EPOS-S Waveform Services

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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 Armeodo, RESIF
  - Nikos Triantafyllis, Kostas Boukouras, NOA

How to become an EIDA node: [www.orfeus-eu.org/data/eida/guidelines/](http://www.orfeus-eu.org/data/eida/guidelines/)
Schematic overview of (raw) waveform and metadata services currently up and running.

- EIDA interactive portal
- web services
- Station Book

Derived products and services via:
- RRSM
- ESM
EIDA interactive portal

- Explore events
- Explore stations
- Submit request
- Download data
- View console

Select earthquake catalogue

Event Information
- Catalog Services: USGS
- Date Interval (yyyy-mm-dd): 2017-08-01 - 2017-10-19
- Minimum Magnitude: 4
- Depth: 0 to 999 km
- Coordinates (Use -ve for S/W, +ve for N/E):
  - N: 44.22
  - W: -14.4
  - 27.27

Event and Station Map
- GFZ
- ISC via IRIS
- USGS
- EMSC

Use left SHIFT + drag mouse to select regions.

Event and Station List
- Request:
  - Freeze
  - Delete Stations
  - Save Stations
  - Delete Events

Events (2 events)
EIDA interactive portal

- Explore events
- Explore stations
- Submit request
- Download data
- View console

**Select network(s)**

**Select station(s)**

- Station Information
  - Browse Inventory
  - User Supplied

- Networks
  - Year from 1980 to 2017
  - Network Type:
    - All permanent nets
  - Network Code:

- Stations
  - by Code
  - by Region
  - by Events

- Filter stations by region:
  - N: 44.22
  - W: -14.4
  - S: 27.27
  - E: 3.09

- Streams
  - by Code
  - by Sampling

- Choose the desired set of channels: Use SHIFT and CTRL to extend the set.

- Event and Station List
  - Events (2 events)
    - Origin Time
      - 2017-08-17T06:44:56
      - 2017-08-17T14:50:43
    - MAG.:
      - 4.2 mb
      - 4.7 mb
    - Type: N
    - Lat.:
      - 39.02
      - 35.80
    - Long.:
      - -9.08
      - 5.80
    - Depth:
      - 10.00

- Stations (104 stations)
  - Network
    - CA
    - CADI
    - 42.34
    - 1.61
    - BH
    - 42.32
    - 1.00
    - HN
    - 40.62
    - 0.49
  - Station
    - CADI
    - 42.34
    - 1.61

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EIDA interactive portal

download your requested data from different EIDA nodes
## EIDA webservice

<table>
<thead>
<tr>
<th>EIDA webservice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>fdsnws-dataselect</strong></td>
<td>FDSN standardized webservice for mini-SEED waveform data.</td>
</tr>
<tr>
<td><strong>fdsnws-station</strong></td>
<td>FDSN standardized webservice for station metadata.</td>
</tr>
<tr>
<td><strong>eidaws-routing</strong></td>
<td>EIDA standardized webservice for routing between EIDA services.</td>
</tr>
<tr>
<td><strong>eidaws-wfcatalog</strong></td>
<td>EIDA standardized webservice for waveform metadata.</td>
</tr>
</tbody>
</table>

### Table: EIDA Node Status

<table>
<thead>
<tr>
<th>EIDA Node</th>
<th>FDSNWS-Dataselect</th>
<th>FDSNWS-Station</th>
<th>EIDAWS-Routing</th>
<th>EIDAWS-WFCatalog</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODC</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.1.1</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>GFZ</td>
<td>Online 1.1.1</td>
<td>Online 1.1.1</td>
<td>Online 1.1.1</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>RESIF</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>In development</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>INGV</td>
<td>Online 1.1.0</td>
<td>Online 1.1.34.9</td>
<td>Online 1.0.4</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>ETHZ</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.0.3</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>BGR</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.0.3</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>NIEP</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>In development</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>KOERI</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.0.2</td>
<td>Offline</td>
</tr>
<tr>
<td>IPGP</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.0.3</td>
<td>In development</td>
</tr>
<tr>
<td>LMU</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.0.3</td>
<td>Online 1.0.0</td>
</tr>
<tr>
<td>NOA</td>
<td>Online 1.1.0</td>
<td>Online 1.1.0</td>
<td>Online 1.1.1</td>
<td>Online 1.0.0</td>
</tr>
</tbody>
</table>
EIDA webservice: example fdsnws-station

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

<?xml version="1.0" encoding="UTF-8"?>

<Network>
  <Description>Belgian Seismic Network</Description>
  <Site>
    <Name>MEMBACH, BELGIUM</Name>
    <Country>BELGIUM</Country>
  </Site>
  <CreationDate>2006-01-01T00:00:00</CreationDate>
</Network>

<Station>
  <Source>SeisComP3</Source>
  <SenderId>ODC</SenderId>
  <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>
    </Station>
  </Network>
  <Elevation>250</Elevation>
</Site>
</FDSNStationXML>
EIDA webservice: example fdsnws-station

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

<table>
<thead>
<tr>
<th>Network</th>
<th>Station</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>SiteName</th>
<th>StartTime</th>
<th>EndTime</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>BEBN</td>
<td>50.797</td>
<td>5.6778</td>
<td>80.0</td>
<td>Eben-Emael, Belgium</td>
<td>2005-06-24T00:00:00</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>BOST</td>
<td>51.2382</td>
<td>2.9387</td>
<td>3.0</td>
<td>Oostende, Belgium</td>
<td>2010-02-19T00:00:00</td>
<td>2014-05-20T23:59:59</td>
</tr>
<tr>
<td>BE</td>
<td>BOST</td>
<td>51.2382</td>
<td>2.9387</td>
<td>3.0</td>
<td>Oostende, Belgium</td>
<td>2014-05-21T00:00:00</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>MEM</td>
<td>50.6092</td>
<td>6.0067</td>
<td>250.0</td>
<td>MEMBACH, BELGIUM</td>
<td>2006-01-01T00:00:00</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>ROC</td>
<td>50.156</td>
<td>5.228</td>
<td>191.0</td>
<td>ROCHEFORT, BELGIUM</td>
<td>2008-01-01T00:00:00</td>
<td>2015-11-18T11:59:59</td>
</tr>
<tr>
<td>BE</td>
<td>ROC</td>
<td>50.156</td>
<td>5.228</td>
<td>191.0</td>
<td>ROCHEFORT, BELGIUM</td>
<td>2015-11-18T12:00:00</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>UCC</td>
<td>50.79724</td>
<td>4.36038</td>
<td>100.0</td>
<td>Uccle, Brussels, Belgium</td>
<td>1998-04-01T00:00:00</td>
<td></td>
</tr>
</tbody>
</table>
```
EIDA webservice example:

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

```xml
<?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>
      <name>wfcatalog</name>
    </params>
  </datacenter>
</service>
```
EIDA webservices – example clients

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

**Data Metrics**
Graphical interface showing daily waveform metrics.

**Data Availability**
Graphical interface showing daily data availability.

**Waveform Viewer**
Graphical interface showing for viewing waveform data.

**Instrument Response**
Interface showing instrument response characteristics.
EIDA webservice – 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 webservice in development

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>eida federator</strong></td>
<td>webservice to provide catalog of data and services at one EIDA node</td>
</tr>
<tr>
<td><strong>eida mediator</strong></td>
<td>webservice for advanced selection of data across EIDA based on user criteria</td>
</tr>
<tr>
<td><strong>authentication service</strong></td>
<td>webservice for managing user attributes (e.g. authentication)</td>
</tr>
</tbody>
</table>
EIDA dissemination tool

Total megabytes requested and requests by fdsnws-dataselect to 2017-10-20

Date in 2017

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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.


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.

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

RRSM
Shakemap ws

ESM
Manually processed wfs

ESM
Shakemap ws

Integrated European Shakemaps

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Other:

- Various hands on sessions (26/10)

<table>
<thead>
<tr>
<th>Hands-on 1</th>
<th>14:00 – 14:50</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISEL C 2.21</td>
<td>ISEL C 3.01</td>
</tr>
<tr>
<td>EIDA-1</td>
<td>EMSC Services-1</td>
</tr>
<tr>
<td>ISEL C 3.16</td>
<td>ISEL C 3.15</td>
</tr>
<tr>
<td>Site Response-1</td>
<td>StationBook-1</td>
</tr>
<tr>
<td>ISEL C 2.23</td>
<td>ISEL C 3.07</td>
</tr>
<tr>
<td>ESM</td>
<td>Hazard Portal-1</td>
</tr>
<tr>
<td>ISEL F -1.11</td>
<td>Waveform Modeling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hands-on 2</th>
<th>14:50 – 15:40</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISEL C 2.21</td>
<td>ISEL C 3.01</td>
</tr>
<tr>
<td>RRSM</td>
<td>Mobile Pool-1</td>
</tr>
<tr>
<td>ISEL C 3.16</td>
<td>ISEL C 3.15</td>
</tr>
<tr>
<td>Site Response-2</td>
<td>StationBook-2</td>
</tr>
<tr>
<td>ISEL C 2.23</td>
<td>ISEL C 3.07</td>
</tr>
<tr>
<td>EDSF-1</td>
<td>AHEAD-1</td>
</tr>
<tr>
<td>ISEL F -1.11</td>
<td>Waveform Modeling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coffee break</th>
<th>15:40 – 16:10</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Hands-on 3</th>
<th>16:10 – 17:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISEL C 2.21</td>
<td>ISEL C 3.01</td>
</tr>
<tr>
<td>EIDA-2</td>
<td>EMSC Services-2</td>
</tr>
<tr>
<td>ISEL C 3.16</td>
<td>ISEL C 3.15</td>
</tr>
<tr>
<td>Mobile Pool-2</td>
<td>AHEAD-2</td>
</tr>
<tr>
<td>ISEL C 2.23</td>
<td>ISEL C 3.07</td>
</tr>
<tr>
<td>EDSF-2</td>
<td>Hazard Portal-2</td>
</tr>
<tr>
<td>ISEL F -1.11</td>
<td>Waveform Modeling</td>
</tr>
</tbody>
</table>

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