

Coordinating Access to Seismic Waveform Data in Europe: Overview of **ORFEUS Activities, Services and Products**

Carlo Cauzzi, Jarek Bieńkowski, Wayne Crawford, Susana Custódio, Sebastiano D'Amico,
Christos Evangelidis, Philippe Guéguen, Christian Haberland, Florian Haslinger, Giovanni Lanzano,
Lars Ottemöller, Stéphane Rondenay, Reinoud Sleeman, and Angelo Strollo

Acknowledgments

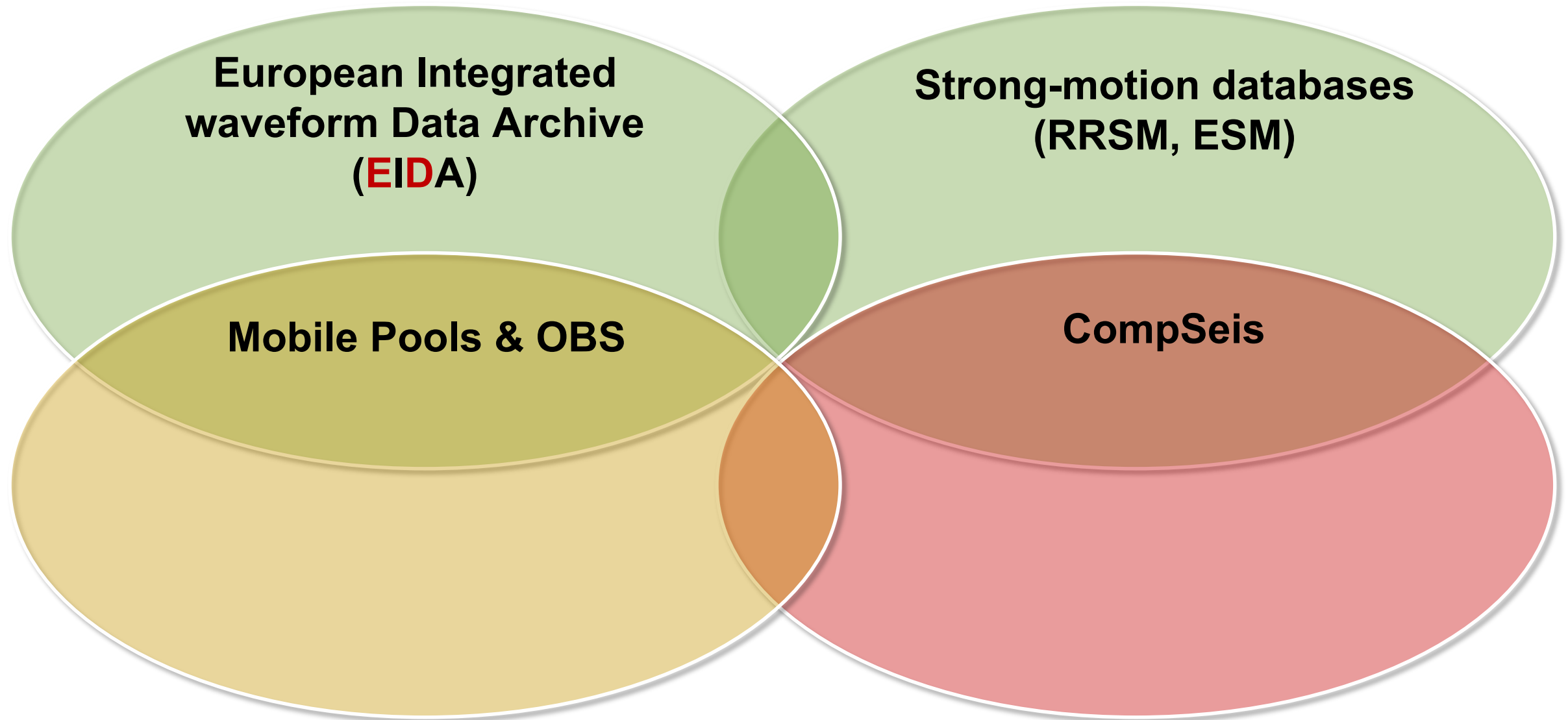
**ORFEUS BoD, ExeCom, BoP,
SMCs, IDGs, UAG, ODC staff,
and all data providers and users of ORFEUS services.**

Please always use network DOIs in your publications!

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



Current and future services





Webinterface

Graphical Interface for waveform and metadata access.



Webservices

APIs for data and metadata access.



Data Quality

Interfaces for data quality visualization.

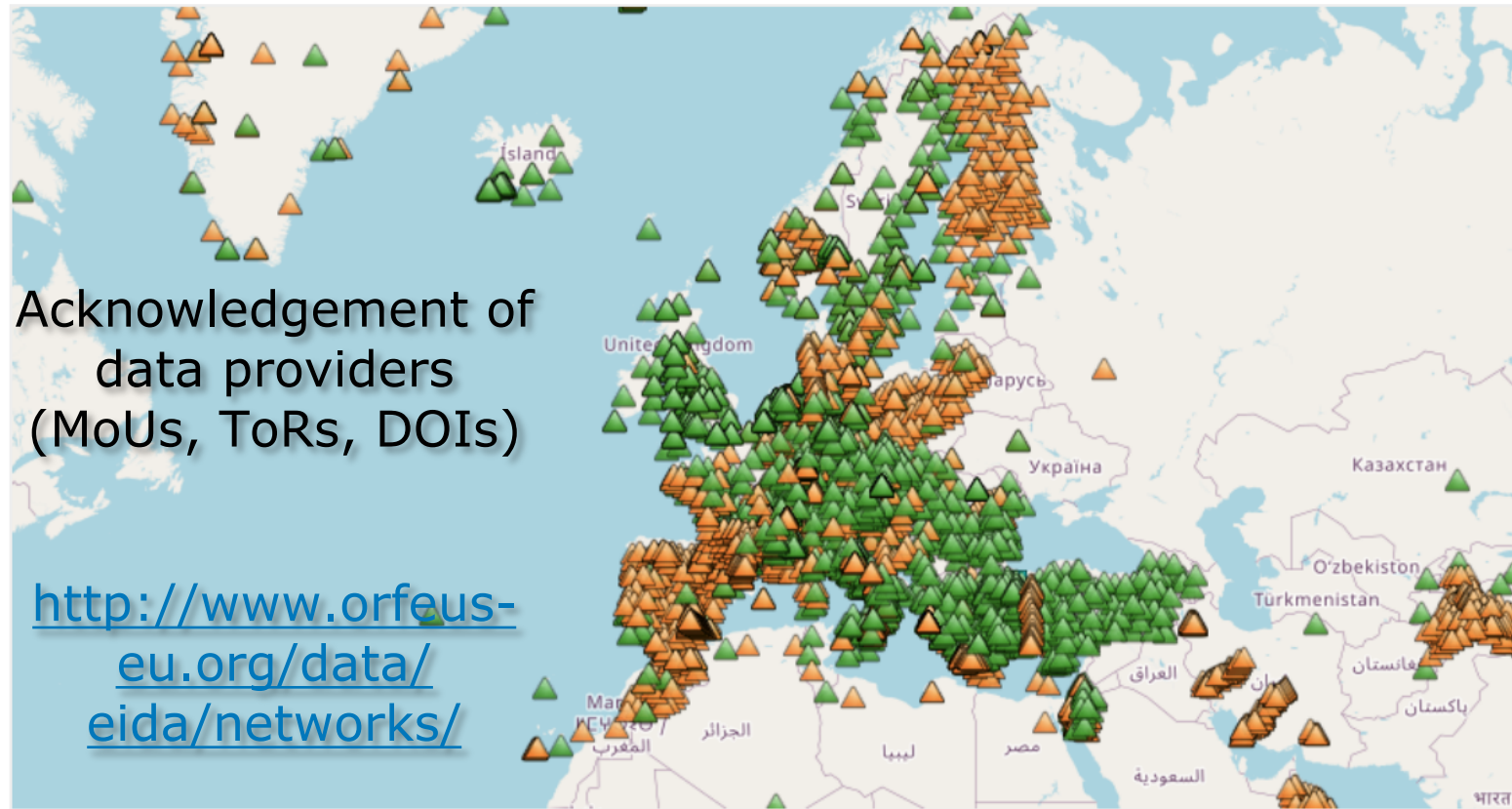


Station Book

Access to the entire EIDA station inventory.

☒ ▲ Operational Station

☒ ▲ Closed Station



Acknowledgement of data providers (MoUs, ToRs, DOIs)

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

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



Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

GFZ
Helmholtz Centre
POTSDAM

Résif^{épos}
Réseau sismologique et géodésique français



Schweizerischer Erdbebendienst
Service Sismologique Suisse
Servizio Sismico Svizzero
Swiss Seismological Service



ICGC
Institut
Cartogràfic i Geològic
de Catalunya

- **Federation**: 600+ TB distributed across 10+2 nodes; **16,000+** stations; **380+** networks
- Standardised services for data discovery, access & download

The EIDA Web Interface

ORFEUS Data Center WebDC3 Web Interface

[Explore events](#) [Explore stations](#) [Submit request](#) [Download data](#) [Console](#) [Information](#)

Stations Controls Use this to add channels to your request. The selection can be made based on the currently selected events or by network/station codes.

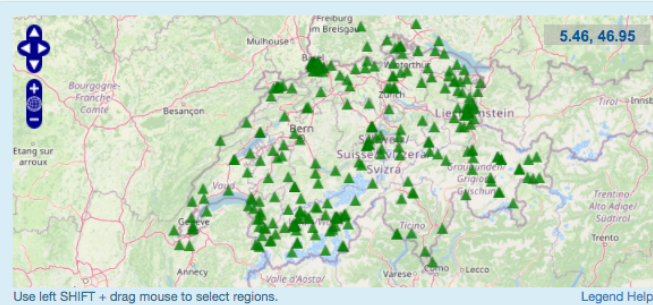
Station Information
[Browse Inventory](#)
[User Supplied](#)

Networks
Year from 1980 to 2020:
Network Type:
All nets
Network Code:
CH (1980) - National S
* = temporary network; + = restricted access

Stations
by Code by Region
by Events
Filter stations by station code:
All Stations

Streams
by Code by Sampling
Choose the desired set of channels:
Use SHIFT and CTRL to extend the set.
HG
HH
LH
BH
Reset Append

Event and Station Map Here the events and stations you choose will be displayed. Use the mouse to drag the map around. Use the Ctrl-Mouse to draw areas for limiting the search of events and stations when the appropriate modules are enabled.



Use left SHIFT + drag mouse to select regions.

Event and Station List Use these tables to check which events and stations have been selected by your search criteria. You can interactively remove unwanted items. Your final request will be built from the currently displayed information.

Request:
Freeze Delete Stations Save Stations Delete Events
Events (-)
No Events loaded
Stations (270 stations)
Network Station Lat. Long. O/R Streams
[x] CH ACB 47.59 8.25 O .BHE,.BHN,.BHZ
.EHE,.EHN,.EHZ
.HGE,.HGN,.HGZ
.HHE,.HHN,.HHZ
.LHE,.LHN,.LHZ
.SHE,.SHN,.SHZ
[x] CH AIGLE 46.34 6.95 O .BHE,.BHN,.BHZ
.HGE,.HGN,.HGZ
.HHE,.HHN,.HHZ
.LHE,.LHN,.LHZ
[x] CH BAI ET 47.94 7.60 O .BHE,.BHN,.BHZ

<http://www.orfeus-eu.org/webdc3>

- Data discovery and interactive access
- Allows for:
 - searching **events** in global and regional catalogues;
 - searching **stations** contributing to the EIDA federated archive;
 - downloading **raw waveform** data (SEED format) and **associated metadata** (SEED and XML) for user-defined time windows, including OT-based start and end times.
- **Being developed:** new Web Interface chiefly based on Web Services.

The EIDA Station Book

STATION BOOK Menu Search Station code or name Find Log in Sign up

Infrastructure
View all nodes
View all networks
History
Recent changes
Other
Quick links
About Station Book

closed
operational

Legend

List of all stations

Show 10 entries Search:

Network	Station code	Site name	Start date
1A 2009	CORRE	Terre Adelie, Correll Nunatak, TERRES AUSTRALES FRANCAISES	2009/11/6
1A 2009	PIDGE	Terre Adelie, Cap Pidgeon, TERRES AUSTRALES FRANCAISES	2009/11/8

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

- Allows discovery and download of metadata of stations contributing to EIDA.
- Data providers can edit advanced metadata (e.g. geophysical characteristics of the recording sites).
- Open source and based on state-of-the-art technology with flexibility to add/incorporate additional metadata.

The **EIDA** Web Services (and other clients / tools)

<http://orfeus-eu.org/data/eida/webservices/>

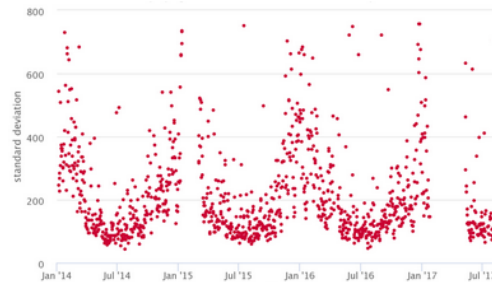
- **FDSN webservice **fdsnws-dataselect****
Provides waveform data in MSEED format
<http://www.orfeus-eu.org/fdsnws/dataselect/1/query>
- **FDSN webservice **fdsnws-station****
Provides station metadata in XML and text format.
<http://www.orfeus-eu.org/fdsnws/station/1/query>
- **EIDA webservice **eidaws-routing****
Provides routes to different EIDA data and services
<http://www.orfeus-eu.org/eidaws/routing/1/query>
- **EIDA webservice **eidaws-wfcatalog****
Provides metadata and quality parameters of wf data
<http://www.orfeus-eu.org/eidaws/wfcatalog/1/query>
- Advanced examples available at:
<https://www.orfeus-eu.org/data/eida/webservices/examples/workflow>

- **EIDA **Federator****
Provides a single, unified access point to the entire EIDA
<http://eida-federator.ethz.ch/fdsnws/station/1/query>
<http://eida-federator.ethz.ch/fdsnws/dataselect/1/query>
<http://eida-federator.ethz.ch/eidaws/wfcatalog/1/query>

- **Obspy**
- **Jupyter notebooks (e.g. SeismoLive)**
- **fdsnws_scripts**

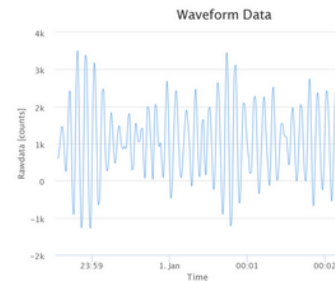
EIDA (meta)data quality and availability tools

<http://orfeus-eu.org/data/eida/quality/>



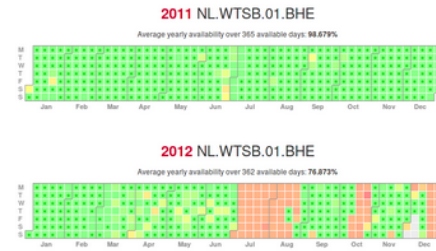
Data Metrics

Graphical interface showing daily waveform metrics.



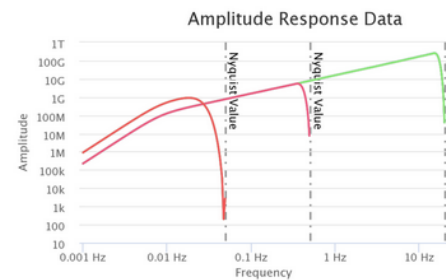
Waveform Viewer

Graphical interface showing for viewing waveform data.



Data Availability

Graphical interface showing daily data availability.



Instrument Response

Interface showing instrument response characteristics.

UAG focus.

Other QC tools
being developed
by other EIDA
nodes, e.g. GFZ,
BGR, SM
community ...

FDSN availability
WS.

- <https://www.orfeus-eu.org/data/eida>
- <https://orfeus-eu.readthedocs.io>
- <https://github.com/EIDA/userfeedback>

Strollo et al. (SRL 2021)

EMB (EIDA Management Board)

C Evangelidis (Chair, NOA, Greece)
H Pedersen (Co-Chair, RESIF, France)
R Sleeman (ODC Director – KNMI)
A Strollo (GFZ, Germany)
K Stammler (BGR, Germany)
P Danecek (INGV, Italy)
L Ottemöller (UiB, Norway)
A Marmureanu (NIEP, Romania)
J Clinton (ETHZ, Switzerland)
D Cambaz (KOERI, Turkey)

EIDG (EIDA IDG, also known as EIDA Technical Commission)

J Bienkowski (Chair, ODC), J Quinteros, D Armbruster, K Boukouras, P Evans, M Fares, S Heimers, A Heinloo, M Hoffmann, P Kästli, M Koymans, V Lauciani, E O Muhire, C Neagoe, M Ozer, L Palangeanu, M Quintiliani, J Schaeffer, L Trani, N Triantafyllis, J Michalek, ...

EUAG (EIDA UAG)

S Rondenay, T Meier, L Vecsey, P Kolinsky, A Schloemer

Sharing data *via* an existing **EIDA** node / becoming an **EIDA** node

Five good reasons to share data:

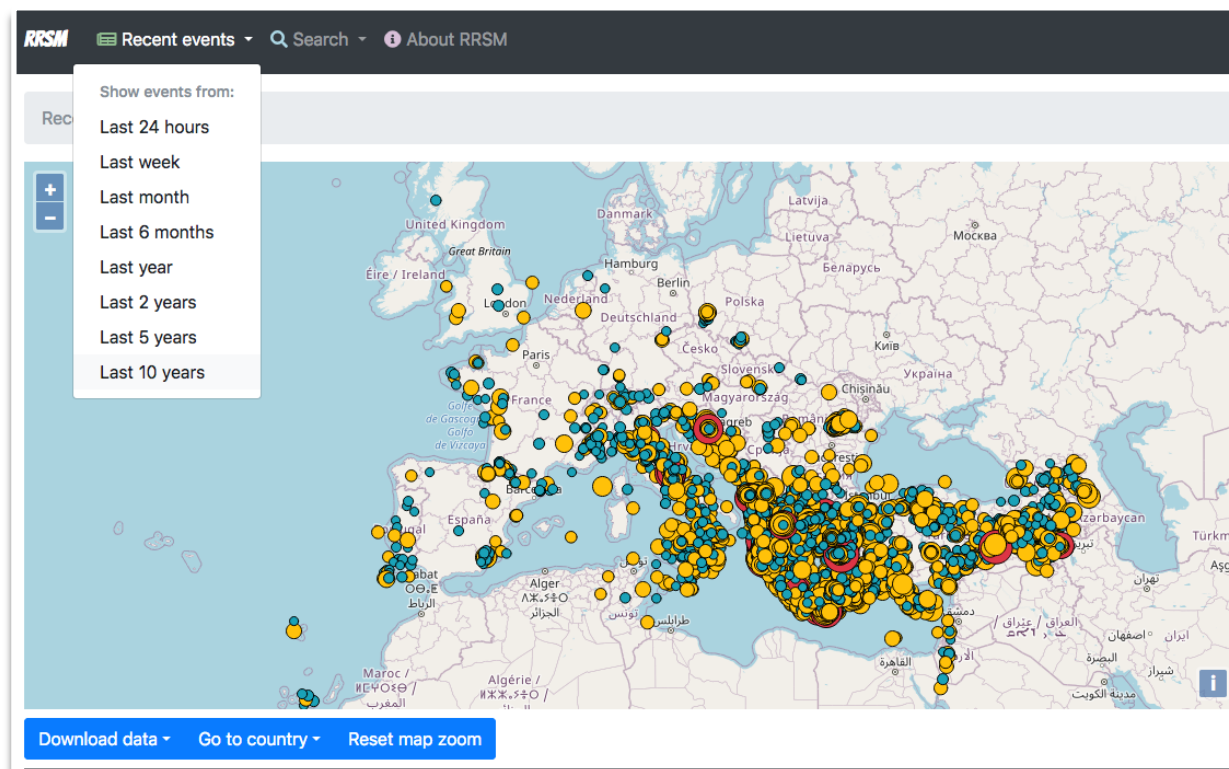
1. Long-term archiving
2. Quality control
3. Improved data access
4. Increased data usage
5. Community participation
(support, visibility, knowledge transfer, engagement)

Becoming an EIDA node

- Guidelines:
<http://orfeus-eu.org/data/eida/guidelines/>
- Long process with technical and political milestones (~ 2+ years)
- Secondary node status possible (LMU; ICGC).

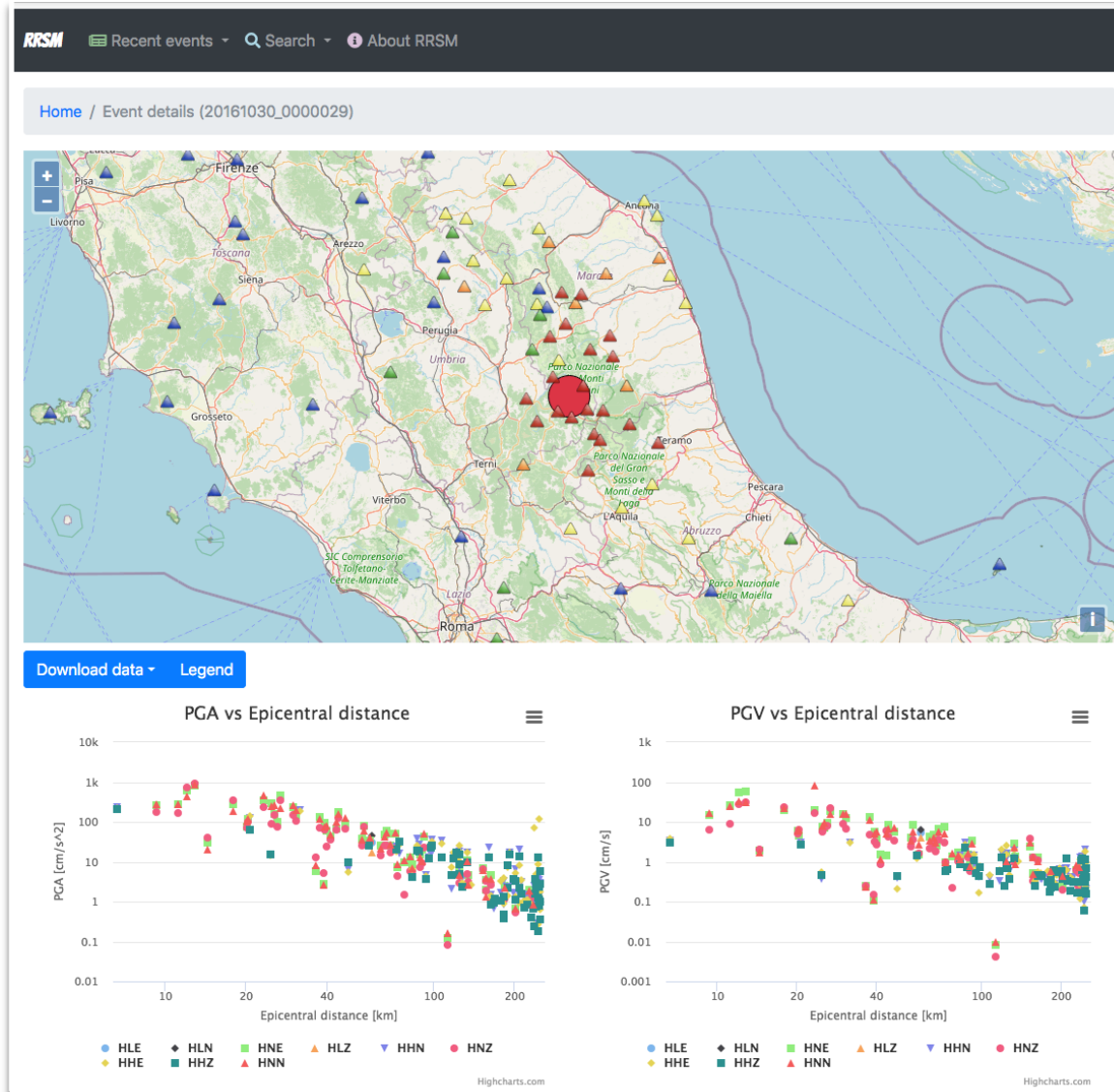
The Rapid Raw Strong-Motion Database RRSM

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



Cauzzi et al. (SRL 2016); Lanzano et al. (SRL 2021)

The Rapid Raw Strong-Motion Database RRSM



- Triggering by EMSC reports of any earthquake with **M (any scale) ≥ 3.5** in the Euro-Med region
- Collection of input data in **near-real-time** from EIDA
- Automatic processing based on SeisComP module scwfparam
- Based on **ad-hoc Web Services**, delivers PGA, PGV, SA(T), SD(T), raw and processed waveforms in SEED format
- **Web Services** deliver input files to USGS-style ShakeMap v3.5, raw and processed waveforms, event and peak-motion information in various formats.
- **Being implemented:** better identification of outliers, improved processing.

The Engineering Strong-Motion Database ESM

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

ESM DATABASE
ENGINEERING STRONG MOTION DATABASE

Home
About
Waveforms
Events
Stations
WEBServices
Products
Tools
Documents
News

Event search

Filters

Search Geophysical Geographic Station

ESM ID
Contains

Event name
Contains

Date Time
From To

Number of records
>=

Search New search

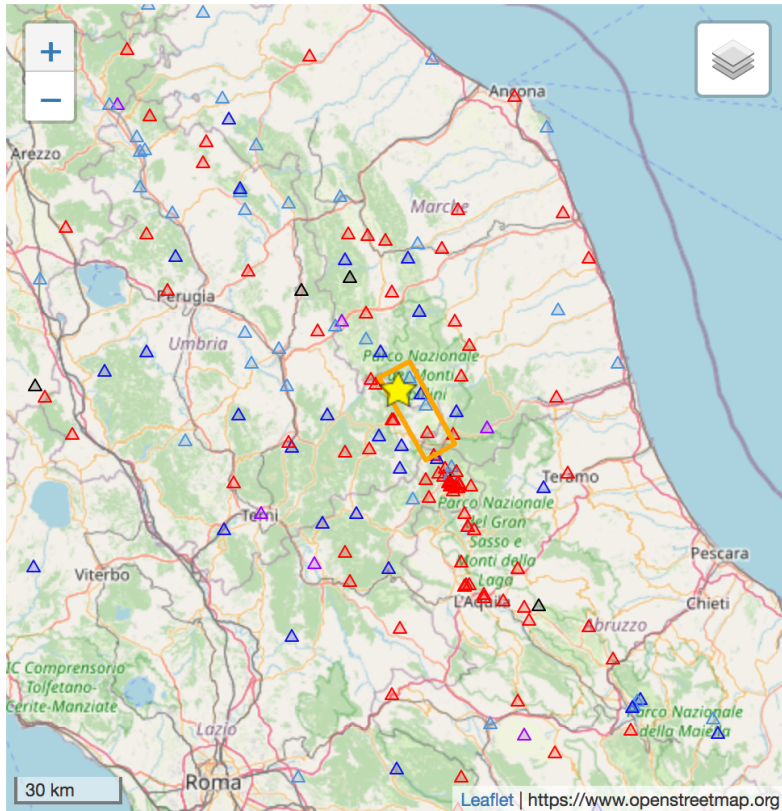
Events on map: 7826 (CTRL + drag mouse to select area) Large map

500 km

Leaflet | <https://www.openstreetmap.org>

Luzi et al. (SRL 2016); Lanzano et al. (SRL 2021)
Manual processing - Puglia et al. (BEE 2018)

The Engineering Strong-Motion Database ESM



- First EMSC magnitude and location, updated using the best manual solution, including finite fault if available; **M (any scale) ≥ 4**
- Input data from EIDA & other Euro-Med SM datasets = **more than 3500 SM stations**
- Delivers PGA, PGV, selected spectral ordinates, response spectra, engineering parameters, raw and processed waveforms - also spectrum-compatible (REXELWeb) - in engineering formats including ASCII and SAC
- **Web Services** deliver manually revised input files to USGS-style ShakeMap (event, peak-motion and fault data), raw and processed waveforms, event and peak-motion information in various formats
- **Being implemented:** enhanced wf processing.
- Note new database licence **cc by-sa 4.0**.

SMMB (Strong-Motion Management Board)

G Lanzano (Chair, ESM & INGV, Italy)
L Luzi (ESM & INGV, Italy)
R Sleeman (ODC & RRSN)
A Michelini & C Cauzzi (EU ShakeMap)
E Maufroy (ISTerre, France)
G Weatherill (GFZ, Germany)
I Kalogeras (NOA, Greece)
K Pitilakis (AUTH, Greece),
N Theodoulidis (ITSAK, Greece)
R Rupakhety (EERC, Iceland)
M Shahvar (BHRC, Iran)
A Marmureanu (NIEP, Romania)
J Clinton (CH, Switzerland)
E Tepeuğur et al. (AFAD, Turkey)
D Kalafat & E Çaktı (KOERI, Turkey)

SMIDG (Strong-Motion IDG)

E Russo, M D'Amico, R Puglia, M Koymans, J Bienkowski, P Kästli, T Kilic, K Konstantinidou, L Manea, N Melis, D Senturk , ...

SMUAG (Strong-Motion UAG)

O-J Ktenidou, D Bindi, F Gallovic

Besides existing data services ...

Services to the Community

- Software and travel grants
- Opportunities to present and publish your work (conferences, focus sections in journals)
- Training on data services (now webinars mainly)
- Domain-specific (virtual) workshops (SM data processing; EIDA data quality; AdriaArray)
- Participation in EPOS through EPOS Seismology
- Participation in EC projects

ORFEUS Annual Observatory Meeting and Workshop

&

2nd International Workshop on AdriaArray

6-7 October 2022 – Potsdam – Germany