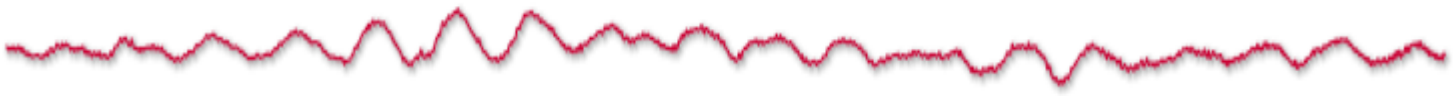
EPOS-S Waveform Services

Reinoud Sleeman
for
TCS Seismology
and
ORFEUS

ORFEUS Annual Workshop & Open EPOS Seismology meeting
25-27 October, Lisbon, Portugal



Context

EPOS TCS Seismology (EPOS-S) builds on existing and new European Infrastructures to provide services for waveform data, earthquake parametric data and hazard data, and integrate these within the EPOS architecture:

ORFEUS (1987)	|	seismological waveform data services (incl. Comp. Seism.)
EMSC (1975)	|	seismological products services
EFEHR (2017/18)	|	services for earthquake hazard and risk

ORFEUS (Observatories and Research Facilities for European Seismology), founded in 1987, is the non-profit foundation that coordinates digital, broadband seismology in the European-Mediterranean area.

ORFEUS coordinates archiving of, and access to, earthquake waveform data from seismic stations in the European Mediterranean region through **EIDA** (European Integrated waveform Data Archive; 2013) in Europe.

EPOS-S Waveform Services

Providing access to:

- **Raw seismic waveforms** and associated quality information provided by the **EIDA** federation (currently 11 nodes; more to come) in ORFEUS
- **Processed accelerometric waveforms** and **strong motion parameters** (derived from waveforms) provided by ORFEUS/ODC (**RRSM**) and INGV (**ESM**)
- **Station Book** (EIDA station information data base) provided by ORFEUS/ODC
- **Waveform modeling** Portal (U. Liverpool)

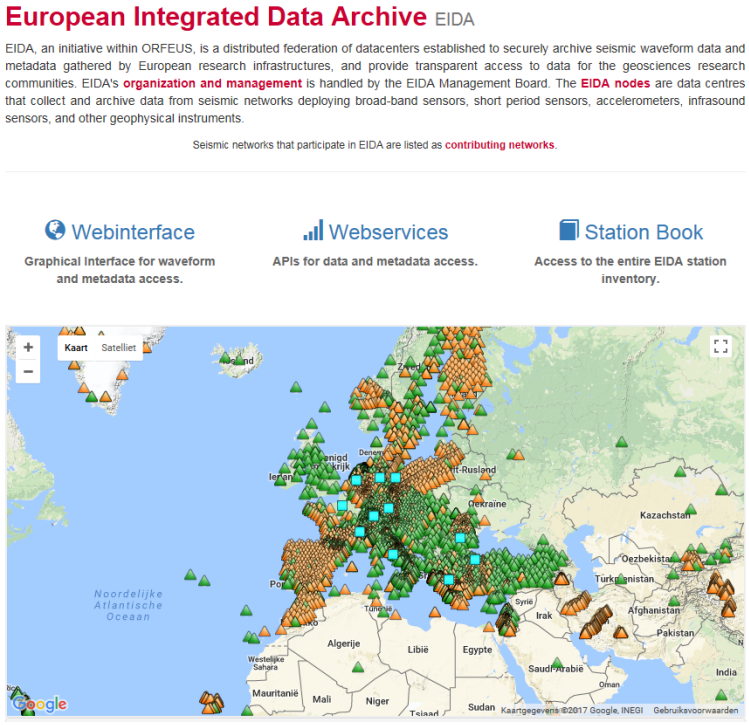
EIDA - The European Integrated Data Archive

EIDA is the European Integrated Data Archive infrastructure within ORFEUS to provide access to seismic waveforms in European archives.

Currently 11 archives are distributing their own data (self operated networks) as well as data on behalf of other network operators in standard formats.

EIDA data holdings:

- **8000 stations**
- **99 permanent networks**
- **97 temporary deployments**
- **400 TB federated in 11 nodes**



EIDA - The European Integrated Data Archive

EIDA Management Board (EMB) and Technical Commision (ETC)

EIDA Management Board

Board Members

- Helle Pedersen, RESIF (Chair)
- John Clinton, ETHZ
- Angelo Strollo, GFZ
- Klaus Stammler, BGR
- Peter Danecek, INGV
- Ali Pinar, KOERI
- Constantin Ionescu, NIEP
- Reinoud Sleeman, ODC - KNMI
- Christos Evangelidis, NOA

EIDA Technical Commission

Commission Members

- Javier Quinteros, GFZ (Chair)
- Luca Trani, Mathijs Koymans, ODC - KNMI
- Andres Heinloo, Peter Evans, GFZ
- Matthias Hoffmann, Erich Odon Muhire, BGR
- Daniel Armbruster, Stefan Heimers, Philippe Kaestli, Carlo Cauzzi, ETHZ
- Valentino Lauciani, Andrea Bono, Massimo Fares, INGV
- Costanza Pardo, IPGP
- Mustafa Comoglu, KOERI
- Cristian Neagoe, Lucian Palangeanu, NIEP
- Gregory Arneodo, RESIF
- Nikos Triantafyllis, Kostas Boukouras, NOA

How to become an EIDA node: www.orfeus-eu.org/data/eida/guidelines/

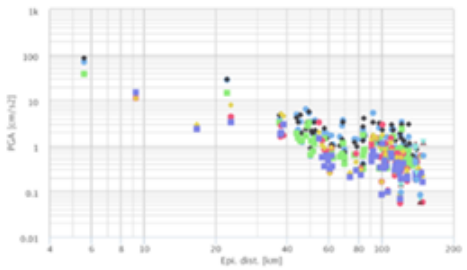
ORFEUS EIDA waveform services

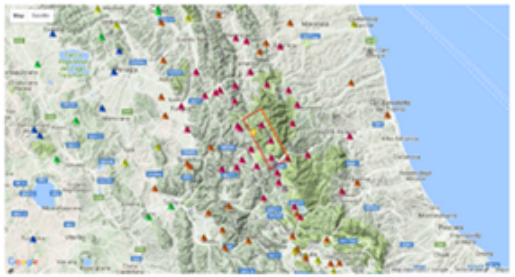
EIDA Node	FDSNWS-Dataselect	FDSNWS-Station	EIDAWS-Routing	EIDAWS-WFCatalog
ODC	Online 1.1.0	Online 1.1.0	Online 1.1.0	Online 1.0.0
GFZ	Online 1.1.1	Online 1.1.1	Online 1.1.1	Online 1.0.0
RESIF	Online 1.1.0	Online 1.1.0	In development	Online 1.0.0
INGV	Online 1.1.0	Online 1.1.34.9	Timed Out	Online 1.0.0
ETHZ	Online 1.1.0	Online 1.1.0	Online 1.0.3	Online 1.0.0
BGR	Online 1.1.0	Online 1.1.0	Online 1.1.0	Online 1.0.0
NIEP	Online 1.1.0	Online 1.1.0	In development	Online 1.0.0
KOERI	Online 1.1.0	Online 1.1.0	Online 1.0.2	Offline
IPGP	Online 1.1.0	Online 1.1.0	Online 1.0.3	In development
LMU	Online 1.1.0	Online 1.1.0	Online 1.0.3	Online 1.0.0
NOA	Online 1.1.0	Online 1.1.0	Online 1.1.0	Online 1.0.0

Webinterface
Graphical Interface for waveform and metadata access.

Webservices
APIs for data and metadata access.

Station Book
Access to the entire EIDA station inventory.





Rapid Raw Strong Motion RRSM

Engineering Strong Motion ESM

Schematic overview of (raw) waveform and metadata services currently up and running.

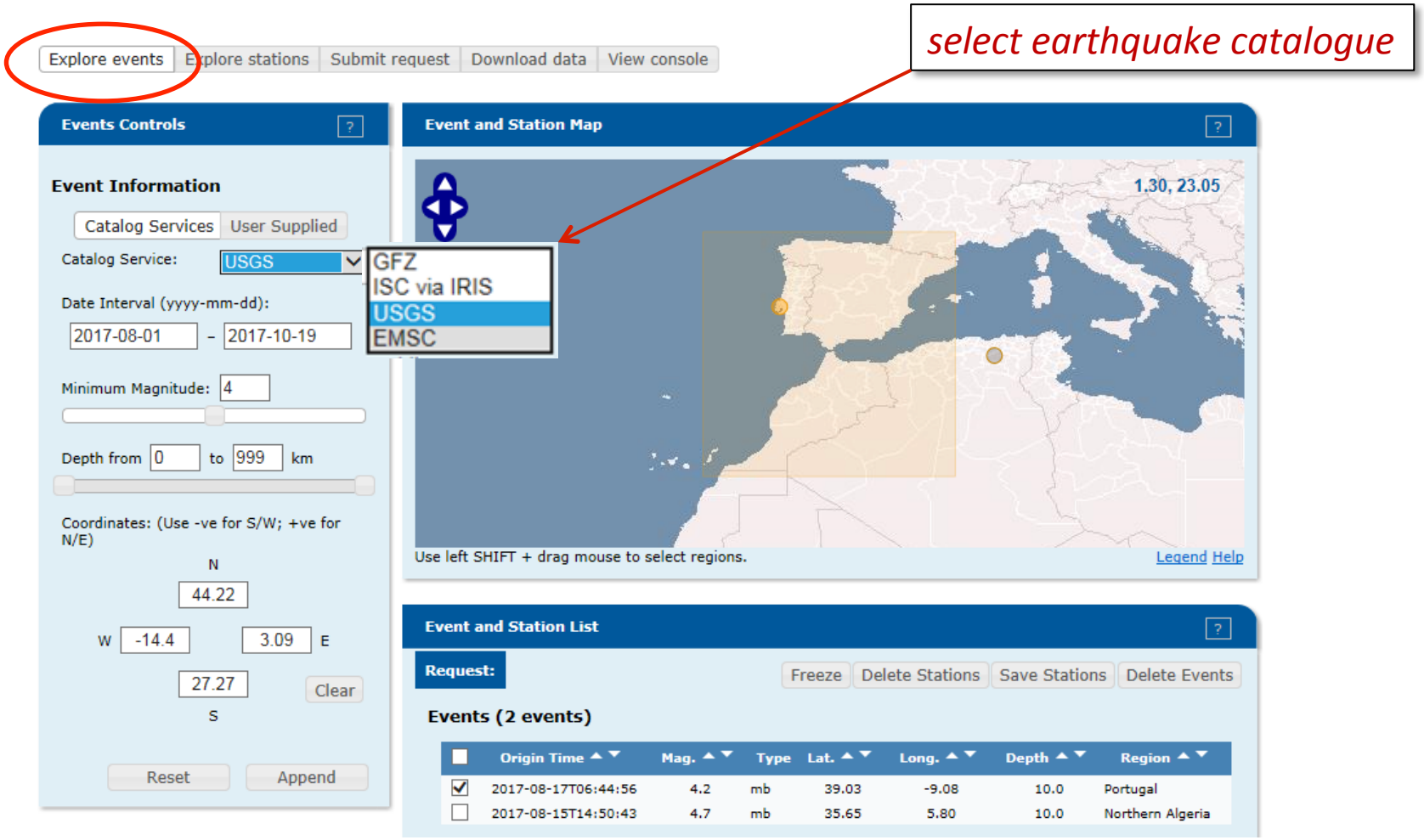
- EIDA interactive portal
- web services
- Station Book

- EIDA stations map

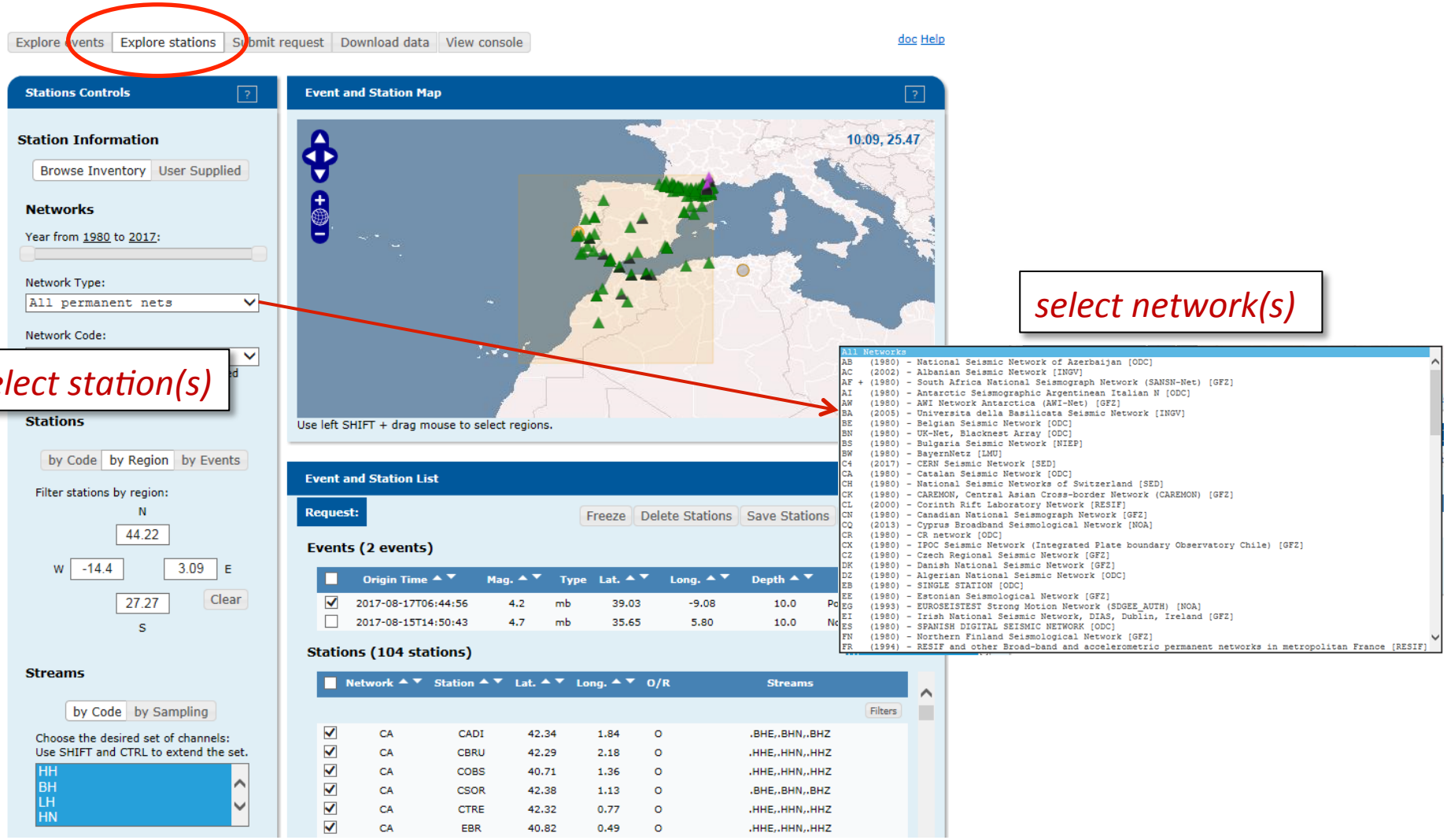
Derived products and services via:

- RRSM
- ESM

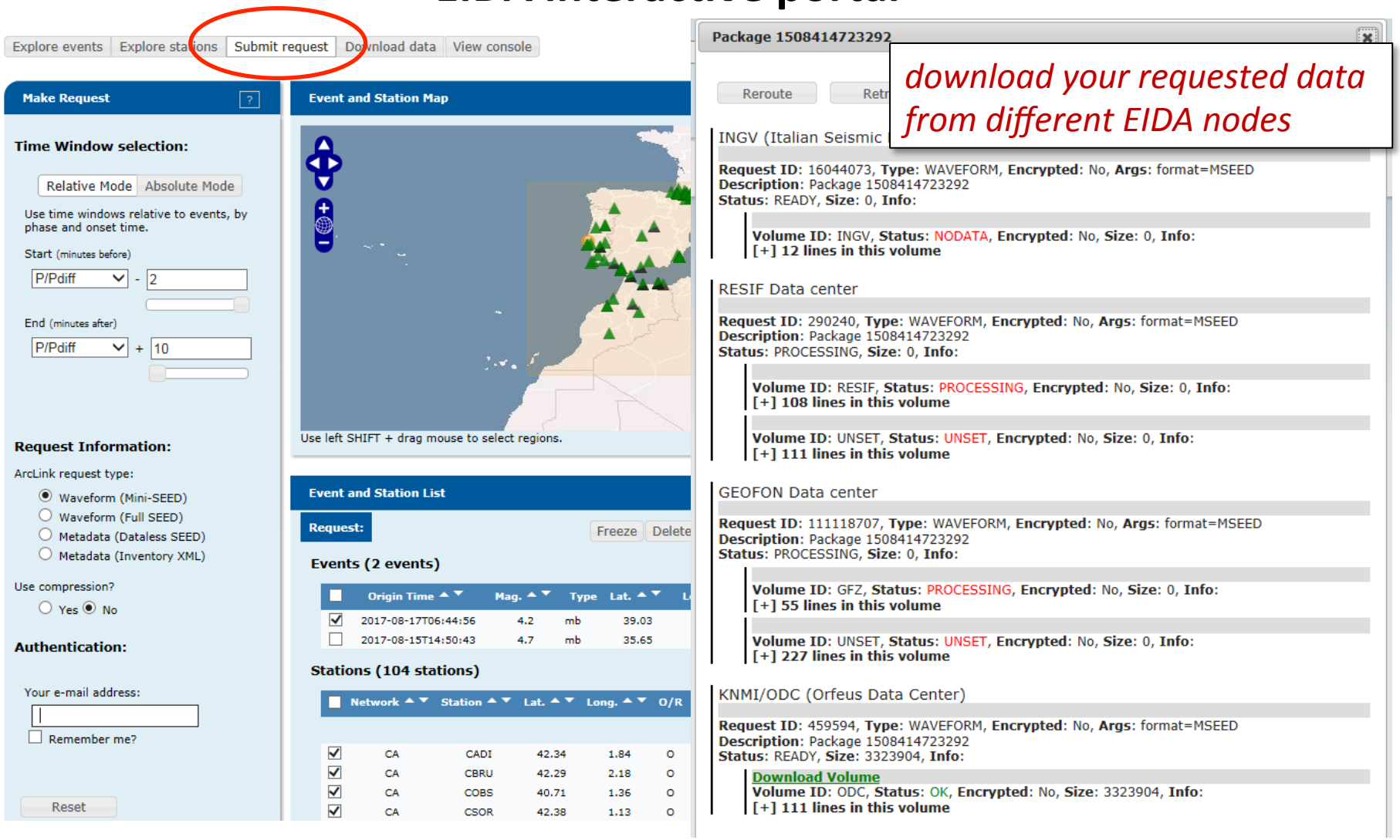
EIDA interactive portal



EIDA interactive portal



EIDA interactive portal



EIDA webservices

fdsnws-dataselect | FDSN standardized webservice for mini-SEED waveform data.
fdsnws-station | FDSN standardized webservice for station metadata.
eidaws-routing | EIDA standardized webservice for routing between EIDA services.
eidaws-wfcatalog | EIDA standardized webservice for waveform metadata.

EIDA Node	FDSNWS-Dataselect	FDSNWS-Station	EIDAWS-Routing	EIDAWS-WFCatalog
ODC	Online 1.1.0	Online 1.1.0	Online 1.1.1	Online 1.0.0
GFZ	Online 1.1.1	Online 1.1.1	Online 1.1.1	Online 1.0.0
RESIF	Online 1.1.0	Online 1.1.0	In development	Online 1.0.0
INGV	Online 1.1.0	Online 1.1.34.9	Online 1.0.4	Online 1.0.0
ETHZ	Online 1.1.0	Online 1.1.0	Online 1.0.3	Online 1.0.0
BGR	Online 1.1.0	Online 1.1.0	Online 1.1.0	Online 1.0.0
NIEP	Online 1.1.0	Online 1.1.0	In development	Online 1.0.0
KOERI	Online 1.1.0	Online 1.1.0	Online 1.0.2	Offline
IPGP	Online 1.1.0	Online 1.1.0	Online 1.0.3	In development
LMU	Online 1.1.0	Online 1.1.0	Online 1.0.3	Online 1.0.0
NOA	Online 1.1.0	Online 1.1.0	Online 1.1.1	Online 1.0.0

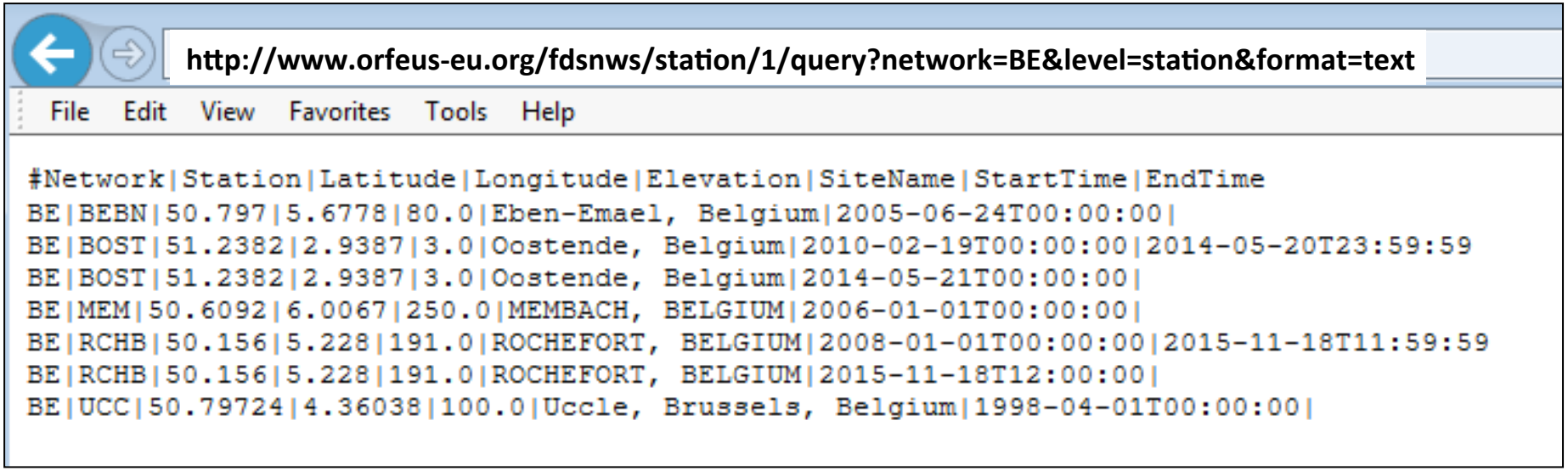
EIDA webservices: example fdsnws-station

http://www.orfeus-eu.org/fdsnws/station/1/query?network=BE&station=MEM&level=station

File Edit View Favorites Tools Help

```
<?xml version="1.0" encoding="UTF-8"?>
- <FDSNStationXML schemaVersion="1.0" xmlns="http://www.fdsn.org/xml/station/1">
    <Source>SeisComP3</Source>
    <Sender>ODC</Sender>
    <Created>2017-10-20T11:10:47</Created>
  - <Network restrictedStatus="open" startDate="1980-01-01T00:00:00" code="BE">
      <Description>Belgian Seismic Network</Description>
    - <Station restrictedStatus="open" startDate="2006-01-01T00:00:00" code="MEM">
        <Latitude>50.6092</Latitude>
        <Longitude>6.0067</Longitude>
        <Elevation>250</Elevation>
      - <Site>
          <Name>MEMBACH, BELGIUM</Name>
          <Country>BELGIUM</Country>
        </Site>
        <CreationDate>2006-01-01T00:00:00</CreationDate>
      </Station>
    </Network>
</FDSNStationXML>
```

EIDA webservices: example fdsnws-station



EIDA webservices: example fdsnws-routing

http://eida.gein.noa.gr/eidaws/routing/1/query?network=PM&service=-wfcatalog

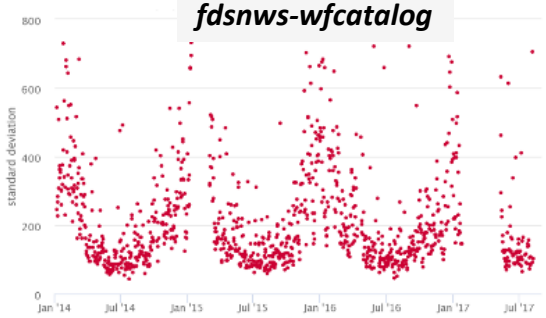
File Edit View Favorites Tools Help

```
<?xml version="1.0"?>
<service>
  <datacenter>
    <url>http://geofon.gfz-potsdam.de/eidaws/wfcatalog/alpha/query</url>
    <params>
      <loc>*</loc>
      <end/>
      <sta>*</sta>
      <cha>*</cha>
      <priority>1</priority>
      <start>1980-01-01 00:00:00</start>
      <net>PM</net>
    </params>
    <name>wfcatalog</name>
  </datacenter>
</service>
```

EIDA webservices – example clients

http://www.orfeus-eu.org/data/odc/quality

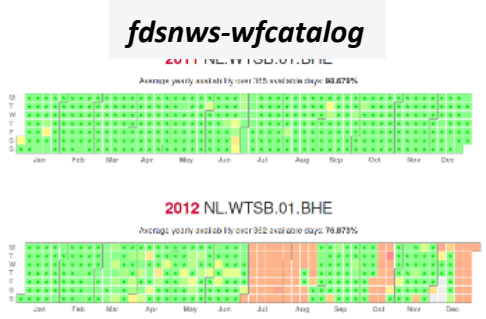
fdsnws-wfcatalog



Data Metrics

Graphical interface showing daily waveform metrics.

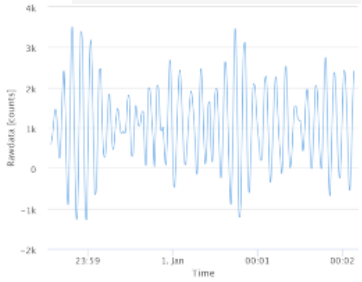
fdsnws-wfcatalog



Data Availability

Graphical interface showing daily data availability.

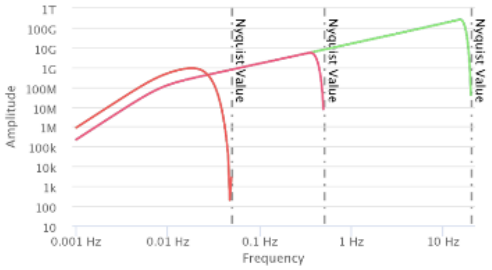
fdsnws-dataselect



Waveform Viewer

Graphical interface showing for viewing waveform data.

fdsnws-station



Instrument Response

Interface showing instrument response characteristics.

EIDA webservices – example clients

fdsnws_fetch - distributed data request tool

- Uses FDSN web services and EIDA routing service
- Supports tokens released by EIDA Authentication Service.
- Client included in ObsPy (next release).
- Provides citation support for each data request (FDSN DOI).

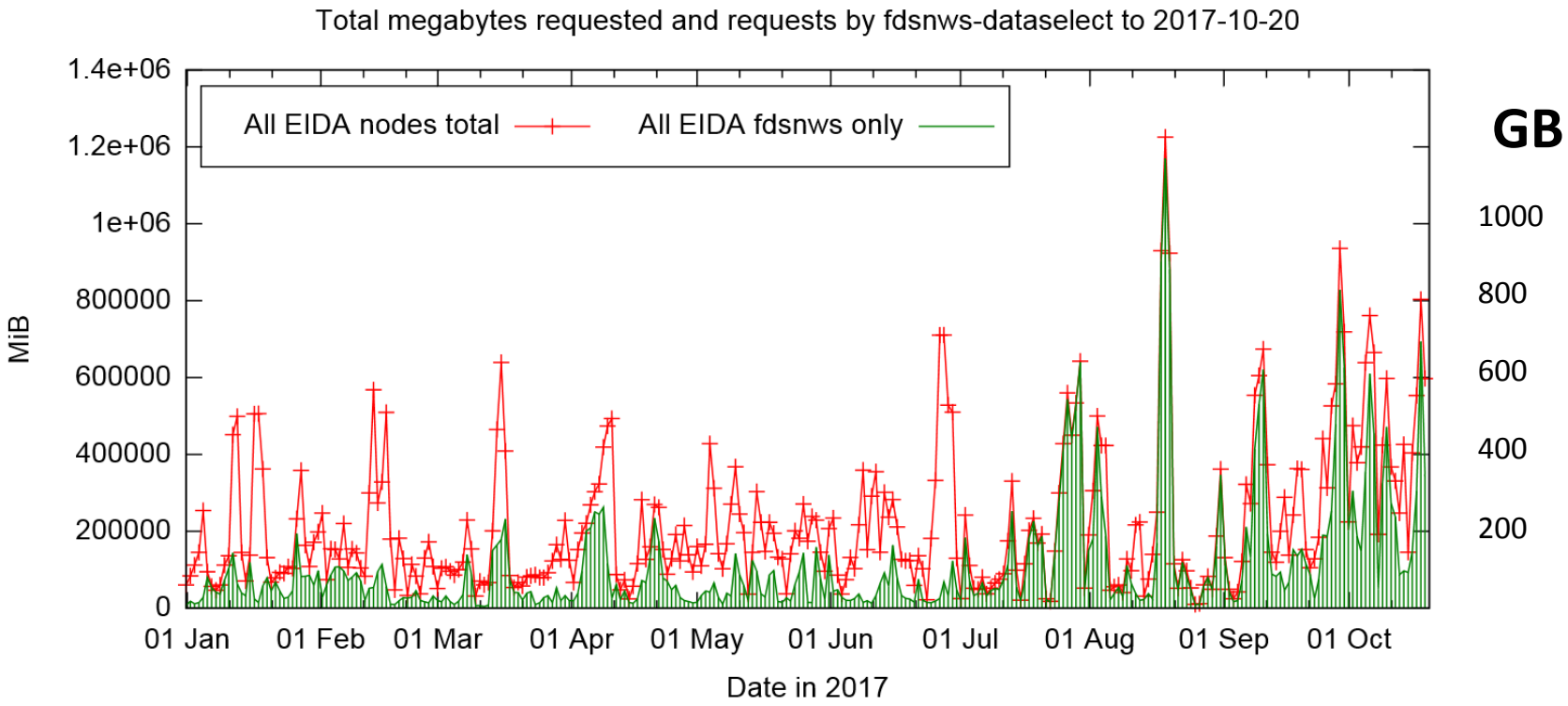
EIDA webservices in development

eida federator | webservice to provide catalog of data and services at one EIDA node

eida mediator | webservice for advanced selection of data across EIDA based on user criteria

authentication service | webservice for managing user attributes (e.g. authentication)

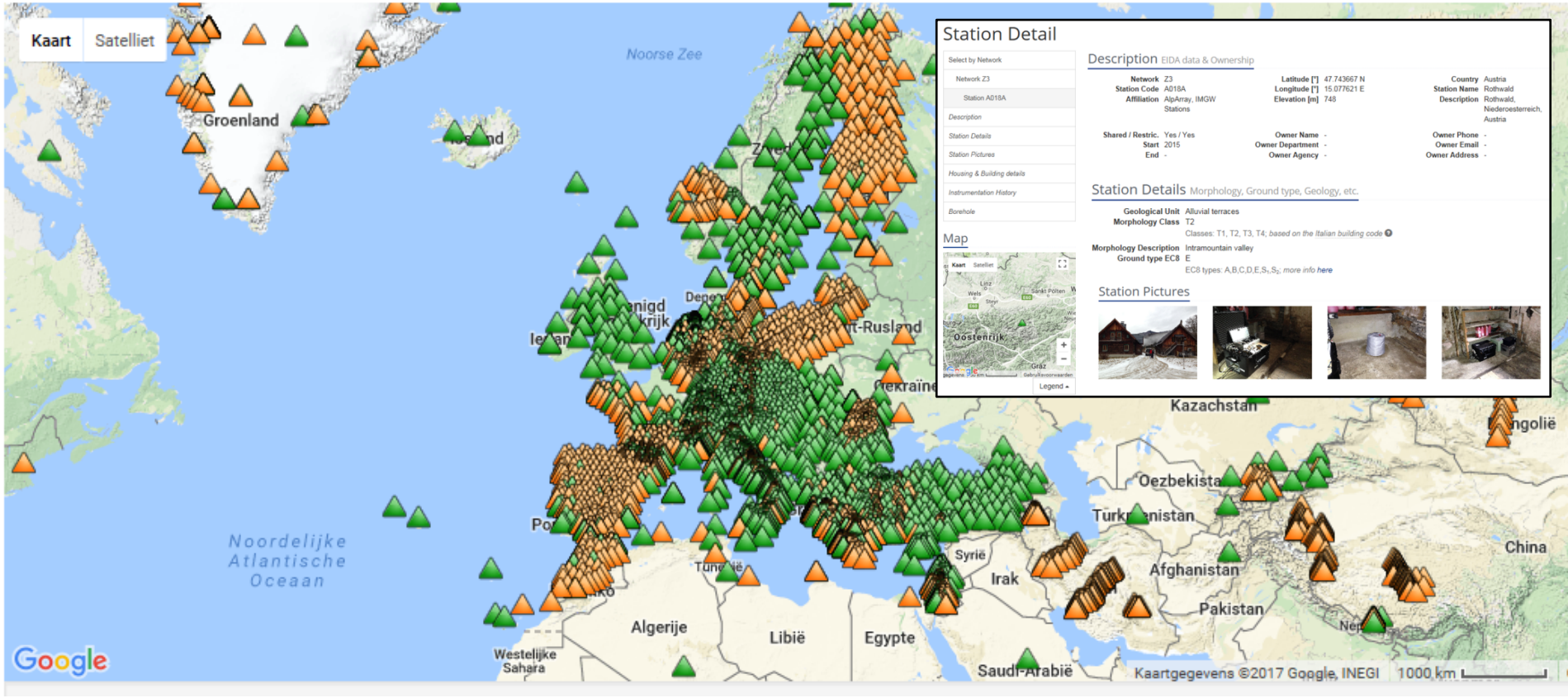
EIDA dissemination tool



European Station Book

All stations by time frame

www.orfeus-eu.org/stationbook



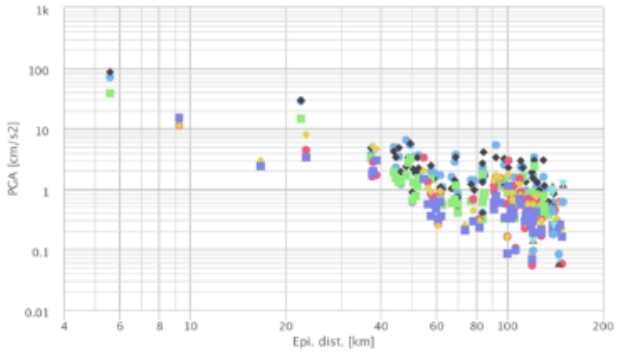
Common network and station metadata: collected automatically from EIDA.
Station and site characteristics: added/edited by network operators.

Strong Motion Data Portals

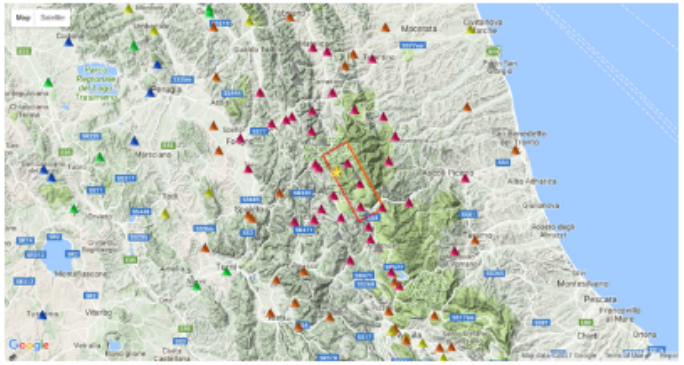
The Rapid Raw Strong Motion (RRSM) is an entirely automated system that uses open data from **EIDA**. It provides earthquake information and strong motion parameters including PGA and PGV within minutes of any event.

The Engineering Strong-Motion database (ESM) is a reviewed archive of accelerometric waveforms from events with magnitudes above 4.0 recorded in Europe and the middle-East since 1969. It provides unprocessed acceleration time-series, manually processed acceleration, velocity, and displacement waveforms, acceleration and displacement response spectra, and other relevant engineering parameters.

www.orfeus-eu.org/rrsm



www.orfeus-eu.org/esm



Rapid Raw Strong Motion RRSM

The RRSM portal exposes earthquake information, peak ground motion parameters, and response spectral amplitudes. Waveform data can be downloaded within minutes after an event exceeding magnitude 3.5 in the European-Mediterranean region.

Introducing the European Rapid Raw Strong-Motion Database. C. Cauzzi et. al., 2016, Seismol. Res. Lett. 87, 4, doi: 10.1785/0220150271

Engineering Strong Motion ESM

ESM allows users to query earthquake and station information and download earthquake waveforms and response spectra for events with magnitudes above 4.0 recorded in the European-Mediterranean and the middle-East regions.

The Engineering Strong-Motion Database: A Platform to Access Pan-European Accelerometric Data. L. Luzi et. al., 2016, Seismol. Res. Lett. 87, 4, doi:: 10.1785/0220150278

RRSM

- Fully automated system (SC3; scwfparam)
- Near real-time
- EIDA waveforms
- EMSC notification (M>3.5); 2005 - present
- Provides waveforms and strong-motion parameters (peak values, spectral ordinates)
- Web interface and webservice

ESM

- Strong motion data (1969 – present) M >= 4
- EIDA waveforms + offline data (e.g. Italian Civil Protection)
- Manual processing (interactive software)
- Provides waveforms and strong-motion parameters (peak values, spectral ordinates)
- Web interface and webservices: ESM parameters, ESM event-dataselect, ESM fdsnws-event, ESM fdsnws-station (e.g. non-EIDA stations)
- Additional products: Parametric flat-file (for Ground Motion Prediction Models).

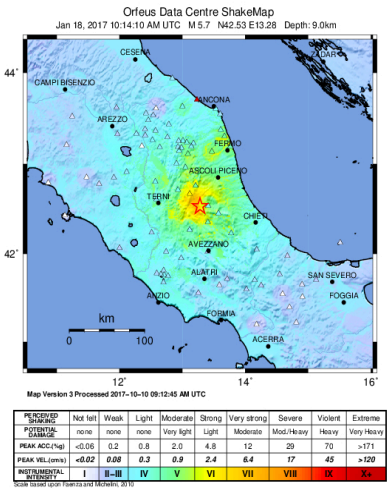
Shakemap webservice (RRSM, ESM): provides output for USGS shakemap software
Event webservice to direct automatically to RRSM or ESM (in dev.)

European shakemaps

RRSM
Automatically processed wfs

ESM
Manually processed wfs

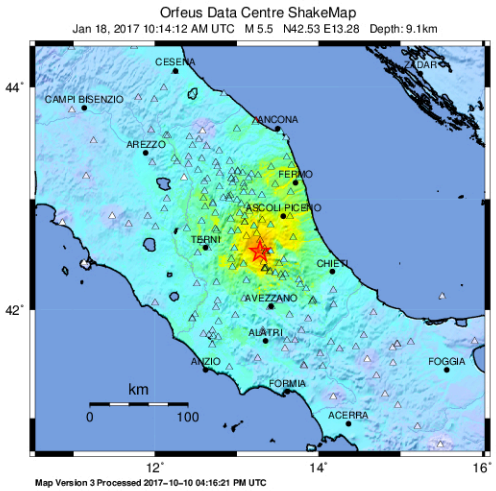
RRSM
Shakemap ws



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.06	0.2	0.8	2.0	4.8	12	29	70	>171
PEAK VEL.(cm/s)	*<0.02*	*0.08*	*0.3*	*0.9*	*2.4*	*6.4*	*17*	*45*	*>120*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Faenza and Michelini, 2010

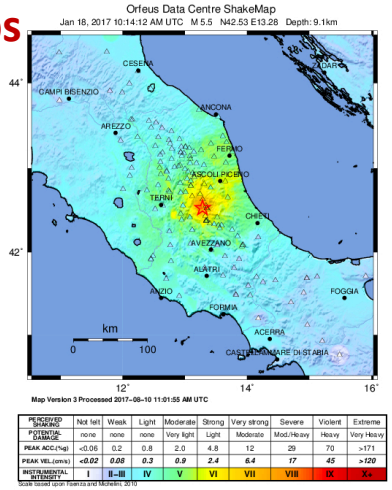
Integrated European Shakemaps



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.06	0.2	0.8	2.0	4.8	12	29	70	>171
PEAK VEL.(cm/s)	*<0.02*	*0.08*	*0.3*	*0.9*	*2.4*	*6.4*	*17*	*45*	*>120*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Faenza and Michelini, 2010

ESM
Shakemap ws



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.06	0.2	0.8	2.0	4.8	12	29	70	>171
PEAK VEL.(cm/s)	*<0.02*	*0.08*	*0.3*	*0.9*	*2.4*	*6.4*	*17*	*45*	*>120*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Faenza and Michelini, 2010

Other:

- Various hands on sessions (26/10)

Hands-on 1	***14:00 – 14:50***					
ISEL C 2.21	ISEL C 3.01	ISEL C 3.16	ISEL C 3.15	ISEL C 2.23	ISEL C 3.07	ISEL F -1.11
EIDA-1	*EMSC Services-1*	*Site Response-1*	*StationBook-1*	*ESM*	*Hazard Portal-1*	*Waveform Modeling*
Hands-on 2	***14:50 – 15:40***					
ISEL C 2.21	ISEL C 3.01	ISEL C 3.16	ISEL C 3.15	ISEL C 2.23	ISEL C 3.07	ISEL F -1.11
RRSM	*Mobile Pool-1*	*Site Response-2*	*StationBook-2*	*EDSF-1*	*AHEAD-1*	*Waveform Modeling*
Coffee break	***15:40 – 16:10***	***ISEL building C***				
Hands-on 3	***16:10 – 17:00***					
ISEL C 2.21	ISEL C 3.01	ISEL C 3.16	ISEL C 3.15	ISEL C 2.23	ISEL C 3.07	ISEL F -1.11
EIDA -2	*EMSC Services-2*	*Mobile Pool-2*	*AHEAD-2*	*EDSF-2*	*Hazard Portal-2*	*Waveform Modeling*

- EPOS-S technical workshop for OBS: coordination for OBS and integration of OBS seismological waveforms in EIDA; *6-7 Nov, IPGP, Paris*