Monitoring seismicity in Italy.

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**THE INGV NATIONAL SEISMIC NETWORK
IN 2000 :
92 short-period mostly
1-C seismometers
(S-13) connected with low
dynamic range telephone
lines**

**Closed station - station
distance:**

**average: 38 km
median: 29 km
minimum: 5 km
maximum: 306 km**
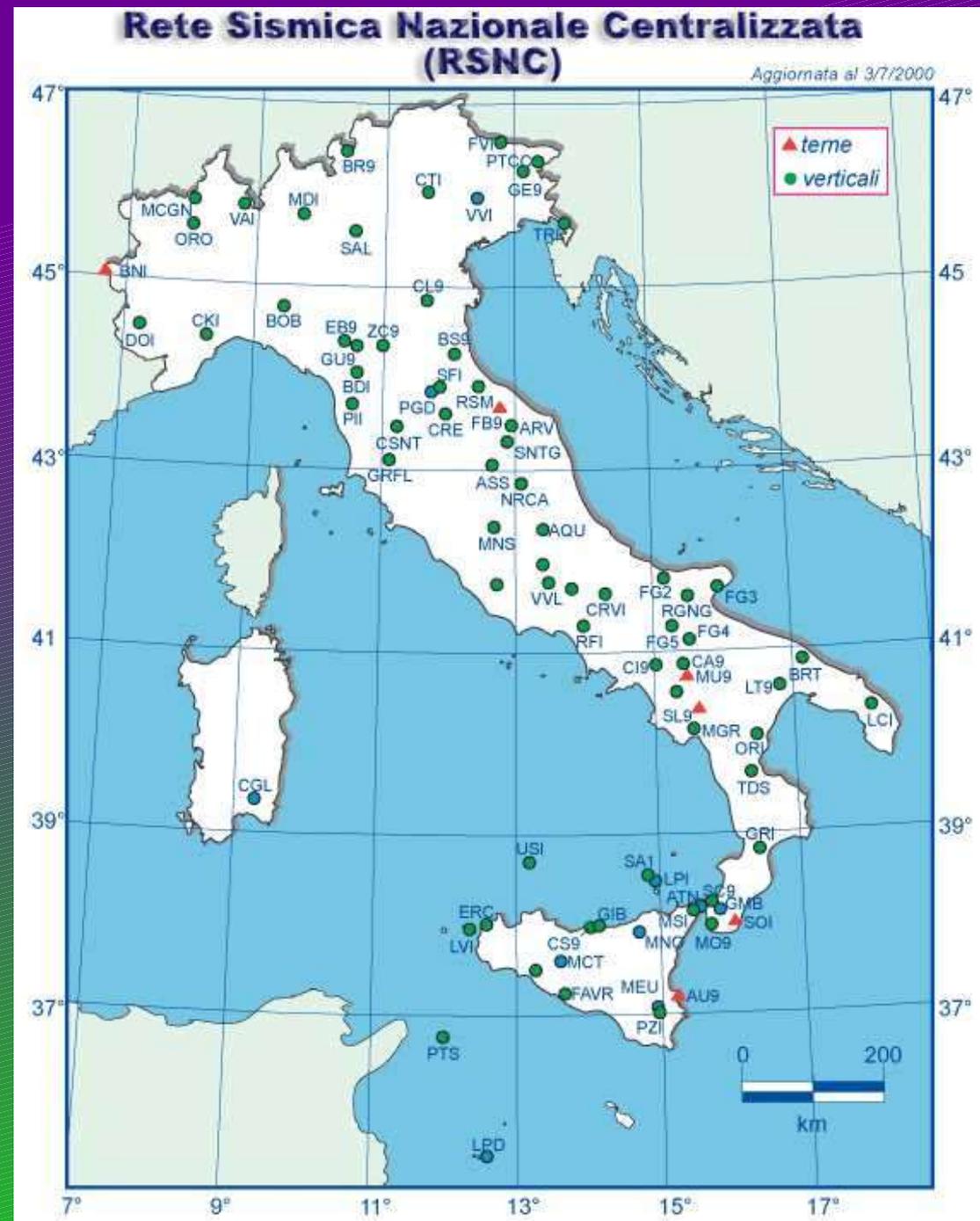
Italian Seismicity 1984-2001
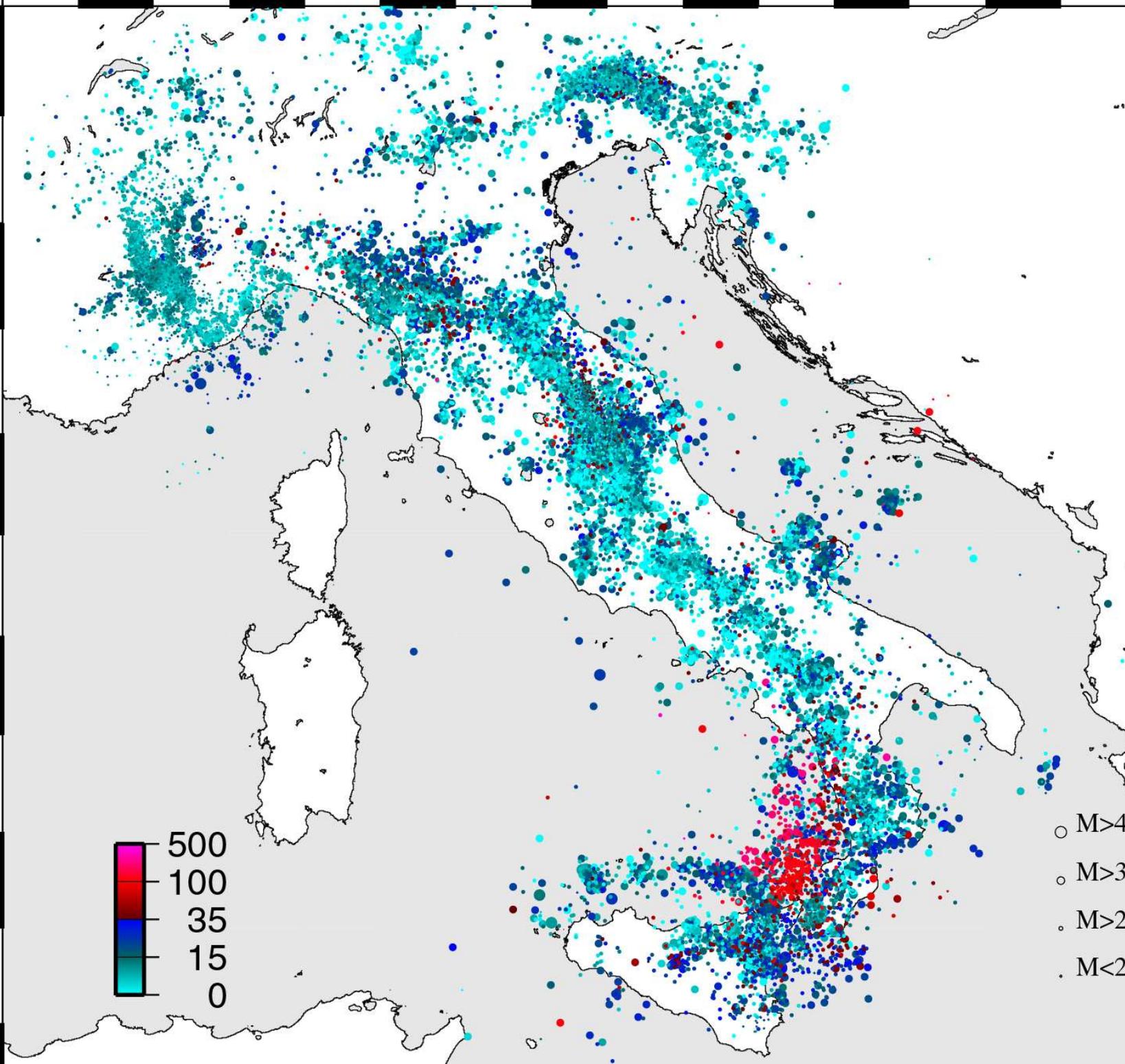
The main **problems** of the old system were:

- slowness of the hypocentral determinations (>5 minutes, often 10)
- slowness of reliable Magnitude estimates especially for stronger shocks (clipped waveforms, MedNet VBB stations called via modem)

Moreover, the sparse and dishomogeneous geometry of the network and the kind of equipment employed in the National Seismic Network in past years have significantly limited our capability to understand the deep structure and the earthquake processes.

Detailed studies on seismogenic structures, on seismic sources characteristics, and deep structure were possible only with temporary experiments; largely spaced networks, as MedNet; other dense local networks.

The Italian National Seismic Network today (and tomorrow…)

- Faster and more accurate hypocentral locations and magnitude

- An integrated system of different scale networks to monitor and study active faults and volcanoes in detail

- Integration of continuous GPS stations

In 2002, we started to test and install a satellite system in parallel of the GAIA and MedNet to guarantee coverage in case of loss of the telephone lines.

Tolfa, Central Italy, August 2002
Libra System, Nanometrics
Trillium 40-s sensor

- High reliability
- Lower tx costs
- Easier connection from remote sites

30 satellite stations will be deployed in 2003 – 2004 (today 23 are running). Probably 60 more in southern Italy in the next three years

INGV-GAIA basic configuration:

- modular design
- robust
- cheap
- serial or IP transmission to the acquisition center in Rome

Currently installed in 32 sites

Modulo AGDF1　　　Modulo GPS1
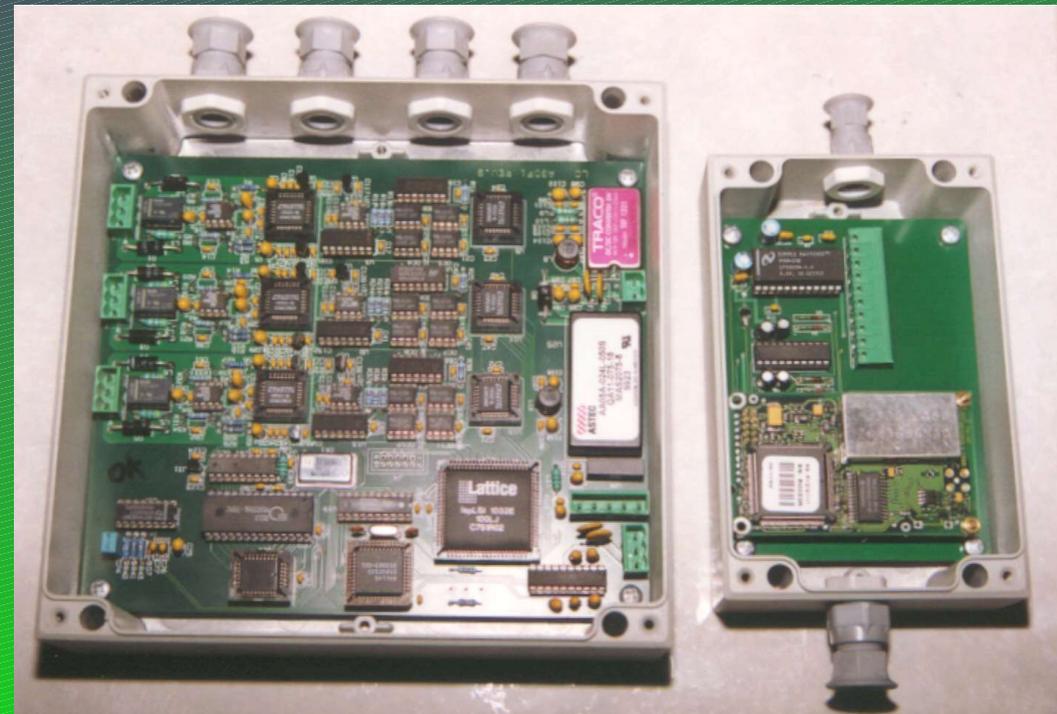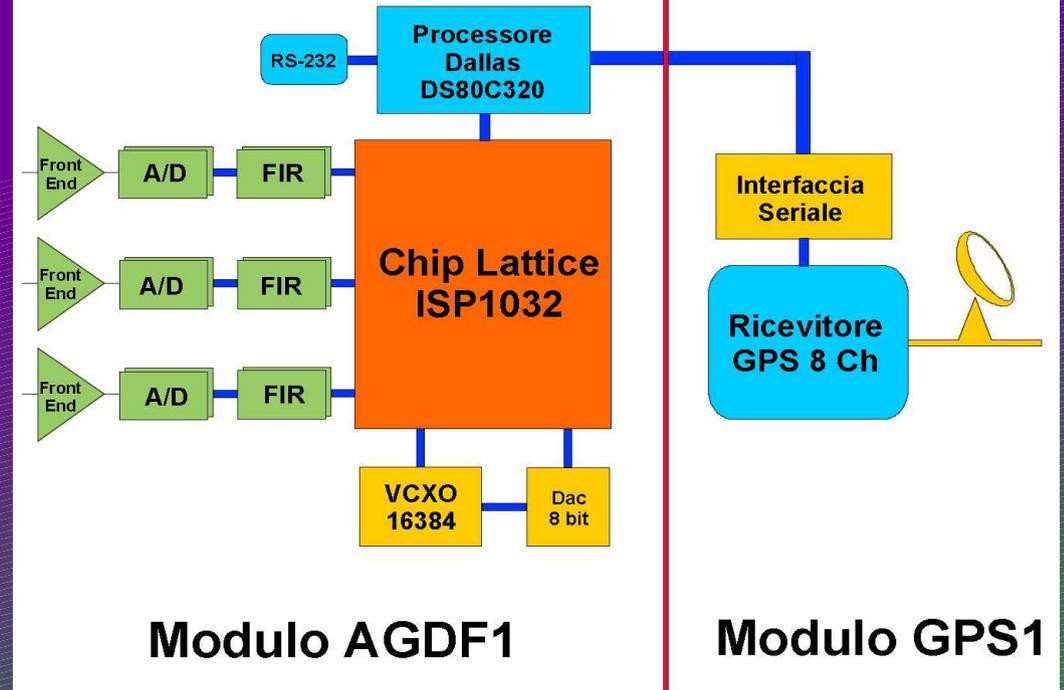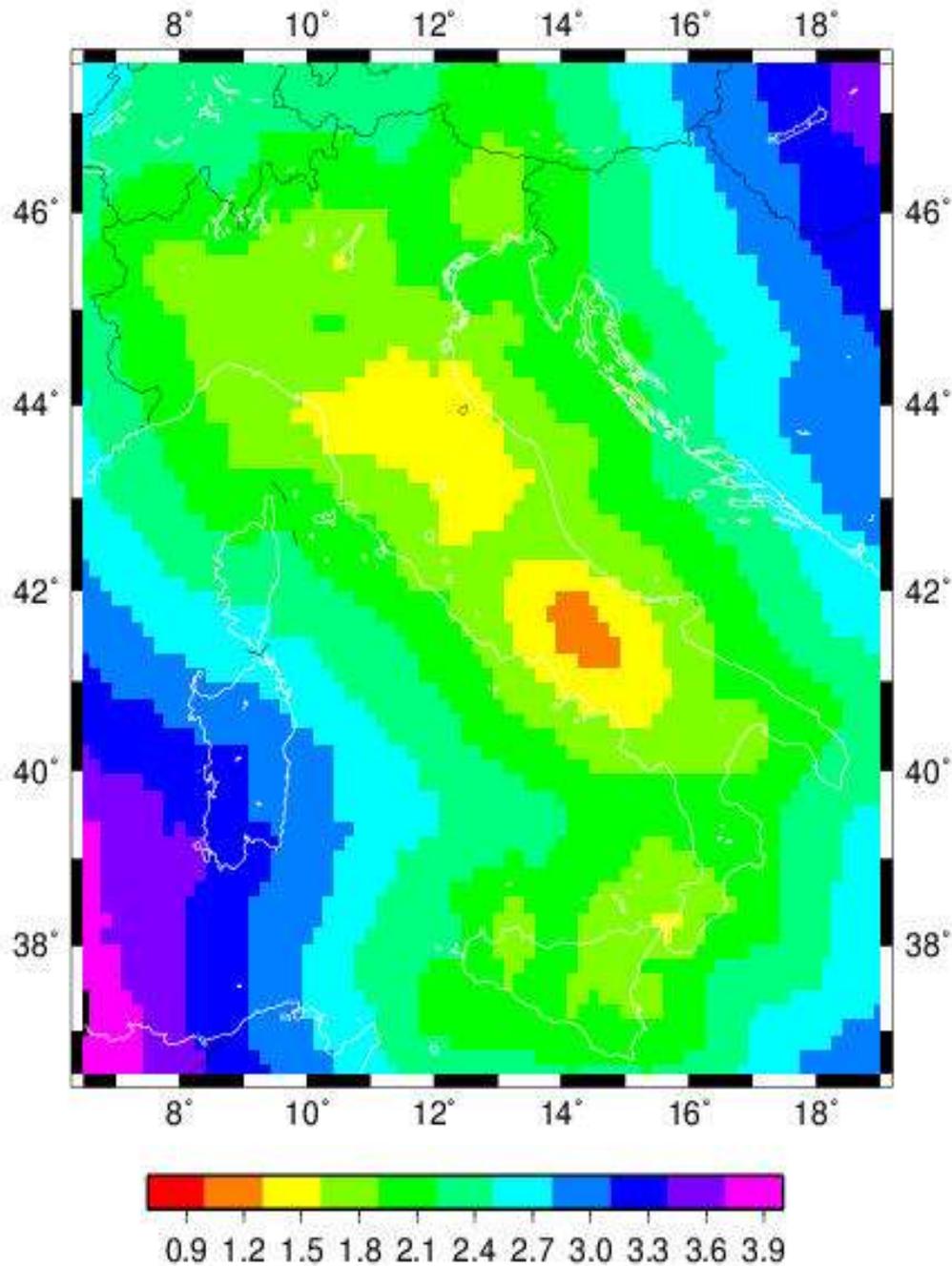
2001:
Detection threshold
Mw> 2.0 in many areas
Higher detection in
Umbria-Marche and
Sannio-Matese
(denser network)

This is done with real geometry, real noise and common assumptions on attenuation and location capability
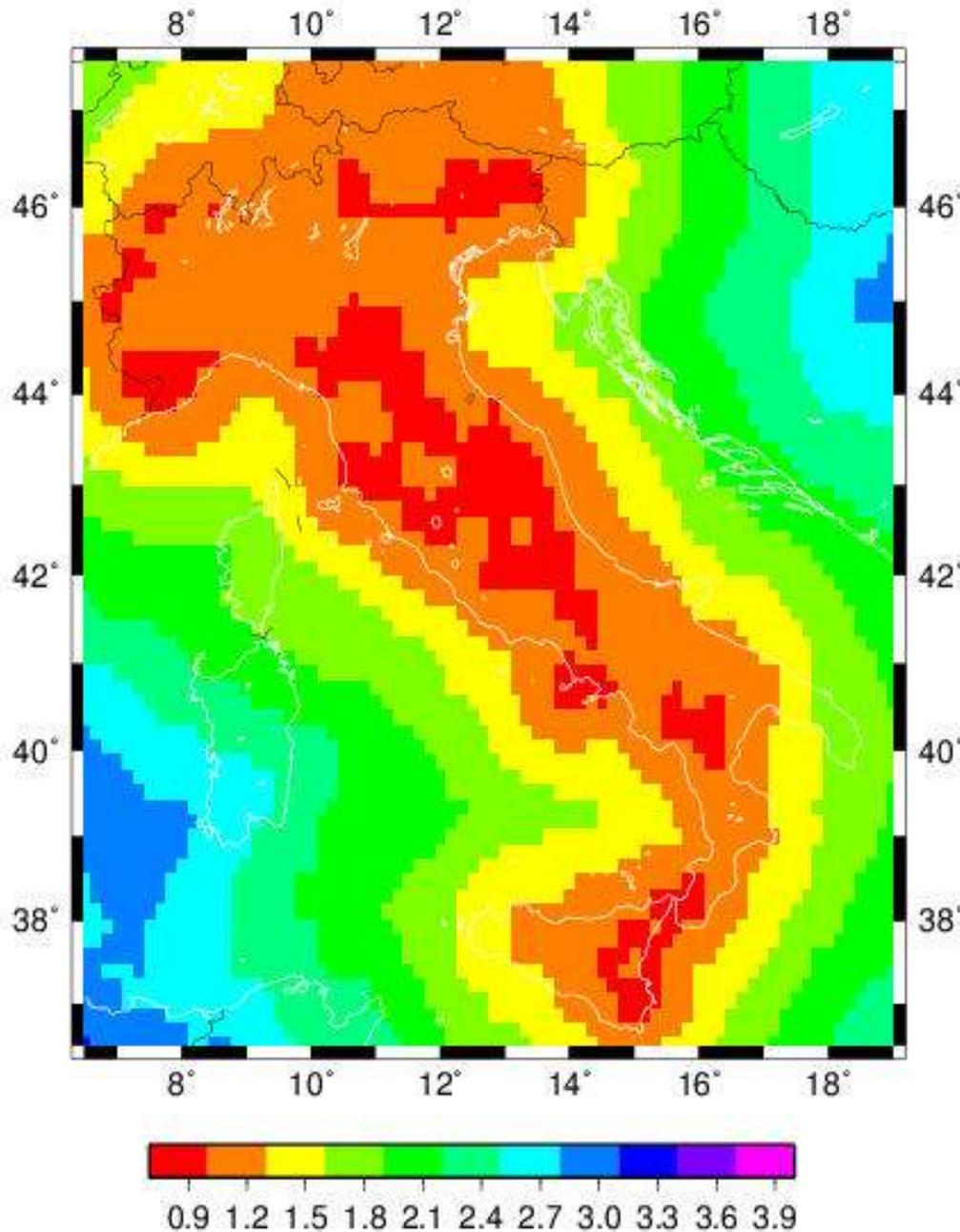
Tomorrow:

mean detection around
1.2 Mw
lower detection in areas
with local networks
(INGV- OV, INGV- CT,
Genova, Udine, ENEL
Greenpower, ENI- Agip..)

This is done with realistic
geometry, real noise and common
assumptions on attenuation and
location capability

This means 10 times more earthquakes …

INGV Centralized Network
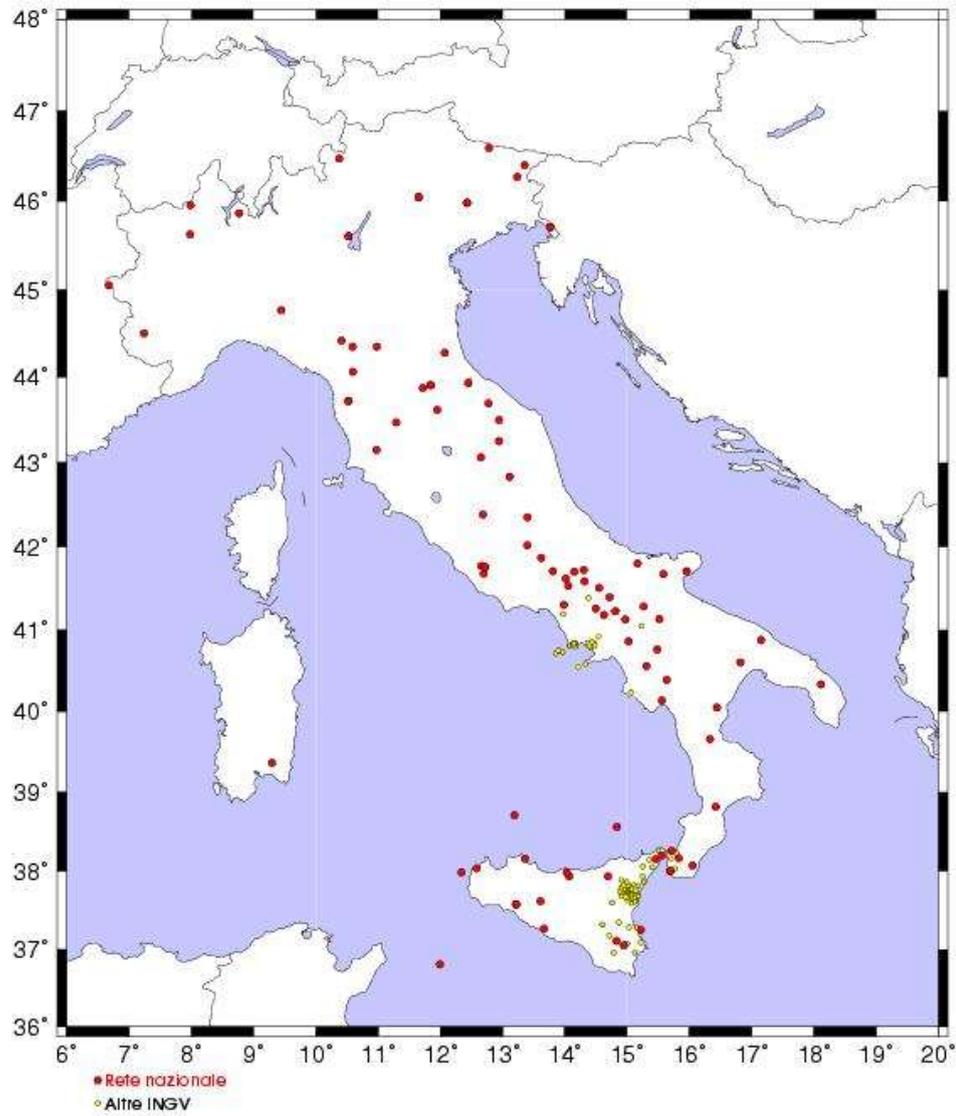
Rete Sismica - situazione a Gennaio 2004

Legend (left map):
- Rete nazionale
- Altre INGV

Legend (right map):
- Stazioni Analogiche
- Stazioni Digitali GAIA
- Stazioni Digitali satellitari
- Stazioni Digitali MedNet
- Stazioni digitali + analogiche
- Siti in preparazione
- Altre reti INGV
- Altre reti collegate

Begin of 2001
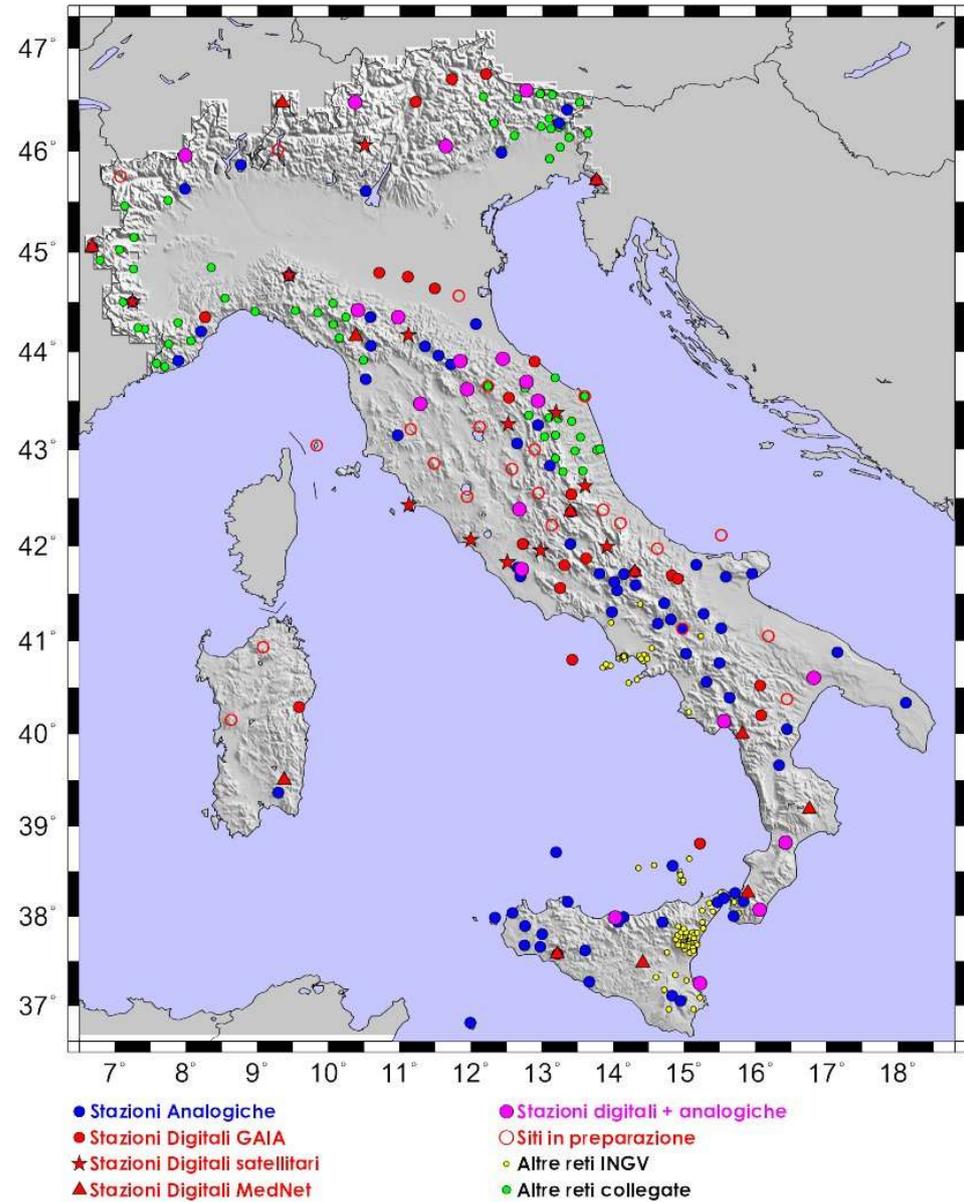
End of 2003

With the new system, we have the first automatic location in 30- 40 seconds….

During the 2002, October 31 shock in Molise, which caused 32 casualties, our first location was available after 40 seconds, although in a region of poor network coverage

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            FIRST  REGIONAL  LOCATION
-----------------------------------------------------------------
  origin time          lat           lon          dep    rms    wrms
  10:32:58.71         41.73         14.91        10.0   2.65   0.52
  +/-   0.34s       +/-3.5km      +/-2.0km      +/-0.0km
      2002/10/31    (41 44.1')    (14 54.6')      fissata
-----------------------------------------------------------------

sta           P-time      S-time    P-res U wght  S-res U wght  del     tt    dur
RGNG   20021031 10:33:09.22          0.17 T 100                 56.6   10.3   0.0
FG5    20021031 10:33:09.68          0.33 T  96                 58.5   10.6   0.0
RNI2   20021031 10:33:10.40          0.33 T  95                 62.9   11.4   0.0
VVLD   20021031 10:33:11.98         -4.98 T   4                107.7   18.3   0.0
FG4    20021031 10:33:13.06         -0.19 T  95                 84.0   14.5   0.0
RFI    20021031 10:33:14.64          0.30 T  91                 90.8   15.6   0.0
CSSN   20021031 10:33:15.28         -0.09 T  94                 97.6   16.7   0.0
SGO    20021031 10:33:16.24         -4.85 T   3                134.8   22.4   0.0
MU9N   20021031 10:33:18.34         -0.24 T  88                118.5   19.9   0.0
PTQR   20021031 10:33:19.84         -0.37 T  77                128.8   21.5   0.0
-----------------------------------------------------------------
    area geografica: SUBAPP.  DAUNO
EV_1032_01 stampato il giorno 31-10-2002 alle ore 11:33 e 38 secondi
```

First automatic location

40 seconds after the shock

RESULTS

- A lower location threshold;

- A drastic reduction in location procedure times: first fully automatic reliable locations are computed within 1 minute from the origin time;

- A faster Local Magnitude estimation (about 5 minutes);

- An event notification to Civil Defence in the same time order (about 1000 events, potentially felt by people, per year);

- A versatile acquisition system, capable of recording and processing many different data formats and protocols, from different networks;

- A robust system, redundant on many a point of view: physical links to the stations, field instrumentation, location systems and procedures;

- Immediate availability of data to further investigations (such as Regional Centroid Moment Tensors).

Target by 2005 of the National Network:

(with the financial support of the National Department of Civile Defence)

A total of <u>140 3-component high dynamics stations</u>

Among them:

- 80 GAIA equipped with wide band sensors (5- or 20-s sensors depending on site) and digital phone lines;
- 30 6-channels satellite stations (Nanometrics) using 30-s sensors and strong motion;
- 30 Broad Band (STS-2 + strong motion) Quanterra or GAIA

30% to 50% of these with <u>continuous GPS receivers</u>

<u>Off-line integration</u> with data from local networks (about 100 more stations, mostly short period)