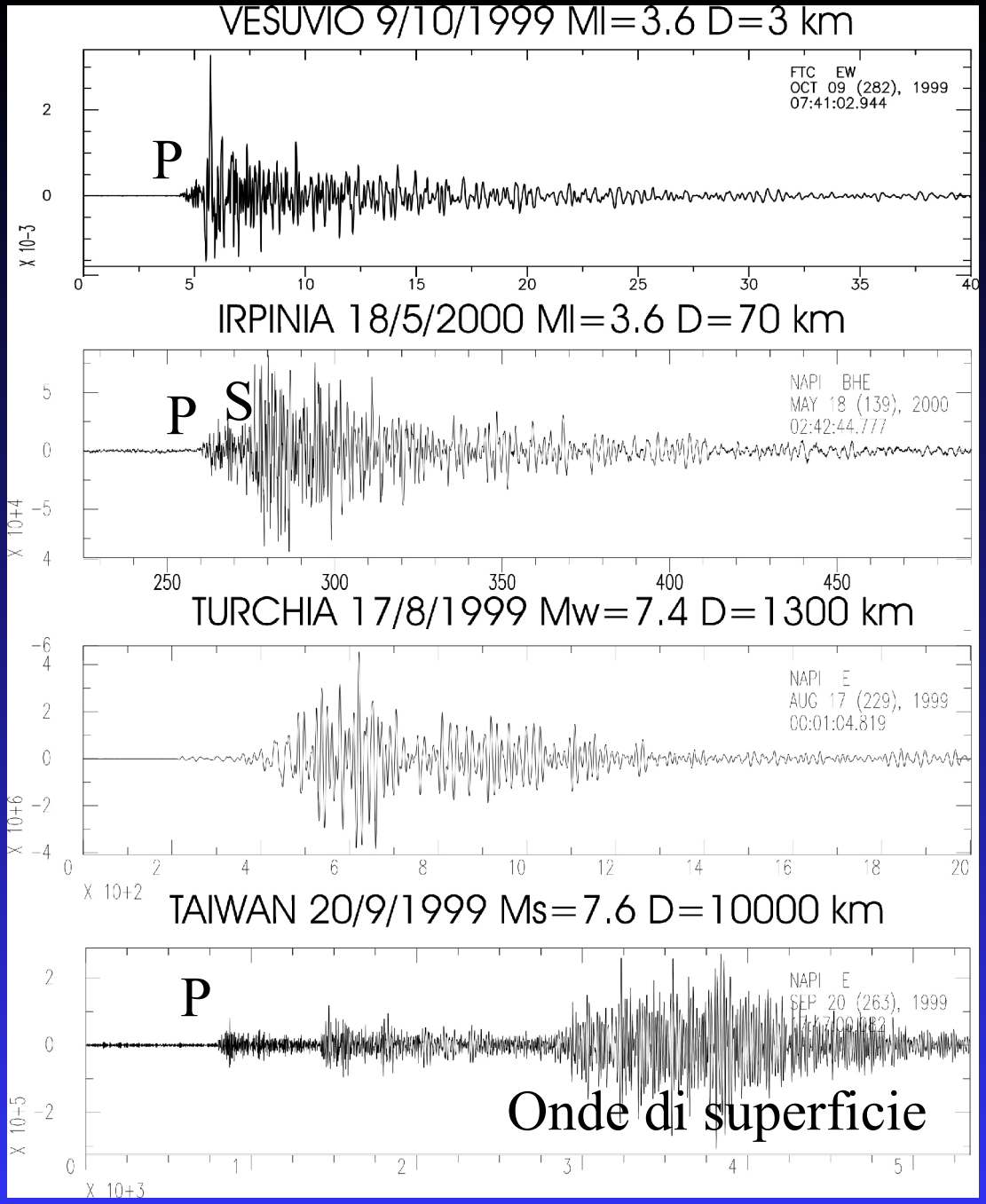
Data : What a mistery

Gaetano Festa & Caroline Francois-Holden

RECORDS vs DISTANCE



Near fault

Local

Regional

Teleseimic

INSTRUMENTS

Accelerometers

Large dynamic range – High frequency (central frequqncy 1-2 Hz, band 0.5-20 Hz)

Near source records, structure vibrations

Seismometers

Low frequency (central frequency 1 Hz, band 0.5 – 4 Hz)

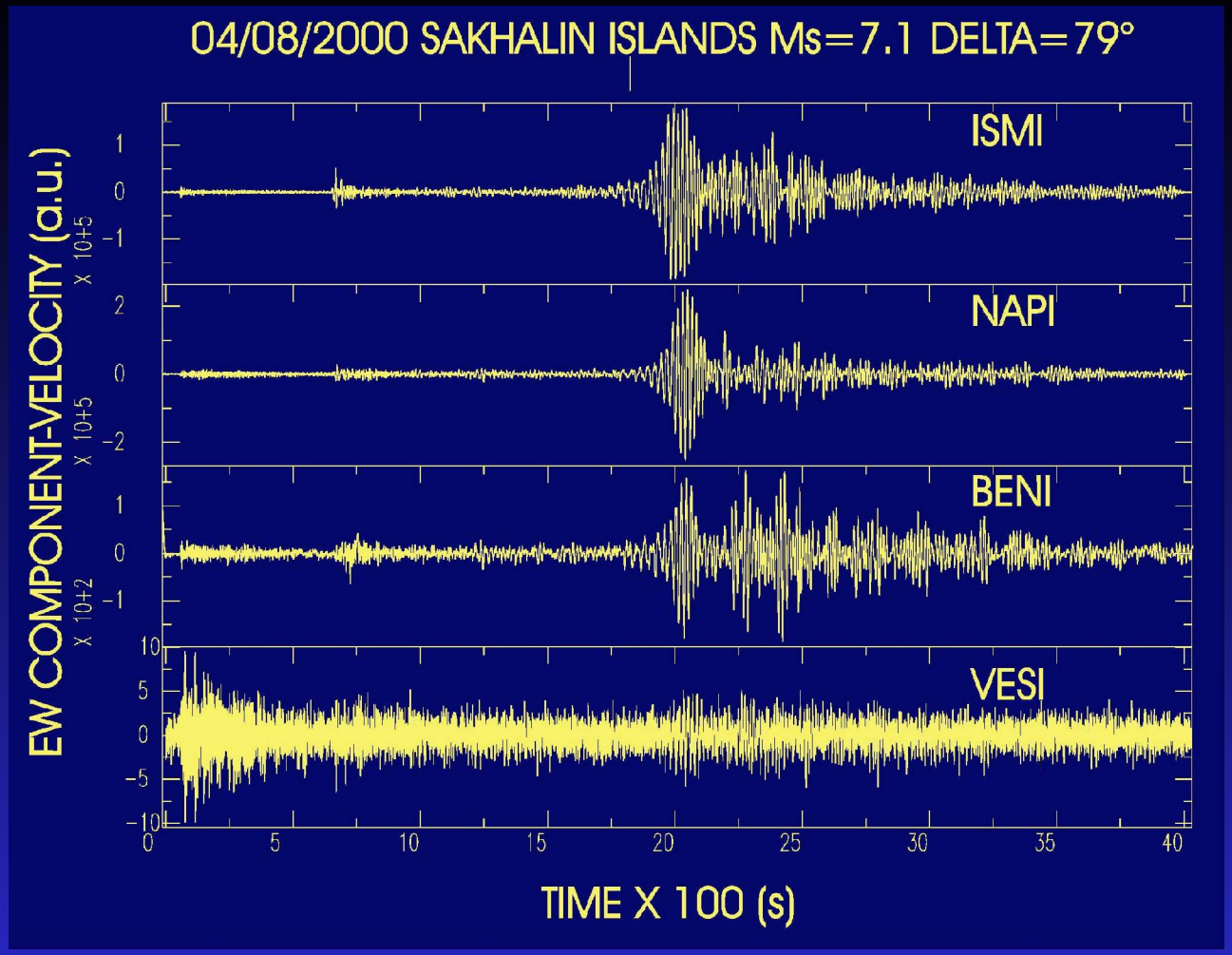
Weak motion, active seismics, regional records

Broad-band sensors

Large response curve, very-low frequency (band 20 s-20 Hz)

Teleseismic records, didactics instruments

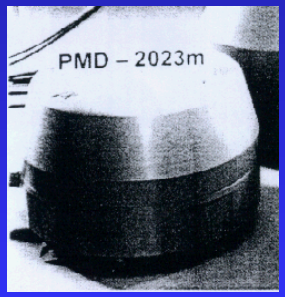
INSTRUMENTS



ISMI e **NAPI** broad-band sensors (PMD)

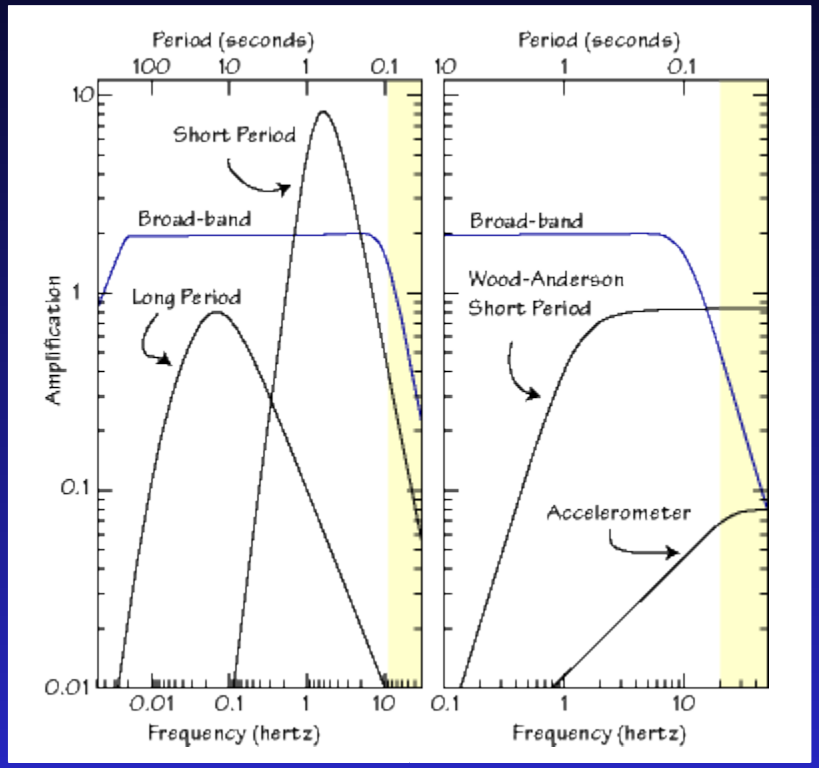
BENI accelerometer (EPISENSOR)

VESI short-period geophon



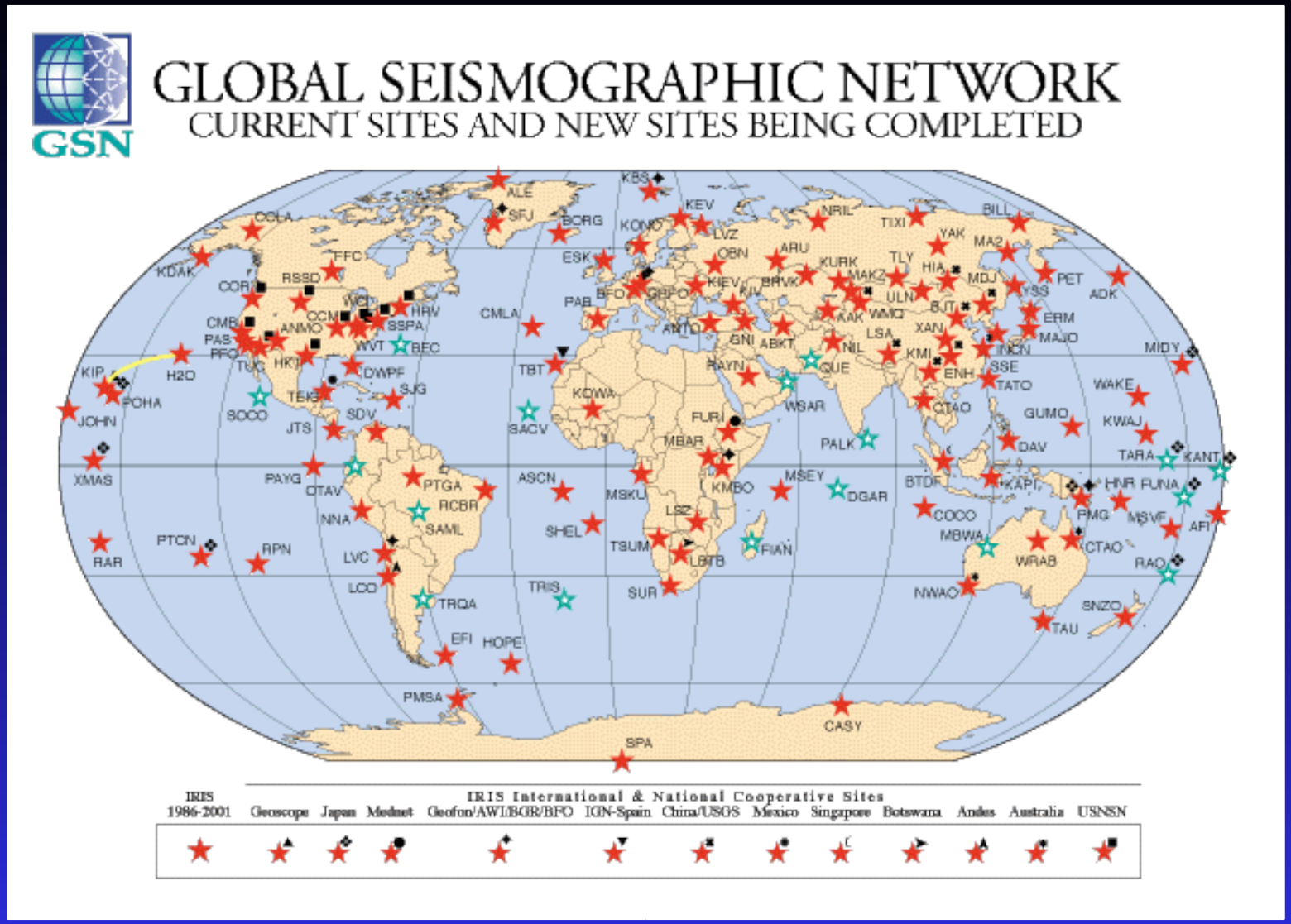
RESPONSE CURVE

The response curve of an instrument is the response to an input delta function



Linearity allows for deconvolution (with conservation of causality)

Seismic networks



www.iris.washington.edu/about/GSN/index.htm

IRIS

The Incorporated Research Institutions for Seismology (IRIS) is a university research consortium

INSTITUTION BOARD MEMBER University of AlabamaAndrew GoodliffeAntonio Rodriguez University of AlaskaDouglas H. ChristensenRoger Hansen University of ArizonaSusan BeckGeorge Zandt Arizona State UniversityMatt FouchEd Garnero University of Arkansas at Little RockHaydar J. Al-ShukriHanan Mahdi Auburn UniversityLorraine W. Wolf Boise State UniversityJohn R. PeltonJames Zollweg Boston CollegeJohn EbelAlan Kafka Boston UniversityGeoffrey AbersRachel E. Abercrombie Brown UniversityKaren Fischer Donald Forsyth California Institute of TechnologyDonald Helmberger Thomas Heaton University of California, BerkeleyBarbara RomanowiczLane Johnson University of California, Los AngelesJohn VidalePaul Davis University of California, RiversideStephen K. ParkDavid D. Oglesby University of California, San DiegoGabi LaskeJon Berger University of California, Santa BarbaraToshiro TanimotoRalph Archuleta University of California, Santa CruzThorne LaySusan Schwartz Carnegie Institution of WashingtonPaul SilverSelwyn Sacks University of Colorado, BoulderMike RitzwollerAnne Sheehan Colorado School of MinesRoel Snieder Thomas M. Boyd Columbia UniversityArt Lerner-LamPaul Richards University of ConnecticutVernon F. CormierLanbo Liu Cornell UniversityMuawia BarazangiLarry Brown University of DelawareSusan McGeary Duke UniversityPeter MalinEylon Shalev Florida International UniversityDean Whitman University of Florida Raymond Russo Georgia Institute of Technology Leland T. Long Harvard UniversityGöran Ekström Adam Dziewonski University of Hawaii at Manoa Gerard Fryer Idaho State University IGPP/Lawrence Livermore National LaboratoryBill WalterPeter Goldstein IGPP/Los Alamos National LaboratoryHans HartseLeigh House University of Illinois at Urbana ChampaignWang-Ping ChenXiaodong Song Indiana UniversityGary L. PavlisMichael Hamburger Indiana University/Purdue University at Fort WayneDipak Chowdhury University of KansasRoss A. Black Kansas State UniversityStephen GaoCharles Oviatt University of KentuckyEdward W. WolleryZhenming Wang Lawrence Berkeley LaboratoryDon W. VascoE. L. Majer Lehigh UniversityAnne MeltzerStéphane Sol Louisiana State UniversityJuan LorenzoRoy Dokka Macalester College John P. Craddock Karl R. Wirth Massachusetts Institute of TechnologyRobert Dirk van der HilstBradford H. Hager University of MiamiTim Dixon Falk Amelung University of MemphisJer-Ming ChiuArch Johnston University of MichiganLarry Ruff Michigan State UniversityKazuya FujitaDavid W. Hyndman Michigan Technological UniversityWayne D. PenningtonJimmy F. Diehl University of MinnesotaJustin Revenaugh Val Chandler University of MissouriEric SandvolMian Liu University of Montana Michael StickneyMarvin Speece University of Nevada, Las VegasCathrine SnelsonJim O'Donnell University of Nevada RenoGlenn BiasiJohn Louie University of New OrleansAbu K.M. Sarwar New Mexico Institute of Mining & TechnologyRichard C.AsterHarold Tobin New Mexico State University James NiThomas Hearn State University of New York at BinghamtonFrancis T. WuJeff Barker State University of New York at Stony BrookWilliam HoltDaniel Davis University of North Carolina, Chapel HillJonathan Lees Jose Rial Northern Illinois UniversityPaul StoddardPhilip Carpenter Northwestern UniversityRay Russo Seth Stein The University of OklahomaRoger YoungJudson Ahern Oklahoma State University Surinder SahaiIbrahim Cemen University of OregonEugene HumphreysDoug Toomey Oregon State UniversityJohn NabelekAnne Trehu Pennsylvania State UniversityShelton S. Alexander Princeton UniversityGuust NoletRobert Phinney University of Puerto Rico at MayagüezChrista von HillebrandtEugenio Asencio Purdue UniversityLawrence W. BraileRobert Nowack Rensselaer Polytechnic InstititeSteven RoeckerRobert McCaffrey Rice UniversityAlan R. LevanderDale Sawyer RutgersVadim LevinMichael J Carr Saint Louis University Brian J. Mitchell Keith Koper San Diego State UniversityRobert MellorsSteven M. Day San Jose State UniversityDonald L. ReedRichard Sedlock University of South CarolinaTom OwensPradeep Talwani University of Southern CaliforniaDavid OkayaThomas H. Jordan Southern Methodist UniversityBrian StumpEugene T. Herrin Stanford UniversityGregory C. BerozaSimon Klemperer Syracuse UniversityDouglas K. Nelson University of TennesseeRichard T. Williams Texas A&M UniversityRichard GibsonPhilip D. Rabinowitz Texas Tech UniversityHarold GurrolaCalvin Barnes University of Texas at AustinClifford A. Frohlich Stephen P. Grand University of Texas at DallasGeorge McMechanJohn Ferguson University of Texas at El PasoKate MillerRandy Keller University of TulsaChristopher L. LinerBryan Tapp University of Utah Robert B. SmithGerald T. Schuster Virginia Polytechnic InstituteJ. Arthur SnokeJohn A Hole Central Washington UniversityTimothy MelbourneCharles Rubin University of WashingtonSteve MaloneKen Creager Washington University, St. LouisDouglas WiensMichael Wysession West Virginia University Thomas H. WilsonRobert Behling University of Wisconsin, MadisonClifford Thurber William J. Lutter University of Wisconsin, Milwaukee Keith A. Sverdrup Brett Ketter University of Wisconsin, OshkoshTimothy Paulsen Thomas Laudon Woods Hole Oceanographic InstitutionRalph StephenAlan Chave Wright State UniversityErnest C. HauserPaul J. Wolfe University of WyomingScott B. Smithson Yale University

OTHER NETWORKS

Cosmos (Consortium of Organizations for Strong Motion Observation System)

http://db.cosmos-eq.org/scripts/default.plx

Information for single stations – Visualization of accelerograms – Very fast download

Mednet (MEDiterranean very broadband seismographic NETwork)

http://mednet.ingv.it/index.html

Simple request indicating the name of the stations

KikNet- KNet (Japan Kiban-Kjoshin and Kjoshin networks)

http://www.kik.bosai.go.jp/

http://www.k-net.bosai.go.jp/

Simple request indicating the name of the stations – Visualization of data

Earthquake in Japan

CATALOG SITES

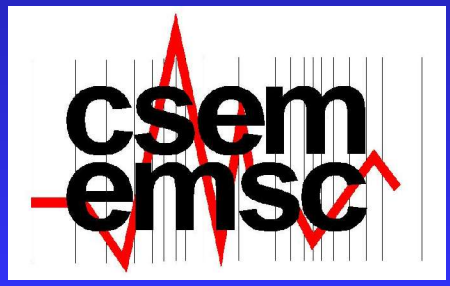
NEIC (From USGS)

http://earthquake.usgs.gov/recenteqsww/Quakes/quakes_all.html

MAP	4.5	2005/07/31 23:41:35	39.487	33.117	10.0	CENTRAL TURKEY
MAP	5.4	2005/07/31 22:06:54	-0.067	123.771	95.4	SULAWESI, INDONESIA
map	3.0	2005/07/31 21:51:16	60.737	-151.841	70.0	KENAI PENINSULA, ALASKA
map	2.7	2005/07/31 21:21:14	33.748	-116.905	14.0	SOUTHERN CALIFORNIA
map	2.9	2005/07/31 21:04:25	33.217	-115.520	13.3	SOUTHERN CALIFORNIA
MAP	4.5	2005/07/31 20:12:33	31.161	141.639	103.9	IZU ISLANDS, JAPAN REGION
MAP	4.7	2005/07/31 19:29:58	13.913	93.168	30.0	ANDAMAN ISLANDS, INDIA REGI
map	2.8	2005/07/31 19:25:29	34.550	-116.255	4.7	SOUTHERN CALIFORNIA
MAP	4.1	2005/07/31 17:55:21	-37.530	176.220	274.0	NORTH ISLAND OF NEW ZEALAND
map	2.9	2005/07/31 16:46:28	46.182	-122.200	1.5	MOUNT ST. HELENS AREA, WASH
MAP	4.3	2005/07/31 16:16:35	29.585	31.080	10.0	EGYPT
MAP	4.5	2005/07/31 15:18:21	39.392	33.182	10.0	CENTRAL TURKEY
map	2.5	2005/07/31 14:51:44	46.190	-122.198	1.6	MOUNT ST. HELENS AREA, WASH
MAP	4.9	2005/07/31 14:09:11	-5.996	146.669	48.6	EASTERN NEW GUINEA REG, PAP
map	3.1	2005/07/31 13:59:49	55.003	-158.818	10.0	ALASKA PENINSULA
MAP	5.1	2005/07/31 12:37:18	0.417	97.814	28.9	NIAS REGION, INDONESIA
MAP	5.1	2005/07/31 12:18:24	0.422	97.747	31.9	NIAS REGION, INDONESIA
map	2.8	2005/07/31 10:42:45	57.623	-154.391	60.0	KODIAK ISLAND REGION, ALASK
map	2.9	2005/07/31 09:52:26	54.485	-163.230	70.0	UNIMAK ISLAND REGION, ALASK
map	3.3	2005/07/31 09:34:39	46.197	-122.190	0.6	MOUNT ST. HELENS AREA, WASH
MAP	4.8	2005/07/31 08:04:31	1.572	97.015	30.0	NIAS REGION, INDONESIA
map	2.6	2005/07/31 07:28:34	51.297	-178.200	20.0	ANDREANOF ISLANDS, ALEUTIAN
map	3.3	2005/07/31 07:07:08	38.718	-92.725	5.1	MISSOURI
map	3.0	2005/07/31 06:09:58	46.191	-122.186	0.0	MOUNT ST. HELENS AREA, WASH
MAP	4.3	2005/07/31 05:53:44	35.567	138.767	99.8	EASTERN HONSHU, JAPAN
MAP	4.8	2005/07/31 05:16:39	-14.285	-75.631	46.8	NEAR THE COAST OF CENTRAL P
map	3.4	2005/07/31 05:00:09	19.104	-64.623	30.7	VIRGIN ISLANDS
map	2.5	2005/07/31 04:20:08	46.196	-122.198	0.0	MOUNT ST. HELENS AREA, WASH
MAP	4.8	2005/07/31 04:20:00	-15.237	-177.173	15.0	FIJI REGION
map	3.6	2005/07/31 04:15:30	19.089	-64.659	23.1	VIRGIN ISLANDS
map	3.8	2005/07/31 04:13:11	19.218	-64.699	5.7	VIRGIN ISLANDS
map	2.6	2005/07/31 03:59:35	32.998	-115.770	7.8	SOUTHERN CALIFORNIA
map	3.3	2005/07/31 03:53:00	19.578	-156.363	5.4	HAWAII REGION, HAWAII
map	2.8	2005/07/31 02:48:25	63.528	-147.422	1.0	CENTRAL ALASKA
MAP	4.2	2005/07/31 02:45:48	23.916	121.264	10.0	TAIWAN
map	3.3	2005/07/31 02:32:37	18.896	-65.456	25.0	PUERTO RICO REGION
map	2.5	2005/07/31 01:37:46	34.547	-116.269	0.0	SOUTHERN CALIFORNIA
MAP	5.2	2005/07/31 01:24:11	-22.638	172.886	20.0	SOUTHEAST OF THE LOYALTY IS
MAP	4.3	2005/07/31 01:11:34	-0.156	96.887	30.0	SOUTHWEST OF SUMATRA, INDON
map	2.5	2005/07/31 01:07:29	63.538	-148.094	1.0	CENTRAL ALASKA

CSEM-EMSC (Mediterranean Bullettin)

http://www.emsc-csem.org/



SIMPLE APPLICATIONS

What information can you quickly get on the earthquake source ?

- Geometry
- Location
- Duration
- Moment
- Directivity

EXERCISE

1) Download the data from IRIS

2) Identify data by Site, station, channel

3) Choose 3 to 4 sites distributed around the fault

4) Preprocessing the data

5) Analysis

DOWNLOAD DATA FROM IRIS

Download from www.iris.edu, then click on data and Seismiquery …. to get here

SeismiQuery

SeismiQuery is a set of pre-formatted database queries that allow users to access data and information stored in the DMC Oracle database. The tools that make up SeismiQuery are categorized like so:

information queries	data holdings	request tools	help pages
These queries target meta data tables and do not include information about specific data holdings.	Queries that target the actual data holdings. One can get a gross overview or a down-to-the-second view of data holdings.	Links to web-based and stand-alone request tools.	How to use SeismiQuery to your advantage. Visual HINTS to each query are below.

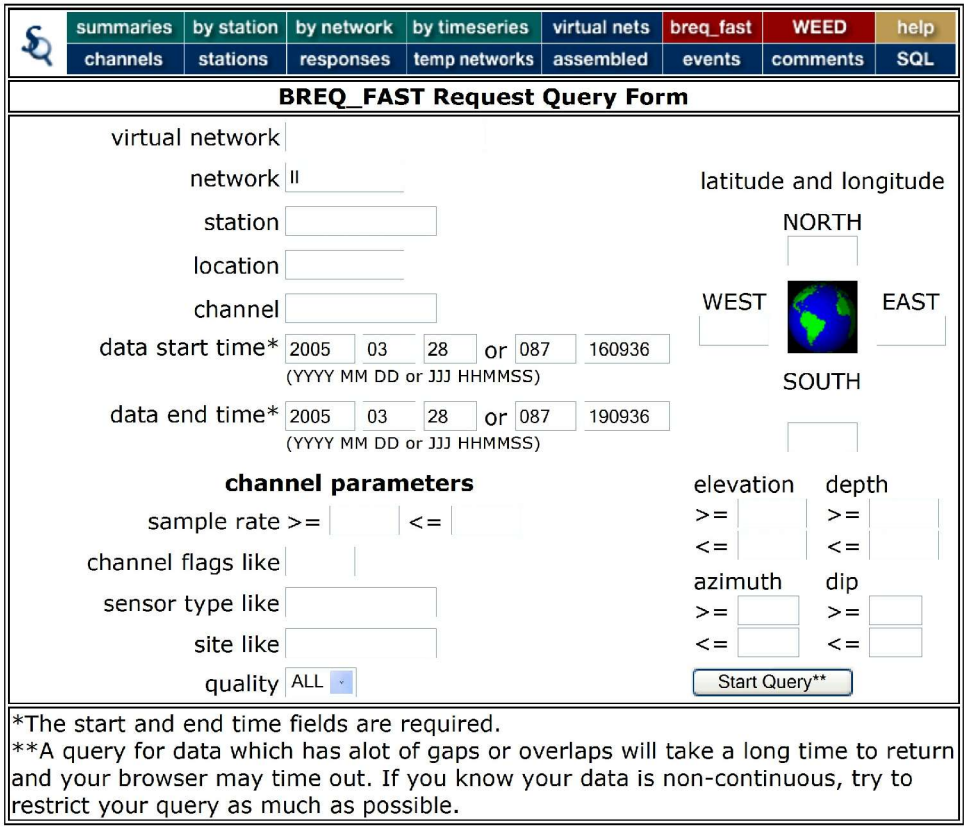
Below is the **hint bar** - roll over each tab to see a visual cue of each option. These hints are only available on this page - the bar acts as a normal navigation tool on all other pages.

DOWNLOAD DATA FROM IRIS

Breq-Fast

Search info through earthquake catalog NEIC :

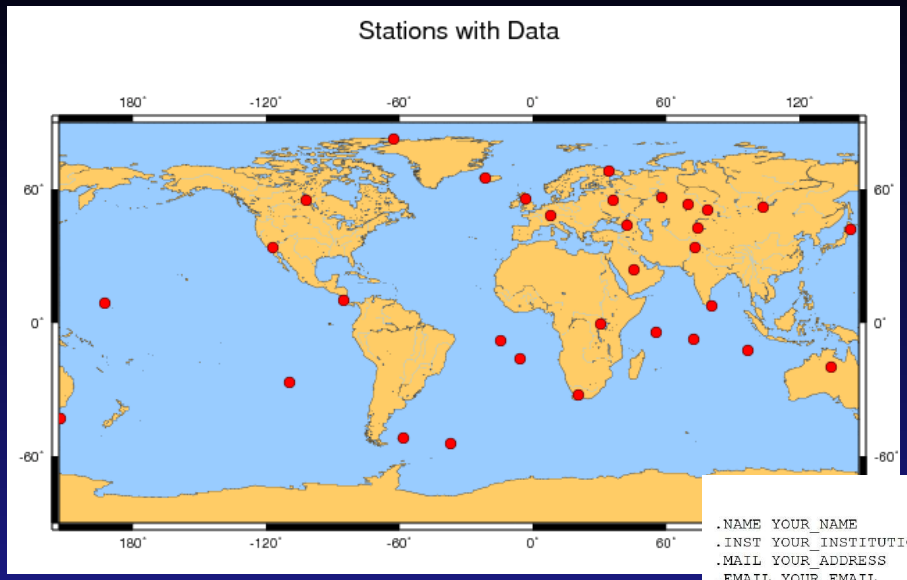
http://earthquake.usgs.gov/recenteqsww/Quakes/quakes_all.html



The partial BREQ_FAST request file that is generated by this query will contain channels which have some data in this time span, and the request window will be the start and end time specifed.

DOWNLOAD DATA FROM IRIS

The operation can require a very long time ...



You need to send a request by e-mail

```
.NAME YOUR_NAME
.INST YOUR_INSTITUTION
.MAIL YOUR_ADDRESS
.EMAIL YOUR_EMAIL
.PHONE YOUR_PHONE
.FAX YOUR_FAX
.MEDIA: YOUR_MEDIA
.ALTERNATE MEDIA: YOUR_ALT1MEDIA
.ALTERNATE MEDIA: YOUR_ALT2MEDIA
.LABEL YOUR_LABEL
.END
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHE 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHN 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHZ 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHE 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHN 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHZ 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LNE 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LNN 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LNZ 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 SHE 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 SHN 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 SHZ 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 VHE 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 VHN 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 VHZ 00
AAK II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 WDO 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHE 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHE 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHN 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHN 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHZ 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 BHZ 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHE 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHE 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHN 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHN 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHZ 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LHZ 10
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LNE 00
ALE II 2005 03 28 16 09 36.0 2005 03 28 19 09 36.0 1 LNN 00
```

EXERCISE/2

Data have been downloaded for the earthquake occurred at 16:09:36 (UTC) on Monday, March 28, 2005, magnitude 8.7, located in NORTHERN SUMATRA, INDONESIA (for more information visit NEIC).

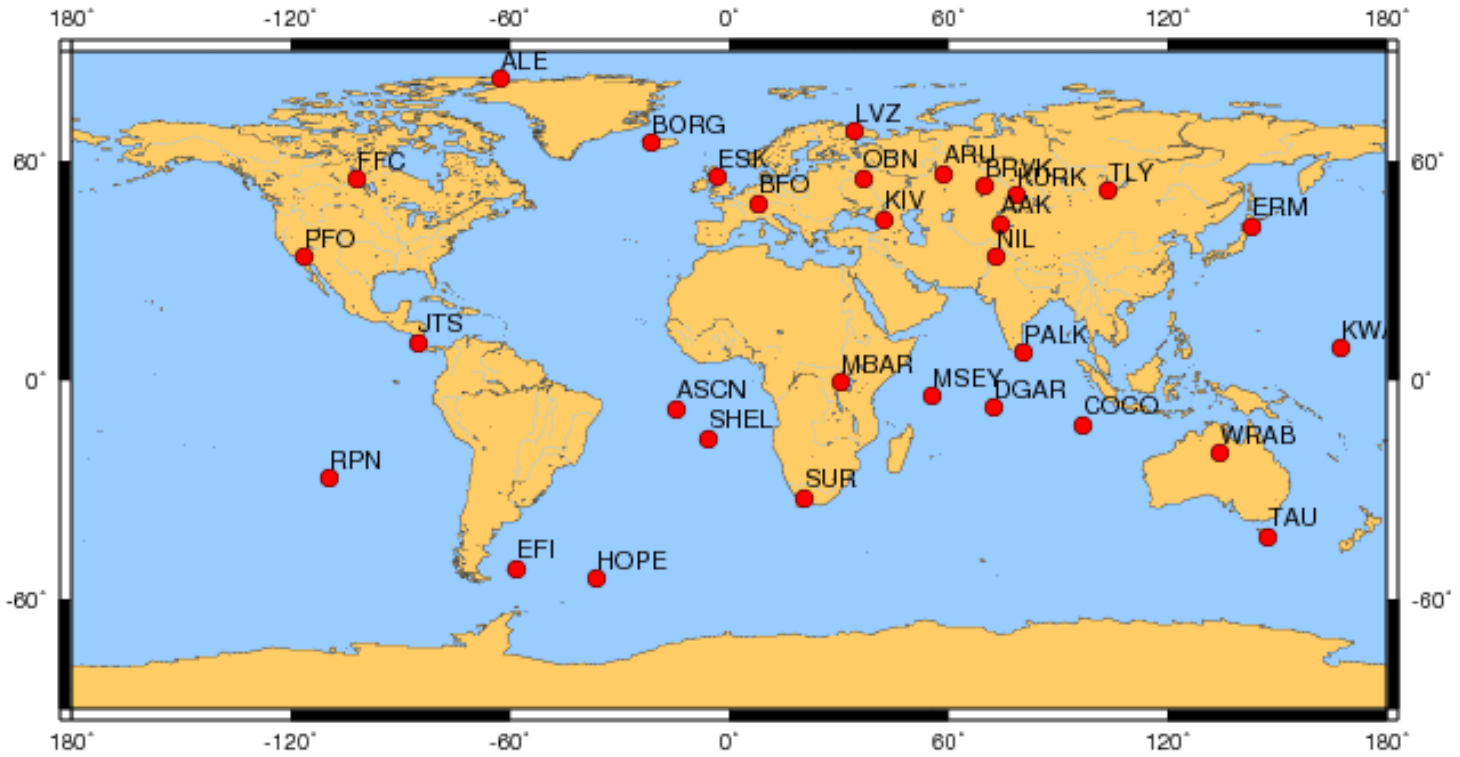
- **Identify data by Site, station, channel**
- **Choose 3 to 4 sites distributed around the fault**
  - Plot all z components for one site (Comments…)
  - Select only BH(ENZ) traces from now on….

CODING OF RECORDS

- **First Letter (*H* High broad band, *B* Broad band, *E* Extremely Short Period, *S* Short Period, *M* Mid Period, *L* Long Period, *V* Very Long Period, *W* Weather)**

- **Second Letter (*H* High Gain Seismometer, *L* Low gain Seismometer, *N* Accelerometer, *G* Gravimeter, *W* Weather)**

STATION MAP


180˚
-120˚
-60˚
0˚
60˚
120˚
180˚
60˚
0˚
-60˚
ALE
BORG
LVZ
ESK
OBN
ARU
BRVK
KORK
TLY
BFO
KIV
AAK
ERM
NIL
FFC
PFO
JTS
PALK
KWA
MBAR
MSEY
DGAR
COCO
ASCN
SHEL
WRAB
RPN
SUR
TAU
EFI
HOPE

EXERCISE/3

- **Data Preprocessing (SAC) :**
  - Correction for the mean and zero level on the borders
  - Removing instrument response
  - Filtering (Test different filters/frequencies)
  - Time scale ? Amplitude units ?

- **Data analysis**
  - Phase analysis (identify P, S, surface wave arrivals)
  - Amplitude analysis (max velocity, displacement)
  - Spectral analysis (shape of frequency spectra for V, D; value of corner frequency)
  - Can we infer information for the rutpure from the corner frequency distribution ?