

# The European Integrated Data Archive and other ORFEUS data, services and products

Angelo Strollo, Javier Quinteros, the EIDA Management Board  
and the **ORFEUS** community

### **ORFEUS** Observatories & Research Facilities for European Seismology

ORFEUS is the non-profit foundation to coordinate and promote digital, broadband seismology in the European-Mediterranean area.

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

#### **01-09-2016** ORFEUS Annual Workshop 2016 - Reminder for Registration

The 2016 ORFEUS Annual Observatory Coordination meeting is organized together with an **EPOS** sponsored workshop on OBS (Ocean Bottom Seismometers) and Mobile Seismic Pools (MSP), to coordinate efficient integration of data from these communities within the European Integrated Data Archive (**EIDA**). The 2016 ORFEUS Annual Observatory Coordination meeting has a focus on seismology in the Balkans and the **AlpArray** seismic network.

**Registration** to these workshops is open **until 15 September**. Please consult the **information pages** for more details.

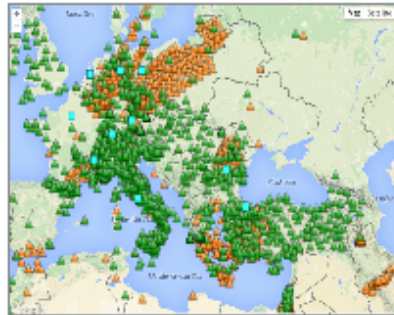


<http://www.orfeus-eu.org/>

## Observatories and Research Facilities for European Seismology

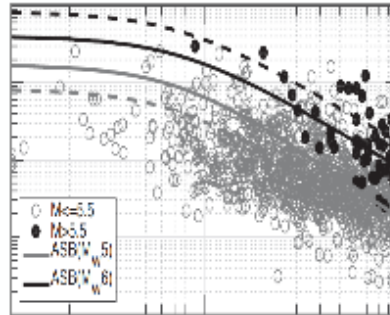
### Data Access, Services and Products

**EIDA**



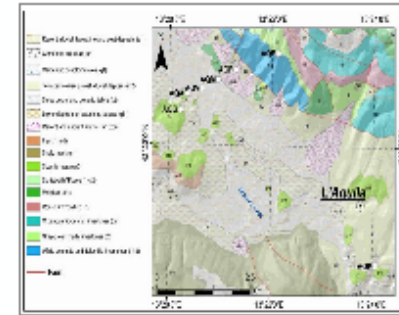
*Interactive access to data from EIDA*

**RRSM**



*Interactive access to rapid, raw strong motion data*

**ESM**



*Interactive access to reviewed strong motion data*

**Web services**

Service Name	URL	Access	Status
Interactive Access to Data	http://www.eida.europa.eu	Available	Operational
Interactive Access to Raw Data	http://www.eida.europa.eu/rrsm	Available	Operational
Interactive Access to Reviewed Data	http://www.eida.europa.eu/esm	Available	Operational
Interactive Access to Station Data	http://www.eida.europa.eu/stationbook	Available	Operational
Interactive Access to Station Status	http://www.eida.europa.eu/status	Available	Operational
Interactive Access to Station Inventory	http://www.eida.europa.eu/stationbook	Available	Operational
Interactive Access to Station Inventory	http://www.eida.europa.eu/stationbook	Available	Operational
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Interactive Access to Station Inventory	http://www.eida.europa.eu/stationbook	Available	Operational


*Access to EIDA data through FDSN web services*

**Station Book**



*Station inventory of EIDA stations*

**Status**



ID	Station Name	Status
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational
IT02	ANAGNI (ANAGNI)	Operational

*Overview of status and usage of EIDA*

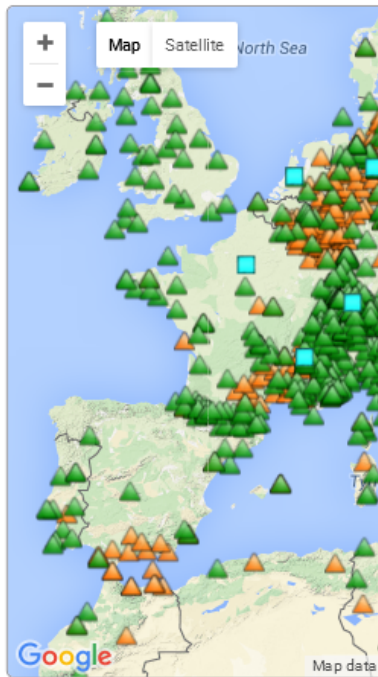
## EIDA Goals

- **safe, persistent archival and dissemination of high quality seismic waveform data collected by European datacenters via distributed archives**
- **easy access for scientists - support multiple access methods, standards**
- **open access** where possible, closed / restricted access is possible
- **all stations require standardised metadata**
- **include best datasets available**
  - **Highest sampling rates of raw data**
  - **Continuous data (event data is supported)**
  - **Focus on permanent networks, also include data from temporary deployments, incl. aftershocks, mobile pools**
  - **Focus on broadband, also includes strong motion, short period**
  - **Near real-time where possible**
  - **Focus on data collected on European plate, also include global data collected by European datacenters**
  - **All data in miniSEED, all metadata in datalessSEED (dB in inventoryXML)**
- **distributed archives allows robust system independent of each individual node**

# EIDA data holdings

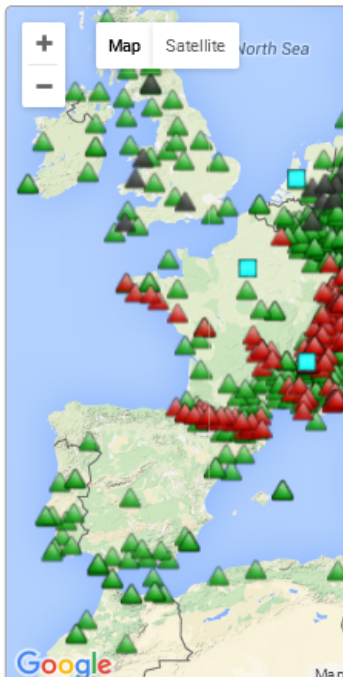
~6000+ stations

350+ TB distributed via 11 nodes



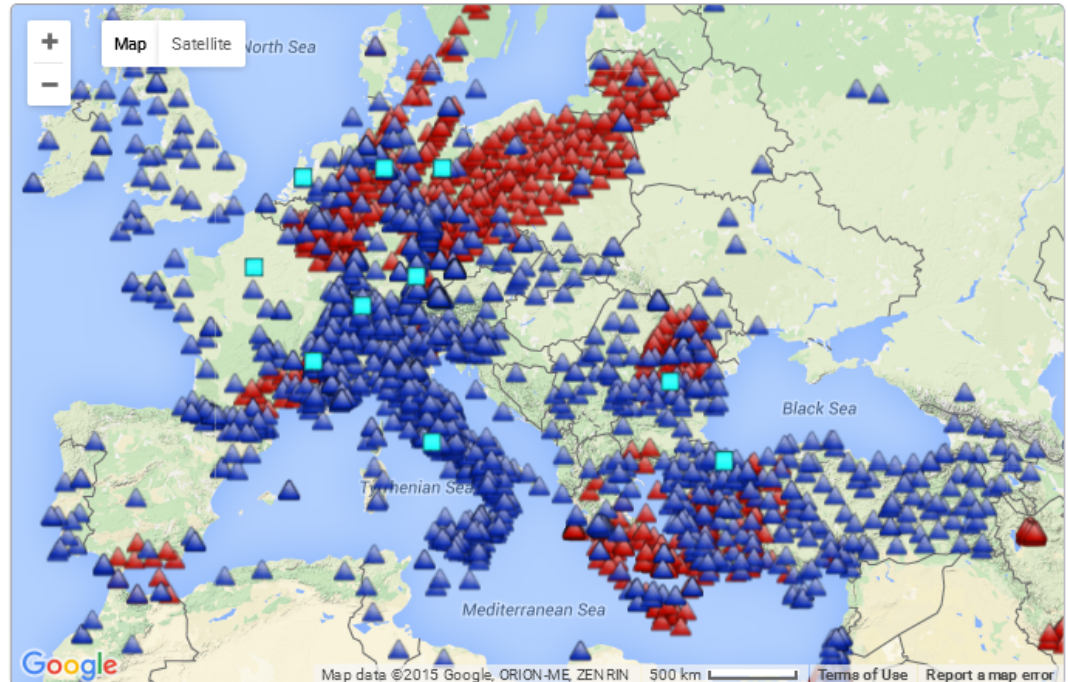
This map shows EIDA stations with unrestricted data access that are in operation (open; **1853**) according to the current metadata, while the orange triangles indicate stations that have stopped operation (closed; **3189**). ORFEUS Data Center updates this map daily (last update: **2015-09-20 12:18:02**).

operational station  closed station



This map shows EIDA stations with unrestricted data access, categorized by sensor type: velocity sensors (**4510**), red triangles with infrasound sensors (**29**). The black squares represent EIDA nodes. ORFEUS Data Center updates this map daily (last update: **2015-09-20 12:18:02**).

velocity (m/s)  infrasound



This map shows EIDA stations with unrestricted data access (total number: **5042**). Blue triangles represent stations (**2367**) that are part of permanent networks (**81**) according to the current metadata, while the red triangles indicate stations (**2674**) that belong to temporary networks (**59**). ORFEUS Data Center updates this map daily (last update: **2015-09-20 12:18:02**).

permanent station  temporary station  EIDA node

show station name labels

Map:  permanent  temporary networks

### EIDA

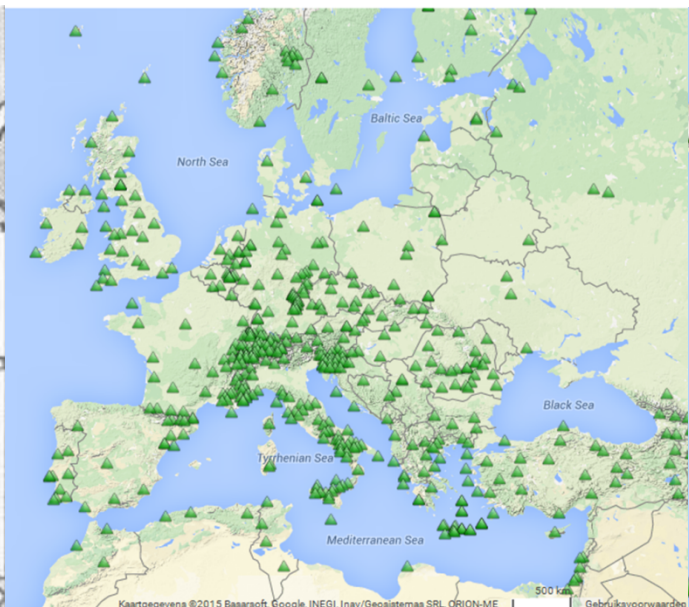
#### From the ORFEUS Data Center (single DC) to EIDA (distributed DC)

- 1986/87: ORFEUS plan launched/realized
- 2012/13: ORFEUS-VEBSN => ORFEUS-EIDA (EIDA = VEBSN + data holdings from 9 European DCs)
- 2016: ORFEUS-EIDA (11 nodes)

1987 - 30



2013 - 613



2016 ~6000



Year - Number of open stations

## Observatories and Research Facilities for European Seismology

### European Integrated Data Archive EIDA

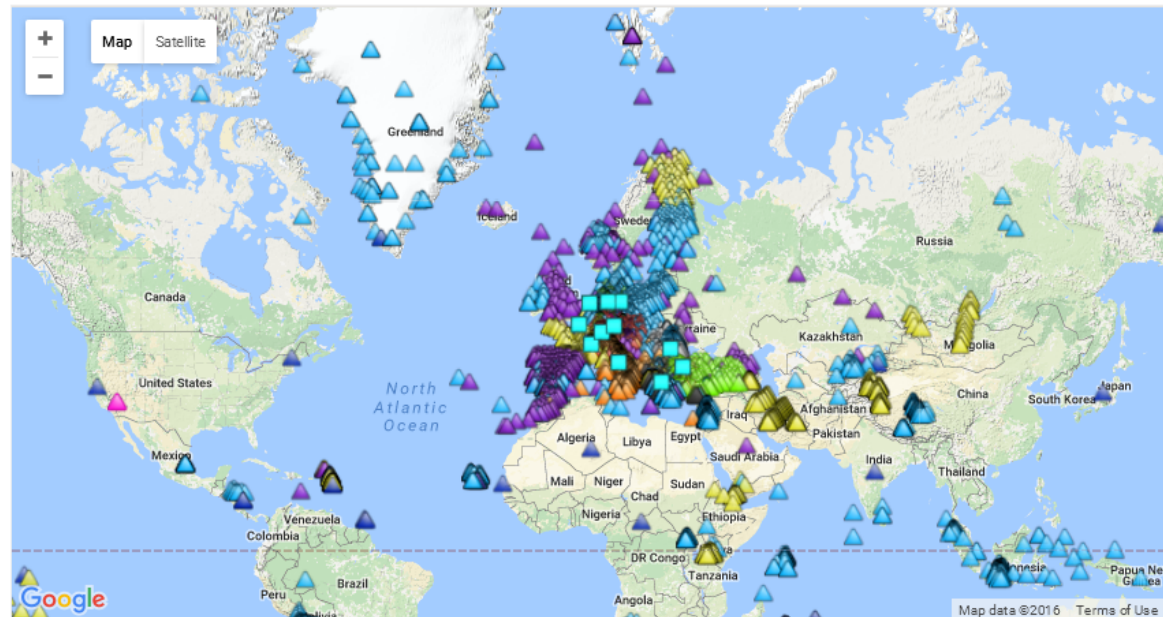
EIDA, an initiative within ORFEUS, is a distributed data center established to (a) securely archive seismic waveform data and metadata gathered by European research infrastructures, and (b) to provide transparent access to the archives by the geosciences research communities. EIDA is **organized and managed** by the EIDA Management Board (EMB).

**EIDA nodes** are data centres which collect and archive data from seismic networks deploying broad-band sensors, short period sensors, accelerometers, infrasound sensors, and other geophysical instruments. Networks and stations contributing data to EIDA are listed in the **EIDA network list** and **station database**. EIDA runs a **monitoring tool** to keep track of the status of the system and the usage in terms of data download.

EIDA Data Portal

FDSN Webservices

Station Book



Stations by Archive

Show station labels  
(max. 100 stations in window)

BGR

ETH

GFZ

INGV

IPGP

KOERI

LMU

NIEP

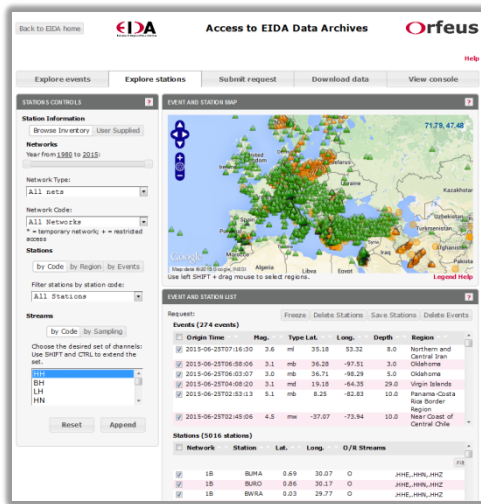
NOA

ODC

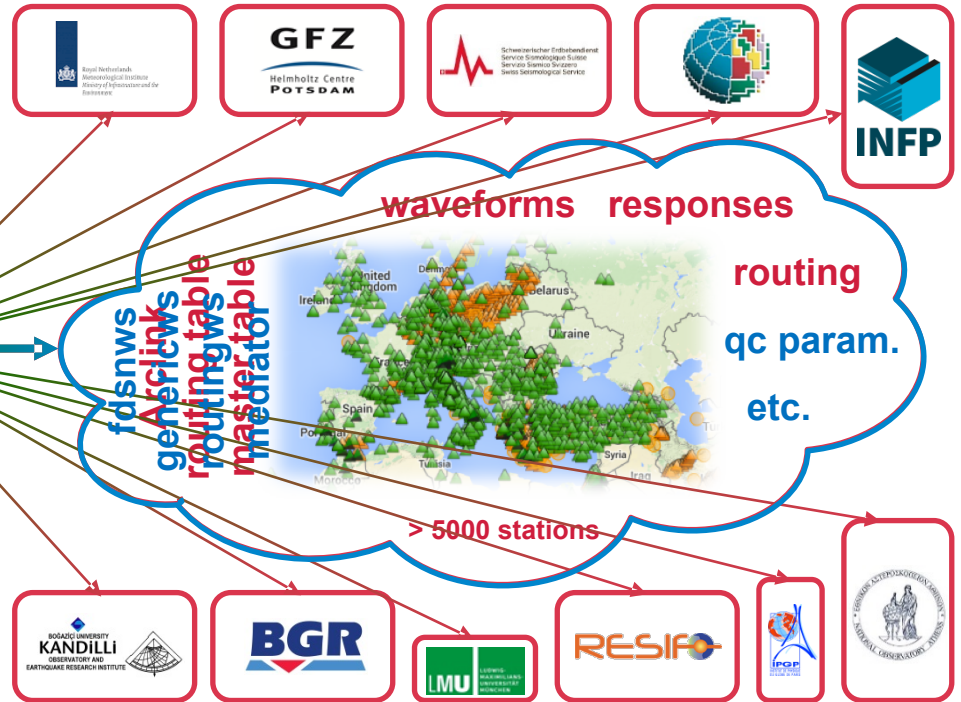
RESIF

EIDA Nodes

# EIDA: how it works?



**Users:  
Geoscientists  
Etc...**





## EIDA dissemination tools

**Orfeus**  
Observatories and Research Facilities for European Seismology

HOME DATA EARTHQUAKES WORKING GROUPS SOFTWARE LINKS ORGANIZATION

Back to EIDA home **EIDA** Access to EIDA Data Archives **Orfeus** Help

Explore events Explore stations Submit request Download data View console

**EVENTS CONTROLS** ?

**Event Information**

Catalog Services: User Supplied

Catalog Service: EMSC

Date Interval (yyyy-mm-dd): 2010-01-01 to 2014-08-28

Minimum Magnitude: 4

Depth from 0 to 999 km

Coordinates: (Use -ve for S/W; +ve for N/E)

N 90

W -180 180 E

-90 Clear

S

**EVENT AND STATION MAP** ?

24.53, 49.29

Map data ©2014 Basarsoft, Google, ORION-ME  
Use left SHIFT + drag mouse to select regions.

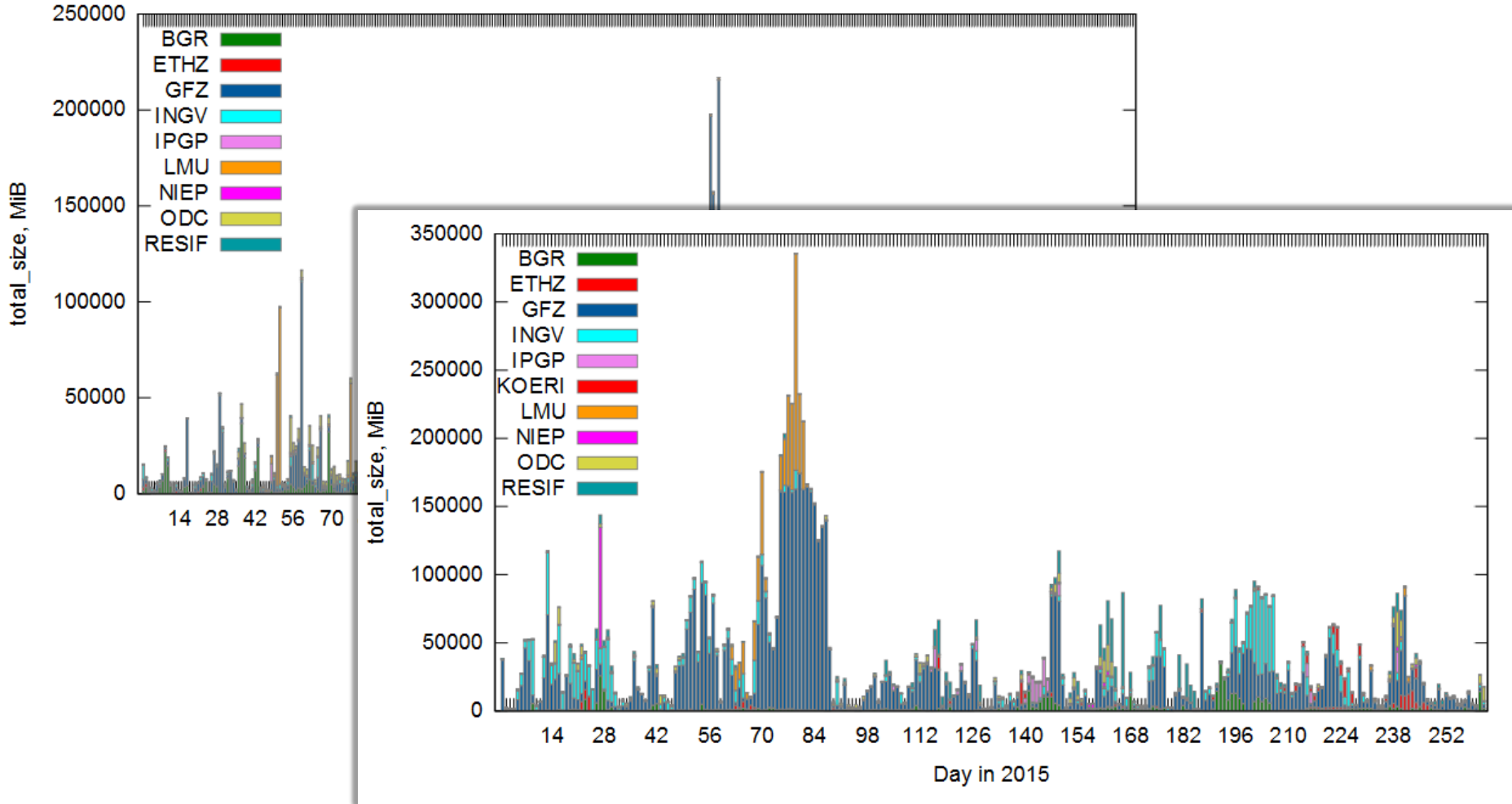
Legend Help

**EVENT AND STATION LIST** ?

Request: Freeze Delete Stations Save Stations Delete Events

EIDA central portal: <http://www.orfeus-eu.org/eida/eida.html>

## EIDA dissemination tools



EIDA monitoring: <http://eida.gfz-potsdam.de/eida/status/>

# Rapid Raw Strong Motion database (RRSM)

A high-quality, automatically and rapidly filled database build on state-of-the-art data collection and processing software to provide near real-time (web) access to open (unrestricted) strong motion data after a significant earthquake in Europe.

The screenshot shows the RRSM Interface website. At the top, there is a navigation bar with the Orfeus logo and menu items: ORFEUS, DATA, EARTHQUAKES, WORKING GROUPS, SOFTWARE, LINKS, ORGANIZATION. Below the navigation bar, there are buttons for 'Station Book' and 'About RRSM'. The main content area is titled 'RRSM Interface Orfeus Data Center' and includes the NERA logo. There are four tabs: 'Home', 'Select Events', 'Select Peak-Motions', and 'Combined Selection'. The 'Home' tab is active, showing 'RRSM Home' and 'Rapid Raw Strong Motion'. Below this, it says 'Latest earthquakes last 12 months'. A map of Europe is displayed with an earthquake epicenter in Italy. A pop-up window shows the following data:

Origin Time (UTC)	2016-08-24 01:36:32
Lat [°]	42.71 N
Lon [°]	13.22 E
Dep [km]	4
Mag	6.2 (mw)
Nsta	89
Nwav	255
Max* PGA [cm/s <sup>2</sup> ]	189.693
Max* PGV [cm/s]	39.3757
Detail	stations

Below the map, there is a table showing 71 to 80 of 533 rows. The table has the following columns: Origin Time (UTC), Lat [°], Lon [°], Dep [km], Mag, Nsta, Nwav, Max\* PGA [cm/s<sup>2</sup>], Max\* PGV [cm/s], and Detail. The table contains five rows of earthquake data.

Origin Time (UTC)	Lat [°]	Lon [°]	Dep [km]	Mag	Nsta	Nwav	Max* PGA [cm/s <sup>2</sup> ]	Max* PGV [cm/s]	Detail
2016-08-24 02:05:58	42.66 N	13.30 E	10	4.3 (mb)	12	36	8.133	0.1727	stations
2016-08-24 02:01:08	42.80 N	13.26 E	8	3.9 (ml)	17	50	3.800	0.1201	stations
2016-08-24 01:56:03	42.67 N	13.23 E	10	4.8 (mb)	16	48	16.607	0.9193	stations
2016-08-24 01:41:39	42.78 N	13.17 E	0	3.8 (ml)	3	9	7.491	0.1223	stations
2016-08-24 01:36:32	42.71 N	13.22 E	4	6.2 (mw)	89	255	189.693	39.3757	stations

<http://www.orfeus-eu.org/opencms/rrsm/index.html>

# Rapid Raw Strong Motion database (RRSM)

A high-quality, automatically and rapidly filled database build on state-of-the-art data collection and processing software to provide near real-time (web) access to open (unrestricted) strong motion data after a significant earthquake in Europe.

RRSM Interface Orfeus Data Center within NERA

Station Book About RRSM

Home Select Events Select Peak-Motions Combined Selection

RRSM Home / Select Events / Results / Event detail Go Back

### Event detail

#### Earthquake data

Event ID	78598970 <small>(EMSC 525680)</small>	Latitude [°]	42.710 N	Waveform Count	255
Origin Time (UTC)	2016-08-24 01:36:32	Longitude [°]	13.220 E	Max PGA [cm/s <sup>2</sup> ]	189.693
Magnitude	6.2 (mw)	Depth [km]	4	Max PGV [cm/s]	39.3757

#### Stations with peaks

PGA values [cm/s<sup>2</sup>]

- ▲ unprocessed
- ▲ from 0 to 10
- ▲ from 10 to 20
- ▲ from 20 to 50
- ▲ from 50 to 100
- ▲ from 100 up

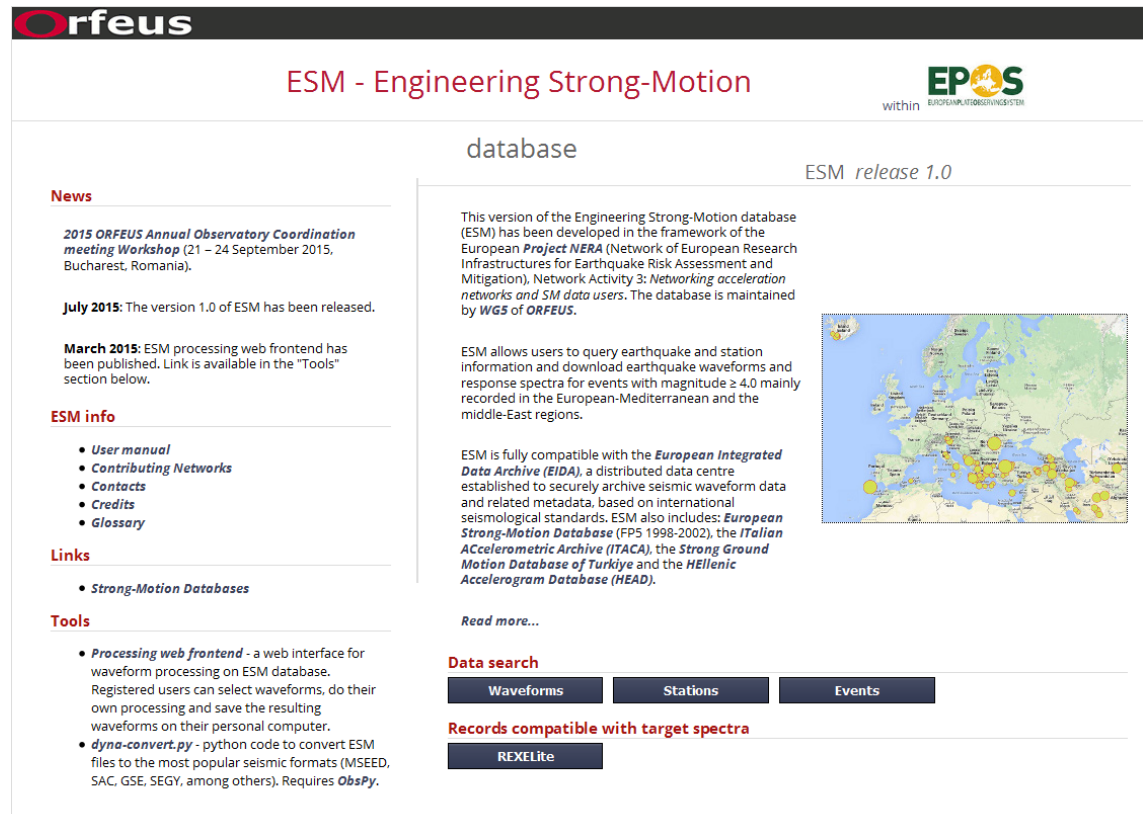
Showing 1 to 10 of 89 rows

Station (Net.Sta.)	Lat [°]	Lon [°]	Elev [m]	Station Name	Epi. Dist. [km]	Max PGA [cm/s <sup>2</sup> ]	Max PGV [cm/s]	Detail
IVRM33	42.509 N	13.215 E	1097		22.36	100.819 (HNE)	8.8024 (HNE)	streams
IVTERO	42.623 N	13.604 E	673	TERAMO	32.85	85.560 (HNN)	4.3892 (HNN)	streams

<http://www.orfeus-eu.org/opencms/rrsm/index.html>

# Engineering Strong Motion database (ESM)

A single, high quality database with historical and present time strong motion waveforms and carefully reviewed metadata, dynamically updated with manually processed data when significant new events occur



The screenshot shows the website for the Engineering Strong-Motion (ESM) database. At the top, there is the Orfeus logo and the EPOS logo (European Plate Observing System). The main heading is "ESM - Engineering Strong-Motion database" with "ESM release 1.0" noted on the right. The page is divided into several sections:

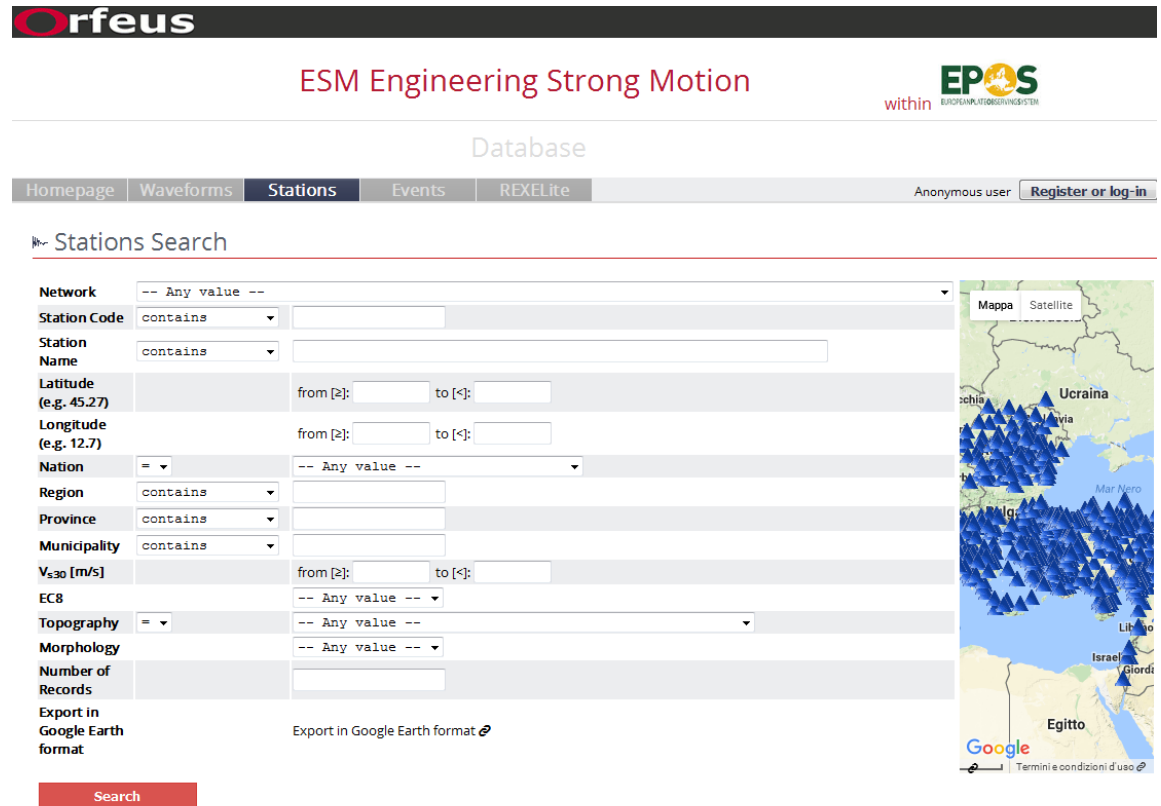
- News:**
  - 2015 ORFEUS Annual Observatory Coordination meeting Workshop** (21 – 24 September 2015, Bucharest, Romania).
  - July 2015:** The version 1.0 of ESM has been released.
  - March 2015:** ESM processing web frontend has been published. Link is available in the "Tools" section below.
- ESM info:**
  - [User manual](#)
  - [Contributing Networks](#)
  - [Contacts](#)
  - [Credits](#)
  - [Glossary](#)
- Links:**
  - [Strong-Motion Databases](#)
- Tools:**
  - Processing web frontend** - a web interface for waveform processing on ESM database. Registered users can select waveforms, do their own processing and save the resulting waveforms on their personal computer.
  - dyna-convert.py** - python code to convert ESM files to the most popular seismic formats (MSEED, SAC, GSE, SEGY, among others). Requires *ObsPy*.

The main content area contains a description of the database, stating it was developed in the framework of the European Project NERA (Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation), Network Activity 3: *Networking acceleration networks and SM data users*. It is maintained by WGS of ORFEUS. A map of Europe shows the distribution of stations. Below the map, it states that ESM is fully compatible with the European Integrated Data Archive (EIDA), the European Strong-Motion Database (FPS 1998-2002), the Italian Accelerometric Archive (ITACA), the Strong Ground Motion Database of Turkiye and the Hellenic Accelerogram Database (HEAD). There are buttons for "Data search" with sub-buttons for "Waveforms", "Stations", and "Events", and a "Records compatible with target spectra" button with a "REXELite" sub-button.

<http://www.orfeus-eu.org/esm>

# Engineering Strong Motion database (ESM)

A single, high quality database with historical and present time strong motion waveforms and carefully reviewed metadata, dynamically updated with manually processed data when significant new events occur



The screenshot shows the ESM Engineering Strong Motion database search interface. At the top, there is the Orfeus logo and the text "ESM Engineering Strong Motion" and "EPoS within EUROPEAN INTEGRATED DATA ARCHIVE". Below this is a navigation bar with tabs for "Homepage", "Waveforms", "Stations", "Events", and "REXELite". The "Stations" tab is selected. To the right of the navigation bar, it says "Anonymous user" and "Register or log-in".

The main section is titled "Database" and "Stations Search". It contains a search form with the following fields:

- Network: -- Any value --
- Station Code: contains [input field]
- Station Name: contains [input field]
- Latitude (e.g. 45.27): from [≥]: [input field] to [≤]: [input field]
- Longitude (e.g. 12.7): from [≥]: [input field] to [≤]: [input field]
- Nation: = [dropdown menu] -- Any value --
- Region: contains [input field]
- Province: contains [input field]
- Municipality: contains [input field]
- V<sub>530</sub> [m/s]: from [≥]: [input field] to [≤]: [input field]
- EC8: -- Any value --
- Topography: = [dropdown menu] -- Any value --
- Morphology: -- Any value --
- Number of Records: [input field]

At the bottom of the search form, there is a link "Export in Google Earth format" and a "Search" button. To the right of the search form is a map showing the location of stations in the Mediterranean region, with blue triangles indicating station locations. The map includes labels for "Ucraina", "Italia", "Egitto", and "Israele".

### RRSM vs ESM

#### **RRSM** Rapid Response SM

Collection of accelerometric data from EIDA immediately after an earthquake

- Magnitude threshold: 3.5
- since **2005**
- wfs are processed automatically (software **scwfparam module of SeisComp3** )
- Station and event metadata are not revised
- Input for SHAKEMAPS provided

**At 2015-06-15:**

- **3700** events
- **>50000** waveforms,
- only digital instruments
- raw wf, DS and PSA (5%-dam.) comp. up to 10s
- PGA and PGV, SA @ 0.1s 0.3s and 1s

#### **ESM** Engineering SM

Collection of accelerometric data from EIDA and/or offline data

- Magnitude threshold: 4
- since **1969**
- wfs are processed manually (Paolucci et al. 2011)
- Station and event metadata are periodically revised

**At 2015-06-15:**

- **2345** events
- **2500** stations
- **14800** waveforms including records from analog instruments
- Unpr. acc, vel, DS and PSA (5% damping) PGA, PGV, PGD

# ORFEUS Station Book

Up-to-date station information (“Station Book”) for strong motion and broadband stations operational in Europe (station metadata, site characterization)

Station Book Orfeus Data Center

Home Search Stations Select by Network Manage Network(s)

European Station Book

All stations by time frame

Map Satellite

Station types: ▲ open ▲ closed

Showing 1 to 10 of 6,755 rows

Net	Sta	Lat [°]	Lon [°]	Elev [m]	Open	Rest.	Country	Station Name	Affiliation	Start	End	Info
1A	CORRE	67.5828 S	144.2750 E	0	No	No				2009	2012	<a href="#">details</a>
1A	PIDGE	66.9820 S	143.8930 E	0	No	No				2009	2012	<a href="#">details</a>
1A	PINGU	67.5955 S	146.0770 E	50	No	No				2009	2012	<a href="#">details</a>
1A	PORMA	66.8184 S	141.3900 E	27	No	No				2009	2012	<a href="#">details</a>

<http://www.orfeus-eu.org/data/stationbook/>



## ORFEUS Station Book

orfeus
ORFEUS DATA EARTHQUAKES WORKING GROUPS SOFTWARE LINKS ORGANIZATION

ORFEUS Interface
About Station Book

### Station Book

Orfeus Data Center

Home
Search Stations
Select by Network
Manage Network(s)

Station Book Home / Select by Network / Network / Station

### Station Detail

Select by Network

- Network CH
- Station SBAS
- Description
- Station Details
- Station Pictures
- Housing & Building details
- Instrumentation History
- Borehole

**Description** EIDA data & Ownership

Network	CH	Latitude [°]	47.193830 N	Country	Switzerland
Station Code	SBAS	Longitude [°]	8.517010 E	Station Name	Baar, Spital, ZG
Affiliation	Swiss Seismological Service	Elevation [m]	434	Description	Baar, Spital, ZG

**Shared / Restrict.** Yes / No

Start	2014	Owner Name	-	Owner Phone	-
End	-	Owner Department	-	Owner Email	-
		Owner Agency	-	Owner Address	-

**Station Details** Morphology, Ground type, Geology, etc.

**Geological Unit** -

**Morphology Class** -  
Classes: T1, T2, T3, T4; based on the [Italian building code](#)

**Morphology Description** -

**Ground type EC8** -  
EC8 types: A,B,C,D,E,S<sub>1</sub>,S<sub>2</sub>; [more info here](#)

**Groundwater Depth [m]** -

**Vs 30 [m/s]** -

**f<sub>0</sub> [Hz]** -  
Fundamental frequency at the site

**Amp(f<sub>0</sub>)** -  
HV amplitude at f<sub>0</sub>

**Basin Flag** -

**Bedrock Depth [m]** -  
Depth to the engineering bedrock (with Vs = 800 m/s)

**Station Pictures**

No pictures found

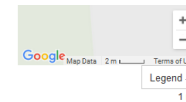
**Metadata files** EIDA

FTP metadata

FDSN Station XML

**Map**

Map
Satellite



### Housing & Building details by sensor location

Loc	Streams	Lat [°]	Lon [°]	Elev [m]	Start	End	Housing Class *	Housing Desc	In Building	No Storeys	Distance to Building [m]
-	HGE,HGN,HGZ	47.193830 N	8.517010 E	434	2014	-	-	-	-	-	-

(\*) Housing Class: Borehole, Bridge, Building, Cave, Dam, Free field, OtherStructure, Tunnel, Underground shelter or Urban free field, following [these details](#)

### Instrumentation History Dataloggers and sensors by location and stream (EIDA)

Showing 1 to 6 of 6 rows

Loc	Stream	Loc Timeframe	Stream Timeframe	Datalogger	Sensor	Gain	Unit	Type
HGE	2014-10-16 / -	2014-10-16 / 2015-09-30					407880	MIS**2
HGE	2014-10-16 / -	2015-09-30 / -					407880	MIS**2
HGN	2014-10-16 / -	2014-10-16 / 2015-09-30					407880	MIS**2
HGN	2014-10-16 / -	2015-09-30 / -					407880	MIS**2
HGZ	2014-10-16 / -	2014-10-16 / 2015-09-30					407880	MIS**2
HGZ	2014-10-16 / -	2015-09-30 / -					407880	MIS**2

Showing 1 to 6 of 6 rows

Copy CSV Excel PDF Print

Filter rows:

89 ms

### Borehole

Borehole	No	Latitude [°]	-	Depth [m]	-
Number of layers	0	Longitude [°]	-	Bedrock Depth [m]	-

BoreHole Layers

Disclaimer This Station Book interface is a beta version and the contained data has not been verified. Please help us clearing severe mistakes if any, by sending your feedback at [stationbook@nrim.nl](mailto:stationbook@nrim.nl)

StationBookInterface © 2014 ODC / ETH

<http://www.orfeus-eu.org/data/stationbook/>

## ORFEUS data infrastructure, services and products

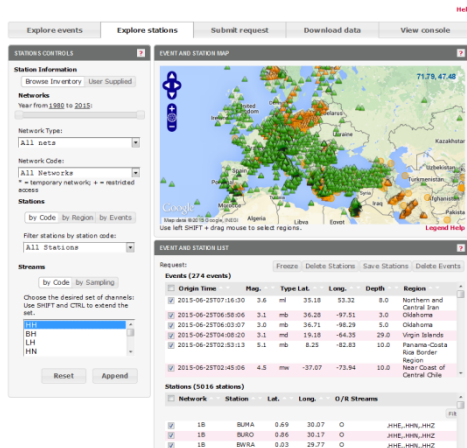
### EIDA => EIDA-Next Generation

More than just data and federated archive

<http://www.orfeus-eu.org/eida/eida.html>

- Coordination of data holdings and software/strategic developments
- Provides quality control of data/metadata
- Helps define seismological center

Access to EIDA Data Archives Orfeus RFEUS community



Users:  
Geoscientists  
Etc...





## EPOS

Implementation Phase project starting 10.2015 +4 years

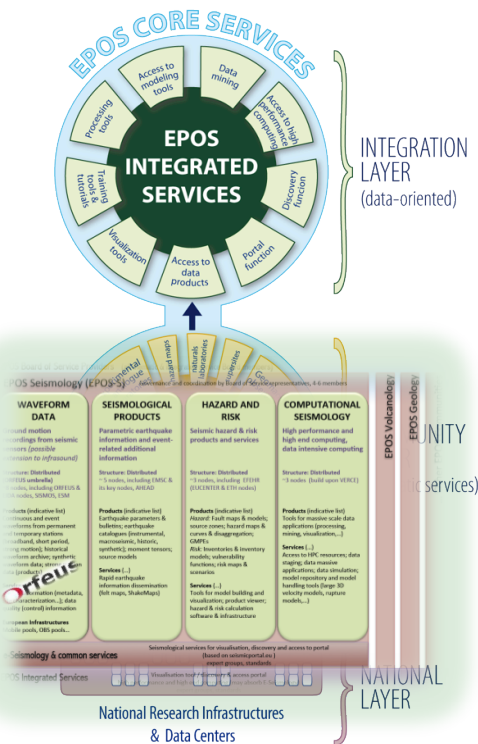


The European Plate Observing System (EPOS) is the ESFRI initiative of the Solid Earth sciences:

- long-term plan to facilitate integrated use of data, models and facilities from pre-existing and newly established research infrastructures for solid Earth science;
- represents a scientific vision and approach to enable innovative multidisciplinary research towards a better understanding of the physical processes controlling earthquakes, volcanic eruptions and unrest episodes, tsunamis, as well as those driving tectonics and Earth surface dynamics.

# EPOS-Seismology

Seismology provides Thematic Core Services (TCS) to EPOS. The multidisciplinary integration and interoperability will be ensured by the Integrated Core Services (ICS).



**EPOS Integrated Core Services** provide simplified access to multidisciplinary data and data-derived products, combine data with modeling results (simulations), processing and visualization tools

**Thematic Core Services** community-driven infrastructures provide discipline-specific data services, these will build on pre-existing international collaboration/organizations (e.g. **ORFEUS**).

The various communities organize their services. Seismology (**EPOS-S**) will provide and extend waveform data offerings through **ORFEUS/EIDA**.

**National Research Infrastructures and facilities** provide services at national level and send data to the European thematic data infrastructures.

## Thanks for your attention!

**Additional information at:**

**<http://www.orfeus-eu.org/index.html>**

**To join ORFEUS contact**

**[orfeus\\_secretary@knmi.nl](mailto:orfeus_secretary@knmi.nl)**