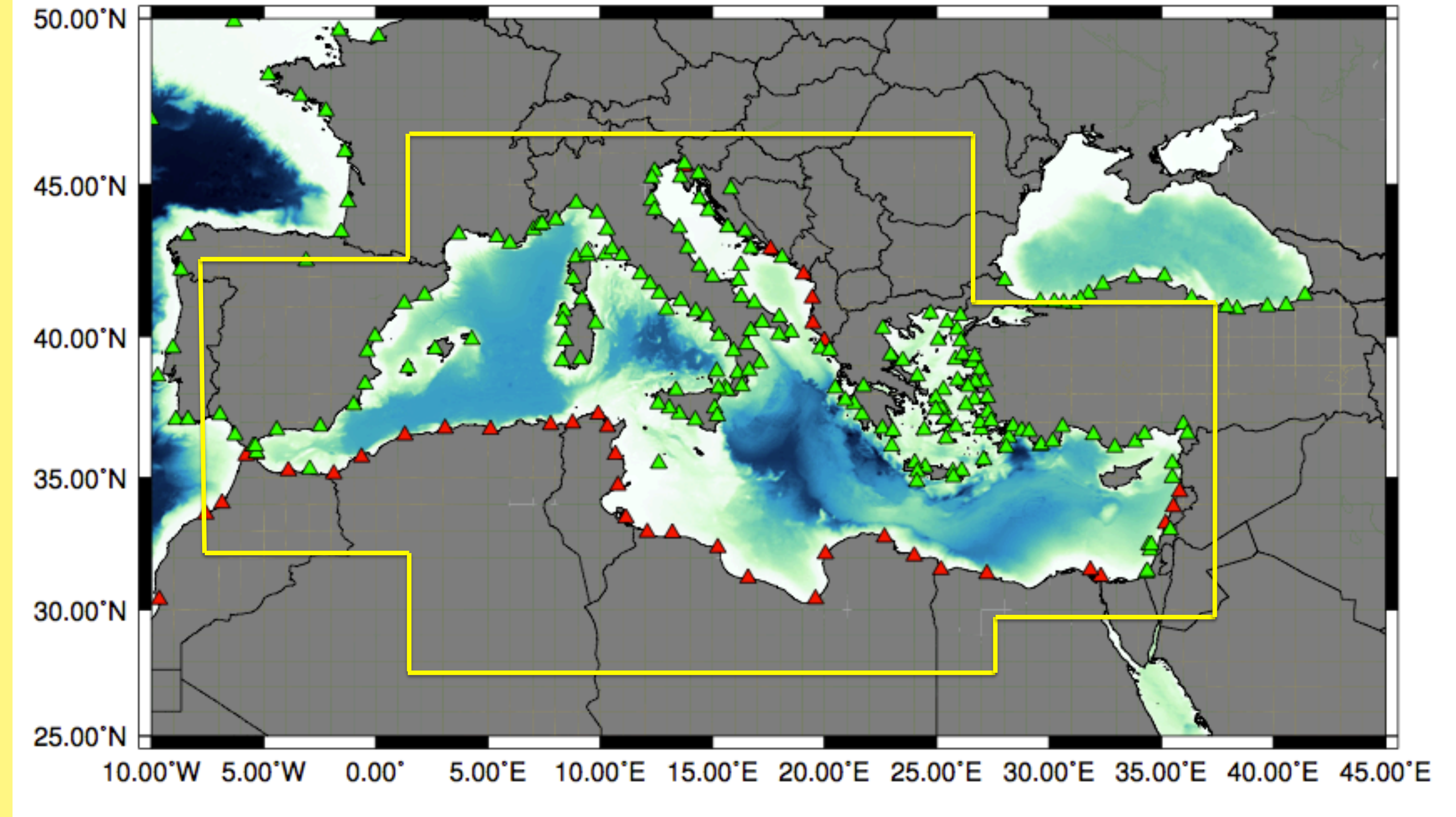


IOC

In progress data exchange with CENALT and NOA

S21A-4425

Monitoring area



All Mediterranean Sea (100km West of Gibraltar; Marmara Sea)

▲ NEAM official forecast points ▲ Unofficial forecast points

Tsunami Evaluation

- Earthquake Parameters estimation (Early-Est)
- Alert levels (NEAM Decision Matrix)
- Theoretical tsunami arrival times estimation (TTT GEOWARE)
- Monitoring sea level

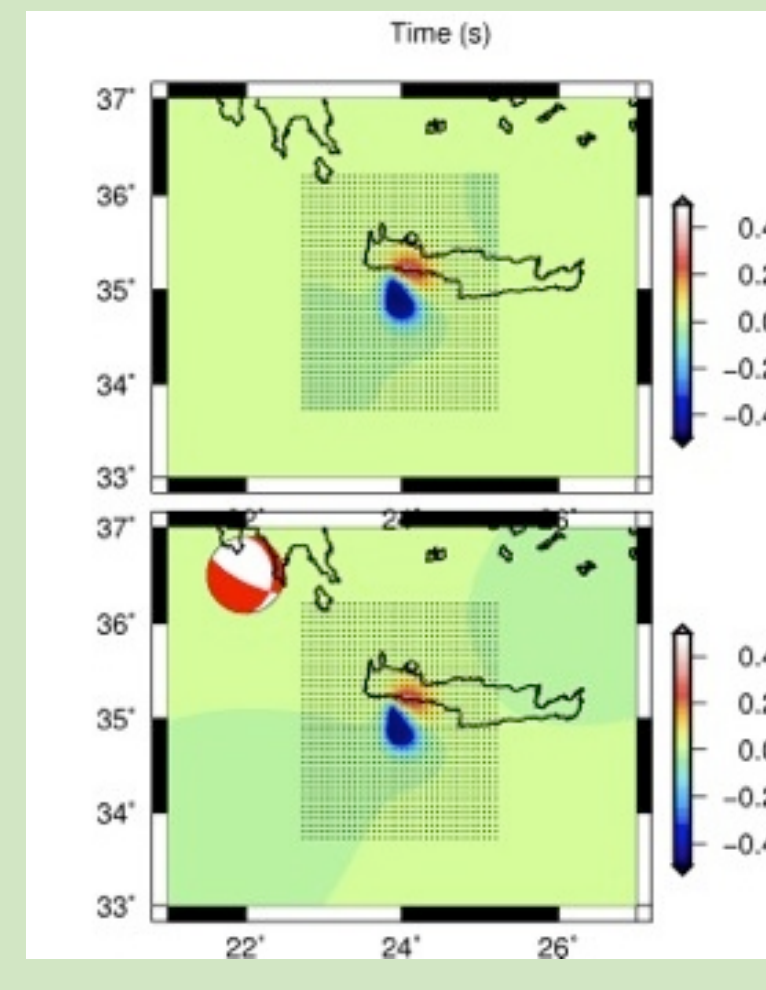
Response timeline

- Within monitoring area
 - 2-3 minutes for first earthquake location
 - 7-8 minutes for stable earthquake location
 - 10-11 minutes for final earthquake location
- First alert issued by 14 minutes based on decision matrix
- Adoption of NEAM decision matrix and communications protocols (ONGOING, CANCELLATION, END)

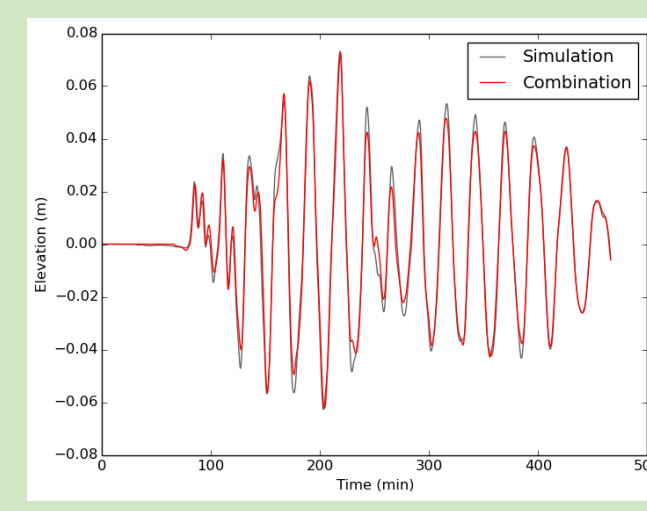
In progress

Using in place of the Decision Matrix:

- Pre-calculated Tsunami Database (in progress)
- Gaussian unit sources 7x7 km (~ 50000 sources)
- Propagation with Hysea GPU Code (Malaga Univ.)

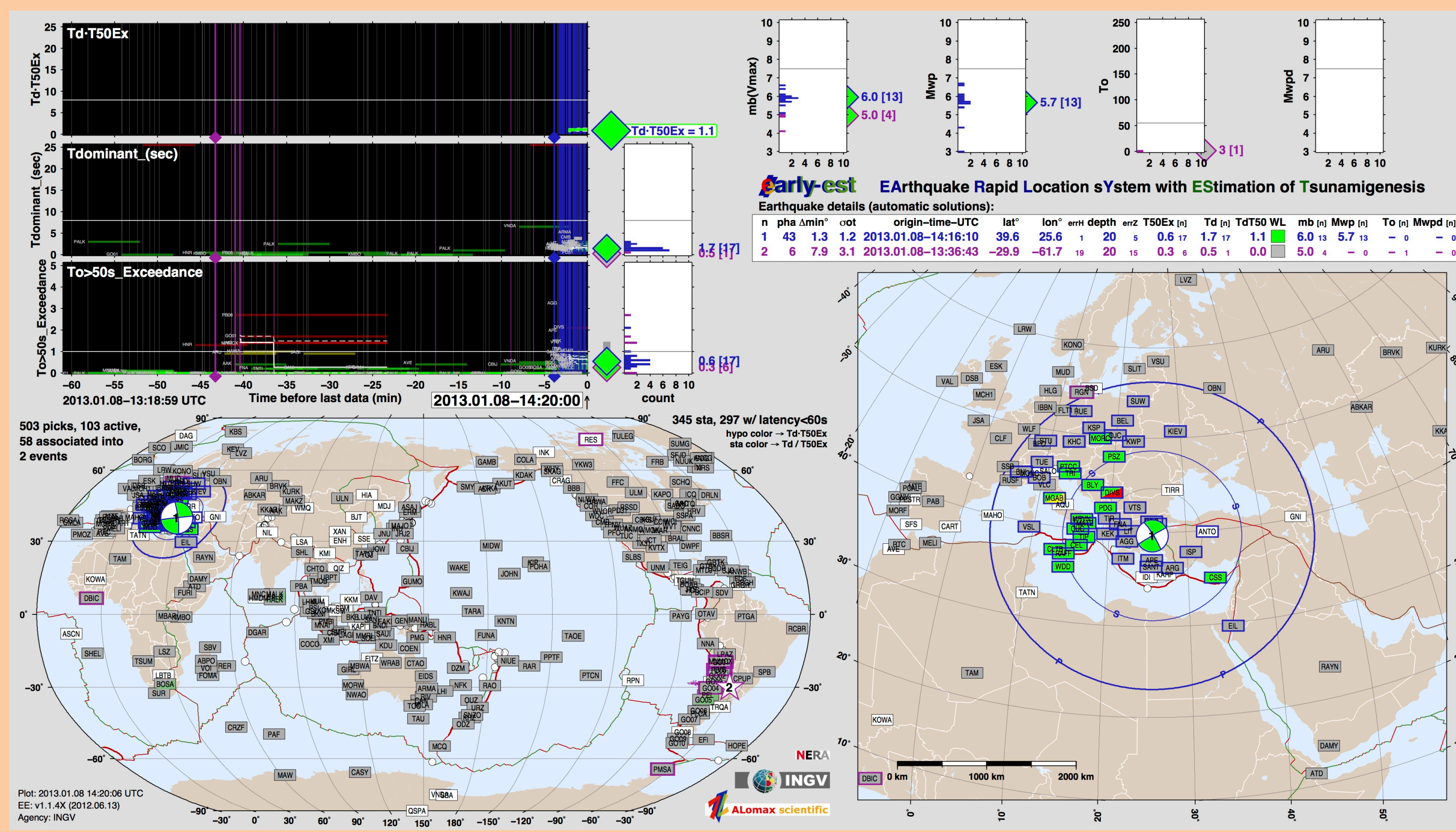


Linear combination of unit sources that reproduce the initial field

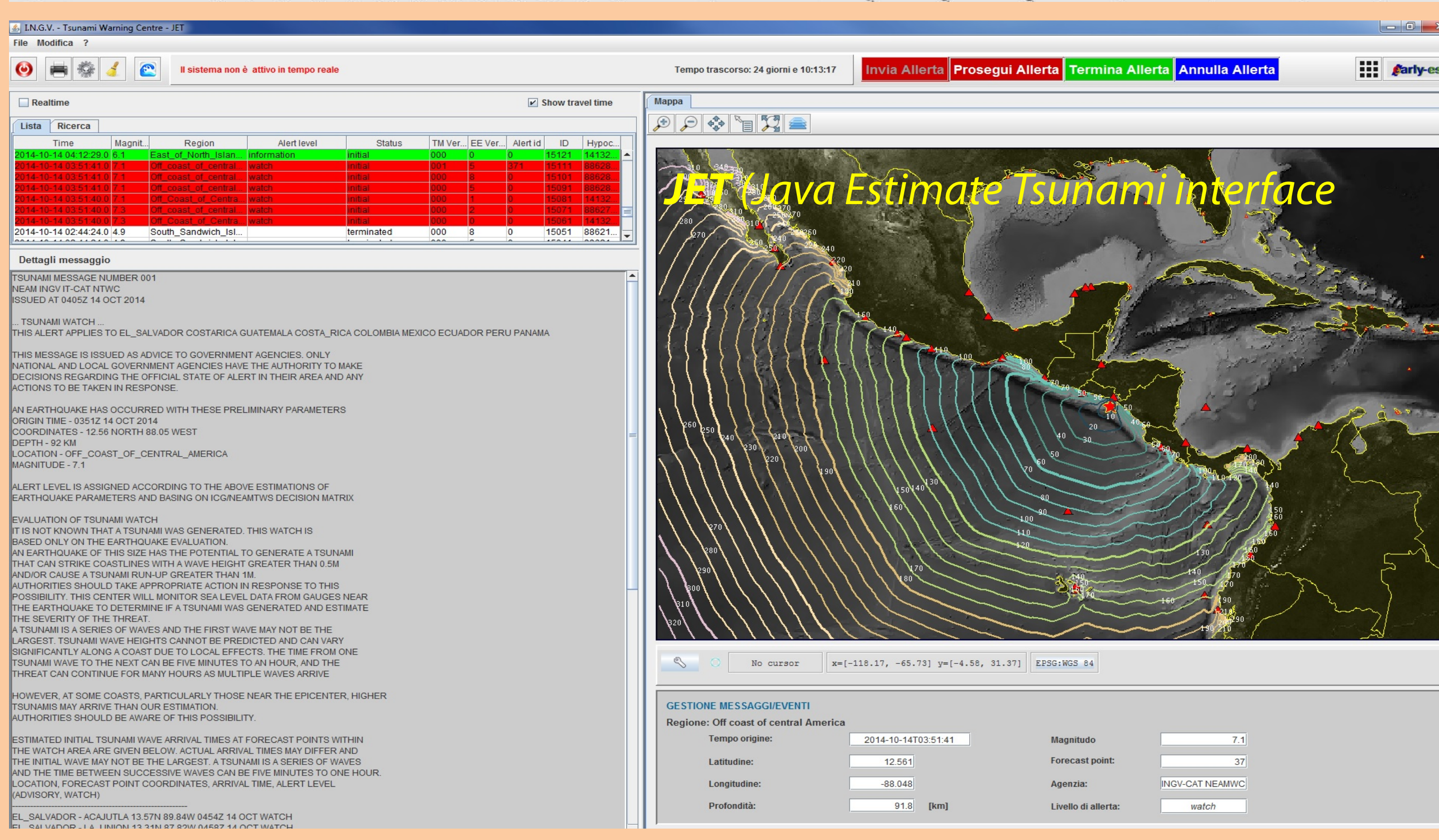
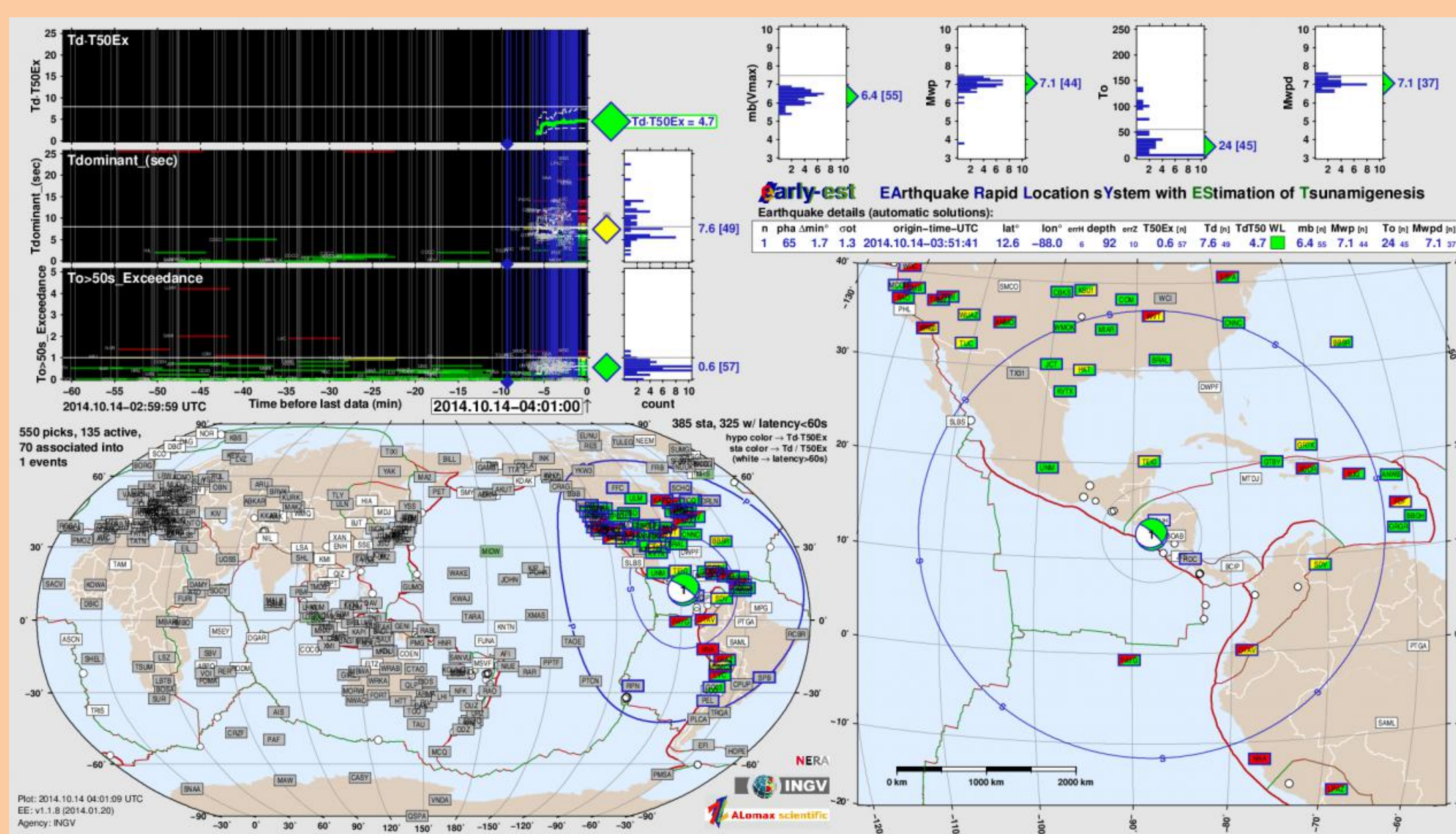


Tsunami forecast at tide gauges/forecast points

Examples (Mediterranean and worldwide)



2013 January 8, East Aegean earthquake location



2014 October 14, Off coast of Central America, earthquake location, tsunami travel times, and example alert message

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CAT started being pre-operative on 2014 October 01 and it will ask for accreditation during 2015