Accesso Aperto ai risultati della ricerca nell'ambito delle Scienze della Terra: Pratiche correnti , Sfide e Piani futuri

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Open access to research results in the solid Earth Sciences: Current practices, challenges and future plans

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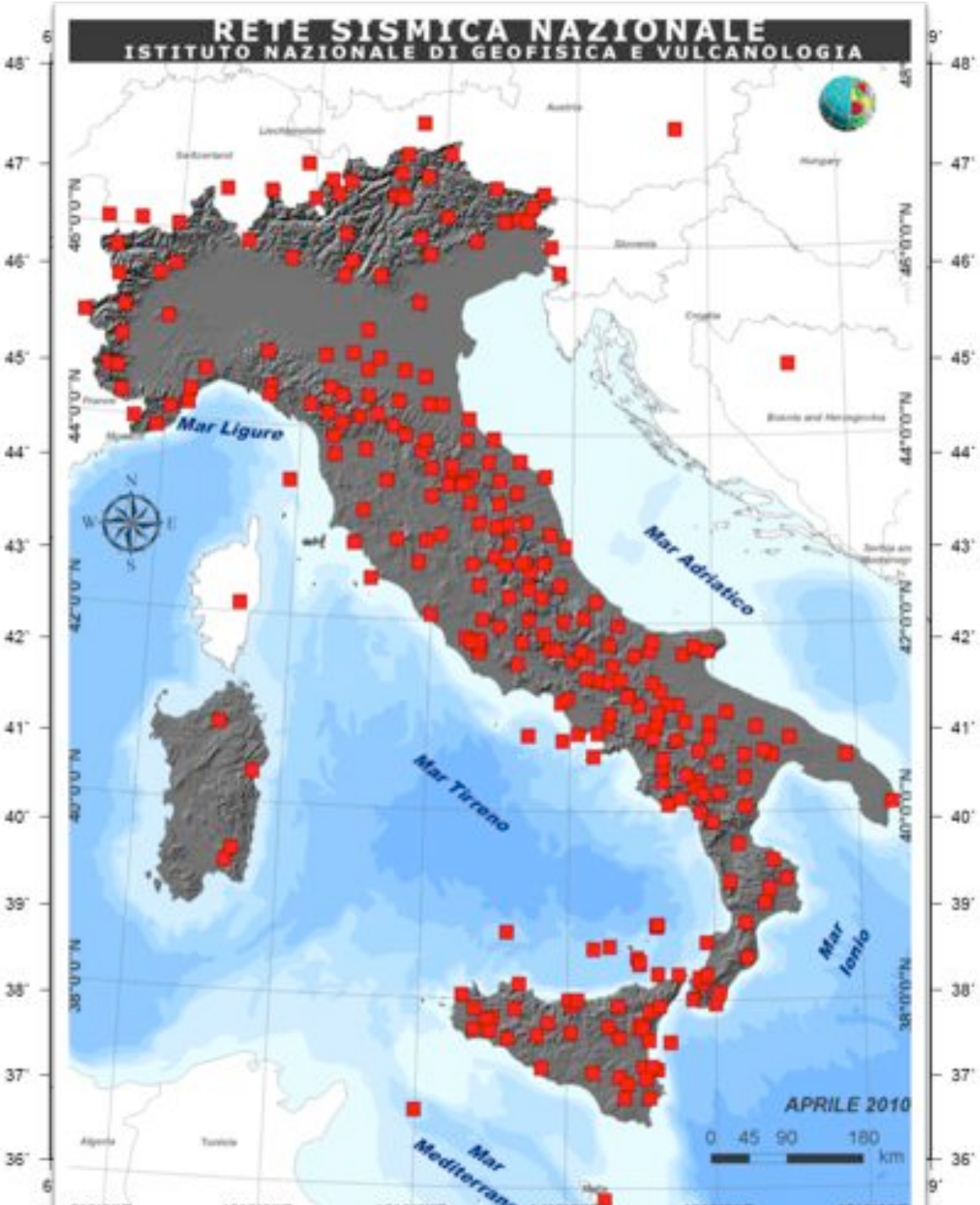
Who am I ?

- Seismologist (geophysicist)
  - Work with earthquakes at local, regional and global scales (e.g., local earthquakes, tsunami alert) where data sharing is routine/praxis
- Involved in EPOS (European Plate Observing System) - the ESFRI approved infrastructure for the solid Earth sciences
- Participating to the EC projects EUDAT and VERCE
- Director of the Centro Nazionale Terremoti

Tasks of the "Centro Nazionale Terremoti"

1. Rapid and efficient seismic monitoring at national level
2. Tsunami watch provider (since Fall 2014)
3. Data:
   - Acquisition
   - Archive (preservation & curation)
   - Accessibility
   - Products



The data from

The National Seismic Network since 1985

Today:

250+ BB stations

147 CGPS

130+ accelerometers

+ other associated networks

INGV - Centro Nazionale Terremoti - UF Analisi Dati per la Sismologia - Situazione stazioni - 296

Ultimo aggiornamento: **2014/04/07 - 17:25:13 UTC**

ABSI (SI)
ACER (IV)
ACOM (NI)
ACOR (NI)
ACST (IV)
AID (IV)
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AMUR (IV)
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ARVD (IV)
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ATSC (IV)
ATTE (IV)
ATVA (IV)
ATVO (IV)
BADI (IV)
BAGS (IV)
BDI (IV)
BERNI (CH)
BHB (GU)
BIOG (IV)
BLLA (IV)

Stazioni - Latenza

<10s (255)	<30s (77)	<1m (6)	<5m (7)	<15m (1)	<1h (1)	<3h (1)	<12h (0)	<1w (4)	<1653w (20)

Stazioni - Legenda contorno

funzionanti nel DB (353).	con problemi nel DB (38).	non ricevute nel SL (32).

Earthquakes in Italy

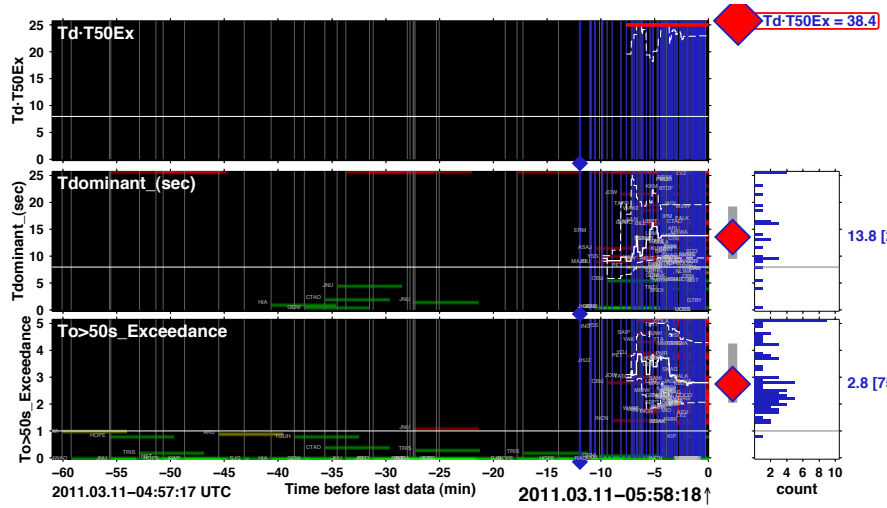
2000-2012

100,000+ events located by The National Seismic Network since 2005

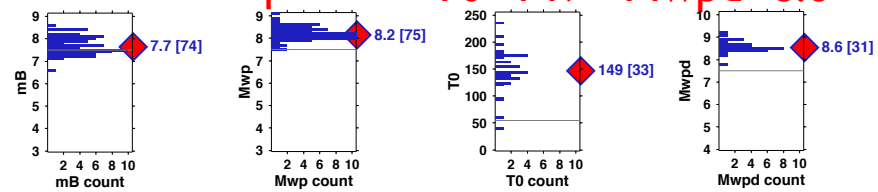
Big improvement in the seismic monitoring system since 2001

From http://iside.rm.ingv.it

Tohoku Earthquake M9.0, 11 March 2011, 05:46:20 GMT (~12' from OT)



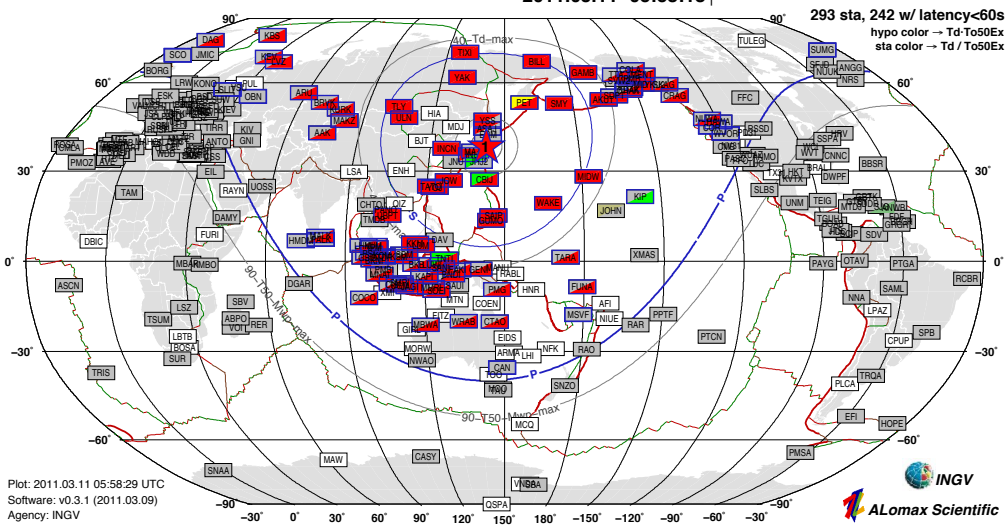
mB=7.7 Mwp=8.2 T0=149 Mwpd=8.6

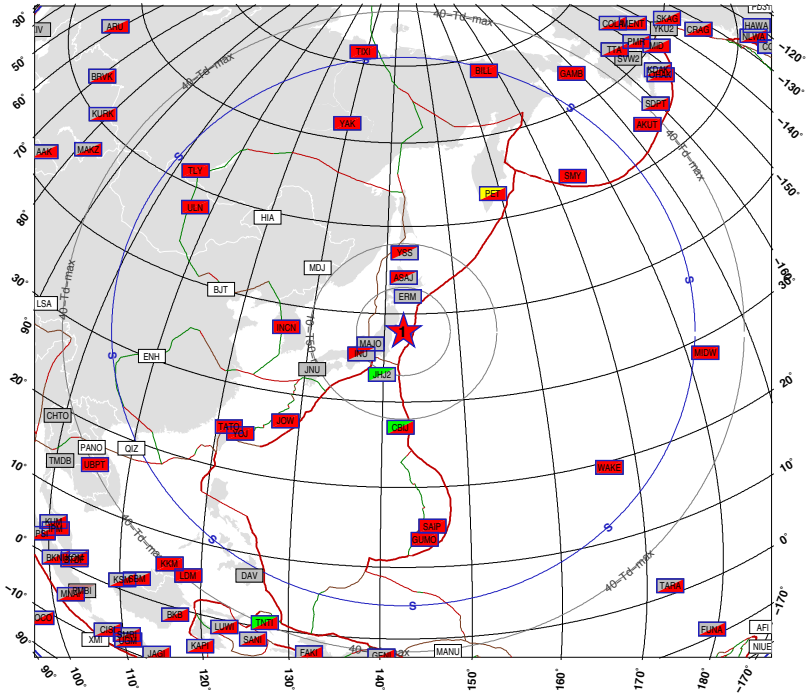


Earthquake Location · Td·T50Ex Level · mB · Mwp · T0 · Mwpd Monitor

Earthquake details (automatic solutions):

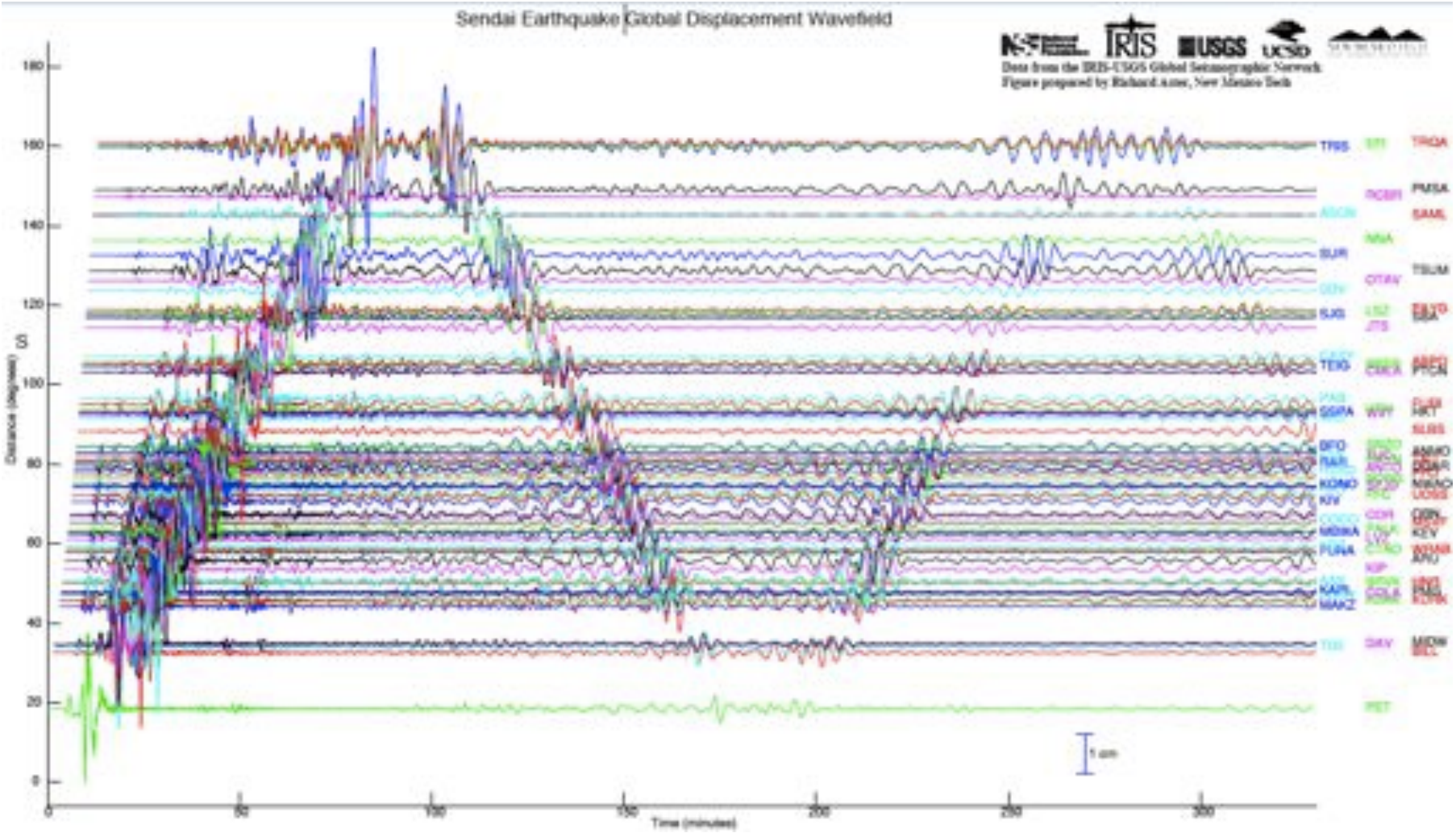
n	pha	Δmin°	σot	origin–time–UTC	lat°	lon°	errZ	depth	errZ	T50Ex [n]	Td [n]	TdT50	WL	mB [n]	Mwp [n]	T0 [n]	Mwpd [n]
1	89	3.8	2.1	2011.03.11–05:46:21	38.0	142.5	25	14	13	2.8 75	13.8 26	38.4		7.7 74	8.2 75	149 33	8.6 31





http://early-est.rm.ingv.it

Tohoku seismological global observations

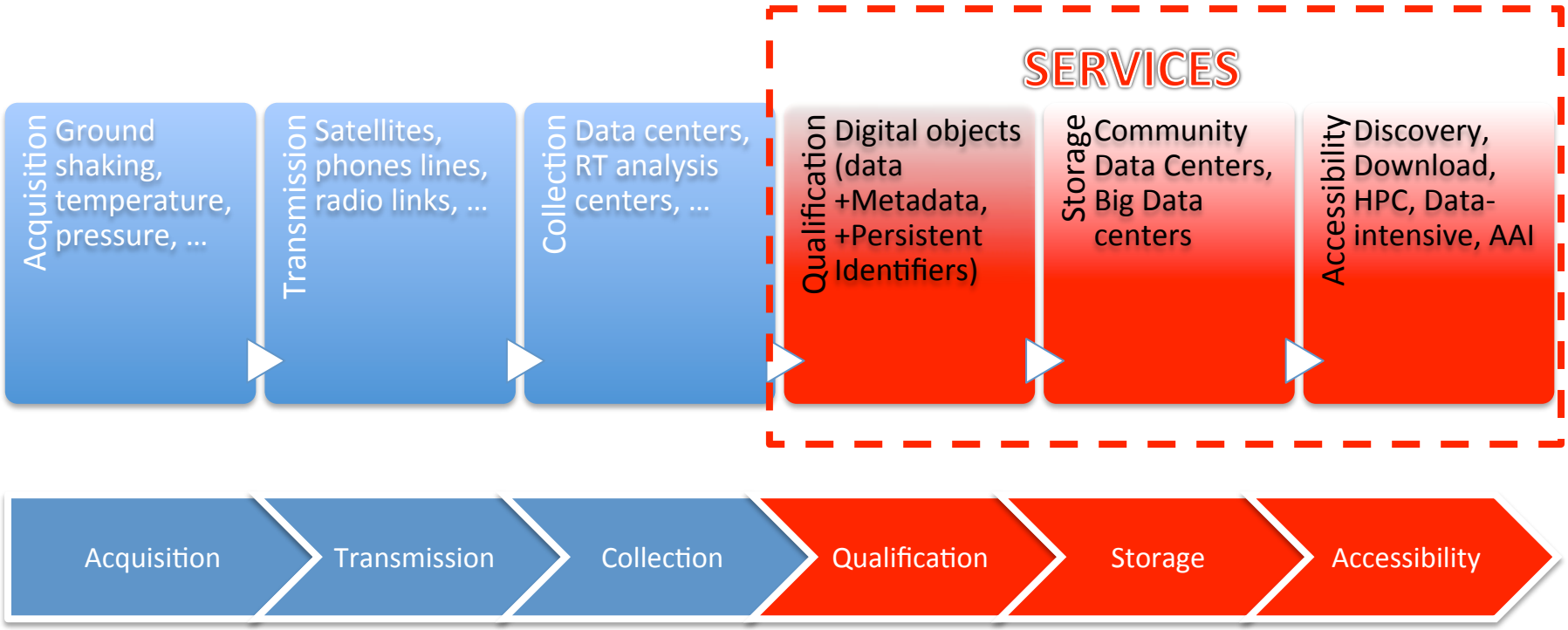


Courtesy of Rick Aster, New Mexico Tech

Key-words for data sharing in seismology

- ✓ Global data ➜ **integration** (from national to global level integration for data and for services)
- ✓ **Open access**
- ✓ Real-time
  - Fundamental for seismic monitoring ➜ **societal impact** ➜ **information** & **dissemination**
- ✓ Data organization accomplished with IT developments primarily WITHIN THE COMMUNITY (many years of investment) ➜ **interoperability**
- ✓ **Progress in science** data promptly available ➜ rapid analysis ➜ improved earthquake knowledge available very shortly
  - Fantastic spin for **education** & **training**
- ✓ Investments in research infrastructures (e.g., data, networks) and in the data centers ➜ **implementation**

Data Timeline



Services

1. Data (Level 0):
   - Access
   - Discovery
   - Quality Control (QC)

2. Products (Level 1):
   - Earthquake Locations
   - Earthquake event phases
3. …
4. …

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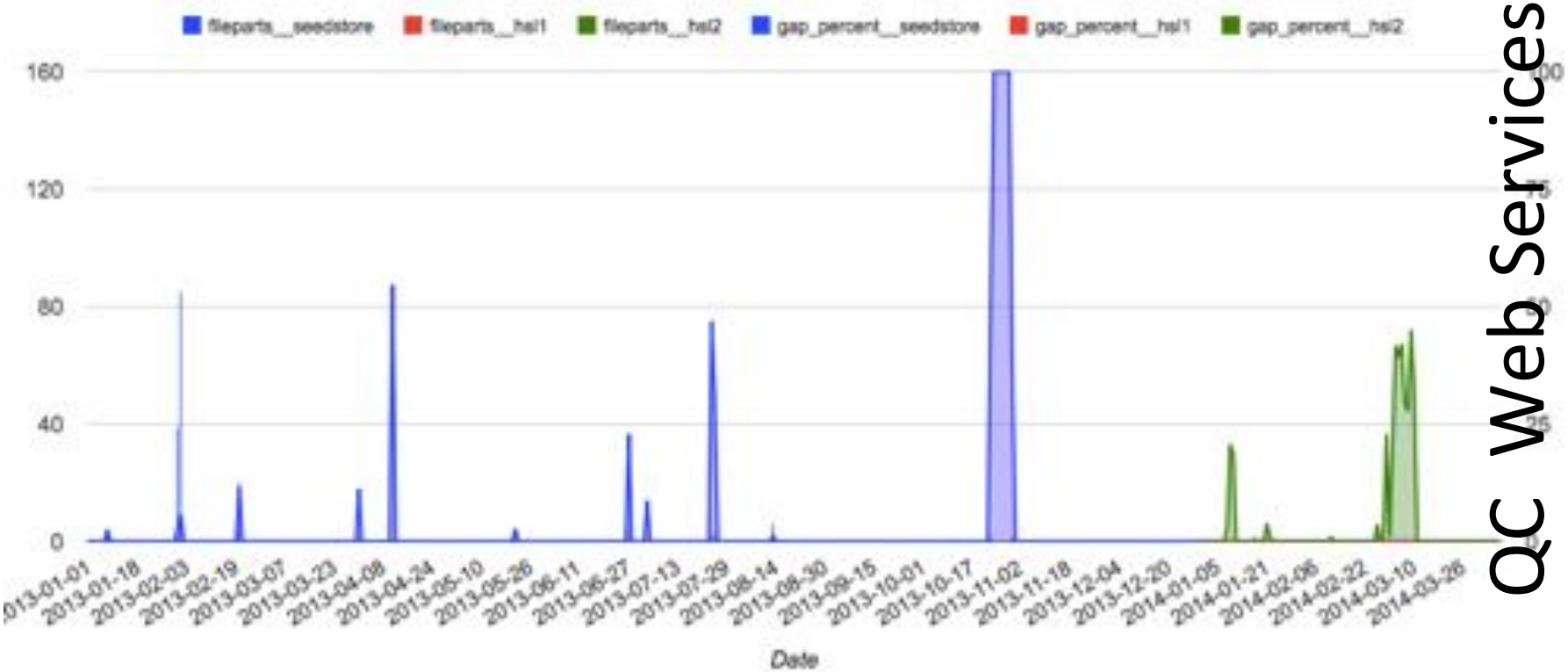
Earthquake Catalog Web Services

INGV – Waveform chart

webservices.rm.ingv.it/ws/mseedstatchart/chart.php?net=MN&sta=BNI&cha=HHZ&starttime=2013-01-01

MN.BNI.HHZ. | 2013-01-01 - 2014-04-07



QC Web Services

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1-02	1	null	null	0.01	null	null
1-03	1	null	null	0	null	null
1-04	1	null	null	0	null	null

ORFEUS – EIDA

www.orfeus-eu.org/eida/eida.html

Orfeus

Observatories and Research Facilities for European Seismology

HOME | DATA | EARTHQUAKES | WORKING GROUPS | SOFTWARE | LINKS | ORGANIZATION

EIDA

- home
- management and structure
- contributing networks
- monitoring
- data access
- data acknowledgements

European Integrated Data Archive (EIDA)

EIDA, an initiative within ORFEUS, is a distributed data centre established to (a) securely archive seismic waveform data and related metadata, gathered by European research infrastructures, and (b) provide transparent access to the archives by the geosciences research communities.

EIDA nodes are data centres which collect and archive data from seismic networks deploying broad-band sensors, short period sensors and accelerometers. Networks contributing data to EIDA are listed in the **ORFEUS EIDA networklist**. All data from the **VEBSN** at ORFEUS Data Center are available through EIDA.

Technically, EIDA is based on an underlying architecture developed by GFZ to provide transparent access to all nodes' data. Data within the distributed archives are accessible via the **ArcLink protocol**.

EIDA data access

World dimension

Data archive federation

EIDA data access

This map shows EIDA stations with unrestricted data access (total number: **3504**). Stations in green are open (operational; **1542**) according to the current metadata, while stations in orange are closed (**1962**). From the total stations **1979** belong to a permanent network (**75**), while **1525** stations belong to a temporary network (**42**). ORFEUS Data Center updates this map daily (last update: **2014/04/07 09:16**).

open station closed station EIDA node

Example of a research use case

***Goal*:**

realistic prediction of ground motion in a particular area based on available data and models

Envisaged Steps:

① Discover *largest earthquakes* in the area

From recent and historical catalogues

② Retrieve *moment tensors* (MT) of the earthquakes in 1.

③ Retrieve *finite fault* (if available) or extrapolate the fault finiteness using the available relationships between magnitude, mechanism and fault width, length and slip.

Envisaged Steps (cont'd):

④ Retrieve macro seismic fields for the earthquakes in 1.

⑤ Retrieve *shakemaps* for the earthquakes in 1. for the different PGMs

⑥ Retrieve *velocity structure*

⑦ Retrieve *geologic map* of the target area

⑧ Visualize model+geologic map+hypocenters using interactive 3D graphics

⑨ Plot the *available waveform data*

⑩ Simulate waveforms (forward modeling) for the earthquakes in 1. and MTs in 2.

11 Calculate misfit between *observed* and *calculated* waveforms

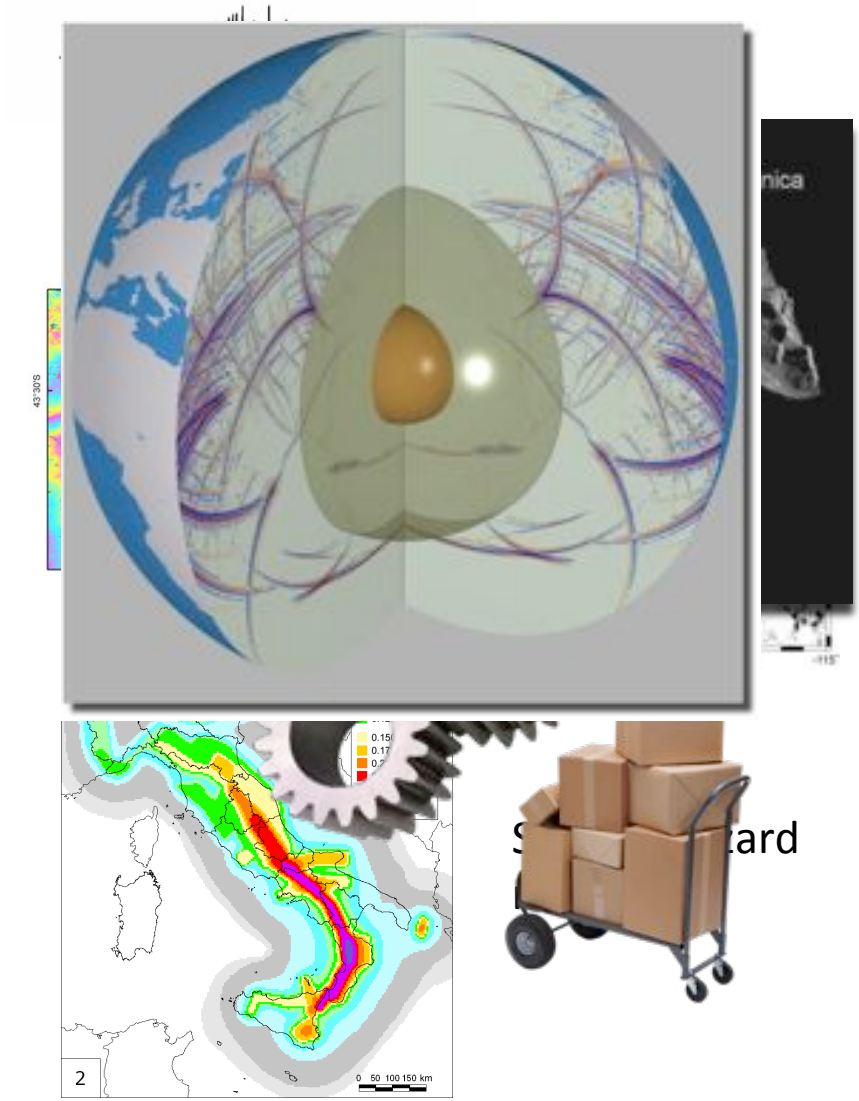
12 Modify *velocity model* and redo steps 9. and 10.

13 If OK match between observed and synthetics, plot the PGMs on a map of the area

14 Compare *calculated* and *observed ground motion*.

Access to Data Products

- **Level 0**: raw data, or basic data
- **Level 1**: data products coming from nearly automated procedures
- **Level 2**: data products resulting by scientists' investigations
- **Level 3**: integrated data products coming from complex analyses or community shared products
- **Level 4**. Software, IT tools



Thank you

Acknowledgments

Massimo Cocco and the EPOS Team.

The EUDAT and VERCE projects.

The INGV data archive and real-time analysis team.

CINECA for helping us to move the first steps in the world of modern data organization and its services from the IT perspective.