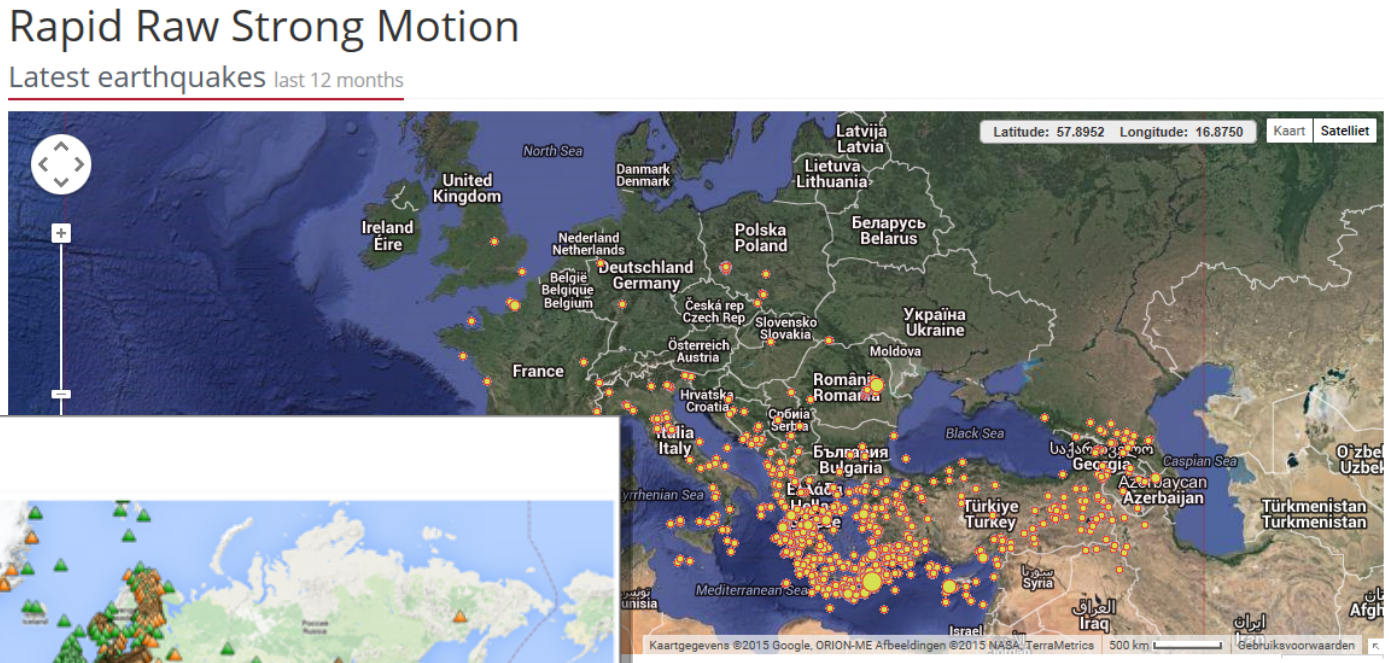
ORFEUS EIDA related products (2): RRSM and Station Book

joint developments by ORFEUS Data Center/KNMI (1) and ETHZ-SED (2) within NERA

Reinoud Sleeman [1], Carlo Cauzzi [2], Jordi Domingo Ballesta [1], Philipp Käestli [2], Odysseus Galanis [1], John Clinton [2]



RRSM and StationBook resulted from NERA

NERA WP3 (NA3) main objectives:

• **Network** the main **accelerometric observatories** in the larger Euro-Mediterranean region, and expand the collection, storage and near real-time access to strong-motion data for the whole region.

• **Foster the interaction** between accelerometric networks in Europe through exchange of data, knowledge and experience.

• **Improve** accelerometric data documentation and station **information** (accurate and up-to-date metadata).

• Build European integrated **data banks of strong-motion** records and associated metadata relevant to earthquake engineering and seismology communities reflecting the state of the art and research needs in these fields.

• **Spread information** to the seismological and engineering community in Europe and surrounding countries.

NERA NA3 key products (services)

- **Station Inventory service**

  up-to-date station information ("Station Book") for strong motion and broad-band stations operational in Europe (station metadata, site characterization); ORFEUS WG-I

- **Rapid Raw Strong Motion service (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 gathered after a significant earthquake in Europe.

- **Engineering Strong Motion service (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

Motivation for RRSM

- a **common service** for seismology, engineering seismology and earthquake engineering communities

- to provide **non-delayed, open access** to rapidly available, high quality seismological and engineering data within minutes after a significant earthquake:
  - *raw waveform data*
  - *engineering parameters (e.g. PGA, PGV, response spectra)*
  - *station and site metadata*

- using and relying on a mature and sustainable data archive organization within ORFEUS: European Integrated Data Archive (**EIDA**)

- using professional software: **SeisComP3** (SC3), SC3 SM extension, "*scwfparam*"

- providing reliable **interfaces** (RRSM web interface & [web services])

- RRSM is developed to bridge the time gap between near real-time and delayed manual reviewed data products.

RRSM service = automated acquisition and processing + interface (GUI)

EIDA – European Integrated Data Archive

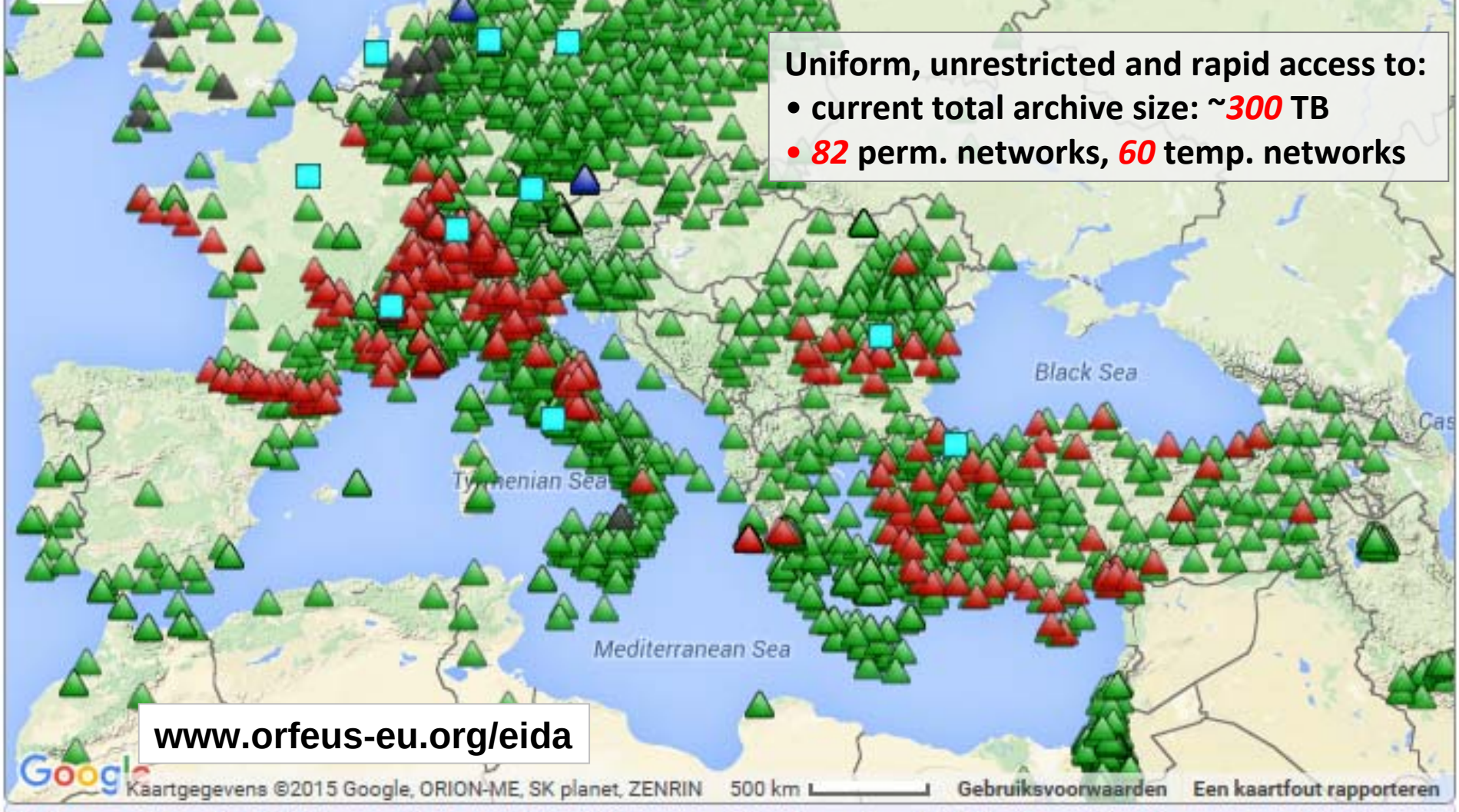
RRSM and StationBook are built on the existing distributed seismological data archives infrastructure in ORFEUS: ***EIDA***

- EIDA is a consortium of large datacenters (EIDA primary nodes) that signed an MoU with ORFEUS (est. Nov 2013; currently 8 nodes).

- 2 EIDA secondary nodes did not sign the MoU but provide direct connection to their archives.

- Each primary node commits to contribute resources to the development and maintenance of the system (both hardware and manpower: IT, seismologists) leading to distributed load, technical expertise and support.

www.orfeus-eu.org/eida



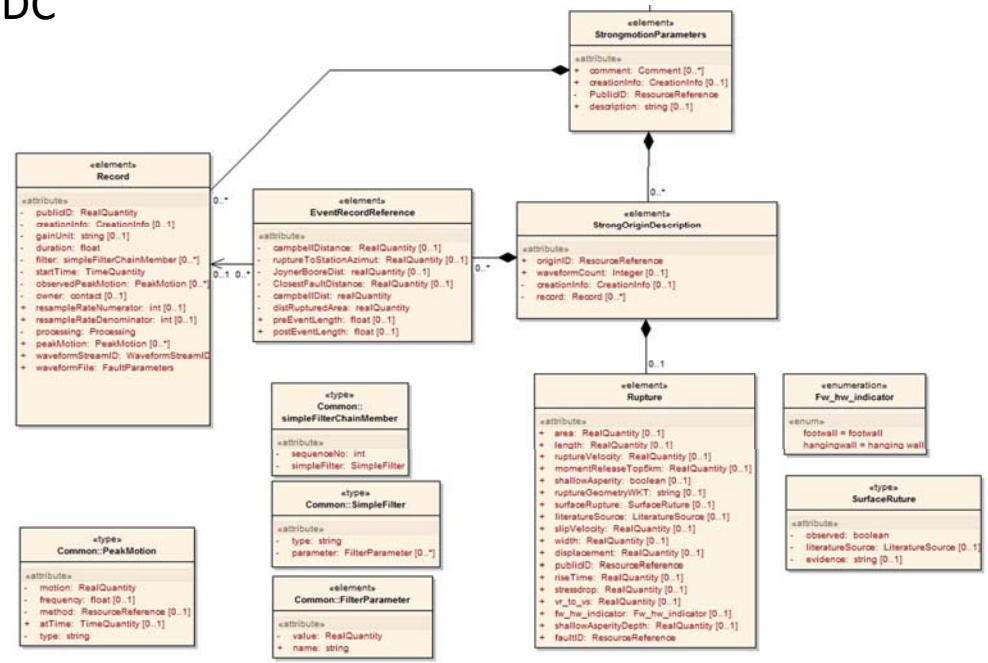
This map shows EIDA stations with unrestricted data access (total number: **5042**). Green triangles represent stations with velocity sensors (**4510**), red triangles are stations with accelerometers (**487**) and blue triangles indicate stations with infrasound sensors (**29**). The black triangles indicate other sensor types (**16**). ORFEUS Data Center updates this map daily (last update: **2015-09-16 12:18:02**).

☑ velocity (m/s) ☑ accel. (m/s^2) show station name labels ☐

☑ infrasound (pa) ☑ other ☑ EIDA node Map: station sensor types

RRSM development within NERA

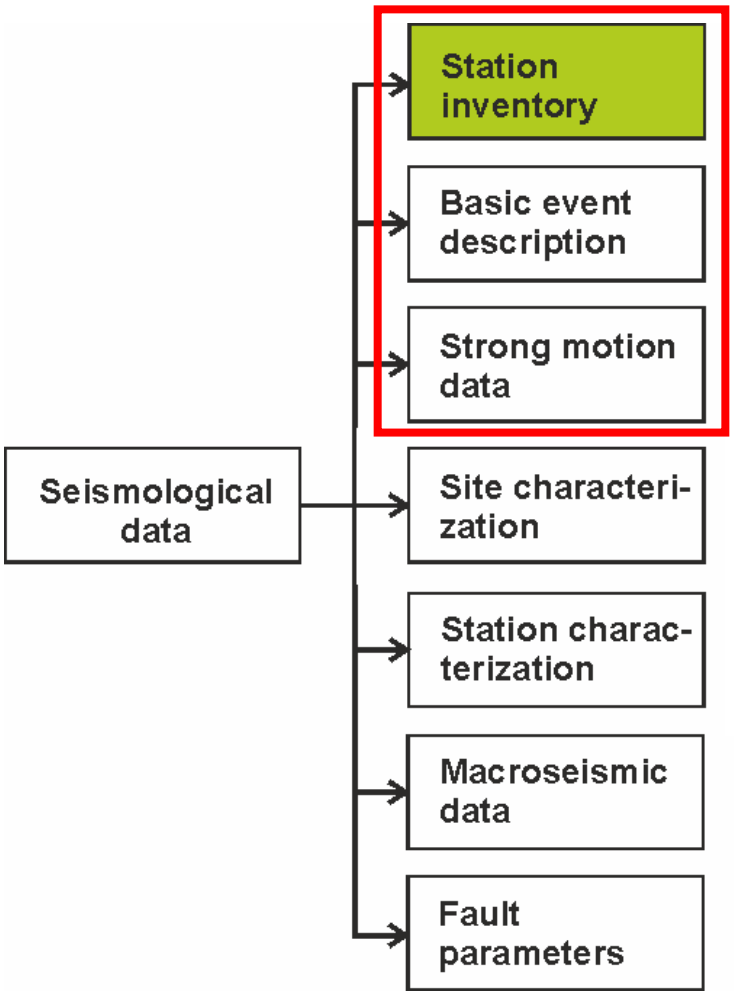
- ETH designed and developed a **data model** for strong-motion data and metadata for the SC3 database and a automatic processing module '***scwfparam***'
- Module '***scwfparam***' implemented in SC3 by GEMPA.
- **RRSM GUI** developed by ODC
- RRSM operated and maintained @ ODC



SeisComP3

Online documentation: http://www.seiscomp3.org/wiki/doc/applications/scwfparam

RRSM datamodel



SC3 datamodel (e.g. stations, affiliation, response)

*Filled trough automated **EIDA** synchronization*

QuakeML & SC3 data model (origin, picks, mag)

*For RRSM: provided by **EMSC***

NA3 extended event and strong motion info (e.g peak values). *Filled by '**scwfparam**' real-time processing.*

To be filled in by **network/station operator** through webinterface (part of StationBook, in development)

Auxilliary information types (e.g. NA3 description of triggered fault)

SeisComP3 Datamodel Extensions for Strong-Motion Data and Metadata

RRSM core processing: scwfparam

Waveform extraction for **SM and BB** data

- Scheduling
  - automatic start
  - offline start
- Waveform query
  - magnitude
  - distance
- Check on new waveforms
- Selection of waveforms to be processed
  - sensor check
  - saturation check
  - sta/lta check
  - co-location check
- Differentiation of velocity traces

Processing scheme

- Aftershock removal (Figini, 2006; Paolucci et al., 2008)
- Pre-event cut-off
- Baseline removal
- Restitution / sensitivity
- correction
- Bandpass filtering (zero padding after Boore, 2005)
- Computation of PGA
- Integration
- Computation of PGV
- Processed waveform archival (optional)

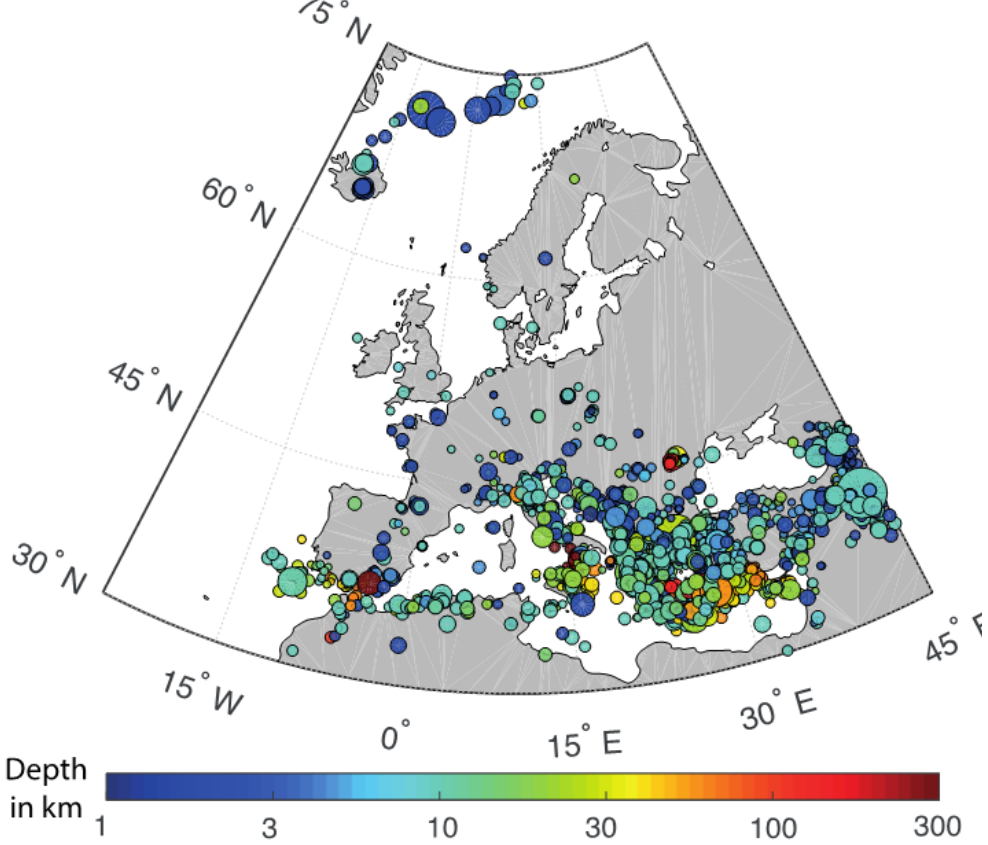
Computation of engineering parameters

- Displacement response spectra
- Pseudo-acceleration response spectra
- Duration based on Arias intensity
- USGS Shakemap input

- peak ground acceleration (PGA)
- peak ground velocity (PGV)
- relative displacement elastic resp. spectr. (DRS; 5% damped)
- pseudo absolute acceleration elastic resp spectr (PSA; 5% damped)
- supports ShakeXML output

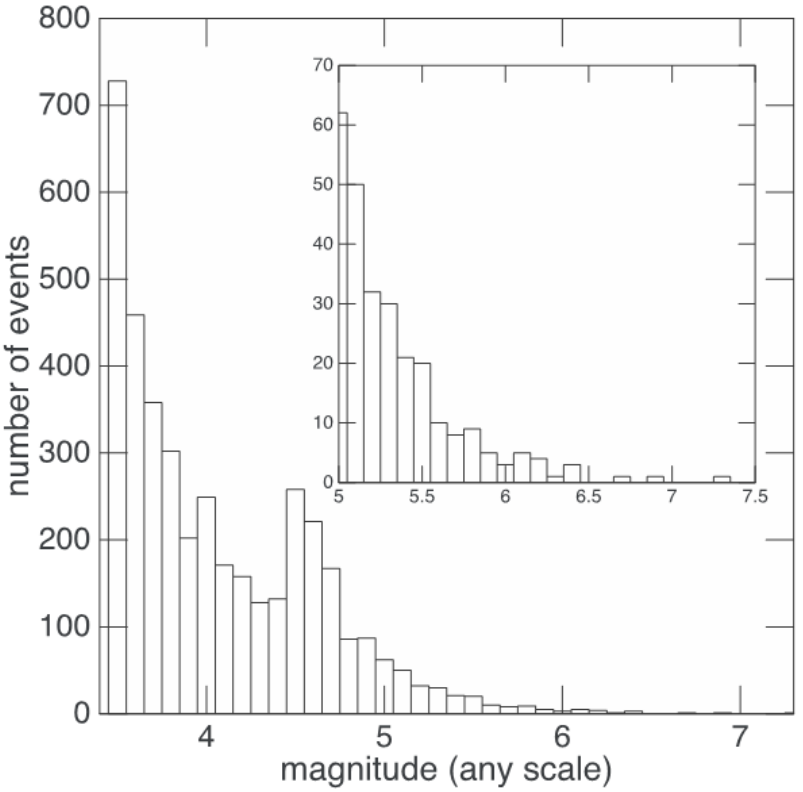
RRSM key features / configuration

- Provides open access to earthquake (strong motion) waveforms and derived engineering parameters within minutes after an earthquake
- Triggered by EMSC earthquake notifications (M >= 3.5; Lat 27^{o}N – 81^{o}N; Lon 32^{o}W – 51^{o}E)
- Automatically and scheduled populated in near real-time (EMSC trigger, OT + 5 min, OT + 15 min, OT + 1 hour, OT + 3 hours, OT + 6 hours, OT + 1 day)
- Jan 2005 – Dec 2011: M 4.5 +
  Jan 2011 – present: M 3.5 +

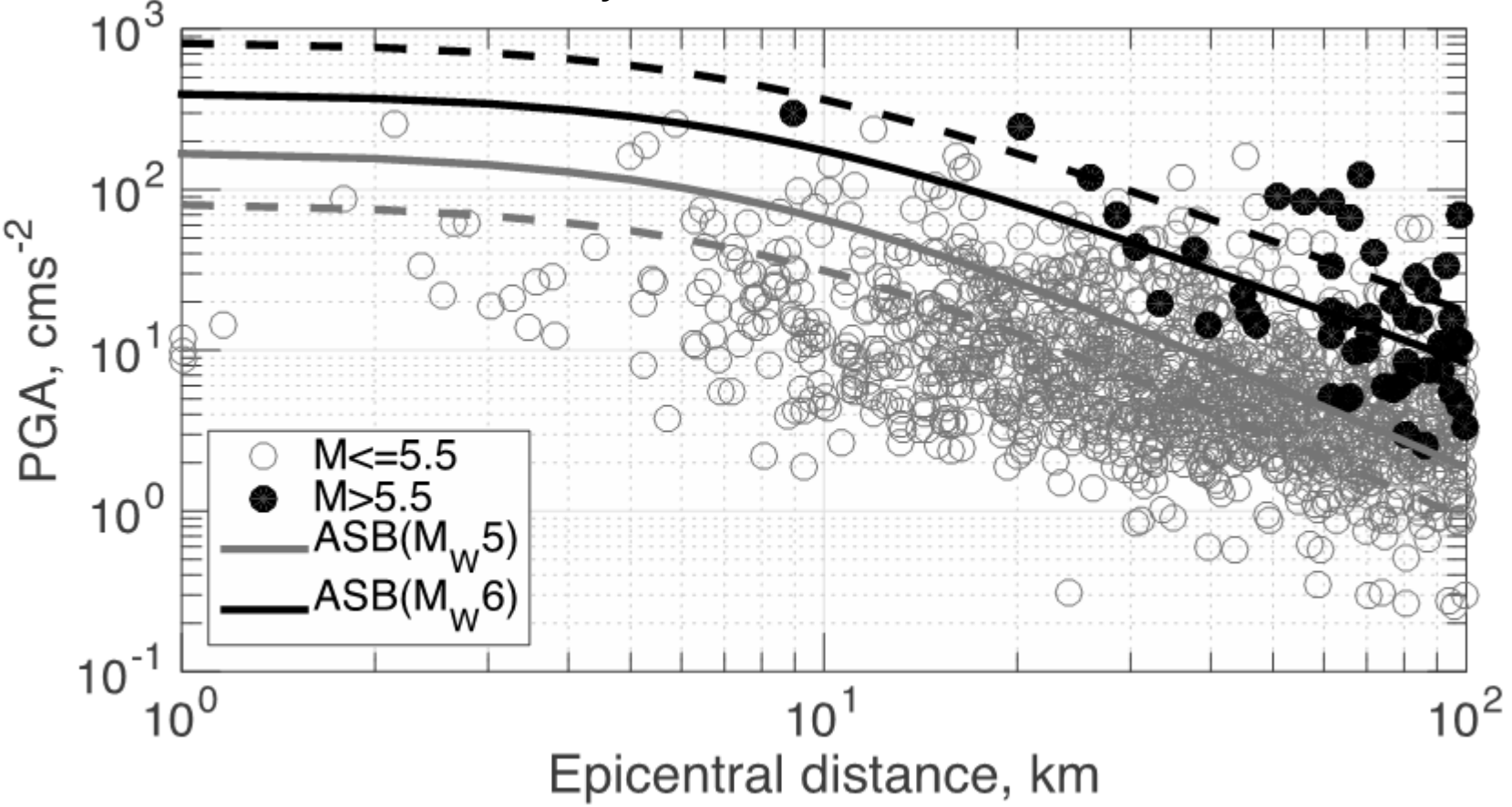


RRSM currently contains:

- 4200 events (1100 with M > 4.5)
- 135000 processed waveforms



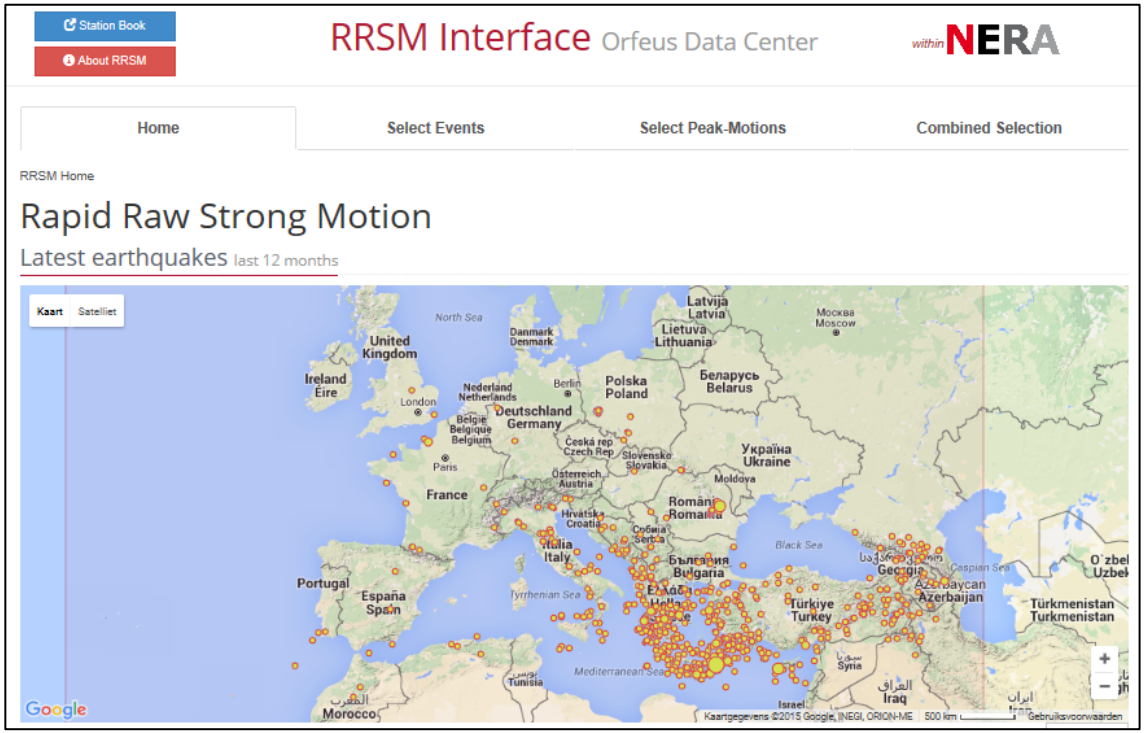
Summary of contents of RRSM

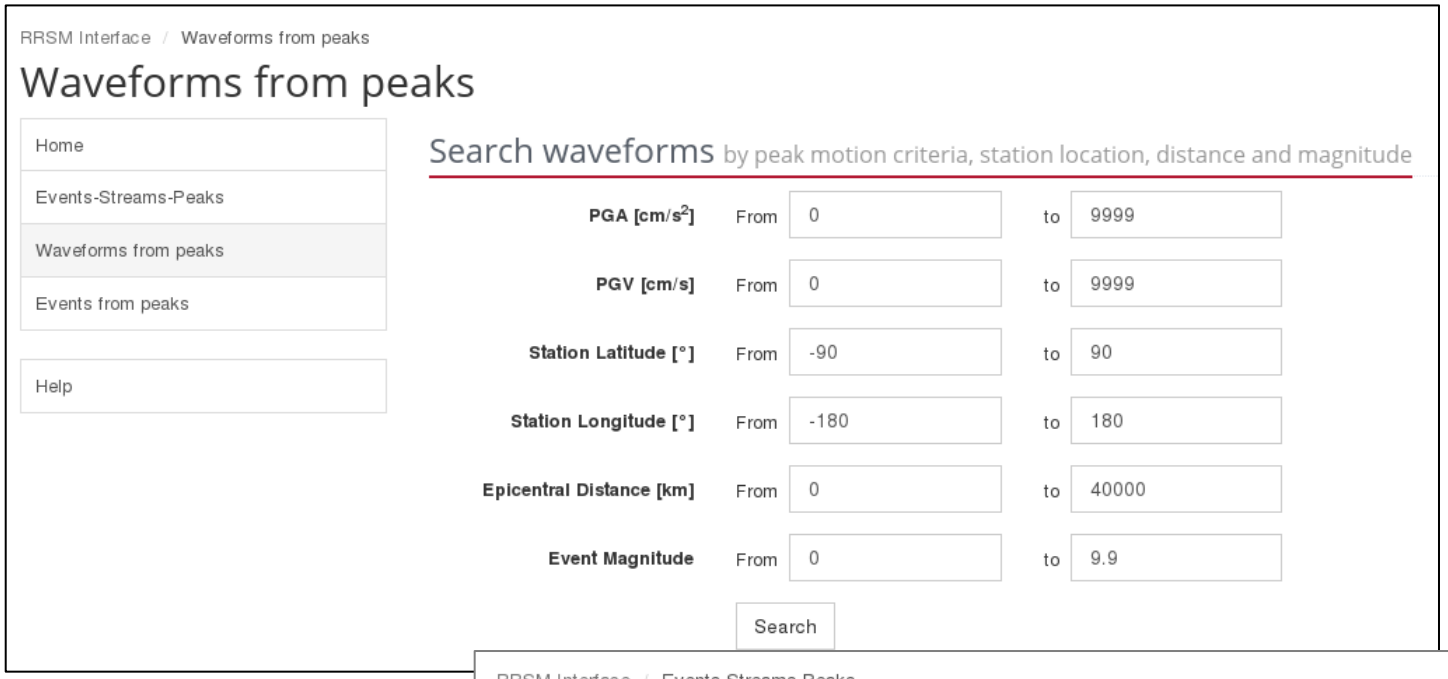


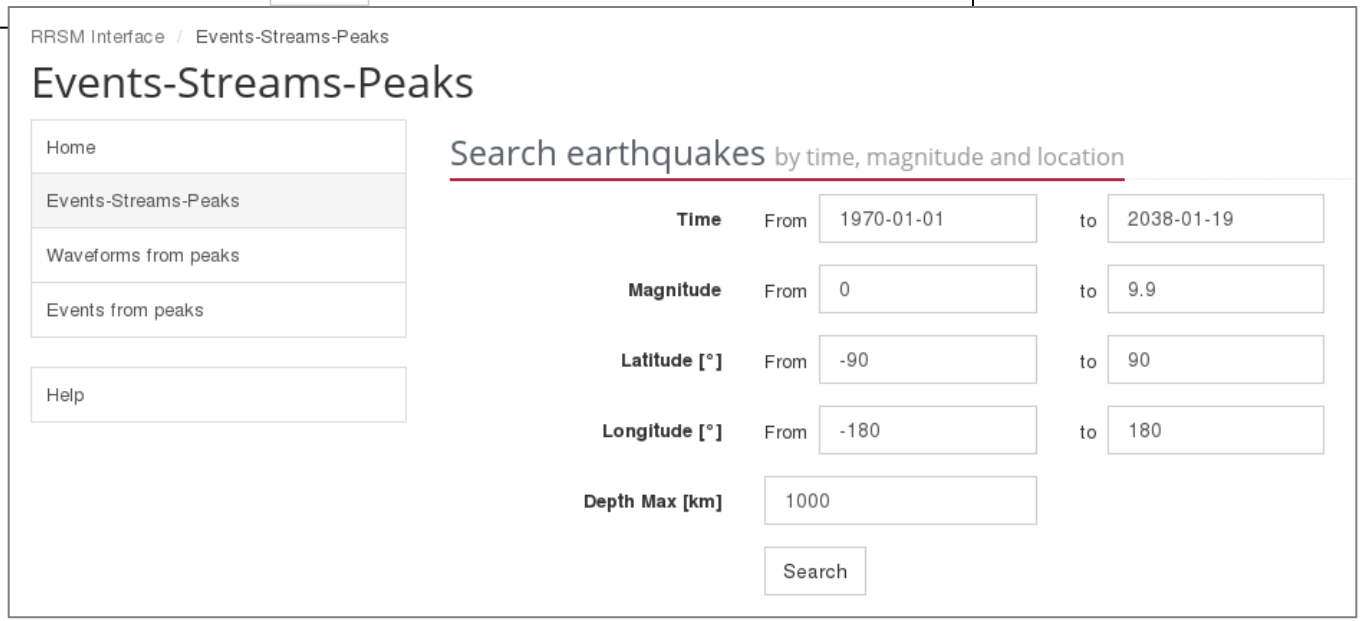
Attenuation of PGA with epicentral distance for events with minimum magnitude larger than 4.5 (any scale). The solid curves are the median predictions of Akkar et al. (2014) for MW5 (grey) and MW6 (black) strike-slip events and $V_{S,30}$ = 800 m/s.

RRSM web-interface (ODC/ETH): www.orfeus-eu.org/rrsm

- retrieving peak-motion values, based on a selection of events and streams
- selecting events, based on peak-motion boundary criteria on specific streams
- selecting data streams, based on peak-motion criteria for specific events




RRSM Interface / Waveforms from peaks
Waveforms from peaks
Home
Events-Streams-Peaks
Waveforms from peaks
Events from peaks
Help
Search waveforms by peak motion criteria, station location, distance and magnitude
PGA [cm/s²] From 0 to 9999
PGV [cm/s] From 0 to 9999
Station Latitude [°] From -90 to 90
Station Longitude [°] From -180 to 180
Epicentral Distance [km] From 0 to 40000
Event Magnitude From 0 to 9.9
Search


RRSM Interface / Events-Streams-Peaks
Events-Streams-Peaks
Home
Events-Streams-Peaks
Waveforms from peaks
Events from peaks
Help
Search earthquakes by time, magnitude and location
Time From 1970-01-01 to 2038-01-19
Magnitude From 0 to 9.9
Latitude [°] From -90 to 90
Longitude [°] From -180 to 180
Depth Max [km] 1000
Search

RRSM Interface / Waveforms from peaks / Results

< Go Back

Results

List of waveforms (event-station combinations)

Showing **1** to **10** of **4,704** rows

<< Previous Next >>

Display 10 rows

Event Time (UTC) & Mag	Station	Lat [°]	Lon [°]	Epi. dist. [km]	Max* PGA [cm/s^2]	Max* PGV [cm/s]	Detail
2014-05-08 05:26:10 Mag=3.9	SJ.BBLS	43.865 N	19.406 E	65.35	0.3160	0.0078	streams
2014-05-08 05:26:10 Mag=3.9	SJ.BEO	44.809 N	20.471 E	192.97	0.8844	0.0232	streams
2014-05-08 05:26:10 Mag=3.9	MN.BLY	44.749 N	17.184 E	236.90	0.0138	0.0007	streams
2014-05-08 03:54:32 Mag=3.6	PL.OJC	50.220 N	19.798 E	53.56	0.0693	0.0043	streams
2014-05-08 03:54:32 Mag=3.6	CZ.OKC	49.838 N	18.147 E	74.36	0.0078	0.0004	streams
2014-05-08 03:54:32 Mag=3.6	CZ.MORC	49.777 N	17.543 E	116.32	0.0544	0.0026	streams
2014-05-08 03:54:32 Mag=3.6	GE.MORC	49.777 N	17.543 E	116.32	0.0133	0.0006	streams
2014-05-08 03:54:32 Mag=3.6	PL.NIE	49.419 N	20.313 E	123.27	0.0221	0.0009	streams
2014-05-08 03:54:32 Mag=3.6	CZ.JAVC	48.859 N	17.671 E	176.52	0.0023	0.0002	streams
2014-05-08 03:54:32 Mag=3.6	SK.VYHS	48.494 N	18.836 E	187.01	0.0009	0.0001	streams

Showing **1** to **10** of **4,704** rows

<< Previous Next >>

Copy CSV Excel PDF Print

Download raw waveforms

Filter rows:

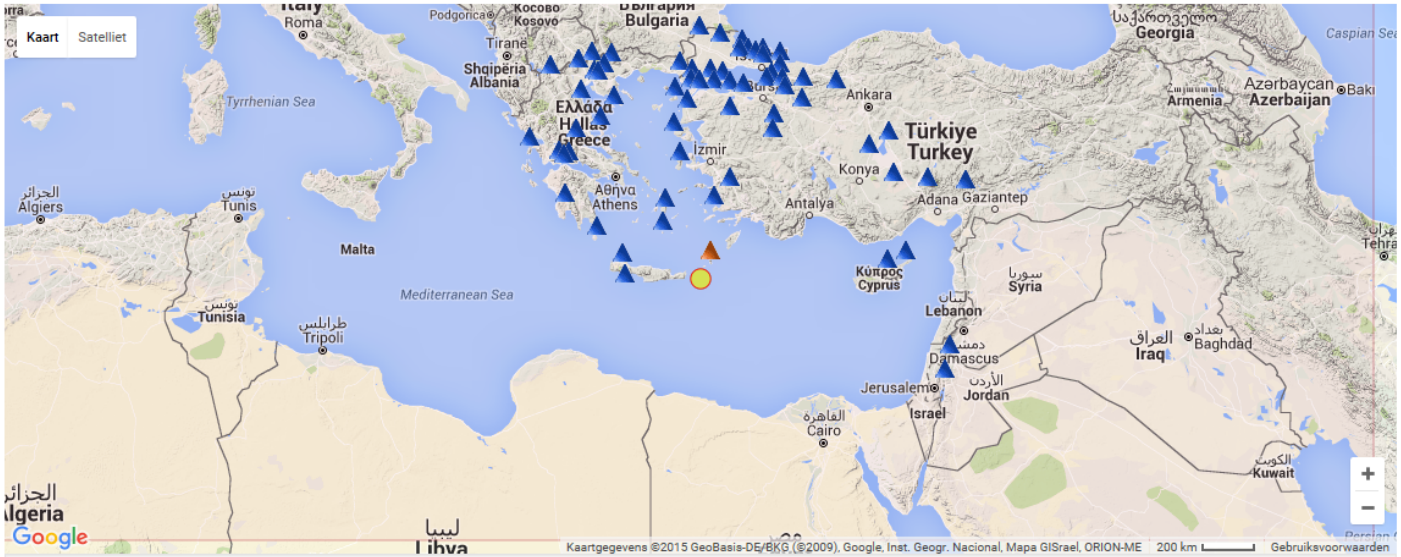
6143 ms

(*) Maximum PGA/PGV of the fetched streams of the station

Earthquake data

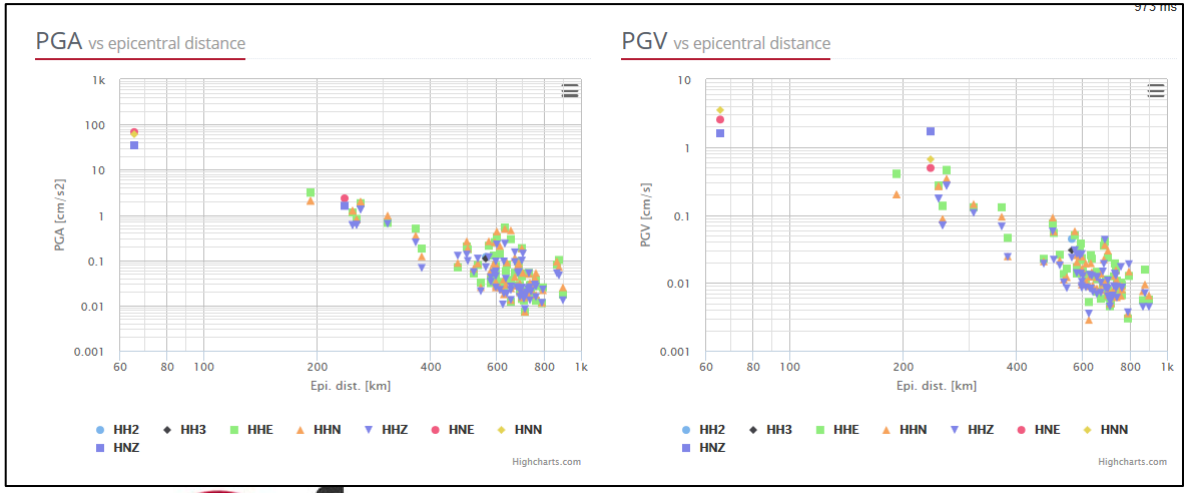
Event ID	42676249 (EMSC 436951)	**Latitude [°]**	35.030 N	**Waveform Count**	207
Origin Time (UTC)	2015-04-16 18:07:44	**Longitude [°]**	26.810 E	**Max PGA [cm/s²]**	68.011
Magnitude	6.1 (mw)	**Depth [km]**	30	**Max PGV [cm/s]**	3.5197

Stations with peaks



PGA values [cm/s²]

unprocessed / outlier | from 0 to 10 | from 10 to 20 | from 20 to 50 | from 50 to 100 | from 100 up



Earthquake data

Event ID	42676249 (EMSC 436951)	**Latitude [°]**	35.030 N	**Waveform Count**	207
Origin Time (UTC)	2015-04-16 18:07:44	**Longitude [°]**	26.810 E	**Max PGA [cm/s²]**	68.011
Magnitude	6.1 (mw)	**Depth [km]**	30	**Max PGV [cm/s]**	3.5197

Station data

Station (Net.Sta.)	HL.IMMV (Station Book)	**Latitude [°]**	35.460 N	**Epi. Dist. [km]**	261.377
Country	Greece	**Longitude [°]**	23.980 E	**Max PGA [cm/s²]**	1.971
Station Name	Varypetro	**Elevation [m]**	88	**Max PGV [cm/s]**	0.4588

Streams with peaks

Stream	Units	PGA [cm/s²]	PGV [cm/s]	PSA@T=0.3s	PSA@T=1.0s	PSA@T=3.0s	Damping	Filter description
HHE	M/S	1.815	0.4588	4.141025	7.350713	1.154014	5 %	acausal_bandpass, order 4, freq 0.05 - 40 Hz
HHN	M/S	1.971	0.3407	4.096045	6.490190	1.349681	5 %	acausal_bandpass, order 4, freq 0.05 - 40 Hz
HHZ	M/S	1.316	0.2696	4.549539	4.601502	0.609634	5 %	acausal_bandpass, order 4, freq 0.05 - 40 Hz

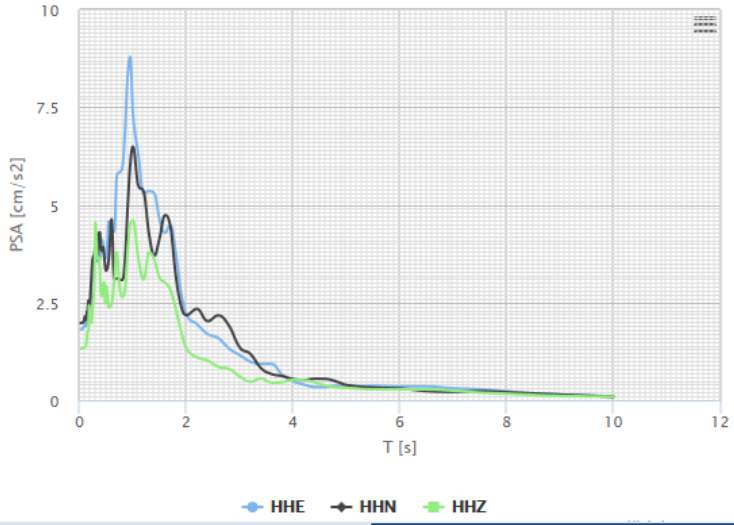
Copy CSV Excel PDF Print

Download raw waveforms

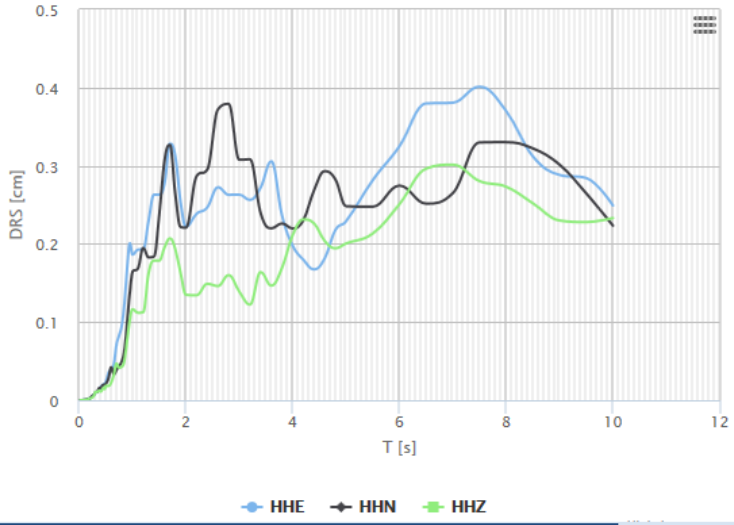
Filter rows:

96 ms

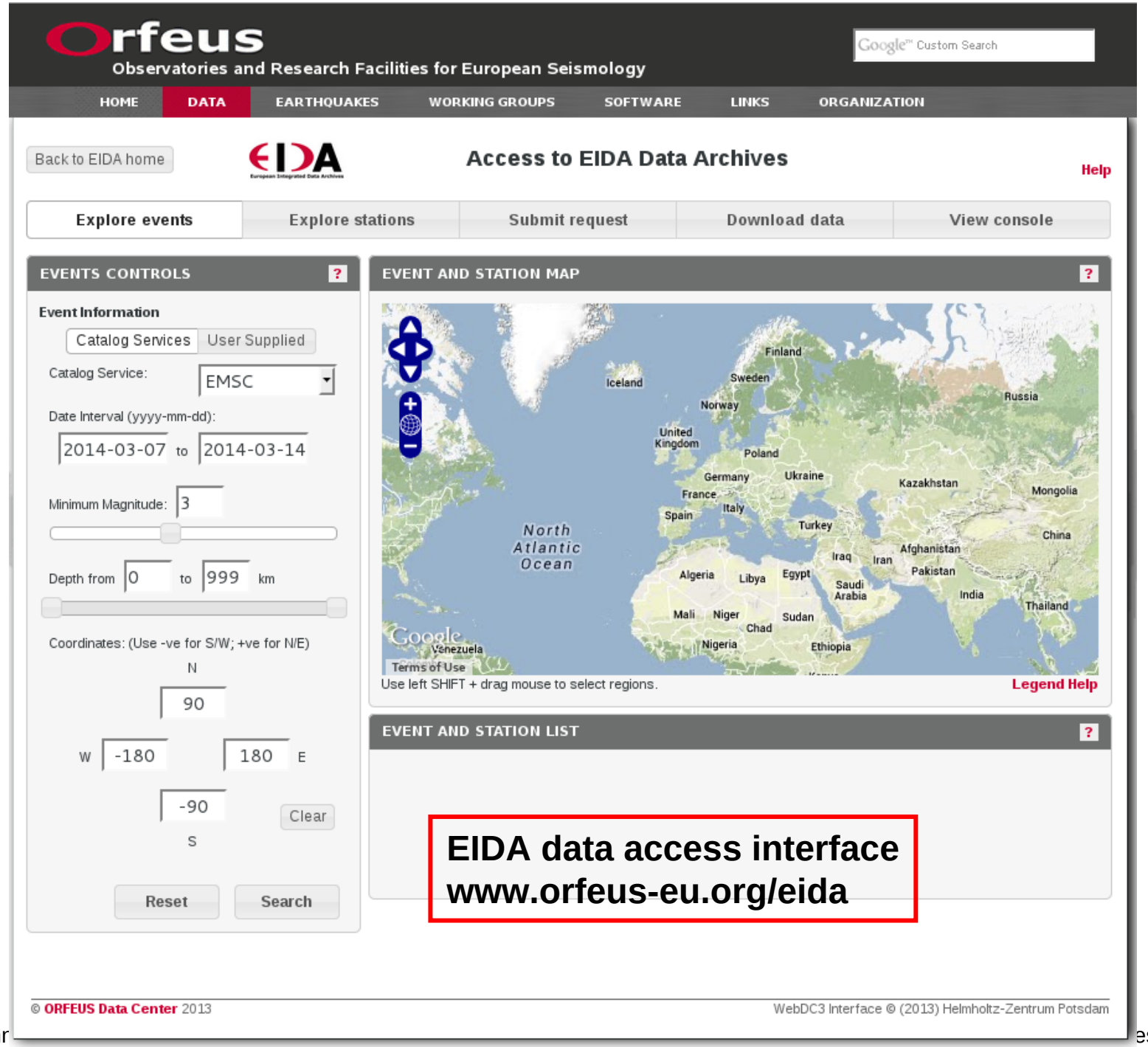
Pseudo-Spectral Acceleration (5% damping)



Displacement Response Spectra (5% damping)

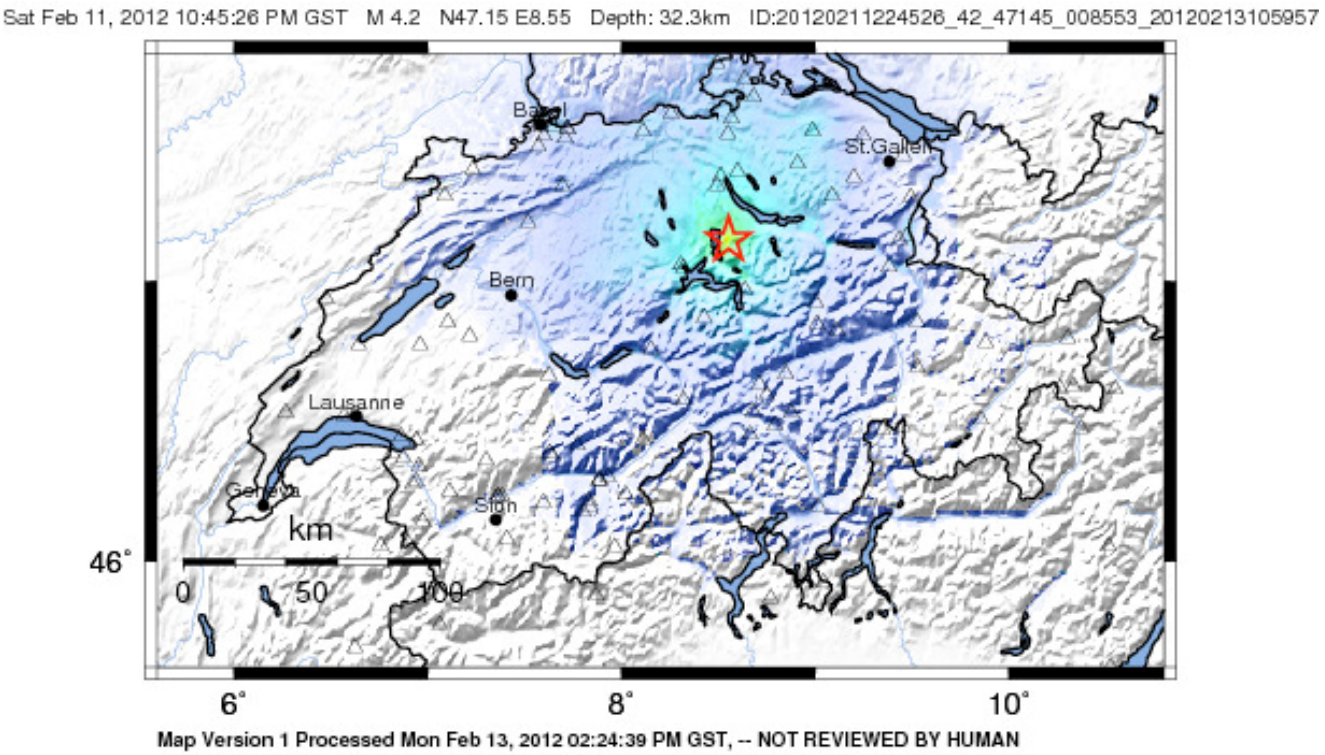


Brings you to the EIDA data download page


Orfeus
Observatories and Research Facilities for European Seismology
Google™ Custom Search
HOME
DATA
EARTHQUAKES
WORKING GROUPS
SOFTWARE
LINKS
ORGANIZATION
Back to EIDA home
EIDA
Access to EIDA Data Archives
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):
2014-03-07
to
2014-03-14
Minimum Magnitude:
3
Depth from
0
to
999
km
Coordinates: (Use -ve for S/W; +ve for N/E)
N
90
W
-180
180
E
-90
S
Clear
Reset
Search
EVENT AND STATION MAP
Finland
Iceland
Sweden
Norway
Russia
United Kingdom
Poland
Germany
Ukraine
Kazakhstan
Mongolia
France
Spain
Italy
Turkey
China
North Atlantic Ocean
Afghanistan
Iraq
Iran
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
India
Thailand
Mali
Niger
Sudan
Chad
Nigeria
Ethiopia
Venezuela
Google
Terms of Use
Use left SHIFT + drag mouse to select regions.
Legend Help
EVENT AND STATION LIST
EIDA data access interface
www.orfeus-eu.org/eida
© ORFEUS Data Center 2013
WebDC3 Interface © (2013) Helmholtz-Zentrum Potsdam

From Scwfparam to ShakeMap

GENERATION OF BASIC USGS-STYLE SHAKEMAP INPUT



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Station Inventory - www.orfeus-eu.org/stationbook

Up-to-date Station Inventory for strong motion and broad-band stations operational in Europe: station metadata, site characterization

- coordination with ORFEUS WG-I
- coordination with EIDA (up-to-date station metadata and waveforms)
- access for network operators (up-to-date site metadata)

history: prototype developed (WG-I; GFU) for viewing
present: StationBook at ODC (integration with RRSM and editing tools)

2-stage metadata gathering policy:

- Inventory automatically filled/updated through EIDA (SEED metadata)
- non-SEED metadata needs to be inserted (interactively) by network operator

European Station Book

All stations by time frame

Connected to synchronized EIDA Inventory DB. Currently synchronized daily by ArcLink. Implementation of using fdsnws-station in progress.

Station Detail

- Select by Network
  - Network DK
    - Station ILUG
      - *Description*
      - *Station Details*
      - *Station Pictures*
      - *Housing & Building details*
      - *Instrumentation History*
      - *Borehole*

Metadata files EIDA

- Dataless SEED
- SC3 Inventory XML
- FDSN Station XML

Description EIDA data & Ownership

Network	DK	**Latitude [°]**	69.217000 N	**Country**	Greenland
Station Code	ILUG	**Longitude [°]**	51.108000 W	**Station Name**	Ilulissat
Affiliation	-	**Elevation [m]**	45	**Description**	Station Ilulissat, Greenland
Shared / Restric.	Yes / No	**Owner Name**	-	**Owner Phone**	-
Start	2004	**Owner Department**	-	**Owner Email**	-
End	2006	**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_1,S_2; *more info here*

Groundwater Depth [m] -

Vs 30 [m/s] -

f_0 [Hz] -

Fundamental frequency at the site

Amp(f_0) -

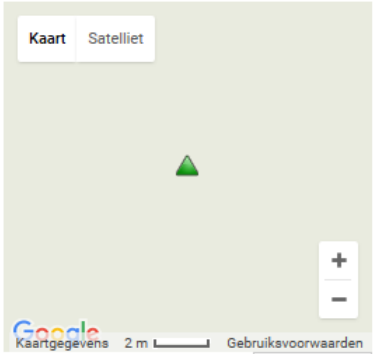
H/V amplitude at f_0

Basin Flag -

Bedrock Depth [m] -

Depth to the engineering bedrock (with Vs ~ 800 m/s)

Map



Legend ▲

1 ms

Station Pictures

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]
--	BHE,BHN,BHZ	50.764000 N	5.931700 E	135	1993	-	-	-	-	-	-
00	BHE,BHN,BHZ	50.764000 N	5.931700 E	135	1993	-	-	-	-	-	-
01	BHE,BHN,BHZ	50.764000 N	5.931700 E	135	1993	-	-	-	-	-	-
02	BHE,BHN,BHZ	50.764000 N	5.931700 E	135	1993	-	-	-	-	-	-

(*) 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)

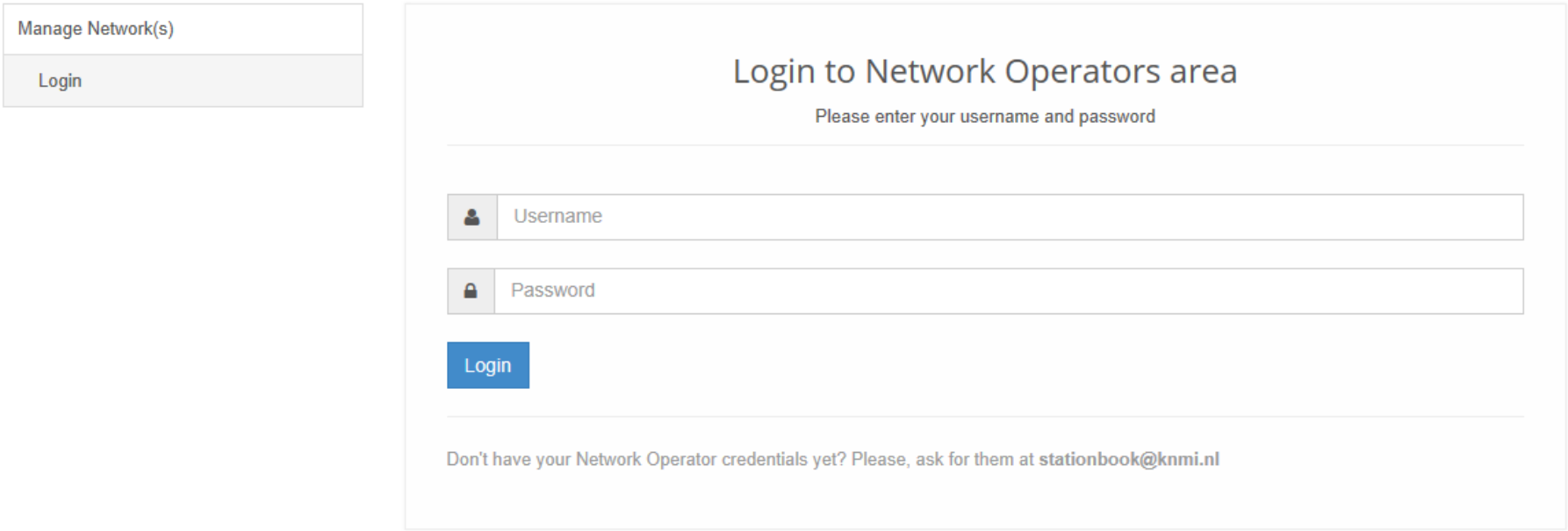
Showing **1** to **10** of **12** rows

<< Previous Next >>

Display 10 rows

Loc	Stream	Loc TimeFrame	Stream TimeFrame	Datalogger	Sensor	Gain	Unit	Type
	BHE	1993-11-03 / -	1993-11-03 / 2003-10-24	HGN.1993.307.H	STS-1	801102000	M/S	
	BHN	1993-11-03 / -	1993-11-03 / 2003-10-24	HGN.1993.307.H	STS-1	808000000	M/S	
	BHZ	1993-11-03 / -	1993-11-03 / 2003-10-24	HGN.1993.307.H	STS-1	814301000	M/S	
00	BHE	1993-11-03 / -	2003-02-04 / 2003-10-24	HGN.2003.035.H00	STS-2	612983000	M/S	
00	BHN	1993-11-03 / -	2003-02-04 / 2003-10-24	HGN.2003.035.H00	STS-2	622733000	M/S	
00	BHZ	1993-11-03 / -	2003-02-04 / 2003-10-24	HGN.2003.035.H00	STS-2	611202000	M/S	
01	BHE	1993-11-03 / -	2003-10-24 / 2009-04-27	HGN.2003.297.H01	STS-1	937454000	M/S	

Network Operator Login



Solid future for RRSM / StationBook

- Embedded in a long term existing, large scale, solid community and coordinated at the European level: ORFEUS
- Build on the ORFEUS infrastructure for a distributed data archive system (EIDA) which strongly benefits from distributed resources and maintenance, as well as commonly developed tools and services to collect, process and provide rapidly high-quality data automatically.
- EPOS; EIDA is a core component of EPOS Seismology (long term strategy for sustainability and support) and the test service to define and establish compliance with EPOS TCS
- Build on SC3 software (widespread, broad support and maintenance, active users group)
- Triggered system based on quick alerts disseminated by EMSC/CSEM

RRSM benefits for data providers

- Embedded in **European infrastructure** (solid future**,** long term support)

- Uniform, proper and clear **acknowledgements** of data providers and their affiliations
  - European scale: ORFEUS, EIDA, StationBook, EUDAT(PID)
  - Global scale (FDSN network code, DOI)
  - detailed data statistics (EIDA)

- **High visibility** and increased use of data, through:
  - the use of novel technology in a distributed data archive system to provide traceable, transparent and homogeneous access to open data (support for restricted data)
  - support of different technologies (web portal, automated procedure, webservices) to retrieve data
  - allowing user specific search criteria and improved access to data
  - support of different data formats

- **Assures** availability and use of up-to-date, **high quality** metadata.