Italian strong motion network - RAN

- Italian Civil protection organization and mandate

- DPC 's general strategy of seismic monitoring

- Project RAN – technical aspects

- Use of RAN strong motion recordings during seismic emergency

- Future developments

Civil protection organization and mandate

The Italian civil protection is organized in a
"*National Service of Civil Protection*"

Components:

-State administrations
-Provincial councils
-Municipalities
-Mountain communities
- Public boards
- Institutes and scientific research
  groups with civil protection purposes
- Any institution or organization, also
  private Citizens
- Associated groups of volunteers
- Professional associations and boards

Operative structures:

- Voluntary service
- Fire Department
- Armed Forces
- Forestry commission
- National groups of scientific research
- Police Forces
- Italian Red Cross
- National Health Service
- the National Mountain rescue and
  speleological corps

The ***National Service of Civil Protection*** aims at safeguarding human life and health, goods, national heritage, human settlements and the environment from all natural or man-made disasters

Activities:

• Forecasting and Warning
• Prevention and Mitigation
• Rescue and Assistance
• Emergency Overcoming

The ***Department of Civil Protection (DPC)*** is a structure of the Prime Minister's Office and has the function of coordinating and directing the National Service of Civil Protection

DPC's seismic monitoring activities:

- seismic surveillance and warning

> DPC has a monetary agreement with INGV for seismic monitoring and warning.
> After few minutes a seismic event INGV send earthquake localization parameters and magnitude value to DPC

structure monitoring

> - OSS – main permanent network (124 structures)
> - RAMSES – simplified system network (14 buildings)
> - OSM – mobile network

- ground motion monitoring

> - RAN – permanent network (464 stations)
> - RAN – mobile network

DPC's General strategy for seismic monitoring

- ## seismic surveillance and warning
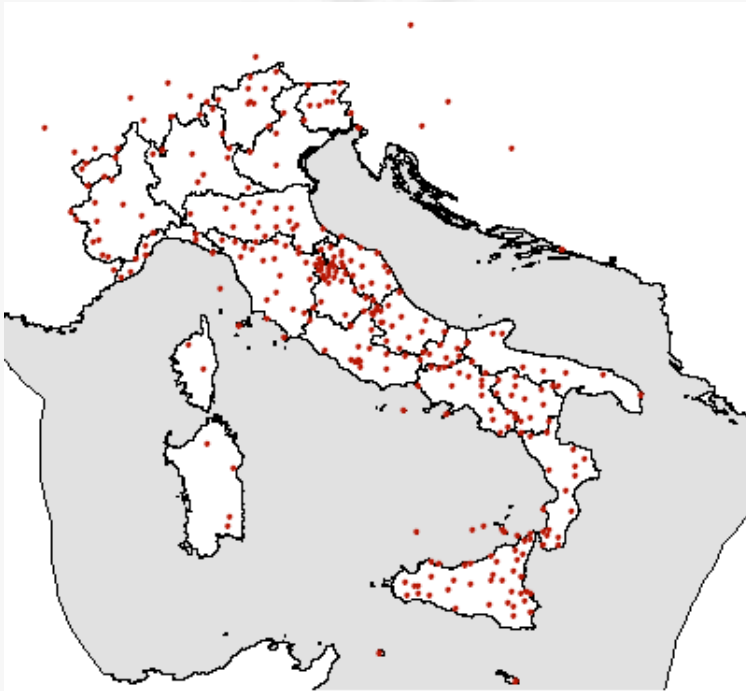
INGV seismic network
(310 stations)

SMS

> INGV Man 27/01/12 To=14:53:13 Ml=5.4 IPO 44.48 10.03 60.8 Eh=0.96 Ez=1.87 G=75 Q=AA D=Frignano P=PARMA C=*,Corniglio, Berceto**,Monchio delle Corti*,Palanzano,T

INGV **web page** dedicated to DPC

>

DPC's General strategy for seismic monitoring

prof. Mauro Dolce
(head office)

eng. Mario Nicoletti
(head service)

Project RAN staff:

2 physicists

2 geologists

1 ITC specialist

2 technicians

Project OSS staff:

5 engineers

4 technicians

DPC's General strategy for seismic monitoring

Mercato Saraceno bridge

Sulmona hospital

Napoli School

S.Daniele City Hall

OSS buildings of social importance are kept under control, and the capacity of the structure to withstand earthquakes is estimated, also through structural modeling and analysis.

Sensors layout

Permanent
OSS network:
124 structures
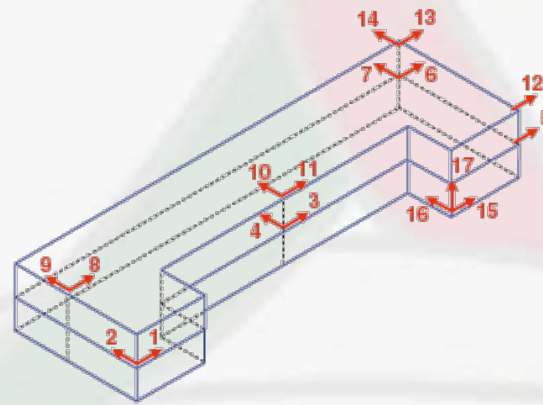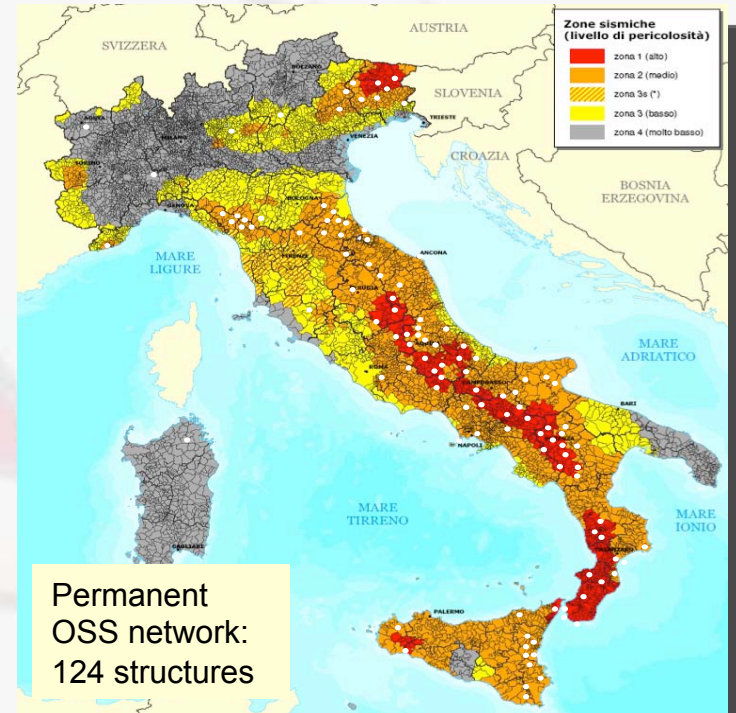
OSS data reach a central server, which processes them to describe both **local ground shaking** and **structural dynamic response. Seismic damage** is assessed, and a comprehensive **Report** is automatically produced and delivered via e-mail. **Damage can be extrapolated to nearby similar structures.**

Project RAN - to increase the number of monitoring stations

- to acquire data from other strong motion networks

- in **14 years**, from 1997, the DPC has:
- ✓ **realized 284** new digital stations (**31** of these will be active within 2012)
- ✓ **replaced 192** analog instruments with **digital** ones
- ✓ **acquired 19** digital stations from Calabria Region

total active stations= 464

Thanks to **inter-institutional agreements between DPC and the regional governments and municipalities** who cooperate to locate the sites and ensure access to it and electrical supply.

- **nowadays**
- ✓ **data from** other local accelerometer networks **(ISNET, RAF) flow into** the **RAN database**

total active stations = 46

Thanks to **monetary agreements between DPC, Universities and Research Institutes**

Project RAN - to increase the number of monitoring stations

- to acquire data from other strong motion networks

> 🟢 **RAF stations: 15**
  http://rtweb.units.it/

⌐ ⚫ **RAN stations: 464**

ISNET stations: 31
  http://isnet.na.infn.it/

Hazard (PGA)

- < 0,025 g
- 0,025 - 0,050
- 0,050 - 0,075
- 0,075 - 0,100
- 0,100 - 0,125
- 0,125 - 0,150
- 0,150 - 0,175
- 0,175 - 0,200
- 0,200 - 0,225
- 0,225 - 0,250
- 0,250 - 0,275
- 0,275 - 0,300

- the underlying base map is the Italian seismic hazard map
(Working Group MPS 2004 http://zonesismiche.mi.ingv.it/)
- different colors depict PGA with a 10% chance of exceedance in 50 years

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission
- data acquisition system

	kinemetrics Etna/Makalu /K2/Basalt	Reftek RT-130	Solgeo Edax	Agecodagis Osiris6
RAN	253			
RAN		192		
RAN			19	
ISNet				31
RAF	15			

	kinemetrics Episensor /Fba23	Syscom MS2007	CFX US4	Guralp CMG5T
RAN	253			
RAN		192		
RAN			19	
ISNet	3			28
RAF	15			

Characteristics of RAN instruments

- 3 channels sensor
- sensor full scale range 1g/2g
- resolution 18bit - 24 bit
- triggered data (200 sps)
- continuous data (100 sps)
- GPS time synchronization
- freq. response ≥ DC-80Hz @200Hz
- local memory up to 2 GB

- triggered data transmission through the GSM and GPRS systems

Project RAN

<u>Main goal</u>:

- to collect high data quality
    - increasing the number of monitoring stations and/or acquiring data from other strong motion networks
    - adopting technical innovations in strong-motion instrumentation, data transmission and data acquisition system
    - adopting good level for stations and data acquisition system maintenance services.

<u>Objective</u>:

- to use strong motion data
    - to optimize the effectiveness regarding the delivery of emergency response services
    - to take a step forward in the evaluation, prevention and mitigation of seismic risk

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission
- data acquisition system

RAN includes the stations of the historical network, located inside ENEL electric transformer substations.

> *GPS and high gain GPRS antennas*

GPRS router (VPN client)

Linux processor <

RT_130 <

ms2007 <

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission
- data acquisition system

The new RAN stations are realized near to urban areas, mostly in free field on land owned by municipality

> *high gain GSM/GPRS antenna*

> *GPS antenna*

> *GPRS/GSM modem*

> *Etna/K2/Makalu FBA23/Episensor*

> *Power line protection*

Project RAN - technical innovations in - strong-motion instrumentation
- data transmission
- data acquisition system

RAN includes also several stations funded by other public administration as 19 stations in Calabria Region.

GPS antenna

GSM antenna <

GSM modem <

EDAX <

US4 <

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission

- data acquisition system

	Kinemetrics	Reftek/Syscom	Solgeo/CFX
Modem GSM Siemens/APSystems	126		19
Modem GPRS APSystems	104		
Router GPRS NB2240		192	
Analog modem US Robotics	2		

The public dynamic IP addresses associated to GPRS SIM card by APN are managed with :

- VPN client configured in Router GPRS

- Monitoring IP addresses sent by modem GPRS

To improve strength of GSM/ GPRS signal high gain antennas, Omni-directional or directive, are installed at stations

21 Basalt will be equipped with router in short time.

Project RAN - technical innovations in - strong-motion instrumentation
- data transmission
- data acquisition system

The whole network will be upgraded to GPRS system within 2012 and an APN dedicated to DPC will be used to manage GPRS connections.

DImon for Etna/K2/Everest with GPRS modem

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission

- data acquisition system

**Dynamic IP address
updated every 60 secs**

SIM s/n

APmon program allows continuous monitoring of GPRS connections

Project RAN - technical innovations in - strong-motion instrumentation

- data transmission

- data acquisition system

MultiTech Modem Bank :
CC1600 -11L Modem
Rack for 16 modems
PS1600 Hot-Swappable
Power Supply
MT5600BR-V92
Rackmount Data Modem
Card

2x

**Sun SPARC Enterprise
M4000 Server :**
4x2.15GHz SPARC 64 VI
64GB RAM
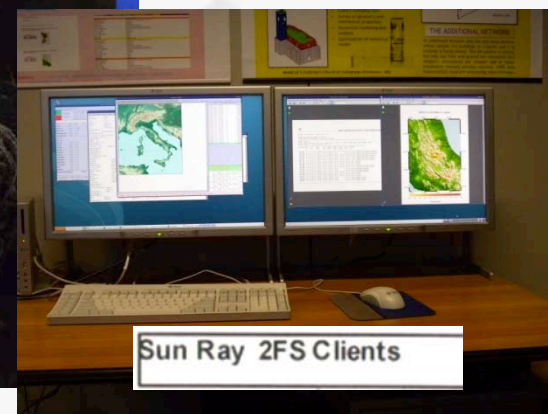2x146 @ 10k SAS HDD
2xGbE ports

Software ANTELOPE

OS Solaris

1x

**Sun SPARC Enterprise
T5220 Server :**
1x8-core T2 @ 1.2GHz
32GB RAM
2x146 GB @ 10k SAS
HDD
4xGbE ports

Software ANTELOPE

OS Solaris

2x

NexSan SATAbeast :
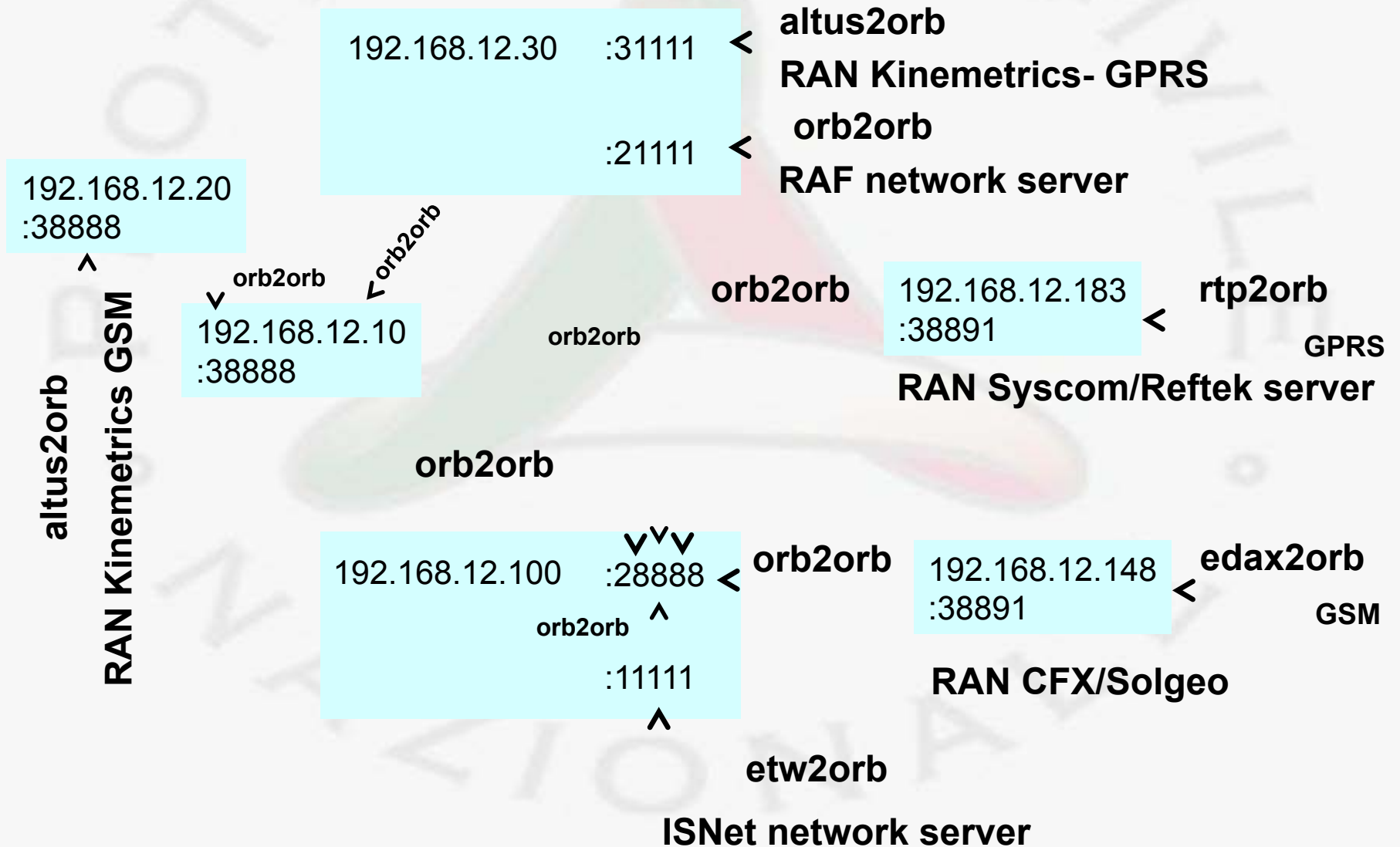1TB @ 7200 HDD
2xiSCSI
2xFiber Channel port

1x

Sun Ray 2FS Clients

Project RAN - technical innovations in - strong-motion instrumentation
- data transmission
- data acquisition system

192.168.12.30   :31111 < **altus2orb**

RAN Kinemetrics- GPRS

:21111 < **orb2orb**

RAF network server

192.168.12.20
:38888

∧

altus2orb

RAN Kinemetrics GSM

orb2orb

orb2orb

192.168.12.10
:38888

orb2orb

orb2orb   192.168.12.183
:38891 < **rtp2orb**

GPRS

RAN Syscom/Reftek server

orb2orb

192.168.12.100   :28888 < **orb2orb**   192.168.12.148
:38891 < **edax2orb**

GSM

orb2orb

∧

:11111

RAN CFX/Solgeo

∧

etw2orb

ISNet network server

Project RAN - good level for stations and data acquisition system
maintenance

A good level of maintenance service for RAN stations and for the
RAN data acquisition center is necessary.
This in order to acquire and retrieve data from the network in
case of seismic event.

DPC requires:

- the 95% of the stations works properly

- the single station cannot be out of service for more than 5 days

- the support in installing temporary stations in epicentral area
  during seismic emergency

Project RAN – use of RAN recordings during seismic emergency
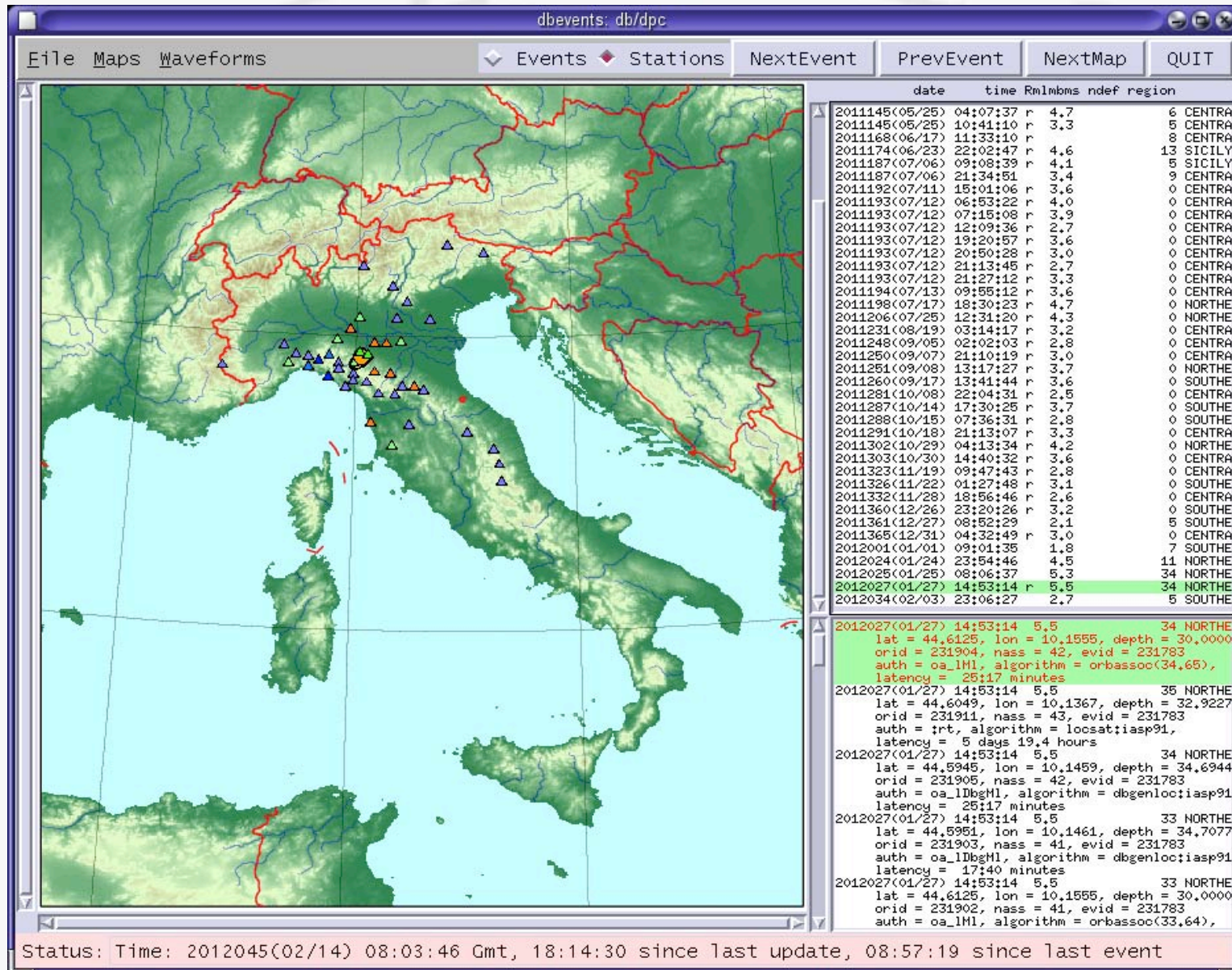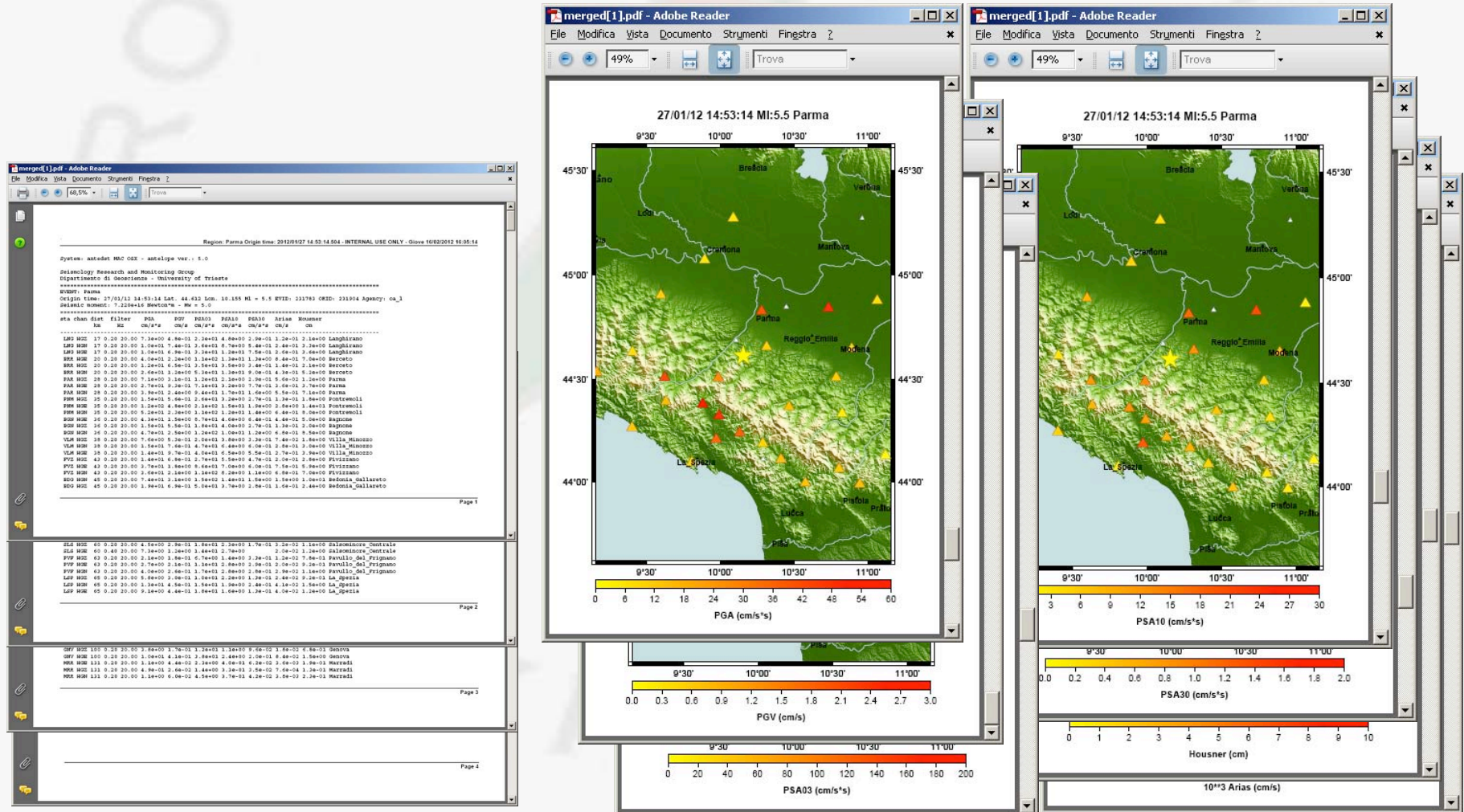

>MI=5.5

>nass=42

Project RAN – use of RAN recordings during seismic emergency

REPORT generated by automatic procedure developed by
University of Trieste – Seismological Research and monitoring group

Project RAN – use of RAN recordings during seismic emergency

If information from INGV ftp site are available, <u>localization parameters and magnitude value</u> calculated by automatic procedure are overwritten and the <u>dist parameter</u> is calculated using the INGV ipocentral parameters.

Project RAN – use of RAN recordings during seismic emergency

The REPORT contains

- an estimation of seismic moment and M_W for the associated event
- epicentral distance for recording stations
- PGA, PGV, PSA03, PSA10, PSA30, Arias and Housner intensities for recorded waveforms

The REPORT is sent by e_mail automatically.

Critical point: Metadata management

The automatic procedure use dbmaster tables that must be updated in real time.

Real time information about changes in metadata of "external" networks (ISNet and RAF) are necessary as well.

Project RAN – data acquisition systems products
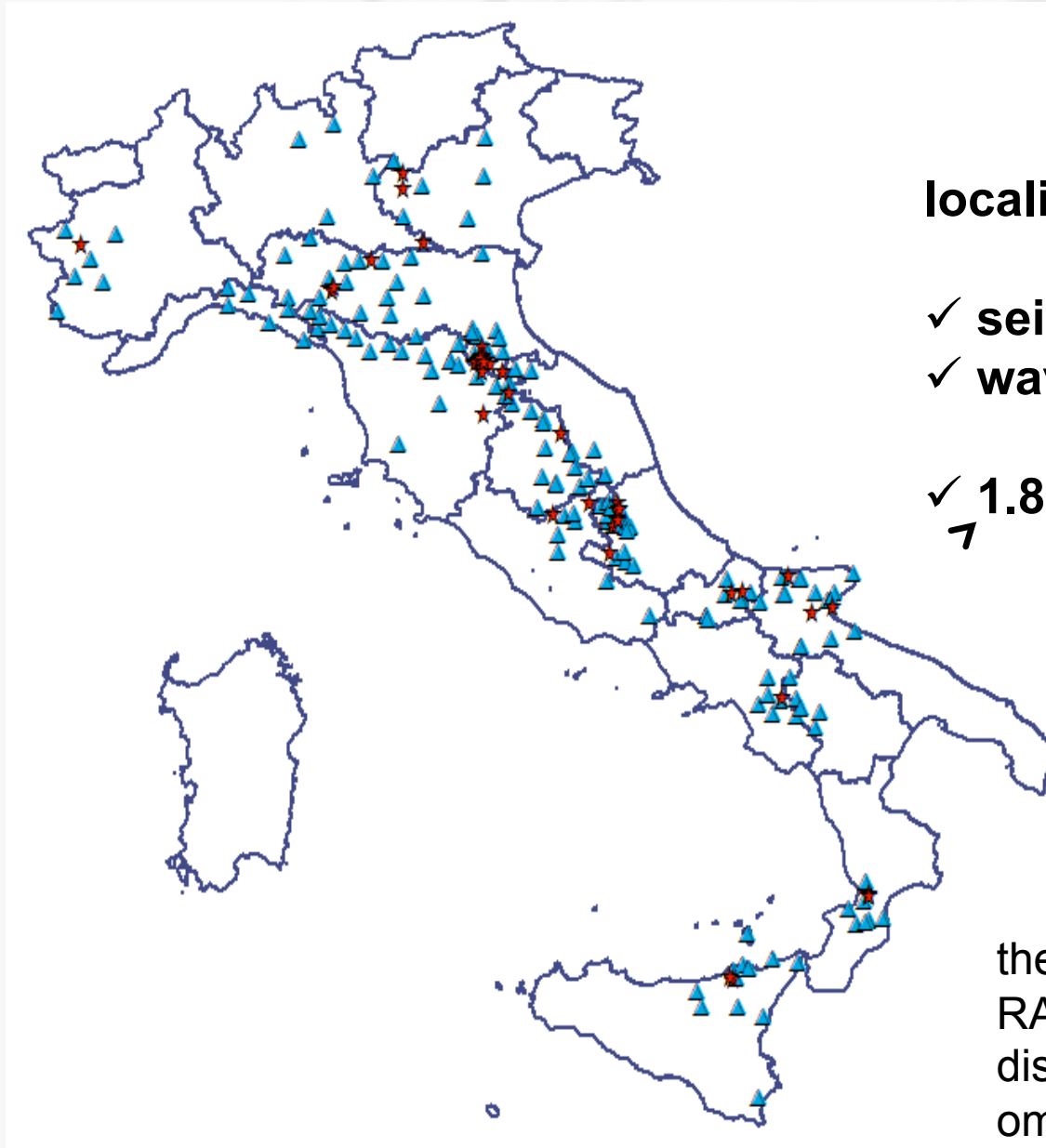
localizations from 2011

✓ **seismic events   =   48**
✓ **waveforms (3 cha) = 693**

✓ **1.8 <MI< 5.4**

the detection capability of the RAN network depends on spatial distribution of stations that is not omogeneous

Project RAN – future developments

• The automatic procedure will be implemented and the report will contain more ground motion and response parameters according to:

Cosenza E., Manfredi G.," Damage indices and damage measure Prog. Struct. Engng Mater. 2000; **2**: 50–59. *Ed. John Wiley & Sons*

• The REPORT will contain information on the site where the station is locate. We will start with EC8 classification.

• Web pages will be generated in real time.

• Antelope database will be populated with RAN data recorded in past years. This database could be used to optimize automatic procedures, event location and local magnitude calculation.

• New stations will be realized in seismic urban area sparsely monitored.